



# **Datasheet**

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**Preliminary Version 0.1** 

2016/12



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#### 1 GENERAL DESCRIPTION

The ST7701S, a 16.7M-color System-on-Chip (SOC) driver LSI designed for small and medium sizes of TFT LCD display, is capable of supporting up to 480RGBX864 in resolution which can transmit graphic data without RAM. The 480-channel source driver has true 8-bit resolution, which generates 256 Gamma-corrected values by an internal D/A converter.

The ST7701S is able to operate with low IO interface power supply and incorporate with several charge pumps to generate various voltage levels that form an on-chip power management system for gate driver and source driver. The built-in timing controller in ST7701S can support several interfaces for the diverse request of medium or small size portable display.ST7701S provides several system interfaces ,which include MIPI/RGB/SPI.For further power control ,the dynamic backlight control function basing on displaying image content is also supported.



#### 2 FEATURES

- Single chip WVGA a-Si TFT-LCD Controller/Driver without Display RAM
- Display Resolution
  - 480\*RGB (H) \*864(V) (WVGA)
  - 480\*RGB (H) \*854(V)
  - 480\*RGB (H) \*800(V)
  - 480\*RGB (H) \*720(V)
  - 480\*RGB (H) \*640(V) (VGA)
  - 480\*RGB (H) \*360(V)
- LCD Driver Output Circuits
  - Source Outputs: 480 RGB Channels
  - Support gate control signals to gate driver in the panel
  - Common Electrode Output
- Display Colors (Color Mode)
  - Full Color mode: 16.7M-colors, RGB=(888) max., Idle Mode Off
  - Reduce color mode: 262K colors
  - Reduce color mode: 65K colors
  - Idle Mode: 8-color, RGB=(111)
- Programmable Pixel Color Format (Color Depth) for Various Display Data input Format
  - 24-bit/pixel: RGB=(888)
  - 18-bit/pixel: RGB=(666)
  - 16-bit/pixel: RGB=(565)
- Display Interface
  - 8 bit,9bit and 16 bit serial peripheral interface
  - 16/18/24 RGB Interface(VSYNC, HSYNC, DOTCLK, ENABLE, DB[17:0], Sync and DE mode)
  - MIPI Display Serial Interface (DSI V1.01 r11 and D-PHY V1.0, 1 clock and 1 or 2 data lane pairs)

Supports one data lane / maximum speed 800Mbps

Supports two data lanes / maximum speed 550Mbps

- Display Features
  - Programmable Partial Display Duty
  - CABC for saving current consumption
  - Color enhancement
- On Chip Build-In Circuits
  - DC/DC Converter
  - Adjustable VCOM Generation
  - Non-Volatile (NV) Memory to Store Initial Register Setting and Factory Default Value (Module ID, Module Version, etc)



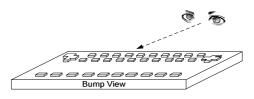
- Timing Controller
- 4 preset Gamma curve with separated RGB Gamma setting
- Build-In NV Memory for LCD Initial Register Setting
  - OTP to store VCOM and ID1~ID3
- Driving Algorithm Support
  - 1-dot/2-dot/3-dot/4-dot Inversion
  - Column Inversion
  - Zigzag Inversion
- Wide Supply Voltage Range
  - I/O Voltage (VDDI to DGND): 1.65V ~ 3.3V (VDDI≤VDD)
  - Analog Voltage (VDDA to AGND): 2.5V ~ 3.6V
  - MIPI Voltage (VDDAM to VSSAM): 2.5V ~ 3.6V
- On-Chip Power System
  - Source Voltage (VAP (GVDD) to VAN (GVCL)): +3.64~6.5V,-1.05~-5V
  - VCOM level: GND
  - Gate driver HIGH level (VGH to AGND): +11.5V ~ +17 V
  - Gate driver LOW level (VGL to AGND): -12V ~ -7.6V
- Optimized layout for COG Assembly
- Operate temperature range: –30°C to +85°C
- Lower Power Consumption

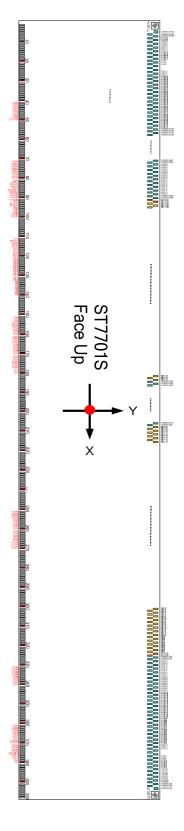


#### **3 PAD ARRANGEMENT**

#### 3.1 Output Bump Dimension

| Au bump height | 9µm                          |  |  |  |
|----------------|------------------------------|--|--|--|
|                | 14μmx95μm                    |  |  |  |
| Au bump size   | Gate: GO1~GO32               |  |  |  |
|                | Source : S1~S1440            |  |  |  |
|                | 40μmx84μm                    |  |  |  |
|                | Input Pads: Pad 1 to Pad 398 |  |  |  |

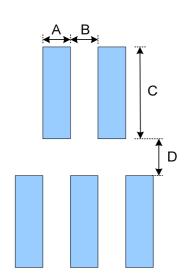






#### 3.2 Input Bump Dimension

#### Output Pads



P400~P2076

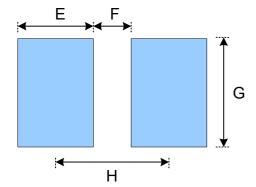
| Symbol | Item                    | Size  |
|--------|-------------------------|-------|
| A      | Bump Width              | 14 um |
| В      | Bump Gap 1 (Horizontal) | 14 um |
| С      | Bump Height             | 95 um |
| D      | Bump Gap 2 (Vertical)   | 30 um |

P399 · P2077

| Symbol | Item                    | Size  |
|--------|-------------------------|-------|
| A      | Bump Width              | 42 um |
| В      | Bump Gap 1 (Horizontal) | 14 um |
| С      | Bump Height             | 95 um |
| D      | Bump Gap 2 (Vertical)   | 30 um |

#### Input Pads

No.1~398

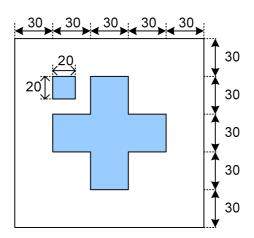


| Symbol | Item        | Size  |  |  |  |
|--------|-------------|-------|--|--|--|
| Е      | Bump Width  | 40 um |  |  |  |
| F      | Bump Gap    | 20um  |  |  |  |
| G      | Bump Height | 84 um |  |  |  |
| Н      | Bump Pitch  | 60 um |  |  |  |

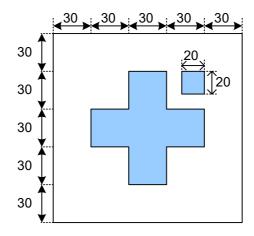


#### 3.3 Alignment Mark Dimension

Alignment Mark ALIGN\_L: (X,Y)=(-11870,302)



● Alignment Mark ALIGN\_R: (X,Y)=(+11870,302)



#### 3.4 Chip Information

| Chip size         | 23970µm x770µm   |  |  |  |
|-------------------|------------------|--|--|--|
|                   | (Tolerance±30um) |  |  |  |
| Chip thickness    | 250μm            |  |  |  |
| Pad Location      | Pad center       |  |  |  |
| Coordinate Origin | Chip center      |  |  |  |

Chip size included scribe line.

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# 4 PAD CENTER COORDINATES (AFTER HEAT CORRECTION)

| PAD<br>No. | PIN Name | x      | Υ    | PAD<br>No. | PIN Name | x     | Υ    | PAD<br>No. | PIN Name | х     | Υ    |
|------------|----------|--------|------|------------|----------|-------|------|------------|----------|-------|------|
| 1          | VSSIDUM0 | -11910 | -315 | 33         | DMY      | -9990 | -315 | 65         | DGND     | -8070 | -315 |
| 2          | VSSIDUM0 | -11850 | -315 | 34         | VSSB     | -9930 | -315 | 66         | VCC      | -8010 | -315 |
| 3          | VSSIDUM1 | -11790 | -315 | 35         | VSSB     | -9870 | -315 | 67         | VCC      | -7950 | -315 |
| 4          | PADA1    | -11730 | -315 | 36         | VSSB     | -9810 | -315 | 68         | VCC      | -7890 | -315 |
| 5          | PADB1    | -11670 | -315 | 37         | VSSB     | -9750 | -315 | 69         | VDDB     | -7830 | -315 |
| 6          | VCOM     | -11610 | -315 | 38         | VDDB     | -9690 | -315 | 70         | VDDB     | -7770 | -315 |
| 7          | VCOM     | -11550 | -315 | 39         | VDDB     | -9630 | -315 | 71         | VDDB     | -7710 | -315 |
| 8          | VCOM     | -11490 | -315 | 40         | VDDB     | -9570 | -315 | 72         | VSSB2    | -7650 | -315 |
| 9          | VCOM     | -11430 | -315 | 41         | VDDB     | -9510 | -315 | 73         | VSSB2    | -7590 | -315 |
| 10         | VCOM     | -11370 | -315 | 42         | VDDB     | -9450 | -315 | 74         | VSSB2    | -7530 | -315 |
| 11         | CNTACT1  | -11310 | -315 | 43         | VDDB     | -9390 | -315 | 75         | VSSB2    | -7470 | -315 |
| 12         | CNTACT1  | -11250 | -315 | 44         | VDDB     | -9330 | -315 | 76         | VSSB2    | -7410 | -315 |
| 13         | VPP      | -11190 | -315 | 45         | VDDB     | -9270 | -315 | 77         | VSSB2    | -7350 | -315 |
| 14         | VPP      | -11130 | -315 | 46         | VSSB     | -9210 | -315 | 78         | AGND     | -7290 | -315 |
| 15         | VPP      | -11070 | -315 | 47         | VSSB     | -9150 | -315 | 79         | AGND     | -7230 | -315 |
| 16         | VPP      | -11010 | -315 | 48         | VSSB     | -9090 | -315 | 80         | AGND     | -7170 | -315 |
| 17         | VPP      | -10950 | -315 | 49         | VSSB     | -9030 | -315 | 81         | VDDI     | -7110 | -315 |
| 18         | VGL      | -10890 | -315 | 50         | TESTO[0] | -8970 | -315 | 82         | LANSEL   | -7050 | -315 |
| 19         | VGL      | -10830 | -315 | 51         | TESTO[1] | -8910 | -315 | 83         | DSWAP    | -6990 | -315 |
| 20         | VGLO     | -10770 | -315 | 52         | TESTO[2] | -8850 | -315 | 84         | PSWAP    | -6930 | -315 |
| 21         | VGLO     | -10710 | -315 | 53         | TESTO[3] | -8790 | -315 | 85         | DGND     | -6870 | -315 |
| 22         | VGL_REG  | -10650 | -315 | 54         | DMY      | -8730 | -315 | 86         | DSTB_SEL | -6810 | -315 |
| 23         | VGL_REG  | -10590 | -315 | 55         | DMY      | -8670 | -315 | 87         | NBWSEL   | -6750 | -315 |
| 24         | VGHEQ2   | -10530 | -315 | 56         | DMY      | -8610 | -315 | 88         | VGSW[3]  | -6690 | -315 |
| 25         | VGHEQ2   | -10470 | -315 | 57         | DMY      | -8550 | -315 | 89         | VGSW[2]  | -6630 | -315 |
| 26         | VSSB2    | -10410 | -315 | 58         | DMY      | -8490 | -315 | 90         | VGSW[1]  | -6570 | -315 |
| 27         | VSSB2    | -10350 | -315 | 59         | DMY      | -8430 | -315 | 91         | VGSW[0]  | -6510 | -315 |
| 28         | VSSB2    | -10290 | -315 | 60         | DMY      | -8370 | -315 | 92         | VDDI     | -6450 | -315 |
| 29         | VSSB2    | -10230 | -315 | 61         | DMY      | -8310 | -315 | 93         | I2C_SA1  | -6390 | -315 |
| 30         | DMY      | -10170 | -315 | 62         | DMY      | -8250 | -315 | 94         | I2C_SA0  | -6330 | -315 |
| 31         | DMY      | -10110 | -315 | 63         | DGND     | -8190 | -315 | 95         | IM[3]    | -6270 | -315 |
| 32         | DMY      | -10050 | -315 | 64         | DGND     | -8130 | -315 | 96         | IM[2]    | -6210 | -315 |

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| PAD No.         PIN Name         X         Y         PAD No.         PIN Name         X         Y         PAD No.         PIN Name No.         X           97         IM[1]         -6150         -315         131         D[11]         -4110         -315         165         VSSB         -2070           98         IM[0]         -6090         -315         132         D[10]         -4050         -315         166         VSSB         -2010           99         GPO[3]         -6030         -315         133         D[9]         -3990         -315         167         VSSB         -1950           100         GPO[2]         -5970         -315         134         D[8]         -3930         -315         168         VSSB         -1890           101         GPO[1]         -5910         -315         135         D[7]         -3870         -315         169         VSSB         -1830           102         GPO[0]         -5850         -315         136         D[6]         -3810         -315         170         VDDA         -1770 | -315<br>-315<br>-315<br>-315 |
|---|------------------------------|
| 98 IM[0] -6090 -315 132 D[10] -4050 -315 166 VSSB -2010  99 GPO[3] -6030 -315 133 D[9] -3990 -315 167 VSSB -1950  100 GPO[2] -5970 -315 134 D[8] -3930 -315 168 VSSB -1890  101 GPO[1] -5910 -315 135 D[7] -3870 -315 169 VSSB -1830  | -315<br>-315<br>-315         |
| 99         GPO[3]         -6030         -315         133         D[9]         -3990         -315         167         VSSB         -1950           100         GPO[2]         -5970         -315         134         D[8]         -3930         -315         168         VSSB         -1890           101         GPO[1]         -5910         -315         135         D[7]         -3870         -315         169         VSSB         -1830   | -315<br>-315                 |
| 100     GPO[2]     -5970     -315     134     D[8]     -3930     -315     168     VSSB     -1890       101     GPO[1]     -5910     -315     135     D[7]     -3870     -315     169     VSSB     -1830   | -315                         |
| 101 GPO[1] -5910 -315 135 D[7] -3870 -315 169 VSSB -1830  |                              |
|   |                              |
| 102 GPO[0] -5850 -315 136 D[6] -3810 -315 170 VDDA -1770  | -315                         |
|   | -315                         |
| 103 EXB1T -5790 -315 137 D[5] -3750 -315 171 VDDA -1710   | -315                         |
| 104 TE_L -5730 -315 138 D[4] -3690 -315 172 VDDA -1650  | -315                         |
| 105 DMY -5670 -315 139 D[3] -3630 -315 173 VDDA -1590   | -315                         |
| 106 SDO -5610 -315 140 D[2] -3570 -315 174 DGND -1530   | -315                         |
| 107 SDA -5550 -315 141 D[1] -3510 -315 175 DGND -1470   | -315                         |
| 108 DCX -5490 -315 142 D[0] -3450 -315 176 DGND -1410   | -315                         |
| 109 SCL -5430 -315 143 DE -3390 -315 177 DGND -1350   | -315                         |
| 110 RDX -5370 -315 144 PCLK -3330 -315 178 VCC -1290  | -315                         |
| 111 CSX -5310 -315 145 HS -3270 -315 179 VCC -1230  | -315                         |
| 112 RESETX -5250 -315 146 VS -3210 -315 180 VCC -1170   | -315                         |
| 113 DGND -5190 -315 147 LEDPWM -3150 -315 181 VCC -1110   | -315                         |
| 114 DGND -5130 -315 148 LEDON -3090 -315 182 VSSM -1050   | -315                         |
| 115 DGND -5070 -315 149 DMY -3030 -315 183 VSSM -990  | -315                         |
| 116 VDDI -5010 -315 150 ERR -2970 -315 184 VSSM -930  | -315                         |
| 117 VDDI -4950 -315 151 VDDI -2910 -315 185 VSSM -870   | -315                         |
| 118 VDDI -4890 -315 152 VDDI -2850 -315 186 VSSM -810   | -315                         |
| 119 D[23] -4830 -315 153 VDDI -2790 -315 187 DP1 -750   | -315                         |
| 120 D[22] -4770 -315 154 DGND -2730 -315 188 DP1 -690   | -315                         |
| 121 D[21] -4710 -315 155 DGND -2670 -315 189 DP1 -630   | -315                         |
| 122 D[20] -4650 -315 156 DGND -2610 -315 190 DP1 -570   | -315                         |
| 123 D[19] -4590 -315 157 VDDB -2550 -315 191 DN1 -510   | -315                         |
| 124 D[18] -4530 -315 158 VDDB -2490 -315 192 DN1 -450   | -315                         |
| 125 D[17] -4470 -315 159 VDDB -2430 -315 193 DN1 -390   | -315                         |
| 126 D[16] -4410 -315 160 VDDB -2370 -315 194 DN1 -330   | -315                         |
| 127 D[15] -4350 -315 161 AGND -2310 -315 195 VSSM -270  | -315                         |
| 128 D[14] -4290 -315 162 AGND -2250 -315 196 VSSM -210  | -315                         |
| 129 D[13] -4230 -315 163 AGND -2190 -315 197 CP -150  | -315                         |
| 130 D[12] -4170 -315 164 AGND -2130 -315 198 CP -90   | -315                         |

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| PAD<br>No. | PIN Name | х    | Y    | PAD<br>No. | PIN Name | х    | Υ    | PAD<br>No. | PIN Name | х    | Υ    |
|------------|----------|------|------|------------|----------|------|------|------------|----------|------|------|
| 199        | СР       | -30  | -315 | 233        | VSSA     | 2010 | -315 | 267        | VCCMD    | 4050 | -315 |
| 200        | CP       | 30   | -315 | 234        | VSSA     | 2070 | -315 | 268        | VCCMD    | 4110 | -315 |
| 201        | CN       | 90   | -315 | 235        | VSSA     | 2130 | -315 | 269        | VCCMD    | 4170 | -315 |
| 202        | CN       | 150  | -315 | 236        | VSSA     | 2190 | -315 | 270        | V12TX    | 4230 | -315 |
| 203        | CN       | 210  | -315 | 237        | V20      | 2250 | -315 | 271        | V12TX    | 4290 | -315 |
| 204        | CN       | 270  | -315 | 238        | V20      | 2310 | -315 | 272        | V12TX    | 4350 | -315 |
| 205        | VSSM     | 330  | -315 | 239        | DMY      | 2370 | -315 | 273        | AVDD     | 4410 | -315 |
| 206        | VSSM     | 390  | -315 | 240        | DMY      | 2430 | -315 | 274        | AVDD     | 4470 | -315 |
| 207        | DP0      | 450  | -315 | 241        | VAP      | 2490 | -315 | 275        | AVDD     | 4530 | -315 |
| 208        | DP0      | 510  | -315 | 242        | VAP      | 2550 | -315 | 276        | AVCL     | 4590 | -315 |
| 209        | DP0      | 570  | -315 | 243        | DMY      | 2610 | -315 | 277        | AVCL     | 4650 | -315 |
| 210        | DP0      | 630  | -315 | 244        | DMY      | 2670 | -315 | 278        | AVCL     | 4710 | -315 |
| 211        | DN0      | 690  | -315 | 245        | VAN      | 2730 | -315 | 279        | DMY      | 4770 | -315 |
| 212        | DN0      | 750  | -315 | 246        | VAN      | 2790 | -315 | 280        | DMY      | 4830 | -315 |
| 213        | DN0      | 810  | -315 | 247        | DMY      | 2850 | -315 | 281        | DMY      | 4890 | -315 |
| 214        | DN0      | 870  | -315 | 248        | DMY      | 2910 | -315 | 282        | DMY      | 4950 | -315 |
| 215        | VSSM     | 930  | -315 | 249        | VDDR1    | 2970 | -315 | 283        | DMY      | 5010 | -315 |
| 216        | VSSM     | 990  | -315 | 250        | VDDR1    | 3030 | -315 | 284        | DMY      | 5070 | -315 |
| 217        | VCCMA    | 1050 | -315 | 251        | VDDR1    | 3090 | -315 | 285        | VDDB     | 5130 | -315 |
| 218        | VCCMA    | 1110 | -315 | 252        | VDDR1    | 3150 | -315 | 286        | VDDB     | 5190 | -315 |
| 219        | VCCMA    | 1170 | -315 | 253        | VDDR1    | 3210 | -315 | 287        | VDDB     | 5250 | -315 |
| 220        | DMY      | 1230 | -315 | 254        | VDDR1    | 3270 | -315 | 288        | VDDB     | 5310 | -315 |
| 221        | DMY      | 1290 | -315 | 255        | VSSR     | 3330 | -315 | 289        | AGND     | 5370 | -315 |
| 222        | DMY      | 1350 | -315 | 256        | VSSR     | 3390 | -315 | 290        | AGND     | 5430 | -315 |
| 223        | VDDM     | 1410 | -315 | 257        | VSSR     | 3450 | -315 | 291        | AGND     | 5490 | -315 |
| 224        | VDDM     | 1470 | -315 | 258        | VSSR     | 3510 | -315 | 292        | AGND     | 5550 | -315 |
| 225        | VDDM     | 1530 | -315 | 259        | VSSR     | 3570 | -315 | 293        | AGND     | 5610 | -315 |
| 226        | VDDM     | 1590 | -315 | 260        | VSSR     | 3630 | -315 | 294        | VSSB     | 5670 | -315 |
| 227        | VDDM     | 1650 | -315 | 261        | VPS1     | 3690 | -315 | 295        | VSSB     | 5730 | -315 |
| 228        | VDDR     | 1710 | -315 | 262        | VPS1     | 3750 | -315 | 296        | VSSB     | 5790 | -315 |
| 229        | VDDR     | 1770 | -315 | 263        | VPS1     | 3810 | -315 | 297        | VSSB     | 5850 | -315 |
| 230        | VDDR     | 1830 | -315 | 264        | VPS2     | 3870 | -315 | 298        | VSSB     | 5910 | -315 |
| 231        | DMY      | 1890 | -315 | 265        | VPS2     | 3930 | -315 | 299        | VSSB     | 5970 | -315 |
| 232        | DMY      | 1950 | -315 | 266        | VPS2     | 3990 | -315 | 300        | DMY      | 6030 | -315 |
|            |          |      |      |            |          |      |      |            |          |      |      |

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| PAD<br>No. | PIN Name | х    | Υ    | PAD<br>No. | PIN Name | х     | Υ    | PAD<br>No. | PIN Name | х     | Υ     |
|------------|----------|------|------|------------|----------|-------|------|------------|----------|-------|-------|
| 301        | DMY      | 6090 | -315 | 335        | VSSB2    | 8130  | -315 | 369        | VGHEQ2   | 10170 | -315  |
| 302        | DMY      | 6150 | -315 | 336        | VSSB     | 8190  | -315 | 370        | VGHEQ2   | 10230 | -315  |
| 303        | DMY      | 6210 | -315 | 337        | VSSB     | 8250  | -315 | 371        | VDDB2    | 10290 | -315  |
| 304        | DMY      | 6270 | -315 | 338        | VSSB     | 8310  | -315 | 372        | VDDB2    | 10350 | -315  |
| 305        | DMY      | 6330 | -315 | 339        | AGND     | 8370  | -315 | 373        | VDDB2    | 10410 | -315  |
| 306        | DMY      | 6390 | -315 | 340        | AGND     | 8430  | -315 | 374        | VDDB2    | 10470 | -315  |
| 307        | DMY      | 6450 | -315 | 341        | AGND     | 8490  | -315 | 375        | VGL_REG  | 10530 | -315  |
| 308        | DMY      | 6510 | -315 | 342        | AGND     | 8550  | -315 | 376        | VGL_REG  | 10590 | -315  |
| 309        | DMY      | 6570 | -315 | 343        | DMY      | 8610  | -315 | 377        | VGLO     | 10650 | -315  |
| 310        | DMY      | 6630 | -315 | 344        | DMY      | 8670  | -315 | 378        | VGLO     | 10710 | -315  |
| 311        | DMY      | 6690 | -315 | 345        | DMY      | 8730  | -315 | 379        | VGL      | 10770 | -315  |
| 312        | DMY      | 6750 | -315 | 346        | DMY      | 8790  | -315 | 380        | VGL      | 10830 | -315  |
| 313        | DMY      | 6810 | -315 | 347        | DMY      | 8850  | -315 | 381        | VGL      | 10890 | -315  |
| 314        | DMY      | 6870 | -315 | 348        | DMY      | 8910  | -315 | 382        | VGL      | 10950 | -315  |
| 315        | DMY      | 6930 | -315 | 349        | DMY      | 8970  | -315 | 383        | DMY      | 11010 | -315  |
| 316        | DMY      | 6990 | -315 | 350        | DMY      | 9030  | -315 | 384        | DMY      | 11070 | -315  |
| 317        | DMY      | 7050 | -315 | 351        | DMY      | 9090  | -315 | 385        | DMY      | 11130 | -315  |
| 318        | DMY      | 7110 | -315 | 352        | VGHP     | 9150  | -315 | 386        | DMY      | 11190 | -315  |
| 319        | DMY      | 7170 | -315 | 353        | VGHP     | 9210  | -315 | 387        | CNTACT2  | 11250 | -315  |
| 320        | DMY      | 7230 | -315 | 354        | VGHP     | 9270  | -315 | 388        | CNTACT2  | 11310 | -315  |
| 321        | DMY      | 7290 | -315 | 355        | VCC      | 9330  | -315 | 389        | VCOM     | 11370 | -315  |
| 322        | DMY      | 7350 | -315 | 356        | VCC      | 9390  | -315 | 390        | VCOM     | 11430 | -315  |
| 323        | DMY      | 7410 | -315 | 357        | VCC      | 9450  | -315 | 391        | VCOM     | 11490 | -315  |
| 324        | VDDB     | 7470 | -315 | 358        | DGND     | 9510  | -315 | 392        | VCOM     | 11550 | -315  |
| 325        | VDDB     | 7530 | -315 | 359        | DGND     | 9570  | -315 | 393        | VCOM     | 11610 | -315  |
| 326        | VDDB     | 7590 | -315 | 360        | DGND     | 9630  | -315 | 394        | PADA2    | 11670 | -315  |
| 327        | VDDB     | 7650 | -315 | 361        | VSSB2    | 9690  | -315 | 395        | PADB2    | 11730 | -315  |
| 328        | VDDB     | 7710 | -315 | 362        | VSSB2    | 9750  | -315 | 396        | VSSIDUM2 | 11790 | -315  |
| 329        | VSSB2    | 7770 | -315 | 363        | VSSB2    | 9810  | -315 | 397        | VSSIDUM3 | 11850 | -315  |
| 330        | VSSB2    | 7830 | -315 | 364        | VSSB2    | 9870  | -315 | 398        | VSSIDUM3 | 11910 | -315  |
| 331        | VSSB2    | 7890 | -315 | 365        | VGHS     | 9930  | -315 | 399        | DMY      | 11760 | 309.5 |
| 332        | VSSB2    | 7950 | -315 | 366        | VGHS     | 9990  | -315 | 400        | DMY      | 11732 | 184.5 |
| 333        | VSSB2    | 8010 | -315 | 367        | VGHO     | 10050 | -315 | 401        | DMY      | 11718 | 309.5 |
| 334        | VSSB2    | 8070 | -315 | 368        | VGHO     | 10110 | -315 | 402        | PADA3    | 11704 | 184.5 |
|            |          |      |      |            |          |       |      |            |          |       |       |

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| PAD No.         PIN Name No.         X         PAD No.         PRAD No.         PIN Name No.         X         PIN Name No.         X         PY           4033         18883         11888         3095         439         COCITOI         111214         3009.5         473         SDUMI         10162         108.5           4040         VORHO         11662         3095         439         GOCITI         111804         309.5         473         SS[2]         10710         309.5           406         VORHO         11662         3095         441         GOCITI         111805         309.5         473         SS[2]         10710         309.5           406         VORLO         11662         3095         441         GOCITI         111805         476         SS[3]         10698         184.5           409         VGLO         11660         309.5         441         GOCITI         111140         181.5         476         SS[3]         10608         198.5           410         GOCITI         11578         309.5         443         GOCITI         11100         184.5         479         SS[3]         10610         1062.4           411         GOCITI  |     |          |       |       |     |          |       |       |     |          |       |       |
|--|-----|----------|-------|-------|-----|----------|-------|-------|-----|----------|-------|-------|
| 404         VGHO         11676         184.5         438         GO[0]         11200         184.5         472         S[1]         10724         184.5           405         VGHO         11662         309.5         439         GO[1]         11186         309.5         473         S[2]         10710         309.5           406         VGHO         11688         184.5         440         GO[1]         11172         184.5         474         S[3]         10696         184.5           407         VGLO         11634         309.5         441         GO[1]         11158         309.5         475         S[4]         10688         184.5           409         VGLO         11668         309.5         443         GO[1]         111102         309.5         477         S[6]         10664         309.5           410         GO[1]         11582         184.5         444         GO[1]         111103         309.5         477         S[6]         10604         184.5           411         GO[2]         11569         309.5         447         GO[1]         11108         184.5         409         S[9]         10612         184.5           412  |     | PIN Name | х     | Y     |     | PIN Name | х     | Y     |     | PIN Name | х     | Y     |
| Mathematical No.   Mathematica | 403 | PADB3    | 11690 | 309.5 | 437 | GO[10]   | 11214 | 309.5 | 471 | SDUM1    | 10738 | 309.5 |
| 406         VGHO         11648         184.5         440         GQ[11]         11172         184.5         474         S[3]         10696         184.5           407         VGLO         11634         309.5         441         GQ[12]         11158         309.5         475         S[4]         10682         309.5           408         VGLO         11608         309.5         443         GQ[12]         11144         184.5         476         S[6]         10668         184.5           4409         VGLO         11608         309.5         443         GQ[13]         11110         309.5         477         S[6]         10664         309.5           411         GQ[1]         11578         309.5         444         GQ[13]         11116         184.5         478         S[7]         10640         184.5           411         GQ[2]         11564         184.5         446         GQ[14]         11108         184.5         480         S[9]         10612         184.5           413         GQ[2]         11536         184.5         448         GQ[15]         11060         184.5         480         S[10]         10622         309.5           41   | 404 | VGHO     | 11676 | 184.5 | 438 | GO[10]   | 11200 | 184.5 | 472 | S[1]     | 10724 | 184.5 |
| 407         VGLO         11634         309.5         441         GG[12]         11158         309.5         475         S[4]         10682         309.5           408         VGLO         11620         184.5         442         GG[12]         11144         184.5         476         S[5]         10668         184.5           409         VGLO         11660         309.5         443         GG[13]         11130         309.5         477         S[6]         10664         308.5           410         GG[1]         11578         309.5         444         GG[13]         11116         184.5         478         S[7]         10660         184.5           411         GG[1]         11578         309.5         445         GG[14]         11102         309.5         479         S[8]         10626         309.5           412         GG[2]         11578         309.5         447         GG[15]         11108         184.5         480         S[9]         10612         184.5           413         GG[2]         11536         184.5         448         GG[15]         11060         184.5         482         S[11]         1052         3184.5           41   | 405 | VGHO     | 11662 | 309.5 | 439 | GO[11]   | 11186 | 309.5 | 473 | S[2]     | 10710 | 309.5 |
| 408         VGLO         11620         184.5         442         GO[12]         11144         184.5         476         S[5]         10688         184.5           409         VGLO         11606         309.5         443         GO[13]         11130         309.5         477         S[6]         10654         309.5           410         GO[11]         11592         184.5         444         GO[13]         11116         184.5         478         S[7]         10640         184.5           411         GO[2]         11564         184.5         446         GO[14]         11102         309.5         479         S[8]         10626         309.5           412         GO[2]         11580         309.5         447         GO[15]         11074         309.5         481         S[10]         10528         309.5           414         VGL         11536         184.5         448         GO[16]         11046         309.5         483         S[12]         10570         309.5           416         VGL         11508         184.5         450         GO[16]         11046         309.5         483         S[12]         10570         309.5           41   | 406 | VGHO     | 11648 | 184.5 | 440 | GO[11]   | 11172 | 184.5 | 474 | S[3]     | 10696 | 184.5 |
| 409         VGLO         11606         309.5         443         GO[13]         11130         309.5         477         S[6]         10654         309.5           410         GO[11]         11592         184.5         444         GO[13]         11116         184.5         478         S[7]         10640         184.5           411         GO[11]         11578         309.5         445         GO[14]         11102         309.5         479         S[8]         10626         309.5           412         GO[2]         11564         184.5         446         GO[15]         11074         309.5         481         S[10]         10528         309.5           414         VGL         11536         184.5         448         GO[16]         11060         184.5         482         S[11]         10598         309.5           416         VGL         11508         184.5         448         GO[16]         11046         309.5         483         S[12]         10570         309.5           416         VGL         11508         184.5         450         GO[16]         11032         184.5         484         S[13]         10522         1050         148.5  | 407 | VGLO     | 11634 | 309.5 | 441 | GO[12]   | 11158 | 309.5 | 475 | S[4]     | 10682 | 309.5 |
| Hard   GO[1]   11592   184.5   444   GO[13]   11116   184.5   478   S[7]   10640   184.5     Hil   GO[1]   11578   309.5   445   GO[14]   11102   309.5   479   S[8]   10626   309.5     Hil   GO[2]   11564   184.5   446   GO[14]   11088   184.5   480   S[9]   10612   184.5     Hil   GO[2]   11550   309.5   447   GO[15]   11074   309.5   481   S[10]   10598   309.5     Hil   VGL   11536   184.5   448   GO[15]   11060   184.5   482   S[11]   10594   184.5     Hil   VGL   11522   309.5   449   GO[16]   11046   309.5   483   S[12]   10570   309.5     Hil   VGL   11508   184.5   450   GO[16]   11032   184.5   484   S[13]   10556   184.5     Hil   DMY   11494   309.5   451   VGHO   11018   309.5   485   S[14]   10542   309.5     Hil   DMY   11480   184.5   452   VGHO   11004   184.5   486   S[15]   10528   184.5     Hil   DMY   11466   309.5   453   VGHO   10990   309.5   487   S[16]   10514   309.5     Hil   VGL   11432   184.5   456   VGHO   10962   309.5   488   S[18]   10466   309.5     Hil   VGL   11442   184.5   456   VGHO   10984   184.5   490   S[19]   10472   184.5     Hil   GO[3]   11396   184.5   458   VGHO   10980   309.5   487   S[20]   10488   309.5     Hil   GO[3]   11396   184.5   458   VGHO   10980   309.5   489   S[21]   10444   184.5     Hil   GO[3]   11368   184.5   458   VGHO   10980   309.5   491   S[20]   10488   309.5     Hil   GO[6]   11326   309.5   486   VGLO   10864   184.5   496   S[25]   10388   184.5     Hil   GO[6]   11326   309.5   486   VGLO   10864   184.5   496   S[25]   10388   184.5     Hil   GO[7]   11288   309.5   486   VGLO   10880   184.5   498   S[27]   10360   184.5     Hil   GO[7]   11284   184.5   486   VGLO   10880   184.5   500   S[29]   10332   184.5     Hil   GO[7]   11284   184.5   486   VGLO   10880   184.5   500   S[29]   10332   184.5     Hil   GO[7]   11284   184.5   486   VGLO   10808   184.5   500   S[29]   10332   184.5     Hil   GO[7]   11284   184.5   486   VGLO   10808   184.5   500   S[29]   10332   184.5     Hil   GO[7]   11284   184.5   486   VGLO   108 | 408 | VGLO     | 11620 | 184.5 | 442 | GO[12]   | 11144 | 184.5 | 476 | S[5]     | 10668 | 184.5 |
| 4111         GO[1]         11578         309.5         445         GO[14]         11102         309.5         479         S[8]         10626         309.5           412         GO[2]         11564         184.5         446         GO[14]         11088         184.5         480         S[9]         10612         184.5           413         GO[2]         11550         309.5         447         GO[15]         11074         309.5         481         S[10]         10598         309.5           414         VGL         11536         184.5         448         GO[16]         11060         184.5         482         S[11]         10570         309.5           416         VGL         11508         184.5         450         GO[16]         11032         184.5         484         S[13]         10570         309.5           417         DMY         11449         309.5         451         VGHO         11018         309.5         485         S[14]         10542         309.5           418         DMY         11466         309.5         453         VGHO         11094         184.5         486         S[15]         10528         184.5           419 <td>409</td> <td>VGLO</td> <td>11606</td> <td>309.5</td> <td>443</td> <td>GO[13]</td> <td>11130</td> <td>309.5</td> <td>477</td> <td>S[6]</td> <td>10654</td> <td>309.5</td>   | 409 | VGLO     | 11606 | 309.5 | 443 | GO[13]   | 11130 | 309.5 | 477 | S[6]     | 10654 | 309.5 |
| Hard   GO 2    11564   184.5   446   GO 14    11088   184.5   480   S 9    10612   184.5     Hard   GO 2    11550   309.5   447   GO 15    11074   309.5   481   S 10    10598   309.5     Hard   VGL   11536   184.5   448   GO 15    11080   184.5   482   S 11    10584   184.5     Hard   VGL   11522   309.5   449   GO 16    11046   309.5   483   S 12    10570   309.5     Hard   VGL   11508   184.5   450   GO 16    11032   184.5   484   S 13    10556   184.5     Hard   DMY   11494   309.5   451   VGHO   11018   309.5   485   S 14    10542   309.5     Hard   DMY   11480   184.5   452   VGHO   11004   184.5   486   S 15    10528   184.5     Hard   DMY   11480   309.5   453   VGHO   10990   309.5   487   S 16    10514   309.5     Hard   VGLO   11452   184.5   454   VGHO   10976   184.5   488   S 17    10500   184.5     Hard   VGLO   11438   309.5   455   VGHO   10962   309.5   489   S 18    10486   309.5     Hard   VGLO   11424   184.5   456   VGHO   10934   309.5   491   S 20   10458   309.5     Hard   GO 3    11396   184.5   458   VGHO   10980   309.5   493   S 22   10430   309.5     Hard   GO 4    11382   309.5   459   VGLO   10982   184.5   494   S 23   10416   184.5     Hard   GO 5    11340   184.5   462   VGLO   10864   184.5   496   S 25   10388   184.5     Hard   GO 6    11326   309.5   463   VGLO   10864   184.5   496   S 25   10388   184.5     Hard   GO 6    11326   309.5   465   VGLO   10864   184.5   496   S 26   10374   309.5     Hard   GO 71   11284   184.5   466   VGLO   10886   184.5   500   S 29   10332   184.5     Hard   GO 71   11284   184.5   466   VGLO   10886   184.5   500   S 29   10332   184.5     Hard   GO 8    11270   309.5   467   VGLO   10808   184.5   500   S 29   10332   184.5     Hard   GO 8    11266   184.5   468   DMY   10780   184.5   500   S 31   10304   184.5     Hard   GO 9   11242   309.5   468   DMY   10780   184.5   500   S 31   10304   184.5     Hard   GO 9   11242   309.5   468   DMY   10786   309.5   503   S 32   309.5   309.5     Hard   GO 9   11242   309.5   468   DMY   1 | 410 | GO[1]    | 11592 | 184.5 | 444 | GO[13]   | 11116 | 184.5 | 478 | S[7]     | 10640 | 184.5 |
| Hard    | 411 | GO[1]    | 11578 | 309.5 | 445 | GO[14]   | 11102 | 309.5 | 479 | S[8]     | 10626 | 309.5 |
| 4144         VGL         11536         184.5         448         GO[15]         11060         184.5         482         S[11]         10584         184.5           415         VGL         11522         309.5         449         GO[16]         11046         309.5         483         S[12]         10570         309.5           416         VGL         11508         184.5         450         GO[16]         11032         184.5         484         S[13]         10556         184.5           417         DMY         11494         309.5         451         VGHO         11018         309.5         485         S[14]         10542         309.5           418         DMY         11480         184.5         452         VGHO         11004         184.5         486         S[15]         10528         184.5           419         DMY         11466         309.5         453         VGHO         10990         309.5         487         S[16]         10514         309.5           420         VGLO         11424         184.5         456         VGHO         10962         309.5         489         S[18]         10486         309.5           422   | 412 | GO[2]    | 11564 | 184.5 | 446 | GO[14]   | 11088 | 184.5 | 480 | S[9]     | 10612 | 184.5 |
| 415         VGL         11522         309.5         449         GO[16]         11046         309.5         483         S[12]         10570         309.5           416         VGL         11508         184.5         450         GO[16]         11032         184.5         484         S[13]         10556         184.5           417         DMY         11494         309.5         451         VGHO         11018         309.5         485         S[14]         10542         309.5           418         DMY         11480         184.5         452         VGHO         11004         184.5         486         S[15]         10528         184.5           419         DMY         11466         309.5         453         VGHO         10976         184.5         486         S[17]         10500         184.5           420         VGLO         11452         184.5         454         VGHO         10976         184.5         488         S[17]         10500         184.5           421         VGLO         11438         309.5         455         VGHO         10962         309.5         489         S[18]         10468         309.5           422   | 413 | GO[2]    | 11550 | 309.5 | 447 | GO[15]   | 11074 | 309.5 | 481 | S[10]    | 10598 | 309.5 |
| 416         VGL         11508         184.5         450         GO[16]         11032         184.5         484         S[13]         10556         184.5           417         DMY         11494         309.5         451         VGHO         11018         309.5         485         S[14]         10542         309.5           418         DMY         11480         184.5         452         VGHO         11004         184.5         486         S[15]         10528         184.5           419         DMY         11466         309.5         453         VGHO         10990         309.5         487         S[16]         10514         309.5           420         VGLO         11438         309.5         455         VGHO         10976         184.5         488         S[17]         10500         184.5           421         VGLO         11438         309.5         455         VGHO         10962         309.5         489         S[18]         10486         309.5           422         VGLO         11424         184.5         456         VGHO         10948         184.5         490         S[19]         10472         184.5           423  | 414 | VGL      | 11536 | 184.5 | 448 | GO[15]   | 11060 | 184.5 | 482 | S[11]    | 10584 | 184.5 |
| 417         DMY         11494         309.5         451         VGHO         11018         309.5         485         S[14]         10542         309.5           418         DMY         11480         184.5         452         VGHO         11004         184.5         486         S[15]         10528         184.5           419         DMY         11466         309.5         453         VGHO         10990         309.5         487         S[16]         10514         309.5           420         VGLO         11432         184.5         454         VGHO         10976         184.5         488         S[17]         10500         184.5           421         VGLO         11438         309.5         455         VGHO         10962         309.5         489         S[18]         10486         309.5           422         VGLO         11424         184.5         456         VGHO         10948         184.5         490         S[19]         10472         184.5           423         GO[3]         11396         184.5         458         VGHO         10934         309.5         491         S[20]         10448         184.5           424  | 415 | VGL      | 11522 | 309.5 | 449 | GO[16]   | 11046 | 309.5 | 483 | S[12]    | 10570 | 309.5 |
| 418         DMY         11480         184.5         452         VGHO         11004         184.5         486         S[15]         10528         184.5           419         DMY         11466         309.5         453         VGHO         10990         309.5         487         S[16]         10514         309.5           420         VGLO         11452         184.5         454         VGHO         10976         184.5         488         S[17]         10500         184.5           421         VGLO         11438         309.5         455         VGHO         10962         309.5         489         S[18]         10486         309.5           422         VGLO         11424         184.5         456         VGHO         10934         309.5         491         S[20]         10458         309.5           422         VGLO         11424         184.5         456         VGHO         10934         309.5         491         S[20]         10458         309.5           423         GO[3]         11396         184.5         458         VGHO         10920         184.5         492         S[21]         10444         184.5           425   | 416 | VGL      | 11508 | 184.5 | 450 | GO[16]   | 11032 | 184.5 | 484 | S[13]    | 10556 | 184.5 |
| 419         DMY         11466         309.5         453         VGHO         10990         309.5         487         S[16]         10514         309.5           420         VGLO         11452         184.5         454         VGHO         10976         184.5         488         S[17]         10500         184.5           421         VGLO         11438         309.5         455         VGHO         10962         309.5         489         S[18]         10486         309.5           422         VGLO         11424         184.5         456         VGHO         10948         184.5         490         S[19]         10472         184.5           423         GO[3]         11410         309.5         457         VGHO         10934         309.5         491         S[20]         10458         309.5           424         GO[3]         11396         184.5         458         VGHO         10920         184.5         492         S[21]         10444         184.5           425         GO[4]         11388         184.5         460         VGLO         10892         184.5         494         S[23]         10416         184.5           426  | 417 | DMY      | 11494 | 309.5 | 451 | VGHO     | 11018 | 309.5 | 485 | S[14]    | 10542 | 309.5 |
| 420         VGLO         11452         184.5         454         VGHO         10976         184.5         488         S[17]         10500         184.5           421         VGLO         11438         309.5         455         VGHO         10962         309.5         489         S[18]         10486         309.5           422         VGLO         11424         184.5         456         VGHO         10948         184.5         490         S[19]         10472         184.5           423         GO[3]         11410         309.5         457         VGHO         10934         309.5         491         S[20]         10458         309.5           424         GO[3]         11396         184.5         458         VGHO         10920         184.5         492         S[21]         10444         184.5           425         GO[4]         11382         309.5         459         VGLO         10906         309.5         493         S[22]         10430         309.5           426         GO[4]         11368         184.5         460         VGLO         10878         309.5         493         S[23]         10416         184.5           427  | 418 | DMY      | 11480 | 184.5 | 452 | VGHO     | 11004 | 184.5 | 486 | S[15]    | 10528 | 184.5 |
| 421         VGLO         11438         309.5         455         VGHO         10962         309.5         489         S[18]         10486         309.5           422         VGLO         11424         184.5         456         VGHO         10948         184.5         490         S[19]         10472         184.5           423         GO[3]         11410         309.5         457         VGHO         10934         309.5         491         S[20]         10458         309.5           424         GO[3]         11396         184.5         458         VGHO         10920         184.5         492         S[21]         10444         184.5           425         GO[4]         11382         309.5         459         VGLO         10906         309.5         493         S[22]         10430         309.5           426         GO[4]         11368         184.5         460         VGLO         10892         184.5         494         S[23]         10416         184.5           427         GO[5]         11340         184.5         462         VGLO         10878         309.5         495         S[24]         10402         309.5           428   | 419 | DMY      | 11466 | 309.5 | 453 | VGHO     | 10990 | 309.5 | 487 | S[16]    | 10514 | 309.5 |
| 422         VGLO         11424         184.5         456         VGHO         10948         184.5         490         S[19]         10472         184.5           423         GO[3]         11410         309.5         457         VGHO         10934         309.5         491         S[20]         10458         309.5           424         GO[3]         11396         184.5         458         VGHO         10920         184.5         492         S[21]         10444         184.5           425         GO[4]         11382         309.5         459         VGLO         10906         309.5         493         S[22]         10430         309.5           426         GO[4]         11368         184.5         460         VGLO         10892         184.5         494         S[23]         10416         184.5           427         GO[5]         11340         184.5         462         VGLO         10864         184.5         496         S[25]         10388         184.5           428         GO[5]         11326         309.5         463         VGLO         10864         184.5         496         S[25]         10388         184.5           429  | 420 | VGLO     | 11452 | 184.5 | 454 | VGHO     | 10976 | 184.5 | 488 | S[17]    | 10500 | 184.5 |
| 423         GO[3]         11410         309.5         457         VGHO         10934         309.5         491         S[20]         10458         309.5           424         GO[3]         11396         184.5         458         VGHO         10920         184.5         492         S[21]         10444         184.5           425         GO[4]         11382         309.5         459         VGLO         10906         309.5         493         S[22]         10430         309.5           426         GO[4]         11368         184.5         460         VGLO         10892         184.5         494         S[23]         10416         184.5           427         GO[5]         11354         309.5         461         VGLO         10878         309.5         495         S[24]         10402         309.5           428         GO[5]         11340         184.5         462         VGLO         10864         184.5         496         S[25]         10388         184.5           429         GO[6]         11326         309.5         463         VGLO         10850         309.5         497         S[26]         10374         309.5           430 <td>421</td> <td>VGLO</td> <td>11438</td> <td>309.5</td> <td>455</td> <td>VGHO</td> <td>10962</td> <td>309.5</td> <td>489</td> <td>S[18]</td> <td>10486</td> <td>309.5</td>   | 421 | VGLO     | 11438 | 309.5 | 455 | VGHO     | 10962 | 309.5 | 489 | S[18]    | 10486 | 309.5 |
| 424         GO[3]         11396         184.5         458         VGHO         10920         184.5         492         S[21]         10444         184.5           425         GO[4]         11382         309.5         459         VGLO         10906         309.5         493         S[22]         10430         309.5           426         GO[4]         11368         184.5         460         VGLO         10892         184.5         494         S[23]         10416         184.5           427         GO[5]         11354         309.5         461         VGLO         10878         309.5         495         S[24]         10402         309.5           428         GO[5]         11340         184.5         462         VGLO         10864         184.5         496         S[25]         10388         184.5           429         GO[6]         11326         309.5         463         VGLO         10850         309.5         497         S[26]         10374         309.5           430         GO[6]         11312         184.5         464         VGLO         10836         184.5         498         S[27]         10360         184.5           431 <td>422</td> <td>VGLO</td> <td>11424</td> <td>184.5</td> <td>456</td> <td>VGHO</td> <td>10948</td> <td>184.5</td> <td>490</td> <td>S[19]</td> <td>10472</td> <td>184.5</td>   | 422 | VGLO     | 11424 | 184.5 | 456 | VGHO     | 10948 | 184.5 | 490 | S[19]    | 10472 | 184.5 |
| 425         GO[4]         11382         309.5         459         VGLO         10906         309.5         493         S[22]         10430         309.5           426         GO[4]         11368         184.5         460         VGLO         10892         184.5         494         S[23]         10416         184.5           427         GO[5]         11354         309.5         461         VGLO         10878         309.5         495         S[24]         10402         309.5           428         GO[5]         11340         184.5         462         VGLO         10864         184.5         496         S[25]         10388         184.5           429         GO[6]         11326         309.5         463         VGLO         10850         309.5         497         S[26]         10374         309.5           430         GO[6]         11312         184.5         464         VGLO         10836         184.5         498         S[27]         10360         184.5           431         GO[7]         11298         309.5         465         VGLO         10822         309.5         499         S[28]         10346         309.5           432 <td>423</td> <td>GO[3]</td> <td>11410</td> <td>309.5</td> <td>457</td> <td>VGHO</td> <td>10934</td> <td>309.5</td> <td>491</td> <td>S[20]</td> <td>10458</td> <td>309.5</td>  | 423 | GO[3]    | 11410 | 309.5 | 457 | VGHO     | 10934 | 309.5 | 491 | S[20]    | 10458 | 309.5 |
| 426         GO[4]         11368         184.5         460         VGLO         10892         184.5         494         S[23]         10416         184.5           427         GO[5]         11354         309.5         461         VGLO         10878         309.5         495         S[24]         10402         309.5           428         GO[5]         11340         184.5         462         VGLO         10864         184.5         496         S[25]         10388         184.5           429         GO[6]         11326         309.5         463         VGLO         10850         309.5         497         S[26]         10374         309.5           430         GO[6]         11312         184.5         464         VGLO         10836         184.5         498         S[27]         10360         184.5           431         GO[7]         11298         309.5         465         VGLO         10822         309.5         499         S[28]         10346         309.5           432         GO[7]         11284         184.5         466         VGLO         10808         184.5         500         S[29]         10332         184.5           433 <td>424</td> <td>GO[3]</td> <td>11396</td> <td>184.5</td> <td>458</td> <td>VGHO</td> <td>10920</td> <td>184.5</td> <td>492</td> <td>S[21]</td> <td>10444</td> <td>184.5</td>  | 424 | GO[3]    | 11396 | 184.5 | 458 | VGHO     | 10920 | 184.5 | 492 | S[21]    | 10444 | 184.5 |
| 427         GO[5]         11354         309.5         461         VGLO         10878         309.5         495         S[24]         10402         309.5           428         GO[5]         11340         184.5         462         VGLO         10864         184.5         496         S[25]         10388         184.5           429         GO[6]         11326         309.5         463         VGLO         10850         309.5         497         S[26]         10374         309.5           430         GO[6]         11312         184.5         464         VGLO         10836         184.5         498         S[27]         10360         184.5           431         GO[7]         11298         309.5         465         VGLO         10822         309.5         499         S[28]         10346         309.5           432         GO[7]         11284         184.5         466         VGLO         10808         184.5         500         S[29]         10332         184.5           433         GO[8]         11270         309.5         467         VGLO         10794         309.5         501         S[30]         10318         309.5           434 <td>425</td> <td>GO[4]</td> <td>11382</td> <td>309.5</td> <td>459</td> <td>VGLO</td> <td>10906</td> <td>309.5</td> <td>493</td> <td>S[22]</td> <td>10430</td> <td>309.5</td>  | 425 | GO[4]    | 11382 | 309.5 | 459 | VGLO     | 10906 | 309.5 | 493 | S[22]    | 10430 | 309.5 |
| 428         GO[5]         11340         184.5         462         VGLO         10864         184.5         496         S[25]         10388         184.5           429         GO[6]         11326         309.5         463         VGLO         10850         309.5         497         S[26]         10374         309.5           430         GO[6]         11312         184.5         464         VGLO         10836         184.5         498         S[27]         10360         184.5           431         GO[7]         11298         309.5         465         VGLO         10822         309.5         499         S[28]         10346         309.5           432         GO[7]         11284         184.5         466         VGLO         10808         184.5         500         S[29]         10332         184.5           433         GO[8]         11270         309.5         467         VGLO         10794         309.5         501         S[30]         10318         309.5           434         GO[8]         11256         184.5         468         DMY         10780         184.5         502         S[31]         10304         184.5           435  | 426 | GO[4]    | 11368 | 184.5 | 460 | VGLO     | 10892 | 184.5 | 494 | S[23]    | 10416 | 184.5 |
| 429         GO[6]         11326         309.5         463         VGLO         10850         309.5         497         S[26]         10374         309.5           430         GO[6]         11312         184.5         464         VGLO         10836         184.5         498         S[27]         10360         184.5           431         GO[7]         11298         309.5         465         VGLO         10822         309.5         499         S[28]         10346         309.5           432         GO[7]         11284         184.5         466         VGLO         10808         184.5         500         S[29]         10332         184.5           433         GO[8]         11270         309.5         467         VGLO         10794         309.5         501         S[30]         10318         309.5           434         GO[8]         11256         184.5         468         DMY         10780         184.5         502         S[31]         10304         184.5           435         GO[9]         11242         309.5         469         DMY         10766         309.5         503         S[32]         10290         309.5   | 427 | GO[5]    | 11354 | 309.5 | 461 | VGLO     | 10878 | 309.5 | 495 | S[24]    | 10402 | 309.5 |
| 430         GO[6]         11312         184.5         464         VGLO         10836         184.5         498         S[27]         10360         184.5           431         GO[7]         11298         309.5         465         VGLO         10822         309.5         499         S[28]         10346         309.5           432         GO[7]         11284         184.5         466         VGLO         10808         184.5         500         S[29]         10332         184.5           433         GO[8]         11270         309.5         467         VGLO         10794         309.5         501         S[30]         10318         309.5           434         GO[8]         11256         184.5         468         DMY         10780         184.5         502         S[31]         10304         184.5           435         GO[9]         11242         309.5         469         DMY         10766         309.5         503         S[32]         10290         309.5  | 428 | GO[5]    | 11340 | 184.5 | 462 | VGLO     | 10864 | 184.5 | 496 | S[25]    | 10388 | 184.5 |
| 431         GO[7]         11298         309.5         465         VGLO         10822         309.5         499         S[28]         10346         309.5           432         GO[7]         11284         184.5         466         VGLO         10808         184.5         500         S[29]         10332         184.5           433         GO[8]         11270         309.5         467         VGLO         10794         309.5         501         S[30]         10318         309.5           434         GO[8]         11256         184.5         468         DMY         10780         184.5         502         S[31]         10304         184.5           435         GO[9]         11242         309.5         469         DMY         10766         309.5         503         S[32]         10290         309.5   | 429 | GO[6]    | 11326 | 309.5 | 463 | VGLO     | 10850 | 309.5 | 497 | S[26]    | 10374 | 309.5 |
| 432         GO[7]         11284         184.5         466         VGLO         10808         184.5         500         S[29]         10332         184.5           433         GO[8]         11270         309.5         467         VGLO         10794         309.5         501         S[30]         10318         309.5           434         GO[8]         11256         184.5         468         DMY         10780         184.5         502         S[31]         10304         184.5           435         GO[9]         11242         309.5         469         DMY         10766         309.5         503         S[32]         10290         309.5  | 430 | GO[6]    | 11312 | 184.5 | 464 | VGLO     | 10836 | 184.5 | 498 | S[27]    | 10360 | 184.5 |
| 433         GO[8]         11270         309.5         467         VGLO         10794         309.5         501         S[30]         10318         309.5           434         GO[8]         11256         184.5         468         DMY         10780         184.5         502         S[31]         10304         184.5           435         GO[9]         11242         309.5         469         DMY         10766         309.5         503         S[32]         10290         309.5   | 431 | GO[7]    | 11298 | 309.5 | 465 | VGLO     | 10822 | 309.5 | 499 | S[28]    | 10346 | 309.5 |
| 434     GO[8]     11256     184.5     468     DMY     10780     184.5     502     S[31]     10304     184.5       435     GO[9]     11242     309.5     469     DMY     10766     309.5     503     S[32]     10290     309.5  | 432 | GO[7]    | 11284 | 184.5 | 466 | VGLO     | 10808 | 184.5 | 500 | S[29]    | 10332 | 184.5 |
| 435 GO[9] 11242 309.5 469 DMY 10766 309.5 503 S[32] 10290 309.5  | 433 | GO[8]    | 11270 | 309.5 | 467 | VGLO     | 10794 | 309.5 | 501 | S[30]    | 10318 | 309.5 |
|  | 434 | GO[8]    | 11256 | 184.5 | 468 | DMY      | 10780 | 184.5 | 502 | S[31]    | 10304 | 184.5 |
| 436 GO[9] 11228 184.5 470 SDUM0 10752 184.5 504 S[33] 10276 184.5  | 435 | GO[9]    | 11242 | 309.5 | 469 | DMY      | 10766 | 309.5 | 503 | S[32]    | 10290 | 309.5 |
|  | 436 | GO[9]    | 11228 | 184.5 | 470 | SDUM0    | 10752 | 184.5 | 504 | S[33]    | 10276 | 184.5 |

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| PAD<br>No. | PIN Name | х     | Υ     | PAD<br>No. | PIN Name | х    | Υ     | PAD<br>No. | PIN Name | х    | Y     |
|------------|----------|-------|-------|------------|----------|------|-------|------------|----------|------|-------|
| 505        | S[34]    | 10262 | 309.5 | 539        | S[68]    | 9786 | 309.5 | 573        | S[102]   | 9310 | 309.5 |
| 506        | S[35]    | 10248 | 184.5 | 540        | S[69]    | 9772 | 184.5 | 574        | S[103]   | 9296 | 184.5 |
| 507        | S[36]    | 10234 | 309.5 | 541        | S[70]    | 9758 | 309.5 | 575        | S[104]   | 9282 | 309.5 |
| 508        | S[37]    | 10220 | 184.5 | 542        | S[71]    | 9744 | 184.5 | 576        | S[105]   | 9268 | 184.5 |
| 509        | S[38]    | 10206 | 309.5 | 543        | S[72]    | 9730 | 309.5 | 577        | S[106]   | 9254 | 309.5 |
| 510        | S[39]    | 10192 | 184.5 | 544        | S[73]    | 9716 | 184.5 | 578        | S[107]   | 9240 | 184.5 |
| 511        | S[40]    | 10178 | 309.5 | 545        | S[74]    | 9702 | 309.5 | 579        | S[108]   | 9226 | 309.5 |
| 512        | S[41]    | 10164 | 184.5 | 546        | S[75]    | 9688 | 184.5 | 580        | S[109]   | 9212 | 184.5 |
| 513        | S[42]    | 10150 | 309.5 | 547        | S[76]    | 9674 | 309.5 | 581        | S[110]   | 9198 | 309.5 |
| 514        | S[43]    | 10136 | 184.5 | 548        | S[77]    | 9660 | 184.5 | 582        | S[111]   | 9184 | 184.5 |
| 515        | S[44]    | 10122 | 309.5 | 549        | S[78]    | 9646 | 309.5 | 583        | S[112]   | 9170 | 309.5 |
| 516        | S[45]    | 10108 | 184.5 | 550        | S[79]    | 9632 | 184.5 | 584        | S[113]   | 9156 | 184.5 |
| 517        | S[46]    | 10094 | 309.5 | 551        | S[80]    | 9618 | 309.5 | 585        | S[114]   | 9142 | 309.5 |
| 518        | S[47]    | 10080 | 184.5 | 552        | S[81]    | 9604 | 184.5 | 586        | S[115]   | 9128 | 184.5 |
| 519        | S[48]    | 10066 | 309.5 | 553        | S[82]    | 9590 | 309.5 | 587        | S[116]   | 9114 | 309.5 |
| 520        | S[49]    | 10052 | 184.5 | 554        | S[83]    | 9576 | 184.5 | 588        | S[117]   | 9100 | 184.5 |
| 521        | S[50]    | 10038 | 309.5 | 555        | S[84]    | 9562 | 309.5 | 589        | S[118]   | 9086 | 309.5 |
| 522        | S[51]    | 10024 | 184.5 | 556        | S[85]    | 9548 | 184.5 | 590        | S[119]   | 9072 | 184.5 |
| 523        | S[52]    | 10010 | 309.5 | 557        | S[86]    | 9534 | 309.5 | 591        | S[120]   | 9058 | 309.5 |
| 524        | S[53]    | 9996  | 184.5 | 558        | S[87]    | 9520 | 184.5 | 592        | S[121]   | 9044 | 184.5 |
| 525        | S[54]    | 9982  | 309.5 | 559        | S[88]    | 9506 | 309.5 | 593        | S[122]   | 9030 | 309.5 |
| 526        | S[55]    | 9968  | 184.5 | 560        | S[89]    | 9492 | 184.5 | 594        | S[123]   | 9016 | 184.5 |
| 527        | S[56]    | 9954  | 309.5 | 561        | S[90]    | 9478 | 309.5 | 595        | S[124]   | 9002 | 309.5 |
| 528        | S[57]    | 9940  | 184.5 | 562        | S[91]    | 9464 | 184.5 | 596        | S[125]   | 8988 | 184.5 |
| 529        | S[58]    | 9926  | 309.5 | 563        | S[92]    | 9450 | 309.5 | 597        | S[126]   | 8974 | 309.5 |
| 530        | S[59]    | 9912  | 184.5 | 564        | S[93]    | 9436 | 184.5 | 598        | S[127]   | 8960 | 184.5 |
| 531        | S[60]    | 9898  | 309.5 | 565        | S[94]    | 9422 | 309.5 | 599        | S[128]   | 8946 | 309.5 |
| 532        | S[61]    | 9884  | 184.5 | 566        | S[95]    | 9408 | 184.5 | 600        | S[129]   | 8932 | 184.5 |
| 533        | S[62]    | 9870  | 309.5 | 567        | S[96]    | 9394 | 309.5 | 601        | S[130]   | 8918 | 309.5 |
| 534        | S[63]    | 9856  | 184.5 | 568        | S[97]    | 9380 | 184.5 | 602        | S[131]   | 8904 | 184.5 |
| 535        | S[64]    | 9842  | 309.5 | 569        | S[98]    | 9366 | 309.5 | 603        | S[132]   | 8890 | 309.5 |
| 536        | S[65]    | 9828  | 184.5 | 570        | S[99]    | 9352 | 184.5 | 604        | S[133]   | 8876 | 184.5 |
| 537        | S[66]    | 9814  | 309.5 | 571        | S[100]   | 9338 | 309.5 | 605        | S[134]   | 8862 | 309.5 |
| 538        | S[67]    | 9800  | 184.5 | 572        | S[101]   | 9324 | 184.5 | 606        | S[135]   | 8848 | 184.5 |
|            |          |       |       |            |          |      |       |            |          |      |       |

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| PAD<br>No. | PIN Name | х    | Υ     | PAD<br>No. | PIN Name | Х    | Υ     | PAD<br>No. | PIN Name | х    | Y     |
|------------|----------|------|-------|------------|----------|------|-------|------------|----------|------|-------|
| 607        | S[136]   | 8834 | 309.5 | 641        | S[170]   | 8358 | 309.5 | 675        | S[204]   | 7882 | 309.5 |
| 608        | S[137]   | 8820 | 184.5 | 642        | S[171]   | 8344 | 184.5 | 676        | S[205]   | 7868 | 184.5 |
| 609        | S[138]   | 8806 | 309.5 | 643        | S[172]   | 8330 | 309.5 | 677        | S[206]   | 7854 | 309.5 |
| 610        | S[139]   | 8792 | 184.5 | 644        | S[173]   | 8316 | 184.5 | 678        | S[207]   | 7840 | 184.5 |
| 611        | S[140]   | 8778 | 309.5 | 645        | S[174]   | 8302 | 309.5 | 679        | S[208]   | 7826 | 309.5 |
| 612        | S[141]   | 8764 | 184.5 | 646        | S[175]   | 8288 | 184.5 | 680        | S[209]   | 7812 | 184.5 |
| 613        | S[142]   | 8750 | 309.5 | 647        | S[176]   | 8274 | 309.5 | 681        | S[210]   | 7798 | 309.5 |
| 614        | S[143]   | 8736 | 184.5 | 648        | S[177]   | 8260 | 184.5 | 682        | S[211]   | 7784 | 184.5 |
| 615        | S[144]   | 8722 | 309.5 | 649        | S[178]   | 8246 | 309.5 | 683        | S[212]   | 7770 | 309.5 |
| 616        | S[145]   | 8708 | 184.5 | 650        | S[179]   | 8232 | 184.5 | 684        | S[213]   | 7756 | 184.5 |
| 617        | S[146]   | 8694 | 309.5 | 651        | S[180]   | 8218 | 309.5 | 685        | S[214]   | 7742 | 309.5 |
| 618        | S[147]   | 8680 | 184.5 | 652        | S[181]   | 8204 | 184.5 | 686        | S[215]   | 7728 | 184.5 |
| 619        | S[148]   | 8666 | 309.5 | 653        | S[182]   | 8190 | 309.5 | 687        | S[216]   | 7714 | 309.5 |
| 620        | S[149]   | 8652 | 184.5 | 654        | S[183]   | 8176 | 184.5 | 688        | S[217]   | 7700 | 184.5 |
| 621        | S[150]   | 8638 | 309.5 | 655        | S[184]   | 8162 | 309.5 | 689        | S[218]   | 7686 | 309.5 |
| 622        | S[151]   | 8624 | 184.5 | 656        | S[185]   | 8148 | 184.5 | 690        | S[219]   | 7672 | 184.5 |
| 623        | S[152]   | 8610 | 309.5 | 657        | S[186]   | 8134 | 309.5 | 691        | S[220]   | 7658 | 309.5 |
| 624        | S[153]   | 8596 | 184.5 | 658        | S[187]   | 8120 | 184.5 | 692        | S[221]   | 7644 | 184.5 |
| 625        | S[154]   | 8582 | 309.5 | 659        | S[188]   | 8106 | 309.5 | 693        | S[222]   | 7630 | 309.5 |
| 626        | S[155]   | 8568 | 184.5 | 660        | S[189]   | 8092 | 184.5 | 694        | S[223]   | 7616 | 184.5 |
| 627        | S[156]   | 8554 | 309.5 | 661        | S[190]   | 8078 | 309.5 | 695        | S[224]   | 7602 | 309.5 |
| 628        | S[157]   | 8540 | 184.5 | 662        | S[191]   | 8064 | 184.5 | 696        | S[225]   | 7588 | 184.5 |
| 629        | S[158]   | 8526 | 309.5 | 663        | S[192]   | 8050 | 309.5 | 697        | S[226]   | 7574 | 309.5 |
| 630        | S[159]   | 8512 | 184.5 | 664        | S[193]   | 8036 | 184.5 | 698        | S[227]   | 7560 | 184.5 |
| 631        | S[160]   | 8498 | 309.5 | 665        | S[194]   | 8022 | 309.5 | 699        | S[228]   | 7546 | 309.5 |
| 632        | S[161]   | 8484 | 184.5 | 666        | S[195]   | 8008 | 184.5 | 700        | S[229]   | 7532 | 184.5 |
| 633        | S[162]   | 8470 | 309.5 | 667        | S[196]   | 7994 | 309.5 | 701        | S[230]   | 7518 | 309.5 |
| 634        | S[163]   | 8456 | 184.5 | 668        | S[197]   | 7980 | 184.5 | 702        | S[231]   | 7504 | 184.5 |
| 635        | S[164]   | 8442 | 309.5 | 669        | S[198]   | 7966 | 309.5 | 703        | S[232]   | 7490 | 309.5 |
| 636        | S[165]   | 8428 | 184.5 | 670        | S[199]   | 7952 | 184.5 | 704        | S[233]   | 7476 | 184.5 |
| 637        | S[166]   | 8414 | 309.5 | 671        | S[200]   | 7938 | 309.5 | 705        | S[234]   | 7462 | 309.5 |
| 638        | S[167]   | 8400 | 184.5 | 672        | S[201]   | 7924 | 184.5 | 706        | S[235]   | 7448 | 184.5 |
| 639        | S[168]   | 8386 | 309.5 | 673        | S[202]   | 7910 | 309.5 | 707        | S[236]   | 7434 | 309.5 |
| 640        | S[169]   | 8372 | 184.5 | 674        | S[203]   | 7896 | 184.5 | 708        | S[237]   | 7420 | 184.5 |
|            |          |      |       |            |          |      |       |            |          |      |       |

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| No.         No.         No.         No.         No.           709         S[238]         7406         309.5         743         S[272]         6930         309.5         777         S[306]         6454         305           710         S[239]         7392         184.5         744         S[273]         6916         184.5         778         S[307]         6440         184           711         S[240]         7378         309.5         745         S[274]         6902         309.5         779         S[308]         6426         305           712         S[241]         7364         184.5         746         S[275]         6888         184.5         780         S[309]         6412         184           713         S[242]         7350         309.5         747         S[276]         6874         309.5         781         S[310]         6398         305           714         S[243]         7336         184.5         748         S[277]         6860         184.5         782         S[311]         6384         184           715         S[244]         7322         309.5         749         S[278]         6846         309.5         <      | 6454 309.5<br>6440 184.5<br>6426 309.5<br>6412 184.5<br>6398 309.5<br>6384 184.5<br>6370 309.5<br>6356 184.5<br>6342 309.5  |
|--|---|
| 710         S[239]         7392         184.5         744         S[273]         6916         184.5         778         S[307]         6440         184           711         S[240]         7378         309.5         745         S[274]         6902         309.5         779         S[308]         6426         306           712         S[241]         7364         184.5         746         S[275]         6888         184.5         780         S[309]         6412         184           713         S[242]         7350         309.5         747         S[276]         6874         309.5         781         S[310]         6398         305           714         S[243]         7336         184.5         748         S[277]         6860         184.5         782         S[311]         6384         184           715         S[244]         7322         309.5         749         S[278]         6846         309.5         783         S[312]         6370         306           716         S[245]         7308         184.5         750         S[279]         6832         184.5         784         S[313]         6356         194           717            | 6440     184.5       6426     309.5       6412     184.5       6398     309.5       6384     184.5       6370     309.5       6356     184.5       6342     309.5 |
| 711         S[240]         7378         309.5         745         S[274]         6902         309.5         779         S[308]         6426         305           712         S[241]         7364         184.5         746         S[275]         6888         184.5         780         S[309]         6412         184           713         S[242]         7350         309.5         747         S[276]         6874         309.5         781         S[310]         6398         305           714         S[243]         7336         184.5         748         S[277]         6860         184.5         782         S[311]         6384         184           715         S[244]         7322         309.5         749         S[279]         6832         184.5         783         S[312]         6370         305           716         S[245]         7308         184.5         750         S[279]         6832         184.5         784         S[313]         6356         184           717         S[246]         7294         309.5         751         S[280]         6818         309.5         785         S[314]         6342         306           718            | 6426     309.5       6412     184.5       6398     309.5       6384     184.5       6370     309.5       6356     184.5       6342     309.5                      |
| 712         S[241]         7364         184.5         746         S[275]         6888         184.5         780         S[309]         6412         184           713         S[242]         7350         309.5         747         S[276]         6874         309.5         781         S[310]         6398         308           714         S[243]         7336         184.5         748         S[277]         6860         184.5         782         S[311]         6384         184           715         S[244]         7322         309.5         749         S[278]         6846         309.5         783         S[312]         6370         308           716         S[245]         7308         184.5         750         S[279]         6832         184.5         784         S[313]         6356         184           717         S[246]         7294         309.5         751         S[280]         6818         309.5         785         S[314]         6342         308           718         S[247]         7280         184.5         752         S[281]         6804         184.5         786         S[315]         6328         184           719            | 6412     184.5       6398     309.5       6384     184.5       6370     309.5       6356     184.5       6342     309.5   |
| 713         S[242]         7350         309.5         747         S[276]         6874         309.5         781         S[310]         6398         306           714         S[243]         7336         184.5         748         S[277]         6860         184.5         782         S[311]         6384         184           715         S[244]         7322         309.5         749         S[278]         6846         309.5         783         S[312]         6370         308           716         S[245]         7308         184.5         750         S[279]         6832         184.5         784         S[313]         6356         184           717         S[246]         7294         309.5         751         S[280]         6818         309.5         785         S[314]         6342         308           718         S[247]         7280         184.5         752         S[281]         6804         184.5         786         S[315]         6328         184           719         S[248]         7266         309.5         753         S[282]         6790         309.5         787         S[316]         6314         305           720            | 6398 309.5<br>6384 184.5<br>6370 309.5<br>6356 184.5<br>6342 309.5  |
| 714         S[243]         7336         184.5         748         S[277]         6860         184.5         782         S[311]         6384         184           715         S[244]         7322         309.5         749         S[278]         6846         309.5         783         S[312]         6370         308           716         S[245]         7308         184.5         750         S[279]         6832         184.5         784         S[313]         6356         184           717         S[246]         7294         309.5         751         S[280]         6818         309.5         785         S[314]         6342         308           718         S[247]         7280         184.5         752         S[281]         6804         184.5         786         S[315]         6328         184           719         S[248]         7266         309.5         753         S[282]         6790         309.5         787         S[316]         6314         308           720         S[249]         7252         184.5         754         S[283]         6776         184.5         788         S[317]         6300         184           721            | 6384 184.5<br>6370 309.5<br>6356 184.5<br>6342 309.5  |
| 715         S[244]         7322         309.5         749         S[278]         6846         309.5         783         S[312]         6370         308           716         S[245]         7308         184.5         750         S[279]         6832         184.5         784         S[313]         6356         184           717         S[246]         7294         309.5         751         S[280]         6818         309.5         785         S[314]         6342         306           718         S[247]         7280         184.5         752         S[281]         6804         184.5         786         S[315]         6328         184           719         S[248]         7266         309.5         753         S[282]         6790         309.5         787         S[316]         6314         308           720         S[249]         7252         184.5         754         S[283]         6776         184.5         788         S[317]         6300         184           721         S[250]         7238         309.5         755         S[284]         6762         309.5         789         S[318]         6286         308           722            | 6370 309.5<br>6356 184.5<br>6342 309.5  |
| 716         S[245]         7308         184.5         750         S[279]         6832         184.5         784         S[313]         6356         184           717         S[246]         7294         309.5         751         S[280]         6818         309.5         785         S[314]         6342         308           718         S[247]         7280         184.5         752         S[281]         6804         184.5         786         S[315]         6328         184           719         S[248]         7266         309.5         753         S[282]         6790         309.5         787         S[316]         6314         308           720         S[249]         7252         184.5         754         S[283]         6776         184.5         788         S[317]         6300         184           721         S[250]         7238         309.5         755         S[284]         6762         309.5         789         S[318]         6286         309           722         S[251]         7224         184.5         756         S[285]         6748         184.5         790         S[319]         6272         184           723            | 6356 184.5<br>6342 309.5  |
| 717         S[246]         7294         309.5         751         S[280]         6818         309.5         785         S[314]         6342         309.5           718         S[247]         7280         184.5         752         S[281]         6804         184.5         786         S[315]         6328         184           719         S[248]         7266         309.5         753         S[282]         6790         309.5         787         S[316]         6314         309.5           720         S[249]         7252         184.5         754         S[283]         6776         184.5         788         S[317]         6300         184.5           721         S[250]         7238         309.5         755         S[284]         6762         309.5         789         S[318]         6286         309.5           722         S[251]         7224         184.5         756         S[285]         6748         184.5         790         S[319]         6272         184.5           723         S[252]         7210         309.5         757         S[286]         6734         309.5         791         S[320]         6258         309.5           72 | 6342 309.5  |
| 718         S[247]         7280         184.5         752         S[281]         6804         184.5         786         S[315]         6328         184           719         S[248]         7266         309.5         753         S[282]         6790         309.5         787         S[316]         6314         308           720         S[249]         7252         184.5         754         S[283]         6776         184.5         788         S[317]         6300         184           721         S[250]         7238         309.5         755         S[284]         6762         309.5         789         S[318]         6286         308           722         S[251]         7224         184.5         756         S[285]         6748         184.5         790         S[319]         6272         184           723         S[252]         7210         309.5         757         S[286]         6734         309.5         791         S[320]         6258         308           724         S[253]         7196         184.5         758         S[287]         6720         184.5         792         S[321]         6244         184           725            |   |
| 719         S[248]         7266         309.5         753         S[282]         6790         309.5         787         S[316]         6314         309           720         S[249]         7252         184.5         754         S[283]         6776         184.5         788         S[317]         6300         184           721         S[250]         7238         309.5         755         S[284]         6762         309.5         789         S[318]         6286         309           722         S[251]         7224         184.5         756         S[285]         6748         184.5         790         S[319]         6272         184           723         S[252]         7210         309.5         757         S[286]         6734         309.5         791         S[320]         6258         309           724         S[253]         7196         184.5         758         S[287]         6720         184.5         792         S[321]         6244         184           725         S[254]         7182         309.5         759         S[288]         6706         309.5         793         S[322]         6230         309           726            | 6328 184.5  |
| 720         S[249]         7252         184.5         754         S[283]         6776         184.5         788         S[317]         6300         184           721         S[250]         7238         309.5         755         S[284]         6762         309.5         789         S[318]         6286         308           722         S[251]         7224         184.5         756         S[285]         6748         184.5         790         S[319]         6272         184           723         S[252]         7210         309.5         757         S[286]         6734         309.5         791         S[320]         6258         308           724         S[253]         7196         184.5         758         S[287]         6720         184.5         792         S[321]         6244         184           725         S[254]         7182         309.5         759         S[288]         6706         309.5         793         S[322]         6230         308           726         S[255]         7168         184.5         760         S[289]         6692         184.5         794         S[323]         6216         184           727            | 104.5   |
| 721         S[250]         7238         309.5         755         S[284]         6762         309.5         789         S[318]         6286         309.5           722         S[251]         7224         184.5         756         S[285]         6748         184.5         790         S[319]         6272         184.5           723         S[252]         7210         309.5         757         S[286]         6734         309.5         791         S[320]         6258         309.5           724         S[253]         7196         184.5         758         S[287]         6720         184.5         792         S[321]         6244         184.5           725         S[254]         7182         309.5         759         S[288]         6706         309.5         793         S[322]         6230         309.5           726         S[255]         7168         184.5         760         S[289]         6692         184.5         794         S[323]         6216         184.5           727         S[256]         7154         309.5         761         S[290]         6678         309.5         795         S[324]         6202         308.5            | 6314 309.5  |
| 722         S[251]         7224         184.5         756         S[285]         6748         184.5         790         S[319]         6272         184           723         S[252]         7210         309.5         757         S[286]         6734         309.5         791         S[320]         6258         309           724         S[253]         7196         184.5         758         S[287]         6720         184.5         792         S[321]         6244         184           725         S[254]         7182         309.5         759         S[288]         6706         309.5         793         S[322]         6230         309           726         S[255]         7168         184.5         760         S[289]         6692         184.5         794         S[323]         6216         184           727         S[256]         7154         309.5         761         S[290]         6678         309.5         795         S[324]         6202         309           728         S[257]         7140         184.5         762         S[291]         6664         184.5         796         S[325]         6188         184           729            | 6300 184.5  |
| 723         S[252]         7210         309.5         757         S[286]         6734         309.5         791         S[320]         6258         309           724         S[253]         7196         184.5         758         S[287]         6720         184.5         792         S[321]         6244         184           725         S[254]         7182         309.5         759         S[288]         6706         309.5         793         S[322]         6230         309           726         S[255]         7168         184.5         760         S[289]         6692         184.5         794         S[323]         6216         184           727         S[256]         7154         309.5         761         S[290]         6678         309.5         795         S[324]         6202         309           728         S[257]         7140         184.5         762         S[291]         6664         184.5         796         S[325]         6188         184           729         S[258]         7126         309.5         763         S[292]         6650         309.5         797         S[326]         6174         309                          | 6286 309.5  |
| 724         S[253]         7196         184.5         758         S[287]         6720         184.5         792         S[321]         6244         184           725         S[254]         7182         309.5         759         S[288]         6706         309.5         793         S[322]         6230         309           726         S[255]         7168         184.5         760         S[289]         6692         184.5         794         S[323]         6216         184           727         S[256]         7154         309.5         761         S[290]         6678         309.5         795         S[324]         6202         309           728         S[257]         7140         184.5         762         S[291]         6664         184.5         796         S[325]         6188         184           729         S[258]         7126         309.5         763         S[292]         6650         309.5         797         S[326]         6174         309  | 6272 184.5  |
| 725         S[254]         7182         309.5         759         S[288]         6706         309.5         793         S[322]         6230         308           726         S[255]         7168         184.5         760         S[289]         6692         184.5         794         S[323]         6216         184           727         S[256]         7154         309.5         761         S[290]         6678         309.5         795         S[324]         6202         308           728         S[257]         7140         184.5         762         S[291]         6664         184.5         796         S[325]         6188         184           729         S[258]         7126         309.5         763         S[292]         6650         309.5         797         S[326]         6174         308  | 6258 309.5  |
| 726         S[255]         7168         184.5         760         S[289]         6692         184.5         794         S[323]         6216         184           727         S[256]         7154         309.5         761         S[290]         6678         309.5         795         S[324]         6202         309           728         S[257]         7140         184.5         762         S[291]         6664         184.5         796         S[325]         6188         184           729         S[258]         7126         309.5         763         S[292]         6650         309.5         797         S[326]         6174         309  | 6244 184.5  |
| 727         S[256]         7154         309.5         761         S[290]         6678         309.5         795         S[324]         6202         309.5           728         S[257]         7140         184.5         762         S[291]         6664         184.5         796         S[325]         6188         184.5           729         S[258]         7126         309.5         763         S[292]         6650         309.5         797         S[326]         6174         309.5  | 6230 309.5  |
| 728         S[257]         7140         184.5         762         S[291]         6664         184.5         796         S[325]         6188         184           729         S[258]         7126         309.5         763         S[292]         6650         309.5         797         S[326]         6174         309  | 6216 184.5  |
| 729 S[258] 7126 309.5 763 S[292] 6650 309.5 797 S[326] 6174 309  | 6202 309.5  |
|  | 6188 184.5  |
|  | 6174 309.5  |
| 730 S[259] 7112 184.5 764 S[293] 6636 184.5 798 S[327] 6160 184  | 6160 184.5  |
| 731 S[260] 7098 309.5 765 S[294] 6622 309.5 799 S[328] 6146 309  | 6146 309.5  |
| 732 S[261] 7084 184.5 766 S[295] 6608 184.5 800 S[329] 6132 184  | 6132 184.5  |
| 733 S[262] 7070 309.5 767 S[296] 6594 309.5 801 S[330] 6118 309  | 6118 309.5  |
| 734 S[263] 7056 184.5 768 S[297] 6580 184.5 802 S[331] 6104 184  | 6104 184.5  |
| 735 S[264] 7042 309.5 769 S[298] 6566 309.5 803 S[332] 6090 309  | 6090 309.5  |
| 736 S[265] 7028 184.5 770 S[299] 6552 184.5 804 S[333] 6076 184  | 6076 184.5  |
| 737 S[266] 7014 309.5 771 S[300] 6538 309.5 805 S[334] 6062 309  | 6062 309.5  |
| 738 S[267] 7000 184.5 772 S[301] 6524 184.5 806 S[335] 6048 184  | 6048 184.5  |
| 739         S[268]         6986         309.5         773         S[302]         6510         309.5         807         S[336]         6034         309  |   |
| 740         S[269]         6972         184.5         774         S[303]         6496         184.5         808         S[337]         6020         184  |   |
| 741         S[270]         6958         309.5         775         S[304]         6482         309.5         809         S[338]         6006         309  | 6034 309.5  |
| 742         S[271]         6944         184.5         776         S[305]         6468         184.5         810         S[339]         5992         184  | 6034 309.5<br>6020 184.5  |

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| PAD   PIN Name   X   |     |          |      |       |     |          |      |       |     |          |      |       |
|--|-----|----------|------|-------|-----|----------|------|-------|-----|----------|------|-------|
| B12  |     | PIN Name | х    | Y     |     | PIN Name | х    | Y     |     | PIN Name | х    | Y     |
| B13   S 342    5950   309.5   847   S 376    5474   309.5   881   S 410    4998   309.5   814   S 343    5936   184.5   848   S 377    5460   184.5   882   S 411    4984   184.5   815   S 344    5922   309.5   849   S 378    5446   309.5   883   S 412    4970   309.5   816   S 345    5908   184.5   850   S 379    5432   184.5   884   S 413    4956   184.5   817   S 346    5884   309.5   851   S 380    5418   309.5   885   S 414    4942   309.5   818   S 347    5880   184.5   852   S 381    5404   184.5   886   S 415    4928   184.5   818   S 347    5880   184.5   852   S 381    5404   184.5   886   S 416    4914   309.5   818   S 349    5866   309.5   853   S 382    5390   309.5   887   S 416    4914   309.5   822   S 349    5852   184.5   854   S 383    5376   184.5   889   S 418    4888   309.5   822   S 351    5824   184.5   856   S 385    5348   184.5   890   S 418    4888   309.5   822   S 351    5824   184.5   856   S 385    5348   184.5   890   S 419    4872   184.5   822   S 351    5824   184.5   858   S 387    5320   184.5   892   S 421    4844   184.5   825   S 353    5796   184.5   858   S 387    5320   184.5   892   S 421    4844   184.5   825   S 355    5768   184.5   860   S 389    5292   184.5   892   S 421    4802   309.5   828   S 357    5760   184.5   860   S 389    5220   184.5   894   S 423    4816   184.5   822   S 355    5768   184.5   860   S 389    5220   309.5   895   S 422    4830   309.5   828   S 355    5764   309.5   861   S 390    5278   309.5   895   S 424    4802   309.5   833   S 359    5712   184.5   862   S 391    5264   184.5   896   S 425    4788   184.5   830   S 425    4788   484.5   830   S 359    5712   184.5   866   S 395    5206   184.5   896   S 425    4786   4784   84.5   833   S 369    5712   184.5   866   S 395    5206   184.5   896   S 425    4786   4784   84.5   833   S 369    5712   184.5   868   S 391    5264   184.5   900   S 429    4732   184.5   833   S 369    5712   184.5   868   S 399    5152   309.5   899   S 428    4766   309.5   833   S 365    5666    | 811 | S[340]   | 5978 | 309.5 | 845 | S[374]   | 5502 | 309.5 | 879 | S[408]   | 5026 | 309.5 |
| B14  | 812 | S[341]   | 5964 | 184.5 | 846 | S[375]   | 5488 | 184.5 | 880 | S[409]   | 5012 | 184.5 |
| B15  | 813 | S[342]   | 5950 | 309.5 | 847 | S[376]   | 5474 | 309.5 | 881 | S[410]   | 4998 | 309.5 |
| Bif   Si345    5908   184.5   850   Si379    5432   184.5   884   Si413    4966   184.5   817   Si346    5894   309.5   851   Si380    5418   309.5   885   Si414    4942   309.5   818   Si347    5880   184.5   852   Si331    5404   184.5   886   Si415    4928   184.5   819   Si248    5866   309.5   853   Si382    5390   309.5   887   Si416    4914   309.5   820   Si349    5852   184.5   854   Si383    5376   184.5   888   Si417    4900   184.5   821   Si350    5838   309.5   855   Si384    5362   309.5   889   Si418    4886   309.5   822   Si351    5824   184.5   856   Si385    5348   184.5   890   Si419    4872   184.5   823   Si352    5810   309.5   857   Si386    5334   309.5   891   Si420    4858   309.5   824   Si353    5796   184.5   858   Si387    5320   184.5   882   Si421    4844   184.5   825   Si354    5762   309.5   859   Si388    5306   309.5   893   Si422    4830   309.5   826   Si355    5768   184.5   860   Si389    5292   184.5   894   Si423    4816   184.5   822   Si356    5754   309.5   861   Si390    5278   309.5   895   Si426    4774   309.5   830   Si369    5726   309.5   863   Si392    5250   309.5   897   Si426    4774   309.5   833   Si360    5698   309.5   863   Si391    5224   309.5   897   Si426    4774   309.5   833   Si360    5698   309.5   863   Si391    5222   309.5   898   Si427    4760   184.5   833   Si360    5698   309.5   863   Si391    5223   309.5   897   Si426    4774   309.5   833   Si360    5698   309.5   863   Si391    5224   309.5   899   Si428    4746   309.5   833   Si360    5698   309.5   869   Si399    5152   184.5   900   Si429    4732   184.5   833   Si360    5698   309.5   869   Si399    5152   184.5   900   Si429    4760   309.5   833   Si360    5665   184.5   868   Si397    5180   184.5   900   Si429    4760   309.5   833   Si360    5665   184.5   868   Si397    5180   184.5   900   Si439    4766   184.5   833   Si366    5665   184.5   869   Si399    5152   184.5   900   Si439    4766   184.5   833   Si366    5666   184.5   869   Si399    5152   184.5   900  | 814 | S[343]   | 5936 | 184.5 | 848 | S[377]   | 5460 | 184.5 | 882 | S[411]   | 4984 | 184.5 |
| 817         S[346]         5894         309.5         851         S[380]         5418         309.5         885         S[414]         4942         309.5           818         S[347]         5880         184.5         852         S[381]         5404         184.5         886         S[415]         4928         184.5           819         S[348]         5866         309.5         853         S[382]         5390         309.5         887         S[416]         4914         309.5           820         S[349]         5852         184.5         854         S[383]         5376         184.5         888         S[417]         4900         184.5           821         S[350]         5838         309.5         855         S[384]         5362         309.5         889         S[418]         4866         309.5           822         S[351]         5824         184.5         856         S[385]         5348         184.5         890         S[419]         4872         184.5           823         S[352]         5810         309.5         857         S[386]         5334         309.5         891         S[420]         4886         309.5  | 815 | S[344]   | 5922 | 309.5 | 849 | S[378]   | 5446 | 309.5 | 883 | S[412]   | 4970 | 309.5 |
| 818         S[347]         5880         184.5         852         S[381]         5404         184.5         886         S[415]         4928         184.5           819         S[348]         5866         309.5         853         S[382]         5390         309.5         887         S[416]         4914         309.5           820         S[349]         5852         184.5         854         S[383]         5376         184.5         888         S[417]         4900         184.5           821         S[350]         5838         309.5         855         S[384]         5362         309.5         889         S[418]         4866         309.5           822         S[351]         5824         184.5         856         S[385]         5348         184.5         890         S[419]         4872         184.5           823         S[352]         5810         309.5         857         S[386]         5334         309.5         891         S[420]         4868         309.5           824         S[353]         5766         184.5         860         S[389]         5320         184.5         892         S[421]         4844         184.5  | 816 | S[345]   | 5908 | 184.5 | 850 | S[379]   | 5432 | 184.5 | 884 | S[413]   | 4956 | 184.5 |
| Right   Signer   Si | 817 | S[346]   | 5894 | 309.5 | 851 | S[380]   | 5418 | 309.5 | 885 | S[414]   | 4942 | 309.5 |
| 820         S[349]         5852         184.5         854         S[383]         5376         184.5         888         S[417]         4900         184.5           821         S[350]         5838         309.5         855         S[384]         5362         309.5         889         S[418]         4886         309.5           822         S[351]         5824         184.5         866         S[385]         5348         184.5         890         S[419]         4872         184.5           823         S[352]         5810         309.5         857         S[386]         5334         309.5         891         S[420]         4858         309.5           824         S[353]         5796         184.5         858         S[387]         5320         184.5         892         S[421]         4844         184.5           825         S[354]         5782         309.5         859         S[388]         5306         309.5         893         S[422]         4830         309.5           826         S[355]         5768         184.5         860         S[389]         5292         184.5         894         S[422]         4860         184.5  | 818 | S[347]   | 5880 | 184.5 | 852 | S[381]   | 5404 | 184.5 | 886 | S[415]   | 4928 | 184.5 |
| 821         S[350]         5838         309.5         855         S[384]         5362         309.5         889         S[418]         4886         309.5           822         S[351]         5824         184.5         856         S[385]         5348         184.5         890         S[419]         4872         184.5           823         S[352]         5810         309.5         857         S[386]         5334         309.5         891         S[420]         4858         309.5           824         S[353]         5796         184.5         858         S[387]         5320         184.5         892         S[421]         4844         184.5           825         S[354]         5782         309.5         859         S[388]         5306         309.5         893         S[422]         4830         309.5           826         S[355]         5768         184.5         860         S[389]         5292         184.5         894         S[423]         4816         184.5           827         S[356]         5754         309.5         862         S[391]         5264         184.5         896         S[425]         4788         184.5  | 819 | S[348]   | 5866 | 309.5 | 853 | S[382]   | 5390 | 309.5 | 887 | S[416]   | 4914 | 309.5 |
| 822         S[351]         5824         184.5         856         S[385]         5348         184.5         890         S[419]         4872         184.5           823         S[352]         5810         309.5         857         S[386]         5334         309.5         891         S[420]         4858         309.5           824         S[353]         5796         184.5         858         S[387]         5320         184.5         892         S[421]         4844         184.5           825         S[354]         5782         309.5         859         S[388]         5306         309.5         893         S[422]         4830         309.5           826         S[355]         5768         184.5         860         S[389]         5292         184.5         894         S[423]         4816         184.5           827         S[366]         5754         309.5         861         S[390]         5278         309.5         895         S[424]         4802         309.5           828         S[357]         5740         184.5         862         S[391]         5264         184.5         896         S[425]         4788         184.5  | 820 | S[349]   | 5852 | 184.5 | 854 | S[383]   | 5376 | 184.5 | 888 | S[417]   | 4900 | 184.5 |
| 823         S[352]         5810         309.5         857         S[386]         5334         309.5         891         S[420]         4858         309.5           824         S[353]         5796         184.5         858         S[387]         5320         184.5         892         S[421]         4844         184.5           825         S[354]         5782         309.5         859         S[388]         5306         309.5         893         S[422]         4830         309.5           826         S[355]         5768         184.5         860         S[389]         5292         184.5         894         S[423]         4816         184.5           827         S[356]         5754         309.5         861         S[390]         5278         309.5         895         S[424]         4802         309.5           828         S[357]         5740         184.5         862         S[391]         5264         184.5         896         S[425]         4788         184.5           829         S[358]         5712         184.5         864         S[393]         5236         184.5         898         S[427]         4760         184.5  | 821 | S[350]   | 5838 | 309.5 | 855 | S[384]   | 5362 | 309.5 | 889 | S[418]   | 4886 | 309.5 |
| 824         S[353]         5796         184.5         858         S[387]         5320         184.5         892         S[421]         4844         184.5           825         S[354]         5782         309.5         859         S[388]         5306         309.5         893         S[422]         4830         309.5           826         S[355]         5768         184.5         860         S[389]         5292         184.5         894         S[423]         4816         184.5           827         S[356]         5754         309.5         861         S[390]         5278         309.5         895         S[424]         4802         309.5           828         S[357]         5740         184.5         862         S[391]         5264         184.5         896         S[425]         4788         184.5           829         S[358]         5726         309.5         863         S[392]         5250         309.5         897         S[426]         4774         309.5           830         S[359]         5712         184.5         864         S[393]         5236         184.5         898         S[427]         4760         184.5  | 822 | S[351]   | 5824 | 184.5 | 856 | S[385]   | 5348 | 184.5 | 890 | S[419]   | 4872 | 184.5 |
| 825         S[354]         5782         309.5         859         S[388]         5306         309.5         893         S[422]         4830         309.5           826         S[355]         5768         184.5         860         S[389]         5292         184.5         894         S[423]         4816         184.5           827         S[356]         5754         309.5         861         S[390]         5278         309.5         895         S[424]         4802         309.5           828         S[357]         5740         184.5         862         S[391]         5264         184.5         896         S[425]         4788         184.5           829         S[358]         5726         309.5         863         S[392]         5250         309.5         897         S[426]         4774         309.5           830         S[359]         5712         184.5         864         S[393]         5236         184.5         898         S[427]         4760         184.5           831         S[360]         5698         309.5         865         S[394]         5222         309.5         899         S[428]         4746         309.5  | 823 | S[352]   | 5810 | 309.5 | 857 | S[386]   | 5334 | 309.5 | 891 | S[420]   | 4858 | 309.5 |
| 826         S[355]         5768         184.5         860         S[389]         5292         184.5         894         S[423]         4816         184.5           827         S[356]         5754         309.5         861         S[390]         5278         309.5         895         S[424]         4802         309.5           828         S[357]         5740         184.5         862         S[391]         5264         184.5         896         S[425]         4788         184.5           829         S[358]         5726         309.5         863         S[392]         5250         309.5         897         S[426]         4774         309.5           830         S[359]         5712         184.5         864         S[393]         5236         184.5         898         S[427]         4760         184.5           831         S[360]         5698         309.5         865         S[394]         5222         309.5         899         S[428]         4746         309.5           832         S[361]         5684         184.5         866         S[395]         5208         184.5         900         S[429]         4732         184.5  | 824 | S[353]   | 5796 | 184.5 | 858 | S[387]   | 5320 | 184.5 | 892 | S[421]   | 4844 | 184.5 |
| 827         S[356]         5754         309.5         861         S[390]         5278         309.5         895         S[424]         4802         309.5           828         S[357]         5740         184.5         862         S[391]         5264         184.5         896         S[425]         4788         184.5           829         S[358]         5726         309.5         863         S[392]         5250         309.5         897         S[426]         4774         309.5           830         S[359]         5712         184.5         864         S[393]         5236         184.5         898         S[427]         4760         184.5           831         S[360]         5698         309.5         865         S[394]         5222         309.5         899         S[428]         4746         309.5           832         S[361]         5684         184.5         866         S[395]         5208         184.5         900         S[429]         4732         184.5           833         S[362]         5670         309.5         867         S[396]         5194         309.5         901         S[430]         4718         309.5  | 825 | S[354]   | 5782 | 309.5 | 859 | S[388]   | 5306 | 309.5 | 893 | S[422]   | 4830 | 309.5 |
| 828         S[357]         5740         184.5         862         S[391]         5264         184.5         896         S[425]         4788         184.5           829         S[358]         5726         309.5         863         S[392]         5250         309.5         897         S[426]         4774         309.5           830         S[359]         5712         184.5         864         S[393]         5236         184.5         898         S[427]         4760         184.5           831         S[360]         5698         309.5         865         S[394]         5222         309.5         899         S[428]         4746         309.5           832         S[361]         5684         184.5         866         S[395]         5208         184.5         900         S[429]         4732         184.5           833         S[362]         5670         309.5         867         S[396]         5194         309.5         901         S[430]         4718         309.5           834         S[363]         5656         184.5         868         S[397]         5180         184.5         902         S[431]         4704         184.5  | 826 | S[355]   | 5768 | 184.5 | 860 | S[389]   | 5292 | 184.5 | 894 | S[423]   | 4816 | 184.5 |
| 829         S[358]         5726         309.5         863         S[392]         5250         309.5         897         S[426]         4774         309.5           830         S[359]         5712         184.5         864         S[393]         5236         184.5         898         S[427]         4760         184.5           831         S[360]         5698         309.5         865         S[394]         5222         309.5         899         S[428]         4746         309.5           832         S[361]         5684         184.5         866         S[395]         5208         184.5         900         S[429]         4732         184.5           833         S[362]         5670         309.5         867         S[396]         5194         309.5         901         S[430]         4718         309.5           834         S[363]         5656         184.5         868         S[397]         5180         184.5         902         S[431]         4704         184.5           835         S[364]         5642         309.5         869         S[398]         5166         309.5         903         S[432]         4690         309.5  | 827 | S[356]   | 5754 | 309.5 | 861 | S[390]   | 5278 | 309.5 | 895 | S[424]   | 4802 | 309.5 |
| 830         S[359]         5712         184.5         864         S[393]         5236         184.5         898         S[427]         4760         184.5           831         S[360]         5698         309.5         865         S[394]         5222         309.5         899         S[428]         4746         309.5           832         S[361]         5684         184.5         866         S[395]         5208         184.5         900         S[429]         4732         184.5           833         S[362]         5670         309.5         867         S[396]         5194         309.5         901         S[430]         4718         309.5           834         S[363]         5656         184.5         868         S[397]         5180         184.5         902         S[431]         4704         184.5           835         S[364]         5642         309.5         869         S[398]         5166         309.5         903         S[432]         4690         309.5           836         S[365]         5628         184.5         870         S[399]         5152         184.5         904         S[433]         4676         184.5  | 828 | S[357]   | 5740 | 184.5 | 862 | S[391]   | 5264 | 184.5 | 896 | S[425]   | 4788 | 184.5 |
| 831         S[360]         5698         309.5         865         S[394]         5222         309.5         899         S[428]         4746         309.5           832         S[361]         5684         184.5         866         S[395]         5208         184.5         900         S[429]         4732         184.5           833         S[362]         5670         309.5         867         S[396]         5194         309.5         901         S[430]         4718         309.5           834         S[363]         5656         184.5         868         S[397]         5180         184.5         902         S[431]         4704         184.5           835         S[364]         5642         309.5         869         S[398]         5166         309.5         903         S[432]         4690         309.5           836         S[365]         5628         184.5         870         S[399]         5152         184.5         904         S[433]         4676         184.5           837         S[366]         5614         309.5         871         S[400]         5138         309.5         905         S[434]         4662         309.5  | 829 | S[358]   | 5726 | 309.5 | 863 | S[392]   | 5250 | 309.5 | 897 | S[426]   | 4774 | 309.5 |
| 832         S[361]         5684         184.5         866         S[395]         5208         184.5         900         S[429]         4732         184.5           833         S[362]         5670         309.5         867         S[396]         5194         309.5         901         S[430]         4718         309.5           834         S[363]         5656         184.5         868         S[397]         5180         184.5         902         S[431]         4704         184.5           835         S[364]         5642         309.5         869         S[398]         5166         309.5         903         S[432]         4690         309.5           836         S[365]         5628         184.5         870         S[399]         5152         184.5         904         S[433]         4676         184.5           837         S[366]         5614         309.5         871         S[400]         5138         309.5         905         S[434]         4662         309.5           838         S[367]         5600         184.5         872         S[401]         5124         184.5         906         S[435]         4648         184.5  | 830 | S[359]   | 5712 | 184.5 | 864 | S[393]   | 5236 | 184.5 | 898 | S[427]   | 4760 | 184.5 |
| 833         S[362]         5670         309.5         867         S[396]         5194         309.5         901         S[430]         4718         309.5           834         S[363]         5656         184.5         868         S[397]         5180         184.5         902         S[431]         4704         184.5           835         S[364]         5642         309.5         869         S[398]         5166         309.5         903         S[432]         4690         309.5           836         S[365]         5628         184.5         870         S[399]         5152         184.5         904         S[433]         4676         184.5           837         S[366]         5614         309.5         871         S[400]         5138         309.5         905         S[434]         4662         309.5           838         S[367]         5600         184.5         872         S[401]         5124         184.5         906         S[435]         4648         184.5           839         S[368]         5586         309.5         873         S[402]         5110         309.5         907         S[436]         4634         309.5  | 831 | S[360]   | 5698 | 309.5 | 865 | S[394]   | 5222 | 309.5 | 899 | S[428]   | 4746 | 309.5 |
| 834         S[363]         5656         184.5         868         S[397]         5180         184.5         902         S[431]         4704         184.5           835         S[364]         5642         309.5         869         S[398]         5166         309.5         903         S[432]         4690         309.5           836         S[365]         5628         184.5         870         S[399]         5152         184.5         904         S[433]         4676         184.5           837         S[366]         5614         309.5         871         S[400]         5138         309.5         905         S[434]         4662         309.5           838         S[367]         5600         184.5         872         S[401]         5124         184.5         906         S[435]         4648         184.5           839         S[368]         5586         309.5         873         S[402]         5110         309.5         907         S[436]         4634         309.5           840         S[369]         5572         184.5         874         S[403]         5096         184.5         908         S[437]         4620         184.5  | 832 | S[361]   | 5684 | 184.5 | 866 | S[395]   | 5208 | 184.5 | 900 | S[429]   | 4732 | 184.5 |
| 835         S[364]         5642         309.5         869         S[398]         5166         309.5         903         S[432]         4690         309.5           836         S[365]         5628         184.5         870         S[399]         5152         184.5         904         S[433]         4676         184.5           837         S[366]         5614         309.5         871         S[400]         5138         309.5         905         S[434]         4662         309.5           838         S[367]         5600         184.5         872         S[401]         5124         184.5         906         S[435]         4648         184.5           839         S[368]         5586         309.5         873         S[402]         5110         309.5         907         S[436]         4634         309.5           840         S[369]         5572         184.5         874         S[403]         5096         184.5         908         S[437]         4620         184.5           841         S[370]         5558         309.5         875         S[404]         5082         309.5         909         S[438]         4606         309.5  | 833 | S[362]   | 5670 | 309.5 | 867 | S[396]   | 5194 | 309.5 | 901 | S[430]   | 4718 | 309.5 |
| 836         S[365]         5628         184.5         870         S[399]         5152         184.5         904         S[433]         4676         184.5           837         S[366]         5614         309.5         871         S[400]         5138         309.5         905         S[434]         4662         309.5           838         S[367]         5600         184.5         872         S[401]         5124         184.5         906         S[435]         4648         184.5           839         S[368]         5586         309.5         873         S[402]         5110         309.5         907         S[436]         4634         309.5           840         S[369]         5572         184.5         874         S[403]         5096         184.5         908         S[437]         4620         184.5           841         S[370]         5558         309.5         875         S[404]         5082         309.5         909         S[438]         4606         309.5           842         S[371]         5544         184.5         876         S[405]         5068         184.5         910         S[439]         4592         184.5  | 834 | S[363]   | 5656 | 184.5 | 868 | S[397]   | 5180 | 184.5 | 902 | S[431]   | 4704 | 184.5 |
| 837         S[366]         5614         309.5         871         S[400]         5138         309.5         905         S[434]         4662         309.5           838         S[367]         5600         184.5         872         S[401]         5124         184.5         906         S[435]         4648         184.5           839         S[368]         5586         309.5         873         S[402]         5110         309.5         907         S[436]         4634         309.5           840         S[369]         5572         184.5         874         S[403]         5096         184.5         908         S[437]         4620         184.5           841         S[370]         5558         309.5         875         S[404]         5082         309.5         909         S[438]         4606         309.5           842         S[371]         5544         184.5         876         S[405]         5068         184.5         910         S[439]         4592         184.5           843         S[372]         5530         309.5         877         S[406]         5054         309.5         911         S[440]         4578         309.5  | 835 | S[364]   | 5642 | 309.5 | 869 | S[398]   | 5166 | 309.5 | 903 | S[432]   | 4690 | 309.5 |
| 838         S[367]         5600         184.5         872         S[401]         5124         184.5         906         S[435]         4648         184.5           839         S[368]         5586         309.5         873         S[402]         5110         309.5         907         S[436]         4634         309.5           840         S[369]         5572         184.5         874         S[403]         5096         184.5         908         S[437]         4620         184.5           841         S[370]         5558         309.5         875         S[404]         5082         309.5         909         S[438]         4606         309.5           842         S[371]         5544         184.5         876         S[405]         5068         184.5         910         S[439]         4592         184.5           843         S[372]         5530         309.5         877         S[406]         5054         309.5         911         S[440]         4578         309.5  | 836 | S[365]   | 5628 | 184.5 | 870 | S[399]   | 5152 | 184.5 | 904 | S[433]   | 4676 | 184.5 |
| 839         S[368]         5586         309.5         873         S[402]         5110         309.5         907         S[436]         4634         309.5           840         S[369]         5572         184.5         874         S[403]         5096         184.5         908         S[437]         4620         184.5           841         S[370]         5558         309.5         875         S[404]         5082         309.5         909         S[438]         4606         309.5           842         S[371]         5544         184.5         876         S[405]         5068         184.5         910         S[439]         4592         184.5           843         S[372]         5530         309.5         877         S[406]         5054         309.5         911         S[440]         4578         309.5  | 837 | S[366]   | 5614 | 309.5 | 871 | S[400]   | 5138 | 309.5 | 905 | S[434]   | 4662 | 309.5 |
| 840         S[369]         5572         184.5         874         S[403]         5096         184.5         908         S[437]         4620         184.5           841         S[370]         5558         309.5         875         S[404]         5082         309.5         909         S[438]         4606         309.5           842         S[371]         5544         184.5         876         S[405]         5068         184.5         910         S[439]         4592         184.5           843         S[372]         5530         309.5         877         S[406]         5054         309.5         911         S[440]         4578         309.5  | 838 | S[367]   | 5600 | 184.5 | 872 | S[401]   | 5124 | 184.5 | 906 | S[435]   | 4648 | 184.5 |
| 841         S[370]         5558         309.5         875         S[404]         5082         309.5         909         S[438]         4606         309.5           842         S[371]         5544         184.5         876         S[405]         5068         184.5         910         S[439]         4592         184.5           843         S[372]         5530         309.5         877         S[406]         5054         309.5         911         S[440]         4578         309.5  | 839 | S[368]   | 5586 | 309.5 | 873 | S[402]   | 5110 | 309.5 | 907 | S[436]   | 4634 | 309.5 |
| 842     S[371]     5544     184.5     876     S[405]     5068     184.5     910     S[439]     4592     184.5       843     S[372]     5530     309.5     877     S[406]     5054     309.5     911     S[440]     4578     309.5  | 840 | S[369]   | 5572 | 184.5 | 874 | S[403]   | 5096 | 184.5 | 908 | S[437]   | 4620 | 184.5 |
| 843         S[372]         5530         309.5         877         S[406]         5054         309.5         911         S[440]         4578         309.5  | 841 | S[370]   | 5558 | 309.5 | 875 | S[404]   | 5082 | 309.5 | 909 | S[438]   | 4606 | 309.5 |
|  | 842 | S[371]   | 5544 | 184.5 | 876 | S[405]   | 5068 | 184.5 | 910 | S[439]   | 4592 | 184.5 |
| 844 S[373] 5516 184.5 878 S[407] 5040 184.5 912 S[441] 4564 184.5  | 843 | S[372]   | 5530 | 309.5 | 877 | S[406]   | 5054 | 309.5 | 911 | S[440]   | 4578 | 309.5 |
|  | 844 | S[373]   | 5516 | 184.5 | 878 | S[407]   | 5040 | 184.5 | 912 | S[441]   | 4564 | 184.5 |

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| PAD<br>No. | PIN Name | х    | Y     | PAD<br>No. | PIN Name | х    | Y     | PAD<br>No. | PIN Name | х    | Y     |
|------------|----------|------|-------|------------|----------|------|-------|------------|----------|------|-------|
| 913        | S[442]   | 4550 | 309.5 | 947        | S[476]   | 4074 | 309.5 | 981        | S[510]   | 3598 | 309.5 |
| 914        | S[443]   | 4536 | 184.5 | 948        | S[477]   | 4060 | 184.5 | 982        | S[511]   | 3584 | 184.5 |
| 915        | S[444]   | 4522 | 309.5 | 949        | S[478]   | 4046 | 309.5 | 983        | S[512]   | 3570 | 309.5 |
| 916        | S[445]   | 4508 | 184.5 | 950        | S[479]   | 4032 | 184.5 | 984        | S[513]   | 3556 | 184.5 |
| 917        | S[446]   | 4494 | 309.5 | 951        | S[480]   | 4018 | 309.5 | 985        | S[514]   | 3542 | 309.5 |
| 918        | S[447]   | 4480 | 184.5 | 952        | S[481]   | 4004 | 184.5 | 986        | S[515]   | 3528 | 184.5 |
| 919        | S[448]   | 4466 | 309.5 | 953        | S[482]   | 3990 | 309.5 | 987        | S[516]   | 3514 | 309.5 |
| 920        | S[449]   | 4452 | 184.5 | 954        | S[483]   | 3976 | 184.5 | 988        | S[517]   | 3500 | 184.5 |
| 921        | S[450]   | 4438 | 309.5 | 955        | S[484]   | 3962 | 309.5 | 989        | S[518]   | 3486 | 309.5 |
| 922        | S[451]   | 4424 | 184.5 | 956        | S[485]   | 3948 | 184.5 | 990        | S[519]   | 3472 | 184.5 |
| 923        | S[452]   | 4410 | 309.5 | 957        | S[486]   | 3934 | 309.5 | 991        | S[520]   | 3458 | 309.5 |
| 924        | S[453]   | 4396 | 184.5 | 958        | S[487]   | 3920 | 184.5 | 992        | S[521]   | 3444 | 184.5 |
| 925        | S[454]   | 4382 | 309.5 | 959        | S[488]   | 3906 | 309.5 | 993        | S[522]   | 3430 | 309.5 |
| 926        | S[455]   | 4368 | 184.5 | 960        | S[489]   | 3892 | 184.5 | 994        | S[523]   | 3416 | 184.5 |
| 927        | S[456]   | 4354 | 309.5 | 961        | S[490]   | 3878 | 309.5 | 995        | S[524]   | 3402 | 309.5 |
| 928        | S[457]   | 4340 | 184.5 | 962        | S[491]   | 3864 | 184.5 | 996        | S[525]   | 3388 | 184.5 |
| 929        | S[458]   | 4326 | 309.5 | 963        | S[492]   | 3850 | 309.5 | 997        | S[526]   | 3374 | 309.5 |
| 930        | S[459]   | 4312 | 184.5 | 964        | S[493]   | 3836 | 184.5 | 998        | S[527]   | 3360 | 184.5 |
| 931        | S[460]   | 4298 | 309.5 | 965        | S[494]   | 3822 | 309.5 | 999        | S[528]   | 3346 | 309.5 |
| 932        | S[461]   | 4284 | 184.5 | 966        | S[495]   | 3808 | 184.5 | 1000       | S[529]   | 3332 | 184.5 |
| 933        | S[462]   | 4270 | 309.5 | 967        | S[496]   | 3794 | 309.5 | 1001       | S[530]   | 3318 | 309.5 |
| 934        | S[463]   | 4256 | 184.5 | 968        | S[497]   | 3780 | 184.5 | 1002       | S[531]   | 3304 | 184.5 |
| 935        | S[464]   | 4242 | 309.5 | 969        | S[498]   | 3766 | 309.5 | 1003       | S[532]   | 3290 | 309.5 |
| 936        | S[465]   | 4228 | 184.5 | 970        | S[499]   | 3752 | 184.5 | 1004       | S[533]   | 3276 | 184.5 |
| 937        | S[466]   | 4214 | 309.5 | 971        | S[500]   | 3738 | 309.5 | 1005       | S[534]   | 3262 | 309.5 |
| 938        | S[467]   | 4200 | 184.5 | 972        | S[501]   | 3724 | 184.5 | 1006       | S[535]   | 3248 | 184.5 |
| 939        | S[468]   | 4186 | 309.5 | 973        | S[502]   | 3710 | 309.5 | 1007       | S[536]   | 3234 | 309.5 |
| 940        | S[469]   | 4172 | 184.5 | 974        | S[503]   | 3696 | 184.5 | 1008       | S[537]   | 3220 | 184.5 |
| 941        | S[470]   | 4158 | 309.5 | 975        | S[504]   | 3682 | 309.5 | 1009       | S[538]   | 3206 | 309.5 |
| 942        | S[471]   | 4144 | 184.5 | 976        | S[505]   | 3668 | 184.5 | 1010       | S[539]   | 3192 | 184.5 |
| 943        | S[472]   | 4130 | 309.5 | 977        | S[506]   | 3654 | 309.5 | 1011       | S[540]   | 3178 | 309.5 |
| 944        | S[473]   | 4116 | 184.5 | 978        | S[507]   | 3640 | 184.5 | 1012       | S[541]   | 3164 | 184.5 |
| 945        | S[474]   | 4102 | 309.5 | 979        | S[508]   | 3626 | 309.5 | 1013       | S[542]   | 3150 | 309.5 |
| 946        | S[475]   | 4088 | 184.5 | 980        | S[509]   | 3612 | 184.5 | 1014       | S[543]   | 3136 | 184.5 |
|            |          |      |       |            |          | _    |       | _          |          |      |       |

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| No.   No.   No.   Signature   No.   No.   No.   No.   No.  |      |          |      |       |      |          |      |       |      |          |      |       |
|--|------|----------|------|-------|------|----------|------|-------|------|----------|------|-------|
| 1016   S 545    3108   184.5   1050   S 579    2632   184.5   1084   S 613    2156   184.5   1017   S 546    3094   309.5   1051   S 580    2618   309.5   1085   S 614    2142   309.5   1018   S 547    3080   184.5   1052   S 581    2604   184.5   1086   S 615    2128   184.5   1019   S 548    3066   309.5   1053   S 582    2590   309.5   1087   S 616    2114   309.5   1020   S 549    3052   184.5   1054   S 583    2576   184.5   1088   S 617    2100   184.5   1021   S 550    3038   309.5   1055   S 584    2562   309.5   1088   S 618    2086   309.5   1022   S 551    3024   184.5   1056   S 585    2548   184.5   1090   S 619    2072   184.5   1023   S 552    3010   309.5   1057   S 586    2534   309.5   1091   S 620    2058   309.5   1024   S 553    2996   184.5   1058   S 588    2506   309.5   1093   S 622    2030   309.5   1026   S 555    2988   184.5   1060   S 589    2492   184.5   1094   S 623    2016   184.5   1027   S 556    2954   309.5   1061   S 590    2478   309.5   1095   S 626    1974   309.5   1030   S 559    2912   184.5   1064   S 593    2436   184.5   1096   S 625    1988   184.5   1033   S 559    2912   184.5   1064   S 593    2436   184.5   1009   S 628    1946   309.5   1034   S 563    2886   309.5   1066   S 595    2408   184.5   1100   S 629    1932   184.5   1034   S 563    2886   309.5   1066   S 595    2408   184.5   1100   S 629    1932   184.5   1034   S 563    2886   309.5   1066   S 595    2394   309.5   1101   S 630    1918   309.5   1034   S 566    2888   309.5   1066   S 596    2394   309.5   1101   S 630    1918   309.5   1034   S 566    2888   309.5   1066   S 596    2394   309.5   1101   S 633    1904   184.5   1035   S 566    2888   184.5   1068   S 597    2380   184.5   1100   S 633    1890   309.5   1034   S 566    2888   184.5   1068   S 597    2380   184.5   1104   S 633    1890   309.5   1036   S 566    2888   184.5   1070   S 599    2352   184.5   1104   S 633    1876   184.5   1037   S 566    2888   184.5   1070   S 599    2352   184.5   1104   S 633    1876   184.5  |      | PIN Name | х    | Υ     |      | PIN Name | х    | Υ     |      | PIN Name | х    | Υ     |
| 1017   S 546    3094   309.5   1051   S 580    2618   309.5   1085   S 614    2142   309   3018   S 547    3080   184.5   1052   S 581    2604   184.5   1086   S 615    2128   184   3019   S 548    3066   309.5   1053   S 582    2590   309.5   1087   S 616    2114   309   3020   S 549    3052   184.5   1054   S 583    2576   184.5   1088   S 617    2100   184   3021   S 550    3038   309.5   1055   S 584    2562   309.5   1089   S 618    2086   309   3022   S 551    3024   184.5   1056   S 585    2548   184.5   1090   S 619    2072   184   3023   S 552    3010   309.5   1057   S 586    2534   309.5   1091   S 620    2058   309   3024   S 553    2996   184.5   1058   S 587    2520   184.5   1092   S 621    2044   184   3025   S 555    2968   184.5   1058   S 587    2520   184.5   1092   S 621    2044   184   3025   S 555    2968   184.5   1060   S 589    2492   184.5   1094   S 623    2016   184   3025   S 556    2954   309.5   1061   S 590    2478   309.5   1095   S 624    2002   309   | 1015 | S[544]   | 3122 | 309.5 | 1049 | S[578]   | 2646 | 309.5 | 1083 | S[612]   | 2170 | 309.5 |
| 1018   S[547]   3080   184.5   1052   S[581]   2604   184.5   1086   S[615]   2128   184   1019   S[548]   3066   309.5   1053   S[582]   2590   309.5   1087   S[616]   2114   309   1020   S[549]   3052   184.5   1054   S[583]   2576   184.5   1088   S[617]   2100   184   1021   S[550]   3038   309.5   1055   S[584]   2562   309.5   1089   S[618]   2086   309   1022   S[551]   3024   184.5   1056   S[585]   2548   184.5   1090   S[619]   2072   184   1023   S[552]   3010   309.5   1057   S[586]   2534   309.5   1091   S[620]   2058   309   1024   S[553]   2996   184.5   1058   S[587]   2520   184.5   1092   S[621]   2044   184   1025   S[554]   2982   309.5   1059   S[588]   2506   309.5   1093   S[622]   2030   309   1026   S[555]   2968   184.5   1060   S[589]   2492   184.5   1094   S[623]   2016   184   1027   S[556]   2954   309.5   1061   S[590]   2478   309.5   1095   S[624]   2002   309   1028   S[557]   2940   184.5   1062   S[591]   2464   184.5   1096   S[625]   1988   184   1029   S[558]   2926   309.5   1063   S[592]   2450   309.5   1097   S[626]   1974   309   1030   S[559]   2912   184.5   1064   S[593]   2436   184.5   1098   S[627]   1960   184   1031   S[560]   2898   309.5   1065   S[594]   2422   309.5   1099   S[628]   1946   309   1034   S[562]   2870   309.5   1067   S[596]   2394   309.5   1101   S[630]   1918   309   1034   S[563]   2856   184.5   1068   S[597]   2380   184.5   1100   S[632]   1932   184   1035   S[564]   2842   309.5   1069   S[598]   2366   309.5   1101   S[630]   1918   309   1036   S[565]   2828   184.5   1069   S[599]   2352   184.5   1104   S[633]   1876   184   1037   S[566]   2814   309.5   1071   S[600]   2338   309.5   1105   S[634]   1862   309.5   10071   S[600]   2338   309.5   1105   S[634]   1862   309.5   30 | 1016 | S[545]   | 3108 | 184.5 | 1050 | S[579]   | 2632 | 184.5 | 1084 | S[613]   | 2156 | 184.5 |
| 1019   S[548]   3066   309.5   1053   S[582]   2590   309.5   1087   S[616]   2114   309   3020   S[549]   3052   184.5   1054   S[583]   2576   184.5   1088   S[617]   2100   184   1021   S[550]   3038   309.5   1055   S[584]   2562   309.5   1089   S[618]   2086   309   3022   S[551]   3024   184.5   1056   S[585]   2548   184.5   1090   S[619]   2072   184   1023   S[552]   3010   309.5   1057   S[586]   2534   309.5   1091   S[620]   2058   309   1024   S[553]   2996   184.5   1058   S[587]   2520   184.5   1092   S[621]   2044   184   1025   S[554]   2982   309.5   1059   S[588]   2506   309.5   1093   S[622]   2030   309   1026   S[555]   2968   184.5   1060   S[589]   2492   184.5   1094   S[623]   2016   184   1027   S[556]   2954   309.5   1061   S[590]   2478   309.5   1095   S[624]   2002   309   1028   S[557]   2940   184.5   1062   S[591]   2464   184.5   1096   S[625]   1988   184   1029   S[558]   2926   309.5   1063   S[592]   2450   309.5   1097   S[626]   1974   309   1030   S[559]   2912   184.5   1064   S[593]   2436   184.5   1098   S[627]   1960   184   1031   S[560]   2898   309.5   1065   S[594]   2422   309.5   1099   S[628]   1946   309   1032   S[561]   2884   184.5   1066   S[595]   2408   184.5   1100   S[629]   1932   184   1033   S[562]   2870   309.5   1067   S[596]   2394   309.5   1101   S[630]   1918   309   1034   S[563]   2856   184.5   1068   S[597]   2380   184.5   1102   S[631]   1904   184   1035   S[564]   2842   309.5   1069   S[596]   2394   309.5   1103   S[632]   1890   309   1036   S[566]   2828   184.5   1070   S[599]   2352   184.5   1104   S[633]   1876   184   1037   S[566]   2814   309.5   1071   S[600]   2338   309.5   1105   S[634]   1862   309   1036   S[566]   2814   309.5   1071   S[600]   2338   309.5   1105   S[634]   1862   309   309.5   1037   S[666]   2814   309.5   1071   S[600]   2338   309.5   1105   S[634]   1862   309   309.5   1037   S[666]   2814   309.5   1071   S[600]   2338   309.5   1105   S[634]   1862   309.5   1036   S[656]   2814   3 | 1017 | S[546]   | 3094 | 309.5 | 1051 | S[580]   | 2618 | 309.5 | 1085 | S[614]   | 2142 | 309.5 |
| 1020   S 549    3052   184.5   1054   S 583    2576   184.5   1088   S 617    2100   184   1021   S 550    3038   309.5   1055   S 584    2562   309.5   1089   S 618    2086   309   1022   S 551    3024   184.5   1056   S 585    2548   184.5   1090   S 619    2072   184   1023   S 552    3010   309.5   1057   S 586    2534   309.5   1091   S 620    2058   309   1024   S 553    2996   184.5   1058   S 587    2520   184.5   1092   S 621    2044   184   1025   S 554    2982   309.5   1059   S 588    2506   309.5   1093   S 622    2030   309   1026   S 555    2968   184.5   1060   S 589    2492   184.5   1094   S 623    2016   184   1027   S 556    2954   309.5   1061   S 590    2478   309.5   1095   S 624    2002   309   1028   S 557    2940   184.5   1062   S 591    2464   184.5   1096   S 625    1988   184   1029   S 558    2926   309.5   1063   S 592    2450   309.5   1097   S 626    1974   309   1030   S 559    2912   184.5   1064   S 593    2436   184.5   1098   S 627    1960   184   1031   S 560    2898   309.5   1065   S 594    2422   309.5   1099   S 628    1946   309   1032   S 561    2884   184.5   1066   S 595    2408   184.5   1100   S 629    1932   184   1033   S 562    2870   309.5   1067   S 596    2394   309.5   1103   S 632    1904   184   1035   S 564    2842   309.5   1069   S 598    2366   309.5   1103   S 632    1890   309   1036   S 566    2828   184.5   1070   S 599    2352   184.5   1104   S 633    1876   184   1037   S 566    2814   309.5   1071   S 600    2338   309.5   1105   S 634    1862   309   1037   S 566    2814   309.5   1071   S 600    2338   309.5   1105   S 634    1862   309   1037   S 566    2814   309.5   1071   S 600    2338   309.5   1105   S 634    1862   309   | 1018 | S[547]   | 3080 | 184.5 | 1052 | S[581]   | 2604 | 184.5 | 1086 | S[615]   | 2128 | 184.5 |
| 1021         S[550]         3038         309.5         1055         S[584]         2562         309.5         1089         S[618]         2086         309           1022         S[551]         3024         184.5         1056         S[585]         2548         184.5         1090         S[619]         2072         184           1023         S[552]         3010         309.5         1057         S[586]         2534         309.5         1091         S[620]         2058         309           1024         S[553]         2996         184.5         1058         S[587]         2520         184.5         1092         S[621]         2044         184           1025         S[554]         2982         309.5         1059         S[588]         2506         309.5         1093         S[622]         2030         309           1026         S[555]         2968         184.5         1060         S[589]         2492         184.5         1094         S[623]         2016         184           1027         S[556]         2954         309.5         1061         S[590]         2478         309.5         1095         S[624]         2002         309   | 1019 | S[548]   | 3066 | 309.5 | 1053 | S[582]   | 2590 | 309.5 | 1087 | S[616]   | 2114 | 309.5 |
| 1022         S[551]         3024         184.5         1056         S[585]         2548         184.5         1090         S[619]         2072         184           1023         S[552]         3010         309.5         1057         S[586]         2534         309.5         1091         S[620]         2058         309           1024         S[553]         2996         184.5         1058         S[587]         2520         184.5         1092         S[621]         2044         184           1025         S[554]         2982         309.5         1059         S[588]         2506         309.5         1093         S[622]         2030         309           1026         S[555]         2968         184.5         1060         S[589]         2492         184.5         1094         S[623]         2016         184           1027         S[556]         2954         309.5         1061         S[590]         2478         309.5         1095         S[624]         2002         309           1028         S[557]         2940         184.5         1062         S[591]         2464         184.5         1096         S[625]         1988         184   | 1020 | S[549]   | 3052 | 184.5 | 1054 | S[583]   | 2576 | 184.5 | 1088 | S[617]   | 2100 | 184.5 |
| 1023         S[552]         3010         309.5         1057         S[586]         2534         309.5         1091         S[620]         2058         309           1024         S[553]         2996         184.5         1058         S[587]         2520         184.5         1092         S[621]         2044         184           1025         S[554]         2982         309.5         1059         S[588]         2506         309.5         1093         S[622]         2030         309           1026         S[555]         2968         184.5         1060         S[589]         2492         184.5         1094         S[623]         2016         184           1027         S[556]         2954         309.5         1061         S[590]         2478         309.5         1095         S[624]         2002         309           1028         S[557]         2940         184.5         1062         S[591]         2464         184.5         1096         S[625]         1988         184           1029         S[558]         2926         309.5         1063         S[592]         2450         309.5         1097         S[626]         1974         309   | 1021 | S[550]   | 3038 | 309.5 | 1055 | S[584]   | 2562 | 309.5 | 1089 | S[618]   | 2086 | 309.5 |
| 1024         S[553]         2996         184.5         1058         S[587]         2520         184.5         1092         S[621]         2044         184           1025         S[554]         2982         309.5         1059         S[588]         2506         309.5         1093         S[622]         2030         309           1026         S[555]         2968         184.5         1060         S[589]         2492         184.5         1094         S[623]         2016         184           1027         S[556]         2954         309.5         1061         S[590]         2478         309.5         1095         S[624]         2002         309           1028         S[557]         2940         184.5         1062         S[591]         2464         184.5         1096         S[625]         1988         184           1029         S[558]         2926         309.5         1063         S[592]         2450         309.5         1097         S[626]         1974         309           1030         S[559]         2912         184.5         1064         S[593]         2436         184.5         1098         S[627]         1960         184   | 1022 | S[551]   | 3024 | 184.5 | 1056 | S[585]   | 2548 | 184.5 | 1090 | S[619]   | 2072 | 184.5 |
| 1025         S[554]         2982         309.5         1059         S[588]         2506         309.5         1093         S[622]         2030         309           1026         S[555]         2968         184.5         1060         S[589]         2492         184.5         1094         S[623]         2016         184           1027         S[556]         2954         309.5         1061         S[590]         2478         309.5         1095         S[624]         2002         309           1028         S[557]         2940         184.5         1062         S[591]         2464         184.5         1096         S[625]         1988         184           1029         S[558]         2926         309.5         1063         S[592]         2450         309.5         1097         S[626]         1974         309           1030         S[559]         2912         184.5         1064         S[593]         2436         184.5         1098         S[627]         1960         184           1031         S[560]         2898         309.5         1065         S[594]         2422         309.5         1099         S[628]         1946         309   | 1023 | S[552]   | 3010 | 309.5 | 1057 | S[586]   | 2534 | 309.5 | 1091 | S[620]   | 2058 | 309.5 |
| 1026         S[555]         2968         184.5         1060         S[589]         2492         184.5         1094         S[623]         2016         184           1027         S[556]         2954         309.5         1061         S[590]         2478         309.5         1095         S[624]         2002         309           1028         S[557]         2940         184.5         1062         S[591]         2464         184.5         1096         S[625]         1988         184           1029         S[558]         2926         309.5         1063         S[592]         2450         309.5         1097         S[626]         1974         309           1030         S[559]         2912         184.5         1064         S[593]         2436         184.5         1098         S[627]         1960         184           1031         S[560]         2898         309.5         1065         S[594]         2422         309.5         1099         S[628]         1946         309           1032         S[561]         2884         184.5         1066         S[595]         2408         184.5         1100         S[629]         1932         184   | 1024 | S[553]   | 2996 | 184.5 | 1058 | S[587]   | 2520 | 184.5 | 1092 | S[621]   | 2044 | 184.5 |
| 1027         S[556]         2954         309.5         1061         S[590]         2478         309.5         1095         S[624]         2002         309           1028         S[557]         2940         184.5         1062         S[591]         2464         184.5         1096         S[625]         1988         184           1029         S[558]         2926         309.5         1063         S[592]         2450         309.5         1097         S[626]         1974         309           1030         S[559]         2912         184.5         1064         S[593]         2436         184.5         1098         S[627]         1960         184           1031         S[560]         2898         309.5         1065         S[594]         2422         309.5         1099         S[628]         1946         309           1032         S[561]         2884         184.5         1066         S[595]         2408         184.5         1100         S[629]         1932         184           1033         S[562]         2870         309.5         1067         S[596]         2394         309.5         1101         S[630]         1918         309   | 1025 | S[554]   | 2982 | 309.5 | 1059 | S[588]   | 2506 | 309.5 | 1093 | S[622]   | 2030 | 309.5 |
| 1028         S[557]         2940         184.5         1062         S[591]         2464         184.5         1096         S[625]         1988         184           1029         S[558]         2926         309.5         1063         S[592]         2450         309.5         1097         S[626]         1974         309           1030         S[559]         2912         184.5         1064         S[593]         2436         184.5         1098         S[627]         1960         184           1031         S[560]         2898         309.5         1065         S[594]         2422         309.5         1099         S[628]         1946         309           1032         S[561]         2884         184.5         1066         S[595]         2408         184.5         1100         S[629]         1932         184           1033         S[562]         2870         309.5         1067         S[596]         2394         309.5         1101         S[630]         1918         309           1034         S[563]         2856         184.5         1068         S[597]         2380         184.5         1102         S[631]         1904         184   | 1026 | S[555]   | 2968 | 184.5 | 1060 | S[589]   | 2492 | 184.5 | 1094 | S[623]   | 2016 | 184.5 |
| 1029         S[558]         2926         309.5         1063         S[592]         2450         309.5         1097         S[626]         1974         309           1030         S[559]         2912         184.5         1064         S[593]         2436         184.5         1098         S[627]         1960         184           1031         S[560]         2898         309.5         1065         S[594]         2422         309.5         1099         S[628]         1946         309           1032         S[561]         2884         184.5         1066         S[595]         2408         184.5         1100         S[629]         1932         184           1033         S[562]         2870         309.5         1067         S[596]         2394         309.5         1101         S[630]         1918         309           1034         S[563]         2856         184.5         1068         S[597]         2380         184.5         1102         S[631]         1904         184           1035         S[564]         2842         309.5         1069         S[598]         2366         309.5         1103         S[632]         1890         309   | 1027 | S[556]   | 2954 | 309.5 | 1061 | S[590]   | 2478 | 309.5 | 1095 | S[624]   | 2002 | 309.5 |
| 1030         S[559]         2912         184.5         1064         S[593]         2436         184.5         1098         S[627]         1960         184           1031         S[560]         2898         309.5         1065         S[594]         2422         309.5         1099         S[628]         1946         309           1032         S[561]         2884         184.5         1066         S[595]         2408         184.5         1100         S[629]         1932         184           1033         S[562]         2870         309.5         1067         S[596]         2394         309.5         1101         S[630]         1918         309           1034         S[563]         2856         184.5         1068         S[597]         2380         184.5         1102         S[631]         1904         184           1035         S[564]         2842         309.5         1069         S[598]         2366         309.5         1103         S[632]         1890         309           1036         S[565]         2828         184.5         1070         S[599]         2352         184.5         1104         S[634]         1862         309   | 1028 | S[557]   | 2940 | 184.5 | 1062 | S[591]   | 2464 | 184.5 | 1096 | S[625]   | 1988 | 184.5 |
| 1031       S[560]       2898       309.5       1065       S[594]       2422       309.5       1099       S[628]       1946       309         1032       S[561]       2884       184.5       1066       S[595]       2408       184.5       1100       S[629]       1932       184         1033       S[562]       2870       309.5       1067       S[596]       2394       309.5       1101       S[630]       1918       309         1034       S[563]       2856       184.5       1068       S[597]       2380       184.5       1102       S[631]       1904       184         1035       S[564]       2842       309.5       1069       S[598]       2366       309.5       1103       S[632]       1890       309         1036       S[565]       2828       184.5       1070       S[599]       2352       184.5       1104       S[633]       1876       184         1037       S[566]       2814       309.5       1071       S[600]       2338       309.5       1105       S[634]       1862       309   | 1029 | S[558]   | 2926 | 309.5 | 1063 | S[592]   | 2450 | 309.5 | 1097 | S[626]   | 1974 | 309.5 |
| 1032     S[561]     2884     184.5     1066     S[595]     2408     184.5     1100     S[629]     1932     184       1033     S[562]     2870     309.5     1067     S[596]     2394     309.5     1101     S[630]     1918     309       1034     S[563]     2856     184.5     1068     S[597]     2380     184.5     1102     S[631]     1904     184       1035     S[564]     2842     309.5     1069     S[598]     2366     309.5     1103     S[632]     1890     309       1036     S[565]     2828     184.5     1070     S[599]     2352     184.5     1104     S[633]     1876     184       1037     S[566]     2814     309.5     1071     S[600]     2338     309.5     1105     S[634]     1862     309  | 1030 | S[559]   | 2912 | 184.5 | 1064 | S[593]   | 2436 | 184.5 | 1098 | S[627]   | 1960 | 184.5 |
| 1033         S[562]         2870         309.5         1067         S[596]         2394         309.5         1101         S[630]         1918         309           1034         S[563]         2856         184.5         1068         S[597]         2380         184.5         1102         S[631]         1904         184           1035         S[564]         2842         309.5         1069         S[598]         2366         309.5         1103         S[632]         1890         309           1036         S[565]         2828         184.5         1070         S[599]         2352         184.5         1104         S[633]         1876         184           1037         S[566]         2814         309.5         1071         S[600]         2338         309.5         1105         S[634]         1862         309   | 1031 | S[560]   | 2898 | 309.5 | 1065 | S[594]   | 2422 | 309.5 | 1099 | S[628]   | 1946 | 309.5 |
| 1034     S[563]     2856     184.5     1068     S[597]     2380     184.5     1102     S[631]     1904     184       1035     S[564]     2842     309.5     1069     S[598]     2366     309.5     1103     S[632]     1890     309       1036     S[565]     2828     184.5     1070     S[599]     2352     184.5     1104     S[633]     1876     184       1037     S[566]     2814     309.5     1071     S[600]     2338     309.5     1105     S[634]     1862     309  | 1032 | S[561]   | 2884 | 184.5 | 1066 | S[595]   | 2408 | 184.5 | 1100 | S[629]   | 1932 | 184.5 |
| 1035     S[564]     2842     309.5     1069     S[598]     2366     309.5     1103     S[632]     1890     309       1036     S[565]     2828     184.5     1070     S[599]     2352     184.5     1104     S[633]     1876     184       1037     S[566]     2814     309.5     1071     S[600]     2338     309.5     1105     S[634]     1862     309   | 1033 | S[562]   | 2870 | 309.5 | 1067 | S[596]   | 2394 | 309.5 | 1101 | S[630]   | 1918 | 309.5 |
| 1036     S[565]     2828     184.5     1070     S[599]     2352     184.5     1104     S[633]     1876     184       1037     S[566]     2814     309.5     1071     S[600]     2338     309.5     1105     S[634]     1862     309  | 1034 | S[563]   | 2856 | 184.5 | 1068 | S[597]   | 2380 | 184.5 | 1102 | S[631]   | 1904 | 184.5 |
| 1037 S[566] 2814 309.5 1071 S[600] 2338 309.5 1105 S[634] 1862 309   | 1035 | S[564]   | 2842 | 309.5 | 1069 | S[598]   | 2366 | 309.5 | 1103 | S[632]   | 1890 | 309.5 |
|  | 1036 | S[565]   | 2828 | 184.5 | 1070 | S[599]   | 2352 | 184.5 | 1104 | S[633]   | 1876 | 184.5 |
| 1038 S[567] 2800 184.5 1072 S[601] 2324 184.5 1106 S[635] 1848 184   | 1037 | S[566]   | 2814 | 309.5 | 1071 | S[600]   | 2338 | 309.5 | 1105 | S[634]   | 1862 | 309.5 |
|  | 1038 | S[567]   | 2800 | 184.5 | 1072 | S[601]   | 2324 | 184.5 | 1106 | S[635]   | 1848 | 184.5 |
| 1039 S[568] 2786 309.5 1073 S[602] 2310 309.5 1107 S[636] 1834 309   | 1039 | S[568]   | 2786 | 309.5 | 1073 | S[602]   | 2310 | 309.5 | 1107 | S[636]   | 1834 | 309.5 |
| 1040 S[569] 2772 184.5 1074 S[603] 2296 184.5 1108 S[637] 1820 184   | 1040 | S[569]   | 2772 | 184.5 | 1074 | S[603]   | 2296 | 184.5 | 1108 | S[637]   | 1820 | 184.5 |
| 1041 S[570] 2758 309.5 1075 S[604] 2282 309.5 1109 S[638] 1806 309   | 1041 | S[570]   | 2758 | 309.5 | 1075 | S[604]   | 2282 | 309.5 | 1109 | S[638]   | 1806 | 309.5 |
| 1042 S[571] 2744 184.5 1076 S[605] 2268 184.5 1110 S[639] 1792 184   | 1042 | S[571]   | 2744 | 184.5 | 1076 | S[605]   | 2268 | 184.5 | 1110 | S[639]   | 1792 | 184.5 |
| 1043 S[572] 2730 309.5 1077 S[606] 2254 309.5 1111 S[640] 1778 309   | 1043 | S[572]   | 2730 | 309.5 | 1077 | S[606]   | 2254 | 309.5 | 1111 | S[640]   | 1778 | 309.5 |
| 1044 S[573] 2716 184.5 1078 S[607] 2240 184.5 1112 S[641] 1764 184   | 1044 | S[573]   | 2716 | 184.5 | 1078 | S[607]   | 2240 | 184.5 | 1112 | S[641]   | 1764 | 184.5 |
| 1045 S[574] 2702 309.5 1079 S[608] 2226 309.5 1113 S[642] 1750 309   | 1045 | S[574]   | 2702 | 309.5 | 1079 | S[608]   | 2226 | 309.5 | 1113 | S[642]   | 1750 | 309.5 |
| 1046 S[575] 2688 184.5 1080 S[609] 2212 184.5 1114 S[643] 1736 184   | 1046 | S[575]   | 2688 | 184.5 | 1080 | S[609]   | 2212 | 184.5 | 1114 | S[643]   | 1736 | 184.5 |
| 1047 S[576] 2674 309.5 1081 S[610] 2198 309.5 1115 S[644] 1722 309   | 1047 | S[576]   | 2674 | 309.5 | 1081 | S[610]   | 2198 | 309.5 | 1115 | S[644]   | 1722 | 309.5 |
| 1048         S[577]         2660         184.5         1082         S[611]         2184         184.5         1116         S[645]         1708         184   | 1048 | S[577]   | 2660 | 184.5 | 1082 | S[611]   | 2184 | 184.5 | 1116 | S[645]   | 1708 | 184.5 |

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| PAD   PIN Name   R   |      |          |      |       |      |          |      |       |      |          |     |       |
|--|------|----------|------|-------|------|----------|------|-------|------|----------|-----|-------|
| 1119   |      | PIN Name | X    | Y     |      | PIN Name | х    | Υ     |      | PIN Name | х   | Υ     |
| 1119   | 1117 | S[646]   | 1694 | 309.5 | 1151 | S[680]   | 1218 | 309.5 | 1185 | S[714]   | 742 | 309.5 |
| 1120   S 649    1652   184.5   1154   S 683    1176   184.5   1188   S 717    700   184.5   1121   S 650    1638   309.5   1155   S 684    1162   309.5   1189   S 718    686   309.5   1122   S 651    1824   184.5   1156   S 685    1148   184.5   1190   S 718    672   184.5   1122   S 651    1824   184.5   1156   S 685    1148   184.5   1190   S 718    672   184.5   1122   S 653    1596   184.5   1156   S 687    1120   184.5   1192   DMY   644   184.5   1125   S 684    1382   309.5   1159   S 688    1106   309.5   1193   DMY   630   309.5   1126   S 685    1568   184.5   1160   S 689    1092   184.5   1194   DMY   616   184.5   1127   S 665    1554   309.5   1161   S 690    1078   309.5   1195   DMY   602   309.5   1128   S 685    1526   309.5   1162   S 691    1064   184.5   1196   DMY   574   309.5   1130   S 689    1512   184.5   1164   S 693    1032   184.5   1196   DMY   574   309.5   1131   S 660    148.5   1164   S 683    1038   184.5   1198   DMY   546   309.5   1133   S 662    1470   309.5   1165   S 691    1008   184.5   1200   DMY   532   184.5   1133   S 662    1470   309.5   1165   S 693    1008   184.5   1200   DMY   532   184.5   1133   S 663    1428   184.5   1168   S 693    994   309.5   1201   DMY   546   309.5   1133   S 666    144.5   148.5   146.5   S 693    994   309.5   1201   DMY   546   309.5   1133   S 666    144.5   1442   309.5   1167   S 693    994   309.5   1201   DMY   546   309.5   1133   S 666    144.5   144.5   146.5   S 693    994   309.5   1201   DMY   546   309.5   1136   S 668    144.5   146.5   S 669    144.5   146.5   S 693    994   309.5   1201   DMY   440   309.5   1136   S 668    144.5   144.5   S 669    144.5   S 669    S  | 1118 | S[647]   | 1680 | 184.5 | 1152 | S[681]   | 1204 | 184.5 | 1186 | S[715]   | 728 | 184.5 |
| 1121   S 650    1638   309.5   1155   S 684    1162   309.5   1189   S 718    686   309.5   1122   S 651    1624   184.5   1156   S 685    1148   184.5   1190   S 719    672   184.5   1123   S 652    1610   309.5   1157   S 666    1134   309.5   1191   S 720    658   309.5   1124   S 653    1596   184.5   1158   S 687    1120   184.5   1192   DMY   644   184.5   1125   S 654    1582   309.5   1159   S 688    1106   309.5   1193   DMY   630   309.5   1126   S 655    1588   184.5   1160   S 689    1092   114.5   1194   DMY   616   184.5   1127   S 666    1954   309.5   1161   S 690    1078   309.5   1195   DMY   602   309.5   1128   S 657    1540   184.5   1162   S 691    1064   184.5   1196   DMY   574   309.5   1133   S 668    1528   309.5   1163   S 692    1050   309.5   1197   DMY   574   309.5   1133   S 660    1484   184.5   1166   S 693    1036   184.5   1198   DMY   546   309.5   1133   S 660    1484   1484   1484.5   1166   S 693    1036   184.5   1199   DMY   546   309.5   1133   S 660    1484   1484.5   1166   S 693    1008   184.5   1200   DMY   546   309.5   1133   S 662    1470   309.5   1167   S 696    994   309.5   1201   DMY   574   309.5   1133   S 666    1442   309.5   1166   S 693    996   309.5   1201   DMY   574   309.5   1133   S 666    1442   309.5   1167   S 698    966   309.5   1201   DMY   480   309.5   1133   S 666    1444   309.5   1170   S 699    952   184.5   1204   DMY   446   309.5   1133   S 666    1444   309.5   1171   S 700    938   309.5   1205   DMY   440   309.5   1138   S 666    1386   309.5   1173   S 702    910   309.5   1207   DMY   442   309.5   1144   S 670    1388   309.5   1177   S 706  884   184.5   1208   DMY   442   309.5   1144   S 670    1388   309.5   1177   S 706  884   309.5   1201   DMY   336   184.5   1144   S 670    1384   309.5   1177   S 706  884   309.5   1201   DMY   336   184.5   1144   S 673    1316   184.5   1176   S 700  882   309.5   1211   DMY   336   309.5   1144   S 673    1316   184.5   1176   S 700  882   309.5   1213   DMY   336   309.5    | 1119 | S[648]   | 1666 | 309.5 | 1153 | S[682]   | 1190 | 309.5 | 1187 | S[716]   | 714 | 309.5 |
| 1122   S 651    1624   184.5   1156   S 685    1148   184.5   1190   S 719    672   184.5   1123   S 652    1610   309.5   1157   S 686    1134   309.5   1191   S 720    658   309.5   1124   S 653    1596   184.5   1158   S 687    1120   184.5   1192   DMY   644   184.5   1125   S 654    1582   309.5   1159   S 688    1106   309.5   1193   DMY   630   309.5   1125   S 655    1588   184.5   1160   S 689    1092   184.5   1194   DMY   616   184.5   1127   S 656    1554   309.5   1161   S 690    1078   309.5   1195   DMY   602   309.5   1128   S 657    1540   184.5   1162   S 689    1064   184.5   1196   DMY   574   309.5   1129   S 658    1526   309.5   1163   S 682    1050   309.5   1197   DMY   574   309.5   1130   S 659    1512   184.5   1164   S 683    1036   184.5   1198   DMY   560   184.5   1131   S 660    1498   309.5   1165   S 684    1022   309.5   1199   DMY   546   309.5   1132   S 661    1484   184.5   1166   S 685    1008   184.5   1200   DMY   532   184.5   1133   S 662    1470   309.5   1167   S 696    994   309.5   1201   DMY   546   309.5   1133   S 668    1442   309.5   1169   S 698    996   309.5   1201   DMY   546   309.5   1138   S 668    1442   309.5   1169   S 698    966   309.5   1201   DMY   546   309.5   1138   S 666    1414   309.5   1177   S 696    994   309.5   1201   DMY   476   184.5   1138   S 668    1428   184.5   1170   S 699    995   184.5   1202   DMY   476   184.5   1138   S 668    1414   309.5   1177   S 706    938   309.5   1207   DMY   448   184.5   1138   S 669    1372   184.5   1174   S 703    896   184.5   1206   DMY   446   309.5   1144   S 673    1368   309.5   1175   S 704    882   309.5   1201   DMY   378   309.5   1144   S 673    1316   184.5   1176   S 706    868   184.5   1210   DMY   378   309.5   1144   S 673    1316   184.5   1176   S 706    868   184.5   1210   DMY   336   184.5   1144   S 673    1316   184.5   1176   S 706    868   184.5   1210   DMY   336   184.5   1144   S 673    1316   184.5   1178   S 707    840   184.5   1210   DMY   336   184.5   114 | 1120 | S[649]   | 1652 | 184.5 | 1154 | S[683]   | 1176 | 184.5 | 1188 | S[717]   | 700 | 184.5 |
| 1123   S 652    1610   309.5   1157   S 686    1134   309.5   1191   S 720    658   309.5   1124   S 653    1596   184.5   1158   S 687    11120   184.5   1192   DMY   644   184.5   1125   S 654    1582   309.5   1159   S 688    1106   309.5   1193   DMY   630   309.5   1126   S 655    1568   184.5   1160   S 689    1092   184.5   1194   DMY   616   184.5   1127   S 656    1554   309.5   1161   S 690    1078   309.5   1195   DMY   602   309.5   1128   S 657    1540   184.5   1162   S 691    1064   184.5   1196   DMY   588   184.5   1129   S 658    1526   309.5   1163   S 692    1050   309.5   1197   DMY   574   309.5   1130   S 659    1512   184.5   1164   S 693    1036   184.5   1198   DMY   560   184.5   1131   S 660    1498   309.5   1165   S 694    1022   309.5   1199   DMY   546   309.5   1132   S 661    1494   184.5   1166   S 695    1008   184.5   1200   DMY   532   184.5   1133   S 662    1470   309.5   1167   S 696    994   309.5   1201   DMY   518   309.5   1135   S 664    1442   309.5   1169   S 698    966   309.5   1201   DMY   476   184.5   1138   S 665    1428   184.5   1170   S 699    952   184.5   1200   DMY   476   184.5   1138   S 667    1400   184.5   1172   S 699    952   184.5   1206   DMY   446   309.5   1138   S 667    1400   184.5   1172   S 700    938   309.5   1205   DMY   446   309.5   1139   S 669    1388   309.5   1173   S 702    910   309.5   1201   DMY   446   309.5   1144   S 667    1344   184.5   1176   S 706    868   184.5   1200   DMY   446   309.5   1144   S 667    1348   184.5   1176   S 706    868   184.5   1200   DMY   446   309.5   1144   S 667    1344   184.5   1176   S 706    868   184.5   1200   DMY   446   309.5   1144   S 667    1348   184.5   1176   S 706    868   184.5   1210   DMY   378   309.5   1144   S 667    1348   184.5   1176   S 706    868   184.5   1210   DMY   378   309.5   1144   S 667    1366   1364   1176   S 706    868   184.5   1210   DMY   378   309.5   1144   S 667    1366   1364   1176   S 706    868   184.5   1210   DMY   336   184.5   1144   S | 1121 | S[650]   | 1638 | 309.5 | 1155 | S[684]   | 1162 | 309.5 | 1189 | S[718]   | 686 | 309.5 |
| 1124   Sig653   1596   184.5   1158   Sig87   1120   184.5   1192   DMY   644   184.5   1125   Sig654   1582   309.5   1159   Sig88   1106   309.5   1193   DMY   630   309.5   1126   Sig655   1568   184.5   1160   Sig89   1092   184.5   1194   DMY   616   184.5   1127   Sig656   1554   309.5   1161   Sig90   1078   309.5   1195   DMY   602   309.5   1128   Sig657   1540   184.5   1162   Sig91   1064   184.5   1196   DMY   588   184.5   1129   Sig658   1526   309.5   1163   Sig92   1050   309.5   1197   DMY   574   309.5   1130   Sig69   1512   184.5   1164   Sig93   1036   184.5   1198   DMY   560   184.5   1131   Sig60   1498   309.5   1165   Sig94   1022   309.5   1199   DMY   546   309.5   1132   Sig61   1484   184.5   1166   Sig95   1008   184.5   1200   DMY   532   184.5   1133   Sig62   1470   309.5   1167   Sig99   994   309.5   1201   DMY   518   309.5   1135   Sig64   1442   309.5   1169   Sig98   966   309.5   1200   DMY   490   309.5   1138   Sig66   1414   309.5   1170   Sig99   952   184.5   1204   DMY   476   184.5   1138   Sig66   1414   309.5   1171   Sig09   994   184.5   1204   DMY   446   309.5   1138   Sig66   1414   309.5   1171   Sig09   995   184.5   1206   DMY   448   184.5   1139   Sig68   1386   309.5   1171   Sig09   992   184.5   1204   DMY   446   309.5   1138   Sig67   1400   184.5   1172   Sig01   938   309.5   1207   DMY   448   184.5   1140   Sig69   1372   184.5   1174   Sig01   882   309.5   1207   DMY   434   309.5   1144   Sig67   1388   309.5   1177   Sig09   886   184.5   1208   DMY   406   309.5   1144   Sig67   1386   309.5   1177   Sig09   886   184.5   1210   DMY   378   309.5   1144   Sig67   1386   309.5   1177   Sig09   886   184.5   1210   DMY   336   184.5   1144   Sig67   1386   309.5   1177   Sig09   882   309.5   1211   DMY   336   184.5   1144   Sig67   1386   309.5   1177   Sig09   882   309.5   1211   DMY   336   184.5   1146   Sig67   1288   184.5   1180   Sig09   812   184.5   1214   DMY   336   184.5   1146   Sig67   1288   184.5   1180   Sig09   812    | 1122 | S[651]   | 1624 | 184.5 | 1156 | S[685]   | 1148 | 184.5 | 1190 | S[719]   | 672 | 184.5 |
| 1125   S 654    1582   309.5   1159   S 688    1106   309.5   1193   DMY   630   309.5     1126   S 655    1568   184.5   1160   S 689    1092   184.5   11194   DMY   616   184.5     1127   S 656    1554   309.5   1161   S 690    1078   309.5   1195   DMY   602   309.5     1128   S 657    1540   184.5   1162   S 691    1064   184.5   1196   DMY   588   184.5     1129   S 658    1526   309.5   1163   S 692    1050   309.5   1197   DMY   574   309.5     1130   S 659    1512   184.5   1164   S 693    1036   184.5   1198   DMY   560   184.5     1131   S 660    1498   309.5   1165   S 694    1022   309.5   1199   DMY   546   309.5     1132   S 661    1484   184.5   1166   S 695    1008   184.5   1200   DMY   532   184.5     1133   S 662    1470   309.5   1167   S 696    994   309.5   1201   DMY   518   309.5     1134   S 663    1456   184.5   1168   S 697    980   184.5   1202   DMY   504   184.5     1135   S 664    1442   309.5   1169   S 698    966   309.5   1203   DMY   490   309.5     1136   S 665    1428   184.5   1170   S 699    952   184.5   1204   DMY   476   184.5     1137   S 666    1414   309.5   1171   S 700    938   309.5   1205   DMY   442   309.5     1138   S 667    1400   184.5   1172   S 701    924   184.5   1206   DMY   448   184.5     1139   S 668    1386   309.5   1173   S 702    910   309.5   1207   DMY   434   309.5     1140   S 669    1372   184.5   1174   S 703    886   184.5   1208   DMY   420   184.5     1141   S 670    1358   309.5   1177   S 706    882   309.5   1211   DMY   378   309.5     1144   S 673    1316   184.5   1178   S 707    840   184.5   1214   DMY   336   184.5     1145   S 676    1288   184.5   1180   S 709    812   184.5   1214   DMY   336   184.5     1146   S 676    1288   184.5   1180   S 709    812   184.5   1216   DMY   336   184.5     1148   S 677    1260   184.5   1183   S 712    770   309.5   1217   DMY   294   309.5     1148   S 677    1260   184.5   1183   S 712    770   309.5   1217   DMY   294   309.5     1149   S 678    1246   309.5   1183   S 712    770   30 | 1123 | S[652]   | 1610 | 309.5 | 1157 | S[686]   | 1134 | 309.5 | 1191 | S[720]   | 658 | 309.5 |
| 1126         S[685]         1568         184.5         1160         S[689]         1092         184.5         1194         DMY         616         184.5           1127         S[656]         1554         309.5         1161         S[690]         1078         309.5         1195         DMY         602         309.5           1128         S[657]         1540         184.5         1162         S[691]         1064         184.5         1196         DMY         588         184.5           1129         S[658]         1526         309.5         1163         S[692]         1050         309.5         1197         DMY         574         309.5           1130         S[659]         1512         184.5         1164         S[693]         1036         184.5         1198         DMY         560         184.5           1131         S[660]         1484         184.5         1166         S[693]         1008         184.5         1200         DMY         546         309.5           1133         S[663]         1470         309.5         1167         S[696]         994         309.5         1201         DMY         518         309.5           1134 <td>1124</td> <td>S[653]</td> <td>1596</td> <td>184.5</td> <td>1158</td> <td>S[687]</td> <td>1120</td> <td>184.5</td> <td>1192</td> <td>DMY</td> <td>644</td> <td>184.5</td>  | 1124 | S[653]   | 1596 | 184.5 | 1158 | S[687]   | 1120 | 184.5 | 1192 | DMY      | 644 | 184.5 |
| 1127         Si656j         1554         309.5         1161         Si690j         1078         309.5         1195         DMY         602         309.5           1128         Si657j         1540         184.5         1162         Si691j         1064         184.5         1196         DMY         588         184.5           1129         Si658j         1526         309.5         1163         Si692j         1050         309.5         1197         DMY         574         309.5           1130         Si658j         1512         184.5         1164         Si693j         1036         184.5         1198         DMY         560         184.5           1131         Si660j         1484         184.5         1166         Si696j         1008         184.5         1200         DMY         546         309.5           1132         Si661j         1484         184.5         1166         Si696j         994         309.5         1201         DMY         518         309.5           1133         Si663j         1442         309.5         1169         Si698j         966         309.5         1201         DMY         504         184.5           1133  | 1125 | S[654]   | 1582 | 309.5 | 1159 | S[688]   | 1106 | 309.5 | 1193 | DMY      | 630 | 309.5 |
| 1128   S[657]   1540   184.5   1162   S[691]   1064   184.5   1196   DMY   588   184.5     1129   S[658]   1526   309.5   1163   S[692]   1050   309.5   1197   DMY   574   309.5     1130   S[659]   1512   184.5   1164   S[693]   1036   184.5   1198   DMY   560   184.5     1131   S[660]   1498   309.5   1165   S[694]   1022   309.5   1199   DMY   546   309.5     1132   S[661]   1484   184.5   1166   S[695]   1008   184.5   1200   DMY   532   184.5     1133   S[662]   1470   309.5   1167   S[696]   994   309.5   1201   DMY   518   309.5     1134   S[663]   1456   184.5   1168   S[697]   980   184.5   1202   DMY   504   184.5     1135   S[664]   1442   309.5   1169   S[698]   966   309.5   1203   DMY   490   309.5     1136   S[665]   1428   184.5   1170   S[699]   952   184.5   1204   DMY   476   184.5     1137   S[666]   1414   309.5   1171   S[700]   938   309.5   1205   DMY   462   309.5     1138   S[667]   1400   184.5   1172   S[701]   924   184.5   1206   DMY   448   184.5     1139   S[668]   1386   309.5   1173   S[702]   910   309.5   1207   DMY   448   184.5     1140   S[669]   1372   184.5   1176   S[705]   868   184.5   1208   DMY   440   309.5     1142   S[671]   1344   184.5   1176   S[705]   868   184.5   1210   DMY   378   309.5     1143   S[672]   1330   309.5   1177   S[706]   854   309.5   1211   DMY   378   309.5     1144   S[673]   1316   184.5   1176   S[705]   868   184.5   1210   DMY   364   184.5     1144   S[673]   1316   184.5   1176   S[705]   868   184.5   1210   DMY   378   309.5     1144   S[673]   1316   184.5   1178   S[707]   840   184.5   1214   DMY   336   184.5     1145   S[674]   1302   309.5   1177   S[708]   826   309.5   1211   DMY   336   184.5     1146   S[675]   1288   184.5   1180   S[707]   840   184.5   1216   DMY   336   184.5     1147   S[676]   1274   309.5   1181   S[710]   798   309.5   1215   DMY   322   309.5     1148   S[677]   1260   184.5   1182   S[711]   784   184.5   1216   DMY   308   184.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5  | 1126 | S[655]   | 1568 | 184.5 | 1160 | S[689]   | 1092 | 184.5 | 1194 | DMY      | 616 | 184.5 |
| 1129         S[658]         1526         309.5         1163         S[692]         1050         309.5         1197         DMY         574         309.5           1130         S[659]         1512         184.5         1164         S[693]         1036         184.5         1198         DMY         560         184.5           1131         S[660]         1498         309.5         1165         S[694]         1022         309.5         1199         DMY         546         309.5           1132         S[661]         1484         184.5         1166         S[695]         1008         184.5         1200         DMY         532         184.5           1133         S[662]         1470         309.5         1167         S[696]         994         309.5         1201         DMY         518         309.5           1134         S[663]         1456         184.5         1168         S[697]         980         184.5         1202         DMY         504         184.5           1135         S[664]         1442         309.5         1170         S[699]         952         184.5         1203         DMY         476         184.5           1137   | 1127 | S[656]   | 1554 | 309.5 | 1161 | S[690]   | 1078 | 309.5 | 1195 | DMY      | 602 | 309.5 |
| 1130   S 659    1512   184.5   1164   S 693    1036   184.5   1198   DMY   560   184.5     1131   S 660    1498   309.5   1165   S 694    1022   309.5   1199   DMY   546   309.5     1132   S 661    1484   184.5   1166   S 695    1008   184.5   1200   DMY   532   184.5     1133   S 662    1470   309.5   1167   S 696    994   309.5   1201   DMY   518   309.5     1134   S 663    1456   184.5   1168   S 697    980   184.5   1202   DMY   504   184.5     1135   S 664    1442   309.5   1169   S 698    966   309.5   1203   DMY   490   309.5     1136   S 665    1428   184.5   1170   S 699    952   184.5   1204   DMY   476   184.5     1137   S 666    1414   309.5   1171   S 700    938   309.5   1205   DMY   462   309.5     1138   S 667    1400   184.5   1172   S 701    924   184.5   1206   DMY   448   184.5     1139   S 668    1386   309.5   1173   S 702    910   309.5   1207   DMY   434   309.5     1140   S 669    1372   184.5   1174   S 703    896   184.5   1208   DMY   406   309.5     1141   S 670    1358   309.5   1175   S 704    882   309.5   1209   DMY   406   309.5     1142   S 671    1344   184.5   1176   S 705    868   184.5   1210   DMY   378   309.5     1144   S 673    1316   184.5   1178   S 707    840   184.5   1212   DMY   364   184.5     1145   S 674    1302   309.5   1179   S 708    826   309.5   1213   DMY   336   184.5     1147   S 676    1288   184.5   1180   S 709    812   184.5   1214   DMY   336   184.5     1148   S 677    1260   184.5   1182   S 711    784   184.5   1216   DMY   308   184.5     1149   S 678    1246   309.5   1183   S 712    770   309.5   1217   DMY   294   309.5     1149   S 678    1246   309.5   1183   S 712    770   309.5   1217   DMY   294   309.5     1149   S 678    1246   309.5   1183   S 712    770   309.5   1217   DMY   294   309.5     1149   S 678    1246   309.5   1183   S 712    770   309.5   1217   DMY   294   309.5     1149   S 678    1246   309.5   1183   S 712    770   309.5   1217   DMY   294   309.5     1149   S 678    1246   309.5   1183   S 712    770   309.5    | 1128 | S[657]   | 1540 | 184.5 | 1162 | S[691]   | 1064 | 184.5 | 1196 | DMY      | 588 | 184.5 |
| 1131   S[660]   1498   309.5   1165   S[694]   1022   309.5   1199   DMY   546   309.5     1132   S[661]   1484   184.5   1166   S[695]   1008   184.5   1200   DMY   532   184.5     1133   S[662]   1470   309.5   1167   S[696]   994   309.5   1201   DMY   518   309.5     1134   S[663]   1456   184.5   1168   S[697]   980   184.5   1202   DMY   504   184.5     1135   S[664]   1442   309.5   1169   S[698]   966   309.5   1203   DMY   490   309.5     1136   S[665]   1428   184.5   1170   S[699]   952   184.5   1204   DMY   476   184.5     1137   S[666]   1414   309.5   1171   S[700]   938   309.5   1205   DMY   462   309.5     1138   S[667]   1400   184.5   1172   S[701]   924   184.5   1206   DMY   448   184.5     1139   S[668]   1386   309.5   1173   S[702]   910   309.5   1207   DMY   434   309.5     1140   S[669]   1372   184.5   1174   S[703]   896   184.5   1208   DMY   440   309.5     1141   S[670]   1358   309.5   1175   S[704]   882   309.5   1209   DMY   406   309.5     1142   S[671]   1344   184.5   1176   S[705]   868   184.5   1210   DMY   378   309.5     1143   S[672]   1330   309.5   1177   S[706]   854   309.5   1211   DMY   378   309.5     1144   S[673]   1316   184.5   1178   S[707]   840   184.5   1212   DMY   364   184.5     1145   S[674]   1302   309.5   1179   S[708]   826   309.5   1213   DMY   336   184.5     1147   S[676]   1274   309.5   1181   S[701]   798   309.5   1215   DMY   336   184.5     1148   S[677]   1260   184.5   1182   S[711]   784   184.5   1216   DMY   308   184.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1 | 1129 | S[658]   | 1526 | 309.5 | 1163 | S[692]   | 1050 | 309.5 | 1197 | DMY      | 574 | 309.5 |
| 1132   S[661]   1484   184.5   1166   S[695]   1008   184.5   1200   DMY   532   184.5     1133   S[662]   1470   309.5   1167   S[696]   994   309.5   1201   DMY   518   309.5     1134   S[663]   1456   184.5   1168   S[697]   980   184.5   1202   DMY   504   184.5     1135   S[664]   1442   309.5   1169   S[698]   966   309.5   1203   DMY   490   309.5     1136   S[665]   1428   184.5   1170   S[699]   952   184.5   1204   DMY   476   184.5     1137   S[666]   1414   309.5   1171   S[700]   938   309.5   1205   DMY   462   309.5     1138   S[667]   1400   184.5   1172   S[701]   924   184.5   1206   DMY   448   184.5     1139   S[668]   1386   309.5   1173   S[702]   910   309.5   1207   DMY   434   309.5     1140   S[669]   1372   184.5   1174   S[703]   896   184.5   1208   DMY   420   184.5     1141   S[670]   1358   309.5   1175   S[704]   882   309.5   1209   DMY   406   309.5     1142   S[671]   1344   184.5   1176   S[705]   868   184.5   1210   DMY   392   184.5     1143   S[672]   1330   309.5   1177   S[706]   854   309.5   1211   DMY   378   309.5     1144   S[673]   1316   184.5   1178   S[707]   840   184.5   1212   DMY   364   184.5     1145   S[674]   1302   309.5   1179   S[708]   826   309.5   1213   DMY   336   184.5     1146   S[675]   1288   184.5   1180   S[709]   812   184.5   1214   DMY   336   184.5     1147   S[676]   1274   309.5   1181   S[710]   798   309.5   1215   DMY   308   184.5     1148   S[677]   1260   184.5   1182   S[711]   784   184.5   1216   DMY   308   184.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   12 | 1130 | S[659]   | 1512 | 184.5 | 1164 | S[693]   | 1036 | 184.5 | 1198 | DMY      | 560 | 184.5 |
| 1133   S[662]   1470   309.5   1167   S[696]   994   309.5   1201   DMY   518   309.5   1134   S[663]   1456   184.5   1168   S[697]   980   184.5   1202   DMY   504   184.5   1135   S[664]   1442   309.5   1169   S[698]   966   309.5   1203   DMY   490   309.5   1136   S[665]   1428   184.5   1170   S[699]   952   184.5   1204   DMY   476   184.5   1137   S[666]   1414   309.5   1171   S[700]   938   309.5   1205   DMY   462   309.5   1138   S[667]   1400   184.5   1172   S[701]   924   184.5   1206   DMY   448   184.5   1139   S[668]   1386   309.5   1173   S[702]   910   309.5   1207   DMY   434   309.5   1140   S[669]   1372   184.5   1174   S[703]   896   184.5   1208   DMY   420   184.5   1141   S[670]   1358   309.5   1175   S[704]   882   309.5   1209   DMY   406   309.5   1142   S[671]   1344   184.5   1176   S[705]   868   184.5   1210   DMY   378   309.5   1144   S[673]   1316   184.5   1178   S[707]   840   184.5   1212   DMY   364   184.5   1145   S[674]   1302   309.5   1179   S[708]   826   309.5   1213   DMY   336   184.5   1147   S[676]   1288   184.5   1180   S[709]   812   184.5   1214   DMY   336   184.5   1147   S[676]   1274   309.5   1181   S[710]   798   309.5   1215   DMY   308   184.5   1148   S[677]   1260   184.5   1182   S[711]   784   184.5   1216   DMY   308   184.5   1148   S[677]   1260   184.5   1182   S[711]   784   184.5   1216   DMY   308   184.5   1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5   1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5   1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5   1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5   1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5   1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5   1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5   S[678]   1149   S[67 | 1131 | S[660]   | 1498 | 309.5 | 1165 | S[694]   | 1022 | 309.5 | 1199 | DMY      | 546 | 309.5 |
| 1134   S[663]   1456   184.5   1168   S[697]   980   184.5   1202   DMY   504   184.5     1135   S[664]   1442   309.5   1169   S[698]   966   309.5   1203   DMY   490   309.5     1136   S[665]   1428   184.5   1170   S[699]   952   184.5   1204   DMY   476   184.5     1137   S[666]   1414   309.5   1171   S[700]   938   309.5   1205   DMY   462   309.5     1138   S[667]   1400   184.5   1172   S[701]   924   184.5   1206   DMY   448   184.5     1139   S[668]   1386   309.5   1173   S[702]   910   309.5   1207   DMY   434   309.5     1140   S[669]   1372   184.5   1174   S[703]   896   184.5   1208   DMY   420   184.5     1141   S[670]   1358   309.5   1175   S[704]   882   309.5   1209   DMY   406   309.5     1142   S[671]   1344   184.5   1176   S[705]   868   184.5   1210   DMY   378   309.5     1143   S[672]   1330   309.5   1177   S[706]   854   309.5   1211   DMY   378   309.5     1144   S[673]   1316   184.5   1178   S[707]   840   184.5   1212   DMY   364   184.5     1145   S[674]   1302   309.5   1179   S[708]   826   309.5   1213   DMY   336   184.5     1146   S[675]   1288   184.5   1180   S[709]   812   184.5   1214   DMY   336   184.5     1147   S[676]   1274   309.5   1181   S[710]   798   309.5   1215   DMY   322   309.5     1148   S[677]   1260   184.5   1182   S[711]   784   184.5   1216   DMY   308   184.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   1217   DMY   294   309.5     1149   S[678]   1246   309.5   1183   S[712]   770   309.5   121 | 1132 | S[661]   | 1484 | 184.5 | 1166 | S[695]   | 1008 | 184.5 | 1200 | DMY      | 532 | 184.5 |
| 1135         S[664]         1442         309.5         1169         S[698]         966         309.5         1203         DMY         490         309.5           1136         S[665]         1428         184.5         1170         S[699]         952         184.5         1204         DMY         476         184.5           1137         S[666]         1414         309.5         1171         S[700]         938         309.5         1205         DMY         462         309.5           1138         S[667]         1400         184.5         1172         S[701]         924         184.5         1206         DMY         448         184.5           1139         S[668]         1386         309.5         1173         S[702]         910         309.5         1207         DMY         434         309.5           1140         S[669]         1372         184.5         1174         S[703]         896         184.5         1208         DMY         420         184.5           1141         S[670]         1358         309.5         1175         S[704]         882         309.5         1209         DMY         406         309.5           1142   | 1133 | S[662]   | 1470 | 309.5 | 1167 | S[696]   | 994  | 309.5 | 1201 | DMY      | 518 | 309.5 |
| 1136         S[665]         1428         184.5         1170         S[699]         952         184.5         1204         DMY         476         184.5           1137         S[666]         1414         309.5         1171         S[700]         938         309.5         1205         DMY         462         309.5           1138         S[667]         1400         184.5         1172         S[701]         924         184.5         1206         DMY         448         184.5           1139         S[668]         1386         309.5         1173         S[702]         910         309.5         1207         DMY         434         309.5           1140         S[669]         1372         184.5         1174         S[703]         896         184.5         1208         DMY         420         184.5           1141         S[670]         1358         309.5         1175         S[704]         882         309.5         1209         DMY         406         309.5           1142         S[671]         1344         184.5         1176         S[705]         868         184.5         1210         DMY         378         309.5           1143   | 1134 | S[663]   | 1456 | 184.5 | 1168 | S[697]   | 980  | 184.5 | 1202 | DMY      | 504 | 184.5 |
| 1137         S[666]         1414         309.5         1171         S[700]         938         309.5         1205         DMY         462         309.5           1138         S[667]         1400         184.5         1172         S[701]         924         184.5         1206         DMY         448         184.5           1139         S[668]         1386         309.5         1173         S[702]         910         309.5         1207         DMY         434         309.5           1140         S[669]         1372         184.5         1174         S[703]         896         184.5         1208         DMY         420         184.5           1141         S[670]         1358         309.5         1175         S[704]         882         309.5         1209         DMY         406         309.5           1142         S[671]         1344         184.5         1176         S[705]         868         184.5         1210         DMY         392         184.5           1143         S[672]         1330         309.5         1177         S[706]         854         309.5         1211         DMY         378         309.5           1144   | 1135 | S[664]   | 1442 | 309.5 | 1169 | S[698]   | 966  | 309.5 | 1203 | DMY      | 490 | 309.5 |
| 1138         S[667]         1400         184.5         1172         S[701]         924         184.5         1206         DMY         448         184.5           1139         S[668]         1386         309.5         1173         S[702]         910         309.5         1207         DMY         434         309.5           1140         S[669]         1372         184.5         1174         S[703]         896         184.5         1208         DMY         420         184.5           1141         S[670]         1358         309.5         1175         S[704]         882         309.5         1209         DMY         406         309.5           1142         S[671]         1344         184.5         1176         S[705]         868         184.5         1210         DMY         392         184.5           1143         S[672]         1330         309.5         1177         S[706]         854         309.5         1211         DMY         378         309.5           1144         S[673]         1316         184.5         1178         S[707]         840         184.5         1212         DMY         364         184.5           1145   | 1136 | S[665]   | 1428 | 184.5 | 1170 | S[699]   | 952  | 184.5 | 1204 | DMY      | 476 | 184.5 |
| 1139         S[668]         1386         309.5         1173         S[702]         910         309.5         1207         DMY         434         309.5           1140         S[669]         1372         184.5         1174         S[703]         896         184.5         1208         DMY         420         184.5           1141         S[670]         1358         309.5         1175         S[704]         882         309.5         1209         DMY         406         309.5           1142         S[671]         1344         184.5         1176         S[705]         868         184.5         1210         DMY         392         184.5           1143         S[672]         1330         309.5         1177         S[706]         854         309.5         1211         DMY         378         309.5           1144         S[673]         1316         184.5         1178         S[707]         840         184.5         1212         DMY         364         184.5           1145         S[674]         1302         309.5         1179         S[708]         826         309.5         1213         DMY         336         184.5           1146   | 1137 | S[666]   | 1414 | 309.5 | 1171 | S[700]   | 938  | 309.5 | 1205 | DMY      | 462 | 309.5 |
| 1140         S[669]         1372         184.5         1174         S[703]         896         184.5         1208         DMY         420         184.5           1141         S[670]         1358         309.5         1175         S[704]         882         309.5         1209         DMY         406         309.5           1142         S[671]         1344         184.5         1176         S[705]         868         184.5         1210         DMY         392         184.5           1143         S[672]         1330         309.5         1177         S[706]         854         309.5         1211         DMY         378         309.5           1144         S[673]         1316         184.5         1178         S[707]         840         184.5         1212         DMY         364         184.5           1145         S[674]         1302         309.5         1179         S[708]         826         309.5         1213         DMY         350         309.5           1146         S[675]         1288         184.5         1180         S[709]         812         184.5         1214         DMY         336         184.5           1147   | 1138 | S[667]   | 1400 | 184.5 | 1172 | S[701]   | 924  | 184.5 | 1206 | DMY      | 448 | 184.5 |
| 1141         S[670]         1358         309.5         1175         S[704]         882         309.5         1209         DMY         406         309.5           1142         S[671]         1344         184.5         1176         S[705]         868         184.5         1210         DMY         392         184.5           1143         S[672]         1330         309.5         1177         S[706]         854         309.5         1211         DMY         378         309.5           1144         S[673]         1316         184.5         1178         S[707]         840         184.5         1212         DMY         364         184.5           1145         S[674]         1302         309.5         1179         S[708]         826         309.5         1213         DMY         350         309.5           1146         S[675]         1288         184.5         1180         S[709]         812         184.5         1214         DMY         336         184.5           1147         S[676]         1274         309.5         1181         S[710]         798         309.5         1215         DMY         308         184.5           1149   | 1139 | S[668]   | 1386 | 309.5 | 1173 | S[702]   | 910  | 309.5 | 1207 | DMY      | 434 | 309.5 |
| 1142         S[671]         1344         184.5         1176         S[705]         868         184.5         1210         DMY         392         184.5           1143         S[672]         1330         309.5         1177         S[706]         854         309.5         1211         DMY         378         309.5           1144         S[673]         1316         184.5         1178         S[707]         840         184.5         1212         DMY         364         184.5           1145         S[674]         1302         309.5         1179         S[708]         826         309.5         1213         DMY         350         309.5           1146         S[675]         1288         184.5         1180         S[709]         812         184.5         1214         DMY         336         184.5           1147         S[676]         1274         309.5         1181         S[710]         798         309.5         1215         DMY         322         309.5           1148         S[677]         1260         184.5         1182         S[711]         784         184.5         1216         DMY         308         184.5           1149   | 1140 | S[669]   | 1372 | 184.5 | 1174 | S[703]   | 896  | 184.5 | 1208 | DMY      | 420 | 184.5 |
| 1143         S[672]         1330         309.5         1177         S[706]         854         309.5         1211         DMY         378         309.5           1144         S[673]         1316         184.5         1178         S[707]         840         184.5         1212         DMY         364         184.5           1145         S[674]         1302         309.5         1179         S[708]         826         309.5         1213         DMY         350         309.5           1146         S[675]         1288         184.5         1180         S[709]         812         184.5         1214         DMY         336         184.5           1147         S[676]         1274         309.5         1181         S[710]         798         309.5         1215         DMY         322         309.5           1148         S[677]         1260         184.5         1182         S[711]         784         184.5         1216         DMY         308         184.5           1149         S[678]         1246         309.5         1183         S[712]         770         309.5         1217         DMY         294         309.5  | 1141 | S[670]   | 1358 | 309.5 | 1175 | S[704]   | 882  | 309.5 | 1209 | DMY      | 406 | 309.5 |
| 1144         S[673]         1316         184.5         1178         S[707]         840         184.5         1212         DMY         364         184.5           1145         S[674]         1302         309.5         1179         S[708]         826         309.5         1213         DMY         350         309.5           1146         S[675]         1288         184.5         1180         S[709]         812         184.5         1214         DMY         336         184.5           1147         S[676]         1274         309.5         1181         S[710]         798         309.5         1215         DMY         322         309.5           1148         S[677]         1260         184.5         1182         S[711]         784         184.5         1216         DMY         308         184.5           1149         S[678]         1246         309.5         1183         S[712]         770         309.5         1217         DMY         294         309.5  | 1142 | S[671]   | 1344 | 184.5 | 1176 | S[705]   | 868  | 184.5 | 1210 | DMY      | 392 | 184.5 |
| 1145         S[674]         1302         309.5         1179         S[708]         826         309.5         1213         DMY         350         309.5           1146         S[675]         1288         184.5         1180         S[709]         812         184.5         1214         DMY         336         184.5           1147         S[676]         1274         309.5         1181         S[710]         798         309.5         1215         DMY         322         309.5           1148         S[677]         1260         184.5         1182         S[711]         784         184.5         1216         DMY         308         184.5           1149         S[678]         1246         309.5         1183         S[712]         770         309.5         1217         DMY         294         309.5  | 1143 | S[672]   | 1330 | 309.5 | 1177 | S[706]   | 854  | 309.5 | 1211 | DMY      | 378 | 309.5 |
| 1146     S[675]     1288     184.5     1180     S[709]     812     184.5     1214     DMY     336     184.5       1147     S[676]     1274     309.5     1181     S[710]     798     309.5     1215     DMY     322     309.5       1148     S[677]     1260     184.5     1182     S[711]     784     184.5     1216     DMY     308     184.5       1149     S[678]     1246     309.5     1183     S[712]     770     309.5     1217     DMY     294     309.5  | 1144 | S[673]   | 1316 | 184.5 | 1178 | S[707]   | 840  | 184.5 | 1212 | DMY      | 364 | 184.5 |
| 1147         S[676]         1274         309.5         1181         S[710]         798         309.5         1215         DMY         322         309.5           1148         S[677]         1260         184.5         1182         S[711]         784         184.5         1216         DMY         308         184.5           1149         S[678]         1246         309.5         1183         S[712]         770         309.5         1217         DMY         294         309.5  | 1145 | S[674]   | 1302 | 309.5 | 1179 | S[708]   | 826  | 309.5 | 1213 | DMY      | 350 | 309.5 |
| 1148     S[677]     1260     184.5     1182     S[711]     784     184.5     1216     DMY     308     184.5       1149     S[678]     1246     309.5     1183     S[712]     770     309.5     1217     DMY     294     309.5  | 1146 | S[675]   | 1288 | 184.5 | 1180 | S[709]   | 812  | 184.5 | 1214 | DMY      | 336 | 184.5 |
| 1149 S[678] 1246 309.5 1183 S[712] 770 309.5 1217 DMY 294 309.5  | 1147 | S[676]   | 1274 | 309.5 | 1181 | S[710]   | 798  | 309.5 | 1215 | DMY      | 322 | 309.5 |
|  | 1148 | S[677]   | 1260 | 184.5 | 1182 | S[711]   | 784  | 184.5 | 1216 | DMY      | 308 | 184.5 |
| 1150 S[679] 1232 184.5 1184 S[713] 756 184.5 1218 DMY 280 184.5  | 1149 | S[678]   | 1246 | 309.5 | 1183 | S[712]   | 770  | 309.5 | 1217 | DMY      | 294 | 309.5 |
|  | 1150 | S[679]   | 1232 | 184.5 | 1184 | S[713]   | 756  | 184.5 | 1218 | DMY      | 280 | 184.5 |

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| PAD<br>No. | PIN Name | х    | Y     | PAD<br>No. | PIN Name | х    | Υ     | PAD<br>No. | PIN Name | х     | Υ     |
|------------|----------|------|-------|------------|----------|------|-------|------------|----------|-------|-------|
| 1219       | DMY      | 266  | 309.5 | 1253       | S[733]   | -210 | 309.5 | 1287       | S[767]   | -686  | 309.5 |
| 1220       | DMY      | 252  | 184.5 | 1254       | S[734]   | -224 | 184.5 | 1288       | S[768]   | -700  | 184.5 |
| 1221       | DMY      | 238  | 309.5 | 1255       | S[735]   | -238 | 309.5 | 1289       | S[769]   | -714  | 309.5 |
| 1222       | DMY      | 224  | 184.5 | 1256       | S[736]   | -252 | 184.5 | 1290       | S[770]   | -728  | 184.5 |
| 1223       | DMY      | 210  | 309.5 | 1257       | S[737]   | -266 | 309.5 | 1291       | S[771]   | -742  | 309.5 |
| 1224       | DMY      | 196  | 184.5 | 1258       | S[738]   | -280 | 184.5 | 1292       | S[772]   | -756  | 184.5 |
| 1225       | DMY      | 182  | 309.5 | 1259       | S[739]   | -294 | 309.5 | 1293       | S[773]   | -770  | 309.5 |
| 1226       | DMY      | 168  | 184.5 | 1260       | S[740]   | -308 | 184.5 | 1294       | S[774]   | -784  | 184.5 |
| 1227       | DMY      | 154  | 309.5 | 1261       | S[741]   | -322 | 309.5 | 1295       | S[775]   | -798  | 309.5 |
| 1228       | DMY      | 140  | 184.5 | 1262       | S[742]   | -336 | 184.5 | 1296       | S[776]   | -812  | 184.5 |
| 1229       | DMY      | 126  | 309.5 | 1263       | S[743]   | -350 | 309.5 | 1297       | S[777]   | -826  | 309.5 |
| 1230       | DMY      | 112  | 184.5 | 1264       | S[744]   | -364 | 184.5 | 1298       | S[778]   | -840  | 184.5 |
| 1231       | DMY      | 98   | 309.5 | 1265       | S[745]   | -378 | 309.5 | 1299       | S[779]   | -854  | 309.5 |
| 1232       | DMY      | 84   | 184.5 | 1266       | S[746]   | -392 | 184.5 | 1300       | S[780]   | -868  | 184.5 |
| 1233       | DMY      | 70   | 309.5 | 1267       | S[747]   | -406 | 309.5 | 1301       | S[781]   | -882  | 309.5 |
| 1234       | DMY      | 56   | 184.5 | 1268       | S[748]   | -420 | 184.5 | 1302       | S[782]   | -896  | 184.5 |
| 1235       | DMY      | 42   | 309.5 | 1269       | S[749]   | -434 | 309.5 | 1303       | S[783]   | -910  | 309.5 |
| 1236       | DMY      | 28   | 184.5 | 1270       | S[750]   | -448 | 184.5 | 1304       | S[784]   | -924  | 184.5 |
| 1237       | DMY      | 14   | 309.5 | 1271       | S[751]   | -462 | 309.5 | 1305       | S[785]   | -938  | 309.5 |
| 1238       | DMY      | 0    | 184.5 | 1272       | S[752]   | -476 | 184.5 | 1306       | S[786]   | -952  | 184.5 |
| 1239       | DMY      | -14  | 309.5 | 1273       | S[753]   | -490 | 309.5 | 1307       | S[787]   | -966  | 309.5 |
| 1240       | DMY      | -28  | 184.5 | 1274       | S[754]   | -504 | 184.5 | 1308       | S[788]   | -980  | 184.5 |
| 1241       | S[721]   | -42  | 309.5 | 1275       | S[755]   | -518 | 309.5 | 1309       | S[789]   | -994  | 309.5 |
| 1242       | S[722]   | -56  | 184.5 | 1276       | S[756]   | -532 | 184.5 | 1310       | S[790]   | -1008 | 184.5 |
| 1243       | S[723]   | -70  | 309.5 | 1277       | S[757]   | -546 | 309.5 | 1311       | S[791]   | -1022 | 309.5 |
| 1244       | S[724]   | -84  | 184.5 | 1278       | S[758]   | -560 | 184.5 | 1312       | S[792]   | -1036 | 184.5 |
| 1245       | S[725]   | -98  | 309.5 | 1279       | S[759]   | -574 | 309.5 | 1313       | S[793]   | -1050 | 309.5 |
| 1246       | S[726]   | -112 | 184.5 | 1280       | S[760]   | -588 | 184.5 | 1314       | S[794]   | -1064 | 184.5 |
| 1247       | S[727]   | -126 | 309.5 | 1281       | S[761]   | -602 | 309.5 | 1315       | S[795]   | -1078 | 309.5 |
| 1248       | S[728]   | -140 | 184.5 | 1282       | S[762]   | -616 | 184.5 | 1316       | S[796]   | -1092 | 184.5 |
| 1249       | S[729]   | -154 | 309.5 | 1283       | S[763]   | -630 | 309.5 | 1317       | S[797]   | -1106 | 309.5 |
| 1250       | S[730]   | -168 | 184.5 | 1284       | S[764]   | -644 | 184.5 | 1318       | S[798]   | -1120 | 184.5 |
| 1251       | S[731]   | -182 | 309.5 | 1285       | S[765]   | -658 | 309.5 | 1319       | S[799]   | -1134 | 309.5 |
| 1252       | S[732]   | -196 | 184.5 | 1286       | S[766]   | -672 | 184.5 | 1320       | S[800]   | -1148 | 184.5 |
|            |          |      |       |            |          |      |       | _          | _        |       |       |

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| PAD (No.)         PIN Name (No.)         PAD (1988)         PAD   |      |          |       |       |      |          |       |       |      |          |       |       |
|--|------|----------|-------|-------|------|----------|-------|-------|------|----------|-------|-------|
| 1322         Signacij        1176         184.5         1366         Signacij        1652         184.5         1390         Signacij        2128         184.5           1323         Signacij        1190         309.5         1357         Signacij        1666         309.5         1391         Signacij         -2142         309.5           1324         Signacij        1204         184.5         1358         Signacij         -1660         184.5         1392         Signacij         -2156         184.5           1326         Signacij         -1218         309.5         1361         Signacij         -1644         309.5         1333         Signacij         -2160         184.5         1360         Signacij         -1644         309.5         1361         Signacij         -1736         184.5         1365         Signacij         -1218         309.5         1361         Signacij         -1736         184.5         1365         Signacij         -1218         309.5         1365         Signacij         -1218         146.5         1362         Signacij         -1736         184.5         1365         Signacij         -1736         184.5         1362         Signacij         -1736         184.5 <th></th> <th>PIN Name</th> <th>х</th> <th>Y</th> <th></th> <th>PIN Name</th> <th>х</th> <th>Y</th> <th></th> <th>PIN Name</th> <th>х</th> <th>Υ</th>  |      | PIN Name | х     | Y     |      | PIN Name | х     | Y     |      | PIN Name | х     | Υ     |
| 1923   S 803    -1190   309.5   1357   S 837    -1666   309.5   1391   S 871   -2142   309.5   1324   S 804    -1204   184.5   1398   S 839    -1680   184.5   1392   S 872   -2156   184.5   1325   S 805    -1218   309.5   1359   S 839    -1694   309.5   1393   S 873    -2170   309.5   1326   S 806    -1232   184.5   1380   S 841    -1722   309.5   1395   S 873    -2170   309.5   1326   S 806    -1232   184.5   1380   S 841    -1722   309.5   1395   S 875    -2198   309.5   1328   S 809    -1260   184.5   1362   S 842    -1736   184.5   1396   S 877    -2212   184.5   1329   S 809    -1274   309.5   1363   S 843    -1776   309.5   1397   S 877    -2226   184.5   1330   S 810    -1288   184.5   1384   S 844    -1784   184.5   1386   S 878    -2240   184.5   1331   S 811    -1302   309.5   1365   S 843    -1778   309.5   1399   S 879    -2246   309.5   1332   S 813    -1330   309.5   1365   S 845    -1778   309.5   1399   S 879    -2246   309.5   1332   S 813    -1330   309.5   1367   S 847    -1806   309.5   1401   S 881    -2282   309.5   1333   S 813    -1330   309.5   1367   S 847    -1806   309.5   1401   S 881    -2282   309.5   1338   S 813    -1330   309.5   1367   S 847    -1806   309.5   1401   S 881    -2282   309.5   1338   S 813    -1330   309.5   1367   S 847    -1806   309.5   1401   S 881    -2282   309.5   1338   S 813    -1338   309.5   1369   S 849    -1834   309.5   1400   S 880    -2310   309.5   1338   S 813    -1338   309.5   1369   S 849    -1834   309.5   1405   S 882    -2286   184.5   1339   S 819    -1448   1345   1376   S 851    -1862   309.5   1405   S 882    -2286   184.5   1339   S 813    -1338   S 813    -1338   S 813    -1309   S 814    -1344   309.5   1376   S 851    -1862   309.5   1405   S 888    -2338   309.5   1338   S 813    -1400   S 880    -2338   309.5   1338   S 813    -1400   S 880    -2338   309.5   1339   S 813    -1400   S 880    -2344   309.5   1338   S 813    -1400   S 880    -2346   309.5   309.5   309.5   309.5   309.5   309.5   309.5   309.5   309.5   309.5    | 1321 | S[801]   | -1162 | 309.5 | 1355 | S[835]   | -1638 | 309.5 | 1389 | S[869]   | -2114 | 309.5 |
| 1324         S(804)         -1204         194.5         1398         S(838)         -1680         194.5         1392         S(872)         -2156         184.5           1325         S(805)         -1218         309.5         1359         S(839)         -1694         309.5         1393         S(873)         -2170         309.5           1326         S(806)         -1232         184.5         1360         S(841)         -1708         184.5         1394         S(874)         -2184         184.5           1328         S(806)         -1260         184.5         1362         S(841)         -1722         309.5         1396         S(876)         -2212         184.5           1329         S(809)         -1274         309.5         1363         S(841)         -1760         194.5         1396         S(876)         -2212         184.5           1330         S(810)         -1288         194.5         1368         S(841)         -1776         309.5         1397         S(879)         -2224         184.5           1331         S(811)         -1310         184.5         1368         S(841)         -1779         309.5         1399         S(879)         -2224  | 1322 | S[802]   | -1176 | 184.5 | 1356 | S[836]   | -1652 | 184.5 | 1390 | S[870]   | -2128 | 184.5 |
| 1325         S(805)         -1218         309.5         1359         S(839)         -1694         309.5         1393         S(873)         -2:70         309.5           1326         S(806)         -1232         184.5         1360         S(840)         -1708         184.5         1394         S(874)         -2:164         184.5           1327         S(807)         -1246         309.5         1361         S(841)         -1722         309.5         1395         S(875)         -2:198         309.5           1328         S(808)         -1274         309.5         1363         S(841)         -1750         309.5         1397         S(877)         -2:226         309.5           1330         S(810)         -1288         194.5         1364         S(844)         -1764         194.5         1398         S(878)         -2226         309.5           1331         S(811)         -13102         309.5         1368         S(846)         -1779         309.5         1399         S(879)         -2254         309.5           1332         S(811)         -1316         194.5         1368         S(846)         -1779         184.5         1400         S(880)         -2226  | 1323 | S[803]   | -1190 | 309.5 | 1357 | S[837]   | -1666 | 309.5 | 1391 | S[871]   | -2142 | 309.5 |
| 1326         S[606]         -1232         184.5         1360         S[840]         -1708         184.5         1394         S[874]         -2184         184.5           1327         S[607]         -1246         309.5         1361         S[841]         -1722         309.5         1395         S[876]         -2188         309.5           1328         S[808]         -1260         184.5         1362         S[842]         -1736         184.5         1396         S[876]         -2212         184.5           1330         S[809]         -1274         309.5         1363         S[843]         -1764         184.5         1398         S[876]         -2240         184.5           1331         S[811]         -1302         309.5         1366         S[846]         -1778         309.5         1398         S[877]         -2254         309.5           1332         S[812]         -1316         184.5         1366         S[846]         -1772         184.5         1400         S[880]         -2262         309.5           1333         S[813]         -1330         309.5         1367         S[841]         -1800         909.5         1401         S[881]         -2262  | 1324 | S[804]   | -1204 | 184.5 | 1358 | S[838]   | -1680 | 184.5 | 1392 | S[872]   | -2156 | 184.5 |
| 1327         S[807]         .1246         309.5         1361         S[841]         .1722         309.5         1395         S[875]         .2198         309.5           1328         S[808]         .1260         184.5         1362         S[842]         .1736         184.5         1396         S[876]         .2212         184.5           1329         S[809]         .1274         309.5         1363         S[843]         .1750         309.5         1397         S[877]         .2226         309.5           1330         S[810]         .1288         184.5         1364         S[844]         .1764         184.5         1398         S[878]         .2240         184.5           1331         S[811]         .1302         309.5         1366         S[846]         .1778         309.5         1399         S[879]         .2254         309.5           1332         S[812]         .1316         184.5         1366         S[846]         .1779         184.5         1400         S[880]         .2228         309.5           1333         S[813]         .1330         309.5         1368         S[848]         .1820         1402         S[822]         .2226         184.5  | 1325 | S[805]   | -1218 | 309.5 | 1359 | S[839]   | -1694 | 309.5 | 1393 | S[873]   | -2170 | 309.5 |
| 1328         S[609]         -1260         184.5         1362         S[842]         -1736         184.5         1396         S[876]         -2212         184.5           1329         S[609]         -1274         309.5         1363         S[843]         -1750         309.5         1397         S[877]         -2226         309.5           1330         S[810]         -1288         184.5         1364         S[844]         -1764         184.5         1398         S[878]         -2240         184.5           1331         S[811]         -1302         309.5         1365         S[846]         -1772         184.5         1400         S[800]         -2268         184.5           1332         S[812]         -1316         184.5         1366         S[846]         -1792         184.5         1400         S[801]         -2226         309.5           1333         S[813]         -1330         309.5         1367         S[847]         -1866         309.5         1401         S[801]         -2226         309.5           1333         S[816]         -1374         184.5         148.0         -184.5         1402         S[823]         -2310         309.5           133   | 1326 | S[806]   | -1232 | 184.5 | 1360 | S[840]   | -1708 | 184.5 | 1394 | S[874]   | -2184 | 184.5 |
| 1329         Sig09j         -1274         309.5         1363         Sig43j         -1750         309.5         1397         Sig87j         -2226         309.5           1330         Sig10j         -1288         184.5         1364         Sig44j         -1764         184.5         1398         Sig78j         -2240         184.5           1331         Sig11j         -1302         309.5         1365         Sig46j         -1772         184.5         1400         Sig80j         -2264         309.5           1332         Sig12j         -1316         184.5         1366         Sig46j         -1792         184.5         1400         Sig80j         -2268         184.5           1333         Sig13j         -1330         309.5         1367         Sig84j         -1860         309.5         1401         Sig81j         -2226         309.5           1334         Sig16j         -1374         184.5         1368         Sig84j         -1820         184.5         1402         Sig82j         -2236         184.5           1335         Sig16j         -1372         184.5         1370         Sig85j         -184.5         1404         Sig84j         -2322         184.5   | 1327 | S[807]   | -1246 | 309.5 | 1361 | S[841]   | -1722 | 309.5 | 1395 | S[875]   | -2198 | 309.5 |
| 1330         S[810]         -1288         184.5         1364         S[844]         -1764         184.5         1398         S[878]         -2240         184.5           1331         S[811]         -1302         309.5         1365         S[846]         -1778         309.5         1399         S[879]         -2254         309.5           1332         S[812]         -1316         184.5         1366         S[846]         -1792         184.5         1400         S[880]         -2288         184.5           1333         S[813]         -1330         309.5         1368         S[846]         -1820         184.5         1402         S[882]         -2296         184.5           1335         S[816]         -1338         309.5         1369         S[849]         -1834         309.5         1403         S[883]         -2310         309.5           1336         S[816]         -1372         184.5         1370         S[850]         -1848         184.5         1404         S[884]         -2226         184.5           1337         S[817]         -1386         309.5         1371         S[851]         -1862         309.5         1405         S[884]         -2222  | 1328 | S[808]   | -1260 | 184.5 | 1362 | S[842]   | -1736 | 184.5 | 1396 | S[876]   | -2212 | 184.5 |
| 1331   S[811]   -1302   309.5   1365   S[846]   -1778   309.5   1399   S[879]   -2254   309.5   1332   S[812]   -1316   184.5   1366   S[846]   -1792   184.5   1400   S[880]   -2268   184.5   1333   S[813]   -1330   309.5   1367   S[847]   -1806   309.5   1401   S[881]   -2282   309.5   1334   S[814]   -1344   184.5   1368   S[848]   -1820   184.5   1402   S[882]   -2296   184.5   1335   S[815]   -1336   309.5   1369   S[849]   -1834   309.5   1403   S[883]   -2310   309.5   1336   S[816]   -1372   184.5   1370   S[850]   -1848   184.5   1404   S[884]   -2324   184.5   1337   S[817]   -1386   309.5   1371   S[851]   -1862   309.5   1405   S[885]   -2338   309.5   1338   S[818]   -1400   184.5   1372   S[852]   -1876   184.5   1406   S[886]   -2352   184.5   1339   S[819]   -1414   309.5   1373   S[853]   -1890   309.5   1407   S[887]   -2366   309.5   1341   S[820]   -1428   184.5   1374   S[854]   -1904   184.5   1408   S[888]   -2380   184.5   1344   S[821]   -1446   184.5   1376   S[855]   -1918   309.5   1410   S[890]   -2408   184.5   1344   S[823]   -1470   309.5   1377   S[857]   -1946   309.5   1411   S[891]   -2422   309.5   1344   S[823]   -1448   184.5   1378   S[859]   -1946   309.5   1411   S[891]   -2422   309.5   1344   S[823]   -1448   184.5   1378   S[859]   -1946   184.5   1410   S[89]   -2436   184.5   1344   S[826]   -1512   184.5   1380   S[860]   -1988   184.5   1414   S[89]   -2428   309.5   1344   S[827]   -1526   309.5   1381   S[861]   -2002   309.5   1417   S[89]   -2448   309.5   1381   S[861]   -2002   309.5   1417   S[89]   -2428   309.5   1345   S[828]   -1540   184.5   1382   S[862]   -2016   184.5   1416   S[89]   -2450   309.5   1345   S[829]   -1554   309.5   1383   S[863]   -2004   184.5   1416   S[89]   -2450   309.5   1345   S[829]   -1554   309.5   1383   S[863]   -2004   184.5   1416   S[89]   -2250   184.5   1350   S[831]   -1568   184.5   1384   S[866]   -2024   184.5   1418   S[89]   -2520   184.5   1350   S[833]   -1560   184.5   1366   S[866]   -2024   184.5   1418 | 1329 | S[809]   | -1274 | 309.5 | 1363 | S[843]   | -1750 | 309.5 | 1397 | S[877]   | -2226 | 309.5 |
| 1332   S[812]   -1316   184.5   1366   S[846]   -1792   184.5   1400   S[880]   -2268   184.5     1333   S[813]   -1330   309.5   1367   S[847]   -1806   309.5   1401   S[881]   -2282   309.5     1334   S[814]   -1344   184.5   1368   S[848]   -1820   184.5   1402   S[882]   -2296   184.5     1335   S[815]   -1358   309.5   1369   S[849]   -1834   309.5   1403   S[883]   -2310   309.5     1336   S[816]   -1372   184.5   1370   S[850]   -1848   184.5   1404   S[884]   -2324   184.5     1337   S[817]   -1386   309.5   1371   S[851]   -1862   309.5   1405   S[865]   -2338   309.5     1338   S[818]   -1400   184.5   1372   S[852]   -1876   184.5   1406   S[866]   -2352   184.5     1339   S[819]   -1414   309.5   1373   S[853]   -1890   309.5   1407   S[887]   -2366   309.5     1340   S[820]   -1428   184.5   1374   S[854]   -1904   184.5   1408   S[888]   -2380   184.5     1341   S[821]   -1442   309.5   1375   S[855]   -1918   309.5   1409   S[889]   -2394   309.5     1342   S[822]   -1456   184.5   1376   S[856]   -1932   184.5   1410   S[890]   -2408   184.5     1343   S[823]   -1470   309.5   1377   S[857]   -1946   309.5   1411   S[891]   -2422   309.5     1344   S[824]   -1484   184.5   1376   S[859]   -1960   184.5   1412   S[892]   -2436   184.5     1343   S[823]   -1470   309.5   1379   S[859]   -1974   309.5   1411   S[891]   -2422   309.5     1344   S[826]   -1512   184.5   1380   S[869]   -1960   184.5   1416   S[896]   -2492   184.5     1348   S[828]   -1540   184.5   1380   S[860]   -1988   184.5   1416   S[896]   -2492   184.5     1349   S[829]   -1554   309.5   1381   S[861]   -2002   309.5   1417   S[897]   -2506   309.5     1348   S[828]   -1568   184.5   1384   S[864]   -2044   184.5   1416   S[896]   -2492   184.5     1349   S[829]   -1554   309.5   1383   S[863]   -2030   309.5   1417   S[897]   -2506   309.5     1350   S[831]   -1560   184.5   1386   S[866]   -2072   184.5   1420   S[900]   -2548   184.5     1351   S[831]   -1560   184.5   1386   S[866]   -2072   184.5   1420   S[900]   -258 | 1330 | S[810]   | -1288 | 184.5 | 1364 | S[844]   | -1764 | 184.5 | 1398 | S[878]   | -2240 | 184.5 |
| 1333         S[813]         -1330         309.5         1367         S[847]         -1806         309.5         1401         S[881]         -2282         309.5           1334         S[814]         -1344         184.5         1368         S[648]         -1820         184.5         1402         S[882]         -2296         184.5           1335         S[815]         -1358         309.5         1369         S[849]         -1834         309.5         1403         S[883]         -2310         309.5           1336         S[816]         -1372         184.5         1370         S[850]         -1848         184.5         1404         S[884]         -2324         184.5           1337         S[817]         -1386         309.5         1371         S[851]         -1862         309.5         1405         S[885]         -2338         309.5           1338         S[818]         -1400         184.5         1372         S[852]         -1876         184.5         1406         S[886]         -2352         184.5           1339         S[819]         -1414         309.5         1373         S[853]         -1890         309.5         1407         S[887]         -2366  | 1331 | S[811]   | -1302 | 309.5 | 1365 | S[845]   | -1778 | 309.5 | 1399 | S[879]   | -2254 | 309.5 |
| 1334   S[814]   -1344   184.5   1368   S[648]   -1820   184.5   1402   S[882]   -2296   184.5     1335   S[815]   -1358   309.5   1369   S[849]   -1834   309.5   1403   S[883]   -2310   309.5     1336   S[816]   -1372   184.5   1370   S[850]   -1848   184.5   1404   S[884]   -2324   184.5     1337   S[817]   -1386   309.5   1371   S[851]   -1862   309.5   1405   S[885]   -2338   309.5     1338   S[818]   -1400   184.5   1372   S[852]   -1876   184.5   1406   S[886]   -2352   184.5     1339   S[819]   -1414   309.5   1373   S[853]   -1890   309.5   1407   S[887]   -2366   309.5     1340   S[820]   -1428   184.5   1374   S[854]   -1904   184.5   1408   S[888]   -2380   184.5     1341   S[821]   -1442   309.5   1375   S[855]   -1918   309.5   1409   S[889]   -2394   309.5     1342   S[822]   -1456   184.5   1376   S[856]   -1932   184.5   1410   S[890]   -2408   184.5     1343   S[823]   -1470   309.5   1377   S[857]   -1946   309.5   1411   S[891]   -2422   309.5     1344   S[824]   -1484   184.5   1378   S[858]   -1960   184.5   1412   S[892]   -2436   184.5     1345   S[825]   -1488   309.5   1379   S[859]   -1974   309.5   1413   S[893]   -2450   309.5     1346   S[826]   -1512   184.5   1380   S[860]   -1988   184.5   1414   S[894]   -2464   184.5     1347   S[827]   -1526   309.5   1381   S[861]   -2002   309.5   1415   S[896]   -2478   309.5     1348   S[828]   -1540   184.5   1382   S[862]   -2016   184.5   1416   S[896]   -2422   184.5     1349   S[829]   -1554   309.5   1383   S[863]   -2000   309.5   1417   S[897]   -2506   309.5     1350   S[830]   -1568   184.5   1384   S[864]   -2044   184.5   1418   S[898]   -2520   184.5     1351   S[831]   -1582   309.5   1383   S[863]   -2036   309.5   1417   S[897]   -2566   309.5     1352   S[832]   -1596   184.5   1386   S[866]   -2072   184.5   1420   S[900]   -2548   184.5     1353   S[831]   -1610   309.5   1387   S[867]   -2086   309.5   1417   S[907]   -2566   309.5     1353   S[833]   -1610   309.5   1387   S[867]   -2086   309.5   1417   S[907]   -254 | 1332 | S[812]   | -1316 | 184.5 | 1366 | S[846]   | -1792 | 184.5 | 1400 | S[880]   | -2268 | 184.5 |
| 1335   S[815]   -1358   309.5   1369   S[849]   -1834   309.5   1403   S[883]   -2310   309.5     1336   S[816]   -1372   184.5   1370   S[850]   -1848   184.5   1404   S[884]   -2324   184.5     1337   S[817]   -1386   309.5   1371   S[851]   -1862   309.5   1405   S[885]   -2338   309.5     1338   S[818]   -1400   184.5   1372   S[852]   -1876   184.5   1406   S[886]   -2352   184.5     1339   S[819]   -1414   309.5   1373   S[853]   -1890   309.5   1407   S[887]   -2366   309.5     1340   S[820]   -1428   184.5   1374   S[854]   -1904   184.5   1408   S[888]   -2380   184.5     1341   S[821]   -1442   309.5   1375   S[855]   -1918   309.5   1409   S[889]   -2394   309.5     1342   S[822]   -1456   184.5   1376   S[856]   -1932   184.5   1410   S[890]   -2408   184.5     1343   S[823]   -1470   309.5   1377   S[857]   -1946   309.5   1411   S[891]   -2422   309.5     1344   S[824]   -1484   184.5   1378   S[858]   -1960   184.5   1412   S[892]   -2436   184.5     1345   S[825]   -1498   309.5   1379   S[859]   -1974   309.5   1413   S[893]   -2450   309.5     1346   S[826]   -1512   184.5   1380   S[861]   -2002   309.5   1415   S[895]   -2478   309.5     1348   S[828]   -1540   184.5   1382   S[862]   -2016   184.5   1416   S[896]   -2492   184.5     1350   S[830]   -1568   184.5   1386   S[863]   -2030   309.5   1417   S[897]   -2506   309.5     1351   S[831]   -1582   309.5   1385   S[863]   -2030   309.5   1419   S[899]   -2534   309.5     1352   S[832]   -1596   184.5   1386   S[866]   -2072   184.5   1420   S[900]   -2548   184.5     1353   S[833]   -1610   309.5   1387   S[867]   -2086   309.5   1421   S[901]   -2562   309.5     1353   S[833]   -1610   309.5   1387   S[867]   -2086   309.5   1421   S[901]   -2562   309.5     1353   S[833]   -1610   309.5   1387   S[867]   -2086   309.5   1421   S[901]   -2562   309.5     1353   S[833]   -1610   309.5   1387   S[867]   -2086   309.5   1421   S[901]   -2562   309.5     1353   S[833]   -1610   309.5   1387   S[867]   -2086   309.5   1421   S[901]   -256 | 1333 | S[813]   | -1330 | 309.5 | 1367 | S[847]   | -1806 | 309.5 | 1401 | S[881]   | -2282 | 309.5 |
| 1336   S[816]   -1372   184.5   1370   S[850]   -1848   184.5   1404   S[884]   -2324   184.5     1337   S[817]   -1386   309.5   1371   S[851]   -1862   309.5   1405   S[885]   -2338   309.5     1338   S[818]   -1400   184.5   1372   S[852]   -1876   184.5   1406   S[886]   -2352   184.5     1339   S[819]   -1414   309.5   1373   S[853]   -1890   309.5   1407   S[887]   -2366   309.5     1340   S[820]   -1428   184.5   1374   S[854]   -1904   184.5   1408   S[888]   -2390   184.5     1341   S[821]   -1442   309.5   1375   S[855]   -1918   309.5   1409   S[889]   -2394   309.5     1342   S[822]   -1456   184.5   1376   S[856]   -1932   184.5   1410   S[890]   -2408   184.5     1343   S[823]   -1470   309.5   1377   S[857]   -1946   309.5   1411   S[891]   -2422   309.5     1344   S[824]   -1484   184.5   1378   S[858]   -1960   184.5   1412   S[892]   -2436   184.5     1345   S[825]   -1498   309.5   1379   S[859]   -1974   309.5   1413   S[893]   -2450   309.5     1346   S[826]   -1512   184.5   1380   S[860]   -1988   184.5   1414   S[894]   -2464   184.5     1347   S[827]   -1526   309.5   1381   S[861]   -2002   309.5   1415   S[895]   -2478   309.5     1348   S[828]   -1540   184.5   1382   S[862]   -2016   184.5   1416   S[896]   -2492   184.5     1350   S[830]   -1568   184.5   1384   S[864]   -2044   184.5   1418   S[898]   -2520   184.5     1351   S[831]   -1582   309.5   1385   S[866]   -2072   184.5   1419   S[899]   -2534   309.5     1352   S[832]   -1596   184.5   1386   S[866]   -2072   184.5   1420   S[900]   -2548   184.5     1353   S[833]   -1610   309.5   1387   S[867]   -2086   309.5   1419   S[899]   -2534   309.5     1353   S[833]   -1610   309.5   1387   S[867]   -2086   309.5   1419   S[899]   -2548   184.5     1353   S[833]   -1610   309.5   1387   S[867]   -2086   309.5   1420   S[900]   -2548   184.5     1353   S[833]   -1610   309.5   1387   S[867]   -2086   309.5   1421   S[901]   -2562   309.5     1353   S[833]   -1610   309.5   1387   S[867]   -2086   309.5   1421   S[901]   -256 | 1334 | S[814]   | -1344 | 184.5 | 1368 | S[848]   | -1820 | 184.5 | 1402 | S[882]   | -2296 | 184.5 |
| 1337   S[817]   -1386   309.5   1371   S[851]   -1862   309.5   1405   S[885]   -2338   309.5     1338   S[818]   -1400   184.5   1372   S[852]   -1876   184.5   1406   S[886]   -2352   184.5     1339   S[819]   -1414   309.5   1373   S[853]   -1890   309.5   1407   S[887]   -2366   309.5     1340   S[820]   -1428   184.5   1374   S[854]   -1904   184.5   1408   S[888]   -2380   184.5     1341   S[821]   -1442   309.5   1375   S[855]   -1918   309.5   1409   S[889]   -2394   309.5     1342   S[822]   -1456   184.5   1376   S[856]   -1932   184.5   1410   S[890]   -2408   184.5     1343   S[823]   -1470   309.5   1377   S[857]   -1946   309.5   1411   S[891]   -2422   309.5     1344   S[824]   -1484   184.5   1378   S[858]   -1960   184.5   1412   S[892]   -2436   184.5     1345   S[825]   -1498   309.5   1379   S[859]   -1974   309.5   1413   S[893]   -2450   309.5     1346   S[826]   -1512   184.5   1380   S[860]   -1988   184.5   1414   S[894]   -2464   184.5     1347   S[827]   -1526   309.5   1381   S[861]   -2002   309.5   1415   S[895]   -2478   309.5     1348   S[828]   -1540   184.5   1382   S[862]   -2016   184.5   1416   S[896]   -2492   184.5     1350   S[830]   -1568   184.5   1384   S[864]   -2044   184.5   1418   S[898]   -2520   184.5     1351   S[831]   -1562   309.5   1385   S[865]   -2058   309.5   1419   S[899]   -2534   309.5     1352   S[832]   -1596   184.5   1386   S[866]   -2072   184.5   1420   S[900]   -2548   184.5     1353   S[833]   -1610   309.5   1387   S[867]   -2086   309.5   1421   S[901]   -2562   309.5     1353   S[833]   -1610   309.5   1387   S[867]   -2086   309.5   1421   S[901]   -2562   309.5     1353   S[833]   -1610   309.5   1387   S[867]   -2086   309.5   1421   S[901]   -2562   309.5     1353   S[833]   -1610   309.5   1387   S[867]   -2086   309.5   1421   S[901]   -2562   309.5     1354   S[833]   -1610   309.5   1387   S[867]   -2086   309.5   1421   S[901]   -2562   309.5     1354   S[833]   -1610   309.5   1387   S[867]   -2086   309.5   1421   S[901]   -256 | 1335 | S[815]   | -1358 | 309.5 | 1369 | S[849]   | -1834 | 309.5 | 1403 | S[883]   | -2310 | 309.5 |
| 1338         S[818]         -1400         184.5         1372         S[852]         -1876         184.5         1406         S[886]         -2352         184.5           1339         S[819]         -1414         309.5         1373         S[853]         -1890         309.5         1407         S[867]         -2366         309.5           1340         S[820]         -1428         184.5         1374         S[854]         -1904         184.5         1408         S[888]         -2390         184.5           1341         S[821]         -1422         309.5         1375         S[856]         -1932         184.5         1409         S[889]         -2394         309.5           1342         S[822]         -1456         184.5         1376         S[856]         -1932         184.5         1410         S[890]         -2408         184.5           1343         S[823]         -1470         309.5         1377         S[857]         -1946         309.5         1411         S[891]         -2422         309.5           1344         S[824]         -1484         184.5         1378         S[859]         -1960         184.5         1412         S[892]         -2436  | 1336 | S[816]   | -1372 | 184.5 | 1370 | S[850]   | -1848 | 184.5 | 1404 | S[884]   | -2324 | 184.5 |
| 1339         S[819]         -1414         309.5         1373         S[853]         -1890         309.5         1407         S[887]         -2366         309.5           1340         S[820]         -1428         184.5         1374         S[854]         -1904         184.5         1408         S[888]         -2380         184.5           1341         S[821]         -1442         309.5         1375         S[855]         -1918         309.5         1409         S[889]         -2394         309.5           1342         S[822]         -1456         184.5         1376         S[856]         -1932         184.5         1410         S[890]         -2408         184.5           1343         S[823]         -1470         309.5         1377         S[857]         -1946         309.5         1411         S[891]         -2422         309.5           1344         S[824]         -1484         184.5         1378         S[858]         -1960         184.5         1412         S[892]         -2436         184.5           1345         S[826]         -1498         309.5         1379         S[859]         -1974         309.5         1413         S[893]         -2450  | 1337 | S[817]   | -1386 | 309.5 | 1371 | S[851]   | -1862 | 309.5 | 1405 | S[885]   | -2338 | 309.5 |
| 1340         S[820]         -1428         184.5         1374         S[854]         -1904         184.5         1408         S[888]         -2380         184.5           1341         S[821]         -1442         309.5         1375         S[855]         -1918         309.5         1409         S[889]         -2394         309.5           1342         S[822]         -1456         184.5         1376         S[856]         -1932         184.5         1410         S[890]         -2408         184.5           1343         S[823]         -1470         309.5         1377         S[857]         -1946         309.5         1411         S[891]         -2422         309.5           1344         S[824]         -1484         184.5         1378         S[858]         -1960         184.5         1412         S[892]         -2436         184.5           1345         S[825]         -1498         309.5         1379         S[858]         -1960         184.5         1412         S[892]         -2436         184.5           1346         S[826]         -1512         184.5         1380         S[860]         -1988         184.5         1414         S[894]         -2464  | 1338 | S[818]   | -1400 | 184.5 | 1372 | S[852]   | -1876 | 184.5 | 1406 | S[886]   | -2352 | 184.5 |
| 1341         S[821]         -1442         309.5         1375         S[855]         -1918         309.5         1409         S[889]         -2394         309.5           1342         S[822]         -1456         184.5         1376         S[856]         -1932         184.5         1410         S[890]         -2408         184.5           1343         S[823]         -1470         309.5         1377         S[857]         -1946         309.5         1411         S[891]         -2422         309.5           1344         S[824]         -1484         184.5         1378         S[858]         -1960         184.5         1412         S[892]         -2436         184.5           1345         S[825]         -1498         309.5         1379         S[859]         -1974         309.5         1413         S[893]         -2450         309.5           1346         S[826]         -1512         184.5         1380         S[860]         -1988         184.5         1414         S[894]         -2464         184.5           1347         S[827]         -1526         309.5         1381         S[861]         -2002         309.5         1415         S[895]         -2478  | 1339 | S[819]   | -1414 | 309.5 | 1373 | S[853]   | -1890 | 309.5 | 1407 | S[887]   | -2366 | 309.5 |
| 1342         S[822]         -1456         184.5         1376         S[856]         -1932         184.5         1410         S[890]         -2408         184.5           1343         S[823]         -1470         309.5         1377         S[857]         -1946         309.5         1411         S[891]         -2422         309.5           1344         S[824]         -1484         184.5         1378         S[858]         -1960         184.5         1412         S[892]         -2436         184.5           1345         S[825]         -1498         309.5         1379         S[859]         -1974         309.5         1413         S[893]         -2450         309.5           1346         S[826]         -1512         184.5         1380         S[860]         -1988         184.5         1414         S[894]         -2464         184.5           1347         S[827]         -1526         309.5         1381         S[861]         -2002         309.5         1415         S[895]         -2478         309.5           1348         S[828]         -1540         184.5         1382         S[862]         -2016         184.5         1416         S[896]         -2492  | 1340 | S[820]   | -1428 | 184.5 | 1374 | S[854]   | -1904 | 184.5 | 1408 | S[888]   | -2380 | 184.5 |
| 1343         S[823]         -1470         309.5         1377         S[857]         -1946         309.5         1411         S[891]         -2422         309.5           1344         S[824]         -1484         184.5         1378         S[858]         -1960         184.5         1412         S[892]         -2436         184.5           1345         S[825]         -1498         309.5         1379         S[859]         -1974         309.5         1413         S[893]         -2450         309.5           1346         S[826]         -1512         184.5         1380         S[860]         -1988         184.5         1414         S[894]         -2464         184.5           1347         S[827]         -1526         309.5         1381         S[861]         -2002         309.5         1415         S[895]         -2478         309.5           1348         S[828]         -1540         184.5         1382         S[862]         -2016         184.5         1416         S[896]         -2492         184.5           1349         S[829]         -1554         309.5         1383         S[863]         -2030         309.5         1417         S[897]         -2506  | 1341 | S[821]   | -1442 | 309.5 | 1375 | S[855]   | -1918 | 309.5 | 1409 | S[889]   | -2394 | 309.5 |
| 1344         S[824]         -1484         184.5         1378         S[858]         -1960         184.5         1412         S[892]         -2436         184.5           1345         S[825]         -1498         309.5         1379         S[859]         -1974         309.5         1413         S[893]         -2450         309.5           1346         S[826]         -1512         184.5         1380         S[860]         -1988         184.5         1414         S[894]         -2464         184.5           1347         S[827]         -1526         309.5         1381         S[861]         -2002         309.5         1415         S[895]         -2478         309.5           1348         S[828]         -1540         184.5         1382         S[862]         -2016         184.5         1416         S[896]         -2492         184.5           1349         S[829]         -1554         309.5         1383         S[863]         -2030         309.5         1417         S[897]         -2506         309.5           1350         S[830]         -1568         184.5         1384         S[864]         -2044         184.5         1418         S[898]         -2520  | 1342 | S[822]   | -1456 | 184.5 | 1376 | S[856]   | -1932 | 184.5 | 1410 | S[890]   | -2408 | 184.5 |
| 1345         S[825]         -1498         309.5         1379         S[859]         -1974         309.5         1413         S[893]         -2450         309.5           1346         S[826]         -1512         184.5         1380         S[860]         -1988         184.5         1414         S[894]         -2464         184.5           1347         S[827]         -1526         309.5         1381         S[861]         -2002         309.5         1415         S[895]         -2478         309.5           1348         S[828]         -1540         184.5         1382         S[862]         -2016         184.5         1416         S[896]         -2492         184.5           1349         S[829]         -1554         309.5         1383         S[863]         -2030         309.5         1417         S[897]         -2506         309.5           1350         S[830]         -1568         184.5         1384         S[864]         -2044         184.5         1418         S[898]         -2520         184.5           1351         S[831]         -1582         309.5         1385         S[865]         -2058         309.5         1419         S[899]         -2534  | 1343 | S[823]   | -1470 | 309.5 | 1377 | S[857]   | -1946 | 309.5 | 1411 | S[891]   | -2422 | 309.5 |
| 1346         S[826]         -1512         184.5         1380         S[860]         -1988         184.5         1414         S[894]         -2464         184.5           1347         S[827]         -1526         309.5         1381         S[861]         -2002         309.5         1415         S[895]         -2478         309.5           1348         S[828]         -1540         184.5         1382         S[862]         -2016         184.5         1416         S[896]         -2492         184.5           1349         S[829]         -1554         309.5         1383         S[863]         -2030         309.5         1417         S[897]         -2506         309.5           1350         S[830]         -1568         184.5         1384         S[864]         -2044         184.5         1418         S[898]         -2520         184.5           1351         S[831]         -1582         309.5         1385         S[865]         -2058         309.5         1419         S[899]         -2534         309.5           1352         S[832]         -1596         184.5         1386         S[866]         -2072         184.5         1420         S[900]         -2548  | 1344 | S[824]   | -1484 | 184.5 | 1378 | S[858]   | -1960 | 184.5 | 1412 | S[892]   | -2436 | 184.5 |
| 1347         S[827]         -1526         309.5         1381         S[861]         -2002         309.5         1415         S[895]         -2478         309.5           1348         S[828]         -1540         184.5         1382         S[862]         -2016         184.5         1416         S[896]         -2492         184.5           1349         S[829]         -1554         309.5         1383         S[863]         -2030         309.5         1417         S[897]         -2506         309.5           1350         S[830]         -1568         184.5         1384         S[864]         -2044         184.5         1418         S[898]         -2520         184.5           1351         S[831]         -1582         309.5         1385         S[865]         -2058         309.5         1419         S[899]         -2534         309.5           1352         S[832]         -1596         184.5         1386         S[866]         -2072         184.5         1420         S[900]         -2548         184.5           1353         S[833]         -1610         309.5         1387         S[867]         -2086         309.5         1421         S[901]         -2562  | 1345 | S[825]   | -1498 | 309.5 | 1379 | S[859]   | -1974 | 309.5 | 1413 | S[893]   | -2450 | 309.5 |
| 1348         S[828]         -1540         184.5         1382         S[862]         -2016         184.5         1416         S[896]         -2492         184.5           1349         S[829]         -1554         309.5         1383         S[863]         -2030         309.5         1417         S[897]         -2506         309.5           1350         S[830]         -1568         184.5         1384         S[864]         -2044         184.5         1418         S[898]         -2520         184.5           1351         S[831]         -1582         309.5         1385         S[865]         -2058         309.5         1419         S[899]         -2534         309.5           1352         S[832]         -1596         184.5         1386         S[866]         -2072         184.5         1420         S[900]         -2548         184.5           1353         S[833]         -1610         309.5         1387         S[867]         -2086         309.5         1421         S[901]         -2562         309.5  | 1346 | S[826]   | -1512 | 184.5 | 1380 | S[860]   | -1988 | 184.5 | 1414 | S[894]   | -2464 | 184.5 |
| 1349         S[829]         -1554         309.5         1383         S[863]         -2030         309.5         1417         S[897]         -2506         309.5           1350         S[830]         -1568         184.5         1384         S[864]         -2044         184.5         1418         S[898]         -2520         184.5           1351         S[831]         -1582         309.5         1385         S[865]         -2058         309.5         1419         S[899]         -2534         309.5           1352         S[832]         -1596         184.5         1386         S[866]         -2072         184.5         1420         S[900]         -2548         184.5           1353         S[833]         -1610         309.5         1387         S[867]         -2086         309.5         1421         S[901]         -2562         309.5  | 1347 | S[827]   | -1526 | 309.5 | 1381 | S[861]   | -2002 | 309.5 | 1415 | S[895]   | -2478 | 309.5 |
| 1350         S[830]         -1568         184.5         1384         S[864]         -2044         184.5         1418         S[898]         -2520         184.5           1351         S[831]         -1582         309.5         1385         S[865]         -2058         309.5         1419         S[899]         -2534         309.5           1352         S[832]         -1596         184.5         1386         S[866]         -2072         184.5         1420         S[900]         -2548         184.5           1353         S[833]         -1610         309.5         1387         S[867]         -2086         309.5         1421         S[901]         -2562         309.5  | 1348 | S[828]   | -1540 | 184.5 | 1382 | S[862]   | -2016 | 184.5 | 1416 | S[896]   | -2492 | 184.5 |
| 1351         S[831]         -1582         309.5         1385         S[865]         -2058         309.5         1419         S[899]         -2534         309.5           1352         S[832]         -1596         184.5         1386         S[866]         -2072         184.5         1420         S[900]         -2548         184.5           1353         S[833]         -1610         309.5         1387         S[867]         -2086         309.5         1421         S[901]         -2562         309.5  | 1349 | S[829]   | -1554 | 309.5 | 1383 | S[863]   | -2030 | 309.5 | 1417 | S[897]   | -2506 | 309.5 |
| 1352     S[832]     -1596     184.5     1386     S[866]     -2072     184.5     1420     S[900]     -2548     184.5       1353     S[833]     -1610     309.5     1387     S[867]     -2086     309.5     1421     S[901]     -2562     309.5  | 1350 | S[830]   | -1568 | 184.5 | 1384 | S[864]   | -2044 | 184.5 | 1418 | S[898]   | -2520 | 184.5 |
| 1353 S[833] -1610 309.5 1387 S[867] -2086 309.5 1421 S[901] -2562 309.5  | 1351 | S[831]   | -1582 | 309.5 | 1385 | S[865]   | -2058 | 309.5 | 1419 | S[899]   | -2534 | 309.5 |
|  | 1352 | S[832]   | -1596 | 184.5 | 1386 | S[866]   | -2072 | 184.5 | 1420 | S[900]   | -2548 | 184.5 |
| 1354 S[834] -1624 184.5 1388 S[868] -2100 184.5 1422 S[902] -2576 184.5  | 1353 | S[833]   | -1610 | 309.5 | 1387 | S[867]   | -2086 | 309.5 | 1421 | S[901]   | -2562 | 309.5 |
|  | 1354 | S[834]   | -1624 | 184.5 | 1388 | S[868]   | -2100 | 184.5 | 1422 | S[902]   | -2576 | 184.5 |

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| PAD   PIN Name   R   |      |          |       |       |      |          |       |       |      |          |       |       |
|--|------|----------|-------|-------|------|----------|-------|-------|------|----------|-------|-------|
| 1424   Signot  |      | PIN Name | х     | Υ     |      | PIN Name | х     | Υ     |      | PIN Name | х     | Υ     |
| 1425   Signost   -2618   309.5   1459   Signost   -3094   309.5   1493   Signost   -3570   309.5   1426   Signost   -2632   184.5   1460   Signost   -3108   184.5   1484   Signost   -3584   184.5   1427   Signost   -2680   184.5   1462   Signost   -3108   184.5   1496   Signost   -3588   309.5   1428   Signost   -2660   184.5   1462   Signost   -3108   184.5   1496   Signost   -3612   184.5   1422   Signost   -2660   184.5   1462   Signost   -3108   184.5   1496   Signost   -3612   184.5   1428   Signost   -2660   184.5   1463   Signost   -3164   184.5   1496   Signost   -3612   184.5   1438   Signost   -3164   184.5   1498   Signost   -3610   184.5   1438   Signost   -3164   184.5   1498   Signost   -3610   184.5   1432   Signost   -2702   309.5   1465   Signost   -3178   309.5   1499   Signost   -3664   309.5   1433   Signost   -2723   309.5   1465   Signost   -3178   309.5   1499   Signost   -3664   309.5   1433   Signost   -2730   309.5   1465   Signost   -3200   309.5   1501   Signost   -3866   184.5   1433   Signost   -2730   309.5   1465   Signost   -3200   309.5   1501   Signost   -3866   184.5   1433   Signost   -2758   309.5   1467   Signost   -3200   309.5   1501   Signost   -3866   184.5   1434   Signost   -2772   184.5   1470   Signost   -3220   184.5   1502   Signost   -3710   309.5   1435   Signost   -3710   309.5   1435   Signost   -3710   309.5   1435   Signost   -3724   184.5   1439   Signost   -3788   309.5   1435   Signost   -3788   Signost   -3798   Sig | 1423 | S[903]   | -2590 | 309.5 | 1457 | S[937]   | -3066 | 309.5 | 1491 | S[971]   | -3542 | 309.5 |
| 1426   S 906    2632   184.5   1460   S 940    3109   184.5   1494   S 974    3584   184.5   1427   S 907    2646   309.5   1461   S 941    3122   309.5   1495   S 975    3598   309.5   1428   S 908    2660   184.5   1462   S 942    3136   184.5   1496   S 976    3612   184.5   1428   S 909    2674   309.5   1463   S 943    3150   309.5   1497   S 977    3626   309.5   1431   S 911    2702   309.5   1465   S 946    3164   184.5   1498   S 978    3640   184.5   1431   S 911    2702   309.5   1465   S 946    3164   184.5   1498   S 979    3654   309.5   1432   S 913    2730   309.5   1467   S 947    3208   309.5   1500   S 980    3682   309.5   1433   S 913    2730   309.5   1468   S 948    3220   184.5   1500   S 982    3696   184.5   1435   S 915    2772   309.5   1469   S 949    3224   309.5   1501   S 981    3682   309.5   1436   S 916    32738   309.5   1436   S 948    3220   184.5   1500   S 982    3696   184.5   1435   S 915    2772   184.5   1470   S 950    3284   184.5   1500   S 988    3770   309.5   1434   3224   309.5  | 1424 | S[904]   | -2604 | 184.5 | 1458 | S[938]   | -3080 | 184.5 | 1492 | S[972]   | -3556 | 184.5 |
| 1427         S[907]         -2646         309.5         1461         S[941]         -3122         309.5         1495         S[975]         -3599         309.5           1428         S[908]         -2660         184.5         1462         S[942]         -3136         184.5         1496         S[976]         -3612         184.5           1429         S[909]         -2674         309.5         1463         S[943]         -3150         309.5         1497         S[977]         -3626         309.5           1430         S[910]         -2688         184.5         1464         S[944]         -3164         184.5         1498         S[979]         -3640         184.5           1431         S[911]         -2702         309.5         1465         S[946]         -3192         184.5         1409         S[979]         -3654         309.5           1432         S[913]         -2703         309.5         1466         S[946]         -3192         184.5         1500         S[980]         -3662         309.5           1433         S[913]         -2773         309.5         1469         S[949]         -3220         184.5         1500         S[982]         -3662  | 1425 | S[905]   | -2618 | 309.5 | 1459 | S[939]   | -3094 | 309.5 | 1493 | S[973]   | -3570 | 309.5 |
| 1428         S[908]         .2660         184.5         1462         S[942]         .3136         184.5         1496         S[976]         .9612         184.5           1429         S[909]         .2674         309.5         1463         S[943]         .3150         309.5         1497         S[977]         .3626         309.5           1430         S[910]         .2688         184.5         1464         S[944]         .3164         184.5         1498         S[978]         .3640         184.5           1431         S[911]         .2702         309.5         1466         S[946]         .3178         309.5         1499         S[979]         .3654         309.5           1432         S[913]         .2700         309.5         1466         S[946]         .3192         184.5         1500         S[980]         .3668         184.5           1433         S[913]         .2720         309.5         1468         S[940]         .3220         184.5         1502         S[982]         .3666         184.5           1435         S[916]         .2728         309.5         1469         S[949]         .3224         309.5         1503         S[983]         .3710  | 1426 | S[906]   | -2632 | 184.5 | 1460 | S[940]   | -3108 | 184.5 | 1494 | S[974]   | -3584 | 184.5 |
| 1429         S[909]         .2674         309.5         1463         S[943]         .3150         309.5         1497         S[977]         .3626         309.5           1430         S[910]         .2688         184.5         1464         S[944]         .3164         184.5         1498         S[978]         .3640         184.5           1431         S[911]         .2702         309.5         1466         S[946]         .3178         309.5         1499         S[979]         .3664         309.5           1432         S[912]         .2716         184.5         1466         S[946]         .3192         184.5         1500         S[980]         .3668         184.5           1433         S[913]         .2730         309.5         1467         S[947]         .3206         309.5         1501         S[981]         .3682         309.5           1434         S[914]         .2744         184.5         1468         S[948]         .3220         184.5         1502         S[982]         .3696         184.5           1435         S[915]         .2788         309.5         1471         S[951]         .3224         184.5         1504         S[984]         .3724  | 1427 | S[907]   | -2646 | 309.5 | 1461 | S[941]   | -3122 | 309.5 | 1495 | S[975]   | -3598 | 309.5 |
| 1430         S[910]         .2688         194.5         1464         S[944]         .3164         184.5         1498         S[978]         .3840         184.5           1431         S[911]         .2702         309.5         1465         S[945]         .3178         309.5         1499         S[979]         .3664         309.5           1432         S[912]         .2716         184.5         1466         S[946]         .3192         184.5         1500         S[980]         .3668         184.5           1433         S[913]         .2730         309.5         1467         S[947]         .3206         309.5         1501         S[981]         .3662         309.5           1434         S[914]         .2744         184.5         1468         S[949]         .3220         184.5         1502         S[982]         .3666         184.5           1435         S[916]         .2772         184.5         1470         S[950]         .3248         184.5         1504         S[984]         .3724         184.5           1437         S[917]         .2786         309.5         1471         S[951]         .3276         184.5         1506         S[986]         .3732  | 1428 | S[908]   | -2660 | 184.5 | 1462 | S[942]   | -3136 | 184.5 | 1496 | S[976]   | -3612 | 184.5 |
| 1431         S[911]         2702         309.5         1465         S[945]         -3178         309.5         1499         S[979]         -3664         309.5           1432         S[912]         -2716         194.5         1466         S[946]         -3192         184.5         1500         S[980]         -3668         184.5           1433         S[913]         -2730         309.5         1467         S[947]         -3206         309.5         1501         S[981]         -3862         309.5           1434         S[914]         -2744         184.5         1468         S[948]         -3220         184.5         1502         S[982]         -3866         184.5           1435         S[916]         -2772         184.5         1470         S[950]         -3248         184.5         1504         S[984]         -3724         184.5           1437         S[917]         -2786         309.5         1471         S[951]         -3262         309.5         1505         S[986]         -3732         184.5           1439         S[918]         -2800         184.5         1472         S[952]         -3276         184.5         1506         S[986]         -3782         1   | 1429 | S[909]   | -2674 | 309.5 | 1463 | S[943]   | -3150 | 309.5 | 1497 | S[977]   | -3626 | 309.5 |
| 1432         S[912]         -2716         184.5         1466         S[946]         -3192         184.5         1500         S[980]         -3668         184.5           1433         S[913]         -2730         309.5         1467         S[947]         -3206         309.5         1501         S[981]         -3682         309.5           1434         S[914]         -2744         184.5         1468         S[948]         -9220         184.5         1502         S[982]         -3696         184.5           1435         S[916]         -2778         309.5         1470         S[950]         -9234         309.5         1503         S[983]         -3710         309.5           1436         S[916]         -2772         184.5         1470         S[950]         -3248         184.5         1504         S[984]         -3724         184.5           1437         S[917]         -2786         309.5         1471         S[951]         -3262         309.5         1505         S[986]         -3738         309.5           1439         S[919]         -2814         309.5         1473         S[953]         -3206         184.5         1506         S[986]         -3752  | 1430 | S[910]   | -2688 | 184.5 | 1464 | S[944]   | -3164 | 184.5 | 1498 | S[978]   | -3640 | 184.5 |
| 1433   S[913]   -2730   309.5   1467   S[947]   -3206   309.5   1501   S[981]   -3682   309.5   1434   S[914]   -2744   184.5   1468   S[948]   -3220   184.5   1502   S[982]   -3696   184.5   1435   S[915]   -2758   309.5   1469   S[949]   -3234   309.5   1503   S[983]   -3710   309.5   1436   S[916]   -2772   184.5   1470   S[950]   -3248   184.5   1504   S[984]   -3724   184.5   1437   S[917]   -2786   309.5   1471   S[951]   -3262   309.5   1505   S[985]   -3738   309.5   1438   S[918]   -2800   184.5   1472   S[952]   -3276   184.5   1506   S[986]   -3752   184.5   1439   S[919]   -2814   309.5   1473   S[953]   -3290   309.5   1507   S[987]   -3766   309.5   1440   S[920]   -2828   184.5   1474   S[954]   -3304   184.5   1508   S[988]   -3780   184.5   1441   S[921]   -2842   309.5   1475   S[955]   -3318   309.5   1509   S[989]   -3794   309.5   1442   S[922]   -2866   184.5   1476   S[956]   -3332   184.5   1510   S[990]   -3808   184.5   1444   S[923]   -2884   184.5   1478   S[958]   -3360   184.5   1511   S[991]   -3822   309.5   1445   S[922]   -2888   309.5   1479   S[959]   -3374   309.5   1513   S[983]   -3850   309.5   1444   S[926]   -2912   184.5   1480   S[960]   -3388   184.5   1514   S[994]   -3864   184.5   1448   S[927]   -2926   309.5   1481   S[961]   -3402   309.5   1515   S[996]   -3878   309.5   1448   S[928]   -2940   184.5   1482   S[962]   -3416   184.5   1516   S[996]   -3892   184.5   1449   S[929]   -2954   309.5   1483   S[963]   -3402   309.5   1517   S[997]   -3906   309.5   1451   S[931]   -2962   309.5   1485   S[966]   -3444   184.5   1518   S[996]   -3920   184.5   1455   S[933]   -2968   184.5   1486   S[966]   -3472   184.5   1510   S[997]   -3946   309.5   1451   S[931]   -2962   309.5   1485   S[966]   -3468   309.5   1517   S[997]   -3906   309.5   1455   S[933]   -2968   184.5   1486   S[966]   -3472   184.5   1510   S[997]   -3940   309.5   1451   S[997]   -3940   309.5   1455   S[933]   -3010   309.5   1485   S[966]   -3472   184.5   1520   S[1001]   -3990   309 | 1431 | S[911]   | -2702 | 309.5 | 1465 | S[945]   | -3178 | 309.5 | 1499 | S[979]   | -3654 | 309.5 |
| 1434         S[914]         -2744         184.5         1468         S[948]         -3220         184.5         1502         S[982]         -3696         184.5           1435         S[915]         -2758         309.5         1469         S[949]         -3234         309.5         1503         S[983]         -3710         309.5           1436         S[916]         -2772         184.5         1470         S[950]         -3248         184.5         1504         S[984]         -3724         184.5           1437         S[917]         -2786         309.5         1471         S[951]         -3262         309.5         1505         S[985]         -3738         309.5           1438         S[918]         -2800         184.5         1472         S[952]         -3276         184.5         1506         S[986]         -3752         184.5           1440         S[920]         -2828         184.5         1474         S[953]         -3304         184.5         1508         S[988]         -3780         184.5           1441         S[921]         -2842         309.5         1475         S[955]         -3318         309.5         1509         S[989]         -3794  | 1432 | S[912]   | -2716 | 184.5 | 1466 | S[946]   | -3192 | 184.5 | 1500 | S[980]   | -3668 | 184.5 |
| 1435         S[916]         -2758         309.5         1469         S[949]         -3234         309.5         1503         S[983]         -3710         309.5           1436         S[916]         -2772         184.5         1470         S[950]         -3248         184.5         1504         S[984]         -3724         184.5           1437         S[917]         -2786         309.5         1471         S[951]         -3262         309.5         1505         S[986]         -3738         309.5           1438         S[918]         -2800         184.5         1472         S[952]         -3276         184.5         1506         S[986]         -3752         184.5           1439         S[919]         -2814         309.5         1473         S[953]         -3290         309.5         1507         S[987]         -3766         309.5           1440         S[920]         -2828         184.5         1474         S[954]         -3304         184.5         1508         S[988]         -3780         184.5           1441         S[921]         -2826         184.5         1476         S[956]         -3332         184.5         1510         S[989]         -3794  | 1433 | S[913]   | -2730 | 309.5 | 1467 | S[947]   | -3206 | 309.5 | 1501 | S[981]   | -3682 | 309.5 |
| 1436         S[916]         -2772         184.5         1470         S[950]         -3248         184.5         1504         S[984]         -3724         184.5           1437         S[917]         -2786         309.5         1471         S[951]         -3262         309.5         1505         S[985]         -3738         309.5           1438         S[918]         -2800         184.5         1472         S[952]         -3276         184.5         1506         S[986]         -3752         184.5           1439         S[919]         -2814         309.5         1473         S[953]         -3290         309.5         1507         S[987]         -3766         309.5           1440         S[920]         -2828         184.5         1474         S[954]         -3304         184.5         1508         S[988]         -3780         184.5           1441         S[921]         -2828         184.5         1476         S[955]         -3318         309.5         1509         S[989]         -3794         309.5           1442         S[922]         -2886         184.5         1476         S[956]         -3332         184.5         1510         S[990]         -3808  | 1434 | S[914]   | -2744 | 184.5 | 1468 | S[948]   | -3220 | 184.5 | 1502 | S[982]   | -3696 | 184.5 |
| 1437         S[917]         -2786         309.5         1471         S[951]         -3262         309.5         1505         S[986]         -3738         309.5           1438         S[918]         -2800         184.5         1472         S[952]         -3276         184.5         1506         S[986]         -3752         184.5           1439         S[919]         -2814         309.5         1473         S[953]         -3290         309.5         1507         S[987]         -3766         309.5           1440         S[920]         -2828         184.5         1474         S[954]         -3304         184.5         1508         S[988]         -3780         184.5           1441         S[921]         -2842         309.5         1475         S[955]         -3318         309.5         1509         S[989]         -3794         309.5           1442         S[922]         -2856         184.5         1476         S[956]         -3332         184.5         1510         S[990]         -3808         184.5           1443         S[923]         -2870         309.5         1477         S[957]         -3346         309.5         1511         S[991]         -3822  | 1435 | S[915]   | -2758 | 309.5 | 1469 | S[949]   | -3234 | 309.5 | 1503 | S[983]   | -3710 | 309.5 |
| 1438         S[918]         -2800         184.5         1472         S[952]         -3276         184.5         1506         S[986]         -3752         184.5           1439         S[919]         -2814         309.5         1473         S[953]         -3290         309.5         1507         S[987]         -3766         309.5           1440         S[920]         -2828         184.5         1474         S[954]         -3304         184.5         1508         S[988]         -3780         184.5           1441         S[921]         -2842         309.5         1475         S[955]         -3318         309.5         1509         S[989]         -3794         309.5           1442         S[922]         -2856         184.5         1476         S[956]         -3332         184.5         1510         S[990]         -3808         184.5           1443         S[922]         -2866         184.5         1477         S[957]         -3346         309.5         1511         S[991]         -3822         309.5           1444         S[924]         -2884         184.5         1479         S[958]         -3374         309.5         1513         S[993]         -3860  | 1436 | S[916]   | -2772 | 184.5 | 1470 | S[950]   | -3248 | 184.5 | 1504 | S[984]   | -3724 | 184.5 |
| 1439         S[919]         -2814         309.5         1473         S[953]         -3290         309.5         1507         S[987]         -3766         309.5           1440         S[920]         -2828         184.5         1474         S[954]         -3304         184.5         1508         S[988]         -3780         184.5           1441         S[921]         -2842         309.5         1475         S[955]         -3318         309.5         1509         S[989]         -3794         309.5           1442         S[922]         -2856         184.5         1476         S[956]         -3332         184.5         1510         S[990]         -3808         184.5           1443         S[923]         -2870         309.5         1477         S[957]         -3346         309.5         1511         S[991]         -3822         309.5           1444         S[924]         -2884         184.5         1478         S[958]         -3360         184.5         1512         S[992]         -3836         184.5           1445         S[926]         -2988         309.5         1479         S[959]         -3374         309.5         1513         S[993]         -3864  | 1437 | S[917]   | -2786 | 309.5 | 1471 | S[951]   | -3262 | 309.5 | 1505 | S[985]   | -3738 | 309.5 |
| 1440         S[920]         -2828         184.5         1474         S[954]         -3304         184.5         1508         S[988]         -3780         184.5           1441         S[921]         -2842         309.5         1475         S[955]         -3318         309.5         1509         S[989]         -3794         309.5           1442         S[922]         -2856         184.5         1476         S[956]         -3332         184.5         1510         S[990]         -3808         184.5           1443         S[923]         -2870         309.5         1477         S[957]         -3346         309.5         1511         S[991]         -3822         309.5           1444         S[924]         -2884         184.5         1478         S[958]         -3360         184.5         1512         S[992]         -3836         184.5           1445         S[925]         -2898         309.5         1479         S[959]         -3374         309.5         1513         S[993]         -3850         309.5           1446         S[926]         -2912         184.5         1480         S[960]         -3388         184.5         1514         S[994]         -3864  | 1438 | S[918]   | -2800 | 184.5 | 1472 | S[952]   | -3276 | 184.5 | 1506 | S[986]   | -3752 | 184.5 |
| 1441         S[921]         -2842         309.5         1475         S[955]         -3318         309.5         1509         S[989]         -3794         309.5           1442         S[922]         -2856         184.5         1476         S[956]         -3332         184.5         1510         S[990]         -3808         184.5           1443         S[923]         -2870         309.5         1477         S[957]         -3346         309.5         1511         S[991]         -3822         309.5           1444         S[924]         -2884         184.5         1478         S[958]         -3360         184.5         1512         S[992]         -3836         184.5           1445         S[925]         -2898         309.5         1479         S[959]         -3374         309.5         1513         S[993]         -3850         309.5           1446         S[926]         -2912         184.5         1480         S[960]         -3388         184.5         1514         S[994]         -3864         184.5           1447         S[927]         -2926         309.5         1481         S[961]         -3402         309.5         1515         S[995]         -3878  | 1439 | S[919]   | -2814 | 309.5 | 1473 | S[953]   | -3290 | 309.5 | 1507 | S[987]   | -3766 | 309.5 |
| 1442         S[922]         -2856         184.5         1476         S[956]         -3332         184.5         1510         S[990]         -3808         184.5           1443         S[923]         -2870         309.5         1477         S[957]         -3346         309.5         1511         S[991]         -3822         309.5           1444         S[924]         -2884         184.5         1478         S[958]         -3360         184.5         1512         S[992]         -3836         184.5           1445         S[926]         -2898         309.5         1479         S[959]         -3374         309.5         1513         S[993]         -3850         309.5           1446         S[926]         -2912         184.5         1480         S[960]         -3388         184.5         1514         S[994]         -3864         184.5           1447         S[927]         -2926         309.5         1481         S[961]         -3402         309.5         1515         S[995]         -3878         309.5           1448         S[928]         -2940         184.5         1482         S[962]         -3416         184.5         1516         S[996]         -3892  | 1440 | S[920]   | -2828 | 184.5 | 1474 | S[954]   | -3304 | 184.5 | 1508 | S[988]   | -3780 | 184.5 |
| 1443         S[923]         -2870         309.5         1477         S[957]         -3346         309.5         1511         S[991]         -3822         309.5           1444         S[924]         -2884         184.5         1478         S[958]         -3360         184.5         1512         S[992]         -3836         184.5           1445         S[925]         -2898         309.5         1479         S[959]         -3374         309.5         1513         S[993]         -3850         309.5           1446         S[926]         -2912         184.5         1480         S[960]         -3388         184.5         1514         S[994]         -3864         184.5           1447         S[927]         -2926         309.5         1481         S[961]         -3402         309.5         1515         S[995]         -3878         309.5           1448         S[928]         -2940         184.5         1482         S[962]         -3416         184.5         1516         S[996]         -3892         184.5           1449         S[929]         -2954         309.5         1483         S[963]         -3430         309.5         1517         S[997]         -3906  | 1441 | S[921]   | -2842 | 309.5 | 1475 | S[955]   | -3318 | 309.5 | 1509 | S[989]   | -3794 | 309.5 |
| 1444         S[924]         -2884         184.5         1478         S[958]         -3360         184.5         1512         S[992]         -3836         184.5           1445         S[925]         -2898         309.5         1479         S[959]         -3374         309.5         1513         S[993]         -3850         309.5           1446         S[926]         -2912         184.5         1480         S[960]         -3388         184.5         1514         S[994]         -3864         184.5           1447         S[927]         -2926         309.5         1481         S[961]         -3402         309.5         1515         S[995]         -3878         309.5           1448         S[928]         -2940         184.5         1482         S[962]         -3416         184.5         1516         S[996]         -3892         184.5           1449         S[929]         -2954         309.5         1483         S[963]         -3430         309.5         1517         S[997]         -3906         309.5           1450         S[930]         -2968         184.5         1484         S[964]         -3444         184.5         1518         S[998]         -3920  | 1442 | S[922]   | -2856 | 184.5 | 1476 | S[956]   | -3332 | 184.5 | 1510 | S[990]   | -3808 | 184.5 |
| 1445         S[925]         -2898         309.5         1479         S[959]         -3374         309.5         1513         S[993]         -3850         309.5           1446         S[926]         -2912         184.5         1480         S[960]         -3388         184.5         1514         S[994]         -3864         184.5           1447         S[927]         -2926         309.5         1481         S[961]         -3402         309.5         1515         S[995]         -3878         309.5           1448         S[928]         -2940         184.5         1482         S[962]         -3416         184.5         1516         S[996]         -3892         184.5           1449         S[929]         -2954         309.5         1483         S[963]         -3430         309.5         1517         S[997]         -3906         309.5           1450         S[930]         -2968         184.5         1484         S[964]         -3444         184.5         1518         S[998]         -3920         184.5           1451         S[931]         -2982         309.5         1485         S[965]         -3458         309.5         1519         S[999]         -3934  | 1443 | S[923]   | -2870 | 309.5 | 1477 | S[957]   | -3346 | 309.5 | 1511 | S[991]   | -3822 | 309.5 |
| 1446         S[926]         -2912         184.5         1480         S[960]         -3388         184.5         1514         S[994]         -3864         184.5           1447         S[927]         -2926         309.5         1481         S[961]         -3402         309.5         1515         S[995]         -3878         309.5           1448         S[928]         -2940         184.5         1482         S[962]         -3416         184.5         1516         S[996]         -3892         184.5           1449         S[929]         -2954         309.5         1483         S[963]         -3430         309.5         1517         S[997]         -3906         309.5           1450         S[930]         -2968         184.5         1484         S[964]         -3444         184.5         1518         S[998]         -3920         184.5           1451         S[931]         -2982         309.5         1485         S[965]         -3458         309.5         1519         S[999]         -3934         309.5           1452         S[932]         -2996         184.5         1486         S[966]         -3472         184.5         1520         S[1000]         -3948 <td< td=""><td>1444</td><td>S[924]</td><td>-2884</td><td>184.5</td><td>1478</td><td>S[958]</td><td>-3360</td><td>184.5</td><td>1512</td><td>S[992]</td><td>-3836</td><td>184.5</td></td<>   | 1444 | S[924]   | -2884 | 184.5 | 1478 | S[958]   | -3360 | 184.5 | 1512 | S[992]   | -3836 | 184.5 |
| 1447         S[927]         -2926         309.5         1481         S[961]         -3402         309.5         1515         S[995]         -3878         309.5           1448         S[928]         -2940         184.5         1482         S[962]         -3416         184.5         1516         S[996]         -3892         184.5           1449         S[929]         -2954         309.5         1483         S[963]         -3430         309.5         1517         S[997]         -3906         309.5           1450         S[930]         -2968         184.5         1484         S[964]         -3444         184.5         1518         S[998]         -3920         184.5           1451         S[931]         -2982         309.5         1485         S[965]         -3458         309.5         1519         S[998]         -3920         184.5           1452         S[932]         -2996         184.5         1486         S[966]         -3472         184.5         1520         S[1000]         -3948         184.5           1453         S[933]         -3010         309.5         1487         S[967]         -3486         309.5         1521         S[1001]         -3962 <t< td=""><td>1445</td><td>S[925]</td><td>-2898</td><td>309.5</td><td>1479</td><td>S[959]</td><td>-3374</td><td>309.5</td><td>1513</td><td>S[993]</td><td>-3850</td><td>309.5</td></t<>  | 1445 | S[925]   | -2898 | 309.5 | 1479 | S[959]   | -3374 | 309.5 | 1513 | S[993]   | -3850 | 309.5 |
| 1448         S[928]         -2940         184.5         1482         S[962]         -3416         184.5         1516         S[996]         -3892         184.5           1449         S[929]         -2954         309.5         1483         S[963]         -3430         309.5         1517         S[997]         -3906         309.5           1450         S[930]         -2968         184.5         1484         S[964]         -3444         184.5         1518         S[998]         -3920         184.5           1451         S[931]         -2982         309.5         1485         S[965]         -3458         309.5         1519         S[999]         -3934         309.5           1452         S[932]         -2996         184.5         1486         S[966]         -3472         184.5         1520         S[1000]         -3948         184.5           1453         S[933]         -3010         309.5         1487         S[967]         -3486         309.5         1521         S[1001]         -3962         309.5           1454         S[934]         -3024         184.5         1488         S[968]         -3500         184.5         1523         S[1003]         -3976         <   | 1446 | S[926]   | -2912 | 184.5 | 1480 | S[960]   | -3388 | 184.5 | 1514 | S[994]   | -3864 | 184.5 |
| 1449         S[929]         -2954         309.5         1483         S[963]         -3430         309.5         1517         S[997]         -3906         309.5           1450         S[930]         -2968         184.5         1484         S[964]         -3444         184.5         1518         S[998]         -3920         184.5           1451         S[931]         -2982         309.5         1485         S[965]         -3458         309.5         1519         S[999]         -3934         309.5           1452         S[932]         -2996         184.5         1486         S[966]         -3472         184.5         1520         S[1000]         -3948         184.5           1453         S[933]         -3010         309.5         1487         S[967]         -3486         309.5         1521         S[1001]         -3962         309.5           1454         S[934]         -3024         184.5         1488         S[968]         -3500         184.5         1522         S[1002]         -3976         184.5           1455         S[935]         -3038         309.5         1489         S[969]         -3514         309.5         1523         S[1003]         -3990  | 1447 | S[927]   | -2926 | 309.5 | 1481 | S[961]   | -3402 | 309.5 | 1515 | S[995]   | -3878 | 309.5 |
| 1450         S[930]         -2968         184.5         1484         S[964]         -3444         184.5         1518         S[998]         -3920         184.5           1451         S[931]         -2982         309.5         1485         S[965]         -3458         309.5         1519         S[999]         -3934         309.5           1452         S[932]         -2996         184.5         1486         S[966]         -3472         184.5         1520         S[1000]         -3948         184.5           1453         S[933]         -3010         309.5         1487         S[967]         -3486         309.5         1521         S[1001]         -3962         309.5           1454         S[934]         -3024         184.5         1488         S[968]         -3500         184.5         1522         S[1002]         -3976         184.5           1455         S[935]         -3038         309.5         1489         S[969]         -3514         309.5         1523         S[1003]         -3990         309.5  | 1448 | S[928]   | -2940 | 184.5 | 1482 | S[962]   | -3416 | 184.5 | 1516 | S[996]   | -3892 | 184.5 |
| 1451         S[931]         -2982         309.5         1485         S[965]         -3458         309.5         1519         S[999]         -3934         309.5           1452         S[932]         -2996         184.5         1486         S[966]         -3472         184.5         1520         S[1000]         -3948         184.5           1453         S[933]         -3010         309.5         1487         S[967]         -3486         309.5         1521         S[1001]         -3962         309.5           1454         S[934]         -3024         184.5         1488         S[968]         -3500         184.5         1522         S[1002]         -3976         184.5           1455         S[935]         -3038         309.5         1489         S[969]         -3514         309.5         1523         S[1003]         -3990         309.5  | 1449 | S[929]   | -2954 | 309.5 | 1483 | S[963]   | -3430 | 309.5 | 1517 | S[997]   | -3906 | 309.5 |
| 1452         S[932]         -2996         184.5         1486         S[966]         -3472         184.5         1520         S[1000]         -3948         184.5           1453         S[933]         -3010         309.5         1487         S[967]         -3486         309.5         1521         S[1001]         -3962         309.5           1454         S[934]         -3024         184.5         1488         S[968]         -3500         184.5         1522         S[1002]         -3976         184.5           1455         S[935]         -3038         309.5         1489         S[969]         -3514         309.5         1523         S[1003]         -3990         309.5  | 1450 | S[930]   | -2968 | 184.5 | 1484 | S[964]   | -3444 | 184.5 | 1518 | S[998]   | -3920 | 184.5 |
| 1453         S[933]         -3010         309.5         1487         S[967]         -3486         309.5         1521         S[1001]         -3962         309.5           1454         S[934]         -3024         184.5         1488         S[968]         -3500         184.5         1522         S[1002]         -3976         184.5           1455         S[935]         -3038         309.5         1489         S[969]         -3514         309.5         1523         S[1003]         -3990         309.5   | 1451 | S[931]   | -2982 | 309.5 | 1485 | S[965]   | -3458 | 309.5 | 1519 | S[999]   | -3934 | 309.5 |
| 1454     S[934]     -3024     184.5     1488     S[968]     -3500     184.5     1522     S[1002]     -3976     184.5       1455     S[935]     -3038     309.5     1489     S[969]     -3514     309.5     1523     S[1003]     -3990     309.5  | 1452 | S[932]   | -2996 | 184.5 | 1486 | S[966]   | -3472 | 184.5 | 1520 | S[1000]  | -3948 | 184.5 |
| 1455         S[935]         -3038         309.5         1489         S[969]         -3514         309.5         1523         S[1003]         -3990         309.5   | 1453 | S[933]   | -3010 | 309.5 | 1487 | S[967]   | -3486 | 309.5 | 1521 | S[1001]  | -3962 | 309.5 |
|  | 1454 | S[934]   | -3024 | 184.5 | 1488 | S[968]   | -3500 | 184.5 | 1522 | S[1002]  | -3976 | 184.5 |
| 1456 S[936] -3052 184.5 1490 S[970] -3528 184.5 1524 S[1004] -4004 184.5   | 1455 | S[935]   | -3038 | 309.5 | 1489 | S[969]   | -3514 | 309.5 | 1523 | S[1003]  | -3990 | 309.5 |
|  | 1456 | S[936]   | -3052 | 184.5 | 1490 | S[970]   | -3528 | 184.5 | 1524 | S[1004]  | -4004 | 184.5 |

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| PAD<br>No. | PIN Name | X     | Υ     | PAD<br>No. | PIN Name | x     | Υ     | PAD<br>No. | PIN Name | х     | Υ     |
|------------|----------|-------|-------|------------|----------|-------|-------|------------|----------|-------|-------|
| 1525       | S[1005]  | -4018 | 309.5 | 1559       | S[1039]  | -4494 | 309.5 | 1593       | S[1073]  | -4970 | 309.5 |
| 1526       | S[1006]  | -4032 | 184.5 | 1560       | S[1040]  | -4508 | 184.5 | 1594       | S[1074]  | -4984 | 184.5 |
| 1527       | S[1007]  | -4046 | 309.5 | 1561       | S[1041]  | -4522 | 309.5 | 1595       | S[1075]  | -4998 | 309.5 |
| 1528       | S[1008]  | -4060 | 184.5 | 1562       | S[1042]  | -4536 | 184.5 | 1596       | S[1076]  | -5012 | 184.5 |
| 1529       | S[1009]  | -4074 | 309.5 | 1563       | S[1043]  | -4550 | 309.5 | 1597       | S[1077]  | -5026 | 309.5 |
| 1530       | S[1010]  | -4088 | 184.5 | 1564       | S[1044]  | -4564 | 184.5 | 1598       | S[1078]  | -5040 | 184.5 |
| 1531       | S[1011]  | -4102 | 309.5 | 1565       | S[1045]  | -4578 | 309.5 | 1599       | S[1079]  | -5054 | 309.5 |
| 1532       | S[1012]  | -4116 | 184.5 | 1566       | S[1046]  | -4592 | 184.5 | 1600       | S[1080]  | -5068 | 184.5 |
| 1533       | S[1013]  | -4130 | 309.5 | 1567       | S[1047]  | -4606 | 309.5 | 1601       | S[1081]  | -5082 | 309.5 |
| 1534       | S[1014]  | -4144 | 184.5 | 1568       | S[1048]  | -4620 | 184.5 | 1602       | S[1082]  | -5096 | 184.5 |
| 1535       | S[1015]  | -4158 | 309.5 | 1569       | S[1049]  | -4634 | 309.5 | 1603       | S[1083]  | -5110 | 309.5 |
| 1536       | S[1016]  | -4172 | 184.5 | 1570       | S[1050]  | -4648 | 184.5 | 1604       | S[1084]  | -5124 | 184.5 |
| 1537       | S[1017]  | -4186 | 309.5 | 1571       | S[1051]  | -4662 | 309.5 | 1605       | S[1085]  | -5138 | 309.5 |
| 1538       | S[1018]  | -4200 | 184.5 | 1572       | S[1052]  | -4676 | 184.5 | 1606       | S[1086]  | -5152 | 184.5 |
| 1539       | S[1019]  | -4214 | 309.5 | 1573       | S[1053]  | -4690 | 309.5 | 1607       | S[1087]  | -5166 | 309.5 |
| 1540       | S[1020]  | -4228 | 184.5 | 1574       | S[1054]  | -4704 | 184.5 | 1608       | S[1088]  | -5180 | 184.5 |
| 1541       | S[1021]  | -4242 | 309.5 | 1575       | S[1055]  | -4718 | 309.5 | 1609       | S[1089]  | -5194 | 309.5 |
| 1542       | S[1022]  | -4256 | 184.5 | 1576       | S[1056]  | -4732 | 184.5 | 1610       | S[1090]  | -5208 | 184.5 |
| 1543       | S[1023]  | -4270 | 309.5 | 1577       | S[1057]  | -4746 | 309.5 | 1611       | S[1091]  | -5222 | 309.5 |
| 1544       | S[1024]  | -4284 | 184.5 | 1578       | S[1058]  | -4760 | 184.5 | 1612       | S[1092]  | -5236 | 184.5 |
| 1545       | S[1025]  | -4298 | 309.5 | 1579       | S[1059]  | -4774 | 309.5 | 1613       | S[1093]  | -5250 | 309.5 |
| 1546       | S[1026]  | -4312 | 184.5 | 1580       | S[1060]  | -4788 | 184.5 | 1614       | S[1094]  | -5264 | 184.5 |
| 1547       | S[1027]  | -4326 | 309.5 | 1581       | S[1061]  | -4802 | 309.5 | 1615       | S[1095]  | -5278 | 309.5 |
| 1548       | S[1028]  | -4340 | 184.5 | 1582       | S[1062]  | -4816 | 184.5 | 1616       | S[1096]  | -5292 | 184.5 |
| 1549       | S[1029]  | -4354 | 309.5 | 1583       | S[1063]  | -4830 | 309.5 | 1617       | S[1097]  | -5306 | 309.5 |
| 1550       | S[1030]  | -4368 | 184.5 | 1584       | S[1064]  | -4844 | 184.5 | 1618       | S[1098]  | -5320 | 184.5 |
| 1551       | S[1031]  | -4382 | 309.5 | 1585       | S[1065]  | -4858 | 309.5 | 1619       | S[1099]  | -5334 | 309.5 |
| 1552       | S[1032]  | -4396 | 184.5 | 1586       | S[1066]  | -4872 | 184.5 | 1620       | S[1100]  | -5348 | 184.5 |
| 1553       | S[1033]  | -4410 | 309.5 | 1587       | S[1067]  | -4886 | 309.5 | 1621       | S[1101]  | -5362 | 309.5 |
| 1554       | S[1034]  | -4424 | 184.5 | 1588       | S[1068]  | -4900 | 184.5 | 1622       | S[1102]  | -5376 | 184.5 |
| 1555       | S[1035]  | -4438 | 309.5 | 1589       | S[1069]  | -4914 | 309.5 | 1623       | S[1103]  | -5390 | 309.5 |
| 1556       | S[1036]  | -4452 | 184.5 | 1590       | S[1070]  | -4928 | 184.5 | 1624       | S[1104]  | -5404 | 184.5 |
| 1557       | S[1037]  | -4466 | 309.5 | 1591       | S[1071]  | -4942 | 309.5 | 1625       | S[1105]  | -5418 | 309.5 |
| 1558       | S[1038]  | -4480 | 184.5 | 1592       | S[1072]  | -4956 | 184.5 | 1626       | S[1106]  | -5432 | 184.5 |

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| PAD<br>No. | PIN Name | X     | Υ     | PAD<br>No. | PIN Name | х     | Υ     | PAD<br>No. | PIN Name | х     | Υ     |
|------------|----------|-------|-------|------------|----------|-------|-------|------------|----------|-------|-------|
| 1627       | S[1107]  | -5446 | 309.5 | 1661       | S[1141]  | -5922 | 309.5 | 1695       | S[1175]  | -6398 | 309.5 |
| 1628       | S[1108]  | -5460 | 184.5 | 1662       | S[1142]  | -5936 | 184.5 | 1696       | S[1176]  | -6412 | 184.5 |
| 1629       | S[1109]  | -5474 | 309.5 | 1663       | S[1143]  | -5950 | 309.5 | 1697       | S[1177]  | -6426 | 309.5 |
| 1630       | S[1110]  | -5488 | 184.5 | 1664       | S[1144]  | -5964 | 184.5 | 1698       | S[1178]  | -6440 | 184.5 |
| 1631       | S[1111]  | -5502 | 309.5 | 1665       | S[1145]  | -5978 | 309.5 | 1699       | S[1179]  | -6454 | 309.5 |
| 1632       | S[1112]  | -5516 | 184.5 | 1666       | S[1146]  | -5992 | 184.5 | 1700       | S[1180]  | -6468 | 184.5 |
| 1633       | S[1113]  | -5530 | 309.5 | 1667       | S[1147]  | -6006 | 309.5 | 1701       | S[1181]  | -6482 | 309.5 |
| 1634       | S[1114]  | -5544 | 184.5 | 1668       | S[1148]  | -6020 | 184.5 | 1702       | S[1182]  | -6496 | 184.5 |
| 1635       | S[1115]  | -5558 | 309.5 | 1669       | S[1149]  | -6034 | 309.5 | 1703       | S[1183]  | -6510 | 309.5 |
| 1636       | S[1116]  | -5572 | 184.5 | 1670       | S[1150]  | -6048 | 184.5 | 1704       | S[1184]  | -6524 | 184.5 |
| 1637       | S[1117]  | -5586 | 309.5 | 1671       | S[1151]  | -6062 | 309.5 | 1705       | S[1185]  | -6538 | 309.5 |
| 1638       | S[1118]  | -5600 | 184.5 | 1672       | S[1152]  | -6076 | 184.5 | 1706       | S[1186]  | -6552 | 184.5 |
| 1639       | S[1119]  | -5614 | 309.5 | 1673       | S[1153]  | -6090 | 309.5 | 1707       | S[1187]  | -6566 | 309.5 |
| 1640       | S[1120]  | -5628 | 184.5 | 1674       | S[1154]  | -6104 | 184.5 | 1708       | S[1188]  | -6580 | 184.5 |
| 1641       | S[1121]  | -5642 | 309.5 | 1675       | S[1155]  | -6118 | 309.5 | 1709       | S[1189]  | -6594 | 309.5 |
| 1642       | S[1122]  | -5656 | 184.5 | 1676       | S[1156]  | -6132 | 184.5 | 1710       | S[1190]  | -6608 | 184.5 |
| 1643       | S[1123]  | -5670 | 309.5 | 1677       | S[1157]  | -6146 | 309.5 | 1711       | S[1191]  | -6622 | 309.5 |
| 1644       | S[1124]  | -5684 | 184.5 | 1678       | S[1158]  | -6160 | 184.5 | 1712       | S[1192]  | -6636 | 184.5 |
| 1645       | S[1125]  | -5698 | 309.5 | 1679       | S[1159]  | -6174 | 309.5 | 1713       | S[1193]  | -6650 | 309.5 |
| 1646       | S[1126]  | -5712 | 184.5 | 1680       | S[1160]  | -6188 | 184.5 | 1714       | S[1194]  | -6664 | 184.5 |
| 1647       | S[1127]  | -5726 | 309.5 | 1681       | S[1161]  | -6202 | 309.5 | 1715       | S[1195]  | -6678 | 309.5 |
| 1648       | S[1128]  | -5740 | 184.5 | 1682       | S[1162]  | -6216 | 184.5 | 1716       | S[1196]  | -6692 | 184.5 |
| 1649       | S[1129]  | -5754 | 309.5 | 1683       | S[1163]  | -6230 | 309.5 | 1717       | S[1197]  | -6706 | 309.5 |
| 1650       | S[1130]  | -5768 | 184.5 | 1684       | S[1164]  | -6244 | 184.5 | 1718       | S[1198]  | -6720 | 184.5 |
| 1651       | S[1131]  | -5782 | 309.5 | 1685       | S[1165]  | -6258 | 309.5 | 1719       | S[1199]  | -6734 | 309.5 |
| 1652       | S[1132]  | -5796 | 184.5 | 1686       | S[1166]  | -6272 | 184.5 | 1720       | S[1200]  | -6748 | 184.5 |
| 1653       | S[1133]  | -5810 | 309.5 | 1687       | S[1167]  | -6286 | 309.5 | 1721       | S[1201]  | -6762 | 309.5 |
| 1654       | S[1134]  | -5824 | 184.5 | 1688       | S[1168]  | -6300 | 184.5 | 1722       | S[1202]  | -6776 | 184.5 |
| 1655       | S[1135]  | -5838 | 309.5 | 1689       | S[1169]  | -6314 | 309.5 | 1723       | S[1203]  | -6790 | 309.5 |
| 1656       | S[1136]  | -5852 | 184.5 | 1690       | S[1170]  | -6328 | 184.5 | 1724       | S[1204]  | -6804 | 184.5 |
| 1657       | S[1137]  | -5866 | 309.5 | 1691       | S[1171]  | -6342 | 309.5 | 1725       | S[1205]  | -6818 | 309.5 |
| 1658       | S[1138]  | -5880 | 184.5 | 1692       | S[1172]  | -6356 | 184.5 | 1726       | S[1206]  | -6832 | 184.5 |
| 1659       | S[1139]  | -5894 | 309.5 | 1693       | S[1173]  | -6370 | 309.5 | 1727       | S[1207]  | -6846 | 309.5 |
| 1660       | S[1140]  | -5908 | 184.5 | 1694       | S[1174]  | -6384 | 184.5 | 1728       | S[1208]  | -6860 | 184.5 |
|            |          |       |       |            |          |       |       |            |          |       |       |

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| PAD<br>No. | PIN Name | x     | Y     | PAD<br>No. | PIN Name | x     | Y     | PAD<br>No. | PIN Name | х     | Υ     |
|------------|----------|-------|-------|------------|----------|-------|-------|------------|----------|-------|-------|
| 1729       | S[1209]  | -6874 | 309.5 | 1763       | S[1243]  | -7350 | 309.5 | 1797       | S[1277]  | -7826 | 309.5 |
| 1730       | S[1210]  | -6888 | 184.5 | 1764       | S[1244]  | -7364 | 184.5 | 1798       | S[1278]  | -7840 | 184.5 |
| 1731       | S[1211]  | -6902 | 309.5 | 1765       | S[1245]  | -7378 | 309.5 | 1799       | S[1279]  | -7854 | 309.5 |
| 1732       | S[1212]  | -6916 | 184.5 | 1766       | S[1246]  | -7392 | 184.5 | 1800       | S[1280]  | -7868 | 184.5 |
| 1733       | S[1213]  | -6930 | 309.5 | 1767       | S[1247]  | -7406 | 309.5 | 1801       | S[1281]  | -7882 | 309.5 |
| 1734       | S[1214]  | -6944 | 184.5 | 1768       | S[1248]  | -7420 | 184.5 | 1802       | S[1282]  | -7896 | 184.5 |
| 1735       | S[1215]  | -6958 | 309.5 | 1769       | S[1249]  | -7434 | 309.5 | 1803       | S[1283]  | -7910 | 309.5 |
| 1736       | S[1216]  | -6972 | 184.5 | 1770       | S[1250]  | -7448 | 184.5 | 1804       | S[1284]  | -7924 | 184.5 |
| 1737       | S[1217]  | -6986 | 309.5 | 1771       | S[1251]  | -7462 | 309.5 | 1805       | S[1285]  | -7938 | 309.5 |
| 1738       | S[1218]  | -7000 | 184.5 | 1772       | S[1252]  | -7476 | 184.5 | 1806       | S[1286]  | -7952 | 184.5 |
| 1739       | S[1219]  | -7014 | 309.5 | 1773       | S[1253]  | -7490 | 309.5 | 1807       | S[1287]  | -7966 | 309.5 |
| 1740       | S[1220]  | -7028 | 184.5 | 1774       | S[1254]  | -7504 | 184.5 | 1808       | S[1288]  | -7980 | 184.5 |
| 1741       | S[1221]  | -7042 | 309.5 | 1775       | S[1255]  | -7518 | 309.5 | 1809       | S[1289]  | -7994 | 309.5 |
| 1742       | S[1222]  | -7056 | 184.5 | 1776       | S[1256]  | -7532 | 184.5 | 1810       | S[1290]  | -8008 | 184.5 |
| 1743       | S[1223]  | -7070 | 309.5 | 1777       | S[1257]  | -7546 | 309.5 | 1811       | S[1291]  | -8022 | 309.5 |
| 1744       | S[1224]  | -7084 | 184.5 | 1778       | S[1258]  | -7560 | 184.5 | 1812       | S[1292]  | -8036 | 184.5 |
| 1745       | S[1225]  | -7098 | 309.5 | 1779       | S[1259]  | -7574 | 309.5 | 1813       | S[1293]  | -8050 | 309.5 |
| 1746       | S[1226]  | -7112 | 184.5 | 1780       | S[1260]  | -7588 | 184.5 | 1814       | S[1294]  | -8064 | 184.5 |
| 1747       | S[1227]  | -7126 | 309.5 | 1781       | S[1261]  | -7602 | 309.5 | 1815       | S[1295]  | -8078 | 309.5 |
| 1748       | S[1228]  | -7140 | 184.5 | 1782       | S[1262]  | -7616 | 184.5 | 1816       | S[1296]  | -8092 | 184.5 |
| 1749       | S[1229]  | -7154 | 309.5 | 1783       | S[1263]  | -7630 | 309.5 | 1817       | S[1297]  | -8106 | 309.5 |
| 1750       | S[1230]  | -7168 | 184.5 | 1784       | S[1264]  | -7644 | 184.5 | 1818       | S[1298]  | -8120 | 184.5 |
| 1751       | S[1231]  | -7182 | 309.5 | 1785       | S[1265]  | -7658 | 309.5 | 1819       | S[1299]  | -8134 | 309.5 |
| 1752       | S[1232]  | -7196 | 184.5 | 1786       | S[1266]  | -7672 | 184.5 | 1820       | S[1300]  | -8148 | 184.5 |
| 1753       | S[1233]  | -7210 | 309.5 | 1787       | S[1267]  | -7686 | 309.5 | 1821       | S[1301]  | -8162 | 309.5 |
| 1754       | S[1234]  | -7224 | 184.5 | 1788       | S[1268]  | -7700 | 184.5 | 1822       | S[1302]  | -8176 | 184.5 |
| 1755       | S[1235]  | -7238 | 309.5 | 1789       | S[1269]  | -7714 | 309.5 | 1823       | S[1303]  | -8190 | 309.5 |
| 1756       | S[1236]  | -7252 | 184.5 | 1790       | S[1270]  | -7728 | 184.5 | 1824       | S[1304]  | -8204 | 184.5 |
| 1757       | S[1237]  | -7266 | 309.5 | 1791       | S[1271]  | -7742 | 309.5 | 1825       | S[1305]  | -8218 | 309.5 |
| 1758       | S[1238]  | -7280 | 184.5 | 1792       | S[1272]  | -7756 | 184.5 | 1826       | S[1306]  | -8232 | 184.5 |
| 1759       | S[1239]  | -7294 | 309.5 | 1793       | S[1273]  | -7770 | 309.5 | 1827       | S[1307]  | -8246 | 309.5 |
| 1760       | S[1240]  | -7308 | 184.5 | 1794       | S[1274]  | -7784 | 184.5 | 1828       | S[1308]  | -8260 | 184.5 |
| 1761       | S[1241]  | -7322 | 309.5 | 1795       | S[1275]  | -7798 | 309.5 | 1829       | S[1309]  | -8274 | 309.5 |
| 1762       | S[1242]  | -7336 | 184.5 | 1796       | S[1276]  | -7812 | 184.5 | 1830       | S[1310]  | -8288 | 184.5 |

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| PAD<br>No. | PIN Name | х     | Y     | PAD<br>No. | PIN Name | х     | Υ     | PAD<br>No. | PIN Name | х     | Υ     |
|------------|----------|-------|-------|------------|----------|-------|-------|------------|----------|-------|-------|
| 1831       | S[1311]  | -8302 | 309.5 | 1865       | S[1345]  | -8778 | 309.5 | 1899       | S[1379]  | -9254 | 309.5 |
| 1832       | S[1312]  | -8316 | 184.5 | 1866       | S[1346]  | -8792 | 184.5 | 1900       | S[1380]  | -9268 | 184.5 |
| 1833       | S[1313]  | -8330 | 309.5 | 1867       | S[1347]  | -8806 | 309.5 | 1901       | S[1381]  | -9282 | 309.5 |
| 1834       | S[1314]  | -8344 | 184.5 | 1868       | S[1348]  | -8820 | 184.5 | 1902       | S[1382]  | -9296 | 184.5 |
| 1835       | S[1315]  | -8358 | 309.5 | 1869       | S[1349]  | -8834 | 309.5 | 1903       | S[1383]  | -9310 | 309.5 |
| 1836       | S[1316]  | -8372 | 184.5 | 1870       | S[1350]  | -8848 | 184.5 | 1904       | S[1384]  | -9324 | 184.5 |
| 1837       | S[1317]  | -8386 | 309.5 | 1871       | S[1351]  | -8862 | 309.5 | 1905       | S[1385]  | -9338 | 309.5 |
| 1838       | S[1318]  | -8400 | 184.5 | 1872       | S[1352]  | -8876 | 184.5 | 1906       | S[1386]  | -9352 | 184.5 |
| 1839       | S[1319]  | -8414 | 309.5 | 1873       | S[1353]  | -8890 | 309.5 | 1907       | S[1387]  | -9366 | 309.5 |
| 1840       | S[1320]  | -8428 | 184.5 | 1874       | S[1354]  | -8904 | 184.5 | 1908       | S[1388]  | -9380 | 184.5 |
| 1841       | S[1321]  | -8442 | 309.5 | 1875       | S[1355]  | -8918 | 309.5 | 1909       | S[1389]  | -9394 | 309.5 |
| 1842       | S[1322]  | -8456 | 184.5 | 1876       | S[1356]  | -8932 | 184.5 | 1910       | S[1390]  | -9408 | 184.5 |
| 1843       | S[1323]  | -8470 | 309.5 | 1877       | S[1357]  | -8946 | 309.5 | 1911       | S[1391]  | -9422 | 309.5 |
| 1844       | S[1324]  | -8484 | 184.5 | 1878       | S[1358]  | -8960 | 184.5 | 1912       | S[1392]  | -9436 | 184.5 |
| 1845       | S[1325]  | -8498 | 309.5 | 1879       | S[1359]  | -8974 | 309.5 | 1913       | S[1393]  | -9450 | 309.5 |
| 1846       | S[1326]  | -8512 | 184.5 | 1880       | S[1360]  | -8988 | 184.5 | 1914       | S[1394]  | -9464 | 184.5 |
| 1847       | S[1327]  | -8526 | 309.5 | 1881       | S[1361]  | -9002 | 309.5 | 1915       | S[1395]  | -9478 | 309.5 |
| 1848       | S[1328]  | -8540 | 184.5 | 1882       | S[1362]  | -9016 | 184.5 | 1916       | S[1396]  | -9492 | 184.5 |
| 1849       | S[1329]  | -8554 | 309.5 | 1883       | S[1363]  | -9030 | 309.5 | 1917       | S[1397]  | -9506 | 309.5 |
| 1850       | S[1330]  | -8568 | 184.5 | 1884       | S[1364]  | -9044 | 184.5 | 1918       | S[1398]  | -9520 | 184.5 |
| 1851       | S[1331]  | -8582 | 309.5 | 1885       | S[1365]  | -9058 | 309.5 | 1919       | S[1399]  | -9534 | 309.5 |
| 1852       | S[1332]  | -8596 | 184.5 | 1886       | S[1366]  | -9072 | 184.5 | 1920       | S[1400]  | -9548 | 184.5 |
| 1853       | S[1333]  | -8610 | 309.5 | 1887       | S[1367]  | -9086 | 309.5 | 1921       | S[1401]  | -9562 | 309.5 |
| 1854       | S[1334]  | -8624 | 184.5 | 1888       | S[1368]  | -9100 | 184.5 | 1922       | S[1402]  | -9576 | 184.5 |
| 1855       | S[1335]  | -8638 | 309.5 | 1889       | S[1369]  | -9114 | 309.5 | 1923       | S[1403]  | -9590 | 309.5 |
| 1856       | S[1336]  | -8652 | 184.5 | 1890       | S[1370]  | -9128 | 184.5 | 1924       | S[1404]  | -9604 | 184.5 |
| 1857       | S[1337]  | -8666 | 309.5 | 1891       | S[1371]  | -9142 | 309.5 | 1925       | S[1405]  | -9618 | 309.5 |
| 1858       | S[1338]  | -8680 | 184.5 | 1892       | S[1372]  | -9156 | 184.5 | 1926       | S[1406]  | -9632 | 184.5 |
| 1859       | S[1339]  | -8694 | 309.5 | 1893       | S[1373]  | -9170 | 309.5 | 1927       | S[1407]  | -9646 | 309.5 |
| 1860       | S[1340]  | -8708 | 184.5 | 1894       | S[1374]  | -9184 | 184.5 | 1928       | S[1408]  | -9660 | 184.5 |
| 1861       | S[1341]  | -8722 | 309.5 | 1895       | S[1375]  | -9198 | 309.5 | 1929       | S[1409]  | -9674 | 309.5 |
| 1862       | S[1342]  | -8736 | 184.5 | 1896       | S[1376]  | -9212 | 184.5 | 1930       | S[1410]  | -9688 | 184.5 |
| 1863       | S[1343]  | -8750 | 309.5 | 1897       | S[1377]  | -9226 | 309.5 | 1931       | S[1411]  | -9702 | 309.5 |
| 1864       | S[1344]  | -8764 | 184.5 | 1898       | S[1378]  | -9240 | 184.5 | 1932       | S[1412]  | -9716 | 184.5 |
|            |          |       |       |            |          |       |       |            |          |       |       |

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| PAD No         PN Name         X         Y         PAD No         PIN Name No         X         PAD No         PN Name No         X         Y           1934         91743         9373         9395         1908         10000         100200         3095         2002         DMY         10686         1845           1934         \$14141         19744         1845         1968         1960         10200         10845         2002         DMY         10700         908-5           1938         \$1(416)         -9772         184.5         1970         VOLO         -10246         308-5         2004         DMY         -10704         108-5           1938         \$1(416)         -9776         184.5         1970         VOLO         -10268         309.5         2004         DMY         -10730         308-5           1938         \$1(414)         -9786         309.5         1977         VOLO         -10268         309.5         2000         DMY         -10760         208-5           1944         \$1(422)         -9862         184.5         1977         VOHO         -10342         308-5         2010         DMY         -10760         1036-5         2011   |      |          |        |       |      |          |        |       |      |          |        |       |
|--|------|----------|--------|-------|------|----------|--------|-------|------|----------|--------|-------|
| 1934   S 1414    .9744   |      | PIN Name | х      | Υ     |      | PIN Name | х      | Υ     |      | PIN Name | х      | Υ     |
| 1935   | 1933 | S[1413]  | -9730  | 309.5 | 1967 | VGLO     | -10206 | 309.5 | 2001 | DMY      | -10682 | 309.5 |
| 1936   S 1416    .9772   184.5   1970   VGLO   .10248   194.5   2004   DMY   .10724   184.5   1937   S 1417    .9786   309.5   1971   VGLO   .10262   309.5   2005   DMY   .10738   309.5   1938   S 1418    .9800   184.5   1972   VGLO   .10276   184.5   2006   DMY   .10752   184.5   1938   S 1418    .9814   309.5   1973   VGLO   .10276   184.5   2006   DMY   .10766   309.5   1940   .1024 | 1934 | S[1414]  | -9744  | 184.5 | 1968 | VGLO     | -10220 | 184.5 | 2002 | DMY      | -10696 | 184.5 |
| 1937   S 1417    .9786   309.5   1971   VGLO   .10262   309.5   2005   DMY   .10738   309.5   1938   S 1418    .9800   184.5   1972   VGLO   .10276   184.5   2006   DMY   .10752   184.5   1939   S 1419    .9814   309.5   1973   VGLO   .10276   184.5   2006   DMY   .10766   309.5   194.5   19 | 1935 | S[1415]  | -9758  | 309.5 | 1969 | VGLO     | -10234 | 309.5 | 2003 | DMY      | -10710 | 309.5 |
| 1938   S 1418    -9800   184.5   1972   VGLO   -10276   184.5   2006   DMY   -10752   184.5   1939   S 1419    -9814   309.5   1973   VGLO   -10290   309.5   2007   DMY   -10766   309.5   194   309.5   3184.5   1974   VGHO   -10304   184.5   2008   DMY   -10780   184.5   1941   S 1421    -9842   309.5   1975   VGHO   -10318   309.5   2009   DMY   -10794   309.5   194   309.5   3194  | 1936 | S[1416]  | -9772  | 184.5 | 1970 | VGLO     | -10248 | 184.5 | 2004 | DMY      | -10724 | 184.5 |
| 1939   S 1419    -9814   309.5   1973   VGLO   -10290   309.5   2007   DMY   -10766   309.5   1940   S 1420    -9828   184.5   1974   VGHO   -10304   184.5   2008   DMY   -10780   184.5   1941   S 1421    -9842   309.5   1975   VGHO   -10318   309.5   2009   DMY   -10794   309.5   1942   S 1422    -9856   184.5   1976   VGHO   -10322   184.5   2010   DMY   -10808   184.5   1942   S 1423    -9870   309.5   1977   VGHO   -10346   309.5   2011   DMY   -10808   184.5   1948   S 1424    -9884   184.5   1978   VGHO   -10346   309.5   2011   DMY   -10822   309.5   1944   S 1426    -9884   184.5   1978   VGHO   -10374   309.5   2012   DMY   -10860   184.5   1945   S 1426    -9912   184.5   1880   VGHO   -10374   309.5   2013   DMY   -10860   309.5   1947   S 1427   -9928   309.5   1981   VGHO   -10402   309.5   2015   DMY   -10864   184.5   1948   S 1428   -9940   184.5   1982   DMY   -10402   309.5   2015   DMY   -10892   184.5   1949   S 1429   -9954   309.5   1983   DMY   -10430   309.5   2017   DMY   -10892   184.5   1950   S 1430   -9968   184.5   1984   DMY   -10458   309.5   2019   DMY   -10894   309.5   1955   S 1433   -9966   184.5   1986   DMY   -10462   309.5   2019   DMY   -10894   309.5   1955   S 1433   -10010   309.5   1986   DMY   -10468   309.5   2020   DMY   -10984   309.5   1955   S 1439   -10024   184.5   1986   DMY   -10468   309.5   2021   DMY   -10968   309.5   1955   S 1439   -10024   184.5   1986   DMY   -10560   184.5   2022   DMY   -10976   184.5   1956   S 1439   -10066   309.5   1989   DMY   -10564   184.5   2026   GO[17]   -11046   309.5   1965   S 1439   -10066   309.5   1989   DMY   -10564   184.5   2026   GO[17]   -11046   309.5   1966   S 1439   -10066   309.5   1989   DMY   -10564   184.5   2026   GO[17]   -11046   309.5   1966   S 1439   -10066   309.5   1989   DMY   -10564   184.5   2026   GO[17]   -11046   309.5   1966   S 1439   -10066   309.5   1989   DMY   -10566   309.5   2027   GO[17]   -11046   309.5   1966   DMY   -10564   309.5   2027   GO[18]   -11060   184.5   1966   DM | 1937 | S[1417]  | -9786  | 309.5 | 1971 | VGLO     | -10262 | 309.5 | 2005 | DMY      | -10738 | 309.5 |
| 1940   S[1420]   .9828   184.5   1974   VGHO   .10304   184.5   2008   DMY   .10780   184.5   1941   S[1421]   .9842   309.5   1975   VGHO   .10318   309.5   2009   DMY   .10794   309.5   1942   S[1422]   .9856   184.5   1976   VGHO   .10332   184.5   2010   DMY   .10808   184.5   1943   S[1423]   .9870   309.5   1977   VGHO   .10346   309.5   2011   DMY   .10822   309.5   1944   S[1424]   .9884   184.5   1978   VGHO   .10360   184.5   2012   DMY   .10836   184.5   1945   S[1425]   .9898   309.5   1979   VGHO   .10360   184.5   2012   DMY   .10866   184.5   1946   S[1426]   .9912   184.5   1980   VGHO   .10374   309.5   2013   DMY   .10864   184.5   1947   S[1427]   .9926   309.5   1981   VGHO   .10402   309.5   2015   DMY   .10878   309.5   1948   S[1428]   .9940   184.5   1982   DMY   .10416   184.5   2016   DMY   .10882   184.5   1949   S[1429]   .9954   309.5   1983   DMY   .10403   309.5   2017   DMY   .10966   309.5   1955   S[1430]   .9968   184.5   1984   DMY   .10444   184.5   2018   DMY   .10934   309.5   1955   S[1431]   .9982   309.5   1985   DMY   .10468   309.5   2019   DMY   .10948   184.5   1955   S[1433]   .10010   309.5   1987   DMY   .10466   309.5   2021   DMY   .10948   184.5   1955   S[1436]   .10024   184.5   1988   DMY   .10500   184.5   2020   DMY   .10948   184.5   1955   S[1437]   .10066   309.5   1991   DMY   .10566   184.5   2026   GO[17]   .11032   184.5   1956   S[1438]   .10080   184.5   1992   DMY   .10566   184.5   2026   GO[17]   .11046   309.5   1955   S[1437]   .10066   309.5   1993   DMY   .10566   184.5   2026   GO[17]   .11046   309.5   1965   S[1430]   .10108   184.5   1994   DMY   .10564   184.5   2026   GO[18]   .11060   184.5   1964   DMY   .10564   184.5   2026   GO[18]   .11068   184.5   1964   DMY   .10566   184.5   2026   GO[18]   .11068   184.5   1964   DMY   .10566   184.5   2026   GO[18]   .11068   184.5   1964   DMY   .10564   184.5   2026   GO[18]   .11068   184.5   1964   DMY   .10566   309.5   2031   GO[19]   .11068   184.5   1965   DMY   .10566   309.5   | 1938 | S[1418]  | -9800  | 184.5 | 1972 | VGLO     | -10276 | 184.5 | 2006 | DMY      | -10752 | 184.5 |
| 1941   S 142   | 1939 | S[1419]  | -9814  | 309.5 | 1973 | VGLO     | -10290 | 309.5 | 2007 | DMY      | -10766 | 309.5 |
| 1942   S 1422  | 1940 | S[1420]  | -9828  | 184.5 | 1974 | VGHO     | -10304 | 184.5 | 2008 | DMY      | -10780 | 184.5 |
| 1943   S 1423    -9870   309.5   1977   VGHO   -10346   309.5   2011   DMY   -10822   309.5     1944   S 1424    -9884   184.5   1978   VGHO   -10360   184.5   2012   DMY   -10836   184.5     1945   S 1425    -9898   309.5   1979   VGHO   -10374   309.5   2013   DMY   -10860   309.5     1946   S 1426    -9912   184.5   1980   VGHO   -10388   184.5   2014   DMY   -10864   184.5     1947   S 1427    -9926   309.5   1981   VGHO   -10402   309.5   2015   DMY   -10878   309.5     1948   S 1428    -9940   184.5   1982   DMY   -10416   184.5   2016   DMY   -10832   184.5     1949   S 1429    -9954   309.5   1983   DMY   -10430   309.5   2017   DMY   -10906   309.5     1950   S 1430    -9988   184.5   1984   DMY   -10444   184.5   2018   DMY   -10920   184.5     1951   S 1431    -9982   309.5   1985   DMY   -10458   309.5   2019   DMY   -10934   309.5     1952   S 1432    -9996   184.5   1986   DMY   -10472   184.5   2020   DMY   -10948   184.5     1953   S 1433    -10010   309.5   1987   DMY   -10486   309.5   2021   DMY   -10962   309.5     1954   S 1436    -10024   184.5   1988   DMY   -10500   184.5   2022   DMY   -10976   184.5     1955   S 1436    -10052   184.5   1990   DMY   -10528   184.5   2024   DMY   -11040   184.5     1958   S 1439    -10066   309.5   1991   DMY   -10528   184.5   2026   GO[17]   -11046   309.5     1958   S 1439    -10080   184.5   1992   DMY   -10566   184.5   2028   GO[17]   -11046   309.5     1960   S 1440    -10108   184.5   1994   DMY   -10584   184.5   2028   GO[18]   -11074   309.5     1960   S 1440    -10108   184.5   1996   DMY   -10586   309.5   2021   GO[18]   -11024   309.5     1960   S 1439    -10064   309.5   1995   DMY   -10566   309.5   2021   GO[19]   -1102   309.5     1960   S 1439    -10094   309.5   1995   DMY   -10586   309.5   2029   GO[18]   -11060   184.5     1961   SDUM2   -10164   184.5   1996   DMY   -10666   309.5   2021   GO[19]   -11102   309.5     1962   SDUM3   -10164   184.5   1996   DMY   -10666   309.5   2021   GO[19]   -11102   309.5     1964   DMY   - | 1941 | S[1421]  | -9842  | 309.5 | 1975 | VGHO     | -10318 | 309.5 | 2009 | DMY      | -10794 | 309.5 |
| 1944   S[1424]   -9884   184.5   1978   VGHO   -10360   184.5   2012   DMY   -10836   184.5     1945   S[1425]   -9898   309.5   1979   VGHO   -10374   309.5   2013   DMY   -10860   309.5     1946   S[1426]   -9912   184.5   1980   VGHO   -10388   184.5   2014   DMY   -10864   184.5     1947   S[1427]   -9926   309.5   1981   VGHO   -10402   309.5   2015   DMY   -10878   309.5     1948   S[1428]   -9940   184.5   1982   DMY   -10416   184.5   2016   DMY   -10892   184.5     1949   S[1429]   -9954   309.5   1983   DMY   -10430   309.5   2017   DMY   -10960   309.5     1950   S[1430]   -9968   184.5   1984   DMY   -10444   184.5   2018   DMY   -10920   184.5     1951   S[1431]   -9982   309.5   1985   DMY   -10472   184.5   2020   DMY   -10948   184.5     1952   S[1432]   -9996   184.5   1986   DMY   -10472   184.5   2020   DMY   -10948   184.5     1953   S[1433]   -10010   309.5   1987   DMY   -10500   184.5   2022   DMY   -10962   309.5     1954   S[1434]   -10024   184.5   1988   DMY   -10500   184.5   2022   DMY   -10976   184.5     1955   S[1436]   -10038   309.5   1991   DMY   -10528   184.5   2024   DMY   -11090   309.5     1958   S[1438]   -10066   309.5   1991   DMY   -10568   184.5   2026   GO[17]   -11046   309.5     1959   S[1439]   -10094   309.5   1993   DMY   -10566   184.5   2026   GO[17]   -11046   309.5     1960   S[1440]   -10108   184.5   1994   DMY   -10568   184.5   2028   GO[18]   -11074   309.5     1961   SDUM2   -10122   309.5   1993   DMY   -10584   184.5   2028   GO[18]   -11074   309.5     1962   SDUM3   -10136   184.5   1996   DMY   -10586   309.5   2031   GO[19]   -11088   184.5     1963   DMY   -10164   184.5   1998   DMY   -10668   309.5   2031   GO[19]   -11102   309.5     1964   DMY   -10164   184.5   1998   DMY   -10664   309.5   2031   GO[19]   -11102   309.5     1965   VGLO   -10178   309.5   1999   DMY   -10664   309.5   2033   GO[20]   -11110   309.5     1965   VGLO   -10178   309.5   1999   DMY   -10664   309.5   2033   GO[20]   -11110   309.5     1965   VGLO   -10178   3 | 1942 | S[1422]  | -9856  | 184.5 | 1976 | VGHO     | -10332 | 184.5 | 2010 | DMY      | -10808 | 184.5 |
| 1945   S[1425]   -9898   309.5   1979   VGHO   -10374   309.5   2013   DMY   -10850   309.5     1946   S[1426]   -9912   184.5   1980   VGHO   -10388   184.5   2014   DMY   -10864   184.5     1947   S[1427]   -9926   309.5   1981   VGHO   -10402   309.5   2015   DMY   -10878   309.5     1948   S[1428]   -9940   184.5   1982   DMY   -10416   184.5   2016   DMY   -10892   184.5     1949   S[1429]   -9954   309.5   1983   DMY   -10430   309.5   2017   DMY   -10906   309.5     1950   S[1430]   -9968   184.5   1984   DMY   -10444   184.5   2018   DMY   -10920   184.5     1951   S[1431]   -9982   309.5   1985   DMY   -10458   309.5   2019   DMY   -10934   309.5     1952   S[1432]   -9966   184.5   1986   DMY   -10472   184.5   2020   DMY   -10948   184.5     1953   S[1433]   -10010   309.5   1987   DMY   -10486   309.5   2021   DMY   -10962   309.5     1954   S[1434]   -10024   184.5   1988   DMY   -10500   184.5   2022   DMY   -10976   184.5     1955   S[1435]   -10038   309.5   1989   DMY   -10514   309.5   2023   DMY   -10990   309.5     1956   S[1436]   -10052   184.5   1990   DMY   -10528   184.5   2024   DMY   -11004   184.5     1959   S[1439]   -10066   309.5   1991   DMY   -10566   184.5   2026   GO[17]   -11032   184.5     1960   S[1440]   -10108   184.5   1992   DMY   -10564   184.5   2028   GO[18]   -11074   309.5     1962   SDUM3   -10136   184.5   1996   DMY   -10584   184.5   2028   GO[18]   -11074   309.5     1963   DMY   -10160   309.5   1997   DMY   -10686   309.5   2021   GO[19]   -11108   309.5     1964   DMY   -10164   184.5   1998   DMY   -10664   309.5   2031   GO[19]   -11102   309.5     1965   VGLO   -10178   309.5   1999   DMY   -10664   309.5   2033   GO[20]   -11116   184.5     1965   VGLO   -10178   309.5   1999   DMY   -10664   309.5   2033   GO[20]   -11116   184.5     1965   VGLO   -10178   309.5   1999   DMY   -10664   309.5   2033   GO[20]   -11116   184.5     1965   VGLO   -10178   309.5   1999   DMY   -10664   309.5   2033   GO[20]   -11116   309.5     1966   VGLO   -10178   309.5 | 1943 | S[1423]  | -9870  | 309.5 | 1977 | VGHO     | -10346 | 309.5 | 2011 | DMY      | -10822 | 309.5 |
| 1946   S[1426]   -9912   184.5   1980   VGHO   -10388   184.5   2014   DMY   -10864   184.5     1947   S[1427]   -9926   309.5   1981   VGHO   -10402   309.5   2015   DMY   -10878   309.5     1948   S[1428]   -9940   184.5   1982   DMY   -10416   184.5   2016   DMY   -10892   184.5     1949   S[1429]   -9954   309.5   1983   DMY   -10430   309.5   2017   DMY   -10906   309.5     1950   S[1430]   -9968   184.5   1984   DMY   -10444   184.5   2018   DMY   -10920   184.5     1951   S[1431]   -9982   309.5   1985   DMY   -10448   309.5   2019   DMY   -10934   309.5     1952   S[1432]   -9996   184.5   1986   DMY   -10472   184.5   2020   DMY   -10948   184.5     1953   S[1433]   -10010   309.5   1987   DMY   -10468   309.5   2021   DMY   -10962   309.5     1954   S[1434]   -10024   184.5   1988   DMY   -10500   184.5   2022   DMY   -10976   184.5     1955   S[1435]   -10038   309.5   1989   DMY   -10514   309.5   2023   DMY   -10990   309.5     1956   S[1436]   -10052   184.5   1990   DMY   -10542   309.5   2025   DMY   -11014   309.5     1958   S[1438]   -10066   309.5   1991   DMY   -10542   309.5   2025   DMY   -11018   309.5     1958   S[1439]   -10094   309.5   1993   DMY   -10566   184.5   2026   GO[17]   -11032   184.5     1960   S[1440]   -10108   184.5   1994   DMY   -10584   184.5   2028   GO[18]   -11060   184.5     1961   SDUM2   -10122   309.5   1995   DMY   -10626   309.5   2021   GO[19]   -11108   184.5     1963   DMY   -10164   184.5   1996   DMY   -10626   309.5   2031   GO[19]   -11108   184.5     1964   DMY   -10164   184.5   1998   DMY   -10664   309.5   2033   GO[20]   -11116   184.5     1965   VGLO   -10178   309.5   1999   DMY   -10664   309.5   2033   GO[20]   -11116   184.5     1965   VGLO   -10178   309.5   1999   DMY   -10664   309.5   2033   GO[20]   -11116   184.5     1965   VGLO   -10178   309.5   1999   DMY   -10664   309.5   2033   GO[20]   -11116   184.5     1965   VGLO   -10178   309.5   1999   DMY   -10664   309.5   2033   GO[20]   -111116   184.5     1965   VGLO   -10178   309. | 1944 | S[1424]  | -9884  | 184.5 | 1978 | VGHO     | -10360 | 184.5 | 2012 | DMY      | -10836 | 184.5 |
| 1947   S[1427]   -9926   309.5   1981   VGHO   -10402   309.5   2015   DMY   -10878   309.5   1948   S[1428]   -9940   184.5   1982   DMY   -10416   184.5   2016   DMY   -10892   184.5   1949   S[1429]   -9954   309.5   1983   DMY   -10403   309.5   2017   DMY   -10906   309.5   1950   S[1430]   -9968   184.5   1984   DMY   -10444   184.5   2018   DMY   -10920   184.5   1951   S[1431]   -9982   309.5   1985   DMY   -10458   309.5   2019   DMY   -10934   309.5   1952   S[1432]   -9996   184.5   1986   DMY   -10472   184.5   2020   DMY   -10948   184.5   1953   S[1433]   -10010   309.5   1987   DMY   -10486   309.5   2021   DMY   -10962   309.5   1954   S[1434]   -10024   184.5   1988   DMY   -10500   184.5   2022   DMY   -10976   184.5   1955   S[1435]   -10038   309.5   1989   DMY   -10500   184.5   2022   DMY   -10990   309.5   1956   S[1436]   -10052   184.5   1990   DMY   -10528   184.5   2024   DMY   -11004   184.5   1957   S[1437]   -10066   309.5   1991   DMY   -10566   184.5   2026   GO[17]   -1108   309.5   1958   S[1438]   -10080   184.5   1992   DMY   -10570   309.5   2027   GO[17]   -11046   309.5   1960   S[1440]   -10108   184.5   1994   DMY   -10584   184.5   2028   GO[18]   -11060   184.5   1961   SDUM2   -10122   309.5   1995   DMY   -10598   309.5   2029   GO[18]   -11048   309.5   1962   SDUM3   -10160   184.5   1996   DMY   -10598   309.5   2029   GO[18]   -11060   184.5   1963   DMY   -10666   309.5   2031   GO[19]   -11102   309.5   1962   SDUM3   -10150   309.5   1997   DMY   -10626   309.5   2031   GO[19]   -11102   309.5   1965   VGLO   -10164   184.5   1998   DMY   -10640   184.5   2032   GO[20]   -11116   184.5   1966   VGLO   -10178   309.5   1999   DMY   -10640   184.5   2033   GO[20]   -11116   184.5   1966   VGLO   -10178   309.5   1999   DMY   -10640   184.5   2033   GO[20]   -11116   184.5   1966   VGLO   -10178   309.5   1999   DMY   -10640   184.5   2033   GO[20]   -11116   184.5   1966   VGLO   -10178   309.5   1999   DMY   -10640   184.5   2033   GO[20]   -11110   309.5   1 | 1945 | S[1425]  | -9898  | 309.5 | 1979 | VGHO     | -10374 | 309.5 | 2013 | DMY      | -10850 | 309.5 |
| 1948         S[1428]         -9940         184.5         1982         DMY         -10416         184.5         2016         DMY         -10892         184.5           1949         S[1429]         -9954         309.5         1983         DMY         -10430         309.5         2017         DMY         -10906         309.5           1950         S[1430]         -9968         184.5         1984         DMY         -10444         184.5         2018         DMY         -10920         184.5           1951         S[1431]         -9982         309.5         1985         DMY         -10458         309.5         2019         DMY         -10934         309.5           1952         S[1432]         -996         184.5         1986         DMY         -10486         309.5         2021         DMY         -10948         184.5           1953         S[1433]         -10010         309.5         1987         DMY         -10486         309.5         2021         DMY         -10962         309.5           1954         S[1434]         -10024         184.5         1988         DMY         -10500         184.5         2022         DMY         -10976         184.5  | 1946 | S[1426]  | -9912  | 184.5 | 1980 | VGHO     | -10388 | 184.5 | 2014 | DMY      | -10864 | 184.5 |
| 1949   S[1429]   -9954   309.5   1983   DMY   -10430   309.5   2017   DMY   -10906   309.5   1950   S[1430]   -9968   184.5   1984   DMY   -10444   184.5   2018   DMY   -10920   184.5   1951   S[1431]   -9982   309.5   1985   DMY   -10458   309.5   2019   DMY   -10934   309.5   1952   S[1432]   -9996   184.5   1986   DMY   -10472   184.5   2020   DMY   -10948   184.5   1953   S[1433]   -10010   309.5   1987   DMY   -10486   309.5   2021   DMY   -10962   309.5   1954   S[1434]   -10024   184.5   1988   DMY   -10500   184.5   2022   DMY   -10976   184.5   1955   S[1435]   -10038   309.5   1989   DMY   -10514   309.5   2023   DMY   -10990   309.5   1956   S[1436]   -10052   184.5   1990   DMY   -10528   184.5   2024   DMY   -11004   184.5   1957   S[1437]   -10066   309.5   1991   DMY   -10542   309.5   2025   DMY   -11018   309.5   1958   S[1438]   -10080   184.5   1992   DMY   -10556   184.5   2026   GO[17]   -11032   184.5   1959   S[1439]   -10094   309.5   1993   DMY   -10570   309.5   2027   GO[17]   -11046   309.5   1960   S[1440]   -10108   184.5   1994   DMY   -10584   184.5   2028   GO[18]   -11060   184.5   1961   SDUM2   -10122   309.5   1995   DMY   -10598   309.5   2029   GO[18]   -11074   309.5   1962   SDUM3   -10136   184.5   1996   DMY   -10612   184.5   2030   GO[19]   -11088   184.5   1963   DMY   -10612   184.5   2030   GO[19]   -11088   184.5   1963   DMY   -10660   309.5   2031   GO[19]   -11102   309.5   1963   DMY   -10660   309.5   2031   GO[19]   -11102   309.5   1964   DMY   -10164   184.5   1998   DMY   -10640   184.5   2032   GO[20]   -11116   184.5   1965   VGLO   -10178   309.5   1999   DMY   -10640   184.5   2032   GO[20]   -11116   184.5   1965   VGLO   -10178   309.5   1999   DMY   -10664   309.5   2033   GO[20]   -11116   184.5   1965   VGLO   -10178   309.5   1999   DMY   -10664   309.5   2033   GO[20]   -11110   309.5   1965   VGLO   -10178   309.5   1999   DMY   -10654   309.5   2033   GO[20]   -11110   309.5   1965   VGLO   -10178   309.5   1999   DMY   -10664   309.5   20 | 1947 | S[1427]  | -9926  | 309.5 | 1981 | VGHO     | -10402 | 309.5 | 2015 | DMY      | -10878 | 309.5 |
| 1950   S[1430]   -9968   184.5   1984   DMY   -10444   184.5   2018   DMY   -10920   184.5     1951   S[1431]   -9982   309.5   1985   DMY   -10458   309.5   2019   DMY   -10934   309.5     1952   S[1432]   -9996   184.5   1986   DMY   -10472   184.5   2020   DMY   -10948   184.5     1953   S[1433]   -10010   309.5   1987   DMY   -10486   309.5   2021   DMY   -10962   309.5     1954   S[1434]   -10024   184.5   1988   DMY   -10500   184.5   2022   DMY   -10976   184.5     1955   S[1435]   -10038   309.5   1989   DMY   -10514   309.5   2023   DMY   -10990   309.5     1956   S[1436]   -10052   184.5   1990   DMY   -10528   184.5   2024   DMY   -11004   184.5     1957   S[1437]   -10066   309.5   1991   DMY   -10542   309.5   2025   DMY   -11018   309.5     1958   S[1438]   -10080   184.5   1992   DMY   -10556   184.5   2026   GO[17]   -11032   184.5     1959   S[1439]   -10094   309.5   1993   DMY   -10570   309.5   2027   GO[17]   -11046   309.5     1960   S[1440]   -10108   184.5   1994   DMY   -10598   309.5   2029   GO[18]   -11060   184.5     1961   SDUM2   -10122   309.5   1995   DMY   -10598   309.5   2029   GO[18]   -11074   309.5     1962   SDUM3   -10136   184.5   1996   DMY   -10626   309.5   2031   GO[19]   -11108   184.5     1963   DMY   -10150   309.5   1997   DMY   -10640   184.5   2032   GO[20]   -11116   184.5     1965   VGLO   -10178   309.5   1999   DMY   -10640   184.5   2032   GO[20]   -11116   184.5     1965   VGLO   -10178   309.5   1999   DMY   -10640   184.5   2032   GO[20]   -11116   184.5     1965   VGLO   -10178   309.5   1999   DMY   -10640   184.5   2033   GO[20]   -11110   309.5     1965   VGLO   -10178   309.5   1999   DMY   -10640   184.5   2033   GO[20]   -11110   309.5     1965   VGLO   -10178   309.5   1999   DMY   -10640   184.5   2033   GO[20]   -11110   309.5     1965   VGLO   -10178   309.5   1999   DMY   -10640   184.5   2033   GO[20]   -11110   309.5     1966   VGLO   -10178   309.5   1999   DMY   -10654   309.5   2033   GO[20]   -111100   309.5                          | 1948 | S[1428]  | -9940  | 184.5 | 1982 | DMY      | -10416 | 184.5 | 2016 | DMY      | -10892 | 184.5 |
| 1951   S[1431]   -9982   309.5   1985   DMY   -10458   309.5   2019   DMY   -10934   309.5   1952   S[1432]   -9996   184.5   1986   DMY   -10472   184.5   2020   DMY   -10948   184.5   1953   S[1433]   -10010   309.5   1987   DMY   -10486   309.5   2021   DMY   -10962   309.5   1954   S[1434]   -10024   184.5   1988   DMY   -10500   184.5   2022   DMY   -10976   184.5   1955   S[1435]   -10038   309.5   1989   DMY   -10514   309.5   2023   DMY   -10990   309.5   1956   S[1436]   -10052   184.5   1990   DMY   -10528   184.5   2024   DMY   -11004   184.5   1957   S[1437]   -10066   309.5   1991   DMY   -10528   184.5   2025   DMY   -11004   184.5   1958   S[1438]   -10080   184.5   1992   DMY   -10556   184.5   2026   GO[17]   -11032   184.5   1959   S[1439]   -10094   309.5   1993   DMY   -10570   309.5   2027   GO[17]   -11046   309.5   1960   S[1440]   -10108   184.5   1994   DMY   -10584   184.5   2028   GO[18]   -11060   184.5   1961   SDUM2   -10122   309.5   1995   DMY   -10598   309.5   2029   GO[18]   -11074   309.5   1962   SDUM3   -10136   184.5   1996   DMY   -10640   184.5   2032   GO[20]   -11108   184.5   1964   DMY   -10164   184.5   1998   DMY   -10640   184.5   2032   GO[20]   -11110   309.5   1965   VGLO   -10178   309.5   1999   DMY   -10654   309.5   2033   GO[20]   -11116   184.5   1965   VGLO   -10178   309.5   1999   DMY   -10654   309.5   2033   GO[20]   -11130   309.5   1965   VGLO   -10178   309.5   1999   DMY   -10654   309.5   2033   GO[20]   -11110   309.5   1965   VGLO   -10178   309.5   1999   DMY   -10654   309.5   2033   GO[20]   -11110   309.5   1965   VGLO   -10178   309.5   1999   DMY   -10654   309.5   2033   GO[20]   -11110   309.5   1965   VGLO   -10178   309.5   1999   DMY   -10654   309.5   2033   GO[20]   -11110   309.5   1965   VGLO   -10178   309.5   1999   DMY   -10654   309.5   2033   GO[20]   -11110   309.5   1965   VGLO   -10178   309.5   1999   DMY   -10654   309.5   2033   GO[20]   -111100   309.5   1965   DMY   -10654   309.5   2033   GO[20]   -111100   309.5 | 1949 | S[1429]  | -9954  | 309.5 | 1983 | DMY      | -10430 | 309.5 | 2017 | DMY      | -10906 | 309.5 |
| 1952         S[1432]         -9996         184.5         1986         DMY         -10472         184.5         2020         DMY         -10948         184.5           1953         S[1433]         -10010         309.5         1987         DMY         -10486         309.5         2021         DMY         -10962         309.5           1954         S[1434]         -10024         184.5         1988         DMY         -10500         184.5         2022         DMY         -10976         184.5           1955         S[1435]         -10038         309.5         1989         DMY         -10514         309.5         2023         DMY         -10990         309.5           1956         S[1436]         -10052         184.5         1990         DMY         -10528         184.5         2024         DMY         -11004         184.5           1957         S[1437]         -1066         309.5         1991         DMY         -10528         184.5         2024         DMY         -11018         309.5           1958         S[1438]         -10080         184.5         1992         DMY         -10556         184.5         2026         GQ[17]         -11046         309.5   | 1950 | S[1430]  | -9968  | 184.5 | 1984 | DMY      | -10444 | 184.5 | 2018 | DMY      | -10920 | 184.5 |
| 1953         S[1433]         -10010         309.5         1987         DMY         -10486         309.5         2021         DMY         -10962         309.5           1954         S[1434]         -10024         184.5         1988         DMY         -10500         184.5         2022         DMY         -10976         184.5           1955         S[1435]         -10038         309.5         1989         DMY         -10514         309.5         2023         DMY         -10990         309.5           1956         S[1436]         -10052         184.5         1990         DMY         -10528         184.5         2024         DMY         -11004         184.5           1957         S[1437]         -1066         309.5         1991         DMY         -10542         309.5         2025         DMY         -11018         309.5           1958         S[1438]         -10090         184.5         1992         DMY         -10556         184.5         2026         GO[17]         -11032         184.5           1959         S[1439]         -10094         309.5         1993         DMY         -10570         309.5         2027         GO[17]         -11046         309.5 <td>1951</td> <td>S[1431]</td> <td>-9982</td> <td>309.5</td> <td>1985</td> <td>DMY</td> <td>-10458</td> <td>309.5</td> <td>2019</td> <td>DMY</td> <td>-10934</td> <td>309.5</td>  | 1951 | S[1431]  | -9982  | 309.5 | 1985 | DMY      | -10458 | 309.5 | 2019 | DMY      | -10934 | 309.5 |
| 1954         S[1434]         -10024         184.5         1988         DMY         -10500         184.5         2022         DMY         -10976         184.5           1955         S[1435]         -10038         309.5         1989         DMY         -10514         309.5         2023         DMY         -10990         309.5           1956         S[1436]         -10052         184.5         1990         DMY         -10528         184.5         2024         DMY         -11004         184.5           1957         S[1437]         -10066         309.5         1991         DMY         -10542         309.5         2025         DMY         -11018         309.5           1958         S[1438]         -10080         184.5         1992         DMY         -10556         184.5         2026         GO[17]         -11032         184.5           1959         S[1439]         -10094         309.5         1993         DMY         -10570         309.5         2027         GO[17]         -11046         309.5           1960         S[1440]         -10108         184.5         1994         DMY         -10584         184.5         2028         GO[18]         -11060         184.5   | 1952 | S[1432]  | -9996  | 184.5 | 1986 | DMY      | -10472 | 184.5 | 2020 | DMY      | -10948 | 184.5 |
| 1955         S[1435]         -10038         309.5         1989         DMY         -10514         309.5         2023         DMY         -10990         309.5           1956         S[1436]         -10052         184.5         1990         DMY         -10528         184.5         2024         DMY         -11004         184.5           1957         S[1437]         -10066         309.5         1991         DMY         -10542         309.5         2025         DMY         -11018         309.5           1958         S[1438]         -10080         184.5         1992         DMY         -10556         184.5         2026         GO[17]         -11032         184.5           1959         S[1439]         -10094         309.5         1993         DMY         -10570         309.5         2027         GO[17]         -11046         309.5           1960         S[1440]         -10108         184.5         1994         DMY         -10584         184.5         2028         GO[18]         -11060         184.5           1961         SDUM2         -10122         309.5         1995         DMY         -10598         309.5         2029         GO[18]         -11074         309.   | 1953 | S[1433]  | -10010 | 309.5 | 1987 | DMY      | -10486 | 309.5 | 2021 | DMY      | -10962 | 309.5 |
| 1956         S[1436]         -10052         184.5         1990         DMY         -10528         184.5         2024         DMY         -11004         184.5           1957         S[1437]         -10066         309.5         1991         DMY         -10542         309.5         2025         DMY         -11018         309.5           1958         S[1438]         -10080         184.5         1992         DMY         -10556         184.5         2026         GO[17]         -11032         184.5           1959         S[1439]         -10094         309.5         1993         DMY         -10570         309.5         2027         GO[17]         -11046         309.5           1960         S[1440]         -10108         184.5         1994         DMY         -10584         184.5         2028         GO[18]         -11060         184.5           1961         SDUM2         -10122         309.5         1995         DMY         -10598         309.5         2029         GO[18]         -11074         309.5           1962         SDUM3         -10136         184.5         1996         DMY         -10612         184.5         2030         GO[19]         -11088         184   | 1954 | S[1434]  | -10024 | 184.5 | 1988 | DMY      | -10500 | 184.5 | 2022 | DMY      | -10976 | 184.5 |
| 1957         S[1437]         -10066         309.5         1991         DMY         -10542         309.5         2025         DMY         -11018         309.5           1958         S[1438]         -10080         184.5         1992         DMY         -10556         184.5         2026         GO[17]         -11032         184.5           1959         S[1439]         -10094         309.5         1993         DMY         -10570         309.5         2027         GO[17]         -11046         309.5           1960         S[1440]         -10108         184.5         1994         DMY         -10584         184.5         2028         GO[18]         -11060         184.5           1961         SDUM2         -10122         309.5         1995         DMY         -10598         309.5         2029         GO[18]         -11074         309.5           1962         SDUM3         -10136         184.5         1996         DMY         -10612         184.5         2030         GO[19]         -11088         184.5           1963         DMY         -10150         309.5         1997         DMY         -10626         309.5         2031         GO[20]         -11116         184.   | 1955 | S[1435]  | -10038 | 309.5 | 1989 | DMY      | -10514 | 309.5 | 2023 | DMY      | -10990 | 309.5 |
| 1958         S[1438]         -10080         184.5         1992         DMY         -10556         184.5         2026         GO[17]         -11032         184.5           1959         S[1439]         -10094         309.5         1993         DMY         -10570         309.5         2027         GO[17]         -11046         309.5           1960         S[1440]         -10108         184.5         1994         DMY         -10584         184.5         2028         GO[18]         -11060         184.5           1961         SDUM2         -10122         309.5         1995         DMY         -10598         309.5         2029         GO[18]         -11074         309.5           1962         SDUM3         -10136         184.5         1996         DMY         -10612         184.5         2030         GO[19]         -11088         184.5           1963         DMY         -10150         309.5         1997         DMY         -10626         309.5         2031         GO[19]         -11102         309.5           1964         DMY         -10164         184.5         1998         DMY         -10640         184.5         2032         GO[20]         -11116         184.5   | 1956 | S[1436]  | -10052 | 184.5 | 1990 | DMY      | -10528 | 184.5 | 2024 | DMY      | -11004 | 184.5 |
| 1959         S[1439]         -10094         309.5         1993         DMY         -10570         309.5         2027         GO[17]         -11046         309.5           1960         S[1440]         -10108         184.5         1994         DMY         -10584         184.5         2028         GO[18]         -11060         184.5           1961         SDUM2         -10122         309.5         1995         DMY         -10598         309.5         2029         GO[18]         -11074         309.5           1962         SDUM3         -10136         184.5         1996         DMY         -10612         184.5         2030         GO[19]         -11088         184.5           1963         DMY         -10150         309.5         1997         DMY         -10626         309.5         2031         GO[19]         -11102         309.5           1964         DMY         -10164         184.5         1998         DMY         -10640         184.5         2032         GO[20]         -11116         184.5           1965         VGLO         -10178         309.5         1999         DMY         -10654         309.5         2033         GO[20]         -11130         309.5 <td>1957</td> <td>S[1437]</td> <td>-10066</td> <td>309.5</td> <td>1991</td> <td>DMY</td> <td>-10542</td> <td>309.5</td> <td>2025</td> <td>DMY</td> <td>-11018</td> <td>309.5</td>  | 1957 | S[1437]  | -10066 | 309.5 | 1991 | DMY      | -10542 | 309.5 | 2025 | DMY      | -11018 | 309.5 |
| 1960         S[1440]         -10108         184.5         1994         DMY         -10584         184.5         2028         GO[18]         -11060         184.5           1961         SDUM2         -10122         309.5         1995         DMY         -10598         309.5         2029         GO[18]         -11074         309.5           1962         SDUM3         -10136         184.5         1996         DMY         -10612         184.5         2030         GO[19]         -11088         184.5           1963         DMY         -10150         309.5         1997         DMY         -10626         309.5         2031         GO[19]         -11102         309.5           1964         DMY         -10164         184.5         1998         DMY         -10640         184.5         2032         GO[20]         -11116         184.5           1965         VGLO         -10178         309.5         1999         DMY         -10654         309.5         2033         GO[20]         -11130         309.5   | 1958 | S[1438]  | -10080 | 184.5 | 1992 | DMY      | -10556 | 184.5 | 2026 | GO[17]   | -11032 | 184.5 |
| 1961         SDUM2         -10122         309.5         1995         DMY         -10598         309.5         2029         GO[18]         -11074         309.5           1962         SDUM3         -10136         184.5         1996         DMY         -10612         184.5         2030         GO[19]         -11088         184.5           1963         DMY         -10150         309.5         1997         DMY         -10626         309.5         2031         GO[19]         -11102         309.5           1964         DMY         -10164         184.5         1998         DMY         -10640         184.5         2032         GO[20]         -11116         184.5           1965         VGLO         -10178         309.5         1999         DMY         -10654         309.5         2033         GO[20]         -11130         309.5  | 1959 | S[1439]  | -10094 | 309.5 | 1993 | DMY      | -10570 | 309.5 | 2027 | GO[17]   | -11046 | 309.5 |
| 1962         SDUM3         -10136         184.5         1996         DMY         -10612         184.5         2030         GO[19]         -11088         184.5           1963         DMY         -10150         309.5         1997         DMY         -10626         309.5         2031         GO[19]         -11102         309.5           1964         DMY         -10164         184.5         1998         DMY         -10640         184.5         2032         GO[20]         -11116         184.5           1965         VGLO         -10178         309.5         1999         DMY         -10654         309.5         2033         GO[20]         -11130         309.5   | 1960 | S[1440]  | -10108 | 184.5 | 1994 | DMY      | -10584 | 184.5 | 2028 | GO[18]   | -11060 | 184.5 |
| 1963         DMY         -10150         309.5         1997         DMY         -10626         309.5         2031         GO[19]         -11102         309.5           1964         DMY         -10164         184.5         1998         DMY         -10640         184.5         2032         GO[20]         -11116         184.5           1965         VGLO         -10178         309.5         1999         DMY         -10654         309.5         2033         GO[20]         -11130         309.5  | 1961 | SDUM2    | -10122 | 309.5 | 1995 | DMY      | -10598 | 309.5 | 2029 | GO[18]   | -11074 | 309.5 |
| 1964         DMY         -10164         184.5         1998         DMY         -10640         184.5         2032         GO[20]         -11116         184.5           1965         VGLO         -10178         309.5         1999         DMY         -10654         309.5         2033         GO[20]         -11130         309.5   | 1962 | SDUM3    | -10136 | 184.5 | 1996 | DMY      | -10612 | 184.5 | 2030 | GO[19]   | -11088 | 184.5 |
| 1965 VGLO -10178 309.5 1999 DMY -10654 309.5 2033 GO[20] -11130 309.5  | 1963 | DMY      | -10150 | 309.5 | 1997 | DMY      | -10626 | 309.5 | 2031 | GO[19]   | -11102 | 309.5 |
|  | 1964 | DMY      | -10164 | 184.5 | 1998 | DMY      | -10640 | 184.5 | 2032 | GO[20]   | -11116 | 184.5 |
| 1966 VGLO -10192 184.5 2000 DMY -10668 184.5 2034 GO[21] -11144 184.5  | 1965 | VGLO     | -10178 | 309.5 | 1999 | DMY      | -10654 | 309.5 | 2033 | GO[20]   | -11130 | 309.5 |
|  | 1966 | VGLO     | -10192 | 184.5 | 2000 | DMY      | -10668 | 184.5 | 2034 | GO[21]   | -11144 | 184.5 |

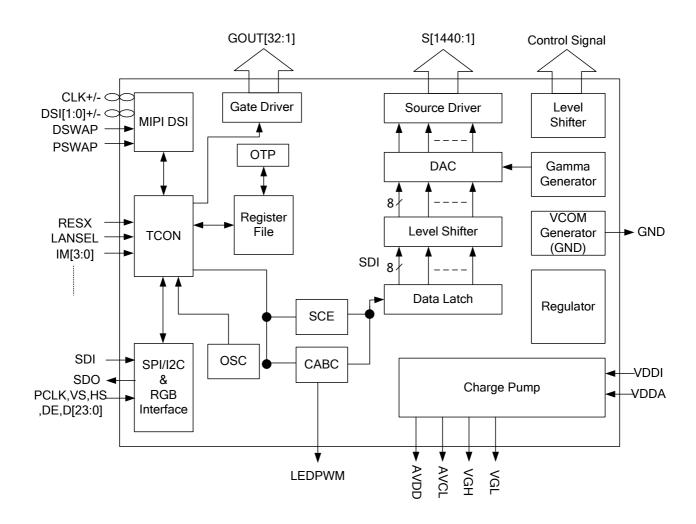
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| PAD<br>No. | PIN Name | х      | Υ     | PAD<br>No. | PIN Name | х      | Υ     | PAD<br>No. | PIN Name | х      | Υ     |
|------------|----------|--------|-------|------------|----------|--------|-------|------------|----------|--------|-------|
| 2035       | GO[21]   | -11158 | 309.5 | 2050       | GO[29]   | -11368 | 184.5 | 2065       | GO[32]   | -11578 | 309.5 |
| 2036       | GO[22]   | -11172 | 184.5 | 2051       | GO[29]   | -11382 | 309.5 | 2066       | GO[32]   | -11592 | 184.5 |
| 2037       | GO[22]   | -11186 | 309.5 | 2052       | GO[30]   | -11396 | 184.5 | 2067       | VGLO     | -11606 | 309.5 |
| 2038       | GO[23]   | -11200 | 184.5 | 2053       | GO[30]   | -11410 | 309.5 | 2068       | VGLO     | -11620 | 184.5 |
| 2039       | GO[23]   | -11214 | 309.5 | 2054       | VGLO     | -11424 | 184.5 | 2069       | VGLO     | -11634 | 309.5 |
| 2040       | GO[24]   | -11228 | 184.5 | 2055       | VGLO     | -11438 | 309.5 | 2070       | VGHO     | -11648 | 184.5 |
| 2041       | GO[24]   | -11242 | 309.5 | 2056       | VGLO     | -11452 | 184.5 | 2071       | VGHO     | -11662 | 309.5 |
| 2042       | GO[25]   | -11256 | 184.5 | 2057       | DMY      | -11466 | 309.5 | 2072       | VGHO     | -11676 | 184.5 |
| 2043       | GO[25]   | -11270 | 309.5 | 2058       | DMY      | -11480 | 184.5 | 2073       | PADA4    | -11690 | 309.5 |
| 2044       | GO[26]   | -11284 | 184.5 | 2059       | DMY      | -11494 | 309.5 | 2074       | PADB4    | -11704 | 184.5 |
| 2045       | GO[26]   | -11298 | 309.5 | 2060       | VGL      | -11508 | 184.5 | 2075       | DMY      | -11718 | 309.5 |
| 2046       | GO[27]   | -11312 | 184.5 | 2061       | VGL      | -11522 | 309.5 | 2076       | DMY      | -11732 | 184.5 |
| 2047       | GO[27]   | -11326 | 309.5 | 2062       | VGL      | -11536 | 184.5 | 2077       | DMY      | -11760 | 309.5 |
| 2048       | GO[28]   | -11340 | 184.5 | 2063       | GO[31]   | -11550 | 309.5 | 2078       | ALIGN_L  | -11870 | 302   |
| 2049       | GO[28]   | -11354 | 309.5 | 2064       | GO[31]   | -11564 | 184.5 | 2079       | ALIGN_R  | 11870  | 302   |



#### **5 BLOCK DIAGRAM**





#### **6 PIN DESCRIPTION**

#### 6.1 Power Supply Pins

| Name  | I/O | Description  | Connect Pin       |
|-------|-----|--|-------------------|
| VDDI  | I   | Power Supply for I/O System.   | VDDI              |
| VDDA  | I   | Power Supply for Analog, Digital System and Booster Circuit.   | VDDA              |
| VDDM  | I   | Power Supply for MIPI Circuit.   | VDDA              |
| VDDB  | I   | Power Supply for internal Circuit.   | VDDA              |
| VDDB2 | I   | Power Supply for internal Circuit.   | VDDA              |
| VDDR  | I   | Power Supply for internal Circuit.   | VDDA              |
| VDDR1 | I   | Power Supply for internal Circuit.   | VDDA              |
| VSSB  | I   | System Ground for internal Circuit.  | AGND              |
| VSSB2 | I   | System Ground for internal Circuit.  | AGND              |
| VSSR  | I   | System Ground for internal Circuit.  | AGND              |
| VSSA  | I   | System Ground for internal Circuit.  | AGND              |
| VSSM  | I   | System Ground for MIPI Circuit.  | AGND              |
| AGND  | I   | System Ground for Analog System and Booster Circuit.   | AGND              |
| DGND  | I   | System Ground for I/O System and Digital System.   | DGND              |
| VPP   | I   | When programming NVM, can select internal power or external power supply voltage (7.5V); the current of lvpp must be more than 10mA.  If select internal power then leaves the pin open when not in use. | External<br>Power |



# 6.2 Bus Interface Pins

| Name            | I/O   |                  | Connect Pin                       |          |            |                                    |           |  |  |
|-----------------|---|------------------|-----------------------------------|----------|------------|------------------------------------|-----------|--|--|
| Digital Control |   |                  |                                   |          |            |                                    |           |  |  |
|                 |   | -The System in   | The System interface mode select. |          |            |                                    |           |  |  |
|                 |   | IM3              | IM2                               | IM1      | IM0        | MPU Interface Mode                 |           |  |  |
|                 |   | 0                | 0                                 | 0        | 1          | RGB+8b SPI(fall)                   |           |  |  |
|                 |   | 0                | 0                                 | 1        | 0          | RGB+9b SPI(fall)                   |           |  |  |
| IM3, IM2,       |   | 0                | 0                                 | 1        | 1          | RGB+16b SPI(rise)                  |           |  |  |
| IM1, IM0        | I   | 0/1              | 1                                 | 0        | 1          | MIPI                               | VDDI/DGND |  |  |
| 11011, 11010    |   | 0                | 1                                 | 1        | 0          | MIPI+16b SPI(rise)                 |           |  |  |
|                 |   | 1                | 0                                 | 0        | 1          | RGB+8b SPI(rise)                   |           |  |  |
|                 |   | 1                | 0                                 | 1        | 1          | RGB+9b SPI(rise) RGB+16b SPI(fall) |           |  |  |
|                 |   | 1                | 1                                 | 1        | 0          | MIPI+16b SPI(fall)                 |           |  |  |
|                 |   | - The external r | eset inn                          | t        |            |                                    |           |  |  |
| RESETSX         |   |                  | •                                 |          | nnut Ra    | sure to execute a power-on         | MPU       |  |  |
| TILOLIOX        | '   | reset after supp | -                                 |          | прии ве    | sure to execute a power on         | WII O     |  |  |
|                 |   |                  |                                   |          | oltage le  | evel sequence of V0~V255.          |           |  |  |
|                 |   | Low: V0 > V1 >   | _                                 |          | •          | ·                                  |           |  |  |
| NBWSEL          | I   | High: V255 > V   |                                   |          |            | •                                  | VDDI/DGND |  |  |
|                 |   | Fix to VDDI lev  |                                   |          |            | ially black                        |           |  |  |
|                 |   |                  |                                   |          |            | ut voltage swing is VDDI to        |           |  |  |
| GO [3:0]        | 0   | DGND.            | o output                          | , p      |            | at rotage chang to real to         | MPU       |  |  |
|                 |   | Leave the pin op | en.                               |          |            |                                    | VDDI/DGND |  |  |
|                 |   |                  |                                   | SF       | PI Interfa | ace                                |           |  |  |
|                 |   | - A chip select  | signal                            |          |            |                                    |           |  |  |
|                 |   | Low: the chip is |                                   |          |            |                                    |           |  |  |
| CSX             | CSX I High: the chip is not selected and not accessible |                  |                                   |          |            |                                    | MPU       |  |  |
|                 |   | Fix to VDDI or   |                                   |          |            |                                    |           |  |  |
|                 |   | - The SPI interf |                                   |          |            |                                    |           |  |  |
|                 |   | parameter sele   |                                   |          |            |                                    |           |  |  |
| DCX             | I   | Low: Command     | MPU                               |          |            |                                    |           |  |  |
|                 |   | High: Paramete   | r                                 |          |            |                                    |           |  |  |
|                 |   | Fix to VDDI or   | DGND le                           | vel when | not in u   | ise.                               |           |  |  |



# **ST7701S**

| Name        | I/O | Description  | Connect Pin |  |  |  |  |  |
|-------------|-----|--|-------------|--|--|--|--|--|
| SCL         | _   | SCL: Serial clock input for SPI interface.                         | MDU         |  |  |  |  |  |
| SCL         | I   | Fix to VDDI or DGND level when not in use.                         | MPU         |  |  |  |  |  |
| SDA         | 1   | SDA: Serial data input/output bidirectional pin for SPI Interface. | MPU         |  |  |  |  |  |
| SDA         | -   | Fix to DGND level when not in use.                                 |             |  |  |  |  |  |
| SDO         | 0   | Serial data output pin used for the SPI Interface.                 |             |  |  |  |  |  |
| 350         | )   | Leave the pin open when not in use.                                | MPU         |  |  |  |  |  |
| I2C_SA[0:1] | I   | Fix to VDDI or DGND level.   | MPU         |  |  |  |  |  |
|             |     | RGB Interface  |             |  |  |  |  |  |
| PCLK        | ı   |  | MPU         |  |  |  |  |  |
| I OLK       | •   | Fix to VDDI or DGND level when not in use.                         | IVII O      |  |  |  |  |  |
| VS          | ı   | Frame synchronizing signal for RGB interface operation             | MPU         |  |  |  |  |  |
| ٧٥          | •   | Fix to VDDI or DGND level when not in use.                         | IVIFO       |  |  |  |  |  |
| HS          | ı   | Line synchronizing signal for RGB interface operation              | MPU         |  |  |  |  |  |
| ПЗ          | •   | Fix to VDDI or DGND level when not in use.                         | IVIFU       |  |  |  |  |  |
|             |     | Data enable signal for RGB interface operation                     |             |  |  |  |  |  |
| DE          | I   | Low: access enabled  | MPU         |  |  |  |  |  |
| DE          |     | High: access inhibited   | IVIPU       |  |  |  |  |  |
|             |     | Fix to VDDI or DGND level when not in use.                         |             |  |  |  |  |  |
|             |     | A 24-bit parallel data bus for RGB Interface.                      |             |  |  |  |  |  |
|             |     | 24-bit/pixel: D[23:16]=R,D[15:8]=G,D[7:0]=B                        |             |  |  |  |  |  |
| DB [23:0]   | 1/0 | 18-bit/pixel: MDT=0:D[21:16]=R,D[13:8]=G,D[5:0]=B                  | MPU         |  |  |  |  |  |
| DB [23.0]   | I/O | MDT=1:D[17:12]=R,D[11:6]=G,D[5:0]=B                                | IVIPU       |  |  |  |  |  |
|             |     | 16-bit/pixel: D[20:16]=R,D[13:8]=G,[4:0]=B                         |             |  |  |  |  |  |
|             |     | Fix to VDDI or DGND level when not in use.                         |             |  |  |  |  |  |
|             |     | CABC Control   |             |  |  |  |  |  |
| LEDON       | 0   | Used for turning On/Off external LED backlight control.            | CABC        |  |  |  |  |  |
| LLDON       | )   | Leave the pin open when not in use.                                | CABO        |  |  |  |  |  |
| LEDPWM      | 0   | The PWM frequency output for LCD driver control.                   | CABC        |  |  |  |  |  |
| LEDF WIVI   | )   | Leave the pin open when not in use.                                | CABC        |  |  |  |  |  |
|             |     | MIPI Interface   |             |  |  |  |  |  |
| СР          |     | MIPI DSI differential clock pair.                                  |             |  |  |  |  |  |
| CN          | 1   | That the COG resistance is less than 10 ohm.                       | MIPI        |  |  |  |  |  |
| 011         |     | If MIPI are not in use, they should be connected to VSSM.          |             |  |  |  |  |  |
| DP0         |     | MIPI DSI differential data pair.                                   |             |  |  |  |  |  |
| DN0         | I/O | That the COG resistance is less than 10 ohm.                       | MIPI        |  |  |  |  |  |
| DP1         |     | If MIPI are not in use, they should be connected to VSSM           |             |  |  |  |  |  |



# **ST7701S**

| Name   | I/O   |           | Description   |             |            |             |           |           |            |      |      | Connect Pin |       |       |      |      |       |       |       |       |      |      |      |       |       |           |      |      |      |  |  |
|--------|-------|-----------|---|-------------|------------|-------------|-----------|-----------|------------|------|------|-------------|-------|-------|------|------|-------|-------|-------|-------|------|------|------|-------|-------|-----------|------|------|------|--|--|
| DN1    |       |           |   |             |            |             |           |           |            |      |      |             |       |       |      |      |       |       |       |       |      |      |      |       |       |           |      |      |      |  |  |
|        |       | CF        | CRC and ECC error output pin for the MIPI interface, activated by |             |            |             |           |           |            |      |      |             |       |       |      |      |       |       |       |       |      |      |      |       |       |           |      |      |      |  |  |
| ERR    | 0     | S/        | W comma   | ınd. This   | pin is out | put low w   | hen it is | not activ | ated. Wh   | en   |      | MIPI        |       |       |      |      |       |       |       |       |      |      |      |       |       |           |      |      |      |  |  |
| ENN    | O     | thi       | s pin is a  | ctivated, i | t is outpu | t high if C | CRC/ECC   | error is  | found.     |      |      | IVIIFI      |       |       |      |      |       |       |       |       |      |      |      |       |       |           |      |      |      |  |  |
|        |       | Le        | ave the pir   | ı open wh   | en not in  | use.        |           |           |            |      |      |             |       |       |      |      |       |       |       |       |      |      |      |       |       |           |      |      |      |  |  |
|        |       | Inp       | out pin to  | select 1 c  | lata lane  | or 2 data   | lanes in  | MIPI/ME   | DI interfa | ace. |      |             |       |       |      |      |       |       |       |       |      |      |      |       |       |           |      |      |      |  |  |
| LANSEL |       | w: 1 data | lane  |             |            |             |           |           |            |      | MIPI |             |       |       |      |      |       |       |       |       |      |      |      |       |       |           |      |      |      |  |  |
| LANGEL | '     | Hi        | gh: 2 data  | lanes       |            |             |           |           |            |      |      | IVIIFI      |       |       |      |      |       |       |       |       |      |      |      |       |       |           |      |      |      |  |  |
|        |       | Fi.       | x to VSSI   | level when  | not in us  | e.          |           |           |            |      |      |             |       |       |      |      |       |       |       |       |      |      |      |       |       |           |      |      |      |  |  |
|        |       | Di        | Differential clock polarity swap                                  |             |            |             |           |           |            |      |      |             |       |       |      |      |       |       |       |       |      |      |      |       |       |           |      |      |      |  |  |
|        |       | Fo        | or MIPI int   | erface      |            |             |           |           |            |      |      |             |       |       |      |      |       |       |       |       |      |      |      |       |       |           |      |      |      |  |  |
|        |       |           |   |             |            |             |           |           |            |      |      |             |       |       |      |      |       |       |       |       |      |      |      |       |       |           |      |      |      |  |  |
|        |       |           | DOWAR   | DOWAD       |            |             | Pi        | ns        |            |      |      |             |       |       |      |      |       |       |       |       |      |      |      |       |       |           |      |      |      |  |  |
| DSWAP  | PSWAP |           |   |             | 1          | 1           | 1         |           |            | 1    |      | ı           | I     | 1     | 1    |      | DSWAP | PSWAP | CLK_P | CLK_N | D0_P | D0_N | D1_P | D1_N  |       | VDDI/DGND |      |      |      |  |  |
| PSWAP  |       |           | ·   | 0           | 0          | CLK_P       | CLK_N     | D0_P      | D0_N       | D1_P | D1_N |             |       |       |      |      |       |       |       |       |      |      |      |       |       |           |      |      |      |  |  |
|        |       |           |   |             |            |             |           |           |            |      |      |             |       |       |      |      |       |       |       |       |      | 0    | 1    | CLK_N | CLK_P | D0_N      | D0_P | D1_N | D1_P |  |  |
|        |       |           |   |             |            |             |           |           |            |      | _    | 0           | CLK_P | CLK_N | D1_P | D1_N | D0_P  | D0_N  |       |       |      |      |      |       |       |           |      |      |      |  |  |
|        |       |           | 1   | 1           | CLK_N      | CLK_P       | D1_N      | D1_P      | D0_N       | D0_P |      |             |       |       |      |      |       |       |       |       |      |      |      |       |       |           |      |      |      |  |  |

Note1. "1" = VDDI level, "0" = DGND level.

Note2. When in parallel mode, unused data pins must be connected to "1" or "0".

Note3. When CSX="1", there is no influence to the parallel and serial interface.



# 6.3 Driver Output Pins

| Name        | I/O | Description  | Connect pin |  |
|-------------|-----|--|-------------|--|
| S [1:1440]  | 0   | Source output voltage signals applied to a LCD panel             | LCD         |  |
| GOUT [1:32] | 0   | Gate control signals and the swing voltage level is VGHO to VGLO | LCD         |  |
| CDUM (0.01  |     | Dummy Source   | LCD         |  |
| SDUM [0:3]  | 0   | Leave the pin open when not in use.                              | LCD         |  |
| VCOM        | 0   | Regulator output for common voltage of panel.                    | LCD         |  |
| VCOIVI      | O   | Fix to AGND level.   | LCD         |  |
| VGL         | 0   | Connect to VGL or OPEN.  | LCD         |  |
| VGLO        | 0   | Negative Output voltage from the regulator.                      | LCD         |  |
| VGL_REG     | 0   | Connect to VGL or OPEN.  | LCD         |  |
| VGHS        | 0   | Connect to VGH.  | LCD         |  |
| VGHO        | 0   | Positive Output voltage from the regulator.                      | LCD         |  |

# 6.4 Test and other pins

| VCCMA       O       Used for monitoring.       OPEN         V20       O       Used for monitoring.       OPEN         VPS1/VPS2       O       Used for monitoring.       OPEN         VCCMD       O       Used for monitoring.       OPEN         V12TX       O       Used for monitoring.       OPEN         AVDD       O       Power Pad for analog Circuit.       OPEN         AVCL       O       Power Pad for analog Circuit.       OPEN         VAN       O       A power output of grayscale voltage.       OPEN         VAP       O       A power output (negative) of gray scale voltage.       OPEN         RDX       I       Input pin for testing.       VDDI/DG         Fix to VDDI or DGND level.       Input pin for testing.       DGND         Fix to DGND level.       DGND       DGND         VGSW[0:3]       I       Input pins for testing.       VDDI/DG         VGSW[0:3]       I       Fix to DGND level when not in use.       VDDI/DG         TESTO[0:3]       O       Output pins for testing.       OPEN         Please keep these pins floating.       OPEN   |                 |          |  |                      |      |
|--|-----------------|----------|--|----------------------|------|
| V20 O Used for monitoring. OPEN  VPS1/VPS2 O Used for monitoring. OPEN  VCCMD O Used for monitoring. OPEN  V12TX O Used for monitoring. OPEN  AVDD O Power Pad for analog Circuit. OPEN  AVCL O Power Pad for analog Circuit. OPEN  AVCL O A power output of grayscale voltage. OPEN  VAN O A power output (negative) of gray scale voltage. OPEN  RDX I Input pin for testing.  Fix to VDDI or DGND level.  EXB1T I Fix to DGND level.  VGSW[0:3] I Input pins for testing.  Fix to DGND level when not in use.  VDDI/DG  TESTO[0:3] O Output pins for testing.  Please keep these pins floating.   | VCC             | 0        | Used for monitoring.                             | OPEN                 |      |
| VPS1/VPS2       O       Used for monitoring.       OPEN         VCCMD       O       Used for monitoring.       OPEN         V12TX       O       Used for monitoring.       OPEN         AVDD       O       Power Pad for analog Circuit.       OPEN         AVCL       O       Power Pad for analog Circuit.       OPEN         VAN       O       A power output of grayscale voltage.       OPEN         VAP       O       A power output (negative) of gray scale voltage.       OPEN         RDX       I       Input pin for testing.       VDDI/DG         Fix to VDDI or DGND level.       VDDI/DG       DGNE         EXB1T       I       Fix to DGND level.       DGNE         VGSW[0:3]       I       Input pins for testing.       VDDI/DG         Fix to DGND level when not in use.       VDDI/DG         TESTO[0:3]       O       Output pins for testing.       OPEN         TESTO[0:3]       O       Output pins for testing.       OPEN  | VCCMA           | 0        | Used for monitoring.                             | OPEN                 |      |
| VCCMD O Used for monitoring. OPEN  V12TX O Used for monitoring. OPEN  AVDD O Power Pad for analog Circuit. OPEN  AVCL O Power Pad for analog Circuit. OPEN  VAN O A power output of grayscale voltage. OPEN  VAP O A power output (negative) of gray scale voltage. OPEN  RDX I Input pin for testing.  Fix to VDDI or DGND level.  DSTB_SEL I input pin for testing.  Fix to DGND level.  EXB1T I Fix to DGND level when not in use.  VGSW[0:3] I Input pins for testing.  Fix to DGND level when not in use.  OUTDI/DG  VDDI/DG  Please keep these pins floating.  OPEN  | V20             | 0        | Used for monitoring.                             | OPEN                 |      |
| V12TX O Used for monitoring. OPEN  AVDD O Power Pad for analog Circuit. OPEN  AVCL O Power Pad for analog Circuit. OPEN  VAN O A power output of grayscale voltage. OPEN  VAP O A power output (negative) of gray scale voltage. OPEN  RDX I Input pin for testing.  Fix to VDDI or DGND level.  DSTB_SEL I input pin for testing.  Fix to DGND level.  EXB1T I This pin is for test  Fix to DGND level when not in use.  VDDI/DG  VDDI/DG  VDDI/DG  VDDI/DG  VDDI/DG  VDDI/DG  Fix to DGND level when not in use.  Output pins for testing.  Fix to DGND level when not in use.  Output pins for testing.  Please keep these pins floating.   | VPS1/VPS2       | 0        | Used for monitoring.                             | OPEN                 |      |
| AVDD O Power Pad for analog Circuit. OPEN  AVCL O Power Pad for analog Circuit. OPEN  VAN O A power output of grayscale voltage. OPEN  VAP O A power output (negative) of gray scale voltage.  RDX I Input pin for testing.  Fix to VDDI or DGND level.  DSTB_SEL I input pin for testing.  Fix to DGND level.  EXB1T I Fix to DGND level when not in use.  VGSW[0:3] I Input pins for testing.  Fix to DGND level when not in use.  Output pins for testing.  Please keep these pins floating.  OPEN  | VCCMD           | 0        | Used for monitoring.                             | OPEN                 |      |
| AVCL O Power Pad for analog Circuit. OPEN  VAN O A power output of grayscale voltage. OPEN  VAP O A power output (negative) of gray scale voltage. OPEN  RDX I Input pin for testing.  Fix to VDDI or DGND level.  DSTB_SEL I input pin for testing.  Fix to DGND level.  EXB1T I This pin is for test  Fix to DGND level when not in use.  VGSW[0:3] I Input pins for testing.  Fix to DGND level when not in use.  Output pins for testing.  Please keep these pins floating.  OPEN  | V12TX           | 0        | Used for monitoring.                             | OPEN                 |      |
| VAN O A power output of grayscale voltage. OPEN  VAP O A power output (negative) of gray scale voltage. OPEN  RDX I Input pin for testing.  Fix to VDDI or DGND level.  DSTB_SEL I Input pin for testing.  Fix to DGND level.  EXB1T I Fix to DGND level when not in use.  VGSW[0:3] I Input pins for testing.  Fix to DGND level when not in use.  VDDI/DG  VDDI/DG  Please keep these pins floating.  OPEN  OPEN | AVDD            | 0        | Power Pad for analog Circuit.                    | OPEN                 |      |
| VAP O A power output (negative) of gray scale voltage.  RDX I Input pin for testing. Fix to VDDI or DGND level.  DSTB_SEL I input pin for testing. Fix to DGND level.  EXB1T I This pin is for test Fix to DGND level when not in use.  VGSW[0:3] I Input pins for testing. Fix to DGND level when not in use.  TESTO[0:3] O Output pins for testing. Please keep these pins floating. OPEN  | AVCL            | 0        | Power Pad for analog Circuit.                    | OPEN                 |      |
| RDX I Input pin for testing.  Fix to VDDI or DGND level.  DSTB_SEL I input pin for testing.  Fix to DGND level.  This pin is for test  Fix to DGND level when not in use.  VGSW[0:3] I Input pins for testing.  Fix to DGND level when not in use.  Output pins for testing.  Please keep these pins floating.  OPEN   | VAN             | 0        | A power output of grayscale voltage.             | OPEN                 |      |
| RDX   I   Fix to VDDI or DGND level.   DGND  | VAP             | 0        | A power output (negative) of gray scale voltage. | OPEN                 |      |
| Fix to VDDI or DGND level.   Input pin for testing.   DGND   | DDV             |          | Input pin for testing.                           | VDDI/DGND            |      |
| DSTB_SEL    Fix to DGND level.    This pin is for test   DGND  | NDX             | <u>'</u> | Fix to VDDI or DGND level.                       | VDDI/DGND            |      |
| Fix to DGND level.  EXB1T  I This pin is for test  Fix to DGND level when not in use.  VGSW[0:3]  I I I I I I I I I I I I I I I I I I I  | DSTR SEI        |          | input pin for testing.                           | DGND                 |      |
| EXB1T  I  Fix to DGND level when not in use.  UGSW[0:3]  I  Input pins for testing. Fix to DGND level when not in use.  Output pins for testing. Please keep these pins floating.  OPEN  |                 | <u>'</u> | Fix to DGND level.                               | DGND                 |      |
| Fix to DGND level when not in use.  UGSW[0:3]  I Input pins for testing. Fix to DGND level when not in use.  Output pins for testing. Please keep these pins floating.  OPEN   | EYR1T           |          |  | This pin is for test | DGND |
| VGSW[0:3]  I Fix to DGND level when not in use.  Output pins for testing. Please keep these pins floating.  VDDI/DG  OPEN  | LABIT           | <u>'</u> | Fix to DGND level when not in use.               | Danb                 |      |
| TESTO[0:3]  Output pins for testing.  Please keep these pins floating.  OPEN   | VGSWIU·31       | ,        | Input pins for testing.                          | VDDI/DGND            |      |
| TESTO[0:3] O Please keep these pins floating.  | V G G V [ 0.5 ] |          | Fix to DGND level when not in use.               | V DDI/DGIND          |      |
| Please keep these pins floating.   | TESTOI0:31      | 0        | Output pins for testing.                         | OPEN                 |      |
| TE L O For IC Test. OPEN   | 12010[0.0]      |          | Please keep these pins floating.                 | OI LIV               |      |
| _   1   1   1   1   1   1   1   1   1  | TE_L            | 0        | For IC Test.                                     | OPEN                 |      |

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|            |     | Leave the pin open when not in use.                               |      |
|------------|-----|---|------|
| VGHP       | 0   | Power Pad for analog Circuit.                                     | OPEN |
| VGHEQ2     | 0   | Output pins for testing.  | OPEN |
| VGHEQ2     |     | Please keep this pin floating.                                    | OPEN |
| VSSIDUM0~3 | ı   | GND Dummy pads. Connect to AGND.                                  | AGND |
| PADA1      |     | These test pins for chip attachment detection.                    |      |
| PADB1      |     | PADA1 to PADA2 are output pins and PADB1 to PADB2 are input pins. |      |
| PADA2      | I/O | -For normal operation:  | OPEN |
| PADB2      |     | Connect PADA1 and PADB1 together by ITO trace.                    |      |
| PADB2      |     | Connect PADA2 and PADB2 together by ITO trace.                    |      |
| CNTACT1    | I/O | Test his for test handing quality                                 | OPEN |
| CNTACT2    | 1/0 | Test pin , for test bonding quality.                              | OFEN |
|            |     | These pins are dummy (no electrical characteristic)               |      |
| DUMMY      | -   | Can pass signal through these pads on TFT panel.                  | OPEN |
|            |     | Please open these pins.   |      |



# 7 DRIVER ELECTRICAL CHARACTERISTICS

## 7.1 Absolute Operation Range

| Item                        | Symbol  | Rating            | Unit                 |
|-----------------------------|---------|-------------------|----------------------|
| Supply Voltage              | VDD     | - 0.3 ~ +3.6      | ٧                    |
| Supply Voltage (Logic)      | VDDI    | - 0.3 ~ +3.6      | ٧                    |
| Driver Supply Voltage       | VGH-VGL | -0.3 ~ +30.0      | ٧                    |
| Logic Input Voltage Range   | VIN     | -0.3 ~ VDDI + 0.5 | ٧                    |
| Logic Output Voltage Range  | VO      | -0.3 ~ VDDI + 0.5 | ٧                    |
| Operating Temperature Range | TOPR    | -30 ~ +85         | $^{\circ}\mathbb{C}$ |
| Storage Temperature Range   | TSTG    | -40 ~ +125        | $^{\circ}\mathbb{C}$ |

**Table 1 Absolute Operation Range** 

Note: If one of the above items is exceeded its maximum limitation momentarily, the quality of the product may be degraded. Absolute maximum limitation, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the recommend range.



# 7.2 DC Characteristics

|   |        |                          | s       | pecification | on      |      | Related               |
|---|--------|--------------------------|---------|--------------|---------|------|-----------------------|
| Parameter   | Symbol | Condition                | MIN.    | TYP.         | MAX.    | Unit | Pins                  |
|   |        |                          |         |              |         |      |                       |
| System Voltage                                      | VDD    | Operating voltage        | 2.5     | 2.8          | 3.6     | V    |                       |
| Interface Operation Voltage                         | VDDI   | I/O Supply<br>Voltage    | 1.65    | 1.8          | 3.3     | V    |                       |
| Gate Driver High Voltage                            | VGH    |                          | 11.5    |              | 17      | V    |                       |
| Gate Driver Low Voltage                             | VGL    |                          | -7.6    |              | -12     | V    |                       |
| Gate Driver Supply Voltage                          |        | VGH-VGL                  | -       |              | 30      | V    |                       |
|   |        | Input / Outp             | out     |              |         |      |                       |
| Logic-High Input Voltage                            | VIH    |                          | 0.7VDDI |              | VDDI    | V    | Note 1                |
| Logic-Low Input Voltage                             | VIL    |                          | VSS     |              | 0.3VDDI | V    | Note 1                |
| Logic-High Output Voltage                           | VOH    | IOH = -1.0mA             | 0.8VDDI |              | VDDI    | V    | Note 1                |
| Differential Input High Threshold Voltage           | VIT+   |                          |         | 0            | 50      | mV   |                       |
| Differential Input Low Threshold Voltage            | VIT-   |                          | -50     | 0            |         | mV   | MIPI_CLK<br>MIPI_Data |
| Single-ended Receiver Input Operation Voltage Range | VIR    |                          | 0.5     |              | 1.2     | V    |                       |
| Logic-Low Output Voltage                            | VOL    | IOL = +1.0mA             | VSS     |              | 0.2VDDI | V    | Note 1                |
| Logic-High Input Current                            | IIH    | VIN = VDDI               |         |              | 1       | uA   | Note 1                |
| Logic-Low Input Current                             | IIL    | VIN = VSS                | -1      |              |         | uA   | Note 1                |
| Input Leakage Current                               | IIL    | IOH = -1.0mA             | -0.1    |              | 0.1     | uA   | Note 1                |
|   |        | VCOM Volta               | ige     |              |         |      |                       |
| VCOM amplitude                                      | VCOM   |                          |         | VSS          |         | V    |                       |
|   |        | Source Driv              | er      |              |         |      |                       |
| Gamma Reference Voltage(Positive)                   | VAP    |                          | 4.4     |              | 6.4     | V    |                       |
| Gamma Reference Voltage(Negative)                   | VAN    |                          | -2.6    |              | -4.6    | V    |                       |
| Source Output Settling Time                         | Tr     | Below with 99% precision |         |              | 10      | us   | Note 2                |

# **Table 2 Basic DC Characteristics**

Notes:

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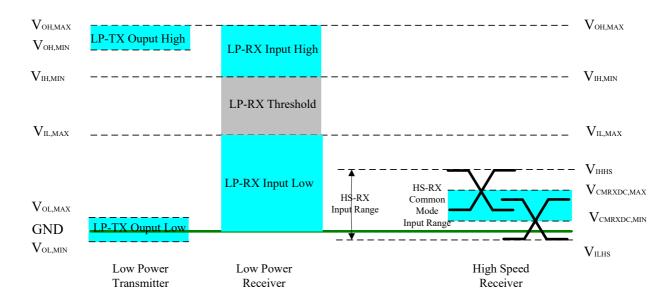




- 2. The Max. value is between measured point of source output and gamma setting value.
- 3. When evaluating the maximum and minimum of VGH, VDD=2.8V.
- 4. The maximum value of |VGH-VGL| can no over 30V.



# 7.3 DC Characteristics



#### 

|                                  | •                |               | D1=1.0, VDD=2.0, A |      |      |  |
|----------------------------------|------------------|---------------|--------------------|------|------|--|
| Parameter                        | Cymbol           |               | Specification      |      |      |  |
| Farameter                        | Symbol           | MIN           | TYP                | MAX  | Unit |  |
| Operation                        | n Voltage for I  | MIPI Receiver |                    |      |      |  |
| Low power mode operating voltage | VLPH             | 1.1           | 1.2                | 1.3  | V    |  |
| MIPI Characte                    | ristics for Higl | n Speed Rece  | iver               |      | ı    |  |
| Single-ended input low voltage   | V ILHS           | -40           | -                  | -    | mV   |  |
| Single-ended input high voltage  | V IHHS           | -             | -                  | 460  | mV   |  |
| Common-mode voltage              | VCMRXDC          | 70            | -                  | 330  | mV   |  |
| Differential input impedance     | ZID              | 80            | 100                | 125  | ohm  |  |
| MIPI Charac                      | teristics for Lo | ow Power Mod  | de                 |      |      |  |
| Pad signal voltage range         | Vı               | -50           | -                  | 1350 | mV   |  |
| Logic 0 input threshold          | VIL              | 0-            | -                  | 550  | mV   |  |
| Logic 1 input threshold          | Vін              | 880           | -                  | 1350 | mV   |  |
| Output low level                 | <b>V</b> ol      | -50           | -                  | 50   | mV   |  |
| Output high level                | Vон              | 1.1           | 1.2                | 1.3  | V    |  |



# 7.4 Power Consumption

#### **RGB** Interface

 $Ta=25\,\mathcal{C}$ , Frame rate = 60Hz, Registers setting are IC default setting.

|                |       | Current Consumption |      |         |      |  |  |  |
|----------------|-------|---------------------|------|---------|------|--|--|--|
| Operation Mode | Image | Тур                 | ical | Maximum |      |  |  |  |
| Operation Mode |       | IDDI                | IDD  | IDDI    | IDD  |  |  |  |
|                |       | (uA)                | (uA) | (uA)    | (uA) |  |  |  |
| Sleep-in mode  |       | 5                   | 45   | 10      | 60   |  |  |  |

## MIPI Interface

 $Ta=25\,C$ , Frame rate = 60Hz, Registers setting are IC default setting.

|                |       |      | Current Co | nsumption |      |
|----------------|-------|------|------------|-----------|------|
| Onevetion Made | Image | Тур  | ical       | Maximum   |      |
| Operation Mode |       | IDDI | IDD        | IDDI      | IDD  |
|                |       | (uA) | (uA)       | (uA)      | (uA) |
| Sleep-in mode  |       | 5    | 70         | 10        | 100  |

# **Table 3 Power Consumption**

#### Notes:

 ${\it 1. The \ Current \ Consumption \ is \ DC \ characteristics \ of \ ST7701S}.$ 

2. *Typical: VDDI=1.8V, VDD=2.8V;* 



## 7.5 AC Characteristics

#### 7.5.1 Serial Interface Characteristics (3-line serial):

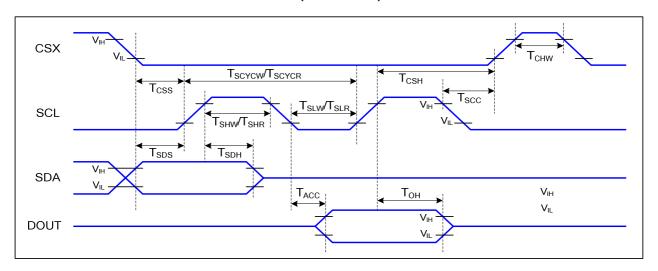


Figure 1 3-line serial Interface Timing Characteristics

VDDI=1.8,VDD=2.8, AGND=DGND=0V, Ta=25  $^{\circ}$ C

| Signal | Symbol             | Parameter                      | Min | Max | Unit | Description |
|--------|--------------------|--------------------------------|-----|-----|------|-------------|
|        | T <sub>CSS</sub>   | Chip select setup time (write) | 15  |     | ns   |             |
|        | T <sub>CSH</sub>   | Chip select hold time (write)  | 15  |     | ns   |             |
| CSX    | T <sub>CSS</sub>   | Chip select setup time (read)  | 60  |     | ns   |             |
|        | T <sub>SCC</sub>   | Chip select hold time (read)   | 60  |     | ns   |             |
|        | $T_CHW$            | Chip select "H" pulse width    | 40  |     | ns   |             |
|        | T <sub>SCYCW</sub> | Serial clock cycle (Write)     | 66  |     | ns   |             |
|        | $T_{SHW}$          | SCL "H" pulse width (Write)    | 15  |     | ns   |             |
| SCL    | T <sub>SLW</sub>   | SCL "L" pulse width (Write)    | 15  |     | ns   |             |
| SCL    | T <sub>SCYCR</sub> | Serial clock cycle (Read)      | 150 |     | ns   |             |
|        | $T_{SHR}$          | SCL "H" pulse width (Read)     | 60  |     | ns   |             |
|        | $T_{SLR}$          | SCL "L" pulse width (Read)     | 60  |     | ns   |             |
| SDA    | T <sub>SDS</sub>   | Data setup time                | 10  |     | ns   |             |
| (DIN)  | T <sub>SDH</sub>   | Data hold time                 | 10  |     | ns   |             |

**Table 4 3-line serial Interface Characteristics** 

Note: The rising time and falling time (Tr, Tf) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

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# 7.5.2 Serial Interface Characteristics (4-line serial):

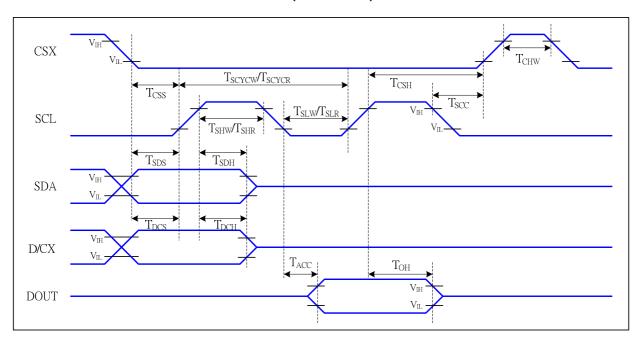


Figure 2 4-line serial Interface Timing Characteristics

VDDI=1.8,VDD=2.8, AGND=DGND=0V, Ta=25  $^{\circ}$ C

| Signal | Symbol             | Parameter                      | MIN | MAX | Unit | Description           |  |
|--------|--------------------|--------------------------------|-----|-----|------|-----------------------|--|
|        | $T_{CSS}$          | Chip select setup time (write) | 15  |     | ns   |                       |  |
|        | T <sub>CSH</sub>   | Chip select hold time (write)  | 15  |     | ns   |                       |  |
| CSX    | T <sub>CSS</sub>   | Chip select setup time (read)  | 60  |     | ns   |                       |  |
|        | T <sub>SCC</sub>   | Chip select hold time (read)   | 65  |     | ns   |                       |  |
|        | T <sub>CHW</sub>   | Chip select "H" pulse width    | 40  |     | ns   |                       |  |
|        | T <sub>SCYCW</sub> | Serial clock cycle (Write)     | 66  |     | ns   | white common d 0 date |  |
|        | $T_SHW$            | SCL "H" pulse width (Write)    | 15  |     | ns   | -write command & data |  |
| SCL    | $T_{SLW}$          | SCL "L" pulse width (Write)    | 15  |     | ns   | ram                   |  |
| SUL    | T <sub>SCYCR</sub> | Serial clock cycle (Read)      | 150 |     | ns   | road command 0 data   |  |
|        | T <sub>SHR</sub>   | SCL "H" pulse width (Read)     | 60  |     | ns   | -read command & data  |  |
|        | $T_{SLR}$          | SCL "L" pulse width (Read)     | 60  |     | ns   | ram                   |  |
| D/CX   | T <sub>DCS</sub>   | D/CX setup time                | 10  |     | ns   |                       |  |
| D/GX   | T <sub>DCH</sub>   | D/CX hold time                 | 10  |     | ns   |                       |  |
| SDA    | T <sub>SDS</sub>   | Data setup time                |     |     | ns   |                       |  |
| (DIN)  | T <sub>SDH</sub>   | Data hold time                 | 10  |     | ns   |                       |  |

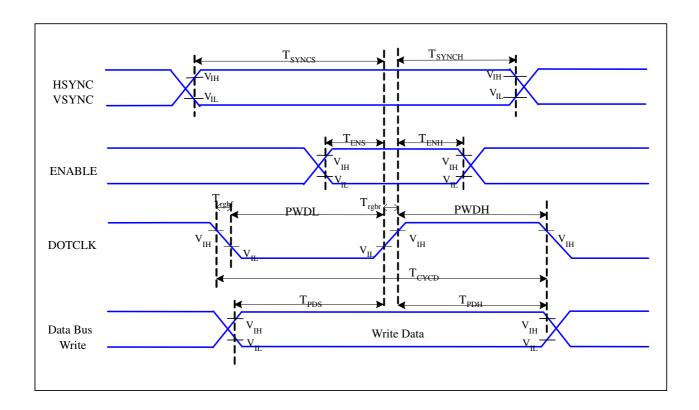
**Table 5 4-line serial Interface Characteristics** 

Note: The rising time and falling time (Tr, Tf) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

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## 7.5.3 RGB Interface Characteristics:



**Figure 3 RGB Interface Timing Characteristics** 

| Signal | Symbol                             | Parameter                           | MIN | MAX | Unit | Description |
|--------|------------------------------------|-------------------------------------|-----|-----|------|-------------|
| HSYNC, | т                                  | VCVNC LICVNC Cotus Time             | _   |     | 20   |             |
| VSYNC  | T <sub>SYNCS</sub>                 | VSYNC, HSYNC Setup Time             | 5   | -   | ns   |             |
| ENABLE | T <sub>ENS</sub>                   | Enable Setup Time                   | 5   | -   | ns   |             |
| ENABLE | T <sub>ENH</sub> Enable Hold Time  |                                     |     | -   | ns   |             |
|        | PWDH                               | DOTCLK High-level Pulse Width       | 15  | -   | ns   |             |
| DOTCLK | PWDL                               | DOTCLK Low-level Pulse Width        | 15  | -   | ns   |             |
| DOTCLK | $T_{CYCD}$                         | DOTCLK Cycle Time                   | 33  | -   | ns   |             |
|        | Trghr, Trghf DOTCLK Rise/Fall time |                                     | -   | 15  | ns   |             |
| DB     | T <sub>PDS</sub>                   | T <sub>PDS</sub> PD Data Setup Time |     | -   | ns   |             |
| DB     | T <sub>PDH</sub> PD Data Hold Time |                                     | 5   | -   | ns   |             |

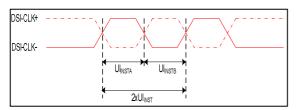
Table 6 18/16 Bits RGB Interface Timing Characteristics

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## 7.5.4 MIPI Interface Characteristics:

## 7.5.4.1 High Speed Mode



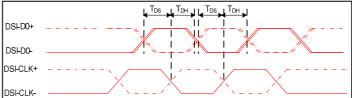


Figure 4 DSI clock channel timing

Figure 5 Rising and falling time on clock and data channel

*VDDI=1.8,VDD=2.8, AGND=DGND=0V, Ta=25 ℃* 

| Signal     | Symbol                                     | Parameter                | MAX  | Unit | Description |   |
|------------|--|--------------------------|------|------|-------------|---|
| DSI-CLK+/- | 2xUI <sub>INSTA</sub>                      | Double UI instantaneous  | 4    | 25   | ns          |   |
| DSI-CLK+/- | UI <sub>INSTA</sub><br>UI <sub>INSTB</sub> | UI instantaneous halfs   |      | 12.5 | ns          | UI = UI <sub>INSTA</sub> =<br>UI <sub>INSTB</sub> |
| DSI-Dn+/-  | tDS  | Data to clock setup time | 0.15 | -    | UI          |   |
| DSI-Dn+/-  | tDH  | Data to clock hold time  | 0.15 | -    | UI          |   |

**Table 7 Mipi Interface- High Speed Mode Timing Characteristics** 

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## 7.5.4.2 Lowe Power Mode

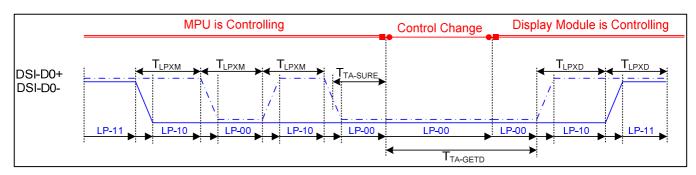


Figure 6 Bus Turnaround (BTA) from display module to MPU Timing

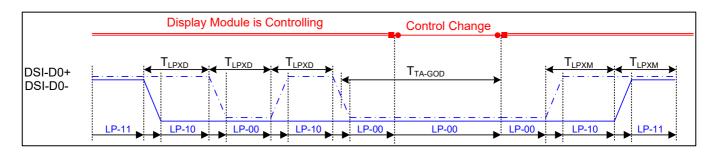


Figure 7 Bus Turnaround (BTA) from MPU to display module Timing

 $VDDI=1.8, VDD=2.8, AGND=DGND=0V, Ta=25 \ ^{\circ}C$ 

| Signal     | Symbol    | Parameter                 | MIN                 | MIN MAX           |     | Description |  |
|------------|-----------|---------------------------|---------------------|-------------------|-----|-------------|--|
|            |           | Length of LP-00,LP-01,    |                     |                   |     |             |  |
| DSI-D0+/-  | TLPXM     | LP-10 or LP-11 periods    | 50                  | 75                | ns  | Input       |  |
|            |           | MPU→Display Module        |                     |                   |     |             |  |
|            |           | Length of LP-00,LP-01,    |                     |                   |     |             |  |
| DSI-D0+/-  | TLPXD     | LP-10 or LP-11 periods    | 50                  | 75                | ns  | Output      |  |
|            |           | MPU→Display Module        |                     |                   |     |             |  |
| DSI-D0+/-  | TTA-SURED | Time-out before the MPU   | _                   | 2xT <sub>LP</sub> | ns  | Output      |  |
| טאי-וטט+/- | TIA-SUNED | start driving             | $T_{LPXD}$          | XD                |     |             |  |
| DSI-D0+/-  | TTA-GETD  | Time to drive LP-00 by    | 5vT                 |                   | 20  | lpout       |  |
| טאי-וטט+/- | TIA-GETD  | display module            | 5xT <sub>LPXD</sub> |                   | ns  | Input       |  |
| DSI-D0+/-  | TTA-GOD   | Time to drive LP-00 after |                     |                   | ns  | Output      |  |
| טטי-טט+/-  | TIA-GOD   | turnaround request-MPU    | 4xT <sub>LPXD</sub> |                   | 115 |             |  |

**Table 8 Mipi Interface Low Power Mode Timing Characteristics** 

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## 7.5.4.3 DSI Bursts Mode

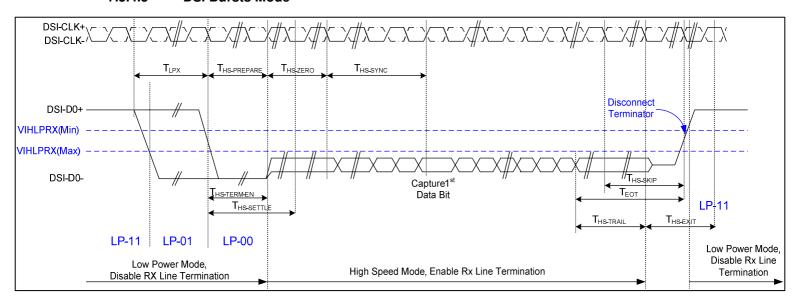


Figure 7 Data lanes-Low Power Mode to/from High Speed Mode Timing

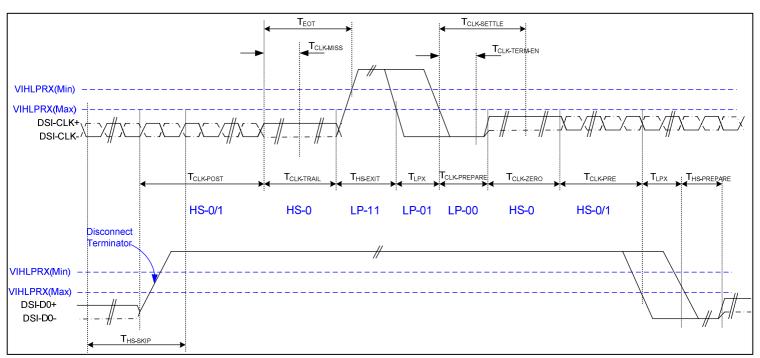


Figure 8 Clock lanes- High Speed Mode to/from Low Power Mode Timing

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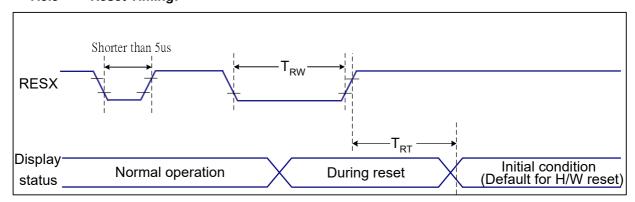


 $VDDI=1.8, VDD=2.8, AGND=DGND=0V, Ta=25 \ \ C$ 

| Signal     | Symbol   | Parameter  | MAX          | Unit       | Description |       |
|------------|--|--|--------------|------------|-------------|-------|
|            | 1  | Low Power Mode to High Speed M   | ode Timi     | ng         | ·           |       |
| DSI-Dn+/-  | TLPX   | Length of any low power state period -   |              |            |             | Input |
| DSI-Dn+/-  | THS-PREPARE  | Time to drive LP-00 to prepare for HS transmission   | 40+4<br>UI   | 85+6<br>UI | ns          | Input |
| DSI-Dn+/-  | THS-TERM-EN  | Time to enable data receiver line termination measured from when Dn crosses VILMAX                                   | -            | 35+4<br>UI | ns          | Input |
| DSI-Dn+/-  | THS-PREPARE<br>+ THS-ZERO  | THS-PREPARE + time to drive HS-0 before the sync sequence  | 140+<br>10UI | -          | ns          | Input |
|            | l  | High Speed Mode to Low Power Mo  | ode Timi     | ng         |             |       |
| DSI-Dn+/-  | THS-SKIP   | Time-out at display module to ignore transition period of EoT  | 40           | 55+4<br>UI | ns          | Input |
| DSI-Dn+/-  | THS-EXIT   | Time to drive LP-11 after HS burst   | 100          | -          | ns          | Input |
| DSI-Dn+/-  | Time to drive flipped differential state after last payload data bit of a HS transmission burst UI |  | -            | ns         | Input       |       |
|            | Hiç  | h Speed Mode to/from Low Power   | Mode Ti      | ming       | •           |       |
| DSI-CLK+/- | TCLK-POS   | Time that the MPU shall  |              | ns         | Input       |       |
| DSI-CLK+/- | TCLK-TRAIL   | Time to drive HS differential state after last payload clock bit of a HS transmission burst                          | 60           | -          | ns          | Input |
| DSI-CLK+/- | THS-EXIT   | Time to drive LP-11 after HS burst   | 100          | -          | ns          | Input |
| DSI-CLK+/- | TCLK-PREPARE   | Time to drive LP-00 to prepare for HS transmission   | 38           | 95         | ns          | Input |
| DSI-CLK+/- | TCLK-TERM-EN   | Time-out at clock lan display module to enable HS transmission   | 38           |            | ns          | Input |
| DSI-CLK+/- | TCLK-PREPARE<br>+ TCLK-ZERO  | Minimum lead HS-0 drive period before starting clock   | 300 -        |            | ns          | Input |
| DSI-CLK+/- | TCLK-PRE   | Time that the HS clock shall be driven prior to any associated data lane beginning the transition from LP to HS mode | 8UI          | -          | ns          | Input |
| DSI-CLK+/- | ТЕОТ   | Time form start of TCLK TRAIL  |              |            |             | Input |



#### 7.5.5 Reset Timing:



**Figure 9 Reset Timing** 

VDDI=1.8,VDD=2.8, AGND=DGND=0V, Ta=25 ℃

| Related Pins | Symbol | Parameter            | MIN | MAX               | Unit |
|--------------|--------|----------------------|-----|-------------------|------|
|              | TRW    | Reset pulse duration | 10  | -                 | us   |
| RESX         | TRT    | Deset sensel         | -   | 5 (Note 1, 5)     | ms   |
|              |        | Reset cancel         |     | 120(Note 1, 6, 7) | ms   |

**Table 9 Reset Timing** 

#### Notes:

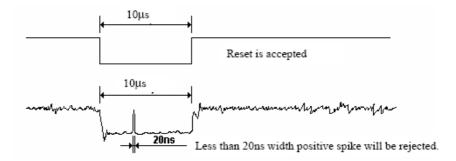
- 1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.
  - 2. Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below:

| RESX Pulse          | Action         |
|---------------------|----------------|
| Shorter than 5us    | Reset Rejected |
| Longer than 9us     | Reset          |
| Between 5us and 9us | Reset starts   |

- 3. During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode.) and then return to Default condition for Hardware Reset.
  - 4. Spike Rejection also applies during a valid reset pulse as shown below:

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- 5. When Reset applied during Sleep In Mode.
- 6. When Reset applied during Sleep Out Mode.
- 7. It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.



# **8 FUNCTION DESCRIPTION**

## 8.1 System Interface

ST7701S supports RGB serial interfaces , and MIPI serial interfaces. Selection of these interfaces are set by IM[3:0] pins as shown below.

| IM3 | IM2 | IM1 | IMO | Interface          | Data pins               |
|-----|-----|-----|-----|--------------------|-------------------------|
|     | 0   | 0   | 1   | RGB+8b_SPI(fall)   | D[0~23]                 |
|     | 0   | 1   | 0   | RGB+9b_SPI(fall)   | D[0~23]                 |
| 0   | 0   | 1   | 1   | RGB+16b_SPI(rise)  | D[0~23]                 |
|     | 1   | 0   | 1   | MIPI               | HSSI_D1_P/N,HSSI_D0_P/N |
|     | 1   | 1   | 0   | MIPI+16b_SPI(rise) | HSSI_D1_P/N,HSSI_D0_P/N |
|     | 0   | 0   | 1   | RGB+8b_SPI(rise)   | D[0~23]                 |
|     | 0   | 1   | 0   | RGB+9b_SPI(rise)   | D[0~23]                 |
| 1   | 0   | 1   | 1   | RGB+16b_SPI(fall)  | D[0~23]                 |
|     | 1   | 0   | 1   | MIPI               | HSSI_D1_P/N,HSSI_D0_P/N |
|     | 1   | 1   | 0   | MIPI+16b_SPI(fall) | HSSI_D1_P/N,HSSI_D0_P/N |

**Table 10 Interface Type Selection** 



#### 8.2 Serial Interface

The serial interface is either 3-lines/9-bits,16-bits or 4-lines/8-bits bi-directional interface for communication between the micro controller and the LCD driver. The 3-lines serial interface use: CSX (chip enable), SCL (serial clock) and SDA (serial data input/output), and the 4-lines serial interface use: CSX (chip enable), D/CX (data/command flag), SCL (serial clock) and SDA (serial data input/output). Serial clock (SCL) is used for interface with MCU only, so it can be stopped when no communication is necessary.

Pin description

3-line serial interface (9 bits)

| Pin Name | Description           |
|----------|-----------------------|
| CSX      | Chip selection signal |
| SCL      | Serial input CLK      |
| SDA      | Serial input data     |
| SDO      | Serial output data    |

#### 4-line serial interface (8 bits)

| Pin Name               | Description  |  |  |  |  |
|------------------------|--|--|--|--|--|
| CSX                    | Chip selection signal                                    |  |  |  |  |
| DCX                    | Data is regarded as a command when SCL is low            |  |  |  |  |
| DOX                    | Data is regarded as a parameter or data when SCL is high |  |  |  |  |
| SCL                    | Clock signal   |  |  |  |  |
| SDA                    | Serial input data  |  |  |  |  |
| SDO Serial output data |  |  |  |  |  |



#### 8.2.1 Serial Interface (SPI)

#### 8.2.1.1 Command write mode

The write mode of the interface means the micro controller writes commands and data to the LCD driver. 3-lines serial data packet contains a control bit D/CX and a transmission byte. In 4-lines serial interface, data packet contains just transmission byte and control bit D/CX is transferred by the D/CX pin. If D/CX is "low", the transmission byte is interpreted as a command byte. If D/CX is "high", the transmission byte is command register as parameter.

Any instruction can be sent in any order to the driver. The MSB is transmitted first. The serial interface is initialized when CSX is high. In this state, SCL clock pulse or SDA data have no effect. A falling edge on CSX enables the serial interface and indicates the start of data transmission.

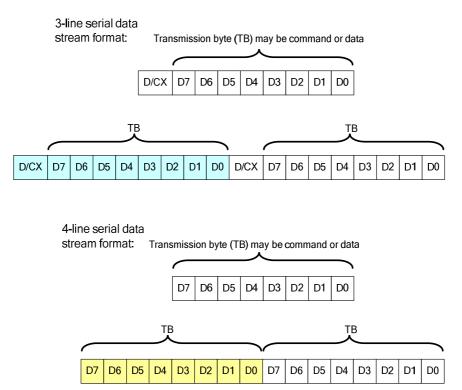


Figure 10 Serial interface data stream format

When CSX is "high", SCL clock is ignored. During the high period of CSX the serial interface is initialized. At the falling edge of CSX, SCL can be high or low. SDA is sampled at the rising edge of SCL. D/CX indicates whether the byte is command (D/CX='0') or parameter data (D/CX='1'). D/CX is sampled when first rising edge of SCL (3-line serial interface) or 8th rising edge of SCL (4-line serial interface). If CSX stays low after the last bit of command/data byte, the serial interface expects the D/CX bit (3-line serial interface) or D7 (4-line serial interface) of the next byte at the next rising edge of SCL..

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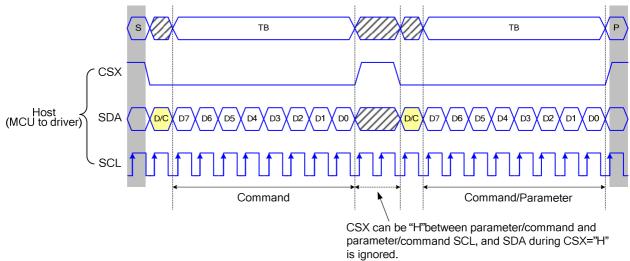


Figure 11 3-line serial interface write protocol (write to register with control bit in transmission)

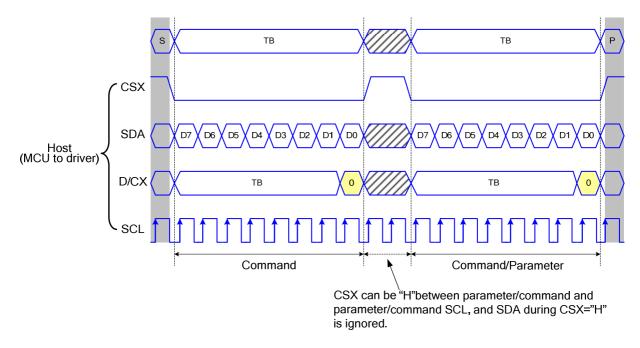


Figure 12 4-line serial interface write protocol (write to register with control bit in transmission)



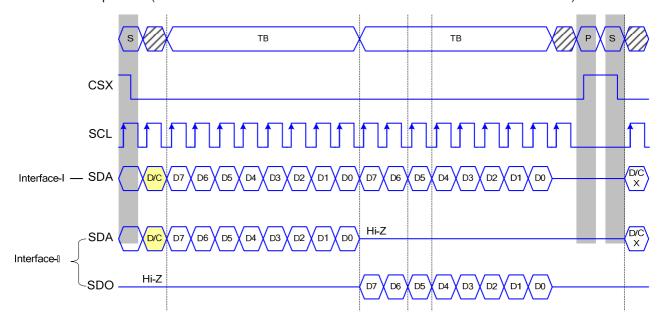
#### 8.2.2 Read function

The read mode of the interface means that the micro controller reads register value from the driver. To achieve read function, the micro controller first has to send a command (read ID or register command) and then the following byte is transmitted in the opposite direction. After that CSX is required to go to high before a new command is send (see the below figure). The driver samples the SDA (input data) at rising edge of SCL, but shifts SDA (output data) at the falling edge of SCL. Thus the micro controller is supported to read at the rising edge of SCL.

After the read status command has been sent, the SDA line must be set to tri-state no later than at the falling edge of SCL of the last bit.

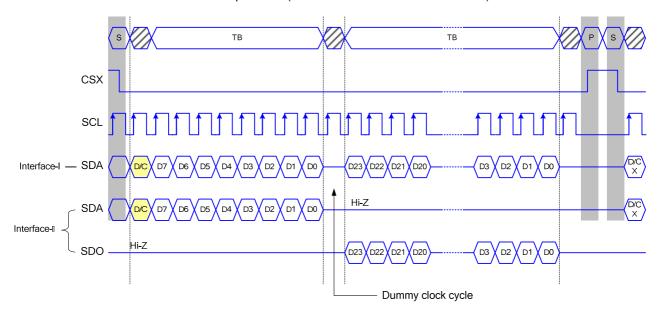
#### 3-line serial interface protocol

3-line serial protocol (for RDID1/RDID2/RDID3/0Ah/0Bh/0Ch/0Dh/0Eh/0Fh command: 8-bit read):



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3-line serial protocol (for RDDID command: 24-bit read)



3-line Serial Protocol (for RDDST command: 32-bit read)

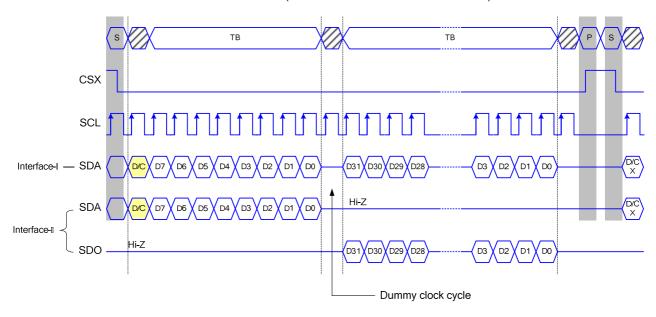


Figure 13 3-line serial interface read protocol

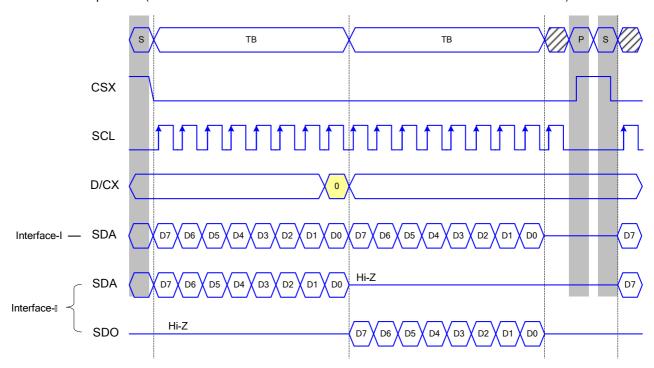
.

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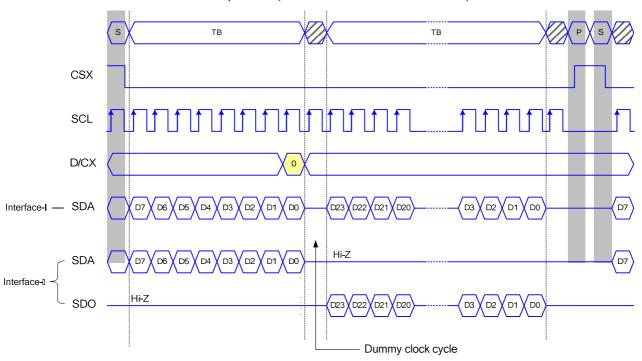


## 4-line serial protocol

4-line serial protocol (for RDID1/RDID2/RDID3/0Ah/0Bh/0Ch/0Dh/0Eh/0Fh command: 8-bit read):



4-line serial protocol (for RDDID command: 24-bit read)



4-line Serial Protocol (for RDDST command: 32-bit read)

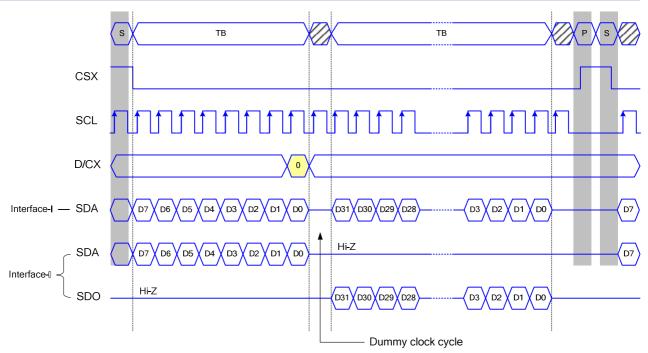


Figure 14 4-line serial interface read protocol



#### 8.3 16 bit Serial Interface

#### 8.3.1 Write Mode

The write mode of the interface means the micro controller writes commands and data to the ST7701S. The serial interface is initialized when CSX is high. In this state, SCL clock pulse or SDI data have no effect. A falling edge on CSX enables the serial interface and indicates the start of data transmission.

When CSX is high, SCL clock is ignored. During the high time of CSX the serial interface is initialized. At the falling CSX edge, SCL can be high or low. SDI/SDO are sampled at the rising edge of SCL. R/W indicates, whether the byte is read command (R/W = '1') or write command (R/W = '0'). It is sampled when first rising SCL edge. If CSX stays low after the last bit of command/data byte, the serial interface expects the R/W bit of the next byte at the next rising edge of SCL.

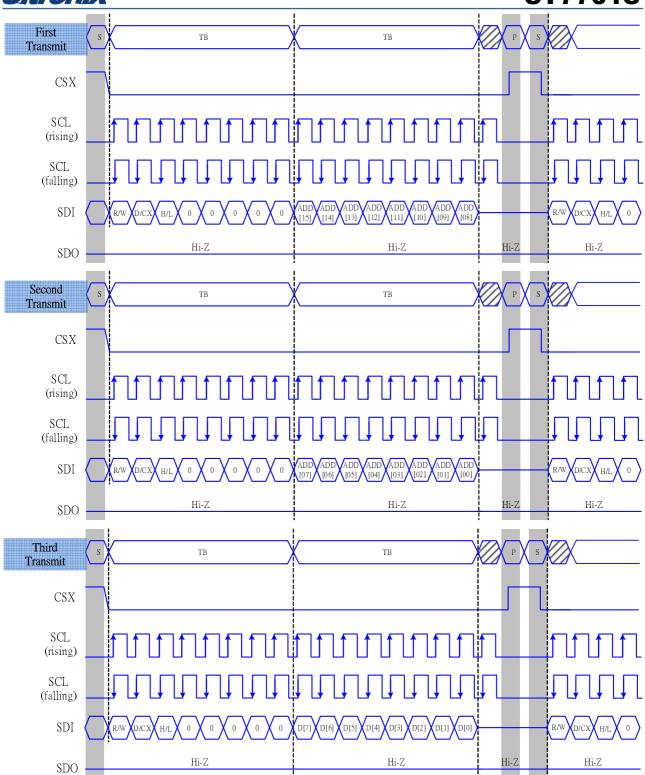


Figure 15 serial 16 bit interface write mode

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## 8.3.2 Read Mode

The read mode of the interface means that the micro controller reads register value from the ST7701S. To do so the micro controller first has to send a command and then the following byte is transmitted in the opposite direction. After that CSX is required to go high before a new command is send. The ST7701S samples the SDI (input data) at the rising edges, but shifts SDO (output data) at the falling SCL edges. Thus the micro controller is supported to read data at the rising SCL edges. After the read status command has been sent, the SDI line must be set to tri-state no later than at the falling SCL edge of the last bit. It doesn't need any dummy clock when execute the command data read.



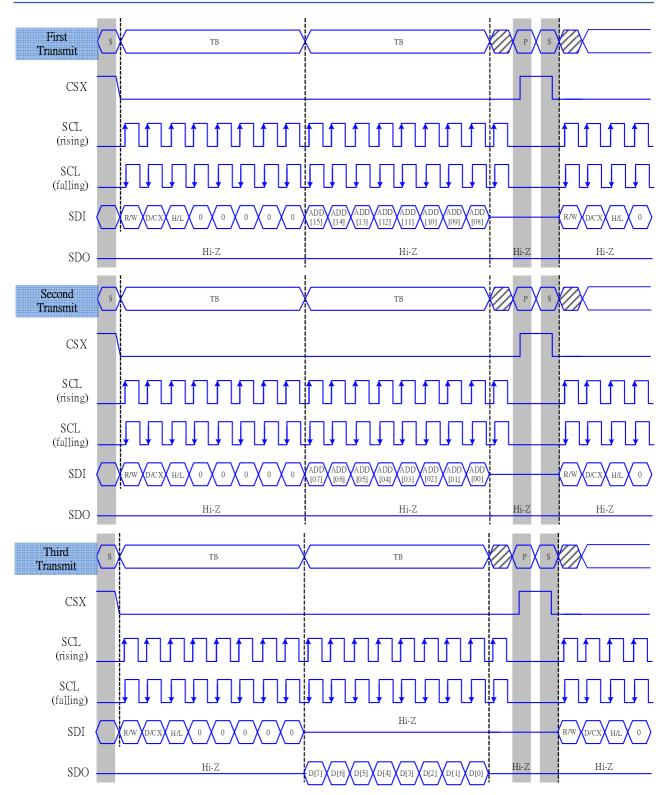


Figure 16 serial 16 bit interface read mode

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## 8.4 Data Transfer Break and Recovery

If there is a break in data transmission by RESX pulse, while transferring a command or frame memory data or multiple parameter command data, before Bit D0 of the byte has been completed, then driver will reject the previous bits and have reset the interface such that it will be ready to receive command data again when the chip select line (CSX) is next activated after RESX have been HIGH state.

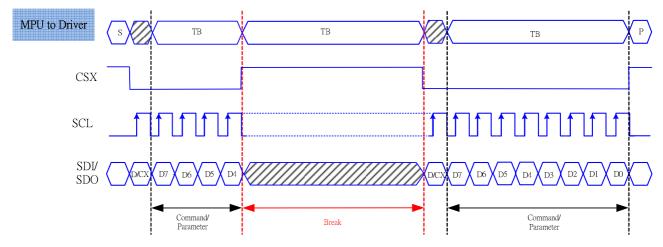


Figure 17 Data Transfer Break and Recovery.

If there is a break in data transmission by CSX pulse, while transferring a command or frame memory data or multiple parameter command data, before Bit D0 of the byte has been completed, then driver will reject the previous bits and have reset the interface such that it will be ready to receive the same byte re-transmitted when the chip select line (CSX) is next activated.

If 1, 2 or more parameter commands are being sent and a break occurs while sending any parameter before the last one and if the host then sends a new command rather than re-transmitting the parameter that was interrupted, then the parameters that were successfully sent are stored and the parameter where the break occurred is rejected. The interface is ready to receive next byte as shown below.

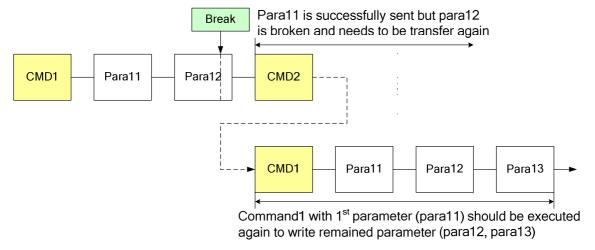


Figure 18 Write interrupts recovery

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If a 2 or more parameter commands are being sent and a break occurs by the other command before the last one is sent, then the parameters that were successfully sent are stored and the other parameter of that command remains previous value.

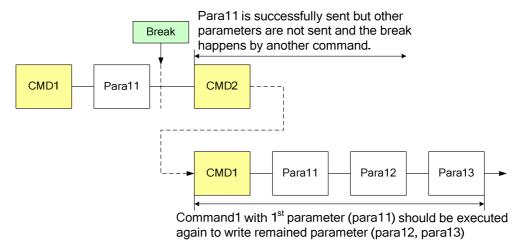


Figure 19 Write interrupts recovery



#### 8.5 Data Transfer Pause

Transferring a Command, Frame Memory Data, or Multiple Parameter Data might invoke a pause in the data transmission. If the Chip Select pin (CSX) is released after a whole byte of a Frame Memory Data or Multiple Parameter Data has been completed, then the ST7701S will wait and continue the Frame Memory Data or Parameter Data Transmission from the point where it was paused. If the Chip Select pin is released after a whole byte of a command has been completely transmitted, then the display module will receive either the command's parameters or a new command when the Chip Select Line is enabled again, as shown below.

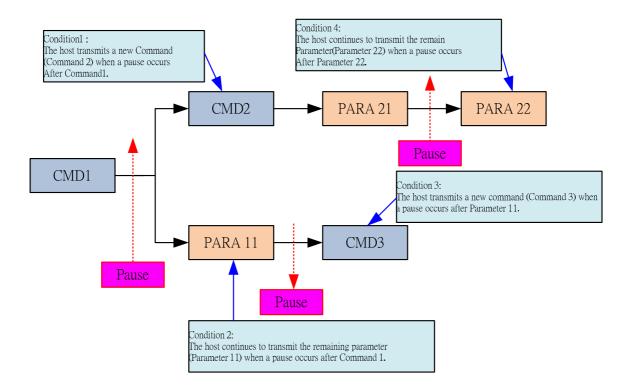


Figure 20 Data Transfer Pause

# 8.5.1 SPI interface pause MPU to Driver S TB TB TB TB TB P CSX SCL SDI/ SDA 0 D7 D6 D5 D4 D3 D2 D1 D0 Command Command Command/ Parameter

The CSX can be in high level between the data and the next command. The SDI(SDA) and SCL are invalid if the CSX is in high level.

Figure 21 Serial Data Transfer Pause

This applies to the following 4 conditions:

- 1) Command-Pause-Command
- 2) Command-Pause-Parameter
- 3) Parameter-Pause-Command
- 4) Parameter-Pause-Parameter



#### 8.6 RGB Interface

The ST7701S support RGB interface Mode 1 and Mode 2. The interface signals as shown in table 6.3.1.

The Mode 1 and Mode 2 function is select by setting in the Command 2, please reference application note.

In RGB Mode 1, writing data to line buffer is done by PCLK and Video Data Bus (D[23:0]), when DE is high state.

The external clocks (PCLK, VS and HS) are used for internal displaying clock. So, controller must always transfer PCLK, VS and HS signal to ST7701S.

In RGB Mode 2, back porch of Vsync is defined by VBP[5:0] of RGBPRCTR command. And back porch of Hsync is defined by HBP[5:0] of RGBPRCTR command. Front porch of Vsync is defined by VFP[5:0] of RGBPRCTR command. And front porch of Hsync is defined by HFP[5:0] of RGBPRCTR command.

| RGB I/F Mode | PCLK | DE       | VS   | HS   | DB[23:0] | Register for Blanking Porch setting |
|--------------|------|----------|------|------|----------|-------------------------------------|
| RGB Mode 1   | Used | Used     | Used | Used | Used     | Not Used                            |
| RGB Mode 2   | Used | Not Used | Used | Used | Used     | Used                                |

| Symbol   | Name            | Description   |
|----------|-----------------|---|
| PCLK     | Pixel clock     | Pixel clock for capturing pixels at display interface |
| HS       | Horizontal sync | Horizontal synchronization timing signal              |
| VS       | Vertical sync   | Vertical synchronization timing signal                |
| DE       | Data enable     | Data enable signal (assertion indicates valid pixels) |
| DB[23:0] | Pixel data      | Pixel data in 16-bit,18-bit and 24-bit format         |

Table 11 The interface signals of RGB interface



### 8.6.1 RGB Color Format

ST7701S supports two kinds of RGB interface, DE mode (mode 1) and HV mode (mode 2), and 16bit/18bit and 24 bit data format. When DE mode is selected and the VSYNC, HSYNC, DOTCLK, DE, D[23:0] pins can be used; when HV mode is selected and the VSYNC, HSYNC, DOTCLK, D[23:0] pins can be used. When using RGB interface, only serial interface can be selected.

| Pad name | 24 bits configuration | 18 bits cor<br>VIPF[3: |            | 16 bits configuration |
|----------|-----------------------|------------------------|------------|-----------------------|
|          | VIPF[3:0]=0111        | MDT=0                  | MDT=1      | VIPF[3:0]=0101        |
| DB[23]   | R7                    | Not used               | Not used   | Not used              |
| DB[22]   | R6                    | Not used               | Not used   | Not used              |
| DB[21]   | R5                    | R5                     | Not used   | Not used              |
| DB[20]   | R4                    | R4                     | Not used   | R4                    |
| DB[19]   | R3                    | R3                     | Not used   | R3                    |
| DB[18]   | R2                    | R2                     | Not used   | R2                    |
| DB[17]   | R1                    | R1                     | R5         | R1                    |
| DB[16]   | R0                    | R0                     | R4         | R0                    |
| DB[15]   | G7                    | Not used               | R3         | Not used              |
| DB[14]   | G6                    | Not used               | R2         | Not used              |
| DB[13]   | G5                    | G5                     | R1         | G5                    |
| DB[12]   | G4                    | G4                     | R0         | G4                    |
| DB[11]   | G3                    | G3                     | G5         | G3                    |
| DB[10]   | G2                    | G2                     | G4         | G2                    |
| DB[09]   | G1                    | G1                     | G3         | G1                    |
| DB[08]   | G0                    | G0                     | G2         | G0                    |
| DB[07]   | В7                    | Not used               | G1         | Not used              |
| DB[06]   | B6                    | Not used               | G0         | Not used              |
| DB[05]   | B5                    | B5                     | <b>B</b> 5 | Not used              |
| DB[04]   | B4                    | B4                     | B4         | B4                    |
| DB[03]   | B3                    | B3                     | B3         | B3                    |
| DB[02]   | B2                    | B2                     | B2         | B2                    |
| DB[01]   | B1                    | B1                     | B1         | B1                    |
| DB[00]   | В0                    | В0                     | В0         | В0                    |

Table 12 The interface color mapping of RGB interface

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### 8.6.2 RGB Interface Definition

The display operation via the RGB interface is synchronized with the VSYNC, HSYNC, and DOTCLK signals. The data can be written only within the specified area with low power consumption by using window address function. The back porch and front porch are used to set the RGB interface timing.

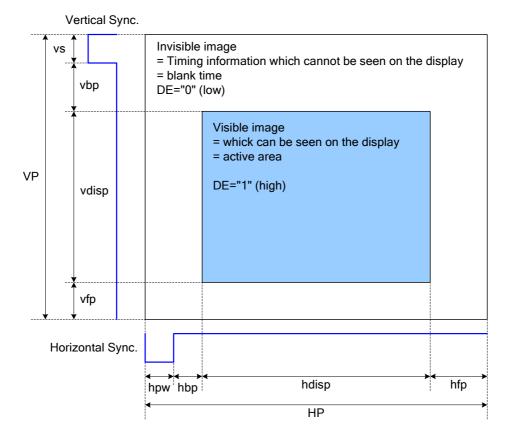


Figure 22 Access Area by RGB Interface

Please refer to the following table for the setting limitation of RGB interface signals.

| Parameter                    | Symbol | Min. | Тур. | Max. | Unit  |
|------------------------------|--------|------|------|------|-------|
| Horizontal Sync. Width       | hpw    | 1    | -    | 255  | Clock |
| Horizontal Sync. Back Porch  | hbp    | 1    |      | 255  | Clock |
| Horizontal Sync. Front Porch | hfp    | 1    |      | -    | Clock |
| Vertical Sync. Width         | VS     | 1    |      | 254  | Line  |
| Vertical Sync. Back Porch    | vbp    | 1    |      | 254  | Line  |
| Vertical Sync. Front Porch   | vfp    | 2    |      |      | Line  |

Note:

1. Typical value are related to the setting frame rate is 60Hz..



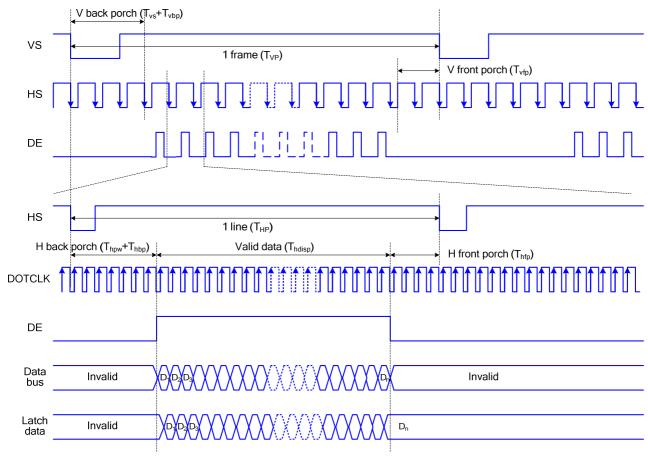
#### 8.6.3 RGB Interface Mode Selection

ST7701S supports two kinds of RGB interface, DE mode and HV mode. The table shown below uses command C3h to select RGB interface mode.

| DE/Sync | RGB Mode |
|---------|----------|
| 0       | DE mode  |
| 1       | HV mode  |

### 8.6.4 RGB Interface Timing

The timing chart of RGB interface DE mode is shown as follows.



Note: The setting of front porch and back porch in host must match that in IC as this mode.

Figure 23 Timing Chart of Signals in RGB Interface DE Mode

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The timing chart of RGB interface HV mode is shown as follows.

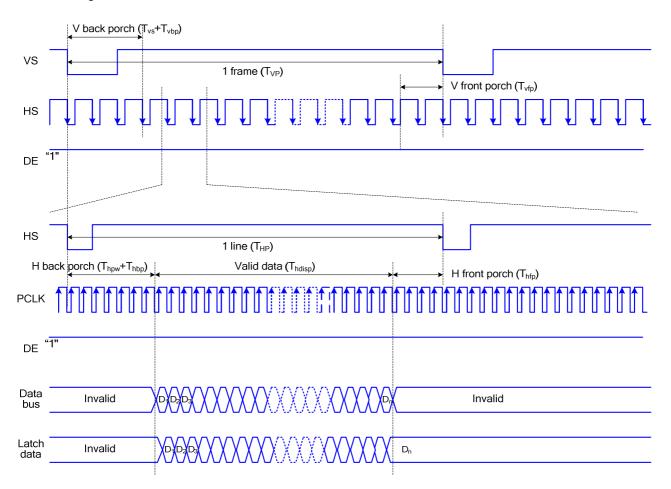


Figure 24 Timing chart of RGB interface HV mod



#### 8.7 MIPI-DSI interface

The Display Serial Interface standard defines protocols between a host processor and peripheral devices that adhere to MIPI Alliance standards for mobile device interfaces. The DSI standard builds on existing standards by adopting pixel formats and command set defined in MIPI Alliance standards.

 ${\sf DSI-compliant\ peripherals\ support\ either\ of\ two\ basic\ modes\ of\ operation:\ Command\ Mode\ and\ Video\ Mode.}$ 

Which mode is used depends on the architecture and capabilities of the peripheral. The mode definitions reflect the primary intended use of DSI for display interconnect, but are not intended to restrict DSI from operating in other applications.

Typically, a peripheral is capable of Command Mode operation or Video Mode operation. Some Video Mode display modules also include a simplified form of Command Mode operation in which the display module may refresh its screen from a reduced-size, or partial, frame buffer, and the interface (DSI) to the host processor may be shut down to reduce power consumption.

Command Mode refers to operation in which transactions primarily take the form of sending commands to a peripheral, such as a display module, that incorporates a display controller. The display controller may include local registers and a frame buffer. Systems using Command Mode write to, and read from, the registers. The host processor indirectly controls activity at the peripheral by sending commands, parameters to the display controller.

The host processor can also read display module status information. Command Mode operation requires a bidirectional interface.

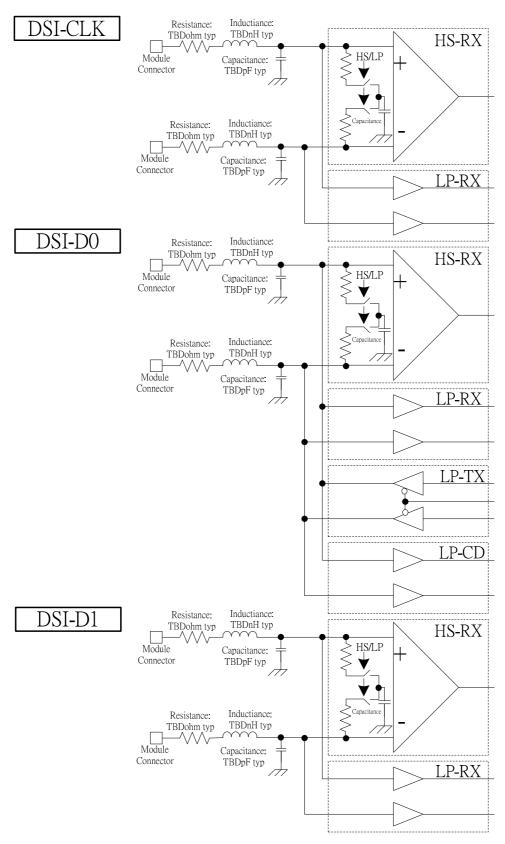
Video Mode refers to operation in which transfers from the host processor to the peripheral take the form of a real-time pixel stream. In normal operation, the display module relies on the host processor to provide image data at sufficient bandwidth to avoid flicker or other visible artifacts in the displayed image. Video information should only be transmitted using High Speed Mode. Some Video Mode architectures may include a simple timing controller and partial frame buffer, used to maintain a partial-screen or lower-resolution image in standby or Low Power Mode. This permits the interface to be shut down to reduce power consumption. To reduce complexity and cost, systems that only operate in Video Mode may use a unidirectional data path.

#### Configuration:

| Lane Pair   | MCU (Master) Display Module (Slave) |
|-------------|-------------------------------------|
|             | Unidirectional Lane                 |
| Clock Lane  | ■ Clock Only                        |
|             | ■ Escape Mode(ULPS Only)            |
|             | Bi-directional Lane                 |
| Data Lane 0 | ■ Forward High-Speed                |
| Data Lane 0 | ■ Bi-directional Escape Mode        |
|             | ■ Bi-directional LPDT               |
|             | Unidirectional Lane                 |
| Data Lana 1 | ■ Forward High-Speed                |
| Data Lane 1 | ■ Escape Mode (ULPM only)           |
|             | ■ No LPDT                           |



## 8.7.1 Display Module Pin Configuration for DSI





### 8.7.2 Display Serial Interface (DSI)

#### 8.7.2.1 General description

The communication can be separated 2 different levels between the MCU and the display module:

- Interface Level : Low level communication
- Packet level: High level communication

#### 8.7.2.2 Interface level communication

#### 8.7.2.2.1 General

The display module uses data and clock lane differential pairs for DSI. Both clock lane and data lane0 can be driven Low Power (LP) or High Speed (HS) mode. Data lane1 and Data lane2 can be driven High Speed mode only.

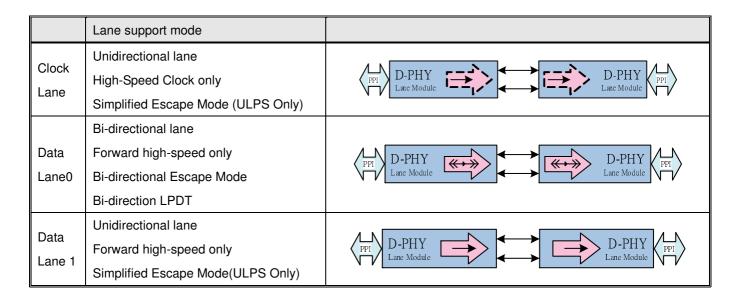


Table 13 The interface color Lane types and support mode

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Low Power mode means that each line of the differential pair is used in single end mode and a differential receiver is disable (A termination resistor of the receiver is disable) and it can be driven into a low power mode.

High Speed mode means that differential pairs (The termination resistor of the receiver is enable) are not used in the single end mode.

There are used different modes and protocols in each mode when there are wanted to transfer information from the MCU to the display module and vice versa.

The State Codes of the High Speed (HS) and Low Power (LP) lane pair are defined below.

| Lane Pair  | Line DC vo | Itage Levels | High Speed(HS) | Low-Power(LP) |             |  |  |  |  |  |  |
|------------|------------|--------------|----------------|---------------|-------------|--|--|--|--|--|--|
| State Code | Dn+ Line   | Dn- Line     | Burst Mode     | Control Mode  | Escape Mode |  |  |  |  |  |  |
| HS-0       | Low (HS)   | High (HS)    | Differential-0 | Note 1        | Note 1      |  |  |  |  |  |  |
| HS-1       | High (HS)  | Low (HS)     | Differential-1 | Note 1        | Note 1      |  |  |  |  |  |  |
| LP-00      | Low (LP)   | Low (LP)     | Not Defined    | Bridge        | Space       |  |  |  |  |  |  |
| LP-01      | Low (LP)   | High (LP)    | Not Defined    | HS-Request    | Mark-0      |  |  |  |  |  |  |
| LP-10      | High (LP)  | Low (LP)     | Not Defined    | LP-Request    | Mark-1      |  |  |  |  |  |  |
| LP-11      | High (LP)  | High (LP)    | Not Defined    | Stop          | Note 2      |  |  |  |  |  |  |

Table 14 High Speed and Low-Power Lane Pair State Descriptions

#### Notes:

1. Low-Power Receivers (LP-Rx) of the lane pair are checking the LP-00 state code, when the Lane Pair is in the High Speed (HS) mode.

2. If Low-Power Receivers (LP-Rx) of the lane pair recognizes LP-11 state code, the lane pair returns to LP-11 of the Control Mode.



### 8.7.2.2.2 DSI-CLK Lanes

DSI-CLK+/- lanes can be driven into three different power modes: Low Power Mode (LPM LP-11), Ultra Low Power Mode (ULPM) or High Speed Clock Mode (HSCM).

Clock lanes are in a single end mode (LP = Low Power) when there is entering or leaving Low Power Mode(LPM) or Ultra Low Power Mode (ULPM).

Clock lanes are in the single end mode (LP = Low Power) when there is entering in or leaving out High Speed Clock Mode (HSCM).

These entering and leaving protocols are using clock lanes in the single end mode to generate an entering or leaving sequences.

The principal flow chart of the different clock lanes power modes is illustrated below.

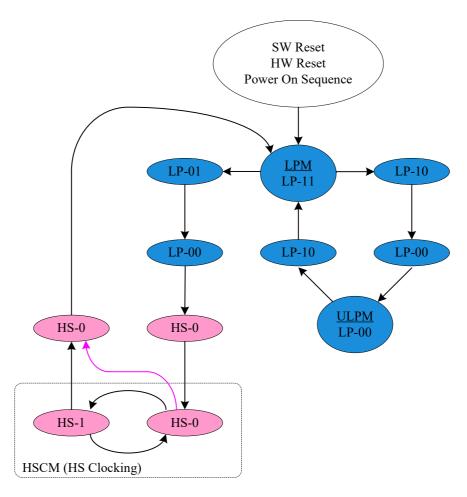


Figure 25 Clock Lanes Power Modes

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### 8.7.2.2.2.1 Low Power Mode (LPM)

DSI-CLK+/- lanes can be driven to the Low Power Mode(LMP), when DSI-CLK lanes are entering LP-11 State Code, in three different ways:

After SW Reset, HW Reset or Power On Sequence=>LP-11

After DSI-CLK+/- lanes are leaving Ultra Low Power Mode (ULPM,LP-00 State Code)=>LP10=>LP-11(LPM).

This sequence is illustrated below.

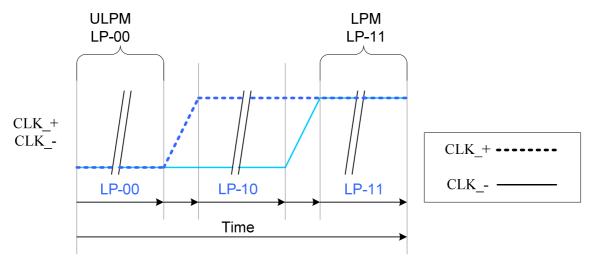


Figure 26 From ULPM to LPM

After DSI-CLK+/- lanes are leaving High Speed Clock Mode (HSCM, HS-0 or HS-1 State Code) =>HS-0 =>LP-11 (LPM).

This sequence is illustrated below.

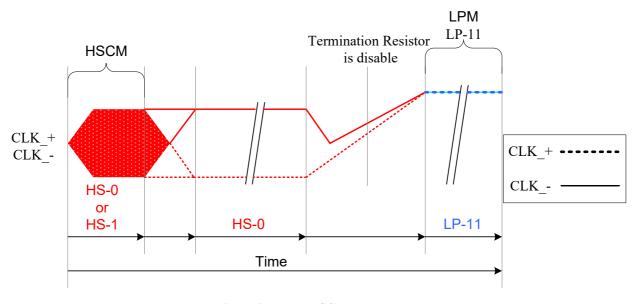


Figure 27 From HSCM to LPM

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All three mode changes are illustrated a flow chart below.

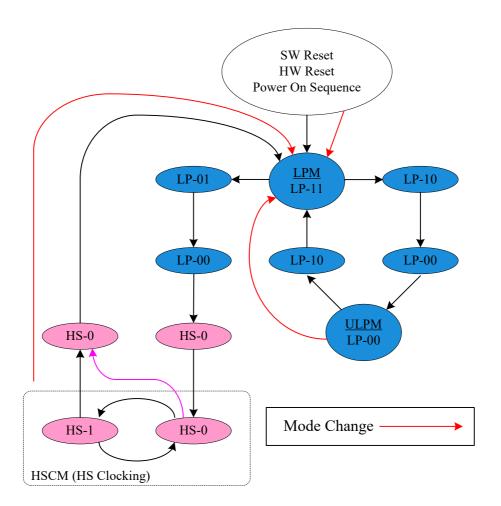


Figure 28 All three mode changes to LPM



### 8.7.2.2.2.2 Ultra Low Power Mode (ULPM)

DSI-CLK+/- lanes can be driven to the Ultra Low power Mode (ULPM), when DSI-CLK lanes are entering LP-00 State Code.

The only entering possibility is from the Low Power Mode (LPM, LP-11 State Code) =>LP-10 =>LP-00(ULPM). This sequence is illustrated below.

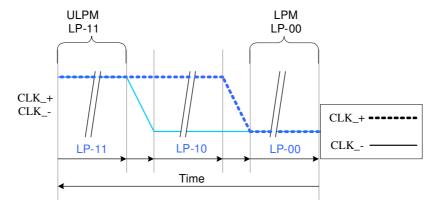


Figure 29 From LPM to UPLM

The mode change is also illustrated below:

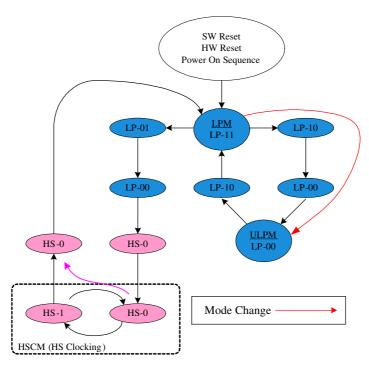


Figure 30 The mode change from LPM to UPLM

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### 8.7.2.2.2.3 High-speed Clock Mode (HSCM)

DSI-CLK+/- lanes can be driven to the High Speed Clock Mode (HSCM), when DSI-CLK lanes are starting to work between HS-0 and HS-1 State Codes.

The only entering possibility is from the Low Power Mode (LPM, LP-11 State Code) =>LP-01 =>LP-00 =>HS-0 =>HS-0/1 (HSCM).

This sequence is illustrated below.

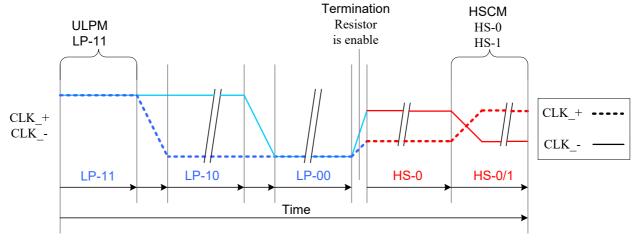


Figure 31 From LPM to HSCM

The mode change is also illustrated below:

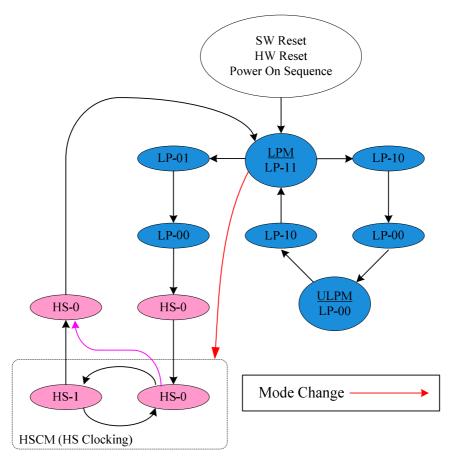


Figure 32 Mode Change from LPM to HSCM on the Flow Chart

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The high speed clock (DSI-CLK+/-) is started before high speed data is sent via DSI-Dn+/- lanes. The high speed clock continues clocking after the high speed data sending has been stopped.

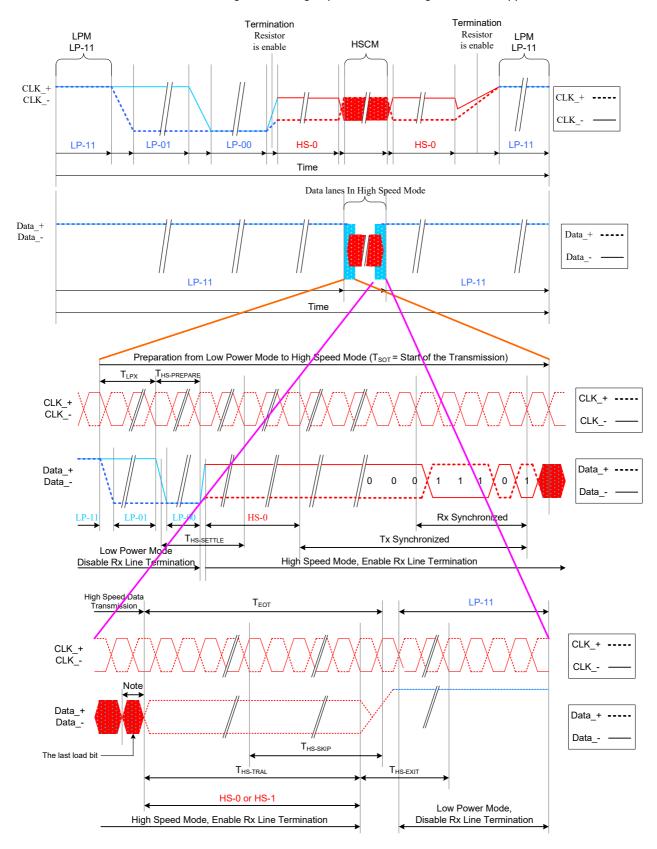


Figure 33 High Speed Clock Burst

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### 8.7.2.2.3 DSI-DATA LANES

#### 8.7.2.2.3.1 GENERAL

DSI-D0+/- Data Lanes can be driven in different modes which are:

- Escape Mode (Only DSI-D0+/- data lanes are used)
- High-Speed Data Transmission (DSI-D1+/- and DSI-D0+/- data lanes are used)
- Bus Turnaround Request (Only DSI-D0+/- data lanes are used)

These modes and their entering codes are defined on the following table.

| Mode                         | Entering Mode Sequence            | Leaving Mode Sequence     |
|------------------------------|-----------------------------------|---------------------------|
| Escape Mode                  | LP-11=>LP-10=>LP-00=>LP-01=>LP-00 | LP-00=>LP-10=>LP11(Mark1) |
| High-Speed Data Transmission | LP-11=>LP-01=>LP-00=>HS-0         | (HS-0 or HS-1) =>LP-11    |
| Bus Turnaround Request       | LP-11=>LP-10=>LP-00=>LP-10=>LP-00 | High-Z                    |

#### Notes:

- 1. Only DSI-D0+/- data lanes are used.
- 2. DSI-D1+/- and DSI-D0+/- data lanes are used.
- 3. More information on section "Bus Turnaround (BTA)"



#### 8.7.2.2.3.2 **ESCAPE MODE**

Data lanes (DSI-D0+/-) can be used in different Escape Modes when data lanes are in Low Power (LP) mode. These Escape Modes are used to:

- Send "Low-Power Data Transmission" (LPDT) e.g. from the MCU to the display module
- Drive data lanes to "Ultra-Low Power State" (ULPS)
- Indicate "Remote Application Reset" (RAR), which is reset the display module
- Indicate "Tearing Effect" (TEE), which is used for a TE trigger event from the display module to the MCU
- Indicate "Acknowledge" (ACK), which is used for a non-error event from the display module to the MCU The basic sequence of the Escape Mode is as follow
- Start: LP-11
- Escape Mode Entry (EME): LP-11 =>LP-10 =>LP-01 =>LP-01
- Escape Command (EC), which is coded, when one of the data lanes is changing from low-to-high-to-low then this changed data lane is presenting a value of the current data bit (DSI-D0+ = 1, DSI-D0- = 0) e.g. when DSI-D0- is changing from low-to-high-to-low, the receiver is latching a data bit, which value is logical 0. The receiver is using this low-to-high-to-low transition for its internal clock.
- · A load if it is needed
- Exit Escape (Mark-1) LP-00 =>LP-10 =>LP-11
- End: LP-11

This basic construction is illustrated below:

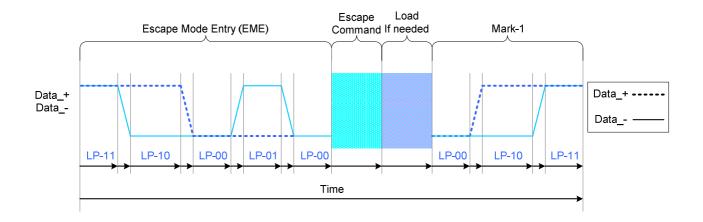


Figure 34 General Escape Mode Sequence

The number of the different Escape Commands (EC) is eight. These eight different escape commands (EC) can be divided 2 different groups: Mode or Trigger. The MCU is informing to the display module that it is controlling data lanes (DSI-D0+/-) with the mode e.g. The MCU can inform to the display module that it can put data lanes in the low power mode. The MCU is waiting from the display module event information, which has been set by the MCU, with the trigger e.g. when the display module reaches a new V-synch, the display module sent to the MCU a TE trigger (TEE), if the MCU has been requested it.

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Escape commands are defined on the next table.

This basic construction is illustrated below:

| Escape Command              | Command Type<br>Mode/Trigger | Entry Command Pattern (First Bit→Last Bit Transmitted) | Dn | D0 |
|-----------------------------|------------------------------|--|----|----|
| Low-Power Data Transmission | Mode                         | 1110 0001 <sub>bin</sub>                               | -  | 0  |
| Ultra-Low Power Mode        | Mode                         | 0001 1110 <sub>bin</sub>                               | 0  | 0  |
| Underfined-1, Note 1        | Mode                         | 1001 1111 <sub>bin</sub>                               | -  | -  |
| Underfined-2, Note 1        | Mode                         | 1101 1110 <sub>bin</sub>                               | -  | -  |
| Remote Application Reset    | Trigger                      | 0110 0010 <sub>bin</sub>                               | -  | 0  |
| Tearing Effect              | Trigger                      | 0101 1101 <sub>bin</sub>                               | -  | -  |
| Acknowledge                 | Trigger                      | 0010 0001 <sub>bin</sub>                               | -  | 0  |
| Unknow-5,Note 1             | Trigger                      | 1010 0000 <sub>bin</sub>                               | -  | -  |

#### Notes:

- 1. This Escape command support has not been implemented on the display module.
- 2. n=1.
- 3. "O"=Supported
- 4. "-"=Not Supported
- 5. Tearing Effect Trigger can not be used in MIPI Video mode.



### Low-Power Data Transmission(LPDT)

The MCU can send data to the display module in Low-Power Data Transmission (LPDT) mode when data lanes are entering in Escape Mode and Low-Power Data Transmission (LPDT) command has been sent to the display module. The display module is also using the same sequence when it is sending data to the MCU.

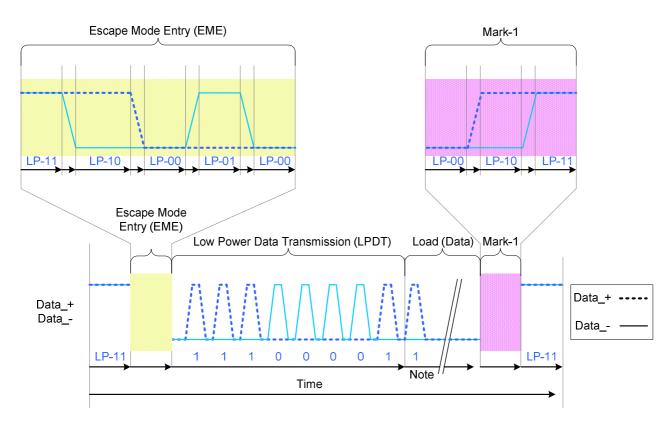
The Low Power Data Transmission (LPDT) is using a following sequence:

- Start: LP-11
- Escape Mode Entry (EME): LP-11 =>LP-10 =>LP-00 =>LP-01 =>LP-00
- Low-Power Data Transmission (LPDT) command in Escape Mode: 1110 0001 (First to Last bit)
- Load (Data): One or more bytes (8 bits)

Data lanes are in pause mode when data lanes are stopped (Bothe lanes are low ) between bytes

- Mark-1: LP-00 =>LP-10 =>LP-11
- End: LP-11

This sequence is illustrated for reference purposes below:



Note: Load (Data) is presenting that the first bit is logical "1" in this Exsample

Figure 35 Low-Power Data Transmission (LPDT)

Notes:

Load(Data) is presenting that the first bit is logical '1' in this example



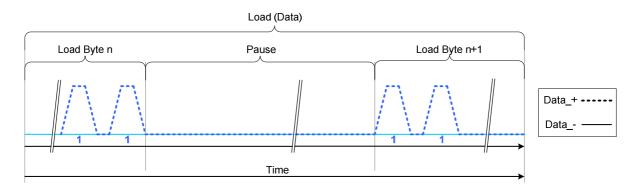


Figure 36 Pause (Example)

### **Ultra-Low Power State (ULPS)**

The MCU can force data lanes in Ultra-Low Power State (ULPS) mode when data lanes are entering in Escape Mode.

The Ultra-Low Power State (ULPS) is using a following sequence:

- Start: LP-11
- Escape Mode Entry (EME): LP-11 =>LP-10 =>LP-00 =>LP-01 =>LP-00
- Ultra-Low Power State (ULPS) command in Escape Mode: 0001 1110 (First to Last bit)
- Ultra-Low Power State (ULPS) when the MCU is keeping data lanes low
- Mark-1: LP-00 =>LP-10 =>LP-11
- End: LP-11

This sequence is illustrated for reference purposes below:

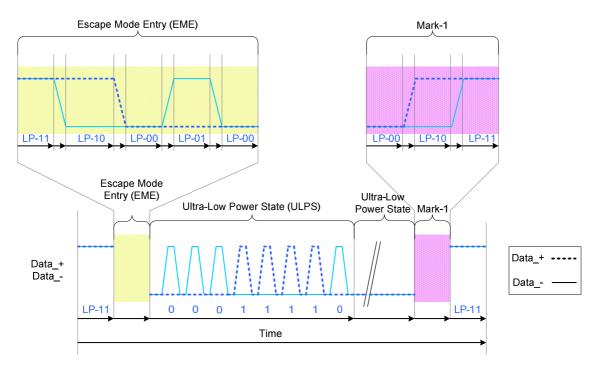


Figure 37 Ultra-Low Power State (ULPS)

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### Remote Application Reset (RAP)

The MCU can inform to the display module that it should be reset in Remote Application Reset (RAR) trigger when data lanes are entering in Escape Mode.

The Remote Application Reset (RAR) is using a following sequence:

- Start: LP-11
- Escape Mode Entry (EME): LP-11 =>LP-10 =>LP-00 =>LP-01 =>LP-00
- Remote Application Reset (RAR) command in Escape Mode: 0110 0010 (First to Last bit)
- Mark-1: LP-00 =>LP-10 =>LP-11
- End: LP-11

This sequence is illustrated for reference purposes below:

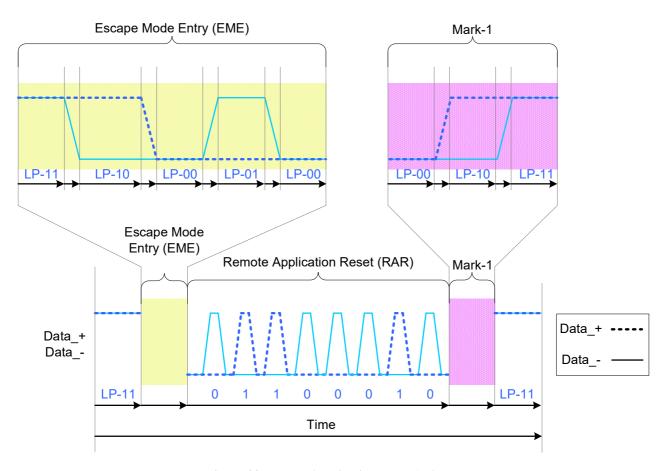


Figure 38 Remote Application Reset (RAR)



### Tearing Effect (TEE)

The display module can inform to the MCU when a tearing effect event (New V-synch) has been happen on the display module by Tearing Effect (TEE).

The Tearing Effect (TEE) is using a following sequence:

- Start: LP-11
- Escape Mode Entry (EME): LP-11 =>LP-10 =>LP-00 =>LP-01 =>LP-00
- Tearing Effect (TEE) trigger in Escape Mode: 0101 1101 (First to Last bit)
- Mark-1: LP-00 =>LP-10 =>LP-11
- End: LP-11

This sequence is illustrated for reference purposes below:

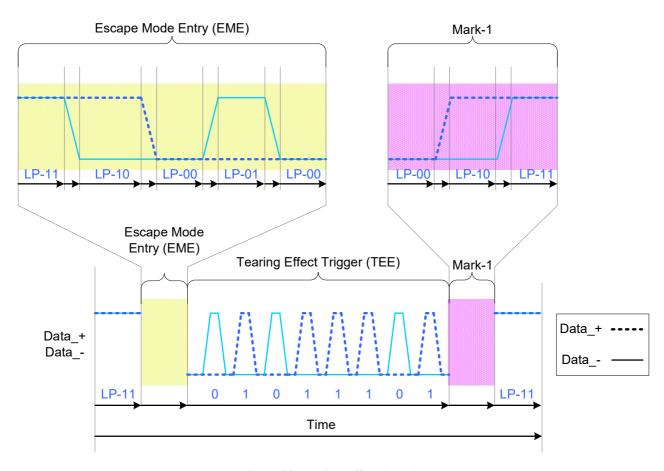


Figure 39 Tearing Effect (TEE)

Note: Tearing Effect (TEE) can not be used in MIPI Video Mode



### Acknowledge (ACK)

The display module can inform to the MCU when an error has not recognized on it by Acknowledge (ACK).

The Acknowledge (ACK) is using a following sequence:

- Start: LP-11
- Escape Mode Entry (EME): LP-11 =>LP-10 =>LP-00 =>LP-01 =>LP-00
- Acknowledge (ACK) command in Escape Mode: 0010 0001 (First to Last bit)
- Mark-1: LP-00 => LP-10 => LP-11
- End: LP-11

This sequence is illustrated for reference purposes below:

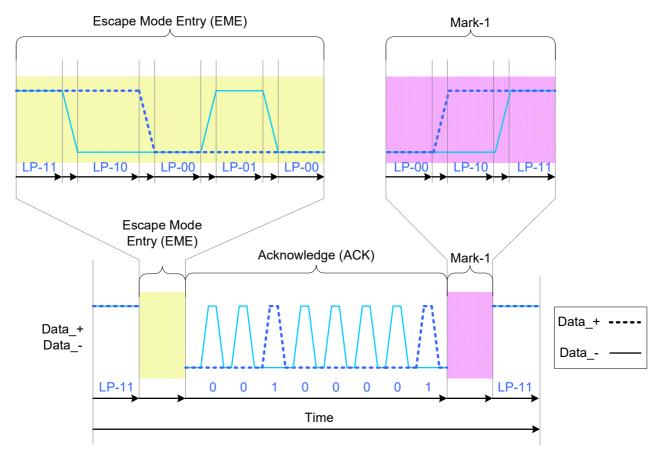


Figure 40 Acknowledge (ACK)



#### 8.7.2.2.3.3 HIGH SPEED DATA TRANSMISSION (HSDT)

#### **Entering High-Speed Data Transmission (T<sub>SOT</sub> of HSDT)**

The display module is entering High-Speed Data Transmission (HSDT) when Clock lanes DSI-CLK+/- have already been entered in the High-Speed Clock Mode (HSCM) by the MCU. See more information on chapter "8.8.2.2.2.3 High-Speed Clock Mode (HSCM)".

Data lanes of the display module are entering (TSOT) in the High-Speed Data Transmission (HSDT) as follows

- Start: LP-11
- HS-Request: LP-01
- HS-Settle: LP-00 => HS-0 (Rx: Lane Termination Enable)
- Rx Synchronization: 011101 (Tx (= MCU) Synchronization: 0001 1101)
- End: High-Speed Data Transmission (HSDT) Ready to receive High-Speed Data Load

This same entering High-Speed Data Transmission (TSOT of HSDT) sequence is illustrated below

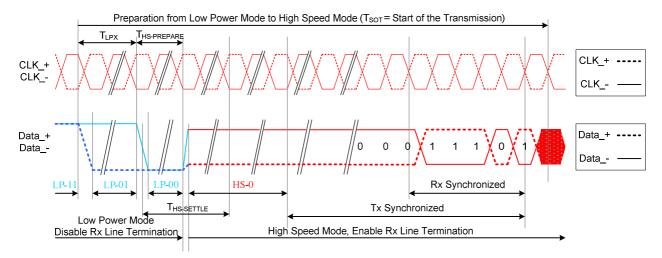


Figure 41 Entering High-Speed Data transmission (T<sub>SOT</sub> of HSDT)



### Leaving High-Speed Data Transmission (T<sub>EOT</sub> of HSDT)

The display module is leaving the High-Speed Data Transmission (TEOT of HSDT) when Clock lanes DSI-CLK+/- are in the High-Speed Clock Mode (HSCM) by the MCU and this HSCM is kept until data lanes are in LP-11 mode. See more information on chapter "5.3.2.2.2.3 High-Speed Clock Mode (HSCM)".

Data lanes of the display module are leaving from the High-Speed Data Transmission (TEOT of HSDT) as follows

- Start: High-Speed Data Transmission (HSDT)
- · Stops High-Speed Data Transmission
- MCU changes to HS-1, if the last load bit is HS-0
- MCU changes to HS-0, if the last load bit is HS-1
- End: LP-11 (Rx: Lane Termination Disable)

This same leaving High-Speed Data Transmission (TEOT of HSDT) sequence is illustrated below

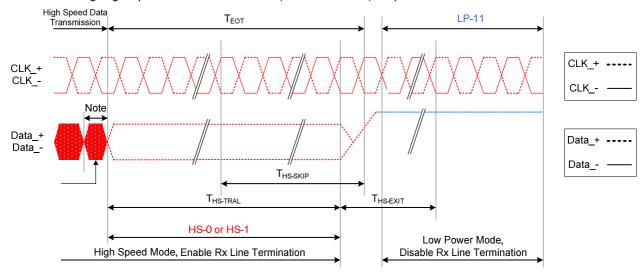


Figure 42 Levaving High-Speed data Transmission (T<sub>EOT</sub> of HSDT)



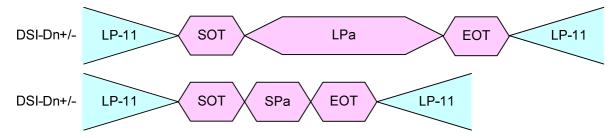
#### **Burst of the High-Speed Data Transmission (HSDT)**

The burst of the high-speed data transmission (HSDT) can consist of one data packet or several data packets.

These data packets can be Long (LPa) or Short (SPa) packets.

These different burst of the High-Speed Data Transmission (HSDT) cases are illustrated for reference purposes below.

Single Packet in High Speed Data Transmission



Multiple Packets in High Speed Data Transmission

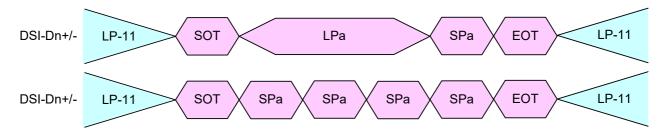
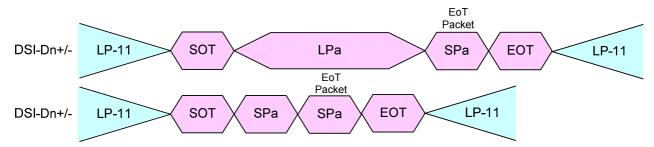


Figure 43 HS Transmission Example with EoT packet disabled

Single Packet in High Speed Data Transmission



Multiple Packets in High Speed Data Transmission

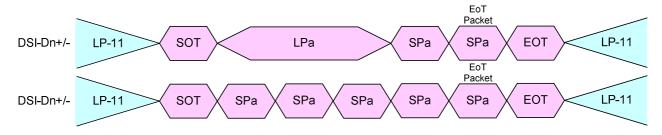


Figure 44 HS Transmission Example with EoT packet enable

# **ST7701S**

| Abbreviation | Explanation                                    |
|--------------|--|
| EOT          | End of the Transmission                        |
| LPa          | Long Packet                                    |
| LP-11        | Low Power Mode, Data lanes are'1's (Stop Mode) |
| SPa          | Short Packet                                   |
| SOT          | Start of the Transmission                      |



#### **Bus Turnaround (BTA)**

The MCU or display module, which is controlling DSI-D0+/- Data Lanes, can start a bus turnaround procedure when it wants information from a receiver, which can be the MCU or display module.

The MCU or display module are using the same sequence when this bus turnaround procedure is used. This sequence is described for reference purposes, when the MCU wants to do the bus turnaround procedure to the display module, as follow.

- · Start (MCU):LP-11
- Turnaround Request (MCU): LP-11 LP-10 LP-00 LP-10 LP-00
- The MCU wait until the display module is starting to control DSI-D0+/- data lanes and the MCU stop to control DSI-D0+/- data lanes (=High-Z)
- The display module changes to the stop mode: LP-00 \_ LP-10 \_ LP-11

The same bus turnaround .procedure (From the MCU to the display module) is illustrated below.

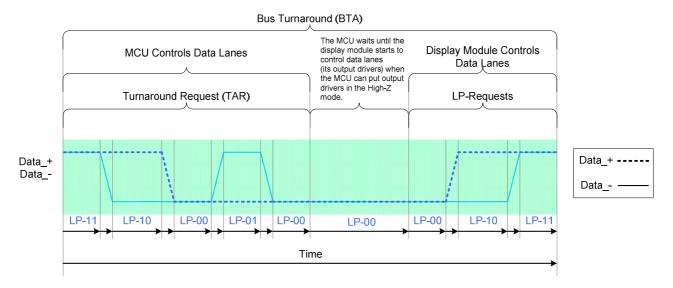


Figure 45 Bus Turnaround Procedure

MCU and the display module terms are switched on above figure, if the Bus Turnaround (BTA) is from the display module to the MCU..

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#### 8.7.2.3 Packet Level Communication

#### 8.7.2.3.1 Short Packet (SPA) And Long Packet (LPA) Structure

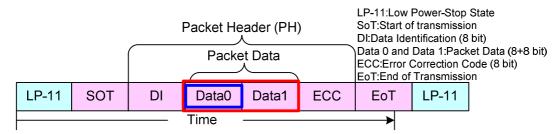
Short Packet (SPa) and Long Packet (LPa) are always used when data transmission is done in Low Power Data Transmission (LPDT) or High-Speed Data Transmission (HSDT) modes.

The lengths of the packets are

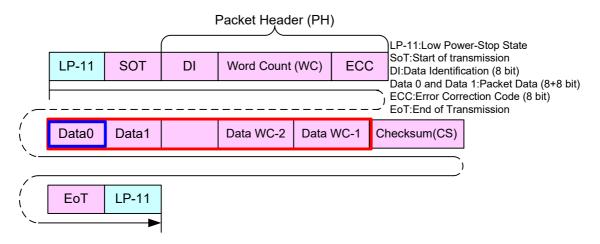
- Short Packet (SPa): 4 bytes
- · Long Packet (LPa): From 6 to 65,541 bytes

The type (SPa or LPa) of the packet can be recognized from their package headers (PH).

Short Packet (Spa) Structure:



Long Packet (Spa) Structure:



Note:

Short Packet (SPa) Structure and Long Packet (LPa) Structure are presenting a single packet sending (= Includes LP-11,

SoT and EoT for each packet sendings).

The other possibility is that there is not needed SoT, EoT and LP-11 between packets if packets have sent in multiple packet format e.g.

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<sup>\*</sup> LP-11 =>SoT =>SPa =>SPa =>EoT =>LP-11

<sup>\*</sup> LP-11 =>SoT =>LPa =>LPa =>EoT =>LP-11



### 8.7.2.3.1.1 Bit Order of the Byte on Packets

The bit order of the byte, what is used on packets, is that the Least Significant Bit (LSB) of the byte is sent in the first and the Most Significant Bit (MSB) of the byte is sent in the last.

This same order is illustrated for reference purposes below.

| DI WC (LSB) |               |   |   |   |   |   |   |   |   |   | WC (MSB) |   |        |   |     |    |   |   |   | ECC |   |        |   |   |   |   |   |   |   |   |                   |
|-------------|---------------|---|---|---|---|---|---|---|---|---|----------|---|--------|---|-----|----|---|---|---|-----|---|--------|---|---|---|---|---|---|---|---|-------------------|
|             | 29 hex 01 hex |   |   |   |   |   |   |   |   |   |          |   | 00 hex |   |     |    |   |   |   |     |   | 06 hex |   |   |   |   |   |   |   |   |                   |
| 1           | 0             | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0        | 0 | 0      | 0 | 0   | 0  | 0 | 0 | 0 | 0   | 0 | 0      | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0                 |
| В           | В             | В | В | В | В | В | В | В | В | В | В        | В | В      | В | В   | В  | В | В | В | В   | В | В      | В | В | В | В | В | В | В | В | В                 |
| 0           | 1             | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3        | 4 | 5      | 6 | 7   | 0  | 1 | 2 | 3 | 4   | 5 | 6      | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7                 |
| Т           |               |   |   |   |   |   | М | Г |   |   |          |   |        |   | М   | Ц  |   |   |   |     |   |        | М | L |   |   |   |   |   |   | М                 |
| S           |               |   |   |   |   |   | S | S |   |   |          |   |        |   | S   | S  |   |   |   |     |   |        | S | s |   |   |   |   |   |   | S                 |
| В           |               |   |   |   |   |   | В | В |   |   |          |   |        |   | В   | в  |   |   |   |     |   |        | В | в |   |   |   |   |   |   | В                 |
|             | _             |   |   |   |   |   |   |   |   |   |          |   | _      | • | Tir | ne | · | _ |   |     |   |        |   |   |   |   |   |   |   |   | $\overline{lack}$ |

Figure 46 Bit Order of Byte on Packets

### 8.7.2.3.1.2 Bit Order of the Multiple Byte Information on Packets

Byte order of the multiple bytes information, what is used on packets, is that the Least Significant (LS) Byte of the information is sent in the first and the Most Significant (MS) Byte of the information is sent in the last e.g. Word Count (WC) consists of 2 bytes (16 bits) when the LS byte is sent in the first and the MS byte is sent in the last. This same order is illustrated for reference purposes below.

|          | 1 | N | ) ( | LS | B | ) |     | WC (MSB)        |   |   |   |    |   |   |          |  |  |  |
|----------|---|---|-----|----|---|---|-----|-----------------|---|---|---|----|---|---|----------|--|--|--|
|          |   | 0 | 1   | he | X |   |     |                 |   | 0 | 0 | he | X |   |          |  |  |  |
| 1        | 0 | 0 | 0   | 0  | 0 | 0 | 0   | 0               | 0 | 0 | 0 | 0  | 0 | 0 | 0        |  |  |  |
| В        | В | В | В   | В  | В | В | В   | В               | В | В | В | В  | В | В | В        |  |  |  |
| 0        | 1 | 2 | 3   | 4  | 5 | 6 | 7   | 7 0 1 2 3 4 5 6 |   |   |   |    |   |   |          |  |  |  |
| T        |   |   |     |    |   |   | М   | L               |   |   |   |    |   |   | М        |  |  |  |
| S        |   |   |     |    |   |   | s   | s               |   |   |   |    |   |   | s        |  |  |  |
| В        |   |   |     |    |   |   | В   | В               |   |   |   |    |   |   | В        |  |  |  |
| $\vdash$ |   |   |     |    | _ | • | Tir | ne              | ) | _ |   |    |   |   | <b>→</b> |  |  |  |

Figure 47 Byte Order of the Multiple Byte on Packets

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#### 8.7.2.3.1.3 Pack Header (PH)

The packet header is always consisting of 4 bytes. The content of these 4 bytes are different if it is used to Short Packet (SPa) or Long Packet (LPa).

Short Packet (SPa):

• 1st byte: Data Identification (DI) => Identification that this is Short Packet (SPa)

• 2nd and 3rd bytes: Packet Data (PD), Data 0 and 1

• 4th byte: Error Correction Code (ECC)

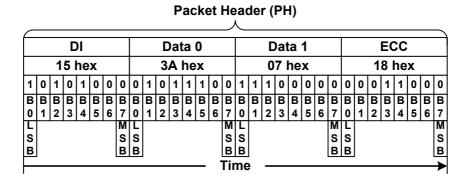


Figure 48 Packet Header (PH) on Short Packet(Spa)

Long Packet (LPa):

• 1st byte: Data Identification (DI) => Identification that this is Long Packet (LPa)

2nd and 3rd bytes: Word Count (WC)

• 4th byte: Error Correction Code (ECC)

#### Packet Header (PH) DI **ECC** WC (LSB) WC (MSB) 29 hex 01 hex 00 hex 06 hex 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 1 0 0 1 0 0 0 1 1 0 0 B 0 BBBBB В В ВВ В ВВВ В ВВВ ВВВВ В В В ВВВ В В В В 1 2 3 4 5 7 0 1 2 3 4 7 0 1 2 3 4 7 0 1 2 3 4 S ss s s S s S вв ВВ ВВ В Time

Figure 49 Packet Header (PH) on Long Packet (LPa)



### Data Identification (DI)

Data Identification (DI) is a part of Packet Header (PH) and it consists of 2 parts:

- Virtual Channel (VC), 2 bits, DI[7...6]
- Data Type (DT), 6 bits, DI[5...0]

The Data Identification (DI) structure is illustrated on a table below.

|            | Data Identification (DI) |       |       |         |         |       |       |  |  |  |  |  |  |  |  |
|------------|--------------------------|-------|-------|---------|---------|-------|-------|--|--|--|--|--|--|--|--|
| Virtual Ch | annel (VC)               |       |       | Data Ty | pe (DT) |       |       |  |  |  |  |  |  |  |  |
| Bit 7      | Bit 6                    | Bit 5 | Bit 4 | Bit 3   | Bit 2   | Bit 1 | Bit 0 |  |  |  |  |  |  |  |  |

Figure 50 Data Identification (DI) Structure

| DI WC (LSB)   |   |   |   |   |   |   |   |   |   |   |   |        | WC (MSB) |   |     |    |   |   |   |        |   | ECC |   |   |   |   |   |   |   |   |               |
|---------------|---|---|---|---|---|---|---|---|---|---|---|--------|----------|---|-----|----|---|---|---|--------|---|-----|---|---|---|---|---|---|---|---|---------------|
| 29 hex 01 hex |   |   |   |   |   |   |   |   |   |   |   | 00 hex |          |   |     |    |   |   |   | 06 hex |   |     |   |   |   |   |   |   |   |   |               |
| 1             | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0      | 0        | 0 | 0   | 0  | 0 | 0 | 0 | 0      | 0 | 0   | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0             |
| В             | В | В | В | В | В | В | В | В | В | В | В | В      | В        | В | В   | В  | В | В | В | В      |   | В   | В | В | В | В | В | В | В | В | В             |
| 0             | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4      | 5        | 6 | 7   | 0  | 1 | 2 | 3 | 4      | 5 | 6   | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7             |
| F             |   |   |   |   |   |   | M | F |   |   |   |        |          |   | М   | Г  | L |   |   |        |   |     |   | Ц |   |   |   |   |   |   | M             |
| S             |   |   |   |   |   |   | S | s |   |   |   |        |          |   | s   | s  |   |   |   |        |   |     | S | s |   |   |   |   |   |   | S             |
| L<br>S<br>B   |   |   |   |   |   |   | В | В |   |   |   |        |          |   | В   | В  |   |   |   |        |   |     | В | В |   |   |   |   |   |   | В             |
|               |   |   |   |   |   |   |   |   |   |   |   |        |          | • | Tir | ne | • | _ |   |        |   |     |   |   |   |   |   |   |   |   | $\overline{}$ |

Figure 51 Data Identification (DI) on the Packet Header(PH)



#### Virtual Channel (VC)

Virtual Channel (VC) is a part of Data Identification (DI[7...6]) structure and it is used to address where a packet is wanted to send from the MCU.

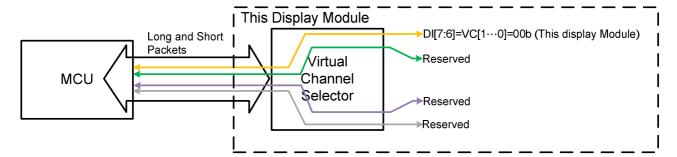
Bits of the Virtual Channel (VC) are illustrated for reference purposes below.

|        | Packet Header (PH) |   |   |   |   |   |   |   |        |   |            |   |   |   |   | ac            | de     | r (     | Pŀ | ł) |    |    |   |   |        |   |   |   |   |   |   |  |  |
|--------|--------------------|---|---|---|---|---|---|---|--------|---|------------|---|---|---|---|---------------|--------|---------|----|----|----|----|---|---|--------|---|---|---|---|---|---|--|--|
| _      |                    |   |   |   |   |   |   |   |        |   |            |   |   |   |   | $\overline{}$ |        |         |    |    |    |    |   |   |        |   |   |   |   |   |   |  |  |
|        | DI WC (LSB)        |   |   |   |   |   |   |   |        |   | WC (MSB) E |   |   |   |   |               |        |         |    |    | EC | CC |   |   |        |   |   |   |   |   |   |  |  |
| 29 hex |                    |   |   |   |   |   |   |   | 01 hex |   |            |   |   |   |   |               | 00 hex |         |    |    |    |    |   |   | 06 hex |   |   |   |   |   |   |  |  |
| 1      | 0                  | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0      | 0 | 0          | 0 | 0 | 0 | 0 | 0             | 0      | 0       | 0  | 0  | 0  | 0  | 0 | 0 | 1      | 1 | 0 | 0 | 0 | 0 | 0 |  |  |
| В      | В                  | В | В | В | В | В | В | В | В      | В | В          | В | В | В | В | В             | В      | В       | В  | В  | В  | В  | В | В | В      | В | В | В | В | В | В |  |  |
| 0      | 1                  | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1      | 2 | 3          | 4 | 5 | 6 | 7 | 0             | 1      | 2       | 3  | 4  | 5  | 6  | 7 | 0 | 1      | 2 | 3 | 4 | 5 | 6 | 7 |  |  |
| T      |                    |   |   |   |   |   | M | ᆫ |        |   |            |   |   |   | М | L             |        |         |    |    |    |    | М | L |        |   |   |   |   |   | М |  |  |
| S      | s s                |   |   |   |   |   |   |   | s      |   |            |   |   |   |   | s s           |        |         |    |    |    |    |   | S | s      |   |   |   |   |   |   |  |  |
| В      | В                  |   |   |   |   |   |   |   | В В    |   |            |   |   |   |   |               |        | в   в в |    |    |    |    |   |   |        |   | 3 |   |   |   |   |  |  |
|        |                    |   |   |   |   |   |   |   |        |   |            |   |   |   |   |               |        |         |    |    |    |    |   | → |        |   |   |   |   |   |   |  |  |

Figure 52 Virtual Channel (VC) on the Packet Header (PH)

Virtual Channel (VC) can address 4 different channels for e.g. 4 different display modules. Devices are using the same virtual channel what the MCU is using to send packets to them e.g.

- The MCU is using the virtual channel 0 when it sends packets to this display module
- This display module is also using the virtual channel 0 when it sends packets to the MCU This functionality is illustrated below.



### Virtual Channel (VC) Configuration

Virtual Channel (VC) always 0 (D[7...6]=VC[1...0]00b) when the MCU is sending "End of Transmission Packet" to the display module. See section "End of Transmission Packet (EoTP)

This display module is not supporting the virtual channel selector for other device (1 to 3) when only possible virtual channel (VC[1...0]) is 00b for this display module.



### Data Type (DT)

Data Type (DT) is a part of Data Identification (DI[5...0]) structure and it is used to define a type of the used data on a packet.

Bits of the Data Type (DT) are illustrated for reference purposes below.

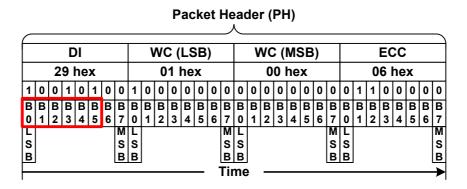


Figure 53 Data Type (DT) on the Packet Header (PH)



This Data Type (DT) also defines what the used packet is: Short Packet (SPa) or Long Packet (LPa). Data Types (DT) are different from the MCU to the display module (or other devices) and vice versa.

These Data Type (DT) are defined on tables below.

| Data Type | Data Type | B   | Packet |
|-----------|-----------|---|--------|
| Hex       | Binary    | Description   | Size   |
| 01h       | 00 0001   | Sync Event, V Sync Start.                           | Short  |
| 11h       | 01 0001   | Sync Event, V Sync End.                             | Short  |
| 21h       | 10 0001   | Sync Event, H Sync Start.                           | Short  |
| 31h       | 11 0001   | Sync Event, H Sync End.                             | Short  |
| 08h       | 00 1000   | End of Transmission (EoT) packet.                   | Short  |
| 02h       | 00 0010   | Color Mode (CM) Off Command.                        | Short  |
| 12h       | 01 0010   | Color Mode (CM) On Command.                         | Short  |
| 22h       | 10 0010   | Shut Down Peripheral Command.                       | Short  |
| 32h       | 11 0010   | Turn On Peripheral Command.                         | Short  |
| 03h       | 00 0011   | Generic Short WRITE, no parameters                  | Short  |
| 13h       | 01 0011   | Generic Short WRITE, 1 parameter.                   | Short  |
| 23h       | 10 0011   | Generic Short WRITE, 2 parameters.                  | Short  |
| 04h       | 00 0100   | Generic READ, no parameters.                        | Short  |
| 14h       | 01 0100   | Generic READ, 1 parameter.                          | Short  |
| 24h       | 10 0100   | Generic READ, 2 parameters.                         | Short  |
| 05h       | 00 0101   | DCS WRITE, no parameter.                            | Short  |
| 15h       | 01 0101   | DCS WRITE, 1 parameter.                             | Short  |
| 06h       | 00 0110   | DCS READ, no parameter.                             | Short  |
| 37h       | 11 0111   | Set Maximum Return Packet Size.                     | Short  |
| 09h       | 00 1001   | Null Packet, no data.                               | Long   |
| 19h       | 01 1001   | Blanking Packet, no data.                           | Long   |
| 29h       | 10 1001   | Generic Long Write.                                 | Long   |
| 39h       | 11 1001   | DCS Long Write/write_LUT Command Packet.            | Long   |
| 0Eh       | 00 1110   | Packed Pixel Stream, 16-bit RGB,5-6-5 Format.       | Long   |
| 1Eh       | 01 1110   | Packed Pixel Stream, 18-bit RGB,6-6-6 Format.       | Long   |
| 2Eh       | 10 1110   | Loosely Packed Pixel Stream,18-bit RGB,6-6-6 Format | Long   |
| 3Eh       | 11 1110   | Packed Pixel Stream,24-bit RGB,8-8-8 Format.        | Long   |

Table 15 Data Type (DT) from MCU to the Display Module (or Other Devices)

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|     | From the Display Module (or Other Devices) to the MCU |   |   |   |   |   |   |        |              |  |  |  |  |  |
|-----|---|---|---|---|---|---|---|--------|--------------|--|--|--|--|--|
| Hex | В   | В | В | В | В | В | Description                                 | Packet | Abbreviation |  |  |  |  |  |
| пех | 5   | 4 | 3 | 2 | 1 | 0 | Description                                 | Facket | Appreviation |  |  |  |  |  |
| 02h | 0   | 0 | 0 | 0 | 1 | 0 | Acknowledge with Error Report               | Short  | AwER         |  |  |  |  |  |
| 1Ch | 0   | 1 | 1 | 1 | 0 | 0 | DCS Read Long Response                      | Short  | DCSRR_L      |  |  |  |  |  |
| 21h | 1   | 0 | 0 | 0 | 0 | 1 | DCS Read Short Response, 1 byte returned    | Short  | DCSRR1_S     |  |  |  |  |  |
| 22h | 1   | 0 | 0 | 0 | 1 | 0 | DCS Read Short Response, 2 byte returned    | Short  | DCSRR2_S     |  |  |  |  |  |
| 1Ah | 0   | 1 | 1 | 0 | 1 | 0 | Generic Read Long Response                  | Short  | GENRR-L      |  |  |  |  |  |
| 11h | 0   | 1 | 0 | 0 | 0 | 1 | Generic Read Short Response,1 byte returned | Short  | GENRR1-S     |  |  |  |  |  |
| 12h | 0   | 1 | 0 | 0 | 1 | 0 | Generic Read Short Response,2 byte returned | Short  | GENRR2-S     |  |  |  |  |  |

Table 16 Data Type (DT) from the Display Module (or Other Devices) to the MCU

The receiver will ignore other Data Type (DT) if they are not defined on tables: "Data Type (DT) from the MCU to the Display Module (or Other Devices)" or "Data Type (DT) from the Display Module (or Other Devices) to the MCU".



#### Packet Data (PD) on the Short Packet (SPa)

Packet Data (PD) of the Short Packet (SPa) is defined after Data Type (DT) of the Data Identification (DI) has indicated that Short Packet (SPa) is wanted to send.

The Word Count (WC) indicates the number of Bytes of Packet of Packet Data (PD) send after the Packet Header.

Packet Data (PD) of the Short Packet (SPa) consists of 2 data bytes: Data 0 and Data 1.

Packet Data (PD) sending order is that Data 0 is sent in the first and the Data 1 is sent in the last.

Bits of Data 1 are set to '0' if the information length is 1 byte.

Packet Data (PD) of the Short Packet (SPa), when the length of the information is 1 or 2 bytes are illustrated for reference purposes below, when Virtual Channel (VC) is 0.

Packet Data (PD) information:

- Data 0: 35hex (Display Command Set (DCS) with 1 Parameter => DI(Data Type (DT)) = 15hex)
- Data 1: 01hex (DCS's parameter)

|           | Packet Header (PH) |   |   |   |   |   |        |   |               |   |   |            |   |     |        |                 |        |       |   |   |       |        |               |   |        |   |   |   |   |        |          |  |
|-----------|--------------------|---|---|---|---|---|--------|---|---------------|---|---|------------|---|-----|--------|-----------------|--------|-------|---|---|-------|--------|---------------|---|--------|---|---|---|---|--------|----------|--|
| $\subset$ | DI Data 0          |   |   |   |   |   |        |   |               |   |   | Data 1 ECC |   |     |        |                 |        |       |   |   |       |        | $\overline{}$ |   |        |   |   |   |   |        |          |  |
| 15 hex    |                    |   |   |   |   |   |        |   | 35 hex        |   |   |            |   |     |        |                 | 01 hex |       |   |   |       |        |               |   | 1E hex |   |   |   |   |        |          |  |
| 1         | 0                  | 1 | 0 | 1 | 0 | 0 | 0      | 1 | 0             | 1 | 0 | 1          | 1 | 0   | 0      | 0               | 0      | 0     | 0 | 1 | 0     | 0      | 0             | 0 | 1      | 1 | 1 | 1 | 0 | 0      | 0        |  |
| В         | В                  | В | В | ı | В | В | В      | В | В             | В |   | В          | В | ı — | В      | -               | Ι      | ı     | В | В | I _ I | В      | В             | В | В      | В | В |   |   |        | В        |  |
| 0         | 1                  | 2 | 3 | 4 | 5 | 6 | 7<br>M | 0 | 0 1 2 3 4 5 6 |   |   |            |   |     | 7<br>M | 0 1 2 3 4 5 6 7 |        |       |   |   |       | 7<br>M | 0             | 1 | 2      | 3 | 4 | 5 | 6 | 7<br>M |          |  |
| S         | S S                |   |   |   |   |   |        |   | s             |   |   |            |   |     |        |                 | S S    |       |   |   |       |        |               | S |        |   |   |   |   |        | M<br>S   |  |
| В         |                    |   |   |   |   |   |        |   |               | S |   |            |   |     |        |                 |        | 1 - 1 |   |   |       |        |               |   |        | - |   |   |   |        |          |  |
|           |                    |   |   |   |   |   |        |   |               |   |   |            | _ |     | Tir    | ne              | )      | _     |   |   |       |        |               |   |        |   |   |   |   |        | <b>→</b> |  |

Figure 54 Packet Data (PD) for Short Packet (SPa), 2 Bytes Information

Packet Data (PD) information:

- Data 0: 10hex (DCS without parameter => DI(Data Type (DT)) = 05hex)
- Data 1: 00hex (Null)

| _      | Packet Header (PH) |   |   |   |   |   |   |   |        |   |   |   |   |   |        | _   |        |   |   |     |          |   |   |          |        |   |   |   |   |   |   |  |
|--------|--------------------|---|---|---|---|---|---|---|--------|---|---|---|---|---|--------|-----|--------|---|---|-----|----------|---|---|----------|--------|---|---|---|---|---|---|--|
|        | DI Data 0          |   |   |   |   |   |   |   |        |   |   |   |   | C | )at    | a   | 1      |   |   | ECC |          |   |   |          |        |   |   |   |   |   |   |  |
| 05 hex |                    |   |   |   |   |   |   |   | 10 hex |   |   |   |   |   |        |     | 00 hex |   |   |     |          |   |   |          | 2C hex |   |   |   |   |   |   |  |
| 1      | 0                  | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0      | 0 | 0 | 1 | 0 | 0 | 0      | 0   | 0      | 0 | 0 | 0   | 0        | 0 | 0 | 0        | 0      | 1 | 1 | 0 | 1 | 0 | 0 |  |
| В      | В                  | В | В | ı | В | В | В | В | В      | В | В | В | В |   |        | - 1 | В      | ı | В | В   |          | В | В | В        | В      | В | В |   | В |   | В |  |
| 0      | 1                  | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1      | 2 | 3 | 4 | 5 | 6 | 7<br>M | 0   | 1      | 2 | 3 | 4   | 5        | 6 | 7 | 0        | 1      | 2 | 3 | 4 | 5 | 6 | 7 |  |
| L      |                    |   |   |   |   |   |   |   | 니      |   |   |   |   |   |        |     | 1 1    |   |   |     |          |   |   | 느        |        |   |   |   |   |   | M |  |
| S      |                    |   |   |   |   |   |   |   |        |   |   | S | S |   |        |     |        |   |   | S   | S        | 5 |   |          |        |   |   | S |   |   |   |  |
| В      |                    |   |   |   |   |   | В | В |        |   |   |   |   |   | В      | В   |        |   |   |     |          |   | В | <u>B</u> | ]      |   |   |   |   |   | В |  |
| -      | Time               |   |   |   |   |   |   |   |        |   |   |   |   | _ |        |     |        |   |   |     | <b>→</b> |   |   |          |        |   |   |   |   |   |   |  |

Figure 55 Packet Data(PD) fo Short Packet (Spa), 1 Bytes Information

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## Word Count (WC) on the Long Packet (LPa)

Word Count (WC) of the Long Packet (LPa) is defined after Data Type (DT) of the Data Identification (DI) has indicated that Long Packet (LPa) is wanted to send.

Word Count (WC) indicates a number of the data bytes of the Packet Data (PD) what is wanted to send after Packet Header (PH) versus Packet Data (PD) of the Short Packet (SPa) is placed in the Packet Header (PH). Word Count (WC) of the Long Packet (LPa) consists of 2 bytes.

These 2 bytes of the Word Count (WC) sending order is that the Least Significant (LS) Byte is sent in the first and the Most Significant (MS) Byte is sent in the last.

Word Count (WC) of the Long Packet (LPa) is illustrated for reference purposes below.

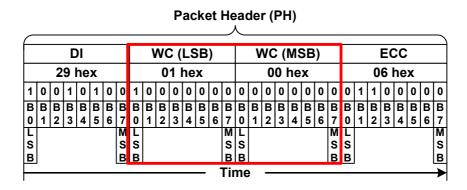
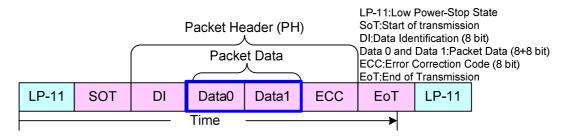
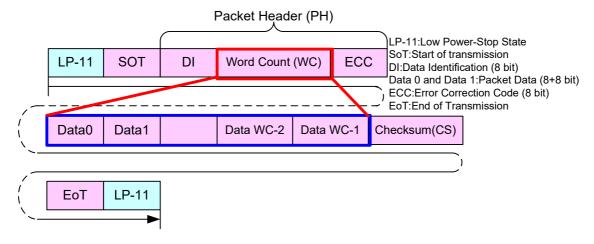


Figure 56 Word Count (WC) on the Long Packet (LPa)

#### **Short Packet:**



## Long Packet:



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## **Error Correction Code (ECC)**

Error Correction Code (ECC) is a part of Packet Header (PH) and its purpose is to identify an error or errors on the Packet Header (PH):

The ECC protects the following field"

- Short Packet (SPa): Data Identification (DI) byte (8 bits, D[0...7]), Packet Data (PD) bytes (16 bits, D[8...23]) and ECC(8 bits: P[0...7])
- Long Packet (LPa): Data Identification (DI) byte (8 bits, D[0...7]), Word Count (WC) bytes (16 bits: D[8...23]) and ECC (8 bits, P[0...7])

D[23...0] and P[7...0] are illustrated for reference purposes below.

| _  |                                       |   |   |    |     |   |   |   |   |     | Р  | ac | :ke | et  | He     | ac | de | r ( | Pŀ | 1) |   |   |   |   |   |   |    |   |       |     | _ |
|--|---------------------------------------|---|---|----|-----|---|---|---|---|-----|----|----|-----|-----|--------|----|----|-----|----|----|---|---|---|---|---|---|----|---|-------|-----|---|
| Ĺ  |                                       |   | С | )I |     |   |   |   |   | С   | at | ta | 0   |     |        |    |    | С   | at | a  | 1 |   |   |   |   |   | ΕC | C |       | _   |   |
| Packet Header (PH)  DI Data 0 Data 1 ECC  05 hex 10 hex 00 hex 2C hex  1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |                                       |   |   |    |     |   |   |   |   |     |    |    |     |     |        |    |    |     |    |    |   |   |   |   |   |   |    |   |       |     |   |
| 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  |                                       |   |   |    |     |   |   |   |   |     |    |    |     |     |        |    |    |     |    |    |   |   |   |   |   |   |    |   |       |     |   |
|  | D D D D D D D D D D D D D D D D D D D |   |   |    |     |   |   |   |   |     |    |    |     |     |        | P  |    |     |    |    |   |   |   |   |   |   |    |   |       |     |   |
| 05 hex   |                                       |   |   |    |     |   |   |   |   |     |    |    |     |     | /<br>B |    |    |     |    |    |   |   |   |   |   |   |    |   |       |     |   |
|  | 1                                     | _ | _ | Ι  | ΙΞ. | _ | 7 | 0 | 1 | I — |    |    | _   | 1 = | 7      | 1- | 1  |     |    | ١. | _ | _ | 7 | 0 | 1 | _ | 3  | 4 | I – I | I – | 7 |
|  |                                       |   |   |    | _   |   |   | L |   | _   |    | _  |     | _   |        | L  |    |     |    | _  |   |   |   | L |   |   | _  |   |       |     |   |
|  | DI                                    |   |   |    |     |   |   |   |   |     |    |    |     |     |        |    |    |     |    |    |   |   |   |   |   |   |    |   |       |     |   |
|  |                                       |   |   |    |     |   | ם | 0 |   |     |    |    |     |     |        |    | ,  |     |    |    |   |   | ם | ם |   |   |    |   |       |     | 2 |
| Г  |                                       |   |   |    |     |   |   |   |   |     |    |    |     |     |        |    | •  |     |    |    |   |   |   |   |   |   |    |   |       |     |   |

D[23..0] and P[7...0] on the Short Packet (SPa)

#### Packet Header (PH) DI WC (LSB) WC (MSB) **ECC** 01 hex 29 hex 00 hex 06 hex 1 0 00000000 0 0 0 0 0 D 4 D 6 D D D D 10 11 12 13 D D D D 14 15 16 17 D D D D 18 19 20 21 D D 22 23 D 8 P 0 B 0 L S B ВВВВ В 0 1 6 0 1 2 0 1 2 s S s SS S S В В В

D[23 $\cdots$ 0] and P[7 $\cdots$ 0] on the Long Packet (LPa)

Error Correction Code (ECC) can recognize one error or several errors and makes correction in one bit error case.

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Bits (P[7...0]) of the Error Correction Code (ECC) are defined, where the symbol '^' is presenting XOR function (Pn is '1' if there is odd number of '1's and Pn is '0' if there is even number of '1's), as follows.

- P7 = 0
- P6 = 0
- P5 = D10^D11^D12^D13^D14^D15^D16^D17^D18^D19^D21^D22^D23
- P4 = D4^D5^D6^D7^D8^D9^D16^D17^D18^D19^D20^D22^D23
- P3 = D1^D2^D3^D7^D8^D9^D13^D14^D15^D19^D20^D21^D23
- P2 = D0^D2^D3^D5^D6^D9^D11^D12^D15^D18^D20^D21^D22
- P1 = D0^D1^D3^D4^D6^D8^D10^D12^D14^D17^D20^D21^D22^D23
- P0 = D0^D1^D2^D4^D5^D7^D10^D11^D13^D16^D20^D21^D22^D23

P7 and P6 are set to '0' because Error Correction Code (ECC) is based on 64 bit value ([D63...0]), but this implementation is based on 24 bit value (D[23...0]). Therefore, there is only needed 6 bits (P[5...0]) for Error Correction Code (ECC).

Packet Header (PH) ECC DI Data 0 Data 1 05 hex 2C hex 10 hex 00 hex 1 0 0 0 o 0 0 0 0 1 0 0 0 00000000 1 1 0 1 0 D 16 D 17 D 18 D 22 B B B B B B B B 0 1 2 3 4 5 6 B B B 4 5 6 S B S S B B S S B B S S B B SB Time

XOR Functionality on the Short Packet (SPa)

#### Packet Header (PH) DI WC (LSB) WC (MSB) ECC 29 hex 01 hex 00 hex 06 hex 0 0 0 0 0 0 0 1 0 1 0 1 0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 D 16 D D 17 18 D D D D 11 12 13 14 D D 21 22 B B BBBBBB В В ВВ BBBB B 7 В 0 B B 1 2 ВВ S B S S B B S S B B S S B B S B Time

XOR Functionality on the Long Packet (LPa)



The transmitter (The MCU or the Display Module) is sending data bits D[23...0] and Error Correction Code (ECC) P[7...0]. The receiver (The Display module or the MCU) is calculate an Internal Error Correction Code (IECC) and compares the received Error Correction Code (ECC) and the Internal Error Correction Code (IECC). This comparison is done when each power bit of ECC and IECC have been done XOR function. The result of this function is PO[7...0].

This functionality, where the transmitter is the MCU and the receiver is the display module, is illustrated for reference purposes below.

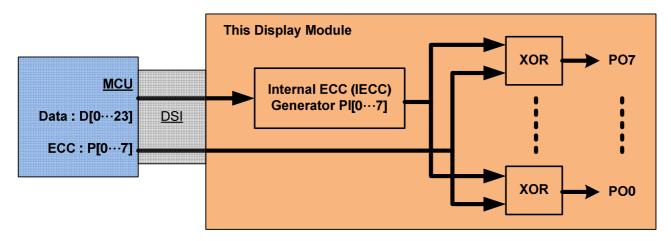


Figure 57 Internal Error Correction Code (IECC) on the Display Module (The Receiver)

The sent data bits (D[23...0]) and ECC (P[7...0]) are received correctly, if a value of the PO[7...0]) is 00h. The sent data bits (D[23...0]) and ECC (P[7...0]) are not received correctly, if a value of the PO[7...0]) is not 00h.

| ECC P[70]     | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 03h            |
|---------------|---|---|---|---|---|---|---|---|----------------|
| IECC PI[70]   | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 03h            |
| XOR(ECC,IECC) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | =00h=>No Error |
| =>PO[70]      |   |   |   |   |   |   |   |   |                |
|               | L |   |   |   |   |   |   | М |                |
|               | S |   |   |   |   |   |   | S |                |
|               | В |   |   |   |   |   |   | В |                |
|               |   |   |   |   |   |   |   |   |                |

| Internal XOR Calculation between ECC and IEC |
|--|
|--|

| ECC P[70]     | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 03h          |
|---------------|---|---|---|---|---|---|---|---|--------------|
| IECC PI[70]   | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0Fh          |
| XOR(ECC,IECC) | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | =0Ch=> Error |
| =>PO[70]      |   |   |   |   |   |   |   |   |              |
|               | L |   |   |   |   |   |   | М |              |
|               | S |   |   |   |   |   |   | S |              |
|               | В |   |   |   |   |   |   | В |              |

Internal XOR Calculation between ECC and IECC Values- Error

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The received Error Correction Code (ECC) can be 00h when the Error Correction Code (ECC) functionality is not used for data values D[23...0] on the transmitter side.

The number of the errors (one or more) can be defined when the value of the PO[7...0] is compared to values on the following table.

| Data Bit | PO7 | PO6 | PO5 | PO4 | PO3 | PO2 | PO1 | PO0 | Hex |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| D[0]     | 0   | 0   | 0   | 0   | 0   | 1   | 1   | 1   | 07h |
| D[1]     | 0   | 0   | 0   | 0   | 1   | 0   | 1   | 1   | 0Bh |
| D[2]     | 0   | 0   | 0   | 0   | 1   | 1   | 0   | 1   | 0Dh |
| D[3]     | 0   | 0   | 0   | 0   | 1   | 1   | 1   | 0   | 0Eh |
| D[4]     | 0   | 0   | 0   | 1   | 0   | 0   | 1   | 1   | 13h |
| D[5]     | 0   | 0   | 0   | 1   | 0   | 1   | 0   | 1   | 15h |
| D[6]     | 0   | 0   | 0   | 1   | 0   | 1   | 1   | 0   | 16h |
| D[7]     | 0   | 0   | 0   | 1   | 1   | 0   | 0   | 1   | 19h |
| D[8]     | 0   | 0   | 0   | 1   | 1   | 0   | 1   | 0   | 1Ah |
| D[9]     | 0   | 0   | 0   | 1   | 1   | 1   | 0   | 0   | 1Ch |
| D[10]    | 0   | 0   | 1   | 0   | 0   | 0   | 1   | 1   | 23h |
| D[11]    | 0   | 0   | 1   | 0   | 0   | 1   | 0   | 1   | 25h |
| D[12]    | 0   | 0   | 1   | 0   | 0   | 1   | 1   | 0   | 26h |
| D[13]    | 0   | 0   | 1   | 0   | 1   | 0   | 0   | 1   | 29h |
| D[14]    | 0   | 0   | 1   | 0   | 1   | 0   | 1   | 0   | 2Ah |
| D[15]    | 0   | 0   | 1   | 0   | 1   | 1   | 0   | 0   | 2Ch |
| D[16]    | 0   | 0   | 1   | 1   | 0   | 0   | 0   | 1   | 31h |
| D[17]    | 0   | 0   | 1   | 1   | 0   | 0   | 1   | 0   | 32h |
| D[18]    | 0   | 0   | 1   | 1   | 0   | 1   | 0   | 0   | 34h |
| D[19]    | 0   | 0   | 1   | 1   | 1   | 0   | 0   | 0   | 38h |
| D[20]    | 0   | 0   | 0   | 1   | 1   | 1   | 1   | 1   | 1Fh |
| D[21]    | 0   | 0   | 1   | 0   | 1   | 1   | 1   | 1   | 2Fh |
| D[22]    | 0   | 0   | 1   | 1   | 0   | 1   | 1   | 1   | 37h |
| D[23]    | 0   | 0   | 1   | 1   | 1   | 0   | 1   | 1   | 3Bh |

One error is detected if the value of the PO[7...0] is on: One Bit Error Value of the Error Correction Code (ECC) and the receiver can correct this one bit error because this found value also defines what is a location of the corrupt bit e.g.

- PO[7...0] = 0Eh
- The bit of the data (D[23...0]), what is not correct, is D[3]

More than one error is detected if the value of the PO[7...0] is not on: One Bit Error Value of the Error Correction Code (ECC) e.g. PO[7...0] = 0Ch.

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X16+X12+X5+X0 as it is illustrated below.

## 8.7.2.3.1.4 Packet Data (PD) on the Long Packet (LPa)

Packet Data (PD) of the Long Packet (LPa) is defined after Packet Header (PH) of the Long Packet (LPa). The number of the data bytes is defined on chapter "Word Count (WC) on the Long Packet (LPa)".

## 8.7.2.3.1.5 Packet Footer (PF) on the Long Packet (LPa)

Packet Footer (PF) of the Long Packet (LPa) is defined after the Packet Data (PD) of the Long Packet (LPa). The Packet Footer (PF) is a checksum value what is calculated from the Packet Data of the Long Packet (LPa). The checksum is using a 16-bit Cyclic Redundancy Check (CRC) value which is generated with a polynomial

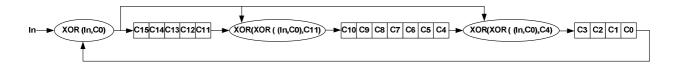


Figure 58 16-bit Cyclic Redundancy Check (CRC) Calculation

The 16-bit Cyclic Redundancy Check (CRC) generator is initialized to FFFFh before calculations. The Least Significant Bit (LSB) of the data byte of the Packet Data (PD) is the first bit what is inputted into the 16-bit Cyclic Redundancy Check (CRC).

An example of the 16-bit Cyclic Redundancy Check (CRC), where the Packet Data (PD) of the Long Packet (LPa) is 01h, is illustrated (step-by-step) below.



| Stop | In     | XOR(In,C0)  | C15 | C14 | C13 | C12 | C11 | XOR(XOR(In,C0),C11(Step-1)) | C10 | С9 | C8 | С7 | C6 | C5 | C4 | XOR(XOR(In,C0),C4(Step-1)) | СЗ | C2 | C1 | CO  | СО |
|------|--------|-------------|-----|-----|-----|-----|-----|-----------------------------|-----|----|----|----|----|----|----|----------------------------|----|----|----|-----|----|
| 0    | х      | х           | 1   | 1   | 1   | 1   | 1   | х                           | 1   | 1  | 1  | 1  | 1  | 1  | 1  | Х                          | 1  | 1  | 1  | 1   | х  |
| 1    | 1(LSB) | 0           | 0   | 1   | 1   | 1   | 1   | 1                           | 1   | 1  | 1  | 1  | 1  | 1  | 1  | 1                          | 1  | 1  | 1  | 1   | 1  |
| 2    | 0      | 1           | 1   | 0   | 1   | 1   | 1   | 0                           | 0   | 1  | 1  | 1  | 1  | 1  | 1  | 0                          | 0  | 1  | 1  | 1   | 1  |
| 3    | 0      | 1           | 1   | 1   | 0   | 1   | 1   | 0                           | 0   | 0  | 1  | 1  | 1  | 1  | 1  | 0                          | 0  | 0  | 1  | 1   | 1  |
| 4    | 0      | 1           | 1   | 1   | 1   | 0   | 1   | 0                           | 0   | 0  | 0  | 1  | 1  | 1  | 1  | 0                          | 0  | 0  | 0  | 1   | 1  |
| 5    | 0      | 1           | 1   | 1   | 1   | 1   | 0   | 0                           | 0   | 0  | 0  | 0  | 1  | 1  | 1  | 0                          | 0  | 0  | 0  | 0   | 0  |
| 6    | 0      | 0           | 0   | 1   | 1   | 1   | 1   | 0                           | 0   | 0  | 0  | 0  | 0  | 1  | 1  | 1                          | 1  | 0  | 0  | 0   | 0  |
| 7    | 0      | 0           | 0   | 0   | 1   | 1   | 1   | 1                           | 1   | 0  | 0  | 0  | 0  | 0  | 0  | 1                          | 1  | 1  | 0  | 0   | 0  |
| 8    | 0(MSB) | 0           | 0   | 0   | 0   | 1   | 1   | 1                           | 1   | 1  | 0  | 0  | 0  | 0  | 0  | 1                          | 1  | 1  | 1  | 0   | 0  |
|      | 1 Byte | CRC Resoult | 0   | 0   | 0   | 1   | 1   |                             | 1   | 1  | 0  | 0  | 0  | 0  | 0  |                            | 1  | 1  | 1  | 0   |    |
|      |        | •           | LSB |     |     |     |     | •                           |     |    |    |    |    |    |    |                            |    |    |    | LSB |    |

Figure 59 CRC Calculation – Packet Data (PD) is 01h

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A value of the Packet Footer (PF) is 1E0Eh in this example. This example (Command 01h has been sent) is illustrated below.

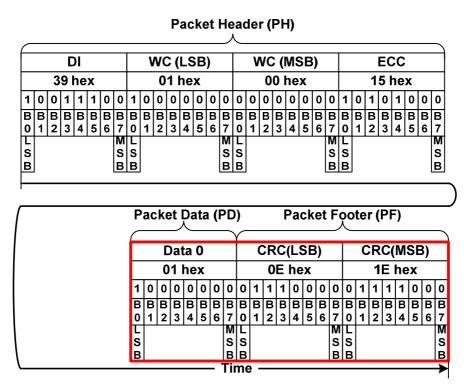


Figure 60 Packet Footer (PF) Example

The receiver is calculated own checksum value from received Packet Data (PD). The receiver compares own checksum and the Packet Footer (PF) what the transmitter has sent.

The received Packet Data (PD) and Packet Footer (PF) are correct if the own checksum of the receiver and Packet Footer (PF) are equal and vice versa the received Packet Data (PD) and Packet Footer (PF) are not correct if the own checksum of the receiver and Packet Footer (PF) are not equal.



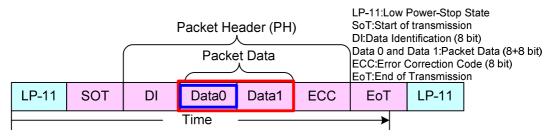
## 8.7.2.3.2 Packet Transmissions

## 8.7.2.3.2.1 Packet from the MCU to the Display Module

## **Display Command Set (DCS)**

Display Command Set (DCS), which is defined on chapter "9 Instruction Description", is used from the MCU to the display module. This Display Command Set (DCS) is always defined on the Data 0 of the Packet Data (PD), which is included in Short Packet (SPa) and Long packet (LPa) as these are illustrated below.

**Short Packet** 



Long Packet:

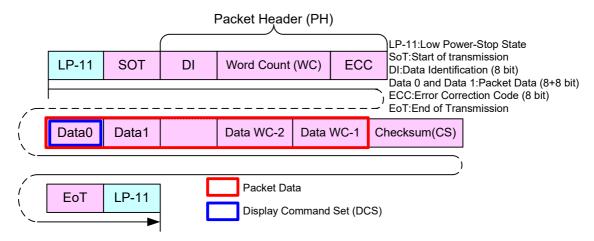


Figure 61 Display Command Set (DCS) on Short Packet (SPa) and Long Packet (LPa)



## Generic Write, 1 Parameter (GENW1-S), Data Type = 01 0011 (13h)

"Generic Write, 1 Parameter" (GENW1-S) is always using a Short Packet (SPa), what is defined on Data Type (DT, 01 0011b), from the MCU to the display module. The content of 2 payload bytes is "command" and 00h.

These commands are defined on a table (See chapter "9 Instruction Description") below

| Command       |
|---------------|
| NOP (00h)     |
| SWRESET (01h) |
| SLPIN (10H)   |
| SLPOUT (11h)  |
| PTLON (12h)   |
| NORON (13h)   |
| INVOFF (20h)  |
| INVON (21h)   |
| ALLPOFF (22h) |
| ALLPON (23h)  |
| DISPOFF (28h) |
| DISPON (29h)  |
| IDMOFF (38h)  |
| IDMON (39h)   |

Short Packet (SPa) is defined e.g.

- Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 01 0011b
- Packet Data (PD)
  - Data 0: "Sleep In (10h)", Display Command Set (DCS)
  - Data 1: Always 00hex
- Error Correction Code (ECC)

This is defined on the Short Packet (SPa) as follows.

| _        |   |   |   |           |   |   |   |          |    |     |          |    |     |  | ر   |     |    |            |            |     |     |           |   |   |   |   |    |            |   |   | _        |
|----------|---|---|---|-----------|---|---|---|----------|----|-----|----------|----|-----|--|-----|-----|----|------------|------------|-----|-----|-----------|---|---|---|---|----|------------|---|---|----------|
|          |   |   |   |           |   |   |   |          |    |     |          |    | Pá  | ac   | ke  | t [ | Эa | ta         |            |     |     |           |   |   |   |   |    |            |   |   | )        |
|          |   |   |   |           |   |   |   |          |    |     |          |    |     |  |     |     |    |            |            |     |     |           |   |   |   |   |    |            |   |   |          |
| $\vdash$ |   |   | Е | <u> </u>  |   |   |   | <u> </u> | ٠, | NIC | <u> </u> | LS | · D | <u> </u>                                     |     |     |    | VC         | ` /        | М   | • D | <u> </u>  |   |   |   |   | ΕC | `^         |   |   |          |
|          |   |   | ᆫ | <u>''</u> |   |   |   |          |    | -   | <u>ر</u> | Lo | 00  | <u>,                                    </u> |     |     | v  | <u>v c</u> | <u>' (</u> | NI. | 90  | <u>''</u> |   |   |   |   |    | <u>, C</u> |   |   |          |
|          |   | 1 | 3 | he        | X |   |   |          |    | 1   | 0 I      | he | X   |  |     |     |    | 0          | 0 I        | he  | X   |           |   |   |   | 3 | 9  | he         | X |   |          |
| 1        | 1 | 0 | 0 | 1         | 0 | 0 | 0 | 0        | 0  | 0   | 0        | 1  | 0   | 0  | 0   | 0   | 0  | 0          | 0          | 0   | 0   | 0         | 0 | 1 | 0 | 0 | 1  | 1          | 1 | 0 | 0        |
| В        | В | В | В | В         | В | В | В | В        | В  | В   | В        | В  | В   | В  | В   | В   | В  | В          | В          | В   | В   | В         | В | В | В | В | В  | В          | В | В | В        |
| 0        | 1 | 2 | 3 | 4         | 5 | 6 | 7 | 0        | 1  | 2   | 3        | 4  | 5   | 6  | 7   | 0   | 1  | 2          | 3          | 4   | 5   | 6         | 7 | 0 | 1 | 2 | 3  | 4          | 5 | 6 | 7        |
| T        |   |   |   |           |   |   | М | L        | Г  |     |          |    |     |  | М   | L   |    |            |            |     |     |           | М | L |   |   |    |            |   |   | М        |
| S        |   |   |   |           |   |   | s | s        |    |     |          |    |     |  | s   | S   |    |            |            |     |     |           | S | s |   |   |    |            |   |   | s        |
| В        |   |   |   |           |   |   | В | В        |    |     |          |    |     |  | В   | В   |    |            |            |     |     |           | В | В |   |   |    |            |   |   | В        |
| $\vdash$ |   |   |   |           |   |   |   |          |    |     |          |    | _   | •  | Tir | ne  | )  | _          |            |     |     |           |   |   |   |   |    |            |   |   | <b>→</b> |

Figure 62 Generic Write,1 Parameter (GENW1-S)-Example

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## Generic Write, 2 Parameter (GENW2-S), Data Type = 10 0011 (23h)

"Generic Write, 2 Parameter" (GENW2-S) is always using a Short Packet (SPa), what is defined on Data Type (DT, 10 0011b), from the MCU to the display module. The content of 2 payload bytes is "command" and "parameter". These commands are defined on a table (See chapter "6 Instruction Description") below.

| Command        |
|----------------|
| GAMSET (26h)   |
| COLMOD (3Ah)   |
| WRDISBV (51h)  |
| WRCTRLD (53h)  |
| WRCABC (55h)   |
| WRCABCMB (5Eh) |

Short Packet (SPa) is defined e.g.

- Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 10 0011b
- Packet Data (PD)
  - Data 0: "PMCSET (3Ah)", Display Command Set (DCS)
  - · Data 1: 01hex, Parameter of the DCS
- Error Correction Code (ECC)

This is defined on the Short Packet (SPa) as follows.

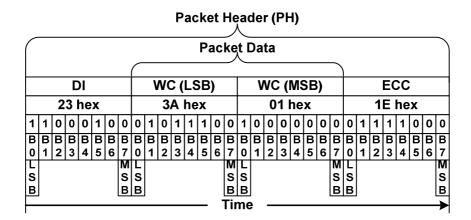


Figure 63 Generic Write, 2 Parameter (GENW2-S) – Example



## Generic Write Long (GENW-L), Data Type = 10 1001 (29h)

"Generic Write Long" (GENW-L) is always using a Long Packet (LPa), what is defined on Data Type (DT, 10 1001b), from the MCU to the display module. Command (No Parameters) and Write (1 or more parameters), are defined on a table (See chapter "6 Instruction Description") below.

|                      | Command               |                       |
|----------------------|-----------------------|-----------------------|
| NOP (00h), Note1     | INVON (21h), Note1    | IDMOFF (38h), Note1   |
| SWRESET (01h), Note1 | ALLPOFF (22h)         | IDMON (39h), Note1    |
| SLPIN (10H), Note1   | ALLPON (23h)          | COLMOD (3Ah) , Note2  |
| SLPOUT (11h), Note1  | GAMSET (26h), , Note2 | WRDISBV (51h), Note2  |
| PTLON (12h), Note1   | DISPOFF (28h), Note1  | WRCTRLD (53h), Note2  |
| NORON (13h), Note1   | DISPON (29h), Note1   | WRCABC (55h), Note2   |
| INVOFF (20h), Note1  | PARLINES (C5h)        | WRCABCMB (5E) , Note2 |

Notes: 1. Also Short Packet (SPa) can be used; See Generic Write, 1 Parameter.

2. Also Short Packet (SPa) can be used; See Generic Write, 2 Parameter.c

Long Packet (LPa), when a command (No Parameter) was sent, is defined e.g.

- Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 10 1001b
- Word Count (WC)
  - Word Count (WC): 0001h
- Error Correction Code (ECC)
- Packet Data (PD): Data 0: "Sleep In (10h)", Display Command Set (DCS)
- Packet Footer (PF)

This is defined on the Long Packet (LPa) as follows.

## Packet Header (PH)

|   |   |                   |                                 |                               |  |   |  |  |   |  |   |        |        |        |        |        |        |             |        |        |        |        |        |        |        |        |        |        |        | $\rightarrow$ |
|---|---|-------------------|---------------------------------|-------------------------------|--|---|--|--|---|--|---|--------|--------|--------|--------|--------|--------|-------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
|   |   | С                 | )                               |                               |  |   |  | ١  | N   | ે (  | LS  | B      | )      |        |        | ۷      | VC     | <b>;</b> (I | MS     | SB     | )      |        |        |        |        | E      | C      | ;      |        |               |
|   | 2 | 9 I               | he                              | X                             |  |   |  |  | 0   | 1  | he  | X      |        |        |        |        | 0      | 0           | he     | X      |        |        |        |        | 0      | 6      | he     | X      |        |               |
| 0 | 0 | 1                 | 0                               | 1                             | 0  | 0   | 1  | 0  | 0   | 0  | 0   | 0      | 0      | 0      | 0      | 0      | 0      | 0           | 0      | 0      | 0      | 0      | 0      | 1      | 1      | 0      | 0      | 0      | 0      | 0             |
| В | В | В                 | В                               | В                             | В  | В   | В  | В  | В   | В  | В   | В      | В      | В      | В      | В      | В      | В           | В      | В      | В      | В      | В      | В      | В      | В      | В      | В      | В      | В             |
| 1 | 2 | 3                 | 4                               | 5                             | 6  | 7   | 0  | 1  | 2   | 3  | 4   | 5      | 6      | 7      | 0      | 1      | 2      | 3           | 4      | 5      | 6      | 7      | 0      | 1      | 2      | 3      | 4      | 5      | 6      | 7             |
|   |   |                   |                                 |                               |  | M   | L  |  |   |  |   |        |        | M      | L      |        |        |             |        |        |        | М      | L      |        |        |        |        |        |        | М             |
|   |   |                   |                                 |                               |  | S   | S  |  |   |  |   |        |        | S      | S      |        |        |             |        |        |        | S      | S      |        |        |        |        |        |        | S             |
|   |   |                   |                                 |                               |  | В   | В  |  |   |  |   |        |        | B      | В      |        |        |             |        |        |        | В      | В      |        |        |        |        |        |        | В             |
|   | 1 | 0 0<br>B B<br>1 2 | 29 I<br>0 0 1<br>B B B<br>1 2 3 | 0 0 1 0<br>B B B B<br>1 2 3 4 | 29 hex 0 0 1 0 1 B B B B B B B 1 2 3 4 5 | 29 hex<br>0 0 1 0 1 0<br>B B B B B B<br>1 2 3 4 5 6 | 29 hex 0 0 1 0 1 0 0 B B B B B B B B B B 1 2 3 4 5 6 7 M S | 29 hex 0 0 1 0 1 0 0 1 B B B B B B B B B B B B B 1 2 3 4 5 6 7 0 M L S S | 29 hex<br>0 0 1 0 1 0 0 1 0<br>B B B B B B B B B B B<br>1 2 3 4 5 6 7 0 1<br>M L<br>S S | 29 hex 0<br>0 0 1 0 1 0 0 1 0 0<br>B B B B B B B B B B B B B B B B B B | 29 hex 01   0   0   0   0   0   0   0   0   0 | 29 hex      | 29 hex | 29 hex | 29 hex | 29 hex | 29 hex | 29 hex | 29 hex | 29 hex | 29 hex | 29 hex | 29 hex | 29 hex        |

| P           | ac     | ke     | t J    | Da       | ta       | (F | D        | )        |        |        | F      | a  | ck     | et | Fg     | 0      | te     | r (I   | PF     | •) |          |    |           |
|-------------|--------|--------|--------|----------|----------|----|----------|----------|--------|--------|--------|----|--------|----|--------|--------|--------|--------|--------|----|----------|----|-----------|
| $\subseteq$ |        | D      | at     | ta       | 0        |    |          | $\vdash$ | (      | R      | C(     | L  | SB     | 5) |        |        | С      | R      | C(     | M  | SE       | 3) | $\exists$ |
|             |        | 1      | 0 I    | he       | X        |    |          |          |        | 0      | 6      | he | X      |    |        |        |        | 1      | F      | he | X        |    |           |
| 0           | 0      | 0      | 0      | 1        | 0        | 0  | 0        | 0        | 1      | 1      | 0      | 0  | 0      | 0  | 0      | 1      | 1      | 1      | 1      | 1  | 0        | 0  | 0         |
| B<br>0      | В<br>1 | B<br>2 | B<br>3 | B<br>4   | B<br>5   |    | B<br>7   | B<br>0   | В<br>1 | B<br>2 | В<br>3 |    | B<br>5 |    | B<br>7 | Во     | В<br>1 | B<br>2 | В<br>3 |    | B<br>5   |    | B<br>7    |
| L<br>S      |        |        |        | <b>.</b> | <b>!</b> |    | M<br>S   | L<br>S   |        |        |        | ·— |        |    | M<br>S | L<br>S |        |        |        |    | <b>.</b> |    | M<br>S    |
| В           |        |        |        |          |          |    | B<br>Tir | B<br>ne  | , _    |        |        |    |        |    | В      | В      |        |        |        |    |          |    | В         |

Figure 64 Generic Long Write(GENW-L) with DCS Only – Example

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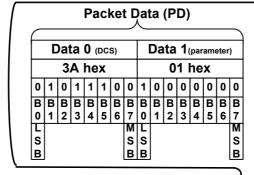
Long Packet (LPa), when a Write (1 parameter) was sent, is defined e.g.

- · Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 10 1001b
- Word Count (WC)
  - Word Count (WC): 0002h
- Error Correction Code (ECC)
- · Packet Data (PD):
  - Data 0: "Gamma Set (3Ah)", Display Command Set (DCS)
  - Data 1: 01hex, Parameter of the DCS
- Packet Footer (PF)

This is defined on the Long Packet (LPa) as follows.

## Packet Header (PH)

| 4 |               |   |   |   |   |   |   | _ |   |   |   |   |   |   |   | _  |     |   |    |   |   |   |   | _ |   |   |    |   |   |   | $\supset$ |
|---|---------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----|-----|---|----|---|---|---|---|---|---|---|----|---|---|---|-----------|
|   | DI WC (LSB)   |   |   |   |   |   |   |   |   |   |   |   |   |   | V | VC | ; ( | M | SB | ( |   |   |   |   | E | C | ;  |   |   |   |           |
|   | 29 hex 02 hex |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    | 0   | 0 | he | X |   |   |   |   | 0 | 6 | he | X |   |   |           |
| 1 | 0             | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0   | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0  | 0 | 0 | 0 | 0         |
| В | В             | В | В | В | В | В | В | В | В | В | В | В | В | В | В | В  | В   | В | В  | В | В | В | В | В | В | В | В  | В | В | В | В         |
| 0 | 1             | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0  | 1   | 2 | 3  | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3  | 4 | 5 | 6 | 7         |
| L |               |   |   |   |   |   | М | L |   |   |   |   |   |   | M | L  |     |   |    |   |   |   | M | L |   |   |    |   |   |   | M         |
| S |               |   |   |   |   |   | S | s |   |   |   |   |   |   | s | S  |     |   |    |   |   |   | s | S |   |   |    |   |   |   | S         |
| В |               |   |   |   |   |   | В | В |   |   |   |   |   |   | В | В  |     |   |    |   |   |   | В | В |   |   |    |   |   |   | В         |



#### Packet Footer (PF) CRC(LSB) CRC(MSB) E3 hex AA hex 1 0 1 0 1 0 0 0 0 1 1 1 0 М S B S B S S В

Figure 65 Generic Long Write (GENW-L) with DCS and 1 Parameter-Example



Long Packet (Lpa), when a Write (4 parameters) was sent, is defined e.g.

- Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 10 1001b
- Word Count (WC)
  - Word Count (WC): 0005h
- Error Correction Code (ECC)
- · Packet Data (PD):
  - Data 0: "PARLINES (30h)", Display Command Set (DCS)
  - Data 1: 00hex, 1st Parameter of the DCS, Start Column SC[15...8]
  - Data 2: 00hex, 2nd Parameter of the DCS, Start Column SC[7...0]
  - Data 3: 01hex, 3rd Parameter of the DCS, End Column EC[15...8]
  - Data 4: 3Fhex, 4th Parameter of the DCS, End Column EC[7...0]
- Packet Footer (PF)

This is defined on the Long Packet (Lpa) as follows.

## Packet Header (PH)

| $\subseteq$ |               |   |   |   |   |   |   |   |   |   |   |   |   |   |   | _ |    |     |    |    |    |   |   |   |   |   |    |   |   |   | $\rightarrow$ |
|-------------|---------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----|-----|----|----|----|---|---|---|---|---|----|---|---|---|---------------|
|             | DI WC (LSB)   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | V | VC | ; ( | MS | SB | 3) |   |   |   |   | E | C  | ; |   |   |               |
|             | 29 hex 05 hex |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | 0  | 0   | he | X  |    |   |   |   | 2 | 5 | he | X |   |   |               |
| 1           | 0             | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0   | 0  | 0  | 0  | 0 | 0 | 1 | 0 | 1 | 0  | 0 | 1 | 0 | 0             |
| В           | В             | В | В | В | В | В | В | В | В | В | В | В | В | В | В | В | В  | В   | В  | В  | В  | В | В | В | В | В | В  | В | В | В | В             |
| 0           | 1             | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1  | 2   | 3  | 4  | 5  | 6 | 7 | 0 | 1 | 2 | 3  | 4 | 5 | 6 | 7             |
| L           |               |   |   |   |   |   | М | L |   |   |   |   |   |   | М | L |    |     |    |    |    |   | М | L |   |   |    |   |   |   | М             |
| S           |               |   |   |   |   |   | S | S |   |   |   |   |   |   | S | S |    |     |    |    |    |   | S | S |   |   |    |   |   |   | S             |
| В           |               |   |   |   |   |   | В | В |   |   |   |   |   |   | В | В |    |     |    |    |    |   | В | В |   |   |    |   |   |   | В             |

#### Packet Data (PD) Data 0 (DCS) Data 1(1stparameter) Data 2(2stparameter) Data 3(3stparameter) 00 hex 30 hex 00 hex 01 hex 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7 0 1 2 3 4 7 S B ΜL L S S B B S S B B S S B B s В

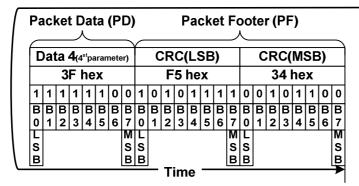


Figure 66 Generic Write Long (GENW-L) with DCS and 4 Parameters-Example



## Generic Read, 1 Parameter (GENR1-S), Data Type = 01 0100 (14h)

"Generic Read, 1 Parameter (GENR1-S) is always using a Short Packet (SPa), what is defined on Data Type (DT,01 0100b), from the MCU to the display module. This command is defined on a table (See chapter "9 Instruction Description") below.

| Com             | mand           |
|-----------------|----------------|
| RDDID (04h)     | RDDSM (0Eh)    |
| RDNUMED (05h)   | RDDSDR (0Fh)   |
| RDRED (06h)     | RDDISBV (52h)  |
| RDGREEN (07h)   | RDCTRLD (54h)  |
| RDBLUE (08h)    | RDCABC (56h)   |
| RDDPM (0Ah)     | RDCABCMB (5Fh) |
| RDDMADCTR (0Bh) | RDID1 (DAh)    |
| RDDCOLMOD (0Ch) | RDID2 (DBh)    |
| RDDIM (0Dh)     | RDID3 (DCh)    |

The MCU has to define to the display module, what is the maximum size of the return packet. A command, what is used for this purpose, is "Set Maximum Return Packet Size" (SMRPS-S), which Data Type (DT) is 11 0111b and which is using Short Packet (SPa) before the MCU can send "Display Command Set (DCS) Read, No Parameter" to the display module. This same sequence is illustrated for reference purposes below.

## Step 1:

- The MCU sends "Set Maximum Return Packet Size" (Short Packet (SPa)) (SMRPS-S) to the display module when it wants to return one byte from the display module
- Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 11 0111b
- Maximum Return Packet Size (MRPS)
  - Data 0: 01hex
  - Data 1: 00hex
- Error Correction Code (ECC)

## Packet Header (PH)

|   |   |   |   |    |   |   | M | ax | im | ıuı | m  | Re | etu | ırr | ۱ F | a | ck | et | Si | ze | (  | MF | RP | S) |   |   |    |    |   |   |   |
|---|---|---|---|----|---|---|---|----|----|-----|----|----|-----|-----|-----|---|----|----|----|----|----|----|----|----|---|---|----|----|---|---|---|
|   |   |   | С | )i |   |   |   |    | M  | RI  | PS | (L | SI  | 3)  |     |   | M  | RF | PS | (N | IS | B) |    |    |   |   | EC | C  | ; |   |   |
|   |   | 3 | 7 | he | X |   |   |    |    | 0   | 1  | he | X   |     |     |   |    | 0  | 0  | he | X  |    |    |    |   | 1 | D  | he | X |   |   |
| 1 | 1 | 1 | 0 | 1  | 1 | 0 | 0 | 1  | 0  | 0   | 0  | 0  | 0   | 0   | 0   | 0 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0 | 1 | 1  | 1  | 0 | 0 | 0 |
| В | В | В | В | В  | В | В | В | В  | В  | В   | В  | В  | В   | В   | В   | В | В  | В  | В  | В  | В  | В  | В  | В  | В | В | В  | В  | В | В | В |
| 0 | 1 | 2 | 3 | 4  | 5 | 6 | 7 | 0  | 1  | 2   | 3  | 4  | 5   | 6   | 7   | 0 | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 0  | 1 | 2 | 3  | 4  | 5 | 6 | 7 |
| T |   |   |   |    |   |   | М | L  |    |     |    |    |     |     | М   | L |    |    |    |    |    |    | М  | L  |   |   |    |    |   |   | М |
| S |   |   |   |    |   |   | s | S  |    |     |    |    |     |     | S   | S |    |    |    |    |    |    | S  | s  |   |   |    |    |   |   | s |
| В |   |   |   |    |   |   | В | В  |    |     |    |    |     |     | В   | В |    |    |    |    |    |    | В  | В  |   |   |    |    |   |   | В |
|   |   |   |   |    |   |   |   |    |    |     |    |    |     | _   | Τi  | m | е  |    |    |    |    |    |    |    |   |   |    |    |   |   | → |

Figure 67 Set Maximum Return Packet Size (SMRPS-S)- Example



#### Step 2:

- The MCU wants to receive a value of the "Read ID1 (DAh)" from the display module when the MCU sends "Generic Read, 1 Parameter" to the display module
- Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 01 0100b
- · Packet Data (PD)
  - Data 0: "Read ID1 (DAh)", Display Command Set (DCS)
  - Data 1: Always 00hex
- Error Correction Code (ECC)

#### Packet Header (PH) **Maximum Return Packet Size (MRPS)** DI MRPS(LSB) MRPS(MSB) **ECC** 14 hex DA hex 00 hex 07 hex B</t 0 L S B S S B B S S B B S S B B S B Time

Figure 68 Generic Read, 1 Parameter (GENR1-S) – Example

Step 3: The display module can send 2 different information to the MCU after Bus Turnaround (BTA)

- 1. An acknowledge with Error Report (AwER), which is using a Short Packet (SPa), if there is an error to receive a command. See section "Acknowledge with Error Report (AwER)".
- 2. Information of the received command. Short Packet (SPa) or Long Packet (LPa)



## Display Command Set (DCS) Write, No Parameter (DCSWN-S), Data Type = 00 0101 (05h)

"Display Command Set (DCS) Write, No Parameter" is always using a Short Packet (SPa), what is defined on Data Type (DT, 00 0101b), from the MCU to the display module. These commands are defined on a table (See chapter "9 Instruction Description") below.

| Com           | mand          |
|---------------|---------------|
| NOP (00h)     | INVON (21h)   |
| SWRESET (01h) | ALLPOFF (22h) |
| SLPIN (10h)   | ALLPON (23h)  |
| SLPOUT (11h)  | DISPOFF (28h) |
| PTLON (12h)   | DISPON (29h)  |
| NORON (13h)   | IDMOFF (38h)  |
| INVOFF (20h)  | IDMON (39h)   |

Short Packet (SPa) is defined e.g.

- Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 00 0101b
- Packet Data (PD)
  - Data 0: "Sleep In (10h)", Display Command Set (DCS)
  - Data 1: Always 00hex
- Error Correction Code (ECC)

This is defined on the Short Packet (SPa) as follows.

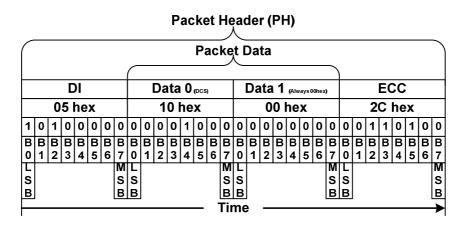


Figure 69 Display Command Set (DCS) Write, No Parameter (DCSWN-S)-Example



## Display Command Set (DCS) Write, 1 Parameter (DCSW1-S), Data Type = 01 0101 (15h)

"Display Command Set (DCS) Write, 1 Parameter" (DCSW1-S) is always using a Short Packet (SPa), what is defined on Data Type (DT, 01 0101b), from the MCU to the display module. These commands are defined on a table (See chapter "9 Instruction Description") below.

| Command        |
|----------------|
| GAMSET (26h)   |
| COLMOD (3Ah)   |
| WRDISBV (51h)  |
| WRCTRLD (53h)  |
| WRCABC (55h)   |
| WRCABCMB (5Eh) |

Short Packet (SPa) is defined e.g.

- · Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 01 0101b
- Packet Data (PD)
  - Data 0: "PMCSET (3Ah)", Display Command Set (DCS)
  - · Data 1: 01hex, Parameter of the DCS
- Error Correction Code (ECC)

This is defined on the Short Packet (SPa) as follows.

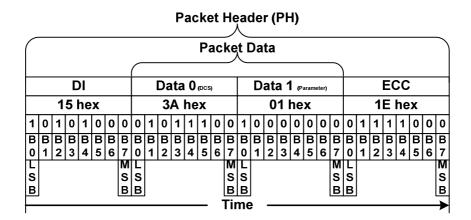


Figure 70 Display Command Set (DCS) Write,1 Parameter (DCSW1-S)-Example



## Display Command Set (DCS) Write Long (DCSW-L), Data Type = 11 1001 (39h)

"Display Command Set (DCS) Write Long" (DCSW-L) is always using a Long Packet (LPa), what is defined on Data Type (DT, 11 1001b), from the MCU to the display module. Command (No Parameters) and Write (1 or more parameters), are defined on a table (See chapter "9 Instruction Description") below

|                      | Command              |                      |
|----------------------|----------------------|----------------------|
| NOP (00h), Note1     | INVON (21h), Note1   | COLMOD (3Ah) , Note2 |
| SWRESET (01h), Note1 | GAMSET (26h), Note2  | WRDISBV (51h), Note2 |
| SLPIN (10h), Note1   | DISPOFF (28h), Note1 | WRCTRLD (53h)        |
| SLPOUT (11h), Note1  | DISPON (29h), Note1  | WRCABC (55h), Note2  |
| PTLON (12h), Note1   | PARLINES (30h)       | WRCABCMB (5Eh)       |
| NORON (13h), Note1   | IDMOFF (38h), Note1  |                      |
| INVOFF (20h), Note1  | IDMON (39h), Note1   |                      |

Notes: 1. Also Short Packet (SPa) can be used; See\_Display Command Set (DCS) Write, No Parameter.

Long Packet (LPa), when a command (No Parameter) was sent, is defined e.g.

- · Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 11 1001b
- Word Count (WC)
  - Word Count (WC): 0001h
- Error Correction Code (ECC)
- Packet Data (PD): Data 0: "Sleep In (10h)", Display Command Set (DCS)
- Packet Footer (PF)

This is defined on the Short Packet (SPa) as follows.

# Packet Header (PH)

| $\angle$ |               |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |      |    |    |    |   |   |   |   |   |    |   |   |   | $\rightarrow$ |
|----------|---------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----|------|----|----|----|---|---|---|---|---|----|---|---|---|---------------|
|          | DI WC (LSB)   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | ٧ | VC | ; (I | MS | SB | 3) |   |   |   |   | E | CC |   |   |   |               |
|          | 39 hex 01 hex |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | 0  | 0    | he | X  |    |   |   |   | 1 | 5 | he | X |   |   |               |
| 1        | 0             | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0    | 0  | 0  | 0  | 0 | 0 | 1 | 0 | 1 | 0  | 1 | 0 | 0 | 0             |
| В        | В             | В | В | В | В | В | В | В | В | В | В | В | В | В | В | В | В  | В    | В  | В  | В  | В | В | В | В | В | В  | В | В | В | В             |
| 0        | 1             | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1  | 2    | 3  | 4  | 5  | 6 | 7 | 0 | 1 | 2 | 3  | 4 | 5 | 6 | 7             |
| L        |               |   |   |   |   |   | M | L |   |   |   |   |   |   | М | L |    |      |    |    |    |   | М | L |   |   |    |   |   |   | М             |
| S        |               |   |   |   |   |   | s | S |   |   |   |   |   |   | s | s |    |      |    |    |    |   | s | s |   |   |    |   |   |   | s             |
| В        |               |   |   |   |   |   | В | В |   |   |   |   |   |   | В | В |    |      |    |    |    |   | В | В |   |   |    |   |   |   | В             |

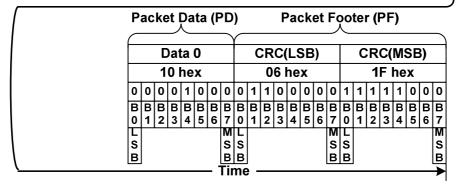


Figure 71 Display Command Set (DCS) Write Long (DCSW-L) with DCS Only-Example

<sup>2.</sup> Also Short Packet (SPa) can be used; See Display Command Set (DCS) Write, 1 Parameter.



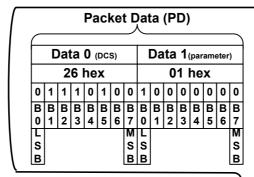
Long Packet (LPa), when a Write (1 parameter) was sent, is defined e.g.

- · Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 11 1001b
- Word Count (WC)
  - Word Count (WC): 0002h
- Error Correction Code (ECC)
- · Packet Data (PD):
  - Data 0: "Gamma Set (26h)", Display Command Set (DCS)
  - Data 1: 01hex, Parameter of the DCS
- Packet Footer (PF)

This is defined on the Short Packet (SPa) as follows

## Packet Header (PH)

| $\vdash$ |               |   |   | ) |   |   |   |   | ١ | N | <b>)</b> ( | LS | ЗB | ) |   |   | ٧ | VC | ; ( | MS | SB | 5) |   |   |   |   | ΕC | CC | ; |   | $\neg$ |
|----------|---------------|---|---|---|---|---|---|---|---|---|------------|----|----|---|---|---|---|----|-----|----|----|----|---|---|---|---|----|----|---|---|--------|
|          | 39 hex 02 hex |   |   |   |   |   |   |   |   |   |            |    |    |   |   |   | 0 | 0  | he  | X  |    |    |   |   | 1 | 3 | he | X  |   |   |        |
| 1        | 0             | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0          | 0  | 0  | 0 | 0 | 0 | 0 | 0  | 0   | 0  | 0  | 0  | 0 | 1 | 1 | 0 | 0  | 1  | 0 | 0 | 0      |
| В        | В             | В | В | В | В | В | В | В | В | В | В          | В  | В  | В | В | В | В | В  | В   | В  | В  | В  | В | В | В | В | В  | В  | В | В | В      |
| 0        | 1             | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3          | 4  | 5  | 6 | 7 | 0 | 1 | 2  | 3   | 4  | 5  | 6  | 7 | 0 | 1 | 2 | 3  | 4  | 5 | 6 | 7      |
| L        |               |   |   |   |   |   | М | L |   |   |            |    |    |   | M | L |   |    |     |    |    |    | M | L |   |   |    |    |   |   | М      |
| S        |               |   |   |   |   |   | S | s |   |   |            |    |    |   | S | S |   |    |     |    |    |    | S | S |   |   |    |    |   |   | S      |
| В        |               |   |   |   |   |   | В | В |   |   |            |    |    |   | В | В |   |    |     |    |    |    | В | В |   |   |    |    |   |   | В      |



## 

Figure 72 Display Command Set (DCS) Write Long with DCS and 1 Parameter-Example



Long Packet (LPa), when a Write (4 parameters) was sent, is defined e.g.

- Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 11 1001b
- Word Count (WC)
  - Word Count (WC): 0005h
- Error Correction Code (ECC)
- · Packet Data (PD):
  - Data 0: "PARLINES (30h)", Display Command Set (DCS)
  - Data 1: 00hex, 1st Parameter of the DCS, Start Column SC[15...8]
  - Data 2: 00hex, 2nd Parameter of the DCS, Start Column SC[7...0]
  - Data 3: 01hex, 3rd Parameter of the DCS, End Column EC[15...8]
  - Data 4: 3Fhex, 4th Parameter of the DCS, End Column EC[7...0]
- Packet Footer (PF)

This is defined on the Short Packet (SPa) as follows.

## Packet Header (PH)

|   |               |   |   |   |   |   |   |   |   |   |   |   |   |   |   | _ |    |   |    |    |    |   |   |   |   |   |    |   |   |   | $\supseteq$ |
|---|---------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----|---|----|----|----|---|---|---|---|---|----|---|---|---|-------------|
|   | DI WC (LSB)   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | ٧ | VC | ( | MS | SB | 3) |   |   |   |   | E | C  | ; |   |   |             |
|   | 39 hex 05 hex |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | 0  | 0 | he | X  |    |   |   |   | 3 | 6 | he | X |   |   |             |
| 1 | 0             | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0  | 0  | 0  | 0 | 0 | 0 | 1 | 1 | 0  | 1 | 1 | 0 | 0           |
| В | В             | В | В | В | В | В | В | В | В | В | В | В | В | В | В | В | В  | В | В  | В  | В  | В | В | В | В | В | В  | В | В | В | В           |
| 0 | 1             | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1  | 2 | 3  | 4  | 5  | 6 | 7 | 0 | 1 | 2 | 3  | 4 | 5 | 6 | 7           |
| П |               |   |   |   |   |   | М | L |   |   |   |   |   |   | M | L |    |   |    |    |    |   | M | Ь |   |   |    |   |   |   | M           |
| S |               |   |   |   |   |   | s | S |   |   |   |   |   |   | s | S |    |   |    |    |    |   | s | S |   |   |    |   |   |   | S           |
| В |               |   |   |   |   |   | В | В |   |   |   |   |   |   | В | В |    |   |    |    |    |   | В | В |   |   |    |   |   |   | В           |
|   |               |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |   |    |    |    |   |   |   |   |   |    |   |   |   |             |

# Packet Data (PD)

| F | Data 0 (DCS)  Data 1(1stparameter) |   |   |   |   |   |   |   |   |   |   |   |   |   | С | at | a | <b>2</b> (2 | s <sup>t</sup> pa | ran | nete | er) | С | at | ta | 3(3 | s <sup>t</sup> pa | aran | nete | er) |   |   |
|---|------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----|---|-------------|-------------------|-----|------|-----|---|----|----|-----|-------------------|------|------|-----|---|---|
| Г | 30 hex 00 hex                      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    | 0 | 0           | he                | X   |      |     |   |    | 0  | 1   | he                | X    |      |     |   |   |
| 0 | 1                                  | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0           | 0                 | 0   | 0    | 0   | 0 | 0  | 1  | 0   | 0                 | 0    | 0    | 0   | 0 | 0 |
| В | 3 1                                | В | В | В | В | В | В | В | В | В | В | В | В | В | В | В  | В | В           | В                 | В   | В    | В   | В | В  | В  | В   | В                 | В    | В    | В   | В | В |
| 0 | ١.                                 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7  | 0 | 1           | 2                 | 3   | 4    | 5   | 6 | 7  | 0  | 1   | 2                 | 3    | 4    | 5   | 6 | 7 |
| F | -Τ                                 |   |   |   |   |   |   | М | Г |   |   |   |   |   |   | M  | L |             |                   |     |      |     |   | M  | Ц  |     |                   |      |      |     |   | M |
| S | ;                                  |   |   |   |   |   |   | S | S |   |   |   |   |   |   | S  | S |             |                   |     |      |     |   | S  | S  |     |                   |      |      |     |   | S |
| B | 3                                  |   |   |   |   |   |   | В | В |   |   |   |   |   |   | В  | В |             |                   |     |      |     |   | В  | В  |     |                   |      |      |     |   | В |

# Packet Data (PD) Packet Footer (PF)

|   |   |     |   | _           | _                |      |      |    |   |   |   |    |    |    |   | _ | _ |   |   |    |    | _  |    |   |
|---|---|-----|---|-------------|------------------|------|------|----|---|---|---|----|----|----|---|---|---|---|---|----|----|----|----|---|
|   |   | )at | a | <b>4</b> (4 | <sup>st</sup> pa | ıran | nete | r) |   | C | R | C( | LS | 3B | ) |   |   | C | R | C( | M  | SE | 3) |   |
|   |   |     | 3 | F           | he               | X    |      |    |   |   | F | 5  | he | X  |   |   |   |   | 3 | 4  | he | X  |    |   |
|   | 1 | 1   | 1 | 1           | 1                | 1    | 0    | 0  | 1 | 0 | 1 | 0  | 1  | 1  | 1 | 1 | 0 | 0 | 1 | 0  | 1  | 1  | 0  | 0 |
|   | В | В   | В | В           | В                | В    | В    | В  | В | В | В | В  | В  | В  | В | В | В | В | В | В  | В  | В  | В  | В |
|   | 0 | 1   | 2 | 3           | 4                | 5    | 6    | 7  | 0 | 1 | 2 | 3  | 4  | 5  | 6 | 7 | 0 | 1 | 2 | 3  | 4  | 5  | 6  | 7 |
|   | Г |     |   |             |                  |      |      | М  | L |   |   |    |    |    |   | М | L |   |   |    |    |    |    | М |
|   | S |     |   |             |                  |      |      | S  | S |   |   |    |    |    |   | S | S |   |   |    |    |    |    | s |
| l | В |     |   |             |                  |      |      | В  | В |   |   |    |    |    |   | В | В |   |   |    |    |    |    | ₽ |
| _ |   |     |   |             |                  |      |      |    |   | _ | T | im | e  | _  |   |   |   |   |   |    |    | _  |    | ~ |

Figure 73 Display Command Set (DCS) Write Long with DCS and 4 Parameters-Example



## Display Command Set (DCS) Read, No Parameter (DCSRN-S), Data Type = 00 0110 (06h)

"Display Command Set (DCS) Read, No Parameter" (DCSRN-S) is always using a Short Packet (SPa), what is defined on Data Type (DT, 00 0110b), from the MCU to the display module. These commands are defined on a table (See chapter "9 Instruction Description") below.

| Com             | mand           |
|-----------------|----------------|
| RDDID (04h)     | RDDSM (0Eh)    |
| RDNUMED (05h)   | RDDSDR (0Fh)   |
| RDRED (06h)     | RDDISBV (52h)  |
| RDGREEN (07h)   | RDCTRLD (54h)  |
| RDBLUE (08h)    | RDCABC (56h)   |
| RDDPM (0Ah)     | RDCABCMB (5Fh) |
| RDDMADCTR (0Bh) | RDID1 (DAh)    |
| RDDCOLMOD (0Ch) | RDID2 (DBh)    |
| RDDIM (0Dh)     | RDID3 (DCh)    |

The MCU has to define to the display module, what is the maximum size of the return packet. A command, what is used for this purpose, is "Set Maximum Return Packet Size" (SMRPS-S), which Data Type (DT) is 11 0111b and which is using Short Packet (SPa) before the MCU can send "Display Command Set (DCS) Read, No Parameter" to the display module. This same sequence is illustrated for reference purposes below.

#### Step 1:

- The MCU sends "Set Maximum Return Packet Size" (Short Packet (SPa)) (SMRPS-S) to the display module when it wants to return one byte from the display module
- · Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 11 0111b
- Maximum Return Packet Size (MRPS)
  - Data 0: 01hex
  - Data 1: 00hex
- Error Correction Code (ECC)

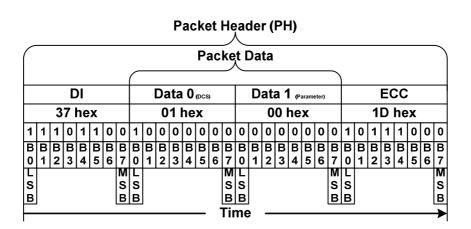


Figure 74 Set Maximum Return Packet Size (SMRPS-S) - Example



#### Step 2:

- The MCU wants to receive a value of the "Read ID1 (DAh)" from the display module when the MCU sends
- "Display Command Set (DCS) Read, No Parameter" to the display module
- Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 00 0110b
- · Packet Data (PD)
  - Data 0: "Read ID1 (DAh)", Display Command Set (DCS)
  - Data 1: Always 00hex
- Error Correction Code (ECC)

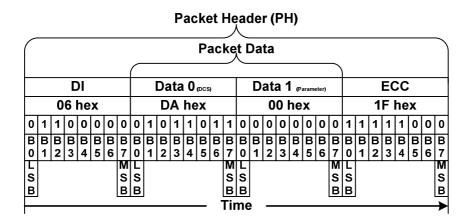


Figure 75 Display Command Set (DCS) Read, No Parameter (DCSRN-S) – Example

Step 3: The display module can send 2 different information to the MCU after Bus Turnaround (BTA)

- 1. An acknowledge with Error Report (AwER), which is using a Short Packet (SPa), if there is an error to receive a command. See section "Acknowledge with Error Report (AwER)".
- 2. Information of the received command. Short Packet (SPa) or Long Packet (LPa)



## Null Packet, No Data (NP-L), Data Type = 00 1001 (09h)

"Null Packet, No Data" (NP-L) is always using a Long Packet (LPa), what is defined on Data Type (DT, 001001b), from the MCU to the display module. The purpose of this command is keeping data lanes in the high speed mode (HSDT), if it is needed. The display module is ignored Packet Data (PD) what the MCU is sending. Long Packet (LPa), when 5 random data bytes of the Packet Data (PD) were sent, is defined e.g.

- Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 00 1001b
- · Word Count (WC)
  - Word Count (WC): 0005h
- Error Correction Code (ECC)
- · Packet Data (PD):
  - Data 0: 89h (Random data)
  - Data 1: 23h (Random data)
  - Data 2: 12h (Random data)
  - Data 3: A2h (Random data)
  - Data 4: E2h (Random data)
- Packet Footer (PF)

This is defined on the Long Packet (LPa) as follows.

#### Packet Header (PH)

| $\subseteq$ |             |   |     |    |   |   |   |               |   |   |     |    |   |    | _             |      |           |    |   |    |   |       |   |        |   |   |   |   |   |   |   |  |
|-------------|-------------|---|-----|----|---|---|---|---------------|---|---|-----|----|---|----|---------------|------|-----------|----|---|----|---|-------|---|--------|---|---|---|---|---|---|---|--|
|             | DI WC (LSB) |   |     |    |   |   |   |               |   |   |     |    | ٧ | VC | ; (           | MS   | <b>SB</b> | 3) |   |    |   |       | E | CC     | ; |   |   |   |   |   |   |  |
|             |             | 0 | 9 I | nе | X |   |   |               |   | 0 | 5 I | he | X |    |               |      |           | 0  | 0 | he | х |       |   | 30 hex |   |   |   |   |   |   |   |  |
| 0           | 1           | 0 | 1   | 1  | 0 | 0 | 0 | 1             | 0 | 1 | 0   | 0  | 0 | 0  | 0             | 0    | 0         | 0  | 0 | 0  | 0 | 0     | 0 | 1      | 1 | 1 | 1 | 0 | 1 | 0 | 0 |  |
| В           | В           | В | В   | В  | В | В | В | В             | В | В | В   | В  | В | В  | В             | В    | В         | В  | В | В  | В | В     | В | В      | В | В | В | В | В | В | В |  |
| 0           |             |   |     |    |   |   |   | 0 1 2 3 4 5 6 |   |   |     |    |   | 7  | 0 1 2 3 4 5 6 |      |           |    |   |    |   | 7     | 0 | 1      | 2 | 3 | 4 | 5 | 6 | 7 |   |  |
| Г           | _           | • |     |    |   |   | М | / L           |   |   |     |    |   | •  | М             | L    |           |    |   |    |   |       | М | L      |   |   |   |   |   | _ | М |  |
| s           |             |   |     |    | s |   |   |               |   |   |     |    | s |    |               |      |           |    |   |    | s | S   S |   |        |   |   |   |   |   |   |   |  |
| В           |             |   |     |    |   |   | В | BB B          |   |   |     |    |   |    |               | IB E |           |    |   |    |   |       | В | В      |   |   |   |   |   |   |   |  |

| ſ | Packet Data (PD) |   |   |   |    |   |   |   |        |   |   |   |   |   |   | _      |  |        |   |   |   |   |   |   |   |        |   |   |   |   |     |        |  |  |
|---|------------------|---|---|---|----|---|---|---|--------|---|---|---|---|---|---|--------|--|--------|---|---|---|---|---|---|---|--------|---|---|---|---|-----|--------|--|--|
|   |                  | Data 0 (DCS) Data 1(1st parameter) Data 2(2st parameter) Data |   |   |    |   |   |   |        |   |   |   |   |   |   |        | ata 3 <sub>(3<sup>st</sup>parameter)</sub> |        |   |   |   |   |   |   |   |        |   |   |   |   |     |        |  |  |
|   |                  |   | 8 | 9 | he | х |   |   | 23 hex |   |   |   |   |   |   |        |  | 12 hex |   |   |   |   |   |   |   | A2 hex |   |   |   |   |     |        |  |  |
|   | 1                | 0   | 0 | 1 | 0  | 0 | 0 | 1 | 1      | 1 | 0 | 0 | 0 | 1 | 0 | 0      | 0  | 1      | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1      | 0 | 0 | 0 | 1 | 0   | 1      |  |  |
|   | В                |   |   |   | ı  |   |   | В | ı      | ı |   |   | ı |   | ı | В      |  |        |   | _ | _ | _ |   | В | В | В      | ı | В | В | _ | I — | В      |  |  |
|   | ٩                | 1   | 2 | 3 | 4  | 5 | 6 | 7 | 0      | 1 | 2 | 3 | 4 | 5 | 6 | 7<br>M | 0  | 1      | 2 | 3 | 4 | 5 | 6 | 7 | P | 1      | 2 | 3 | 4 | 5 | 6   | 7      |  |  |
|   | s                |   |   |   |    |   |   | S | s      |   |   |   |   |   |   | S      | s  |        |   |   |   |   |   | s | s |        |   |   |   |   |     | M<br>S |  |  |
| ١ | В                |   |   |   |    |   |   | B | В      |   |   |   |   |   |   | В      | В  |        |   |   |   |   |   | B | B |        |   |   |   |   |     | В      |  |  |

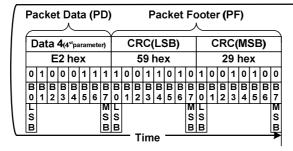


Figure 76 Null Packet, No Data (NP-L)-Example

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## End of Transmission Packet (EoTP), Data Type = 00 1000 (08h)

"End of Transmission Packet" (EoTP) is always using a Short Packet (SPa), what is defined on Data Type (DT, 001000b), from the MCU to the display module. The purpose of this command is terminated the high speed mode (HPDT) properly when there is added this extra packet after the last payload packet before "End of Transmission" (EoT), which is an interface level functionality.

The MCU can decide if it want to use the "End of Transmission Packet" (EoTP) or not. The ST7701S has the capability to support both: i.e. If MCU applies the EoTP, it shall report the "DSI Protocol Violation" error when the EoTP is not detected in the high speed (HS). This error reporting can be enable/disable by bit DIS\_EoTP\_HS of command B100h (page 0).

The display module is or isn't receiving "End of Transmission Packet" (EoTP) from the MCU during the Low Power Data Transmission (LPDT) mode before "Marked-1" (=leaving Escape mode) what ends the Low Power Data Transmission (LPDT) mode.

The display module is not allowed to send "End of Transmission Packet" (EoTP) to MCU during the Low Power Data Transmission (LPDT) mode.

The summary of the receiving and transmitting EoTP is listed below.

| Direction           | Display Module (DM) in              | Display Module (DM) in              |
|---------------------|-------------------------------------|-------------------------------------|
| Direction           | High Speed Data Transmission (HPDT) | Low Power Data Transmission (LPDT)  |
| MCU=>Display Driver | With or Without EoTP is Supported   | With or Without EoTP is Supported   |
| Display Driver=>MCU | HS Mode is not available            | EoTP can not be sent by the Display |
|                     | (EoTP is not available)             | Driver                              |

Table 17 Receiving and Transmitting EoTP during LPDT



Short Packet (SPa) is using a fixed format as follow

- Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 00 1000b
- Packet Data (PD):
  - Data 0: 0Fh
  - Data 1: 0Fh
- Error Correction Code (ECC)
- ECC: 01h

|          | Packet Header (PH)  |   |   |   |   |   |        |   |   |   |   |   |   |   |        |       |    |   |   |   |   |   |   |     |   |   |   |    |   |   |   |
|----------|---------------------|---|---|---|---|---|--------|---|---|---|---|---|---|---|--------|-------|----|---|---|---|---|---|---|-----|---|---|---|----|---|---|---|
|          | Packet Data         |   |   |   |   |   |        |   |   |   |   |   |   |   |        |       |    |   |   |   |   |   |   |     |   |   |   |    |   |   |   |
|          |                     |   |   |   |   |   |        |   |   |   |   |   |   |   |        | EC    | CC | ; |   |   |   |   |   |     |   |   |   |    |   |   |   |
|          | 08 hex 0F hex 0F he |   |   |   |   |   |        |   |   |   |   |   |   |   | he     | ex 01 |    |   |   |   |   |   |   | hex |   |   |   |    |   |   |   |
| 0        | 0                   | 0 | 1 | 0 | 0 | 0 | 0      | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0      | 1     | 1  | 1 | 1 | 0 | 0 | 0 | 0 | 1   | 0 | 0 | 0 | 0  | 0 | 0 | 0 |
| В        | В                   | В |   |   |   | ı | В      |   | В | В |   |   | В | В |        |       | В  |   |   | В | В |   | В | В   | В |   |   | ١. | В | _ | В |
| 원        | 1                   | 2 | 3 | 4 | 5 | 6 | 7<br>M | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 7<br>M | 읻닏    | 1  | 2 | 3 | 4 | 5 | 6 | M | 0   | 1 | 2 | 3 | 4  | 5 | _ | M |
| s        |                     |   |   |   |   |   |        |   |   |   |   |   | s | s |        |       |    |   |   |   | s | s |   |     |   |   |   |    | s |   |   |
| В        |                     |   |   |   |   |   |        |   |   |   |   | B | В |   |        |       |    |   |   | В | В | J |   |     |   |   |   | B  |   |   |   |
| $\vdash$ |                     |   |   |   |   |   |        |   |   |   |   |   | _ |   | 111    | ne    | ,  | _ |   |   |   |   |   |     |   |   |   |    | _ | _ | ~ |

Figure 77 End of Transmission Packet (EoTP)

Some use case of the "End of Transmission Packet" (EoTP) are illustrated only for reference purpose below.

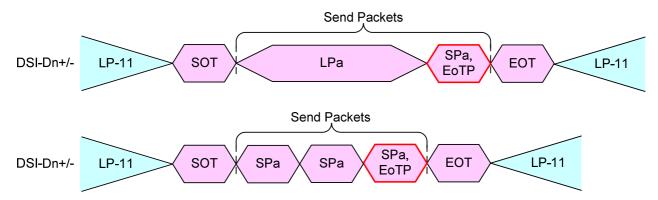


Figure 78 End of Transmission Packet (EoTP)-Example

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## Sync Event (H Start, H End, V Start, V End), Data Type = xx 0001 (x1h)

Sync Events are Short packets and, therefore, can time-accurately represent events like the start and end of sync pulses. As "start" and "end" are separate and distinct events, the length of sync pulses, as well as position relative to active pixel data, e.g. front and back porch display timing, may be accurately conveyed to the peripheral. The Sync Events are defined as follows:

- Data Type = 00 0001 (01h) V Sync Start
- Data Type = 01 0001 (11h) V Sync End
- Data Type = 10 0001 (21h) H Sync Start
- Data Type = 11 0001 (31h) H Sync End

In order to represent timing information as accurately as possible a V Sync Start event represents the start of the VSA and also implies an H Sync Start event for the first line of the VSA. Similarly, a V Sync End event implies an H Sync Start event for the last line of the VSA..

Sync events should occur in pairs, Sync Start and Sync End, if accurate 1054 pulse-length information needs to be conveyed. Alternatively, if only a single point (event) in time is required, a single sync event (normally, Sync Start) may be transmitted to the peripheral. Sync events may be concatenated with blanking packets to convey inter-line timing accurately and avoid the overhead of switching between LPS and HS for every event. Note there is a power penalty for keeping the data line in HS mode, however. Display modules that do not need traditional sync/blanking/pixel timing should transmit pixel data in a high-speed burst then put the bus in Low Power Mode, for reduced power consumption. The recommended burst size is a scan line of pixels, which may be temporarily stored in a line buffer on the display module.

#### Color Mode On Command, and, Data Type = 01 0010 (12h)

Color Mode On is a Short packet command that switches a Video Mode display module to 8-colors mode for power saving.

## Color Mode Off Command, Data Type = 00 0010 (02h)

Color Mode Off is a Short packet command that returns a Video Mode display module from 8-colors mode to normal display operation.

## Shutdown Peripheral Command, Data Type = 10 0010 (22h)

Shutdown Peripheral command is a Short packet command that turns off the display in a Video Mode display module for power saving. Note the interface shall remain powered in order to receive the turn-on, or wake-up, command.

## Turn On Peripheral Command, Data Type = 11 0010 (32h)

Turn On Peripheral command is Short packet command that turns on the display in a Video Mode display module for normal display operation.

## Blanking Packet (Long), Data Type = 01 1001 (19h)

A Blanking packet is used to convey blanking timing information in a Long packet. Normally, the packet represents a period between active scan lines of a Video Mode display, where traditional display timing is provided from the host processor to the display module. The blanking period may have Sync Event packets interspersed between blanking segments. Like all packets, the Blanking packet contents shall be an integer number of bytes. Blanking packets may contain arbitrary data as payload. The Blanking packet consists of the DI byte, a two-byte WC, an ECC byte, a payload of length WC bytes, and a two-byte checksum.

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Packed Pixel Stream, 16-bit Format, Long packet, Data Type = 00 1110 (0Eh)

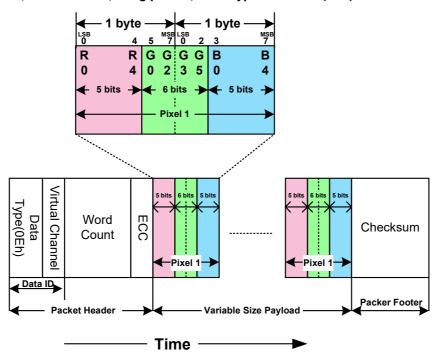


Figure 79 16-bit per Pixel-RGB Color Format, Long packet

Packed Pixel Stream 16-Bit Format is a Long packet used to transmit image data formatted as 16-bit pixels to a Video Mode display module. The packet consists of the DI byte, a two-byte WC, an ECC byte, a payload of length WC bytes and a two-byte checksum. Pixel format is five bits red, six bits green, five bits blue, in that order. Note that the "Green" component is split across two bytes. Within a color component, the LSB is sent first, the MSB last. With this format, pixel boundaries align with byte boundaries every two bytes. The total line width (displayed plus non-displayed pixels) should be a multiple of two bytes.

Normally, the display module has no frame buffer of its own, so all image data shall be supplied by the host processor at a sufficiently high rate to avoid flicker or other visible artifacts.



Packed Pixel Stream, 18-bit Format, Long packet, Data type = 01 1110 (1Eh)

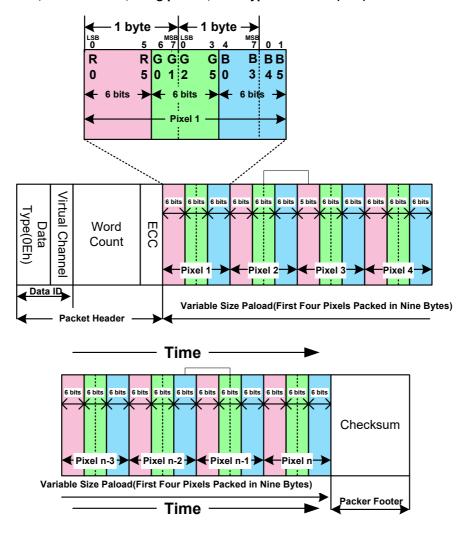


Figure 80 18-bit per Pixel-RGB Color Format, Long pack

Packed Pixel Stream 18-Bit Format (Packed) is a Long packet. It is used to transmit RGB image data formatted as pixels to a Video Mode display module that displays 18-bit pixels The packet consists of the DI byte, a two-byte WC, an ECC byte, a payload of length WC bytes and a two-byte Checksum. Pixel format is red (6 bits), green (6 bits) and blue (6 bits), in that order. Within a color component, the LSB is sent first, the MSB last.

Note that pixel boundaries only align with byte boundaries every four pixels (nine bytes). Preferably, display modules employing this format have a horizontal extent (width in pixels) evenly divisible by four, so no partial bytes remain at the end of the display line data. If the active (displayed) horizontal width is not a multiple of four pixels, the transmitter shall send additional fill pixels at the end of the display line to make the transmitted width a multiple of four pixels. The receiving peripheral shall not display the fill pixels when refreshing the display device.

For example, if a display device has an active display width of 399 pixels, the transmitter should send 400 pixels in one or more packets. The receiver should display the first 399 pixels and discard the last pixel of the transmission.

With this format, the total line width (displayed plus non-displayed pixels) should be a multiple of four pixels (nine bytes).

Pixel Stream, 18-bit Format in Three Bytes, Long packet, Data Type = 101110 (2Eh)

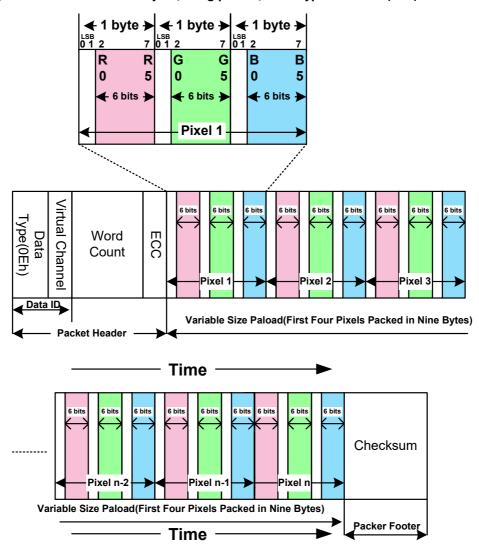


Figure 81 18-bit per Pixel (Loosely Packed)-RGB Color Format, Long pack

In the 18-bit Pixel Loosely Packed format, each R, G, or B color component is six bits but is shifted to the upper bits of the byte, such that the valid pixel bits occupy bits [7:2] of each byte. Bits [1:0] of each payload byte representing active pixels are ignored. As a result, each pixel requires three bytes as it is transmitted across the Link. This requires more bandwidth than the "packed" format, but requires less shifting and multiplexing logic in the packing and unpacking functions on each end of the Link.

This format is used to transmit RGB image data formatted as pixels to a Video Mode display module that displays 18-bit pixels. The packet consists of the DI byte, a two-byte WC, an ECC byte, a payload of length WC bytes and a two-byte Checksum. The pixel format is red (6 bits), green (6 bits) and blue (6 bits) in that order. Within a color component, the LSB is sent first, the MSB last.

With this format, pixel boundaries align with byte boundaries every three bytes. The total line width (displayed plus non-displayed pixels) should be a multiple of three bytes.



## Packed Pixel Stream, 24-bit Format, Long packet, Data Type = 11 1110 (3Eh)

Packed Pixel Stream 24-Bit Format is a Long packet. It is used to transmit image data formatted as 24-bit pixels to a Video Mode display module. The packet consists of the DI byte, a two-byte WC, an ECC byte, a payload of length WC bytes and a two-byte Checksum. The pixel format is red (8 bits), green (8 bits) and blue (8 bits), in that order. Each color component occupies one byte in the pixel stream; no components are split across byte boundaries. Within a color component, the LSB is sent first, the MSB last.

With this format, pixel boundaries align with byte boundaries every three bytes. The total line width (displayed plus non-displayed pixels) should be a multiple of three bytes.

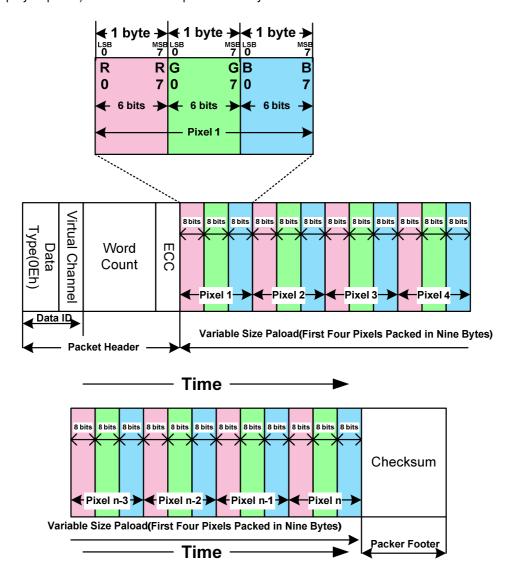


Figure 82 24-bit per Pixel -RGB Color Format, Long packet

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## 8.7.2.3.2.2

## PACKET FROM THE DISPLAY MODULE TO THE MCU

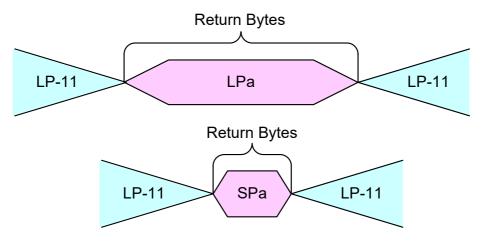
#### **Used Packet Types**

The display module is always using Short Packet (SPa) or Long Packet (LPa), when it is returning information to the MCU after the MCU has requested information from the Display Module. This information can be a response of the Display Command Set (DCS) Read, No Parameter",(DCSRN-S)) or an Acknowledge with Error Report .The used packet type is defined on Data Type (DT)..

A number of the return bytes are more than the maximum size of the Packet Data (PD) on Long Packet (LPa) or Short Packet (SPa) when the display module is sending return bytes in several packets until all return bytes have been sent from the display module to the MCU.

It is not possible that the display module is sending return bytes in several packets even if the maximum size of the Packet Data (PD) could be sent on a packet.

Both cases are illustrated for reference purposes below.



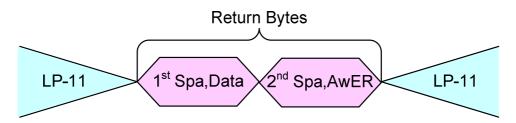
**Return Bytes on Signal Packet** 



| Data Type<br>Hex | Data Type<br>Binary | Symbol   | Description                                 | Packet Size |
|------------------|---------------------|----------|---|-------------|
| 02h              | 00 0010             | AwER     | Acknowledge & Error Report                  | Short       |
| 1Ch              | 01 1100             | DCSRR-L  | DCS Long Read Response                      | Long        |
| 21h              | 10 0001             | SCSRR1-S | DCS Short Read Response, 1 Byte returned    | Short       |
| 22h              | 01 0010             | DCSRR2-S | DCS Short Read Response, 2 Byte returned    | Short       |
| 1Ah              | 01 1010             | GENRR-L  | Generic Long Read Response                  | Long        |
| 11h              | 01 0001             | GENRR1-S | Generic Long Read Response, 1 Byte returned | Short       |
| 12h              | 01 0010             | GENRR2-S | Generic Long Read Response, 2 Byte returned | Short       |

Table 18 Data Type for Display Module-sourced Packets

The display module is return 2 packets (1st packet: Data, 2nd packet Acknowledge with Error Report ) to the MCU when the display module has received a read command. See section "Display Command Set (DCS) Read, No Parameter (DCSRN-S)" where has been detected and corrected a single bit error by the EEC (See bit 8 on Table" Acknowledge with Error Report (AwER) for Short Packet (SPa) Response"). This return packets are illustrated for reference purpose below.



**Exception When Return Bytes on Several Packet** 

AwER=Acknowledge with Error Report



## Acknowledge with Error Report (AwER), Data Type = 00 0010(02h)

"Acknowledge with Error Report" (AwER) is always using a Short Packet (SPa), what is defined on Data Type (DT,00 0010b), from the display module to the MCU.

The Packet Data (PD) can include bits, which are defining the current error, when a corresponding bit is set to '1', as they are defined on the following table.

| Bit | Description                                    |
|-----|--|
| 0   | SoT Error                                      |
| 1   | SoT Sync Error                                 |
| 2   | EoT Sync Error                                 |
| 3   | Escape Mode Entry Command Error                |
| 4   | Low-Power Transmit Sync Error                  |
| 5   | Any Protocol Timer Time-Out                    |
| 6   | False Control Error                            |
| 7   | Contention is Detected on the Display Module   |
| 8   | ECC Error, single-bit (detected and corrected) |
| 9   | ECC Error, multi-bit (detected, not corrected) |
| 10  | Checksum Error (Long packet only)              |
| 11  | DSI Data Type (DT) Not Recognized              |
| 12  | DSI Virtual Channel (VC) ID Invalid            |
| 13  | Invalid Transmission Length                    |
| 14  | Reserved, Set to '0' internally                |
| 15  | DSI Protocol Violation                         |

Table 19 Acknowledge with Error Report (AwER) for Long Packet (LPa) Response

| Bit | Description                                       |
|-----|---|
| 0   | SoT Error   |
| 1   | SoT Sync Error                                    |
| 2   | EoT Sync Error                                    |
| 3   | Escape Mode Entry Command Error                   |
| 4   | Low-Power Transmit Sync Error                     |
| 5   | Any Protocol Timer Time-Out                       |
| 6   | False Control Error                               |
| 7   | Contention is Detected on the Display Module      |
| 8   | ECC Error, single-bit (detected and corrected)    |
| 9   | ECC Error, multi-bit (detected, not corrected)    |
| 10  | Set to "0" internally (Only for Long Packet (LP)) |
| 11  | DSI Data Type (DT) Not Recognized                 |
| 12  | DSI Virtual Channel (VC) ID Invalid               |
| 13  | Invalid Transmission Length                       |
| 14  | Reserved, Set to '0' internally                   |
| 15  | DSI Protocol Violation                            |

Table 20 Acknowledge with Error Report (AwER) for Short Packet (SPa) Response



These errors are only included on the last packet, which has been received from the MCU to the display module before Bus Turnaround (BTA).

The display module ignores the received packet which includes error or errors

Acknowledge with Error Report (AwER) of the Short Packet (SPa) is defined e.g.

- Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 00 0010b
- Packet Data (PD):
  - Bit 8: ECC Error, single-bit (detected and corrected)
  - AwER: 0100h
- Error Correction Code (ECC)

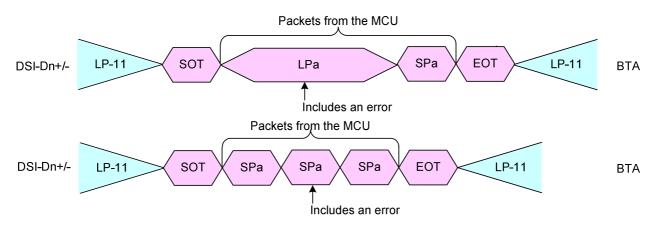
This is defined on the Short Packet (SPa) as follows.

|   | Packet Header (PH)     |   |   |   |   |   |   |   |   |   |   |   |   |   |    | _   |     |   |   |    |   |   |   |   |   |   |   |   |   |   |   |
|---|------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|----|-----|-----|---|---|----|---|---|---|---|---|---|---|---|---|---|---|
|   | Packet Data(PD)        |   |   |   |   |   |   |   |   |   |   |   |   |   |    |     |     |   |   |    |   |   |   |   |   |   |   |   |   |   |   |
|   | DI AWER(LSB) AWER(MSB) |   |   |   |   |   |   |   |   |   |   |   |   |   |    | ECC |     |   |   |    |   |   |   |   |   |   |   |   |   |   |   |
|   | 02 hex 00 hex 01 hex   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |     |     | 3 | Α | he | X |   |   |   |   |   |   |   |   |   |   |
| 0 | 1                      | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 1   | 0   | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 |
| В | В                      | В | В | В | В | В | В | В | В | В | В | В | В | В | В  | В   | В   | В |   | В  | В | В | В | В | В |   |   | В | В | В | В |
| 0 | 1                      | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7  | 0   | 1   | 2 | 3 | 4  | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Г |                        |   |   |   |   |   | М |   |   |   |   |   |   |   |    | Г   |     |   |   |    |   |   | М | L |   |   |   |   |   |   | M |
|   | S                      |   |   |   |   |   |   |   |   |   |   |   |   | S |    | l   |     |   |   |    |   | s | S |   |   |   |   |   |   | S |   |
| В | B BB BB B              |   |   |   |   |   |   |   |   |   |   |   |   |   | В  | В   | ]   |   |   |    |   |   | В |   |   |   |   |   |   |   |   |
|   |                        |   |   |   |   |   |   |   |   |   |   |   |   | _ | Ti | m   | e · |   |   |    |   |   |   |   |   |   |   |   |   |   | → |

Packet Header (DLI)

Acknowledge with Error Report (AwER)-Example

It is possible that the display module receivers several packets, which include error, from the MPU before the MPU performs the Bus Turnaround (BTA). Some examples are illustrated below for reference purpose.



**Error Packet** 

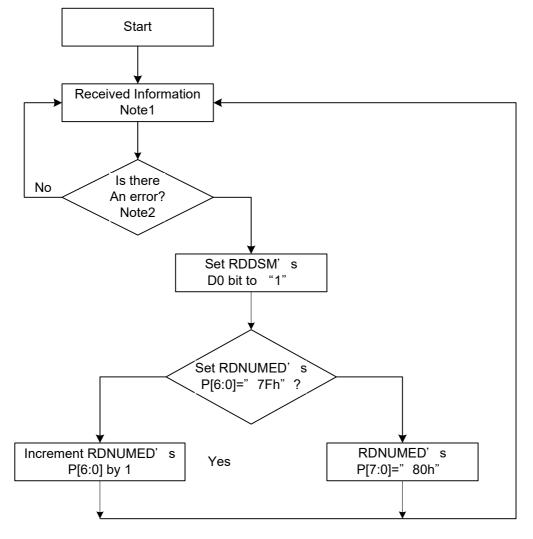


Therefore, there is needed a method to check if there has been errors on the previous packets. These errors of the previous packets can check "Read Display Signal Mode (0Eh)" and "Read Number of the Errors on DSI (05h)" commands.

The bit D0 of the "Read Display Signal Mode (0Eh)" command has been set to '1' if a received packet includes an error.

The number of the packets, which are including an ECC or CRC error, are calculated on the RDNUMED register, which can read "Read Number of the Errors on DSI (05h)" command. This command also sets the RDNUMED register to 00h as well as set the bit D0 of the "Read Display Signal Mode (0Eh)" command to '0' after the MCU has read the RDNUMED register from the display module.

The functionality of the RDNUMED register is illustrated for reference purposes below.



#### Notes:

- 1. This information can Interface or Packet Level Communication but it is always from the MCU to the display module in this case.
- 2. CRC or ECC error.



## DCS Read Long Response (DCSRR-L), Data Type = 01 1100(1Ch)

"DCS Read Long Response" (DCSRR-L) is always using a Long Packet (LPa), what is defined on Data Type (DT,01 1100b), from the display module to the MCU. "DCS Read Long Response" (DCSRR-L) is used when the display module wants to response a DCS Read command, which the MCU has sent to the display module.

"DCS Read Long Response" (DCSRR-L) is used when the display module wants to response a DCS Read command, which the MCU has sent to the display module.

Long Packet (LPa), which includes 5 data bytes of the Packet Data (PD), is defined e.g.

- Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 01 1100b
- Word Count (WC)
  - Word Count (WC): 0005h
- Error Correction Code (ECC)
- Packet Data (PD):
  - Data 0: 89h
  - Data 1: 23h
  - Data 2: 12h
  - Data 3: A2h
  - Data 4: E2h
- Packet Footer (PF)

This is defined on the Long Packet (LP) as follows.



## Packet Header (PH)

| $\angle$ |   |   |   |    |   |   |   |   |   |    |     |    |   |   |   |   |   |    |     |    |    |   |   |   |   |   |   |    |   |   |        |
|----------|---|---|---|----|---|---|---|---|---|----|-----|----|---|---|---|---|---|----|-----|----|----|---|---|---|---|---|---|----|---|---|--------|
|          |   |   | Е | )I |   |   |   |   | ١ | NC | ) ( | LS | B | ) |   |   | ٧ | ۷C | ) ( | MS | 3B | ( |   |   |   |   | E | C  | ; |   |        |
|          |   | 1 | С | he | X |   |   |   |   | 0  | 5   | he | X |   |   |   |   | 0  | 0   | he | X  |   |   |   |   | 2 | 9 | he | X |   | $\neg$ |
| 0        | 0 | 1 | 1 | 1  | 0 | 0 | 0 | 0 | 1 | 0  | 1   | 0  | 0 | 0 | 0 | 0 | 0 | 0  | 0   | 0  | 0  | 0 | 0 | 1 | 0 | 0 | 1 | 0  | 1 | 0 | 0      |
| В        | В | В | В | В  | В | В | В | В | В | В  | В   | В  | В | В | В | В | В | В  | В   | В  | В  | В | В | В | В | В | В | В  | В | В | В      |
| 0        | 1 | 2 | 3 | 4  | 5 | 6 | 7 | 0 | 1 | 2  | 3   | 4  | 5 | 6 | 7 | 0 | 1 | 2  | 3   | 4  | 5  | 6 | 7 | 0 | 1 | 2 | 3 | 4  | 5 | 6 | 7      |
| T        |   |   |   |    |   |   | M | Ц |   |    |     |    |   |   | M | L |   |    |     |    |    |   | М | L |   |   |   |    |   |   | M      |
| S        |   |   |   |    |   |   | s | s |   |    |     |    |   |   | s | S |   |    |     |    |    |   | s | s |   |   |   |    |   |   | s      |
| В        |   |   |   |    |   |   | В | В |   |    |     |    |   |   | В | В |   |    |     |    |    |   | В | В |   |   |   |    |   |   | В      |

| <b>Packet</b> | Data | (PD) |
|---------------|------|------|
|               |      |      |

| ( | _ |   |     |   |     |    |    |        |        |     |    |     |                  |      |      | _      |        |     |   |             |                  |      |      |        |        |     |    |             |                    |      |      |        |
|---|---|---|-----|---|-----|----|----|--------|--------|-----|----|-----|------------------|------|------|--------|--------|-----|---|-------------|------------------|------|------|--------|--------|-----|----|-------------|--------------------|------|------|--------|
|   |   | С | )at | a | 0 ( | DC | S) |        |        | )at | ta | 1(1 | <sup>st</sup> pa | ırar | nete | er)    | С      | )at | a | <b>2</b> (2 | <sup>st</sup> pa | ıran | nete | er)    | С      | )at | ta | <b>3</b> (3 | s <sup>st</sup> pa | ıran | nete | er)    |
| ſ |   |   | 8   | 9 | he  | X  |    |        |        |     | 2  | 3   | he               | X    |      |        |        |     | 1 | 2           | he               | X    |      |        |        |     | Α  | 2           | he                 | X    |      |        |
| - | 0 | 0 | 0   | 1 | 1   | 0  | 0  | 1      | 1      | 1   | 0  | 0   | 0                | 1    | 0    | 0      | 0      | 1   | 0 | 0           | 1                | 0    | 0    | 0      | 0      | 1   | 0  | 0           | 0                  | 1    | 0    | 1      |
| Ī | В | В | В   | В | В   | В  | В  | В      | В      | В   | В  | В   | В                | В    | В    | В      | В      | В   | В | В           | В                | В    | В    | В      | В      | В   | В  | В           | В                  | В    | В    | В      |
|   | 0 | 1 | 2   | 3 | 4   | 5  | 6  | 7      | 0      | 1   | 2  | 3   | 4                | 5    | 6    | 7      | 0      | 1   | 2 | 3           | 4                | 5    | 6    | 7      | 0      | 1   | 2  | 3           | 4                  | 5    | 6    | 7      |
| - | S |   |     |   |     |    |    | M<br>S | L<br>S |     |    |     |                  |      |      | M<br>S | L<br>S |     |   |             |                  |      |      | M<br>S | L<br>S |     |    |             |                    |      |      | M<br>S |
|   | В |   |     |   |     |    |    | В      | В      |     |    |     |                  |      |      | ı –    | В      |     |   |             |                  |      |      | В      | В      |     |    |             |                    |      |      | В      |

Packet Data (PD) Packet Footer (PF)

|   | _ |    |   | _           | _                  |      |      | $\overline{}$ | _ |   |    |    |    |    |    |   | _ |   |   |    |    |    |    | $\overline{}$ |
|---|---|----|---|-------------|--------------------|------|------|---------------|---|---|----|----|----|----|----|---|---|---|---|----|----|----|----|---------------|
|   | С | at | a | <b>4</b> (4 | l <sup>st</sup> pa | ıran | nete | er)           |   | C | R  | C( | LS | SB | 3) |   |   | С | R | C( | M  | SE | 3) |               |
|   |   |    | Е | 2           | he                 | X    |      |               |   |   | 5  | 9  | ne | X  |    |   |   |   | 2 | 9  | ne | X  |    |               |
|   | 0 | 1  | 1 | 1           | 0                  | 1    | 0    | 0             | 1 | 0 | 0  | 1  | 1  | 0  | 1  | 0 | 1 | 0 | 0 | 1  | 0  | 1  | 0  | 0             |
|   | В | В  | В | В           | В                  | В    | В    | В             | В | В | В  | В  | В  | В  | В  | В | В | В | В | _  | В  | _  | В  | В             |
|   | 0 | 1  | 2 | 3           | 4                  | 5    | 6    | 7             | 0 | 1 | 2  | 3  | 4  | 5  | 6  | 7 | 0 | 1 | 2 | 3  | 4  | 5  | 6  | 7             |
|   | Г |    |   |             |                    |      |      | М             | E |   |    |    |    |    |    | M | ┖ |   |   |    |    |    |    | М             |
|   | S |    |   |             |                    |      |      | s             | s |   |    |    |    |    |    | S | s |   |   |    |    |    |    | S             |
|   | В |    |   |             |                    |      |      | В             | В |   | _  |    |    |    |    | В | В |   |   |    |    |    |    | В             |
| _ |   |    |   |             |                    |      |      |               |   |   | Ti | im | е  |    |    |   |   |   |   |    |    |    | _  | ~             |

DCS Read Long Response(DCSRR-L)-Example



## DCS Read Short Response, 1 Byte Returned (DCSRR1-S), Data Type = 10 0001(21h)

"DCS Read Short Response, 1 Byte Returned" (DCSRR1-S) is always using a Short Packet (SPa), what is defined on Data Type (DT, 10 0001b), from the display module to the MCU. "DCS Read Short Response, 1 Byte Returned" (DCSRR1-S) is used when the display module wants to response a DCS Read command, which the MCU has sent to the display module.

Short Packet (SPa) is defined e.g.

- Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 10 0001b
- Packet Data (PD):
  - Data 0: 45h
  - Data 1: 00h (Always)
- Error Correction Code (ECC)

This is defined on the Short Packet (SP) as follows.

|          |   |   |    |    |   |   |   |   |   |   | Р  | ac | ke | et | He  | ac | ek  | r ( | Pŀ | 1) |   |   |   |   |   |   |            |    |   |   |             |
|----------|---|---|----|----|---|---|---|---|---|---|----|----|----|----|-----|----|-----|-----|----|----|---|---|---|---|---|---|------------|----|---|---|-------------|
|          |   |   |    |    |   |   |   | _ |   |   |    | Pa | ас | ke | t [ | )a | ta  | (PI | D) |    |   |   | _ |   |   |   |            |    |   |   |             |
|          |   |   | D  | )I |   |   |   |   |   | D | at | a  | 0  |    |     |    |     | С   | at | a  | 1 |   |   |   |   |   | EC         | C  |   |   |             |
|          |   | 2 | 11 | he | X |   |   |   |   | 4 | 5  | he | X  |    |     |    |     | 0   | 0  | he | X |   |   |   |   | 0 | <u>1 I</u> | he | X |   |             |
| 1        | 0 | 0 | 0  | 0  | 1 | 0 | 0 | 1 | 0 | 1 | 0  | 0  | 0  | 1  | 0   | 0  | 0   | 0   | 0  | 0  | 0 | 0 | 0 | 1 | 0 | 0 | 0          | 0  | 0 | 0 | 0           |
| В        | В | В | В  |    |   | В | В | В | В |   |    | В  | В  | В  | В   | В  | В   | В   | В  | В  | В | В | В | В | В | В | В          | В  | В | В | В           |
| 0        | 1 | 2 | 3  | 4  | 5 | 6 | 7 | 0 | 1 | 2 | 3  | 4  | 5  | 6  | 7   | 0  | 1   | 2   | 3  | 4  | 5 | 6 | 7 | 0 | 1 | 2 | 3          | 4  | 5 | 6 | 7           |
| L        |   |   |    |    |   |   | M | L |   |   |    |    |    |    | М   | L  |     |     |    |    |   |   | М | L |   |   |            |    |   |   | M           |
| S        |   |   |    |    |   |   | S | S | l |   |    |    |    |    | S   | S  |     |     |    |    |   |   | S | S |   |   |            |    |   |   | s           |
| В        |   |   |    |    |   |   | В | В |   |   |    |    |    |    | В   | В  |     |     |    |    |   |   | В | В |   |   |            |    |   |   | В           |
| $\vdash$ |   |   |    |    |   |   |   |   |   |   |    |    |    | _  | Ti  | m  | e · |     |    |    |   |   |   |   |   |   |            |    |   |   | <b>&gt;</b> |

DCS Read Short Response,1 Byte Returned(DCSRR1-S)-Example



## DCS Read Short Response, 2 Bytes Returned (DCSRR2-S), Data Type = 10 0010(22h)

"DCS Read Short Response, 2 Bytes Returned" (DCSRR2-S) is always using a Short Packet (SPa), what is defined on Data Type (DT, 10 0010b), from the display module to the MCU. "DCS Read Short Response, 2 Bytes Returned" (DCSRR2-S) is used when the display module wants to response a DCS Read command, which the MCU has sent to the display module.

Short Packet (SPa) is defined e.g.

- · Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 10 0010b
- · Packet Data (PD):
  - Data 0: 45h
  - Data 1: 32h
- Error Correction Code (ECC)

This is defined on the Short Packet (SPa) as follows.

Packet Header (PH) Packet Data(PD) DI Data 0 **ECC** Data 1 22 hex 45 hex 32 hex 0F hex 0 1 0 0 0 1 0 0 1 0 0 1 0 0 1 0 0 0 1 0 0 0 1 0 0 1 0 0 1 1 1 0 0 0 1 1 1 1 0 0 0 0 
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DCS Read Short Response,2 Bytes Returned (DCSRR2-S) - Example



## Generic Read Long Response (GENRR-L), Data Type = 01 1010(1Ah)

"Generic Read Long Response" (GENRR-L) is always using a Long Packet (LPa), what is defined on Data Type (DT, 01 1010b), from the display module to the MCU. "Generic Read Long Response" (GENRR-L) is used when the display module wants to response a Generic Read command, which the MCU has sent to the display module. Long Packet (LPa), which includes 5 data bytes of the Packet Data (PD), is defined e.g.

- Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 01 1010b
- Word Count (WC)
  - Word Count (WC): 0005h
- Error Correction Code (ECC)
- · Packet Data (PD):
  - Data 0: 89h
  - Data 1: 23h
  - Data 2: 12h
  - Data 3: A2h
  - Data 4: E2h
- Packet Footer (PF)

This is defined on the Long Packet (LP) as follows.

#### Packet Header (PH)

|          |                   |                     |                        |                                     |   |  |  |   |   |  |  |  |   |        | _      |        |  |   |        |  |        | _   |   |        |        |        |        |        |        | $\rightarrow$ |
|----------|-------------------|---------------------|------------------------|-------------------------------------|---|--|--|---|---|--|--|--|---|--------|--------|--------|--|---|--------|--|--------|---|---|--------|--------|--------|--------|--------|--------|---------------|
|          |                   |                     | Ν                      |                                     |   |  |  | ١   | N   | C (  | LS   | B  | )   |        |        | ۷      | VC   | ; (   | MS     | 3B   | )      |   |   |        |        | E      | C      |        |        | 1             |
|          | 1                 | Α                   | he                     | X                                   |   |  |  |   | 0   | 5  | he   | X  |   |        |        |        | 0  | 0   | he     | Х  |        |   |   |        | 2      | F      | he     | X      |        |               |
| 1        | 0                 | 1                   | 1                      | 0                                   | 0   | 0  | 0  | 1   | 0   | 1  | 0  | 0  | 0   | 0      | 0      | 0      | 0  | 0   | 0      | 0  | 0      | 0   | 1   | 1      | 1      | 1      | 0      | 1      | 0      | 0             |
| 3 E      | В                 | В                   | В                      | В                                   | В   | В  | В  | В   | В   | В  | В  | В  | В   | В      | В      | В      | В  | В   | В      | В  | В      | В   | В   | В      | В      | В      | В      | В      | В      | В             |
| 1        | 2                 | 3                   | 4                      | 5                                   | 6   | 7  | 0  | 1   | 2   | 3  | 4  | 5  | 6   | 7      | 0      | 1      | 2  | 3   | 4      | 5  | 6      | 7   | 0   | 1      | 2      | 3      | 4      | 5      | 6      | 7             |
|          |                   |                     |                        |                                     |   | М  | L  |   |   |  |  |  |   | М      | L      |        |  |   |        |  |        | М   | L   |        |        |        |        |        |        | M             |
| <b>;</b> |                   |                     |                        |                                     |   | s  | S  |   |   |  |  |  |   | S      | s      |        |  |   |        |  |        | S   | S   |        |        |        |        |        |        | s             |
| 3        |                   |                     |                        |                                     |   | В  | В  |   |   |  |  |  |   | В      | В      |        |  |   |        |  |        | В   | В   |        |        |        |        |        |        | В             |
|          | ) 1<br>3 E<br>) 1 | 1 0<br>3 B B<br>1 2 | 1A 1 0 1 8 B B B 1 2 3 | 0 1 0 1 1<br>3 B B B B<br>0 1 2 3 4 | 1A hex<br>0 1 0 1 1 0<br>3 B B B B B<br>0 1 2 3 4 5 | 1A hex 0 1 0 1 1 0 0 3 B B B B B B 1 1 2 3 4 5 6 | 1A hex  1 0 1 1 0 0 0  B B B B B B B B  1 2 3 4 5 6 7  M S | 1A hex    1 0 1 1 0 0 0 0   3 B B B B B B B B B B B B B B B B B B | 1A hex    1   0   1   1   0   0   0   0   1     3   B   B   B   B   B   B   B   B   B | 1A hex 0<br>0 1 0 1 1 0 0 0 0 1 0<br>3 B B B B B B B B B B B B B B B B B B B | 1A hex 05<br>0 1 0 1 1 0 0 0 0 1 0 1<br>3 B B B B B B B B B B B<br>1 1 2 3 4 5 6 7 0 1 2 3<br>6 M L<br>S S | 1A hex 05 he 0 1 0 1 1 0 0 0 0 1 0 1 0 8 B B B B B B B B B B B B B B B B B B B | 1A hex 05 hex 0 1 0 1 1 0 0 0 0 1 0 1 0 0 8 B B B B B B B B B B B B B B B B B B B | 1A hex | 1A hex | 1A hex | 1A hex 05 hex 05 lex 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | 1A hex 05 hex 0 1 0 1 0 0 0 0 1 0 1 0 0 0 0 0 0 0 3 B B B B B B B B B B B B B B B B B B B | 1A hex | 1A hex 05 hex 00 he  1 0 1 1 0 0 0 0 1 0 1 0 0 0 0 0 0 0 0 | 1A hex | 1A hex 05 hex 00 hex    1   0   1   1   0   0   0   1   0   1   0   0 | 1A hex 05 hex 00 hex    1   0   1   1   0   0   0   1   0   1   0   0 | 1A hex        |

| $\int_{-\infty}^{\infty}$ |   |   |    |    |     |    |    |   |   |    |   |     | Pa               | acl  | ke   | t C | a | ta | (P   | D)          | )                |      |      |     |   |   |    |     |                   |      |      | $\overline{}$ |
|---------------------------|---|---|----|----|-----|----|----|---|---|----|---|-----|------------------|------|------|-----|---|----|------|-------------|------------------|------|------|-----|---|---|----|-----|-------------------|------|------|---------------|
|                           |   | Е | at | ta | 0 ( | DC | S) |   | С | at | а | 1(1 | <sup>st</sup> pa | ıran | nete | er) | Е | at | ta : | <b>2</b> (2 | <sup>st</sup> pa | ıran | nete | er) | С | a | ta | 3(3 | s <sup>t</sup> pa | aran | nete | r)            |
|                           |   |   | 8  | 9  | he  | X  |    |   |   |    | 2 | 3   | he               | X    |      |     |   |    | 1    | 2           | he               | X    |      |     |   |   | Α  | 2   | he                | X    |      |               |
|                           | 0 | 0 | 0  | 1  | 1   | 0  | 0  | 1 | 1 | 1  | 0 | 0   | 0                | 1    | 0    | 0   | 0 | 1  | 0    | 0           | 1                | 0    | 0    | 0   | 0 | 1 | 0  | 0   | 0                 | 1    | 0    | 1             |
| - 1                       | В | В | В  | В  | В   | В  | В  | В | В | В  | В | В   | В                | В    | В    | В   | В | В  | В    | В           | В                | В    | В    | В   | В | В | В  | В   | В                 | В    | В    | В             |
|                           | 0 | 1 | 2  | 3  | 4   | 5  | 6  | 7 | 0 | 1  | 2 | 3   | 4                | 5    | 6    | 7   | 0 | 1  | 2    | 3           | 4                | 5    | 6    | 7   | 0 | 1 | 2  | 3   | 4                 | 5    | 6    | 7             |
| П                         | Г |   |    |    |     |    |    | M | L |    |   |     |                  |      |      | М   | ᆫ |    |      |             |                  |      |      | M   | L |   |    |     |                   |      |      | M             |
| Ш                         | S |   |    |    |     |    |    | S | S |    |   |     |                  |      |      | S   | S |    |      |             |                  |      |      | s   | S |   |    |     |                   |      |      | S             |
| ١                         | В |   |    |    |     |    |    | В | В |    |   |     |                  |      |      | В   | В |    |      |             |                  |      |      | В   | В |   |    |     |                   |      |      | В             |

|   | Pa | ıcl | (e | t [ | Dat              | ta   | (P   | D)  | 1 |   |   | F  | a  | ck | et | Fo | 00 | te | r (I | PF | )  |    |    | _ |
|---|----|-----|----|-----|------------------|------|------|-----|---|---|---|----|----|----|----|----|----|----|------|----|----|----|----|---|
|   | D  | at  | a  | 4(4 | <sup>st</sup> pa | ıran | nete | er) |   | C | R | C( | LS | SB | 3) |    |    | С  | R    | C( | M  | SE | 3) | コ |
|   |    |     | Ε  | 2   | he               | X    |      |     |   |   | 5 | 9  | he | X  |    |    |    |    | 2    | 9  | he | X  |    |   |
|   | 0  | 1   | 1  | 1   | 0                | 1    | 0    | 0   | 1 | 0 | 0 | 1  | 1  | 0  | 1  | 0  | 1  | 0  | 0    | 1  | 0  | 1  | 0  | 0 |
|   | В  | В   | В  | _   | В                | В    | В    | В   | В | В |   | В  | В  | В  |    | В  | В  | В  | В    | _  | В  | В  | В  | В |
|   | 0  | 1   | 2  | 3   | 4                | 5    | 6    | 7   | 0 | 1 | 2 | 3  | 4  | 5  | 6  | 7  | 0  | 1  | 2    | 3  | 4  | 5  | 6  | 7 |
|   | L  |     |    |     |                  |      |      | М   | L |   |   |    |    |    |    | М  | L  |    |      |    |    |    |    | M |
|   | S  |     |    |     |                  |      |      | S   | S |   |   |    |    |    |    | S  | S  |    |      |    |    |    |    | S |
| \ | В  |     |    |     |                  |      |      | В   | В |   |   |    |    |    |    | В  | В  |    |      |    |    |    |    | В |
| _ |    |     |    |     |                  |      |      |     |   |   | T | im | е  |    |    |    |    |    |      |    |    |    |    | ~ |



## Generic Read Short Response, 1 Byte Returned (GENRR1-S), Data Type = 01 0001(11h)

"Generic Read Short Response, 1 Byte Returned" (GENRR1-S) is always using a Short Packet (SPa), what is defined on Data Type (DT, 01 0001b), from the display module to the MCU. "Generic Read Short Response, 1 Byte Returned" (GENRR1-S) is used when the display module wants to response a Generic Read command, which the MCU has sent to the display module.

Short Packet (SPa) is defined e.g.

- · Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 01 0001b
- · Packet Data (PD):
  - Data 0: 45h
  - · Data 1: 00h (Always)
- Error Correction Code (ECC)

This is defined on the Short Packet (SP) as follows.

Packet Header (PH) Packet Data(PD) DI Data 0 Data 1 **ECC** 22 hex 45 hex 32 hex 0F hex 0|1|0|0|0|1|0|0|1|0|1|0|0|0|1|0|0|1|0|0|1|1|0|0|1 |1|1|1|0|0|0|0 0 L S B 5 6 7 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7 0 1 2 3 4 1 2 3 4 7 M L S S B B МL МL М S S B B S S B B s **Time** 

Generic Read Short Response,1 Byte Returned (GENRR1-S)-Example



## Generic Read Short Response, 2 Bytes Returned (GENRR2-S), Data Type = 01 0010(12h)

"Generic Read Short Response, 2 Bytes Returned" (GENRR2-S) is always using a Short Packet (SPa), what is defined on Data Type (DT, 01 0010b), from the display module to the MCU. "Generic Read Short Response, 2 Bytes Returned" (GENRR2-S) is used when the display module wants to response a Generic Read command, which the MCU has sent to the display module.

Short Packet (SPa) is defined e.g.

- · Data Identification (DI)
  - Virtual Channel (VC, DI[7...6]): 00b
  - Data Type (DT, DI[5...0]): 01 0010b
- · Packet Data (PD):
  - Data 0: 45h
  - Data 1: 32h
- Error Correction Code (ECC)

This is defined on the Short Packet (SP) as follows.

Packet Header (PH) Packet Data(PD) DI Data 0 Data 1 **ECC** 12 hex 45 hex 32 hex 09 hex |1|0|0|1|0|0|0|1|0|1|0|0|0|1|0|0|1|0|0|1|1|0|0|1|0|0|1|0|0|0 88888888888888888888888888888 |7|0|1|2|3|4|5|6|7|0|1|2 7 0 O L S B 1 2 3 4 5 6 3 4 5 6 1 2 3 4 6 7 M L S S B B ML МL M S S B B S S B B S В **Time** 

Generic Read Short Response, 2 Bytes Returned (GENRR2-S)-Example



## 8.7.2.3.3 COMMUNICATION SEQUENCES

#### 8.7.2.3.3.1 GENERAL

The communication sequences can be done on interface or packet levels between the MCU and the display module. See chapters "Interface Level Communication" and "Packet Level Communication".

This communication sequence description is for DSI data lanes and it has been assumed that the needed low level communication is done on DSI clock lanes (DSI-CLK+/-) automatically.

Functions of the interface level communication is described on the following table.

| Interface Mode | Abbreviation | Interface Action Description |
|----------------|--------------|------------------------------|
|                | LP-11        | Stop state                   |
|                | LPDT         | Low power data transmission  |
|                | ULPS         | Ultra-Low power state        |
| Low Power      | RAR          | Remote application reset     |
|                | TEE          | Tearing effect event         |
|                | ACK          | Acknowledge (No error)       |
|                | BTA          | Bus turnaround               |
| High Speed     | HSDT         | High speed data transmission |

**Table 21 Interface Level Communication** 

Functions of the packet level communication are described on the following table.

| Packet Sender  | Abbreviation | Packet Size | Packet Description             |
|----------------|--------------|-------------|--------------------------------|
|                | DCSW1-S      | SPa         | DCS Write,1 Parameter          |
|                | DCSWN-S      | SPa         | DCS Write, No parameter        |
| MCU            | DCSW-L       | LPa         | DCS Write,Long                 |
| IVICO          | DCSRN-S      | SPa         | DCS Read,No Parameter          |
|                | SMRPS-S      | SPa         | Set maximum return packet size |
|                | NP-L         | LPa         | Null packet, No data           |
|                | AwER         | SPa         | Acknowledge with error report  |
| Display Modulo | DCSRR-L      | LPa         | DCS Read, Long Response        |
| Display Module | DCSRR1-S     | SPa         | DCS Read, Short Response       |
|                | DCSRR2-S     | SPa         | DCS Read, Short Response       |

**Table 22 Packet Level Communication** 

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## 8.7.2.3.3.2 **SEQUENCES**

## DCS Write, 1 Parameter Sequence

A Short Packet (SPa) of "Display Command Set (DCS) Write, 1 Parameter (DCSW1-S)" is defined on chapter "Display Command Set (DCS) Write, 1 Parameter (DCSW1-S)" and example sequences, how this packet is used, is described on following tables.

DCS Write,1 Parameter Sequence - Example 1

|      | MCL              | J                            |                          | Display M                    | 1odule           |         |
|------|------------------|------------------------------|--------------------------|------------------------------|------------------|---------|
| Line | Packet<br>Sender | Interface<br>Mode<br>Control | Information<br>Direction | Interface<br>Mode<br>Control | Packet<br>Sender | Comment |
| 1    | -                | LP-11                        | =>                       | -                            | -                | Start   |
| 2    | DCSW1-S          | LPDT                         | =>                       | -                            | -                |         |
| 3    | =                | LP-11                        | =>                       |                              | =                | End     |

## DCS Write,1 Parmeter Sequence - Example2

|      | MCL              | J                            |                          | Display M                    | 1odule           |                            |
|------|------------------|------------------------------|--------------------------|------------------------------|------------------|----------------------------|
| Line | Packet<br>Sender | Interface<br>Mode<br>Control | Information<br>Direction | Interface<br>Mode<br>Control | Packet<br>Sender | Comment                    |
| 1    | -                | LP-11                        | =>                       | -                            | -                | Start                      |
| 2    | DCSW1-S          | HSDT                         | =>                       | -                            | -                |                            |
| 3    | EoTP             | HSDT                         | =>                       | -                            | -                | End of Transmission Packet |
| 4    | -                | LP-11                        | =>                       | -                            | -                | End                        |

## DCS Write, 1 Parameter Sequence - Example 3

|      | MCL              |                              |                          | Display N                    | Module 1         |   |
|------|------------------|------------------------------|--------------------------|------------------------------|------------------|---|
| Line | Packet<br>Sender | Interface<br>Mode<br>Control | Information<br>Direction | Interface<br>Mode<br>Control | Packet<br>Sender | Comment   |
| 1    | -                | LP-11                        | =>                       | -                            | -                | Start   |
| 2    | DCSW1-S          | HSDT                         | =>                       | -                            | -                |   |
| 3    | EoTP             | HSDT                         | =>                       | -                            | -                | End of Transmission Packet                                  |
| 4    | -                | LP-11                        | =>                       | -                            | -                |   |
| 5    | -                | ВТА                          | <=>                      | ВТА                          | -                | Interface control change from the MCU to the display module |
| 6    | -                | -                            | <=                       | LP-11                        | -                | If no error=>goto line8 If error=goto line 13               |
| 7    |                  |                              |                          |                              |                  |   |
| 8    | -                | -                            | <=                       | ACK                          | -                | No error  |
| 9    | -                | 1                            | <=                       | LP-11                        | -                |   |
| 10   | -                | ВТА                          | <=>                      | ВТА                          | -                | Interface control change from the display module to the MCU |
| 11   | -                | LP-11                        | =>                       | -                            | -                | End   |
| 12   |                  |                              |                          |                              |                  |   |
| 13   | -                | -                            | <=                       | LPDT                         | AwER             | Error report  |
| 14   | -                | -                            | <=                       | LP-11                        | =                |   |
| 15   | -                | BTA                          | <=>                      | BTA                          | -                |   |
| 16   | -                | LP-11                        | =>                       | -                            | -                | End   |

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# DCS Write, No Parameter Sequence

A Short Packet (SPa) of "Display Command Set (DCS) Write, No Parameter (DCSWN-S)" is defined on chapter "Display Command Set (DCS) Write, No Parameter (DCSWN-S)" and example sequences, how this packet is used, is described on following tables.

## DCS Write, No Parameter Sequence-Example 1

|      | MCU              |                              | Display Module           |                              |                  |         |
|------|------------------|------------------------------|--------------------------|------------------------------|------------------|---------|
| Line | Packet<br>Sender | Interface<br>Mode<br>Control | Information<br>Direction | Interface<br>Mode<br>Control | Packet<br>Sender | Comment |
| 1    | -                | LP-11                        | =>                       | -                            | -                | Start   |
| 2    | DCSW1-S          | LPDT                         | =>                       | -                            | -                |         |
| 3    | -                | LP-11                        | =>                       | -                            | -                | End     |

## DCS Write, No Parmeter Sequence – Example2

|      | MCL              | l                            |                          | Display Module               |                  |                            |
|------|------------------|------------------------------|--------------------------|------------------------------|------------------|----------------------------|
| Line | Packet<br>Sender | Interface<br>Mode<br>Control | Information<br>Direction | Interface<br>Mode<br>Control | Packet<br>Sender | Comment                    |
| 1    | -                | LP-11                        | =>                       | -                            | -                | Start                      |
| 2    | DCSW1-S          | HSDT                         | =>                       | -                            | -                |                            |
| 3    | EoTP             | HSDT                         | =>                       | -                            | -                | End of Transmission Packet |
| 4    | -                | LP-11                        | =>                       | -                            | -                | End                        |

## DCS Write, No Parameter Sequence - Example 3

|      | MCU              |                              |                          | Display M                    | <b>1</b> odule   |   |
|------|------------------|------------------------------|--------------------------|------------------------------|------------------|---|
| Line | Packet<br>Sender | Interface<br>Mode<br>Control | Information<br>Direction | Interface<br>Mode<br>Control | Packet<br>Sender | Comment   |
| 1    | -                | LP-11                        | =>                       | -                            | -                | Start   |
| 2    | DCSW1-S          | HSDT                         | =>                       | -                            | -                |   |
| 3    | EoTP             | HSDT                         | =>                       | -                            | -                | End of Transmission Packet                                  |
| 4    | =                | LP-11                        | =>                       | -                            | -                |   |
| 5    | -                | ВТА                          | <=>                      | ВТА                          | -                | Interface control change from the MCU to the display module |
| 6    | -                | -                            | <=                       | LP-11                        | -                | If no error=>goto line8 If error=goto line 13               |
| 7    |                  |                              |                          |                              |                  |   |
| 8    | -                | -                            | <=                       | ACK                          | -                | No error  |
| 9    | =                | -                            | <=                       | LP-11                        | -                |   |
| 10   | -                | ВТА                          | <=>                      | ВТА                          | -                | Interface control change from the display module to the MCU |
| 11   | =                | LP-11                        | =>                       | -                            | -                | End   |
| 12   |                  |                              |                          |                              |                  |   |
| 13   | -                | 1                            | <=                       | LPDT                         | AwER             | Error report  |
| 14   | -                | -                            | <=                       | LP-11                        | -                |   |
| 15   | -                | BTA                          | <=>                      | BTA                          | -                |   |
| 16   | -                | LP-11                        | =>                       | -                            | -                | End   |



# **DCS Write Long Sequence**

A Long Packet (LPa) of "Display Command Set (DCS) Write Long (DCSW-L)" is defined on chapter "Display Command Set (DCS) Write Long (DCSW-L)" and example sequences, how this packet is used, is described on following tables.

## DCS Write, Long Sequence-Example 1

|      | MCL              | MCU                          |                          | Display Module               |                  |         |
|------|------------------|------------------------------|--------------------------|------------------------------|------------------|---------|
| Line | Packet<br>Sender | Interface<br>Mode<br>Control | Information<br>Direction | Interface<br>Mode<br>Control | Packet<br>Sender | Comment |
| 1    | -                | LP-11                        | =>                       | -                            | -                | Start   |
| 2    | DCSW-L           | LPDT                         | =>                       | -                            | -                |         |
| 3    | -                | LP-11                        | =>                       | -                            | -                | End     |

## DCS Write, Long Sequence – Example2

|      | MCL              | l                            |                          | Display M                    | <i>l</i> lodule  |                            |
|------|------------------|------------------------------|--------------------------|------------------------------|------------------|----------------------------|
| Line | Packet<br>Sender | Interface<br>Mode<br>Control | Information<br>Direction | Interface<br>Mode<br>Control | Packet<br>Sender | Comment                    |
| 1    | -                | LP-11                        | =>                       | -                            | -                | Start                      |
| 2    | DCSW-L           | HSDT                         | =>                       | -                            | -                |                            |
| 3    | EoTP             | HSDT                         | =>                       | -                            | -                | End of Transmission Packet |
| 4    | -                | LP-11                        | =>                       | -                            | -                | End                        |

## DCS Write, Long Sequence - Example 3

|      | MCU              |                              |                          | Display M                    | Module 1         |   |
|------|------------------|------------------------------|--------------------------|------------------------------|------------------|---|
| Line | Packet<br>Sender | Interface<br>Mode<br>Control | Information<br>Direction | Interface<br>Mode<br>Control | Packet<br>Sender | Comment   |
| 1    | -                | LP-11                        | =>                       | -                            | -                | Start   |
| 2    | DCSW-L           | HSDT                         | =>                       | -                            | -                |   |
| 3    | EoTP             | HSDT                         | =>                       | -                            | -                | End of Transmission Packet                                  |
| 4    | -                | LP-11                        | =>                       | -                            | -                |   |
| 5    | -                | ВТА                          | <=>                      | ВТА                          | -                | Interface control change from the MCU to the display module |
| 6    | -                | -                            | <=                       | LP-11                        | -                | If no error=>goto line8 If error=goto line 13               |
| 7    |                  |                              |                          |                              |                  |   |
| 8    | -                | -                            | <=                       | ACK                          | -                | No error  |
| 9    | -                | -                            | <=                       | LP-11                        | -                |   |
| 10   | -                | ВТА                          | <=>                      | ВТА                          | -                | Interface control change from the display module to the MCU |
| 11   | -                | LP-11                        | =>                       | -                            | -                | End   |
| 12   |                  |                              |                          |                              |                  |   |
| 13   | -                | -                            | <=                       | LPDT                         | AwER             | Error report  |
| 14   | -                | -                            | <=                       | LP-11                        | -                |   |
| 15   | -                | BTA                          | <=>                      | BTA                          | -                |   |
| 16   | -                | LP-11                        | =>                       | -                            | -                | End   |



# DCS Read, No Parameter Sequence

A Short Packet (SPa) of "Display Command Set (DCS) Read, No Parameter (DCSRN-S)" is defined on chapter "Display Command Set (DCS) Read, No Parameter (DCSRN-S)" and example sequences, how this packet is used, is described on following tables.

DCS Read, No Parameter Sequence - Example 1

|      | MCL              | J                            |                          | Displa                       | y Module         |   |
|------|------------------|------------------------------|--------------------------|------------------------------|------------------|---|
| Line | Packet<br>Sender | Interface<br>Mode<br>Control | Information<br>Direction | Interface<br>Mode<br>Control | Packet<br>Sender | Comment   |
| 1    | =                | LP-11                        | =>                       |                              | -                | Start   |
| 2    | SMRPS-S          | HSDT                         | =>                       |                              | -                | Define how many data byte is wanted to read: 1 byte   |
| 3    | DCSRN-S          | HSDT                         | =>                       |                              | -                | Wanted to get a response ID1 (DAh)  |
| 4    | EoTP             | HSDT                         | =>                       |                              | -                | End of Transmission Packet  |
| 5    | -                | LP-11                        | =>                       |                              | -                |   |
| 6    | -                | ВТА                          | <=>                      | ВТА                          | -                | Interface control change from the MCU to the display module                                   |
| 7    | -                | -                            | <=                       | LP-11                        | -                | If no error=>goto line 9 If error=> goto line 14 If error is corrected by ECC =>go to line 19 |
| 8    |                  |                              |                          |                              |                  |   |
| 9    | -                | -                            | <=                       | LPDT                         | DCSRR1-S         | Responsed 1 byte return   |
| 10   | -                | -                            | <=                       | LP-11                        | -                |   |
| 11   | -                | ВТА                          | <=>                      | ВТА                          | -                | Interface control change from the Display module to the MCU                                   |
| 12   | -                | LP-11                        | =>                       | -                            | -                | End   |
| 13   |                  |                              |                          |                              |                  |   |
| 14   | =                | -                            | <=                       | LPDT                         | AwER             | Error report  |
| 15   | -                | -                            | <=                       | LP-11                        | -                |   |
| 16   | -                | ВТА                          | <=>                      | ВТА                          | -                | Interface Control change from the Display module to the MCU                                   |
| 17   | -                | LP-11                        | =>                       | -                            | -                | End   |
| 18   |                  |                              |                          | _                            | _                |   |
| 19   |                  | -                            | <=                       | LPDT                         | DCSRR1-S         | Responsed 1 byte return   |
| 20   | -                | -                            | <=                       | LPDT                         | AwER             | Error Report (Error is Corrected by ECC)  |
| 21   | -                | -                            | <=                       | LP-11                        | -                |   |
| 22   | -                | ВТА                          | <=>                      | ВТА                          | -                | Interface control change from the display module to the MCU                                   |
| 23   | -                | LP-11                        | =>                       | -                            | -                | End   |



# **Null Packet, No Data Sequence**

A Long Packet (LPa) of "Null Packet, No Data (NP-L)" is defined on chapter "Null Packet, No Data (NP-L)" and example sequences, how this packet is used, is described on following tables.

Null Packet, No Parameter Sequence - Example

|      | MCL              | J                            |                          | Display I                    | Module           |   |  |
|------|------------------|------------------------------|--------------------------|------------------------------|------------------|---|--|
| Line | Packet<br>Sender | Interface<br>Mode<br>Control | Information<br>Direction | Interface<br>Mode<br>Control | Packet<br>Sender | Comment                                   |  |
| 1    | -                | LP-11                        | =>                       | -                            | -                | Start                                     |  |
| 2    | NP-L             | HSDT                         | =>                       | -                            | -                | Only high speed data transmission Is used |  |
| 3    | EoTP             | HSDT                         | =>                       | -                            | -                | End of Transmission Packet                |  |
| 4    | -                | LP-11                        | =>                       | =                            | =                | End                                       |  |

#### **End of Transmission Packet**

A Short Packet (SPa) of "End of Transmission (EoT)" is defined on chapter "End of Transmission Packet (EoT)" and an example sequences, how this packet is used, is described on following tables.

## End of Transmission Packet - Example

|      | MCL              |                              |                          | Display Module               |                  |   |
|------|------------------|------------------------------|--------------------------|------------------------------|------------------|---|
| Line | Packet<br>Sender | Interface<br>Mode<br>Control | Information<br>Direction | Interface<br>Mode<br>Control | Packet<br>Sender | Comment                                   |
| 1    | -                | LP-11                        | =>                       | -                            | -                | Start                                     |
| 2    | NP-L             | HSDT                         | =>                       | -                            | -                | Only high speed data transmission Is used |
| 3    | EoTP             | HSDT                         | =>                       | ı                            | ı                | End of Transmission Packet                |
| 4    | -                | LP-11                        | =>                       | -                            | -                | End                                       |



#### 8.7.2.4 Video Mode Communication

Video Mode peripherals require pixel data delivered in real time. This section specifies the format and timing of DSI traffic for this type of display module.

#### 8.7.2.4.1 TRANSMISSION PACKET SEQUENCES

DSI supports several formats, or packet sequences, for Video Mode data transmission. The peripheral's timing requirements dictate which format is appropriate. In the following sections, Burst Mode refers to time-compression of the RGB pixel (active video) portion of the transmission. In addition, these terms are used throughout the following sections:

- Non-Burst Mode with Sync Pulses enables the peripheral to accurately reconstruct original video timing, including sync pulse widths.
- Non-Burst Mode with Sync Events similar to above, but accurate reconstruction of sync pulse widths is not required, so a single Sync Event is substituted.
- Burst mode RGB pixel packets are time-compressed, leaving more time during a scan line for LP mode (saving power) or for multiplexing other transmissions onto the DSI link.

In the following figures the Blanking or Low-Power Interval (BLLP) is defined as a period during which video packets such as pixel-stream and sync event packets are not actively transmitted to the peripheral. To enable PHY synchronization the host processor should periodically end HS transmission and drive the Data Lanes to the LP state. This transition should take place at least once per frame; shown as LPM in the figures in this section. It is recommended to return to LP state once per scan-line during the horizontal blanking time. Regardless of the frequency of BLLP periods, the host processor is responsible for meeting all documented peripheral timing requirements. Note, at lower frequencies BLLP periods will approach, or become, zero, and burst mode will be indistinguishable from non-burst mode.

During the BLLP the DSI Link may do any of the following:

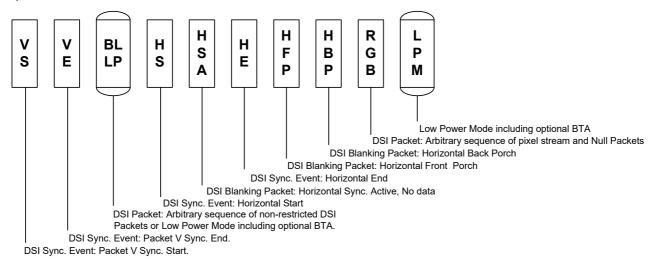
- Remain in Idle Mode with the host processor in LP-11 state and the peripheral in LP-RX
- Transmit one or more non-video packets from the host processor to the peripheral using Escape Mode
- Transmit one or more non-video packets from the host processor to the peripheral using HS Mode
- If the previous processor-to-peripheral transmission ended with BTA, transmit one or more packets from the peripheral to the host processor using Escape Mode
- Transmit one or more packets from the host processor to a different peripheral using a different Virtual Channel ID

The sequence of packets within the BLLP or RGB portion of a HS transmission is arbitrary. The host processor may compose any sequence of packets, including iterations, within the limits of the packet format definitions. For all timing cases, the first line of a frame shall start with VS; all other lines shall start with HS. This is also true in the special case when VSA+VBP=0. Note that the position of synchronization packets, such as VS and HS, in time is of utmost importance since this has a direct impact on the visual performance of the display panel.

Normally, RGB pixel data is sent with one full scan line of pixels in a single packet. If necessary, a horizontal scan-line of active pixels may be divided into two or more packets. However, individual pixels shall not be split across packets.



Transmission packet components used in the figures in this section are defined in Figure below unless otherwise specified.



## **DSI Video Mode Interface Timing Legend**

If a peripheral timing specification for HBP or HFP minimum period is zero, the corresponding Blanking Packet may be omitted. If the HBP or HFP maximum period is zero, the corresponding blanking packet shall be omitted. There are two limitation for MIPI Video mode 2 Lane:

- (1) The packet number for H-porch or 1-line data should be even.
- (2) Packet Pixel Stream should be start at Lane0.



## 8.7.2.4.2 NON-BURST MODE WITH SYNC PULSES

With this format, the goal is to accurately convey DPI-type timing over the DSI serial Link. This includes matching DPI pixel-transmission rates, and widths of timing events like sync pulses. Accordingly, synchronization periods are defined using packets transmitting both start and end of sync pulses. An example of this mode is shown in Figure below.

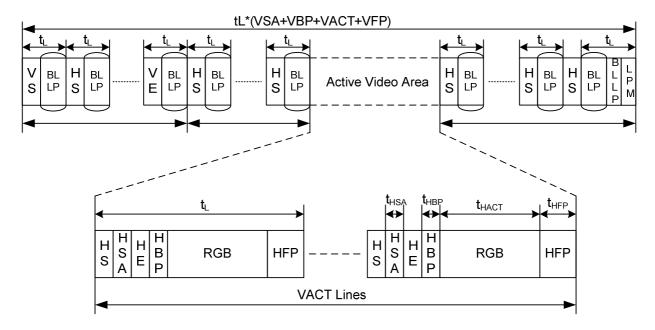


Figure 83 DSI Video Mode Interface Timing: Non-Burst Transmission with Sync Start and End

Normally, periods shown as HSA (Horizontal Sync Active), HBP (Horizontal Back Porch) and HFP (Horizontal Front Porch) are filled by Blanking Packets, with lengths (including packet overhead) calculated to match the period specified by the peripheral's data sheet. Alternatively, if there is sufficient time to transition from HS to LP mode and back again, a timed interval in LP mode may substitute for a Blanking Packet, thus saving power.

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## 8.7.2.4.3 NON-BURST MODE

This mode is a simplification of the format described in section 5.3.2.4.2 "Non-Burst Mode with Sync Pulse" .Only the start of each synchronization pulse is transmitted. The peripheral may regenerate sync pulses as needed from each Sync Event packet received. Pixels are transmitted at the same rate as they would in a corresponding parallel display interface such as DPI-2. An example of this mode is shown in Figure below.

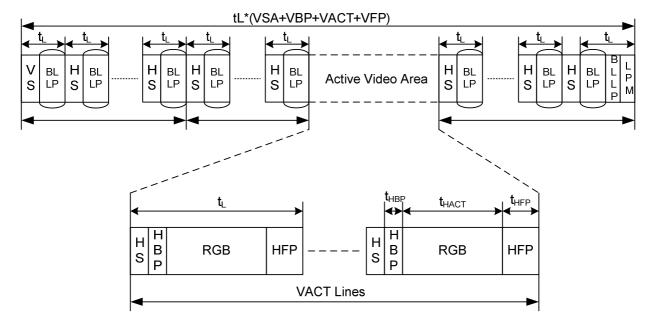


Figure 84 DSI Video Mode Interface Timing: Non-burst Transmission

As with the previous Non-Burst Mode, if there is sufficient time to transition from HS to LP mode and back again, a timed interval in LP mode may substitute for a Blanking Packet, thus saving power.

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#### 8.7.2.4.4 BURST MODE

In this mode, blocks of pixel data can be transferred in a shorter time using a time-compressed burst format. This is a good strategy to reduce overall DSI power consumption, as well as enabling larger blocks of time for other data transmissions over the Link in either direction. There may be a line buffer or similar memory on the peripheral to accommodate incoming data at high speed. Following HS pixel data transmission, the bus goes to Low Power Mode, during which it may remain idle, i.e. the host processor remains in LP-11 state, or LP transmission may take place in either direction. If the peripheral takes control of the bus for sending data to the host processor, its transmission time shall be limited to ensure data underflow does not occur from its internal buffer memory to the display device. An example of this mode is shown in Figure below.

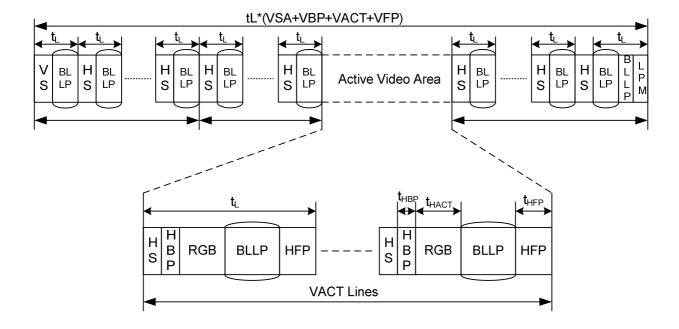


Figure 85 DSI Video Mode Interface Timing: Burst Transmission

Similar to the Non-Burst Mode scenario, if there is sufficient time to transition from HS to LP mode and back again, a timed interval in LP mode may substitute for a Blanking Packet, thus saving power.

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# 9 POWER ON/OFF SEQUENCE

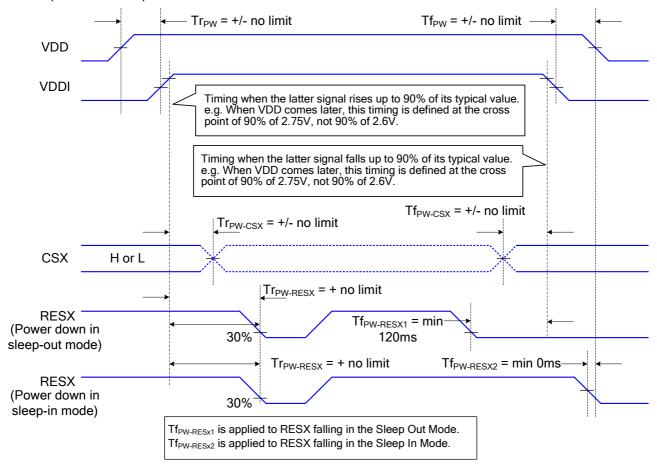
VDDI and VDDA can be applied or powered down in any order. During the Power Off sequence, if the LCD is in the Sleep Out mode, VDDA and VDDI must be powered down with minimum 120msec. If the LCD is in the Sleep In mode, VDDA and VDDI can be powered down with minimum 0msec after the RESX is released.

CSX can be applied at any timing or can be permanently grounded. RESX has high priority over CSX.

#### Notes:

- 1. There will be no damage to the ST7701S if the power sequences are not met.
- 2. There will be no abnormal visible effects on the display panel during the Power On/Off Sequences.
- 3. There will be no abnormal visible effects on the display between the end of Power On Sequence and before receiving the Sleep Out command, and also between receiving the Sleep In command and the Power Off Sequence.
- 4. If the RESX line is not steadily held by the host during the Power On Sequence as defined in Sections 9.1 and 9.2, then it will be necessary to apply the Hardware Reset (RESX) after the completion of the Host Power On Sequence to ensure correct operations. Otherwise, all the functions are not guaranteed.

The power on/off sequence is illustrated below





## 9.1 Uncontrolled Power Off

The uncontrolled power-off means a situation which removed a battery without the controlled power off sequence. It will neither damage the module or the host interface.

If uncontrolled power-off happened, the display will go blank and there will not any visible effect on the display (blank display) and remains blank until "Power On Sequence" powers it up.



# 10 POWER LEVEL DEFINITION

#### 10.1 Power Level

7 level modes are defined they are in order of maximum power consumption to minimum power consumption:

1. Normal Mode On (full display), Idle Mode Off, Sleep Out.

In this mode, the display is able to show maximum 16.7M colors.

2. Partial Mode On, Idle Mode Off, Sleep Out

In this mode, part of the display is used with maximum 16.7M colors.

3. Normal Mode On (full display), Idle Mode On, Sleep Out.

In this mode, the full display is used but with 8 colors.

4. Partial Mode On, Idle Mode On, Sleep Out

In this mode, part of the display is used but with 8 colors.

5. Sleep In Mode.

In this mode, the DC/DC converter, internal oscillator and panel driver circuit are stopped. Only the MPU interface and registers are working with VDDI power supply.

6. Deep Standby Mode.

In this mode, the DC/DC converter, internal oscillator and panel driver circuit are stopped. The MPU interface and registers are not working.

7. Power Off Mode

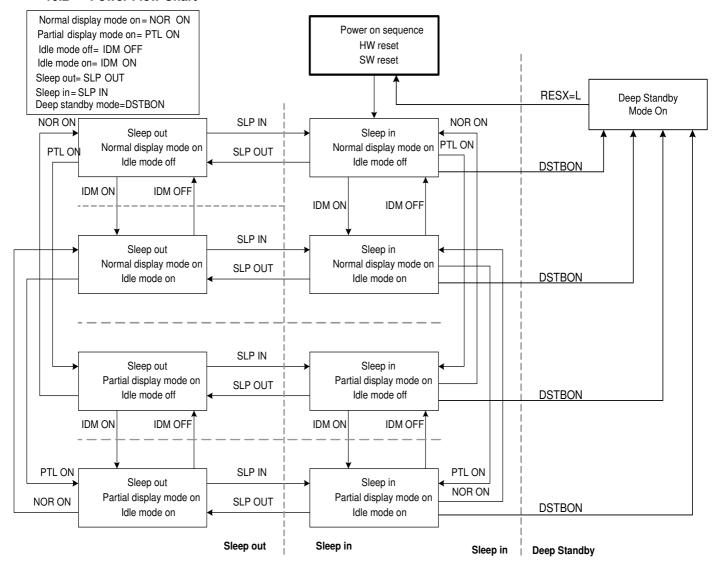
In this mode, VDDI and VDDA/VDDB are removed.

NOTE: Transition between mode 1~5 is controllable by MPU commands. Mode 6 is entered for power saving with

both power supplies for I/O and analog circuits and can be exited by hardware reset only (RESX=L). Mode 7 is entered only when both power supplies for I/O and analog circuits are removed.



#### 10.2 Power Flow Chart



#### NOTES:

- 1) There is not any abnormal visual effect when there is changing from one power mode to another power mode.
- 2) There is not any limitation, which is not specified by this spec, when there is changing from one power mode to another power mode



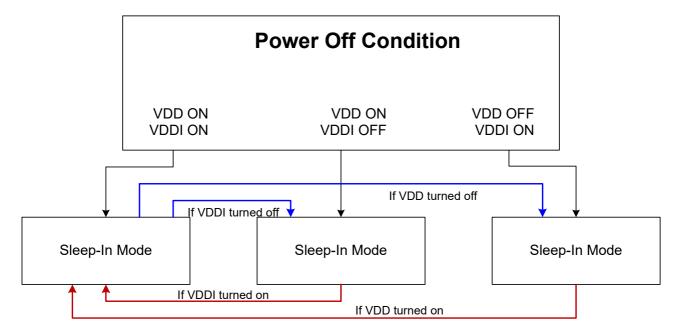
The following table represents the Registers its mode state.

| Mode              | Dogistor            | Control     |           |  |
|-------------------|---------------------|-------------|-----------|--|
| Wode              | Register            | Enter       | Exit      |  |
| Sleep in mode     | Keep                | Command     |           |  |
| Deep-standby mode | Loss                | Command     | Reset pin |  |
| Reset=L           | Keep(Default Value) | Reset (H/W) |           |  |

The condition for irregular power off mode is shown below.

| Power Off Mode | VDD | VDDI | RESX        | I/O |
|----------------|-----|------|-------------|-----|
| Mode 1         | ON  | OFF  | High to Low | Low |
| Mode 2         | OFF | ON   | High to Low | Low |

Note: VDD means VDDA, VDDB





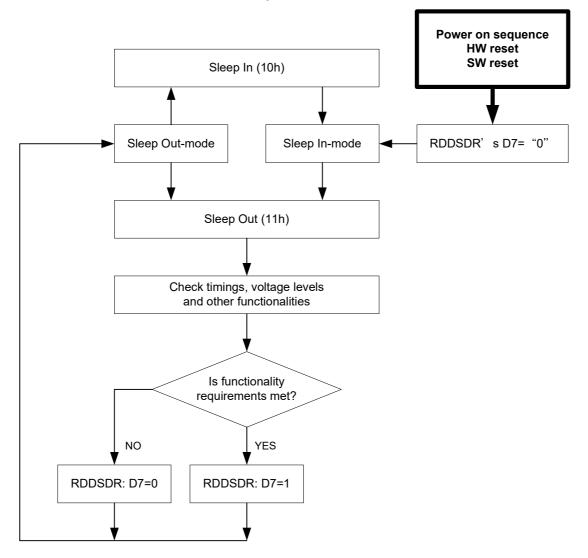
## 10.3 Sleep Out –Command and self-diagnostic functions of the display module

## 10.3.1 Register loading Detection

Sleep Out-command is a trigger for an internal function of the display module, which indicates, if the display module loading function of factory default values from ROM to registers of the display controller is working properly.

There are compared factory values of the ROM and register values of the display controller by the display controller (1st step: compare register and ROM values, 2nd step: loads ROM values to registers). If those both values (ROM and register values) are same, there is inverted (= increased by 1) a bit, which is defined in command RDDSDR (The used bit of this command is D7). If those both values are not same, this bit (D7) is not inverted (= not increased by 1).

The flow chart for this internal function is following:



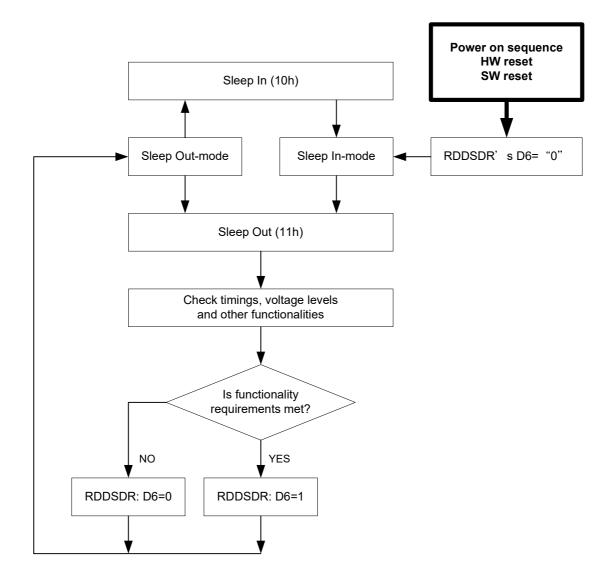


# 10.3.2 Functionality Detection

Sleep Out-command is a trigger for an internal function of the display module.

The internal function (= the display controller) is comparing if the display module is still meeting functionality requirements (e.g. booster voltage levels, timings, etc.). If functionality requirement is met, bit-6 of RDDSDR is set to 1, which defined in command Read Display Self-Diagnostic Result (RDDSDR). The used bit of this command is D6. If functionality requirement is not same, this bit (D6) is set to 0.

The flow chart for this internal function is following:





# 11 GAMMA CORRECTION

ST7701S incorporate the gamma correction function to display 16M colors for the LCD panel. The gamma correction is performed with 3 groups of registers, which are gradient adjustment, contrast adjustment and fine- adjustment registers for positive and negative polarities, and RGB can be adjusted individually.



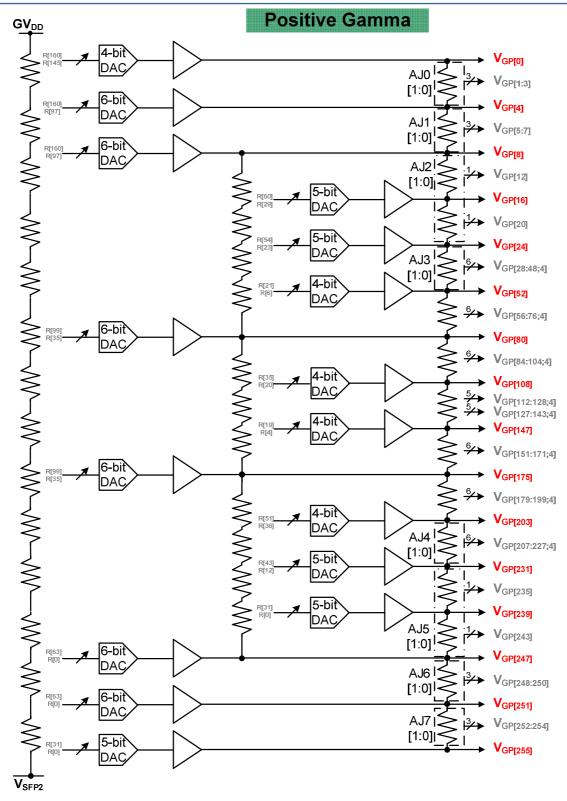


Figure 86 Gray scale Voltage Generation (Positive)



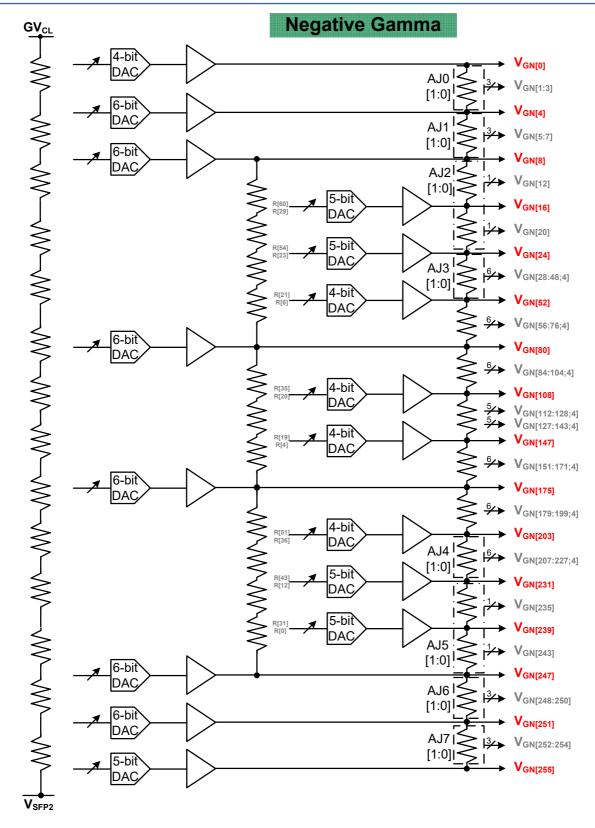


Figure 87 Gray scale Voltage Generation (Positive)



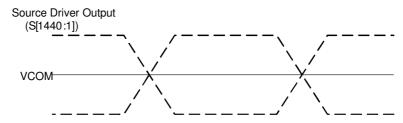


Figure 88 Relationship between Source Output and VCOM

## Percentage adjustment:

AJ0P[1:0], AJ1P[1:0], AJ2P[1:0], AJ3P[1:0], AJ0N[1:0], AJ1N[1:0], AJ2N[1:0], AJ3N[1:0], these register are used to adjust the voltage level of interpolation point. The following table is the detail description.

# AJ0P[1:0]/AJ0N[1:0]:

|         | 00h | 01h | 02h | 03h |
|---------|-----|-----|-----|-----|
| VP1/VN1 | 64% | 75% | 70% | 53% |
| VP2/VN2 | 27% | 50% | 41% | 17% |
| VP3/VN3 | 9%  | 25% | 15% | 3%  |
| VP5/VN5 | 75% | 75% | 88% | 88% |
| VP6/VN6 | 50% | 50% | 58% | 58% |
| VP7/VN7 | 25% | 25% | 29% | 29% |

## AJ1P[1:0]/AJ1N[1:0]:

|           | 00h | 01h | 02h | 03h |
|-----------|-----|-----|-----|-----|
| VP12/VN12 | 50% | 54% | 50% | 60% |
| VP20/VN20 | 50% | 44% | 50% | 42% |
| VP28/VN28 | 86% | 71% | 80% | 66% |
| VP32/VN32 | 71% | 57% | 63% | 49% |
| VP36/VN36 | 57% | 40% | 49% | 34% |
| VP40/VN40 | 43% | 29% | 34% | 23% |
| VP44/VN44 | 29% | 17% | 20% | 14% |
| VP48/VN48 | 14% | 6%  | 9%  | 6%  |



# AJ2P[1:0]/AJ2N[1:0]:

|             | 00h | 01h | 02h | 03h |
|-------------|-----|-----|-----|-----|
| VP207/VN207 | 86% | 86% | 86% | 89% |
| VP211/VN211 | 71% | 71% | 77% | 80% |
| VP215/VN215 | 57% | 60% | 63% | 69% |
| VP219/VN219 | 43% | 43% | 46% | 51% |
| VP223/VN223 | 29% | 34% | 31% | 37% |
| VP227/VN227 | 14% | 17% | 14% | 20% |
| VP235/VN235 | 50% | 56% | 47% | 47% |
| VP243/VN243 | 50% | 50% | 50% | 53% |

# AJ3P[1:0]/AJ3N[1:0]:

|             | 00h | 01h | 02h | 03h |
|-------------|-----|-----|-----|-----|
| VP248/VN248 | 75% | 75% | 71% | 71% |
| VP249/VN249 | 50% | 50% | 42% | 42% |
| VP250/VN250 | 25% | 25% | 13% | 13% |
| VP252/VN252 | 91% | 75% | 85% | 97% |
| VP253/VN253 | 73% | 50% | 59% | 83% |
| VP254/VN254 | 36% | 25% | 30% | 48% |

Table 23 voltage level percentage adjustment description



## 11.1 Gray voltage generator for digital gamma correction

ST7701S digital gamma function can implement the RGB gamma correction independently. ST7701S utilizes look-up table of digital gamma to change ram data, and then display the changed data from source driver. The following diagram shows the data flow of digital gamma.

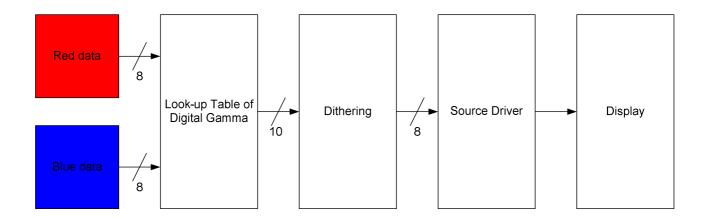


Figure 89 Block diagram of digital gamma

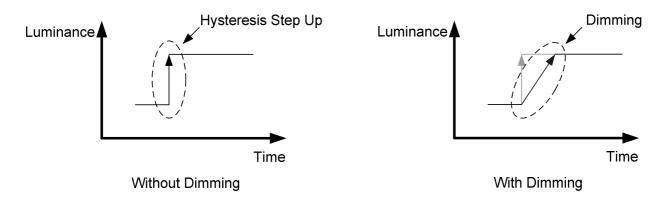
There are 2 registers and each register has 260 bytes to set R, G, B gamma independently. When bit DGMEN be set to 1, R and B gamma will be mapped via look-up table of digital gamma to gray level voltage.



## 11.2 Display Dimming

#### **General Description**

A dimming function (how fast to change the brightness from old to new level and what are brightness levels during the change) is used when changing from one brightness level to another. This dimming function curve is the same in increment and decrement. The basic idea is described below.



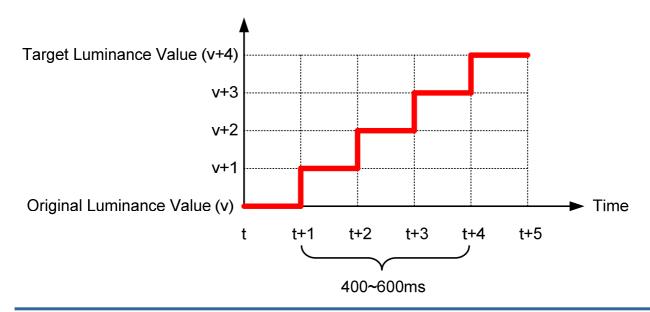
Dimming function can be enable and disable. See "Write CTRL Display (53h)" (bit DD) for more information.

## **Dimming Requirement**

Dimming function in the display module should be implemented so that 400-600ms is used for the transition between the original brightness value and the target brightness value. The transferring time steps between these two brightness values are equal making the transition linear.

The dimming function is working similarly in both upward and downward directions.

An upward example is illustrate below



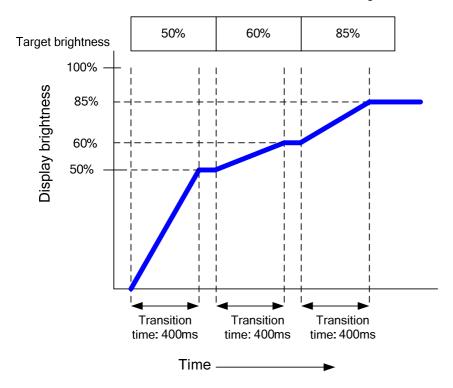
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# **Definition of brightness transition time**

Shorter transition time than 500ms.

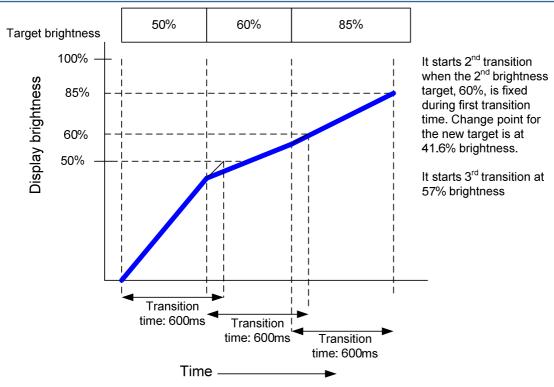
There is some stable time between transitions. Below drawing is for transition time: 400ms.



Longer transition time than 500ms

There is no any stable time between transitions. Below drawing is for transition time: 600ms.







## 11.3 Content Adaptive Brightness Control (CABC)

#### **Definition of CABC**

A Content Adaptive Brightness Control function can be used to reduce the power consumption of the luminance source. Content adaptation means that content gray level scale can be increased while simultaneously lowering brightness of the backlight to achieve same perceived brightness. The adjusted gray level scale and thus the power consumption reduction

Definition of Modes and target power reduction ratio:

- Off mode: Content Adaptive Brightness Control functionality is totally off.
- UI [User interface] image mode: Optimized for UI image. It is kept image quality as much as possible. Target power consumption reduction ratio: 10% or less.
- Still picture mode: Optimized for still picture. Some image quality degradation would be acceptable. Target power consumption reduction ratio: more than 30%.
- Moving image mode: Optimized for moving image. It is focused on the biggest power reduction with image quality degradation. Target power consumption reduction ratio: more than 30%.

Note 1: Updating partial area of the image data should be supported by CABC functionality.

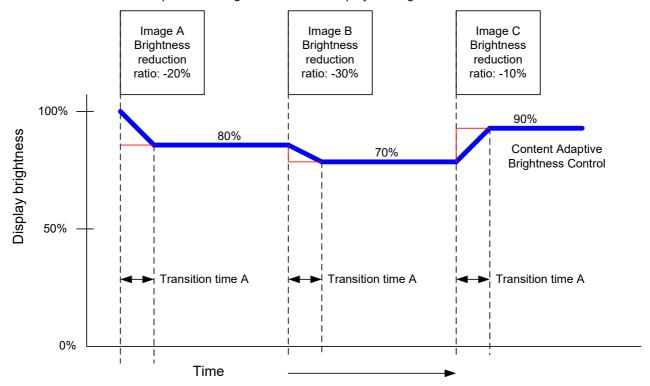
Note 2: Processing power consumption of CABC should be minimized.



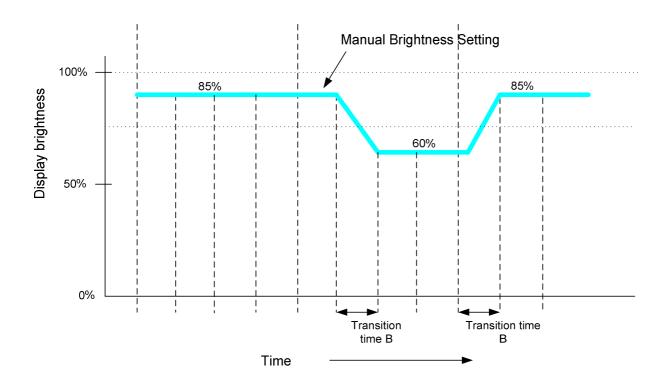
The transition time for dimming function is illustrated below.

- Content Adaptive Brightness Control
   Display brightness is changed, according to the image contents. The following graph mentions the case of displaying three different images.
- Image A: -20% brightness reduction
- Image B: -30% brightness reduction
- Image C: -30% brightness reduction

Transition time from the previous image to the current displayed image is "transition time A".



Manual brightness setting and Dimming function

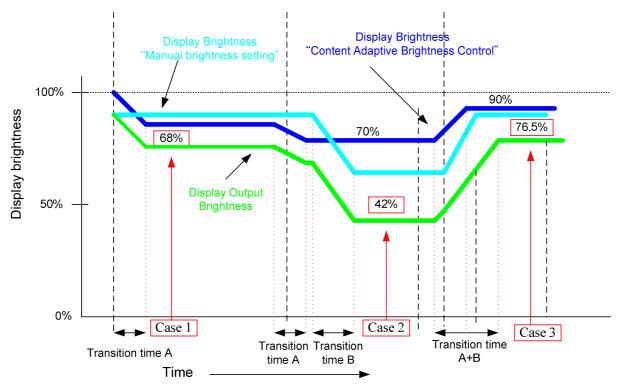




#### Combine Display brightness

Green line in the following graph is for the output brightness of display. It is combined with both display brightness, which are defined in the above graphs.

Maximum transition time is transition time A+B.



Brightness level calculates with the following formula.

Display Output brightness = Manual Brightness setting \* CABC brightness ratio

|        | Manual Brightness setting | Brightness ratio [CABC] | Display Output brightness |
|--------|---------------------------|-------------------------|---------------------------|
| Case 1 | 85%                       | 80%                     | 68%                       |
| Case 2 | 60%                       | 70%                     | 42%                       |
| Case 3 | 85%                       | 90%                     | 76.5%                     |

Transition time from the current brightness to target brightness is A+B in the worst case.



#### Minimum brightness setting of CABC function

CABC function is automatically reduced backlight brightness based on image contents. In the case of the combination with the LABC or manual brightness setting, display brightness is too dark. It must affect to image quality degradation. CABC minimum brightness setting is to avoid too much brightness reduction. When CABC is active, CABC can not reduce the display brightness to less than CABC minimum brightness setting. If CABC algorithm works without any abnormal visual effect, image processing function can operate even when the brightness can not be changed.

This function does not affect to the other function, manual brightness setting. Manual brightness can be set the display brightness to less than CABC minimum brightness. Smooth transition and dimming function can be worked as normal.

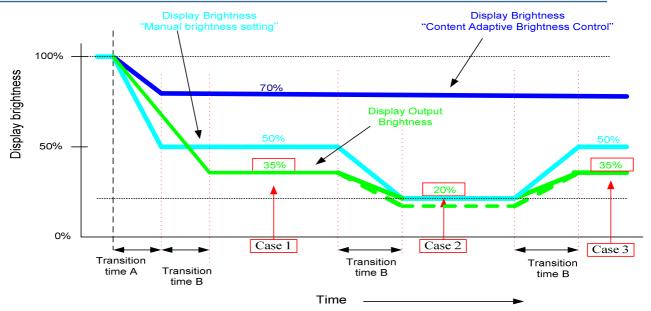
When display brightness is turned off (BCTRL=0 of the Write CTRL Display (53h)"), CABC minimum brightness setting is ignored. "Read CABC minimum brightness (5Fh)" always read the setting value of "Write CABC minimum brightness (5Eh)".

|          | WRCABC (55h) | Function | RDCABCMB (5Fh) | Image         |
|----------|--------------|----------|----------------|---------------|
| Sleep-in |              | NA       | WRCABCMB (5Eh) |               |
| CABC off | 00b          | Disable  | WRCABCMB (5Eh) | Original      |
| CABC on  | 01b/10b/11b  | Enable   | WRCABCMB (5Eh) | CABC modified |

Brightness level calculates with the following formula.

Display Output Brightness = Manual brightness setting \* CABC brightness ratio

Below drawing is for the explanation of the CABC minimum brightness setting.



CABC minimum brightness value = 51 (33h: 20% display brightness)

|        | Display Brightness | Brightness ratio | Calculation result | Display Output | Image         |
|--------|--------------------|------------------|--------------------|----------------|---------------|
|        | [manual setting]   | [CABC]           | of the display     | Brightness     |               |
|        |                    |                  | brightness formula |                |               |
| Case 1 | 50%                | 70%              | 35%                | 35%            | CABC modified |
| Case 2 | 20%                | 70%              | 14%                | 20%            | CABC modified |
| Case 3 | 50%                | 70%              | 35%                | 35%            | CABC modified |

At the case 2, the calculation result of the display brightness is 14%. CABC minimum brightness value is set to 20% brightness. Actual display brightness is 20% as the CABC minimum brightness setting.



## 12 COMMAND

#### 12.1 Command Transmission Mode on MIPI Interface

| Command        | MIPI Transmission Mode |
|----------------|------------------------|
| Command Table1 | LPDT / HSDT            |
| Command Table2 | LPDT                   |

#### 12.2 System Function Command Table 1

| Instruction | Add  | ress   | R/W/ | PNUM | D7      | D6    | D5    | D4       | D3       | D2    | D1       | D0 | Function                            |
|-------------|------|--------|------|------|---------|-------|-------|----------|----------|-------|----------|----|-------------------------------------|
|             | MIPI | SPI-16 | С    |      |         |       |       |          |          |       |          |    |                                     |
| NOP         | 00h  | 0000h  | С    | 0    | 0       | 0     | 0     | 0        | 0        | 0     | 0        | 0  | No operation                        |
| SWRESET     | 01h  | 0100h  | С    | 0    | 0       | 0     | 0     | 0        | 0        | 0     | 0        | 1  | Software reset                      |
|             |      | 0400h  |      |      |         |       |       | ID1 read |          |       |          |    |                                     |
| RDDID       | 04h  | 0401h  | R    | 3    |         |       |       | ID2      | [7:0]    |       |          |    | ID2 read                            |
|             |      | 0402h  |      |      |         |       |       | ID3      | [7:0]    |       |          |    | ID3 read                            |
| RDNUMED     | 05h  | 0500h  | R    | 1    | ErrOver |       |       |          | Err[6:0] |       |          |    | Read No. of the Errors on DSI only  |
| RDRED       | 06h  | 0600h  | R    | 1    |         |       |       | R_1s     | st[7:0]  |       |          |    | Read the first pixel of Color R     |
| RDGREEN     | 07h  | 0700h  | R    | 1    |         |       |       | G_1      | st[7:0]  |       |          |    | Read the first pixel of Color G     |
| RDBLUE      | 08h  | 0800h  | R    | 1    |         |       |       | B_1s     | st[7:0]  |       |          |    | Read the first pixel of Color B     |
| RDDPM       | 0Ah  | 0A00h  | R    | 1    | BSTON   | 0     | 0     | SLPOUT   | 1        | DISON |          |    | Read Display Power Mode             |
| RDDMADCTL   | 0Bh  | 0B00h  | R    | 1    |         |       |       | ML       | BGR      |       |          |    | Read Display MADCTR                 |
| RDDCOLMOD   | 0Ch  | 0C00h  | R    | 1    |         | VIPF  | [2:0] |          |          |       |          |    | Read Display Pixel Format           |
| RDDIM       | 0Dh  | 0D00h  | R    | 1    |         |       | INVON | ALPXLON  | ALPXLOFF |       | GCS[2:0] |    | Read Display Image Mode             |
| RDDSM       | 0Eh  | 0E00h  | R    | 1    | TEON    | TELMD |       |          |          |       |          |    | Read Display Signal Mode            |
| RDDSDR      | 0Fh  | 0F00h  | R    | 1    | RLD     | FUND  | 0     | 0        |          |       |          |    | Read Display Self-diagnostic result |
| SLPIN       | 10h  | 1000h  | С    | 0    | 0       | 0     | 0     | 0        | 0        | 0     | 1        | 0  | Sleep in                            |
| SLPOUT      | 11h  | 1100h  | С    | 0    | 0       | 0     | 0     | 1        | 0        | 0     | 0        | 1  | Sleep out                           |
| PTLON       | 12h  | 1200h  | С    | 0    | 0       | 0     | 0     | 1        | 0        | 0     | 1        | 0  | Partial mode on                     |
| NORON       | 13h  | 1300h  | С    | 0    | 0       | 0     | 0     | 1        | 0        | 0     | 1        | 1  | Normal display mode on              |
| INVOFF      | 20h  | 2000h  | С    | 0    | 0       | 0     | 1     | 0        | 0        | 0     | 0        | 0  | Display inversion off (normal)      |
| INVON       | 21h  | 2100h  | С    | 0    | 0       | 0     | 1     | 0        | 0        | 0     | 0        | 1  | Display inversion on                |
| ALLPOFF     | 22h  | 2200h  | С    | 0    | 0       | 0     | 1     | 0        | 0        | 0     | 1        | 0  | All pixel off (black)               |
| ALLPON      | 23h  | 2300h  | С    | 0    | 0       | 0     | 1     | 0        | 0        | 0     | 1        | 1  | All pixel on (white)                |
| GAMSET      | 26h  | 2600h  | W    | 1    | 1       | 1     |       |          |          | GC    | [3:0]    |    | Gamma curve select                  |
| DISPOFF     | 28h  | 2800h  | С    | 0    | 0       | 0     | 1     | 0        | 1        | 0     | 0        | 0  | Display off                         |
| DISPON      | 29h  | 2900h  | С    | 0    | 0       | 0     | 1     | 0        | 1        | 0     | 0        | 1  | Display on                          |

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# **ST7701S**

|             | Add  | ress   | R/W/ |      |       |      |           |        |         |      |       |         |  |
|-------------|------|--------|------|------|-------|------|-----------|--------|---------|------|-------|---------|--|
| Instruction | MIPI | SPI-16 | С    | PNUM | D7    | D6   | D5        | D4     | D3      | D2   | D1    | D0      | Function   |
| TEOFF       | 34h  | 3400h  | С    | 0    | 0     | 0    | 1         | 1      | 0       | 1    | 0     | 0       | Tearing effect line off                                  |
| TEON        | 35h  | 3500h  | W    | 0    | 0     | 0    | 1         | 1      | 0       | 1    | 0     | 1       | Tearing effect line on                                   |
| MADCTL      | 36h  | 3600h  | W    | 1    |       |      |           | ML     | BGR     |      |       |         | Display data access control                              |
| IDMOFF      | 38h  | 3800h  | С    | 0    |       |      |           |        |         |      |       |         | Idle mode off  |
| IDMON       | 39h  | 3900h  | С    | 0    |       |      |           |        |         |      |       |         | Idle mode on   |
| COLMOD      | 3Ah  | 3A00h  | W    | 0    |       |      | VIPF[2:0] |        |         |      |       |         | Interface Pixel Format                                   |
|             |      | 4500h  |      |      |       |      |           | TESI   | _[15:8] |      | •     | •       |  |
| GSL         | 45h  | 4501h  | R    | 2    |       |      |           | TES    | L[7:0]  |      |       |         | Read Tear line   |
| WRDIBV      | 51h  | 5100h  | W    | 1    |       |      |           | DB     | /[7:0]  |      |       |         | Write display brightness                                 |
| RDDISBV     | 52h  | 5200h  | R    | 1    |       |      |           | DB     | /[7:0]  |      |       |         | Read display brightness value                            |
| WRCTRLD     | 53h  | 5300h  | W    | 1    |       |      | BCTRL     |        | DD      | BL   |       |         | Write control display                                    |
| RRCTRLD     | 54h  | 5400h  | R    | 1    |       |      | BCTRL     |        | DD      | BL   |       |         | Read control display value                               |
| WRCABC      | 55h  | 5500h  | W    | 1    | CE_ON |      | CE_MI     | D[1:0] |         |      | CABC_ | MD[1:0] | Write CABC mode  |
| RRCABC      | 56h  | 5600h  | R    | 1    | CE_ON |      | CE_MI     | D[1:0] |         |      | CABC_ | MD[1:0] | Read CABC mode   |
| WRCABCMB    | 5Eh  | 5E00h  | W    | 1    |       |      |           | СМІ    | 3[7:0]  |      |       |         | Write CABC minimum brightness                            |
| RRCABCMB    | 5Fh  | 5F00h  | R    | 1    |       |      |           | СМІ    | 3[7:0]  |      |       |         | Read CABC minimum brightness                             |
| RDABCSD     | 68h  | 6800h  | R    | 1    | RLD   | FUND |           |        |         |      |       |         | Read Automatic Brightness Control Self-Diagnostic Result |
| RDBWLB      | 70h  | 7000h  | R    | 1    | BKx1  | BKx0 | BKy1      | BKy0   | Wx1     | Wx0  | Wy1   | Wy0     | Read Black/White Low Bits                                |
| RDBkx       | 71h  | 7100h  | R    | 1    | ВКх9  | BKx8 | BKx7      | BKx6   | BKx5    | BKx4 | ВКх3  | BKx2    | Read BKx   |
| RDBky       | 72h  | 7200h  | R    | 1    | ВКу9  | BKy8 | ВКу7      | BKy6   | BKy5    | BKy4 | ВКу3  | BKy2    | Read Bky   |
| RDWx        | 73h  | 7300h  | R    | 1    | Wx9   | Wx8  | Wx7       | Wx6    | Wx5     | Wx4  | Wx3   | Wx2     | Read Wx  |
| RDWy        | 74h  | 7400h  | R    | 1    | Wy9   | Wy8  | Wy7       | Wy6    | Wy5     | Wy4  | Wy3   | Wy2     | Read Wy  |
| RDRGLB      | 75h  | 7500h  | R    | 1    | Rx1   | Rx0  | Ry1       | Ry0    | Gx1     | Gx0  | Gy1   | Gy0     | Read Red/Green Low bits                                  |
| RDRx        | 76h  | 7600h  | R    | 1    | Rx9   | Rx8  | Rx7       | Rx6    | Rx5     | Rx4  | Rx3   | Rx2     | Read Rx  |
| RDRy        | 77h  | 7700h  | R    | 1    | Ry9   | Ry8  | Ry7       | Ry6    | Ry5     | Ry4  | Ry3   | Ry2     | Read Ry  |
| RDGx        | 78h  | 7800h  | R    | 1    | Gx9   | Gx8  | Gx7       | Gx6    | Gx5     | Gx4  | Gx3   | Gx2     | Read Gx  |
| RDGy        | 79h  | 7900h  | R    | 1    | Gy9   | Gy8  | Gy7       | Gy6    | Gy5     | Gy4  | Gy3   | Gy2     | Read Gy  |
| RDBALB      | 7Ah  | 7A00h  | R    | 1    | Bx1   | Bx0  | By1       | By0    | Ax1     | Ax0  | Ay1   | Ay0     | Blue/AColour Low Bits                                    |
| RDBx        | 7Bh  | 7B00h  | R    | 1    | Вх9   | Bx8  | Bx7       | Bx6    | Bx5     | Bx4  | Вх3   | Bx2     | Read Bx  |
| RDBy        | 7Ch  | 7C00h  | R    | 1    | Ву9   | Ву8  | Ву7       | By6    | By5     | By4  | ВуЗ   | By2     | Read By  |
| RDAx        | 7Dh  | 7D00h  | R    | 1    | Ax9   | Ax8  | Ax7       | Ax6    | Ax5     | Ax4  | АхЗ   | Ax2     | Read Ax  |
| RDAy        | 7Eh  | 7E00h  | R    | 1    | Ау9   | Ay8  | Ау7       | Ay6    | Ay5     | Ay4  | At3   | Ay2     | Read Ay  |

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| Instruction | Add  | ress   | R/W/ | PNUM    | D7                     | D6 | D5 | D4   | D3   | D2 | D1       | D0       | Function                                |          |  |          |  |          |  |          |          |          |  |          |  |          |  |                        |
|-------------|------|--------|------|---------|------------------------|----|----|------|--|----|----------|----------|---|----------|--|----------|--|----------|--|----------|----------|----------|--|----------|--|----------|--|------------------------|
| Instruction | MIPI | SPI-16 | С    | PINUIVI | D/                     | Do | DS | D4   | D3   | D2 | DI       | DU       | Function                                |          |  |          |  |          |  |          |          |          |  |          |  |          |  |                        |
|             |      | A100h  |      |         |                        |    |    | 0x   | 77   |    |          |          | Read the DDB from the provided location |          |  |          |  |          |  |          |          |          |  |          |  |          |  |                        |
|             |      | A101h  |      |         |                        |    |    | 0x   | 01   |    |          |          | provided issaudi.                       |          |  |          |  |          |  |          |          |          |  |          |  |          |  |                        |
| RDDDBS/     | A1h  | A102h  | R    | 5       |                        |    |    | MID[ | 15:8]  |    |          |          |   |          |  |          |  |          |  |          |          |          |  |          |  |          |  |                        |
| CHKSUM      |      | A103h  |      |         |                        |    |    | MID  | [7:0]  |    |          |          |   |          |  |          |  |          |  |          |          |          |  |          |  |          |  |                        |
|             |      | A104h  |      |         |                        |    |    |      |  |    |          |          |   |          |  |          |  |          |  |          |          |          |  |          |  |          |  |                        |
|             |      | A800h  |      |         |                        |    |    |      | Continue reading the DDB from the last read location |    |          |          |   |          |  |          |  |          |  |          |          |          |  |          |  |          |  |                        |
|             |      | A801h  |      |         |                        |    |    | SID  | [7:0]  |    |          |          | nom tro tack road roods.                |          |  |          |  |          |  |          |          |          |  |          |  |          |  |                        |
| RDDDBC      | A8h  | A802h  | R    | 5       |                        |    |    | MID[ | 15:8]  |    |          |          |   |          |  |          |  |          |  |          |          |          |  |          |  |          |  |                        |
|             |      | A803h  |      |         |                        |    |    | MID  | [7:0]  |    |          |          |   |          |  |          |  |          |  |          |          |          |  |          |  |          |  |                        |
|             |      | A804h  |      |         |                        |    |    | 8'   | hff  |    |          |          |   |          |  |          |  |          |  |          |          |          |  |          |  |          |  |                        |
| RDFCS       | AAh  | AA00h  | R    | 1       | FCS[7:0] Read First Ch |    |    |      | Read First Checksum                                  |    |          |          |   |          |  |          |  |          |  |          |          |          |  |          |  |          |  |                        |
| RDCCS       | AFh  | AF00h  | R    | 1       | CCS[7:0]               |    |    |      | CCS[7:0]   |    |          | CCS[7:0] |   | CCS[7:0] |  | CCS[7:0] |  | CCS[7:0] |  |          |          | CCS[7:0] |  | CCS[7:0] |  | CCS[7:0] |  | Read Continue Checksum |
| RDID1       | DAh  | DA00h  | R    | 1       | ID1[7:0]               |    |    |      |  |    |          | ID1[7:0] |   |          |  | ID1[7:0] |  |          |  |          | Read ID1 |          |  |          |  |          |  |                        |
| RDID2       | DBh  | DB00h  | R    | 1       | ID2[7:0]               |    |    |      |  |    | ID2[7:0] |          |   |          |  | ID2[7:0] |  |          |  | Read ID2 |          |          |  |          |  |          |  |                        |
| RDID3       | DCh  | DC00h  | R    | 1       | ID3[7:0]               |    |    |      |  |    |          | Read ID3 |   |          |  |          |  |          |  |          |          |          |  |          |  |          |  |                        |

**Table 24 System Function Command List** 

#### Note:

- 1. In MIPI interface, parameters of the command are stores onto registers when the last parameter of the command has been received. Also, parameters of the command are not stored onto registers if there has been happen a break. This note is valid when a number of the parameters is equal or less than 32.
- 2. The 8-bit address code for "MIPI" in above table and following command description means include 3-wire 9-bit SPI and 4-wire 8-bit SPI.

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## 12.2.1 NOP (00/0000h)

| 00H          |         | NOP (No Operation) |  |                                      |           |        |        |           |           |    |    |    |  |  |  |
|--------------|---------|--------------------|--|--------------------------------------|-----------|--------|--------|-----------|-----------|----|----|----|--|--|--|
| Inst / Para  | R/W     | Add                | lress  | D15-8                                | D7        | D6     | D5     | D4        | D3        | D2 | D1 | D0 |  |  |  |
| IIISt / Fala | □/ VV   | MIPI               | SPI-16                                       | D15-6                                | D/        | Do     | DS     | D4        | DS        | DZ | וט | DU |  |  |  |
| NOP          | W       | 00h                | 0000h  |                                      |           |        | No Arg | gument    |           |    |    |    |  |  |  |
| Parameter    | No Para | ameter             |  |                                      |           |        |        |           |           |    |    |    |  |  |  |
| Description  |         |                    |  | command. It doe<br>to terminate para |           |        |        | display ı | module.   |    |    |    |  |  |  |
| Restriction  |         |                    |  |                                      |           |        |        |           |           |    |    |    |  |  |  |
|              |         |                    | Status Availability                          |                                      |           |        |        |           |           |    |    |    |  |  |  |
|              |         | Nor                | Normal Mode On, Idle Mode Off, Sleep Out Yes |                                      |           |        |        |           |           |    |    |    |  |  |  |
| Register     |         | Nor                | mal Mod                                      | e On, Idle Mode                      | On, Sle   | ep Out |        |           | Yes       |    |    |    |  |  |  |
| Availability |         | Pai                | tial Mode                                    | e On, Idle Mode                      | Off, Slee | ep Out |        |           | Yes       |    |    |    |  |  |  |
|              |         | Pai                | tial Mode                                    | e On, Idle Mode                      | On, Slee  | ep Out | Yes    |           |           |    |    |    |  |  |  |
|              |         |                    |  | Sleep In                             |           |        |        |           | Yes       |    |    |    |  |  |  |
|              |         |                    |  |                                      |           |        |        |           |           |    |    |    |  |  |  |
|              |         |                    |  | Status                               |           |        |        | Defa      | ult Value | )  |    |    |  |  |  |
| Default      |         |                    | Pow  | er On Sequence                       | )         |        |        |           | N/A       |    |    |    |  |  |  |
| Delault      |         |                    | S/W Reset N/A                                |                                      |           |        |        |           |           |    |    |    |  |  |  |
|              |         |                    |  | H/W Reset                            |           |        |        |           | N/A       |    |    |    |  |  |  |
| Flow Chart   |         |                    |  |                                      |           |        |        |           |           |    |    |    |  |  |  |



## 12.2.2 SWRESET (01h/0100h): Software Reset

| 01H          |            |            |             |  | SWRESE         | T (Softwa  | are Reset     | :)   |             |            |           |        |
|--------------|------------|------------|-------------|--|----------------|------------|---------------|--|-------------|------------|-----------|--------|
|              |            | Add        | dress       |  |                |            |               |  |             |            |           |        |
| Inst / Para  | R/W        | MIPI       | SPI-16      | D15-8  | D7             | D6         | D5            | D4   | D3          | D2         | D1        | D0     |
| SWRESET      | W          | 01h        | 0100h       | xx   | 0              | 0          | 0             | 0  | 0           | 0          | 0         | 1      |
| Parameter    | No Para    | meter      |             |  |                | •          | •             | •  |             | •          | •         |        |
|              | "-" Don't  | care       |             |  |                |            |               |  |             |            |           |        |
| Description  | -The disp  | olay mod   | lule perfor | ms a software rese   | et, registe    | rs are wri | tten with     | their SW i   | eset defa   | ult values | 3.        |        |
|              | -Frame r   | nemory (   | contents a  | re unaffected by the   | nis comma      | and.       |               |  |             |            |           |        |
|              | It will be | necessa    | ry to wait  | 5msec before sen   | ding new       | command    | d following   | g software   | reset.      |            |           |        |
|              | The disp   | lay modu   | ule loads a | all display suppliers  | s' factory     | default va | lues to th    | e register   | s during t  | his 5mse   | C.        |        |
| Restriction  | If softwa  | re reset i | s sent dur  | ring sleep in mode   | , it will be   | necessar   | y to wait     | 120msec  | before se   | nding sle  | ep out co | mmand. |
| ricotriction |            |            |             | annot be sent duri   | -              | -          |               |  |             |            |           |        |
|              | When M     | IPI Video  | Mode ap     | plication, the shut  | down pac       | ket shoul  | d be sent     | (leave to  | video mo    | ode) befor | е         |        |
|              | S/W rese   | et         |             |  |                |            |               |  |             |            |           |        |
|              |            |            |             | Chahua   |                |            |               |  | ا:امامانام  | 4          |           |        |
|              |            |            | Normal Ma   | Status   | Off Class      | o Out      |               |  | Availabili  | ty         |           |        |
|              |            |            |             | ode On, Idle Mode  |                |            |               |  | Yes<br>Yes  |            |           |        |
| Register     |            |            |             | ode On, Idle Mode  |                |            |               |  | Yes         |            |           |        |
| Availability |            |            |             | de On, Idle Mode<br>de On, Idle Mode                         |                |            |               |  | Yes         |            |           |        |
|              |            |            | Partial Mo  | Sleep In   | On, Sieep      | Out        |               |  | Yes         |            |           |        |
|              |            |            |             | Sieep iii  |                |            |               |  | 162         |            |           |        |
|              |            |            |             | Otation  |                |            |               | D-4-   | . dt Malaca |            |           |        |
|              |            |            | D-          | Status   |                |            |               |  | ult Value   |            |           |        |
| Default      |            |            | Po          | wer On Sequence  |                |            |               |  | N/A         |            |           |        |
| Doradit      |            |            |             | S/W Reset<br>H/W Reset                                       |                |            |               |  | N/A<br>N/A  |            |           |        |
|              |            |            |             | n/w neset  |                |            |               |  | IN/A        |            |           |        |
| Flow Chart   |            |            |             | Display w<br>Blank sci<br>Set<br>Comma<br>To S/W Do<br>Value | rhole reen Ind | Host       | Par D A A Sec | egend mmand rameter isplay action Mode quential ansfer |             |            |           |        |



## 12.2.3 RDDID (04h/0400h~0402h): Read Display ID

| 04H          |   |  |  |   | RDDID                          | (Read Dis | splay ID)          |  |                           |                                       |         |          |
|--------------|---|--|--|---|--------------------------------|-----------|--------------------|--|---------------------------|---------------------------------------|---------|----------|
| <b></b>      |   | Add  | ress   |   |                                |           | ,, . <del></del> , |  |                           |                                       |         |          |
| Inst / Para  | R/W   | MIPI   | SPI-16   | D15-8   | D7                             | D6        | D5                 | D4                                       | D3                        | D2                                    | D1      | D0       |
|              |   |  | 0400h  | 00h   |                                |           |                    | ID1                                      | [7:0]                     |                                       |         |          |
| RDDID        | R   | 04h  | 0401h  | 00h   |                                |           |                    | ID2                                      | [7:0]                     |                                       |         |          |
|              |   |  | 0402h  | 00h   |                                |           |                    | ID3                                      | [7:0]                     |                                       |         |          |
| Description  | -The 1 <sup>st</sup>   -The 2 <sup>nd</sup> -The 3 <sup>rd</sup> -The 4 <sup>th</sup> | paramete<br>paramete<br>paramete<br>paramete<br>inds RDI | r is dumm<br>er (ID1): L<br>er (ID2): L0<br>er (ID3): L0 | oit display identificany data  CD module's man  CD module/driver  CD module/driver  Ah, DBh, DCh) r | ufacturer<br>version IC<br>ID. | ID.       | ond to th          | ne param                                 | neters 2,3                | 3,4 of th                             | e comma | and 04h, |
| Restriction  | -   |  |  |   |                                |           |                    |  |                           |                                       |         |          |
|              |   |  |  |   |                                |           |                    |  |                           |                                       |         |          |
|              |   |  |  | Status  |                                |           |                    |  | Availabili                | ty                                    |         |          |
|              |   |  |  | de On, Idle Mode  | •                              |           |                    |  | Yes                       |                                       |         |          |
| Register     |   |  |  | de On, Idle Mode  |                                |           |                    |  | Yes                       |                                       |         |          |
| availability |   |  |  | de On, Idle Mode  |                                |           |                    |  | Yes                       |                                       |         |          |
|              |   | F  | Partial Mod  | de On, Idle Mode  | On, Sleep                      | Out       |                    |  | Yes                       |                                       |         |          |
|              |   |  |  | Sleep In  |                                |           |                    |  | Yes                       |                                       |         |          |
|              |   |  |  |   |                                |           |                    |  |                           |                                       |         |          |
|              |   |  |  | 0   |                                |           |                    | Defa                                     | ult Value                 |                                       |         |          |
|              |   |  |  | Status  |                                |           | ID1                |  | ID2                       | II                                    | 03      |          |
| Default      |   |  | Pov  | wer On Sequence   |                                |           | 0xFF               | (  | OxFF                      | 0×                                    | :FF     |          |
|              |   |  |  | S/W Reset   |                                |           | 0xFF               | (  | OxFF                      | 0x                                    | :FF     |          |
|              |   |  |  | H/W Reset   |                                |           | 0xFF               | (  | OxFF                      | 0×                                    | FF      |          |
| Flow Chart   |   |  |  | Send 1st Parame ID1[7:0]  Send 2nd Parame ID2[7:0]  Send 3rd Parame ID3[7:0]                        | eter                           | H<br>Dri  | Ver   /            | Legs Comr Paran Disp Acti Mo Seque trans | nand neter olay de ential | 7   7   7   7   7   7   7   7   7   7 |         |          |



#### 12.2.4 RDNUMED (05h/0500h): Read Number of Errors on DSI

| 05H          | RDNUMED    |   |              |   |             |            |              |  |                         |            |    |    |  |  |
|--------------|------------|---|--------------|---|-------------|------------|--------------|--|-------------------------|------------|----|----|--|--|
| Inet / Dave  | R/W        | Addı  | ess          | D1E 0                                     | D7          | De         | DE           | D4                                       | Do                      | DO         | D1 | DO |  |  |
| Inst / Para  | Ft/VV      | Others  | SPI-16       | D15-8                                     | D7          | D6         | D5           | D4                                       | D3                      | D2         | D1 | D0 |  |  |
| RDNUMED      | R          | 05h   | Χ            | X   | Errover     |            |              |  | Err[6:0]                |            |    |    |  |  |
|              |            |   | r is telling | g a number of the p                       | parity erro | rs on DSI  | . The mo     | re detaile                               | d descript              | ion of the |    |    |  |  |
| Dagawinstian | bits is be |   | III          |   |             |            |              |  |                         |            |    |    |  |  |
| Description  |            |   |              | mber of the parity or is overflow with P[ |             |            |              |  |                         |            |    |    |  |  |
|              |            |   |              | MIPI DSI only. It is                      |             | n for othe | ers interfa  | ce operat                                | ion.                    |            |    |    |  |  |
| Restriction  | -          | ·   |              |   |             |            |              |  |                         |            |    |    |  |  |
| ricomonon    |            |   |              |   |             |            |              |  |                         |            |    |    |  |  |
|              |            |   |              | Status                                    |             |            |              |  | Availabili              | ty         |    |    |  |  |
|              |            | N   | ormal Mo     | ode On, Idle Mode                         | Off, Sleep  | Out        |              |  | Yes                     |            |    |    |  |  |
| Register     |            | Normal Mode On, Idle Mode On, Sleep Out Yes         |              |   |             |            |              |  |                         |            |    |    |  |  |
| availability |            | Partial Mode On, Idle Mode Off, Sleep Out  Yes  Yes |              |   |             |            |              |  |                         |            |    |    |  |  |
|              |            | F   | artial Mo    | de On, Idle Mode                          | On, Sleep   | Out        |              |  | Yes                     |            |    |    |  |  |
|              |            |   |              | Sleep In                                  |             |            |              |  | Yes                     |            |    |    |  |  |
|              |            |   |              |   |             |            |              |  |                         |            |    |    |  |  |
|              |            |   |              |   |             |            |              | Defaul                                   | t Value                 |            |    |    |  |  |
|              |            |   |              | Statu                                     | S           |            | Er           | rover                                    | Err[6                   | 6:0]       |    |    |  |  |
| Default      |            |   | Powe         | r On Sequence                             |             |            |              | 0  | 000-0                   | 000        |    |    |  |  |
|              |            |   | S/W F        | Reset                                     |             |            |              | 0  | 000-0                   | 000        |    |    |  |  |
|              |            |   | H/W I        | Reset                                     |             |            |              | 0  | 000-0                   | 000        |    |    |  |  |
| Flow Chart   |            |   | -            | RDNUMED(0)                                | •••••       |            | Iost I [ ver | Lega Comm Paran Disp Acti Mo Seque trans | nand neter olay dential |            |    |    |  |  |



## 12.2.5 RDRED (06h/0600h): Read the first pixel of Red Color

| 06H                      |                        |                                    |                                     |   |                        | RDRED                    |                                  |                               |                                    |                                       |          |    |
|--------------------------|------------------------|------------------------------------|-------------------------------------|---|------------------------|--------------------------|----------------------------------|-------------------------------|------------------------------------|---------------------------------------|----------|----|
| Inst / Para              | R/W                    | Add                                | ress                                | D15-8   | D7                     | D6                       | D5                               | D4                            | D3                                 | D2                                    | D1       | D0 |
| IIISt / Fala             | IT/ VV                 | MIPI                               | SPI-16                              | D13-6   | <i>D1</i>              | D0                       | D3                               | D4                            | D3                                 | DZ.                                   | Di       | DU |
| RDRED                    | R                      | Χ                                  | 0600h                               | X   |                        |                          |                                  | R_1s                          | t[7:0]                             |                                       |          |    |
| Description              | Only the<br>-16-bit fo | relevant<br>ormat: R4<br>ormat: R5 | bits are us<br>is MSB a<br>is MSB a | red component val<br>sed according to p<br>and R0 is LSB. R7,<br>and R0 is LSB. R7<br>and R0 is LSB.    | ixel forma             | at, unused<br>R5 are set | bits are s<br>to "0".            |                               | -                                  |                                       |          |    |
| Restriction              | -                      |                                    |                                     |   |                        |                          |                                  |                               |                                    |                                       |          |    |
| Register<br>availability |                        | N                                  | lormal Mo<br>Partial Mo             | Status ode On, Idle Mode ode On, Idle Mode ode On, Idle Mode de On, Idle Mode de On, Idle Mode Sleep In | On, Slee<br>Off, Sleep | p Out<br>o Out           |                                  |                               | Availabili Yes Yes Yes Yes Yes Yes | ty                                    |          |    |
| Default                  | S/W                    | ver On Se<br>/ Reset<br>/ Reset    | equence                             |   |                        |                          |                                  |                               | Default<br>00h<br>00h<br>00h       | t Value (D                            | 7 to D0) |    |
| Flow Chart               |                        |                                    |                                     | Dummy Rea  Send R [7:0] da  | d                      | H<br>Dri                 | ost   [<br>ver   /<br>  (<br>  ( | Comn Param Disp Acti Mo Seque | nand neter lay on de ntial         | 7   7   7   7   7   7   7   7   7   7 |          |    |



## 12.2.6 RDGREEN (07h/0700h): Read the first pixel of Green Color

| 07H                   |            |          |             |  |             | RDGREE      | N              |                          |                            |            |     |     |
|-----------------------|------------|----------|-------------|--|-------------|-------------|----------------|--------------------------|----------------------------|------------|-----|-----|
| 1                     | Dan        | Add      | ress        | D.1.T.0                                |             | -           |                | F :                      | <b>D</b> 2                 | P. 2       | F . | D.2 |
| Inst / Para           | R/W        | MIPI     | SPI-16      | D15-8                                  | D7          | D6          | D5             | D4                       | D3                         | D2         | D1  | D0  |
| RDGREEN               | R          | Χ        | 0700h       | X                                      |             |             |                | G_1s                     | st[7:0]                    |            |     |     |
|                       | This com   | nmand re | turns the   | green component v                      | value of tl | ne first pi | xel in the     | active fran              | ne.                        |            |     |     |
|                       | -          |          |             | sed according to p                     |             |             |                | set to "0".              |                            |            |     |     |
| Description           |            |          |             | and G0 is LSB. G7,                     |             |             |                |                          |                            |            |     |     |
|                       |            |          |             | and G0 is LSB. G7                      | and G6 a    | re set to   | "0".           |                          |                            |            |     |     |
|                       | -24-bit to | rmat: G7 | is MSB a    | ind G0 is LSB.                         |             |             |                |                          |                            |            |     |     |
| Restriction           | -          |          |             |  |             |             |                |                          |                            |            |     |     |
|                       |            |          |             |  |             |             |                |                          |                            |            |     |     |
|                       |            |          |             | Status                                 |             |             |                |                          | Availabili                 | ty         |     |     |
|                       |            |          |             | ode On, Idle Mode                      |             |             |                |                          | Yes                        |            |     |     |
| Register availability |            |          |             | ode On, Idle Mode                      |             |             |                |                          | Yes<br>Yes                 |            |     |     |
| avaliability          |            |          |             | de On, Idle Mode                       |             |             |                |                          | Yes                        |            |     |     |
|                       |            |          | artiai ivio | Sleep In                               | On, Sieer   | Out         |                |                          | Yes                        |            |     |     |
|                       |            |          |             | Оісер ІІІ                              |             |             |                |                          | 103                        |            |     |     |
|                       |            |          |             |  |             |             |                |                          |                            |            |     |     |
|                       |            | S        | tatus       |  |             | [           | Default Va     | lue (D7 to               | D0)                        |            |     |     |
| Default               |            | Р        | ower On     | Sequence                               |             | (           | 00h            |                          |                            |            |     |     |
| Boladit               |            | S        | /W Reset    |  |             | (           | 00h            |                          |                            |            |     |     |
|                       |            | Н        | /W Reset    |  |             | (           | )0h            |                          |                            |            |     |     |
| Flow Chart            |            |          |             | PDGREEN(07  Dummy Read  Send G[7:0] da | d           |             | Host     river | Comm Param Disp Acti Moo | nand neter lay on de ntial | 7<br> <br> |     |     |



## 12.2.7 RDBLUE (08h/0800h): Read the first pixel of Blue Color

| 08H          |           |            |            |                                     |           | RDBLUI   |                |                                      |                            |     |    |    |
|--------------|-----------|------------|------------|-------------------------------------|-----------|----------|----------------|--------------------------------------|----------------------------|-----|----|----|
|              |           | Add        | ress       |                                     |           |          |                |                                      |                            |     |    |    |
| Inst / Para  | R/W       | MIPI       | SPI-16     | D15-8                               | D7        | D6       | D5             | D4                                   | D3                         | D2  | D1 | D0 |
| RDBLUE       | R         | Χ          | 0800h      | Х                                   |           | -        |                | B_1s                                 | t[7:0]                     | -   | -  |    |
|              |           |            |            | blue component va                   |           |          |                |                                      | Э.                         |     |    |    |
|              | -         |            |            | sed according to p                  |           |          |                | set to "0".                          |                            |     |    |    |
| Description  |           |            |            | nd B0 is LSB. B7,                   |           |          |                |                                      |                            |     |    |    |
|              |           |            |            | nd B0 is LSB. B7 a<br>nd B0 is LSB. | and B6 ar | e set to | 0".            |                                      |                            |     |    |    |
| Restriction  | -24-01110 | illial. D7 | is iviou a | ilu bu is Lob.                      |           |          |                |                                      |                            |     |    |    |
| nestriction  | -         |            |            |                                     |           |          |                |                                      |                            |     |    |    |
|              |           |            |            | Status                              |           |          |                |                                      | Availabili                 | tv  |    |    |
|              |           |            | Jormal Mo  | ode On, Idle Mode                   | Off. Slee | p Out    |                |                                      | Yes                        | • 9 |    |    |
| Register     |           |            |            | ode On, Idle Mode                   |           |          |                |                                      | Yes                        |     |    |    |
| availability |           |            |            | de On, Idle Mode                    |           |          |                |                                      | Yes                        |     |    |    |
|              |           | F          | Partial Mo | de On, Idle Mode                    | On, Sleep | Out      |                |                                      | Yes                        |     |    |    |
|              |           |            |            | Sleep In                            |           |          |                |                                      | Yes                        |     |    |    |
|              |           |            |            |                                     |           |          |                |                                      |                            |     |    |    |
|              |           | _          |            |                                     |           |          |                |                                      |                            |     | _  |    |
|              |           |            | tatus      |                                     |           |          | Default Va     | ue (D7 to                            | D0)                        |     |    |    |
| Default      |           |            |            | Sequence                            |           |          | )0h            |                                      |                            |     | _  |    |
|              |           |            | /W Reset   |                                     |           |          | 00h            |                                      |                            |     |    |    |
|              |           | LH         | /W Reset   |                                     |           | (        | )0h            |                                      |                            |     |    |    |
| Flow Chart   |           |            |            | Dummy Read                          | d         |          | Host     river | Comn Param Disp Acti Moc Seque trans | nand neter lay on de ntial |     |    |    |



## 12.2.8 RDDPM (0Ah/0A00h): Read Display Power Mode

| 0AH          | •    |  |        |            | oon). Nead D        | . ,         | RDDF      |                |                               |                            |                                       |    |    |
|--------------|------|--|--------|------------|---------------------|-------------|-----------|----------------|-------------------------------|----------------------------|---------------------------------------|----|----|
| UATT         |      |  | Addre  | ess        |                     |             | וטטר      | IVI            |                               |                            |                                       |    |    |
| Inst / Para  | R/V  | V MI   |        | SPI-16     | D15-8               | D7          | D6        | D5             | D4                            | D3                         | D2                                    | D1 | D0 |
| RDDPM        | R    | 0.4  | ۸h     | 0A00h      | Χ                   | BSTON       | 0         | 0              | SLPOUT                        | 1                          | DISON                                 |    |    |
|              | This | commar                                       | nd ind | licates th | ne current status o | of the disp | lay as de | escribed       | in the table b                | elow:                      |                                       |    |    |
|              |      | Bit  |        |            | Description         |             |           |                | \                             | /alue                      |                                       |    |    |
|              |      | D7   |        | Booster    | Voltage Status      |             | "1"=E     | Booster C      | n, "0"=Boost                  | er Off                     |                                       |    |    |
|              |      | D6   |        | Not Def    | ined                |             | Set to    | o "0" (not     | used)                         |                            |                                       |    |    |
| Description  |      | D5   |        | Not Def    | ined                |             | Set to    | o "0" (not     | used)                         |                            |                                       |    |    |
| Description  |      | D4   |        | Sleep Ir   | n/Out               |             | "1" =     | Sleep O        | ut Mode, "0" :                | = Sleep I                  | n Mode                                |    |    |
|              |      | D3   |        | Not Def    | ined                |             | Set to    | o "1" (not     | used)                         |                            |                                       |    |    |
|              |      | D2   |        | Display    | On/Off              |             | "1" =     | Display i      | s On, "0" = D                 | isplay is                  | Off                                   |    |    |
|              |      | D1   |        | Not Def    | ined                |             |           | o "0" (not     |                               |                            |                                       |    |    |
|              |      | D0   |        | Not Def    | ined                |             | Set to    | o "0" (not     | used)                         |                            |                                       |    |    |
| Restriction  | -    |  |        |            |                     |             |           |                |                               |                            |                                       |    |    |
|              |      |  |        |            | Status              |             |           |                |                               | Availabili                 | ty                                    |    |    |
|              |      | Normal Mode On, Idle Mode Off, Sleep Out Yes |        |            |                     |             |           |                |                               |                            |                                       |    |    |
| Register     |      |  | N      | Iormal M   | ode On, Idle Mod    | le On, Sle  | ep Out    |                |                               | Yes                        |                                       |    |    |
| availability |      |  | F      | Partial Mo | ode On, Idle Mod    | e Off, Slee | p Out     |                |                               | Yes                        |                                       |    |    |
|              |      |  | P      | Partial Mo | ode On, Idle Mod    | e On, Slee  | p Out     |                |                               | Yes                        |                                       |    |    |
|              |      |  |        |            | Sleep In            |             |           |                |                               | Yes                        |                                       |    |    |
|              |      |  |        |            |                     |             |           |                |                               |                            |                                       |    |    |
|              |      |  |        | tatus      |                     |             |           |                | Value (D7 to                  | D0)                        |                                       |    |    |
| Default      |      |  |        |            | Sequence            |             |           | 08h            |                               |                            |                                       |    |    |
|              |      |  |        | W Rese     |                     |             |           | 08h            |                               |                            |                                       |    |    |
|              |      |  | H      | /W Rese    | t                   |             |           | 08h            |                               |                            |                                       |    |    |
| Flow Chart   |      |  |        |            | RDDPM(0,            | ••••••      | I         | Host<br>Driver | Lege Comm Param Disp Acti Moo | nand heter heter lay on de | 7   7   7   7   7   7   7   7   7   7 |    |    |



## 12.2.9 RDDMADCTL (0Bh/0B00h): Read Display MADCTL

| 0BH          |      |     |         |              |                     | R          | DDMAD    | CTL                                 |  |                                   |   |    |    |
|--------------|------|-----|---------|--------------|---------------------|------------|----------|-------------------------------------|--|-----------------------------------|---|----|----|
|              |      |     | Add     | dress        | D.1                 |            |          |                                     |  |                                   |   |    |    |
| Inst / Para  | R/\  | ^   | MIPI    | SPI-16       | D15-8               | D7         | D6       | D5                                  | D4                                     | D3                                | D2                                      | D1 | D0 |
| RDDMADCTL    | R    | 1   | 0Bh     | 0B00h        | Х                   |            |          |                                     | ML                                     | BGR                               |   |    |    |
|              | This | com | mand ir | ndicates the | e current status of | the displa | y as des | cribed in t                         | he table b                             | elow:                             |   |    |    |
|              |      | Bit |         | Descripti    | ion                 |            | Value    |                                     |  |                                   |   |    |    |
|              |      | D7  | ~D5     | Not Defin    | ned                 |            | Set to   | "0" (not us                         | ed)                                    |                                   |   |    |    |
|              |      | D4  |         | Vertical r   | refresh Order (ML)  |            |          | ncrement,                           |  |                                   |   |    |    |
| Description  |      | D3  |         | RGB-BG       | R Order             |            |          | GB color                            | •                                      |                                   |   |    |    |
|              |      | D2  |         |              |                     |            | "0"      |                                     |  |                                   |   |    |    |
|              |      | D1  |         | Not Defin    | ned                 |            | Set to   | "0" (not us                         | ed)                                    |                                   |   |    |    |
|              |      | D0  |         | Not Defin    | ned                 |            | Set to   | "0" (not us                         | ed)                                    |                                   |   |    |    |
| Restriction  | -    |     |         |              |                     |            |          |                                     |  |                                   |   |    |    |
|              |      |     |         |              |                     |            |          |                                     |  |                                   |   |    |    |
|              |      |     |         |              | Status              |            |          |                                     |  | Availabilit                       | .y                                      |    |    |
|              |      |     |         |              | ode On, Idle Mode   |            |          |                                     |  | Yes                               |   |    |    |
| Register     |      |     |         |              | ode On, Idle Mode   |            |          |                                     |  | Yes                               |   |    |    |
| availability |      |     |         |              | de On, Idle Mode    |            |          |                                     |  | Yes                               |   |    |    |
|              |      |     |         | Partial Mo   | de On, Idle Mode    | On, Sleep  | Out      |                                     |  | Yes                               |   |    |    |
|              |      |     |         |              | Sleep In            |            |          |                                     |  | Yes                               |   |    |    |
|              |      |     | _       |              |                     |            |          |                                     |  |                                   |   |    |    |
|              |      |     |         | Status       |                     |            |          | Default Va                          | lue (D7 to                             | D0)                               |   |    |    |
| Default      |      |     |         | Power On :   |                     |            |          | 00h                                 |  |                                   |   |    |    |
|              |      |     |         | S/W Reset    |                     |            |          | 00h                                 |  |                                   |   |    |    |
|              |      |     | I       | H/W Reset    |                     |            | (        | 00h                                 |  |                                   |   |    |    |
| Flow Chart   |      |     |         | -            | RDDMADCTL(          |            |          | Host   [<br>river   /<br>  (<br>  ( | Leg Comr Paran Disp Act Mc Seque tran: | nand neter  play  ion  de  ential | <br> <br> <br> <br> <br> <br> <br> <br> |    |    |



## 12.2.10 RDDCOLMOD (0Ch/0C00h): Read Display Pixel Format

| 0CH          |      |     |         |               |                             | RI         | DDCOLM     | )D          |            |                   |            |    |    |
|--------------|------|-----|---------|---------------|-----------------------------|------------|------------|-------------|------------|-------------------|------------|----|----|
|              |      |     | Add     | dress         |                             |            |            |             |            |                   |            |    |    |
| Inst / Para  | RΛ   | ^   | MIPI    | SPI-16        | D15-8                       | D7         | D6         | D5          | D4         | D3                | D2         | D1 | D0 |
| RDDCOLMOD    | R    |     | 0Ch     | 0C00h         | Х                           |            |            | VIPF[2:0]   |            |                   |            |    |    |
|              | This | com | mand in | dicates the   | e current status of         | the displa | ay as desc | ribed in t  | he table l | pelow:            |            |    |    |
|              |      | Bit |         | Descripti     | ion                         |            | Value      |             |            |                   |            |    |    |
|              |      | D7  |         | Not Defi      | ned                         |            | Set to "0  | )" (not us  | ed)        |                   |            |    |    |
|              |      |     |         |               |                             |            | "101" =    | 16-bit / p  | ixel       |                   |            |    |    |
|              |      | D6  | ~D4     | RGB Inte      | erface Color Forma          | at         | "110" =    | 18-bit / pi | ixel       |                   |            |    |    |
| Description  |      |     |         |               |                             |            |            | 24-bit / pi |            |                   |            |    |    |
|              |      | D3  |         | Not Defin     |                             |            |            | )" (not us  |            |                   |            |    |    |
|              |      | D2  |         | Not Defin     |                             |            |            | )" (not us  |            |                   |            |    |    |
|              |      | D1  |         | Not Defi      |                             |            |            | )" (not us  |            |                   |            |    |    |
|              |      | D0  |         | Not Defi      | ned                         |            | Set to "   | )" (not us  | ed)        |                   |            |    |    |
| _            |      |     |         |               |                             |            |            |             |            |                   |            |    |    |
| Restriction  | -    |     |         |               |                             |            |            |             |            |                   |            |    |    |
|              |      |     |         |               | Ctatus                      |            |            |             |            | Availabili        | 4          |    |    |
|              |      |     |         | Normal Ma     | Status<br>ode On, Idle Mode | Off Sloor  | n Out      |             |            | Availabili<br>Yes | ıty        |    |    |
| Register     |      |     |         |               | ode On, Idle Mode           |            |            |             |            | Yes               |            |    |    |
| availability |      |     |         |               | de On, Idle Mode            |            |            |             |            | Yes               |            |    |    |
| avanaomity   |      |     |         |               | de On, Idle Mode            |            |            |             |            | Yes               |            |    |    |
|              |      |     |         | T ditial IVIO | Sleep In                    | O11, 0100p | , out      |             |            | Yes               |            |    |    |
|              |      |     |         |               | •                           |            |            | ı           |            |                   |            |    |    |
|              |      |     |         |               |                             |            |            |             |            |                   |            |    |    |
|              |      |     | 5       | Status        |                             |            | D          | efault Val  | ue (D7 to  | D0)               |            |    |    |
| Default      |      |     | F       | Power On      | Sequence                    |            | 70         | )h          |            |                   |            |    |    |
| Delault      |      |     | 5       | S/W Reset     |                             |            | 70         | )h          |            |                   |            |    |    |
|              |      |     | ŀ       | H/W Reset     |                             |            | 70         | )h          |            |                   |            |    |    |
|              |      |     |         |               |                             |            |            |             |            |                   |            |    |    |
|              |      |     |         |               |                             |            |            | ٢-          |            |                   | 7.         |    |    |
|              |      |     |         |               |                             |            |            | - 1         | Leg        | end               | !          |    |    |
|              |      |     |         |               | RDDCOLMOD(                  | OCh)       | T1         |             |            |                   | ]          |    |    |
|              |      |     |         | -             |                             |            |            | ost         | Comi       | nand              | ] <b> </b> |    |    |
|              |      |     |         | _             | C 1.1et D                   |            | Dri        |             | Parar      | neter             | 7¦ -       |    |    |
| ·            |      |     |         |               | Send 1st Parame             | eter<br>   |            |             | Dist       | olav              | ) <b> </b> |    |    |
| Flow Chart   |      |     |         |               |                             |            |            | \           |            |                   | / I        |    |    |
|              |      |     |         |               |                             |            |            |             | Act        | ion               | , .<br>    |    |    |
|              |      |     |         |               |                             |            |            | ' (         | Mo         | ode               | ) [        |    |    |
|              |      |     |         |               |                             |            |            |             | Seque      | ential            | 1 I        |    |    |
|              |      |     |         |               |                             |            |            | - i         | tran       |                   |            |    |    |
|              |      |     |         |               |                             |            |            | L           |            |                   | _1         |    |    |
|              |      |     |         |               |                             |            |            |             |            |                   |            |    |    |



## 12.2.11 RDDIM (0Dh/0D00h): Read Display Image Mode

| 0DH          |      |      |         |           |                                 |           |         | RDDIM      |                                 |   |    |         |    |
|--------------|------|------|---------|-----------|---------------------------------|-----------|---------|------------|---------------------------------|---|----|---------|----|
|              |      | Т    | Addr    | ess       |                                 |           |         |            | T                               |   |    |         |    |
| Inst / Para  | R/V  | ٧    | - 1     | SPI-16    | D15-8                           | D7        | D6      | D5         | D4                              | D3  | D2 | D1      | D0 |
| RDDIM        | R    | C    | Dh      | 0D00h     | Χ                               |           |         | INVON      | ALPXLON                         | ALPXLOFF  |    | GCS[2:0 | ]  |
|              | This | comm | nand ir | ndicates  | the current stat                | us of the | displa  | y as descr | bed in the tabl                 | e below:  |    |         |    |
|              |      | Bit  |         | Descr     |                                 |           |         | Value      |                                 |   |    |         |    |
|              |      | D7~  | D6      | Not De    |                                 |           |         |            | O" (not used)                   |   |    |         |    |
|              |      | D5   |         |           | ion On/Off                      |           |         |            | sion On, "0"=Ir                 |   |    |         | _  |
| Description  |      | D4   |         | All Pix   |                                 |           |         |            | e display,"0"=N                 |   |    |         | _  |
|              |      | D3   |         | All Pix   | el Off                          |           |         |            | display,"0"=No<br>C0, "001"=GC1 | ormal display                                     |    |         |    |
|              |      | D2~  | D0      | Gamm      | na Curve Select                 | ion       |         |            | 00, 001 =GC1<br>02, "011"=GC3   |   |    |         |    |
|              |      | D2   | Во      | Gaiiiii   | ia Gaive Geleet                 | 1011      |         |            | 111"=not define                 | ed  |    |         |    |
|              |      |      |         | 1         |                                 |           |         |            |                                 |   |    |         |    |
| Restriction  | -    |      |         |           |                                 |           |         |            |                                 |   |    |         |    |
|              |      |      |         |           |                                 |           |         |            |                                 |   |    |         |    |
|              |      |      |         |           | Statu                           | s         |         |            |                                 | Availability                                      |    |         |    |
|              |      |      |         | Normal    | Mode On, Idle N                 | √lode Off | , Sleep | Out        |                                 | Yes   |    |         |    |
| Register     |      |      |         | Normal    | Mode On, Idle N                 | /lode On  | , Sleep | Out        |                                 | Yes   |    |         |    |
| availability |      | ļ    |         | Partial I | Mode On, Idle M                 | lode Off  | Sleep   | Out        |                                 | Yes   |    |         |    |
|              |      | ļ    |         | Partial I | Mode On, Idle M                 |           | , Sleep | Out        |                                 | Yes   |    |         |    |
|              |      | L    |         |           | Sleep                           | In        |         |            |                                 | Yes   |    |         |    |
|              |      |      |         |           |                                 |           |         |            |                                 |   |    |         |    |
|              |      |      | 9       | Status    |                                 |           |         | De         | fault Value (D7                 | to D0)  |    |         |    |
|              |      |      |         |           | n Sequence                      |           |         | 00         |                                 | 10 20)  |    | 7       |    |
| Default      |      |      |         | S/W Res   |                                 |           |         | 00         | 1                               |   |    |         |    |
|              |      |      | Ī       | H/W Res   | set                             |           |         | 00         | า                               |   |    |         |    |
|              |      |      |         |           |                                 |           |         | •          |                                 |   |    |         |    |
| Flow Chart   |      |      |         | 4         | RDDIN<br>Send 1 <sup>st</sup> F | 7         |         | Ho<br>Driv | er   Co                         | mmand rameter risplay Action Mode quential ansfer |    |         |    |



## 12.2.12 RDDSM (0Eh/0E00h): Read Display Signal Mode

| 0EH                      |     |                 | •                              | Loon). Head  |  |                       | DSM                                    |        |           |  |    |    |    |
|--------------------------|-----|-----------------|--------------------------------|--|--|-----------------------|--|--------|-----------|--|----|----|----|
| Inst / Para              | R/V | V A             | ddress                         | D15-8  | D7   | D6                    | D5                                     | 5      | D4        | D3   | D2 | D1 | D0 |
| RDDSM                    | R   | 0Eh             |                                | Х  | TEON   | TELMD                 |  |        |           |  |    |    |    |
| Description              |     | Bit D7 D6 D4~D0 | Tearin                         | g Effect Line O  |  | "1'                   | lue<br>=On,"0":<br>=Mode2<br>t to "000 | 2,"0"= |           | )  |    |    |    |
| Restriction              | -   |                 |                                |  |  |                       |  |        |           |  |    |    |    |
| Register<br>availability |     |                 | Normal<br>Partial I            | Statu<br>Mode On, Idle I<br>Mode On, Idle I<br>Mode On, Idle I<br>Mode On, Idle I<br>Sleep | Mode Off, S<br>Mode On, S<br>Mode Off, S<br>Mode On, S | Sleep Ou<br>Sleep Out | t                                      |        |           | Availab<br>Yes<br>Yes<br>Yes<br>Yes                          |    |    |    |
| Default                  |     |                 | Status Power C S/W Res H/W Res |  |  |                       | Defa<br>00h<br>00h<br>00h              | ult V  | /alue (D7 | to D0)   |    |    |    |
| Flow Chart               |     |                 |                                | RDDS.  Send 1st  | M(0Eh) Parameter                                       |                       | Hos<br>Drive                           |        | Par D A   | egend  mmand  rameter  isplay  ction  Mode  quential  ansfer | 7  |    |    |



## 12.2.13 RDDSDR (0Fh/0F00h): Read Display Self-Diagnostic Result

| 0FH                      |     |                 |                        | or outij. Heat   | •  | -                    | SDR                         |        |           |   |    |    |    |
|--------------------------|-----|-----------------|------------------------|--|--|----------------------|-----------------------------|--------|-----------|---|----|----|----|
| Inst / Para              | R/V | V Ad            | dress<br>SPI-16        | D15-8  | D7   | D6                   | D5                          | 5      | D4        | D3  | D2 | D1 | D0 |
| RDDSDR                   | R   | 0Fh             | 0F00h                  | Х  | RLD  | FUND                 | 0                           |        | 0         |   |    |    |    |
| Description              |     | Bit D7 D5 D5~D0 |                        | ter Loading Detectionality Detection   |  | Se<br>Se             | lue<br>e sectic<br>e sectic | n 10   |           | ed)   |    |    |    |
| Restriction              | -   |                 |                        |  |  |                      |                             |        |           |   |    |    |    |
| Register<br>availability |     |                 | Normal<br>Partial I    | Statu<br>Mode On, Idle M<br>Mode On, Idle M<br>Mode On, Idle M<br>Mode On, Idle M<br>Sleep | Mode Off, S<br>Mode On, S<br>Mode Off, S<br>Mode On, S | Sleep Ou<br>Sleep Ou | t                           |        |           | Availab<br>Yes<br>Yes<br>Yes<br>Yes                             | :  |    |    |
| Default                  |     |                 | Status Power C S/W Res |  |  |                      | Defa<br>00h<br>00h<br>00h   | ault \ | Value (D7 | to D0)  |    |    |    |
| Flow Chart               |     |                 |                        | RDDSE<br>Send 1st F  | 1  |                      | Hos<br>Drive                |        | Co Pa D A | egend  mmand  rameter  Display  Action  Mode  quential  ransfer |    |    |    |



## 12.2.14 SLPIN (10h/1000h): Sleep in

| 10H   |  |   |  |  |  | SLF  | PIN                            |   |   |                            |    |    |  |
|---|--|---|--|--|--|--|--------------------------------|---|---|----------------------------|----|----|--|
| In at / Dava                                    | D/M/   | Add   | dress  | D4E 0  | D7   | DC   | DE                             | D4  | Do  | DO                         | D1 | Do |  |
| Inst / Para                                     | R/W  | MIPI  | SPI-16   | D15-8  | D7   | D6   | D5                             | D4  | D3  | D2                         | D1 | D0 |  |
| SLPIN   | W  | 10h   | 1000h  | Х  |  |  |                                | No Arg  | gument  |                            |    |    |  |
| Description  Restriction  Register availability | In this m<br>stopped<br>Control<br>User ca<br>this info<br>Sleep C   | node the<br>l.<br>Interfac<br>n send l<br>rmation<br>out-mode<br>g function | e as will a PCLK, HS is valid d e. on does n in internal  Normal  Normal | Mode On, Idle N  | and register ation on Rafter Sleep tere is charank displayed ank displayed Mode Off, Stock of Mode Off, Stoc | ers are still GB I/F for In comma nging mod y  Sleep Out Sleep Out | oscillatory working. blank dis | wer consun<br>or is stoppe<br>splay after s<br>re is used N | Availab Yes Yes                                   | ommand a de On in          |    |    |  |
| Default   | Partial Mode On, Idle Mode Off, Sleep Out Partial Mode On, Idle Mode On, Sleep Out Sleep In  Status Default Value (D7 to D0) Power On Sequence S/W Reset Sleep In Mode H/W Reset Sleep In Mode |   |  |  |  |  |                                |   |   |                            |    |    |  |
| Flow Chart                                      |  |   | Disp screened Effect   | splinto Sleep can be check be splint (10h)  SPLIN(10h)  SPLIN(10h) |  | (0Ah) com S DC/DC S Internal                                       |                                |   | Command  Lege Comm Param Displ Action Sequentrans | nd eter / lay on de  ntial |    |    |  |



## 12.2.15 SLPOUT (11h/1100h): Sleep Out

| 11H                      |   |   |   |  |  | SLPC   | DUT                  |                            |                                     |                              |                               |             |  |
|--------------------------|---|---|---|--|--|--|----------------------|----------------------------|-------------------------------------|------------------------------|-------------------------------|-------------|--|
| Inst / Para              | R/W   | Addres  | ess<br>SPI-16                               | D15-8  | D7   | D6   | D5                   | D4                         | D3                                  | D2                           | D1                            | D0          |  |
| SLPOUT                   | W   |   | 1100h                                       | Х  |  |  |                      | No Arg                     | gument                              |                              | ı                             |             |  |
| Description              | In this m<br>User car<br>at least 2<br>There is   | ode the D<br>start to s<br>frames b<br>used an in | OC/DC of<br>send PC<br>pefore S<br>internal | converter is ena<br>CLK, HS and VS<br>Sleep Out commoscillator for bla<br>e control about  | information<br>nand, if the<br>ank displa              | on on RGB<br>ere is left S<br>y.             | I/F befo<br>leep In- | ore Sleep O<br>mode to Sle | ut commar                           | nd and this                  | information                   | on is valid |  |
| Restriction              | -   |   |   |  |  |  |                      |                            |                                     |                              |                               |             |  |
| Register<br>availability |   | N<br>F  | Normal I<br>Partial N                       | Statu<br>Mode On, Idle M<br>Mode On, Idle M<br>Mode On, Idle M<br>Mode On, Idle M<br>Sleep   | Mode Off, S<br>Mode On, S<br>Mode Off, S<br>Mode On, S | Sleep Out                                    |                      |                            | Availab<br>Yes<br>Yes<br>Yes<br>Yes |                              |                               |             |  |
| Default                  | Status Default Value (D7 to D0) Power On Sequence Sleep In Mode S/W Reset Sleep In Mode H/W Reset Sleep In Mode |   |   |  |  |  |                      |                            |                                     |                              |                               |             |  |
| Flow Chart               | It takes a  | about 120   | Into DC All                                 | Description of the second of t | o In mode  | Display w<br>screen(Au<br>Effect to D<br>Com | hole blan            |                            | Common Display  Action  Sequentrans | nd eter / ay ) on  de  ntial | <br> <br> <br> <br> <br> <br> |             |  |



## 12.2.16 PTLON (12h/1200h): Partial Display Mode On

| 12H          |          |   |  |                   |              | PTL        | NC         |              |             |            |    |    |  |  |  |  |
|--------------|----------|---|--|-------------------|--------------|------------|------------|--------------|-------------|------------|----|----|--|--|--|--|
| Inst / Para  | R/W      | Add   | Iress  | D15-8             | D7           | De         | D5         | D4           | D3          | Do         | D1 | D0 |  |  |  |  |
| inst / Para  | H/VV     | MIPI  | SPI-16                                       | 8-כוע             | D7           | D6         | Do         | D4           | D3          | D2         | וט | DU |  |  |  |  |
| PTLON        | W        | 12h   | 1200h  | Χ                 |              |            |            | No Arg       | gument      |            |    |    |  |  |  |  |
|              | This cor | mmand t   | turns on I                                   | Partial mode. Th  | e partial m  | ode windo  | ow is des  | cribed by th | ne Partial  | Area       |    |    |  |  |  |  |
|              | comma    | nd.   |  |                   |              |            |            |              |             |            |    |    |  |  |  |  |
| Description  | To leave | Partial   | mode, th                                     | e Normal Displa   | y Mode O     | n commar   | nd (13H) : | should be v  | vritten.    |            |    |    |  |  |  |  |
|              | There is | no abn  | ormal vis                                    | ual effect during | mode cha     | ange betwe | een Norm   | nal mode O   | n to Partia | al mode Oi | n. |    |  |  |  |  |
| Restriction  | This cor | mmand l   | has no ef                                    | fect when Partia  | ıl Display r | node is ac | tive.      |              |             |            |    |    |  |  |  |  |
|              |          | Status Availability   |  |                   |              |            |            |              |             |            |    |    |  |  |  |  |
|              |          | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes |  |                   |              |            |            |              |             |            |    |    |  |  |  |  |
|              |          |   | Normal Mode On, Idle Mode Off, Sleep Out Yes |                   |              |            |            |              |             |            |    |    |  |  |  |  |
| Register     |          |   |  | Mode On, Idle N   |              | •          |            |              | Yes         |            |    |    |  |  |  |  |
| availability |          |   |  | Mode On, Idle M   |              | •          |            |              | Yes         |            |    |    |  |  |  |  |
|              |          |   | Partial                                      | Mode On, Idle M   |              | leep Out   |            |              | Yes         |            |    |    |  |  |  |  |
|              |          |   |  | Sleep             | In           |            |            |              | Yes         |            |    |    |  |  |  |  |
|              |          | _   |  |                   |              |            |            |              |             |            |    |    |  |  |  |  |
|              |          | Π   | Status                                       |                   |              |            | Default    | Value (D7    | to D0)      |            |    |    |  |  |  |  |
| Defeat       |          |   | Power C                                      | n Sequence        |              |            | Norma      | Mode On      |             |            |    |    |  |  |  |  |
| Default      |          |   | S/W Res                                      | set               |              |            | Norma      | l Mode On    |             |            |    |    |  |  |  |  |
|              |          |   | H/W Res                                      | set               |              |            | Norma      | Mode On      |             |            |    |    |  |  |  |  |
|              |          |   | (221)  |                   |              |            |            |              |             |            |    |    |  |  |  |  |
| Flow Chart   | See Pa   | tial Area   | a (30h)                                      |                   |              |            |            |              |             |            |    |    |  |  |  |  |



## 12.2.17 NORON (13h/1300h): Normal Display Mode On

| 13H                      |                     |  |                                |   |                       | NOR        | ON               |  |           |         |    |    |  |  |
|--------------------------|---------------------|--|--------------------------------|---|-----------------------|------------|------------------|--|-----------|---------|----|----|--|--|
| Inst / Para              | R/W                 | Add<br>MIPI  | lress<br>SPI-16                | D15-8   | D7                    | D6         | D5               | D4   | D3        | D2      | D1 | D0 |  |  |
| NORON                    | W                   | 13h  | 1300h                          | Х   |                       | I          |                  | No Arg                                     | gument    | I.      | l. |    |  |  |
| Description              | Normal<br>Exit fror | display  | mode on<br>ON by the           | ne display to non<br>means Partial n<br>Partial mode O<br>ual effect during | node off.<br>n commar | nd (12h)   | Partial mo       | ode On to                                  | Normal mo | ode On. |    |    |  |  |
| Restriction              | This cor            | nis command has no effect when Normal Display mode is active.  |                                |   |                       |            |                  |  |           |         |    |    |  |  |
| Register<br>availability |                     | This command has no effect when Normal Display mode is active.  Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode On, Sleep Out Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes |                                |   |                       |            |                  |  |           |         |    |    |  |  |
| Default                  |                     |  | Status Power C S/W Res H/W Res |   |                       |            | Normal<br>Normal | Value (D7<br>Mode On<br>Mode On<br>Mode On | to D0)    |         |    |    |  |  |
| Flow Chart               | See Pa              | rtial Area   | a Definitio                    | on Descriptions f   | for details           | of when to | use this o       | command                                    |           |         |    |    |  |  |



## 12.2.18 INVOFF (20h/2000h): Display Inversion Off

| 20H          |          |   |                 |                          |              | INVC        | )FF        |         |                |    |    |    |  |  |
|--------------|----------|---|-----------------|--------------------------|--------------|-------------|------------|---------|----------------|----|----|----|--|--|
| Inst / Para  | R/W      | Add<br>MIPI   | dress<br>SPI-16 | D15-8                    | D7           | D6          | D5         | D4      | D3             | D2 | D1 | D0 |  |  |
| INVOFF       | W        | 20h   | 2000h           | Х                        |              |             |            | No Arg  | gument         | •  | •  |    |  |  |
| Description  |          |   |                 | recover from d           |              | ersion mod  | e.<br>N =  | Display |                |    |    |    |  |  |
|              |          |   |                 |                          |              |             |            |         |                |    |    |    |  |  |
| Restriction  | This cor | mmand   | has no ef       | fect when modu           | ıle is alrea | dy in Inver | sion Off r | node.   |                |    |    |    |  |  |
|              |          |   | Normal          | Statu<br>Mode On, Idle N |              | Sleen Out   |            |         | Availab<br>Yes |    |    |    |  |  |
| Register     |          |   |                 | Mode On, Idle I          |              |             |            |         | Yes            |    |    |    |  |  |
| availability |          |   |                 |                          |              |             |            |         |                |    |    |    |  |  |
|              |          | Partial Mode On, Idle Mode Off, Sleep Out  Partial Mode On, Idle Mode On, Sleep Out  Yes  Yes |                 |                          |              |             |            |         |                |    |    |    |  |  |
|              |          | Sleep In Yes  |                 |                          |              |             |            |         |                |    |    |    |  |  |
| Default      |          | · · · · · · · · · · · · · · · · · · ·   |                 |                          |              |             |            |         |                |    |    |    |  |  |
| Flow Chart   |          | S/W Reset Display Inversion off   |                 |                          |              |             |            |         |                |    |    |    |  |  |



## 12.2.19 INVON (21h/2100h): Display Inversion On

| 21H          |           |  |                 |   |              | INV         | NC        |                    |                |     |    |    |  |  |
|--------------|-----------|--|-----------------|---|--------------|-------------|-----------|--------------------|----------------|-----|----|----|--|--|
| Inst / Para  | R/W       |  | dress           | D15-8                                   | D7           | D6          | D5        | D4                 | D3             | D2  | D1 | D0 |  |  |
| INVON        | W         | MIPI<br>21h  | SPI-16<br>2100h | X                                       |              |             |           | No Arc             | gument         |     |    |    |  |  |
| 1144014      |           |  | 1               | enter display i                         | nversion m   | iode.       |           | 1407119            | gament         |     |    |    |  |  |
|              | This co   | mmand  | does not        | change any oth                          | er status.   |             |           |                    |                |     |    |    |  |  |
|              | To exit t | rom Dis  | play Inve       | rsion On, the D                         | isplay Inve  | rsion Off c | ommand    | (20h) shou         | ıld be writt   | en. |    |    |  |  |
| Description  |           |  |                 |   |              |             |           | Display            |                |     |    |    |  |  |
|              |           |  |                 |   |              | <b> </b>    |           |                    |                |     |    |    |  |  |
|              |           |  |                 |   |              |             | $\bigvee$ |                    |                |     |    |    |  |  |
| Restriction  | This co   | mmand  | has no ef       | fect when modu                          | ule is alrea | dy in Inver | sion On n | node.              |                |     |    |    |  |  |
|              |           |  |                 |   |              |             |           |                    |                |     |    |    |  |  |
|              |           |  | Normal          | Statu<br>Mode On, Idle                  |              | Sloop Out   |           |                    | Availab<br>Yes |     |    |    |  |  |
| Register     |           |  |                 | Mode On, Idle                           |              |             |           |                    | Yes            |     |    |    |  |  |
| availability |           |  |                 | Mode On, Idle N                         |              |             |           |                    | Yes            |     |    |    |  |  |
|              |           |  | Partial I       |   |              | Sleep Out   |           |                    | Yes            |     |    |    |  |  |
|              |           | Partial Mode On, Idle Mode On, Sleep Out  Sleep In  Yes  Yes |                 |   |              |             |           |                    |                |     |    |    |  |  |
|              |           |  |                 |   |              |             |           |                    |                |     |    |    |  |  |
|              |           | ļ  | Status          |   |              |             |           | Value (D7          |                |     |    |    |  |  |
| Default      |           | -  |                 | n Sequence                              |              |             |           | Inversion          |                |     |    |    |  |  |
|              |           | -  | S/W Res         |   |              |             |           | Inversion          |                |     |    |    |  |  |
|              |           | L  | 1777 1100       | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, |              |             | Γοιορίας  |                    | 0.11           |     |    |    |  |  |
|              |           |  |                 |   |              |             | ۱ –       |                    |                |     |    |    |  |  |
|              |           |  |                 |   |              |             | 1         | Legen              | i [            |     |    |    |  |  |
|              |           |  |                 |   |              |             |           | Comma              | nd             |     |    |    |  |  |
|              |           |  |                 | Display I                               | nversion Of  | f )         |           | Paramet            | 1              |     |    |    |  |  |
|              |           |  |                 |   | <u> </u>     |             | 1_        |                    |                |     |    |    |  |  |
| Flow Chart   |           |  |                 | INV                                     | ON(21h)      |             |           | Display            | <u> </u>       |     |    |    |  |  |
|              |           |  |                 |   | <del>\</del> |             |           | Action             | <u>-</u> ->i   |     |    |    |  |  |
|              |           |  |                 | Display I                               | nversion On  | )           | i C       | Mode               | !              |     |    |    |  |  |
|              |           |  |                 |   |              |             |           | Sequent<br>transfe |                |     |    |    |  |  |
|              |           |  |                 |   |              |             |           |                    | · <br>         |     |    |    |  |  |
|              |           |  |                 |   |              |             |           |                    |                |     |    |    |  |  |



## 12.2.20 ALLPOFF (22h/2200h): All Pixel Off

| 22H          |           |   |           |   |              | ALLP           | OFF       |                    |               |             |            |            |  |
|--------------|-----------|---|-----------|---|--------------|----------------|-----------|--------------------|---------------|-------------|------------|------------|--|
|              | D         | Add   | lress     | D.17.0                                  |              |                |           |                    | <b>D</b> 0    | <b>D</b> 2  | F :        | D.         |  |
| Inst / Para  | R/W       | MIPI  | SPI-16    | D15-8                                   | D7           | D6             | D5        | D4                 | D3            | D2          | D1         | D0         |  |
| ALLPOFF      | W         | 22h   | 2200h     | Х                                       |              |                |           | No Arg             | gument        |             |            |            |  |
|              | This cor  | nmand   | turns the | display panel b                         | lack in Sle  | ep Out mo      | ode and   | a status of t      | he Displa     | y On/Off re | egister ca | n be on or |  |
|              | off. This | comma   | and does  | not change any                          | other stat   | us.            |           |                    |               |             |            |            |  |
|              |           |   |           | _                                       |              | _              |           | Display            |               |             |            |            |  |
| Description  |           |   |           |   |              |                | N         |                    |               |             |            |            |  |
|              |           |   |           | H                                       |              | $H \sqcap$     | ' >       |                    |               |             |            |            |  |
|              |           |   |           |   |              |                | V         |                    |               |             |            |            |  |
| D. statetien | This are  |   |           | الما الما الما الما الما الما الما الما |              | alia da All Di |           |                    |               |             |            |            |  |
| Restriction  | inis cor  | rimand  | nas no ef | fect when modu                          | ile is airea | ay in Ali Pi   | xei Off m | ioae.              |               |             |            |            |  |
|              |           |   |           | Statu                                   | S            |                |           |                    | Availab       | oility      |            |            |  |
|              |           |   | Normal    | Mode On, Idle N                         |              | Sleep Out      |           |                    | Yes           |             |            |            |  |
| Register     |           |   |           |   |              |                |           |                    | Yes           | 1           |            |            |  |
| availability |           | Partial Mode On, Idle Mode Off, Sleep Out Yes |           |   |              |                |           |                    |               |             |            |            |  |
|              |           | Partial Mode On, Idle Mode On, Sleep Out Yes  |           |   |              |                |           |                    |               |             |            |            |  |
|              |           | Sleep In Yes                                  |           |   |              |                |           |                    |               |             |            |            |  |
|              |           |   |           |   |              |                |           |                    |               |             |            |            |  |
|              |           | Γ   | Status    |   |              |                | Defau     | t Value (D7        | to D0)        |             |            |            |  |
|              |           | ı   |           | n Sequence                              |              |                | All pix   | ·                  |               |             |            |            |  |
| Default      |           |   | S/W Res   | set                                     |              |                | All pix   | el off             |               |             |            |            |  |
|              |           |   | H/W Res   | set                                     |              |                | All pix   | el off             |               |             |            |            |  |
|              |           |   |           |   |              |                |           |                    |               |             |            |            |  |
|              |           |   |           |   |              |                | ٢ -       |                    |               |             |            |            |  |
|              |           |   |           |   |              |                | 1         | Legen              | i             |             |            |            |  |
|              |           |   |           |   |              |                |           |                    | -             |             |            |            |  |
|              |           |   |           |   | isplay Mod   | e              |           | Comma              |               |             |            |            |  |
|              |           |   |           |   | On           |                | 1/        | Paramet            | er /          |             |            |            |  |
| Flow Chart   |           |   |           | ALID                                    | DEE(OCL)     | 1              | (         | Display            | <u> </u>      |             |            |            |  |
| o onait      |           |   |           | [ ALLP                                  | OFF(22h)     |                |           | Action             | <u> </u>      |             |            |            |  |
|              |           |   |           |   | <b>★</b>     |                | 1,        |                    |               |             |            |            |  |
|              |           |   |           | Black                                   | Display      |                | 1         | Mode               | ;             |             |            |            |  |
|              |           |   |           |   |              |                |           | Sequent<br>transfe |               |             |            |            |  |
|              |           |   |           |   |              |                |           |                    | $\overline{}$ |             |            |            |  |
|              |           |   |           |   |              |                |           |                    | ·             |             |            |            |  |



## 12.2.21 ALLPON (23h/2300h): All Pixel ON

| 23H          |   |   | ,          | 30011). All F    |              | ALLF      | ON        |             |           |             |            |            |  |  |
|--------------|---|---|------------|------------------|--------------|-----------|-----------|-------------|-----------|-------------|------------|------------|--|--|
| 2011         |   | ٨٨  | dress      |                  |              | ALL!      | ON        |             |           |             |            |            |  |  |
| Inst / Para  | R/W   | MIPI  | SPI-16     | D15-8            | D7           | D6        | D5        | D4          | D3        | D2          | D1         | D0         |  |  |
| ALLPOFF      | W   | 23h   | 2300h      | Х                |              |           |           | No Arg      | gument    |             |            |            |  |  |
|              |   |   |            | display panel v  |              |           | ode and a |             | he Displa | y On/Off re | egister ca | n be on or |  |  |
| Description  |   |   |            |                  |              |           |           | Display     |           |             |            |            |  |  |
|              |   |   |            | l Display Mode   |              |           |           | eave this m | ode. The  | display pai | nel        |            |  |  |
|              | is showi  | ng the  | display da | ıta after "Norma | ıl Display C | On" comma | and.      |             |           |             |            |            |  |  |
| Restriction  | This command has no effect when module is already in all Pixel On mode. |   |            |                  |              |           |           |             |           |             |            |            |  |  |
|              |   | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode On Sleep Out Yes   |            |                  |              |           |           |             |           |             |            |            |  |  |
| Register     |   | Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode On, Sleep Out Yes   |            |                  |              |           |           |             |           |             |            |            |  |  |
| availability |   |   |            | Mode On, Idle N  |              |           |           |             | Yes       |             |            |            |  |  |
|              |   |   | Partial I  | Mode On, Idle N  | Mode On, S   | Sleep Out |           |             | Yes       | ;           |            |            |  |  |
|              |   |   |            | Sleep            | In           |           |           |             | Yes       | 1           |            |            |  |  |
|              |   |   |            |                  |              |           |           |             |           |             |            |            |  |  |
|              |   | Ī   | Status     |                  |              |           | Default   | Value (D7   | to D0)    |             |            |            |  |  |
| Defect       |   |   | Power C    | n Sequence       |              |           | All Pixe  | el off      |           |             |            |            |  |  |
| Default      |   |   | S/W Res    | set              |              |           | All Pixe  | el off      |           |             |            |            |  |  |
|              |   | <u> </u>  | H/W Res    | set              |              |           | All Pixe  | el off      |           |             |            |            |  |  |
|              |   |   |            |                  |              |           |           |             |           |             |            |            |  |  |
| Flow Chart   |   | Status  Power On Sequence All Pixel off S/W Reset All Pixel off H/W Reset All Pixel off  Legend  Command  Parameter  Display  ALLPON(23h)  White Display  Mode  Sequential transfer |            |                  |              |           |           |             |           |             |            |            |  |  |



## 12.2.22 GAMSET (26h/2600h): Gamma Set

| 26H          |           |   | ·            | oon). Gar                             |            | GAM       | SET   |           |            |       |       |    |  |  |  |
|--------------|-----------|---|--------------|---------------------------------------|------------|-----------|-------|-----------|------------|-------|-------|----|--|--|--|
|              |           | Adr   | dress        |                                       |            |           |       |           |            |       |       |    |  |  |  |
| Inst / Para  | R/W       | MIPI  | SPI-16       | D15-8                                 | D7         | D6        | D5    | D4        | D3         | D2    | D1    | D0 |  |  |  |
| GAMSET       | W         | 23h   | 2300h        | Χ                                     |            |           |       |           |            | GC    | [3:0] |    |  |  |  |
|              |           |   |              | select the des                        |            |           |       |           |            |       |       | эе |  |  |  |
|              |           |   |              | GC[3:0]                               | Para       | meter     |       | Curve Se  | lected     |       |       |    |  |  |  |
| Description  |           |   |              | 01h                                   | G          | iC0       | Ga    | mma Curve | e 1 (G=2.2 | 2)    |       |    |  |  |  |
| Description  |           |   |              | 02h                                   | G          | iC1       |       | Reser     | ved        |       |       |    |  |  |  |
|              |           |   |              | 04h                                   | G          | iC2       |       | Reser     | ved        |       |       |    |  |  |  |
|              |           |   |              | 08h                                   | G          | iC3       |       | Reser     | ved        |       |       |    |  |  |  |
|              | Note :All | other va  | lues are und | defined.                              |            |           |       |           |            |       |       |    |  |  |  |
| Restriction  |           | Values of GC [7:0] not shown in table above are invalid and will not change the current selected gamma curve u is received.  Status  Availability                   |              |                                       |            |           |       |           |            |       |       |    |  |  |  |
|              |           |   |              | Stat                                  | us         |           |       |           | Availab    | ility |       |    |  |  |  |
|              |           | Normal Mode On, Idle Mode Off, Sleep Out  Yes   |              |                                       |            |           |       |           |            |       |       |    |  |  |  |
| Register     |           | Normal Mode On, Idle Mode On, Sleep Out Yes   |              |                                       |            |           |       |           |            |       |       |    |  |  |  |
| availability |           | Partial Mode On, Idle Mode Off, Sleep Out Yes   |              |                                       |            |           |       |           |            |       |       |    |  |  |  |
|              |           |   | Partial M    | lode On, Idle                         | Mode On, S | Sleep Out |       |           | Yes        |       |       |    |  |  |  |
|              |           |   |              | Sleep                                 | o In       |           |       |           | Yes        |       |       |    |  |  |  |
|              |           |   |              |                                       |            |           |       |           |            |       |       |    |  |  |  |
|              |           | Г   | 0            |                                       |            |           | D ( ) | N/ 1 /D7  | . 50)      |       |       |    |  |  |  |
|              |           | -   |              | . 0                                   |            |           |       |           | to D0)     |       |       |    |  |  |  |
| Default      |           | -   |              | · · · · · · · · · · · · · · · · · · · |            |           | +     |           |            |       |       |    |  |  |  |
|              |           | -   |              |                                       |            |           |       |           |            |       |       |    |  |  |  |
|              |           | L   | n/w nes      | <del>3</del> 1                        |            |           | nesen | eu        |            |       |       |    |  |  |  |
| Flow Chart   |           | Status  Power On Sequence Reserved S/W Reset Reserved  H/W Reset  Reserved    Command     Parameter     Display     Action     Curve Loaded     Sequential transfer |              |                                       |            |           |       |           |            |       |       |    |  |  |  |



## 12.2.23 DISPOFF (28h/2800h): Display Off

| 28H          |          |   |            |                 |                         | DISP         | OFF            |  |              |             |            |     |  |  |
|--------------|----------|---|------------|-----------------|-------------------------|--------------|----------------|--|--------------|-------------|------------|-----|--|--|
| lead / D     | DAM      | Add   | dress      | D45.0           | D-7                     | D.           | 55             | 5.4  | <b>D</b> 2   | D2          | D.         | D.0 |  |  |
| Inst / Para  | R/W      | MIPI  | SPI-16     | D15-8           | D7                      | D6           | D5             | D4   | D3           | D2          | D1         | D0  |  |  |
| DISPOFF      | W        | 28h   | 2800h      | Х               |                         |              |                | No Arç   | gument       |             |            |     |  |  |
|              | This co  | mmand   | is used to | enter into DISF | PLAY OFF                | mode. In t   | this mod       | e, the displa                                    | ay data is o | disables ar | nd blank p | age |  |  |
|              | inserted | l.  |            |                 |                         |              |                |  |              |             |            |     |  |  |
|              | This co  | mmand   | does not   | change any oth  | er status. <sup>-</sup> | There will I | be no ab       | normal visit                                     | ole effect o | n the disp  | lay.       |     |  |  |
| Description  |          |   |            |                 |                         |              |                | Display  |              | ·           | ·          |     |  |  |
| Besonption   |          |   |            | Е               |                         | $\Box$       | <sub>k</sub> E | <del>                                     </del> | -            |             |            |     |  |  |
|              |          |   |            |                 |                         | ┨┌─          | ) / E          |  | 3            |             |            |     |  |  |
|              |          |   |            | F               |                         | ┧┖┈          | νF             |  | =            |             |            |     |  |  |
|              |          |   |            |                 |                         |              | <u> </u>       |  |              |             |            |     |  |  |
| Restriction  | This co  | mmand   | has no ef  | fect when modu  | ıle is alrea            | dy in Displ  | ay Off m       | node.  |              |             |            |     |  |  |
|              |          |   |            |                 |                         |              |                |  |              |             |            | Ī   |  |  |
|              |          |   |            | Statu           |                         |              |                |  | Availab      |             |            |     |  |  |
|              |          |   |            | Mode On, Idle I |                         |              |                |  | Yes          |             |            |     |  |  |
| Register     |          | Normal Mode On, Idle Mode On, Sleep Out  Partial Mode On, Idle Mode Off, Sleep Out  Yes       |            |                 |                         |              |                |  |              |             |            |     |  |  |
| availability |          | Partial Mode On, Idle Mode Off, Sleep Out  Partial Mode On, Idle Mode On, Sleep Out  Yes  Yes |            |                 |                         |              |                |  |              |             |            |     |  |  |
|              |          |   | railiai    | Sleep           |                         | sieep Out    |                |  | Yes          |             |            |     |  |  |
|              |          |   |            | 0.000           |                         |              |                |  |              |             |            |     |  |  |
|              |          | _   |            |                 |                         |              |                |  |              |             |            |     |  |  |
|              |          |   | Status     |                 |                         |              | Defau          | lt Value (D7                                     | to D0)       |             |            |     |  |  |
| Default      |          |   | Power C    | n Sequence      |                         |              | Displa         | ay off   |              |             |            |     |  |  |
| 2 ordan      |          | -   | S/W Res    |                 |                         |              | Displa         |  |              |             |            |     |  |  |
|              |          | <u>_</u>  | H/W Res    | set             |                         |              | Displa         | ay off   |              |             |            |     |  |  |
|              |          |   |            |                 |                         |              |                |  |              |             |            |     |  |  |
|              |          |   |            |                 |                         |              | Γ.             | <u> </u>   | ¬            |             |            |     |  |  |
|              |          |   |            |                 |                         |              | !              | Legen  | d            |             |            |     |  |  |
|              |          |   |            |                 |                         |              |                |  | <br>         |             |            |     |  |  |
|              |          |   |            | Display         | On Mode                 |              |                | Comma  | I            |             |            |     |  |  |
|              |          |   |            |                 | 1                       | /            | 1/             | Paramet  | er /         |             |            |     |  |  |
| Flow Chart   |          |   |            | Dian            | <b>★</b>                | 7            |                | Displa   | y) İ         |             |            |     |  |  |
| o onait      |          |   |            | DISPO           | OFF(28h)                |              |                | Action   | <u> </u>     |             |            |     |  |  |
|              |          |   |            |                 | <b>*</b>                |              | İ              |  |              |             |            |     |  |  |
|              |          |   |            | Display         | Off Mode                | )            | 1 (            | Mode   | )            |             |            |     |  |  |
|              |          |   |            |                 |                         |              | I              | Sequent  |              |             |            |     |  |  |
|              |          |   |            |                 |                         |              | _ [ [          | transfe  | 1            |             |            |     |  |  |
|              |          |   |            |                 |                         |              |                |  | '            |             |            |     |  |  |



## 12.2.24 DISPON (29h/2900h): Display On

| 29H                   |   |  |            |                 |              | DISF         | ON               |              |                   |             |            |     |  |  |
|-----------------------|---|--|------------|-----------------|--------------|--------------|------------------|--------------|-------------------|-------------|------------|-----|--|--|
| Inst / Para           | R/W   | Add  | dress      | D15-8           | D7           | D6           | D5               | D4           | D3                | D2          | D1         | D0  |  |  |
| ilist/ Para           | IT/VV   | MIPI   | SPI-16     | D10-0           | D7           | סט           | Do               | D4           | D3                | D2          | וט         | DU  |  |  |
| DISPON                | W   | 29h  | 2900h      | Х               |              |              |                  | No Arg       | gument            |             |            |     |  |  |
|                       | This co   | mmand  | is used to | enter into DISI | PLAY OFF     | mode. In t   | his mode         | , the displa | ıy data is d      | disables ar | nd blank p | age |  |  |
|                       | inserted  | d.   |            |                 |              |              |                  |              |                   |             |            |     |  |  |
|                       | This co   | mmand  | does not   | change any oth  | er status.   | There will I | oe no abr        | ormal visib  | ole effect o      | n the disp  | lay.       |     |  |  |
| Description           |   |  |            |                 |              |              |                  | Display      |                   |             |            |     |  |  |
| '                     |   |  |            | Е               |              | В            | N $\blacksquare$ |              |                   |             |            |     |  |  |
|                       |   |  |            |                 |              | $ \dagger $  | '                |              |                   |             |            |     |  |  |
|                       |   |  |            |                 |              | Ħ ' ̄        | $V \vdash $      |              |                   |             |            |     |  |  |
|                       |   |  |            |                 |              |              |                  |              |                   |             |            |     |  |  |
| Restriction           | This co   | mmand  | has no ef  | fect when modu  | ıle is alrea | dy in Displ  | ay Off mo        | ode.         |                   |             |            |     |  |  |
|                       |   |  |            | -               |              |              |                  |              | • "               |             |            |     |  |  |
|                       |   |  |            | Statu           |              | 21 0 1       |                  |              | Availab           |             |            |     |  |  |
| Pogiator              |   |  |            | Mode On, Idle I |              |              |                  |              | Yes               |             |            |     |  |  |
| Register availability |   | Normal Mode On, Idle Mode On, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes |            |                 |              |              |                  |              |                   |             |            |     |  |  |
| availability          | <u> </u>  |  |            |                 |              |              |                  |              |                   |             |            |     |  |  |
|                       | Partial Mode On, Idle Mode On, Sleep Out Yes Sleep In Yes |  |            |                 |              |              |                  |              |                   |             |            |     |  |  |
|                       |   | <u>U</u>   |            |                 |              |              | •                |              |                   |             |            |     |  |  |
|                       |   |  |            |                 |              |              |                  |              |                   |             | _          |     |  |  |
|                       |   |  | Status     |                 |              |              |                  | Value (D7    | to D0)            |             |            |     |  |  |
| Default               |   | -  |            | n Sequence      |              |              | Display          |              |                   |             |            |     |  |  |
|                       |   |  | S/W Res    |                 |              |              | Display          |              |                   |             |            |     |  |  |
|                       |   | L  | H/W Res    | set             |              |              | Display          | Off          |                   |             |            |     |  |  |
|                       |   |  |            |                 |              |              |                  |              |                   |             |            |     |  |  |
|                       |   |  |            |                 |              |              | ļ —              | Legen        | — <b>— ¬</b><br>1 |             |            |     |  |  |
|                       |   |  |            |                 |              |              | l<br>I           | Legen        |                   |             |            |     |  |  |
|                       |   |  |            |                 |              |              |                  | Comma        | nd                |             |            |     |  |  |
|                       |   |  |            | Display         | Off Mode     |              |                  | Paramet      |                   |             |            |     |  |  |
|                       |   |  |            |                 | <del></del>  | /<br>¬       | i <sup>∠</sup>   |              |                   |             |            |     |  |  |
| Flow Chart            |   |  |            | DISP            | ON(29h)      |              | 1                | Display      | <u>/</u>          |             |            |     |  |  |
|                       |   |  |            |                 | $\downarrow$ | _            | ! <              | Action       | $\supset$ !       |             |            |     |  |  |
|                       |   |  |            | Display         | On Mode      |              |                  | Mode         |                   |             |            |     |  |  |
|                       |   |  |            | 2 ispini)       |              | /            | \                | Sequenti     |                   |             |            |     |  |  |
|                       |   |  |            |                 |              |              | <br>             | transfe      |                   |             |            |     |  |  |
|                       |   |  |            |                 |              |              | L                |              | . <b>_</b> l      |             |            |     |  |  |
|                       |   |  |            |                 |              |              |                  |              |                   |             |            |     |  |  |



## 12.2.25 TEOFF (34h/3400h):Tearing Effect Line OFF

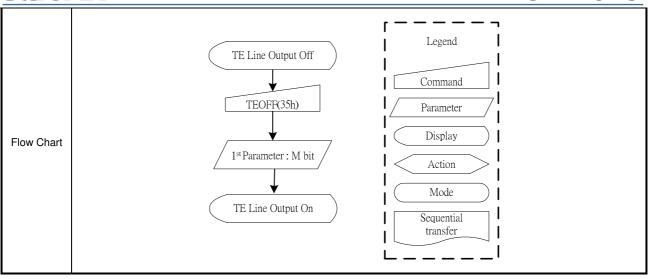
| 34H                      |          |   |                   |  |  | TEC          | )FF        |  |                                     |            |            |          |
|--------------------------|----------|---|-------------------|--|--|--------------|------------|--|-------------------------------------|------------|------------|----------|
|                          |          | Add   | dress             |  |  |              |            |  |                                     |            |            |          |
| Inst / Para              | R/W      | MIPI  | SPI-16            | D15-8  | D7   | D6           | D5         | D4   | D3                                  | D2         | D1         | D0       |
| TEOFF                    | W        | 34h   | 3400h             | Χ  |  |              |            | No Arç   | gument                              |            |            |          |
| Description              | This cor | mmand   | is used to        | turn off the Dis   | play modu  | ule's Tearin | g Effect o | utput signa                                      | al (Active I                        | Low) on th | e TE signa | al line. |
| Restriction              | This cor | mmand   | has no ef         | fect when the To   | earing Effe  | ect output i | s already  | OFF.   |                                     |            |            |          |
| Register<br>availability |          |   | Normal<br>Partial | Statu<br>Mode On, Idle I<br>Mode On, Idle I<br>Mode On, Idle I<br>Mode On, Idle I<br>Sleep | Mode Off, and Mode Off, and Mode Off, and Mode Off, and Mode On, and Mode Off, | Sleep Out    |            |  | Availab<br>Yes<br>Yes<br>Yes<br>Yes |            |            |          |
| Default                  |          | Status  Default Value (D7 to D0)  Power On Sequence  S/W Reset  00h  H/W Reset  00h |                   |  |  |              |            |  |                                     |            |            |          |
| Flow Chart               |          |   |                   | TEO  | FF(34h)  Output OFF  |              |            | Comma Paramet Displa Action Mode Sequent transfe | nd   I                              |            |            |          |



## 12.2.26 TEON (35h/3500h):Tearing Effect Line ON

| 35H          |          |   |            |                                    |             | TEC          | ON               |            |             |                  |                     |             |  |  |
|--------------|----------|---|------------|------------------------------------|-------------|--------------|------------------|------------|-------------|------------------|---------------------|-------------|--|--|
| Inat / Dava  | R/W      | Add   | Iress      | D15-8                              | D7          | D6           | D5               | D4         | D3          | D2               | D1                  | D0          |  |  |
| Inst / Para  | H/VV     | MIPI  | SPI-16     | D13-6                              | D/          | D6           | סט               | D4         | D3          | D2               | וט                  | DU          |  |  |
| TEOFF        | W        | 35h   | 3500h      | Χ                                  |             |              |                  |            |             |                  |                     | М           |  |  |
|              | This cor | mmand i   | is used to | turn ON the Tea                    | aring Effec | t output si  | gnal on th       | e TE signa | l line. Cha | anging the       | MADCTL              | bit B4 will |  |  |
|              | not affe | ct this o   | utput. The | e Tearing Effect                   | Line On ha  | as one par   | ameter, w        | hich descr | ibes the n  | node of the      | e Tearing E         | Effect      |  |  |
|              | Output   | Line.   |            |                                    |             |              |                  |            |             |                  |                     |             |  |  |
|              | When M   | 1 = 0: Th   | ne Tearing | g Effect Output li                 | ne consist  | ts of V-Bla  | nking info       | mation on  | ly:         |                  |                     |             |  |  |
|              |          |   |            | ا                                  |             |              | $T_{vdl}$        |            |             | T <sub>vdh</sub> | J                   |             |  |  |
| Description  | Vertica  | ıl time s   | scale      |                                    |             |              |                  |            |             | 7                |                     |             |  |  |
| , '          |          |   |            | F"                                 |             |              | V DI . I .       |            |             |                  |                     | ,           |  |  |
|              | wnen iv  | /hen M = 1: The Tearing Effect Output Line consists of both V-Blanking and H-Blanking information:  T <sub>vdl</sub> T <sub>vdh</sub> |            |                                    |             |              |                  |            |             |                  |                     |             |  |  |
|              | Vortica  | ıl time s   |            |                                    |             |              | l <sub>vdl</sub> |            |             | Vdh              | $\rightrightarrows$ |             |  |  |
|              | vertica  |   | scale      | <del>}</del> _                     |             |              |                  |            |             | <b>/</b> ¦       | +                   |             |  |  |
|              | Note: D  | Note: During the Sleep In Mode with Tearing Effect Line On, Tearing Effect Output pin will be active Low.                             |            |                                    |             |              |                  |            |             |                  |                     |             |  |  |
| Restriction  | This cor | mmand   | has no ef  | fect when the Te                   | earing Effe | ct output is | s already (      | OFF.       |             |                  |                     |             |  |  |
|              |          |   |            |                                    |             |              |                  |            |             |                  |                     |             |  |  |
|              |          |   |            | Statu                              | -           |              |                  |            | Availab     | -                |                     |             |  |  |
|              |          |   |            | Mode On, Idle N                    |             |              |                  |            | Yes         |                  |                     |             |  |  |
| Register     |          |   |            | Mode On, Idle N                    |             |              |                  |            | Yes         |                  |                     |             |  |  |
| availability |          |   |            | Mode On, Idle M<br>Mode On, Idle M |             | <u> </u>     |                  |            | Yes         |                  |                     |             |  |  |
|              |          |   | Partial i  | Sleep                              |             | sieep Out    |                  |            | Yes<br>Yes  |                  |                     |             |  |  |
|              |          |   |            | Оісср                              |             |              |                  |            | 103         | '                |                     |             |  |  |
|              |          |   |            |                                    |             |              |                  |            |             |                  |                     |             |  |  |
|              |          |   | Status     |                                    |             |              | Default          | Value (D7  | to D0)      |                  |                     |             |  |  |
| Default      |          |   | Power C    | n Sequence                         |             |              | 00h              |            |             |                  |                     |             |  |  |
| Default      |          |   | S/W Res    | set                                |             |              | 00h              |            |             |                  |                     |             |  |  |
|              |          |   | H/W Res    | set                                |             |              | 00h              |            |             |                  |                     |             |  |  |
|              |          |   |            |                                    |             |              |                  |            |             |                  |                     |             |  |  |

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## 12.2.27 MADCTL(36h/3600h): Display data access control

| 36H          |         |   |           |            |    | IDMO | OFF    |             |          |    |    |    |  |  |  |
|--------------|---------|---|-----------|------------|----|------|--------|-------------|----------|----|----|----|--|--|--|
| Inst / Para  | R/W     | Add<br>MIPI   | spl-16    | D15-8      | D7 | D6   | D5     | D4          | D3       | D2 | D1 | D0 |  |  |  |
| IDMOFF       | W       | 36h   | 3600h     | Х          |    |      |        | ML          | BGR      |    |    |    |  |  |  |
|              | ML: GE  | T Scan  | direction | selection. |    |      |        |             |          |    |    |    |  |  |  |
|              | ML= 0 ( | Get norr  | nal scan. |            |    |      |        |             |          |    |    |    |  |  |  |
|              | ML=1 G  | et reve   | rse scan. |            |    |      |        |             |          |    |    |    |  |  |  |
| Description  | BGR:    |   |           |            |    |      |        |             |          |    |    |    |  |  |  |
|              | BGR=0   | →RGB  |           |            |    |      |        |             |          |    |    |    |  |  |  |
|              | BGR=1   | →BGR  |           |            |    |      |        |             |          |    |    |    |  |  |  |
| Restriction  | This co | This command has no effect when module is already in Idle Off mode. |           |            |    |      |        |             |          |    |    |    |  |  |  |
|              |         | Status Availability   |           |            |    |      |        |             |          |    |    |    |  |  |  |
|              |         | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes   |           |            |    |      |        |             |          |    |    |    |  |  |  |
| Register     |         | Normal Mode On, Idle Mode On, Sleep Out Yes                         |           |            |    |      |        |             |          |    |    |    |  |  |  |
| availability |         | Partial Mode On, Idle Mode Off, Sleep Out Yes                       |           |            |    |      |        |             |          |    |    |    |  |  |  |
|              |         | Partial Mode On, Idle Mode On, Sleep Out Yes                        |           |            |    |      |        |             |          |    |    |    |  |  |  |
|              |         | Sleep In Yes  |           |            |    |      |        |             |          |    |    |    |  |  |  |
|              |         | GIOOP III 165   |           |            |    |      |        |             |          |    |    |    |  |  |  |
|              |         | Ī   | Status    |            |    |      | Defaul | t Value (D7 | ' to D0) |    |    |    |  |  |  |
| Default      |         |   | Power C   | n Sequence |    |      | 00H    | ·           | ·        |    |    |    |  |  |  |
| Default      |         |   | S/W Res   | set        |    |      | 00H    |             |          |    |    |    |  |  |  |
|              |         |   | H/W Re    | set        |    |      | 00H    |             |          |    |    |    |  |  |  |
| Flow Chart   |         | S/W Reset 00H   |           |            |    |      |        |             |          |    |    |    |  |  |  |



## 12.2.28 IDMOFF (38h/3800h): Idle Mode Off

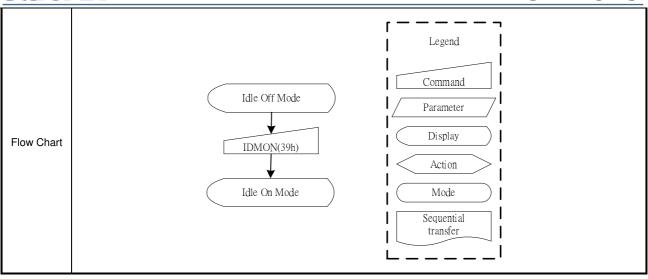
| 38H                      |          |  |                 |                 |              | IDMO         | OFF        |        |        |    |    |    |  |
|--------------------------|----------|--|-----------------|-----------------|--------------|--------------|------------|--------|--------|----|----|----|--|
| Inst / Para              | R/W      | Add<br>MIPI  | dress<br>SPI-16 | D15-8           | D7           | D6           | D5         | D4     | D3     | D2 | D1 | D0 |  |
| IDMOFF                   | W        | 38h  | 3800h           | Х               |              |              | •          | No Arg | gument |    | •  |    |  |
| Description              |          |  |                 | recover from lo |              |              | 'M colors. |        |        |    |    |    |  |
| Restriction              | This cor | mmand  | has no ef       | fect when modu  | ıle is alrea | dy in Idle ( | Off mode.  |        |        |    |    |    |  |
| Register<br>availability |          | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode On, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes  Status Default Value (D7 to D0) |                 |                 |              |              |            |        |        |    |    |    |  |
| Default                  |          | Status  Default Value (D7 to D0)  Power On Sequence Idle Mode off  S/W Reset Idle Mode off  H/W Reset Idle Mode off  |                 |                 |              |              |            |        |        |    |    |    |  |
| Flow Chart               |          | S/W Reset Idle Mode off  |                 |                 |              |              |            |        |        |    |    |    |  |



## 12.2.29 IDMON (39h/3900h): Idle Mode On

|                | R/W N     | Address   |                   |               |            |               |             |            |          |      |    |  |  |  |  |
|----------------|-----------|---|-------------------|---------------|------------|---------------|-------------|------------|----------|------|----|--|--|--|--|
| IDMON          |           | IIPI SPI-16   | D15-8             | D7            | D6         | D5            | D4          | D3         | D2       | D1   | D0 |  |  |  |  |
|                | W 3       | 3900h   | Х                 |               | Į.         | 1             | No Arg      | jument     | I.       | l .  |    |  |  |  |  |
|                |           |   | (Exampl           | e)Frame       | e Data     |               | Display     |            |          |      |    |  |  |  |  |
|                |           | Top-Left (  | _                 |               |            | $\Rightarrow$ |             |            |          |      |    |  |  |  |  |
| Th             | his comm  | nand is used to   | enter into Idle   | mode on.      |            |               |             |            |          |      |    |  |  |  |  |
| In             | the idle  | on mode, colo   | r expression is r | educed. T     | he primar  | y and the     | secondary   | colors usi | ng MSB o | f    |    |  |  |  |  |
| Description ea | ach R, G, | ch R, G, and B in Frame Data, 8 color depth data is displayed.  Color R5 R4 R3 R2 R1 R0 G5 G4 G3 G2 G1 G0 B5 B4 B3 B4 B1 B0                         |                   |               |            |               |             |            |          |      |    |  |  |  |  |
|                |           |   |                   |               |            |               |             |            |          |      |    |  |  |  |  |
|                |           | Color         R5 R4 R3 R2 R1 R0         G5 G4 G3 G2 G1 G0         B5 B4 B3 B4 B1 B0           Black         0xxxxxx         0xxxxxx         0xxxxxx |                   |               |            |               |             |            |          |      |    |  |  |  |  |
|                |           | Blue  | 0x                | XXXX          |            | C             | XXXXX       |            | 1xx      | (XXX |    |  |  |  |  |
|                |           | Red   | 1x                | XXXX          |            | C             | XXXXX       |            | 0xx      | (XXX |    |  |  |  |  |
|                |           | Magenta   | 1x                | XXXX          |            | C             | XXXXX       |            | 1xx      | XXX  |    |  |  |  |  |
|                | -         | Green   |                   | XXXX          |            |               | XXXXX       |            |          | (XXX |    |  |  |  |  |
|                | -         | Cyan  | +                 | XXXX          |            |               | XXXXX       |            |          | (XXX |    |  |  |  |  |
|                |           | Yellow<br>White   |                   | XXXX          |            |               | XXXXX       |            |          | (XXX |    |  |  |  |  |
|                |           | vvnite  | IX                | XXXX          |            |               | xxxxx       |            | IXX      | (XXX |    |  |  |  |  |
| Restriction Th | his comm  | nand has no ef  | fect when modu    | lle is alread | dy in Idle | On mode       |             |            |          |      |    |  |  |  |  |
|                |           |   | Statu             | S             |            |               |             | Availab    | ility    |      |    |  |  |  |  |
|                |           | Normal  | Mode On, Idle N   | Mode Off, S   | Sleep Out  |               |             | Yes        |          |      |    |  |  |  |  |
| Register       |           | Normal  | Mode On, Idle N   | Mode On, S    | Sleep Out  |               |             | Yes        |          |      |    |  |  |  |  |
| availability   |           | Partial I   | Mode On, Idle N   | Node Off, S   | Sleep Out  |               |             | Yes        |          |      |    |  |  |  |  |
|                |           | Partial I   | Mode On, Idle N   | lode On, S    | Sleep Out  |               |             | Yes        |          |      |    |  |  |  |  |
|                |           |   | Sleep             | In            |            |               |             | Yes        |          |      |    |  |  |  |  |
|                |           |   |                   |               |            |               |             |            |          |      |    |  |  |  |  |
|                |           | Status  |                   |               |            | Defau         | t Value (D7 | to D0)     |          |      |    |  |  |  |  |
| Data: II       |           | Power C   | n Sequence        |               |            | Idle M        | ode off     |            |          |      |    |  |  |  |  |
| Default        |           | S/W Res   | set               |               |            | Idle M        | ode off     |            |          |      |    |  |  |  |  |
|                |           | H/W Res   | set               |               |            | Idle M        | ode off     |            |          |      |    |  |  |  |  |
|                |           |   |                   |               |            |               |             |            |          |      |    |  |  |  |  |

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## 12.2.30 COLMOD (3Ah/3A00h): Interface Pixel Format

| ЗАН          |          |   |            |                |                      | COL          | /OD          |               |                |    |      |    |  |  |
|--------------|----------|---|------------|----------------|----------------------|--------------|--------------|---------------|----------------|----|------|----|--|--|
| Inst / Para  | R/W      | Ado   | dress      | D15-8          | D7                   | D6           | D5           | D4            | D3             | D2 | D1   | D0 |  |  |
|              |          | MIPI  | SPI-16     |                | "                    |              |              |               | 50             | 52 | , D1 | 50 |  |  |
| COLMOD       | W        | 3Ah   | 3A00h      | Х              |                      | •            | VIPF[2       | :0]           |                |    |      |    |  |  |
|              | This co  | mmand   | is used to | define the for | mat of RGE           | picture da   | ata.         |               |                |    |      |    |  |  |
|              | The form | mats are  | shown in   | the table:     |                      |              |              | _             |                |    |      |    |  |  |
|              |          |   |            | Bit            | NAME                 |              |              | DESCRIPT      | ION            |    |      |    |  |  |
| Description  |          |   |            |                |                      |              |              | "101"=16-b    |                |    |      |    |  |  |
|              |          |   |            | VIPF[2:0]      | Pixel Forma          | t for RGB Ir | iterface     | "110"=18-bi   | •              |    |      |    |  |  |
|              |          |   |            |                |                      |              |              |               | not defined    | ı  |      |    |  |  |
|              |          |   |            |                |                      |              |              |               |                |    |      |    |  |  |
| Restriction  | There is | There is no visible effect until the display data is written to.  |            |                |                      |              |              |               |                |    |      |    |  |  |
|              |          | Status Availability   |            |                |                      |              |              |               |                |    |      |    |  |  |
|              |          | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes |            |                |                      |              |              |               |                |    |      |    |  |  |
| Register     |          |   |            | Mode On, Idle  |                      |              |              |               | Yes            |    |      |    |  |  |
| availability |          |   | Partial N  | lode On, Idle  | Mode Off, S          | Sleep Out    |              |               | Yes            |    |      |    |  |  |
|              |          |   | Partial M  | lode On, Idle  |                      | Sleep Out    |              |               | Yes            |    |      |    |  |  |
|              |          |   |            | Slee           | p In                 |              |              |               | Yes            |    |      |    |  |  |
|              |          |   |            |                |                      |              |              |               |                |    |      |    |  |  |
|              |          | ſ   | Status     |                |                      |              | Defa         | ult Value (D7 | ' to D0)       |    |      |    |  |  |
| D.( "        |          | j   |            | n Sequence     |                      |              | 70h          |               |                |    |      |    |  |  |
| Default      |          |   | S/W Res    | et             |                      |              | 70h          |               |                |    |      |    |  |  |
|              |          |   | H/W Res    | et             |                      |              | 70h          |               |                |    |      |    |  |  |
| <u> </u>     |          |   |            |                |                      |              |              |               |                |    |      |    |  |  |
|              |          |   |            |                |                      |              | Ĺ.           |               |                |    |      |    |  |  |
|              |          |   |            | 24-bi          | t/pixel Mode         |              |              | Legeno        | 1 <b> </b>     |    |      |    |  |  |
|              |          |   |            |                | Ţ                    | /            | <br>         | Commai        | nd             |    |      |    |  |  |
|              |          |   |            | COL            | MOD(3Ah)             |              |              |               | <u> </u>       |    |      |    |  |  |
|              |          |   |            |                |                      | _            | $i^{\angle}$ | Paramet       |                |    |      |    |  |  |
| Flow Chart   |          |   |            | / P            | <b>★</b><br>arameter | 7            | 1            | Display       | <u>/</u>       |    |      |    |  |  |
|              |          |   |            | / VIPF         | [2:0]=" 110"         | _/           |              | Action        | $\rightarrow$  |    |      |    |  |  |
|              |          |   |            |                | <u> </u>             |              | <br>         | Mode          | $ \frac{1}{1}$ |    |      |    |  |  |
|              |          |   |            | ( 18-bi        | t/pixel Mode         |              |              | Sequenti      | ;              |    |      |    |  |  |
|              |          |   |            |                |                      |              | i            | transfe       |                |    |      |    |  |  |
|              |          |   |            |                |                      |              | Ĺ            | . – –         | I              |    |      |    |  |  |
|              | <u> </u> |   |            |                |                      |              |              |               |                |    |      |    |  |  |



## 12.2.31 GSL (45h): Get Scan Line

| 45H                      |     |   |   |                                |                      | GS | L              |  |   |                            |    |    |  |  |
|--------------------------|-----|---|---|--------------------------------|----------------------|----|----------------|--|---|----------------------------|----|----|--|--|
| Inst / Para              | R/W | Add<br>MIPI   | ress<br>SPI-16  | D15-8                          | D7                   | D6 | D5             | D4                                       | D3  | D2                         | D1 | D0 |  |  |
| GSL                      | R   | 45h   | 4500h<br>4501h  | X<br>X                         |                      |    |                |  | [15:8]<br>S[7:0]                                  |                            | l  |    |  |  |
| Description              |     | define  |   | rrent scan line N              |                      |    |                |  |   |                            |    |    |  |  |
| Restriction              |     |   |   |                                |                      |    |                |  |   |                            |    |    |  |  |
| Register<br>availability |     |   | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode On, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes |                                |                      |    |                |  |   |                            |    |    |  |  |
| Default                  |     | Status Default Value (D7 to D0) Power On Sequence 00h S/W Reset 00h H/W Reset 00h |   |                                |                      |    |                |  |   |                            |    |    |  |  |
| Flow Chart               |     |   | <u>/</u>  | Dumm  2nd Pat N[1  3rd Par N[7 | y Read  ameter  5:8] |    | Host<br>Driver | Pa Pa Pa Pa Pa Pa Pa Pa Pa Pa Pa Pa Pa P | mmand rameter risplay Action Mode quential ansfer | 7<br>7<br>1<br>7<br>1<br>7 |    |    |  |  |



## 12.2.32 WRDISBV (51h): Write Display Brightness

| 51H          |   |  |                 |                   |            | WRDI          | SBV          |             |            |            |             |      |  |  |  |
|--------------|---|--|-----------------|-------------------|------------|---------------|--------------|-------------|------------|------------|-------------|------|--|--|--|
| Inst / Para  | R/W   | Add<br>MIPI  | lress<br>SPI-16 | D15-8             | D7         | D6            | D5           | D4          | D3         | D2         | D1          | D0   |  |  |  |
| WRDISBV      | W   | 51h  | 5100h           | Х                 |            | 1             | 1            | DBV         | [7:0]      |            |             | ı    |  |  |  |
|              | This cor  | mmand i  | is used to      | adjust the brig   | htness val | ue of the d   | isplay.      |             |            |            |             |      |  |  |  |
|              | It should   | d be che   | ecked wha       | at the relationsh | ip betweei | n this writte | en value a   | and output  | brightness | of the dis | play is. Th | is   |  |  |  |
| Description  | relations   | ship is d  | efined on       | the display mo    | dule speci | fication.     |              |             |            |            |             |      |  |  |  |
|              | In princi   | ple relat  | tionship is     | s that 00h value  | means th   | e lowest bi   | rightness    | and FFh va  | alue mean  | s the high | est brightn | ess. |  |  |  |
| Restriction  | The disp  | olay sup   | plier can       | not use this con  | nmand for  | tuning (e.g   | ı. factory t | uning, etc. | ).         |            |             |      |  |  |  |
|              |   | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode On, Sleep Out Yes |                 |                   |            |               |              |             |            |            |             |      |  |  |  |
|              |   |  |                 |                   |            |               |              |             |            |            |             |      |  |  |  |
| Register     |   | Normal Mode On, Idle Mode On, Sleep Out Yes  |                 |                   |            |               |              |             |            |            |             |      |  |  |  |
| availability |   | Partial Mode On, Idle Mode Off, Sleep Out Yes  |                 |                   |            |               |              |             |            |            |             |      |  |  |  |
|              |   | Partial Mode On, Idle Mode On, Sleep Out Yes   |                 |                   |            |               |              |             |            |            |             |      |  |  |  |
|              |   | Sleep In Yes   |                 |                   |            |               |              |             |            |            |             |      |  |  |  |
| Default      | Status Default Value (D7 to D0) Power On Sequence 00h S/W Reset 00h H/W Reset 00h |  |                 |                   |            |               |              |             |            |            |             |      |  |  |  |
| Flow Chart   | S/W Reset 00h   |  |                 |                   |            |               |              |             |            |            |             |      |  |  |  |



## 12.2.33 RDDISBV (52h/5200h): Read Display Brightness Value

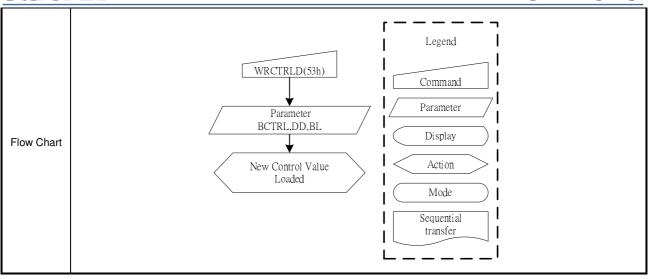
| 52H          |          |             |             |                               |             | RDDI         | SBV         |                      |              |             |             |          |
|--------------|----------|-------------|-------------|-------------------------------|-------------|--------------|-------------|----------------------|--------------|-------------|-------------|----------|
| Leat / Dave  | DAM      | Add         | dress       | D45.0                         | D.7         | Do           | DE          | D.4                  | Do           | Do          | D4          | Do       |
| Inst / Para  | R/W      | MIPI        | SPI-16      | D15-8                         | D7          | D6           | D5          | D4                   | D3           | D2          | D1          | D0       |
| WRDISBV      | R        | 52h         | 5200h       | X                             |             |              |             | DBV                  | [7:0]        |             |             |          |
|              | This co  | mmand       | returns th  | e brightness va               | lue of the  | display.     |             |                      |              |             |             |          |
|              | It shoul | d be che    | ecked wha   | at the relationsh             | ip betweer  | n this retur | ned value   | and outpu            | ıt brightne: | ss of the d | lisplay. Th | is       |
|              | relation | ship is c   | defined on  | the display mo                | dule speci  | fication is. |             |                      |              |             |             |          |
| Description  | In princ | iple the    | relationsh  | ip is that 00h va             | alue mean   | s the lowes  | st brightne | ess and FF           | h value m    | eans the h  | nighest bri | ghtness. |
|              | DBV[7:   | 0] is res   | et when d   | isplay is in slee             | p in mode.  |              |             |                      |              |             |             |          |
|              | DBV[7:   | 0] is '0' v | when bit E  | CTRL of write (               | CTRL disp   | ay comma     | ınd (53h)   | is '0'               |              |             |             |          |
|              | DBV[7:   | 0] IS ma    | ınual set b | orightness speci              | fied with w | rite CTRL    | display c   | ommand (             | 53h) when    | bit BCTR    | L is '1'    |          |
| Restriction  |          |             |             |                               |             |              |             |                      |              |             |             |          |
|              |          |             |             |                               |             |              |             |                      |              |             |             |          |
|              |          |             | Normal      | Statu                         |             | Cloop Out    |             |                      | Availab      | ılıty       |             |          |
| Register     |          |             |             | Mode On, Idle Mode On, Idle M |             |              |             |                      | Yes<br>Yes   |             |             |          |
| availability |          |             |             | Mode On, Idle N               |             |              |             |                      | Yes          |             |             |          |
|              |          |             |             | Mode On, Idle N               |             |              |             |                      | Yes          |             |             |          |
|              |          |             |             | Sleep                         | In          |              |             |                      | Yes          |             |             |          |
|              |          |             |             |                               |             |              |             |                      |              |             |             |          |
|              |          | Ī           | Status      |                               |             |              | Default     | Value (D7            | to D0)       |             |             |          |
|              |          | ľ           |             | n Sequence                    |             |              | 00h         | value (B)            | 10 00)       |             |             |          |
| Default      |          | İ           | S/W Res     | •                             |             |              | 00h         |                      |              |             |             |          |
|              |          |             | H/W Res     | set                           |             |              | 00h         |                      |              |             |             |          |
|              |          | _           |             |                               |             |              |             |                      |              |             | •           |          |
|              |          |             |             |                               |             |              | ١ –         | <b>—</b> — -         |              |             |             |          |
|              |          |             |             |                               |             |              | 1           | Legend               |              |             |             |          |
|              |          |             |             | R                             | DDISB(521   | 1) Ho        | oct         |                      | -            |             |             |          |
|              |          |             |             |                               |             | Driv         |             | Commar               | I            |             |             |          |
|              |          |             |             | Se                            | end Parame  |              | 7 ¦_        | Paramete             | er /         |             |             |          |
| Flow Chart   |          |             |             |                               | DBV[7:0]    | /            | ic          | Display              | 1            |             |             |          |
|              |          |             |             |                               |             |              | i <         | Action               | ->!          |             |             |          |
|              |          |             |             |                               |             |              |             |                      | !            |             |             |          |
|              |          |             |             |                               |             |              |             | Mode                 |              |             |             |          |
|              |          |             |             |                               |             |              |             | Sequenti<br>transfer |              |             |             |          |
|              |          |             |             |                               |             |              |             |                      |              |             |             |          |
|              |          |             |             |                               |             |              |             |                      |              |             |             |          |



## 12.2.34 WRCTRLD (53h/5300h): Write CTRL Display

| 53H          |           |   |                |                          |              | WRC         | ΓRLD           |             |                |             |           |         |  |  |  |
|--------------|-----------|---|----------------|--------------------------|--------------|-------------|----------------|-------------|----------------|-------------|-----------|---------|--|--|--|
|              |           | Add   | lress          |                          |              |             |                |             |                |             |           |         |  |  |  |
| Inst / Para  | R/W       | MIPI  | SPI-16         | D15-8                    | D7           | D6          | D5             | D4          | D3             | D2          | D1        | D0      |  |  |  |
| WRCTRLD      | W         | 53h   | 5300h          | Х                        |              |             | BCTRL          |             | DD             | BL          |           |         |  |  |  |
|              | This cor  | nmand   | is used to     | control display          | brightnes    | S.          |                |             |                |             |           |         |  |  |  |
|              | BCTRL:    | Brightn   | ness Cont      | trol Block On/Off        | , This bit i | s always u  | sed to swi     | tch brightr | ness for di    | splay.      |           |         |  |  |  |
|              | 0 = Off ( | Brightn   | ess regis      | ter are 00h, DB\         | /[7:0])      |             |                |             |                |             |           |         |  |  |  |
|              | 1 = On (  | (Brightn  | ess regis      | ter are active, a        | ccording to  | the other   | paramete       | rs.)        |                |             |           |         |  |  |  |
|              | DD: Dis   | play Din  | nming (O       | nly for manual b         | rightness    | setting)    |                |             |                |             |           |         |  |  |  |
|              | DD = 0:   | Display   | / Dimming      | g is off.                |              |             |                |             |                |             |           |         |  |  |  |
| Description  |           |   | · Dimmin       | -                        |              |             |                |             |                |             |           |         |  |  |  |
| 2 000        |           |   | ontrol On      | -                        |              |             |                |             |                |             |           |         |  |  |  |
|              |           | _   |                | off backlight circ       | uit. Contr   | ol lines mu | st be low.)    |             |                |             |           |         |  |  |  |
|              | 1 = On    |   |                |                          |              |             |                |             |                |             |           |         |  |  |  |
|              |           |   |                |                          |              |             |                |             |                |             |           |         |  |  |  |
|              |           | mming function is adapted to the brightness registers for display when bit BCTRL is changed at DD=1.  nen BL bit changed from 'on' to 'off', backlight is turned off without gradual dimming, even if dimming-on (DD=1) are |                |                          |              |             |                |             |                |             |           |         |  |  |  |
|              |           |   | anged fro      | om fon to form, ba       | acklight is  | turnea ott  | without gra    | aduai dimr  | ning, ever     | ı it almmin | g-on (DD= | :1) are |  |  |  |
|              | selected  | 1.  |                |                          |              |             |                |             |                |             |           |         |  |  |  |
| Restriction  |           |   |                |                          |              |             |                |             |                |             |           |         |  |  |  |
|              |           |   |                | 0: :                     |              |             |                |             | <b>A</b> 11 1  |             |           |         |  |  |  |
|              |           |   | Normal         | Statu<br>Mode On, Idle N |              | Sloop Out   |                |             | Availab<br>Yes | -           |           |         |  |  |  |
| Register     |           |   |                | Mode On, Idle M          |              |             |                |             | Yes            |             |           |         |  |  |  |
| availability |           |   |                | Mode On, Idle N          |              | -           |                |             | Yes            |             |           |         |  |  |  |
| -            |           |   |                | Mode On, Idle M          |              | -           |                |             | Yes            |             |           |         |  |  |  |
|              |           |   |                | Sleep                    | In           |             |                |             | Yes            |             |           |         |  |  |  |
|              |           |   |                |                          |              |             |                |             |                |             |           |         |  |  |  |
|              |           | Г   | <b>.</b>       |                          |              |             |                | /==         |                |             |           |         |  |  |  |
|              |           |   | Status Power C | On Sequence              |              |             | Default<br>00h | Value (D7   | to D0)         |             |           |         |  |  |  |
| Default      |           | -   | S/W Res        | ·                        |              |             | 00h            |             |                |             | $\dashv$  |         |  |  |  |
|              |           | F   | H/W Re         |                          |              |             | 00h            |             |                |             |           |         |  |  |  |
|              |           | L   |                |                          |              |             | L              |             |                |             |           |         |  |  |  |
|              |           |   |                |                          |              |             |                |             |                |             |           |         |  |  |  |

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## 12.2.35 RDCTRLD (54h): Read CTRL Value Display

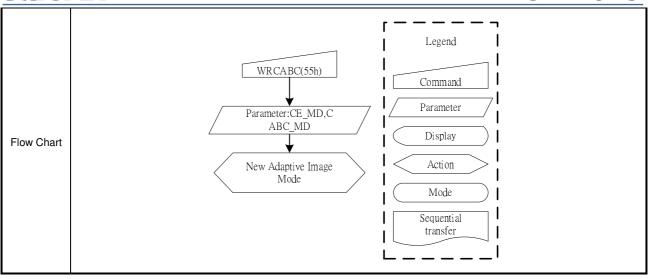
| 54H                   |          |          |                   |                               |                        | WRC         | ΓRLD         |              |             |        |    |      |
|-----------------------|----------|----------|-------------------|-------------------------------|------------------------|-------------|--------------|--------------|-------------|--------|----|------|
|                       | 5.44     | Add      | dress             | 545.0                         |                        |             |              | 5.4          | -           |        | 5. | D.o. |
| Inst / Para           | R/W      | MIPI     | SPI-16            | D15-8                         | D7                     | D6          | D5           | D4           | D3          | D2     | D1 | D0   |
| RDCTRLD               | R        | 54h      | 5400h             | X                             |                        |             | BCTRL        |              | DD          | BL     |    |      |
|                       | This cor | mmand    | returns a         | mbient light and              | brightnes              | s control v | alues        |              |             |        |    |      |
|                       | BCTRL    | Brightr  | ness Cont         | rol Block On/Off              | f, This bit            | is always ι | sed to sw    | itch brighti | ness for di | splay. |    |      |
|                       | 0 = Off  |          | 1 = On            |                               |                        |             |              |              |             |        |    |      |
| Description           | DD: Dis  | play Dir | mming (O          | nly for manual b              | rightness              | setting)    |              |              |             |        |    |      |
|                       | DD = 0   |          | DD = 1            |                               |                        |             |              |              |             |        |    |      |
|                       | BL: Bac  | klight C | ontrol On         | /Off                          |                        |             |              |              |             |        |    |      |
|                       | 0 = Off  |          | 1 = On            |                               |                        |             |              |              |             |        |    |      |
| Restriction           |          |          |                   |                               |                        |             |              |              |             |        |    |      |
|                       |          |          |                   |                               |                        |             |              |              |             |        |    |      |
|                       |          |          |                   | Statu                         |                        |             |              |              | Availab     |        |    |      |
| Deviates              |          |          |                   | Mode On, Idle M               |                        |             |              |              | Yes         |        |    |      |
| Register availability |          | -        |                   | Mode On, Idle Mode On, Idle M |                        |             |              |              | Yes<br>Yes  |        |    |      |
| availability          |          |          |                   | Mode On, Idle N               |                        |             |              |              | Yes         |        |    |      |
|                       |          |          |                   | Sleep                         |                        |             |              |              | Yes         |        |    |      |
|                       |          |          |                   |                               |                        |             |              |              |             |        |    |      |
|                       |          | ı        | O                 |                               |                        |             | 5            | (5=          | . 50)       |        |    |      |
|                       |          | ŀ        | Status<br>Power C | n Sequence                    |                        |             | 00h          | Value (D7    | to D0)      |        |    |      |
| Default               |          | -        | S/W Res           |                               |                        |             | 00h          |              |             |        |    |      |
|                       |          |          | H/W Res           |                               |                        |             | 00h          |              |             |        |    |      |
|                       |          | _        |                   |                               |                        |             |              |              |             |        |    |      |
|                       |          |          |                   |                               |                        |             | ۱ –          |              |             |        |    |      |
|                       |          |          |                   |                               |                        |             | !            | Legend       | !  <br>!    |        |    |      |
|                       |          |          |                   | RI                            | OCTRLD(5               | 4h) H       | ost <b>j</b> | Commar       |             |        |    |      |
|                       |          |          |                   | •••                           | ••••                   | Driv        |              |              |             |        |    |      |
|                       |          |          |                   | So                            | end Parame<br>CTRL,DD, | ter         | 7 ¦_         | Paramete     | er /        |        |    |      |
| Flow Chart            |          |          |                   | <u> </u>                      | CTRL,DD,               | <u> </u>    |              | Display      | ·)          |        |    |      |
|                       |          |          |                   |                               |                        |             | ! <          | Action       | >¦          |        |    |      |
|                       |          |          |                   |                               |                        |             |              | Mode         | <u> </u>    |        |    |      |
|                       |          |          |                   |                               |                        |             | _            | Sequenti     |             |        |    |      |
|                       |          |          |                   |                               |                        |             |              | transfer     |             |        |    |      |
|                       |          |          |                   |                               |                        |             | L.           |              | I           |        |    |      |
|                       |          |          |                   |                               |                        |             |              |              |             |        |    |      |



# 12.2.36 WRCACE (55h/5500h): Write Content Adaptive Brightness Control and Color Enhancement

| 55H          |                                 |   |                   |                                |             | WR        | CACE          |             |            |             |            |         |  |  |
|--------------|---------------------------------|---|-------------------|--------------------------------|-------------|-----------|---------------|-------------|------------|-------------|------------|---------|--|--|
| Inst / Para  | R/W                             | Add                                     | lress             | D15-8                          | D7          | D6        | D5            | D4          | D3         | D2          | D1         | D0      |  |  |
|              |                                 | MIPI                                    | SPI-16            | D13-0                          |             | D0        |               |             | D3         | DZ.         |            |         |  |  |
| WRCACE       | W                               | 55h                                     | 5500h             | Х                              | CE_ON       |           | CEMI          |             |            |             |            | MD[1:0] |  |  |
|              | This co                         | mmand                                   | is used to        | o set parameter                | s for image | e content | based adap    | otive brigh | tness cont | rol functio | nality and | Color   |  |  |
|              | Enhanc                          | ement f                                 | unction           |                                |             |           |               |             |            |             |            |         |  |  |
|              | CE_ON                           | l="1",Co                                | lor enhar         | ncement on                     | CE_ON:      | ="0",Colo | r enhancem    | ent off     |            |             |            |         |  |  |
|              | There a                         | re three                                | color en          | hancement leve                 | els can be  | set.      |               |             |            | <u>-</u>    |            |         |  |  |
|              |                                 |   |                   | CEMD[1]                        | CEMD[0]     |           | Function      |             |            |             |            |         |  |  |
|              |                                 |   |                   | 0                              | 0           |           | Low enhan     | cement      |            |             |            |         |  |  |
|              |                                 |   |                   | 0                              | 1           |           | Medium en     | hancemer    | nt         |             |            |         |  |  |
| Description  |                                 |   |                   | 1                              | 1           |           | High enhar    | cement      |            |             |            |         |  |  |
|              | There is                        | s possib                                | le to use         | d 4 different mo               | des for cor | ntent ada | ptive image   | functional  | ity, which | are define  | d on a tab | le      |  |  |
|              | below.                          | ·                                       |                   |                                |             |           |               |             | •          |             |            |         |  |  |
|              |                                 | CABC_MD[1] CABC_MD[0] Function          |                   |                                |             |           |               |             |            |             |            |         |  |  |
|              |                                 | CABC_MD[1] CABC_MD[0] Function  0 0 Off |                   |                                |             |           |               |             |            |             |            |         |  |  |
|              |                                 |   |                   |                                |             |           | User Interf   | aaa Mada    |            |             |            |         |  |  |
|              |                                 |   |                   | 0                              | 1           |           |               |             |            |             |            |         |  |  |
|              |                                 |   |                   | 1                              | 0           |           | Still Picture |             |            |             |            |         |  |  |
|              |                                 |   |                   | 1                              | 1           |           | Moving Im     | age         |            |             |            |         |  |  |
| Restriction  |                                 |   |                   |                                |             |           |               |             |            |             |            |         |  |  |
|              |                                 |   |                   | _                              |             |           |               |             |            |             |            |         |  |  |
|              |                                 |   | N. a. was all     | Stati                          |             | Class O   | .4            |             | Availab    | -           |            |         |  |  |
| Register     |                                 |   |                   | Mode On, Idle<br>Mode On, Idle |             |           |               |             | Yes<br>Yes |             |            |         |  |  |
| availability |                                 |   |                   | Mode On, Idle I                |             |           |               |             | Yes        |             |            |         |  |  |
|              |                                 |   |                   | Mode On, Idle I                |             |           |               |             | Yes        |             |            |         |  |  |
|              |                                 |   |                   | Sleep                          | ln          |           |               |             | Yes        |             |            |         |  |  |
|              |                                 |   |                   |                                |             |           |               |             |            |             |            |         |  |  |
|              | Status Default Value (D7 to D0) |   |                   |                                |             |           |               |             |            |             |            |         |  |  |
|              |                                 | ŀ                                       | Status<br>Power ( | On Sequence                    |             |           | 00h           | value (D/   | 10 D0)     |             |            |         |  |  |
| Default      |                                 | -                                       | S/W Re            |                                |             |           | 00h           |             |            |             |            |         |  |  |
|              |                                 | ŀ                                       | H/W Re            |                                |             |           | 00h           |             |            |             |            |         |  |  |
|              |                                 | •                                       |                   | •                              |             |           |               |             |            |             |            |         |  |  |
|              |                                 |   |                   |                                |             |           |               |             |            |             |            |         |  |  |

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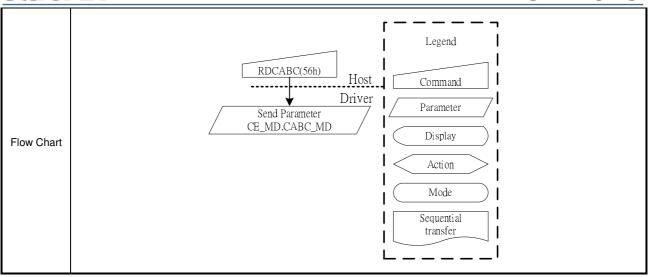




## 12.2.37 RDCABC (56h/5600h): Read Content Adaptive Brightness Control

| 56H          |                               |                                |                   |                                       |              | RDC        | CABC         |             |            |             |            |         |  |  |
|--------------|-------------------------------|--------------------------------|-------------------|---------------------------------------|--------------|------------|--------------|-------------|------------|-------------|------------|---------|--|--|
| Inst / Para  | R/W                           | Add                            | dress             | D15-8                                 | D7           | D6         | D5           | D4          | D3         | D2          | D1         | D0      |  |  |
| IIISt / Fala | IT/VV                         | MIPI                           | SPI-16            | D13-0                                 |              | D0         |              |             | DS         | DZ          |            |         |  |  |
| RDCABC       | R                             | 56h                            | 5600h             | Х                                     | CE_ON        |            |              | D[1:0]      |            |             |            | MD[1:0] |  |  |
|              | This co                       | mmand                          | is used t         | o read the settin                     | ngs for ima  | ge conten  | t based ad   | aptive brig | htness co  | ntrol funct | ionality.  |         |  |  |
|              | CE_ON                         | l="1",Co                       | lor enhar         | ncement on                            | CE_ON:       | ="0",Color | enhancen     | nent off    |            |             |            |         |  |  |
|              | There a                       | are three                      | color en          | hancement leve                        | els can be s | set.       |              |             |            |             |            |         |  |  |
|              |                               |                                |                   | CEMD[1]                               | CEMD[0]      | 1          | Function     |             |            |             |            |         |  |  |
|              |                               |                                |                   | 0                                     | 0            | 1          | Low enhan    | cement      |            |             |            |         |  |  |
|              |                               |                                |                   | 0                                     | 1            | 1          | Medium er    | hancemer    | nt         |             |            |         |  |  |
|              |                               |                                |                   | 1                                     | 1            | 1          | High enhar   | ncement     |            |             |            |         |  |  |
| Description  | There is                      | s possib                       | le to use         | d 4 different mo                      | des for cor  | ntent adap | tive image   | functional  | ity, which | are define  | d on a tab | le      |  |  |
|              | below.                        |                                |                   |                                       |              |            |              |             |            |             |            |         |  |  |
|              |                               | CABC_MD[1] CABC_MD[0] Function |                   |                                       |              |            |              |             |            |             |            |         |  |  |
|              | 0 0 Off                       |                                |                   |                                       |              |            |              |             |            |             |            |         |  |  |
|              | 0 0 Off 0 User Interface Mode |                                |                   |                                       |              |            |              |             |            |             |            |         |  |  |
|              |                               |                                |                   |                                       |              |            |              |             |            |             |            |         |  |  |
|              |                               |                                |                   | 1                                     | 0            |            | Still Pictur |             |            |             |            |         |  |  |
|              |                               |                                |                   | 1                                     | 1            |            | Moving Im    | age         |            |             |            |         |  |  |
|              | '-': Don                      | 't care                        |                   |                                       |              |            |              |             |            |             |            |         |  |  |
| Restriction  |                               |                                |                   |                                       |              |            |              |             |            |             |            |         |  |  |
|              |                               |                                |                   |                                       |              |            |              |             |            |             |            |         |  |  |
|              |                               |                                | Nama              | Stati                                 |              | Class Ou   |              |             | Availab    |             |            |         |  |  |
| Register     |                               |                                |                   | Mode On, Idle Mode On, Idle           |              |            |              |             | Yes<br>Yes |             |            |         |  |  |
| availability |                               |                                |                   | Mode On, Idle I                       |              |            |              |             | Yes        |             |            |         |  |  |
|              |                               |                                |                   | Mode On, Idle I                       |              |            |              |             | Yes        |             |            |         |  |  |
|              |                               |                                |                   | Sleep                                 | ) In         |            |              |             | Yes        |             |            |         |  |  |
|              |                               |                                |                   |                                       |              |            |              |             |            |             |            |         |  |  |
|              |                               | Ī                              | Obstant           |                                       |              |            | Defectly     | V-1 (D7     | t- D0)     |             |            |         |  |  |
|              |                               | ł                              | Status<br>Power ( | On Sequence                           |              |            | 00h          | Value (D7   | to D0)     |             |            |         |  |  |
| Default      |                               | ł                              | S/W Re            | · · · · · · · · · · · · · · · · · · · |              |            | 00h          |             |            |             |            |         |  |  |
|              |                               | Ì                              | H/W Re            |                                       |              |            | 00h          |             |            |             |            |         |  |  |
|              |                               |                                |                   |                                       |              |            |              |             |            |             |            |         |  |  |
|              | _                             |                                | _                 |                                       | ·            |            |              |             |            |             | ·          | ·       |  |  |

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## 12.2.38 WRCABCMB (5Eh/5E00h): Write CABC Minimum Brightness

| 5EH          |   |  |                 |                  |  | WRCAI       | BCMB        |   |  |       |             |            |  |  |  |
|--------------|---|--|-----------------|------------------|--|-------------|-------------|---|--|-------|-------------|------------|--|--|--|
| Inst / Para  | R/W   | Add<br>MIPI                                  | dress<br>SPI-16 | D15-8            | D7   | D6          | D5          | D4  | D3   | D2    | D1          | D0         |  |  |  |
| WRCABCMB     | W   | 5Eh  | 5E00h           | Х                |  | 1           |             | CME   | I<br>B[7:0]  |       |             |            |  |  |  |
|              |   |  |                 | set the minimu   | m brightn                                    | ess value o | of the disp |   |  | n.    |             |            |  |  |  |
| Description  |   |  |                 | s that 00h value | _  |             | -           | -   |  |       | s the brigi | ntness for |  |  |  |
| Boompaon     | CABC.   |  |                 |                  |  |             | J           |   |  |       | J           |            |  |  |  |
| Restriction  |   |  |                 |                  |  |             |             |   |  |       |             |            |  |  |  |
|              |   |  |                 | Statu            | S  |             |             |   | Availab  | ility |             |            |  |  |  |
|              |   |  | Normal          | Mode On, Idle I  | Mode Off,                                    | Sleep Out   |             |   | Yes  |       |             |            |  |  |  |
| Register     |   |  | Normal          | Mode On, Idle I  | Mode On,                                     | Sleep Out   |             |   | Yes  |       |             |            |  |  |  |
| availability |   |  | Partial         | Mode On, Idle N  | Node Off,                                    | Sleep Out   |             |   | Yes  |       |             |            |  |  |  |
|              |   | Partial Mode On, Idle Mode On, Sleep Out Yes |                 |                  |  |             |             |   |  |       |             |            |  |  |  |
|              |   | Sleep In Yes                                 |                 |                  |  |             |             |   |  |       |             |            |  |  |  |
| Default      | Status Default Value (D7 to D0) Power On Sequence 00h S/W Reset 00h H/W Reset 00h |  |                 |                  |  |             |             |   |  |       |             |            |  |  |  |
| Flow Chart   |   |  |                 | Pa New I         | CABCME( urameter:CN  Display Lun /alue Loade | MB /        | 7           | Comman Paramete Display Action Mode Sequenti transfer | dd   dd   ler   le |       |             |            |  |  |  |



## 12.2.39 RDCABCMB (5Fh/5F00h): Read CABC Minimum Brightness

| 5FH                   |  |  |                 |                  |           | WRCA        | ВСМВ       |           |            |           |             |            |  |  |  |
|-----------------------|--|--|-----------------|------------------|-----------|-------------|------------|-----------|------------|-----------|-------------|------------|--|--|--|
| Inst / Para           | R/W  | Add<br>MIPI  | dress<br>SPI-16 | D15-8            | D7        | D6          | D5         | D4        | D3         | D2        | D1          | D0         |  |  |  |
| WRCABCMB              | R  | 5Fh  | 5F00h           | Х                |           |             |            | CMB       | 8[7:0]     |           | I           |            |  |  |  |
|                       | This cor   | nmand  | returns th      | ne minimum brig  | htness va | lue of CAB  | C function |           |            |           |             |            |  |  |  |
| Description           |  | ple rela   | tionship i      | s that 00h value | means th  | e lowest bi | ightness f | or CABC a | and FFh va | alue mean | s the brigl | ntness for |  |  |  |
|                       | CABC.  |  |                 |                  |           |             |            |           |            |           |             |            |  |  |  |
| Restriction           |  |  |                 |                  |           |             |            |           |            |           |             |            |  |  |  |
|                       |  | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On Idle Mode On Sleep Out Yes |                 |                  |           |             |            |           |            |           |             |            |  |  |  |
| Dogistor              |  | Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode On, Sleep Out Yes                    |                 |                  |           |             |            |           |            |           |             |            |  |  |  |
| Register availability |  | Normal Mode On, Idle Mode On, Sleep Out  Yes  Partial Mode On, Idle Mode Off, Sleep Out  Yes                 |                 |                  |           |             |            |           |            |           |             |            |  |  |  |
| aramasmi,             |  | Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes                  |                 |                  |           |             |            |           |            |           |             |            |  |  |  |
|                       |  | Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes   |                 |                  |           |             |            |           |            |           |             |            |  |  |  |
|                       |  | Sleep In Yes   |                 |                  |           |             |            |           |            |           |             |            |  |  |  |
| Default               | Status Default Value (D7 to D0) Power On Sequence 00h S/W Reset 00h H/W Reset 00h            |  |                 |                  |           |             |            |           |            |           |             |            |  |  |  |
| Flow Chart            | RDCABCMB(5Fh) Host Command Driver Send Parameter CMB Display Action Mode Sequential transfer |  |                 |                  |           |             |            |           |            |           |             |            |  |  |  |



## 12.2.40 RDABCSDR (68h/6800h): Read Automatic Brightness Control Self-Diagnostic Result

| 68H                      |   |   |                 |       |     | WRCA        | всмв       |              |            |            |           |             |  |  |  |
|--------------------------|---|---|-----------------|-------|-----|-------------|------------|--------------|------------|------------|-----------|-------------|--|--|--|
| Inst / Para              | R/W   | Add<br>MIPI   | dress<br>SPI-16 | D15-8 | D7  | D6          | D5         | D4           | D3         | D2         | D1        | D0          |  |  |  |
| WRCABCMB                 | R   | 68h   | 6800h           | Х     | RLD | FUND        |            |              |            |            |           |             |  |  |  |
| Description              | sleep ou  | it -comr<br>egister<br>Functio  |                 |       |     | e display s | elf-diagno | ostic result | s for auto | matic brig | htness co | ntrol after |  |  |  |
| Restriction              |   | <u> </u>  |                 |       |     |             |            |              |            |            |           |             |  |  |  |
| Register<br>availability |   | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode On, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes |                 |       |     |             |            |              |            |            |           |             |  |  |  |
| Default                  | Status Default Value (D7 to D0) Power On Sequence 00h S/W Reset 00h H/W Reset 00h |   |                 |       |     |             |            |              |            |            |           |             |  |  |  |
| Flow Chart               |   |   |                 |       |     |             |            |              |            |            |           |             |  |  |  |



## 12.2.41 RDBWLB (70h/7000h):Read Black/White Low Bits

| 70H          |          |  |                 |                               |            | RDB\        | WLB            |                 |  |     |     |     |  |  |
|--------------|----------|--|-----------------|-------------------------------|------------|-------------|----------------|-----------------|--|-----|-----|-----|--|--|
| Inst / Para  | R/W      | Add<br>MIPI  | dress<br>SPI-16 | D15-8                         | D7         | D6          | D5             | D4              | D3   | D2  | D1  | D0  |  |  |
| RDBWLB       | R        | 70h  | 7000h           | Х                             | BKx1       | BKx0        | BKy1           | BKy0            | Wx1  | Wx0 | Wy1 | Wy0 |  |  |
|              | This cor | nmand  | reads the       | e lowest bits of b            | lack and v | vhite color | character      | istics.         |  |     |     |     |  |  |
| Description  | Black: B | kx and   | Bky             |                               |            |             |                |                 |  |     |     |     |  |  |
|              | White: V | Vx and   | Wy              |                               |            |             |                |                 |  |     |     |     |  |  |
| Restriction  |          |  |                 |                               |            |             |                |                 |  |     |     |     |  |  |
|              |          |  |                 |                               |            |             |                |                 |  |     |     |     |  |  |
|              |          |  |                 | Statu                         |            | O. O.       |                |                 | Availab  |     |     |     |  |  |
| Register     |          |  |                 | Mode On, Idle Mode On, Idle M |            |             |                |                 | Yes<br>Yes   |     |     |     |  |  |
| availability |          |  |                 | Mode On, Idle N               |            |             |                |                 | Yes  |     |     |     |  |  |
| ,            |          |  |                 |                               |            |             |                |                 |  |     |     |     |  |  |
|              |          | Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes                               |                 |                               |            |             |                |                 |  |     |     |     |  |  |
| Default      |          | Status  Default Value (D7 to D0)  Power On Sequence  XXh  S/W Reset  XXh  H/W Reset  XXh |                 |                               |            |             |                |                 |  |     |     |     |  |  |
| Flow Chart   |          |  | 2               | RDBW!  Send 1st F  Send 2rd 1 | 1          |             | Host<br>Driver | Co Pa D A A Sec | egend mmand rameter isplay action Mode quential ansfer |     |     |     |  |  |



## 12.2.42 RDBkx (71h/7100h):Read Bkx

| 71H                      |          |  |                   |  |  | RDI                    | 3kx            |        |  |                                       |    |    |  |
|--------------------------|----------|--|-------------------|--|--|------------------------|----------------|--------|--|---------------------------------------|----|----|--|
| Inst / Para              | R/W      | Add<br>MIPI  | dress<br>SPI-16   | D15-8  | D7   | D6                     | D5             | D4     | D3   | D2                                    | D1 | D0 |  |
| RDBkx                    | R        | 71h  | 7100h             | Х  |  |                        |                | BKx    | [9:2]  |                                       | I  |    |  |
| Description              | This cor | nmand  | reads the         | Bkx bits (Bkx [  | 9:2]) of bla                                   | ack color cl           | naracterist    | ics.   |  |                                       |    |    |  |
| Restriction              | Only the | 2nd p  | arameter          | is sent on the D   | SI; the 1st                                    | t paramete             | r is not ser   | nt.    |  |                                       |    |    |  |
| Register<br>availability |          |  | Normal<br>Partial | Statu<br>Mode On, Idle I<br>Mode On, Idle I<br>Mode On, Idle I<br>Mode On, Idle I<br>Sleep | Mode Off,<br>Mode On,<br>Mode Off,<br>Mode On, | Sleep Out<br>Sleep Out |                |        | Availab<br>Yes<br>Yes<br>Yes<br>Yes                    |                                       |    |    |  |
| Default                  |          | Status Default Value (D7 to D0)  Power On Sequence XXh  S/W Reset XXh  H/W Reset XXh |                   |  |  |                        |                |        |  |                                       |    |    |  |
| Flow Chart               |          |  | 2                 | Send 1st 1   | 9:2](71h) Parameter Parameter                  |                        | Host<br>Driver | Co Pau | egend mmand rameter isplay action Mode quential ansfer | 7   7   7   7   7   7   7   7   7   7 |    |    |  |



## 12.2.43 RDBky (72h/7200h):Read Bky

| 72H                      |  |   |                 |                  |              | RDI         | Зky         |       |       |    |    |    |  |  |
|--------------------------|--|---|-----------------|------------------|--------------|-------------|-------------|-------|-------|----|----|----|--|--|
| Inst / Para              | R/W  | Add<br>MIPI   | dress<br>SPI-16 | D15-8            | D7           | D6          | D5          | D4    | D3    | D2 | D1 | D0 |  |  |
| RDBky                    | R  | 72h   | 7200h           | Х                |              |             |             | ВКу   | [9:2] |    |    |    |  |  |
| Description              | This co  | mmand   | reads the       | Bkx bits (Bky [  | 9:2]) of bla | ck color cl | naracteris  | tics. |       |    |    |    |  |  |
| Restriction              | Only the   | e 2nd pa  | arameter        | is sent on the D | SI; the 1st  | paramete    | r is not se | nt.   |       |    |    |    |  |  |
| Register<br>availability |  | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode On, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes |                 |                  |              |             |             |       |       |    |    |    |  |  |
| Default                  | Status Default Value (D7 to D0)  Power On Sequence XXh  S/W Reset XXh  H/W Reset XXh |   |                 |                  |              |             |             |       |       |    |    |    |  |  |



## 12.2.44 RDWx (73h/7300h):Read Wx

| 73H                      |   |   |                 |                  |              | RD'         | Wx           |     |      |    |          |    |  |
|--------------------------|---|---|-----------------|------------------|--------------|-------------|--------------|-----|------|----|----------|----|--|
| Inst / Para              | R/W   | Add<br>MIPI   | dress<br>SPI-16 | D15-8            | D7           | D6          | D5           | D4  | D3   | D2 | D1       | D0 |  |
| RDWx                     | R   | 72h   | 7200h           | Х                |              |             |              | Wx[ | 9:2] |    | <u>I</u> |    |  |
| Description              | This co   | mmand   | reads the       | Wx bits (Bky [9  | ):2]) of bla | ck color ch | aracteristi  | cs. |      |    |          |    |  |
| Restriction              | Only the  | e 2nd pa  | arameter        | is sent on the D | SI; the 1st  | paramete    | r is not ser | nt. |      |    |          |    |  |
| Register<br>availability |   | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode On, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes |                 |                  |              |             |              |     |      |    |          |    |  |
| Default                  | Status Default Value (D7 to D0) Power On Sequence XXh S/W Reset XXh H/W Reset XXh |   |                 |                  |              |             |              |     |      |    |          |    |  |



## 12.2.45 RDWy (74h/7400h):Read Wy

| 74H                      |          |   |                 |                  |              | RD          | Иy           |          |      |    |    |    |  |
|--------------------------|----------|---|-----------------|------------------|--------------|-------------|--------------|----------|------|----|----|----|--|
| Inst / Para              | R/W      | Add<br>MIPI   | dress<br>SPI-16 | D15-8            | D7           | D6          | D5           | D4       | D3   | D2 | D1 | D0 |  |
| RDWy                     | R        | 74h   | 7400h           | X                |              |             |              | l<br>Wy[ | 9:2] |    |    |    |  |
| Description              |          | mmand<br>n't care   | reads the       | Wx bits (Bky [9  | :2]) of blac | ck color ch | aracteristi  |          | •    |    |    |    |  |
| Restriction              | Only the | e 2nd pa  | arameter        | is sent on the D | SI; the 1st  | paramete    | r is not sei | nt.      |      |    |    |    |  |
| Register<br>availability |          | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode On, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes |                 |                  |              |             |              |          |      |    |    |    |  |
| Default                  |          | Status Default Value (D7 to D0)  Power On Sequence XXh  S/W Reset XXh  H/W Reset XXh  |                 |                  |              |             |              |          |      |    |    |    |  |



## 12.2.46 RDRGLB (75h/7500h):Read Red/Green Low Bits

| 75H          |  |                     |                 |                   |             | RDR        | GLB          |       |     |     |     |     |  |  |
|--------------|--|---------------------|-----------------|-------------------|-------------|------------|--------------|-------|-----|-----|-----|-----|--|--|
| Inst / Para  | R/W  | Add<br>MIPI         | dress<br>SPI-16 | D15-8             | D7          | D6         | D5           | D4    | D3  | D2  | D1  | D0  |  |  |
| RDRGLB       | R  | 75h                 | 7500h           | Х                 | Rx1         | Rx0        | Ry1          | Ry0   | Gx1 | Gx0 | Gy1 | Gy0 |  |  |
|              | This co  | mmand               | reads the       | lowest bits of re | ed and gre  | en color c | haracteris   | tics. |     |     |     |     |  |  |
| Description  | Red: Rx  | and Ry              | /               |                   |             |            |              |       |     |     |     |     |  |  |
|              | Green:   | Gx and              | Gy              |                   |             |            |              |       |     |     |     |     |  |  |
| Restriction  | Only the   | e 2nd pa            | arameter        | is sent on the D  | SI; the 1st | paramete   | r is not sei | nt.   |     |     |     |     |  |  |
|              |  | Status Availability |                 |                   |             |            |              |       |     |     |     |     |  |  |
|              |  | -                   |                 |                   |             |            |              |       |     |     |     |     |  |  |
|              |  | -                   |                 |                   |             |            |              |       | Yes |     |     |     |  |  |
| Register     |  | -                   |                 | Mode On, Idle N   |             | -          |              |       | Yes |     |     |     |  |  |
| availability |  |                     |                 | Mode On, Idle N   |             | •          |              |       | Yes |     |     |     |  |  |
|              |  | -                   | Partial         | Mode On, Idle N   |             | Sleep Out  |              |       | Yes |     |     |     |  |  |
|              |  |                     |                 | Sleep             | In          |            |              |       | Yes |     |     |     |  |  |
| Default      | Status  Default Value (D7 to D0)  Power On Sequence  XXh  S/W Reset  XXh  H/W Reset  XXh |                     |                 |                   |             |            |              |       |     |     |     |     |  |  |



## 12.2.47 RDRx (76h/7600h):Read Rx

| 76H          |         |   |  |                  |              | RD          | Rx           |     |      |    |    |    |  |  |  |
|--------------|---------|---|--|------------------|--------------|-------------|--------------|-----|------|----|----|----|--|--|--|
| Inst / Para  | R/W     | Add<br>MIPI   | dress<br>SPI-16                              | D15-8            | D7           | D6          | D5           | D4  | D3   | D2 | D1 | D0 |  |  |  |
| RDRx         | R       | 76h   | 7600h  | X                |              |             |              | Rx[ | 9:2] |    |    |    |  |  |  |
| Description  |         | mmand   |  | Rx bits (Rx [9:2 | 2]) of red ( | color chara | cteristics.  |     |      |    |    |    |  |  |  |
| Restriction  | Only th | e 2nd pa  | arameter i                                   | s sent on the D  | SI; the 1s   | t paramete  | r is not ser | nt. |      |    |    |    |  |  |  |
|              |         | Status Availability   |  |                  |              |             |              |     |      |    |    |    |  |  |  |
|              |         |   | Normal Mode On, Idle Mode Off, Sleep Out Yes |                  |              |             |              |     |      |    |    |    |  |  |  |
| Register     |         |   | Normal Mode On, Idle Mode On, Sleep Out Yes  |                  |              |             |              |     |      |    |    |    |  |  |  |
| availability |         |   | Partial                                      | Mode On, Idle N  | Mode Off,    | Sleep Out   |              |     | Yes  |    |    |    |  |  |  |
|              |         |   | Partial                                      | Mode On, Idle N  | Mode On,     | Sleep Out   |              |     | Yes  |    |    |    |  |  |  |
|              |         |   |  | Sleep            | In           |             |              |     | Yes  |    |    |    |  |  |  |
| Default      |         | Status  Default Value (D7 to D0)  Power On Sequence  S/W Reset  H/W Reset  XXh  XXh |  |                  |              |             |              |     |      |    |    |    |  |  |  |



## 12.2.48 RDRy (77h/7700h):Read Ry

| 77H                      |          |   |                        |                  |              | RD         | Ry                           |           |        |    |    |    |  |
|--------------------------|----------|---|------------------------|------------------|--------------|------------|------------------------------|-----------|--------|----|----|----|--|
| Inst / Para              | R/W      | Add<br>MIPI   | ress<br>SPI-16         | D15-8            | D7           | D6         | D5                           | D4        | D3     | D2 | D1 | D0 |  |
| RDRy                     | R        | 77h   | 7700h                  | Х                |              |            |                              | I<br>Ry[ˈ | 9:2]   |    |    |    |  |
| Description              | This cor | nmand   | reads the              | Rx bits (Ry [9:2 | 2]) of red c | olor chara | cteristics.                  |           |        |    |    |    |  |
| Restriction              | Only the | e 2nd pa  | arameter               | is sent on the D | SI; the 1st  | paramete   | r is not ser                 | nt.       |        |    |    |    |  |
| Register<br>availability |          | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode On, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes |                        |                  |              |            |                              |           |        |    |    |    |  |
| Default                  |          |   | Status Power C S/W Re: |                  |              |            | Default<br>XXh<br>XXh<br>XXh | Value (D7 | to D0) |    |    |    |  |



## 12.2.49 RDGx (78h/7800h):Read Gx

| 78H          |   |  |                 |                  |             | RD          | Gx           |     |           |    |    |    |  |  |  |
|--------------|---|--|-----------------|------------------|-------------|-------------|--------------|-----|-----------|----|----|----|--|--|--|
| Inst / Para  | R/W   | Add<br>MIPI  | dress<br>SPI-16 | D15-8            | D7          | D6          | D5           | D4  | D3        | D2 | D1 | D0 |  |  |  |
| RDGx         | R   | 77h  | 7700h           | X                |             |             |              | Gx[ | l<br>9:21 |    |    |    |  |  |  |
| Description  |   |  |                 | Rx bits (Gx [9:  | 2]) of red  | color chara | cteristics.  |     | 1         |    |    |    |  |  |  |
| Restriction  | Only the  | e 2nd pa   | arameter        | is sent on the D | SI; the 1st | paramete    | r is not ser | nt. |           |    |    |    |  |  |  |
|              |   | Status Availability  |                 |                  |             |             |              |     |           |    |    |    |  |  |  |
|              |   |  |                 |                  |             |             |              |     |           |    |    |    |  |  |  |
|              |   | Normal Mode On, Idle Mode Off, Sleep Out  Yes  Normal Mode On, Idle Mode On, Sleep Out |                 |                  |             |             |              |     |           |    |    |    |  |  |  |
| Register     |   | Normal Mode On, Idle Mode On, Sleep Out Yes  |                 |                  |             |             |              |     |           |    |    |    |  |  |  |
| availability |   |  | Partial         | Mode On, Idle N  | Mode Off,   | Sleep Out   |              |     | Yes       |    |    |    |  |  |  |
|              |   |  | Partial         | Mode On, Idle N  | Mode On,    | Sleep Out   |              |     | Yes       |    |    |    |  |  |  |
|              |   |  |                 | Sleep            | In          |             |              |     | Yes       |    |    |    |  |  |  |
| Default      | Status Default Value (D7 to D0) Power On Sequence XXh S/W Reset XXh H/W Reset XXh |  |                 |                  |             |             |              |     |           |    |    |    |  |  |  |



## 12.2.50 RDGy (79h/7900h):Read Gy

| 79H          |   |   |                 |                  |              | RD          | Gy           |     |      |    |    |    |  |  |
|--------------|---|---|-----------------|------------------|--------------|-------------|--------------|-----|------|----|----|----|--|--|
| Inst / Para  | R/W   | Add<br>MIPI   | dress<br>SPI-16 | D15-8            | D7           | D6          | D5           | D4  | D3   | D2 | D1 | D0 |  |  |
| RDGy         | R   | 79h   | 7900h           | Х                |              |             |              | Gy[ | 9:2] |    |    |    |  |  |
| Description  | This co   | mmand   | reads the       | Gx bits (Gx [9:  | 2]) of red ( | color chara | cteristics.  |     |      |    |    |    |  |  |
| Restriction  | Only the  | e 2nd pa  | arameter        | is sent on the D | SI; the 1st  | paramete    | r is not ser | nt. |      |    |    |    |  |  |
|              |   | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes |                 |                  |              |             |              |     |      |    |    |    |  |  |
|              |   | Normal Mode On, Idle Mode Off, Sleep Out Yes                      |                 |                  |              |             |              |     |      |    |    |    |  |  |
| Register     |   | Normal Mode On, Idle Mode On, Sleep Out Yes                       |                 |                  |              |             |              |     |      |    |    |    |  |  |
| availability |   |   | Partial         | Mode On, Idle N  | /lode Off,   | Sleep Out   |              |     | Yes  |    |    |    |  |  |
|              |   |   | Partial         | Mode On, Idle N  | /lode On,    | Sleep Out   |              |     | Yes  |    |    |    |  |  |
|              |   |   |                 | Sleep            | In           |             |              |     | Yes  |    |    |    |  |  |
| Default      | Status Default Value (D7 to D0) Power On Sequence XXh S/W Reset XXh H/W Reset XXh |   |                 |                  |              |             |              |     |      |    |    |    |  |  |



## 12.2.51 RDBALB (7Ah/7A00h):Read Blue/A Color Low Bits

| 7AH          |                       |              |                     |                  |             |            |              |           |        |     |     |     |  |  |
|--------------|-----------------------|--------------|---------------------|------------------|-------------|------------|--------------|-----------|--------|-----|-----|-----|--|--|
| Inst / Para  | R/W                   | Add          | lress               | D15-8            | D7          | D6         | D5           | D4        | D3     | D2  | D1  | D0  |  |  |
| mot/ r ara   | ,                     | MIPI         | SPI-16              | 5100             |             |            |              | J .       | 20     |     |     |     |  |  |
| RDBALB       | R                     | 7 <b>A</b> h | 7A00h               | Χ                | Bx1         | Bx0        | By1          | By0       | Ax1    | Ax0 | Ay1 | Ay0 |  |  |
|              | This cor              | mmand        | reads the           | lowest bits of b | lue and A   | color colo | r characte   | ristics.  |        |     |     |     |  |  |
| Description  | Blue: B               | x and By     | /                   |                  |             |            |              |           |        |     |     |     |  |  |
|              | A color:              | Ax and       | Ау                  |                  |             |            |              |           |        |     |     |     |  |  |
| Restriction  | Only the              | e 2nd pa     | arameter            | is sent on the D | SI; the 1st | paramete   | r is not sei | nt.       |        |     |     |     |  |  |
|              |                       | Chab.ca      |                     |                  |             |            |              |           |        |     |     |     |  |  |
|              |                       |              | Status Availability |                  |             |            |              |           |        |     |     |     |  |  |
|              |                       |              | Normal              | Mode On, Idle N  | Mode Off,   | Sleep Out  |              |           | Yes    |     |     |     |  |  |
| Register     |                       |              | Normal              | Mode On, Idle N  | Mode On,    | Sleep Out  |              |           | Yes    |     |     |     |  |  |
| availability |                       |              | Partial             | Mode On, Idle N  | Node Off, S | Sleep Out  |              |           | Yes    |     |     |     |  |  |
|              |                       |              | Partial             | Mode On, Idle N  | lode On, S  | Sleep Out  |              |           | Yes    |     |     |     |  |  |
|              |                       |              |                     | Sleep            | In          |            |              |           | Yes    |     |     |     |  |  |
|              |                       |              |                     |                  |             |            |              |           |        |     |     |     |  |  |
|              |                       |              |                     |                  |             |            |              |           |        |     |     |     |  |  |
|              |                       |              | Status              |                  |             |            | Default      | Value (D7 | to D0) |     |     |     |  |  |
| Default      | Power On Sequence XXh |              |                     |                  |             |            |              |           |        |     |     |     |  |  |
| Delauit      |                       |              | S/W Res             | set              |             |            | XXh          |           |        |     |     |     |  |  |
|              |                       |              | H/W Re              | set              |             |            | XXh          |           |        |     |     |     |  |  |
|              |                       | _            |                     |                  |             |            |              |           |        |     |     |     |  |  |



## 12.2.52 RDBx (7Bh/7B00h):Read Bx

| 7BH          |                       |                                 |  |                  |              | RD          | Вх          |     |      |    |    |    |  |  |  |
|--------------|-----------------------|---------------------------------|--|------------------|--------------|-------------|-------------|-----|------|----|----|----|--|--|--|
| Inst / Para  | R/W                   | Ado                             | dress  | D15-8            | D7           | D6          | D5          | D4  | D3   | D2 | D1 | D0 |  |  |  |
| IIISt / Fara | □/ VV                 | MIPI                            | SPI-16                                       | D13-6            | D7           | D6          | D5          | D4  | DS   | DZ | וט | DU |  |  |  |
| RDBx         | R                     | 7Bh                             | 7B00h  | Χ                |              |             |             | Bx[ | 9:2] |    |    |    |  |  |  |
| Description  | This co               | mmand                           | reads the                                    | Bx bits (Bx [9:2 | 2]) of red c | olor charad | cteristics. |     |      |    |    |    |  |  |  |
| Restriction  | Only the              | e 2nd pa                        | arameter                                     | is sent on the D | SI; the 1st  | paramete    | r is not se | nt. |      |    |    |    |  |  |  |
|              |                       |                                 | Status Availability                          |                  |              |             |             |     |      |    |    |    |  |  |  |
|              |                       |                                 |  |                  |              |             |             |     |      |    |    |    |  |  |  |
|              |                       |                                 | Normal Mode On, Idle Mode Off, Sleep Out Yes |                  |              |             |             |     |      |    |    |    |  |  |  |
| Register     |                       |                                 | Normal                                       | Mode On, Idle I  | Mode On,     | Sleep Out   |             |     | Yes  |    |    |    |  |  |  |
| availability |                       |                                 | Partial                                      | Mode On, Idle N  | /lode Off,   | Sleep Out   |             |     | Yes  |    |    |    |  |  |  |
|              |                       |                                 | Partial                                      | Mode On, Idle N  | /lode On,    | Sleep Out   |             |     | Yes  |    |    |    |  |  |  |
|              |                       |                                 |  | Sleep            | In           |             |             |     | Yes  |    |    |    |  |  |  |
|              |                       |                                 |  |                  |              |             |             |     |      |    |    |    |  |  |  |
|              |                       | Г                               |  |                  |              |             |             |     |      |    | _  |    |  |  |  |
|              |                       | Status Default Value (D7 to D0) |  |                  |              |             |             |     |      |    |    |    |  |  |  |
| Default      | Power On Sequence XXh |                                 |  |                  |              |             |             |     |      |    |    |    |  |  |  |
| Delault      |                       |                                 | S/W Res                                      | set              |              |             | XXh         |     |      |    |    |    |  |  |  |
|              |                       |                                 | H/W Re                                       | set              |              |             | XXh         |     |      |    |    |    |  |  |  |
|              |                       | _                               |  |                  |              |             |             |     |      |    |    |    |  |  |  |



## 12.2.53 RDBy (7Ch/7C00h):Read By

| 7CH                      |  |   |                 |                  |              | RD         | Ву           |     |           |    |    |    |  |
|--------------------------|--|---|-----------------|------------------|--------------|------------|--------------|-----|-----------|----|----|----|--|
| Inst / Para              | R/W  | Add<br>MIPI   | dress<br>SPI-16 | D15-8            | D7           | D6         | D5           | D4  | D3        | D2 | D1 | D0 |  |
| RDBx                     | R  | 7Ch   | 7C00h           | X                |              |            |              | By[ | !<br>9:2] |    |    |    |  |
| Description              | This co  | mmand   | reads the       | By bits (By [9:2 | 2]) of red o | olor chara | cteristics.  |     |           |    |    |    |  |
| Restriction              | Only th  | e 2nd pa  | arameter        | is sent on the D | SI; the 1st  | paramete   | r is not ser | nt. |           |    |    |    |  |
| Register<br>availability |  | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode On, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes |                 |                  |              |            |              |     |           |    |    |    |  |
| Default                  | Status Default Value (D7 to D0)  Power On Sequence XXh  S/W Reset XXh  H/W Reset XXh |   |                 |                  |              |            |              |     |           |    |    |    |  |



## 12.2.54 RDAx (7Dh/7D00h):Read Ax

| 7DH                      |         | RDAx  |   |                  |              |            |                              |           |        |    |     |    |  |
|--------------------------|---------|---|---|------------------|--------------|------------|------------------------------|-----------|--------|----|-----|----|--|
| Inst / Para              | R/W     | Add<br>MIPI   | ress<br>SPI-16                          | D15-8            | D7           | D6         | D5                           | D4        | D3     | D2 | D1  | D0 |  |
| RDAx                     | R       | 7Dh   | 7D00h                                   | Х                |              |            |                              | Ax[       | 9:2]   |    | I . |    |  |
| Description              | This co | mmand   | reads the                               | Ax bits (Ax [9:2 | 2]) of red c | olor chara | cteristics.                  |           |        |    |     |    |  |
| Restriction              | Only th | Only the 2nd parameter is sent on the DSI; the 1st parameter is not sent.   |   |                  |              |            |                              |           |        |    |     |    |  |
| Register<br>availability |         | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode On, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes |   |                  |              |            |                              |           |        |    |     |    |  |
| Default                  |         |   | Status<br>Power C<br>S/W Res<br>H/W Res |                  |              |            | Default<br>XXh<br>XXh<br>XXh | Value (D7 | to D0) |    |     |    |  |



## 12.2.55 RDAy (7Eh/7E00h):Read Ay

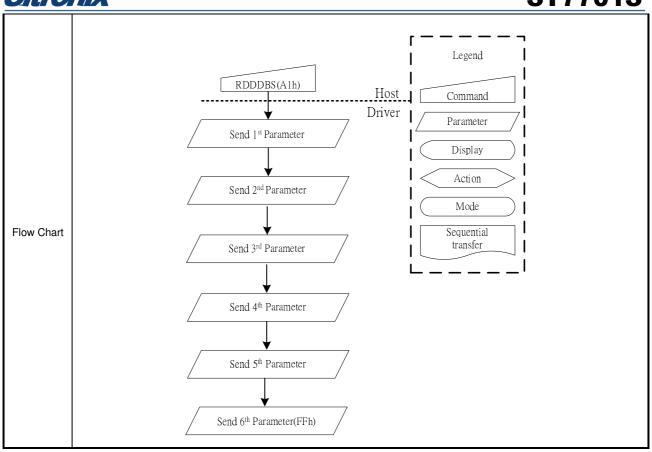
| 7EH                      |         |   |                              |                    |              | RD                              | Ау                           |           |        |    |    |    |  |  |  |
|--------------------------|---------|---|------------------------------|--------------------|--------------|---------------------------------|------------------------------|-----------|--------|----|----|----|--|--|--|
| Inst / Para              | R/W     | Add<br>MIPI   | dress<br>SPI-16              | D15-8              | D7           | D6                              | D5                           | D4        | D3     | D2 | D1 | D0 |  |  |  |
| RDAy                     | R       | 7Dh   | 7D00h                        | X                  |              |                                 |                              | Ay[       | 9:2]   |    |    |    |  |  |  |
| Description              | This co | mmand   | reads the                    | e Ay bits (Ay [9:2 | 2]) of red c | ) of red color characteristics. |                              |           |        |    |    |    |  |  |  |
| Restriction              | Only th | Only the 2nd parameter is sent on the DSI; the 1st parameter is not sent.   |                              |                    |              |                                 |                              |           |        |    |    |    |  |  |  |
| Register<br>availability |         | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode On, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes |                              |                    |              |                                 |                              |           |        |    |    |    |  |  |  |
| Default                  |         |   | Status Power C S/W Re H/W Re |                    |              |                                 | Default<br>XXh<br>XXh<br>XXh | Value (D7 | to D0) |    |    |    |  |  |  |



## 12.2.56 RDDDBS (A1h/A100h): Read DDB Start

| Robbeauth   Robb | A1H          |   |  |            |                   |            | RDD         | OBS       |              |               |          |            |      |  |  |  |
|--|--------------|---|--|------------|-------------------|------------|-------------|-----------|--------------|---------------|----------|------------|------|--|--|--|
| RDDDBS   R   | Inst / Dave  | DAV   | Add  | dress      | D1E 0             | D7         | De          | DE        | D4           | Do            | DO       | D1         | Do   |  |  |  |
| RDDDBS R A1h A102h X MID[7:0] A103h A103h B1hff  This command reads the supplier identification and display module mode/revision information.  Parameter 1: the ID of IC.(0x77).  Parameter 2: the ID of IC.(0x01).  Parameter 3: MRID [7:0] LCD module/driver ID.  Parameter 4: MRID [15:8] IC version code.  Parameter 5: FFh - Exit code – there is no more data in the Descriptor Block  This read sequence can be interrupted by any command and it can be continued by the Read DDB Continue (A8h) command.  For example, RDDDBS => 1st parameter has been sent => 2nd parameter has been sent => interrupt => RDDDBC => 3rd parameter of the RDDDBS has been sent.  Restriction  Register availability  Normal Mode On, Idle Mode Off, Sleep Out Yes Normal Mode On, Idle Mode Off, Sleep Out Yes Sleep In Yes  Status Default Value (D7 to D0)  Power On Sequence XXh  SW Reset XXXh   | inst/Para    | H/VV  | MIPI   | SPI-16     | ס-כוע             | D/         | סט          | סט        | D4           | D3            | DZ       | וט         | DU   |  |  |  |
| RDDDBS   |              |   |  | A100h      |                   |            |             |           | 0x           | 77            |          |            |      |  |  |  |
| A103h A104h 8/hff  This command reads the supplier identification and display module mode/revision information.  Parameter 1: the ID of IC.(0x77).  Parameter 2: the ID of IC.(0x01).  Parameter 3: MRID [7:0] LCD module/driver ID.  Parameter 4: MRID [15:8] IC version code.  Parameter 5: FFh - Exit code – there is no more data in the Descriptor Block  This read sequence can be interrupted by any command and it can be continued by the Read DDB Continue (A8h) command.  For example, RDDDBS => 1st parameter has been sent => 2nd parameter has been sent => interrupt => RDDDBC => 3rd parameter of the RDDDBS has been sent.  Restriction  Register  availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes  Status  Default Value (D7 to D0)  Power On Sequence XXh  SW Reset XXXh  |              |   |  | A101h      |                   |            | 0x01        |           |              |               |          |            |      |  |  |  |
| A104h 8hff  This command reads the supplier identification and display module mode/revision information.  Parameter 1: the ID of IC.(0x77).  Parameter 3: MRID [7:0] LCD module/driver ID.  Parameter 4: MRID [15:8] IC version code.  Parameter 5: FFh - Exit code – there is no more data in the Descriptor Block  This read sequence can be interrupted by any command and it can be continued by the Read DDB Continue (A8h) command.  For example, RDDDBS => 1st parameter has been sent => 2nd parameter has been sent => interrupt => RDDDBC => 3rd parameter of the RDDDBS has been sent.  Restriction  Register availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Sleep In Yes  Sleep In Yes  Status Default Value (D7 to D0)  Power On Sequence XXh  SW Reset XXh   | RDDDBS       | R   | A1h  | A102h      | Χ                 |            |             |           | MID[         | 15:8]         |          |            |      |  |  |  |
| This command reads the supplier identification and display module mode/revision information.  Parameter 1: the ID of IC.(0x77).  Parameter 2: the ID of IC.(0x01).  Parameter 3: MRID [7:0] LCD module/driver ID.  Parameter 4: MRID [15:8] IC version code.  Parameter 5: FFh - Exit code – there is no more data in the Descriptor Block  This read sequence can be interrupted by any command and it can be continued by the Read DDB Continue (A8h) command.  For example, RDDDBS => 1st parameter has been sent => 2nd parameter has been sent => interrupt => RDDDBC => 3rd parameter of the RDDDBS has been sent.  Restriction  Register availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes  Status  Default Value (D7 to D0)  Power On Sequence XXh  SW Reset XXh   |              |   |  | A103h      |                   |            |             |           | MID          | [7:0]         |          |            |      |  |  |  |
| Parameter 1: the ID of IC.(0x77).  Parameter 2: the ID of IC.(0x01).  Parameter 3: MRID [7:0] LCD module/driver ID.  Parameter 4: MRID [15:8] IC version code.  Parameter 5: FFh - Exit code – there is no more data in the Descriptor Block  This read sequence can be interrupted by any command and it can be continued by the Read DDB Continue (A8h) command.  For example, RDDDBS => 1st parameter has been sent => 2nd parameter has been sent => interrupt => RDDDBC => 3rd parameter of the RDDDBS has been sent.  Restriction  Register  availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Sleep In Yes  Status  Default Value (D7 to D0)  Power On Sequence XXh  SW Reset XXh  |              |   |  | A104h      |                   |            |             |           | 8'l          | nff           |          |            |      |  |  |  |
| Parameter 2: the ID of IC.(0x01). Parameter 3: MRID [7:0] LCD module/driver ID. Parameter 4: MRID [15:8] IC version code. Parameter 5: FFh - Exit code – there is no more data in the Descriptor Block This read sequence can be interrupted by any command and it can be continued by the Read DDB Continue (A8h) command. For example, RDDDBS => 1st parameter has been sent => 2nd parameter has been sent => interrupt => RDDDBC => 3rd parameter of the RDDDBS has been sent.  Restriction  Register availability    Status   |              | This co   | mmand  | reads the  | supplier identifi | cation and | d display m | odule mo  | de/revisior  | n information | on.      |            |      |  |  |  |
| Parameter 3: MRID [7:0] LCD module/driver ID.  Parameter 4: MRID [15:8] IC version code.  Parameter 5: FFh - Exit code – there is no more data in the Descriptor Block  This read sequence can be interrupted by any command and it can be continued by the Read DDB Continue (A8h) command.  For example, RDDDBS => 1st parameter has been sent => 2nd parameter has been sent => interrupt => RDDDBC => 3rd parameter of the RDDDBS has been sent.  Restriction  Register availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Sleep In Yes  Status  Default Value (D7 to D0)  Power On Sequence XXh  SW Reset XXh   |              | Parame  | ter 1: th  | e ID of IC | C.(0x77).         |            |             |           |              |               |          |            |      |  |  |  |
| Parameter 4: MRID [15:8] IC version code. Parameter 5: FFh - Exit code – there is no more data in the Descriptor Block This read sequence can be interrupted by any command and it can be continued by the Read DDB Continue (A8h) command. For example, RDDDBS => 1st parameter has been sent => 2nd parameter has been sent => interrupt => RDDDBC => 3rd parameter of the RDDDBS has been sent.  Restriction    Status  |              | Parame  | rameter 2: the ID of IC.(0x01).  |            |                   |            |             |           |              |               |          |            |      |  |  |  |
| Parameter 5: FFh - Exit code – there is no more data in the Descriptor Block This read sequence can be interrupted by any command and it can be continued by the Read DDB Continue (A8h) command. For example, RDDDBS => 1st parameter has been sent => 2nd parameter has been sent => interrupt => RDDDBC => 3rd parameter of the RDDDBS has been sent.  Restriction  Register availability  Normal Mode On, Idle Mode Off, Sleep Out Yes Normal Mode On, Idle Mode Off, Sleep Out Yes Partial Mode On, Idle Mode On, Sleep Out Yes Sleep In Yes  Status  Default Value (D7 to D0) Power On Sequence XXh S/W Reset XXh  |              | Parame  | meter 3: MRID [7:0] LCD module/driver ID.                                    |            |                   |            |             |           |              |               |          |            |      |  |  |  |
| Parameter 5: FFh - Exit code – there is no more data in the Descriptor Block  This read sequence can be interrupted by any command and it can be continued by the Read DDB Continue (A8h) command.  For example, RDDDBS => 1st parameter has been sent => 2nd parameter has been sent => interrupt => RDDDBC => 3rd parameter of the RDDDBS has been sent.  Restriction  Restriction  Register availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes  Status  Default Value (D7 to D0)  Power On Sequence XXh  S/W Reset XXh   |              | Parame  | ter 4: M   | IRID [15:8 | B] IC version cod | le.        |             |           |              |               |          |            |      |  |  |  |
| command. For example, RDDDBS => 1st parameter has been sent => 2nd parameter has been sent => interrupt => RDDDBC => 3rd parameter of the RDDDBS has been sent.  Restriction    Status   | Description  | Parame  | Parameter 5: FFh - Exit code – there is no more data in the Descriptor Block |            |                   |            |             |           |              |               |          |            |      |  |  |  |
| For example, RDDDBS => 1st parameter has been sent => 2nd parameter has been sent => interrupt => RDDDBC => 3rd parameter of the RDDDBS has been sent.  Restriction  Register availability  Register availability  Partial Mode On, Idle Mode Off, Sleep Out Yes Partial Mode On, Idle Mode Off, Sleep Out Yes Partial Mode On, Idle Mode Off, Sleep Out Yes Sleep In Yes  Status  Default Value (D7 to D0) Power On Sequence XXh SW Reset XXh   |              | This rea  | ad seque   | ence can   | be interrupted b  | y any con  | nmand and   | it can be | continued    | by the Re     | ad DDB C | ontinue (A | (8h) |  |  |  |
| Status   |              | command.  |  |            |                   |            |             |           |              |               |          |            |      |  |  |  |
| Register availability  Partial Mode On, Idle Mode Off, Sleep Out  Partial Mode On, Idle Mode Off, Sleep Out  Partial Mode On, Idle Mode Off, Sleep Out  Partial Mode On, Idle Mode Off, Sleep Out  Partial Mode On, Idle Mode Off, Sleep Out  Partial Mode On, Idle Mode On, Sleep Out  Yes  Sleep In  Status  Default Value (D7 to D0)  Power On Sequence  XXh  SW Reset  XXh   |              | For example, RDDDBS => 1st parameter has been sent => 2nd parameter has been sent => interrupt => RDDDBC => |  |            |                   |            |             |           |              |               |          |            |      |  |  |  |
| Register availability  Normal Mode On, Idle Mode Off, Sleep Out  Normal Mode On, Idle Mode On, Sleep Out  Partial Mode On, Idle Mode Off, Sleep Out  Partial Mode On, Idle Mode Off, Sleep Out  Partial Mode On, Idle Mode On, Sleep Out  Yes  Partial Mode On, Idle Mode On, Sleep Out  Yes  Sleep In  Status  Default Value (D7 to D0)  Power On Sequence  XXh  S/W Reset  XXh   |              | 3rd para  | ameter o   | of the RD  | DDBS has been     | sent.      |             |           |              |               |          |            |      |  |  |  |
| Register availability  Register availability  Register availability  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes  Status  Default Value (D7 to D0)  Power On Sequence XXh  S/W Reset XXh  | Restriction  |   |  |            |                   |            |             |           |              |               |          |            |      |  |  |  |
| Register availability  Register availability  Register availability  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes  Status  Default Value (D7 to D0)  Power On Sequence XXh  S/W Reset XXh  |              |   |  |            |                   |            |             |           |              |               |          |            |      |  |  |  |
| Register availability    Normal Mode On, Idle Mode On, Sleep Out   Yes   |              |   |  |            | Statu             | s          |             |           | Availability |               |          |            |      |  |  |  |
| Availability  Partial Mode On, Idle Mode Off, Sleep Out Partial Mode On, Idle Mode On, Sleep Out Sleep In  Status Default Value (D7 to D0) Power On Sequence XXh S/W Reset XXh   |              |   |  | Normal     | Mode On, Idle M   | Mode Off,  | Sleep Out   |           | Yes          |               |          |            |      |  |  |  |
| Partial Mode On, Idle Mode On, Sleep Out  Sleep In  Yes  Sleep In  Status  Default Value (D7 to D0)  Power On Sequence  XXh  S/W Reset  XXh  | Register     |   |  | Normal     | Mode On, Idle M   | Mode On,   | Sleep Out   |           |              | Yes           |          |            |      |  |  |  |
| Status Default Value (D7 to D0) Power On Sequence XXh S/W Reset XXh  | availability |   |  | Partial    | Mode On, Idle N   | Node Off,  | Sleep Out   |           |              | Yes           |          |            |      |  |  |  |
| Default Value (D7 to D0)  Power On Sequence XXh  S/W Reset XXh   |              |   |  | Partial    | Mode On, Idle N   | lode On,   | Sleep Out   |           |              | Yes           |          |            |      |  |  |  |
| Default Power On Sequence XXh  S/W Reset XXh   |              |   |  |            | Sleep             | In         |             |           |              | Yes           |          |            |      |  |  |  |
| Default Power On Sequence XXh  S/W Reset XXh   |              |   |  |            |                   |            |             |           |              |               |          |            |      |  |  |  |
| Default Power On Sequence XXh  S/W Reset XXh   |              |   |  | Status     |                   |            |             | Default   | Value (D7    | to D0)        |          |            |      |  |  |  |
| Default S/W Reset XXh  |              |   | ľ  |            | On Sequence       |            |             |           |              | 10 2 0)       |          |            |      |  |  |  |
|  | Default      |   | ŀ  |            |                   |            |             |           |              |               |          |            |      |  |  |  |
|  |              |   | ŀ  |            |                   |            |             |           |              |               |          |            |      |  |  |  |
|  |              |   |  |            |                   |            |             |           |              |               |          |            |      |  |  |  |

Sitronix ST7701S





## 12.2.57 RDDDBC (A8h/A800h): Read DDB Continue

| A8H          |         |          |                        |                 |                            | RDDI           | OBC                         |  |            |           |            |          |  |  |
|--------------|---------|----------|------------------------|-----------------|----------------------------|----------------|-----------------------------|--|------------|-----------|------------|----------|--|--|
|              | D.444   | Add      | dress                  | D. ( T. 4       |                            | D.0            | 5-                          | 5.   | -          |           | <b>D</b> . | D.0      |  |  |
| Inst / Para  | R/W     | MIPI     | SPI-16                 | D15-8           | D7                         | D6             | D5                          | D4   | D3         | D2        | D1         | D0       |  |  |
|              |         |          | A800h                  |                 |                            |                |                             | SID[   | 15:8]      | •         | •          |          |  |  |
|              |         |          | A801h                  |                 |                            |                | SID[7:0]                    |  |            |           |            |          |  |  |
| RDDDBC       | R       | A8h      | A802h                  | Χ               |                            |                |                             | MID[   | 15:8]      |           |            |          |  |  |
|              |         |          | A803h MID[7:0]         |                 |                            |                |                             |  |            |           |            |          |  |  |
|              |         |          | A804h                  |                 |                            |                |                             | 8'l  |            |           |            |          |  |  |
| Description  | This co | mmand    | is used to             | read the suppli | ier's identi               | fication and   | d revision                  | n informatio   | n from the | point whe | ere RDDD   | BS (A1h) |  |  |
| Description  | was int | errupted | by anoth               | ner command.    |                            |                |                             |  |            |           |            |          |  |  |
| Restriction  |         |          |                        |                 |                            |                |                             |  |            |           |            |          |  |  |
|              |         |          |                        |                 |                            |                |                             |  |            |           |            | ]        |  |  |
|              |         |          |                        | Statu           |                            |                |                             |  | Availab    |           |            |          |  |  |
|              |         |          |                        | Mode On, Idle I |                            |                |                             |  | Yes        |           |            |          |  |  |
| Register     |         |          |                        | Mode On, Idle I |                            |                |                             |  | Yes        |           |            |          |  |  |
| availability |         |          |                        | Mode On, Idle N |                            |                |                             |  | Yes        |           |            |          |  |  |
|              |         |          | Partial                | Mode On, Idle N |                            | Sleep Out      |                             |  | Yes        |           |            |          |  |  |
|              |         |          |                        | Sleep           | In                         |                |                             |  | Yes        |           |            |          |  |  |
| Default      |         |          | Status Power C S/W Res |                 |                            |                | Defaul<br>XXh<br>XXh<br>XXh | XXh  |            |           |            |          |  |  |
| Flow Chart   |         |          |                        | RDD             | DBC(A8h) DBS Data DBS Data | Host<br>Driver |                             | Legend  Command  Parameter  Display  Action  Mode  Sequential transfer |            |           |            |          |  |  |



## 12.2.58 RDFCS (AAh/AA00h): Read First Checksum

| AAH                      |          |   |                        |                                       |                          | RDF                          | CS             |             |   |                                       |            |        |  |
|--------------------------|----------|---|------------------------|---------------------------------------|--------------------------|------------------------------|----------------|-------------|---|---------------------------------------|------------|--------|--|
| Inst / Para              | R/W      | Add<br>MIPI   | dress<br>SPI-16        | D15-8                                 | D7                       | D6                           | D5             | D4          | D3  | D2                                    | D1         | D0     |  |
| RDFCS                    | R        | 7Dh   | 7D00h                  | Х                                     |                          | II.                          |                | FCS         | [7:0]   |                                       | I.         | •      |  |
| Description              |          |   |                        | e first checksum<br>gisters and/or Fr |                          |                              |                | e User's aı | rea and the   | e Frame M                             | lemory aft | er the |  |
| Restriction              | Only the | 2nd pa  | arameter               | is sent on the D                      | SI; the 1s               | paramete                     | r is not se    | nt.         |   |                                       |            |        |  |
| Register<br>availability |          | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode On, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes |                        |                                       |                          |                              |                |             |   |                                       |            |        |  |
| Default                  |          |   | Status Power C S/W Res |                                       |                          | Default<br>78h<br>78h<br>78h | 78h            |             |   |                                       |            |        |  |
| Flow Chart               |          |   | 2                      | Send 1st I                            | S(AAh) Parameter CS[7:0] |                              | Host<br>Driver | Co          | egend mmand rameter risplay Action Mode quential ansfer | 7   7   7   7   7   7   7   7   7   7 |            |        |  |



## 12.2.59 RDCCS (AFh/AF00h): Read Continue Checksum

| AFH          |           |  |                 |                  |                          | RDC          | ccs            |             |  |             |             |             |  |
|--------------|-----------|--|-----------------|------------------|--------------------------|--------------|----------------|-------------|--|-------------|-------------|-------------|--|
| Inst / Para  | R/W       | Add<br>MIPI  | dress<br>SPI-16 | D15-8            | D7                       | D6           | D5             | D4          | D3   | D2          | D1          | D0          |  |
| RDCCS        | R         | AFh  | AF00h           | Х                |                          |              |                | C           | CS[7:0]  | 1           | ı           | 1           |  |
|              | This cor  | nmand  | reads the       | following check  | sum that                 | is calculate | ed conti       | nuously af  | er the first c   | hecksum t   | from regist | ters of the |  |
| Description  | User's a  | rea and  | d the Fran      | me Memory afte   | r the write              | access to    | those re       | egisters an | d/or Frame   | Memory is   | done.       |             |  |
|              | It is nec | essary 1   | to wait 30      | Oms after the la | st write ac              | cess to re   | gisters o      | of the User | s area befo  | re this che | cksum val   | ue can be   |  |
| Restriction  | read the  | first tin  | ne.             |                  |                          |              |                |             |  |             |             |             |  |
|              | Only the  | Only the 2nd parameter is sent on the DSI; the 1st parameter is not sent.            |                 |                  |                          |              |                |             |  |             |             |             |  |
|              |           |  |                 | Statu            | ıe                       |              |                |             | Availab  | nility      |             |             |  |
|              |           |  | Normal          | Mode On, Idle I  |                          | Sleep Out    |                |             | Yes  |             |             |             |  |
| Register     |           |  | Normal          | Mode On, Idle I  | Mode On,                 | Sleep Out    |                |             | Yes  | i           |             |             |  |
| availability |           |  |                 | Mode On, Idle N  |                          |              |                |             | Yes  | i           |             |             |  |
|              |           |  | Partial         | Mode On, Idle N  |                          | Sleep Out    |                |             | Yes  |             |             |             |  |
|              |           |  |                 | Sleep            | In                       |              |                |             | Yes  |             |             |             |  |
| Default      |           | Status Default Value (D7 to D0)  Power On Sequence 78h  S/W Reset 78h  H/W Reset 78h |                 |                  |                          |              |                |             |  |             |             |             |  |
| Flow Chart   |           |  | 2               | Send 1st 1       | S(AFh) Parameter CS[7:0] |              | Host<br>Driver |             | Legend Command Parameter Display Action Mode Sequential transfer |             |             |             |  |



## 12.2.60 RDID1 (DAh/DA00h): Read ID1

| DAH                      |  |   |                 | -             |           | RDI       | D1             |               |  |    |    |    |
|--------------------------|--|---|-----------------|---------------|-----------|-----------|----------------|---------------|--|----|----|----|
| Inst / Para              | R/W  | Add<br>MIPI   | dress<br>SPI-16 | D15-8         | D7        | D6        | D5             | D4            | D3   | D2 | D1 | D0 |
| RDID1                    | R  | DAh   | DA00h           | Х             |           | 1         |                | ID1[          | 7:0]   |    |    |    |
| Description              | -This rea  | ad byte   | identifies      | the LCD modul | e's manu  | facturer. |                |               |  |    |    |    |
| Restriction              |  |   |                 |               |           |           |                |               |  |    |    |    |
| Register<br>availability |  | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode On, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes |                 |               |           |           |                |               |  |    |    |    |
| Default                  | Status Default Value (D7 to D0)  Power On Sequence xxh  S/W Reset xxh  H/W Reset xxh |   |                 |               |           |           |                |               |  |    |    |    |
| Flow Chart               |  |   | 2               | Send 1st 1    | Parameter |           | Host<br>Driver | Co Paul D D A | egend mmand rameter isplay action Mode quential ansfer |    |    |    |



#### 12.2.61 RDID2 (DBh/DB00h): Read ID2

| DBH                      |           |         |                        | -  |  | RDI                    | D2                  |           |  |    |    |    |
|--------------------------|-----------|---------|------------------------|--|--|------------------------|---------------------|-----------|--|----|----|----|
| Inst / Para              | R/W       | Add     | dress<br>SPI-16        | D15-8  | D7   | D6                     | D5                  | D4        | D3   | D2 | D1 | D0 |
| RDID2                    | R         | DBh     | DB00h                  | Х  |  |                        |                     | ID2[      | [7:0]  |    |    |    |
| Description              | -This rea | ad byte | identifies             | the LCD modul  | e's manu                                       | facturer.              |                     |           |  |    |    |    |
| Restriction              |           |         |                        |  |  |                        |                     |           |  |    |    |    |
| Register<br>availability |           |         | Normal<br>Partial      | Statu<br>Mode On, Idle I<br>Mode On, Idle I<br>Mode On, Idle I<br>Mode On, Idle I<br>Sleep | Mode Off,<br>Mode On,<br>Mode Off,<br>Mode On, | Sleep Out<br>Sleep Out |                     |           | Availab<br>Yes<br>Yes<br>Yes<br>Yes                        |    |    |    |
| Default                  |           |         | Status Power C S/W Res |  |  |                        | Default xxh xxh xxh | Value (D7 | to D0)   |    |    |    |
| Flow Chart               |           |         | 2                      | Send 1st 1   | 2(DBh) Parameter D2[7:0]                       |                        | Host<br>Driver      | Pau  D  A | egend  mmand rameter risplay Action  Mode quential ransfer |    |    |    |



#### 12.2.62 RDID3 (DCh/DC00h): Read ID3

| DCH                      |          |             |                        |   |  | RDI       | D3                  |  |  |       |    |    |
|--------------------------|----------|-------------|------------------------|---|--|-----------|---------------------|--|--|-------|----|----|
| Inst / Para              | R/W      | Add<br>MIPI | dress<br>SPI-16        | D15-8   | D7   | D6        | D5                  | D4   | D3   | D2    | D1 | D0 |
| RDID3                    | R        | DCh         | DC00h                  | Х   |  |           |                     | ID3[                                       | [7:0]  |       |    |    |
| Description              | -This re | ad byte     | identifies             | the LCD modul   | e's manuf                                      | acturer.  |                     |  |  |       |    |    |
| Restriction              |          |             |                        |   |  |           |                     |  |  |       |    |    |
| Register<br>availability |          |             | Normal<br>Partial      | Statu<br>Mode On, Idle M<br>Mode On, Idle M<br>Mode On, Idle M<br>Sleep | Mode Off,<br>Mode On,<br>Mode Off,<br>Mode On, | Sleep Out |                     |  | Availab<br>Yes<br>Yes<br>Yes<br>Yes                      | ility |    |    |
| Default                  |          |             | Status Power C S/W Res |   |  |           | Default xxh xxh xxh | Value (D7                                  | to D0)   |       |    |    |
| Flow Chart               |          |             | 2                      |   | 3(DCh) Parameter D3[7:0]                       |           | Host<br>Driver      | Co Pau Pau Pau Pau Pau Pau Pau Pau Pau Pau | egend mmand rameter risplay Action Mode quential ransfer |       |    |    |

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#### 12.3 System Function Command Table 2

| Instruction | Add  | ress   | R/W | PNUM | D7 | D6 | D5 | D4  | D3 | D2 | D1 | D0    | Function                        |
|-------------|------|--------|-----|------|----|----|----|-----|----|----|----|-------|---------------------------------|
| mstruction  | MIPI | SPI-16 |     | PNOM | D7 | Do | סט | D4  | טט | D2 | וט | DO    | Function                        |
|             |      | FF00h  |     |      | 0  | 1  | 1  | 1   | 0  | 1  | 1  | 1     |                                 |
|             |      | FF01h  |     |      | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1     |                                 |
| CN2BKxSEL   | FFh  | FF02h  | W   | 5    | == |    |    | ==  | == |    |    | -     | Command2_BKx Function Selection |
|             |      | FF03h  |     |      |    |    |    |     |    |    |    |       |                                 |
|             |      | FF04h  |     |      | 0  | 0  | 0  | CN2 | 0  | 0  | 0  | BKSEL |                                 |

# Command2\_BK0

|             |      | lress  |       |      |      |        |    |    |       |            |         |    |                                 |
|-------------|------|--------|-------|------|------|--------|----|----|-------|------------|---------|----|---------------------------------|
| Instruction | MIPI | SPI-16 | R/W/C | PNUM | D7   | D6     | D5 | D4 | D3    | D2         | D1      | D0 | Function                        |
|             |      | B000h  |       |      | AJ0F | P[1:0] |    |    |       | VC0F       | P[3:0]  |    |                                 |
|             |      | B001h  |       |      | AJ1F | P[1:0] |    |    | VC4F  | P[5:0]     |         |    |                                 |
|             |      | B002h  |       |      | AJ2F | P[1:0] |    |    | VC8F  | P[5:0]     |         |    |                                 |
|             |      | B003h  |       |      | 1    |        |    |    |       | VC16P[4:0] |         |    |                                 |
|             |      | B004h  |       |      | AJ3F | P[1:0] |    |    |       | VC24P[4:0] |         |    |                                 |
|             |      | B005h  |       |      | -    | ==     |    |    |       | VC52       | P[3:0]  |    |                                 |
|             |      | B006h  |       |      | 1    | ==     |    |    | VC80  | P[5:0]     |         |    |                                 |
| PVGAMCTRL   | B0h  | B007h  | w     | 16   | 1    |        |    |    |       | VC108      | 3P[3:0] |    | Positive Voltage Gamma Control  |
| FVGAINGTAL  | DUII | B008h  |       | 16   | 1    | ==     |    | == |       | VC147      | 7P[3:0] |    | rositive voltage Gamina Control |
|             |      | B009h  |       |      | 1    |        |    |    | VC175 | 5P[5:0]    |         |    |                                 |
|             |      | B00Ah  |       |      | 1    | ==     |    |    |       | VC203      | 3P[3:0] |    |                                 |
|             |      | B00Bh  |       |      | AJ4F | P[1:0] |    |    | ,     | VC231P[4:0 | ]       |    |                                 |
|             |      | B00Ch  |       |      | 1    |        |    |    | ,     | VC239P[4:0 | ]       |    |                                 |
|             |      | B00Dh  |       |      | AJ5F | P[1:0] |    |    | VC247 | 7P[5:0]    |         |    |                                 |
|             |      | B00Eh  |       |      | AJ6F | P[1:0] |    |    | VC251 | P[5:0]     |         |    |                                 |
|             |      | B00Fh  |       |      | AJ7F | P[1:0] |    |    | ,     | VC255P[4:0 | ]       |    |                                 |
|             |      | B100h  |       |      | AJON | N[1:0] |    |    |       | VC01       | N[3:0]  |    |                                 |
|             |      | B101h  |       |      | AJ1N | N[1:0] |    |    | VC4N  | N[5:0]     |         |    |                                 |
|             |      | B102h  |       |      | AJ2N | N[1:0] |    |    | AJ2F  | P[1:0]     |         |    |                                 |
|             |      | B103h  |       |      |      |        |    |    |       | VC16N[4:0] |         |    |                                 |
| NVGAMCTRL   | B1h  | B104h  | w     | 16   |      |        |    |    |       | VC24N[4:0] |         |    | Negative Voltage Gamma Control  |
|             |      | B105h  |       |      |      |        |    |    |       | VC52       | N[3:0]  |    |                                 |
|             |      | B106h  |       |      |      |        |    | T  | VC80  | N[5:0]     |         |    |                                 |
|             |      | B107h  |       |      |      |        |    |    |       | VC108      | 3N[3:0] |    |                                 |
|             |      | B108h  |       |      |      |        |    |    |       | VC147      | 7N[3:0] |    |                                 |

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|             | Add  | ress   |       |      |      |        |           |        |        |            |          |       |                                      |
|-------------|------|--------|-------|------|------|--------|-----------|--------|--------|------------|----------|-------|--------------------------------------|
| Instruction | MIPI | SPI-16 | R/W/C | PNUM | D7   | D6     | D5        | D4     | D3     | D2         | D1       | D0    | Function                             |
|             |      | B109h  |       |      |      |        |           |        | VC175  | 5N[5:0]    |          |       |                                      |
|             |      | B10Ah  |       |      |      |        |           |        |        | VC20       | 3N[3:0]  |       |                                      |
|             |      | B10Bh  |       |      | AJ4N | N[1:0] | AJ4P[1:0] |        | ,      | VC231N[4:0 | ]        |       |                                      |
|             |      | B10Ch  |       |      |      |        |           |        | ,      | VC239N[4:0 | ]        |       |                                      |
|             |      | B10Dh  |       |      | AJ5N | N[1:0] |           |        | AJ5F   | P[1:0]     |          |       |                                      |
|             |      | B10Eh  |       |      | AJ6N | N[1:0] |           |        | AJ6F   | P[1:0]     |          |       |                                      |
|             |      | B10Fh  |       |      | AJ7N | N[1:0] | AJ7P[1:0] |        | ,      | VC255N[4:0 | ]        |       |                                      |
| DGMEN       | B8   | B800h  | W     | 1    | 0    | 0      | 0         | DGM_ON | 0      | 0          | 0        | 0     | Digital Gamma Enable                 |
|             |      | B900   |       |      |      |        |           | P0[    | [7:0]  |            |          |       |                                      |
|             |      | B901   |       |      |      |        |           |        |        |            | P0[      | 9:8]  |                                      |
|             |      | B902   |       |      |      |        |           |        |        |            | P4[      | 1:0]  |                                      |
|             |      | B903   |       |      |      |        |           |        |        |            |          |       |                                      |
|             |      | B904   |       |      |      |        |           | P8[    | 7:0]   |            |          |       |                                      |
|             |      | B905   |       |      |      |        |           | ==     |        |            | P8[      | 9:8]  |                                      |
|             |      | B906   |       |      |      |        |           | ==     |        |            | P12      | [1:0] |                                      |
| DGMLUTR     | В9   | B907   | w     | 130  |      |        |           |        |        |            |          |       | Digital Gamma Look-up Table for Red  |
|             |      | :      |       |      |      |        |           |        | :      |            |          |       | -                                    |
|             |      | :      |       |      |      |        |           |        | :      |            |          |       |                                      |
|             |      | B97C   |       |      |      | I      | 1         | P248   | 3[7:0] | I          | 1        |       |                                      |
|             |      | B97D   |       |      |      |        |           |        |        |            | P248     | [9:8] |                                      |
|             |      | B97E   |       |      |      |        |           |        |        |            | P252     | [1:0] |                                      |
|             |      | B97F   |       |      |      |        |           |        |        |            |          |       |                                      |
|             |      | B980   |       |      |      | Γ      | ı         | P25    | 5[7:0] | Γ          | ı        |       |                                      |
|             |      | B981   |       |      |      |        |           |        |        |            | P255     | [9:8] |                                      |
|             |      | BA00   |       |      |      |        | Τ         | P0[    | [7:0]  |            | Τ        |       | _                                    |
|             |      | BA01   |       |      |      |        |           |        |        |            | P0[      |       |                                      |
|             |      | BA02   |       |      |      |        |           |        |        |            | P4[      |       |                                      |
|             |      | BA03   |       |      |      |        |           |        |        |            |          |       |                                      |
| DGMLUTB     | ВА   | BA04   | w     | 130  |      |        | <u> </u>  |        | 7:0]   |            | <u> </u> |       | Digital Gamma Look-up Table for Blue |
|             |      | BA05   |       |      |      |        |           |        |        |            | P8[      |       | -                                    |
|             |      | BA06   |       |      |      |        |           |        |        |            | P12      |       | -                                    |
|             |      | BA07   |       |      |      |        |           |        |        |            |          |       | -                                    |
|             |      | :      |       |      | :    |        |           |        |        |            |          |       | -                                    |
|             |      | :      |       |      | :    |        |           |        |        |            |          |       |                                      |

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| Instruction | Add | ress<br>SPI-16 | R/W/C | PNUM | D7       | D6      | D5          | D4            | D3        | D2        | D1         | D0        | Function                                   |
|-------------|-----|----------------|-------|------|----------|---------|-------------|---------------|-----------|-----------|------------|-----------|--|
|             |     | BA7C           |       |      |          |         |             | P248          | 3[7:0]    |           |            |           |  |
|             |     | BA7D           |       |      |          |         |             |               |           |           | P248       | 3[9:8]    |  |
|             |     | BA7E           |       |      |          |         |             |               |           |           | P252       | 2[1:0]    |  |
|             |     | BA7F           |       |      |          |         |             |               |           |           |            |           |  |
|             |     | BA80           |       |      |          |         |             | P255          | 5[7:0]    |           |            |           |  |
|             |     | BA81           |       |      | -1-      |         |             |               | -         |           | P255       | 5[9:8]    |  |
| LNESET      | C0  | C000           | w     | 2    | LDE_EN   |         |             |               | Line[6:0] |           |            |           | Diaplay Line cetting                       |
| LNESET      | CO  | C001           | VV    | 2    |          |         |             |               | -         |           | Line_D     | elta[1:0] | Display Line setting                       |
| PORCTRL     | C1  | C100           | W     | 2    |          |         |             | VBP           | [7:0]     |           |            |           | Porch control                              |
| TONOTHE     | O1  | C101           | VV    | 2    |          |         |             | VFP           | [7:0]     |           |            |           | T OTCH CONTROL                             |
| INVSEL      | C2  | C200           | w     | 2    | 0        | 0       | 1           | 1             | 0         |           | NLINV[2:0] |           | Inversion selection & Frame Rate Control   |
|             | 02  | C201           | ••    | 2    |          |         |             |               |           | RTNI[4:0] | T          | T         | inversion delegation a Traine Take Control |
|             |     | C300           |       | 3    | DE/HV    |         |             |               | VSP       | HSP       | DP         | EP        |  |
| RGBCTRL     | СЗ  | C301           | W     | 3    |          |         |             | HBP_HV        | RGB[7:0]  |           |            |           | RGB control                                |
|             |     | C302           |       | 3    |          |         |             | VBP_HV        | RGB[7:0]  |           |            |           |  |
|             |     | C500           |       | 4    |          | T       |             | PTSA          | A[7:0]    |           | T          |           |  |
| PARCTRL     | C5  | C501           | w     | 4    |          |         |             |               |           |           | PTSA       | A[9:8]    | Partial mode Control                       |
|             |     | C502           |       | 4    |          | П       |             | PTE/          | A[7:0]    |           | Π          |           |  |
|             |     | C503           |       | 4    |          |         | ==          |               |           |           | PTEA       | A[9:8]    |  |
| SDIR        | C7  | C700           | W     | 1    |          |         |             |               |           | SS        |            |           | Source direction control                   |
| PDOTSET     | C8  | C800           | W     | 1    | Z_EN     | Z_SDM1S | Z_GltoR     |               |           |           |            |           | Pesudo-Dot inversion driving setting       |
| COLCTRL     | CD  | CD00           | w     | 1    |          |         | INV_LED PWM | INV_LED ON    | MDT       |           | EPF[2:0]   |           | Color Control                              |
| SECTRL      | E0  | E000           | W     | 1    |          |         |             | SRE           |           | SRE_al    | pha[3:0]   |           | Sunlight Readable Enhancement              |
| NRCTRL      | E1  | E100           | W     | 1    |          |         |             | NRE           |           |           | NR_m       | nd[1:0]   | Noise Reduce Control                       |
| SECTRL      | E2  | E200           | W     | 1    |          |         |             | SE            |           | Y_ga      | in[3;0]    |           | Sharpness Control                          |
| CCCTRL      | E3  | E300           | W     | 1    |          |         |             |               | -         |           |            | CCE       | Color Calibration Control                  |
| SKCTRL      | E4  | E400           | W     | 1    |          |         |             | SKE           |           |           | Skin_ce_   | _mid[1:0] | Skin Tone Preservation Control             |
| NVMSETE     | EA  | EA00           | W     | 1    |          |         |             |               |           |           |            | ADEN      | NVM address Setting Enable                 |
| CABCCTRL    | EE  | EE00           | W     | 1    | <b>'</b> | 1,      | ٠           | LEDPWR<br>SEL | ٠         | ٠         | ٠          | LED_EN    | CABC Control                               |

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# Command2\_BK1

| Last matters | Ado  | Iress  | DAMO  | DAILINA | D.7 | Do        | D.F.        | D.4     | D.O.           | DO      | D.1        | Do       | Franks                        |
|--------------|------|--------|-------|---------|-----|-----------|-------------|---------|----------------|---------|------------|----------|-------------------------------|
| Instruction  | MIPI | SPI-16 | R/W/C | PNUM    | D7  | D6        | D5          | D4      | D3             | D2      | D1         | D0       | Function                      |
| VRHS         | B0   | B000   | W     | 1       |     |           |             | VRH     | <b>A</b> [7:0] |         |            |          | Vop amplitude setting         |
| VCOMS        | B1   | B100   | W     | 1       |     |           |             | VCO     | M[7:0]         |         |            |          | VCOM amplitude setting        |
| VGHSS        | B2   | B200   | W     | 1       |     |           |             |         |                | VGHS    | SS[3:0]    |          | VGH Voltage setting           |
| TESCMD       | ВЗ   | B300   | W     | 1       | 1   |           |             |         |                | 0       | 0          | 0        | TEST Command Setting          |
| VGLS         | B5   | B500   | W     | 1       | 0   | 1         |             |         |                | VGL     | S[3:0]     |          | VGL Voltage setting           |
| VRHDV        | В6   | B600   | W     | 1       | 0   |           |             | ,       | VRH_DV[6:0]    |         |            |          | VRH_DV Voltage setting        |
| PWCTRL1      | В7   | B700   | W     | 1       | AP  | [1:0]     |             |         | APIS[          | [1:0]   | APO        | S[1:0]   | Power Control 1               |
| PWCTRL2      | В8   | B800   | W     | 1       |     |           | AVDI        | D[1:0]  |                |         | AVC        | L[1:0]   | Power Control 2               |
| PWCTRL3      | В9   | B900   | W     | 1       |     |           | SVPO        | _PUM    |                |         | SVNC       | _PUM     | Power Control 3               |
| PCLKS 1      | ВА   | BA00   | W     | 1       |     |           | STP4C       | KS[1:0] |                |         | STP1C      | KS[1:0]  | Power pumping clk selection 1 |
| PCLKS 2      | BB   | BB00   | W     | 1       |     |           |             |         |                |         | SBSTC      | KS[1:0]  | Power pumping clk selection 2 |
| PCLKS 3      | вс   | BC00   | W     | 1       |     |           | STP3C       | KS[1:0] | STP2PC         | KS[1:0] | STP2S0     | CKS[1:0] | Power pumping clk selection 3 |
| PDR1         | C1   | C100   | W     | 1       | 0   | 1         | 1           | 1       |                | Т       | 2D         |          | Source pre_drive timing set1  |
| PDR2         | C2   | C200   | W     | 1       | 0   | 1         | 1           | 1       |                | Т       | 3D         |          | Source pre_drive timing set2  |
| MIPISET 1    | D0   | D000   | W     | 1       | 1   | 0         | 0           | 0       | EOTP_EN        | 0       | ERR_S      | EL[1:0]  | MIPI Setting 1                |
|              |      | D100   |       |         |     | Mpc_tl    | px1[3:0]    |         |                | Mpc_tl  | px0[3:0]   |          |                               |
| MIDIOET      | D.4  | D101   |       |         |     | Mpc_txtii | meadj[3:0]  |         |                | Mpc_tl  | px2[3:0]   |          | MIDLO III                     |
| MIPISET 2    | D1   | D102   | W     | 4       |     |           |             |         |                | Mpc_tt  | ago[3:0]   |          | MIPI Setting 2                |
|              |      | D103   |       |         |     |           |             |         |                | Mpc_tta | aget[3:0]  |          |                               |
| MIPISET 3    | D2   | D200   | W     | 1       |     |           | 1           | 1       |                | PHY_tta | sure[3:0]  |          | MIPI Setting 3                |
| MIDIOET (    | Do   | D300   | 14/   | 0       |     |           |             |         |                |         | PHY_CSK[2: | 0]       | MIDI O Him a 4                |
| MIPISET 4    | D3   | D301   | W     | 2       | 1   | F         | PHY_dsk1[2: | 0]      |                | ı       | PHY_dsk0[2 | :0]      | MIPI Setting 4                |

# Command2\_BK3

| Instruction | Add  | ress   | R/W/C | PNUM    | D7 | D6 | D5 | D4   | D3      | D2 | D1 | D0    | Function                   |
|-------------|------|--------|-------|---------|----|----|----|------|---------|----|----|-------|----------------------------|
| Instruction | MIPI | SPI-16 |       | PINUIVI | D7 | Do | Do | D4   | D3      | D2 | DI | DO    | FullClioff                 |
|             |      | C800   |       |         | 0  | 1  | 1  | 1    | 0       | 1  | 1  | 1     |                            |
| NI) (MEN    | 00   | C801   |       |         | 0  | 0  | 0  | 0    | 0       | 0  | 0  | 1     | NIVA Facilia               |
| NVMEN       | C8   | C802   | W     | 4       | 1  | 1  | 1  | 0    | 1       | 1  | 1  | 0     | NVM Enable                 |
|             |      | C803   |       |         | 0  | 0  | 0  | 0    | 0       | 1  | 0  | 0     |                            |
|             |      | CA00   |       |         |    |    | -  | -    |         |    | PA | [9:8] |                            |
| NVMSET      | CA   | CA01   | W     | 3       |    |    |    | PA   | [7:0]   |    |    |       | NVM manual control Setting |
|             |      | CA02   |       |         |    |    |    | PDIN | I [7:0] |    |    |       |                            |

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| Instructio | 2 | Add  | ress   | R/W/C | PNUM  | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Function           |
|------------|---|------|--------|-------|-------|----|----|----|----|----|----|----|----|--------------------|
| instructio | 1 | MIPI | SPI-16 |       | PINUM | D/ | Do | D5 | D4 | DS | D2 | DI | DU | FullCuofi          |
| PROMAC     | Г | CC   | CC01   | W     | 1     | 1  | 0  | 1  | 0  | 1  | 0  | 1  | 0  | NVM Program Active |

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#### 12.3.1 CND2BKxSEL (FFh/FF00h): Command2 BKx Selection

| FFH          |         |        |          |                 |           | CND2E     | 3KxSEL    |            |          |           |        |        |
|--------------|---------|--------|----------|-----------------|-----------|-----------|-----------|------------|----------|-----------|--------|--------|
| Inst / Para  | R/W     | Add    | dress    | D15-8           | D7        | D6        | D5        | D4         | D3       | D2        | D1     | D0     |
| mot/raid     | 11,77   | MIPI   | SPI-16   | 2100            | ,         | - 50      |           | J-         | 50       | <i>52</i> | 51     | 50     |
|              | W       |        | FF00h    | Х               | 0         | 1         | 1         | 1          | 0        | 1         | 1      | 1      |
|              | W       |        | FF01h    | Х               | 0         | 0         | 0         | 0          | 0        | 0         | 0      | 1      |
| CN2BKxSEL    | W       | FFh    | FF02h    | Х               | 0         | 0         | 0         | 0          | 0        | 0         | 0      | 0      |
|              | W       |        | FF03h    | X               | 0         | 0         | 0         | 0          | 0        | 0         | 0      | 0      |
|              | W       |        | FF04h    | X               | 0         | 0         | 0         | CN2        | 0        | 0         | 0      | BKxSEL |
|              | This co | omman  | d is use | d to select the | function  | of Comm   | and BK0   | or Comr    | nand BK  | 1.        |        |        |
|              | When    | CN2='1 | l'enable | the BK funct    | on of Co  | mmand2,   | CN2='0'   | disable t  | he BK fu | nction of | Commai | nd2.   |
|              |         |        |          |                 | BKxSEL    | BKx F     | unction S | Select     |          |           |        |        |
| Description  |         |        |          |                 | 00h       | BK0       |           |            |          |           |        |        |
|              |         |        |          |                 | 01h       | BK1       |           |            |          |           |        |        |
|              |         |        |          | <br>            | 03h       | ВК3       |           |            |          |           |        |        |
| Destriction  |         |        |          |                 |           |           |           |            | _        |           |        |        |
| Restriction  |         |        |          |                 |           |           |           |            |          |           |        |        |
|              |         |        |          | Stat            | us        |           |           |            | Availa   | bility    |        |        |
|              |         |        | Normal   | Mode On, Idle   | Mode Off, | Sleep Out | t         |            | Ye       | S         |        |        |
| Register     |         |        | Normal   | Mode On, Idle   | Mode On,  | Sleep Out | t         |            | Yes      | S         |        |        |
| availability |         |        | Partial  | Mode On, Idle   | Mode Off, | Sleep Out |           |            | Yes      | S         |        |        |
|              |         |        | Partial  | Mode On, Idle   | Mode On,  | Sleep Out |           |            | Yes      | S         |        | -      |
|              |         |        |          | Sleep           | o In      |           |           |            | Yes      | S         |        | _      |
|              |         |        |          |                 |           |           |           |            |          |           |        |        |
|              |         | Ī      | Status   |                 |           |           | Defaul    | t Value (D | 7 to D0) |           |        |        |
| Default      |         |        | Power C  | On Sequence     |           |           | 00h       |            |          |           |        |        |
| Default      |         |        | S/W Re   | set             |           |           | 00h       |            |          |           |        |        |
|              |         |        | H/W Re   | set             |           |           | 00h       |            |          |           |        |        |
|              |         |        |          |                 |           |           |           |            |          |           |        |        |



#### 12.3.2 Command 2 BK0 Function

#### 12.3.2.1 PVGAMCTRL (B0h/B000h): Positive Voltage Gamma Control

| ВОН         |     |          |                | IL (BOII/BOOK | -        | PVGAMC    |                                       |            |      |                     |         |    |
|-------------|-----|----------|----------------|---------------|----------|-----------|---------------------------------------|------------|------|---------------------|---------|----|
|             |     | Add      | ress           |               |          |           |                                       |            |      |                     |         |    |
| Inst / Para | R/W | MIPI     | SPI-16         | D15-8         | D7       | D6        | D5                                    | D4         | D3   | D2                  | D1      | D0 |
|             | W   |          | B000h          | Х             | AJ0F     | P[1:0]    |                                       |            |      | VC0                 | P[3:0]  |    |
|             | W   |          | B001h          | Х             | AJ1F     | P[1:0]    |                                       |            | VC4  | P[5:0]              |         |    |
|             | W   |          | B002h          | Х             | AJ2F     | P[1:0]    |                                       |            | VC8  | P[5:0]              |         |    |
|             | W   |          | B003h          | Х             |          |           |                                       |            |      | VC16P[4:            | 0]      |    |
|             | W   |          | B004h          | Х             | AJ3F     | P[1:0]    |                                       |            |      | VC24P[4:            | 0]      |    |
|             | W   |          | B005h          | Х             |          |           |                                       |            |      | VC5                 | 2P[3:0] |    |
|             | W   |          | B006h          | Х             |          |           |                                       |            | VC80 | )P[5:0]             |         |    |
| PVGAMCTRL   | W   | B0h      | B007h          | Х             |          |           |                                       |            |      |                     | 8P[3:0] |    |
|             | W   |          | B008h          | Х             |          |           |                                       |            |      |                     | 7P[3:0] |    |
|             | W   |          | B009h          | X             |          |           |                                       |            | VC17 | 5P[5:0]             |         |    |
|             | W   |          | B00Ah          | +             |          |           |                                       |            |      |                     | 3P[3:0] |    |
|             | W   |          | B00Bh          | +             | AJ4F     |           |                                       |            |      | /C231P[4            |         |    |
|             | W   |          | B00Ch<br>B00Dh | +             | <br>AJ5F |           |                                       |            |      | /C239P[4<br>7P[5:0] | :0]     |    |
|             | W   |          | B00Eh          | +             | AJ6F     |           |                                       |            |      | 7F[5:0]<br>1P[5:0]  |         |    |
|             | W   |          | B00Fh          |               | AJ7F     |           | ·                                     |            |      | /C255P[4            | ·01     |    |
|             |     | refer to |                |               |          |           | <del>.</del> .                        |            |      |                     |         |    |
|             |     |          |                | Value(hex)    |          |           | \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ | /alue(hex) |      |                     |         |    |
|             | V   | C0P[3:0] |                | 00H           | VC       | 239P[4:0] |                                       | 00H        |      |                     |         |    |
|             | V   | C4P[5:0] |                | 00H           | VC       | 247P[5:0] |                                       | 00H        |      |                     |         |    |
|             | V   | C8P[5:0] |                | 00H           | VC       | 251P[5:0] |                                       | 00H        |      |                     |         |    |
|             | VC  | C16P[4:0 | ]              | 00H           | VC       | 255P[4:0] |                                       | 00H        |      |                     |         |    |
| Description | VC  | C24P[4:0 | ]              | 00H           | A,       | J0P[1:0]  |                                       | 00H        |      |                     |         |    |
| Description | VC  | C52P[3:0 | ]              | 00H           | A        | J1P[1:0]  |                                       | 00H        |      |                     |         |    |
|             | VC  | C80P[5:0 | ]              | 00H           | A        | J2P[1:0]  |                                       | 00H        |      |                     |         |    |
|             | VC  | 108P[3:0 | 0]             | 00H           | A        | J3P[1:0]  |                                       | 00H        |      |                     |         |    |
|             | VC  | 147P[3:0 | 0]             | 00H           | A        | J4P[1:0]  |                                       | 00H        |      |                     |         |    |
|             | VC  | 175P[5:0 | 0]             | 00H           | A        | J5P[1:0]  |                                       | 00H        |      |                     |         |    |
|             | VC  | 203P[3:0 | 0]             | 00H           | A        | J6P[1:0]  |                                       | 00H        |      |                     |         |    |
|             | VC  | 231P[4:0 | 0]             | 00H           | A        | J7P[1:0]  |                                       | 00H        |      |                     |         |    |
| Restriction |     |          |                |               |          |           |                                       |            |      |                     |         |    |

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|              | Status                                       |             | Availability |  |
|--------------|--|-------------|--------------|--|
|              | Normal Mode On, Idle Mode Off, S             | leep Out    | Yes          |  |
| Register     | Normal Mode On, Idle Mode On, S              | leep Out    | Yes          |  |
| availability | Partial Mode On, Idle Mode Off, S            | leep Out    | Yes          |  |
|              | D :: 1M   O   I   M   O   O                  | loon Out    | Yes          |  |
|              | Partial Mode On, Idle Mode On, S             | leep Out    | 163          |  |
|              | Partial Mode On, Idle Mode On, S<br>Sleep In | eep Out     | Yes          |  |
|              | · · · · · · · · · · · · · · · · · · ·        |             |              |  |
| Default      | Sleep In                                     |             | Yes          |  |
| Default      | Sleep In                                     | Default Val | Yes          |  |



# 12.3.2.2 NVGAMCTRL (B1h/B100h): Negative Voltage Gamma Control

| B1H         |        |          |        |            |      | NVGAMC    | TRL (BK0 | )          |      |          |         |    |
|-------------|--------|----------|--------|------------|------|-----------|----------|------------|------|----------|---------|----|
| Inst / Dave | DAM    | Add      | ress   | D45.0      | D7   | DC        | Dr       | D4         | Do   | DO       | D1      | DO |
| Inst / Para | R/W    | MIPI     | SPI-16 | D15-8      | D7   | D6        | D5       | D4         | D3   | D2       | D1      | D0 |
|             | W      |          | B100h  | Х          | AJ0I | N[1:0]    |          |            |      | VC0      | N[3:0]  |    |
|             | W      |          | B101h  | Х          | AJ1I | N[1:0]    |          |            | VC8  | N[5:0]   |         |    |
|             | W      |          | B102h  | X          | AJ2I | N[1:0]    |          |            | VC8  | N[5:0]   |         |    |
|             | W      |          | B103h  | X          |      |           |          |            |      | VC16N[4: | 0]      |    |
|             | W      |          | B104h  | X          | AJ3I | N[1:0]    |          |            | 1    | VC24N[4: | 0]      |    |
|             | W      |          | B105h  | Х          |      |           |          |            |      | VC52     | 2N[3:0] |    |
|             | W      |          | B106h  | Х          |      |           |          |            | VC80 | N[5:0]   |         |    |
| NVGAMCTRL   | W      | B0h      | B107h  | Х          |      |           |          |            |      | VC10     | 8N[3:0] |    |
|             | W      | 2011     | B108h  | Х          |      |           |          |            |      | VC14     | 7N[3:0] |    |
|             | W      |          | B109h  | Х          |      |           |          | _          | VC17 | 5N[5:0]  |         |    |
|             | W      |          | B10Ah  | Х          |      |           |          |            |      |          | 3N[3:0] |    |
| -<br>-<br>- | W      |          | B10Bh  | Х          | AJ4I | N[1:0]    |          |            |      | /C231N[4 |         |    |
|             | W      |          | B10Ch  | Х          |      |           |          |            |      | /C239N[4 | :0]     |    |
|             | W      |          | B10Dh  | Х          |      | N[1:0]    |          |            |      | 7N[5:0]  |         |    |
|             | W      |          | B10Eh  | Х          |      | N[1:0]    |          |            |      | 1N[5:0]  |         |    |
|             | W      | refer to | B10Fh  | Х          | AJ7I | N[1:0]    |          |            |      | /C255N[4 | :0]     |    |
|             | Defaul | t value: |        | Value(hex) |      |           |          | /alue(hex) |      |          |         |    |
|             |        | 001100   |        |            |      | 200011401 | ,        |            |      |          |         |    |
|             |        | C0N[3:0] | -      | 00H        |      | 239N[4:0] |          | 00H        |      |          |         |    |
|             | V      | C4N[5:0] | ]      | 00H        | VC   | 247N[5:0] |          | 00H        |      |          |         |    |
|             | V      | C8N[5:0] | ]      | 00H        | VC   | 251N[5:0] |          | 00H        |      |          |         |    |
|             | VC     | C16N[4:0 | )]     | 00H        | VC   | 255N[4:0] |          | 00H        |      |          |         |    |
| Description | VC     | C24N[4:0 | )]     | 00H        | А    | J0N[1:0]  |          | 00H        |      |          |         |    |
|             | VC     | C52N[3:0 | )]     | 00H        | А    | J1N[1:0]  |          | 00H        |      |          |         |    |
|             | VC     | C80N[5:0 | )]     | 00H        | А    | J2N[1:0]  |          | 00H        |      |          |         |    |
|             | VC     | 108N[3:  | 0]     | 00H        | А    | J3N[1:0]  |          | 00H        |      |          |         |    |
|             | VC     | 147N[3:  | 0]     | 00H        | А    | J4N[1:0]  |          | 00H        |      |          |         |    |
|             | VC     | 175N[5:  | 0]     | 00H        | А    | J5N[1:0]  |          | 00H        |      |          |         |    |
|             | VC     | 203N[3:  | 0]     | 00H        | А    | J6N[1:0]  |          | 00H        |      |          |         |    |
| -           |        | 231N[4:  |        | 00H        |      | J7N[1:0]  |          | 00H        |      |          |         |    |
| Restriction |        |          |        |            | 1    |           | ı        |            |      |          |         |    |

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|              | Status                             |             | Availability         |   |
|--------------|------------------------------------|-------------|----------------------|---|
|              | Normal Mode On, Idle Mode Off, S   | Sleep Out   | Yes                  |   |
| Register     | Normal Mode On, Idle Mode On, S    | Sleep Out   | Yes                  |   |
| availability | Partial Mode On, Idle Mode Off, SI | leep Out    | Yes                  |   |
|              | Partial Mode On, Idle Mode On, SI  | leep Out    | Yes                  |   |
|              |                                    |             |                      |   |
|              | Sleep In                           |             | Yes                  |   |
|              | ·                                  | Default Val | Yes<br>ue (D7 to D0) |   |
| Default      | Sleep In                           | Default Val |                      | _ |
| Default      | Sleep In  Status                   |             |                      | ] |



# 12.3.2.3 DGMEN (B8h/B800h): Digital Gamma Enable

| В8Н          |                                 |                                   |           |                  |            | DGM        | EN (BK0) |        |     |    |    |    |  |
|--------------|---------------------------------|-----------------------------------|-----------|------------------|------------|------------|----------|--------|-----|----|----|----|--|
| Inst / Para  | R/W                             | Add                               | dress     | D15-8            | D7         | D6         | D5       | D4     | D3  | D2 | D1 | D0 |  |
|              | ,                               | MIPI                              | SPI-16    |                  |            |            |          |        |     |    |    |    |  |
| DGMEN        | W                               | B8h                               | B800h     | Χ                | 0          | 0          | 0        | DGM_ON | 0   | 0  | 0  | 0  |  |
|              | DGM_                            | <b>ON</b> :Dig                    | gital Gar | nma Enable       |            |            |          |        |     |    |    |    |  |
| Description  | DGM_                            | ON="0                             | ", disab  | le this function | <b>1</b> . |            |          |        |     |    |    |    |  |
|              | DGM_                            | DGM_ON="1", enable this function. |           |                  |            |            |          |        |     |    |    |    |  |
| Restriction  |                                 |                                   |           |                  |            |            |          |        |     |    |    |    |  |
|              | Status Availability             |                                   |           |                  |            |            |          |        |     |    |    | 1  |  |
|              |                                 |                                   | Norma     | l Mode On, Idle  | Mode Of    | f, Sleep O | ut       |        | Yes | ,  |    | 1  |  |
| Register     |                                 |                                   | Norma     | l Mode On, Idle  | Mode Or    | n, Sleep O | ut       |        | Yes |    |    |    |  |
| availability |                                 |                                   | Partial   | Mode On, Idle    | Mode Off   | , Sleep O  | ut       |        | Yes |    |    |    |  |
|              |                                 |                                   | Partial   | Mode On, Idle    | Mode On    | , Sleep O  | ut       |        | Yes | i  |    |    |  |
|              |                                 |                                   |           | Slee             | p In       |            |          |        | Yes |    |    |    |  |
|              |                                 |                                   |           |                  |            |            |          |        |     |    |    |    |  |
|              | Status Default Value (D7 to D0) |                                   |           |                  |            |            |          |        |     |    |    |    |  |
| Default      |                                 |                                   | Power     | On Sequence      |            |            | 00h      |        |     |    |    |    |  |
| Default      |                                 |                                   | S/W Re    | eset             |            |            | 00h      |        |     |    |    |    |  |
|              |                                 |                                   | H/W Re    | eset             |            |            | 00h      |        |     |    |    |    |  |
|              |                                 |                                   |           |                  |            |            |          |        |     |    |    |    |  |



# 12.3.2.4 DGMLUTR (B9h/B900h): Digital Gamma Look-up Table for Red

| В9Н          |         |      |           |                        |    | DGMLUT    | R (BK0) |           |            |    |      |        |
|--------------|---------|------|-----------|------------------------|----|-----------|---------|-----------|------------|----|------|--------|
|              |         | Add  | dress     |                        |    |           |         |           |            |    |      |        |
| Inst / Para  | R/W     | MIPI | SPI-16    | D15-8                  | D7 | D6        | D5      | D4        | D3         | D2 | D1   | D0     |
|              | W       |      | B900h     | Х                      |    |           |         | P0[       | 7:0]       |    |      |        |
|              | W       |      | B901h     | Х                      |    |           |         |           |            |    | P0[  | 9:8]   |
|              | W       |      | B902h     | Х                      |    |           |         |           | -          |    | P4[  | 1:0]   |
|              | W       |      | B903h     | Χ                      |    |           |         |           | -          |    | -    | -      |
|              | W       |      | B904h     | Χ                      |    |           |         | P8[       | 7:0]       |    |      |        |
|              | W       |      | B905h     | Х                      |    |           |         |           | -          |    | P8[  | 9:8]   |
|              | W       |      | B906h     | Χ                      |    |           |         |           | -          |    | P12  | [1:0]  |
| DOMILITE     | W       | Dok  | B907h     | Χ                      |    |           |         |           |            |    |      |        |
| DGMLUTB -    | W       | B9h  | :         | Χ                      |    |           |         | :         | <u> </u>   |    |      |        |
|              | W       |      | :         | Χ                      |    |           |         | :         | :          |    |      |        |
|              | W       |      | B97Ch     | Χ                      |    |           |         | P248      | 3[7:0]     |    |      |        |
|              | W       |      | B97Dh     | Χ                      |    |           |         |           |            |    | P248 | 8[9:8] |
|              | W       |      | B97Eh     | Χ                      |    |           |         |           |            |    | P252 | 2[1:0] |
|              | W       |      | B97Fh     | X                      |    |           |         |           |            |    |      |        |
|              | W       |      | B980h     | Χ                      |    | , ,       |         | P255      | [7:0]      | 1  |      |        |
|              | W       |      | B981h     | Χ                      |    |           |         |           |            |    | P255 | 5[9:8] |
| Description  | Digital | Gamm | ıa Look-ι | up Table for Re        | ed |           |         |           |            |    |      |        |
| Restriction  |         |      |           |                        |    |           |         |           |            |    |      |        |
|              |         |      |           | _                      |    |           |         |           |            |    |      |        |
|              |         |      | Normal    | Statu<br>Mode On, Idle |    | Class Out |         |           | Availab    | -  |      |        |
| Register     |         |      |           | Mode On, Idle          |    | -         |         |           | Yes<br>Yes |    |      |        |
| availability |         |      |           | Mode On, Idle I        |    |           |         |           | Yes        |    |      |        |
| ,            |         |      |           | Mode On, Idle N        |    |           |         |           | Yes        |    |      |        |
|              |         |      |           | Sleep                  | ln |           |         |           | Yes        |    |      |        |
|              |         |      | -         |                        |    |           |         |           |            |    |      |        |
|              |         |      | Status    |                        |    |           | Default | Value (D7 | ' to D0)   |    |      |        |
|              |         |      |           | On Sequence            |    |           | All "0" | .4.00 (D7 | .0 00)     |    |      |        |
| Default      |         |      | S/W Res   |                        |    |           | All "0" |           |            |    |      |        |
|              |         |      | H/W Re    | set                    |    |           | All "0" |           |            |    |      |        |
|              |         |      |           |                        |    |           |         |           |            |    |      |        |



# 12.3.2.5 DGMLUTB (BAh/BA00h): Digital Gamma Look-up Table for Blue

| BAH          |         |      |           |                                |    | DGMLUT | TB (BK0) |           |            |    |      |        |
|--------------|---------|------|-----------|--------------------------------|----|--------|----------|-----------|------------|----|------|--------|
| Inst / Dava  | R/W     | Add  | dress     | D15-8                          | D7 | De     | DE       | D4        | Da         | Do | D1   | D0     |
| Inst / Para  | IT/VV   | MIPI | SPI-16    | ס-פוע                          | D7 | D6     | D5       | D4        | D3         | D2 | וט   | DU     |
|              | W       |      | BA00h     | Х                              |    |        |          | P0[       | 7:0]       |    |      |        |
|              | W       |      | BA01h     | Х                              |    |        |          |           |            |    | P0[  | 9:8]   |
|              | W       |      | BA02h     | Χ                              |    |        |          |           |            |    | P4[  | 1:0]   |
|              | W       |      | BA03h     | Χ                              |    |        |          |           |            |    |      |        |
|              | W       |      | BA04h     | Χ                              |    |        |          | P8[       | 7:0]       |    |      |        |
|              | W       |      | BA05h     | Χ                              |    |        |          |           |            |    | P8[  | 9:8]   |
|              | W       |      | BA06h     | Χ                              |    |        |          |           |            |    | P12  | [1:0]  |
| DOMILITE     | W       | DAL  | BA07h     | Χ                              |    |        |          |           |            |    |      |        |
| DGMLUTB      | W       | BAh  | :         | Χ                              |    |        |          |           | <u> </u>   |    |      |        |
|              | W       |      | :         | Χ                              |    |        |          |           | :          |    |      |        |
|              | W       |      | BA7Ch     | Χ                              |    |        |          | P248      | 8[7:0]     |    |      |        |
|              | W       |      | BA7Dh     | Χ                              |    |        |          |           |            |    | P248 | 8[9:8] |
|              | W       |      | BA7Eh     | Χ                              |    |        |          |           |            |    | P252 | 2[1:0] |
|              | W       |      | BA7Fh     | Χ                              |    |        |          |           |            |    |      |        |
|              | W       |      | BA80h     | Х                              |    |        |          | P255      | [7:0]      |    |      |        |
|              | W       |      | BA81h     | Х                              |    |        |          |           |            |    | P255 | 5[9:8] |
| Description  | Digital | Gamm | ıa Look-ι | ıp Table for Bl                | ue |        |          |           |            |    |      |        |
| Restriction  |         |      |           |                                |    |        |          |           |            |    |      |        |
|              |         |      |           |                                |    |        |          |           |            |    |      |        |
|              |         |      | Name      | Stati                          |    | 01     |          |           | Availab    |    |      |        |
| Register     |         |      |           | Mode On, Idle<br>Mode On, Idle |    |        |          |           | Yes<br>Yes |    |      |        |
| availability |         |      |           | Mode On, Idle I                |    |        |          |           | Yes        |    |      |        |
|              |         |      |           | Mode On, Idle I                |    | -      |          |           | Yes        |    |      |        |
|              |         |      |           | Sleep                          |    |        |          |           | Yes        |    |      |        |
|              |         |      |           |                                |    |        |          |           |            |    |      |        |
|              |         |      | Status    |                                |    |        | Default  | Value (D7 | to D0)     |    |      |        |
| Deferrit     |         |      | Power C   | n Sequence                     |    |        | All "0"  |           |            |    |      |        |
| Default      |         |      | S/W Res   | set                            |    |        | All "0"  |           |            |    |      |        |
|              |         |      | H/W Res   | set                            |    |        | All "0"  |           |            |    |      |        |
|              |         |      |           |                                |    |        |          |           |            |    |      |        |



#### 12.3.2.6 LNESET (C0h/C000h): Display Line Setting

| C0H          |   |   |                 |                 |             | LNESE     | T (BK0)      |             |           |          |         |           |  |  |
|--------------|---|---|-----------------|-----------------|-------------|-----------|--------------|-------------|-----------|----------|---------|-----------|--|--|
| Inst / Para  | R/W   | Add<br>MIPI   | ress<br>SPI-16  | D15-8           | D7          | D6        | D5           | D4          | D3        | D2       | D1      | D0        |  |  |
|              | W   | IVIII I   | C000h           | X               | LDE_EN      |           |              |             | Line[6:0] |          |         |           |  |  |
| LNESET       | W   | C0h   | C00011          | X               | LDL_LIN     |           |              |             |           |          | Line_de | 10.11ctl  |  |  |
|              |   | :• <b>01</b> · di   |                 | e setting       |             |           |              |             |           |          | Line_uc | Fita[1.0] |  |  |
|              | _   | -   |                 | ū               |             |           |              |             |           |          |         |           |  |  |
|              |   |   |                 | line enable     |             |           |              |             |           |          |         |           |  |  |
|              | LDE_E   | LDE_EN="0",no add delta line , NL= (Line[6:0]+1)*8  EX:(C0:0x6b,0x00)  (0x6b,1) x 8)=864: |                 |                 |             |           |              |             |           |          |         |           |  |  |
| Description  | EX:(C   | X:(C0:0x6b,0x00) → ((0x6b+1) x 8)=864;  |                 |                 |             |           |              |             |           |          |         |           |  |  |
|              | LDE_EN="1",add delta line , NL=(Line[6:0]+1)*8+ Line_delta[1:0]*2 |   |                 |                 |             |           |              |             |           |          |         |           |  |  |
|              | EX: (C  | 0:0xe9  | ,0x03) <b>-</b> | •((0x69+1) x8   | ) + ( 3x2 ) | =854      |              |             |           |          |         |           |  |  |
|              | SCNL  | EX: (C0:0xe9,0x03)→((0x69+1) x8) + ( 3x2 )=854  SCNL= NL+VBP+VFP                          |                 |                 |             |           |              |             |           |          |         |           |  |  |
| Restriction  |   |   |                 |                 |             |           |              |             |           |          |         |           |  |  |
|              |   |   |                 |                 |             |           |              |             |           |          |         |           |  |  |
|              |   |   |                 | Sta             |             |           |              |             | Availat   | -        |         |           |  |  |
|              |   |   |                 | l Mode On, Idle |             | •         |              |             | Yes       |          |         |           |  |  |
| Register     |   |   |                 | l Mode On, Idle |             | •         |              |             | Yes       |          |         |           |  |  |
| availability |   |   |                 | Mode On, Idle   |             |           |              |             | Yes       |          |         |           |  |  |
|              |   |   | Partial         | Mode On, Idle   |             | Sleep Out | t            |             | Yes       |          |         |           |  |  |
|              |   |   |                 | Slee            | p In        |           |              |             | Yes       | <b>S</b> |         |           |  |  |
|              |   |   |                 |                 |             |           |              |             |           |          | _       |           |  |  |
|              |   | Sta   | itus            |                 |             |           | Default Valı | ue (D7 to I | D0)       |          |         |           |  |  |
| Default      |   | Po  | wer On S        | equence         |             | 6         | 6bh/00h      |             |           |          |         |           |  |  |
| Delauit      |   | S/V   | V Reset         |                 |             | 6         | 6bh/00h      |             |           |          |         |           |  |  |
|              |   | H/\   | N Reset         |                 |             | 6         | 6bh/00h      |             |           |          |         |           |  |  |
|              |   |   |                 |                 |             |           |              |             |           |          |         |           |  |  |



# 12.3.2.7 PORCTRL (C1h/C100h):Porch Control

| C1H          |       |                  |          |                 |            | PORCT       | RL (BK0)    |             |         |        |    |     |  |  |  |
|--------------|-------|------------------|----------|-----------------|------------|-------------|-------------|-------------|---------|--------|----|-----|--|--|--|
| 5            |       | Add              | dress    | D. T. 0         |            |             |             | -           |         | 5.0    |    | D.0 |  |  |  |
| Inst / Para  | R/W   | MIPI             | SPI-16   | D15-8           | D7         | D6          | D5          | D4          | D3      | D2     | D1 | D0  |  |  |  |
| DODOTOL      | W     | 0.11             | C100h    | Х               |            |             |             | VBP         | [7:0]   |        |    |     |  |  |  |
| PORCTRL      | W     | C1h              | C101h    | Х               |            |             |             | VFP         | [7:0]   |        |    |     |  |  |  |
|              | VBP[7 | <b>':0]:</b> Ba  | ck-Porc  | h Vertical line | setting fo | or display. |             |             |         |        |    |     |  |  |  |
| Description  | VFP[7 | : <b>0]:</b> Fro | ont-Porc | h Vertical line | setting fo | or display. |             |             |         |        |    |     |  |  |  |
| Restriction  |       |                  | - V / V  |                 |            |             |             |             |         |        |    |     |  |  |  |
|              |       |                  |          |                 |            |             |             |             |         |        |    |     |  |  |  |
|              |       |                  |          | Stat            | tus        |             |             |             | Availab | oility |    |     |  |  |  |
|              |       |                  | Norma    | l Mode On, Idle | Mode Off,  | , Sleep Ou  | t           |             | Yes     | 3      |    |     |  |  |  |
| Register     |       |                  | Norma    | l Mode On, Idle | Mode On,   | , Sleep Ou  | t           |             | Yes     | 3      |    |     |  |  |  |
| availability |       |                  | Partial  | Mode On, Idle   | Mode Off,  | Sleep Out   |             |             | Yes     | 3      |    |     |  |  |  |
|              |       |                  | Partial  | Mode On, Idle   | Mode On,   | Sleep Out   | :           |             | Yes     | 3      |    |     |  |  |  |
|              |       |                  |          | Slee            | p In       |             |             |             | Yes     | 3      |    |     |  |  |  |
|              |       |                  |          |                 |            |             |             |             |         |        |    |     |  |  |  |
|              |       | Sta              | atus     |                 |            |             | Default Val | ue (D7 to I | D0)     |        |    |     |  |  |  |
| Defeat       |       | Po               | wer On S | Sequence        |            | 0           | 4h/02h      |             |         |        |    |     |  |  |  |
| Default      |       | S/\              | N Reset  |                 |            | C           | 4h/02h      |             |         |        |    |     |  |  |  |
|              |       | H/\              | N Reset  |                 |            | 0           | 4h/02h      |             |         |        |    |     |  |  |  |
|              |       |                  |          |                 |            |             |             |             |         |        |    |     |  |  |  |



#### 12.3.2.8 INVSET (C2h/C200h):Inversion selection & Frame Rate Control

| C2H                   |                         |                  |         |                                      |                                       | INVSE    | T (BK0) |             |            |           |           |    |
|-----------------------|-------------------------|------------------|---------|--------------------------------------|---------------------------------------|----------|---------|-------------|------------|-----------|-----------|----|
| Inst / Para           | R/W                     | Add              | dress   | D15-8                                | D7                                    | D6       | D5      | D4          | D3         | D2        | D1        | D0 |
| IIISI / Faia          | □/ VV                   | MIPI             | SPI-16  | D10-6                                | D/                                    | D6       | DS      | D4          | DS         | DZ        | Di        | DU |
| INVSET                | W                       | C2h              | C200h   | Х                                    | 0                                     | 0        | 1       | 1           | 0          |           | NLINV[2:0 |    |
| INVOET                | W                       | GZII             | C201h   | X                                    |                                       |          |         |             |            | RTNI[4:0] |           |    |
|                       | NLIN                    | <b>/[2:0]:</b> l | nversio | n Selection                          |                                       |          |         |             |            |           |           |    |
|                       | NI                      | _INV[2:          | 0]      | Inversion                            |                                       |          |         |             |            |           |           |    |
|                       |                         | 0                |         | 1 Dot                                |                                       |          |         |             |            |           |           |    |
| Description           |                         | 1                |         | 2 Dot                                |                                       |          |         |             |            |           |           |    |
|                       |                         | 7                |         | Column                               |                                       |          |         |             |            |           |           |    |
|                       | RTNI[                   | <b>4:0]</b> :mi  | nimum   | number of pcl                        | k in each                             | line     |         |             |            |           |           |    |
|                       | PCLK=512+(RTNI[4:0]x16) |                  |         |                                      |                                       |          |         |             |            |           |           |    |
| Restriction           |                         |                  |         |                                      |                                       |          |         |             |            |           |           |    |
|                       |                         |                  |         |                                      |                                       |          |         |             |            |           |           |    |
|                       |                         |                  |         |                                      | itus                                  |          |         |             | Availab    |           |           |    |
|                       |                         |                  |         | al Mode On, Idle                     |                                       |          |         |             | Yes        |           |           |    |
| Register availability |                         |                  |         | al Mode On, Idle<br>al Mode On, Idle |                                       | •        |         |             | Yes<br>Yes |           |           |    |
| avaliability          |                         |                  |         | al Mode On, Idle                     |                                       | · ·      |         |             | Yes        |           |           |    |
|                       |                         |                  | ı aıtı  |                                      | ep In                                 | Sieep Ou | ı       |             | Yes        |           |           |    |
|                       |                         |                  |         | 0.00                                 | , , , , , , , , , , , , , , , , , , , |          |         |             |            |           |           |    |
|                       |                         | _                |         |                                      |                                       |          |         |             |            |           |           |    |
|                       |                         |                  | atus    |                                      |                                       |          |         | ue (D7 to I | D0)        |           |           |    |
| Default               |                         |                  |         | Sequence                             |                                       |          | 0h/00h  |             |            |           |           |    |
|                       |                         | -                | N Reset |                                      |                                       | -        | 0h/00h  |             |            |           |           |    |
|                       |                         | H/\              | W Reset |                                      |                                       |          | 0h/00h  |             |            |           |           |    |
|                       |                         |                  |         |                                      |                                       |          |         |             |            |           |           |    |



# 12.3.2.9 RGBCTRL (C3h/C300h):RGB control

| C3H                             | RGBCTRL (BK0)                                    |          |           |                             |            |           |            |             |            |              |                 |           |  |
|---------------------------------|--|----------|-----------|-----------------------------|------------|-----------|------------|-------------|------------|--------------|-----------------|-----------|--|
|                                 |  | Add      | dress     |                             |            |           |            |             |            |              |                 |           |  |
| Inst / Para                     | R/W  | MIPI     | SPI-16    | D15-8                       | D7         | D6        | D5         | D4          | D3         | D2           | D1              | D0        |  |
|                                 | W  |          | C300h     | Х                           | DE/HV      |           |            |             | VSP        | HSP          | DP              | EP        |  |
| RGBCTRL                         | W  | C3h      | C301h     | Х                           |            |           |            | HBP_HV      | RGB[7:0]   |              |                 |           |  |
|                                 | W  |          | C302h     | X                           |            |           |            | VBP_HV      | RGB[7:0]   |              |                 |           |  |
|                                 | DE/HV  | :RGB     | Mode se   | election                    |            |           |            |             |            |              |                 |           |  |
|                                 | DE/HV  | /="0",R  | GB DE     | mode.                       |            |           |            |             |            |              |                 |           |  |
|                                 | DE/HV  | /="1",R  | GB HV     | mode.                       |            |           |            |             |            |              |                 |           |  |
|                                 | VSP :  | Sets th  | ne signa  | polarity of th              | e VSYNC    | pin.      |            |             |            |              |                 |           |  |
|                                 | VSP="  | '0", Lov | v active  |                             |            |           |            |             |            |              |                 |           |  |
|                                 | VSP="  | '1", Hig | h active  |                             |            |           |            |             |            |              |                 |           |  |
|                                 | HSP :  | Sets th  | ne signa  | I polarity of th            | e HSYNC    | pin.      |            |             |            |              |                 |           |  |
|                                 | HSP='  | '0", Lov | w active  |                             |            |           |            |             |            |              |                 |           |  |
| Description                     | HSP='  | '1", Hig | h active  |                             |            |           |            |             |            |              |                 |           |  |
| 2 000                           | DP : Sets the signal polarity of the DOTCLK pin. |          |           |                             |            |           |            |             |            |              |                 |           |  |
|                                 |  |          | - ,       | nput on the p               |            | •         | TCLK       |             |            |              |                 |           |  |
|                                 |  |          |           | nput on the n               |            |           |            |             |            |              |                 |           |  |
|                                 |  |          |           | olarity of the              | _          | _         |            |             |            |              |                 |           |  |
|                                 |  |          |           | 323-0 is writte             |            |           | : "1" Disa | ble data    | write onei | ration who   | en FNAR         | I F = "0" |  |
|                                 |  |          |           | 323-0 is writte             |            |           |            |             |            |              |                 |           |  |
|                                 |  |          |           | RGB interface               |            |           |            |             |            |              |                 |           |  |
|                                 |  |          |           | RGB interface               | -          | •         | _          |             |            | idiii Settii | 19 13 0 0 0 0 2 | •         |  |
| Destriction                     |  | ivnai    | 5[7.U]. F | idb iiileiiace              | risyiic ba | ack poici | setting it | טווו אדו וכ | ue.        |              |                 |           |  |
| Restriction                     |  |          |           |                             |            |           |            |             |            |              |                 |           |  |
|                                 |  |          |           | Sta                         | tus        |           |            |             | Availab    | oility       |                 |           |  |
|                                 |  |          |           | l Mode On, Idle             |            |           |            |             | Yes        |              |                 |           |  |
| Register                        |  |          |           | l Mode On, Idle             |            |           |            |             | Yes        |              |                 |           |  |
| availability                    |  |          |           | Mode On, Idle Mode On, Idle |            | •         |            |             | Yes<br>Yes |              |                 |           |  |
|                                 |  |          | T ditid   | Slee                        |            | Olcop Ou  |            |             | Yes        |              |                 |           |  |
|                                 |  |          |           |                             |            |           | <u></u>    |             |            |              |                 |           |  |
| Status Default Value (D7 to D0) |  |          |           |                             |            |           |            |             |            |              |                 |           |  |
|                                 |  |          |           | Sequence                    |            |           | 00h/10h/08 | •           | JU) -      |              |                 |           |  |
| Default                         |  |          | N Reset   | 2-1-000                     |            |           | 00h/10h/08 |             |            |              |                 |           |  |
|                                 |  | Η/\      | W Reset   |                             |            | (         | 00h/10h/08 | ßh          |            |              |                 |           |  |
|                                 | n/w neset 0011/1011/0011                         |          |           |                             |            |           |            |             |            |              |                 |           |  |



# 12.3.2.10 PARCTRL (C5h/C500h):Partial Mode Control

| C5H          |      |   |          |                 |           | PARCT      | RL (BK0)    |             |                |        |      |                |  |  |
|--------------|------|---|----------|-----------------|-----------|------------|-------------|-------------|----------------|--------|------|----------------|--|--|
| Inst / Para  | R/W  | Add                                       | dress    | D15-8           | D7        | D6         | D5          | D4          | D3             | D2     | D1   | D0             |  |  |
| inst / Para  | H/VV | MIPI                                      | SPI-16   | 8-6ות           | D7        | Dβ         | D5          | D4          | D3             | D2     | וט   | DU             |  |  |
|              | W    |   | C500h    | X               |           |            |             | PTS/        | <b>A</b> [7:0] |        |      |                |  |  |
|              | W    |   | C501h    | Х               |           |            |             |             |                |        | PTS  | 4[9:8]         |  |  |
| PARCTRL      | W    | C5h                                       | C502h    | Х               |           |            |             | PTE/        | <b>A</b> [7:0] |        |      |                |  |  |
|              | W    |   | C503     | Х               | -         |            |             |             |                |        | PTE/ | <b>A</b> [9:8] |  |  |
|              | PTSA | [9:0]: Partial display start line address |          |                 |           |            |             |             |                |        |      |                |  |  |
| Description  | PTEA | EA[9:0]: Partial display end line address |          |                 |           |            |             |             |                |        |      |                |  |  |
| Restriction  |      |   |          |                 |           |            |             |             |                |        |      |                |  |  |
|              |      |   |          | Sta             | tus       |            |             |             | Availat        | oility |      |                |  |  |
|              |      |   | Norma    | l Mode On, Idle | Mode Off  | , Sleep Οι | ıt          |             | Yes            | 6      |      |                |  |  |
| Register     |      |   | Norma    | l Mode On, Idle | Mode On   | , Sleep Οι | ut          |             | Yes            | 3      |      |                |  |  |
| availability |      |   | Partia   | Mode On, Idle   | Mode Off, | Sleep Ou   | t           |             | Yes            | 3      |      |                |  |  |
|              |      |   | Partia   | Mode On, Idle   | Mode On,  | Sleep Ou   | t           |             | Yes            | 3      |      |                |  |  |
|              |      |   |          | Slee            | p In      |            |             |             | Yes            | 3      |      |                |  |  |
|              |      |   |          |                 |           |            |             |             |                |        |      |                |  |  |
|              |      | Sta                                       | atus     |                 |           | [          | Default Val | ue (D7 to I | D0)            |        |      |                |  |  |
| Default      |      | Ро  | wer On S | Sequence        |           | (          | 00h/00h/5fl | h/03h       |                |        |      |                |  |  |
| Derauit      |      | S٨  | N Reset  |                 |           | (          | 00h/00h/5fl | h/03h       |                |        |      |                |  |  |
|              |      | H/\                                       | W Reset  |                 |           | (          | 00h/00h/5fl | h/03h       |                |        |      |                |  |  |
|              |      |   |          |                 |           |            |             |             |                |        |      |                |  |  |



# 12.3.2.11 SDIR (C7h/C700): X-direction Control

| C7H          |       |                          |           |                  |           | PDOS       | ET (BK0)    |              |            |        |     |    |
|--------------|-------|--------------------------|-----------|------------------|-----------|------------|-------------|--------------|------------|--------|-----|----|
| / D          | D.44  | Add                      | dress     | D.1. 0           | 57        | D.0        | D.          | <b>D</b> 4   | <b>D</b> 0 |        | 6.1 |    |
| Inst / Para  | R/W   | MIPI                     | SPI-16    | D15-8            | D7        | D6         | D5          | D4           | D3         | D2     | D1  | D0 |
| PDOSET       | W     | C7h                      | C500h     | X                |           |            |             |              |            | SS     |     |    |
|              | SS:To | selecti                  | on x-dire | ection.          |           |            |             |              |            |        |     |    |
| Description  | SS="0 | ,sourc                   | e form 0  | ) to 479         |           |            |             |              |            |        |     |    |
|              | SS="1 | "1",source form 479 to 0 |           |                  |           |            |             |              |            |        |     |    |
| Restriction  |       |                          |           |                  |           |            |             |              |            |        |     |    |
|              |       |                          |           | Sta              | tus       |            |             |              | Availat    | oility |     |    |
|              |       |                          | Norma     | ıl Mode On, Idle |           | , Sleep Οι | ut          |              | Yes        | -      |     |    |
| Register     |       |                          | Norma     | ıl Mode On, Idle | Mode On   | , Sleep Oı | ut          |              | Yes        | ;      |     |    |
| availability |       |                          | Partia    | l Mode On, Idle  | Mode Off, | Sleep Ou   | t           |              | Yes        | 3      |     |    |
|              |       |                          | Partia    | l Mode On, Idle  | Mode On,  | Sleep Ou   | t           |              | Yes        | 3      |     |    |
|              |       |                          |           | Slee             | p In      |            |             |              | Yes        | 3      |     |    |
|              |       |                          |           |                  |           |            |             |              |            |        |     |    |
|              |       | Sta                      | atus      |                  |           | ı          | Default Val | lue (D7 to I | D0)        |        |     |    |
| Default      |       | Po                       | wer On S  | Sequence         |           | (          | 00h         |              |            |        |     |    |
| Dorault      |       | SΛ                       | N Reset   |                  |           | (          | 00h         |              |            |        |     |    |
|              |       | HΛ                       | N Reset   |                  |           | (          | 00h         |              |            |        |     |    |
|              |       |                          |           |                  |           |            |             |              |            |        |     |    |



# 12.3.2.12 PDOSET (C8h/C800h):Pseudo-Dot inversion diving setting

| C8H          |                                 |                             |                 |                  |            | PDOSE         | T (BK0)   |    |                |        |    |    |  |  |
|--------------|---------------------------------|-----------------------------|-----------------|------------------|------------|---------------|-----------|----|----------------|--------|----|----|--|--|
| Inst / Para  | R/W                             | Add<br>MIPI                 | dress<br>SPI-16 | D15-8            | D7         | D6            | D5        | D4 | D3             | D2     | D1 | D0 |  |  |
| PDOSET       | W                               | C5h                         | C500h           | Х                | Z_EN       | Z_SDM1        | Z_Gltor   |    |                |        |    |    |  |  |
|              | Z_EN:                           | :To ena                     | ıble pseı       | udo-dot invers   | sion drivi | ng.           | <u>I</u>  |    | I              | I      | I. |    |  |  |
|              | Z_EN:                           | ="0",en                     | able PD         | OSET setting     |            |               |           |    |                |        |    |    |  |  |
|              | Z_EN:                           | ="1",dis                    | sable PD        | OSET setting     | 9          |               |           |    |                |        |    |    |  |  |
|              | Z_SDI                           | M1: SD                      | )UM_1 c         | or SDUM_2 er     | nable cor  | ntrol (for Z- | inv only) |    |                |        |    |    |  |  |
| Description  | Z_SDI                           | Z_SDM1="0",SDUM_2 is enable |                 |                  |            |               |           |    |                |        |    |    |  |  |
|              | Z_SM                            |                             |                 |                  |            |               |           |    |                |        |    |    |  |  |
|              | Z_Glt                           |                             |                 |                  |            |               |           |    |                |        |    |    |  |  |
|              | Z_Gltd                          | or="0",L                    | side fir        | st               |            |               |           |    |                |        |    |    |  |  |
|              | Z_Gltd                          | or="1",F                    | R-side fi       | rst              |            |               |           |    |                |        |    |    |  |  |
| Restriction  |                                 |                             |                 |                  |            |               |           |    |                |        |    |    |  |  |
|              |                                 |                             |                 | Cta              | atus       |               |           |    | Availab        | :1:4.7 |    |    |  |  |
|              |                                 |                             | Norma           | al Mode On, Idle |            | f. Sleep Out  |           |    | Availab<br>Yes |        |    |    |  |  |
| Register     |                                 |                             |                 | al Mode On, Idle |            |               |           |    | Yes            |        |    |    |  |  |
| availability |                                 |                             | Partia          | l Mode On, Idle  | Mode Of    | f, Sleep Out  |           |    | Yes            |        |    |    |  |  |
|              |                                 |                             | Partia          | l Mode On, Idle  | Mode Or    | n, Sleep Out  |           |    | Yes            |        |    |    |  |  |
|              |                                 |                             |                 | Slee             | ep In      |               |           |    | Yes            |        |    |    |  |  |
|              | <del> </del>                    |                             |                 |                  |            |               |           |    |                |        |    |    |  |  |
|              | Status Default Value (D7 to D0) |                             |                 |                  |            |               |           |    |                |        |    |    |  |  |
| Default      |                                 |                             |                 | Sequence         |            |               | 0h        |    |                |        |    |    |  |  |
| Bordan       |                                 |                             | W Reset         |                  |            |               | 0h        |    |                |        |    |    |  |  |
|              |                                 | H/                          | W Reset         |                  |            | 0             | 0h        |    |                |        |    |    |  |  |
|              |                                 |                             |                 |                  |            |               |           |    |                |        |    |    |  |  |



# 12.3.2.13 COLCTRL (CDh/CD00h):Color Control

| CDH          |                       |  |          |                 |           | COL         | CTRL (BK0)     |                |            |            |          |    |  |  |
|--------------|-----------------------|--|----------|-----------------|-----------|-------------|----------------|----------------|------------|------------|----------|----|--|--|
| / 5          | D 444                 | Add  | dress    | D45.0           | D.7       | D.0         | 5.5            | 5.4            | <b>D</b> 0 | <b>D</b> 0 | D.4      | Do |  |  |
| Inst / Para  | R/W                   | MIPI   | SPI-16   | D15-8           | D7        | D6          | D5             | D4             | D3         | D2         | D1       | D0 |  |  |
| COLCTRL      | W                     | CDh  | CD00h    | Х               |           |             | INV_LED<br>PWM | INV_LED<br>_ON | MDT        |            | EPF[2:0] |    |  |  |
|              | INV_L                 | ED PV  | VM: LED  | DPWM polarit    | y control |             |                |                |            |            |          |    |  |  |
|              | INV_L                 | .ED PV   | VM="0",  | polarity norm   | nal.      |             |                |                |            |            |          |    |  |  |
|              | INV_L                 | ED PV  | VM="1",  | polarity reve   | rse.      |             |                |                |            |            |          |    |  |  |
|              | INV_L                 | ED_O   | N: LED_  | ON polarity     | control.  |             |                |                |            |            |          |    |  |  |
|              | INV L                 | .ED OI   | N="0", p | olarity norma   | ıl.       |             |                |                |            |            |          |    |  |  |
|              |                       |  |          | olarity revers  |           |             |                |                |            |            |          |    |  |  |
|              |                       |  |          | nat argument    |           | K) See T    | able 17        |                |            |            |          |    |  |  |
| Description  |                       | -  |          | at argument r   |           | 11,000 11   | 2010 17.       |                |            |            |          |    |  |  |
| Description  |                       |  |          | ot to DB[17:0]  |           |             |                |                |            |            |          |    |  |  |
|              |                       |  |          |                 | -         | ol mada     | .\             |                |            |            |          |    |  |  |
|              |                       | F[2:0]: end of pixel format (for 65k & 262k mode) opy self MSB |          |                 |           |             |                |                |            |            |          |    |  |  |
|              |                       | copy self MSB  |          |                 |           |             |                |                |            |            |          |    |  |  |
|              |                       |  |          |                 |           |             |                |                |            |            |          |    |  |  |
|              |                       | y self L   | SB       |                 |           |             |                |                |            |            |          |    |  |  |
|              | 4:FIX                 | 0  |          |                 |           |             |                |                |            |            |          |    |  |  |
|              | 5:FIX                 | 1  |          |                 |           |             |                |                |            |            |          |    |  |  |
| Restriction  |                       |  |          |                 |           |             |                |                |            |            |          |    |  |  |
|              |                       |  |          | Q <sub>1</sub>  | atus      |             |                |                | Availabil  | itv        |          |    |  |  |
|              |                       |  | Norma    | al Mode On, Id  |           | Off. Sleep  | Out            |                | Yes        | щ          |          |    |  |  |
| Register     |                       |  |          | al Mode On, Id  |           |             |                |                | Yes        |            |          |    |  |  |
| availability |                       |  | Partia   | ıl Mode On, Idl | e Mode O  | ff, Sleep ( | Out            |                | Yes        |            |          |    |  |  |
|              |                       |  | Partia   | ıl Mode On, Idl | e Mode O  | n, Sleep (  | Dut            |                | Yes        |            |          |    |  |  |
|              |                       |  |          | Sle             | ep In     |             |                |                | Yes        |            |          |    |  |  |
|              |                       |  |          |                 |           |             |                |                |            |            |          |    |  |  |
|              |                       | Sta  | atus     |                 |           |             | Default Val    | lue (D7 to D0  | ))         |            |          |    |  |  |
| Default      | Power On Sequence 00h |  |          |                 |           |             |                |                |            |            |          |    |  |  |
| Delault      |                       | S/   | W Reset  |                 |           |             | 00h            |                |            |            |          |    |  |  |
|              |                       | H/   | W Reset  |                 |           |             | 00h            |                |            |            |          |    |  |  |
| <u> </u>     |                       |  |          |                 |           |             |                |                |            |            |          |    |  |  |



# 12.3.2.14 SECTRL (E0h/E000h):Sunlight Readable Enhancement

| E0H          |                     |                       |                    |                  |           | SECTE      | RL (BK0)    |             |     |          |          |    |  |
|--------------|---------------------|-----------------------|--------------------|------------------|-----------|------------|-------------|-------------|-----|----------|----------|----|--|
| Inst / Dave  | R/W                 | Add                   | dress              | D45.0            | D7        | D6         | D5          | D4          | Do  | Do       | D4       | DO |  |
| Inst / Para  | H/VV                | MIPI                  | SPI-16             | D15-8            | D7        | Dб         | D5          | D4          | D3  | D2       | D1       | D0 |  |
| SECTRL       | W                   | E0h                   | E000h              | Х                |           |            |             | SRE         |     | SRE_al   | pha[3:0] |    |  |
|              | SRE:                | Sunligh               | t Reada            | ıble Enhancer    | ment (SRI | E) enable  | control.    |             |     |          |          |    |  |
|              | SRE=                | "0", Su               | nlight Re          | eadable Enha     | ncement   | disable.   |             |             |     |          |          |    |  |
| Description  | SRE=                | "1", Su               | nlight Re          | eadable Enha     | ncement   | enable.    |             |             |     |          |          |    |  |
|              | SRE_                | alpha:                | Sunlight           | Readable Enl     | hancemn   | et (SRE)   | level sele  | ection      |     |          |          |    |  |
|              | [00:0F              | -<br>-] <b>→</b> [ lo | [ lower : highest] |                  |           |            |             |             |     |          |          |    |  |
| Restriction  |                     |                       |                    |                  |           |            |             |             |     |          |          |    |  |
|              | Status Availability |                       |                    |                  |           |            |             |             |     |          |          |    |  |
|              |                     |                       | Norma              | ıl Mode On, Idle |           | , Sleep Ou | t           |             | Yes | -        |          |    |  |
| Register     |                     |                       | Norma              | ıl Mode On, Idle | Mode On   | , Sleep Ou | ıt          |             | Yes | 3        |          |    |  |
| availability |                     |                       | Partia             | l Mode On, Idle  | Mode Off, | Sleep Ou   | t           |             | Yes | 3        |          |    |  |
|              |                     |                       | Partia             | Mode On, Idle    | Mode On,  | Sleep Ou   | t           |             | Yes | 3        |          |    |  |
|              |                     |                       |                    | Slee             | p In      |            |             |             | Yes | <u> </u> |          |    |  |
|              |                     |                       |                    |                  |           |            |             |             |     |          |          |    |  |
|              |                     | Sta                   | atus               |                  |           | Г          | Default Val | ue (D7 to I | D0) |          |          |    |  |
| Default      |                     | Ро                    | wer On S           | Sequence         |           | C          | )0h         |             |     |          |          |    |  |
| Boildan      |                     |                       | W Reset            |                  |           | (          | )0h         |             |     |          |          |    |  |
|              |                     | H/\                   | N Reset            |                  |           | C          | )0h         |             |     |          |          |    |  |
|              |                     |                       |                    |                  |           |            |             |             |     |          |          |    |  |



# 12.3.2.15 NRCTRL (E1h/E100h):Noise Reduce Control

| E1H          |      |                                 |                              |                  |            | NRCT       | RL (BK0) |     |         |        |      |         |  |  |
|--------------|------|---------------------------------|------------------------------|------------------|------------|------------|----------|-----|---------|--------|------|---------|--|--|
|              | 544  | Add                             | dress                        | D. T. G          |            |            | ,        |     |         |        |      |         |  |  |
| Inst / Para  | R/W  | MIPI                            | SPI-16                       | D15-8            | D7         | D6         | D5       | D4  | D3      | D2     | D1   | D0      |  |  |
| NRCTRL       | W    | E1h                             | E100h                        | Х                |            |            |          | NRE |         |        | NR_n | nd[1:0] |  |  |
|              | NRE: | Noise F                         | Reduce                       | Function Enal    | ole Contro | ol.        |          |     |         |        |      |         |  |  |
|              | NRE= | "0", No                         | ise Red                      | uce Function     | disable.   |            |          |     |         |        |      |         |  |  |
| Description  | NRE= | "1". No                         | ise Redi                     | uce Function     | enable.    |            |          |     |         |        |      |         |  |  |
|              |      |                                 |                              |                  |            |            |          |     |         |        |      |         |  |  |
| Restriction  | _    | <b>14</b> .11010                | pise Reduce level selection. |                  |            |            |          |     |         |        |      |         |  |  |
| Restriction  |      |                                 |                              |                  |            |            |          |     |         |        |      |         |  |  |
|              |      |                                 |                              | Sta              | tus        |            |          |     | Availat | oility |      |         |  |  |
|              |      |                                 | Norma                        | ıl Mode On, Idle | Mode Off   | , Sleep Ou | t        |     | Yes     | 3      |      |         |  |  |
| Register     |      |                                 | Norma                        | ıl Mode On, Idle | Mode On    | , Sleep Ou | it       |     | Yes     | 3      |      |         |  |  |
| availability |      |                                 | Partia                       | l Mode On, Idle  | Mode Off,  | Sleep Ou   | t        |     | Yes     | 5      |      |         |  |  |
|              |      |                                 | Partia                       | l Mode On, Idle  | Mode On,   | Sleep Ou   | t        |     | Yes     | 3      |      |         |  |  |
|              |      |                                 |                              | Slee             | p In       |            |          |     | Yes     | 3      |      |         |  |  |
|              |      |                                 |                              |                  |            |            |          |     |         |        |      |         |  |  |
|              |      | Status Default Value (D7 to D0) |                              |                  |            |            |          |     |         |        |      |         |  |  |
| Default      |      | Ро                              | wer On S                     | Sequence         |            | C          | )0h      |     |         |        |      |         |  |  |
| Default      |      | SΛ                              | N Reset                      |                  |            | (          | )0h      |     |         |        |      |         |  |  |
|              |      | HΛ                              | N Reset                      |                  |            | c          | 00h      |     |         |        |      |         |  |  |
|              |      |                                 |                              |                  |            |            |          |     |         |        |      |         |  |  |



# 12.3.2.16 SECTRL (E2h/E200h):Sharpness Control

| E2H          |                                 |                | PI SPI-16 |                 |           |          |     |     |            |          |        |    |  |
|--------------|---------------------------------|----------------|-----------|-----------------|-----------|----------|-----|-----|------------|----------|--------|----|--|
| / D          | DAY                             | Add            | dress     | D.1. 0          | 1         |          | ,   | D.4 | <b>D</b> 0 |          | ,      | 6  |  |
| Inst / Para  | R/W                             | MIPI           | SPI-16    | D15-8           | D7        | D6       | D5  | D4  | D3         | D2       | וט     | D0 |  |
| SECTRL       | W                               | E2h            | E200h     | Х               |           |          |     | SE  |            | Y_gai    | n[3:0] |    |  |
|              | SE: Sh                          | narpne         | ss Funct  | tion Enable Co  | ontrol.   |          |     | •   |            |          |        |    |  |
|              | SE="0                           | ", Shar        | pness F   | unction disab   | le.       |          |     |     |            |          |        |    |  |
| Description  | SE="1                           | ", Shar        | pness F   | unction enabl   | e.        |          |     |     |            |          |        |    |  |
|              | Y_gai                           | <b>n</b> :Shar | rpness le | evel Selection  |           |          |     |     |            |          |        |    |  |
| Restriction  |                                 |                | •         |                 |           |          |     |     |            |          |        |    |  |
|              |                                 |                |           | Sta             | tue       |          |     |     | Availak    | sility   |        |    |  |
|              |                                 |                | Norma     |                 |           | Sleen Ou | t   |     |            | -        |        |    |  |
| Register     |                                 |                |           |                 |           | •        |     |     |            |          |        |    |  |
| availability |                                 |                | Partia    | l Mode On, Idle | Mode Off, | Sleep Ou | t   |     | Yes        | 3        |        |    |  |
|              |                                 |                | Partia    | Mode On, Idle   | Mode On,  | Sleep Ou | t   |     | Yes        | 3        |        |    |  |
|              |                                 |                |           | Slee            | p In      |          |     |     | Yes        | <u> </u> |        |    |  |
|              |                                 |                |           |                 |           |          |     |     |            |          |        |    |  |
|              | Status Default Value (D7 to D0) |                |           |                 |           |          |     |     |            |          |        |    |  |
| Default      |                                 | Po             | wer On S  | Sequence        |           | C        | 00h |     |            |          |        |    |  |
| Delauit      |                                 | SΛ             | N Reset   |                 |           | (        | )0h |     |            |          |        |    |  |
|              |                                 | HΛ             | N Reset   |                 |           | (        | )0h |     |            |          |        |    |  |
|              |                                 |                |           |                 |           |          |     |     |            |          |        |    |  |



#### 12.3.2.17 CCCTRL (E3h/E300h):Color Calibration Control

| ЕЗН          |   |                                 |                                    |                  |           | CCCTF    | RL (BK0) |    |     |    |    |     |  |  |
|--------------|---|---------------------------------|------------------------------------|------------------|-----------|----------|----------|----|-----|----|----|-----|--|--|
| Inst / Para  | R/W   | Add                             | dress                              | D15-8            | D7        | D6       | D5       | D4 | D3  | D2 | D1 | D0  |  |  |
| inst / Para  | H/VV  | MIPI                            | SPI-16                             | 8-כות            | D7        | Dб       | סט       | D4 | D3  | D2 | וט | DU  |  |  |
| CCCTRL       | W   | E3h                             | E300h                              | Х                |           |          |          |    |     |    |    | CCE |  |  |
|              | CCE:  | Color C                         | Calibratio                         | on Function E    | nable Co  | ntrol.   |          |    |     |    |    |     |  |  |
| Description  | CCE=  | "0", Co                         | lor Calib                          | ration Function  | n disable | ).       |          |    |     |    |    |     |  |  |
|              | CCE=  | "1", Co                         | Color Calibration Function enable. |                  |           |          |          |    |     |    |    |     |  |  |
| Restriction  |   |                                 |                                    |                  |           |          |          |    |     |    |    |     |  |  |
|              |   |                                 | Status Availability                |                  |           |          |          |    |     |    |    |     |  |  |
|              | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes |                                 |                                    |                  |           |          |          |    |     |    |    |     |  |  |
|              |   |                                 |                                    |                  |           | •        |          |    | Yes |    |    |     |  |  |
| Register     |   |                                 |                                    | Il Mode On, Idle |           |          |          |    | Yes |    |    |     |  |  |
| availability |   |                                 |                                    | l Mode On, Idle  |           |          |          |    | Yes |    |    |     |  |  |
|              |   |                                 | Partia                             | l Mode On, Idle  | Mode On,  | Sleep Ou | t        |    | Yes | 5  |    |     |  |  |
|              |   |                                 |                                    | Slee             | p In      |          |          |    | Yes | 3  |    |     |  |  |
|              |   |                                 |                                    |                  |           |          |          |    |     |    |    |     |  |  |
|              |   | Status Default Value (D7 to D0) |                                    |                  |           |          |          |    |     |    |    |     |  |  |
| Default      |   | Ро                              | wer On S                           | Sequence         |           | C        | 00h      |    |     |    |    |     |  |  |
| Derauit      |   | S٨                              | N Reset                            |                  |           | C        | 00h      |    |     |    |    |     |  |  |
|              |   | H/\                             | N Reset                            |                  |           | C        | 00h      |    |     |    |    |     |  |  |
|              |   |                                 |                                    |                  |           |          |          |    |     |    |    |     |  |  |



# 12.3.2.18 SKCTRL (E4h/E400h):Skin Tone Preservation Control

| E4H          |                       |                     |   |                                      |            | SKCTF    | RL (BK0)    |             |            |    |         |           |  |  |  |
|--------------|-----------------------|---------------------|---|--------------------------------------|------------|----------|-------------|-------------|------------|----|---------|-----------|--|--|--|
| / 5          | D 444                 | Add                 | dress   | D45.0                                | D.7        | Do       | D.F.        | D.4         | <b>D</b> 0 | D0 | D.4     | Do        |  |  |  |
| Inst / Para  | R/W                   | MIPI                | SPI-16  | D15-8                                | D7         | D6       | D5          | D4          | D3         | D2 | D1      | D0        |  |  |  |
| SKCTRL       | W                     | E4h                 | E400h   | Х                                    |            |          |             | SKE         |            |    | Skin_ce | _mid[1:0] |  |  |  |
|              | SKE:                  | Skin To             | ne Pres                                       | ervation enab                        | le control |          |             |             |            |    |         |           |  |  |  |
|              | SKE=                  | "0", Ski            | n Tone F                                      | Preservation o                       | lisable.   |          |             |             |            |    |         |           |  |  |  |
| Description  | SKE=                  | "1", Ski            | n Tone F                                      | Preservation e                       | nable.     |          |             |             |            |    |         |           |  |  |  |
|              | Skin_                 | ce_mic              | ce_mid: Skin Tone Preservation enable control |                                      |            |          |             |             |            |    |         |           |  |  |  |
| Restriction  |                       |                     |   |                                      |            |          |             |             |            |    |         |           |  |  |  |
|              |                       | Status Availability |   |                                      |            |          |             |             |            |    |         |           |  |  |  |
|              |                       |                     | Norma   |                                      |            | Clean Ou |             |             | Availat    | -  |         |           |  |  |  |
| Register     |                       | -                   |   | ıl Mode On, Idle<br>ıl Mode On, Idle |            |          |             |             | Yes        |    |         |           |  |  |  |
| availability |                       |                     |   | I Mode On, Idle                      |            |          |             |             | Yes        |    |         |           |  |  |  |
|              |                       |                     |   | I Mode On, Idle                      |            |          |             |             | Yes        |    |         |           |  |  |  |
|              |                       |                     |   | Slee                                 |            |          |             |             | Yes        | S  |         |           |  |  |  |
|              |                       |                     |   |                                      |            |          |             |             |            |    |         |           |  |  |  |
|              |                       | Sta                 | atus  |                                      |            |          | Default Val | ue (D7 to I | D0)        |    |         |           |  |  |  |
|              | Power On Sequence 00h |                     |   |                                      |            |          |             |             |            |    |         |           |  |  |  |
| Default      |                       | SΛ                  | N Reset                                       |                                      |            | C        | )0h         |             |            |    |         |           |  |  |  |
|              |                       | H/\                 | N Reset                                       |                                      |            | (        | )0h         |             |            |    |         |           |  |  |  |
|              |                       |                     |   |                                      |            |          |             |             |            |    |         |           |  |  |  |



#### 12.3.2.19 NVMSETE (EAH/EA00H): NVM Address Setting Enable

| EAH          |                       |         |                     |                  |            | NVMSE      | TE (BK0)    |             |     |      |    |      |  |
|--------------|-----------------------|---------|---------------------|------------------|------------|------------|-------------|-------------|-----|------|----|------|--|
| Inst / Para  | R/W                   | Add     | dress               | D15-8            | D7         | D6         | D5          | D4          | D3  | D2   | D1 | D0   |  |
| mot / r ara  | 10,44                 | MIPI    | SPI-16              | D10 0            | <i>D</i> , |            |             | D-1         |     | - DE |    | 50   |  |
| NVMSETE      | W                     | EAh     | EA00h               | X                |            |            | -           |             |     |      | -  | ADEN |  |
|              | ADEN                  | I:NVM   | Address             | Setting Enab     | e.         |            |             |             |     |      |    |      |  |
| Description  | ADEN                  | ="0", N | VM Add              | Iress Setting o  | lisable.   |            |             |             |     |      |    |      |  |
|              | ADEN                  | ="1", N | IVM Add             | Iress Setting e  | nable.     |            |             |             |     |      |    |      |  |
| Restriction  |                       |         |                     |                  |            |            |             |             |     |      |    |      |  |
|              |                       |         | Status Availability |                  |            |            |             |             |     |      |    |      |  |
|              |                       |         | Norma               | al Mode On, Idle |            | . Sleep Ou | t           |             | Yes | -    |    |      |  |
| Register     |                       |         |                     | al Mode On, Idle |            | •          |             |             | Yes |      |    |      |  |
| availability |                       |         |                     | l Mode On, Idle  |            |            |             |             | Yes | 3    |    |      |  |
|              |                       |         | Partia              | l Mode On, Idle  | Mode On,   | Sleep Out  | t           |             | Yes | 3    |    |      |  |
|              |                       |         |                     | Slee             | p In       |            |             |             | Yes | 3    |    |      |  |
|              |                       |         |                     |                  |            |            |             |             |     |      |    |      |  |
|              |                       | Sta     | atus                |                  |            | Г          | Default Val | ue (D7 to I | D0) |      |    |      |  |
| Default      | Power On Sequence 00h |         |                     |                  |            |            |             |             |     |      |    |      |  |
| Derauit      | S/W Reset 00h         |         |                     |                  |            |            |             |             |     |      |    |      |  |
|              |                       | H/\     | W Reset             |                  |            | C          | )0h         |             |     |      |    |      |  |
|              |                       |         |                     |                  |            |            |             |             |     |      |    |      |  |



#### 12.3.2.20 CABCCTRL (EEh/EE00h):CABC Control

| EEH                   |  |                                   |                                |                                      |            | CABCO       | CTRL (BKC | ))     |            |       |    |     |  |  |  |
|-----------------------|--|-----------------------------------|--------------------------------|--------------------------------------|------------|-------------|-----------|--------|------------|-------|----|-----|--|--|--|
| leat / Dava           | DAV  | Ado                               | dress                          | D45.0                                | D7         | DC          | סר        | D4     | Do         | DO    | D4 | Do  |  |  |  |
| Inst / Para           | R/W  | MIPI                              | SPI-16                         | D15-8                                | D7         | D6          | D5        | D4     | D3         | D2    | D1 | D0  |  |  |  |
| CABCCTRL              | W  | EEh                               | EE00h                          | Х                                    |            |             |           | LEDPWR |            |       |    | LED |  |  |  |
|                       |  |                                   |                                |                                      |            |             |           | SEL    |            |       |    | ON  |  |  |  |
|                       | LED_   | ON: LE                            | ED_ON o                        | output control                       |            |             |           |        |            |       |    |     |  |  |  |
|                       | LED_0  | ON ="0                            | ",LED_C                        | ON output cor                        | ntrol off. |             |           |        |            |       |    |     |  |  |  |
|                       | LED_0  | ON ="1                            | ", LED_                        | ON output co                         | ntrol on.  |             |           |        |            |       |    |     |  |  |  |
| Description           | LEDP   | WR SE                             | L: LED                         | _ON output le                        | vel selec  | tion.       |           |        |            |       |    |     |  |  |  |
|                       | LEDP   | WR SEL ="0",output level is VDDI. |                                |                                      |            |             |           |        |            |       |    |     |  |  |  |
|                       | LEDP   | WR SE                             | EL ="1", output level is VDDB. |                                      |            |             |           |        |            |       |    |     |  |  |  |
| Restriction           |  |                                   |                                |                                      |            |             |           |        |            |       |    |     |  |  |  |
|                       |  |                                   |                                |                                      |            |             |           |        |            |       |    |     |  |  |  |
|                       |  |                                   |                                |                                      | atus       | " 01 0      |           |        | Availab    | ility |    |     |  |  |  |
| Dogistor              |  |                                   |                                | al Mode On, Idle<br>al Mode On, Idle |            |             |           |        | Yes<br>Yes |       |    |     |  |  |  |
| Register availability |  |                                   |                                | I Mode On, Idle                      |            |             |           |        | Yes        |       |    |     |  |  |  |
| availability          |  |                                   |                                | I Mode On, Idle                      |            | •           |           |        | Yes        |       |    |     |  |  |  |
|                       |  |                                   | - artic                        |                                      | ep In      | i, 0.00p 0. | ut.       |        | Yes        |       |    |     |  |  |  |
|                       |  | <u> </u>                          |                                |                                      |            |             |           |        |            |       |    |     |  |  |  |
|                       |  |                                   |                                |                                      |            |             |           |        |            |       |    |     |  |  |  |
|                       | Status Default Value (D7 to D0)  Power On Sequence 00h |                                   |                                |                                      |            |             |           |        |            |       |    |     |  |  |  |
| Default               |  |                                   | wer On S<br>W Reset            | sequence                             |            |             | 00h       |        |            |       |    |     |  |  |  |
|                       |  |                                   |                                |                                      |            |             |           |        |            |       |    |     |  |  |  |
|                       |  | Π/                                | vv nesel                       |                                      |            |             | UUII      |        |            |       |    |     |  |  |  |
|                       |  | H/                                | W Reset                        |                                      |            |             | 00h       |        |            |       |    |     |  |  |  |



#### 12.3.2.21 DSTB: Deep Standby Mode Enable

|                          |  | ="0", DSTB Mode Setting disable.  |         |       |      |    |            |    |     |          |    |    |  |  |  |
|--------------------------|--|---|---------|-------|------|----|------------|----|-----|----------|----|----|--|--|--|
| Inst / Para              | R/W  |   |         | D15-8 | D7   | D6 | D5         | D4 | D3  | D2       | D1 | D0 |  |  |  |
|                          | W  |   | FF00h   | Х     | 0    | 1  | 1          | 1  | 0   | 1        | 1  | 1  |  |  |  |
|                          | W  |   | FF01h   | Х     | 0    | 0  | 0          | 0  | 0   | 0        | 0  | 1  |  |  |  |
|                          | W  |   | FF02h   | Х     | 0    | 0  | 0          | 0  | 0   | 0        | 0  | 0  |  |  |  |
| PARCTRL                  | W  | FFh   | FF03    | Х     | 0    | 0  | 0          | 0  | 0   | 0        | 0  | 0  |  |  |  |
|                          |  |   |         |       |      |    |            |    |     |          | 0  |    |  |  |  |
|                          | W  |   |         |       |      |    |            |    |     |          |    |    |  |  |  |
|                          | DSTB   | DSTB:DSTB Mode Enable Setting.  |         |       |      |    |            |    |     |          |    |    |  |  |  |
| Description              | DSTB:  | DSTB="0", DSTB Mode Setting disable.  |         |       |      |    |            |    |     |          |    |    |  |  |  |
|                          | DSTB:  | DSTB="1", DSTB Mode Setting disable.  |         |       |      |    |            |    |     |          |    |    |  |  |  |
| Restriction              |  |   |         |       |      |    |            |    |     |          |    |    |  |  |  |
| Register<br>availability |  | Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode On, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes |         |       |      |    |            |    |     |          |    |    |  |  |  |
|                          |  | <u> </u>  |         | Slee  | p In |    |            |    | Yes | <u> </u> |    |    |  |  |  |
| Default                  | Status Default Value (D7 to D0)  Power On Sequence 00h |   |         |       |      |    |            |    |     |          |    |    |  |  |  |
| 25/44/1                  |  |   | W Reset |       |      | +  | 00h<br>00h |    |     |          |    |    |  |  |  |



#### 12.3.2.22 DSTBT: Deep Standby Mode Active

|               |       | T="0", DSTB Mode not Active.  T="1", DSTB Mode Active.  Status Availability  Normal Mode On, Idle Mode Off, Sleep Out Yes  Normal Mode On, Idle Mode On, Sleep Out Yes  Partial Mode On, Idle Mode Off, Sleep Out Yes  Partial Mode On, Idle Mode On, Sleep Out Yes  Sleep In Yes |          |                 |           |            |             |             |         |        |    |    |  |  |  |
|---------------|-------|---|----------|-----------------|-----------|------------|-------------|-------------|---------|--------|----|----|--|--|--|
| In at / Davis | DAM   | Add   | dress    | D4E 0           | 7         | 2          | Dr          | D.4         | 6       | 6      | 2  | Do |  |  |  |
| Inst / Para   | R/W   | MIPI  | SPI-16   | 8-כות           | D/        | Dб         | D5          | D4          | D3      | D2     | וט | DO |  |  |  |
|               | W     |   | FF00h    | X               | 0         | 1          | 1           | 1           | 0       | 1      | 1  | 1  |  |  |  |
|               | W     |   | FF01h    | Х               | 0         | 0          | 0           | 0           | 0       | 0      | 0  | 1  |  |  |  |
| PARCTRL       | W     | FFh   | FF02h    | Х               | 0         | 0          | 0           | 0           | 0       | 0      | 0  | 0  |  |  |  |
|               | W     |   | FF03     | Х               | 0         | 0          | 0           | 0           | 0       | 0      | 0  | 0  |  |  |  |
|               | W     |   | FF04     | Х               | DSTBT     | 0          | 0           | 0           | 0       | 0      | 0  | 0  |  |  |  |
|               | DSTB  | DSTBT:DSTB Mode Active.   |          |                 |           |            |             |             |         |        |    |    |  |  |  |
| Description   | DSTB. | DSTBT="0", DSTB Mode not Active.  |          |                 |           |            |             |             |         |        |    |    |  |  |  |
|               | DSTB. | DSTBT="1", DSTB Mode Active.  |          |                 |           |            |             |             |         |        |    |    |  |  |  |
| Restriction   |       |   |          |                 |           |            |             |             |         |        |    |    |  |  |  |
|               |       |   |          | Sta             | tus       |            |             |             | Availah | oility |    |    |  |  |  |
|               |       |   | Norma    |                 |           | , Sleep Οι | ıt          |             |         | -      |    |    |  |  |  |
| Register      |       |   | Norma    | l Mode On, Idle | Mode On   | , Sleep Ou | ıt          |             | Yes     | 3      |    |    |  |  |  |
| availability  |       |   | Partia   | l Mode On, Idle | Mode Off, | Sleep Ou   | t           |             | Yes     | 5      |    |    |  |  |  |
|               |       |   | Partia   | l Mode On, Idle | Mode On,  | Sleep Ou   | t           |             | Yes     | 3      |    |    |  |  |  |
|               |       |   |          | Slee            | p In      |            |             |             | Yes     | 3      |    |    |  |  |  |
|               |       |   |          |                 |           |            |             |             |         |        |    |    |  |  |  |
|               |       | Sta   | atus     |                 |           | I          | Default Val | ue (D7 to I | D0)     |        |    |    |  |  |  |
| Default       |       | Ро  | wer On S | Sequence        |           | (          | 00h         |             |         |        |    |    |  |  |  |
| Dorault       |       | S٨  | N Reset  |                 |           | (          | 00h         |             |         |        |    |    |  |  |  |
|               |       | H/\   | W Reset  |                 |           | (          | 00h         |             |         |        |    |    |  |  |  |
| 1             |       |   |          |                 |           |            |             |             |         |        |    |    |  |  |  |

#### **Enter DSTB Mode Flow:**

Step1: 0xFF:0x77/0x01/0x00/0x00/0x00/0x80

Step2: 0xFF:0x77/0x01/0x00/0x00/0x80



#### 12.3.3 Command 2 BK1 Function

#### 12.3.3.1 VRHS (B0h/B000h):Vop Amplitude setting

| ВОН          |                       |         | VRHS (BK1)   Or   D6   D5   D4   D3   D2   D1   D0 |                 |           |             |            |               |         |       |    |    |  |  |  |
|--------------|-----------------------|---------|--|-----------------|-----------|-------------|------------|---------------|---------|-------|----|----|--|--|--|
| Inat / Dage  | R/W                   | Add     | dress  | D4E 0           | D7        | DC          | DE         | D4            | Do      | Do    | D1 | Do |  |  |  |
| Inst / Para  | H/VV                  | MIPI    | SPI-16   | D15-8           | D7        | D6          | D5         | D4            | D3      | D2    | וט | DU |  |  |  |
| VRHS         | W                     | B0h     | B000h  | Х               |           |             |            | VRHA          | [7:0]   |       |    |    |  |  |  |
|              | VRH                   | 4[7:0]: | : VRH S  | Set.            |           |             |            |               |         |       |    |    |  |  |  |
|              | Vop=3                 | 3.5375  | +(VRHA   | [7:0]x0.0125)   | ;         |             |            |               |         |       |    |    |  |  |  |
| Description  | VRHP                  | =Vop+   | (Vcom+   | Vcom offset);   |           |             |            |               |         |       |    |    |  |  |  |
|              | VRHN                  | l=-Vop- | +(Vcom-  | +Vcom offset)   | ;         |             |            |               |         |       |    |    |  |  |  |
| Restriction  |                       |         |  |                 |           |             |            |               |         |       |    |    |  |  |  |
|              |                       |         |  |                 |           |             |            |               |         |       |    |    |  |  |  |
|              |                       |         |  | Sta             | atus      |             |            |               | Availab | ility |    |    |  |  |  |
|              |                       |         | Norma  | al Mode On, Idl | e Mode O  | ff, Sleep O | ut         |               | Yes     |       |    |    |  |  |  |
| Register     |                       |         | Norma  | al Mode On, Idl | e Mode O  | n, Sleep O  | ut         |               | Yes     |       |    |    |  |  |  |
| availability |                       |         | Partia   | I Mode On, Idle | e Mode Of | f, Sleep O  | ut         |               | Yes     |       |    |    |  |  |  |
|              |                       |         | Partia   | l Mode On, Idle | Mode Or   | n, Sleep O  | ut         |               | Yes     |       |    |    |  |  |  |
|              |                       |         |  | Sle             | ep In     |             |            |               | Yes     |       |    |    |  |  |  |
|              |                       |         |  |                 |           |             |            |               |         |       |    |    |  |  |  |
|              |                       | Sta     | atus   |                 |           |             | Default Va | alue (D7 to D | 0)      |       |    |    |  |  |  |
| Default      | Power On Sequence 4dh |         |  |                 |           |             |            |               |         |       |    |    |  |  |  |
| Derauit      |                       | S/      | W Reset  |                 |           |             | 4dh        |               |         |       |    |    |  |  |  |
|              |                       | H/      | W Reset  |                 |           |             | 4dh        |               |         |       |    |    |  |  |  |
|              |                       |         |  |                 |           |             |            |               |         |       |    |    |  |  |  |



# 12.3.3.2 VCOMS (B1h/B100h):VCOM amplitude setting

| B1H          |                       |        |   |                 |       | VCC      | M (BK1)    |               |       |    |    |     |  |  |
|--------------|-----------------------|--------|---|-----------------|-------|----------|------------|---------------|-------|----|----|-----|--|--|
| 5            |                       | Add    | dress   | 5.5             | -     |          | ,          |               |       |    | ,  | D.0 |  |  |
| Inst / Para  | R/W                   | MIPI   | SPI-16  | D15-8           | D7    | D6       | D5         | D4            | D3    | D2 | D1 | D0  |  |  |
| VCOM         | W                     | B1h    | B100h   | Х               |       |          |            | VCOM          | [7:0] |    |    |     |  |  |
|              | VCO                   | M[7:0] | : VCON  | /I Set.         |       |          |            |               |       |    |    |     |  |  |
| Description  | VCOM                  | 1=0.1+ | (VCOM[  | 7:0] x 0.0125   | );    |          |            |               |       |    |    |     |  |  |
| Restriction  |                       |        |   |                 |       |          |            |               |       |    |    |     |  |  |
|              |                       |        | Status Availability   |                 |       |          |            |               |       |    |    |     |  |  |
|              |                       |        |   |                 |       |          |            |               |       |    |    |     |  |  |
| Register     |                       |        | Normal Mode On, Idle Mode Off, Sleep Out  Yes  Normal Mode On, Idle Mode On, Sleep Out  Yes |                 |       |          |            |               |       |    |    |     |  |  |
| availability |                       |        |   | l Mode On, Idle |       |          |            |               | Yes   |    |    |     |  |  |
|              |                       |        |   | I Mode On, Idle |       | <u> </u> |            |               | Yes   |    |    |     |  |  |
|              |                       |        |   |                 | ep In |          |            |               | Yes   |    |    |     |  |  |
|              |                       |        |   |                 |       |          |            |               |       |    |    |     |  |  |
|              |                       | Sta    | atus  |                 |       |          | Default Va | alue (D7 to D | 0)    |    |    |     |  |  |
| D ( )        | Power On Sequence 40h |        |   |                 |       |          |            |               |       |    |    |     |  |  |
| Default      | S/W Reset 40h         |        |   |                 |       |          |            |               |       |    |    |     |  |  |
|              |                       | H/\    | W Reset   |                 |       |          | 40h        |               |       |    |    |     |  |  |
|              |                       |        |   |                 |       |          |            |               |       |    |    |     |  |  |



# 12.3.3.3 VGHSS (B2h/B200h):VGH Voltage setting

| B2H                      | VGHSS (BK1)                            |                   |         |   |       |            |     |                          |         |      |         |    |  |  |
|--------------------------|--|-------------------|---------|---|-------|------------|-----|--------------------------|---------|------|---------|----|--|--|
| Inst / Para              | R/W                                    | Address           |         | D15-8   | D7    | D6         | D5  | D4                       | D3      | D2   | D1      | D0 |  |  |
|                          |  | MIPI              | SPI-16  |   |       |            |     |                          |         |      |         |    |  |  |
| VGHSS                    | W                                      | B2h               | B200h   | Х   |       |            |     |                          |         | VGHS | SS[3:0] |    |  |  |
|                          | VGHSS[3:0]: Gate High Voltage setting. |                   |         |   |       |            |     |                          |         |      |         |    |  |  |
| Description              |  |                   |         | VGHSS[3:  | :0]   | Voltage    | VGH | SS[3:0]                  | Voltage |      |         |    |  |  |
|                          |  |                   |         | 00H   |       | 11.5       |     | )7H                      | 15.0    |      |         |    |  |  |
|                          |  |                   |         | 01H   |       | 12.0       | -   | )8H                      | 15.5    |      |         |    |  |  |
|                          |  |                   |         | 02H   |       | 12.5       |     | 9H                       | 16.0    |      |         |    |  |  |
|                          |  |                   |         | 03H   |       | 13.0       | _   | AH                       | 16.5    |      |         |    |  |  |
|                          |  |                   |         | 04H   |       | 13.5       |     | BH                       | 17.0    |      |         |    |  |  |
|                          |  |                   |         | 05H   |       | 14.0       | -   | CH                       | 17.0    |      |         |    |  |  |
|                          |  |                   |         | 06H   |       | 14.5       | 0   | DH                       | 17.0    |      |         |    |  |  |
|                          |  |                   |         |   |       |            |     |                          |         |      |         |    |  |  |
| Restriction              |  |                   |         |   |       |            |     |                          |         |      |         |    |  |  |
|                          |  |                   |         | _   |       |            |     |                          |         |      |         |    |  |  |
|                          |  |                   | NI      | Status  |       |            |     | Availability             |         |      |         |    |  |  |
| Register<br>availability |  |                   |         | Mode On, Idle Mode Off, Sleep Out  Mode On, Idle Mode On, Sleep Out |       |            |     | Yes<br>Yes               |         |      |         |    |  |  |
|                          |  |                   |         | I Mode On, Idle   |       |            |     |                          |         |      |         |    |  |  |
|                          |  |                   |         | l Mode On, Idle   |       |            |     |                          |         |      |         |    |  |  |
|                          |  |                   | T ditid |   | ep In | i, olcop o | at  |                          |         |      |         |    |  |  |
|                          |  |                   |         | 3.0   | i.    |            |     |                          | Yes     |      |         |    |  |  |
| Default                  |  |                   |         |   |       |            |     |                          |         |      |         |    |  |  |
|                          |  | Status            |         |   |       |            |     | Default Value (D7 to D0) |         |      |         |    |  |  |
|                          |  | Power On Sequence |         |   |       |            |     | 02h                      |         |      |         |    |  |  |
|                          |  |                   | W Reset |   |       | +          | 02h |                          |         |      |         |    |  |  |
|                          |  | H/                | W Reset |   |       |            | 02h |                          |         |      |         |    |  |  |
|                          |  |                   |         |   |       |            |     |                          |         |      |         |    |  |  |



# 12.3.3.4 TESTCMD (B3h/B300h):TEST Command Setting

| ВЗН          | TESTCMD (BK1)  |   |   |                                      |           |            |     |                          |              |    |    |    |  |  |
|--------------|----------------|---|---|--------------------------------------|-----------|------------|-----|--------------------------|--------------|----|----|----|--|--|
| Inst / Para  | R/W            | Add                                       | dress                                   | D15-8                                | D7        | D6         | D5  | D4                       | D3           | D2 | D1 | D0 |  |  |
|              |                | MIPI                                      | SPI-16                                  |                                      |           |            |     |                          |              |    |    |    |  |  |
| TESTCMD      | W              | B3h                                       | B300h                                   | Х                                    | 1         |            |     |                          |              | 0  | 0  | 0  |  |  |
| Description  | TESTCMD: 0x80H |   |   |                                      |           |            |     |                          |              |    |    |    |  |  |
| Restriction  |                |   |   |                                      |           |            |     |                          |              |    |    |    |  |  |
|              |                | Status                                    |   |                                      |           |            |     |                          | Availability |    |    |    |  |  |
|              |                |   | Norma                                   | al Mode On, Idle Mode Off, Sleep Out |           |            |     |                          |              |    |    |    |  |  |
| Register     |                |   | Normal Mode On, Idle Mode On, Sleep Out |                                      |           |            |     |                          | Yes          |    |    |    |  |  |
| availability |                | Partial Mode On, Idle Mode Off, Sleep Out |   |                                      |           |            |     | Yes                      |              |    |    |    |  |  |
|              |                |   | Partia                                  | ıl Mode On, Idle                     | e Mode Or | n, Sleep O | ut  | Yes                      |              |    |    |    |  |  |
|              |                | Sleep In                                  |   |                                      |           |            |     |                          |              |    |    |    |  |  |
|              |                |   |   |                                      |           |            |     |                          |              |    |    |    |  |  |
| Default      |                | Status                                    |   |                                      |           |            |     | Default Value (D7 to D0) |              |    |    |    |  |  |
|              |                | Power On Sequence                         |   |                                      |           |            | 00h |                          |              |    |    |    |  |  |
|              |                | S/W Reset                                 |   |                                      |           |            | 00h |                          |              |    |    |    |  |  |
|              |                | H/W Reset 00h                             |   |                                      |           |            |     | 00h                      |              |    |    |    |  |  |
|              |                |   |   |                                      |           |            |     |                          |              |    |    |    |  |  |



## 12.3.3.5 VGLS (B5h/B500h):VGL Voltage setting

| B5H                   |      |         |         |                                    |            | VGL        | .S (BK1) |             |            |       |        |    |
|-----------------------|------|---------|---------|------------------------------------|------------|------------|----------|-------------|------------|-------|--------|----|
| Inst / Para           | R/W  |         | dress   | D15-8                              | D7         | D6         | D5       | D4          | D3         | D2    | D1     | D0 |
|                       |      | MIPI    | SPI-16  |                                    |            |            |          |             |            |       |        |    |
| VGLS                  | W    | B5h     | B500h   | X                                  |            | 1          |          |             |            | VGL   | S[3:0] |    |
|                       | VGLS | S[3:0]: | Gate L  | .ow Voltage                        | setting.   |            |          |             |            |       |        |    |
|                       |      |         |         | VGLS[3:0                           | )]         | Voltage    | VGH      | SS[3:0]     | Voltage    |       |        |    |
|                       |      |         |         | 00H                                |            | -7.06      | (        | )8H         | -9.83      |       |        |    |
|                       |      |         |         | 01H                                |            | -7.47      | (        | )9H         | -10.17     |       |        |    |
| Description           |      |         |         | 02H                                |            | -7.91      | C        | )AH         | -10.53     |       |        |    |
| Description           |      |         |         | 03H                                |            | -8.14      |          | )BH         | -10.91     |       |        |    |
|                       |      |         |         | 04H                                |            | -8.65      |          | CH          | -11.31     |       |        |    |
|                       |      |         |         | 05H                                |            | -8.92      |          | DH          | -11.74     |       |        |    |
|                       |      | 06H     |         | -9.21                              | 0EH<br>0FH |            | -12.20   |             |            |       |        |    |
|                       |      |         |         | 07H                                |            | -9.51      | (        | )FH         | -12.69     |       |        |    |
| Restriction           |      |         |         |                                    |            |            |          |             |            |       |        |    |
|                       |      |         |         |                                    |            |            |          |             |            |       |        |    |
|                       |      |         |         |                                    | atus       | ."         |          |             | Availab    | ility |        |    |
| <b>.</b>              |      |         |         | al Mode On, Idl                    |            |            |          |             | Yes        |       |        |    |
| Register availability |      |         |         | al Mode On, Idl<br>I Mode On, Idle |            | •          | 1        |             | Yes<br>Yes |       |        |    |
| avaliability          |      |         |         | I Mode On, Idle                    |            |            | 1        |             | Yes        |       |        |    |
|                       |      |         | i artia |                                    | ep In      | n, olcep o | ut       |             | Yes        |       |        |    |
|                       |      |         |         | 310                                |            |            |          |             |            |       |        |    |
|                       |      |         |         |                                    |            |            |          |             |            |       |        |    |
|                       |      |         | atus    |                                    |            |            |          | alue (D7 to | D0)        |       |        |    |
| Default               |      |         |         | Sequence                           |            |            | 07h      |             |            |       |        |    |
|                       |      |         | W Reset |                                    |            |            | 07h      |             |            |       |        |    |
|                       |      | H/      | W Reset |                                    |            |            | 07h      |             |            |       |        |    |
|                       |      |         |         |                                    |            |            |          |             |            |       |        |    |



## 12.3.3.6 PWCTRL1 (B7h/B700h):Power Control 1

| В7Н                   |                             | PWCTRL1 (BK1)   |          |                                    |          |            |                          |       |            |            |     |        |  |
|-----------------------|-----------------------------|-----------------|----------|------------------------------------|----------|------------|--------------------------|-------|------------|------------|-----|--------|--|
| / D                   | D 444                       | Add             | dress    | D45.0                              | D.7      | D0         | D.F.                     | 5.4   | <b>D</b> 0 | <b>D</b> 0 | D.4 | D.0    |  |
| Inst / Para           | R/W                         | MIPI            | SPI-16   | D15-8                              | D7       | D6         | D5                       | D4    | D3         | D2         | D1  | D0     |  |
| PWCTRL1               | W                           | B7h             | B700h    | Х                                  | AP[      | [1:0]      |                          |       | APIS       | S[1:0]     | APO | S[1:0] |  |
|                       | AP[1                        | : <b>0]:</b> Ga | amma (   | OP bias curr                       | ent sele | ction.     |                          | •     |            |            | ı   |        |  |
|                       | Al                          | P[1:0]          | Curr     | ent                                |          |            |                          |       |            |            |     |        |  |
|                       |                             | 00H             | Ot       |                                    |          |            |                          |       |            |            |     |        |  |
|                       | (                           | 01H             | Mi       | n                                  |          |            |                          |       |            |            |     |        |  |
|                       | (                           | 02H             | Mide     | dle                                |          |            |                          |       |            |            |     |        |  |
|                       | (                           | 03H             | Ма       | ıx                                 |          |            |                          |       |            |            |     |        |  |
|                       | APIS                        | [1:0]:          | Source   | OP input st                        | age bias | current    | selectio                 | n     |            |            |     |        |  |
|                       | AP                          | IS[1:0]         | Curr     | ent                                |          |            |                          |       |            |            |     |        |  |
| December              | (                           | D0H             | Of       | ff                                 |          |            |                          |       |            |            |     |        |  |
| Description           | (                           | 01H             | Mi       | n                                  |          |            |                          |       |            |            |     |        |  |
|                       | (                           | 02H             | Mide     | dle                                |          |            |                          |       |            |            |     |        |  |
|                       | (                           | 03H             | Ма       | ax                                 |          |            |                          |       |            |            |     |        |  |
|                       | APO                         | S[1:0]:         | : Sourc  | e OP output                        | stage b  | ias curre  | ent selec                | tion. |            |            |     |        |  |
|                       | APO                         | OS[1:0]         | Curr     | ent                                |          |            |                          |       |            |            |     |        |  |
|                       | (                           | 00H Off         |          |                                    |          |            |                          |       |            |            |     |        |  |
|                       | (                           | 01H             | Mi       | n                                  |          |            |                          |       |            |            |     |        |  |
|                       | (                           | 02H             | Mide     | dle                                |          |            |                          |       |            |            |     |        |  |
|                       | (                           | 03H             | Ма       | ax                                 |          |            |                          |       |            |            |     |        |  |
| Restriction           |                             |                 |          |                                    |          |            |                          |       |            |            |     |        |  |
|                       |                             |                 |          | _                                  |          |            |                          |       |            |            |     |        |  |
|                       |                             |                 | Manne    |                                    | atus     | " Ola O    |                          |       | Availab    | ility      |     |        |  |
| Danistan              |                             |                 |          | al Mode On, Idl<br>al Mode On, Idl |          |            | +                        |       | Yes<br>Yes |            |     |        |  |
| Register availability |                             |                 |          | al Mode On, Idle                   |          |            |                          |       | Yes        |            |     |        |  |
| availability          |                             |                 |          | al Mode On, Idle                   |          |            |                          |       | Yes        |            |     |        |  |
|                       |                             |                 | 1 artic  |                                    | ep In    | i, cicop o | Yes                      |       |            |            |     |        |  |
|                       |                             | <u> </u>        |          |                                    | - r-     |            | J                        |       |            |            |     |        |  |
|                       |                             |                 |          |                                    |          |            |                          |       |            |            |     |        |  |
|                       |                             |                 | atus     | 2                                  |          |            | Default Value (D7 to D0) |       |            |            |     |        |  |
| Default               |                             |                 |          | Sequence                           |          |            | 8Ch<br>8Ch               |       |            |            |     |        |  |
|                       | S/W Reset 8Ch H/W Reset 8Ch |                 |          |                                    |          |            |                          |       |            |            |     |        |  |
|                       |                             |                 | vv nesel |                                    |          |            | JUII                     |       |            |            |     |        |  |
|                       |                             |                 |          |                                    |          |            |                          |       |            |            |     |        |  |



## 12.3.3.7 PWCTRL2 (B8h/B800h):Power Control 2

| В8Н          |               | PWCTRL2 (BK1)  |         |                                       |           |             |           |               |         |       |      |        |  |
|--------------|---------------|----------------|---------|---------------------------------------|-----------|-------------|-----------|---------------|---------|-------|------|--------|--|
| Inst / Para  | R/W           | Add            | dress   | D15-8                                 | D7        | D6          | D5        | D4            | D3      | D2    | D1   | D0     |  |
|              |               | MIPI           | SPI-16  |                                       |           |             |           |               |         |       |      |        |  |
| PWCTRL2      | W             | B8h            | B800h   | X                                     |           |             | AVE       | DD[1:0]       |         |       | AVCI | _[1:0] |  |
|              | AVD           | D[1:0]:        | : AVDD  | voltage sett                          | ing.      |             |           |               |         |       |      |        |  |
|              | AVE           | D[1:0]         | AVE     | DD                                    |           |             |           |               |         |       |      |        |  |
|              | (             | )0H            | 6.2     | V                                     |           |             |           |               |         |       |      |        |  |
|              | (             | )1H            | 6.4     |                                       |           |             |           |               |         |       |      |        |  |
|              | (             | )2H            | 6.6     |                                       |           |             |           |               |         |       |      |        |  |
| Description  | <u> </u>      | )3H            | 6.8     |                                       |           |             |           |               |         |       |      |        |  |
| Description  | AVCL          | <u>-[1:0]:</u> | AVCL    | voltage setti                         | ng        |             |           |               |         |       |      |        |  |
|              | AVO           | CL[1:0]        | AVO     |                                       |           |             |           |               |         |       |      |        |  |
|              |               | )0H            | -4.4    |                                       |           |             |           |               |         |       |      |        |  |
|              |               | )1H            | -4.6    |                                       |           |             |           |               |         |       |      |        |  |
|              | 02H -4.8 V    |                |         |                                       |           |             |           |               |         |       |      |        |  |
|              |               | 03H -5.0 V     |         |                                       |           |             |           |               |         |       |      |        |  |
| Restriction  |               |                |         |                                       |           |             |           |               |         |       |      |        |  |
|              |               |                |         | St                                    | atus      |             |           |               | Availab | ility |      |        |  |
|              |               |                | Norma   | al Mode On, Idl                       |           | ff. Sleep C | out       |               | Yes     | iiity |      |        |  |
| Register     |               |                |         | al Mode On, Idl                       |           |             |           |               | Yes     |       |      |        |  |
| availability |               |                |         | ıl Mode On, Idle                      |           |             |           |               | Yes     |       |      |        |  |
|              |               |                | Partia  | ıl Mode On, Idle                      | e Mode Or | n, Sleep O  | ut        |               | Yes     |       |      |        |  |
|              |               |                |         | Sle                                   | ep In     |             |           |               | Yes     |       |      |        |  |
|              |               |                |         |                                       |           |             |           |               |         |       |      |        |  |
|              |               | Sta            | atus    |                                       |           |             | Default V | alue (D7 to D | (0)     |       |      |        |  |
|              |               |                |         | Sequence                              |           |             | 21h       |               |         |       |      |        |  |
| Default      |               |                | W Reset | · · · · · · · · · · · · · · · · · · · |           |             | 21h       |               |         |       |      |        |  |
|              | H/W Reset 21h |                |         |                                       |           |             |           |               |         |       |      |        |  |
|              |               |                |         | -                                     |           |             |           |               |         |       |      |        |  |
|              |               |                |         |                                       |           |             |           |               |         |       |      | ·      |  |



#### 12.3.3.8 PWCTRL3 (B9h/B900h):Power Control 2

| B8H          |      |                               |               |                   |           |      |            |               |         |    |        |          |  |
|--------------|------|-------------------------------|---------------|-------------------|-----------|------|------------|---------------|---------|----|--------|----------|--|
| Inst / Para  | R/W  | Add                           | dress         | D15-8             | D7        | D6   | D5         | D4            | D3      | D2 | D1     | D0       |  |
| inst / Para  | H/VV | MIPI                          | SPI-16        |                   | D/        | סט   | טט         | D4            | D3      | D2 | וט     | DU       |  |
| PWCTRL3      | W    | B9h                           | B900h         | n X               |           |      | SVPO_      | _PUM[1:0]     |         |    | SVNO_I | PUM[1:0] |  |
|              | SVPC | D_PUI                         | M: sou        | rce pumping       | cell sett | ing. |            |               |         |    |        |          |  |
|              | SVP  | O_PUM                         | [1:0]         | Cell set          |           |      |            |               |         |    |        |          |  |
|              |      | 00H                           |               | 4                 |           |      |            |               |         |    |        |          |  |
|              |      | 01H                           |               | 5                 |           |      |            |               |         |    |        |          |  |
|              |      | 02H                           |               | 6                 |           |      |            |               |         |    |        |          |  |
|              |      | 03H                           |               | 7                 |           |      |            |               |         |    |        |          |  |
| Description  | SVNC | D_PUI                         | <b>M:</b> sou | irce pumping      | cell sett | ing. |            |               |         |    |        |          |  |
|              | SVN  | O_PUM                         | [1:0]         | Cell set          |           |      |            |               |         |    |        |          |  |
|              |      | 00H                           |               | 4                 |           |      |            |               |         |    |        |          |  |
|              |      | 01H                           |               | 5                 |           |      |            |               |         |    |        |          |  |
|              |      | 02H                           |               | 6                 |           |      |            |               |         |    |        |          |  |
|              |      | 03H                           |               | 7                 |           |      |            |               |         |    |        |          |  |
| Restriction  |      |                               |               |                   |           |      |            |               |         |    |        |          |  |
|              |      |                               |               |                   |           |      |            |               |         |    |        |          |  |
|              |      |                               |               |                   | atus      |      |            |               | Availab | -  |        |          |  |
|              |      |                               |               | nal Mode On, Idl  |           |      |            |               | Yes     |    |        |          |  |
| Register     |      |                               |               | nal Mode On, Idl  |           |      |            |               | Yes     |    |        |          |  |
| availability |      |                               |               | ial Mode On, Idle |           |      |            |               | Yes     |    |        |          |  |
|              |      | Partial Mode On, Idle Mode On |               |                   |           |      | ut         |               | Yes     |    |        |          |  |
|              |      |                               |               | Sie               | ep In     |      |            |               | Yes     |    |        |          |  |
|              |      |                               |               |                   |           |      |            |               |         |    |        |          |  |
|              |      | Sta                           | atus          |                   |           |      | Default Va | alue (D7 to D | 0)      |    |        |          |  |
| Default      |      | Po                            | wer On        | Sequence          |           |      | 21h        |               |         |    |        |          |  |
| Delault      |      | S/W Reset 21h                 |               |                   |           |      |            |               |         |    |        |          |  |
|              |      | H/                            | W Rese        | et                |           |      | 21h        |               |         |    |        |          |  |
|              |      |                               |               |                   |           |      |            |               |         |    |        |          |  |



## 12.3.3.9 PCLKS1 (BAh/BA00h):Power pumping clk selection 1

| ВАН          |        | PCLKS1 (BK1) |                 |                 |           |            |            |               |            |    |       |          |
|--------------|--------|--------------|-----------------|-----------------|-----------|------------|------------|---------------|------------|----|-------|----------|
| Inst / Para  | R/W    | Add          | dress           | D15-8           | D7        | D6         | D5         | D4            | D3         | D2 | D1    | D0       |
| mst/raia     | 11/ VV | MIPI         | SPI-16          | D13-0           | <i>D1</i> | DO         | D3         | D4            | D3         | DZ | D1    | DU       |
| PCLKS1       | W      | BAh          | BA00h           | Χ               |           |            | STP4       | CKS[1:0]      |            |    | STP1C | KS [1:0] |
|              | STP4   | CKS[         | <b>1:0]:</b> st | ep4 pumping     | g clk sel | ection.    |            |               |            |    |       |          |
|              | STP4   | 4CKS[1       | :0] C           | CLK             |           |            |            |               |            |    |       |          |
|              |        | 00H          | 3.3             | MHz             |           |            |            |               |            |    |       |          |
|              |        | 01H          | 4.0             | MHz             |           |            |            |               |            |    |       |          |
|              |        | 02H          | 2.5             | MHz             |           |            |            |               |            |    |       |          |
|              |        | 03H          | 6.0             | MHz             |           |            |            |               |            |    |       |          |
| Description  | STP1   | CKS[         | 1:0]: st        | ep1 pumpino     | g clk sel | ection.    |            |               |            |    |       |          |
|              | STP1   | ICKS[1       | :0] C           | CLK             |           |            |            |               |            |    |       |          |
|              |        | 00H          | 3.3             | MHz             |           |            |            |               |            |    |       |          |
|              |        | 01H          | 4.0             | MHz             |           |            |            |               |            |    |       |          |
|              |        | 02H          | 2.5             | MHz             |           |            |            |               |            |    |       |          |
|              |        | 03H 6.0 MHz  |                 |                 |           |            |            |               |            |    |       |          |
| Restriction  |        |              |                 |                 |           |            |            |               |            |    |       |          |
|              |        |              |                 |                 |           |            |            |               |            |    |       |          |
|              |        |              |                 |                 | atus      |            |            |               | Availab    |    |       |          |
|              |        |              |                 | al Mode On, Idl |           |            |            |               | Yes        |    |       |          |
| Register     |        |              |                 | al Mode On, Idl |           |            |            |               | Yes        |    |       |          |
| availability |        |              |                 | l Mode On, Idle |           |            |            |               | Yes        |    |       |          |
|              |        |              | Partia          | l Mode On, Idle | ep In     | ı, Sieep O | ut         |               | Yes<br>Yes |    |       |          |
|              |        |              |                 | Sie             | ер ш      |            |            |               | 162        |    |       |          |
|              |        | _            |                 |                 |           |            |            |               |            |    |       |          |
|              |        | St           | atus            |                 |           |            | Default Va | alue (D7 to D | 0)         |    |       |          |
| Default      |        | Po           | ower On S       | Sequence        |           |            | 22h        |               |            |    |       |          |
| Dorault      |        | S/           | W Reset         |                 |           |            | 22h        |               |            |    |       |          |
|              |        | H/           | W Reset         |                 |           |            | 22h        |               |            |    |       |          |
|              |        |              |                 |                 |           |            |            |               |            |    |       |          |



## 12.3.3.10 PCLKS2 (BBh/BB00h):Power pumping clk selection 2

| ВВН          |      | PCLKS2 (BK1) |   |                 |           |            |     |    |     |    |       |         |
|--------------|------|--------------|---|-----------------|-----------|------------|-----|----|-----|----|-------|---------|
|              |      | Add          | dress   |                 |           |            |     |    |     |    |       |         |
| Inst / Para  | R/W  | MIPI         | SPI-16  | D15-8           | D7        | D6         | D5  | D4 | D3  | D2 | D1    | D0      |
| PCLKS1       | W    | BBh          | BB00h   | Х               |           |            |     |    |     |    | SBSTC | KS[1:0] |
|              | SBS1 | CKS[         | <b>1:0]:</b> so                               | ource pumpi     | ng clk s  | election.  |     |    |     |    |       |         |
|              | SBS  | TCKS[1       | :0] (   | CLK             |           |            |     |    |     |    |       |         |
|              |      | 00H          | 5.0   | ) MHz           |           |            |     |    |     |    |       |         |
| Description  |      | 01H          | 6.7   | ' MHz           |           |            |     |    |     |    |       |         |
|              |      | 02H          | 8.0   | ) MHz           |           |            |     |    |     |    |       |         |
|              |      | 03H          | 10  | MHz             |           |            |     |    |     |    |       |         |
|              |      |              |   |                 |           |            |     |    |     |    |       |         |
| Restriction  |      |              |   |                 |           |            |     |    |     |    |       |         |
|              |      |              | Status Availability                           |                 |           |            |     |    |     |    |       |         |
|              |      |              | Normal Mode On, Idle Mode Off, Sleep Out  Yes |                 |           |            |     |    |     |    |       |         |
| Register     |      |              |   | al Mode On, Idl |           |            |     |    | Yes |    |       |         |
| availability |      |              | Partia  | al Mode On, Idl | e Mode Of | f, Sleep O | ut  |    | Yes |    |       |         |
|              |      |              | Partia  | al Mode On, Idl | e Mode Or | n, Sleep O | ut  |    | Yes |    |       |         |
|              |      | Sleep In     |   |                 |           |            |     |    | Yes |    |       |         |
|              |      |              |   |                 |           |            |     |    |     |    |       |         |
|              |      | Sta          | Status Default Value (D7 to D0)               |                 |           |            |     |    |     |    |       |         |
| Defeuilt     |      | Po           | wer On S                                      | Sequence        |           |            | 02h |    |     |    |       |         |
| Default      |      | S/           | W Reset                                       |                 |           |            | 02h |    |     |    |       |         |
|              |      | H/           | W Reset                                       |                 |           | 02h        |     |    |     |    |       |         |
|              |      |              |   |                 |           |            |     |    |     |    |       |         |



## 12.3.3.11 PCLKS3 (BCh/BC00h):Power pumping clk selection 3

| ВСН                   |      | PCLKS3 (BK1) |                    |                                      |           |            |            |               |            |            |        |           |
|-----------------------|------|--------------|--------------------|--------------------------------------|-----------|------------|------------|---------------|------------|------------|--------|-----------|
| In at / D             | DAY  | Add          | dress              | D45.0                                | D-7       | D.         | D          | F. (          | D.         | <b>D</b> 0 | F.1    | D.        |
| Inst / Para           | R/W  | MIPI         | SPI-16             | D15-8                                | D7        | D6         | D5         | D4            | D3         | D2         | D1     | D0        |
| PCLKS3                | W    | BCh          | BC00h              | Х                                    |           |            | STP3       | CKS[1:0]      | STP2C      | KS[1:0]    | STP2S0 | CKS [1:0] |
|                       | STP3 | CKS[         | 1:0]: st           | ep3 pumpino                          | g clk sel | ection.    |            |               |            |            |        |           |
|                       | STP  | 4CKS[1:      | :0] C              | CLK                                  |           |            |            |               |            |            |        |           |
|                       |      | 00H          | 2.5                | MHz                                  |           |            |            |               |            |            |        |           |
|                       |      | 01H          | 3.3                | MHz                                  |           |            |            |               |            |            |        |           |
|                       |      | 02H          | 4.0                | MHz                                  |           |            |            |               |            |            |        |           |
|                       |      | 03H          | 5.0                | MHz                                  |           |            |            |               |            |            |        |           |
|                       | STP2 | CKS[         | 1:0]: st           | ep2_VGHP                             | pumpin    | g clk sel  | ection.    |               |            |            |        |           |
|                       | STP  | 1CKS[1:      | :0] C              | CLK                                  |           |            |            |               |            |            |        |           |
| Description           |      | 00H          | 2.5                | MHz                                  |           |            |            |               |            |            |        |           |
| Description           |      | 01H          | 3.3                | MHz                                  |           |            |            |               |            |            |        |           |
|                       |      | 02H          | 4.0                | MHz                                  |           |            |            |               |            |            |        |           |
|                       |      | 03H          | 5.0                | MHz                                  |           |            |            |               |            |            |        |           |
|                       | STP2 | SCKS         | <b>[1:0]:</b> s    | step2 VGHS                           | pumpin    | g clk sel  | ection.    |               |            |            |        |           |
|                       | STP  | 2SCKS[       | 1:0]               | CLK                                  |           |            |            |               |            |            |        |           |
|                       |      | 00H          | 2.                 | .5 MHz                               |           |            |            |               |            |            |        |           |
|                       |      | 01H          | 3.                 | .3 MHz                               |           |            |            |               |            |            |        |           |
|                       |      | 02H          | 4.                 | .0 MHz                               |           |            |            |               |            |            |        |           |
|                       |      | 03H          | 5.                 | .0 MHz                               |           |            |            |               |            |            |        |           |
| Restriction           |      |              |                    |                                      |           |            |            |               |            |            |        |           |
|                       |      |              |                    | _                                    |           |            |            |               |            |            |        |           |
|                       |      |              |                    |                                      | atus      | " 0 0      |            |               | Availab    |            |        |           |
| 5                     |      |              |                    | al Mode On, Idl                      |           |            |            |               | Yes        |            |        |           |
| Register availability |      |              |                    | al Mode On, Idl                      |           |            |            |               | Yes        |            |        |           |
| avaliability          |      |              |                    | al Mode On, Idle<br>al Mode On, Idle |           |            |            |               | Yes<br>Yes |            |        |           |
|                       |      |              | i aitic            |                                      | ep In     | i, olcop o | ut         |               | Yes        |            |        |           |
|                       |      | <u> </u>     |                    | 0.0                                  | ор III    |            |            |               | 100        |            |        |           |
|                       |      | 01           |                    |                                      |           |            | 5 ( 11)    |               | 2)         |            |        |           |
|                       |      |              | atus               | 2                                    |           |            |            | alue (D7 to D | 0)         |            |        |           |
| Default               |      |              |                    | Sequence                             |           |            | 22h<br>22h |               |            |            |        |           |
|                       |      |              | W Reset<br>W Reset |                                      |           |            | 22h<br>22h |               |            |            |        |           |
|                       |      | [ [7]        | vv nesel           |                                      |           |            | ۲۲۱۱       |               |            |            |        |           |
|                       |      |              |                    |                                      |           |            |            |               |            |            |        |           |



## 12.3.3.12 SPD1 (C1h/C100h): Source pre\_drive timing set1

| C1H          |       | SPD1(BK1) |   |  |           |            |         |     |         |       |            |            |  |
|--------------|-------|-----------|---|--|-----------|------------|---------|-----|---------|-------|------------|------------|--|
| / D          | D.444 | Add       | dress                                       | D.1. 0                                       | 1         |            | ,       | 5.4 |         |       | <b>D</b> 4 | <b>D</b> 0 |  |
| Inst / Para  | R/W   | MIPI      | SPI-16                                      | D15-8  | D7        | D6         | D5      | D4  | D3      | D2    | D1         | D0         |  |
| SPD1         | W     | C1h       | C100h                                       | Х  | 0         | 1          | 1       | 1   |         | T2D   | [3:0]      |            |  |
|              | T2D   | [3:0]:    | source                                      | pre_drive tin                                | ning sett | ing.(GN    | D to VD | D)  |         |       |            |            |  |
| Description  | Adju  | st Rang   | ge : 0 ~                                    | 3 uS   |           |            |         |     |         |       |            |            |  |
| 2 000р       | 1 ste | p is 0.2  | 2uS   |  |           |            |         |     |         |       |            |            |  |
|              |       |           |   |  |           |            |         |     |         |       |            |            |  |
| Restriction  |       |           |   |  |           |            |         |     |         |       |            |            |  |
|              |       |           |   | Sti  | atus      |            |         |     | Availab | ilitv |            |            |  |
|              |       |           | Norma                                       | Normal Mode On, Idle Mode Off, Sleep Out Yes |           |            |         |     |         |       |            |            |  |
| Register     |       |           | Normal Mode On, Idle Mode On, Sleep Out Yes |  |           |            |         |     |         |       |            |            |  |
| availability |       |           | Partia                                      | al Mode On, Idle                             | e Mode Of | f, Sleep O | ut      |     | Yes     |       |            |            |  |
|              |       |           | Partia                                      | al Mode On, Idle                             | e Mode Or | n, Sleep O | ut      |     | Yes     |       |            |            |  |
|              |       |           |   | Sle  | ep In     |            |         |     | Yes     |       |            |            |  |
|              |       |           |   |  |           |            |         |     |         |       |            |            |  |
|              |       | Sta       | Status Default Value (D7 to D0)             |  |           |            |         |     |         |       |            |            |  |
| Default      |       | Po        | wer On S                                    | Sequence                                     |           |            | 75h     |     |         |       |            |            |  |
| Delauli      |       | S/        | W Reset                                     |  |           |            | 75h     |     |         |       |            |            |  |
|              |       | H/        | W Reset                                     |  |           |            | 75h     |     |         |       |            |            |  |
|              |       |           |   |  |           |            |         |     |         |       |            |            |  |



## 12.3.3.13 SPD2 (C2h/C200h):Source EQ2 Setting

| C1H          |       | SPD2 (BK1)                      |  |                  |           |            |          |           |     |     |       |    |
|--------------|-------|---------------------------------|--|------------------|-----------|------------|----------|-----------|-----|-----|-------|----|
| last / Dave  | R/W   | Add                             | dress  | D45.0            | D.7       | Do         | DE       | D4        | Do  | Do  | D4    | Do |
| Inst / Para  | H/VV  | MIPI                            | SPI-16                                       | D15-8            | D7        | D6         | D5       | D4        | D3  | D2  | D1    | D0 |
| SPD2         | W     | C2h                             | C200h  | Х                | 0         | 1          | 1        | 1         |     | T3D | [3:0] |    |
|              | T3D   | [3:0]:                          | source                                       | pre_drive tin    | ning sett | ting (VDI  | D to 2*V | DD level) |     |     |       |    |
| Description  | Adju  | st Ranç                         | ge : 4 ~                                     | 12 uS            |           |            |          |           |     |     |       |    |
| Boompaon     | 1 ste | p is 0.8                        | 3 uS   |                  |           |            |          |           |     |     |       |    |
|              |       |                                 |  |                  |           |            |          |           |     |     |       |    |
| Restriction  |       |                                 |  |                  |           |            |          |           |     |     |       |    |
|              |       |                                 | Status Availability                          |                  |           |            |          |           |     |     |       |    |
|              |       |                                 | Normal Mode On, Idle Mode Off, Sleep Out Yes |                  |           |            |          |           |     |     |       |    |
| Register     |       |                                 | Normal Mode On, Idle Mode On, Sleep Out Yes  |                  |           |            |          |           |     |     |       |    |
| availability |       |                                 | Partia                                       | al Mode On, Idle | e Mode Of | f, Sleep O | ut       |           | Yes |     |       |    |
|              |       |                                 | Partia                                       | al Mode On, Idle | e Mode Or | n, Sleep O | ut       |           | Yes |     |       |    |
|              |       | Sleep In Yes                    |  |                  |           |            |          |           |     |     |       |    |
|              |       |                                 |  |                  |           |            |          |           |     |     |       |    |
|              |       | Status Default Value (D7 to D0) |  |                  |           |            |          |           |     |     |       |    |
| Default      |       | Po                              | wer On                                       | Sequence         |           |            | 75h      |           |     |     |       |    |
| Derauit      |       | S/                              | W Reset                                      |                  |           |            | 75h      |           |     |     |       |    |
|              |       | H/                              | W Reset                                      |                  |           |            | 75h      |           |     |     |       |    |
|              |       |                                 |  |                  |           |            |          |           |     |     |       |    |



## 12.3.3.14 MIPISET1 (D0h/D000h):MIPI Setting 1

| D0H          |                   |         |                                 |                 |           | MIPIS       | SET1 (BK | 1)  |          |      |       |         |  |
|--------------|-------------------|---------|---------------------------------|-----------------|-----------|-------------|----------|-----|----------|------|-------|---------|--|
| / 5          | D.A.Y.            | Add     | ress                            | D45.0           | D7        | Do          | D.F.     | 5.4 | 50       |      |       |         |  |
| Inst / Para  | R/W               | MIPI    | SPI-16                          | D15-8           | D7        | D6          | D5       | D4  | D3       | D2   | D1    | D0      |  |
| MIPISET1     | W                 | D0h     | D000h                           | Х               | 1         | 0           | 0        | 0   | EOT_EN   | 0    | ERR_S | EL[1:0] |  |
|              | EOT_              | EN: p   | rotocol                         | selection e     | rror repo | orting en   | able     |     |          |      |       |         |  |
|              | EOT_              | EN="0"  | ,disable                        | e eotp report   | error.    |             |          |     |          |      |       |         |  |
|              | EOT_              | EN="1"  | ,enable                         | eotp report     | error.    |             |          |     |          |      |       |         |  |
|              | ERR_              | SEL[    | 1:0]: E                         | RR pin outp     | ut signa  | l setting   | •        |     |          |      |       |         |  |
| Description  | ERR               | _SEL[1: | 0]                              | output          |           |             |          |     |          |      |       |         |  |
|              |                   | 00H     | Dis                             | able            |           |             |          |     |          |      |       |         |  |
|              |                   | 01H     | CR                              | C error only    |           |             |          |     |          |      |       |         |  |
|              |                   | 02H     | EC                              | C error only    |           |             |          |     |          |      |       |         |  |
|              | 03H CRC+ECC error |         |                                 |                 |           |             |          |     |          |      |       |         |  |
| Restriction  |                   |         |                                 |                 |           |             |          |     |          |      |       |         |  |
|              |                   |         |                                 | Si              | atus      |             |          |     | Availabi | litv |       |         |  |
|              |                   |         | Norm                            | al Mode On, Id  | le Mode C | Off, Sleep  | Out      |     | Yes      | ,    |       |         |  |
| Register     |                   |         |                                 | al Mode On, Id  |           | -           |          |     | Yes      |      |       |         |  |
| availability |                   |         | Partia                          | al Mode On, Idi | e Mode C  | ff, Sleep C | Out      |     | Yes      |      |       |         |  |
|              |                   |         | Partia                          | al Mode On, Idl | e Mode O  | n, Sleep C  | Out      |     | Yes      |      |       |         |  |
|              | Sleep In Yes      |         |                                 |                 |           |             |          |     |          |      |       |         |  |
|              |                   |         |                                 |                 |           |             |          |     |          |      |       |         |  |
|              |                   | Sta     | Status Default Value (D7 to D0) |                 |           |             |          |     |          |      |       |         |  |
| Default      |                   | Po      | wer On                          | Sequence        |           |             |          |     |          |      |       |         |  |
| Delauit      |                   | S/\     | W Reset                         |                 |           | 00h         |          |     |          |      |       |         |  |
|              |                   | H/      | W Reset                         | 1               |           | 00h         |          |     |          |      |       |         |  |
|              |                   |         |                                 |                 |           |             |          |     |          |      |       |         |  |



#### 12.3.3.15 MIPISET2 (D1h/D100h):MIPI Setting 2

| D1H          |  | MIPISET2 (BK1)   |   |                  |                              |                     |           |           |                   |         |           |    |
|--------------|--|--|---|------------------|------------------------------|---------------------|-----------|-----------|-------------------|---------|-----------|----|
| DIII         |  | Ada  | dress                                       |                  |                              | IVIII 10            | LIZ (DIX  | 1         |                   |         |           |    |
| Inst / Para  | R/W  | MIPI   | SPI-16                                      | D15-8            | D7                           | D6                  | D5        | D4        | D3                | D2      | D1        | D0 |
|              |  |  | D100h                                       | x X              |                              | Mpc_tl <sub> </sub> | ox1[3:0]  |           |                   | Mpc_tlp | ox0{3:0}  |    |
| MIPISET2     | W  | D1h  | D101h                                       | ı X              |                              | Mpc_txtir           | neadj[3:0 | ]         |                   | Mpc_tlp | ox2{3:0}  |    |
| WIIFIGETZ    | VV   | וווט   | D102h                                       | X X              |                              |                     |           |           |                   | Mpc_tta | ago[3:0]  |    |
|              |  |  | D103h                                       | n X              |                              |                     |           |           |                   | Mpc_tta | aget[3:0] |    |
| Description  | B:<br>C:<br>D:<br>←                            | :T <sub>TA-GC</sub> :T <sub>TA-SL</sub> :T <sub>TA-GE</sub> A :Mpc_:PHY_:Mpc_:Mpc_tMpc_tMpc_tMpc_tMpc_tMpc_tMpc_tMpc_t | :Tim  URE:Tim  B  A  C  ttago  ttasuo tlpx0 |                  | f g h  b:ove d:Mp f:Mpc h:Mp | side star           |           | DT        | →<br>—<br>—       |         |           |    |
|              |  | REG  |   | D                | escription                   |                     |           |           | Va                | alue    |           |    |
|              | Мрс  | _tlpx0   |   | Rx LPM state     | timeout s                    | ignal               | ste       | p:        |                   |         |           |    |
|              |  | _tlpx1   |   | Rx LPM state     | timeout s                    | ignal               | ste       | p:        |                   |         |           |    |
|              | <del>                                   </del> | _tlpx2   |   | RX_to_TX LP1     |                              |                     | ste       | p:        |                   |         |           |    |
|              |  | _txtime  |   | LPM transmitti   |                              |                     | ste       |           |                   |         |           |    |
|              |  | _ttago   |   | Tx->Rx BTA tir   |                              |                     | Ra        | nge:0~13, | if >13 <b>→</b> 1 | 3       |           |    |
|              | Мрс  | Mpc_ttaget Tx BTA setting  |   |                  | timeout                      | signal              | ste       | p:        |                   |         |           |    |
| Restriction  |  |  |   |                  |                              |                     |           |           |                   |         |           |    |
|              |  |  |   | S                | tatus                        |                     |           |           | Availa            | bility  |           |    |
|              |  |  | Normal Mode On, Idle Mode Off, Sleep Ou     |                  |                              |                     |           | Out Yes   |                   |         |           |    |
| Register     |  |  | Normal Mode On, Idle Mode On, Sleep Out     |                  |                              |                     |           | Out Yes   |                   |         |           |    |
| availability |  |  | Par   | tial Mode On, Id | le Mode O                    | ff, Sleep O         | ut        |           | Ye                | s       |           |    |
|              |  | Partial Mode On, Idle Mode On, Sleep Ou  |   |                  |                              |                     |           |           |                   |         |           |    |
|              |  | Sleep In   |   |                  |                              |                     |           | Yes       |                   |         |           |    |



# ST7701S

Default

| Status            | Default Value (D7 to D0) |
|-------------------|--------------------------|
| Power On Sequence | 31h/03h/04h/05h          |
| S/W Reset         | 00h/03h/04h/05h          |
| H/W Reset         | 00h/03h/04h/05h          |



## 12.3.3.16 MIPISET3 (D2h/D200h):MIPI Setting 3

| D2H          | MIPISET3 (BK1)  |             |                                       |                |    |             |                                      |            |                  |    |    |    |
|--------------|---|-------------|---------------------------------------|----------------|----|-------------|--------------------------------------|------------|------------------|----|----|----|
|              |   | Ado         | dress                                 |                |    |             |                                      |            |                  |    |    |    |
| Inst / Para  | R/W   | MIPI        | SPI-16                                | D15-8          | D7 | D6          | D5                                   | D4         | D3               | D2 | D1 | D0 |
| MIPISET3     | W   | W D2h D200h |                                       |                |    |             | 1                                    | 1          | Phy_ttasure[3:0] |    |    |    |
|              | A:Host to Display BTA  B:T <sub>TA-GO</sub> : Time to drive LP_00 after Turnaround Request  C:T <sub>TA-SURE:</sub> Time-out before new Tx side start driving  D:T <sub>TA-GET</sub> : Time to drive LP_00 by new Tx  A B LPDT  A:Mpc_ttago  c:PHY_ttasure  d:Mpc_ttaget  e:Mpc_tlpx0  g:Mpc_tlpx0  f:Mpc_tlpx2  g:Mpc_tlpx0  i:Mpc_tlpx1  i:Mpc_txtimeadj  Phy_ttausre: Rx->Tx BTA timeout signal  Step: |             |                                       |                |    |             |                                      |            |                  |    |    |    |
| Restriction  |   |             |                                       |                |    |             |                                      |            |                  |    |    |    |
|              | Status  Normal Mode On, Idle Mode Off, Sleep Ou   |             |                                       |                |    |             | Availability  Yes                    |            |                  |    |    |    |
| Register     |   |             |                                       |                |    |             |                                      |            |                  |    |    |    |
| availability |   | -           |                                       |                |    |             |                                      | Yes        |                  |    |    |    |
|              |   | -           | Parti                                 | al Mode On, Id |    | rı, Sieep O | uí                                   | Yes<br>Yes |                  |    |    |    |
|              |   |             | Sleep In                              |                |    |             |                                      |            | Ye               | 5  |    |    |
| Default      |   | Po<br>S/    | atus<br>ower On<br>W Reset<br>W Reset |                |    |             | Default Value (D7 to D0) 31h 31h 31h |            |                  |    |    |    |
|              |   |             |                                       |                |    |             |                                      |            |                  |    |    |    |

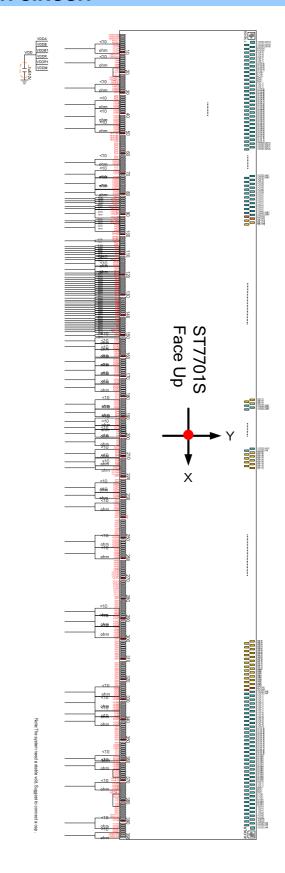


#### 12.3.3.17 MIPISET4 (D3h/D300h):MIPI Setting 4

| D3H          | MIPISET4 (BK1)                   |                                      |         |                |        |                          |              |         |     |     |           |          |  |  |
|--------------|----------------------------------|--------------------------------------|---------|----------------|--------|--------------------------|--------------|---------|-----|-----|-----------|----------|--|--|
| Inst / Para  | R/W                              | Address                              |         |                |        |                          |              |         |     |     |           |          |  |  |
|              |                                  | MIPI                                 | SPI-16  | D15-8          | D7     | D6                       | D5           | D4      | D3  | D2  | D1        | D0       |  |  |
| MIPISET4     | W                                | W D3h                                | D300h   | Х              |        |                          |              | 1       |     | Pl  | HY_CSK[2: | [2:0]    |  |  |
|              |                                  |                                      | D301h   | Х              |        | Pl                       | HY_dsk1[2    | :0]     |     | Pŀ  | HY_dsk0[2 | sk0[2:0] |  |  |
|              | PHY_CSK: MIPI Clock Lane Delay   |                                      |         |                |        |                          |              |         |     |     |           |          |  |  |
|              | Step: 1 step 200ps               |                                      |         |                |        |                          |              |         |     |     |           |          |  |  |
|              | PHY_dsk1: MIPI Data 1 Lane Delay |                                      |         |                |        |                          |              |         |     |     |           |          |  |  |
| Description  | Step: 1 step 200ps               |                                      |         |                |        |                          |              |         |     |     |           |          |  |  |
|              | PHY_dsk0: MIPI Data 0 Lane Delay |                                      |         |                |        |                          |              |         |     |     |           |          |  |  |
|              | Step: 1 step 200ps               |                                      |         |                |        |                          |              |         |     |     |           |          |  |  |
| Restriction  |                                  |                                      |         |                |        |                          |              |         |     |     |           |          |  |  |
| ricstriction |                                  |                                      |         |                |        |                          |              |         |     |     |           |          |  |  |
|              |                                  | Status                               |         |                |        |                          | Availability |         |     |     |           |          |  |  |
|              |                                  |                                      |         |                |        | e Mode Off, Sleep Out    |              |         | Yes |     |           |          |  |  |
| Register     |                                  |                                      |         |                |        | le Mode On, Sleep Out    |              |         |     | Yes |           |          |  |  |
| availability |                                  |                                      |         | al Mode On, Id |        |                          |              | Yes     |     |     |           |          |  |  |
|              |                                  | Partial Mode On, Idle Mode On, Sleep |         |                |        |                          | ut           | Yes     |     |     |           |          |  |  |
|              |                                  |                                      |         | SI             | eep In |                          |              | Yes     |     |     |           |          |  |  |
|              |                                  |                                      |         |                |        |                          |              |         |     |     |           |          |  |  |
| Default      |                                  | Status                               |         |                |        | Default Value (D7 to D0) |              |         |     |     |           |          |  |  |
|              |                                  | P                                    | ower On | Sequence       |        | 00h/00h                  |              |         |     |     |           |          |  |  |
|              |                                  | S/W Reset                            |         |                |        |                          | 00h/00h      |         |     |     |           |          |  |  |
|              |                                  | H/W Reset 00                         |         |                |        |                          |              | 00h/00h |     |     |           |          |  |  |
|              |                                  |                                      |         |                |        |                          |              |         |     |     |           |          |  |  |



## **13 APPLICATION CIRCUIT**





#### 13.1 Voltage Generation

The following is the ST7701S analog voltage pattern diagram:

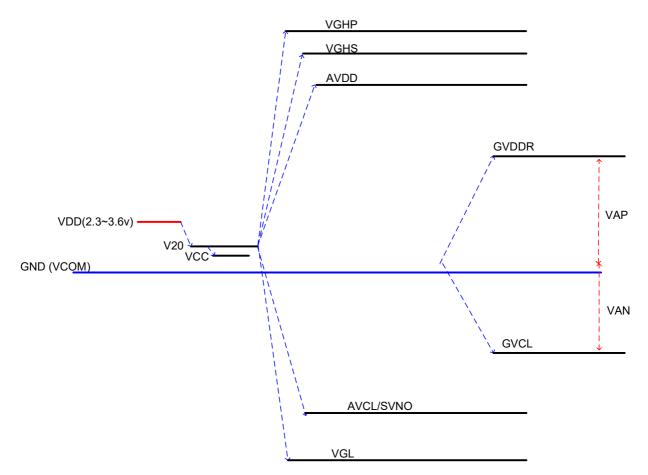


Figure 90 Power Booster Level



#### 13.2 Relationship about source voltage

The relationship about source voltage is shown as below:

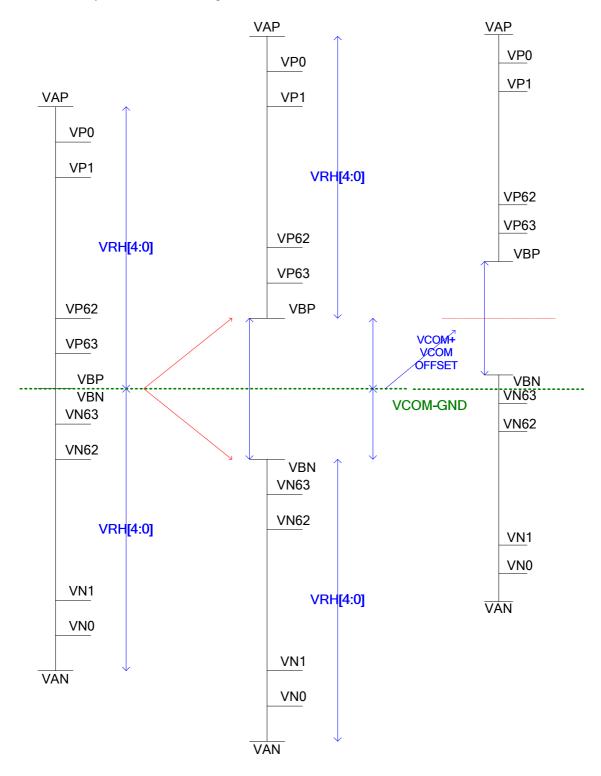


Figure 91 Relationship about source voltage

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## **14 REVISION HISTORY**

| Version | Date    | Description      |  |  |  |  |  |  |
|---------|---------|------------------|--|--|--|--|--|--|
| V1.0    | 2016/12 | Preliminary V0.1 |  |  |  |  |  |  |
|         |         |                  |  |  |  |  |  |  |
|         |         |                  |  |  |  |  |  |  |