ILITEK
Enrich visual experience

ILI9486L

a-Si TFT LCD Single Chip Driver
320RGBx480 Resolution and 262K-color

Specification
Preliminary

Version: V0.06
Document No: ILI9486L_DS_V006.pdf

ILI TECHNOLOGY CORP.
8F, No. 38, Taiyuan St, Jhubei City,
Taiwan 302, R.O.C.
Tel.886-3-5600099; Fax.886-3-5600585
http://www.ilitek.com

Table of Contents

Section ***Page***

1. Introduction

ILI9486L is a 262,144-color single-chip SoC driver for a-Si TFT liquid crystal display with resolution of 320RGBx480 dots, comprising a 960-channel source driver, a 480-channel gate driver, 345,600bytes GRAM for graphic data of 320RGBx480 dots, and power supply circuit.

The ILI9486L supports parallel CPU 8-/9-/16-/18-bit data bus interface and 3-/4-line serial peripheral interfaces (SPI). The ILI9486L is also compliant with RGB (16-/18-bit) data bus for video image display.

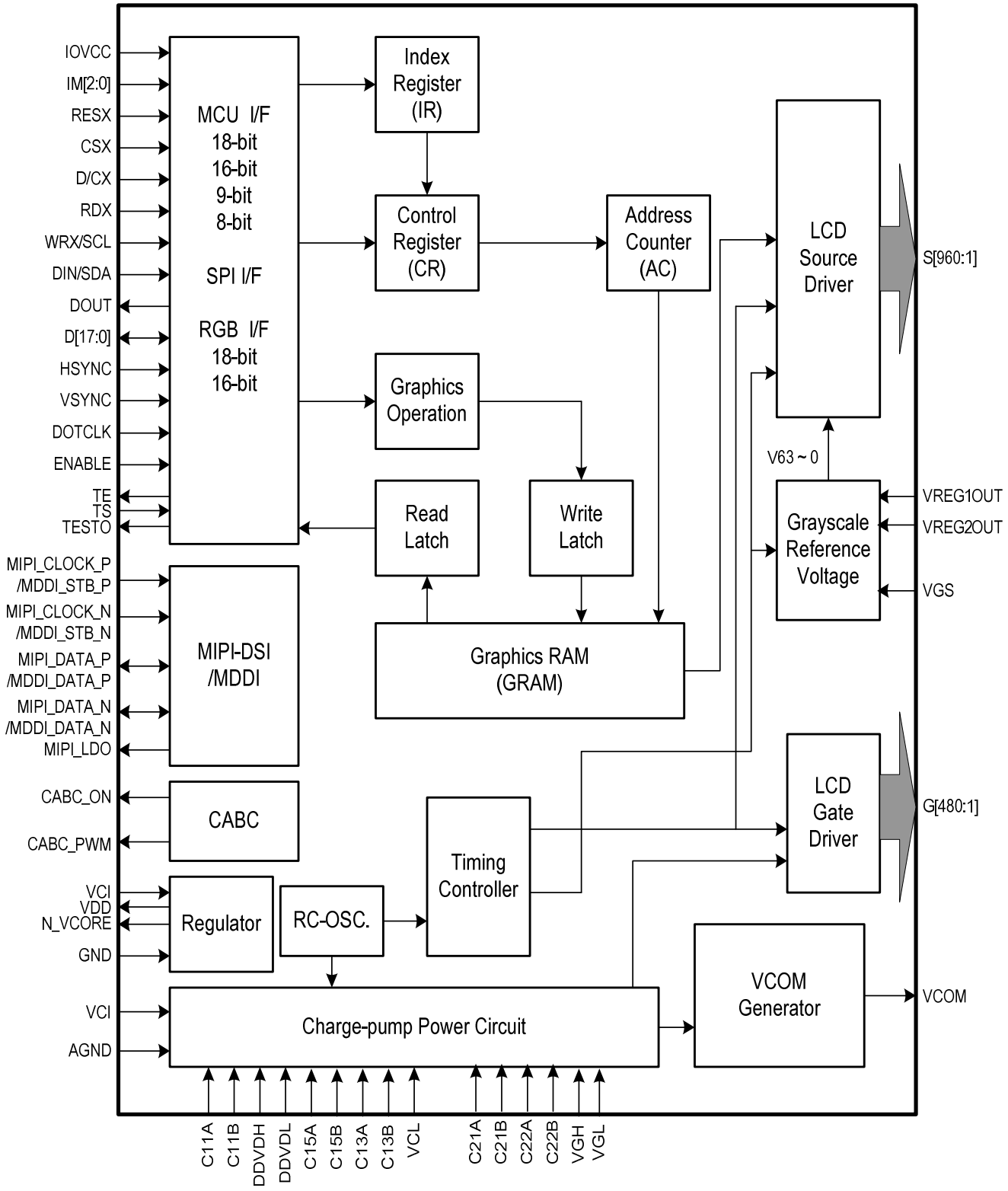
ILI9486L can operate with 1.65V I/O interface voltage and support wide analog power supply range. ILI9486L also supports a function to display in 8 colors and a sleep mode, allowing for precise power control by software and these features make the ILI9486L as an ideal LCD driver for medium or small size portable products such as digital cellular phones, smart phone, MP3 and PMP where long battery life is a major concern.

2. Features

- Display resolution: [320xRGB](H) x 480(V)
- Output:
  - 960 source outputs
  - 480 gate outputs
  - Common electrode output
- a-TFT LCD driver with on-chip full display RAM: 345,600 bytes
- Interface
  - 8-bits, 9-bits, 16-bts, 18-bits interface with 8080-series MCU
  - 16-bits, 18-bits RGB interface with graphic controller
  - 3-line / 4-line serial interface
- Display mode:
  - Full color mode (Idle mode OFF) : 262K-colors, 65K-colors.
  - Reduce color mode (Idle mode ON) : 8-color.
- Power saving mode:
  - Deep-standby mode
  - Sleep mode
- On chip functions:
  - DC VCOM generator and adjustment
  - Timing generator
  - Oscillator
  - DC/DC converter
  - Dot/Column/Z inversion
  - Separate RGB Gamma correction
  - CABC(Content adaptive brightness control)
- MTP (4 times):
  - 8-bits for ID1
  - 8-bits for ID2
  - 8-bits for ID3
  - 7-bits for VCOM adjustment
- Low -power consumption architecture
  - Low operating power supplies:
    - IOVCC = 1.65V ~ 3.6V (Digital)
    - VCI = 2.5V ~ 3.6V (Analog)

- LCD Voltage drive:
  - Source/VCOM power supply voltage
    - DDVDH - GND = 4.5V ~ 6.0V
    - VCL - GND = -2.0~-3.0V
    - VCI1 - VCL ≦ 6.0V
  - Gate driver output voltage
    - VGH - GND = 10.0V ~ 20.0V
    - VGL - GND = -5.0V ~ -15.0V
    - VGH - VGL ≦ 32.0V
  - VCOM driver output voltage
    - VCOM = 0~-2.0V
- Operate temperature range: -40℃ to 85℃
- a-Si TFT LCD storage capacitor : Cst on Common structure only

3. Block Diagram



4. Pin Descriptions

<table>
<tr><th colspan="4">Bus Interface Pins</th></tr>
<tr><th>Pin Name</th><th>I/O</th><th>Type</th><th>Descriptions</th></tr>
<tr><td>IM[2:0]</td><td>I</td><td>MPU
IOVCC/DGND</td><td>- Select the interface mode
<table>
<tr><th>IM2</th><th>IM1</th><th>IM0</th><th>Interface</th><th>Data Pin in Use</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>8080 18-bit bus interface</td><td>DB[17:0]</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>8080 9-bit bus interface</td><td>DB[8:0]</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>8080 16-bit bus interface</td><td>DB[15:0]</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>8080 8-bit bus interface</td><td>DB[7:0]</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Prohibited</td><td>-</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>3-line SPI</td><td>SDA</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Prohibited</td><td>-</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>4-line SPI</td><td>SDA</td></tr>
</table></td></tr>
<tr><td>RESX</td><td>I</td><td>MPU/
Reset circuit</td><td>- The external reset input.
- Initializes the chip with a low input. Be sure to execute a power-on reset after supplying power.</td></tr>
<tr><td>CSX</td><td>I</td><td>MPU</td><td>- A chip select signal.
Low: the chip is selected and accessible
High: the chip is not selected and not accessible
Fix to IOVCC or DGND level when not in use.</td></tr>
<tr><td>D/CX</td><td>I</td><td>MPU</td><td>- Parallel interface (D/CX): The signal for command or parameter select.
Low: Command.
High: Parameter.
Fix to IOVCC or DGND level when not in use.</td></tr>
<tr><td>WRX/SCL</td><td>I</td><td>MPU
IOVCC</td><td>- 8080 system (WRX): Serves as a write signal and writes data at the rising edge.
- 3/4-line serial interface (SCL): The pin used as serial clock pin.
Fix to IOVCC or DGND level when not in use.</td></tr>
<tr><td>RDX</td><td>I</td><td>MPU</td><td>- 8080 system (RDX): Serves as a read signal and read data at the rising edge.
Fix to IOVCC or DGND level when not in use.</td></tr>
<tr><td>DIN/SDA</td><td>I/O</td><td>MPU</td><td>- Serial data input / output.
Fix to IOVCC or DGND level when not in use.</td></tr>
<tr><td>DOUT</td><td>O</td><td>MCU</td><td>- Serial data output
Leave the pin to open when not in use.</td></tr>
<tr><td>TE</td><td>O</td><td>MPU</td><td>- Tearing effect output.
Leave the pin to open when not in use.</td></tr>
<tr><td>CABC_PWM</td><td>O</td><td>VCI</td><td>- Back light control pin.
Leave the pin to open when not in use.</td></tr>
<tr><td>CABC_ON</td><td>O</td><td>VCI</td><td>- Back light control pin.
Leave the pin to open when not in use.</td></tr>
<tr><td>MIPI_CLOCK_P</td><td>I</td><td>MIPI</td><td>Leave the pin to open.</td></tr>
<tr><td>MIPI_CLOCK_N</td><td>I</td><td>MIPI</td><td>Leave the pin to open.</td></tr>
<tr><td>MIPI_DATA_P</td><td>I/O</td><td>MIPI</td><td>Leave the pin to open.</td></tr>
<tr><td>MIPI_DATA_N</td><td>I/O</td><td>MIPI</td><td>Leave the pin to open.</td></tr>
</table>

<table>
<tr><td>DB[17:0]</td><td>I/O</td><td>MPU</td><td>A 18-bit parallel bi-directional data bus for MCU system
<table>
<tr><th>Interface Mode</th><th>Data Pin in Use</th></tr>
<tr><td>8-bit MCU System Interface Mode</td><td>DB[7:0]</td></tr>
<tr><td>9-bit MCU System Interface Mode</td><td>DB[8:0]</td></tr>
<tr><td>16-bit MCU System Interface Mode</td><td>DB[15:0]</td></tr>
<tr><td>18-bit MCU System Interface Mode</td><td>DB[17:0]</td></tr>
<tr><td>16-bit RGB Interface Mode</td><td>DB[15:0]</td></tr>
<tr><td>18-bit RGB Interface Mode</td><td>DB[17:0]</td></tr>
</table>
Fix to DGND level when not in use.</td></tr>
<tr><td>VSYNC</td><td>I</td><td>MPU</td><td>Frame synchronizing signal for RGB interface operation.
Fix to DGND level when not in use.</td></tr>
<tr><td>HSYNC</td><td>I</td><td>MPU</td><td>- Line synchronizing signal for RGB interface operation.
Fix to DGND level when not in use.</td></tr>
<tr><td>ENABLE</td><td>I</td><td>MPU</td><td>- Data enable signal for RGB interface operation.
Low : access enabled.
High : access inhibited.
Fix to DGND level when not in use.</td></tr>
<tr><td>DOTCLK</td><td>I</td><td>MPU</td><td>- Dot clock signal for RGB interface operation.
Fix to IOVCC level when not in use.</td></tr>
</table>

LCD Driving Signals			
Pin Name	I/O	Type	Descriptions
S961~S1	O	LCD	- Source output voltage signals applied to liquid crystal. ***Leave the pin to open when not in use.***
G480~G1	O	LCD	- Gate line output signals. VGH: the level selecting gate lines VGL: the level not selecting gate lines ***Leave the pin to open when not in use.***
VCOM	O	-	- The power supply of common voltage in DC VCOM driving. - The voltage range is set between -2V to 0V.
VREG1OUT	O	-	- Internal generated stable power for source driver unit. - The voltage level can be set by VRH1[4:0]. - VREG1OUT is a positive grayscale reference voltage of source driver. - VREG1OUT =3.6~5.5V
VREG2OUT	O	-	- Internal generated stable power for source driver unit. - The voltage level can be set by VRH2[4:0]. - VREG2OUT is a negative grayscale reference voltage of source driver. - VREG2OUT =-3.6~-5.5V
VGS	I	-	Reference level for grayscale generating circuit.

Charge-pump and Regulator Circuit			
Pin Name	I/O	Type	Descriptions
VCI	P	Power supply	- A supply voltage to the analog circuit. Connect to an external power supply of 2.5 ~ 3.6V.
DDVDH	O	Stabilizing capacitor	- Power supply for the source driver and VCOM driver. - Connect to a stabilizing capacitor between DDVDH and GND.
DDVDL	O	Stabilizing capacitor	- Power supply for the source driver and VCOM driver. - Connect to a stabilizing capacitor between DDVDL and GND.
VGH	O	Stabilizing capacitor	- Power supply for the gate driver. - Connect to a stabilizing capacitor between VGH and GND.
VGL	O	Stabilizing	- Power supply for the gate driver. .

		capacitor	- Connect to a stabilizing capacitor between VGL and GND.
VCL	O	Stabilizing capacitor	- VCOML driver power supply. - VCL = 0.5 ~ -VCI, place a stabilizing capacitor between VCL and GND.
C11A, C11B C15A, C15B	O	Step-up capacitor	- Capacitor connection pins for the step-up circuit 1
C13A, C13B C21A, C21B C22A, C22B	O	Step-up capacitor	- Capacitor connection pins for the step-up circuit 2.

Power Pads			
Pin Name	I/O	Type	Descriptions
IOVCC	P	Power supply	- A supply voltage to the digital circuit. Connect to an external power supply of 1.65 ~ 3.6V.
VDD	O	Power	- Digital circuit power pad. Connect these pins with the 1uF capacitor.
N_VCORE	O	Power	- Digital circuit negative power pad. Connect these pins with the 1uF capacitor.
DGND	P	Power supply	- DGND for the digital side: DGND = 0V. In case of COG, connect to GND on the FPC to prevent noise.
AGND	P	Power supply	- AGND for the analog side: AGND = 0V. In case of COG, connect to GND on the FPC to prevent noise.
VPG	P	Power supply	- Power supply pin for the NV memory programming. Please provide 7 volt to this pin for NV memory programming.
MIPI_LDO	P	Stabilizing capacitor	Leave this pad as open.

Test Pads			
Pin Name	I/O	Type	Descriptions
DUMMY	-	-	-- Dummy pad. ***Leave the pin to be open when not in use.***
TS[2:0]	I	IOGND	- Test pins These pins are internal pulled low. Please leave these pins as open or connected to GND.
TEST[5:0]	O	-	-TEST[5:0]: When set in test mode, the pin are test pins. ***Leave these pins to be open when not in use.***
V1T V62T VWT	I	-	- Test pins. ***Leave these pins to be open when not in use.***

Liquid crystal power supply specifications Table

No.	Item		Description
1	TFT Source Driver		960 pins (320 x RGB)
2	TFT Gate Driver		480 pins
3	TFT Display's Capacitor Structure		Cst structure only (Cs on Common)
4	Liquid Crystal Drive Output	S1 ~ S960	V0 ~ V63 grayscales
		G1 ~ G480	VGH – VGL
		VCOM	0~-2.0V
5	Input Voltage	IOVCC	1.65 ~ 3.60V
		VCI	2.50 ~ 3.60V
6	Liquid Crystal Drive Voltages	DDVDH	4.5V ~ 6.5V
		DDVDL	-6.5V ~ -4.5V
		VGH	10.0V ~ 20.0V
		VGL	-5.0V ~ -15.0V
		VCL	-1.9 ~ -3.0V
		VGH – VGL	Max. 32.0V
7	Internal Step-up Circuits	DDVDH	VCI1 X2
		DDVDL	-(VCI1-VCL)
		VGH	VCI1 x4, x5, x6
		VGL	VCI1 x-3, x-4, x-5
		VCL	VCI1 x-1

5. Pad Arrangement and Coordination

Chip Size: 22850um x 850um

Chip thickness : 250um (typ.)

Pad Location: Pad Center.

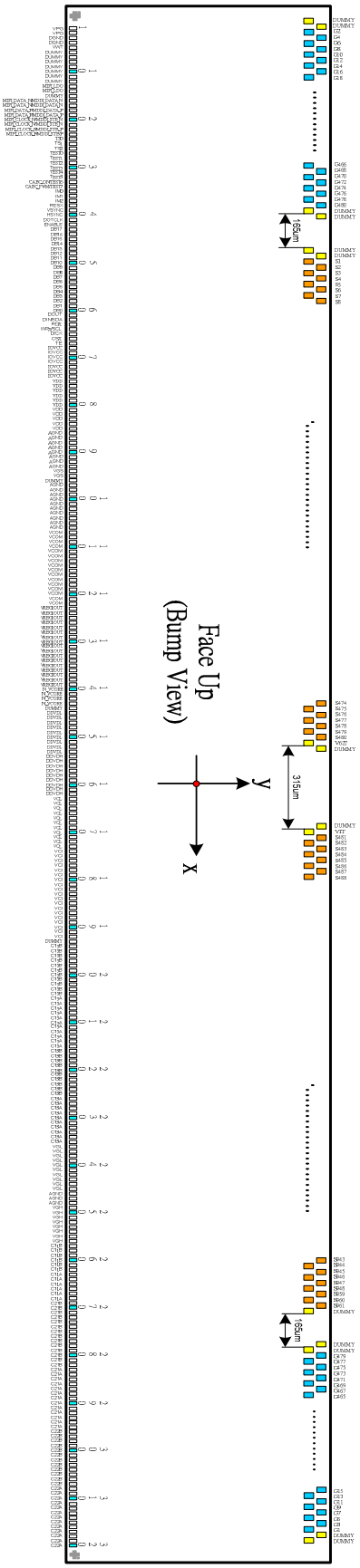
Coordinate Origin: Chip center

Au bump height: 15um (typ.)

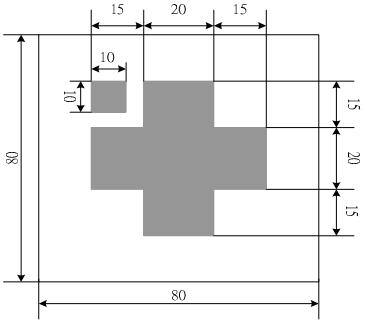
Au Bump Size:

1. 15um x 100um
   Gate: G1 ~ G480
   Source: S1 ~ S961

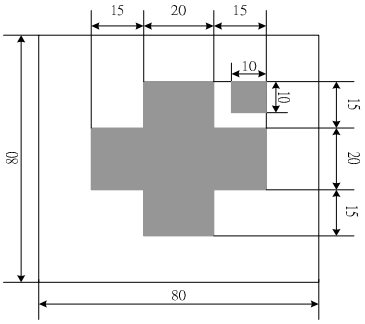
2. 50um x 80um
   Input Pads
   Pad 1 to 320.



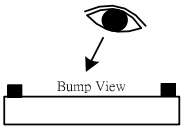
Alignment Marks



Alignment Mark: Left



Alignment Mark: Right



No.	Name	X	Y	No.	Name	X	Y	No.	Name	X	Y	No.	Name	X	Y	No.	Name	X	Y
1	VPG	-11165	-279	51	DB9	-7665	-279	101	AGND	-4165	-279	151	DDVDL	-665	-279	201	C13B	2835	-279
2	VPG	-11095	-279	52	DB8	-7595	-279	102	AGND	-4095	-279	152	DDVDL	-595	-279	202	C13B	2905	-279
3	DGND	-11025	-279	53	DB7	-7525	-279	103	AGND	-4025	-279	153	DDVDL	-525	-279	203	C13B	2975	-279
4	DGND	-10955	-279	54	DB6	-7455	-279	104	AGND	-3955	-279	154	DDVDH	-455	-279	204	C13B	3045	-279
5	VWT	-10885	-279	55	DB5	-7385	-279	105	AGND	-3885	-279	155	DDVDH	-385	-279	205	C13A	3115	-279
6	DUMMY	-10815	-279	56	DB4	-7315	-279	106	AGND	-3815	-279	156	DDVDH	-315	-279	206	C13A	3185	-279
7	DUMMY	-10745	-279	57	DB3	-7245	-279	107	VCOM	-3745	-279	157	DDVDH	-245	-279	207	C13A	3255	-279
8	DUMMY	-10675	-279	58	DB2	-7175	-279	108	VCOM	-3675	-279	158	DDVDH	-175	-279	208	C13A	3325	-279
9	DUMMY	-10605	-279	59	DB1	-7105	-279	109	VCOM	-3605	-279	159	DDVDH	-105	-279	209	C13A	3395	-279
10	DUMMY	-10535	-279	60	DB0	-7035	-279	110	VCOM	-3535	-279	160	DDVDH	-35	-279	210	C13A	3465	-279
11	DUMMY	-10465	-279	61	DOUT	-6965	-279	111	VCOM	-3465	-279	161	DDVDH	35	-279	211	C13A	3535	-279
12	DUMMY	-10395	-279	62	DIN/SDA	-6895	-279	112	VCOM	-3395	-279	162	DDVDH	105	-279	212	C13A	3605	-279
13	MIPI_LDO	-10325	-279	63	RDX	-6825	-279	113	VCOM	-3325	-279	163	VCL	175	-279	213	C13A	3675	-279
14	MIPI_LDO	-10255	-279	64	WRX/SCL	-6755	-279	114	VCOM	-3255	-279	164	VCL	245	-279	214	C13A	3745	-279
15	DUMMY	-10185	-279	65	D/CX	-6685	-279	115	VCOM	-3185	-279	165	VCL	315	-279	215	C13A	3815	-279
16	MIPI_DATA_N	-10115	-279	66	CSX	-6615	-279	116	VCOM	-3115	-279	166	VCL	385	-279	216	C15B	3885	-279
17	MIPI_DATA_N	-10045	-279	67	TE	-6545	-279	117	VCOM	-3045	-279	167	VCL	455	-279	217	C15B	3955	-279
18	MIPI_DATA_P	-9975	-279	68	IOVCC	-6475	-279	118	VCOM	-2975	-279	168	VCL	525	-279	218	C15B	4025	-279
19	MIPI_DATA_P	-9905	-279	69	IOVCC	-6405	-279	119	VCOM	-2905	-279	169	VCL	595	-279	219	C15B	4095	-279
20	MIPI_CLOCK_N	-9835	-279	70	IOVCC	-6335	-279	120	VCOM	-2835	-279	170	VCL	665	-279	220	C15B	4165	-279
21	MIPI_CLOCK_N	-9765	-279	71	IOVCC	-6265	-279	121	VCOM	-2765	-279	171	VCL	735	-279	221	C15B	4235	-279
22	MIPI_CLOCK_P	-9695	-279	72	IOVCC	-6195	-279	122	VCOM	-2695	-279	172	VCL	805	-279	222	C15B	4305	-279
23	MIPI_CLOCK_P	-9625	-279	73	IOVCC	-6125	-279	123	VREG1OUT	-2625	-279	173	VCL	875	-279	223	C15B	4375	-279
24	TS0	-9555	-279	74	IOVCC	-6055	-279	124	VREG1OUT	-2555	-279	174	VCI	945	-279	224	C15B	4445	-279
25	TS1	-9485	-279	75	VDD	-5985	-279	125	VREG1OUT	-2485	-279	175	VCI	1015	-279	225	C15B	4515	-279
26	TS2	-9415	-279	76	VDD	-5915	-279	126	VREG1OUT	-2415	-279	176	VCI	1085	-279	226	C15A	4585	-279
27	TEST0	-9345	-279	77	VDD	-5845	-279	127	VREG1OUT	-2345	-279	177	VCI	1155	-279	227	C15A	4655	-279
28	TEST1	-9275	-279	78	VDD	-5775	-279	128	VREG1OUT	-2275	-279	178	VCI	1225	-279	228	C15A	4725	-279
29	TEST2	-9205	-279	79	VDD	-5705	-279	129	VREG1OUT	-2205	-279	179	VCI	1295	-279	229	C15A	4795	-279
30	TEST3	-9135	-279	80	VDD	-5635	-279	130	VREG1OUT	-2135	-279	180	VCI	1365	-279	230	C15A	4865	-279
31	TEST4	-9065	-279	81	VDD	-5565	-279	131	VREG1OUT	-2065	-279	181	VCI	1435	-279	231	C15A	4935	-279
32	TEST5	-8995	-279	82	VDD	-5495	-279	132	VREG1OUT	-1995	-279	182	VCI	1505	-279	232	C15A	5005	-279
33	CABC_ON	-8925	-279	83	VDD	-5425	-279	133	VREG2OUT	-1925	-279	183	VCI	1575	-279	233	C15A	5075	-279
34	CABC_PWM	-8855	-279	84	VDD	-5355	-279	134	VREG2OUT	-1855	-279	184	VCI	1645	-279	234	C15A	5145	-279
35	IM0/ID	-8785	-279	85	VDD	-5285	-279	135	VREG2OUT	-1785	-279	185	VCI	1715	-279	235	C15A	5215	-279
36	IM1	-8715	-279	86	AGND	-5215	-279	136	VREG2OUT	-1715	-279	186	VCI	1785	-279	236	VGL	5285	-279
37	IM2	-8645	-279	87	AGND	-5145	-279	137	VREG2OUT	-1645	-279	187	VCI	1855	-279	237	VGL	5355	-279
38	RESX	-8575	-279	88	AGND	-5075	-279	138	VREG2OUT	-1575	-279	188	VCI	1925	-279	238	VGL	5425	-279
39	VSYNC	-8505	-279	89	AGND	-5005	-279	139	VREG2OUT	-1505	-279	189	VCI	1995	-279	239	VGL	5495	-279
40	HSYNC	-8435	-279	90	AGND	-4935	-279	140	N_VCORE	-1435	-279	190	VCI	2065	-279	240	VGL	5565	-279
41	DOTCLK	-8365	-279	91	AGND	-4865	-279	141	N_VCORE	-1365	-279	191	VCI	2135	-279	241	VGL	5635	-279
42	ENABLE	-8295	-279	92	AGND	-4795	-279	142	N_VCORE	-1295	-279	192	VCI	2205	-279	242	VGL	5705	-279
43	DB17	-8225	-279	93	AGND	-4725	-279	143	N_VCORE	-1225	-279	193	DUMMY	2275	-279	243	VGL	5775	-279
44	DB16	-8155	-279	94	VGS	-4655	-279	144	DUMMY	-1155	-279	194	C13B	2345	-279	244	VGL	5845	-279
45	DB15	-8085	-279	95	VGS	-4585	-279	145	DDVDL	-1085	-279	195	C13B	2415	-279	245	VGL	5915	-279
46	DB14	-8015	-279	96	DUMMY	-4515	-279	146	DDVDL	-1015	-279	196	C13B	2485	-279	246	AGND	5985	-279
47	DB13	-7945	-279	97	AGND	-4445	-279	147	DDVDL	-945	-279	197	C13B	2555	-279	247	AGND	6055	-279
48	DB12	-7875	-279	98	AGND	-4375	-279	148	DDVDL	-875	-279	198	C13B	2625	-279	248	AGND	6125	-279
49	DB11	-7805	-279	99	AGND	-4305	-279	149	DDVDL	-805	-279	199	C13B	2695	-279	249	VGH	6195	-279
50	DB10	-7735	-279	100	AGND	-4235	-279	150	DDVDL	-735	-279	200	C13B	2765	-279	250	VGH	6265	-279

No.	Name	X	Y
251	VGH	6335	-279
252	VGH	6405	-279
253	VGH	6475	-279
254	VGH	6545	-279
255	VGH	6615	-279
256	VGH	6685	-279
257	C11B	6755	-279
258	C11B	6825	-279
259	C11B	6895	-279
260	C11B	6965	-279
261	C11B	7035	-279
262	C11B	7105	-279
263	C11A	7175	-279
264	C11A	7245	-279
265	C11A	7315	-279
266	C11A	7385	-279
267	C11A	7455	-279
268	C11A	7525	-279
269	C21B	7595	-279
270	C21B	7665	-279
271	C21B	7735	-279
272	C21B	7805	-279
273	C21B	7875	-279
274	C21B	7945	-279
275	C21B	8015	-279
276	C21B	8085	-279
277	C21B	8155	-279
278	C21B	8225	-279
279	C21B	8295	-279
280	C21B	8365	-279
281	C21B	8435	-279
282	C21B	8505	-279
283	C21A	8575	-279
284	C21A	8645	-279
285	C21A	8715	-279
286	C21A	8785	-279
287	C21A	8855	-279
288	C21A	8925	-279
289	C21A	8995	-279
290	C21A	9065	-279
291	C21A	9135	-279
292	C21A	9205	-279
293	C21A	9275	-279
294	C21A	9345	-279
295	C21A	9415	-279
296	C22B	9485	-279
297	C22B	9555	-279
298	C22B	9625	-279
299	C22B	9695	-279
300	C22B	9765	-279
301	C22B	9835	-279
302	C22B	9905	-279
303	C22B	9975	-279
304	C22B	10045	-279
305	C22B	10115	-279
306	C22B	10185	-279
307	C22B	10255	-279
308	C22A	10325	-279
309	C22A	10395	-279
310	C22A	10465	-279
311	C22A	10535	-279
312	C22A	10605	-279
313	C22A	10675	-279
314	C22A	10745	-279
315	C22A	10815	-279
316	C22A	10885	-279
317	C22A	10955	-279
318	C22A	11025	-279
319	C22A	11095	-279
320	C22A	11165	-279
321	DUMMY	11205	164
322	DUMMY	11190	289
323	G1	11175	164
324	G3	11160	289
325	G5	11145	164
326	G7	11130	289
327	G9	11115	164
328	G11	11100	289
329	G13	11085	164
330	G15	11070	289
331	G17	11055	164
332	G19	11040	289
333	G21	11025	164
334	G23	11010	289
335	G25	10995	164
336	G27	10980	289
337	G29	10965	164
338	G31	10950	289
339	G33	10935	164
340	G35	10920	289
341	G37	10905	164
342	G39	10890	289
343	G41	10875	164
344	G43	10860	289
345	G45	10845	164
346	G47	10830	289
347	G49	10815	164
348	G51	10800	289
349	G53	10785	164
350	G55	10770	289
351	G57	10755	164
352	G59	10740	289
353	G61	10725	164
354	G63	10710	289
355	G65	10695	164
356	G67	10680	289
357	G69	10665	164
358	G71	10650	289
359	G73	10635	164
360	G75	10620	289
361	G77	10605	164
362	G79	10590	289
363	G81	10575	164
364	G83	10560	289
365	G85	10545	164
366	G87	10530	289
367	G89	10515	164
368	G91	10500	289
369	G93	10485	164
370	G95	10470	289
371	G97	10455	164
372	G99	10440	289
373	G101	10425	164
374	G103	10410	289
375	G105	10395	164
376	G107	10380	289
377	G109	10365	164
378	G111	10350	289
379	G113	10335	164
380	G115	10320	289
381	G117	10305	164
382	G119	10290	289
383	G121	10275	164
384	G123	10260	289
385	G125	10245	164
386	G127	10230	289
387	G129	10215	164
388	G131	10200	289
389	G133	10185	164
390	G135	10170	289
391	G137	10155	164
392	G139	10140	289
393	G141	10125	164
394	G143	10110	289
395	G145	10095	164
396	G147	10080	289
397	G149	10065	164
398	G151	10050	289
399	G153	10035	164
400	G155	10020	289
401	G157	10005	164
402	G159	9990	289
403	G161	9975	164
404	G163	9960	289
405	G165	9945	164
406	G167	9930	289
407	G169	9915	164
408	G171	9900	289
409	G173	9885	164
410	G175	9870	289
411	G177	9855	164
412	G179	9840	289
413	G181	9825	164
414	G183	9810	289
415	G185	9795	164
416	G187	9780	289
417	G189	9765	164
418	G191	9750	289
419	G193	9735	164
420	G195	9720	289
421	G197	9705	164
422	G199	9690	289
423	G201	9675	164
424	G203	9660	289
425	G205	9645	164
426	G207	9630	289
427	G209	9615	164
428	G211	9600	289
429	G213	9585	164
430	G215	9570	289
431	G217	9555	164
432	G219	9540	289
433	G221	9525	164
434	G223	9510	289
435	G225	9495	164
436	G227	9480	289
437	G229	9465	164
438	G231	9450	289
439	G233	9435	164
440	G235	9420	289
441	G237	9405	164
442	G239	9390	289
443	G241	9375	164
444	G243	9360	289
445	G245	9345	164
446	G247	9330	289
447	G249	9315	164
448	G251	9300	289
449	G253	9285	164
450	G255	9270	289
451	G257	9255	164
452	G259	9240	289
453	G261	9225	164
454	G263	9210	289
455	G265	9195	164
456	G267	9180	289
457	G269	9165	164
458	G271	9150	289
459	G273	9135	164
460	G275	9120	289
461	G277	9105	164
462	G279	9090	289
463	G281	9075	164
464	G283	9060	289
465	G285	9045	164
466	G287	9030	289
467	G289	9015	164
468	G291	9000	289
469	G293	8985	164
470	G295	8970	289
471	G297	8955	164
472	G299	8940	289
473	G301	8925	164
474	G303	8910	289
475	G305	8895	164
476	G307	8880	289
477	G309	8865	164
478	G311	8850	289
479	G313	8835	164
480	G315	8820	289
481	G317	8805	164
482	G319	8790	289
483	G321	8775	164
484	G323	8760	289
485	G325	8745	164
486	G327	8730	289
487	G329	8715	164
488	G331	8700	289
489	G333	8685	164
490	G335	8670	289
491	G337	8655	164
492	G339	8640	289
493	G341	8625	164
494	G343	8610	289
495	G345	8595	164
496	G347	8580	289
497	G349	8565	164
498	G351	8550	289
499	G353	8535	164
500	G355	8520	289

No.	Name	X	Y
501	G357	8505	164
502	G359	8490	289
503	G361	8475	164
504	G363	8460	289
505	G365	8445	164
506	G367	8430	289
507	G369	8415	164
508	G371	8400	289
509	G373	8385	164
510	G375	8370	289
511	G377	8355	164
512	G379	8340	289
513	G381	8325	164
514	G383	8310	289
515	G385	8295	164
516	G387	8280	289
517	G389	8265	164
518	G391	8250	289
519	G393	8235	164
520	G395	8220	289
521	G397	8205	164
522	G399	8190	289
523	G401	8175	164
524	G403	8160	289
525	G405	8145	164
526	G407	8130	289
527	G409	8115	164
528	G411	8100	289
529	G413	8085	164
530	G415	8070	289
531	G417	8055	164
532	G419	8040	289
533	G421	8025	164
534	G423	8010	289
535	G425	7995	164
536	G427	7980	289
537	G429	7965	164
538	G431	7950	289
539	G433	7935	164
540	G435	7920	289
541	G437	7905	164
542	G439	7890	289
543	G441	7875	164
544	G443	7860	289
545	G445	7845	164
546	G447	7830	289
547	G449	7815	164
548	G451	7800	289
549	G453	7785	164
550	G455	7770	289

No.	Name	X	Y
551	G457	7755	164
552	G459	7740	289
553	G461	7725	164
554	G463	7710	289
555	G465	7695	164
556	G467	7680	289
557	G469	7665	164
558	G471	7650	289
559	G473	7635	164
560	G475	7620	289
561	G477	7605	164
562	G479	7590	289
563	DUMMY	7575	164
564	DUMMY	7560	289
565	DUMMY	7395	164
566	S961	7380	289
567	S960	7365	164
568	S959	7350	289
569	S958	7335	164
570	S957	7320	289
571	S956	7305	164
572	S955	7290	289
573	S954	7275	164
574	S953	7260	289
575	S952	7245	164
576	S951	7230	289
577	S950	7215	164
578	S949	7200	289
579	S948	7185	164
580	S947	7170	289
581	S946	7155	164
582	S945	7140	289
583	S944	7125	164
584	S943	7110	289
585	S942	7095	164
586	S941	7080	289
587	S940	7065	164
588	S939	7050	289
589	S938	7035	164
590	S937	7020	289
591	S936	7005	164
592	S935	6990	289
593	S934	6975	164
594	S933	6960	289
595	S932	6945	164
596	S931	6930	289
597	S930	6915	164
598	S929	6900	289
599	S928	6885	164
600	S927	6870	289

No.	Name	X	Y
601	S926	6855	164
602	S925	6840	289
603	S924	6825	164
604	S923	6810	289
605	S922	6795	164
606	S921	6780	289
607	S920	6765	164
608	S919	6750	289
609	S918	6735	164
610	S917	6720	289
611	S916	6705	164
612	S915	6690	289
613	S914	6675	164
614	S913	6660	289
615	S912	6645	164
616	S911	6630	289
617	S910	6615	164
618	S909	6600	289
619	S908	6585	164
620	S907	6570	289
621	S906	6555	164
622	S905	6540	289
623	S904	6525	164
624	S903	6510	289
625	S902	6495	164
626	S901	6480	289
627	S900	6465	164
628	S899	6450	289
629	S898	6435	164
630	S897	6420	289
631	S896	6405	164
632	S895	6390	289
633	S894	6375	164
634	S893	6360	289
635	S892	6345	164
636	S891	6330	289
637	S890	6315	164
638	S889	6300	289
639	S888	6285	164
640	S887	6270	289
641	S886	6255	164
642	S885	6240	289
643	S884	6225	164
644	S883	6210	289
645	S882	6195	164
646	S881	6180	289
647	S880	6165	164
648	S879	6150	289
649	S878	6135	164
650	S877	6120	289

No.	Name	X	Y
651	S876	6105	164
652	S875	6090	289
653	S874	6075	164
654	S873	6060	289
655	S872	6045	164
656	S871	6030	289
657	S870	6015	164
658	S869	6000	289
659	S868	5985	164
660	S867	5970	289
661	S866	5955	164
662	S865	5940	289
663	S864	5925	164
664	S863	5910	289
665	S862	5895	164
666	S861	5880	289
667	S860	5865	164
668	S859	5850	289
669	S858	5835	164
670	S857	5820	289
671	S856	5805	164
672	S855	5790	289
673	S854	5775	164
674	S853	5760	289
675	S852	5745	164
676	S851	5730	289
677	S850	5715	164
678	S849	5700	289
679	S848	5685	164
680	S847	5670	289
681	S846	5655	164
682	S845	5640	289
683	S844	5625	164
684	S843	5610	289
685	S842	5595	164
686	S841	5580	289
687	S840	5565	164
688	S839	5550	289
689	S838	5535	164
690	S837	5520	289
691	S836	5505	164
692	S835	5490	289
693	S834	5475	164
694	S833	5460	289
695	S832	5445	164
696	S831	5430	289
697	S830	5415	164
698	S829	5400	289
699	S828	5385	164
700	S827	5370	289

No.	Name	X	Y
701	S826	5355	164
702	S825	5340	289
703	S824	5325	164
704	S823	5310	289
705	S822	5295	164
706	S821	5280	289
707	S820	5265	164
708	S819	5250	289
709	S818	5235	164
710	S817	5220	289
711	S816	5205	164
712	S815	5190	289
713	S814	5175	164
714	S813	5160	289
715	S812	5145	164
716	S811	5130	289
717	S810	5115	164
718	S809	5100	289
719	S808	5085	164
720	S807	5070	289
721	S806	5055	164
722	S805	5040	289
723	S804	5025	164
724	S803	5010	289
725	S802	4995	164
726	S801	4980	289
727	S800	4965	164
728	S799	4950	289
729	S798	4935	164
730	S797	4920	289
731	S796	4905	164
732	S795	4890	289
733	S794	4875	164
734	S793	4860	289
735	S792	4845	164
736	S791	4830	289
737	S790	4815	164
738	S789	4800	289
739	S788	4785	164
740	S787	4770	289
741	S786	4755	164
742	S785	4740	289
743	S784	4725	164
744	S783	4710	289
745	S782	4695	164
746	S781	4680	289
747	S780	4665	164
748	S779	4650	289
749	S778	4635	164
750	S777	4620	289

No.	Name	X	Y
751	S776	4605	164
752	S775	4590	289
753	S774	4575	164
754	S773	4560	289
755	S772	4545	164
756	S771	4530	289
757	S770	4515	164
758	S769	4500	289
759	S768	4485	164
760	S767	4470	289
761	S766	4455	164
762	S765	4440	289
763	S764	4425	164
764	S763	4410	289
765	S762	4395	164
766	S761	4380	289
767	S760	4365	164
768	S759	4350	289
769	S758	4335	164
770	S757	4320	289
771	S756	4305	164
772	S755	4290	289
773	S754	4275	164
774	S753	4260	289
775	S752	4245	164
776	S751	4230	289
777	S750	4215	164
778	S749	4200	289
779	S748	4185	164
780	S747	4170	289
781	S746	4155	164
782	S745	4140	289
783	S744	4125	164
784	S743	4110	289
785	S742	4095	164
786	S741	4080	289
787	S740	4065	164
788	S739	4050	289
789	S738	4035	164
790	S737	4020	289
791	S736	4005	164
792	S735	3990	289
793	S734	3975	164
794	S733	3960	289
795	S732	3945	164
796	S731	3930	289
797	S730	3915	164
798	S729	3900	289
799	S728	3885	164
800	S727	3870	289

No.	Name	X	Y
801	S726	3855	164
802	S725	3840	289
803	S724	3825	164
804	S723	3810	289
805	S722	3795	164
806	S721	3780	289
807	S720	3765	164
808	S719	3750	289
809	S718	3735	164
810	S717	3720	289
811	S716	3705	164
812	S715	3690	289
813	S714	3675	164
814	S713	3660	289
815	S712	3645	164
816	S711	3630	289
817	S710	3615	164
818	S709	3600	289
819	S708	3585	164
820	S707	3570	289
821	S706	3555	164
822	S705	3540	289
823	S704	3525	164
824	S703	3510	289
825	S702	3495	164
826	S701	3480	289
827	S700	3465	164
828	S699	3450	289
829	S698	3435	164
830	S697	3420	289
831	S696	3405	164
832	S695	3390	289
833	S694	3375	164
834	S693	3360	289
835	S692	3345	164
836	S691	3330	289
837	S690	3315	164
838	S689	3300	289
839	S688	3285	164
840	S687	3270	289
841	S686	3255	164
842	S685	3240	289
843	S684	3225	164
844	S683	3210	289
845	S682	3195	164
846	S681	3180	289
847	S680	3165	164
848	S679	3150	289
849	S678	3135	164
850	S677	3120	289

No.	Name	X	Y
851	S676	3105	164
852	S675	3090	289
853	S674	3075	164
854	S673	3060	289
855	S672	3045	164
856	S671	3030	289
857	S670	3015	164
858	S669	3000	289
859	S668	2985	164
860	S667	2970	289
861	S666	2955	164
862	S665	2940	289
863	S664	2925	164
864	S663	2910	289
865	S662	2895	164
866	S661	2880	289
867	S660	2865	164
868	S659	2850	289
869	S658	2835	164
870	S657	2820	289
871	S656	2805	164
872	S655	2790	289
873	S654	2775	164
874	S653	2760	289
875	S652	2745	164
876	S651	2730	289
877	S650	2715	164
878	S649	2700	289
879	S648	2685	164
880	S647	2670	289
881	S646	2655	164
882	S645	2640	289
883	S644	2625	164
884	S643	2610	289
885	S642	2595	164
886	S641	2580	289
887	S640	2565	164
888	S639	2550	289
889	S638	2535	164
890	S637	2520	289
891	S636	2505	164
892	S635	2490	289
893	S634	2475	164
894	S633	2460	289
895	S632	2445	164
896	S631	2430	289
897	S630	2415	164
898	S629	2400	289
899	S628	2385	164
900	S627	2370	289

No.	Name	X	Y
901	S626	2355	164
902	S625	2340	289
903	S624	2325	164
904	S623	2310	289
905	S622	2295	164
906	S621	2280	289
907	S620	2265	164
908	S619	2250	289
909	S618	2235	164
910	S617	2220	289
911	S616	2205	164
912	S615	2190	289
913	S614	2175	164
914	S613	2160	289
915	S612	2145	164
916	S611	2130	289
917	S610	2115	164
918	S609	2100	289
919	S608	2085	164
920	S607	2070	289
921	S606	2055	164
922	S605	2040	289
923	S604	2025	164
924	S603	2010	289
925	S602	1995	164
926	S601	1980	289
927	S600	1965	164
928	S599	1950	289
929	S598	1935	164
930	S597	1920	289
931	S596	1905	164
932	S595	1890	289
933	S594	1875	164
934	S593	1860	289
935	S592	1845	164
936	S591	1830	289
937	S590	1815	164
938	S589	1800	289
939	S588	1785	164
940	S587	1770	289
941	S586	1755	164
942	S585	1740	289
943	S584	1725	164
944	S583	1710	289
945	S582	1695	164
946	S581	1680	289
947	S580	1665	164
948	S579	1650	289
949	S578	1635	164
950	S577	1620	289

No.	Name	X	Y
951	S576	1605	164
952	S575	1590	289
953	S574	1575	164
954	S573	1560	289
955	S572	1545	164
956	S571	1530	289
957	S570	1515	164
958	S569	1500	289
959	S568	1485	164
960	S567	1470	289
961	S566	1455	164
962	S565	1440	289
963	S564	1425	164
964	S563	1410	289
965	S562	1395	164
966	S561	1380	289
967	S560	1365	164
968	S559	1350	289
969	S558	1335	164
970	S557	1320	289
971	S556	1305	164
972	S555	1290	289
973	S554	1275	164
974	S553	1260	289
975	S552	1245	164
976	S551	1230	289
977	S550	1215	164
978	S549	1200	289
979	S548	1185	164
980	S547	1170	289
981	S546	1155	164
982	S545	1140	289
983	S544	1125	164
984	S543	1110	289
985	S542	1095	164
986	S541	1080	289
987	S540	1065	164
988	S539	1050	289
989	S538	1035	164
990	S537	1020	289
991	S536	1005	164
992	S535	990	289
993	S534	975	164
994	S533	960	289
995	S532	945	164
996	S531	930	289
997	S530	915	164
998	S529	900	289
999	S528	885	164
1000	S527	870	289

No.	Name	X	Y
1001	S526	855	164
1002	S525	840	289
1003	S524	825	164
1004	S523	810	289
1005	S522	795	164
1006	S521	780	289
1007	S520	765	164
1008	S519	750	289
1009	S518	735	164
1010	S517	720	289
1011	S516	705	164
1012	S515	690	289
1013	S514	675	164
1014	S513	660	289
1015	S512	645	164
1016	S511	630	289
1017	S510	615	164
1018	S509	600	289
1019	S508	585	164
1020	S507	570	289
1021	S506	555	164
1022	S505	540	289
1023	S504	525	164
1024	S503	510	289
1025	S502	495	164
1026	S501	480	289
1027	S500	465	164
1028	S499	450	289
1029	S498	435	164
1030	S497	420	289
1031	S496	405	164
1032	S495	390	289
1033	S494	375	164
1034	S493	360	289
1035	S492	345	164
1036	S491	330	289
1037	S490	315	164
1038	S489	300	289
1039	S488	285	164
1040	S487	270	289
1041	S486	255	164
1042	S485	240	289
1043	S484	225	164
1044	S483	210	289
1045	S482	195	164
1046	S481	180	289
1047	V1T	165	164
1048	DUMMY	150	289
1049	DUMMY	-150	289
1050	V62T	-165	164

No.	Name	X	Y
1051	S480	-180	289
1052	S479	-195	164
1053	S478	-210	289
1054	S477	-225	164
1055	S476	-240	289
1056	S475	-255	164
1057	S474	-270	289
1058	S473	-285	164
1059	S472	-300	289
1060	S471	-315	164
1061	S470	-330	289
1062	S469	-345	164
1063	S468	-360	289
1064	S467	-375	164
1065	S466	-390	289
1066	S465	-405	164
1067	S464	-420	289
1068	S463	-435	164
1069	S462	-450	289
1070	S461	-465	164
1071	S460	-480	289
1072	S459	-495	164
1073	S458	-510	289
1074	S457	-525	164
1075	S456	-540	289
1076	S455	-555	164
1077	S454	-570	289
1078	S453	-585	164
1079	S452	-600	289
1080	S451	-615	164
1081	S450	-630	289
1082	S449	-645	164
1083	S448	-660	289
1084	S447	-675	164
1085	S446	-690	289
1086	S445	-705	164
1087	S444	-720	289
1088	S443	-735	164
1089	S442	-750	289
1090	S441	-765	164
1091	S440	-780	289
1092	S439	-795	164
1093	S438	-810	289
1094	S437	-825	164
1095	S436	-840	289
1096	S435	-855	164
1097	S434	-870	289
1098	S433	-885	164
1099	S432	-900	289
1100	S431	-915	164

No.	Name	X	Y
1101	S430	-930	289
1102	S429	-945	164
1103	S428	-960	289
1104	S427	-975	164
1105	S426	-990	289
1106	S425	-1005	164
1107	S424	-1020	289
1108	S423	-1035	164
1109	S422	-1050	289
1110	S421	-1065	164
1111	S420	-1080	289
1112	S419	-1095	164
1113	S418	-1110	289
1114	S417	-1125	164
1115	S416	-1140	289
1116	S415	-1155	164
1117	S414	-1170	289
1118	S413	-1185	164
1119	S412	-1200	289
1120	S411	-1215	164
1121	S410	-1230	289
1122	S409	-1245	164
1123	S408	-1260	289
1124	S407	-1275	164
1125	S406	-1290	289
1126	S405	-1305	164
1127	S404	-1320	289
1128	S403	-1335	164
1129	S402	-1350	289
1130	S401	-1365	164
1131	S400	-1380	289
1132	S399	-1395	164
1133	S398	-1410	289
1134	S397	-1425	164
1135	S396	-1440	289
1136	S395	-1455	164
1137	S394	-1470	289
1138	S393	-1485	164
1139	S392	-1500	289
1140	S391	-1515	164
1141	S390	-1530	289
1142	S389	-1545	164
1143	S388	-1560	289
1144	S387	-1575	164
1145	S386	-1590	289
1146	S385	-1605	164
1147	S384	-1620	289
1148	S383	-1635	164
1149	S382	-1650	289
1150	S381	-1665	164

No.	Name	X	Y
1151	S380	-1680	289
1152	S379	-1695	164
1153	S378	-1710	289
1154	S377	-1725	164
1155	S376	-1740	289
1156	S375	-1755	164
1157	S374	-1770	289
1158	S373	-1785	164
1159	S372	-1800	289
1160	S371	-1815	164
1161	S370	-1830	289
1162	S369	-1845	164
1163	S368	-1860	289
1164	S367	-1875	164
1165	S366	-1890	289
1166	S365	-1905	164
1167	S364	-1920	289
1168	S363	-1935	164
1169	S362	-1950	289
1170	S361	-1965	164
1171	S360	-1980	289
1172	S359	-1995	164
1173	S358	-2010	289
1174	S357	-2025	164
1175	S356	-2040	289
1176	S355	-2055	164
1177	S354	-2070	289
1178	S353	-2085	164
1179	S352	-2100	289
1180	S351	-2115	164
1181	S350	-2130	289
1182	S349	-2145	164
1183	S348	-2160	289
1184	S347	-2175	164
1185	S346	-2190	289
1186	S345	-2205	164
1187	S344	-2220	289
1188	S343	-2235	164
1189	S342	-2250	289
1190	S341	-2265	164
1191	S340	-2280	289
1192	S339	-2295	164
1193	S338	-2310	289
1194	S337	-2325	164
1195	S336	-2340	289
1196	S335	-2355	164
1197	S334	-2370	289
1198	S333	-2385	164
1199	S332	-2400	289
1200	S331	-2415	164

No.	Name	X	Y
1201	S330	-2430	289
1202	S329	-2445	164
1203	S328	-2460	289
1204	S327	-2475	164
1205	S326	-2490	289
1206	S325	-2505	164
1207	S324	-2520	289
1208	S323	-2535	164
1209	S322	-2550	289
1210	S321	-2565	164
1211	S320	-2580	289
1212	S319	-2595	164
1213	S318	-2610	289
1214	S317	-2625	164
1215	S316	-2640	289
1216	S315	-2655	164
1217	S314	-2670	289
1218	S313	-2685	164
1219	S312	-2700	289
1220	S311	-2715	164
1221	S310	-2730	289
1222	S309	-2745	164
1223	S308	-2760	289
1224	S307	-2775	164
1225	S306	-2790	289
1226	S305	-2805	164
1227	S304	-2820	289
1228	S303	-2835	164
1229	S302	-2850	289
1230	S301	-2865	164
1231	S300	-2880	289
1232	S299	-2895	164
1233	S298	-2910	289
1234	S297	-2925	164
1235	S296	-2940	289
1236	S295	-2955	164
1237	S294	-2970	289
1238	S293	-2985	164
1239	S292	-3000	289
1240	S291	-3015	164
1241	S290	-3030	289
1242	S289	-3045	164
1243	S288	-3060	289
1244	S287	-3075	164
1245	S286	-3090	289
1246	S285	-3105	164
1247	S284	-3120	289
1248	S283	-3135	164
1249	S282	-3150	289
1250	S281	-3165	164

No.	Name	X	Y
1251	S280	-3180	289
1252	S279	-3195	164
1253	S278	-3210	289
1254	S277	-3225	164
1255	S276	-3240	289
1256	S275	-3255	164
1257	S274	-3270	289
1258	S273	-3285	164
1259	S272	-3300	289
1260	S271	-3315	164
1261	S270	-3330	289
1262	S269	-3345	164
1263	S268	-3360	289
1264	S267	-3375	164
1265	S266	-3390	289
1266	S265	-3405	164
1267	S264	-3420	289
1268	S263	-3435	164
1269	S262	-3450	289
1270	S261	-3465	164
1271	S260	-3480	289
1272	S259	-3495	164
1273	S258	-3510	289
1274	S257	-3525	164
1275	S256	-3540	289
1276	S255	-3555	164
1277	S254	-3570	289
1278	S253	-3585	164
1279	S252	-3600	289
1280	S251	-3615	164
1281	S250	-3630	289
1282	S249	-3645	164
1283	S248	-3660	289
1284	S247	-3675	164
1285	S246	-3690	289
1286	S245	-3705	164
1287	S244	-3720	289
1288	S243	-3735	164
1289	S242	-3750	289
1290	S241	-3765	164
1291	S240	-3780	289
1292	S239	-3795	164
1293	S238	-3810	289
1294	S237	-3825	164
1295	S236	-3840	289
1296	S235	-3855	164
1297	S234	-3870	289
1298	S233	-3885	164
1299	S232	-3900	289
1300	S231	-3915	164

No.	Name	X	Y
1301	S230	-3930	289
1302	S229	-3945	164
1303	S228	-3960	289
1304	S227	-3975	164
1305	S226	-3990	289
1306	S225	-4005	164
1307	S224	-4020	289
1308	S223	-4035	164
1309	S222	-4050	289
1310	S221	-4065	164
1311	S220	-4080	289
1312	S219	-4095	164
1313	S218	-4110	289
1314	S217	-4125	164
1315	S216	-4140	289
1316	S215	-4155	164
1317	S214	-4170	289
1318	S213	-4185	164
1319	S212	-4200	289
1320	S211	-4215	164
1321	S210	-4230	289
1322	S209	-4245	164
1323	S208	-4260	289
1324	S207	-4275	164
1325	S206	-4290	289
1326	S205	-4305	164
1327	S204	-4320	289
1328	S203	-4335	164
1329	S202	-4350	289
1330	S201	-4365	164
1331	S200	-4380	289
1332	S199	-4395	164
1333	S198	-4410	289
1334	S197	-4425	164
1335	S196	-4440	289
1336	S195	-4455	164
1337	S194	-4470	289
1338	S193	-4485	164
1339	S192	-4500	289
1340	S191	-4515	164
1341	S190	-4530	289
1342	S189	-4545	164
1343	S188	-4560	289
1344	S187	-4575	164
1345	S186	-4590	289
1346	S185	-4605	164
1347	S184	-4620	289
1348	S183	-4635	164
1349	S182	-4650	289
1350	S181	-4665	164

No.	Name	X	Y
1351	S180	-4680	289
1352	S179	-4695	164
1353	S178	-4710	289
1354	S177	-4725	164
1355	S176	-4740	289
1356	S175	-4755	164
1357	S174	-4770	289
1358	S173	-4785	164
1359	S172	-4800	289
1360	S171	-4815	164
1361	S170	-4830	289
1362	S169	-4845	164
1363	S168	-4860	289
1364	S167	-4875	164
1365	S166	-4890	289
1366	S165	-4905	164
1367	S164	-4920	289
1368	S163	-4935	164
1369	S162	-4950	289
1370	S161	-4965	164
1371	S160	-4980	289
1372	S159	-4995	164
1373	S158	-5010	289
1374	S157	-5025	164
1375	S156	-5040	289
1376	S155	-5055	164
1377	S154	-5070	289
1378	S153	-5085	164
1379	S152	-5100	289
1380	S151	-5115	164
1381	S150	-5130	289
1382	S149	-5145	164
1383	S148	-5160	289
1384	S147	-5175	164
1385	S146	-5190	289
1386	S145	-5205	164
1387	S144	-5220	289
1388	S143	-5235	164
1389	S142	-5250	289
1390	S141	-5265	164
1391	S140	-5280	289
1392	S139	-5295	164
1393	S138	-5310	289
1394	S137	-5325	164
1395	S136	-5340	289
1396	S135	-5355	164
1397	S134	-5370	289
1398	S133	-5385	164
1399	S132	-5400	289
1400	S131	-5415	164

No.	Name	X	Y
1401	S130	-5430	289
1402	S129	-5445	164
1403	S128	-5460	289
1404	S127	-5475	164
1405	S126	-5490	289
1406	S125	-5505	164
1407	S124	-5520	289
1408	S123	-5535	164
1409	S122	-5550	289
1410	S121	-5565	164
1411	S120	-5580	289
1412	S119	-5595	164
1413	S118	-5610	289
1414	S117	-5625	164
1415	S116	-5640	289
1416	S115	-5655	164
1417	S114	-5670	289
1418	S113	-5685	164
1419	S112	-5700	289
1420	S111	-5715	164
1421	S110	-5730	289
1422	S109	-5745	164
1423	S108	-5760	289
1424	S107	-5775	164
1425	S106	-5790	289
1426	S105	-5805	164
1427	S104	-5820	289
1428	S103	-5835	164
1429	S102	-5850	289
1430	S101	-5865	164
1431	S100	-5880	289
1432	S99	-5895	164
1433	S98	-5910	289
1434	S97	-5925	164
1435	S96	-5940	289
1436	S95	-5955	164
1437	S94	-5970	289
1438	S93	-5985	164
1439	S92	-6000	289
1440	S91	-6015	164
1441	S90	-6030	289
1442	S89	-6045	164
1443	S88	-6060	289
1444	S87	-6075	164
1445	S86	-6090	289
1446	S85	-6105	164
1447	S84	-6120	289
1448	S83	-6135	164
1449	S82	-6150	289
1450	S81	-6165	164

No.	Name	X	Y
1451	S80	-6180	289
1452	S79	-6195	164
1453	S78	-6210	289
1454	S77	-6225	164
1455	S76	-6240	289
1456	S75	-6255	164
1457	S74	-6270	289
1458	S73	-6285	164
1459	S72	-6300	289
1460	S71	-6315	164
1461	S70	-6330	289
1462	S69	-6345	164
1463	S68	-6360	289
1464	S67	-6375	164
1465	S66	-6390	289
1466	S65	-6405	164
1467	S64	-6420	289
1468	S63	-6435	164
1469	S62	-6450	289
1470	S61	-6465	164
1471	S60	-6480	289
1472	S59	-6495	164
1473	S58	-6510	289
1474	S57	-6525	164
1475	S56	-6540	289
1476	S55	-6555	164
1477	S54	-6570	289
1478	S53	-6585	164
1479	S52	-6600	289
1480	S51	-6615	164
1481	S50	-6630	289
1482	S49	-6645	164
1483	S48	-6660	289
1484	S47	-6675	164
1485	S46	-6690	289
1486	S45	-6705	164
1487	S44	-6720	289
1488	S43	-6735	164
1489	S42	-6750	289
1490	S41	-6765	164
1491	S40	-6780	289
1492	S39	-6795	164
1493	S38	-6810	289
1494	S37	-6825	164
1495	S36	-6840	289
1496	S35	-6855	164
1497	S34	-6870	289
1498	S33	-6885	164
1499	S32	-6900	289
1500	S31	-6915	164

No.	Name	X	Y
1501	S30	-6930	289
1502	S29	-6945	164
1503	S28	-6960	289
1504	S27	-6975	164
1505	S26	-6990	289
1506	S25	-7005	164
1507	S24	-7020	289
1508	S23	-7035	164
1509	S22	-7050	289
1510	S21	-7065	164
1511	S20	-7080	289
1512	S19	-7095	164
1513	S18	-7110	289
1514	S17	-7125	164
1515	S16	-7140	289
1516	S15	-7155	164
1517	S14	-7170	289
1518	S13	-7185	164
1519	S12	-7200	289
1520	S11	-7215	164
1521	S10	-7230	289
1522	S9	-7245	164
1523	S8	-7260	289
1524	S7	-7275	164
1525	S6	-7290	289
1526	S5	-7305	164
1527	S4	-7320	289
1528	S3	-7335	164
1529	S2	-7350	289
1530	S1	-7365	164
1531	DUMMY	-7380	289
1532	DUMMY	-7395	164
1533	DUMMY	-7560	289
1534	DUMMY	-7575	164
1535	G480	-7590	289
1536	G478	-7605	164
1537	G476	-7620	289
1538	G474	-7635	164
1539	G472	-7650	289
1540	G470	-7665	164
1541	G468	-7680	289
1542	G466	-7695	164
1543	G464	-7710	289
1544	G462	-7725	164
1545	G460	-7740	289
1546	G458	-7755	164
1547	G456	-7770	289
1548	G454	-7785	164
1549	G452	-7800	289
1550	G450	-7815	164

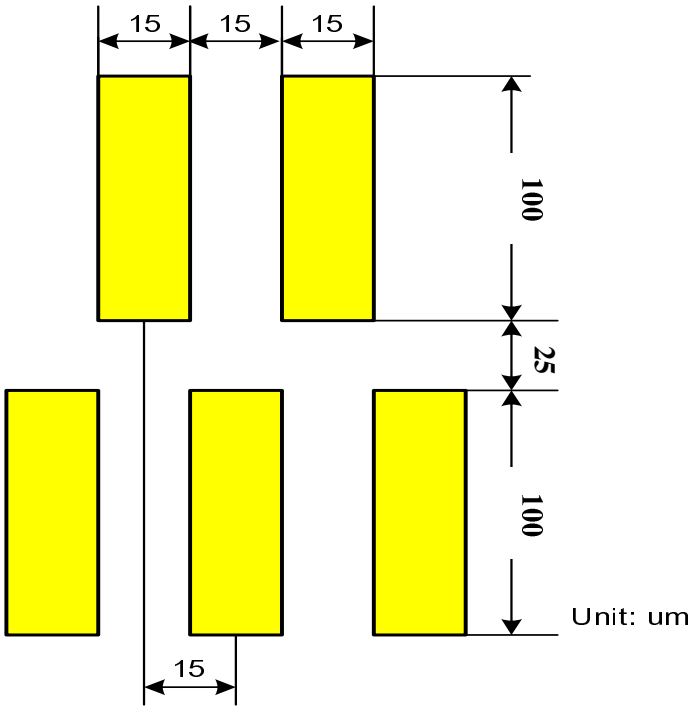
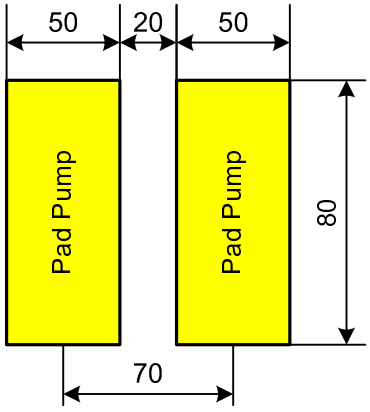
No.	Name	X	Y
1551	G448	-7830	289
1552	G446	-7845	164
1553	G444	-7860	289
1554	G442	-7875	164
1555	G440	-7890	289
1556	G438	-7905	164
1557	G436	-7920	289
1558	G434	-7935	164
1559	G432	-7950	289
1560	G430	-7965	164
1561	G428	-7980	289
1562	G426	-7995	164
1563	G424	-8010	289
1564	G422	-8025	164
1565	G420	-8040	289
1566	G418	-8055	164
1567	G416	-8070	289
1568	G414	-8085	164
1569	G412	-8100	289
1570	G410	-8115	164
1571	G408	-8130	289
1572	G406	-8145	164
1573	G404	-8160	289
1574	G402	-8175	164
1575	G400	-8190	289
1576	G398	-8205	164
1577	G396	-8220	289
1578	G394	-8235	164
1579	G392	-8250	289
1580	G390	-8265	164
1581	G388	-8280	289
1582	G386	-8295	164
1583	G384	-8310	289
1584	G382	-8325	164
1585	G380	-8340	289
1586	G378	-8355	164
1587	G376	-8370	289
1588	G374	-8385	164
1589	G372	-8400	289
1590	G370	-8415	164
1591	G368	-8430	289
1592	G366	-8445	164
1593	G364	-8460	289
1594	G362	-8475	164
1595	G360	-8490	289
1596	G358	-8505	164
1597	G356	-8520	289
1598	G354	-8535	164
1599	G352	-8550	289
1600	G350	-8565	164

No.	Name	X	Y
1601	G348	-8580	289
1602	G346	-8595	164
1603	G344	-8610	289
1604	G342	-8625	164
1605	G340	-8640	289
1606	G338	-8655	164
1607	G336	-8670	289
1608	G334	-8685	164
1609	G332	-8700	289
1610	G330	-8715	164
1611	G328	-8730	289
1612	G326	-8745	164
1613	G324	-8760	289
1614	G322	-8775	164
1615	G320	-8790	289
1616	G318	-8805	164
1617	G316	-8820	289
1618	G314	-8835	164
1619	G312	-8850	289
1620	G310	-8865	164
1621	G308	-8880	289
1622	G306	-8895	164
1623	G304	-8910	289
1624	G302	-8925	164
1625	G300	-8940	289
1626	G298	-8955	164
1627	G296	-8970	289
1628	G294	-8985	164
1629	G292	-9000	289
1630	G290	-9015	164
1631	G288	-9030	289
1632	G286	-9045	164
1633	G284	-9060	289
1634	G282	-9075	164
1635	G280	-9090	289
1636	G278	-9105	164
1637	G276	-9120	289
1638	G274	-9135	164
1639	G272	-9150	289
1640	G270	-9165	164
1641	G268	-9180	289
1642	G266	-9195	164
1643	G264	-9210	289
1644	G262	-9225	164
1645	G260	-9240	289
1646	G258	-9255	164
1647	G256	-9270	289
1648	G254	-9285	164
1649	G252	-9300	289
1650	G250	-9315	164

No.	Name	X	Y
1651	G248	-9330	289
1652	G246	-9345	164
1653	G244	-9360	289
1654	G242	-9375	164
1655	G240	-9390	289
1656	G238	-9405	164
1657	G236	-9420	289
1658	G234	-9435	164
1659	G232	-9450	289
1660	G230	-9465	164
1661	G228	-9480	289
1662	G226	-9495	164
1663	G224	-9510	289
1664	G222	-9525	164
1665	G220	-9540	289
1666	G218	-9555	164
1667	G216	-9570	289
1668	G214	-9585	164
1669	G212	-9600	289
1670	G210	-9615	164
1671	G208	-9630	289
1672	G206	-9645	164
1673	G204	-9660	289
1674	G202	-9675	164
1675	G200	-9690	289
1676	G198	-9705	164
1677	G196	-9720	289
1678	G194	-9735	164
1679	G192	-9750	289
1680	G190	-9765	164
1681	G188	-9780	289
1682	G186	-9795	164
1683	G184	-9810	289
1684	G182	-9825	164
1685	G180	-9840	289
1686	G178	-9855	164
1687	G176	-9870	289
1688	G174	-9885	164
1689	G172	-9900	289
1690	G170	-9915	164
1691	G168	-9930	289
1692	G166	-9945	164
1693	G164	-9960	289
1694	G162	-9975	164
1695	G160	-9990	289
1696	G158	-10005	164
1697	G156	-10020	289
1698	G154	-10035	164
1699	G152	-10050	289
1700	G150	-10065	164

No.	Name	X	Y
1701	G148	-10080	289
1702	G146	-10095	164
1703	G144	-10110	289
1704	G142	-10125	164
1705	G140	-10140	289
1706	G138	-10155	164
1707	G136	-10170	289
1708	G134	-10185	164
1709	G132	-10200	289
1710	G130	-10215	164
1711	G128	-10230	289
1712	G126	-10245	164
1713	G124	-10260	289
1714	G122	-10275	164
1715	G120	-10290	289
1716	G118	-10305	164
1717	G116	-10320	289
1718	G114	-10335	164
1719	G112	-10350	289
1720	G110	-10365	164
1721	G108	-10380	289
1722	G106	-10395	164
1723	G104	-10410	289
1724	G102	-10425	164
1725	G100	-10440	289
1726	G98	-10455	164
1727	G96	-10470	289
1728	G94	-10485	164
1729	G92	-10500	289
1730	G90	-10515	164
1731	G88	-10530	289
1732	G86	-10545	164
1733	G84	-10560	289
1734	G82	-10575	164
1735	G80	-10590	289
1736	G78	-10605	164
1737	G76	-10620	289
1738	G74	-10635	164
1739	G72	-10650	289
1740	G70	-10665	164
1741	G68	-10680	289
1742	G66	-10695	164
1743	G64	-10710	289
1744	G62	-10725	164
1745	G60	-10740	289
1746	G58	-10755	164
1747	G56	-10770	289
1748	G54	-10785	164
1749	G52	-10800	289
1750	G50	-10815	164

No.	Name	X	Y
1751	G48	-10830	289
1752	G46	-10845	164
1753	G44	-10860	289
1754	G42	-10875	164
1755	G40	-10890	289
1756	G38	-10905	164
1757	G36	-10920	289
1758	G34	-10935	164
1759	G32	-10950	289
1760	G30	-10965	164
1761	G28	-10980	289
1762	G26	-10995	164
1763	G24	-11010	289
1764	G22	-11025	164
1765	G20	-11040	289
1766	G18	-11055	164
1767	G16	-11070	289
1768	G14	-11085	164
1769	G12	-11100	289
1770	G10	-11115	164
1771	G8	-11130	289
1772	G6	-11145	164
1773	G4	-11160	289
1774	G2	-11175	164
1775	DUMMY	-11190	289
1776	DUMMY	-11205	164
Alignment mark -Left		-11300	-270
Alignment mark -Right		11300	-270

S1 ~ S960 G1 ~ G480 (No. 321 ~ 1776)	
I/O pads (No.1 ~ 320)	

6. Block Function Description

MCU System Interface

The ILI9486L supplies four kinds of MCU system interface with 8080-series parallel interface, 3-/4-line serial and RGB interface. The selection of the given interfaces are done by external IM [2:0] pins and shown as below:

IM2	IM1	IM0	Interface	Data Pin in Use
0	0	0	8080 18-bit bus interface	DB[17:0]
0	0	1	8080 9-bit bus interface	DB[8:0]
0	1	0	8080 16-bit bus interface	DB[15:0]
0	1	1	8080 8-bit bus interface	DB[7:0]
1	0	0	Prohibited	-
1	0	1	3-line SPI	SDA
1	1	0	Prohibited	
1	1	1	4-line SPI	SDA

ILI9486L has a 16-bit index register (IR), a 18-bit write-data register (WDR), and an 18-bit read-data register (RDR). The IR is the register to store index information from control registers and the internal GRAM. The WDR is the register to temporarily store data to be written to control registers and the internal GRAM. The RDR is the register to temporarily store data read from the GRAM. Data from the MPU to be written to the internal GRAM are first written to the WDR and then automatically written to the internal GRAM in internal operation. Data are read via the RDR from the internal GRAM. Therefore, invalid data are read out to the data bus when the ILI9486L read the first data from the internal GRAM. Valid data are read out after the ILI9486L performs the second read operation.

Register are written consecutively as the register execution time except starting oscillator takes 0 clock cycle.

8080-Series			Operation
D/CX	RDX	WRX	
"L"	"H"	↑	Write command
"H"	↑	"H"	Read parameter
"H"	"H"	↑	Write parameter

Address Counter (AC)

The address counter (AC) gives an address to the internal GRAM. When the index of the register for setting a RAM address in the AC is written to the IR, the address information is sent from the IR to the AC. As writing data to the internal GRAM, the address in the AC is automatically updated plus or minus 1. The window address

function enables writing data only in the rectangular area arbitrarily set by users on the GRAM.

Graphic RAM (GRAM)

The GRAM is graphics RAM storing bit-pattern data of 345,600 bytes with 18 bits per pixel, enabling a maximum 320(RGB) x480 dot graphic display.

Grayscale Voltage Generating Circuit

Grayscale voltage generating circuit generates a liquid crystal drive voltage, which corresponds to grayscale level set in the Gamma correction register. The ILI9486L can display 262k colors at the maximum.

Power Supply Circuit

The LCD drive power supply circuit generates the voltage levels as VREG1OUT, VGH, VGL and VCOM for driving TFT LCD panel.

Timing Generating

The timing generator generates timing signals for internal circuits such as the internal GRAM. The timing for display operation such as RAM read operation and the timing for internal operation such as RAM access by MPU is outputted separately so that they do not interfere with each other.

Oscillator

The ILI9486L incorporates RC oscillator circuit. The frame frequency is changeable by command settings.

Panel Driver Circuit

The liquid crystal display driver circuit consists of a 960-output source drivers (S1~S960) and a 480-output gate driver (G1~G480).

7. Function Description

7.1. MCU interfaces

ILI9486L provides the 18-/16-/9-/8-bit parallel system interface for 8080 series, and 3-/4-line serial system interface for serial data input. The input system interface is selected by external pins as IM [2:0] and the bit formal per pixel color order is selected by DBI [2:0] bits.

7.1.1. MCU interface selection

The selection of a given interfaces are done by setting external pins IM [2:0] as show in the following table.

IM2	IM1	IM0	Interface	Data Pin in Use
0	0	0	8080 18-bit bus interface	DB[17:0]
0	0	1	8080 9-bit bus interface	DB[8:0]
0	1	0	8080 16-bit bus interface	DB[15:0]
0	1	1	8080 8-bit bus interface	DB[7:0]
1	0	0	Prohibited	-
1	0	1	3-line SPI	SDA
1	1	0	Prohibited	-
1	1	1	4-line SPI	SDA

7.1.2. 8080-Series Parallel Interface

ILI9486L can be accessed via 8-/9-/16-/18-bit MCU 8080-series parallel interface. The chip-select CSX (active low) is used to enable or disable ILI9486L chip. The RESX (active low) is an external reset signal. WRX is the parallel data write strobe, RDX is the parallel data read strobe and DB[17:0] is parallel data bus.

The MCU latches the input data at the rising edge of WRX signal. The D/CX is the signal of data/command selection. When D/CX='1', DB[17:0] bits are display RAM data or command parameters. When D/CX='0', D B[17:0] bits are commands.

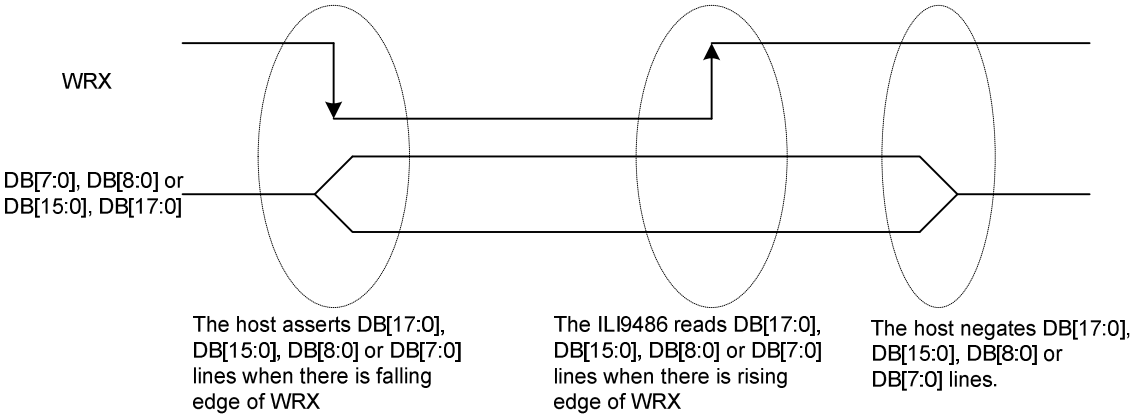
The 8080-series bi-directional interface can be used for communication between the MCU controller and LCD driver chip. The selection of 8080-series parallel interface is shown as the table in the following.

IM2	IM1	IM0	MPU-Interface Mode	WRX	RDX	D/CX	Function
0	0	0	8080 MCU 18-bit bus interface	↑	"H"	"L"	Write command code.
				"H"	↑	"H"	Read internal status.
				↑	"H"	"H"	Write parameter or display data.
				"H"	↑	"H"	Reads parameter or display data.
0	0	1	8080 MCU 9-bit bus interface	↑	"H"	"L"	Write command code.
				"H"	↑	"H"	Read internal status.
				↑	"H"	"H"	Write parameter or display data.
				"H"	↑	"H"	Reads parameter or display data.
0	1	0	8080 MCU 16-bit bus interface	↑	"H"	"L"	Write command code.
				"H"	↑	"H"	Read internal status.
				↑	"H"	"H"	Write parameter or display data.
				"H"	↑	"H"	Reads parameter or display data.
0	1	1	8080 MCU 8-bit bus interface	↑	"H"	"L"	Write command code.
				"H"	↑	"H"	Read internal status.
				↑	"H"	"H"	Write parameter or display data.
				"H"	↑	"H"	Reads parameter or display data.

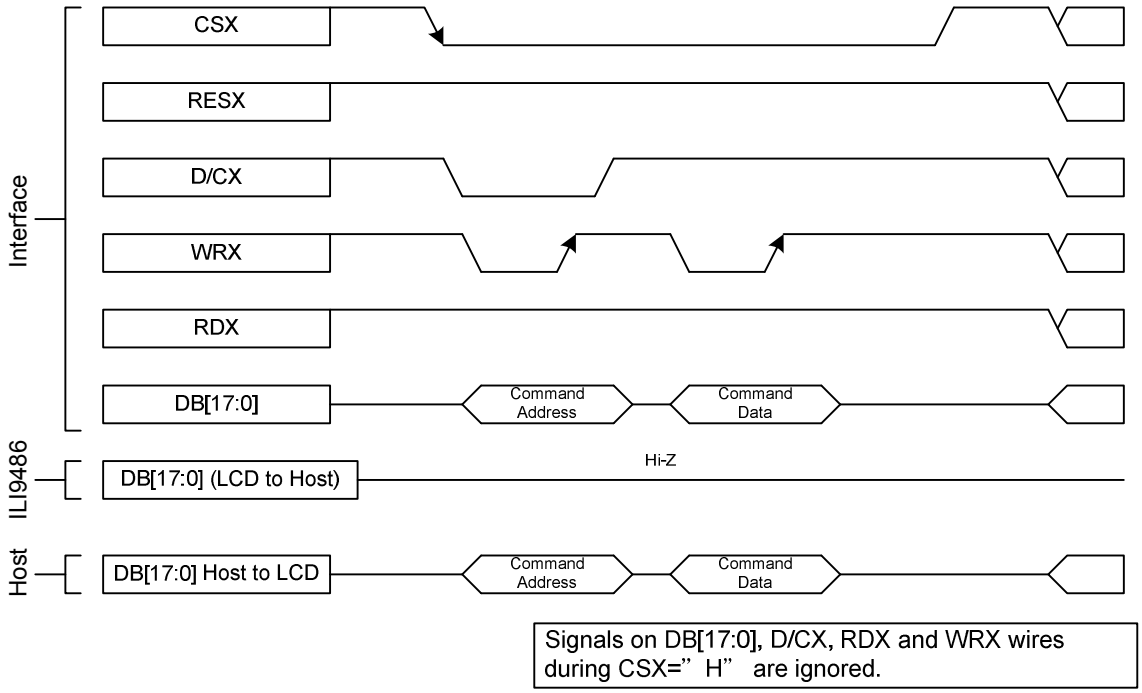
7.1.2.1. Write Cycle Sequence

The WRX signal is driven from high to low then pulled back to high during the write cycle. The host processor provides information during the write cycle when the display module captures the information from host processor on the rising edge of WRX. When the D/CX signal is driven to low level, then input data on the interface is interpreted as command information. The D/CX signal also can be pulled high level when the data on the interface is RAM data or command parameter.

The following figure shows a write cycle for the 8080 MCU interface.



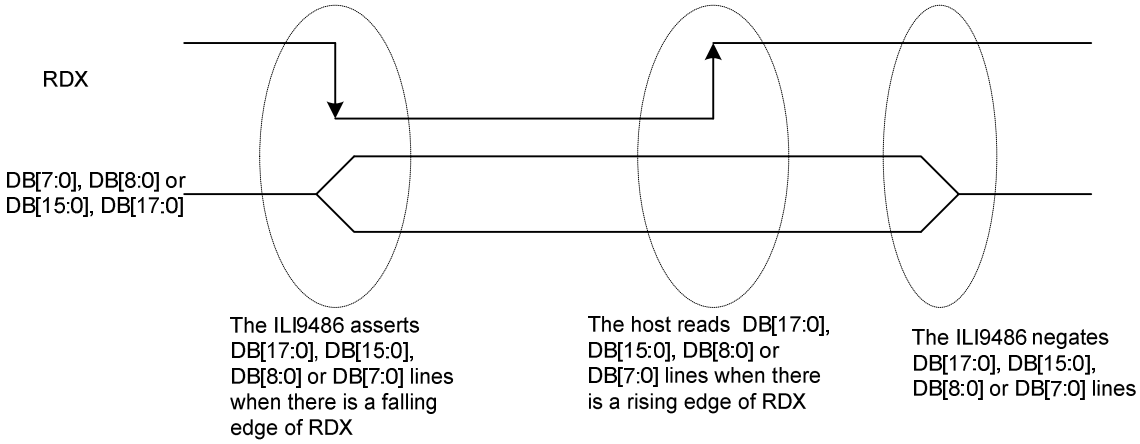
Note: WRX is an unsynchronized signal (It can be stopped)



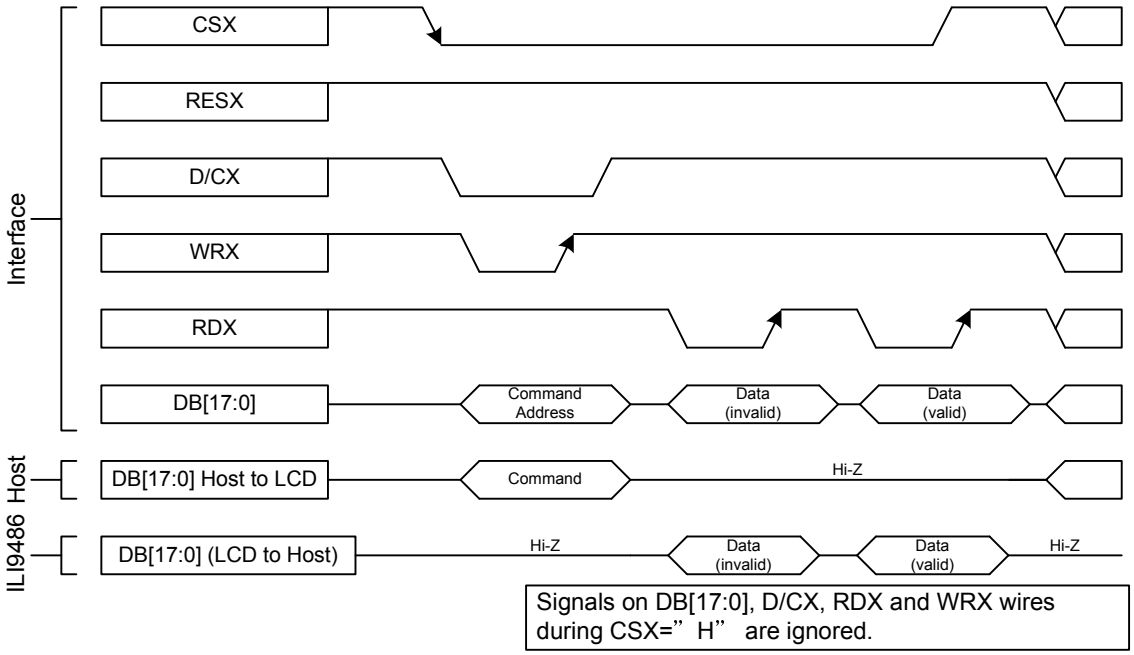
7.1.2.2. Read Cycle Sequence

The RDX signal is driven from high to low then allowed to be pulled back to high during the read cycle. The display module provides information to the host processor during the read cycle while the host processor reads the display module information on the rising edge of RDX signal. When the D/CX signal is driven to low level, then input data on the interface is interpreted as internal status or parameter. The D/CX signal also can be pulled high level when the data on the interface is RAM data or command parameter.

The following figure shows the read cycle for the 8080 MCU interface.



Note: RDX is an unsynchronized signal (It can be stopped).



Note: Read Data is only valid when the D/CX input is pulled high. If D/CX is driven low during read then the display information outputs will be High-Z.

7.1.3. Serial Interface

The selection of this interface is done by IM [2:0] bits. Please refer to the Table in the following.

IM2	IM1	IM0	MPU-Interface Mode	CSX	D/CX	SCL	Function
1	0	1	3-line serial interface	"L"	-	↑	Read/Write command, parameter or display data.
1	1	1	4-line serial interface	"L"	"L"/"H"	↑	Read/Write command, parameter or display data.

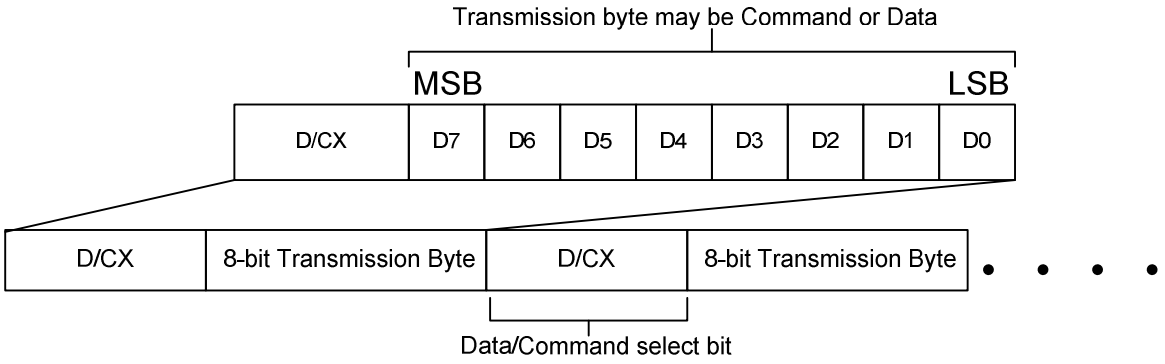
ILI9486L supplies 3-lines/ 9-bit and 4-line/8-bit bi-directional serial interfaces for communication between the host and ILI9486L. The 3-line serial mode consists of the chip enable input (CSX), the serial clock input (SCL) and serial data Input/Output (SDA). The 4-line serial mode consists of the Data/Command selection input (D/CX), chip enable input (CSX), the serial clock input (SCL) and serial data Input/Output (SDA) for data transmission. The data bus (D [17:0]) which are not used, must be leave these unused pins to open. Serial clock (SCL) is used for interface with MCU only, so it can be stopped when no communication is necessary.

7.1.3.1. Write Cycle Sequence

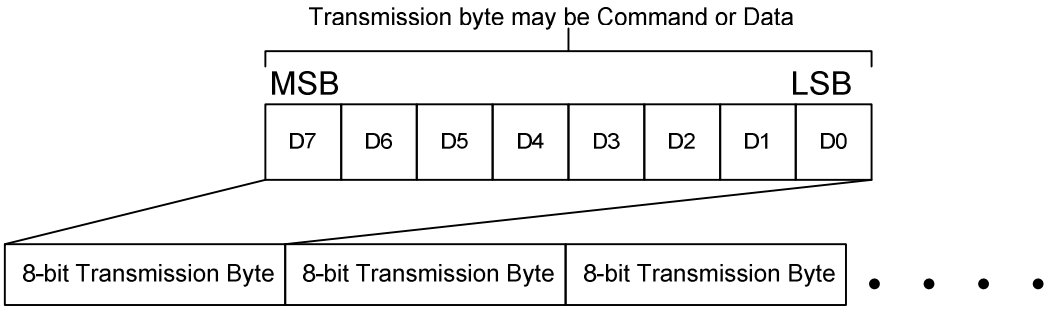
The write mode of the interface means the host writes commands and data to ILI9486L. The 3-lines serial data packet contains a data/command select bit (D/CX) and a transmission byte. If D/CX is "low", the transmission byte is interpreted as a command byte. If D/CX is "high", the transmission byte is stored in the display data RAM (Memory write command), or command register as parameter.

Any instruction can be sent in any order to the ILI9486L and the MSB is transmitted first. The serial interface is initialized when CSX is high status. In this state, SCL clock pulse and SDA data are no effect. A falling edge on CSX enables the serial interface and indicates the start of data transmission. See the detail of data format for 3-/4-line serial interface.

Data Format for 3-line Serial Interface

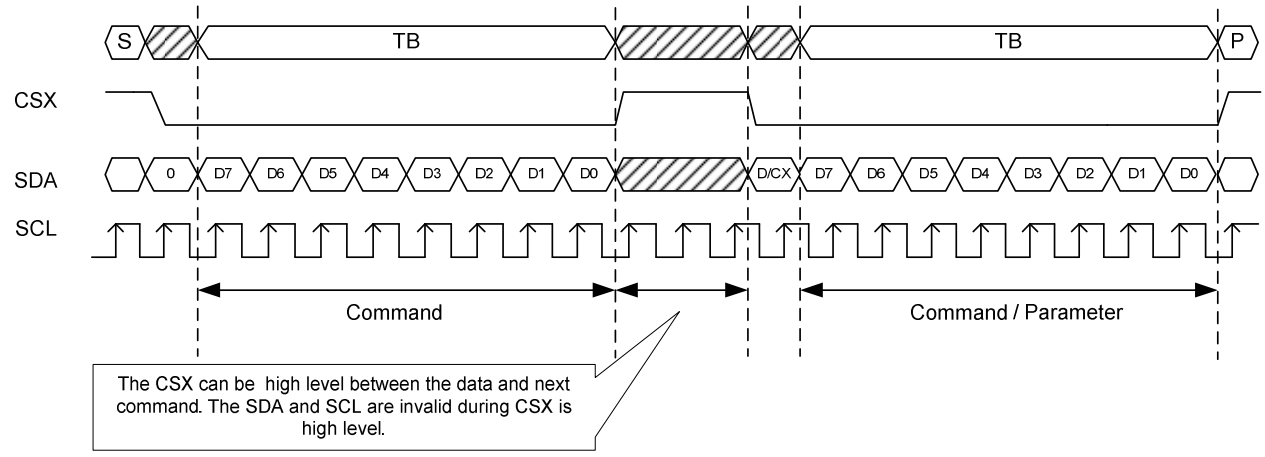


Data Format for 4-line Serial Interface

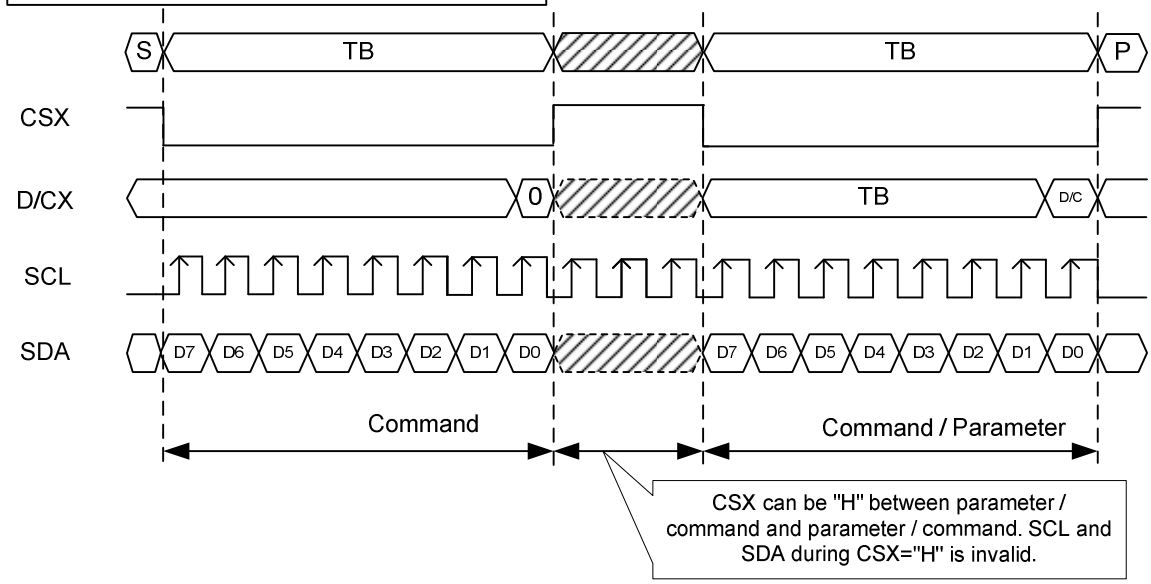


The host drives the CSX pin to low and starts by setting the D/CX bit on SDA. The bit is read by ILI9486L on the first rising edge of SCL signal. On the next falling edge of SCL, the MSB data bit (D7) is set on SDA by the host. On the next falling edge of SCL the next bit (D6) is set on SDA. If the optional D/CX signal is used, a byte is eight read cycle long. The 3/4-line serial interface writes sequence described in the Figure as below.

3-line Serial Interface Protocol



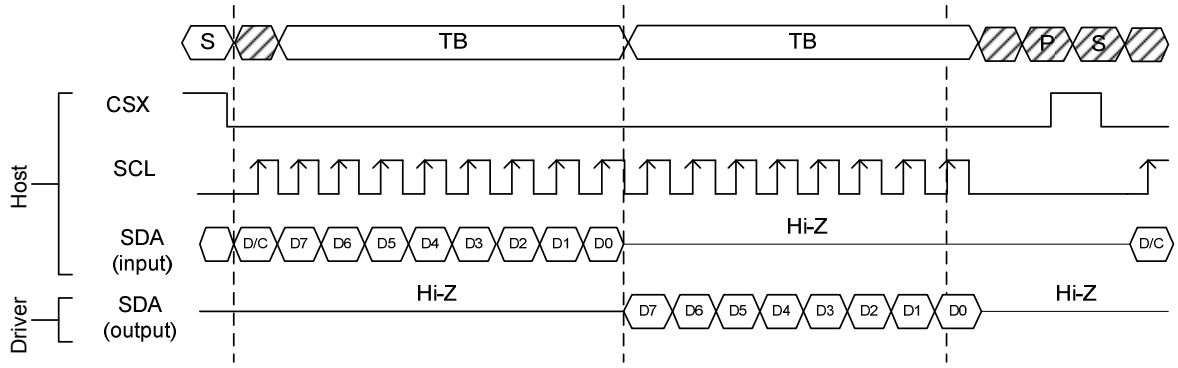
4-line Serial Interface Protocol



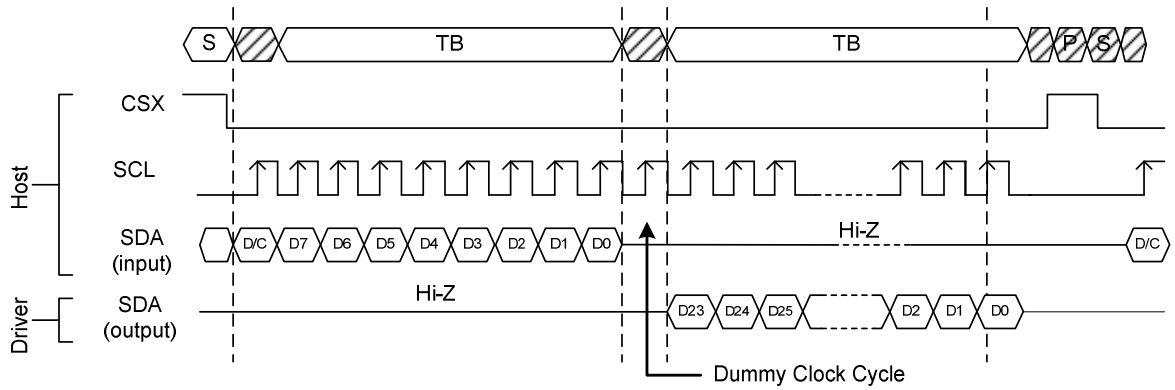
7.1.3.2. Read Cycle Sequence

The read mode of the interface means that the host reads register value from ILI9486L. The host has to send a command (Read ID or register command) and then the following byte is transmitted in the opposite direction. The ILI9486L samples the SDA (input data) at the rising edges of SCL (serial clock), but shifts SDA (output data) at falling edges of SCL (serial clock). 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. The read mode has three types of transmitted command data (8-/24-/32-bit) according command code.

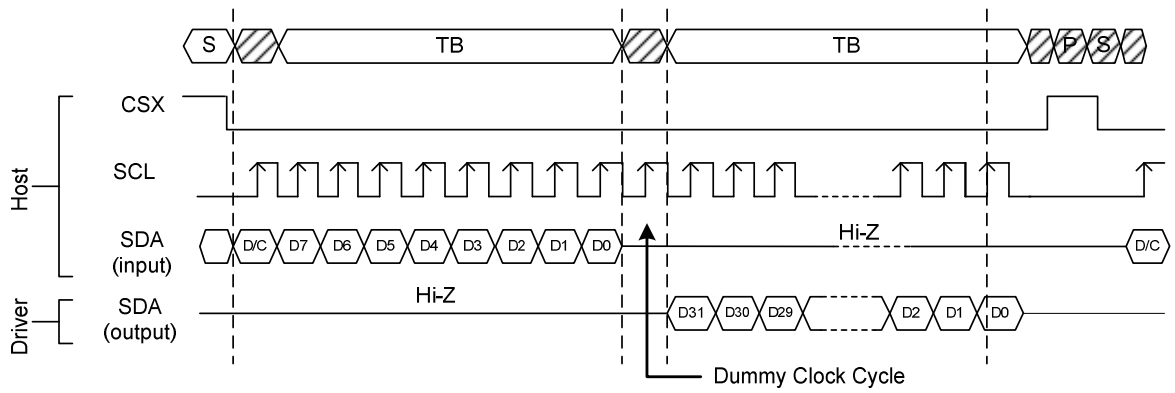
3-line Serial Protocol (for RDID1/RDID2/RDID3/0Ah/0Bh/0Ch/0Dh/0Eh/0Fh command: 8-bit read)



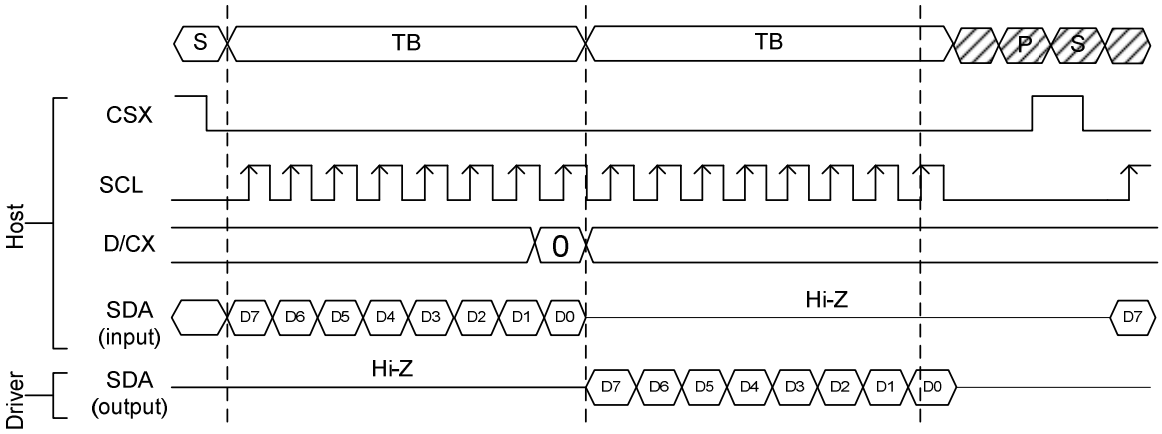
3-line Serial Protocol (for RDDID command: 24-bit read)



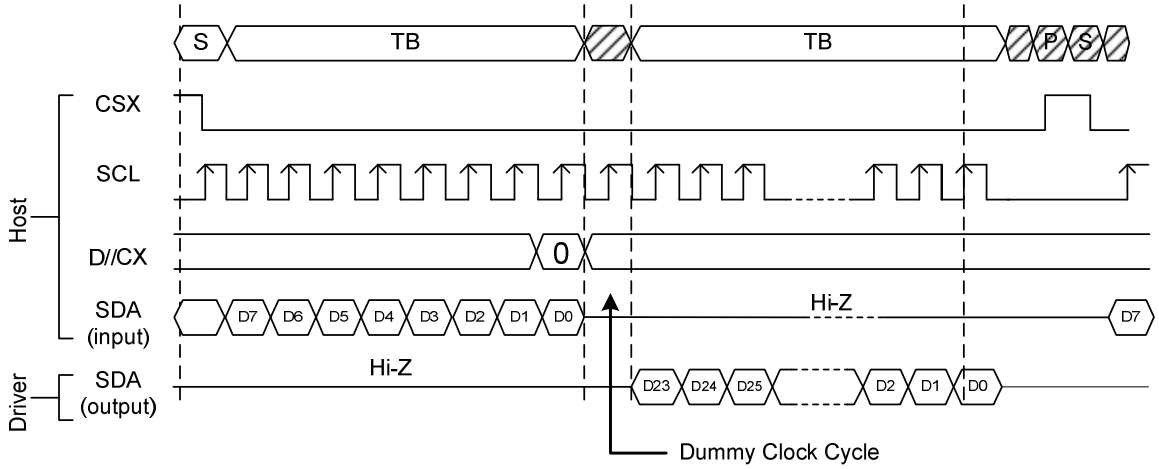
3-line Serial Protocol (for RDDST command: 32-bit read)



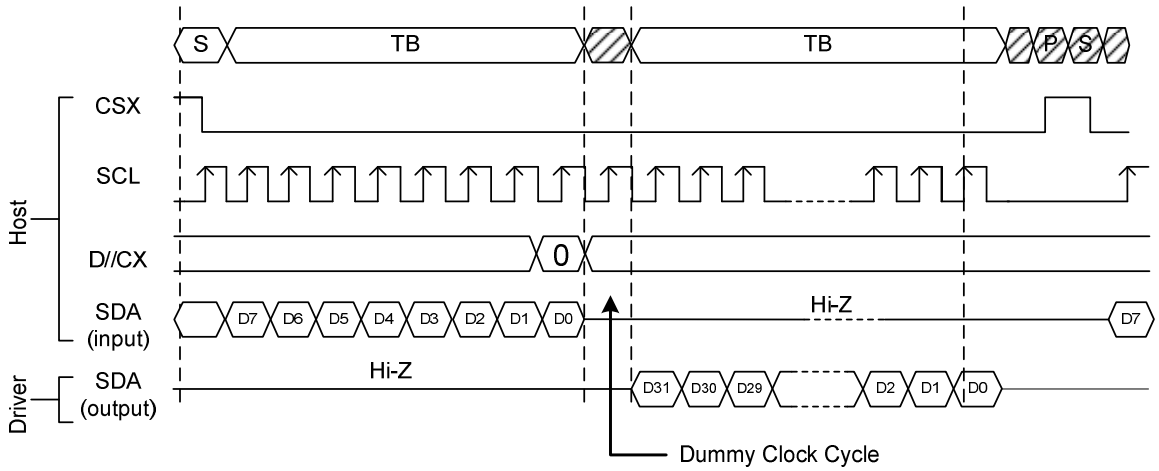
4-line Serial Protocol (for RDID1/RDID2/RDID3/0Ah/0Bh/0Ch/0Dh/0Eh/0Fh command: 8-bit read)



4-line Serial Protocol (for RDDID command: 24-bit read)

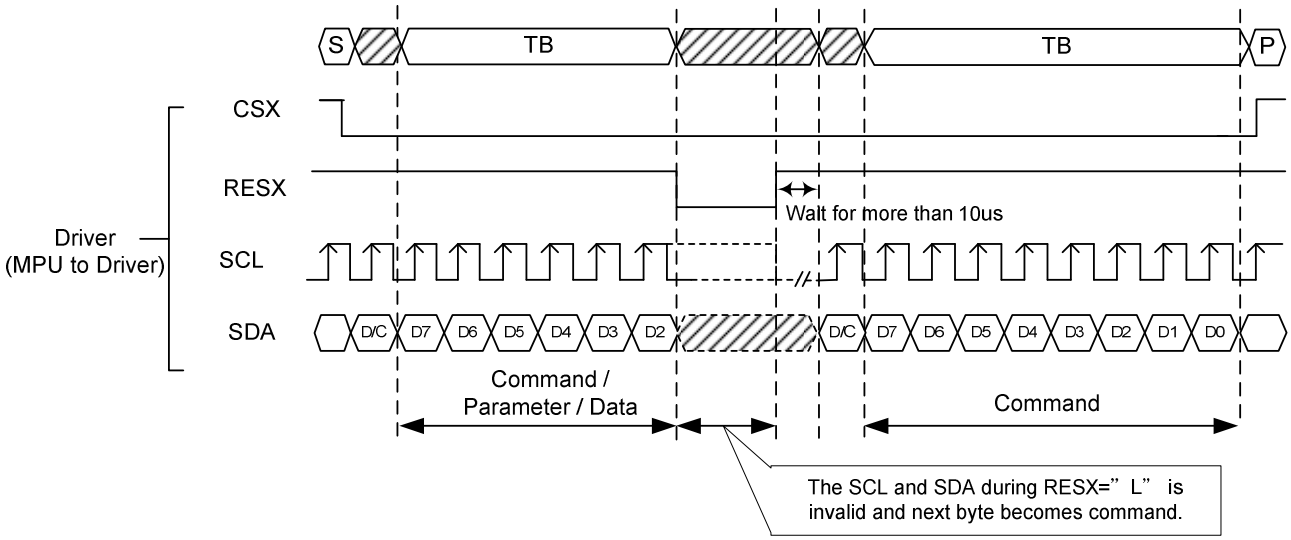


4-line Serial Protocol (for RDDST command: 32-bit read)

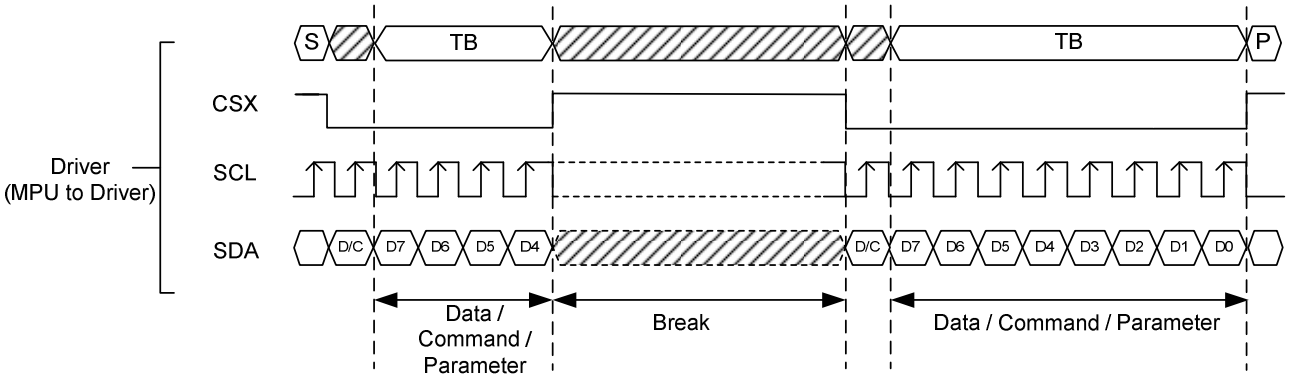


7.1.4. Data Transfer Break and Recovery

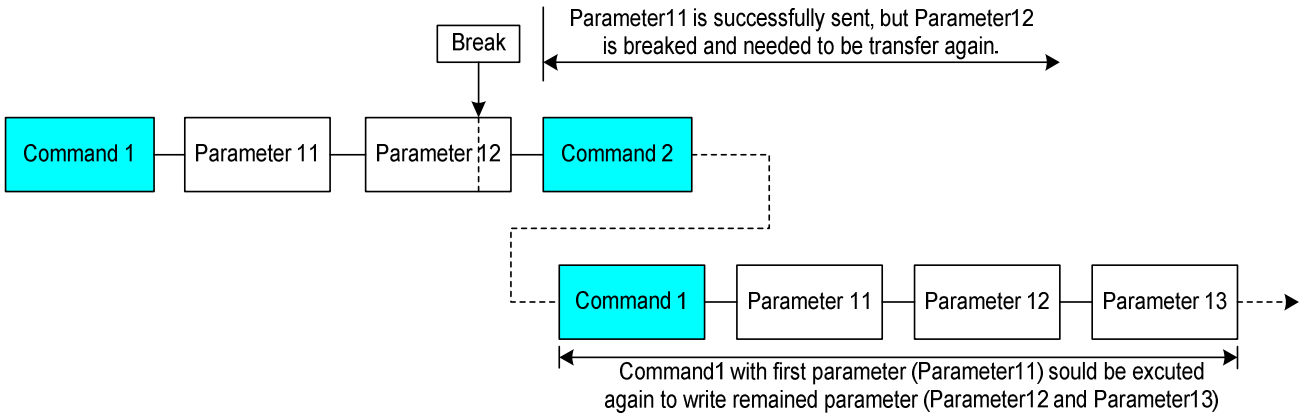
If there is a break in data transmission by RESX pulse, while transferring a Command or Frame Memory Data or Multiple Parameter command Data, before Bit D0 of the byte has been completed, then the driver will reject the previous bits and have reset the interface such that it will be ready to receive command data again when the chip select pin (CSX) is next activated after RESX have been High state.



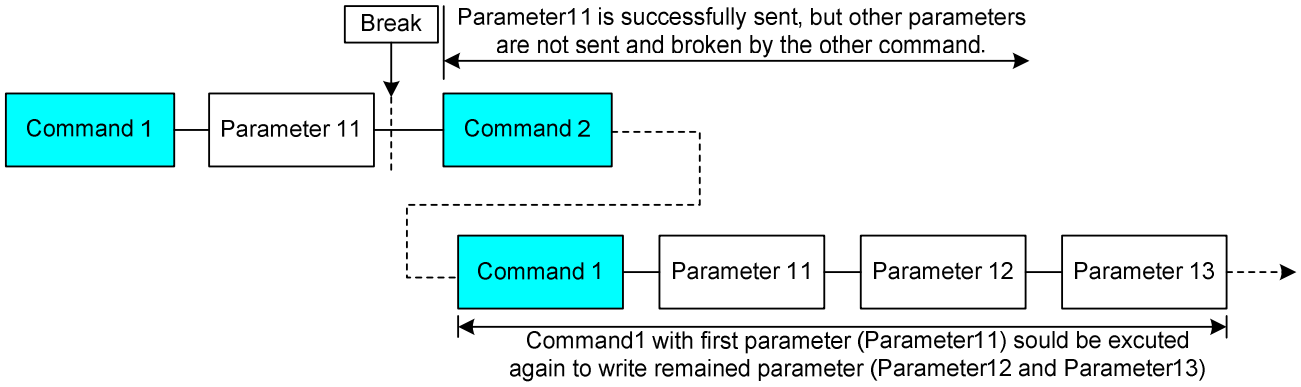
If there is a break in data transmission by CSX pulse, while transferring a Command or Frame Memory Data or Multiple Parameter command Data, before Bit D0 of the byte has been completed, then the driver will reject the previous bits and have reset the interface such that it will be ready to receive the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



If a two or more parameter command is 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 continue to send the remained parameters 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.



If a two or more parameter command is 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.



7.1.5. Data Transfer Pause

It will be possible when transferring a Command, Frame Memory Data or Multiple Parameter Data to 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 ILI9486L 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 completed, then the display module will receive either the command's parameters (if appropriate) or a new command when the Chip Select Line is next enabled as shown below.

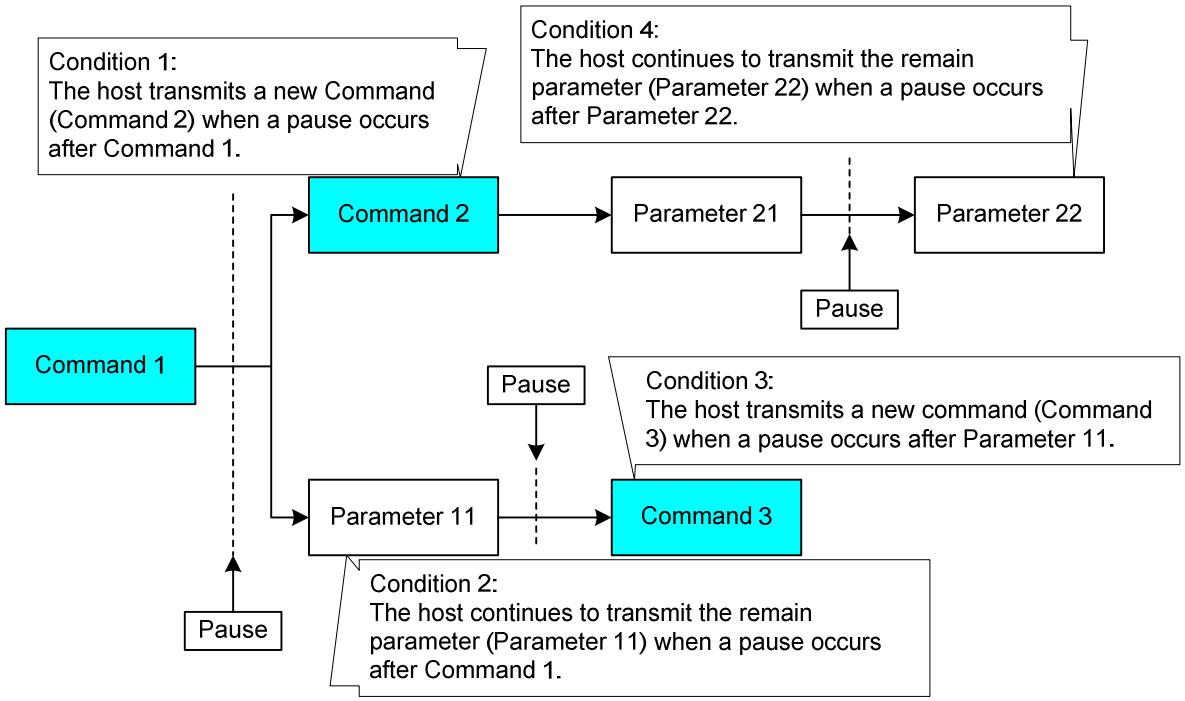
This applies to the following 4 conditions:

1) Command-Pause-Command

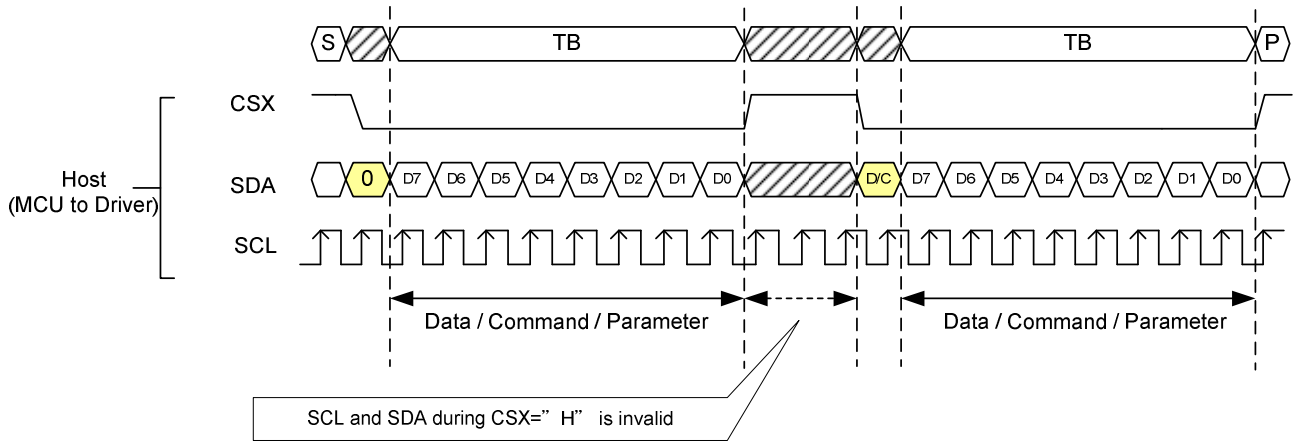
2) Command-Pause-Parameter

3) Parameter-Pause-Command

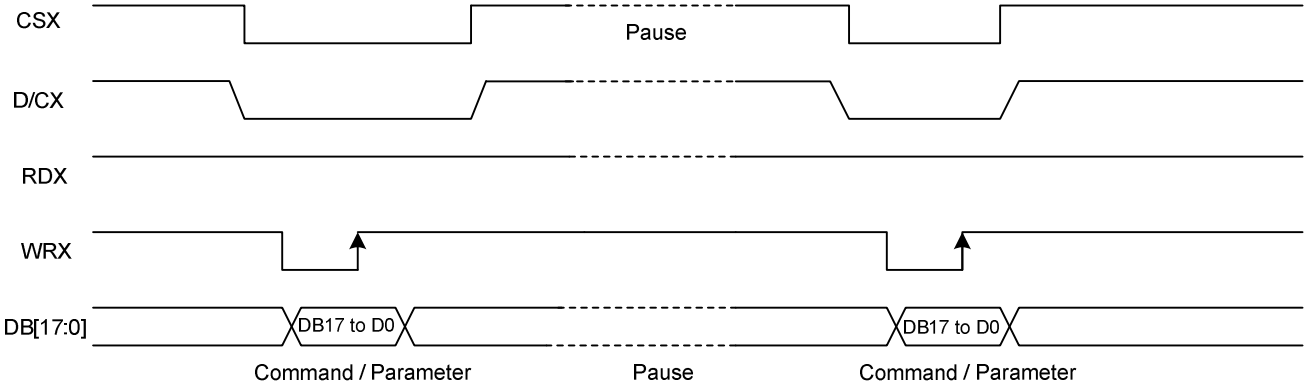
4) Parameter-Pause-Parameter



7.1.5.1. Serial Interface Pause



7.1.5.2. Parallel Interface Pause

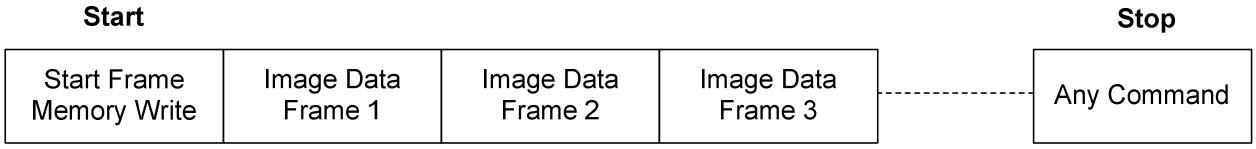


7.1.6. Data Transfer Mode

ILI9486L can provide four different kinds of color depth (8-bit/pixel, 9-bit/pixel, 16-bit/pixel and 18-bit/pixel) display data to the graphic RAM. The data format is described for each interface. Data can be downloaded to the Frame Memory by 2 methods.

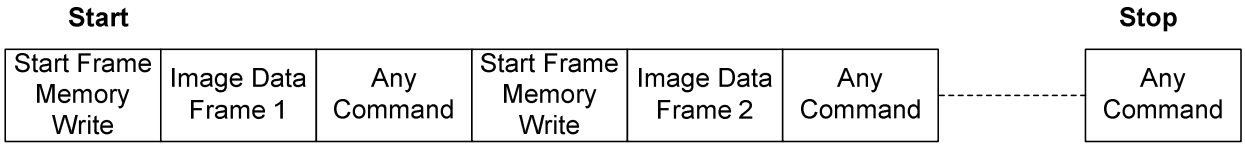
7.1.6.1. Method 1

The Image data is sent to the Frame Memory in the successive Frame writing, each time the Frame Memory is filled by image data, the Frame Memory pointer is reset to the start point and the next Frame is written.



7.1.6.2. Method 2

Image Data is sent and at the end of each Frame Memory download, a command is sent to stop Frame Memory Writing. Then Start Memory Write command is sent, and a new Frame is downloaded.



Note 1: These apply to all data transfer Color modes on both serial and parallel interfaces.

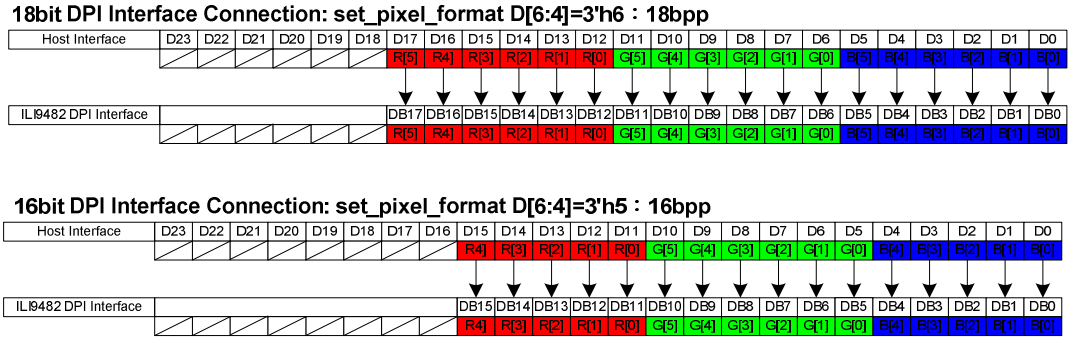
Note 2: The frame memory can contain both odd and even number of pixels for both methods. Only complete pixel data will be stored in the frame memory.

7.2. RGB Interface

7.2.1. RGB Interface Selection

ILI9486L has the RGB interface and these interfaces can be selected by RCM bit. When RCM is set to “0”, the DE mode is selected which utilizes VSYNC, HSYNC, DOTCLK, DE, D [17:0] pins; when RCM is set to “1”, the SYNC mode is selected which utilizes which utilizes VSYNC, HSYNC, DOTCLK, D [17:0] pins. ILI9486 supports several pixel format that can be selected by DPI[3:0] bits in “Pixel Format Set (3Ah)” command. The selection of a given interfaces are done by DPI[3:0] as show in the following table.

RCM	DPI[2:0]				RGB Interface Mode	RGB Mode	Used Pins
0	0	1	1	0	18-bit RGB interface (262K colors)	**DE Mode** Valid data is determined by the DE signal	VSYNC, HSYNC, DE, DOTCLK,D[17:0]
0	0	1	0	1	16-bit RGB interface (65K colors)		VSYNC, HSYNC, DE, DOTCLK,D[15:0]
1	0	1	1	0	18-bit RGB interface (262K colors)	**SYNC Mode** In SYNC mode, DE signal is ignored; blanking porch is determined by B5h command.	VSYNC, HSYNC, DOTCLK, D[17:0]
1	0	1	0	1	16-bit RGB interface (65K colors)		VSYNC, HSYNC, DOTCLK, D[15:0]



Pixel clock (DOTCLK) is running all the time without stopping and it is used to entering VSYNC, HSYNC, ENABLE and DB[17:0] states when there is a rising edge of the DOTCLK. The DOTCLK can not be used as continues internal clock for other functions of the display module.

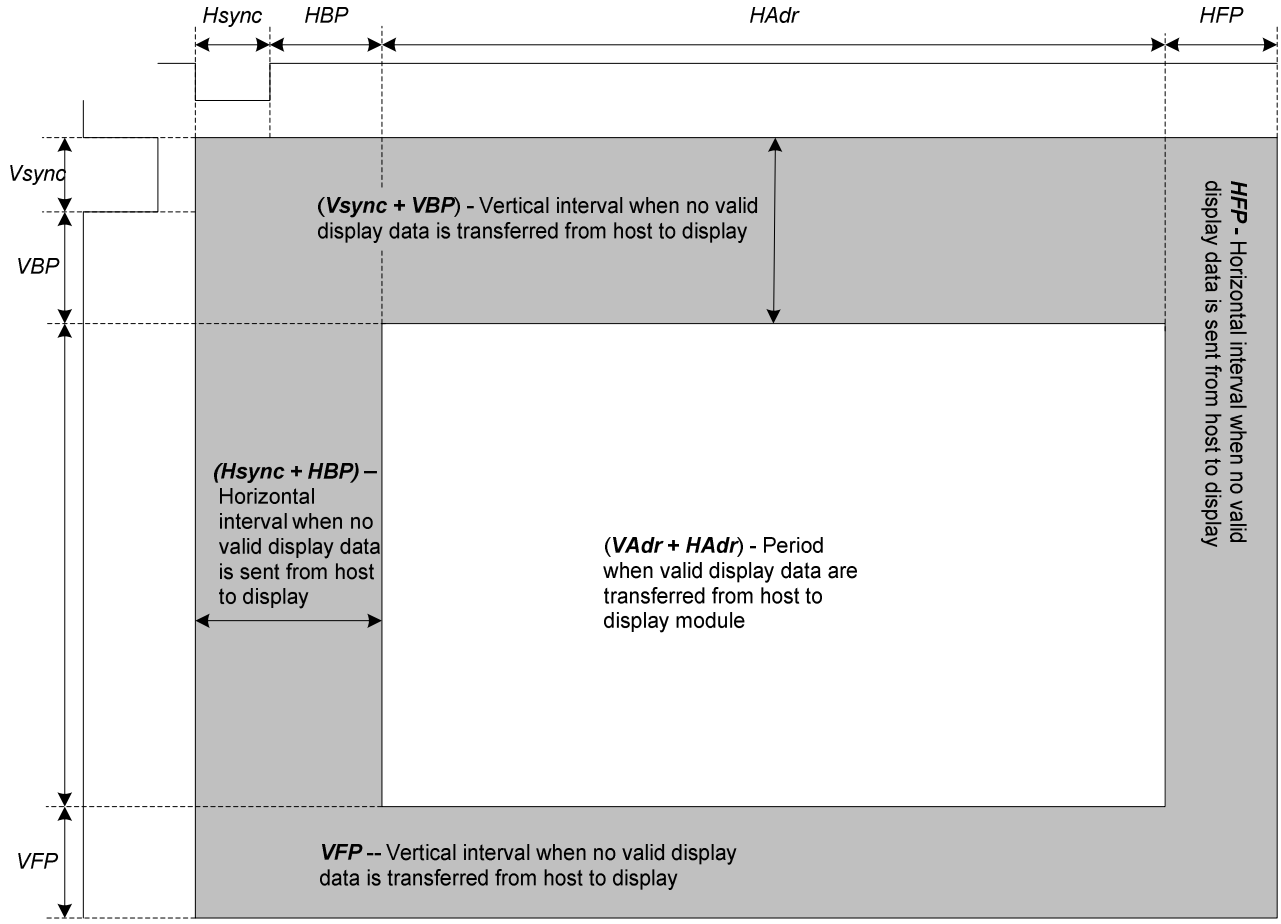
Vertical synchronization (VSYNC) is used to tell when there is received a new frame of the display. This is low enable and its state is read to the display module by a rising edge of the DOTCLK signal.

Horizontal synchronization (HSYNC) is used to tell when there is received a new line of the frame. This is low enable and its state is read to the display module by a rising edge of the DOTCLK signal.

Data Enable (ENABLE) is used to tell when there is received RGB information that should be transferred on the display. This is a high enable and its state is read to the display module by a rising edge of the DOTCLK signal.

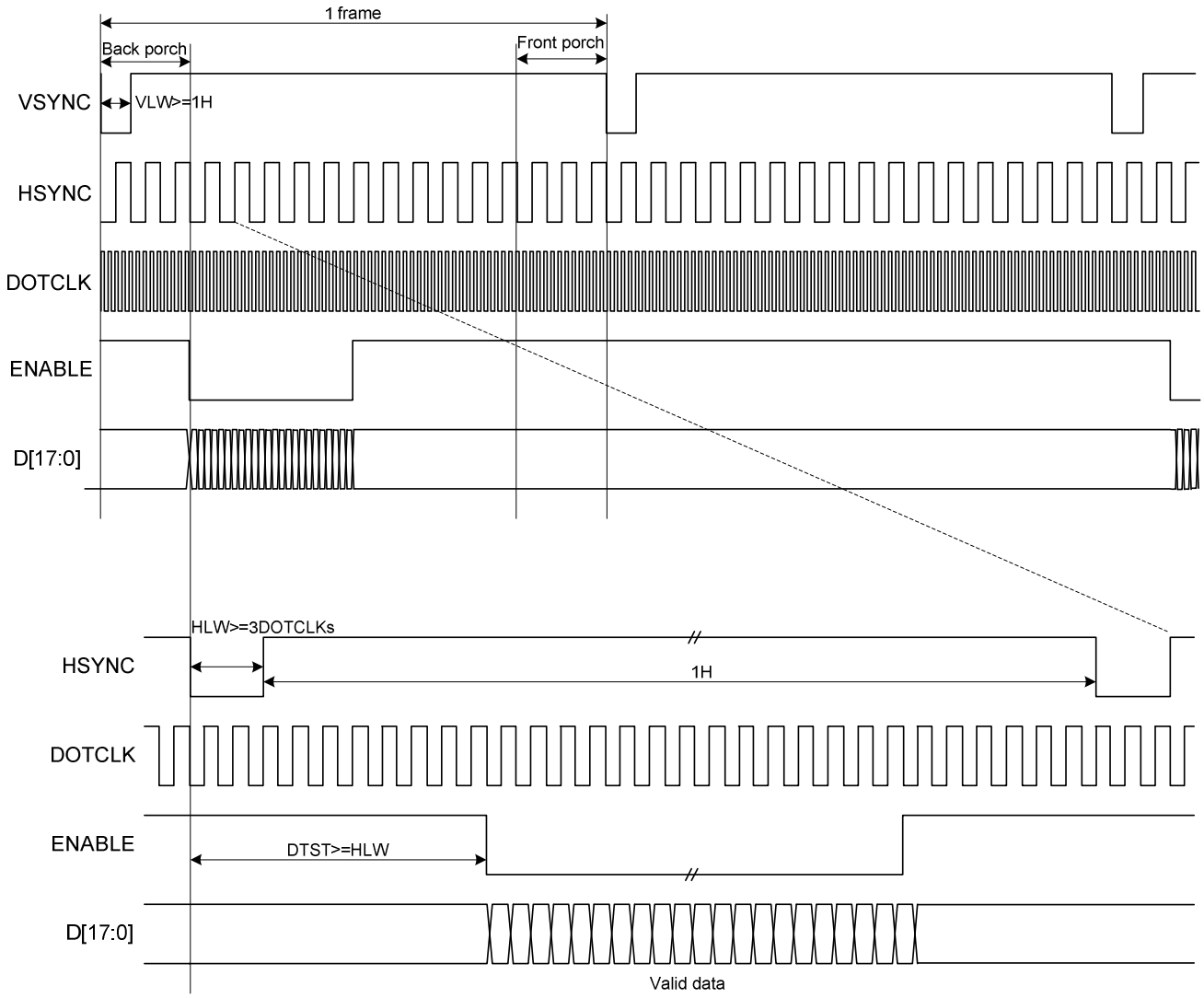
DB[17:0] are used to tell what is the information of the image that is transferred on the display (When

ENABLE= ’0’ (low) and there is a rising edge of DOTCLK). DB[17:0] can be ‘0’ (low) or ‘1’ (high). These lines are read by a rising edge of the DOTCLK signal. In RGB interface modes, the input display data is written to GRAM first then outputs corresponding source voltage according the gray data from GRAM.



7.2.2. RGB Interface Timing

The timing chart of 18-/16-bit RGB interface mode is shown as below.



VLW : VSYNC Low Width
HLW : HSYNC Low Width
DTST : Data Transfer Startup Time

Note 1: The DE signal is not needed when RGB interface SYNC mode is selected.

Note 2: VSPL='0', HSPL='0', DPL='0' and EPL='0' of "Interface Mode Control (B0h)" command.

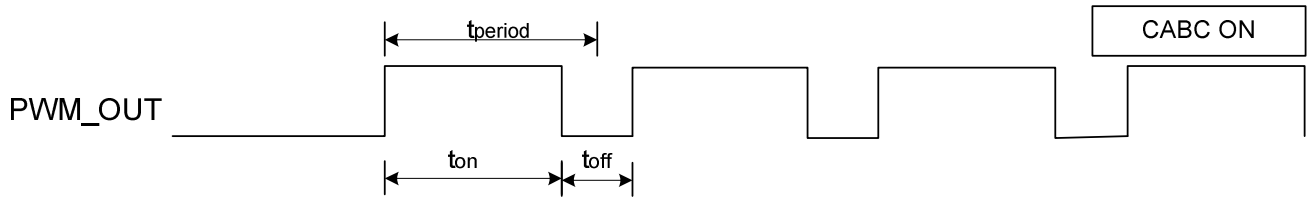
7.3. CABC (Content Adaptive Brightness Control)

ILI9486L provides a dynamic backlight control function as CABC (Content adaptive brightness control) to reduce the power consumption of the luminance source. ILI9486L will refer the gray scale content of display image to output a PWM waveform to LED driver for backlight brightness control. Content adaptation means that the content of gray sale can be increased while simultaneously lowering brightness of the backlight to achieve the same perceived brightness. The adjusted gray level scale and thus the power consumption reduction depend on the content of the image.

ILI9486L can calculate the backlight brightness level and send a PWM pulse to LED driver via PWM_OUT pin for backlight brightness control purpose. The PWM frequency can be adjusted by PWM_DIV parameters and the calculating equation as below:

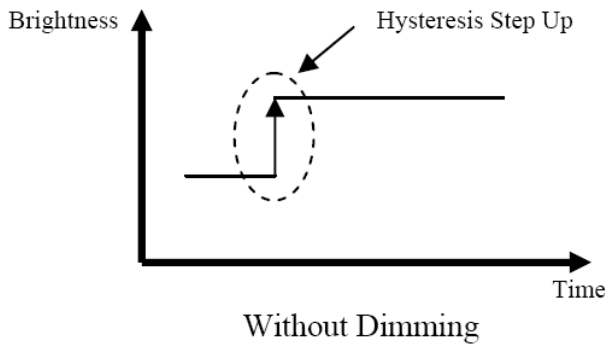
$$f_{PWM\_OUT} = \frac{18MHz}{(PWM\_DIV[7:0]+1)\times 255}$$

The figure in the following is the basic timing diagram which is applied ILI9486L to control LED driver.

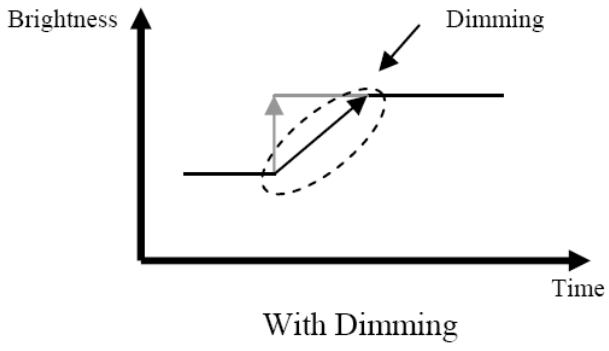


Display Backlight Dimming Control

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 brightness level to another. This dimming function curve is the same in increment and decrement directions. The basic idea is described below.



Without Dimming



With Dimming

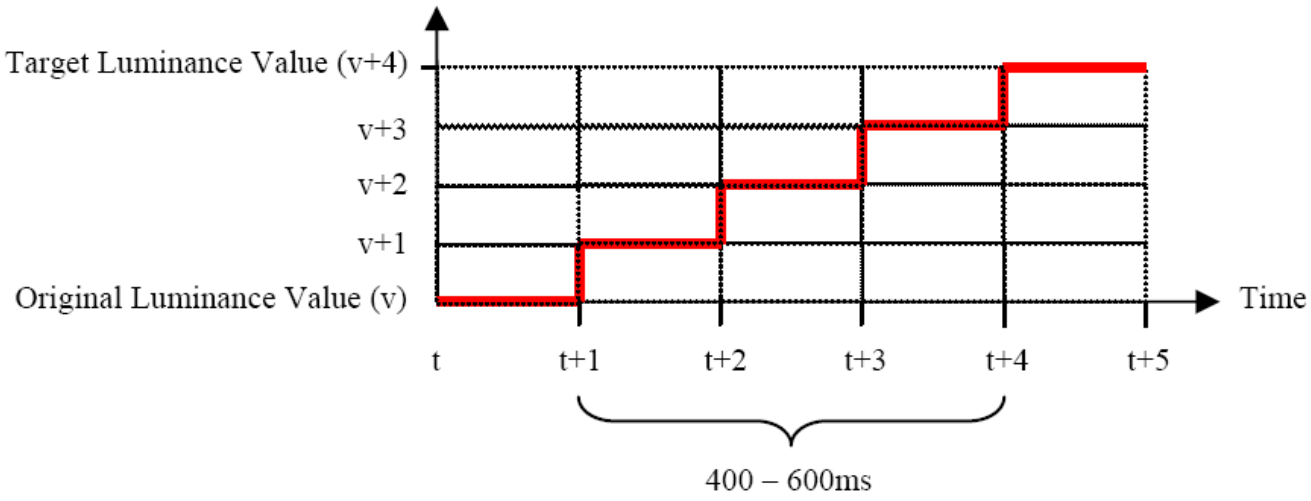
Dimming function can be enabled and disabled. See command “Write CTRL Display(53h), bit3(DD) for more information.

Dimming Requirment

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.

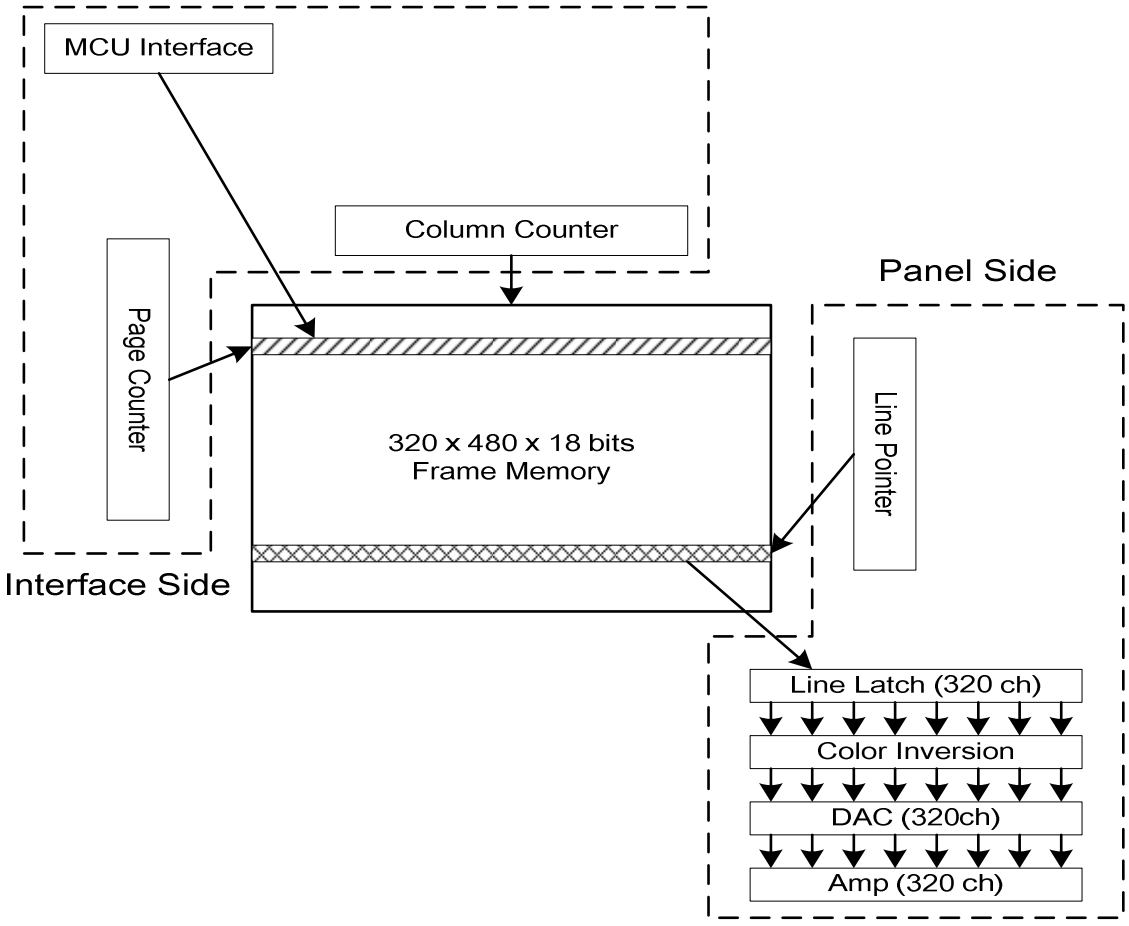
The dimming function is working similarly in both upward and downward directions.

An upward example is illustrated below.



7.4. Display Data RAM (DDRAM)

The ILI9486L has an integrated 320x480x18-bit graphic type static RAM. This 345,600-byte memory allows storing a 320xRGBx480 image with an 18-bit resolution (262K-color). There will be no abnormal visible effect on the display when there is a simultaneous Panel Read and Interface Read or Write to the same location of the Frame Memory.

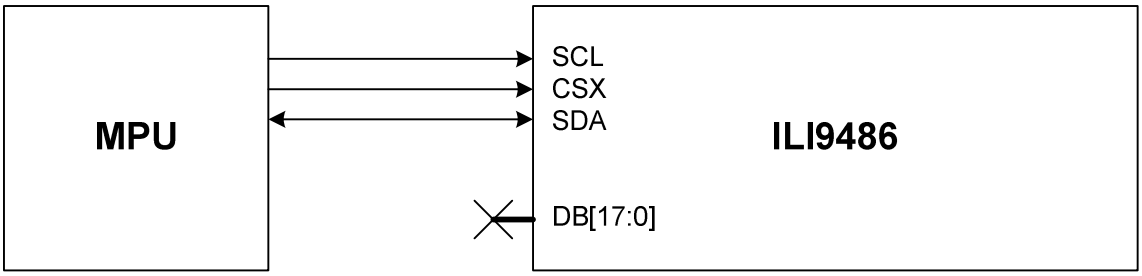


7.5. Display Data Format

ILI9486L supplies 18-/16-/9-/8-bit parallel MCU interface with 8080-series and 3-/4-line serial interface and 16-/18-bit parallel RGB interface. The parallel MCU interface and serial interface mode can be selected by external pins IM [2:0].

7.5.1. 3-line Serial Interface

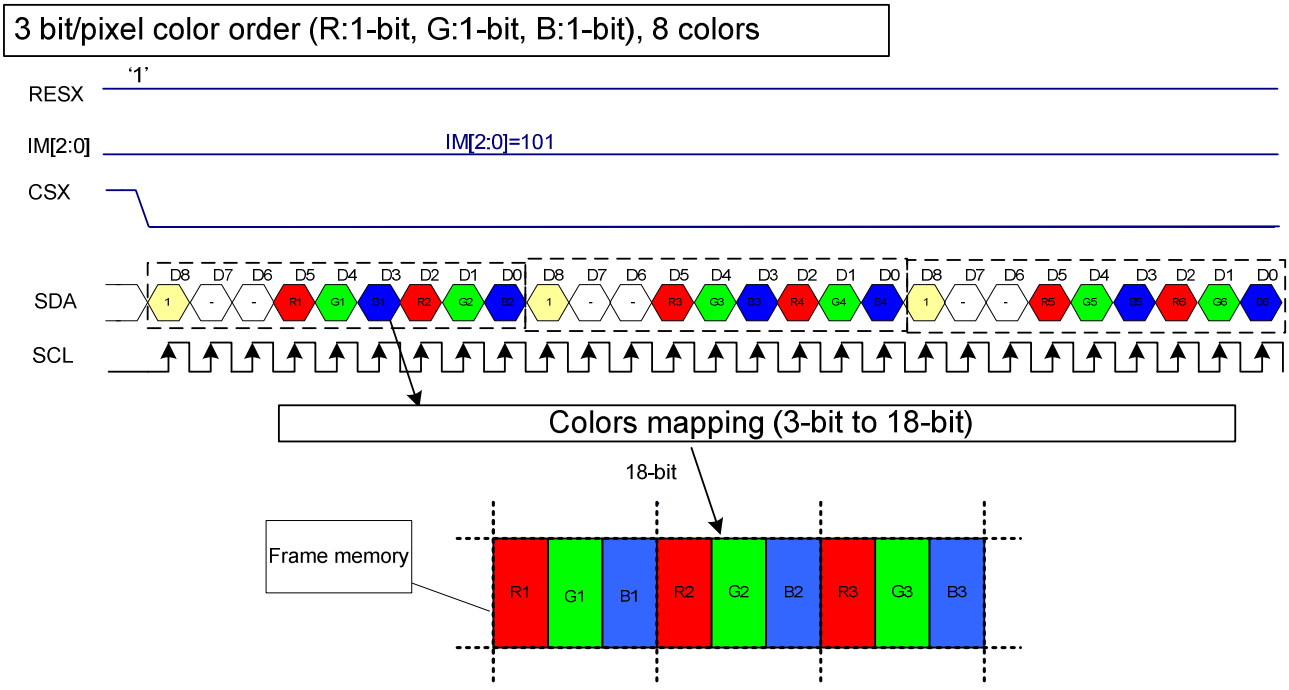
The 3-line/9-bit serial bus interface of ILI9486L can be used by setting external pin as IM [2:0] to "101". The figure in the following is the example of interface with 8080 microcomputer system interface.



In 3-line serial interface, different display data formats are available for two color depths supported by the LCM listed below.

-8 colors, RGB 1, 1, 1 -bits input

-262k colors, RGB 6, 6, 6 -bits input.



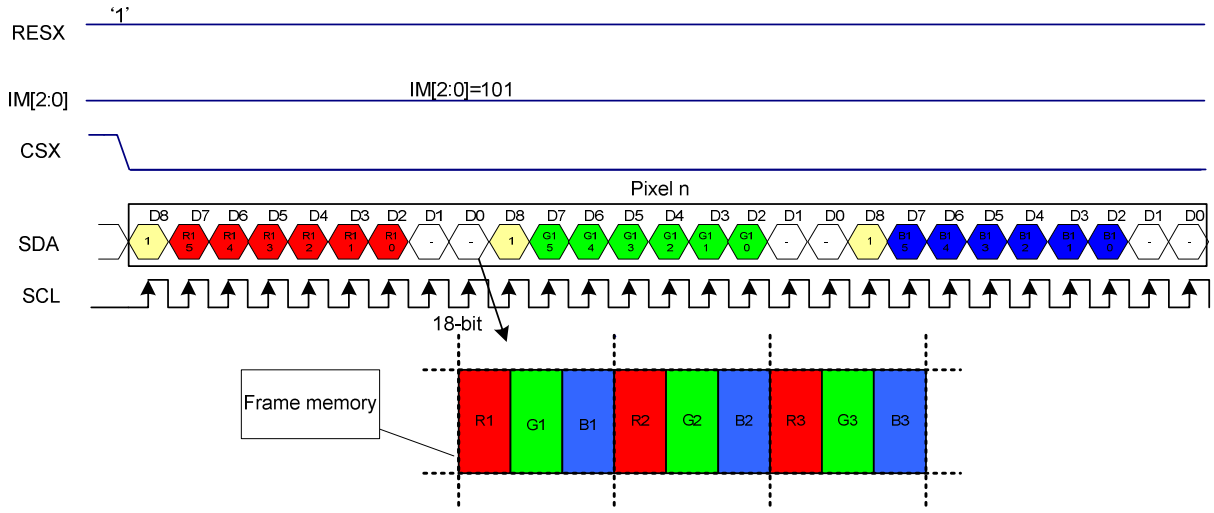
Note 1: The pixel data with 16-bit color depth information.

Note 2: The most significant bits are: Rx4, Gx5 and Bx4.

Note 3: The least significant bits are: Rx0, Gx0 and Bx0.

Note 4: '-'= Don't care – Leave these pins to Open.

18 bit/pixel color order (R:6-bit, G:6-bit, B:6-bit), 262,144 colors



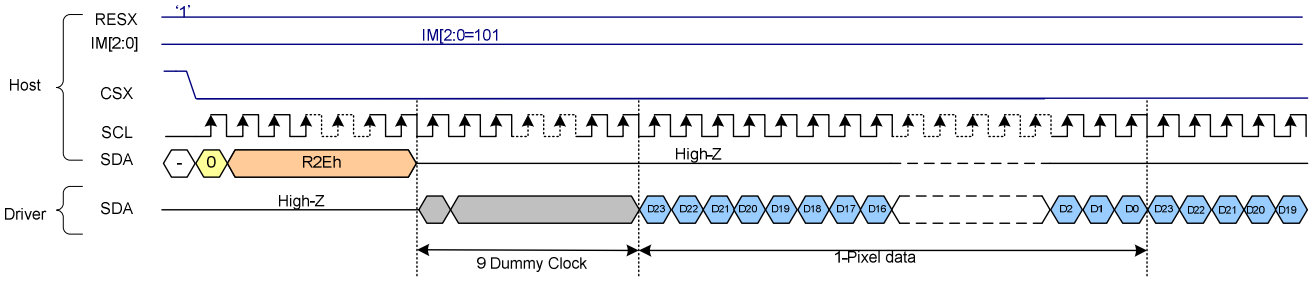
Note 1: The pixel data with 18-bit color depth information.

Note 2: The most significant bits are: Rx5, Gx5 and Bx5.

Note 3: The least significant bits are : Rx0, Gx0 and Bx0.

Note 4: '-'= Don't care - Leave these pins to Open.

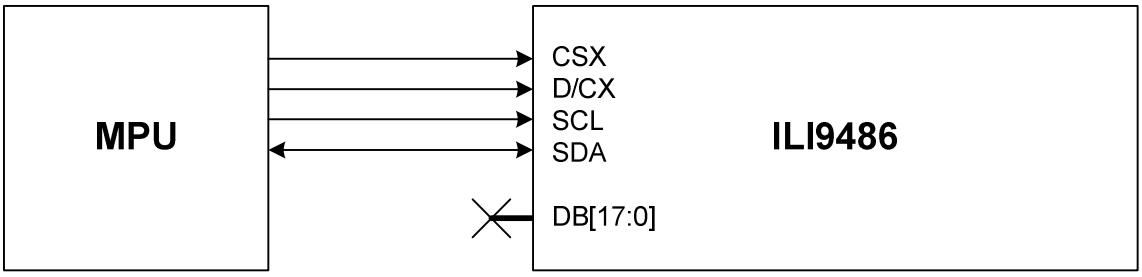
Read data through 3-line SPI mode



Note 1: '-'= Don't care – Leave these pins to Open.

7.5.2. 4-line Serial Interface

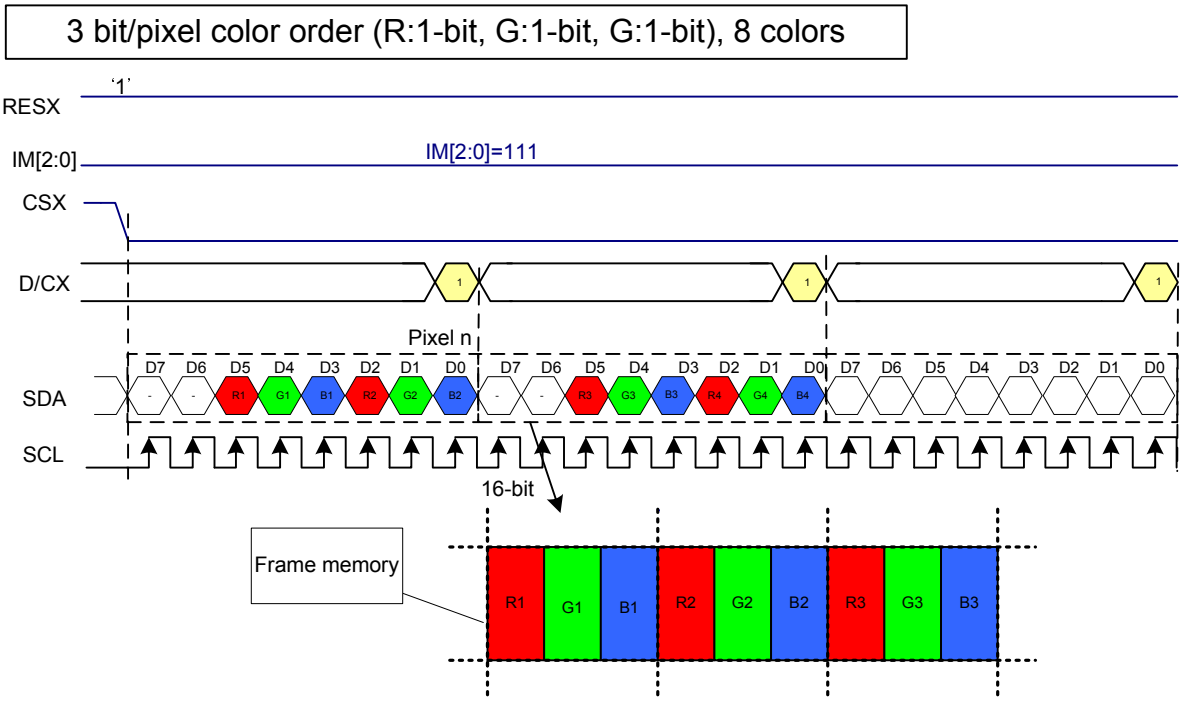
The 4-line/8-bit serial bus interface of ILI9486L can be used by setting external pin as IM [2:0] to “111”. The figure in the following is the example of interface with 8080 microcomputer system interface.



In 4-line serial interface, different display data formats are available for two color depths supported by the LCM listed below.

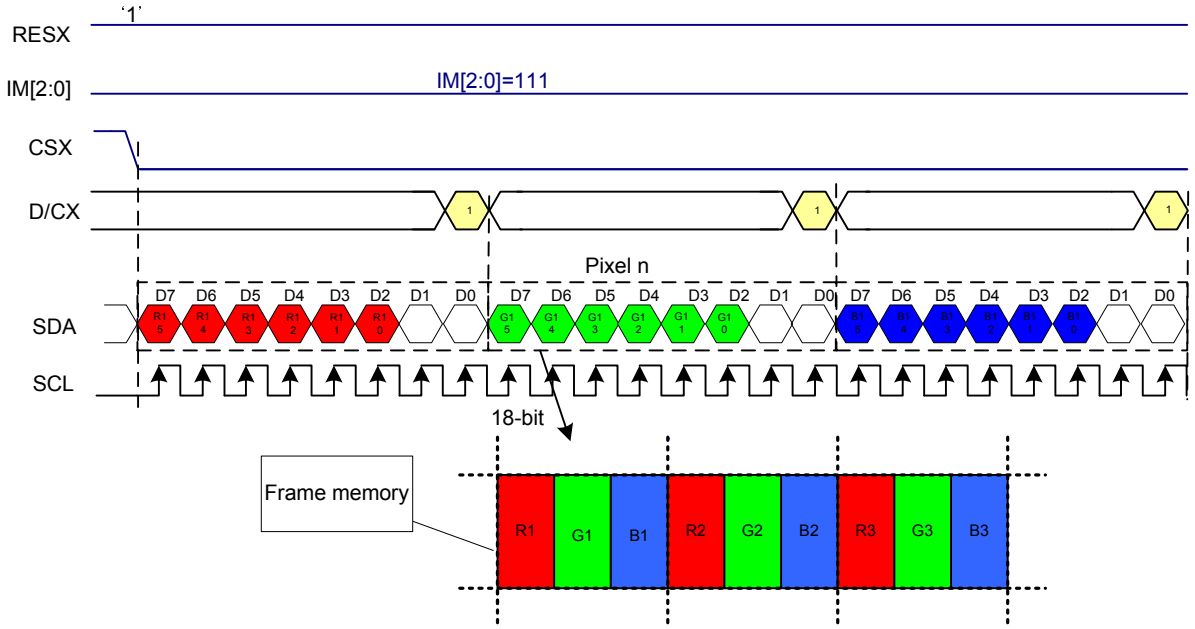
-8 colors, RGB 1, 1, 1 -bits input.

-262k colors, RGB 6, 6, 6 -bits input.



Note : '-'= Don't care – Leave these pins to Open.

18 bit/pixel color order (R:6-bit, G:6-bit, B:6-bit) , 262,144 colors



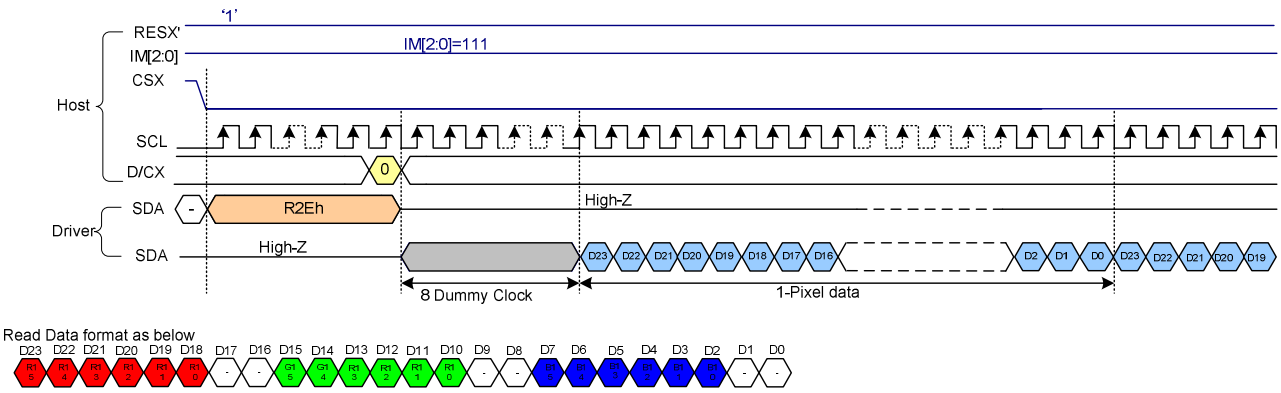
Note 1: The pixel data with 18-bit color depth information.

Note 2: The most significant bits are: Rx5, Gx5 and Bx5.

Note 3: The least significant bits are: Rx0, Gx0 and Bx0.

Note 4: '-'= Don't care – Leave these pins to Open.

Read data through 4-line SPI mode

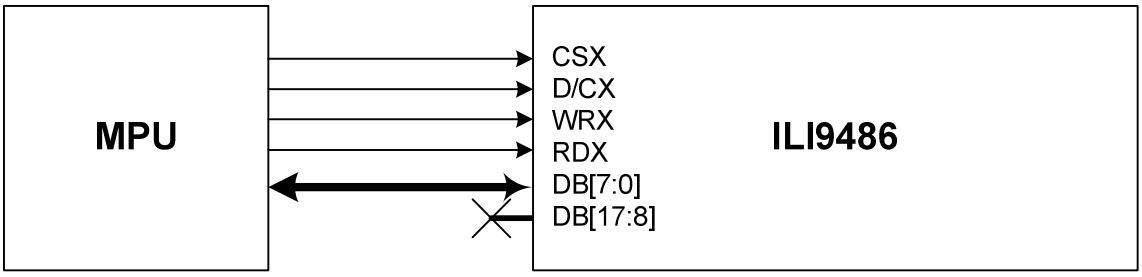


Note 1: '-'= Don't care – Leave these pins to Open.

7.5.3. 8-bit Parallel MCU Interface

The 8080-system 8-bit parallel bus interface of ILI9486L can be used by setting external pin as IM [2:0] to “011”.

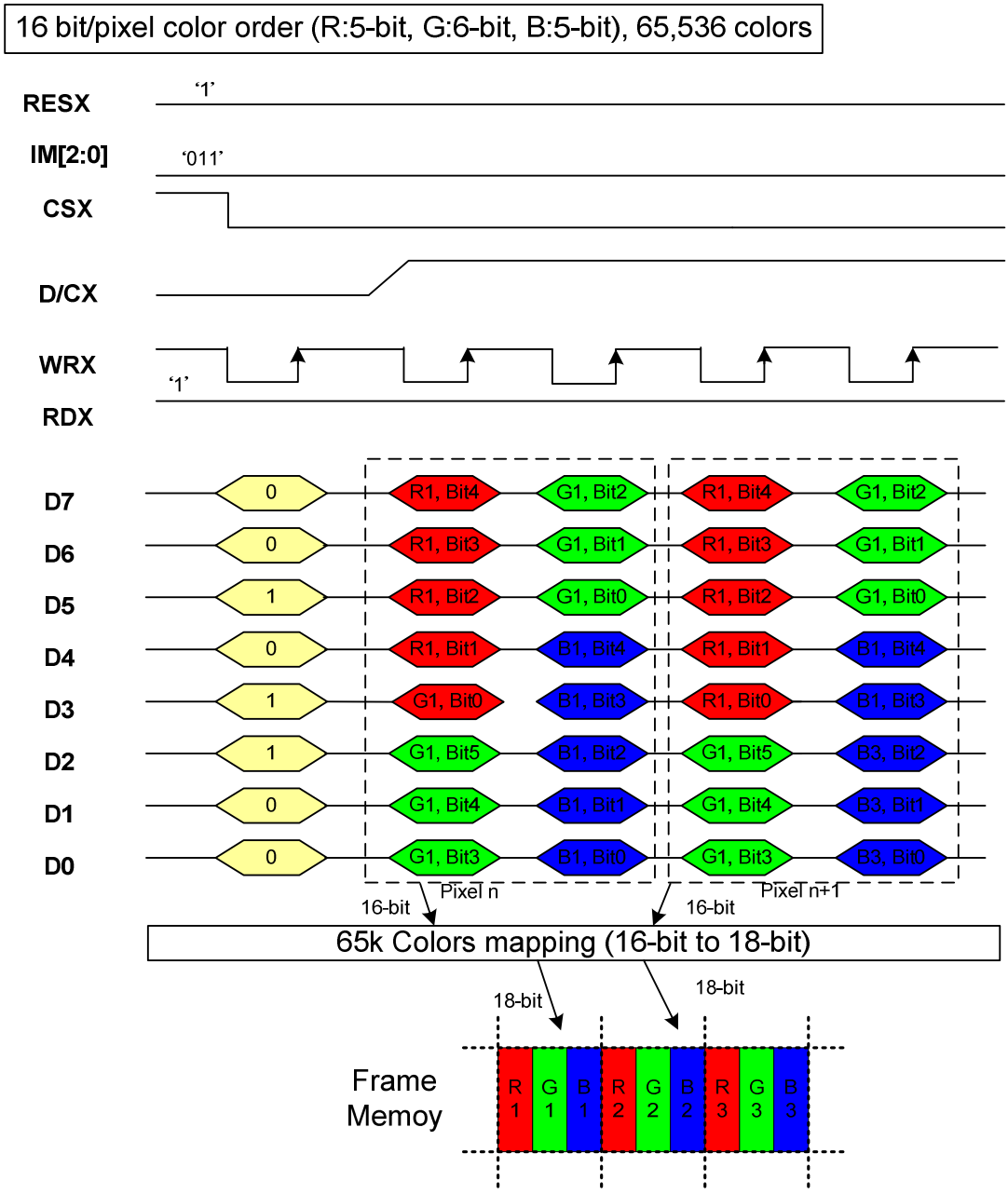
The figure in the following is the example of interface with 8080 microcomputer system interface.



Different display data formats are available for two color depths supported by listed below.

- 65K-Colors, RGB 5, 6, 5 -bits input data.
- 262K-Colors, RGB 6, 6, 6 -bits input data.

7.5.3.1. 8-bit Data Bus for 16-bit/pixel (RGB 5-6-5 bits input), 65K-color

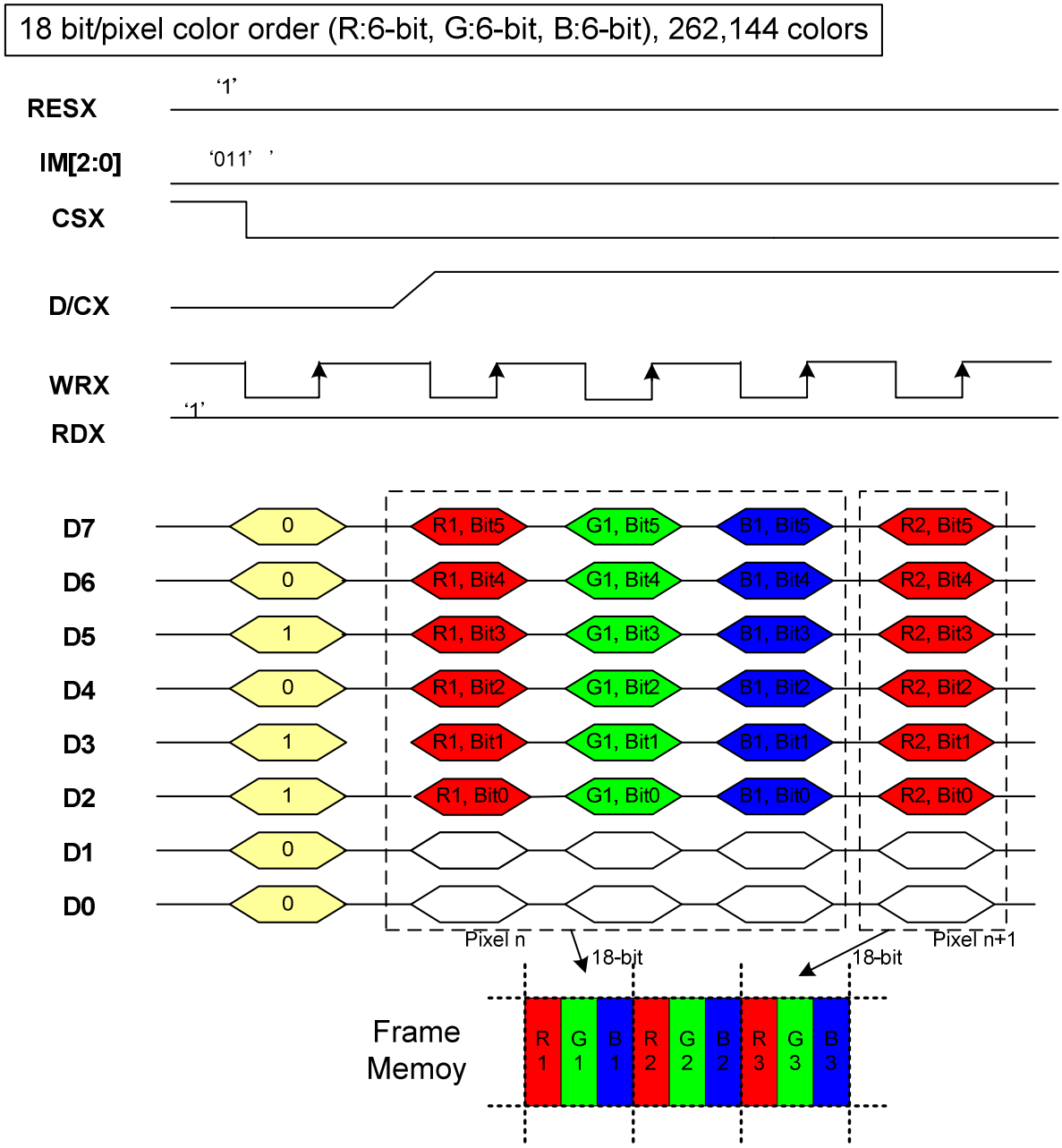


Note 1: The data order is as follows, MSB=D7, LSB=D0 and picture data is MSB=Bit 5, LSB=Bit 0 for Green data and MSB=Bit 4, LSB=Bit0 for Red and Blue data.

Note 2: 2-times transfer is used to transmit 1 pixel data with the 16-bits color depth information.

Note 3: '-'= Don't care – Leave these pins to Open.

7.5.3.2. 8-bit Data Bus for 18-bit/pixel (RGB 6-6-6 bits input), 262K-color



Note 1: The data order is as follows, MSB=D7, LSB=D0 and picture data is MSB=Bit 5, LSB=Bit 0 for Green, Red and Blue data.

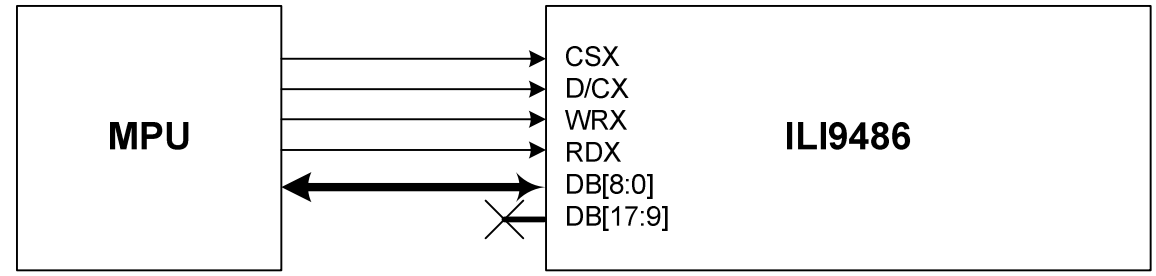
Note 2: 3-times transfer is used to transmit 1 pixel data with the 18-bits color depth information.

Note 3: '-'= Don't care – Leave these pins to Open.

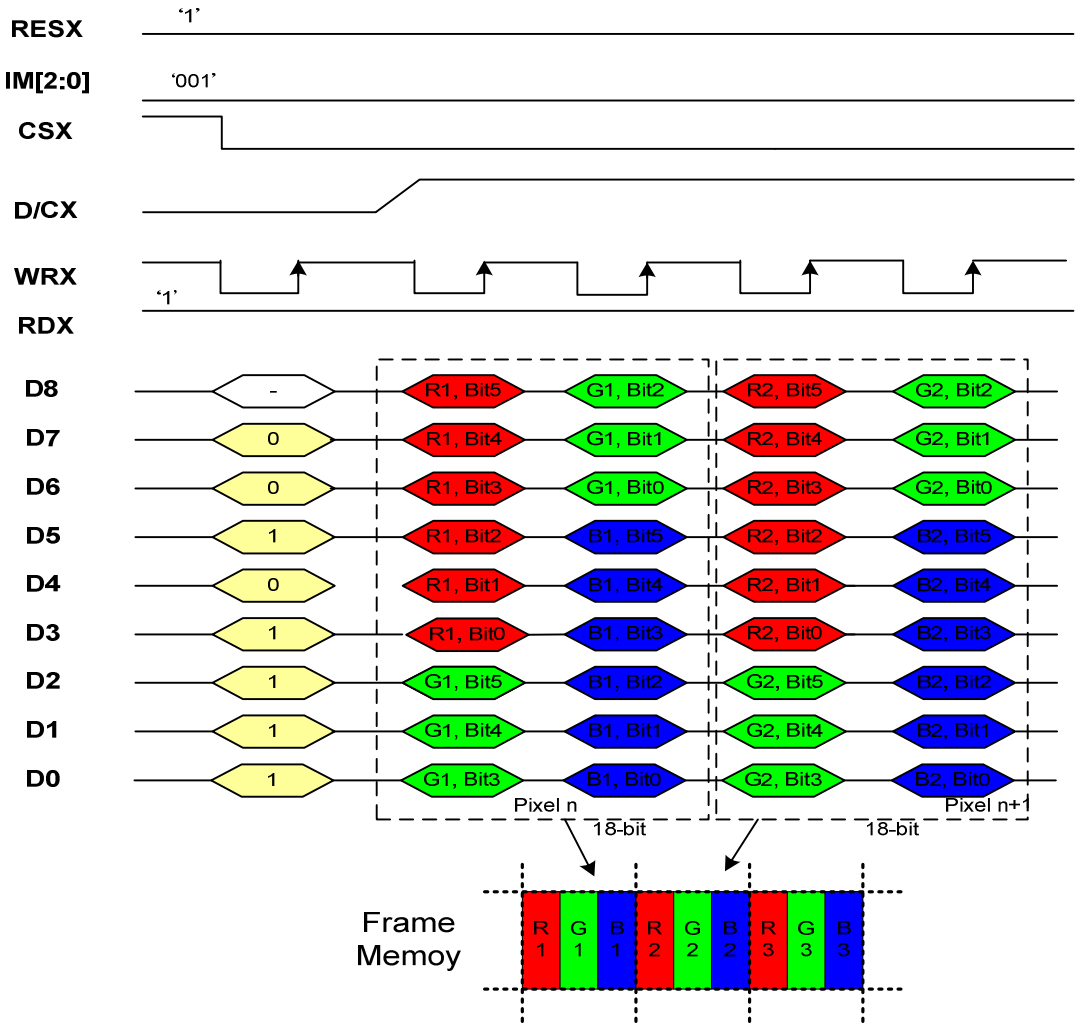
7.5.4. 9-bit Parallel MCU Interface

The 8080-system 9-bit parallel bus interface of ILI9486L can be used by setting external pin as IM [2:0] to “001”.

The figure in the following is the example of interface with 8080 microcomputer system interface.



18 bit/pixel color order (R:6-bit, G:6-bit, B:6-bit), 262,144 colors



Note 1: The data order is as follows, MSB=D8, LSB=D0 and picture data is MSB=Bit 5, LSB=Bit 0 for Green, Red and Blue data.

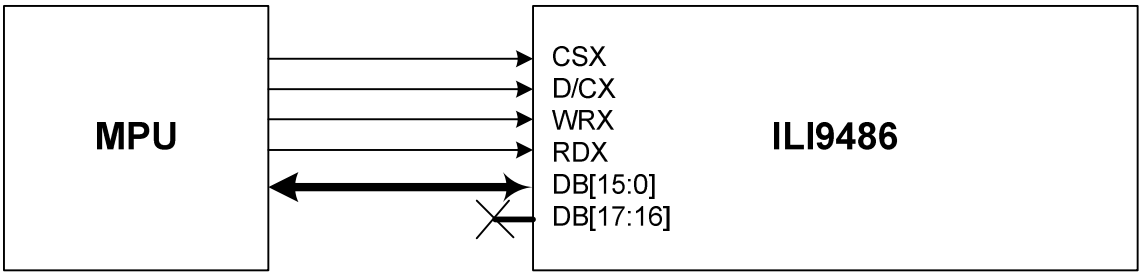
Note 2: 2-times transfer is used to transmit 1 pixel data with the 18-bits color depth information.

Note 3: ‘-‘= Don’t care – Leave these pins to Open.

7.5.5. 16-bit Parallel MCU Interface

The 8080-system 16-bit parallel bus interface of ILI9486L can be used by setting external pin as IM [2:0] to “010”.

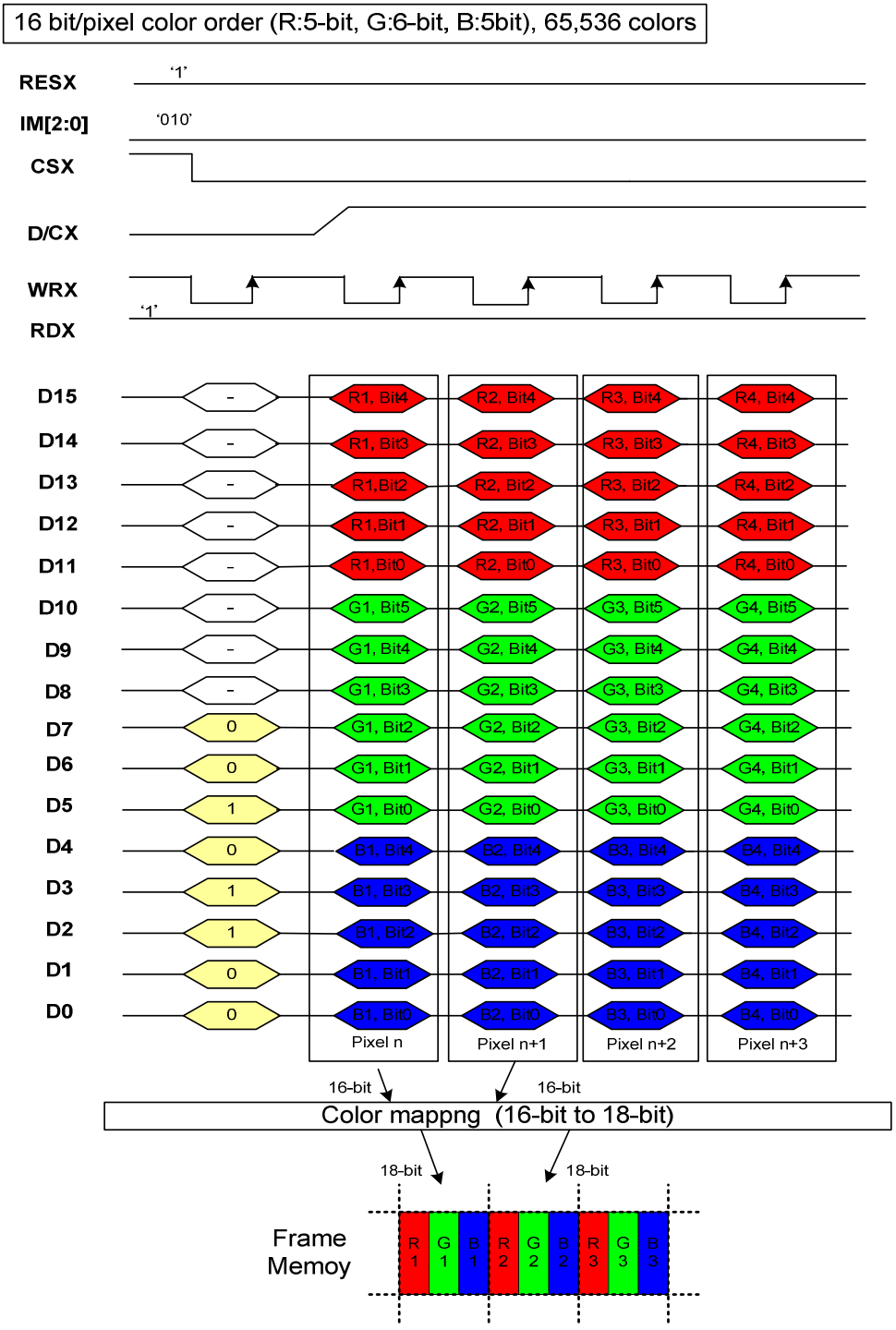
The figure in the following is the example of interface with 8080 microcomputer system interface.



Different display data formats are available for two colors depth supported by listed below.

- 65K-Colors, RGB 5, 6, 5 -bits input data.
- 262K-Colors, RGB 6, 6, 6 -bits input data.

7.5.5.1. 16-bit Data Bus for 16-bit/pixel (RGB 5-6-5 bits input), 65K-color

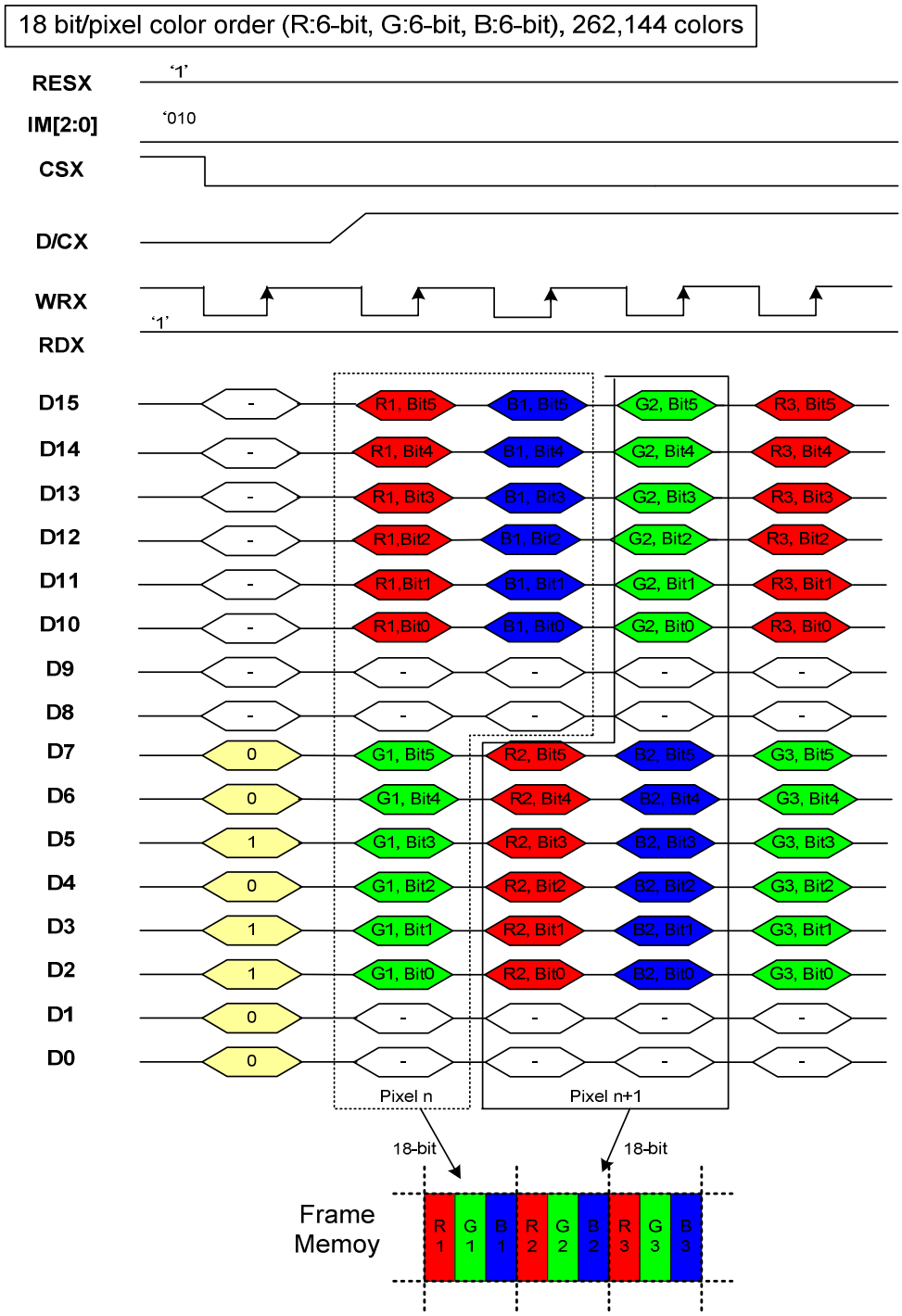


Note 1: The data order is as follows, MSB=D15, LSB=D0 and picture data is MSB=Bit 5, LSB=Bit 0 for Green data and MSB=Bit 4, LSB=Bit0 for Red and Blue data.

Note 2: 1-times transfer is used to transmit 1 pixel data with the 16-bits color depth information.

Note 3: '-'= Don't care – Leave these pins to Open.

7.5.5.2. 16-bit Data Bus for 18-bit/pixel (RGB 6-6-6 bits input), 262K-color



Note 1: The data order is as follows, MSB=D15, LSB=D0 and picture data is MSB=Bit 5, LSB=Bit 0 for Green, Red and Blue data.

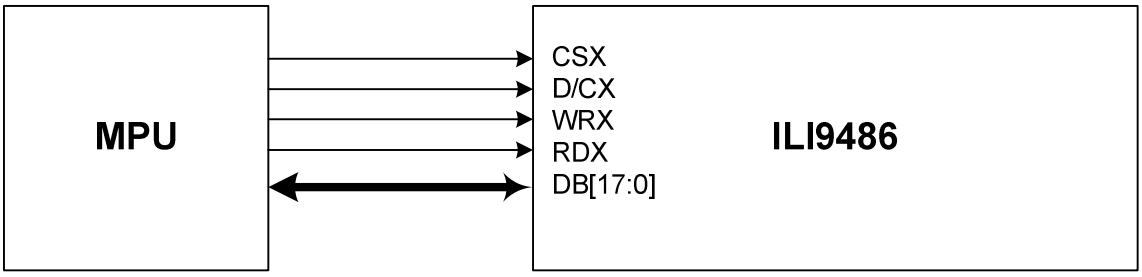
Note 2: 2-times transfer is used to transmit 1 pixel data with the 18-bits color depth information.

Note 3: '-'= Don't care – Leave these pins to Open.

7.5.6. 18-bit Parallel MCU Interface

The 8080-system 18-bit parallel bus interface of ILI9486L can be used by setting external pin as IM [2:0] to “000”.

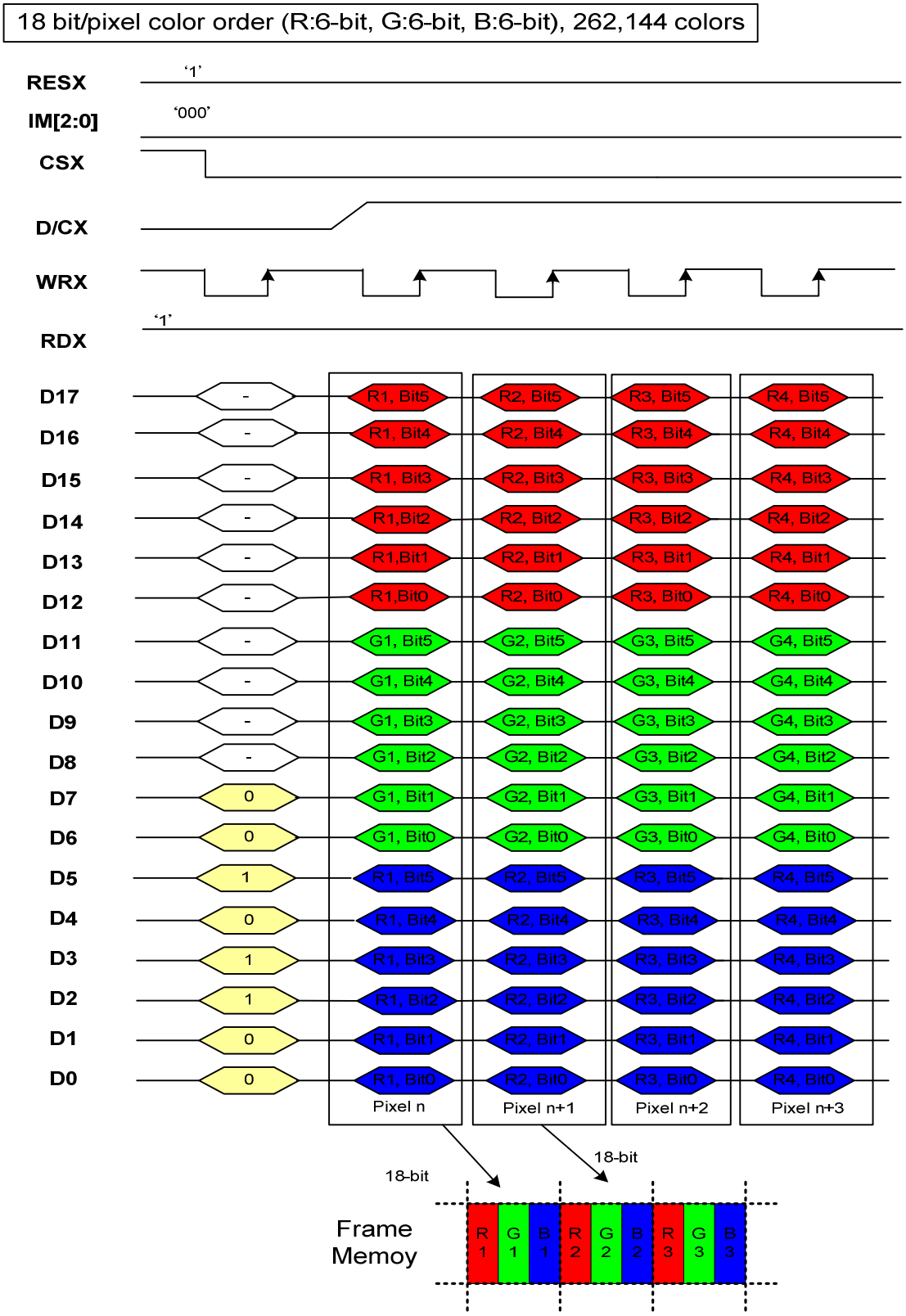
The figure in the following is the example of interface with 8080 microcomputer system interface.



Different display data formats are available for one color depth only supported by listed below.

- 262K-Colors, RGB 6, 6, 6 -bits input data.

7.5.6.1. 18-bit Data Bus for 18-bit/pixel (RGB 6-6-6 bits input), 262K-color



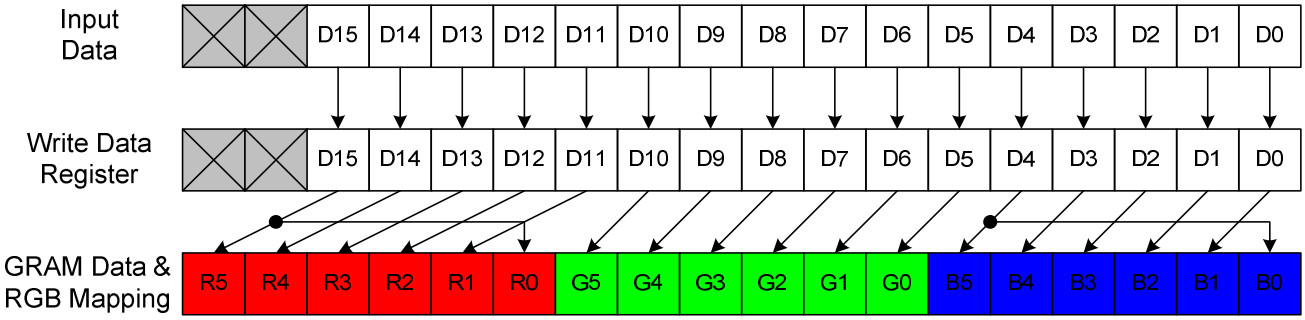
Note 1: The data order is as follows, MSB=D17, LSB=D0 and picture data is MSB=Bit 5, LSB=Bit 0 for Green and MSB=Bit4, LSB=Bit0 for Red and Blue data.

Note 2: 1-times transfer is used to transmit 1 pixel data with the 16-bits color depth information.

Note 3: '-'= Don't care – Leave these pins to Open.

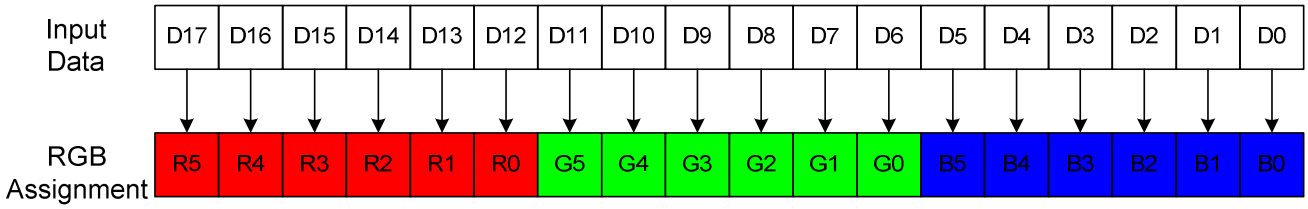
7.5.7. 16-bit Parallel RGB Interface

The 16-bit RGB interface is selected by setting the DPI[2:0] bits to “101”. The display operation is synchronized with VSYNC, HSYNC and DOTCLK signals. The display data are transferred to the internal GRAM in synchronization with the display operation via 16-bit RGB data bus (D[15:0]). Both D17 and D16 pins must be left to OPEN for ensure normally operation. Registers can be set by the system interface.



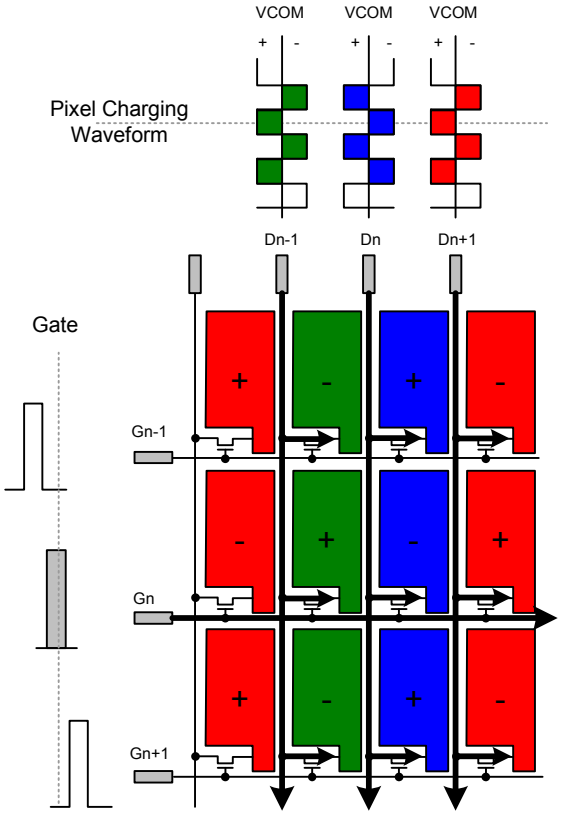
7.5.8. 18-bit Parallel RGB Interface

The 18-bit RGB interface is selected by setting the DPI[2:0] bits to “110”. The display operation is synchronized with VSYNC, HSYNC and DOTCLK signals. The display data are transferred to the internal GRAM in synchronization with the display operation via 18-bit RGB data bus (DB[17:0]) according to the data enable signal (ENABLE). Registers can be set by the system interface.

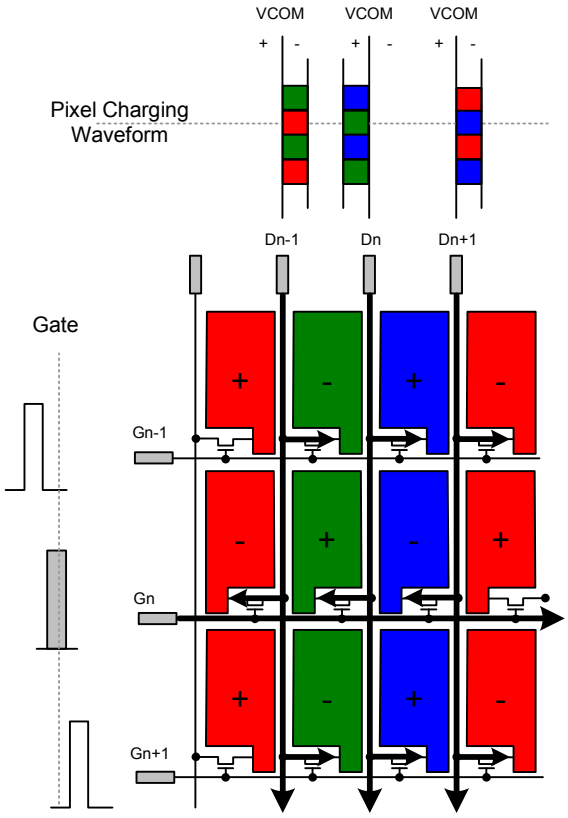


7.6. Z-inversion

The ILI9486L supports Z-inversion for reduce power consumption. The Zigzag can decrease the switching frequency, relative to the magnitude of the display power consumption, and the switching level. This method will have a addendum data line after the last data line.



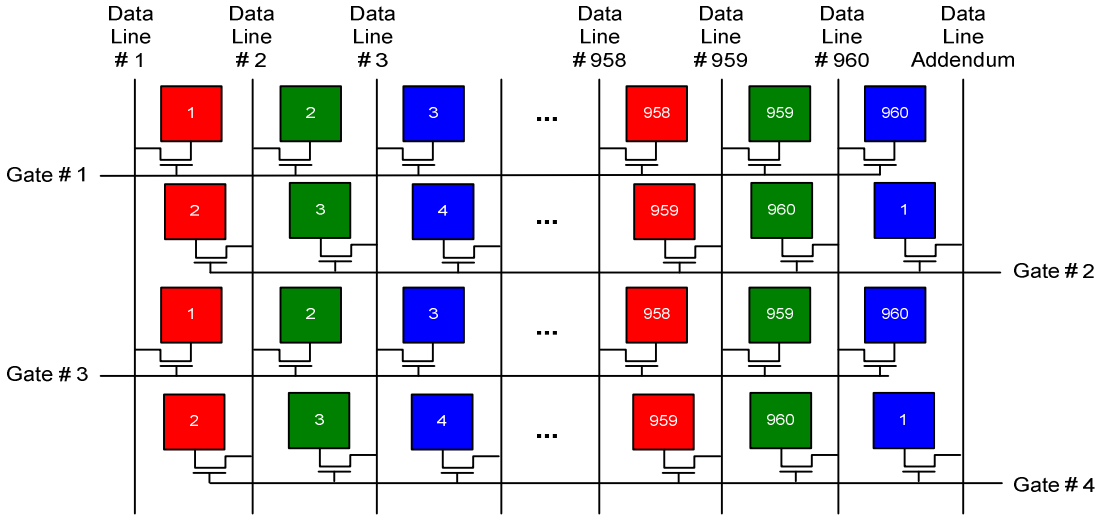
1-Dot Inversion Driving



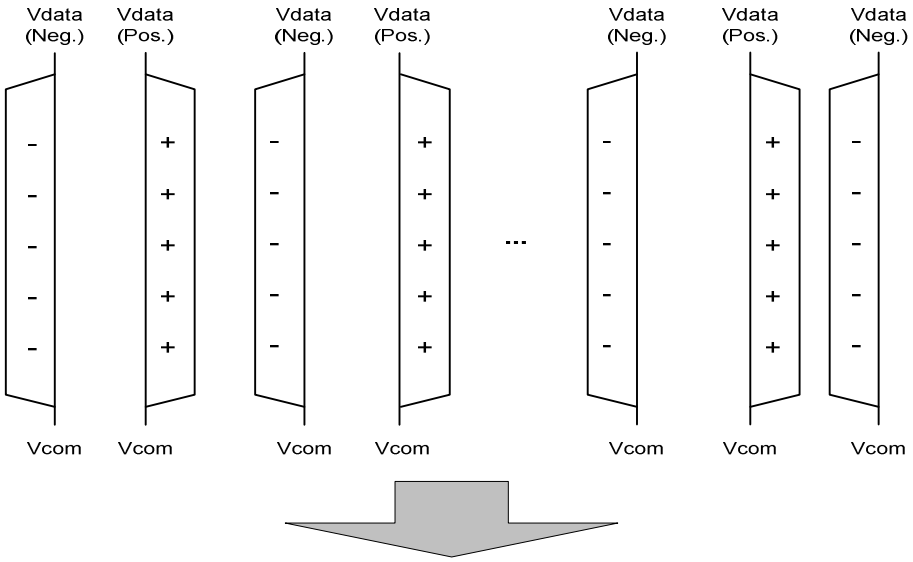
Vertical Bi-Color driving

7.8.1 Z-inversion concept

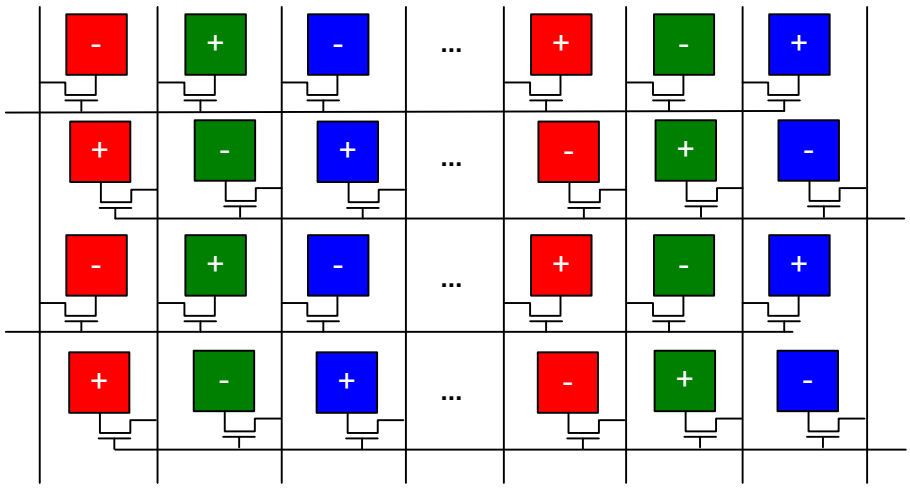
The Zigzag method uses the same polarity of data line of the column inversion to show out the 1-dot inversion.



Column Inversion



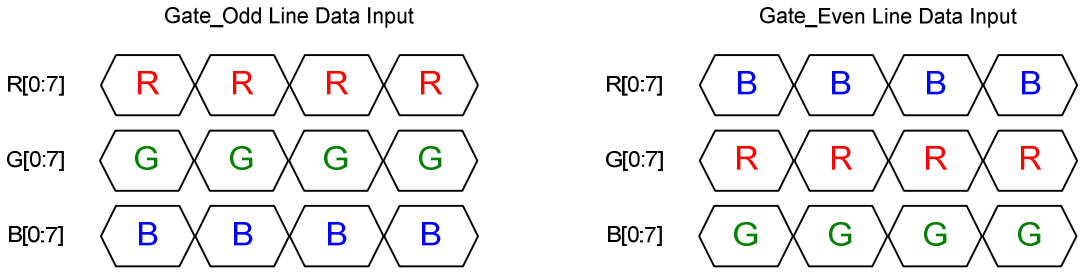
1-Dot Inversion

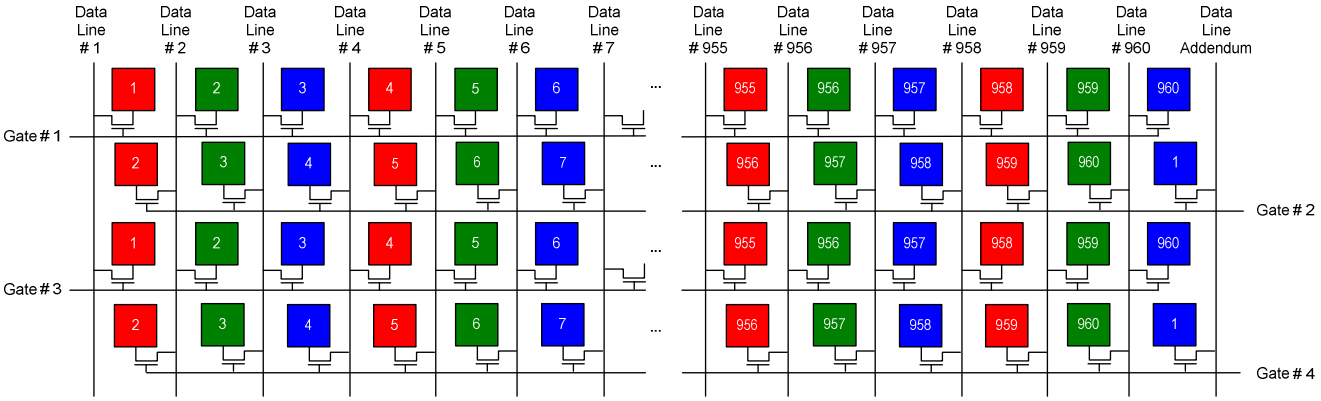


7.8.2 Z-inversion Odd/Even Gate data input method

Gate_Odd line : using the normally data input mode and put on the R, G, B date to sub-pixel R, G, B respectively.

Gate_Even line : put on the G, B, R data to sub-pixel R, G, B respectively.





7.8.3 Z-inversion data input method

The driving panel display method is that added the one sub pixel at the Gate_Even shift the data output.

Red

	Data # 1	Data # 2	Data # 3	Data # 4	Data # 5	Data # 6	...	Data # 955	Data # 956	Data # 957	Data # 958	Data # 959	Data # 960	Data Option
Gate_Odd	R	G	B	R	G	B		R	G	B	R	G	B	
Gate_Even	R	G	B	R	G	B		R	G	B	R	G	B	
Gate_Odd	R	G	B	R	G	B		R	G	B	R	G	B	
Gate_Even	R	G	B	R	G	B		R	G	B	R	G	B	

Green

	Data # 1	Data # 2	Data # 3	Data # 4	Data # 5	Data # 6	...	Data # 955	Data # 956	Data # 957	Data # 958	Data # 959	Data # 960	Data Option
Gate_Odd	R	G	B	R	G	B		R	G	B	R	G	B	
Gate_Even	R	G	B	R	G	B		R	G	B	R	G	B	
Gate_Odd	R	G	B	R	G	B		R	G	B	R	G	B	
Gate_Even	R	G	B	R	G	B		R	G	B	R	G	B	

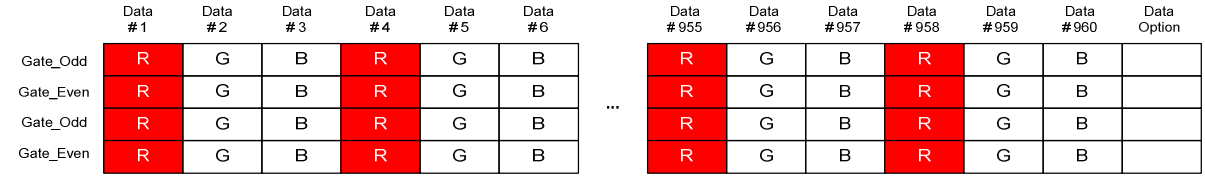
Blue

	Data # 1	Data # 2	Data # 3	Data # 4	Data # 5	Data # 6	...	Data # 955	Data # 956	Data # 957	Data # 958	Data # 959	Data # 960	Data Option
Gate_Odd	R	G	B	R	G	B		R	G	B	R	G	B	
Gate_Even	R	G	B	R	G	B		R	G	B	R	G	B	
Gate_Odd	R	G	B	R	G	B		R	G	B	R	G	B	
Gate_Even	R	G	B	R	G	B		R	G	B	R	G	B	

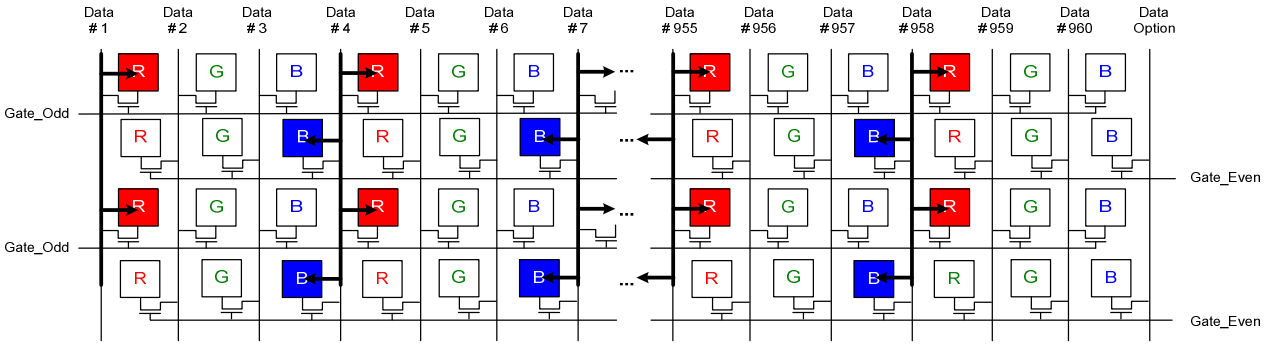
7.8.3.1 Z-inversion RED Data display

The below figure is normally panel driving method for Red data input. For driving Red pattern, the Red and Blue sub pixel will light up line by line when the data signal input.

Input Data Signal

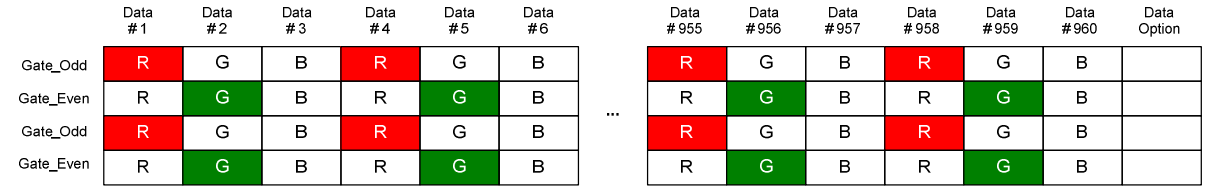


Panel Driving

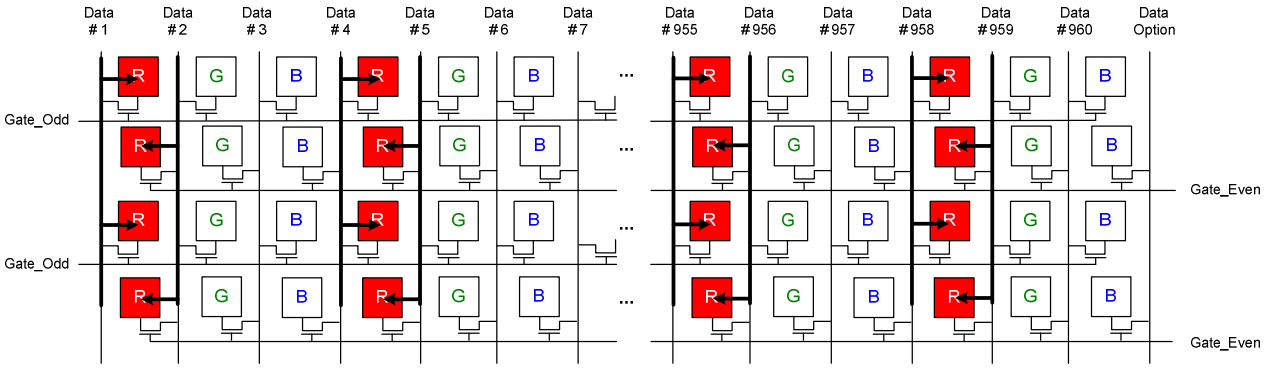


The below figure is Z-inversion panel driving method. The panel will be drive by the Red data input of the Gate_Odd and the Green data input of the Gate_Even.

Input Data Signal



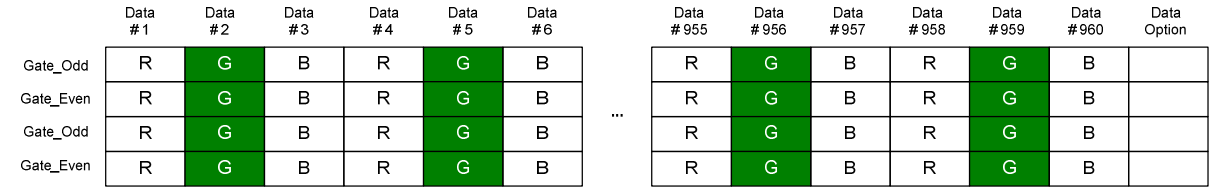
Panel Driving



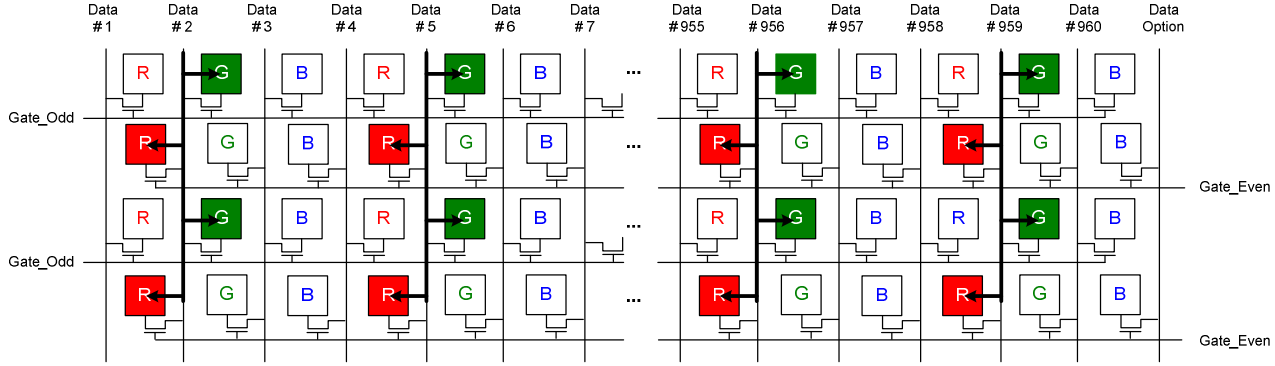
7.8.3.2 Z-inversion GREEN Data display

The below figure is normally panel driving method for Green data input. For driving Green pattern, the Green and Red sub pixel will light up line by line when the data signal input.

Input Data Signal

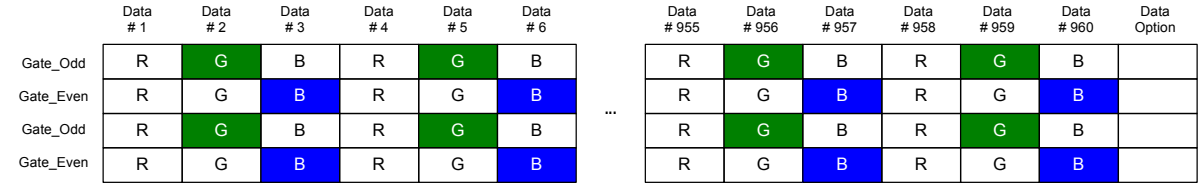


Panel Driving

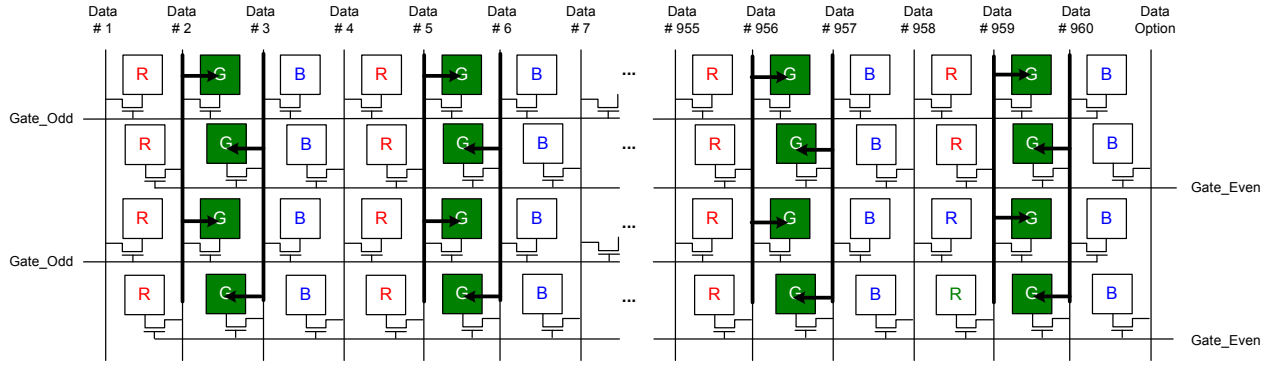


The below figure is Z-inversion panel driving method. The panel will be drive by the Green data input of the Gate_Odd and the Blue data input of the Gate_Even.

Input Data Signal



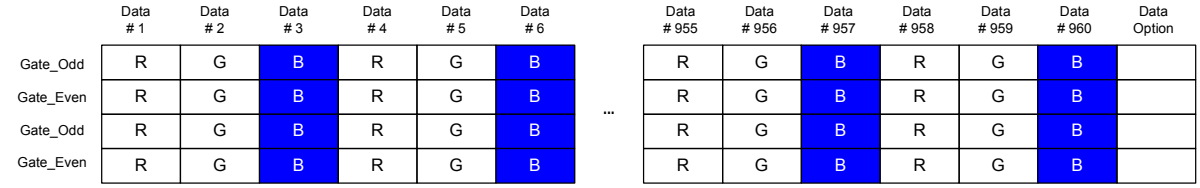
Panel Driving



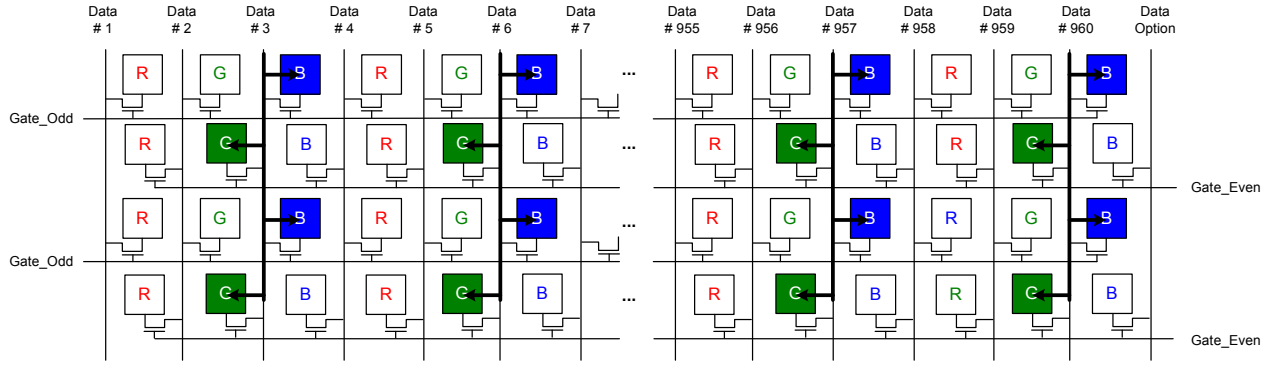
7.8.3.3 Z-inversion BLUE Data display

The below figure is normally panel driving method for Blue data input. For driving Blue pattern, the Blue and Green sub pixel will light up line by line when the data signal input.

Input Data Signal

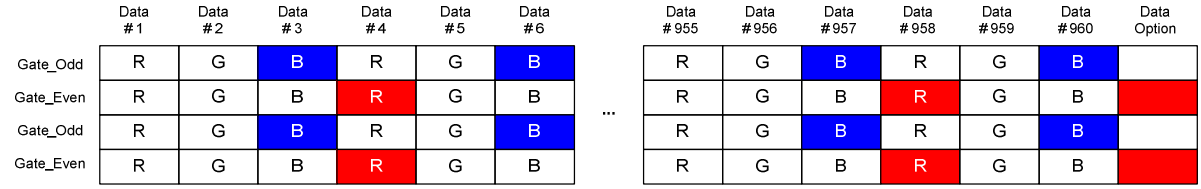


Panel Driving

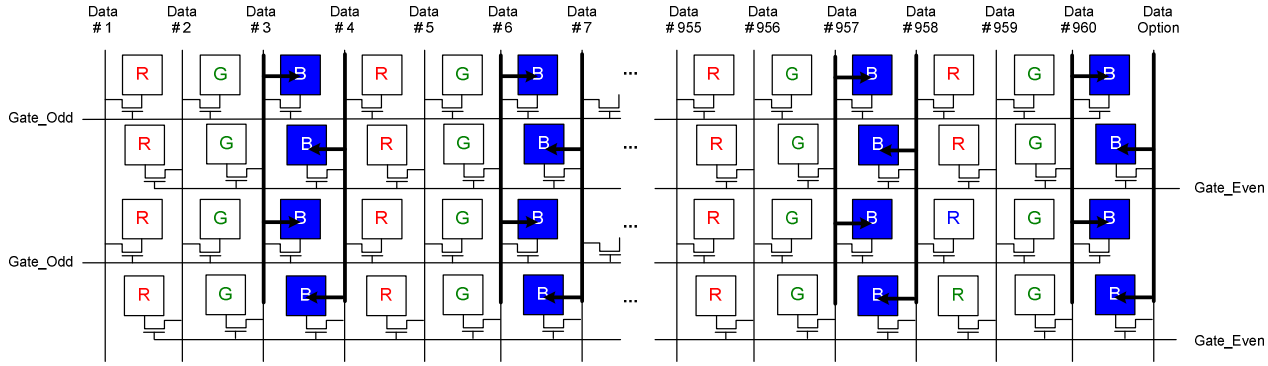


The below figure is Z-inversion panel driving method. The panel will be drive by the Blue data input of the Gate_Odd and the Red data input of the Gate_Even.

Input Data Signal



Panel Driving



8. Command

8.1. Command List

Regular Command Set													
Command Function	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Hex
NOP	0	1	↑	XXXXXXXX	0	0	0	0	0	0	0	0	00h
Soft Reset	0	1	↑	XXXXXXXX	0	0	0	0	0	0	0	1	01h
Read display identification information	0	1	↑	XXXXXXXX	0	0	0	0	0	1	0	0	04h
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XXXXXXXX	ID1 [7:0]								XX
	1	↑	1	XXXXXXXX	ID2 [7:0]								XX
	1	↑	1	XXXXXXXX	ID3 [7:0]								XX
Read Number of the Errors on DSI	0	↑	1	XXXXXXXX	0	0	0	0	0	1	0	1	05h
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XXXXXXXX	P[7:0]								XX
Read Display Status	0	↑	1	XXXXXXXX	0	0	0	0	1	0	0	1	09h
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XXXXXXXX	D[31:24]								XX
	1	↑	1	XXXXXXXX	D[23:16]								XX
	1	↑	1	XXXXXXXX	D[15:8]								XX
	1	↑	1	XXXXXXXX	D[7:0]								XX
Read Display Power Mode	0	↑	1	XXXXXXXX	0	0	0	0	1	0	1	0	0Ah
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XXXXXXXX	D[7:2]						0	0	XX
Read Display MADCTL	0	↑	1	XXXXXXXX	0	0	0	0	1	0	1	1	0Bh
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XXXXXXXX	D[7:2]						0	0	XX
Read Pixel Format	0	↑	1	XXXXXXXX	0	0	0	0	1	1	0	0	0Ch
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XXXXXXXX	DPI[3:0]				0	DBI[2:0]			XX
Read Display Image Mode	0	↑	1	XXXXXXXX	0	0	0	0	1	1	0	1	0Dh
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XXXXXXXX	D[7:0]								XX
Read Display signal Mode	0	↑	1	XXXXXXXX	0	0	0	0	1	1	1	0	0Eh
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XXXXXXXX	D7	D6	D5	D4	D3	D2	D1	D0	XX
Read Display Self-Diagnostic Result	0	↑	1	XXXXXXXX	0	0	0	0	1	1	1	1	0Fh
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XXXXXXXX	D7	D6	0	0	0	0	0	D0	XX
Sleep IN	0	1	↑	XXXXXXXX	0	0	0	1	0	0	0	0	10h
Sleep OUT	0	1	↑	XXXXXXXX	0	0	0	1	0	0	0	1	11h
Partial Mode ON	0	1	↑	XXXXXXXX	0	0	0	1	0	0	1	0	12h
Normal Display Mode ON	0	1	↑	XXXXXXXX	0	0	0	1	0	0	1	1	13h
Display Inversion OFF	0	1	↑	XXXXXXXX	0	0	1	0	0	0	0	0	20h
Display Inversion ON	0	1	↑	XXXXXXXX	0	0	1	0	0	0	0	1	21h
Display OFF	0	1	↑	XXXXXXXX	0	0	1	0	1	0	0	0	28h
Display ON	0	1	↑	XXXXXXXX	0	0	1	0	1	0	0	1	29h
Column Address Set	0	1	↑	XXXXXXXX	0	0	1	0	1	0	1	0	2Ah
	1	1	↑	XXXXXXXX	SC[15:8]								XX
	1	1	↑	XXXXXXXX	SC[7:0]								XX
	1	1	↑	XXXXXXXX	EC[15:8]								XX
	1	1	↑	XXXXXXXX	EC[7:0]								XX
Page Address Set	0	1	↑	XXXXXXXX	0	0	1	0	1	0	1	1	2Bh
	1	1	↑	XXXXXXXX	SP[15:8]								XX
	1	1	↑	XXXXXXXX	SP[7:0]								XX
	1	1	↑	XXXXXXXX	EP[15:8]								XX
	1	1	↑	XXXXXXXX	EP[7:0]								XX
Memory Write	0	1	↑	XXXXXXXX	0	0	1	0	1	1	0	0	2Ch
	1	1	↑	D1[15:0]									XX
	1	1	↑	Dx[15:0]									XX
	1	1	↑	Dn[15:0]									XX
Memory Read	0	↑	1	XXXXXXXX	0	0	1	0	1	1	1	0	2Eh
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX

	1	↑	1	D1[15:0]									XX
	1	↑	1	Dx[15:0]									XX
	1	↑	1	Dn[15:0]									XX
	1	↑	1	XXXXXXXX	Pn[7:0]								XX
Partial Area	0	1	↑	XXXXXXXX	0	0	1	1	0	0	0	0	30h
	1	1	↑	XXXXXXXX	SR[15:8]								XX
	1	1	↑	XXXXXXXX	SR[7:0]								XX
	1	1	↑	XXXXXXXX	ER[15:8]								XX
	1	1	↑	XXXXXXXX	ER[7:0]								XX
Vertical Scrolling Definition	0	1	↑	XXXXXXXX	0	0	1	1	0	0	1	1	33h
	1	1	↑	XXXXXXXX	TFA[15:8]								XX
	1	1	↑	XXXXXXXX	TFA[7:0]								XX
	1	1	↑	XXXXXXXX	VSA[15:8]								XX
	1	1	↑	XXXXXXXX	VSA[7:0]								XX
	1	1	↑	XXXXXXXX	BFA[15:8]								XX
	1	1	↑	XXXXXXXX	BFA[7:0]								XX
Tearing Effect Line OFF	0	1	↑	XXXXXXXX	0	0	1	1	0	1	0	0	34h
Tearing Effect Line ON	0	1	↑	XXXXXXXX	0	0	1	1	0	1	0	1	35h
Memory Access Control	0	1	↑	XXXXXXXX	0	0	1	1	0	1	1	0	36h
	1	1	↑	XXXXXXXX	MY	MX	MV	ML	BGR	MH	X	X	XX
Vertical Scrolling Start Address	0	1	↑	XXXXXXXX	0	0	1	1	0	1	1	1	37h
	1	1	↑	XXXXXXXX	VSP[15:8]								XX
	1	1	↑	XXXXXXXX	VSP[7:0]								XX
Idle Mode OFF	0	1	↑	XXXXXXXX	0	0	1	1	1	0	0	0	38h
Idle Mode ON	0	1	↑	XXXXXXXX	0	0	1	1	1	0	0	1	39h
Interface Pixel Format	0	1	↑	XXXXXXXX	0	0	1	1	1	0	1	0	3Ah
	1	1	↑	XXXXXXXX	0	DPI[6:4]			0	DBI[2:0]			XX
Memory Write Continue	0	1	↑	XXXXXXXX	0	0	1	1	1	1	0	0	3Ch
	1	1	↑	D1[15:0]									XX
	1	1	↑	Dx[15:0]									XX
	1	1	↑	Dn[15:0]									XX
Memory Read Continue	0	↑	1	XXXXXXXX	0	0	1	1	1	1	1	0	3Eh
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
	1	↑	1	D1[15:0]									XX
	1	↑	1	Dx[15:0]									XX
	1	↑	1	Dn[15:0]									XX
Write Tear Scan line	0	1	↑	XXXXXXXX	0	1	0	0	0	1	0	0	44h
	1	1	↑	XXXXXXXX	N[15:8]								XX
	1	1	↑	XXXXXXXX	N[7:0]								XX
Read Tear Scan Line	0	↑	1	XXXXXXXX	0	1	0	0	0	1	0	1	45h
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XXXXXXXX	N[15:8]								XX
	1	↑	1	XXXXXXXX	N[7:0]								XX
Write Display Brightness value	0	1	↑	XXXXXXXX	0	1	0	1	0	0	0	1	51h
	1	1	↑	XXXXXXXX	DBV[7:0]								XX
Read Display Brightness Value	0	1	↑	XXXXXXXX	0	1	0	1	1	0	1	0	52h
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XXXXXXXX	DBV[7:0]								XX
Write CTRL Display value	0	1	↑	XXXXXXXX	0	1	0	1	0	0	1	1	53h
	1	1	↑	XXXXXXXX	0	0	BCTRL	0	DD	BL	0	0	XX
Read CTRL Display value	0	1	↑	XXXXXXXX	0	1	0	1	0	1	0	0	54h
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XXXXXXXX	0	0	BCTRL	0	DD	BL	0	0	XX
Write Content Adaptive Brightness Control value	0	1	↑	XXXXXXXX	0	1	0	1	0	1	0	1	55h
	1	1	↑	XXXXXXXX	0	0	0	0	0	0	C[1:0]		XX
Read Content Adaptive Brightness Control value	0	1	↑	XXXXXXXX	0	1	0	1	0	1	1	0	56h
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XXXXXXXX	0	0	0	0	0	0	C[1:0]		XX
Write CABC Minimum Brightness	0	1	↑	XXXXXXXX	0	1	0	1	1	1	1	0	5Eh
	1	1	↑	XXXXXXXX	CMB[7:0]								XX
Read CABC Minimum Brightness	0	1	↑	XXXXXXXX	0	1	0	1	1	1	1	1	5Fh
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XXXXXXXX	CMB[7:0]								XX
Read First Checksum	0	1	↑	XXXXXXXX	1	0	1	0	1	0	1	0	AAh
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX

	1	↑	1	XXXXXXXX	FCS[7:0]								XX
Read Continue Checksum	0	1	↑	XXXXXXXX	1	0	1	0	1	1	1	1	AFh
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XXXXXXXX	CCS[7:0]								XX
Read ID1	0	1	↑	XXXXXXXX	1	1	0	1	1	0	1	0	DAh
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XXXXXXXX	ID1[7:0]								XX
Read ID2	0	1	↑	XXXXXXXX	1	0	1	0	1	0	1	1	DBh
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XXXXXXXX	ID2[7:0]								XX
Read ID3	0	1	↑	XXXXXXXX	1	0	1	0	1	1	0	0	DCh
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XXXXXXXX	ID3[7:0]								XX

Extended Command Set													
Command Function	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Interface Mode Control	0	1	↑	XXXXXXXX	1	0	1	1	0	0	0	0	B0h
	1	1	↑	XXXXXXXX	SDA_EN	0	0	0	VSPL	HSPL	DPL	EPL	XX
Frame Rate Control（In Normal Mode/Full Colors）	0	1	↑	XXXXXXXX	1	0	1	1	0	0	0	1	B1h
	1	1	↑	XXXXXXXX	FRS[3:0]				0	0	DIVA[1:0]		XX
	1	1	↑	XXXXXXXX	0	0	0	RTNA[4:0]					XX
Frame Rate Control（In Idle Mode/8 colors）	0	1	↑	XXXXXXXX	1	0	1	1	0	0	1	0	B2h
	1	1	↑	XXXXXXXX	0	0	0	0	0	0	DIVB[1:0]		XX
	1	1	↑	XXXXXXXX	0	0	0	RTNB[4:0]					XX
Frame Rate Control（In Partial Mode/Full colors）	0	1	↑	XXXXXXXX	1	0	1	1	0	0	1	1	B3h
	1	1	↑	XXXXXXXX	0	0	0	0	0	0	DIVC[1:0]		XX
	1	1	↑	XXXXXXXX	0	0	0	RTN[4:0]					XX
Display Inversion Control	0	1	↑	XXXXXXXX	1	0	1	1	0	1	0	0	B4h
	1	1	↑	XXXXXXXX	0	0	0	ZINV	0	0	DINV[1:0]		XX
Blanking Porch Control	0	1	↑	XXXXXXXX	1	0	1	1	0	1	0	1	B5h
	1	1	↑	XXXXXXXX	VFP[7:0]								XX
	1	1	↑	XXXXXXXX	VBP[7:0]								XX
	1	1	↑	XXXXXXXX	0	0	0	HFP[4:0]					XX
	1	1	↑	XXXXXXXX	HBP[7:0]								XX
Display Function Control	0	1	↑	XXXXXXXX	1	0	1	1	0	1	1	0	B6h
	1	1	↑	XXXXXXXX	BYPASS	0	RM	DM	PTG[1:0]		PT[1:0]		XX
	1	1	↑	XXXXXXXX	0	GS	SS	SM	ISC[3:0]				XX
	1	1	↑	XXXXXXXX	0	0	NL[5:0]						XX
Entry Mode Set	0	1	↑	XXXXXXXX	1	0	1	1	0	1	1	1	B7h
	1	1	↑	XXXXXXXX	EPF[1:0]		0	0	DSTB	GON	DTE	GAS	XX
Power Control 1	0	1	↑	XXXXXXXX	1	1	0	0	0	0	0	0	C0h
	1	1	↑	XXXXXXXX	0	0	0	VRH1[4:0]					XX
	1	1	↑	XXXXXXXX	0	0	0	VRH2[4:0]					XX
Power Control 2	0	1	↑	XXXXXXXX	1	1	0	0	0	0	0	1	C1h
	1	1	↑	XXXXXXXX	0	0	0	0	0	BT[2:0]			XX
	1	1	↑	XXXXXXXX	0	0	0	0	0	VC[2:0]			XX
Power Control 3	0	1	↑	XXXXXXXX	1	1	0	0	0	0	1	0	C2h
	1	1	↑	XXXXXXXX	0	DCA1[2:0]			0	DCA0[2:0]			XX
Power Control 4	0	1	↑	XXXXXXXX	1	1	0	0	0	0	1	1	C3h
	1	1	↑	XXXXXXXX	0	DCB1[2:0]			0	DCB0[2:0]			XX
Power Control 5	0	1	↑	XXXXXXXX	1	1	0	0	0	1	0	0	C4h
	1	1	↑	XXXXXXXX	0	DCC2[2:0]			0	DCC0[2:0]			XX
VCOM Control 1	0	↑	1	XXXXXXXX	1	1	0	0	0	1	0	1	C5h
	1	1	↑	XXXXXXXX	0	0	0	0	0	0	0	nVM	XX
	1	1	↑	XXXXXXXX	VCM_REG[7:0]								XX
	1	1	↑	XXXXXXXX	VCM_REG_EN	0	0	0	0	0	0	0	XX
	1	↑	1	XXXXXXXX	VCM_OUT[7:0]								XX
CABC Control 1	0	1	↑	XXXXXXXX	1	1	0	0	0	1	1	0	C6h

	1	1	↑	XXXXXXXX	SCD_VLINE[7:0]									XX
	1	1	↑	XXXXXXXX	0	0	0	0	0	SCD_VLINE[10:8]				XX
CABC Control 2	0	1	↑	XXXXXXXX	1	1	0	0	1	0	0	0		C8h
	1	1	↑	XXXXXXXX	0	0	0	0	0	LEDONR	LEDONPOL	PWMPOL		XX
	1	1	↑	XXXXXXXX	PWM_DIV[7:0]									XX
CABC Control 3	0	1	↑	XXXXXXXX	1	1	0	0	1	0	0	1		C9h
	1	1	↑	XXXXXXXX	THRES_MOV[3:0]				THRES_STILL[3:0]					XX
CABC Control 4	0	1	↑	XXXXXXXX	1	1	0	0	1	0	1	0		CAh
	1	1	↑	XXXXXXXX	0	0	0	0	THRES_UI[3:0]					XX
CABC Control 5	0	1	↑	XXXXXXXX	1	1	0	0	1	0	1	1		CBh
	1	1	↑	XXXXXXXX	DTH_MOV[3:0]				DTH_STILL[3:0]					XX
CABC Control 6	0	1	↑	XXXXXXXX	1	1	0	0	1	1	0	0		CCh
	1	1	↑	XXXXXXXX	0	0	0	0	DTH_UI[3:0]					XX
CABC Control 7	0	1	↑	XXXXXXXX	1	1	0	0	1	1	0	1		CDh
	1	1	↑	XXXXXXXX	0	DIM_MOV[2:0]			0	DIM_STILL[2:0]				XX
CABC Control 8	0	1	↑	XXXXXXXX	1	1	0	0	1	1	1	0		CEh
	1	1	↑	XXXXXXXX	DIM_MIN[3:0]				0	DIM_UI[2:0]				XX
CABC Control 9	0	1	↑	XXXXXXXX										CFh
	1	1	↑	XXXXXXXX	PWM_DIV[7:0]									XX
NV Memory Write	0	1	↑	XXXXXXXX	1	1	0	1	0	0	0	0		D0h
	1	1	↑	XXXXXXXX	0	0	0	PGM_ADR[4:0]						XX
	1	1	↑	XXXXXXXX	PGM_DATA[7:0]									XX
NV Memory Protection Key	0	1	↑	XXXXXXXX	1	1	0	1	0	0	0	1		D1h
	1	1	↑	XXXXXXXX	KEY[23:16]									XX
	0	↑	1	XXXXXXXX	KEY[15:8]									XX
	1	↑	1	XXXXXXXX	KEY[7:0]									XX
NV Memory Status Read	1	↑	1	XXXXXXXX	1	1	0	1	0	0	1	0		D2h
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X		XX
	0	1	↑	XXXXXXXX	ID2_CNT[3:0]				ID1_CNT[3:0]					XX
	1	1	↑	XXXXXXXX	VMF_CNT[3:0]				ID3_CNT[3:0]					XX
	1	1	↑	XXXXXXXX	BUSY	0	0	0	0	0	0	0		XX
	1	1	↑	XXXXXXXX	OTP_DATA[7:0]									XX
Read ID4	0	↑	1	XXXXXXXX	1	1	0	1	0	0	1	1		D3h
	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X		XX
	1	↑	1	XXXXXXXX	ID41[7:0]									XX
	1	↑	1	XXXXXXXX	ID42[7:0]									XX
	1	↑	1	XXXXXXXX	ID43[7:0]									XX
PGAMCTRL（Positive Gamma Control）	0	1	↑	XXXXXXXX	1	1	1	0	0	0	0	0		E0h
	1	1	↑	XXXXXXXX	0	0	0	0	VP0[3:0]					XX
	1	1	↑	XXXXXXXX	0	0	VP1[5:0]							XX
	1	1	↑	XXXXXXXX	0	0	VP2[5:0]							XX
	1	1	↑	XXXXXXXX	0	0	0	0	VP4[3:0]					XX
	1	1	↑	XXXXXXXX	0	0	0	VP6[4:0]						XX
	1	1	↑	XXXXXXXX	0	0	0	0	VP13[3:0]					XX
	1	1	↑	XXXXXXXX	0	VP20[6:0]								XX
	1	1	↑	XXXXXXXX	VP36[3:0]				VP27[3:0]					XX
	1	1	↑	XXXXXXXX	0	VP43[6:0]								XX
	1	1	↑	XXXXXXXX	0	0	0	0	VP50[3:0]					XX
	1	1	↑	XXXXXXXX	0	0	0	VP57[4:0]						XX
	1	1	↑	XXXXXXXX	0	0	0	0	VP59[3:0]					XX
	1	1	↑	XXXXXXXX	0	0	VP61[5:0]							XX
	1	1	↑	XXXXXXXX	0	0	VP62[5:0]							XX
	1	1	↑	XXXXXXXX	0	0	0	0	VP63[3:0]					XX
NGAMCTRL（Negative Gamma Control）	0	1	↑	XXXXXXXX	1	1	1	0	0	0	0	1		E1h
	1	1	↑	XXXXXXXX	0	0	0	0	VN0[3:0]					XX
	1	1	↑	XXXXXXXX	0	0	VN1[5:0]							XX
	1	1	↑	XXXXXXXX	0	0	VN2[5:0]							XX

	1	1	↑	XXXXXXXX	0		0	0	0	VN4[3:0]				XX
	1	1	↑	XXXXXXXX	0		0	0	VN6[4:0]					XX
	1	1	↑	XXXXXXXX	0		0	0		VN13[3:0]				XX
	1	1	↑	XXXXXXXX	0	VN20[6:0]								XX
	1	1	↑	XXXXXXXX	VN36[3:0]					VN27[3:0]				XX
	1	1	↑	XXXXXXXX	0	VN43[6:0]								XX
	1	1	↑	XXXXXXXX	0		0	0	0	VN50[3:0]				XX
	1	1	↑	XXXXXXXX	0		0	0	VN57[4:0]					XX
	1	1	↑	XXXXXXXX	0		0	0	0	VN59[3:0]				XX
	1	1	↑	XXXXXXXX	0		0	VN61[5:0]						XX
	1	1	↑	XXXXXXXX	0		0	VN62[5:0]						XX
	1	1	↑	XXXXXXXX	0		0	0	0	VN63[3:0]				XX
Digital Gamma Control 1	0	1	↑	XXXXXXXX	1		1	1	0	0	0	0	1	E2h
	1	1	↑	XXXXXXXX	RCA0[3:0]					BCA0[3:0]				XX
	1	1	↑	XXXXXXXX	RCAx[3:0]					BCAx[3:0]				XX
	1	1	↑	XXXXXXXX	RCA63[3:0]					BCA63[3:0]				XX
Digital Gamma Control 2	0	1	↑	XXXXXXXX	1		1	1	0	0	0	0	1	E3h
	1	1	↑	XXXXXXXX	RFA0[3:0]					BFA0[3:0]				XX
	1	1	↑	XXXXXXXX	RFAx[3:0]					BFAx[3:0]				XX
	1	1	↑	XXXXXXXX	RFA255[3:0]					BFA255[3:0]				XX
SPI Read Command Setting	0	1	↑	XXXXXXXX	1	1	1	1		1	0	1	1	FBh
	1	1	↑	XXXXXXXX	0	0	0	SPI_READ_EN		SPI_CNT[3:0]				XX

8.2. Command Description

8.2.1. NOP (00h)

00h	NOP (No Operation)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	0	0	0	0	0	0	00h
Parameter	No parameter												
Description	This command is an empty command; it does not have any effect on ILI9486L. However it can be used to terminate Frame Memory Write or Read as described in RAMWR (Memory Write) and RAMRD (Memory Read) Commands. X = Don't care.												
Restriction	None												
Register Availability													

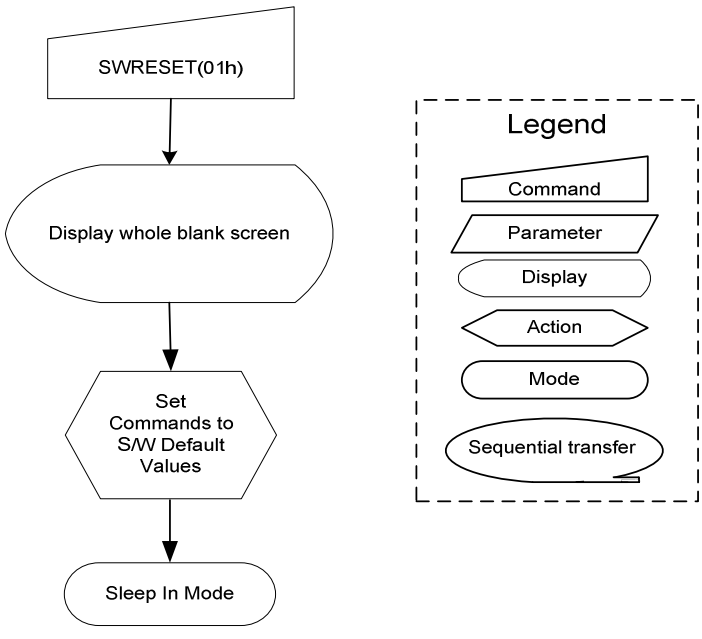
Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
Power On Sequence	N/A
SW Reset	N/A
HW Reset	N/A

Flow Chart	None

8.2.2. Soft Reset (01h)

01h	SWRESET (Soft Reset)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	0	0	0	0	0	1	01h
Parameter	No parameter												
Description	When the Software Reset command is written, it causes software reset. It resets the commands and parameters to their S/W Reset default values. (See default tables in each command description.) The display is blank immediately Note: The Frame Memory contents is kept or not by this command. X = Don't care												
Restriction	It will be necessary to wait 5msec before sending new command following software reset. The display module loads all display supplier factory default values to the registers during this 5msec. If Software Reset is applied during Sleep Out mode, it will be necessary to wait 120msec before sending Sleep out command. Software Reset Command cannot be sent during Sleep Out sequence.												
Register Availability													
Default													
Flow Chart													

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
Power On Sequence	N/A
SW Reset	N/A
HW Reset	N/A

8.2.3. Read display identification information (04h)

04h	RDDIDIF (Read Display Identification Information)												
	D/CX	RDX	WRX	D[17:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XX	0	0	0	0	0	1	0	0	04h
1st Parameter	1	↑	1	XX	X	X	X	X	X	X	X	X	X
2ndParameter	1	↑	1	XX	ID1 [7:0]								XX
3rd Parameter	1	↑	1	XX	ID2 [7:0]								XX
4th Parameter	1	↑	1	XX	ID3 [7:0]								XX
Description	This read byte returns 24 bits display identification information. The 1st parameter is dummy data. The 2nd parameter (ID1 [7:0]): LCD module's manufacturer ID. The 3rd parameter (ID2 [7:0]): LCD module/driver version ID. The 4th parameter (ID3 [7:0]): LCD module/driver ID.												
Restriction													

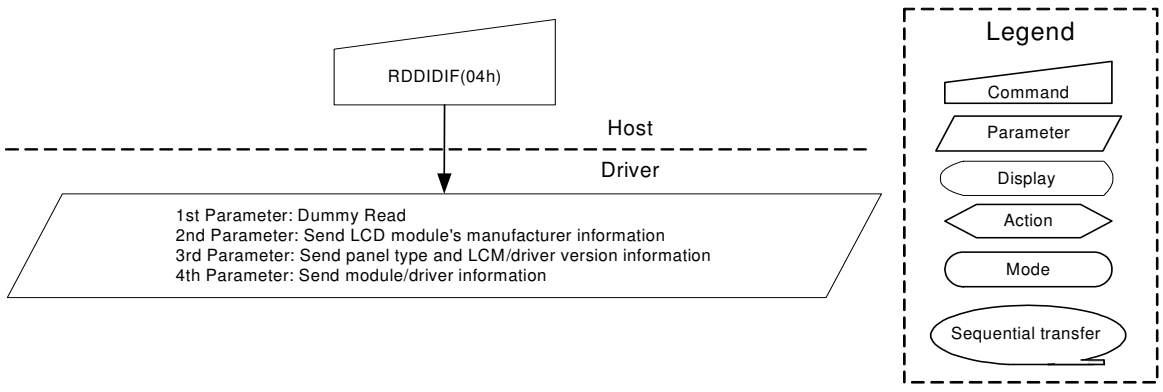
Register Availability

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
Power On Sequence	See description
SW Reset	See description
HW Reset	See description

Flow Chart



8.2.4. Read Number of the Errors on DSI (05h)

05h	RDNUMED (Read Number of the Errors on DSI)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	0	0	0	1	0	1	05h
1st Parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2nd Parameter	1	↑	1	XXXXXXXX	P[7:0]								XX

Description

The second parameter is telling a number of the errors on DSI. The more detailed description of the bits is below.

P [6..0] bits are telling a number of the errors.

P [7] is set to '1' if there is overflow with P[6..0] bits.

P [7...0] bits are set to '0's (as well as RDDSM(0Eh)'s D0 is set '0' at the same time) after there is sent the second parameter information (= The read function is completed).

This function is always returning P [7...0] = 00h if the parallel MCU interface is selected.

X = can be '0' or '1'

Restriction

ILI9486L is sending 2nd parameter value on the data lines if the MCU wants to read more than one parameter (= more than 2 RDX cycle) on parallel MCU interface.

Only 2nd parameter is sent on DSI (The 1st parameter is not sent).

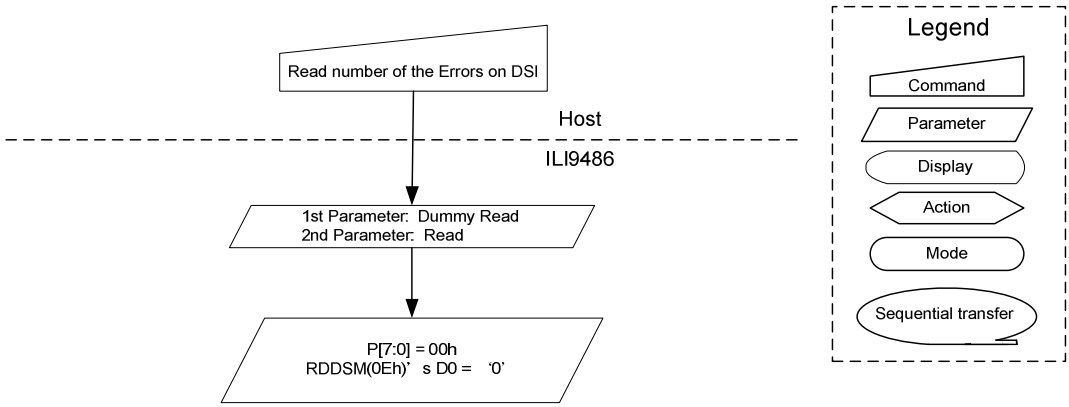
Register Availability

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
Power On Sequence	08_{HEX}
SW Reset	08_{HEX}
HW Reset	08_{HEX}

Flow Chart



8.2.5. Read Display Status (09h)

09h	RDDST (Read Display Status)												
	D/CX	RDX	WRX	D17-8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XX	0	0	0	0	1	0	0	1	09h
1st Parameter	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
2nd Parameter	1	↑	1	XX	D [31:25]							0	XX
3rd Parameter	1	↑	1	XX	0	D [22:20]			D [19:16]				XX
4th Parameter	1	↑	1	XX	D15	0	D13	0	0	D [10:8]			XX
5th Parameter	1	↑	1	XX	D [7:5]			0	0	0	0	0	XX

Description

This command indicates the current status of the display as described in the table below:

Bit	Description	Value	Status
D31	Booster voltage status	0	Booster OFF
		1	Booster ON
D30	Row address order	0	Top to Bottom (When MADCTL B7='0')
		1	Bottom to Top (When MADCTL B7='1')
D29	Column address order	0	Left to Right (When MADCTL B6='0').
		1	Right to Left (When MADCTL B6='1').
D28	Row/column exchange	0	Normal Mode (When MADCTL B5='0').
		1	Reverse Mode (When MADCTL B5='1').
D27	Vertical refresh	0	LCD Refresh Top to Bottom (When MADCTL B4='0')
		1	LCD Refresh Bottom to Top (When MADCTL B4='1').
D26	RGB/BGR order	0	RGB (When MADCTL B3='0')
		1	BGR (When MADCTL B3='1')
D25	Horizontal refresh order	0	LCD Refresh Left to Right (When MADCTL B2='0')
		1	LCD Refresh Right to Left (When MADCTL B2='1')
D24	Not used	0	---
D23	Not used	0	---
D22	Interface color pixel format definition	011	12-bit/pixel
D21		101	16-bit/pixel
D20		110	18-bit/pixel
D19	Idle mode ON/OFF	0	Idle Mode OFF
		1	Idle Mode ON
D18	Partial mode ON/OFF	0	Partial Mode OFF
		1	Partial Mode ON.
D17	Sleep IN/OUT	0	Sleep IN Mode
		1	Sleep OUT Mode.
D16	Display normal mode ON/OFF	0	Display Normal Mode OFF.
		1	Display Normal Mode ON.
D15	Vertical scrolling status	0	Vertical Scroll OFF
		1	Vertical Scroll ON
D14	Not used	0	---
D13	Inversion status	0	Inversion OFF
		1	Inversion ON
D12	All pixel ON	0	Not defined
D11	All pixel OFF	0	Not defined
D10	Display ON/OFF	0	Display is OFF
		1	Display is ON
D9	Tearing effect line ON/OFF	0	Tearing Effect Line OFF
		1	Tearing Effect ON
D[8:6]	Gamma curve selection	000	GC0
		001	GC1
		010	GC2
		011	GC3
		other	Not defined

	D5	Tearing effect line mode	0	Mode 1, V-Blanking only
			1	Mode 2, both H-Blanking and V-Blanking.
	D4	Not used	0	---
	D3	Not used	0	---
	D2	Not used	0	---
	D1	Not used	0	---
	D0	Not used	0	---

X = Don't care

Restriction

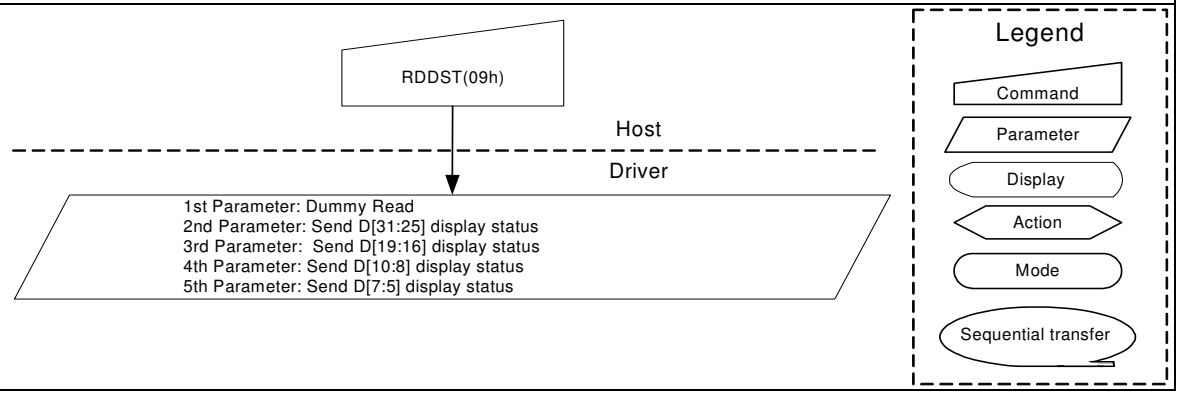
Register Availability

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
Power On Sequence	32'h00610000h
SW Reset	32'h00610000h
HW Reset	32'h00610000h

Flow Chart



8.2.6. Read Display Power Mode (0Ah)

0Ah	RDDPM (Read Display Power Mode)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	0	0	1	0	1	0	0Ah
1st Parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2nd Parameter	1	↑	1	XXXXXXXX	D[7:2]						0	0	XX

Description

This command indicates the current status of the display as described in the table below:

Bit	Description	Comment
D7	Booster Voltage Status	
D6	Idle Mode On/Off	
D5	Partial Mode On/Off	
D4	Sleep In/Out	
D3	Display Normal Mode On/Off	
D2	Display On/Off	
D1	Not Defined	Set to '0'
D0	Not Defined	Set to '0'

Bit D7 – Booster Voltage Status

'0' = Booster Off or has a fault.

'1' = Booster On and working OK.

Bit D6 - Idle Mode On/Off

'0' = Idle Mode Off.

'1' = Idle Mode On.

Bit D5 – Partial Mode On/Off

'0' = Partial Mode Off.

'1' = Partial Mode On.

Bit D4 – Sleep In/Out

'0' = Sleep In Mode.

'1' = Sleep Out Mode.

Bit D3 – Display Normal Mode On/Off

'0' = Display Normal Mode Off.

'1' = Display Normal Mode On.

Bit D2 – Display On/Off

'0' = Display is Off.

'1' = Display is On.

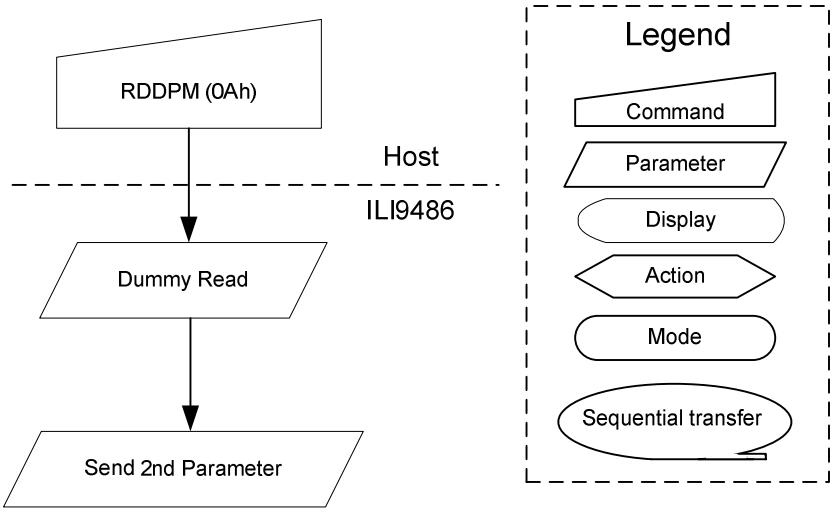
Bit D1 – Not Defined

'This bit is not applicable for this project, so it is set to '0'

Bit D0 – Not Defined

'This bit is not applicable for this project, so it is set to '0'

X = Don't care

<table>
<tr><td>Restriction</td><td>ILI9486L is sending 2nd parameter value on the data lines if the MCU wants to read more than one parameter (= more than 2 RDX cycle) on parallel MCU interface.
Only 2nd parameter is sent on DSI (The 1st parameter is not sent).</td></tr>
<tr><td>Register Availability</td><td>
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table>
</td></tr>
<tr><td>Default</td><td>
<table>
<tr><th>Status</th><th>Default Value</th></tr>
<tr><td>Power On Sequence</td><td>08_{HEX}</td></tr>
<tr><td>SW Reset</td><td>08_{HEX}</td></tr>
<tr><td>HW Reset</td><td>08_{HEX}</td></tr>
</table>
</td></tr>
<tr><td>Flow Chart</td><td> 
</td></tr>
</table>

8.2.7. Read Display MADCTL (0Bh)

0Bh	RDDMADCTL (Read Display MADCTL)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	0	0	1	0	1	1	0Bh
1st Parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2nd Parameter	1	↑	1	XXXXXXXX	D[7:2]						0	0	XX

Description

This command indicates the current status of the display as described in the table below:

Bit	Description	Comment
D7	Page Address Order	
D6	Column Address Order	
D5	Page/Column Order	
D4	Line Address Order	
D3	RGB/BGR Order	
D2	Display Data Latch Data Order	
D1	Reserved	Set to '0'
D0	Reserved	Set to '0'

- Bit D7 – Page Address Order
  '0' = Top to Bottom
  '1' = Bottom to Top
- Bit D6 – Column Address Order
  '0' = Left to Right
  '1' = Right to Left
- Bit D5 - Page/Column Order
  '0' = Normal Mode
  '1' = Reverse Mode
  Note: For Bits D7 to D5, also refer to Section 9.3 MCU to memory write/read direction.
- Bit D4 – Line Address Order
  '0' = LCD Refresh Top to Bottom
  '1' = LCD Refresh Bottom to Top
- Bit D3 – RGB/BGR Order
  '0' = RGB
  '1' = BGR
- Bit D2 – Display Data Latch Data Order
  '0' = LCD Refresh Left to Right
  '1' = LCD Refresh Right to Left

Restriction

ILI9486L is sending 2nd parameter value on the data lines if the MCU wants to read more than one parameter (= more than 2 RDX cycle) on parallel MCU interface.

Only 2nd parameter is sent on DSI (The 1st parameter is not sent).

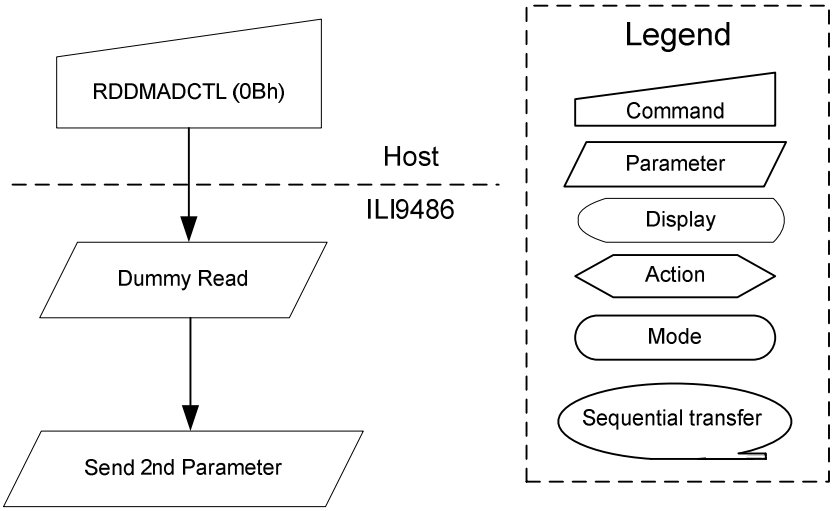
Register Availability

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
Power On Sequence	00_{HEX}
SW Reset	**No Change**
HW Reset	00_{HEX}

Flow Chart



8.2.8. Read Display Pixel Format (0Ch)

0Ch	RDDCOLMOD (Read Display COLMOD)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	0	0	1	1	0	0	0Ch
1st Parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2nd Parameter	1	↑	1	XXXXXXXX	DPI[3:0]				0	DBI[2:0]			XX

Description

This command indicates the current status of the display as described in the table below:

DPI[3:0]				RGB Interface Format
0	0	0	0	Reserved
0	0	0	1	Reserved
0	0	1	0	Reserved
0	0	1	1	Reserved
0	1	0	0	Reserved
0	1	0	1	16 bits / pixel
0	1	1	0	18 bits / pixel
0	1	1	1	Reserved

DBI[2:0]			CPU Interface Format
0	0	0	Reserved
0	0	1	Reserved
0	1	0	Reserved
0	1	1	Reserved
1	0	0	Reserved
1	0	1	16 bits / pixel
1	1	0	18 bits / pixel
1	1	1	Reserved

Restriction

ILI9486L is sending 2nd parameter value on the data lines if the MCU wants to read more than one parameter (= more than 2 RDX cycle) on parallel MCU interface.

Only 2nd parameter is sent on DSI (The 1st parameter is not sent).

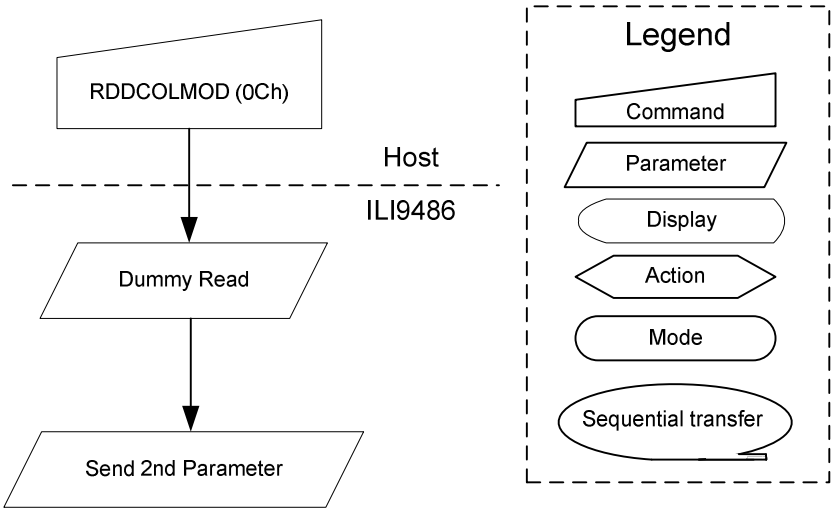
Register Availability

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
Power On Sequence	06_{HEX}
SW Reset	**No Change**
HW Reset	06_{HEX}

Flow Chart



8.2.9. Read Display Image Mode (0Dh)

0Dh	RDDIM (Read Display Image Mode)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	0	0	1	1	0	1	0Dh
1st Parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2nd Parameter	1	↑	1	XXXXXXXX	D[7:0]								XX

Description

ILI9486L returns the Display Image Mode status.

Bit	Description
D7	Vertical Scrolling Status
D6	Reserved
D5	Inversion On/Off
D4	Reserved
D3	Reserved
D2	Gamma Curve Selection
D1	Gamma Curve Selection
D0	Gamma Curve Selection

This command indicates the current status of the display as described in the table below:

- Bit D7 – Vertical Scrolling On/Off

  '0' = Vertical Scrolling is Off.

  '1' = Vertical Scrolling is On.
- Bit D6 – Reserved
- Bit D5 – Inversion On/Off

  '0' = Inversion is Off.

  '1' = Inversion is On.
- Bit D4 – Reserved
- Bit D3 – Reserved
- Bits D2, D1, D0 – Gamma Curve Selection

  These bits are not applicable for this project, so they are set to '000', only support Gamma 2.2.

Restriction

ILI9486L is sending 2nd parameter value on the data lines if the MCU wants to read more than one parameter (= more than 2 RDX cycle) on parallel MCU interface.

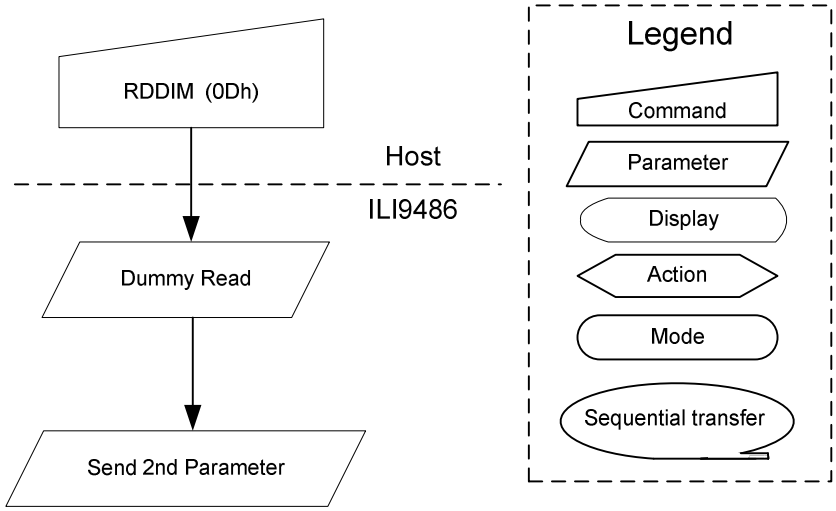
Only 2nd parameter is sent on DSI (The 1st parameter is not sent).

Register 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
Power On Sequence	00_{HEX}
SW Reset	00_{HEX}
HW Reset	00_{HEX}

Flow Chart	

8.2.10. Read Display Signal Mode (0Eh)

0Eh	RDDSM (Read Display Signal Mode)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	0	0	1	1	1	0	0Eh
1st Parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2nd Parameter	1	↑	1	XXXXXXXX	D7	D6	D5	D4	D3	D2	D1	D0	XX

Description

This command indicates the current status of the display as described in the table below:

Bit	Value	Function
D7	0	Tearing Effect Line OFF
	1	Tearing Effect Line ON
D6	0	Tearing Effect Line Mode 1
	1	Tearing Effect Line Mode 2
D5	0	Horizontal Sync (RGB interface) OFF
	1	Horizontal Sync (RGB interface) ON
D4	0	Vertical Sync (RGB interface) OFF
	1	Vertical Sync (RGB interface) ON
D3	0	Pixel Clock (DOTCLK, RGB interface) OFF
	1	Pixel Clock (DOTCLK, RGB interface) ON
D2	0	Data Enable (DE, RGB interface) OFF
	1	Data Enable (DE, RGB interface) ON
D1	0	Reserved
	1	Reserved
D0	0	No Error on DSI
	1	Error on DSI

Restriction

ILI9486L is sending 2nd parameter value on the data lines if the MCU wants to read more than one parameter (= more than 2 RDX cycle) on parallel MCU interface.

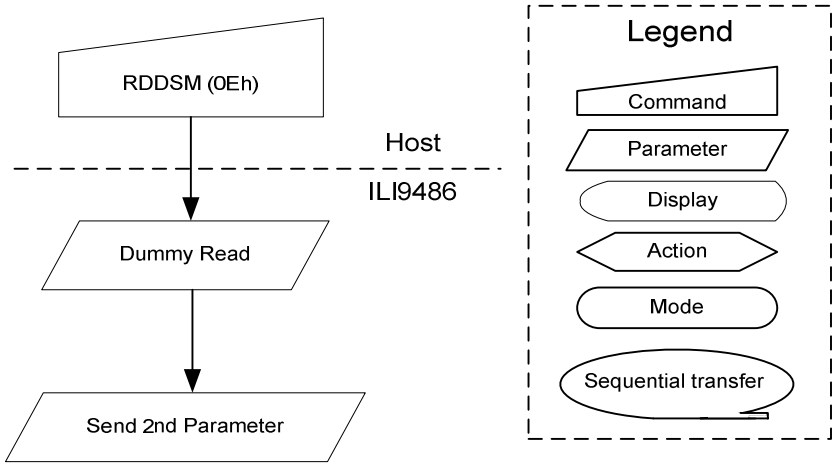
Only 2nd parameter is sent on DSI (The 1st parameter is not sent).

Register 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
Power On Sequence	00_{HEX}
SW Reset	00_{HEX}
HW Reset	00_{HEX}

Flow Chart	

8.2.11. Read Display Self-Diagnostic Result (0Fh)

0Fh	RDDSDR (Read Display Self-Diagnostic Result)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	0	0	1	1	1	1	0Fh
1st Parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2nd Parameter	1	↑	1	XXXXXXXX	D7	D6	0	0	0	0	0	D0	XX

Description

This command indicates the status of the display self-diagnostic results after Sleep Out -command as described in the table below:

Bit	Description	Action
D7	Register Loading Detection	Invert the D7 bit if register values loading work properly.
D6	Functionality Detection	Invert the D6 bit if the display is functionality
D5	Not Used	'0'
D4	Not Used	'0'
D3	Not Used	'0'
D2	Not Used	'0'
D1	Not Used	'0'
D0	Checksums Comparison	'0' = Checksums are same '1' = Checksums are not same

Restriction

It will be necessary to wait 300ms after there is the last write access on User area registers before there can read Bit D0 value.

ILI9486L is sending 2nd parameter value on the data lines if the MCU wants to read more than one parameter (= more than 2 RDX cycle) on parallel MCU interface.

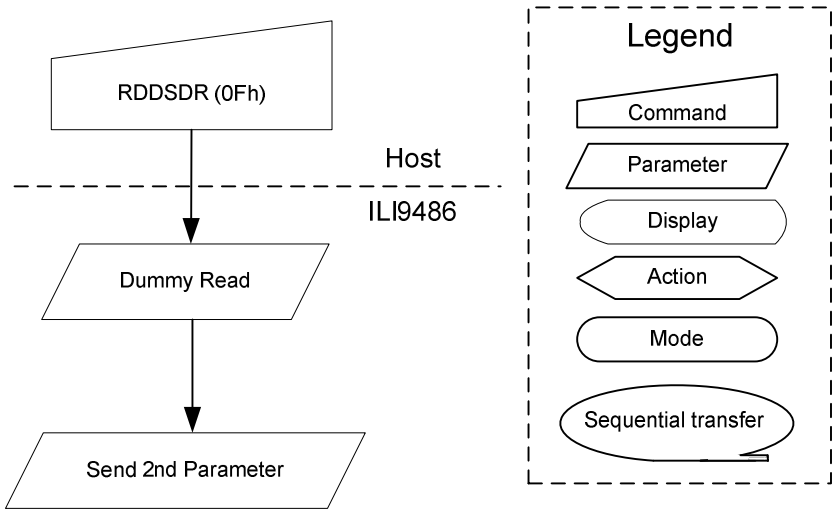
Only 2nd parameter is sent on DSI (The 1st parameter is not sent).

Register 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
Power On Sequence	00_{HEX}
SW Reset	00_{HEX}
HW Reset	00_{HEX}

Flow Chart	

8.2.12. Sleep IN (10h)

10h	SLPIN (Sleep IN)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	0	1	0	0	0	0	10h
Parameter	No parameter												
Description	This command causes ILI9486L to enter the minimum power consumption mode. In this mode e.g. the DC/DC converter is stopped, Internal oscillator is stopped, and panel scanning is stopped. Out → Blank → STOP MCU interface and memory are still working and the memory keeps its contents. Dimming function does not work when there is changing mode from Sleep OUT to Sleep IN. X = Don't care												
Restriction	This command has no effect when module is already in sleep in mode. Sleep In Mode can only be left by the Sleep Out Command (11h). It will be necessary to wait 5msec before sending next command; this is to allow time for the supply voltages and clock circuits to stabilize. It will be necessary to wait 120msec after sending Sleep Out command (when in Sleep In Mode) before Sleep In command can be sent.												

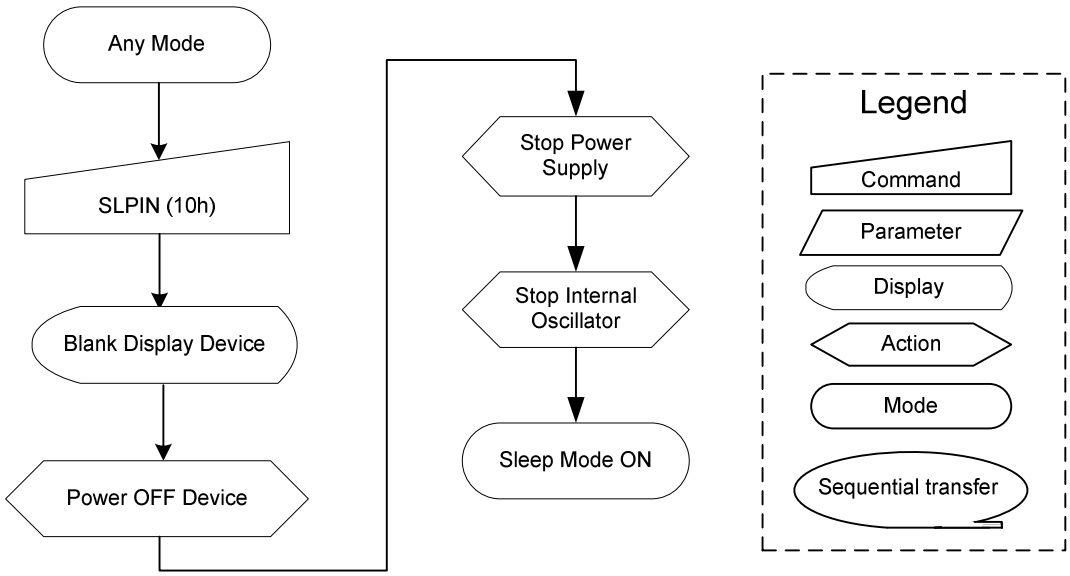
Register Availability

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

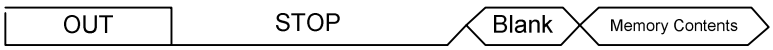
Default

Status	Default Value
Power On Sequence	Sleep IN Mode
SW Reset	Sleep IN Mode
HW Reset	Sleep IN Mode

Flow Chart



8.2.13. Sleep OUT (11h)

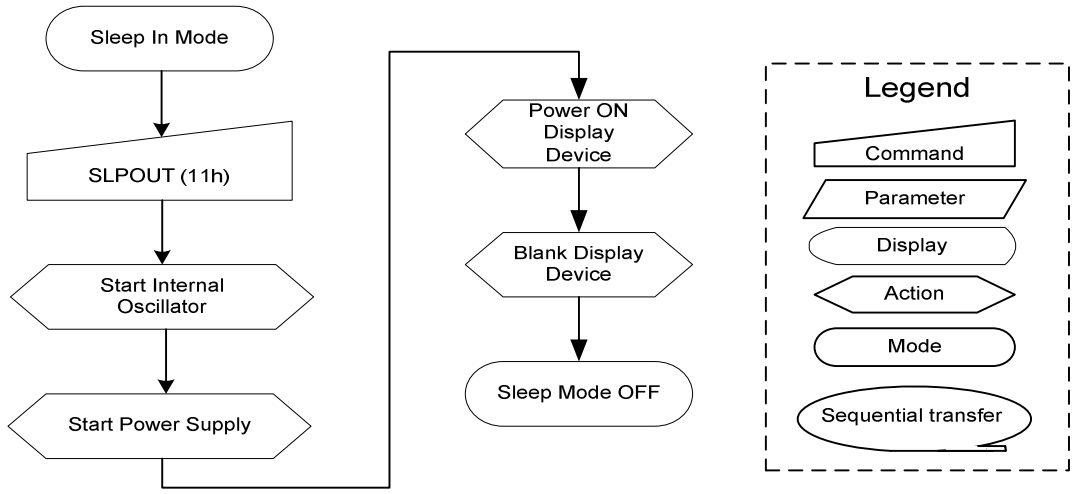
11h	SLPOUT (Sleep OUT)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	0	1	0	0	0	1	11h
Parameter	No parameter												
Description	This command turns off sleep mode. In this mode e.g. the DC/DC converter is enabled, Internal oscillator is started, and panel scanning is started.  X = Don't care												
Restriction	Sleep Out Mode can only be left by the Sleep In Command (10h). It will be necessary to wait 5msec before sending next command; this is to allow time for the supply voltages and clock circuits to stabilize. ILI9486L loads all display supplier's factory default values to the registers during this 5msec and there cannot be any abnormal visual effect on the display image if factory default and register values are same when this load is done and when ILI9486L is already Sleep Out –mode. ILI9486L is doing self-diagnostic functions during this 5msec. It will be necessary to wait 120msec after sending Sleep In command (when in Sleep Out mode) before Sleep Out command can be sent.												
Register 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
Power On Sequence	Sleep IN Mode
SW Reset	Sleep IN Mode
HW Reset	Sleep IN Mode

Flow Chart



8.2.14. Partial Mode ON (12h)

12h	PTLON (Partial Mode ON)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	0	1	0	0	1	0	12h
Parameter	No parameter												
Description	This command turns on partial mode The partial mode window is described by the Partial Area command (30H). To leave Partial mode, the Normal Display Mode On command (13H) should be written.												
Restriction	This command has no effect when Partial Display Mode is already active.												
Register 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
Power On Sequence	Sleep IN Mode
SW Reset	Sleep IN Mode
HW Reset	Sleep IN Mode

Flow Chart	See Partial Area (30h)

8.2.15. Normal Display Mode ON (13h)

13h	NORON (Normal Display Mode ON)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	0	1	0	0	1	1	13h
Parameter	No parameter												
Description	This command returns the display to normal mode. Normal display mode on means Partial mode off and Scroll mode off. X = Don't care												
Restriction	This command has no effect when Normal Display mode is active.												
Register Availability													

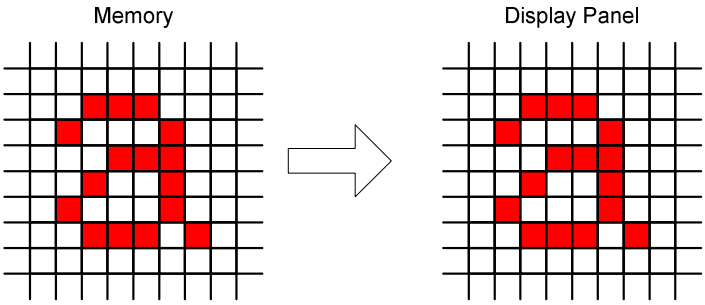
Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value
Power On Sequence	Normal Display Mode On
SW Reset	Normal Display Mode On
HW Reset	Normal Display Mode On

Flow Chart	See Partial Area Descriptions for details of when to use this command.

8.2.16. Display Inversion OFF (20h)

20h	INVOFF (Display Inversion OFF)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	1	0	0	0	0	0	20h
Parameter	No parameter												
Description	This command is used to recover from display inversion mode. Output from the Frame Memory is enabled. This command makes no change of the content of frame memory. This command doesn't change any other status.  X = Don't care												
Restriction	This command has no effect when ILI9486L is already in Inversion off mode.												

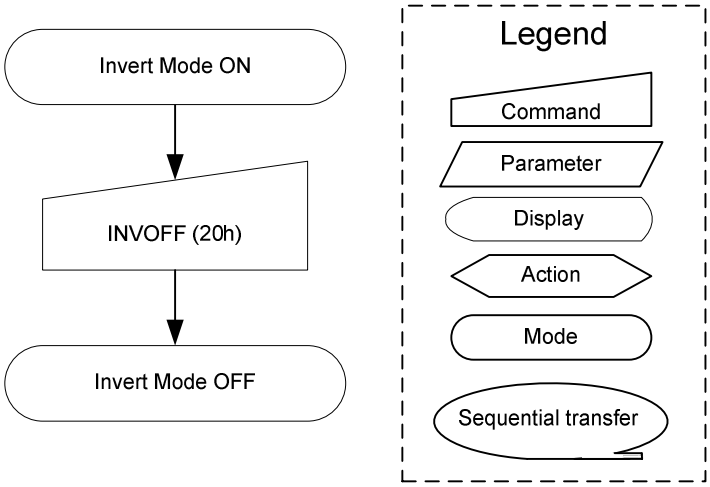
Register Availability

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

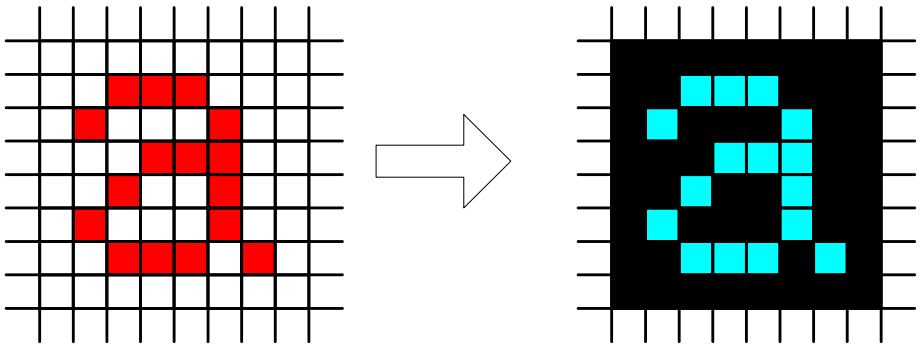
Default

Status	Default Value
Power On Sequence	Display Inversion OFF
SW Reset	Display Inversion OFF
HW Reset	Display Inversion OFF

Flow Chart



8.2.17. Display Inversion ON (21h)

21h	INVON (Display Inversion ON)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	1	0	0	0	0	1	21h
Parameter	No parameter												
Description	This command is used to enter into display inversion mode. This command makes no change of the content of frame memory. Every bit is inverted from the frame memory to the display. This command doesn't change any other status. To exit Display inversion mode, the Display inversion OFF command (20h) should be written.  X = Don't care												
Restriction	This command has no effect when ILI9486L is already in Inversion on mode.												

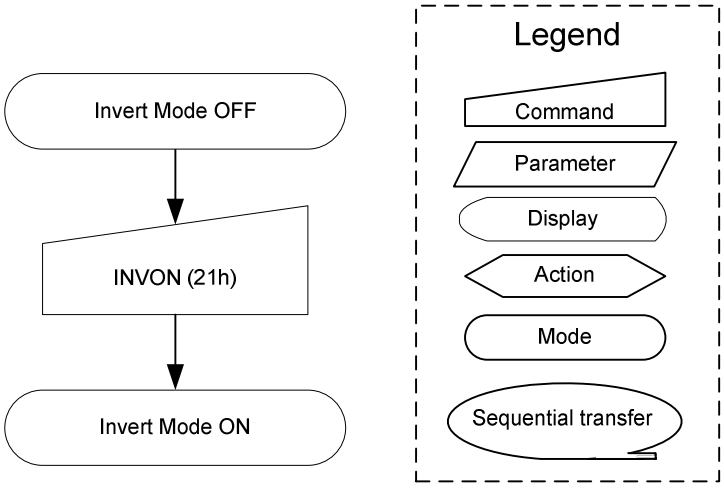
Register Availability

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

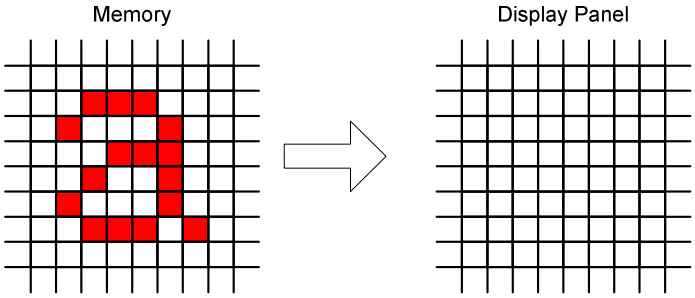
Default

Status	Default Value
Power On Sequence	Display Inversion OFF
SW Reset	Display Inversion OFF
HW Reset	Display Inversion OFF

Flow Chart



8.2.18. Display OFF (28h)

28h	DISOFF (Display OFF)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	1	0	1	0	0	0	28h
Parameter	No parameter												
Description	This command causes ILI9486L to stop displaying the image data on the display device. The frame memory contents remain unchanged. No status bits are changed.  X = Don't care												
Restriction	This command has no effect when ILI9486L is already in Display off mode.												

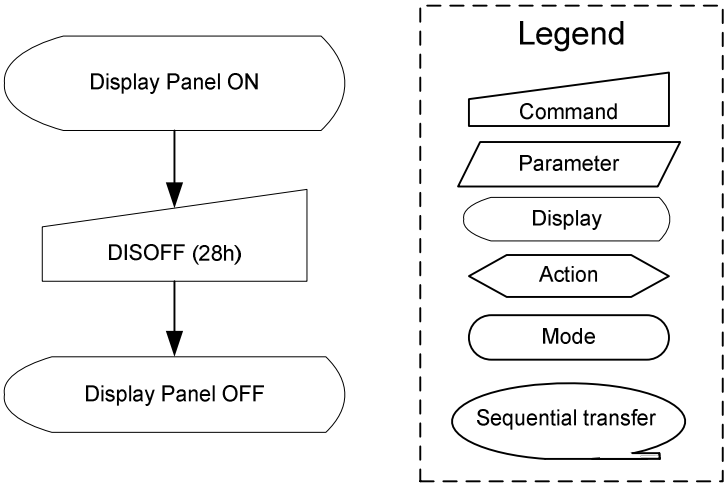
Register Availability

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

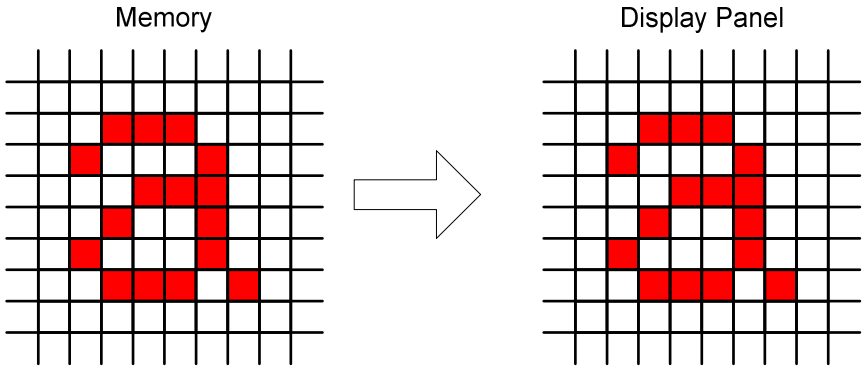
Default

Status	Default Value
Power On Sequence	Display OFF
SW Reset	Display OFF
HW Reset	Display OFF

Flow Chart



8.2.19. Display ON (29h)

29h	DISON (Display ON)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	1	0	1	0	0	1	29h
Parameter	No parameter												
Description	This command causes ILI9486L to start displaying the image data on the display device. The frame memory contents remain unchanged. No status bits are changed.  X = Don't care												
Restriction	This command has no effect when ILI9486L is already in Display on mode.												

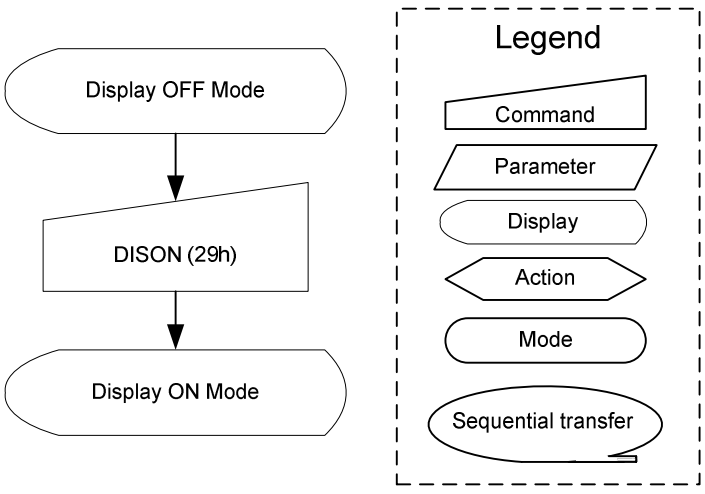
Register Availability

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
Power On Sequence	Display OFF
SW Reset	Display OFF
HW Reset	Display OFF

Flow Chart

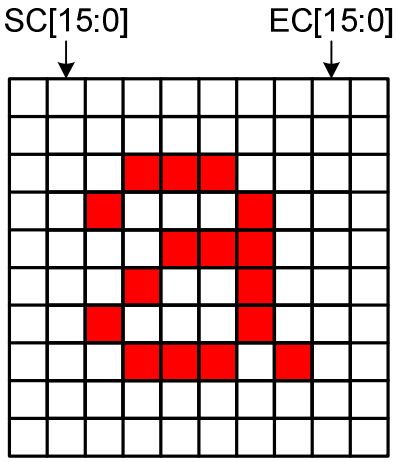


8.2.20. Column Address Set (2Ah)

2Ah	CASET (Column Address Set)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	1	0	1	0	1	0	2Ah
1st Parameter	1	1	↑	XXXXXXXX	SC[15:8]								XX
2nd Parameter	1	1	↑	XXXXXXXX	SC[7:0]								XX
3rd Parameter	1	1	↑	XXXXXXXX	EC[15:8]								XX
4th Parameter	1	1	↑	XXXXXXXX	EC[7:0]								XX

Description

This command is used to define area of frame memory where MCU can access. This command makes no change on the other driver status. The values of SC[15:0] and EC[15:0] are referred when RAMWR command comes. Each value represents one column line in the Frame Memory.



Restriction

SC[15:0] always must be equal to or less than EC[15:0].

Note 1: When SC[15:0] or EC[15:0] is greater than 013Fh (When MADCTL's B5 = 0) or 01DFh (When MADCTL's B5 = 1), data of out of range will be ignored

Register Availability

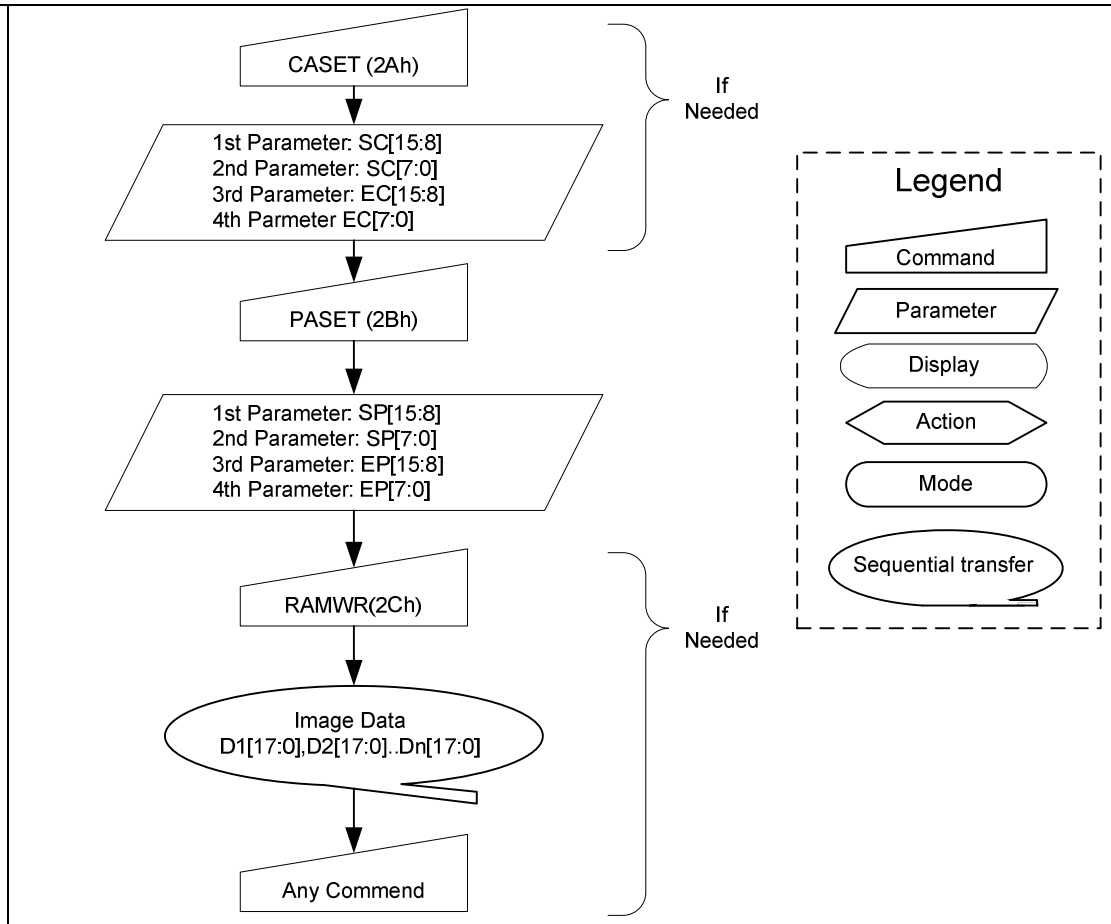
Status	Availability
Normal Mode On, Idle Mode Off, Sleep Out	Yes
Normal Mode On, Idle Mode On, Sleep Out	Yes
Partial Mode On, Idle Mode Off, Sleep Out	Yes
Partial Mode On, Idle Mode On, Sleep Out	Yes
Sleep In	Yes

Default

Status	Default Value	
Power On Sequence	SC[15:0]=0000h	EC[15:0]=00EFh
SW Reset	SC[15:0]=0000h	If MADCTL's B5 = 0: EC[15:0]=013Fh If MADCTL's B5 = 1: EC[15:0]=01DFh
HW Reset	SC[15:0]=0000h	EC[15:0]=013Fh

如果memory access control 的MV(B5)为0则EC默认=320.
如果MV(行列交换)为1，则EC默认=480.

Flow Chart

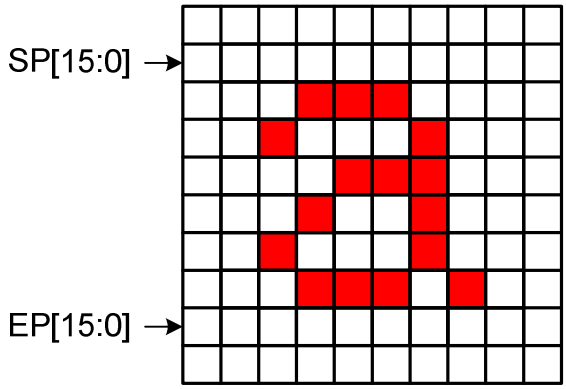


8.2.21. Page Address Set (2Bh)

2Bh	PASET (Page Address Set)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	1	0	1	0	1	1	2Bh
1st Parameter	1	1	↑	XXXXXXXX	SP[15:8]								XX
2nd Parameter	1	1	↑	XXXXXXXX	SP[7:0]								XX
3rd Parameter	1	1	↑	XXXXXXXX	EP[15:8]								XX
4th Parameter	1	1	↑	XXXXXXXX	EP[7:0]								XX

Description

This command is used to define area of frame memory where MCU can access. This command makes no change on the other driver status. The values of SP[15:0] and EP[15:0] are referred when RAMWR command comes. Each value represents one Page line in the Frame Memory.



X = don't care

Restriction

SP[15:0] always must be equal to or less than EP[15:0]

When SP[15:0] or EP[15:0] is greater than 01DFh (When MADCTL's B5 = 0) or 013Fh (When MADCTL's B5 = 1), data of out of range will be ignored.

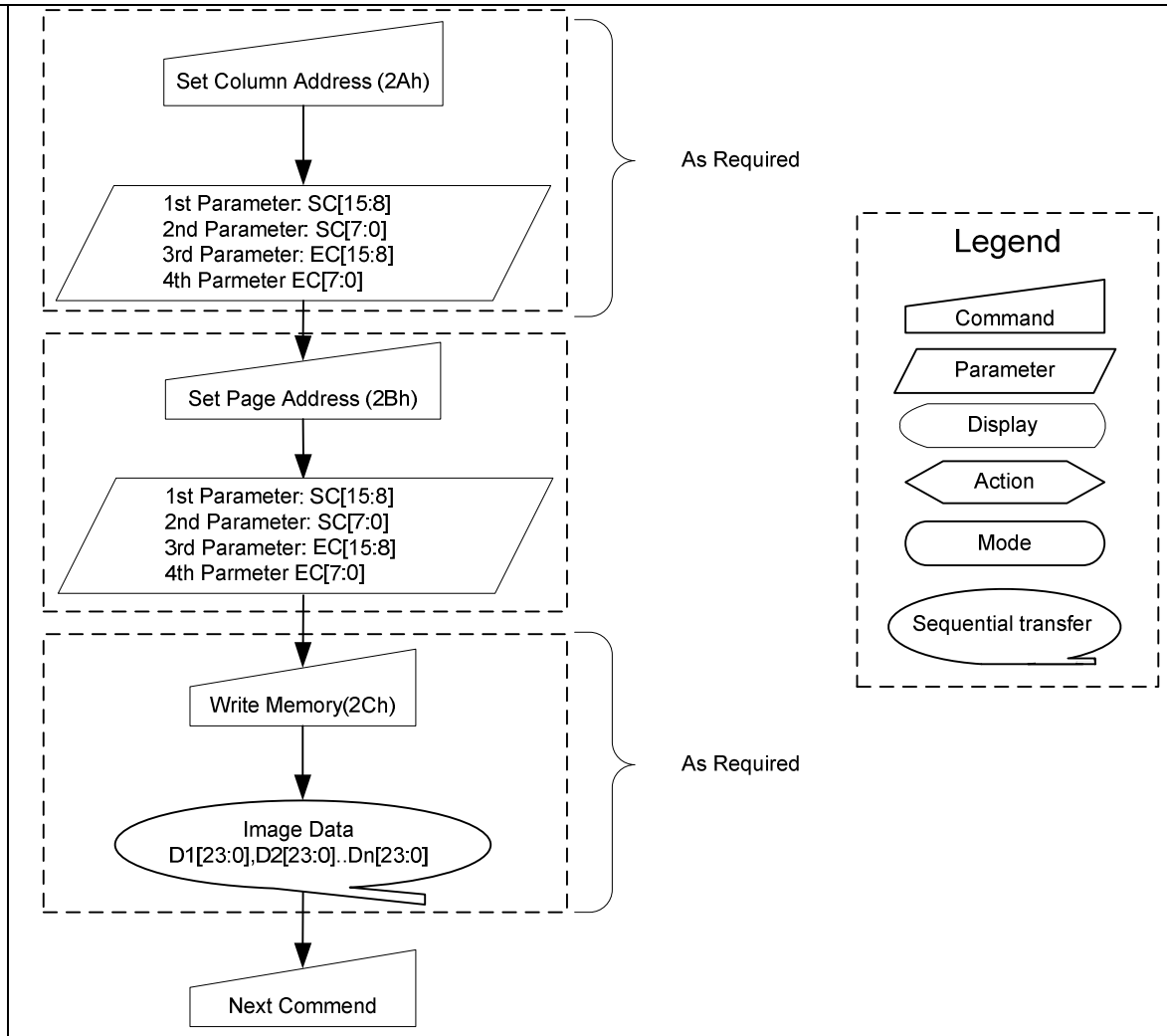
Register Availability

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	
Power On Sequence	SP[15:0]=0000h	EP[15:0]=013Fh
SW Reset	SP[15:0]=0000h	If MADCTL's B5 = 0: EP[15:0]=01DFh If MADCTL's B5 = 1: EP[15:0]=013Fh
HW Reset	SP[15:0]=0000h	EP[15:0]=01EFh

Flow Chart



8.2.22. Memory Write (2Ch)

2Ch	RAMWR (Memory Write)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	1	0	1	1	0	0	2Ch
1st Parameter	1	1	↑	D1[15:0]									XX
:	1	1	↑	Dx[15:0]									XX
Nth Parameter	1	1	↑	Dn[15:0]									XX

Description

This command transfers image data from the host processor to ILI9486L's frame memory starting at the pixel location specified by preceding Column Address Set (2Ah) and Page Address Set (2Bh) commands.

If Memory Access Control (36h) B5 = 0:

The column and page registers are reset to the Start Column (SC) and Start Page (SP), respectively. Pixel Data 1 is stored in frame memory at (SC, SP). The column register is then incremented and pixels are written to the frame memory until the column register equals the End Column (EC) value. The column register is then reset to SC and the page register is incremented. Pixels are written to the frame memory until the page register equals the End Page (EP) value or the host processor sends another command. If the number of pixels exceeds (EC – SC + 1) * (EP – SP + 1) the extra pixels are ignored.

If Memory Access control (36h) B5 = 1:

The column and page registers are reset to the Start Column (SC) and Start Page (SP), respectively. Pixel Data 1 is stored in frame memory at (SC, SP). The page register is then incremented and pixels are written to the frame memory until the page register equals the End Page (EP) value. The page register is then reset to SP and the column register is incremented. Pixels are written to the frame memory until the column register equals the End column (EC) value or the host processor sends another command. If the number of pixels exceeds (EC – SC + 1) * (EP – SP + 1) the extra pixels are ignored.

Restriction

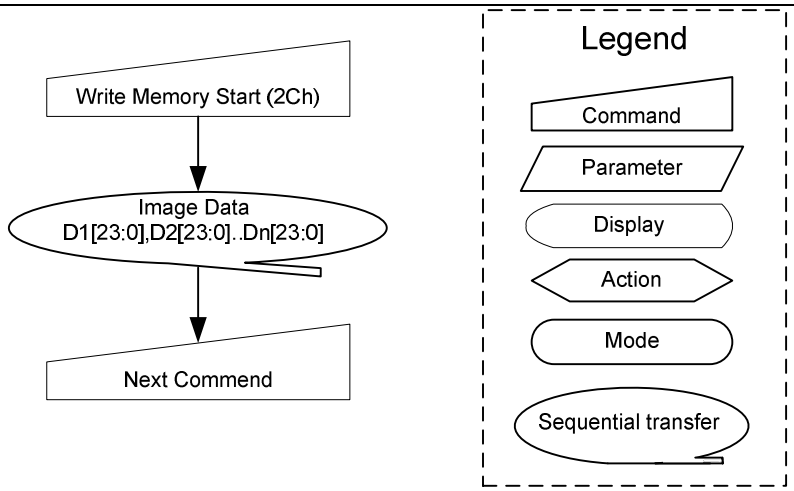
There is no restriction on length of parameters.

Register 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
Power On Sequence	Contents of memory is set randomly
SW Reset	Contents of memory is set randomly
HW Reset	Contents of memory is set randomly

Flow Chart	

8.2.23. Memory Read (2Eh)

2Eh	RAMRD (Memory Read)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	1	0	1	1	1	0	2Eh
1st Parameter	1	1	↑	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2nd Parameter	1	1	↑	D1[15:0]									XX
:	1	1	↑	Dx[15:0]									XX
(N+1)th Parameter	1	1	↑	Dn[15:0]									XX

Description

This command transfers image data from ILI9486L's frame memory to the host processor starting at the pixel location specified by preceding set_column_address and set_page_address commands.

If Memory Access control B5 = 0:

The column and page registers are reset to the Start Column (SC) and Start Page (SP), respectively. Pixels are read from frame memory at (SC, SP). The column register is then incremented and pixels read from the frame memory until the column register equals the End Column (EC) value. The column register is then reset to SC and the page register is incremented. Pixels are read from the frame memory until the page register equals the End Page (EP) value or the host processor sends another command.

If Memory Access Control B5 = 1:

The column and page registers are reset to the Start Column (SC) and Start Page (SP), respectively. Pixels are read from frame memory at (SC, SP). The page register is then incremented and pixels read from the frame memory until the page register equals the End Page (EP) value. The page register is then reset to SP and the column register is incremented. Pixels are read from the frame memory until the column register equals the End Column (EC) value or the host processor sends another command.

Restriction

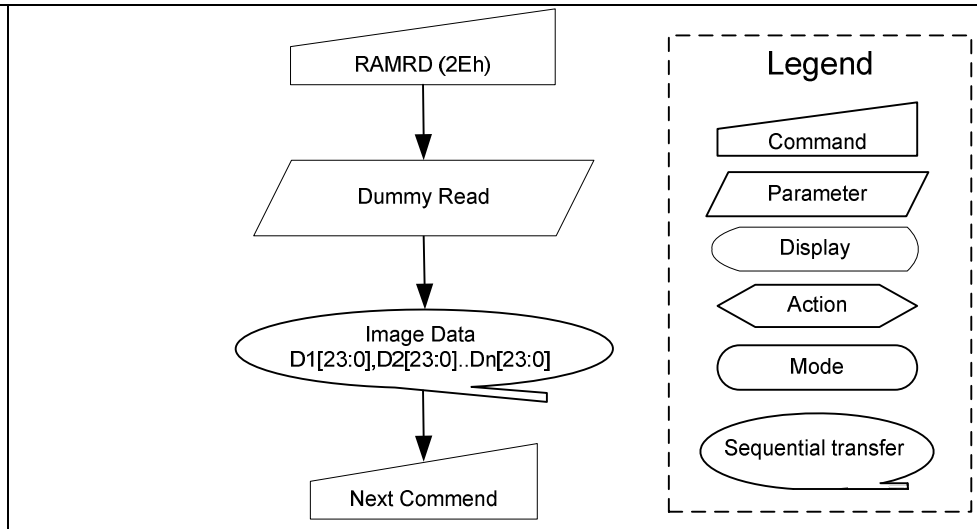
There is no restriction on length of parameters.

Register 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
Power On Sequence	Contents of memory is set randomly
SW Reset	Contents of memory is set randomly
HW Reset	Contents of memory is set randomly

Flow Chart	

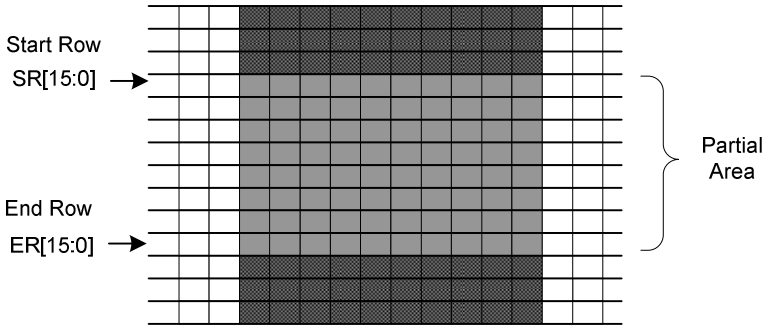
8.2.24. Partial Area (30h)

30h	PLTAR (Partial Area)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	1	1	0	0	0	0	30h
1st Parameter	1	1	↑	XXXXXXXX	SR[15:8]								XX
2nd Parameter	1	1	↑	XXXXXXXX	SR[7:0]								XX
3rd Parameter	1	1	↑	XXXXXXXX	ER[15:8]								XX
4th Parameter	1	1	↑	XXXXXXXX	ER[7:0]								XX

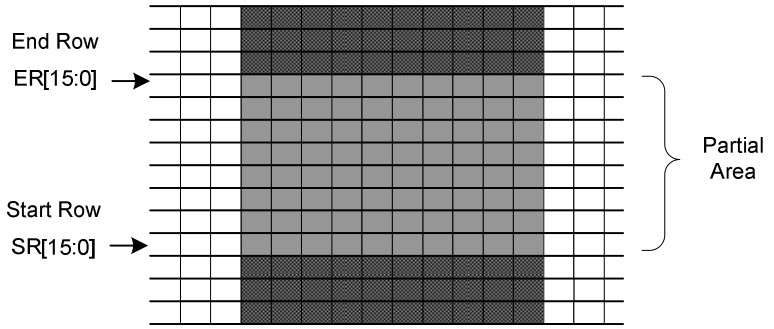
Description

This command defines the Partial Display mode's display area. There are two parameters associated with this command, the first defines the Start Row (SR) and the second the End Row (ER), as illustrated in the following figure. SR and ER refer to the Frame Memory

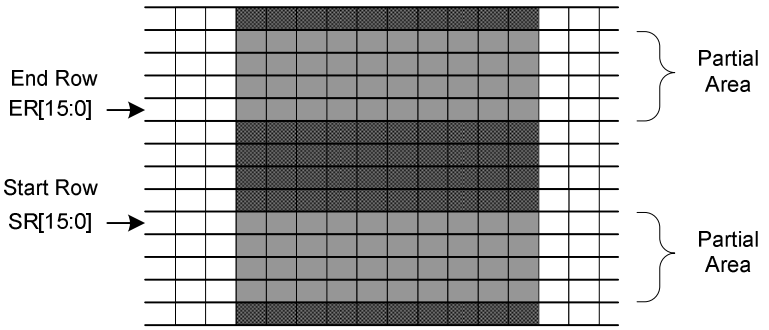
If End Row>Start Row when MADCTL B4=0:-



If End Row>Start Row when MADCTL B4=1:-



If End Row<Start Row when MADCTL B4=0:-



If End Row = Start Row then the Partial Area will be one row deep.

X = don't care.

Restriction

SR[15:0] and ER[15:0] cannot be 0000h nor exceed the last vertical line number (01EFh).

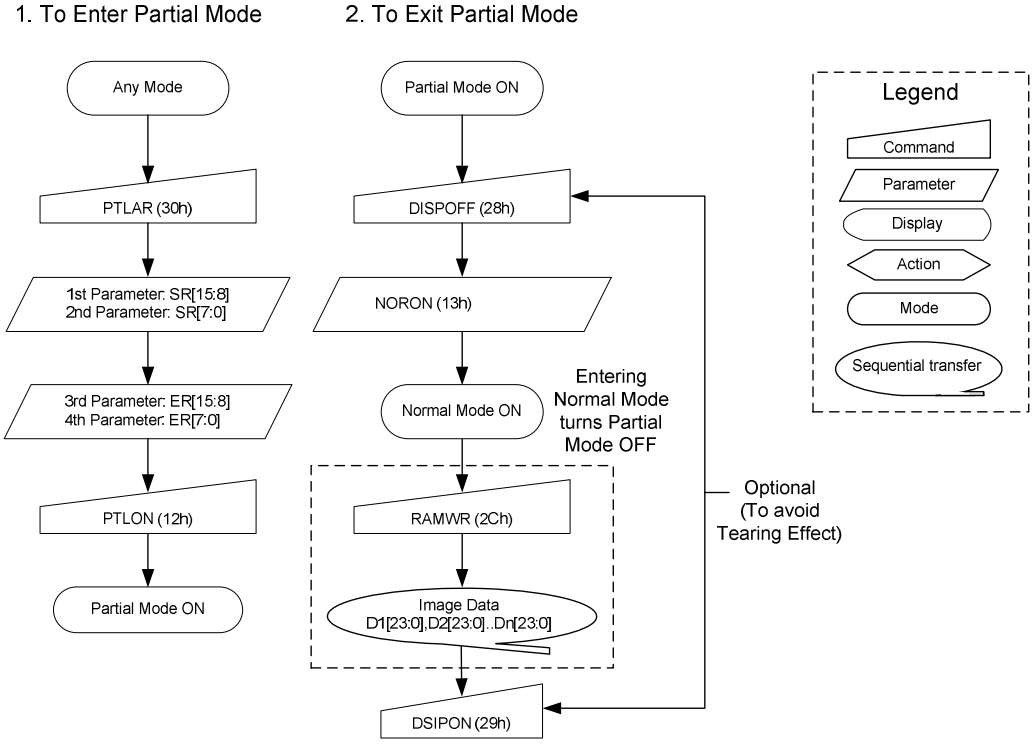
Register Availability

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	
Power On Sequence	SR[15:0]=0000_{HEX}	ER[15:0]=$01DF_{HEX}$
SW Reset	SR[15:0]=0000_{HEX}	ER[15:0]=$01DF_{HEX}$
HW Reset	SR[15:0]=0000_{HEX}	ER[15:0]=$01DF_{HEX}$

Flow Chart



8.2.25. Vertical Scrolling Definition (33h)

33h	VSCRDEF (Vertical Scrolling Definition)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	1	1	0	0	1	1	33h
1st Parameter	1	1	↑	XXXXXXXX	TFA[15:8]								XX
2nd Parameter	1	1	↑	XXXXXXXX	TFA[7:0]								XX
3rd Parameter	1	1	↑	XXXXXXXX	VSA[15:8]								XX
4th Parameter	1	1	↑	XXXXXXXX	VSA[7:0]								XX
5th Parameter	1	1	↑	XXXXXXXX	BFA[15:8]								XX
6th Parameter	1	1	↑	XXXXXXXX	BFA[7:0]								XX

Description

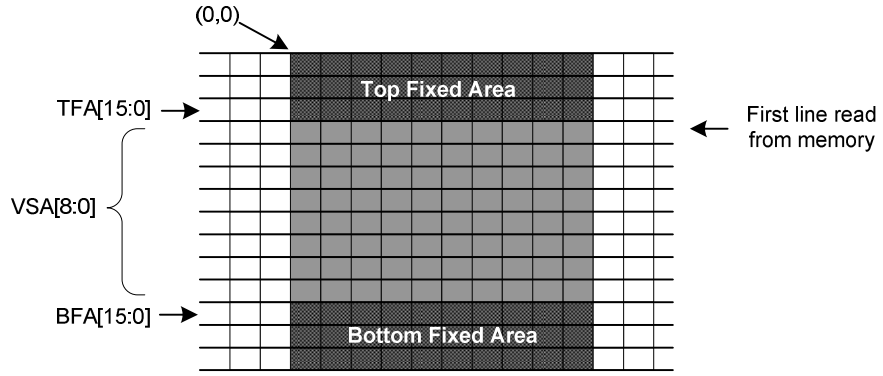
This command defines the display vertical scrolling area.

Memory Access Control (36h) B4 = 0:

The 1st & 2nd parameter, TFA[8:0], describes the Top Fixed Area in number of lines from the top of the frame memory. The top of the frame memory and top of the display device are aligned. The 3rd & 4th parameter, VSA[8:0], describes the height of the Vertical Scrolling Area in number of lines of frame memory from the Vertical Scrolling Start Address. The first line of the Vertical Scrolling Area starts immediately after the bottom most line of the Top Fixed Area. The last line of the Vertical Scrolling Area ends immediately before the top most line of the Bottom Fixed Area.

The 5th & 6th parameter, BFA[8:0], describes the Bottom Fixed Area in number of lines from the bottom of the frame memory. The bottom of the frame memory and bottom of the display device are aligned.

TFA, VSA and BFA refer to the Frame Memory Line Pointer.



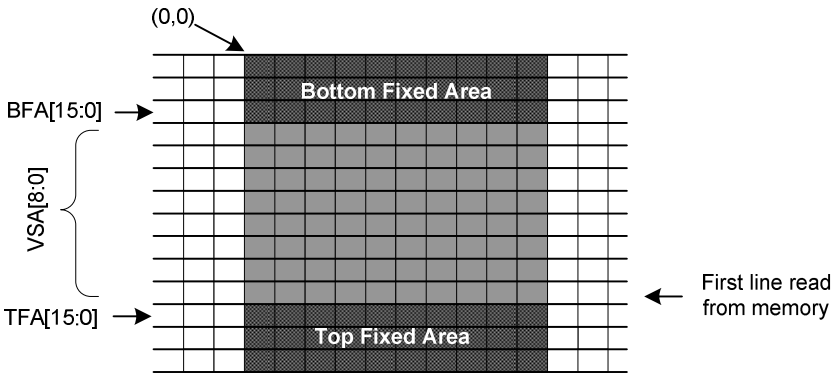
Memory Access Control (36h) B4 = 1:

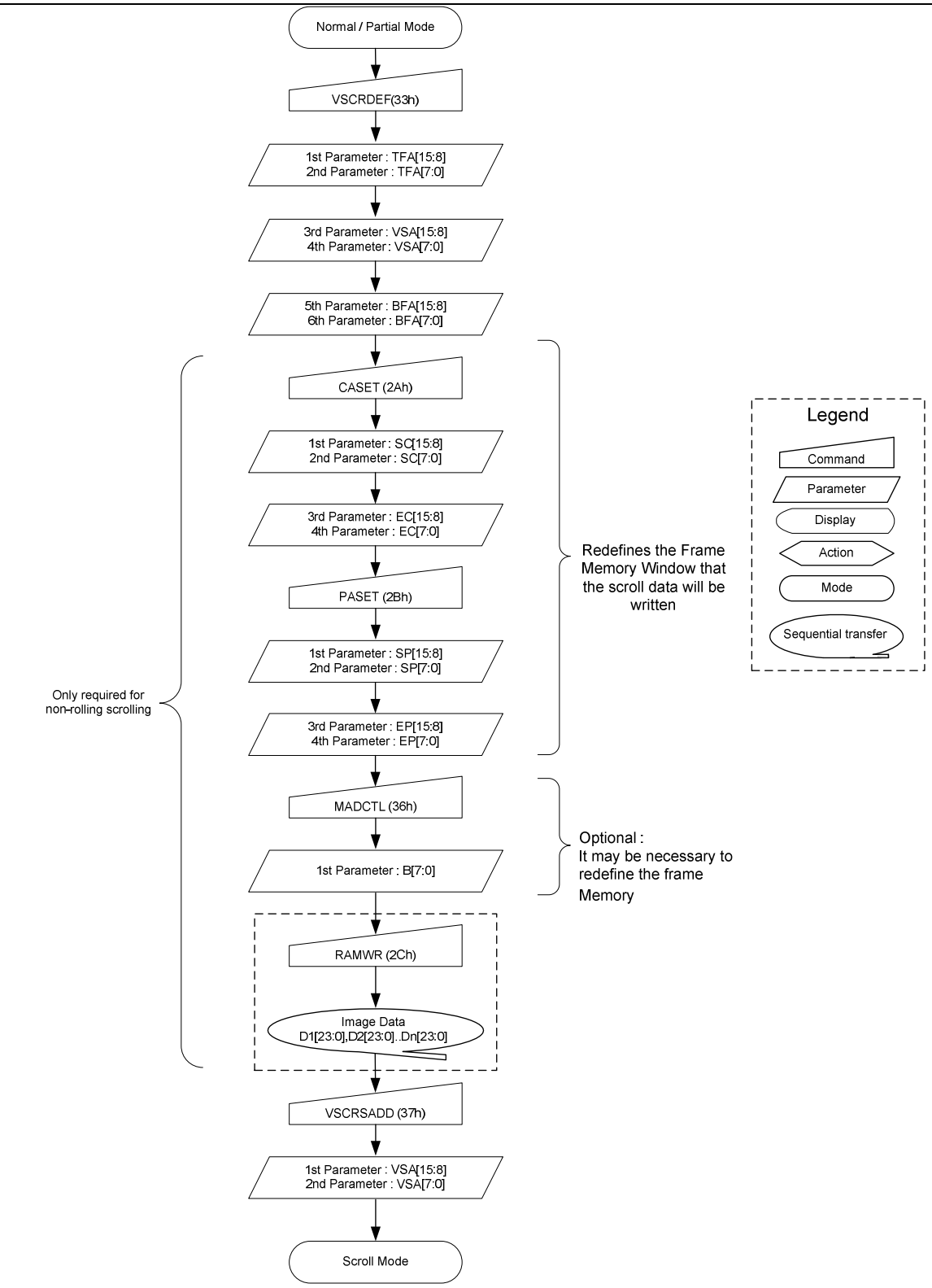
The 1st & 2nd parameter, TFA[8:0], describes the Top Fixed Area in number of lines from the bottom of the frame memory. The bottom of the frame memory and bottom of the display device are aligned.

The 3rd & 4th parameter, VSA[8:0], describes the height of the Vertical Scrolling Area in number of lines of frame memory from the Vertical Scrolling Start Address. The first line of the Vertical Scrolling Area starts immediately after the top most line of the Top Fixed Area. The last line of the Vertical Scrolling Area ends immediately before the bottom most line of the Bottom Fixed Area.

The 5th & 6th parameter, BFA[8:0], describes the Bottom Fixed Area in number of lines from the top of the frame memory. The top of the frame memory and top of the display device are aligned.

TFA, VSA and BFA refer to the Frame Memory Line Pointer.

<table>
<tr><td></td><td> 
</td></tr>
<tr><td>Restriction</td><td>The sum of TFA, VSA and BFA must equal the number of the display device’s horizontal lines (pages), otherwise Scrolling mode is undefined. In Vertical Scroll Mode, set_address_mode B5 should be set to ‘0’ – this only affects the Frame Memory Write.</td></tr>
<tr><td>Register Availability</td><td><table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table></td></tr>
<tr><td>Default</td><td><table>
<tr><th>Status</th><th colspan="3">Default Value</th></tr>
<tr><td>Power On Sequence</td><td>TFA[15:0]=0000_{HEX}</td><td>VSA[15:0]=$01E0_{HEX}$</td><td>BFA[15:0]=0000_{HEX}</td></tr>
<tr><td>SW Reset</td><td>TFA [15:0]=0000_{HEX}</td><td>VSA[15:0]=$01E0_{HEX}$</td><td>BFA[15:0]=0000_{HEX}</td></tr>
<tr><td>HW Reset</td><td>TFA [15:0]=0000_{HEX}</td><td>VSA[15:0]=$01E0_{HEX}$</td><td>BFA[15:0]=0000_{HEX}</td></tr>
</table></td></tr>
<tr><td>Flow Chart</td><td>1. To enter Vertical Scroll Mode:</td></tr>
</table>



Since the value of the Vertical Scrolling Start Address is absolute with reference to the Frame Memory, it must not enter the fixed area; otherwise an undesirable image may be shown on the Display Panel.

8.2.26. Tearing Effect Line OFF (34h)

34h	TEOFF (Tearing Effect Line OFF)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	1	1	0	1	0	0	34h
Parameter	No parameter												
Description	This command turns off ILI9486L's Tearing Effect output signal on the TE signal line.												
Restriction	This command has no effect when the Tearing Effect output is already off.												

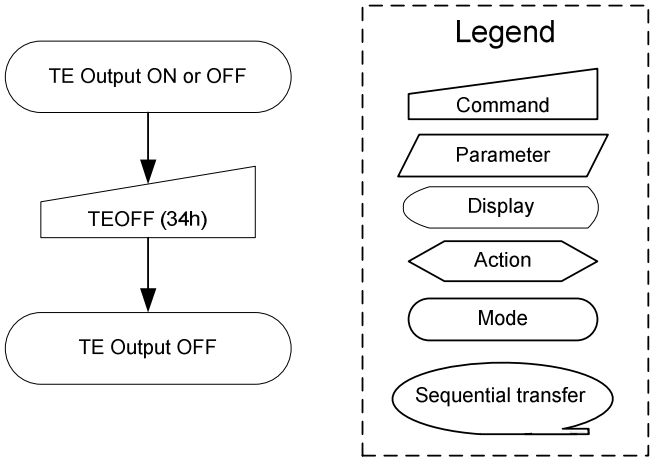
Register Availability

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

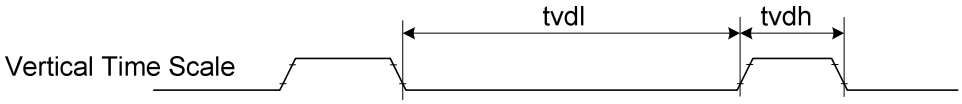
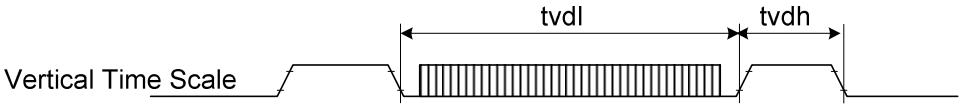
Default

Status	Default Value
Power On Sequence	OFF
SW Reset	OFF
HW Reset	OFF

Flow Chart



8.2.27. Tearing Effect Line ON (35h)

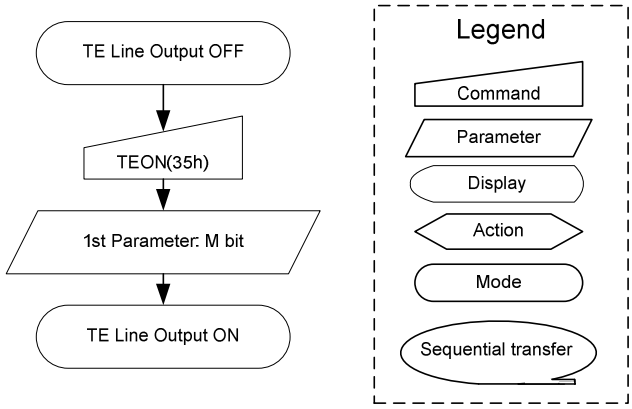
35h	TEON (Tearing Effect Line ON)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	1	1	0	1	0	1	35h
Parameter	1	1	↑	XXXXXXXX	X	X	X	X	X	X	X	M	XX
Parameter	No parameter												
Description	This command is used to turn ON the Tearing Effect output signal from the TE signal line. This output is not affected by changing MADCTL bit B4. The Tearing Effect Line On has one parameter which describes the mode of the Tearing Effect Output Line. (X=Don't Care). When **M=0**: The Tearing Effect Output line consists of V-Blanking information only:  When **M=1**: The Tearing Effect Output Line consists of both V-Blanking and H-Blanking information:  Note: During Sleep In Mode with Tearing Effect Line On, Tearing Effect Output pin will be active Low. X = don't care.												
Restriction	This command has no effect when the Tearing Effect output is already off.												

Register 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
Power On Sequence	OFF
SW Reset	OFF
HW Reset	OFF

Flow Chart	

8.2.28. Memory Access Control (36h)

36h	MADCTL (Memory Access Control)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	1	1	0	1	1	0	36h
Parameter	1	1	↑	XXXXXXXX	MY	MX	MV	ML	BGR	MH	X	X	XX

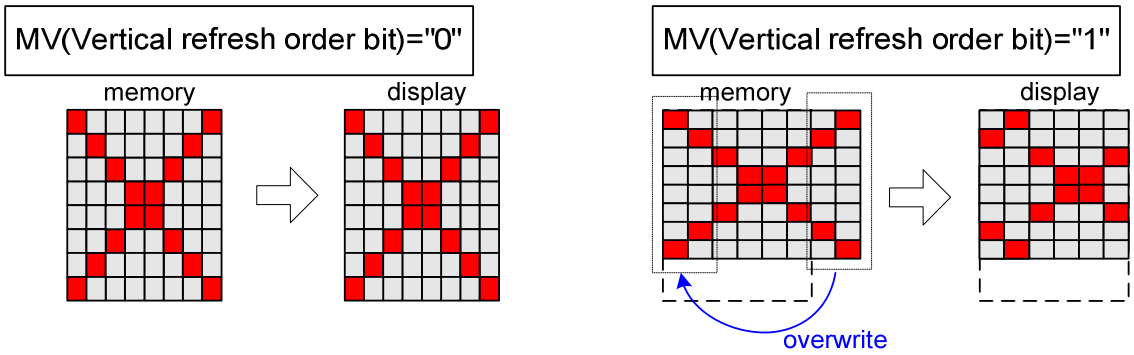
Description

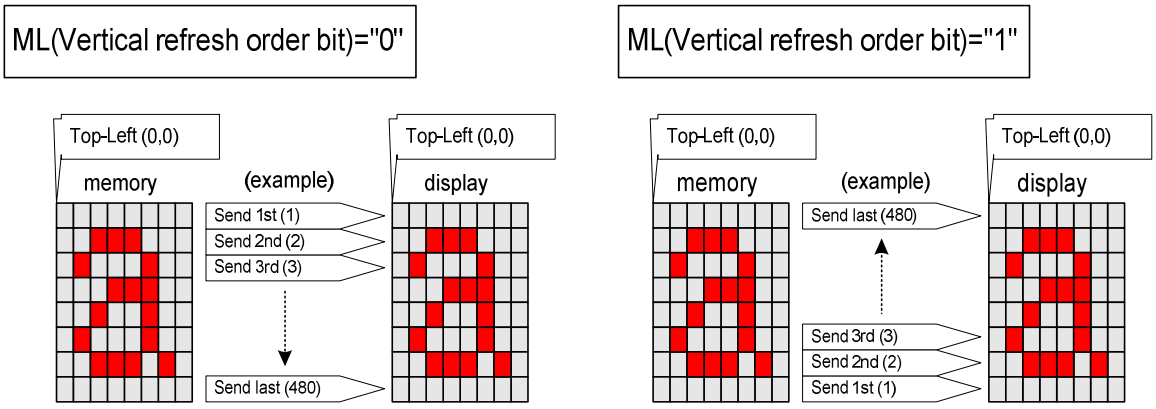
This command defines read/write scanning direction of frame memory.

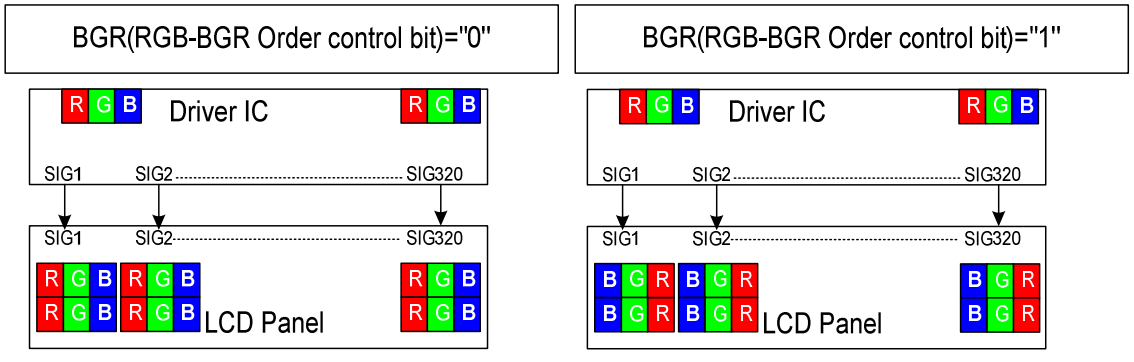
This command makes no change on the other driver status.

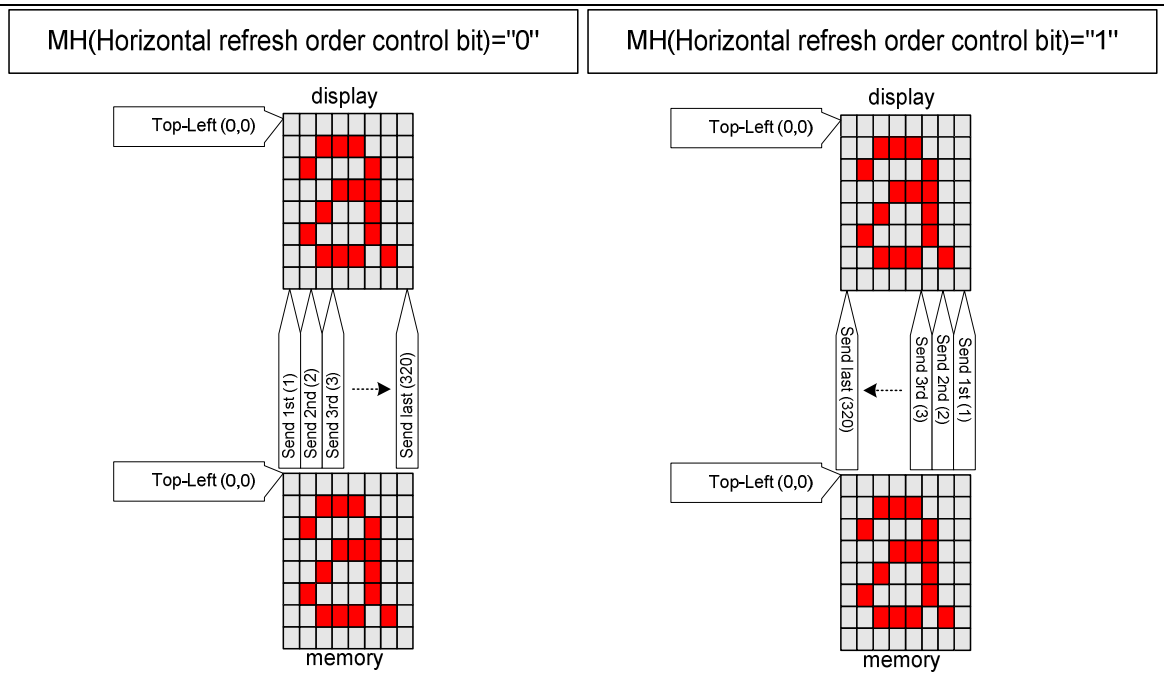
Bit	Symbol	Name	Description
D7	MY	行 Row Address Order	These 3 bits control MPU to memory write/read direction.
D6	MX	列 Column Address Order	
D5	MV	行/列交换 ow / Column Exchange	
D4	ML	垂直 Vertical Refresh Order	刷新方向 LCD vertical refresh direction control.
D3	BGR	RGB-BGR Order	Color selector switch control (0=RGB color filter panel, 1=BGR color filter panel)
D2	MH	Horizontal Refresh ORDER	LCD horizontal refreshing direction control.
D1	X	Reserved	Reserved
D0	X	Reserved	Reserved

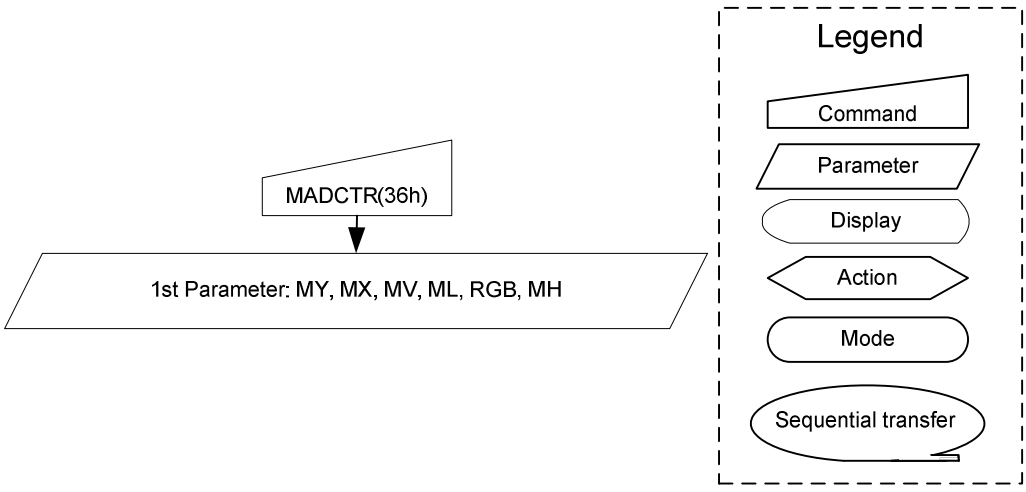
X = don't care.







<table>
<tr><td></td><td>


Note: Top-Left (0,0) means a physical memory location.
</td></tr>
<tr><td>Restriction</td><td></td></tr>
<tr><td>Register Availability</td><td>
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table>
</td></tr>
<tr><td>Default</td><td>
<table>
<tr><th>Status</th><th>Default Value</th></tr>
<tr><td>Power On Sequence</td><td>00h</td></tr>
<tr><td>SW Reset</td><td>No change</td></tr>
<tr><td>HW Reset</td><td>00h</td></tr>
</table>
</td></tr>
<tr><td>Flow Chart</td><td>


</td></tr>
</table>

8.2.29. Vertical Scrolling Start Address (37h)

37h	VSCRSADD (Vertical Scrolling Start Address)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	1	1	0	1	1	1	37h
1st Parameter	1	1	↑	XXXXXXXX	VSP[15:8]								XX
2nd Parameter	1	1	↑	XXXXXXXX	VSP[7:0]								XX

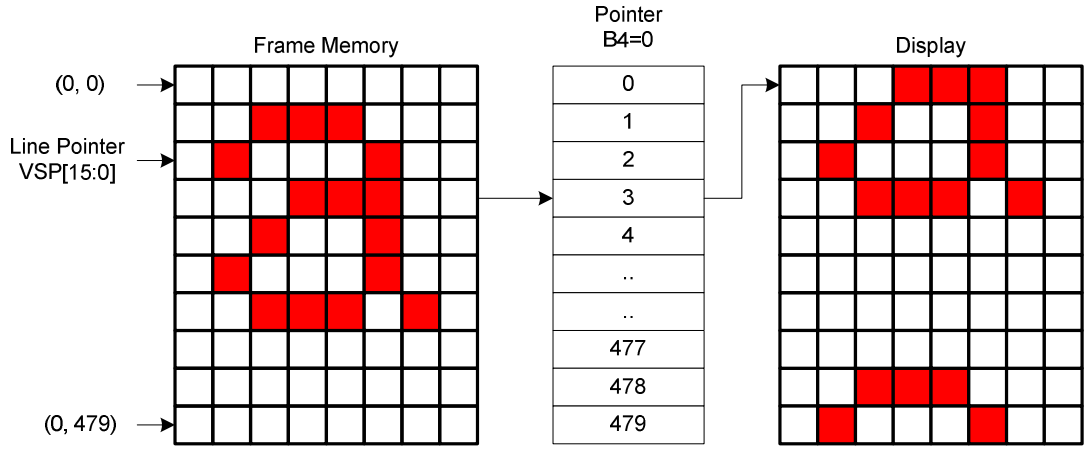
Description

This command is used together with Vertical Scrolling Definition (33h). These two commands describe the scrolling area and the scrolling mode. The Vertical Scrolling Start Address command has one parameter which describes the address of the line in the Frame Memory that will be written as the first line after the last line of the Top Fixed Area on the display as illustrated below:-

When MADCTL B4=0

Example:

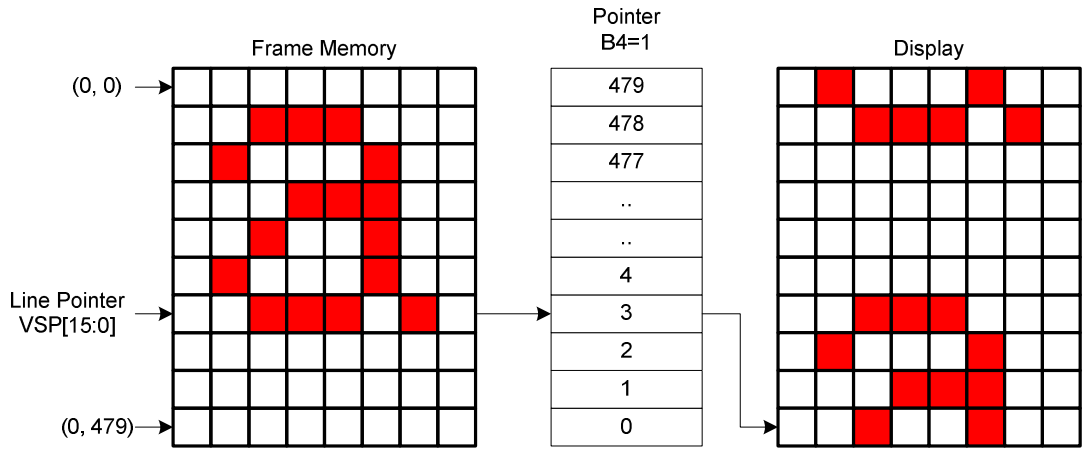
When Top Fixed Area = Bottom Fixed Area = 00, Vertical Scrolling Area = 480 and VSP='3'.



When MADCTL B4=1

Example:

When Top Fixed Area = Bottom Fixed Area = 00, Vertical Scrolling Area = 480 and VSP='3'.



Notes: (1) When new Pointer position and Picture Data are sent, the result on the display will happen at the next Panel Scan to avoid tearing effect.

VSP refers to the Frame Memory line Pointer.

X = Don't care

<table>
<tr><td>Restriction</td><td>Since the value of the Vertical Scrolling Start Address is absolute (with reference to the Frame Memory), it must not enter the fixed area (defined by Vertical Scrolling Definition (33h) – otherwise undesirable image will be displayed on the Panel.</td></tr>
<tr><td>Register Availability</td><td>
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table>
</td></tr>
<tr><td>Default</td><td>
<table>
<tr><th>Status</th><th>Default Value</th></tr>
<tr><td>Power On Sequence</td><td>00h</td></tr>
<tr><td>SW Reset</td><td>00h</td></tr>
<tr><td>HW Reset</td><td>00h</td></tr>
</table>
</td></tr>
<tr><td>Flow Chart</td><td>See Vertical Scrolling Definition (33h) description.</td></tr>
</table>

8.2.30. Idle Mode OFF (38h)

38h	IDMOFF (Idle Mode OFF)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	1	1	1	0	0	0	38h
Parameter	No parameter												
Description	This command causes ILI9486L to exit Idle mode. In Idle OFF mode, display panel can display maximum 262,144 colors.												
Restriction	This command has no effect when ILI9486L is not in Idle mode.												

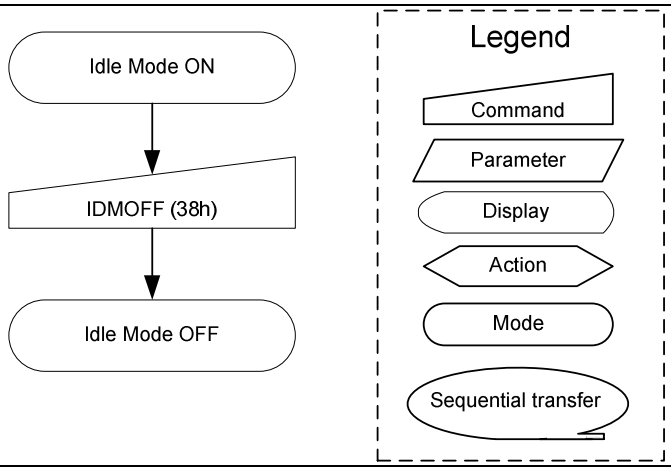
Register Availability

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
Power On Sequence	Idle Mode Off
SW Reset	Idle Mode Off
HW Reset	Idle Mode Off

Flow Chart



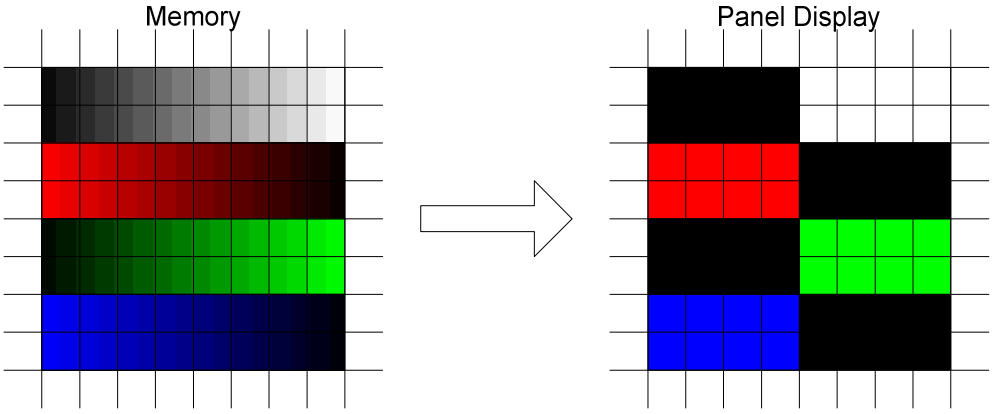
8.2.31. Idle Mode ON (39h)

39h	IDMON (Idle Mode ON)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	1	1	1	0	0	1	39h
Parameter	No parameter												

Description

This command is used to enter into Idle mode on.

In the idle on mode, color expression is reduced. The primary and the secondary colors using MSB of each R, G and B in the Frame Memory, 8 color depth data is displayed.



Memory Contents vs Display Color			
	$R_5\ R_4\ R_3\ R_2\ R_1\ R_0$	$G_5\ G_4\ G_3\ G_2\ G_1\ G_0$	$B_5\ B_4\ B_3\ B_2\ B_1\ B_0$
Black	0XXXXX	0XXXXX	0XXXXX
Blue	0XXXXX	0XXXXX	1XXXXX
Red	1XXXXX	0XXXXX	0XXXXX
Magenta	1XXXXX	0XXXXX	1XXXXX
Green	0XXXXX	1XXXXX	0XXXXX
Cyan	0XXXXX	1XXXXX	1XXXXX
Yellow	1XXXXX	1XXXXX	0XXXXX
White	1XXXXX	1XXXXX	1XXXXX

X = don't care.

Restriction

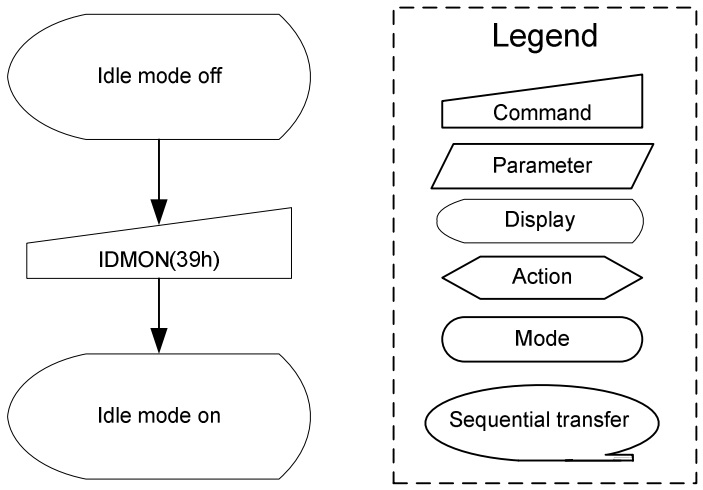
This command has no effect when module is already in idle off mode.

Register 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
Power On Sequence	Idle mode OFF
SW Reset	Idle mode OFF
HW Reset	Idle mode OFF

Flow Chart	

8.2.32. Interface Pixel Format (3Ah)

3Ah	COLMOD (Interface Pixel Format)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	0	1	1	1	0	1	0	3Ah
Parameter	1	1	↑	XXXXXXXX	DPI[3:0]				X	DBI[2:0]			XX

Description

This command sets the pixel format for the RGB image data used by the interface. DPI[3:0] is the pixel format select of RGB interface and DBI[2:0] is the pixel format of CPU interface. If a particular interface, either RGB interface or CPU interface, is not used then the corresponding bits in the parameter are ignored. The pixel format are shown in the table below.

DPI[3:0]				RGB Interface Format
0	0	0	0	Reserved
0	0	0	1	Reserved
0	0	1	0	Reserved
0	0	1	1	Reserved
0	1	0	0	Reserved
0	1	0	1	16 bits / pixel
0	1	1	0	18 bits / pixel
0	1	1	1	Reserved

DBI[2:0]			CPU Interface Format
0	0	0	Reserved
0	0	1	Reserved
0	1	0	Reserved
0	1	1	Reserved
1	0	0	Reserved
1	0	1	16 bits / pixel
1	1	0	18 bits / pixel
1	1	1	Reserved

X = don't care

Restriction

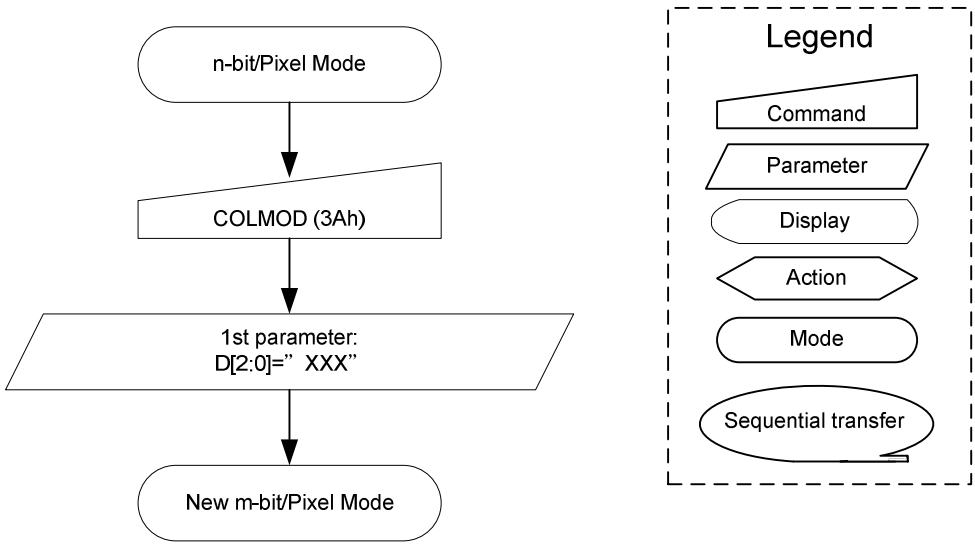
Register Availability

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

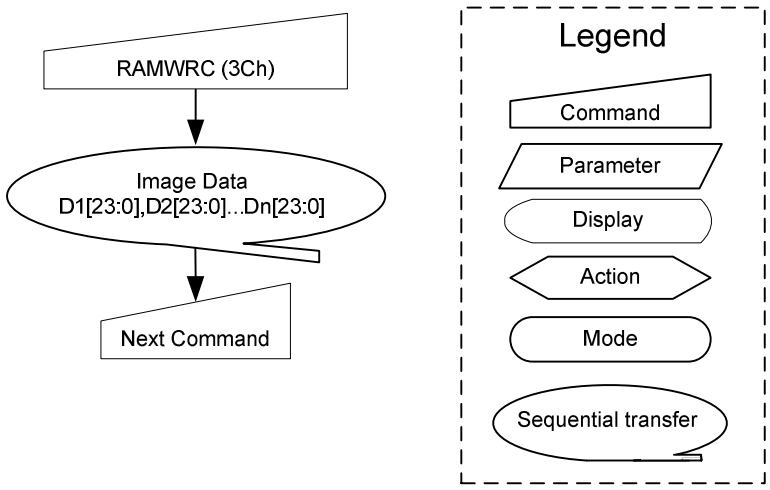
Status	Default Value
Power On Sequence	06h
SW Reset	06h
HW Reset	06h

Flow Chart



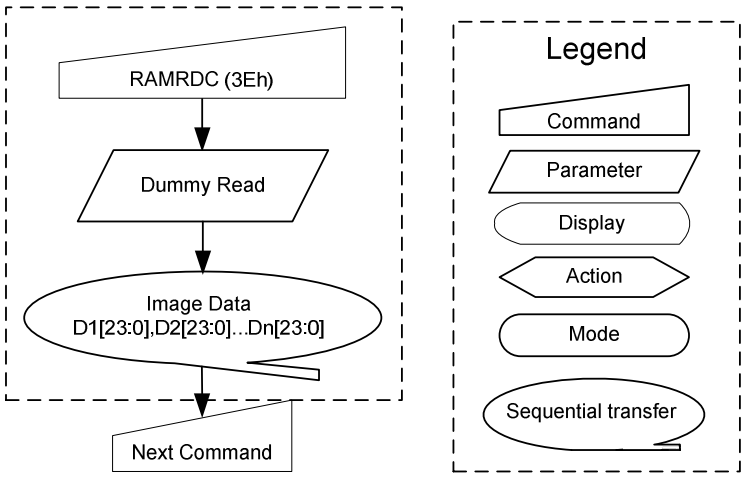
8.2.33. Memory Write Continue (3Ch)

<table>
<tr><th>3Ch</th><th colspan="13">RAMWRC (Memory Write Continue)</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D[15:8]</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>0</td><td>1</td><td>↑</td><td>XXXXXXXX</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>3Ch</td></tr>
<tr><td>1st Parameter</td><td>1</td><td>1</td><td>↑</td><td colspan="9">D1[15:0]</td><td>XX</td></tr>
<tr><td>:</td><td>1</td><td>1</td><td>↑</td><td colspan="9">Dx[15:0]</td><td>XX</td></tr>
<tr><td>Nth Parameter</td><td>1</td><td>1</td><td>↑</td><td colspan="9">Dn[15:0]</td><td>XX</td></tr>
<tr><td>Description</td><td colspan="13">This command is used to transfer data from MCU to frame memory, if there is wanted to continue memory write after “Memory Write (2Ch)” command.
This command makes no change to the other driver status.
When this command is accepted, the column register and the page register are not reset to the Start Column/Start Page positions as it has been done on “Memory Write (2Ch)” command.
Then D[15:0] is stored in frame memory and the column register and the page register incremented as table below: Column and Page Counter Control.
<table>
<tr><th>Condition</th><th>Column counter</th><th>Page Counter</th></tr>
<tr><td>When RAMWR/RAMRD command is accepted</td><td>Return to “Start Column”</td><td>Return to “Start Page”</td></tr>
<tr><td>Complete Pixel Read/Write action</td><td>Increment by 1</td><td>No change</td></tr>
<tr><td>The Column counter value is large than “End Column”</td><td>Return to “Start Column”</td><td>Increment by 1</td></tr>
<tr><td>The Page counter value is large than “End Page”</td><td>Return to “Start Column”</td><td>Return to “Start Page”</td></tr>
</table>
Sending any other command can stop frame Write.
X = don’t care.</td></tr>
<tr><td>Restriction</td><td colspan="13">There is no restriction on length of parameters.
No access in the frame memory in Sleep In mode.</td></tr>
<tr><td>Register Availability</td><td colspan="13">
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table>
</td></tr>
<tr><td>Default</td><td colspan="13">
<table>
<tr><th>Status</th><th>Default Value</th></tr>
<tr><td>Power On Sequence</td><td>Contents of memory is set randomly</td></tr>
<tr><td>SW Reset</td><td>Contents of memory is set randomly</td></tr>
<tr><td>HW Reset</td><td>Contents of memory is set randomly</td></tr>
</table>
</td></tr>
</table>

Flow Chart	

8.2.34. Memory Read Continue (3Eh)

<table>
<tr><th>3Eh</th><th colspan="12">RAMRDRC (Memory Read Continue)</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D[15:8]</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>0</td><td>1</td><td>↑</td><td>XXXXXXXX</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>3Eh</td></tr>
<tr><td>1st Parameter</td><td>1</td><td>↑</td><td>1</td><td>XXXXXXXX</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>XX</td></tr>
<tr><td>2nd Parameter</td><td>1</td><td>↑</td><td>1</td><td colspan="9">D1[15:0]</td><td>XX</td></tr>
<tr><td>:</td><td>1</td><td>↑</td><td>1</td><td colspan="9">Dx[15:0]</td><td>XX</td></tr>
<tr><td>Nth Parameter</td><td>1</td><td>↑</td><td>1</td><td colspan="9">Dn[15:0]</td><td>XX</td></tr>
<tr><td>Description</td><td colspan="13">This command is used to transfer data from frame memory to MCU, if there is wanted to continue memory read after “Memory Read (2Eh)” command.
This command makes no change to the other driver status.
When this command is accepted, the column register and the page register are not reset to the Start Column/Start Page positions as it has been done on “Memory Read (2Eh)” command.
Then D[15:0] is read back from the frame memory and the column register and the page register incremented as table below:
Column and Page Counter Control.
<table>
<tr><th>Condition</th><th>Column counter</th><th>Page Counter</th></tr>
<tr><td>When RAMWR/RAMRD command is accepted</td><td>Return to “Start Column”</td><td>Return to “Start Page”</td></tr>
<tr><td>Complete Pixel Read/Write action</td><td>Increment by 1</td><td>No change</td></tr>
<tr><td>The Column counter value is large than “End Column”</td><td>Return to “Start Column”</td><td>Increment by 1</td></tr>
<tr><td>The Page counter value is large than “End Page”</td><td>Return to “Start Column”</td><td>Return to “Start Page”</td></tr>
</table>
Frame Read can be stopped by sending any other command.
X = can be ‘0’ or ‘1’</td></tr>
<tr><td>Restriction</td><td colspan="13">There is no restriction on length of parameters.
No access in the frame memory in Sleep In mode.</td></tr>
<tr><td>Register Availability</td><td colspan="13">
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode On, Idle Mode On, Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table>
</td></tr>
<tr><td>Default</td><td colspan="13">
<table>
<tr><th>Status</th><th>Default Value</th></tr>
<tr><td>Power On Sequence</td><td>Contents of memory is set randomly</td></tr>
<tr><td>SW Reset</td><td>Contents of memory is set randomly</td></tr>
<tr><td>HW Reset</td><td>Contents of memory is set randomly</td></tr>
</table>
</td></tr>
</table>

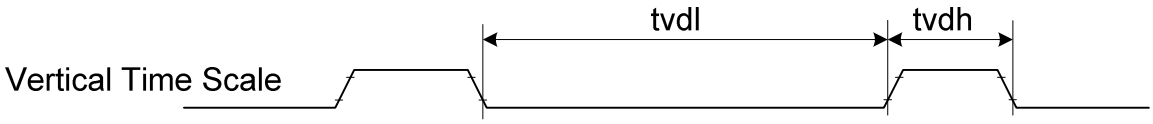
Flow Chart	

8.2.35. Write Tear Scan Line (44h)

44h	TESLWR (Write Tear Scan Line)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	1	0	0	0	1	0	0	44h
1st Parameter	1	1	↑	XXXXXXXX	N[15:8]								XX
2nd Parameter	1	1	↑	XXXXXXXX	N[7:0]								XX

Description

This command turns on the display Tearing Effect output signal on the TE signal line when the display reaches line N. The TE signal is not affected by changing Memory Access Control bit B4. The Tearing Effect Line On has one parameter that describes the Tearing Effect Output Line mode. The Tearing Effect Output line consists of V-Blanking information only.



Note that Set Tear Scan Line with N = 0 is equivalent to Tearing Effect Line ON with M = 0.

The Tearing Effect Output line shall be active low when ILI9486L is in Sleep mode.

Restriction

This command has no effect when Tearing Effect output is already ON.

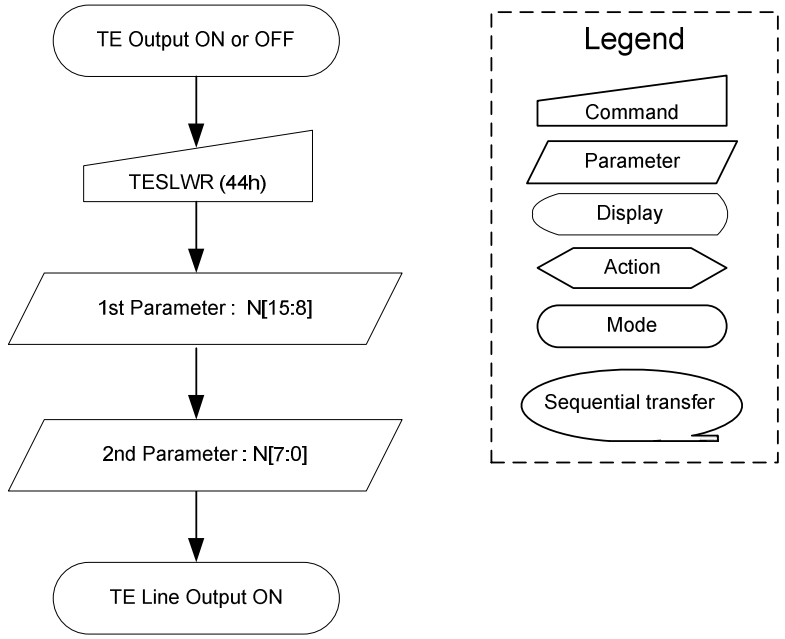
Register Availability

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
Power On Sequence	00h
SW Reset	No change
HW Reset	00h

Flow Chart



8.2.36. Read Scan Line (45h)

45h	TESLRD (Read Tear Scan Line)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	1	0	0	0	1	0	1	45h
1st Parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2nd Parameter	1	↑	1	XXXXXXXX	N[15:8]								XX
3rd Parameter	1	↑	1	XXXXXXXX	N[7:0]								XX
Description	The display returns the current scan line, N, used to update the display device. The total number of scan lines on a display device is defined as VSYNC + VBP + VACT + VFP. The first scan line is defined as the first line of V-Sync and is denoted as Line 0. When in Sleep Mode, the value returned by Read Scan Line command is undefined.												
Restriction	None												

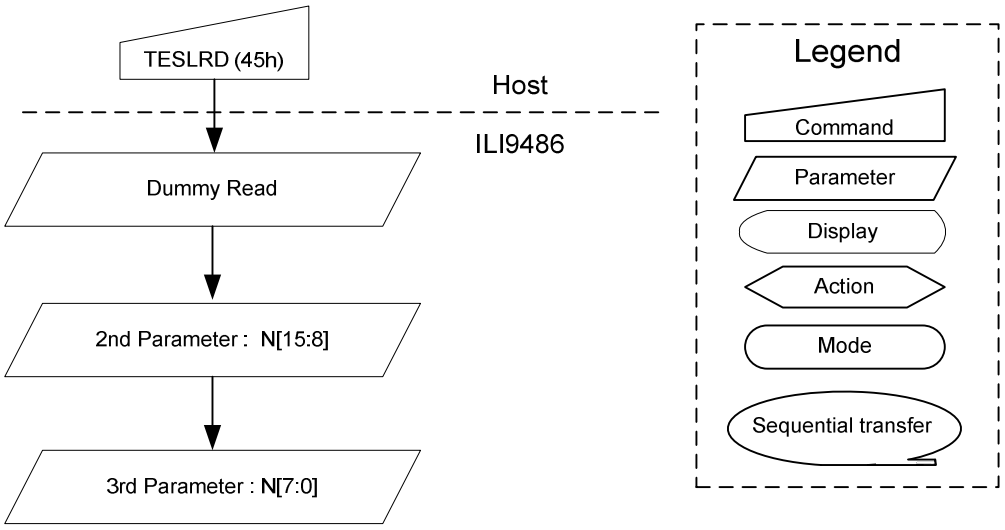
Register Availability

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
Power On Sequence	00h
SW Reset	No change
HW Reset	00h

Flow Chart



8.2.37. Write Display Brightness Value (51h)

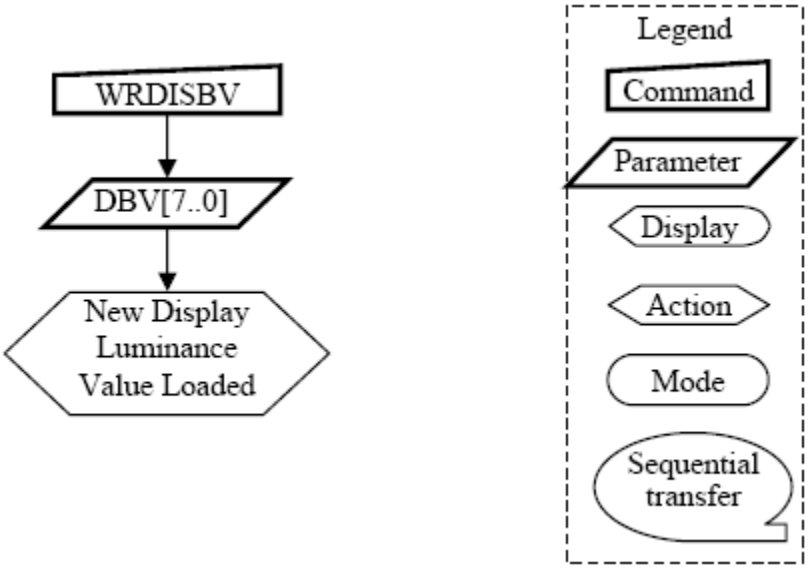
51h	WRDISBV (Write Display Brightness)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	1	0	1	0	0	0	1	51h
1st Parameter	1	1	↑	XXXXXXXX	DBV[7:0]								XX
Description	This command is used to adjust the brightness value of the display. **DBV[7:0]**: 8 bit, for display brightness of manual brightness setting and CABC in ILI9486L. There is a PWM output signal, PWM_OUT pin, to control the LED driver IC in order to control display brightness. In principle relationship is that 00h value means the lowest brightness and FFh value means the highest brightness.												
Restriction													
Register 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
Power ON Sequence	00h
H/W Reset	00h

Flow Chart



8.2.38. Read Display Brightness Value (52h)

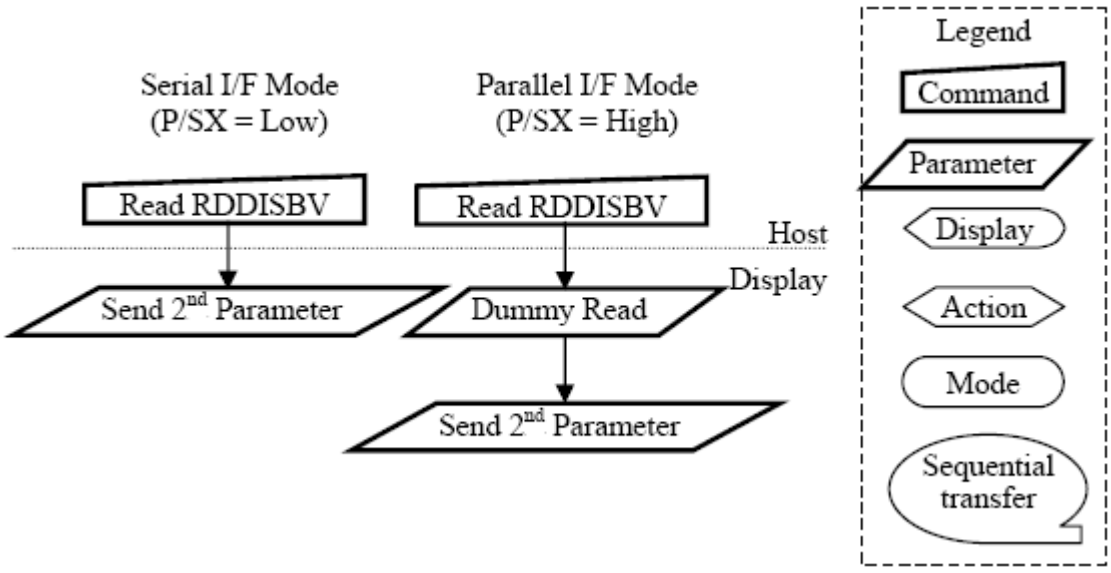
52h	RDDISBV (Read Display Brightness Value)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	1	0	1	0	0	1	0	52h
1st Parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2nd Parameter	1	↑	1	XXXXXXXX	DBV[7:0]								XX
Description	This command is used to return the brightness value of the display. DBV[7:0] is reset when display is in sleep-in mode. DBV[7:0] is '0' when bit BCTRL of "Write CTRL Display (53h)" command is '0'. DBV[7:0] is manual set brightness specified with "Write CTRL Display (53h)" command when BCTRL bit is '1'. When bit BCTRL of "Write CTRL Display (53h)" command is '1' and C1/C0 bit of "Write Content Adaptive Brightness Control (55h)" command are '0', DBV[7:0] output is the brightness value specified with " Write Display Brightness (51h)" command.												
Restriction	ILI9486L is sending 2nd parameter value on the data lines if the MCU wants to read more than one parameter (= more than 2 RDX cycle) on parallel MCU interface. Only 2nd parameter is sent on DSI (The 1st parameter is not sent).												

Register 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
Power ON Sequence	00h
H/W Reset	00h



8.2.39. Write CTRL Display Value (53h)

<table>
<tr><th>53h</th><th colspan="13">WRCTRLD (Write Control Display)</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D[15:8]</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>0</td><td>1</td><td>↑</td><td>XXXXXXXX</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>53h</td></tr>
<tr><td>1st Parameter</td><td>1</td><td>1</td><td>↑</td><td>XXXXXXXX</td><td>X</td><td>X</td><td>BCTRL</td><td>X</td><td>DD</td><td>BL</td><td>X</td><td>X</td><td>XX</td></tr>
<tr><td>Description</td><td colspan="13">This command is used to control display brightness.

BCTRL: Brightness Control Block On/Off, This bit is always used to switch brightness for display.

BCTRL | Description
0 | Brightness Control Block OFF (DBV[7:0]=00h)
1 | Brightness Control Block ON (DBV[7:0] is active)

DD: Display Dimming Control. This function is only for manual brightness setting.

DD | Description
0 | Display Dimming OFF
1 | Display Dimming ON

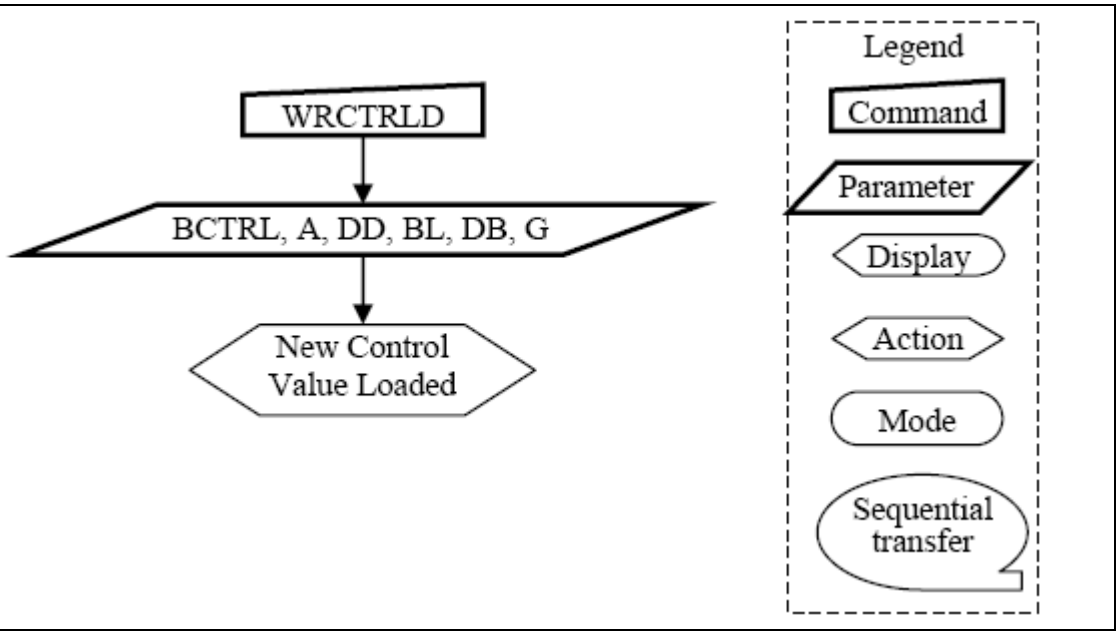
BL: Backlight Control On/Off

BL | Description
0 | Backlight Control OFF
1 | Backlight Control ON

Dimming function is adapted to the brightness registers for display when bit BCTRL is changed at DD=1, e.g. BCTRL: 0 -> 1 or 1-> 0.

When BL bit change from “On” to “Off”, backlight is turned off without gradual dimming, even if dimming-on (DD=1) are selected.

X = Don’t care</td></tr>
<tr><td>Restriction</td><td colspan="13"></td></tr>
<tr><td>Register Availability</td><td colspan="13">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</td></tr>
<tr><td>Default</td><td colspan="13">Status | Default Value
Power ON Sequence | 00h
H/W Reset | 00h</td></tr>
</table>

Flow Chart	

8.2.40. Read CTRL Display Value (54h)

54h	RDCTRLD (Read Control Display Value)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	1	0	1	0	1	0	0	54h
1st Parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2nd Parameter	1	↑	1	XXXXXXXX	X	X	BCTRL	X	DD	BL	X	X	XX

Description

This command is used to control display brightness.

BCTRL: Brightness Control Block On/Off, This bit is always used to switch brightness for display.

BCTRL	Description
0	Brightness Control Block OFF (DBV[7:0]=00h)
1	Brightness Control Block ON (DBV[7:0] is active)

DD: Display Dimming Control. This function is only for manual brightness setting.

DD	Description
0	Display Dimming OFF
1	Display Dimming ON

BL: Backlight Control On/Off

BL	Description
0	Backlight Control OFF
1	Backlight Control ON

X = Don't care

Restriction

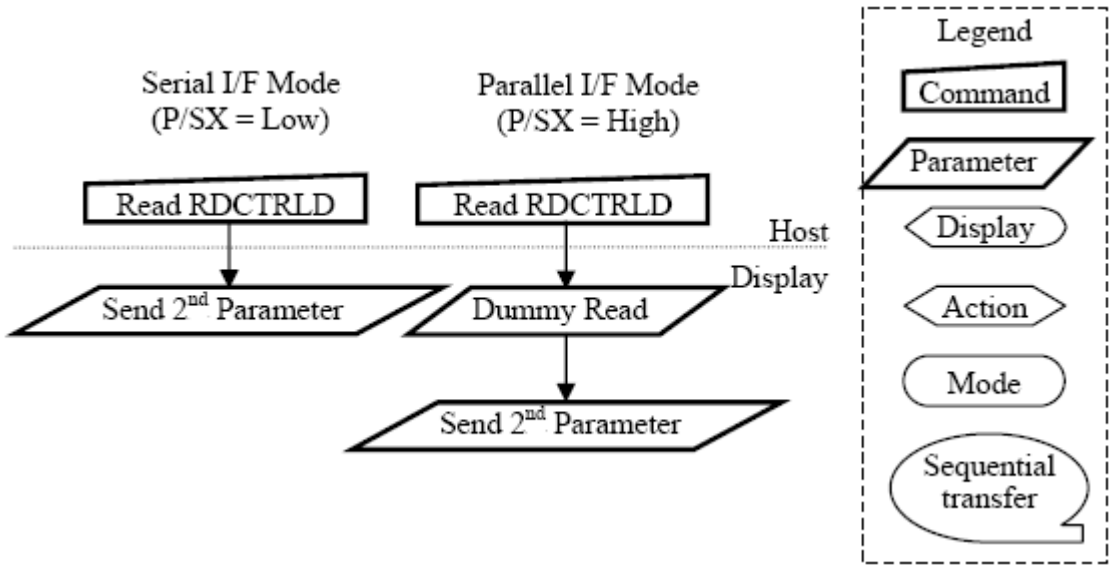
Register Availability

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
Power ON Sequence	00h
H/W Reset	00h

Flow Chart



8.2.41. Write Content Adaptive Brightness Control Value (55h)

55h	WRCABC (Write Content Adaptive Brightness Control)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	1	0	1	0	1	0	1	55h
1st Parameter	1	1	↑	XXXXXXXX	X	X	X	X	X	X	C[1:0]		XX

Description

This command is used to set parameters for image content based adaptive brightness control functionality.

There is possible to use 4 different modes for content adaptive image functionality, which are defined on a table below.

C[1:0]		Description
0	0	CABC OFF
0	1	User Interface Image
1	0	Still Picture
1	1	Moving Image

X = Don't care

Restriction

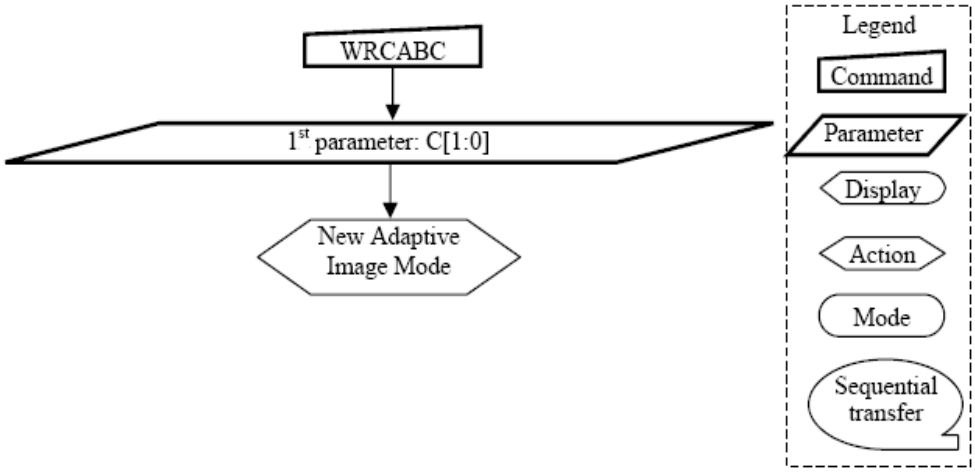
Register Availability

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
Power ON Sequence	00h
H/W Reset	00h

Flow Chart



8.2.42. Read Content Adaptive Brightness Control Value (56h)

56h	RDCABC (Read Content Adaptive Brightness Control)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	1	0	1	0	1	1	0	56h
1st Parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2nd Parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	C[1:0]		XX

Description

This command is used to read the settings for image content based adaptive brightness control functionality. There is possible to use 4 different modes for content adaptive image functionality which are defined on the table below.

C[1:0]		Description
0	0	CABC OFF
0	1	User Interface Image
1	0	Still Picture
1	1	Moving Image

X = Don't care

Restriction

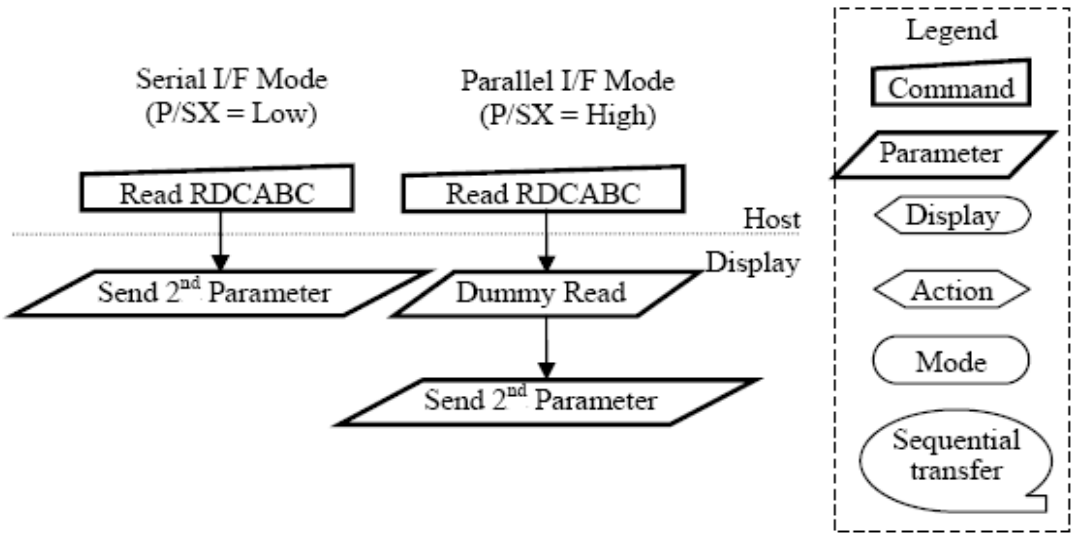
Register Availability

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
Power ON Sequence	00h
H/W Reset	00h

Flow Chart



8.2.43. Write CABC Minimum Brightness (5Eh)

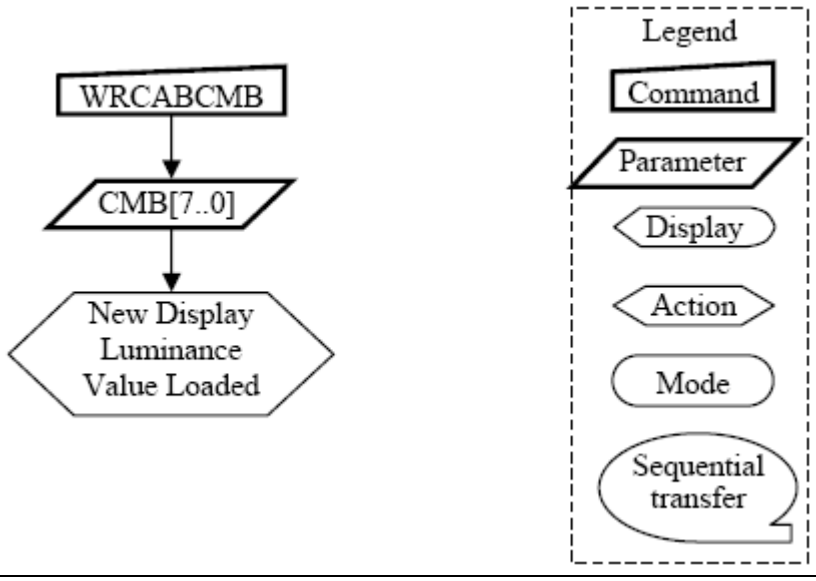
5Eh	WRCABCMB (Write CABC Minimum Brightness)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	1	0	1	1	1	1	0	5Eh
1st Parameter	1	1	↑	XXXXXXXX	CMB[7:0]								XX
Description	This command is used to set the minimum brightness value of the display for CABC function. **CMB[7:**0]: CABC minimum brightness control, this parameter is used to avoid too much brightness reduction. When CABC is active, CABC can not reduce the display brightness to less than CABC minimum brightness setting. Image processing function is worked as normal, even if 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 "Write CTRL Display (53h)"), CABC minimum brightness setting is ignored. In principle relationship is that 00h value means the lowest brightness for CABC and FFh value means the highest brightness for CABC.												
Restriction													
Register 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
Power ON Sequence	00h
H/W Reset	00h

Flow Chart



8.2.44. Read CABC Minimum Brightness (5Fh)

5Fh	RDCABCMB (Read CABC Minimum Brightness)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	0	1	0	1	1	1	1	1	5Fh
1st Parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2nd Parameter	1	↑	1	XXXXXXXX	CMB[7:0]								XX
Description	This command returns the minimum brightness value of CABC function. In principle the relationship is that 00h value means the lowest brightness and FFh value means the highest brightness. CMB[7:0] is CABC minimum brightness specified with "Write CABC minimum brightness (5Eh)" command.												
Restriction	ILI9486L is sending 2nd parameter value on the data lines if the MCU wants to read more than one parameter (= more than 2 RDX cycle) on parallel MCU interface. Only 2nd parameter is sent on DSI (The 1st parameter is not sent).												

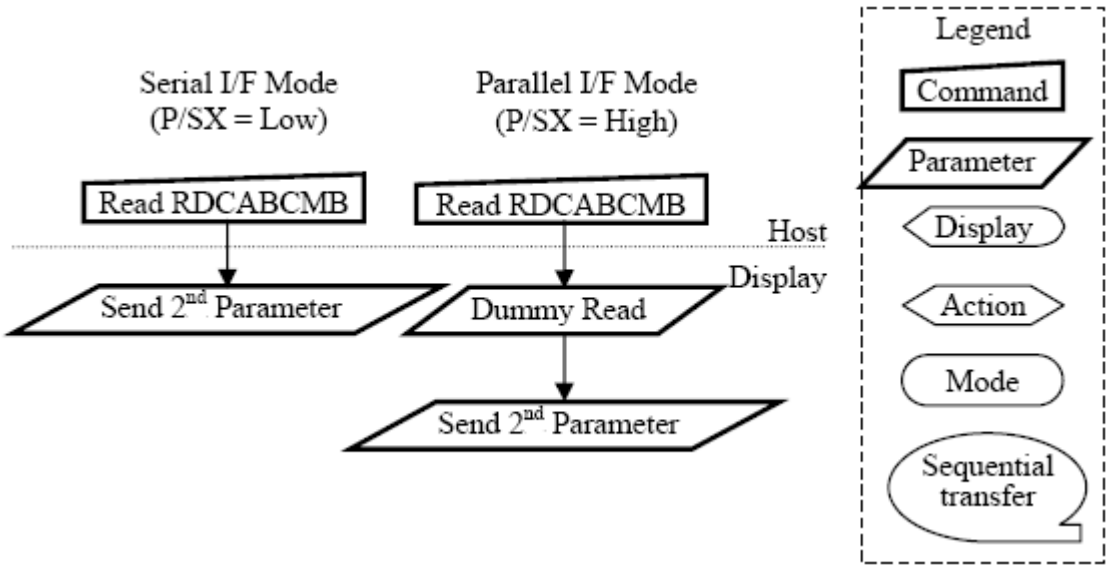
Register Availability

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

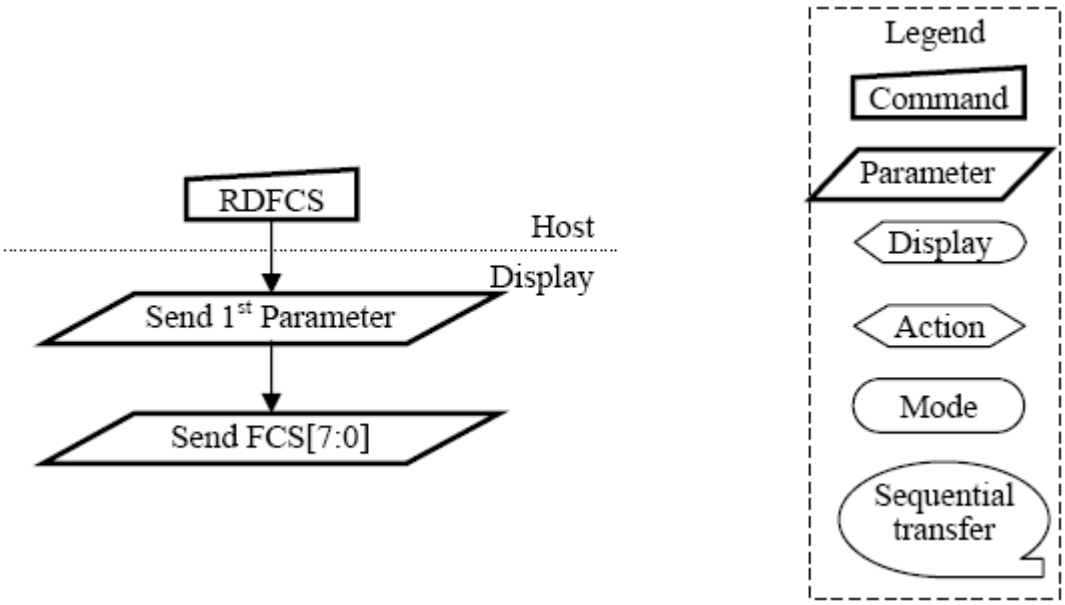
Default

Status	Default Value
Power ON Sequence	00h
H/W Reset	00h

Flow Chart



8.2.45. Read First Checksum (AAh)

AAh	RDFCS (Read First Checksum)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	0	1	0	1	0	1	0	AAh
1st Parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2nd Parameter	1	↑	1	XXXXXXXX	FCS[7:0]								XX
Description	This command returns the first checksum what has been calculated from User's area registers and the frame memory after the write access to those registers and/or frame memory has been done. X = can be '0' or '1'												
Restriction	It will be necessary to wait 150ms after there is the last write access on User area registers before there can read this checksum value. ILI9486L is sending 2nd parameter value on the data lines if the MCU wants to read more than one parameter (= more than 2 RDX cycle) on parallel MCU interface. Only 2nd parameter is sent on DSI (The 1st parameter is not sent).												
Register 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 Power ON Sequence: 00h H/W Reset: 00h												
Flow Chart													

8.2.46. Read Continue Checksum (AFh)

AFh	RDCFCS (Read Continue Checksum)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	0	1	0	1	1	1	1	AFh
1st Parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2nd Parameter	1	↑	1	XXXXXXXX	CCS[7:0]								XX
Description	This command returns the continue checksum what has been calculated continuously after the first checksum has calculated from User's area registers and the frame memory after the write access to those registers and/or frame memory has been done. X = can be '0' or '1'												
Restriction	It will be necessary to wait 300ms after there is the last write access on User area registers before there can read this checksum value in the first time. ILI9486L is sending 2nd parameter value on the data lines if the MCU wants to read more than one parameter (= more than 2 RDX cycle) on parallel MCU interface. Only 2nd parameter is sent on DSI (The 1st parameter is not sent).												

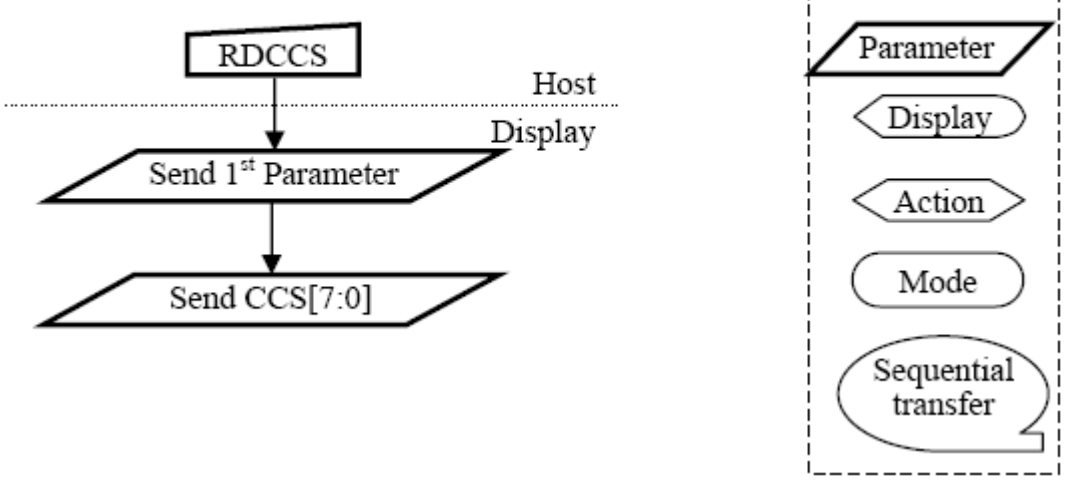
Register Availability

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
Power ON Sequence	00h
H/W Reset	00h

Flow Chart



8.2.47. Read ID1 (DAh)

DAh	RDID1 (Read ID1)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	0	1	1	0	1	0	DAh
1st parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2nd arameter	1	↑	1	XXXXXXXX	ID1[7:0]								XX
Description	This read byte identifies the LCD module's manufacturer ID and it is specified by User The 1st parameter is dummy data. The 2nd parameter is LCD module's manufacturer ID. X = Don't care												
Restriction	ILI9486L is sending 2nd parameter value on the data lines if the MCU wants to read more than one parameter (= more than 2 RDX cycle) on parallel MCU interface. Only 2nd parameter is sent on DSI (The 1st parameter is not sent).												

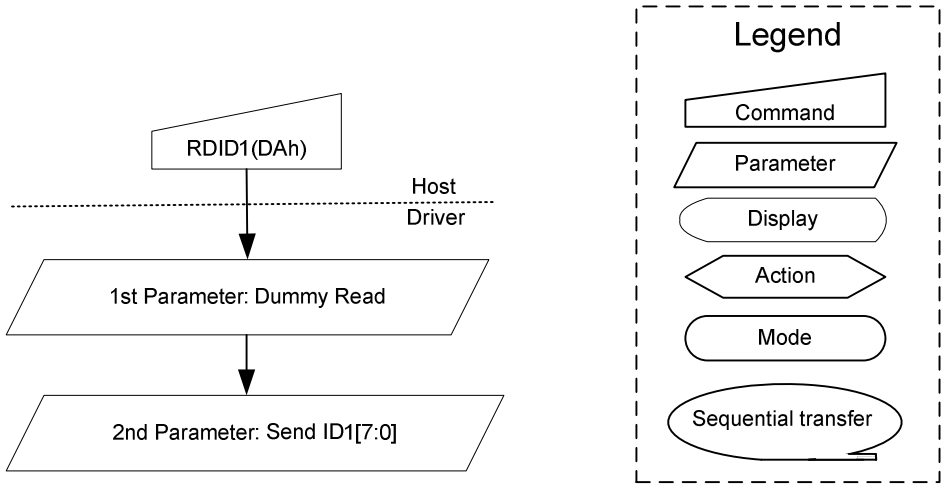
Register Availability

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
Power On Sequence	XXh
HW Reset	XXh

Flow Chart



8.2.48. Read ID2 (DBh)

DBh	RDID2 (Read ID2)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	0	1	1	0	1	1	DBh
1st parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2nd arameter	1	↑	1	XXXXXXXX	1	ID2[6:0]							XX
Description	This read byte is used to track the LCD module/driver version. It is defined by display supplier (with User's agreement) and changes each time a revision is made to the display, material or construction specifications. The 1st parameter is dummy data. The 2nd parameter is LCD module/driver version ID and the ID parameter range is from 80h to FFh. The ID2 can be programmed by OTP function. X = Don't care												
Restriction	ILI9486L is sending 2nd parameter value on the data lines if the MCU wants to read more than one parameter (= more than 2 RDX cycle) on parallel MCU interface. Only 2nd parameter is sent on DSI (The 1st parameter is not sent).												

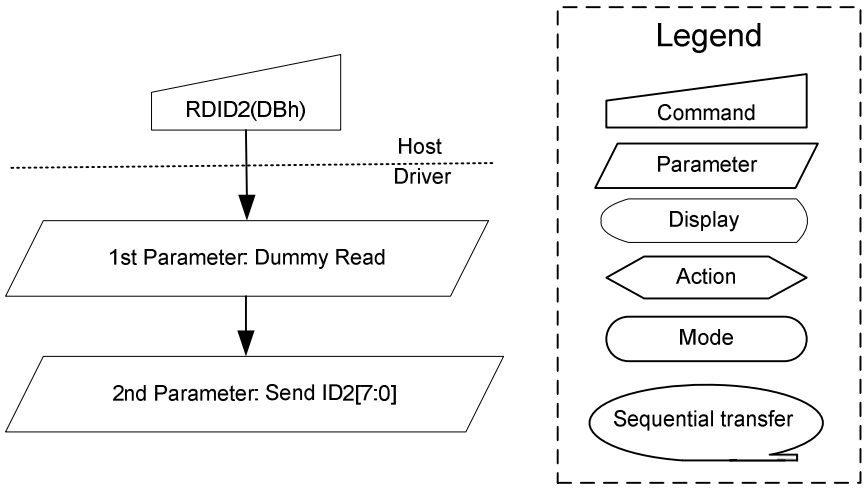
Register Availability

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 (Before OTP program)	Default Value (After OTP program)
Power On Sequence	80h	OTP value
SW Reset	80h	OTP value
HW Reset	80h	OTP value

Flow Chart



8.2.49. Read ID3 (DCh)

DCh	RDID3 (Read ID3)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	0	1	1	1	0	0	DCh
1st parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2nd parameter	1	↑	1	XXXXXXXX	ID3[7:0]								XX
Description	This read byte identifies the LCD module/driver and It is specified by User. The 1st parameter is dummy data. The 2nd parameter is LCD module/driver ID. The ID3 can be programmed by OTP function. X = Don't care												
Restriction	ILI9486L is sending 2nd parameter value on the data lines if the MCU wants to read more than one parameter (= more than 2 RDX cycle) on parallel MCU interface. Only 2nd parameter is sent on DSI (The 1st parameter is not sent).												

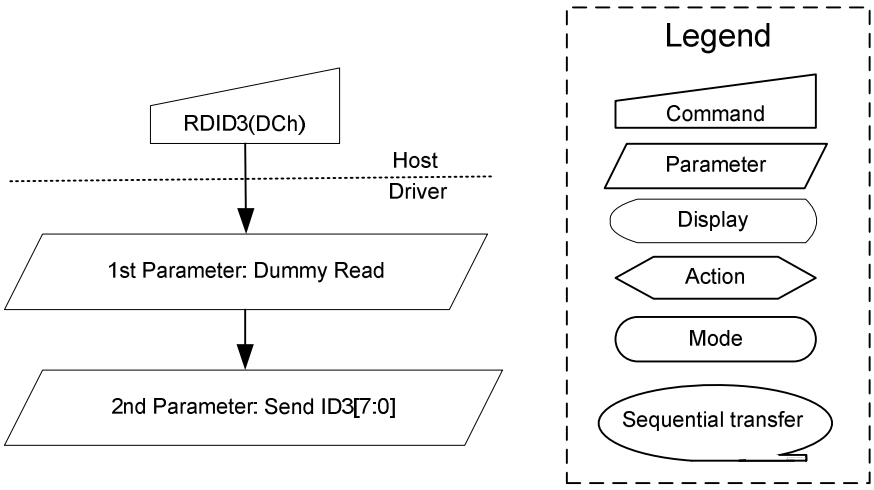
Register Availability

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 (Before OTP program)	Default Value (After OTP program)
Power On Sequence	00h	OTP value
SW Reset	00h	OTP value
HW Reset	00h	OTP value

Flow Chart



8.2.50. Interface Mode Control (B0h)

B0h	IFMODE (Interface Mode Control)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	0	1	1	0	0	0	0	B0h
1st Parameter	1	1	↑	XXXXXXXX	SDA_EN	0	0	0	VSPL	HSPL	DPL	EPL	XX

Description

Sets the operation status of the display interface. The setting becomes effective as soon as the command is received.

EPL: DE polarity ("0"= High enable for RGB interface, "1"=Low enable for RGB interface)

DPL: PCLK polarity set ("0"=data fetched at the rising time, "1"=data fetched at the falling time)

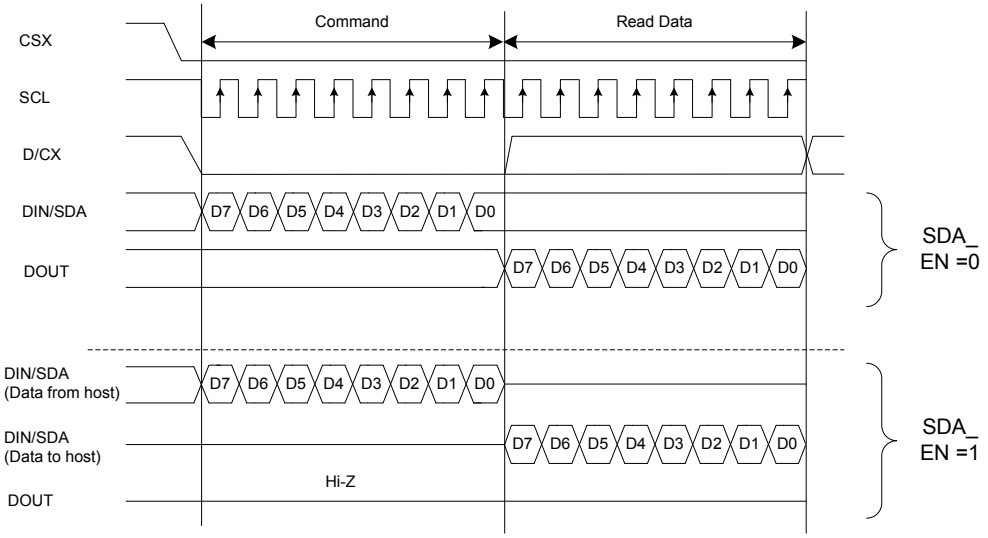
HSPL: HSYNC polarity ("0"=Low level sync clock, "1"=High level sync clock)

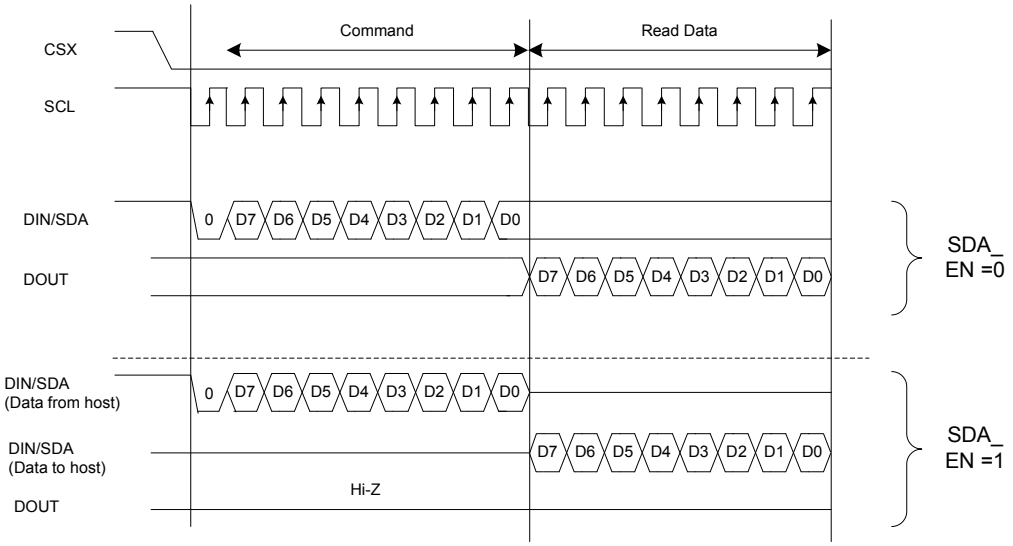
VSPL: VSYNC polarity ("0"= Low level sync clock, "1"= High level sync clock)

SDA_EN: 3/4 wire serial interface selection

SDA_EN = "0", DIN and DOUT pins are used for 3/4 wire serial interface.

SDA_EN = "1", DIN/SDA pin is used for 3/4 wire serial interface and DOUT pin is not used.





Restriction

Register 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				
	SDA_EN	EPL	DPL	HSPL	VSPL
Power ON Sequence	0b	0b	0b	0b	0b
H/W Reset	`0b	0b	0b	0b	0b

8.2.51. Frame Rate Control (In Normal Mode/Full Colors) (B1h)

B1h	FRMCTR1 (Frame Rate Control (In Normal Mode / Full colors))												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	0	1	1	0	0	0	1	B1h
1st Parameter	1	1	↑	XXXXXXXX	FRS[3:0]				0	0	DIVA[1:0]		XX
2nd parameter	1	1	↑	XXXXXXXX	0	0	0	RTNA[4:0]					XX

Description

FRS[3:0]: Sets the frame frequency of full color normal mode.

FRS[3:0]				Frame rate(Hz)
0	0	0	0	28
0	0	0	1	30
0	0	1	0	32
0	0	1	1	34
0	1	0	0	36
0	1	0	1	39
0	1	1	0	42
0	1	1	1	46
1	0	0	0	50
1	0	0	1	56
1	0	1	0	62
1	0	1	1	70
1	1	0	0	81
1	1	0	1	96
1	1	1	0	117
1	1	1	1	117

DIVA [1:0] : division ratio for internal clocks when Normal mode.

DIVA[1:0]		Division Ratio
0	0	fosc
0	1	fosc / 2
1	0	fosc / 4
1	1	fosc / 8

RTNA [4:0] : RTNA[4:0] is used to set 1H (line) period of Normal mode at CPU interface.

RTNA[4:0]					Clock per Line
0	0	0	0	0	Setting prohibited
0	0	0	0	1	Setting prohibited
0	0	0	1	0	Setting prohibited
0	0	0	1	1	Setting prohibited
0	0	1	0	0	Setting prohibited
0	0	1	0	1	Setting prohibited
0	0	1	1	0	Setting prohibited
0	0	1	1	1	Setting prohibited
0	1	0	0	0	Setting prohibited
0	1	0	0	1	Setting prohibited

RTNA[4:0]					Clock per Line
0	1	0	1	1	Setting prohibited
0	1	1	0	0	Setting prohibited
0	1	1	0	1	Setting prohibited
0	1	1	1	0	Setting prohibited
0	1	1	1	1	Setting prohibited
1	0	0	0	0	16 clocks
1	0	0	0	1	17 clocks
1	0	0	1	0	18 clocks
1	0	0	1	1	19 clocks
1	0	1	0	0	20 clocks

RTNA[4:0]					Clock per Line
1	0	1	1	0	22 clocks
1	0	1	1	1	23 clocks
1	0	0	0	0	24 clocks
1	0	0	0	1	25 clocks
1	0	0	1	0	26 clocks
1	0	1	1	1	27 clocks
1	1	0	0	0	28 clocks
1	1	0	0	1	29 clocks
1	1	0	1	0	30 clocks
1	1	1	1	1	31 clocks

	0 1 0 1 0 Setting prohibited 1 0 1 0 1 21 clocks
Restriction	
Register Availability	
Default	

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		
	FRS [3:0]	DIVA[1:0]	RTNA[4:0]
Power ON Sequence	4'b1011	2'b00	5'b10001
H/W Reset	4'b1011	2'b00	5'b10001

8.2.52. Frame Rate Control (In Idle Mode/8 colors) (B2h)

_B2h	FRMCTR2 (Frame Rate Control (In Idle Mode / 8 colors))												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	0	1	1	0	0	1	0	B2h
1st Parameter	1	1	↑	XXXXXXXX	0	0	0	0	0	0	DIVB[1:0]		XX
2nd parameter	1	1	↑	XXXXXXXX	0	0	0	RTNB[4:0]					XX

Description

Sets the division ratio for internal clocks of Idle mode at CPU interface.

DIVB [1:0] : division ratio for internal clocks when Idle mode.

DIVB[1:0]		Division Ratio
0	0	fosc
0	1	fosc / 2
1	0	fosc / 4
1	1	fosc / 8

RTNB [4:0] : RTNB[4:0] is used to set 1H (line) period of Idle mode at CPU interface.

RTNB[4:0]					Clock per Line
0	0	0	0	0	Setting prohibited
0	0	0	0	1	Setting prohibited
0	0	0	1	0	Setting prohibited
0	0	0	1	1	Setting prohibited
0	0	1	0	0	Setting prohibited
0	0	1	0	1	Setting prohibited
0	0	1	1	0	Setting prohibited
0	0	1	1	1	Setting prohibited
0	1	0	0	0	Setting prohibited
0	1	0	0	1	Setting prohibited
0	1	0	1	0	Setting prohibited

RTNB[4:0]					Clock per Line
0	1	0	1	1	Setting prohibited
0	1	1	0	0	Setting prohibited
0	1	1	0	1	Setting prohibited
0	1	1	1	0	Setting prohibited
0	1	1	1	1	Setting prohibited
1	0	0	0	0	16 clocks
1	0	0	0	1	17 clocks
1	0	0	1	0	18 clocks
1	0	0	1	1	19 clocks
1	0	1	0	0	20 clocks
1	0	1	0	1	21 clocks

RTNB[4:0]					Clock per Line
1	0	1	1	0	22 clocks
1	0	1	1	1	23 clocks
1	0	0	0	0	24 clocks
1	0	0	0	1	25 clocks
1	0	0	1	0	26 clocks
1	0	1	1	1	27 clocks
1	1	0	0	0	28 clocks
1	1	0	0	1	29 clocks
1	1	0	1	0	30 clocks
1	1	1	1	1	31 clocks

Restriction

Register 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	
	DIVB[1:0]	RTNB[4:0]
Power ON Sequence	2'b00	5'b10001
H/W Reset	2'b00	5'b10001

8.2.53. Frame Rate control (In Partial Mode/Full Colors) (B3h)

_B3h	FRMCTR3 (Frame Rate Control (In Partial Mode / Full colors))												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	0	1	1	0	0	1	1	B3h
1st Parameter	1	1	↑	XXXXXXXX	0	0	0	0	0	0	DIVC[1:0]		XX
2nd parameter	1	1	↑	XXXXXXXX	0	0	0	RTNC[4:0]					XX

Description

Sets the division ratio for internal clocks of Partial mode (Idle mode off) at CPU interface.

DIVC [1:0] : division ratio for internal clocks when Partial mode.

DIVC[1:0]		Division Ratio
0	0	fosc
0	1	fosc / 2
1	0	fosc / 4
1	1	fosc / 8

RTNC [4:0] : RTNC[4:0] is used to set 1H (line) period of Partial mode at CPU interface.

RTNC[4:0]					Clock per Line
0	0	0	0	0	Setting prohibited
0	0	0	0	1	Setting prohibited
0	0	0	1	0	Setting prohibited
0	0	0	1	1	Setting prohibited
0	0	1	0	0	Setting prohibited
0	0	1	0	1	Setting prohibited
0	0	1	1	0	Setting prohibited
0	0	1	1	1	Setting prohibited
0	1	0	0	0	Setting prohibited
0	1	0	0	1	Setting prohibited
0	1	0	1	0	Setting prohibited

RTNC[4:0]					Clock per Line
0	1	0	1	1	Setting prohibited
0	1	1	0	0	Setting prohibited
0	1	1	0	1	Setting prohibited
0	1	1	1	0	Setting prohibited
0	1	1	1	1	Setting prohibited
1	0	0	0	0	16 clocks
1	0	0	0	1	17 clocks
1	0	0	1	0	18 clocks
1	0	0	1	1	19 clocks
1	0	1	0	0	20 clocks
1	0	1	0	1	21 clocks

RTNC[4:0]					Clock per Line
1	0	1	1	0	22 clocks
1	0	1	1	1	23 clocks
1	0	0	0	0	24 clocks
1	0	0	0	1	25 clocks
1	0	0	1	0	26 clocks
1	0	1	1	1	27 clocks
1	1	0	0	0	28 clocks
1	1	0	0	1	29 clocks
1	1	0	1	0	30 clocks
1	1	1	1	1	31 clocks

Restriction

Register 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	
	DIVC[1:0]	RTNC[4:0]
Power ON Sequence	2'b00	5'b10001
H/W Reset	2'b00	5'b10001

8.2.54. Display Inversion Control (B4h)

B4h	INVTR (Display Inversion Control)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	0	1	1	0	1	0	0	B4h
1st Parameter	1	1	↑	XXXXXXXX	0	0	0	ZINV	0	0	DINV[1:0]		XX

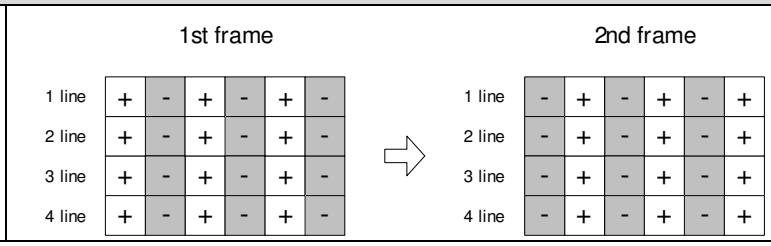
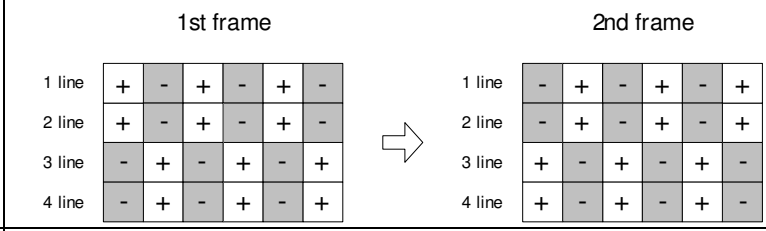
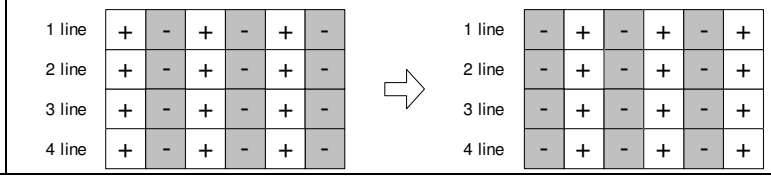
Description

ZINV : Set Z-inversion mode

0 : Disable Z-inversion

1 : Enable Z-inversion mode

DINV[1:0] : Set the inversion mode

DINV [1:0]	Dot inversion mode	
2'b00	Column inversion	
2'b01	Setting prohibited	
2'b10	2-dot inversion	
2'b11	4-dot inversion	

Restriction

Register 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	
	ZINV	DINV[1:0]
Power ON Sequence	1'b0	2'b00
H/W Reset	1'b0	2'b00

8.2.55. Blanking Porch Control (B5h)

B5h	PRCTR (Blanking Porch)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	0	1	1	0	1	0	1	B5h
1st parameter	1	1	↑	XXXXXXXX	VFP[7:0]								XX
2nd parameter	1	1	↑	XXXXXXXX	VBP[7:0]								XX
3nd parameter	1	1	↑	XXXXXXXX	0	0	0	HFP[4:0]					XX
4nd parameter	1	1	↑	XXXXXXXX	HBP[7:0]								XX

Description

VFP [7:0] / **VBP [7:0]:** The FP [7:0] and BP [7:0] bits specify the line number of vertical front and back porch period respectively.

FP[7:0]	Number of lines of front porch
00000000	Setting prohibited
00000001	Setting prohibited
00000010	2
00000011	3
:	:
11111100	252
11111101	253
11111110	254
11111111	255

BP[7:0]	Number of lines of back porch
00000000	Setting prohibited
00000001	Setting prohibited
00000010	2
00000011	3
:	:
11111100	252
11111101	253
11111110	254
11111111	254

HFP [4:0]: The HFP [4:0] bits specify the dotclk number of horizontal front porch period.

HFP[4:0]	Number of dotclk of front porch
00000	Setting prohibited
00001	Setting prohibited
00010	2
00011	3
:	:
11100	28
11101	29
11110	30
11111	31

HBP [7:0]: The HBP[7:0] bits specify the dotclk number of horizontal back porch period.

HBP[7:0]	Number of dotclk of front porch
00000000	Setting prohibited
00000001	Setting prohibited
00000010	2
00000011	3
:	:
11111100	252
11111101	253
11111110	254
11111111	255

Restriction

Register 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			
	VFP[7:0]	VBP[7:0]	HFP[4:0]	HBP[7:0]
Power ON Sequence	8'b00000010	8'b00000010	8'b00001010	8'b00000100
H/W Reset	8'b00000010	8'b00000010	8'b00001010	8'b00000100

8.2.56. Display Function Control (B6h)

B6h	DISCTRL (Display Function Control)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	0	1	1	0	1	1	0	B6h
1st parameter	1	1	↑	XXXXXXXX	BYPASS	RCM	RM	DM	PTG[1:0]		PT[1:0]		XX
2nd parameter	1	1	↑	XXXXXXXX	0	GS	SS	SM	ISC[3:0]				XX
3rd Parameter	1	1	↑	XXXXXXXX	0	0	NL[5:0]						XX

Description

DM: Select the display operation mode.

DM	Interface Mode
0	Internal system clock
1	RGB interface

RM: Select the interface to access the GRAM. When RM='0', the driver will write display data to GRAM via system interface and the driver will write display data to GRAM via RGB interface when RM='1'.

RM	Interface for RAM access
0	System interface
1	RGB interface

RCM: RGB interface selection (refer to the RGB interface section).

RCM	RGB transfer mode
0	DE Mode
1	SYNC Mode

BYPASS: Select the display data path whether memory or direct to shift register when RGB interface is used.

BYPASS	Display data path
0	Memory
1	Direct to shift register

Note: *RGB input signal, when set to bypass mode the Hsync low≧3,HBP≧3, HFP≧10.*

PTG [1:0]: Set the scan mode in non-display area.

PTG1	PTG0	Gate outputs in non-display area	Source outputs in non-display area
0	0	Normal scan	Set with the PT[2:0] bits
0	1	Setting prohibited	---
1	0	Interval scan	Set with the PT[2:0] bits
1	1	Setting prohibited	---

PT [1:0]: Determine source/VCOM output in a non-display area in the partial display mode.

PT[1:0]		Source output on non-display area
0	0	V63
0	1	V0
1	0	AGND
1	1	Hi-Z

SS: Select the shift direction of outputs from the source driver.

SS	Source Output Scan Direction
0	S1 → S960
1	S960 → S1

In addition to the shift direction, the settings for both SS and BGR bits are required to change the assignment of R, G, B dots to the source driver pins.

To assign R, G, B dots to the source driver pins from S1 to S960, set SS = 0.

To assign R, G, B dots to the source driver pins from S960 to S1, set SS = 1.

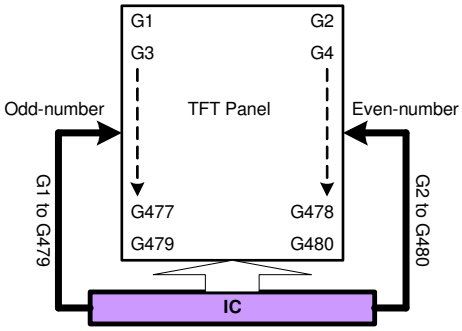
ISC[3:0]: Set the scan cycle when PTG selects interval scan in non-display area drive period. The scan cycle is defined by n frame periods, where n is an odd number from 3 to 31. The polarity of liquid crystal drive voltage from the gate driver is inverted in the same timing as the interval scan cycle.

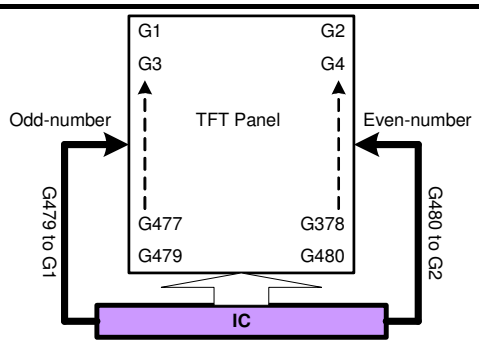
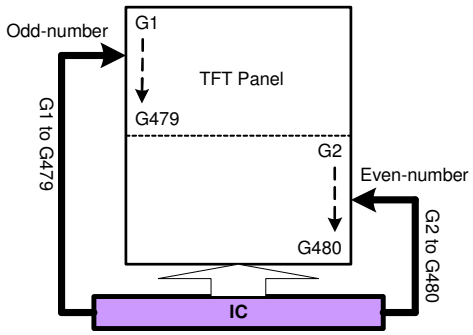
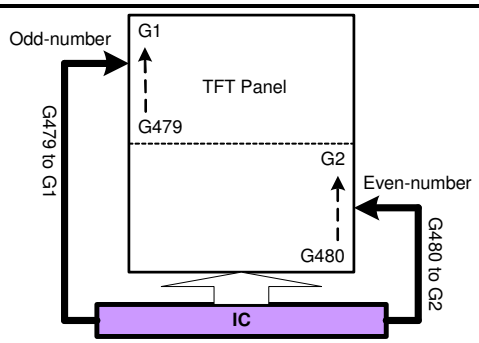
ISC[3:0]	Scan cycle	(f_{FRAME})=60Hz
4'h0	Setting inhibited	–
4'h1	3 frames	50ms
4'h2	5 frames	84ms
4'h3	7 frames	117ms
4'h4	9 frames	150ms
4'h5	11 frames	184ms
4'h6	13 frames	217ms
4'h7	15 frames	251ms
4'h8	17 frames	284ms
4'h9	19 frames	317ms
4'hA	21 frames	351ms
4'hB	23 frames	384ms
4'hC	25 frames	418ms
4'hD	27 frames	451ms
4'hE	29 frames	484ms
4'hF	31 frames	518ms

GS: Sets the direction of scan by the gate driver.

GS	Gate Output Scan Direction
0	G1 → G480
1	G480 → G1

SM: Sets the gate driver pin arrangement in combination with the GS bit (R60h) to select the optimal scan mode for the module.

SM	GS	Scan Direction	Gate Output Sequence
0	0		G1, G2, G3, G4, …,G476 G477, G478, G479, G480

	0	1		G480, G479, G478, …, G9 G7, G5, G4, G3, G2, G1
	1	0		G1, G3, G5, G7, …,G471 G473, G475, G477, G479 G2, G4, G6, G8, …,G472 G474, G476, G478, G480
	1	1		G480, G478, G476, …,G14 G12, G10, G8, G6, G4, G2 G479, G477, G475,…,G13 G11, G9, G7, G5, G3, G1

NL [5:0]: Sets the number of lines to drive the LCD at an interval of 8 lines. The GRAM address mapping is not affected by the number of lines set by NL[5:0]. The number of lines must be the same or more than the number of lines necessary for the size of the liquid crystal panel.

NL[5:0]	LCD Drive Line
6'h00 ~ 6'h3B	8 * (NL5:0]+1) lines
Others	Setting inhibited

Restriction	

Register 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						
	PTG[1:0]	PT[1:0]	GS	SS	SM	ISC[3:0]	NL[5:0]
Power ON Sequence	2'b00	2'b00	1'b0	1'b0	1'b0	4'b0010	6'b111011
H/W Reset	2'b00	2'b00	1'b0	1'b0	1'b0	4'b0010	6'b111011

Status	Default Value		
	RM	DM	BYPASS
Power ON Sequence	1'b0	1'b0	1'b1
H/W Reset	1'b0	1'b0	1'b1

8.2.57. Entry Mode Set (B7h)

B7h	ETMOD (Entry Mode Set)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	0	1	1	0	1	1	1	B7h
Parameter	1	1	↑	XXXXXXXX	EPF[1:0]		0	0	DSTB	GON	DTE	GAS	XX

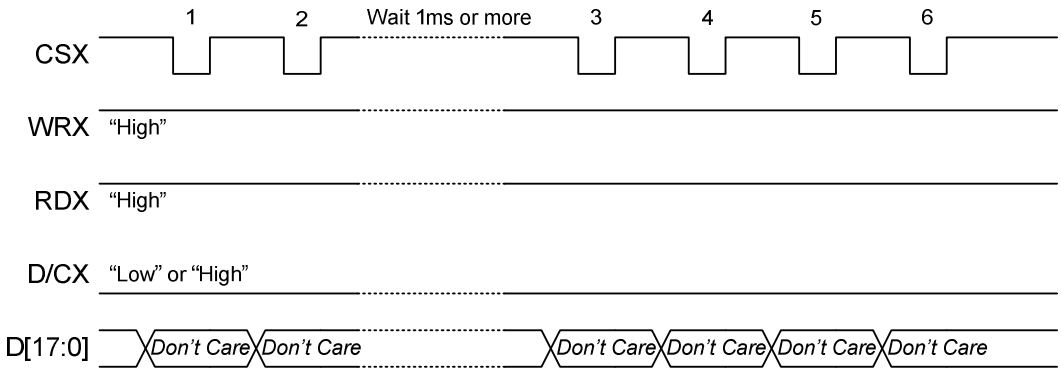
Description

DSTB: The ILI9486L driver enters the Deep Standby Mode when DSTB is set to high ("1"). In Deep Standby mode, both internal logic power and SRAM power are turn off, the display data stored in the Frame Memory and the instructions are not saved. Rewrite Frame Memory content and instructions after the Deep Standby Mode is exited.

Note: ILI9486L provides two ways to exit the Deep Standby Mode:

(1) Exit Deep Standby Mode by pull down CSX to low ("0") 6 times.

(2) Input a RESX pulse with effective low level duration to start up the inside logic regulator and makes a transition to the initial state.



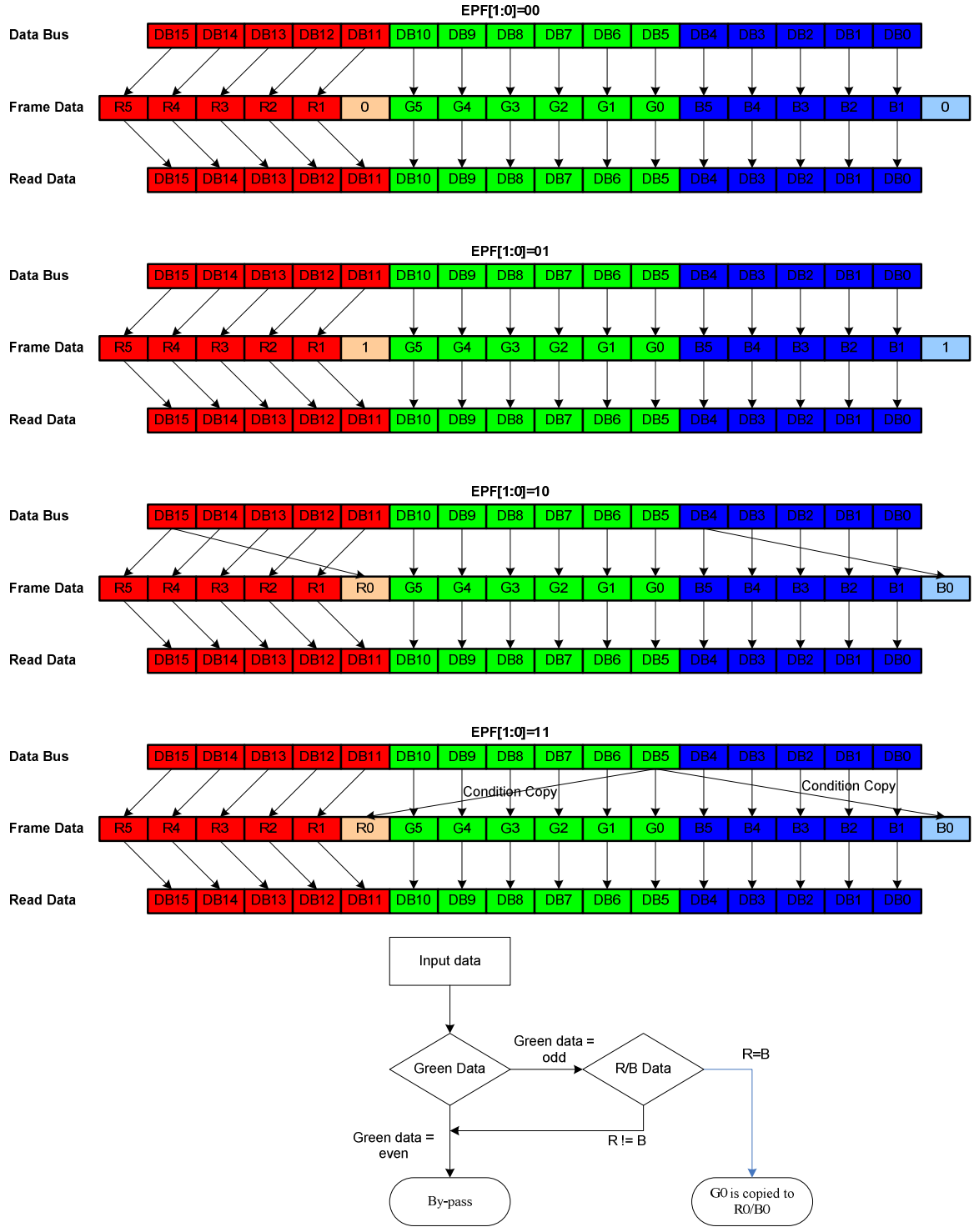
GAS: Low voltage detection control.

GAS	Low voltage detection
0	Enable
1	Disable

GON/DTE: Set the output level of gate driver G1 ~ G320 as follows

GON	DTE	G1~G320 Gate Output
0	0	VGH
0	1	VGH
1	0	VGL
1	1	Normal display

EPF[1:0] Set the data format when 16bbp (R,G,B) to 18 bbp (r, g, b) is stored in the internal GRAM



Restriction	

Register 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				
	EPF[1:0]	DSTB	GON	DTE	GAS
Power ON Sequence	2'b00	1'b0	1'b1	1'b1	1'b0
H/W Reset	2b'00	1'b0	1'b1	1'b1	1'b0

8.2.58. Power Control 1 (C0h)

C0h	PWCTRL 1 (Power Control 1)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	0	0	0	0	0	0	C0h
1st Parameter	1	1	↑	XXXXXXXX	0	0	0	VRH1[4:0]					XX
2nd Parameter	1	1	↑	XXXXXXXX	0	0	0	VRH2[4:0]					XX

Description

VRH1[4:0]: Sets the VREG1OUT voltage for positive gamma

VRH1[4:0]	VREG1OUT	VRH1[4:0]	VREG1OUT
5'h00	Halt (Vreg1out =Hiz)	5'h10	1.25 x 3.65 = 4.5625
5'h01	1.25 x 2.90 = 3.6250	5'h11	1.25 x 3.70 = 4.6250
5'h02	1.25 x 2.95 = 3.6875	5'h12	1.25 x 3.75 = 4.6875
5'h03	1.25 x 3.00 = 3.7500	5'h13	1.25 x 3.80 = 4.7500
5'h04	1.25 x 3.05 = 3.8125	5'h14	1.25 x 3.85 = 4.8125
5'h05	1.25 x 3.10 = 3.8750	5'h15	1.25 x 3.90 = 4.8750
5'h06	1.25 x 3.15 = 3.9375	5'h16	1.25 x 3.95 = 4.9375
5'h07	1.25 x 3.20 = 4.0000	5'h17	1.25 x 4.00 = 5.0000
5'h08	1.25 x 3.25 = 4.0625	5'h18	1.25 x 4.05 = 5.0625
5'h09	1.25 x 3.30 = 4.1250	5'h19	1.25 x 4.10 = 5.1250
5'h0A	1.25 x 3.35 = 4.1875	5'h1A	1.25 x 4.15 = 5.1875
5'h0B	1.25 x 3.40 = 4.2500	5'h1B	1.25 x 4.20 = 5.2500
5'h0C	1.25 x 3.45 = 4.3125	5'h1C	1.25 x 4.25 = 5.3125
5'h0D	1.25 x 3.50 = 4.3750	5'h1D	1.25 x 4.30 = 5.3750
5'h0E	1.25 x 3.55 = 4.4375	5'h1E	1.25 x 4.35 = 5.4375
5'h0F	1.25 x 3.60 = 4.5000	5'h1F	1.25 x 4.40 = 5.5000

VRH2[4:0]: Sets the VREG2OUT voltage for negative gamma

VRH2[4:0]	VREG2OUT	VRH2[4:0]	VREG2OUT
5'h00	Halt (Vreg2out =Hiz)	5'h10	-1.25 x 3.65 = -4.5625
5'h01	-1.25 x 2.90 = -3.6250	5'h11	-1.25 x 3.70 = -4.6250
5'h02	-1.25 x 2.95 = -3.6875	5'h12	-1.25 x 3.75 = -4.6875
5'h03	-1.25 x 3.00 = -3.7500	5'h13	-1.25 x 3.80 = -4.7500
5'h04	-1.25 x 3.05 = -3.8125	5'h14	-1.25 x 3.85 = -4.8125
5'h05	-1.25 x 3.10 = -3.8750	5'h15	-1.25 x 3.90 = -4.8750
5'h06	-1.25 x 3.15 = -3.9375	5'h16	-1.25 x 3.95 = -4.9375
5'h07	-1.25 x 3.20 = -4.0000	5'h17	-1.25 x 4.00 = -5.0000
5'h08	-1.25 x 3.25 = -4.0625	5'h18	-1.25 x 4.05 = -5.0625
5'h09	-1.25 x 3.30 = -4.1250	5'h19	-1.25 x 4.10 = -5.1250
5'h0A	-1.25 x 3.35 = -4.1875	5'h1A	-1.25 x 4.15 = -5.1875
5'h0B	-1.25 x 3.40 = -4.2500	5'h1B	-1.25 x 4.20 = -5.2500
5'h0C	-1.25 x 3.45 = -4.3125	5'h1C	-1.25 x 4.25 = -5.3125
5'h0D	-1.25 x 3.50 = -4.3750	5'h1D	-1.25 x 4.30 = -5.3750
5'h0E	-1.25 x 3.55 = -4.4375	5'h1E	-1.25 x 4.35 = -5.4375
5'h0F	-1.25 x 3.60 = -4.5000	5'h1F	-1.25 x 4.40 = -5.5000

Restriction

Register 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	VRH1	VRH2
Power ON Sequence	5'b01110	5'b01110
H/W Reset	5'b01110	5'b01110

8.2.59. Power Control 2 (C1h)

C1h	PWCTRL 2 (Power Control 2)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	0	0	0	0	0	1	C1h
1st parameter	1	1	↑	XXXXXXXX	0	1	0	0	0	BT[2:0]			4X
2nd parameter	1	1	↑	XXXXXXXX	0	0	0	0	0	VC[2:0]			XX

Description

BT [2:0]: Sets the factor used in the step-up circuits.

Select the optimal step-up factor for the operating voltage. To reduce power consumption, set a smaller factor.

BT[2:0]	DDVDH	DDVDL	VCL	VGH	VGL
4'h0	Vci1 x 2	-(VCI1-VCL)	- Vci1	Vci1 x 6	- Vci1 x 5
4'h1					- Vci1 x 4
4'h2					- Vci1 x 3
4'h3				Vci1 x 5	- Vci1 x 5
4'h4					- Vci1 x 4
4'h5					- Vci1 x 3
4'h6				Vci1 x 4	- Vci1 x4
4'h7					- Vci1 x3

Note: To prevent the device damage, please keep VGH – DDVDH < 8V condition.

VC [2:0]: Sets VCI1 regulator output voltage.

VC[2:0]	Vci1 voltage
3'h0	External VCI

Restriction

Register 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	
	BT[2:0]	VC[2:0]
Power ON Sequence	3'b000	3'b000
H/W Reset	3'b000	3'b000

8.2.60. Power Control 3 (For Normal Mode) (C2h)

C2h	PWCTRL 3 (Power Control 3)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	0	0	0	0	1	0	C2h
1st parameter	1	1	↑	XXXXXXXX	0	DCA1[2:0]			0	DCA0[2:0]			XX

Description

DCA0 [2:0]: Selects the operating frequency of the step-up circuit 1/4/5 for Normal mode. The higher step-up operating frequency enhances the drivability of the step-up circuit and the quality of display but increases the current consumption. Adjust the frequency taking the trade-off between the display quality and the current consumption into account.

DCA1 [2:0]: Selects the operating frequency of the step-up circuit 2/3 for Normal mode. The higher step-up operating frequency enhances the drivability of the step-up circuit and the quality of display but increases the current consumption. Adjust the frequency taking the trade-off between the display quality and the current consumption into account.

DCA0[2:0]			Step-up cycle for step-up circuit 1/4/5
0	0	0	1/8 H
0	0	1	1/4 H
0	1	0	1/2 H
0	1	1	1 H
1	0	0	2 H

DCA1[2:0]			Step-up cycle for step-up circuit 2/3
0	0	0	1/2 H
0	0	1	1 H
0	1	0	2 H
0	1	1	4 H
1	0	0	8 H

Restriction

Register 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	
	DCA0[2:0]	DCA1[2:0]
Power ON Sequence	3'b011	3'b011
H/W Reset	3'b011	3'b011

8.2.61. Power Control 4 (For Idle Mode) (C3h)

C3h	PWCTRL 4 (Power Control 4)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	0	0	0	0	1	1	C3h
1st Parameter	1	1	↑	XXXXXXXX	0	DCB1[2:0]			0	DCB0[2:0]			XX

Description

DCB0 [2:0]: Selects the operating frequency of the step-up circuit 1/4/5 for Idle mode. The higher step-up operating frequency enhances the drivability of the step-up circuit and the quality of display but increases the current consumption. Adjust the frequency taking the trade-off between the display quality and the current consumption into account.

DCB1 [2:0]: Selects the operating frequency of the step-up circuit 2/3 for Idle mode. The higher step-up operating frequency enhances the drivability of the step-up circuit and the quality of display but increases the current consumption. Adjust the frequency taking the trade-off between the display quality and the current consumption into account.

DCB0[2:0]			Step-up cycle for step-up circuit 1/4/5
0	0	0	1/8 H
0	0	1	1/4 H
0	1	0	1/2 H
0	1	1	1 H
1	0	0	2 H

DCB1[2:0]			Step-up cycle for step-up circuit 2/3
0	0	0	1/2 H
0	0	1	1 H
0	1	0	2 H
0	1	1	4 H
1	0	0	8 H

Restriction

Register 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	
	DCB0[2:0]	DCB1[2:0]
Power ON Sequence	3'b011	3'b011
H/W Reset	3'b011	3'b011

8.2.62. Power Control 5 (For Partial Mode) (C4h)

C4h	PWCTRL 5 (Power Control 5)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	0	0	0	1	0	0	C4h
1st Parameter	1	1	↑	XXXXXXXX	0	DCC1[2:0]			0	DCC0[2:0]			XX

Description

DCC0 [2:0]: Selects the operating frequency of the step-up circuit 1/4/5 for Partial mode. The higher step-up operating frequency enhances the drivability of the step-up circuit and the quality of display but increases the current consumption. Adjust the frequency taking the trade-off between the display quality and the current consumption into account.

DCC1 [2:0]: Selects the operating frequency of the step-up circuit 2/3 for Partial mode. The higher step-up operating frequency enhances the drivability of the step-up circuit and the quality of display but increases the current consumption. Adjust the frequency taking the trade-off between the display quality and the current consumption into account.

DCC0[2:0]			Step-up cycle for step-up circuit 1/4/5
0	0	0	1/8 H
0	0	1	1/4 H
0	1	0	1/2 H
0	1	1	1 H
1	0	0	2 H

DCC1[2:0]			Step-up cycle for step-up circuit 2/3
0	0	0	1/2 H
0	0	1	1 H
0	1	0	2 H
0	1	1	4 H
1	0	0	8 H

Restriction

Register 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	
	DCC0[2:0]	DCC1[2:0]
Power ON Sequence	3'b011	3'b011
H/W Reset	3'b011	3'b011

8.2.63. VCOM Control (C5h)

C5h	VMCTRL (VCOM Control)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	0	0	0	1	0	1	C5h
1st Parameter	1	↑	1	XXXXXXXX	0	0	0	0	0	0	0	nVM	XX
2ndParameter	1	1	↑	XXXXXXXX	VCM_REG[7:0]								XX
3rdParameter	1	1	↑	XXXXXXXX	VCM_REG_EN	0	0	0	0	0	0	0	XX
4rdParameter	1	↑	1	XXXXXXXX	VCM_OUT[7:0]								XX

Description

nVM : When the NV memory is programmed, the nVM will be set as '1' automatically.
0 : NV memory is not programmed
1 : NV memory is programmed

VCM_REG [7:0] is used to set factor to generate VCOM voltage from the reference voltage VREG2OUT.

VCM[7:0]								VCOM
0	0	0	0	0	0	0	0	-2
0	0	0	0	0	0	0	1	-1.98438
0	0	0	0	0	0	1	0	-1.96875
0	0	0	0	0	0	1	1	-1.95313
0	0	0	0	0	1	0	0	-1.9375
0	0	0	0	0	1	0	1	-1.92188
0	0	0	0	0	1	1	0	-1.90625
0	0	0	0	0	1	1	1	-1.89063
0	0	0	0	1	0	0	0	-1.875
0	0	0	0	1	0	0	1	-1.85938
0	0	0	0	1	0	1	0	-1.84375
0	0	0	0	1	0	1	1	-1.82813
0	0	0	0	1	1	0	0	-1.8125
0	0	0	0	1	1	0	1	-1.79688
0	0	0	0	1	1	1	0	-1.78125
0	0	0	0	1	1	1	1	-1.76563
0	0	0	1	0	0	0	0	-1.75
0	0	0	1	0	0	0	1	-1.73438
0	0	0	1	0	0	1	0	-1.71875
0	0	0	1	0	0	1	1	-1.70313
0	0	0	1	0	1	0	0	-1.6875
0	0	0	1	0	1	0	1	-1.67188
0	0	0	1	0	1	1	0	-1.65625
0	0	0	1	0	1	1	1	-1.64063
0	0	0	1	1	0	0	0	-1.625
0	0	0	1	1	0	0	1	-1.60938
0	0	0	1	1	0	1	0	-1.59375
0	0	0	1	1	0	1	1	-1.57813
0	0	0	1	1	1	0	0	-1.5625
0	0	0	1	1	1	0	1	-1.54688
0	0	0	1	1	1	1	0	-1.53125
0	0	0	1	1	1	1	1	-1.51563
0	0	1	0	0	0	0	0	-1.5
0	0	1	0	0	0	0	1	-1.48438
0	0	1	0	0	0	1	0	-1.46875
0	0	1	0	0	0	1	1	-1.45313
0	0	1	0	0	1	0	0	-1.4375
0	0	1	0	0	1	0	1	-1.42188
0	0	1	0	0	1	1	0	-1.40625
0	0	1	0	0	1	1	1	-1.39063
0	0	1	0	1	0	0	0	-1.375
0	0	1	0	1	0	0	1	-1.35938
0	0	1	0	1	0	1	0	-1.34375
0	0	1	0	1	0	1	1	-1.32813

		0	0	1	0	1	1	0	0	-1.3125
		0	0	1	0	1	1	0	1	-1.29688
		0	0	1	0	1	1	1	0	-1.28125
		0	0	1	0	1	1	1	1	-1.26563
		0	0	1	1	0	0	0	0	-1.25
		0	0	1	1	0	0	0	1	-1.23438
		0	0	1	1	0	0	1	0	-1.21875
		0	0	1	1	0	0	1	1	-1.20313
		0	0	1	1	0	1	0	0	-1.1875
		0	0	1	1	0	1	0	1	-1.17188
		0	0	1	1	0	1	1	0	-1.15625
		0	0	1	1	0	1	1	1	-1.14063
		0	0	1	1	1	0	0	0	-1.125
		0	0	1	1	1	0	0	1	-1.10938
		0	0	1	1	1	0	1	0	-1.09375
		0	0	1	1	1	0	1	1	-1.07813
		0	0	1	1	1	1	0	0	-1.0625
		0	0	1	1	1	1	0	1	-1.04688
		0	0	1	1	1	1	1	0	-1.03125
		0	0	1	1	1	1	1	1	-1.01563
		0	1	0	0	0	0	0	0	-1
		0	1	0	0	0	0	0	1	-0.98438
		0	1	0	0	0	0	1	0	-0.96875
		0	1	0	0	0	0	1	1	-0.95313
		0	1	0	0	0	1	0	0	-0.9375
		0	1	0	0	0	1	0	1	-0.92188
		0	1	0	0	0	1	1	0	-0.90625
		0	1	0	0	0	1	1	1	-0.89063
		0	1	0	0	1	0	0	0	-0.875
		0	1	0	0	1	0	0	1	-0.85938
		0	1	0	0	1	0	1	0	-0.84375
		0	1	0	0	1	0	1	1	-0.82813
		0	1	0	0	1	1	0	0	-0.8125
		0	1	0	0	1	1	0	1	-0.79688
		0	1	0	0	1	1	1	0	-0.78125
		0	1	0	0	1	1	1	1	-0.76563
		0	1	0	1	0	0	0	0	-0.75
		0	1	0	1	0	0	0	1	-0.73438
		0	1	0	1	0	0	1	0	-0.71875
		0	1	0	1	0	0	1	1	-0.70313
		0	1	0	1	0	1	0	0	-0.6875
		0	1	0	1	0	1	0	1	-0.67188
		0	1	0	1	0	1	1	0	-0.65625
		0	1	0	1	0	1	1	1	-0.64063
		0	1	0	1	1	0	0	0	-0.625
		0	1	0	1	1	0	0	1	-0.60938
		0	1	0	1	1	0	1	0	-0.59375
		0	1	0	1	1	0	1	1	-0.57813
		0	1	0	1	1	1	0	0	-0.5625
		0	1	0	1	1	1	0	1	-0.54688
		0	1	0	1	1	1	1	0	-0.53125
		0	1	0	1	1	1	1	1	-0.51563
		0	1	1	0	0	0	0	0	-0.5
		0	1	1	0	0	0	0	1	-0.48438
		0	1	1	0	0	0	1	0	-0.46875
		0	1	1	0	0	0	1	1	-0.45313
		0	1	1	0	0	1	0	0	-0.4375
		0	1	1	0	0	1	0	1	-0.42188

0	1	1	0	0	1	1	0	-0.40625
0	1	1	0	0	1	1	1	-0.39063
0	1	1	0	1	0	0	0	-0.375
0	1	1	0	1	0	0	1	-0.35938
0	1	1	0	1	0	1	0	-0.34375
0	1	1	0	1	0	1	1	-0.32813
0	1	1	0	1	1	0	0	-0.3125
0	1	1	0	1	1	0	1	-0.29688
0	1	1	0	1	1	1	0	-0.28125
0	1	1	0	1	1	1	1	-0.26563
0	1	1	1	0	0	0	0	-0.25
0	1	1	1	0	0	0	1	-0.23438
0	1	1	1	0	0	1	0	-0.21875
0	1	1	1	0	0	1	1	-0.20313
0	1	1	1	0	1	0	0	-0.1875
0	1	1	1	0	1	0	1	-0.17188
0	1	1	1	0	1	1	0	-0.15625
0	1	1	1	0	1	1	1	-0.14063
0	1	1	1	1	0	0	0	-0.125
0	1	1	1	1	0	0	1	-0.10938
0	1	1	1	1	0	1	0	-0.09375
0	1	1	1	1	0	1	1	-0.07813
0	1	1	1	1	1	0	0	-0.0625
0	1	1	1	1	1	0	1	-0.04688
0	1	1	1	1	1	1	0	-0.03125
0	1	1	1	1	1	1	1	-0.01563
1	0	0	0	0	0	0	0	0
10000001~11111110								Inbibit
11111111								Halt

VCM_REG_EN: Select the Vcom value from **VCM_REG [7:0]** or **NV memory**.

0: VCOM value from NV memory.
1: VCOM value from VCM_REG [7:0].

VCM_OUT [7:0]: NV memory programmed value.

Restriction

Register 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			
	VCM_OUT[7:0]	VCM_REG_EN	VCM_REG[7:0]	nVM
Power ON Sequence	8'bXXXXXXXX	1'b0	8'b01100000	X
H/W Reset	8'bXXXXXXXX	1'b0	8'b01100000	X

8.2.64. CABC Control 1 (C6h)

C6h	CABCCTRL9 (CABC Control 9)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	0	0	0	1	1	0	C6h
1st Parameter	1	1	↑	XXXXXXXX	SCD_VLINE[7:0]								XX
2nd Parameter	1	1	↑	XXXXXXXX	0	0	0	0	0	SCD_VLINE[10:8]			XX

Description

SCD_VLINE [10:0]: This parameter is used set the display line per frame while partial mode ON.

SCD_VLINE[8:0]											Display line
D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	
0	0	0	0	0	0	0	0	0	0	0	Setting prohibited
0	0	0	0	0	0	0	0	0	0	1	1 line
0	0	0	0	0	0	0	0	0	1	0	2 lines
0	0	0	0	0	0	0	0	0	1	1	3 lines
0	0	0	0	0	0	0	0	1	0	0	4 lines
:											:
:											:
0	0	1	1	1	0	1	1	1	0	1	477 lines
0	0	1	1	1	0	1	1	1	1	0	478 lines
0	0	1	1	1	0	1	1	1	1	1	479 lines
0	0	1	1	1	1	0	0	0	0	0	480 lines
Others											Setting prohibited

Restriction

Register 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
Power ON Sequence	11'b00111100000
S/W Reset	11'b00111100000
H/W Reset	11'b00111100000

8.2.65. CABC Control 2 (C8h)

<table>
<tr><th>C8h</th><th colspan="12">CABCTRL1 (CABC Control 1)</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D[15:8]</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>0</td><td>1</td><td>↑</td><td>XXXXXXXX</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>C8h</td></tr>
<tr><td>1st Parameter</td><td>1</td><td>1</td><td>↑</td><td>XXXXXXXX</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>LEDONR</td><td>LEDONPOL</td><td>PWMPOL</td><td>XX</td></tr>
<tr><td>Description</td><td colspan="13">
PWMPOL: The bit is used to define polarity of CABC_PWM signal.
<table>
<tr><th>BL</th><th>LEDPWMPOL</th><th>CABC_PWM pin</th></tr>
<tr><td>0</td><td>0</td><td>Always low</td></tr>
<tr><td>0</td><td>1</td><td>Always high</td></tr>
<tr><td>1</td><td>0</td><td>Original polarity of PWM signal</td></tr>
<tr><td>1</td><td>1</td><td>Inversed polarity of PWM signal</td></tr>
</table>
LEDONPOL: This bit is used to control CABC_ON pin.
<table>
<tr><th>BL</th><th>LEDONPOL</th><th>CABC_ON pin</th></tr>
<tr><td>0</td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>LEDONR</td></tr>
<tr><td>1</td><td>1</td><td>Inversed LEDONR</td></tr>
</table>
LEDONR: This bit is used to control CABC_ON pin.
<table>
<tr><th>LEDONR</th><th>Description</th></tr>
<tr><td>0</td><td>Low</td></tr>
<tr><td>1</td><td>High</td></tr>
</table>
</td></tr>
<tr><td>Restriction</td><td colspan="13"></td></tr>
<tr><td>Register Availability</td><td colspan="13">
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode ON, Idle Mode OFF, Sleep OUT</td><td>Yes</td></tr>
<tr><td>Normal Mode ON, Idle Mode ON, Sleep OUT</td><td>Yes</td></tr>
<tr><td>Partial Mode ON, Idle Mode OFF, Sleep OUT</td><td>Yes</td></tr>
<tr><td>Partial Mode ON, Idle Mode ON, Sleep OUT</td><td>Yes</td></tr>
<tr><td>Sleep IN</td><td>Yes</td></tr>
</table>
</td></tr>
<tr><td>Default</td><td colspan="13">
<table>
<tr><th rowspan="2">Status</th><th colspan="3">Default Value</th></tr>
<tr><th>LEDONR</th><th>LEDONPOL</th><th>LEDPWMPOL</th></tr>
<tr><td>Power On Sequence</td><td>1’b0</td><td>1’b0</td><td>1’b0</td></tr>
<tr><td>SW Reset</td><td>No change</td><td>No change</td><td>No change</td></tr>
<tr><td>HW Reset</td><td>1’b0</td><td>1’b0</td><td>1’b0</td></tr>
</table>
</td></tr>
</table>

8.2.66. CABC Control 3 (C9h)

C9h	CABCCTRL2 (CABC Control 2)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	0	0	1	0	0	1	C9h
1st Parameter	1	1	↑	XXXXXXXX	THRES_MOV[3:0]				THRES_STILL[3:0]				XX

Description

THRES_MOV [3:0]: This parameter is used to set the ratio (percentage) of the maximum number of pixels that makes display image white (data="63) to the total of pixels by image process in MOVING image mode. After this parameter sets the number of pixels that makes display image white, threshold grayscale value (DTH) that makes display image white is set so that the number of the pixels set by this parameter does not change.

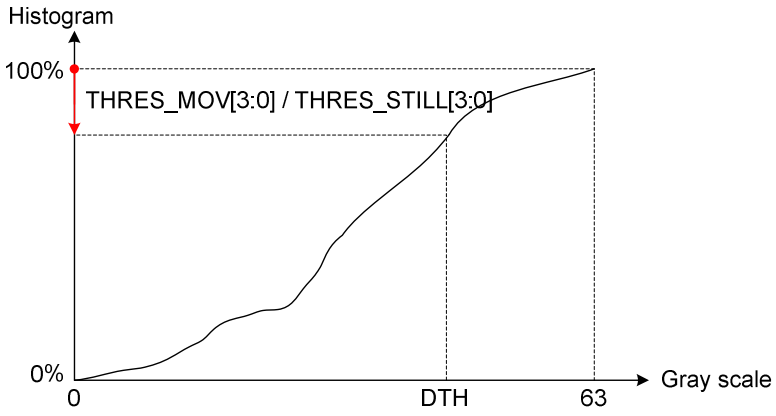
THRES_MOV[3:0]				Description
D3	D2	D1	D0	
0	0	0	0	99 %
0	0	0	1	98 %
0	0	1	0	96 %
0	0	1	1	94 %
0	1	0	0	92 %
0	1	0	1	90 %
0	1	1	0	88 %
0	1	1	1	86 %

THRES_MOV[3:0]				Description
D3	D2	D1	D0	
1	0	0	0	84 %
1	0	0	1	82 %
1	0	1	0	80 %
1	0	1	1	78 %
1	1	0	0	76 %
1	1	0	1	74 %
1	1	1	0	72 %
1	1	1	1	70 %

THRES_STILL [3:0]: This parameter is used to set the ratio (percentage) of the maximum number of pixels that makes display image white (data="63) to the total of pixels by image process in STILL mode. After this parameter sets the number of pixels that makes display image white, threshold grayscale value (DTH) that makes display image white is set so that the number of the pixels set by this parameter does not change.

THRES_STILLI[3:0]				Description
D3	D2	D1	D0	
0	0	0	0	99 %
0	0	0	1	98 %
0	0	1	0	96 %
0	0	1	1	94 %
0	1	0	0	92 %
0	1	0	1	90 %
0	1	1	0	88 %
0	1	1	1	86 %

THRES_STILL[3:0]				Description
D3	D2	D1	D0	
1	0	0	0	84 %
1	0	0	1	82 %
1	0	1	0	80 %
1	0	1	1	78 %
1	1	0	0	76 %
1	1	0	1	74 %
1	1	1	0	72 %
1	1	1	1	70 %



Restriction

Register 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	
	THRES_MOV[3:0]	THRES_STILL[3:0]
Power ON Sequence	4'b1011 b	4'b1011 b
S/W Reset	4'b1011 b	4'b1011 b
H/W Reset	4'b1011 b	4'b1011 b

8.2.67. CABC Control 4 (CAh)

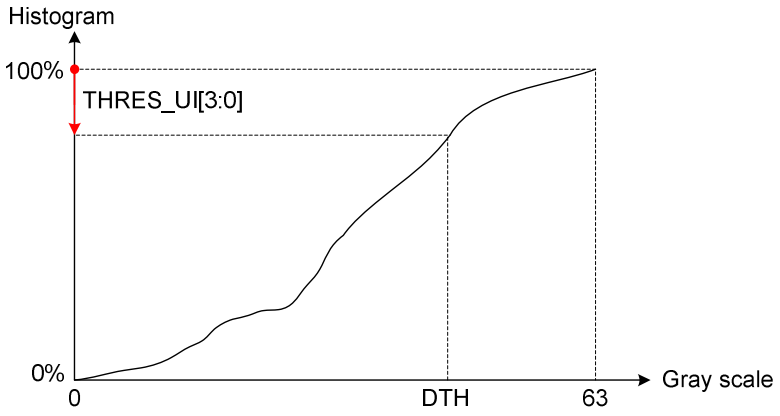
CAh	CABCCTRL3 (CABC Control 3)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	0	0	1	0	1	0	CAh
1st Parameter	1	1	↑	XXXXXXXX	0	0	0	0	THRES_UI[3:0]				XX

Description

THRES_UI [3:0]: This parameter is used to set the ratio (percentage) of the maximum number of pixels that makes display image white (data="63) to the total of pixels by image process in USER INTERFACE mode. After this parameter sets the number of pixels that makes display image white, threshold grayscale value (DTH) that makes display image white is set so that the number of the pixels set by this parameter does not change.

THRES_UI[3:0]				Description
D3	D2	D1	D0	
0	0	0	0	99 %
0	0	0	1	98 %
0	0	1	0	96 %
0	0	1	1	94 %
0	1	0	0	92 %
0	1	0	1	90 %
0	1	1	0	88 %
0	1	1	1	86 %

THRES_UI[3:0]				Description
D3	D2	D1	D0	
1	0	0	0	84 %
1	0	0	1	82 %
1	0	1	0	80 %
1	0	1	1	78 %
1	1	0	0	76 %
1	1	0	1	74 %
1	1	1	0	72 %
1	1	1	1	70 %



Restriction

Register 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
Power ON Sequence	4'b1011 b
S/W Reset	4'b1011 b
H/W Reset	4'b1011 b

8.2.68. CABC Control 5 (CBh)

CBh	CABCCTRL4 (CABC Control 4)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	0	0	1	0	1	1	CBh
1st Parameter	1	1	↑	XXXXXXXX	DTH_MOV[3:0]				DTH_STILL[3:0]				XX

Description

DTH_MOV [3:0]: This parameter is used set the minimum limitation of grayscale threshold value in MOVING image mode.

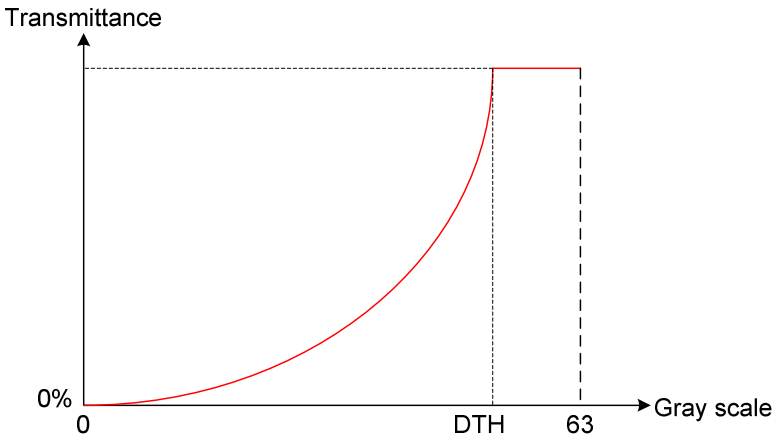
DTH_MOV[3:0]				Description
D3	D2	D1	D0	
0	0	0	0	224
0	0	0	1	220
0	0	1	0	216
0	0	1	1	212
0	1	0	0	208
0	1	0	1	204
0	1	1	0	200
0	1	1	1	196

DTH_MOV[3:0]				Description
D3	D2	D1	D0	
1	0	0	0	192
1	0	0	1	188
1	0	1	0	184
1	0	1	1	180
1	1	0	0	176
1	1	0	1	172
1	1	1	0	168
1	1	1	1	164

DTH_OPT [2:0]: This parameter is used to set the minimum limitation of grayscale threshold value in STILL image mode.

DTH_STILLI[3:0]				Description
D3	D2	D1	D0	
0	0	0	0	224
0	0	0	1	220
0	0	1	0	216
0	0	1	1	212
0	1	0	0	208
0	1	0	1	204
0	1	1	0	200
0	1	1	1	196

DTH_STILL[3:0]				Description
D3	D2	D1	D0	
1	0	0	0	192
1	0	0	1	188
1	0	1	0	184
1	0	1	1	180
1	1	0	0	176
1	1	0	1	172
1	1	1	0	168
1	1	1	1	164



Restriction

Register 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	
	DTH_MOV[3:0]	DTH_STILL[3:0]
Power ON Sequence	4'b1010 b	4'b1000 b
S/W Reset	4'b1010 b	4'b1000 b
H/W Reset	4'b1010 b	4'b1000 b

8.2.69. CABC Control 6 (CCh)

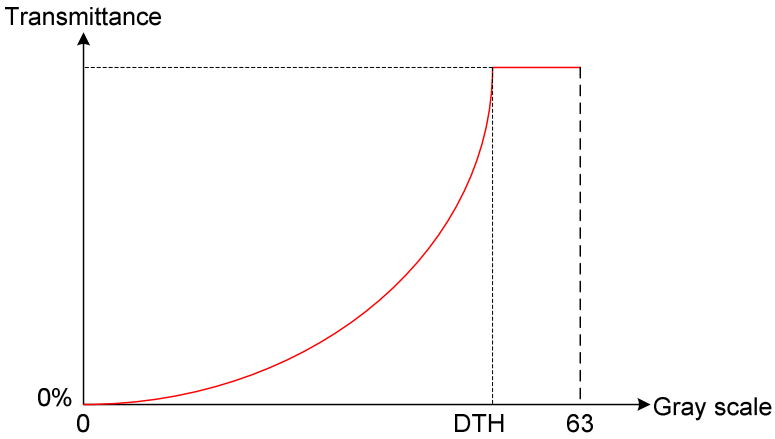
CCh	CABCCTRL5 (CABC Control 5)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	0	0	1	1	0	0	CCh
1st Parameter	1	1	↑	XXXXXXXX	0	0	0	0	DTH_UI[3:0]				XX

Description

DTH_UI [3:0]: This parameter is used set the minimum limitation of grayscale threshold value in USER INTERFACE mode.

DTH_UI[3:0]				Description
D3	D2	D1	D0	
0	0	0	0	252
0	0	0	1	248
0	0	1	0	244
0	0	1	1	240
0	1	0	0	236
0	1	0	1	232
0	1	1	0	228
0	1	1	1	224

DTH_UI[3:0]				Description
D3	D2	D1	D0	
1	0	0	0	220
1	0	0	1	216
1	0	1	0	212
1	0	1	1	208
1	1	0	0	204
1	1	0	1	200
1	1	1	0	196
1	1	1	1	192



Restriction

Register 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
Power ON Sequence	4'b0100 b
S/W Reset	4'b0100 b
H/W Reset	4'b0100 b

8.2.70. CABC Control 7 (CDh)

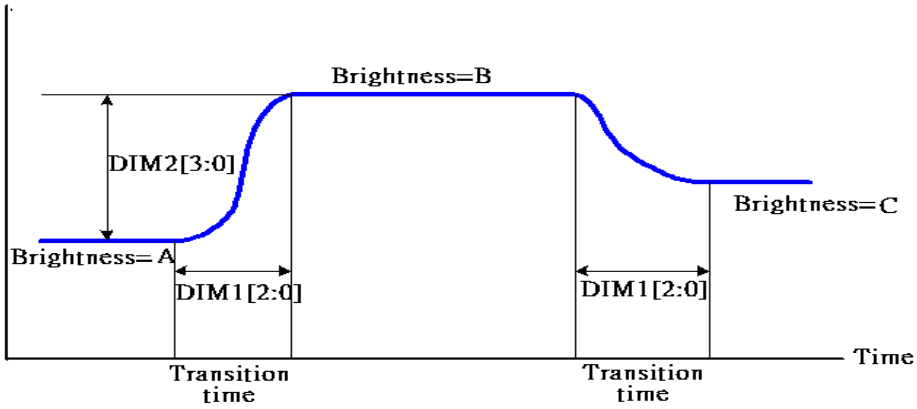
CDh	CABCCTRL6 (CABC Control 6)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	0	0	1	1	0	1	CDh
1st Parameter	1	1	↑	XXXXXXXX	0	DIM_MOV[2:0]			0	DIM_STILL[2:0]			XX

Description

DIM_STILL [2:0]: This parameter is used set the transition time of brightness level change to avoid the sharp brightness change on vision in still mode.

DIM_MOV [2:0]: This parameter is used set the transition time of brightness level change to avoid the sharp brightness change on vision in still mode.

DIM_MOV[2:0]/DIM_STILL[2 :0]			Description
D2	D1	D0	
0	0	0	1 frame
0	0	1	1 frame
0	1	0	2 frames
0	1	1	4 frames
1	0	0	8 frames
1	0	1	16 frames
1	1	0	32 frames
1	1	1	64 frames



*Note: As above picture **DIM1[2:0]** mean **DIM_MOV[2:0]** or **DIM_STILL[2:0]** or **DIM_UI[2:0]** in different mode.*

Restriction

Register 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	
	DIM_MOV[2:0]	DIM_STILL[2:0]
Power ON Sequence	4'b100 b	3'b011 b
S/W Reset	4'b100 b	3'b011 b
H/W Reset	4'b100 b	3'b011 b

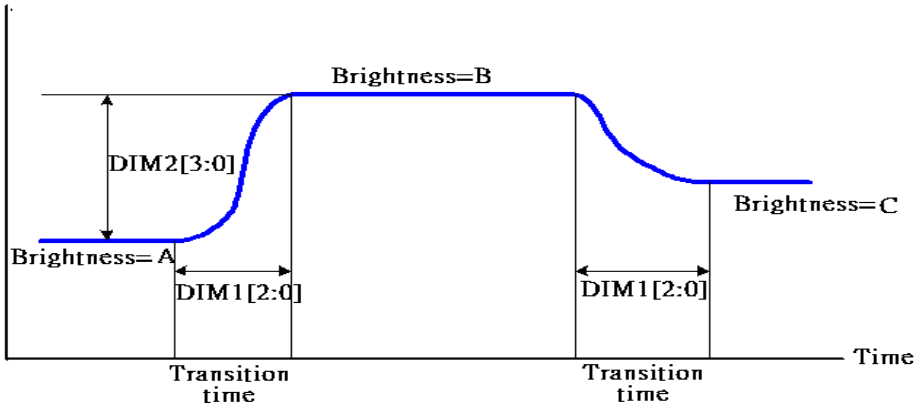
8.2.71. CABC Control 8 (CEh)

CEh	CABCCTRL7 (CABC Control 7)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	0	0	1	1	1	0	CEh
1st Parameter	1	1	↑	XXXXXXXX	DIM_MIN[3:0]				0	DIM_UI[2:0]			XX

Description

DIM_UI [2:0]: This parameter is used set the transition time of brightness level change to avoid the sharp brightness change on vision in UI mode.

DIM_MOV[2:0]/DIM_STILL[2 :0]			Description
D2	D1	D0	
0	0	0	1 frame
0	0	1	1 frame
0	1	0	2 frames
0	1	1	4 frames
1	0	0	8 frames
1	0	1	16 frames
1	1	0	32 frames
1	1	1	64 frames



*Note1: As above picture **DIM1[2:0]** mean **DIM_MOV[2:0]** or **DIM_STILL[2:0]** or **DIM_UI[2:0]** in different mode.*

*Note2: As above picture **DIM2[3:0]** mean **DIM_MIN[3:0]**.*

DIM_MIN [3:0]: The parameter is used to set the imitation of minimum brightness change. If the parameter is large than the difference between target brightness and current brightness, then the brightness will not change.

Restriction

Register 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	
	DIM_MIN[3:0]	DIM_UI[2:0]
Power ON Sequence	4'b0000 b	3'b010 b
S/W Reset	4'b0000 b	3'b010 b
H/W Reset	4'b0000 b	3'b010 b

8.2.72. CABC Control 9 (CFh)

CFh	CABCCTRL8 (CABC Control 8)												
	DCX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	0	0	1	1	1	1	CFh
1st Parameter	1	1	↑	XXXXXXXX	PWM_DIV[7:0]								XX

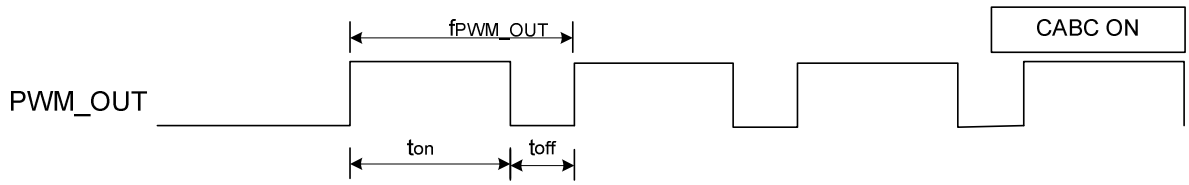
Description

PWM_DIV [7:0]: PWM_OUT output period control. This command is used to adjust the PWM waveform period of PWM_OUT.

The PWM period can be calculated using the equation in the following.

$$f_{PWM\_OUT} = \frac{18MHz}{(PWM\_DIV[7:0]+1)\times 255}$$

PWM_DIV[7:0]								f_{PWM_OUT}
D7	D6	D5	D4	D3	D2	D1	D0	
0	0	0	0	0	0	0	0	70.58 KHz
0	0	0	0	0	0	0	1	35.29 KHz
0	0	0	0	0	0	1	0	23.53 KHz
0	0	0	0	0	0	1	1	17.64 KHz
0	0	0	0	0	1	0	0	14.11KHz
:								:
1	1	1	1	1	0	1	1	280.0Hz
1	1	1	1	1	1	0	0	279.0 Hz
1	1	1	1	1	1	0	1	277.9 Hz
1	1	1	1	1	1	1	0	276.8 Hz
1	1	1	1	1	1	1	1	275.8 Hz



Note : The output frequency tolerance of internal frequency divider in CABC is ±10%

Restriction: EXTC should be high to enable this command

Register 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
Power ON Sequence	8'b00011000
H/W Reset	8'b00011000

8.2.73. NV Memory Write (D0h)

<table>
<tr><th>D0h</th><th colspan="13">NVMWR (NV Memory Write)</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D[15:8]</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>0</td><td>1</td><td>↑</td><td>XXXXXXXX</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>D0h</td></tr>
<tr><td>1st Parameter</td><td>1</td><td>1</td><td>↑</td><td>XXXXXXXX</td><td>0</td><td>0</td><td>0</td><td colspan="5">PGM_ADR[4:0]</td><td>XX</td></tr>
<tr><td>2nd Parameter</td><td>1</td><td>1</td><td>↑</td><td>XXXXXXXX</td><td colspan="9">PGM_DATA[7:0]</td><td>XX</td></tr>
<tr><td>Description</td><td colspan="13">This command is used to program the NV memory data. After a successful OTP operation, the information of PGM_DATA [7:0] will programmed to NV memory.

PGM_ADR [4:0]: The select bits of ID1, ID2, ID3, VMF[6:0] programming.

<table>
<tr><th colspan="5">PGM_ADR[4:0]</th><th>Programmed NV Memory Selection</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>ID1 programming</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>ID2 programming</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>ID3 programming</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>VMF[6:0] programming</td></tr>
<tr><td colspan="5">Others</td><td>Reserved</td></tr>
</table>

PGM_DATA [7:0]: The PGM_DATA is set by user.</td></tr>
<tr><td>Restriction</td><td colspan="13"></td></tr>
<tr><td>Register Availability</td><td colspan="13">
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode ON, Idle Mode OFF, Sleep OUT</td><td>Yes</td></tr>
<tr><td>Normal Mode ON, Idle Mode ON, Sleep OUT</td><td>Yes</td></tr>
<tr><td>Partial Mode ON, Idle Mode OFF, Sleep OUT</td><td>Yes</td></tr>
<tr><td>Partial Mode ON, Idle Mode ON, Sleep OUT</td><td>Yes</td></tr>
<tr><td>Sleep IN</td><td>Yes</td></tr>
</table>
</td></tr>
<tr><td>Default</td><td colspan="13">
<table>
<tr><th rowspan="2">Status</th><th colspan="2">Default Value</th></tr>
<tr><th>PGM_ADR[4:0]</th><th>PGM_DATA[7:0]</th></tr>
<tr><td>Power ON Sequence</td><td>3’b00000</td><td>8’bXXXXXXXX</td></tr>
<tr><td>H/W Reset</td><td>3’b00000</td><td>8’bXXXXXXXX</td></tr>
</table>
</td></tr>
</table>

8.2.74. NV Memory Protection Key (D1h)

<table>
<tr><th>D1h</th><th colspan="13">NVMPKEY (NV Memory Protection Key)</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D[15:8]</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>0</td><td>1</td><td>↑</td><td>XXXXXXXX</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>D1h</td></tr>
<tr><td>1st Parameter</td><td>1</td><td>1</td><td>↑</td><td>XXXXXXXX</td><td colspan="8">KEY[23:16]</td><td>55h</td></tr>
<tr><td>2nd Parameter</td><td>1</td><td>1</td><td>↑</td><td>XXXXXXXX</td><td colspan="8">KEY[15:8]</td><td>AAh</td></tr>
<tr><td>3rd Parameter</td><td>1</td><td>1</td><td>↑</td><td>XXXXXXXX</td><td colspan="8">KEY[7:0]</td><td>66h</td></tr>
<tr><td>Description</td><td colspan="13">KEY [23:0]: NV memory programming protection key. When writing OTP data to D0h, this register must be set to 0x55AA66h to enable OTP programming. If D1h register is not written with 0x55AA66h, then NV memory programming will be aborted.</td></tr>
<tr><td>Restriction</td><td colspan="13"></td></tr>
<tr><td>Register Availability</td><td colspan="13">
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode ON, Idle Mode OFF, Sleep OUT</td><td>Yes</td></tr>
<tr><td>Normal Mode ON, Idle Mode ON, Sleep OUT</td><td>Yes</td></tr>
<tr><td>Partial Mode ON, Idle Mode OFF, Sleep OUT</td><td>Yes</td></tr>
<tr><td>Partial Mode ON, Idle Mode ON, Sleep OUT</td><td>Yes</td></tr>
<tr><td>Sleep IN</td><td>Yes</td></tr>
</table>
</td></tr>
<tr><td>Default</td><td colspan="13">
<table>
<tr><th>Status</th><th>Default Value</th></tr>
<tr><td>Power ON Sequence</td><td>24’h55AA66h</td></tr>
<tr><td>H/W Reset</td><td>24’h55AA66h</td></tr>
</table>
</td></tr>
</table>

8.2.75. NV Memory Status Read (D2h)

D2h	RDNVM (NV Memory Status Read)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	0	1	0	0	1	0	D2h
1st Parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2nd Parameter	1	↑	1	XXXXXXXX	ID2_CNT[3:0]				ID1_CNT[3:0]				XX
3rd Parameter	1	↑	1	XXXXXXXX	VMF_CNT[3:0]				ID3_CNT[3:0]				XX
4th Parameter	1	↑	1	XXXXXXXX	BUSY	0	0	0	0	0	0	0	XX

Description

PGM_CNT [1:0]: NV memory program record. The bits will increase "+1" automatically after writing the NV_VMF [5:0] to NV memory.

ID1_CNT[3:0]/ID2_CNT[3:0] / ID3_CNT[3:0] / VMF_CNT[3:0]				Description
0	0	0	0	No Programmed
0	0	0	1	Programmed 1 time
0	0	1	1	Programmed 2 times
0	1	1	1	Programmed 3 times
1	1	1	1	Programmed 4 times

BUSY: The status bit of NV memory programming.

BUSY	The Status of NV Memory
0	Idle
1	Busy

Restriction

Register 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						
		ID3_CNT	ID2_CNT	ID1_CNT	VMF_CNT	BUSY	OTP_DATA
Power ON Sequence	X	X	X	X	X	X	X
H/W Reset	X	X	X	X	X	X	X

8.2.76. Read ID4 (D3h)

D3h	RDID4 (Read ID4)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	0	1	0	0	1	1	D3h
1st Parameter	1	↑	1	XXXXXXXX	X	X	X	X	X	X	X	X	XX
2ndParameter	1	↑	1	XXXXXXXX	0	0	0	0	0	0	0	0	00h
3rdParameter	1	↑	1	XXXXXXXX	1	0	0	1	0	1	0	0	94h
4th Parameter	1	↑	1	XXXXXXXX	1	0	0	0	0	0	1	0	86h
Description	Read IC device code. The 1st parameter is dummy read period. The 2nd parameter means the IC version. The 3rd and 4th parameter mean the IC model name.												
Restriction													

Register 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
Power ON Sequence	ID4=24'h009486h
H/W Reset	ID4=24'h009486h

8.2.77. PGAMCTRL(Positive Gamma Control) (E0h)

	PGAMCTRL (Positive Gamma Control)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	1	0	0	0	0	0	E0h
1st Parameter	1	1	↑	XXXXXXXX	0	0	0	VP0[4:0]					XX
2ndParameter	1	1	↑	XXXXXXXX	0	0	VP1[5:0]						XX
3rdParameter	1	1	↑	XXXXXXXX	0	0	VP2[5:0]						XX
4th Parameter	1	1	↑	XXXXXXXX	0	0	0	0	VP4[3:0]				XX
5th Parameter	1	1	↑	XXXXXXXX	0	0	0	VP6[4:0]					XX
6th Parameter	1	1	↑	XXXXXXXX	0	0	0	0	VP13[3:0]				XX
7th Parameter	1	1	↑	XXXXXXXX	0	VP20[6:0]							XX
8th Parameter	1	1	↑	XXXXXXXX	VP36[3:0]				VP27[3:0]				XX
9th Parameter	1	1	↑	XXXXXXXX	0	VP43[6:0]							XX
10thParameter	1	1	↑	XXXXXXXX	0	0	0	0	VP50[3:0]				XX
11thParameter	1	1	↑	XXXXXXXX	0	0	0	VP57[4:0]					XX
12thParameter	1	1	↑	XXXXXXXX	0	0	0	0	VP59[3:0]				XX
13thParameter	1	1	↑	XXXXXXXX	0	0	VP61[5:0]						XX
14thParameter	1	1	↑	XXXXXXXX	0	0	VP62[5:0]						XX
15thParameter	1	1	↑	XXXXXXXX	0	0	0	VP63[4:0]					XX
Description	Set the gray scale voltage to adjust the gamma characteristics of the TFT panel.												
Restriction													

Register 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

8.2.78. NGAMCTRL (Negative Gamma Correction) (E1h)

	NGAMCTRL (Negative Gamma Correction)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	1	0	0	0	0	1	E1h
1st Parameter	1	1	↑	XXXXXXXX	0	0	0	VN0[4:0]					XX
2ndParameter	1	1	↑	XXXXXXXX	0	0	VN1[5:0]						XX
3rdParameter	1	1	↑	XXXXXXXX	0	0	VN2[5:0]						XX
4th Parameter	1	1	↑	XXXXXXXX	0	0	0	0	VN4[3:0]				XX
5th Parameter	1	1	↑	XXXXXXXX	0	0	0	RVN6[4:0]					XX
6th Parameter	1	1	↑	XXXXXXXX	0	0	0	0	VN13[3:0]				XX
7th Parameter	1	1	↑	XXXXXXXX	0	VN20[6:0]							XX
8th Parameter	1	1	↑	XXXXXXXX	VN36[3:0]				VN27[3:0]				XX
9th Parameter	1	1	↑	XXXXXXXX	0	VN43[6:0]							XX
10thParameter	1	1	↑	XXXXXXXX	0	0	0	0	VN50[3:0]				XX
11thParameter	1	1	↑	XXXXXXXX	0	0	0	VN57[4:0]					XX
12thParameter	1	1	↑	XXXXXXXX	0	0	0	0	VN59[3:0]				XX
13thParameter	1	1	↑	XXXXXXXX	0	0	VN61[5:0]						XX
14thParameter	1	1	↑	XXXXXXXX	0	0	VN62[5:0]						XX
15thParameter	1	1	↑	XXXXXXXX	0	0	0	VN63[4:0]					XX
Description	Set the gray scale voltage to adjust the gamma characteristics of the TFT panel.												
Restriction													
Register 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

8.2.79. Digital Gamma Control 1 (E2h)

E2h	DGAMCTRL (Digital Gamma Control 1)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	1	0	0	0	1	0	E2h
1st Parameter	1	1	↑	XXXXXXXX	RCA0[3:0]				BCA0[3:0]				XX
:	1	1	↑	XXXXXXXX	RCAx[3:0]				BCAx[3:0]				XX
16rdParameter	1	1	↑	XXXXXXXX	RCA15[3:0]				BCA15[3:0]				XX
Description	**RCAx [3:0]:** Gamma Macro-adjustment registers for red gamma curve. **BCAx [3:0]:** Gamma Macro-adjustment registers for blue gamma curve.												
Restriction													
Register 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	
	RCAx[3:0]	BCAx[3:0]
Power ON Sequence	TBD	TBD
H/W Reset	TBD	TBD

8.2.80. Digital Gamma Control 2 (E3h)

E3h	DGAMCTRL (Digital Gamma Control 2)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	1	0	0	0	1	1	E3h
1st Parameter	1	1	↑	XXXXXXXX	RFA0[3:0]				BFA0[3:0]				XX
:	1	1	↑	XXXXXXXX	RFAx[3:0]				BFAx[3:0]				XX
64rdParameter	1	1	↑	XXXXXXXX	RFA63[3:0]				BFA63[3:0]				XX
Description	**RFAx [3:0]:** Gamma Micro-adjustment register for red gamma curve. **BFAx [3:0]:** Gamma Micro-adjustment register for blue gamma curve.												
Restriction													
Register 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	
	RFAx[3:0]	BFAx[3:0]
Power ON Sequence	TBD	TBD
H/W Reset	TBD	TBD

8.2.81. SPI Read Command Setting(FBh)

FBh	DGAMCTRL (Digital Gamma Control 2)												
	D/CX	RDX	WRX	D[15:8]	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	XXXXXXXX	1	1	1	1	1	0	1	1	FBh
1st Parameter	1	1	↑	XXXXXXXX	0	0	0	SPI_READ_EN	SPI_CNT[3:0]				XX
Description	**SPI_READ_EN:** SPI read enable (see note). **SPI_CNT [3:0]:** SPI read parameter number (see note) *Note: Set "RFBh" once only usefull to read one parameter of register one time, the next read need to set "RFBh" again.*												
Restriction													

Register 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

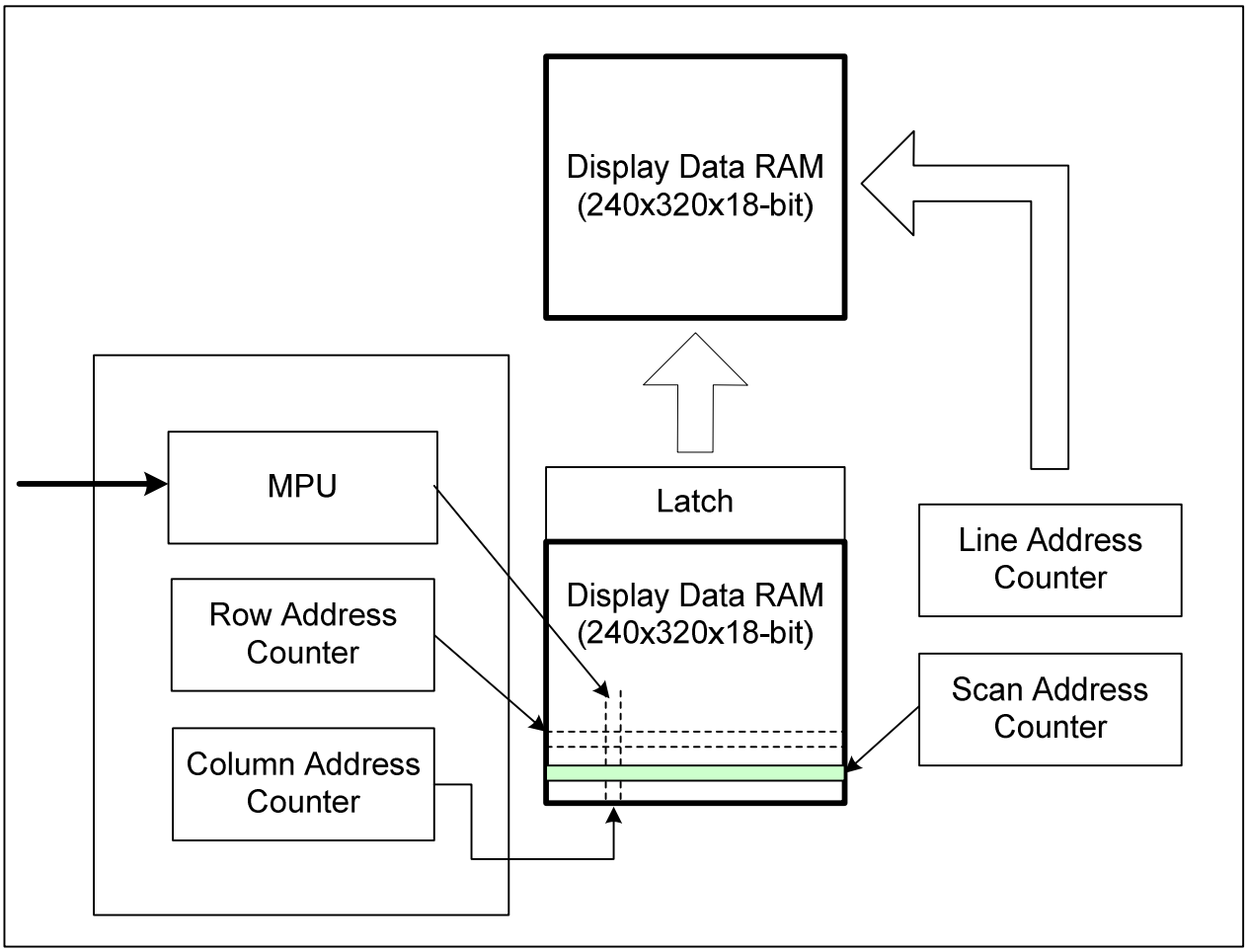
Default

Status	Default Value	
	SPI_READ_EN	SPI_CNT[3:0]
Power ON Sequence	1'b0	4'b0000
H/W Reset	1'b0	4'b0000

9. Display Data RAM

9.1. Configuration

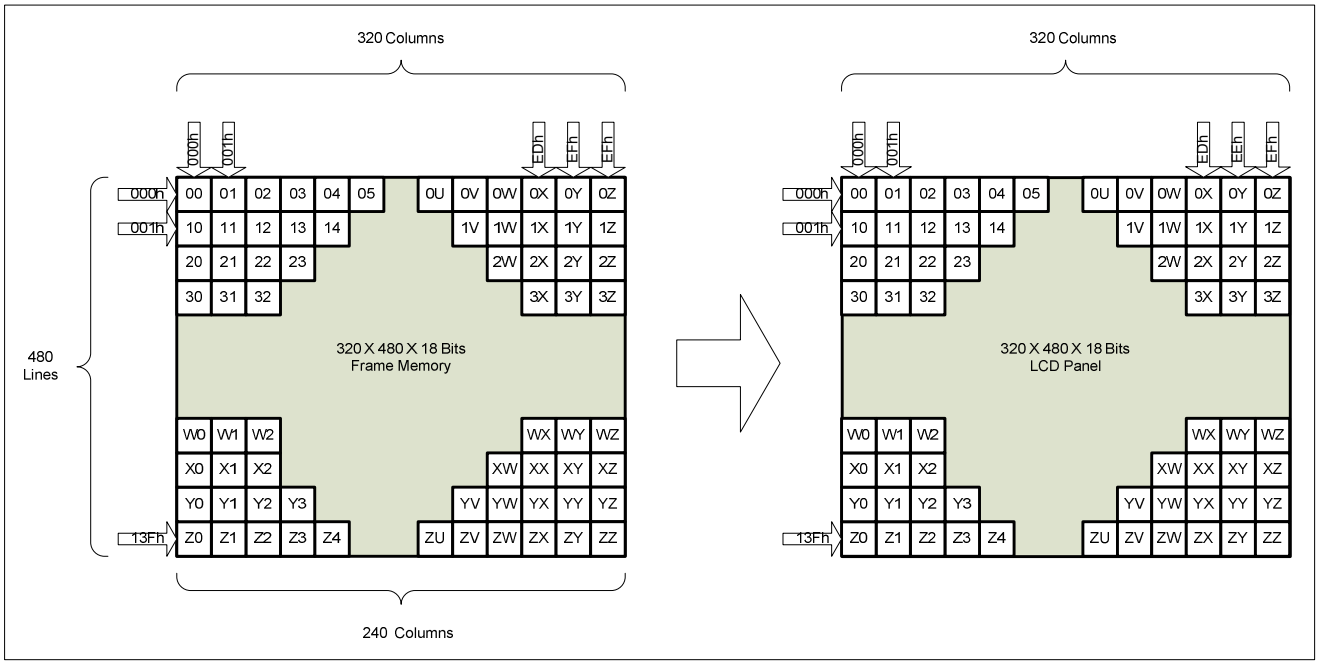
The display data RAM stores display dots and consists of 345,600 bits (320x480x18 bits). There is no restriction on access to the RAM even when the display data on the same address is loaded to DAC. There will be no abnormal visible effect on the display when there is a simultaneous Panel Read and Interface Read or Write to the same location of the Frame Memory.



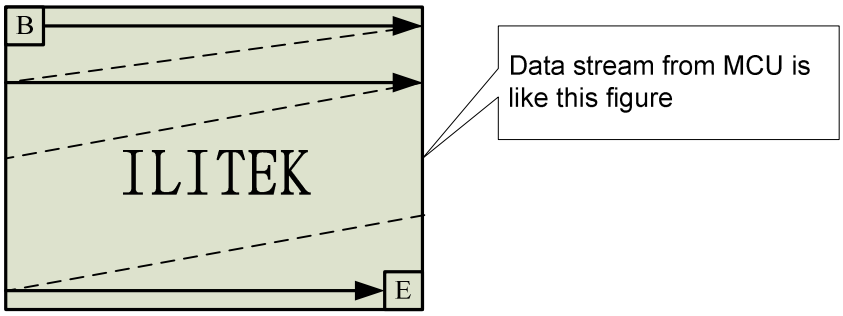
9.2. Memory to Display Address Mapping

In this mode, the content of the frame memory within an area where column pointer is 0000h to 013Fh and page pointer is 0000h to 01DFh is displayed.

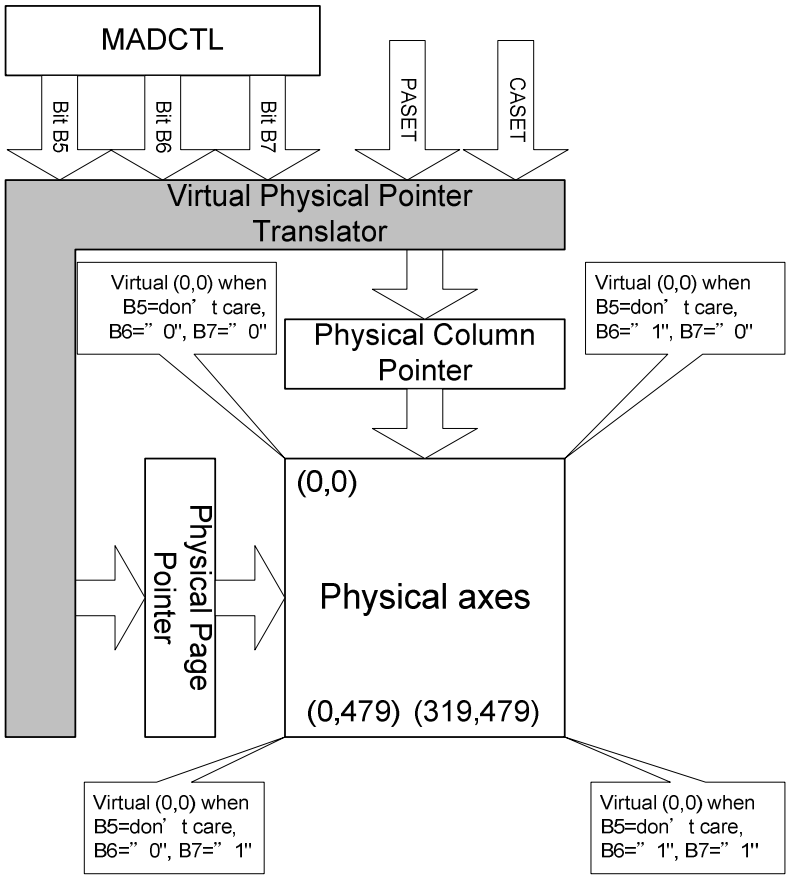
To display a dot on leftmost top corner, store the dot data at (column pointer, page pointer) = (0,0)



9.3. MCU to memory write/read direction



The data is written in the order illustrated above. The Counter which dictates where in the physical memory the data is to be written is controlled by “Memory Data Access Control” Command, Bits B5, B6, and B7 as described below.



B5	B6	B7	CASET	PASET
0	0	0	Direct to Physical Column Pointer	Direct to Physical Page Pointer
0	0	1	Direct to Physical Column Pointer	Direct to (479-Physical Page Pointer)
0	1	0	Direct to (319-Physical Column Pointer)	Direct to Physical Page Pointer
0	1	1	Direct to (319-Physical Column Pointer)	Direct to (479-Physical Page Pointer)
1	0	0	Direct to Physical Page Pointer	Direct to Physical Column Pointer
1	0	1	Direct to (479-Physical Page Pointer)	Direct to Physical Column Pointer
1	1	0	Direct to Physical Page Pointer	Direct to (319-Physical Column Pointer)
1	1	1	Direct to (479-Physical Page Pointer)	Direct to (319-Physical Column Pointer)

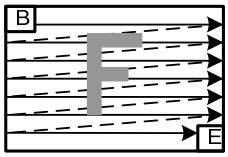
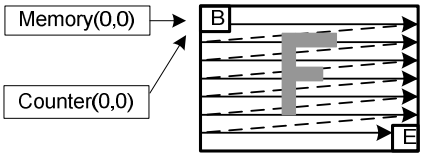
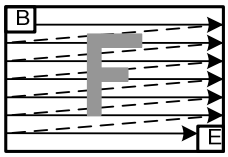
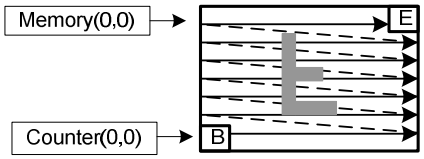
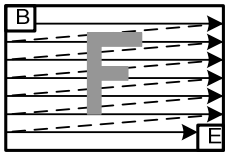
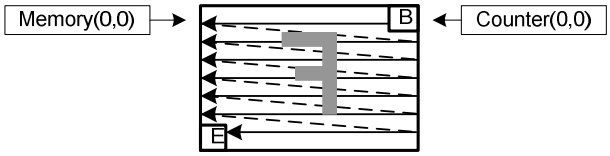
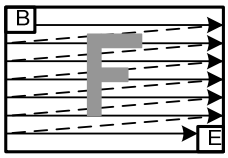
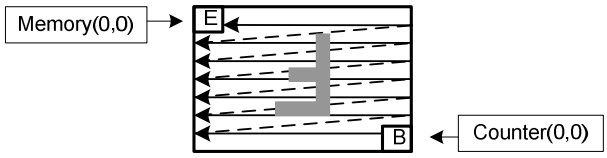
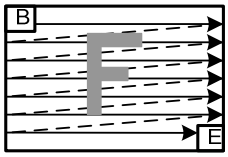
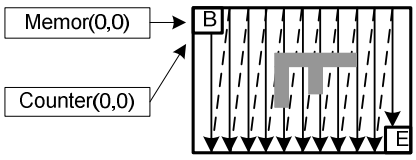
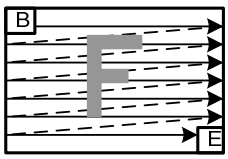
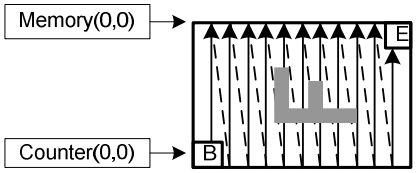
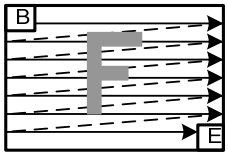
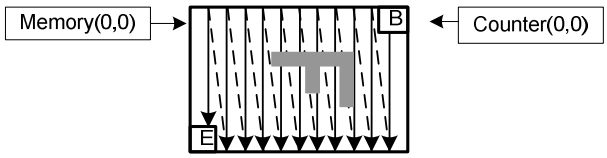
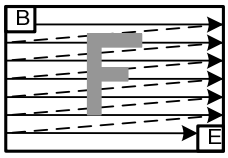
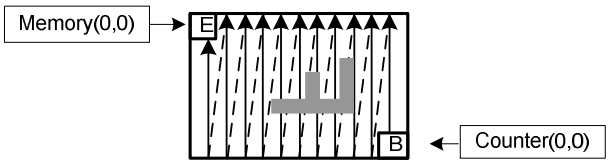
Condition	Column Counter	Page counter
When RAMWR/RAMRD command is accepted	Return to “Start column”	Return to “Start Page”
Complete Pixel Read/Write action	Increment by 1	No change
The Column values is large than “End Column”	Return to “Start column”	Increment by 1
The Page counter is large than “End Page”	Return to “Start column”	Return to “Start Page”

Note: Data is always written to the Frame Memory in the same order, regardless of the Memory Write Direction set by MADCTL bits B7, B6 and B5.

The write order for each pixel unit is

D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0

One pixel unit represents 1 column and 1 page counter value on the Frame Memory.

Display Data Direction	MADCTR Parameter			Image in the Memory (MPU)	Image in the Driver (Frame Memory)
	MV	MX	MY		
Normal	0	0	0		
Y-Mirror	0	0	1		
X-Mirror	0	1	0		
X-Mirror Y-Mirror	0	1	1		
X-Y Exchange	1	0	0		
X-Y Exchange Y-Mirror	1	0	1		
XY Exchange X-Mirror	1	1	0		
XY Exchange X-YMirror	1	1	1		

10. Tearing Effect Information

The Tearing Effect output supplies to the MCU a Panel synchronization information (= Tearing Effect Information) which is telling the position of the refreshing on the display panel, to the MCU which can decide when it can send image information to ILI9486L (Mainly used for a moving image e.g. video clips) that there can avoid the abnormal visual effect on the display panel of ILI9486L.

This information can be enabled or disabled by the Tearing Effect Line Off & On commands. The mode of the Tearing Effect Signal is defined by the parameter of the Tearing Effect Line Off & On commands.

This Tearing Effect information can be sent in two different ways:

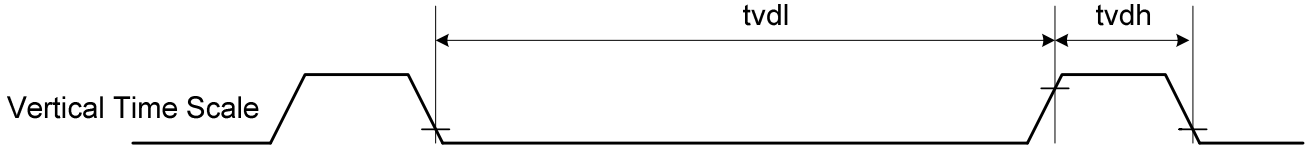
- Separated Line, which is so-called Tearing Effect (TE) line.
- Bus, which is so-called Tearing Effect (TEE) Bus Trigger, when ILI9486L is sending a trigger to the MCU.

The TE line is used in MCU parallel interface. The TE line can also be used in DSI case if the tearing Effect (TEE) Bus Trigger is not possible to use.The Tearing Effect (TEE) Bus Trigger is only used in DSI case.

10.1. Tearing Effect Line

10.1.1. Tearing Effect Line Modes

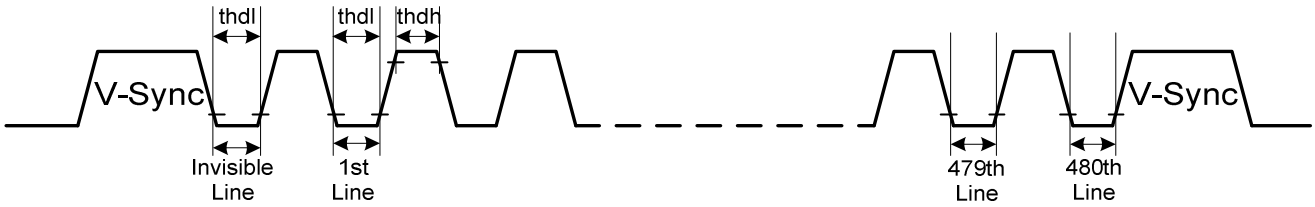
Mode 1, the Tearing Effect Output signal consists of V-Sync information only:



tvdh = The LCD display is not updated from the Frame Memory.

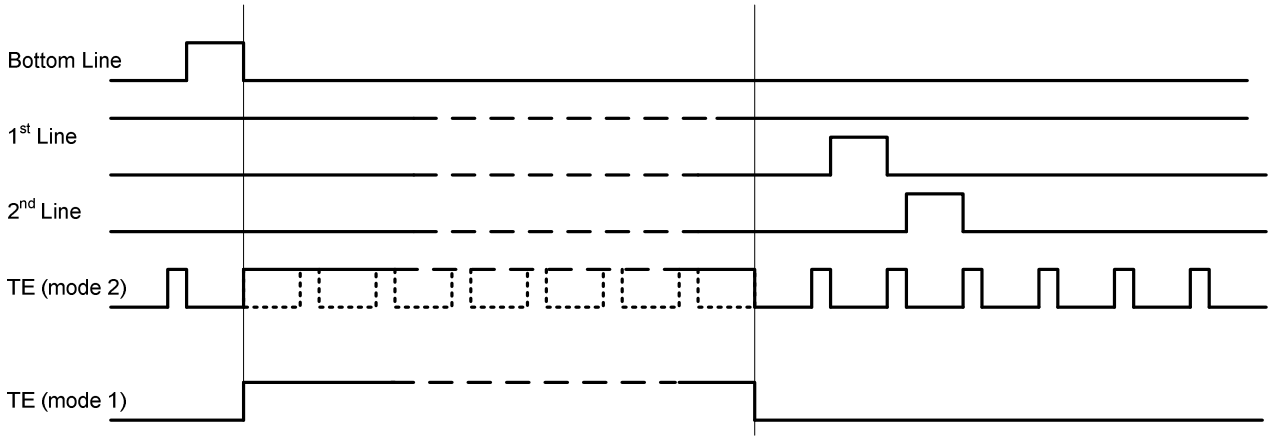
tvdl = The LCD display is updated from the Frame Memory (except Invisible Line – see below).

Mode 2, the tearing effect output signal consists of V-Sync and H-Sync information; there is one V-sync and 480 H-sync pulses per field:



thdh = The LCD display is not updated from the Frame Memory.

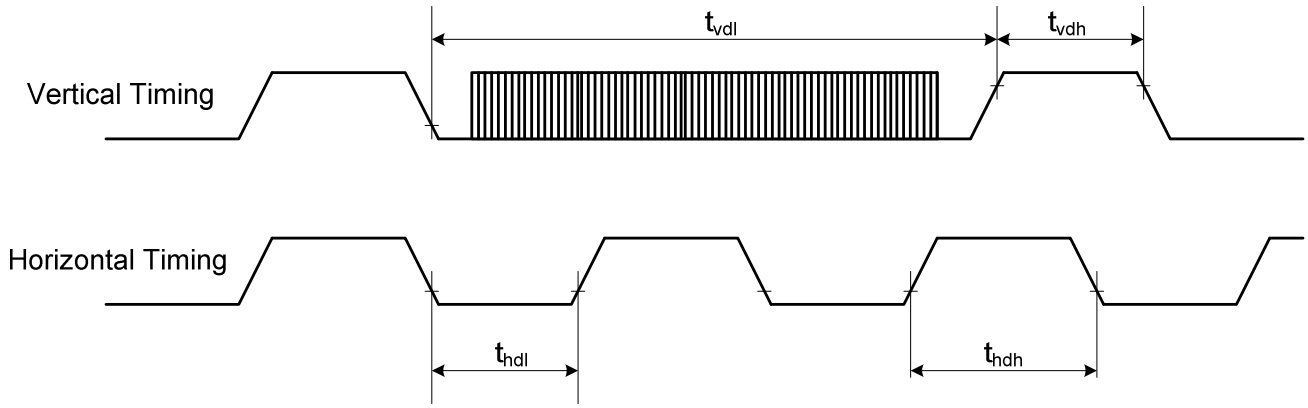
thdl = The LCD display is updated from the Frame Memory (except Invisible Line – see above).



Note: During Sleep In Mode, the Tearing Effect Output Pin is active Low.

10.1.2. Tearing Effect Line Timing

The tearing effect signal is described below:



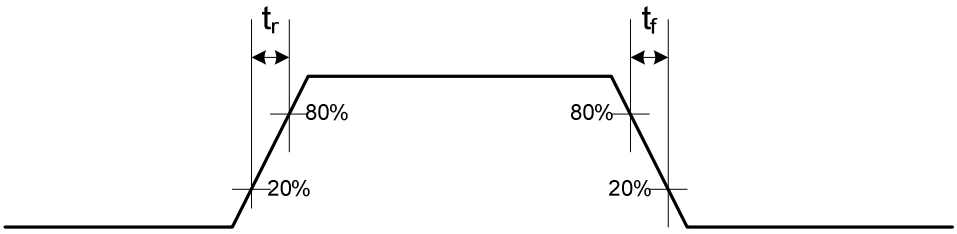
AC characteristics of Tearing Effect Signal (Frame Rate = 60.5Hz)

Symbol	Parameter	Min.	Max.	Unit	Description
t_{vdl}	Vertical timing low duration	TBD	TBD	ms	
t_{vdh}	Vertical timing high duration	1000	TBD	us	
t_{hdl}	Horizontal timing low duration	TBD	TBD	us	
t_{hdh}	Horizontal timing high duration	TBD	500	us	

Notes: 1. The timings in Table as above apply when MADCTL B4=0 and B4=1

2. Minimum frequency of the TE-line can not be less than 25Hz when the TE-line is active on Mode 1.

3. The signal's rise and fall times (tf, tr) are stipulated to be equal to or less than 15ns.



The Tearing Effect Output Line is fed back to the MCU and should be used to avoid Tearing Effect.

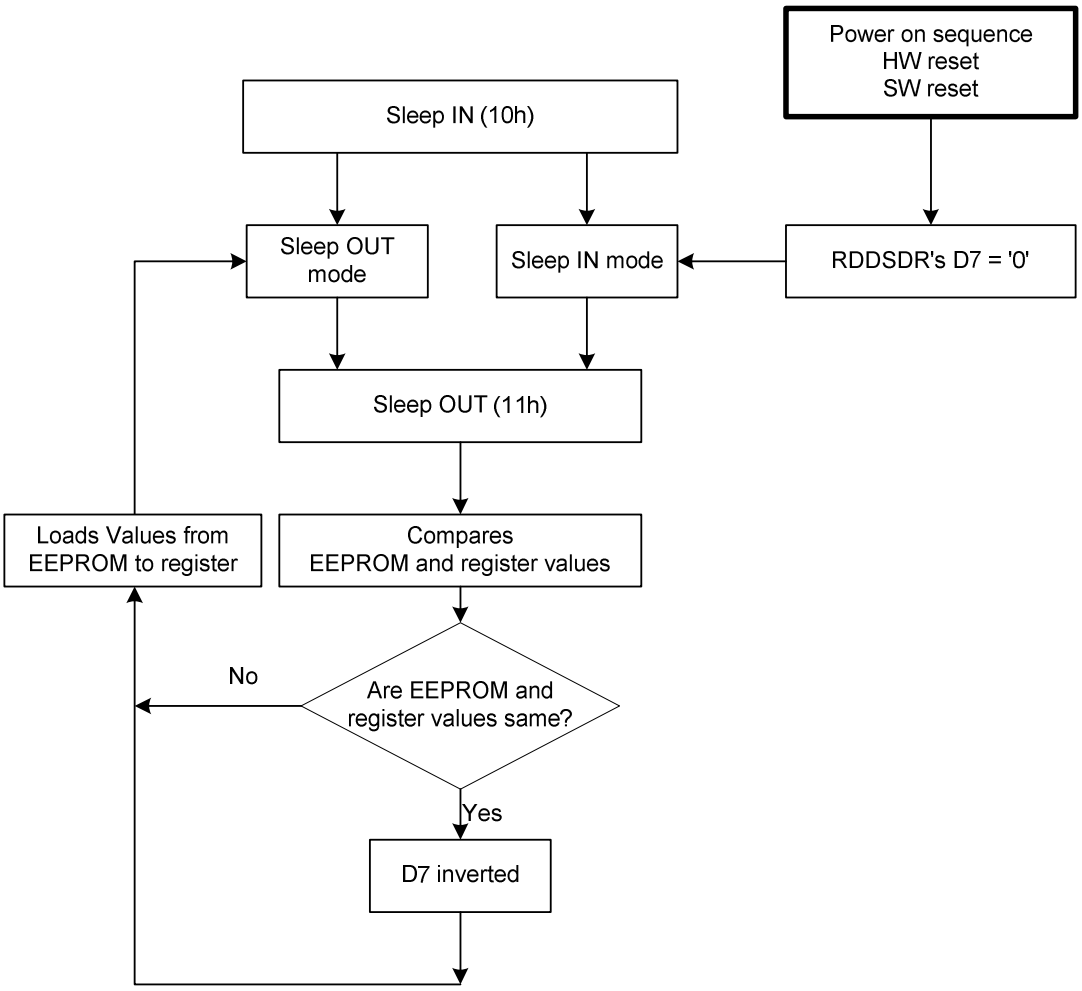
11. Sleep Out – Command and Self-Diagnostic Functions

11.1. Register loading Detection

Sleep Out-command (Command “Sleep Out (11h)”) is a trigger for an internal function of ILI9486L, which indicates, if ILI9486L loading function of factory default values from EEPROM (or similar device) to registers of the display controller is working properly.

There are compared factory values of the EEPROM and register values of the display controller by the display controller (1st step: compares register and EEPROM values, 2nd step: loads EEPROM values to registers). If those both values (EEPROM and register values) are same, there is inverted (= increased by 1) a bit, which is defined in command “Read Display Self-Diagnostic Result (0Fh)” (= 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:



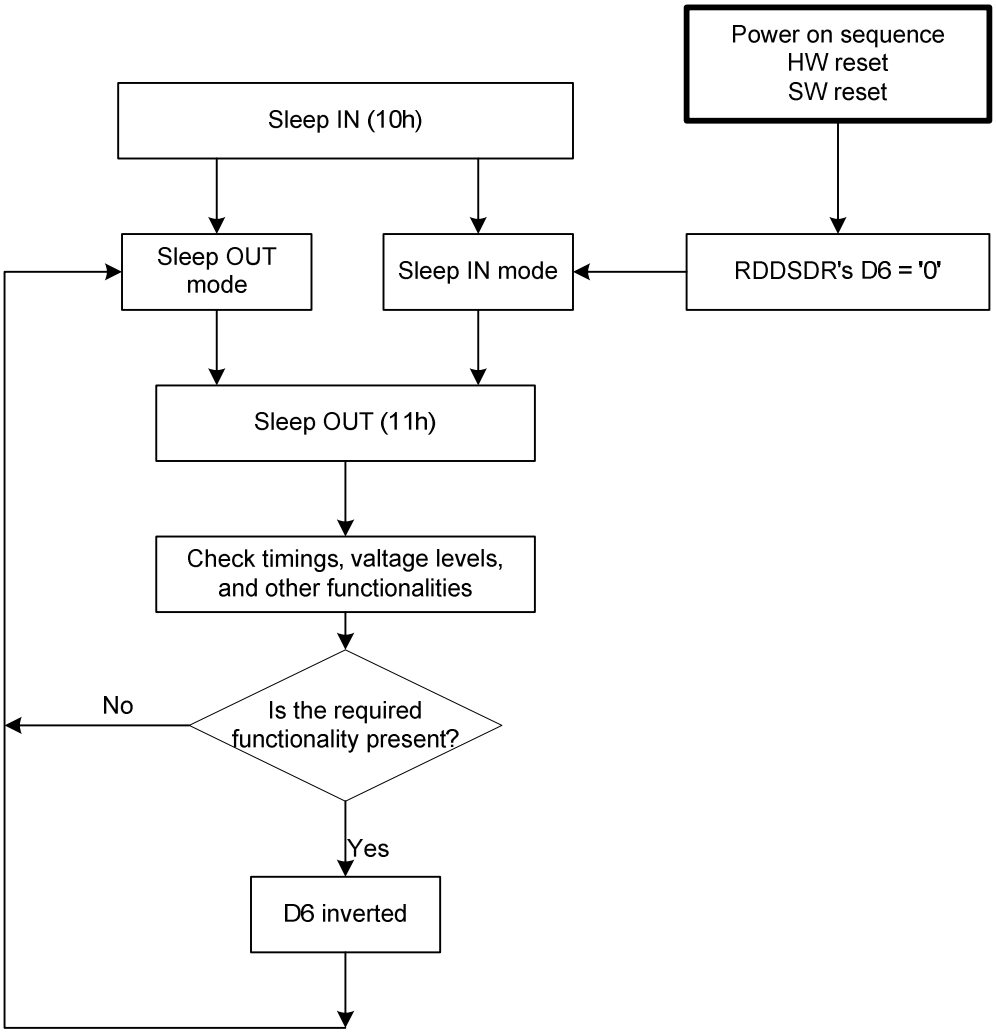
Note 1: There is not compared and loaded register values, which can be changed by User (User area commands: 00h to AFh and DAh to DDh), by ILI9486L.

11.2. Functionality Detection

Sleep Out-command (Command “Sleep Out (11h)”) is a trigger for an internal function of ILI9486L, which indicates, if ILI9486L is still running and meets functionality requirements.

The internal function (= the display controller) is comparing, if ILI9486L is still meeting functionality requirements (e.g. booster voltage levels, timings, etc.) If functionality requirement is met, there is an inverted (= increased by 1) bit, which defined in command “Read Display Self- Diagnostic Result (0Fh)” (= RDDSDR) (The used bit of this command is D6). If functionality requirement is not same, this bit (D6) is not inverted (= increased by 1). The flow chart for this internal function is shown as below.

The flow chart for this internal function is following:



Note 1: There is needed 120msec after Sleep Out -command, when there is changing from Sleep In –mode to Sleep Out -mode, before there is possible to check if User’s functionality requirements are met and a value of RDDSDR’s D6 is valid. Otherwise, there is 5msec delay for D6’s value, when Sleep Out –command is sent in Sleep Out -mode.

12. Power ON/OFF Sequence

IOVCC and VCI can be applied in any order. VCI and IOVCC can be powered down in any order. During power off, if LCD is in the Sleep Out mode, VCI and IOVCC must be powered down minimum 120msec after RESX has been released.

During power off, if LCD is in the Sleep In mode, IOVCC or VCI can be powered down minimum 0msec after RESX has been released.

Note 1: There will be no damage to ILI9486L if the power sequences are not met.

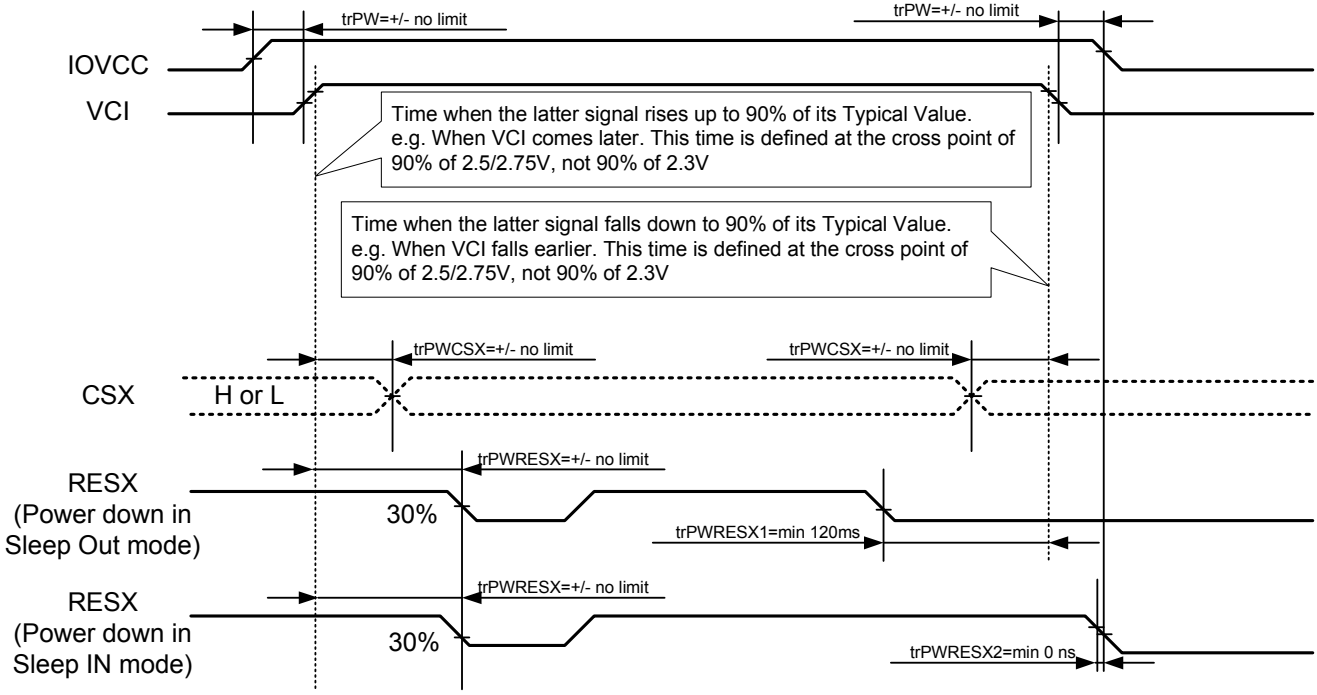
Note 2: There will be no abnormal visible effects on the display panel during the Power On/Off Sequences.

Note 3: There will be no abnormal visible effects on the display between end of Power On Sequence and before receiving Sleep Out command. Also between receiving Sleep In command and Power Off Sequence.

Note 4: If RESX line is not held stable by host during Power On Sequence as defined in Sections 12.1 and 12.2, then it will be necessary to apply a Hardware Reset (RESX) after Host Power On Sequence is complete to ensure correct operation. Otherwise function is not guaranteed.

12.1. Case 1 – RESX line is held High or Unstable by Host at Power ON

If RESX line is held High or unstable by the host during Power On, then a Hardware Reset must be applied after both VCI and IOVCC have been applied – otherwise correct functionality is not guaranteed. There is no timing restriction upon this hardware reset.



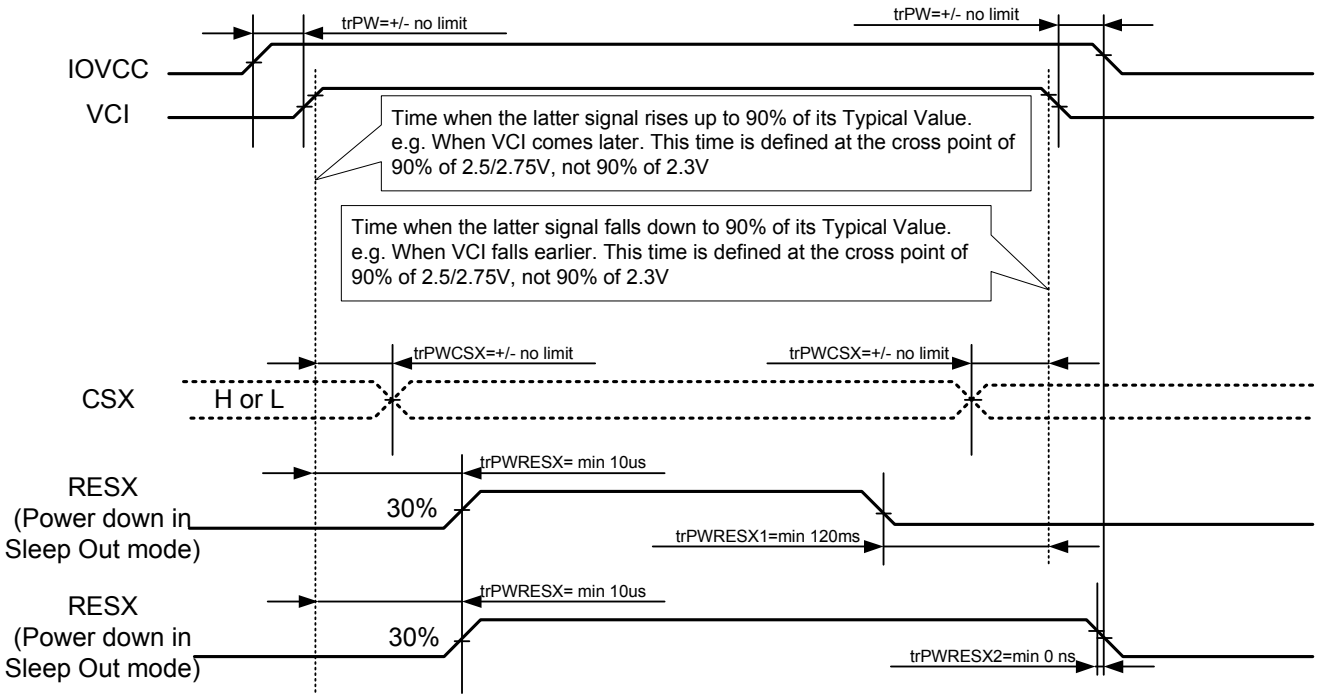
trPWRESX1 is applied to RESX falling in the Sleep Out Mode
trPWRESX2 is applied to RESX falling in the Sleep In Mode

Note 1: Unless otherwise specified, timings herein show cross point at 50% of signal power level.

12.2. Case 2 – RESX line is held Low by Host at Power ON

If RESX line is held Low (and stable) by the host during Power On, then the RESX must be held low for minimum

10µsec after both VCI and IOVCC have been applied.



trPWRESX1 is applied to RESX falling in the Sleep Out Mode
trPWRESX2 is applied to RESX falling in the Sleep In Mode

Note 1: Unless otherwise specified, timings herein show cross point at 50% of signal power level.

12.3. Uncontrolled Power Off

The uncontrolled power off means a situation when e.g. there is removed a battery without the controlled power off sequence. There will not be any damages for ILI9486L or ILI9486L will not cause any damages for the host or lines of the interface. At an uncontrolled power off event, ILI9486L will force the display to blank and will not be any abnormal visible effects with in 1 second on the display and remains blank until “Power On Sequence” powers it up.

13. Power Level Definition

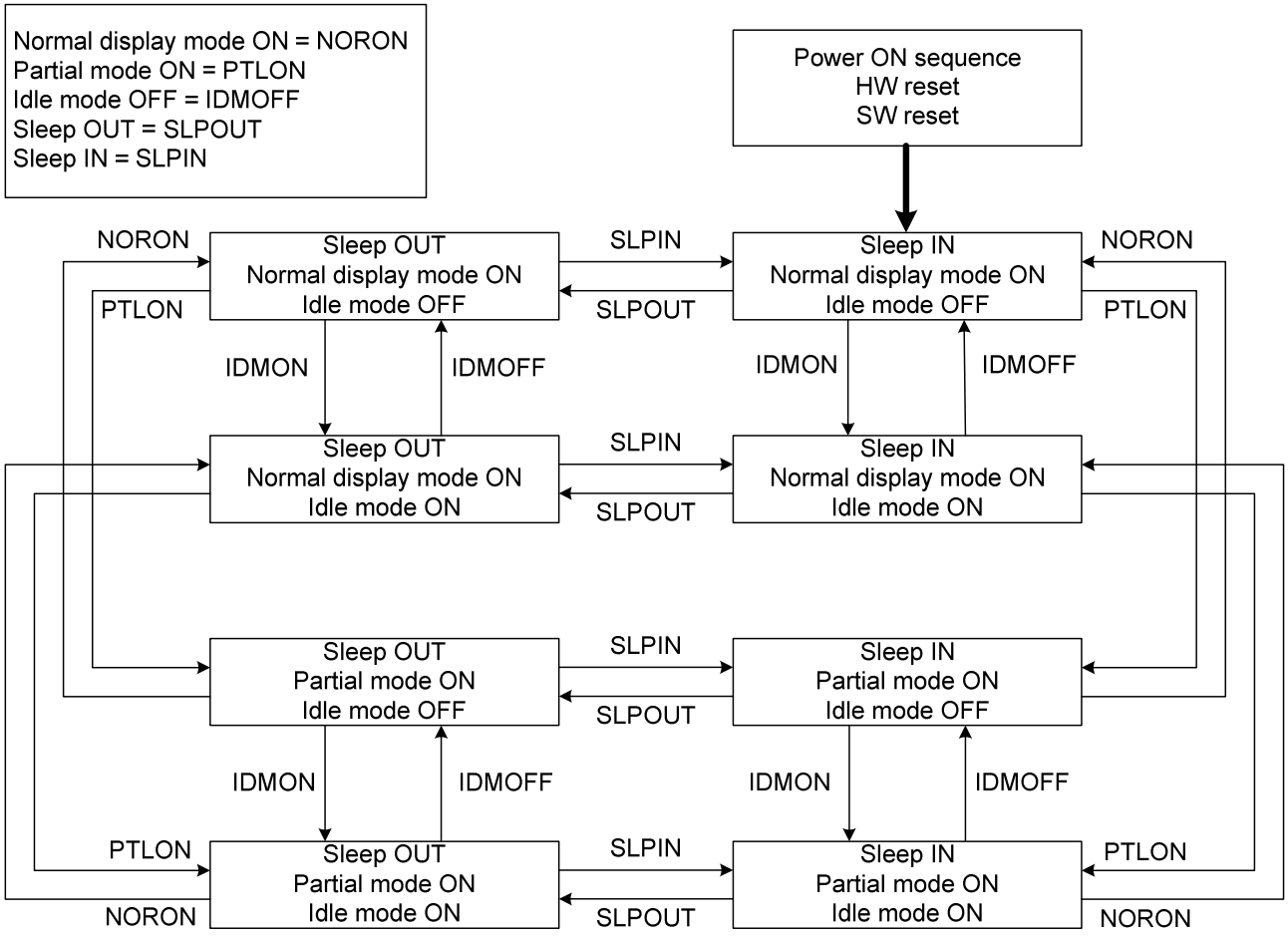
13.1. Power Levels

6 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 262,144 colors.
2. Partial Mode On, Idle Mode Off, Sleep Out.
   In this mode part of the display is used with maximum 262,144 colors.
3. Normal Mode On (full display), Idle Mode On, Sleep Out.
   In this mode, the full display area 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 MCU interface and memory works with IOVCC power supply. Contents of the memory are safe.
6. Power Off Mode.
   In this mode, both VCI and IOVCC are removed.

Note1: Transition between modes 1-5 is controllable by MCU commands. Mode 6 is entered only when both Power supplies are removed.

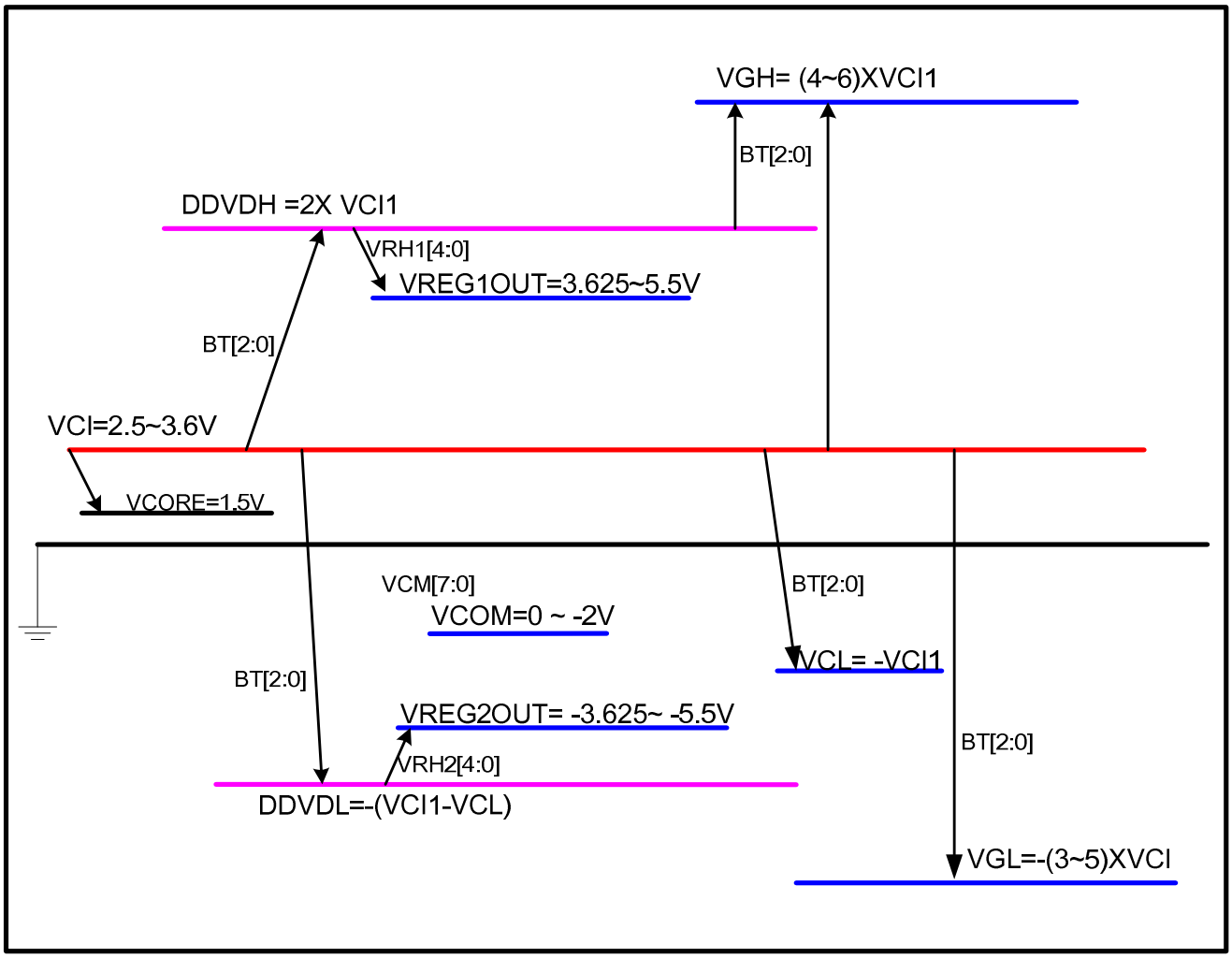
13.2. Power Flow Chart



Note 1: There is not any abnormal visual effect when there is changing from one power mode to another power mode.

Note 2: There is not any limitation, which is not specified by User, when there is changing from one power mode to another power mode.

13.3. LCM Voltage Generation



14. Reset

14.1. Registers

The registers that are initialized are listed as below:

Register	After Powered ON	After Hardware Reset	After Software Reset
Frame Memory	Random	Random	Random
Sleep	In	In	In
Display Mode	Normal	Normal	Normal
Display Status	Display Off	Display Off	Display Off
Idle Mode	Off	Off	Off
Column Start Address	0000 h	0000 h	0000 h
Column End Address	013F h	013F h	013F h
Page Start Address	0000 h	0000 h	0000 h
Page End Address	01F h	013F h	013F h
Gamma Setting	GC0	GC0	GC0
Partial Area Start	0000 h	0000 h	0000 h
Partial Area End	01DF h	01DF h	01DF h
Memory Data Access Control	00 h	00 h	00h
RDNUMED	00 h	00 h	00h
RDDPM	08 h	08 h	08 h
RDDMADCTL	00 h	00 h	00 h
RDDCOLMOD	07 h	07 h	07 h
RDDIM	00 h	00 h	00 h
RDDSM	00 h	00 h	00 h
RDDSDR	00 h	00 h	00 h
RDDISBV	00 h	00 h	00 h
RDCTRLD	00 h	00 h	00 h
RDCABC	00 h	00 h	00 h
RDCABCMB	00 h	00 h	00 h
TE Output Line	Off	Off	Off
TE Line Mode	Mode 1 (Note 3)	Mode 1 (Note 3)	Mode 1 (Note 3)

Note 1: There will be no abnormal visible effects on the display when S/W or H/W Resets are applied.

Note 2: After Powered-On Reset finishes within 10µs after both VCI & IOVCC are applied.

Note 3: Mode 1 means Tearing Effect Output Line consists of V-Blanking Information only.

14.2. Output Pins, I/O Pins

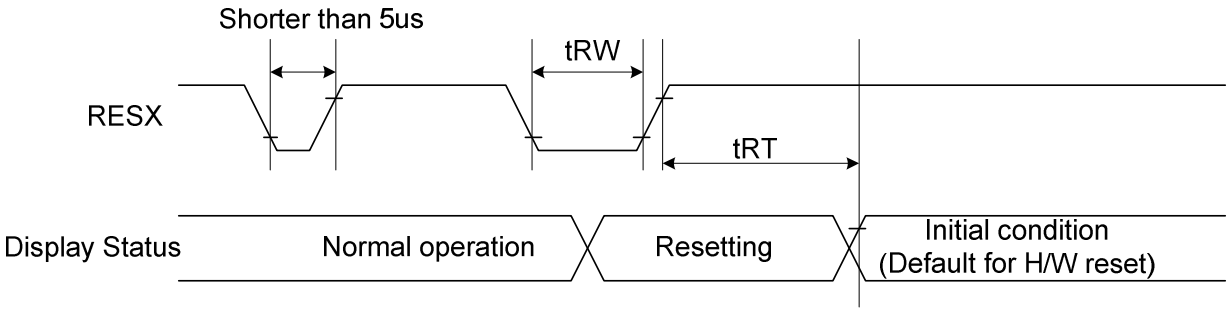
	After Power ON	After Hardware Reset	After Software Reset
TE line	Low	Low	Low
DB[17:0] (output driver), SDA	Hi-Z (Inactive)	Hi-Z (Inactive)	Hi-Z (Inactive)

Note 1: There will be no output from DB[17:0] during Power ON/OFF sequence, hardware reset and software reset.

14.3. Input Pins

	During Power ON Process	After Power ON	After Hardware Reset	After Software Reset	During Power OFF Process
RESX	See Chapter 12	Input valid	Input valid	Input valid	See Chapter 12
CSX	Input invalid	Input valid	Input valid	Input valid	Input invalid
D/CX	Input invalid	Input valid	Input valid	Input valid	Input invalid
WRX	Input invalid	Input valid	Input valid	Input valid	Input invalid
RDX	Input invalid	Input valid	Input valid	Input valid	Input invalid
RWX	Input invalid	Input valid	Input valid	Input valid	Input invalid
SCL	Input invalid	Input valid	Input valid	Input valid	Input invalid
DB[17:0] (input driver), SDA	Input invalid	Input valid	Input valid	Input valid	Input invalid

14.4. Reset Timing



Signal	Symbol	Parameter	Min	Max	Unit
RESX	tRW	Reset pulse duration	10		uS
	tRT	Reset cancel		5 (note 1,5)	mS
				120 (note 1,6,7)	mS

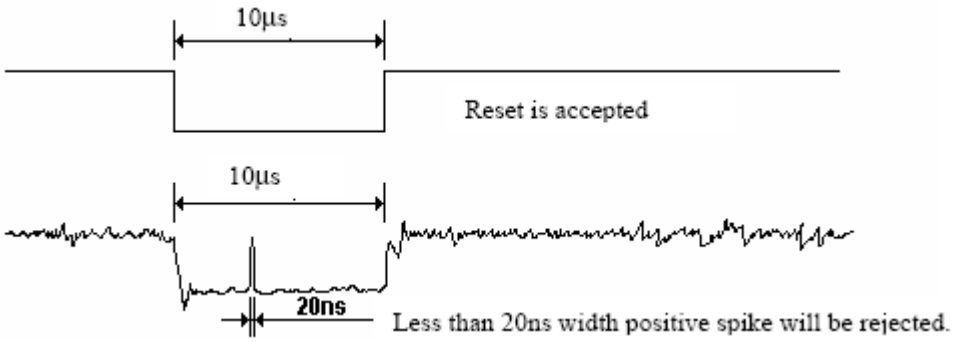
Note 1: The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from EEPROM to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.

Note 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

Note 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.

Note 4: Spike Rejection also applies during a valid reset pulse as shown below:

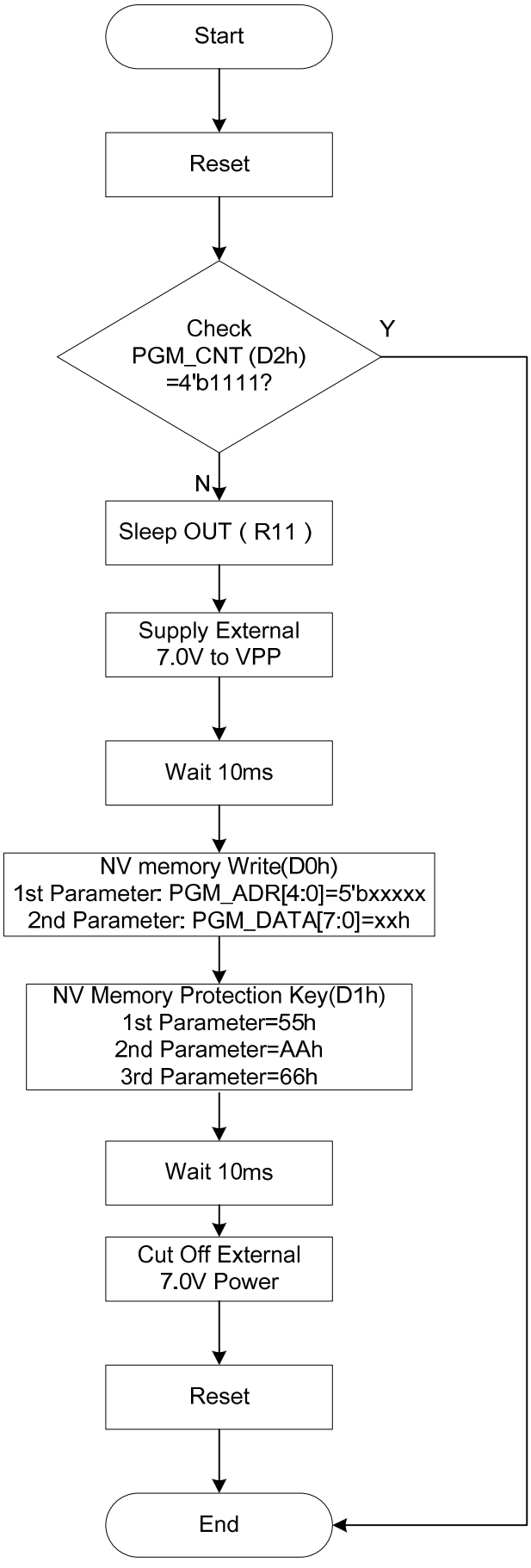


Note 5: When Reset applied during Sleep In Mode.

Note 6: When Reset applied during Sleep Out Mode.

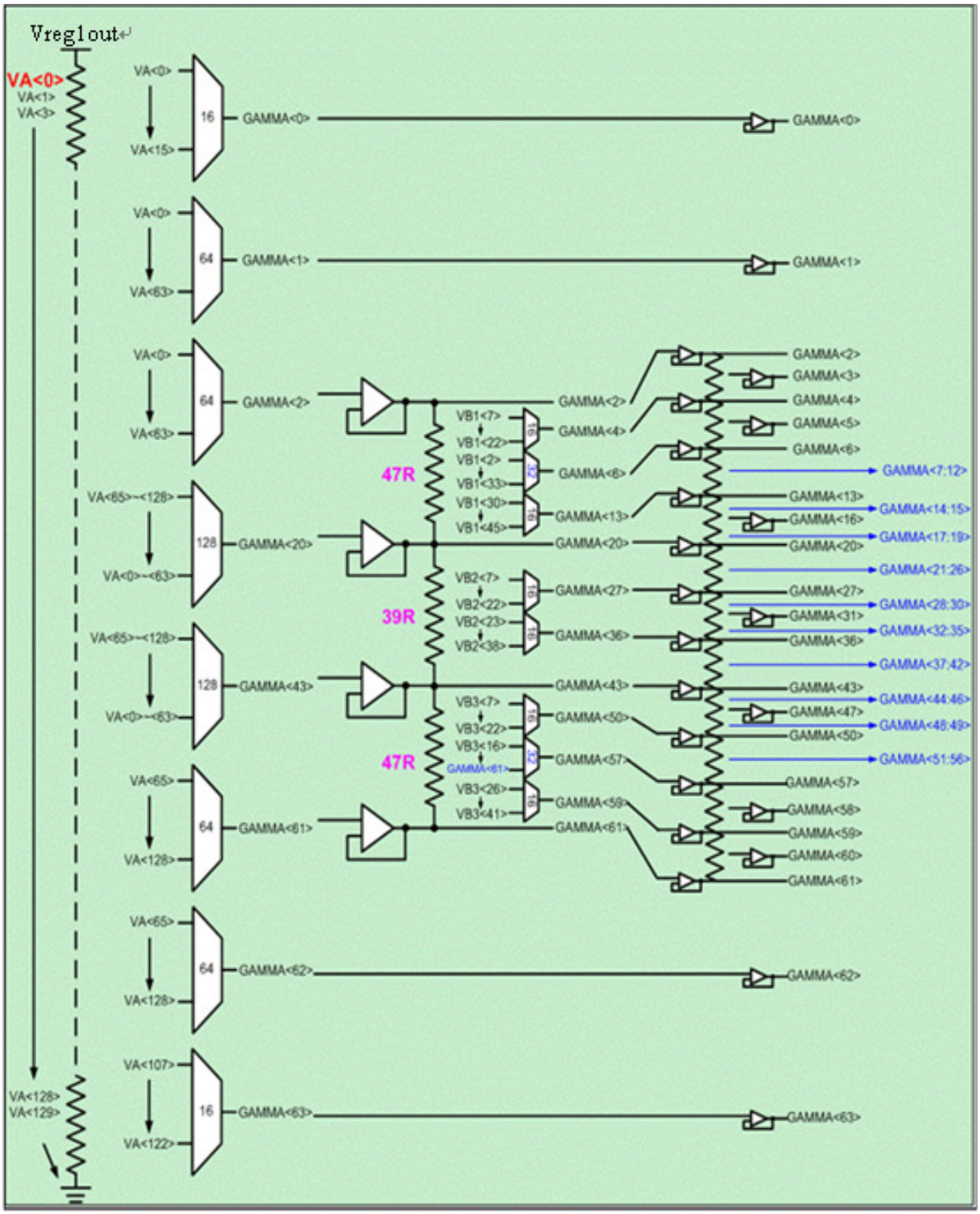
Note7: It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

15. NV Memory Programming Flow

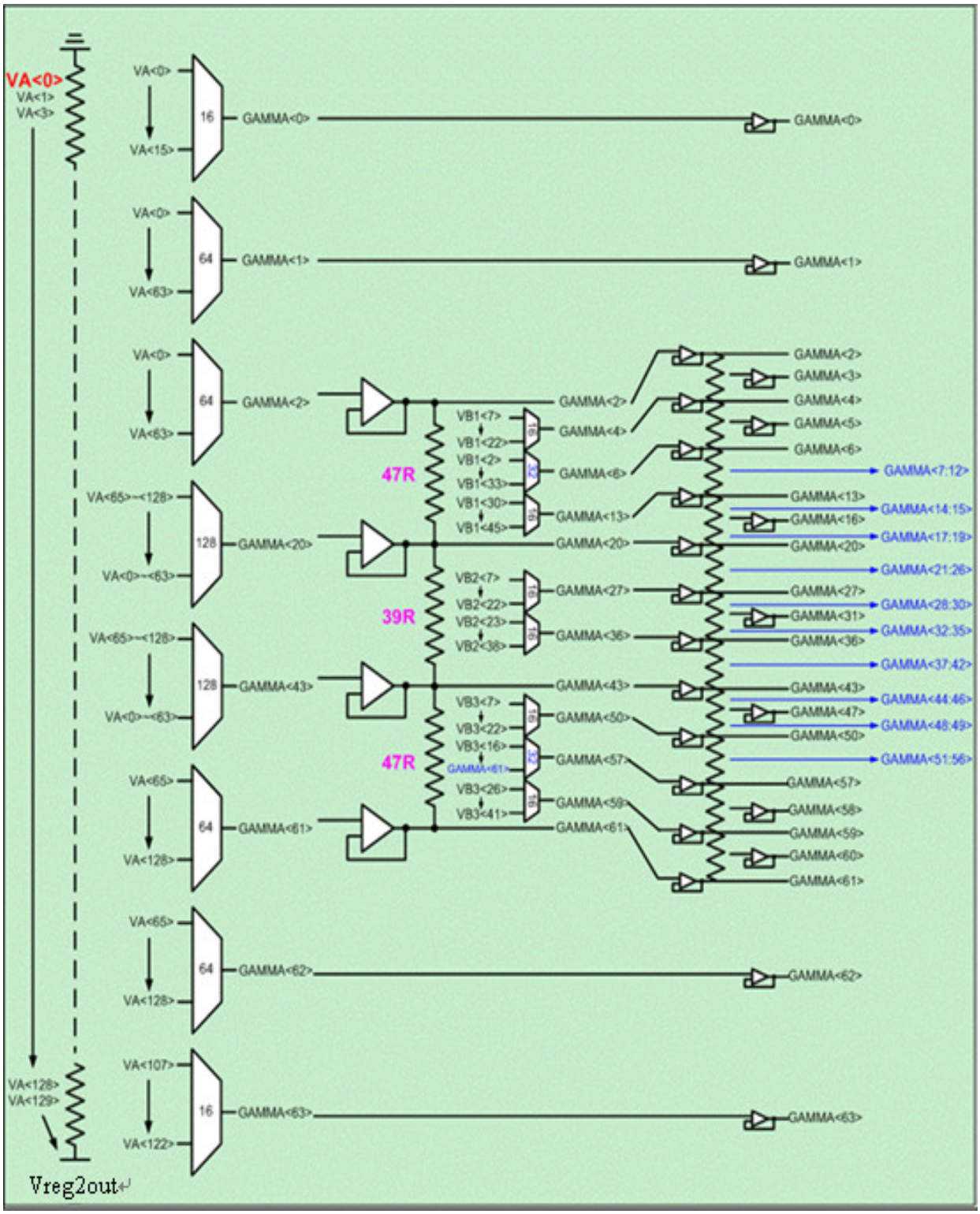


16. Gamma Correction

Positive Gamma Control (E0h)



Negative Gamma Control (E1h)



17. Electrical Characteristics

17.1. Absolute Maximum Ratings

The absolute maximum rating is listed on following table. When ILI9486L is used out of the absolute maximum ratings, ILI9486L may be permanently damaged. To use ILI9486L within the following electrical characteristics limit is strongly recommended for normal operation. If these electrical characteristic conditions are exceeded during normal operation, ILI9486 will malfunction and cause poor reliability.

Item	Symbol	Unit	Value
Supply voltage	VCI	V	-0.3 ~ +5.0
Supply voltage (Logic)	IOVCC	V	-0.3 ~ +4.6
Supply voltage (Digital)	VCORE	V	-0.3 ~ +2.4
Driver supply voltage	VGH-VGL	V	-0.3 ~ +33.0
Logic input voltage range	VIN	V	-0.3 ~ IOVCC + 0.3
Logic output voltage range	VOUT	V	-0.3 ~ IOVCC + 0.3
Operating temperature	Topr	℃	-40 ~ +85
Storage temperature	Tstg	℃	-55 ~ +110
Notes:If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum ratings.			

17.2. DC Characteristics

DSI is using different state codes which are depending on DC voltage levels of the clock and data lanes. The meaning of the state codes is defined on the following table.

State Code	Line DC Voltage Levels	
	CLOCK_P or DATA_N	CLOCK_N or DATA_P
HS-0	Low (HS)	High (HS)
HS-1	High (HS)	Low (HS)
LP-00	Low (LP)	Low (LP)
LP-01	Low (LP)	High (LP)
LP-10	High (LP)	Low (LP)
LP-11	High (LP)	Low (LP)

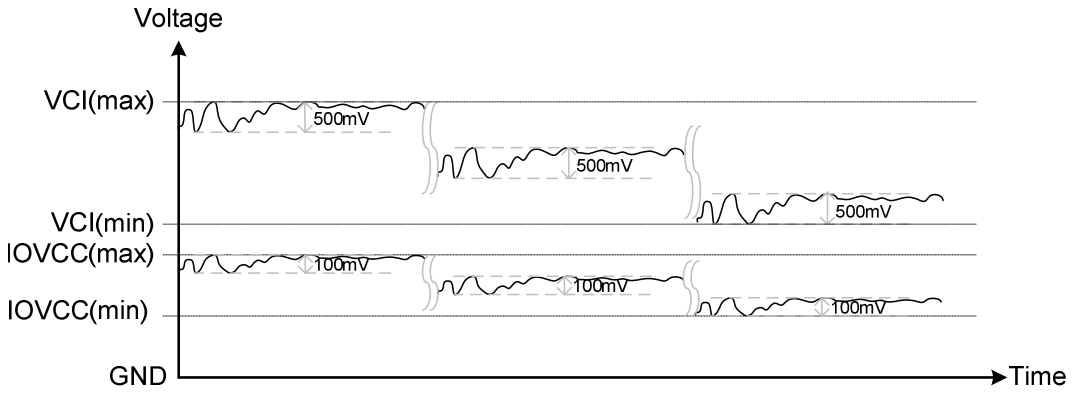
Note: Ta=-30℃ to 70℃ (to +85℃ no damage)

17.2.1. DC characteristics for Power Lines

Parameter	Symbol	Condition	Specification			Unit
			Min.	Typ.	Max.	
Analog power supply voltage	V_{CI}	Operating voltage	2.5	3.7	4.8	V
Digital power supply voltage	V_{IOVCC}	I/O supply voltage	1.65	1.8	1.95	V
Analog power supply voltage noise	V_{CI_NOISE}	Noise window, 0 to 100MHz	-	-	500	mV
Digital power supply voltage noise	V_{IOVCC_NOISE}	Noise window, 0 to 100MHz	-	-	500	mV

Note 1: Ta=-30℃ to 70℃ (to +85℃ no damage)

Note 2: These values are not symmetric amplitude, which centre points are IOVCC or VCI. See examples as reference purposes, when VCI_NOISE and IOVCC_NOISE are maximums, below.



17.2.2. DC characteristics for DSI LP mode

DC levels of the LP-00, LP-01, LP-10 and LP-11 are defined on table below: DC Characteristics for DSI LP mode when LP-RX, LP-CD or LP-TX is mentioned on the condition column. Other logical levels of the table are for MCU interface.

Parameter	Symbol	Condition	Specification			Unit
Logic High level output voltage	V_{OH}	I_{OUT}=-1mA ; Note 2	0.8 V_{IOVCC}	-	V_{IOVCC}	V
Logic Low level output voltage	V_{OL}	I_{OUT}=-1mA ; Note 2	0.0	-	0.2V_{IOVCC}	V
Logic High level input voltage	V_{IHLPCD}	LP-CD ; Note 3	450	-	1350	mV
Logic Low level input voltage	V_{ILLPCD}	LP-CD ; Note 3	0.0	-	200	mV
Logic High level input voltage	V_{IHLPRX}	LP-RX (CLOCK, DATA) ; Note 3	880	-	1350	mV
Logic Low level input voltage	V_{ILLPRX}	LP-RX (CLOCK, DATA) ; Note 3	0.0	-	550	mV
Logic Low level input voltage	$V_{ILLPRXULP}$	LP-RX (CLOCK ULP mode), Note 3	0.0	-	300	mV
Logic high level output voltage	V_{OHLPTX}	LP-TX (DATA), Note 3	1.1	-	1.3	V
Logic Low level output voltage	V_{OLLPTX}	LP-TX (DATA), Note 3	-50	-	50	mV
Logic High level input current	I_{IH}	LP-CD, LP-RX, Note 3	-	-	10	uA
Logic Low level input current	I_{IL}	LP-CD, LP-RX, Note 3	-10	-	-	uA

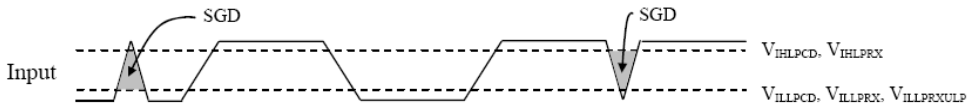
Note: (1) Ta=-30℃ to 70℃ (to +85℃ no damage)

(2) PWM_OUT, TE

(3) DSI High Speed mode is off

17.2.3. Spike / Glitch Rejection

Spike / Glitch Rejection – DSI					
Signal	Symbol	Parameter	Min	Max	Unit
Input (DSI-CLOCK_P/N, DSI-CLOCK_P/N)	SGD	Input pulse rejection for DSI	--	300	Vps



17.2.4. DC Characteristics for DSI HS mode

DC levels of the HS-0 and HS-0 are defined on table below: DC Characteristics for DSI HS mode.

Parameter	Symbol	Condition	Specification			Unit
Input Common Mode Voltage for Clock	V_{CMCLK}	DSI-CLOCK_P/N ; Note 2,3	70	-	330	mV
Input Common Mode Voltage for Data	V_{CMDATA}	DSI-DATA_P/N ; Note 2,3	70	-	330	mV
Common Mode Ripple for Clock Equal or Less than 450MHz	$V_{CMRCLKL450}$	DSI-CLOCK_P/N ; Note 4	-50	-	50	mV
Common Mode Ripple for Data Equal or Less than 450MHz	$V_{CMRDATAL450}$	DSI-DATA_P/N ; Note 4	-50	-	50	mV
Common Mode Ripple for Clock More than 450MHz (peak sine wave)	$V_{CMRCLKM450}$	DSI-CLOCK_P/N	-	-	100	mV
Common Mode Ripple for Data More than 450MHz (peak sine wave)	$V_{CMRDATAM450}$	DSI-DATA_P/N	-	-	100	mV
Differential Input Low Level Threshold Voltage for Clock	$V_{THLCLK-}$	DSI-CLOCK_P/N	-70	-	-	mV
Differential Input Low Level Threshold Voltage for Data	$V_{THLDATA-}$	DSI-DATA_P/N	-70	-	-	mV
Differential Input High Level Threshold Voltage for Clock	$V_{THHCLK+}$	DSI-CLOCK_P/N	-	-	70	mV
Differential Input High Level Threshold Voltage for Data	$V_{THHDATA+}$	DSI-DATA_P/N	-	-	70	mV
Single-ended Input Low Voltage	V_{ILHS}	DSI-CLOCK_P/N, DSI-DATA_P/N ; Note 3	-40	-	-	mV
Single-ended Input High Voltage	V_{IHHS}	DSI-CLOCK_P/N, DSI-DATA_P/N ; Note 3	-	-	460	mV
Differential Termination Resistor	R_{TERM}	DSI-CLOCK_P/N, DSI-DATA_P/N	80	100	125	Ω
Single-ended Threshold Voltage for Termination Enable	$V_{TERM-EN}$	DSI-CLOCK_P/N, DSI-DATA_P/N	-	-	450	mV
Termination Capacitor	C_{TERM}	DSI-CLOCK_P/N, DSI-DATA_P/N	-	-	14	pF

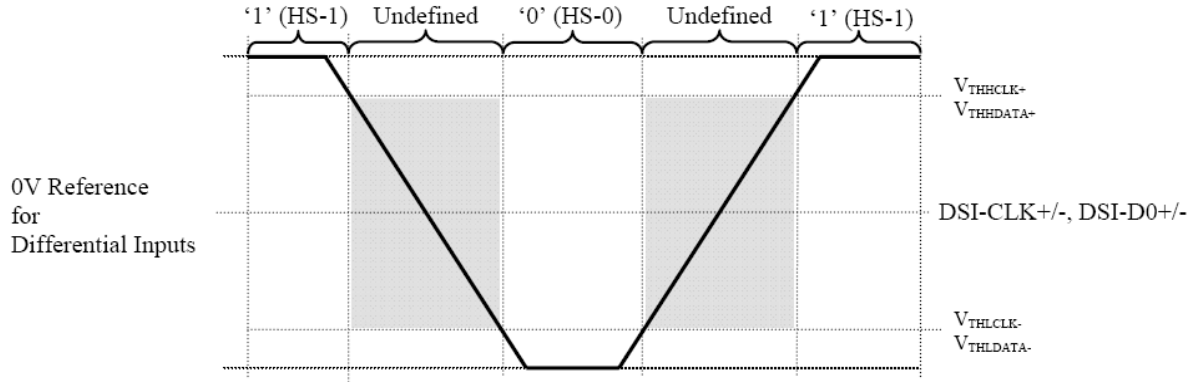
Note: (1) Ta = -30 to 70 ℃ (to +85 ℃ no damage), IOVCC = 1.65 to 1.95V, GND = 0V

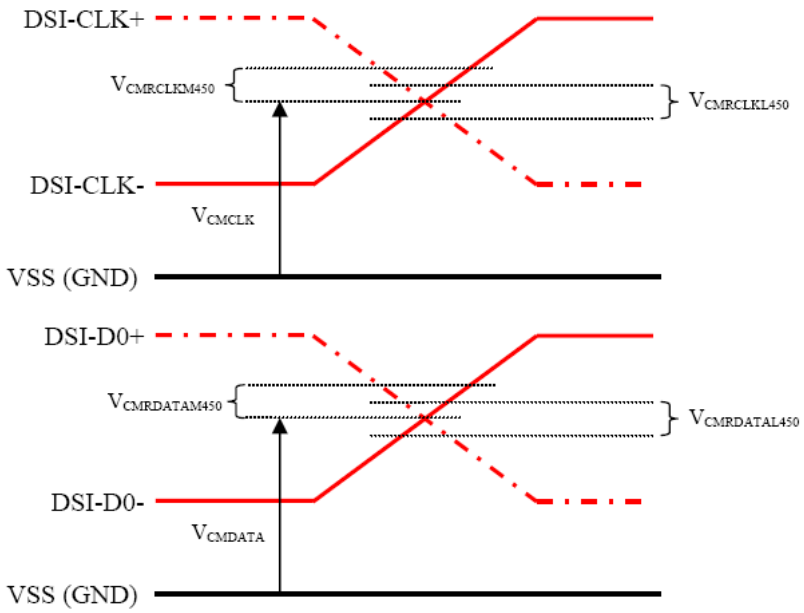
(2) Includes 50mV (-50mV to 50mV) ground difference

(3) Without VCMRCLKM450/VCMRDATAM450

(4) Without 50mV (-50mV to 50mV) ground difference

The DSI receiver (HS mode) is understanding that there is logical '1' (HS-1) when a differential voltage is more than VTHH (CLK+/DATA+) and the DSI receiver (HS mode) is understanding that there is logical '0' (HS-0) when a differential voltage is more than VTHL (CLK-/DATA-). There is undefined state if the differential voltage is less than VTHH (CLK+/DATA+) and less than VTHL (CLK-/DATA-). A reference figure is below.

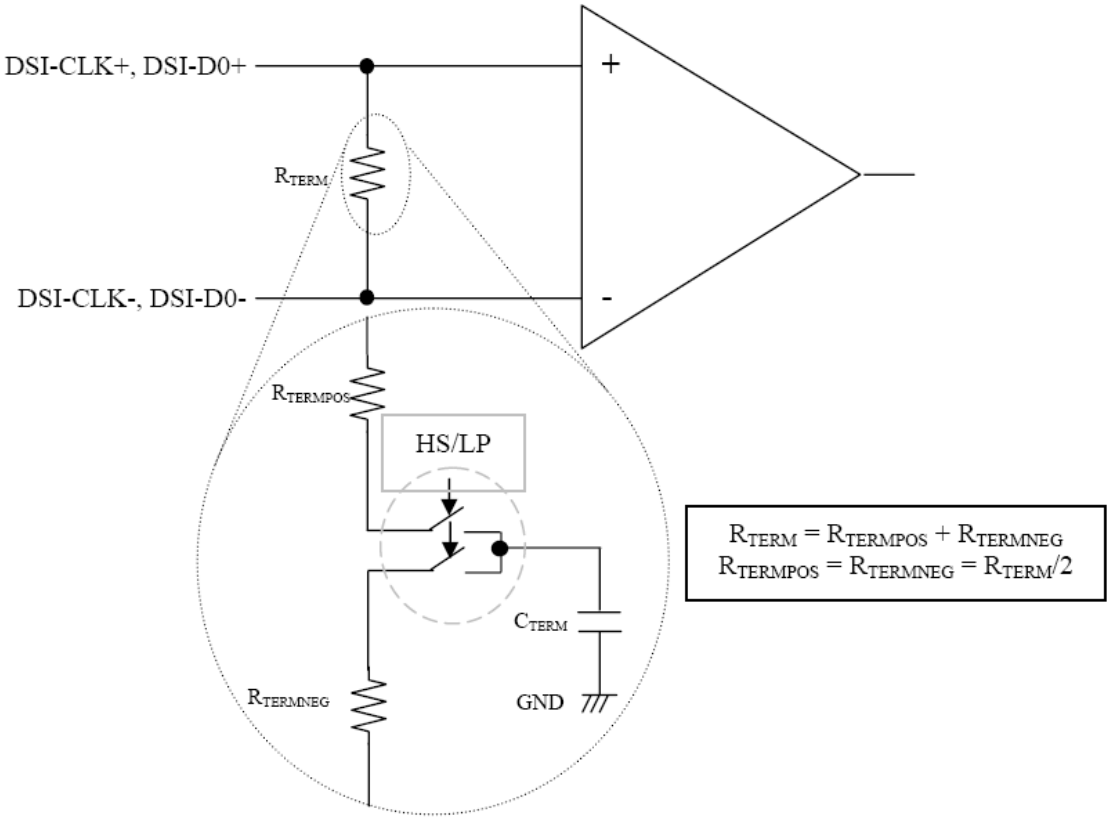




The termination resistor (RTERM) of the differential DSI receiver can be driven two different states by the receiver:

- Low Power (LP) mode when the termination resistor is not connected between differential inputs DSI-CLK+ <=> DSI-CLK- or DSI-D0+ <=> DSI-D0-)
- High Speed (HS) mode when the termination resistor is connected between differential inputs (DSI-CLK+ <=> DSI-CLK- or DSI-D0+ <=> DSI-D0-)

The termination switch (HS/LP), when the termination resistor is not connected, is illustrated below.



17.2.5. DC Characteristics for Panel Driving

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Power & Operation Voltage							
Analog operating voltage	VCI	-	2.5	2.8	3.6	V	
Logic operating voltage	IOVCC	-	1.65	2.8	3.6	V	
Digital operating voltage	VCORE	Digital block power supply	-	1.5	-	V	Note2
Gate Driver High Voltage	VGH	-	10.0	-	16.0	V	Note3
Gate Driver Low Voltage	VGL	-	-16.0	-	-9.0	V	Note3
Driver Supply Voltage	-	|VGH-VGL|	19	-	32	V	Note3
VCOM Operation							
VCOM Amplitude Voltage	VCOM	-	0	-	-2.0	V	Note3
Source Driver							
Source Output Range	Vsout	-	0.1	-	VREG1OUT-0.1	V	Note4
Positive Gamma Reference Voltage	VREG1OUT	-	3.6	-	5.5	V	Note3
Negative Gamma Reference Voltage	VREG2OUT		-5.5		-3.6	V	Note3
Source Output Setting Time	Tr	Below with 99% precision	-	15	20	uS	Note4,5
Output Deviation Voltage (Source Output channel)	Vdev	Sout>=4.2V Sout<=0.8V	-	-	20	mV	Note4
		4.2V>Sout>0.8V	-	-	15	mV	-
Output Offset Voltage	VOFSET	-	-	-	35	mV	Note6
Booster Operation							
1st Booster (VCI1x2) Voltage	DDVDH	-	4.5	-	6.0	V	Note3
1st Booster (VCI1x2) Voltage	DDVDL	-	-6.0	-	-4.5	V	Note3
1st Booster (VCI1x2 Drop Voltage	VCI1x2 drop	loading=1mA	-	-	5	%	Note3
Liner Range	Vliner	-	0.2	-	DDVDH-0.2	V	

Note 1: IOVCC=1.65 to 3.6V, VCI=2.5 to 3.6V, AGND=DGND=0V, Ta=-30 to 70 (to +85 no damage) ℃.

Note2: Please supply digital IOVCC voltage equal or less than analog VCI voltage.

Note2, 3, 4: When the measurements are performed with LCD module. Measurement Points are like below.

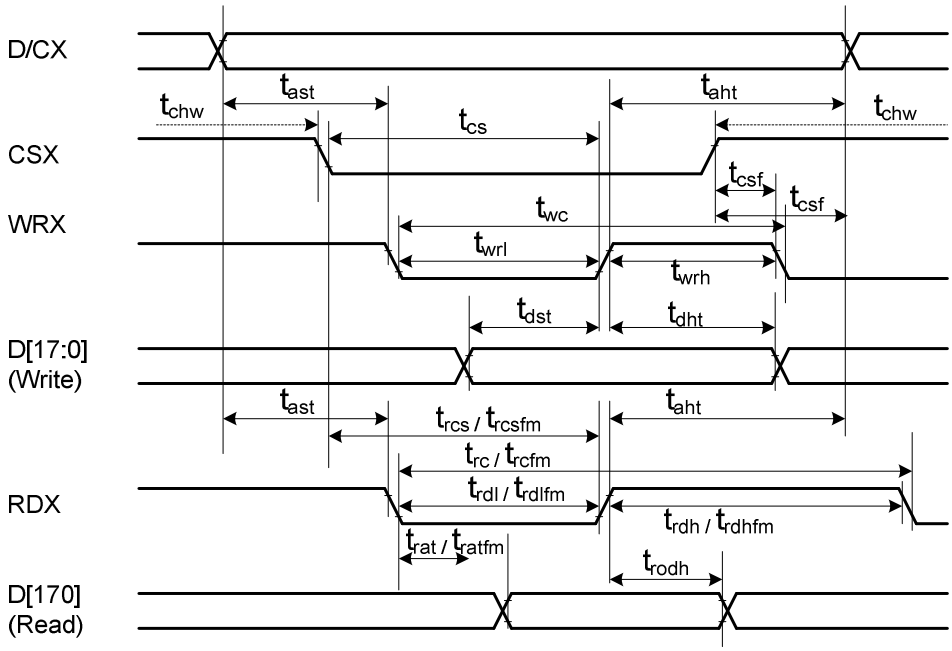
Note3: CSX, RDX, WRX, DB[17:0], D/CX, RESX, TE, SDA, SCL, IM2, IM1, IM0, and Test pins.

Note5: Source channel loading = 10pF/channel, Gate channel loading = 50pF/channel

Note6: The Max. Value is between with Note 4 measure point and Gamma setting value

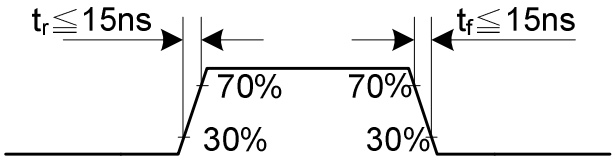
17.3. AC Characteristics

17.3.1. Display Parallel 18/16/9/8-bit Interface Timing Characteristics (8080-series)

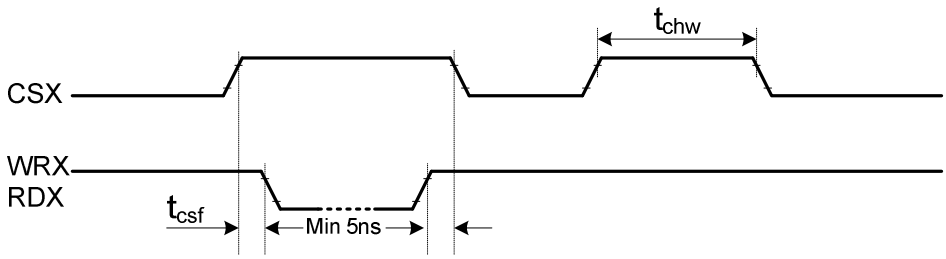


Signal	Symbol	Parameter	min	max	Unit	Description
DCX	tast	Address setup time	0	-	ns	-
	taht	Address hold time (Write/Read)	0	-	ns	-
CSX	tchw	CSX "H" pulse width	0	-	ns	-
	tcs	Chip Select setup time (Write)	15	-	ns	-
	trcs	Chip Select setup time (Read ID)	45	-	ns	-
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	-
	tcsf	Chip Select Wait time (Write/Read)	0	-	ns	-
WRX	twc	Write cycle	50	-	ns	-
	twrh	Write Control pulse H duration	15	-	ns	-
	twrl	Write Control pulse L duration	15	-	ns	-
RDX (FM)	trcfm	Read Cycle (FM)	450	-	ns	When read from Frame Memory
	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
RDX (ID)	trc	Read cycle (ID)	160	-	ns	When read ID data
	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
DB[17:0], DB[15:0], DB[8:0] DB[7:0]	tdst	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	40	ns	
	tratfm	Read access time	-	340	ns	
	trod	Read output disable time	20	80	ns	

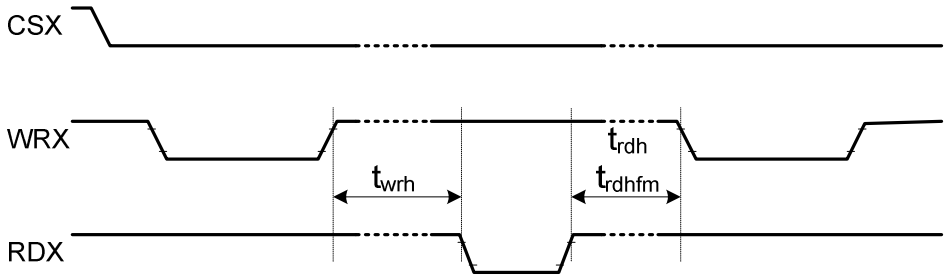
Note: (1) Ta = -30 to 70 ℃, IOVCC=1.65V to 3.6V, VCI=2.5V to 3.6V, AGND=DGND=0V



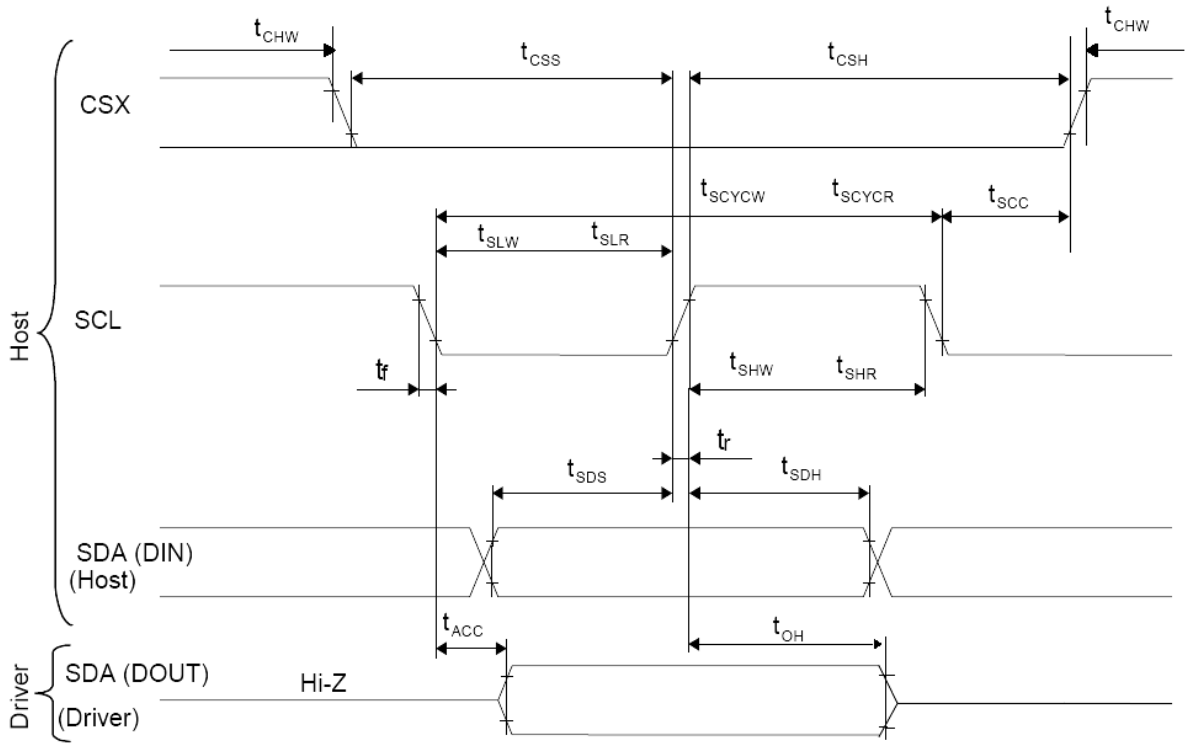
(2) Logic high and low levels are specified as 30% and 70% of IOVCC for input signals.



(3) Logic high and low levels are specified as 30% and 70% of IOVCC for input signals.

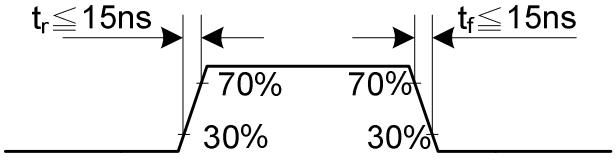


17.3.2. Display Serial Interface Timing Characteristics (3-line SPI system)

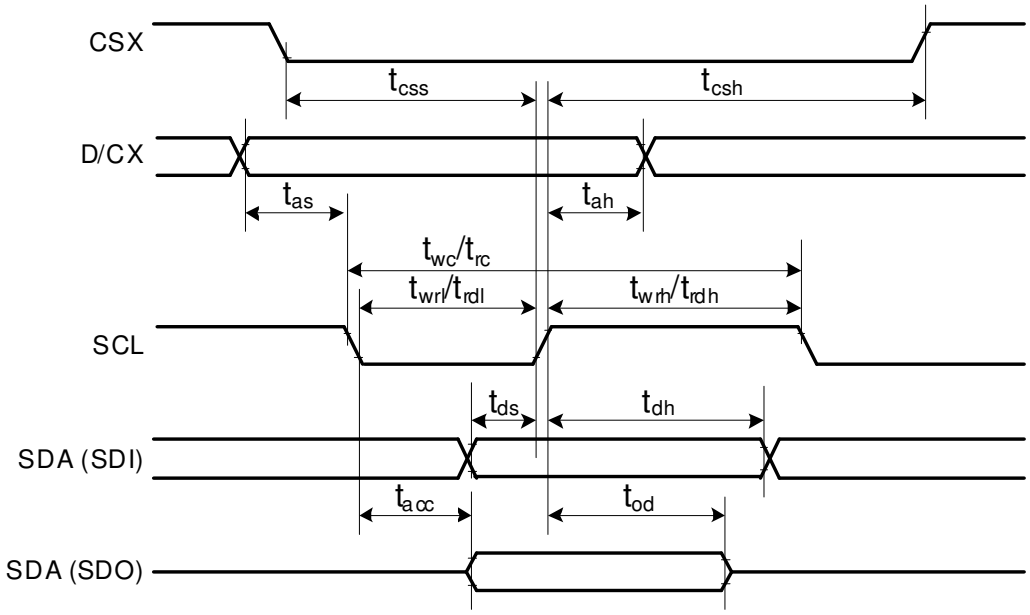


Signal	Symbol	Parameter	min	max	Unit	Description
SCL	tscycw	Serial Clock Cycle (Write)	66	-	ns	
	tshw	SCL “H” Pulse Width (Write)	15	-	ns	
	tslw	SCL “L” Pulse Width (Write)	15	-	ns	
	tscycr	Serial Clock Cycle (Read)	150	-	ns	
	tshr	SCL “H” Pulse Width (Read)	60	-	ns	
	tslr	SCL “L” Pulse Width (Read)	60	-	ns	
SDA / SDI (Input)	tsds	Data setup time (Write)	10	-	ns	
	tsdh	Data hold time (Write)	10	-	ns	
SDA / SDO (Output)	tacc	Access time (Read)	10	50	ns	
	toh	Output disable time (Read)	15	50	ns	
CSX	tscc	SCL-CSX	15	-	ns	
	tchw	CSX “H” Pulse Width	40	-	ns	
	tcss	CSX-SCL Time	60	-	ns	
	tcsh		65	-	ns	

Note: Ta = -30 to 70 ℃, IOVCC=1.65V to 3.6V, VCI=2.5V to 3.6V, AGND=DGND=0V, T=10+/-0.5ns



17.3.3. Display Serial Interface Timing Characteristics (4-line SPI system)

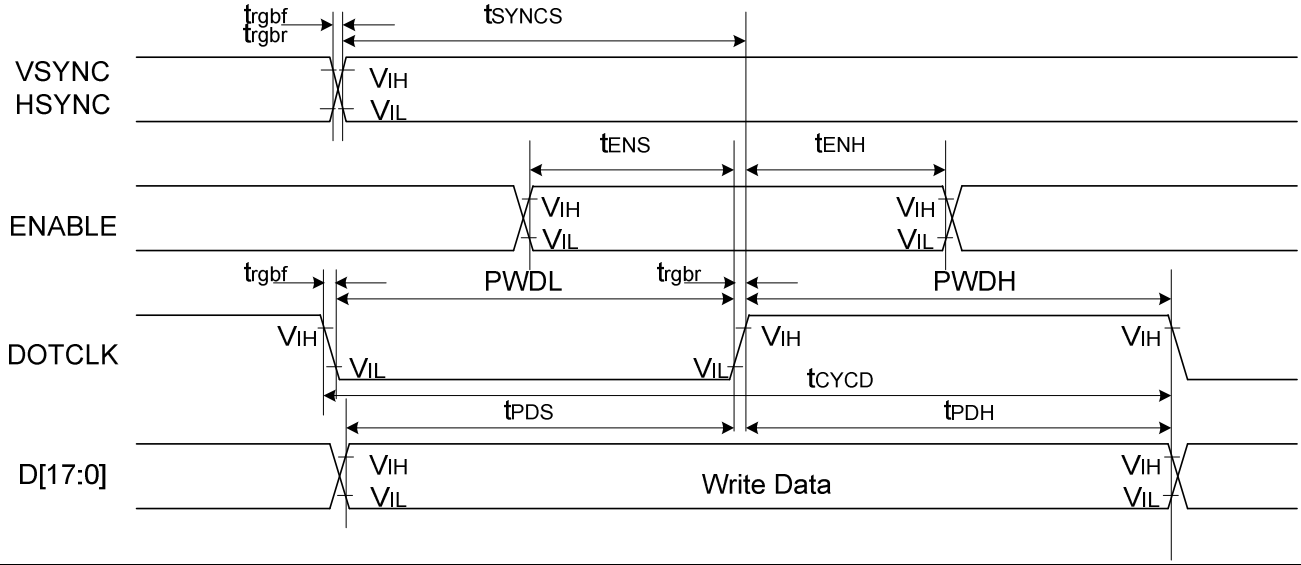


Signal	Symbol	Parameter	min	max	Unit	Description
CSX	tcss	Chip select time (Write)	15	-	ns	
	tcsh	Chip select hold time (Read)	60	-	ns	
SCL	twc	Serial clock cycle (Write)	66	-	ns	
	twrh	SCL “H” pulse width (Write)	15	-	ns	
	twrl	SCL “L” pulse width (Write)	15	-	ns	
	trc	Serial clock cycle (Read)	150	-	ns	
	trdh	SCL “H” pulse width (Read)	60	-	ns	
	trdl	SCL “L” pulse width (Read)	60	-	ns	
D/CX	tas	D/CX setup time	10	-	ns	
	tah	D/CX hold time (Write / Read)	10	-	ns	
SDA / SDI (Input)	tds	Data setup time (Write)	10	-	ns	
	tdh	Data hold time (Write)	10	-	ns	
SDA / SDO (Output)	tacc	Access time (Read)	10	50	ns	For maximum CL=30pF
	tod	Output disable time (Read)	15	50	ns	For minimum CL=8pF

Note: (1) Ta = -30 to 70 ℃, IOVCC=1.65V to 3.6V, VCI=2.5V to 3.6V, AGND=DGND=0V, T=10+/-0.5ns.

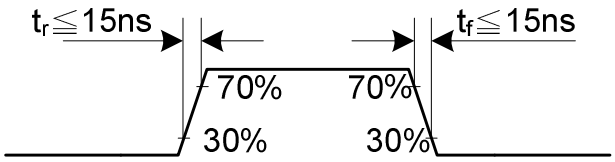
(2) Does not include signal rise and fall times.

17.3.4. Parallel 18/16-bit RGB Interface Timing Characteristics

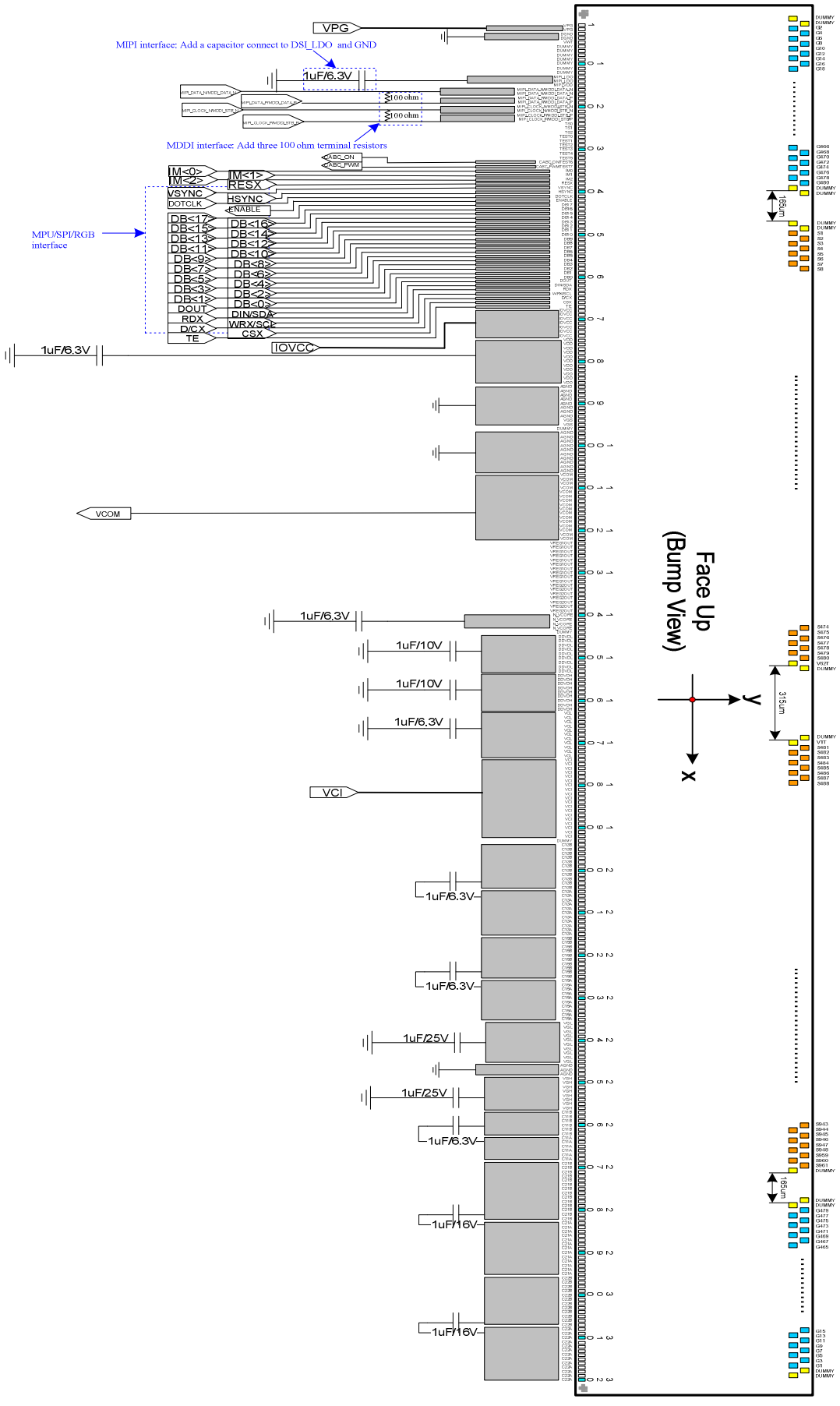


Signal	Symbol	Parameter	min	max	Unit	Description
VSYNC / HSYNC	t_{SYNCS}	VSYNC/HSYNC setup time	15	-	ns	18/16-bit bus RGB interface mode
	t_{SYNCH}	VSYNC/HSYNC hold time	15	-	ns	
ENABLE	t_{ENS}	ENABLE setup time	15	-	ns	
	t_{ENH}	ENABLE hold time	15	-	ns	
DB[17:0]	t_{POS}	Data setup time	15	-	ns	
	t_{PDH}	Data hold time	15	-	ns	
DOTCLK	PWDH	DOTCLK high-level period	15	-	ns	
	PWDL	DOTCLK low-level period	15	-	ns	
	t_{CYCD}	DOTCLK cycle time	66	-	ns	
	t_{rgbr} , t_{rgbf}	DOTCLK,HSYNC,VSYNC rise/fall time	-	15	ns	

Note: Ta = -30 to 70 ℃, IOVCC=1.65V to 3.6V, VCI=2.5V to 3.3V, AGND=DGND=0V



18. Application Circuit



The following table shows specifications of external elements connected to ILI9486L's power supply circuit.

Items	Recommended Specification	Pin connection
Capacity 1 µF (B characteristics)	6.3V	C11A/B, C13A/B, C15A/B, VCL, VDD, N_VCORE(back up)
	10V	DDVDH, DDVDL
	16V	C21 A/B, C22A/B(for +6,-3 backup)
	25V	VGH, VGL

19. Revision History

Version No.	Date	Page	Description
V.001	2010/09/02	All	New created
V.001	2010/11/04	147	Modify command list
		286	Add LCM voltage generation
		310	Application circuit
V.001	2010/11/23	230	Modify command
V.001	2011/01/03	10	Modify VCOM and VGH-VGL voltage
		25	Modify pad size
		239	Modify command RC1（Remove SAP）
		257	Modify command RD0
		297	Modify write cycle（66ns -> 50ns）
V.001	2011/02/25	290	Modify Gamma Correction
		291	
V.001	2011/03/01	16	Modify pad size
		18-24	Modify source and gate pad locations
V.001	2011/03/25	12-13	Modify pin description
		240-242	Modify command RC2 RC3 RC4
		235	Modify command RB7
		259	Modify command RD2（Remove OTP_DATA）
		289	Modify NV Memory programming flow
		311	Modify capacity
V.002	2011/04/01	239	Modify command RC1
		289	Modify NV Memory programming flow
V.003	2011/04/08	16	Modify the chip thickness
V.004	2011/04/22	227	Modify the inversion mode (DINV[1:0])
		239	Modify the VCI1 output voltage selection (VC[2:0])
V.005	2011/05/04	227	Modify the inversion mode (DINV[1:0])
V.006	2011/05/11	18	Modify the C22B (No.296) pad location typo