



» **DATA SHEET**
(DOC No. HX8357-B-DS)

» **HX8357-B**

320RGB x 480 dot, 262K color,
with internal GRAM,
TFT Mobile Single Chip Driver
Version 01 May, 2010

Himax Technologies, Inc.
<http://www.himax.com.tw>

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320RGB x 480 dot, 262K color, with internal
GRAM, TFT Mobile Single Chip Driver



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Version 01

May, 2010

1. General Description

This document describes Himax's HX8357-B is designed to provide a single-chip solution that combines a gate driver, a source driver, power supply circuit for 262,144 colors to drive a TFT panel with 320RGBx480 dots.

The HX8357-B can be operated in low-voltage (1.65V) condition for the interface and integrated internal boosters that produce the liquid crystal voltage, breeder resistance and the voltage follower circuit for liquid crystal driver. In addition, The HX8357-B also supports various functions to reduce the power consumption of a LCD system via software control.

The HX8357-B is suitable for any small portable battery-driven and long-term driving products, such as small PDAs, digital cellular phones and bi-directional pages.

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2. Features

2.1 Display

- Resolution:
 - 320(H) x RGB(H) x 480(V)
- Display Color modes
 - Normal Display Mode On
 - 65,536(R(5),G(6),B(5)) colors
 - 262,144(R(6),G(6),B(6)) colors
 - Idle Mode On
 - 8 (R(1),G(1),B(1)) colors.

2.2 Display Module

- On module VCOM control (-2.0 to 5.5V Common electrode output voltage range)
- On module DC/DC converter
 - DDVDH = 4.6 to 6.0V (Source output voltage range)
 - VGH = +9.0 to +16.5V (Positive Gate output voltage range)
 - VGL = -6.0 to -13.5V (Negative Gate output voltage range)
- Frame Memory area 320 (H) x 480 (V) x 18 bit

2.3 Display/Control Interface

- Display Interface types supported
 - MIPI-DBI Type-B 8-/9-/16-/18-bit MPU parallel interface.
 - MIPI-DBI Type-C OPTION1/3 Serial data transfer interface.
 - MIPI-DPI 16-/18-data lines parallel video (RGB) interface.
- Color modes
 - 16 bit/pixel: R(5), G(6), B(5)
 - 18 bit/pixel: R(6), G(6), B(6)

2.4 Display Module

- Logic power supply (IOVCC): 1.65V ~ 3.3V
- Analog power supply (VCI): 2.5V ~ 3.3V
- OTP programming voltage (VPP): 7.5V ± 0.2

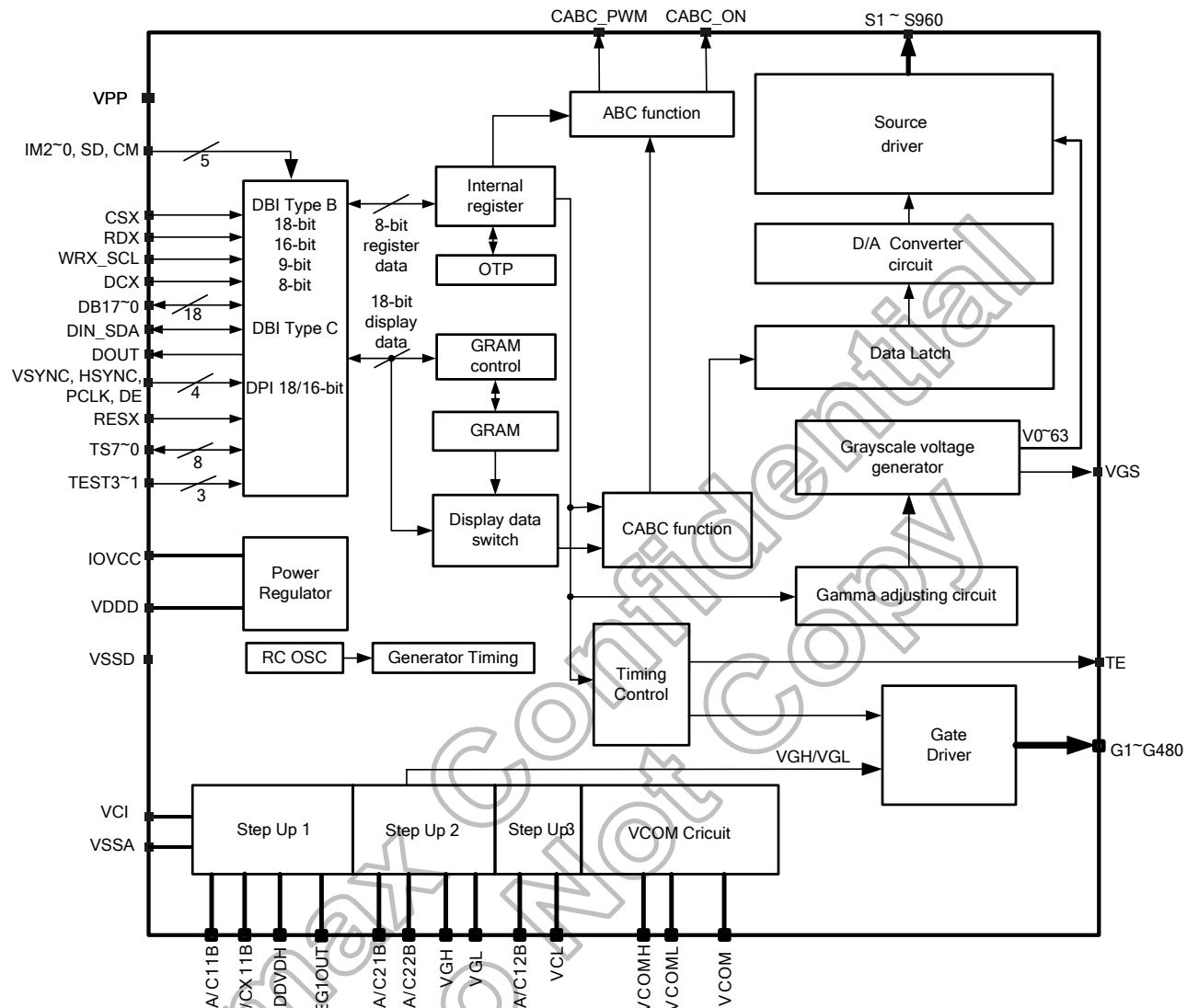
2.5 Miscellaneous

- Low power consumption, suitable for battery operated systems
- Image sticking eliminated function
- CMOS compatible inputs
- Optimized layout for COG assembly
- Temperature range: -40 ~ +85 °C
- Proprietary multi phase driving for lower power consumption
- Support Line inversion or Frame inversion
- Support Vertical scrolling
- Support Partial display mode
- Support normal black/normal white LCD
- Support wide view angle display
- On-chip OTP (One-time-programming) and MTP(Five-time-programming for some register) non-volatile memory
- Support Content Adaptive Brightness Control(CABC) function

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3. Device Overview

3.1 Block Diagram



3.2 Pin Description

Input Parts									
Signals	I/O	Pin Number	Connected with	Description					
IM2, IM1, IM0	I	3	VSSD/ IOVCC	Select the MPU interface mode as listed below.					
				IM2	IM1	IM0	Interface mode	DB pins	Color mode
				0	0	0	DBI Type-B 18-bit	DB17-DB0: Data	262K
				0	0	1	DBI Type-B 9-bit	DB17-DB9: Unused, DB8-DB0: Data	262K
				0	1	0	DBI Type-B 16-bit	DB17-DB16: Unused, DB15-DB0: Data	65K / 262K
				0	1	1	DBI Type-B 8-bit	DB17-DB8: Unused, DB7-DB0: Data.	65K / 262K
				1	0	0	Inhibited	-	-
				1	0	1	DBI Type-C Option 1 (9 bits)	DB17-DB0: Data, DIN_SDA, DOUT	8 / 262K
				1	1	0	Inhibited	-	-
				1	1	1	DBI Type-C Option 3 (8 bits)	DB17-DB0: Data. DIN_SDA, DOUT	8 / 262K
Pixel format (RGB565/RGB666) is selected by Command (0x3Ah)									
CSX	I	1	MPU	Chip select signal. Low: chip can be accessed; High: chip cannot be accessed. If not use, please connect to IOVCC.					
RESX	I	1	MPU or reset circuit	Reset pin. Setting either pin low initializes the LSI. Must be reset after power is supplied. If not use, please connect to IOVCC.					
WRX_SCL	I	1	MPU	DBI Type-B: Serves as a write signal and write data at the low level. DBI Type-C: it servers as SCL (Serial Clock). If not use, please connect to IOVCC.					
RDX	I	1	MPU	DBI Type-B: Serves as a read signal and read data at the low level. If not use, please connect to IOVCC.					
DCX	I	1	MPU	Data / Command Selection pin If not use, please connect to IOVCC.					
VSYNC	I	1	MPU	Frame synchronizing signal for DPI I/F mode. If not use, please connect to IOVCC.					
H SYNC	I	1	MPU	Frame synchronizing signal for DPI I/F mode. If not use, please connect to IOVCC.					
PCLK	I	1	MPU	Pixel clock signal for DPI I/F mode. If not use, please connect to VSSD.					
DE	I	1	MPU	A DATA ENABLE signal for DPI I/F mode. If not use, please connect to VSSD.					
SD	I	1	MCU	Control pin of Normal display or shut down display in DPI(RM=1) interface mode.					
				SD	Display mode				
				0	Normal display				
CM	I	1	MCU	Shut down display					
				Color mode direction H/W select pin in DPI interface mode.					
				CM	Color mode				
				0	Normal display color				
				1	8-Color mode				

Output Part				
Signals	I/O	Pin Number	Connected with	Description
S1~S960	O	960	LCD	Output voltages applied to the liquid crystal.
G1~G480	O	480	LCD	Gate driver output pins. These pins output VGH, VGL
VCOM	O	16	TFT common electrode	The power supply of common voltage in TFT driving. The voltage amplitude between VCOMH and VCOML is output. Connect this pin to the common electrode in TFT panel.
TE	O	1	MPU	Tearing effect output. If not used, please open this pin.
CABC_ON	O	1	LED driver IC	If use CABC function (setting by BL), the pin can connect to external LED driver IC. The output voltage range = VSSD~ IOVCC. If not used, please open this pin.
CABC_PWM	O	1	LED driver IC	Backlight On/Off control pin. If use CABC function, the pin can connect to external LED driver IC. The output voltage range = VSSD~ IOVCC. If not used, please open this pin.
DOUT	O	1	MPU	Serial data output pin in serial bus system interface. If not used, please open this pin.

Input/Output Part				
Signals	I/O	Pin Number	Connected with	Description
DB17~0	I/O	18	MPU	When Operates in MIPI DBI interface mode, it is used like an 18-bit bi-directional data bus. 8-bit bus: use DB7-DB0 9-bit bus: use DB8-DB0 16-bit bus: use DB15-DB0 18-bit bus: use DB17-DB0 When Operation in MIPI DPI interface mode, it is an 18-bit bus RGB data bus. 6-bit bus: use DB5-DB0 16-bit bus: use DB15-DB0 18-bit bus: use DB17-DB0 If not used, please connect to VSSD.
DIN_SDA	I/O	1	MPU	Serial data input pin or input/output pin in serial bus system interface. The data is inputted on the rising edge of the SCL signal. If not used, please connect to VSSD.

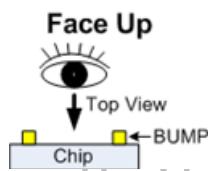
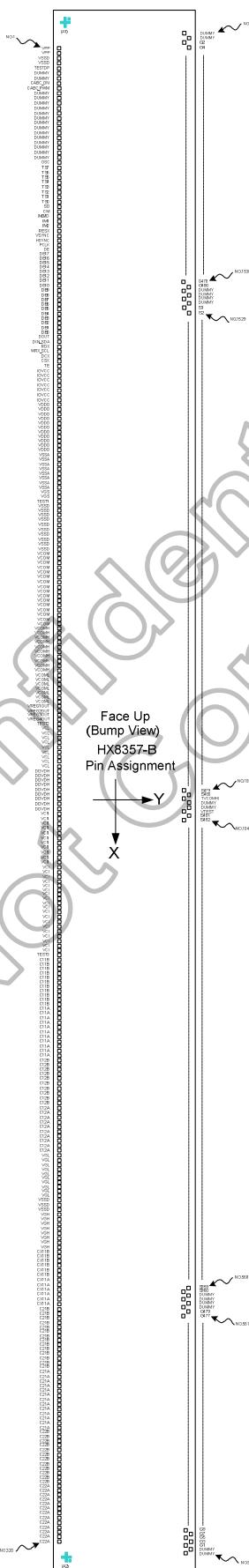
Power Part				
Signals	I/O	Pin Number	Connected with	Description
IOVCC	P	7	Power Supply	IO Pad and Digital power supply, 1.65V~3.3V
VCI	P	19	Power Supply	Analog power supply, 2.5V~3.3V
VPP	P	2	Power Supply	Power supply pin used in OTP program mode and operates at $7.5V \pm 0.2$. If not in OTP program mode, please let it open.
VSSD	P	15	Ground	Digital ground
VSSA	P	8	Ground	Analog ground
VDDD	O	11	Stabilizing Capacitor	Output from internal logic voltage. Connect to a stabilizing capacitor
VREG1OUT VREG2OUT VREG3OUT VREG4OUT	P	4	Stabilizing Capacitor	Internal generated stable power for source driver unit.
VCI1	O	11	Open	Internal reference voltage output pin, please open this pin.
VCOMH	P	10	Stabilizing capacitor	Connect this pin to the capacitor for stabilization. This pin indicates a high level of VCOM amplitude generated in driving the VCOM alternation.
VCOML	P	7	Stabilizing capacitor	When the VCOM alternation is driven, this pin indicates a low level of VCOM amplitude. Connect this pin to a capacitor for stabilization.

Power Part				
Signals	I/O	Pin Number	Connected with	Description
VCL	P	9	Stabilizing capacitor	A negative voltage for VCOML circuit, VCL=-VCI
DDVDH	P	9	Stabilizing capacitor	An output from the step-up circuit1. Connect to a stabilizing capacitor between VSSA and DDVDH. (See "configuration of the power supply").
VGH	P	8	Stabilizing capacitor	An output from the step-up circuit2.or 4 ~ 6 time the VCI level. The step-up rate is determined with BT3-0 bits. Connect to a stabilizing capacitor between VSSA and VGH. (See "configuration of the power supply").
VGL	P	10	Stabilizing capacitor	An output from the step-up circuit2.or -3 ~ -5 time the VCI level. The step-up rate is determined with BT3-0 bits. Connect to a stabilizing capacitor between VSSA and VGL. Place a schottkey barrier diode between VSSD and VGL. Place a schottkey barrier diode (see "configuration of the power supply").
VGS	I	2	VSSD or external resistor	Connect to a variable resistor to adjusting internal gamma reference voltage for matching the characteristic of different panel used.
C11A,C11B CX11A,CX11B	P	34	Step-up Capacitor	Connect to the step-up capacitors according to the step-up 1 factor. Leave this pin open if the internal step-up circuit is not used.
C12A, C12B	P	20	Step-up Capacitor	Connect to the step-up capacitors for step up circuit 3 operation. Leave this pin open if the internal step-up circuit is not used.
C21A,C21B C22A,C22B	P	52	Step-up Capacitor	Connect these pins to the capacitors for the step-up circuit 2. According to the step-up rate. When not using the step-up circuit2, disconnect them.

Test Pin and Others				
Signals	I/O	Pin Number	Connected with	Description
TEST3-1	I	3	GND	Test pin input (Internal pull low)
OSC	I	1	Open	A test pin. Disconnect it.
TESTDP	I	1	Open	A test pin. Disconnect it.
VTEST	O	1	Open	A test pin. Disconnect it.
TVCOMHI	O	1	Open	A test pin. Disconnect it.
TS7~0	O	8	Open	A test pin. Disconnect it.
DUMMY	-	31	Open	Dummy pin. Disconnect it.

3.3 Pin Assignment

■ Chip Size : 23250 x 847 um (Include seal ring and scribe line)
■ Chip thickness : 250um ± 25um
■ Pad Location : PAD Center
■ Coordinate Origin : Chip Center
■ Au Bump Size :
1.80 um x 50um Input: No. 1 to 320
2. 120 um x 15 um Staggered LCD output side No. 321 to 1776
■ The chip size includes the core size, seal ring size and scribe line size.
■ Au bump pitch : Refer to Pad Coordinate.
■ Au bump height : 15 um ± 3 um.
■ Numbers in the figure corresponds to pad coordinate numbers.



3.4 Pad Coordinates

No.	Name	X	Y	Bump size
1	VPP	-11165	-309	50 * 80
2	VPP	-11095	-309	50 * 80
3	VSSD	-11025	-309	50 * 80
4	VSSD	-10955	-309	50 * 80
5	TESTDP	-10885	-309	50 * 80
6	DUMMY1	-10815	-309	50 * 80
7	DUMMY2	-10745	-309	50 * 80
8	CABC_ON	-10675	-309	50 * 80
9	CABC_PWM	-10605	-309	50 * 80
10	DUMMY3	-10535	-309	50 * 80
11	DUMMY4	-10465	-309	50 * 80
12	DUMMY5	-10395	-309	50 * 80
13	DUMMY6	-10325	-309	50 * 80
14	DUMMY7	-10255	-309	50 * 80
15	DUMMY8	-10185	-309	50 * 80
16	DUMMY9	-10115	-309	50 * 80
17	DUMMY10	-10045	-309	50 * 80
18	DUMMY11	-9975	-309	50 * 80
19	DUMMY12	-9905	-309	50 * 80
20	DUMMY13	-9835	-309	50 * 80
21	DUMMY14	-9765	-309	50 * 80
22	DUMMY15	-9695	-309	50 * 80
23	DUMMY16	-9625	-309	50 * 80
24	OSC	-9555	-309	50 * 80
25	TS7	-9485	-309	50 * 80
26	TS6	-9415	-309	50 * 80
27	TS5	-9345	-309	50 * 80
28	TS4	-9275	-309	50 * 80
29	TS3	-9205	-309	50 * 80
30	TS2	-9135	-309	50 * 80
31	TS1	-9065	-309	50 * 80
32	TS0	-8995	-309	50 * 80
33	SD	-8925	-309	50 * 80
34	CM	-8855	-309	50 * 80
35	IMO	-8785	-309	50 * 80
36	IM1	-8715	-309	50 * 80
37	IM2	-8645	-309	50 * 80
38	RESX	-8575	-309	50 * 80
39	VSYNC	-8505	-309	50 * 80
40	H SYNC	-8435	-309	50 * 80
41	PCLK	-8365	-309	50 * 80
42	DE	-8295	-309	50 * 80
43	DB17	-8225	-309	50 * 80
44	DB16	-8155	-309	50 * 80
45	DB15	-8085	-309	50 * 80
46	DB14	-8015	-309	50 * 80
47	DB13	-7945	-309	50 * 80
48	DB12	-7875	-309	50 * 80
49	DB11	-7805	-309	50 * 80
50	DB10	-7735	-309	50 * 80
51	DB9	-7665	-309	50 * 80
52	DB8	-7595	-309	50 * 80
53	DB7	-7525	-309	50 * 80
54	DB6	-7455	-309	50 * 80
55	DB5	-7385	-309	50 * 80
56	DB4	-7315	-309	50 * 80
57	DB3	-7245	-309	50 * 80
58	DB2	-7175	-309	50 * 80
59	DB1	-7105	-309	50 * 80
60	DB0	-7035	-309	50 * 80
61	DOUT	-6965	-309	50 * 80
62	DIN_SDA	-6895	-309	50 * 80
63	RDX	-6825	-309	50 * 80
64	WRX_SCL	-6755	-309	50 * 80
65	DCX	-6685	-309	50 * 80
66	CSX	-6615	-309	50 * 80
67	TE	-6545	-309	50 * 80
68	IOVCC	-6475	-309	50 * 80
69	IOVCC	-6405	-309	50 * 80
70	IOVCC	-6335	-309	50 * 80
71	IOVCC	-6265	-309	50 * 80
72	IOVCC	-6195	-309	50 * 80
73	IOVCC	-6125	-309	50 * 80
74	IOVCC	-6055	-309	50 * 80
75	VDDD	-5985	-309	50 * 80
76	VDDD	-5915	-309	50 * 80
77	VDDD	-5845	-309	50 * 80
78	VDDD	-5775	-309	50 * 80
79	VDDD	-5705	-309	50 * 80
80	VDDD	-5635	-309	50 * 80
81	VDDD	-5565	-309	50 * 80
82	VDDD	-5495	-309	50 * 80
83	VDDD	-5425	-309	50 * 80
84	VDDD	-5355	-309	50 * 80
85	VDDD	-5285	-309	50 * 80
86	VSSA	-5215	-309	50 * 80
87	VSSA	-5145	-309	50 * 80
88	VSSA	-5075	-309	50 * 80
89	VSSA	-5005	-309	50 * 80
90	VSSA	-4935	-309	50 * 80
91	VSSA	-4865	-309	50 * 80
92	VSSA	-4795	-309	50 * 80
93	VSSA	-4725	-309	50 * 80
94	VGS	-4655	-309	50 * 80
95	VGS	-4585	-309	50 * 80
96	TEST1	-4515	-309	50 * 80
97	VSSD	-4445	-309	50 * 80
98	VSSD	-4375	-309	50 * 80
99	VSSD	-4305	-309	50 * 80
100	VSSD	-4235	-309	50 * 80
101	VSSD	-4165	-309	50 * 80
102	VSSD	-4095	-309	50 * 80
103	VSSD	-4025	-309	50 * 80
104	VSSD	-3955	-309	50 * 80
105	VSSD	-3885	-309	50 * 80
106	VSSD	-3815	-309	50 * 80
107	VCOM	-3745	-309	50 * 80
108	VCOM	-3675	-309	50 * 80
109	VCOM	-3605	-309	50 * 80
110	VCOM	-3535	-309	50 * 80
111	VCOM	-3465	-309	50 * 80
112	VCOM	-3395	-309	50 * 80
113	VCOM	-3325	-309	50 * 80
114	VCOM	-3255	-309	50 * 80
115	VCOM	-3185	-309	50 * 80
116	VCOM	-3115	-309	50 * 80
117	VCOM	-3045	-309	50 * 80
118	VCOM	-2975	-309	50 * 80
119	VCOM	-2905	-309	50 * 80
120	VCOM	-2835	-309	50 * 80
121	VCOM	-2765	-309	50 * 80
122	VCOM	-2695	-309	50 * 80
123	VCOMH	-2625	-309	50 * 80
124	VCOMH	-2555	-309	50 * 80
125	VCOMH	-2485	-309	50 * 80
126	VCOMH	-2415	-309	50 * 80
127	VCOMH	-2345	-309	50 * 80
128	VCOMH	-2275	-309	50 * 80
129	VCOMH	-2205	-309	50 * 80
130	VCOMH	-2135	-309	50 * 80
131	VCOMH	-2065	-309	50 * 80
132	VCOMH	-1995	-309	50 * 80
133	VCOML	-1925	-309	50 * 80
134	VCOML	-1855	-309	50 * 80
135	VCOML	-1785	-309	50 * 80
136	VCOML	-1715	-309	50 * 80
137	VCOML	-1645	-309	50 * 80
138	VCOML	-1575	-309	50 * 80
139	VCOML	-1505	-309	50 * 80
140	VREG1OUT	-1435	-309	50 * 80
141	VREG2OUT	-1365	-309	50 * 80
142	VREG3OUT	-1295	-309	50 * 80
143	VREG4OUT	-1225	-309	50 * 80
144	TEST2	-1155	-309	50 * 80
145	VCL	-1085	-309	50 * 80
146	VCL	-1015	-309	50 * 80
147	VCL	-945	-309	50 * 80
148	VCL	-875	-309	50 * 80
149	VCL	-805	-309	50 * 80
150	VCL	-735	-309	50 * 80
151	VCL	-665	-309	50 * 80
152	VCL	-595	-309	50 * 80
153	VCL	-525	-309	50 * 80
154	DDVDH	-455	-309	50 * 80
155	DDVDH	-385	-309	50 * 80
156	DDVDH	-315	-309	50 * 80
157	DDVDH	-245	-309	50 * 80
158	DDVDH	-175	-309	50 * 80
159	DDVDH	-105	-309	50 * 80
160	DDVDH	-35	-309	50 * 80
161	DDVDH	35	-309	50 * 80
162	DDVDH	105	-309	50 * 80
163	VCI1	175	-309	50 * 80
164	VCI1	245	-309	50 * 80
165	VCI1	315	-309	50 * 80
166	VCI1	385	-309	50 * 80
167	VCI1	455	-309	50 * 80
168	VCI1	525	-309	50 * 80
169	VCI1	595	-309	50 * 80
170	VCI1	665	-309	50 * 80
171	VCI1	735	-309	50 * 80
172	VCI1	805	-309	50 * 80
173	VCI1	875	-309	50 * 80
174	VCI	945	-309	50 * 80
175	VCI	1015	-309	50 * 80
176	VCI	1085	-309	50 * 80
177	VCI	1155	-309	50 * 80
178	VCI	1225	-309	50 * 80
179	VCI	1295	-309	50 * 80
180	VCI	1365	-309	50 * 80

No.	Name	X	Y	Bump size	No.	Name	X	Y	Bump size	No.	Name	X	Y	Bump size	No.	Name	X	Y	Bump size
241	VGL	5635	-309	50 * 80	301	C22B	9835	-309	50 * 80	361	G77	10605	124	15 * 120	421	G197	9705	124	15 * 120
242	VGL	5705	-309	50 * 80	302	C22B	9905	-309	50 * 80	362	G79	10590	269	15 * 120	422	G199	9690	269	15 * 120
243	VGL	5775	-309	50 * 80	303	C22B	9975	-309	50 * 80	363	G81	10575	124	15 * 120	423	G201	9675	124	15 * 120
244	VGL	5845	-309	50 * 80	304	C22B	10045	-309	50 * 80	364	G83	10560	269	15 * 120	424	G203	9660	269	15 * 120
245	VGL	5915	-309	50 * 80	305	C22B	10115	-309	50 * 80	365	G85	10545	124	15 * 120	425	G205	9645	124	15 * 120
246	VSSD	5985	-309	50 * 80	306	C22B	10185	-309	50 * 80	366	G87	10530	269	15 * 120	426	G207	9630	269	15 * 120
247	VSSD	6055	-309	50 * 80	307	C22B	10255	-309	50 * 80	367	G89	10515	124	15 * 120	427	G209	9615	124	15 * 120
248	VSSD	6125	-309	50 * 80	308	C22A	10325	-309	50 * 80	368	G91	10500	269	15 * 120	428	G211	9600	269	15 * 120
249	VGH	6195	-309	50 * 80	309	C22A	10395	-309	50 * 80	369	G93	10485	124	15 * 120	429	G213	9585	124	15 * 120
250	VGH	6265	-309	50 * 80	310	C22A	10465	-309	50 * 80	370	G95	10470	269	15 * 120	430	G215	9570	269	15 * 120
251	VGH	6335	-309	50 * 80	311	C22A	10535	-309	50 * 80	371	G97	10455	124	15 * 120	431	G217	9555	124	15 * 120
252	VGH	6405	-309	50 * 80	312	C22A	10605	-309	50 * 80	372	G99	10440	269	15 * 120	432	G219	9540	269	15 * 120
253	VGH	6475	-309	50 * 80	313	C22A	10675	-309	50 * 80	373	G101	10425	124	15 * 120	433	G221	9525	124	15 * 120
254	VGH	6545	-309	50 * 80	314	C22A	10745	-309	50 * 80	374	G103	10410	269	15 * 120	434	G223	9510	269	15 * 120
255	VGH	6615	-309	50 * 80	315	C22A	10815	-309	50 * 80	375	G105	10395	124	15 * 120	435	G225	9495	124	15 * 120
256	VGH	6685	-309	50 * 80	316	C22A	10885	-309	50 * 80	376	G107	10380	269	15 * 120	436	G227	9480	269	15 * 120
257	C12B	6755	-309	50 * 80	317	C22A	10955	-309	50 * 80	377	G109	10365	124	15 * 120	437	G229	9465	124	15 * 120
258	C12B	6825	-309	50 * 80	318	C22A	11025	-309	50 * 80	378	G111	10350	269	15 * 120	438	G231	9450	269	15 * 120
259	C12B	6895	-309	50 * 80	319	C22A	11095	-309	50 * 80	379	G113	10335	124	15 * 120	439	G233	9435	124	15 * 120
260	C12B	6965	-309	50 * 80	320	C22A	11165	-309	50 * 80	380	G115	10320	269	15 * 120	440	G235	9420	269	15 * 120
261	C12B	7035	-309	50 * 80	321	DUMMY17	11205	124	15 * 120	381	G117	10305	124	15 * 120	441	G237	9405	124	15 * 120
262	C12B	7105	-309	50 * 80	322	DUMMY18	11190	269	15 * 120	382	G119	10290	269	15 * 120	442	G239	9390	269	15 * 120
263	C12A	7175	-309	50 * 80	323	G1	11175	124	15 * 120	383	G121	10275	124	15 * 120	443	G241	9375	124	15 * 120
264	C12A	7245	-309	50 * 80	324	G3	11160	269	15 * 120	384	G123	10260	269	15 * 120	444	G243	9360	269	15 * 120
265	C12A	7315	-309	50 * 80	325	G5	11145	124	15 * 120	385	G125	10245	124	15 * 120	445	G245	9345	124	15 * 120
266	C12A	7385	-309	50 * 80	326	G7	11130	269	15 * 120	386	G127	10230	269	15 * 120	446	G247	9330	269	15 * 120
267	C12A	7455	-309	50 * 80	327	G9	11115	124	15 * 120	387	G129	10215	124	15 * 120	447	G249	9315	124	15 * 120
268	C12A	7525	-309	50 * 80	328	G11	11100	269	15 * 120	388	G131	10200	269	15 * 120	448	G251	9300	269	15 * 120
269	C21B	7595	-309	50 * 80	329	G13	11085	124	15 * 120	389	G133	10185	124	15 * 120	449	G253	9285	124	15 * 120
270	C21B	7665	-309	50 * 80	330	G15	11070	269	15 * 120	390	G135	10170	269	15 * 120	450	G255	9270	269	15 * 120
271	C21B	7735	-309	50 * 80	331	G17	11055	124	15 * 120	391	G137	10155	124	15 * 120	451	G257	9255	124	15 * 120
272	C21B	7805	-309	50 * 80	332	G19	11040	269	15 * 120	392	G139	10140	269	15 * 120	452	G259	9240	269	15 * 120
273	C21B	7875	-309	50 * 80	333	G21	11025	124	15 * 120	393	G141	10125	124	15 * 120	453	G261	9225	124	15 * 120
274	C21B	7945	-309	50 * 80	334	G23	11010	269	15 * 120	394	G143	10110	269	15 * 120	454	G263	9210	269	15 * 120
275	C21B	8015	-309	50 * 80	335	G25	10995	124	15 * 120	395	G145	10095	124	15 * 120	455	G265	9195	124	15 * 120
276	C21B	8085	-309	50 * 80	336	G27	10980	269	15 * 120	396	G147	10080	269	15 * 120	456	G267	9180	269	15 * 120
277	C21B	8155	-309	50 * 80	337	G29	10965	124	15 * 120	397	G149	10065	124	15 * 120	457	G269	9165	124	15 * 120
278	C21B	8225	-309	50 * 80	338	G31	10950	269	15 * 120	398	G151	10050	269	15 * 120	458	G271	9150	269	15 * 120
279	C21B	8295	-309	50 * 80	339	G33	10935	124	15 * 120	399	G153	10035	124	15 * 120	459	G273	9135	124	15 * 120
280	C21B	8365	-309	50 * 80	340	G35	10920	269	15 * 120	400	G155	10020	269	15 * 120	460	G275	9120	269	15 * 120
281	C21B	8435	-309	50 * 80	341	G37	10905	124	15 * 120	401	G157	10005	124	15 * 120	461	G277	9105	124	15 * 120
282	C21B	8505	-309	50 * 80	342	G39	10890	269	15 * 120	402	G159	9990	269	15 * 120	462	G279	9090	269	15 * 120
283	C21A	8575	-309	50 * 80	343	G41	10875	124	15 * 120	403	G161	9975	124	15 * 120	463	G281	9075	124	15 * 120
284	C21A	8645	-309	50 * 80	344	G43	10860	269	15 * 120	404	G163	9960	269	15 * 120	464	G283	9060	269	15 * 120
285	C21A	8715	-309	50 * 80	345	G45	10845	124	15 * 120	405	G165	9945	124	15 * 120	465	G285	9045	124	15 * 120
286	C21A	8785	-309	50 * 80	346	G47	10830	269	15 * 120	406	G167	9930	269	15 * 120	466	G287	9030	269	15 * 120
287	C21A	8855	-309	50 * 80	347	G49	10815	124	15 * 120	407	G169	9915	124	15 * 120	467	G289	9015	124	15 * 120
288	C21A	8925	-309	50 * 80	348	G51	10800	269	15 * 120	408	G171	9900	269	15 * 120	468	G291	9000	269	15 * 120
289	C21A	8995	-309	50 * 80	349	G53	10785	124	15 * 120	409	G173	9885	124	15 * 120	469	G293	8985	124	15 * 120
290	C21A	9065	-309	50 * 80	350	G55	10770	269	15 * 120	410	G175	9870	269	15 * 120	470	G295	8970	269	15 * 120
291	C21A	9135	-309	50 * 80	351	G57	10755	124	15 * 120	411	G177	9855	124	15 * 120	471	G297	8955	124	15 * 120
292	C21A	9205	-309	50 * 80	352	G59	10740	269	15 * 120	412	G179	9840	269	15 * 120	472	G299	8940	269	15 * 120
293	C21A	9275	-309	50 * 80	353	G61	10725	124	15 * 120	413	G181	9825	124	15 * 120	473	G301	8925	124	15 * 120
294	C21A	9345	-309	50 * 80	354	G63	10710	269	15 * 120	414	G183	9810	269	15 * 120	474	G303	8910	269	15 * 120
295	C21A	9415	-309	50 * 80	355	G65	10695	124	15 * 120	415	G185	9795	124	15 * 120	475	G305	8895	124	15 * 120
296	C22B	9485	-309	50 * 80	356	G67	10680	269	15 * 120	416	G187	9780	269	15 * 120	476	G307	8880	269	15 * 120
297	C22B	9555	-309	50 * 80	357	G69	10665	124	15 * 120	417	G189	9765	124	15 * 120	477	G309	8865	124	15 * 120
298	C22B	9625	-309	50 * 80	358	G71	10650	269	15 * 120	418	G191								

No.	Name	X	Y	Bump size
481	G317	8805	124	15 * 120
482	G319	8790	269	15 * 120
483	G321	8775	124	15 * 120
484	G323	8760	269	15 * 120
485	G325	8745	124	15 * 120
486	G327	8730	269	15 * 120
487	G329	8715	124	15 * 120
488	G331	8700	269	15 * 120
489	G333	8685	124	15 * 120
490	G335	8670	269	15 * 120
491	G337	8655	124	15 * 120
492	G339	8640	269	15 * 120
493	G341	8625	124	15 * 120
494	G343	8610	269	15 * 120
495	G345	8595	124	15 * 120
496	G347	8580	269	15 * 120
497	G349	8565	124	15 * 120
498	G351	8550	269	15 * 120
499	G353	8535	124	15 * 120
500	G355	8520	269	15 * 120
501	G357	8505	124	15 * 120
502	G359	8490	269	15 * 120
503	G361	8475	124	15 * 120
504	G363	8460	269	15 * 120
505	G365	8445	124	15 * 120
506	G367	8430	269	15 * 120
507	G369	8415	124	15 * 120
508	G371	8400	269	15 * 120
509	G373	8385	124	15 * 120
510	G375	8370	269	15 * 120
511	G377	8355	124	15 * 120
512	G379	8340	269	15 * 120
513	G381	8325	124	15 * 120
514	G383	8310	269	15 * 120
515	G385	8295	124	15 * 120
516	G387	8280	269	15 * 120
517	G389	8265	124	15 * 120
518	G391	8250	269	15 * 120
519	G393	8235	124	15 * 120
520	G395	8220	269	15 * 120
521	G397	8205	124	15 * 120
522	G399	8190	269	15 * 120
523	G401	8175	124	15 * 120
524	G403	8160	269	15 * 120
525	G405	8145	124	15 * 120
526	G407	8130	269	15 * 120
527	G409	8115	124	15 * 120
528	G411	8100	269	15 * 120
529	G413	8085	124	15 * 120
530	G415	8070	269	15 * 120
531	G417	8055	124	15 * 120
532	G419	8040	269	15 * 120
533	G421	8025	124	15 * 120
534	G423	8010	269	15 * 120
535	G425	7995	124	15 * 120
536	G427	7980	269	15 * 120
537	G429	7965	124	15 * 120
538	G431	7950	269	15 * 120
539	G433	7935	124	15 * 120
540	G435	7920	269	15 * 120

No.	Name	X	Y	Bump size
541	G437	7905	124	15 * 120
542	G439	7890	269	15 * 120
543	G441	7875	124	15 * 120
544	G443	7860	269	15 * 120
545	G445	7845	124	15 * 120
546	G447	7830	269	15 * 120
547	G449	7815	124	15 * 120
548	G451	7800	269	15 * 120
549	G453	7785	124	15 * 120
550	G455	7770	269	15 * 120
551	G457	7755	124	15 * 120
552	G459	7740	269	15 * 120
553	G461	7725	124	15 * 120
554	G463	7710	269	15 * 120
555	G465	7695	124	15 * 120
556	G467	7680	269	15 * 120
557	G469	7665	124	15 * 120
558	G471	7650	269	15 * 120
559	G473	7635	124	15 * 120
560	G475	7620	269	15 * 120
561	G477	7605	124	15 * 120
562	G479	7590	269	15 * 120
563	DUMMY19	7575	124	15 * 120
564	DUMMY20	7560	269	15 * 120
565	DUMMY21	7395	124	15 * 120
566	DUMMY22	7380	269	15 * 120
567	S960	7365	124	15 * 120
568	S959	7350	269	15 * 120
569	S958	7335	124	15 * 120
570	S957	7320	269	15 * 120
571	S956	7305	124	15 * 120
572	S955	7290	269	15 * 120
573	S954	7275	124	15 * 120
574	S953	7260	269	15 * 120
575	S952	7245	124	15 * 120
576	S951	7230	269	15 * 120
577	S950	7215	124	15 * 120
578	S949	7200	269	15 * 120
579	S948	7185	124	15 * 120
580	S947	7170	269	15 * 120
581	S946	7155	124	15 * 120
582	S945	7140	269	15 * 120
583	S944	7125	124	15 * 120
584	S943	7110	269	15 * 120
585	S942	7095	124	15 * 120
586	S941	7080	269	15 * 120
587	S940	7065	124	15 * 120
588	S939	7050	269	15 * 120
589	S938	7035	124	15 * 120
590	S937	7020	269	15 * 120
591	S936	7005	124	15 * 120
592	S935	6990	269	15 * 120
593	S934	6975	124	15 * 120
594	S933	6960	269	15 * 120
595	S932	6945	124	15 * 120
596	S931	6930	269	15 * 120
597	S930	6915	124	15 * 120
598	S929	6900	269	15 * 120
599	S928	6885	124	15 * 120
600	S927	6870	269	15 * 120

No.	Name	X	Y	Bump size
601	S926	6855	124	15 * 120
602	S925	6840	269	15 * 120
603	S924	6825	124	15 * 120
604	S923	6810	269	15 * 120
605	S922	6795	124	15 * 120
606	S921	6780	269	15 * 120
607	S920	6765	124	15 * 120
608	S919	6750	269	15 * 120
609	S918	6735	124	15 * 120
610	S917	6720	269	15 * 120
611	S916	6705	124	15 * 120
612	S915	6690	269	15 * 120
613	S914	6675	124	15 * 120
614	S913	6660	269	15 * 120
615	S912	6645	124	15 * 120
616	S911	6630	269	15 * 120
617	S910	6615	124	15 * 120
618	S909	6600	269	15 * 120
619	S908	6585	124	15 * 120
620	S907	6570	269	15 * 120
621	S906	6555	124	15 * 120
622	S905	6540	269	15 * 120
623	S904	6525	124	15 * 120
624	S903	6510	269	15 * 120
625	S902	6495	124	15 * 120
626	S901	6480	269	15 * 120
627	S900	6465	124	15 * 120
628	S899	6450	269	15 * 120
629	S898	6435	124	15 * 120
630	S897	6420	269	15 * 120
631	S896	6405	124	15 * 120
632	S895	6390	269	15 * 120
633	S894	6375	124	15 * 120
634	S893	6360	269	15 * 120
635	S892	6345	124	15 * 120
636	S891	6330	269	15 * 120
637	S890	6315	124	15 * 120
638	S889	6300	269	15 * 120
639	S888	6285	124	15 * 120
640	S887	6270	269	15 * 120
641	S886	6255	124	15 * 120
642	S885	6240	269	15 * 120
643	S884	6225	124	15 * 120
644	S883	6210	269	15 * 120
645	S882	6195	124	15 * 120
646	S881	6180	269	15 * 120
647	S880	6165	124	15 * 120
648	S879	6150	269	15 * 120
649	S878	6135	124	15 * 120
650	S877	6120	269	15 * 120
651	S876	6105	124	15 * 120
652	S875	6090	269	15 * 120
653	S874	6075	124	15 * 120
654	S873	6060	269	15 * 120
655	S872	6045	124	15 * 120
656	S871	6030	269	15 * 120
657	S870	6015	124	15 * 120
658	S869	6000	269	15 * 120
659	S868	5985	124	15 * 120
660	S867	5970	269	15 * 120

No.	Name	X	Y	Bump size
661	S866	5955	124	15 * 120
662	S865	5940	269	15 * 120
663	S864	5925	124	15 * 120
664	S863	5910	269	15 * 120
665	S862	5895	124	15 * 120
666	S861	5880	269	15 * 120
667	S860	5865	124	15 * 120
668	S859	5850	269	15 * 120
669	S858	5835	124	15 * 120
670	S857	5820	269	15 * 120
671	S856	5805	124	15 * 120
672	S855	5790	269	15 * 120
673	S854	5775	124	15 * 120
674	S853	5760	269	15 * 120
675	S852	5745	124	15 * 120
676	S851	5730	269	15 * 120
677	S850	5715	124	15 * 120
678	S849	5700	269	15 * 120
679	S848	5685	124	15 * 120
680	S847	5670	269	15 * 120
681	S846	5655	12	

No.	Name	X	Y	Bump size
721	S806	5055	124	15 * 120
722	S805	5040	269	15 * 120
723	S804	5025	124	15 * 120
724	S803	5010	269	15 * 120
725	S802	4995	124	15 * 120
726	S801	4980	269	15 * 120
727	S800	4965	124	15 * 120
728	S799	4950	269	15 * 120
729	S798	4935	124	15 * 120
730	S797	4920	269	15 * 120
731	S796	4905	124	15 * 120
732	S795	4890	269	15 * 120
733	S794	4875	124	15 * 120
734	S793	4860	269	15 * 120
735	S792	4845	124	15 * 120
736	S791	4830	269	15 * 120
737	S790	4815	124	15 * 120
738	S789	4800	269	15 * 120
739	S788	4785	124	15 * 120
740	S787	4770	269	15 * 120
741	S786	4755	124	15 * 120
742	S785	4740	269	15 * 120
743	S784	4725	124	15 * 120
744	S783	4710	269	15 * 120
745	S782	4695	124	15 * 120
746	S781	4680	269	15 * 120
747	S780	4665	124	15 * 120
748	S779	4650	269	15 * 120
749	S778	4635	124	15 * 120
750	S777	4620	269	15 * 120
751	S776	4605	124	15 * 120
752	S775	4590	269	15 * 120
753	S774	4575	124	15 * 120
754	S773	4560	269	15 * 120
755	S772	4545	124	15 * 120
756	S771	4530	269	15 * 120
757	S770	4515	124	15 * 120
758	S769	4500	269	15 * 120
759	S768	4485	124	15 * 120
760	S767	4470	269	15 * 120
761	S766	4455	124	15 * 120
762	S765	4440	269	15 * 120
763	S764	4425	124	15 * 120
764	S763	4410	269	15 * 120
765	S762	4395	124	15 * 120
766	S761	4380	269	15 * 120
767	S760	4365	124	15 * 120
768	S759	4350	269	15 * 120
769	S758	4335	124	15 * 120
770	S757	4320	269	15 * 120
771	S756	4305	124	15 * 120
772	S755	4290	269	15 * 120
773	S754	4275	124	15 * 120
774	S753	4260	269	15 * 120
775	S752	4245	124	15 * 120
776	S751	4230	269	15 * 120
777	S750	4215	124	15 * 120
778	S749	4200	269	15 * 120
779	S748	4185	124	15 * 120
780	S747	4170	269	15 * 120

No.	Name	X	Y	Bump size
781	S746	4155	124	15 * 120
782	S745	4140	269	15 * 120
783	S744	4125	124	15 * 120
784	S743	4110	269	15 * 120
785	S742	4095	124	15 * 120
786	S741	4080	269	15 * 120
787	S740	4065	124	15 * 120
788	S739	4050	269	15 * 120
789	S738	4035	124	15 * 120
790	S737	4020	269	15 * 120
791	S736	4005	124	15 * 120
792	S735	3990	269	15 * 120
793	S734	3975	124	15 * 120
794	S733	3960	269	15 * 120
795	S732	3945	124	15 * 120
796	S731	3930	269	15 * 120
797	S730	3915	124	15 * 120
798	S729	3900	269	15 * 120
799	S728	3885	124	15 * 120
800	S727	3870	269	15 * 120
801	S726	3855	124	15 * 120
802	S725	3840	269	15 * 120
803	S724	3825	124	15 * 120
804	S723	3810	269	15 * 120
805	S722	3795	124	15 * 120
806	S721	3780	269	15 * 120
807	S720	3765	124	15 * 120
808	S719	3750	269	15 * 120
809	S718	3735	124	15 * 120
810	S717	3720	269	15 * 120
811	S716	3705	124	15 * 120
812	S715	3690	269	15 * 120
813	S714	3675	124	15 * 120
814	S713	3660	269	15 * 120
815	S712	3645	124	15 * 120
816	S711	3630	269	15 * 120
817	S710	3615	124	15 * 120
818	S709	3600	269	15 * 120
819	S708	3585	124	15 * 120
820	S707	3570	269	15 * 120
821	S706	3555	124	15 * 120
822	S705	3540	269	15 * 120
823	S704	3525	124	15 * 120
824	S703	3510	269	15 * 120
825	S702	3495	124	15 * 120
826	S701	3480	269	15 * 120
827	S700	3465	124	15 * 120
828	S699	3450	269	15 * 120
829	S698	3435	124	15 * 120
830	S697	3420	269	15 * 120
831	S696	3405	124	15 * 120
832	S695	3390	269	15 * 120
833	S694	3375	124	15 * 120
834	S693	3360	269	15 * 120
835	S692	3345	124	15 * 120
836	S691	3330	269	15 * 120
837	S690	3315	124	15 * 120
838	S689	3300	269	15 * 120
839	S688	3285	124	15 * 120
840	S687	3270	269	15 * 120

No.	Name	X	Y	Bump size
841	S686	3255	124	15 * 120
842	S685	3240	269	15 * 120
843	S684	3225	124	15 * 120
844	S683	3210	269	15 * 120
845	S682	3195	124	15 * 120
846	S681	3180	269	15 * 120
847	S680	3165	124	15 * 120
848	S679	3150	269	15 * 120
849	S678	3135	124	15 * 120
850	S677	3120	269	15 * 120
851	S676	3105	124	15 * 120
852	S675	3090	269	15 * 120
853	S674	3075	124	15 * 120
854	S673	3060	269	15 * 120
855	S672	3045	124	15 * 120
856	S671	3030	269	15 * 120
857	S670	3015	124	15 * 120
858	S669	3000	269	15 * 120
859	S668	2985	124	15 * 120
860	S667	2970	269	15 * 120
861	S666	2955	124	15 * 120
862	S665	2940	269	15 * 120
863	S664	2925	124	15 * 120
864	S663	2910	269	15 * 120
865	S662	2895	124	15 * 120
866	S661	2880	269	15 * 120
867	S660	2865	124	15 * 120
868	S659	2850	269	15 * 120
869	S658	2835	124	15 * 120
870	S657	2820	269	15 * 120
871	S656	2805	124	15 * 120
872	S655	2790	269	15 * 120
873	S654	2775	124	15 * 120
874	S653	2760	269	15 * 120
875	S652	2745	124	15 * 120
876	S651	2730	269	15 * 120
877	S650	2715	124	15 * 120
878	S649	2700	269	15 * 120
879	S648	2685	124	15 * 120
880	S647	2670	269	15 * 120
881	S646	2655	124	15 * 120
882	S645	2640	269	15 * 120
883	S644	2625	124	15 * 120
884	S643	2610	269	15 * 120
885	S642	2595	124	15 * 120
886	S641	2580	269	15 * 120
887	S640	2565	124	15 * 120
888	S639	2550	269	15 * 120
889	S638	2535	124	15 * 120
890	S637	2520	269	15 * 120
891	S636	2505	124	15 * 120
892	S635	2490	269	15 * 120
893	S634	2475	124	15 * 120
894	S633	2460	269	15 * 120
895	S632	2445	124	15 * 120
896	S631	2430	269	15 * 120
897	S630	2415	124	15 * 120
898	S629	2400	269	15 * 120
899	S628	2385	124	15 * 120
900	S627	2370	269	15 * 120

No.	Name	X	Y	Bump size
901	S626	2355	124	15 * 120
902	S625	2340	269	15 * 120
903	S624	2325	124	15 * 120
904	S623	2310	269	15 * 120
905	S622	2295	124	15 * 120
906	S621	2280	269	15 * 120
907	S620	2265	124	15 * 120
908	S619	2250	269	15 * 120
909	S618	2235	124	15 * 120
910	S617	2220	269	15 * 120
911	S616	2205	124	15 * 120
912	S615	2190	269	15 * 120
913	S614	2175	124	15 * 120
914	S613	2160	269	15 * 120
915	S612	2145	124	15 * 120
916	S611	2130	269	15 * 120
917	S610	2115	124	15 * 120
918	S609	2100	269	15 * 120
919	S608	2085	124	15 * 120
920	S607	2070	269	15 * 120
921	S606	2055		

No.	Name	X	Y	Bump size	No.	Name	X	Y	Bump size	No.	Name	X	Y	Bump size
961	S566	1455	124	15 * 120	1021	S506	555	124	15 * 120	1081	S450	-630	269	15 * 120
962	S565	1440	269	15 * 120	1022	S505	540	269	15 * 120	1082	S449	-645	124	15 * 120
963	S564	1425	124	15 * 120	1023	S504	525	124	15 * 120	1083	S448	-660	269	15 * 120
964	S563	1410	269	15 * 120	1024	S503	510	269	15 * 120	1084	S447	-675	124	15 * 120
965	S562	1395	124	15 * 120	1025	S502	495	124	15 * 120	1085	S446	-690	269	15 * 120
966	S561	1380	269	15 * 120	1026	S501	480	269	15 * 120	1086	S445	-705	124	15 * 120
967	S560	1365	124	15 * 120	1027	S500	465	124	15 * 120	1087	S444	-720	269	15 * 120
968	S559	1350	269	15 * 120	1028	S499	450	269	15 * 120	1088	S443	-735	124	15 * 120
969	S558	1335	124	15 * 120	1029	S498	435	124	15 * 120	1089	S442	-750	269	15 * 120
970	S557	1320	269	15 * 120	1030	S497	420	269	15 * 120	1090	S441	-765	124	15 * 120
971	S556	1305	124	15 * 120	1031	S496	405	124	15 * 120	1091	S440	-780	269	15 * 120
972	S555	1290	269	15 * 120	1032	S495	390	269	15 * 120	1092	S439	-795	124	15 * 120
973	S554	1275	124	15 * 120	1033	S494	375	124	15 * 120	1093	S438	-810	269	15 * 120
974	S553	1260	269	15 * 120	1034	S493	360	269	15 * 120	1094	S437	-825	124	15 * 120
975	S552	1245	124	15 * 120	1035	S492	345	124	15 * 120	1095	S436	-840	269	15 * 120
976	S551	1230	269	15 * 120	1036	S491	330	269	15 * 120	1096	S435	-855	124	15 * 120
977	S550	1215	124	15 * 120	1037	S490	315	124	15 * 120	1097	S434	-870	269	15 * 120
978	S549	1200	269	15 * 120	1038	S489	300	269	15 * 120	1098	S433	-885	124	15 * 120
979	S548	1185	124	15 * 120	1039	S488	285	124	15 * 120	1099	S432	-900	269	15 * 120
980	S547	1170	269	15 * 120	1040	S487	270	269	15 * 120	1100	S431	-915	124	15 * 120
981	S546	1155	124	15 * 120	1041	S486	255	124	15 * 120	1101	S430	-930	269	15 * 120
982	S545	1140	269	15 * 120	1042	S485	240	269	15 * 120	1102	S429	-945	124	15 * 120
983	S544	1125	124	15 * 120	1043	S484	225	124	15 * 120	1103	S428	-960	269	15 * 120
984	S543	1110	269	15 * 120	1044	S483	210	269	15 * 120	1104	S427	-975	124	15 * 120
985	S542	1095	124	15 * 120	1045	S482	195	124	15 * 120	1105	S426	-990	269	15 * 120
986	S541	1080	269	15 * 120	1046	S481	180	269	15 * 120	1106	S425	-1005	124	15 * 120
987	S540	1065	124	15 * 120	1047	VTEST	165	124	15 * 120	1107	S424	-1020	269	15 * 120
988	S539	1050	269	15 * 120	1048	DUMMY23	150	269	15 * 120	1108	S423	-1035	124	15 * 120
989	S538	1035	124	15 * 120	1049	DUMMY24	-150	269	15 * 120	1109	S422	-1050	269	15 * 120
990	S537	1020	269	15 * 120	1050	TCOMH1	-165	124	15 * 120	1110	S421	-1065	124	15 * 120
991	S536	1005	124	15 * 120	1051	S480	-180	269	15 * 120	1111	S420	-1080	269	15 * 120
992	S535	990	269	15 * 120	1052	S479	-195	124	15 * 120	1112	S419	-1095	124	15 * 120
993	S534	975	124	15 * 120	1053	S478	-210	269	15 * 120	1113	S418	-1110	269	15 * 120
994	S533	960	269	15 * 120	1054	S477	-225	124	15 * 120	1114	S417	-1125	124	15 * 120
995	S532	945	124	15 * 120	1055	S476	-240	269	15 * 120	1115	S416	-1140	269	15 * 120
996	S531	930	269	15 * 120	1056	S475	-255	124	15 * 120	1116	S415	-1155	124	15 * 120
997	S530	915	124	15 * 120	1057	S474	-270	269	15 * 120	1117	S414	-1170	269	15 * 120
998	S529	900	269	15 * 120	1058	S473	-285	124	15 * 120	1118	S413	-1185	124	15 * 120
999	S528	885	124	15 * 120	1059	S472	-300	269	15 * 120	1119	S412	-1200	269	15 * 120
1000	S527	870	269	15 * 120	1060	S471	-315	124	15 * 120	1120	S411	-1215	124	15 * 120
1001	S526	855	124	15 * 120	1061	S470	-330	269	15 * 120	1121	S410	-1230	269	15 * 120
1002	S525	840	269	15 * 120	1062	S469	-345	124	15 * 120	1122	S409	-1245	124	15 * 120
1003	S524	825	124	15 * 120	1063	S468	-360	269	15 * 120	1123	S408	-1260	269	15 * 120
1004	S523	810	269	15 * 120	1064	S467	-375	124	15 * 120	1124	S407	-1275	124	15 * 120
1005	S522	795	124	15 * 120	1065	S466	-390	269	15 * 120	1125	S406	-1290	269	15 * 120
1006	S521	780	269	15 * 120	1066	S465	-405	124	15 * 120	1126	S405	-1305	124	15 * 120
1007	S520	765	124	15 * 120	1067	S464	-420	269	15 * 120	1127	S404	-1320	269	15 * 120
1008	S519	750	269	15 * 120	1068	S463	-435	124	15 * 120	1128	S403	-1335	124	15 * 120
1009	S518	735	124	15 * 120	1069	S462	-450	269	15 * 120	1129	S402	-1350	269	15 * 120
1010	S517	720	269	15 * 120	1070	S461	-465	124	15 * 120	1130	S401	-1365	124	15 * 120
1011	S516	705	124	15 * 120	1071	S460	-480	269	15 * 120	1131	S400	-1380	269	15 * 120
1012	S515	690	269	15 * 120	1072	S459	-495	124	15 * 120	1132	S399	-1395	124	15 * 120
1013	S514	675	124	15 * 120	1073	S458	-510	269	15 * 120	1133	S398	-1410	269	15 * 120
1014	S513	660	269	15 * 120	1074	S457	-525	124	15 * 120	1134	S397	-1425	124	15 * 120
1015	S512	645	124	15 * 120	1075	S456	-540	269	15 * 120	1135	S396	-1440	269	15 * 120
1016	S511	630	269	15 * 120	1076	S455	-555	124	15 * 120	1136	S395	-1455	124	15 * 120
1017	S510	615	124	15 * 120	1077	S454	-570	269	15 * 120	1137	S394	-1470	269	15 * 120
1018	S509	600	269	15 * 120	1078	S453	-585	124	15 * 120	1138	S393	-1485	124	15 * 120
1019	S508	585	124	15 * 120	1079	S452	-600	269	15 * 120	1139	S392	-1500	269	15 * 120
1020	S507	570	269	15 * 120	1080	S451	-615	124	15 * 120	1140	S391	-1515	124	15 * 120

No.	Name	X	Y	Bump size
1201	S330	-2430	269	15 * 120
1202	S329	-2445	124	15 * 120
1203	S328	-2460	269	15 * 120
1204	S327	-2475	124	15 * 120
1205	S326	-2490	269	15 * 120
1206	S325	-2505	124	15 * 120
1207	S324	-2520	269	15 * 120
1208	S323	-2535	124	15 * 120
1209	S322	-2550	269	15 * 120
1210	S321	-2565	124	15 * 120
1211	S320	-2580	269	15 * 120
1212	S319	-2595	124	15 * 120
1213	S318	-2610	269	15 * 120
1214	S317	-2625	124	15 * 120
1215	S316	-2640	269	15 * 120
1216	S315	-2655	124	15 * 120
1217	S314	-2670	269	15 * 120
1218	S313	-2685	124	15 * 120
1219	S312	-2700	269	15 * 120
1220	S311	-2715	124	15 * 120
1221	S310	-2730	269	15 * 120
1222	S309	-2745	124	15 * 120
1223	S308	-2760	269	15 * 120
1224	S307	-2775	124	15 * 120
1225	S306	-2790	269	15 * 120
1226	S305	-2805	124	15 * 120
1227	S304	-2820	269	15 * 120
1228	S303	-2835	124	15 * 120
1229	S302	-2850	269	15 * 120
1230	S301	-2865	124	15 * 120
1231	S300	-2880	269	15 * 120
1232	S299	-2895	124	15 * 120
1233	S298	-2910	269	15 * 120
1234	S297	-2925	124	15 * 120
1235	S296	-2940	269	15 * 120
1236	S295	-2955	124	15 * 120
1237	S294	-2970	269	15 * 120
1238	S293	-2985	124	15 * 120
1239	S292	-3000	269	15 * 120
1240	S291	-3015	124	15 * 120
1241	S290	-3030	269	15 * 120
1242	S289	-3045	124	15 * 120
1243	S288	-3060	269	15 * 120
1244	S287	-3075	124	15 * 120
1245	S286	-3090	269	15 * 120
1246	S285	-3105	124	15 * 120
1247	S284	-3120	269	15 * 120
1248	S283	-3135	124	15 * 120
1249	S282	-3150	269	15 * 120
1250	S281	-3165	124	15 * 120
1251	S280	-3180	269	15 * 120
1252	S279	-3195	124	15 * 120
1253	S278	-3210	269	15 * 120
1254	S277	-3225	124	15 * 120
1255	S276	-3240	269	15 * 120
1256	S275	-3255	124	15 * 120
1257	S274	-3270	269	15 * 120
1258	S273	-3285	124	15 * 120
1259	S272	-3300	269	15 * 120
1260	S271	-3315	124	15 * 120

No.	Name	X	Y	Bump size
1261	S270	-3330	269	15 * 120
1262	S269	-3345	124	15 * 120
1263	S268	-3360	269	15 * 120
1264	S267	-3375	124	15 * 120
1265	S266	-3390	269	15 * 120
1266	S265	-3405	124	15 * 120
1267	S264	-3420	269	15 * 120
1268	S263	-3435	124	15 * 120
1269	S262	-3450	269	15 * 120
1270	S261	-3465	124	15 * 120
1271	S260	-3480	269	15 * 120
1272	S259	-3495	124	15 * 120
1273	S258	-3510	269	15 * 120
1274	S257	-3525	124	15 * 120
1275	S256	-3540	269	15 * 120
1276	S255	-3555	124	15 * 120
1277	S254	-3570	269	15 * 120
1278	S253	-3585	124	15 * 120
1279	S252	-3600	269	15 * 120
1280	S251	-3615	124	15 * 120
1281	S250	-3630	269	15 * 120
1282	S249	-3645	124	15 * 120
1283	S248	-3660	269	15 * 120
1284	S247	-3675	124	15 * 120
1285	S246	-3690	269	15 * 120
1286	S245	-3705	124	15 * 120
1287	S244	-3720	269	15 * 120
1288	S243	-3735	124	15 * 120
1289	S242	-3750	269	15 * 120
1290	S241	-3765	124	15 * 120
1291	S240	-3780	269	15 * 120
1292	S239	-3795	124	15 * 120
1293	S238	-3810	269	15 * 120
1294	S237	-3825	124	15 * 120
1295	S236	-3840	269	15 * 120
1296	S235	-3855	124	15 * 120
1297	S234	-3870	269	15 * 120
1298	S233	-3885	124	15 * 120
1299	S232	-3900	269	15 * 120
1300	S231	-3915	124	15 * 120
1301	S230	-3930	269	15 * 120
1302	S229	-3945	124	15 * 120
1303	S228	-3960	269	15 * 120
1304	S227	-3975	124	15 * 120
1305	S226	-3990	269	15 * 120
1306	S225	-4005	124	15 * 120
1307	S224	-4020	269	15 * 120
1308	S223	-4035	124	15 * 120
1309	S222	-4050	269	15 * 120
1310	S221	-4065	124	15 * 120
1311	S220	-4080	269	15 * 120
1312	S219	-4095	124	15 * 120
1313	S218	-4110	269	15 * 120
1314	S217	-4125	124	15 * 120
1315	S216	-4140	269	15 * 120
1316	S215	-4155	124	15 * 120
1317	S214	-4170	269	15 * 120
1318	S213	-4185	124	15 * 120
1319	S212	-4200	269	15 * 120
1320	S211	-4215	124	15 * 120

No.	Name	X	Y	Bump size
1321	S210	-4230	269	15 * 120
1322	S209	-4245	124	15 * 120
1323	S208	-4260	269	15 * 120
1324	S207	-4275	124	15 * 120
1325	S206	-4290	269	15 * 120
1326	S205	-4305	124	15 * 120
1327	S204	-4320	269	15 * 120
1328	S203	-4335	124	15 * 120
1329	S202	-4350	269	15 * 120
1330	S201	-4365	124	15 * 120
1331	S200	-4380	269	15 * 120
1332	S199	-4395	124	15 * 120
1333	S198	-4410	269	15 * 120
1334	S197	-4425	124	15 * 120
1335	S196	-4440	269	15 * 120
1336	S195	-4455	124	15 * 120
1337	S194	-4470	269	15 * 120
1338	S193	-4485	124	15 * 120
1339	S192	-4500	269	15 * 120
1340	S191	-4515	124	15 * 120
1341	S190	-4530	269	15 * 120
1342	S189	-4545	124	15 * 120
1343	S188	-4560	269	15 * 120
1344	S187	-4575	124	15 * 120
1345	S186	-4590	269	15 * 120
1346	S185	-4605	124	15 * 120
1347	S184	-4620	269	15 * 120
1348	S183	-4635	124	15 * 120
1349	S182	-4650	269	15 * 120
1350	S181	-4665	124	15 * 120
1351	S180	-4680	269	15 * 120
1352	S179	-4695	124	15 * 120
1353	S178	-4710	269	15 * 120
1354	S177	-4725	124	15 * 120
1355	S176	-4740	269	15 * 120
1356	S175	-4755	124	15 * 120
1357	S174	-4770	269	15 * 120
1358	S173	-4785	124	15 * 120
1359	S172	-4800	269	15 * 120
1360	S171	-4815	124	15 * 120
1361	S170	-4830	269	15 * 120
1362	S169	-4845	124	15 * 120
1363	S168	-4860	269	15 * 120
1364	S167	-4875	124	15 * 120
1365	S166	-4890	269	15 * 120
1366	S165	-4905	124	15 * 120
1367	S164	-4920	269	15 * 120
1368	S163	-4935	124	15 * 120
1369	S162	-4950	269	15 * 120
1370	S161	-4965	124	15 * 120
1371	S160	-4980	269	15 * 120
1372	S159	-4995	124	15 * 120
1373	S158	-5010	269	15 * 120
1374	S157	-5025	124	15 * 120
1375	S156	-5040	269	15 * 120
1376	S155	-5055	124	15 * 120
1377	S154	-5070	269	15 * 120
1378	S153	-5085	124	15 * 120
1379	S152	-5100	269	15 * 120
1380	S151	-5115	124	15 * 120

No.	Name	X	Y	Bump size
1381	S150	-5130	269	15 * 120
1382	S149	-5145	124	15 * 120
1383	S148	-5160	269	15 * 120
1384	S147	-5175	124	15 * 120
1385	S146	-5190	269	15 * 120
1386	S145	-5205	124	15 * 120
1387	S144	-5220	269	15 * 120
1388	S143	-5235	124	15 * 120
1389	S142	-5250	269	15 * 120
1390	S141	-5265	124	15 * 120
1391	S140	-5280	269	15 * 120
1392	S139	-5295	124	15 * 120
1393	S138	-5310	269	15 * 120
1394	S137	-5325	124	15 * 120
1395	S136	-5340	269	15 * 120
1396	S135	-5355	124	15 * 120
1397	S134	-5370	269	15 * 1

No.	Name	X	Y	Bump size	No.	Name	X	Y	Bump size	No.	Name	X	Y	Bump size
1441	S90	-6030	269	15 * 120	1501	S30	-6930	269	15 * 120	1561	G428	-7980	269	15 * 120
1442	S89	-6045	124	15 * 120	1502	S29	-6945	124	15 * 120	1562	G426	-7995	124	15 * 120
1443	S88	-6060	269	15 * 120	1503	S28	-6960	269	15 * 120	1563	G424	-8010	269	15 * 120
1444	S87	-6075	124	15 * 120	1504	S27	-6975	124	15 * 120	1564	G422	-8025	124	15 * 120
1445	S86	-6090	269	15 * 120	1505	S26	-6990	269	15 * 120	1565	G420	-8040	269	15 * 120
1446	S85	-6105	124	15 * 120	1506	S25	-7005	124	15 * 120	1566	G418	-8055	124	15 * 120
1447	S84	-6120	269	15 * 120	1507	S24	-7020	269	15 * 120	1567	G416	-8070	269	15 * 120
1448	S83	-6135	124	15 * 120	1508	S23	-7035	124	15 * 120	1568	G414	-8085	124	15 * 120
1449	S82	-6150	269	15 * 120	1509	S22	-7050	269	15 * 120	1569	G412	-8100	269	15 * 120
1450	S81	-6165	124	15 * 120	1510	S21	-7065	124	15 * 120	1570	G410	-8115	124	15 * 120
1451	S80	-6180	269	15 * 120	1511	S20	-7080	269	15 * 120	1571	G408	-8130	269	15 * 120
1452	S79	-6195	124	15 * 120	1512	S19	-7095	124	15 * 120	1572	G406	-8145	124	15 * 120
1453	S78	-6210	269	15 * 120	1513	S18	-7110	269	15 * 120	1573	G404	-8160	269	15 * 120
1454	S77	-6225	124	15 * 120	1514	S17	-7125	124	15 * 120	1574	G402	-8175	124	15 * 120
1455	S76	-6240	269	15 * 120	1515	S16	-7140	269	15 * 120	1575	G400	-8190	269	15 * 120
1456	S75	-6255	124	15 * 120	1516	S15	-7155	124	15 * 120	1576	G398	-8205	124	15 * 120
1457	S74	-6270	269	15 * 120	1517	S14	-7170	269	15 * 120	1577	G396	-8220	269	15 * 120
1458	S73	-6285	124	15 * 120	1518	S13	-7185	124	15 * 120	1578	G394	-8235	124	15 * 120
1459	S72	-6300	269	15 * 120	1519	S12	-7200	269	15 * 120	1579	G392	-8250	269	15 * 120
1460	S71	-6315	124	15 * 120	1520	S11	-7215	124	15 * 120	1580	G390	-8265	124	15 * 120
1461	S70	-6330	269	15 * 120	1521	S10	-7230	269	15 * 120	1581	G388	-8280	269	15 * 120
1462	S69	-6345	124	15 * 120	1522	S9	-7245	124	15 * 120	1582	G386	-8295	124	15 * 120
1463	S68	-6360	269	15 * 120	1523	S8	-7260	269	15 * 120	1583	G384	-8310	269	15 * 120
1464	S67	-6375	124	15 * 120	1524	S7	-7275	124	15 * 120	1584	G382	-8325	124	15 * 120
1465	S66	-6390	269	15 * 120	1525	S6	-7290	269	15 * 120	1585	G380	-8340	269	15 * 120
1466	S65	-6405	124	15 * 120	1526	S5	-7305	124	15 * 120	1586	G378	-8355	124	15 * 120
1467	S64	-6420	269	15 * 120	1527	S4	-7320	269	15 * 120	1587	G376	-8370	269	15 * 120
1468	S63	-6435	124	15 * 120	1528	S3	-7335	124	15 * 120	1588	G374	-8385	124	15 * 120
1469	S62	-6450	269	15 * 120	1529	S2	-7350	269	15 * 120	1589	G372	-8400	269	15 * 120
1470	S61	-6465	124	15 * 120	1530	S1	-7365	124	15 * 120	1590	G370	-8415	124	15 * 120
1471	S60	-6480	269	15 * 120	1531	DUMMY25	-7380	269	15 * 120	1591	G368	-8430	269	15 * 120
1472	S59	-6495	124	15 * 120	1532	DUMMY26	-7395	124	15 * 120	1592	G366	-8445	124	15 * 120
1473	S58	-6510	269	15 * 120	1533	DUMMY27	-7560	269	15 * 120	1593	G364	-8460	269	15 * 120
1474	S57	-6525	124	15 * 120	1534	DUMMY28	-7575	124	15 * 120	1594	G362	-8475	124	15 * 120
1475	S56	-6540	269	15 * 120	1535	G480	-7590	269	15 * 120	1595	G360	-8490	269	15 * 120
1476	S55	-6555	124	15 * 120	1536	G478	-7605	124	15 * 120	1596	G358	-8505	124	15 * 120
1477	S54	-6570	269	15 * 120	1537	G476	-7620	269	15 * 120	1597	G356	-8520	269	15 * 120
1478	S53	-6585	124	15 * 120	1538	G474	-7635	124	15 * 120	1598	G354	-8535	124	15 * 120
1479	S52	-6600	269	15 * 120	1539	G472	-7650	269	15 * 120	1599	G352	-8550	269	15 * 120
1480	S51	-6615	124	15 * 120	1540	G470	-7665	124	15 * 120	1600	G350	-8565	124	15 * 120
1481	S50	-6630	269	15 * 120	1541	G468	-7680	269	15 * 120	1601	G348	-8580	269	15 * 120
1482	S49	-6645	124	15 * 120	1542	G466	-7695	124	15 * 120	1602	G346	-8595	124	15 * 120
1483	S48	-6660	269	15 * 120	1543	G464	-7710	269	15 * 120	1603	G344	-8610	269	15 * 120
1484	S47	-6675	124	15 * 120	1544	G462	-7725	124	15 * 120	1604	G342	-8625	124	15 * 120
1485	S46	-6690	269	15 * 120	1545	G460	-7740	269	15 * 120	1605	G340	-8640	269	15 * 120
1486	S45	-6705	124	15 * 120	1546	G458	-7755	124	15 * 120	1606	G338	-8655	124	15 * 120
1487	S44	-6720	269	15 * 120	1547	G456	-7770	269	15 * 120	1607	G336	-8670	269	15 * 120
1488	S43	-6735	124	15 * 120	1548	G454	-7785	124	15 * 120	1608	G334	-8685	124	15 * 120
1489	S42	-6750	269	15 * 120	1549	G452	-7800	269	15 * 120	1609	G332	-8700	269	15 * 120
1490	S41	-6765	124	15 * 120	1550	G450	-7815	124	15 * 120	1610	G330	-8715	124	15 * 120
1491	S40	-6780	269	15 * 120	1551	G448	-7830	269	15 * 120	1611	G328	-8730	269	15 * 120
1492	S39	-6795	124	15 * 120	1552	G446	-7845	124	15 * 120	1612	G326	-8745	124	15 * 120
1493	S38	-6810	269	15 * 120	1553	G444	-7860	269	15 * 120	1613	G324	-8760	269	15 * 120
1494	S37	-6825	124	15 * 120	1554	G442	-7875	124	15 * 120	1614	G322	-8775	124	15 * 120
1495	S36	-6840	269	15 * 120	1555	G440	-7890	269	15 * 120	1615	G320	-8790	269	15 * 120
1496	S35	-6855	124	15 * 120	1556	G438	-7905	124	15 * 120	1616	G318	-8805	124	15 * 120
1497	S34	-6870	269	15 * 120	1557	G436	-7920	269	15 * 120	1617	G316	-8820	269	15 * 120
1498	S33	-6885	124	15 * 120	1558	G434	-7935	124	15 * 120	1618	G314	-8835	124	15 * 120
1499	S32	-6900	269	15 * 120	1559	G432	-7950	269	15 * 120	1619	G312	-8850	269	15 * 120
1500	S31	-6915	124	15 * 120	1560	G430	-7965	124	15 * 120	1620	G310	-8865	124	15 * 120

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May, 2010

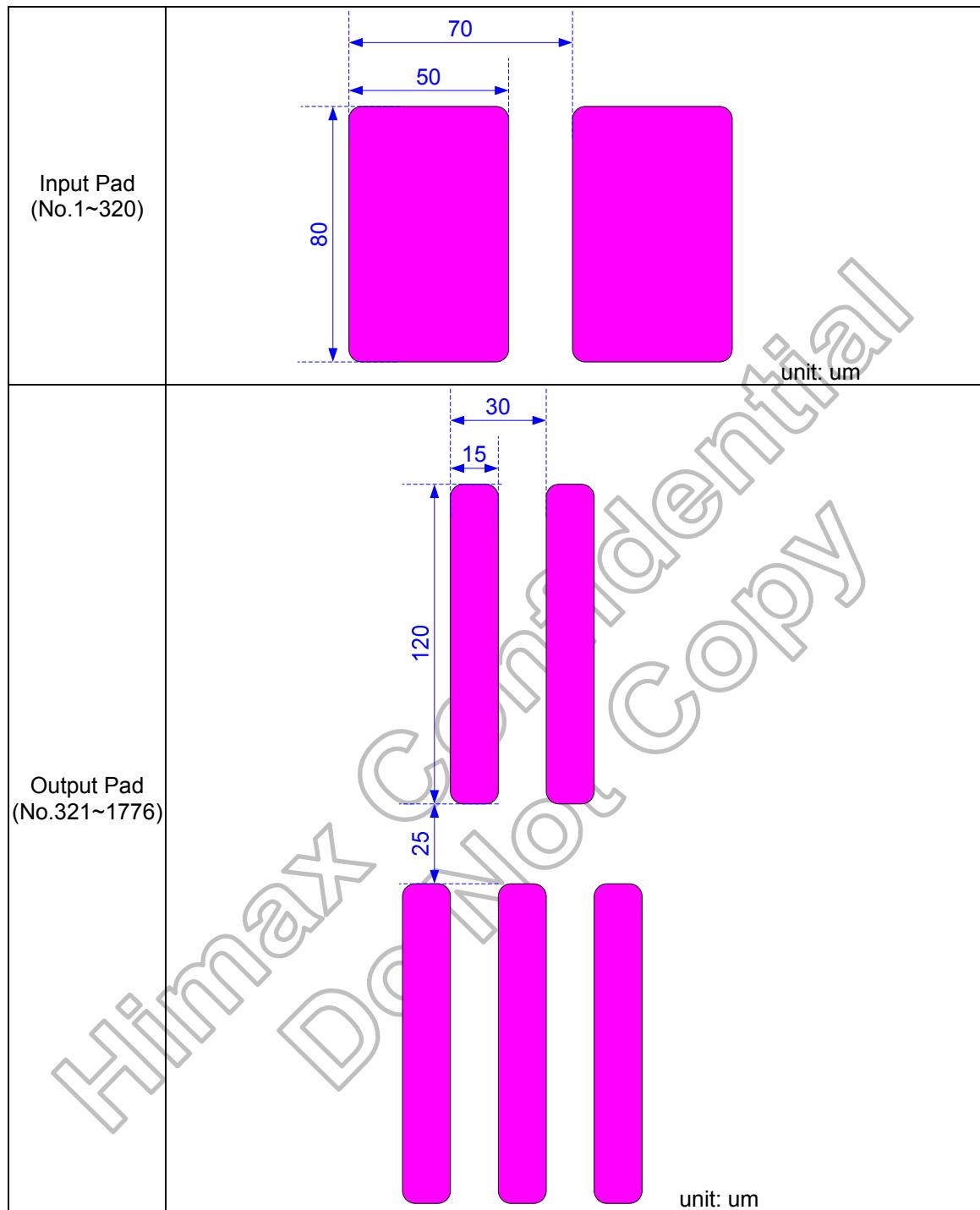
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No.	Name	X	Y	Bump size
1681	G188	-9780	269	15 * 120
1682	G186	-9795	124	15 * 120
1683	G184	-9810	269	15 * 120
1684	G182	-9825	124	15 * 120
1685	G180	-9840	269	15 * 120
1686	G178	-9855	124	15 * 120
1687	G176	-9870	269	15 * 120
1688	G174	-9885	124	15 * 120
1689	G172	-9900	269	15 * 120
1690	G170	-9915	124	15 * 120
1691	G168	-9930	269	15 * 120
1692	G166	-9945	124	15 * 120
1693	G164	-9960	269	15 * 120
1694	G162	-9975	124	15 * 120
1695	G160	-9990	269	15 * 120
1696	G158	-10005	124	15 * 120
1697	G156	-10020	269	15 * 120
1698	G154	-10035	124	15 * 120
1699	G152	-10050	269	15 * 120
1700	G150	-10065	124	15 * 120
1701	G148	-10080	269	15 * 120
1702	G146	-10095	124	15 * 120
1703	G144	-10110	269	15 * 120
1704	G142	-10125	124	15 * 120
1705	G140	-10140	269	15 * 120
1706	G138	-10155	124	15 * 120
1707	G136	-10170	269	15 * 120
1708	G134	-10185	124	15 * 120
1709	G132	-10200	269	15 * 120
1710	G130	-10215	124	15 * 120
1711	G128	-10230	269	15 * 120
1712	G126	-10245	124	15 * 120
1713	G124	-10260	269	15 * 120
1714	G122	-10275	124	15 * 120
1715	G120	-10290	269	15 * 120
1716	G118	-10305	124	15 * 120
1717	G116	-10320	269	15 * 120
1718	G114	-10335	124	15 * 120
1719	G112	-10350	269	15 * 120
1720	G110	-10365	124	15 * 120
1721	G108	-10380	269	15 * 120
1722	G106	-10395	124	15 * 120
1723	G104	-10410	269	15 * 120
1724	G102	-10425	124	15 * 120
1725	G100	-10440	269	15 * 120
1726	G98	-10455	124	15 * 120
1727	G96	-10470	269	15 * 120
1728	G94	-10485	124	15 * 120
1729	G92	-10500	269	15 * 120
1730	G90	-10515	124	15 * 120
1731	G88	-10530	269	15 * 120
1732	G86	-10545	124	15 * 120
1733	G84	-10560	269	15 * 120
1734	G82	-10575	124	15 * 120
1735	G80	-10590	269	15 * 120
1736	G78	-10605	124	15 * 120
1737	G76	-10620	269	15 * 120
1738	G74	-10635	124	15 * 120
1739	G72	-10650	269	15 * 120
1740	G70	-10665	124	15 * 120

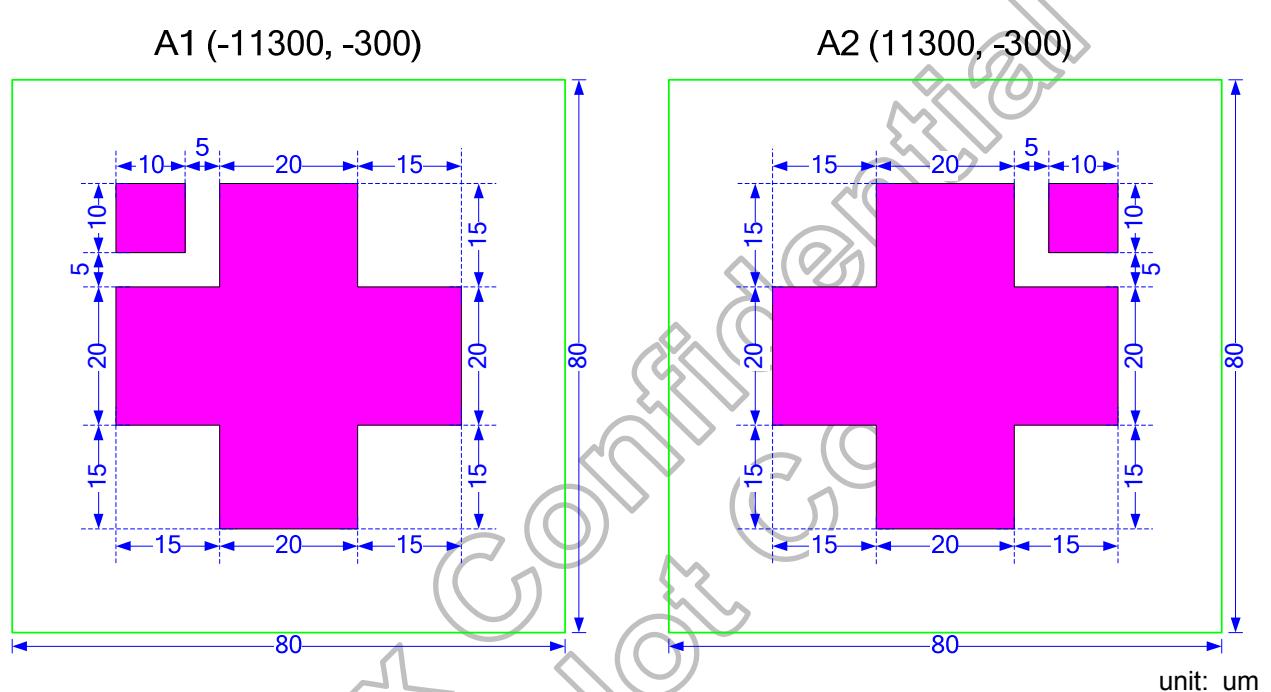
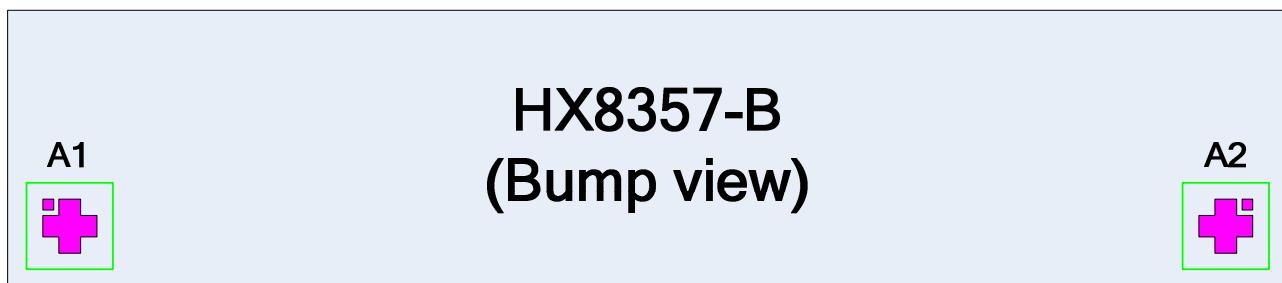
No.	Name	X	Y	Bump size
1741	G68	-10680	269	15 * 120
1742	G66	-10695	124	15 * 120
1743	G64	-10710	269	15 * 120
1744	G62	-10725	124	15 * 120
1745	G60	-10740	269	15 * 120
1746	G58	-10755	124	15 * 120
1747	G56	-10770	269	15 * 120
1748	G54	-10785	124	15 * 120
1749	G52	-10800	269	15 * 120
1750	G50	-10815	124	15 * 120
1751	G48	-10830	269	15 * 120
1752	G46	-10845	124	15 * 120
1753	G44	-10860	269	15 * 120
1754	G42	-10875	124	15 * 120
1755	G40	-10890	269	15 * 120
1756	G38	-10905	124	15 * 120
1757	G36	-10920	269	15 * 120
1758	G34	-10935	124	15 * 120
1759	G32	-10950	269	15 * 120
1760	G30	-10965	124	15 * 120
1761	G28	-10980	269	15 * 120
1762	G26	-10995	124	15 * 120
1763	G24	-11010	269	15 * 120
1764	G22	-11025	124	15 * 120
1765	G20	-11040	269	15 * 120
1766	G18	-11055	124	15 * 120
1767	G16	-11070	269	15 * 120
1768	G14	-11085	124	15 * 120
1769	G12	-11100	269	15 * 120
1770	G10	-11115	124	15 * 120
1771	G8	-11130	269	15 * 120
1772	G6	-11145	124	15 * 120
1773	G4	-11160	269	15 * 120
1774	G2	-11175	124	15 * 120
1775	DUMMY29	-11190	269	15 * 120
1776	DUMMY30	-11205	124	15 * 120

No.	Name	X	Y
A1	Alignment	-11300	-300
A2	Alignment	11300	-300

3.5 Bump Arrangement



3.6 Alignment Mark



4. Interface Description

The HX8357-B supports MIPI interfaces: DBI (Display Bus Interface), DPI(Display Pixel Interface). Where DBI supports (18-/16-/9-/8-bit interface) Parallel Interface (Type-B) and Serial interface (Type-C). The interface mode can be selected by IM2-0 pins setting as show in table4.1.

IM2	IM1	IMO	Interface	Color mode
0	0	0	DBI Type-B 18-bit	262K
0	0	1	DBI Type-B 9-bit	262K
0	1	0	DBI Type-B 16-bit	65K / 262K
0	1	1	DBI Type-B 8-bit	65K / 262K
1	0	0	Inhibited	-
1	0	1	DBI Type-C Option 1(9 bits)	8 / 262K
1	1	0	Inhibited	-
1	1	1	DBI Type-C Option 3 (8 bits)	8 / 262K

Table 4.1: Interface Selection

The HX8357-B includes an index register (IR), which is stored the index data of internal control register and GRAM. When DCX ="L", the command via DBI interface write into register. when DCX ="H", GRAM data via R2Ch register can be written through data bus. There are two 16-bit bus control registers, which are used to temporarily store the data written to or read from the GRAM. When the data is written into the GRAM from the MPU, it is first written into the write-data latch and then automatically written into the GRAM by internal operation. Data is read through the read-data latch when reading from the GRAM.

When data is read from the GRAM to the MPU, it is first read from GRAM to the read-data latch and then data is read to MPU through the read-data latch in next read operation. Therefore, the read data in data bus in first read operation is invalid, and the read data in data bus in second and the following read operation is valid.

Interface	RDX	WRX_SCL	DCX	DB17 –DB0 or other input pin
DBI Type-C Option 1	Unused	SCL	Unused	DB17 – DB0: 18 bit data bus DIN_SDA
DBI Type-C Option 3	Unused	SCL	DCX	DB17 – DB0: 18 bit data bus DIN_SDA
DBI Type-B 8-bit parallel	RDX	WRX	DCX	DB17 – DB8: Unused, DB7 – DB0 : 8 bit data bus
DBI Type-B 9-bit parallel	RDX	WRX	DCX	DB17 – DB9: Unused, DB8 – DB0: 9 bit data bus
DBI Type-B 16-bit parallel	RDX	WRX	DCX	DB17 – DB16: Unused, DB15 – DB0: 16 bit data bus
DBI Type-B 18-bit parallel	RDX	WRX	DCX	DB17 – DB0: 18 bit data bus

Table 4.2: Pin connection according of different interface

4.1 MIPI DBI-B Interface

The selection of DBI Type-B interface is by IM2 pin .When this pin is Low state (VSSD), the interface is use DBI system. And use IM1~IM0 pin to select DBI-B interface mode. The parallel interface timing diagram is described in Figure 4.1 and 4.2.

DBI Type-B Write to register or GRAM

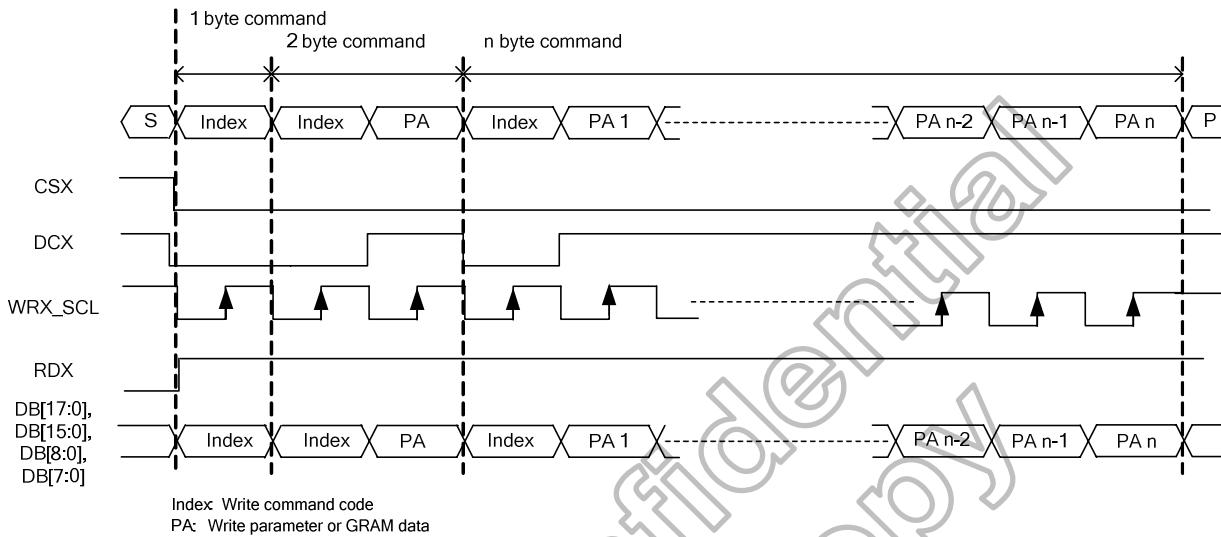


Figure 4.1: DBI-B System interface protocol, write to register or GRAM

DBI Type-B Read from register or GRAM

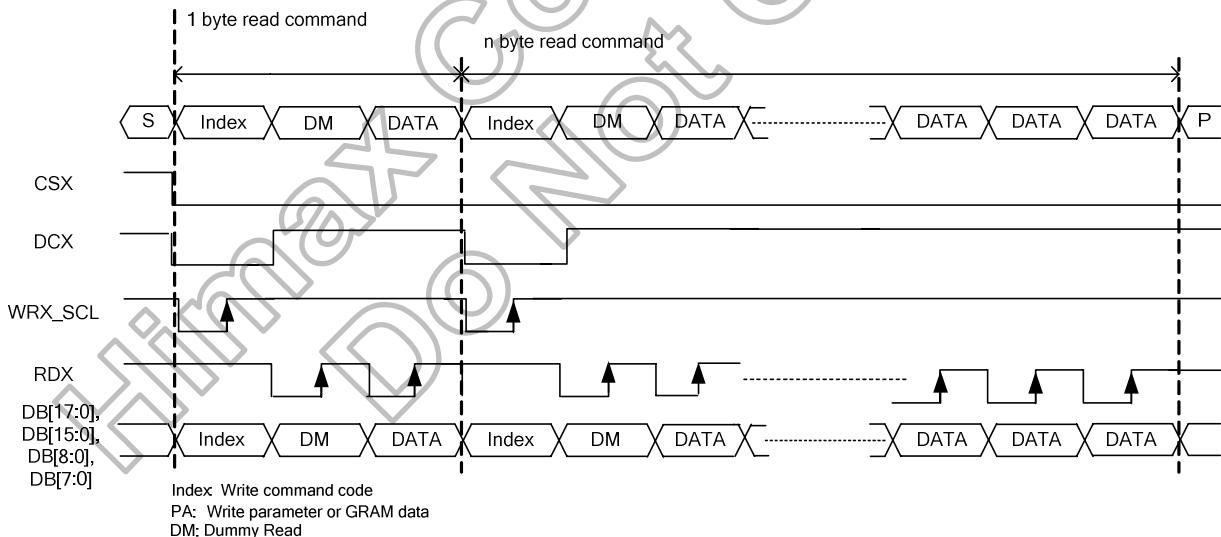


Figure 4.2: DBI-B System interface protocol, read from register or GRAM

4.1.1 DBI Type-B 18-bit Parallel Bus System Interface

The DBI-B system 18-bit bus parallel data transfer can be used by setting “IM2-0” pins to “000”. The Figure 4.3 is the example of interface with 18-bit DBI Type-B microcomputer system interface.

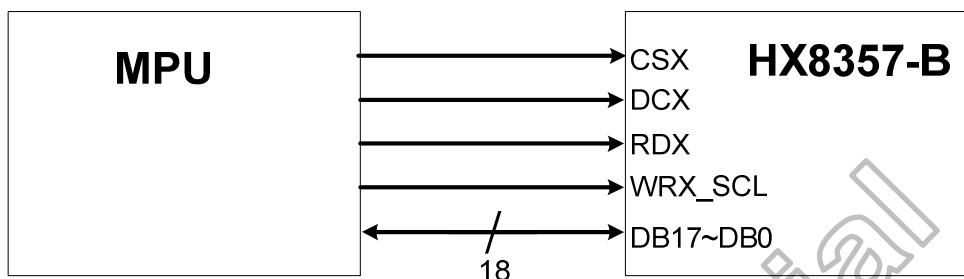


Figure 4.3: Example of DBI Type-B System 18-Bit Parallel Bus Interface

4.1.2 16-bit Parallel Bus System Interface

The DBI-B system 16-bit bus parallel data transfer can be used by setting “IM2-0” pins to “010”. The Figure 4.4 is the example of interface with 16-bit DBI Type-B microcomputer system interface.

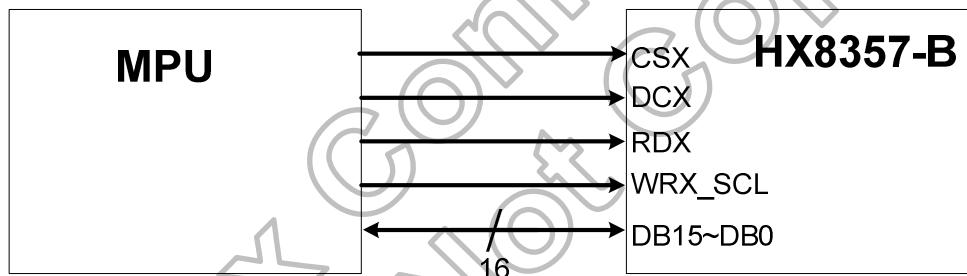


Figure 4.4: Example of DBI Type-B System 16-bit bus Interface

4.1.3 9-bit Parallel Bus System Interface

The DBI Type-B system 9-bit bus parallel data transfer can be used by setting “IM2-0” pins to “001”. The Figure 4.5 is the example of interface with 9-bit DBI Type-B microcomputer system interface.

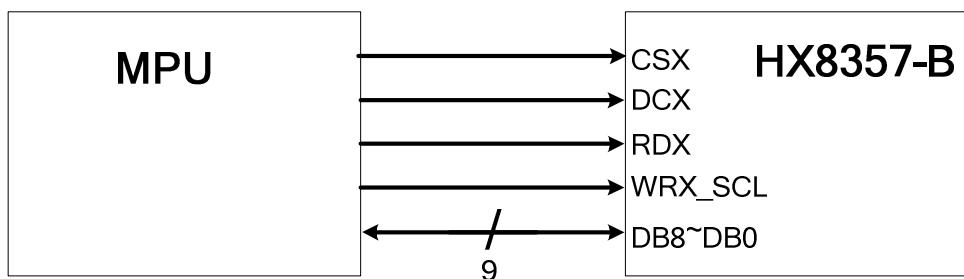


Figure 4.5: Example of DBI Type-B System 9-bit bus Interface

4.1.4 8-bit Parallel Bus System Interface

The DBI Type-B system 8-bit bus parallel data transfer can be used by setting “IM2-0” pins to “011”. The Figure 4.6 is the example of interface with 8-bit DBI Type-B microcomputer system interface.

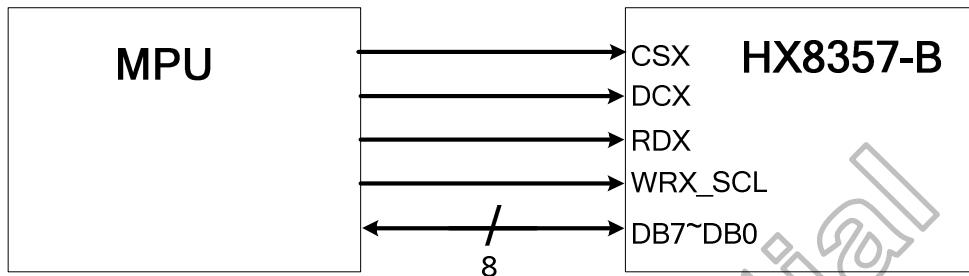


Figure 4.6: Example of DBI Type-B System 8-bit bus Interface

4.1.5 DBI Type-B Interface Data Color Coding

DBI Type-B Interface Data Color Coding for GRAM data **Write**

- DBI Type-B 8-Bits Bus Interface (IM2, IM1, IM0="011")

Register	DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Command
Set_pixel_format DFM	x	x	x	x	x	x	x	x	x	0	0	1	0	1	1	0	0	2CH	
3'h5 X	x	x	x	x	x	x	x	x	x	R4	R3	R2	R1	R0	G5	G4	G3	65K-Color (1-pixels/ 2-transfer)	
	x	x	x	x	x	x	x	x	x	G2	G1	G0	B4	B3	B2	B1	B0		
3'h6 X	x	x	x	x	x	x	x	x	x	R5	R4	R3	R2	R1	R0	x	x	262K-Color (1-pixels/ 3-transfer)	
	x	x	x	x	x	x	x	x	x	G5	G4	G3	G2	G1	G0	x	x		
	x	x	x	x	x	x	x	x	x	B5	B4	B3	B2	B1	B0	x	x		

Table 4.3: DBI Type-B 8-Bits Interface GRAM Write Table

- DBI Type-B 9-Bits Bus Interface (IM2,IM1,IM0="001")

Register	DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Command
Set_pixel_format DFM	x	x	x	x	x	x	x	x	x	0	0	1	0	1	1	0	0	2CH	
3'h6 X	x	x	x	x	x	x	x	x	x	R5	R4	R3	R2	R1	R0	G5	G4	G3	262K-Color (1-pixels/ 2-transfer)
	x	x	x	x	x	x	x	x	x	G2	G1	G0	B5	B4	B3	B2	B1	B0	

Table 4.4: DBI Type-B 9-Bits Interface GRAM Write Set Table

- DBI Type-B 16-Bits Bus Interface (IM2,IM1,IM0="010")

Register	DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Command
Set_pixel_format DFM	x	x	x	x	x	x	x	x	x	0	0	1	0	1	1	0	0	2CH	
3'h5 X	x	x	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B4	B3	B2	B1	B0	65K-Color (1-pixels/ 1-transfer)
	x	x	R05	R04	R03	R02	R01	R00	x	x	G05	G04	G03	G02	G01	G00	x	x	
3'h6	0	x	B05	B04	B03	B02	B01	B00	x	x	R15	R14	R13	R12	R11	R10	x	x	262K-Color (2-pixels/ 3-transfer)
		x	G15	G14	G13	G12	G11	G10	x	x	B15	B14	B13	B12	B11	B10	x	x	
	1	x	x	x	x	x	x	x	x	x	R05	R04	R03	R02	R01	R00	x	x	262K-Color (1-pixels/ 2-transfer)
		x	G05	G04	G03	G02	G01	G00	x	x	B05	B04	B03	B02	B01	B00	x	x	
		x	x	x	x	x	x	x	x	x	R15	R14	R13	R12	R11	R10	x	x	
		x	G15	G14	G13	G12	G11	G10	x	x	B15	B14	B13	B12	B11	B10	x	x	

Table 4.5: DBI Type-B 16-Bits Interface GRAM Write Table

- DBI Type-B 18-Bits Bus Interface (IM2,IM1,IM0="000")

Register	DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Command
Set_pixel_format DFM	x	x	x	x	x	x	x	x	x	0	0	1	0	1	1	0	0	2CH	
3'h6 X	R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0	262K-Color (1-pixels/ 1-transfer)

Table 4.6: DBI Type-B 18-Bits Interface GRAM Write Set Table

- DBI Type-B 16-Bits Data extend to 18-Bit

Register	GRAM Data																		
Set_pixel_format EPF[1:0]	DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
3'h5	2'h0	R4	R3	R2	R1	R0	0	G5	G4	G3	G2	G1	G0	B4	B3	B2	B1	B0	0
	2'h1	R4	R3	R2	R1	R0	1	G5	G4	G3	G2	G1	G0	B4	B3	B2	B1	B0	1
	2'h2	R4	R3	R2	R1	R0	R4	G5	G4	G3	G2	G1	G0	B4	B3	B2	B1	B0	B4

Table 4.7: DBI Type-B 16-Bits Data extend to 18-Bit

DBI Type-B Interface Data Color Coding for RAM data **Read**

- DBI Type-B 8-Bits Bus Interface (IM2, IM1, IM0="011")

Register		DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Command
Set_pixel_format	DFM	x	x	x	x	x	x	x	x	x	0	0	1	0	1	1	1	0	2EH	
3'h5	X	x	x	x	x	x	x	x	x	x	R4	R3	R2	R1	R0	G5	G4	G3	65K-Color (1-pixels/ 2-transfer)	
		x	x	x	x	x	x	x	x	x	G2	G1	G0	B4	B3	B2	B1	B0		
3'h6	X	x	x	x	x	x	x	x	x	x	R5	R4	R3	R2	R1	R0	x	x	262K-Color (1-pixels/ 3-transfer)	
		x	x	x	x	x	x	x	x	x	G5	G4	G3	G2	G1	G0	x	x		
		x	x	x	x	x	x	x	x	x	B5	B4	B3	B2	B1	B0	x	x		

Table 4.8: DBI Type-B 8-Bits Interface GRAM Read Table

- DBI Type-B 9-Bits Bus Interface (IM2, IM1, IM0="001")

Register		DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Command
Set_pixel_format	DFM	x	x	x	x	x	x	x	x	x	0	0	1	0	1	1	1	1	0	2EH
3'h6	X	x	x	x	x	x	x	x	x	x	R5	R4	R3	R2	R1	R0	G5	G4	G3	262K-Color (1-pixels/ 2-transfer)
		x	x	x	x	x	x	x	x	x	G2	G1	G0	B5	B4	B3	B2	B1	B0	

Table 4.9: DBI Type-B 9-Bits Interface GRAM Read Set Table

- DBI Type-B 16-Bits Bus Interface (IM2, IM1, IM0="010")

Register		DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Command
Set_pixel_format	DFM	x	x	x	x	x	x	x	x	x	0	0	1	0	1	1	1	1	0	2EH
3'h5	X	x	x	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B4	B3	B2	B1	B0	65K-Color (1-pixels/ 1-transfer)
		x	x	R05	R04	R03	R02	R01	R00	x	x	G05	G04	G03	G02	G01	G00	x	x	
3'h6	0	x	x	B05	B04	B03	B02	B01	B00	x	x	R15	R14	R13	R12	R11	R10	x	x	262K-Color (2-pixels/ 3-transfer)
		x	x	G15	G14	G13	G12	G11	G10	x	x	B15	B14	B13	B12	B11	B10	x	x	
		x	x	x	x	x	x	x	x	x	R05	R04	R03	R02	R01	R00	x	x	262K-Color (1-pixels/ 2-transfer)	
	1	x	x	G05	G04	G03	G02	G01	G00	x	x	B05	B04	B03	B02	B01	B00	x	x	

Table 4.10: DBI Type-B 16-Bits Interface GRAM Read Table

- DBI Type-B 18-Bits Bus Interface (IM2, IM1, IM0="000")

Register		DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Command
Set_pixel_format	DFM	x	x	x	x	x	x	x	x	x	0	0	1	0	1	1	1	1	0	2EH
3'h6	X	R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0	262K-Color (1-pixels/ 1-transfer)

Table 4.11: DBI Type-B 18-Bits Interface GRAM Read Set Table

4.2 Serial Data Transfer Interface (MIPI DBI Type-C)

The HX8357-B supports two type serial data transfer interface, the interface selection by setting IM2-0 pins, The IM2-0 set “101” is select 3 wire option1 serial bus. The IM2-0 is set “111” when select 4 wire option3 serial bus.

The 3 wire serial bus is use: chip select line (CSX), serial input/output data (SDA) and the serial transfer clock line (WRX_SCL).The 4 wire serial bus is use: chip select line (CSX), data/command select (DCX), serial input/output data (DIN_SDA, DOUT) and the serial transfer clock line (WRX_SCL).

4.2.1 Serial data write mode

The 3-Pin serial data packet contains a control bit DCX and a transmission byte and in 4-pin serial case, data packet contains just transmission byte and control signal DCX is transferred by DCX pin. If DCX is low, the transmission byte is command byte. If DCX is high, the transmission byte is stored in to command register or GRAM. The MSB is transmitted first. The serial interface is initialized when CSX is high. In this state, SCL clock pulse or serial input/output data (DIN_SDA) have no effect. A falling edge on CSX enables the serial interface and indicates the start of data transmission.

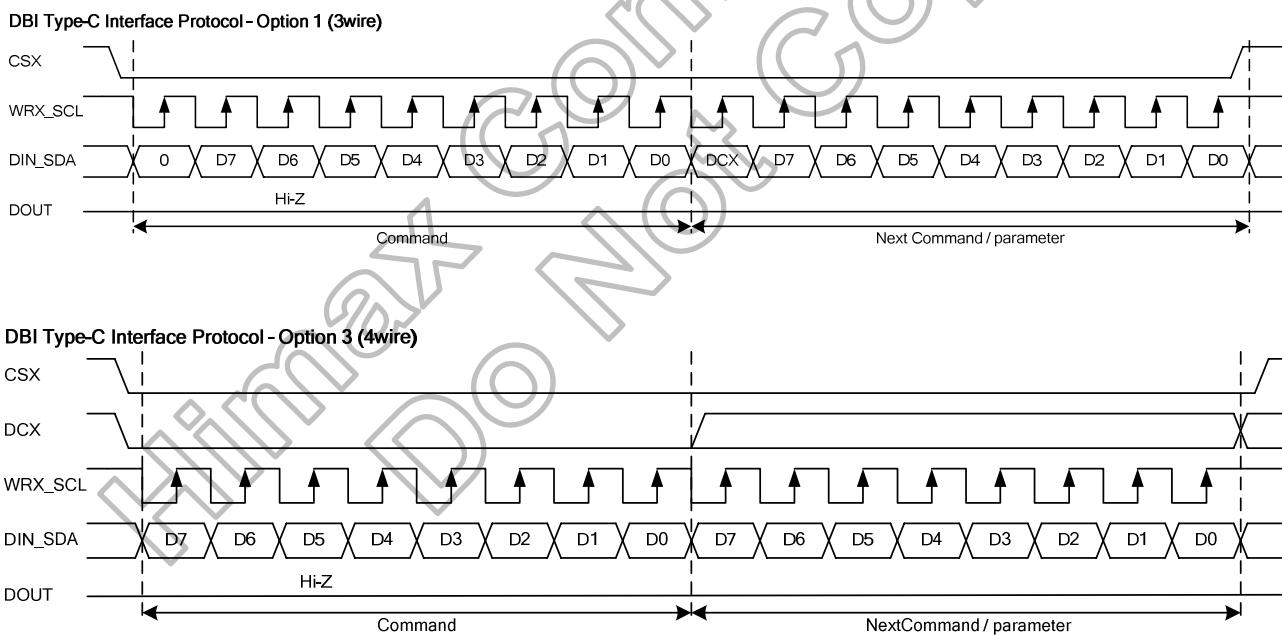
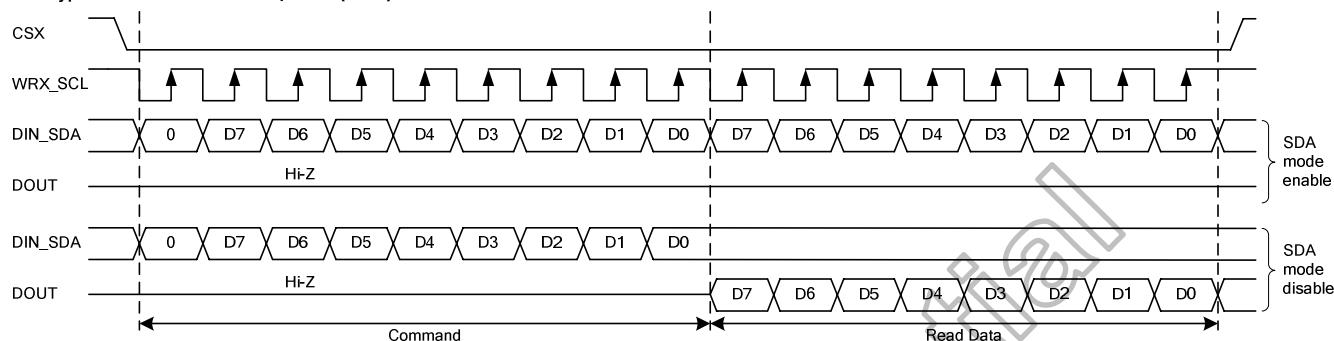


Figure 4.7: DBI Type-C Serial Interface protocol 3 wire/4 wire, write mode

4.2.2 Serial data read mode

The micro-controller first has to send a command and then the following byte is transmitted in the opposite direction. The 3-wire serial read data format which just needs 8-bit.

DBI Type-C Interface Protocol - Option 1 (3wire)



DBI Type-C Interface Protocol - Option 3 (4wire)

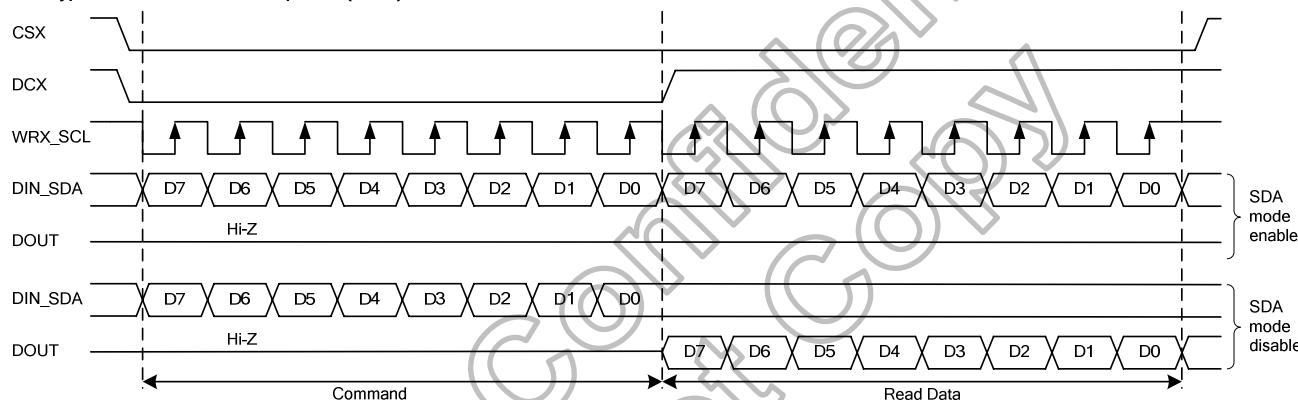


Figure 4.8: Type-C Serial Interface protocol 3 wire/4 wire read mode

4.2.3 DBI Type-C Interface Data Color Coding

- DBI Type-C 3/4-wire serial bus Interface (IM2, IM1, IM0="101" or "111")

Register	D7	D6	D5	D4	D3	D2	D1	D0	Command
Set_pixel_format	DFM	0	0	1	0	1	1	0	2CH
3'h1	0	X	X	R00	G00	B00	R10	G10	B10
	1	X	R00	G00	B00	X	R10	G10	B10
3'h6	X	R5	R4	R3	R2	R1	R0	X	8-Color (1-pixels/ 1-transfer)
		G5	G4	G3	G2	G1	G0	X	262K-Color (1-pixels/ 3-transfer)
		B5	B4	B3	B2	B1	B0	X	

Table 4.12: DBI Type-C Interface GRAM write Table

- DBI TYPE-C 3-Bits Data extend to 18-Bit

Register	GRAM Data																		
Set_pixel_format	EPF[1:0]	DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
3'h1	XX	R0	R0	R0	R0	R0	R0	G0	G0	G0	G0	G0	G0	B0	B0	B0	B0	B0	

Table 4.13: DBI Type-C 3-Bits Data extend to 18-Bit

4.2.4 Break and Pause Sequences

If there is a break on data transmission when transmit a command before a whole byte has been completed, then the display module will have reset the interface such that it will be ready to receive the same byte re-transmitted when the chip select line (CSX) is next activated. See the following figure.

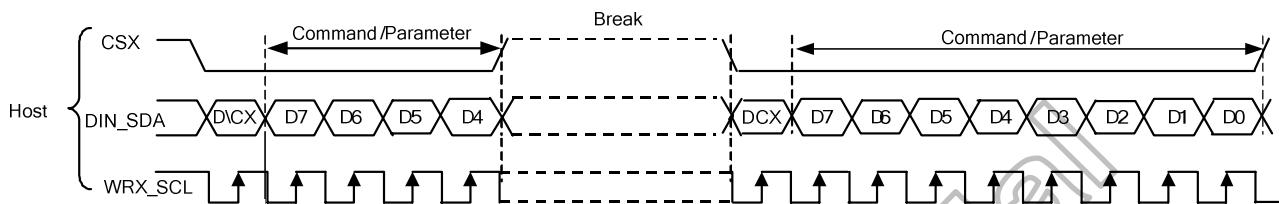


Figure 4.9: Display Module Data Transfer Recovery

If a one 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 retransmitting the parameter that was interrupted, then the parameters that were successfully sent are stored and the parameter where the break occurred is rejected. The interface is ready to receive next byte as shown:

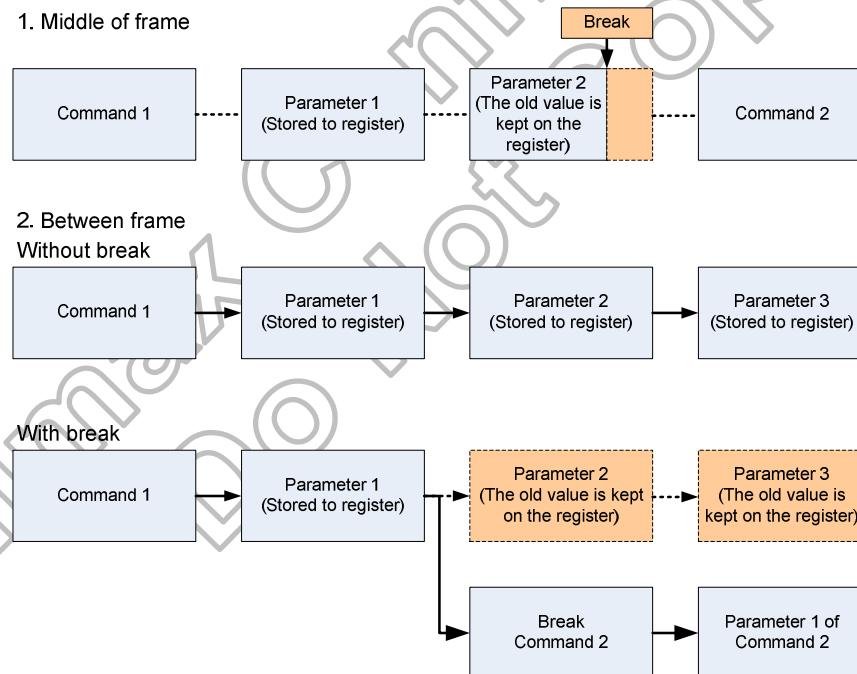


Figure 4.10: Break during parameter

The host processor can pause a write sequence by pulling the CSX signal high between command or data bytes. The display module shall wait for the host processor to drive CSX low before continuing the read or write sequence at the point where the sequence was paused.

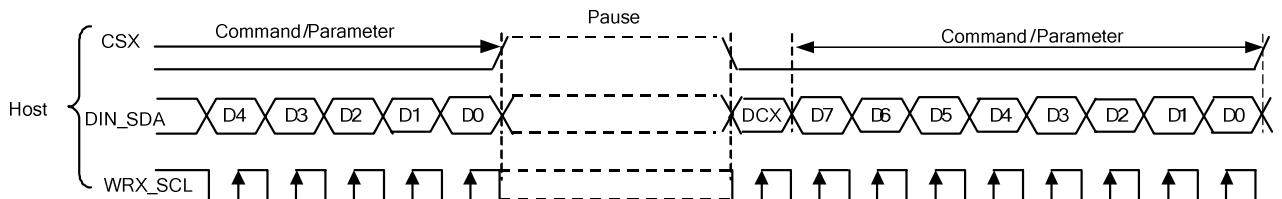


Figure 4.11: Display Module Data Transfer Pause

There are 4 cases where there is possible to see this kind of pause:

- a. Command – Pause – Command
- b. Command – Pause – Parameter
- c. Parameter – Pause – Command
- d. Parameter – Pause – Parameter

4.3 MIPI DPI interface (Display Pixel Interface)

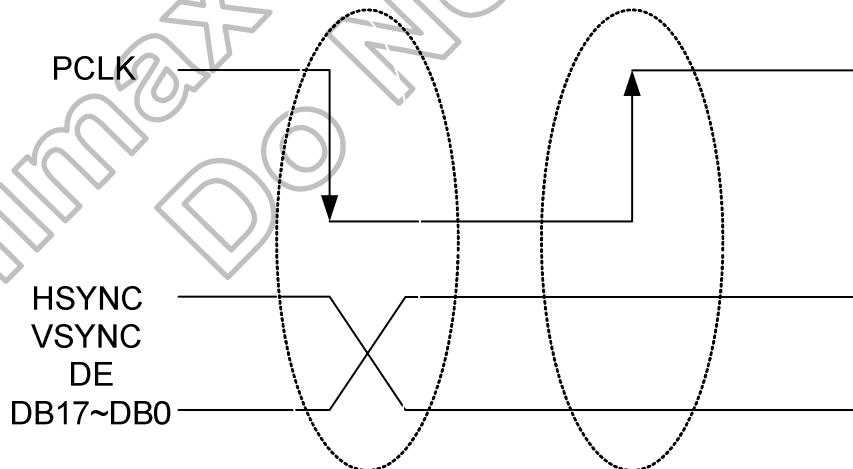
The HX8357-B uses 16 or 18-bit parallel RGB interface which includes: HSYNC, VSYNC, DE, PCLK, DB17~DB0. The interface is active after Power On sequence. Pixel clock (PCLK) is running all the time without stopping and it is used to entering HSYNC, VSYNC, DE and DB17~DB0 –lines states when there is a rising edge of the PCLK. The PCLK cannot be used as continue internal clock for other functions of the display module e.g. Sleep In –mode etc. Vertical synchronization (VSYNC) is used to tell when there is received a new frame of the display.

This is negative ('-', '0', low) active and its state is read to the display module by a rising edge of the PCLK-line. Horizontal synchronization (HSYNC) is used to tell when there is received a new line of the frame.

This is negative ('-', '0', low) active and its state is read to the display module by a rising edge of the PCLK-line. Data enable (DE) is used to tell when there is received RGB information that should be transferred on the display.

This is positive ('+', '1', high) active and its state is read to the display module by a rising edge of the PCLK-line. DB17~DB0 (18 bit: R5-R0, G5-G0 and B5-B0; 16 bit: R4- R0, G5-G0 and B4-B0) are used to tell what is the information of the image that is transferred on the display (when DE =1 and there is a rising edge of PCLK). DB17~DB0 – lines can be set to "0" (low) or "1" (high). These lines are read by a rising edge of the PCLK-line.

The pixel clock cycle is described in the following figure.



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

Figure 4.12: PCLK cycle

General Timing Diagram

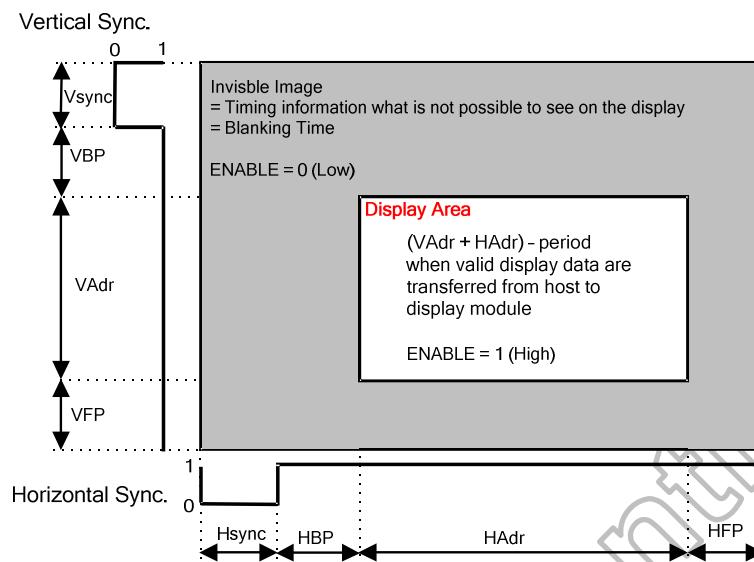


Figure 4.13: General Timing Diagram

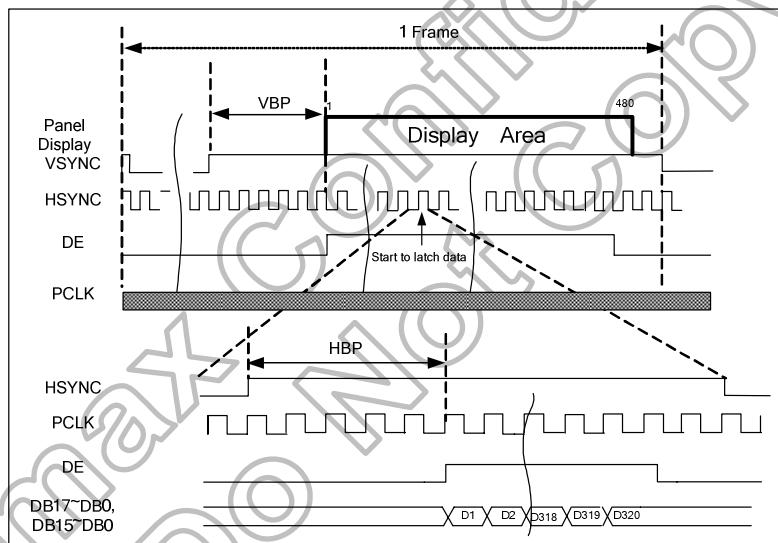


Figure 4.14: DPI (320RGBx480) timing diagram

The image information must be correct on the display, when the timings are in range on the interface. However, the image information can be incorrect on the display, when timings are out of the range on the interface (Out of the range timings cannot cause any damage on the display module or it cannot cause any damage on the host side). The correct image information must be displayed automatically (by the display module) on the next frame (vertical sync.), when there is returned from out of the range to in range interface timings.

The MIPI DPI interface includes two types which are 16-/18-bit data format by register 3Ah (set_pixel_format) to select.

4.3.1 16 bit/pixel Color Order on the DPI I/F

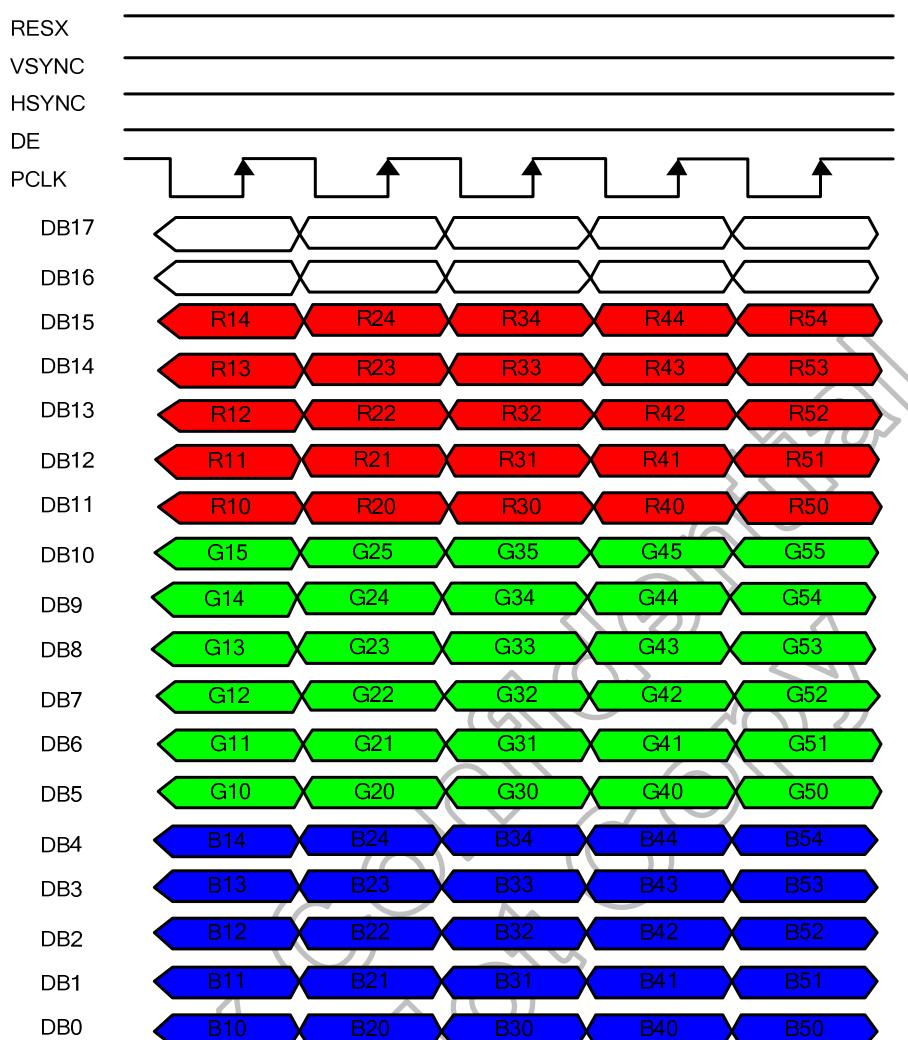


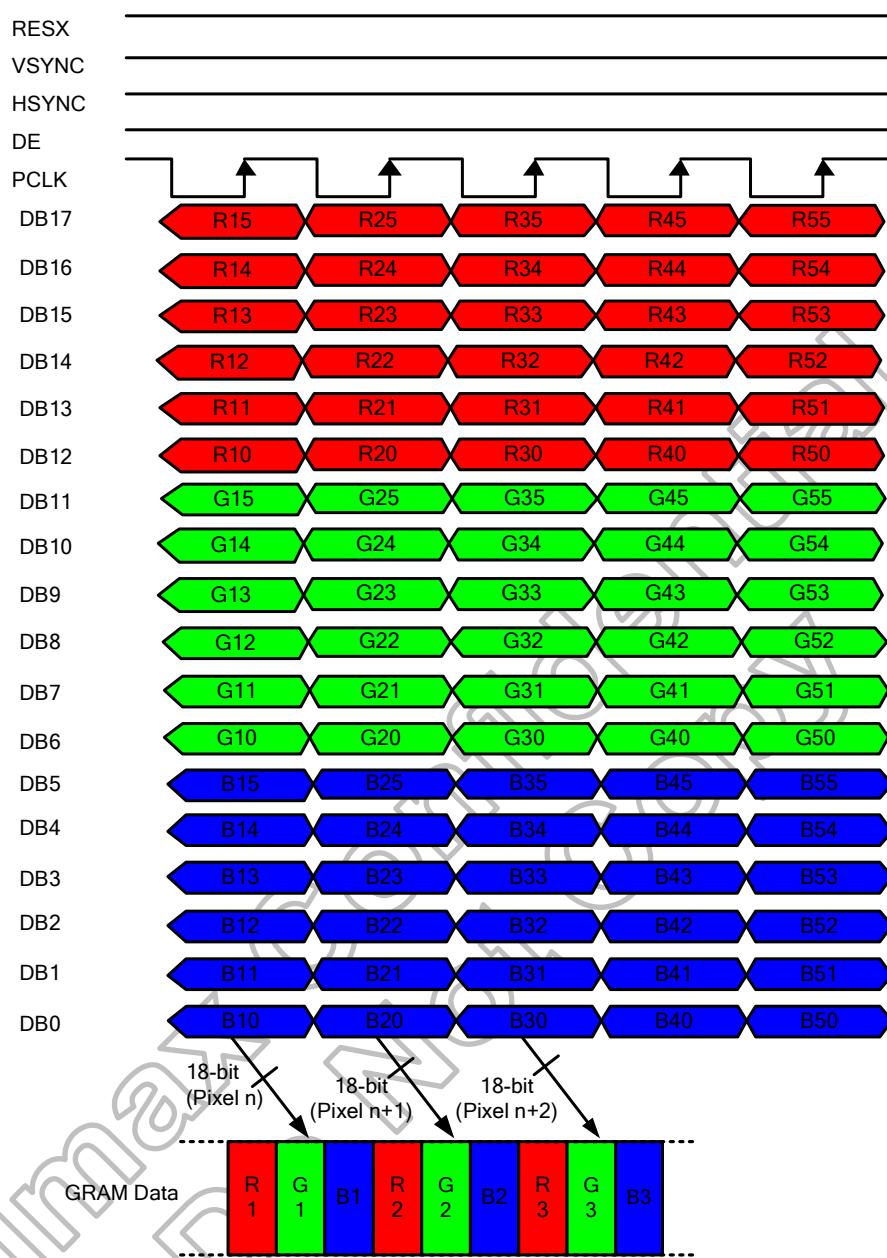
Figure 4.15: 16 bit/pixel 65k Color Order on the DPI I/F

- DPI 16-Bits Data extend to 18-Bit

Register		GRAM Data / Display data																			
Set_pixel_format	EPF[1:0]	DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
3'h5	2'h0	R4	R3	R2	R1	R0	0	G5	G4	G3	G2	G1	G0	B4	B3	B2	B1	B0	0		
	2'h1	R4	R3	R2	R1	R0	1	G5	G4	G3	G2	G1	G0	B4	B3	B2	B1	B0	1		
	2'h2	R4	R3	R2	R1	R0	R4	G5	G4	G3	G2	G1	G0	B4	B3	B2	B1	B0	B4		

Table 4.14: DPI 16-Bits Data extend to 18-Bit

4.3.2 18 bit/pixel Color Order on the DPI I/F



Note: The Data order is as follows, MSB = DB17, LSB = DB0 and Picture Data is MSB = Bit5, LSB = Bit0 for Red, Green and Blue data.

Figure 4.16: 18 bit/pixel - 262k Color Order on the DPI I/F

4.3.3 Shutdown and Color Mode Signals

The HX8357-B is support hardware pin control function on DPI interface. If use this function, some OTP data need program for display quality, example Gamma setting, VCOM setting and Power voltage setting.

4.3.3.1 Shutdown for DPI interface hardware control

The Shutdown signal, SD, is used to turn on or turn off the display module. When SD is asserted high, the host processor should stop the video stream data to the display module to reduce interface signal power consumption.

PCLK may also be turned off to further reduce power consumption. The display module may reduce its power consumption by switching off its internal circuits. The control interface shall remain powered on.

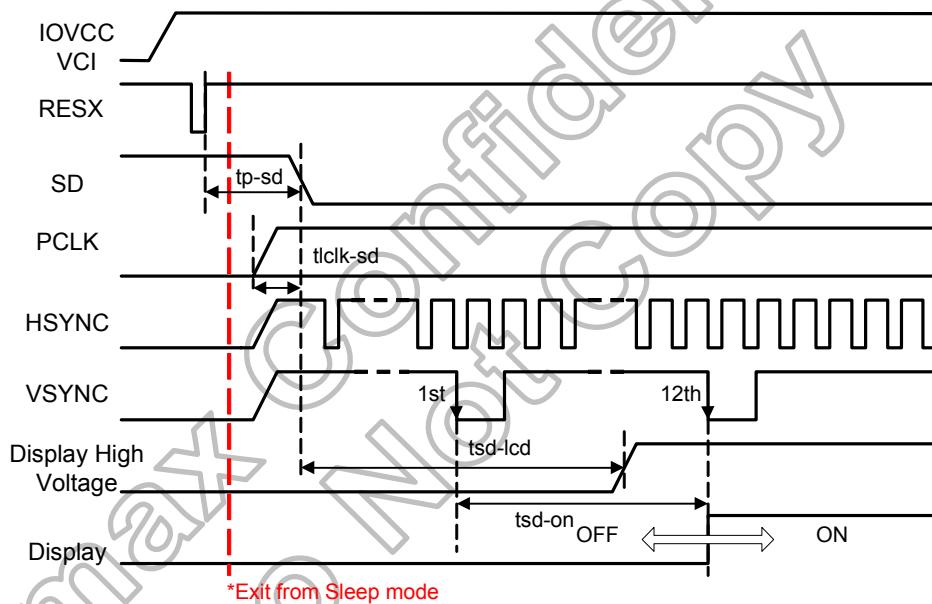


Figure 4.17: Power on and Shutdown Recovery Sequence

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
RESX off to falling edge of SD	tp-sd	-	5	-	-	ms
PCLK input to the falling edge of SD	tclk-sd	-	1	-	-	PCLK
Falling edge of SD to display start	tsd-on	-	-	12	-	Vertical period

Table 4.15: AC timing for power-on sequence and recovery sequence from shutdown

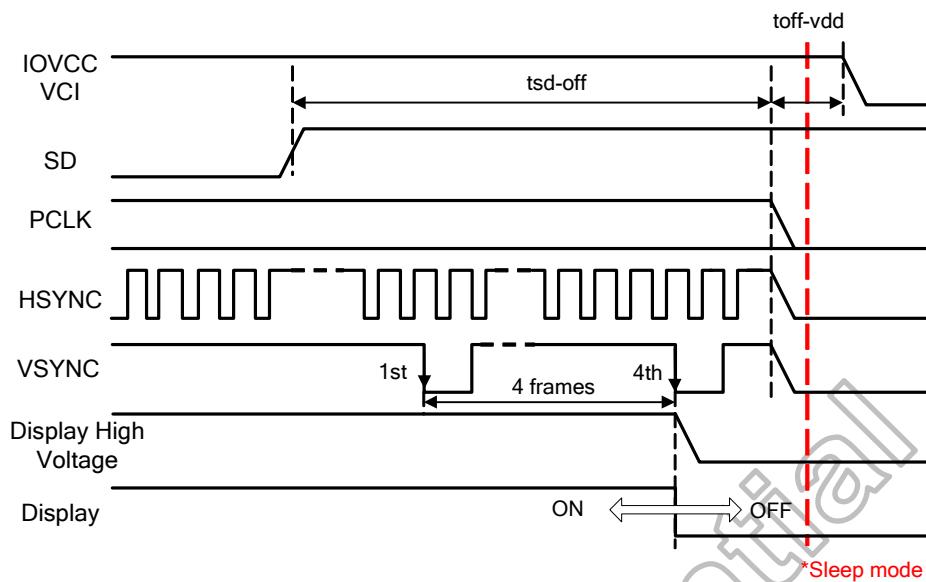


Figure 4.18: Power off and Shutdown Sequence

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Rising edge of SD to display off	tsd-off	-	4	-	-	Vertical period
Input-signal-off to IOVCC/VCI off	toff-vdd	-	0	-	-	s

Table 4.16: AC timing for power-off sequence and shutdown sequence

Color mode for DPI interface hardware control

The Color Mode signal, CM, is used to change the displayed number of colors. When CM is asserted high, the display module shall show the image data using eight colors, MSB for each R, G, and B color components. All unnecessary circuits on the display module may be stopped at the same time to reduce display module power consumption.

Transition from full-color mode to 8-color mode shall occur on the VSYNC following a low-to-high transition on CM.

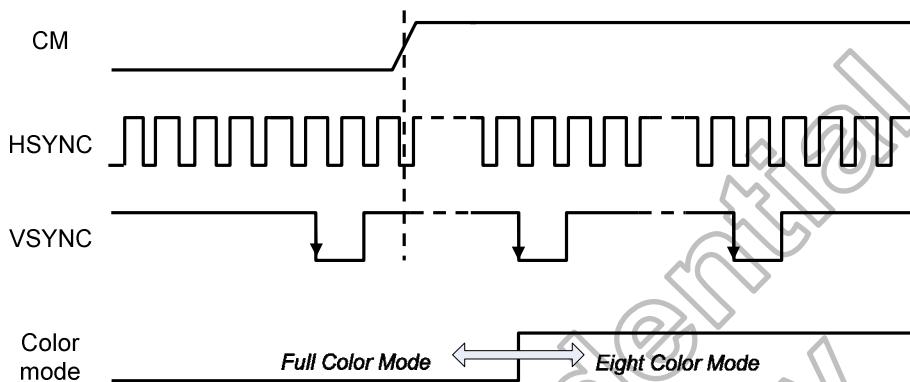


Figure 4.19: Full-color to 8-color Mode Transition Sequence

Transition from 8-color mode to full-color mode shall occur on the Vsync following a high-to-low transition on CM.

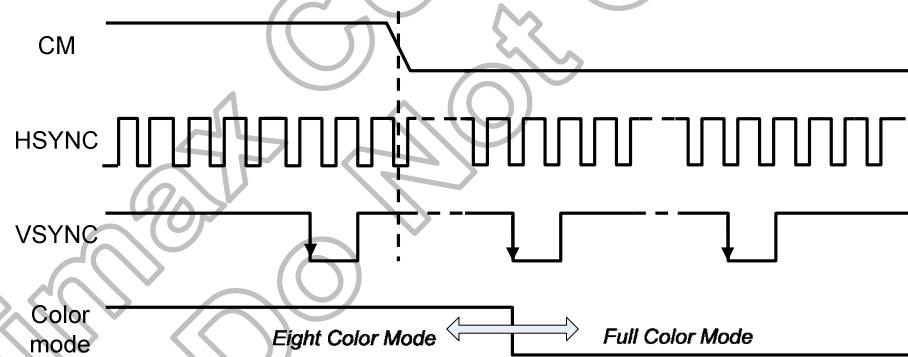


Figure 4.20: 8-color to Full-color Mode Transition Sequence

5. Function Description

5.1 Display Data GRAM

The display data RAM stores display dots and consists of 2,764,800 bits (320x18x480 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.

5.1.1 Address Counter (AC)

The HX8357-B contains an address counter (AC) which assigns address for writing/reading pixel data to/from GRAM. The address pointers set the position of GRAM whose addresses range:

MX	MY	MV	X Range	Y Range	Panel Resolution
X	X	0	0~319d	0~479d	320RGB x480 dot
		1	0~479d	0~319d	

Table 5.1: Addresses Counter Range

Every time when a pixel data is written into the GRAM, the X address or Y address of AC will be automatically increased by 1 (or decreased by 1), which is decided by the register (MV, MX and MY bit) setting.

To simplify the address control of GRAM access, the window address function allows for writing data only to a window area of GRAM specified by registers. After data is written to the GRAM, the AC will be increased or decreased within setting window address-range which is specified by the Column address register (start: SC, end: EC) or the Row address register (start: SP, end: EP). Therefore, the data can be written consecutively without thinking a data wrap by those bit function.

5.1.2 MCU to Memory Write/Read Direction

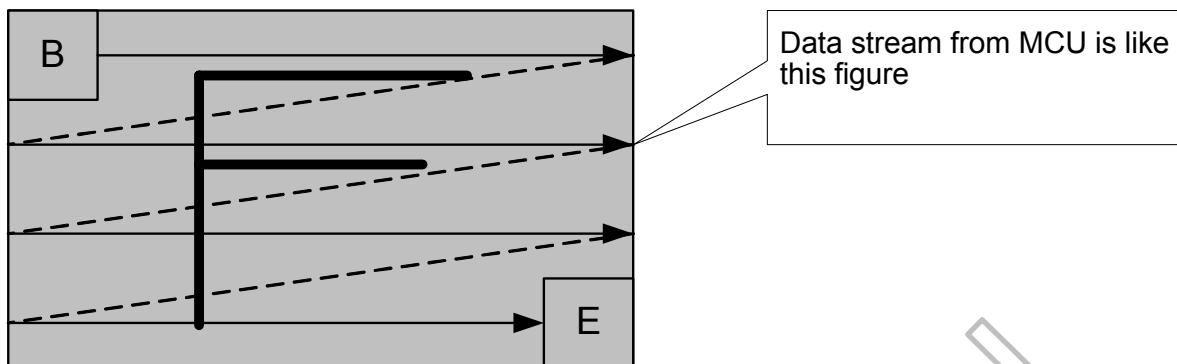


Figure 5.1: MCU to Memory Write/Read Direction

The data is written in the order as illustrated above. The counter that dictates which physical memory the data is to be written is controlled by “Memory Access Control” Command, Bits MY, MX, MV as described below.

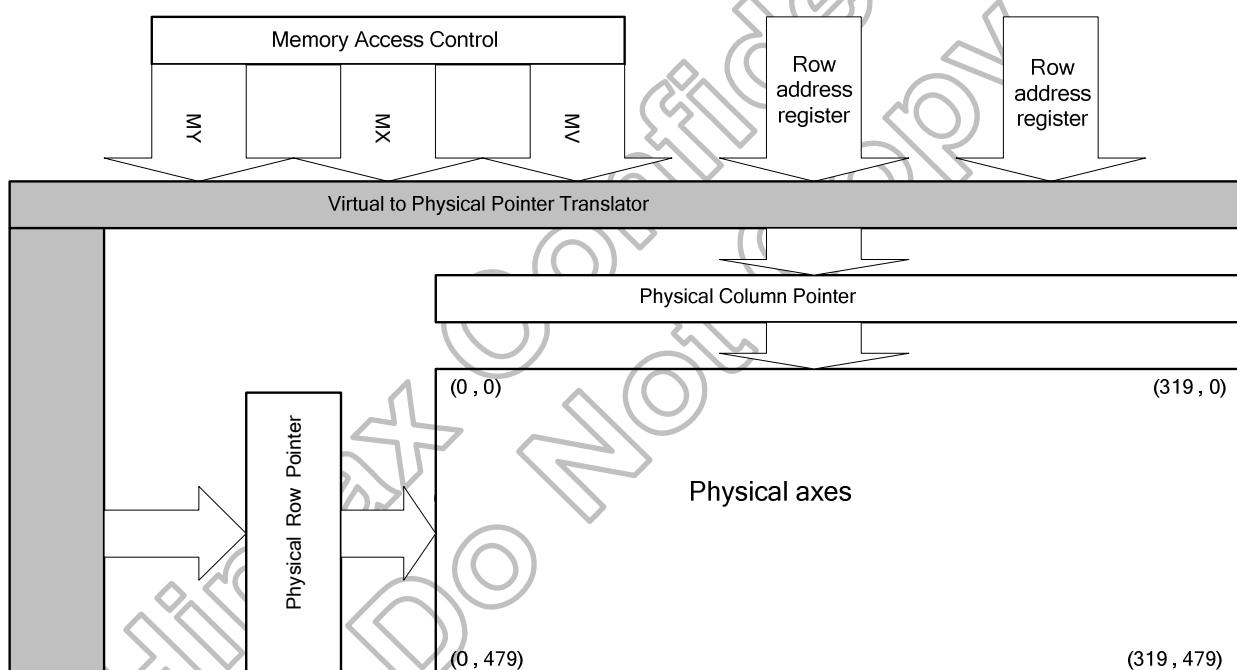


Figure 5.2: MY, MX, MV Setting of GRAM control

MV	MX	MY	CASET	PASET
0	0	0	Direct to Physical Column Pointer	Direct to Physical Row Pointer
0	0	1	Direct to Physical Column Pointer	Direct to (479-Physical Row Pointer) with SC
0	1	0	Direct to (319-Physical Column Pointer)	Direct to Physical Row Pointer
0	1	1	Direct to (319-Physical Column Pointer)	Direct to (479-Physical Row Pointer)
1	0	0	Direct to Physical Row Pointer	Direct to Physical Column Pointer
1	0	1	Direct to (479-Physical Row Pointer)	Direct to Physical Column Pointer
1	1	0	Direct to Physical Row Pointer	Direct to (319-Physical Column Pointer)
1	1	1	Direct to (479-Physical Row Pointer)	Direct to (319-Physical Column Pointer)

Table 5.2: MY, MX, MV Setting of GRAM address mapping

The following figure depicts the update method set by MV, MX and MY bit.

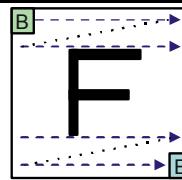
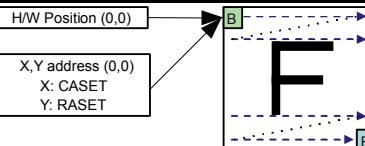
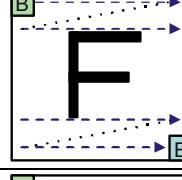
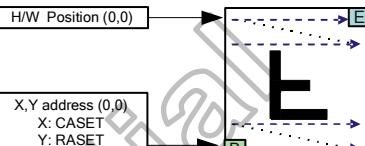
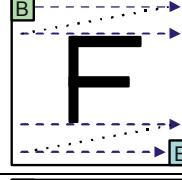
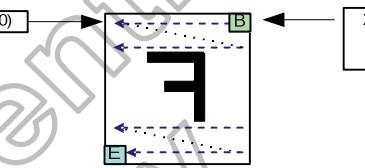
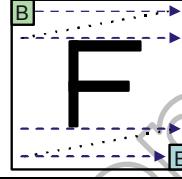
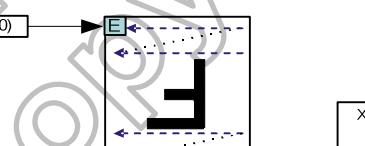
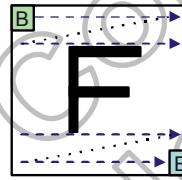
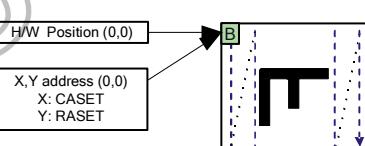
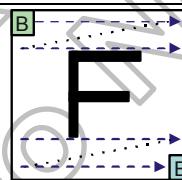
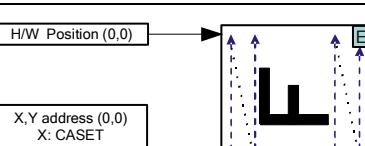
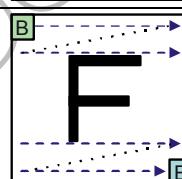
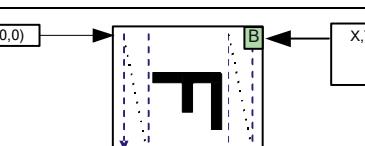
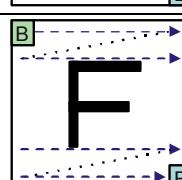
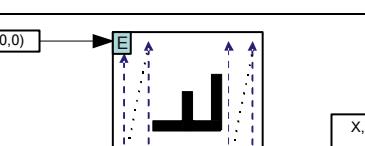
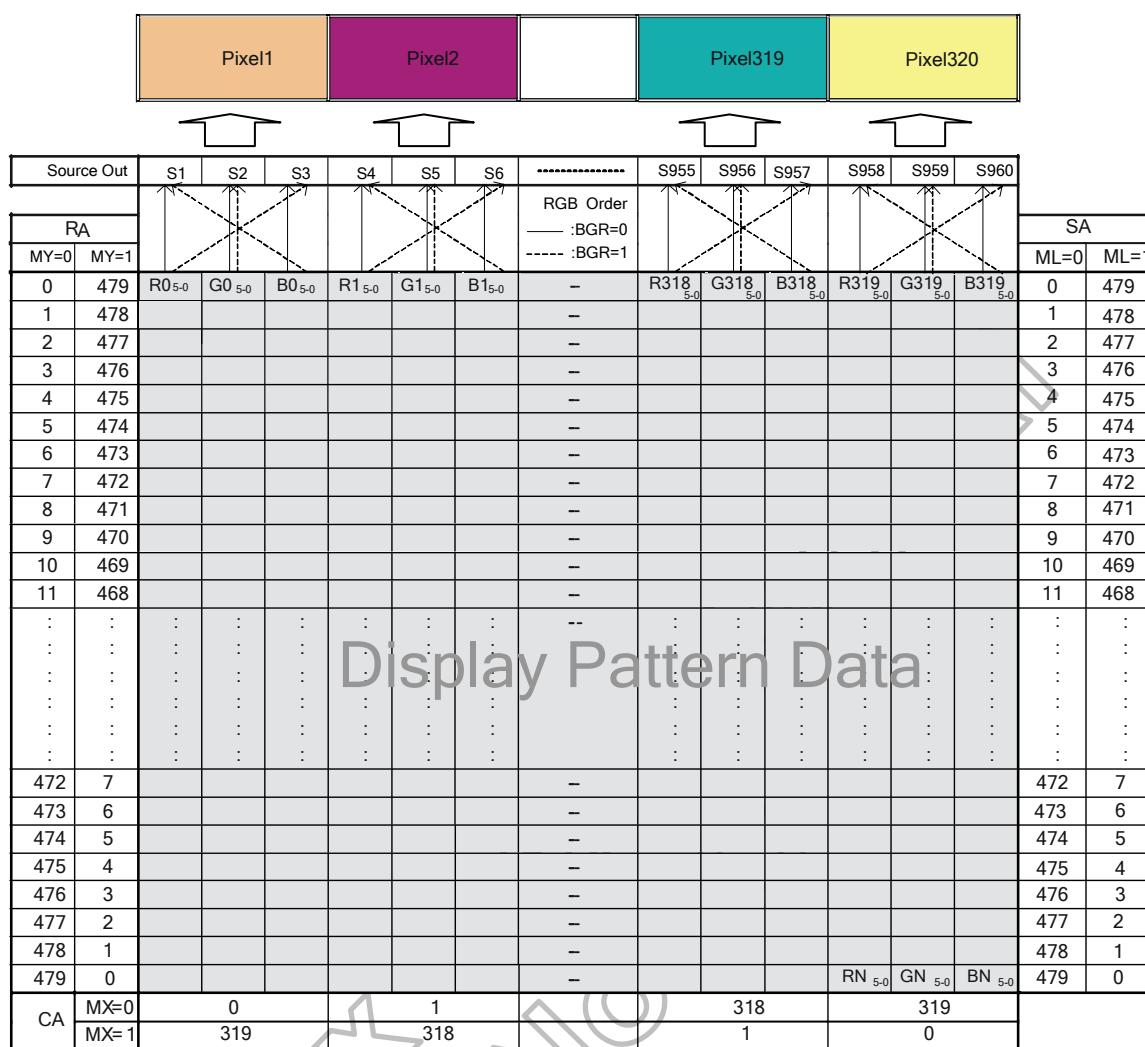
Display Data Direction	Memory Access Control			Image in the Host	Image in the Driver (GRAM)
	MV	MX	MY		
Normal	0	0	0		 H/W Position (0,0) X,Y address (0,0) X: CASET Y: RASET
Y-Mirror	0	0	1		 H/W Position (0,0) X,Y address (0,0) X: CASET Y: RASET
X-Mirror	0	1	0		 H/W Position (0,0) X,Y address (0,0) X: CASET Y: RASET
X-Mirror Y-Mirror	0	1	1		 H/W Position (0,0) X,Y address (0,0) X: CASET Y: RASET
X-Y Exchange	1	0	0		 H/W Position (0,0) X,Y address (0,0) X: CASET Y: RASET
X-Y Exchange Y-Mirror	1	0	1		 H/W Position (0,0) X,Y address (0,0) X: CASET Y: RASET
X-Y Exchange X-Mirror	1	1	0		 H/W Position (0,0) X,Y address (0,0) X: CASET Y: RASET
X-Y Exchange X-Mirror Y-Mirror	1	1	1		 H/W Position (0,0) X,Y address (0,0) X: CASET Y: RASET

Figure 5.3: Address Direction Settings

5.1.3 Source, Gate and Memory Map



		Pixel1						Pixel2				Pixel319			Pixel320					
		Source Out			S1	S2	S3	S4	S5	S6	Source Out			S955	S956	S957	S958	S959	S960	
		RA		MY=0	RA	RA	RA	RA	RA	RA	SA		ML=0	ML=1						
		MY=1																		
0	479	R0	5-0	G0	5-0	B0	5-0	R1	5-0	G1	5-0	B1	5-0	-	R318	5-0	G318	5-0	B318	5-0
1	478													-						
2	477													-						
3	476													-						
4	475													-						
5	474													-						
6	473													-						
7	472													-						
8	471													-						
9	470													-						
10	469													-						
11	468													-						
:	:	:	:	:	:	:	:	:	:	:	:	:	--	:	:	:	:	:		
:	:	:	:	:	:	:	:	:	:	:	:	:		:	:	:	:	:		
:	:	:	:	:	:	:	:	:	:	:	:	:		:	:	:	:	:		
:	:	:	:	:	:	:	:	:	:	:	:	:		:	:	:	:	:		
:	:	:	:	:	:	:	:	:	:	:	:	:		:	:	:	:	:		
472	7												-						472 7	
473	6												-						473 6	
474	5												-						474 5	
475	4												-						475 4	
476	3												-						476 3	
477	2												-						477 2	
478	1												-						478 1	
479	0												-	RN	5-0	GN	5-0	BN	5-0	
CA		MX=0	0			1			318			319							479 0	
		MX=1	319			318			1			0								

Note: RA = Row Address.

CA = Column Address.

SA = Scan Address.

MX = Mirror X-axis (Column address direction parameter), D6 parameter of Memory Access Control (R36h) command

MY = Mirror Y-axis (Row address direction parameter), D7 parameter of Memory Access Control (R36h) command

ML = Scan direction parameter, D4 parameter of Memory Access Control (R36h) command

BGR = Red, Green and Blue pixel position change, D3 parameter of Memory Access Control (R36h) command

Figure 5.4: Memory Map - 320RGBx480 dot

5.1.4 Fully Display, Partial Display, Vertical Scrolling Display

5.1.4.1 Fully Display

Example: (1) 320RGBx480 dot display mode.

(2) NORON (Normal Display Mode On) instruction (R13h).

(3) SC=0x000h, EC=0x13Fh (R2Ah) and SP=0x000h, EP=0x1DFh (R2Bh), ML=0.

GRAM	00h	01h	-----	13Eh	13Fh
	DB---DB 17 --- 0	DB---DB 17 --- 0	-----	DB---DB 17 --- 0	DB---DB 17 --- 0
000h	000000H	000001H	-----	00013EH	00013FH
001h	001000H	001001H	-----	00113EH	00113FH
002h	002000H	002001H	-----	00213EH	00213FH
003h	003000H	003001H	-----	00313EH	00313FH
004h	004000H	004001H	-----	00413EH	00413FH
005h	005000H	005001H	-----	00513EH	00513FH
-----	-----	-----	-----	-----	-----
1DAh	1DA000H	1DA001H	-----	1DA13EH	1DA13FH
1DBh	1DB000H	1DB001H	-----	1DB13EH	1DB13FH
1DCh	1DC000H	1DC001H	-----	1DC13EH	1DC13FH
1DDh	1DD000H	1DD001H	-----	1DD13EH	1DD13FH
1DEh	1DE000H	1DE001H	-----	1DE13EH	1DE13FH
1DFh	1DF000H	1DF001H	-----	1DF13EH	1DF13FH

Table 5.3: Memory map of full display

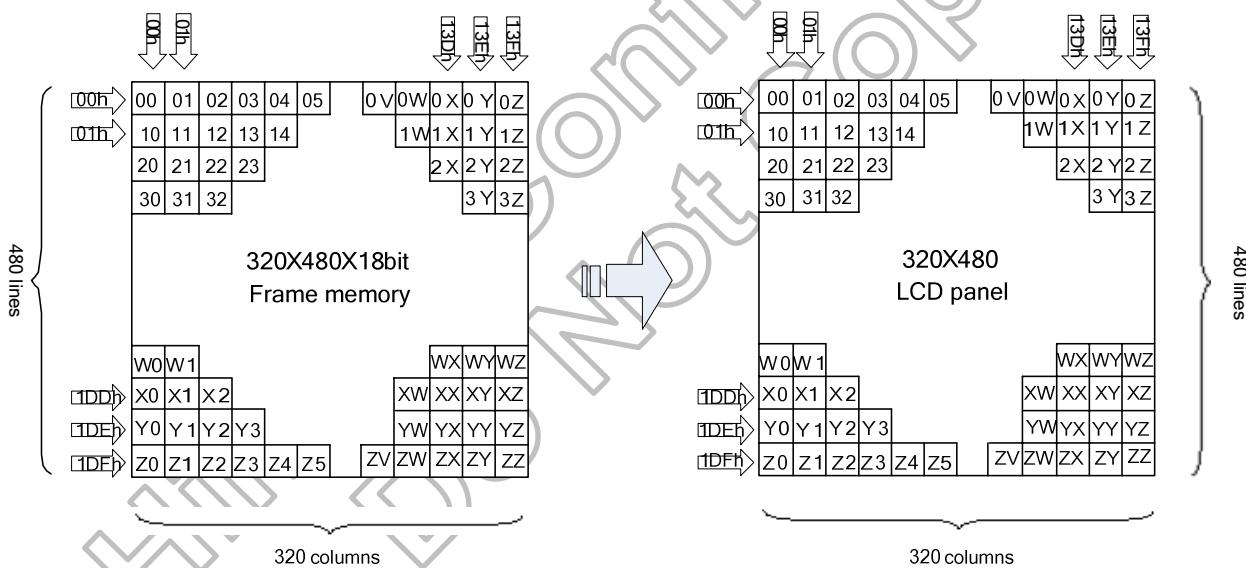


Figure 5.5: Memory map of full display

5.1.4.2 Partial Display

- Example: (1) 320RGBx480 dot display mode.
 (2) PLTON instruction (R12h).
 (3) SR[15:0]=0002h, ER[15:0]=01DBh, ML=0.

GRAM	00h	01h	-----	13Eh	13Fh
	DB---DB 17 --- 0	DB---DB 17 --- 0	-----	DB---DB 17 --- 0	DB---DB 17 --- 0
000h	000000H	000001H	-----	00013EH	00013FH
001h	001000H	001001H	-----	00113EH	00113FH
002h	002000H	002001H	-----	00213EH	00213FH
003h	003000H	003001H	-----	00313EH	00313FH
004h	004000H	004001H	-----	00413EH	00413FH
005h	005000H	005001H	-----	00513EH	00513FH
1DAh	1DA000H	1DA001H	-----	1DA13EH	1DA13FH
1DBh	1DB000H	1DB001H	-----	1DB13EH	1DB13FH
1DCh	1DC000H	1DC001H	-----	1DC13EH	1DC13FH
1DDh	1DD000H	1DD001H	-----	1DD13EH	1DD13FH
1DEh	1DE000H	1DE001H	-----	1DE13EH	1DE13FH
1DFh	1DF000H	1DF001H	-----	1DF13EH	1DF13FH

LCD panel S/G pins	Pixel 1	Pixel 2	-----	Pixel319	Pixel320
G1	000000H	000001H	-----	00013EH	00013FH
G2	001000H	001001H	-----	00113EH	00113FH
G3	002000H	002001H	-----	00213EH	00213FH
G4	003000H	003001H	-----	00313EH	00313FH
G5	004000H	004001H	-----	00413EH	00413FH
G6	005000H	005001H	-----	00513EH	00513FH
G475	1DA000H	1DA001H	-----	1DA13EH	1DA13FH
G476	1DB000H	1DB001H	-----	1DB13EH	1DB13FH
G477	1DC000H	1DC001H	-----	1DC13EH	1DC13FH
G478	1DD000H	1DD001H	-----	1DD13EH	1DD13FH
G479	1DE000H	1DE001H	-----	1DE13EH	1DE13FH
G480	1DF000H	1DF001H	-----	1DF13EH	1DF13FH

Table 5.4: Memory map of partial display

5.1.4.3 Vertical Scrolling Display

The vertical scrolling display is specified by VSCRDEF instruction (R33h) and VSCRSADD instruction (R37h).

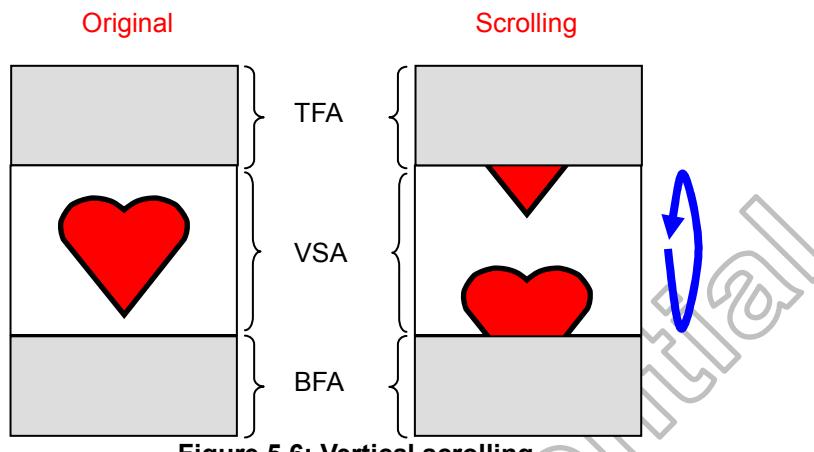


Figure 5.6: Vertical scrolling

When Vertical Scrolling Definition Parameters ($TFA + VSA + BFA = \text{Panel total scan lines}$). In this case, scrolling is applied as shown below.

Example 1: (1) 320RGBx480 dot display mode.

- (2) $TFA=2$, $VSA=478$, $BFA=0$ when MADCTL B4=0
- (3) $VSCRSADD=03h$

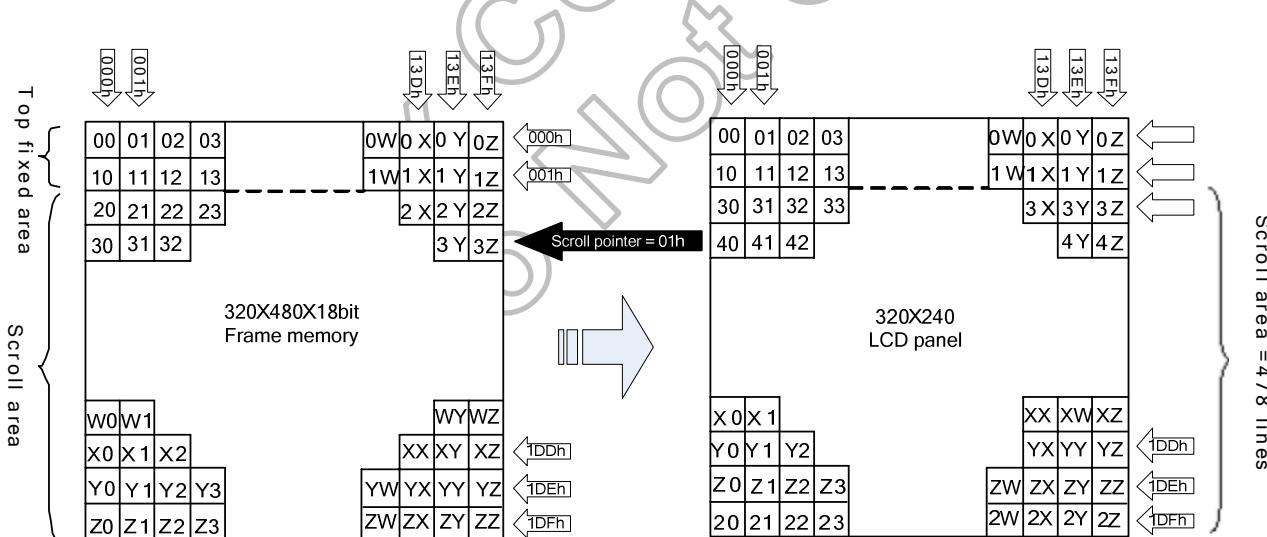


Figure 5.7: Memory map of vertical scrolling example 1

Example 2: (1) 320RGBx480 dot display mode.

- (2) TFA=2, VSA=476, BFA=2 when MADCTL B4=0
- (3) VSCRSADD=03h

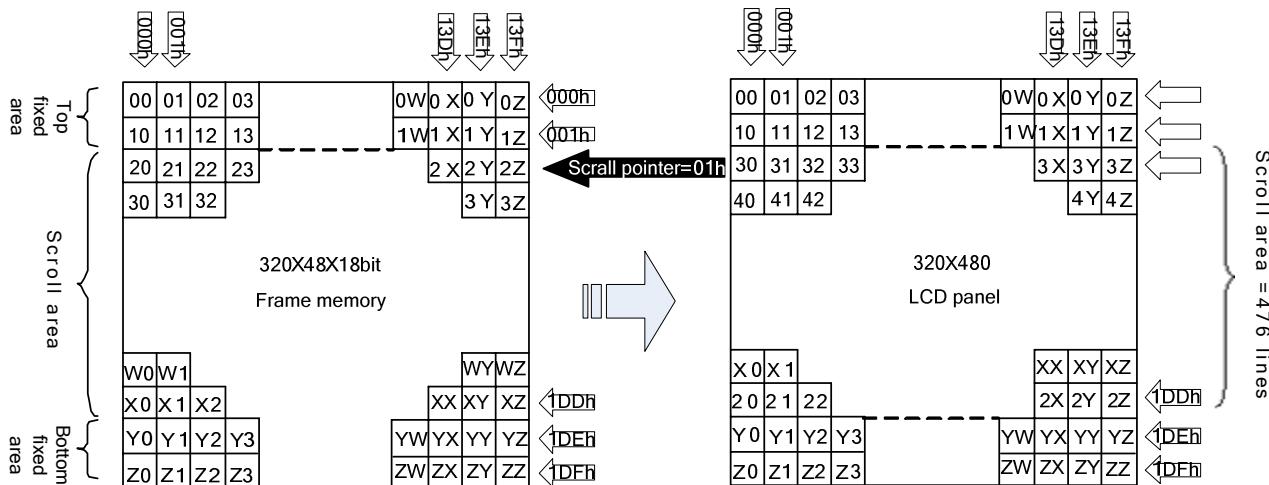


Figure 5.8: Memory map of vertical scrolling example 2

Example 3: (1) 320RGBx480 dot display mode.

- (2) TFA=2, VSA=476, BFA=2 when MADCTL B4=0
- (3) VSCRSADD=04h

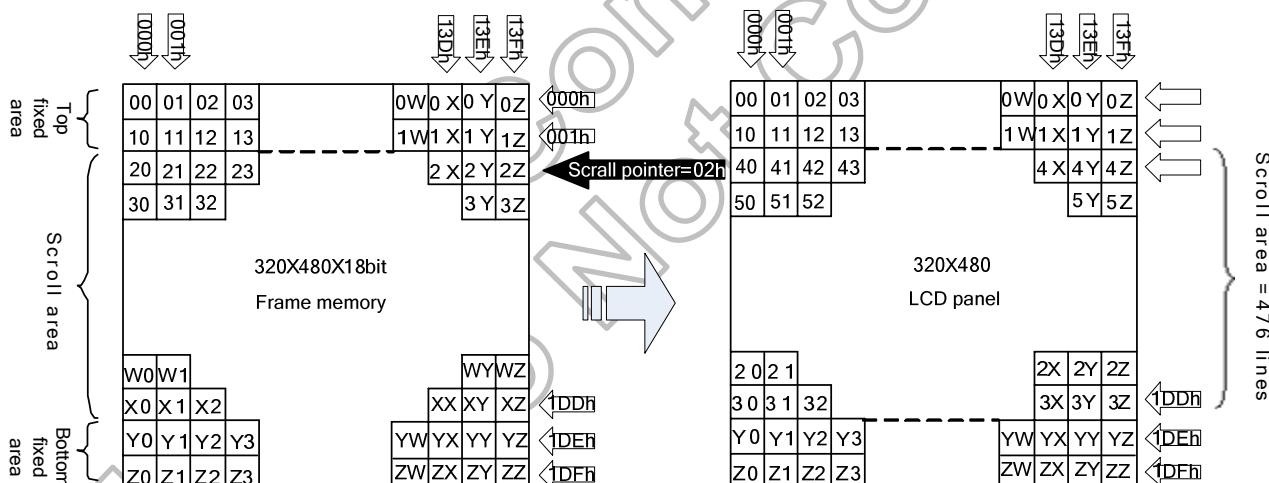


Figure 5.9: Memory map of vertical scrolling example 3

Vertical Scroll Example

There are 2 types of vertical scrolling, which are determined by the commands “Vertical Scrolling Definition” (33h) and “Vertical Scrolling Start Address” (37h).

Case 1: TFA + VSA + BFA ≠ Panel scan lines

N/A. Do not set TFA + VSA + BFA≠Panel scan lines. In that case, unexpected picture will be shown.

Case 2: TFA + VSA + BFA = Panel scan lines (Scrolling)

Example 1: (1) 320RGBx480 dot display mode.

(2) When TFA=0, VSA=480, BFA=0 and VSCRSADD=40, MADCTL parameter B4="0"

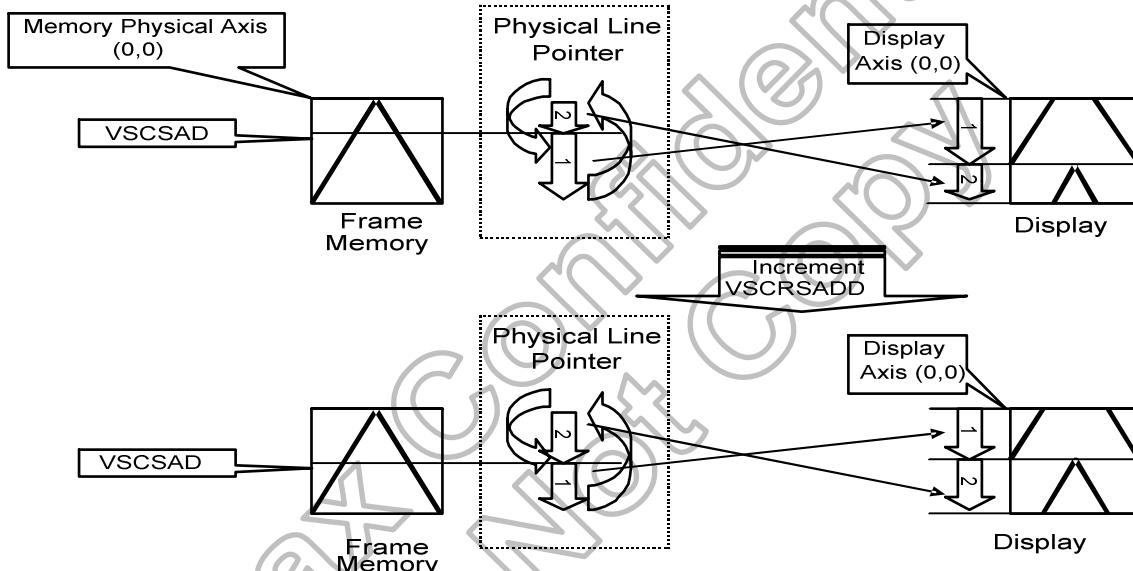


Figure 5.10: Display of Vertical Scroll Example 1

Example 2: (1) 320RGBx480 dot display mode.

(2) TFA=60, VSA=420, BFA=0 and VSCRSADD =160. MADCTRL parameter
B4="1"

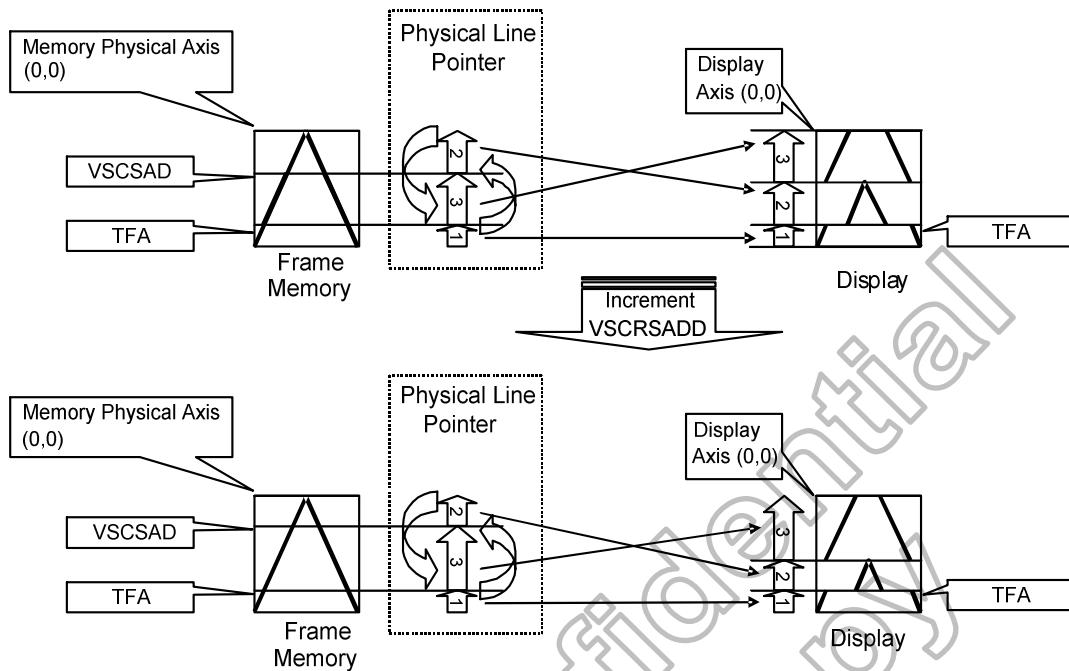


Figure 5.11: Display of Vertical Scroll Example 2

5.2 Tearing Effect Output Line

The Tearing Effect output line supplies to the MPU a Panel synchronization signal. This signal 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 On command. The signal can be used by the MPU to synchronize Frame Memory Writing when displaying video images.

5.2.1 Tearing Effect Line Modes

Mode 1, the Tearing Effect Output signal consists of V-Blanking Information only:

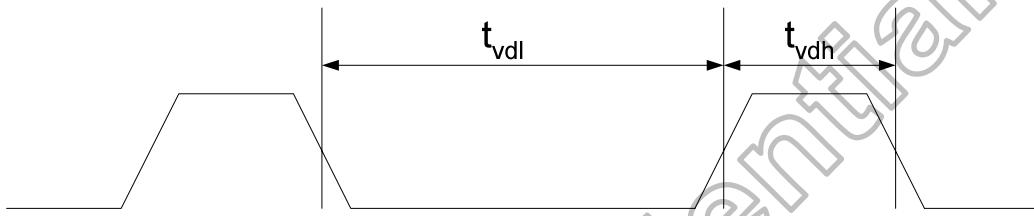


Figure 5.12: Tearing Effect Output signal mode 1

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)

Under Mode1, the TE output timing will be defined by TSEL[15:0] setting.

Ex: 1. TSEL[15:0]=0, then TE signal will output after last Line finished.

TSEL[15:0]=2, then TE signal will output at second Line start.

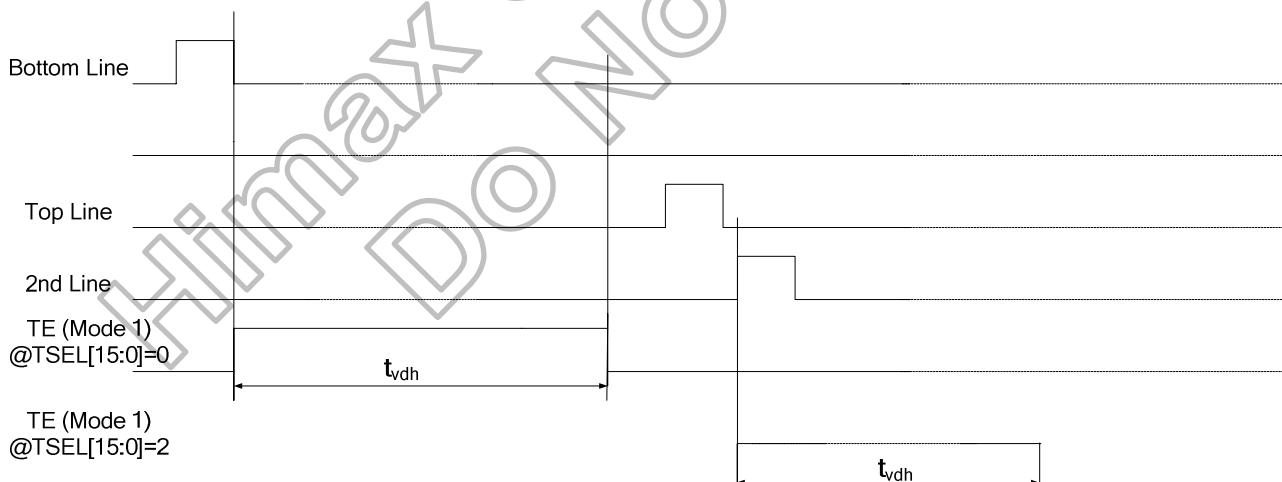


Figure 5.13: TE Delay Output

Mode 2, the Tearing Effect Output signal consists of V-Blanking and H-Blanking Information, there is one V-sync and 480 H-sync pulses per field.

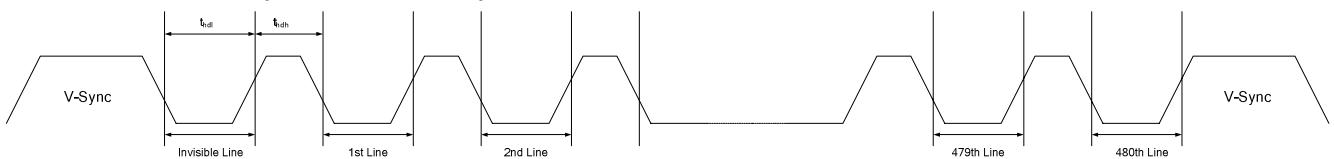


Figure 5.14: Tearing Effect Output signal mode 2

t_{dh}= The LCD display is not updated from the Frame Memory

t_{hd}= The LCD display is updated from the Frame Memory (except Invisible Line – see above)

Under Mode2, the H-sync pulse output amount will be defined by TSEL[15:0] setting.

Ex: TSEL[15:0]=0, then TE signal will output 480 H-sync.

TSEL[15:0]=1, then TE signal will output 480 H-sync.

TSEL[15:0]=2, then TE signal will output 479 H-sync.

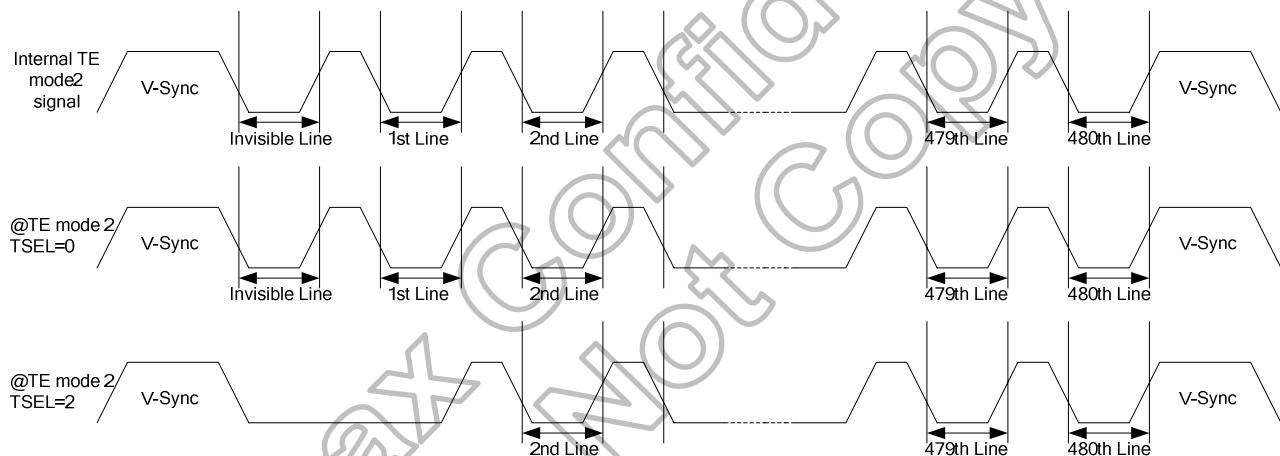
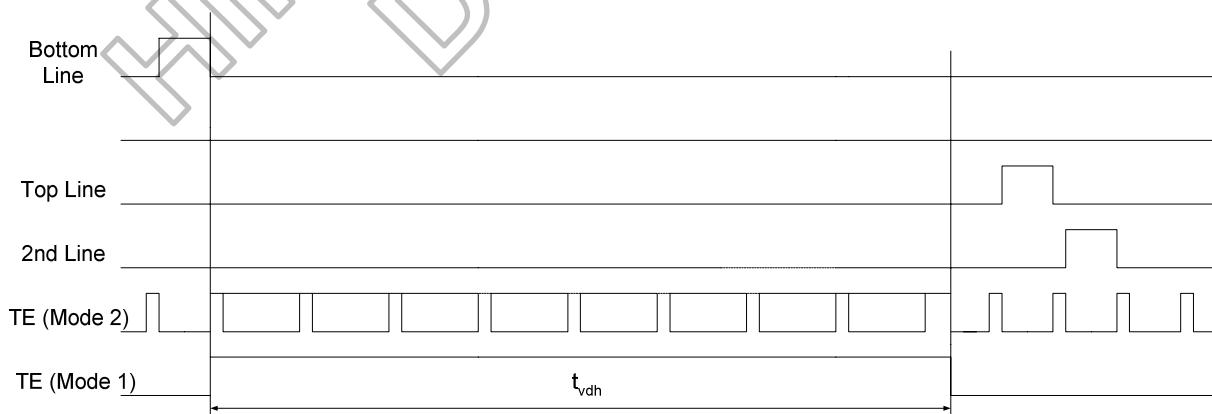


Figure 5.15: TE Output for TELINE setting



Note: During Sleep in Mode, the Tearing Output Pin is active Low

Figure 5.16: Tearing Effect Output signal

5.2.2 Tearing Effect Line Timing

The Tearing Effect signal is described below:

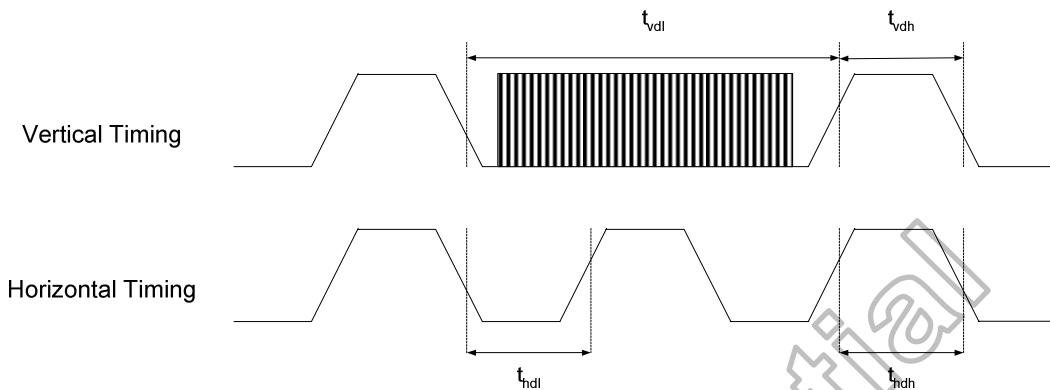


Figure 5.17: Tearing Effect Line Timing

Idle Mode Off

Symbol	Parameter	Min.	Max.	Unit	description
tvdl	Vertical Timing Low Duration	-	-	ms	-
tvdh	Vertical Timing High Duration	-	-	us	-
thdl	Horizontal Timing Low Duration	-	-	us	-
thdh	Horizontal Timing High Duration	-	500	us	-

Note: The timings in Table 5.5 apply when MADCTL ML=0 and ML=1

Table 5.5: AC characteristics of Tearing Effect Signal

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

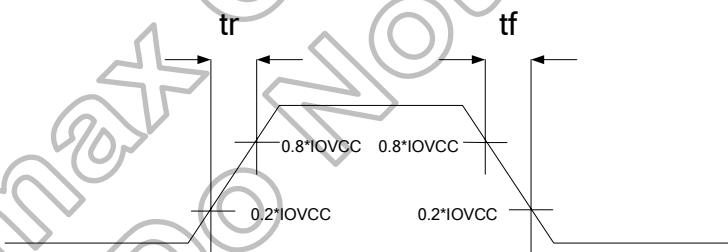
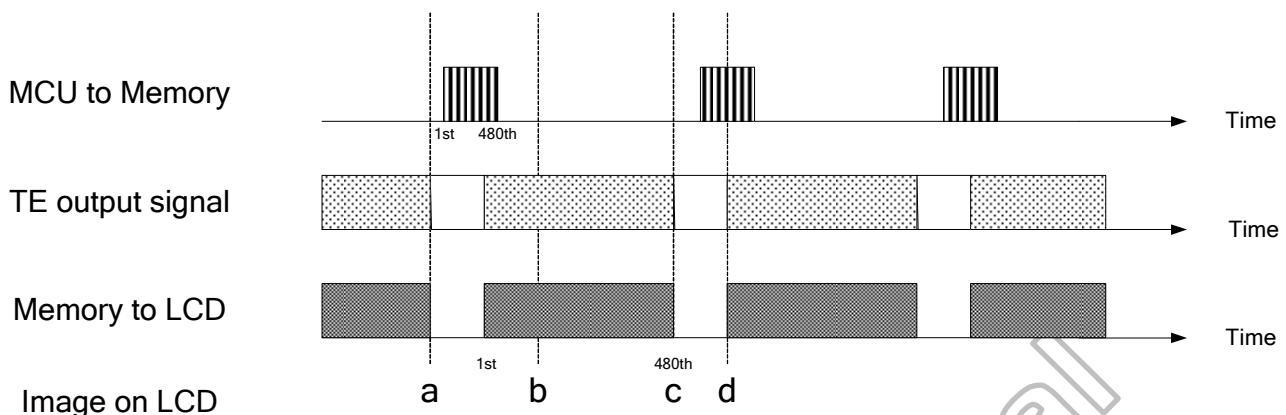
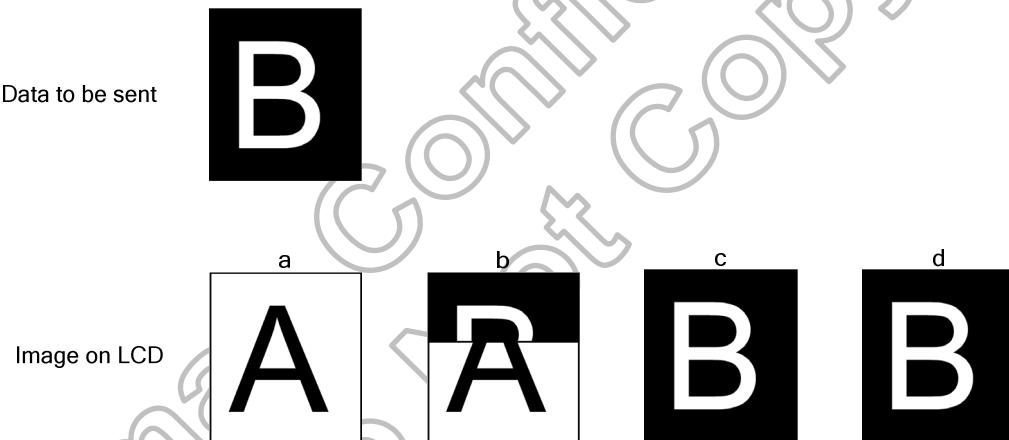


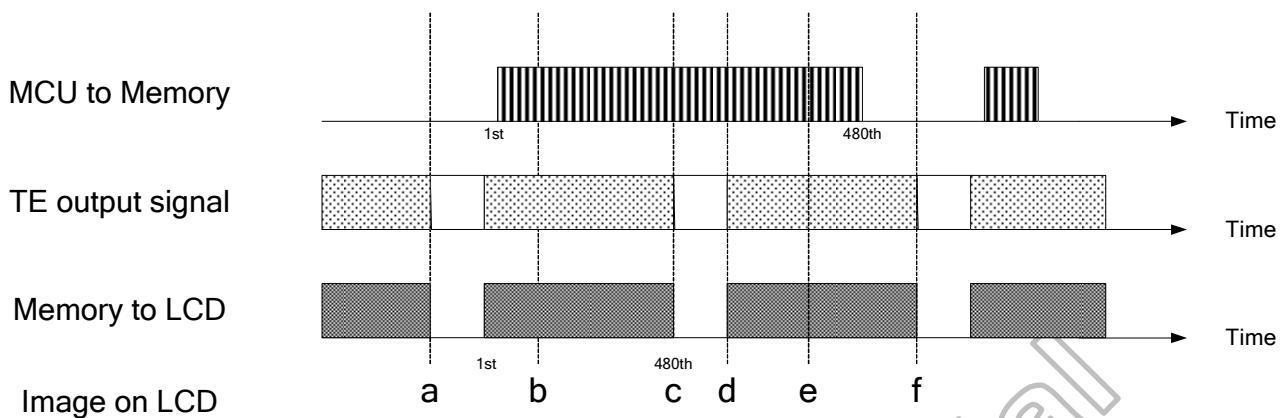
Figure 5.18: Rise and fall times of TE signal

The Tearing Effect Output Line is fed back to the MPU and should be used as shown below to avoid Tearing Effect:

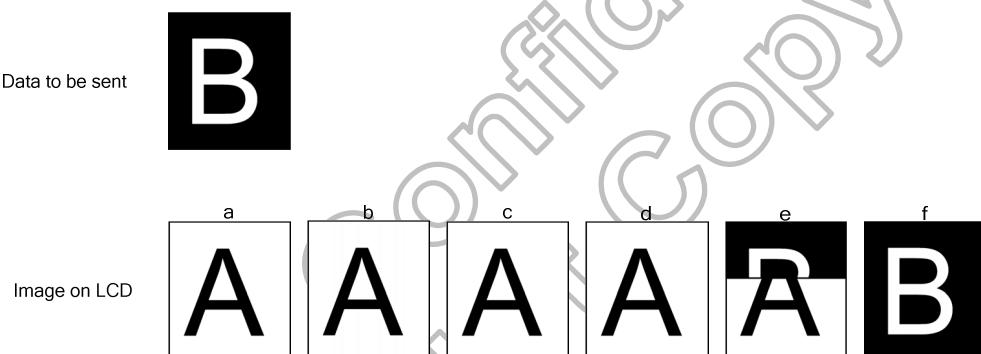
Example 1: MPU's Write is faster than Panel's Read.**Figure 5.19: Tearing Effect - Example 1-1**

Data write to Frame Memory is now synchronized to the Panel Scan. It should be written during the vertical sync pulse of the Tearing Effect Output Line. This ensures that data is always written ahead of the panel scan and each Panel Frame refresh has a complete new image:

**Figure 5.20: Tearing Effect - Example 1-2**

Example 2: MPU's Write is slower than Panel's Read.**Figure 5.21: Tearing Effect - Example 2-1**

The MPU to Frame Memory write begins just after Panel Read has commenced i.e. after one horizontal sync pulse of the Tearing Effect Output Line. This allows time for the image to download behind the Panel Read pointer and finishing download during the subsequent Frame before the Read Pointer "catches" the MPU to Frame memory write position.

**Figure 5.22: Tearing Effect - Example 2-2**

5.3 Oscillator

The HX8357-B can oscillate an internal R-C oscillator with an internal oscillation resistor (R_f). The oscillation frequency is changed according to the UADJ[3:0] internal register. Please refer to Set OSC control register (RC5h). The default frequency is 5.2MHz.

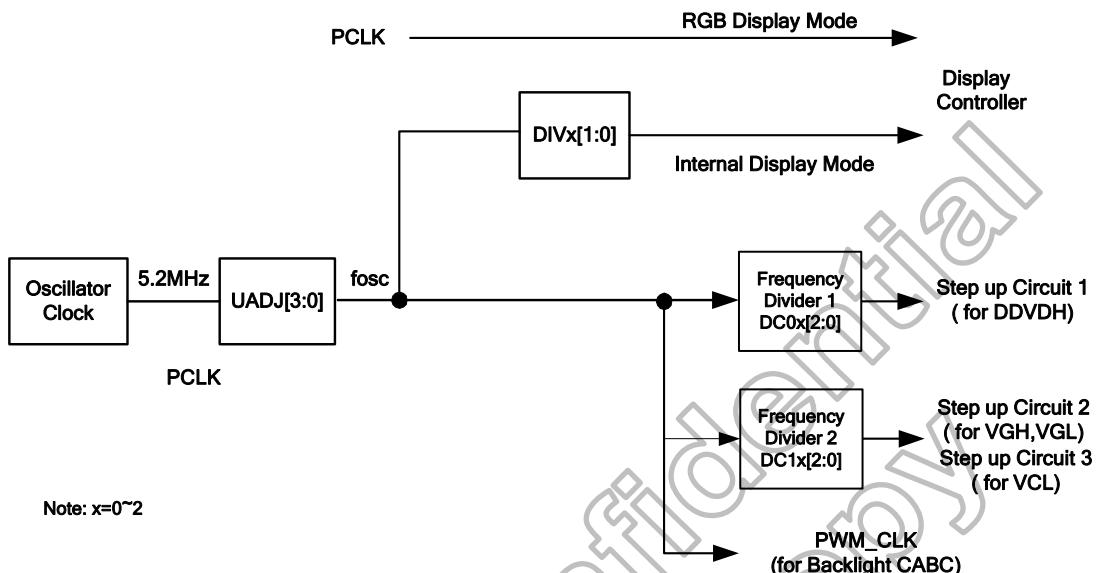


Figure 5.23: Oscillation Circuit

5.4 Source Driver

The HX8357-B contains a 960 channels of source driver (S1~S960) which is used for driving the source line of TFT LCD panel. The source driver converts the digital data from GRAM into the analog voltage for 960 channels and generates corresponding gray scale voltage output, which can realize a 262K colors display simultaneously. Since the output circuit of this source driver incorporates an operational amplifier, a positive and a negative voltage can be alternately outputted from each channel.

5.5 Gate Driver

The HX8357-B contains a 480 gate channels of gate driver (G1~G480) which is used for driving the gate. The gate driver level is VGH when scan some line, VGL the other lines.

5.6 LCD Power Generation Circuit

5.6.1 LCD Power Generation Scheme

The boost voltage generated is shown as below.

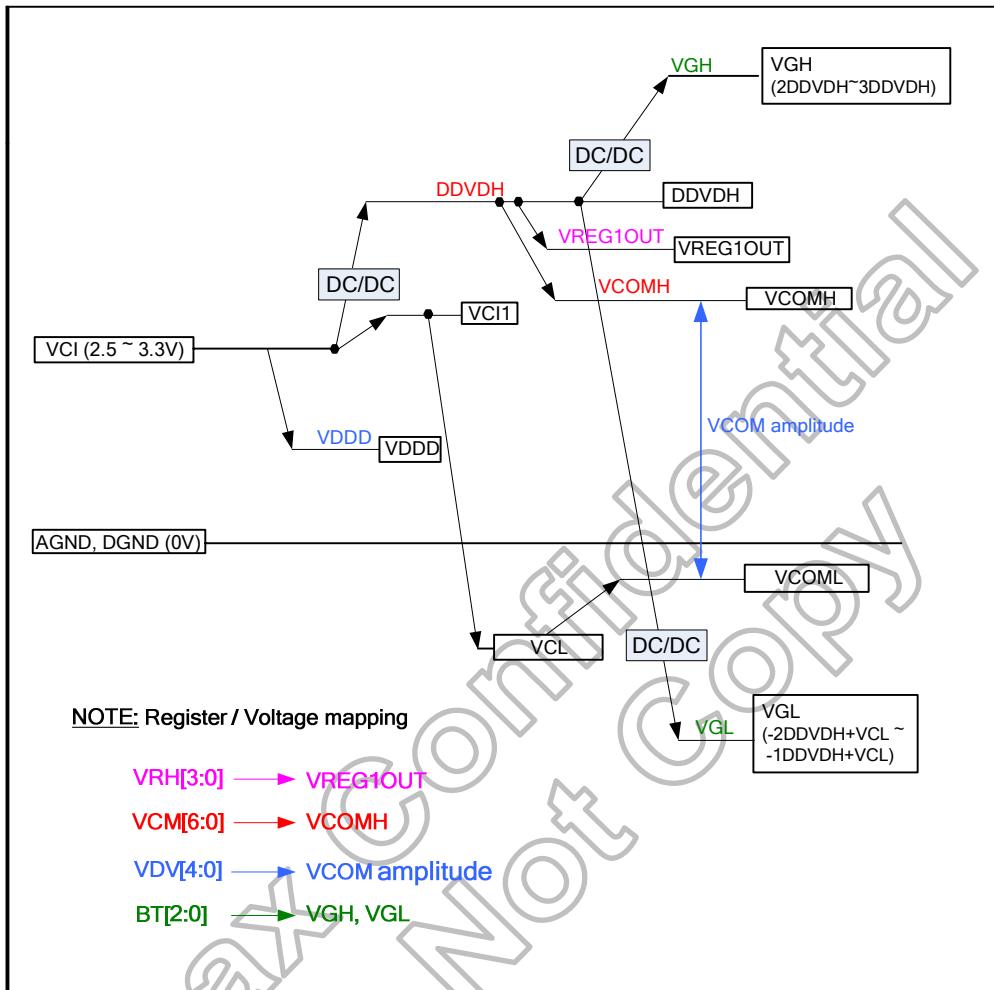
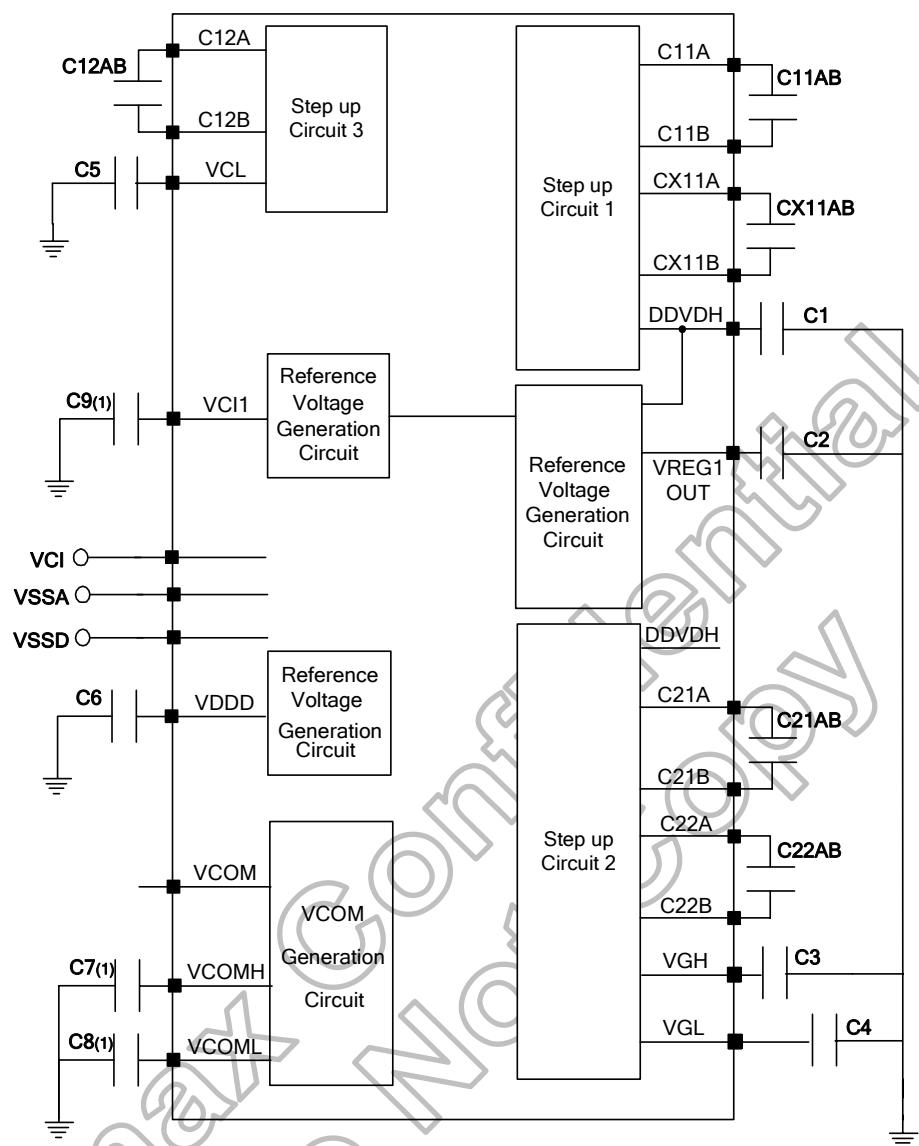


Figure 5.24: LCD Power Generation Scheme

5.6.2 Various Boosting Steps



Note: If Display quality normal, the C7, C8 and C9 can remove.

Figure 5.25: Various Boosting Steps

Specification of Connected Passive Component

Capacitor	Recommended voltage	Capacity	Note
C1 (DDVDH)	10V	1μF (B characteristics)	-
C2 (VREG1OUT)	10V	1μF (B characteristics)	-
C3 (VGH)	25V	1μF (B characteristics)	-
C4 (VGL)	16V	1μF (B characteristics)	-
C5 (VCL)	6V	1μF (B characteristics)	-
C6(VDD)	6V	1μF (B characteristics)	-
C7 (VCOMH)	10V	1μF (B characteristics)	(1)
C8(VCOML)	6V	1μF (B characteristics)	(1)
C9(VCI1)	6V	1μF (B characteristics)	(1)
C11AB (C11A/B)	6V	1μF (B characteristics)	-
CX11AB (CX11A/B)	6V	1μF (B characteristics)	-
C12AB (C12A/B)	6V	1μF (B characteristics)	-
C21AB (C21A/B)	10V	1μF (B characteristics)	-
C22AB (C22A/B)	10V	1μF (B characteristics)	-

Note: (1) If Display quality normal, the C7, C8 and C9 can remove.

Table 5.6: The adoptability of Capacitor

5.7 Gamma Characteristic Correction Function

The HX8357-B incorporates gamma adjustment function for the 262,144-color display (64 grayscale for each R, G, B color). Gamma adjustment operation is implemented by deciding the 8 grayscale levels firstly in gamma adjustment control registers to match the LCD panel. Then total 64 grayscale levels are generated in grayscale voltage generator. These registers are available for both polarities.

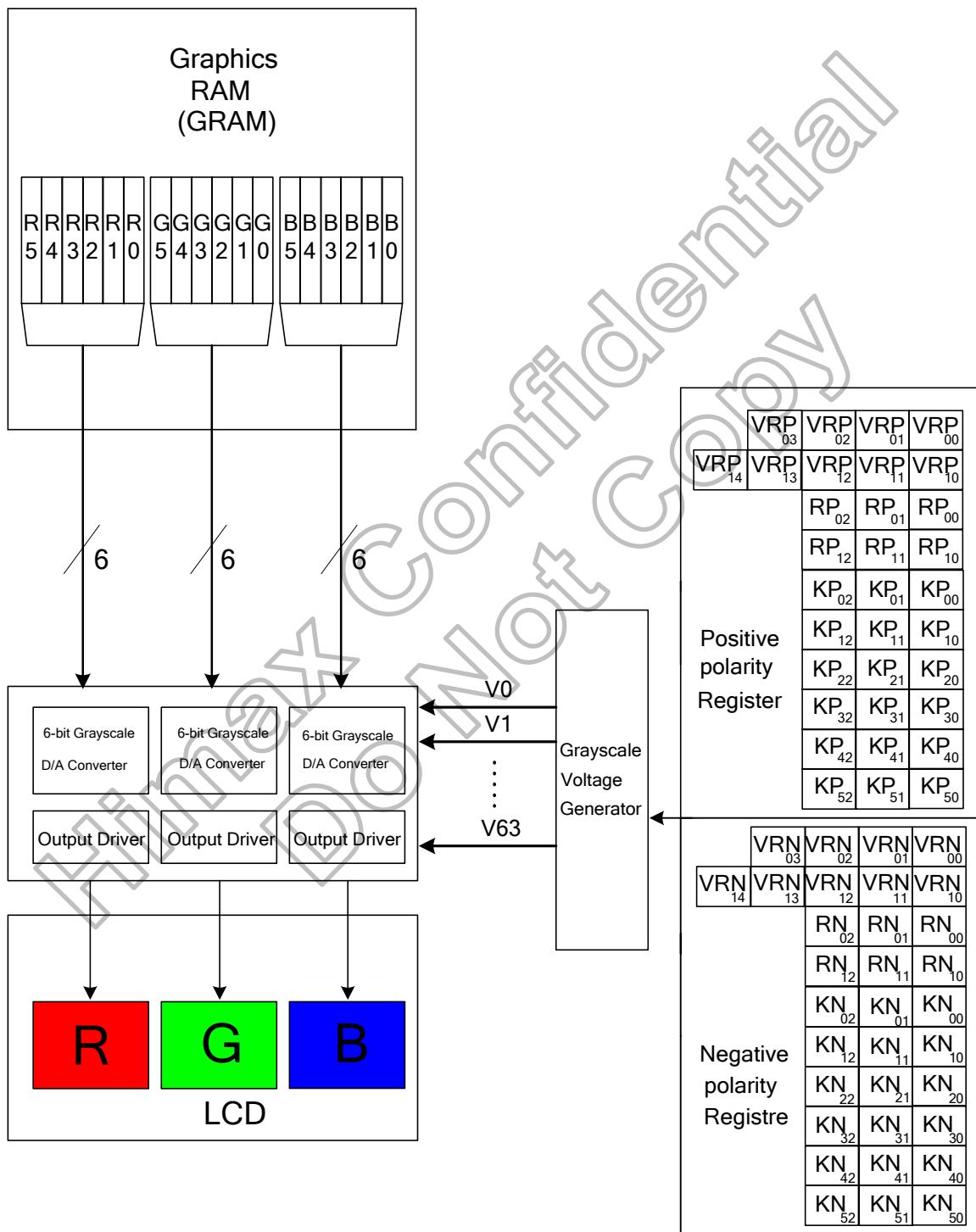


Figure 5.26: Grayscale Control

5.7.1 Structure of Grayscale Voltage Generator

Eight reference gamma voltages $V_{gP/N}(0, 1, 8, 20, 43, 55, 62, 63)$ for positive and negative polarity are specified by the center adjustment, the micro adjustment and the offset adjustment registers firstly. With those eight voltages injected into specified node of grayscale voltage generator, total 64 grayscale voltages (V_0-V_{63}) can be generated from grayscale amplifier for LCD panel used.

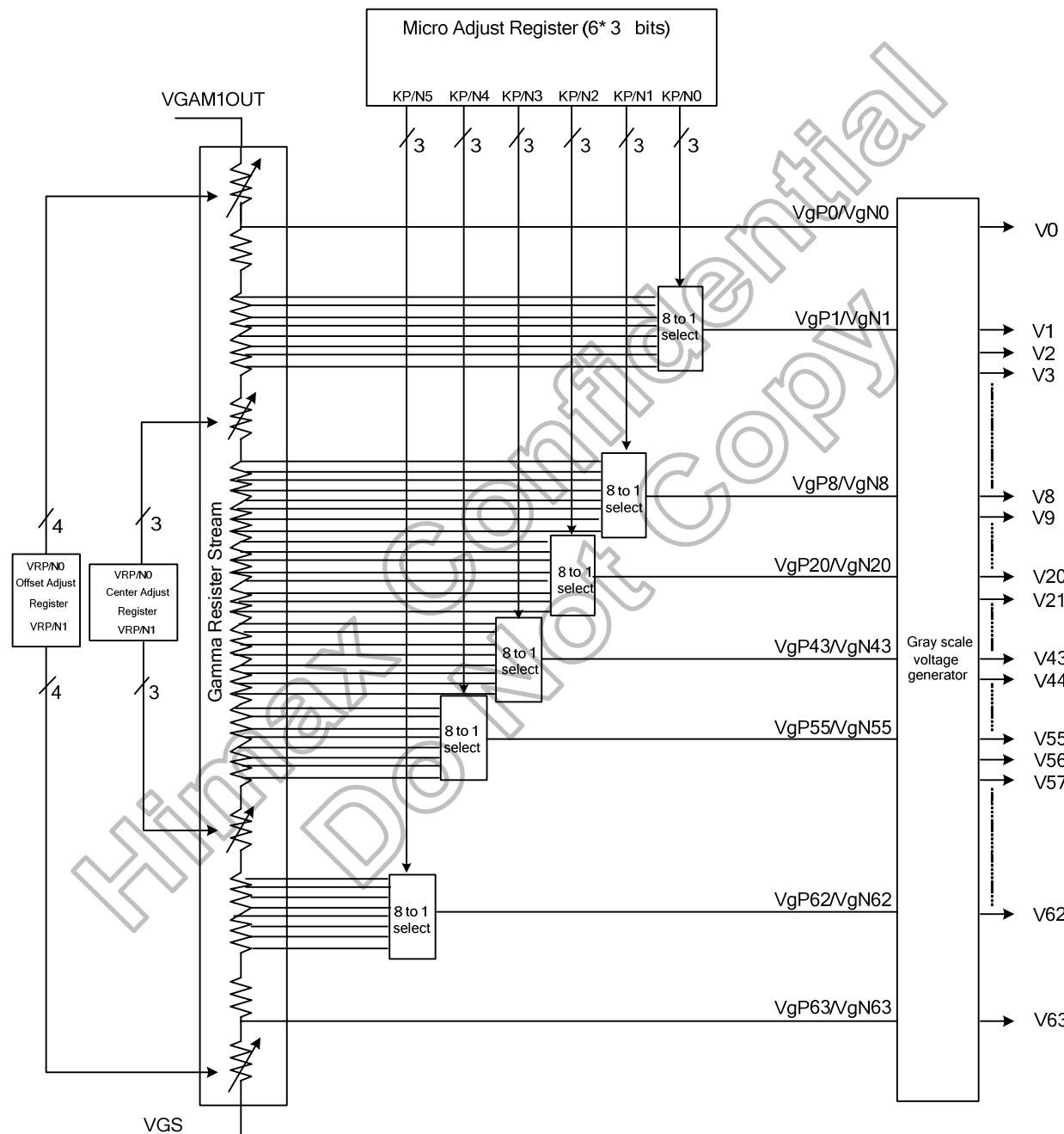


Figure 5.27: Structure of Grayscale Voltage Generator

5.7.2 Gamma-Characteristics Adjustment Register

This HX8357-B has register groups for specifying a series grayscale voltage that meets the Gamma-characteristics for the LCD panel used. These registers are divided into two groups, which correspond to the gradient, amplitude, and macro adjustment of the voltage for the grayscale characteristics. The polarity of each register can be specified independently. (R, G, and B are common.)

A. Offset adjustment registers 0/1

The offset adjustment variable registers are used to adjust the amplitude of the grayscale voltage. This function is implemented by controlling these variable resistors in the top and bottom of the gamma resistor stream for reference gamma voltage generation. These registers are available for both positive and negative polarities

B. Gamma center adjustment registers

The gamma center adjustment registers are used to adjust the reference gamma voltage in the middle level of grayscale without changing the dynamic range. This function is implemented by choosing one input of 8 to 1 selector in the gamma resistor stream for reference gamma voltage generation. These registers are available for both positive and negative polarities.

C. Gamma macro adjustment registers

The gamma macro adjustment registers can be used for fine adjustment of the reference gamma voltage. This function is implemented by controlling the 8-to-1 selectors (KP/N0~5), each of which has 8 inputs and generate one reference voltage output (VgP/N) 1, 8, 20, 43, 55, 62). These registers are available for both positive and negative polarities.

Register Groups	Positive Polarity	Negative Polarity	Description
Center Adjustment	RP0 2-0	RN0 2-0	Variable resistor (VRCP/N0) for center adjustment
	RP1 2-0	RN1 2-0	Variable resistor (VRCP/N1) for center adjustment
Macro Adjustment	KP0 2-0	KN0 2-0	8-to-1 selector (voltage level of grayscale 1)
	KP1 2-0	KN1 2-0	8-to-1 selector (voltage level of grayscale 8)
	KP2 2-0	KN2 2-0	8-to-1 selector (voltage level of grayscale 20)
	KP3 2-0	KN3 2-0	8-to-1 selector (voltage level of grayscale 43)
	KP4 2-0	KN4 2-0	8-to-1 selector (voltage level of grayscale 55)
	KP5 2-0	KN5 2-0	8-to-1 selector (voltage level of grayscale 62)
Offset Adjustment	VRP0 3-0	VRN0 3-0	Variable resistor (VROP/N0) for offset adjustment
	VRP1 4-0	VRN1 4-0	Variable resistor (VROP/N1) for offset adjustment

Table 5.7: Gamma-Adjustment Registers

5.7.3 Gamma resister stream and 8 to 1 Selector

The block consists of two gamma resister streams one is for positive polarity and the other is for negative polarity, each one including eight gamma reference voltages. (VgP/N) 0, 1, 8, 20, 43, 55, 62, 63). Furthermore, the block has pin (VGS) to connect a variable resistor outside the chip for the variation between panels if needed.

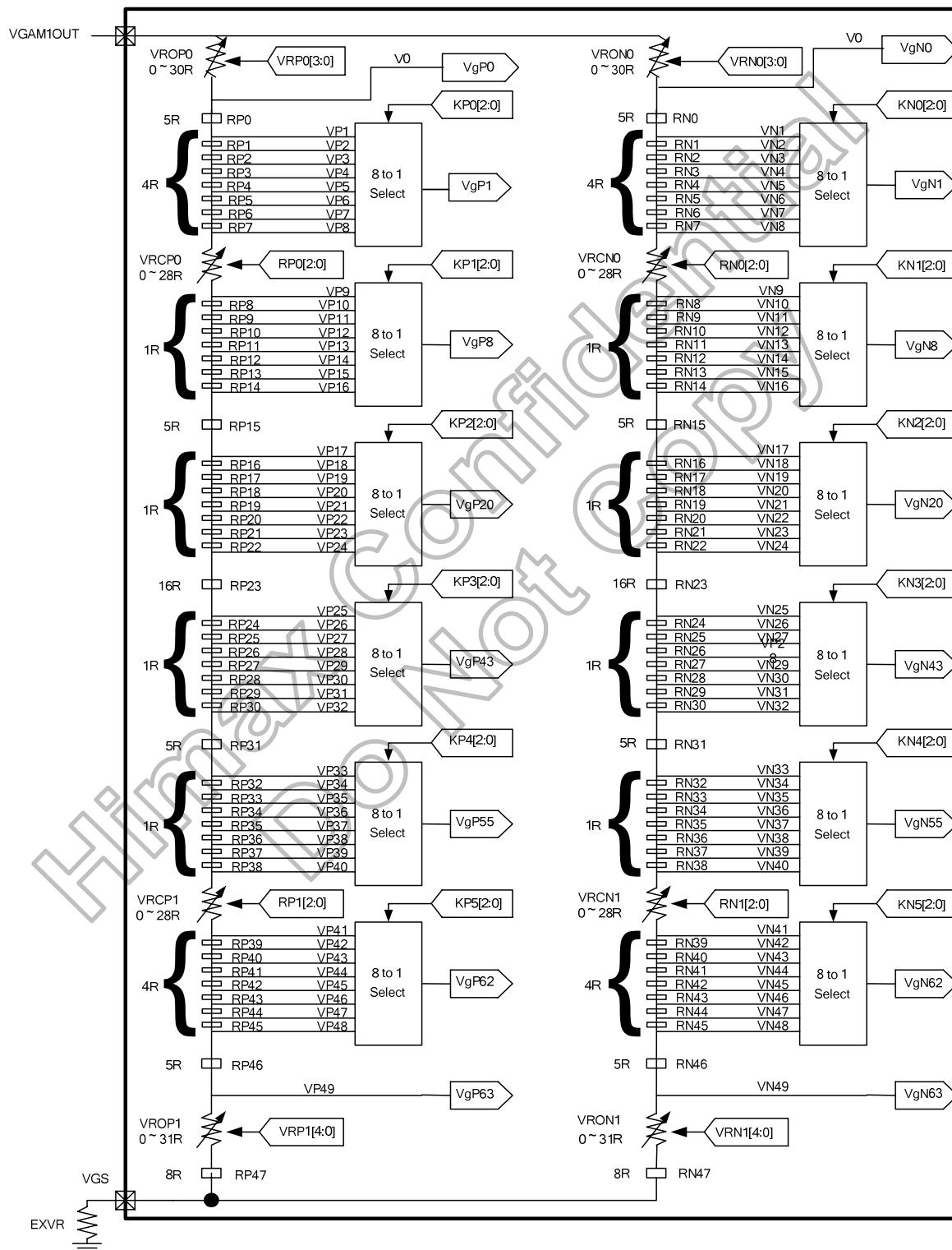


Figure 5.28: Gamma Resister Stream and Gamma Reference Voltage

A. Variable resistor

There are two types of variable resistors, one is for center adjustment, and the other is for offset adjustment. The resistances are decided by setting values in the center adjustment, offset adjustment registers. Their relationships are shown below.

Value in Register VR(P/N)0 3-0	Resistance VRO(P/N)0
0000	0R
0001	2R
0010	4R
•	•
•	•
1101	26R
1110	28R
1111	30R

Table 5.8: Offset Adjustment 0

Value in Register VR(P/N)1 4-0	Resistance VRO(P/N)1
00000	0R
00001	1R
00010	2R
•	•
•	•
11101	29R
11110	30R
11111	31R

Table 5.9: Offset Adjustment 1

Value in Register R(P/N)0/1 2-0	Resistance VRC(P/N)0/1
000	0R
001	4R
010	8R
011	12R
100	16R
101	20R
110	24R
111	28R

Table 5.10: Center Adjustment

B. 8 to 1 Selector

The 8 to 1 selector has eight input voltages generated by gamma register stream. It outputs one reference voltages selected from inputs for gamma reference voltage generation by setting value in macro adjustment register. These six 8 to 1 selectors and the relationship are shown below.

Value in Register K(P/N) 2-0	Voltage level					
	Vg(P/N) 1	Vg(P/N) 8	Vg(P/N) 20	Vg(P/N) 43	V(P/N) 55	V(P/N) 62
000	VP(N)1	VP(N)9	VP(N)17	VP(N)25	VP(N)33	VP(N)41
001	VP(N)2	VP(N)10	VP(N)18	VP(N)26	VP(N)34	VP(N)42
010	VP(N)3	VP(N)11	VP(N)19	VP(N)27	VP(N)35	VP(N)43
011	VP(N)4	VP(N)12	VP(N)20	VP(N)28	VP(N)36	VP(N)44
100	VP(N)5	VP(N)13	VP(N)21	VP(N)29	VP(N)37	VP(N)45
101	VP(N)6	VP(N)14	VP(N)22	VP(N)30	VP(N)38	VP(N)46
110	VP(N)7	VP(N)15	VP(N)23	VP(N)31	VP(N)39	VP(N)47
111	VP(N)8	VP(N)16	VP(N)24	VP(N)32	VP(N)40	VP(N)48

Table 5.11: Output Voltage of 8 to 1 Selector

The grayscale levels are determined by the following formulas

Reference Voltage	Macro Adjustment Value	Formula	Pin
VgP0	-	VGAM1OUT-VD*VROP0 /sumRP	VP0
VgP1	KP0 2-0=000	VGAM1OUT-VD((VROP0+5R) /sumRP	VP1
	KP0 2-0=001	VGAM1OUT-VD((VROP0+9R) /sumRP	VP2
	KP0 2-0=010	VGAM1OUT-VD((VROP0+13R) /sumRP	VP3
	KP0 2-0=011	VGAM1OUT-VD((VROP0+17R) /sumRP	VP4
	KP0 2-0=100	VGAM1OUT-VD((VROP0+21R) /sumRP	VP5
	KP0 2-0=101	VGAM1OUT-VD((VROP0+25R) /sumRP	VP6
	KP0 2-0=110	VGAM1OUT-VD((VROP0+29R) /sumRP	VP7
	KP0 2-0=111	VGAM1OUT-VD((VROP0+33R) /sumRP	VP8
VgP8	KP1 2-0=000	VGAM1OUT-VD((VROP0+33R+VRCP0) /sumRP	VP9
	KP1 2-0=001	VGAM1OUT-VD((VROP0+34R+VRCP0) /sumRP	VP10
	KP1 2-0=010	VGAM1OUT-VD((VROP0+35R+VRCP0) /sumRP	VP11
	KP1 2-0=011	VGAM1OUT-VD((VROP0+36R+VRCP0) /sumRP	VP12
	KP1 2-0=100	VGAM1OUT-VD((VROP0+37R+VRCP0) /sumRP	VP13
	KP1 2-0=101	VGAM1OUT-VD((VROP0+38R+VRCP0) /sumRP	VP14
	KP1 2-0=110	VGAM1OUT-VD((VROP0+39R+VRCP0) /sumRP	VP15
	KP1 2-0=111	VGAM1OUT-VD((VROP0+40R+VRCP0) /sumRP	VP16
VgP20	KP2 2-0=000	VGAM1OUT-VD((VROP0+45R+VRCP0) /sumRP	VP17
	KP2 2-0=001	VGAM1OUT-VD((VROP0+46R+VRCP0) /sumRP	VP18
	KP2 2-0=010	VGAM1OUT-VD((VROP0+47R+VRCP0) /sumRP	VP19
	KP2 2-0=011	VGAM1OUT-VD((VROP0+48R+VRCP0) /sumRP	VP20
	KP2 2-0=100	VGAM1OUT-VD((VROP0+49R+VRCP0) /sumRP	VP21
	KP2 2-0=101	VGAM1OUT-VD((VROP0+50R+VRCP0) /sumRP	VP22
	KP2 2-0=110	VGAM1OUT-VD((VROP0+51R+VRCP0) /sumRP	VP23
	KP2 2-0=111	VGAM1OUT-VD((VROP0+52R+VRCP0) /sumRP	VP24
VgP43	KP3 2-0=000	VGAM1OUT-VD((VROP0+68R+VRCP0) /sumRP	VP25
	KP3 2-0=001	VGAM1OUT-VD((VROP0+69R+VRCP0) /sumRP	VP26
	KP3 2-0=010	VGAM1OUT-VD((VROP0+70R+VRCP0) /sumRP	VP27
	KP3 2-0=011	VGAM1OUT-VD((VROP0+71R+VRCP0) /sumRP	V2P8
	KP3 2-0=100	VGAM1OUT-VD((VROP0+72R+VRCP0) /sumRP	VP29
	KP3 2-0=101	VGAM1OUT-VD((VROP0+73R+VRCP0) /sumRP	VP30
	KP3 2-0=110	VGAM1OUT-VD((VROP0+74R+VRCP0) /sumRP	VP31
	KP3 2-0=111	VGAM1OUT-VD((VROP0+75R+VRCP0) /sumRP	VP32
VgP55	KP4 2-0=000	VGAM1OUT-VD((VROP0+80R+VRCP0) /sumRP	VP33
	KP4 2-0=001	VGAM1OUT-VD((VROP0+81R+VRCP0) /sumRP	VP34
	KP4 2-0=010	VGAM1OUT-VD((VROP0+82R+VRCP0) /sumRP	VP35
	KP4 2-0=011	VGAM1OUT-VD((VROP0+83R+VRCP0) /sumRP	VP36
	KP4 2-0=100	VGAM1OUT-VD((VROP0+84R+VRCP0) /sumRP	VP37
	KP4 2-0=101	VGAM1OUT-VD((VROP0+85R+VRCP0) /sumRP	VP38
	KP4 2-0=110	VGAM1OUT-VD((VROP0+86R+VRCP0) /sumRP	VP39
	KP4 2-0=111	VGAM1OUT-VD((VROP0+87R+VRCP0) /sumRP	VP40
VgP62	KP5 2-0=000	VGAM1OUT-VD((VROP0+87R+VRCP0+VRCP1) /sumRP	VP41
	KP5 2-0=001	VGAM1OUT-VD((VROP0+91R+VRCP0+VRCP1) /sumRP	VP42
	KP5 2-0=010	VGAM1OUT-VD((VROP0+95R+VRCP0+VRCP1) /sumRP	VP43
	KP5 2-0=011	VGAM1OUT-VD((VROP0+99R+VRCP0+VRCP1) /sumRP	VP44
	KP5 2-0=100	VGAM1OUT-VD((VROP0+103R+VRCP0+VRCP1) /sumRP	VP45
	KP5 2-0=101	VGAM1OUT-VD((VROP0+107R+VRCP0+VRCP1) /sumRP	VP46
	KP5 2-0=110	VGAM1OUT-VD((VROP0+111R+VRCP0+VRCP1) /sumRP	VP47
	KP5 2-0=111	VGAM1OUT-VD((VROP0+115R+VRCP0+VRCP1) /sumRP	VP48
VgP63	-	VGAM1OUT-VD((VROP0+120R+VRCP0+VRCP1) /sumRP	VP49

SumRP = 128R + VROP0+ VROP1+ VRCP0+ VRCP1.

SumRN = 128R+ VRON0+ VRON1+ VRCN0 + VRCN1.

VD=(VGAM1OUT-VGS).

[sumRPx (sumRN/ (sumRP+sumRN))]/ [sumRP×sumRN/ (sumRP+sumRN) +EXVR]

Table 5.12: Voltage Calculation Formula (Positive Polarity)

Grayscale Voltage	Formula
V0	VgP0
V1	VgP1
V2	V8+(V1-V8)*(30/48)
V3	V8+(V1-V8)*(23/48)
V4	V8+(V1-V8)*(16/48)
V5	V8+(V1-V8)*(12/48)
V6	V8+(V1-V8)*(8/48)
V7	V8+(V1-V8)*(4/48)
V8	VgP8
V9	V20+(V8-V20)*(22/24)
V10	V20+(V8-V20)*(20/24)
V11	V20+(V8-V20)*(18/24)
V12	V20+(V8-V20)*(16/24)
V13	V20+(V8-V20)*(14/24)
V14	V20+(V8-V20)*(12/24)
V15	V20+(V8-V20)*(10/24)
V16	V20+(V8-V20)*(8/24)
V17	V20+(V8-V20)*(6/24)
V18	V20+(V8-V20)*(4/24)
V19	V20+(V8-V20)*(2/24)
V20	VINP3
V21	V43+(V20-V43)*(22/23)
V22	V43+(V20-V43)*(21/23)
V23	V43+(V20-V43)*(20/23)
V24	V43+(V20-V43)*(19/23)
V25	V43+(V20-V43)*(18/23)
V26	V43+(V20-V43)*(17/23)
V27	V43+(V20-V43)*(16/23)
V28	V43+(V20-V43)*(15/23)
V29	V43+(V20-V43)*(14/23)
V30	V43+(V20-V43)*(13/23)
V31	V43+(V20-V43)*(12/23)
V32	V43+(V20-V43)*(11/23)
V33	V43+(V20-V43)*(10/23)
V34	V43+(V20-V43)*(9/23)
V35	V43+(V20-V43)*(8/23)
V36	V43+(V20-V43)*(7/23)
V37	V43+(V20-V43)*(6/23)
V38	V43+(V20-V43)*(5/23)
V39	V43+(V20-V43)*(4/23)
V40	V43+(V20-V43)*(3/23)
V41	V43+(V20-V43)*(2/23)
V42	V43+(V20-V43)*(1/23)
V43	VINP4
V44	V55+(V43-V55)*(22/24)
V45	V55+(V43-V55)*(20/24)
V46	V55+(V43-V55)*(18/24)
V47	V55+(V43-V55)*(16/24)
V48	V55+(V43-V55)*(14/24)
V49	V55+(V43-V55)*(12/24)
V50	V55+(V43-V55)*(10/24)
V51	V55+(V43-V55)*(8/24)
V52	V55+(V43-V55)*(6/24)
V53	V55+(V43-V55)*(4/24)
V54	V55+(V43-V55)*(2/24)
V55	VINP5
V56	V62+(V55-V62)*(44/48)
V57	V62+(V55-V62)*(40/48)
V58	V62+(V55-V62)*(36/48)
V59	V62+(V55-V62)*(32/48)
V60	V62+(V55-V62)*(25/48)
V61	V62+(V55-V62)*(18/48)
V62	VINP6
V63	VINP7

Table 5.13: Voltage Calculation Formula of Grayscale Voltage (Positive Polarity)

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May, 2010

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Reference Voltage	Macro Adjustment Value	Formula	Pin
VgN0	-	VGAM1OUT-VD*VRON0 /sumRN	VN0
VgN1	KN0 2-0=000	VGAM1OUT-VD((VRON0+5R) /sumRN	VN1
	KN0 2-0=001	VGAM1OUT-VD((VRON0+9R) /sumRN	VN2
	KN0 2-0=010	VGAM1OUT-VD((VRON0+13R) /sumRN	VN3
	KN0 2-0=011	VGAM1OUT-VD((VRON0+17R) /sumRN	VN4
	KN0 2-0=100	VGAM1OUT-VD((VRON0+21R) /sumRN	VN5
	KN0 2-0=101	VGAM1OUT-VD((VRON0+25R) /sumRN	VN6
	KN0 2-0=110	VGAM1OUT-VD((VRON0+29R) /sumRN	VN7
	KN0 2-0=111	VGAM1OUT-VD((VRON0+33R) /sumRN	VN8
	KN1 2-0=000	VGAM1OUT-VD((VRON0+33R+VRCN0) /sumRN	VN9
VgN8	KN1 2-0=001	VGAM1OUT-VD((VRON0+34R+VRCN0) /sumRN	VN10
	KN1 2-0=010	VGAM1OUT-VD((VRON0+35R+VRCN0) /sumRN	VN11
	KN1 2-0=011	VGAM1OUT-VD((VRON0+36R+VRCN0) /sumRN	VN12
	KN1 2-0=100	VGAM1OUT-VD((VRON0+37R+VRCN0) /sumRN	VN13
	KN1 2-0=101	VGAM1OUT-VD((VRON0+38R+VRCN0) /sumRN	VN14
	KN1 2-0=110	VGAM1OUT-VD((VRON0+39R+VRCN0) /sumRN	VN15
	KN1 2-0=111	VGAM1OUT-VD((VRON0+40R+VRCN0) /sumRN	VN16
	KN2 2-0=000	VGAM1OUT-VD((VRON0+45R+VRCN0) /sumRN	VN17
	KN2 2-0=001	VGAM1OUT-VD((VRON0+46R+VRCN0) /sumRN	VN18
VgN20	KN2 2-0=010	VGAM1OUT-VD((VRON0+47R+VRCN0) /sumRN	VN19
	KN2 2-0=011	VGAM1OUT-VD((VRON0+48R+VRCN0) /sumRN	VN20
	KN2 2-0=100	VGAM1OUT-VD((VRON0+49R+VRCN0) /sumRN	VN21
	KN2 2-0=101	VGAM1OUT-VD((VRON0+50R+VRCN0) /sumRN	VN22
	KN2 2-0=110	VGAM1OUT-VD((VRON0+51R+VRCN0) /sumRN	VN23
	KN2 2-0=111	VGAM1OUT-VD((VRON0+52R+VRCN0) /sumRN	VN24
	KN3 2-0=000	VGAM1OUT-VD((VRON0+68R+VRCN0) /sumRN	VN25
	KN3 2-0=001	VGAM1OUT-VD((VRON0+69R+VRCN0) /sumRN	VN26
	KN3 2-0=010	VGAM1OUT-VD((VRON0+70R+VRCN0) /sumRN	VN27
VgN43	KN3 2-0=011	VGAM1OUT-VD((VRON0+71R+VRCN0) /sumRN	VNP8
	KN3 2-0=100	VGAM1OUT-VD((VRON0+72R+VRCN0) /sumRN	VN29
	KN3 2-0=101	VGAM1OUT-VD((VRON0+73R+VRCN0) /sumRN	VN30
	KN3 2-0=110	VGAM1OUT-VD((VRON0+74R+VRCN0) /sumRN	VN31
	KN3 2-0=111	VGAM1OUT-VD((VRON0+75R+VRCN0) /sumRN	VN32
	KN4 2-0=000	VGAM1OUT-VD((VRON0+80R+VRCN0) /sumRN	VN33
	KN4 2-0=001	VGAM1OUT-VD((VRON0+81R+VRCN0) /sumRN	VN34
	KN4 2-0=010	VGAM1OUT-VD((VRON0+82R+VRCN0) /sumRN	VN35
	KN4 2-0=011	VGAM1OUT-VD((VRON0+83R+VRCN0) /sumRN	VN36
VgN55	KN4 2-0=100	VGAM1OUT-VD((VRON0+84R+VRCN0) /sumRN	VN37
	KN4 2-0=101	VGAM1OUT-VD((VRON0+85R+VRCN0) /sumRN	VN38
	KN4 2-0=110	VGAM1OUT-VD((VRON0+86R+VRCN0) /sumRN	VN39
	KN4 2-0=111	VGAM1OUT-VD((VRON0+87R+VRCN0) /sumRN	VN40
	KN5 2-0=000	VGAM1OUT-VD((VRON0+87R+VRCN0+VRCN1) /sumRN	VN41
	KN5 2-0=001	VGAM1OUT-VD((VRON0+91R+VRCN0+VRCN1) /sumRN	VN42
	KN5 2-0=010	VGAM1OUT-VD((VRON0+95R+VRCN0+VRCN1) /sumRN	VN43
	KN5 2-0=011	VGAM1OUT-VD((VRON0+99R+VRCN0+VRCN1) /sumRN	VN44
	KN5 2-0=100	VGAM1OUT-VD((VRON0+103R+VRCN0+VRCN1) /sumRN	VN45
VgN62	KN5 2-0=101	VGAM1OUT-VD((VRON0+107R+VRCN0+VRCN1) /sumRN	VN46
	KN5 2-0=110	VGAM1OUT-VD((VRON0+111R+VRCN0+VRCN1) /sumRN	VN47
	KN5 2-0=111	VGAM1OUT-VD((VRON0+115R+VRCN0+VRCN1) /sumRN	VN48
	VgN63	-	VGAM1OUT-VD((VRON0+120R+VRCN0+VRCN1) /sumRN

SumRP = 128R + VROP0+ VROP1+ VRCP0+ VRCP1;

SumRN = 128R+ VRON0+ VRON1+ VRCN0 + VRCN1

VD = (VGAM1OUT-VGS) [sumRP(sumRN/(sumRP+sumRN))]/[sumRP(sumRN/(sumRP+sumRN)+EXVR)]

Table 5.14: Voltage Calculation Formula (Negative Polarity)

Grayscale Voltage	Formula
V0	V_{gN0}
V1	V_{lgN1}
V2	$V8+(V1-V8)*(30/48)$
V3	$V8+(V1-V8)*(23/48)$
V4	$V8+(V1-V8)*(16/48)$
V5	$V8+(V1-V8)*(12/48)$
V6	$V8+(V1-V8)*(8/48)$
V7	$V8+(V1-V8)*(4/48)$
V8	V_{gN8}
V9	$V20+(V8-V20)*(22/24)$
V10	$V20+(V8-V20)*(20/24)$
V11	$V20+(V8-V20)*(18/24)$
V12	$V20+(V8-V20)*(16/24)$
V13	$V20+(V8-V20)*(14/24)$
V14	$V20+(V8-V20)*(12/24)$
V15	$V20+(V8-V20)*(10/24)$
V16	$V20+(V8-V20)*(8/24)$
V17	$V20+(V8-V20)*(6/24)$
V18	$V20+(V8-V20)*(4/24)$
V19	$V20+(V8-V20)*(2/24)$
V20	V_{gN20}
V21	$V43+(V20-V43)*(22/23)$
V22	$V43+(V20-V43)*(21/23)$
V23	$V43+(V20-V43)*(20/23)$
V24	$V43+(V20-V43)*(19/23)$
V25	$V43+(V20-V43)*(18/23)$
V26	$V43+(V20-V43)*(17/23)$
V27	$V43+(V20-V43)*(16/23)$
V28	$V43+(V20-V43)*(15/23)$
V29	$V43+(V20-V43)*(14/23)$
V30	$V43+(V20-V43)*(13/23)$
V31	$V43+(V20-V43)*(12/23)$
V32	$V43+(V20-V43)*(11/23)$
V33	$V43+(V20-V43)*(10/23)$
V34	$V43+(V20-V43)*(9/23)$
V35	$V43+(V20-V43)*(8/23)$
V36	$V43+(V20-V43)*(7/23)$
V37	$V43+(V20-V43)*(6/23)$
V38	$V43+(V20-V43)*(5/23)$
V39	$V43+(V20-V43)*(4/23)$
V40	$V43+(V20-V43)*(3/23)$
V41	$V43+(V20-V43)*(2/23)$
V42	$V43+(V20-V43)*(1/23)$
V43	V_{gN43}
V44	$V55+(V43-V55)*(22/24)$
V45	$V55+(V43-V55)*(20/24)$
V46	$V55+(V43-V55)*(18/24)$
V47	$V55+(V43-V55)*(16/24)$
V48	$V55+(V43-V55)*(14/24)$
V49	$V55+(V43-V55)*(12/24)$
V50	$V55+(V43-V55)*(10/24)$
V51	$V55+(V43-V55)*(8/24)$
V52	$V55+(V43-V55)*(6/24)$
V53	$V55+(V43-V55)*(4/24)$
V54	$V55+(V43-V55)*(2/24)$
V55	V_{gN55}
V56	$V62+(V55-V62)*(44/48)$
V57	$V62+(V55-V62)*(40/48)$
V58	$V62+(V55-V62)*(36/48)$
V59	$V62+(V55-V62)*(32/48)$
V60	$V62+(V55-V62)*(25/48)$
V61	$V62+(V55-V62)*(18/48)$
V62	V_{gN62}
V63	V_{gN63}

Table 5.15: Voltage Calculation Formula of Grayscale Voltage (Negative Polarity)

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Relationship between GRAM Data and Output Level.

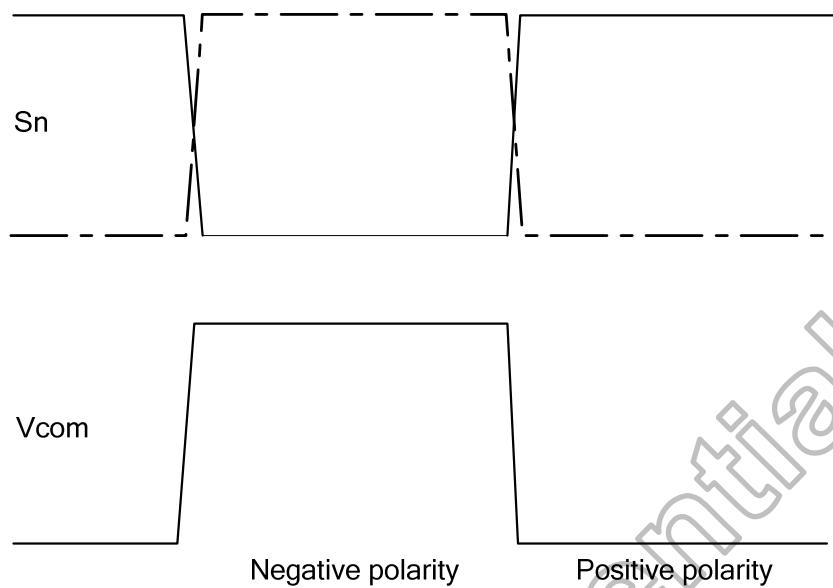
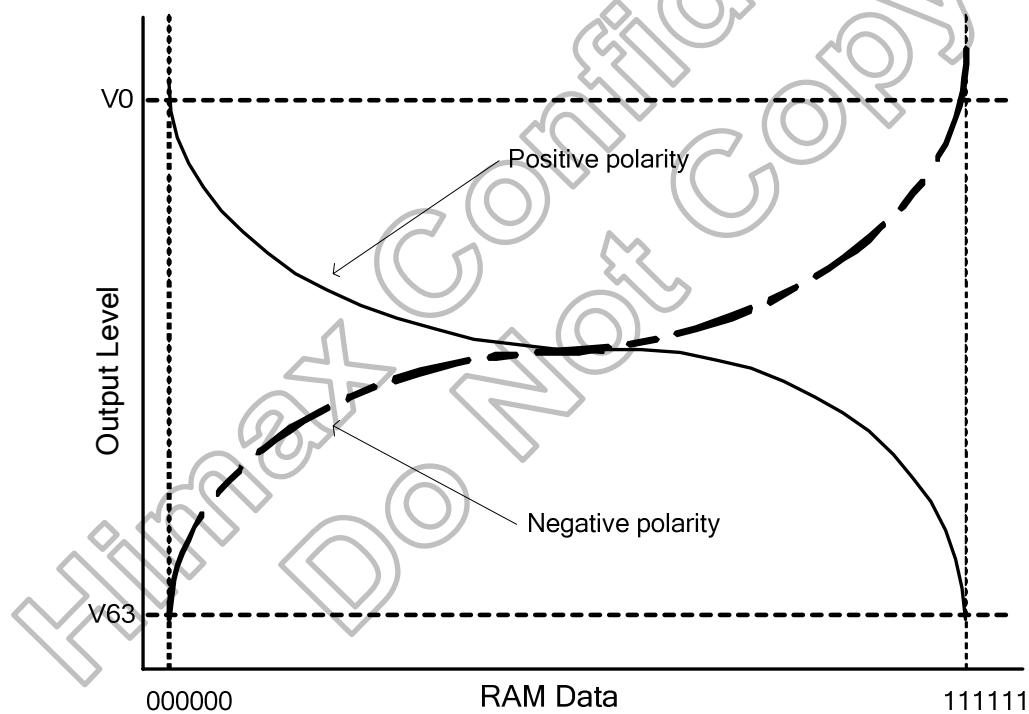


Figure 5.29: Relationship between Source Output and Vcom



(Same characteristic for each RGB)

Figure 5.30: Relationships between GRAM Data and Output Level

5.8 Power Flow Chart for Different Power Modes

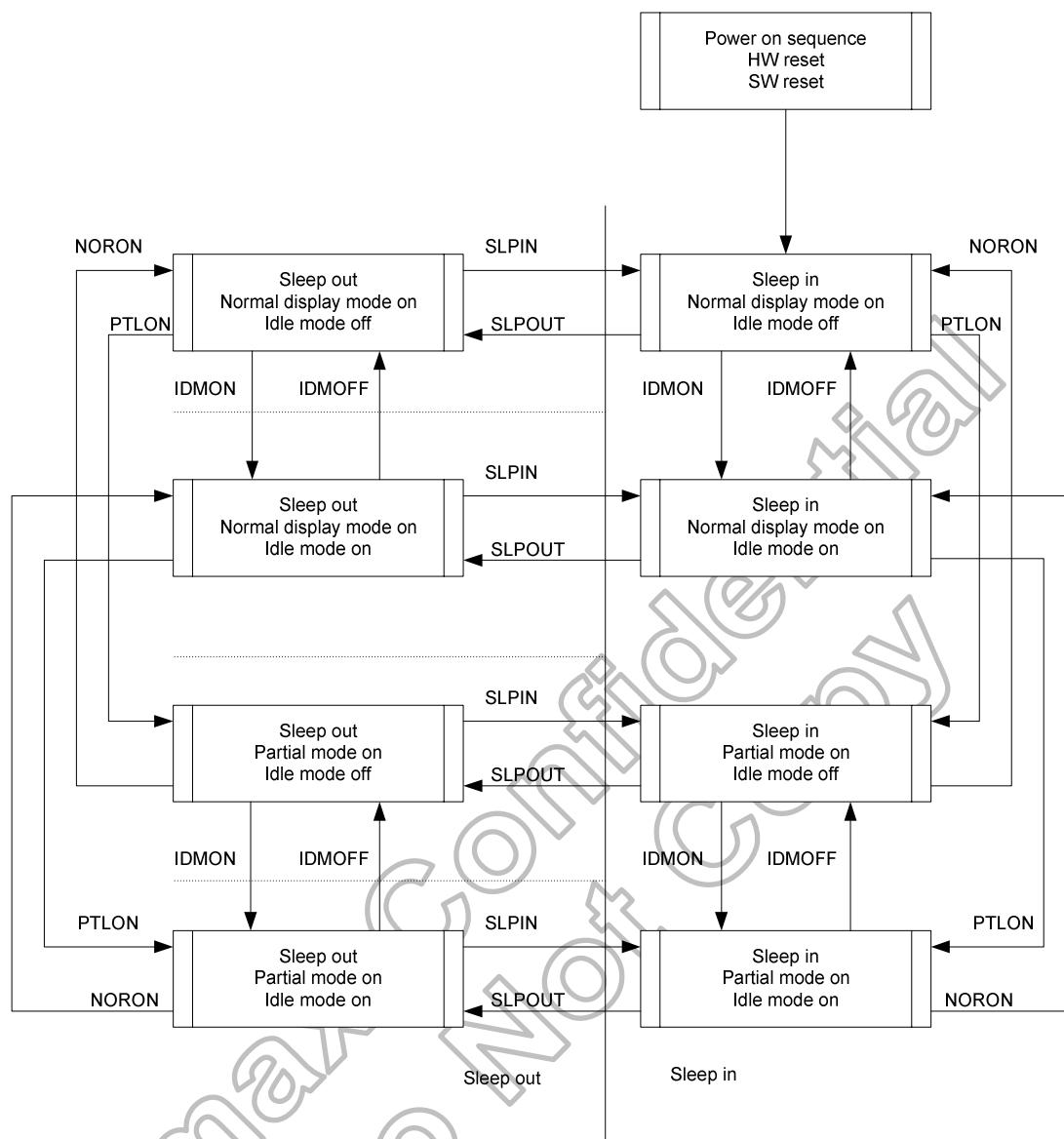


Figure 5.31: Power Flow Chart for Different Power Modes

Mode		Meaning	Other word
Display Mode	Normal Mode	Driving Mode for Fully Display "Partial Mode Off" and "Scroll Mode Off"	Normal Mode On Normal Display Mode On
	Partial Mode	Driving Mode for Partial Display	Partial Mode On
Color Mode	Idle Mode On	8 Color Mode	-
	Idle Mode Off	Full Color Mode	-

Table 5.16: Mode definition

5.9 Input / Output Pin State

5.9.1 Output or Bi-directional (I/O) Pins

Output or Bi-directional pins	After Power On	After Hardware Reset	After Software Reset
TE	Low	Low	Low
CABC_ON, CABC_PWM	Low	Low	Low
DB17 to DB0 (Output driver)	High-Z (Inactive)	High-Z (Inactive)	High-Z (Inactive)

Table 5.17: Characteristics of Output or Bi-directional (I/O) Pins

5.9.2 Input Pins

Input pins	During Power On Process	After Power On	After Hardware Reset	After Software Reset	During Power Off Process
RESX	Section 7.12	Input valid	Input valid	Input valid	Section 7.12
CSX	Input valid	Input valid	Input valid	Input valid	Input valid
DCX	Input valid	Input valid	Input valid	Input valid	Input valid
WRX_SCL	Input valid	Input valid	Input valid	Input valid	Input valid
RDX	Input valid	Input valid	Input valid	Input valid	Input valid
DB17 to DB0 DIN_SDA	Input valid	Input valid	Input valid	Input valid	Input valid
HSYNC	Input valid	Input valid	Input valid	Input valid	Input valid
VSYNC	Input valid	Input valid	Input valid	Input valid	Input valid
PCLK	Input valid	Input valid	Input valid	Input valid	Input valid
DE	Input valid	Input valid	Input valid	Input valid	Input valid
IM2, IM1, IM0, SD, CM	Input valid	Input valid	Input valid	Input valid	Input valid
TEST3-1	Low	Low	Low	Low	Low

Table 5.18: Characteristics of Input Pins

5.10 Sleep Out –Command and Self-Diagnostic functions of The Display Module

5.10.1 Register loading Detection

Sleep Out-command (See section 6.2.13 “Sleep Out (11h)”) is a trigger for an internal function of the display module, which indicates, if the display module loading function of factory default values from OTP (or similar device) to registers of the display controller is working properly. There are compared factory values of the OTP and register values of the display controller by the display controller. If those both values (OTP and register values) are same, there is inverted (=increased by 1) a bit, which is defined in command 6.2.9 “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 (= increased by 1).

The flow chart for this internal function is following:

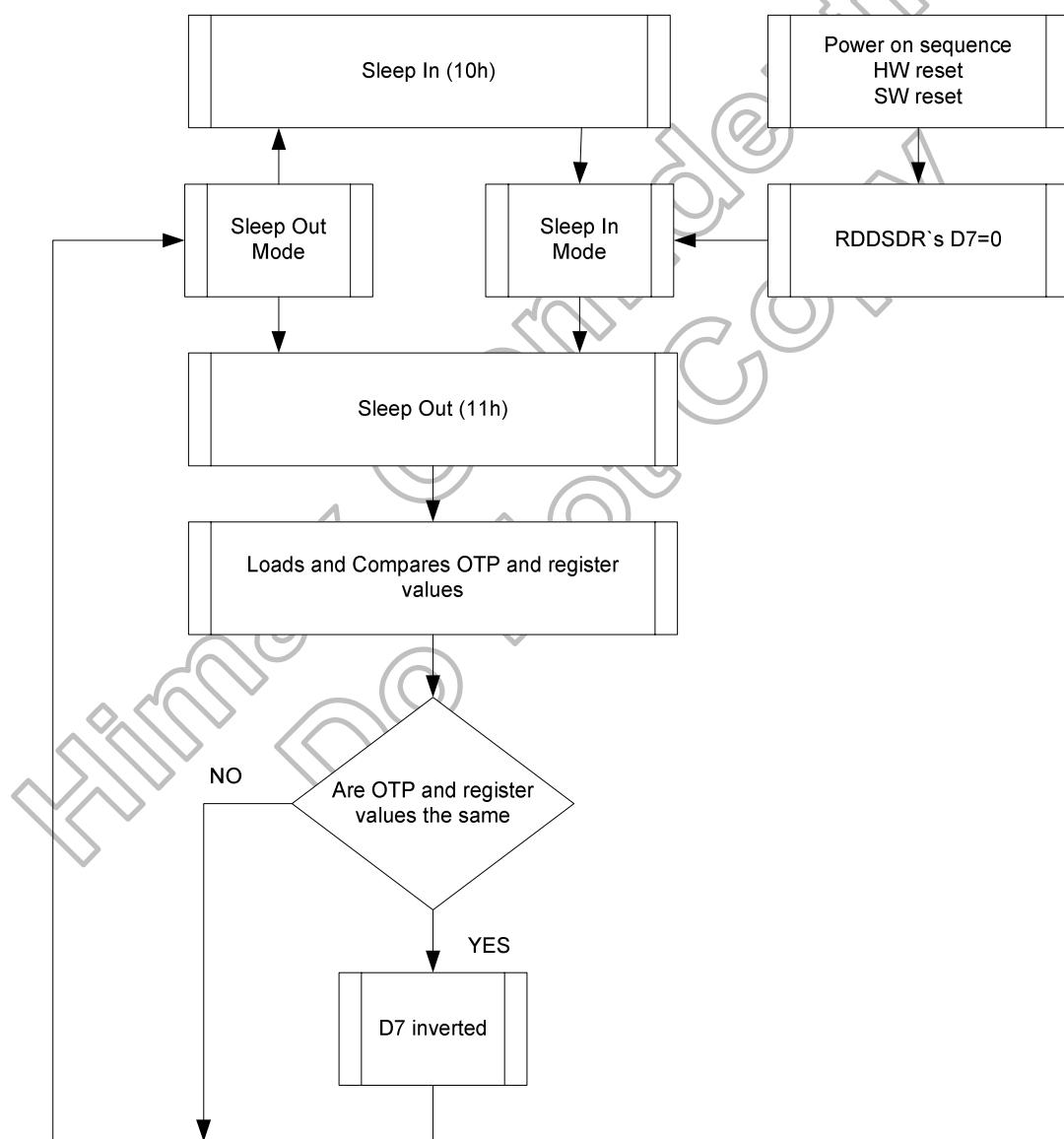


Figure 5.32: Sleep Out Flow Chart – Command and Self-Diagnostic Functions

5.10.2 Functionality Detection

Sleep Out-command (See section 6.2.13 “Sleep Out (11h)”) is a trigger for an internal function of the display module, which indicates, if the display module is still running and meets functionality requirements.

The internal function (= the display controller) is comparing, if the display module is still meeting functionality requirements (e.g. booster voltage levels, timings, etc.). If functionality requirement is met, there is inverted (= increased by 1) a bit, which defined in command 6.2.11 “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 following:

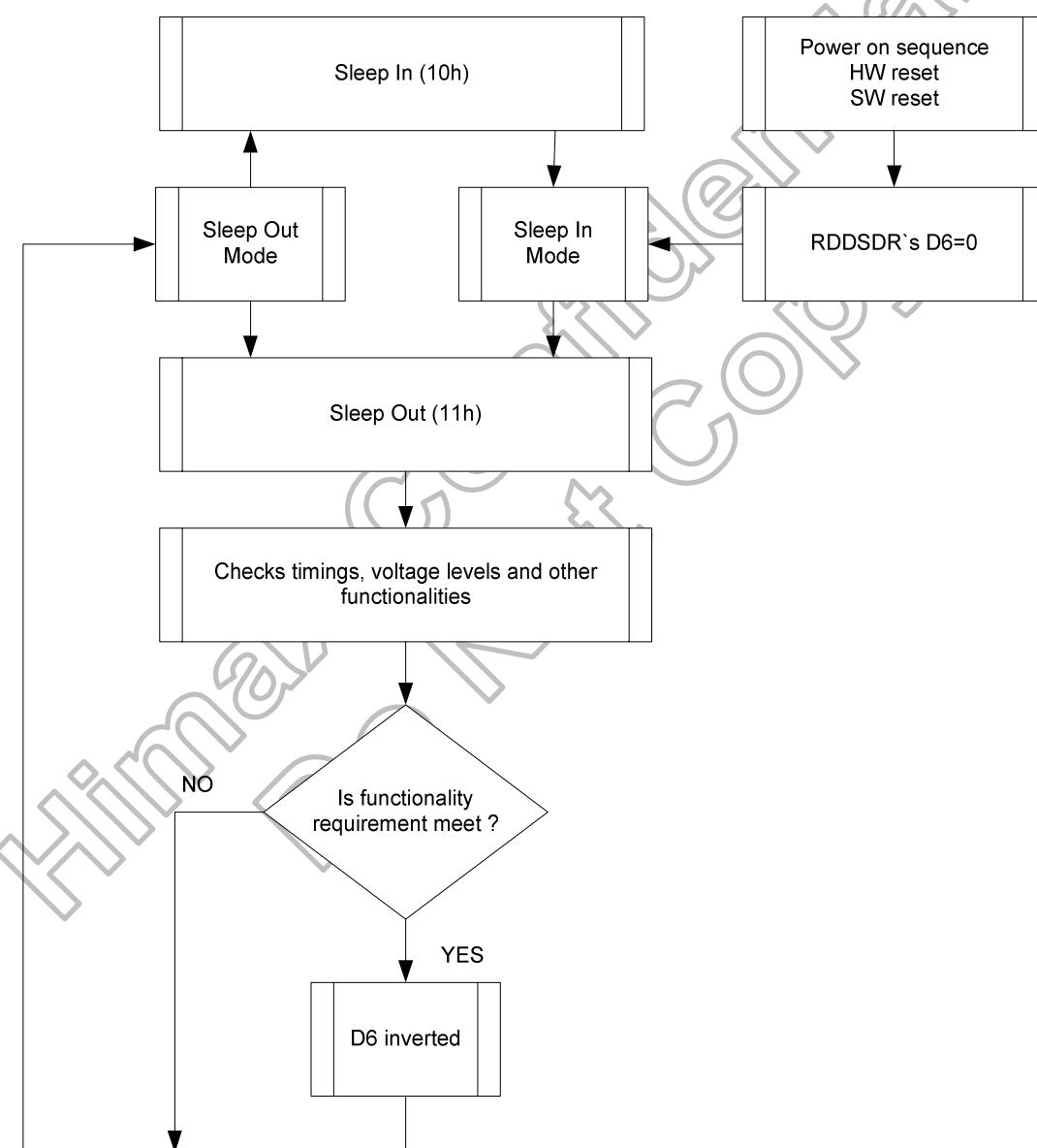


Figure 5.33: Sleep Out Flow Chart Internal Function Detection

5.11 Power On/Off Sequence

IOVCC and VCI can be applied in any order. IOVCC and VCI can be powered down in any order. During power off, if LCD is in the Sleep Out mode, IOVCC and VCI must be powered down minimum 120msec after RESX has been released. During power off, if LCD is in the Sleep In mode, IOVCC and VCI can be powered down minimum 0msec after RESX has been released. CSX can be applied at any timing or can be permanently grounded. RESX has priority over CSX. There will be no damage to the display module if the power sequences are not met. There will be no abnormal visible effects on the display panel during the Power On/Off Sequences. 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. If RESX line is not held stable by host during Power on Sequence as defined in Sections 5.11.1 and 5.11.2, 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. The power on/off sequence is illustrated below.

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5.11.1 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 IOVCC and VCI have been applied – otherwise correct functionality is not guaranteed. There is no timing restriction upon this hardware reset.

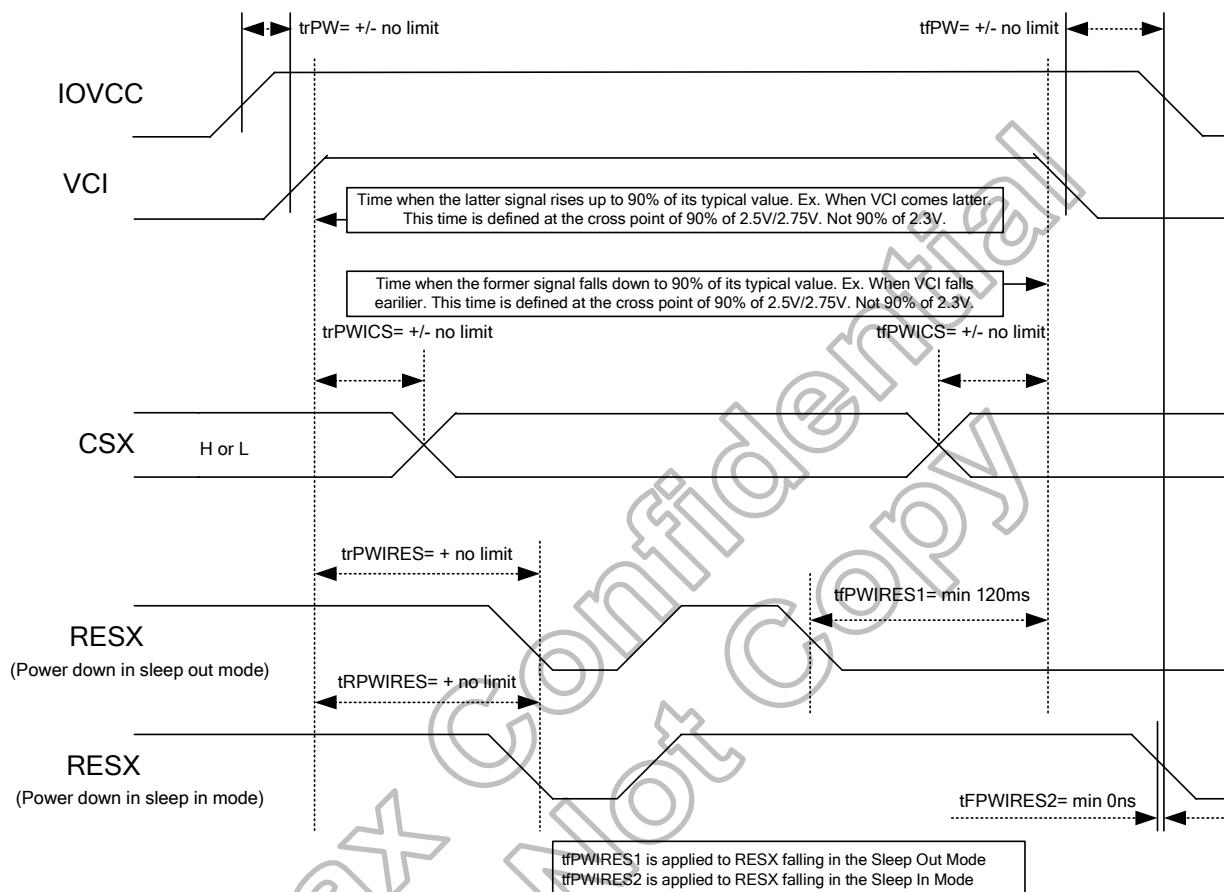


Figure 5.34: Case 1 –RESX line is held High or Unstable by Host at Power On

5.11.2 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 10 μ sec after both IOVCC and VCI have been applied.

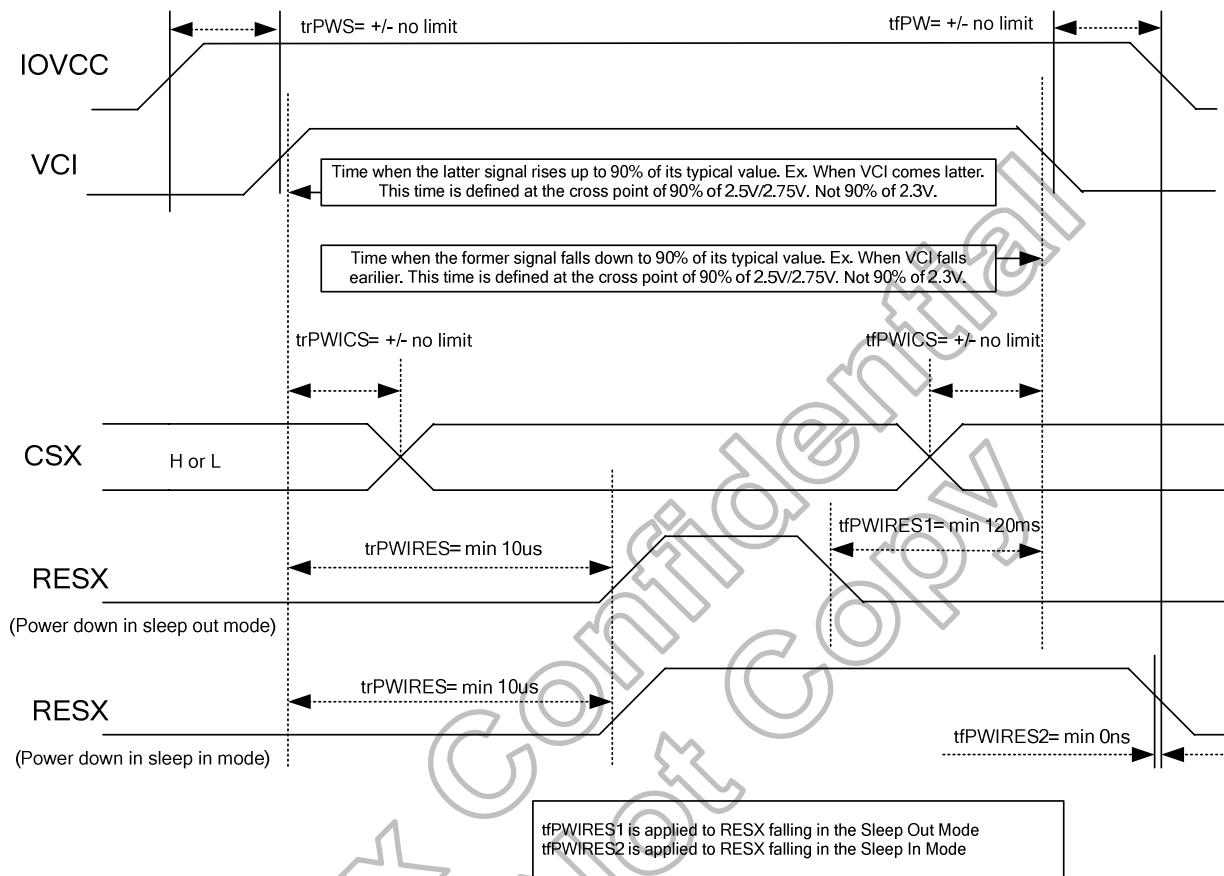


Figure 5.35: Case 2 – RESX line is held Low by Host at Power On

5.12 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 the display module or the display module will not cause any damages for the host or lines of the interface. At an uncontrolled power off the display will go blank and there will not be any visible effects within 1 second on the display (blank display) and remains blank until "Power on Sequence" powers it

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5.13 Content Adaptive Brightness Control (CABC) Function

The general block diagram of the CABC and the brightness control is illustrated below:

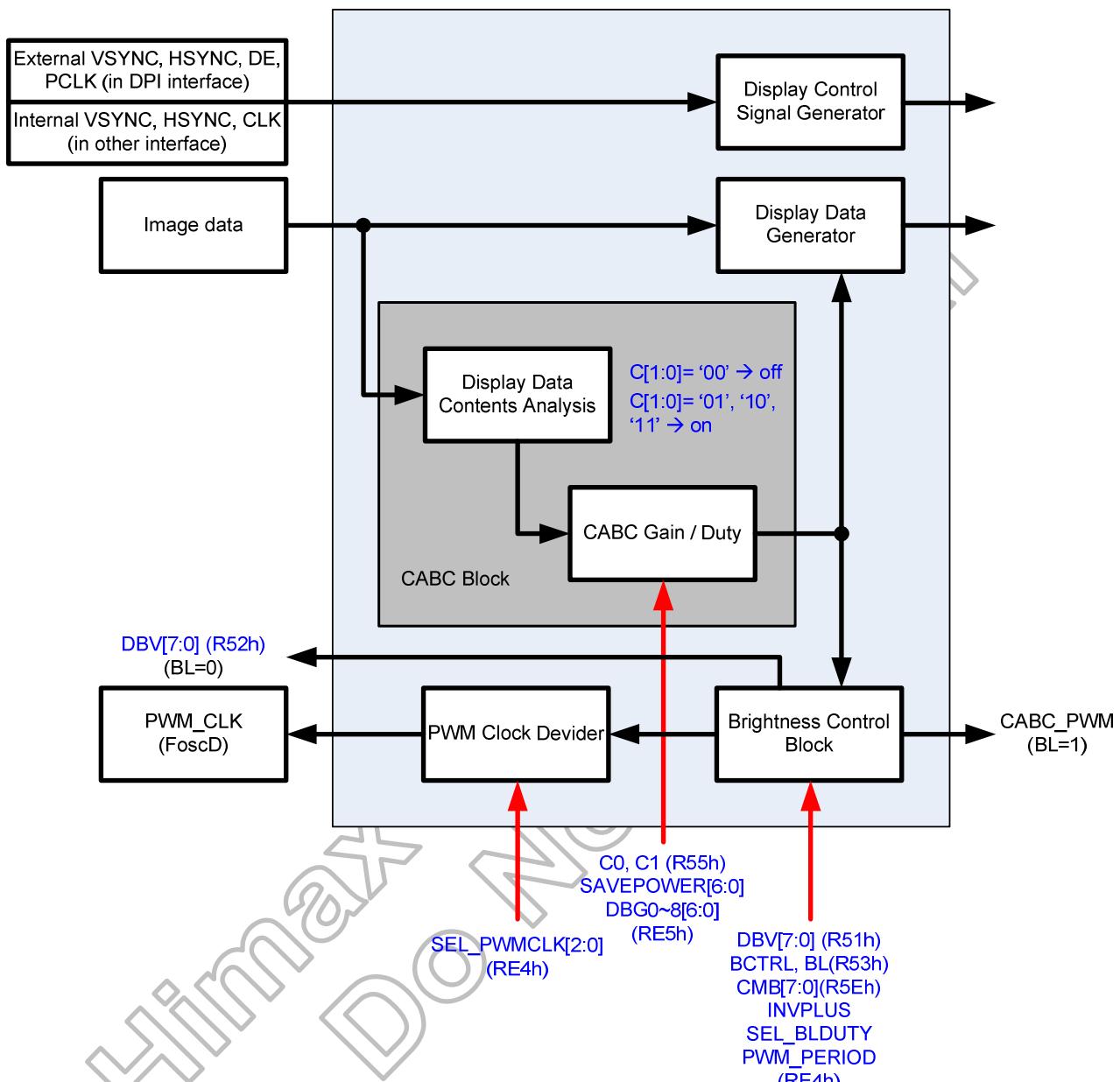


Figure 5.36 : Block diagram of the CABC

5.13.1 Module Architectures

HX8357-B can support two module architectures for CABC operation. The **BL** bit setting of R53h can be used to select used display module architecture. White LED driver circuit for display backlight is located on the main PWB, not in the display module both in architecture I and II.

- Architecture I

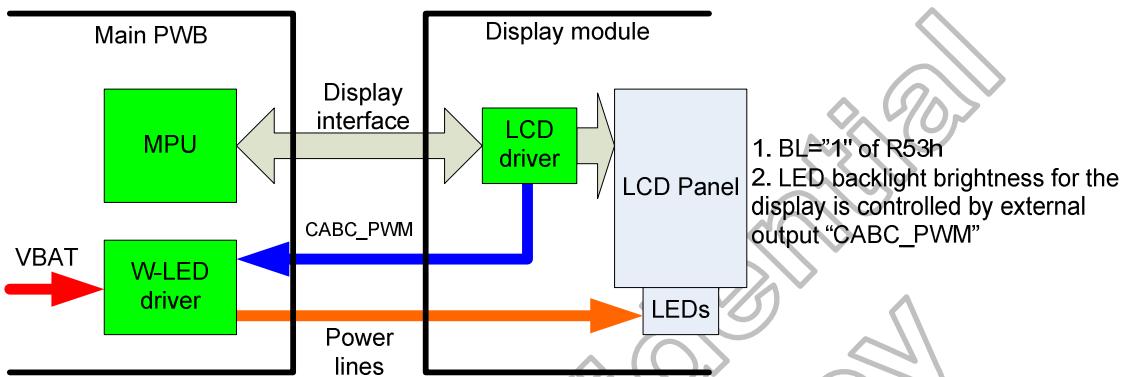


Figure 5.37: Module architecture I

- Architecture II

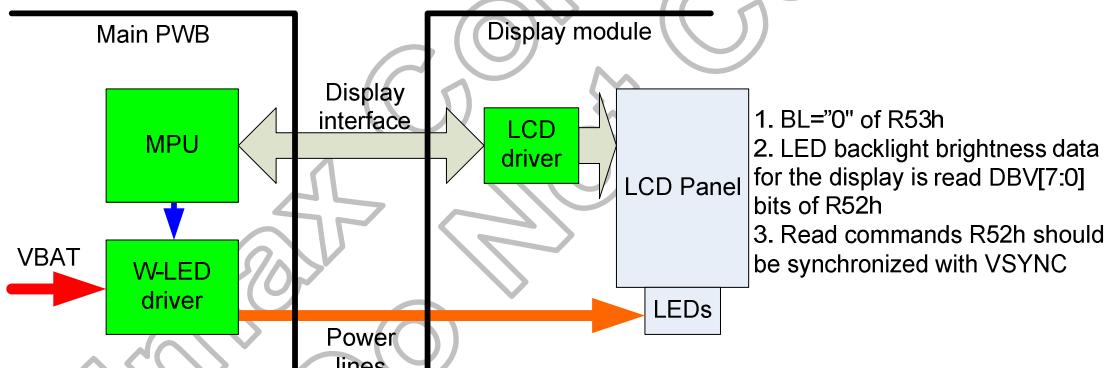


Figure 5.38: Module architecture II

5.13.2 CABC Block

There are DBG0~8[6:0] register bits in CABC block to define the “CABC gain”/ “CABC duty” table. Every DBGx[6:0] has 33 gain/duty value setting.

After one-frame display data content analysis, LSI will generate one CABC gain / CABC duty value calculated from DBG0~8[6:0] register bits setting (by using interpolated method) for display data generating and for backlight PWM pulse generating.

Please note that the CABC gain / CABC duty value calculated by the LSI is one of the 33 gain/duty value setting in DBGxx[6:0].

Please note that: Duty (valid level period (LED on) / one complete period) = 1/ gain.

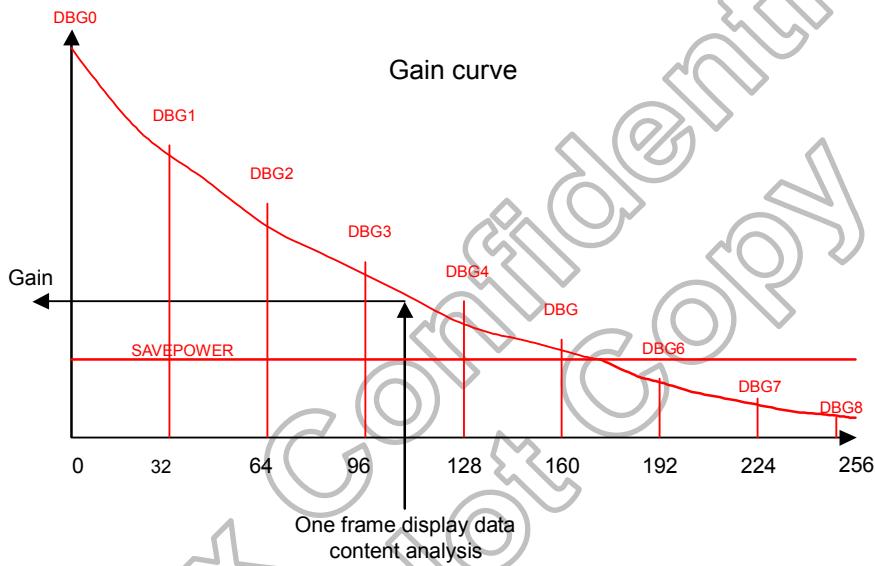


Figure 5.39: CABC Gain / CABC Duty Generation

For power saving of backlight module, there are **SAVEPOWER[6:0]** bits to define the “minimum gain”/ “maximum duty” of CABC block output. If the CABC gain/duty after one-frame display data contents analysis is smaller (gain)/larger(duty) than **SAVEPOWER[6:0]** bits setting, the CABC block will output CABC gain/duty equal to **SAVEPOWER[6:0]** and ignore the result of display data contents analysis.

5.13.3 Brightness Control Block

There is an external output signal from brightness block, CABC_PWM, to control the LED driver IC in order to control display brightness. The CABC_PWM output active polarity is defined by **INVPULS** bit of RCCh.

The CABC_PWM output frequency is controlled by **PWM_PERIOD[7:0]** bits of RE4h setting.

PWM_PERIOD[7:0]	Frequency Hz	PWM_PERIOD[7:0]	Frequency Hz
0	42K	1A	16K
1	41K	1B	15K
2	40K	1C	14K
3	39K	1D	13K
4	38K	1E	12K
5	37K	1F	11K
6	36K	20	10K
7	35K	21	9K
8	34K	22	8K
9	33K	23	7K
A	32K	24	6K
B	31K	25	5K
C	30K	26	4K
D	29K	27	3K
E	28K	28	2K
F	27K	29	1K
10	26K	2A	900
11	25K	2B	800
12	24K	2C	700
13	23K	2D	600
14	22K	2E	500
15	21K	2F	400
16	20K	30	300
17	19K	31	200
18	18K	32	100
19	17K		

Note: The OSC clock is 5.2MHz

5.13.4 Minimum brightness setting of CABC function

CABC function is automatically reduced backlight brightness based on image contents. In the case of the combination with the CABC or manual brightness setting, display brightness is too dark. It must affect to image quality degradation. CABC minimum brightness setting (**CMB[7:0]** bits of R5Eh) is to avoid too much brightness reduction.

When CABC is active, CABC can not reduce the display brightness to less than CABC minimum brightness setting. 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.

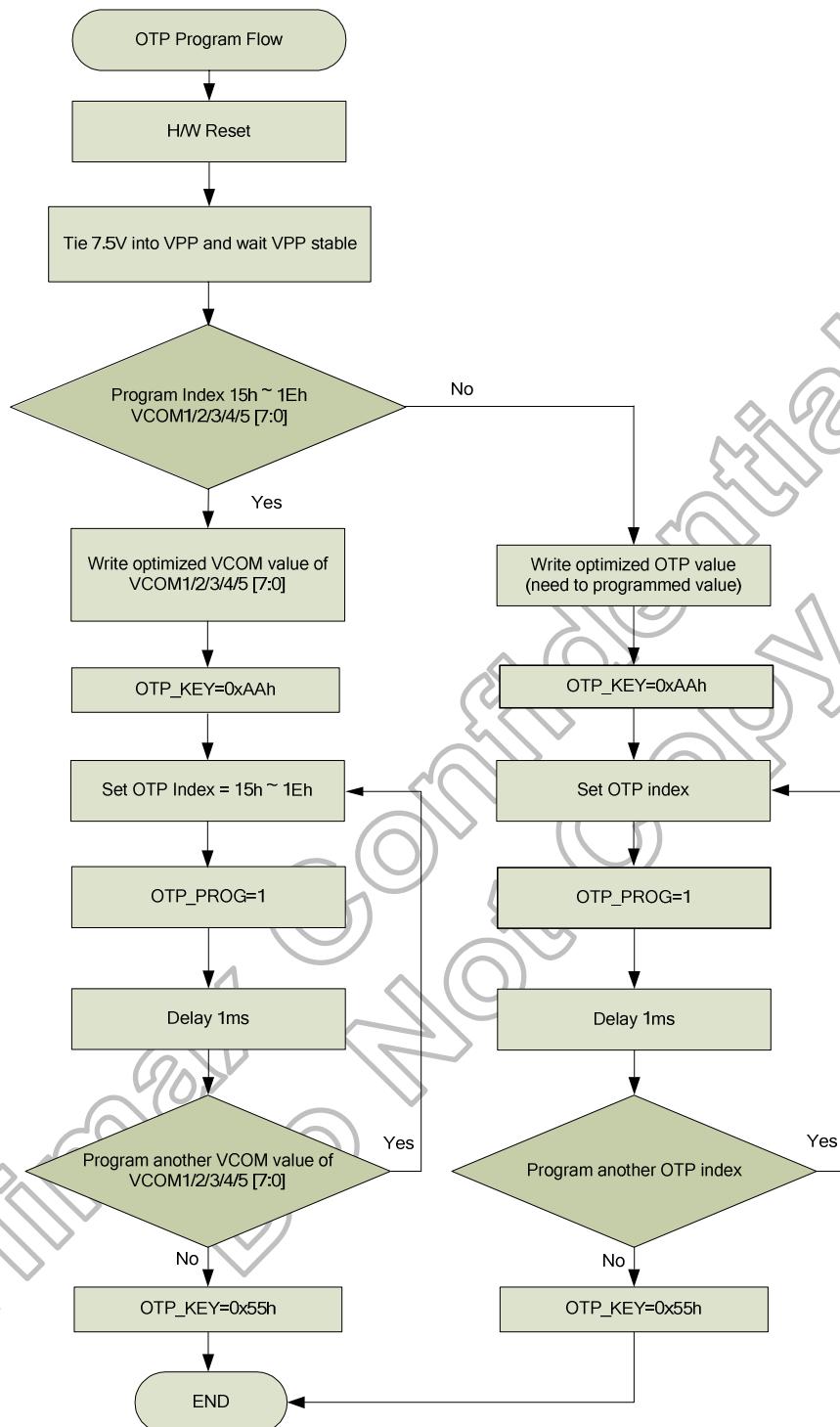
When display brightness is turned off (**BCTRL='0'** of R53h), CABC minimum brightness setting is ignored. “**CMB[7:0]**, Read CABC minimum brightness (R5Fh) “always read the setting value of “**CMB[7:0]**, Write CABC minimum brightness (R5Eh)”

5.14 OTP Programming

5.14.1 OTP Table

OTP_INDEX (HEX)	Ref. Command	B7	B6	B5	B4	B3	B2	B1	B0
0		VALID_ID1	VALID_ID2	VALID_ID3	VALID_ID4	VALID_ID5			
1						ID11			
2						ID12			
3						ID13			
4						ID14			
5						ID21			
6						ID22			
7						ID23			
8						ID24			
9						ID31			
A						ID32			
B						ID33			
C						ID34			
D						ID41			
E						ID42			
F						ID43			
10						ID44			
11						ID51			
12						ID52			
13						ID53			
14						ID54			
15	VCOM1(D1)	VALID_VCM1				VCM1[6:0]			
16		-	-	-		VDV1[4:0]			
17	VCOM2(D1)	VALID_VCM2				VCM2[6:0]			
18		-	-	-		VDV2[4:0]			
19	VCOM3(D1)	VALID_VCM3				VCM3[6:0]			
1A		-	-	-		VDV3[4:0]			
1B	VCOM4(D1)	VALID_VCM4				VCM4[6:0]			
1C		-	-	-		VDV4[4:0]			
1D	VCOM5(D1)	VALID_VCM5				VCM5[6:0]			
1E		-	-	-		VDV5[4:0]			
30	SETOSC(C5)	VALID_OSC	-	-	-	-	-	UADJ[2:0]	
35		VALID_GAMMA		KP1[2:0]				KP0[2:0]	
36		-		KP3[2:0]				KP2[2:0]	
37		-		KP5[2:0]				KP4[2:0]	
38		-		RP1[2:0]				RP0[2:0]	
39		-	-	-		VRP0[3:0]			
3A		-	-	-		VRP1[4:0]			
3B		-		KN1[2:0]				KN0[2:0]	
3C		-		KN3[2:0]				KN2[2:0]	
3D		-		KN5[2:0]				KN4[2:0]	
3E		-		RN1[2:0]				RN0[2:0]	
3F		-	-	-		VRN0[3:0]			
40		-	-	-		VRN1[4:0]			

5.14.2 OTP Programming flow



OTP_KEY[7:0](8'h00)	Description	Note
AAh	Enter OTP Program mode	
55h	Leave OTP Program mode	
Other value	Invalid	1. If OTP is in OTP program mode, then keep OTP program mode. 2. If OTP is in non-OTP program mode, then keep non-OTP program mode. 3. OTP_KEY[7:0] can be ignored when user want to do OTP program.

Figure 5.40: OTP Programming Sequence

5.14.3 Programming sequence

Step	Operation			
1	Power on and reset the module			
2	Connect external power 7.5V to VPP pin			
3	Wait 100ms for VPP stable			
4	Write optimized value to related register			
	Command	Register	Description	
	ID1 (E0h)	ID1[7:0]	LCD module/driver version	
	ID2 (E0h)	ID2[7:0]	LCD module/driver version	
	ID3 (E0h)	ID3[7:0]	LCD module/driver version	
	ID4 (E0h)	ID4[7:0]	LCD module/driver version	
	ID5 (E0h)	ID5[7:0]	LCD module/driver version	
	VCOM1 (D1h)	VCM1[6:0], VDV1[4:0]	VCOMH and VCOM amplitude setting.	
	VCOM2 (D1h)	VCM2[6:0], VDV2[4:0]	VCOMH and VCOM amplitude setting.	
	VCOM3 (D1h)	VCM3[6:0], VDV3[4:0]	VCOMH and VCOM amplitude setting.	
	VCOM4 (D1h)	VCM4[6:0], VDV4[4:0]	VCOMH and VCOM amplitude setting.	
	VCOM5 (D1h)	VCM5[6:0], VDV5[4:0]	VCOMH and VCOM amplitude setting.	
	GAMMA(C8h)	Gamma value	Set gamma parameter	
5	Set OTP_KEY[7:0] (RE3h)=0xAAh to enter OTP program mode.			
6	Specify OTP_index			
	OTP_index (Write – For Program)	OTP_index (Read – For get OTP value)	Parameter	
	0x00h	0x00h	VALID_ID1, VALID_ID2, VALID_ID3, VALID_ID4, VALID_ID5	
	0x01h	0x01h	ID1[7:0]	
	0x02h	0x02h		
	0x03h	0x03h		
	0x04h	0x04h		
	0x15h	0x15h	VALID_VCM1, VCM1[6:0], VDV1[4:0]	
	0x16h	0x16h		
	0x35h ~ 0x40h	0x35h ~ 0x40h		
7	Set OTP_Mask=0x00h, programming the entire bit of one parameter.			
8	Set OTP_PROG=1, Internal register begin write to OTP according to OTP_index.			
9	Wait 1 ms			
10	Complete programming one parameter to OTP. If continue to programming other parameter, return to step (5). Otherwise, set OTP_KEY[7:0]=0x55h to leave OTP program mode and power off the module and remove the external power on PVSS pin.			

Note: Set OTP_KEY[7:0] can be ignored when user want to do OTP program.

5.14.4 OTP Read flow

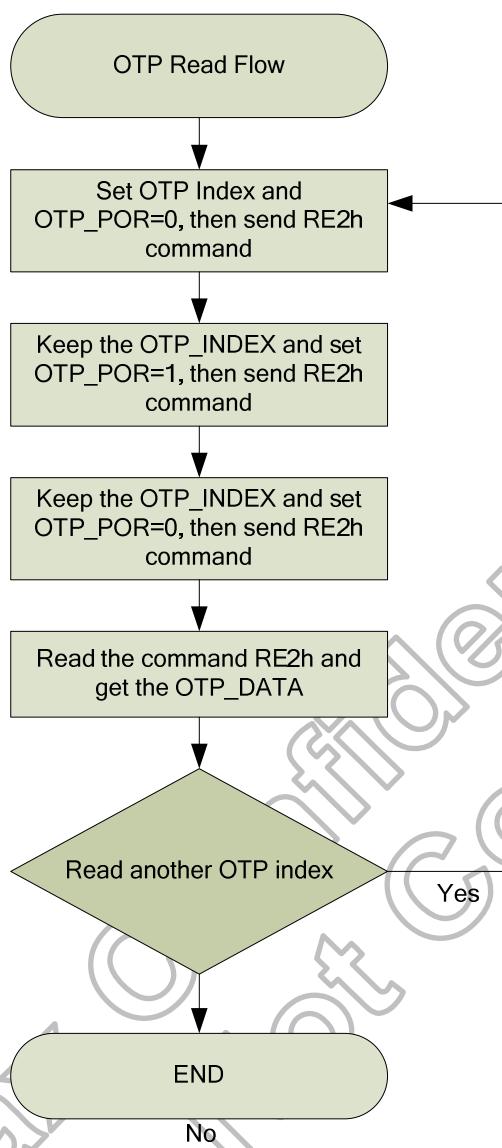
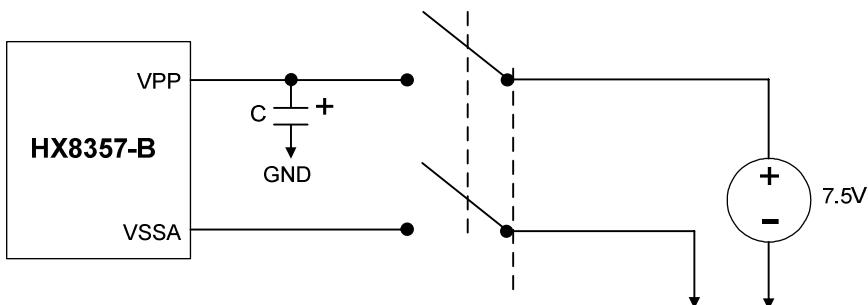


Figure 5.41: OTP Read Sequence

5.14.5 Programming circuitry

Note: (1) Connect external power at Step
(2) C=1uF (built-in the module)

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6. Command

6.1 Standard Command List

(Hex)	Operation Code	DCX	WRX	RDX	D17 ~D8	D7	D6	D5	D4	D3	D2	D1	D0	Function	Display mod Implementation Requirement
															DM[1:0]
															00,01,10 11
00	NOP	0	↑	1	-	0	0	0	0	0	0	0	0	No Operation	Y Y
01	SWRESET	0	↑	1	-	0	0	0	0	0	0	0	1	Software reset	Y Y
06	RDRED	0	↑	1	-	0	0	0	0	0	1	1	0	Read Red	N Y
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read	
		1	1	↑	-	R7	R6	R5	R4	R3	R2	R1	R0	-	
07	RDGREN	0	↑	1	-	0	0	0	0	0	1	1	1	Read Green	N Y
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read	
		1	1	↑	-	G7	G6	G5	G4	G3	G2	G1	G0	-	
08	RDBLUE	0	↑	1	-	0	0	0	0	1	0	0	0	Read Blue	N Y
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read	
		1	1	↑	-	B7	B6	B5	B4	B3	B2	B1	B0	-	
0A	RDDPM	0	↑	1	-	0	0	0	0	1	0	1	0	Read Display Power Mode	Y Y
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read	
		1	1	↑	-	D[7:0]						-			
0B	RDDMADCTL	0	↑	1	-	0	0	0	0	1	0	1	1	Read Display MADCTL	Y Y
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read	
		1	1	↑	-	D[7:0]						-			
0C	RDDCOLMOD	0	↑	1	-	0	0	0	0	1	1	0	0	Read Display Pixel Format	Y Y
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read	
		1	1	↑	-	x	D6	D5	D4	x	D2	D1	D0	-	
0D	RDDIM	0	↑	1	-	0	0	0	0	1	1	0	1	Read Display Image Mode	Y Y
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read	
		1	1	↑	-	D[7:0]						-			
0E	RDDSM	0	↑	1	-	0	0	0	0	1	1	1	0	Read Display Signal Mode	Y Y
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read	
		1	1	↑	-	D[7:0]						-			
0F	RDDSDR	0	↑	1	-	0	0	0	0	1	1	1	1	Read Display Self-Diagnostic Result	Y Y
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read	
		1	1	↑	-	D[7:0]						-			
10	SLPIN	0	↑	1	-	0	0	0	1	0	0	0	0	Sleep in and charge-pump off	Y Y
11	SLPOUT	0	↑	1	-	0	0	0	1	0	0	0	1	Sleep out and charge-pump on	Y Y
12	PTLON	0	↑	1	-	0	0	0	1	0	0	1	0	Partial Mode On	Y N
13	NORON	0	↑	1	-	0	0	0	1	0	0	1	1	Normal Display Mode On	Y N

(Hex)	Operation Code	DCX	WRX	RDX	D17 ~D8	D7	D6	D5	D4	D3	D2	D1	D0	Function	Display mod Implementation Requirement			
															DM[1:0]			
															00,01,10	11		
20	INVOFF	0	↑	1	-	0	0	1	0	0	0	0	1	Display Inversion off	Y	Y		
21	INVON	0	↑	1	-	0	0	1	0	0	0	1	0	Display Inversion on	Y	Y		
28	DISPOFF	0	↑	1	-	0	0	1	0	1	0	0	0	Display off	Y	Y		
29	DISPON	0	↑	1	-	0	0	1	0	1	0	0	1	Display on	Y	Y		
2A	CASET	0	↑	1	-	0	0	1	0	1	0	1	0	Column Address Set	Y	N		
		1	↑	1	-	SC[15:8] (8'b0)							Column address start					
		1	↑	1	-	SC[7:0] (8'b0)							Column address start					
		1	↑	1	-	EC[15:8] (8'b0000_0001)							Column address end					
		1	↑	1	-	EC[7:0] (8'b0011_1111)							Column address end					
2B	PASET	0	↑	1	-	0	0	1	0	1	0	1	1	Row address set	Y	N		
		1	↑	1	-	SP[15:8] (8'b0)							Row address start					
		1	↑	1	-	SP[7:0] (8'b0)							Row address start					
		1	↑	1	-	EP[15:8] (8'b0000_0001)							Row address end					
		1	↑	1	-	EP[7:0] (8'b1101_1111)							Row address end					
2C	RAMWR	0	↑	1	-	0	0	1	0	1	1	0	0	Memory write	Y	N		
2E	RAMRD	1	↑	1	-	Write data							-		Y	N		
		0	↑	1	-	0	0	1	0	1	1	1	0	Memory read				
		1	↑	1	-	-	-	-	-	-	-	-	-	Dummy read				
30	PLTAR	1	1	↑	-	Read data							-		Y	N		
		0	↑	1	-	0	0	1	1	0	0	0	0	Partial address set				
		1	↑	1	-	SR[15:8] (8'b0)							Start row					
		1	↑	1	-	SR[7:0] (8'b0)							Start row					
		1	↑	1	-	ER[15:8] (8'b0000_0001)							End row					
33	VSCRDEF	1	↑	1	-	ER[7:0] (8'b1101_1111)							End row		Y	N		
		0	↑	1	-	0	0	1	1	0	0	1	1	Vertical Scrolling Definition)				
		1	↑	1	-	TFA[15:8] (8'b0)							Top Fixed Area					
		1	↑	1	-	TFA[7:0] (8'b0)							Top Fixed Area					
		1	↑	1	-	VSA[15:8] (8'b0000_0001)							Height of the Vertical Scrolling Area					
		1	↑	1	-	VSA[7:0] (8'b1101_1111)							Height of the Vertical Scrolling Area					
		1	↑	1	-	BFA[15:8] (8'b0)							Bottom Fixed Area					
		1	↑	1	-	BFA[7:0] (8'b0)							Bottom Fixed Area					

(Hex)	Operation Code	DCX	WRX	RDX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	Function	Display mod Implementation Requirement						
															DM[1:0]						
															00,01,10	11					
34	TEOFF	0	↑	1	-	0	0	1	1	0	1	0	0	Tearing Effect line off	Y	N					
35	TEON	0	↑	1	-	0	0	1	1	0	1	0	1	Tearing Effect Line ON	Y	N					
		0	↑	1	-	-	-	-	-	-	-	-	-	TEM ODE							
36	MADCTL	0	↑	1	-	0	0	1	1	0	1	1	0	Memory Access Control)	Y	Y					
		1	↑	1	-	MY (0)	MX (0)	MV (0)	ML (0)	BGR (0)	0	SS (0)	GS (0)	-							
37	VSCRADD	0	↑	1	-	0	0	1	1	0	1	1	1	Vertical Scrolling Start Address	Y	N					
		1	↑	1	-	VSP[15:8] (8'b0)								-							
		1	↑	1	-	VSP[7:0] (8'b0)								-							
38	IDMOFF	0	↑	1	-	0	0	1	1	1	0	0	0	Idle mode off	Y	N					
39	IDMON	0	↑	1	-	0	0	1	1	1	0	0	1	Idle mode on	Y	N					
3A	COLMOD	0	↑	1	-	0	0	1	1	1	0	1	0	Interface Pixel Format	Y	Y					
		1	↑	1	-	0	D[6:4]		0	D[2:0]		-		-							
3C	RAMWRCON	0	↑	1	-	0	0	1	1	1	1	0	0	Memory write	Y	N					
		1	↑	1	-	Write data								-							
3E	RAMRDCON	0	↑	1	-	0	0	1	1	1	1	1	0	Memory read	Y	N					
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read							
		1	1	↑	-	Read data								-							
44	TESL	0	↑	1	-	0	1	0	0	0	1	0	0	Set tear scan line	Y	N					
		1	↑	1	-	TELINE[15:8] (8'b0)								-							
		1	↑	1	-	TELINE[7:0] (8'b0)								-							
45	GETSL	0	↑	1	-	0	1	0	0	0	1	0	1	Get the current scan line.	Y	N					
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read							
		1	1	↑	-	SL[15:8]								-							
		1	1	↑	-	SL[7:0]								-							
A1	Read_DDB_start	0	↑	1	-	1	0	1	0	0	0	0	1	Read the DDB from the provided location.	Y	Y					
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read							
		1	1	↑	-	ID1								The five bytes always output							
		1	1	↑	-	ID2															
		1	1	↑	-	ID3															
		1	1	↑	-	ID4															
		1	1	↑	-	8'hFF															

CABC command list

(Hex)	Operation Code	DCX	WRX	RDX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	Function	Display mod Implementation Requirement
		DM[1:0]													00,01,10
		Y													11
51	WRDISBV	0	↑	1	-	-	-	-	-	-	-	-	-	Write Display Brightness Value	Y
		0	↑	1	-	DBV[7:0] (8'b0)								-	
52	RDDISBV	0	↑	1	-	0	1	0	1	0	0	1	0	Read Display Brightness Value	Y
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read	
		1	1	↑	-	DBV[7:0]								-	
53	WRCTRLD	0	↑	1	-	0	1	0	1	0	0	1	1	Write Control Display	Y
		1	↑	1	-	-	-	BCT RL (0)	-	DD (0)	BL (0)	-	-	-	
54	RDCTRLD	0	↑	1	-	0	1	0	1	0	1	0	0	Read Control Value Display	Y
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read	
		1	1	↑	-	0	0	BCT RL	0	DD	BL	0	0	-	
55	WRCABC	0	↑	1	-	0	1	0	1	0	1	0	1	-	Y
		1	↑	1	-	-	-	-	-	-	-	CABC[1:0] (00)	Write Adaptive Brightness Control		
56	RDCABC	0	↑	1	-	0	1	0	1	0	1	1	0	Read Content Adaptive Brightness Control	Y
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read	
		1	1	↑	-	-	-	-	-	-	-	CABC[1:0]	-		
5E	WRCABCMB	0	↑	1	-	0	1	0	1	1	1	1	0	Write CABC minimum brightness	Y
		1	↑	1	-	CMB[7:0]								-	
5F	RDCABCMB	0	↑	1	-	0	1	0	1	1	1	1	1	Read CABC minimum brightness	Y
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read	
		1	1	↑	-	CMB[7:0]								-	
68	RDABCSDR	0	↑	1	-	0	1	1	0	1	0	0	0	Read Automatic Brightness Control Self-Diagnostic Result	Y
		1	1	↑	-	-	-	-	-	-	-	-	-	Dummy read	
		1	1	↑	-	-	-	-	-	-	-	-	-	-	

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May, 2010

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User Define Command List Table

(Hex)	Operation Code	DCX	WRX	RDX	D17 ~D8	D7	D6	D5	D4	D3	D2	D1	D0	Function
B0	SETEXTC	0	↑	1	-	1	0	1	1	0	0	0	0	Set extended command
		1	↑	1	-	0	0	0	0	0	0	0	EXTC[1:0]	-
B3	SETGRAM	0	↑	1	-	1	0	1	1	0	0	1	1	Set GRAM access and Interface
		1	↑	1	-	0	0	0	0	0	0	0	0	-
		1	↑	1	-	0	0	0	0	0	0	0	TEI[2:0]	-
		1	↑	1	-	0	0	0	0	0	0	0	DEN[3:0]	-
		1	↑	1	-	0	0	EPF[1:0]	0	0	0	0	DFM	-
B4	SETDISPLAY	0	↑	1	-	1	0	1	1	0	1	0	0	Set Display mode and GRAM write mode
		1	↑	1	-	0	0	0	RM	0	0	DM[1:0]	-	
BF	GETDEVICEID	0	↑	1	-	1	0	1	1	1	1	1	1	Read Device ID
		1	↑	1	-	-	-	MIPI Alliance code					0x01	
		1	↑	1	-	-	-	MIPI Alliance code					0x62	
		1	↑	1	-	-	-	Device ID					0x83	
		1	↑	1	-	-	-	Device ID					0x57	
		1	↑	1	-	-	-	-					0xFF	
C0	SETPANEL	0	↑	1	-	1	1	1	1	1	1	0	0	Set Panel Driving
		1	↑	1	-	0	0	0	REV	SM	GS	0	0	-
		1	↑	1	-	0	0	NL[5:0]					-	
		1	↑	1	-	0	0	0	NDL	0	PTS[2:0]			-
		1	↑	1	-	0	0	0	PTG	ISC[3:0]				-
C1	SETNORTIME	0	↑	1	-	0	0	0	0	1	0	1	1	Set display timing for Normal mode
		1	↑	1	-	0	0	0	BC0	0	0	DIV0[1:0]		-
		1	↑	1	-	0	0	0	RTN0[4:0]					-
		1	↑	1	-	FP0[3:0]				BF0[3:0]				
C2	SETPARTIME	0	↑	1	-	1	1	0	0	0	0	1	0	Set display timing for Partial mode
		1	↑	1	-	0	0	0	BC1	0	0	DIV1[1:0]		-
		1	↑	1	-	0	0	0	RTN1[4:0]					-
		1	↑	1	-	FP1[3:0]				BF1[3:0]				
C3	SETIDLTIME	0	↑	1	-	1	1	0	0	0	0	1	1	Set display timing for Idle mode
		1	↑	1	-	0	0	0	BC2	0	0	DIV2[1:0]		-
		1	↑	1	-	0	0	0	RTN2[4:0]					-
		1	↑	1	-	FP2[3:0]				BF2[3:0]				
C5	SETOSC	0	↑	1	-	1	1	0	0	0	1	0	1	Set display frame
		1	↑	1	-	0	0	0	0	0	UADJ[3:0]			-
C6	SETRGB	0	↑	1	-	1	1	0	0	0	0	0	0	Set RGB Interface
		1	↑	1	-	SDA_N	E	0	VPL	HPL	0	EPL	DPL	-

(Hex)	Operation Code	DCX	WRX	RDX	D17 ~D8	D7	D6	D5	D4	D3	D2	D1	D0	Function			
C8	SETGAMMA	0	↑	1	-	1	1	0	0	1	0	0	0	Set Gamma curve			
		1	↑	1	-	0	KP12	KP11	KP10	0	KP02	KP01	KP00	-			
		1	↑	1	-	0	KP32	KP31	KP30	0	KP22	KP21	KP20	-			
		1	↑	1	-	0	KP52	KP51	KP50	0	KP42	KP41	KP40	-			
		1	↑	1	-	0	RP12	RP11	RP10	0	RP02	RP01	RP00	-			
		1	↑	1	-	0	0	0	0	VRP	VRP	VRP	VRP	-			
		1	↑	1	-	0	0	0	VRP	VRP	VRP	VRP	VRP	-			
		1	↑	1	-	0	KN12	KN11	KN10	0	KN02	KN01	KN00	-			
		1	↑	1	-	0	KN32	KN31	KN30	0	KN22	KN21	KN20	-			
		1	↑	1	-	0	KN52	KN51	KN50	0	KN42	KN41	KN40	-			
		1	↑	1	-	0	RN12	RN11	RN10	0	RN02	RN01	RN00	-			
		1	↑	1	-	0	0	0	0	VRN	VRN	VRN	VRN	-			
		1	↑	1	-	0	0	0	VRN	VRN	VRN	VRN	VRN	-			
D0	SETPOWER	0	↑	1	-	1	1	0	1	0	0	0	0	Set Power			
		1	↑	1	-	0	AP[2:0]			0	VC[2:0]			-			
		1	↑	1	-	0	PON	0	0	0	BT[2:0]			-			
		1	↑	1	-	0	0	0	0	VRH[3:0]			-				
D1	SETVCOM	0	↑	1	-	1	1	0	1	0	0	0	1	Set VCOM			
		1	↑	1	-	0	VCM[6:0]							-			
		1	↑	1	-	0	0	0	0	VDV[4:0]				-			
D2	SETNORPOW	0	↑	1	-	1	1	0	1	0	0	1	0	Set Power of Normal mode			
		1	↑	1	-	0	0	0	0	SAP0[2:0]							
		1	↑	1	-	0	DC10[2:0]			DC00[2:0]							
D3	SETPARPOW	0	↑	1	-	1	1	0	1	0	0	1	1	Set Power of Partial mode			
		1	↑	1	-	0	0	0	0	SAP1[2:0]							
		1	↑	1	-	0	DC11[2:0]			DC01[2:0]							
D4	SETIDLPOW	0	↑	1	-	1	1	0	1	0	1	0	0	Set Power of Idle mode			
		1	↑	1	-	0	0	0	0	SAP2[2:0]							
		1	↑	1	-	0	DC12[2:0]			DC02[2:0]							
E0	SETID	0	↑	1	-	1	1	1	0	0	0	0	0	Set ID			
		1	↑	1	-	ID1								-			
		1	↑	1	-	ID2								-			
		1	↑	1	-	ID3								-			
		1	↑	1	-	ID4								-			
E2	SETOTP	0	↑	1	-	1	1	1	0	0	0	0	1	0	Set OTP		
		1	↑	1	-	OTP_MASK[7:0]									-		
		1	↑	1	-	OTP_INDEX[7:0]									-		
		1	↑	1	-	1	OTP_L OAD_D ISABL E	OTP_T EST	OTP_P OR	OTP_P WE	OTP_PT M[1:0]	VPP_S EL	OTP_P RO G			-	
		1	↑	1	-	OTP_DATA[7:0]									-		
E3	SETOTPKY	0	↑	1	-	1	1	1	0	0	0	0	1	1	Set OTP Key		
		1	↑	1	-	OTP_KEY[7:0]									-		
E4	SETCABC	0	↑	1	-	1	1	1	0	0	1	0	0	Set CABC Control			
		1	↑	1	-	0	SEL_PWMCLK[2:0]			SEL_GAIN [1:0]	INVPU LS (1)	SEL_BLD UTY (1)			-		
		1	↑	1	-	PWM_PERIOD[7:0]									-		
		1	↑	1	-	0	DIM_FRAME[6:0]								-		

(Hex)	Operation Code	DCX	WRX	RDX	D17 ~D8	D7	D6	D5	D4	D3	D2	D1	D0	Function	
E9	SETPANEL	0	↑	1	-	1	1	1	0	1	0	0	1	Set Panel related register	
		1	↑	1	-	0	0	0	0	SS_P ANEL	0	0	BGR PANEL	-	
EE	SETEQ	0	↑	1	-	1	1	1	0	1	1	1	0	Set EQ function	
		1	↑	1	-	EQVCI_M1[7:0]									-
		1	↑	1	-	EQGND_M1[7:0]									-
		1	↑	1	-	EQVCI_M0[7:0]									-
		1	↑	1	-	EQGND_M0[7:0]									-

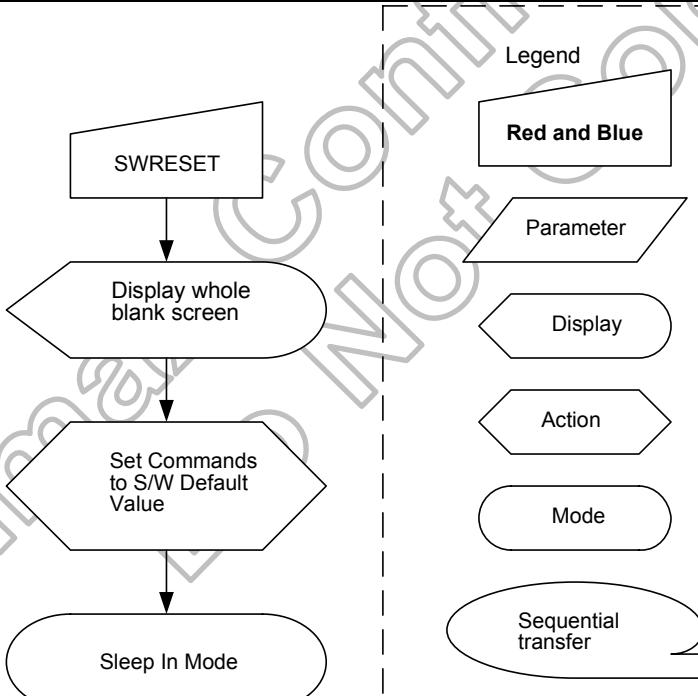
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DO Not Copy

6.2 Command Description

6.2.1 NOP

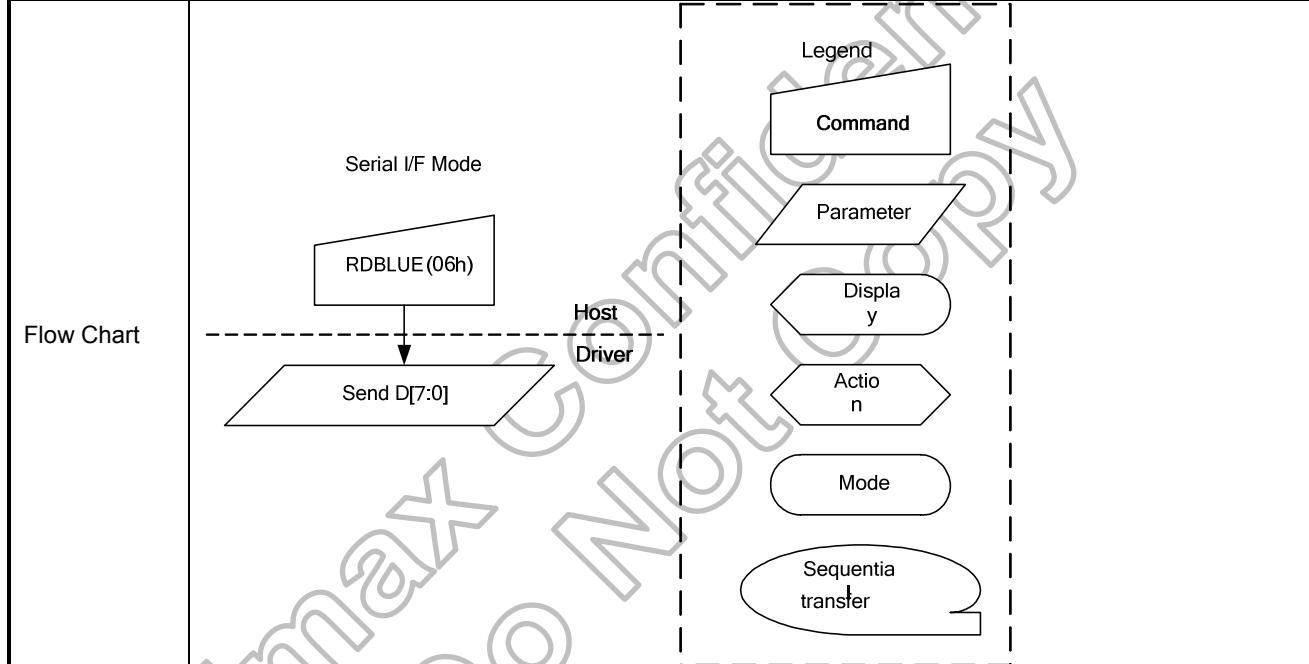
00H	NOP (No Operation)												
	DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	0	0	0	0	0	0	0	0	00
Parameter	No Parameter												
Description	This command is an empty command; it does not have any effect on the display module. However it can be used to terminate Frame Memory Write or Read as described in RAMWR (Memory Write) and RAMRD (Memory Read) Commands.												
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										
Default	Sleep In or Booster Off		Yes										
	Status		Default Value										
	Power On Sequence		N/A										
	S/W Reset		N/A										
H/W Reset		N/A											
Flow Chart													

6.2.2 Software Reset (01h)

01 H		SWRESET (Software Reset)																								
		DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX												
Command		0	1	↑	1	0	0	0	0	0	0	0	1	01												
Parameter	No Parameter																									
Description	<p>When the Software Reset command is written, it causes a software reset. It resets the commands and parameters to their S/W Reset default values. (See default tables in each command description.) Note: The Frame Memory contents are unaffected by this command</p> <p><u>It will be necessary to wait 5msec before sending new command following software reset.</u></p>																									
Restriction	<p>The display module loads all display suppliers' 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.</p>																									
Register Availability	<table border="1"> <tr> <td>Status</td> <td>Availability</td> </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 or Booster Off</td> <td>Yes</td> </tr> </table>														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 or Booster Off	Yes
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 or Booster Off	Yes																									
Default	<table border="1"> <tr> <td>Status</td> <td>Default Value</td> </tr> <tr> <td>Power On Sequence</td> <td>N/A</td> </tr> <tr> <td>S/W Reset</td> <td>N/A</td> </tr> <tr> <td>H/W Reset</td> <td>N/A</td> </tr> </table>														Status	Default Value	Power On Sequence	N/A	S/W Reset	N/A	H/W Reset	N/A				
Status	Default Value																									
Power On Sequence	N/A																									
S/W Reset	N/A																									
H/W Reset	N/A																									
Flow Chart	 <pre> graph TD SWRESET[SWRESET] --> Blank[Display whole blank screen] Blank --> Default[Set Commands to S/W Default Value] Default --> SleepIn[Sleep In Mode] </pre> <p>Legend:</p> <ul style="list-style-type: none"> Red and Blue: Parameter Display: Display Action: Action Mode: Mode Sequential transfer: Sequential transfer 																									

6.2.3 Get_red_channel (06h)

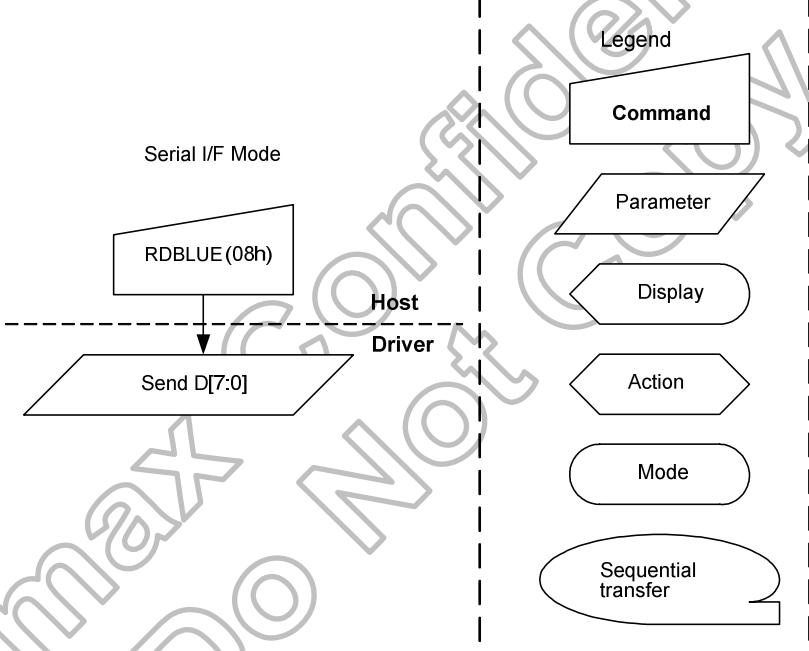
06 H		RDRED (Read Red Colour)												
		DCX	NRD	NWR	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command		0	1	↑	-	0	0	0	0	0	1	1	0	06
1 st parameter	1	↑	1	-	x	x	x	x	x	x	x	x	x	Dummy read
2 nd parameter	1	↑	1	-	R7	R6	R5	R4	R3	R2	R1	R0	xx	
Description	The first parameter is telling red colour value of the first pixel of the frame when there is used DPI I/F. 16 bit format: R5 is MSB and R1 is LSB. R7, R6 and R0 are set to '0'. 18 bit format: R5 is MSB and R0 is LSB. R7 and R6 are set to '0'.													
Restriction	The command is active when DM[1:0] = "11"													
Register Availability	Status		Availability											
	Sleep Out			Sleep In										
Default	Status		Default Value											
	Power On Sequence			S/W Reset										



6.2.4 Get_green_channel (07h)

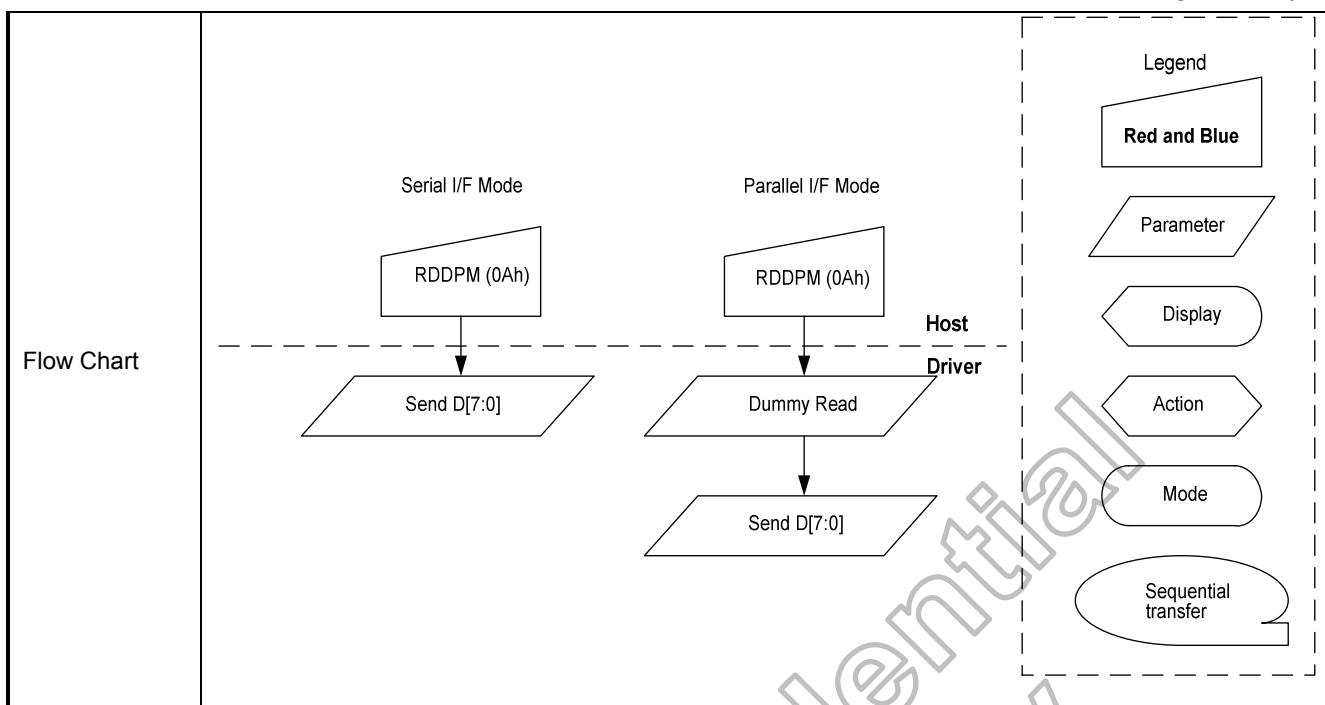
07 H		RDGREEN (Read Green Colour)												
		DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1		↑	-	0	0	0	0	0	1	1	1	01
1 st parameter	1	↑		1	-	x	x	x	x	x	x	x	x	Dummy read
2 nd parameter	1	↑		1	-	G7	G6	G5	G4	G3	G2	G1	G0	xx
Description	The first parameter is telling green colour value of the first pixel of the frame when there is used DPI I/F. 16 and 18 bit formats: G5 is MSB and G0 is LSB. G7 and G6 are set to '0'.													
Restriction	The command is active when DM[1:0] = "11"													
Register Availability	Status		Availability											
	Sleep Out													
	Sleep In													
Default	Status		Default Value											
	Power On Sequence													
	S/W Reset													
	H/W Reset													
Flow Chart	<p>Serial I/F Mode</p> <p>RDBLUE(07h)</p> <p>Host Driver</p> <p>Send D[7:0]</p> <p>Legend:</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer 													

6.2.5 Get_blue_channel (08h)

08 H		RDBLUE (Read Blue Colour)												
		DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command		0	1	↑	-	0	0	0	0	1	0	0	0	08
1 st parameter	1	↑	1		-	x	x	x	x	x	x	x	x	Dummy read
2 nd parameter	1	↑	1		-	B7	B6	B5	B4	B3	B2	B1	B0	xx
Description	The first parameter is telling blue colour value of the first pixel of the frame when there is used DPI I/F. 16 bit format: B5 is MSB and B1 is LSB. B7, B6 and B0 are set to '0'. 18 bit format: B5 is MSB and B0 is LSB. B7 and B6 are set to '0'.													
Restriction	The command is active when DM[1:0] = "11"													
Register Availability	Status		Availability											
	Sleep Out		Yes											
	Sleep In		Yes											
Default	Status		Default Value											
	Power On Sequence		00h											
	S/W Reset		00h											
	H/W Reset		00h											
Flow Chart	 <pre> graph TD RDBLUE[RDBLUE(08h)] --> Send[Send D[7:0]] subgraph Legend [Legend] direction TB C[Command] --- T1[Parameter] C --- T2[Display] C --- A[Action] C --- M[Mode] C --- ST[Sequential transfer] end subgraph SIF [Serial I/F Mode] direction TB RDBLUE --> Send Send --- Host[Host] Host --- Driver[Driver] end </pre>													

6.2.6 Get_power_mode (0Ah)

0A H		RDDPM (Read Display Power Mode)																									
		DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX													
Command		0	1	↑	-	0	0	0	0	1	0	1	0	0A													
1 st parameter		1	↑	1	-	x	x	x	x	x	x	x	x	Dummy read													
2 nd parameter		1	↑	1	-	D7	D6	D5	D4	D3	D2	0	0	xx													
Description	This command indicates the current status of the display as described in the table below:																										
	Bit	Description								Comment																	
	D7	Not Defined								Set to '0'																	
	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'																	
Description	Bits D7 for future use and are set to '0'. 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.																										
Restrictions																											
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																								
Default	Status		Default Value																								
	Power On Sequence		08HEX																								
	S/W Reset		08HEX																								
	H/W Reset		08HEX																								

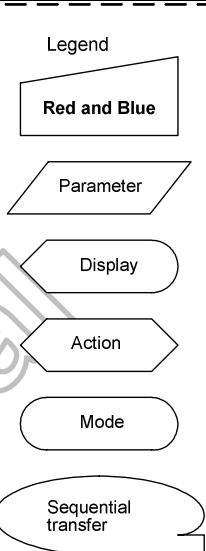


6.2.7 Read Display MADCTL (0Bh)

0B H		RDDMADCTL (Read Display MADCTL)																																							
		DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX																											
Command		0	1	↑	-	0	0	0	0	1	0	1	1	0B																											
1 st parameter		1	↑	1	-	x	x	x	x	x	x	x	x	Dummy read																											
2 nd parameter		1	↑	1	-	D7	D6	D5	D4	D3	0	D1	D0	xx																											
Description	<p>This command indicates the current status of the display as described in the table below:</p> <table border="1"> <thead> <tr> <th>Bit</th><th>Description</th><th>Comment</th></tr> </thead> <tbody> <tr> <td>D7</td><td>Page Address Order</td><td></td></tr> <tr> <td>D6</td><td>Column Address Order</td><td></td></tr> <tr> <td>D5</td><td>Page/Column Order</td><td></td></tr> <tr> <td>D4</td><td>Line Address Order</td><td></td></tr> <tr> <td>D3</td><td>RGB/BGR Order</td><td></td></tr> <tr> <td>D2</td><td>Reserved</td><td>Set to '0'</td></tr> <tr> <td>D1</td><td>Flip Horizontal</td><td></td></tr> <tr> <td>D0</td><td>Flip Vertical</td><td></td></tr> </tbody> </table>														Bit	Description	Comment	D7	Page Address Order		D6	Column Address Order		D5	Page/Column Order		D4	Line Address Order		D3	RGB/BGR Order		D2	Reserved	Set to '0'	D1	Flip Horizontal		D0	Flip Vertical	
Bit	Description	Comment																																							
D7	Page Address Order																																								
D6	Column Address Order																																								
D5	Page/Column Order																																								
D4	Line Address Order																																								
D3	RGB/BGR Order																																								
D2	Reserved	Set to '0'																																							
D1	Flip Horizontal																																								
D0	Flip Vertical																																								
<p>Bit D7 – Page Address Order '0' = Top to Bottom (When MADCTL B7='0'). '1' = Bottom to Top (When MADCTL B7='1').</p>																																									
<p>Bit D6 – Column Address Order '0' = Left to Right (When MADCTL B6='0'). '1' = Right to Left (When MADCTL B6='1').</p>																																									
<p>Bit D5 – Page/Column Order '0' = Normal (When MADCTL B5='0'). '1' = Rotation (When MADCTL B5='1').</p>																																									
<p>Note: For Bits D7 to D5, also refer to Section 5.1.3 MCU to memory write/read direction.</p>																																									
<p>Bit D4 – Line Address Order '0' = LCD Refresh Top to Bottom (When MADCTL B4='0'). '1' = LCD Refresh Bottom to Top (When MADCTL B4='1').</p>																																									
<p>Bit D3 – RGB/BGR Order '0' = RGB (When MADCTL B3='0'). '1' = BGR (When MADCTL B3='1').</p>																																									
<p>Note: For Bits D4 and D3 also refer to 9.2.29 Set_address_mode (36h).</p>																																									
<p>Bit D2 is for future use and is set to '0'.</p>																																									
<p>Bit D1 – Flip Horizontal This bit flips the image shown on the display device left to right. No change is made to the frame memory. '0' = Normal '1' = Flipped</p>																																									
<p>Bit D0 – Flip Vertical This bit flips the image shown on the display device top to bottom. No change is made to the frame memory. '0' = Normal</p>																																									
Restrictions																																									
Register Availability	<table border="1"> <thead> <tr> <th>Status</th><th>Availability</th></tr> </thead> <tbody> <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> </tbody> </table>														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																	
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																																								

Default	Status	Default Value	
	Power On Sequence	00HEX	

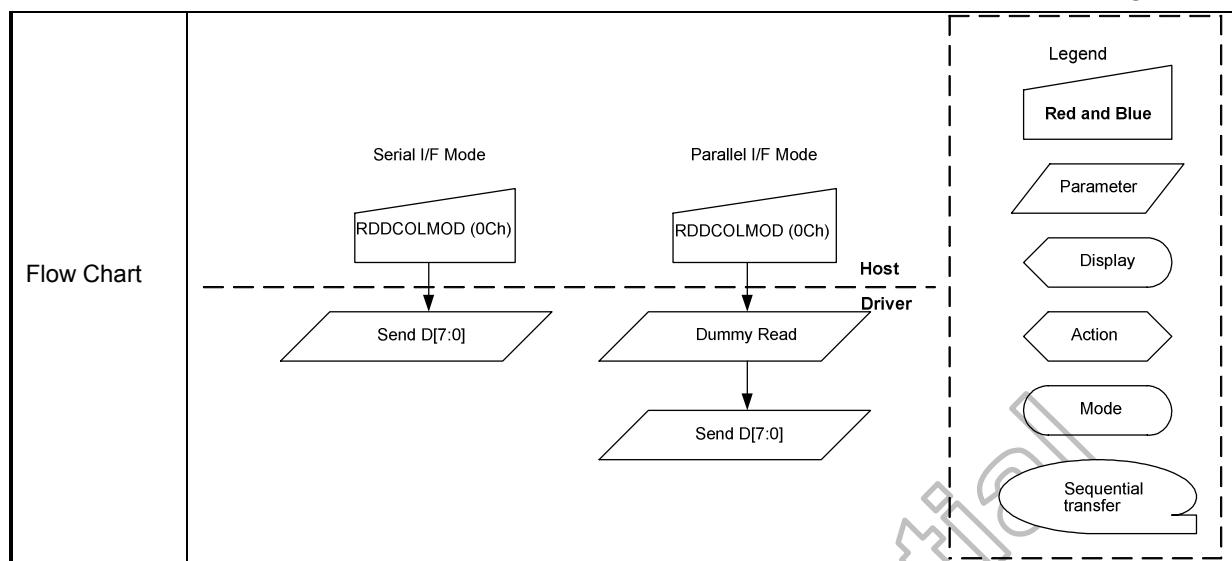
Flow Chart	Serial I/F Mode	Parallel I/F Mode	Legend
	<p>RDDMADCTR (0Bh)</p> <p>Send D[7:0]</p>	<p>RDDMADCTR (0Bh)</p> <p>Dummy Read</p> <p>Send D[7:0]</p>	



- Red and Blue
- Parameter
- Display
- Action
- Mode
- Sequential transfer

6.2.8 Get_pixel_format (0Ch)

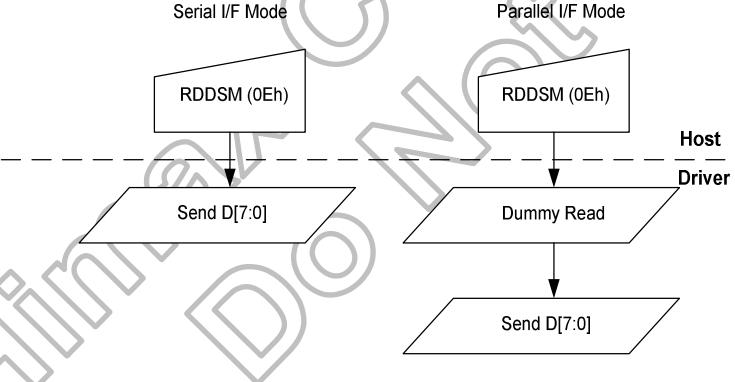
0C H		RDDCOLMOD (Read Display COLMOD)																						
		DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX										
Command		0	1	↑	-	0	0	0	0	1	1	0	0	0C										
1 st parameter		1	↑	1	-	x	x	x	x	x	x	x	x	Dummy read										
2 nd parameter		1	↑	1		-	D6	D5	D4	-	D2	D1	D0	xx										
Description	This command indicates the current status of the display as described in the table below:																							
	Bit	Description								Comment														
	D7	Reserved								Set to '0'														
	D6	DPI Interface Pixel format																						
	D5																							
	D4																							
	D3									Reserved														
	D2	DBI Interface Pixel format																						
	D1																							
	D0																							
Description	Bits D6, D5, D4 – DPI Interface Colour Pixel Format Definition Bits D2, D1, D0 – DBI Interface Colour Pixel Format Definition. See section "6.2.33 Set_pixel_format (3Ah)".																							
	Interface Colour Format				D6/D2			D5/D1			D4/D0													
	Not Defined				0			0			0													
	3 bit/pixel				0			0			1													
	Not Defined				0			1			0													
	Not Defined				0			1			1													
	Not Defined				1			0			0													
	16 bit/pixel				1			0			1													
	18 bit/pixel				1			1			0													
	Not Defined				1			1			1													
Restrictions	If a particular interface, either DBI or DPI, is not used then the corresponding bits in the																							
	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 or Booster Off		Yes																					
	Default																							
	Status		Default Value																					
	Power On Sequence		66HEX																					
	S/W Reset		66HEX																					
	H/W Reset		66HEX																					



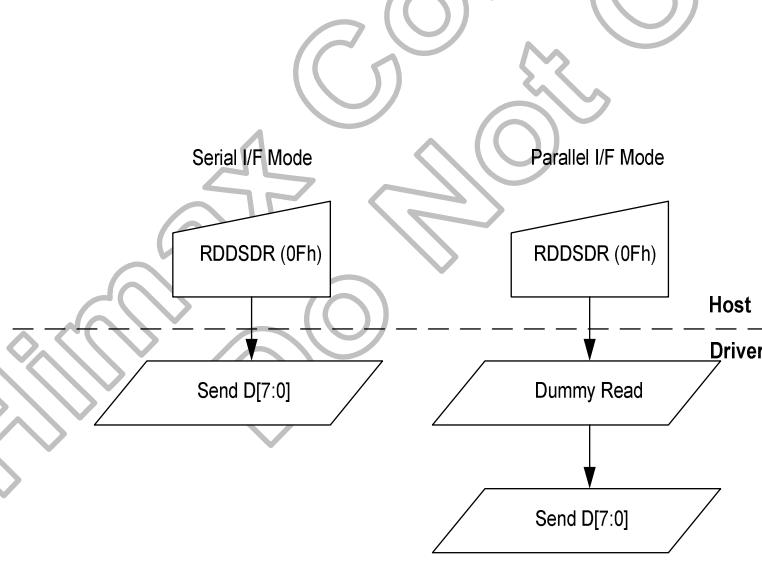
6.2.9 Get_display_mode (0Dh)

0D H		RDDIM (Read Display Image Mode)																								
		DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX												
Command		0	1	↑	-	0	0	0	0	1	1	0	1	0D												
1 st parameter		1	↑	1	-	x	x	x	x	x	x	x	x	Dummy read												
2 nd parameter		1	↑	1	-	D7	0	D5	0	0	D2	D1	D0	xx												
Description	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 – Horizontal Scrolling Status This bit is not applicable for this project, so it is set to '0' 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 bit are not applicable for this project, so they are set to '000'																									
Restrictions																										
Register Availability	<table border="1"> <tr> <td>status</td> <td>Availability</td> </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 or Booster Off</td> <td>Yes</td> </tr> </table>														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 or Booster Off	Yes
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 or Booster Off	Yes																									
Default	<table border="1"> <tr> <td>Status</td> <td>Default Value</td> </tr> <tr> <td>Power On Sequence</td> <td>00HEX</td> </tr> <tr> <td>S/W Reset</td> <td>00HEX</td> </tr> <tr> <td>H/W Reset</td> <td>00HEX</td> </tr> </table>														Status	Default Value	Power On Sequence	00HEX	S/W Reset	00HEX	H/W Reset	00HEX				
Status	Default Value																									
Power On Sequence	00HEX																									
S/W Reset	00HEX																									
H/W Reset	00HEX																									
Flow Chart	<p>Legend:</p> <ul style="list-style-type: none"> Red and Blue Parameter Display Action Mode Sequential transfer 																									

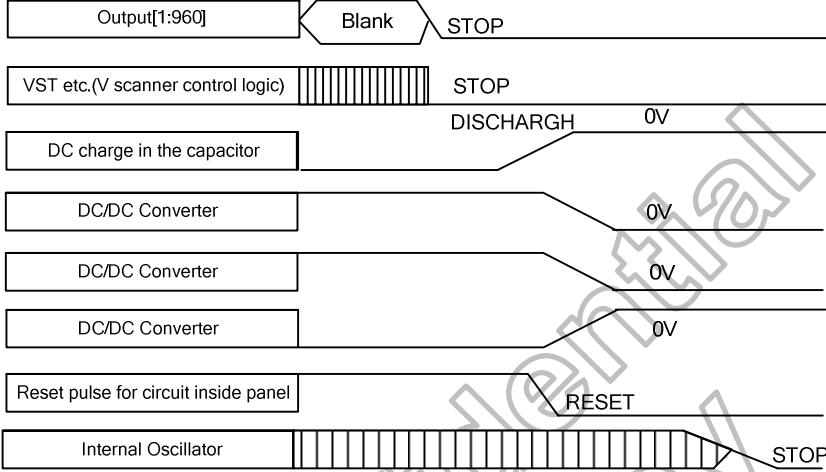
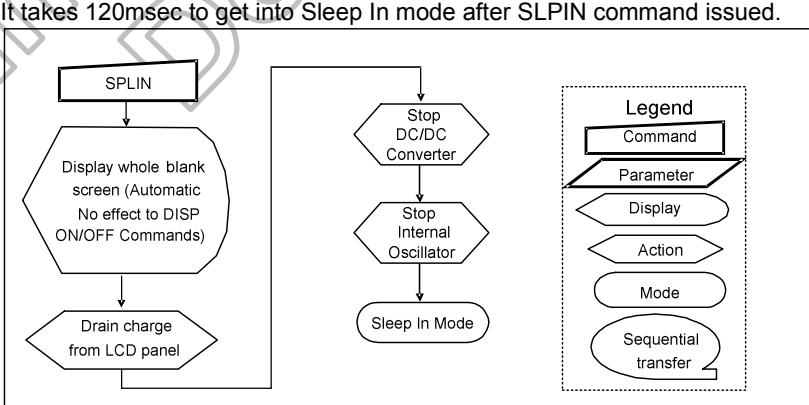
6.2.10 Get_signal_mode (0Eh)

0E H RDDSM (Read Display Signal Mode)														
	DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX	
Command	0	1	↑	-	0	0	0	0	1	1	1	0	0E	
1 st parameter	1	↑	1	-	x	x	x	x	x	x	x	x	Dummy read	
2 nd parameter	1	↑	1	-	D7	D6	0	0	0	0	0	0	xx	
Description	This command indicates the current status of the display as described in the table below: Bit D7 – Tearing Effect Line On/Off '0' = Tearing Effect Line Off. '1' = Tearing Effect On. Bit D6 – Tearing Effect Line Output Mode, see section 7.1 for mode definitions. '0' = Mode 1. '1' = Mode 2. D5 are D0 – are for future use and are set to '0'.													
Restrictions														
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 or Booster Off		Yes											
Default	Status		Default Value											
	Power On Sequence		00HEX											
	S/W Reset		00HEX											
Flow Chart	 <pre> graph TD RDDSM[RDDSM (0Eh)] --> Send1[/Send D[7:0]/] RDDSM --> Send2[/Send D[7:0]/] Send1 --> Host[Host] Send2 --> Driver[Driver] Host --> DummyRead[/Dummy Read/] DummyRead --> Send2 </pre> <p>Legend:</p> <ul style="list-style-type: none"> Red and Blue: Box Parameter: Parallelogram Display: Hexagon Action: Oval Mode: Ellipse Sequential transfer: Ellipse with arrow 													

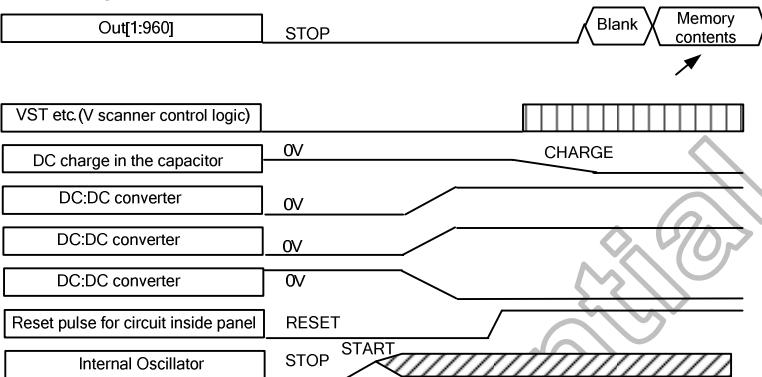
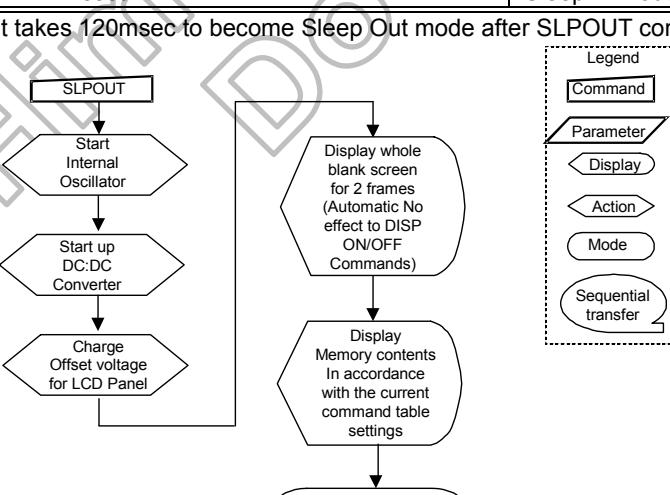
6.2.11 Get_diagnostic_result (0Fh)

0F H		RDDSDR (Read Display Self-Diagnostic Result)																								
		DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX												
Command		0	1	↑	-	0	0	0	0	1	1	1	1	0F												
1 st parameter		1	↑	1	-	x	x	x	x	x	x	x	x	Dummy read												
2 nd parameter		1	1	1	-	D7	D6	D5	D4	0	0	0	0	xx												
Description	The display module returns the self-diagnostic results following a Sleep Out command. See section 7.10 for a description of the status results. Bit D7 – Register Loading Detection Bit D6 – Functionality Detection Bit D5 – Chip Attachment Detection Set to '0' if feature unimplemented. Bit D4 – Display Glass Break Detection Set to '0' if feature unimplemented. Bits D[3:0] – Reserved Set to '0'.																									
Restrictions																										
Register Availability	<table border="1"> <tr> <td>Status</td> <td>Availability</td> </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 or Booster Off</td> <td>Yes</td> </tr> </table>		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 or Booster Off	Yes												
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 or Booster Off	Yes																									
Default	<table border="1"> <tr> <td>Status</td> <td>Default Value</td> </tr> <tr> <td>Power On Sequence</td> <td>00HEX</td> </tr> <tr> <td>S/W Reset</td> <td>00HEX</td> </tr> <tr> <td>H/W Reset</td> <td>00HEX</td> </tr> </table>		Status	Default Value	Power On Sequence	00HEX	S/W Reset	00HEX	H/W Reset	00HEX																
Status	Default Value																									
Power On Sequence	00HEX																									
S/W Reset	00HEX																									
H/W Reset	00HEX																									
Flow Chart	 <pre> graph TD RDDSDR[RDDSDR (0Fh)] --> Send1[/Send D[7:0]/] RDDSDR --> ParallelI[Parallel I/F Mode] ParallelI --> DummyRead1[Dummy Read] ParallelI --> Send2[/Send D[7:0]/] Send1 --> Host[Host] Host --> Driver[Driver] Driver --> DummyRead1 DummyRead1 --> Send2 SerialI[Serial I/F Mode] --> Send1 </pre> <p>Legend:</p> <ul style="list-style-type: none"> Red and Blue: Action Parameter: Parameter Display: Display Action: Action Mode: Mode Sequential transfer: Sequential transfer 																									

6.2.12 Enter_sleep_mode (10h)

10 H	SLPIN (Sleep In)																									
	DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX													
Command	0	1	↑	-	0	0	0	1	0	0	0	0	10													
Parameter	No Parameter																									
Description	<p>This command causes the LCD module to enter the minimum power consumption mode. In this mode the DC/DC converter is stopped, Internal oscillator is stopped, and panel scanning is stopped.</p>  <p>MCU interface and memory are still working and the memory keeps its contents.</p>																									
Restriction	<p>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.</p>																									
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <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 or Booster Off</td> <td>Yes</td> </tr> </tbody> </table>														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 or Booster Off	Yes
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Sleep In or Booster Off	Yes																									
Default	<table border="1"> <thead> <tr> <th>Status</th> <th>Default Value</th> </tr> </thead> <tbody> <tr> <td>Power On Sequence</td> <td>Sleep in mode</td> </tr> <tr> <td>S/W Reset</td> <td>Sleep in mode</td> </tr> <tr> <td>H/W Reset</td> <td>Sleep in mode</td> </tr> </tbody> </table>														Status	Default Value	Power On Sequence	Sleep in mode	S/W Reset	Sleep in mode	H/W Reset	Sleep in mode				
Status	Default Value																									
Power On Sequence	Sleep in mode																									
S/W Reset	Sleep in mode																									
H/W Reset	Sleep in mode																									
Flow Chart	<p>It takes 120msec to get into Sleep In mode after SLPIN command issued.</p> 																									

6.2.13 Exit_sleep_omde (11h)

11 H	SLPOUT (Sleep Out)												
Command	DCX RDX WRX D17~D8 D7 D6 D5 D4 D3 D2 D1 D0 HEX 0 1 ↑ - 0 0 0 1 0 0 0 1 11												
Parameter	No Parameter												
Description	<p>This command turns off sleep mode. In this mode the DC/DC converter is enabled, Internal oscillator is started, and panel scanning is started.</p> 												
Restriction	<p>This command has no effect when module is already in sleep out mode. 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. The display module 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 the display module is already Sleep Out –mode.</p> <p>The display module 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.</p>												
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <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 or Booster Off</td> <td>Yes</td> </tr> </tbody> </table>	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 or Booster Off	Yes
Status	Availability												
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Normal Mode On, Idle Mode On, Sleep Out	Yes												
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Partial Mode On, Idle Mode On, Sleep Out	Yes												
Sleep In or Booster Off	Yes												
Default	<table border="1"> <thead> <tr> <th>Status</th> <th>Default Value</th> </tr> </thead> <tbody> <tr> <td>Power On Sequence</td> <td>Sleep In Mode</td> </tr> <tr> <td>S/W Reset</td> <td>Sleep In Mode</td> </tr> <tr> <td>H/W Reset</td> <td>Sleep In Mode</td> </tr> </tbody> </table>	Status	Default Value	Power On Sequence	Sleep In Mode	S/W Reset	Sleep In Mode	H/W Reset	Sleep In Mode				
Status	Default Value												
Power On Sequence	Sleep In Mode												
S/W Reset	Sleep In Mode												
H/W Reset	Sleep In Mode												
Flow Chart	<p>It takes 120msec to become Sleep Out mode after SLPOUT command issued.</p> 												

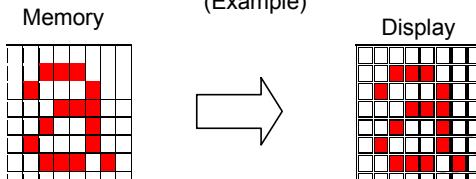
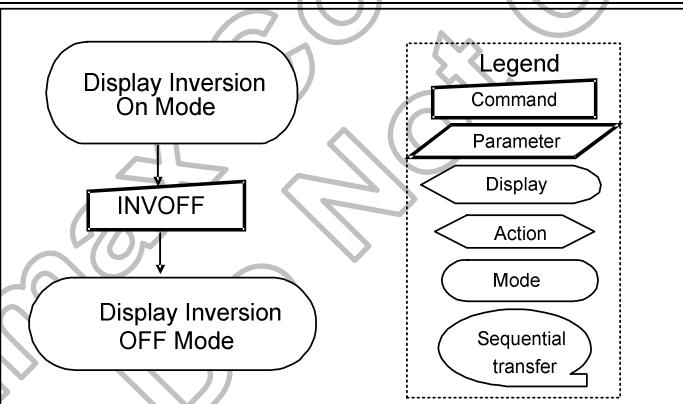
6.2.14 Enter_partial_mode (12h)

12 H	PTLON (Partial Mode On)																							
	DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX											
Command	0	1	↑	-	0	0	0	1	0	0	1	0	12											
Parameter	No Parameter																							
Description	This command turns on partial mode. The partial mode window is described by the "Set_partial_area" command (30H). To leave Partial mode, the "Enter_norma_mode" command (13H) should be written.																							
Restrictions	This command has no effect when Partial 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																					
Default	Status		Default Value																					
	Power On Sequence		Normal Mode On																					
	S/W Reset		Normal Mode On																					
	H/W Reset		Normal Mode On																					
Flow Chart	See Partial Area (30h)																							

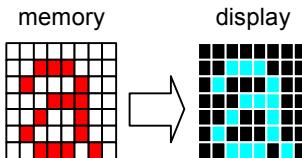
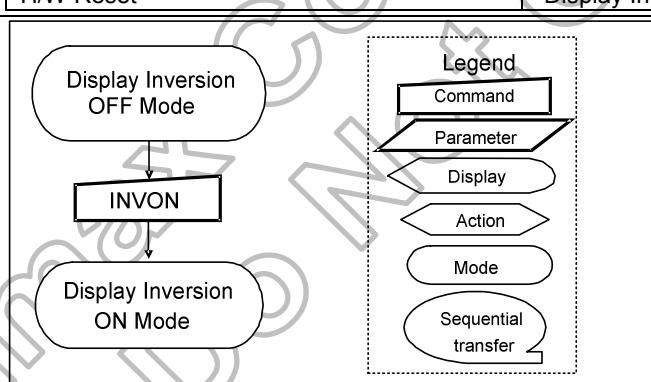
6.2.15 Enter_normal_mode (13h)

13 H	NORON (Normal Display Mode On)																							
	DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX											
Command	0	1	↑	-	0	0	0	1	0	0	1	1	13											
Parameter	No Parameter																							
Description	This command returns the display to normal mode. Normal display mode is means Partial mode off, Scroll mode Off.																							
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 or Booster Off		Yes																					
Default	Status		Default Value																					
	Power On Sequence		Normal Mode On																					
	S/W Reset		Normal Mode On																					
	H/W Reset		Normal Mode On																					
Flow Chart	See Partial Area and Vertical Scrolling Definition Descriptions for details of when to use this command.																							

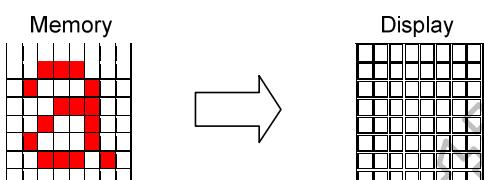
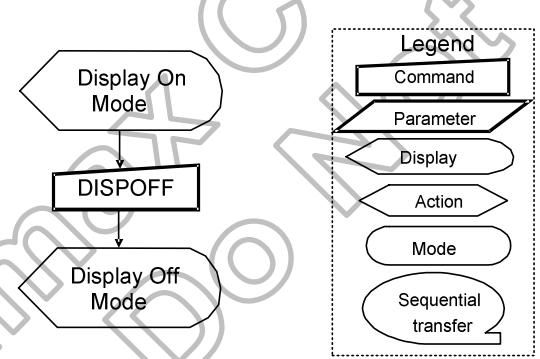
6.2.16 Exit_inversion_mode (20h)

20 H	INVOFF (Display Inversion Off)																									
	DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX													
Command	0	1	↑	-	0	0	1	0	0	0	0	0	0	20												
Parameter	No Parameter																									
Description	This command is used to recover from display inversion mode. This command makes no change of contents of frame memory. This command does not change any other status. (Example)																									
	 (Example)																									
Restriction	This command has no effect when module is already in inversion off mode.																									
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <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 or Booster Off</td> <td>Yes</td> </tr> </tbody> </table>														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 or Booster Off	Yes
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Status	Default Value																									
Power On Sequence	Display Inversion off																									
S/W Reset	Display Inversion off																									
H/W Reset	Display Inversion off																									
Flow Chart																										

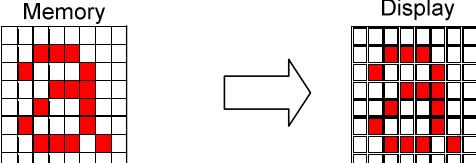
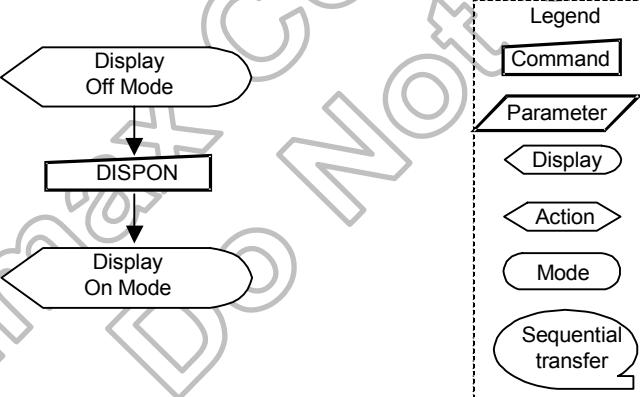
6.2.17 Enter_inversion_mode (21h)

21 H	INVON (Display Inversion On)																									
	DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX													
Command	0	1	↑	-	0	0	1	0	0	0	0	1	21													
Parameter	No Parameter																									
Description	<p>This command is used to enter into display inversion mode. This command makes no change of contents of frame memory. Every bit is inverted from the frame memory to the display. This command does not change any other status.</p> <p>(Example)</p> 																									
Restriction	This command has no effect when module is already in inversion on mode.																									
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <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 or Booster Off</td> <td>Yes</td> </tr> </tbody> </table>														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 or Booster Off	Yes
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Status	Default Value																									
Power On Sequence	Display Inversion off																									
S/W Reset	Display Inversion off																									
H/W Reset	Display Inversion off																									
Flow Chart	 <pre> graph TD A([Display Inversion OFF Mode]) --> B[INVON] B --> C([Display Inversion ON Mode]) </pre> <p>Legend:</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer 																									

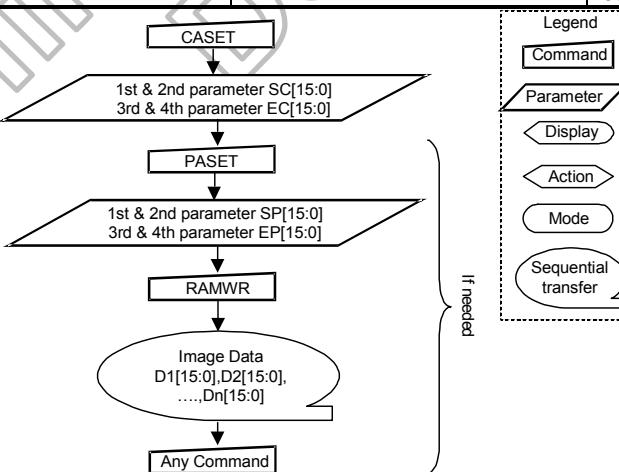
6.2.18 Set_display_off (28h)

28H	DISPOFF (Display Off)																									
	DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0		HEX												
Command	0	1	↑	-	0	0	1	0	1	0	0	0	28													
Parameter	No Parameter																									
Description	<p>This command is used to enter into DISPLAY OFF mode. In this mode, the output from Frame Memory is disabled and blank page inserted.</p> <p>This command makes no change of contents of frame memory.</p> <p>This command does not change any other status.</p> <p>There will be no abnormal visible effect on the display.</p> <p style="text-align: center;">Example</p> 																									
Restriction	This command has no effect when module is already in display off mode.																									
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <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 or Booster Off</td> <td>Yes</td> </tr> </tbody> </table>														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 or Booster Off	Yes
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Status	Default Value																									
Power On Sequence	Display off																									
S/W Reset	Display off																									
H/W Reset	Display off																									
Flow Chart	 <pre> graph TD A([Display On Mode]) --> B[DISPOFF] B --> C([Display Off Mode]) </pre> <p>Legend:</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer 																									

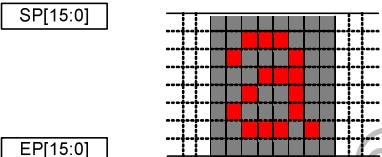
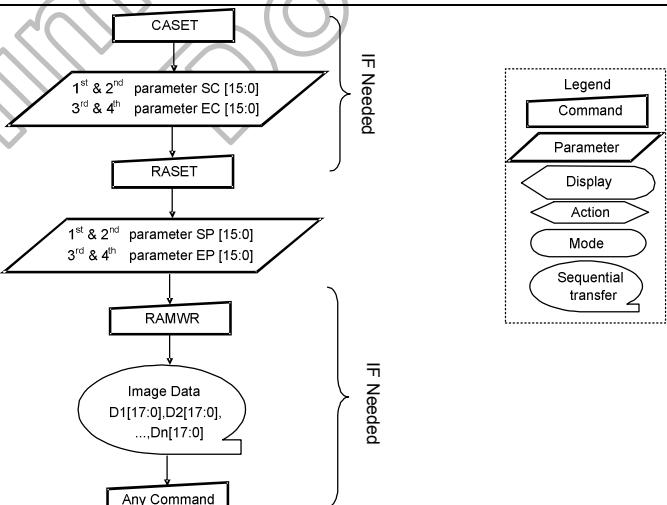
6.2.19 Set_display_on (29h)

29 H	DISPON (Display On)												
Command	DCX RDX WRX D17~D8 D7 D6 D5 D4 D3 D2 D1 D0 HEX 0 1 ↑ - 0 0 1 0 1 0 0 1 29												
Parameter	No Parameter												
Description	<p>This command is used to recover from DISPLAY OFF mode. Output from the Frame Memory is enabled.</p> <p>This command makes no change of contents of frame memory.</p> <p>This command does not change any other status.</p> <p>(Example)</p> 												
Restriction	This command has no effect when module is already in display on mode.												
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <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 or Booster Off</td> <td>Yes</td> </tr> </tbody> </table>	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 or Booster Off	Yes
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 or Booster Off	Yes												
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Status	Default Value												
Power On Sequence	Display off												
S/W Reset	Display off												
H/W Reset	Display off												
Flow Chart	 <pre> graph TD A([Display Off Mode]) --> B[DISPON] B --> C([Display On Mode]) </pre>												

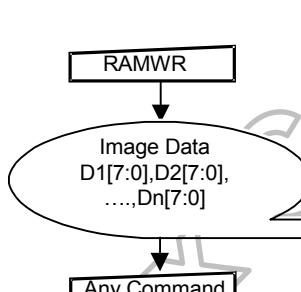
6.2.20 Set_column_address (2Ah)

2A H		CASET (Column Address Set)																													
		DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX																	
Command		0	1	↑	-	0	0	1	0	1	0	1	0	2A																	
1 st parameter		1	1	↑	-	SC15	SC14	SC13	SC12	SC11	SC10	SC9	SC8	00..																	
2 nd parameter		1	1	↑	-	SC7	SC6	SC5	SC4	SC3	SC2	SC1	SC0	Note 1																	
3 rd parameter	3rd	1	1	↑	-	EC15	EC14	EC13	EC12	EC11	EC10	EC9	EC8	00..																	
4 th parameter	4th	1	1	↑	-	EC7	EC6	EC5	EC4	EC3	EC2	EC1	EC0	Note 1																	
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 horizontal line (when MADCTL's B5=0) or vertical line (when MADCTL's B5=1), data of out of range will be ignored.																														
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <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 or Booster Off</td> <td>Yes</td> </tr> </tbody> </table>														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 or Booster Off	Yes					
Status	Availability																														
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Partial Mode On, Idle Mode On, Sleep Out	Yes																														
Sleep In or Booster Off	Yes																														
Default	<table border="1"> <thead> <tr> <th>Status</th> <th>Default Value</th> </tr> </thead> <tbody> <tr> <td>Power On Sequence</td> <td>SC[15:0]=0000</td> <td>The frame memory Column addresses corresponding to the last vertical line.</td> </tr> <tr> <td rowspan="3">S/W Reset</td> <td>When MADCTL's B5=0:</td> <td>When MADCTL's B5=0:</td> </tr> <tr> <td>SC[15:0]=0000</td> <td>The frame memory column addresses corresponding to the last vertical line.</td> </tr> <tr> <td>When MADCTL's B5=1:</td> <td>When MADCTL's B5=1:</td> </tr> <tr> <td rowspan="2">H/W Reset</td> <td>SC[15:0]=0000</td> <td>The frame memory column addresses corresponding to the last horizontal line.</td> </tr> <tr> <td>SC[15:0]=0000</td> <td>The frame memory column addresses corresponding to the last horizontal line.</td> </tr> </tbody> </table>														Status	Default Value	Power On Sequence	SC[15:0]=0000	The frame memory Column addresses corresponding to the last vertical line.	S/W Reset	When MADCTL's B5=0:	When MADCTL's B5=0:	SC[15:0]=0000	The frame memory column addresses corresponding to the last vertical line.	When MADCTL's B5=1:	When MADCTL's B5=1:	H/W Reset	SC[15:0]=0000	The frame memory column addresses corresponding to the last horizontal line.	SC[15:0]=0000	The frame memory column addresses corresponding to the last horizontal line.
Status	Default Value																														
Power On Sequence	SC[15:0]=0000	The frame memory Column addresses corresponding to the last vertical line.																													
S/W Reset	When MADCTL's B5=0:	When MADCTL's B5=0:																													
	SC[15:0]=0000	The frame memory column addresses corresponding to the last vertical line.																													
	When MADCTL's B5=1:	When MADCTL's B5=1:																													
H/W Reset	SC[15:0]=0000	The frame memory column addresses corresponding to the last horizontal line.																													
	SC[15:0]=0000	The frame memory column addresses corresponding to the last horizontal line.																													
Flow Chart	 <pre> graph TD CASET --> PASET PASET --> RAMWR RAMWR --> ImageData([Image Data D1[15:0], D2[15:0], ..., Dn[15:0]]) ImageData --> AnyCommand([Any Command]) </pre> <p>Legend:</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer <p>If needed</p>																														

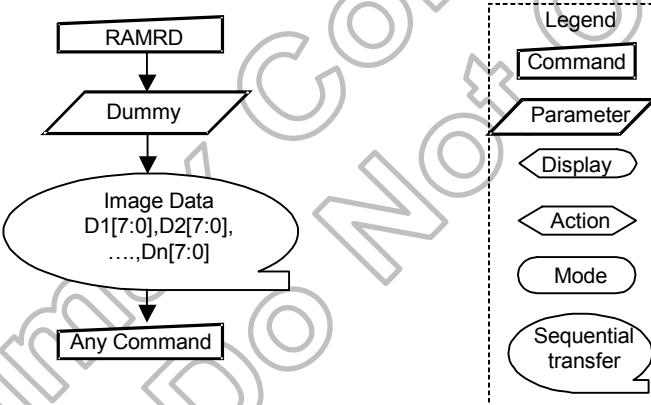
6.2.21 Set_page_address (2Bh)

2B H	PASET (Page Address Set)										
	DCX RDX WRX D17~D8 D7 D6 D5 D4 D3 D2 D1 D0 HEX										
Command	0 1 ↑ - 0 0 1 0 1 0 1 1 2B										
1 st parameter	1 1 ↑ - SP15 SP14 SP13 SP12 SP11 SP10 SP9 SP8 00 ...										
2 nd parameter	1 1 ↑ - SP7 SP6 SP5 SP4 SP3 SP2 SP1 SP0 Note 1										
3 rd parameter	1 1 ↑ - EP15 EP14 EP13 EP12 EP11 EP10 EP9 EP8 00 ...										
4 th parameter	1 1 ↑ - EP7 EP6 EP5 EP4 EP3 EP2 EP1 EP0 Note 1										
Description	<p>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.</p> <p>(Example)</p> 										
Restriction	<p>SP[15:0] always must be equal to or less than EP[15:0] Note 1: When SP[15:0] or EP[15:0] is greater than vertical line (When MADCTL's B5=0) or horizontal line (When MADCTL's B5=1), data of out of range will be ignored.</p>										
Register Availability	<table border="1"> <thead> <tr> <th>Status</th><th>Availability</th></tr> </thead> <tbody> <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> </tbody> </table>	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
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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										
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Default	<table border="1"> <thead> <tr> <th>Status</th><th>Default Value</th></tr> </thead> <tbody> <tr> <td>Power On Sequence</td><td>SP[15:0]=0000 The frame memory page addresses corresponding to the last horizontal line.</td></tr> <tr> <td rowspan="3">S/W Reset</td><td>When MADCTL's B5=0: SP[15:0]=0000 The frame memory page addresses corresponding to the last horizontal line.</td></tr> <tr><td>When MADCTL's B5=1: SP[15:0]=0000 The frame memory page addresses corresponding to the last vertical line.</td></tr> <tr><td>When MADCTL's B5=1: SP[15:0]=0000 The frame memory page addresses corresponding to the last horizontal line.</td></tr> <tr> <td>H/W Reset</td><td>SP[15:0]=0000 The frame memory page addresses corresponding to the last horizontal line.</td></tr> </tbody> </table>	Status	Default Value	Power On Sequence	SP[15:0]=0000 The frame memory page addresses corresponding to the last horizontal line.	S/W Reset	When MADCTL's B5=0: SP[15:0]=0000 The frame memory page addresses corresponding to the last horizontal line.	When MADCTL's B5=1: SP[15:0]=0000 The frame memory page addresses corresponding to the last vertical line.	When MADCTL's B5=1: SP[15:0]=0000 The frame memory page addresses corresponding to the last horizontal line.	H/W Reset	SP[15:0]=0000 The frame memory page addresses corresponding to the last horizontal line.
Status	Default Value										
Power On Sequence	SP[15:0]=0000 The frame memory page addresses corresponding to the last horizontal line.										
S/W Reset	When MADCTL's B5=0: SP[15:0]=0000 The frame memory page addresses corresponding to the last horizontal line.										
	When MADCTL's B5=1: SP[15:0]=0000 The frame memory page addresses corresponding to the last vertical line.										
	When MADCTL's B5=1: SP[15:0]=0000 The frame memory page addresses corresponding to the last horizontal line.										
H/W Reset	SP[15:0]=0000 The frame memory page addresses corresponding to the last horizontal line.										
Flow Chart	 <pre> graph TD CASET[CASET] --> RASET[RASET] RASET --> RAMWR[RAMWR] RAMWR --> ImageData([Image Data D1[17:0], D2[17:0], ..., Dn[17:0]]) ImageData --> AnyCommand[Any Command] </pre> <p>The flowchart shows the sequence of commands: CASET → RASET → RAMWR → Image Data → Any Command. The RAMWR step is preceded by parameters SP[15:0] and EP[15:0]. A legend on the right defines symbols for Command, Parameter, Display, Action, Mode, and Sequential transfer.</p>										

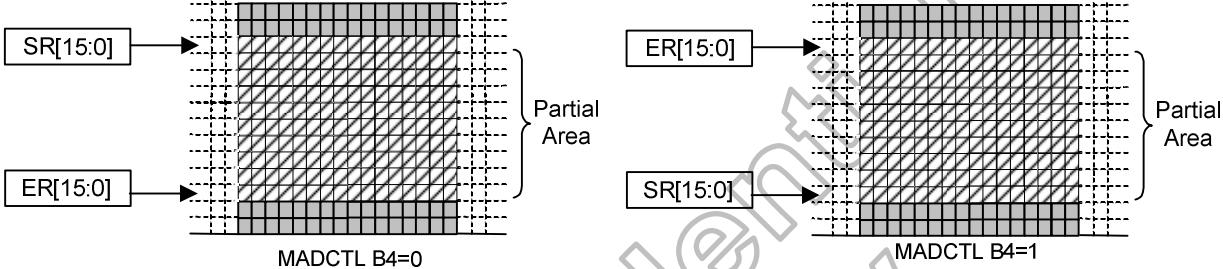
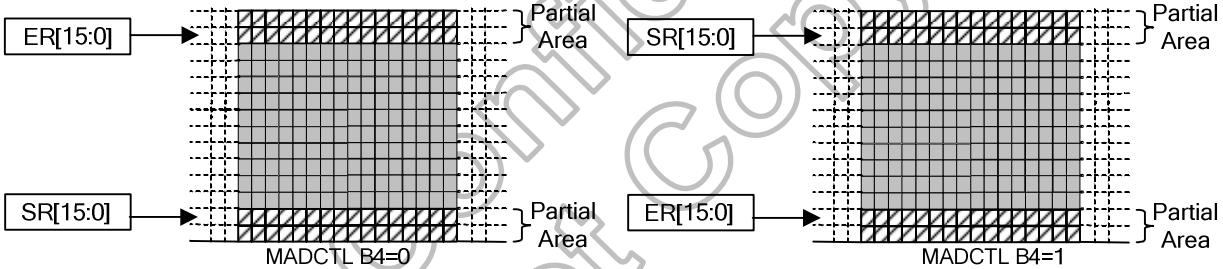
6.2.22 Write_memory_start (2Ch)

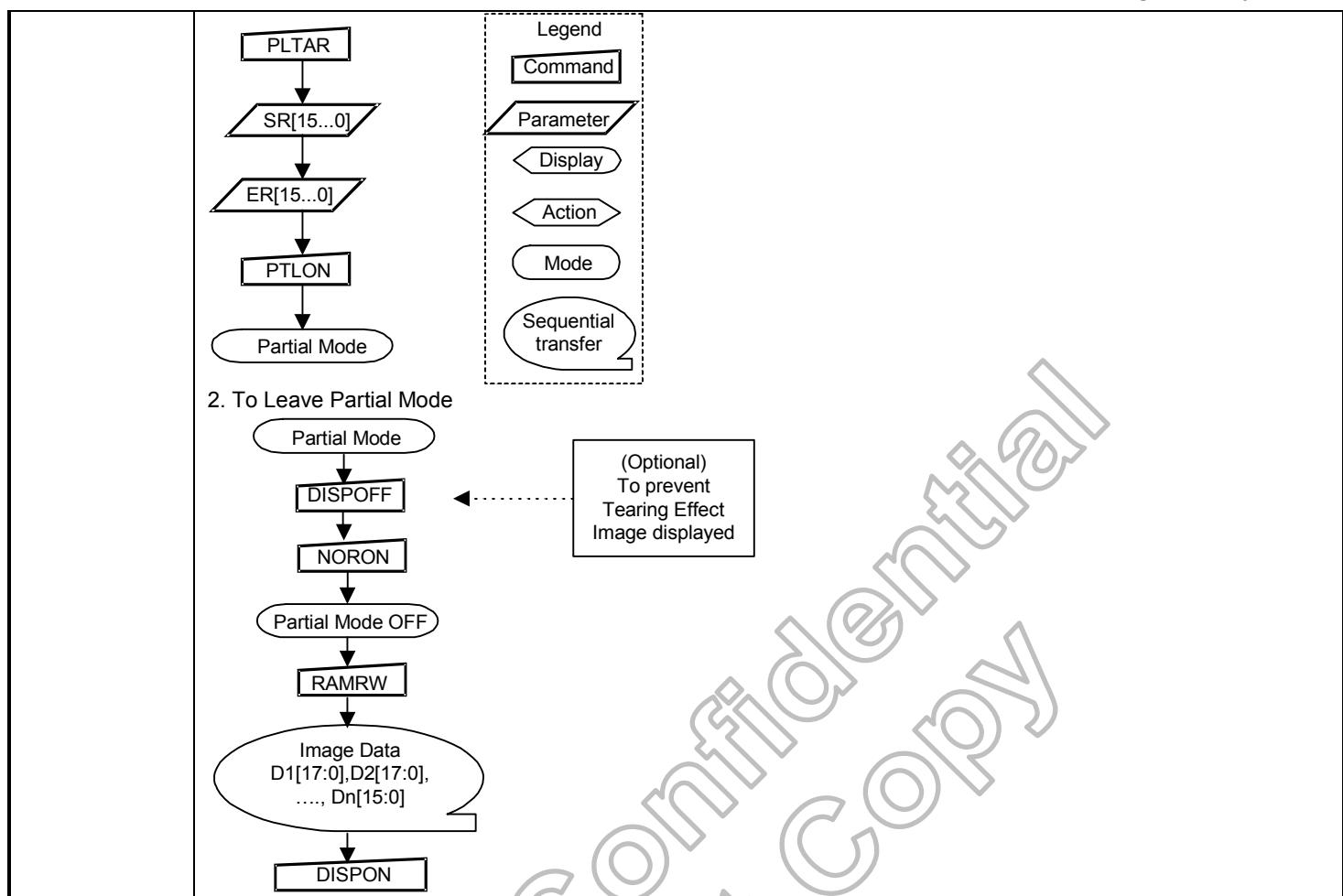
2C H		RAMWR (Memory Write)																						
		DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX										
Command	0	1		↑	-	0	0	1	0	1	1	0	0	2C										
1 st parameter	1	1		↑	-	D17	D16	D15	D14	D13	D12	D11	D10	00..FF										
:	1	1		↑	-	Dx7	Dx6	Dx5	Dx4	Dx3	Dx2	Dx1	Dx0	00..FF										
N th parameter	1	1		↑	-	Dn7	Dn6	Dn5	Dn4	Dn3	Dn2	Dn1	Dn0	00..FF										
Description	This command is used to transfer data from MCU to frame memory. This command makes no change to the other driver status. When this command is accepted, the column register and the page register are reset to the Start Column/Start Page positions. The Start Column/Start Page positions are different in accordance with MADCTL setting. Then D[7:0] is stored in frame memory and the column register. Sending any other command can stop frame Write.																							
Restriction	In all colour modes, there is no restriction on length of parameters.																							
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <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> </tbody> </table>														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
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Status	Default Value																							
Power On Sequence	Contents of memory is set randomly																							
S/W Reset	Contents of memory is not cleared																							
Flow Chart	 <p>Legend:</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer 																							

6.2.23 Raed_memory_start (2Eh)

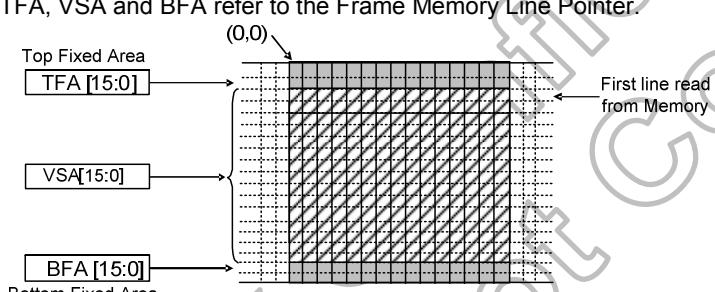
2E H		RAMRD (Memory Read)																									
		DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX													
Command	0	1	↑		-	0	0	1	0	1	1	1	0	2E													
1 st parameter	1	↑		1	-	X	X	X	X	X	X	X	X	Dummy read													
2 nd parameter	1	↑		1	-	D17	D16	D15	D14	D13	D12	D11	D10	00..FF													
:	1	↑		1	-	Dx7	Dx6	Dx5	Dx4	Dx3	Dx2	Dx1	Dx0	00..FF													
(n+1) th parameter	1	↑		1	-	Dn7	Dn6	Dn5	Dn4	Dn3	Dn2	Dn1	Dn0	00..FF													
Description	This command is used to transfer data from frame memory to MCU. This command makes no change to the other driver status. When this command is accepted, the column register and the page register are reset to the Start Column/Start Page positions. The Start Column/Start Page positions are different in accordance with MADCTL setting. Frame Read can be stopped by sending any other command.																										
Restriction	In all colour modes, the Frame Read is always 24bit so there is no restriction on length of parameters. Note – Memory Read is only possible via the Parallel Interface.																										
Register Availability	<table border="1"> <tr> <td>Status</td> <td>Availability</td> </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 or Booster Off</td> <td>Yes</td> </tr> </table>															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 or Booster Off	Yes
Status	Availability																										
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Default	<table border="1"> <tr> <td>Status</td> <td>Default Value</td> </tr> <tr> <td>Power On Sequence</td> <td>Contents of memory is set randomly</td> </tr> <tr> <td>S/W Reset</td> <td>Contents of memory is not cleared</td> </tr> <tr> <td>H/W Reset</td> <td>Contents of memory is not cleared</td> </tr> </table>															Status	Default Value	Power On Sequence	Contents of memory is set randomly	S/W Reset	Contents of memory is not cleared	H/W Reset	Contents of memory is not cleared				
Status	Default Value																										
Power On Sequence	Contents of memory is set randomly																										
S/W Reset	Contents of memory is not cleared																										
H/W Reset	Contents of memory is not cleared																										
Flow Chart	 <pre> graph TD RAMRD[RAMRD] --> Dummy{Dummy} Dummy --> ImageData([Image Data D1[7:0], D2[7:0], ..., Dn[7:0]]) ImageData --> AnyCommand[Any Command] </pre> <p>Legend:</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer 																										

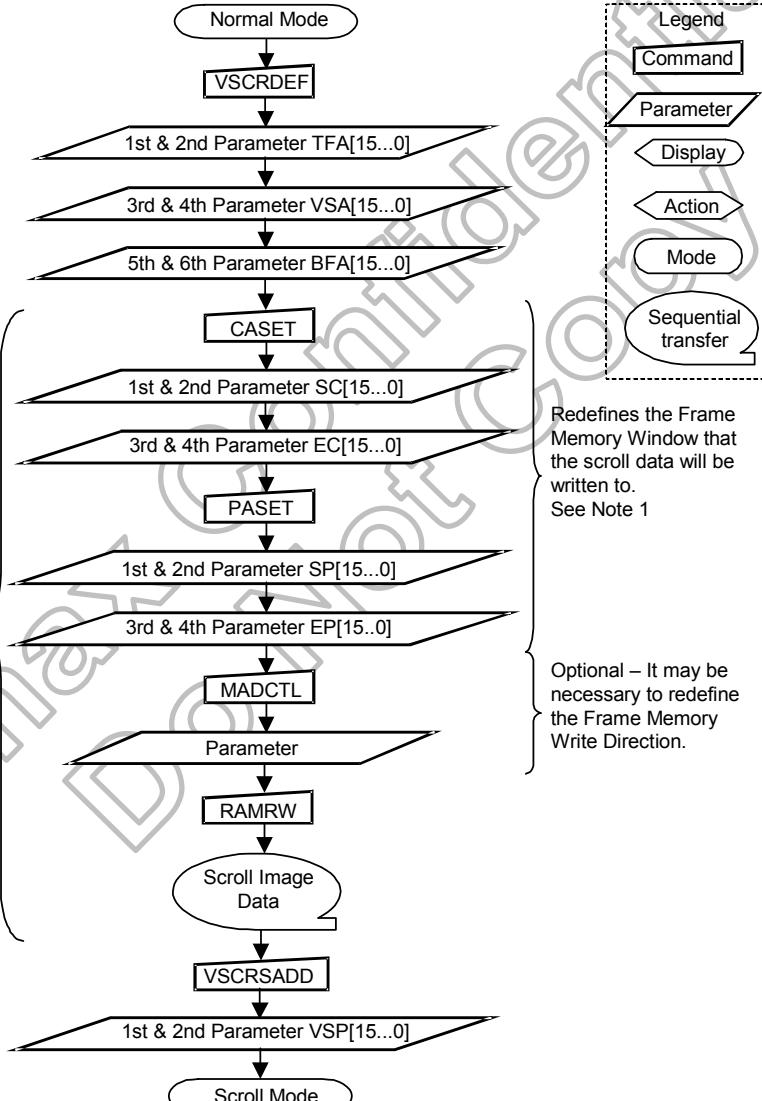
6.2.24 Set_partial_area (30h)

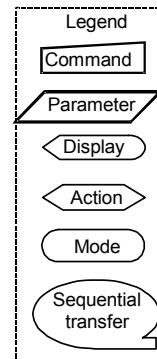
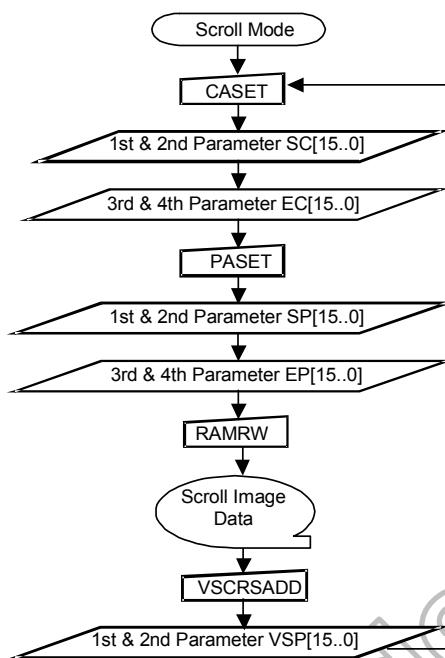
30 H		PLTAR (Partial Area)																								
		DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX												
Command	0	1		↑	-	0	0	1	1	0	0	0	0	30												
1 st Parameter	1	1		↑	-	SR15	SR14	SR13	SR12	SR11	SR10	SR9	SR8	xx												
2 nd Parameter	1	1		↑	-	SR7	SR6	SR5	SR4	SR3	SR2	SR1	SR0	xx												
3 rd Parameter	1	1		↑	-	ER15	ER14	ER13	ER12	ER11	ER10	ER9	ER8	xx												
4 th Parameter	1	1		↑	-	ER7	ER6	ER5	ER4	ER3	ER2	ER1	ER0	xx												
Description	<p>This command defines the partial mode's display area. There are 4 parameters associated with this command, the first defines the Start Row (SR) and the second the End Row (ER), as illustrated in the figures below. SR and ER refer to the Frame Memory Line Pointer.</p> <p>If End Row>Start Row</p>  <p>If End Row<Start Row</p>  <p>If End Row = Start Row then the Partial Area will be one row.</p>																									
Restriction	SR[15:0] and ER[15:0] cannot exceed the last vertical line number.																									
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <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> </tbody> </table>														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		
Status	Availability																									
Normal Mode On, Idle Mode Off, Sleep Out	Yes																									
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Partial Mode On, Idle Mode On, Sleep Out	Yes																									
Default	<table border="1"> <thead> <tr> <th>Status</th> <th colspan="2">Default Value</th> </tr> </thead> <tbody> <tr> <td>Power On Sequence</td> <td>SR[15..0]=00</td> <td>ER[15..0]= Vertical line number</td> </tr> <tr> <td>S/W Reset</td> <td>SR[15..0]=00</td> <td>ER[15..0]= Vertical line number</td> </tr> <tr> <td>H/W Reset</td> <td>SR[15..0]=00</td> <td>ER[15..0]= Vertical line number</td> </tr> </tbody> </table>														Status	Default Value		Power On Sequence	SR[15..0]=00	ER[15..0]= Vertical line number	S/W Reset	SR[15..0]=00	ER[15..0]= Vertical line number	H/W Reset	SR[15..0]=00	ER[15..0]= Vertical line number
Status	Default Value																									
Power On Sequence	SR[15..0]=00	ER[15..0]= Vertical line number																								
S/W Reset	SR[15..0]=00	ER[15..0]= Vertical line number																								
H/W Reset	SR[15..0]=00	ER[15..0]= Vertical line number																								
Flow Chart	1. To Enter Partial Mode:-																									



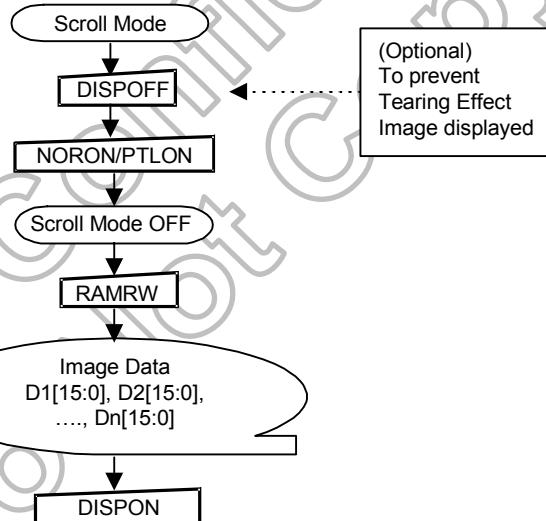
6.2.25 Set_scroll_area (33h)

33 H		VSCRDEF (Vertical Scrolling Definition)																			
		DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX							
Command		0	1	↑	-	0	0	1	1	0	0	1	1	33							
1 st parameter		1	1	↑	-	TFA 15	TFA 14	TFA 13	TFA 12	TFA 11	TFA 10	TFA 9	TFA 8	xx							
2 nd parameter		1	1	↑	-	TFA 7	TFA 6	TFA 5	TFA 4	TFA 3	TFA 2	TFA 1	TFA 0	xx							
3 rd parameter		1	1	↑	-	VSA 15	VSA 14	VSA 13	VSA 12	VSA 11	VSA 10	VSA 9	VSA 8	xx							
4 th parameter		1	1	↑	-	VSA 7	VSA 6	VSA 5	VSA 4	VSA 3	VSA 2	VSA 1	VSA 0	xx							
5 th parameter		1	1	↑	-	BFA 15	BFA 14	BFA 13	BFA 12	BFA 11	BFA 10	BFA 9	BFA 8	xx							
6 th parameter		1	1	↑	-	BFA 7	BFA 6	BFA 5	BFA 4	BFA 3	BFA 2	BFA 1	BFA 0	xx							
Description	<p>When MADCTL B4=0</p> <p>The 1st & 2nd parameter TFA[15..0] describes the Top Fixed Area (in No. of lines from top of the Frame Memory and Display).</p> <p>The 3rd & 4th parameter VSA[15..0] describes the height of the Vertical Scrolling Area (in No. of lines of the Frame Memory [not the display] from the Vertical Scrolling Start Address). The first line read from Frame Memory appears immediately after the bottom most line of the Top Fixed Area.</p> <p>The 5th & 6th parameter BFA[15..0] describes the Bottom Fixed Area (in No. of lines from Bottom of the Frame Memory and Display).</p> <p>TFA, VSA and BFA refer to the Frame Memory Line Pointer.</p> 																				
Restriction	<p>The condition is (TFA+VSA+BFA)= Vertical line number, otherwise Scrolling mode is undefined.</p> <p>In Vertical Scroll Mode, MADCTL B5 should be set to '0' – this only affects the Frame Memory Write.</p>																				
Register Availability	<table border="1"> <tr> <td>Status</td> <td>Availability</td> </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> </table>		Status	Availability	Normal Mode On, Idle Mode Off, Sleep Out	Yes	Normal Mode On, Idle Mode On, Sleep Out	Yes													
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 or Booster Off	Yes	
Default	Status	Default Value	
	Power On Sequence	TFA[15..0]=0000	VSA[15..0]= The frame memory page address corresponding to the last horizontal line.
	S/W Reset	TFA[15..0]=0000	BFA[15..0]=0000
Flow Charts	H/W Reset	TFA[15..0]=0000	VSA[15..0]= The frame memory page address corresponding to the last horizontal line.
			BFA[15..0]=0000
1. To enter Vertical Scroll Mode:			
 <p>The flowchart illustrates the sequence of commands required to enter Vertical Scroll Mode. It starts with VSCRDEF, followed by CASET, PASET, MADCTL, RAMRW, and finally VSCRADD. Each command is associated with specific parameters (e.g., TFA[15..0], VSA[15..0], BFA[15..0], SC[15..0], EC[15..0], SP[15..0], EP[15..0], VSP[15..0]) and includes a note regarding the redefinition of the frame memory window. A legend on the right defines symbols: Command (rectangle), Parameter (diamond), Display (parallelogram), Action (triangle), Mode (oval), and Sequential transfer (trapezoid).</p>			
<p>Note: The Frame Memory Window size must be defined correctly otherwise undesirable image will be displayed.</p> <p>2. Continuous Scroll:</p>			



3. To Leave Vertical Scroll Mode:



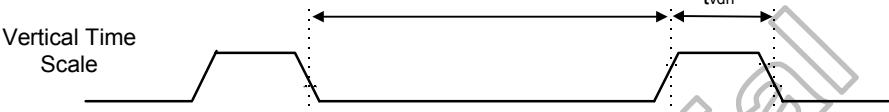
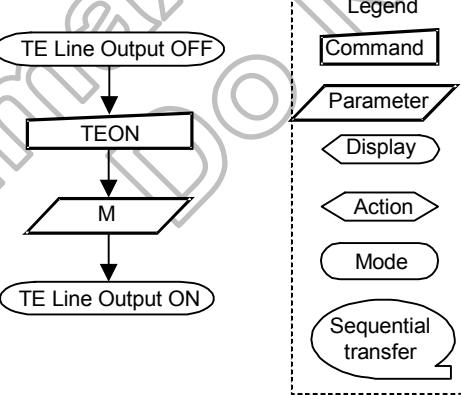
Note: Scroll Mode can be left by both the Normal Display Mode On (13h) and Partial Mode On (12h) commands.

6.2.26 Set_tear_off (34h)

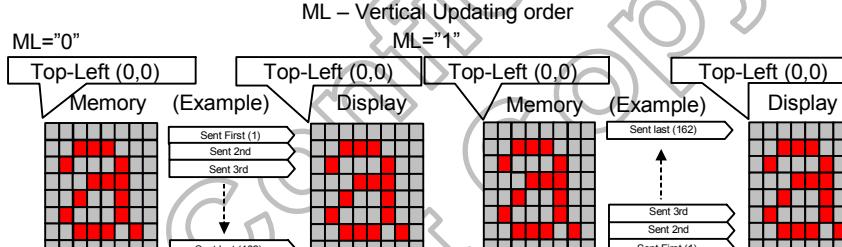
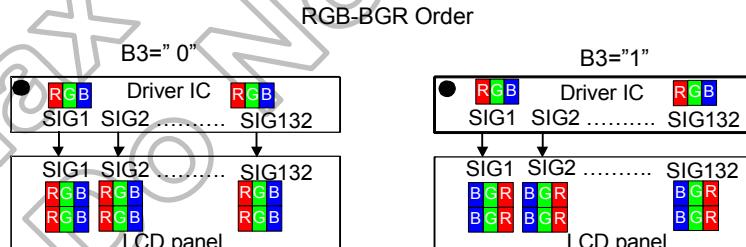
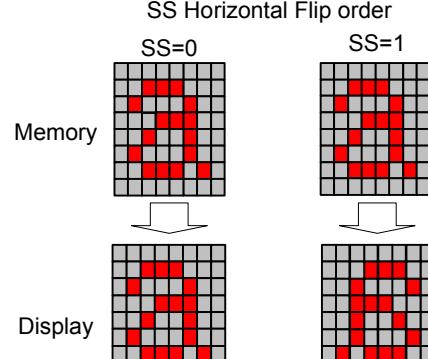
34 H	TEOFF (Tearing Effect Line OFF)													
	DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX	
Command	0	1	↑	-	0	0	1	1	0	1	0	0	34	
Parameter	No Parameter													
Description	This command is used to turn OFF (Active Low) the Tearing Effect output signal from the TE signal line.													
Restriction	This command has no effect when 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 or Booster Off		Yes											
Default	Status		Default Value											
	Power On Sequence		Off											
	S/W Reset		Off											
	H/W Reset		Off											
Flow Chart	<pre> graph TD A([TE Line Output ON]) --> B[TEOFF] B --> C([TE Line Output OFF]) </pre> <p>Legend:</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer 													

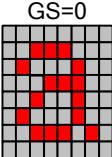
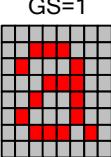
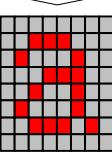
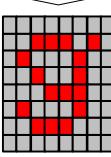
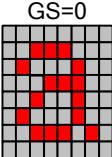
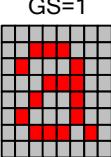
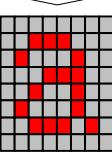
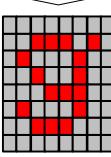
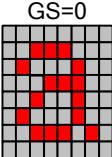
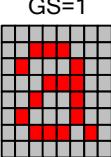
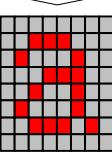
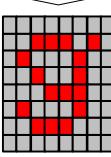
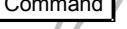
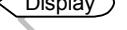
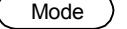
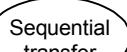
6.2.27 Set_tear_on (35h)

35 H		TEON (Tearing Effect Line ON)												
		DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command		0	1	↑	-	0	0	1	1	0	1	0	1	35
Parameter		1	1	↑	-	X	X	X	X	X	X	X	M	xx

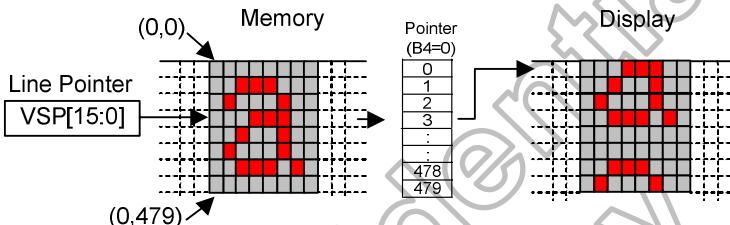
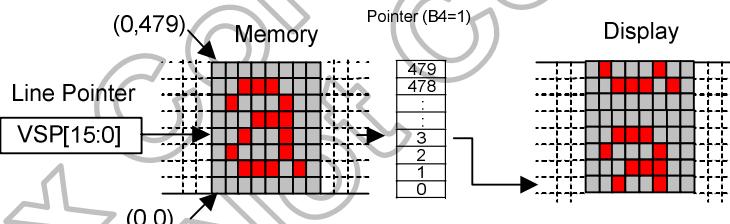
Description	<p>This command is used to turn ON the Tearing Effect output signal from the TE signal. This output is not affected by changing MADCTL bit B4.</p> <p>The Tearing Effect Line On has one parameter which describes the mode of the Tearing Effect Output Line. (X=Don't Care).</p> <p>When M=0:</p> <p>The Tearing Effect Output line consists of V-Blanking information only:</p>  <p>When M=1:</p> <p>The Tearing Effect Output Line consists of both V-Blanking and H-Blanking information:</p>  <p>Note: During Sleep In Mode with Tearing Effect Line On, Tearing Effect Output pin will be active Low.</p>																									
Restriction	This command has no effect when Tearing Effect output is already ON.																									
Register Availability	<table border="1"> <tr> <td>Status</td> <td>Availability</td> </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 or Booster Off</td> <td>Yes</td> </tr> </table>														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 or Booster Off	Yes
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Power On Sequence	Off																									
S/W Reset	Off																									
H/W Reset	Off																									
Flow Chart	 <pre> graph TD A([TE Line Output OFF]) --> B[TEON] B --> C[M] C --> D([TE Line Output ON]) </pre>																									

6.2.28 Set_address_mode (36h)

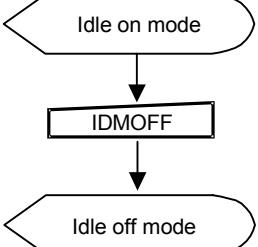
36 H		MADCTL (Memory Access Control)																																								
		DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX																												
Command		0	1	↑	-	0	0	1	1	0	1	1	0	36																												
1 st parameter		1	1	↑	-	B7	B6	B5	B4	B3	0	B1	B0	XX																												
This command defines read/write scanning direction of frame memory. This command makes no change on the other driver status.																																										
Bit Assignment																																										
<table border="1"> <thead> <tr> <th>BIT</th><th>NAME</th><th>DESCRIPTION</th></tr> </thead> <tbody> <tr> <td>B7</td><td>PAGE ADDRESS ORDER (MY)</td><td>These 3 bits controls MCU to memory write/read direction.</td></tr> <tr> <td>B6</td><td>COLUMN ADDRESS ORDER (MX)</td><td></td></tr> <tr> <td>B5</td><td>PAGE/COLUMN SELECTION (MV)</td><td></td></tr> <tr> <td>B4</td><td>Vertical ORDER (ML)</td><td>LCD vertical refresh direction control</td></tr> <tr> <td>B3</td><td>RGB-BGR ORDER (BGR)</td><td>Colour selector switch control (0=RGB colour filter panel, 1=BGR colour filter panel)</td></tr> <tr> <td>B2</td><td></td><td>LCD horizontal refresh direction control</td></tr> <tr> <td>B3</td><td>Horizontal Flip(SS)</td><td>Colour selector switch control (0=RGB colour filter panel, 1=BGR colour filter panel)</td></tr> <tr> <td>B3</td><td>Vertical Flip(GS)</td><td>Colour selector switch control (0=RGB colour filter panel, 1=BGR colour filter panel)</td></tr> </tbody> </table>																BIT	NAME	DESCRIPTION	B7	PAGE ADDRESS ORDER (MY)	These 3 bits controls MCU to memory write/read direction.	B6	COLUMN ADDRESS ORDER (MX)		B5	PAGE/COLUMN SELECTION (MV)		B4	Vertical ORDER (ML)	LCD vertical refresh direction control	B3	RGB-BGR ORDER (BGR)	Colour selector switch control (0=RGB colour filter panel, 1=BGR colour filter panel)	B2		LCD horizontal refresh direction control	B3	Horizontal Flip(SS)	Colour selector switch control (0=RGB colour filter panel, 1=BGR colour filter panel)	B3	Vertical Flip(GS)	Colour selector switch control (0=RGB colour filter panel, 1=BGR colour filter panel)
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B3	Vertical Flip(GS)	Colour selector switch control (0=RGB colour filter panel, 1=BGR colour filter panel)																																								
<p>Description</p> <p>ML – Vertical Updating order</p> <p>ML="0" ML="1"</p>  <p>Note: Top-Left (0, 0) means a physical memory location.</p> <p>RGB-BGR Order</p> <p>B3="0" B3="1"</p>  <p>SS Horizontal Flip order</p> <p>SS=0 SS=1</p> 																																										

	<p style="text-align: center;">GS Vertical Flip order</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; width: 50%;">GS=0</td><td style="text-align: center; width: 50%;">GS=1</td></tr> <tr> <td style="text-align: center;">Memory</td><td style="text-align: center;">Memory</td></tr> <tr> <td></td><td></td></tr> <tr> <td></td><td></td></tr> </table>	GS=0	GS=1	Memory	Memory								
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Memory	Memory												
													
													
Restriction													
Register Availability	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Status</th><th style="text-align: left;">Availability</th></tr> </thead> <tbody> <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 or Booster Off</td><td>Yes</td></tr> </tbody> </table>	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 or Booster Off	Yes
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S/W Reset	No Change												
H/W Reset	B7=0,B6=0,B5=0,B4=0,B3=0,B2=0,B1=0,B0=0												
Flow Chart	<p style="text-align: center;">Legend</p> <div style="text-align: center; margin-left: 100px;">       </div> <p style="text-align: center;">  ↓  </p>												

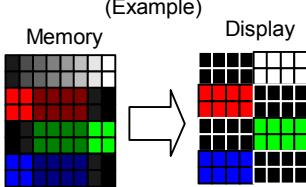
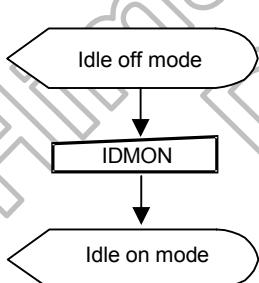
6.2.29 Set_scroll_start (37h)

37 H		VSCRSADD (Vertical Scrolling Start Address)																								
		DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX												
Command		0	1	↑	-	0	0	1	1	0	1	1	1	37												
1 st parameter		1	1	↑	-	VSP 15	VSP 14	VSP 13	VSP 12	VSP 11	VSP 10	VSP 9	VSP 8													
2 nd parameter		0	1	↑	-	VSP 7	VSP 6	VSP 5	VSP 4	VSP 3	VSP 2	VSP 1	VSP 0													
Description	<p>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:</p> <p>When MADCTL B4=0</p> <p>Example:</p> <p>When Top Fixed Area = Bottom Fixed Area = 00, Vertical Scrolling Area = 480 and VSP=3 (Example)</p>  <p>When MADCTL B4=1</p> <p>Example:</p> <p>When Top Fixed Area = Bottom Fixed Area = 00, Vertical Scrolling Area = 480 and VSP=3 (Example)</p>  <p>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.</p>																									
Restriction	<p>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).</p>																									
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <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>No</td> </tr> <tr> <td>Partial Mode On, Idle Mode On, Sleep Out</td> <td>No</td> </tr> <tr> <td>Sleep In or Booster Off</td> <td>Yes</td> </tr> </tbody> </table>														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	No	Partial Mode On, Idle Mode On, Sleep Out	No	Sleep In or Booster Off	Yes
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Flow Chart	See Vertical Scrolling Definition (33h) description.																									

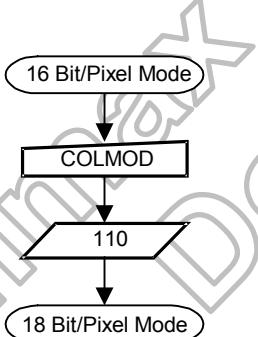
6.2.30 Exit_idle_mode (38h)

38 H	IDMOFF (Idle mode off)																							
	DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX											
Command	0	1	↑	-	0	0	1	1	1	0	0	0	38											
Parameter	No Parameter																							
Description	This command is used to recover from Idle mode on. In the idle off mode, LCD can display maximum 262K colours.																							
Restriction	This command has no effect when module is already in idle off mode.																							
Register Availability	<table border="1"> <tr> <td>Status</td> <td>Availability</td> </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> </table>														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
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Power On Sequence	Idle off mode																							
S/W Reset	Idle off mode																							
H/W Reset	Idle off mode																							
Flow Chart	 <p>Legend:</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer <pre> graph TD A([Idle on mode]) --> B[IDMOFF] B --> C([Idle off mode]) </pre>																							

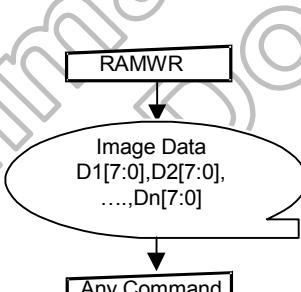
6.2.31 Enter_Idle_mode (39h)

39 H	IDMON (Idle mode on)																																				
	DCX RDX WRX DB15~DB8 DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0 HEX																																				
Command	0 1 ↑ - 0 0 1 1 1 0 0 1 39																																				
Parameter	No Parameter																																				
Description	<p>This command is used to enter into Idle mode on. In the idle on mode, colour expression is reduced. The primary and the secondary colours using MSB of each R, G and B in the Frame Memory, 8 colour depth data is displayed.</p> <p>(Example)</p>  <p>Memory Display</p>																																				
	Memory contents vs. Display Colour																																				
	<table border="1"> <thead> <tr> <th></th> <th>R6 R4 R3 R2 R1 R0</th> <th>G5 G4 G3 G2 G1 G0</th> <th>B5 B4 B3 B2 B1 B0</th> </tr> </thead> <tbody> <tr> <td>Black</td> <td>0XXXXX</td> <td>0XXXXX</td> <td>0XXXXX</td> </tr> <tr> <td>Blue</td> <td>0XXXXX</td> <td>0XXXXX</td> <td>1XXXXX</td> </tr> <tr> <td>Red</td> <td>1XXXXX</td> <td>0XXXXX</td> <td>0XXXXX</td> </tr> <tr> <td>Magenta</td> <td>1XXXXX</td> <td>0XXXXX</td> <td>1XXXXX</td> </tr> <tr> <td>Green</td> <td>0XXXXX</td> <td>1XXXXX</td> <td>0XXXXX</td> </tr> <tr> <td>Cyan</td> <td>0XXXXX</td> <td>1XXXXX</td> <td>1XXXXX</td> </tr> <tr> <td>Yellow</td> <td>1XXXXX</td> <td>1XXXXX</td> <td>0XXXXX</td> </tr> <tr> <td>White</td> <td>1XXXXX</td> <td>1XXXXX</td> <td>1XXXXX</td> </tr> </tbody> </table> <p>X=don't care</p>		R6 R4 R3 R2 R1 R0	G5 G4 G3 G2 G1 G0	B5 B4 B3 B2 B1 B0	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
	R6 R4 R3 R2 R1 R0	G5 G4 G3 G2 G1 G0	B5 B4 B3 B2 B1 B0																																		
Black	0XXXXX	0XXXXX	0XXXXX																																		
Blue	0XXXXX	0XXXXX	1XXXXX																																		
Red	1XXXXX	0XXXXX	0XXXXX																																		
Magenta	1XXXXX	0XXXXX	1XXXXX																																		
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White	1XXXXX	1XXXXX	1XXXXX																																		
Restriction	This command has no effect when module is already in idle on mode.																																				
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <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 or Booster Off</td> <td>Yes</td> </tr> </tbody> </table>	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 or Booster Off	Yes																								
Status	Availability																																				
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Sleep In or Booster Off	Yes																																				
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Status	Default Value																																				
Power On Sequence	Idle off mode																																				
S/W Reset	Idle off mode																																				
H/W Reset	Idle off mode																																				
Flow Chart	 <pre> graph TD A([Idle off mode]) --> B[IDMON] B --> C([Idle on mode]) </pre> <p>Legend:</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer 																																				

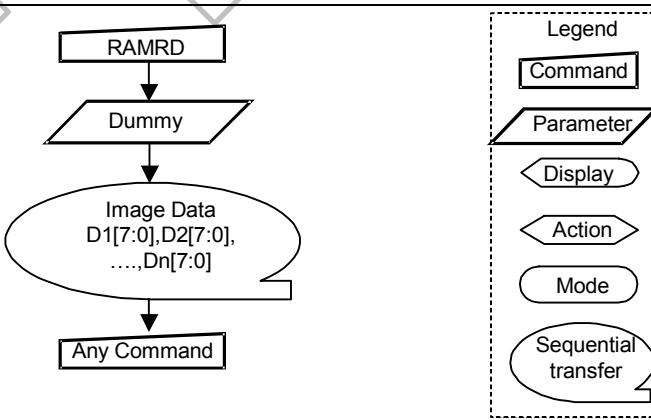
6.2.32 Set_pixel_format (3Ah)

3A H		COLMOD (Interface Pixel Format)																																																	
		DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX																																					
Command		0	1	↑	-	0	0	1	1	1	0	1	0	3A																																					
1 st parameter		1	1	↑	-	X	D6	D5	D4	X	D2	D1	D0	XX																																					
Description		This command is used to define the format of RGB picture data. D6~D4: DPI Pixel format Definition. D2~D0: DBI Pixel format Definition. The formats are shown in the table: <table border="1"> <thead> <tr> <th>Pixel Format</th> <th>D6/D2</th> <th>D5/D1</th> <th>D4/D0</th> </tr> </thead> <tbody> <tr> <td>Not Defined</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>3 Bit/Pixel</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>Not Defined</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>Not Defined</td> <td>0</td> <td>1</td> <td>1</td> </tr> <tr> <td>Not Defined</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>16 Bit/Pixel</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>18 Bit/Pixel</td> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>Not Defined</td> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table> If a particular interface, enter DBI or DPI, is not used then the corresponding bits in the parameter returned from the display module undefined.														Pixel Format	D6/D2	D5/D1	D4/D0	Not Defined	0	0	0	3 Bit/Pixel	0	0	1	Not Defined	0	1	0	Not Defined	0	1	1	Not Defined	1	0	0	16 Bit/Pixel	1	0	1	18 Bit/Pixel	1	1	0	Not Defined	1	1	1
Pixel Format	D6/D2	D5/D1	D4/D0																																																
Not Defined	0	0	0																																																
3 Bit/Pixel	0	0	1																																																
Not Defined	0	1	0																																																
Not Defined	0	1	1																																																
Not Defined	1	0	0																																																
16 Bit/Pixel	1	0	1																																																
18 Bit/Pixel	1	1	0																																																
Not Defined	1	1	1																																																
Restriction	There is no visible effect until the Frame Memory is written to.																																																		
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																																																
Default	Status		Default Value																																																
	Power On Sequence		18 Bit/Pixel																																																
	S/W Reset		18 Bit/Pixel																																																
	H/W Reset		18 Bit/Pixel																																																
Flow Chart	 <p>Legend:</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer 																																																		

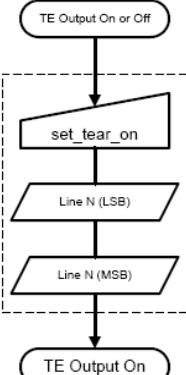
6.2.33 Write_memory_continue (3Ch)

3C H		Write memory continue																																																																																							
		DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX																																																																											
Command		0	1	↑	-	0	0	1	1	1	1	0	0	3C																																																																											
1 st parameter		1	1	↑	-	D17	D16	D15	D14	D13	D12	D11	D10	00..FF																																																																											
:		1	1	↑	-	Dx7	Dx6	Dx5	Dx4	Dx3	Dx2	Dx1	Dx0	00..FF																																																																											
N th parameter		1	1	↑	-	Dn7	Dn6	Dn5	Dn4	Dn3	Dn2	Dn1	Dn0	00..FF																																																																											
Description	<p>This command transfers image data from the host processor to the display module's frame memory continuing from the pixel location following the previous write_memory_continue or write_memory_start command. Sending any other command can stop frame Write.</p> <p>If set_address_mode B5 = 0: Data is written continuing from the pixel location after the write range of the previous write_memory_start or write_memory_continue. 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.</p> <p>If set_address_mode B5 = 1: Data is written continuing from the pixel location after the write range of the previous write_memory_start or write_memory_continue. 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.</p>																																																																																								
Restriction	In all colour modes, there is no restriction on length of parameters.																																																																																								
Register Availability	<table border="1"> <tr> <td>Status</td> <td>Availability</td> <td colspan="13"></td></tr> <tr> <td>Normal Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td><td colspan="13"></td></tr> <tr> <td>Normal Mode On, Idle Mode On, Sleep Out</td><td>Yes</td><td colspan="13"></td></tr> <tr> <td>Partial Mode On, Idle Mode Off, Sleep Out</td><td>Yes</td><td colspan="13"></td></tr> <tr> <td>Partial Mode On, Idle Mode On, Sleep Out</td><td>Yes</td><td colspan="13" rowspan="2"></td></tr> </table>														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													
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Power On Sequence	Contents of memory is set randomly																																																																																								
S/W Reset	Contents of memory is not cleared																																																																																								
Flow Chart	 <pre> graph TD RAMWR[RAMWR] --> ImageData((Image Data D1[7:0], D2[7:0], ..., Dn[7:0])) ImageData --> AnyCommand[Any Command] </pre> <p>Legend:</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer 																																																																																								

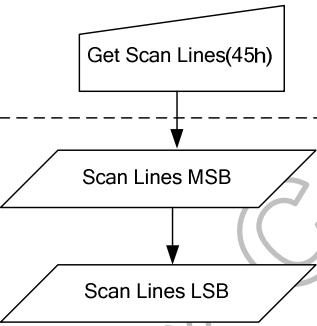
6.2.34 Raed_memory_continue (3Eh)

3E H	Raed_memory_continue																									
	DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX													
Command	0	1	↑	-	0	0	1	1	1	1	1	0	3E													
1 st parameter	1	↑	1	-	X	X	X	X	X	X	X	X	Dummy read													
2 nd parameter	1	↑	1	-	D17	D16	D15	D14	D13	D12	D11	D10	00..FF													
:	1	↑	1	-	Dx7	Dx6	Dx5	Dx4	Dx3	Dx2	Dx1	Dx0	00..FF													
(n+1) th parameter	1	↑	1	-	Dn7	Dn6	Dn5	Dn4	Dn3	Dn2	Dn1	Dn0	00..FF													
Description	<p>This command transfers image data from the display module's frame memory to the host processor continuing from the location following the previous read_memory_continue or read_memory_start command.</p> <p>If set_address_mode B5 = 0: Pixels are read continuing from the pixel location after the read range of the previous read_memory_start or read_memory_continue. The column register is then incremented and pixels are 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.</p> <p>If set_address_mode B5 = 1: Pixels are read continuing from the pixel location after the read range of the previous read_memory_start or read_memory_continue. The page register is then incremented and pixels are 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.</p>																									
Restriction	<p>Regardless of the color mode set in set_pixel_format, the pixel format returned by read_memory_continue is always 24-bit so there is no restriction on the length of data.</p> <p>A read_memory_start should follow a set_column_address, set_page_address or set_address_mode to define the read location. Otherwise, data read with read_memory_continue is undefined.</p>																									
Register Availability	<table border="1"> <tr> <td>Status</td> <td>Availability</td> </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 or Booster Off</td> <td>Yes</td> </tr> </table>														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 or Booster Off	Yes
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Default	<table border="1"> <tr> <td>Status</td> <td>Default Value</td> </tr> <tr> <td>Power On Sequence</td> <td>Contents of memory is set randomly</td> </tr> <tr> <td>S/W Reset</td> <td>Contents of memory is not cleared</td> </tr> <tr> <td>H/W Reset</td> <td>Contents of memory is not cleared</td> </tr> </table>														Status	Default Value	Power On Sequence	Contents of memory is set randomly	S/W Reset	Contents of memory is not cleared	H/W Reset	Contents of memory is not cleared				
Status	Default Value																									
Power On Sequence	Contents of memory is set randomly																									
S/W Reset	Contents of memory is not cleared																									
H/W Reset	Contents of memory is not cleared																									
Flow Chart	 <pre> graph TD RAMRD[RAMRD] --> Dummy{Dummy} Dummy --> ImageData([Image Data D1[7:0], D2[7:0], ..., Dn[7:0]]) ImageData --> AnyCommand[Any Command] </pre> <p>Legend:</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer 																									

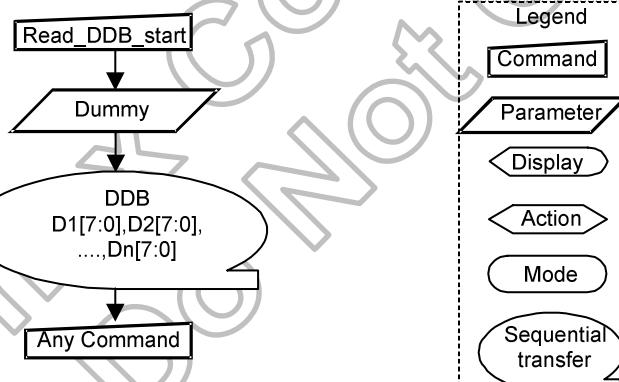
6.2.35 Set tear scan lines(44h)

44 H		TEST(Tear Effect Scan Lines)																							
		DCX	NWR	NRD	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX											
Command		0	1	↑	-	0	1	0	0	0	1	0	0	44											
1 st parameter		1	1	↑	-	TELINE[15:8](8'b0)						00..FF													
2 nd parameter		1	1	↑	-	TELINE[7:0](8'b0)						00..FF													
Description	This command turns on the display module's Tearing Effect output signal on the TE signal Line. The TE signal 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. See chapter "5.2 Tearing Effect Output Line".																								
Restriction	The command has no effect when Tearing Effect output is already ON.																								
Register Availability	<table border="1"> <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 or Booster Off</td> <td>Yes</td> </tr> </table>	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 or Booster Off	Yes				
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 or Booster Off	Yes																								
Default	<table border="1"> <tr> <th>Status</th> <th>Default Value</th> </tr> <tr> <td>Power On Sequence</td> <td>TELINE[15:8]=0000h</td> </tr> <tr> <td>S/W Reset</td> <td>TELINE[15:8]=0000h</td> </tr> <tr> <td>H/W Reset</td> <td>TELINE[15:8]=0000h</td> </tr> </table>	Status	Default Value	Power On Sequence	TELINE[15:8]=0000h	S/W Reset	TELINE[15:8]=0000h	H/W Reset	TELINE[15:8]=0000h																
Status	Default Value																								
Power On Sequence	TELINE[15:8]=0000h																								
S/W Reset	TELINE[15:8]=0000h																								
H/W Reset	TELINE[15:8]=0000h																								
Flow Chart	 <pre> graph TD A([TE Output On or Off]) --> B[/set_tear_on/] B --> C[/Line N (LSB)/] C --> D[/Line N (MSB)/] D --> E([TE Output On]) </pre>																								

6.2.36 Get scan lines(45h)

45H		GETSL(Mipi new Get Scan Lines)																				
		DCX	NWR	NRD	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX								
Command		0	1	↑	-	0	0	1	1	1	1	1	0	3E								
1 st parameter		1	↑	1	-	-	-	-	-	-	-	-	-	-								
2 nd parameter		1	↑	1	-	SL[15:8]							00..FF									
3 rd parameter		1	↑	1	-	SL[7:0]							00..FF									
Description	The display module returns the current scanline, N, used to update the display device. The total number of scanlines on a display device is defined as VSYNC + VBP + VACT + VFP. The first scanline is defined as the first line of V Sync and is denoted as Line 0. When in Sleep Mode, the value returned by get_scanline is undefined.																					
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																			
Default	Sleep In or Booster Off		Yes																			
	Status		Default Value																			
	Power On Sequence		Undefined																			
	S/W Reset		Undefined																			
Flow Chart		 <pre> graph TD A[Get Scan Lines(45h)] --> B[Scan Lines MSB] A --> C[Scan Lines LSB] subgraph Host [Host] A end subgraph Driver [Driver] B C end </pre>																				

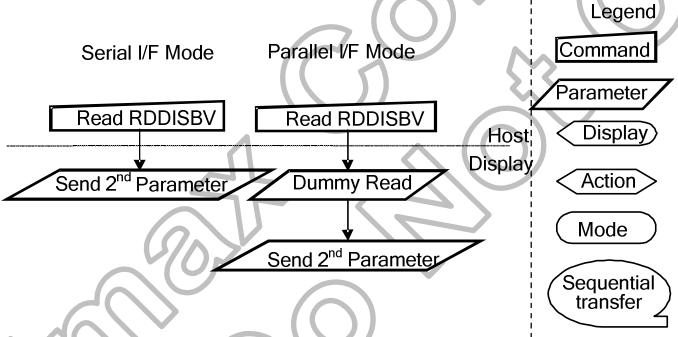
6.2.37 Read_DDB_start (A1h)

A1 H		Read_DDB_start													
		DCX	RDX	WRX	D17~D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX	
Command	0	1		↑	-	1	0	1	0	0	0	0	1	A1	
1 st parameter	1		↑	1	-	x	x	x	x	x	x	x	X	Dummy read	
2 nd parameter	1	↑	1	-										ID1	
3 rd parameter	1	↑	1	-										ID2	
4 th parameter	1	↑	1	-										ID3	
5 th parameter	1	↑	1	-										ID4	
6 th parameter	1	↑	1	-		1	1	1	1	1	1	1	1	0xFF	
Description	The format of returned data is as follows: Parameter 1: Dummy read. Parameter 2: Supplier ID code ID1. Parameter 3: Supplier ID code ID2. Parameter 4: Supplier Elective Data code ID3. Parameter 5: Supplier Elective Data code ID4. Parameter 6: single-byte <i>Escape or Exit Code</i> (0xFF).														
Restrictions															
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												
Default	Sleep In or Booster Off		Yes												
	Status		Default Value												
	Power On Sequence		OTP Value												
	S/W Reset		OTP Value												
	H/W Reset		OTP Value												
Flow Chart	 <pre> graph TD A[Read_DDB_start] --> B{Dummy} B --> C((DDB D1[7:0], D2[7:0], ..., Dn[7:0])) C --> D[Any Command] </pre> <p>Legend:</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer 														

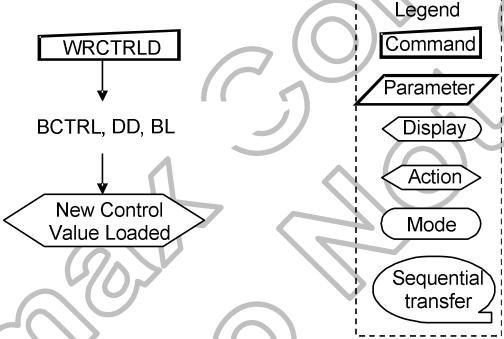
6.2.38 Write Display Brightness (51h)

51 H		WRDISBV (Write Display Brightness)																				
		DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX								
Command		0	1	↑	-	0	1	0	1	0	0	0	1	51								
1 st parameter		1	1	↑	-	DBV[7:0]								00 ... FF								
Description	This command is used to adjust the brightness value of the display. It should be checked what the relationship between this written value and output brightness of the display is. This relationship is defined on the display module specification. In principle relationship is that 00h value means the lowest brightness and FFh value means the highest brightness. See chapter "7.17.4 Brightness Control Block".																					
Restriction																						
Register Availability		Status		Availability																		
Sleep Out		Sleep Out		Yes																		
Sleep In		Sleep In		Yes																		
Default		Status		Default Value																		
Power On Sequence		Power On Sequence		00h																		
S/W Reset		S/W Reset		00h																		
H/W Reset		H/W Reset		00h																		
Flow Chart	<pre> graph TD A[WRDISBV] --> B{DBV[7..0]} B --> C{New Display Luminance Value Loaded} </pre> <p>Legend</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer 																					

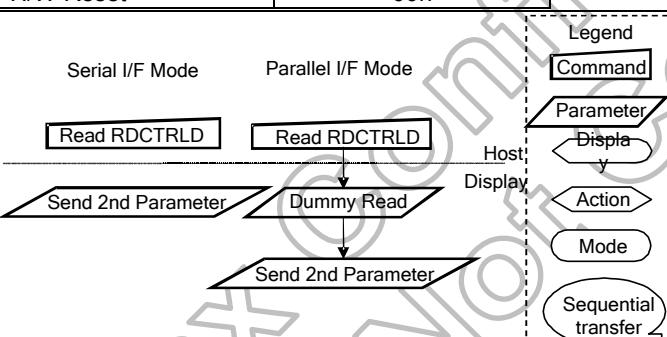
6.2.39 Read Display Brightness Value (52h)

52 H RDDISBV (Read Display Brightness Value)																					
	DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX								
Command	0	1	↑	-	0	1	0	1	0	0	1	0	52								
1 st parameter	1	↑	1	-	xx	xx	xx	xx	xx	xx	xx	xx	xx								
2 nd parameter	1	↑	1	-	DBV[7:0]								xx								
Description	This command returns the brightness value of the display. It should be checked what the relationship between this returned value and output brightness of the display. This relationship is defined on the display module specification is. In principle the relationship is that 00h value means the lowest brightness and FFh value means the highest brightness. See chapters: "7.17.4 Brightness Control Block", 7.14.1 Display configuration" and "6.2.39 Write Display Brightness (51h)" DBV[7:0] is reset when display is in sleep-in mode. DBV[7:0] is '0' when bit BCTRL of "6.2.41 Write CTRL Display (53h)" command is '0'. DBV[7:0] is manual set brightness specified with "6.2.41 Write CTRL Display (53h)" command when bit BCTRL is '1'. When bit BCTRL of "6.2.41 Write CTRL Display (53h)" command is '1' and bit C1/C0 of "6.2.43 Write Content Adaptive Brightness Control (55h)" are '0', DBV[7:0] output is the brightness value specified with "6.2.39 Write Display Brightness (51h)" command. Refers to "2.8.1 Display configuration" for the function matrix.																				
Restriction																					
Register Availability	<table border="1"> <tr> <td>Status</td> <td>Availability</td> </tr> <tr> <td>Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In</td> <td>Yes</td> </tr> </table>													Status	Availability	Sleep Out	Yes	Sleep In	Yes		
Status	Availability																				
Sleep Out	Yes																				
Sleep In	Yes																				
Default	<table border="1"> <tr> <td>Status</td> <td>Default Value</td> </tr> <tr> <td>Power On Sequence</td> <td>00h</td> </tr> <tr> <td>S/W Reset</td> <td>00h</td> </tr> <tr> <td>H/W Reset</td> <td>00h</td> </tr> </table>													Status	Default Value	Power On Sequence	00h	S/W Reset	00h	H/W Reset	00h
Status	Default Value																				
Power On Sequence	00h																				
S/W Reset	00h																				
H/W Reset	00h																				
Flow Chart	 <p>Legend:</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer 																				

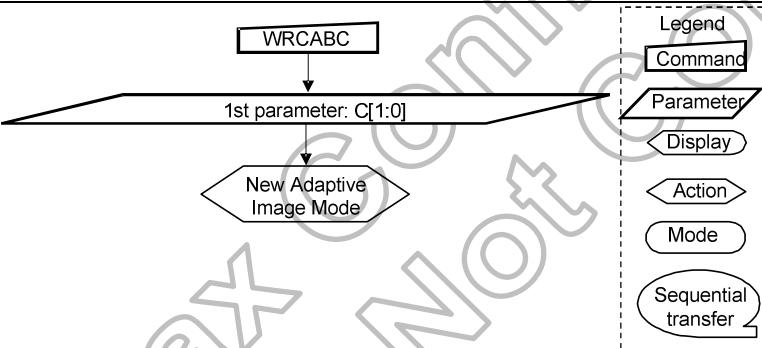
6.2.40 Write CTRL Display (53h)

53 H		WRCTRLD (Write Control Display)																				
		DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX								
Command		0	1	↑	-	0	1	0	1	0	0	1	1	53								
1 st parameter		1	1	↑	-	xx	xx	BCTRL	xx	DD	BL	xx	xx	00.. FF								
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. 0 = Off (Brightness registers are 00h, DBV[7..0]) 1 = On (Brightness registers are active, according to the other parameters.) Display Dimming (DD): (Only for manual brightness setting) DD = 0: Display Dimming is off DD = 1: Display Dimming is on BL: Backlight Control On/Off 0 = Off (Completely turn off backlight circuit. Control lines must be low.) 1 = 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.																					
Restriction																						
Register Availability	<table border="1"> <tr> <td>Status</td> <td>Availability</td> </tr> <tr> <td>Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In</td> <td>Yes</td> </tr> </table>														Status	Availability	Sleep Out	Yes	Sleep In	Yes		
Status	Availability																					
Sleep Out	Yes																					
Sleep In	Yes																					
Default	<table border="1"> <tr> <td>Status</td> <td>Default Value</td> </tr> <tr> <td>Power On Sequence</td> <td>00h</td> </tr> <tr> <td>S/W Reset</td> <td>00h</td> </tr> <tr> <td>H/W Reset</td> <td>00h</td> </tr> </table>														Status	Default Value	Power On Sequence	00h	S/W Reset	00h	H/W Reset	00h
Status	Default Value																					
Power On Sequence	00h																					
S/W Reset	00h																					
H/W Reset	00h																					
Flow Chart	 <pre> graph TD WRCTRLD[WRCTRLD] --> BCTRL[BCTRL, DD, BL] BCTRL --> NewValue{New Control Value Loaded} </pre>																					

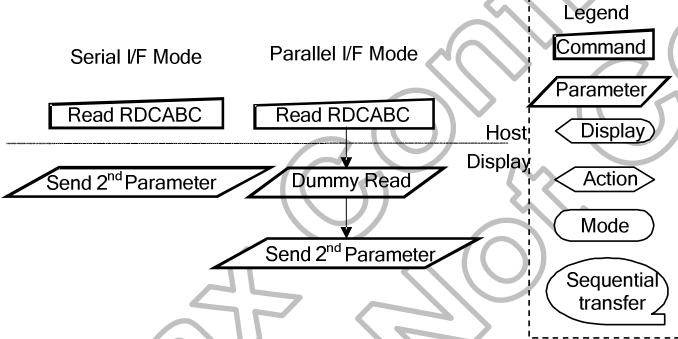
6.2.41 Read CTRL Value Display (54h)

54 H		RDCTRLD (Read Control Value Display)																
		DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX				
Command		0	1	↑	-	0	1	0	1	0	0	1	1	54				
1 st parameter		1	↑	1	-	xx												
2 nd parameter		1	↑	1	-	0	0	BCTRL	0	DD	BL	0	0	xx				
Description	This command returns ambient light and brightness control values, see chapter: "6.2.41 Write CTRL Display (53h)X". BCTRL: Brightness Control Block On/Off, This bit is always used to switch brightness for display. 0 = Off 1 = On Display Dimming (DD): DD = 0: Display Dimming is off DD = 1: Display Dimming is on BL: Backlight Control On/Off 0 = Off (completely turn off backlight circuit and CABC_ON output is VSSD) 1 = On (CABC_ON output is IOVCC)																	
Restriction																		
Register Availability		Status		Availability														
Sleep Out		Sleep Out		Yes														
Sleep In		Sleep In		Yes														
Default		Status		Default Value														
Power On Sequence		Power On Sequence		00h														
S/W Reset		S/W Reset		00h														
H/W Reset		H/W Reset		00h														
Flow Chart	 <p>Legend</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer 																	

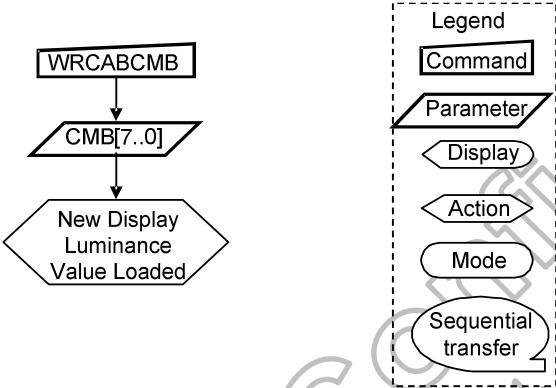
6.2.42 Write Content Adaptive Brightness Control (55h)

55 H	WRCABC (Write Content Adaptive Brightness Control)																															
	DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0																				
Command	0	1	↑	-	0	1	0	1	0	1	0	1																				
1 st parameter	1	1	↑	-	xx	xx	xx	xx	xx	xx	CABC[1:0]	xx																				
Description	<p>This command is used to set parameters for image content based adaptive brightness control functionality.</p> <p>There is possible to use 4 different modes for content adaptive image functionality, which are defined on a table below. See chapter "7.17 Content Adaptive Brightness Control (CABC)".</p> <table border="1"> <tr> <th>C1</th><th>C0</th><th>Function</th><th>Note</th></tr> <tr> <td>0</td><td>0</td><td>Off</td><td></td></tr> <tr> <td>0</td><td>1</td><td>User Interface Image</td><td></td></tr> <tr> <td>1</td><td>0</td><td>Still Picture</td><td></td></tr> <tr> <td>1</td><td>1</td><td>Moving Image</td><td></td></tr> </table> <p>X = Don't care.</p>												C1	C0	Function	Note	0	0	Off		0	1	User Interface Image		1	0	Still Picture		1	1	Moving Image	
C1	C0	Function	Note																													
0	0	Off																														
0	1	User Interface Image																														
1	0	Still Picture																														
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Sleep Out	Yes																															
Sleep In	Yes																															
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Status	Default Value																															
Power On Sequence	00h																															
S/W Reset	00h																															
H/W Reset	00h																															
Flow Chart	 <pre> graph TD A[WRCABC] --> B[1st parameter: C[1:0]] B --> C{New Adaptive Image Mode} </pre>																															

6.2.43 Read Content Adaptive Brightness Control (56h)

56 H		RDCABC (Read Content Adaptive Brightness Control)																				
		DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX								
Command		0	1	↑	-	0	1	0	1	0	1	1	0	56								
1 st parameter		1	↑	1	-	XX																
2 nd parameter		1	↑	1	-	0	0	0	0	0	0	C1	C0	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. See chapter "7.17 Content Adaptive Brightness Control (CABC)".																					
Restriction																						
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In</td> <td>Yes</td> </tr> </tbody> </table>														Status	Availability	Sleep Out	Yes	Sleep In	Yes		
Status	Availability																					
Sleep Out	Yes																					
Sleep In	Yes																					
Default	<table border="1"> <thead> <tr> <th>Status</th> <th>Default Value</th> </tr> </thead> <tbody> <tr> <td>Power On Sequence</td> <td>00h</td> </tr> <tr> <td>S/W Reset</td> <td>00h</td> </tr> <tr> <td>H/W Reset</td> <td>00h</td> </tr> </tbody> </table>														Status	Default Value	Power On Sequence	00h	S/W Reset	00h	H/W Reset	00h
Status	Default Value																					
Power On Sequence	00h																					
S/W Reset	00h																					
H/W Reset	00h																					
Flow Chart	 <p>Legend:</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer 																					

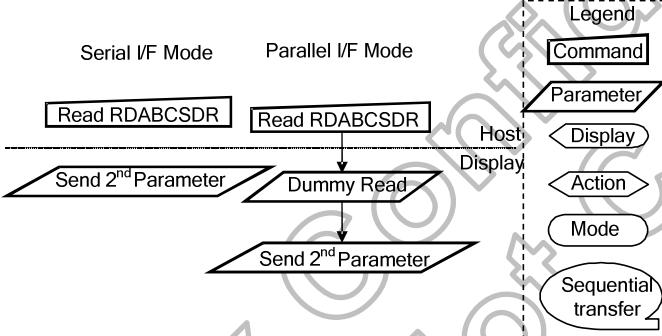
6.2.44 Write CABC minimum brightness (5Eh)

5E H		WRCABCMB (Write CABC minimum brightness)												
		DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command		0	1	↑	-	0	1	0	1	1	1	1	0	5E
1 st parameter		1	1	1	-									CMB[7:0]
Description	This command is used to set the minimum brightness value of the display for CABC function. In principle relationship is that 00h value means the lowest brightness for CABC and FFh value means the highest brightness for CABC. See chapter "7.17.4 Minimum brightness setting of CABC function".													00.. FF
Restriction														
Register Availability		Status		Availability										
Sleep Out		Sleep Out		Yes										
Sleep In		Sleep In		Yes										
Default		Status		Default Value										
Power On Sequence		Power On Sequence		00h										
S/W Reset		S/W Reset		00h										
H/W Reset		H/W Reset		00h										
Flow Chart	 <p>Legend</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer 													

6.2.45 Read CABC minimum brightness (5Fh)

5F H		RDCABCMB (Read CABC minimum brightness)																					
		DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX									
Command		0	1	↑	-	0	1	0	1	1	1	1	1	5F									
1 st parameter		1	↑	1	-	XX	XX	XX	XX	XX	XX	XX	XX	XX									
2 nd parameter		1	↑	1	-									XX									
		CMB[7:0]																					
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. See chapter "7.17.4 Minimum brightness setting of CABC function". CMB[7:0] is CABC minimum brightness specified with "6.2.45 Write CABC minimum brightness (5Eh)" command.																					
Restriction																							
Register Availability		<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In</td> <td>Yes</td> </tr> </tbody> </table>		Status	Availability	Sleep Out	Yes	Sleep In	Yes														
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Sleep In	Yes																						
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Status	Default Value																						
Power On Sequence	00h																						
S/W Reset	00h																						
H/W Reset	00h																						
Flow Chart		<p>Legend</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer 																					

6.2.46 Read Automatic Brightness Control Self-Diagnostic Result (68h)

68 H		RDABCSDR (Read Automatic Brightness Control Self-Diagnostic Result)																			
		DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX							
Command		0	1	↑	-	0	1	1	0	1	0	0	0	68							
1 st parameter		1	↑	1	-	XX	XX	XX	XX	XX	XX	XX	XX	XX							
2 nd parameter		1	↑	1	-	D[7:6]		0	0	0	0	0	0	XX							
Description	This command indicates the status of the display self-diagnostic results for automatic brightness control after Sleep Out -command as described in the table below: • Bit D7 – Register Loading Detection See section “7.15.1 Register loading Detection”. • Bit D6 – Functionality Detection See section “X7.15.2 Functionality Detection”. • Bits D5, D4, D3, D2, D1 and D0 are for future use and are set to ‘0’.																				
Restriction																					
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In</td> <td>Yes</td> </tr> </tbody> </table>													Status	Availability	Sleep Out	Yes	Sleep In	Yes		
Status	Availability																				
Sleep Out	Yes																				
Sleep In	Yes																				
Default	<table border="1"> <thead> <tr> <th>Status</th> <th>Default Value</th> </tr> </thead> <tbody> <tr> <td>Power On Sequence</td> <td>00h</td> </tr> <tr> <td>S/W Reset</td> <td>00h</td> </tr> <tr> <td>H/W Reset</td> <td>00h</td> </tr> </tbody> </table>													Status	Default Value	Power On Sequence	00h	S/W Reset	00h	H/W Reset	00h
Status	Default Value																				
Power On Sequence	00h																				
S/W Reset	00h																				
H/W Reset	00h																				
Flow Chart	 <p>Legend:</p> <ul style="list-style-type: none"> Command Parameter Display Action Mode Sequential transfer 																				

6.2.47 Set extended command set (B0h)

B0 H	SETEXTC												
	DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	1	0	1	1	0	0	0	0	B0
1 st parameter	1	1	↑	-	0	0	0	0	0	0	EXTC[1:0]	XX	

Description	EXTC[1:0]: This register is select command access protect mode.												
	EXTC[1:0]	User Command		Himax command									
		00h ~ AFh		B0h	B1h~DFh	E0h~EFh	F0h~FFh						
	00	Yes		Yes	Yes	Yes	Yes						Yes
	01	Yes		Yes	Yes	Yes	Yes						No

Restriction																					
Register Availability	<table border="1"> <tr> <th>Status</th> <th>Availability</th> </tr> <tr> <td>Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In</td> <td>Yes</td> </tr> </table>													Status	Availability	Sleep Out	Yes	Sleep In	Yes		
Status	Availability																				
Sleep Out	Yes																				
Sleep In	Yes																				
Default	<table border="1"> <tr> <th>Status</th> <th>Default Value</th> </tr> <tr> <td>Power On Sequence</td> <td>00h</td> </tr> <tr> <td>S/W Reset</td> <td>00h</td> </tr> <tr> <td>H/W Reset</td> <td>00h</td> </tr> </table>													Status	Default Value	Power On Sequence	00h	S/W Reset	00h	H/W Reset	00h
Status	Default Value																				
Power On Sequence	00h																				
S/W Reset	00h																				
H/W Reset	00h																				

Flow Chart													

6.2.48 Set GRAM access and Interface (B3h)

B3 H	SETGRAM																																																																																																																																																																																				
	DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX																																																																																																																																																																								
Command	0	1	↑	-	1	0	1	1	0	0	1	1	B3																																																																																																																																																																								
1 st parameter	1	1	↑	-	0	0	0	0	0	0	0	0	00h																																																																																																																																																																								
2 nd parameter	1	1	↑	-	0	0	0	0	0	TEI[2:0]			00h~07h																																																																																																																																																																								
3 rd parameter	1	1	↑	-	0	0	0	0	0	DENC[3:0]			00h~07h																																																																																																																																																																								
4 th parameter	1	1	↑	-	0	0	EPF[1:0]		0	0	0	DFM																																																																																																																																																																									
Description	TEI[2:0]: TE output cycle setting. <table border="1"> <tr><th>TEI[2:0]</th><th>TE output cycle</th></tr> <tr><td>000</td><td>1 frame</td></tr> <tr><td>001</td><td>2 frame</td></tr> <tr><td>011</td><td>4 frame</td></tr> <tr><td>101</td><td>6 frame</td></tr> <tr><td>Others</td><td>Prohibited</td></tr> </table> DENC[2:0]: Select GRAM write cycle in RGB interface. <table border="1"> <tr><th>DENC[2:0]</th><th>GRAM write cycle</th></tr> <tr><td>000</td><td>1 frame</td></tr> <tr><td>001</td><td>2 frame</td></tr> <tr><td>010</td><td>3 frame</td></tr> <tr><td>011</td><td>4 frame</td></tr> <tr><td>100</td><td>5 frame</td></tr> <tr><td>101</td><td>6 frame</td></tr> <tr><td>110</td><td>7 frame</td></tr> <tr><td>111</td><td>8 frame</td></tr> </table> DFM: It is define image data read/write format to GRAM in DBI Type-B 16bit interface and DBI Type-C Interface. See chapter “4.1.5 DBI TYPE-B Interface Data Color Coding” and “4.2.3 DBI TYPE-C Interface Data Color Coding”.														TEI[2:0]	TE output cycle	000	1 frame	001	2 frame	011	4 frame	101	6 frame	Others	Prohibited	DENC[2:0]	GRAM write cycle	000	1 frame	001	2 frame	010	3 frame	011	4 frame	100	5 frame	101	6 frame	110	7 frame	111	8 frame																																																																																																																																									
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100	5 frame																																																																																																																																																																																				
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EPF[1:0]: Data format select for 16bbp to 18bbp. <table border="1"> <tr><th>EPF[1:0]</th><th colspan="14">GRAM Data</th></tr> <tr> <td>7</td><td>DB1</td><td>DB1</td><td>DB1</td><td>DB1</td><td>DB1</td><td>DB1</td><td>DB1</td><td>DB1</td><td>DB9</td><td>DB8</td><td>DB7</td><td>DB6</td><td>DB5</td><td>DB4</td><td>DB3</td><td>DB2</td><td>DB1</td><td>DB0</td> </tr> <tr> <td>6</td><td>R4</td><td>R3</td><td>R2</td><td>R1</td><td>R0</td><td>0</td><td>G5</td><td>G4</td><td>G3</td><td>G2</td><td>G1</td><td>G0</td><td>B4</td><td>B3</td><td>B2</td><td>B1</td><td>B0</td><td>0</td> </tr> <tr> <td>5</td><td>R4</td><td>R3</td><td>R2</td><td>R1</td><td>R0</td><td>1</td><td>G5</td><td>G4</td><td>G3</td><td>G2</td><td>G1</td><td>G0</td><td>B4</td><td>B3</td><td>B2</td><td>B1</td><td>B0</td><td>1</td> </tr> <tr> <td>4</td><td>R4</td><td>R3</td><td>R2</td><td>R1</td><td>R0</td><td>R4</td><td>G5</td><td>G4</td><td>G3</td><td>G2</td><td>G1</td><td>G0</td><td>B4</td><td>B3</td><td>B2</td><td>B1</td><td>B0</td><td>B4</td> </tr> <tr> <td>3</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>x</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>x</td> </tr> <tr> <td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </table>															EPF[1:0]	GRAM Data														7	DB1	DB1	DB1	DB1	DB1	DB1	DB1	DB1	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	6	R4	R3	R2	R1	R0	0	G5	G4	G3	G2	G1	G0	B4	B3	B2	B1	B0	0	5	R4	R3	R2	R1	R0	1	G5	G4	G3	G2	G1	G0	B4	B3	B2	B1	B0	1	4	R4	R3	R2	R1	R0	R4	G5	G4	G3	G2	G1	G0	B4	B3	B2	B1	B0	B4	3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2																			1																			0																		
EPF[1:0]	GRAM Data																																																																																																																																																																																				
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6	R4	R3	R2	R1	R0	0	G5	G4	G3	G2	G1	G0	B4	B3	B2	B1	B0	0																																																																																																																																																																			
5	R4	R3	R2	R1	R0	1	G5	G4	G3	G2	G1	G0	B4	B3	B2	B1	B0	1																																																																																																																																																																			
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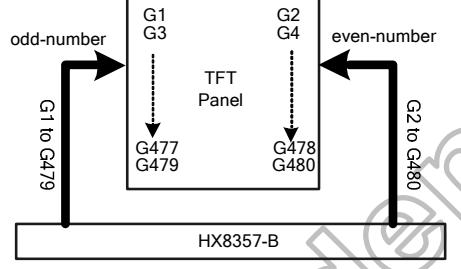
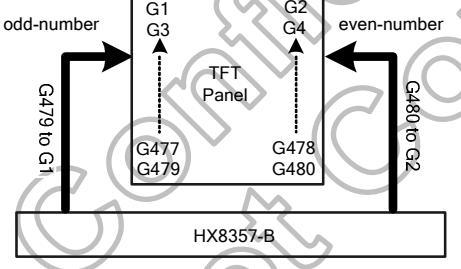
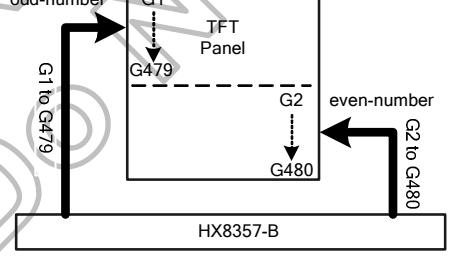
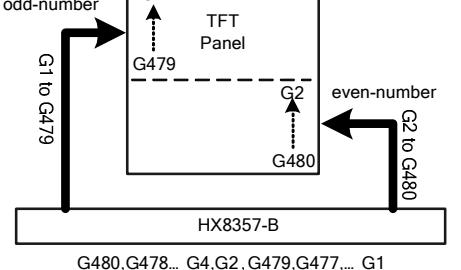
6.2.49 Set Display mode (B4h)

B4 H	SETDISPLAY																												
	DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX																
Command	0	1	↑	-	1	0	1	1	0	1	0	0	B4																
1 st parameter	1	1	↑	-	0	0	0	RM	0	0	DM[1:0]	XX																	
RM: The bit is used to select an interface for the Frame Memory access operation. The Frame Memory is accessed only via the interface defined by RM bit. Because the interface can be selected separately from display operation mode, writing data to the Frame Memory is possible via system interface when RM = 0, even in the DPI display operation. RM setting is enabled from the next frame. Wait 1 frame to transfer data after setting																													
Description	<table border="1"> <tr><td>RM</td><td>Interface for RAM Access</td></tr> <tr><td>0</td><td>DBI Interface (CPU)</td></tr> <tr><td>1</td><td>DPI Interface (RGB)</td></tr> </table>														RM	Interface for RAM Access	0	DBI Interface (CPU)	1	DPI Interface (RGB)									
RM	Interface for RAM Access																												
0	DBI Interface (CPU)																												
1	DPI Interface (RGB)																												
DM[1:0]: The bit is used to select display operation mode. The setting allows switching between display operation in synchronization with internal oscillation clock, VSYNC, HSYNC or DPI signal.																													
Restriction	<table border="1"> <tr><td>DM 1</td><td>DM 0</td><td>Display Mode</td></tr> <tr><td>0</td><td>0</td><td>Internal oscillation clock</td></tr> <tr><td>0</td><td>1</td><td>External VSYNC + HSYNC (Display data from GRAM)</td></tr> <tr><td>1</td><td>0</td><td>External VSYNC (Display data from GRAM)</td></tr> <tr><td>1</td><td>1</td><td>External DPI (RGB Through mode)</td></tr> </table>														DM 1	DM 0	Display Mode	0	0	Internal oscillation clock	0	1	External VSYNC + HSYNC (Display data from GRAM)	1	0	External VSYNC (Display data from GRAM)	1	1	External DPI (RGB Through mode)
DM 1	DM 0	Display Mode																											
0	0	Internal oscillation clock																											
0	1	External VSYNC + HSYNC (Display data from GRAM)																											
1	0	External VSYNC (Display data from GRAM)																											
1	1	External DPI (RGB Through mode)																											
Note1: Switching between VSYNC, HSYNC and DPI operation is prohibited. Note2: When DM[1:0]=00, 01 and 11, the VSYNC frequency must slow then driver IC's frame rate.																													
Register Availability	<table border="1"> <tr><th>Status</th><th>Availability</th></tr> <tr><td>Sleep Out</td><td>Yes</td></tr> <tr><td>Sleep In</td><td>Yes</td></tr> </table>														Status	Availability	Sleep Out	Yes	Sleep In	Yes									
Status	Availability																												
Sleep Out	Yes																												
Sleep In	Yes																												
Default	<table border="1"> <tr><th>Status</th><th>Default Value</th></tr> <tr><td>Power On Sequence</td><td></td></tr> <tr><td>S/W Reset</td><td>No change</td></tr> <tr><td>H/W Reset</td><td></td></tr> </table>														Status	Default Value	Power On Sequence		S/W Reset	No change	H/W Reset								
Status	Default Value																												
Power On Sequence																													
S/W Reset	No change																												
H/W Reset																													
Flow Chart																													

6.2.50 Get Device ID (BFh)

BF H	GETDEVICEID																				
	DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX								
Command	0	1	↑	-	1	0	1	1	1	1	1	1	BF								
1 st parameter	1	↑	1	-	0	0	0	0	0	0	0	1	01								
2 nd parameter	1	↑	1	-	0	1	1	0	0	0	1	0	62								
3 rd parameter	1	↑	1	-	1	0	0	0	0	0	1	1	83								
4 th parameter	1	↑	1	-	0	1	0	1	0	1	1	1	57								
5 th parameter	1	↑	1	-	1	1	1	1	1	1	1	1	FF								
Description	The format of returned data is as follows: Parameter 1: MIPI Alliance code. Parameter 2: MIPI Alliance code. Parameter 3: Device ID code. Parameter 4: Device ID code. Parameter 5: single-byte <i>Escape or Exit Code</i> (0xFF).																				
Restriction																					
Register Availability	<table border="1"> <tr> <th>Status</th> <th>Availability</th> </tr> <tr> <td>Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In</td> <td>Yes</td> </tr> </table>		Status	Availability	Sleep Out	Yes	Sleep In	Yes													
Status	Availability																				
Sleep Out	Yes																				
Sleep In	Yes																				
Default	<table border="1"> <tr> <th>Status</th> <th>Default Value</th> </tr> <tr> <td>Power On Sequence</td> <td></td> </tr> <tr> <td>S/W Reset</td> <td>No change</td> </tr> <tr> <td>H/W Reset</td> <td></td> </tr> </table>		Status	Default Value	Power On Sequence		S/W Reset	No change	H/W Reset												
Status	Default Value																				
Power On Sequence																					
S/W Reset	No change																				
H/W Reset																					
Flow Chart																					

6.2.51 Set Panel Driving (C0h)

C0 H	SETPANEL														
	DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX		
Command	0	1	↑	-	1	1	0	0	0	0	0	0	0	C0	
1 st parameter	1	1	↑	-	0	0	0	REV	SM	GS	0	0	0	XX	
2 nd parameter	1	1	↑	-	0	0								NL[5:0]	XX
3 rd parameter	1	1	↑	-	0									SCN[6:0]	XX
4 th parameter	1	1	↑	-	0	0	0	NDL	0					PTS[2:0]	XX
5 th parameter	1	1	↑	-	0	0	0	PTG						ISC[3:0]	XX
GS: Select the optimal scan mode for the module. SM: Sets the gate driver pin arrangement in combination.															
Description	SM GS		Scan direction												
	0	0	 odd-number: G1 to G479 even-number: G2 to G480 TFT Panel: G1, G2, G3, G4 G477, G479, G478, G480												
	0	1	 odd-number: G479 to G1 even-number: G480 to G2 TFT Panel: G1, G2, G3, G4 G479, G477, G478, G480												
	1	0	 odd-number: G1 to G479 even-number: G2 to G480 TFT Panel: G1, G2 G479, G480												
	1	1	 odd-number: G1 to G479 even-number: G2 to G480 TFT Panel: G1, G2 G479, G480												

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REV: Enables the grayscale inversion of the image in display area.

REV	GRAM Data	Display area	
		VCOM = "L"	VCOM = "H"
0	18'h00000	V63P	V0N
	: 18'h3FFFF	: V0P	: V63N
1	18'h00000	V0P	V63N
	: 18'h3FFFF	: V63P	: V0N

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 Driver line number
0x00 ~ 0x3B	8*(NL[5:0]+1) line
Other setting	Inhibited

SCN[6:0]: Scan line start position.

SCN[6:0]	Start position of Gate			
	SM=0		SM=1	
	GS=0	GS=1	GS=0	GS=1
0x00 ~ 0x3B	G[1+SCN[6:0]*4]	G[480- SCN[6:0]*4]	G[1+SCN[6:0]*8]	G[480- SCN[6:0]*4]
0x3C ~ 0x77	G[1+SCN[6:0]*4]	G[480- SCN[6:0]*4]	G[2+(SCN[6:0]-0x3C)*8]	G[479- (SCN[6:0]-0x3C)*8]
Other setting	Inhibited	Inhibited	Inhibited	Inhibited

PTS[2:0]: Set the source output level in non-display area drive period (front/back porch period and blank area between partial displays).

PTS[2:0]	Source output level in non-display area			
	VCOM = "L"		VCOM = "H"	
000	V63P	V0N	V0P	V63N
001	V0P	V63N	V63P	V0N
010	GND	GND	GND	GND
011	Hi-Z	Hi-Z	Hi-Z	Hi-Z
Other	Inhibited	Inhibited	Inhibited	Inhibited

NDL: Sets the source output level in non-display area of refresh scan cycle. Settings are different to normally black panels and normally white panels.

NDL	Source output level in non-display area of refresh scan cycle	
	VCOM = "L"	VCOM = "H"
0	V63P	V0N
1	V0P	V63N

ISC[3:0]: Specify the refresh scan cycle of gate driver when **PTG** select in non-display area. Then refresh scan cycle is set to an odd number from 0~31. The polarity is inverted every scan cycle.

ISC3	ISC2	ISC1	ISC0	Scan Cycle	f _{FLM} = 60Hz
0	0	0	0	1 frame	17ms
0	0	0	1	3 frames	50ms
0	0	1	0	5 frames	83ms
0	0	1	1	7 frames	117ms
0	1	0	0	9 frames	150ms
0	1	0	1	11 frames	183ms
0	1	1	0	13 frames	217ms
0	1	1	1	15 frames	250ms
1	0	0	0	17 frames	283ms
1	0	0	1	19 frames	317ms
1	0	1	0	21 frames	350ms
1	0	1	1	23 frames	383ms
1	1	0	0	25 frames	417ms
1	1	0	1	27 frames	450ms
1	1	1	0	29 frames	483ms
1	1	1	1	31 frames	517ms

	PTG: Specify the scan mode of gate driver in non-display area.	
	PTG	Gate Outputs in Non-display Area
	0	Normal Drive
	1	Interval Drive
Restriction		
Register Availability	Status	Availability
	Sleep Out	Yes
	Sleep In	Yes
Default	Status	Default Value
	Power On Sequence	
	S/W Reset	No change
	H/W Reset	
Flow Chart		

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6.2.52 Set display timing for Normal mode (C1h)

C1 H	SETNORTIM																																
	DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX																				
Command	0	1	↑	-	1	1	0	0	0	0	0	1	C1																				
1 st parameter	1	1	↑	-	0	0	0	BC0	0	0	DIV0[1:0]		XX																				
2 nd parameter	1	1	↑	-	0	0	0		RTN0[4:0]				XX																				
3 rd parameter	1	1	↑	-	FP0[3:0]				BP0[3:0]				XX																				
Description	BC0: Frame/Line inversion select.																																
	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>BC0</th> <th>Inversion mode</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Frame</td> </tr> <tr> <td>1</td> <td>Line</td> </tr> </tbody> </table>														BC0	Inversion mode	0	Frame	1	Line													
BC0	Inversion mode																																
0	Frame																																
1	Line																																
Description	DIV0[1:0]: Specify the division ratio of internal clocks in Normal mode for internal operation. When used internal clock for the display operation, frame frequency can be adjusted with the RTN1[4:0] bits (1H period clock cycle), FP1[3:0], and BP1[3:0] bits.																																
	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>DIV0[1:0]</th> <th>Division ratio</th> </tr> </thead> <tbody> <tr> <td>00</td> <td>1/1</td> </tr> <tr> <td>01</td> <td>1/2</td> </tr> <tr> <td>10</td> <td>1/4</td> </tr> <tr> <td>11</td> <td>1/8</td> </tr> </tbody> </table>														DIV0[1:0]	Division ratio	00	1/1	01	1/2	10	1/4	11	1/8									
DIV0[1:0]	Division ratio																																
00	1/1																																
01	1/2																																
10	1/4																																
11	1/8																																
Description	RTN0[4:0]: Specify clock number of one line period in Normal mode for internal operation. Clock cycles=1/internal operation clock frequency(fosc)																																
	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>RTN0[4:0]</th> <th>Clock number per Line</th> </tr> </thead> <tbody> <tr> <td>5'b10000</td> <td>168</td> </tr> <tr> <td>5'b10001</td> <td>169</td> </tr> <tr> <td>5'b10010</td> <td>170</td> </tr> <tr> <td>5'b10011</td> <td>171</td> </tr> <tr> <td>5'b10100</td> <td>172</td> </tr> <tr> <td>:</td> <td>:</td> </tr> <tr> <td>5'b11110</td> <td>182</td> </tr> <tr> <td>5'b11111</td> <td>183</td> </tr> <tr> <td>Other</td> <td>Inhibited</td> </tr> </tbody> </table>														RTN0[4:0]	Clock number per Line	5'b10000	168	5'b10001	169	5'b10010	170	5'b10011	171	5'b10100	172	:	:	5'b11110	182	5'b11111	183	Other
RTN0[4:0]	Clock number per Line																																
5'b10000	168																																
5'b10001	169																																
5'b10010	170																																
5'b10011	171																																
5'b10100	172																																
:	:																																
5'b11110	182																																
5'b11111	183																																
Other	Inhibited																																
Description	FP0[3:0]: Set the number of lines for a front porch period (a blank period following the end of display). BP0[3:0]: Set the number of lines for a back porch period (a blank period made before the beginning of display).																																
	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>FP0[3:0] / BP0[3:0]</th> <th>Front / Back porch period</th> </tr> </thead> <tbody> <tr> <td>4'b0000</td> <td>Inhibited</td> </tr> <tr> <td>4'b0001</td> <td>Inhibited</td> </tr> <tr> <td>4'b0010</td> <td>2 lines</td> </tr> <tr> <td>4'b0011</td> <td>3 lines</td> </tr> <tr> <td>4'b0100</td> <td>4 lines</td> </tr> <tr> <td>:</td> <td>:</td> </tr> <tr> <td>4'b1110</td> <td>14 lines</td> </tr> <tr> <td>4'b1111</td> <td>15 lines</td> </tr> </tbody> </table>														FP0[3:0] / BP0[3:0]	Front / Back porch period	4'b0000	Inhibited	4'b0001	Inhibited	4'b0010	2 lines	4'b0011	3 lines	4'b0100	4 lines	:	:	4'b1110	14 lines	4'b1111	15 lines	
FP0[3:0] / BP0[3:0]	Front / Back porch period																																
4'b0000	Inhibited																																
4'b0001	Inhibited																																
4'b0010	2 lines																																
4'b0011	3 lines																																
4'b0100	4 lines																																
:	:																																
4'b1110	14 lines																																
4'b1111	15 lines																																
Description	The condition in setting BP and FP bits are: $BP \geq 4$ lines, $FP \geq 2$ lines, $BP+FP \leq 30$ lines																																
	Formula for the Frame Frequency during internal display mode: $\text{Frame frequency} = \text{fosc} / (\text{RTN} \times \text{DIV} \times (\text{Scan Line} + \text{FP} + \text{BP})) \text{ [Hz]}$																																
Restriction																																	
Register Availability	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In</td> <td>Yes</td> </tr> </tbody> </table>														Status	Availability	Sleep Out	Yes	Sleep In	Yes													
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6.2.53 Set display timing for Partial mode (C2h)

C2 H	SETPARTIM																																
	DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX																				
Command	0	1	↑	-	1	1	0	0	0	0	1	0	C2																				
1 st parameter	1	1	↑	-	0	0	0	BC1	0	0	DIV1[1:0]		XX																				
2 nd parameter	1	1	↑	-	0	0	0		RTN1[4:0]				XX																				
3 rd parameter	1	1	↑	-		FP1[3:0]			BP1[3:0]				XX																				
Description	BC1: Frame/Line inversion select.																																
	BC1		Inversion mode																														
	0		Frame																														
	1		Line																														
DIV1[1:0]: Specify the division ratio of internal clocks in Normal mode for internal operation. When used internal clock for the display operation, frame frequency can be adjusted with the RTN1[4:0] bits (1H period clock cycle), FP1[3:0], and BP1[3:0] bits.																																	
<table border="1"> <tr> <td>DIV1[1:0]</td><td>Division ratio</td></tr> <tr> <td>00</td><td>1/1</td></tr> <tr> <td>01</td><td>1/2</td></tr> <tr> <td>10</td><td>1/4</td></tr> <tr> <td>11</td><td>1/8</td></tr> </table>														DIV1[1:0]	Division ratio	00	1/1	01	1/2	10	1/4	11	1/8										
DIV1[1:0]	Division ratio																																
00	1/1																																
01	1/2																																
10	1/4																																
11	1/8																																
RTN1[4:0]: Specify clock number of one line period in Normal mode for internal operation. Clock cycles=1/internal operation clock frequency(fosc)																																	
<table border="1"> <tr> <td>RTN1[4:0]</td><td>Clock number per Line</td></tr> <tr> <td>5'b10000</td><td>168</td></tr> <tr> <td>5'b10001</td><td>169</td></tr> <tr> <td>5'b10010</td><td>170</td></tr> <tr> <td>5'b10011</td><td>171</td></tr> <tr> <td>5'b10100</td><td>172</td></tr> <tr> <td>:</td><td>:</td></tr> <tr> <td>5'b11110</td><td>182</td></tr> <tr> <td>5'b11111</td><td>183</td></tr> <tr> <td>Other</td><td>Inhibited</td></tr> </table>														RTN1[4:0]	Clock number per Line	5'b10000	168	5'b10001	169	5'b10010	170	5'b10011	171	5'b10100	172	:	:	5'b11110	182	5'b11111	183	Other	Inhibited
RTN1[4:0]	Clock number per Line																																
5'b10000	168																																
5'b10001	169																																
5'b10010	170																																
5'b10011	171																																
5'b10100	172																																
:	:																																
5'b11110	182																																
5'b11111	183																																
Other	Inhibited																																
FP1[3:0]: Set the number of lines for a front porch period (a blank period following the end of display). BP1[3:0]: Set the number of lines for a back porch period (a blank period made before the beginning of display).																																	
<table border="1"> <tr> <td>FP1[3:0] / BP1[3:0]</td><td>Front / Back porch period</td></tr> <tr> <td>4'b0000</td><td>Inhibited</td></tr> <tr> <td>4'b0001</td><td>Inhibited</td></tr> <tr> <td>4'b0010</td><td>2 lines</td></tr> <tr> <td>4'b0011</td><td>3 lines</td></tr> <tr> <td>4'b0100</td><td>4 lines</td></tr> <tr> <td>:</td><td>:</td></tr> <tr> <td>4'b1110</td><td>14 lines</td></tr> <tr> <td>4'b1111</td><td>15 lines</td></tr> </table>														FP1[3:0] / BP1[3:0]	Front / Back porch period	4'b0000	Inhibited	4'b0001	Inhibited	4'b0010	2 lines	4'b0011	3 lines	4'b0100	4 lines	:	:	4'b1110	14 lines	4'b1111	15 lines		
FP1[3:0] / BP1[3:0]	Front / Back porch period																																
4'b0000	Inhibited																																
4'b0001	Inhibited																																
4'b0010	2 lines																																
4'b0011	3 lines																																
4'b0100	4 lines																																
:	:																																
4'b1110	14 lines																																
4'b1111	15 lines																																
The condition in setting BP and FP bits are: $BP \geq 4$ lines, $FP \geq 2$ lines, $BP+FP \leq 30$ lines																																	
Formula for the Frame Frequency during internal display mode: $\text{Frame frequency} = \text{fosc}/(\text{RTN} \times \text{DIV} \times (\text{Scan Line}+\text{FP}+\text{BP})) [\text{Hz}]$																																	
Restriction																																	
Register Availability	Status		Availability																														
	Sleep Out		Yes																														
Default	Status		Default Value																														
	Power On Sequence																																
<table border="1"> <tr> <td>S/W Reset</td><td>No change</td></tr> <tr> <td>H/W Reset</td><td></td></tr> </table>														S/W Reset	No change	H/W Reset																	
S/W Reset	No change																																
H/W Reset																																	
Flow Chart																																	

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6.2.54 Set display timing for Idle mode (C3h)

C3 H	SETIDLTIM																															
	DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX																			
Command	0	1	↑	-	1	1	0	0	0	0	1	1	C3																			
1 st parameter	1	1	↑	-	0	0	0	BC2	0	0	DIV2[1:0]		XX																			
2 nd parameter	1	1	↑	-	0	0	0	RTN2[4:0]				XX																				
3 rd parameter	1	1	↑	-	FP2[3:0]				BP2[3:0]				XX																			
Description	BC2: Frame/Line inversion select.																															
	BC2		Inversion mode																													
	0		Frame																													
	1		Line																													
Description	DIV2[1:0]: Specify the division ratio of internal clocks in Normal mode for internal operation. When used internal clock for the display operation, frame frequency can be adjusted with the RTN2[4:0] bits (1H period clock cycle), FP2[3:0], and BP2[3:0] bits.																															
	DIV2[1:0]		Division ratio																													
	00		1/1																													
	01		1/2																													
Description	10		1/4																													
	11		1/8																													
	RTN2[4:0]: Specify clock number of one line period in Normal mode for internal operation.																															
	Clock cycles=1/internal operation clock frequency(fosc)																															
Description	RTN2[4:0]		Clock number per Line																													
	5'b10000		168																													
	5'b10001		169																													
	5'b10010		170																													
	5'b10011		171																													
	5'b10100		172																													
	:		:																													
	5'b11110		182																													
	5'b11111		183																													
	Other		Inhibited																													
Description	FP2[3:0] / BP2[3:0]: Set the number of lines for a front porch period (a blank period following the end of display).																															
	BP2[3:0]: Set the number of lines for a back porch period (a blank period made before the beginning of display).																															
	FP2[3:0] / BP2[3:0]		Front / Back porch period																													
	4'b0000		Inhibited																													
	4'b0001		Inhibited																													
	4'b0010		2 lines																													
	4'b0011		3 lines																													
	4'b0100		4 lines																													
	:		:																													
	4'b1110		14 lines																													
Restriction	4'b1111		15 lines																													
	The condition in setting BP and FP bits are: BP≥4 lines, FP≥2 lines, BP+FP≤30 lines																															
	Formula for the Frame Frequency during internal display mode:																															
	Frame frequency = fosc/(RTN × DIV × (Scan Line+FP+BP)) [Hz]																															
Default	Status		Default Value																													
	Power On Sequence																															
	S/W Reset		No change																													
	H/W Reset																															
Flow Chart																																

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6.2.55 Set display frame (C5h)

C5 H	SETOSC																	
	DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX					
Command	0	1	↑	-	1	1	0	0	0	1	0	1	C5					
1 st parameter	1	1	↑	-	0	0	0	0	UADJ[3:0]				XX					
UADJ[3:0]: Set the frame rate of full colors normal mode.																		
Description	UADJ[3:0]	Frame Rate(Hz±5%)																
	0000	21.70																
	0001	26.40																
	0010	31.64																
	0011	36.56																
	0100	41.33																
	0101	45.85																
	0110	50.68																
	0111	55.13																
	1000	61.51																
	1001	65.92																
	1010	70.46																
	1011	74.84																
	1100	79.30																
	1101	83.73																
	1110	87.98																
	1111	92.35																
Restriction																		
Register Availability	Status	Availability																
	Sleep Out	Yes																
	Sleep In	Yes																
Default	Status	Default Value																
	Power On Sequence																	
	S/W Reset	No change																
Flow Chart																		

6.2.56 Set RGB Interface (C6h)

C6 H	SETRGB																																
	DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX																				
Command	0	1	↑	-	1	1	0	0	0	1	1	0	C6																				
1 st parameter	1	1	↑	-	SDA_EN	0	0	VPL	HPL	0	EPL	DPL	XX																				
This command is used to set RGB interface related register																																	
EPL: Specify the polarity of Enable pin in DPI interface mode.																																	
<table border="1"> <tr> <th>EPL</th><th>ENABLE pin</th><th>Display image</th><th>Operation</th></tr> <tr> <td>0</td><td>Low</td><td>Enable</td><td>Write data to DB17-0</td></tr> <tr> <td>0</td><td>High</td><td>Disable</td><td>Disable</td></tr> <tr> <td>1</td><td>Low</td><td>Disable</td><td>Disable</td></tr> <tr> <td>1</td><td>High</td><td>Enable</td><td>Write data to DB17-0</td></tr> </table>													EPL	ENABLE pin	Display image	Operation	0	Low	Enable	Write data to DB17-0	0	High	Disable	Disable	1	Low	Disable	Disable	1	High	Enable	Write data to DB17-0	
EPL	ENABLE pin	Display image	Operation																														
0	Low	Enable	Write data to DB17-0																														
0	High	Disable	Disable																														
1	Low	Disable	Disable																														
1	High	Enable	Write data to DB17-0																														
VPL: The polarity of VSYNC pin. When VSPL=0, the VSYNC pin is Low active. When VSPL=1, the VSYNC pin is High active.																																	
HPL: The polarity of HSYNC pin. When HSPL=0, the HSYNC pin is Low active. When HSPL=1, the HSYNC pin is High active.																																	
DPL: The polarity of DOTCLK pin. When DPL=0, the data is read on the rising edge of DOTCLK signal. When DPL=1, the data is read on the falling edge of DOTCLK signal.																																	
SDA_EN: DBI Type-C interface pin selection																																	
<table border="1"> <tr> <th>SDA_EN</th><th>DIN_SDA</th><th>DOUT</th></tr> <tr> <td>0</td><td>Data Input</td><td>Data output</td></tr> <tr> <td>1</td><td>Data input/output</td><td>Not used</td></tr> </table>													SDA_EN	DIN_SDA	DOUT	0	Data Input	Data output	1	Data input/output	Not used												
SDA_EN	DIN_SDA	DOUT																															
0	Data Input	Data output																															
1	Data input/output	Not used																															
Restriction																																	
Register Availability	Status		Availability																														
	Sleep Out		Yes																														
Default	Status		Default Value																														
	Power On Sequence																																
S/W Reset																																	
H/W Reset																																	
Flow Chart																																	

6.2.57 Set Gamma (C8h)

C8 H	SETGAMMA																					
	DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX									
Command	0	1	↑	-	1	1	0	0	1	0	0	0	C8									
1 st parameter	1	1	↑	-	0	KP1[2:0]			0	KP0[2:0]			XX									
2 nd parameter	1	1	↑	-	0	KP3[2:0]			0	KP2[2:0]			XX									
3 rd parameter	1	1	↑	-	0	KP5[2:0]			0	KP4[2:0]			XX									
4 th parameter	1	1	↑	-	0	RP1[2:0]			0	RP0[2:0]			XX									
5 th parameter	1	1	↑	-	0	0	0	0	VRP0[3:0]				XX									
6 th parameter	1	1	↑	-	0	0	0	VRP1[4:0]					XX									
7 th parameter	1	1	↑	-	0	KN1[2:0]			0	KN0[2:0]			XX									
8 th parameter	1	1	↑	-	0	KN3[2:0]			0	KN2[2:0]			XX									
9 th parameter	1	1	↑	-	0	KN5[2:0]			0	KN4[2:0]			XX									
10 th parameter	1	1	↑	-	0	RN1[2:0]			0	RN0[2:0]			XX									
11 th parameter	1	1	↑	-	0	0	0	0	VRN0[3:0]				XX									
12 th parameter	1	1	↑	-	0	0	0	VRN1[4:0]					XX									
Description	This command is used for Gamma Curve related Setting. For details, please refer to “5.7 Gamma Characteristic Correction Function”																					
Restriction																						
Register Availability	<table border="1"> <tr> <th>Status</th> <th>Availability</th> </tr> <tr> <td>Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In</td> <td>Yes</td> </tr> </table>														Status	Availability	Sleep Out	Yes	Sleep In	Yes		
Status	Availability																					
Sleep Out	Yes																					
Sleep In	Yes																					
Default	<table border="1"> <tr> <th>Status</th> <th>Default Value</th> </tr> <tr> <td>Power On Sequence</td> <td></td> </tr> <tr> <td>S/W Reset</td> <td>No change</td> </tr> <tr> <td>H/W Reset</td> <td></td> </tr> </table>														Status	Default Value	Power On Sequence		S/W Reset	No change	H/W Reset	
Status	Default Value																					
Power On Sequence																						
S/W Reset	No change																					
H/W Reset																						
Flow Chart																						

6.2.58 Set Power (D0h)

D0H	SETPOWER													
	DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX	
Command	0	1	↑	-	1	1	0	1	0	0	0	0	0	D0
1 st parameter	1	1	↑	-	0	AP[2:0]			0	VC[2:0]			XX	
2 nd parameter	1	1	↑	-	0	PON	0	0	0	BT[2:0]				
3 rd parameter	1	1	↑	-	0	0	0	0	VRH[3:0]					

AP[2:0]: Adjust the amount of current driving for the operational amplifier in the power supply circuit. When the amount of fixed current is increased, the LCD driving capacity and the display quality are high, but the current consumption is increased.

Adjust the fixed current by considering both the display quality and the current consumption.

AP2	AP1	AP0	Constant Current of Operational Amplifier
0	0	0	Operation of the operational amplifier stops
0	0	1	Medium
0	1	0	Medium
0	1	1	Medium
1	0	0	Medium High
1	0	1	Large
1	1	0	Setting Inhibited
1	1	1	Setting Inhibited

VC[2:0]: Set VCI1 voltage

VC[2:0]	VCI1	DDVDH		VCL
		DDVDH_TRI=0	DDVDH_TRI=1	
000	3.24V	6.48V	6.67V	-3.24V
001	3.06V	6.12V	6.48V	-3.06V
010	2.91V	5.82V	6.12V	-2.91V
011	2.77V	5.54V	5.97V	-2.77V
100	2.64V	5.28V	5.67V	-2.64V
101	2.47V	4.94V	5.40V	-2.47V
110	1.92V	3.84V	5.16V	-1.92V
111	VCI	VCIx2	inhibited	-VCI

Note: 1. VCI1 \leq (VCI-0.15)V.

Description

BT[3:0]: Switch the output factor of step-up circuit 2 for VGH and VGL voltage generation. The LCD drive voltage level can be selected according to the characteristic of liquid crystal which panel used. Lower amplification of the step-up circuit consumes less current and then the power consumption can be reduced.

BT2	BT1	BT0	VGH	VGL
0	0	0	3xDDVDH	-2DDVDH+VCL
0	0	1		-2DDVDH
0	1	0		-DDVDH+VCL
0	1	1		-2DDVDH+VCL
1	0	0		-2DDVDH
1	0	1		-DDVDH+VCL
1	1	0		-2DDVDH
1	1	1		-DDVDH+VCL

PON: Specify on/off control of step-up circuit 2 for VGH, VGL voltage generation.

PON	Operation of step-up circuit 2
0	OFF
1	ON

VRH[3:0]: Specify the VREG1 voltage adjusting. VREG1 voltage is for gamma voltage setting.

Note: setting restriction: VREG1OUT \leq (DDVDH-0.3V)

VRH[3:0]	VREG1
0000	Halt
0001	4.000v
0010	4.125v
0011	4.250v
0100	4.375v
0101	4.500v
0110	4.625v
0111	4.750v

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	1000	4.875v	
	1001	5.000v	
	1010	5.125v	
	1011	5.250v	
	1100	5.500v	
	1101	5.750v	
	1110	6.000v	
	1111	6.000v	
Restriction			
Register Availability	Status	Availability	
	Sleep Out	Yes	
	Sleep In	Yes	
Default	Status	Default Value	
	Power On Sequence		
	S/W Reset	No change	
	H/W Reset		
Flow Chart			

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6.2.59 Set VCOM (D1h)

D1H	SETVCOM																																																																																																																																																																																																																												
	DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX																																																																																																																																																																																																																
Command	0	1	↑	-	1	1	0	1	0	0	0	1	D1																																																																																																																																																																																																																
1 st parameter	1	1	↑	-	0				VCM[6:0]				XX																																																																																																																																																																																																																
2 nd parameter	1	1	↑	-	0	0	0			VDV[4:0]																																																																																																																																																																																																																			
Description	<p>VCM(6-0): Set the VCOMH voltage (High level voltage of VCOM) It is possible to amplify from 0.492 to 1 times of VREG1OUT voltage.</p> <table border="1"> <thead> <tr> <th>VCM[6:0]</th> <th>VCOMH</th> <th>VCM[6:0]</th> <th>VCOMH</th> </tr> </thead> <tbody> <tr><td>0 0 0 0 0 0 0</td><td>0.492xVREG1OUT</td><td>1 0 0 0 0 0 0</td><td>0.748xVREG1OUT</td></tr> <tr><td>0 0 0 0 0 0 1</td><td>0.496xVREG1OUT</td><td>1 0 0 0 0 0 1</td><td>0.752xVREG1OUT</td></tr> <tr><td>0 0 0 0 0 1 0</td><td>0.500xVREG1OUT</td><td>1 0 0 0 0 1 0</td><td>0.756xVREG1OUT</td></tr> <tr><td>0 0 0 0 0 1 1</td><td>0.504xVREG1OUT</td><td>1 0 0 0 0 1 1</td><td>0.760xVREG1OUT</td></tr> <tr><td>0 0 0 0 1 0 0</td><td>0.508xVREG1OUT</td><td>1 0 0 0 1 0 0</td><td>0.764xVREG1OUT</td></tr> <tr><td>0 0 0 0 1 0 1</td><td>0.512xVREG1OUT</td><td>1 0 0 0 1 0 1</td><td>0.768xVREG1OUT</td></tr> <tr><td>0 0 0 0 1 1 0</td><td>0.516xVREG1OUT</td><td>1 0 0 0 1 1 0</td><td>0.772xVREG1OUT</td></tr> <tr><td>0 0 0 0 1 1 1</td><td>0.520xVREG1OUT</td><td>1 0 0 0 1 1 1</td><td>0.776xVREG1OUT</td></tr> <tr><td>0 0 0 1 0 0 0</td><td>0.524xVREG1OUT</td><td>1 0 0 1 0 0 0</td><td>0.780xVREG1OUT</td></tr> <tr><td>0 0 0 1 0 0 1</td><td>0.528xVREG1OUT</td><td>1 0 0 1 0 0 1</td><td>0.784xVREG1OUT</td></tr> <tr><td>0 0 0 1 0 1 0</td><td>0.532xVREG1OUT</td><td>1 0 0 1 0 1 0</td><td>0.788xVREG1OUT</td></tr> <tr><td>0 0 0 1 0 1 1</td><td>0.536xVREG1OUT</td><td>1 0 0 1 0 1 1</td><td>0.792xVREG1OUT</td></tr> <tr><td>0 0 0 1 1 0 0</td><td>0.540xVREG1OUT</td><td>1 0 0 1 1 0 0</td><td>0.796xVREG1OUT</td></tr> <tr><td>0 0 0 1 1 0 1</td><td>0.544xVREG1OUT</td><td>1 0 0 1 1 0 1</td><td>0.800xVREG1OUT</td></tr> <tr><td>0 0 0 1 1 1 0</td><td>0.548xVREG1OUT</td><td>1 0 0 1 1 1 0</td><td>0.804xVREG1OUT</td></tr> <tr><td>0 0 0 1 1 1 1</td><td>0.552xVREG1OUT</td><td>1 0 0 1 1 1 1</td><td>0.808xVREG1OUT</td></tr> <tr><td>0 0 1 0 0 0 0</td><td>0.556xVREG1OUT</td><td>1 0 1 0 0 0 0</td><td>0.812xVREG1OUT</td></tr> <tr><td>0 0 1 0 0 0 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0 1 1 0 0 0 1	0.688xVREG1OUT	1 1 1 0 0 0 1	0.944xVREG1OUT																																																																																																																																																																																																																										
0 1 1 0 0 1 0	0.692xVREG1OUT	1 1 1 0 0 1 0	0.948xVREG1OUT																																																																																																																																																																																																																										
0 1 1 0 0 1 1	0.696xVREG1OUT	1 1 1 0 0 1 1	0.952xVREG1OUT																																																																																																																																																																																																																										
0 1 1 0 1 0 0	0.700xVREG1OUT	1 1 1 0 1 0 0	0.956xVREG1OUT																																																																																																																																																																																																																										
0 1 1 0 1 0 1	0.704xVREG1OUT	1 1 1 0 1 0 1	0.960xVREG1OUT																																																																																																																																																																																																																										

Himax Confidential

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-P.165-

May, 2010

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0 1 1 0 1 1 0	0.708xVREG1OUT	1 1 1 0 1 1 0	0.964xVREG1OUT
0 1 1 0 1 1 1	0.712xVREG1OUT	1 1 1 0 1 1 1	0.968xVREG1OUT
0 1 1 1 0 0 0	0.716xVREG1OUT	1 1 1 1 0 0 0	0.972xVREG1OUT
0 1 1 1 0 0 1	0.720xVREG1OUT	1 1 1 1 0 0 1	0.976xVREG1OUT
0 1 1 1 0 1 0	0.724xVREG1OUT	1 1 1 1 0 1 0	0.980xVREG1OUT
0 1 1 1 0 1 1	0.728xVREG1OUT	1 1 1 1 0 1 1	0.984xVREG1OUT
0 1 1 1 1 0 0	0.732xVREG1OUT	1 1 1 1 1 0 0	0.988xVREG1OUT
0 1 1 1 1 0 1	0.736xVREG1OUT	1 1 1 1 1 0 1	0.992xVREG1OUT
0 1 1 1 1 1 0	0.740xVREG1OUT	1 1 1 1 1 1 0	0.996xVREG1OUT
0 1 1 1 1 1 1	0.744xVREG1OUT	1 1 1 1 1 1 1	1.000xVREG1OUT

VDV(4-0): Specify the VCOM amplitude factors for panel common driving ($VCOML = VCOMH - VCOM$ amplitude, $VCOML \geq VCL + 0.5V$). It is possible to setup from 0.7 to 1.32 times of VREG1OUT. When $VCOMG = 0$, the VDV(4-0) setup is invalid and VCOML is output VSSA

VDV[4:0]	VMAG
0 0 0 0 0	0.70xVREG1OUT
0 0 0 0 1	0.72xVREG1OUT
0 0 0 1 0	0.74xVREG1OUT
0 0 0 1 1	0.76xVREG1OUT
0 0 1 0 0	0.78xVREG1OUT
0 0 1 0 1	0.80xVREG1OUT
0 0 1 1 0	0.82xVREG1OUT
0 0 1 1 1	0.84xVREG1OUT
0 1 0 0 0	0.86xVREG1OUT
0 1 0 0 1	0.88xVREG1OUT
0 1 0 1 0	0.90xVREG1OUT
0 1 0 1 1	0.92xVREG1OUT
0 1 1 0 0	0.94xVREG1OUT
0 1 1 0 1	0.96xVREG1OUT
0 1 1 1 0	0.98xVREG1OUT
0 1 1 1 1	1.00xVREG1OUT
1 0 0 0 0	1.02xVREG1OUT
1 0 0 0 1	1.04xVREG1OUT
1 0 0 1 0	1.06xVREG1OUT
1 0 0 1 1	1.08xVREG1OUT
1 0 1 0 0	1.10xVREG1OUT
1 0 1 0 1	1.12xVREG1OUT
1 0 1 1 0	1.14xVREG1OUT
1 0 1 1 1	1.16xVREG1OUT
1 1 0 0 0	1.18xVREG1OUT
1 1 0 0 1	1.20xVREG1OUT
1 1 0 1 0	1.22xVREG1OUT
1 1 0 1 1	1.24xVREG1OUT
1 1 1 0 0	1.26xVREG1OUT
1 1 1 0 1	1.28xVREG1OUT
1 1 1 1 0	1.30xVREG1OUT
1 1 1 1 1	1.32xVREG1OUT

Restriction		
Register Availability	Status	Availability
	Sleep Out	Yes
	Sleep In	Yes
Default	Status	Default Value
	Power On Sequence	
	S/W Reset	No change
	H/W Reset	
Flow Chart		

6.2.60 Set Power for Normal mode (D2h)

D2H	SETNORPOW																																																						
	DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX																																										
Command	0	1	↑	-	1	1	0	1	0	0	1	0	D2																																										
1 st parameter	1	1	↑	-	0	0	0	0	0	SAP0[2:0]			XX																																										
2 nd parameter	1	1	↑	-	0	DC10[2:0]			0	DC00[2:0]			XX																																										
	SAP0[2:0]: Adjust the amount of fixed current from the fixed current source for the source and gamma driver operational amplifier in the Normal display.																																																						
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	DC00[2:0]: Set the operating frequency of the step-up circuit 1 and extra step-up circuit 1 for DDVDH voltage generation in Normal mode.																																																						
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S/W Reset	No change																																																						
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Flow Chart																																																							

6.2.61 Set Power for Partial mode (D3h)

D3H		SETPARPOW																																																																																																																																																	
		DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX																																																																																																																																					
Command		0	1	↑	-	1	1	0	1	0	0	1	1	D3																																																																																																																																					
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Default	<table border="1"> <thead> <tr> <th>Status</th> <th>Default Value</th> </tr> </thead> <tbody> <tr> <td>Power On Sequence</td> <td></td> </tr> <tr> <td>S/W Reset</td> <td>No change</td> </tr> <tr> <td>H/W Reset</td> <td></td> </tr> </tbody> </table>			Status	Default Value	Power On Sequence		S/W Reset	No change	H/W Reset																																																																																																																																									
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H/W Reset																																																																																																																																																			
Flow Chart																																																																																																																																																			

6.2.62 Set Power for Idle mode (D4h)

D4H	SETIDLPOW																											
	DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX															
Command	0	1	↑	-	1	1	0	1	0	1	0	0	D4															
1 st parameter	1	1	↑	-	0	0	0	0	0	SAP2[2:0]	XX	XX																
2 nd parameter	1	1	↑	-	0	DC12[2:0]		0	DC02[2:0]		XX																	
	SAP2[2:0]: Adjust the amount of fixed current from the fixed current source for the source and gamma driver operational amplifier in the Normal display.																											
	SAP2[2:0]			Gamma Driver Amplifier				Source Driver Amplifier																				
	0	0	0	Operation Stop				Operation Stop																				
	0	0	1	1.00				1.00																				
	0	1	0	1.00				0.75																				
	0	1	1	1.00				0.50																				
	1	0	0	0.75				1.00																				
	1	0	1	0.75				0.75																				
	1	1	0	0.75				0.50																				
	1	1	1	0.5				0.50																				
	DC02[2:0]: Set the operating frequency of the step-up circuit 1 and extra step-up circuit 1 for DDVDH voltage generation in Idle mode.																											
	For details, please refer to "5.6 Oscillator" section.																											
Description	DC02[2:0]			Operation Frequency of Step-up Circuit 1 and Extra Step-up Circuit 1																								
	0	0	0	1/4 x H Line Frequency																								
	0	0	1	1/2 x H Line Frequency																								
	0	1	0	1 x H Line Frequency																								
	0	1	1	Setting Inhibited																								
	1	0	0	2 x H Line Frequency																								
	1	0	1	3 x H Line Frequency																								
	1	1	0	4 x H Line Frequency																								
	1	1	1	8 x H Line Frequency																								
	DC12[2:0]: Set the operating frequency of the step-up circuit 2 and 3 for VGH, VGL and VCL voltage generation in Idle mode.																											
	DC12[2:0]			Operation Frequency of Step-up Circuit 2 , Step-up Circuit 3																								
	0	0	0	1/4 x H Line Frequency																								
	0	0	1	1/2 x H Line Frequency																								
	0	1	0	1 x H Line Frequency																								
	0	1	1	Setting Inhibited																								
	1	0	0	2 x H Line Frequency																								
	1	0	1	3 x H Line Frequency																								
	1	1	0	4 x H Line Frequency																								
	1	1	1	8 x H Line Frequency																								
	Note: Ensure that the operation frequency of step-up circuit 1 \geq step-up circuit 2																											
Restriction																												
Register Availability	Status			Availability																								
	Sleep Out			Yes																								
	Sleep In			Yes																								
Default	Status			Default Value																								
	Power On Sequence																											
	S/W Reset			No change																								
	H/W Reset																											
Flow Chart																												

6.2.63 Set ID (E0h)

E0 H		SETID (Set ID)													
		DCX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX	
Command		0	1	↑	-	1	1	1	0	0	0	0	0	E0	
1 st parameter		1	↑	1	-				ID1[7:0]					--	
2 nd parameter		1	↑	1	-				ID2[7:0]					--	
3 rd parameter		1	↑	1	-				ID3[7:0]					--	
4 th parameter		1	↑	1	-				ID4[7:0]					--	
Description	ID1~4: User can program any value to OTP for module number.														
Restrictions	SETEXTC turn on 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													
Default	Sleep In	Yes													
	Status	Default Value													
	Power On Sequence	All 0x00h													
	S/W Reset	No Change													
Flow Chart															

6.2.64 Set OTP Related Setting (E2h)

E2 H		SETOTP(Set OTP Related Setting)																								
		DCX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX												
Command		0	1	↑	-	1	1	1	0	0	0	1	0	E2												
1 st parameter		1	↑	1	-	OTP_MASK[7:0]								-												
2 nd parameter		1	↑	1	-	OTP_INDEX[7:0]								-												
3 rd parameter		1	↑	1	-	OTP_LOA D_DI SABL_E	OTP_TEST	OTP_POR	OTP_PWE	OTP_PTM[1:0]	VPP_SEL	OTP_PROG		-												
4 th parameter		1	↑	1	-	OTP_DATA[7:0]								-												
Description	<p>This command is used to set OTP Related Setting</p> <p>OTP_MASK[7:0]: Bit programming mask, if 1, means don't programming this bit</p> <p>OTP_INDEX[6:0]: Set location of OTP to be programmed</p> <p>OTP_LOAD_DISABLE: When written to 1, auto load from OTP to internal register when SLPOUT command received is disabled, this is used when OTP is not yet programmed</p> <p>OTP_TEST: Internal use, not open. Please set "0".</p> <p>OTP_POR: OTP read control bit.</p> <p>OTP_PWE: Internal use, not open. Please set "0".</p> <p>OTP_PTM[1:0]: Internal use, not open. Please set "00".</p> <p>VPP_SEL: Internal use, not open. Please set "0".</p> <p>OTP_PROG: When set OTP_PROG=1, internal register begin written to OTP. Please refer to "5.14.2 OTP programming flow".</p> <p>OTP_DATA[7:0]: OTP data of read OTP index.</p>																									
Restrictions	SETEXTC turn on to enable this command.																									
Register Availability	<table border="1"> <tr> <td>Status</td> <td>Availability</td> </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>	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	Availability																									
Normal Mode On, Idle Mode Off, Sleep Out	Yes																									
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Partial Mode On, Idle Mode On, Sleep Out	Yes																									
Sleep In	Yes																									
Default	<table border="1"> <tr> <td>Status</td> <td>Default Value</td> </tr> <tr> <td>Power On Sequence</td> <td>OTP_MASK[7:0]=8'h00, OTP_INDEX[6:0]=7'h7F, OTP_LOAD_DISABLE=0, DCCLK_DISABLE=0, OTP_TEST=0, OTP_POR=0, OTP_PWE=0, OTP_PTM[1:0]=2'b00, VPP_SEL=0, OTP_PROG=0</td> </tr> <tr> <td>S/W Reset</td> <td>No change</td> </tr> <tr> <td>H/W Reset</td> <td>OTP_MASK[7:0]=8'h00, OTP_INDEX[6:0]=7'h7F, OTP_LOAD_DISABLE=0, DCCLK_DISABLE=0, OTP_TEST=0, OTP_POR=0, OTP_PWE=0, OTP_PTM[1:0]=2'b00, VPP_SEL=0, OTP_PROG=0</td> </tr> </table>													Status	Default Value	Power On Sequence	OTP_MASK[7:0]=8'h00, OTP_INDEX[6:0]=7'h7F, OTP_LOAD_DISABLE=0, DCCLK_DISABLE=0, OTP_TEST=0, OTP_POR=0, OTP_PWE=0, OTP_PTM[1:0]=2'b00, VPP_SEL=0, OTP_PROG=0	S/W Reset	No change	H/W Reset	OTP_MASK[7:0]=8'h00, OTP_INDEX[6:0]=7'h7F, OTP_LOAD_DISABLE=0, DCCLK_DISABLE=0, OTP_TEST=0, OTP_POR=0, OTP_PWE=0, OTP_PTM[1:0]=2'b00, VPP_SEL=0, OTP_PROG=0					
Status	Default Value																									
Power On Sequence	OTP_MASK[7:0]=8'h00, OTP_INDEX[6:0]=7'h7F, OTP_LOAD_DISABLE=0, DCCLK_DISABLE=0, OTP_TEST=0, OTP_POR=0, OTP_PWE=0, OTP_PTM[1:0]=2'b00, VPP_SEL=0, OTP_PROG=0																									
S/W Reset	No change																									
H/W Reset	OTP_MASK[7:0]=8'h00, OTP_INDEX[6:0]=7'h7F, OTP_LOAD_DISABLE=0, DCCLK_DISABLE=0, OTP_TEST=0, OTP_POR=0, OTP_PWE=0, OTP_PTM[1:0]=2'b00, VPP_SEL=0, OTP_PROG=0																									
Flow Chart																										

6.2.65 SETOTPKEY (E3h)

E3 H		SET OTP_KEY																								
		DCX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX												
Command		0	1	↑	-	1	1	1	0	0	0	1	1	E3												
1 st parameter		1	↑	1	-	OTP_KEY[7:0]																				
Description	<p>OTP_KEY[7:0]: To enter or leave OTP program mode. When enter OTP program mode, other user commands can't be set. Only stop OTP program and set OTP_KEY[7:0]=55h, leave OTP program mode, then the other user commands can be set.</p> <table border="1"> <thead> <tr> <th>OTP_KEY[7:0]</th> <th>Description</th> <th>Note</th> </tr> </thead> <tbody> <tr> <td>AAh</td> <td>Enter OTP program mode</td> <td></td> </tr> <tr> <td>55h</td> <td>Leave OTP program mode</td> <td></td> </tr> <tr> <td>Other values</td> <td>Invalid</td> <td>If OTP is in OTP program mode, then keep OTP program mode If OTP is in non-OTP program mode, then keep non-OTP program mode.</td> </tr> </tbody> </table> <p>OTP_KEY[7:0] can be ignored when user want to do OTP program.</p>														OTP_KEY[7:0]	Description	Note	AAh	Enter OTP program mode		55h	Leave OTP program mode		Other values	Invalid	If OTP is in OTP program mode, then keep OTP program mode If OTP is in non-OTP program mode, then keep non-OTP program mode.
OTP_KEY[7:0]	Description	Note																								
AAh	Enter OTP program mode																									
55h	Leave OTP program mode																									
Other values	Invalid	If OTP is in OTP program mode, then keep OTP program mode If OTP is in non-OTP program mode, then keep non-OTP program mode.																								
Restrictions	SETEXTC turn on to enable this command.																									
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <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 or Booster Off</td> <td>Yes</td> </tr> </tbody> </table>														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 or Booster Off	Yes
Status	Availability																									
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Status	Default Value																									
Power On Sequence	OTP_KEY[7:0]=8'h00																									
S/W Reset	No change																									
H/W Reset	OTP_KEY[7:0]=8'h00																									
Flow Chart																										

6.2.66 SET CABC(E4h)

E4 H		SETCABC																																																																																																																														
		DCX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX																																																																																																																		
Command		0	1	↑	-	1	1	1	0	0	1	0	1	E4																																																																																																																		
1 st Parameter		1	↑	1	-	0	SEL_PWMCLK[2:0]		SEL_GAIN[1:0]		INVPU_Ls	SEL_BLDUTY	-																																																																																																																			
2 nd Parameter		1	↑	1	-	PWM_PERIOD[7:0]								-																																																																																																																		
3 rd Parameter		1	↑	1	-	0	DIM_FRAME[6:0]																																																																																																																									
Description	SEL_PWMCLK[2:0]: Internal PWM_CLK divider for CABC clock. <table border="1"> <tr><th>SEL_PWMCLK[2:0]</th><th>Divider</th></tr> <tr><td>0</td><td>PWM_CLK/1</td></tr> <tr><td>1</td><td>PWM_CLK/2</td></tr> <tr><td>2</td><td>PWM_CLK/4</td></tr> <tr><td>3</td><td>PWM_CLK/8</td></tr> <tr><td>4</td><td>PWM_CLK/16</td></tr> <tr><td>5</td><td>PWM_CLK/32</td></tr> <tr><td>6</td><td>PWM_CLK/64</td></tr> <tr><td>7</td><td>PWM_CLK/128</td></tr> </table> <p>Note:1. PWM_CLK is OSC frequency in any interface</p> <p>SEL_GAIN[1:0]: Internal use, not open. Please set to "1".</p> <p>INVPU_Ls: The polarity setting of PWM_OUT.</p> <p>Condition: BL=1, BCTRL=1 and DBV[7:0]=0x00h INVPU_Ls=1, PWM_OUT will pull Low. INVPU_Ls=0, PWM_OUT will pull High.</p> <p>SEL_BLDUTY: Internal use, not open. Please set to "1".</p> <p>PWM_PERIOD[7:0]: The backlight PWM output frequency setting.</p> <table border="1"> <tr><th>PWM_PERIOD[7:0]</th><th>Frequency Hz</th><th>PWM_PERIOD[7:0]</th><th>Frequency Hz</th></tr> <tr><td>0</td><td>42K</td><td>1A</td><td>16K</td></tr> <tr><td>1</td><td>41K</td><td>1B</td><td>15K</td></tr> <tr><td>2</td><td>40K</td><td>1C</td><td>14K</td></tr> <tr><td>3</td><td>39K</td><td>1D</td><td>13K</td></tr> <tr><td>4</td><td>38K</td><td>1E</td><td>12K</td></tr> <tr><td>5</td><td>37K</td><td>1F</td><td>11K</td></tr> <tr><td>6</td><td>36K</td><td>20</td><td>10K</td></tr> <tr><td>7</td><td>35K</td><td>21</td><td>9K</td></tr> <tr><td>8</td><td>34K</td><td>22</td><td>8K</td></tr> <tr><td>9</td><td>33K</td><td>23</td><td>7K</td></tr> <tr><td>A</td><td>32K</td><td>24</td><td>6K</td></tr> <tr><td>B</td><td>31K</td><td>25</td><td>5K</td></tr> <tr><td>C</td><td>30K</td><td>26</td><td>4K</td></tr> <tr><td>D</td><td>29K</td><td>27</td><td>3K</td></tr> <tr><td>E</td><td>28K</td><td>28</td><td>2K</td></tr> <tr><td>F</td><td>27K</td><td>29</td><td>1K</td></tr> <tr><td>10</td><td>26K</td><td>2A</td><td>900</td></tr> <tr><td>11</td><td>25K</td><td>2B</td><td>800</td></tr> <tr><td>12</td><td>24K</td><td>2C</td><td>700</td></tr> <tr><td>13</td><td>23K</td><td>2D</td><td>600</td></tr> <tr><td>14</td><td>22K</td><td>2E</td><td>500</td></tr> <tr><td>15</td><td>21K</td><td>2F</td><td>400</td></tr> <tr><td>16</td><td>20K</td><td>30</td><td>300</td></tr> <tr><td>17</td><td>19K</td><td>31</td><td>200</td></tr> <tr><td>18</td><td>18K</td><td>32</td><td>100</td></tr> <tr><td>19</td><td>17K</td><td></td><td></td></tr> </table> <p>DIM_FRAME[6:0]: Manual brightness setting dimming period.</p>		SEL_PWMCLK[2:0]	Divider	0	PWM_CLK/1	1	PWM_CLK/2	2	PWM_CLK/4	3	PWM_CLK/8	4	PWM_CLK/16	5	PWM_CLK/32	6	PWM_CLK/64	7	PWM_CLK/128	PWM_PERIOD[7:0]	Frequency Hz	PWM_PERIOD[7:0]	Frequency Hz	0	42K	1A	16K	1	41K	1B	15K	2	40K	1C	14K	3	39K	1D	13K	4	38K	1E	12K	5	37K	1F	11K	6	36K	20	10K	7	35K	21	9K	8	34K	22	8K	9	33K	23	7K	A	32K	24	6K	B	31K	25	5K	C	30K	26	4K	D	29K	27	3K	E	28K	28	2K	F	27K	29	1K	10	26K	2A	900	11	25K	2B	800	12	24K	2C	700	13	23K	2D	600	14	22K	2E	500	15	21K	2F	400	16	20K	30	300	17	19K	31	200	18	18K	32	100	19	17K		
SEL_PWMCLK[2:0]	Divider																																																																																																																															
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18	18K	32	100																																																																																																																													
19	17K																																																																																																																															
Restriction	SETEXTC turn on to enable this command.																																																																																																																															

Register Availability	Status	Availability
	Normal Display On, Sleep Out	Yes
	Partial Display On, Sleep Out	Yes
	Sleep In or Booster Off	Yes
Default	Status	Default Value
	Power On Sequence	
	S/W Reset	PWM_PERIOD[7:0]= OTP value, DIM_FRAME[6:0]=OTP value Others=No Change
	H/W Reset	
Flow Chart		

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6.2.67 Set CABC Gain (E5h)

E5H	SETCABCGAIN (Set CABC Gain)												
	DCX	RDX	WRX	D15-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	0	1	↑	-	1	1	1	0	0	1	0	1	E5
1 st parameter	1	↑	1	-	0								--
2 nd parameter	1	↑	1	-	0								--
3 rd parameter	1	↑	1	-	0								--
4 th parameter	1	↑	1	-	0								--
5 th parameter	1	↑	1	-	0								--
6 th parameter	1	↑	1	-	0								--
7 th parameter	1	↑	1	-	0								--
8 th parameter	1	↑	1	-	0								--
9 th parameter	1	↑	1	-	0								--
10 th parameter	1	↑	1	-	0								SAVEPOWER[6:0]
DBG0~8[6:0]: Gain select register 0~8.													
Description	DBG0~8[6:0]							CABC Gain	CABC Duty				
	0	0	x	x	x	x	x						Reserve
	0	1	0	0	0	0	0	1+0/32	100%				
	0	1	0	0	0	0	1	1+1/32	96.97%				
	0	1	0	0	0	1	0	1+2/32	94.12%				
	0	1	0	0	0	1	1	1+3/32	91.43%				
	0	1	0	0	1	0	0	1+4/32	88.89%				
	0	1	0	0	1	0	1	1+5/32	86.49%				
	0	1	0	0	1	1	0	1+6/32	84.21%				
	0	1	0	0	1	1	1	1+7/32	82.05%				
	0	1	0	1	0	0	0	1+8/32	80%				
	0	1	0	1	0	0	1	1+9/32	78.05%				
	0	1	0	1	0	1	0	1+10/32	76.19%				
	0	1	0	1	0	1	1	1+11/32	74.42%				
	0	1	0	1	1	0	0	1+12/32	72.73%				
	0	1	0	1	1	0	1	1+13/32	71.11%				
	0	1	0	1	1	1	0	1+14/32	69.57%				
	0	1	0	1	1	1	1	1+15/32	68.09%				
	0	1	1	0	0	0	0	1+16/32	66.67%				
	0	1	1	0	0	0	1	1+17/32	65.31%				
	0	1	1	0	0	1	0	1+18/32	64%				
	0	1	1	0	0	1	1	1+19/32	62.75%				
	0	1	1	0	1	0	0	1+20/32	61.54%				
	0	1	1	0	1	0	1	1+21/32	60.38%				
	0	1	1	0	1	1	0	1+22/32	59.26%				
	0	1	1	0	1	1	1	1+23/32	58.18%				
	0	1	1	1	0	0	0	1+24/32	57.14%				
	0	1	1	1	0	0	1	1+25/32	56.14%				
	0	1	1	1	0	1	0	1+26/32	55.17%				
	0	1	1	1	1	0	1	1+27/32	54.24%				
	0	1	1	1	1	1	0	1+28/32	53.33%				
	0	1	1	1	1	1	0	1+29/32	52.46%				
	0	1	1	1	1	1	0	1+30/32	51.61%				
	0	1	1	1	1	1	1	1+31/32	50.79%				
	1	0	0	0	0	0	0	1+32/32	50%				
Restrictions	SETEXTC turn on to enable this command.												

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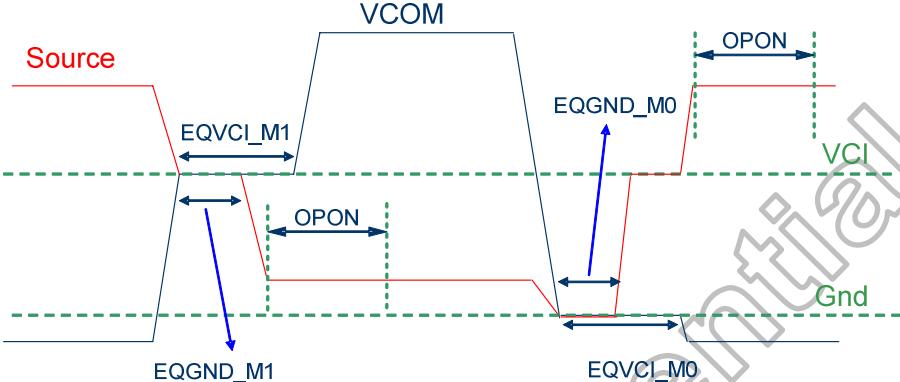
	Status	Availability
Register Availability	Normal Mode On, Idle Mode Off, Sleep Out	Yes
	Normal Mode On, Idle Mode On, Sleep Out	Yes
	Partial Mode On, Idle Mode Off, Sleep Out	Yes
	Partial Mode On, Idle Mode On, Sleep Out	Yes
	Sleep In	Yes
Default	Status	Default Value
	Power On Sequence	DBG0[6:0]=8'h40h, DBG1[6:0]=8'h3Ch, DBG2[6:0]=8'h38h, DBG3[6:0]=8'h34h, DBG4[6:0]=8'h33h, DBG5[6:0]=8'h32h, DBG6[6:0]=8'h2Bh, DBG7[6:0]=8'h24h, DBG8[6:0]=8'h22h
	S/W Reset	No Change
	H/W Reset	DBG0[6:0]=8'h40h, DBG1[6:0]=8'h3Ch, DBG2[6:0]=8'h38h, DBG3[6:0]=8'h34h, DBG4[6:0]=8'h33h, DBG5[6:0]=8'h32h, DBG6[6:0]=8'h2Bh, DBG7[6:0]=8'h24h, DBG8[6:0]=8'h22h
Flow Chart		

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6.2.68 Set Panel related (E9h)

E9 H		SETPANEL																				
		DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX								
Command		0	1	↑	-	1	1	1	0	1	0	0	1	E9								
1 st parameter		1	1	↑	-	0	0	0	0	SS_PANEL	0	0	BGR_PA_NEL	XX								
Description	This command is internal use for display panel setting. SS_PANEL: The source driver output shift direction selected. When SS_PANEL = 0, the shift direction don't reverse. When SS_PANEL = 1, the shift direction will be reversed. BGR_PANEL: The color filter order direction selected.																					
Restriction																						
Register Availability	<table border="1"> <thead> <tr> <th>Status</th> <th>Availability</th> </tr> </thead> <tbody> <tr> <td>Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In</td> <td>Yes</td> </tr> </tbody> </table>		Status	Availability	Sleep Out	Yes	Sleep In	Yes														
Status	Availability																					
Sleep Out	Yes																					
Sleep In	Yes																					
Default	<table border="1"> <thead> <tr> <th>Status</th> <th>Default Value</th> </tr> </thead> <tbody> <tr> <td>Power On Sequence</td> <td></td> </tr> <tr> <td>S/W Reset</td> <td>No change</td> </tr> <tr> <td>H/W Reset</td> <td></td> </tr> </tbody> </table>		Status	Default Value	Power On Sequence		S/W Reset	No change	H/W Reset													
Status	Default Value																					
Power On Sequence																						
S/W Reset	No change																					
H/W Reset																						
Flow Chart																						

6.2.69 Set EQ function (EEh)

EEH	SETEQ																					
	DCX	RDX	WRX	D17-D8	D7	D6	D5	D4	D3	D2	D1	D0	HEX									
Command	0	1	↑	-	1	1	1	0	1	1	1	0	EE									
1 st parameter	1	1	↑	-									EQVCI_M1[7:0]									
2 nd parameter	1	1	↑	-									EQGND_M1[7:0]									
3 rd parameter	1	1	↑	-									EQVCI_M0[7:0]									
4 th parameter	1	1	↑	-									EQGND_M0[7:0]									
Description	 <p>The diagram illustrates the timing sequence for the Set EQ function. It shows the Source signal transitioning from low to high, followed by the VCOM signal. The OPON signal is asserted during the transition of VCOM. The EQVCI_M1 signal is asserted before the OPON signal. The EQGND_M1 signal is asserted during the OPON period. The EQVCI_M0 signal is asserted after the OPON signal. The EQGND_M0 signal is asserted during the transition of VCOM. The Gnd signal is shown as a reference ground level.</p>																					
Restriction																						
Register Availability	<table border="1"> <tr> <th>Status</th> <th>Availability</th> </tr> <tr> <td>Sleep Out</td> <td>Yes</td> </tr> <tr> <td>Sleep In</td> <td>Yes</td> </tr> </table>		Status	Availability	Sleep Out	Yes	Sleep In	Yes														
Status	Availability																					
Sleep Out	Yes																					
Sleep In	Yes																					
Default	<table border="1"> <tr> <th>Status</th> <th>Default Value</th> </tr> <tr> <td>Power On Sequence</td> <td></td> </tr> <tr> <td>S/W Reset</td> <td>No change</td> </tr> <tr> <td>H/W Reset</td> <td></td> </tr> </table>		Status	Default Value	Power On Sequence		S/W Reset	No change	H/W Reset													
Status	Default Value																					
Power On Sequence																						
S/W Reset	No change																					
H/W Reset																						
Flow Chart																						

7. Layout Recommendation

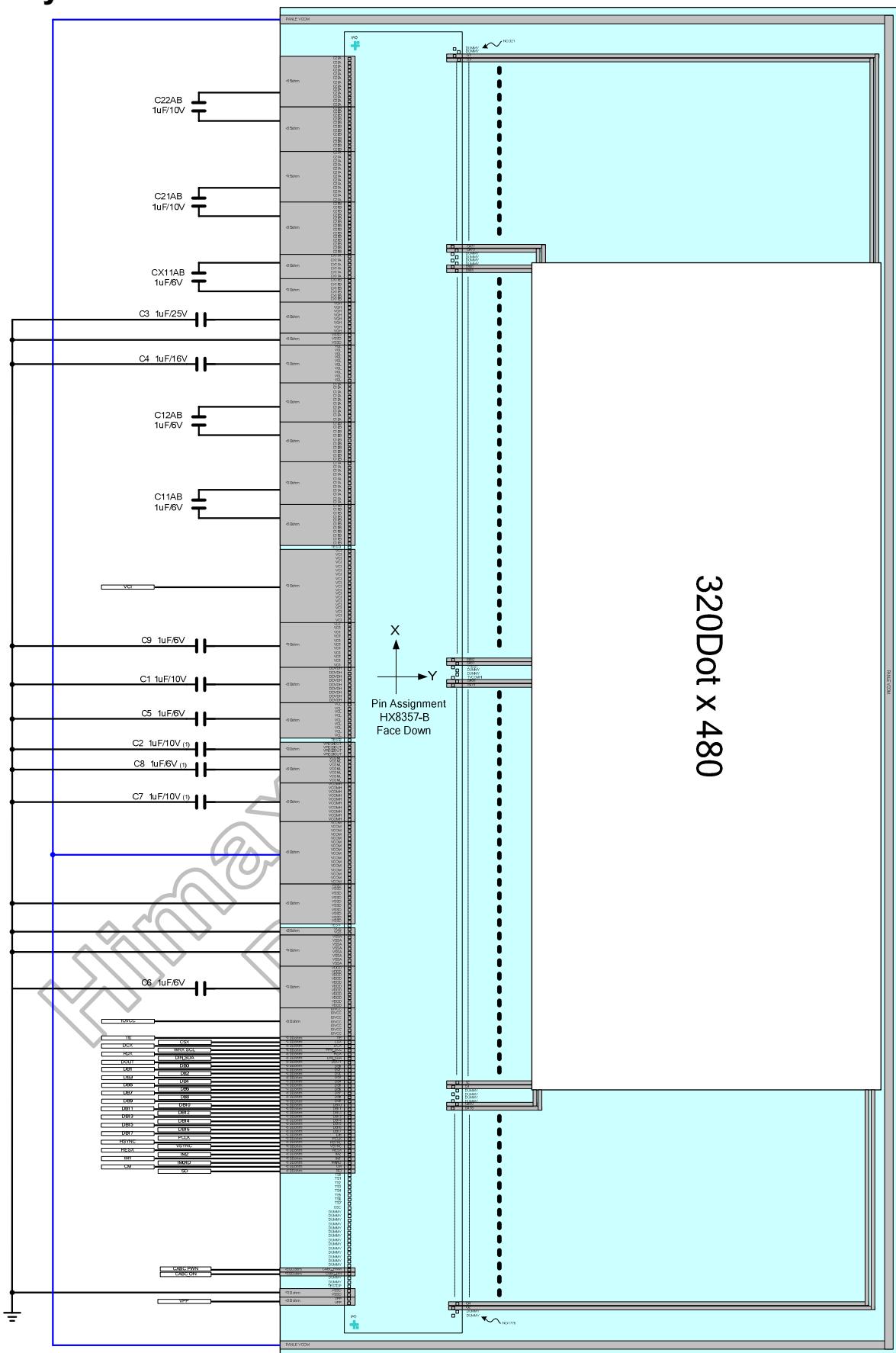


Figure 7.1: Layout Recommendation of HX8357-B

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7.1 Maximum layout resistance

Name	Type	Maximum Series Resistance	Unit
IOVCC	Power supply	10	Ω
VCI	Power supply	10	Ω
VPP	Power supply	10	Ω
VSSA	Power supply	10	Ω
VSSD	Power supply	10	Ω
IM[2:0], SD, CM	Input	100	Ω
CSX, DCX, WRX_SCL, RDX, RESX	Input	100	Ω
PCLK, DE, VSYNC, HSYNC	Input	100	Ω
VGS	Input	30	Ω
TEST[3:1]	Input	100	Ω
VGH	Capacitor connection	10	Ω
VGL	Capacitor connection	10	Ω
VCL	Capacitor connection	10	Ω
VCI1	Capacitor connection	10	Ω
DDVDH	Capacitor connection	10	Ω
VDDD	Capacitor connection	10	Ω
VREG1OUT, VREG2OUT, VREG3OUT, VREG4OUT	Capacitor connection	30	Ω
VCOM	Panel connection	10	Ω
VCOMH, VCOML	Capacitor connection	10	Ω
C11A, C11B, CX11A, CX11B	Capacitor connection	10	Ω
C12A, C12B	Capacitor connection	10	Ω
C21A, C21B	Capacitor connection	15	Ω
C22A, C22B	Capacitor connection	15	Ω
TE, DOUT, CABC_ON, CABC_PWM	Output	100	Ω
DIN_SDA, DB[17:0]	Input/Output	100	Ω

Table 7.1: Maximum Layout Resistance

7.2 External Components Connection

Capacitor	Recommended voltage	Capacity	Note
C1 (DDVDH-VSSA)	10V	1μF (B characteristics)	-
C2 (VREG1OUT-VSSA)	10V	1μF (B characteristics)	-
C3 (VGH-VSSA)	25V	1μF (B characteristics)	-
C4 (VGL-VSSA)	16V	1μF (B characteristics)	-
C5 (VCL-VSSA)	6V	1μF (B characteristics)	-
C6(VDD-VSSA)	6V	1μF (B characteristics)	-
C7 (VCOMH-VSSA)	10V	1μF (B characteristics)	Note ⁽¹⁾
C8 (VCOML-VSSA)	6V	1μF (B characteristics)	Note ⁽¹⁾
C9 (VC11-VSSA)	6V	1μF (B characteristics)	Note ⁽¹⁾
C11AB (C11A/B)	6V	1μF (B characteristics)	-
CX11AB (CX11A/B)	6V	1μF (B characteristics)	-
C12AB (C12A/B)	6V	1μF (B characteristics)	-
C21AB (C21A/B)	10V	1μF (B characteristics)	-
C22AB (C22A/B)	10V	1μF (B characteristics)	-

Note: (1) If Display quality normal, the C7, C8 and C9 can remove.

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8. Electrical Characteristic

8.1 Absolute Maximum Ratings

Item	Symbol	Unit	Value	Note
Power Supply Voltage 1	IOVCC~VSSD	V	-0.3 to +3.6	Note ^{(1),(2)}
Power Supply Voltage 2	VCI ~ VSSA	V	-0.3 to +3.6	Note ^{(1),(3)}
Power Supply Voltage 3	DDVDH ~ GAND	V	-0.3 to +6.6	Note ⁽⁴⁾
Power Supply Voltage 4	VSSA ~ VCL	V	-0.3 to -3.6	Note ⁽⁵⁾
Power Supply Voltage 5	DDVDH ~ VCL	V	-0.3 to +9.6	Note ⁽⁶⁾
Power Supply Voltage 6	VGH ~ VSSA	V	-0.3 to +18.5	Note ⁽⁷⁾
Power Supply Voltage 7	VSSA ~ VGL	V	0 to -16.5	Note ⁽⁸⁾
Input Voltage	V _{IN}	V	-0.3 to IOVCC+0.3	-
Operating Temperature	Topr	°C	-40 to +85	Note ^{(9),(10)}
Storage Temperature	Tstg	°C	-55 to +110	Note ^{(9),(10)}

Note: (1) IOVCC, VSSD must be maintained.

(2) To make sure IOVCC ≥ VSSD.

(3) To make sure VCI ≥ VSSA.

(4) To make sure DDVDH ≥ VSSA.

(5) To make sure VSSA ≥ VCL.

(6) To make sure DDVDH ≥ VCL.

(7) To make sure VGH ≥ VSSA.

(8) To make sure VSSA ≥ VGL

VGH +|VGL| < 32V

(9) For die and wafer products, specified up to +85°C.

(10) This temperature specifications apply to the TCP package.

8.2 DC Characteristics

(VSSA=0V, IOVCC=1.65V to 3.3V, VCI=2.5V to 3.3V, TA = -30 to 70°C)

Item	Symbol	Unit	Test Condition	Min.	Typ.	Max.	Note
Input high voltage	V _{IH}	V	IOVCC= 1.65 ~ 3.3V	0.7xIOVCC	-	IOVCC	-
Input low voltage	V _{IL}	V	IOVCC= 1.65 ~ 3.3V	-0.3V	-	0.3xIOVCC	-
Output high voltage (DB17-0 Pins)	V _{OH1}	V	I _{OH} = -0.1 mA	0.8xIOVCC	-	-	-
Output low voltage (DB17-0 Pins)	V _{OL1}	V	IOVCC= 1.65 ~ 2.4V I _{OL} = 0.1mA	-	-	0.2xIOVCC	-
I/O leakage current	I _{Li}	μA	Vin = 0 ~ IOVCC	-1	-	1	-
Current consumption during normal operation (IOVCC – VSSD)	I _{OP(IOVCC)}	μA	IOVCC=VCI=2.8V , TA=25°C , No loading	-	-	10	-
Current consumption during normal operation (VCI – VSSA)	I _{OP(VCI)}	mA		-	-	15	-
Current consumption during sleep in mode (IOVCC – VSSD)	I _{SL(IOVCC)}	μA		-	-	5	-
Current consumption during sleep in mode (VCI – VSSA)	I _{SL(VCI)}	μA		-	-	20	
Output voltage deviation	-	mV	-	-	5	-	-
Dispersion of the Average Output Voltage	V	mV	-	-	35	-	-

Table 8.1: DC Characteristic

8.3 AC Characteristics

8.3.1 DBI Type-B interface characteristics

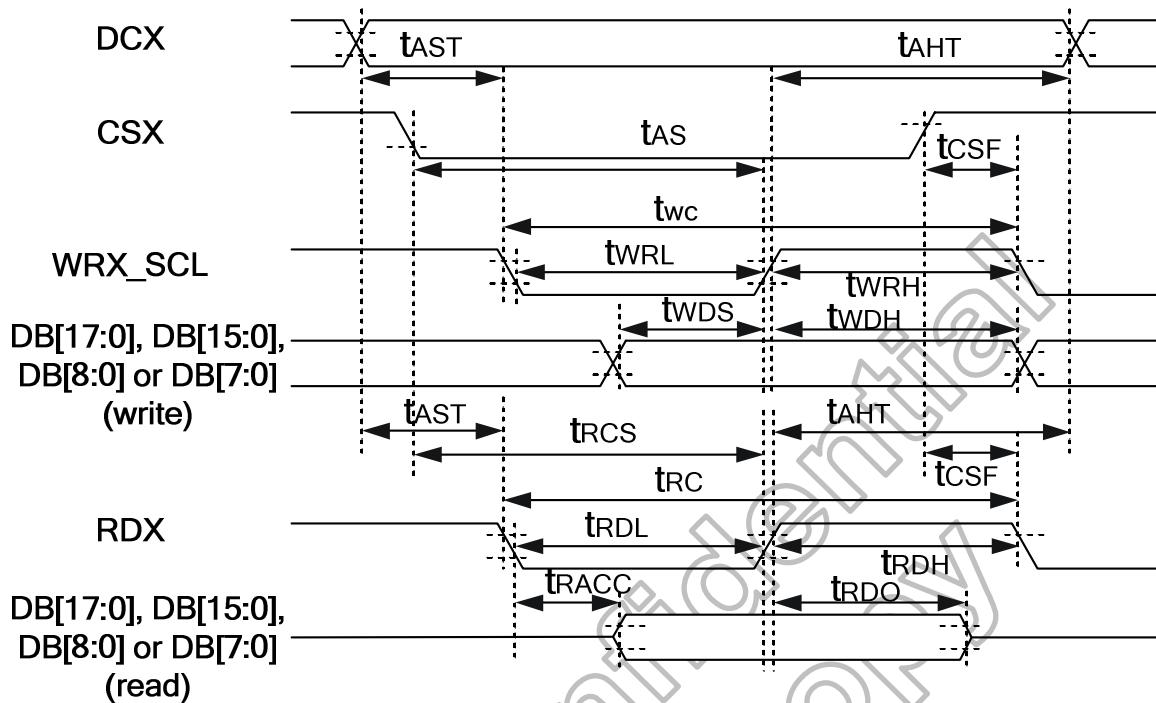


Figure 8.1: DBI Type-B interface characteristics

(VSSA=0V, IOVCC=1.65V to 3.3V, VCI=2.5V to 3.3V, $T_A = -30$ to 70°C)

Signal	Symbol	Parameter	Min.	Max.	Unit	Description
DCX	tAST	Address setup time	10	-	ns	-
	tAHT	Address hold time (Write/Read)	10	-	ns	-
CSX	tCS	Chip select setup time (Write)	20	-	ns	-
	tRCS	Chip select setup time (Read)	190	-	ns	-
	tCSF	Chip select wait time (Write/Read)	20	-	ns	-
WRX_SCL	tWC	Write cycle	100	-	ns	-
	tWRH	Control pulse "H" duration	30	-	ns	-
	tWRL	Control pulse "L" duration	25	-	ns	-
RDX	tRC	Read cycle	450	-	ns	-
	tRDH	Control pulse "H" duration	250	-	ns	-
	tRDL	Control pulse "L" duration	170	-	ns	-
DB[17:0], DB[15:0], DB[8:0], or DB[7:0]	tWDT	Data setup time	15	-	ns	For maximum CL=30pF
	tWHT	Data hold time	25	-	ns	For minimum CL=8pF
	tRACC	Read access time	10	340	ns	
	tROH	Output disable time	10	-	ns	

Note: The input signal rise time and fall time (t_r, t_f) is specified at 15 ns or less.

Logic high and low levels are specified as 30% and 70% of IOVCC for Input signals.

Table 8.2: DBI Type-B Interface Characteristics

8.3.2 DBI Type-C interface characteristics

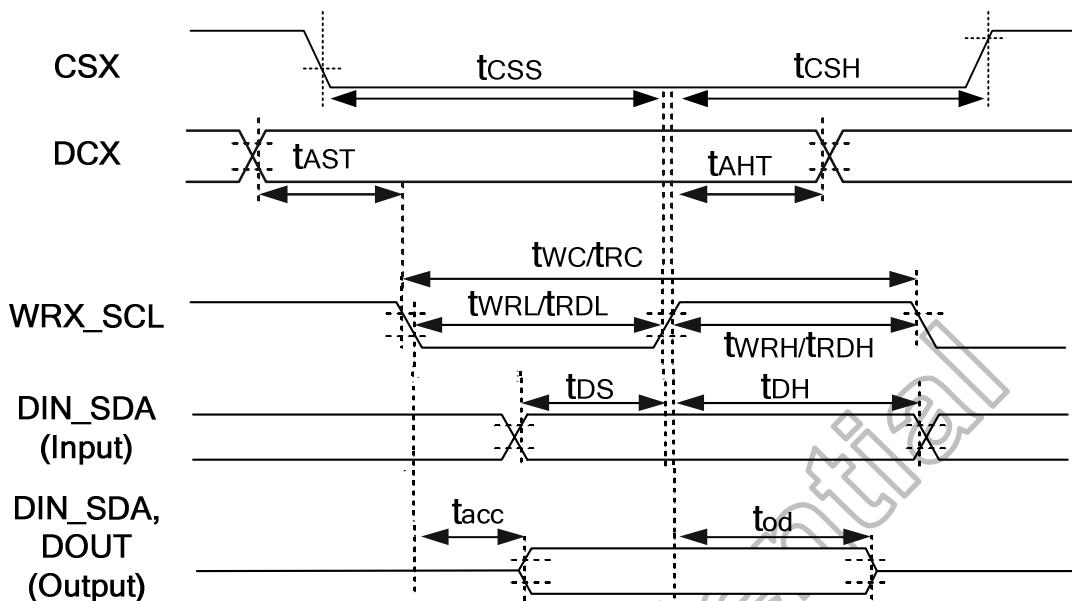


Figure 8.2: DBI Type-C interface characteristics

(VSSA=0V, IOVCC=1.65V to 3.3V, VCI=2.5V to 3.3V, $T_A = -30$ to 70°C)

Signal	Symbol	Parameter	Min.	Max.	Unit	Description
CSX	t_{CSS} t_{CSH}	Chip select setup time (Write) Chip select setup time (Read)	40 40	-	ns	-
DCX	t_{AST} t_{AHT}	Address setup time Address hold time (Write/Read)	10 10	-	ns	-
WRX_SCL (Write)	t_{WC} t_{WRH} t_{WRL}	Write cycle Control pulse "H" duration Control pulse "L" duration	100 40 40	-	ns	-
WRX_SCL (Read)	t_{RC} t_{RDH} t_{RDL}	Read cycle Control pulse "H" duration Control pulse "L" duration	300 120 120	-	ns	-
DIN_SDA (Input)	t_{DS} t_{DT}	Data setup time Data hold time	30 30	-	ns	For maximum $C_L=30\text{pF}$ For minimum $C_L=8\text{pF}$
DIN_SDA, DOUT (Output)	t_{ACC} t_{OD}	Read access time Output disable time	- 10	100	ns	

Note: The input signal rise time and fall time (t_r , t_f) is specified at 15 ns or less.

Logic high and low levels are specified as 30% and 70% of IOVCC for Input signals.

Table 8.3: DBI Type-C Interface Characteristics

8.3.3 DPI Interface Characteristics

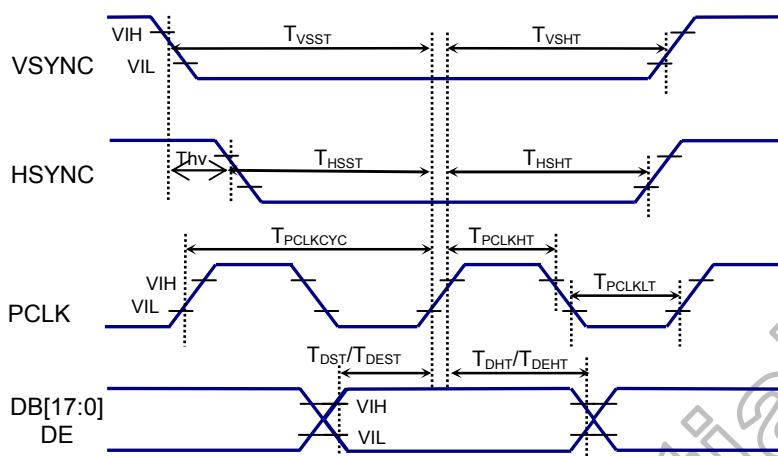


Figure 8.3: DPI Interface Characteristics 1

(VSSA=0V, IOVCC=1.65V to 3.3V, VCI=2.5V to 3.3V, TA = -30 to 70°C)

Item	Symbol	Condition	Spec.			Unit
			Min.	Typ.	Max.	
PCLK cycle time	TDCYC	-	125	-	-	ns
Pixel low pulse width	TCLKLT	-	15	-	-	ns
Pixel high pulse width	TCLKHT	-	15	-	-	ns
Vertical Sync. set-up time	TVSST	-	15	-	-	ns
Vertical Sync. hold time	TVSSH	-	15	-	-	ns
Horizontal Sync. set-up time	THSST	-	15	-	-	ns
Horizontal Sync. hold time	THSSH	-	15	-	-	ns
Data Enable set-up time	TDEST	-	15	-	-	ns
Data Enable hold time	TDEHT	-	15	-	-	ns
Data setup time	TDST	-	15	-	-	ns
Data hold time	TDHT	-	15	-	-	ns

Note: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.

Table 8.4: DPI Interface Characteristics 1



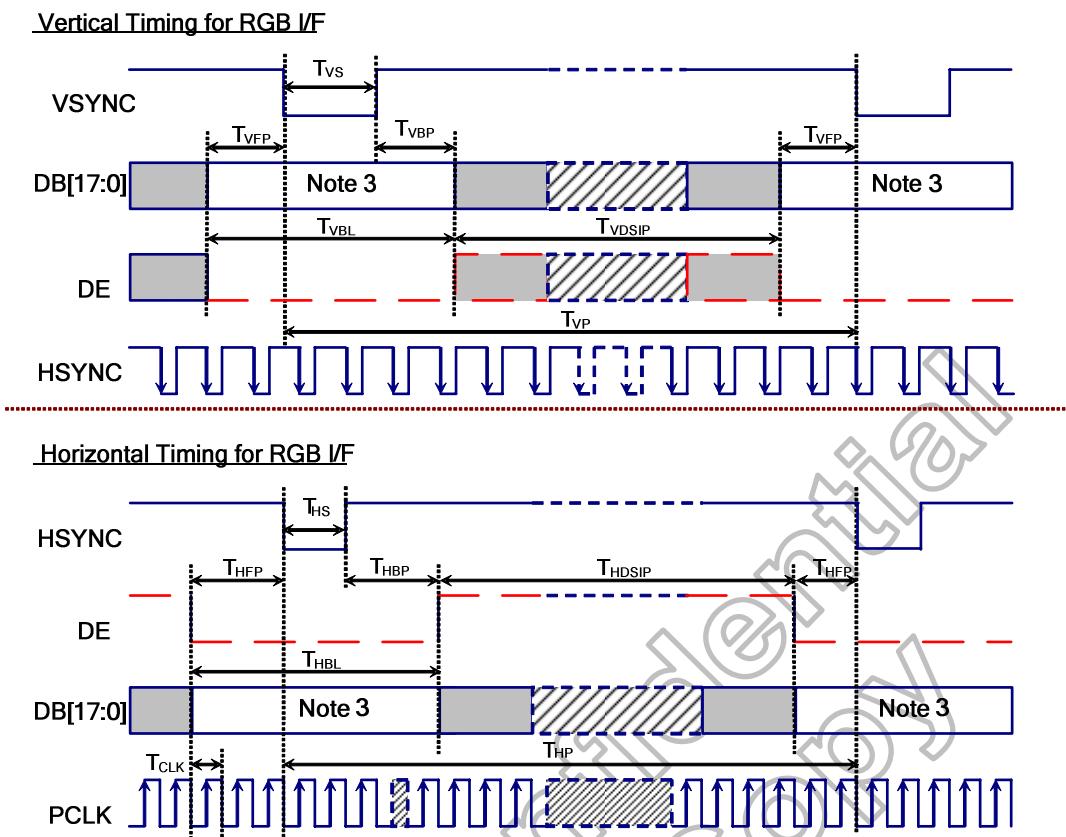


Figure 8.4: DPI Interface Characteristics 2

Item	Symbol	Condition	Specification			Unit
			Min	Typ.	Max	
Vertical Timing						
Vertical cycle period	T_{VP}	-	486	-	-	HS
Vertical low pulse width	T_{VS}	-	2	-	-	HS
Vertical front porch	T_{VFP}	-	2	-	-	HS
Vertical back porch	T_{VBP}	-	2	-	-	HS
Vertical blanking period	T_{VBL}	$T_{VS} + T_{VBP} + T_{VFP}$	6	-	-	HS
Vertical active area	T_{VDISP}	-	480			HS
Vertical refresh rate	TVRR	Frame rate	50	60	70	Hz
Horizontal Timing						
Horizontal cycle period	T_{HP}	-	326	-	-	PCLK
Horizontal low pulse width	T_{HS}	-	2	-	-	PCLK
Horizontal front porch	T_{HFP}	-	2	-	-	PCLK
Horizontal back porch	T_{HBP}	-	2	-	-	PCLK
Horizontal blanking period	T_{HBL}	$T_{HS} + T_{HBP} + T_{HFP}$	6	-	-	PCLK
Horizontal active area	T_{HDISP}	-	320			PCLK
Pixel clock cycle TVRR=60Hz	f_{CLKCYC}	-	-	8	-	MHz

Note: (1) IOVCC=1.65 to 3.3V, VCI=2.5 to 3.3V, VSSA=VSSD=0V, Ta=-30 to 70°C (to +85°C no damage)

(2) Data lines can be set to "High" or "Low" during blanking time – Don't care.

(3) HP is multiples of PCLK.

Table 8.5: DPI Interface Characteristics 2

8.3.4 Reset Input Timing

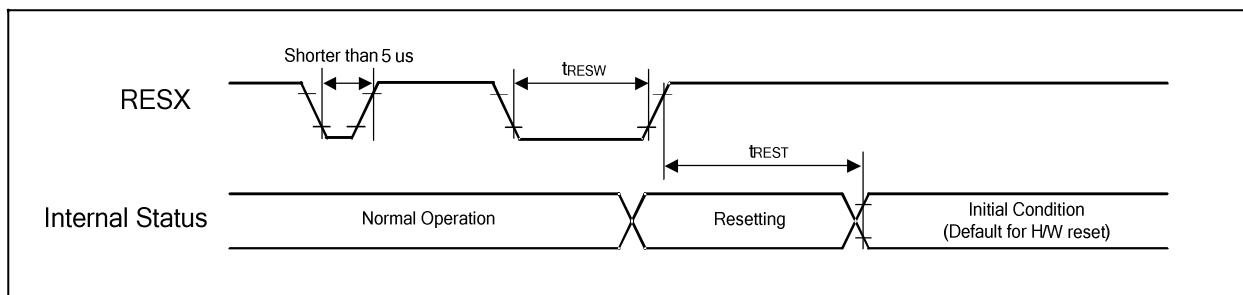


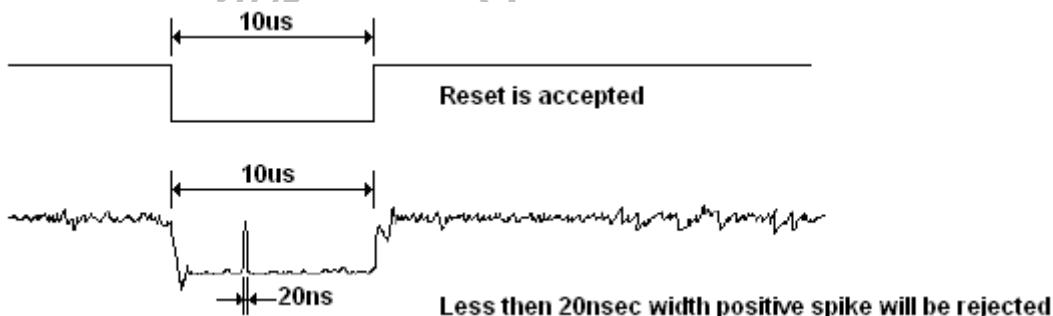
Figure 8.5: Reset Input Timing

Symbol	Parameter	Related Pins	Min.	Typ.	Max.	Note	Unit
tRESW	Reset low pulse width ⁽¹⁾	RESX	10	-	-	-	μs
tREST	Reset complete time ⁽¹⁾	-	-	-	5	When reset applied during Sleep In mode	ms
		-	-	-	120	When reset applied during Sleep Out mode	ms

Note: (1) Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the following table. RESET Pulse.

RESET	Action
Shorter than 5μs	Reset Rejected
Longer than 10μs	Reset
Between 5 μs and 10μs	Reset Start

- (2) 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 H/W reset.
- (3) During Reset Complete Time, ID2 and VCOMOF value in OTP will be latched to internal register during this period. This loading is done every time when there is H/W reset complete time (tREST) within 1ms after a rising edge of RESX.
- (4) Spike Rejection also applies during a valid reset pulse as shown as below:



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

Table 8.6: Reset Input Timing

9. Ordering Information

Part No.	Package
HX8357-B000 <u>PDxxx</u>	PD : mean COG xxx : mean chip thickness (μm), (default: 250 μm)

10. Revision History

Version	Date	Description of Changes
01	2010/01/18	1. New setup 2. Modify the frame rate of DPI Interface Characteristics 2 (P187) 3. Modify Operation Frequency of Step-up Circuit 1 and 2 (P167~169) 4. Modify BP min setting of C1h, C2h, C3h (P157~159) 5. Add note2 of B4h (P152) 6. Modify tRCS timing of DBI Type-B Interface Characteristics (P184) 7. Delete Deep standby function 8. Modify the description of 5.12 Content Adaptive Brightness Control (CABC) Function (P80~83) 9. Modify the description of PWM_PERIOD of E4h (P173) 10. Add Set CABC GAIN command(E5h) (P175) 11. Delete the NOTE ₍₁₎ of VERG1OUT of External Components Connection (P181) 12. Modify the description of Get Device ID (BFh) (P153) 13. Modify Figure 5.24: LCD Power Generation (P59) 14. Modify Table5.5: AC characteristics of Tearing Effect Signal (P55) 15. Modify Table 8.1: DC Characteristic (P183) 16. Remove 'Preliminary' wording (All pages)
	2010/05/26	