NV3023B Datasheet

A-Si TFT LCD Single Chip Driver
132RGBx162 Resolution and 262K color

Version 2.7
Dec, 2023

Introduction

NV3023B is a 262,144-color one-chip SoC driver for a-Si TFT liquid crystal display with resolution of 132RGBx162 dots, comprising a 396-channel source driver, a 162-channel gate driver, 48,114 bytes GRAM for graphic data of 132RGBx162 dots, and power supply circuit.

The NV3023B supports 8-bit data bus interface and serial peripheral interfaces (SPI). It also supplies 6-bit RGB interface for driving video signal directly from application controller. The moving picture area can be specified in internal GRAM by window address function. The specified window area can be updated selectively, so that moving picture can be displayed simultaneously independent of still picture area.

NV3023B can operate with 1.65V I/O interface voltage, and an incorporated voltage follower circuit to generate voltage levels for driving an LCD. The NV3023B also supports a function to display in 8 colors idle mode, allowing for precise power control by software. So these features make the NV3023B an ideal LCD driver for medium or small size portable products such as digital cellular phones, smart phone, MP3 and PMP, on which long battery life is a major concern.

1. Features

- Display resolution options
  - 120(RGB) (H) X 160 (V)
  - 128(RGB) (H) X 128 (V)
  - 128(RGB) (H) X 160 (V)
  - 130(RGB) (H) X 130 (V)
  - 132(RGB) (H) X 132(V)
  - 132(RGB) (H) X 162 (V)
- LCD Driver Output Circuits
  - 396 source outputs
  - 162 gate outputs
  - Common electrode output
- TFT-LCD driver with on-chip full display RAM: 48,114 bytes
- System Interfaces
  - 8-bits interface with 8080-series MCU
  - 8-bits interface with 6800-series MCU
  - 6-bits RGB interface
  - 3-pin/4-pin serial interface
- Display color modes
  - Full color mode (idle mode off): 262K-colors
  - Reduced color modes (idle mode on): 8-colors
- On Chip Functions
  - VCOM generator and adjustment
  - Timing generator
  - Oscillator
  - DC/DC converter
  - Line/frame inversion
  - Factory default value (Maker ID, Version ID, Module ID, etc) are stored on the display module

- Low–Power Consumption
  - Low operating power supplies
    - IOVCC = 1.65V ~ 3.6 V (interface I/O)
    - VCI = 2.5V ~ 4.8 V (analog)
- LCD Voltage Drive
  - Source/VCOM power supply voltage
    - DDVDHAC – AGND = 4.5V ~ 5.2V
    - VCL – AGND = -1.0V ~ -3.0V
    - VCI － VCL ≦ 5.0V
  - Gate driver output voltage
    - VGH – AGND = 10V ~ 15V
    - VGL – AGND = -7.5V ~ -13V
    - VGH － VGL ≦ 28V
  - VCOM driver output voltage
    - VCOMH = 2.793V ~ 4.833V
    - VCOML = -2.093V ~ 0.631V
- Operate Temperature Range: -30℃ to 85℃

2. Pin Descriptions

<table>
<tr><th>Pin Name</th><th>I/O</th><th>Descriptions</th></tr>
<tr><td colspan="3">Power Supply Pin</td></tr>
<tr><td>IOVCC</td><td>I</td><td>Power supply for interface logic circuits (1.65 ~ 3.6V)</td></tr>
<tr><td>VCI</td><td>I</td><td>Power supply for analog circuit.
Could connect to external power supply (VCI=2.5~4.8V).</td></tr>
<tr><td>VSSI</td><td>I</td><td>System Ground for I/O System</td></tr>
<tr><td>AGND</td><td>I</td><td>System Ground for Analog System and Booster Circuit.</td></tr>
<tr><td>DGND</td><td>I</td><td>System Ground for Digital System.</td></tr>
<tr><td colspan="3">Interface Logic Pin</td></tr>
<tr><td>P68</td><td>I</td><td>8080/6800 MCU Interface Mode Selection
P68 = ‘1’ : Select 6800-MCU parallel interface
P68 = ‘0’ : Select 8080-MCU parallel interface
Note: If not used, please fix this pin at VSS level.</td></tr>
<tr><td>IM2
IM1
IM0</td><td>I</td><td>MCU Parallel interface bus and Serial interface select :
<table>
<tr><th>IM2</th><th>IM1</th><th>IM0</th><th>SPI4W</th><th>Interface Type</th></tr>
<tr><td>1</td><td>0</td><td>0</td><td>X</td><td>MCU 8-bit Parallel</td></tr>
<tr><td>0</td><td>X</td><td>X</td><td>1</td><td>SPI 4 Wire Serial</td></tr>
<tr><td>0</td><td>X</td><td>X</td><td>0</td><td>SPI 3 Wire Serial(or 2 Data Line SPI configured by register 3Dh)</td></tr>
</table></td></tr>
<tr><td>SPI4W</td><td></td><td>SPI4W=’0’, 3-line SPI Enable or 2 Data Line SPI Enable.
SPI4W=’1’, 4-line SPI Enable.
If Not Used, Please fix this Pin at VSS Level.</td></tr>
<tr><td>RESX</td><td>I</td><td>Chip Reset Pin (“Low Active”)
Note: Keep this pin without glitch</td></tr>
<tr><td>CSX</td><td>I</td><td>Chip Select Pin (“Low Active”)
Pull down when chip accessable</td></tr>
<tr><td>DCX</td><td>I</td><td>Reuse Pin according parallel and serial interface:
➢ MCU Interface: Distinguish Data (‘1’) or Command (‘0’).
➢ SPI Interface: Used as ‘SCL’ clock pin.
If not used, please connect this pin to VSS.</td></tr>
<tr><td>RDX</td><td>I</td><td>➢ 8080-parallel interface: used as ‘Read’ enable.
➢ 6800-parallel interface:
1. when WRX=’0’ , RDX used as ‘write’ enable;
2. When WRX=’1’, RDX used as ‘Read’ enable.</td></tr>
<tr><td>WRX</td><td>I</td><td>➢ 8080-parallel interface, used as write enable.
➢ 6800-parallel interface, used to distinguish ‘write’ or ‘read’ operation.
➢ SPI 4-wire interface, used as D/CX.
➢ 2 Data Line SPI used as data input.</td></tr>
</table>

<table>
<tr><th>Pin Name</th><th>I/O</th><th>Descriptions</th></tr>
<tr><td>D[7:0]</td><td>I/O</td><td>➢ SPI without RGB interface : D[0] used as SDI/O, others don’t care;
➢ SPI with RGB interface : D[5:0] used as data bus;
➢ MCU interface : D[7:0] used as data bus;
Note : When RGB interface enable , SPI should use ‘SDA’ pin as SDI/O</td></tr>
<tr><td>TE</td><td>O</td><td>Tearing effect output pin to synchronize MCU to frame writing</td></tr>
<tr><td>TEST12/SDA</td><td>I/O</td><td>When RCM[1]=’1’,SDA is used for SPI write/read data line;
When RCM[0]=’0’,SDA is not used;</td></tr>
<tr><td>TEST8/PCLK</td><td>I</td><td>RGB interface pixel clock signal</td></tr>
<tr><td>TEST10/HS</td><td>I</td><td>RGB interface horizontal synchronization signal</td></tr>
<tr><td>TEST11/VS</td><td>I</td><td>RGB interface vertical synchronization signal</td></tr>
<tr><td>TEST9/DE</td><td>I</td><td>RGB interface data enable signal</td></tr>
<tr><td colspan="3">Mode Selection Pin</td></tr>
<tr><td>GM2
GM1
GM0</td><td>I</td><td>Panel Resolution Selection Pins.
<table>
<tr><th>GM2</th><th>GM1</th><th>GM0</th><th>Descriptions</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>132RGBX162(S1~396 and G1~G162 output)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>128RGBX128(S7~390 and G2~G129 output)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>120RGBX160(S7~366 and G2~G161 output)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>128RGBX160(S7~390 and G2~G161 output)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>130RGBX130(S7~396 and G2~G131 output)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>132RGBX132(S1~396 and G2~G133 output)</td></tr>
</table></td></tr>
<tr><td>VPP</td><td>I</td><td>When writing NVM, it needs external power supply voltage (7.5V).</td></tr>
<tr><td colspan="3">Driver Output and other pins</td></tr>
<tr><td>S1~S396</td><td>O</td><td>Source driver output pins.</td></tr>
<tr><td>G1~G162</td><td>O</td><td>Gate driver output pins.</td></tr>
<tr><td>VDD</td><td>O</td><td>Test pin for internal digital logic Power supply</td></tr>
<tr><td>GVDD</td><td>O</td><td>A power supply for Grayscale Voltage Generator</td></tr>
<tr><td>DDVDHAC</td><td>O</td><td>A power supply pin for source driver block that is generated from power block. Output of booster 1 circuit (output of 2-times output of VCI).</td></tr>
<tr><td>VCL</td><td>O</td><td>A power supply pin for generating VCOML</td></tr>
<tr><td>VGH</td><td>O</td><td>Power supply for Gate Driver</td></tr>
<tr><td>VGL</td><td>O</td><td>Negative power supply for Gate Driver</td></tr>
<tr><td>VCOMH</td><td>O</td><td>The high level of VCOM AC voltage.</td></tr>
<tr><td>VCOML</td><td>O</td><td>The low level of VCOM AC voltage.</td></tr>
<tr><td>VCOM</td><td>O</td><td>TFT display common electrode power supply. Alternates between voltage levels between VCOMH-VCOML.
Registers set the alternating cycle for operating or halting VCOM.</td></tr>
<tr><td>TEST_C<3:0></td><td>O</td><td>Test pin, it is not accessible to user.must be open.</td></tr>
<tr><td>TESTOP<4></td><td>I</td><td>External clock input</td></tr>
<tr><td>RCM0</td><td>I</td><td>Test pin, it is not accessible to user.</td></tr>
<tr><td>RCM1</td><td>I</td><td>RGB interface enable.</td></tr>
<tr><td>TESTOP<8:5>/
TESTOP<3:1>/
SRGB/SMX/SMY/
LCM/EXTC</td><td>/</td><td>These pins are dummy</td></tr>
</table>

3. Bump Arrangement and Coordination

3.1. Bump Arrangement

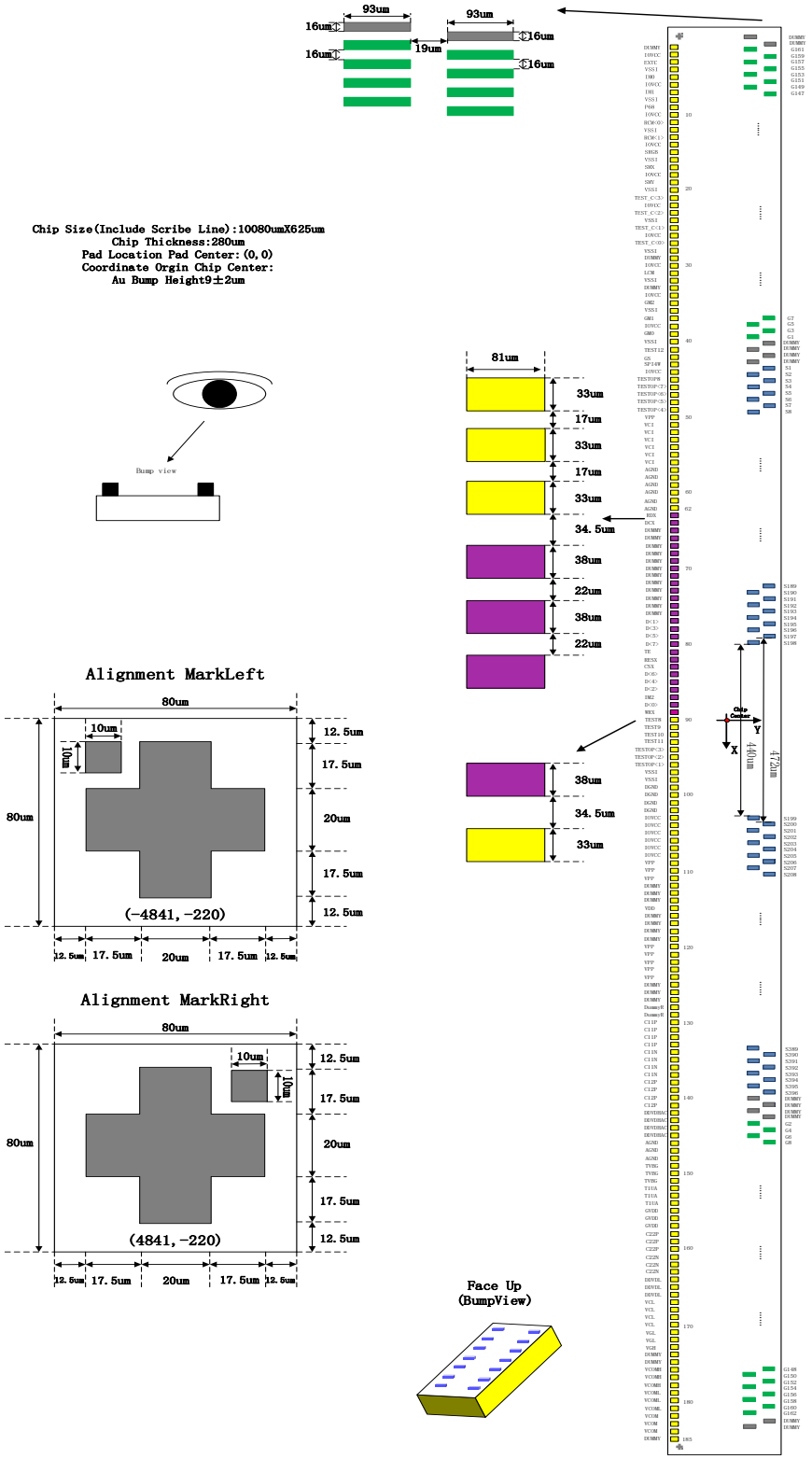


Figure 3-1 Pad Arrangement

3.2. Pin Connection

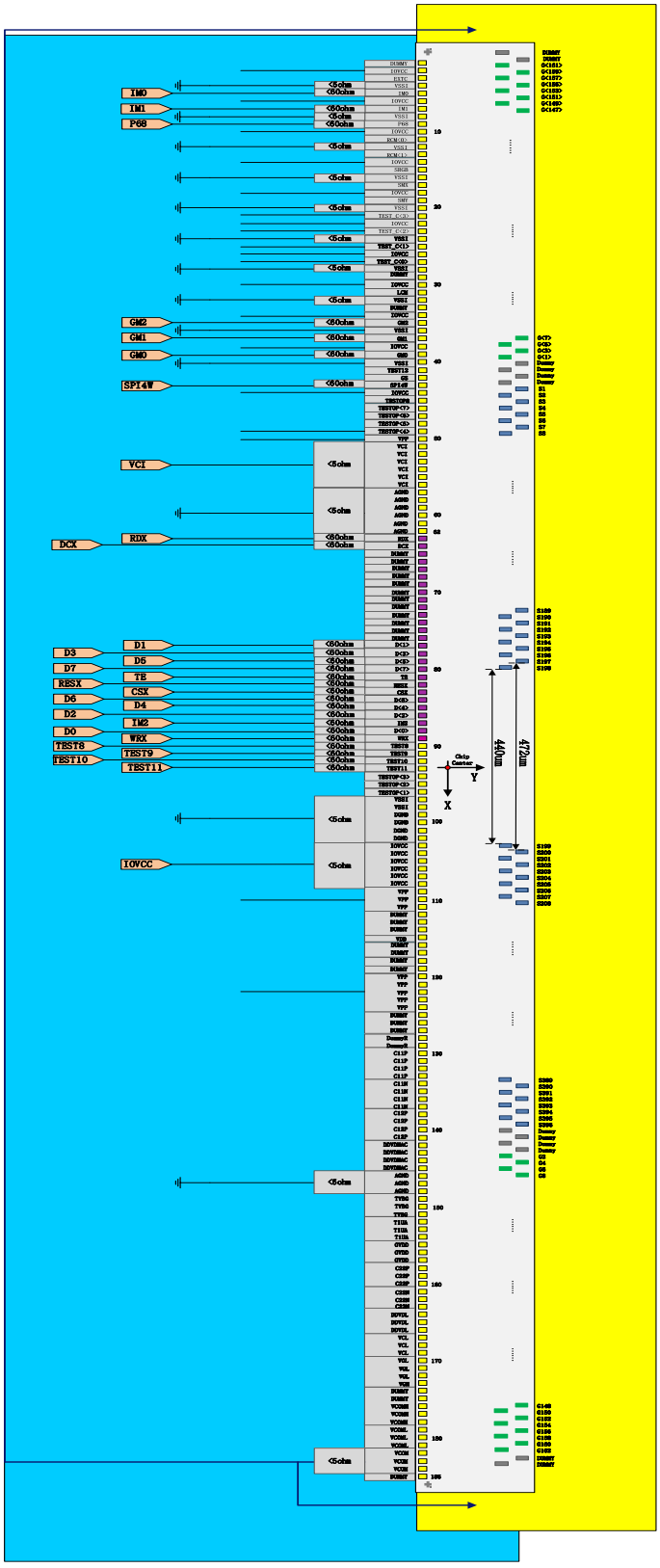


Figure 3-2 Pad Connection

3.3. Pad Coordination

No	PAD Name	X	Y
1	DUMMY	-4750	-231
2	IOVCC	-4700	-231
3	EXTC	-4650	-231
4	VSSI	-4600	-231
5	IM0	-4550	-231
6	IOVCC	-4500	-231
7	IM1	-4450	-231
8	VSSI	-4400	-231
9	P68	-4350	-231
10	IOVCC	-4300	-231
11	RCM<0>	-4250	-231
12	VSSI	-4200	-231
13	RCM<1>	-4150	-231
14	IOVCC	-4100	-231
15	SRGB	-4050	-231
16	VSSI	-4000	-231
17	SMX	-3950	-231
18	IOVCC	-3900	-231
19	SMY	-3850	-231
20	VSSI	-3800	-231
21	TEST_C<3>	-3750	-231
22	IOVCC	-3700	-231
23	TEST_C<2>	-3650	-231
24	VSSI	-3600	-231
25	TEST_C<1>	-3550	-231
26	IOVCC	-3500	-231
27	TEST_C<0>	-3450	-231
28	VSSI	-3400	-231
29	DUMMY	-3350	-231
30	IOVCC	-3300	-231
31	LCM	-3250	-231
32	VSSI	-3200	-231
33	DUMMY	-3150	-231
34	IOVCC	-3100	-231
35	GM2	-3050	-231
36	VSSI	-3000	-231
37	GM1	-2950	-231
38	IOVCC	-2900	-231
39	GM0	-2850	-231
40	VSSI	-2800	-231
41	TEST12	-2750	-231
42	GS	-2700	-231
43	SPI4W	-2650	-231
44	IOVCC	-2600	-231
45	TESTOP8	-2550	-231
46	TESTOP<7>	-2500	-231
47	TESTOP<6>	-2450	-231
48	TESTOP<5>	-2400	-231
49	TESTOP<4>	-2350	-231
50	VPP	-2300	-231
51	VCI	-2250	-231
52	VCI	-2200	-231
53	VCI	-2150	-231
54	VCI	-2100	-231
55	VCI	-2050	-231
56	VCI	-2000	-231
57	AGND	-1950	-231
58	AGND	-1900	-231
59	AGND	-1850	-231
60	AGND	-1800	-231
61	AGND	-1750	-231
62	AGND	-1700	-231
63	RDX	-1630	-231
64	DCX	-1570	-231
65	DUMMY	-1510	-231
66	DUMMY	-1450	-231
67	DUMMY	-1390	-231

No	PAD Name	X	Y
68	DUMMY	-1330	-231
69	DUMMY	-1270	-231
70	DUMMY	-1210	-231
71	DUMMY	-1150	-231
72	DUMMY	-1090	-231
73	DUMMY	-1030	-231
74	DUMMY	-970	-231
75	DUMMY	-910	-231
76	DUMMY	-850	-231
77	D<1>	-790	-231
78	D<3>	-730	-231
79	D<5>	-670	-231
80	D<7>	-610	-231
81	TE	-550	-231
82	RESX	-490	-231
83	CSX	-430	-231
84	D<6>	-370	-231
85	D<4>	-310	-231
86	D<2>	-250	-231
87	IM2	-190	-231
88	D<0>	-130	-231
89	WRX	-70	-231
90	TEST8	0	-231
91	TEST9	50	-231
92	TEST10	100	-231
93	TEST11	150	-231
94	TESTOP<3>	200	-231
95	TESTOP<2>	250	-231
96	TESTOP<1>	300	-231
97	VSSI	350	-231
98	VSSI	400	-231
99	DGND	450	-231
100	DGND	500	-231
101	DGND	550	-231
102	DGND	600	-231
103	IOVCC	650	-231
104	IOVCC	700	-231
105	IOVCC	750	-231
106	IOVCC	800	-231
107	IOVCC	850	-231
108	IOVCC	900	-231
109	VPP	950	-231
110	VPP	1000	-231
111	VPP	1050	-231
112	DUMMY	1100	-231
113	DUMMY	1150	-231
114	DUMMY	1200	-231
115	VDD	1250	-231
116	DUMMY	1300	-231
117	DUMMY	1350	-231
118	DUMMY	1400	-231
119	DUMMY	1450	-231
120	VPP	1500	-231
121	VPP	1550	-231
122	VPP	1600	-231
123	VPP	1650	-231
124	VPP	1700	-231
125	DUMMY	1750	-231
126	DUMMY	1800	-231
127	DUMMY	1850	-231
128	DummyR	1900	-231
129	DummyR	1950	-231
130	C11P	2000	-231
131	C11P	2050	-231
132	C11P	2100	-231
133	C11P	2150	-231
134	C11N	2200	-231

No	PAD Name	X	Y
135	C11N	2250	-231
136	C11N	2300	-231
137	C11N	2350	-231
138	C12P	2400	-231
139	C12P	2450	-231
140	C12P	2500	-231
141	C12P	2550	-231
142	DDVDHAC	2600	-231
143	DDVDHAC	2650	-231
144	DDVDHAC	2700	-231
145	DDVDHAC	2750	-231
146	AGND	2800	-231
147	AGND	2850	-231
148	AGND	2900	-231
149	TVBG	2950	-231
150	TVBG	3000	-231
151	TVBG	3050	-231
152	T1UA	3100	-231
153	T1UA	3150	-231
154	T1UA	3200	-231
155	GVDD	3250	-231
156	GVDD	3300	-231
157	GVDD	3350	-231
158	C22P	3400	-231
159	C22P	3450	-231
160	C22P	3500	-231
161	C22N	3550	-231
162	C22N	3600	-231
163	C22N	3650	-231
164	DDVDL	3700	-231
165	DDVDL	3750	-231
166	DDVDL	3800	-231
167	VCL	3850	-231
168	VCL	3900	-231
169	VCL	3950	-231
170	VGL	4000	-231
171	VGL	4050	-231
172	VGL	4100	-231
173	VGH	4150	-231
174	DUMMY	4200	-231
175	DUMMY	4250	-231
176	VCOMH	4300	-231
177	VCOMH	4350	-231
178	VCOMH	4400	-231
179	VCOML	4450	-231
180	VCOML	4500	-231
181	VCOML	4550	-231
182	VCOM	4600	-231
183	VCOM	4650	-231
184	VCOM	4700	-231
185	DUMMY	4750	-231
186	DUMMY	4772	112.5
187	DUMMY	4756	224.5
188	G162	4740	112.5
189	G160	4724	224.5
190	G158	4708	112.5
191	G156	4692	224.5
192	G154	4676	112.5
193	G152	4660	224.5
194	G150	4644	112.5
195	G148	4628	224.5
196	G146	4612	112.5
197	G144	4596	224.5
198	G142	4580	112.5
199	G140	4564	224.5
200	G138	4548	112.5
201	G136	4532	224.5

No	PAD Name	X	Y
202	G134	4516	112.5
203	G132	4500	224.5
204	G130	4484	112.5
205	G128	4468	224.5
206	G126	4452	112.5
207	G124	4436	224.5
208	G122	4420	112.5
209	G120	4404	224.5
210	G118	4388	112.5
211	G116	4372	224.5
212	G114	4356	112.5
213	G112	4340	224.5
214	G110	4324	112.5
215	G108	4308	224.5
216	G106	4292	112.5
217	G104	4276	224.5
218	G102	4260	112.5
219	G100	4244	224.5
220	G98	4228	112.5
221	G96	4212	224.5
222	G94	4196	112.5
223	G92	4180	224.5
224	G90	4164	112.5
225	G88	4148	224.5
226	G86	4132	112.5
227	G84	4116	224.5
228	G82	4100	112.5
229	G80	4084	224.5
230	G78	4068	112.5
231	G76	4052	224.5
232	G74	4036	112.5
233	G72	4020	224.5
234	G70	4004	112.5
235	G68	3988	224.5
236	G66	3972	112.5
237	G64	3956	224.5
238	G62	3940	112.5
239	G60	3924	224.5
240	G58	3908	112.5
241	G56	3892	224.5
242	G54	3876	112.5
243	G52	3860	224.5
244	G50	3844	112.5
245	G48	3828	224.5
246	G46	3812	112.5
247	G44	3796	224.5
248	G42	3780	112.5
249	G40	3764	224.5
250	G38	3748	112.5
251	G36	3732	224.5
252	G34	3716	112.5
253	G32	3700	224.5
254	G30	3684	112.5
255	G28	3668	224.5
256	G26	3652	112.5
257	G24	3636	224.5
258	G22	3620	112.5
259	G20	3604	224.5
260	G18	3588	112.5
261	G16	3572	224.5
262	G14	3556	112.5
263	G12	3540	224.5
264	G10	3524	112.5
265	G8	3508	224.5
266	G6	3492	112.5
267	G4	3476	224.5
268	G2	3460	112.5
269	DUMMY	3444	224.5
270	DUMMY	3428	112.5
271	DUMMY	3412	224.5

No	PAD Name	X	Y
272	DUMMY	3396	112.5
273	S396	3380	224.5
274	S395	3364	112.5
275	S394	3348	224.5
276	S393	3332	112.5
277	S392	3316	224.5
278	S391	3300	112.5
279	S390	3284	224.5
280	S389	3268	112.5
281	S388	3252	224.5
282	S387	3236	112.5
283	S386	3220	224.5
284	S385	3204	112.5
285	S384	3188	224.5
286	S383	3172	112.5
287	S382	3156	224.5
288	S381	3140	112.5
289	S380	3124	224.5
290	S379	3108	112.5
291	S378	3092	224.5
292	S377	3076	112.5
293	S376	3060	224.5
294	S375	3044	112.5
295	S374	3028	224.5
296	S373	3012	112.5
297	S372	2996	224.5
298	S371	2980	112.5
299	S370	2964	224.5
300	S369	2948	112.5
301	S368	2932	224.5
302	S367	2916	112.5
303	S366	2900	224.5
304	S365	2884	112.5
305	S364	2868	224.5
306	S363	2852	112.5
307	S362	2836	224.5
308	S361	2820	112.5
309	S360	2804	224.5
310	S359	2788	112.5
311	S358	2772	224.5
312	S357	2756	112.5
313	S356	2740	224.5
314	S355	2724	112.5
315	S354	2708	224.5
316	S353	2692	112.5
317	S352	2676	224.5
318	S351	2660	112.5
319	S350	2644	224.5
320	S349	2628	112.5
321	S348	2612	224.5
322	S347	2596	112.5
323	S346	2580	224.5
324	S345	2564	112.5
325	S344	2548	224.5
326	S343	2532	112.5
327	S342	2516	224.5
328	S341	2500	112.5
329	S340	2484	224.5
330	S339	2468	112.5
331	S338	2452	224.5
332	S337	2436	112.5
333	S336	2420	224.5
334	S335	2404	112.5
335	S334	2388	224.5
336	S333	2372	112.5
337	S332	2356	224.5
338	S331	2340	112.5
339	S330	2324	224.5
340	S329	2308	112.5
341	S328	2292	224.5

No	PAD Name	X	Y
342	S327	2276	112.5
343	S326	2260	224.5
344	S325	2244	112.5
345	S324	2228	224.5
346	S323	2212	112.5
347	S322	2196	224.5
348	S321	2180	112.5
349	S320	2164	224.5
350	S319	2148	112.5
351	S318	2132	224.5
352	S317	2116	112.5
353	S316	2100	224.5
354	S315	2084	112.5
355	S314	2068	224.5
356	S313	2052	112.5
357	S312	2036	224.5
358	S311	2020	112.5
359	S310	2004	224.5
360	S309	1988	112.5
361	S308	1972	224.5
362	S307	1956	112.5
363	S306	1940	224.5
364	S305	1924	112.5
365	S304	1908	224.5
366	S303	1892	112.5
367	S302	1876	224.5
368	S301	1860	112.5
369	S300	1844	224.5
370	S299	1828	112.5
371	S298	1812	224.5
372	S297	1796	112.5
373	S296	1780	224.5
374	S295	1764	112.5
375	S294	1748	224.5
376	S293	1732	112.5
377	S292	1716	224.5
378	S291	1700	112.5
379	S290	1684	224.5
380	S289	1668	112.5
381	S288	1652	224.5
382	S287	1636	112.5
383	S286	1620	224.5
384	S285	1604	112.5
385	S284	1588	224.5
386	S283	1572	112.5
387	S282	1556	224.5
388	S281	1540	112.5
389	S280	1524	224.5
390	S279	1508	112.5
391	S278	1492	224.5
392	S277	1476	112.5
393	S276	1460	224.5
394	S275	1444	112.5
395	S274	1428	224.5
396	S273	1412	112.5
397	S272	1396	224.5
398	S271	1380	112.5
399	S270	1364	224.5
400	S269	1348	112.5
401	S268	1332	224.5
402	S267	1316	112.5
403	S266	1300	224.5
404	S265	1284	112.5
405	S264	1268	224.5
406	S263	1252	112.5
407	S262	1236	224.5
408	S261	1220	112.5
409	S260	1204	224.5
410	S259	1188	112.5
411	S258	1172	224.5

No	PAD Name	X	Y
412	S257	1156	112.5
413	S256	1140	224.5
414	S255	1124	112.5
415	S254	1108	224.5
416	S253	1092	112.5
417	S252	1076	224.5
418	S251	1060	112.5
419	S250	1044	224.5
420	S249	1028	112.5
421	S248	1012	224.5
422	S247	996	112.5
423	S246	980	224.5
424	S245	964	112.5
425	S244	948	224.5
426	S243	932	112.5
427	S242	916	224.5
428	S241	900	112.5
429	S240	884	224.5
430	S239	868	112.5
431	S238	852	224.5
432	S237	836	112.5
433	S236	820	224.5
434	S235	804	112.5
435	S234	788	224.5
436	S233	772	112.5
437	S232	756	224.5
438	S231	740	112.5
439	S230	724	224.5
440	S229	708	112.5
441	S228	692	224.5
442	S227	676	112.5
443	S226	660	224.5
444	S225	644	112.5
445	S224	628	224.5
446	S223	612	112.5
447	S222	596	224.5
448	S221	580	112.5
449	S220	564	224.5
450	S219	548	112.5
451	S218	532	224.5
452	S217	516	112.5
453	S216	500	224.5
454	S215	484	112.5
455	S214	468	224.5
456	S213	452	112.5
457	S212	436	224.5
458	S211	420	112.5
459	S210	404	224.5
460	S209	388	112.5
461	S208	372	224.5
462	S207	356	112.5
463	S206	340	224.5
464	S205	324	112.5
465	S204	308	224.5
466	S203	292	112.5
467	S202	276	224.5
468	S201	260	112.5
469	S200	244	224.5
470	S199	228	112.5
471	S198	-228	112.5
472	S197	-244	224.5
473	S196	-260	112.5
474	S195	-276	224.5
475	S194	-292	112.5
476	S193	-308	224.5
477	S192	-324	112.5
478	S191	-340	224.5
479	S190	-356	112.5
480	S189	-372	224.5
481	S188	-388	112.5

No	PAD Name	X	Y
482	S187	-404	224.5
483	S186	-420	112.5
484	S185	-436	224.5
485	S184	-452	112.5
486	S183	-468	224.5
487	S182	-484	112.5
488	S181	-500	224.5
489	S180	-516	112.5
490	S179	-532	224.5
491	S178	-548	112.5
492	S177	-564	224.5
493	S176	-580	112.5
494	S175	-596	224.5
495	S174	-612	112.5
496	S173	-628	224.5
497	S172	-644	112.5
498	S171	-660	224.5
499	S170	-676	112.5
500	S169	-692	224.5
501	S168	-708	112.5
502	S167	-724	224.5
503	S166	-740	112.5
504	S165	-756	224.5
505	S164	-772	112.5
506	S163	-788	224.5
507	S162	-804	112.5
508	S161	-820	224.5
509	S160	-836	112.5
510	S159	-852	224.5
511	S158	-868	112.5
512	S157	-884	224.5
513	S156	-900	112.5
514	S155	-916	224.5
515	S154	-932	112.5
516	S153	-948	224.5
517	S152	-964	112.5
518	S151	-980	224.5
519	S150	-996	112.5
520	S149	-1012	224.5
521	S148	-1028	112.5
522	S147	-1044	224.5
523	S146	-1060	112.5
524	S145	-1076	224.5
525	S144	-1092	112.5
526	S143	-1108	224.5
527	S142	-1124	112.5
528	S141	-1140	224.5
529	S140	-1156	112.5
530	S139	-1172	224.5
531	S138	-1188	112.5
532	S137	-1204	224.5
533	S136	-1220	112.5
534	S135	-1236	224.5
535	S134	-1252	112.5
536	S133	-1268	224.5
537	S132	-1284	112.5
538	S131	-1300	224.5
539	S130	-1316	112.5
540	S129	-1332	224.5
541	S128	-1348	112.5
542	S127	-1364	224.5
543	S126	-1380	112.5
544	S125	-1396	224.5
545	S124	-1412	112.5
546	S123	-1428	224.5
547	S122	-1444	112.5
548	S121	-1460	224.5
549	S120	-1476	112.5
550	S119	-1492	224.5
551	S118	-1508	112.5

No	PAD Name	X	Y
552	S117	-1524	224.5
553	S116	-1540	112.5
554	S115	-1556	224.5
555	S114	-1572	112.5
556	S113	-1588	224.5
557	S112	-1604	112.5
558	S111	-1620	224.5
559	S110	-1636	112.5
560	S109	-1652	224.5
561	S108	-1668	112.5
562	S107	-1684	224.5
563	S106	-1700	112.5
564	S105	-1716	224.5
565	S104	-1732	112.5
566	S103	-1748	224.5
567	S102	-1764	112.5
568	S101	-1780	224.5
569	S100	-1796	112.5
570	S99	-1812	224.5
571	S98	-1828	112.5
572	S97	-1844	224.5
573	S96	-1860	112.5
574	S95	-1876	224.5
575	S94	-1892	112.5
576	S93	-1908	224.5
577	S92	-1924	112.5
578	S91	-1940	224.5
579	S90	-1956	112.5
580	S89	-1972	224.5
581	S88	-1988	112.5
582	S87	-2004	224.5
583	S86	-2020	112.5
584	S85	-2036	224.5
585	S84	-2052	112.5
586	S83	-2068	224.5
587	S82	-2084	112.5
588	S81	-2100	224.5
589	S80	-2116	112.5
590	S79	-2132	224.5
591	S78	-2148	112.5
592	S77	-2164	224.5
593	S76	-2180	112.5
594	S75	-2196	224.5
595	S74	-2212	112.5
596	S73	-2228	224.5
597	S72	-2244	112.5
598	S71	-2260	224.5
599	S70	-2276	112.5
600	S69	-2292	224.5
601	S68	-2308	112.5
602	S67	-2324	224.5
603	S66	-2340	112.5
604	S65	-2356	224.5
605	S64	-2372	112.5
606	S63	-2388	224.5
607	S62	-2404	112.5
608	S61	-2420	224.5
609	S60	-2436	112.5
610	S59	-2452	224.5
611	S58	-2468	112.5
612	S57	-2484	224.5
613	S56	-2500	112.5
614	S55	-2516	224.5
615	S54	-2532	112.5
616	S53	-2548	224.5
617	S52	-2564	112.5
618	S51	-2580	224.5
619	S50	-2596	112.5
620	S49	-2612	224.5
621	S48	-2628	112.5

No	PAD Name	X	Y
622	S47	-2644	224.5
623	S46	-2660	112.5
624	S45	-2676	224.5
625	S44	-2692	112.5
626	S43	-2708	224.5
627	S42	-2724	112.5
628	S41	-2740	224.5
629	S40	-2756	112.5
630	S39	-2772	224.5
631	S38	-2788	112.5
632	S37	-2804	224.5
633	S36	-2820	112.5
634	S35	-2836	224.5
635	S34	-2852	112.5
636	S33	-2868	224.5
637	S32	-2884	112.5
638	S31	-2900	224.5
639	S30	-2916	112.5
640	S29	-2932	224.5
641	S28	-2948	112.5
642	S27	-2964	224.5
643	S26	-2980	112.5
644	S25	-2996	224.5
645	S24	-3012	112.5
646	S23	-3028	224.5
647	S22	-3044	112.5
648	S21	-3060	224.5
649	S20	-3076	112.5
650	S19	-3092	224.5
651	S18	-3108	112.5
652	S17	-3124	224.5
653	S16	-3140	112.5
654	S15	-3156	224.5
655	S14	-3172	112.5
656	S13	-3188	224.5
657	S12	-3204	112.5
658	S11	-3220	224.5
659	S10	-3236	112.5
660	S9	-3252	224.5
661	S8	-3268	112.5
662	S7	-3284	224.5
663	S6	-3300	112.5
664	S5	-3316	224.5
665	S4	-3332	112.5
666	S3	-3348	224.5
667	S2	-3364	112.5

No	PAD Name	X	Y
668	S1	-3380	224.5
669	DUMMY	-3396	112.5
670	DUMMY	-3412	224.5
671	DUMMY	-3428	112.5
672	DUMMY	-3444	224.5
673	G1	-3460	112.5
674	G3	-3476	224.5
675	G5	-3492	112.5
676	G7	-3508	224.5
677	G9	-3524	112.5
678	G11	-3540	224.5
679	G13	-3556	112.5
680	G15	-3572	224.5
681	G17	-3588	112.5
682	G19	-3604	224.5
683	G21	-3620	112.5
684	G23	-3636	224.5
685	G25	-3652	112.5
686	G27	-3668	224.5
687	G29	-3684	112.5
688	G31	-3700	224.5
689	G33	-3716	112.5
690	G35	-3732	224.5
691	G37	-3748	112.5
692	G39	-3764	224.5
693	G41	-3780	112.5
694	G43	-3796	224.5
695	G45	-3812	112.5
696	G47	-3828	224.5
697	G49	-3844	112.5
698	G51	-3860	224.5
699	G53	-3876	112.5
700	G55	-3892	224.5
701	G57	-3908	112.5
702	G59	-3924	224.5
703	G61	-3940	112.5
704	G63	-3956	224.5
705	G65	-3972	112.5
706	G67	-3988	224.5
707	G69	-4004	112.5
708	G71	-4020	224.5
709	G73	-4036	112.5
710	G75	-4052	224.5
711	G77	-4068	112.5
712	G79	-4084	224.5
713	G81	-4100	112.5

No	PAD Name	X	Y
714	G83	-4116	224.5
715	G85	-4132	112.5
716	G87	-4148	224.5
717	G89	-4164	112.5
718	G91	-4180	224.5
719	G93	-4196	112.5
720	G95	-4212	224.5
721	G97	-4228	112.5
722	G99	-4244	224.5
723	G101	-4260	112.5
724	G103	-4276	224.5
725	G105	-4292	112.5
726	G107	-4308	224.5
727	G109	-4324	112.5
728	G111	-4340	224.5
729	G113	-4356	112.5
730	G115	-4372	224.5
731	G117	-4388	112.5
732	G119	-4404	224.5
733	G121	-4420	112.5
734	G123	-4436	224.5
735	G125	-4452	112.5
736	G127	-4468	224.5
737	G129	-4484	112.5
738	G131	-4500	224.5
739	G133	-4516	112.5
740	G135	-4532	224.5
741	G137	-4548	112.5
742	G139	-4564	224.5
743	G141	-4580	112.5
744	G143	-4596	224.5
745	G145	-4612	112.5
746	G147	-4628	224.5
747	G149	-4644	112.5
748	G151	-4660	224.5
749	G153	-4676	112.5
750	G155	-4692	224.5
751	G157	-4708	112.5
752	G159	-4724	224.5
753	G161	-4740	112.5
754	DUMMY	-4756	224.5
755	DUMMY	-4772	112.5

4. Interface Description

4.1. Interface Type Selection

The selection of a given interfaces are done by setting P68, IM2, IM1, and IM0 pins as show in below tables.

Table 4-1 Interface Type Selection

P68	IM2	IM1	IM0	Interface	Read Back Selection
X	0	X	X	Serial interface	Via the read instruction (8-bit , 24-bit and 32-bit read parameter)
0	1	0	0	8080 MCU 8-bit Parallel	RDX strobe (8-bit read data and 8-bit read parameter)
1	1	0	0	6800 MCU 8-bit Parallel	RDX strobe (8-bit read data and 8-bit read parameter)

4.2. Serial Interface

The Module uses a 3-wire 9-bit serial interface or 4-pins/8-bit bi-directional interface for communication between the micro controller and the LCD driver chip. The 3-pins serial use: CSX (chip enable), SCL (serial clock) and SDA (serial data input/output) and the 4-pins serial use: CSX (chip enable), D/CX (data/ command select), SCL (serial clock), and SDA (serial data input/output).

Table 4-2 Serial Interface Type Selection

IM2	4WSPI	Interface	Read back selection
0	0	3-Pins Serial Interface(or 2 Data Line SPI)	Via the read instruction (8-bit , 24-bit and 32-bit read parameter)
0	1	4-Pins Serial Interface	Via the read instruction (8-bit , 24-bit and 32-bit read parameter)

4.2.1 Command/Data Write

The write mode of the interface means the micro controller writes commands and data to the LCD driver. 3-pins serial data packet contains a control bit D/CX and a transmission byte, but in 4-pins serial case, data packet contains just transmission byte and control bit D/CX is transferred by the D/CX pin. If D/CX is “low”, the transmission byte is interpreted as a command byte. If D/CX is “high”, the transmission byte is stored in the display data RAM (Memory write command), or command register as parameter.

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

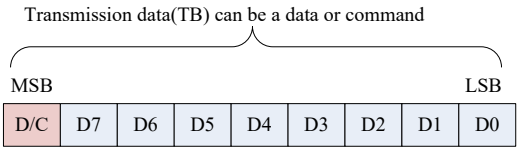


Figure 4-2-1-1 SPI 3-Wire Write Data Format

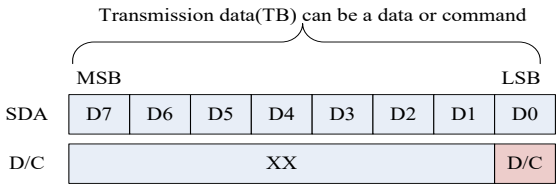


Figure 4-2-1-2 SPI 4-Wire Write Data Format

When CSX is “high”, SCL clock is ignored. At the falling edge of CSX, SCL can be high or low. SDA is sampled at the rising edge of SCL. D/CX indicates, whether the byte is command code (D/CX=’0’) or parameter/RAM data (D/CX=’1’). If CSX stays low after the last bit of command/data byte, the serial interface expects the D/CX bit (3-pin serial interface) or D7 (4-pins serial interface) of the next byte at the next rising edge of SCL.

4.2.2 Command/Data Read

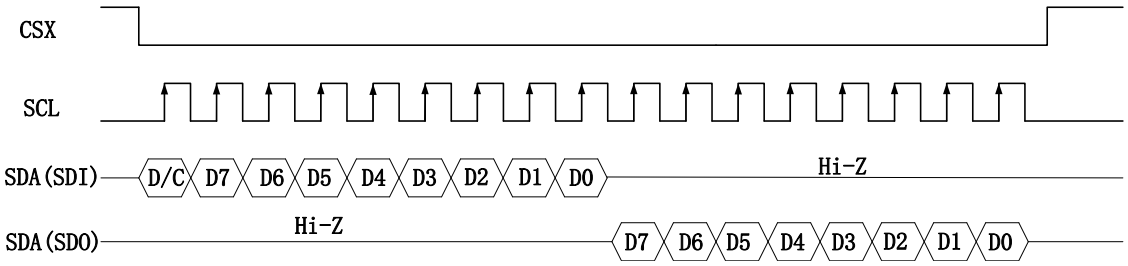


Figure 4-2-2-1 SPI 3-Wire 8-bit Read Operation
(For 'DAH/DBH/DCH/0Ah/0Bh/0Ch/0Dh/0Eh/0Fh' Command)

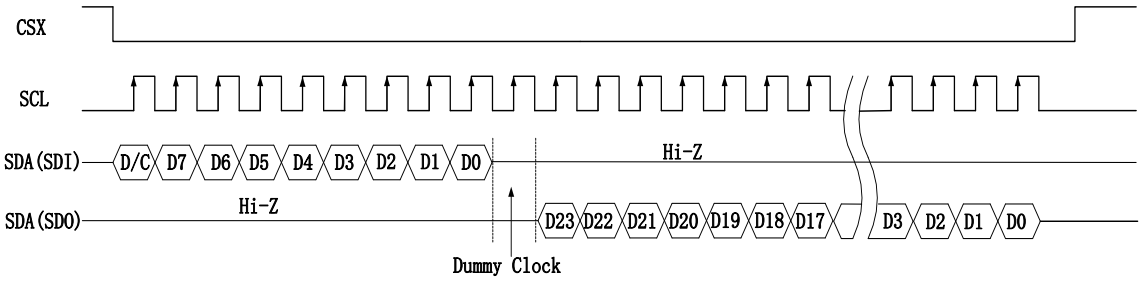


Figure 4-2-2-2 SPI 3-Wire 24-bit Read Operation
(For '04H' Command with one dummy clock)

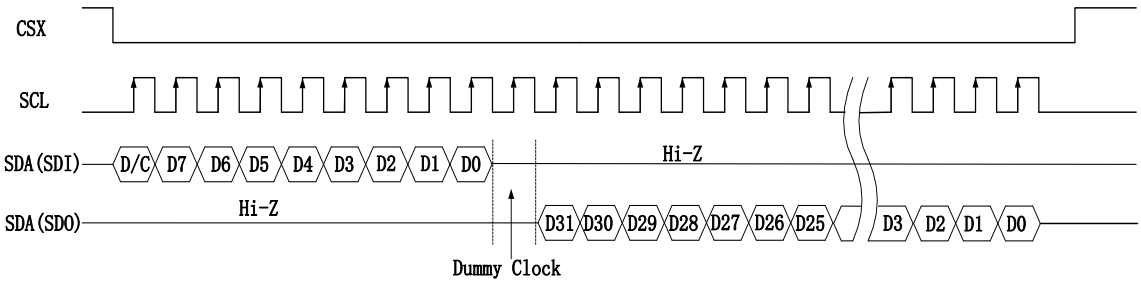


Figure 4-2-2-3 SPI 3-Wire 32-bit Read Operation
(For '09H' Command with one dummy clock)

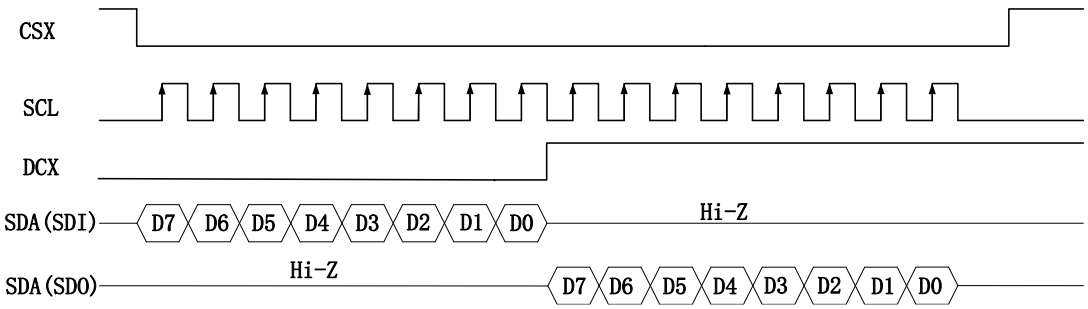


Figure 4-2-2-4 SPI 4-Wire 8-bit Read Operation
(For 'DAH/DBH/DCH/0Ah/0Bh/0Ch/0Dh/0Eh/0Fh' Command)

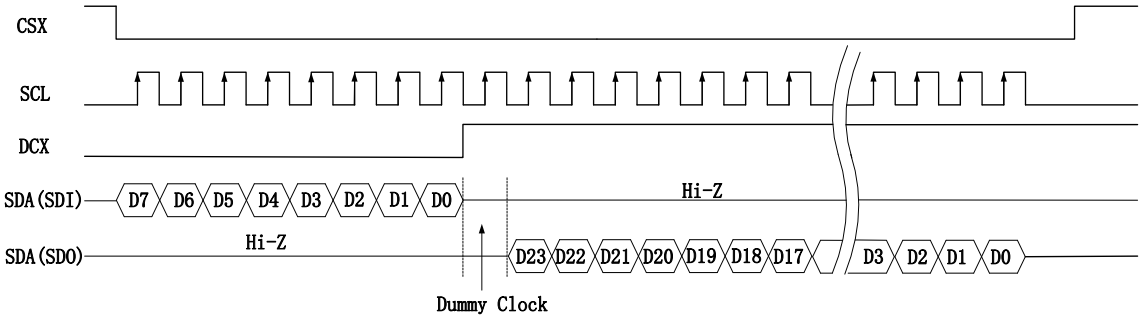


Figure 4-2-2-5 SPI 4-Wire 24-bit Read Operation
(For '04H' Command with one dummy clock)

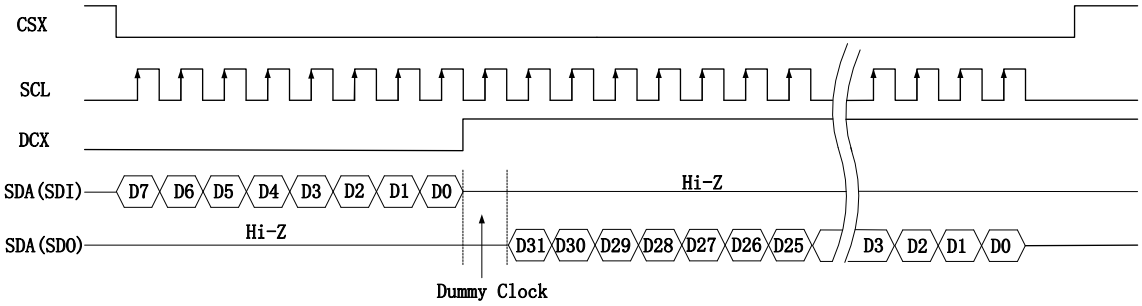


Figure 4-2-2-6 SPI 4-Wire 32-bit Read Operation
(For '09H' Command with one dummy clock)

4.3. 8080-Series Parallel Interface (P68='0')

The MCU uses an 11-wires 8-data parallel interface. The chip-select CSX (active low) enables and disables the parallel interface. RESX (active low) is an external reset signal. WRX is the parallel data write, RDX is the parallel data read and D[7:0] is parallel data.

The graphics controller chip reads the data at the rising edge of WRX signal. The D/CX is the data/command flag. When D/CX='1', D[7:0] bits are display RAM data or command parameters. When D/C='0', D[7:0] bits are commands.

The 8080-series bi-direction interface can be used for communication between the micro- controller and LCD driver chip. The selection of this interface is done when P68 pin is low state (GND). Interface bus width can be selected with IM2, IM1 and IM0. The interface functions of 8080-series parallel interface are given in Table 4-3-1.

Table 4-3-1 8080 MCU Operation

P68	IM2	IM1	IM0	Interface	D/CX	RDX	WRX	Function
0	1	0	0	8-bit parallel	L	H	R	Write 8-bit command
					H	H	R	Write 8-bit display data or 8-bit parameter
					H	R	H	Read 8-bit display data or 8-bit parameter

Note: Reading operation applied for command code: DAh, DBh, DCh, 04h, 09h, 0Ah, 0Bh, 0Ch, 0Dh, 0Eh, 0Fh

4.3.1. Write Cycle/Sequence

The write cycle means that the host writes information (command or/and data) to the display via the interface. Each write cycle (WRX high-low-high sequence) consists of 3 control (D/CX, RDX, WRX) and data signals (D[7…0]). D/CX bit is a control signal, which tells if the data is a command or a data. The data signals are a command if the control signal is low (= ‘0’) and vice versa it is data (= ‘1’). The write cycle is described in the following figure.

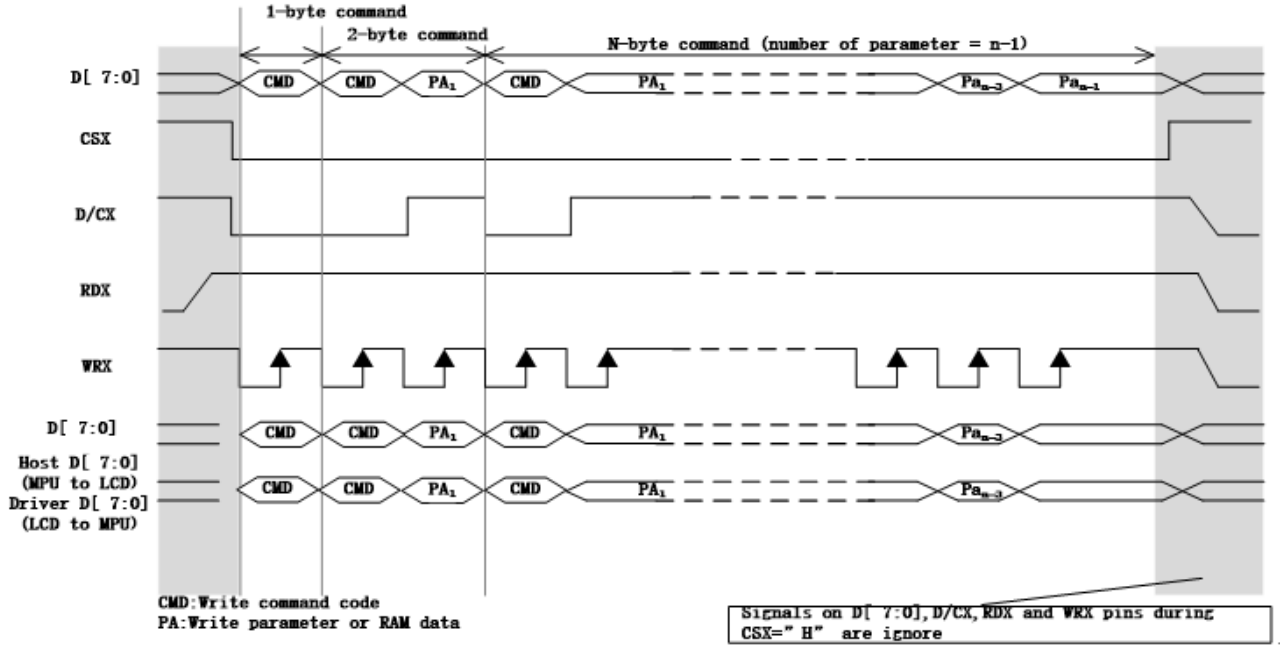


Figure 4-3-1 8080 MCU Write sequence

4.3.2. Read Cycle/Sequence

The read cycle (RDX high-low-high sequence) means that the host reads information from the display via interface. The display sends data (D[7:0]) to the host when there is a falling edge of RDX and the host reads data when there is a rising edge of RDX.

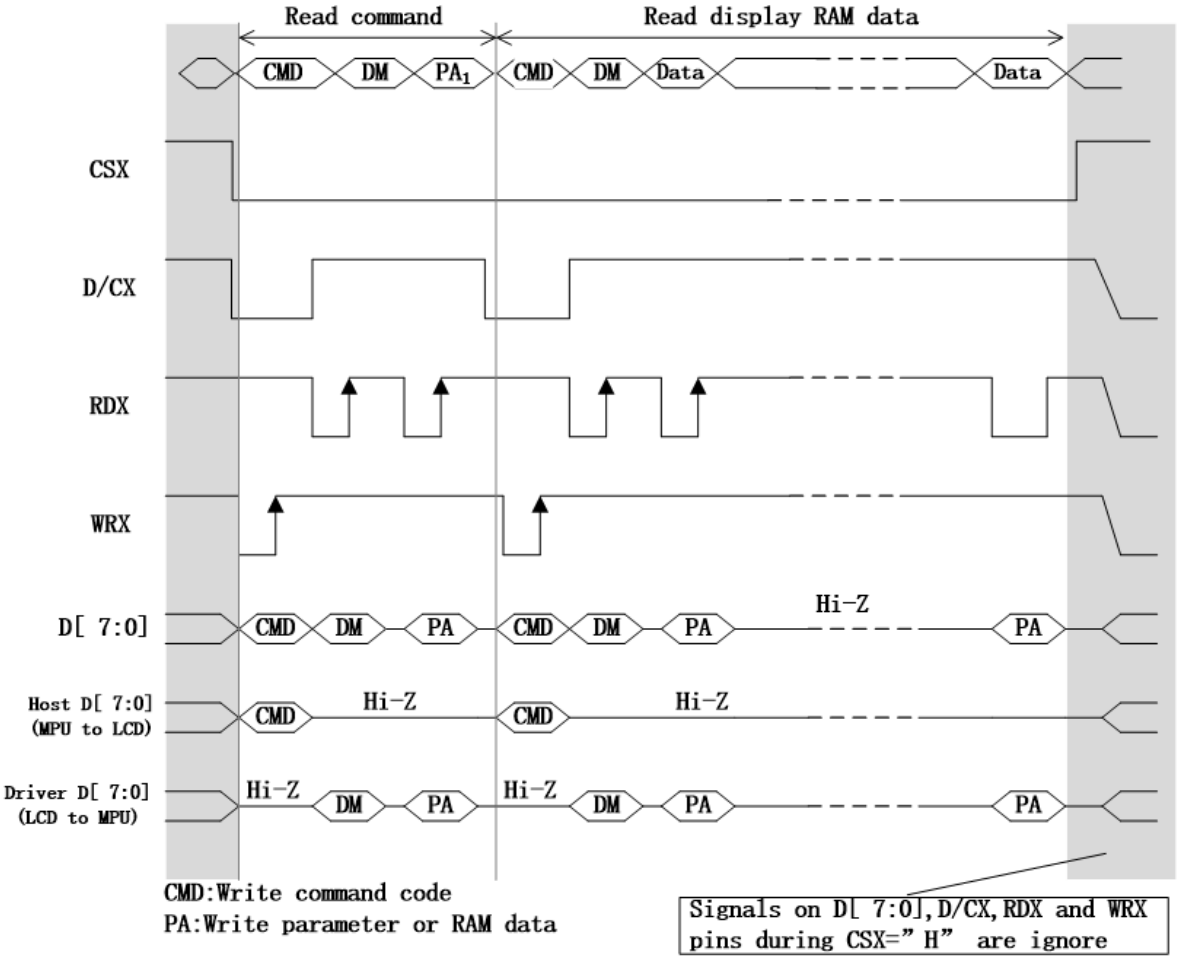


Figure 4-3-2 8080 Read sequence

4.4. 6800-Series Parallel Interface (P68='1')

The MCU uses a 11-wires 8-data parallel interface. The chip-select CSX (active low) enables and disables the parallel interface. RESX (active low) is an external reset signal. WRX is read/write flag, RDX is the parallel data read/write enable and D[7:0] is parallel data.

The Graphics Controller Chip reads the data at the falling edge of RDX signal when WRX = '1' and writes the data at the falling of the RDX signal when R/WX='0'. The D/CX is the data or command flag. When D/CX='1', D[7:0] bits are display RAM data or command parameters. When D/C='0', D[7:0] bits are commands.

The 6800-series bi-direction interface can be used for communication between the micro- controller and LCD driver chip. The selection of this interface is done when P68 pin is high state (IOVCC). Interface bus width can be selected with IM2, IM1 and IM0. The interface functions of 6800-series parallel interface are given in Table 4-4-1.

Table 4-4-1 6800 MCU Operation

P68	IM2	IM1	IM0	Interface	D/CX	WRX	RDX	Function
1	1	0	0	8-bit parallel	L	L	F	Write 8-bit command
					H	L	F	Write 8-bit display data or 8-bit parameter
					H	H	F	Read 8-bit display data or 8-bit parameter

Note: Reading operation applied for command code: DAh, DBh, DCh, 04h, 09h, 0Ah, 0Bh, 0Ch, 0Dh, 0Eh, 0Fh

4.4.1. Write Cycle Sequence

The write cycle means that the host writes information (command or/and data) to the display via the interface. Each write cycle consists of 3 control (D/CX, RDX, WRX) and data signals (D[7:0]). D/CX bit is a control signal, which tells if the data is a command or a data. The data signals are a command if the control signal is low (D/CX= ‘0’), vice versa, it is data (D/CX= ‘1’).WRX work as write or read flag, WRX=’0’ stands for write operation, WRX=’1’ means read operation.The detail write cycle is described in the Figure 4-4-1.

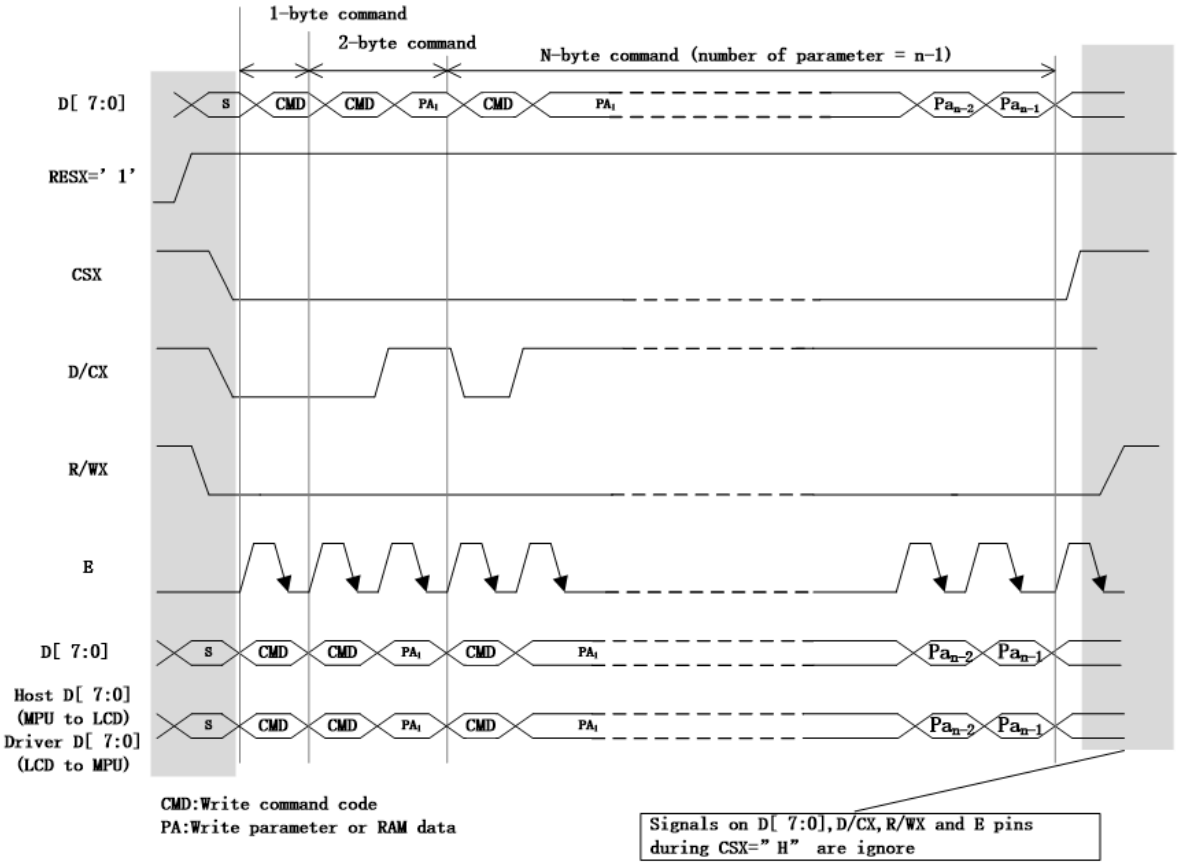


Figure 4-4-1 6800 Write Sequence

4.4.2. Read Cycle Sequence

The read cycle means that the host reads information (commend or/and data) to the display via the interface. Each read cycle consists of 3 control (D/CX, WRX, RDX) and data (D[7:0]). D/CX bit is control signal, which tells if the data is a command or a data. The data signals are the command if the control signal is low and vice versa it is data . WRX work as write or read flag, WRX=’0’ stands for write operation, WRX=’1’ means read operation. The detail read cycle is described in the figure Figure 4-4-2.

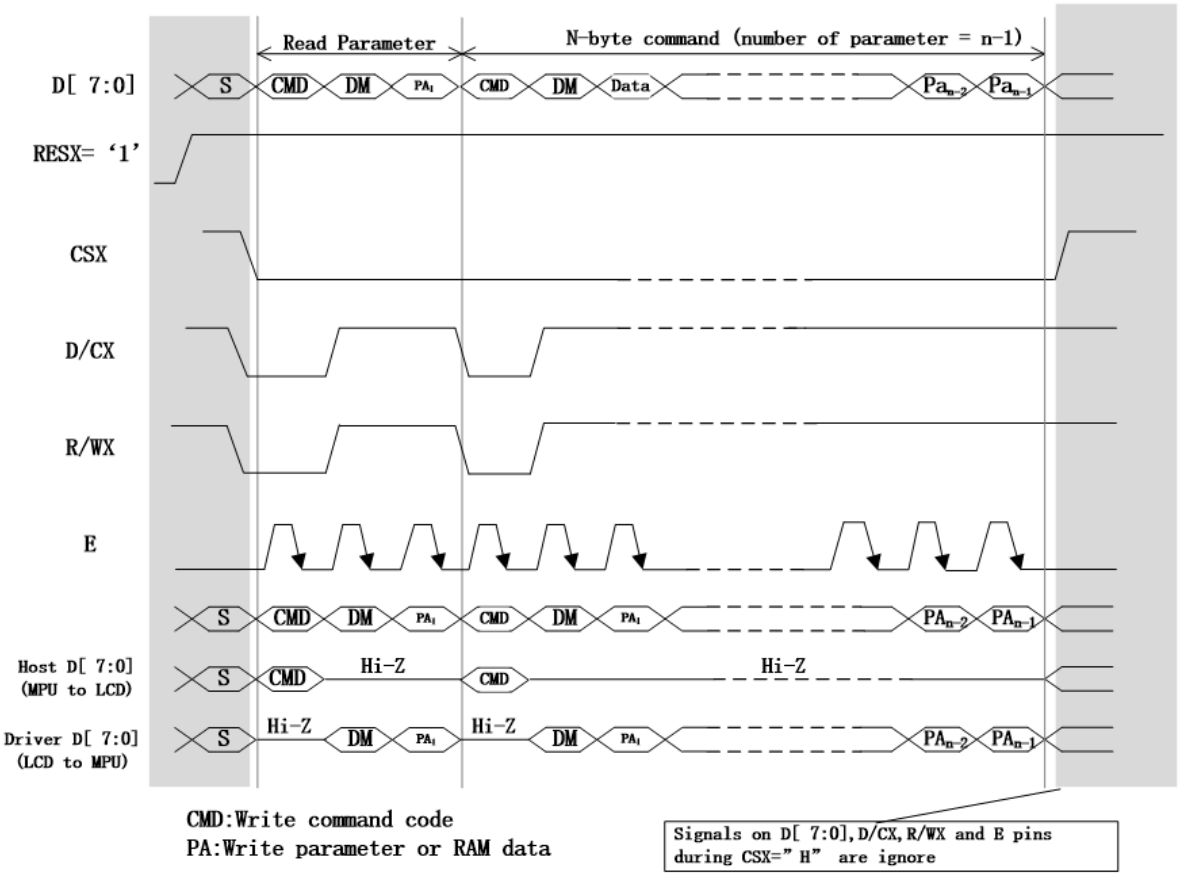


Figure 4-4-2 6800 Read Sequence

4.5. Serial Interface Recovery Function

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

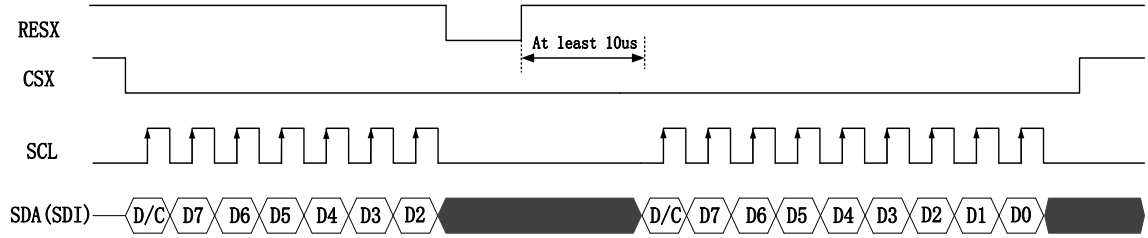


Figure 4-5-1 Serial interface recovery

If there is a break in data transmission by CSX pulse, while transferring a Command or Frame Memory Data or Multiple Parameter command Data, before Bit D0 of the byte has been completed, Then the Driver will reject the previous bits and should 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 example.

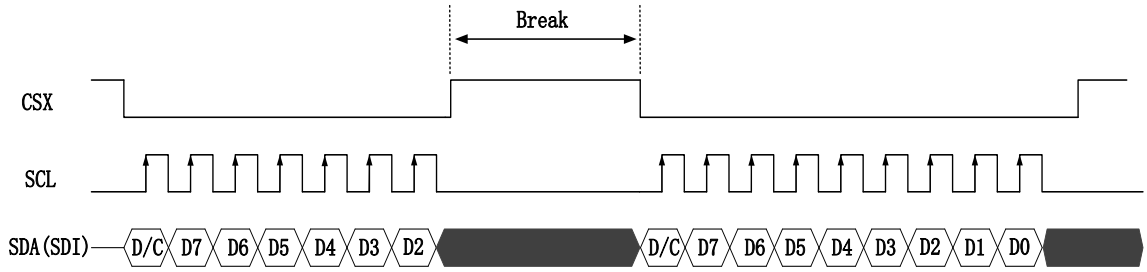


Figure 4-5-2 Serial interface recovery 2

If 1, 2 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 re-transmitting the parameter that was interrupted, then the parameters that were successfully sent are stored and the parameter where the break occurred is rejected. The interface is ready to receive next byte as show below.

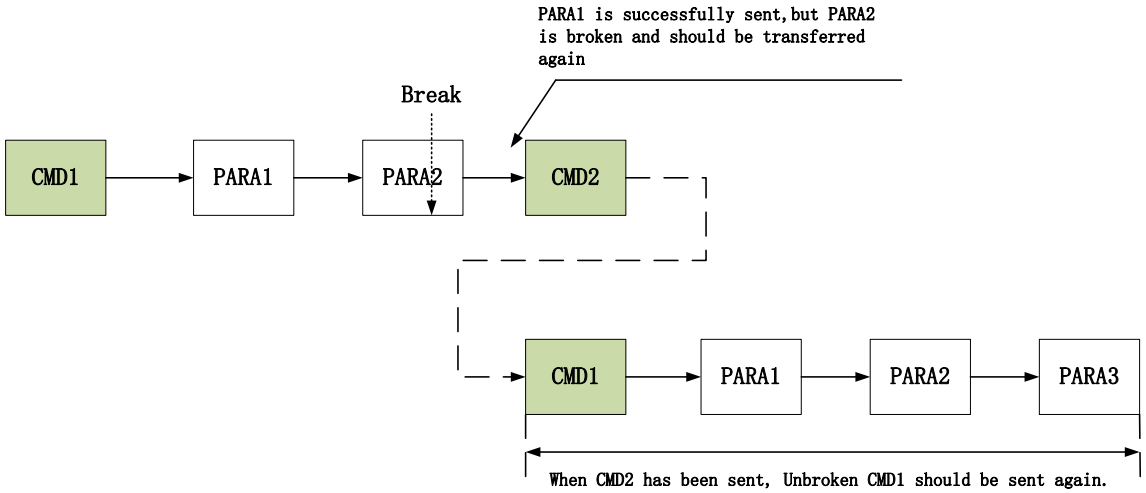


Figure 4-5-3 Serial interface recovery 3

4.6. Display Data Transmission Pause

It will be possible when transferring a Command, Frame Memory Data or Multiple Parameter Data to invoke a pause in the data transmission. If the Chip Select Line is released after a whole byte of a Frame Memory Data or Multiple Parameter Data has been completed, then the Display Module will wait and continue the Frame Memory Data or Parameter Data Transmission from the point where it was paused. If the Chip Select Line is released after a whole byte of a command has been completed, then the Display Module will receive either the command's parameters (if appropriate) or a new command when the Chip Select Line is next enabled as shown below:

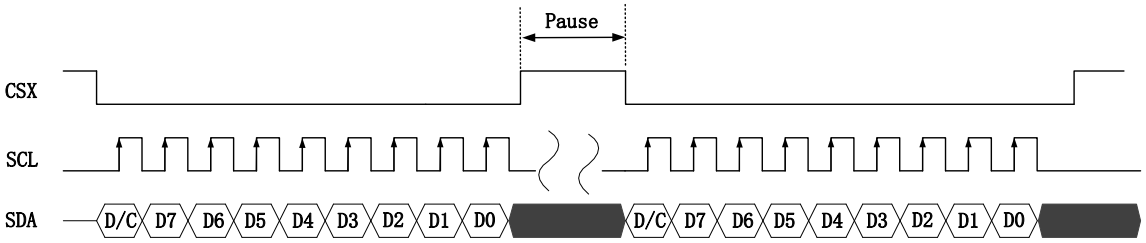


Figure 4-6 Serial interface recovery 3

4.7. Display Data Transfer Mode

The data format is described for each interface. Data can be downloaded to the Frame Memory by 2 methods.

Method 1:

The Image data is sent to the Frame Memory in successive Frame writes, each

time the Frame Memory is filled, the Frame Memory pointer is reset to the start point and the next Frame is written.

Start Frame Write	Image Data Frame1	Image Data Frame2	Image Data Frame3

Method 2:

After image data is sent and at the end of each Frame Memory download, a command is sent to stop Frame Memory Write. Then Start Memory Write command is sent, and a new Frame is downloading.

Start Frame Write	Image Data Frame1	Any Command	Start Frame Write	Image Data Frame2	Any Command	. . .	Any Command

4.8. RGB Interface

4.8.1. RGB Interface Selection

The RGB interface mode is available for NV3023B and the interface is selected by setting the VIPF[3:0]=4'b1110 and RCM=1 bits as following table.

Table 4-8-1 RGB Interface Selection

VIPF[3:0]				RGB Interface	Data Bus
1	1	1	0	6-bit RGB interface	D[5:0]
Others				Setting prohibited	

The display operation via RGB interface is synchronized with the VS, HS and PCLK signals. The RGB interface transfers the updated data to GRAM and the update area is defined by the window address function. The back porch and back porch are used to set the RGB interface timing.

- 6-bit data bus interface (D[5:0] is used) , VIPF[3] = 1110

First Transmission						Second Transmission						Third Transmission					
D5	D4	D3	D2	D1	D0	D5	D4	D3	D2	D1	D0	D5	D4	D3	D2	D1	D0
R[5]	R[4]	R[3]	R[2]	R[1]	R[0]	G[5]	G[4]	G[3]	G[2]	G[1]	G[0]	B[5]	B[4]	B[3]	B[2]	B[1]	B[0]

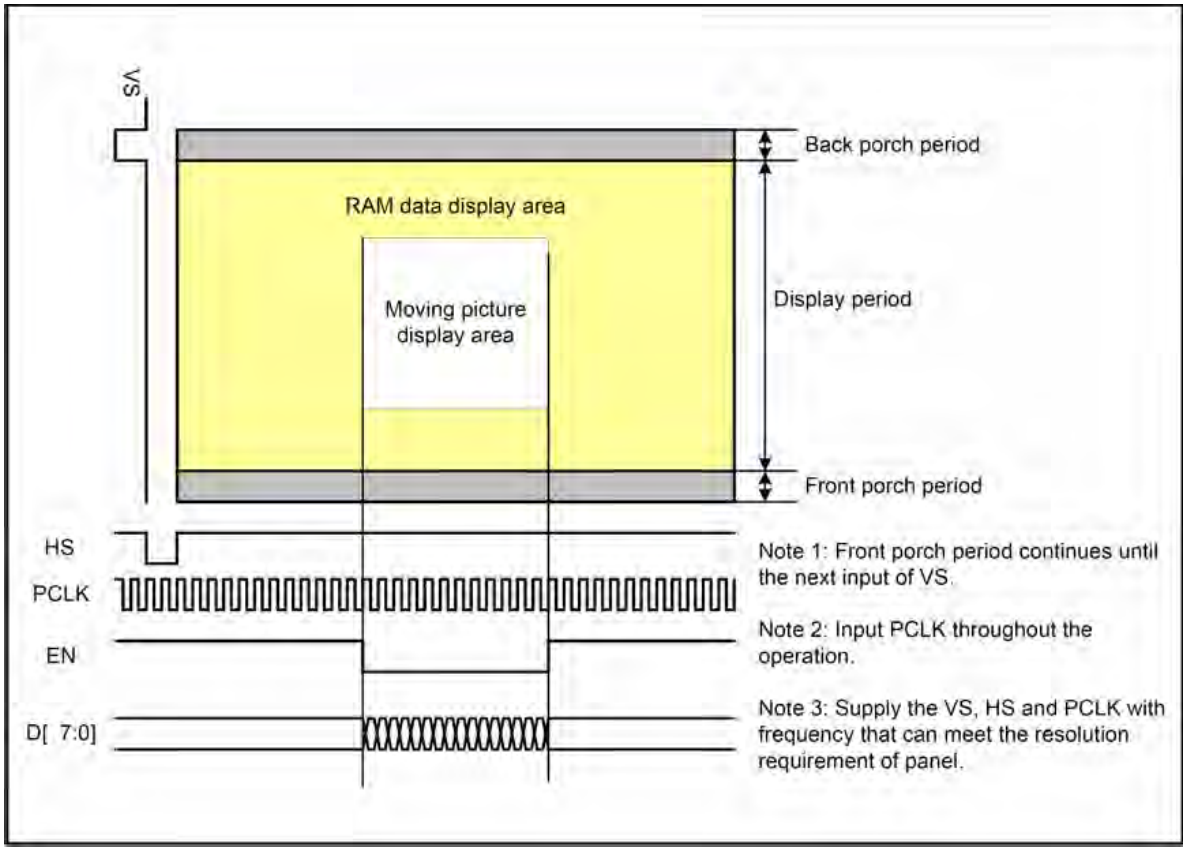
Pixel clock (PCLK) is running all the time without stopping and it is used to entering VS, HS, EN and D[7:0] states when there is a rising edge of the PCLK. The PCLK can not be used as continues internal clock for other functions of the display

module.

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

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

Data Enable (DE) is used to tell when there is received RGB information that should be transferred on the display. This is a high enable and its state is read to the display module by a rising edge of the PCLK signal. D[7:0] are used to tell what is the information of the image that is transferred on the display (When EN= ’1’ and there is a rising edge of PCLK). D[7:0] can be ‘0’ (low) or ‘1’ (high). These lines are read by a rising edge of the PCLK signal.



4.8.2. RGB Interface Timing

The timing chart of 6-bit RGB interface mode is shown as below:

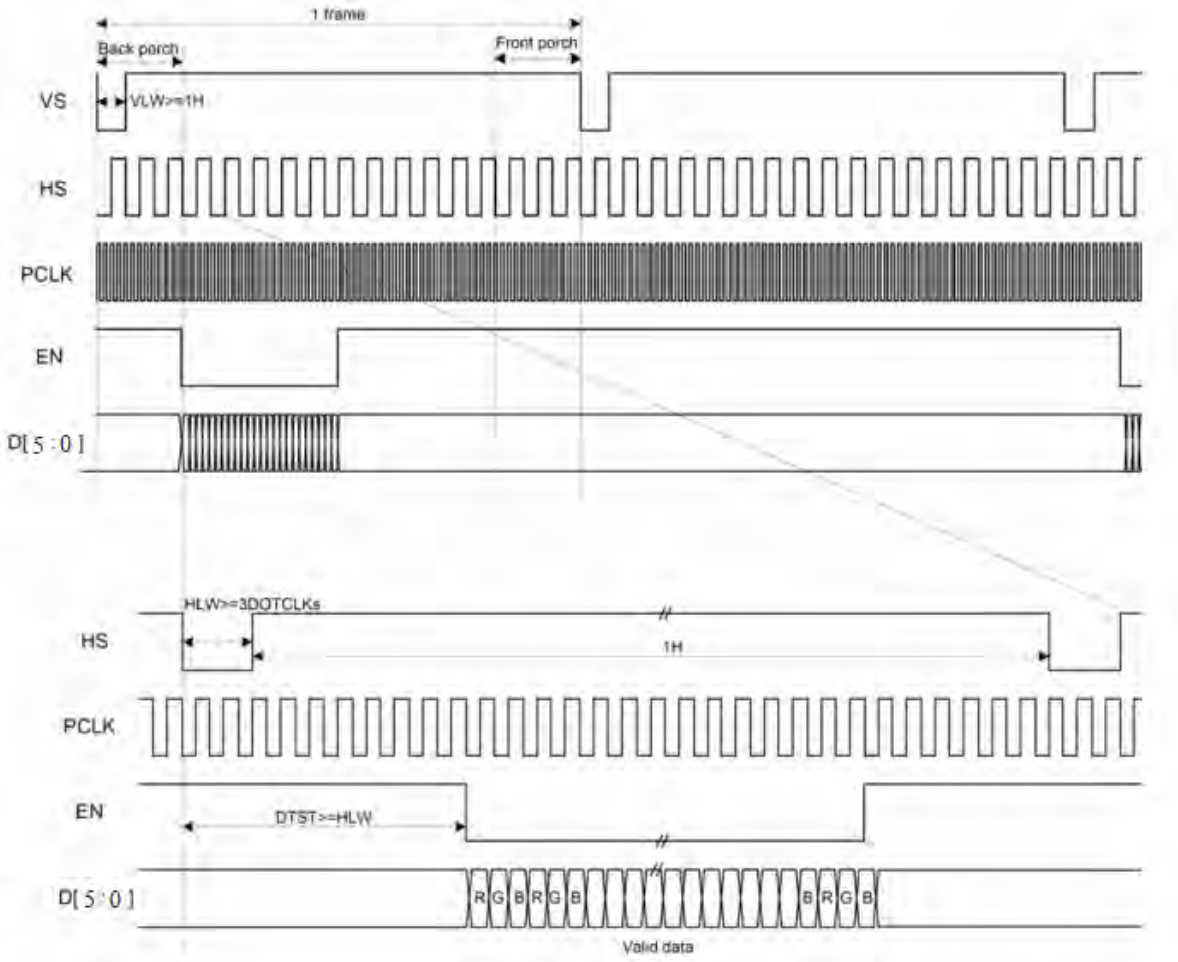


Figure 4-8-2-1 Timing Chart of Signals in 6-bit RGB Interface Mode

Note 1: In 6-bit RGB interface mode, each dot of one pixel (R, G and B) is transferred in synchronization with PCLK.

Note 2: In 6-bit RGB interface mode, set the cycles of VS, HS and EN to 3 multiples of PCLK.

4.8.3 RGB Interface Mode Selection

NV3023B supplies a RGB interface with DE mode and can be selected by pull high external “RCM” pad.

When use RGB interface, writing data to frame memory is done by “PCLK” and Video Data Bus. So, controller (host) needn’t always transfer PCLK, VS, HS and DE signals to driver.

4.9. Display Data Color Coding

4.9.1. Serial Interface

Different display data formats are available for three colors depth supported by the LCM listed below.

- 4k colors, RGB 4-4-4-bits input
- 65K colors, RGB 5-6-5-bits input
- 262K colors, RGB 6-6-6-bits input

Data format and Reconstruct ways are shown as follow figures:

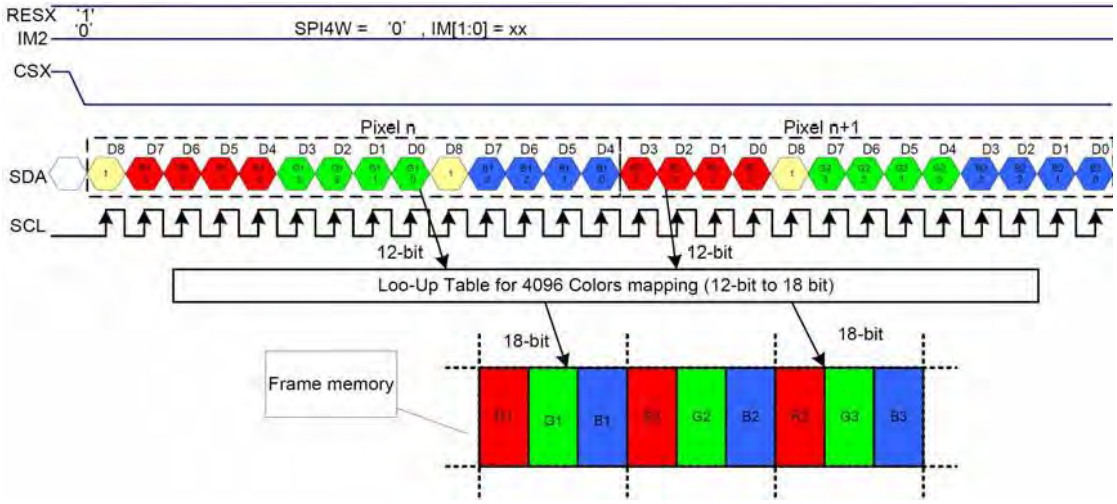


Figure 4-9-1-1 SPI 3-Wire 9-bit RGB4-4-4 Write Data Format

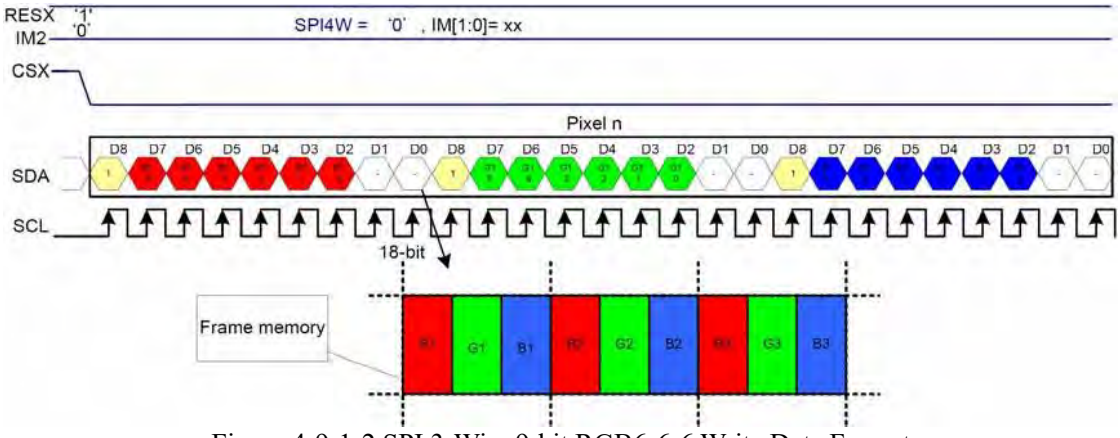


Figure 4-9-1-2 SPI 3-Wire 9-bit RGB6-6-6 Write Data Format

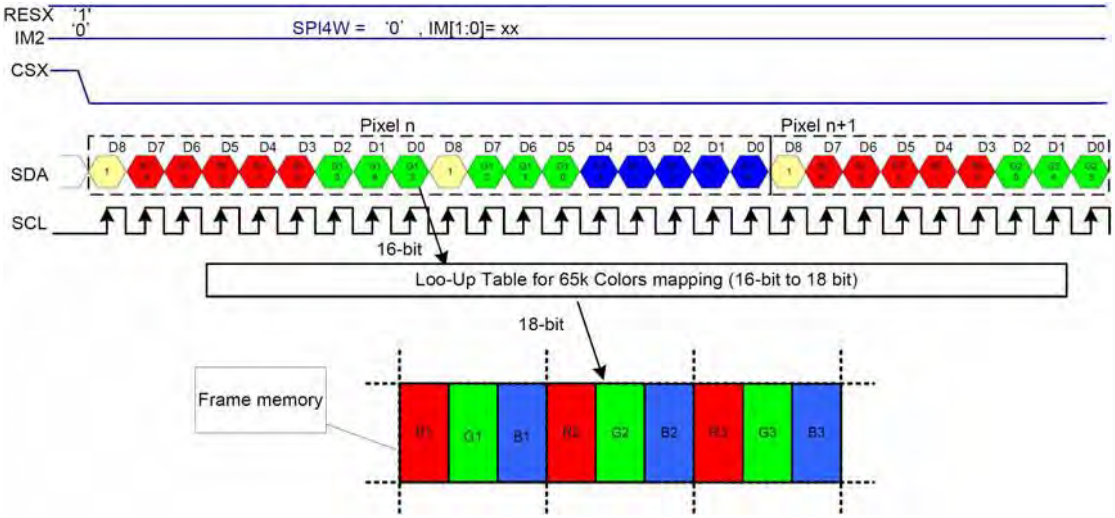


Figure 4-9-1-3 SPI 3-Wire 9-bit RGB5-6-5 Write Data Format

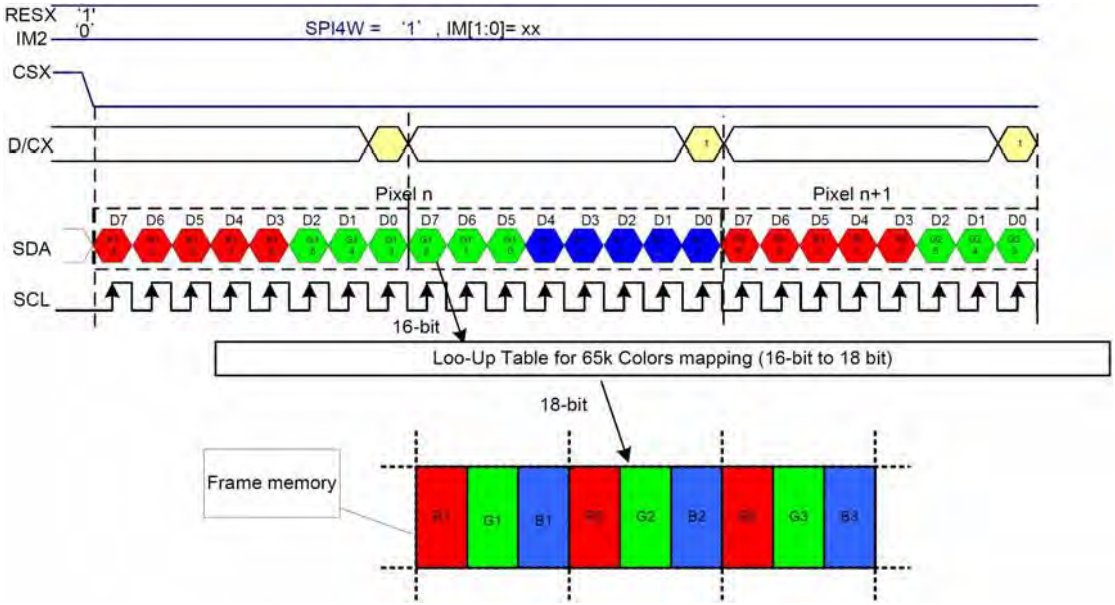


Figure 4-9-1-4 SPI 4-Wire 8-bit RGB5-6-5 Write Data Format

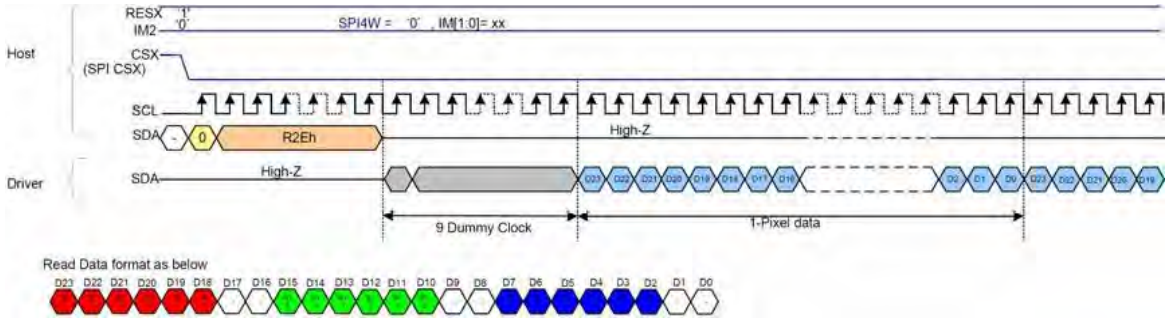


Figure 4-9-1-5 SPI 3-Wire Read Data Format

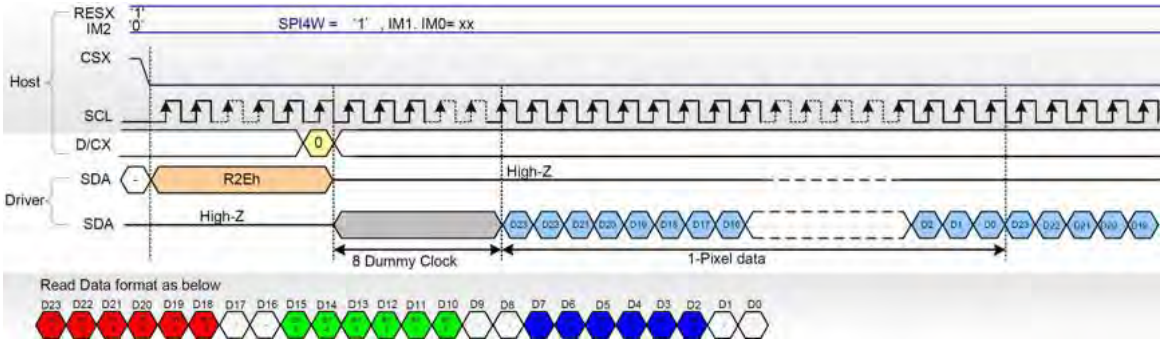


Figure 4-9-1-6 SPI 4-Wire Read Data Format

4.9.2. Parallel 8-bit Interface (IM=”100”)

Different display data formats are available for three colors depth supported by the LCM listed below.

- 4k colors, RGB 4-4-4-bits input
- 65K colors, RGB 5-6-5-bits input
- 262K colors, RGB 6-6-6-bits input

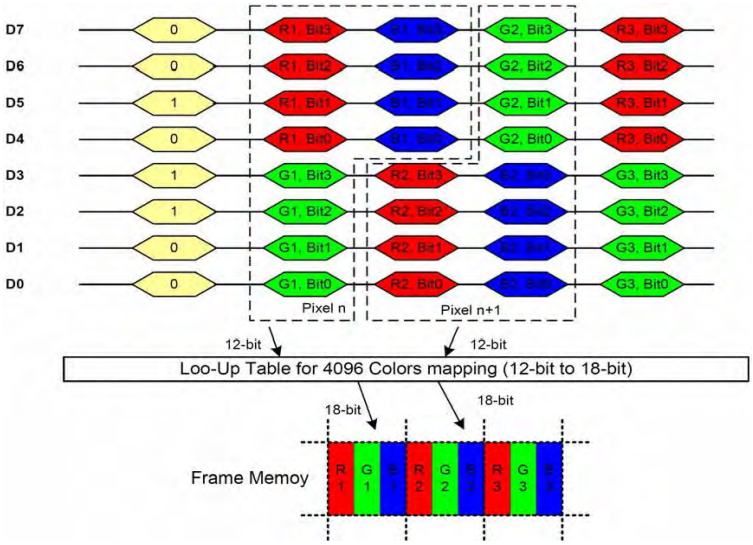


Figure 4-9-2-1 Two pixel (RGB4-4-4) in each three 8-bit write data packets

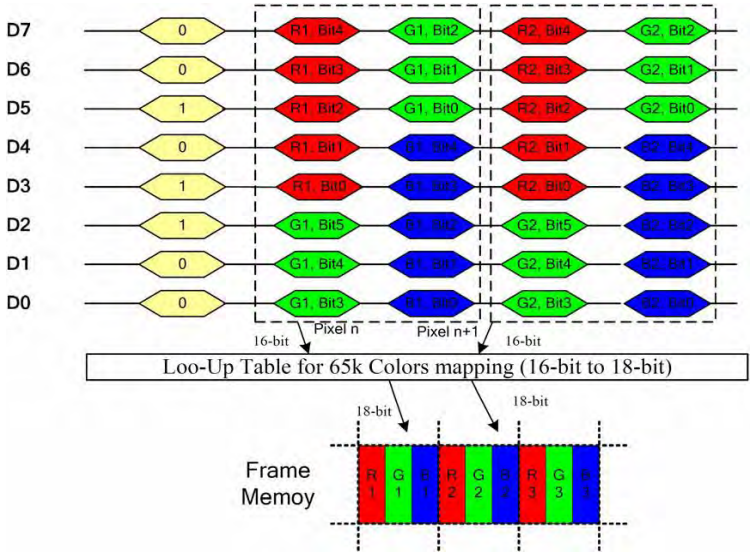


Figure 4-9-2-2 One pixel (RGB5-6-5) in each two 8-bit write data packets

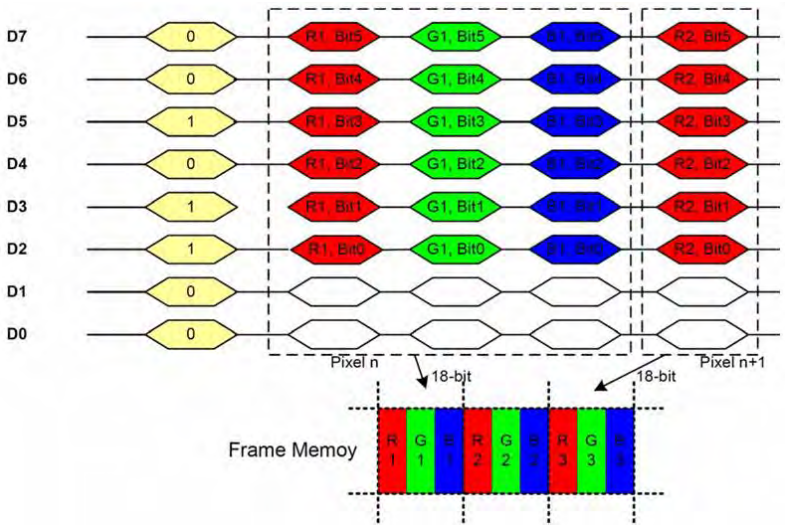
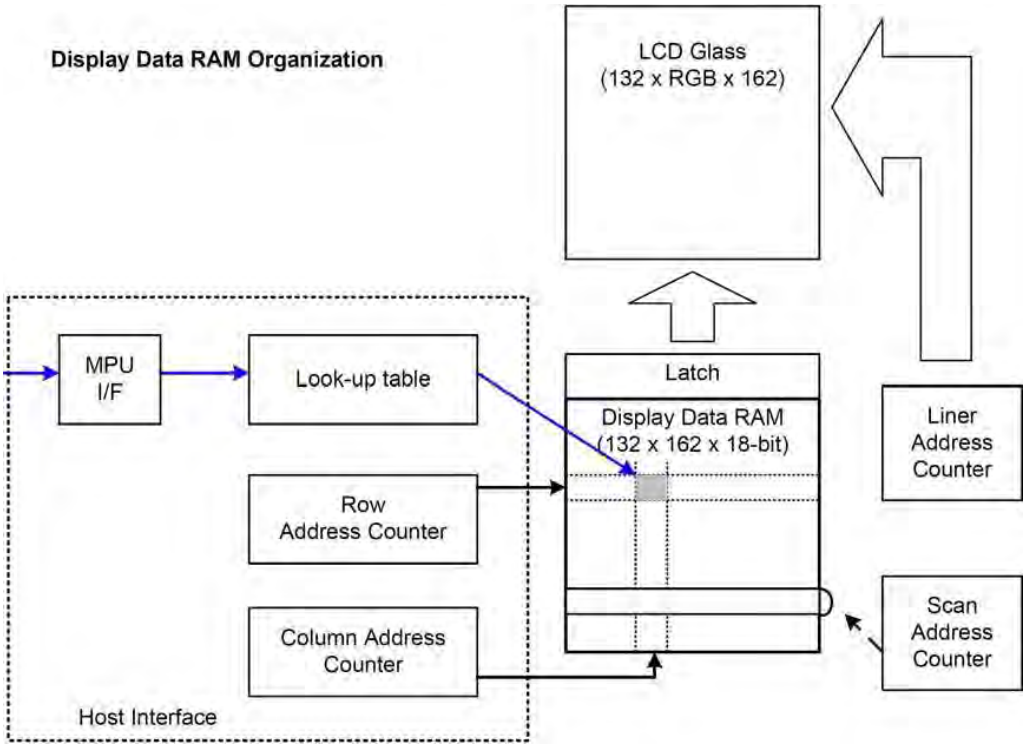


Figure 4-9-2-3 One pixel (RGB6-6-6) in each three 8-bit write data packets

5. Display Data with SRAM

5.1. SRAM Organization

The display data SRAM stores display dots and consists of 384,912 bits (132x18x162 bits). There is no restriction on access to the RAM even when the display data on the same address is loaded to “Source”. 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.



5.2. Memory To Display Mapping

Display data are writen in different direction according to different MX/MY settings, and scan read from SRAM also controlled by ML configuration.The detail as below figure shows:

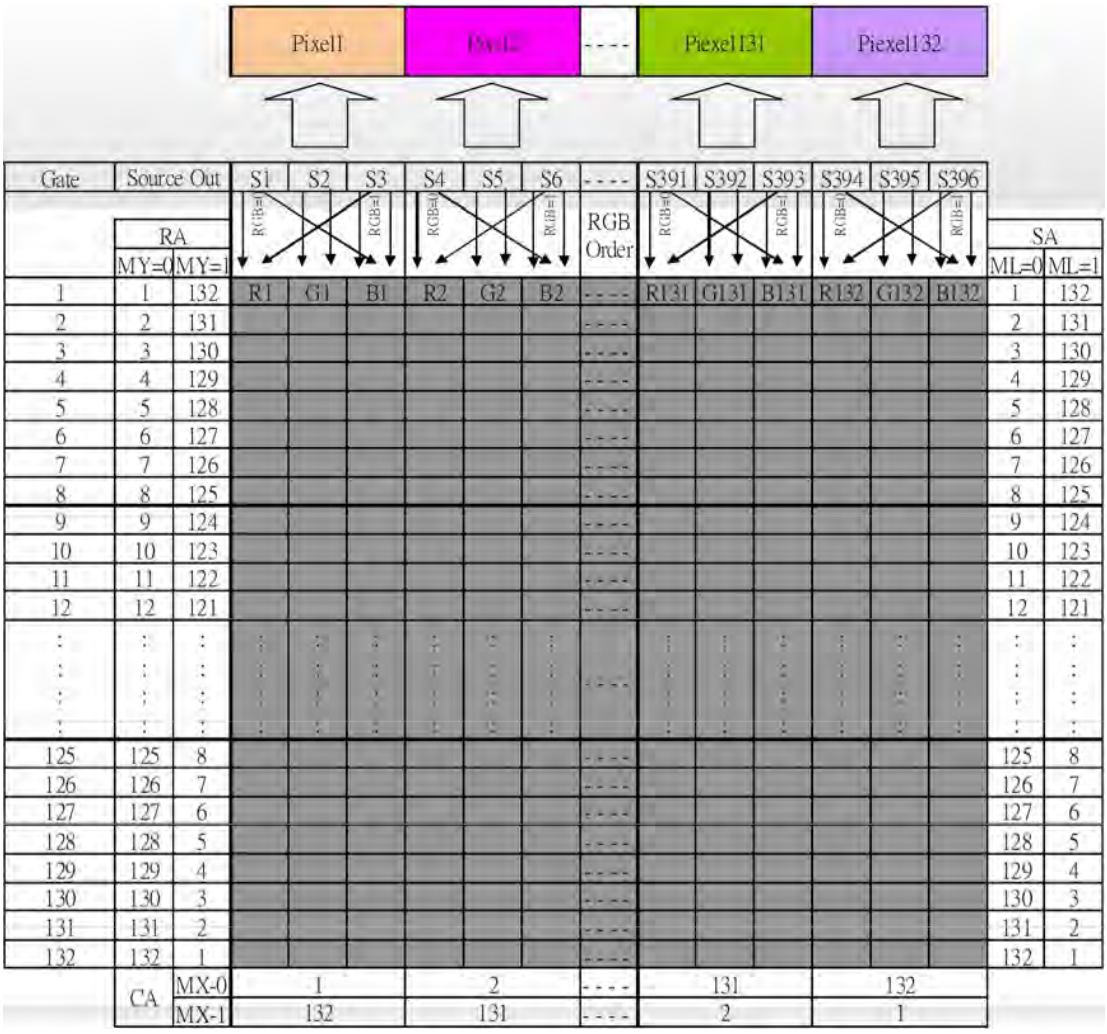


Figure 5-2 Display Data Mapping in SRAM

Note:

RA: Row Address
CA: Column Address
SA: Scan Address
MX: Mirror X-axis (Column address direction parameter), configured by MADCTL command
MY: Mirror Y-axis (Row address direction parameter), configured by MADCTL command
ML: Scan direction parameter, configured by MADCTL command
RGB: Red, Blue subpixel position change, configured by MADCTL command

5.3. MCU To SRAM Access Direction

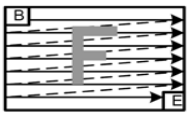
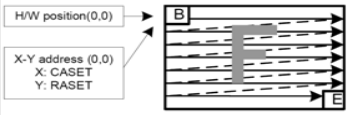
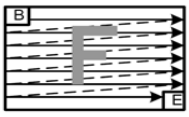
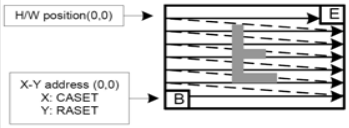
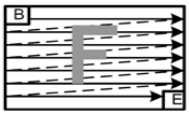
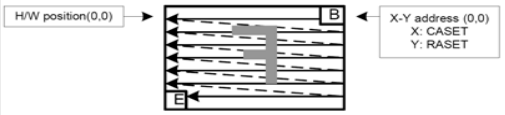
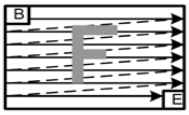
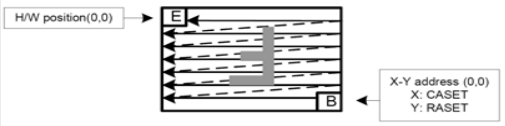
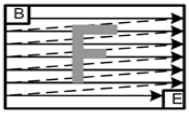
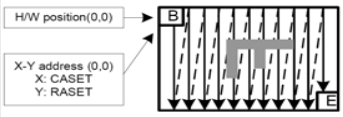
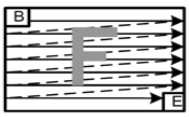
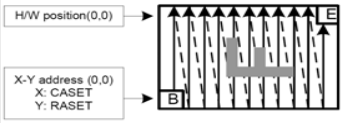
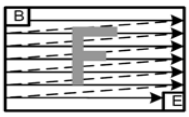
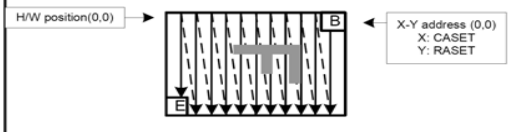
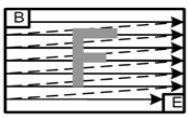
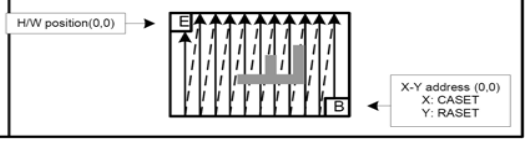
The address counter set the addresses of the display data RAM for writing and reading. Data is written pixel-wise into the RAM matrix of DRIVER. The data for one pixel or two pixels is collected (RGB 6-6-6-bit), according to the data formats. As soon as this pixel-data information is complete the"Write access" is activated on the RAM. The locations of RAM are addressed by the address pointers. When GM=011, 132RGB x 162, the address ranges are X=0 to X=131 (83h) and Y=0 to Y=161 (A1h). Addresses outside these ranges are not allowed. Before writing to the RAM a window must be defined into which will be written. The window is programmable via the command register XS, YS designating the start address and XE, YE designating the end address.

For example the whole display contents will be written, the window is defined by the following values: XS=0(0h) YS=0(0h) and XE=131(83h), YE=161(A1h) In vertical addressing mode (MV=1), the Y-address increments after each byte, after the last Y-address (Y=YE), Y wraps around to YS and X increments to address the next column. In horizontal addressing mode (V=0), the X-address increments after each byte, after the last X-address(X=XE), X wraps around to XS and Y increments to address the next row. After the every last address (X=XE and Y=YE) the address pointers wrap around to address (X=XS and Y=YS).

For flexibility in handling a wide variety of display architectures, the commands "CASET, RASET" and "MADCTR", define flags MX and MY, which allows mirroring of the X-address and Y-address. All combinations of flags are allowed. Below table shows the available combinations of writing to the display RAM. When MX, MY and MV will be changed the data bust be rewritten to the display RAM. For each image orientation, the controls for the column and page counters apply as below:

Condition	Column Counter	Row Counter
When RAMWR/RAMRD command is accepted	Return to “Start Column(XS)”	Return to “Start Row(YS)”
Complete Pixel Read/Write action	Increment by 1	No change
The Column counter value is larger than “End Column(XE)”	Return to “Start Column(XS)”	Increment by 1
The Column counter value is larger than “End Column(XE)” and the Row counter value is larger than “End Row(YE)”	Return to “Start Column(XS)”	Return to “Start Row (YS)”

Table 5-3 Frame Data Write Direction According to the MADCTR parameters (MV, MX and MY)

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

6. Tearing Effect

The Tearing Effect output line supplies to the MCU 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 MCU to synchronize Frame Memory Writing when displaying video images.

6.1. Tearing Effect Line Modes

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

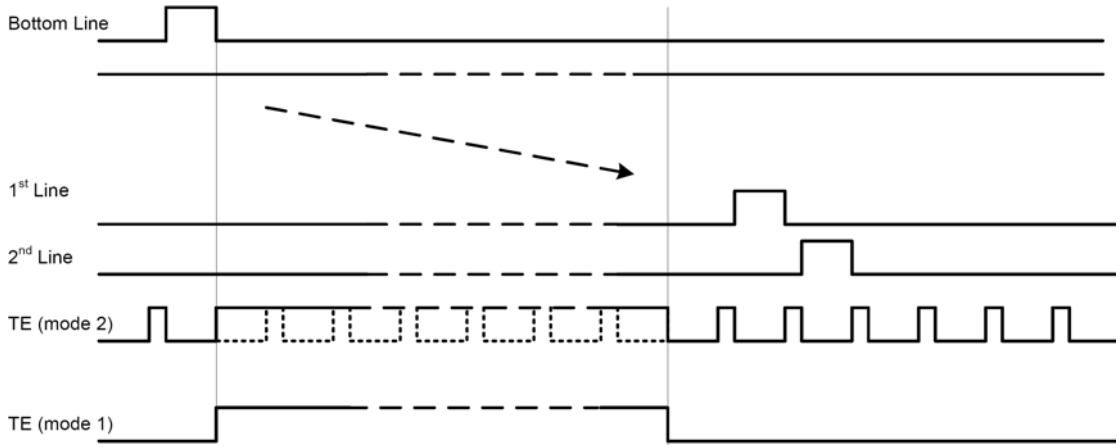
Tvdh = The LCD display is not updated from the Frame Memory.

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

Mode 2, the Tearing Effect Output signal consists of V-Sync and H-Sync information, There is one V-sync and 162 H-sync pulses per field:

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

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



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

6.2. Tearing Effect Line Timing

The Tearing Effect signal is described below:

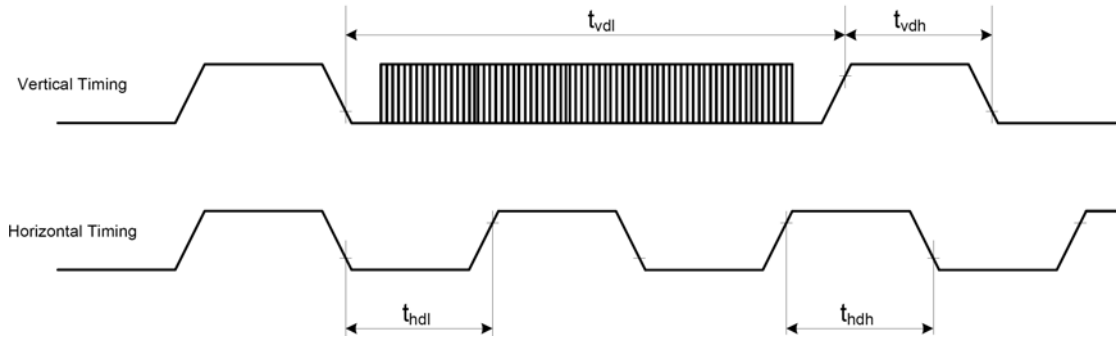


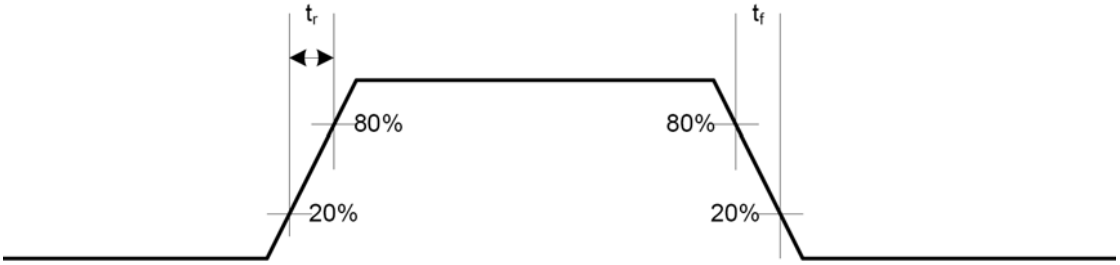
Table 6-2 AC characteristics of Tearing Effect Signal Idle Mode Off/On (Frame Rate = 58.9Hz)

Symbol	Parameter	MIN	MAX	Unit	Descritpion
tvdl	Vertical Timing Low Duration	13	-	Ms	
tvdh	Vertical Timing High Duration	1000	-	µs	
thdl	Horizontal Timing Low Duration	33	-	µs	
thdh	Horizontal Timing High Duration	25	500	µs	

Notes:

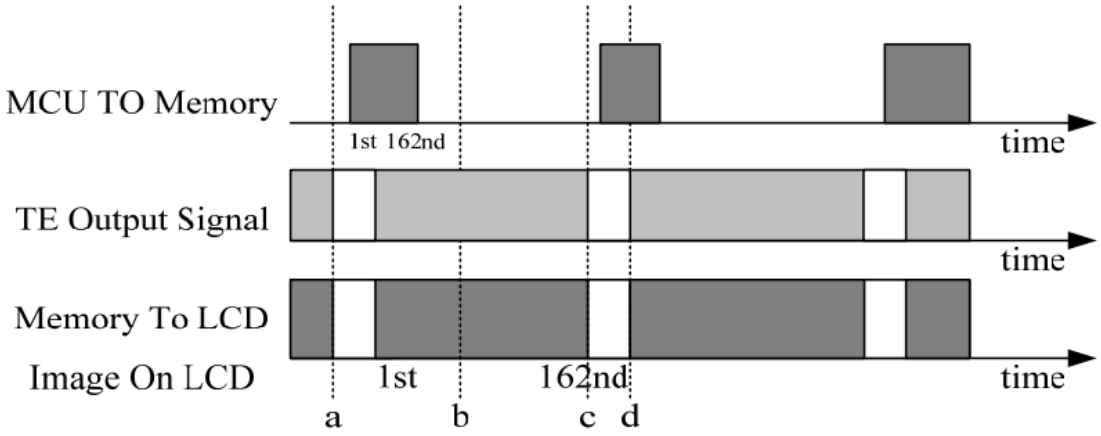
The timings in Table 7-2 apply when MADCTL B4=0

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



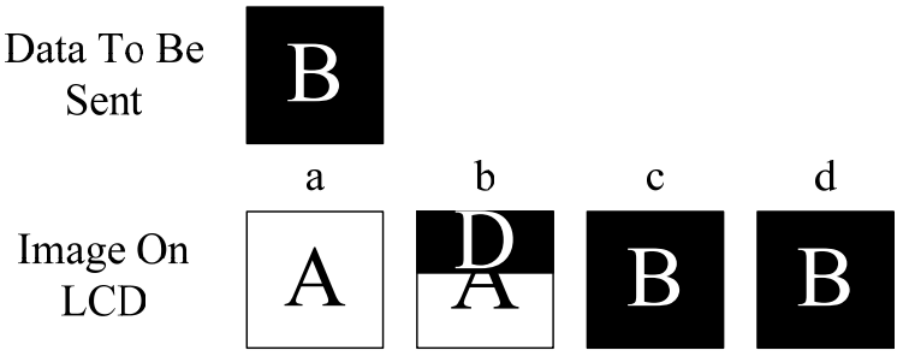
The Tearing Effect Output Line is fed back to the MCU and should be used as shown below to avoid Tearing Effect:

6.2.1. Example 1 MCU Write is Faster than Panel Read

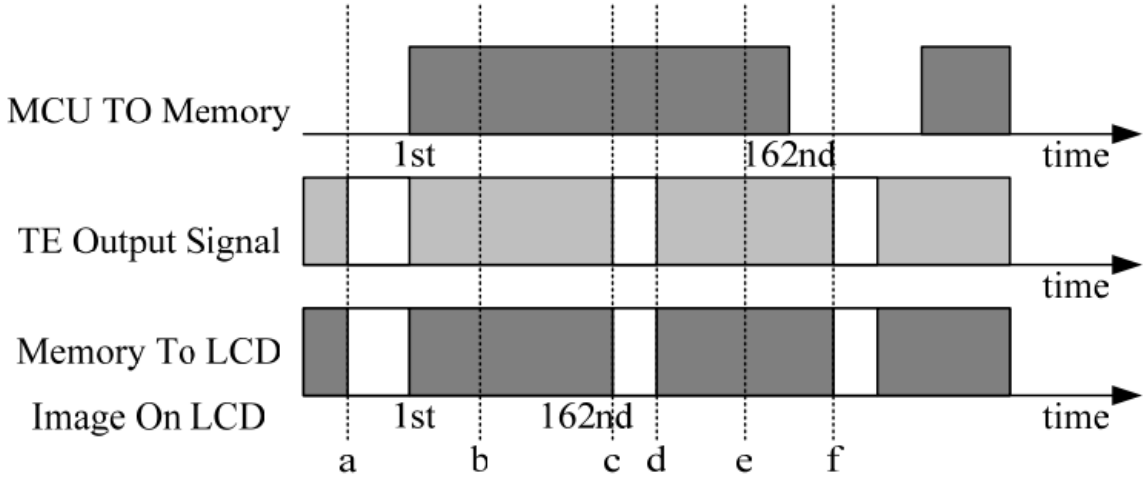


The MCU to Frame Memory write begins just after Panel Read has commenced i.e. after one horizontal sync pulse of the Tearing Effect Output Line. This allows time for the image to download behind the Panel Read pointer and finishing download during the subsequent Frame before the Read Pointer “catches”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

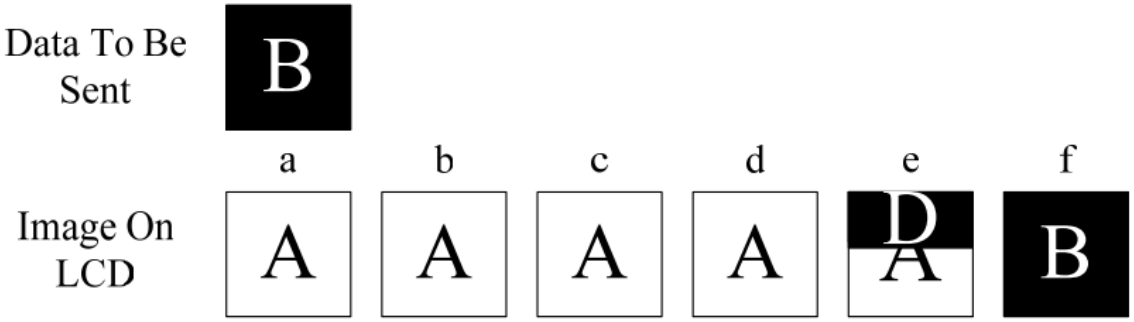
Frame refresh has a complete new image:



6.2.2. Example 2 MCU Write is slower than Panel Read



The MCU 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 MCU to Frame memory write position.



7. Power ON/OFF Sequence

IOVCC and VCI can be applied in any order.

VCI and IOVCC can be powered down in any order.

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

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

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

Notes:

There will be no damage to the display module if the power sequences are not met.

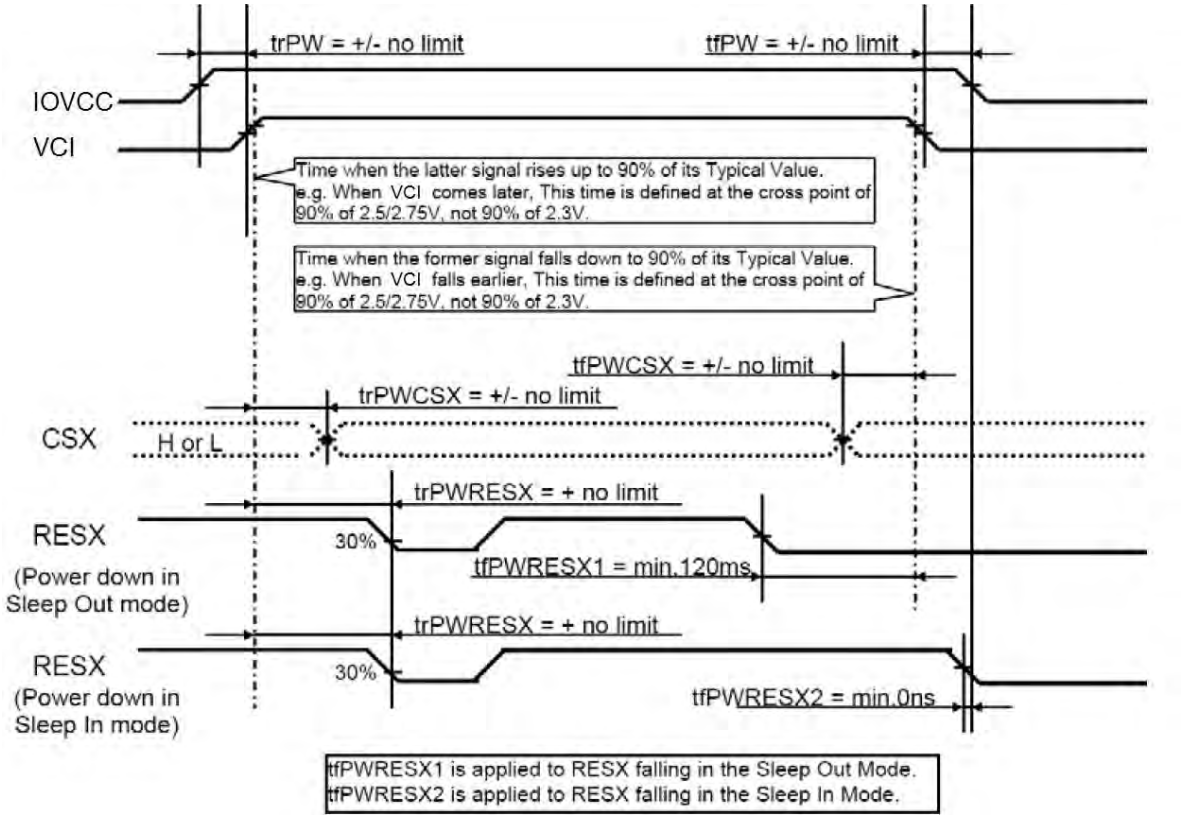
There will be no abnormal visible effects on the display panel during the Power On/Off Sequences.

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 8.1 and 8.2, 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.

7.1. Case 1 - RESX line is held high or Unstable by Host at Power On

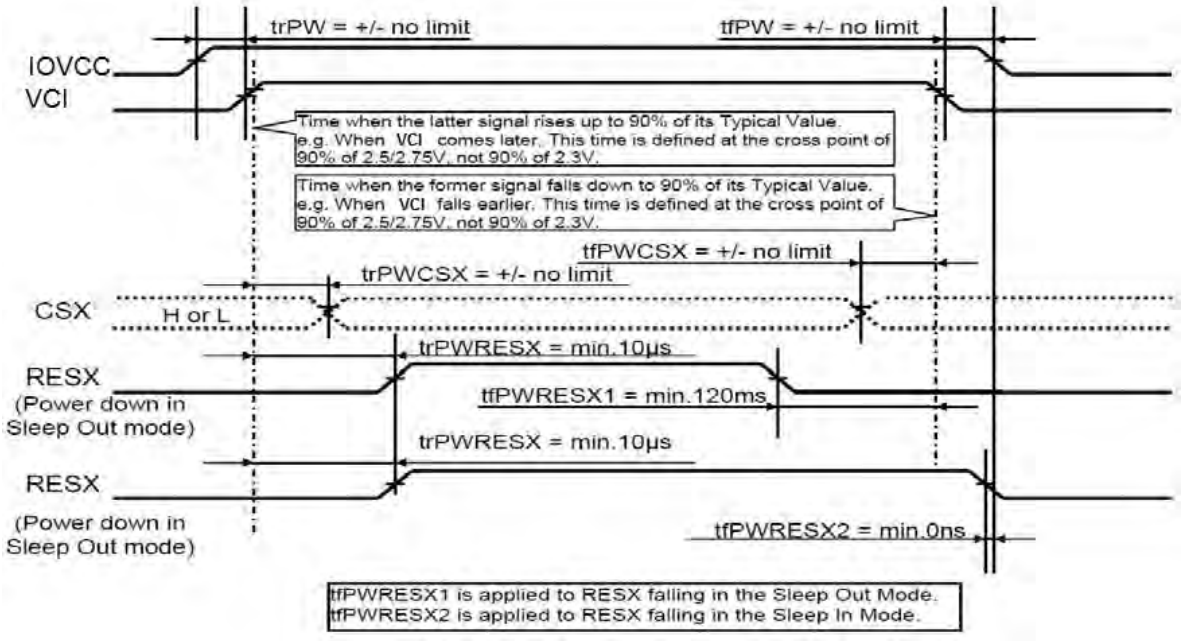
If RESX line is held high or unstable by the host during Power On, then a Hardware Reset must be applied after both VCI and IOVCC have been applied – otherwise correct functionality is not guaranteed. There is no timing restriction upon this hardware reset.



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

7.2. 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 µsec after both VCI and IOVCC have been applied.



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

7.3. Uncontrolled Power Off

The uncontrolled power off means a situation when e.g. there is removed a battery without the controlled power off sequence. The display module must meet following requirements:

There cannot be any damages for the display module or the display module cannot cause any damages for the host or lines of the interface.

There cannot be any abnormal visible effects (= Display must be blank) within 1 second on the display and remains blank until “Power On Sequence” powers it up.

8. Power Level Definition

8.1. Power Levels

6 level modes are defined they are in order of Maximum Power consumption to Minimum Power Consumption:

1. Normal Mode On (full display), Idle Mode Off, Sleep Out. In this mode, the display is able to show maximum 262,144 colors.

2. Partial Mode On, Idle Mode Off, Sleep Out. In this mode part of the display is used with maximum 262,144 colors.

3. Normal Mode On (full display), Idle Mode On, Sleep Out. In this mode, the full display area is used but with 8 colors.

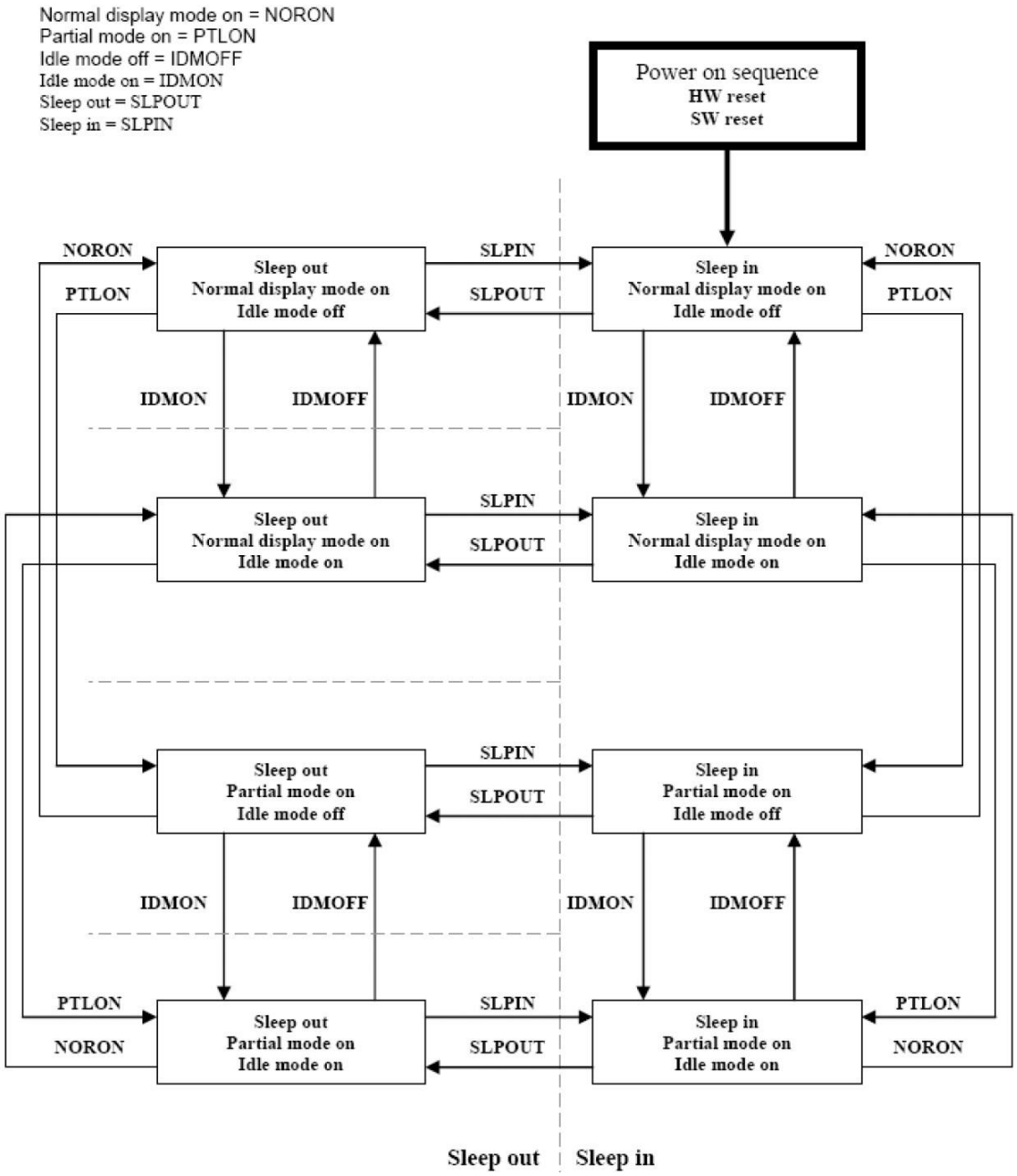
4. Partial Mode On, Idle Mode On, Sleep Out. In this mode, part of the display is used but with 8 colors.

5. Sleep In Mode. In this mode, the DC/DC converter, internal oscillator and panel driver circuit are stopped. Only the MCU interface and memory works with IOVCC power supply. Contents of the memory are safe.

6. Power Off Mode. In this mode, both VCI and IOVCC are removed.

Note: Transition between modes 1-5 is controllable by MCU commands. Mode 6 is entered only when both Power supplies are removed.If RESX line is held high or unstable by the host during Power On, then a Hardware Reset must be applied after both VCI and IOVCC have been applied – otherwise correct functionality is not guaranteed. There is no timing restriction upon

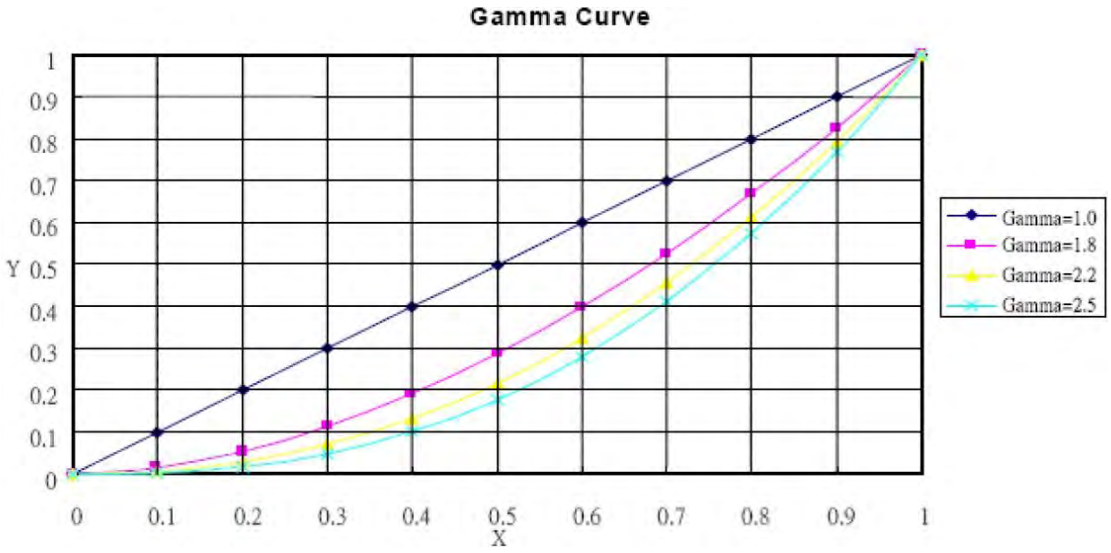
8.2. Power Flow Chart



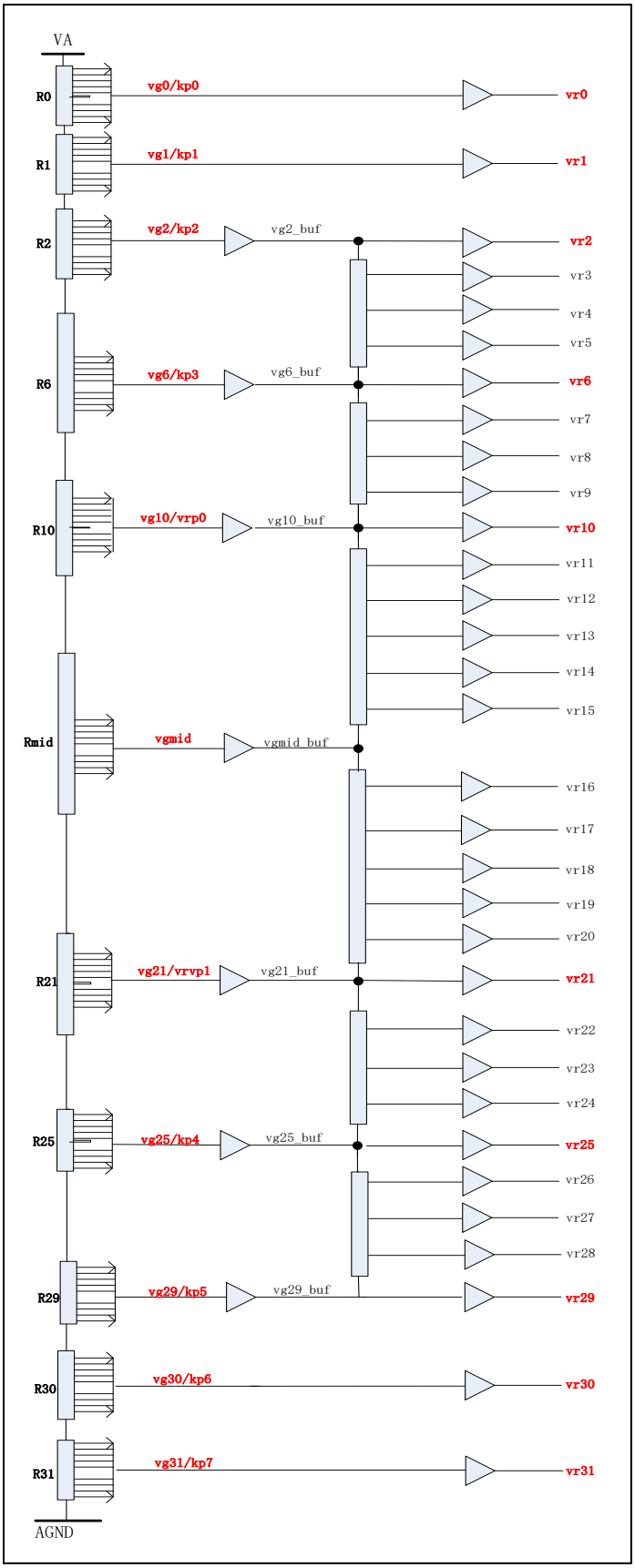
Note 1: There is not any abnormal visual effect when there is changing from one power mode to another power mode.
Note 2: There is not any limitation, which is not specified by Nokia, when there is changing from one power mode to another power mode.
Note 3: It is recommended that it should be enter Sleep in before power off.

9. Gamma Curve

9.1. Gamma curve according to the Gamma 1.0/1.8/2.2/2.5



9.2. Gamma Structure



10. Reset Function

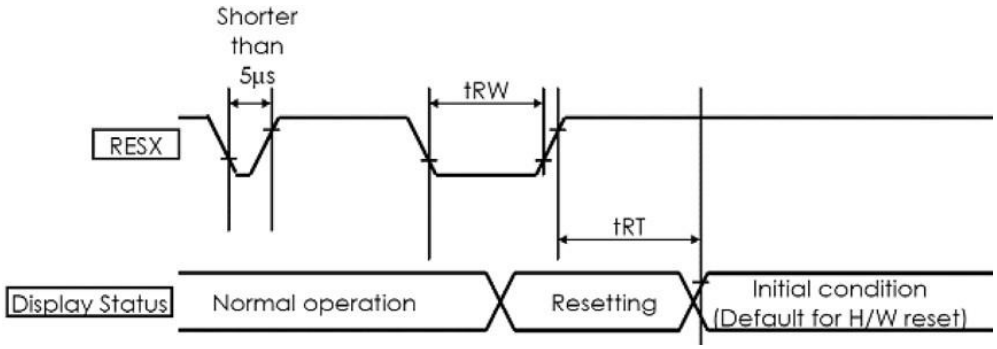
10.1. State of Register After Different Reset

The registers for resolution 128(RGB) x160 are initialized are listed below:

Item	After Power On	After Hardware Reset	After Software Reset
Frame memory	Random	No Change	No Change
Sleep In/Out	In	In	In
Display On/Off	Off	Off	Off
Display mode(normal/partial)	Normal	Normal	Normal
Display Inversion On/Off	Off	Off	Off
Display Idle Mode On/Off	Off	Off	Off
Column:Start Address(XS)	0000h	0000h	0000h
Column:End Address(XE)	007Fh	007Fh	007Fh
Row:Start Address(YS)	0000h	0000h	0000h
Row:End Address(YE)	009Fh	009Fh	009Fh
Gamma Setting	GC0	GC0	GC0
Color Set	262K	262K	262K
Partial:Start Address(PSL)	0000h	0000h	0000h
Partial:End Address(PEL)	009Fh	009Fh	009Fh
Scroll:Vertical scrolling	Off	Off	Off
Scroll:Top Fixed Area(TFA)	0000h	0000h	0000h
Scroll:Scroll Area(VSA)	00A0h	00A0h	00A0h
Scroll:Bottom Fixed Area(BFA)	0000h	0000h	0000h
Scroll Start Address (SSA)	0000h	0000h	0000h
Tearing:On/Off	Off	Off	Off
Tearing Effect Mode*3	0(Mode1)	0(Mode1)	0(Mode1)
Memory Data Access Control (MY/MX/MV/ML/MH/RGB)	0/0/0/0/0/0	0/0/0/0/0/0	No change
Interface Pixel Color Format	6(18-Bit/Pixel)	6(18-Bit/Pixel)	No change
RDDPM	08h	08h	08h
RDDMADCTR	0	0	No change
RDDCOLMOD	6(18-Bit/Pixel)	6(18-Bit/Pixel)	No change
RDDIM	00h	00h	No change
RDDSM	00h	00h	00h
RDDSER	00h	00h	00h
ID1	33h	33h	33h
ID2	30h	30h	30h
ID3	25h	25h	25h

Notes: 1. There will be no abnormal visible effects on the display when S/W or H/W Reset are applied.
2. After Powered-On Reset finishes within 10μs after both VCI & IOVCC are applied.
3. Mode 1 means Tearing Effect Output Line consists of V-Blanking Information only.

10.2. Reset Timing



(VSS=0V, IOVCC=1.65V to 3.6V, VCI=2.5V to 3.6V, Ta = -30 to 85℃)

Symbol	Parameter	Related Pins	MIN	TYP	MAX	Note	Unit
tRW	Valid Reset low pulse width	RESX	10	-	-	-	us
tRT	Valid Reset Complete width	RESX	-	-	5	When reset applied during Sleep in mode	ms
		RESX	-	-	120	When reset applied during Sleep out mode	ms

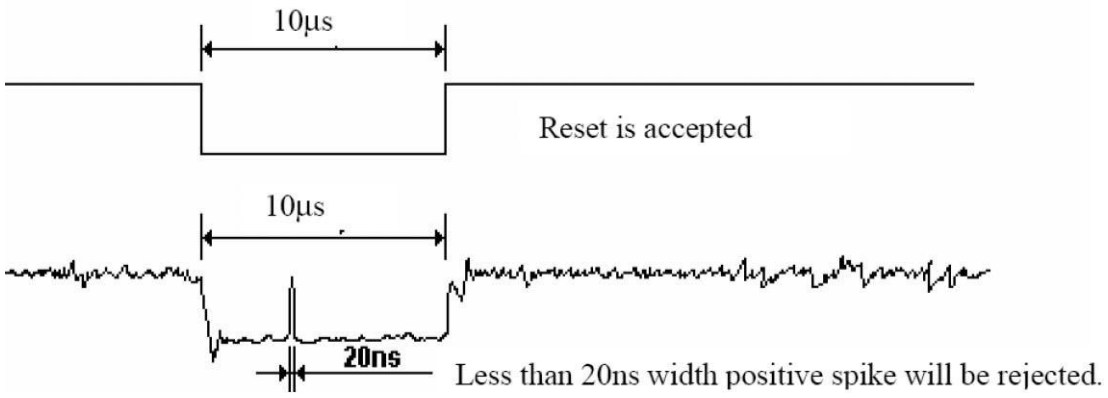
Note:

1> Spike due to an electrostatic discharge on RESX line does not cause system reset according to the table below.

RESX Pulse	Action
Shorten than 5us	Reset Rejected
Longer than 10us	Reset
Between 5us and 10us	Reset starts(It depends on voltage and temperature condition)

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 Hardware Reset.

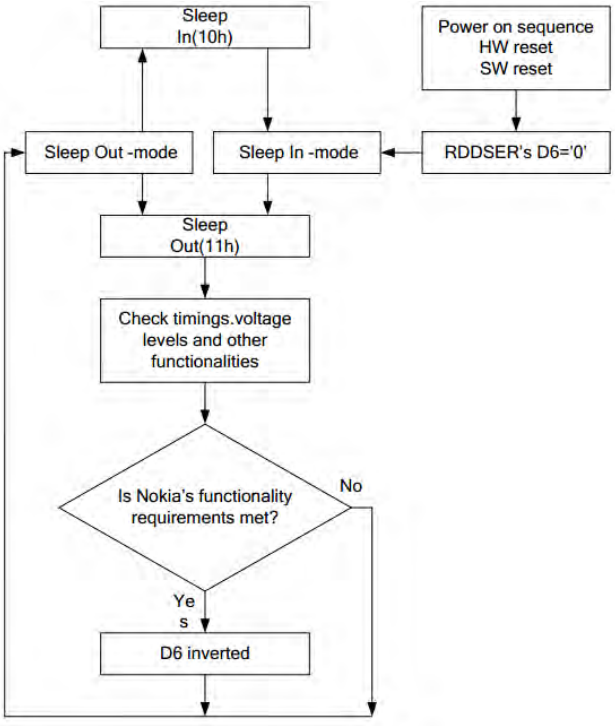
3> Spike Rejection also applies during a valid reset pulse as shown below:



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

11. Sleep Out and Self-Diagnostic Functions of Display

Sleep Out-command (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 (only Booster voltage level). If functionality requirement is met, there is inverted a bit, which defined in command ("0Fh", The used bit of this command is D6). If functionality requirement is not same, this bit (D6) is not inverted. The flow chart for this internal function is following:



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

12. Command

12.1. System Function Command List and Description

Addr	Name	R/W	D7	D6	D5	D4	D3	D2	D1	D0
0x00	NOP	W								
0x01	SWRESET	W								
0x04	RDDID	R	sys_id1[7:0]							
			sys_id2[7:0]							
			sys_id3[7:0]							
0x09	RDDST	R	boost_on	my	mx	mv	ml	rgb		
			pixel_fmt[3:0]				idle_on	ptl_on	slpout	normal_on
			scroll_on	1'b0	invon	1'b0	1'b0	dispon	te_on	1'b0
			1'b0	1'b0	telom	rgb_on				
0x0A	RDDPM	R	boost_on	idle_on	ptl_on	slpout	normal_on	dispon	2'd0	
0x0B	RDD_MADCTR	R	my	mx	mv	ml	sbgr	3'd0		
0x0C	RDD_COLMOD	R	vipf[3:0]				1'b0	ifpf[2:0]		
0x0D	RDDIM	R	scroll_on	1'b0	invon	5'd0				
0x0E	RDDSM	R	te_on	telom	6'd0					
0x0F	RDDSDR	R	{4{self_diag}}				4'd0			
0x10	SLPIN	W								
0x11	SLPOUT	W								
0x12	PTLON	W								
0x13	NORON	W								
0x20	INVOFF	W								
0x21	INVON	W								
0x28	DISPOFF	W								
0x29	DISPON	W								
0x2A	CASET	W	col_st_set[7:0]							
			col_ed_set[7:0]							
0x2B	RASET	W	row_st_set[7:0]							
			row_ed_set[7:0]							
0x2C	RAMWR	W								
0x30	PTLAR	W	ptl_st_set[7:0]							
			ptl_ed_set[7:0]							
0x33	SCRLAR	W	tfa[7:0]							
			vsa[7:0]							
0x34	TEOFF	W								

Addr	Name	R/W	D7	D6	D5	D4	D3	D2	D1	D0
0x35	TEON	W								
0x36	MADCTR	W	my	mx	mv	ml	rgb			
0x37	VSCSAD	W	ssa[7:0]							
0x38	IDMOFF	W								
0x39	IDMON	W								
0x3A	COLMOD	W	vipf[3:0]					ifpf[2:0]		
0xDA	RDID1	R	sys_id1[7:0]							
0xDB	RDID2	R	sys_id2[7:0]							
0xDC	RDID3	R	sys_id3[7:0]							

12.1.1. NOP (00h)

<table>
<tr><th>00H</th><th colspan="11">No Operation</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>00H</td></tr>
<tr><td>Parameter</td><td colspan="12">No Parameter</td></tr>
<tr><td>Description</td><td colspan="12">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 White or Read as described in RAMWR (Memory White) and RAMRD (Memory Read) Commands.
X=Don’t care.</td></tr>
<tr><td>Restriction</td><td colspan="12">None</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value</th></tr><tr><td>Power On Sequence</td><td>N/A</td></tr><tr><td>SW Reset</td><td>N/A</td></tr><tr><td>HW Reset</td><td>N/A</td></tr></table></td></tr>
</table>

12.1.2. SWRESET (01h)

<table>
<tr><th>01H</th><th colspan="12">Software Reset</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>01H</td></tr>
<tr><td>Parameter</td><td colspan="12">No Parameter</td></tr>
<tr><td>Description</td><td colspan="12">When the Software Reset command is written, it causes software reset. It resets the commands and parameters to their S/W Reset default values. (See default tables in each command description.)
Note: The Frame Memory contents are affected by this command.
X=Don’t care</td></tr>
<tr><td>Restriction</td><td colspan="12">None</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value</th></tr><tr><td>Power On Sequence</td><td>N/A</td></tr><tr><td>SW Reset</td><td>N/A</td></tr><tr><td>HW Reset</td><td>N/A</td></tr></table></td></tr>
</table>

12.1.3. RDDID (04h)

<table>
<tr><td>04H</td><td colspan="12">Read Display ID</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>R</td><td>H</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>04H</td></tr>
<tr><td>Parameter1</td><td>H</td><td>R</td><td>H</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>Parameter2</td><td>H</td><td>R</td><td>H</td><td colspan="8">SYS_ID1[7:0]</td><td>33H</td></tr>
<tr><td>Parameter3</td><td>H</td><td>R</td><td>H</td><td colspan="8">SYS_ID2[7:0]</td><td>30H</td></tr>
<tr><td>Parameter4</td><td>H</td><td>R</td><td>H</td><td colspan="8">SYS_ID3[7:0]</td><td>25H</td></tr>
<tr><td>Description</td><td colspan="12">This read byte returns 24-bit display identification.
The 1st Parameter is dummy read.
The 2st Parameter (SYS_ID1): LCD module’s manufacture ID.
The 3st Parameter (SYS_ID2): LCD module/driver version ID.
The 4st Parameter (SYS_ID3): LCD module/driver version ID.
Note: Commands RDDID1/2/3 (DAh, DBh, DCh) read data correspond to the parameters 1, 2, 3 of command 04h, respectively.</td></tr>
<tr><td>Restriction</td><td colspan="12">None</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th rowspan="2">Status</th><th colspan="3">Default Value</th></tr><tr><th>ID1</th><th>ID2</th><th>ID3</th></tr><tr><td>Power On Sequence</td><td>8’h33</td><td>8’h30</td><td>8’h25</td></tr><tr><td>SW Reset</td><td>8’h33</td><td>8’h30</td><td>8’h25</td></tr><tr><td>HW Reset</td><td>8’h33</td><td>8’h30</td><td>8’h25</td></tr></table></td></tr>
</table>

12.1.4. RDDST (09h)

09H	Read Display Status											
	D/CX	RDX	WRX	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	L	R	H	0	0	0	0	1	0	0	1	09H
Parameter1	H	R	H	X	X	X	X	X	X	X	X	X
Parameter2	H	R	H	BOOST_ON	MY	MX	MV	ML	RGB	0	0	00H
Parameter3	H	R	H	PIXEL_FMT[3:0]				IDLO_ON	PTL_ON	SLPOUT	NORMAL_ON	61H
Parameter4	H	R	H	SCROLL_ON	0	INVON	0	0	DISPON	TE_ON	0	00H
Parameter5	H	R	H	0	0	TELOM	RGB_ON					00H

Description

Bit	Description	Value
BOOST_ON	Booster Voltage Status	“1”=Booster on,“0”=Booster off
MY	Row Address Order	“1”=Decrement. (Bottom to Top), when MADCTL (36h) D7=“1”
		“0”=Increment.(Top to Bottom),when MADCTL (36h) D7=“0”
MX	Column Address Order	“1”=Decrement.(Right to Left),when MADCTL(36h)D6=“1”
		“0”=Increment.(Left to Right),when MADCTL(36h)D6=“0”
MV	Row/Column Exchange	“1”=Row/column exchange. when MADCTL (36h) D5=“1”
		“0”=Normal(MV=0).when MADCTL (36h) D5=“0”
ML	Vertical refresh Order	“1”=Decrement.(LCD refresh Bottom to Top, when MADCTL (36h) D4=“1”
		“0”=Increment.(LCD refresh Top to Bottom), when MADCTL(36h)D4=“0”
RGB	RGB/BGR Order	“1”=BGR.when MADCTL(36h)D3=“1”
		“0”=RGB.when MADCTL(36h)D3=“0”
PIXEL_FMT[3:0]	Interface Color Pixel Format Definition	“0011”=12-bit/pixel
		“0101”=16-bit/pixel
		“0110”=18-bit/pixel
		The other=not defined
IDLE_ON	Idle Mode On/Off	“1”=On,“0”=Off
PTL_ON	Partial Mode On/Off	“1”=On,“0”=Off
SLPOUT	Sleep In/Out	“1”=On,“0”=Off
NORMAL_ON	Display Normal Mode On/Off	“1”=Normal Display,“0”=Normal Display Off
SCROLL_ON	Vertical Scrolling Status	“1”=Scroll On,“0”=Scroll Off
INVON	Inversion Status	“1”=On,“0”=Off

<table>
<tr><td></td><td>
<table>
<tr><td>DISPON</td><td>Display On/Off</td><td>“1”=On,“0”=Off</td></tr>
<tr><td>TE_ON</td><td>Tearing effect line on/off</td><td>“1”=On,“0”=Off</td></tr>
<tr><td>TELOM</td><td>Tearing effect line mode</td><td>“0”=mode1,“1”=mode2,</td></tr>
<tr><td>RGB_ON</td><td>RGB interface flag</td><td>“0x1A”=RGB ON,”0x00”=RGB OFF</td></tr>
</table>
</td></tr>
<tr><td>Restriction</td><td>None</td></tr>
<tr><td>Register Availability</td><td>
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table>
</td></tr>
<tr><td>Default</td><td>
<table>
<tr><th rowspan="2">Status</th><th colspan="4">Default Value(ST31 to ST0)</th></tr>
<tr><th>ST[31-24]</th><th>ST[23-16]</th><th>ST[15-8]</th><th>ST[7-0]</th></tr>
<tr><td>Power on Sequence</td><td>0000-0100</td><td>0110-0001</td><td>0000-0000</td><td>0000-0000</td></tr>
<tr><td>SW Reset</td><td>0xxx-xxx0</td><td>0xxx-0001</td><td>0000-0000</td><td>0000-0000</td></tr>
<tr><td>HW Reset</td><td>0000-0000</td><td>0110-0001</td><td>0000-0000</td><td>0000-0000</td></tr>
</table>
</td></tr>
</table>

12.1.5. RDDPM (0Ah)

0AH	Read Display Power Mode											
	D/CX	RDX	WRX	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	L	R	H	0	0	0	0	1	0	1	0	0AH
Parameter1	H	R	H	X	X	X	X	X	X	X	X	X
Parameter2	H	R	H	BOOST_ON	IDLO_ON	PTL_ON	SLPOUT	NORMAL_ON	DISPOM	0	0	-

Description

Bit	Description	Value
BOOST_ON	Booster Voltage Status	“1”=Booster On “0”Booster Off
IDLE_ON	Idle mode On/Off	“1”=Idle mode On “0”=Idle mode Off
PTL_ON	Partial Mode On/Off	“1”=Partial Mode On “0”=Partial Mode Off
SLPOUT	Sleep In/Off	“1”=Sleep Out “0”=Sleep In
NORMAL_ON	Display Normal Mode On/Off	“1”=Normal Display “0”=Partial Display
DISPON	Display On/Off	“1”=Display On “0”=Display Off

Restriction: None

Register Availability

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

Default

Status	Default Value(D7 to D0)
Power On Sequence	0000_1000(08h)
SW Reset	0000_1000(08h)
HW Reset	0000_1000(08h)

12.1.6. RDDMADCTL (0Bh)

0BH	Read Display MADCTL											
	D/CX	RDX	WRX	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	L	R	H	0	0	0	0	1	0	1	1	0BH
Parameter1	H	R	H	X	X	X	X	X	X	X	X	X
Parameter2	H	R	H	MY	MX	MV	ML	SBGR	0	0	0	-

Description

Bit	Description	Value
MY	Page Address Order	“1”=Decrement,“0”=Increment
MX	Column Address Order	“1”=Decrement,“0”=Increment
MV	Page/Column Order	“1”=Row/column exchange (MV=1) “0”=Normal(MV=0)
ML	Line Address Order	“1”=LCD Refresh Bottom to top “0”=LCD Refresh top to Bottom
SBGR	RGB/BGR Order	“1”=BGR, “0”=RGB

Restriction: None

Register Availability

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

Default

Status	Default Value(D7 to D0)
Power On Sequence	8’h08
SW Reset	8’h08
HW Reset	8’h08

12.1.7. RDDCOLMOD (0Ch)

<table>
<tr><td>0CH</td><td colspan="12">Read Display Pixel Format</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>R</td><td>H</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0CH</td></tr>
<tr><td>Parameter1</td><td>H</td><td>R</td><td>H</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>Parameter2</td><td>H</td><td>R</td><td>H</td><td colspan="4">VIPF [3:0]</td><td>0</td><td colspan="3">IFPF [2:0]</td><td>-</td></tr>
<tr><td>Description</td><td colspan="12">The 1st Parameter is dummy read.
<table>
<tr><th colspan="2">Bit</th><th>Description</th><th>Value</th></tr>
<tr><td>D7</td><td>VIPF3</td><td rowspan="4">RGB Interface Color Format</td><td rowspan="4">0101=16 bit/pixel(1 time data transfer)
0110=18 bit/pixel(1 time data transfer)
1110=18 bit/pixel(3 times data transfer)
The other=not defined</td></tr>
<tr><td>D6</td><td>VIPF2</td></tr>
<tr><td>D5</td><td>VIPF1</td></tr>
<tr><td>D4</td><td>VIPF0</td></tr>
<tr><td>D3</td><td>D3</td><td></td><td>“0”（Not Used)</td></tr>
<tr><td>D2</td><td>IFPF2</td><td rowspan="3">Control Interface Color Format</td><td rowspan="3">“011”=12 bit/pixel
“101”=16 bit/pixel
“110”=18 bit/pixel
The other=not defined</td></tr>
<tr><td>D1</td><td>IFPF1</td></tr>
<tr><td>D0</td><td>IFPF0</td></tr>
</table></td></tr>
<tr><td>Restriction</td><td colspan="12">None</td></tr>
<tr><td>Register Availability</td><td colspan="12">
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table></td></tr>
<tr><td>Default</td><td colspan="12">
<table>
<tr><th>Status</th><th>Default Value(D7 to D0)</th></tr>
<tr><td>Power On Sequence</td><td>0110_0110(18bit/pixel)</td></tr>
<tr><td>SW Reset</td><td>No Change</td></tr>
<tr><td>HW Reset</td><td>0110_0110(18bit/pixel)</td></tr>
</table></td></tr>
</table>

12.1.8. RDDIM (0Dh)

<table>
<tr><td>0DH</td><td colspan="12">Read Display Image Mode</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>R</td><td>H</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0DH</td></tr>
<tr><td>Parameter1</td><td>H</td><td>R</td><td>H</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>Parameter2</td><td>H</td><td>R</td><td>H</td><td>SCROLL_ON</td><td>0</td><td>INVON</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>-</td></tr>
<tr><td>Description</td><td colspan="12">The 1st Parameter is dummy read.
<table>
<tr><th>Bit</th><th>Description</th><th>Value</th></tr>
<tr><td>D7</td><td>Scrolling On/Off</td><td>“1”=Scrolling is On
“0”=Scrolling is Off</td></tr>
<tr><td>D5</td><td>Inversion On/Off</td><td>“1”=Inversion is On
“0”=Inversion is Off</td></tr>
</table></td></tr>
<tr><td>Restriction</td><td colspan="12">None</td></tr>
<tr><td>Register Availability</td><td colspan="12">
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table></td></tr>
<tr><td>Default</td><td colspan="12">
<table>
<tr><th>Status</th><th>Default Value(D7 to D0)</th></tr>
<tr><td>Power On Sequence</td><td>8’h00</td></tr>
<tr><td>SW Reset</td><td>8’h00</td></tr>
<tr><td>HW Reset</td><td>8’h00</td></tr>
</table></td></tr>
</table>

12.1.9. RDDSM (0Eh)

<table>
<tr><td>0EH</td><td colspan="11">Read Display Signal Mode</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>R</td><td>H</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0EH</td></tr>
<tr><td>Parameter1</td><td>H</td><td>R</td><td>H</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>Parameter2</td><td>H</td><td>R</td><td>H</td><td>TE_ON</td><td>TALOM</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>-</td></tr>
<tr><td>Description</td><td colspan="11">The 1st Parameter is dummy read.
<table><tr><th>Bit</th><th>Description</th><th>Value</th></tr><tr><td>D7</td><td>Tearing Effect Line On/Off</td><td>“0”=Off, “1”= On</td></tr><tr><td>D6</td><td>Tearing Effect Line Mode</td><td>“0”=Mode1,“1”= Mode2</td></tr></table></td></tr>
<tr><td>Restriction</td><td colspan="11">None</td></tr>
<tr><td>Register Availability</td><td colspan="11"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="11"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h00</td></tr><tr><td>SW Reset</td><td>8’h00</td></tr><tr><td>HW Reset</td><td>8’h00</td></tr></table></td></tr>
</table>

12.1.10. RDDSDR (0Fh)

<table>
<tr><td>0FH</td><td colspan="11">Read Display Self-Diagnostic Result</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>R</td><td>H</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0FH</td></tr>
<tr><td>Parameter1</td><td>H</td><td>R</td><td>H</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>Parameter2</td><td>H</td><td>R</td><td>H</td><td colspan="4">SELF_DIAG[3:0]</td><td>0</td><td>0</td><td>0</td><td>0</td><td>-</td></tr>
<tr><td>Description</td><td colspan="12">The 1st Parameter is dummy read.
If internal function work correctly, send this command will get an inverted result every time.</td></tr>
<tr><td>Restriction</td><td colspan="12">None</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>SLPIN</td></tr><tr><td>SW Reset</td><td>8’h00</td></tr><tr><td>HW Reset</td><td>8’h00</td></tr></table></td></tr>
</table>

12.1.11. SLPIN (10h)

<table>
<tr><th>10H</th><th colspan="12">Sleep In</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>10H</td></tr>
<tr><td>Parameter</td><td colspan="12">No Parameter</td></tr>
<tr><td>Description</td><td colspan="12">This command causes the LCD module to enter the minimum power consumption mode.
In this mode e.g. the DC/DC converter is stopped, Internal oscillator is stopped, and panel scanning is stopped.
MCU interface and memory are still working and the memory keeps it’s contents.</td></tr>
<tr><td>Restriction</td><td colspan="12">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.</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>SLPIN</td></tr><tr><td>SW Reset</td><td>SLPIN</td></tr><tr><td>HW Reset</td><td>SLPIN</td></tr></table></td></tr>
</table>

12.1.12. SLPOUT(11h)

<table>
<tr><td>11H</td><td colspan="11">Sleep Out</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>11H</td></tr>
<tr><td>Parameter</td><td colspan="11">No Parameter</td></tr>
<tr><td>Description</td><td colspan="11">This command turns off sleep mode.
In this mode e.g. the DC/DC converter is enabled. Internal oscillator is started, and panel scanning is started.</td></tr>
<tr><td>Restriction</td><td colspan="11">This command has no effect when module is already in sleep out mode. Sleep Our 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 clock circuits to stabilize.
The display module loads all display supplier’s factory default values to the registers during this 120msec 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.
The display module is doing self-diagnostic function 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.
This command has no effect when module is already in sleep out mode.
Sleep Out Mode can only be left by HW Reset, Software Reset (01h), Sleep In (10h), or a NMI event trigger.</td></tr>
<tr><td>Register Availability</td><td colspan="11"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="11"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>SLPIN</td></tr><tr><td>SW Reset</td><td>SLPIN</td></tr><tr><td>HW Reset</td><td>SLPIN</td></tr></table></td></tr>
</table>

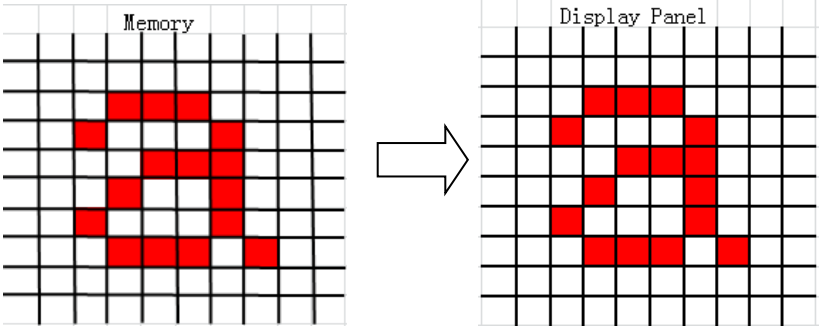
12.1.13. PTLON (12h)

<table>
<tr><td>12H</td><td colspan="11">Partial Display Mode On</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>12H</td></tr>
<tr><td>Parameter</td><td colspan="11">No Parameter</td></tr>
<tr><td>Description</td><td colspan="11">This command turns on partial mode.The partial mode is described by the Partial Area command (30h).
To leave Partial mode, the Normal Display On command (13h) should be written.
X=Don’t care
Note: If a command is written in a frame cycle, the command becomes effective from the next frame.</td></tr>
<tr><td>Restriction</td><td colspan="11">This command has no effect during Partial mode is active.</td></tr>
<tr><td>Register Availability</td><td colspan="11"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="11"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>Normal Display On</td></tr><tr><td>SW Reset</td><td>Normal Display On</td></tr><tr><td>HW Reset</td><td>Normal Display On</td></tr></table></td></tr>
</table>

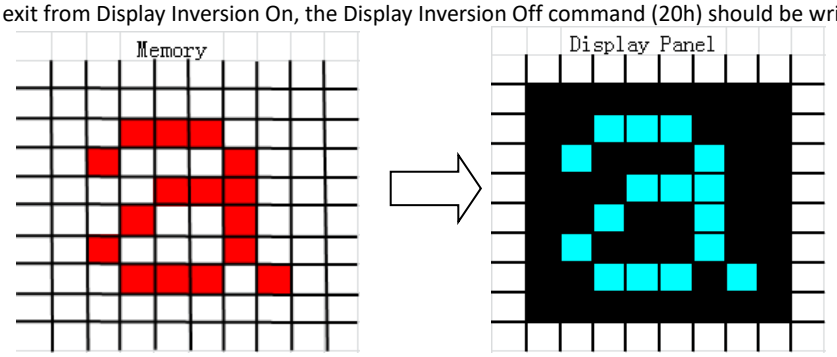
12.1.14. NORON (13h)

<table>
<tr><th>13H</th><th colspan="11">Normal Display Mode On</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>13H</td></tr>
<tr><td>Parameter</td><td colspan="11">No Parameter</td></tr>
<tr><td>Description</td><td colspan="11">This command returns the display to normal mode.
Normal display mode on means Partial mode off and Scroll mode off.
Exit from NORON by the Partial mode On command (12h)
X=Don’t care
Note: If a command is written in a frame cycle, the command becomes effective from the next frame.</td></tr>
<tr><td>Restriction</td><td colspan="11">This command has no effect when Normal Display mode is active.</td></tr>
<tr><td>Register Availability</td><td colspan="11"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="11"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>Normal Display On</td></tr><tr><td>SW Reset</td><td>Normal Display On</td></tr><tr><td>HW Reset</td><td>Normal Display On</td></tr></table></td></tr>
</table>

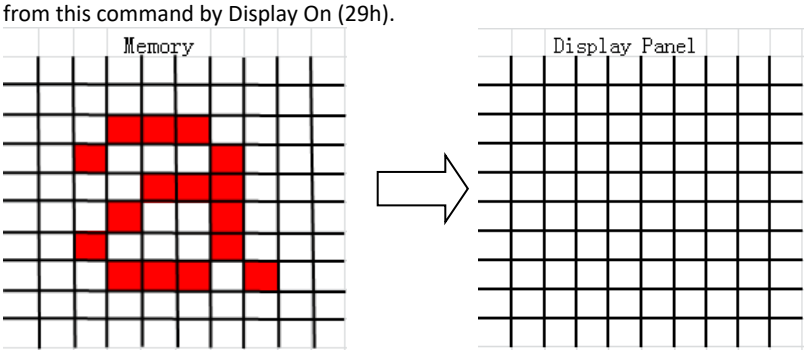
12.1.15. INVOFF (20h)

<table>
<tr><th>20H</th><th colspan="11">Display Inversion Off</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>20H</td></tr>
<tr><td>Parameter</td><td colspan="11">No Parameter</td></tr>
<tr><td>Description</td><td colspan="11">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.
  </td></tr>
<tr><td>Restriction</td><td colspan="11">This command has no effect when module is already in inversion off mode.</td></tr>
<tr><td>Register Availability</td><td colspan="11"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="11"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>Normal Display On</td></tr><tr><td>SW Reset</td><td>Normal Display On</td></tr><tr><td>HW Reset</td><td>Normal Display On</td></tr></table></td></tr>
</table>

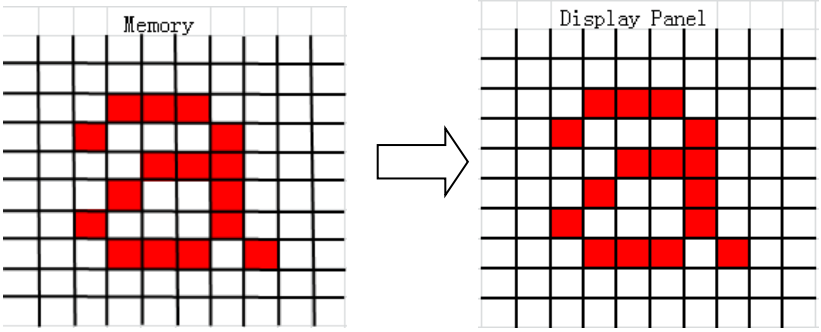
12.1.16. INVON (21h)

<table>
<tr><th>21H</th><th colspan="11">Display Inversion On</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>21H</td></tr>
<tr><td>Parameter</td><td colspan="11">No Parameter</td></tr>
<tr><td>Description</td><td colspan="11">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.
To exit from Display Inversion On, the Display Inversion Off command (20h) should be written.
  </td></tr>
<tr><td>Restriction</td><td colspan="11">This command has no effect when module is already in inversion on mode.</td></tr>
<tr><td>Register Availability</td><td colspan="11"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="11"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>Normal Display On</td></tr><tr><td>SW Reset</td><td>Normal Display On</td></tr><tr><td>HW Reset</td><td>Normal Display On</td></tr></table></td></tr>
</table>

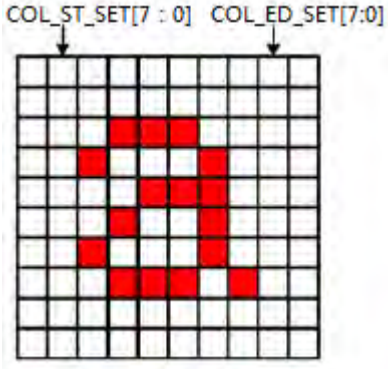
12.1.17. DISPOFF (28h)

<table>
<tr><td>28H</td><td colspan="11">Display Off</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>28H</td></tr>
<tr><td>Parameter</td><td colspan="11">No Parameter</td></tr>
<tr><td>Description</td><td colspan="11">This command is used to enter into DISPLAY OFF mode. In this mode, the output from Frame Memory is disabled and blank page inserted.
This command makes no change of contents of frame memory.
This command does not change any other status.
There will be no abnormal visible effect on the display.
Exit from this command by Display On (29h).
  </td></tr>
<tr><td>Restriction</td><td colspan="11">This command has no effect when module is already in display off mode.</td></tr>
<tr><td>Register Availability</td><td colspan="11"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="11"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>Display Off</td></tr><tr><td>SW Reset</td><td>Display Off</td></tr><tr><td>HW Reset</td><td>Display Off</td></tr></table></td></tr>
</table>

12.1.18 DISPON (29h)

<table>
<tr><td>29H</td><td colspan="11">Display On</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>29H</td></tr>
<tr><td>Parameter</td><td colspan="11">No Parameter</td></tr>
<tr><td>Description</td><td colspan="11">This command is used to recover from DISPLAY OFF mode. Output from the Frame Memory is enabled.
This command makes no change of contents of frame memory.
This command does not change any other status.
 
</td></tr>
<tr><td>Restriction</td><td colspan="11">This command has no effect when module is already in display on mode.</td></tr>
<tr><td>Register Availability</td><td colspan="11"><table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table></td></tr>
<tr><td>Default</td><td colspan="11"><table>
<tr><th>Status</th><th>Default Value(D7 to D0)</th></tr>
<tr><td>Power On Sequence</td><td>Display On</td></tr>
<tr><td>SW Reset</td><td>Display On</td></tr>
<tr><td>HW Reset</td><td>Display On</td></tr>
</table></td></tr>
</table>

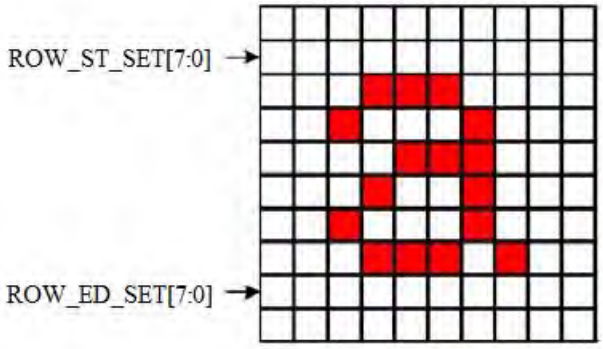
12.1.19 CASET (2Ah)

<table>
<tr><th>2AH</th><th colspan="12">Column Address Set</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>2AH</td></tr>
<tr><td>Parameter1</td><td>H</td><td>H</td><td>R</td><td colspan="8">COL_ST_SET[15:8]</td><td>00H</td></tr>
<tr><td>Parameter2</td><td>H</td><td>H</td><td>R</td><td colspan="8">COL_ST_SET[7:0]</td><td>00H</td></tr>
<tr><td>Parameter3</td><td>H</td><td>H</td><td>R</td><td colspan="8">COL_ED_SET[15:8]</td><td>00H</td></tr>
<tr><td>Parameter4</td><td>H</td><td>H</td><td>R</td><td colspan="8">COL_ED_SET[7:0]</td><td>83H</td></tr>
<tr><td>Description</td><td colspan="12">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 value of COL_ST_SET[7:0] and COL_ED_SET[7:0] are referred when RAMWR command comes.
Each value represents one column line in the Frame Memory.
 
</td></tr>
<tr><td>Restriction</td><td colspan="12">XS[7:0] always must be equal to or less than XE[7:0].
When XS[7:0] or XE[7:0] is greater than maximum row address like below, data of out of range wull be ignored.
1. 132x132 memory base(GM=’101’)
(Parameter range:0≦XS[7:0]≦XE[7:0]≦131(0083H)):MV=”0”
(Parameter range:0≦XS[7:0]≦XE[7:0]≦131(0083H)):MV=”1”
2. 130x130 memory base(GM=’100’)
(Parameter range:0≦XS[7:0]≦XE[7:0]≦129(0081H)):MV=”0”
(Parameter range:0≦XS[7:0]≦XE[7:0]≦129(0081H)):MV=”1”
3. 128x160 memory base(GM=’011’)
(Parameter range:0≦XS[7:0]≦XE[7:0]≦127(007FH)):MV=”0”
(Parameter range:0≦XS[7:0]≦XE[7:0]≦159(009FH)):MV=”1”
4. 120x160 memory base(GM=’010’)
(Parameter range:0≦XS[7:0]≦XE[7:0]≦119(0077H)):MV=”0”
(Parameter range:0≦XS[7:0]≦XE[7:0]≦159(009FH)):MV=”1”
5. 128x128 memory base(GM=’001’)
(Parameter range:0≦XS[7:0]≦XE[7:0]≦127(007FH)):MV=”0”
(Parameter range:0≦XS[7:0]≦XE[7:0]≦127(007FH)):MV=”1”
6. 132x162 memory base(GM=’000’)
(Parameter range:0≦XS[7:0]≦XE[7:0]≦131(0083H)):MV=”0”
(Parameter range:0≦XS[7:0]≦XE[7:0]≦127(00A1H)):MV=”1”</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr></table></td></tr>
</table>

	Partial Mode on,Idle Mode On,Sleep Out: Yes Sleep In: Yes
Default	

Status	Default Value		
(132x132 GM=”101”)	XS[7:0]	XE[7:0]	EX[7:0](MV=1)
Power On Sequence	0000h	0083h(131)	
S/W Reset	0000h	0083h(131)	0083h(131)
H/W Reset	0000h	0083h(131)	
Status	**Default Value**		
(130x130 GM=”100”)	XS[7:0]	XE[7:0]	EX[7:0](MV=1)
Power On Sequence	0000h	0081h(129)	
S/W Reset	0000h	0081h(129)	0081h(129)
H/W Reset	0000h	0081h(129)	
Status	**Default Value**		
(128x160 GM=”011”)	XS[7:0]	XE[7:0]	EX[7:0](MV=1)
Power On Sequence	0000h	007Fh(127)	
S/W Reset	0000h	007Fh(127)	009Fh(159)
H/W Reset	0000h	007Fh(127)	
Status	**Default Value**		
(120x160 GM=”010”)	XS[7:0]	XE[7:0]	EX[7:0](MV=1)
Power On Sequence	0000h	0077h(119)	
S/W Reset	0000h	007Fh(119)	009Fh(159)
H/W Reset	0000h	0077h(119)	
Status	**Default Value**		
(128x128 GM=”001”)	XS[7:0]	XE[7:0]	EX[7:0](MV=1)
Power On Sequence	0000h	007Fh(127)	
S/W Reset	0000h	007Fh(127)	009Fh(127)
H/W Reset	0000h	0077h(119)	
Status	**Default Value**		
(132x162 GM=”000”)	XS[7:0]	XE[7:0]	EX[7:0](MV=1)
Power On Sequence	0000h	0083h(131)	
S/W Reset	0000h	0083h(131)	00A1h(161)
HW Reset	0000h	0083H(131)	

12.1.20 RASET (2Bh)

2BH	Row Address Set											
	D/CX	RDX	WRX	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	L	H	R	0	0	1	0	1	0	1	1	2BH
Parameter1	H	H	R	ROW_ST_SET[15:8]								00H
Parameter2	H	H	R	ROW_ST_SET[7:0]								00H
Parameter3	H	H	R	ROW_ED_SET[15:8]								00H
Parameter4	H	H	R	ROW_ED_SET[7:0]								A1H
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 value of ROW_ST_SET[7:0] and ROW_ED_SET[7:0] are referred when RAMWR command comes. Each value represents one Page line in the Frame Memory.  											
Restriction	YS[7:0] always must be equal to or less than EP[7:0]. When YS[7:0] or YE[7:0] is greater than maximum row address like below,data of out of range wull be ignored. **132x132 memory base(GM='101')** (Parameter range:0≦YS[7:0]≦YE[7:0]≦131(0083H)):MV="0" (Parameter range:0≦YS[7:0]≦YE[7:0]≦131(0083H)):MV="1" **130x130 memory base(GM='100')** (Parameter range:0≦YS[7:0]≦YE[7:0]≦129(0081H)):MV="0" (Parameter range:0≦YS[7:0]≦YE[7:0]≦129(0081H)):MV="1" **128x160 memory base(GM='011')** (Parameter range:0≦YS[7:0]≦YE[7:0]≦159(009FH)):MV="0" (Parameter range:0≦YS[7:0]≦YE[7:0]≦127(009FH)):MV="1" **120x160 memory base(GM='010')** (Parameter range:0≦YS[7:0]≦YE[7:0]≦159(009FH)):MV="0" (Parameter range:0≦YS[7:0]≦YE[7:0]≦119(007FH)):MV="1" **128x128 memory base(GM='001')** (Parameter range:0≦YS[7:0]≦YE[7:0]≦127(007FH)):MV="0" (Parameter range:0≦YS[7:0]≦YE[7:0]≦127(007FH)):MV="1" **132x162 memory base(GM='000')** (Parameter range:0≦YS[7:0]≦YE[7:0]≦161(00A1H)):MV="0" (Parameter range:0≦YS[7:0]≦YE[7:0]≦131(0083H)):MV="1"											
Register Availability												

Status	Availability
Normal Mode on,Idle Mode Off,Sleep Out	Yes
Normal Mode on,Idle Mode On,Sleep Out	Yes

		Partial Mode on,Idle Mode Off,Sleep Out	Yes
		Partial Mode on,Idle Mode On,Sleep Out	Yes
		Sleep In	Yes

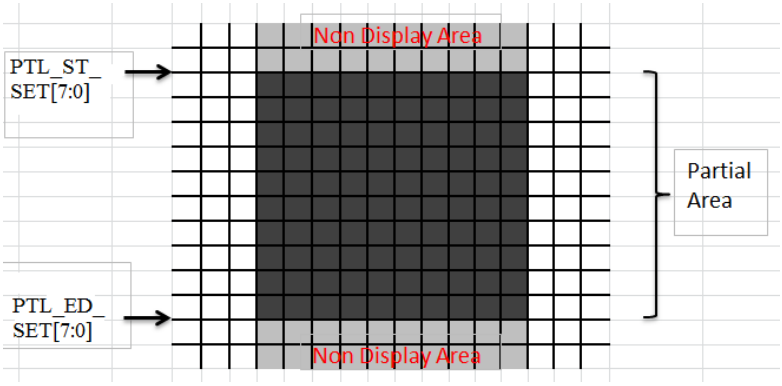
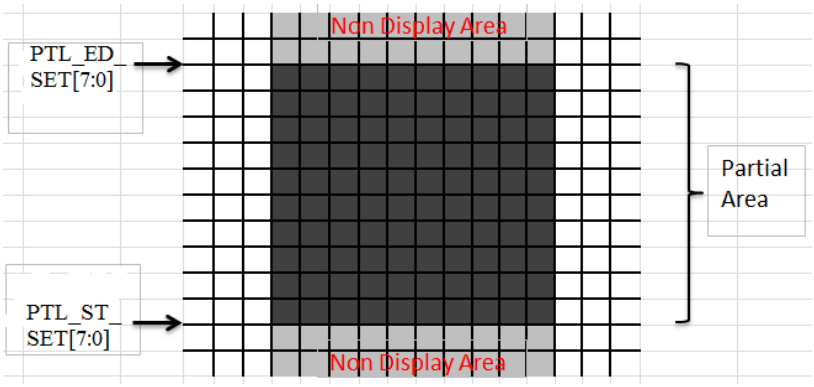
Default

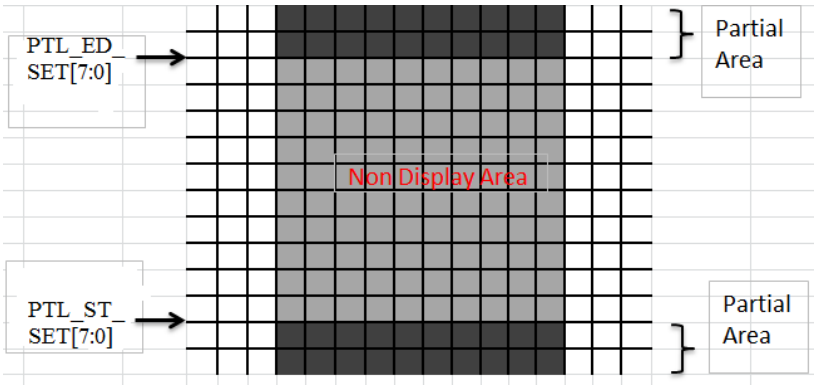
Status	**Default Value**		
(132x132 GM=”101”)	YS[7:0]	YE[7:0]	YX[7:0](MV=1)
Power On Sequence	0000h	83h(131)	
S/W Reset	0000h	83h(131)	83h(131)
H/W Reset	0000h	83h(131)	
Status	**Default Value**		
(130x130 GM=”100”)	YS[7:0]	YE[7:0]	YX[7:0](MV=1)
Power On Sequence	0000h	81h(129)	
S/W Reset	0000h	81h(129)	81h(129)
H/W Reset	0000h	81h(129)	
Status	**Default Value**		
(128x160 GM=”011”)	YS[7:0]	YE[7:0]	YX[7:0](MV=1)
Power On Sequence	00h	9Fh(159)	
S/W Reset	00h	9Fh(159)	7Fh(127)
H/W Reset	00h	9Fh(159)	
Status	**Default Value**		
(120x160 GM=”010”)	YS[7:0]	YE[7:0]	YX[7:0](MV=1)
Power On Sequence	00h	9Fh(159)	
S/W Reset	00h	9Fh(159)	77h(119)
H/W Reset	00h	9Fh(159)	
Status	**Default Value**		
(128x128 GM=”001”)	YS[7:0]	YE[7:0]	YX[7:0](MV=1)
Power On Sequence	00h	7Fh(127)	
S/W Reset	00h	7Fh(127)	7Fh(127)
H/W Reset	00h	7Fh(127)	
Status	**Default Value**		
(132x162 GM=”000”)	YS[7:0]	YE[7:0]	YX[7:0](MV=1)
Power On Sequence	00h	A1h(161)	
S/W Reset	00h	A1h(161)	83h(131)
HW Reset	00h	A1h(161)	

12.1.21 RAMWR (2Ch)

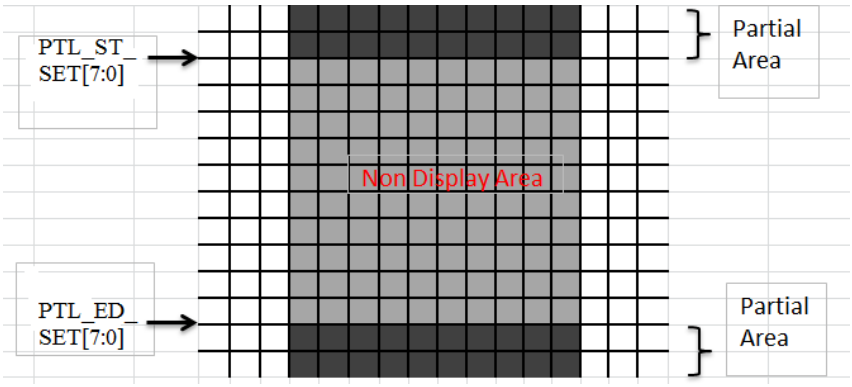
<table>
<tr><th>2CH</th><th colspan="12">Memory Write</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>2CH</td></tr>
<tr><td>1st Parameter</td><td>H</td><td>H</td><td>R</td><td colspan="8">No Parameter</td><td>-</td></tr>
<tr><td>Description</td><td colspan="12">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 and the row register incremented.
Sending any other command can stop frame Write.</td></tr>
<tr><td>Restriction</td><td colspan="12">In all color modes, there is no restriction on length of parameters.
1. 132x132 memory base (GM=”101”)
132x132x18-bit memory can be written by this command.
Memory range(0000h,0000h)->(0083h,083h)
2. 130x130 memory base (GM=”100”)
130x130x18-bit memory can be written by this command.
Memory range(0000h,0000h)->(0081h,081h)
3. 128x160 memory base (GM=”011”)
128x160x18-bit memory can be written by this command.
Memory range(0000h,0000h)->(007Fh,09Fh)
4. 120x160 memory base (GM=”010”)
120x160x18-bit memory can be written by this command.
Memory range(0000h,0000h)->(0077h,09Fh)
5. 128x128 memory base (GM=”001”)
128x128x18-bit memory can be written by this command.
Memory range(0000h,0000h)->(007Fh,007Fh)
6. 132x162 memory base (GM=”000”)
132x162x18-bit memory can be written by this command.
Memory range(0000h,0000h)->(0083h,00A1h)</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>Contents of memory is set randomly</td></tr><tr><td>SW Reset</td><td>Contents of memory is not cleared</td></tr><tr><td>HW Reset</td><td>Contents of memory is not cleared</td></tr></table></td></tr>
</table>

12.1.22 PTLAR(30h)

30H	Partial Area											
	D/CX	RDX	WRX	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	L	H	R	0	0	1	1	0	0	0	0	30H
Parameter1	H	H	R	PTL_ST_SET[15:8]								00H
Parameter2	H	H	R	PTL_ST_SET[7:0]								00H
Parameter3	H	H	R	PTL_ED_SET[15:8]								00H
Parameter4	H	H	R	PTL_ED_SET[7:0]								a1H
Description	This command defines the partial mode's display area.There are 4 parameters associated with this command, the first defines the Start Row(PSL) and the second the End Row(PEL),as illustrated in the figure below.PSL and PEL refer to the Frame Memory Line Pointer. If End Row>Start Row when MADCTL ML=0:  If End Row>Start Row when MADCTL ML=1:  If End Row<Start Row when MADCTL ML=0:											



If End Row<Start Row when MADCTL ML=1:



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

Restriction	No Restriction

Register Availability

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

Default

Status	Default Value						
	PSL[7:0]	PEL[7:0]					
GM	"xxx"	"101"	"100"	"011"	"010"	"001"	"000"
Power On Sequence	8'h00	8'h83	8'h81	8'h9F	8'h9F	8'h7F	8'hA1
SW Reset	8'h00	8'h83	8'h81	8'h9F	8'h9F	8'h7F	8'hA1
HW Reset	8'h00	8'h83	8'h81	8'h9F	8'h9F	8'h7F	8'hA1

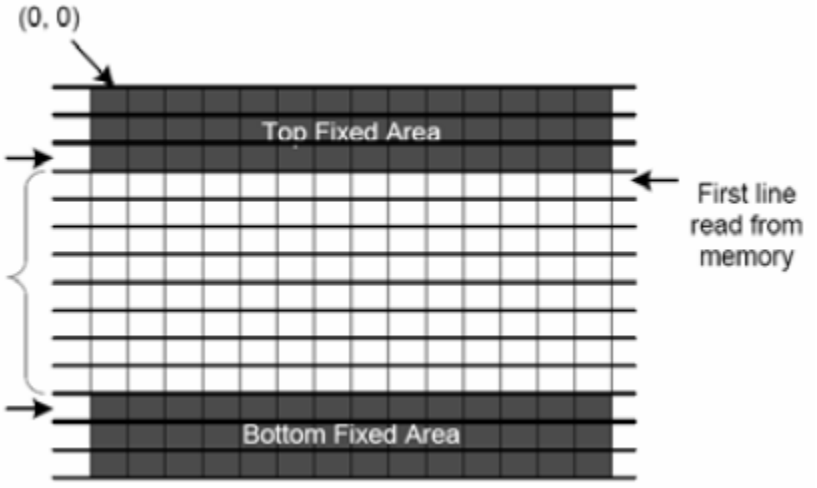
12.1.23 SCRLAR (33h)

33H	Scroll Area											
	D/CX	RDX	WRX	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	L	H	R	0	0	1	1	0	0	1	1	33H
Parameter1	H	H	R	TFA[15:8]								00H
Parameter2	H	H	R	TFA[7:0]								00H
Parameter3	H	H	R	VSA[15:8]								00H
Parameter4	H	H	R	VSA[7:0]								00H

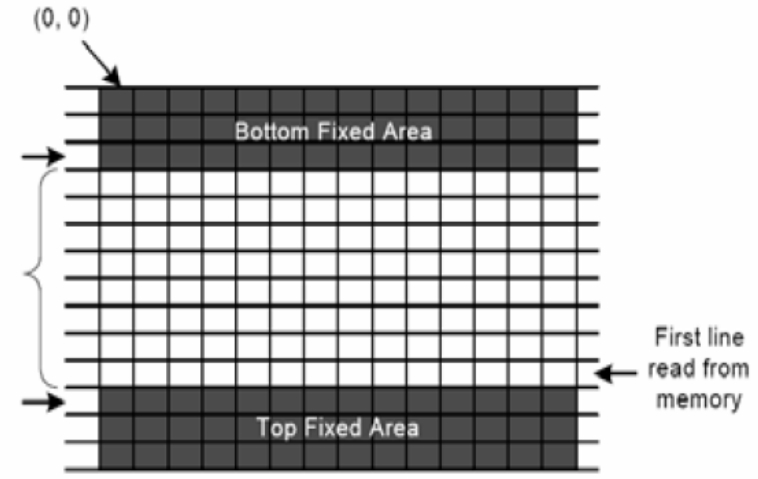
Description

This command defines the Vertical Scrolling Area of the display.
When MADCTL ML=0
The 1st &2nd parameter TFA[7:0]describes the Top Fixed Area (in No.of lines from TOP of the Frame Memory and Display).
The 3rd &4th parameter VSA[7:0]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.

TFA, VSA refer to the Frame Memory Line Point.



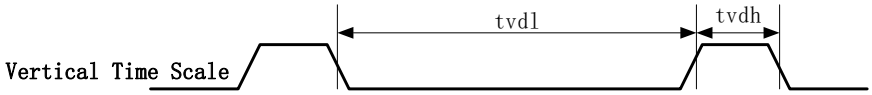
When MADCTL ML=1
The 1st &2nd parameter TFA[7:0] describes the Top Fixed Area (in No.of lines from Bottom of the Frame Memory and Display).
The 3rd &4th parameter VSA[7:0] describes the height of the Vertical Sxrolling Area (in No.of lines of the Frame Memory [not the display] from the Vertical Scrolling Start Address). The first line read from Frame Memory appears immediately after the top most line of the Top Fixed Area.

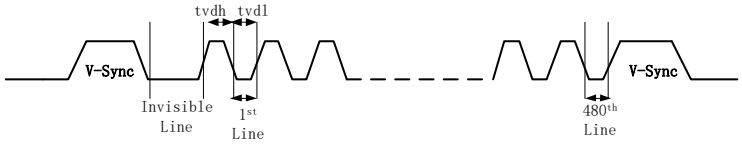
<table>
<tr><td></td><td> 
</td></tr>
<tr><td>Restriction</td><td>The condition is (TFA+VSA+BFA)=128 in 128RGBx128(GM=”001”)
The condition is (TFA+VSA+BFA)=130 in 130RGBx130(GM=”100”)
The condition is (TFA+VSA+BFA)=132 in 132RGBx132(GM=”101”)
The condition is (TFA+VSA+BFA)=160 in 128RGBx160(GM=”011”)
or 120 RGB x 160 (GM=”010”)
The condition is (TFA+VSA+BFA)=162 in 132RGBx162(GM=”000”)
Otherwise Scrolling mode is undefined.
In Vertical Scroll Mode,MADCTL parameter MV should be set to “0”
this affects the Frame memory Write.</td></tr>
<tr><td>Register Availability</td><td><table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table></td></tr>
<tr><td>Default</td><td><table>
<tr><th rowspan="2">Status</th><th colspan="7">Defalut Value</th></tr>
<tr><th>TFA[7:0]</th><th colspan="6">VSA[7:0]</th></tr>
<tr><td>GM</td><td>"xx"</td><td>"101"</td><td>"100"</td><td>"011"</td><td>"010"</td><td>"001"</td><td>"000"</td></tr>
<tr><td>Power On Sequence</td><td>8’h00</td><td>8’h83</td><td>8’h81</td><td>8’hA0</td><td>8’hA0</td><td>8’h80</td><td>8’hA2</td></tr>
<tr><td>SW Reset</td><td>8’h00</td><td>8’h83</td><td>8’h81</td><td>8’hA0</td><td>8’hA0</td><td>8’h80</td><td>8’hA2</td></tr>
<tr><td>HW Reset</td><td>8’h00</td><td>8’h83</td><td>8’h81</td><td>8’hA0</td><td>8’hA0</td><td>8’h80</td><td>8’hA2</td></tr>
</table></td></tr>
</table>

12.1.24 TEOFF (34h)

<table>
<tr><th>34H</th><th colspan="11">Tearing Effect Line Off</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>34H</td></tr>
<tr><td>Parameter</td><td colspan="11">No Parameter</td></tr>
<tr><td>Description</td><td colspan="11">This command is used to turn OFF (Active Low) the Tearing Effect output single from the TE signal line.</td></tr>
<tr><td>Restriction</td><td colspan="11">This command has no effect when Tearing Effect output is already OFF.</td></tr>
<tr><td>Register Availability</td><td colspan="11"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="11"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>OFF</td></tr><tr><td>SW Reset</td><td>OFF</td></tr><tr><td>HW Reset</td><td>OFF</td></tr></table></td></tr>
</table>

12.1.25 TEON (35h)

<table>
<tr><th>35H</th><th colspan="11">Tearing Effect Line On</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>35H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td colspan="8">No Parameter</td><td>-</td></tr>
<tr><td>Description</td><td colspan="12">This command is used to turn ON the Tearing Effect output signal from the TE signal line.This output is not affected by charging MADCTL bit ML.
The Tearing Effect Line On has one parameter which describes the mode of the Tearing Effect Output Line. (X=Don’t Care).
When TELOM=0:
The Tearing Effect Output line consists of V-Blanking information only:
 

When TELOM =1:
The Tearing Effect Output line consists of both V-Blanking and H-Blanking information:
 

Note: During Sleep In Mode with Tearing Effect Line On, Tearing Effect Output pin will be active LOW.
Display Data Format for color coding (18 bit cases), when there is used 8,9,16 or 18 data line for image data.</td></tr>
<tr><td>Restriction</td><td colspan="12">This command has no effect when Tearing Effect output is already ON.</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>Tearing effect off & TELOM=0</td></tr><tr><td>SW Reset</td><td>Tearing effect off & TELOM=0</td></tr><tr><td>HW Reset</td><td>Tearing effect off & TELOM=0</td></tr></table></td></tr>
</table>

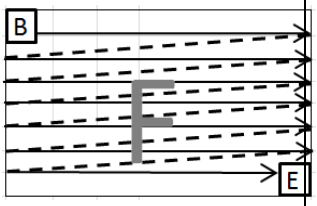
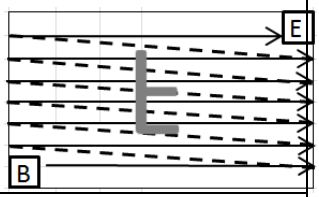
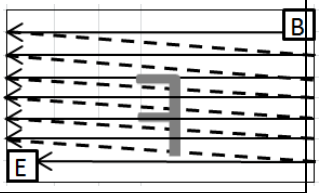
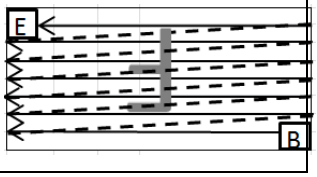
12.1.26 MADCTR (36h)

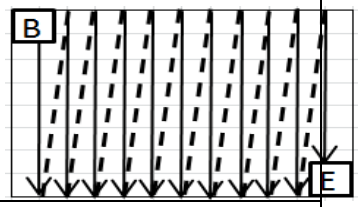
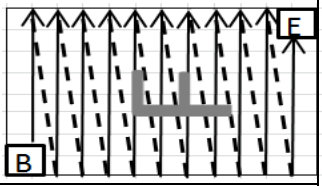
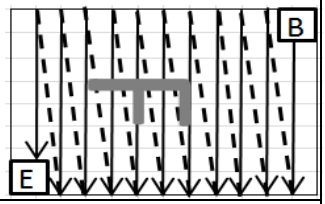
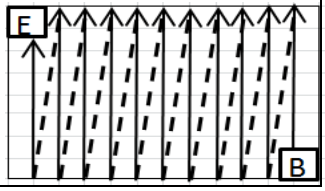
36H	Memory Data Access Control											
	D/CX	RDX	WRX	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	L	H	R	0	0	1	1	0	1	1	0	36H
Parameter	H	H	R	MY	MX	MV	ML	RGB	0	0	0	00H

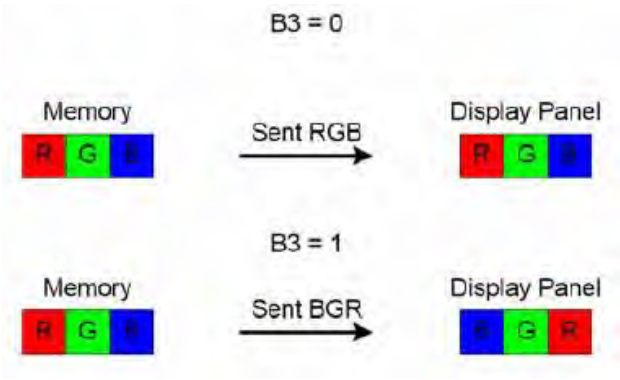
Description

This command defines read/write scanning direction of frame memory.
This command makes no change on the other driver status.
Bit Assignment

Bit	Description	Value
MY	Row Address Order	These 3 bits controls MPU to memory write/read direction.
MX	Column Address Order	
MV	Page/Column Selection	
ML	Vertical Order	LCD Vertical refresh direction control
RGB	RGB/BGR Order	Color selector switch control 0=RGB color filter panel 1=BGR color filter panel

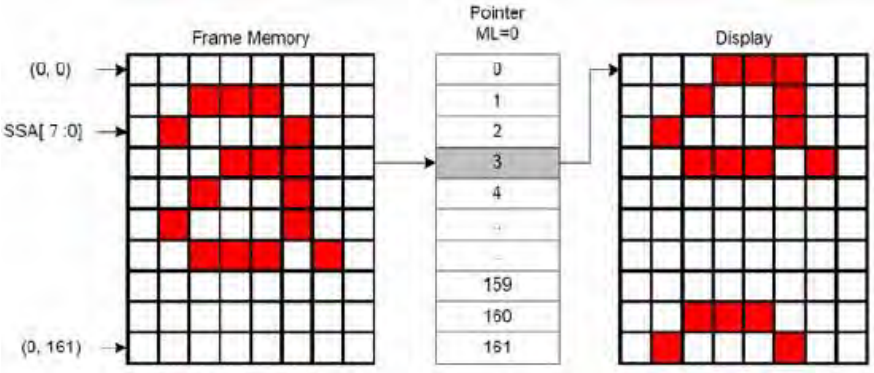
B5	B6	B7	Image in Frame Memory
0	0	0	
0	0	1	
0	1	0	
0	1	1	

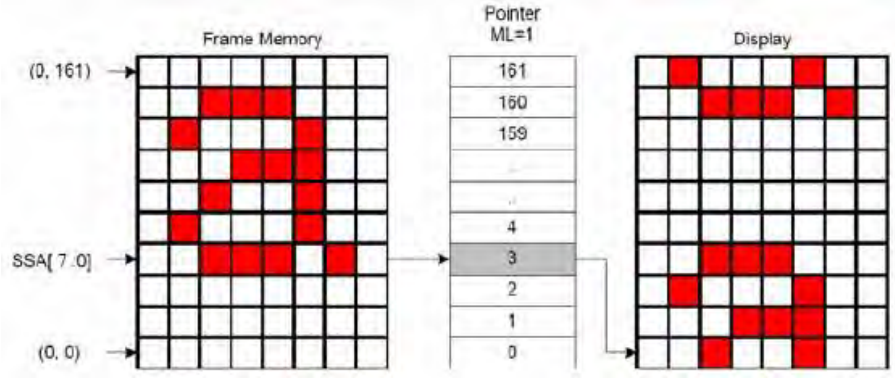
B5	B6	B7	Image in Frame Memory
1	0	0	
1	0	1	
1	1	0	
1	1	1	

<table>
<tr><td></td><td> 
</td></tr>
<tr><td>Restriction</td><td></td></tr>
<tr><td>Register Availability</td><td>
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table>
</td></tr>
<tr><td>Default</td><td>
<table>
<tr><th>Status</th><th>Default Value</th></tr>
<tr><td>Power On Sequence</td><td>8’h00</td></tr>
<tr><td>SW Reset</td><td>8’h00</td></tr>
<tr><td>HW Reset</td><td>8’h00</td></tr>
</table>
</td></tr>
</table>

12.1.27 VSCSAD (37h)

<table>
<tr><td>37H</td><td colspan="12">Vertical Scroll Start Address of RAM</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td><td>37H</td></tr>
<tr><td>Parameter1</td><td>H</td><td>H</td><td>R</td><td colspan="8">SSA[15:8]</td><td>00H</td></tr>
<tr><td>Parameter2</td><td>H</td><td>H</td><td>R</td><td colspan="8">SSA[7:0]</td><td>00H</td></tr>
<tr><td>Description</td><td colspan="12">This command is used together with Vertical Scrolling Definition(33h).These two command describe the scrolling area and 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 lin of the Top Fixed Area on thd display as illustrated below.
This command Start the scrolling.

When MADCTL ML=0
Example: GM=000,132RGBx162
When Top Fixed Area=Bottom Fixed Area=00, Vertical Scrolling Area=162 and Vertical Scrolling Pointer SSA=”3”.
 

When MADCTL ML=1
Example:GM=000,132RGBx162
When Top Fixed Area=Bottom Fixed Area=00, Vertical Scrolling Area=162 and SSA=”3”.
 

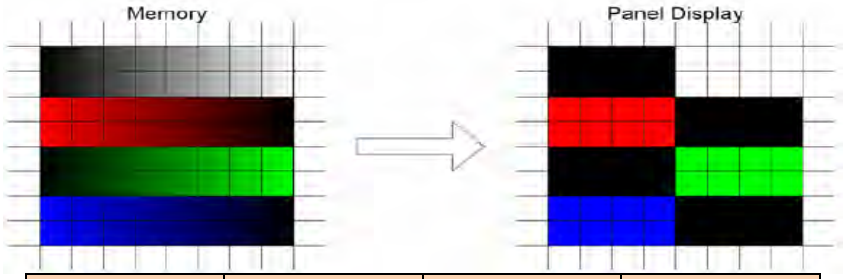
Note:
When new Pointer position and Picture Data are sent, the result on the display will happen at the next Panel Scan to avoid tearing effect. SSA refers to the Frame Memory scan address.
When new Pointer position and Picture Data, internal system works as 128x128 and maximum scan address becomes 127 internal of 161.</td></tr>
<tr><td>Restriction</td><td colspan="12"></td></tr>
</table>

<table>
<tr><td>Register Availability</td><td>
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table>
</td></tr>
<tr><td>Default</td><td>
<table>
<tr><th>Status</th><th>Default Value</th></tr>
<tr><td>Power On Sequence</td><td>8’h00</td></tr>
<tr><td>SW Reset</td><td>8’h00</td></tr>
<tr><td>HW Reset</td><td>8’h00</td></tr>
</table>
</td></tr>
</table>

12.1.28 IDMOFF (38h)

<table>
<tr><th>38H</th><th colspan="12">Idle Mode Off</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>38H</td></tr>
<tr><td>Parameter</td><td colspan="12">No Parameter</td></tr>
<tr><td>Description</td><td colspan="12">This command is used to recover from Idle mode on.
There will be no abnormal visible effect on the display mode change transition.
In the Idle off mode
1, LCD can display maximum 4096, 65k, 262k colors.
2, Normal frame frequency is applied.</td></tr>
<tr><td>Restriction</td><td colspan="12">This command has no effect when module is already in Idle off mode.</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>Idle Mode Off</td></tr><tr><td>SW Reset</td><td>Idle Mode Off</td></tr><tr><td>HW Reset</td><td>Idle Mode Off</td></tr></table></td></tr>
</table>

12.1.29 IDMON (39h)

<table>
<tr><td>39H</td><td colspan="11">Idle Mode On</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>39H</td></tr>
<tr><td>Parameter</td><td colspan="11">No Parameter</td></tr>
<tr><td>Description</td><td colspan="11">This command is used to enter into Idle mode on.
There will be no abnormal visible effect on the display mode change transition.
In the Idle mode.
Color expression is reduced. The primary and the secondary colors using MSB of each R,G and B in the Frame Memory, 8 color depth data is displayed.
8-Color mode frame frequency is applied.
Exit from IDMON by Idle Mode Off (38h) command.
 

<table>
<tr><th>Reduced Color</th><th>R[5:0]</th><th>G[5:0]</th><th>B[5:0]</th></tr>
<tr><td>Black</td><td>0XXXX</td><td>0XXXX</td><td>0XXXX</td></tr>
<tr><td>Blue</td><td>0XXXX</td><td>0XXXX</td><td>1XXXX</td></tr>
<tr><td>Red</td><td>1XXXX</td><td>0XXXX</td><td>0XXXX</td></tr>
<tr><td>Magenta</td><td>1XXXX</td><td>0XXXX</td><td>1XXXX</td></tr>
<tr><td>Green</td><td>0XXXX</td><td>1XXXX</td><td>0XXXX</td></tr>
<tr><td>Cyan</td><td>0XXXX</td><td>1XXXX</td><td>1XXXX</td></tr>
<tr><td>Yellow</td><td>1XXXX</td><td>1XXXX</td><td>0XXXX</td></tr>
<tr><td>White</td><td>1XXXX</td><td>1XXXX</td><td>1XXXX</td></tr>
</table></td></tr>
<tr><td>Restriction</td><td colspan="11">This command has no effect when module is already in idle on mode.</td></tr>
<tr><td>Register Availability</td><td colspan="11"><table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table></td></tr>
<tr><td>Default</td><td colspan="11"><table>
<tr><th>Status</th><th>Default Value(D7 to D0)</th></tr>
<tr><td>Power On Sequence</td><td>Idle Mode On</td></tr>
<tr><td>SW Reset</td><td>Idle Mode On</td></tr>
<tr><td>HW Reset</td><td>Idle Mode On</td></tr>
</table></td></tr>
</table>

12.1.30 COLMOD (3Ah)

<table>
<tr><th>3AH</th><th colspan="12">Interface Color Mode Set</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>3AH</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td colspan="5">VIPF[3:0]</td><td>0</td><td colspan="3">IFPF[2:0]</td><td>66H</td></tr>
<tr><td>Description</td><td colspan="13">This command is used to define the format of RGB picture data,which is to be transferred via the MCU interface.The formats are shown in the table:
<table>
<tr><th>Bit</th><th>Description</th><th>Value</th></tr>
<tr><td>VIPF3</td><td rowspan="4">RGB Interface Color Format</td><td rowspan="4">"0101"=16 bit/pixel(1 time data transfer)
"0110"=18 bit/pixel(1 time data transfer)
"1110"=18 bit/pixel(3 time data transfer)
The others=not defined</td></tr>
<tr><td>VIPF2</td></tr>
<tr><td>VIPF1</td></tr>
<tr><td>VIPF0</td></tr>
<tr><td>D3</td><td></td><td>"0"(Not Used)</td></tr>
<tr><td>IFPF2</td><td rowspan="3">Control Interface Color Format</td><td rowspan="3">"011"=12 bit/pixel
"101"=16 bit/pixel
"110"=18 bit/pixel
The others=not defined</td></tr>
<tr><td>IFPF1</td></tr>
<tr><td>IFPF0</td></tr>
</table>
Note:
1. In 12-bits /Pixel, 16-bits/Pixel mode, the LUT is applied to transfer data into the Frame Memory.
2. When VIPF[3:0]=1110, 6-bits data width of 3-times transfer is used to transmit 1 pixel data with the 18-bits color depth information.</td></tr>
<tr><td>Restriction</td><td colspan="13">This command has no effect when module is already in Idle off mode.</td></tr>
<tr><td>Register Availability</td><td colspan="13">
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table></td></tr>
<tr><td>Default</td><td colspan="13">
<table>
<tr><th>Status</th><th>Default Value(D7 to D0)</th></tr>
<tr><td>Power On Sequence</td><td>8’h66</td></tr>
<tr><td>SW Reset</td><td>8’h66</td></tr>
<tr><td>HW Reset</td><td>8’h66</td></tr>
</table></td></tr>
</table>

12.1.31 LVD_DETECT (44h)

<table>
<tr><td>3AH</td><td colspan="12">LVD Detect</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>44H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">lvd_sel[1:0]</td><td>02H</td></tr>
<tr><td>Description</td><td colspan="12">lvd_sel[1:0]: LVD threshold selection signal
<table>
<tr><td>lvd_sel[1:0]</td><td>LVD threshold(Unit:V)</td></tr>
<tr><td>00</td><td>1.8</td></tr>
<tr><td>01</td><td>2.0</td></tr>
<tr><td>10</td><td>2.2</td></tr>
<tr><td>11</td><td>2.4</td></tr>
</table></td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table></td></tr>
<tr><td>Default</td><td colspan="12"><table>
<tr><th>Status</th><th>Default Value(D7 to D0)</th></tr>
<tr><td>Power On Sequence</td><td>8’h02</td></tr>
<tr><td>SW Reset</td><td>8’h02</td></tr>
<tr><td>HW Reset</td><td>8’h02</td></tr>
</table></td></tr>
</table>

12.1.32 RDID1 (DAh)

<table>
<tr><td>DAH</td><td colspan="12">Read ID1 Value</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>DAH</td></tr>
<tr><td>Parameter1</td><td>H</td><td>R</td><td>H</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>Parameter2</td><td>H</td><td>R</td><td>H</td><td colspan="8">SYS_ID1[7:0]</td><td>33H</td></tr>
<tr><td>Description</td><td colspan="12">The 1st Parameter is dummy read.
This read byte return 8-bit LCD module’s ID.
The parameter(SYS_ID7- SYS_ID0): LCD module manufacturer ID</td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h33</td></tr><tr><td>SW Reset</td><td>8’h33</td></tr><tr><td>HW Reset</td><td>8’h33</td></tr></table></td></tr>
</table>

12.1.33 RDID2 (DBh)

<table>
<tr><th>DBH</th><th colspan="12">Read ID2 Value</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>DBH</td></tr>
<tr><td>Parameter1</td><td>H</td><td>R</td><td>H</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>Parameter2</td><td>H</td><td>R</td><td>H</td><td colspan="8">SYS_ID2[7:0]</td><td>30H</td></tr>
<tr><td>Description</td><td colspan="12">The 1st Parameter is dummy read.
This read byte return 8-bit LCD module’s ID.</td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h30</td></tr><tr><td>SW Reset</td><td>8’h30</td></tr><tr><td>HW Reset</td><td>8’h30</td></tr></table></td></tr>
</table>

12.1.34 RDID3 (DCh)

<table>
<tr><td>DCH</td><td colspan="12">Read ID3 Value</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>DCH</td></tr>
<tr><td>Parameter1</td><td>H</td><td>R</td><td>H</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>Parameter2</td><td>H</td><td>R</td><td>H</td><td colspan="8">SYS_ID3[7:0]</td><td>25H</td></tr>
<tr><td>Description</td><td colspan="12">The 1st Parameter is dummy read.
This read byte return 8-bit LCD module’s ID.</td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h25</td></tr><tr><td>SW Reset</td><td>8’h25</td></tr><tr><td>HW Reset</td><td>8’h25</td></tr></table></td></tr>
</table>

12.2 Panel Function Command List and Description

Addr	Name	R/W	D7	D6	D5	D4	D3	D2	D1	D0
0x3D	SPI2SET	W					spi2line_en		spi2line_mode[1:0]	
0x51	PWCTR 1	W				ddvdh_clp_en		ddvdh_clamp[2:0]		
0x52	PWCTR 2	W				vgh_clp_en			vgh_clamp[1:0]	
0x53	PWCTR 3	W				vgl_clp_en			vgl_clamp[1:0]	
0x61	FRMCTR 1	W	hbp[7:0]							
0x62	FRMCTR 2	W	hfp[7:0]							
0x63	FRMCTR 3	W		vbp[6:0]						
0x64	FRMCTR 4	W		vfp[6:0]						
0x82	RGBCTR	W					dpi_dp	dpi_ep	dpi_hsp	dpi_vsp
0x84	GATEST	W	gate_st[7:0]							
0x85	GATEED	W	gate_ed[7:0]							
0x87	PWCTR 4	W				vrh[4:0]				
0x88	VMCTR 1	W			vcm[5:0]					
0x89	VMCTR 2	W			vcom_vdv[5:0]					
0x93	SRCSET	W		ndl	te_sel	src_en_sel	cs_dly_option		polar_sel[1:0]	
0x94	SRCST	W	src_st[7:0]							
0x95	PCHGST	W	pchg_st[7:0]							
0xB1	PWCTR 5	W					bth[1:0]		btl[1:0]	
0xB2	PWCTR 6	W	ddvdh_clk_sel[1:0]		vgh_clk_sel[1:0]		vgl_clk_sel[1:0]		vcl_clk_sel[1:0]	
0xC3	GATE_REV	W				src_ss				gate_gs
0xC4	REGU_TEST	W					regu_ad[2:0]			
0xD1	RDOTP 1	R	otp_rd_dat[7:0]							
0xD3	RDDID	R	sys_id1[7:0]							
			sys_id2[7:0]							

Addr	Name	R/W	D7	D6	D5	D4	D3	D2	D1	D0
			sys_id3[7:0]							
0xE0	OTPCTR 0	W						otp_ptm[2:0]		
0xE1	OTPCTR 1	W		vpp_src_sel	otp_burn_en		otp_sclk	otp_wr_en	otp_rd_en	otp_pct
0xE2	OTPCTR 2	W							otp_bl_en	otp_wl_en
0xE3	OTPCTR 3	W	otp_paddr[7:0]							
0xE5	OTPCTR 5	W	otp_wr_dat[7:0]							
0xE6	OTPCTR 6	W							otp_esd_en	otp_slpout_en

12.2.1 SPI2SET (3Dh)

<table>
<tr><td>3DH</td><td colspan="12">SPI 2 Line Set</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>3DH</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td>0</td><td>0</td><td>0</td><td>0</td><td>SPI2LINE_EN</td><td>0</td><td colspan="2">SPI2LINE_MODE[1:0]</td><td>00H</td></tr>
<tr><td>Description</td><td colspan="12">SPI2LINE_EN: Enable SPI two data line function. “0” is OFF,”1” is ON;
SPI2LINE_MODE[1:0]: Select different data combination on data lines.

<table>
<tr><th>MODE[1:0]</th><th>Pixel format</th><th>Transmit method</th></tr>
<tr><td>00</td><td rowspan="2">5-6-5</td><td rowspan="2">One transmit per pixel</td></tr>
<tr><td>11</td></tr>
<tr><td>01</td><td>6-6-6</td><td>One transmit per pixel</td></tr>
<tr><td>10</td><td>6-6-6</td><td>Three transmits each two pixels</td></tr>
</table></td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12">
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table></td></tr>
<tr><td>Default</td><td colspan="12">
<table>
<tr><th>Status</th><th>Default Value(D7 to D0)</th></tr>
<tr><td>Power On Sequence</td><td>8’h00</td></tr>
<tr><td>SW Reset</td><td>8’h00</td></tr>
<tr><td>HW Reset</td><td>8’h00</td></tr>
</table></td></tr>
</table>

12.2.2 PWCTR1 (51h)

<table>
<tr><td>51H</td><td colspan="12">Power Control 1</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>51H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td>0</td><td>0</td><td>0</td><td>DDVDH_CLP_EN</td><td>0</td><td colspan="3">DDVDH_CLAMP[2:0]</td><td>15H</td></tr>
<tr><td>Description</td><td colspan="12">DDVDH_CLP_EN: This command is used to define DDVDH clamp enable.

<table><tr><th>DDVDH_CLP_EN</th><th>Description</th></tr><tr><td>0</td><td>Disable the clamp</td></tr><tr><td>1</td><td>Enable the clamp</td></tr></table>
DDVDH_CLAMP[2:0]: This command is used to define DDVDH clamp value
<table><tr><th>DDVDH_CLAMP[2:0]</th><th>DDVDH (V)</th></tr><tr><td>000</td><td>4.5</td></tr><tr><td>001</td><td>4.6</td></tr><tr><td>010</td><td>4.7</td></tr><tr><td>011</td><td>4.8</td></tr><tr><td>100</td><td>4.9</td></tr><tr><td>101</td><td>5</td></tr><tr><td>110</td><td>5.1</td></tr><tr><td>111</td><td>5.2</td></tr></table></td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h15</td></tr><tr><td>SW Reset</td><td>8’h15</td></tr><tr><td>HW Reset</td><td>8’h15</td></tr></table></td></tr>
</table>

12.2.3 PWCTR 2 (52h)

<table>
<tr><td>52H</td><td colspan="12">Power Control 2</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>52H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td>0</td><td>0</td><td>0</td><td>VGH_CLP_EN</td><td>0</td><td>0</td><td colspan="2">VGH_CLAMP[1:0]</td><td>13H</td></tr>
<tr><td>Description</td><td colspan="12">VGH_CLP_EN: This command is used to define VGH clamp enable.
<table>
<tr><th>VGH_CLP_EN</th><th>Description</th></tr>
<tr><td>0</td><td>Disable the clamp</td></tr>
<tr><td>1</td><td>Enable the clamp</td></tr>
</table>
VGH_CLAMP[1:0]: This command is used to define VGH clamp value.
<table>
<tr><th>VGH_CLAMP[1:0]</th><th>VGH (unit:V)</th></tr>
<tr><td>00</td><td>10</td></tr>
<tr><td>01</td><td>12</td></tr>
<tr><td>10</td><td>13.5</td></tr>
<tr><td>11</td><td>15</td></tr>
</table></td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12">
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table></td></tr>
<tr><td>Default</td><td colspan="12">
<table>
<tr><th>Status</th><th>Default Value(D7 to D0)</th></tr>
<tr><td>Power On Sequence</td><td>8’h13</td></tr>
<tr><td>SW Reset</td><td>8’h13</td></tr>
<tr><td>HW Reset</td><td>8’h13</td></tr>
</table></td></tr>
</table>

12.2.4 PWCTR 3 (53h)

<table>
<tr><td>53H</td><td colspan="12">Power Control 3</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>53H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td>0</td><td>0</td><td>0</td><td>VGL_CLP_EN</td><td>0</td><td>0</td><td colspan="2">VGL_CLAMP[1:0]</td><td>11H</td></tr>
<tr><td>Description</td><td colspan="12">This command is used to set the VGL clamp voltage.
<table>
<tr><th>VGL_CLAMP[1]</th><th>VGL_CLAMP[0]</th><th>VGL</th></tr>
<tr><td>0</td><td>0</td><td>-7.5</td></tr>
<tr><td>0</td><td>1</td><td>-10</td></tr>
<tr><td>1</td><td>0</td><td>-12.5</td></tr>
<tr><td>1</td><td>1</td><td>-13</td></tr>
</table></td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12">
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table></td></tr>
<tr><td>Default</td><td colspan="12">
<table>
<tr><th>Status</th><th>Default Value(D7 to D0)</th></tr>
<tr><td>Power On Sequence</td><td>8’h11</td></tr>
<tr><td>SW Reset</td><td>8’h11</td></tr>
<tr><td>HW Reset</td><td>8’h11</td></tr>
</table></td></tr>
</table>

12.2.5 FRMCTR 1 (61h)

<table>
<tr><td>61H</td><td colspan="11">Frame Rate Control 1</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>61H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td colspan="8">HBP[7:0]</td><td>05H</td></tr>
<tr><td>Description</td><td colspan="12">Internal frame rate control register, used to enlarge horizontal scan cycle.
Frame rate=fosc/4*(131+HBP+HFP)*(162+VBP+VFP)
Fosc=6MHz</td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h05</td></tr><tr><td>SW Reset</td><td>8’h05</td></tr><tr><td>HW Reset</td><td>8’h05</td></tr></table></td></tr>
</table>

12.2.6 FRMCTR 2 (62h)

<table>
<tr><td>62H</td><td colspan="11">Frame Rate Control 2</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>62H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td colspan="8">HFP[7:0]</td><td>05H</td></tr>
<tr><td>Description</td><td colspan="12">Internal frame rate control register, used to enlarge horizontal scan cycle.
Frame rate=fosc/4*(131+HBP+HFP)*(162+VBP+VFP)
Fosc=6MHz</td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h05</td></tr><tr><td>SW Reset</td><td>8’h05</td></tr><tr><td>HW Reset</td><td>8’h05</td></tr></table></td></tr>
</table>

12.2.7 FRMCTR 3 (63h)

<table>
<tr><td>63H</td><td colspan="12">Frame Rate Control 3</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>63H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td>0</td><td colspan="7">VBP[6:0]</td><td>08H</td></tr>
<tr><td>Description</td><td colspan="12">Internal frame rate control register, used to enlarge vertical scan cycle.
Frame rate=fosc/4*(131+HBP+HFP)*(162+VBP+VFP)
Fosc=6MHz</td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h08</td></tr><tr><td>SW Reset</td><td>8’h08</td></tr><tr><td>HW Reset</td><td>8’h08</td></tr></table></td></tr>
</table>

12.2.8 FRMCTR (64h)

<table>
<tr><td>64H</td><td colspan="12">Frame Rate Control 4</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>64H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td>0</td><td colspan="7">VFP[6:0]</td><td>08H</td></tr>
<tr><td>Description</td><td colspan="12">Internal frame rate control register, used to enlarge vertical scan cycle.
Frame rate=fosc/4*(131+HBP+HFP)*(162+VBP+VFP)
Fosc=6MHz</td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h08</td></tr><tr><td>SW Reset</td><td>8’h08</td></tr><tr><td>HW Reset</td><td>8’h08</td></tr></table></td></tr>
</table>

12.2.9 RGBCTR (82h)

<table>
<tr><td>82H</td><td colspan="11">RGB Interface Control</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>82H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td>0</td><td>0</td><td>0</td><td>0</td><td>DPI_DP</td><td>DPI_EP</td><td>DPI_HSP</td><td>DPI_VSP</td><td>00H</td></tr>
<tr><td>Description</td><td colspan="11">DPI_DP : PCLK polarity (“1”= data fetched at falling time, “0”= data fetched at rising time);
DPI_EP : DE polarity (“1”= Low enable, “0”=High enable)
DPI_HSP: HS polarity(“1”=Low level sync clock, “0”=High level sync clock)
DPI_VSP: VS polarity(“1”=Low level sync clock, “0”=High level sync clock)</td></tr>
<tr><td>Restriction</td><td colspan="11">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="11"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="11"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h00</td></tr><tr><td>SW Reset</td><td>8’h00</td></tr><tr><td>HW Reset</td><td>8’h00</td></tr></table></td></tr>
</table>

12.2.10 GATEST (84h)

<table>
<tr><td>84H</td><td colspan="12">GATE START SETTING</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>84H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td colspan="8">GATE_ST[7:0]</td><td>14H</td></tr>
<tr><td>Description</td><td colspan="12">Gate enables start position setting.</td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h14</td></tr><tr><td>SW Reset</td><td>8’h14</td></tr><tr><td>HW Reset</td><td>8’h14</td></tr></table></td></tr>
</table>

12.2.11 GATEED (85h)

<table>
<tr><td>85H</td><td colspan="12">GATE END SETTING</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>85H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td colspan="8">GATE_ED[7:0]</td><td>78H</td></tr>
<tr><td>Description</td><td colspan="12">Gate enables end position setting.</td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h78</td></tr><tr><td>SW Reset</td><td>8’h78</td></tr><tr><td>HW Reset</td><td>8’h78</td></tr></table></td></tr>
</table>

12.2.12 PWCTR 4 (87h)

<table>
<tr><td>87H</td><td colspan="12">Power Control 4</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>87H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td>0</td><td>0</td><td>0</td><td colspan="5">GVDD_ADJ[4:0]</td><td>16H</td></tr>
<tr><td>Description</td><td colspan="12">GVDD_ADJ[4:0]: This command is used to define GVDD trimming value.
<table>
<tr><th>gvdd_adj[4:0]</th><th>GVDD</th><th>gvdd_adj[4:0]</th><th>GVDD</th></tr>
<tr><td>00100</td><td>3.80</td><td>10000</td><td>4.40</td></tr>
<tr><td>00101</td><td>3.85</td><td>10001</td><td>4.45</td></tr>
<tr><td>00110</td><td>3.90</td><td>10010</td><td>4.50</td></tr>
<tr><td>00111</td><td>3.95</td><td>10011</td><td>4.55</td></tr>
<tr><td>01000</td><td>4.00</td><td>10100</td><td>4.60</td></tr>
<tr><td>01001</td><td>4.05</td><td>10101</td><td>4.65</td></tr>
<tr><td>01010</td><td>4.10</td><td>10110</td><td>4.70</td></tr>
<tr><td>01011</td><td>4.15</td><td>10111</td><td>4.75</td></tr>
<tr><td>01100</td><td>4.20</td><td>11000</td><td>4.80</td></tr>
<tr><td>01101</td><td>4.25</td><td>11001</td><td>4.85</td></tr>
<tr><td>01110</td><td>4.30</td><td>11010</td><td>4.90</td></tr>
<tr><td>01111</td><td>4.35</td><td>11011</td><td>4.95</td></tr>
</table></td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12">
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table></td></tr>
<tr><td>Default</td><td colspan="12">
<table>
<tr><th>Status</th><th>Default Value(D7 to D0)</th></tr>
<tr><td>Power On Sequence</td><td>8’h16</td></tr>
<tr><td>SW Reset</td><td>8’h16</td></tr>
<tr><td>HW Reset</td><td>8’h16</td></tr>
</table></td></tr>
</table>

12.2.13 VMCTR 1 (88h)

88H	VCOM Control 1											
	D/CX	**RDX**	**WRX**	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	L	H	R	1	0	0	0	1	0	0	0	88H
Parameter	H	H	R	0	VCM[6:0]							14H

Description

VCM[6:0]: This command is used to define VCOMH trimming value.

VCM[6:0]	VCOMH	VCM[6:0]	VCOMH	VCM[6:0]	VCOMH
0000111	GVDD*219/298	0100000	GVDD*244/298	0111001	GVDD*269/298
0001000	GVDD*220/298	0100001	GVDD*245/298	0111010	GVDD*270/298
0001001	GVDD*221/298	0100010	GVDD*246/298	0111011	GVDD*271/298
0001010	GVDD*222/298	0100011	GVDD*247/298	0111100	GVDD*272/298
0001011	GVDD*223/298	0100100	GVDD*248/298	0111101	GVDD*273/298
0001100	GVDD*224/298	0100101	GVDD*249/298	0111110	GVDD*274/298
0001101	GVDD*225/298	0100110	GVDD*250/298	0111111	GVDD*275/298
0001110	GVDD*226/298	0100111	GVDD*251/298	1000000	GVDD*276/298
0001111	GVDD*227/298	0101000	GVDD*252/298	1000001	GVDD*277/298
0010000	GVDD*228/298	0101001	GVDD*253/298	1000010	GVDD*278/298
0010001	GVDD*229/298	0101010	GVDD*254/298	1000011	GVDD*279/298
0010010	GVDD*230/298	0101011	GVDD*255/298	1000100	GVDD*280/298
0010011	GVDD*231/298	0101100	GVDD*256/298	1000101	GVDD*281/298
0010100	**GVDD*232/298**	0101101	GVDD*257/298	1000110	GVDD*282/298
0010101	GVDD*233/298	0101110	GVDD*258/298	1000111	GVDD*283/298
0010110	GVDD*234/298	0101111	GVDD*259/298	1001000	GVDD*284/298
0010111	GVDD*235298	0110000	GVDD*260/298	1001001	GVDD*285/298
0011000	GVDD*236/298	0110001	GVDD*261/298	1001010	GVDD*286/298
0011001	GVDD*237/298	0110010	GVDD*262/298	1001011	GVDD*287/298
0011010	GVDD*238/298	0110011	GVDD*263/298	1001100	GVDD*288/298
0011011	GVDD*239/298	0110100	GVDD*264/298	1001101	GVDD*289/298
0011100	GVDD*240/298	0110101	GVDD*265/298	1001110	GVDD*290/298
0011101	GVDD*241/298	0110110	GVDD*266/298	1001111	GVDD*291/298
0011110	GVDD*242/298	0110111	GVDD*267/298	-	-
0011111	GVDD*243/298	0111000	GVDD*268/298	-	-

Note: This value need GVDD set in 4.7V.

Restriction: Should set “FF=A5” before configure this registers

Register Availability

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

Default	

Status	Default Value(D7 to D0)
Power On Sequence	8'h14
SW Reset	8'h14
HW Reset	8'h14

12.2.14 VMCTR 2 (89h)

89H	VCOM Control 2											
	D/CX	**RDX**	**WRX**	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	L	H	R	1	0	0	0	1	0	0	1	89H
Parameter	H	H	R	0	VCOM_VDV[6:0]							34H

Description

VCOM_VDV[6:0]: This command is used to define VCOML trimming value.

VCOM_VDV[6:0]	VCOML	VCOM_VDV[6:0]	VCOML	VCOM_VDV[6:0]	VCOML
0000111	VCOMH-(GVDD*253)/298	0100111	VCOMH-(GVDD*285)/298	1000111	VCOMH-(GVDD*318)/298
0001000	VCOMH-(GVDD*254)/298	0101000	VCOMH-(GVDD*286)/298	1001000	VCOMH-(GVDD*319)/298
0001001	VCOMH-(GVDD*255)/298	0101001	VCOMH-(GVDD*287)/298	1001001	VCOMH-(GVDD*320)/298
0001010	VCOMH-(GVDD*256)/298	0101010	VCOMH-(GVDD*288)/298	1001010	VCOMH-(GVDD*321)/298
0001011	VCOMH-(GVDD*257)/298	0101011	VCOMH-(GVDD*289)/298	1001011	VCOMH-(GVDD*322)/298
0001100	VCOMH-(GVDD*258)/298	0101100	VCOMH-(GVDD*290)/298	1001100	VCOMH-(GVDD*323)/298
0001101	VCOMH-(GVDD*259)/298	0101101	VCOMH-(GVDD*291)/298	1001101	VCOMH-(GVDD*324)/298
0001110	VCOMH-(GVDD*260)/298	0101110	VCOMH-(GVDD*292)/298	1001110	VCOMH-(GVDD*325)/298
0001111	VCOMH-(GVDD*261)/298	0101111	VCOMH-(GVDD*293)/298	1001111	VCOMH-(GVDD*326)/298
0010000	VCOMH-(GVDD*262)/298	0110000	VCOMH-(GVDD*294)/298	1010000	VCOMH-(GVDD*327)/298
0010001	VCOMH-(GVDD*263)/298	0110001	VCOMH-(GVDD*295)/298	1010001	VCOMH-(GVDD*328)/298
0010010	VCOMH-(GVDD*264)/298	0110010	VCOMH-(GVDD*296)/298	1010010	VCOMH-(GVDD*329)/298
0010011	VCOMH-(GVDD*265)/298	0110011	VCOMH-(GVDD*297)/298	1010011	VCOMH-(GVDD*330)/298
0010100	VCOMH-(GVDD*266)/298	**0110100**	**VCOMH-(GVDD*298)/298**	1010100	VCOMH-(GVDD*331)/298
0010101	VCOMH-(GVDD*267)/298	0110101	VCOMH-(GVDD*299)/298	1010101	VCOMH-(GVDD*332)/298
0010110	VCOMH-(GVDD*268)/298	0110110	VCOMH-(GVDD*300)/298	1010110	VCOMH-(GVDD*333)/298
0010111	VCOMH-(GVDD*269)/298	0110111	VCOMH-(GVDD*301)/298	1010111	VCOMH-(GVDD*334)/298
0011000	VCOMH-(GVDD*270)/298	0111000	VCOMH-(GVDD*302)/298	1011000	VCOMH-(GVDD*335)/298
0011001	VCOMH-(GVDD*271)/298	0111001	VCOMH-(GVDD*303)/298	1011001	VCOMH-(GVDD*336)/298
0011010	VCOMH-(GVDD*272)/298	0111010	VCOMH-(GVDD*304)/298	1011010	VCOMH-(GVDD*337)/298
0011011	VCOMH-(GVDD*273)/298	0111011	VCOMH-(GVDD*305)/298	1011011	VCOMH-(GVDD*338)/298
0011100	VCOMH-(GVDD*274)/298	0111100	VCOMH-(GVDD*307)/298	1011100	VCOMH-(GVDD*339)/298
0011101	VCOMH-(GVDD*275)/298	0111101	VCOMH-(GVDD*308)/298	1011101	VCOMH-(GVDD*340)/298
0011110	VCOMH-(GVDD*276)/298	0111110	VCOMH-(GVDD*309)/298	1011110	VCOMH-(GVDD*341)/298
0011111	VCOMH-(GVDD*277)/298	0111111	VCOMH-(GVDD*310/298	1011111	VCOMH-(GVDD*342)/298
0100000	VCOMH-(GVDD*278)/298	1000000	VCOMH-(GVDD*311/298	1100000	VCOMH-(GVDD*343)/298
0100001	VCOMH-(GVDD*279)/298	1000001	VCOMH-(GVDD*312/298	1100001	VCOMH-(GVDD*344)/298
0100010	VCOMH-(GVDD*280)/298	1000010	VCOMH-(GVDD*313/298	1100010	VCOMH-(GVDD*345)/298
0100011	VCOMH-(GVDD*281)/298	1000011	VCOMH-(GVDD*314/298	-	-

0100100	VCOMH-(GVDD*282)/298	1000100	VCOMH-(GVDD*315/298	-	-
0100101	VCOMH-(GVDD*283)/298	1000101	VCOMH-(GVDD*316/298	-	-
0100110	VCOMH-(GVDD*284)/298	1000110	VCOMH-(GVDD*317/298	-	-

Note: This value need VCOMH set in 3.659V, GVDD set in 4.7V.

Restriction	Should set “FF=A5” before configure this registers

Register Availability

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

Default

Status	Default Value(D7 to D0)
Power On Sequence	8’h34
SW Reset	8’h34
HW Reset	8’h34

12.2.15 SRCSET (93h)

<table>
<tr><td>93H</td><td colspan="12">SOURCE SET</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>93H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td>0</td><td>NDL</td><td>TE_SEL</td><td>SRC_EN_SEL</td><td>CS_DLY_OPTION</td><td>0</td><td colspan="2">POLAR_SEL[1:0]</td><td>60H</td></tr>
<tr><td>Description</td><td colspan="12">NDL: Select max or min voltage to clear screen.
TE_SEL:Tearing Effect Line Mode
SRC_EN_SEL: Decide if the source enable is open during v-porch area. “1” is OPEN, “0” is CLOSE;
CS_DLY_OPTION: The CSX signal sent by the interface is delayed 8ns
POLAR_SEL[1:0]:Line inversion and frame inversion selection
<table>
<tr><th>POLAR_SEL[1:0]</th><th>Description</th></tr>
<tr><td>00</td><td>one line inversion</td></tr>
<tr><td>01</td><td>two-line inversion</td></tr>
<tr><td>10</td><td>four-line inversion</td></tr>
<tr><td>11</td><td>frame inversion</td></tr>
</table></td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12">
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table></td></tr>
<tr><td>Default</td><td colspan="12">
<table>
<tr><th>Status</th><th>Default Value(D7 to D0)</th></tr>
<tr><td>Power On Sequence</td><td>8’h60</td></tr>
<tr><td>SW Reset</td><td>8’h60</td></tr>
<tr><td>HW Reset</td><td>8’h60</td></tr>
</table></td></tr>
</table>

12.2.16 SRCST (94h)

<table>
<tr><td>94H</td><td colspan="12">SOURCE START SETTING</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>94H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td colspan="8">SRC_ST[7:0]</td><td>0AH</td></tr>
<tr><td>Description</td><td colspan="12">src_out_ctrl start position setting.</td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h0A</td></tr><tr><td>SW Reset</td><td>8’h0A</td></tr><tr><td>HW Reset</td><td>8’h0A</td></tr></table></td></tr>
</table>

12.2.17 PCHGST (95h)

<table>
<tr><td>95H</td><td colspan="11">SOURCE PRECHARGE START SETTING</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>95H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td colspan="8">PCHG_ST[7:0]</td><td>03H</td></tr>
<tr><td>Description</td><td colspan="12">Source pre-charge start position setting.</td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h03</td></tr><tr><td>SW Reset</td><td>8’h03</td></tr><tr><td>HW Reset</td><td>8’h03</td></tr></table></td></tr>
</table>

12.2.18 PWCTR 5 (B1h)

<table>
<tr><td>B1H</td><td colspan="12">Power Control 5</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>B1H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td>0</td><td>0</td><td>0</td><td>0</td><td colspan="2">BTH[1:0]</td><td colspan="2">BTL[1:0]</td><td>0FH</td></tr>
<tr><td>Description</td><td colspan="12">BTH[1:0]: is used to define the ratio in VGH pump.
<table>
<tr><th>BTH[1:0]</th><th>BTH[1:0]</th><th>VGH</th></tr>
<tr><td>0</td><td>0</td><td>4*VCI</td></tr>
<tr><td>0</td><td>1</td><td>5*VCI</td></tr>
<tr><td>1</td><td>0</td><td>6*VCI</td></tr>
<tr><td>1</td><td>1</td><td>6*VCI</td></tr>
</table>
BTL[1:0]: is used to define the ratio in VGL pump.
<table>
<tr><th>BTL[1:0]</th><th>BTL[1:0]</th><th>VGL</th></tr>
<tr><td>0</td><td>0</td><td>-3*VCI</td></tr>
<tr><td>0</td><td>1</td><td>-4*VCI</td></tr>
<tr><td>1</td><td>0</td><td>-5*VCI</td></tr>
<tr><td>1</td><td>1</td><td>-5*VCI</td></tr>
</table></td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12">
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table></td></tr>
<tr><td>Default</td><td colspan="12">
<table>
<tr><th>Status</th><th>Default Value(D7 to D0)</th></tr>
<tr><td>Power On Sequence</td><td>8’h0F</td></tr>
<tr><td>SW Reset</td><td>8’h0F</td></tr>
<tr><td>HW Reset</td><td>8’h0F</td></tr>
</table></td></tr>
</table>

12.2.19 PWCTR 6 (B2h)

<table>
<tr><td>B2H</td><td colspan="11">Power Control 6</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>B2H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td colspan="2">DDVDH_CLK_SEL[1:0]</td><td colspan="2">VGH_CLK_SEL[1:0]</td><td colspan="2">VGL_CLK_SEL[1:0]</td><td colspan="2">VCL_CLK_SEL[1:0]</td><td>55H</td></tr>
<tr><td>Description</td><td colspan="12">
DDVDH_CLK_SEL[1:0] is used to set the operation frequency of DDVDH pump.
<table>
<tr><th>DDVDH_CLK_SEL [1]</th><th>DDVDH_CLK_SEL [0]</th><th>Frequency</th></tr>
<tr><td>0</td><td>0</td><td>1 * OSC</td></tr>
<tr><td>0</td><td>1</td><td>1/2 * OSC</td></tr>
<tr><td>1</td><td>0</td><td>1/4 * OSC</td></tr>
<tr><td>1</td><td>1</td><td>1/8 * OSC</td></tr>
</table>
VGH_CLK_SEL [1:0] is used to set the operation frequency of VGH pump.
<table>
<tr><th>VGH_CLK_SEL [1]</th><th>VGH_CLK_SEL [0]</th><th>Frequency</th></tr>
<tr><td>0</td><td>0</td><td>1 * OSC</td></tr>
<tr><td>0</td><td>1</td><td>1/2 * OSC</td></tr>
<tr><td>1</td><td>0</td><td>1/4 * OSC</td></tr>
<tr><td>1</td><td>1</td><td>1/8 * OSC</td></tr>
</table>
VGL_CLK_SEL [1:0] is used to set the operation frequency of VGL pump.
<table>
<tr><th>VGL_CLK_SEL [1]</th><th>VGL_CLK_SEL [0]</th><th>Frequency</th></tr>
<tr><td>0</td><td>0</td><td>1 * OSC</td></tr>
<tr><td>0</td><td>1</td><td>1/2 * OSC</td></tr>
<tr><td>1</td><td>0</td><td>1/4 * OSC</td></tr>
<tr><td>1</td><td>1</td><td>1/8 * OSC</td></tr>
</table>
VCL_CLK_SEL [1:0] is used to set the operation frequency of VCL pump.
<table>
<tr><th>VCL_CLK_SEL [1]</th><th>VCL_CLK_SEL [0]</th><th>Frequency</th></tr>
<tr><td>0</td><td>0</td><td>1 * OSC</td></tr>
<tr><td>0</td><td>1</td><td>1/2 * OSC</td></tr>
<tr><td>1</td><td>0</td><td>1/4 * OSC</td></tr>
<tr><td>1</td><td>1</td><td>1/8 * OSC</td></tr>
</table>
</td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12">
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table>
</td></tr>
<tr><td>Default</td><td colspan="12"></td></tr>
</table>

Status	Default Value(D7 to D0)
Power On Sequence	8'h55
SW Reset	8'h55
HW Reset	8'h55

12.2.20 CHOP (B5h)

<table>
<tr><td>B5H</td><td colspan="12">CHOP SET</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>B5H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td>0</td><td>0</td><td colspan="2">CHOP_SEL[1:0]</td><td>GAM_FLW_FIX</td><td>0</td><td colspan="2">GAM_BIAS_FIX[1:0]</td><td>30H</td></tr>
<tr><td>Description</td><td colspan="12">CHOPPER_SEL: Gamma chopper function option.
<table>
<tr><td>CHOP_SEL[1:0]</td><td>Description</td></tr>
<tr><td>00</td><td>2 frame chopper</td></tr>
<tr><td>01</td><td>1 line chopper (1 frame chopper polarity change)</td></tr>
<tr><td>10</td><td>1 line chopper (2 frame chopper polarity change)</td></tr>
<tr><td>11</td><td>NONE</td></tr>
</table>
GAM_BIAS_FIX[1:0] is used to adjust gamma op’s bias current, default =00.
GAM_FLW_FIX is used to change gamma op’s driver capacity, default =0.</td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12">
<table>
<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></td></tr>
<tr><td>Default</td><td colspan="12">
<table>
<tr><td>Status</td><td>Default Value(D7 to D0)</td></tr>
<tr><td>Power On Sequence</td><td>8’h30</td></tr>
<tr><td>SW Reset</td><td>8’h30</td></tr>
<tr><td>HW Reset</td><td>8’h30</td></tr>
</table></td></tr>
</table>

12.2.21 GATE_REV (C3h)

<table>
<tr><td>C3H</td><td colspan="11">GATE_REV</td></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>C3H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td>0</td><td>0</td><td>0</td><td>SRC_SS</td><td>0</td><td>0</td><td>0</td><td>GATE_GS</td><td>10H</td></tr>
<tr><td>Description</td><td colspan="11">SRC_SS: source reverse scan control. “1” is reverse, “0” is normal.
GATE_GS: gate reverse scan control. “1” is reverse, “0” is normal.</td></tr>
<tr><td>Restriction</td><td colspan="11">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="11"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="11"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h10</td></tr><tr><td>SW Reset</td><td>8’h10</td></tr><tr><td>HW Reset</td><td>8’h10</td></tr></table></td></tr>
</table>

12.2.22 REGU_TEST (C4h)

<table>
<tr><th>C4H</th><th colspan="11">REGU_TEST</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>C4H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td>TEST_BGR_EN</td><td>0</td><td>0</td><td>0</td><td colspan="3">REGU_AD[2:0]</td><td>BGR_OUT_EN</td><td>00H</td></tr>
<tr><td>Description</td><td colspan="12">REGU_AD[2:0]: vdd18 trimming signal.
<table>
<tr><th>REGU_AD[2:0]</th><th>VDD18</th></tr>
<tr><td>000</td><td>1.85</td></tr>
<tr><td>001</td><td>1.90</td></tr>
<tr><td>010</td><td>1.96</td></tr>
<tr><td>011</td><td>2.11</td></tr>
<tr><td>100</td><td>1.60</td></tr>
<tr><td>101</td><td>1.67</td></tr>
<tr><td>110</td><td>1.74</td></tr>
<tr><td>111</td><td>1.80</td></tr>
</table></td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12">
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table></td></tr>
<tr><td>Default</td><td colspan="12">
<table>
<tr><th>Status</th><th>Default Value(D7 to D0)</th></tr>
<tr><td>Power On Sequence</td><td>8’h00</td></tr>
<tr><td>SW Reset</td><td>8’h00</td></tr>
<tr><td>HW Reset</td><td>8’h00</td></tr>
</table></td></tr>
</table>

12.2.23 RDOTP 1 (D1h)

<table>
<tr><th>D1H</th><th colspan="12">Read OTP Data 1</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>D1H</td></tr>
<tr><td>Parameter1</td><td>H</td><td>R</td><td>H</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>Parameter2</td><td>H</td><td>R</td><td>H</td><td colspan="8">OTP_RD_DAT[7:0]</td><td>-</td></tr>
<tr><td>Description</td><td colspan="12">OTP read data[7:0]</td></tr>
<tr><td>Restriction</td><td colspan="12">The 1st Parameter is dummy read.
Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h00</td></tr><tr><td>SW Reset</td><td>8’h00</td></tr><tr><td>HW Reset</td><td>8’h00</td></tr></table></td></tr>
</table>

12.2.24 RDDID (D3h)

<table>
<tr><th>D3H</th><th colspan="12">Read Display ID</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>R</td><td>H</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>D3H</td></tr>
<tr><td>Parameter1</td><td>H</td><td>R</td><td>H</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>Parameter2</td><td>H</td><td>R</td><td>H</td><td colspan="8">SYS_ID1[7:0]</td><td>33H</td></tr>
<tr><td>Parameter3</td><td>H</td><td>R</td><td>H</td><td colspan="8">SYS_ID2[7:0]</td><td>30H</td></tr>
<tr><td>Parameter4</td><td>H</td><td>R</td><td>H</td><td colspan="8">SYS_ID3[7:0]</td><td>25H</td></tr>
<tr><td>Description</td><td colspan="12">This read byte returns 24-bit display identification.
The 1st Parameter is dummy read.
The 2st Parameter (SYS_ID1): LCD module’s manufacture ID.
The 3st Parameter (SYS_ID2): LCD module/driver version ID.
The 4st Parameter (SYS_ID3): LCD module/driver version ID.
Note: Commands RDDID1/2/3 (DAh, DBh, DCh) read data correspond to the parameters 1, 2, 3 of command D3h, respectively.</td></tr>
<tr><td>Restriction</td><td colspan="12">None</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th rowspan="2">Status</th><th colspan="3">Default Value</th></tr><tr><th>ID1</th><th>ID2</th><th>ID3</th></tr><tr><td>Power On Sequence</td><td>8’h33</td><td>8’h30</td><td>8’h25</td></tr><tr><td>SW Reset</td><td>8’h33</td><td>8’h30</td><td>8’h25</td></tr><tr><td>HW Reset</td><td>8’h33</td><td>8’h30</td><td>8’h25</td></tr></table></td></tr>
</table>

12.2.25 OTPCTR 0 (E0h)

<table>
<tr><th>E1H</th><th colspan="12">OTP Control 0</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>E0H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td colspan="3">OTP_PTM[2:0]</td><td>00H</td></tr>
<tr><td>Description</td><td colspan="13">Detail operations refer to OTP datasheet.</td></tr>
<tr><td>Restriction</td><td colspan="13">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="13"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="13"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h00</td></tr><tr><td>SW Reset</td><td>8’h00</td></tr><tr><td>HW Reset</td><td>8’h00</td></tr></table></td></tr>
</table>

12.2.25 OTPCTR 1 (E1h)

E1H	OTP Control 1											
	D/CX	**RDX**	**WRX**	D7	D6	D5	D4	D3	D2	D1	D0	HEX
Command	L	H	R	1	1	1	0	0	0	0	1	E1H
Parameter	H	H	R	0	VPP_SRC_SEL	OTP_BURN_EN	0	OTP_SCLK	OTP_WR_EN	OTP_RD_EN	OTP_PCT	00H
Description	Detail operations refer to OTP datasheet.											
Restriction	Should set “FF=A5” before configure this registers											
Register Availability												

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

Default

Status	Default Value(D7 to D0)
Power On Sequence	8’h00
SW Reset	8’h00
HW Reset	8’h00

12.2.26 OTPCTR 2 (E2h)

<table>
<tr><th>E2H</th><th colspan="11">OTP Control 2</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>E2H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>OTP_BL_EN</td><td>OTP_WL_EN</td><td>00H</td></tr>
<tr><td>Description</td><td colspan="12">Detail operations refer to OTP datasheet.</td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12">
<table>
<tr><th>Status</th><th>Availability</th></tr>
<tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr>
<tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr>
<tr><td>Sleep In</td><td>Yes</td></tr>
</table>
</td></tr>
<tr><td>Default</td><td colspan="12">
<table>
<tr><th>Status</th><th>Default Value(D7 to D0)</th></tr>
<tr><td>Power On Sequence</td><td>8’h00</td></tr>
<tr><td>SW Reset</td><td>8’h00</td></tr>
<tr><td>HW Reset</td><td>8’h00</td></tr>
</table>
</td></tr>
</table>

12.2.26 OTPCTR 3 (E3h)

<table>
<tr><th>E2H</th><th colspan="12">OTP Control 3</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>E3H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td colspan="8">OTP_PADDR[7:0]</td><td>00H</td></tr>
<tr><td>Description</td><td colspan="12">Detail operations refer to OTP datasheet.</td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h00</td></tr><tr><td>SW Reset</td><td>8’h00</td></tr><tr><td>HW Reset</td><td>8’h00</td></tr></table></td></tr>
</table>

12.2.27 OTPCTR 5 (E5h)

<table>
<tr><th>E3H</th><th colspan="12">OTP Control 5</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>E5H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td colspan="8">OTP_WR_DAT[7:0]</td><td>00H</td></tr>
<tr><td>Description</td><td colspan="12">Detail operations refer to OTP datasheet.</td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h00</td></tr><tr><td>SW Reset</td><td>8’h00</td></tr><tr><td>HW Reset</td><td>8’h00</td></tr></table></td></tr>
</table>

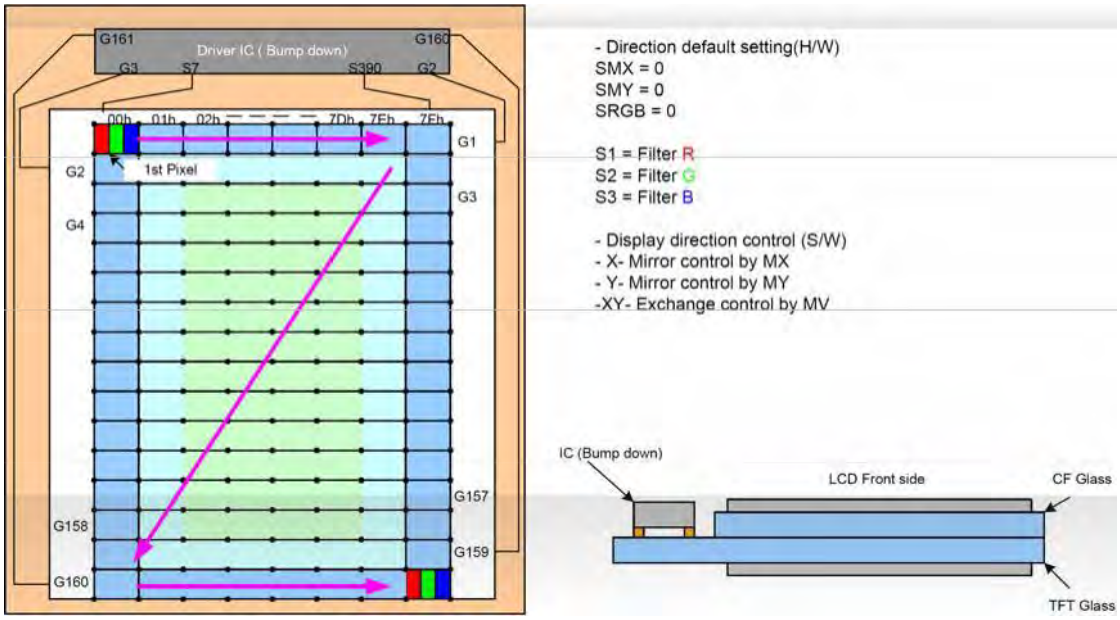
12.2.28 OTPCTR 6 (E6h)

<table>
<tr><th>E4H</th><th colspan="12">OTP Control 6</th></tr>
<tr><td></td><td>D/CX</td><td>RDX</td><td>WRX</td><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td><td>HEX</td></tr>
<tr><td>Command</td><td>L</td><td>H</td><td>R</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>E6H</td></tr>
<tr><td>Parameter</td><td>H</td><td>H</td><td>R</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>OTP_ESD_EN</td><td>OTP_SLPOUT_EN</td><td>02H</td></tr>
<tr><td>Description</td><td colspan="12">OTP_ESD_EN: The switch to decide if reload OTP after ESD triggered.
OTP_SLPOUT_EN: The switch to decide if reload OTP after SLPOUT command.</td></tr>
<tr><td>Restriction</td><td colspan="12">Should set “FF=A5” before configure this registers</td></tr>
<tr><td>Register Availability</td><td colspan="12"><table><tr><th>Status</th><th>Availability</th></tr><tr><td>Normal Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Normal Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode Off,Sleep Out</td><td>Yes</td></tr><tr><td>Partial Mode on,Idle Mode On,Sleep Out</td><td>Yes</td></tr><tr><td>Sleep In</td><td>Yes</td></tr></table></td></tr>
<tr><td>Default</td><td colspan="12"><table><tr><th>Status</th><th>Default Value(D7 to D0)</th></tr><tr><td>Power On Sequence</td><td>8’h02</td></tr><tr><td>SW Reset</td><td>8’h02</td></tr><tr><td>HW Reset</td><td>8’h02</td></tr></table></td></tr>
</table>

13. Example Panel Connection (GM=”011”)

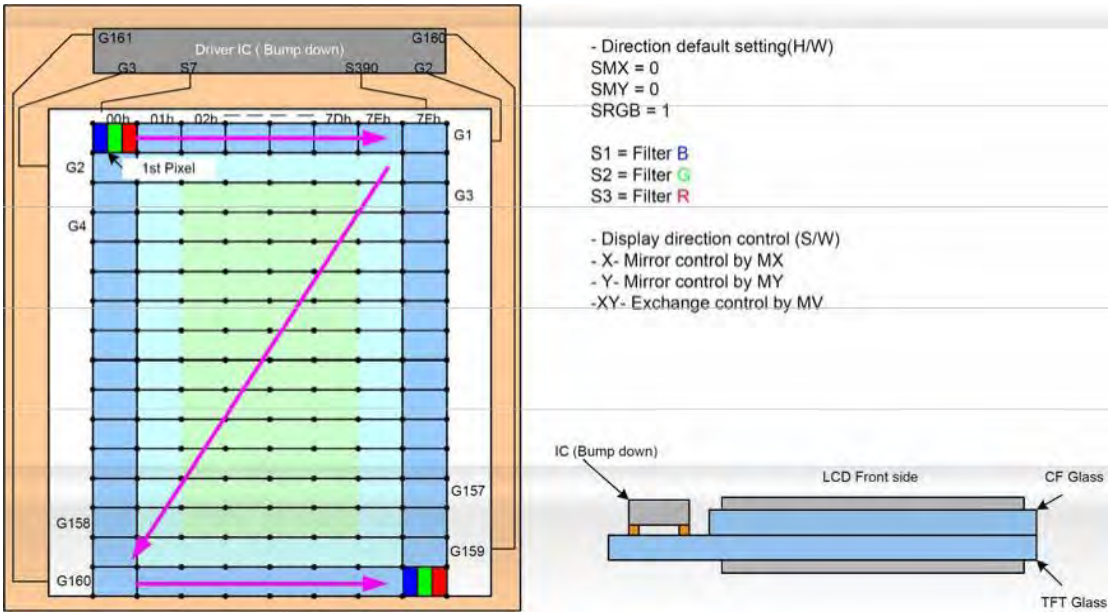
CASE 1: First pixel is at left_top of the panel

RGB order is “R.G.B”



CASE 2: First pixel is at left_top of the panel

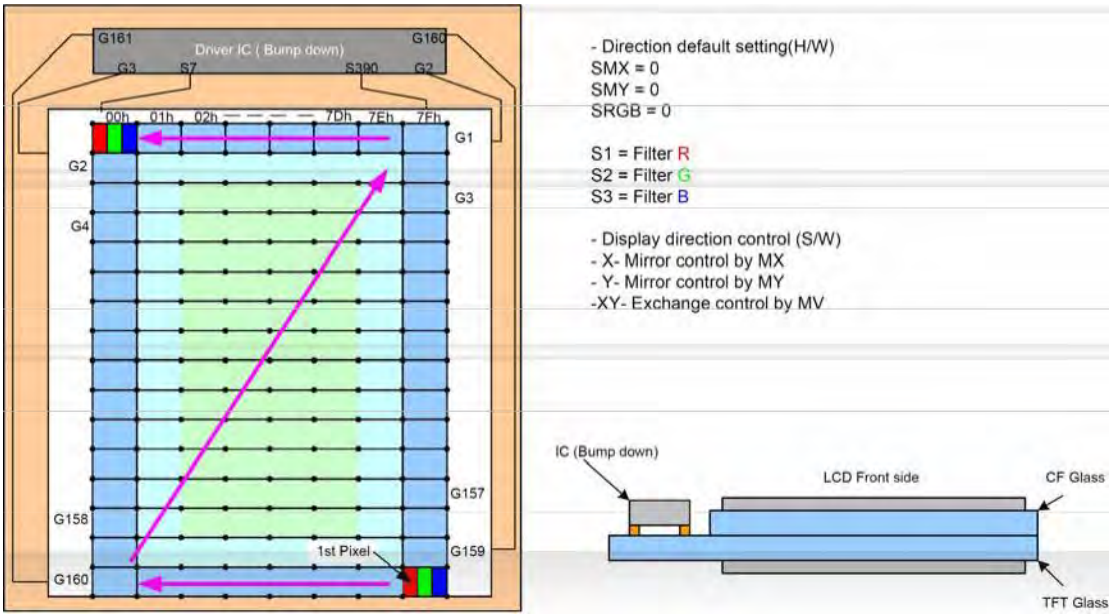
RGB order is “B.G.R”



CASE 3: First pixel is at Right_bottom of the panel
RGB order is “R.G.B”

CASE 3: First pixel is at Right_bottom of the panel

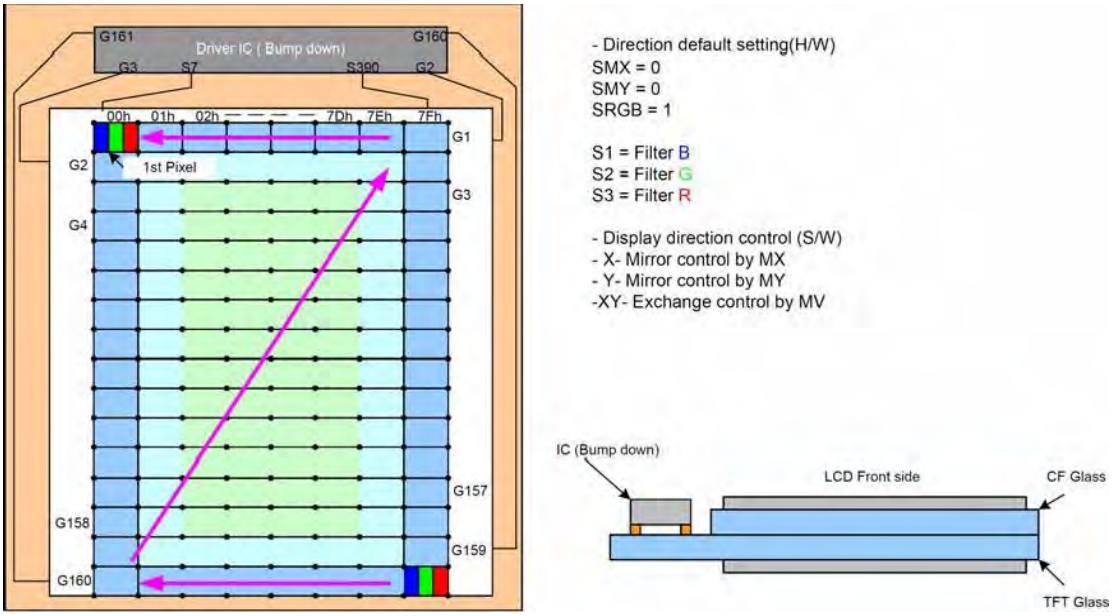
RGB order is “R.G.B”



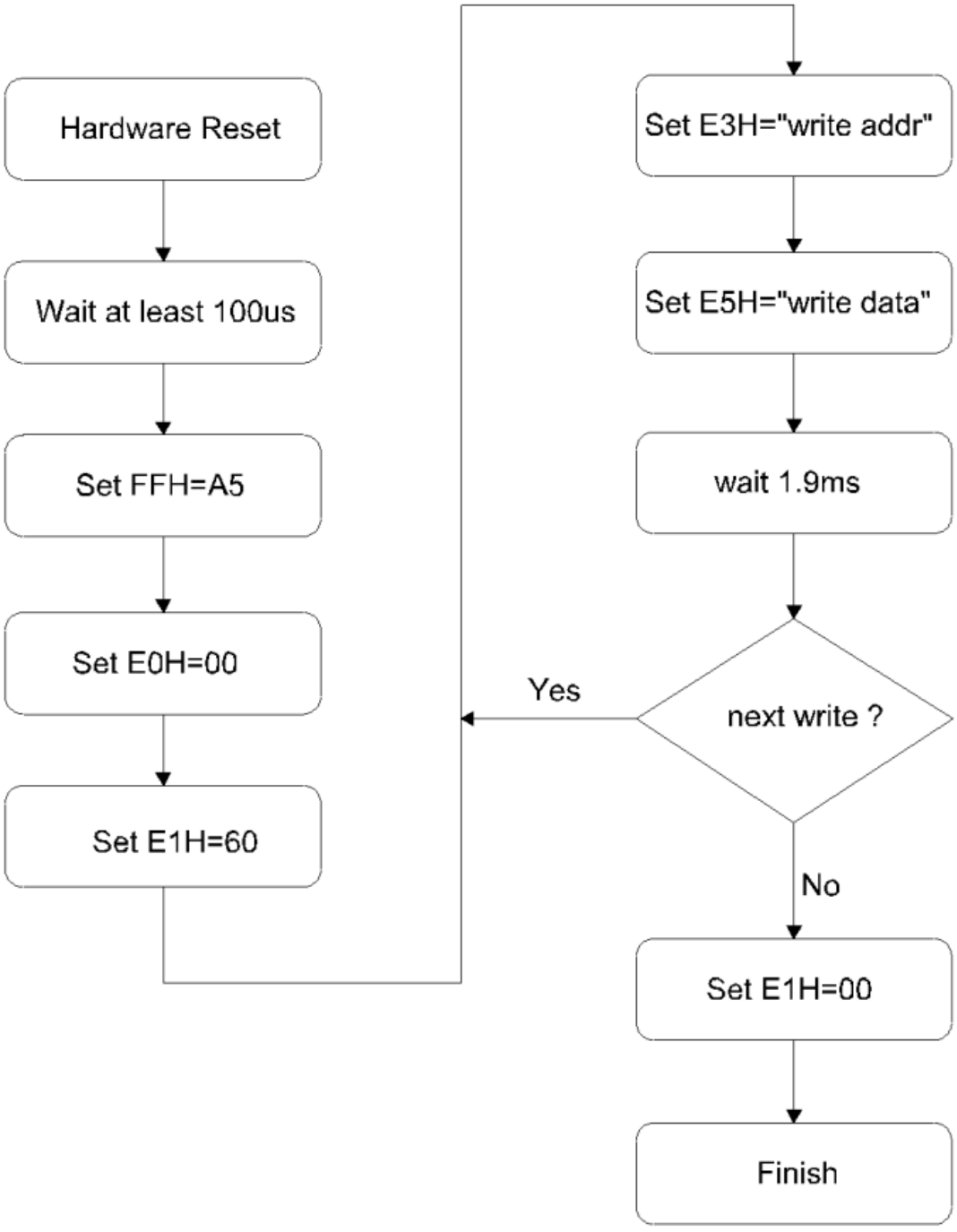
CASE 4: First pixel is at Right_bottom of the panel

RGB order is “B.G.R”

CASE 3: First pixel is at Right_bottom of the panel
RGB order is “R.G.B”



14. OTP Flow


Hardware Reset
Wait at least 100us
Set FFH=A5
Set E0H=00
Set E1H=60
Set E3H="write addr"
Set E5H="write data"
wait 1.9ms
next write ?
Yes
No
Set E1H=00
Finish

15. Electrical Characteristics

15.1. Absolute Maximum Ratings

The absolute maximum rating is listed on following table. When NV3023B is used out of the absolute maximum ratings, the NV3023B may be permanently damaged. So working within the following electrical characteristics limit is strongly recommended during normal operation.

Item	Symbol	Unit	Value Note
Supply voltage	VCI	V	-0.3~+4.8
Supply voltage(Logic)	IOVCC	V	-0.3~+3.6
Supply voltage(Digital)	VCC	V	-0.3~+1.95
Driver supply voltage	VGH-VGL	V	-0.3~+30.0
Logic input voltage range	VIN	V	-0.3~IOVCC+0.3
Logic output voltage range	VO	V	-0.3~IOVCC+0.3
Operation temperature	Topr	℃	-35~+85
Storage temperature	Tstg	℃	-55~+110

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

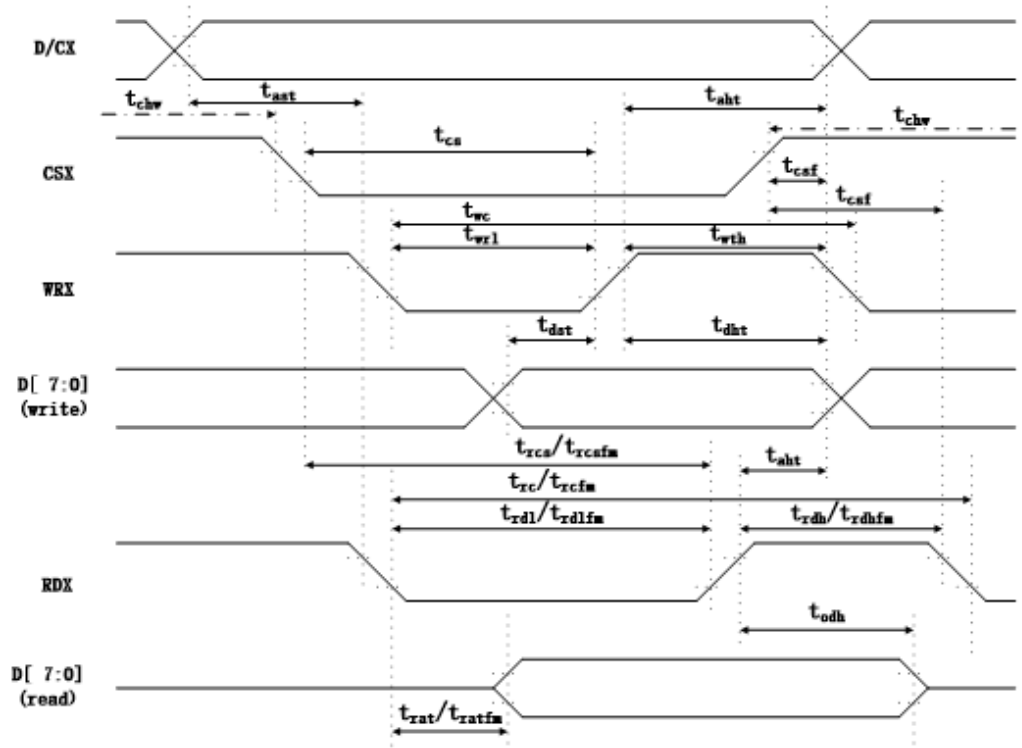
15.2. DC Characteristics

Item	Symbol	Unit	Condition	Min.	Typ.	Max.	Note
Power & Operation Voltage							
Analog Operation Voltage	VCI	V	Operation Voltage	2.5	2.75	4.8	Note2
Logic Operation Voltage	IOVCC	V	I/O Supply Voltage	1.65	1.8	3.6	Note2
Digital Operation Voltage	VDD	V	Digital Supply Voltage		1.85		Note2
Gate Driver High Voltage	VGH	V		10		15	Note3
Gate Driver Low Voltage	VGL	V		-13		-7.5	Note3
Driver Supply Voltage		V	|VGH-VGL|	17.5		28	Note3
Input/Output							
Logic High Level Input Voltage	VIH	V		0.7IOVCC		IOVCC	Note1,2, 3
Logic Low Level Input Voltage	VIL	V		VSS		0.3IOVCC	Note1,2, 3
Logic High Level Output Voltage	VOH	V	IOH=-1.0mA	0.8IOVCC		IOVCC	Note1,2, 3
Logic Low Level Output Voltage	VOL	V	IOL=1.0mA	VSS		0.2IOVCC	Note1,2, 3
Logic Input Leakage Current	IIL	uA	VIN=IOVCC or VSS	-0.1		0.1	Note1,2, 3
VCOM Operation							
VCOM High Voltage	VCOMH	V	Ccom=12nF	2.793	3.659	4.833	Note3
VCOM Low Voltage	VCOML	V	Ccom=12nF	-2.093	-1.041	0.631	Note3
VCOM Amplitude Voltage	VOMA	V	|VCOMH-VCOML|	3.226	4.7	5.731	Note3
Source Driver							
Source Output Range	Vsout	V		0.10		4.90	Note4
Gama Reference Voltage	GVDD	V		3.8	4.7	4.95	Note3

Note 1: IOVCC=1.65 to 3.6V, VCI=2.5 to 3.6V, AGND=GND=0V, Ta=-30 to 70 (to +85 ℃ ℃ no damage)
Note2: Please supply digital IOVCC voltage equal or less than analog VCI voltage. (IOVCC≦VCI)
Note2, 3, 4: When the measurements are performed with LCD module. Measurement Points are like below.
Note3: CSX, RDX, WRX, D[23:0], D/CX, RESX, TE, PCLK, VS, HS, DE, SDA, SCL, GM2, GM1, GM0, RCM1, RCM0, P68, IM2, IM1, IM0, SRGB, REV, SMX, SMY, RL, TB, IDM, SHUT, PREG, GS and Test pins.
Note5: Source channel loading = 10pF/channel, Gate channel loading = 50pF/channel

15.3. AC Characteristics

15.3.1 Parallel MCU 8-bit BUS



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

Table 15.3.1 AC characteristics of parallel MCU I/F in asynchronous mode

Signal	Symbol	Parameter	MIN	MAX	UNIT	Description
D/CX	TAST	Address Setup Time	0		ns	
	THAT	Address Hold Time (W/R)	10		ns	
CSX	TCHW	“S” “H” Pulse Width	0		ns	
	TCS	Chip Select Setup Time(W)	10		ns	
	TRCS	Chip Select Setup Time (Read ID)	45		ns	
	TRCSFM	Chip Select Setup Time (Read FM)	355		ns	
	TCSF	Chip Select Wait Time (W/R)	10		ns	
WRX	TWC	Write Cycle	80		ns	
	TWRH	Control Pulse H Duration	40		ns	
	TWRL	Control Pulse L Duration	40		ns	
RDX	TRC	Read Cycle(ID)	160		ns	When Read ID
	TRDH	Control Pulse H Duration(ID)	90		ns	
	TRDL	Control Pulse L Duration(ID)	45		ns	
RDX	TRCFM	Read Cycle(FM)	450		ns	When Read From Frame Memory
	TRDHFM	Control Pulse H	90		ns	

		Duration(FM)				
	TRDLFM	Control Pulse L Duration(FM)	355		ns	
D[7:0]	TDST	Data Setup Time	10		ns	CLmax=30pF Clmin=8pF
	TDHT	Data Hold Time	10		ns	
	TRAT	Read Access Time(ID)		40	ns	
	TRATFM	Read Access Time(FM)		340	ns	
	TODH	Output Disable Time	20	80	ns	

Note 1: IOVCC 1.65 to 3.6V, VCI=2.6 to 3.6V, AGND=GND=0V, Ta=-30 to 70 °C (to +85°C no damage)
Note 2: This input signal rise time and fall time (tr, tf) is specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of IOVCC for input signals

15.3.2 Display Serial Interface(SPI)

15.3.2.1 SPI 3-Wire Interface

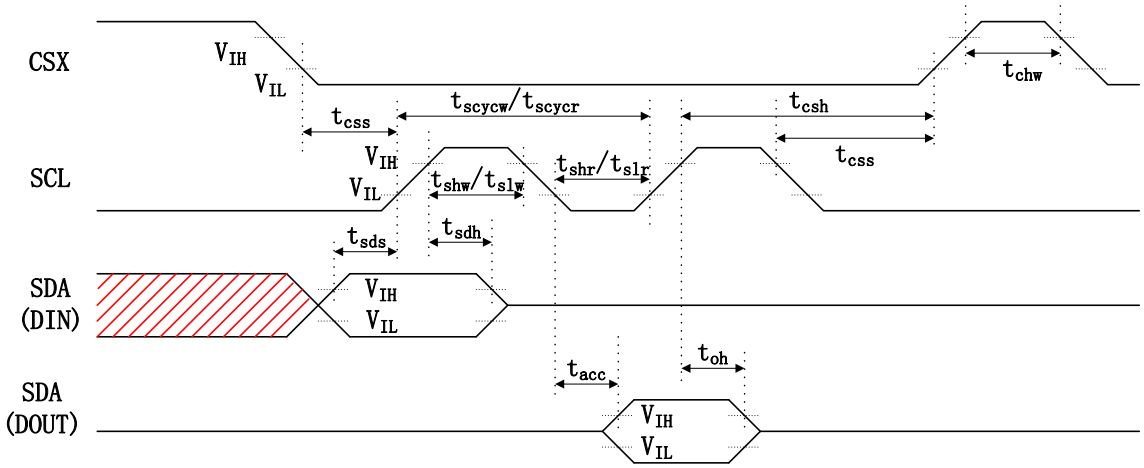


Table 15.3.2.1: 3-pin Serial Interface Characteristics

Signal	Symbol	Parameter	MIN	MAX	UNIT	Description
CSX	TCSS	Chip Select Setup Time	10		ns	
	TCSH	Chip Select Hold Time	30		ns	
	TCHW	Chip Select “H” Pulse Width	30		ns	
SCL	TSCYCW	Serial Clock Cycle(Write)	16		ns	
	TSHW	S”L””H” Pulse Width(Write)	8		ns	
	TSLW	S”L””L” Pulse Width(Write)	8		ns	
	TSCYCR	Serial Clock Cycle(Read)	150		ns	
	TSHR	S”L””H” Pulse Width(Read)	60		ns	
	TSLR	S”L””L” Pulse Width(Read)	60		ns	

Signal	Symbol	Parameter	MIN	MAX	UNIT	Description
SDA(DIN) /(DOUT)	TSDS	Data Setup Time	15		ns	
	TSDH	Data Hold Time	5		ns	
	TACC	Access Time	5	50	ns	CLmax=30pF CLmin=8pF
	TOH	Output Disable Time	10		ns	

Note 1: IOVCC=1.65 to 3.6V, VCI=2.6 to 3.6V, AGND=GND=0V. Ta=-30 to 70℃ (to +85℃ no damage)
Note 2: The input signal rise time and fall time(tr, tf) is specified at 15 ns or less. Logic high and low levels are specified as 10% and 90% of IOVCC for Input signals.

15.3.2.2 SPI 4-Wire Interface

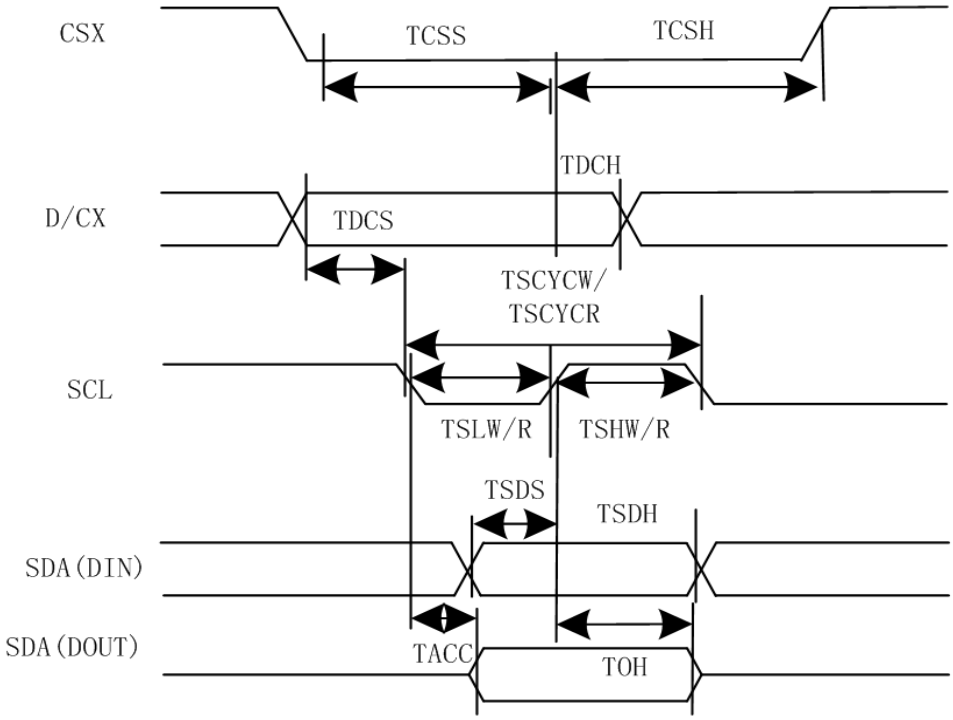


Table 15.3.2.2: 4 pin Serial Interface Characteristics

Signal	Symbol	Parameter	MIN	MAX	UNIT	Description
CSX	TCSS	Chip Select Setup Time	10		ns	
	TCSH	Chip Select Hold Time	30		ns	
	TCHW	Chip Select “H” Pulse Width	30		ns	
SCL	TSCYCW	Serial Clock Cycle(Write)	16		ns	
	TSHW	S”L””H” Pulse Width(Write)	8		ns	
	TSLW	S”L””L” Pulse Width(Write)	8		ns	
	TSCYCR	Serial Clock Cycle(Read)	150		ns	

	TSHR	S”L””H” Pulse Width(Read)	60		ns	
	TSLR	S”L””L” Pulse Width(Read)	60		ns	
D/CX	TDCS	D/CX Setup Time	5		ns	
	TDCH	D/CX Hold Time	5		ns	
SDA(DIN) (DOUT)	TSDS	Data Setup Time	9.5		ns	
	TSDH	Data Hold Time	5		ns	
	TACC	Access Time	5	50	ns	CLmax=30pF CLmin=8pF
	TOH	Output Disable Time	10		ns	

Note 1: IOVCC=1.65 to 3.6V, VCI=2.6 to 3.6V, AGND=GND=0V. Ta=-30 to 70℃ (to +85℃ no damage)
Note 2: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less. Logic high and low levels are specified as 10% and 90% of IOVCC for Input signals.

15.3.3 Parallel RGB 6-bit BUS

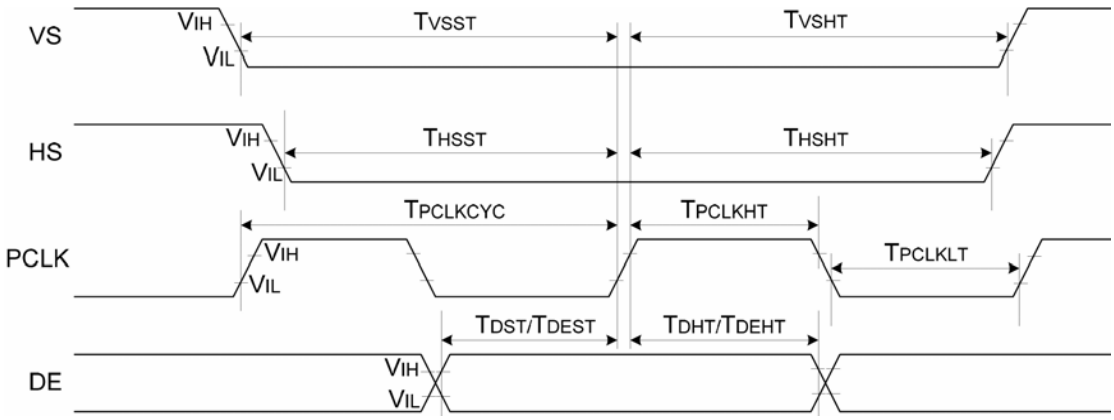


Table 15.3.3 RGB Interface Charateristics

Signal	Symbol	Parameter	MIN	MAX	UNIT	Description
PCLK	TPCLKCYC	TPCLK Cycle Time	66		ns	
	TPCLKLT	Pixel Low Pulse Width	15	-	ns	
	TPCLKHT	Pixel High Pulse Width	15	-	ns	
VS	TVSST	Vertical Sync.setup time	15	-	ns	
	TVSHT	Vertical Sync.hold time	15	-	ns	
HS	THSST	Horizontal Sync.setup time	15	-	ns	
	THSHT	Horizontal Sync.hold time	15	-	ns	
DE	TDEST	Data Enable Setup Time	15	-	ns	
	TDEHT	Data Enable Hold Time	15	-	ns	
D[5:0]	TDST	Data Setup Time	15	-	ns	
	TDHT	Data Hold Time	15	-	ns	

16. Revision History

Date	Revision	Page	Description
2018/07/12	V1.0	All	First Release
2018/10/10	V1.1	All	
2018/10/23	V1.2	All	
2022/04/28	V1.3	All	
2022/05/10	V1.4	1~11	
2022/06/21	V1.5		1.87H，88H，89H default value and list 2.VCOMH，VCOML，GVDD driver output voltage and High Voltage / Low Voltage 3.SPI 4-wire sequence diagram
2022/07/22	V1.6	110	Update the default value of 53H
2022/11/09	V1.7	111~114	Update the Frame rate
2022/12/05	V1.8	All	Update the MCU Interface and RGB Interface
2023/02/02	V1.9	7	Add description of 2 data line SPI
2023/05/07	V2.0		Update the register section
2023/07/24	V2.1	134	Update the OTP Flow in chapter14
2023/08/18	V2.2	99	Update the 3Dh register
2023/08/30	V2.3		Update the “Chapter 2 Pin Descriptions” and “Chapter 3 Bump Arrangement and Coordination ”
2023/09/28	V2.4	140	Update the value of TSDS of SPI 4-Wire Interface in “Chapter 15.3.2.2”
2023/11/17	V2.5	8	Add the description of EXTC pad in “Chapter 2”
2023/12/18	V2.6	10	Add the recommended wiring resistance values in “Chapter 3.2 Pin Connection”
2023/12/22	V2.7	93	Add the 44h register in “Chapter 12.1.31 LVD_DETECT”