



## SPECIFICATION FOR LCD MODULE

Customer P/N:

Santek P/N: ST0400A1-RSMLW-F

DOC. Revision: RS02

Customer Approval:

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	SIGNATURE	DATE
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RS01	2014-12-30	First Issue	GQ_Zhou
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## 1. APPLICATIONS

These specifications apply to 10.08cm(3.97inch) TFT-LCD monitor products, which are intended for civilian use.

- As to the use of these products, and/or the use of the information and / or the drawings in these specifications, Santek shall not guarantee an industrial right, intellectual property, or any other rights of a third party.
  
- If these products will be used in an application where a higher level of reliability and safety is needed, in terms of function and accuracy, such as transportation equipment (aircraft, train, automobile, etc.), disaster-prevention, security equipment, or various safety equipment, customer shall contact Santek for technical assistance in advance.
  
- These products shall not be used in critical application that requires the highest level of reliability and safety, such as aerospace equipment, main lines of telecommunications equipment, control equipment for nuclear plants, or medical life-support equipment.
  
- Santek shall not be liable for any damage arising from the misuse, abuse, and/or miss-operation of these products that do not meet with the operating conditions and precautions described in these specifications.
  
- Santek shall not be obliged to burden the responsibility for destruction by static electricity broken out in customer's processes.
  
- If any issues arise as to the information provided in these specifications or any other information, Santek will discuss them with customer in good faith and try to seek solutions or improvements.
  
- Complaint about non-conformance to the specifications on this document shall be notified to Santek within six months from the date of production or three months from the date of shipment, together with return of the actual products .  
After the expiration date designated above, Santek shall have the right to reject any complaint.

**2. GENERAL SPECIFICATIONS**

Item	Specification	Remark
Display type	16,777,216 Colors, Transmissive mode Normally black	
Product description	LCD monitor with internal CPU interface circuit	
Dot arrangement	RGB stripe arrangement	Refer to figure 1
Input signal	Register : Serial Peripheral Interface (SPI) Data : 24 bit RGB interface	
Backlight	High brightness LED, side light	

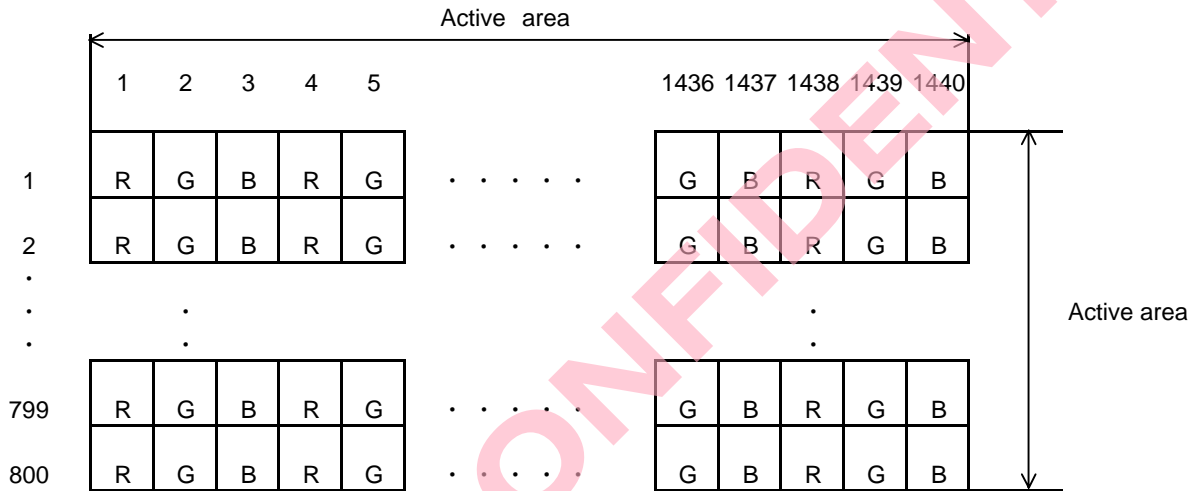
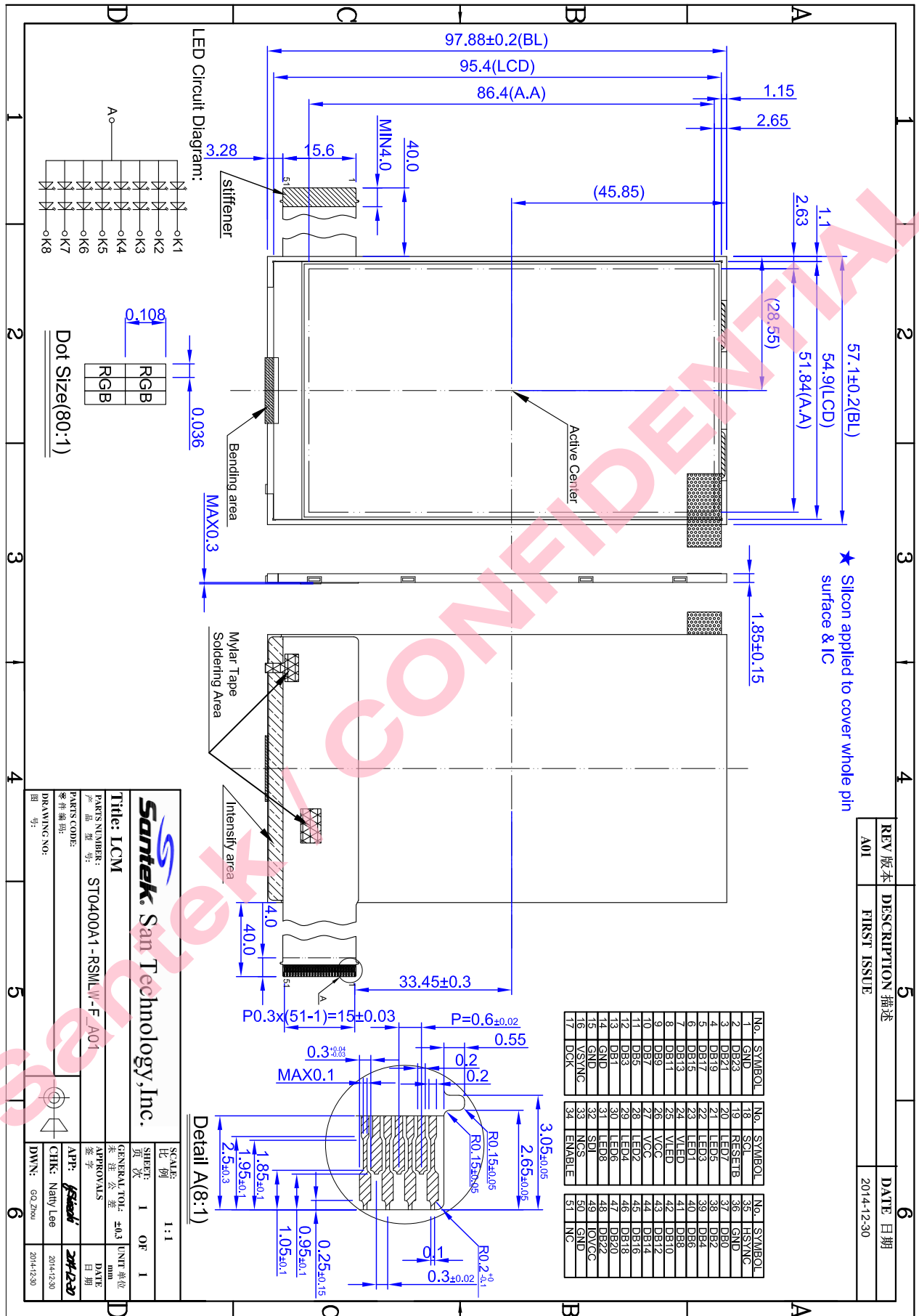


Figure 1 Dot arrangement

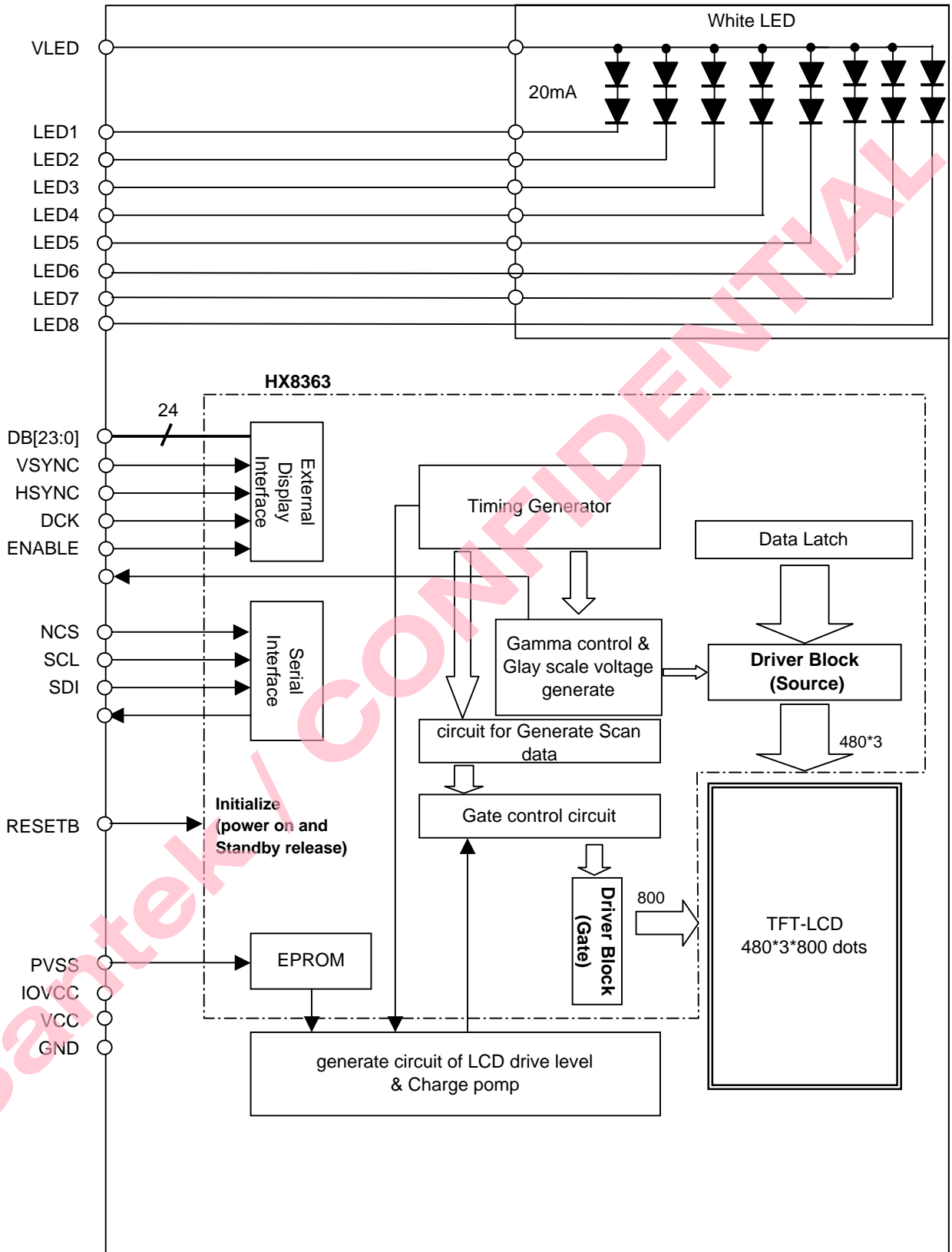
**3. DIMENSIONS AND OUTWARD FORM**

**3.1. DIMENSIONS**

Item	Specification	Unit	Remarks
Monitor outline dimensions	57.10(H) x 97.88(V) x 1.85(D)	mm	Refer to mechanical drawing
Active area	51.84 (H) x 86.40 (V)	mm	Diagonal: 3.97inch
Number of dots	480 x RGB(H) x 800 (V)	Dot	
Dot pitch	36.0 (H) x 108.0 (V)	um	
Hardness of panel surface	3	H	200g
Weight	22	g	



4. Block Diagram



5.FPC Terminals

No.	Symbol	Details	Remark	IO
1	GND	GROUND		P
2	DB23	Unidirectional Data Bus	R[7] MSB	I
3	DB21	Unidirectional Data Bus	R[5]	I
4	DB19	Unidirectional Data Bus	R[3]	I
5	DB17	Unidirectional Data Bus	R[1]	I
6	DB15	Unidirectional Data Bus	G[7] MSB	I
7	DB13	Unidirectional Data Bus	G[5]	I
8	DB11	Unidirectional Data Bus	G[3]	I
9	DB9	Unidirectional Data Bus	G[1]	I
10	DB7	Unidirectional Data Bus	B[7] MSB	I
11	DB5	Unidirectional Data Bus	B[5]	I
12	DB3	Unidirectional Data Bus	B[3]	I
13	DB1	Unidirectional Data Bus	B[1]	I
14	GND	GROUND		P
15	GND	GROUND		P
16	VSXNC	VSXNC		I
17	DCK	DOTCLK		I
18	SCL	3-Wire SPI clock		I
19	RESETB	LCD Reset	L:Initialize Power_ON Reset is Required when Turning on the Power	I
20	LED7	Backlight LED Cathode7		P
21	LED5	Backlight LED Cathode5		P
22	LED3	Backlight LED Cathode3		P
23	LED1	Backlight LED Cathode1		P
24	VLED	Power supply for Backlight LED		P
25	VLED			P
26	VCC	Power	2.8±0.1[V]	P
27	VCC			P
28	LED2	Backlight LED Cathode2		P
29	LED4	Backlight LED Cathode4		P
30	LED6	Backlight LED Cathode6		P
30	LED8	Backlight LED Cathode8		P
32	SDI	3-Wire SPI DATA input		I
33	NCS	3-Wire SPI Chip Select		I
34	ENABLE	ENABLE		I
35	HSXNC	HSXNC		I
36	GND	GROUND		P
37	DB0	Unidirectional Data Bus	B[0] LSB	I
38	DB2	Unidirectional Data Bus	B[2]	I
39	DB4	Unidirectional Data Bus	B[4]	I
40	DB6	Unidirectional Data Bus	B[6]	I
41	DB8	Unidirectional Data Bus	G[0] LSB	I
42	DB10	Unidirectional Data Bus	G[2]	I
43	DB12	Unidirectional Data Bus	G[4]	I
44	DB14	Unidirectional Data Bus	G[6]	I
45	DB16	Unidirectional Data Bus	R[0] LSB	I
46	DB18	Unidirectional Data Bus	R[2]	I
47	DB20	Unidirectional Data Bus	R[4]	I
48	DB22	Unidirectional Data Bus	R[6]	I
49	IOVCC	Power	1.8±0.1[V]	P
50	GND	GROUND		P
50	NC	No Connection		N

DB23	DB22	DB21	DB20	DB19	DB18	DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0								
R[7]	R[6]	R[5]	R[4]	R[3]	R[2]	R[1]	R[0]	G[7]	G[6]	G[5]	G[4]	G[3]	G[2]	G[1]	G[0]	B[7]	B[6]	B[5]	B[4]	B[3]	B[2]	B[1]	B[0]								
MSB								LSB								MSB								LSB							

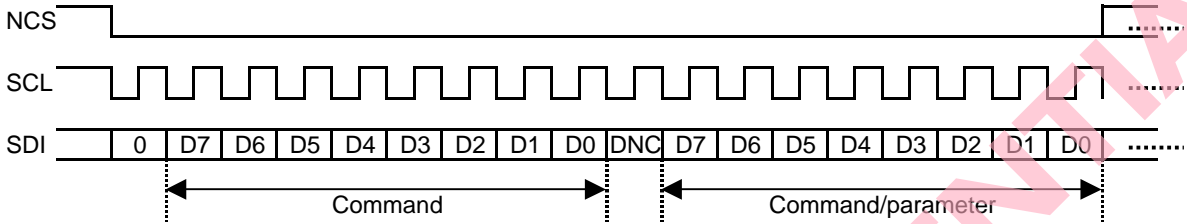


### 6. Serial Data Transfer Interface

Instructions are transferred using 3 wire serial data transfer interface. The 3 wire serial bus uses chip select line (NCS), serial input data (SDI) and serial transfer clock line (SCL).

The 3 wire serial data packet is consists of control bit DNC and transmission byte. If the control bit is low, the transmission byte is command byte. If the control bit is high, the transmission byte is stored to command register. DNC should be transferred first , followed by MSB of transmission byte.

The serial interface is initialized when NCS is high, and the falling edge of NCS enables the serial interface.



7.Instruction list

(1)

(Hex)	Register	DNC	D7	D6	D5	D4	D3	D2	D1	D0
00	NOP	0	0	0	0	0	0	0	0	0
	initial	-	-	-	-	-	-	-	-	-
recommend	-	-	-	-	-	-	-	-	-	-
01	SWRESET	0	0	0	0	0	0	0	0	1
	initial	-	-	-	-	-	-	-	-	-
recommend	-	-	-	-	-	-	-	-	-	-
06	RDRED	0	0	0	0	0	0	1	1	0
	initial	-	-	-	-	-	-	-	-	-
recommend	-	-	-	-	-	-	-	-	-	-
07	RDGREEN	0	0	0	0	0	0	1	1	1
	initial	-	-	-	-	-	-	-	-	-
recommend	-	-	-	-	-	-	-	-	-	-
08	RDBLUE	0	0	0	0	0	1	0	0	0
	initial	-	-	-	-	-	-	-	-	-
recommend	-	-	-	-	-	-	-	-	-	-
0A	RDDPM	0	0	0	0	0	1	0	1	0
	initial	-	-	-	-	-	-	-	-	-
recommend	-	-	-	-	-	-	-	-	-	-
0B	RDDMADCTL	0	0	0	0	0	1	0	1	1
	initial	-	-	-	-	-	-	-	-	-
recommend	-	-	-	-	-	-	-	-	-	-
0C	RDDCOLMOD	0	0	0	0	0	1	1	0	0
	initial	-	-	-	-	-	-	-	-	-
recommend	-	-	-	-	-	-	-	-	-	-
0D	RDDIM	0	0	0	0	0	1	1	0	1
	initial	-	-	-	-	-	-	-	-	-
recommend	-	-	-	-	-	-	-	-	-	-
0E	RDDSM	0	0	0	0	0	1	1	1	0
	initial	-	-	-	-	-	-	-	-	-
recommend	-	-	-	-	-	-	-	-	-	-
0F	RDDSDR	0	0	0	0	0	1	1	1	1
	initial	-	-	-	-	-	-	-	-	-
recommend	-	-	-	-	-	-	-	-	-	-
10	SLPIN	0	0	0	0	1	0	0	0	0
	initial	-	-	-	-	-	-	-	-	-
recommend	-	-	-	-	-	-	-	-	-	-
11	SLPOUT	0	0	0	0	1	0	0	0	1
	initial	-	-	-	-	-	-	-	-	-
recommend	-	-	-	-	-	-	-	-	-	-
20	INVOFF	0	0	0	1	0	0	0	0	0
	initial	-	-	-	-	-	-	-	-	-
recommend	-	-	-	-	-	-	-	-	-	-
21	INVON	0	0	0	1	0	0	0	0	1
	initial	-	-	-	-	-	-	-	-	-
recommend	-	-	-	-	-	-	-	-	-	-
26	GAMSET	0	0	0	1	0	0	1	1	0
	initial	-	-	-	-	-	-	-	-	-
recommend	-	-	-	-	-	-	-	-	-	-
28	DISPOFF	0	0	0	1	0	1	0	0	0
	initial	-	-	-	-	-	-	-	-	-
recommend	-	-	-	-	-	-	-	-	-	-
29	DISPON	0	0	0	1	0	1	0	0	1
	initial	-	-	-	-	-	-	-	-	-
recommend	-	-	-	-	-	-	-	-	-	-

(2)

(Hex)	Register	DNC	D7	D6	D5	D4	D3	D2	D1	D0
36	MADCTL	0	0	0	1	1	0	1	1	0
		1	-	-	-	-	BGR	-	SS	GS
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
3A	COLMOD	0	0	0	1	1	1	0	1	0
		1	-	CSEL_RGB[2:0]			-	-	-	-
	initial	-	0	1	1	1	0	0	0	0
	recommend	-	0	1	1	1	0	0	0	0
B1	SETPOWER	0	1	0	1	1	0	0	0	1
		1	-	VSN_EN	VSP_EN	VGL_EN	VGH_EN	-	VDDN_HIZ	SLP
	initial	-	1	0	0	0	0	0	0	1
	recommend	-	0	1	1	1	1	0	0	0
	1	-	FS12	FS11	FS10	-	AP2	AP1	AP0	
	initial	-	0	0	1	1	0	0	0	
	recommend	-	0	0	1	0	1	0	0	
	1	-	-	-	-	BT3	BT2	BT1	BT0	
	initial	-	0	0	0	0	0	0	0	
	recommend	-	0	0	0	0	1	0	0	
	1	DT1	DT0	DC1	DC0	DC_DIV3	DC_DIV2	DC_DIV1	DC_DIV0	
	initial	-	0	0	1	1	0	0	0	
	recommend	-	0	0	0	0	0	0	1	
	1	-	DTPS2	DTPS1	DTPS0	-	DTP2	DTP1	DTP0	
	initial	-	0	0	0	0	1	0	0	
	recommend	-	0	0	0	0	0	1	0	
	1	-	DTNS2	DTNS1	DTNS0	-	DTN2	DTN1	DTN0	
	initial	-	0	0	0	1	0	1	1	
	recommend	-	0	0	0	0	0	0	1	
	1	-	-	-	BTP4	BTP3	BTP2	BTP1	BTP0	
	initial	-	0	0	0	0	1	1	1	
	recommend	-	0	0	0	1	0	0	0	
	1	-	-	-	BTN4	BTN3	BTN2	BTN1	BTN0	
	initial	-	0	0	0	0	1	1	1	
	recommend	-	0	0	0	1	0	0	0	
	1	VRHP7	VRHP6	VRHP5	VRHP4	VRHP3	VRHP2	VRHP1	VRHP0	
	initial	-	0	0	1	0	0	1	0	
	recommend	-	0	0	1	1	0	1	0	
	1	VRHN7	VRHN6	VRHN5	VRHN4	VRHN3	VRHN2	VRHN1	VRHN0	
	initial	-	0	0	1	0	1	1	0	
	recommend	-	0	0	1	1	1	1	0	
	1	-	-	VRMP5	VRMP4	VRMP3	VRMP2	VRMP1	VRMP0	
initial	-	0	0	0	1	1	0	0		
recommend	-	0	0	1	1	1	1	1		
1	-	-	VRMN5	VRMN4	VRMN3	VRMN2	VRMN1	VRMN0		
initial	-	0	0	0	1	1	0	0		
recommend	-	0	0	1	1	1	1	1		
B3	SETRGBIF	0	1	0	1	1	0	0	1	1
		1	-	-	-	-	DPL	HSPL	VSPL	EPL
	initial	-	0	0	0	0	0	0	0	1
	recommend	-	0	0	0	0	0	0	0	1

(3)

(Hex)	Register	DNC	D7	D6	D5	D4	D3	D2	D1	D0
B4	SETRGBIF	0	1	0	1	1	0	1	0	0
		1	-	-	-	-	NW[1:0]		-	-
	initial	-	0	0	0	0	1	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
	1	SON[7:0]								
	initial	-	0	0	0	1	0	0	1	0
	recommend	-	0	0	0	0	1	0	0	0
	1	SOFF[7:0]								
	initial	-	0	1	1	1	0	0	1	0
	recommend	-	0	1	1	0	1	1	1	0
	1	EQS[7:0]								
	initial	-	0	0	0	1	0	0	1	0
	recommend	-	0	0	0	0	0	1	1	1
	1	EQON[7:0]								
	initial	-	0	0	0	0	0	1	1	0
	recommend	-	0	0	0	0	0	0	0	1
	1	GDON[7:0]								
	initial	-	0	0	0	0	0	0	1	1
	recommend	-	0	0	0	0	0	0	0	1
	1	GDOFF[7:0]								
initial	-	0	1	1	0	0	0	0	0	
recommend	-	0	1	1	0	0	0	1	0	
1	GVSSP1[7:0]									
initial	-	0	0	0	0	0	0	1	1	
recommend	-	0	0	0	0	0	0	0	1	
1	GVSSP2[7:0]									
initial	-	0	1	0	1	1	0	1	0	
recommend	-	0	1	0	1	0	1	1	1	
B9	SETRGBIF	0	1	0	1	1	1	0	0	1
		1	EXTC1[7:0]							
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	1	1	1	1	1	1	1	1
	1	EXTC2[7:0]								
	initial	-	0	0	0	0	0	0	0	0
recommend	-	1	0	0	0	0	0	1	1	
1	EXTC3[7:0]									
initial	-	0	0	0	0	0	0	0	0	
recommend	-	0	1	1	0	0	0	1	1	
C1	SETDGLUT	0	1	1	0	0	0	0	0	1
		1	-	-	-	-	-	-	-	DGC_EN
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
	1	D1[7:0]								
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
	1	D2[7:0]								
	initial	-	0	0	0	0	1	0	0	0
	recommend	-	0	0	0	0	1	0	0	0
	1	D3[7:0]								
	initial	-	0	0	0	1	0	0	0	0
	recommend	-	0	0	0	1	0	0	0	0
	1	D4[7:0]								
initial	-	0	0	0	1	1	0	0	0	
recommend	-	0	0	0	1	1	0	0	0	

(4)

(Hex)	Register	DNC	D7	D6	D5	D4	D3	D2	D1	D0
C1	SETDGCLUT	1	D5[7:0]							
	initial	-	0	0	1	0	0	0	0	0
	recommend	-	0	0	1	0	0	0	0	0
		1	D6[7:0]							
	initial	-	0	0	1	0	1	0	0	0
	recommend	-	0	0	1	0	1	0	0	0
		1	D7[7:0]							
	initial	-	0	0	1	1	0	0	0	0
	recommend	-	0	0	1	1	0	0	0	0
		1	D8[7:0]							
	initial	-	0	0	1	1	1	0	0	0
	recommend	-	0	0	1	1	1	0	0	0
		1	D9[7:0]							
	initial	-	0	1	0	0	0	0	0	0
	recommend	-	0	1	0	0	0	0	0	0
		1	D10[7:0]							
	initial	-	0	1	0	0	1	0	0	0
	recommend	-	0	1	0	0	1	0	0	0
		1	D11[7:0]							
	initial	-	0	1	0	1	0	0	0	0
	recommend	-	0	1	0	1	0	0	0	0
		1	D12[7:0]							
	initial	-	0	1	0	1	1	0	0	0
	recommend	-	0	1	0	1	1	0	0	0
	1	D13[7:0]								
initial	-	0	1	1	0	0	0	0	0	
recommend	-	0	1	1	0	0	0	0	0	
	1	D14[7:0]								
initial	-	0	1	1	0	1	0	0	0	
recommend	-	0	1	1	0	1	0	0	0	
	1	D15[7:0]								
initial	-	0	1	1	1	0	0	0	0	
recommend	-	0	1	1	1	0	0	0	0	
	1	D16[7:0]								
initial	-	0	1	1	1	1	0	0	0	
recommend	-	0	1	1	1	1	0	0	0	
	1	D17[7:0]								
initial	-	1	0	0	0	0	0	0	0	
recommend	-	1	0	0	0	0	0	0	0	
	1	D18[7:0]								
initial	-	1	0	0	0	1	0	0	0	
recommend	-	1	0	0	0	1	0	0	0	
	1	D19[7:0]								
initial	-	1	0	0	1	0	0	0	0	
recommend	-	1	0	0	1	0	0	0	0	
	1	D20[7:0]								
initial	-	1	0	0	1	1	0	0	0	
recommend	-	1	0	0	1	1	0	0	0	
	1	D21[7:0]								
initial	-	1	0	1	0	0	0	0	0	
recommend	-	1	0	1	0	0	0	0	0	
	1	D22[7:0]								
initial	-	1	0	1	0	1	0	0	0	
recommend	-	1	0	1	0	1	0	0	0	

SETDGCLUT continues to the next page.

(5)

(Hex)	Register	DNC	D7	D6	D5	D4	D3	D2	D1	D0
C1	SETDGCLUT	1	D23[7:0]							
	initial	-	1	0	1	1	0	0	0	0
	recommend	-	1	0	1	1	0	0	0	0
		1	D24[7:0]							
	initial	-	1	0	1	1	1	0	0	0
	recommend	-	1	0	1	1	1	0	0	0
		1	D25[7:0]							
	initial	-	1	1	0	0	0	0	0	0
	recommend	-	1	1	0	0	0	0	0	0
		1	D26[7:0]							
	initial	-	1	1	0	0	1	0	0	0
	recommend	-	1	1	0	0	1	0	0	0
		1	D27[7:0]							
	initial	-	1	1	0	1	0	0	0	0
	recommend	-	1	1	0	1	0	0	0	0
		1	D28[7:0]							
	initial	-	1	1	0	1	1	0	0	0
	recommend	-	1	1	0	1	1	0	0	0
		1	D29[7:0]							
	initial	-	1	1	1	0	0	0	0	0
	recommend	-	1	1	1	0	0	0	0	0
		1	D30[7:0]							
	initial	-	1	1	1	0	1	0	0	0
	recommend	-	1	1	1	0	1	0	0	0
		1	D31[7:0]							
	initial	-	1	1	1	1	0	0	0	0
	recommend	-	1	1	1	1	0	0	0	0
		1	D32[7:0]							
	initial	-	1	1	1	1	1	0	0	0
	recommend	-	1	1	1	1	1	0	0	0
		1	D33[7:0]							
	initial	-	1	1	1	1	1	1	1	1
	recommend	-	1	1	1	1	1	1	1	1
		1	D34[7:0]							
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
		1	D35[7:0]							
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
		1	D36[7:0]							
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
		1	D37[7:0]							
	initial	-	0	0	0	0	0	0	0	0
recommend	-	0	0	0	0	0	0	0	0	
	1	D38[7:0]								
initial	-	0	0	0	0	0	0	0	0	
recommend	-	0	0	0	0	0	0	0	0	
	1	D39[7:0]								
initial	-	0	0	0	0	0	0	0	0	
recommend	-	0	0	0	0	0	0	0	0	
	1	D40[7:0]								
initial	-	0	0	0	0	0	0	0	0	
recommend	-	0	0	0	0	0	0	0	0	

SETDGCLUT continues to the next page.

(6)

(Hex)	Register	DNC	D7	D6	D5	D4	D3	D2	D1	D0	
C1	SETDGCLUT	1	D41[7:0]								
	initial	-	0	0	0	0	0	0	0	0	
	recommend	-	0	0	0	0	0	0	0	0	
			1	D42[7:0]							
	initial	-	0	0	0	0	0	0	0	0	
	recommend	-	0	0	0	0	0	0	0	0	
			1	D43[7:0]							
	initial	-	0	0	0	0	0	0	0	0	
	recommend	-	0	0	0	0	0	0	0	0	
			1	D44[7:0]							
	initial	-	0	0	0	0	1	0	0	0	
	recommend	-	0	0	0	0	1	0	0	0	
			1	D45[7:0]							
	initial	-	0	0	0	1	0	0	0	0	
	recommend	-	0	0	0	1	0	0	0	0	
			1	D46[7:0]							
	initial	-	0	0	0	1	1	0	0	0	
	recommend	-	0	0	0	1	1	0	0	0	
			1	D47[7:0]							
	initial	-	0	0	1	0	0	0	0	0	
	recommend	-	0	0	1	0	0	0	0	0	
			1	D48[7:0]							
	initial	-	0	0	1	0	1	0	0	0	
	recommend	-	0	0	1	0	1	0	0	0	
			1	D49[7:0]							
	initial	-	0	0	1	1	0	0	0	0	
	recommend	-	0	0	1	1	0	0	0	0	
			1	D50[7:0]							
	initial	-	0	0	1	1	1	0	0	0	
	recommend	-	0	0	1	1	1	0	0	0	
			1	D51[7:0]							
	initial	-	0	1	0	0	0	0	0	0	
recommend	-	0	1	0	0	0	0	0	0		
		1	D52[7:0]								
initial	-	0	1	0	0	1	0	0	0		
recommend	-	0	1	0	0	1	0	0	0		
		1	D53[7:0]								
initial	-	0	1	0	1	0	0	0	0		
recommend	-	0	1	0	1	0	0	0	0		
		1	D54[7:0]								
initial	-	0	1	0	1	1	0	0	0		
recommend	-	0	1	0	1	1	0	0	0		
		1	D55[7:0]								
initial	-	0	1	1	0	0	0	0	0		
recommend	-	0	1	1	0	0	0	0	0		
		1	D56[7:0]								
initial	-	0	1	1	0	1	0	0	0		
recommend	-	0	1	1	0	1	0	0	0		
		1	D57[7:0]								
initial	-	0	1	1	1	0	0	0	0		
recommend	-	0	1	1	1	0	0	0	0		
		1	D58[7:0]								
initial	-	0	1	1	1	1	0	0	0		
recommend	-	0	1	1	1	1	0	0	0		

SETDGCLUT continues to the next page.

(7)

(Hex)	Register	DNC	D7	D6	D5	D4	D3	D2	D1	D0
C1	SETDGCLUT	1	D59[7:0]							
	initial	-	1	0	0	0	0	0	0	0
	recommend	-	1	0	0	0	0	0	0	0
		1	D60[7:0]							
	initial	-	1	0	0	0	1	0	0	0
	recommend	-	1	0	0	0	1	0	0	0
		1	D61[7:0]							
	initial	-	1	0	0	1	0	0	0	0
	recommend	-	1	0	0	1	0	0	0	0
		1	D62[7:0]							
	initial	-	1	0	0	1	1	0	0	0
	recommend	-	1	0	0	1	1	0	0	0
		1	D63[7:0]							
	initial	-	1	0	1	0	0	0	0	0
	recommend	-	1	0	1	0	0	0	0	0
		1	D64[7:0]							
	initial	-	1	0	1	0	1	0	0	0
	recommend	-	1	0	1	0	1	0	0	0
		1	D65[7:0]							
	initial	-	1	0	1	1	0	0	0	0
	recommend	-	1	0	1	1	0	0	0	0
		1	D66[7:0]							
	initial	-	1	0	1	1	1	0	0	0
	recommend	-	1	0	1	1	1	0	0	0
		1	D67[7:0]							
	initial	-	1	1	0	0	0	0	0	0
	recommend	-	1	1	0	0	0	0	0	0
		1	D68[7:0]							
initial	-	1	1	0	0	1	0	0	0	
recommend	-	1	1	0	0	1	0	0	0	
	1	D69[7:0]								
initial	-	1	1	0	1	0	0	0	0	
recommend	-	1	1	0	1	0	0	0	0	
	1	D70[7:0]								
initial	-	1	1	0	1	1	0	0	0	
recommend	-	1	1	0	1	1	0	0	0	
	1	D71[7:0]								
initial	-	1	1	1	0	0	0	0	0	
recommend	-	1	1	1	0	0	0	0	0	
	1	D72[7:0]								
initial	-	1	1	1	0	1	0	0	0	
recommend	-	1	1	1	0	1	0	0	0	
	1	D73[7:0]								
initial	-	1	1	1	1	0	0	0	0	
recommend	-	1	1	1	1	0	0	0	0	
	1	D74[7:0]								
initial	-	1	1	1	1	1	0	0	0	
recommend	-	1	1	1	1	1	0	0	0	
	1	D75[7:0]								
initial	-	1	1	1	1	1	1	1	1	
recommend	-	1	1	1	1	1	1	1	1	
	1	D76[7:0]								
initial	-	0	0	0	0	0	0	0	0	
recommend	-	0	0	0	0	0	0	0	0	

SETDGCLUT continues to the next page.



(8)

(Hex)	Register	DNC	D7	D6	D5	D4	D3	D2	D1	D0
C1	SETDGCLUT	1	D77[7:0]							
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
		1	D78[7:0]							
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
		1	D79[7:0]							
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
		1	D80[7:0]							
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
		1	D81[7:0]							
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
		1	D82[7:0]							
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
		1	D83[7:0]							
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
		1	D84[7:0]							
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
		1	D85[7:0]							
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
		1	D86[7:0]							
initial	-	0	0	0	0	1	0	0	0	
recommend	-	0	0	0	0	1	0	0	0	
	1	D87[7:0]								
initial	-	0	0	0	1	0	0	0	0	
recommend	-	0	0	0	1	0	0	0	0	
	1	D88[7:0]								
initial	-	0	0	0	1	1	0	0	0	
recommend	-	0	0	0	1	1	0	0	0	
	1	D89[7:0]								
initial	-	0	0	1	0	0	0	0	0	
recommend	-	0	0	1	0	0	0	0	0	
	1	D90[7:0]								
initial	-	0	0	1	0	1	0	0	0	
recommend	-	0	0	1	0	1	0	0	0	
	1	D91[7:0]								
initial	-	0	0	1	1	0	0	0	0	
recommend	-	0	0	1	1	0	0	0	0	
	1	D92[7:0]								
initial	-	0	0	1	1	1	0	0	0	
recommend	-	0	0	1	1	1	0	0	0	
	1	D93[7:0]								
initial	-	0	1	0	0	0	0	0	0	
recommend	-	0	1	0	0	0	0	0	0	
	1	D94[7:0]								
initial	-	0	1	0	0	1	0	0	0	
recommend	-	0	1	0	0	1	0	0	0	

SETDGCLUT continues to the next page.

(9)

(Hex)	Register	DNC	D7	D6	D5	D4	D3	D2	D1	D0
C1	SETDGCLUT	1	D95[7:0]							
	initial	-	0	1	0	1	0	0	0	0
	recommend	-	0	1	0	1	0	0	0	0
		1	D96[7:0]							
	initial	-	0	1	0	1	1	0	0	0
	recommend	-	0	1	0	1	1	0	0	0
		1	D97[7:0]							
	initial	-	0	1	1	0	0	0	0	0
	recommend	-	0	1	1	0	0	0	0	0
		1	D98[7:0]							
	initial	-	0	1	1	0	1	0	0	0
	recommend	-	0	1	1	0	1	0	0	0
		1	D99[7:0]							
	initial	-	0	1	1	1	0	0	0	0
	recommend	-	0	1	1	1	0	0	0	0
		1	D100[7:0]							
	initial	-	0	1	1	1	1	0	0	0
	recommend	-	0	1	1	1	1	0	0	0
		1	D101[7:0]							
	initial	-	1	0	0	0	0	0	0	0
	recommend	-	1	0	0	0	0	0	0	0
		1	D102[7:0]							
	initial	-	1	0	0	0	1	0	0	0
	recommend	-	1	0	0	0	1	0	0	0
		1	D103[7:0]							
	initial	-	1	0	0	1	0	0	0	0
	recommend	-	1	0	0	1	0	0	0	0
		1	D104[7:0]							
initial	-	1	0	0	1	1	0	0	0	
recommend	-	1	0	0	1	1	0	0	0	
	1	D105[7:0]								
initial	-	1	0	1	0	0	0	0	0	
recommend	-	1	0	1	0	0	0	0	0	
	1	D106[7:0]								
initial	-	1	0	1	0	1	0	0	0	
recommend	-	1	0	1	0	1	0	0	0	
	1	D107[7:0]								
initial	-	1	0	1	1	0	0	0	0	
recommend	-	1	0	1	1	0	0	0	0	
	1	D108[7:0]								
initial	-	1	0	1	1	1	0	0	0	
recommend	-	1	0	1	1	1	0	0	0	
	1	D109[7:0]								
initial	-	1	1	0	0	0	0	0	0	
recommend	-	1	1	0	0	0	0	0	0	
	1	D110[7:0]								
initial	-	1	1	0	0	1	0	0	0	
recommend	-	1	1	0	0	1	0	0	0	
	1	D111[7:0]								
initial	-	1	1	0	1	0	0	0	0	
recommend	-	1	1	0	1	0	0	0	0	
	1	D112[7:0]								
initial	-	1	1	0	1	1	0	0	0	
recommend	-	1	1	0	1	1	0	0	0	

SETDGCLUT continues to the next page.

(10)

(Hex)	Register	DNC	D7	D6	D5	D4	D3	D2	D1	D0
C1	SETDGCLUT	1	D113[7:0]							
	initial	-	1	1	1	0	0	0	0	0
	recommend	-	1	1	1	0	0	0	0	0
		1	D114[7:0]							
	initial	-	1	1	1	0	1	0	0	0
	recommend	-	1	1	1	0	1	0	0	0
		1	D115[7:0]							
	initial	-	1	1	1	1	0	0	0	0
	recommend	-	1	1	1	1	0	0	0	0
		1	D116[7:0]							
	initial	-	1	1	1	1	1	0	0	0
	recommend	-	1	1	1	1	1	0	0	0
		1	D117[7:0]							
	initial	-	1	1	1	1	1	1	1	1
	recommend	-	1	1	1	1	1	1	1	1
		1	D118[7:0]							
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
		1	D119[7:0]							
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
		1	D120[7:0]							
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
		1	D121[7:0]							
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
		1	D122[7:0]							
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	0	0	0	0
		1	D123[7:0]							
	initial	-	0	0	0	0	0	0	0	0
recommend	-	0	0	0	0	0	0	0	0	
	1	D124[7:0]								
initial	-	0	0	0	0	0	0	0	0	
recommend	-	0	0	0	0	0	0	0	0	
	1	D125[7:0]								
initial	-	0	0	0	0	0	0	0	0	
recommend	-	0	0	0	0	0	0	0	0	
	1	D126[7:0]								
initial	-	0	0	0	0	0	0	0	0	
recommend	-	0	0	0	0	0	0	0	0	
CC	SETDGCLUT	0	1	1	0	0	1	1	0	0
		1	-	-	-	SM_PAN EL	SS_PAN EL	GS_PAN EL	REV_PA NEL	BGR_PA NEL
	initial	-	0	0	0	0	0	0	0	0
	recommend	-	0	0	0	0	1	0	1	1

(11)

(Hex)	Register	DNC	D7	D6	D5	D4	D3	D2	D1	D0		
E0	SET SIP READ INDEX	0	1	1	1	0	0	0	0	0		
		1	-	-	G1_VRP0[5:0]							
		initial	-	0	0	0	0	0	1	0	1	
		recommend	1	0	0	0	0	0	0	1	1	
		1	G1_CGMP0[1:0]	G1_VRP1[5:0]								
		initial	-	0	0	0	1	0	0	0	1	
		recommend	1	0	1	0	0	1	0	0	1	
		1	G1_CGMP1[1:0]	G1_VRP2[5:0]								
		initial	-	0	0	0	1	0	1	0	1	
		recommend	1	0	1	0	0	1	1	1	0	
		1	G1_CGMP2[1:0]	G1_VRP3[5:0]								
		initial	-	0	0	1	0	0	1	0	0	
		recommend	1	0	1	0	0	1	1	0	0	
		1	G1_CGMP3[1:0]	G1_VRP4[5:0]								
		initial	-	0	0	1	0	0	1	1	1	
		recommend	1	0	1	0	1	0	1	1	1	
		1	G1_CGM P5	G1_CGM P4	G1_VRP5[5:0]							
		initial	-	0	0	1	0	0	1	1	1	
		recommend	1	1	1	1	1	0	1	0	0	
		1	-	G1_PRP 0[6]	-	G1_PKP0[4:0]						
		initial	-	0	0	0	0	0	1	1	0	
		recommend	1	0	0	0	0	1	0	1	1	
		1	G1_PRP0[5:4]	-	G1_PKP1[4:0]							
		initial	-	1	0	0	0	1	1	0	1	
		recommend	1	0	1	0	0	1	1	1	0	
		1	G1_PRP0[3:2]	-	G1_PKP2[4:0]							
		initial	-	0	0	0	1	0	0	0	1	
		recommend	1	1	0	0	1	0	0	1	0	
		1	G1_PRP0[1:0]	-	G1_PKP3[4:0]							
		initial	-	1	1	0	1	0	1	0	1	
		recommend	-	0	1	0	1	0	1	1	1	
		1	-	G1_PRP 1[6]	-	G1_PKP4[4:0]						
		initial	-	0	0	0	1	1	0	0	1	
		recommend	-	0	0	0	1	1	0	1	0	
		1	G1_PRP1[5:4]	-	G1_PKP5[4:0]							
		initial	-	1	1	0	1	0	1	1	0	
		recommend	-	1	0	0	1	1	0	0	1	
		1	G1_PRP1[3:2]	-	G1_PKP6[4:0]							
		initial	-	1	0	0	1	0	1	1	1	
		recommend	-	1	0	0	1	0	1	1	0	
1	G1_PRP1[1:0]	-	G1_PKP7[4:0]									
initial	-	0	0	0	0	1	0	0	1			
recommend	-	0	0	0	0	1	1	0	0			
1	-	-	G1_PKP8[4:0]									
initial	-	0	0	0	0	1	0	0	1			
recommend	-	0	0	0	1	0	0	0	0			
1	-	-	G1_VRN0[5:0]									
initial	-	0	0	0	0	0	1	0	1			
recommend	-	0	0	0	0	0	0	0	1			
1	G1_CGMN0[1:0]	G1_VRN1[5:0]										
initial	-	0	0	0	1	0	0	0	1			
recommend	-	0	1	0	0	0	1	1	1			

SET SPI READ INDEX continues to the next page.

(12)

(Hex)	Register	DNC	D7	D6	D5	D4	D3	D2	D1	D0
		1	G1_CGMN1[1:0]		G1_VRN2[5:0]					
	initial	-	0	0	0	1	0	1	0	1
	recommend	-	0	1	0	0	1	1	0	1
		1	G1_CGMN2[1:0]		G1_VRN3[5:0]					
	initial	-	0	0	1	0	0	1	0	0
	recommend	-	0	1	0	1	0	1	1	1
		1	G1_CGMN3[1:0]		G1_VRN4[5:0]					
	initial	-	0	0	1	0	0	1	1	1
	recommend	-	0	1	1	0	0	0	1	0
		1	G1_CGMN5	G1_CGMN4	G1_VRN5[5:0]					
	initial	-	0	0	1	0	0	1	1	1
	recommend	-	1	1	1	1	1	1	1	1
		1	-	G1_PRN0[6]	-	G1_PKN0[4:0]				
	initial	-	0	0	0	0	0	1	1	0
	recommend	-	0	0	0	0	1	0	1	0
		1	G1_PRN0[5:4]		-	G1_PKN1[4:0]				
	initial	-	1	0	0	0	1	1	0	1
	recommend	-	0	1	0	0	1	1	1	0
		1	G1_PRN0[3:2]		-	G1_PKN2[4:0]				
	initial	-	0	0	0	1	0	0	0	1
	recommend	-	1	1	0	1	0	0	0	1
		1	G1_PRN0[1:0]		-	G1_PKN3[4:0]				
	initial	-	1	1	0	1	0	1	0	1
	recommend	-	0	0	0	1	0	1	1	0
		1	-	G1_PRN1[6]	-	G1_PKN4[4:0]				
	initial	-	0	0	0	1	0	1	1	0
	recommend	-	0	0	0	1	1	0	0	1
		1	G1_PRN1[5:4]		-	G1_PKN5[4:0]				
	initial	-	1	1	0	1	0	1	1	0
	recommend	-	1	0	0	1	1	0	0	0
		1	G1_PRN1[3:2]		-	G1_PKN6[4:0]				
	initial	-	1	0	0	1	0	1	1	1
	recommend	-	1	1	0	1	0	1	1	0
		1	G1_PRN1[1:0]		-	G1_PKN7[4:0]				
	initial	-	0	0	0	0	1	0	0	1
	recommend	-	0	0	0	0	1	1	1	0
		1	-	-	-	G1_PKN8[4:0]				
	initial	-	0	0	0	0	1	0	0	1
	recommend	-	0	0	0	0	1	0	0	1
FE	SET SPI READ INDEX	0	1	1	1	1	1	1	1	0
		1	CMD_ADD[7:0]							
	initial	-	-	-	-	-	-	-	-	-
	recommend	-	-	-	-	-	-	-	-	-
FF	SPIREAD	0	1	1	1	1	1	1	1	1
		1	CMD_DATA1[7:0]							
	initial	-	-	-	-	-	-	-	-	-
	recommend	-	-	-	-	-	-	-	-	-
		1	...							
	initial	-	-	-	-	-	-	-	-	-
	recommend	-	-	-	-	-	-	-	-	-
		1	CMD_DATAN[7:0]							
	initial	-	-	-	-	-	-	-	-	-
	recommend	-	-	-	-	-	-	-	-	-

8. SEQUENCE

[Power\_on Sequence]

No.		Function	DNC	Command/Parameter
		RESETB=0		
	Wait	wait 1 msec or more		
	Power on	IOVCC, VCC on		
	Wait	wait 10 msec or more		
		RESETB=1		
	Wait	wait 10 msec or more		
	RGB signals	RGB signals start		
	Wait	wait 2 frames or more		
1	Enable extented commands	Enable extented commands	0	B9h
		Parameter 1	1	FFh
		Parameter 2	1	83h
		Parameter 3	1	63h
2	Set power	Set power	0	B1h
		Parameter 1	1	81h
		Parameter 2	1	24h
		Parameter 3	1	04h
		Parameter 4	1	02h
		Parameter 5	1	02h
		Parameter 6	1	03h
		Parameter 7	1	10h
		Parameter 8	1	10h
		Parameter 9	1	34h
		Parameter 10	1	3Ch
		Parameter 11	1	3Fh
		Parameter 12	1	3Fh
3	Sleep out	Sleep out	0	11h
	Wait	wait 5 msec or more		
4	Display inversion off	Display inversion off	0	20h
5	Memory access control	Memory access control	0	36h
		Parameter 1	1	00h
6	Interface pixel format	Interface pixel format	0	3Ah
		Parameter 1	1	70h
	Wait	wait 120 msec or more		
7	Set power	Set power	0	B1h
		Parameter 1	1	78h
		Parameter 2	1	24h
		Parameter 3	1	04h
		Parameter 4	1	02h
		Parameter 5	1	02h
		Parameter 6	1	03h
		Parameter 7	1	10h
		Parameter 8	1	10h
		Parameter 9	1	34h
		Parameter 10	1	3Ch
		Parameter 11	1	3Fh
		Parameter 12	1	3Fh
8	Set RGB interface related register	Set RGB interface related register	0	B3h
		Parameter 1	1	01h
9	Set display waveform cycle	Set display waveform cycle	0	B4h
		Parameter 1	1	00h
		Parameter 2	1	08h
		Parameter 3	1	6Eh
		Parameter 4	1	07h
		Parameter 5	1	01h
		Parameter 6	1	01h
		Parameter 7	1	62h
		Parameter 8	1	01h
		Parameter 9	1	57h

No.	Function	DNC	Command/Parameter
10	Set panel	Set panel	0 CCh
		Parameter 1	1 0Bh
11	Set gamma curve related setting	Set gamma curve related setting	0 E0h
		Parameter 1	1 03h
		Parameter 2	1 49h
		Parameter 3	1 4Eh
		Parameter 4	1 4Ch
		Parameter 5	1 57h
		Parameter 6	1 F4h
		Parameter 7	1 0Bh
		Parameter 8	1 4Eh
		Parameter 9	1 92h
		Parameter 10	1 57h
		Parameter 11	1 1Ah
		Parameter 12	1 99h
		Parameter 13	1 96h
		Parameter 14	1 0Ch
		Parameter 15	1 10h
		Parameter 16	1 01h
		Parameter 17	1 47h
		Parameter 18	1 4Dh
		Parameter 19	1 57h
		Parameter 20	1 62h
		Parameter 21	1 FFh
		Parameter 22	1 0Ah
		Parameter 23	1 4Eh
		Parameter 24	1 D1h
		Parameter 25	1 16h
		Parameter 26	1 19h
		Parameter 27	1 98h
		Parameter 28	1 D6h
		Parameter 29	1 0Eh
Parameter 30	1 11h		
	Wait	wait 5 msec or more	
12	Display on	Display on	0 29h

**Power off sequence**

No.	Function	DNC	Command/Parameter
1	Display off	0	28h
	Wait		
2	Sleep in	0	10h
	Wait		
3	RGB signals		RGB signals stop

↓  
Power off

**Sleep sequence**

No.	Function	DNC	Command/Parameter
1	Sleep in	0	10h
	Wait		
2	RGB signals		RGB signals stop

**Sleep release sequence**

No.	Function	DNC	Command/Parameter
1	RGB signals		
	Wait		
2	Sleep out	0	11h

Santek / CONFIDENTIAL



Refresh sequence

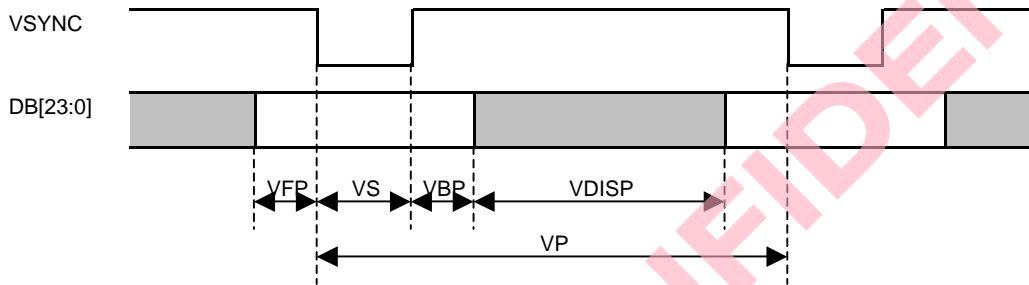
No.	Function	DNC	Command/Parameter
1	Enable extented commands	0	B9h
	Parameter 1	1	FFh
	Parameter 2	1	83h
	Parameter 3	1	63h
2	Display inversion off	0	20h
3	Memory access control	0	36h
	Parameter 1	1	00h
4	Interface pixel format	0	3Ah
	Parameter 1	1	70h
5	Set power	0	B1h
	Parameter 1	1	78h
	Parameter 2	1	24h
	Parameter 3	1	04h
	Parameter 4	1	02h
	Parameter 5	1	02h
	Parameter 6	1	03h
	Parameter 7	1	10h
	Parameter 8	1	10h
	Parameter 9	1	34h
	Parameter 10	1	3Ch
	Parameter 11	1	3Fh
	Parameter 12	1	3Fh
6	Set RGB interface related register	0	B3h
	Parameter 1	1	01h
7	Set display waveform cycle	0	B4h
	Parameter 1	1	00h
	Parameter 2	1	08h
	Parameter 3	1	6Eh
	Parameter 4	1	07h
	Parameter 5	1	01h
	Parameter 6	1	01h
	Parameter 7	1	62h
	Parameter 8	1	01h
	Parameter 9	1	57h
8	Set panel	0	CCh
	Parameter 1	1	0Bh
9	Set gamma curve related setting	0	E0h
	Parameter 1	1	03h
	Parameter 2	1	49h
	Parameter 3	1	4Eh
	Parameter 4	1	4Ch
	Parameter 5	1	57h
	Parameter 6	1	F4h
	Parameter 7	1	0Bh
	Parameter 8	1	4Eh
	Parameter 9	1	92h
	Parameter 10	1	57h
	Parameter 11	1	1Ah
	Parameter 12	1	99h
	Parameter 13	1	96h
	Parameter 14	1	0Ch
	Parameter 15	1	10h
	Parameter 16	1	01h
	Parameter 17	1	47h
	Parameter 18	1	4Dh
	Parameter 19	1	57h
	Parameter 20	1	62h
	Parameter 21	1	FFh
	Parameter 22	1	0Ah
	Parameter 23	1	4Eh
	Parameter 24	1	D1h
	Parameter 25	1	16h
	Parameter 26	1	19h
	Parameter 27	1	98h
	Parameter 28	1	D6h
	Parameter 29	1	0Eh
	Parameter 30	1	11h
10	Display on	0	29h

## 9. RGB Interface

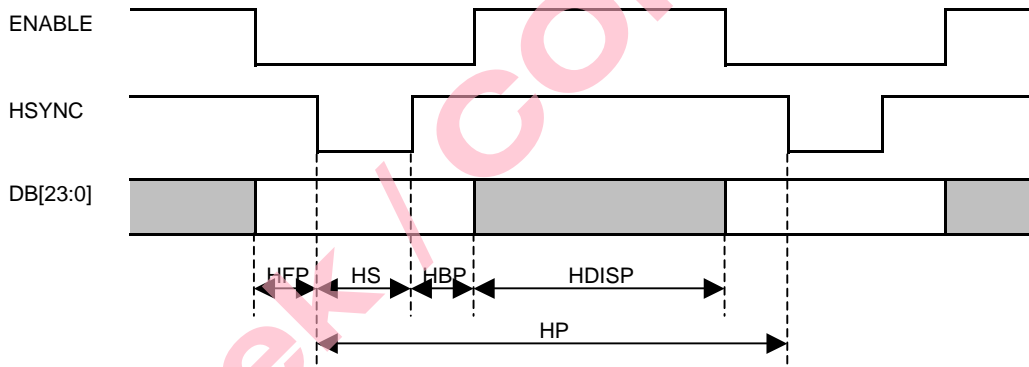
### Recommended RGB interface timing

Item	Symbol	Recommended	Unit
Vertical cycle	VP	806	Line
Vertical low pulse width	VS	2	Line
Vertical front porch	VFP	2	Line
Vertical back porch	VBP	2	Line
Vertical active area	VDISP	800	Line
Vertical refresh rate	VRR	60	Hz
HS cycle	HP	508	DCK
HS low pulse width	HS	10	DCK
Horizontal back porch	HBP	10	DCK
Horizontal front porch	HFP	8	DCK
Horizontal active area	HDISP	480	DCK
Pixel clock frequency	DCK	24.576	MHz

#### Vertical timing



#### Horizontal timing



10. Absolute Maximum Ratings

Item	Symbol	Condition	Rating		Unit	Terminal
			MIN	MAX		
Power supply voltage	VCC		-0.3	4.6	V	VCC
IO logic voltage	IOVCC		-0.3	4.6	V	IOVCC
Input voltage	VI		-0.3	IOVCC+0.3	V	RESETB, SDI, SCL, NCS, VSYNC, HSYNC, DCK, ENABLE, DB[23:0]
LED current	ILED		0	25	mA	VLED, LED1, ..., LED8
Storage temperature	Tstg		-30	+80	°C	

11. Recommended Operating Conditions

Item	Symbol	Unit	Rating			Unit	Terminals
			MIN	TYP	MAX		
Supply voltage	VCC		2.7	2.8	2.9	V	VCC
IO logic voltage	IOVCC		1.7	1.8	1.9	V	IOVCC (VCC ≥ IOVCC)
LED current	ILED			20		mA	VLED, LED1, ..., LED7
Operation temperature	Top		-20	+25	+70	C	Temperature at the surface of the display

12. Electrical Characteristics

12.1 DC Characteristics

If no conditions are specified, then VCC=2.8V, IOVCC=1.8V, Ta=25°C.

Items	Symbol	Condition	Rating			Unit	Terminals
			MIN	TYP	MAX		
High level input voltage	VIH1		0.8IOVCC		IOVCC	V	RESETB, SDI, SCL, NCS, VSYNC, HSYNC, DCK, ENABLE, DB[23:0]
Low level input voltage	VIL1		0		0.2IOVCC	V	
Current Consumption	ICC1	VCC=2.8V, IOVCC=1.8V		9.8	19.6	mA	VCC
	ICC2	VCC=2.8V, IOVCC=1.8V stand by		-	100	uA	
	IOICC1	VCC=2.8V, IOVCC=1.8V		10	30	uA	IOVCC
	IOICC2	VCC=2.8V, IOVCC=1.8V stand by		-	10	uA	

\* A still image (color bar) on display , when accessing to the driver by RGB interface mode.

12.2 AC Characteristics  
RESET timing



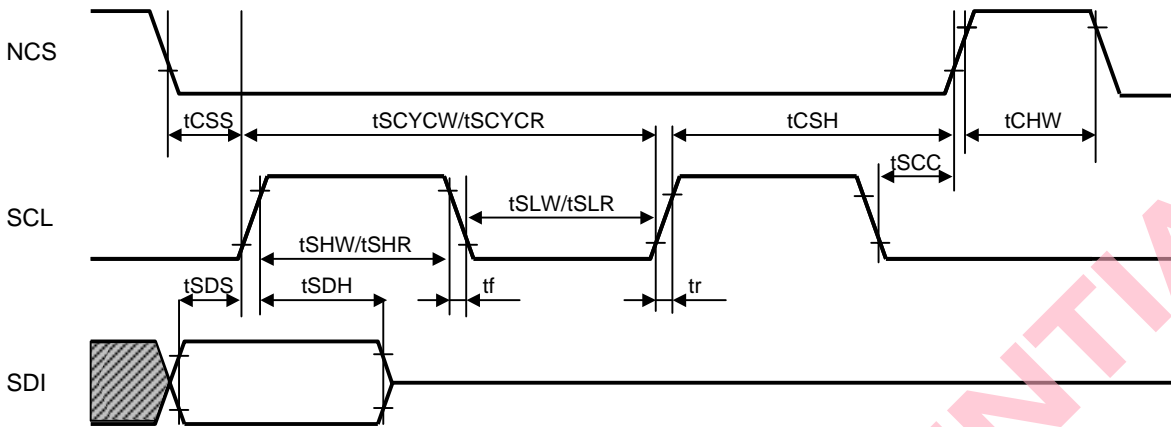
Reset low pulse width shorter than 10us do not make reset. It means undesired short pulse such as glitch, bouncing noise or electrostatic discharge do not cause irregular system reset. Please refer to the table below.

RESET timing spec

item	Symbol	Condition	Rating			Unit
			MIN	TYP	MAX	
Reset low pulse width	$t_{RES}$		10	-	-	us

tRES Pulse	Action
Shorter than 5us	No reset
Longer than 10us	Reset
Between 5us and 10us	Not determined

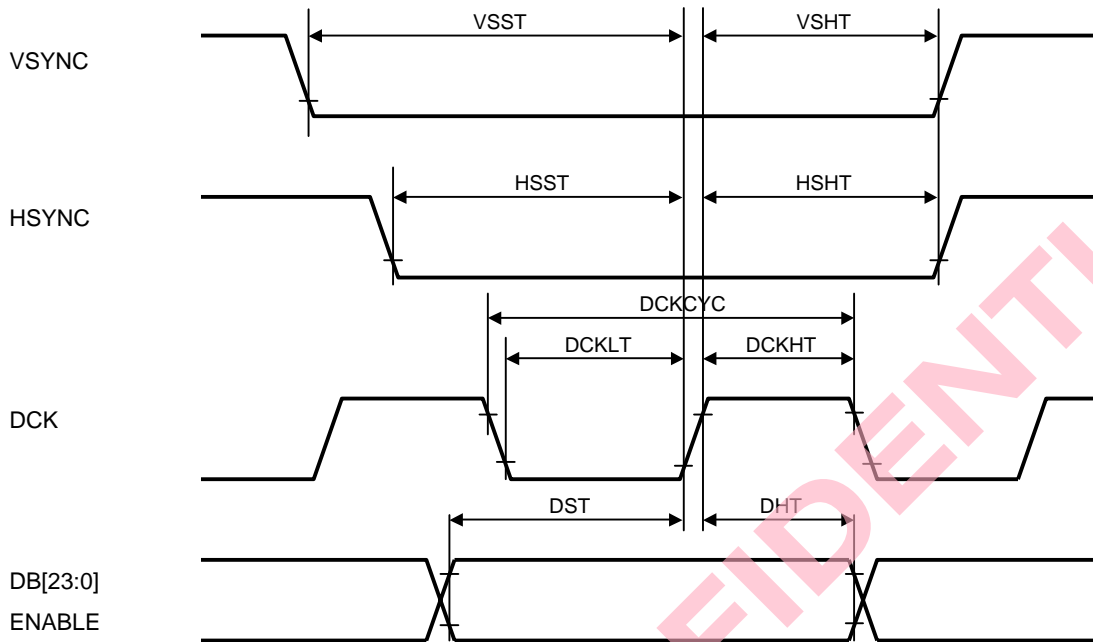
Serial Peripheral Interface(SPI)



Item	Symbol	Condition	Rating			Unit
			MIN	TYP	MAX	
Serial Clock Write Cycle	$t_{SCYCW}$		100		-	ns
Serial Clock Read Cycle	$t_{SCYCR}$		200		-	ns
Pulse Width High at Write	$t_{SHW}$		50		-	ns
Pulse Width High at Read	$t_{SHR}$		100		-	ns
Pulse Width Low at Write	$t_{SLW}$		50		-	ns
Pulse Width Low at Read	$t_{SLR}$		100		-	ns
CSB Setup Time at Write	$t_{CSS}$		50		-	ns
CSB Setup Time at Read	$t_{CSS}$		100		-	ns
CSB Hold Time at Write	$t_{SCH}$		50		-	ns
CSB Hold Time at Read	$t_{SCH}$		100		-	ns
SDI Setup Time	$t_{SDS}$		50		-	ns
SDI Hold Time	$t_{SDH}$		50		-	ns
Rising/Falling Time	$t_R, t_F$		-		10	ns

Remarks 1. All timing data is specified at 30 to 70% of VCCIO.

24 bit RGB interface



Item	Symbol	Condition	Rating			Unit
			MIN	TYP	MAX	
VSYNC Setup Time	VSST		10	-	-	ns
VSYNC Hold Time	VSHT		10	-	-	ns
HSYNC Setup Time	HSST		10	-	-	ns
HSYNC Hold Time	HSHT		10	-	-	ns
DCK Clock Cycle	DCKCYC	Frame Frequency= 50 to 70 Hz	31	-	49.2	ns
DCK Low Time	DCKLT		10	-	-	ns
DCK High Time	DCKHT		10	-	-	ns
Data Setup Time for DB[23:0]	DST		10	-	-	ns
Data Hold Time for DB[23:0]	DHT		10	-	-	ns

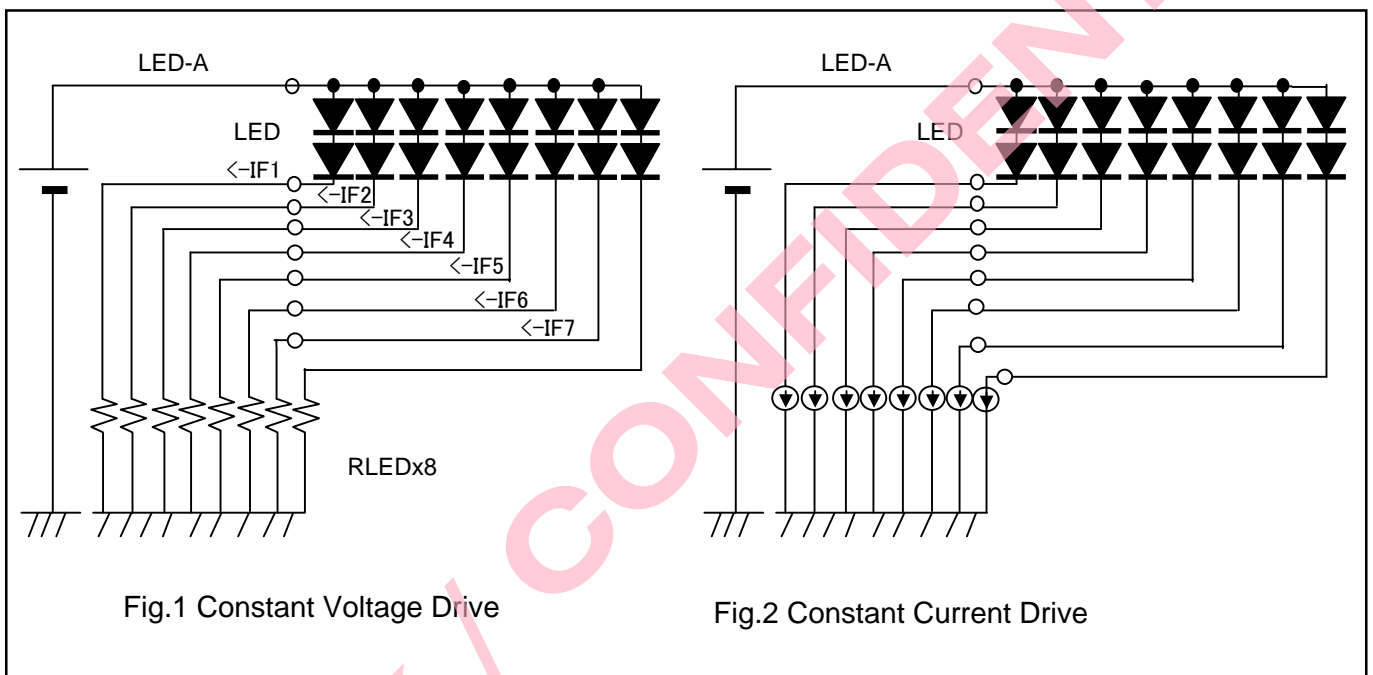
Note: (1) Signal rise and fall times are equal to or less than 20 ns.  
 (2) Input signals are measured by 0.30 x IOVCC for low state and 0.70 x IOVCC for high state.

### 13. About LED drive circuit

As a light source for back lights, high luminosity white LEDs are adopted. And the terminal output of the anodes and cathodes of the LEDs are carried out. There are 'Constant Voltage Drive Method (Fig.1)' and 'Constant Current Drive Method (Fig.2)' as a drive circuit system which drives them. In the meaning which suppresses the variation within a field and the average luminosity variation, 'Constant Current Drive Method' is recommended.

The VF-IF characteristic of LEDs varies every LED, i.e. the current values which flows to LED differ even if it impresses fixed voltage. As a result the brightness of five LEDs varies in a 'Constant Voltage Drive Method'. When it sees on a screen, it becomes luminosity variation within a field.

As opposed to this, in a 'Constant Current Drive Method', it is controlled to become so that fixed current flows even if VF-IF characteristic of LED varies. And the luminosity difference of five LEDs becomes small.

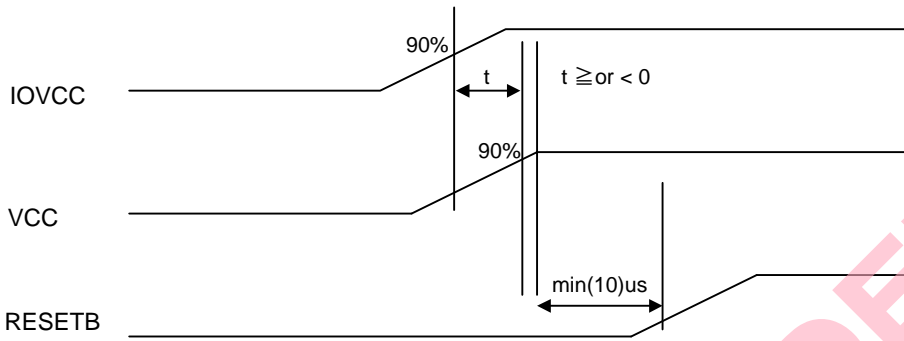


## 14. External Power on/off Sequence

### 14.1 External Power On sequence

VCC and IOVCC can be applied in any order.

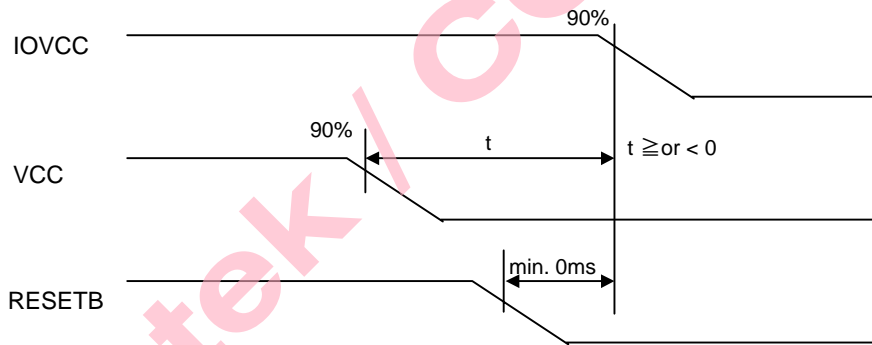
RESETB must be kept low for minimum 10usec after both VCC and IOVCC have reached it's target voltage.



### 14.2 External Power Off sequence

VCC and IOVCC can be powered down in any order.

If the module is in "Sleep In" mode, IOVCC and VCC can be powered down minimum 0 msec after RESETB has been released.





15. CHARACTERISTICS

15.1. OPTICAL CHARACTERISTICS

Measure condition

Measuring equipment :CS1000(Konica Minolta),LCD7000(Otsuka Electronics),EZcontast160D(ELDIM)

Driving conditions: VCC=2.8V, IOVCC=1.8V, GND=0V

Optimized Vcom/c, VLCD=(Vsigpp±Vcomp)/2

Back light: Forward current [ILED] = 20mA x 8, Measuring temperature: Ta=25°C

Item	Symbol	Condition	MIN	TYP	MAX	Unit	Note	Remarks
Response time	Rise time	TON VLCD=1.0V→4.7V	-	-	60	ms	1	*
	Fall time	TOFF VLCD=4.7V→1.0V	-	-	40	ms		
Contrast ratio	CR	VLCD=4.7V / 1.0V	500	750	-		2	*
Viewing angle	Left	θ L VLCD=1.0V / 4.7V	80	-	-	deg	3	*
	Right	θ R	80	-	-	deg		
	Up	φ U CR>=5	80	-	-	deg		
	Down	φ D	80	-	-	deg		
V-T Threshold voltage	V90		3.80	4.10	4.40	V	4	*
	V50		2.80	3.10	3.40	V		
	V10		2.20	2.50	2.80	V		
White V-T characteristic			See Figure 3					Reference
White chromaticity	x	VLCD=4.7V	See Figure 4				5	
	y							
Image sticking			No image sticking shall remain after displaying the window pattern for 2 hours				6	
Center brightness		VLCD=4.7V	700	800	-	cd/m <sup>2</sup>	7	
Brightness distribution		VLCD=4.7V	70	-	-	%	8	9point

Note: Note1-8 Refer to the Appendix A"Standed measurement method of optical characteristics for TFT-LCD monitors".

Note: \* The value are measured in module states.

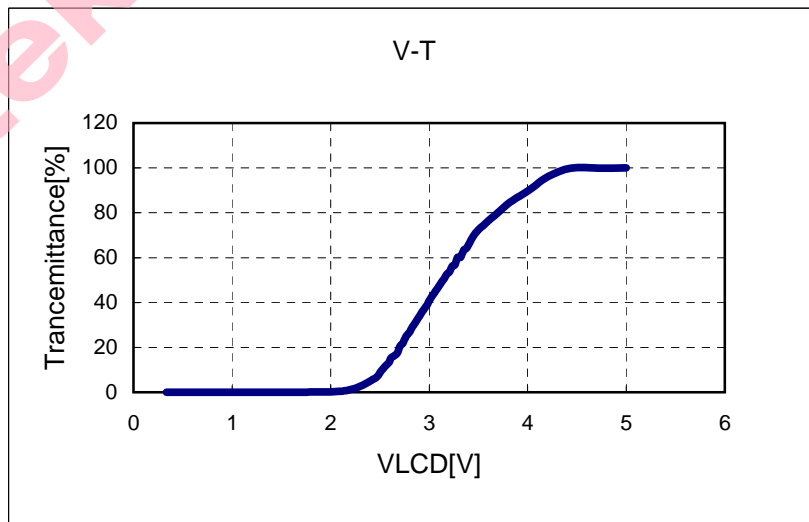
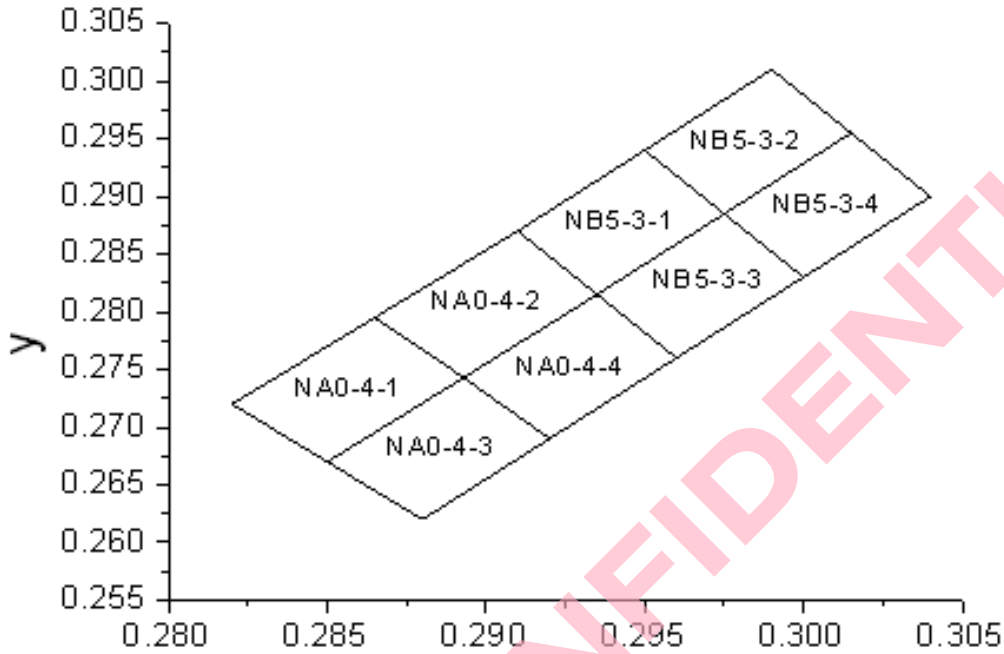


Fig.3 White V-T characteristics

The C.I.E. 1931 Chromaticity Diagram



**15.2. TEMPERATURE CHARACTERISTICS**

Measuring condition

Measuring equipment: CS1000(Konica Minolta), LCD7000(Otsuka Electronics)

Driving conditions: VCC=2.8V, IOVCC=1.8V, GND=0V

Vcom/C is adjusted to an optimum value.

$V_{LCD} = (V_{sigpp} \pm V_{compp}) / 2$

Back light: Forward current [ILED] = 20mA x 8

Item		Symbol	Rating		Reference
			Ta=-10°C	Ta=60°C	
Contrast		CR	200 or more	200 or more	
Response time	Rise time	TON	Under 200ms	Under 30ms	*
	Fall time	TOFF	Under 200ms	Under 50ms	*
Display quality			Defects and nonuniformity shall be inconspicuous.		As criteria of 16.

Note) \* The values are measured in module states.

**15.3. BACK LIGHT CHARACTERISTICS**

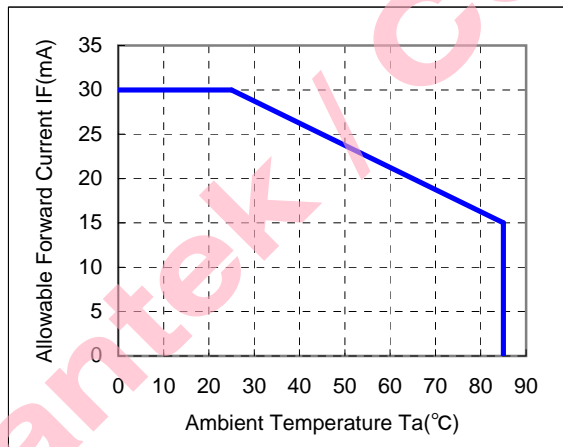
**15.3.1. BACKLIGHT ELECTRIC CHARACTERISTICS**

Ta=25°C

Item	Symbol	Conditions	MIN	MAX	Unit
Forward Voltage	VF	Forward current [IF] = 20 mA	5.4	6.2	V
Reverse Voltage	VR	Reverse current [IR] = 10 mA		5.0	V

**15.3.2. ALLOWABLE MAXIMUM BACKLIGHT CURRENT**

LED White Chromaticity Rank:(NY)



**15.3.3. SERVICE LIFE OF BACKLIGHT**

Definition

When the center luminance drops to 50% of the initial value, the back light is considered to have reached the end of its effective service life.

Back light: ILED=20mA

Term of guarantee

Lighting condition	Ambient temperature	Average life
Continuously lit	25±5°C	5000H

Average life means the period which the survival rate falls under 50%

16. CRITERIA

16.1. DISPLAY APPEARANCE SPECIFICATIONS

Testing conditions

Display monitor should be inspected with the following conditions.

Viewing direction	Perpendicular to the LCD surface.
Driving signal	Raster pattern(RGB signal color and white)
Signal condition	VLCD : 1.0V, 3.0V, 4.7V [3steps]
Distance between display and eye	30cm
Illuminance	200 to 350 lx
Backlight	Forward current [ILED] = 20mA x 8

Item	Definition	Criteria
Display defect	Line defect 3 or more dot defects on a straight line	None
	Dot defect Unusual brightness of the dots unit due to defects of TFT or CF, or dust, etc. High brightness defect: Visible through 2% ND filter. Low brightness defect: Visible through 5% ND filter. Dark defect: Dark dot at VLCD=3.0V	Refer to Table 1.
Display quality	Stain Unevenness of brightness (white stain, black stain, etc.)	Invisible through 1%ND filter
	Foreign matter Dust between the glass and the polarizer	0.1 ≥ D Ignore 0.2 ≥ D > 0.1 2 ≥ N D > 0.2 0
		Dust between the LCD and the backlight.
	Others	Due to boundary sample

Average diameter :D(mm)  
Permissible number :N

Table 1

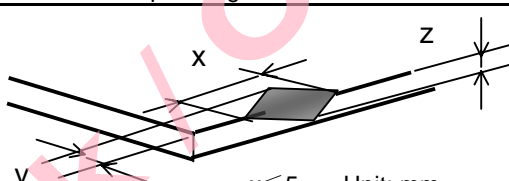
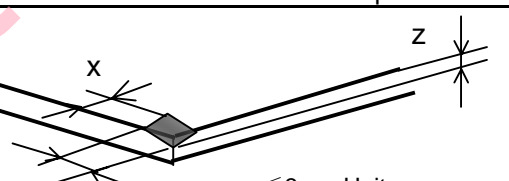
Bright dot	Dark dot	Total
2	6	8

Connected 2 dot defects is counted in 1 dot.

16.2. APPEARANCE CRITERIA

Testing conditions

Illuminance 1200~2000 lx  
Distance between display 30cm

Item	Criteria	Remarks										
Polarizer	Scratch <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Size</th> <th>Qty</th> </tr> </thead> <tbody> <tr> <td><math>L \leq 2.0</math>, <math>W \leq 0.02</math></td> <td>Ignore</td> </tr> <tr> <td><math>L \leq 2.0</math>, <math>0.02 &lt; W \leq 0.03</math></td> <td>2(*)</td> </tr> <tr> <td><math>L \leq 1.0</math>, <math>0.03 &lt; W \leq 0.05</math></td> <td>1</td> </tr> <tr> <td><math>0.05 &lt; W</math></td> <td>0</td> </tr> </tbody> </table>	Size	Qty	$L \leq 2.0$ , $W \leq 0.02$	Ignore	$L \leq 2.0$ , $0.02 < W \leq 0.03$	2(*)	$L \leq 1.0$ , $0.03 < W \leq 0.05$	1	$0.05 < W$	0	Applied to active area Length: L(mm) Width: W(mm)  (*) Any distances between scratches shall be 5mm or more.
	Size	Qty										
	$L \leq 2.0$ , $W \leq 0.02$	Ignore										
	$L \leq 2.0$ , $0.02 < W \leq 0.03$	2(*)										
	$L \leq 1.0$ , $0.03 < W \leq 0.05$	1										
$0.05 < W$	0											
Dent Dust <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Size</th> <th>Qty</th> </tr> </thead> <tbody> <tr> <td><math>D \leq 0.1</math></td> <td>Ignore</td> </tr> <tr> <td><math>0.1 &lt; D \leq 0.15</math></td> <td>2</td> </tr> <tr> <td><math>0.15 &lt; D \leq 0.2</math></td> <td>1</td> </tr> <tr> <td><math>0.2 &lt; D</math></td> <td>0</td> </tr> </tbody> </table>	Size	Qty	$D \leq 0.1$	Ignore	$0.1 < D \leq 0.15$	2	$0.15 < D \leq 0.2$	1	$0.2 < D$	0	Applied to active area Average diameter: D(mm)	
Size	Qty											
$D \leq 0.1$	Ignore											
$0.1 < D \leq 0.15$	2											
$0.15 < D \leq 0.2$	1											
$0.2 < D$	0											
Bubble (round shape) <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Size</th> <th>Qty</th> </tr> </thead> <tbody> <tr> <td><math>D \leq 0.2</math></td> <td>Ignore</td> </tr> <tr> <td><math>0.2 &lt; D \leq 0.35</math></td> <td>1</td> </tr> <tr> <td><math>0.35 &lt; D</math></td> <td>0</td> </tr> </tbody> </table>	Size	Qty	$D \leq 0.2$	Ignore	$0.2 < D \leq 0.35$	1	$0.35 < D$	0	Applied to active area Average diameter: D(mm)			
Size	Qty											
$D \leq 0.2$	Ignore											
$0.2 < D \leq 0.35$	1											
$0.35 < D$	0											
Stain	Invisible items while the monitor is turned on shall be ignored.	Applied to active area										
Connector	No function trouble											
Cable	No function trouble Scratch of the GND pad is ignored.											
Glass crack	Edge  <p style="margin-left: 40px;"> <math>x \leq 5</math> Unit: mm  <math>y \leq 1</math>  <math>z \leq t</math> (t: Glass thickness)           </p> <p>There shall be no crack that will expand</p>											
	Corner  <p style="margin-left: 40px;"> <math>x \leq 3</math> Unit: mm  <math>y \leq 3</math>  <math>z \leq t</math> (t: Glass thickness)           </p> <p>In case that either x or y is less than 0.5mm, the other can be ignored.</p> <p>Don't reach active area. There shall be no crack that will expand</p>											

17. RELIABILITY TEST RESULT

Test item		Test condition	number of failures /number of examinations
Endurance test	High temperature storage	Ta=80°C, 240H	0/3
	Low temperature storage	Ta=-30°C, 240H	0/3
	High temperature/humidity storage	Ta=60°C, RH=90%, non condensing	※ 0/3
	High temperature operation	Tp=70°C, 240H	0/3
	Low temperature operation	Tp=-20°C, 240H	0/3
	High temperature/humidity operation	Tp=40°C, RH=90%, non condensing	※ 0/3
	Thermal shock storage	-30<->80°C (30min/30min) 10cycle	0/3
Mechanical test	Electrostatic discharge test (No operation)	In accordance with EIAJ ED-4701/300. C=200pF, R=0Ω, V=±200V 3 times discharge for each between the terminals of input voltages, that are all bundled and connected to the ground, and the other terminals.	0/3
	Vibration test	Amplitude 1.5mm, f=10 to 55Hz, 2 hours each in the X, Y, and Z directions.	0/3
	Impact test	Use ORTUSTECH original jigs. Apply half-sine curve of peak acceleration 1,000 m/s <sup>2</sup> for operation time 6ms, 3 times each in X, Y, and Z directions, in accordance with JIS C 60068-2-27-1995.	0/3
Packing test	Packing vibration-proof test	19.6m/s <sup>2</sup> acceleration and f=10->55->10Hz, apply in each of X, Y, and Z direction for 30 minutes.	0/1 packing
	Packing drop test	Drop the packing from 75cm height, one time each for 6-faces, 3-edges, and 1-corner.	0/1 packing

Note : Ta = Ambient temperature      Tp = Panel temperature

Note : Please do not hold on displaying a same or similar picture while each operation test.

※The profile of high temperature/humidity storage and High Temperature/humidity operation (Pure water of over 10MΩ·cm shall be used.)

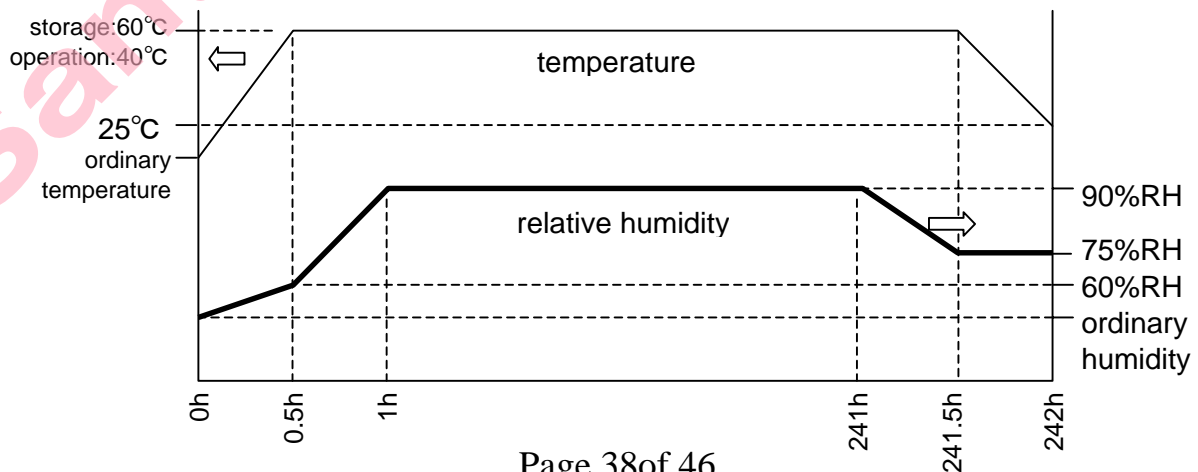
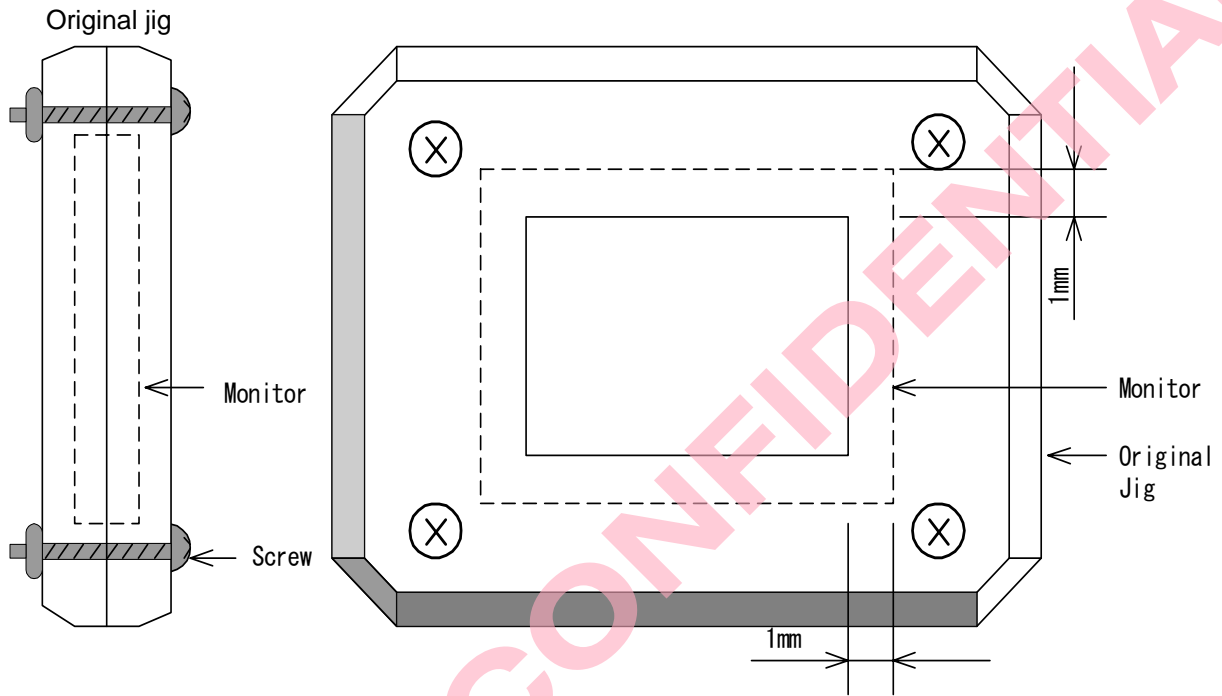


Table2. Reliability Criteria

Measure the parameters after leaving the monitor at the ordinary temperature for 2 hours or more after the test completion.

Item	Standard	Remarks
Contrast ratio	200 or more	
Display quality	No visible abnormality shall be seen.	As criteria of 16.



Note) LCD has to be held in the perimeter area with 1mm width.

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**18 . PACKING SPECIFICATIONS**

TBD

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19. HANDLING PRECAUTIONS  
19.1. PRECAUTIONS

 <b>Caution</b>
<ol style="list-style-type: none"><li>(1) Do not make an impact on the glass, because it may break, causing possible dangers.</li><li>(2) In case that the glass breaks, do not touch it directly with hands. (You may get glass splinters in your hands or cut your skin.)</li><li>(3) In the event that you injure yourself, receive first aid and consult a physician.</li><li>(4) Do not put the liquid crystal in your mouth. In the event that the liquid crystal panel breaks, the liquid crystal inside will seep out. Although its toxicity has not been verified, you should not put the panel in your mouth. )</li><li>(5) If the liquid crystal gets on your skin or clothing, wash it off thoroughly. (In the event that the liquid crystal gets on your clothing or hand, wipe it off with alcohol, or carefully wash it off with soap and water. If it gets into your eyes, wash your eyes with clean running water for at least 15 minutes, then see a physician )</li><li>(6) When disposing this product, follow the industrial waste disposal standards of the country or region concerned.</li><li>(7) Do not connect or disconnect this product while the set remains switched on.</li><li>(8) This product has been assembled to a high degree of accuracy. Do not attempt to dismantle or modify it.</li><li>(9) A part of soldering part has been exposed, and avoid contact (short-circuit) with a metallic part of the case etc. about FPC of this model, please. Please insulate it with the insulating tape etc. if necessary. The defective operation is caused, and there is a possibility to generation of heat and the ignition.</li><li>(10) Since excess current protection circuit is not built in this TFT module, there is the possibility that LCD module or peripheral circuit become feverish and burned in case abnormal operation is generated. We recommend you to add excess current protection circuit to power supply.</li></ol>



**Caution :**

This mark is used to indicate a precaution or an instruction which, if not correctly observed, may result in bodily injuries, or material damages alone.

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**19.2. HANDLING PRECAUTIONS**

- 1) Wear finger sacks when handling the monitors at the incoming inspection and/or the production lines, and keep the working area very clean.  
Do not touch the surface of the monitor because it is vulnerable.
- 2) Wear a wrist-strap and use an ion blower to avoid electrostatic discharge when handling this product, because it contains an LED that is vulnerable to electrostatic discharge.  
Designate an appropriate operating area, and set equipment, tools, and machines properly when handling this product.
- 3) Do not scratch or hit the monitor surface with a tool, and do not drop the monitor, because the LCD panel made of glass substrates is fragile and the polarizing film is vulnerable to friction and mechanical impacts.  
In case that the monitor was accidentally dropped, it must be regarded as defective, and do not use it any longer.
- 4) Do not use or store the monitor in a place where dew is expected.
- 5) Do not store the LCD under direct sunlight or at a place exposed to ultraviolet rays because it will cause the deterioration of the LCD.
- 6) Do not stain the cables or make them damaged, because these might cause contact defects and/or wrong effects on the reliability.
- 7) Do not bend or pull the FPC part or carry the monitor just by holding the FPC with fingers.
- 8) Before assembling, remove the protection film from the surface of the monitor according to section 20.5.

**19.3. OPERATING PRECAUTIONS**

- 1) Do not expose the driver ICs on the monitor to strong lights during operation.  
It may cause function failures, because the driver ICs have no light shield.
- 2) When driving the monitor, apply the input signal after the power voltage is supplied.  
When turning off the power, turn off the input signal before or at the same timing of switching off the power.
- 3) Apply the optimum value of Vcom/c when using the monitor.

**19.4. SHIPPING CARTON BOX STORAGE CONDITIONS****Environment**

- Temperature: 0 to 40 °C
- Relative humidity: 60% or less

Shall have no dew if the temperature is low and the humidity is high.

**• Atmosphere**

Any poisonous gases and chemical substances such as acid or alkaline, which will erode electronic components and/or wiring materials, shall not be detected in a storage room.

- Period Within approx. 3 months
- Unpacking

In order to prevent the TFT monitors from being damaged by static electricity during the unpacking process, adjust the relative humidity of the working room to 50%RH or higher, and take effective measures such as static electricity grounding.

### 19.5. PRECAUTIONS AT PROTECTION FILM REMOVING PROCESS

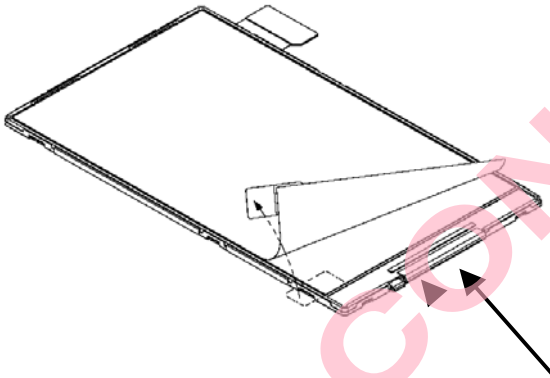
When removing the protection film from the monitor screen, static electricity may be generated, causing a function destruction or absorbing dusts. To avoid them, the following environment and working methods are recommended.

#### A) Working environment

- a) Keep the relative humidity at 50% to 70% and the temperature at 15 to 27°C
- b) Workers shall wear conductive working clothes, conductive shoes, conductive finger sacks, and wrist-strap bands. The working floor shall also be conductive.
- c) The working room shall be a clean room, preventing dusts from coming in.  
Setting an adhesive mat at the entrance of the room is recommended.

#### B) Working method

- a) Place an ion blower with an optimal distance from the monitor and an optimal wind direction.
- b) Put an adhesive tape (Scotch tape, etc.) on the LCD protection film's corners near the ion blower to protect the polarizing film from being damaged.
- c) Pull the adhesive tape slowly (taking more than 2 seconds to complete) towards the operator to remove the protection film.



Blower wind direction (Set an ion blower with its adequate conditions.)

### 19.6. OTHERS

- 1. Please make it to the structure to suppress surroundings of the front polarizer for the display irregularity prevention.

**20. APPENDIX :**

Standard Measurement Method of Optical Characteristics for TFT-LCD Monitors.

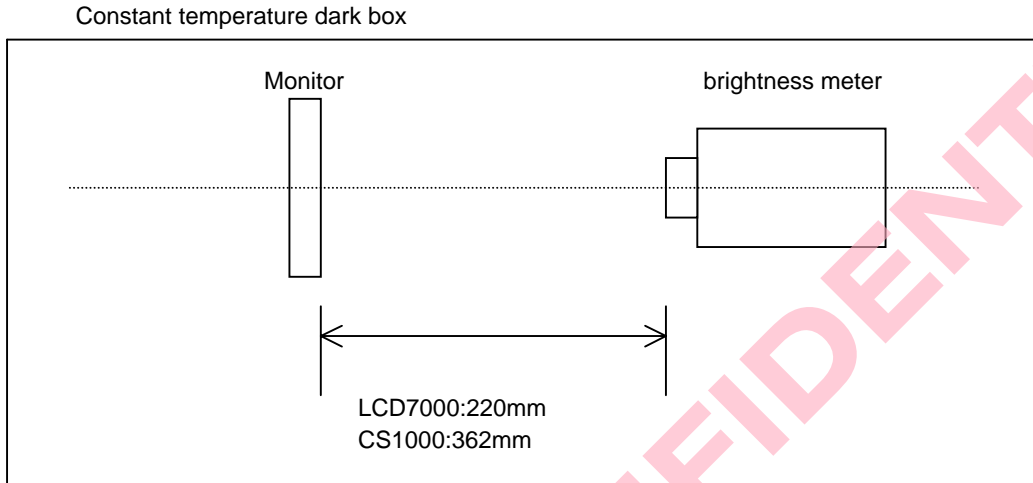
1 Testing conditions

Measuring instrument: CS1000(Konica Minolta), LCD7000(Otsuka Electronics)

Driving conditions: See "Standard measuring method for optical characteristics."

Measuring temperature : Unless otherwise specified, the temperature is 25°C

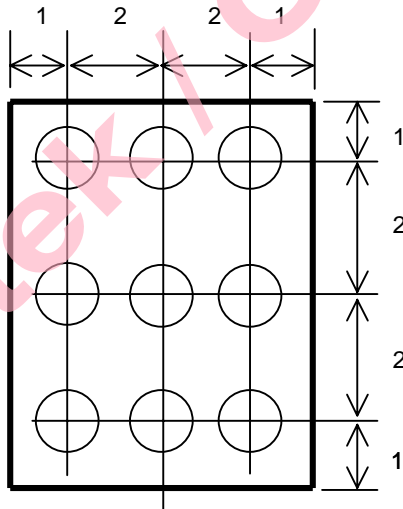
Measuring system : See the diagram below. The brightness meter is positioned on the normal line on the measuring point.



A measuring run should be started after allowing the back light to be lit for 30 minutes.

Measuring points : The center point of the screen

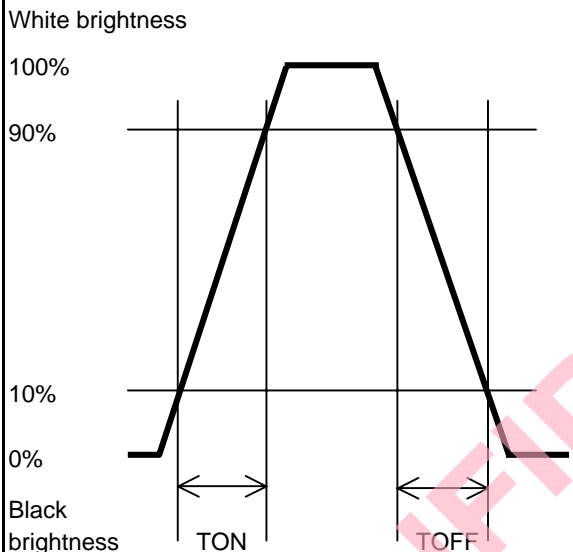
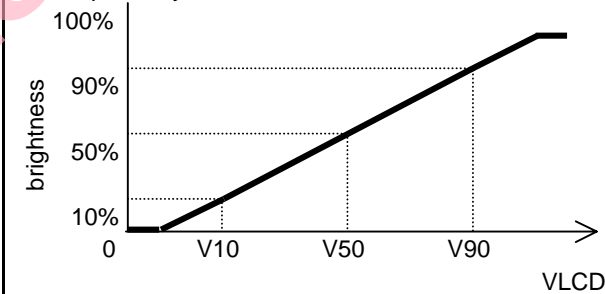
For obtaining the brightness distribution only, nine points shall be measured shown below.



Dimensional ratio of active area

Backlight: ILED=20mA×8

2 Testing method

Note	Item	Testing method	Measuring equipment	remarks
1	Response time	<p>Measure output signal waves with a brightness meter when the raster or window pattern is changed over from white to black and from black to white</p> <p style="text-align: center;">Black                      White                      Black</p>  <p>White brightness</p> <p>100%</p> <p>90%</p> <p>10%</p> <p>0%</p> <p>Black brightness</p> <p>TON</p> <p>TOFF</p>	LCD7000	<p>Black VLCD=1.0V</p> <p>White VLCD=4.7V</p> <p>T ON Rise time</p> <p>T OFF Fall time</p>
2	Contrast ratio	<p>Put the raster or window pattern on the display. Then measure the maximum brightness Y1 (VLCD = 4.7V) and the minimum brightness Y2 (VLCD =1.0V) at the center of the display.</p> <p style="text-align: center;">Contrast ratio = Y1/Y2</p> <p style="text-align: center;">Measurement spot diameter: 0.3mmφ</p>	LCD7000	
3	Viewing angle Horizontal $\theta$ Vertical $\phi$	<p>Change the viewing angles step by step in up, down, left, and right direction each, and measure contrast ratio to obtain respective angle where contrast ratio becomes 5.</p>	EZcontast 160D	
4	V-T threshold	<p>Change the VLCD by 0.1V step and measure module brightness. VLCD, where the brightness is 90%, 50%, and 10% of the maximum value, is defined as V90, V50, and V10 respectively.</p>  <p>brightness</p> <p>100%</p> <p>90%</p> <p>50%</p> <p>10%</p> <p>0</p> <p>V10</p> <p>V50</p> <p>V90</p> <p>VLCD</p>	LCD7000	
5	White chromaticity	<p>Measure chromatically coordinates x and y of the CIE 1931 calorimetric system under VLCD =4.7V.</p> <p>Color matching function is at view of 2deg</p>	CS1000	

Note	Item	Testing method	Measuring equipment	Remarks
6	Image sticking	Confirm image stickings with eyes after displaying the window pattern (White / Black) for 2 hours		Vcom/C is adjusted to optimum value.
7	Center brightness	Measure the brightness at the center of the screen.	CS1000	
8	Brightness distribution	(Brightness distribution) = $100 \times B/A \%$ A : max. brightness of the 9 points B : min. brightness of the 9 points	CS1000	

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