Product Specification				
SGD DISPLAY THE WORLD	Model: GDTQ35SP7G2R0	Rev. No.	Issued Date.	Page.
		A	JAN,31,08	1 / 36

Thin-Film-Transistor LCD Module
Model: GDTQ35SP7G2R0

Acceptance

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Revise Records

Rev.	Date	Contents	Written	Approved
A	2007/08/01	Preliminary Specification	Kevin Lin	Garry Chen
-	2008/01/31	Modify Color Chromaticity	Kavinchang	Jameslu

Special Notes

Note1.	
Note2.	
Note3.	
Note4.	
Note5.	

Contents

1. General Description and Features

GDTQ35SP7G2R0 is a TM (Transmissive) type color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This model is composed of a TFT-LCD module, a driver circuit, a back-light unit and a touch screen panel (TSP). The resolution of a 3.5" contains 320RGBx240 dots and can display up to 16.7M colors. The following table described the features of GDTQ35SP7G2R0.

1.1 Features

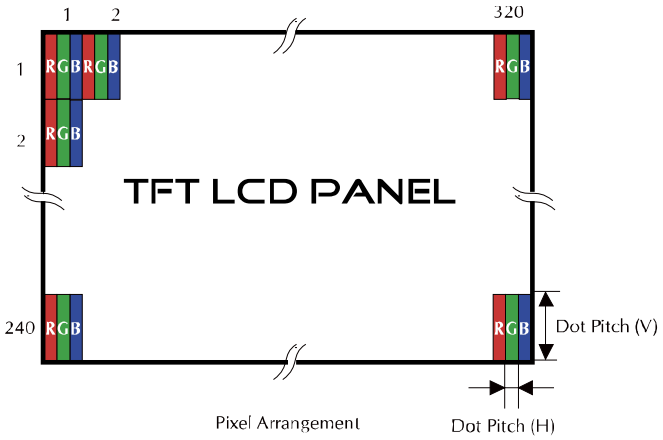
- Transmissive and back-light with six LEDs are available.
- TN (Twisted Nematic) mode.
- Programmable Frame & N-line polarity inversion.
- Using the Touch Screen Panel (Film to Glass type).
- System & Graphic interface 3-lines SPI + 8bits color RGB.
- DEN (Data Enable Input) mode, SYNC mode
- Gate Driver IC embedded on Panel

1.2 Applications

- Display terminals for DSC (Digital Still Camera), PMP (Portable Multimedia Player) application products.

1.3 LCD Module

Item	Specification	Unit
Screen Size	3.5 inches	Diagonal
Display Resolution	320 x RGB x 240	Dot
Dot Pitch	0.219 (H) x 0.219 (V)	mm
Active Area	70.08 (H) x 52.56 (V)	mm
Outline Dimension	76.9 (W) x 63.9 (H) x 4.4 (D)	mm
Display Mode	Normally white/Transmissive	--
Pixel Arrangement	RGB-Stripe	--
Surface Treatment	Anti-glare (AG)	--
Display Color	16.7 M	--
Viewing Direction	6 o'clock	--
Input Interface	Digital 8-bits color RGB	--
Color Gamut	NTSC 60%	--

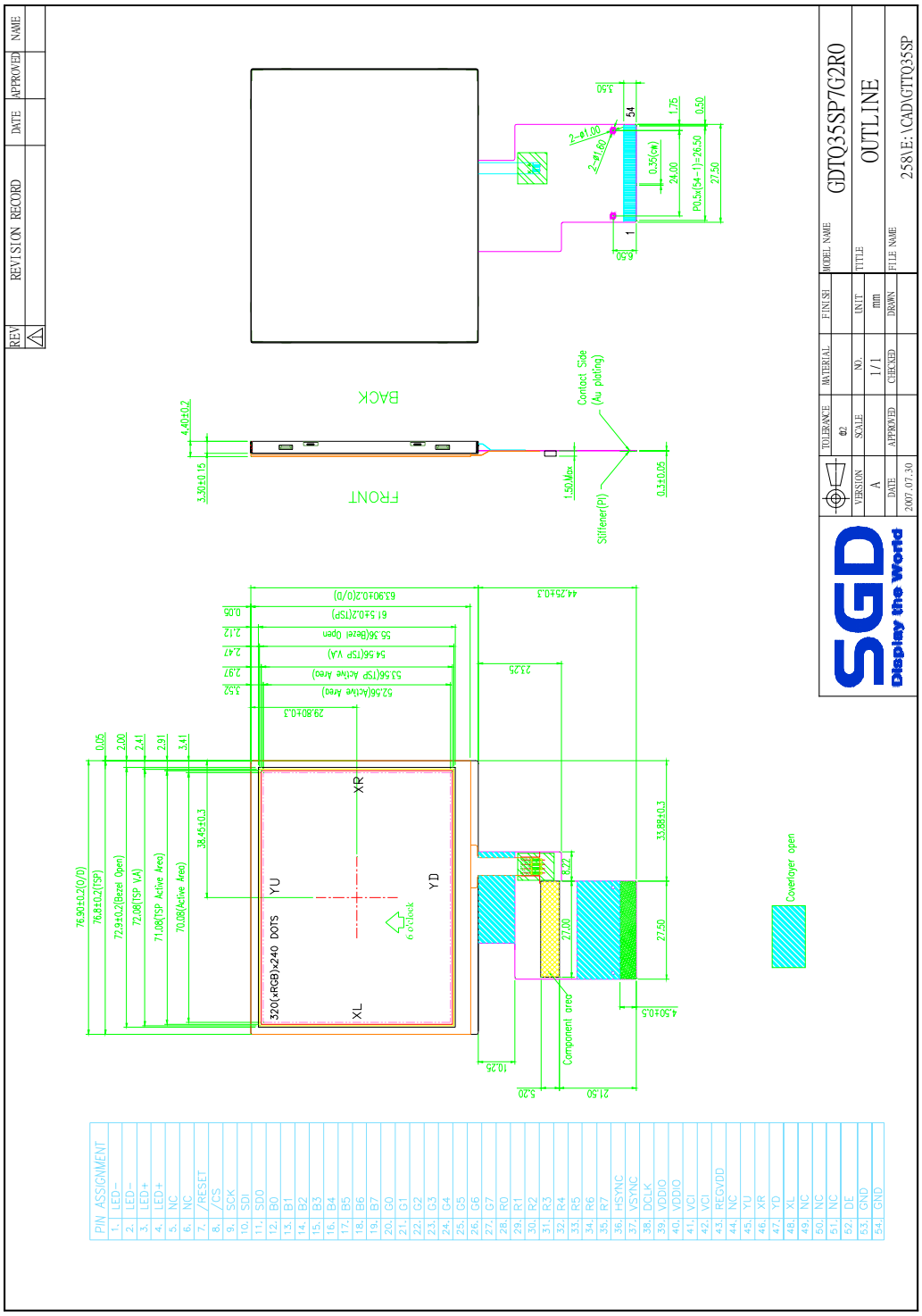


2. Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	--	76.90	--	mm	--
	Vertical (V)	--	63.90	--	mm	(1)
	Thickness (T)	--	4.40	--	mm	(2)
Weight		--	N/A	--	g	--

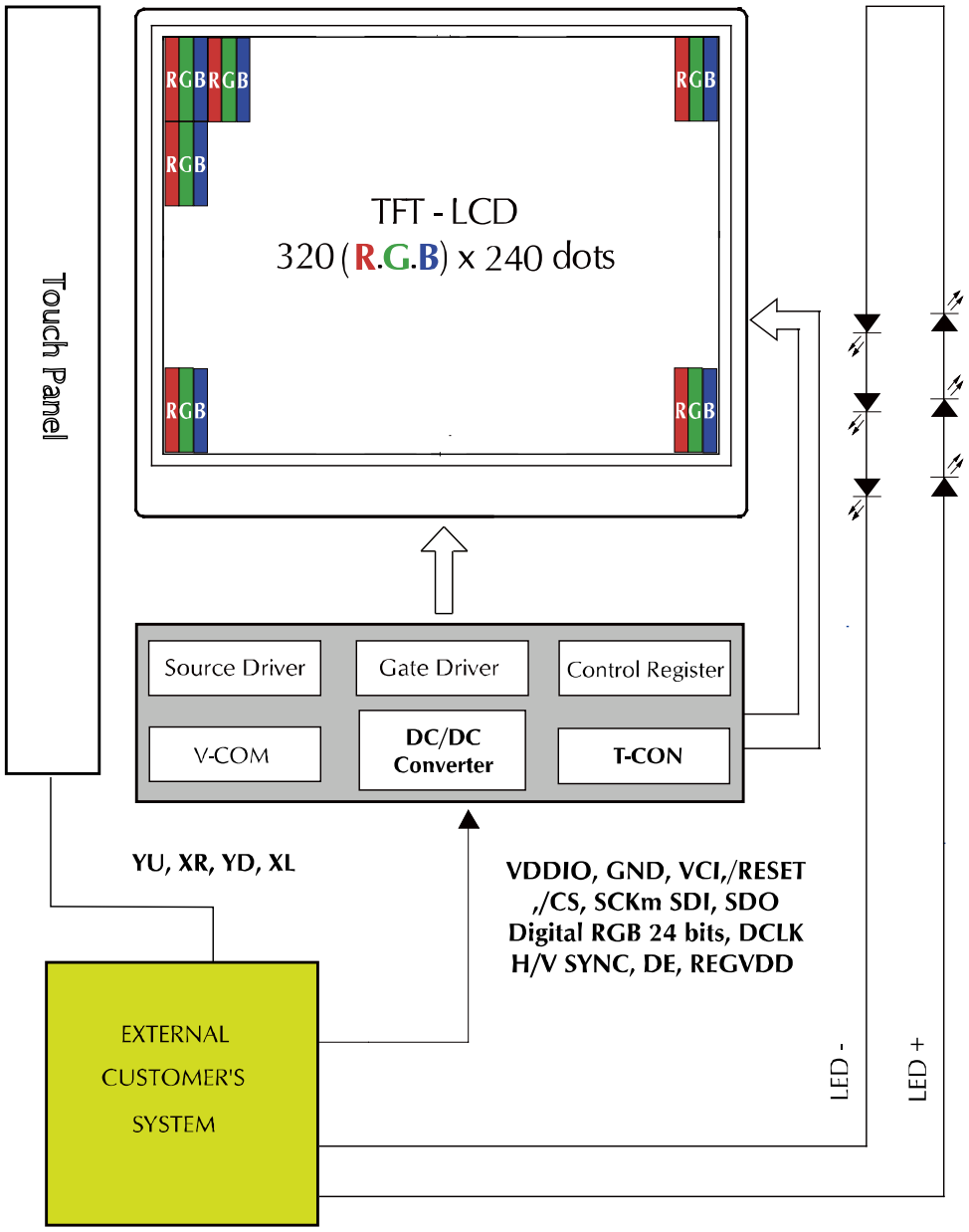
Note (1) Not include FPC.
Refer to the Outline Dimension for further information.
(2) Back-light & touch screen unit are included.

3. Dimensional Outlines



4. Block Diagram

4.1 TFT-LCD Module with BLU & TSP



5. Input Terminal Pin Assignment

5.1 Pin Assignment (LCD)

Pin No.	Symbol	I/O	Function	Remark
1	LED-	I	Backlight LED Ground	
2	LED-	I	Backlight LED Ground	
3	LED+	I	Backlight LED Power	
4	LED+	I	Backlight LED Power	
5	N/C	---	Not Connection	
6	N/C	--	Not Connection	
7	/RESET	I	Hardware Reset	
8	/CS	I	Serial Interfaces, Chip Select bar	
9	SCLK	I	Serial Interfaces and I2C Clock	
10	SDI	I	SPI Interface Data Clock	
11	SDO	O	SPI Interface Data	
12	B0	I	Blue Data Bit 0	
13	B1	I	Blue Data Bit 1	
14	B2	I	Blue Data Bit 2	
15	B3	I	Blue Data Bit 3	
16	B4	I	Blue Data Bit 4	
17	B5	I	Blue Data Bit 5	
18	B6	I	Blue Data Bit 6	
19	B7	I	Blue Data Bit 7	
20	G0	I	Green Data Bit0	
21	G1	I	Green Data Bit1	
22	G2	I	Green Data Bit2	
23	G3	I	Green Data Bit3	
24	G4	I	Green Data Bit4	
25	G5	I	Green Data Bit5	
26	G6	I	Green Data Bit6	
27	G7	I	Green Data Bit7	
28	R0	I	Red Data Bit0	
29	R1	I	Red Data Bit1	
30	R2	I	Red Data Bit2	
31	R3	I	Red Data Bit3	
32	R4	I	Red Data Bit4	
33	R5	I	Red Data Bit5	

34	R6	I	Red Data Bit6	
35	R7	I	Red Data Bit7	
36	H_{SYNC}	I	Horizontal Sync Input	
37	V_{SYNC}	I	Vertical Sync Input	
38	D_{CLK}	I	Dot Data Clock	
39	V_{DDIO}	P	Voltage input pin for I/O logic. - Connect to system Vdd	
40	V_{DDIO}	P	Voltage input pin for I/O logic. - Connect to system Vdd	
41	V_{CI}	P	Booster input voltage pin. - Connect to voltage source between 2.5V to 3.6V	
42	V_{CI}	P	Positive Power Supply for Interfaces and Control lines	
43	REGVDD	I	Input pin to enable internal voltage regulation. -Connect to VDDIO if System Vdd > 2.5V -Connect to GND if 2.5V ³ System Vdd ³ 1.8V, internal regulator will be disabled	
44	N/C	--	Not Connection	
45	YU	I	Touch Panel Top Side	
46	XR	I	Touch Panel Right Side	
47	YD	I	Touch Panel Bottom Side	
48	XL	I	Touch Panel Left Side	
49	N/C	--	Not Connection	
50	N/C	--	Not Connection	
51	N/C	--	Not Connection	
52	DE	I	Data Enable Input	
53	GND	P	Ground	
54	GND	P	Ground	

6. Optical Characteristics

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (1).
Measuring equipment: LCD-5000, BM-5A, BM-7, PR-650, EZ-Contrast

(Ta=25±2°C , VDDIO = V_{CI}=2.8V, I_f=40mA)

Item		Symbol	Condition	Min	Type	Max	Unit	Note
Brightness		--		--	250	--	cd/m^2	--
Response time		T_R	θ=0°	--	15	20	ms	Note.
		T_F		--	35	50	ms	
Contrast ratio		CR	At optimized viewing angle	240	300	--	--	Note.
Color Chromaticity (CIE1931)	Red	R_X	θ=0° Normal Viewing Angle	0.590	0.640	0.690	--	Note.
		R_Y		0.294	0.344	0.394		
	Green	G_X		0.248	0.298	0.348	--	
		G_Y		0.532	0.583	0.633		
	Blue	B_X		0.090	0.140	0.190	--	
		B_Y		0.080	0.130	0.180		
	White	Wx		0.262	0.312	0.362	--	
		Wy		0.299	0.349	0.399		
Viewing Angle (6H)	Hor.	θ_R	CR≥10	50	60	--	Degree	Note.
		θ_L		50	60	--		
	Ver.	ϕ_H		50	60	--		
		ϕ_L		50	60	--		

Note : Definition of Transmittance (T%)

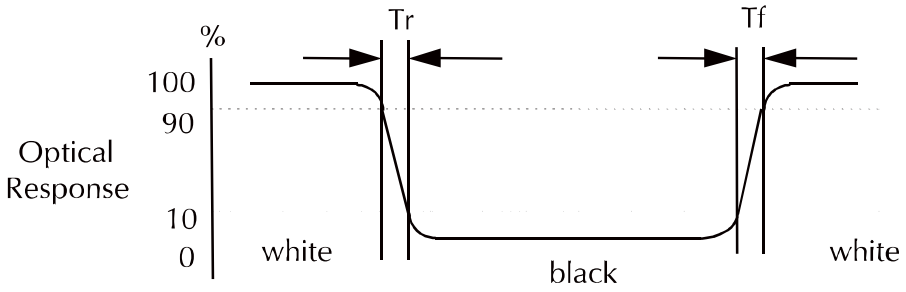
T = Aperture Ratio (TFT) x W_Y (CF)

a. Test equipment setup

After stabilizing and leaving the panel alone shall be warmed up for the stable operation of LCM, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7(fast) with a viewing angle of 2° at a distance of 50cm and normal direction.

b. Definition of response time: Tr and Tf

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".

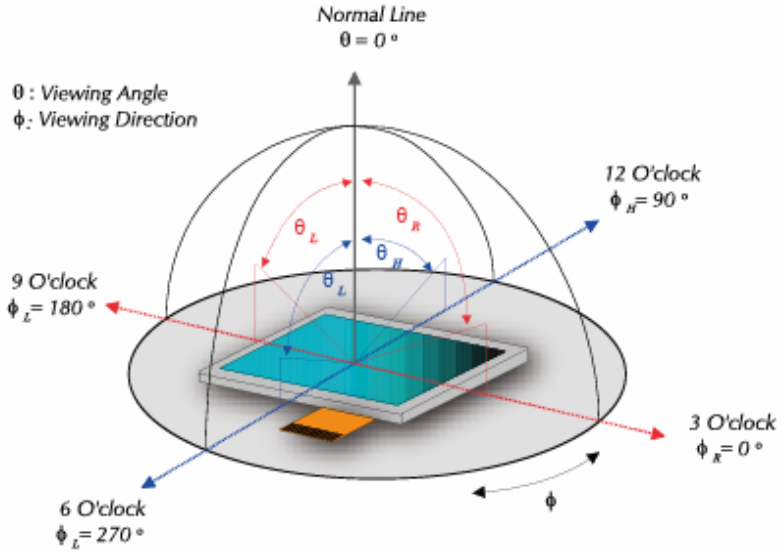


c. Definition of contrast ratio:

$$\text{Contrast Ratio (CR)} = \frac{\text{Brightness measured when LCD is at "white state"}}{\text{Brightness measured when LCD is at "black state"}}$$

d. Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

e. View Angle



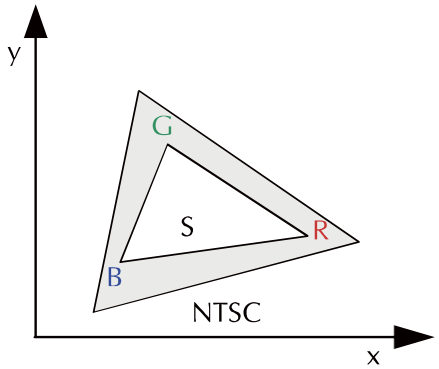
f. Definition of Luminance of White: Luminance of white at the center points

Light Source of Back-Light Unit	LED Type

g. Definition of White Uniformity

$$\text{White Uniformity} = \frac{\text{Min. luminance of white among 5-points}}{\text{Max. luminance of white among 5-points}}$$

h. The definition of Color Gamut -Color Chromaticity CIE 1931
Color coordinate of white & red, green, blue at center point.
Color Gamut : NTSC(%) = (RGB Triangle Area / NTSC Triangle Area) x 100



7. Touch Screen Panel Specifications

7.1 Touch Panel

7.1.1 Electrical Characteristics

Item	Min.	Typ.	Max.	Unit	Note
Linearity	-1.5	-	1.5	%	Analog X and Y directions
Terminal resistance	200	-	700	Ω	X(Glass side)
	200	-	900	Ω	Y(Film side)
Insulation resistance	20	-	-	MΩ	DC 25V
Voltage	-	5.0	7.0	V	DC
Chattering	-	-	10	ms	100kΩ pull-up
Transparency	-	82	-	%	Non-glare

Caution (1) : Do not operate it with a thing except a polyacetal pen (tip R0.8mm or less) or a finger, especially those with hard or sharp tips such as a ball point pen or a mechanical pencil.

7.1.2 Mechanical & Reliability Characteristics

Item	Min.	Typ.	Max.	Unit	Note
Activation force	-		80	g	(1)
Durability-surface scratching	Write 100,000	-	-	characters	(2)
Durability-surface pitting	1,000,000	-	-	touches	(3)
Surface hardness	3	-	-	H	JIS K5400,ASTM D3363

Note (1) Stylus pen Input : R0.8mm polyacetal pen or Finger

Note (2) Measurement for Surface area - Scratch 100,000 times straight line on the Film with a stylus change every 20,000times

- Force : 150gf
- Speed : 100mm/sec
- Stylus : R0.8 polyacetal tip

Note (2) Pit 1,000,000 times on the Film with a R8.0 silicon rubber.

- Force : Force : 250gf
- Speed : 3times/sec

8. Absolute Maximum Ratings

8.1 Absolute Ratings of Environment

If the operating condition exceeds the following absolute maximum ratings, the TFT LCD module may be damaged permanently.

(Ta=25±2°C, V_{SS}=GND=0)

Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	T_{STG}	-20	70	°C	(1)
Operating temperature (Ambient temperature)	T_{OPR}	-10	60	°C	(1), (2)

Note (1) 95 % RH Max. (40 °C ≥ Ta)

Maximum wet-bulb temperature at 39 °C or less. (Ta > 40 °C) No condensation.

Note (2) In case of below 0°, the response time of liquid crystal (LC) becomes slower and the color of panel becomes darker than normal one. Level of retardation depends on temperature, because of LC's character.

8.2 Electrical Absolute Rating

8.2.1 TFT-LCD Module

(Voltage Referenced to VSS)

Item	Symbol	Value		Unit	Condition
		Min.	Max.		
Supply Voltage	VDD	-0.3	+2.7	V	--
	VDDIO	-0.3	+4.0	V	--
Input Voltage	VCI	VSS-0.3	5.0	V	--
Current Drain Per Pin Excluding VDD and VSS	I	--	25	mA	--
Input Resistance	Ron	TBD	TBD	W	--

8.2.2 Back-Light Unit

(Ta=25±2°C)

Item	Symbol	Min.	Max.	Unit	Note
Current	I_f	--	30	mA	(1)

Note (1) Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded. Functional operation should be restricted to the conditions described under normal operating conditions.

9. Electrical Characteristics

9.1 TFT-LCD Module (DC Characteristics)

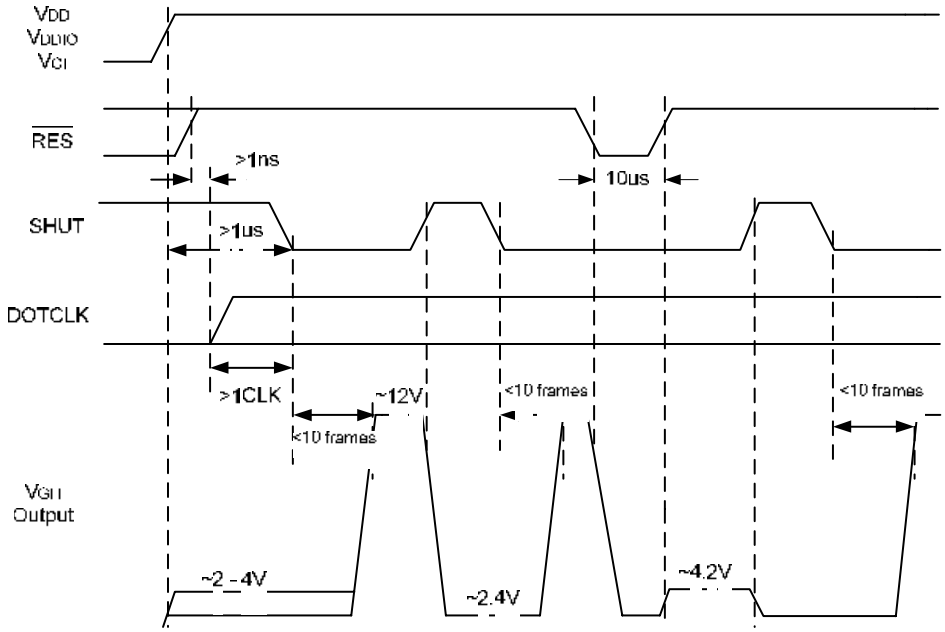
(Unless otherwise specified, Voltage Referenced to VSS,VDDIO=2.8V, TA=25°C)

Item	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
System power supply pins of the logic block	V_{DD}	Recommend Operating Voltage, Possible Operating Voltage	1.8	-	2.50	V
Power supply pin of IO pins	V_{DDIO}	Recommend Operating Voltage, Possible Operating Voltage	1.8	-	3.6	V
Booster Reference Supply Voltage Range	V_{CI}	Recommend Operating Voltage, Possible Operating Voltage	2.5 or V_{DDIO}	-	3.6	V
Sleep mode current	I_{sleep}	--	--	50	--	μA
Operating mode current	I_{dp}	VCI=3.3V	--	10	12	mA
Negative VCI Output Voltage	V_{CIM}	No panel loading	$-V_{CI}$	-	$-V_{CI}$+ 0.7	V
VCIX2 primary booster efficiency (1)	V_{CIX2}	No panel loading, ITO for VCIX2,VCI and VCHS = 10 Ohm	83	90	--	%
Gate driver High Output Voltage Booster efficiency (2)	V_{GH}	No panel loading; 4x booster; ITO for CYP, CYN, VCIX2, VCI and VCHS = 10 Ohm	84	89.5	--	%
		No panel loading; 5x booster; ITO for CYP, CYN, VCIX2, VCI and VCHS = 10 Ohm	80	88.5	--	%
		No panel loading; 6x booster; ITO for CYP, CYN, VCIX2, VCI and VCHS = 10 Ohm	72	80	--	%
Gate driver Low Output Voltage	V_{GL}	--	$-V_{GH}$	--	-5.1	V
VCOM High Output Voltage	V_{COMH}	--	-	-	5.54	V
VCOM Low Output Voltage	V_{COML}	--	V_{CIM}+ 0.5	-	-	V
VCOM Amplitude	V_{COMA}	--	-	-	6	V
VLCD63 Output Voltage	V_{LCD63}	--	-	-	5.57	V
Max. Source Voltage Variation	ΔV_{LCD63}		-2	-	2	%
Logic High Output Voltage	V_{OH1}	I out = -100μA	0.9* V_{DDIO}	-	V_{DD}	V
Source Output Voltage Deviation	V_{VD}	--	-	±20	-	mV
Source Output Voltage Offset	V_{OS}	--	-	-	±30	mV

Item	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Logic Low Output Voltage	V_{OL1}	I out = 100μA	0	-	0.1* V_{DDIO}	V
Logic High Input voltage	V_{IH1}	--	0.8* V_{DDIO}	-	V_{DDIO}	V
Logic Low Input voltage	V_{IL1}	--	0	-	0.2* V_{DDIO}	V
Logic High Output Current Source	I_{OH}	V out = VDD – 0.4V	50	-	-	μA
Logic Low Output Current Drain	I_{OL}	V out = 0.4V	-	-	-50	μA
Logic Output Tri-state Current Drain Source	I_{OZ}	--	-1	-	1	μA
Logic Input Current	I_{IL}/I_{IH}	--	-1	-	1	μA
Logic Pins Input Capacitance	C_{IN}	--	-	5	7.5	pF
Source drivers output resistance	R_{SON}	--	-	1	-	kΩ
Gate drivers output resistance	R_{GON}	--	-	500	-	Ω
VCOM output resistance	R_{CON}	--	-	200	-	Ω

Note : (1) VCIX2 efficiency = VCIX2 / (2 x VCI) x 100%
(2) VGH efficiency = VGH / (VCI x n) x 100% (where n = booster factor)

9.2 VGH Output Against SHUT & RES



VGH Output Against SHUT & RES

Note: (1) The minimum cycle time of SHUT is 10 + 2 frames.
(2) DOTCLK must be provided for boosting of VGH. The above timing diagram assumed voltages and DOTCLK are continuous supplied after power on.
(3) VGH and VGL will be forced to VSS at the low stage of RESB.
(4) The minimum pulse width of RESB is 10us.

9.3 Backlight Unit

The back-light system is an edge-lighting type with **six** white LEDs (Light Emitting Diode).

(Ta=25±2°C)

Item	Symbol	Value			Unit	Condition
		Min.	Typ.	Max.		
Power Consumption	P_{LED}	-	408	-	mW	
LED Current	If	-	20	-	mA	

Note (1) Six LEDs serial type.

(2) Where If = 20mA, $V_B = P_{LED} / If$

10. Basic Display Color and Gray Scale

	Color & Gray Scale	Data Signal																							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(127)	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Green	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(127)	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Blue	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(127)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

0 : Low level voltage, 1 :High level voltage

Each basic color can be displayed in 256 gray scales from 8 bit data signals. With the combination of total 24 bit data signals, the 16,777,216-color display can be achieved on the screen.

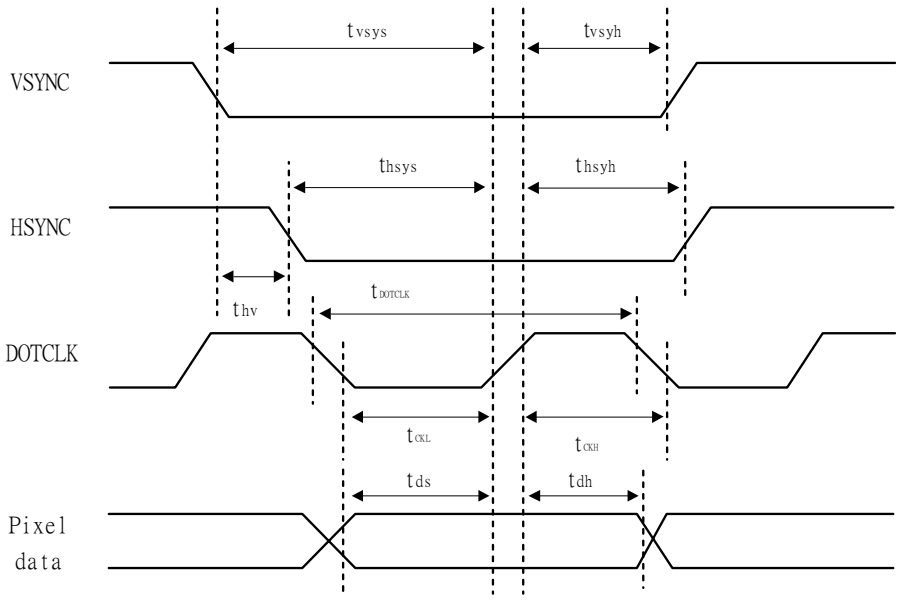
11. AC Timing

11.1 AC Characteristics (Pixel Timing)

(Unless otherwise specified, Voltage Referenced to VSS, VDDIO = 2.8V, TA = 25°C)

Item	Symbol	Min.	Typ.	Max.	Unit
DOTCLK Frequency	fDOTCLK	-	6.5	10	MHz
DOTCLK Period	tDOTCLK	100	154	-	ns
Vertical Sync Setup Time	tvsys	20	-	-	ns
Vertical Sync Hold Time	tvsyh	20	-	-	ns
Horizontal Sync Setup Time	thsys	20	-	-	ns
Horizontal Sync Hold Time	thsyh	20	-	-	ns
Phase difference of Sync Signal Falling Edge	thv	1	-	240	tDOTCLK
DOTCLK Low Period	tCKL	50	-	-	ns
DOTCLK High Period	tCKH	50	-	-	ns
Data Setup Time	tds	12	-	-	ns
Data hold Time	tdh	12	-	-	ns
Reset pulse width	tRES	10	-	-	us

Note: External clock source must be provided to DOTCLK pin of HX8238-A. The driver will not operate if absent of the clocking signal.

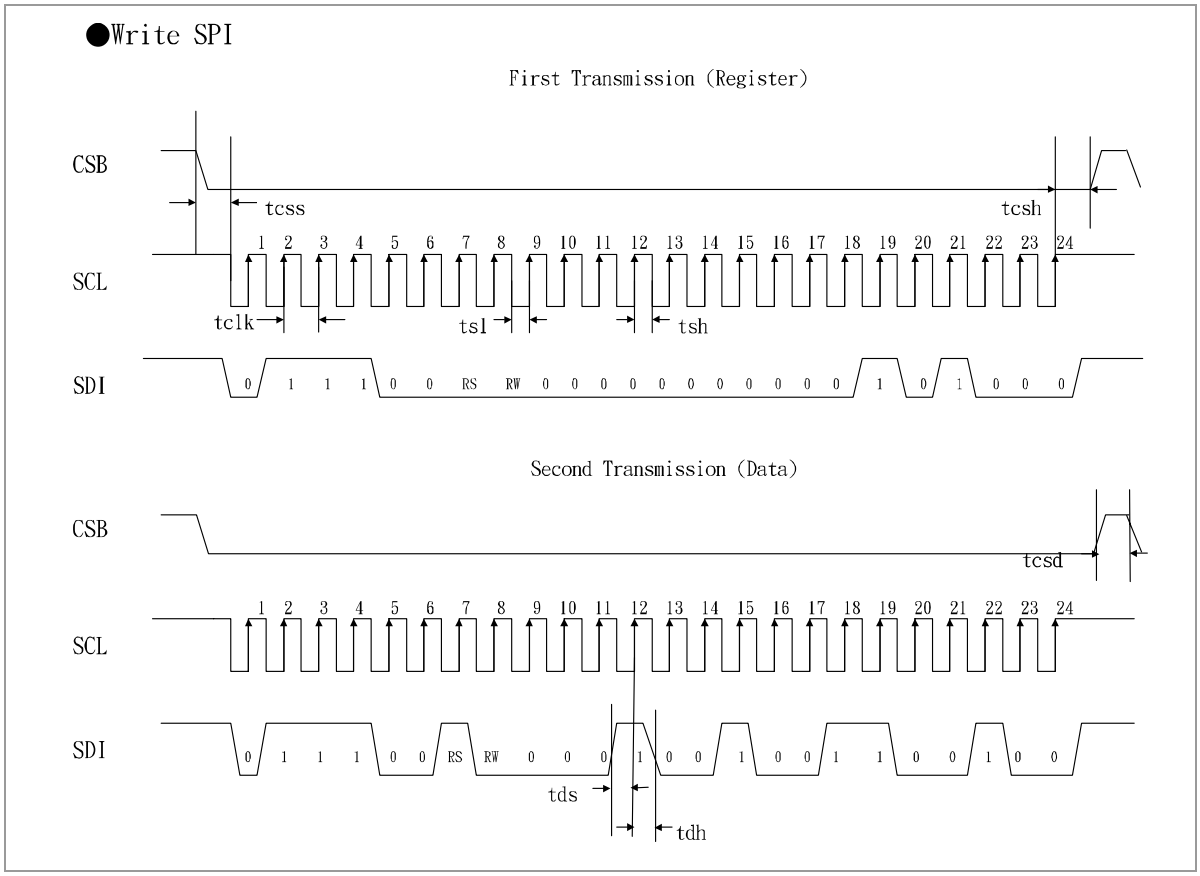


Pixel Timing

11.2 SPI Timing Characteristics

Item	Symbol	Min.	Typ.	Max.	Unit
Serial Clock Frequency	fclk	-	-	20	MHz
Serial Clock Cycle Time	tclk	50	-	-	ns
Clock Low Width	tsl	25	-	-	ns
Clock High Width	tsh	25	-	-	ns
Chip Select Setup Time	tcss	0	-	-	ns
Chip Select Hold Time	tcsh	10	-	-	ns
Chip Select High Delay Time	tcsd	20	-	-	ns
Data Setup Time	tds	5	-	-	ns
Data Hold Time	tdh	10	-	-	ns

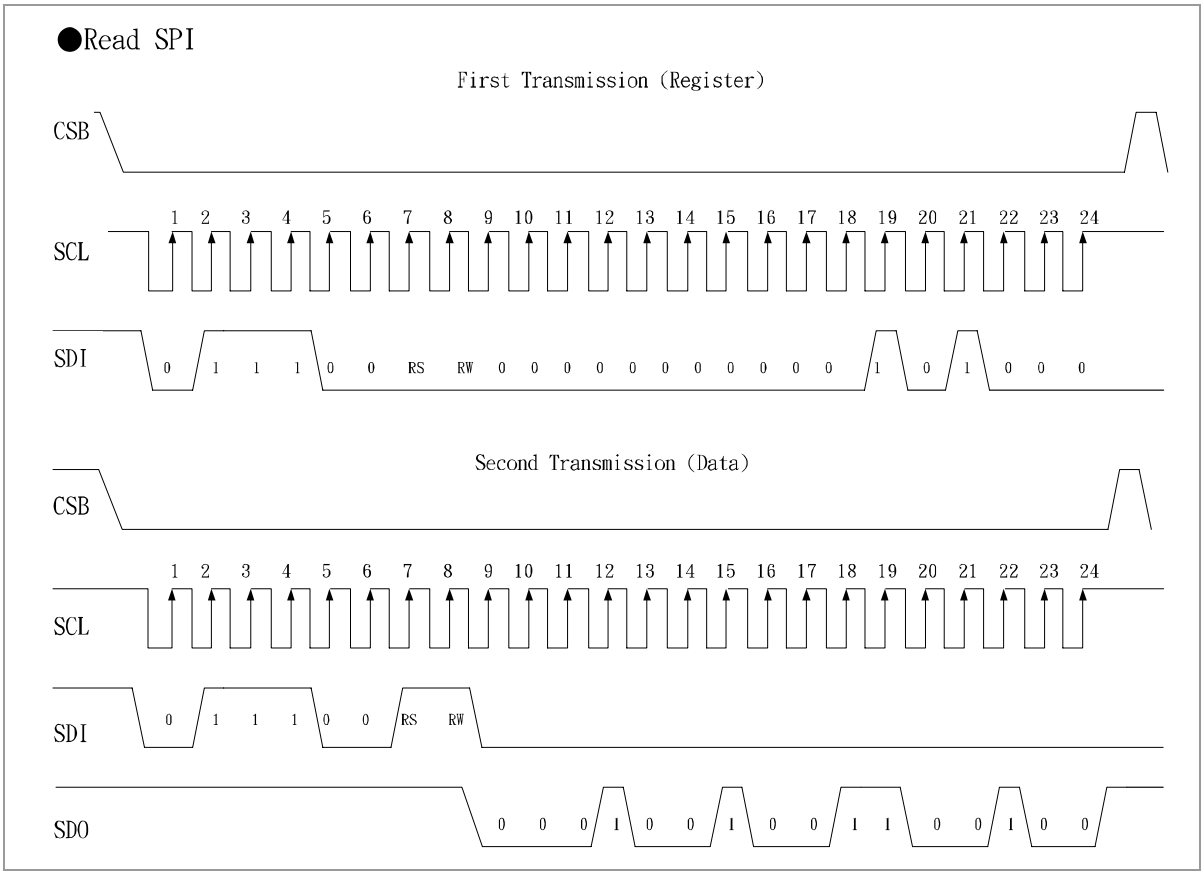
11.3 Write SPI interface Timing Diagram



Note: The example writes "0x1264h" to register R28h.

SPID connected to VSS.

11.4 Read SPI interface Timing Diagram

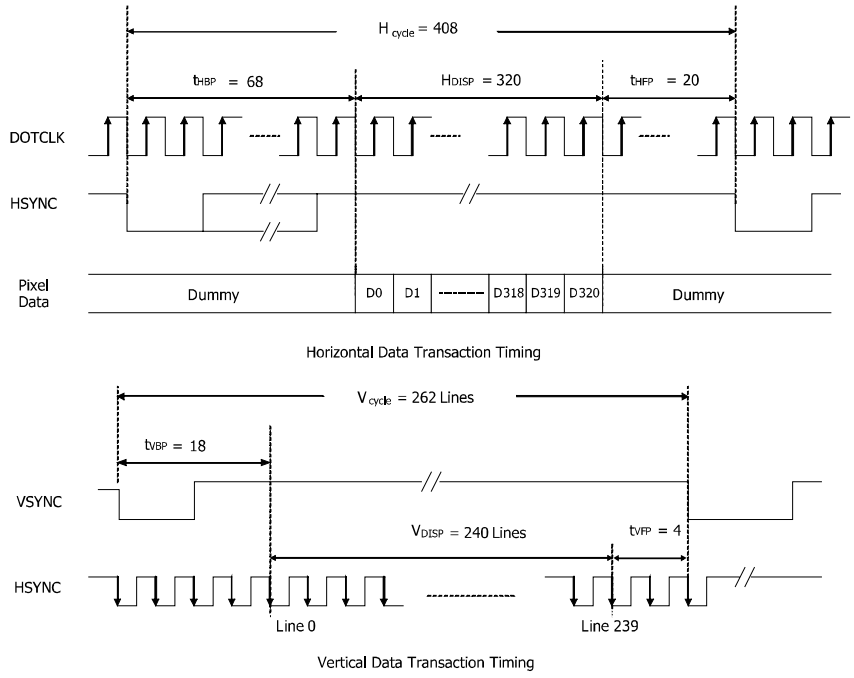


Note: The example Read "0x1264h" from register R28h.

11.5 AC Characteristics

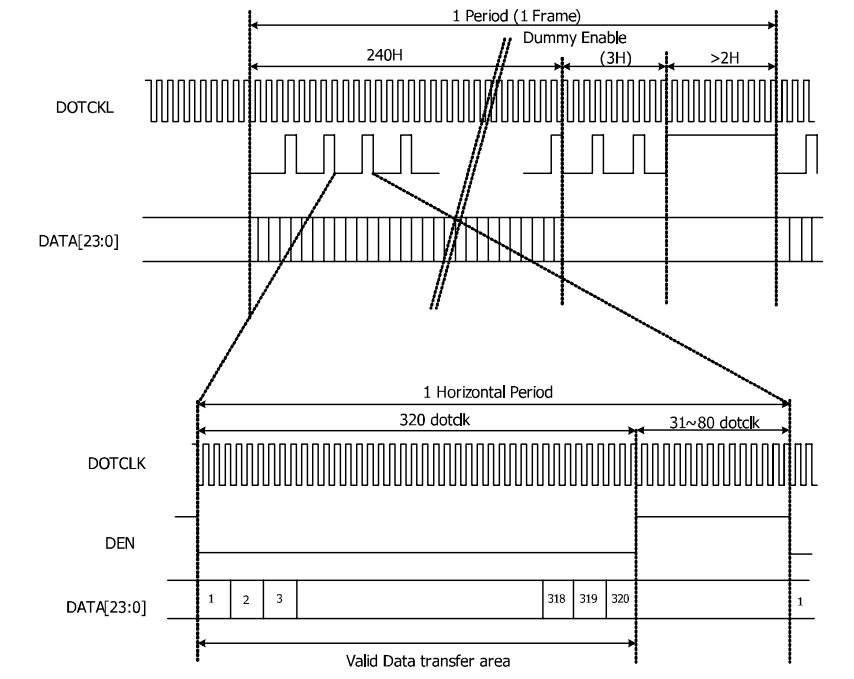
Item		Symbol	Min.	Typ.	Max.	Unit
DOTCLK Frequency		fDOTCLK	-	6.5	10	MHz
DOTCLK Period		tDOTCLK	100	154	-	ns
Horizontal Frequency (Line)		fH	-	14.9	22.35	KHz
Vertical Frequency (Refresh)		fV	-	60	90	Hz
Horizontal Back Porch		tHBP	-	68	-	tDOTCLK
Horizontal Front Porch		tHFP	-	20	-	tDOTCLK
Horizontal Data Start Point		tHBP	-	68	-	tDOTCLK
Horizontal Blanking Period		tHBP + tHFP	-	88	-	tDOTCLK
Horizontal Display Area		HDISP	-	320	-	tDOTCLK
Horizontal Cycle		Hcycle	-	408	450	tDOTCLK
Vertical Back Porch		tVBP	-	18	-	Lines
Vertical Front Porch		tVFP	-	4	-	Lines
Vertical Data Start Point		tVBP	-	18	-	Lines
Vertical Blanking Period		tVBP + tVFP	-	22	-	Lines
Vertical Display Area	NTSC	VDISP	-	240	-	Lines
	PAL			280(PALM=0)		
				288(PALM=1)		
Vertical Cycle	NTSC	Vcycle	-	262	350	Lines
	PAL			313		

11.6 Timing in Parallel RGB (24 bit SYNC Mode)



Data transaction timing in parallel RGB (24 bit) interface (SYNC mode)

11.7 Timing in Parallel RGB (24 bit DE Mode)



Signal timing in DE mode

12. Quality Standard for LCD

12.1 Objective

This specification book is the standard for LCD module general inspection. And also this book will be refer to customer approval specification.

12.2 Scope

This specification book is applicable to general LCD module. If supplier has any doubt or requirement, then it can be discussed.

12.2.1 Acceptable Quality Level

INSPECTION	SAMPLING PROCEDURES	A.Q.L
Major	MIL-STD-105E Inspection Level II Normal Inspection, Single sample inspection	1
Minor	MIL-STD-105E Inspection Level II Normal Inspection, Single sample inspection	1.5

Major defect :

A major defect is a defect that could result in failure or extremely reduction on the usability of the product for its intended purpose.

Minor defect :

A minor defect is one that does not materially reduce the usability of the product for its intended purple or is a departure from established standards giving no significant bearing on the effective use or operation of the unit.

12.2.2 Inspection Conditions

12.2.2.1 The environmental conditions for inspection shall be as follows

- Room Temperature : 25±10°C
- Humidity Temperature : 45±20%RH

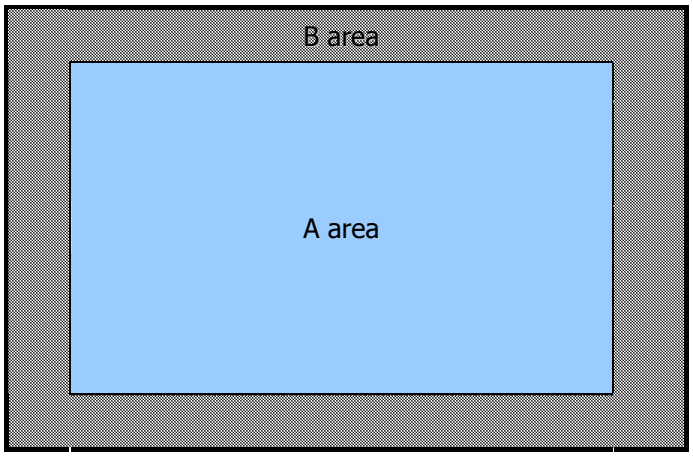
12.2.3 The external visual inspection

- The inspection shall be performed by using 40Watts fluorescent lamp for illumination and the distance between LCD and eyes of the inspector shall be 30cm or more.

12.2.4 Inspection Item

Pinhole, Bright spot, Black spot, White spot, Black line, White Line, Foreign particle, Bubble	The color of a small area is different from the remainder. The phenomenon dose not change with voltage.
Contrast variation	The color of a small area is different from the remainder. The phenomenon change with voltage.
Glass defect	Glass crack, Chip
Operating	Function, Contrast, Uniformity, Components

12.2.5 Definition of the Area

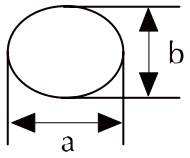
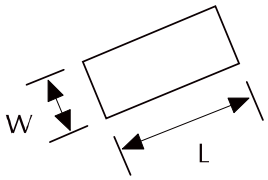
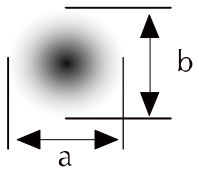
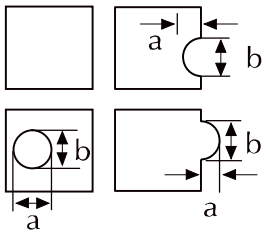


A area: Viewing Area

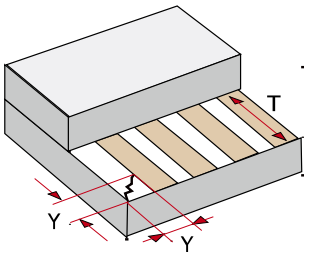
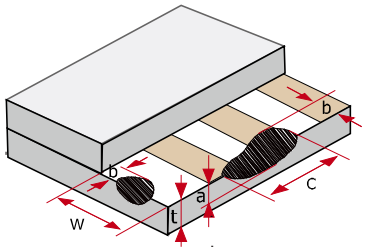
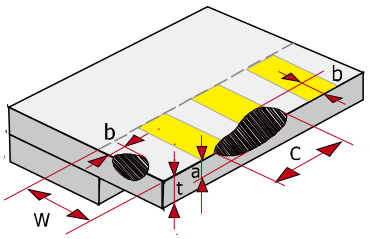
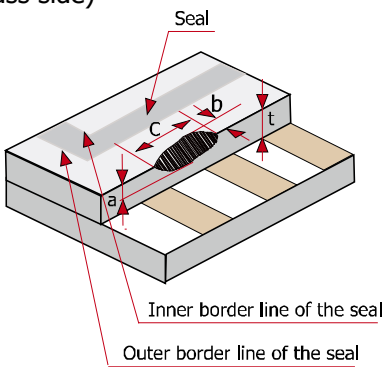
B area: Out of Viewing Area

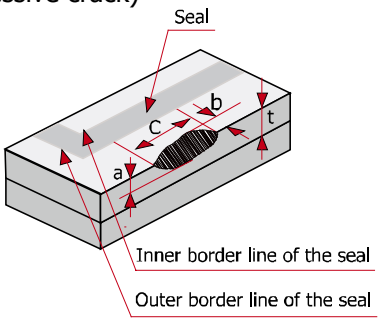
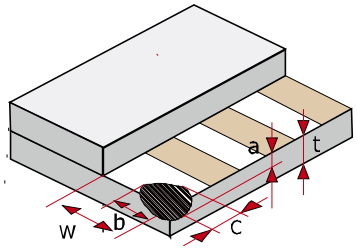
12.3 Inspection specification

12.3.1 Non-operating inspection specification

Class of defects	No.	Inspection Item	Criteria of defects		Acceptable Q'ty	
					Zone A	Zone B
Major	1	Circuits	1. Circuit short		0	0
			2. Circuit open			
Minor	2	(Black spot, White spot, Bright spot, Foreign particle)  $\phi = (a+b)/2$	A	$\phi \le 0.1$	*	Ignore
			B	$0.1 < \phi < 0.2$	3	
			C	$0.2 \le \phi < 0.3$	1	
			D	$0.3 \le \phi$	0	
			Total defect point (B,C)		3	
			* Reject when 5 or more spots are gathered within 5mm circle.			
	3	(Black line, White line)  	A	$W \le 0.02$	-	*	Ignore
			B	$0.02 < W \le 0.05$	$L \le 5$	2	
			C	$0.05 < W \le 0.1$	$L \le 3$	2	
			D	$0.1 < W$	-	0	
			Total defect point (B,C)			3	
			* Reject when 5 or more spots are gathered within 5mm circle.			
	4	(Contrast variation)  $\phi = (a+b)/2$	A	$\phi \le 0.3$	Ignore	Ignore
			B	$0.3 < \phi \le 0.4$	2	
			C	$0.4 < \phi \le 0.5$	1	
			D	$0.5 < \phi$	0	
			Total defect point (B,C)		3	
	5	(Pattern deformity)  $\phi = (a+b)/2$	1. Pin hole			
			A	$\phi \le 0.15$	Ignore	Ignore
			B	$0.15 < \phi \le 0.2$	2 (*)	
				$0.2 < \phi$	0	
			* Two pin hole shall not formed in the single dot			
			2. Excess, void			
			A	$a \le 0.2$ and $b \le 0.2$	Ignore	Ignore
			B	$0.2 < a$ or $0.2 < b$	0	

Minor	6	Dot defect	A	Bright dot	0	Ignore
			B	Dark dot	1	
			* This inspection item does not apply to B/W LCD			
	7	Bubble between Polarizer and panel	A	$\phi \leq 0.3$	Ignore	Ignore
			B	$0.3 < \phi \leq 0.5$	2	
			C	$0.5 < \phi$	0	
	8	Polarizer scratch and particle	Circular: Same as inspection item No.2			Ignore
			Linear: Same as inspection item No.3			
	9	Polarizer Dent	A	$\phi \leq 0.2$	Ignore	Ignore
			B	$0.2 < \phi \leq 0.3$	2	
			C	$0.3 < \phi \leq 0.4$	1	
			D	$0.4 < \phi$	0	
			Total defect point (B,C)		3	
	10	Bubble in the Cell	Any size		0	0
	11	Dirt on polarizer	Dirt which can be wiped easily should be accepted.			
	12	Protection film	The protection film should not be stripped up to viewing area and the peeled off angle should not exceed 20 degrees.			
	13	Polarizer shift	1. Shifting in position should not exceed the glass outline dimension. 2. Incomplete covering of the viewing area due to shifting is not allowed. 3. Shifting in position should be within the tolerance (refer to module dimensional drawing)			
	14	Silicon	1. Silicon must cover all circuits. 2. Silicon thickness should be within specification (refer to module dimensional drawing)			
	15	Tape	1. Location: refer to specification. 2. Insufficient adhesive.			
Major	16	TCP, FPC defect	Film or Pattern should not have crack.			
	17	Components	Missing components not allowed.			

Class of defects	No.	Inspection Item	Criteria of defects
Major	18	(Progressive crack) 	Reject any progressive crack.
Minor	19	(The front lead terminals) 	a ≤ t b ≤ 1 c ≤ 7.0 * Glass crack should not cover alignment mark
	20	(The rear of lead terminals) 	a ≤ t b ≤ 1 c ≤ 7.0
	21	(Short glass side) 	a ≤ t c ≤ 7.0 b < Inner border line of the each

Class of defects	No.	Inspection Item	Criteria of defects
Major	22	(Progressive crack) 	Reject any progressive crack.
	23	(Corner) 	a ≤ t b ≤ 3.0 c ≤ 3.0 * Glass crack should not cover patterns used for recognition and assembly, alignment mark and patterns.

* Condition of item 2~9

1. Distance between defects must be more than 10mm with light on, more than 15mm with light off.
2. Total acceptable defect number
   - Defects with light on : 6 points
   - Defects with light off : 4 points
   - Total defect point : 6 points
3. Regarding the defect distance and total acceptable defect number, above 2-A, 3-A should be neglected.

*Condition of item 19 ~ 23

1. Total acceptable defect number: 4

Class of defects	No.	Inspection Item	Criteria of defects
Major	1	No display	--
	2	Abnormal operation	--
	3	Contrast defect	Judge according to module specification. Establish boundary sample if required.
	4	Viewing angle defect	Judge according to module specification. Establish boundary sample if required.
	5	Excess power consumption	Judge according to module specification.
	6	Back-light, LED defect	1. No lit-on 2. Different color 3. Low brightness
	7	Speaker, Vibrator defect	1. No operation 2. Abnormal operation
Minor	8	Cross-talk defect	No noticeable crosstalk. Establish boundary sample if required.
	9	Uneven brightness	No noticeable unevenness allowed. Establish boundary sample if required.
	10	Uneven color	No noticeable unevenness allowed. Establish boundary sample if required.
	11	Spot, Pinhole, Foreign particle, Line	Same as in Chapter 7.1

13. Reliability Condition for LCD

13.1 Main LCD Reliability Test

13.1.1. Reliability Test Condition

No.	Panel	Item	Condition	Test time	Note
1	√	High temp. operating	60°C	120 Hrs	--
2	√	Low temp. operating	-10°C	120 Hrs	--
3	√	High temp. storage	70°C	120 Hrs	--
4	√	Low temp. storage	-20°C	120 Hrs	--
5	√	High Temp / High Humidity Storage	T = 60°C /85%. For (But no condensation dew)	120 Hrs	--
6	√	High Temp/ High Humidity Operating	T = 40°C /85% For (But no condensation dew)	120 Hrs	--
7	√	Thermal Shock (Non-Operation)	-10 ← → 60°C, 50 cycle 30min 30min	1 Hrs	--
8	√	Vibration (Non-Operation)	Frequency:10 ~ 55Hz, mp:1.5mm Sweep Time : 11min Test Time : 2hrs for each direction of X,Y,Z	--	--
9	√	Shock (Non-Operation)	Acceleration : 100G, Period : 6ms Directions of X,Y,Z Cycles: Twice	--	--

13.1.2. Operating Test Pattern

No.	Items	Test Pattern
1	Test Pattern in Driving Condition	1. Full Red 2. Full Green 3. Full Blue 4. Gradation (horizontal) 5. Gradation (vertical) 6. Character (111111) 7. Full White 8. Full Black 9. Black Line (horizontal) 10. Black Line (vertical) 11. Mosaic (1X1) The Test Pattern is changed 1sec. The same Pattern are repeated.
2	Black Square	Black Window and White Background

13.1.3. Test Method

The method of visual inspection is equal to the appearance standard. Evaluation and assessment made two hours after return to room temperature (25±5°C). The LCDs subjected to the test must not have dew condensation.

The test pattern is gray scale and the operating voltage sweep from Vth to Vsat variable. The non-uniformity and other appearance are checked in LCD.

13.1.4. Result Evaluation Criteria

There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.

13.1.5. Life time

Life time expectancy of LCD Panel is approximately 50,000 hours under the room environment. Definition on the termination of life time is deterioration of contrast ratio by one fifth against initial value.

13.1.6. Basic rule for Reliability test

* Place all the samples under room temperature & humidity for 24 hours after reliability stressing.
* Room environment means 25+/-10°C, 45+/-20%RH
* There should be no condensation during the test.
* One LCD module shall be used for one test item only and once.

13.1.7. Judgment Criteria for reliability test No. 1-2

* Contrast (or Brightness) ratio variation is within 50% of the initial value.
* No abnormal function
* No extreme decay on appearance

13.1.8. Life time

Main Display (LCD module): Life time expectancy of LCD Panel is approximately 50,000 hours under the room environment.

Definition on the termination of life time is deterioration of contrast ratio by one fifth against initial value. (25 ± 10°C, 45 ± 20%RH).

Life time shall be defined as one of below cases:

- When the contrast ratio for Main display reaches 30% of initial condition and the brightness (or luminance with polarizer) for sub display reaches 50% of initial condition.
- When the appearance degradation appears.

14. Precautions

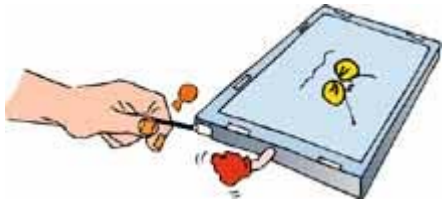
14.1 Operation

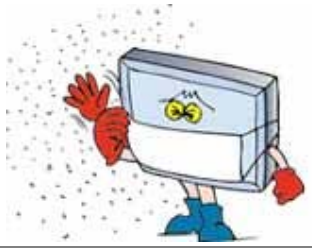
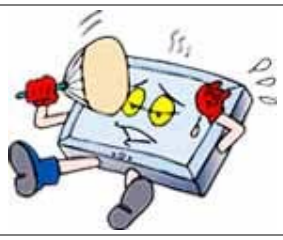
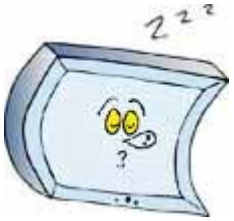
Burn-in sometimes happens when the same character was displayed at along time. Therefore, to prevent Burn-in, it is recommended to set up a Screen-saver function.

14.2 Safety

The liquid crystal in the LCD is poisonous, DO NOT put it in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and water.

14.3 Handling

	a. The LCD module shall be installed flat, without twisting or bending. b. COF or FPC has narrow pattern width, so easily become open circuit by external force. DO NOT apply pressure to COF or FPC especially in bending area.
	c. To avoid damage in appearance or malfunction, DO NOT subject the module to mechanical shock or to excessive force on its surface.
	d. The polarizer attached to the display is very easy to damage, handle it with care to avoid scratching.
	e. To avoid contamination on the display surface, DO NOT touch the display surface with bare hands. f. Provide a space so that the LCD module does not come into contact with other components.

	g. To protect the LCD panel from external pressure, put covering glass (acrylic board or similar board) to keep appropriate space between them.
	h. Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
	i. Property of semiconductor devices may be affected when they are exposed to light possibly resulting in malfunctioning of the ICs. To prevent such malfunctioning of the ICs, your design and mounting layout done are so that the IC is not exposed to light in actual use.
	j. Strong light exposure causes degradation of color filter. It may not recover
	k. DO NOT contact with water to avoid Metal corrosion. l. When it is not in use, the screen must be turned off or the pattern must be frequently changed by a screen saver. If it displays the same pattern for a long period of time, brightness down/image sticking may develop due to the LCD structure.
	m. Never disassemble LCD product under any circumstances. If unqualified operators or users assemble the product after disassembling it, it may not function or its operation may be seriously affected.

14.4 Static electricity

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge.

	a. The LCD module shall be installed flat, without twisting or bending. Ground soldering iron tips, tools and testers when they operate. b. Ground your body when handling the products. c. DO NOT apply voltage to the input terminal without applying power supply. d. DO NOT apply voltage that exceeds the absolute maximum rating. e. Store the products in an anti-electrostatic container. f. Peel off protect tape, attached to polarizer, slowly to minimize ESD damage.

14.5 Storage

	Store the products in a dark place at +5 ~ +25 degree C, low humidity (50%RH or less). DO NOT store the products in an atmosphere containing organic solvents or corrosive gases.

14.6 Cleaning

	a. DO NOT wipe the polarizer with dry cloth, as it might cause scratch. b. Wipe the polarizer with a soft cloth soaked with petroleum IPA, other chemical might damage.

14.7 Waste

	When dispose of LCD module, manage it at the production waste according to the relevant laws and regulations.

15. Warranty

This product has been manufactured to your company's specifications as a part for use in your company's general electronic products. It is guaranteed to perform according to delivery specifications. For any other use apart from general electronic equipment, we cannot take responsibility if the product is used in medical devices, nuclear power control equipment, aerospace equipment, fire and security systems, or any other applications in which there is a direct risk to human life and where extremely high levels of reliability are required. If the product is to be used in any of the above applications, we will need to enter into a separate product liability agreement.

1 We cannot accept responsibility for any defect, which may arise from additional manufacturing of the product (including disassembly and reassembly), after product delivery.

2 We cannot accept responsibility for any defect, which may arise after the application of strong external force to the product.

3 We cannot accept responsibility for any defect, which may arise due to the application of static electricity after the product has passed your company's acceptance inspection procedures.

4 We cannot accept responsibility for industrial property, which may arise through the use of your product, with exception to those issues relating directly to the structure or method of manufacturing of our product. SGD-origin longer than one year from SGD production.