

TFT Module Specification

MODEL: 13-035QMTB00A0-S

< ◇ > PRELIMINARY SPECIFICATION

< ◆ > APPROVAL SPECIFICATION

CUSTOMER
APPROVED BY
DATE:

DESIGNED	CHECKED	APPROVED
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RECORD OF REVISION

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1. GENERAL DESCRIPTION

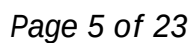
1.1 Description

The specifications is model 13-035QMTB00A0-S is a color active matrix thin film transistor (TFT) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This model is composed of a TFT LCD panel, a driving circuit, a back light system. This TFT LCD has a 3.5 (4:3) inch diagonally measured active display area with QVGA (320 horizontal by 240 vertical pixels) resolution.

1.2 Features:

No.	Item	Specification	Unit
1	Panel Size	3.5"	Inch
2	Number of Pixels	320 (W) x RGB x 240 (H)	Pixels
3	Active Area	70.08 (W) × 52.56 (H)	mm
4	Pixel Pitch	0.219 (W) x 0.219 (H)	mm
5	Outline Dimension	76.9 (W) × 63.9 (H) × 3.3 (T)	mm
6	Number of Colors	16.7M	- -
7	Display Mode	TN / Normally White / Transmissive	- -
8	View Direction	6 o'clock(Gray Inversion)	
9	Display Format	RGB vertical stripe	- -
10	Surface Treatment	Anti-Glare	- -
11	Contrast Ratio	450 (Typ.)	- -
12	Luminance (cd/m ²)	900 (Typ.)	cd/m ²
13	Interface	RGB 24bit Interface	- -
14	Backlight	White LED	- -
15	Driver IC	--	- -
16	Operation Temperature	-20 ~ 70	°C
17	Storage Temperature	-30 ~ 80	°C
18	Weight	(35)	g

1/3/2014



3. PIN DESCRIPTION

Pin No.	Symbol	I/O	Function	Note
1	LED-	P	Backlight LED Ground	
2	LED-	P	Backlight LED Ground	
3	LED+	P	Backlight LED Power	
4	LED+	P	Backlight LED Power	
5	NC	-	No Connection	
6	NC	-	No Connection	
7	/RESET	I	Reset Signal Connect to VDDIO when not used.	
8	/CS	I	SPI Interfaces, Chip Select pin, Leave it OPEN when not used	
9	SCK	I	SPI Interface Clock pin Leave it OPEN when not used	
10	SDI	I	SPI Interface Data INPUT pin Leave it OPEN when not used	
11	SDO	O	SPI Interface Data OUPUT pin Leave it OPEN when not used	
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	HSYNC	I	Horizontal Sync Input	
37	VSYNC	I	Vertical Sync Input	
38	DCLK	I	Dot Clock signal	
39	VDDIO	P	Voltage input pin for I/O logic. (2.5V to 3.6V)	
40	VDDIO	P	Voltage input pin for I/O logic. (2.5V to 3.6V)	
41	VCI	P	Booster input voltage pin. (2.5V to 3.6V)	
42	VCI	P	Booster input voltage pin. (2.5V to 3.6V)	
43	REGVDD	I	Connect to voltage source between 2.5V to 3.6V	
44	NC	--	No Connection	
45	NC	--	No Connection	
46	NC	--	No Connection	
47	NC	--	No Connection	
48	NC	--	No Connection	
49	NC	--	No Connection	
50	NC	--	No Connection	
51	NC	--	No Connection	
52	DE	I	Data Enable Input	
53	GND	P	Ground	
54	GND	P	Ground	

4. ABSOLUTE MAXIMUM RATINGS

4.1 Electrical Absolute Rating

4.1.1 TFT LCD Module

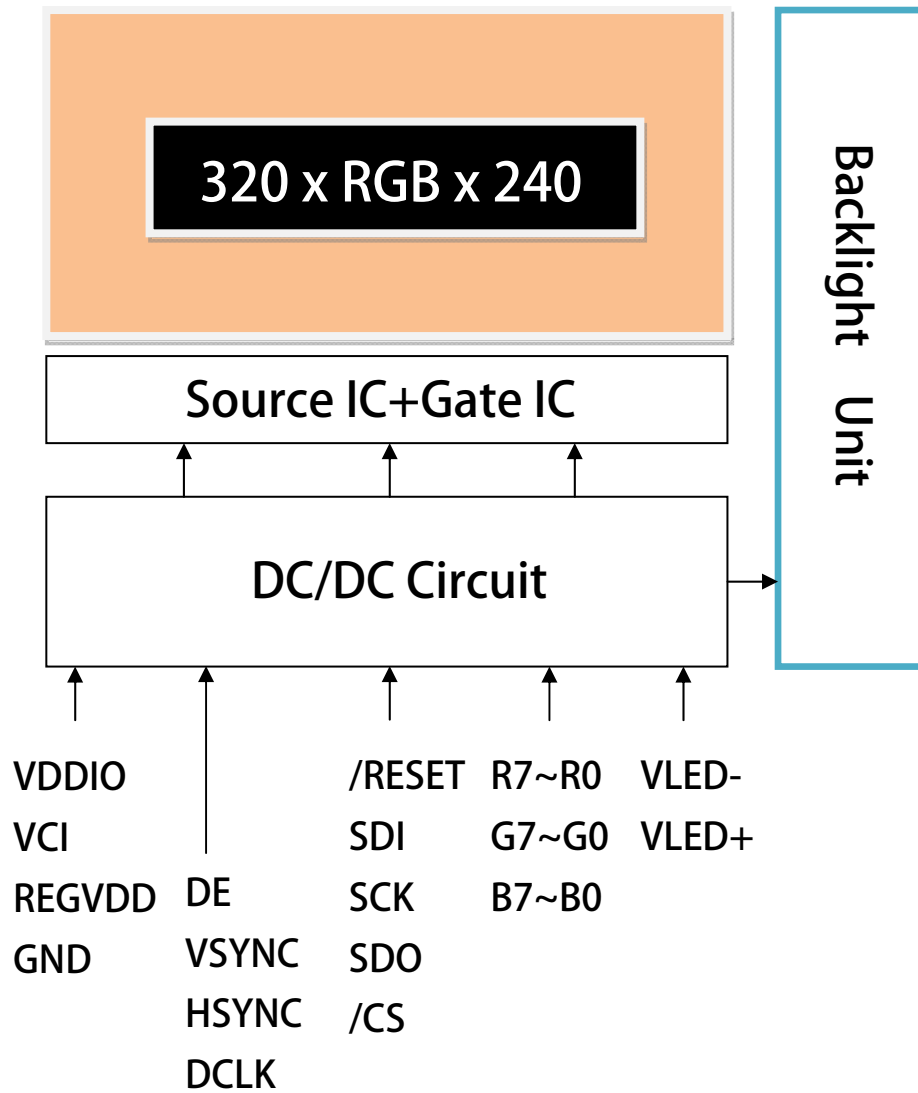
Item	Symbol	Values		Unit	Note
		Min.	Max.		
Power supply voltage	VDDIO	-0.3	4.0	V	
	VCI	-0.3	3.96	V	

4.1.2 Environment Absolute Rating

Item	Symbol	Values			Unit	Note
		Min.	Typ.	Max.		
Operating Temperature	Topa	-20		70	°C	Ambient temperature
Storage Temperature	Tstg	-30		80	°C	

5. BLOCK DIAGRAM

5.1 TFT LCD Module



6. Relationship Between Displayed Color and Input

6.1 8 bit

	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

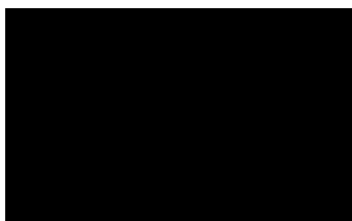
Each basic color can be displayed in 256 gray scales from 8 bit data signals. With the combination of total 24 bit data signals, the 16,777,216-color display can be achieved on the screen.

7. ELECTRICAL CHARACTERISTICS

7.1 TFT LCD Module

Item		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power supply voltage		VDDIO	2.5	3.3	3.6	V	
		VCI	2.5	3.3	3.6	V	
Input Voltage for logic	H Level	VIH	0.8xVDDIO	-	VDDIO	V	
	L Level	VIL	0	-	0.2xVDDIO	V	
Digital Current		IDD	-	(16)	(23)	mA	Note1

Note 1: frame =60Hz , Ta=25°C , Display pattern : Black pattern



7.2 Backlight Unit

Item	Symbol	Value			Unit	Condition
		Min.	Typ.	Max.		
LED Voltage	VL	(18)	(19.2)	(20.4)	V	
LED Current	If	-	(20)	-	mA	6S
Power Consumption	PBL	-	384	-	mW	
LED Life Time (25°C)	-	(20000)	-	-	hr	(1)

Note (1): The “LED life time” is defined as the module brightness decrease to 50% original brightness that the ambient temperature is 25°C 60% RH.

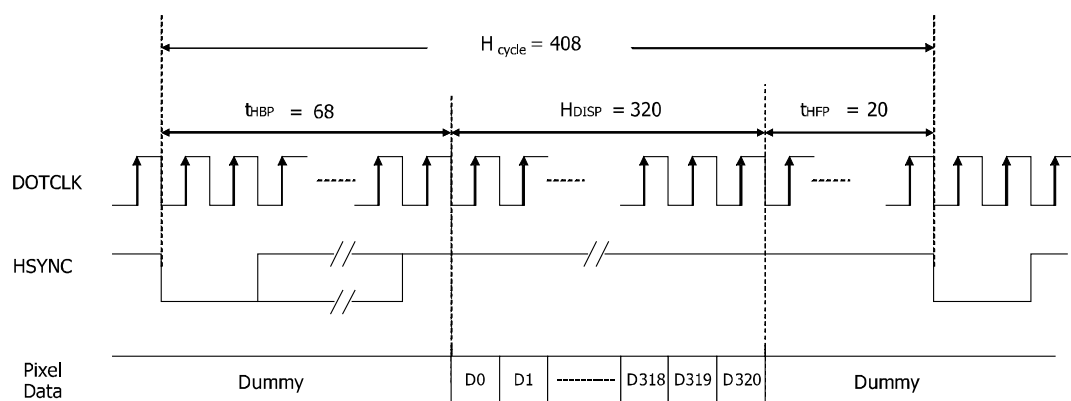


BACKLIGHT CIRCUIT

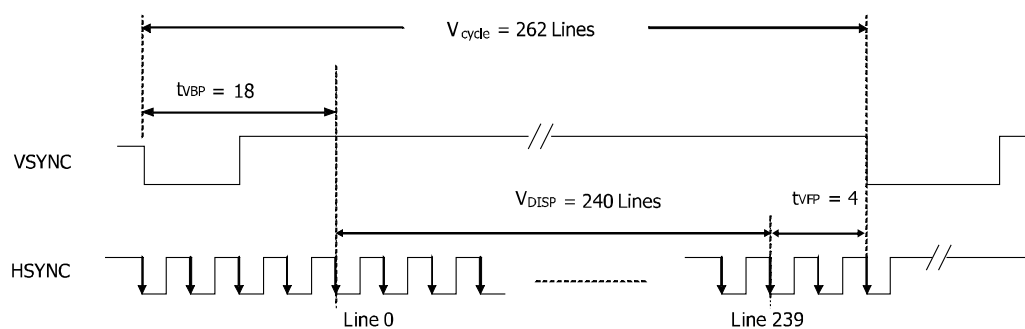
7.3 INTERFACE SPECIFICATIONS

7.3.1 Timing 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		



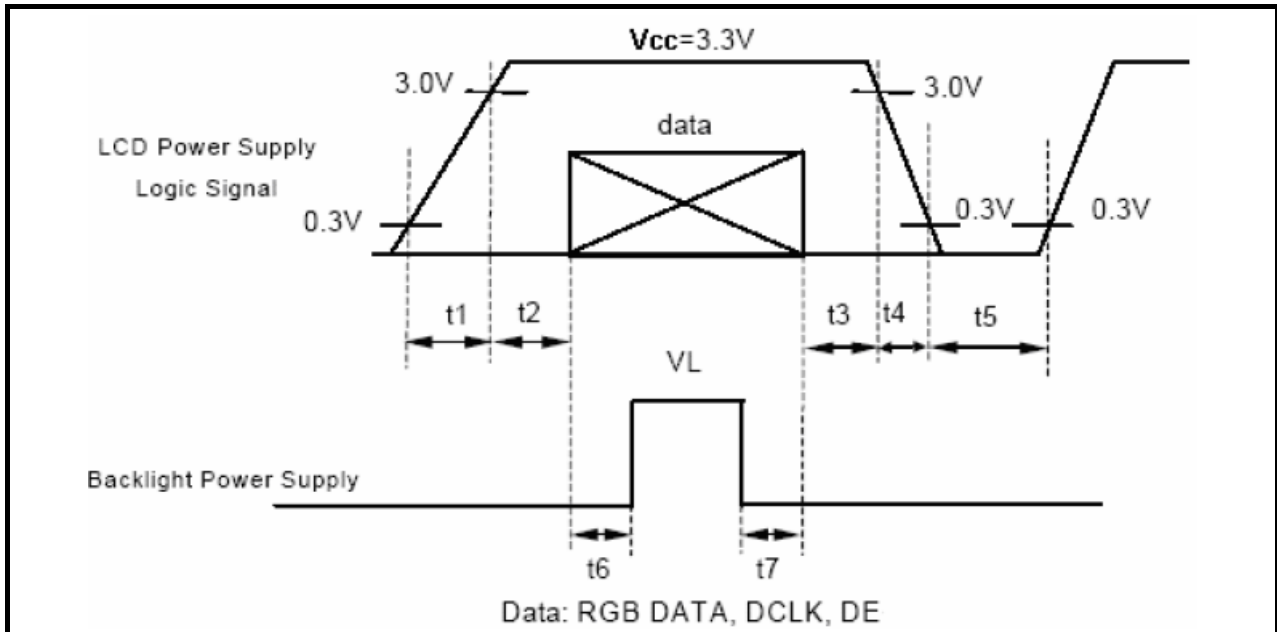
Horizontal Data Transaction Timing



Vertical Data Transaction Timing

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

7.4 Power On / Off Sequence



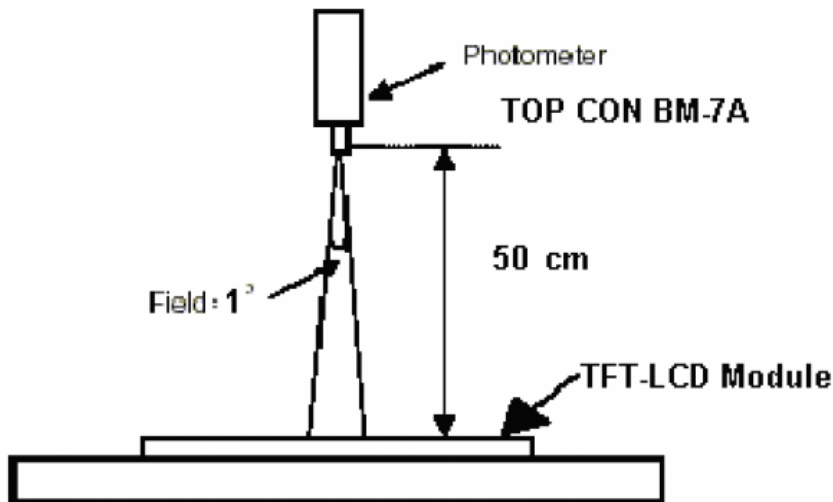
$t_1 \leq 10ms : 1 sec \leq t_5$
 $200ms \leq t_2 : 100ms \leq t_6$
 $0 < t_3 \leq 100ms : 100ms \leq t_7$
 $0 < t_4 \leq 10ms$

8. OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Brightness	--	Note1, Note 3, ($\theta = 0^\circ$; Normal Viewing Angle)	720	900	--	cd/m ²
Uniformity	B-uni		70	75	-	%
Contrast Ratio	CR		300	450	--	--
Response Time	Tr		--	15	20	ms
	Tf		--	35	50	ms
Color Chromaticity	White	Wx	0.260	0.310	0.360	--
		Wy	0.280	0.330	0.380	--
View angle	Horizontal	$\theta x+$	50	60	--	
		$\theta x-$	50	60	--	
	Vertical	$\theta Y+$	40	50	--	
		$\theta Y-$	50	60	--	
Image sticking	tis	2 hours	--	--	2	Sec

Note : The following optical specifications shall be measured in a darkroom or equivalent state (ambient luminance ≤ 1 lux, and at room temperature). The operation temperature is $25^\circ\text{C} \pm 2^\circ\text{C}$. The measurement method is shown in Note1.

Note1: The method of optical measurement:

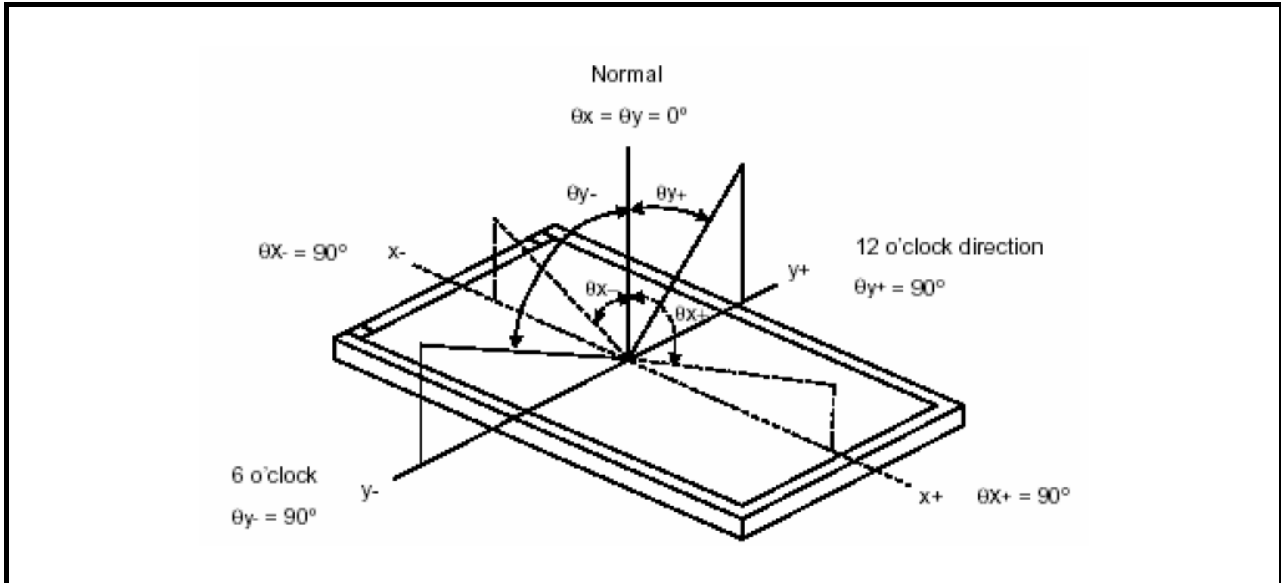


Note2: Measured at the center area of the panel and at the viewing angle of the $\theta x = \theta y = 0^\circ$

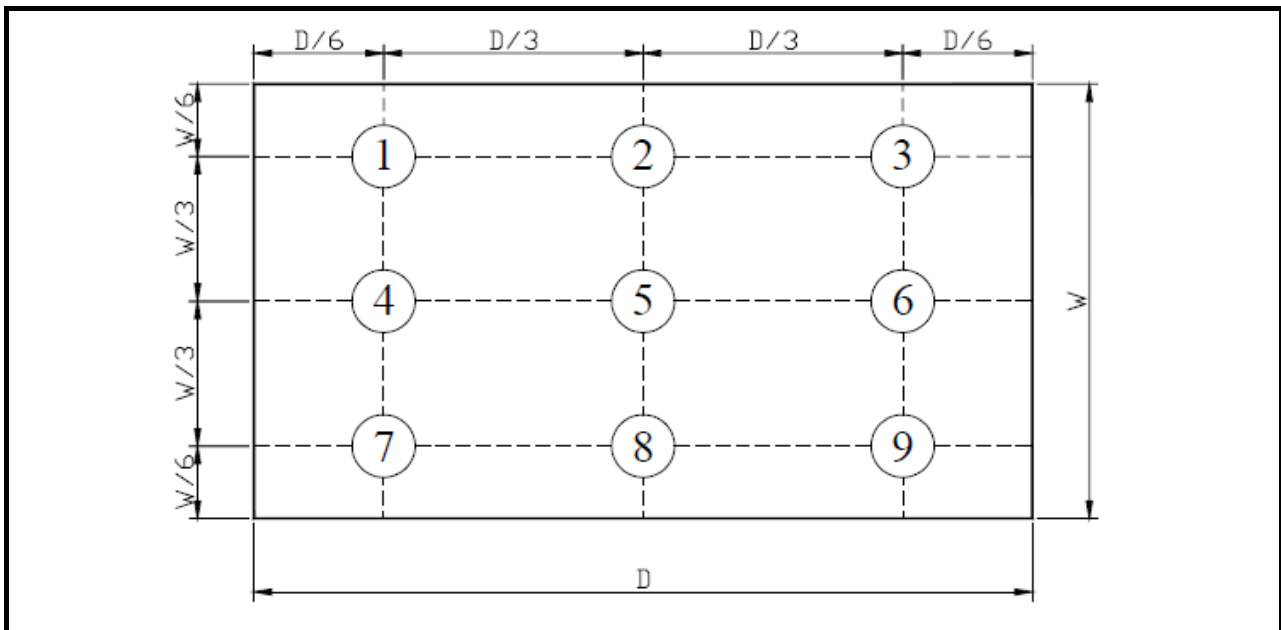
Note3: Definition of Contrast Ratio (CR):

CR = Luminance with all pixels in white state $\div$ Luminance with all pixels in Black state

Note4: Definition of Viewing Angle:



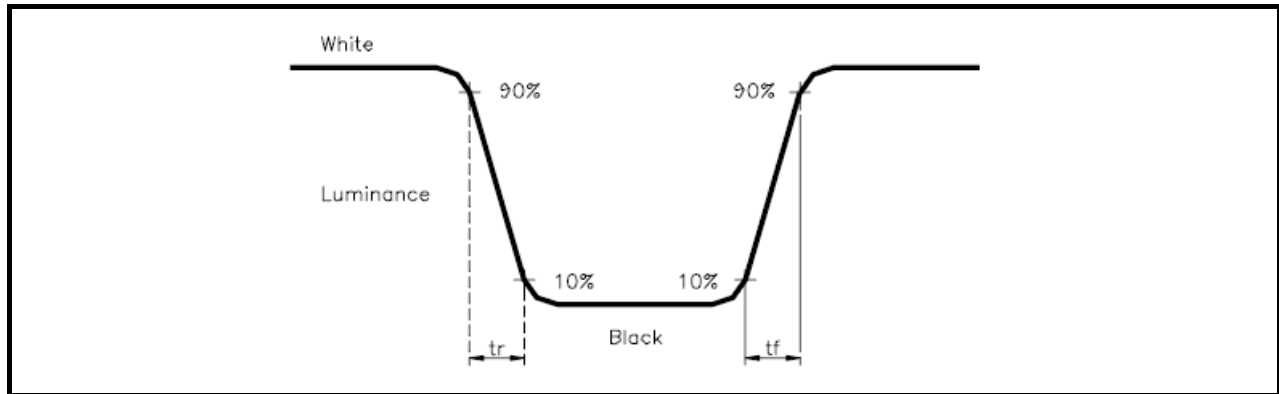
Note 5: Definition of Brightness Uniformity (B-uni):



B-uni = (Minimum luminance of 9 points ÷ Maximum luminance of 9 points) X 100%

Note 6: Definition of Response Time:

The Response Time is set initially by defining the “Rising Time (T_r)” and the “Falling Time (T_f)” respectively. T_r and T_f are defined as following figure



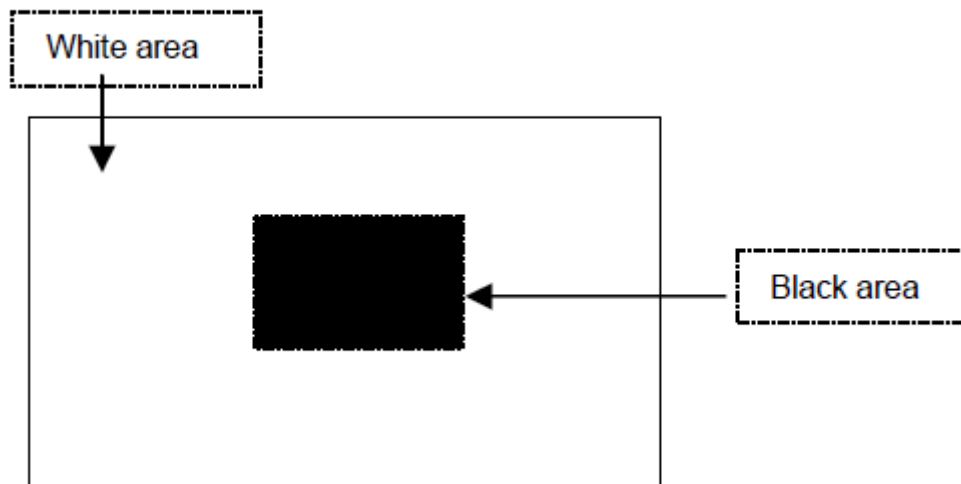
Note 7: Definition of Chromaticity:

The color coordinates (W_x, W_y), (R_x, R_y), (G_x, G_y), and (B_x, B_y) are obtained with all pixels in the viewing field at white, red, green, and blue states, respectively.

Note 8: Definition of Image sticking (tis):

Continuously display the test pattern shown in the figure below for 2 hours. Then display a completely white screen. The previous image shall not persist more than 2 sec at 25 °C

Image sticking pattern



9. RELIABILITY

9.1 Test Condition

9.1.1 Temperature and Humidity(Ambient Temperature)

Temperature : $25 \pm 5^{\circ}\text{C}$

Humidity : $65 \pm 5\%$

9.1.2 Operation

Unless specified otherwise, test will be conducted under function state.

9.1.3 Container

Unless specified otherwise, vibration test will be conducted to the product itself without putting it in a container.

9.1.4 Test Frequency

In case of related to deterioration such as shock test. It will be conducted only once.

9.2 TESTS

No.	ITEM	CONDITION CRITERION
1	High Temperature Storage	80°C, 120 hrs
2	Low Temperature Storage	-30°C, 120 hrs
3	High Temperature Operating	70°C, 120 hrs
4	Low Temperature Operating	-20°C, 120 hrs
5	High Temperature/Humidity Non-Operating	60°C, 90%RH, 120 hrs
6	Temperature Shock Non-Operating	-30°C $\longleftrightarrow$ 80°C (0.5hr each), 25 cycles
7	Vibration Test Non-Operating	Frequency:0 ~ 55 Hz Amplitude:1.5 mm Sweep Time:11min Test Period:6 Cycles for each Direction of X,Y,Z
8	Electro-static Discharge Non-Operating	150pF,330Ω Air:± 8KV;Contact: ±4KV 10 times/point;4 points/panel face

Note1: The test sample have recovery time for 24 hours at room temperature before the function check. In the standard conditions, there is no any touch panel function NG issue occurred.

9.3 JUDGMENT STANDARD

The judgment of the above test should be made as follow:

Pass: Normal display image with no obvious non-uniformity and no line defect. Partial transformation of the module parts should be ignored.

Fail: No display image, obvious non-uniformity, or line defects.

9.4 INCOMING INSPECTION STANDARDS

No.	Parameter	Criteria												
1	Operating	Display function: No Display malfunction (Major)												
		Contrast ratio (Black, White): Does not meet specified range in the spec. (Major) (Note:3)												
		Line Defect: No obvious Vertical and Horizontal line defect in bright, dark and colored. (Major) (Note:1)												
		Point Defect : Active area ≤ 5 dots (Minor) (Note:1)												
		<table><tr><th rowspan="2">Item</th><th>Acceptable number</th><th rowspan="2">Total</th></tr><tr><th>Active Area</th></tr><tr><td>Bright</td><td>2</td><td rowspan="2">5</td></tr><tr><td>Dark</td><td>4</td></tr></table>	Item	Acceptable number	Total	Active Area	Bright	2	5	Dark	4			
		Item		Acceptable number		Total								
			Active Area											
		Bright	2	5										
		Dark	4											
		Non-uniformity: Visible through 5%ND filter. (Minor)												
Foreign material in Black or White spots shape ($W>1/4L$)														
<table><tr><th>Zone Dimension</th><th>Acceptable number</th><th rowspan="4">Class Of Defects</th><th rowspan="4">AQL Level</th></tr><tr><td>D> 0.5</td><td>0</td></tr><tr><td>0.3 < D $\leq$ 0.5</td><td>5</td></tr><tr><td>D $\leq$ 0.3</td><td>*</td></tr></table>	Zone Dimension	Acceptable number	Class Of Defects	AQL Level	D> 0.5	0	0.3 < D $\leq$ 0.5	5	D $\leq$ 0.3	*				
Zone Dimension	Acceptable number	Class Of Defects			AQL Level									
D> 0.5	0													
0.3 < D $\leq$ 0.5	5													
D $\leq$ 0.3	*													
D = (Long + Short) / 2 *: Disregard														
Foreign Material in Line or spiral shape ($W\leq1/4L$) (Note: 4)														
<table><tr><th>L (mm) \ W(mm)</th><th>Zone</th><th>Acceptable number</th><th rowspan="4">Class Of Defects</th><th rowspan="4">AQL Level</th></tr><tr><td>L >5</td><td>W>0.1</td><td>0</td></tr><tr><td>0.5 < L $\leq$ 5</td><td>0.03 < W$\leq$0.1</td><td>5</td></tr><tr><td>L $\leq$0.5</td><td>W$\leq$0.03</td><td>*</td></tr></table>	L (mm) \ W(mm)	Zone	Acceptable number	Class Of Defects	AQL Level	L >5	W>0.1	0	0.5 < L $\leq$ 5	0.03 < W $\leq$ 0.1	5	L $\leq$ 0.5	W $\leq$ 0.03	*
L (mm) \ W(mm)	Zone	Acceptable number	Class Of Defects			AQL Level								
L >5	W>0.1	0												
0.5 < L $\leq$ 5	0.03 < W $\leq$ 0.1	5												
L $\leq$ 0.5	W $\leq$ 0.03	*												
L : Length W : Width *: Disregard														
2	External Inspection (non-operating)	Dimension: Outline (Major)												
		Bezel appearance: uneven (Minor)												
		Scratch on the polarize: (Note:2)												
		<table><tr><th>L (mm) \ W(mm)</th><th>Zone</th><th>Acceptable number</th><th rowspan="3">Class Of Defects</th><th rowspan="3">AQL Level</th></tr><tr><td>--</td><td>W>0.1</td><td>0</td></tr><tr><td>L $\leq$ 3</td><td>W$\leq$0.1</td><td>3</td></tr></table>	L (mm) \ W(mm)	Zone	Acceptable number	Class Of Defects	AQL Level	--	W>0.1	0	L $\leq$ 3	W $\leq$ 0.1	3	
		L (mm) \ W(mm)	Zone	Acceptable number	Class Of Defects			AQL Level						
		--	W>0.1	0										
		L $\leq$ 3	W $\leq$ 0.1	3										
		L : Length W : Width *: Disregard												
		Dent or bubble on the polarize (Note:2)												
		<table><tr><th>Zone Dimension</th><th>Acceptable number</th><th rowspan="3">Class Of Defects</th><th rowspan="3">AQL Level</th></tr><tr><td>D$\leq$0.3</td><td>*</td></tr><tr><td>D$\leq$0.5</td><td>3</td></tr></table>	Zone Dimension	Acceptable number	Class Of Defects	AQL Level	D $\leq$ 0.3	*	D $\leq$ 0.5	3				
Zone Dimension	Acceptable number	Class Of Defects	AQL Level											
D $\leq$ 0.3	*													
D $\leq$ 0.5	3													
D = (Long + Short) / 2 *: Disregard														

Class of defects	Major	AQL 0.65%	Definition
	Minor	AQL 1.5%	Definition
			It is a defect that is likely to result in failure or to reduce materially the usability of the product for the intended function.
			It is a defect that will not result in functioning problem with deviation classified.

Note1:

(a) Bright point defect is defined as point defect of R,G,B with area $>1/2$ pixel respectively

(b) Dark point defect is defined as visible in full white pattern.

(c) Definition of distribution of point defect is as follows:

- minimum separation between dark point defects should be larger than 5mm.
- minimum separation between bright point defects should be larger than 5mm.

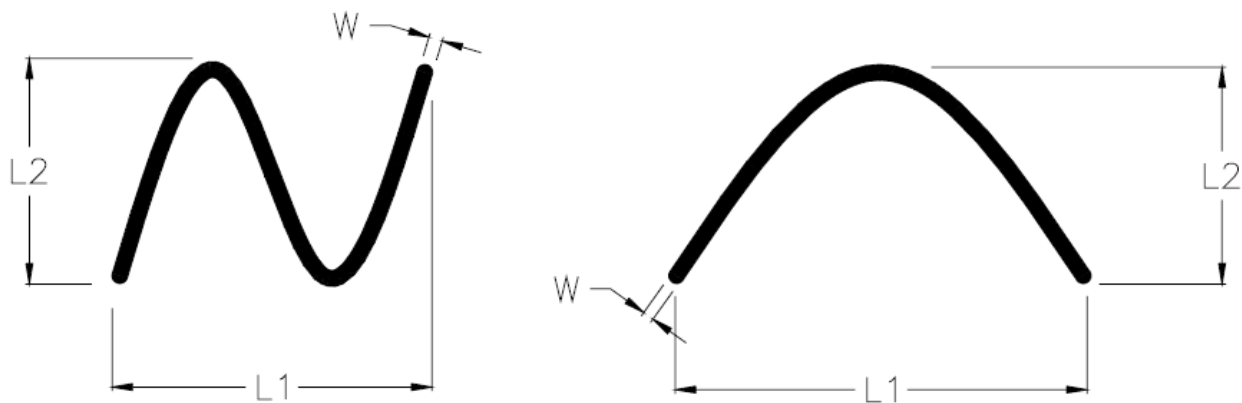
(d) Definition of joined bright point defect and joined dark point defect are as follows:

- Two or more joined bright point defects must be nil.
- Three joined dark point defects must be nil.
- Coupling of one dark and one bright point in junction is counted as one dark and bright spot with 1 pair maximum.
- Two Joined dark point is counted as two dark points with 2 pair maximum.

Note2: The external inspection should be conducted at the distance 30 ± 5 cm between the eyes of inspector and the panel.

Note3: Luminance measurement for contrast ratio is at the distance 50 ± 5 cm between the detective head and the panel with ambient luminance less than 1 lux. Contrast ratio is obtained at optimum view angle.

Note4: W-Width in mm , L-length of Max.(L1,L2) in mm.



9.5 Sampling Condition

Unless otherwise agree in written, the sampling inspection shall be applied to the incoming inspection of customer.

Lot size: Quantity of shipment lot per model.

Sampling type: normal inspection, single sampling

Sampling table: MIL-STD-105E

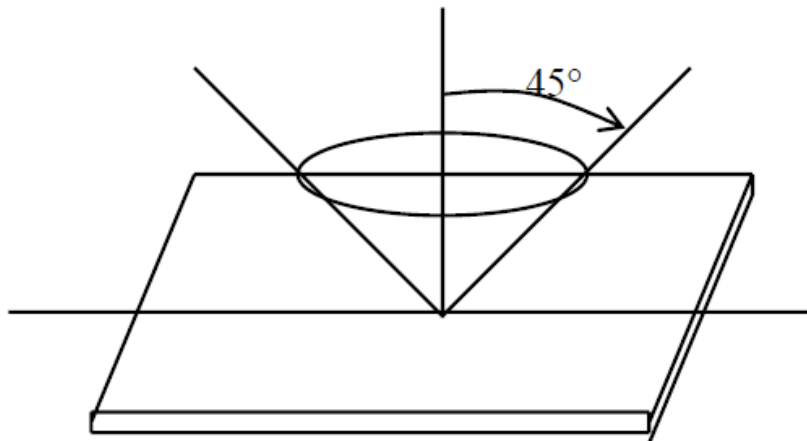
Inspection level: Level II

9.6 Inspection conditions

The LCD shall be inspected under 40W white fluorescent light.

$\theta \leq 45^\circ$ inspection under non-operating condition.

$\theta \leq 5^\circ$ inspection under operating condition



10. PRECAUTION RELATING PRODUCT HANDLING

10.1 SAFETY

10.1.1 If the LCD panel breaks , be careful not to get the liquid crystal to touch your skin.

10.1.2 If the liquid crystal touches your skin or clothes , please wash it off immediately by using soap and water.

10.2 HANDLING

10.2.1 Avoid any strong mechanical shock which can break the glass.

10.2.2 Avoid static electricity which can damage the CMOS LSI—When working with the module, be sure to ground your body and any electrical equipment you may be using.

10.2.3 Do not remove the panel or frame from the module.

10.2.4 The polarizing plate of the display is very fragile. So , please handle it very carefully, Do not touch, push or rub the exposed polarizing with anything harder than an HB pencil lead (glass , tweezers , etc.)

10.2.5 Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the surface of plate.

10.2.6 Do not touch the display area with bare hands , this will stain the display area.

10.2.7 Do not use ketonics solvent & aromatic solvent. Use with a soft cloth soaked with a cleaning naphtha solvent.

10.2.8 To control temperature and time of soldering is $280 \pm 10^{\circ}\text{C}$ and 3-5 sec.

10.2.9 To avoid liquid (include organic solvent) stained on LCM.

10.3 STORAGE

10.3.1 Store the panel or module in a dark place where the temperature is $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ and the humidity is below 65% RH.

10.3.2 Do not place the module near organics solvents or corrosive gases.

10.3.3 Do not crush, shake, or jolt the module.

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