

# LIQUID CRYSTAL DISPLAY MODULE

## Product Specification

<b>PRODUCT NUMBER</b>	<b>84-0208-000C</b>
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<b>PRODUCT DESCRIPTION</b>	<b>480x110 LCD MODULE, TRMNS, WHT B/L, MVA, 24 BIT RGB, RoHS IN PLASTIC CARRIER, GLASS COVER LENS</b>
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Document Control	Engineering

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**REVISION RECORD**

<b>Rev.</b>	<b>Date</b>	<b>Page</b>	<b>Par.</b>	<b>Comment</b>	<b>ECN No.</b>
A	01/06/15	--	--	New DCA Release	
B	3/10/15	4, 5		Update Mechanical Drawing (additions ONLY) Correct Diagonal Size	

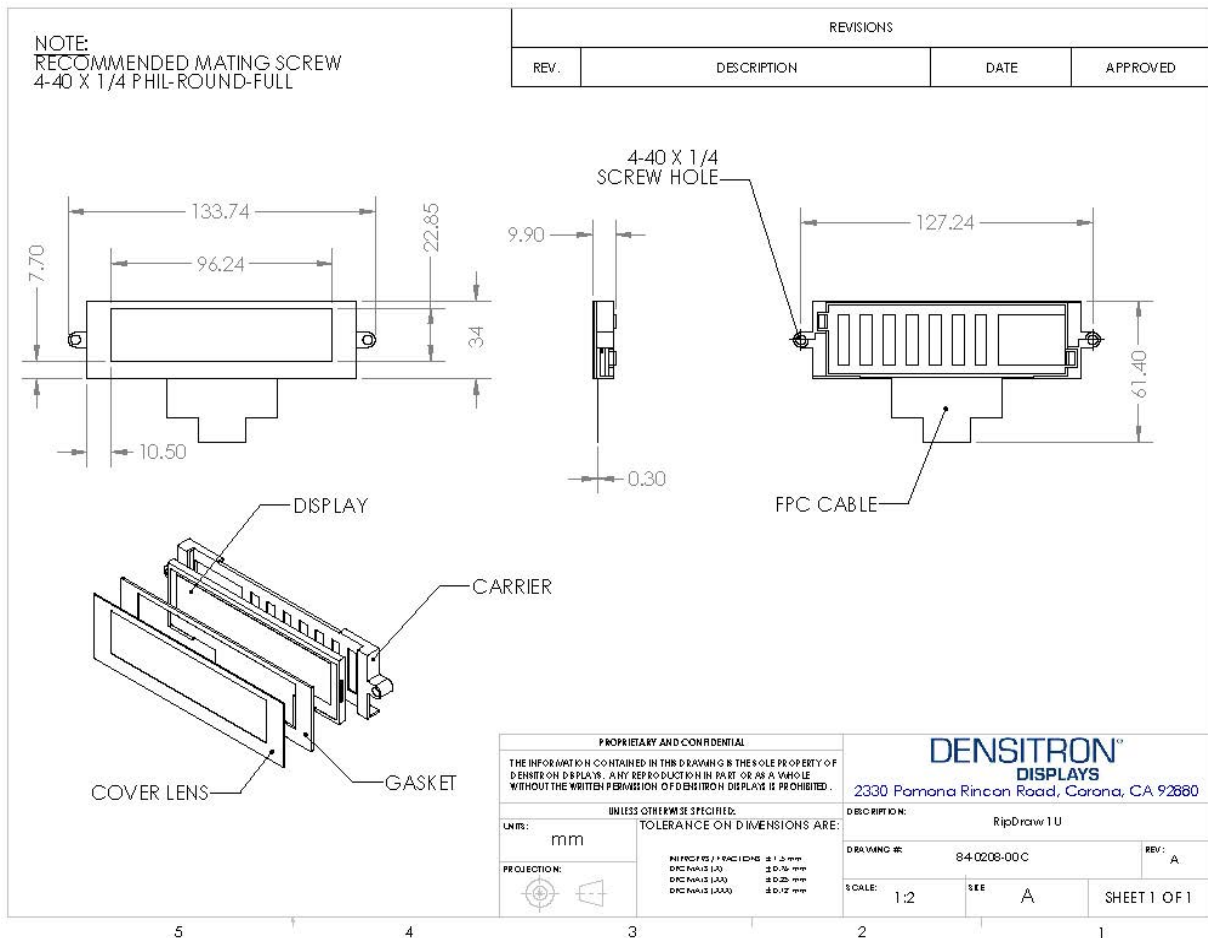
## 1 GENERAL SPECIFICATIONS

ITEM	DESCRIPTION	UNIT
Outline Dimension	133.74 (W) x 34.0 (H) x 9.90 (D) (Not including cable)	mm
Display Mode	Transmissive, Normally Black	-
LCD Surface Treatment	None	-
Screen Hardness	7	Mohs
Viewing Area	95.24 (W) X 21.85 (H)	mm
Viewing Angle	Full View Angle (VA)	O' Clock
Pixel Pitch	0.198 X 0.198	mm
Pixel Arrangement	RGB Stripe	-
Technology Type	a-Si color TFT, MVA	-
Size	3.85	inch
Resolution	480 RGB x 110 Min	pixels
Interface	24-bits RGB	-
Controller	OTA5180A-C3	
With/Without TSP	Without TSP	-
LED Numbers	10	-
RoHS Compliant	Yes	-

## 2 FEATURES

- The display module is a 1U rack mount supported TFT-LCD and can display 16 million collars.
- Glass Cover Lens, Black Mask

### 3 MECHANICAL DRAWING



### 4 ELECTRICAL CHARACTERISTICS

#### 4.1 Absolute Maximum Ratings

AGND = GND = 0V, Ta = 25°C

Item	Symbol	Min.	Max.	Unit	Remark
Power Voltage	V <sub>CC</sub>	-0.3	4.5	V	-
Backlight Forward Current	I <sub>LED</sub>	-	25	mA	for each LED
Operating Temperature	T <sub>OPR</sub>	-30	85	°C	-
Storage Temperature	T <sub>STG</sub>	-40	90	°C	-

The absolute maximum rating values of this product are not allowed to be exceeded at any time. Should a module be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme case, the module may be permanently destroyed.

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## 4.2 Recommended Operating Conditions

AGND = GND = 0V, Ta = 25°C

Item	Symbol	Min.	Typ.	Max.	Unit
Power Voltage	V <sub>CC</sub>	3.0	3.3	3.6	V
Input Logic High Voltage	V <sub>IH</sub>	0.7V <sub>CC</sub>	-	V <sub>CC</sub>	V
Input Logic Low Voltage	V <sub>IL</sub>	0	-	0.3V <sub>CC</sub>	V

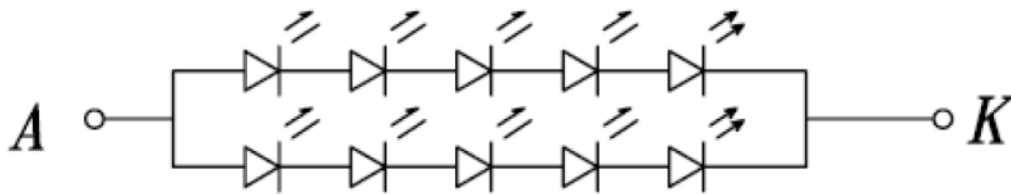
## 4.3 Recommended Driving Condition for Backlight

Ta = 25°C

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Voltage	V <sub>F</sub>	14	16	18	V	1
Forward Current	I <sub>F</sub>	-	40	-	mA	
Luminous Intensity	L <sub>V</sub>	8,000	-	-	cd/m <sup>2</sup>	
Chromaticity Coordinate	X	X=0.26	-	X=0.32	-	
	Y	Y=0.26	-	Y=0.32	-	
Operating Life Time	-	20,000			hours	2

### Notes:

- The LED supply voltage is defined by the number of LED at Ta=25°C and I<sub>F</sub> = 40mA.
- The “Operating Life Time” is defined as the module brightness decrease to 50% original brightness at Ta=25°C and I<sub>F</sub> = 40mA. The LED lifetime could be decreased if operating I<sub>F</sub> is larger than 40 mA.



## 4.4 Interface Pin Assignment

Pin No	Symbol	I/O	Description	Note
1-2	GND	P	Ground	
3-4	VCC	P	Logic regulator power supply	
5-12	R0-R7	I	Data Bit	
13-20	G0-G7	I	Data Bit	
21-28	B0-B7	I	Data Bit	
29	GND	P	Ground	

30	DOTCLK	I	Clock signal for data latching and internal counter of the timing controller.	
31	DISPLAY		Display on/off mode control.	
32	HSYNC	I	Horizontal sync input with negative polarity.	
33	VSYNC	I	Vertical sync input with negative polarity.	
34	SCL	I	Serial communication clock input.	1
35	SDA	I/O	Serial communication data input and output.	
36	CS	I	Serial Communication chip select	
37-38	NC	-	No connection	
39	K	P	LED backlight cathode	
40	A	P	LED backlight anode	

**Notes:**

1. If this pin does not connect with SPI, please connect to NC

## 5 TIMING CHARACTERISTICS

### 5.1 AC Electrical Characteristics

Item	Symbol	Min.	Typ.	Max.	Unit	Conditions
CLK pulse duty	Tcw	40	50	60	%	
Hsync width	Thw	1.0	-	-	DCLK	
Hsync period	Th	55	60	65	us	
Vsync setup time	Tvst	12	-	-	ns	
Vsync hold time	Tvhd	12	-	-	ns	
Hsync setup time	Thst	12	-	-	ns	
Hsync hold time	Thhd	12	-	-	ns	
Data set-up time	Tdsu	12	-	-	ns	
Data hold time	Tdhd	12	-	-	ns	
DE set-up time	Tdesu	12	-	-	ns	
DE hold time	Tdehd	12	-	-	ns	
SD output stable time	Tst	-	10	12	us	
GD output rise and fall time	Tgst	-	500	1000	ns	
<b>Serial communication</b>						
Delay between CSB and Vsync	Tcv	1			us	
CS input setup time	Ts0	50			ns	
Serial data input setup time	Ts1	50			ns	
CS input hold time	Th0	50			ns	
Serial data input hold time	Th1	50			ns	
SCL pulse high width	Twh1	50			ns	
SCL pulse low width	Twl1	50			ns	
CS pulse high width	Tw2	400			ns	

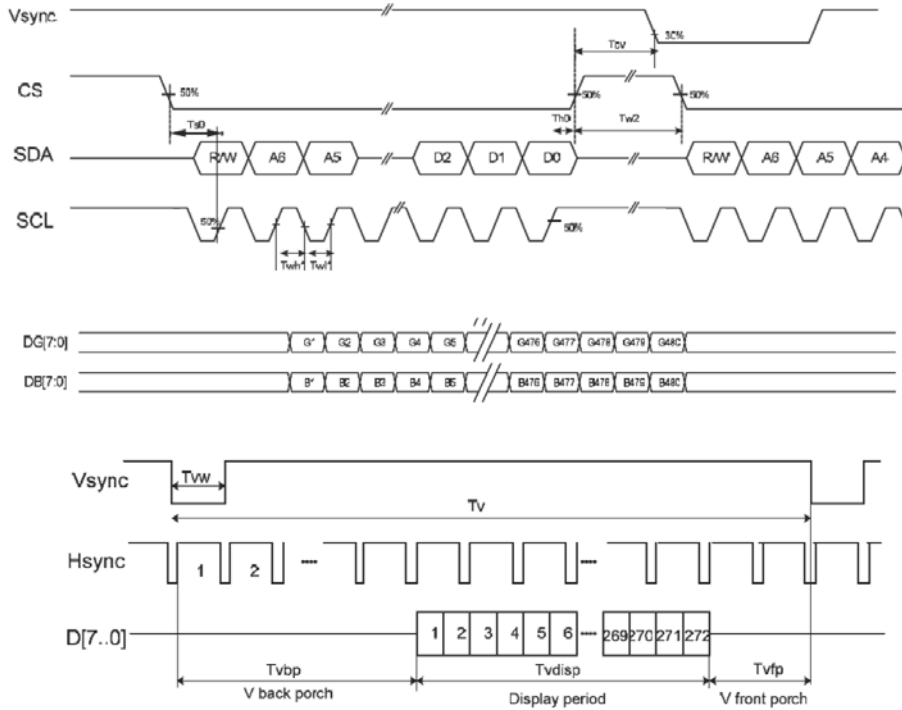
### 5.2 DC Electrical Characteristics

#### DC Characteristics for Digital Circuit

Item	Symbol	Min.	Typ.	Max.	Unit	Conditions
Low Level Input Voltage	Vil	GND	-	0.3xVDDIO	V	
High Level Input Voltage	Vih	0.7xVDDIO	-	VDDIO	uA	
High Level Output Voltage	Voh	VDDIO-0.4	-	VDDIO	ohm	
Low Level Output Voltage	Vol	GND	-	GND+0.4	uA	
Input Leakage Current	Iil			±1.0		
Pull High/Low Resistor	Rp	-	100K	-	ohm	
Digital Stand-by Current	Ist		5.0	20	uA	DCLK stopped, Output Hi-Z
Digital Operating Current	Icc	-	4	-	mA	DCLK = 9MHz



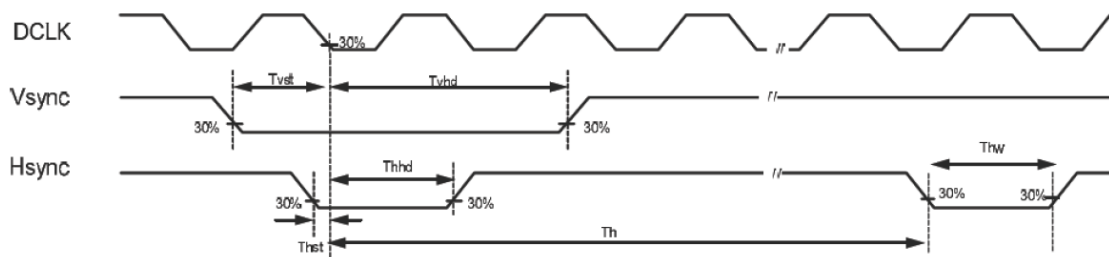
### 5.3 Timing



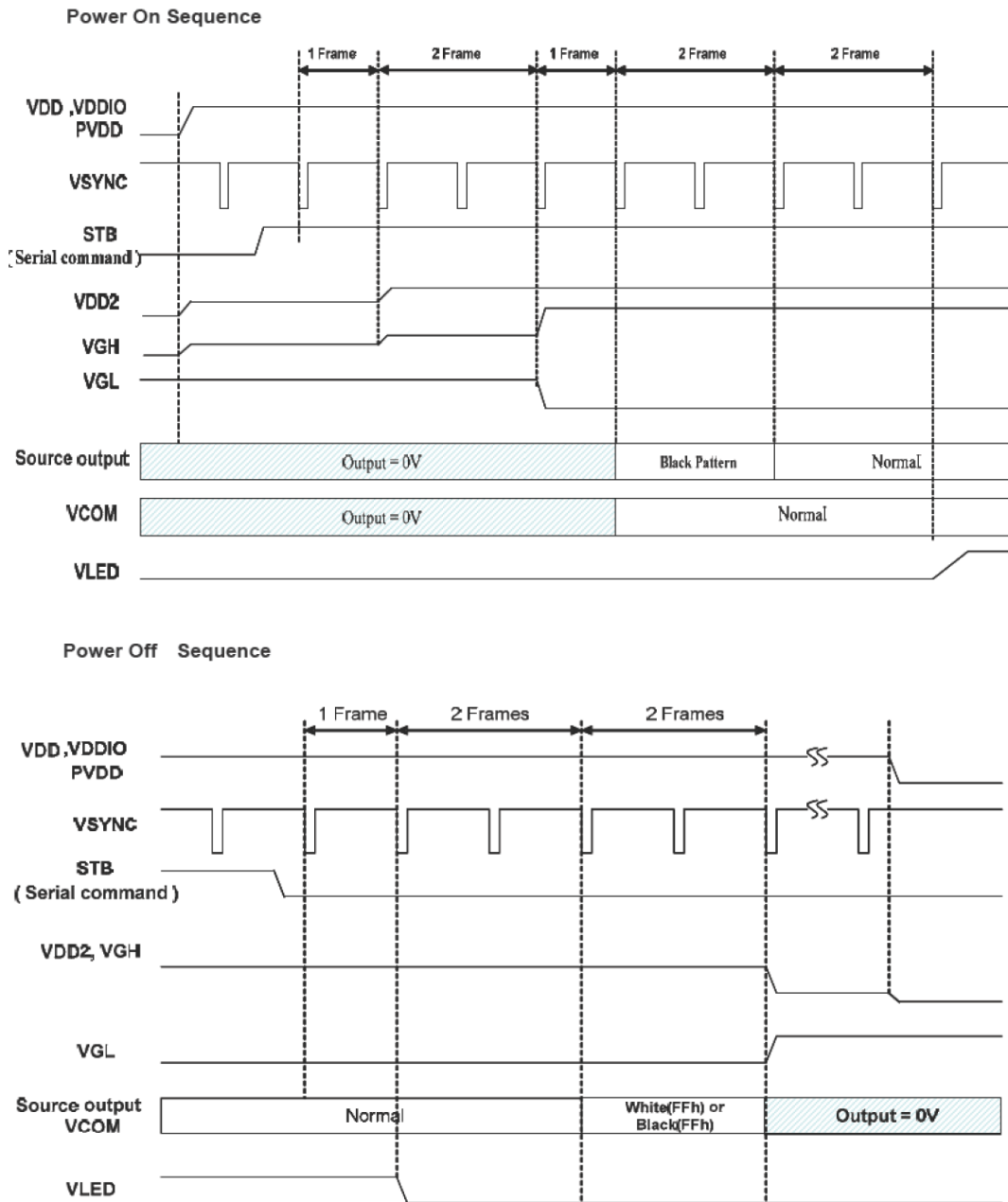
### 5.4 Data Input Format

Item	Symbol	Min.	Typ.	Max.	Unit		
DCLK Frequency	Fclk	5	9	12	MHz		
DCLK Period	Tclk	83	110	200	ns		
Hsync	Period Time	Th	490	531	605	DCLK	
	Display Period	Thdisp		480		DCLK	
	Back Porch	Thbp	8	43		DCLK	By H_BLANKING setting
	Front Porch	Thfp	2	8		DCLK	
	Pulse Width	Thw	1			DCLK	
Vsync	Period Time	Tv	275	288	335	H	
	Display Period	Tvdisp		272		H	
	Back Porch	Tvbp	2	12		H	By V_BLANKING setting
	Front Porch	Tvfp	1	4		H	
	Pulse Width	Tvw	1	10		H	

### 5.5 Input Clock and Data Timing Diagram



## 5.6 Power ON/OFF Sequence



### Notes:

- When normally-black LC is used, please send black pattern to discharge panel.
- When normally-white LC is used, please send white pattern to discharge panel.

## 6 OPTICAL CHARACTERISTICS

Ta = 25°C

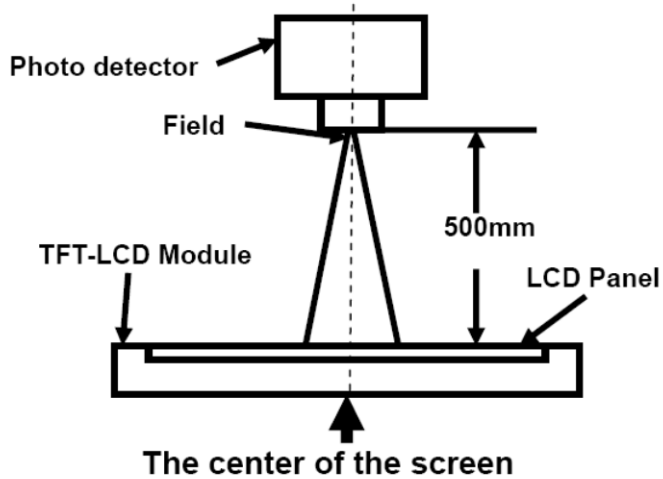
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Viewing Angle	$\theta T$	CR $\geq$ 10	-	70		deg	2
	$\theta B$		-	70	-	deg	
	$\theta L$		-	70	-	deg	
	$\theta R$		-	70	-	deg	
Contrast Ratio	CR	$\theta = 0^\circ$	-	500	-	-	1, 3
Response Time	T <sub>ON</sub> + T <sub>OFF</sub>	Ta = 25°C	-	35	-	ms	1, 4
Chromaticity	W <sub>x</sub>	x	-	0.117	0.137	0.157	1, 5
	W <sub>y</sub>	y	-	0.113	0.133	0.153	
Uniformity	U	-	80	-	-	%	5
Luminance	L	-	420	-	-	cd/m <sup>2</sup>	1, 5

### Test Conditions:

1. I<sub>F</sub> = 40 mA (Backlight current), VCC = 3.3 V, the ambient temperature is 25°C.
2. The test systems refer to Note 2.

Note 1: Definition of optical measurement system.

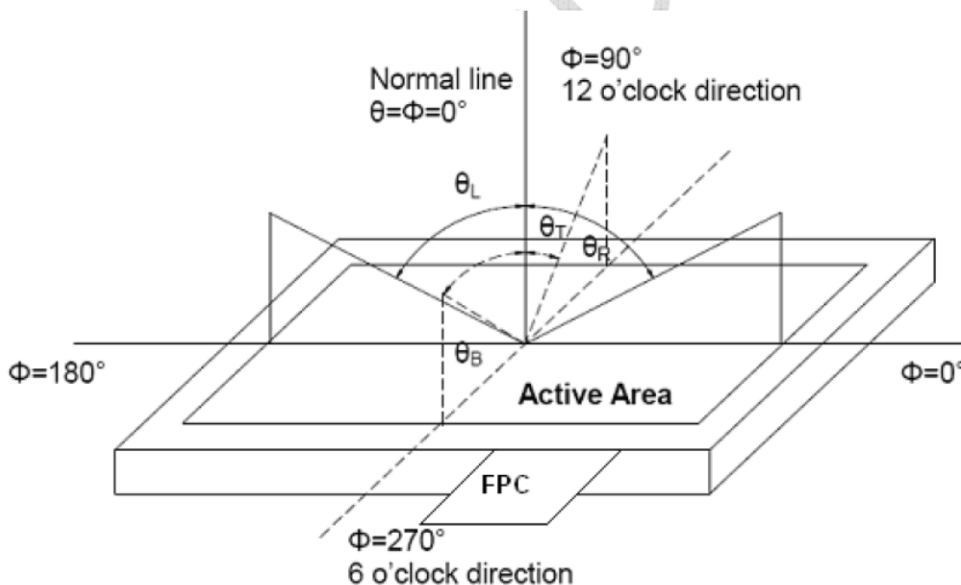
The optical characteristics should be measured in dark room. After 5 Minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



Item	Photo detector	Field
Contrast Ratio	BM-5A	1°
Luminance		
Lum Uniformity	SR-3A	
Chromaticity		
Response Time	TRD100	-

Note 2: Definition of viewing angle range and measurement system.

viewing angle is measured at the center point of the LCD by CONOSCOPE(ergo-80).



Note 3: Definition of contrast ratio

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD is on the "White" state}}{\text{Luminance measured when LCD is on the "Black" state}}$$

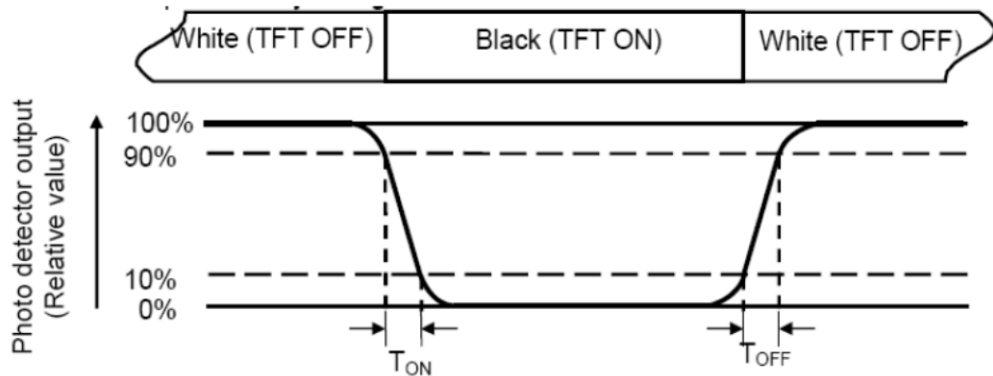
"White state": The state is that the LCD should drive by  $V_{white}$ .

"Black state": The state is that the LCD should drive by  $V_{black}$ .

$V_{white}$ : To be determined     $V_{black}$ : To be determined.

Note 4: Definition of Response time

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time ( $T_{ON}$ ) is the time between photo detector output intensity changed from 90% to 10%. And fall time ( $T_{OFF}$ ) is the time between photo detector output intensity changed from 10% to 90%.



Note 5: Definition of color chromaticity (CIE1931)

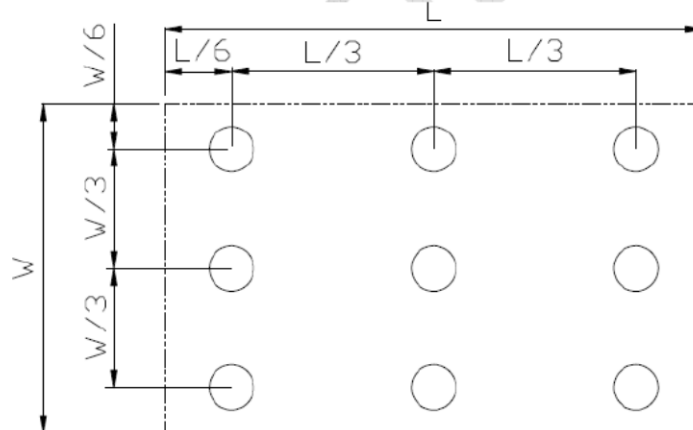
Color coordinates measured at center point of LCD.

Note 6: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

$$\text{Luminance Uniformity (U)} = L_{\min} / L_{\max}$$

L-----Active area length W----- Active area width



$L_{\max}$ : The measured Maximum luminance of all measurement position.

$L_{\min}$ : The measured Minimum luminance of all measurement position.

Note 7: Definition of Luminance:

Measure the luminance of white state at center point.

## 7 RELIABILITY TEST

No.	Test Item	Test Condition	Inspection after Test
1	High Temperature Storage	90 ± 2°C / 240 hours	Inspection after 2~4hours storage at room temperature, the sample shall be free from these defects: 1. Air bubble in the LCD 2. Seal leak 3. Non-display 4. Missing segments 5. Glass crack 6. Current IDD is twice as high as the initial value.
2	Low Temperature Storage	-40 ± 2°C / 240 hours	
3	High Temperature Operating	85 ± 2°C / 240 hours	
4	Low Temperature Operating	-30 ± 2°C / 240 hours	
5	Temperature Cycle	-40°C~25°C~ 85°C X 10cycles (60min) (5min) (60min)	
6	Damp Proof Test	60°C ± 5°C X 90%RH / 240hours	
7	Vibration Test	Frequency: 10Hz ~ 55Hz ~ 10Hz Amplitude: 1.5mm, X, Y, Z direction for total	
8	Drop Test	Drop from 1m height, once, each side of carton. (Packing condition)	
9	ESD Test	Voltage: ±6KV R: 330. C: 150pF Air discharge, 10times	

**Remark:**

1. The test samples should be applied to only one test item.
2. Sample size for each test item is 5~10pcs.
3. For Damp Proof Test, Pure water (Resistance > 10MΩ) should be used.
4. In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judge as a good part.
5. EL evaluation should be accepted from reliability test with humidity and temperature: Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence EL has.
6. Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.
7. Please use automatic switch menu (or roll menu) testing mode when test operating mode.

## 8 QUALITY ASSURANCE

### 8.1 Conformity

1. Test must be performed under 40W fluorescent light and the distance of view must be at  $30 \pm 10$  cm.
2. Room temperature:  $25 \pm 5^{\circ}\text{C}$   
Humidity:  $(60 \pm 10) \% \text{RH}$

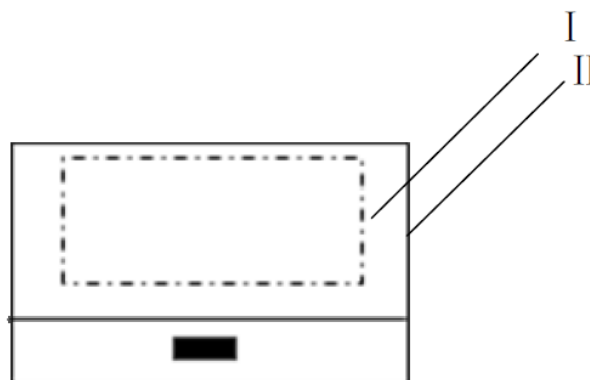
### 8.2 Quality Specification

Quality specification shall be based on GB2828-87, inspection level II.

	Item	Check Level	AQL
Major	1. Liquid crystal leakage 2. Wrong polarizer 3. Outside dimension 4. Bright dot, Dark dot 5. Display abnormal 6. Glass crack	II	0.25
Minor	1. Spot Defect (Including black spot, white spot, pinhole, foreign particle, bubbles, damage ) 2. Fragment 3. Line Defect (Including black line, white line, scratch) 4. Incision defect 5. Newton's ring 6. Other visual defects	II	1.0


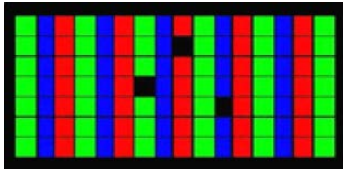
### 8.3 Zone Definition

- I Area: Viewing Area  
II Area: Outside Viewing Area



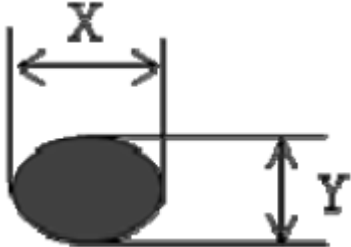
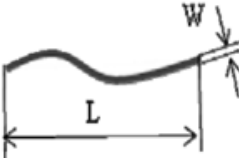
## 8.4 Inspection Criteria

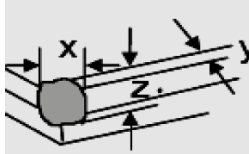
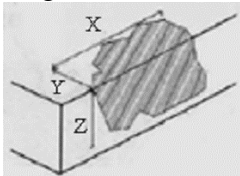
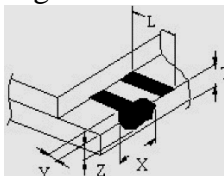
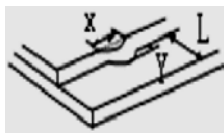

### 8.4.1 Bright / Dark Dots Definition

Name	Explanation	Definition
Bright Dot	Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern  	The definition of dot: The size of a defective dot over 1/2 of single pixel dot is regarded as one defective dot.  Note: One pixel consists of 3 sub-pixels, including R, G, and B dot. (Sub-pixel = Dot)
Dark Dot	Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue pattern.  	
Adjacent Dot	Adjacent two sub-pixel are defect (define two dot defect)	



8.4.2 Inspection Standard

No.	Items	Criterion		Check Procedure	Defect Class
1	Bright / Dark Dot	Under 6" (Contain 6")	Bright dot: no Dark dot : $N \leq 3$ Note: be more than 5mm apart	Visual Examination	Major
		6" – 12"	Bright dot : $N \leq 4$ Dark dot : $N \leq 5$ Total Bright and Dark Dots : $N \leq 8$ Note: 1. Two bright dot defects (red, green, blue, and white) should be larger than 15mm ; 2. The distance between black dot defects or black and bright dot defects should be more than 5mm apart.		
2	Spot Defect (Including black spot, white spot, Pinhole, foreign particle, bubbles, damage)  $D = (X + Y) / 2$	Under 6" (Contain 6")	$D \leq 0.1$ Ignore $0.1 < D \leq 0.35$ $N \leq 3$ $0.35 < D$ $N = 0$	Visual Examination	Minor
		6" – 12"	$D \leq 0.3$ Ignore $0.3 < D \leq 0.6$ $N \leq 4$ $0.6 < D$ $N = 0$		
3	Line Defect (Including black line, white line, scratch) 	Under 6" (Contain 6")	$W \leq 0.02$ Ignore $0.02 < W \leq 0.04$ $L \leq 5$ $N \leq 2$ $0.04 < W \leq 0.06$ $L \leq 5$ $N \leq 1$ $W > 0.06$ $N = 0$	Visual Examination	Minor
		6" – 12"	$W \leq 0.07$ Ignore $0.07 < W \leq 0.1$ $L \leq 10$ $N \leq 4$ $W > 0.1$ $N = 0$		

No.	Item	Criterion	Check Procedure	Defect Class
4	Display Abnormal	Not allowed	Visual Examination	Major
5	Outside Dimension	According to drawing	Visual Examination	Major
6	Glass crack	Not allowed	Visual Examination	Major
7	Leak	Not allowed	Visual Examination	Major
8	Corner Fragment 	$X \leq 3$ $Y \leq 3$ $Z \leq T$ Ignore Note: 1. No hurt identifying wire, seal 2. T: Glass thickness X: Length Y: Width Z: thickness	Visual Examination	Minor
	Side Fragment 	$Y \leq 1$ $Z \leq T$ Ignore Note: 1. No hurt identifying wire, seal 2. T: Glass thickness X: Length Y: Width Z: thickness	Visual Examination	Minor
9	Step Fragment 	$Y \leq 1$ and $Y \leq 1/4 L$	Visual Examination	Minor
	Incision Defect 	$Y \leq 1$ and accord with outside dimension	Visual Examination	Minor
10	Newton's ring (CTP or Cover board)  $D=(X+Y)/2$	Under 6" (Contain 6")  6" - 12"	$W \leq 0.02$ Ignore $0.02 < W \leq 0.04$ $L \leq 5$ $N \leq 2$ $0.04 < W \leq 0.06$ $L \leq 5$ $N \leq 1$ $W > 0.06$ $N = 0$  $W \leq 0.07$ Ignore $0.07 < W \leq 0.1$ $L \leq 10$ $N \leq 4$ $W > 0.1$ $N = 0$	Visual Examination  Minor

## 9 HANDLING PRECAUTIONS

### *Safety*

If the LCD panel breaks, be careful not to get the liquid crystal fluid in your mouth or in your eyes. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

### *Mounting and Design*

Place a transparent plate (e.g. acrylic, polycarbonate or glass) on the display surface to protect the display from external pressure. Leave a small gap between the transparent plate and the display surface. When assembling with a zebra connector, clean the surface of the pads with alcohol and keep the surrounding air very clean. Design the system so that no input signal is given unless the power supply voltage is applied.

### *Caution during LCD cleaning*

Lightly wipe the display surface with a soft cloth soaked with Isopropyl alcohol, Ethyl alcohol or Trichlorotrifluoroethane. Do not wipe the display surface with dry or hard materials that will damage the polarizer surface. Do not use aromatic solvents (toluene and xylene), or ketonic solvents (ketone and acetone).

### *Caution against Static Charge*

As the display uses C-MOS LSI drivers, connect any unused input terminal to VDD or VSS. Do not input any signals before power is turned on. Also, ground your body, work/assembly table and assembly equipment to protect against static electricity.

### *Packaging*

Displays use LCD elements, and must be treated as such. Avoid strong shock and drop from a height. To prevent displays from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.

### *Caution during operation*

It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life. Direct current causes an electrochemical reaction with remarkable deterioration of the display quality. Give careful consideration to prevent direct current during ON/OFF timing and during operation. Response time is extremely delayed at temperatures lower than the operating temperature range while, at high temperatures, displays become dark. However, this phenomenon is reversible and does not mean a malfunction or a display that has been permanently damaged. If the display area is pushed on hard during operation, some graphics will be abnormally displayed but returns to a normal condition after turning off the display once. Even a small amount of condensation on the contact pads (terminals) can cause an electro-chemical reaction which causes missing rows and columns. Give careful attention to avoid condensation.

### *Storage*

Store the display in a dark place where the temperature is  $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$  and the humidity below 50%RH. Store the display in a clean environment, free from dust, organic solvents and corrosive gases. Do not crash, shake or jolt the display (including accessories).

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