DMT150XGHLNT0-1A

PRODUCT SPECIFICATION

Version 1.4
Nov 17, 2022

Customer's Approval	
Signature	*Date*

Prepared by *Victoria Ho*
Approved by *Evan Huang*

Revision History

VERSION	DATE	DESCRIPTION	AUTHOR
1.0	Sep 03, 2021	Revised Storage temperature Page.25 Added packaging method	Chi Huang
1.1	Nov 09, 2021	Add conductive foam to FOG's PCB" p.11 Update 3.2.2 Backlight P.12 Update 3.3 Interface Pin Assignment P.25 Update 6. Quality Assurance Specification P.31~32 Update 7. 7. Reliability Specification	Chi Huang
1.2	Dec 08, 2021	p.5 Added Side screw torque and material type of metal p.6~7 updated the drawing p.11 Added note3 p.12 Added plating of connector contact in note1 p.15 updated the table of data signal	Chi Huang
1.3	Nov 11, 2022	p.26 modify the definition of 2 adjacent bright dots	Victoria Ho
1.4	Nov 17, 2022	Modify dot==>sub pixel	Victoria Ho

Legal Notice

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1. General Description

1.1 Introduction

This is a 15.0” size colour active matrix TFT LCD module that uses amorphous silicon TFT as a switching device. The display is normally black mode and featuring high contrast and excellent colour saturation. The resolution of the TFT-LCD is 1024 x 768 and can display up to 16.7M/262K colours. The display module supports LVDS interface.

1.2 Main Features

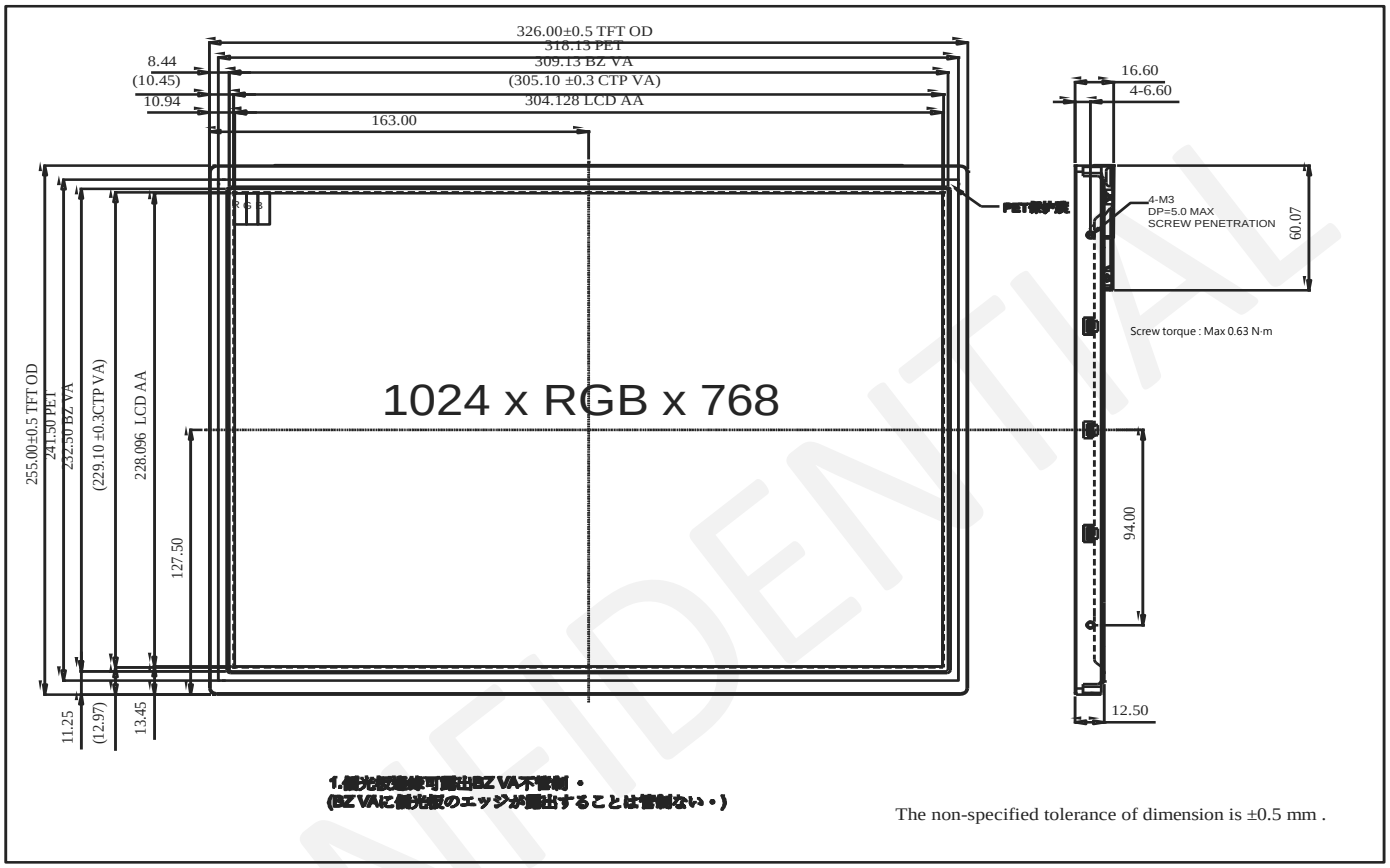
Item	Contents
Display Type	TFT LCD
Screen Size	15.0” Diagonal
Display Format	1024 x RGB x 768 Pixels
No. of Colour	16.7M/262K
Overall Dimensions	326.0(W) x 255.0 (H) x 16.6 (D) mm
Active Area	304.128 (W) x 228.096(H) mm
Mode	Normally Black / VA
Surface Treatment	Hard Coating (3H), Anti-Glare
Viewing Direction	All round
Interface	6/8-bit LVDS
Backlight Type	LED
Operating Temperature	-20°C ~ +70°C
Storage Temperature	-20°C ~ +80°C
ROHS	Compliant to RoHS 2.0

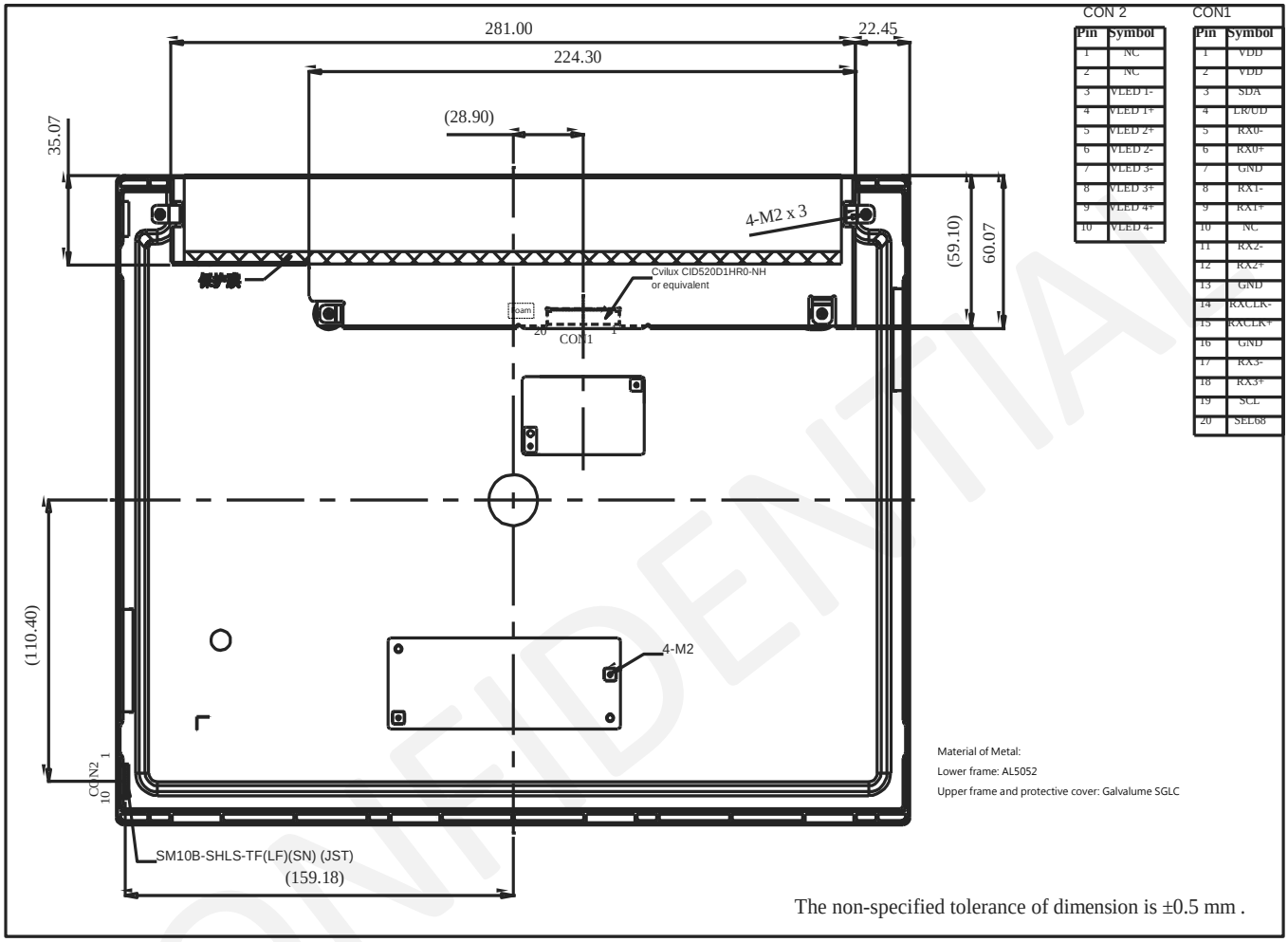
2. Mechanical Specification

2.1 Mechanical Characteristics

Item	Characteristic	Unit
Display Format	1024 x RGB x 768	Pixels
Overall Dimensions	326.0(W) x 255.0 (H) x 16.6 (D)	mm
Active Area	304.128 (W) x 228.096(H)	mm
Pixel Pitch	0.297 (W) x 0.297 (H)	mm
Weight	970	g
Side screw torque	Max 0.63 N・m (This is a reference value, does not provide screws.)	
Material of Lower frame	AL5052	
Material of Upper frame	Galvalume SGLC	
Material of protective cover	Galvalume SGLC	

2.2 Mechanical Drawing





CON 2

Pin	Symbol
1	NC
2	NC
3	VLED 1-
4	VLED 1+
5	VLED 2+
6	VLED 2-
7	VLED 3-
8	VLED 3+
9	VLED 4+
10	VLED 4-

CON1

Pin	Symbol
1	VDD
2	VDD
3	SDA
4	LR/UD
5	RX0-
6	RX0+
7	GND
8	RX1-
9	RX1+
10	NC
11	RX2-
12	RX2+
13	GND
14	RXCLK-
15	RXCLK+
16	GND
17	RX3-
18	RX3+
19	SCL
20	SEL68

3. Electrical Specification

3.1 Absolute Maximum Ratings

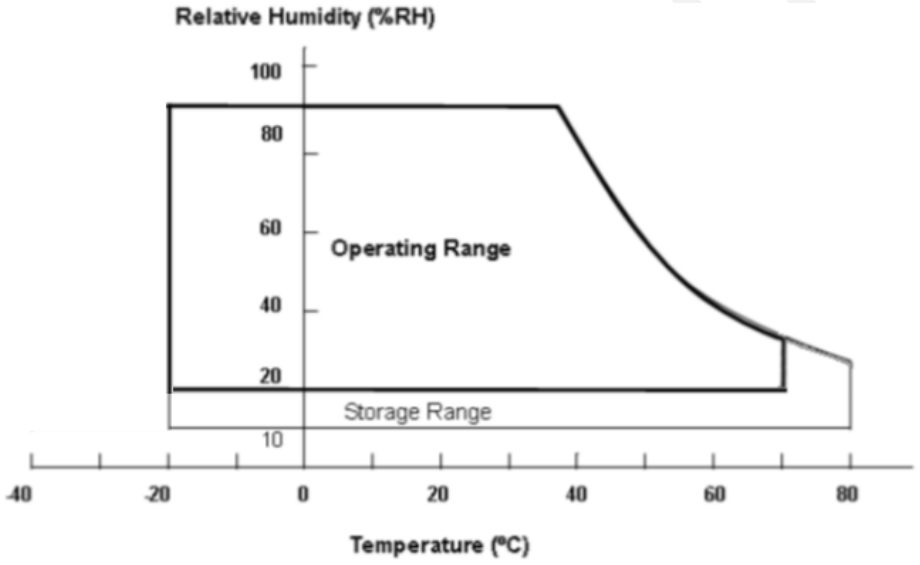
3.1.1 Absolute Ratings of Environment

Item	Symbol	Min	Max	Unit	Note
Operating Ambient Temperature	T_{OP}	-20	+70	°C	1, 2, 3
Storage Temperature	T_{ST}	-20	+80	°C	1, 2, 3

Note 1: Temperature define as the ambient temperature. Temperature and relative humidity range is shown in the figure below.

Note 2: 90 %RH Max. (Ta < 40℃).

Note 3: Wet-bulb temperature should be 39℃ Max.



3.1.2 Storage Conditions

High temperature or humidity may reduce the performance of panel. Please store LCD panel within the specified storage conditions.

Storage Condition: With packing.

Storage temperature range: 25±5 ºC.

Storage humidity range: 50±10%RH.

Shelf life: 30days

3.1.3 Electrical Absolute Ratings

3.1.2.1 TFT LCD Module

Item	Symbol	Min	Max	Unit	Note
Power Supply Voltage	VCC	-0.3	4	V	1
Logic Input Voltage	VI	-0.3	VCC+0.3	V	

Note 1: Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

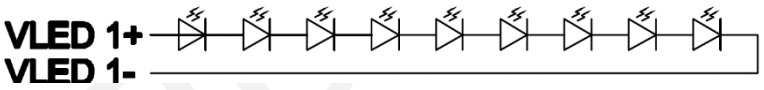
3.1.2.2 Backlight Unit

Item	Symbol	Min	Max	Unit	Note
Backlight (LED) Current	IF	0	180	mA	1, 2, 3

Note 1: Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note 2: Specified values are for lamp (Refer to 6.1 for further information).

Note 3: 1 LED String



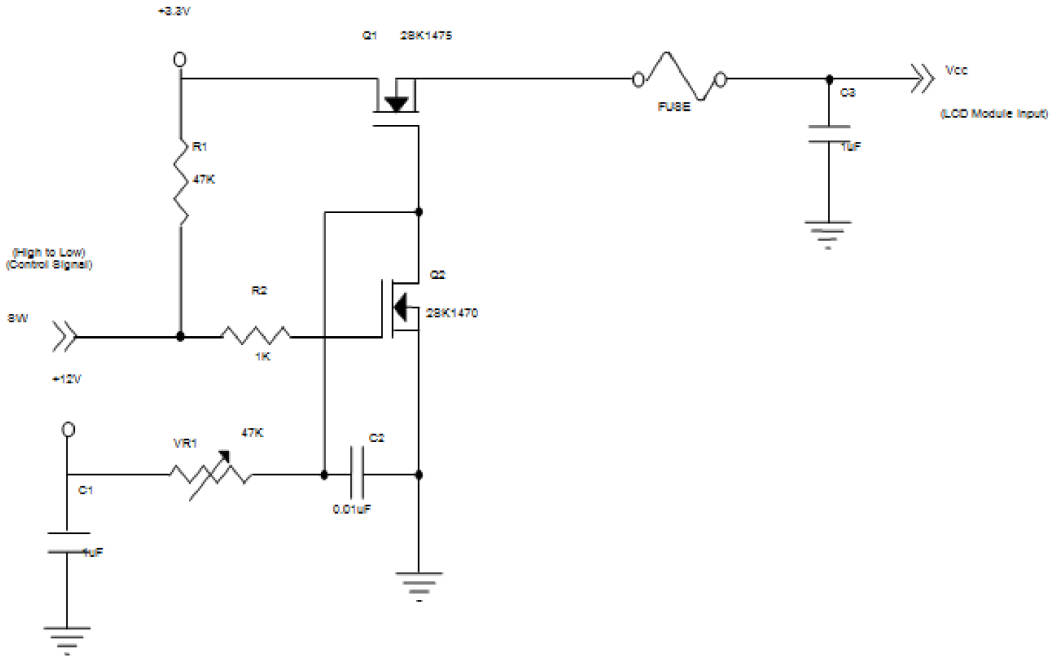
3.2 Electrical Characteristics

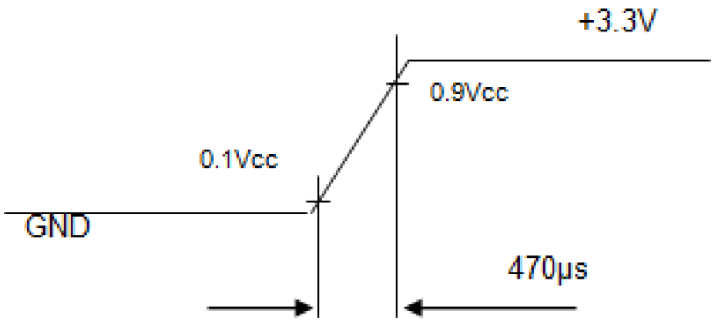
3.2.1 TFT LCD Module

Item		Symbol	Condition	Min	Typ.	Max	Unit	Note
Power Supply Voltage		V_{CC}	-	3.0	3.3	3.6	V	-
Ripple Voltage		V_{RP}	-		-	100	mVP-p	-
Rush Current		I_{RUSH}	-	-	-	2.0	A	2
Power Supply Current	White	I_{CC}	-	-	455	545	mA	3a
	Black			-	350	420	mA	3b
LVDS Differential Input Voltage		Vid	-	200	-	600	mV	-
LVDS Common Input Voltage		Vic	-	1.0	1.2	1.4	V	-
Differential Input Voltage for LVDS Receiver Threshold	"H" Level	V_{IH}	-	-	-	100	mV	-
	"L" Level	V_{IL}	-	-100	-	-	mV	-
Terminating Resistor		RT	-	-	100	-	Ohm	-

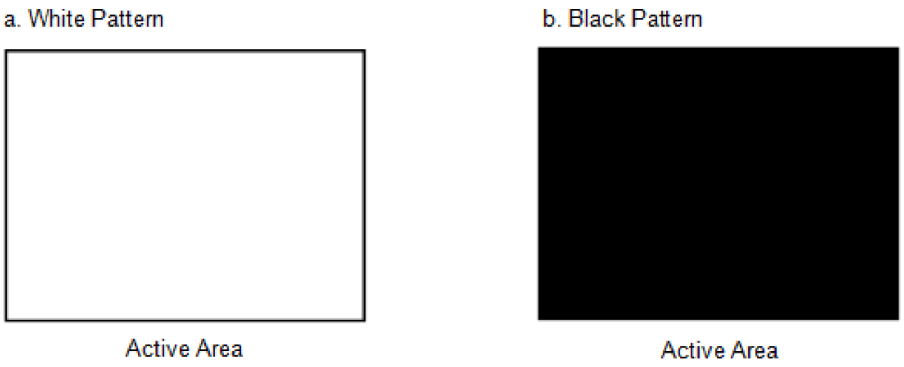
Note 1: The assembly should be always operated within above ranges.

Note 2: Measurement Conditions:



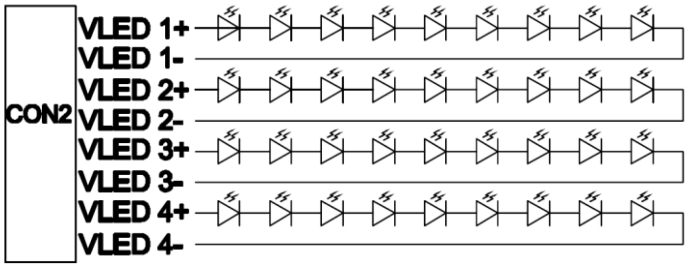


Note 3: The specified power supply is under the conditions at VDD=3.3V, Ta=25 ± 2 ºC, DC Current and fv = 60Hz, whereas a power dissipation check pattern below is displayed.



3.2.2 Backlight

Item	Symbol	Condition	Min	Typ.	Max	Unit	Note
LED Voltage	V_F	IF=110mA,Ta=25℃	-	(27)	32.4	V	1
LED Current	I_F	Ta=25℃	-	4*110	120	mA	-
LED Life Time	LT	IF=110mA,Ta=25℃	80,000	100,000	-	h	1



Note 1. The single LED lamp case. Brightness to be decreased to 50% of the initial value

3.3 Interface Pin Assignment

3.3.1 TFT LCD Module (CN1)

No.	Symbol	I/O	Function	Polarity	Note
1	VCC	P	Power Supply: +3.3V (typical)	-	-
2	VCC	P	Power Supply: +3.3V (typical)	-	-
3	NC	-	No Connection (Reserve for inner test)	-	4
4	LR/UD	I	Reverse Scan Control H or NC = Normal Mode. L = Horizontal / Vertical Reverse Scan.	-	3
5	RX0-	I	LVDS Differential Data Input	Negative	-
6	RX0+	I	LVDS Differential Data Input	Positive	-
7	GND	P	Ground	-	-
8	RX1-	I	LVDS Differential Data Input	Negative	-
9	RX1+	I	LVDS Differential Data Input	Positive	-
10	NC	-	No Connection (Reserve for inner test)	-	4
11	RX2-	I	LVDS Differential Data Input	Negative	-
12	RX2+	I	LVDS Differential Data Input	Positive	-
13	GND	P	Ground	-	-
14	RXCLK-	I	LVDS Differential Data Input	Negative	-
15	RXCLK+	I	LVDS Differential Data Input	Positive	-
16	GND	P	Ground	-	-
17	RX3-	I	LVDS Differential Data Input	Negative	-
18	RX3+	I	LVDS Differential Data Input	Positive	-
19	NC	-	No Connection (Reserve for inner test)	-	4
20	SEL68	I	LVDS 6/8 bit select function control, High=6bit Input Mode Low or NC=8bit Input Mode	-	3

Note 1. Connector Part No.: Cvilux CID520D1HR0-NH (Matte Tin Plated) or equivalent.

Note 2. User's connector Part No.: Hirose DF14-20S-1.25C or equivalent.

Note 3. "Low" stands for 0V. "High" stands for 3.3V. "NC" stands for "No Connection".

Note 4. Pin3, Pin10, Pin19 input signals should be set to no connection or ground, this module would operate normally.

Note 5. Pin3, Pin19 are I2C bus. Flicker can adjust by using the software of Auto-Vcom,

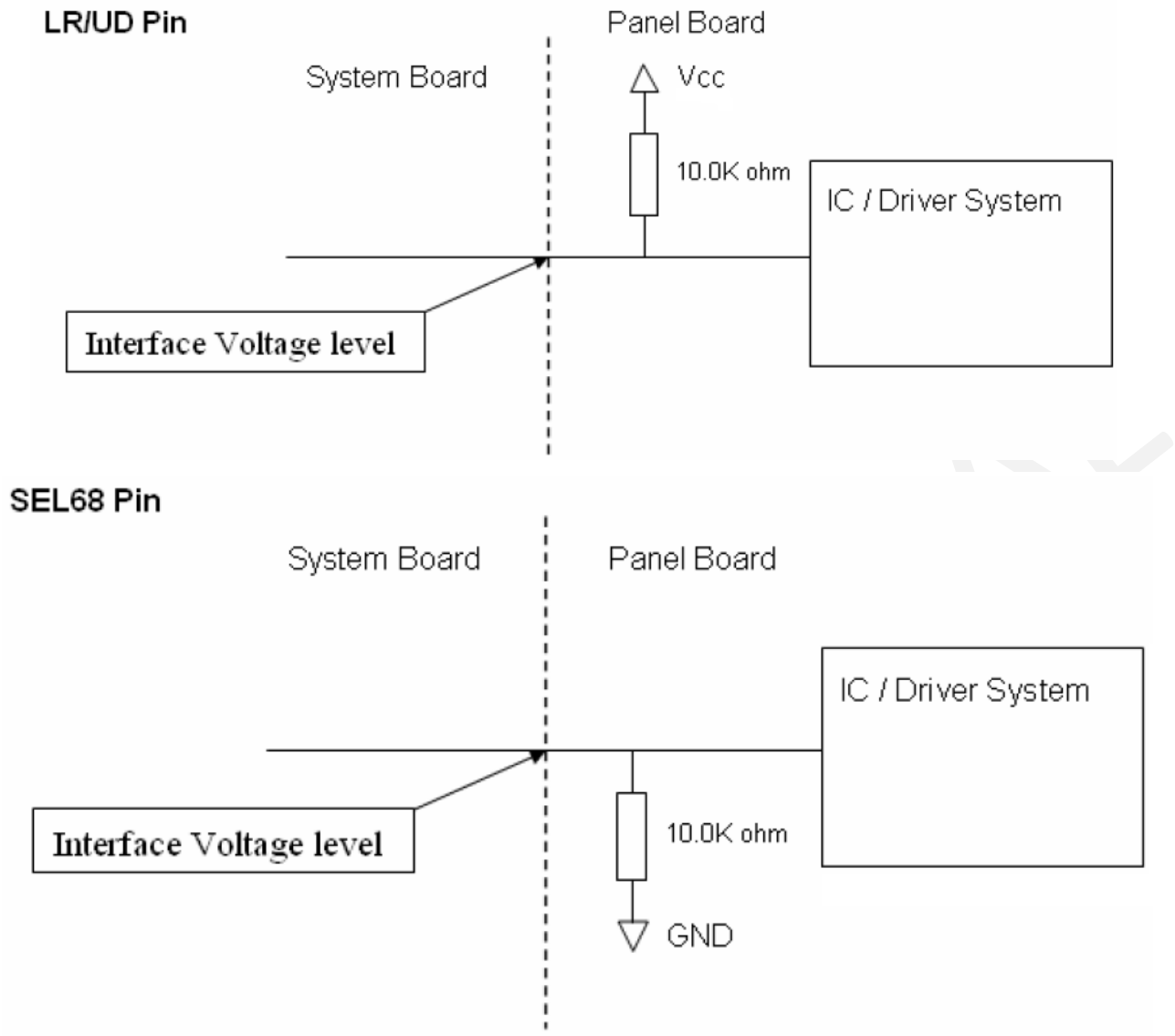


Fig.1 Normal Scan

Fig. 1 Normal scan (Pin 4, LR/UD = High or NC)

Fig.2 Reverse Scan

Fig. 2 Reverse scan (Pin 4, LR/UD = Low)

3.3.2 BACKLIGHT UNIT (CN2)

No.	Symbol	I/O	Function	Remark
1	NC	-	This pin should be open.	-
2	NC	-	This pin should be open.	-
3	LED C1	P	LED cathode 1	-
4	LED A1	P	LED anode 1	-
5	LED A2	P	LED anode 2	-
6	LED C2	P	LED cathode 2	-
7	LED C3	P	LED cathode 3	-
8	LED A3	P	LED anode 3	-
9	LED A4	P	LED anode 4	-
10	LED C4	P	LED cathode 4	-

Note 1: Backlight-side connector: SM10B-SHLS-TF(LF)(SN)(JST) or equivalent.

Note 2: User's Corresponding connector: SHLP-10V-S-B(JST) or equivalent.

3.4 Color Data Input Assignment

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color. The higher the binary input the brighter the color. The table below provides the assignment of color versus data input.

Color		Data Signal																							
		Red								Green								Blue							
		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 Colors	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

Color		Data Signal																							
		Red								Green								Blue							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Gray Scale of Red	Red(0)/Dark	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(253)	1	1	1	1	1	1	0	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
Gray Scale of Green	Green(0)/Dark	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	0	0	0	0	0	0	0	0	0
	Green(2)	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:	0:
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	Green(253)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	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
Gray Scale of Blue	Blue(0)/Dark	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:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	Blue(253)	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(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Blue(255)																								

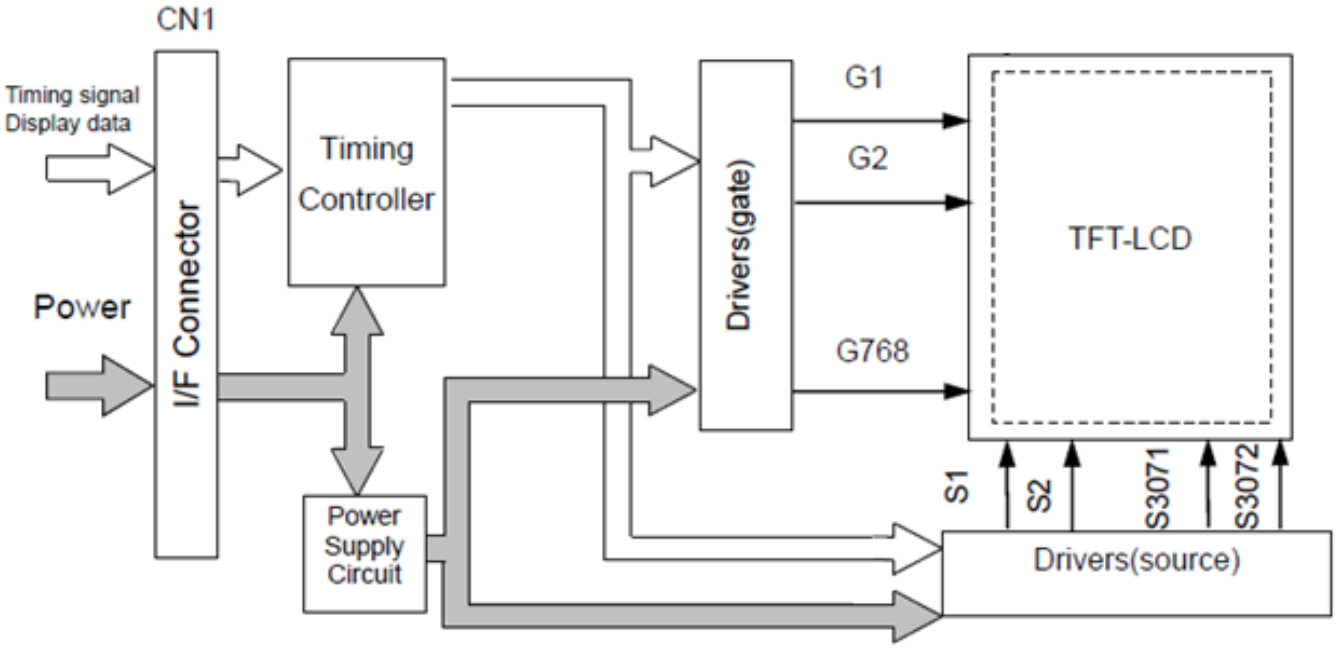
Note 1: 0: Low Level Voltage, 1: High Level Voltage

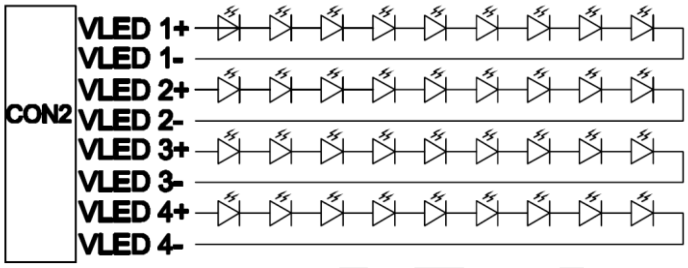
Note 2: Display Position and Scan Direction

Note 3: Scanning Direction

The following figures show the images see from the front view. The arrow indicates the direction of scan.

3.5 Block Diagram





3.6 Timing Characteristics

3.6.1 Input Signal Timing Specifications

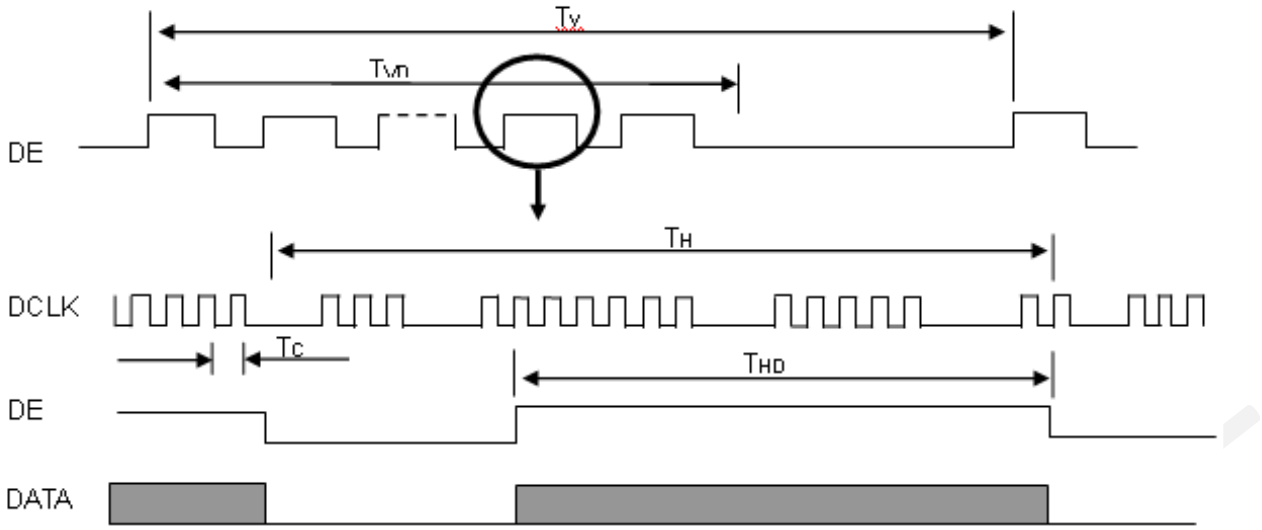
The input signal timing specifications are shown as the following table and timing diagram.

Item	Item	Symbol	Min	Typ.	Max	Unit	Note
LVDS Clock	Frequency	Fc	53.35	65	80	MHz	-
	Period	Tc	12.5	15.38	18.75	ns	-
	Input Cycle to Cycle Jitter	T_{rcl}	-	-	200	ns	1
	Input Clock to Data Skew	TLVCCS	-0.02*Tc	-	0.02*Tc	Ps	2
	Spread Spectrum Modulation Range	F_{clkin_mod}	-	-	1.02*Fc	MHz	3
	Spread Spectrum Modulation Frequency	F_{SSM}	-	-	200	KHz	
Vertical Display Term	Frame Rate	Fr	55	60	70	Hz	Tv=Tvd+Tvb
	Total	Tv	780	806	840	Th	-
	Active Display	Tvd	768	768	768	Th	-
	Blank	Tvb	Tv-Tvd	38	Tv-Tvd	Th	-
Horizontal Display Term	Total	Th	1240	1344	1360	Tc	Th=Thd+Thb
	Active Display	Thd	1024	1024	1024	Tc	-
	Blank	Thb	Th-Thd	320	Th-Thd	Tc	-

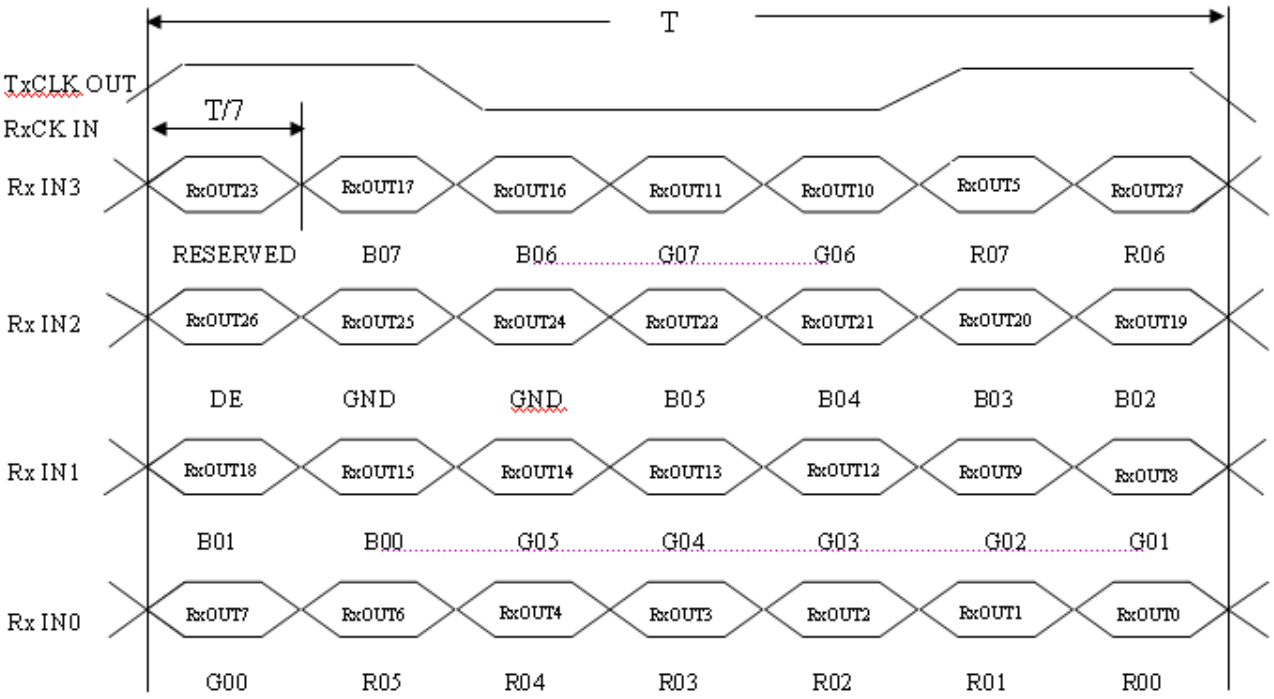
Note 1: Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

Note 2: The Tv(Tvd+Tvb) must be integer, otherwise, the module would operate abnormally.

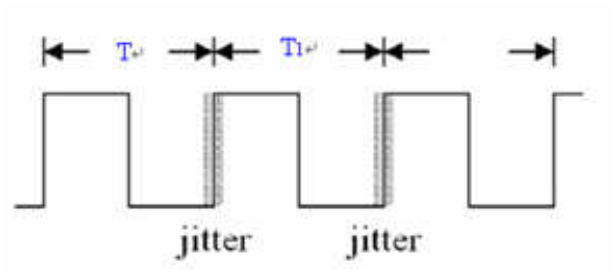
Input Signal Timing Diagram



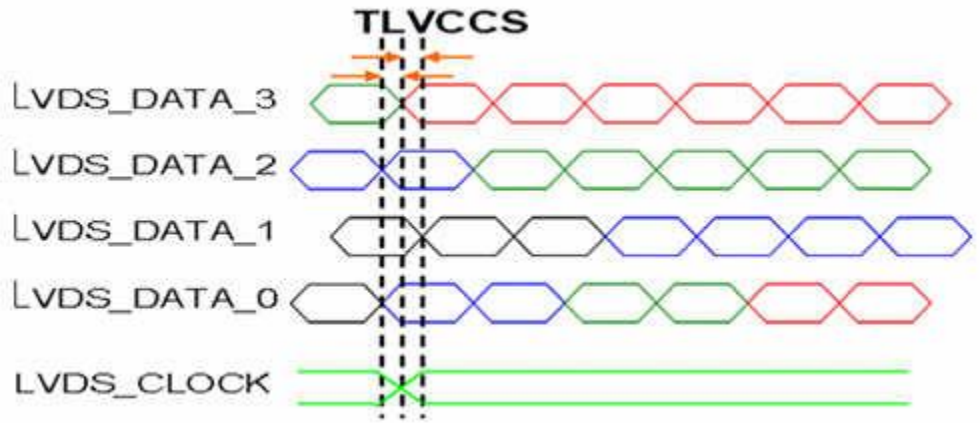
Timing Diagram of LVDS



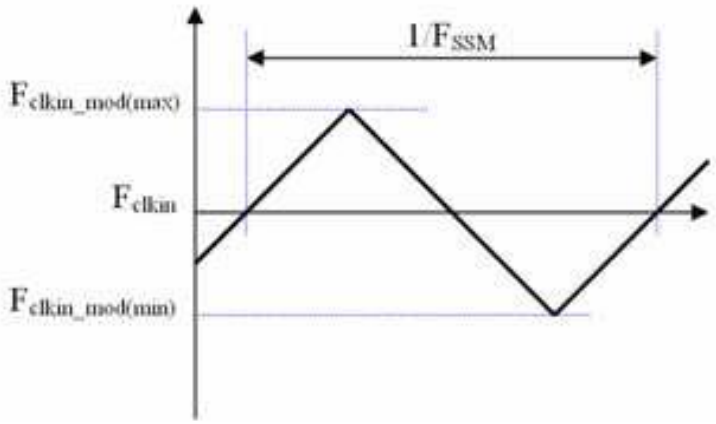
Note 1: The input clock cycle-to-cycle jitter is defined as below figures. Trcl = I T1 – TI



Note 2: Input Clock to data skew is defined as below figures.



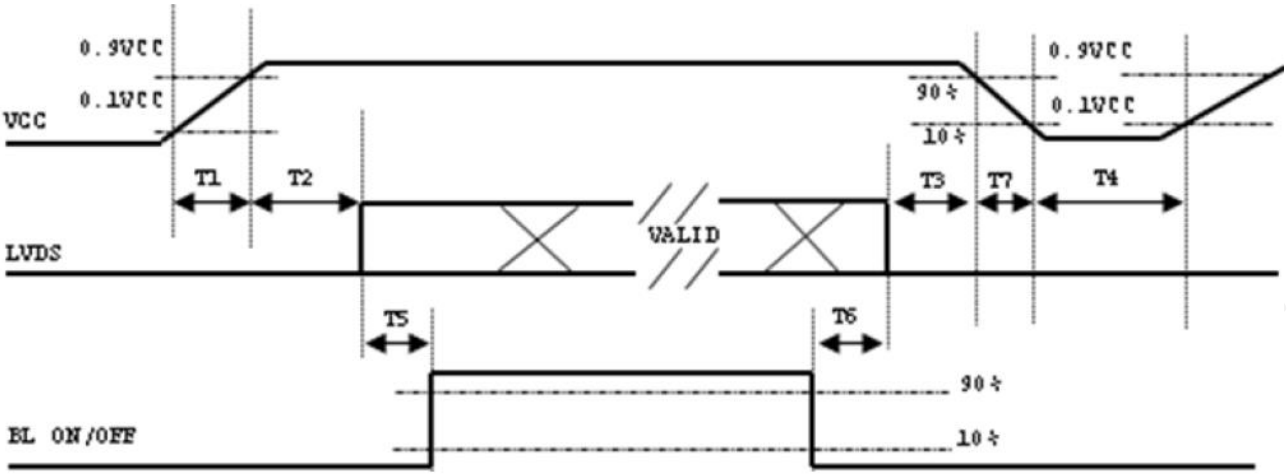
Note 3: The SSCG (Spread spectrum clock generator) is defined as below figures.



3.6.2 Power On/Off Sequence

To prevent a latch-up or DC operation of LCD assembly, the power on/off sequence should be as the diagram below.

Power On/Off Sequence



Note 1: Please avoid floating state of interface signal at invalid period.

Note 2: When the interface signal is invalid, be sure to pull down the power supply of LCD VCC to 0 V.

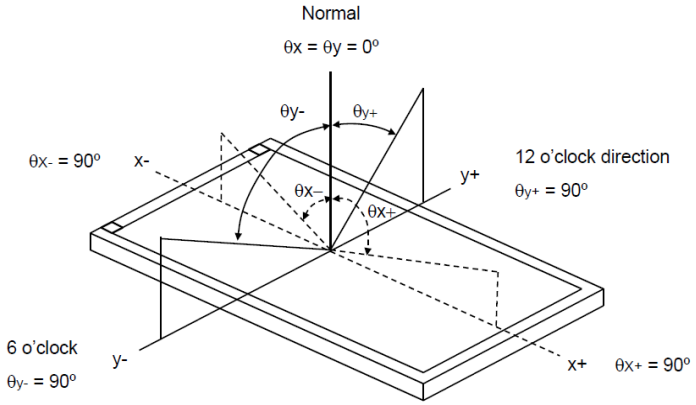
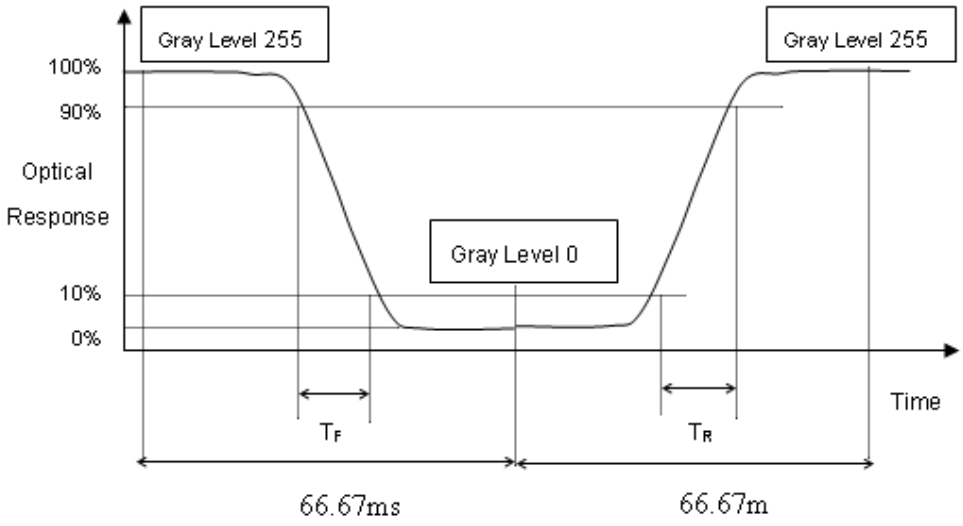
Note 3: The Backlight converter power must be turned on after the power supply for the logic and the interface signal is valid.

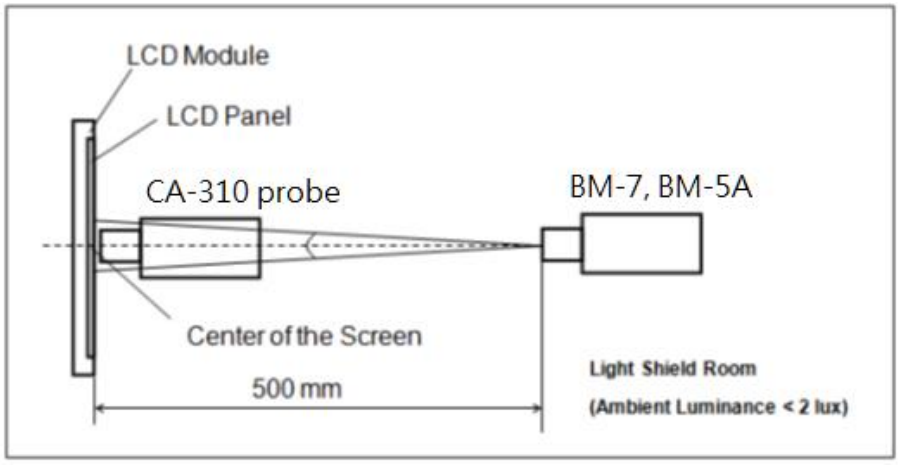
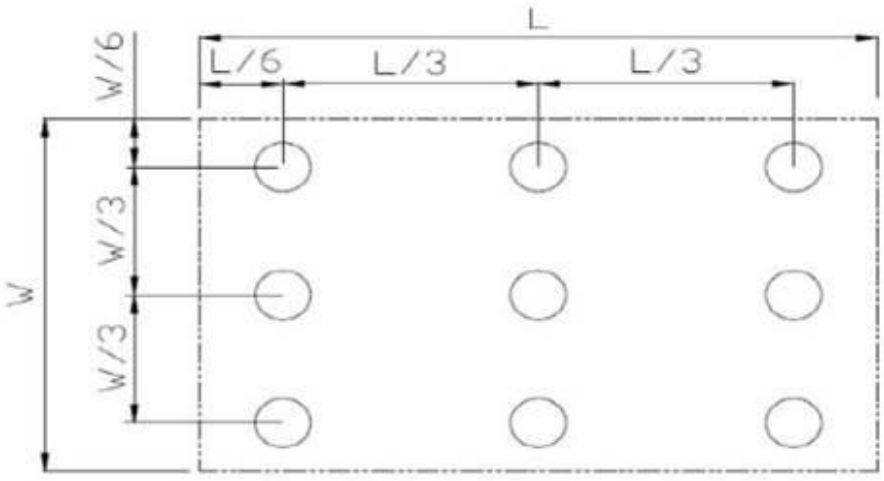
Item	Min	Typ.	Max	Unit	Note
T1	0.5	-	10	ms	-
T2	0	-	50	ms	-
T3	0	-	50	ms	-
T4	500	-	-	ms	-
T5	450	-	-	ms	-
T6	200	-	-	ms	-
T7	10	-	100	ms	-

4. Optical Specification

4.1 Optical Characteristics

Characteristics		Symbol	Conditions	Min	Typ.	Max	Unit	Note
Contrast Ratio		CR	θ = 0° BM-7、BM-5	1800	2500	-	-	2, 5
Response time		TR		-	16	21	ms	3,5
		TF		-	7	14		
Center Luminance of White		Lc	θ = 0° CA-310	640	800	-	cd/m^2	4, 5
Luminance Uniformity		U	θ = 0° BM-7	70	-	-	%	5, 6
Viewing Angle	Left	θ_x-	CR≧10 BM-7、BM-5	80	88	-	Deg.	1, 5
	Right	θ_x+		80	88	-		
	Up	θ_Y+		80	88	-		
	Down	θ_Y-		80	88	-		
Colour Chromaticity	Red	Rx	θ = 0° CA-310	Typ. -0.05	0.64	Typ. +0.05	-	1, 5, 6
		Ry			0.34			
	Green	Gx			0.32			
		Gy			0.60			
	Blue	Bx			0.15			
		By			0.05			
	White	Wx			0.31			
		Wy			0.34			

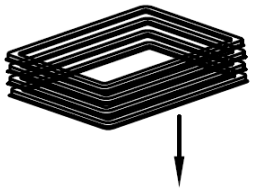
Note	Item	Test method
1	Definition of Viewing Angle (θx, θy)	
2	Definition of Contrast Ratio (CR)	The contrast ratio can be calculated by the following expression. Contrast Ratio (CR) = L255 / L0 L255: Luminance of gray level 255 L 0: Luminance of gray level 0 CR = CR (5) CR (X) is corresponding to the Contrast Ratio of the point X at the figure in Note (6). Contrast ratio (CR) = Luminance measured when LCD is at "white state" / Luminance measured when LCD is at "black state"
3	Definition of Response Time (T_R, T_F)	
4	Definition of Luminance of White (LC)	Measure the luminance of gray level 255 at center point LC = L (5) L (x) is corresponding to the luminance of the point X at Figure in Note (6). Measuring equipment: Konica Minolta CA-310

Note	Item	Test method
5	Measurement Setup	The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room. 
6	Definition of Luminance Uniformity (U)	Active area is divided into 9 measuring areas (reference the picture in below). Every measuring point is placed at the center of each measuring area. Luminance Uniformity (U) = Lmin/Lmax x100% L = Active area length W = Active area width 
7	Definition of color chromaticity	CIE 1931 color spaces. Color coordinates measured at the center point of LCD.

5. Packaging

1 piece /Tray

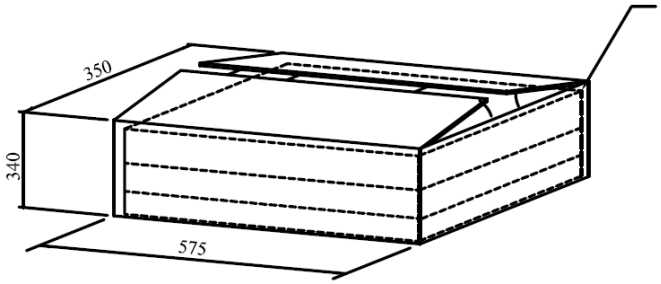
1トレイに1枚入れ



1 piece /Tray

One set =3 trays + 1 dummy tray

3層トレイ+1層トレイ(モジュール無し)=1セット



3 sets / Carton

1段ボールに3セット入れ

6. Quality Assurance Specification

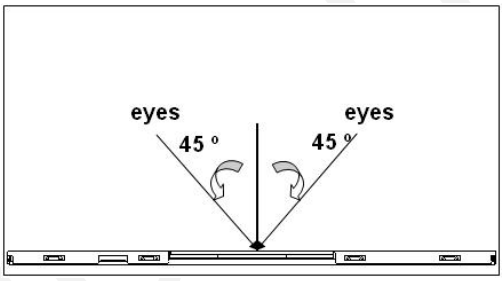
6.1 Conformity

The performance, function and reliability of the shipped products conform to the Product Specification.

6.2 Environment Required

Customer's test & measurement are required to be conducted under the following conditions:

Temperature:		15℃~25℃
Humidity:		55 ±15%
Visual inspection：	Illumination	More than 500 Lux; Inspection Distance: 20cm~30cm
Electrical inspection：	Illumination	100Lux~300Lux; Inspection Distance: 20cm~30cm
Visual angle：		The test direction is base on about around 45º of Vertical line



Sub-pixel Definition:

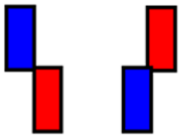
R G B R G B R G B	Sub-pixel Defect
R G B R G B R G B	Adjacent Sub-pixel Defect
R G B R G B R G B	Cluster

Note 1. If pixel or partial sub-pixel defects exceed 50% of the affected pixel or sub-pixel area, it shall be considered as 1 defect.

Note 2. There should be no distinct non-uniformity visible through 5% ND Filter within 2 seconds inspection times.

Note 3. Mura and bright sub-pixel inspected through 5% transmission ND Filter as following.

Note 4. The judging criteria for the arrangement of 2 adjacent bright sub-pixels are as follows, please refer to the item Bright sub-pixel、Dark sub-pixel On-display Pixel on Inspection Criteria for the allowable quantity and bright sub-pixel size judgment standards.

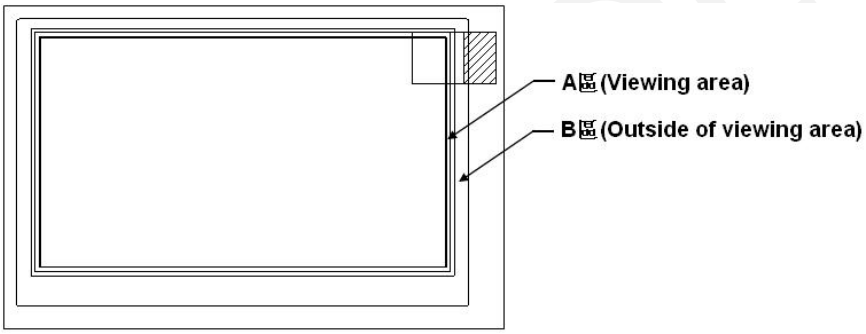
2 sub-pixel adjacent vertical is NG	2 sub-pixel adjacent slant is NG
	
Horizontal adjacent sub-pixel judge as the same with bright pixel and dark pixel.	

6.3 Delivery Assurance

6.3.1 Delivery Inspection Standards

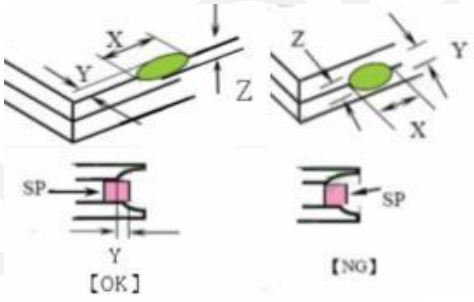
Class II, Normal Inspection, MIL-STD-105E

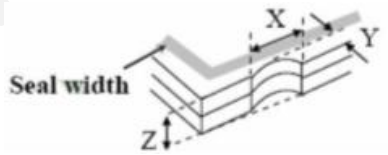
6.3.2 Zone Definition

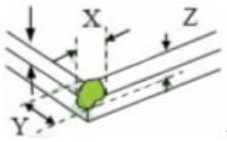


6.3.3 Inspection Criteria

<table>
<tr><th>Class</th><th>Item</th><th>Criteria</th></tr>
<tr><td>Maj</td><td>Packing &
Indicate</td><td>1.1. Mixed product types.
1.2. The part number is inconsistent with work order of production.
1.3. Assembled in inverse direction.
1.4. The quantity is inconsistent with work order of production.</td></tr>
<tr><td>Maj</td><td>Size</td><td>Product size and structure must meet the structure diagram</td></tr>
<tr><td>Min</td><td>The crack of glass</td><td>Symbols:
X: The length of crack.
Y: The width of crack.
Z: The thickness of crack.
W: Terminal length.
T: The thickness of glass.
a:LCD side length.

3.1. General glass chip:
3.1.1. Chip on panel surface and crack between panels;
 



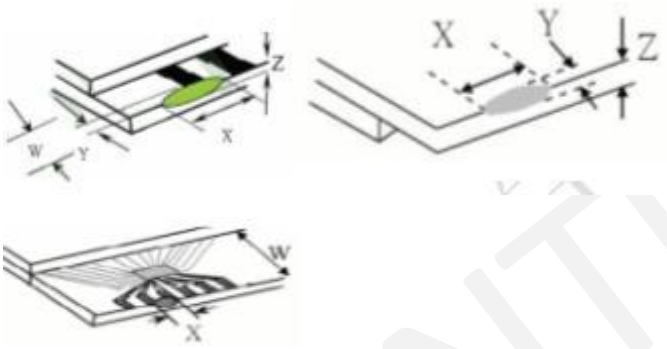
<table>
<tr><td>X</td><td>Y</td><td>Z</td></tr>
<tr><td>≤a</td><td>Crack can't enter viewing area</td><td>≤1/2t</td></tr>
<tr><td>≤a</td><td>Crack can't exceed the half of SP width</td><td>1/2t＜Z≤2t</td></tr>
</table>
3.1.2. Corner crack：
 
</td></tr>
</table>

Class	Item	Criteria

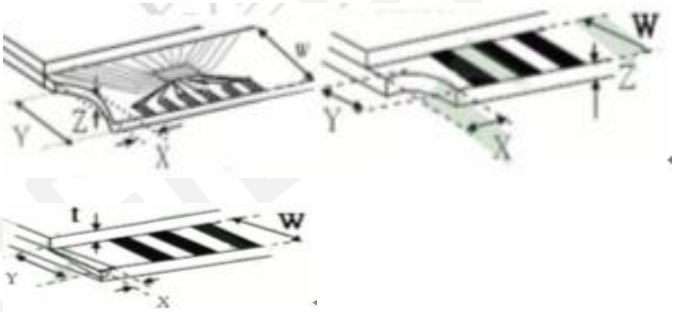
X	Y	Z
≤1/5a	Crack can't enter viewing area	≤1/2t
≤1/5a	Crack can't exceed the half of SP width	1/2t＜Z≤2t

3.2. Protrusion over terminal:

3.2.1.Chip on electrode pad:



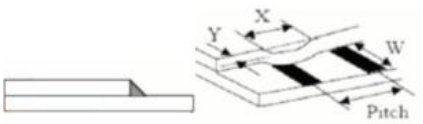
3.2.2. Non-conductive portion:



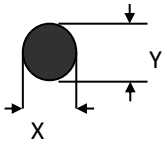
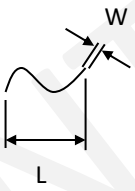
X	Y	Z
≤1/3a	≤W	≤t
X	Y	Z

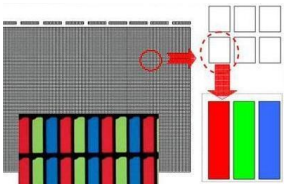
Note：If the chipped area touches the ITO terminal,over 2/3 of the ITO must remain and be inspected according to electrode terminal specifications.

3.2.3.Glass remain：



X	Y	Z
≤a	≤1/3W	≤t
X	Y	Z

<table>
<tr><th>Class</th><th>Item</th><th colspan="4">Criteria</th></tr>
<tr><td rowspan="6">Min</td><td rowspan="6">Spot Defect</td><td colspan="4">Round type: as per following drawing, ∅ = (X+Y)/2  </td></tr>
<tr><td colspan="4">4.1 Round type (Non-display or display):</td></tr>
<tr><td colspan="2">Judging standard</td><td colspan="2">Acceptable Quantity</td></tr>
<tr><td colspan="2">∅≤0.3 mm</td><td colspan="2">Ignore</td></tr>
<tr><td colspan="2">0.3<∅≤0.5mm</td><td colspan="2">5</td></tr>
<tr><td colspan="2">0.5 mm<∅</td><td colspan="2">0</td></tr>
<tr><td rowspan="6">Min</td><td rowspan="6">Line Defect (LCD/ Polarizer backlight black/white line, scratch, stain)</td><td colspan="4">5.1 Line type: as per following drawing  </td></tr>
<tr><td colspan="4">5.1 Line type(Non-display or display):</td></tr>
<tr><td colspan="2">Judging standard</td><td colspan="2">Acceptable Quantity</td></tr>
<tr><td>W≤0.07 mm</td><td>-</td><td colspan="2">Ignore</td></tr>
<tr><td>0.07 mm<W≤0.1 mm</td><td>L ≤ 5 mm</td><td colspan="2">5</td></tr>
<tr><td>0.1 mm<W</td><td>L > 5 mm</td><td colspan="2">0</td></tr>
<tr><td rowspan="6">Min</td><td rowspan="6">Polarizer Bubble</td><td>Area</td><td>Judging standard</td><td colspan="2">Acceptable Quantity</td></tr>
<tr><td rowspan="3">A area (Viewing area)</td><td>∅ < 0.2 mm</td><td colspan="2">Ignore</td></tr>
<tr><td>0.2mm＜∅≦0.3mm</td><td colspan="2">3</td></tr>
<tr><td>0.3mm＜∅≦0.5mm</td><td colspan="2">1</td></tr>
<tr><td>0.5mm＜∅</td><td colspan="2">0</td></tr>
<tr><td>B area (Outside of viewing area)</td><td>-</td><td colspan="2">Ignore</td></tr>
<tr><td>Min</td><td>The folding and peeled off in polarizer</td><td colspan="4">The folding and peeled off in (Degumming)polarizer are not acceptable.</td></tr>
<tr><td>Maj</td><td>Brightness and uniformity、Chroma</td><td colspan="4">Shall be in accordance with the drawings and specification requirements specifications.</td></tr>
</table>

<table>
<tr><th>Class</th><th>Item</th><th>Criteria</th></tr>
<tr><td>Maj</td><td>MURA</td><td>5% ND Filter</td></tr>
<tr><td>Maj</td><td>Electrical Testing</td><td>1. Missing line character and icon.
2. No function or no display.
3. Display malfunction.
4. LCD viewing angle defect.
5. Current consumption exceeds product specifications.</td></tr>
<tr><td>Min</td><td>Bright pixel、Dark pixel On-display
Pixel ： 3 sub-pixel in 1 pixel</td><td> 
<table>
<tr><th>Item</th><th>Judging standard</th><th>Acceptable Quantity</th></tr>
<tr><td rowspan="2">Bright Pixel</td><td>D≦1/2 Pixel</td><td>Ignore</td></tr>
<tr><td>1/2 Pixel＜D≦1 Pixel</td><td>3</td></tr>
<tr><td rowspan="2">Dark Pixel</td><td>D≦1/2 Pixel</td><td>Ignore</td></tr>
<tr><td>1/2 Pixel＜D≦1 Pixel</td><td>4</td></tr>
<tr><td colspan="2">Total</td><td>6</td></tr>
</table></td></tr>
</table>

6.3.4 Non-conforming Analysis

Purchaser should supply Densitron with detailed data of non-conforming sample.

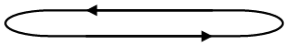
After accepting it, Densitron should complete the analysis in two weeks from receiving the sample.
If the analysis cannot be completed on time, Densitron must inform the purchaser.

6.3.5 Handling of Non-conforming Displays

If any non-conforming displays are found during customer acceptance inspection which Densitron is clearly responsible for, return them to Densitron.
Both Densitron and customer should analyse the reason and discuss the handling of non-conforming displays when the reason is not clear.
Equally, both sides should discuss and come to agreement for issues pertaining to modification of Densitron quality assurance standard.

7. Reliability Specification

7.1 Reliability Tests

Test Item	Content of Test	Test Condition	Note
High Temperature storage	Endurance test applying the high storage temperature for a long time.	80℃ 240hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-20℃ 240hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70℃ 240hrs	-
Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20℃ 240hrs	1
High Temperature/ Humidity Operation	The module should be allowed to stand at 60 ℃,90%RH max	40℃,90%RH 240hrs	1,2
Thermal shock resistance	The sample should be allowed stand the following 10 cycles of operation -20℃ 25℃ 70℃  30min 5min 30min 1 cycle	-20℃/80℃ 100 cycles	-
Vibration test	Endurance test applying the vibration during transportation and using.	〖9.8 m/s2〗 (≒1.0G)(Sine wave) Vibration Frequency : 5~500Hz(0.5 8^0/ 1 minutes) One cycle 60 minutes to 3 directions of X,Y,Z for Each ,total 180 minutes	**3**
Static electricity test	Endurance test applying the electric stress to the terminal.	VS=±8kV(contact), RS=330Ω,CS=150pF 10 times/s VS=±200v(air), RS=0Ω,CS=200pF 10 times/s	-

Test Item	Content of Test	Test Condition	Note
Impact Testing	Determine the strength and impact value of the material, and judge the toughness and brittleness of the material according to the measured experimental value	〖980 m/s2〗 (≒100G) (1/2Sine wave) 2ms (±X, ±Y, ±Z) One cycle each, 6 times in total	-

Note1: No dew condensation to be observed.

Note2: The function test shall be conducted after 4 hours storage at the normal Temperature and humidity after remove from the test chamber.

Note3: The packing have to including into the vibration testing.

*Even there's minor defects on the exterior, as long as the electrical characteristics are within the standard, we'll accept it. For the points that are not listed on the spec. sheet, please confirm with us.

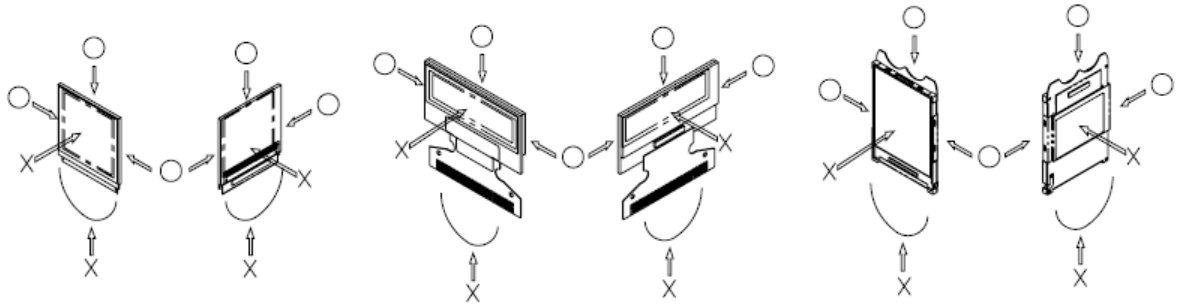
7.1.1 Inspection Check Standard

After the completion of the described reliability test, the samples are to be left at room temperature for 4 hrs prior to conducting the inspection check at 25±2 °C, 50±10% RH.

8. Handling Precautions

8.1 Handling Precautions

1) Since the display panel is being made of glass, do not apply mechanical impacts such as dropping from a high position.
2) If the display panel is broken by some accident and the internal organic substance leaks out, be careful not to inhale nor lick the organic substance.
3) If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water
4) If pressure is applied to the display surface or its neighborhood of the display module, the cell structure may be damaged and be careful not to apply pressure to these sections.
5) The polarizer covering the surface of the display module is soft and easily scratched. Please be careful when handling the display module.
6) When the surface of the polarizer of the display module has soil, clean the surface. It takes advantage of by using following adhesion tape.
   a. Scotch Mending Tape No. 810 or an equivalent
   b. Never try to breathe upon the soiled surface nor wipe the surface using cloth containing solvent such as ethyl alcohol, since the surface of the polarizer will become cloudy.
   c. Also, pay attention that the following liquid and solvent may spoil the polarizer:
      - Water
      - Ketone
      - Aromatic Solvents
7) Hold the display module very carefully when placing it into the system housing. Do not apply excessive stress or pressure to display module. And, do not over bend the film with electrode pattern layouts. These stresses will



influence the display performance. Also, secure sufficient rigidity for the outer cases.
8) Do not apply stress to the LSI chips and the surrounding molded sections.
9) Do not disassemble nor modify the display module.
10) Do not apply input signals while the logic power is off.
11) Pay sufficient attention to the working environments when handing display modules to prevent occurrence of element breakage accidents by static electricity.

a. Be sure to make human body grounding when handling display modules.
b. Be sure to ground tools to use or assembly such as soldering irons.
c. To suppress generation of static electricity, avoid carrying out assembly work under dry environments.
d. Protective film is being applied to the surface of the display panel of the display module. Be careful since static electricity may be generated when exfoliating the protective film.

12) Protection film is being applied to the surface of the display panel and removes the protection film before assembling it. If the display module has been stored for a long period of time, residue adhesive material of the protection film may remain on the surface of the display panel after removed of the film. In such case, remove the residue material by the method introduced in the above Section 5).
13) If electric current is applied when the display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful to avoid the above.

8.2 Storage Precautions

1) When storing display modules, put them in static electricity preventive bags avoiding exposure to direct sun light nor to lights of fluorescent lamps, etc. and, also, avoiding high temperature and high humidity environments or low temperature (less than 0°C) environments. (We recommend you to store these modules in the packaged state when they were shipped from Densitron) At that time, be careful not to let water drops adhere to the packages or bags nor let dewing occur with them.
2) If electric current is applied when water drops are adhering to the surface of the display module, when the display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful about the above.

8.3 Designing Precautions

1) The absolute maximum ratings are the ratings which cannot be exceeded for display module, and if these values are exceeded, panel damage may be happen.
2) To prevent occurrence of malfunctioning by noise, pay attention to satisfy the VIL and VIH specifications and, at the same time, to make the signal line cable as short as possible.
3) We recommend you to install excess current preventive unit (fuses, etc.) to the power circuit (VDD). (Recommend value: 0.5A)
4) Pay sufficient attention to avoid occurrence of mutual noise interference with the neighboring devices.
5) As for EMI, take necessary measures on the equipment side basically.
6) When fastening the display module, fasten the external plastic housing section.
7) If power supply to the display module is forcibly shut down by such errors as taking out the main battery while the display panel is in operation, we cannot guarantee the quality of this display module.

8.4 Operation Precautions

1) It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life.
2) 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.
3) 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.
4) To protect display modules from performance drops by static electricity rapture, etc., do not touch the following sections whenever possible while handling the display modules.
   a. Pins and electrodes
   b. Pattern layouts such as the FPC
5) When the driver is being exposed (COG), semiconductor elements change their characteristics when light is radiated according to the principle of the solar battery. Consequently, if the driver is exposed to light, malfunctioning may occur.
   a. Design the product and installation method so that the driver may be shielded from light in actual usage.
   b. Design the product and installation method so that the driver may be shielded from light during the inspection processes.
6) Although the display module stores the operation state data by the commands and the indication data, when excessive external noise, etc. enters into the module, the internal status may be changed. It therefore is necessary to take appropriate measures to suppress noise generation or to protect from influences of noise on the system design.
7) We recommend you to construct its software to make periodical refreshment of the operation statuses (re-setting of the commands and re-transference of the display data) to cope with catastrophic noise.

8.5 Other Precautions

1) Request the qualified companies to handle industrial wastes when disposing of the display modules. Or, when burning them, be sure to observe the environmental and hygienic laws and regulations.