LIQUID CRYSTAL DISPLAY MODULE

Product Specification

CUSTOMER	**Standard**
CUSTOMER PART NUMBER	
PRODUCT NUMBER	**DET101WSNLNT0M-2A**

Product Mgr	Design Eng
Bruno Recaldini	**Sunny**
Date: 03-Dec-14	Date: 03-Dec-14

TABLE OF CONTENTS

REVISION RECORD

Rev.	Date	Page	Chapt.	Comment	ECN no.
1.0	03-Jan-14			Initial Release	

1 MAIN FEATURES

ITEM	CONTENTS
Screen Size	10.1” Diagonal
Display Format	1024 x RGB x 600 Dots
N° of Colour	262K
Overall Dimensions	244 mm (H) x 143 mm (V) x 12.4 mm (D)
Active Area	222.72 mm (H) x 125.28 mm (V)
LCD Type	TFT
Mode	Transmissive / Normally White
Viewing Direction	Full view
Electrical Interface	LVDS
Backlight Type	LED
Operating Temperature	-30°C ~ +85°C
Storage Temperature	-30°C ~ +85°C
RoHS compliant	Yes

2 MECHANICAL SPECIFICATION

2.1 MECHANICAL CHARACTERISTICS

ITEM	CHARACTERISTIC	UNIT
Display Format	1024 x RGB x 600 Dots	Dots
Overall Dimensions	244 (H) x 143 (V) x 12.4 (D)	mm
Active Area	222.72 (H) x 125.28 (V)	mm
pixel Pitch	0.2175 (H) x 0.2088 (V)	mm
Weight	440 (MAX)	g

2.2 MECHANICAL DRAWING

Fig1: Reference outline drawing: Front side

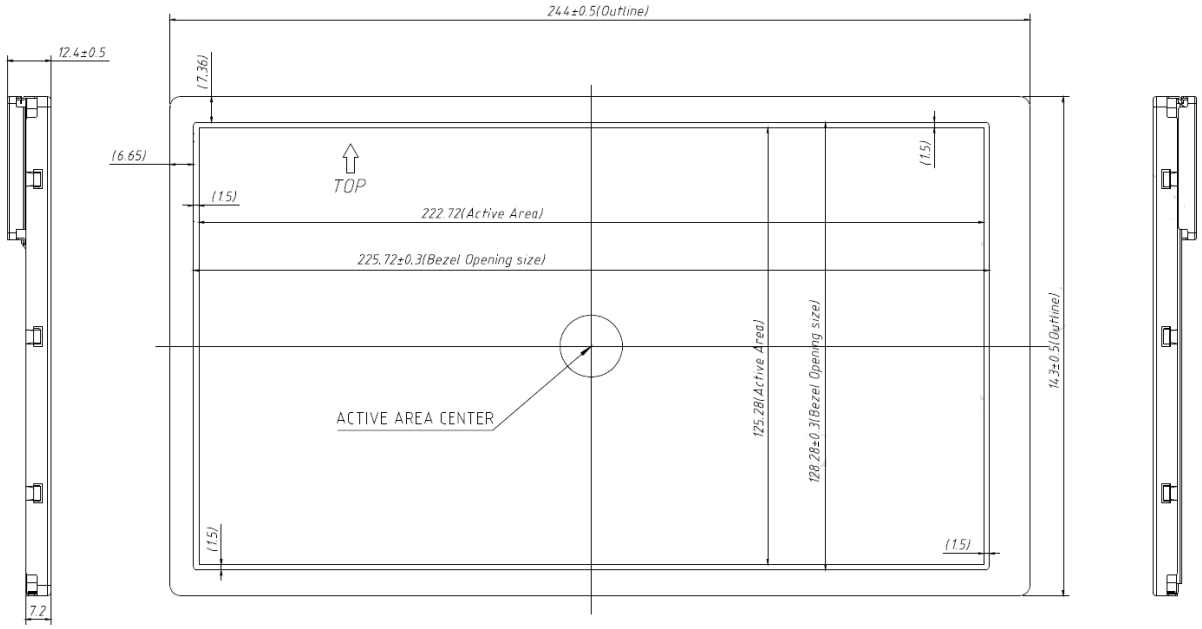
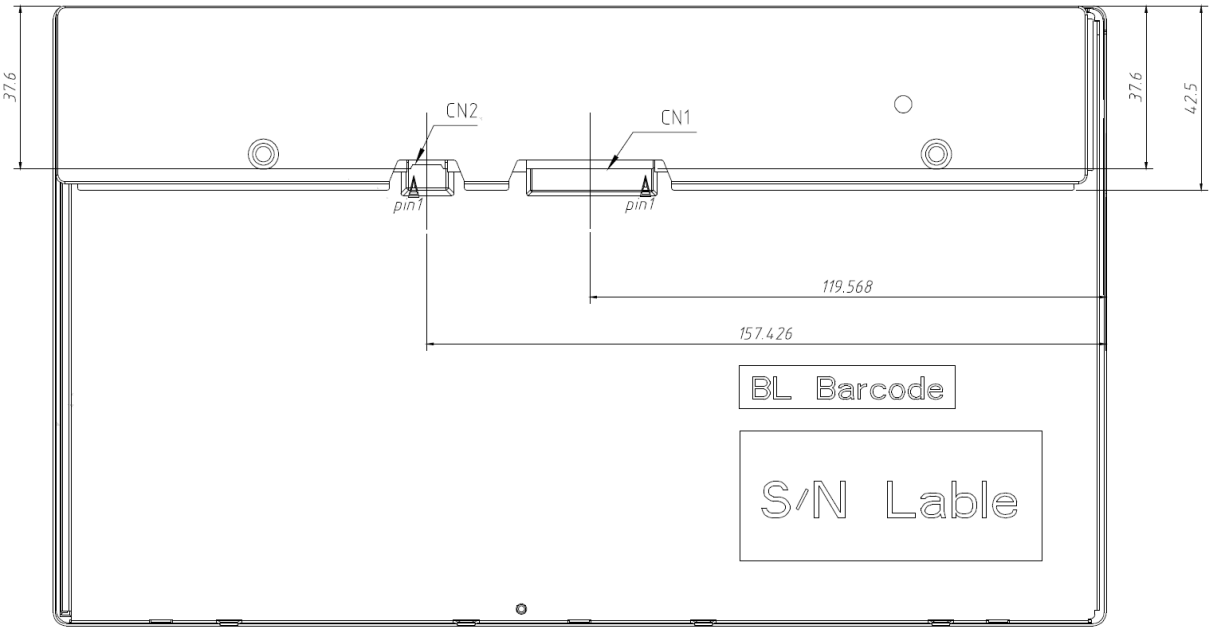


Fig2: Reference outline drawing: Back side



3 ELECTRICAL SPECIFICATION

3.1 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Condition	Min	Max	Unit	Note
Operating Temperature	TOP		-30	85	°C	1
Storage Temperature	TST		-30	85	°C	1,2,3
Operating Humidity	HOP		10	85	%RH	4
Storage Humidity	HST		10	95	%RH	4
Supply Voltage	V_{IN}	Logic	-0.3	3.6	V	5
	V_{LED}	LED Driver Vin	-0.3	24		
Power Supply Fuse current Setting	I_{fuse}	Vin from 10% to 90%, rise timie 500us	-	1.5	A	
PWM voltage	V_{PWM}	PWM Dimming voltage	0.8	5.0	V	

Please make sure to keep the temperature of LCD module is less than 80°C

Note 1. 90 % RH Max for Ta<50 °C, and 60% RH for Ta≥50°C.

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

Note 3. Only operation is guaranteed at operating temperature. Contrast, response time, another display quality are evaluated at +25°C.

Note 4. Storage Range & Operating Range Picture:

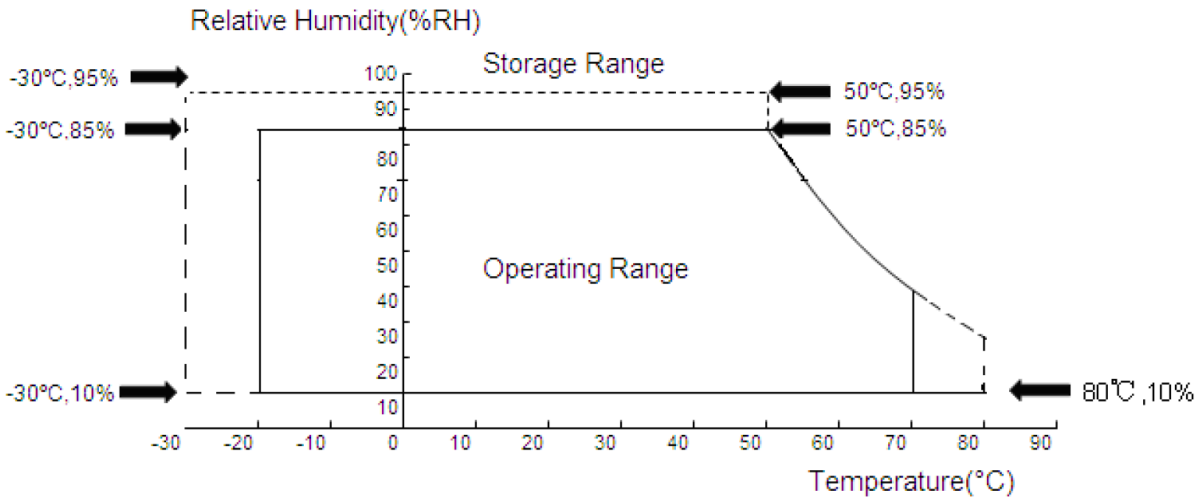


Fig 3: Storage Range & Operating Range Picture

Note 5. Humidity: 85%RH MAX (T<40°C) Note static electricity. Maximum wet bulb temperature at 39°C or less. (T>40°C) No condensation.

3.2 ELECTRICAL CHARACTERISTICS

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
System Power Supply						
Input Power Supply Voltage	V_{IN}	3	3.3	3.6	V	
Input Power Supply Current	I_{VIN}	-	-	191	mA	Black pattern,60Hz
Input Inrush Current	I_{RUSH}	-	-	1.5	A	0.5ms rise time (10%~90%)
Input Power Voltage Ripple	V_{RPL}	-	-	200	mV	Vp-p
REV	VH	2.0	3.3	5.0	V	
	VL	-	-	0.8		
LED Power Supply						
Input Power Supply Voltage	V_{LED_IN}	8	12	16	V	
Input Power Supply Current	I_{VLED_IN}	-	-	543	mA	
EN/PWM	VIH	2.0	3.3	5.0	V	
	VIL	-	-	0.8	V	
LVDS Signals						
Differential Input High Threshold	Vth	-	-	+100	mV	Vcm=+1.2V
Differential Input Low Threshold	Vtl	-100	-	-	mV	Vcm=+1.2V
Magnitude Differential Input Voltage	|Vid|	200	-	600	mV	
Common Mode Voltage	Vcm	1	1.2	1.4	V	Vth -Vtl = 200mV
Common Mode Voltage Offset	ΔVcm	-50	-	50	mV	Vth -Vtl = 200mV

Note A: Input signals shall be low or Hi-Z state when VIN is off.
Note B: All electrical characteristics for LVDS signal are defined and shall be measured at the interface connector of LCD.
Note C: White Pattern at 3.3V driving voltage.

3.3 INTERFACE PIN ASSIGNMENT

Item: FDP Down Connector (20 pin pitch=1.25mm)
Connector recommended model: MSB240420HD

Pin #	Signal Name	Description	Remarks
1	VDD	LCD power supply (Typ. +3.3V)	
2	VDD	LCD power supply (Typ. +3.3V)	
3	VSS	Ground	
4	REV	Revers Scan Selection	
5	Rin1-	-LVDS differential data input	
6	Rin1+	+LVDS differential data input	
7	VSS	Ground	
8	Rin2-	-LVDS differential data input	
9	Rin2+	+LVDS differential data input	
10	VSS	Ground	
11	Rin3-	-LVDS differential data input	
12	Rin3+	+LVDS differential data input	
13	VSS	GND	
14	ClkIN-	-LVDS differential clock input	
15	ClkIN+	+LVDS differential clock input	
16	GND	GND	
17	Rin4-	-LVDS differential data input	
18	Rin4+	+LVDS differential data input	
19	VSS	Ground	
20	NC	Internal use	High Active

3.4 BLOCK DIAGRAM

It shows the functional block diagram of the LED module.

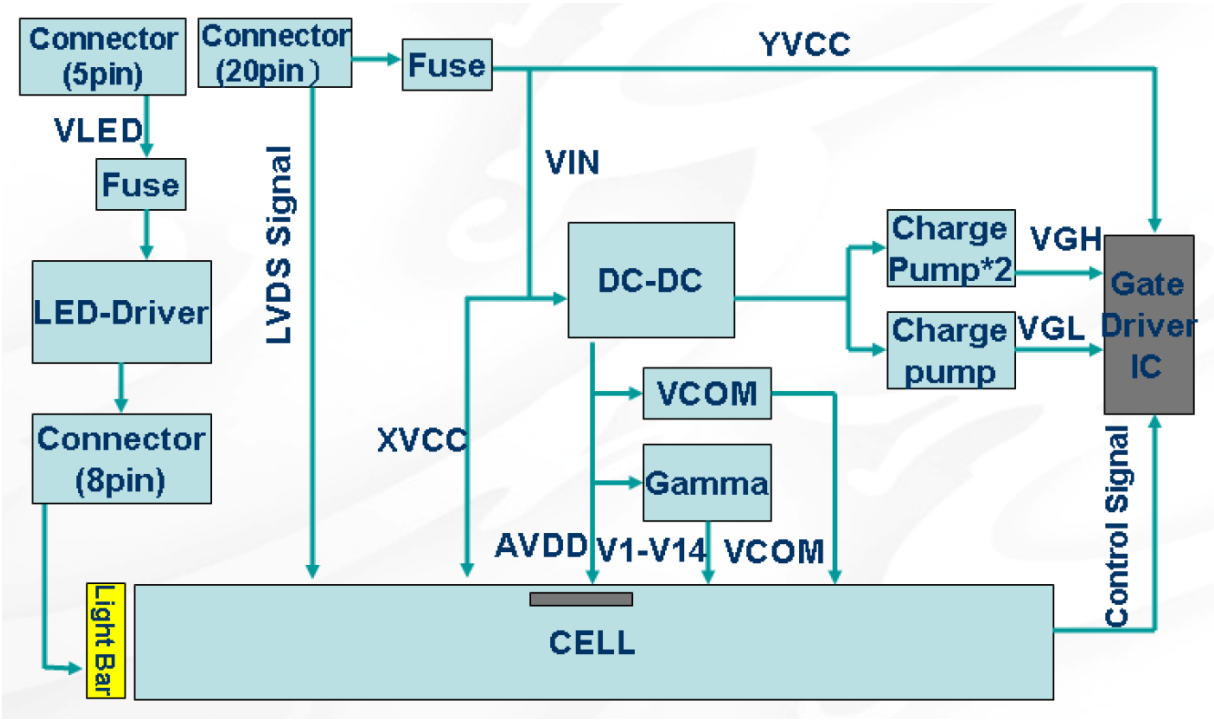


Fig4: Block Diagram

3.5 TIMING CHARACTERISTICS

3.4.1 Interface timings

Synchronization Method: DE only

Parameter	Symbol	Unit	Min.	Typ.	Max.
LVDS Clock Frequency <single >	fdck	MHz	45	51.2	57
H Total Time	Thp	clocks	1324	1344	1364
H Active Time	HA	clocks	1024	1024	1024
H Blanking Time	THBLANK	clocks	300	320	340
V Total Time	Tvp	lines	625	635	645
V Active Time	VA	lines	600	600	600
V Blanking Time	TVBLANK	lines	25	35	45
V Frequency	fv	Hz	55	60	65

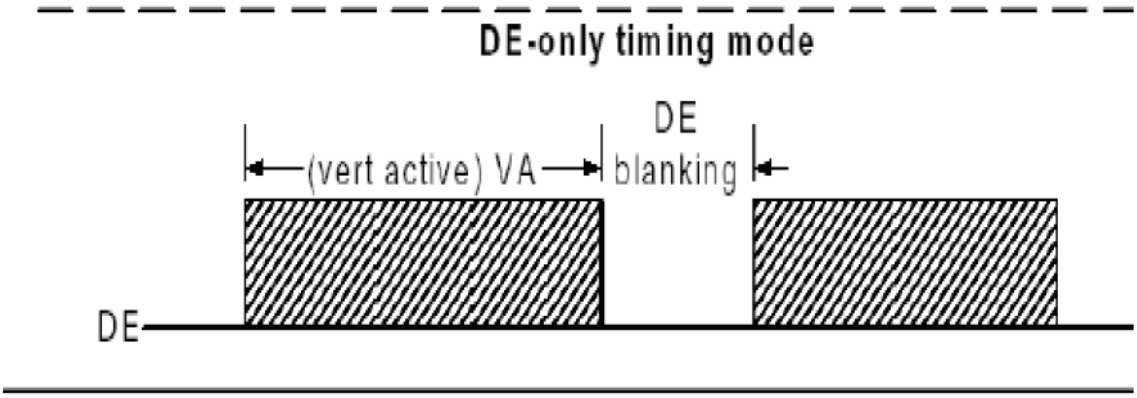


Fig 5: DE-only timing mode

3.4.2 Timing Diagram of Interface Signal

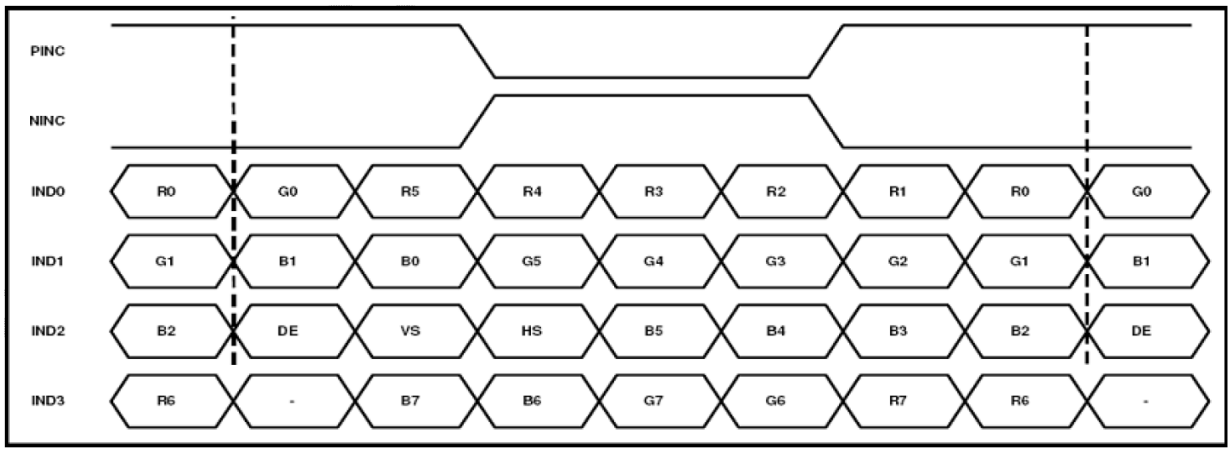
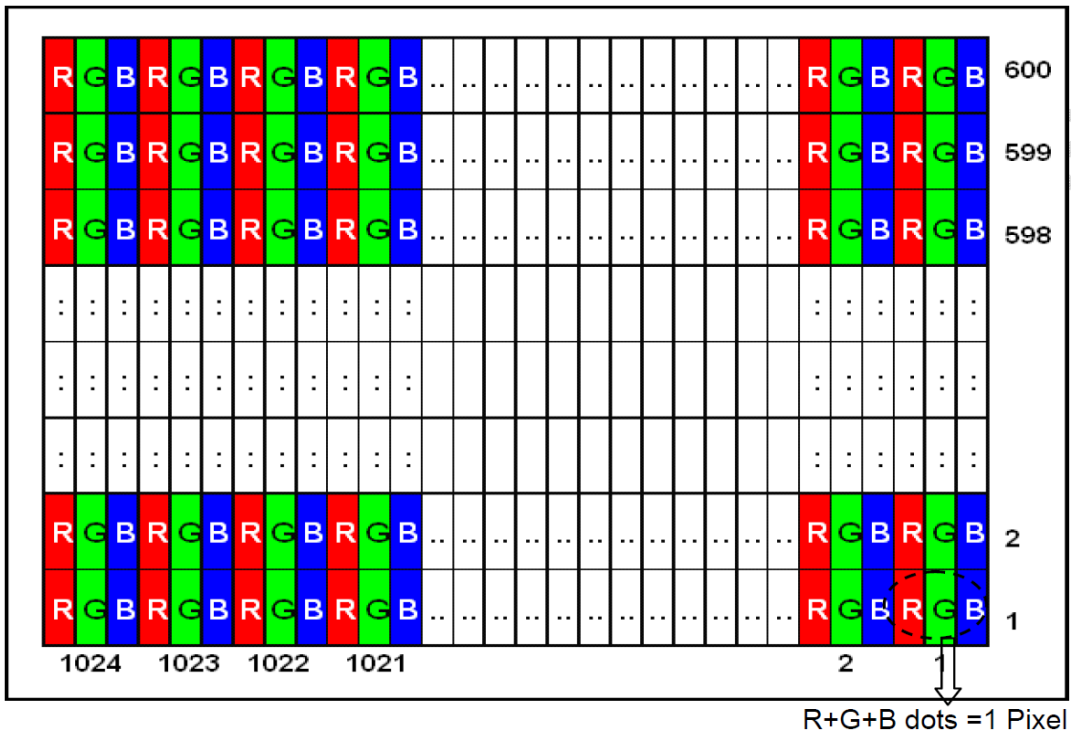


Fig6: LVDS Data Mapping

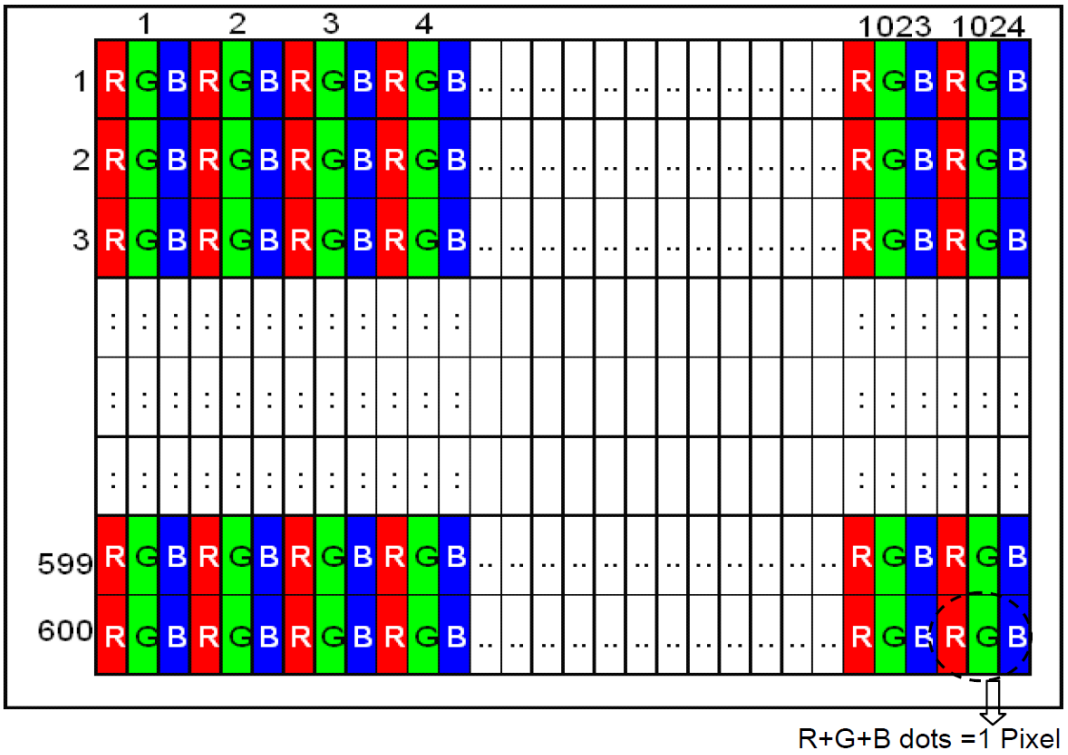
3.6 PIXEL DATA FORMAT

Fig 7: Pixel Format

REV=H



REV=L



3.7 POWER SEQUENCE

Power ON/OFF Sequence

VDD power on/off sequence is as follows. Interface signals are also shown in the chart.

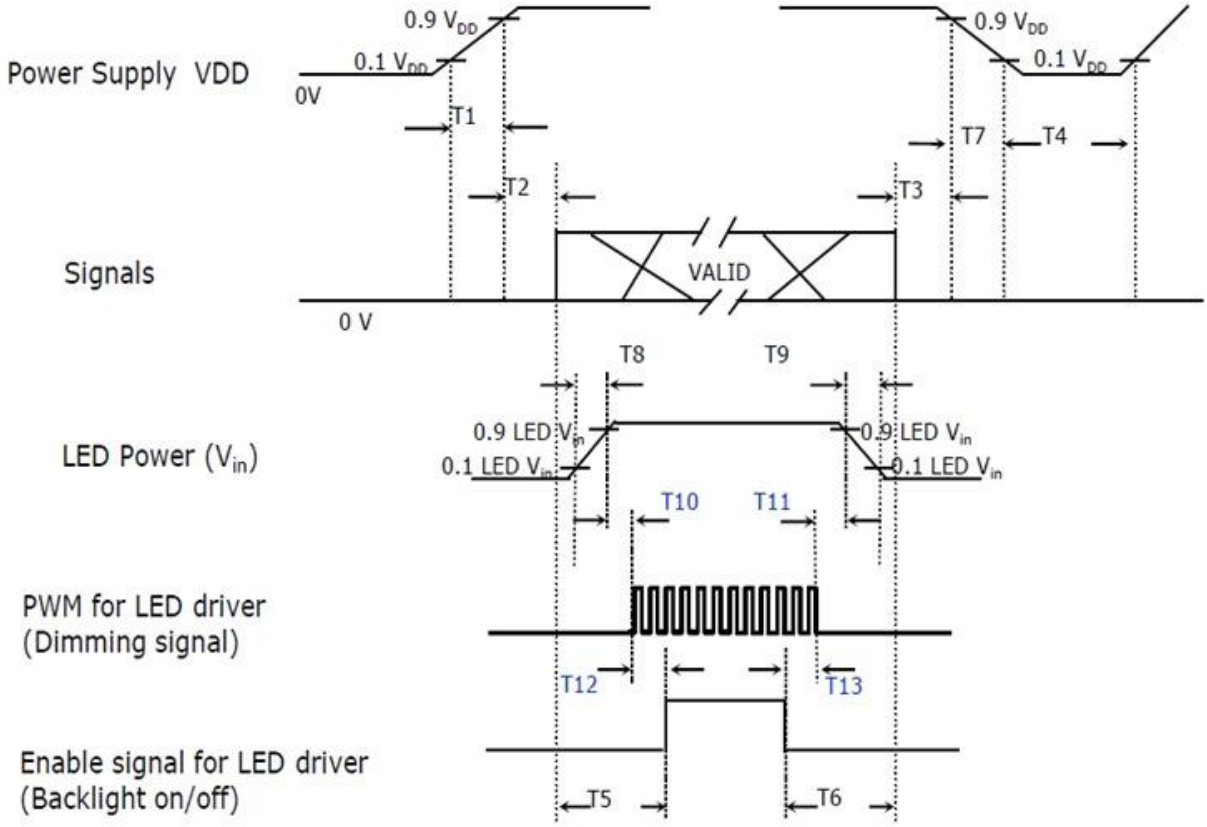


Fig 8: Power Sequencing

Table: Power sequence Requirement

Parameter	Symbol	Unit	min	typ	max
VDD rising Time from 10% to 90%	T1	ms	0.5	-	10
Delay from VDD to valid data at power ON	T2	ms	0	-	50
Delay from valid data OFF to VDD OFF at power OFF	T3	ms	0	-	50
VDD OFF time for Windows restart	T4	ms	500	-	-
Delay from valid data to B/L enable at power ON	T5	ms	200	-	-
Delay from valid data off to B/L disable at power OFF	T6	ms	200	-	-
VDD falling time from 90% to 10%	T7	ms	0	-	10
LED Vin rising time from 10% to 90%	T8	ms	0.5	-	10
LED Vin falling time from 90% to 10%	T9	ms	0.5	-	10
Delay from LED driver Vin rising time 90% to PWM ON	T10	ms	0	-	10
Delay from PWM Off to LED Driver Vin falling time 10%,Must Keep rule	T11	ms	0	-	-
Delay from PWM ON to B/L Enable ON, Must Keep rule	T12	ms	0	-	-
Delay from B/L Enable Off to PWM Off	T13	ms	0	-	-

4 OPTICAL SPECIFICATION

4.1 OPTICAL CHARACTERISTICS

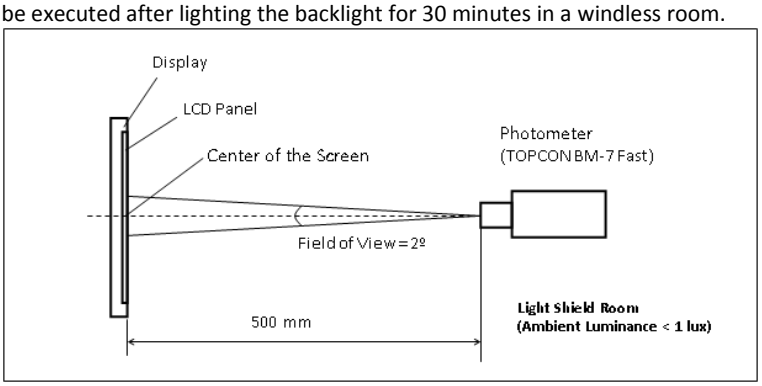
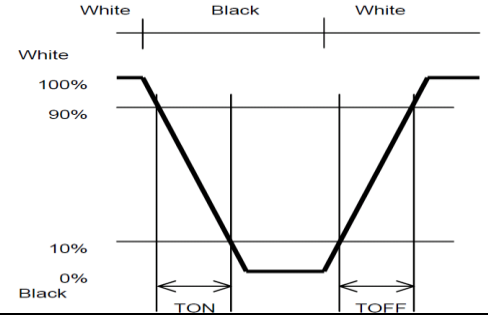
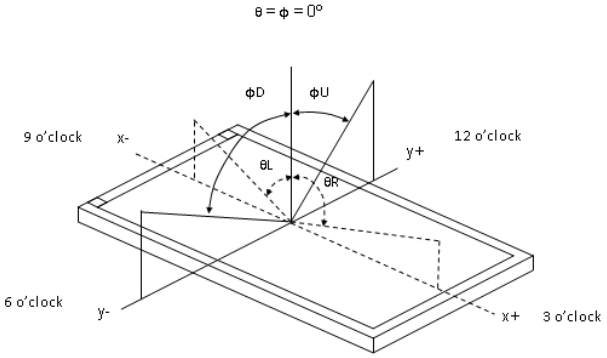
Driving condition: IOVCC = VCI = 2.8V, VSS = 0V
Backlight: I_LED=240 mA, V_LED=12V, PWM_LED: Duty 100%
Measured temperature: Ta ＝ 25° C

Item		Symbol	Condition	MIN	TYP	MAX	Unit	Note
Response Time		TR+TF	θ=Φ=0° Normal Viewing Angle	-	16	20	ms	2
Contrast Ratio		CR		400	500	-		3
Viewing Angle	Left	θL	CR ≥ 10	70	80	-	deg	4
	Right	θR		70	80	-	deg	
	Up	ϕU		70	80	-	deg	
	Down	ϕD		70	80	-	deg	
Colour Chromaticity	Red	Rx	CR ≥ 10	Typ.-0.03	0.579	Typ.+0.03	-	5
		Ry			0.344		-	
	Green	Gx			0.326		-	
		Gy			0.591		-	
	Blue	Bx			0.159		-	
		By			0.131		-	
	White	Wx		0.255	0.305	0.355	-	
		Wy		0.275	0.325	0.375	-	
Centre Brightness			centre	400	500	-	cd/m²	6
Brightness Distribution			9 Points	75	80	-	%	7

Note: Measurement Setup:

The LCD module should be stabilized at given temperature (25°C) for 15 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting backlight 15 minutes in a windless room.

Test Method

Note	Item	Test method
1	Setup	The display should be stabilised at a given temperature for 30 minutes to avoid abrupt temperature change during measuring. In order to stabilise the luminance, measurements should be executed after lighting the backlight for 30 minutes in a windless room. 
2	Response time	Measure output signal waveform by the luminance meter when raster of window pattern is changed from white to black and from black to white. 
3	Contrast ratio	Measure maximum brightness and minimum brightness at the centre of the screen by displaying raster or window pattern. Then calculate the ratio between these two values. Contrast Ratio (CR) = $\frac{\text{Brightness of unselected position (white)}}{\text{Brightness of selected position (black)}}$
4	Viewing angle Horizontal θ Vertical Ø	Move the luminance meter from right to left and up and down and determinate the angles where contrast ratio is 10 
5	Colour chromaticity	Measure chromaticity coordinates x and y of CIE1931 colorimetric system
6	Centre brightness	Measure the brightness at the centre of the screen
7	Brightness distribution	(Brightness distribution)= 100 x B/A % A: max. brightness of the 9 points B: min. brightness of the 9 points

5 BACKLIGHT SPECIFICATION

5.1 LED DRIVING CONDITIONS

5.1.1 LED INTERFACE PIN ASSIGNMENT

Connector mode: MSB24038P5A or compatible
Manufactured: STM or compatible
Mating model number: P24038P5A or compatible

Pin #	Signal Name	Description	Remarks
1	VCC	Power Supply, 12V (typical)	
2	GND	Ground	
3	EN	3.3V (typical)	
4	PWM	3.3V (typical)	
5	NC	Not Connection	

5.1.2 PARAMETER GUIDELINE OF LED BACKLIGHT

ITEM		Min.	Typ.	Max.	Units	Condition
VIN_VLED		8	12	16	V	Duty=100%
I_{VIN_LED}		-	-	543	mA	
F_{DIM}		100	-	1k	Hz	
DUTY		5	-	100	%	
CTRL	VIH	2	3.3	5	V	
	VIL	0	-	0.8		
Vout		-	(22.4)	-	V	
Iout		-	(160)	-	mA	
Efficiency		(80)				
L_T		50,000	-	-	Hours	LED Life Time

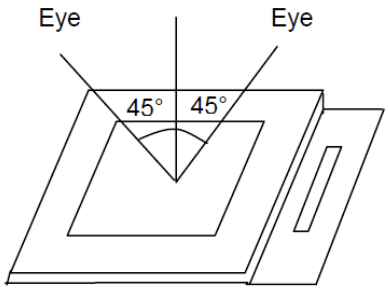
Note1: The LED life time define as the estimated time to 50% degradation of initial luminous.

6 QUALITY ASSURANCE SPECIFICATION

6.1 DELIVERY INSPECTION STANDARDS

Inspection Conditions

Inspection distance: 30 cm ± 2 cm
Viewing angle: ±45°



Environmental Conditions

Ambient temperature: 23°C ±5°C
Ambient humidity: 55±10% RH
Ambient illumination: 1000~1500 lux

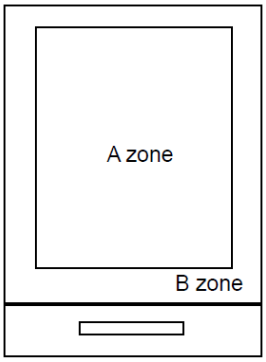
Sampling Conditions

1. Lot size: quantity of shipment lot per model
2. Sampling method:

Sampling Plan		ANSI / ASQC Z1.4-1993
		Normal inspection, Single Sampling
AQL	Major Defect	0.65%
	Minor Defect	1.5%

Definition of Area

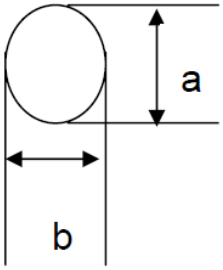
A zone: active area
B zone: viewing area

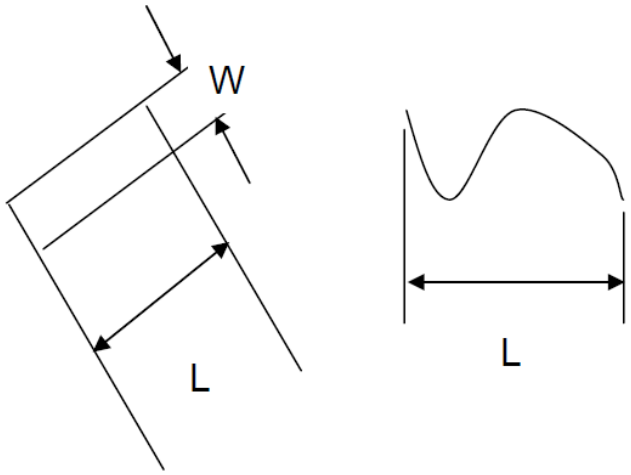


Basic Principle

A set of sample to indicate the limit of acceptable quality level shall be discussed should a dispute occur.

Inspection Criteria

<table>
<tr><th>No.</th><th>Item</th><th>Criteria (Unit: mm)</th></tr>
<tr><td>01</td><td>Black / White spot
Foreign material
(Round type)
Pinholes
Stain
Particles inside cell.
(Minor defect)</td><td>


φ= (a + b) /2
<table>
<tr><th>Area / Size</th><th>Acc. Qty</th></tr>
<tr><td>φ≤0.10</td><td>Ignore</td></tr>
<tr><td>0.10<φ≤0.15</td><td>2</td></tr>
<tr><td>0.15<φ≤0.25</td><td>1</td></tr>
<tr><td>0.25<φ</td><td>0</td></tr>
<tr><td>Total</td><td>2 no include
φ≤ 0.10</td></tr>
</table>
Distance between 2 defects should more than 3mm apart.
</td></tr>
<tr><td>02</td><td>Black and White line
Scratch
Foreign material
(Line type)
(Minor defect)</td><td>


</td></tr>
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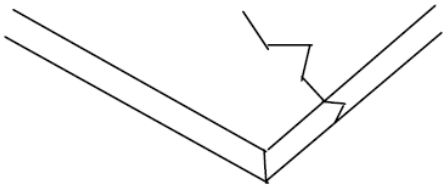
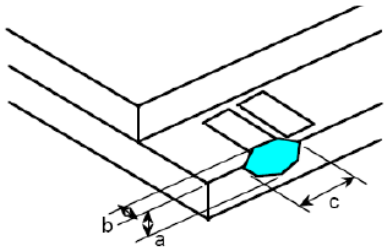
		<table><tr><th>Length</th><th>Width</th><th>Acc. Qty</th></tr><tr><td>/</td><td>W ≦ 0.03</td><td>Ignore</td></tr><tr><td>L ≦ 2.5</td><td>0.03 < W ≦ 0.05</td><td>3</td></tr><tr><td>L ≦ 2.5</td><td>0.05 < W ≦ 0.10</td><td>2</td></tr><tr><td>/</td><td>0.1 < W</td><td>0</td></tr><tr><td colspan="2">Total</td><td>3</td></tr></table> Distance between 2 defects should more than 3mm apart. Scratches not viewable through the back of the display are acceptable.
03	Glass Crack (Minor defect)	 Crack is potential to enlarge, any type is not allowed.

04	Glass Chipping Pad Area: (Minor defect) 	<table><tr><th>Length and Width</th><th>Acc. Qty</th></tr><tr><td>c > 3.0, b< 1.0</td><td>1</td></tr><tr><td>c< 3.0, b< 1.0</td><td>3</td></tr><tr><td colspan="2">a<Glass Thickness</td></tr></table>

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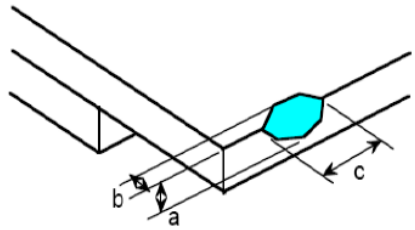
<td>Glass Chipping Rear of Pad Area:
(Minor defect)
 
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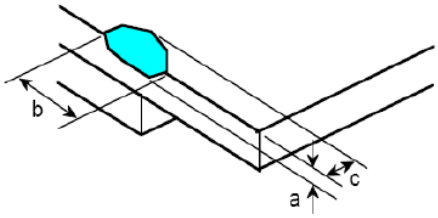
<td>06</td>
<td>Glass Chipping Except Pad Area:
(Minor defect)
 
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<tr><td>c< 3.0, b< 1.0</td><td>2</td></tr>
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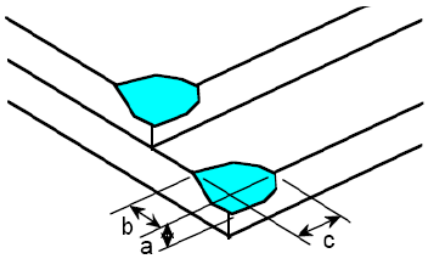
<tr>
<td>07</td>
<td>Glass Corner Chipping:
(Minor defect)
 
</td>
<td><table>
<tr><th>Length and Width</th><th>Acc. Qty</th></tr>
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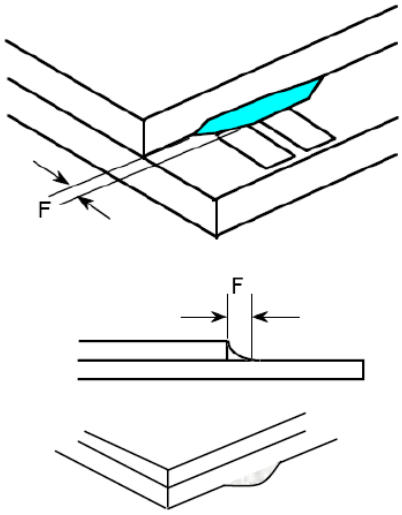
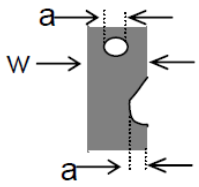
<tr><td colspan="2">a<Glass Thickness</td></tr>
</table></td>
</tr>
</table>

<table>
<tr>
<td>08</td>
<td>Glass Burr:
(Minor defect)
  </td>
<td><table><tr><th>Length</th><th>Acc. Qty</th></tr><tr><td>F < 1.0</td><td>Ignore</td></tr></table>
Glass burr don’t affect assemble and module dimension.</td>
</tr>
<tr>
<td>09</td>
<td>FPC Defect:
(Minor defect)
  </td>
<td>9.1 Dent, pinhole width a<w/3.
(w: circuitry width.)
9.2 Open circuit is unacceptable.
9.3 No oxidation, contamination and distortion.</td>
</tr>
<tr>
<td>10</td>
<td>Bubble on Polarizer
(Minor defect)</td>
<td colspan="2"><table><tr><th>Diameter</th><th>Acc. Qty</th></tr><tr><td>φ≤0.20</td><td>Ignore</td></tr><tr><td>0.20 <φ≤0.30</td><td>4</td></tr><tr><td>0.30 < φ</td><td>None</td></tr></table></td>
</tr>
<tr>
<td>11</td>
<td>Dent on Polarizer
(Minor defect)</td>
<td colspan="2"><table><tr><th>Diameter</th><th>Acc. Qty</th></tr><tr><td>φ≤0.20</td><td>Ignore</td></tr><tr><td>0.20 <φ≤0.30</td><td>4</td></tr><tr><td>0.30 < φ</td><td>None</td></tr></table></td>
</tr>
<tr>
<td>12</td>
<td>Bezel</td>
<td colspan="2">12.1 No rust, distortion on the Bezel.
12.2 No visible fingerprints, stains or other contamination.</td>
</tr>
</table>

13	Touch Panel	D: Diameter W: width L: length 13.1 Spot: D<0.25 is acceptable 0.25≤D≤0.4 2dots are acceptable and the distance between defects should more than 10 mm. D>0.4 is unacceptable 13.2 Dent: D>0.40 is unacceptable 13.3 Scratch: W≤0.03, L≤10 is acceptable, 0.03<W≤0.10, L≤10 is acceptable Distance between 2 defects should more than 10 mm. W>0.10 is unacceptable.
14	PCB	14.1 No distortion or contamination on PCB terminals. 14.2 All components on PCB must same as documented on the BOM/component layout. 14.3 Follow IPC-A-600F.
15	Soldering	Follow IPC-A-610C standard
16	Electrical Defect (Major defect)	The below defects must be rejected. 16.1 Missing vertical / horizontal segment, 16.2 Abnormal Display. 16.3 No function or no display. 16.4 Current exceeds product specifications. 16.5 LCD viewing angle defect. 16.6 No Backlight. 16.7 Dark Backlight. 16.8 Touch Panel no function. 16.9 Dark Dot –one Allowed. 16.10 Bright Dot – one Allowed. Remark: 1. A pixel defect is acceptable if one color is none functional and causes a bright dot. The display may have one case where one color is out and cause a dark dot. 2. Bright dot caused by scratch and foreign object accords to item 1.

Remark: LCD Panel Broken shall be rejected. Defect out of LCD viewing area is acceptable.

Classification of Defects

Visual defects (except no or wrong label) are treated as minor defects, while electrical defects are treated as major defects.
Two minor defects are equal to one major defect in lot sampling inspection.

Identification / marking criteria

Any unit with illegible / wrong / double or no marking / label shall be rejected.

6.2 DEALING WITH CUSTOMER COMPLAINTS

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.

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		Test Condition
Durability Test	High Temperature Storage	Ta= 85˚C 300h
	Low Temperature Storage	Ta=-30˚C 300h
	Temperature Cycle Storage	-20°C for 30 min, then 70°C for 30 min, 20 cycles
	High Temperature Operation	Tp= 85°C 300h
	Low Temperature Operation	Tp= -30°C 300h
	High Temperature & Humidity Operation	Tp= 40°C RH= 90% 96h Non condensing
	Thermal Shock Resistance	-20°C to 60°C, 1h/each cycle, 100 cycles

Note: Ta=ambient temperature Tp= Panel temperature

Notes:
1. No dew condensation to be observed.
2. The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.
3. No cosmetic or functional defects should be allowed.
4. Total current consumption should be less than twice the initial value.

8 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 Trichlorotriflorothane.
Do not wipe the display surface with dry or hard materials that will damage the polariser 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°C ± 10°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).