

DMT057VGNTRS0-1B

PRODUCT SPECIFICATION

Version 1.0
Mar 19, 2024



<i>Customer's Approval</i>	
<u>Signature</u>	<u>Date</u>

Prepared by Yvette Hsieh
Approved by Evan Huang

Revision History

VERSION	DATE	DESCRIPTION	AUTHOR
0.1	Jul 04, 2022	Preliminary	Victoria Ho
0.2	Aug 16, 2022	1. Modify mechanical drawing – p.6 2. Revised Electrical and Optical specification – p.11 & p.14	Victoria Ho
0.3	Jan 30, 2023	1. Modify mechanical drawing – p.6 2. Modify the Pins assignment (Pin 3 、 4 、 30 、 31)– p.8	Victoria Ho
0.4	Feb 06, 2023	1. Added directions of L/R and U/D – p.9 2. Modify the viewing angle– p.15	Victoria Ho
0.5	Mar 08, 2023	1. Changed the latch of DCLK. – p.8 2. Modify the Pins assignment (Pin 3 、 4 、 30 、 31)– p.8 3. Added ELECTRICAL SPECIFICATION TOUCH – p.15	Victoria Ho
0.6	Mar 29, 2023	1. Modify pin name of Drawing – p.6 2. Modify the waveform of AC Electrical Characteristics- p.11	Victoria Ho
0.7	Jun 28, 2023	1. Added RTP specification – p.15~16	Yvette Hsieh
1.0	Mar 19, 2024	1. Add product picture and Legal Notice 2. Add weight – p.5 3. Add operating current – p.7 4. Add backlight circuit diagram – p.19 03/19/2024 Initial Release	Yvette Hsieh

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1. General Description

1.1 Introduction

This is a 5.7" size colour active matrix TFT LCD module that uses amorphous silicon TFT as a switching device. The display is normally white mode, transmissive, and featuring high contrast and excellent colour saturation. The resolution of the TFT-LCD is 640 x 480 and can display up to 262K colours. The display module supports 18-bit RGB interface and tape bonding 4 wire resistive touch panel.

1.2 Main Features

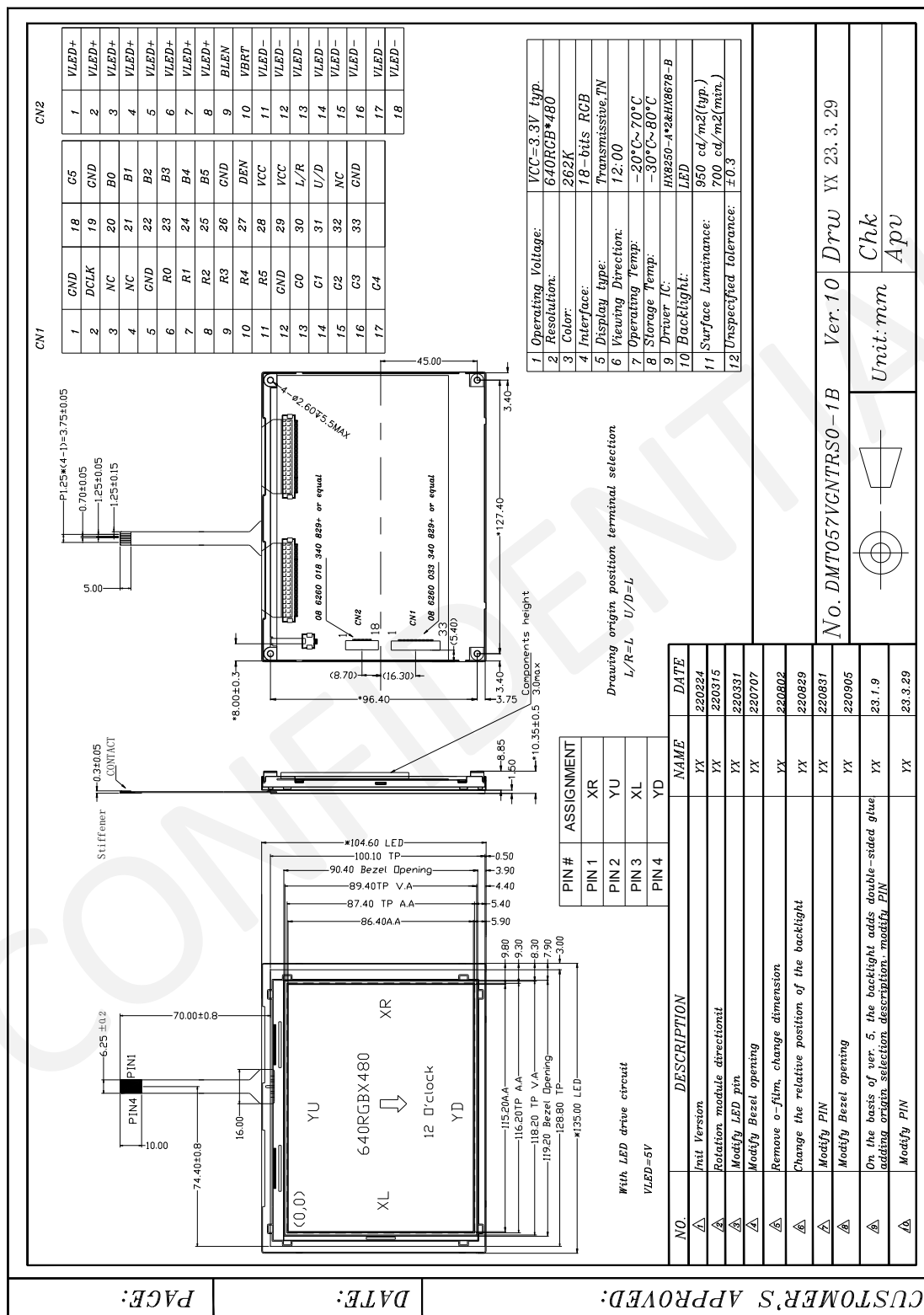
Item	Contents
Display Type	TFT LCD
Screen Size	5.7" Diagonal
Display Format	640 x RGB x 480 Dots
No. of Colour	262K
Overall Dimensions	135.00 (W) x 104.60 (H) x 10.35±0.5 (D) mm
Active Area	115.2 (W) x 86.4 (H) mm
Mode	Normally White / TN / Transmissive
Surface Treatment	Anti-glare (2H)
Viewing Direction	12 o'clock
Interface	18-bit RGB
Driver IC	HX8250-A*2 & HX8678-A
Backlight Type	LED, White, 27 chips
Touch Panel	Resistive Touch Panel
Touch Interface	4 Wire
Bonding Type	Tape Bonding
Operating Temperature	-20°C ~ +70°C
Storage Temperature	-30°C ~ +80°C
ROHS	Compliant to RoHS

2. Mechanical Specification

2.1 Mechanical Characteristics

Item	Characteristic	Unit
Display Format	640 x RGB x 480	Dots
Overall Dimensions	135.00 (W) x 104.60 (H) x 10.35±0.5 (D)	mm
Active Area	115.2 (W) x 86.4 (H)	mm
Dot Pitch	0.18 (W) x 0.18(H)	mm
Weight	162	g
IC Controller/Driver	HX8250-A*2 & HX8678-A	

2.2 Mechanical Drawing



3. Electrical Specification

3.1 Absolute Maximum Ratings

(AGND = GND = 0V, Ta = 25°C)

Item	Symbol	Min	Max	Unit	Note
Digital Supply Voltage	VCC	-0.3	7	V	1
Operating Temperature	T _{OP}	-20	70	°C	-
Storage Temperature	T _{ST}	-30	80	°C	-

Note 1: When this module is used beyond the above absolute maximum ratings, permanent breakage of the module may occur. For normal operations, it is desirable to use this module under the conditions according to Section 3.2 "Electrical Characteristics", to avoid malfunctioning.

Note 2: Background colour changes slightly depending on ambient temperature. This phenomenon is reversible.

Note 3: Please refer to item of RELIABILITY.

3.2 Electrical Characteristics

Recommended Operating Condition

AGND = GND = 0V, Ta = 25°C

Item	Symbol	Condition	Min	Typ.	Max	Unit	Note
Power Supply Voltage	VCC	-	2.7	3.3	3.6	V	-
Operating current	I _{CC}	-	-	120	-	mA	-
Level Input High Voltage	V _{IH}	-	0.7 VCC	-	VCC	V	-
Level Input Low Voltage	V _{IL}	-	GND	-	0.3 VCC	V	-

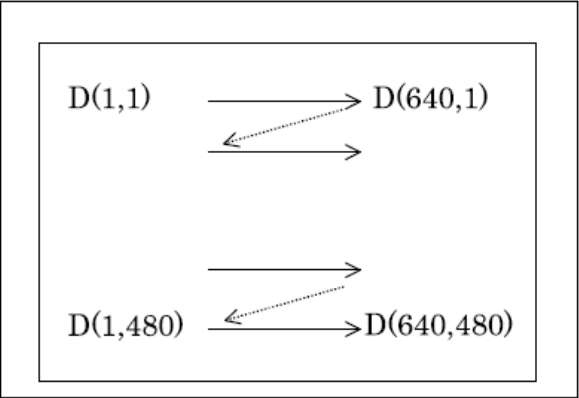
3.3 Interface Pin Assignment

CN1(08 6260 033 340 829+ or equivalent)

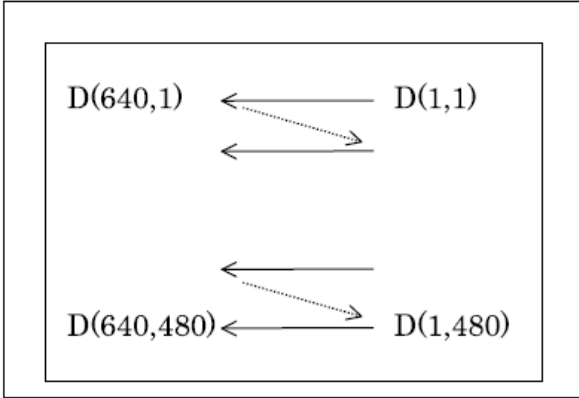
No.	Symbol	I/O	Function
1	GND	P	Ground
2	DCLK	I	Clock signal. Latching data at the falling edge.
3	NC(GND)	-	No connection
4	NC(GND)	-	No connection
5	GND	P	Ground
6-11	R0-R5	I	Red data bit
12	GND	P	Ground
13-18	G0-G5	I	Green data input
19	GND	P	Ground
20-25	B0-B5	I	Blue data bit
26	GND	P	Ground
27	DEN	I	Input data enable control. When DE mode, active High to enable data input
28	VCC	P	Analog power
29	VCC	P	Analog power
30	L/R	I	The shift direction of device internal shift register is controlled by this pin as shown below: LR=L, Normal scan LR=H, Left/Right reverse scan
31	U/D	I	Up/down scan setting. When UD=L, normal scan. When UD=H, Up/Down reverse scan.
32	NC	-	No connection
33	GND	P	Ground

Note 1:

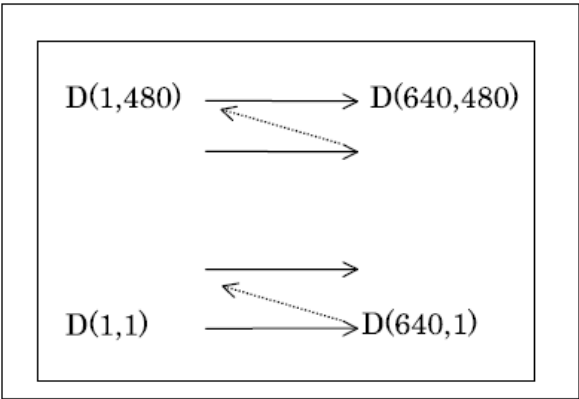
R/L=Low, U/D=Low



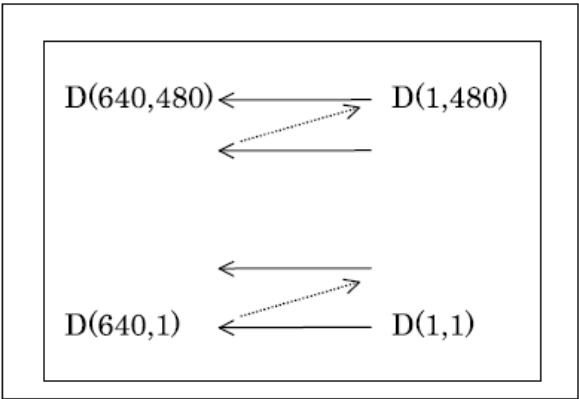
R/L=High, U/D= Low



R/L=Low, U/D=High



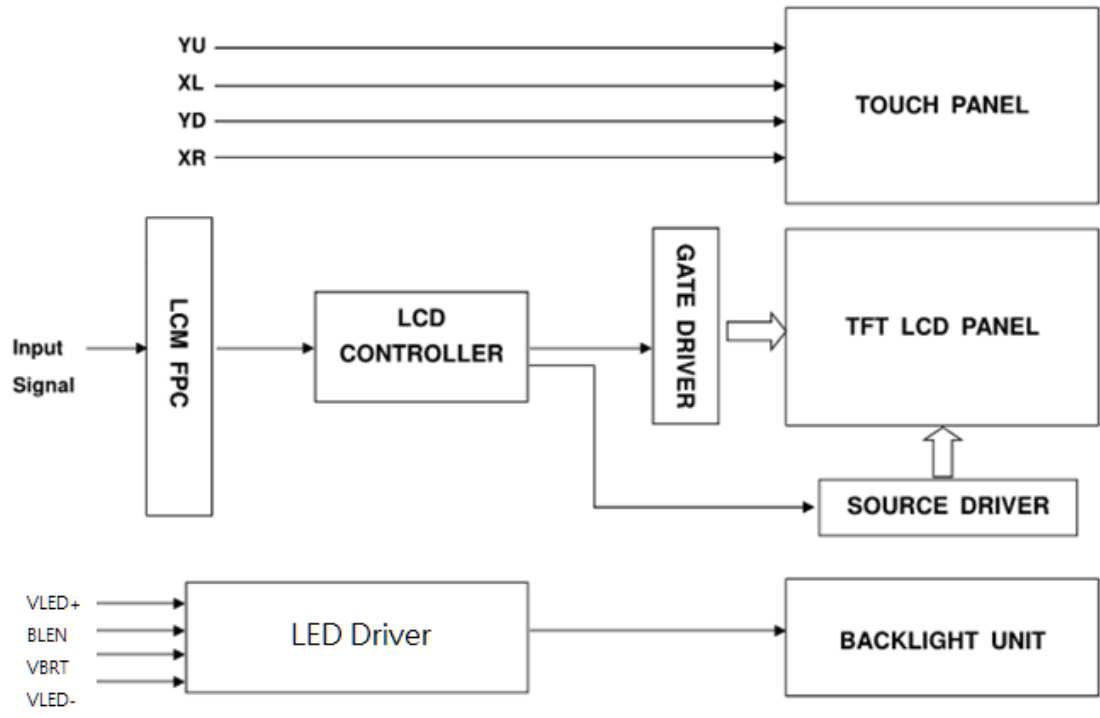
R/L=High, U/D=High



CN2

No.	Symbol	I/O	Function
1-8	VLED+	P	LED anode
9	BL EN	I	ON-OFF (High: ON, Low: OFF)
10	VBRT	I	Voltage for dimming
11-18	VLED-	P	LED cathode

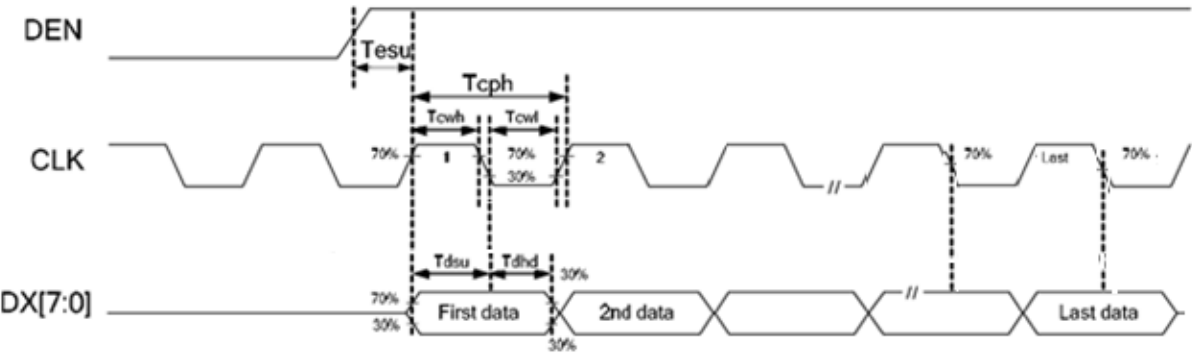
3.4 Block Diagram



3.5 Timing Characteristics

3.5.1 AC Electrical Characteristics

Item	Symbol	Min	Typ.	Max	Unit
Data Setup Time	Tdsu	10	-	-	ns
Data Hold Time	Tdhd	10	-	-	ns
RSTB Low Pulse Width	TRst	10	-	-	us
DCLK Cycle Time	Tcph	-	39.7	-	ns
DCLK Pulse Duty	Tcwh	40	50	60	%
DEN Setup Time	Tesu	10	-	-	ns

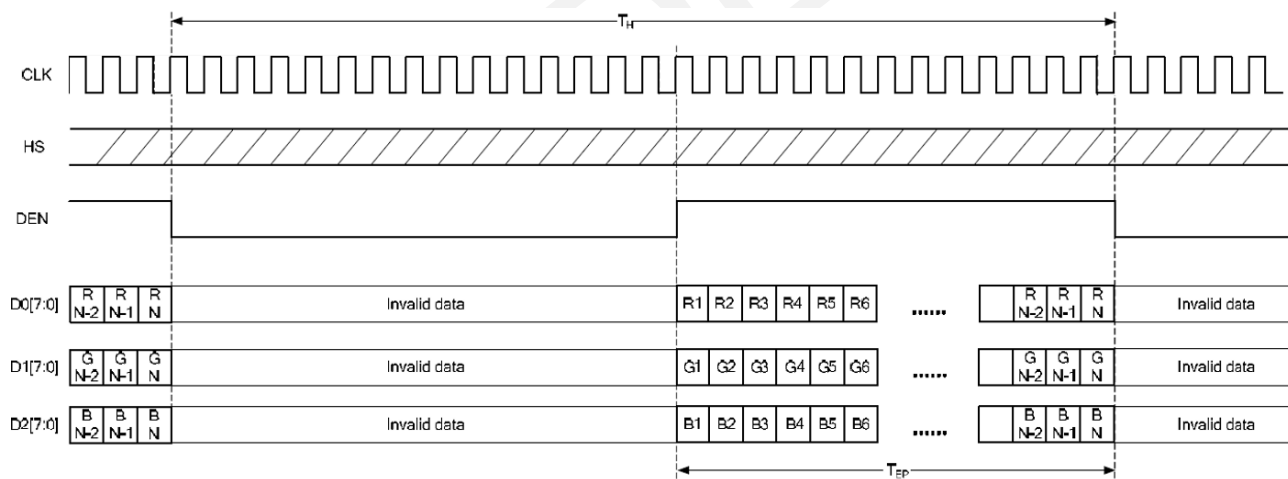


3.5.2 Input Timing

Item	Symbol	Min	Typ.	Max	Unit	Note
CLK frequency	F_{CPH}	21.7	25.175	27.3	MHz	-
CLK period	T_{CPH}	36.6	39.7	46.1	ns	-
CLK pulse duty	T_{CWH}	40	50	60	%	-
HS period	T_H	-	800	-	T_{CPH}	-
HS Effective time	T_{HA}	640			T_{CPH}	-
HS pulse width	T_{WH}	5	30		T_{CPH}	-
HS-first horizontal data time	T_{HS}	112	144	175	T_{CPH}	-
DEN pulse width	T_{EP}	-	640	-	T_{CPH}	-
VS pulse width	T_{WV}	1	3	5	T_H	-
VS-DEN time	T_{STV}	-	35	-	T_H	-
VS period	T_V	-	525	-	T_H	-
VS Effective time	T_{VA}	480			T_H	-

Note: When SYNC mode is used, 1st data start from 144th CLK after HS falling.

RGB DE Mode Horizontal Data Format



3.5.3 DC Electrical Characteristics

Item	Symbol	Min	Typ.	Max	Unit
Power Supply Voltage	VCC	2.7	3.3	3.6	V
Low Level Input Voltage	V _{IL}	0	-	0.3 VCC	V
High Level Input Voltage	V _{IH}	0.7 VCC	-	VCC	V
Pull High Resistance	R _H	600	900	1200	kΩ
Pull Low Resistance	R _L	600	900	1200	kΩ
Analog Standby Current	I _{VDD}			10	uA
Digital Standby Current	I _{VCC}			10	uA

3.5.4 Power ON/OFF Sequence

To prevent the device damage from latch up, the power ON/ OFF sequence shown below must be followed.

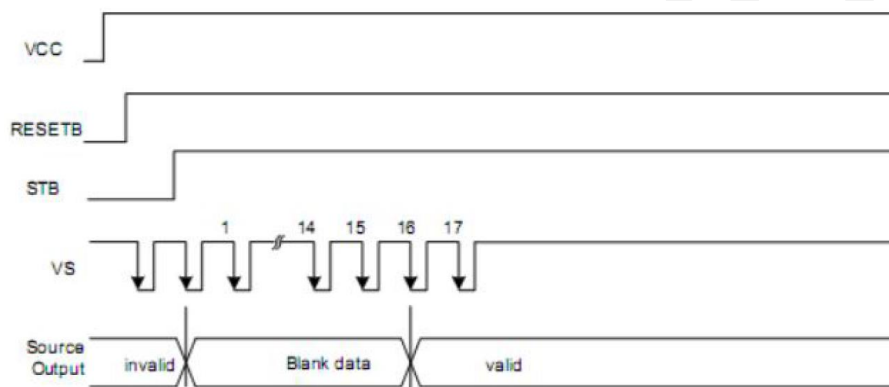
Power ON: VCC, GND->VDD

Power OFF: VSS->VCC, GND

HX8250-A01 has a power ON sequence control function. There are two kinds of the mode. One is auto mode, and another is manual mode.

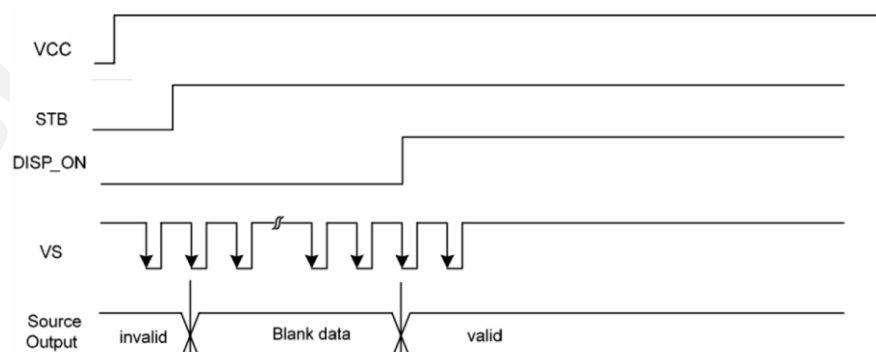
Auto Mode: When power is ON, blank data is outputted for 16-frames (default value) first, from the falling edge of the following VS signal. The blank data would be gray level 255 for normally white panel. It can be defined in register R5 A_TIME1(bit 5) and A_TIME0(bit 4) when AUTO_DP(bit 7) = "H"

Power on control for Auto Mode



Manual Mode: When power is ON, you should set the register R5 AUTO_DP(bit 7) = "L" to stay at the manual mode. Blank data is outputted until the DISP_ON(bit 6) = H then display the normal image.

Power on control for Manual Mode



4. Electrical Specification Touch

4.1 Construction

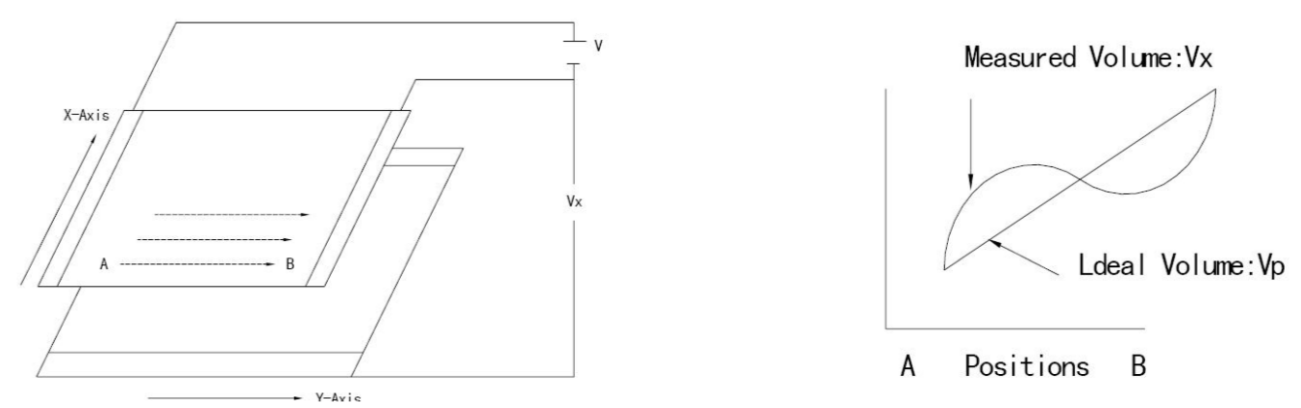
Construction	Materials	Thickness	Construction	Materials	Thickness
Up circuit	ITO Film	0.188mm	Spacer	Spacer	0.1mm
Lower circuit	ITO Glass	1.1mm	Connection	FPC	0.3mm
Spacer	3M7956MP	0.15mm			

4.2 Conditions of Use and Storage

Item	Value (Condition)	Note
Temperature Range Upon Operation	-20°C~70°C (Humidity: 20%~90%; non-condensing)	In a simple substance
Temperature Range Upon Storage	-30°C~80°C (Humidity: 20%~90%; non-condensing)	In a simple substance

4.3 Electrical Characteristics

Item	Value	Note
Operating Voltage	DC ≤ 10V	-
Max current	1mA	
Insulation Resistance	20MΩ or above (DC 25V)	Connect X + ~X- and Y+ ~Y-, apply 25VDC Between X and Y for perform measurements
Resistance between Terminals	X direction [Film side]: 371~866Ω	-
	Y direction [Glass side]: 236~551Ω	
Chattering Times	<15 msec	-
Linearity	≤ 1.5%	-



4.4 Mechanical Characteristics

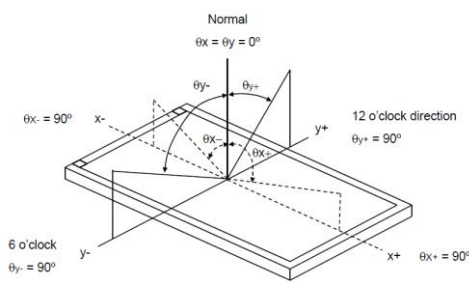
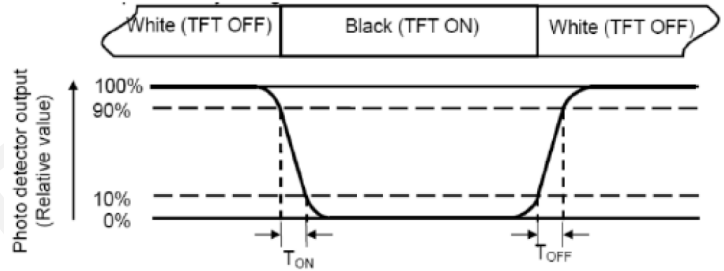
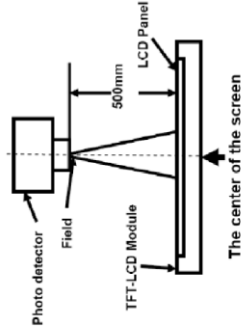
Item		Value	Note
Operating force		30-80g	-
Surface Hardness		≥3H	-
Optical Characteristics	Transparency	≥75%	-
	Haze	≤15%	
	Clarity	> 65%	
Operation lift	Tapping times	1,000,000 times	-
	Pen sliding times	100,000 times	

5. Optical Specification

5.1 Optical Characteristics

Characteristics		Symbol	Conditions	Min	Typ.	Max	Unit	Note
Contrast Ratio		CR	$\theta = 0^{\circ}$	200	300	-	-	1, 2
Response time (25°C)		TR + TF	Normal viewing angle	-	20	30	ms	1, 3
Viewing Angle	Left	θ_{x-}	CR>10	-	70		-	1, 4
	Right	θ_{x+}		-	70			
	Up	θ_{y+}		-	60	-		
	Down	θ_{y-}		-	40	-		
Colour Chromaticity	Red	Rx		(0.587)	(0.627)	(0.667)	-	1, 4
		Ry		(0.305)	(0.345)	(0.385)		
	Green	Gx		(0.587)	(0.627)	(0.667)		
		Gy		(0.305)	(0.345)	(0.385)		
	Blue	Bx		(0.271)	(0.311)	(0.351)		
		By		(0.510)	(0.550)	(0.590)		
	White	Wx		(0.274)	(0.314)	(0.354)		
		Wy		(0.305)	(0.345)	(0.385)		
Luminance		Lv		500	680	-	cd/m ²	4

Note: Measuring Condition = in dark room, at ambient temperature 25±2°C, for 15min, warm-up time.

Note	Item	Test method														
1	Definition of Viewing Angle (θ_x, θ_y)															
2	Definition of Contrast Ratio (CR)	Measured at the center point of panel $\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD is at "white state"}}{\text{Luminance measured when LCD is at "black state"}}$														
3	Definition of Response Time (T_R, T_F)	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%. 														
4	Definition of Optical Measurement Setup	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.  <table><thead><tr><th>Item</th><th>Photo detector</th><th>Field</th></tr></thead><tbody><tr><td>Contrast Ratio</td><td rowspan="3">CS1000</td><td rowspan="3">1°</td></tr><tr><td>Luminance</td></tr><tr><td>Lum Uniformity</td></tr><tr><td>Chromaticity</td><td>CS1000</td><td></td></tr><tr><td>Response Time</td><td>DMS703</td><td>-</td></tr></tbody></table>	Item	Photo detector	Field	Contrast Ratio	CS1000	1°	Luminance	Lum Uniformity	Chromaticity	CS1000		Response Time	DMS703	-
Item	Photo detector	Field														
Contrast Ratio	CS1000	1°														
Luminance																
Lum Uniformity																
Chromaticity	CS1000															
Response Time	DMS703	-														

6. LED Backlight Specification

6.1 LED Backlight Characteristics

The back-light system is edge-lighting type with 27 chips LED.

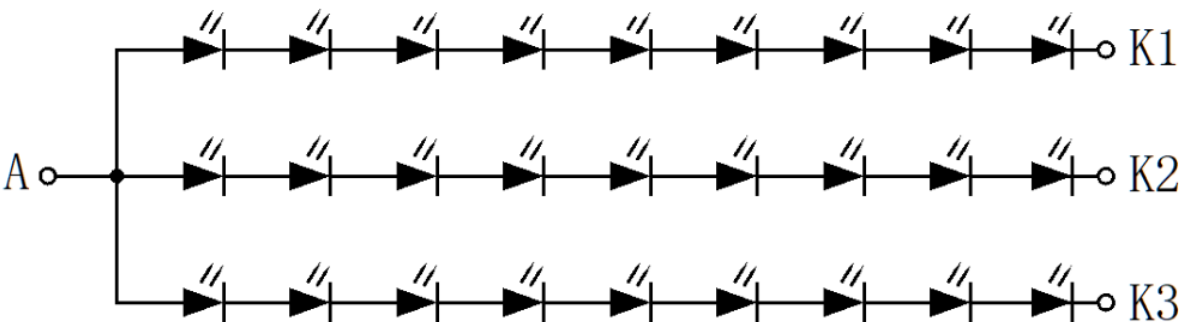
Item		Symbol	Condition	Min	Typ.	Max	Unit	Note
Forward Current		I_{BL}	$T_a=25^{\circ}\text{C}$	-	400	-	mA	-
Forward Voltage		V_L		-	5	-	V	-
LED Lifetime		Hr		50000	-	-	Hour	1, 2
Input & Control Signal	On	V_{ON}		0.8VL	-	VL	V	-
	Off	V_{OFF}		-	-	0.2VL	V	-
	Voltage for dimming	V_{BRT}		0	-	2.5	V	-

Note 1: LED lifetime (Hr) can be defined as the time in which it continues to operate under the condition:

$T_a=25\pm3^{\circ}\text{C}$, typical IL (I_f) value indicated in the above table until the brightness becomes less than 50%.

Note 2: The “LED lifetime” is defined as the module brightness decreases to 50% original brightness at $T_a=25^{\circ}\text{C}$ and $I_L=400\text{mA}$. The LED lifetime could be decreased if operating IL is larger than 400mA. The constant current driving method is suggested.

6.2 Internal Circuit Diagram

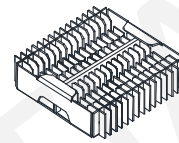
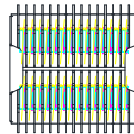
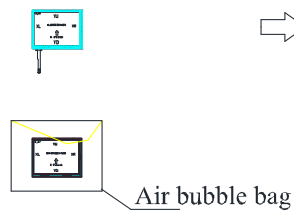


7. Packaging

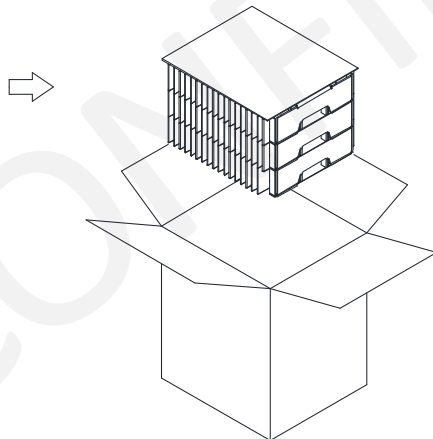
Packing Process:

1) Putting one Module into
a black ESD bag

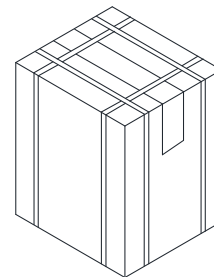
2) Putting 28 pcs Modules into the inner box
(TYPE:130C)



4) Putting 3 small inner
boxes into one out
carton



5) Packing finished



Note: $28 \times 3 = 84$ pcs/Outcarton

Dimension (Small carton): 385*325*130mm

Dimension (Out carton): 394*344*470mm

8. Quality Assurance Specification

8.1 Conformity

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

8.2 Environment Required

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

Temperature:	25 ± 5°C
Humidity:	65% ± 5% RH
Viewing Angle:	Normal Viewing Angle*
Illumination:	Single fluorescent light (40W)
Viewing distance:	35 ± 5cm
Inspection Time (Perceptibility Test Time):	20 seconds max.
Finger glove (or finger cover) must be worn by the inspector.	
Inspection table or jig must be anti-electrostatic.	

*The vision of inspector should be perpendicular to the surface of the Module.

Note: If the product is uneven or contains bright spot, use 2%ND filter to check and confirm. The unevenness or bright spot can be ignored if it appears invisible through the 2%ND filter.

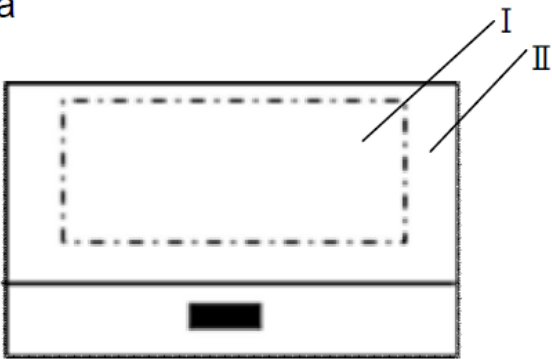
8.3 Delivery Assurance

8.3.1 Delivery Inspection Standards

Class II, Normal Inspection, GB2828.

8.3.2 Zone Definition

- I area: viewing area
- II area: outside viewing area



8.3.3 Criteria & Acceptable Quality Level


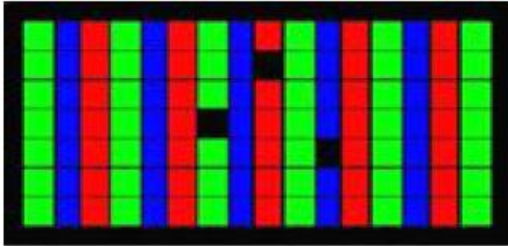
Partition	AQL	Item	Check Level
Major	0.65	1. Liquid crystal leakage 2. Wrong polarizer 3. Outside dimension 4. Bright dot, dark dot 5. Abnormal display 6. Cracked glass	II
Minor	1.0	1. Spot Defect (Including black spot, white spot, pinhole, foreign particle, bubbles, hurt) 2. Fragment 3. Line Defect (Including black line, white line, scratch) 4. Incision defect 5. Newton's ring 6. Other visual defects	II

8.3.4 Criteria & Classification

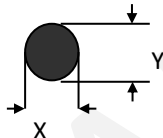
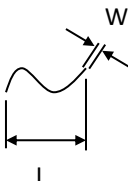
Below tables shows the inspection standard of appearance test for area I (Viewing Area).

*Defects appearing on area II can be ignored.

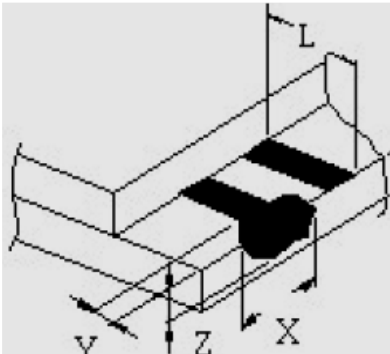
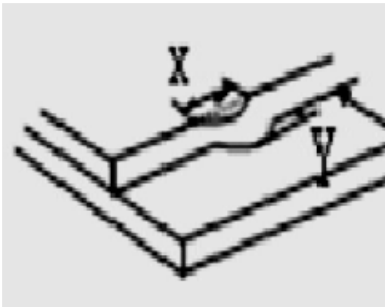
8.3.4.1 Description of Bright/Dark Dots

Item	Description	Definition
Bright Dot	<div>Dots appearing bright and unchanged in size in which LCD panel is displaying under black pattern.</div> <div></div>	<div>The definition of dot: The size of a defective dot over 1/2 of single pixel dot is regarded as one defective dot.</div> <div>Note: One pixel consists of 3 sub-pixels, including R, G, and B dots. (Sub-pixel = Dot)</div>
Dark Dot	<div>Dots appearing dark and unchanged in size in which LCD panel is displaying under pure red, green, or blue pattern.</div> <div></div>	
Adjacent Dots	<div>Two adjacent sub-pixels are defects (defined as two-dots defect).</div>	

Units: mm

Class	Item	Criteria		
Major	Bright/Dark Dot	<p>Bright dot: $N \leq 3$</p> <p>Dark dot: $N \leq 4$</p> <p>Total: $N \leq 6$</p> <p>Note 1: The distance between two defective dots shall be greater than 5mm.</p> <p>Note 2: Adjacent dot defect: $N \leq 0$</p>		
Minor	Spot Defect	<p>Round type: as per following drawing, $\varnothing = (X+Y)/2$</p> 		
		1) Black and white spot, pinhole, foreign matter, dent, backlight, foreign matter		
		Size\Zone	Acceptable Quantity	
		$\varnothing \leq 0.2$	Ignore	
		$0.2 < \varnothing \leq 0.5$	$N \leq 4$	
		$0.5 < \varnothing$	0	
		2) Bubble		
		Size\Zone	Acceptable Quantity	
		$\varnothing \leq 0.2$	Ignore	Ignore
		$0.2 < \varnothing \leq 0.5$	$N \leq 4$	
		$0.5 < \varnothing$	0	
Minor	Line Defect	<p>Line type: as per following drawing</p> 		
		1) Black and white line, backlight foreign matter etc.		
		Width	Length	Acceptable quantity
		$W \leq 0.03$	Ignore	Ignore
		$0.03 < W \leq 0.1$	$L \leq 5$	$N \leq 4$
		$0.1 < W$	$5 < L$	0
		2) Scratch		
		Width	Length	Acceptable quantity
		$W \leq 0.03$	Ignore	Ignore
		$0.03 < W \leq 0.2$	$1.0 < L \leq 5.0$	$N \leq 4$

Class	Item	Criteria		
		0.2<W	5 < L	0
Major	Abnormal Display	Not allowed.		
Major	Outside Dimension	Accords with the drawing (Checking with callipers)		
Major	Cracked Glass	Not allowed.		
Major	Leakage	Not allowed.		
Minor	Corner Fragment	<p>$X \leq 3, Y \leq 3, Z \leq T$: Ignore</p> <p>Note:</p> <p>1) No hurt identifying, wire, seal</p> <p>2) T: Glass thickness - X: Length Y: Width Z: thickness</p>		
Minor	Side Fragment	<p>$Y \leq 1, Z \leq T$: Ignore</p> <p>Note:</p> <p>1) No hurt identifying, wire, seal</p> <p>2) T: Glass thickness - X: Length Y: Width Z: thickness</p>		

Class	Item	Criteria
Minor	Step Fragment	<div>$Y \leq 1, Y \leq 1/4 L$</div> <div></div>
Minor	Incision Defect	<div>$Y \leq 1$ and accords with outside dimension.</div> <div></div>

8.4 Dealing with Customer Complaints

8.4.1 Non-conforming Analysis

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

8.4.2 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.

9. Reliability Specification

9.1 Reliability Tests

Test Item	Test Condition	Evaluation and assessment
High Temperature Operation	70±2°C, 240 hrs	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 1) Air bubble in the LCD; 2) Non-display; 3) Missing segments/line; 4) Glass crack; 5) Current IDD is twice higher than initial value.
Low Temperature Operation	-20±2°C, 240 hrs	
High Temperature Storage	80±2°C, 240 hrs	
Low Temperature Storage	-30±2°C, 240 hrs	
High Temperature & High Humidity Operation	+40±5°C, 90% RH, 240 hours	
Thermal Shock (Non-operation)	-30°C,30 min ↔ 80°C,30 min, Change time: 5min 10CYC.	
ESD test	C=150pF, R=330, 5points/panel Air: ±8KV, 10 times; Contact: ±6KV, 10 times; (Environment: 15°C~35°C, 30%~60%).	
Vibration (Non-operation)	Frequency range:10~55Hz, Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X.Y.Z. (3 hours for total) (Package condition).	
Box Drop Test	1 Corner 3 Edges 6 faces, 80 cm (MEDIUM BOX)	

Note 1: The test samples should be applied to only one test item.

Note 2: Sample size for each test item is 5~10pcs.

Note 3: For Damp Proof Test, Pure water(Resistance > 10MΩ) should be used.

Note 4: In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.

Note 5: Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

Note 6: The color fading mura of polarizing filter should not care.

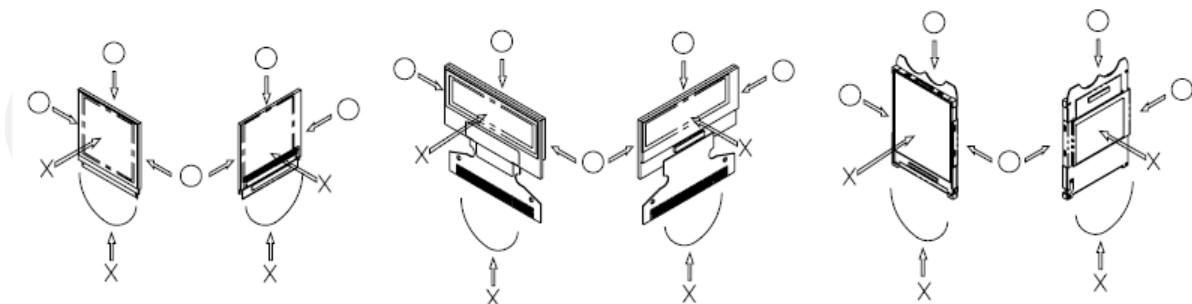
9.1.1 Inspection Check Standard

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±5 °C, 65±10% RH.

10. Handling Precautions

10.1 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 neighbourhood 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.

10.2 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.

10.3 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 neighbouring 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.

10.4 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.

10.5 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.