DMT038Q2NTNT0-1A

PRODUCT SPECIFICATION

Version 0.1
Dec 03, 2019
TBD

Customer's Approval	
Signature	*Date*

Prepared by *Chi Huang*
Approved by *Isaac Huang & Eric Wan*

Revision History

VERSION	DATE	DESCRIPTION	AUTHOR
0.1	Dec 03, 2019	Preliminary	Erica Cheng

Legal Notice

Table of Contents

1. General Description

1.1 Introduction

This is a 3.83” size colour active matrix TFT LCD module with glare polarizer 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 480 x 110 and can display up to 16M colours. The display module supports 24-bits RGB interface.

1.2 Main Features

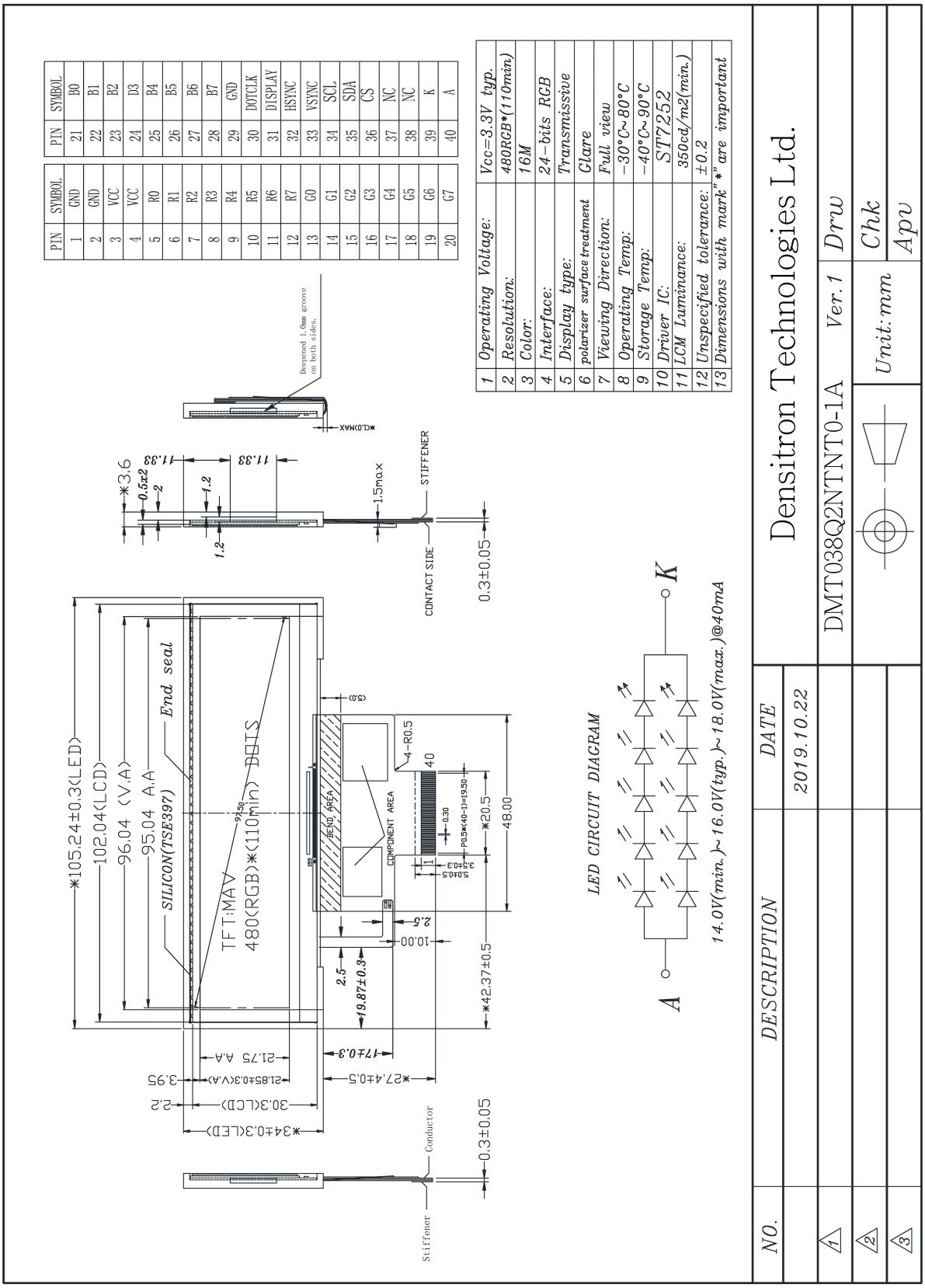
Item	Contents
Display Type	TFT LCD
Screen Size	3.83” Diagonal
Display Format	480 x RGB x 110 Dots
No. of Colour	16M
Overall Dimensions	105.24 (W) x 34 (H) x 3.6 (D) mm
Active Area	95.04 (W) x 21.75 (H) mm
Mode	Normally White / Transmissive
Surface Treatment	Glare
Viewing Direction	All round
Interface	24-bits RGB
Driver IC	ST7252
Backlight Type	LED, White, 10 chips
Operating Temperature	-30°C ~ +80°C
Storage Temperature	-40°C ~ +90°C
ROHS	Compliant to RoHS 2.0

2. Mechanical Specification

2.1 Mechanical Characteristics

Item	Characteristic	Unit
Display Format	480 x RGB x 110	Dots
Overall Dimensions	105.24 (W) x 34 (H) x 3.6 (D)	mm
Active Area	95.04 (W) x 21.75 (H)	mm
Pixel pitch	0.198 (W) x 0.198 (H)	mm
Weight	TBD	g
IC Controller/Driver	ST7252	

2.2 Mechanical Drawing



3. Electrical Specification

3.1 Absolute Maximum Ratings

AGND = GND = 0V, Ta = 25°C

Item	Symbol	Min	Max	Unit	Note
Power Voltage	VCC	-0.3	4.6	V	-
Operating Temperature	T_{OPR}	-30	80	°C	2, 3
Storage Temperature	T_{STG}	-40	90	°C	2, 3

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

AGND = GND = 0V, Ta = 25°C

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Power Voltage	VCC	-	3.0	3.3	3.6	V	-
Input Logic High Voltage	V_{IH}	-	0.7 VCC	-	VCC	V	-
Input Logic Low Voltage	V_{IL}	-	0	-	0.3 VCC	V	-

3.3 Interface Pin Assignment

No.	Symbol	I/O	Function
1-2	GND	P	Ground
3-4	VCC	P	Monitoring pin of internal digital power
5-12	R0- R7	I	Data bit
13-20	G0- G7	I	Data bit
21-28	B0- B7	I	Data bit
29	GND	P	Ground
30	DOTCLK	I	Clock signal; latching data at the falling edge
31	DISPLAY	I	Display control / standby mode selection. DISP = “Low” : Standby; (Default) DISP = “High” : Normal display
32	HSYNC	I	Horizontal sync signal; negative polarity
33	VSYNC	I	Vertical sync signal; negative polarity
34	SCL	I	Serial communication clock input
35	SDA	-	Serial communication data input and output
36	CS	I	Serial communication chip select.
37-38	NC	-	No connection
39	K	P	LED cathode
40	A	P	LED anode

* For further details, please refer to ST7252 data sheet.

3.4 Block Diagram

TBD

3.5 Timing Characteristics

Please refer to Sitronix IC ST7252 datasheet for more information.

3.5.1 AC Electrical Characteristics

VDD = VDDI = 3.3V, AGND = 0V

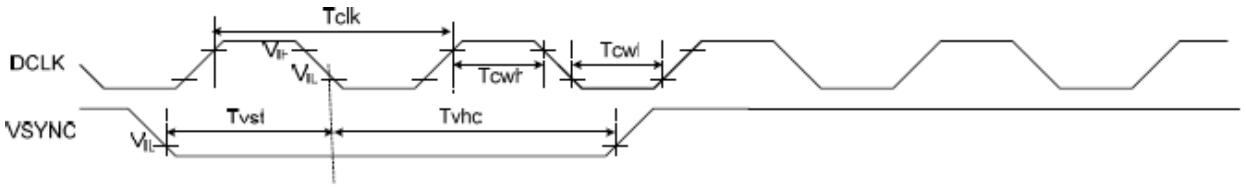
Item	Symbol	Min	Typ.	Max	Unit	Conditions	Note
System Operation Timing							
VDD Power Source Slew Time	TPOR	-	-	20	ms	From 0v to 99% VDD	-
GRB Pulse Width	tRSTW	10	50	-	us	R = 10Kohm, C = 1uF	-
Input/ Output Timing							
CLK Pulse Duty	Tcw	40	50	50	%	-	-
Hsync Width	Thw	1	-	-	DCLK	-	-
Hsync Period	Th	55	60	65	us	-	-
Vsync Setup Time	Tvst	12	-	-	ns	-	-
Vsync Hold Time	Tvhd	12	-	-	ns	-	-
Hsync Setup Time	Thst	12	-	-	ns	-	-
Hsync Hold Time	Thhd	12	-	-	ns	-	-
Data Setup Time	Tdsu	12	-	-	ns	-	-
Data Hold Time	Tdhd	12	-	-	ns	-	-
SD Output Stable Time	Tst	-	-	12	us	Output settled within +20mV Loading = 6.8k+28.2pF.	-
GD Output Rise and Fall Time	Tgst	-	-	6	us	Output settled (5%~95%), Loading = 4.7k+29.8pF.	-
3-Wire Serial Communication							
Delay Between CSB And Vsync	Tcv	1	-	-	us	-	-
CS Input Setup Time	Ts0	50	-	-	ns	-	-
Serial Data Input Setup Time	Ts1	50	-	-	ns	-	-
CS Input Hold Time	Th0	50	-	-	ns	-	-
Serial Data Input Hold Time	Th1	50	-	-	ns	-	-
SCL Pulse High Width	Twh1	50	-	-	ns	-	-
SCL Pulse Low Width	Twl1	50	-	-	ns	-	-
CS Pulse High Width	Tw2	400	-	-	ns	-	-

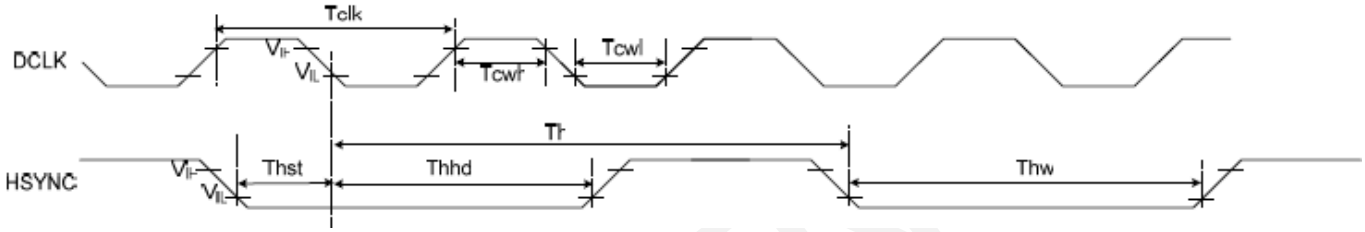
3.5.2 DC Electrical Characteristics

Item	Symbol	Min	Typ.	Max	Unit	Conditions	Note
Recommended Operating Range							
System Voltage	VDD	3.0	3.3	3.6	V	-	-
IO System Voltage	VDDI	1.65	-	VDD	V	-	-
Charge Pump System Voltage	PVDD	3.0	3.3	3.6	V	-	-
NVM System Voltage	VPP	7.4	7.5	7.6	V	-	-
DC Characteristics for Digital Circuit							
Logic-High Input Voltage	Vih	0.7 VDDI	-	VDDI	V	VDDI = 3.3V	-
Logic-Low Input Voltage	Vil	DGND	-	0.3 VDDI	V	VDDI = 3.3V	-
Logic-High Output Voltage	Voh	VDDI-0.4	-	VDDI	V	VDDI = 3.3V	-
Logic-Low Output Voltage	Vol	DGND	-	DGND+0.4	V	VDDI = 3.3V	-
DC Characteristics for Analog Circuit							
Positive High-Voltage Power	VGH	13	15	16	V	PVDD = 3.3V	-
Negative High-Voltage Power	VGL	-10	-10	-7	V	PVDD = 3.3V	-
Output Voltage Deviation	Vod	-	±35	±45	mV	-	-
Standby Current	Isc	-	-	50	uA	VDD = PVDD = 3.3V	-
Operation Current	Ioc	-	20	-	mA	No Load, VDD = PVDD = 3.3V @ FR=60Hz	-

3.5.3 Timing

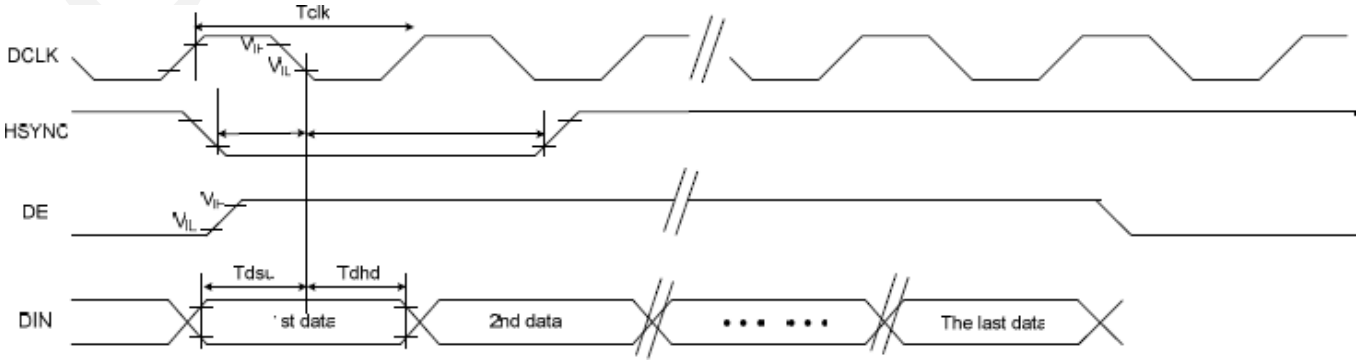
3.5.3.1 Clock and Data Input Timing Diagram



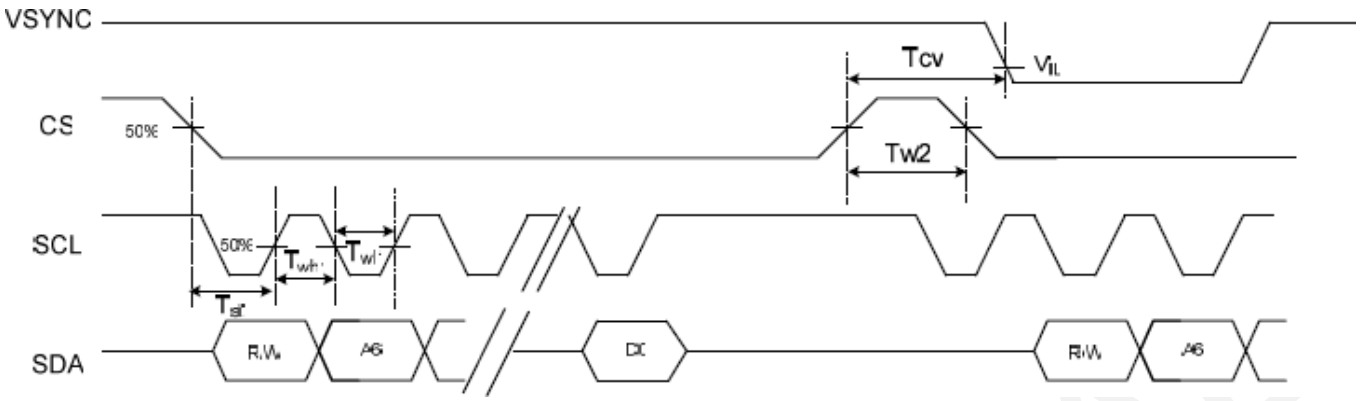


3.5.3.2 SYNC Mode

3.5.3.3 SYNC-DE Mode

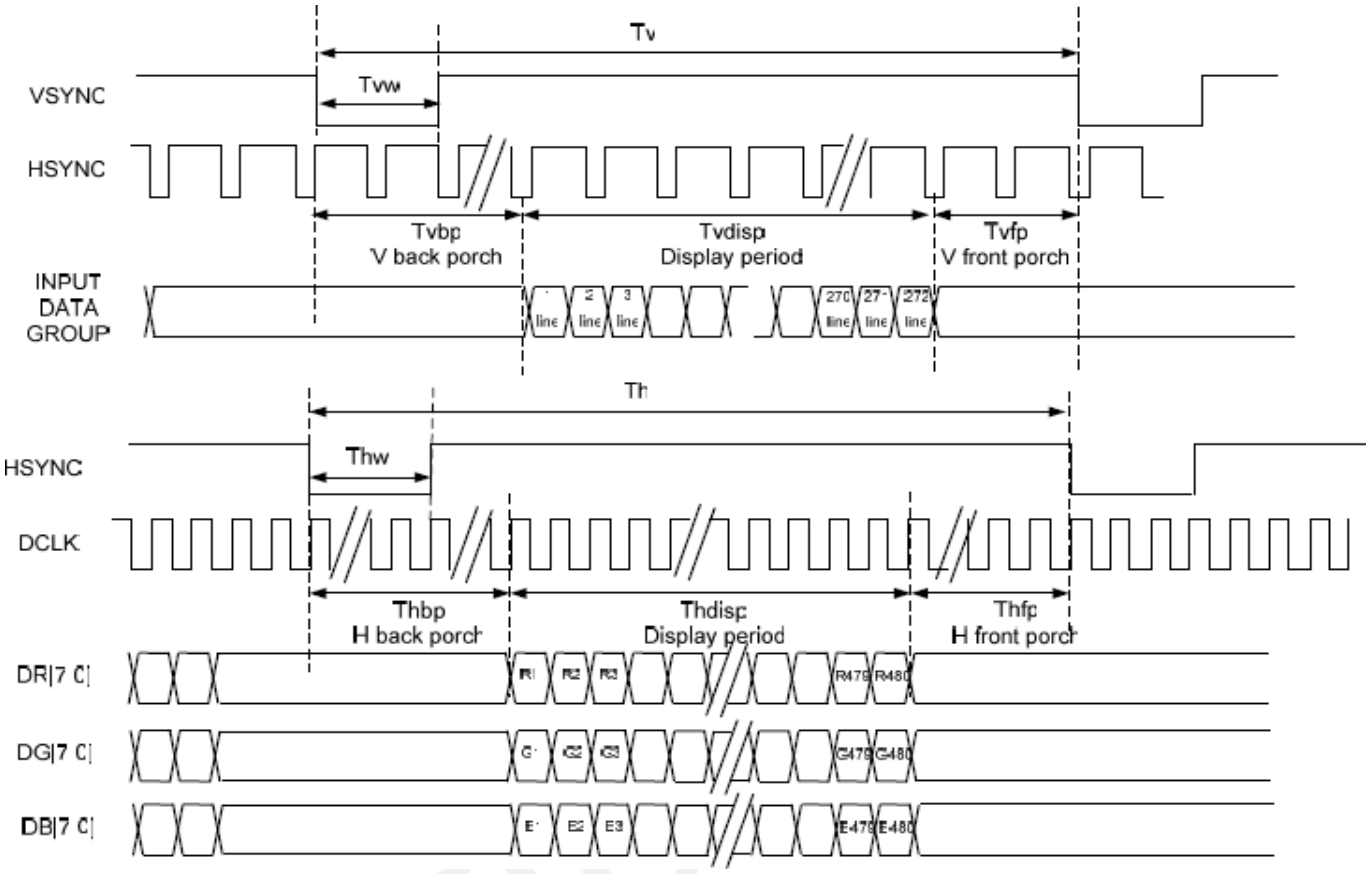


3.5.3.4 3-Wire Communication Timing Diagram

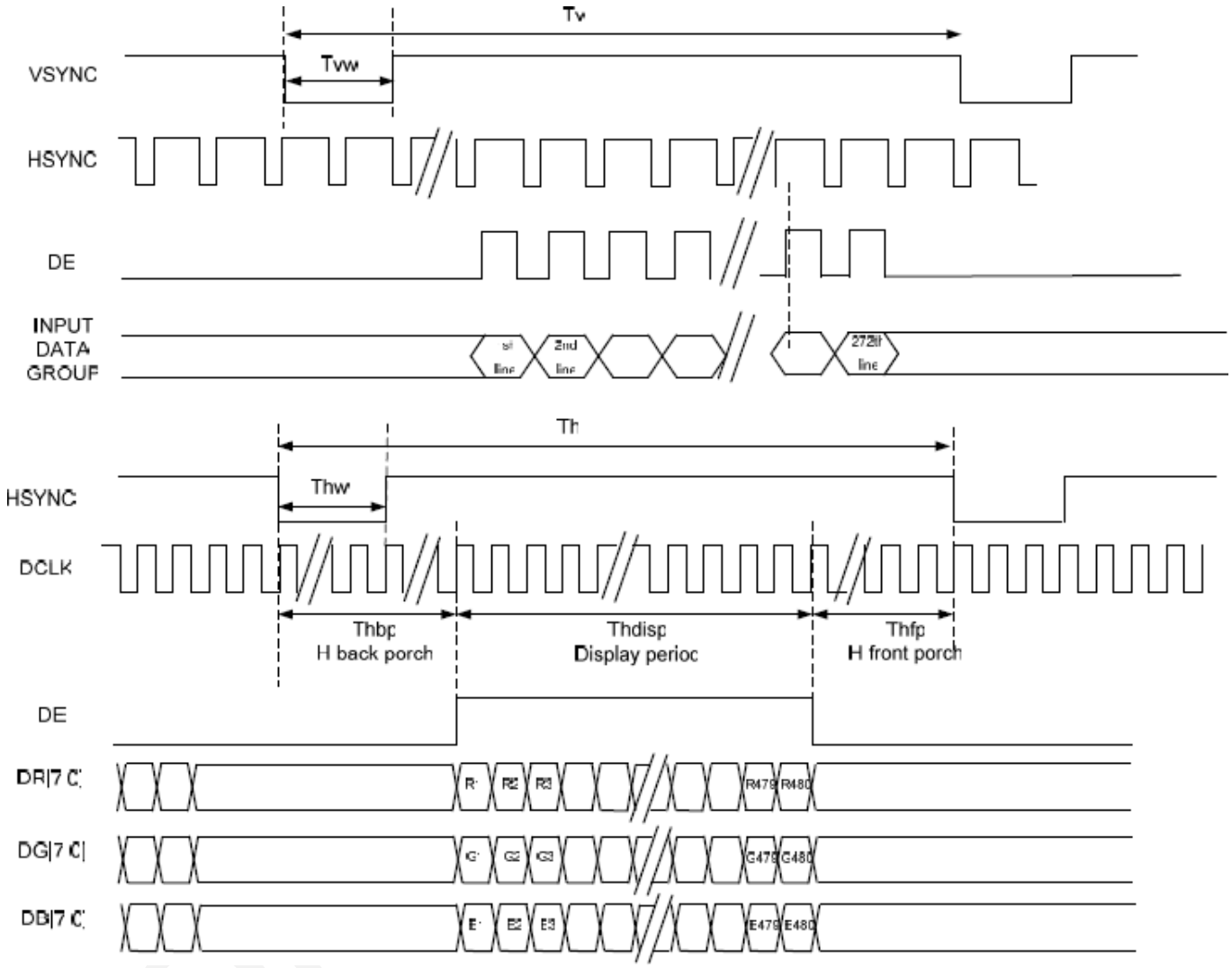


Item		Symbol	Min	Typ.	Max	Unit	Conditions	Note
DCLK Frequency		Fclk	8	9	12	MHz	-	-
DCLK Period		Tclk	83	111	125	ns	-	-
HSYNC	Period Time	Th	485	525	532	DCLK	-	-
	Display Period	Thdisp	-	480	-	DCLK	-	-
	Back Porch	Thbp	3	43	50	DCLK	By H_Blanking Setting	-
	Front Porch	Thfp	2	2	2	DCLK	-	-
	Pulse Width	Thw	1	1	1	DCLK	-	-
VSYNC	Period Time	Tv	275	285	303	-	-	-
	Display Period	Tvdisp	-	272	-	-	-	-
	Back Porch	Tvbp	2	12	30	-	By V_Blanking Setting	-
	Front Porch	Tvfp	1	1	1	-	-	-
	Pulse Width	Tvw	1	1	1	-	-	-

3.5.3.5 SYNC Mode Timing Diagram

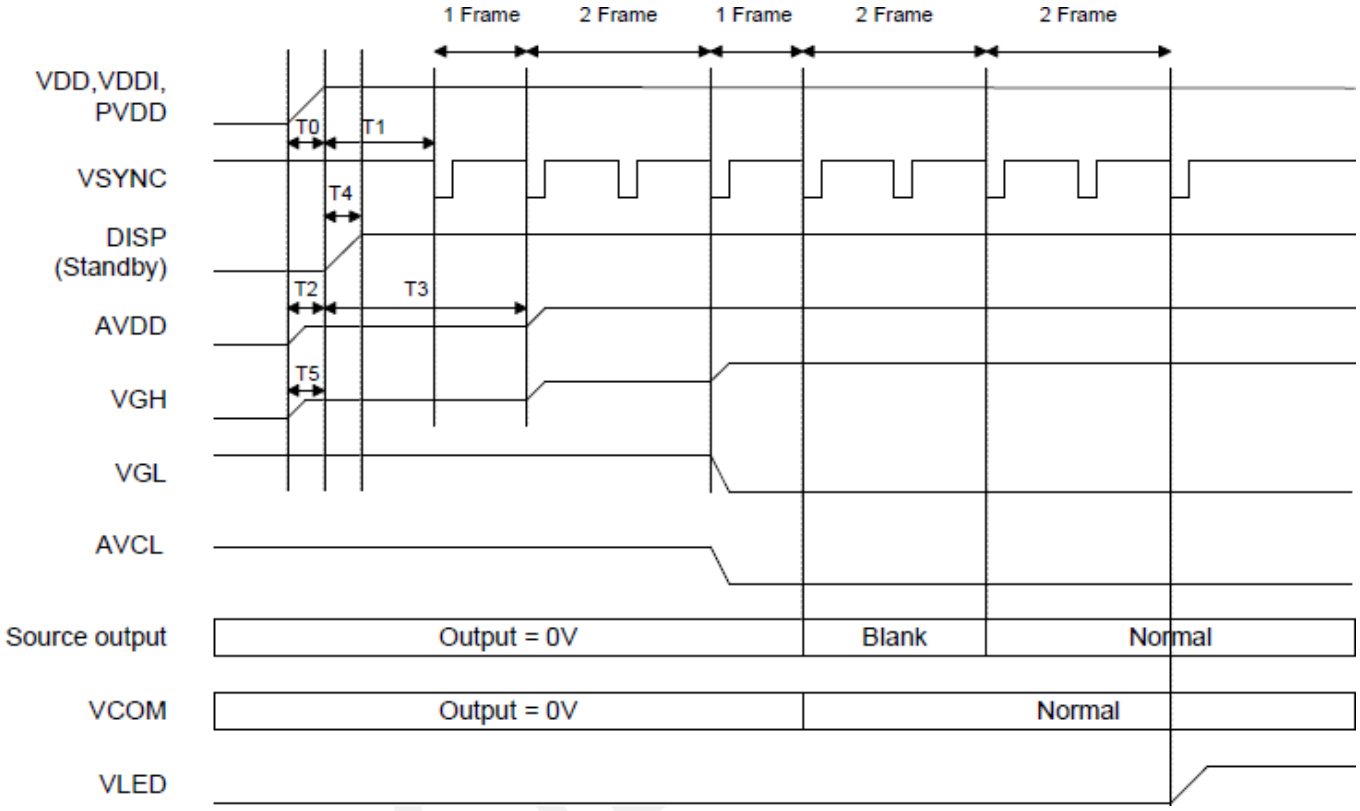


3.5.3.6 SYNC-DE Mode Timing Diagram



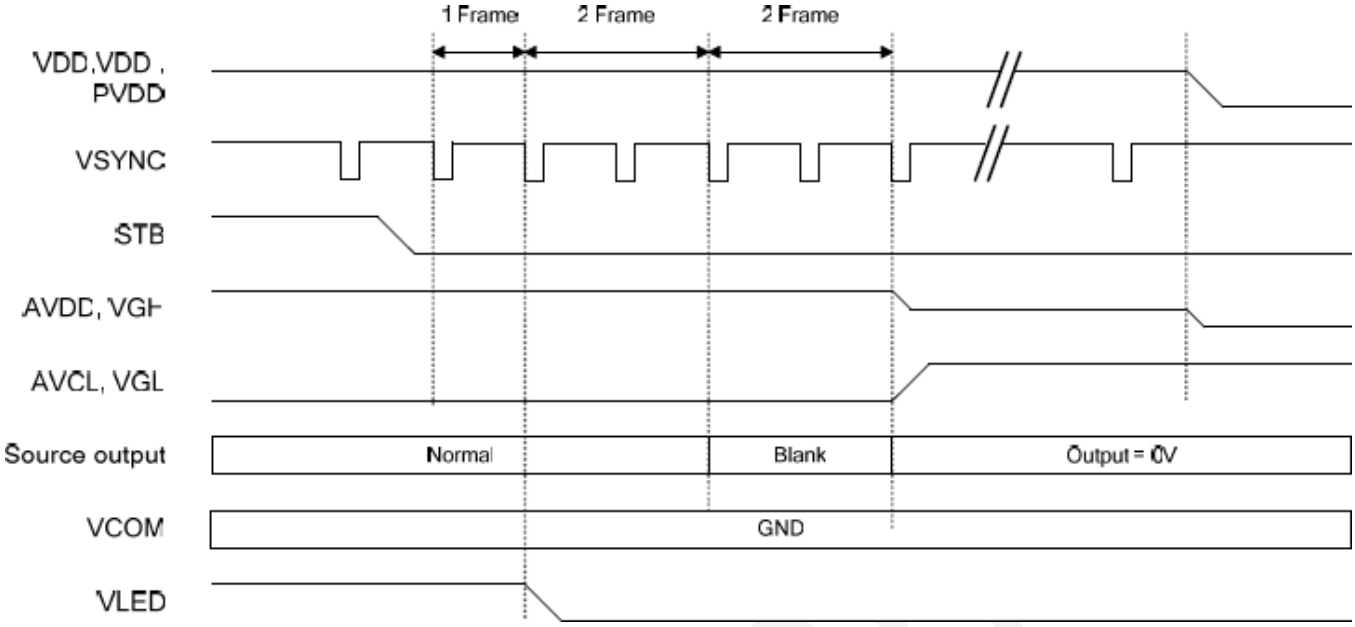
3.5.4 Power ON/OFF Sequence

3.5.4.1 Power On Sequence



	Description	Min Time
T0	Determined by the external power	-
T1	Time from stable VDD, VDDI, PVDD set-up to the first VSYNC	T1 = 0
T2	Time from AVDD=0V TI AVDD=3.3V	T2 = T0
T3	Time from AVDD=3.3V TI AVDD=6.0V	T3 = T1 + (1*Frame)
T4	Time from stable VDD, VDDI, PVDD set-up to DISP asserted	T4 = 0
T5	Time from VGH = 0V to VGH = 3.3V	T5 = T0

3.5.4.2 Power Off Sequence



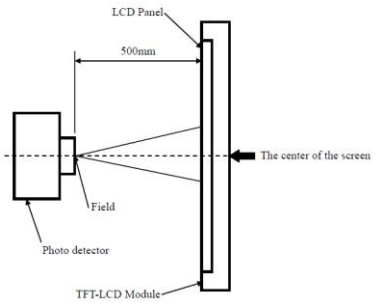
4. Optical Specification

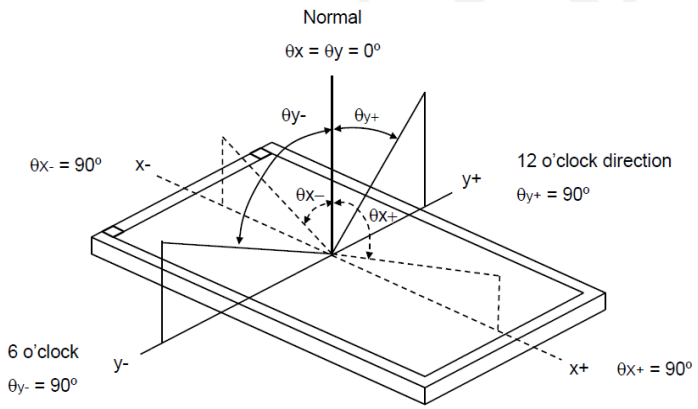
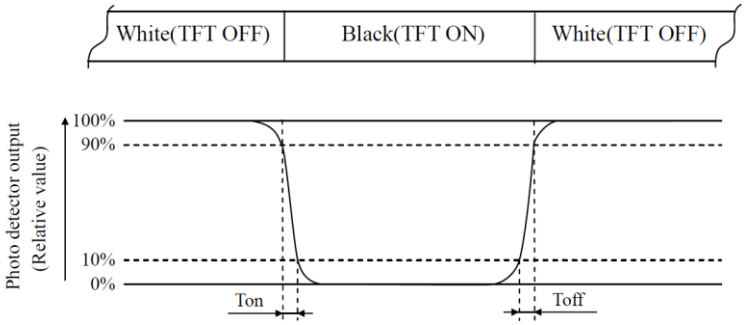
4.1 Optical Characteristics

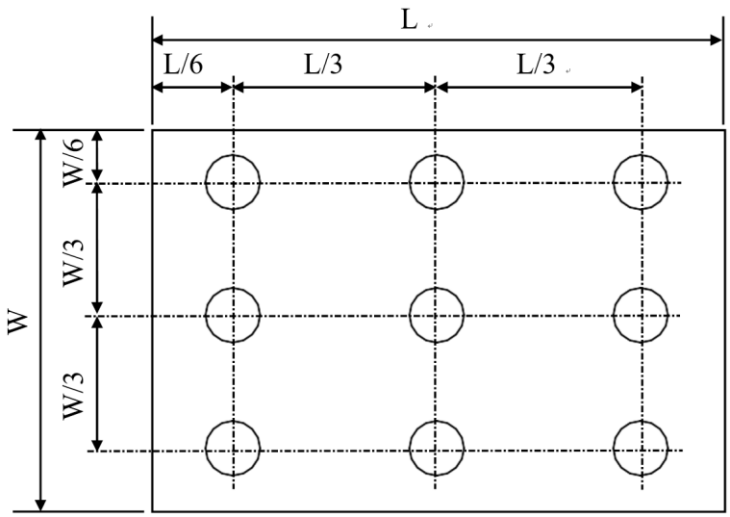
Characteristics		Symbol	Conditions	Min	Typ	Max	Unit	Note
Contrast Ratio		CR	θ = 0°	-	500	-	-	1, 3
Response time		T_{ON} + T_{OFF}	25°C	-	35	-	ms	1, 4
Viewing Angle	Left	θ_{x-}	CR≧10	-	70	-	deg	2
	Right	θ_{x+}		-	70	-		
	Up	θ_{Y+}		-	70	-		
	Down	θ_{Y-}		-	70	-		
Colour Chromaticity	Red	Rx	-	0.633	0.653	0.673	-	1, 5
		Ry		0.312	0.332	0.352		
	Green	Gx		0.294	0.314	0.334		
		Gy		0.555	0.575	0.595		
	Blue	Bx		0.117	0.137	0.157		
		By		0.113	0.133	0.153		
	White	Wx		0.287	0.307	0.373		
		Wy		0.321	0.341	0.361		
Luminance		L	-	350	-	-	cd/m^2	1, 5
Uniformity		U	-	TBD	-	-	%	5

Test Conditions:

1. If= 40mA (Backlight current), VCC =3.3V, the ambient temperature is 25°C.
2. The test systems refer to Note 2.

<table>
<tr><th>Note</th><th>Item</th><th>Test method</th></tr>
<tr><td>1</td><td>Definition of Optical Measurement System</td><td>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 grounded when measuring the center area of the panel.
 

<table>
<tr><th>Item</th><th>Photo detector</th><th>Field</th></tr>
<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>
</table></td></tr>
<tr><td>2</td><td>Definition of Viewing Angle (θx, θy)</td><td> 
</td></tr>
<tr><td>3</td><td>Definition of Contrast Ratio (CR)</td><td>$\text{Contrast ratio(CR)} = \frac{\text{Luminance measured when LCD is on the "White" state}}{\text{Luminance measured when LCD is on the "Black" state}}$</td></tr>
<tr><td>4</td><td>Definition of Response Time (T_{ON}, T_{OFF})</td><td>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% to90%.
 
</td></tr>
</table>

Note	Item	Test method
5	Definition of Color Chromaticity (CIE1931)	Color coordinates measured at center point of LCD.
6	Definition of Luminance Uniformity	Active area is divided into 9 measuring areas. Every measuring point is placed at the center of each measuring area. Luminance Uniformity (U)=Lmin / Lmax L: Active area length; W: Active area width  L max: The measured Maximum luminance of all measurement position. L min: The measured Minimum luminance of all measurement position.
7	luminance	Definition of luminance: Measure the luminance of white state at center point

5. LED Backlight Specification

5.1 LED Backlight Characteristics

(Ta = 25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Forward Voltage	Vf	-	14	16	18	V	-
Forward Current	If	-	-	40	-	mA	-
Operating Life Time	-	-	36000	-	-	Hours	-

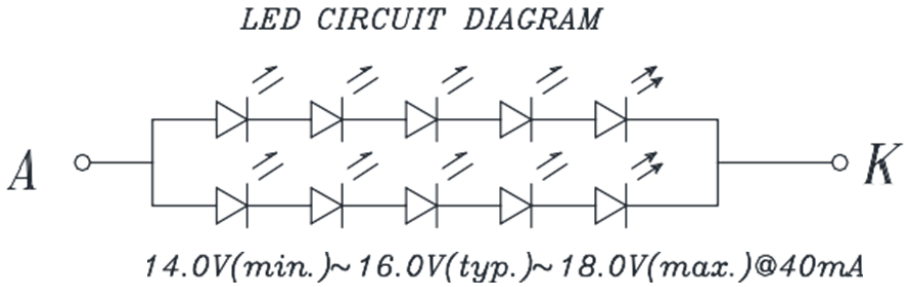
Note 1: Ta means ambient temperature of TFT-LCD module.

Note 2: IF, VF are defined for one channel LED. There are two LED channel in back light unit.

Note 3: If the module is driven by high current or at high ambient temperature & humidity condition. The operating life will be reduced.

Note 4: Operating life means brightness goes down to 50% initial brightness. Minimum operating life time is estimated data.

5.2 INTERNAL CIRCUIT DIAGRAM



6. Packaging

TBD

7. Quality Assurance Specification

7.1 Conformity

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

7.2 Environment Required

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

Temperature:	25 ± 5°C
Humidity:	60% ± 10% RH
Illumination:	under 40W fluorescent light
Viewing distance:	30 ± 10cm

Finger glove (or finger cover) must be worn by the inspector.

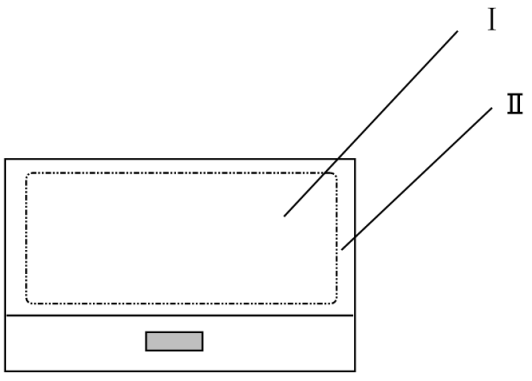
Inspection table or jig must be anti-electrostatic.

7.3 Delivery Assurance

7.3.1 Delivery Inspection Standards

Inspection Level II, GB2828-87

7.3.2 Zone Definition



Ⅰ area: viewing area

Ⅱ area: outside viewing area

7.3.3 Criteria & Acceptable Quality Level

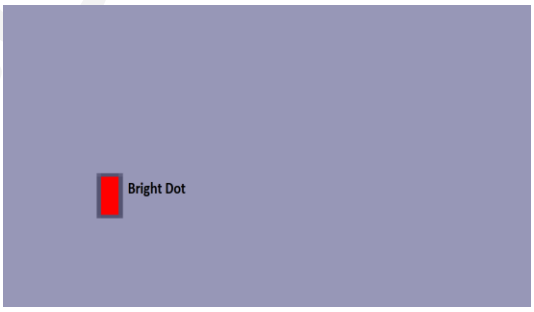
Partition	AQL	Definition
Major	0.25	1. Liquid crystal leakage 2. Wrong polarizer 3. Outside dimension 4. Bright dot、dark dot 5. Display abnormal 6. Class crack
Minor	1.0	1. Spot defect (including black spot, white spot, pinhole, foreign particle, bubbles, hurt) 2. Fragment 3. Line defect (including black line, white line, scratch) 4. Incision defect 5. Newton's ring 6. Other visual defects

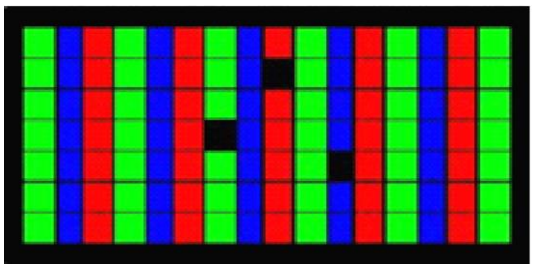
7.3.4 Packing Inspection

Standard of appearance test for Ⅰ area: (unit: mm)

Note: Defect ignore for Ⅱ area.

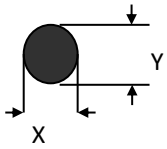
Bright/Dark Dots Description:

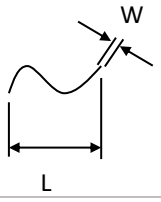
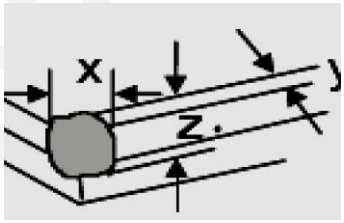
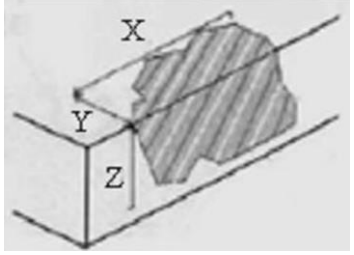
Item	Description	Definition
Bright Dot	Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern. 	The definition of dot: The size of a defective dot over 1/2 of single pixel dot is regarded as one defective dot. **Note:** One pixel consists of 3 sub-pixels, including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

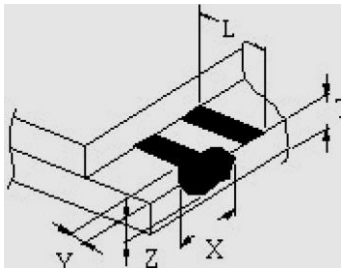
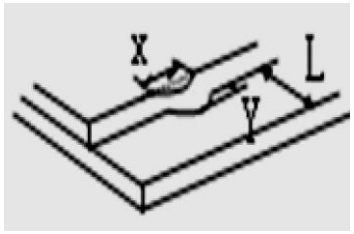
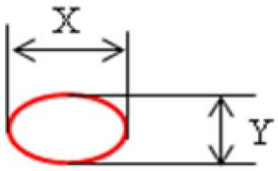
Item	Description	Definition
		
Adjacent Dot	Adjacent two sub-pixel are defect (define two dot defect)	

Inspection standard

Units: mm

Class	Item	Criteria	
Major	Bright / Dark Dot	1) Under 6” (contain 6”)	
		Bright Dot: 2 Dark Dot: N≦4 Note: be more than 5mm apart	
		2) 6”-12”	
		Bright Dot: N≤4 Dark dot: N≤5 Total Bright and Dark Dots: N≤8 **Note 1:** Two bright dot defects (red, green, blue, and white) should be larger than 15mm **Note 2:** The distance between black dot defects or black and bright dot defects should be more than 5mm apart.	
Minor	Spot Defect (Including black spot, white spot, Pinhole, foreign particle, bubbles, hurt）	Round type: as per following drawing, ∅ = (X+Y)/2 	
		1) Under 6” (contain 6”)	
		Φ≤0.1	Ignore
		0.1<Φ≤0.35	3
		0.35<∅	0
		2) 6” – 12”	
		∅≤0.3	Ignore
		0.3<∅≤0.6	4
		0.6<∅	0

<table>
<tr><th>Class</th><th>Item</th><th colspan="3">Criteria</th></tr>
<tr><td rowspan="11">Minor</td><td rowspan="11">Line Defect
(LCD/Polarizer
black/white line,
scratch, stain)</td><td colspan="3">Line type: as per following drawing  </td></tr>
<tr><td colspan="3">1) Under 6” (contain 6”)</td></tr>
<tr><td>W≤0.02</td><td colspan="2">Ignore</td></tr>
<tr><td>0.02<W≤0.04</td><td>L ≤ 5</td><td>N ≤ 2</td></tr>
<tr><td>0.04<W≤0.06</td><td>L ≤ 5</td><td>N ≤ 1</td></tr>
<tr><td>0.06<W</td><td colspan="2">N = 0</td></tr>
<tr><td colspan="3">2) 6” – 12”</td></tr>
<tr><td>W≤0.07</td><td colspan="2">Ignore</td></tr>
<tr><td>0.07<W≤0.1</td><td>L ≤ 10</td><td>N ≤ 4</td></tr>
<tr><td>0.1<W</td><td colspan="2">N = 0</td></tr>
<tr><td>Major</td><td>Display
Abnormal</td><td colspan="3">Not allowed</td></tr>
<tr><td>Major</td><td>Outside
Dimension</td><td colspan="3">Accord with drawing</td></tr>
<tr><td>Major</td><td>Glass Crack</td><td colspan="3">Not allowed</td></tr>
<tr><td>Major</td><td>Leak</td><td colspan="3">Not allowed</td></tr>
<tr><td>Minor</td><td>Corner Fragment</td><td colspan="3"> 
X≤3; Y≤3; Z≤T => Ignore
Note 1: No hurt identifying, wire, seal
Note 2: T: Glass thickness; X: Length; Y: Width; Z: thickness</td></tr>
<tr><td>Minor</td><td>Side Fragment</td><td colspan="3"> 
Y≤1; Z≤T => Ignore
Note 1: No hurt identifying, wire, seal</td></tr>
</table>

Class	Item	Criteria
		Note 2: T: Glass thickness; X: Length; Y: Width; Z: thickness
Minor	Step Fragment	 Y≤1 and Y≤1/4 L
Minor	Incision Defect	 Y≤1 and accord with outside dimension
Minor	Newton's Ring (CTP or Cover board)	 $D=(X+Y)/2$ Under 6" (contain 6"): D≤25, N≤3; D＞25, N=0 6"-12": D≤70, N≤5; D＞70, N=0

7.4 Dealing with Customer Complaints

7.4.1 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.

7.4.2 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.

8. Reliability Specification

8.1 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) Sealleak; 3) Non-display; 4) missing segments; 5) Glass crack; 6) 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	
Temperature Cycle	-40°C ~ 25°C ~ 90°C × 10 cycles (30min.) (5min.) (30min.)	
Damp Proof Test	40°C ± 5°C × 90%RH, 240 hrs	
Vibration Test	Frequency: 10Hz~55Hz~10Hz Amplitude: 1.5mm, X, Y, Z direction for total 3 hours (Packing condition)	
Dropping Test	Drop to the ground from 1m height, one time, every side of carton. (Packing condition)	
ESD test	Voltage: ±8KV R: 330Ω C: 150pF Air discharge, 10time	
	Voltage: ±6KV R: 330Ω C: 150pF Contact discharge, 10time	

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 judge as a good part.

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

Note 6: Please use automatic switch menu (or roll menu) testing mode when test operating mode.

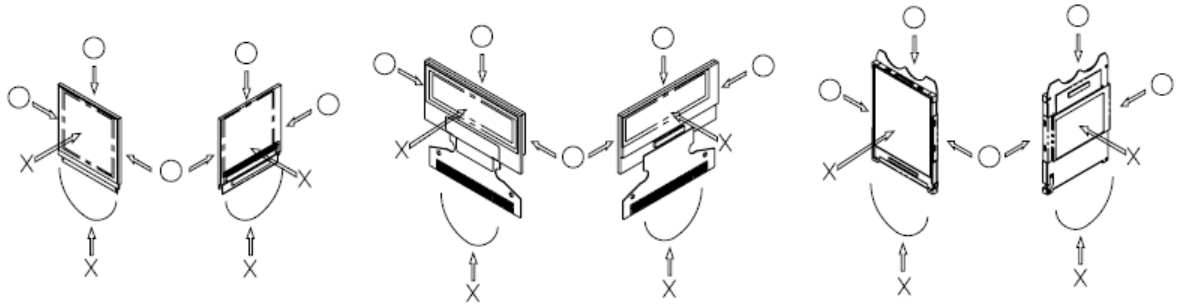
8.1.1 Inspection Check Standard

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 23±5 °C, 55±15% RH.

9. Handling Precautions

9.1 Handling Precautions

1) Since the display panel is being made of glass, do not apply mechanical impacts such us 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.

9.2 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.

9.3 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.

9.4 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.

9.5 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.