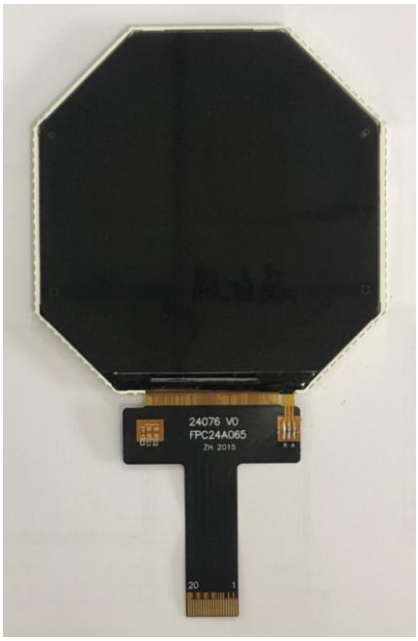
DMT024QBNMNT0-1A
PRODUCT SPECIFICATION

Version 1.1
Apr 27, 2021



Customer's Approval	
Signature	*Date*

Prepared by *Joyce Huang*
Approved by *Odin Hung* and *Eric Wan*

Revision History

VERSION	DATE	DESCRIPTION	AUTHOR
1.0	Jun 29, 2020	Initial Release	Joyce Huang
1.1	Apr 27, 2021	Revise a typo of Forward Voltage.	Joyce Huang

Legal Notice

Table of Contents

1. General Description

1.1 Introduction

This is a 2.47” size colour active matrix TFT LCD module that uses amorphous silicon TFT as a switching device. The display is normally black mode, transmissive, and featuring high contrast and excellent colour saturation. The resolution of the TFT-LCD is 480 x 480 and can display up to 16.7M colours. The display module supports 2 Lane MIPI interface.

1.2 Main Features

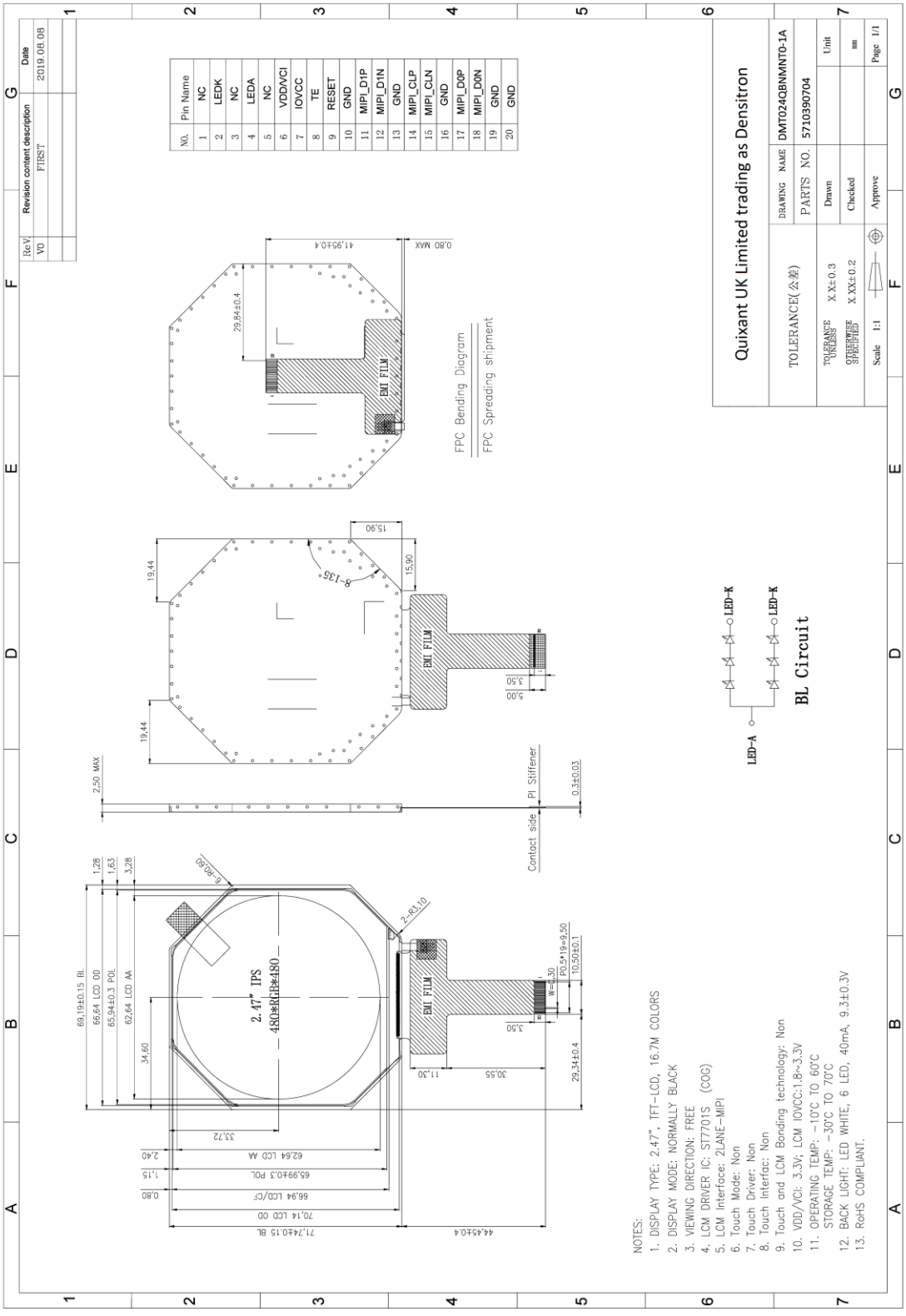
Item	Contents
Display Type	TFT LCD
Screen Size	2.47” Diagonal
Display Format	480 x RGB x 480 Dots
No. of Colour	16.7M
Overall Dimensions	66.64 (W) x 70.14 (H) x 2.50 (D) mm
Active Area	62.64 (W) x 62.64 (H) mm
Mode	Normally Black / Transmissive / IPS
Surface Treatment	Anti-Glare (3H)
Viewing Direction	All round
Interface	2 Lane MIPI
Driver IC	ST7701S
Backlight Type	LED, White, 6 chips
Operating Temperature	-10°C ~ +60°C
Storage Temperature	-30°C ~ +70°C
ROHS	Compliant to RoHS 2.0

2. Mechanical Specification

2.1 Mechanical Characteristics

Item	Characteristic	Unit
Display Format	480 x RGB x 480	Dots
Overall Dimensions	66.64 (W) x 70.14 (H) x 2.50 (D)	mm
Active Area	62.64 (W) x 62.64 (H)	mm
Dot Pitch	0.1305(H)*0.1305(V)	mm
Weight	20	g
IC Controller/Driver	ST7701S	

2.2 Mechanical Drawing



3. Electrical Specification

3.1 Absolute Maximum Ratings

Item	Symbol	Min	Typ.	Max	Unit	Note
Digital Supply Voltage	VCI	-0.3	-	4.6	V	1
Digital Interface Supply Voltage	IOVCC	-0.3	-	4.6	V	1
Operating Temperature	TOP	-10	-	+60	°C	-
Storage Temperature	TST	-30	-	+70	°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.

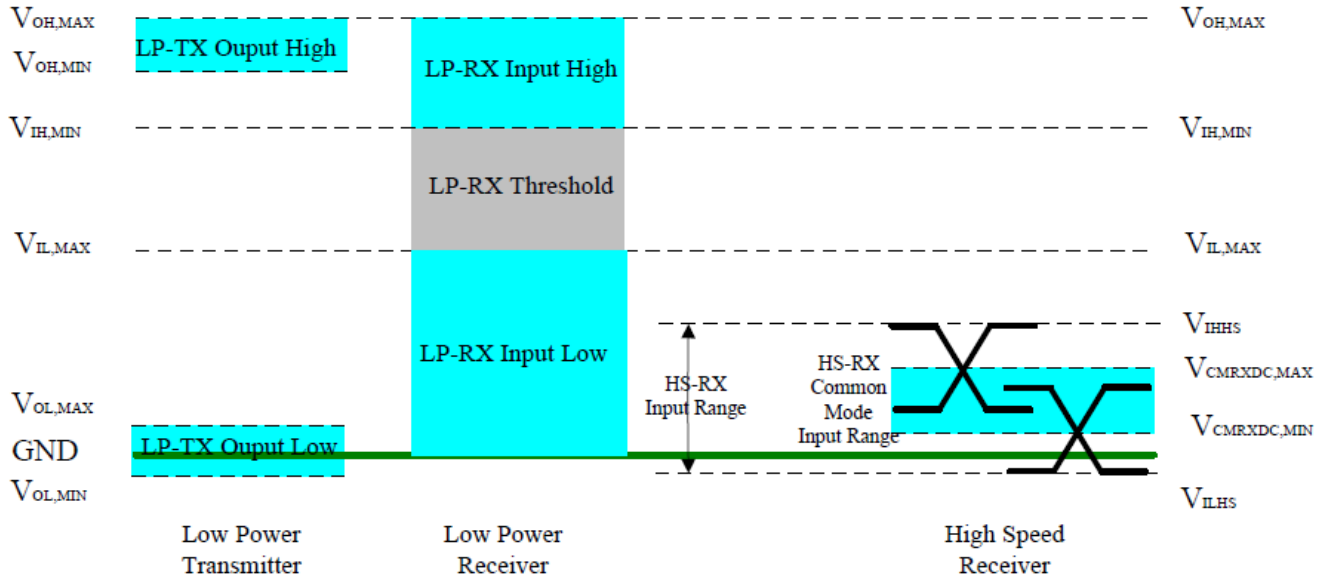
Note 2: Background colour changes slightly depending on ambient temperature. This phenomenon is reversible.

Note 3: Please refer to item of RELIABILITY.

3.2 Electrical Characteristics

Item	Symbol	Condition	Min	Typ.	Max	Unit	Note
Digital Supply Voltage	VCI	-	2.5	3.3	3.6	V	-
Digital Interface Supply Voltage	IOVCC	-	1.65	1.8	3.3	V	-
Normal Mode Current	IDD		-	15	-	mA	-
Differential Input High Threshold Voltage	VIT+	-	-	0	50	mV	MIPI_CLK MIPI_Data
Differential Input Low Threshold Voltage	VIT-	-	-50	0	-	mV	
Sigle-ended Receiver Input Operation Voltage Range	VIR	-	0.5	-	1.2	V	

3.3 MIPI DC Electrical Characteristics

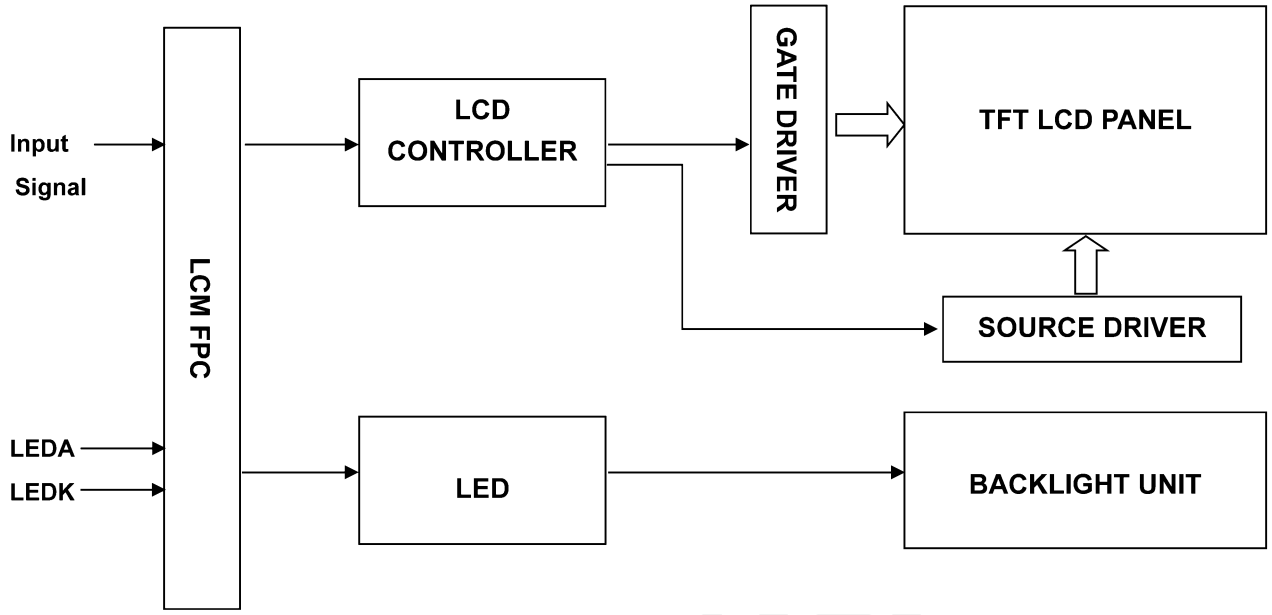


Item	Symbol	Min	Typ.	Max	Unit	Note
Operation Voltage for MIPI Receiver						
Low Power Mode Operating Voltage	V_{LPH}	1.1	1.2	1.3	V	-
MIPI Characteristics for High Speed Receiver						
Single-ended Input Low Voltage	VILHS	-40	-	-	mV	-
Single-ended Input High Voltage	VIHHS	-	-	460	mV	-
Common-mode Voltage	VCMRXDC	70	-	330	mV	-
Differential Input Impedance	ZID	80	100	125	Ohm	-
MIPI Characteristics for Low Power Mode						
Pad Signal Voltage Range	VI	-50	-	1350	mV	-
Logic 0 Input Threshold	VIL	0	-	550	mV	-
Logic 1 Input Threshold	VIH	880	-	1350	mV	-
Output Low Level	VOL	-50	-	50	mV	-
Output High Level	VOH	1.1	1.2	1.3	V	-

3.4 Interface Pin Assignment

No.	Symbol	I/O	Function
1	NC	-	NC
2	LEDK	P	Cathode pin of backlight.
3	NC	-	NC
4	LEDA	P	Anode pin of backlight.
5	NC	-	NC
6	VCI	P	Supply Voltage (3.3V).
7	IOVCC	P	7 IOVCC I/O power supply voltage
8	TE	O	-Tearing effect output Leave the pin to open when not in use.
9	RESET	I	- The external reset input. Initializes the chip with a low input. Be sure to execute a power-on reset after supplying power.
10	GND	P	Ground
11	MIPI_D1P	I/O	MIPI DSI differential data pair (DSI-Dn+/-). If MIPI are not used, they should be connected to DGND
12	MIPI_D1N	I/O	
13	GND	P	Ground
14	MIPI_CLP	I	MIPI DSI differential clock pair (DSI-CLK+/-). If MIPI are not used, they should be connected to DGND.
15	MIPI_CLN	I	
16	GND	P	Ground
17	MIPI_D0P	I/O	MIPI DSI differential data pair (DSI-Dn+/-). If MIPI are not used, they should be connected to DGND
18	MIPI_D0N	I/O	
19	GND	P	Ground
20	GND	P	Ground

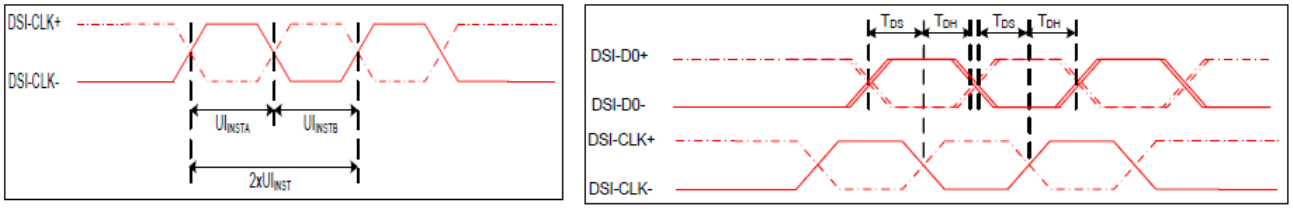
3.5 Block Diagram



3.6 Timing Characteristics

3.6.1 MIPI Interface Characteristics

DSI Clock Channel Timing

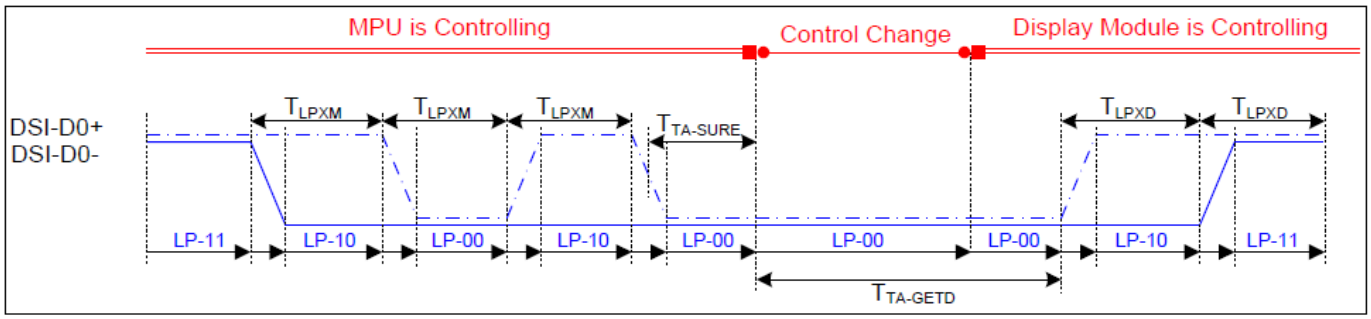


MIPI Interface-High SpeedMode Timing Characteristics

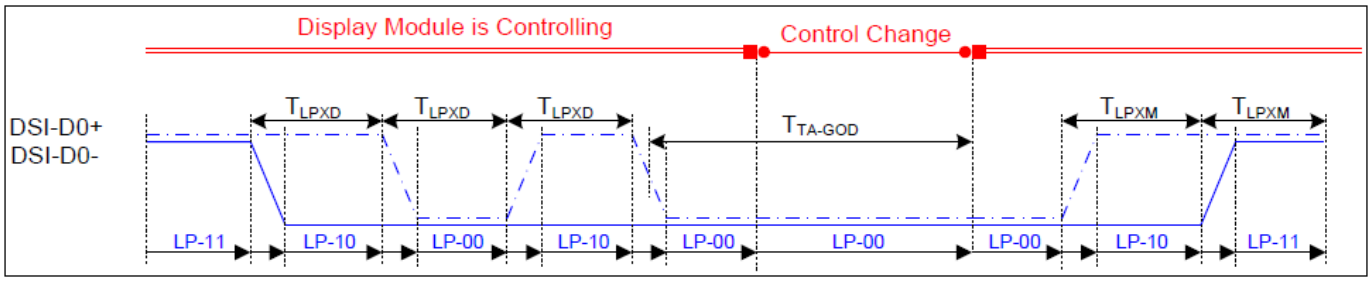
Item	Symbol	Description	Min	Typ.	Max	Unit	Note
DSI-CLK+/-	$2xUI_{INSTA}$	Double UI instantaneous	4	-	25	ns	-
DSI-CLK+/-	UI_{INSTA} UI_{INSTB}	UI instantaneous halfs	2	-	12.5	ns	UI= UI_{INSTA}= UI_{INSTB}
DSI-Dn+/-	t_{DS}	Data to clock setup time	0.15	-	-	UI	-
DSI-Dn+/-	t_{DH}	Data to clock hold time	0.15	-	-	UI	-

3.6.2 Low Power Mode

Bus Turnaround (BTA) from display module to MPU Timing



Bus Turnaround (BTA) from MPU to display module Timing

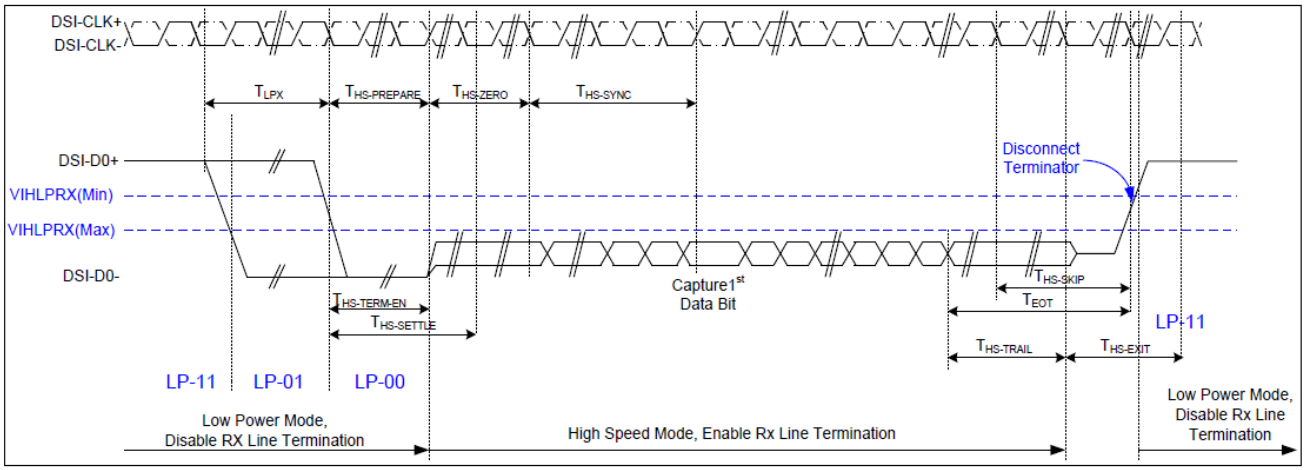


Mipi Interface Low Power Mode Timing Characteristics

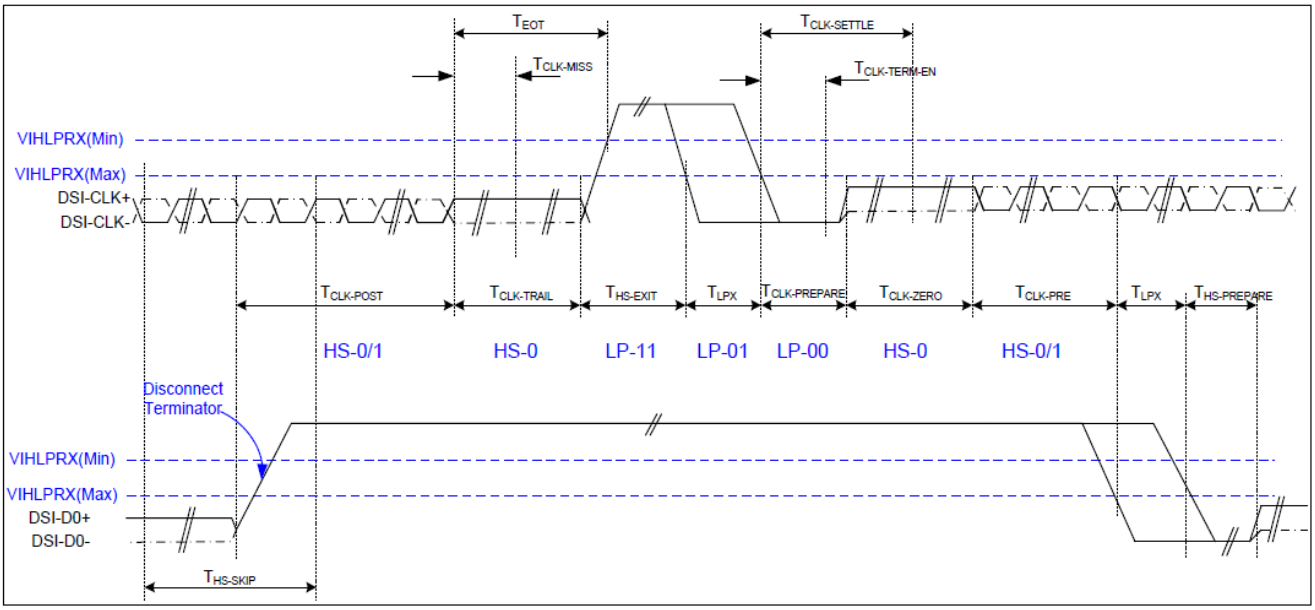
Item	Symbol	Parameter	Min	Max	Unit	Description
DSI-D0+/-	TLPXM	Length of LP-00, LP-01, LP-10 or LP-11 periods MPU→Display Module	50	75	ns	Input
DSI-D0+/-	TLPXD	Length of LP-00, LP-01, LP-10 or LP-11 periods MPU→Display Module	50	75	ns	Output
DSI-D0+/-	TTA-SURED	Time-out before the MPU start driving	TLPXD	2xTLPXD	ns	Output
DSI-D0+/-	TTA-GETD	Time to drive LP-00 by display module	5xTLPXD		ns	Input
DSI-D0+/-	TTA-GOD	Time to drive LP-00 after turnaround request-MPU	4xTLPXD		ns	Input

3.6.3 Bursts Mode

Data lanes-Low Power Mode to/from High Speed Mode Timing



Clock lanes- High Speed Mode to/from Low Power Mode Timing



Item	Symbol	Parameter	Min	Max	Unit	Description
Low Power Mode to High Speed Mode Timing						
DSI-DN+/-	TLPX	Length of any low power state period	50	-	ns	Input
DSI-DN+/-	THS-PREPARE	Time to drive LP-00 to prepare for HS transmission	40+4UI	85+6UI	ns	Input
DSI-DN+/-	THS-TERM-EN	Time to enable data receiver line termination measured from when Dn crosses VILMAX	-	35+4UI	ns	Input

Item	Symbol	Parameter	Min	Max	Unit	Description
DSI-DN+/-	THS-PREPARE+THS-ERO	THS-PREPARE+time to drive HS-0 before the sync sequence	140+10 UI	-	ns	Input
High Speed Mode to Low Power Mode Timing						
DSI-DN+/-	THS-SKIP	Time-out at display module to ignore transition period of EoT	40		ns	Input
DSI-DN+/-	THS-EXIT	Time to drive LP-11 after HS burst	100		ns	Input
DSI-DN+/-	THS-TRAIL	Time to drive flipped differential state after last payload data bit of a HS transmission burst	60+4UI		ns	Input
High Speed Mode to/from Low Power Mode Timing						
DSI-CLK+/-	TCLK-POS	Time that the MPU shall continue sending HS clock after the last associated data lane has transition to LP mode	60+52UI		-	Input
DSI-CLK+/-	TCLK-TRAIL	Time to drive HS differential state after last payload clock bit of a HS transmission burst	60		-	Input
DSI-CLK+/-	THS-EXIT	Time to drive KP-11 after HS burst	100		-	Input
DSI-CLK+/-	TCLK-PREPARE	Time to drive LP-00 to prepare for HS transmission	38		95	Input
DSI-CLK+/-	TCLK-TERM-EN	Time-out at clock lan display module to enable HS transition	-		38	Input
DSI-CLK+/-	TCLK-PREPARE+TCLK-ZERO	Minimum lead HS-0 drive period before starting clock	300		-	Input
DSI-CLK+/-	TCLK-PRE	Time that the HS clock shall be driven prior to any associated data lane beginning the transition from LP to HS mode	8UI		-	Input
DSI-CLK+/-	TEOT	Time form start of TCLK-TRAIL period to start of LP-11 state	-		105ns +12UI	Input

3.7 Reset Timing

Figure: Reset Timing

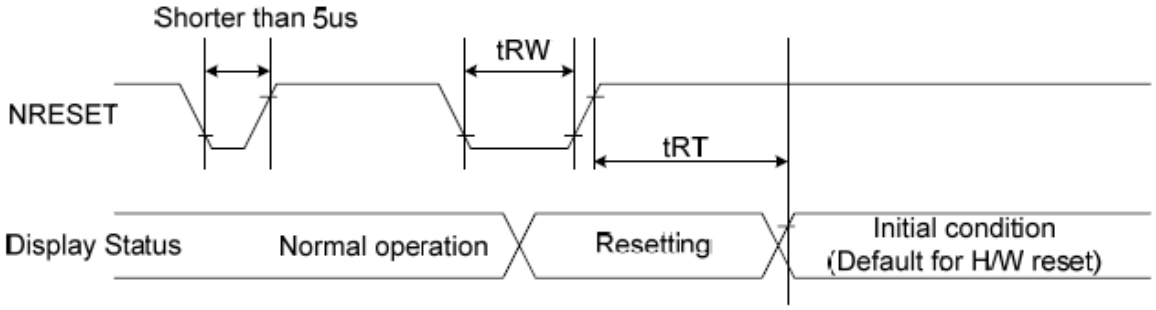


Table: Reset Timing

Signal	Symbol	Description	Min	Max	Unit	Note
RESX	tRW	Reset Pulse Duration	10	-	us	-
	tRT	Reset Cancel	-	5	ms	1, 5
			-	120	ms	1, 6, 7

Note1: The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from OTP to registers. This loading is done every time when there is H/W reset cancel time (tRT) within 5ms after a rising edge of RESX.

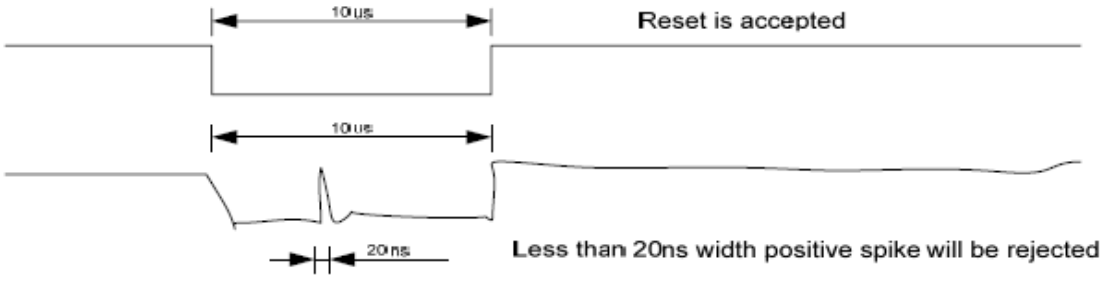
Note 2: Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the Table below.

Table: Reset Description

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9us	Reset Starts

Note 3: During the resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120ms, when Reset Starts in Sleep Out mode. The display remains the blank state in Sleep On mode.) and then return to Default condition for Hardware Reset.

Note 4: Spike Rejection also applies during a valid reset pulse as shown below:



Note 5: When Reset applied during Sleep In Mode.

Note 6: When Reset applied during Sleep Out Mode.

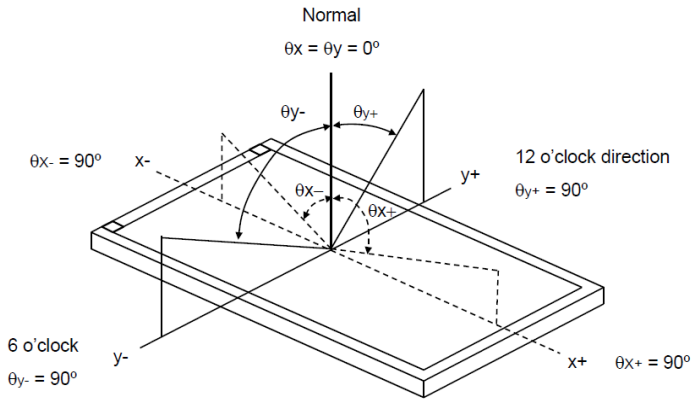
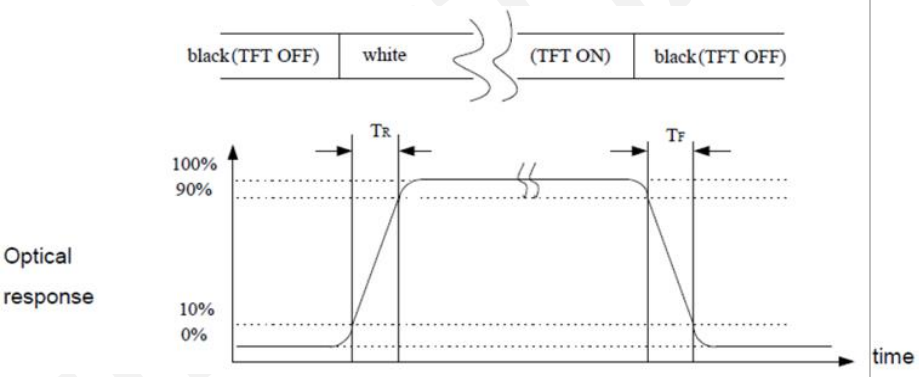
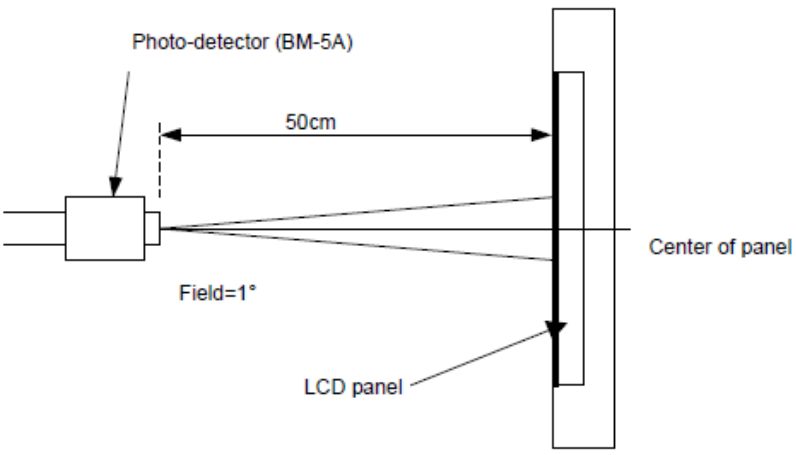
Note 7: It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

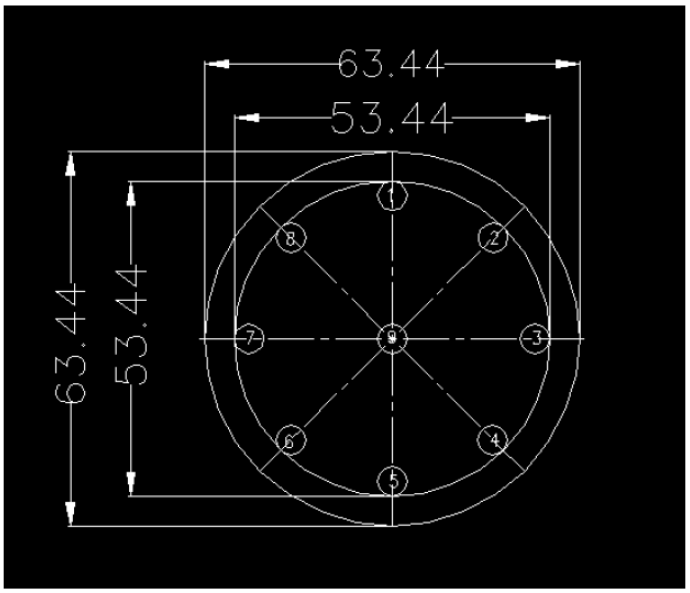
4. Optical Specification

4.1 Optical Characteristics

Characteristics		Symbol	Conditions	Min	Typ.	Max	Unit	Note
Contrast Ratio		CR	θ = 0° Normal viewing angle	800	1000	-	-	1, 2
Response Time	Rising	$T_R + T_F$		-	-	35	msec	1, 3
	Falling							-
Color Gamut		S(%)	-	65	70	-	%	-
Viewing Angle	Left	θ_x-	CR>10	-	85	-	-	1, 4
	Right	θ_x+		-	85	-		
	Up	θ_Y+		-	85	-		
	Down	θ_Y-		-	85	-		
Colour Chromaticity	Red	Rx	θ = 0° Normal viewing angle	0.6030	0.6230	0.6430	-	1, 4 CF glass
		Ry		0.3228	0.3428	0.3628		
	Green	Gx		0.3049	0.3249	0.3449		
		Gy		0.5678	0.5878	0.6078		
	Blue	Bx		0.1298	0.1498	0.1698		
		By		0.0474	0.0674	0.0874		
	White	Wx		0.2571	0.2971	0.3371		
		Wy		0.2848	0.3248	0.3648		
Luminance		Lv	I_F = 40 mA	380	430	-	cd/m^2	5
Uniformity		Avg	-	80	-	-	%	5

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

Note	Item	Test method
1	Definition of Viewing Angle (θx, θy)	
2	Definition of Contrast Ratio (CR)	Measured at the center point of panel 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 Optical Measurement Setup	
5	Definition of Luminance Uniformity	Luminance Uniformity of these 9 points is defined as below:

Note	Item	Test method
		 $\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$ $\text{Luminance} = \frac{\text{Total Luminance of 9 points}}{9}$

5. LED Backlight Specification

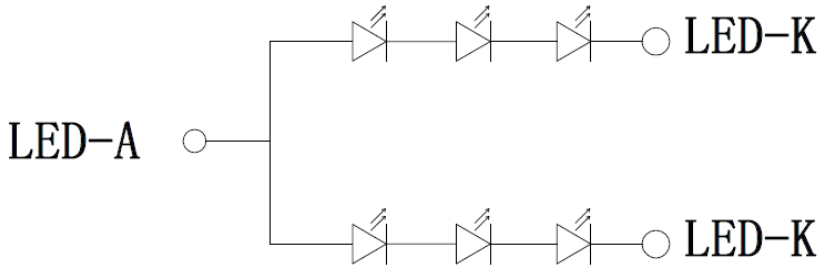
5.1 LED Backlight Characteristics

Item	Symbol	Condition	Min	Typ.	Max	Unit	Note
Forward Current	I_F	-	-	40	-	mA	-
Forward Voltage	V_F	-	-	9.3	-	V	-
LED Life Time	Hr	-	-	50000	-	Hour	1, 2

Note 1: LED life time (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25±3℃, typical IL (I_F) value indicated in the above table until the brightness becomes less than 50%.

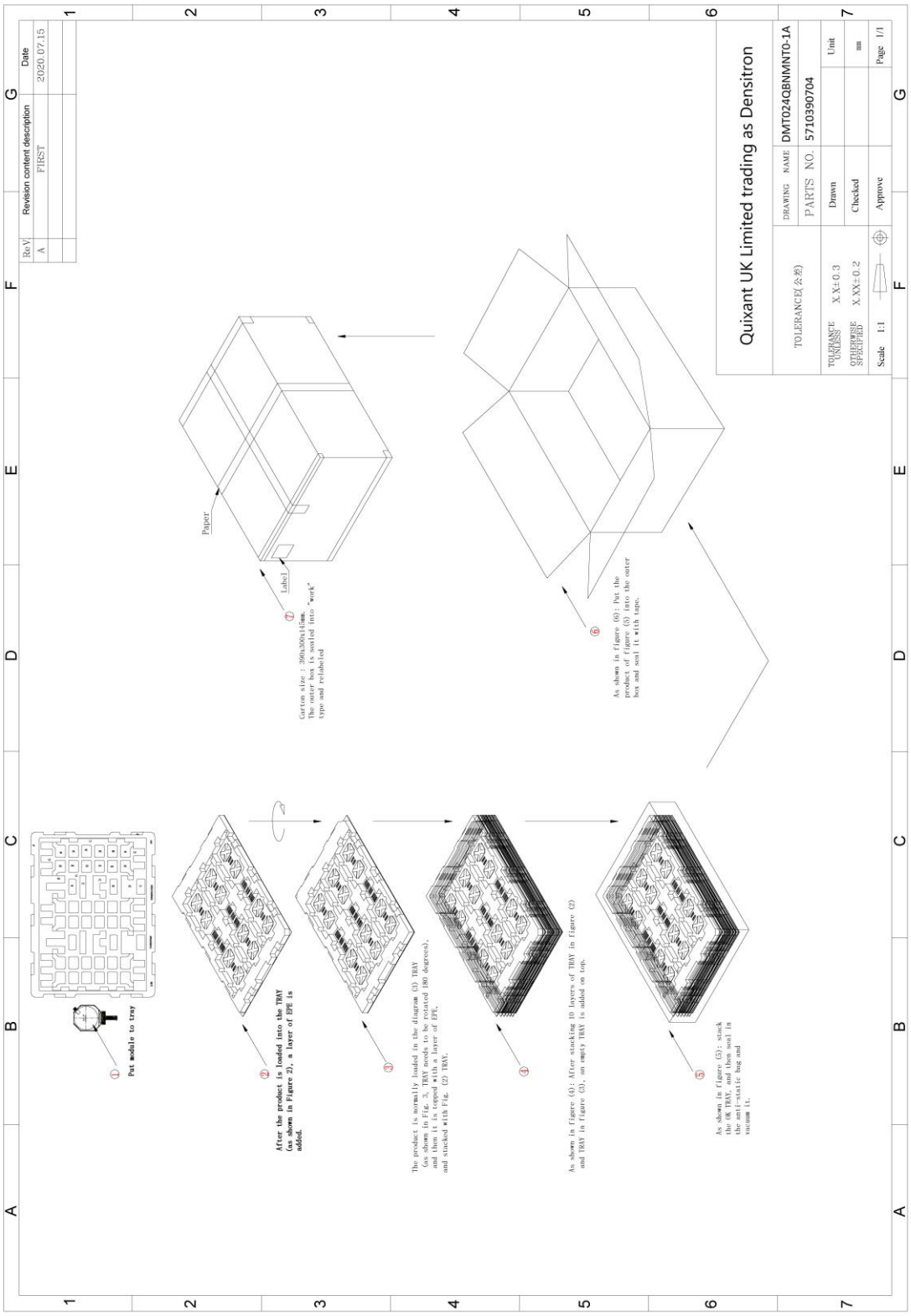
Note 2: The "LED life time" is defined as the module brightness decreases to 50% original brightness at Ta=25℃ and IL=40mA. The LED lifetime could be decreased if operating IL is larger than 40mA. The constant current driving method is suggested.

5.2 INTERNAL CIRCUIT DIAGRAM



BL Circuit

6. Packaging


Quixant UK Limited trading as Densitron
DRAWING NAME DMT024QBNMNT0-1A
PARTS NO. 5710390704
Drawn
Checked
Approve
Scale 1:1
Page 1/1
Date 2020.07.15
Revision content description FIRST
Paper
Label
Carton size : 300x300x145mm.
The outer box is sealed into "work" type and relabeled
As shown in figure (6): Put the product of figure (5) into the outer box and seal it with tape.
Put module to tray
After the product is loaded into the TRAY (as shown in Figure 2), a layer of EPE is added.
The product is normally loaded in the diagram (3) TRAY (as shown in Fig. 3, TRAY needs to be rotated 180 degrees), and then is covered with a layer of EPE, and stacked with Fig. (2) TRAY.
As shown in figure (4): After stacking 10 layers of TRAY in figure (2) and TRAY in figure (3), an empty TRAY is added on top.
As shown in figure (5): stack the 4 TRAYs and then put them in the anti-static bag and vacuum it.

7. Quality Assurance Specification

7.1 Conformity

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

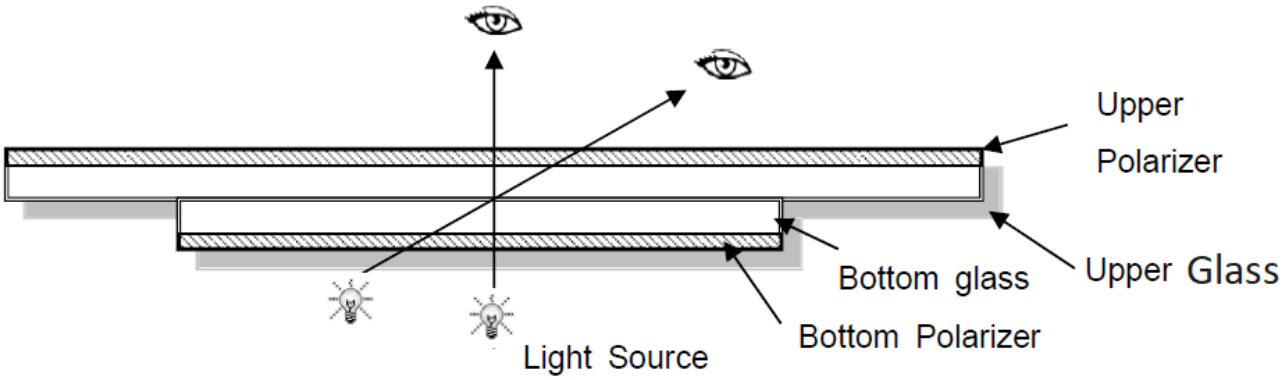
7.2 Environment Required

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

Temperature:	25 ± 5°C
Humidity:	65% ± 10% RH
Viewing Angle:	Normal Viewing Angle
Illumination:	Single fluorescent lamp (300 to 700 Lux)
Viewing distance:	30 - 50cm

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

Inspection table or jig must be anti-electrostatic.

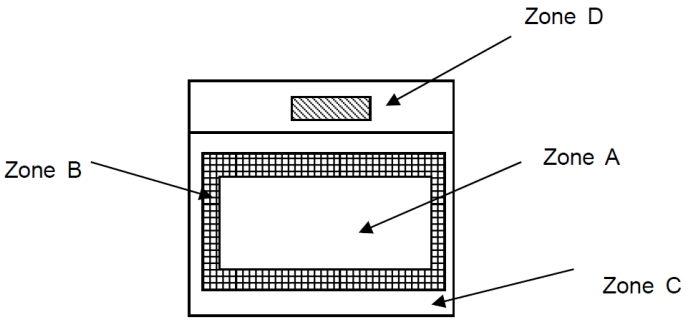


7.3 Delivery Assurance

7.3.1 Delivery Inspection Standards

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

7.3.2 Zone Definition



Zone A: Effective Viewing Area (Character or Digit can be seen)

Zone B: Viewing Area except Zone A

Zone C: Outside (Zone A + Zone B) Area which cannot be seen after assembly by customer.

Zone D: IC Bonding Area

Note: Generally, visual defects in Zone C can be ignored when it doesn't affect product function or appearance after assembly by customer

7.3.3 Criteria & Acceptable Quality Level

Partition	AQL	Definition
Major	0.65	Defects in Pattern Check (Display On)
Minor	1.5	Defects in Cosmetic Check (Display Off)

LCD: Liquid Crystal Display, TP: Touch Panel, LCM: Liquid Crystal Module

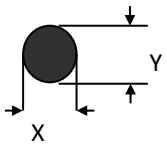
No.	Items	Criteria	Classification of defects
1	Functional defects	1) No display, open or miss line 2) Display abnormally 3) Backlight no lighting, abnormal lighting. 4) TP no function	Major
2	Missing	Missing component	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed	
4	Color tone	Color unevenness, refer to limited sample	Minor
5	Spot Line defect	Light dot, Dim spot, Polarizer Bubble; Polarizer accidented spot.	
6	Soldering Appearance	Good soldering, Peeling off is not allowed.	
7	LCD/Polarizer	Black/White spot/line, scratch, crack, etc.	

Note 1: Light dot: Dots appear bright and unchanged in size in which LD panel is displaying under black pattern.

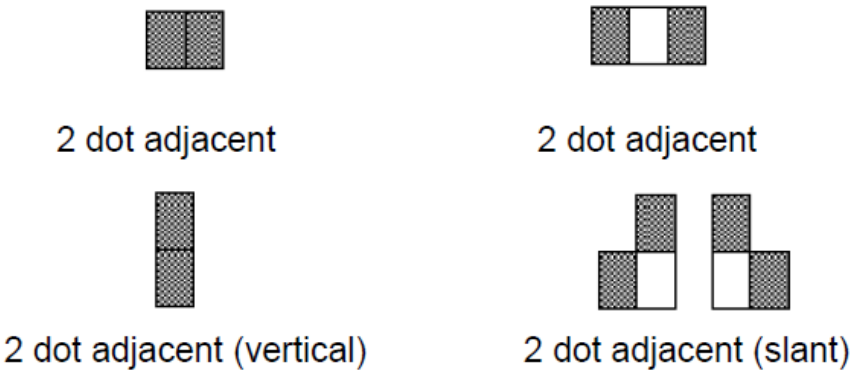
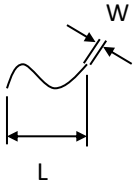
Note 2: Dim dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.

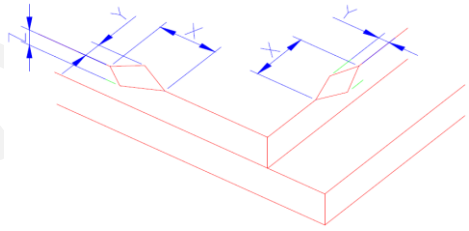
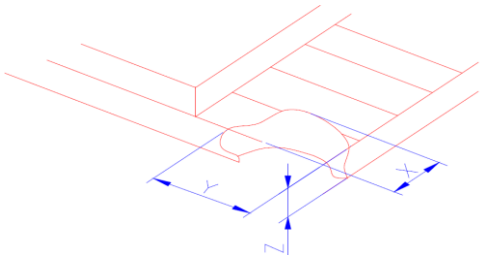
7.3.4 Criteria & Classification

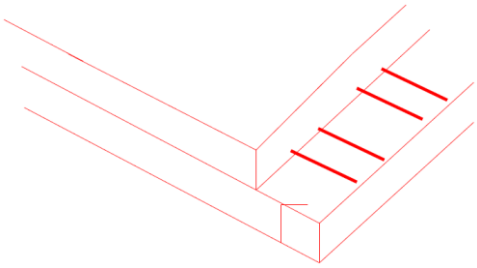
Units: mm

<table>
<tr><th>Class</th><th>Item</th><th colspan="5">Criteria</th></tr>
<tr><td rowspan="24">Minor</td><td rowspan="24">Spot Defect</td><td colspan="5">Round type: as per following drawing, ∅ = (X+Y)/2  </td></tr>
<tr><td colspan="5">1) Light Dot (black/white spot, pinhole, etc.)</td></tr>
<tr><td rowspan="2">Size\Zone</td><td colspan="3">Acceptable Quantity</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td>∅≤0.15</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.15<∅≤0.25</td><td colspan="2">3 (distance ≧ 6mm)</td></tr>
<tr><td>0.25<∅≤0.40</td><td colspan="2">2 (distance ≧ 6mm)</td></tr>
<tr><td>0.40<∅</td><td colspan="2">0</td></tr>
<tr><td colspan="5">2) Dim Spot (light leakage, dent, dark spot, etc.)</td></tr>
<tr><td rowspan="2">Size\Zone</td><td colspan="3">Acceptable Quantity</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td>∅≤0.10</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.10<∅≤0.25</td><td colspan="2">3 (distance ≧ 10mm)</td></tr>
<tr><td>0.25<∅≤0.30</td><td colspan="2">2</td></tr>
<tr><td>0.35<∅</td><td colspan="2">0</td></tr>
<tr><td colspan="5">3) Polarizer Accidented Spot</td></tr>
<tr><td rowspan="2">Size\Zone</td><td colspan="3">Acceptable Quantity</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td>∅≤0.2</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.2<∅≤0.5</td><td colspan="2">2 (distance ≧ 6mm)</td></tr>
<tr><td>0.5<∅</td><td colspan="2">0</td></tr>
<tr><td colspan="5">4) Pixel Bad Points</td></tr>
<tr><td>Item</td><td>Zone A</td><td colspan="3">Acceptable Qty</td></tr>
<tr><td rowspan="3">Bright Dot</td><td>Random</td><td colspan="3">N≤2</td></tr>
<tr><td>2 dots adjacent</td><td colspan="3">N≤0</td></tr>
<tr><td>3 dots adjacent</td><td colspan="3">N≤0</td></tr>
<tr><td rowspan="2">Dark Dot</td><td>Random</td><td colspan="3">N≤2</td></tr>
<tr><td>2 dots adjacent</td><td colspan="3">N≤0</td></tr>
</table>

<table>
<tr><th>Class</th><th>Item</th><th colspan="3">Criteria</th></tr>
<tr><td rowspan="6"></td><td rowspan="6"></td><td></td><td>3 dots adjacent</td><td>N≤0</td></tr>
<tr><td>Distance</td><td>1. Minimum distance between bright dots.
2. Minimum distance between dark dots.
3. Minimum distance between dark and bright dot.</td><td>5mm</td></tr>
<tr><td colspan="2">Total bright and dark dot</td><td>N≤4</td></tr>
<tr><td colspan="3">Note 1: Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.
Note 2: Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.
Note 3: 2 dot adjacent=1 pair=2 dots

Picture:
 
</td></tr>
<tr><td colspan="3">5) Polarizer Bubble</td></tr>
<tr><td rowspan="2">Size\Zone</td><td colspan="3">Acceptable Quantity</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td>∅≤0.2</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.2<∅≤0.4</td><td colspan="2">3 (distance ≧ 6mm)</td></tr>
<tr><td>0.4<∅</td><td colspan="2">0</td></tr>
<tr><td>Minor</td><td>Line Defect (LCD/Polarizer backlight black/white line,</td><td colspan="3">Line type: as per following drawing
 
</td></tr>
</table>

<table>
<tr><th>Class</th><th>Item</th><th colspan="5">Criteria</th></tr>
<tr><td rowspan="5"></td><td rowspan="5">scratch, stain)</td><td rowspan="2">Width</td><td rowspan="2">Length</td><td colspan="3">Acceptable quantity</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td>W≤0.03</td><td>Ignore</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.03<W≤0.04</td><td>L ≤ 3.0</td><td colspan="2">N ≤ 2</td></tr>
<tr><td>0.04<W≤0.05</td><td>L ≤ 2.0</td><td colspan="2">N ≤ 1</td></tr>
<tr><td>0.05<W</td><td colspan="5">Define as spot defect</td></tr>
<tr><td>Minor</td><td>Electronic Components SMT</td><td colspan="6">Not allow missing parts, solderless connection, cold solder joint, mismatch.
The positive and negative polarity opposite.</td></tr>
<tr><td>Minor</td><td>Display Color & Brightness</td><td colspan="6">1. Color: Measuring the color coordinates. The measurement standard according to the datasheet or samples.
2. Brightness: Measuring the brightness of White screen. The measurement standard according to the datasheet or Samples.</td></tr>
<tr><td>Minor</td><td>LCD Mura/Waving/ Hot Spot</td><td colspan="6">Not visible through 5% ND filter in 50% gray or judge by limit sampl
e if necessary.</td></tr>
<tr><td>Minor</td><td>LCD Crack/Broken</td><td colspan="6">Symbols:
X: Length, Y: Width, Z: Height, L: Length of ITO, T: Height of LCD
1) The edge of LCD broken: X≦3.0mm; Y<Inner border line of the seal; Z≦T
 
2) LCD corner broken: X≦3.0mm; Y≦L; Z≦T
  </td></tr>
</table>

Class	Item	Criteria
Major	LCD Crack	The LCD with extensive crack is not acceptable. 

Criteria (functional items)

No.	Item	Criteria
1	No display	Not allowed
2	Missing segment	
3	Short	
4	Backlight no lighting	

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	Inspection after test
High Temperature Operation	60°C, 96 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	-10°C, 96 hrs	
High Temperature Storage	70°C, 96 hrs	
Low Temperature Storage	-30°C, 96 hrs	
High Temperature & High Humidity Operating	+60℃, 90％RH, 96HR	
Thermal Shock (Non-operation)	-30℃,30 min ↔ 70℃,30 min, Change time:5min 20CYC.	
ESD test	C=150pF, R=330,5points/panel Air: ±8KV, 5times; Contact: ±6KV, 5 times; (Environment: 15℃~35℃, 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. (6 hours for total) (Package condition).	
Box Drop Test	1 Corner 3 Edges 6 faces,80cm (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.

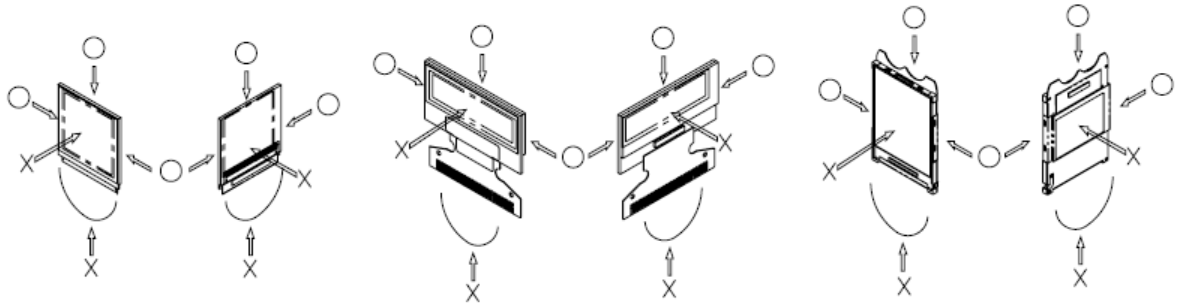
8.1.1 Inspection Check Standard

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 25±5 °C, 65±10% 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.