DMT050HDNMCMI-1C
PRODUCT SPECIFICATION

Version 0.2
Mar 30, 2021

TBD

Customer's Approval	
Signature	*Date*

Prepared by *Joyce Huang*
Approved by *Eric Wan*

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Revision History

VERSION	DATE	DESCRIPTION	AUTHOR
1.0	Sep 08, 2020	Initial Release	Joyce Huang
0.2	Mar 30, 2021	Revise Surface treatment, touch panel type, bonding type, and LCD Spec. Delete cover photo.	Joyce Huang

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Table of Contents

1. GENERAL DESCRIPTION 5

1.1 Introduction 5
1.2 Main Features 5
1.3 Touch Features 6

2. MECHANICAL SPECIFICATION 7

2.1 Mechanical Characteristics 7
2.2 Mechanical Drawing 8

3. ELECTRICAL SPECIFICATION 9

3.1 Absolute Maximum Ratings 9
3.2 Electrical Characteristics 9
3.3 Interface Pin Assignment 10
3.4 Block Diagram 12
3.5 Timing Characteristics 13

4. ELECTRICAL SPECIFICATION TOUCH 16

4.1 Touch Information 16
4.2 I^2C 17

5. OPTICAL SPECIFICATION 19

5.1 Optical Characteristics 19

6. LED BACKLIGHT SPECIFICATION 22

6.1 LED Backlight Characteristics 22
6.2 Internal Circuit Diagram 22

7. PACKAGING 23

8. QUALITY ASSURANCE SPECIFICATION 24

8.1 Conformity 24
8.2 Environment Required 24
8.3 Delivery Assurance 24
8.4 Dealing with Customer Complaints 32

9. RELIABILITY SPECIFICATION 33

9.1 Reliability Tests 33

CONFIDENTIAL

10. HANDLING PRECAUTIONS 34

10.1 Handling Precautions 34
10.2 Storage Precautions 35
10.3 Designing Precautions 35
10.4 Operation Precautions 36
10.5 Other Precautions 36

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1. General Description

1.1 Introduction

This is a 5” 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 720 x 1280 and can display up to 16.7M colours. The display module supports 1/2/3/4 Lane MIPI interface and optical bonding touch panel.

1.2 Main Features

Item	Contents
Display Type	TFT LCD
Screen Size	5” Diagonal
Display Format	720 x RGB x 1280 Dots
No. of Colour	16.7M
Overall Dimensions	73 (W) x 133.2 (H) x 3.79 (D) mm
Active Area	61.78 (W) x 109.82 (H) mm
Mode	Normally Black / Transmissive / IPS
Surface Treatment	Glare (7H)
Viewing Direction	All round
Interface	1/2/3/4 Lane MIPI
Driver IC	AXS15217
Backlight Type	LED, White, 12 chips
Touch Panel	CTP (in-cell)
Touch Interface	I^2C
Bonding Type	Optical Bonding (Cover lens & TFT in-cell)
Operating Temperature	-20°C ~ +70°C
Storage Temperature	-30°C ~ +80°C
ROHS	Compliant to RoHS 2.0

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1.3 Touch Features

Item	Contents
Touch Panel	CTP (in-cell)
Structure	TFT in-cell
Touch Interface	I^2C
Slave Address	0x70 (8bit)
Bonding Type	Optical Bonding (Cover lens & TFT in-cell)
Touch mode	Multi-touch

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2. Mechanical Specification

2.1 Mechanical Characteristics

Item	Characteristic	Unit
Display Format	720 x RGB x 1280	Dots
Overall Dimensions	73 (W) x 133.2 (H) x 3.79 (D)	mm
Active Area	61.78 (W) x 109.82 (H)	mm
Dot Pitch	0.0285 (W) x 0.0858 (H)	mm
Weight	TBD	g
IC Controller/Driver	AXS15217	

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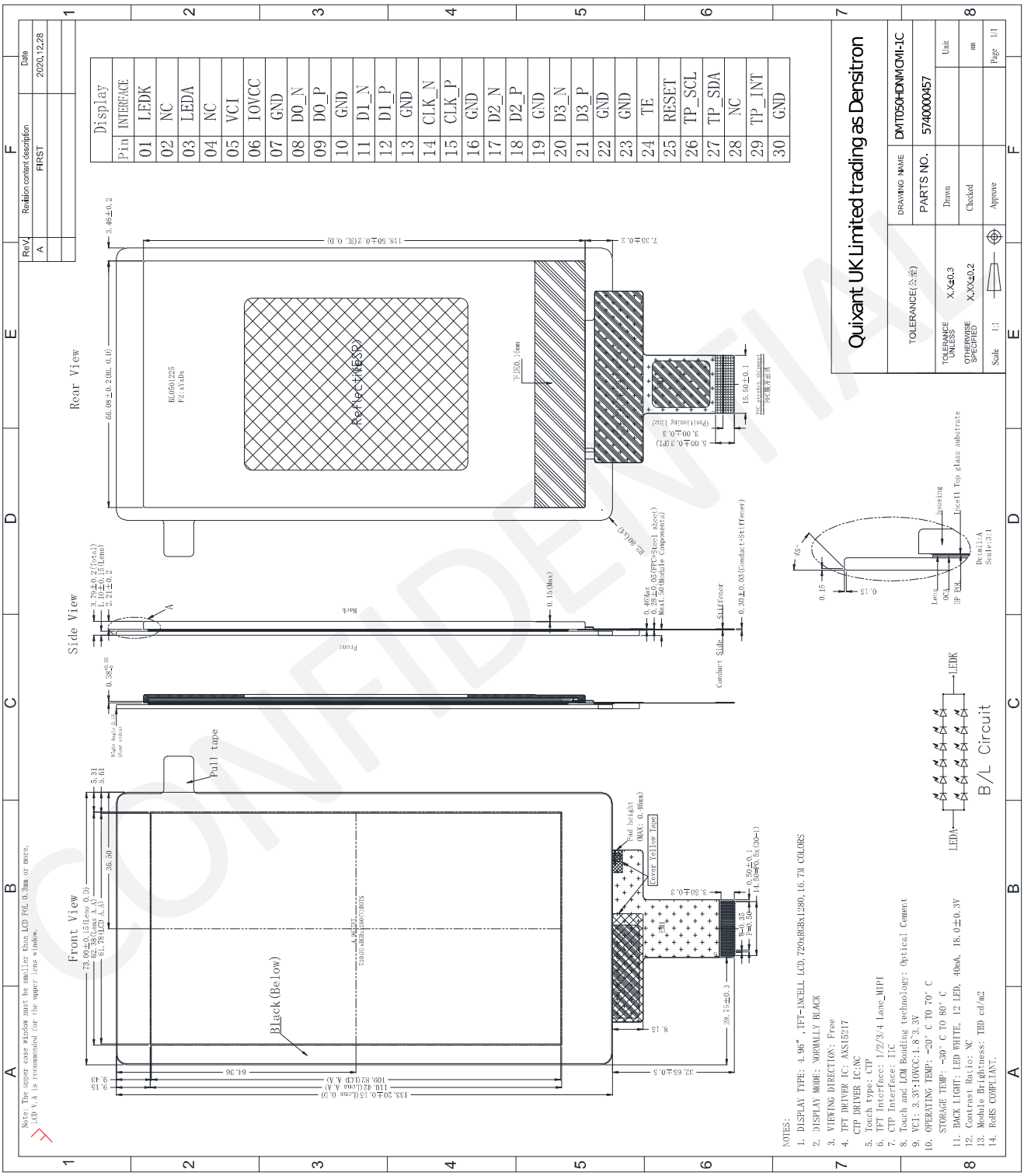
2.2 Mechanical Drawing



Pin	Display INTERFACE
01	LEDK
02	NC
03	LEDA
04	NC
05	VCI
06	IOVCC
07	GND
08	D0_N
09	D0_P
10	GND
11	D1_N
12	D1_P
13	GND
14	CLK_N
15	CLK_P
16	GND
17	D2_N
18	D2_P
19	GND
20	D3_N
21	D3_P
22	GND
23	GND
24	TE
25	RESET
26	TP_SCL
27	TP_SDA
28	NC
29	TP_INT
30	GND

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3. Electrical Specification

3.1 Absolute Maximum Ratings

Item	Symbol	Min	Max	Unit	Note
Digital Supply Voltage	VCI	-0.3	4.5	V	1
Digital Supply I/O Voltage	IOVCC	-0.3	4.5	V	-
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

3.2.1 DC Characteristics

Characteristics	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Digital Supply Voltage	VCI	-	2.3	3.3	3.6	V	-
Digital Supply I/O Voltage	IOVCC	-	1.65	1.8	1.95	V	-

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3.3 Interface Pin Assignment

3.3.1 TFT Pin Define

NO.	Symbol	I/O	Function
1	LEDA	P	Cathode pin of backlight.
2	NC	-	No connection
3	LEDA	P	Anode pin of backlight.
4	NC	-	No connection
5	VCI	P	Power supply（3.3V）
6	IOVCC	P	Power supply(1.8V)
7	GND	P	Ground
8	D0_N	I	MIPI DSI :Data differential Signal input pins.(Data lane0)
9	D0_P	I	
10	GND	P	Ground
11	D1_N	I	MIPI DSI :Data differential Signal input pins.(Data lane1)
12	D1_P	I	
13	GND	P	Ground
14	CLK_N	I	MIPI DSI : CLOCK differential signal input pins.
15	CLK_P	I	
16	GND	P	Ground
17	D2_N	I	MIPI DSI :Data differential Signal input pins.(Data lane2)
18	D2_P	I	
19	GND	P	Ground
20	D3_N	I	MIPI DSI :Data differential Signal input pins.(Data lane3)
21	D3_P	I	
22	GND	P	Ground
23	GND	P	Ground
24	TE	O	Tear effect signal

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NO.	Symbol	I/O	Function
25	RESET	I	LCD reset Signal, Active Low
26	TP_SCL	I	Touch IIC Clock signal
27	TP_SDA	I	Touch IIC Data signal
28	NC	-	No connection.
29	TP_INT	I	Touch Interrupt signal
30	GND	P	Ground.

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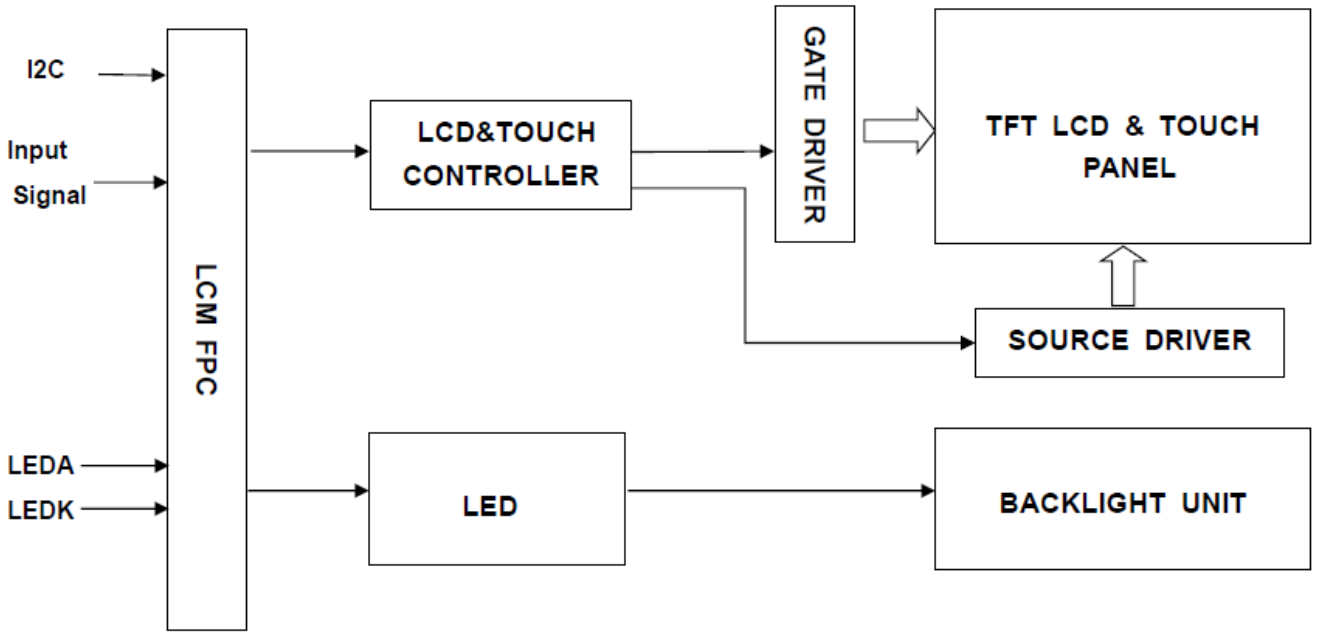
3.4 Block Diagram



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3.5 Timing Characteristics

3.5.1 MIPI Porch

Item	Symbol	Min	Typ.	Max	Unit	Note
Horizontal Synchronization	Hsync	-	16	-	PCLK	-
Horizontal Back Porch	HBP	-	17	-	PCLK	-
Horizontal Front Porch	HFP	-	20	-	PCLK	-
Horizontal Address	HAdr	-	720	-	PCLK	-
Vertical Synchronization	Vsync	-	16	-	HSYNC	-
Vertical Back Porch	VBP	-	13	-	HSYNC	-
Vertical Front Porch	BFP	-	24	-	HSYNC	-
Vertical Address	Vadr	-	1280	-	HSYNC	-

3.5.2 MIPI-DSII Characteristics

3.5.2.1 Low Power Mode

Item	Symbol	Description	Min	Typ.	Max	Unit	Note
DSI-D0+/-	T_{LPXM}	Length of LP-00, LP-01, LP-10 or LP-11 periods MPU to Display Module	50	-	-	ns	-
DSI-D0+/-	T_{LPXD}	Length of LP-00, LP-01, LP-10 or LP-12 periods Display Module to MPU	58	-	-	ns	-
DSI-D0+/-	$T_{TA-SURED}$	Time-out before the MPU start driving	T_{LPXD}	-	$2XT_{LPXD}$	ns	-
DSI-D0+/-	$T_{TA-FETD}$	Time to drive LP-00 by display module	$5XT_{LPXD}$	-	-	ns	-
DSI-D0+/-	T_{TA-GOD}	Time to drive LP-00 after turnaround request-MPU	$4XT_{LPXD}$	-	-	ns	-
DSI-D0+/-	Ratio T_{LPX}	Ratio of TLPXM/TLPXD between MCU and Display module	2/3	-	3/2	-	-

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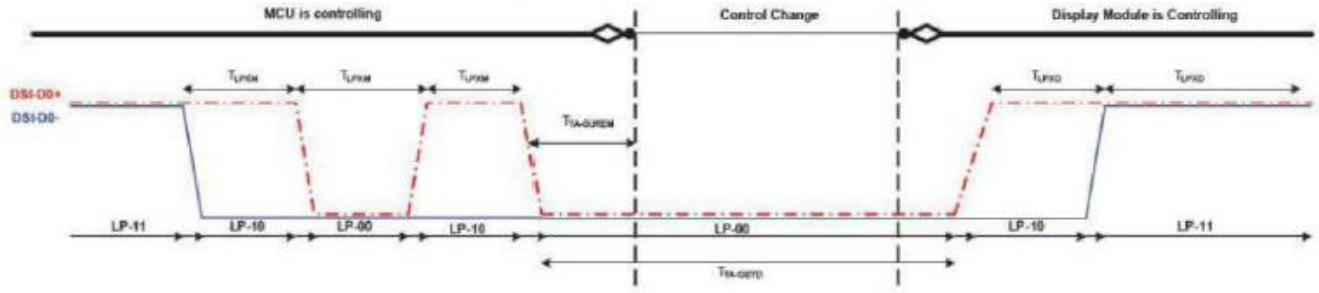
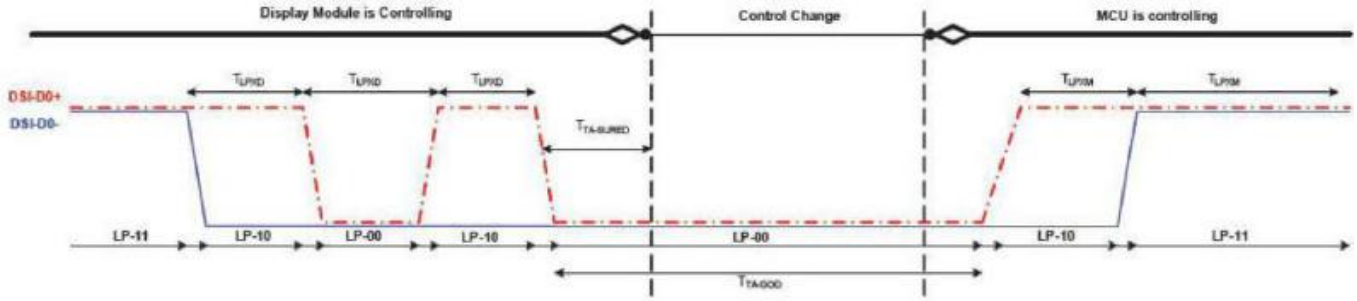
BTA from the MCU to the Display Module



BTA from the Display Module to the MCU



3.5.2.2 LP-11 between High Speed and Power Modes

DSI-D0 High Speed or Low Power Modes are starting or finishing from/to Stop State (SS, LP-11) when 4 different combinations, what are listed below, are possible:

1. High Speed Mode→Stop State (SS, LP-11)→High Speed Mode
2. High Speed Mode→Stop State (SS, LP-11)→Low Power Mode
3. Low Power Mode→Stop State (SS, LP-11)→High Speed Mode
4. Low Power Mode→Stop State (SS, LP-11)→Low Power Mode

The Low Power Mode is also including 2 different functions:

1. Escape
2. Bus Turnaround (BTA)

Stop State (SS, LP-11) Timings from Previous Mode to Next Mode

Previous \ Next	Escape Mode			HSDT			BTA		
	Min	Typ.	Max	Min	Typ.	Max	Min	Typ.	Max
Escape Mode	100ns	-	-	100ns	-	-	100ns	-	-
HSDT	60ns+52UI	-	-	60ns+52UI	-	-	60ns+52UI	-	-
BTA	100ns	-	-	100ns	-	-	100ns	-	-

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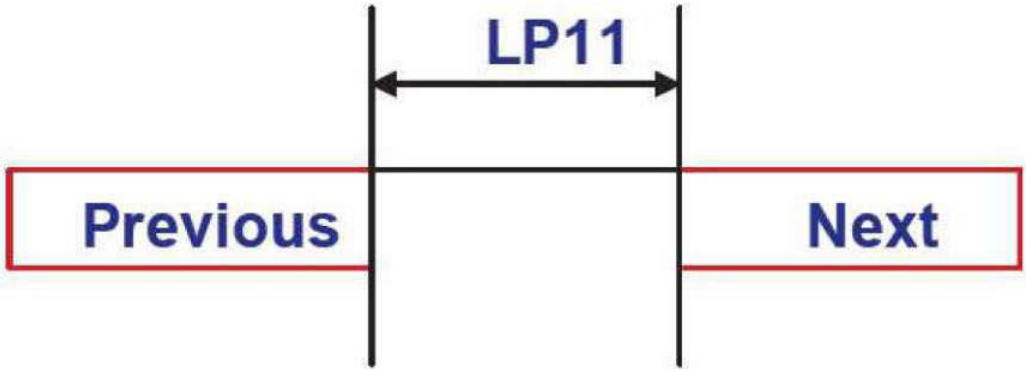
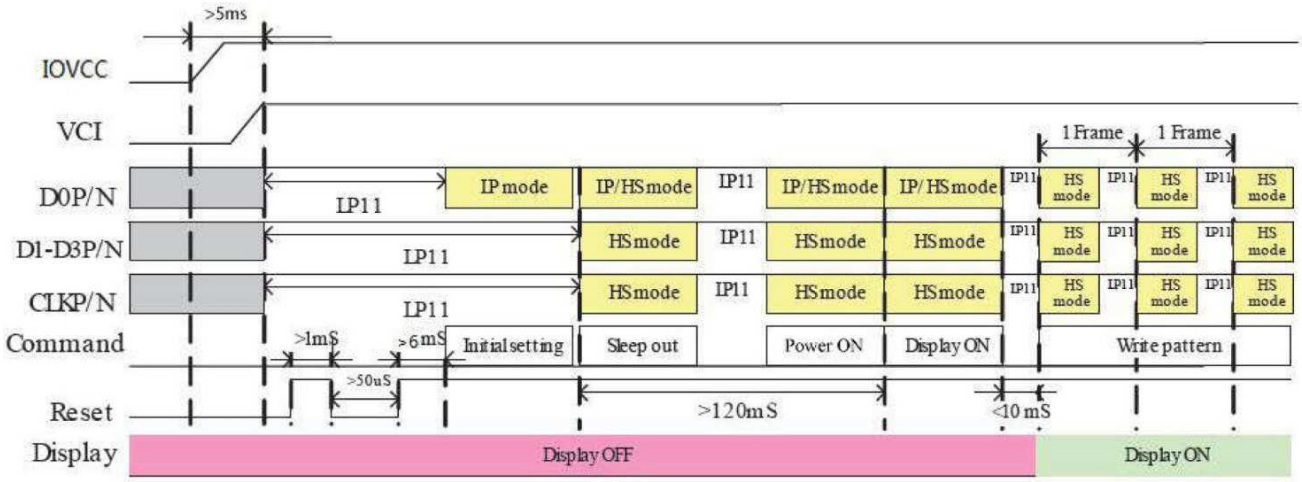
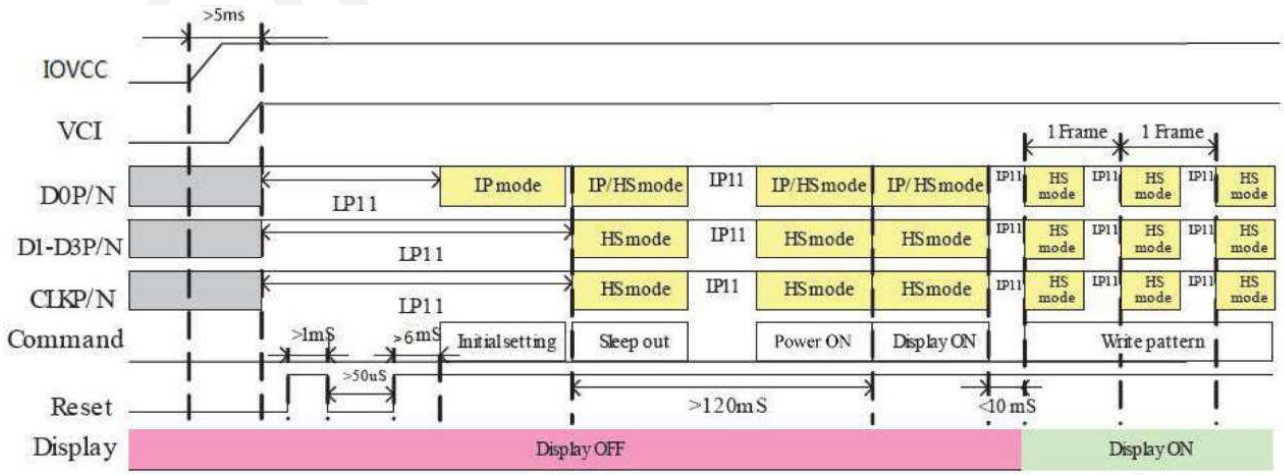


3.5.2.3 Power-on/off Sequence for MIPI Interface

Power on Sequence for MIPI Interface



Power on Sequence for MIPI Interface



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4. Electrical Specification Touch

4.1 Touch Information

I^2C	an interface for data exchange with host.
TP-INT	an interrupt signal to inform the host processor that touch data is ready for read.
TP_RESET	an external low signal reset the chip. The default I^2C slave address is 0x70 (8 bits) and the slave address can be set.
TP Coordinate	Left Top
TP Resolution	720 x 1280 Support for multi-touch
The IO Voltage	1.8V

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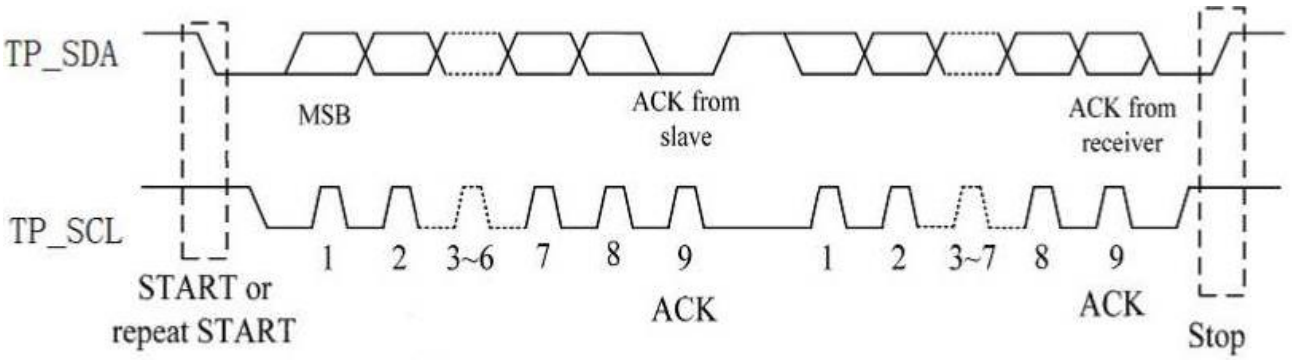
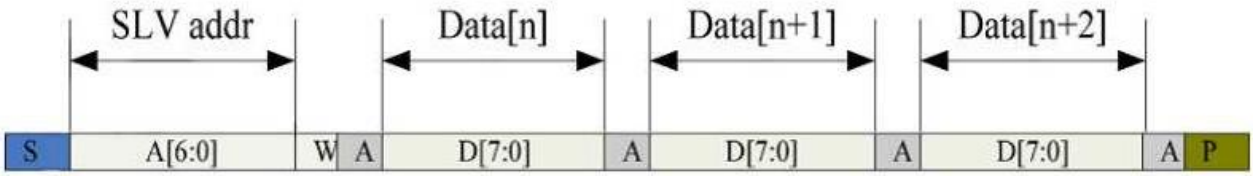
4.2 I²C

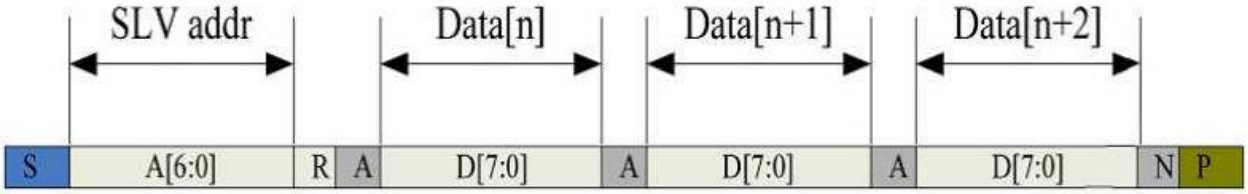
The I²C is always configured in the slave mode.



I2C Serial Data Transfer Format



I2C master write, slaver read



I2C master read, slaver write

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Mnemonics Description

Mnemonics	Description
S	I²C Start or I2C Restart
A [6:0]	Slave address
R/W	Read/Write bit, “1” for read, “0” for write
A(N)	ACK (NACK)
P	Stop: the indication of the end of a packet (if this bit is missing, S will indicate the end of the current)

I²C Timing Characteristics

Item	Min	Typ.	Max	Unit
SCL Frequency	50	-	200	KHz
Bus free time between a STOP and START condition	30	-	-	us
Hold time (repeated) START condition	30	-	-	us
Data setup time	500	-	-	us
Setup time or a repeated START condition	30	-	-	us
Setup time for STOP condition	30	-	-	us

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5. Optical Specification

5.1 Optical Characteristics

Characteristics		Symbol	Conditions	Min	Typ.	Max	Unit	Note
Contrast Ratio		CR	θ = 0° Normal viewing angle	1000	1500	-	-	1, 2
Response time	Rising	TR + TF		-	26	30	msec	1, 3
	Falling							
Viewing Angle	Left	θ_x-	CR>10	75	80	-	-	1, 4
	Right	θ_x+		75	80	-		
	Up	θ_Y+		75	80	-		
	Down	θ_Y-		75	80	-		
Colour Chromaticity	Red	Rx	-	TBD	TBD	TBD	-	1, 4
		Ry		TBD	TBD	TBD		
	Green	Gx		TBD	TBD	TBD		
		Gy		TBD	TBD	TBD		
	Blue	Bx		TBD	TBD	TBD		
		By		TBD	TBD	TBD		
	White	Wx		TBD	TBD	TBD		
		Wy		TBD	TBD	TBD		
Luminance		Lv	I_F = 40 mA	-	500	-	cd/m^2	5
Uniformity		Avg	-	80	-	-	%	5

*The data comes from the LCD specification.

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

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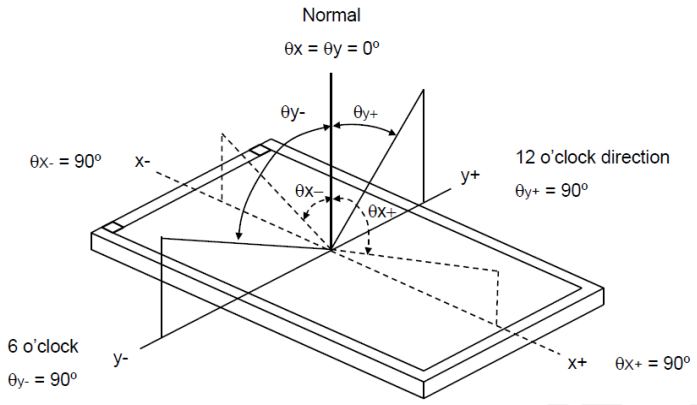
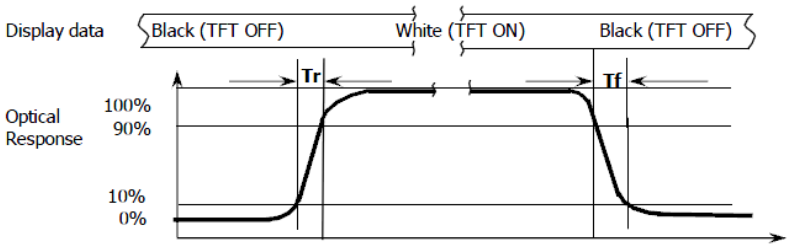
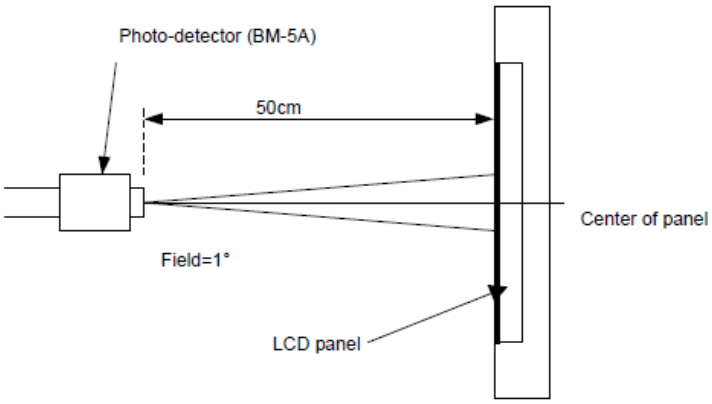
Note	Item	Test method
1	Definition of Viewing Angle (θx, θy)	
2	Definition of Contrast Ratio (CR)	Measured at the center point of panel Contrast ratio (CR) = Luminance measured when LCD is at "white state" / Luminance measured when LCD is at "black state"
3	Definition of Response Time (T_R, T_F)	
4	Definition of Optical Measurement Setup	

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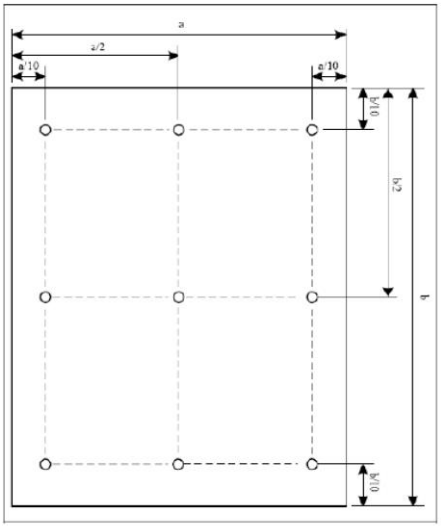
Note	Item	Test method
5	Definition of Luminance Uniformity	Luminance Uniformity of these 9 points is defined as below:  $\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$ $\text{Luminance} = \frac{\text{Total Luminance of 9 points}}{9}$

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6. LED Backlight Specification

6.1 LED Backlight Characteristics

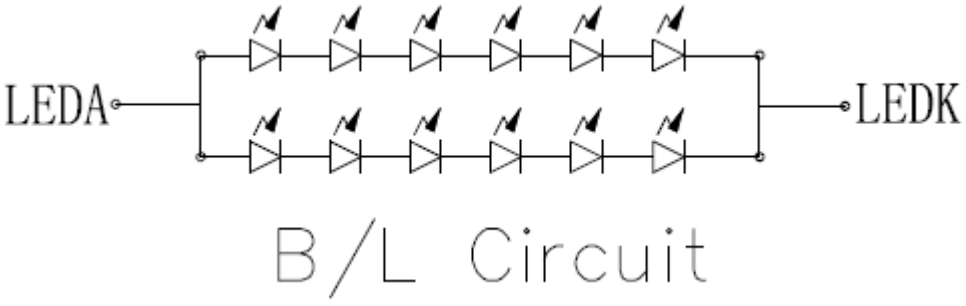
The backlight system is edge-lighting type with 12 chips LED.

Item	Symbol	Condition	Min	Typ.	Max	Unit	Note
Forward Current	I_F	-	35	40	-	mA	-
Forward Voltage	V_F	-	-	18	-	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.

6.2 Internal Circuit Diagram



B/L Circuit

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7. Packaging

TBD

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8. Quality Assurance Specification

8.1 Conformity

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

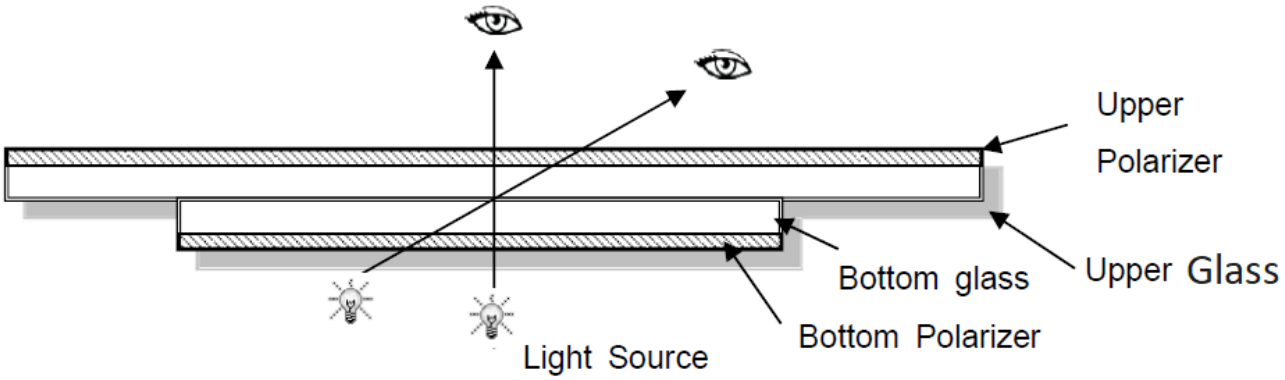
8.2 Environment Required

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

Temperature:	25 ± 5°C
Humidity:	65% ± 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.



8.3 Delivery Assurance

8.3.1 Delivery Inspection Standards

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

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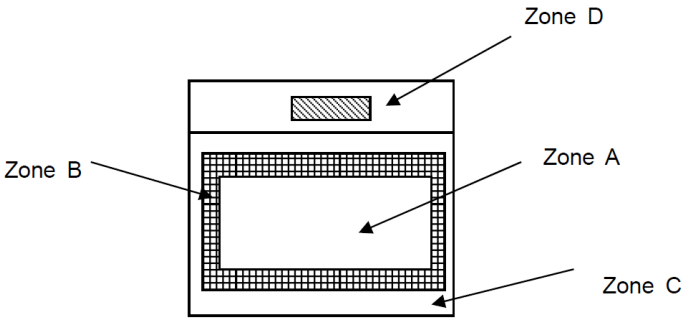
8.3.2 Zone Definition



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

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8.3.3 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, short 3) Backlight no lighting, abnormal lighting.	Major
2	Missing	Missing component and etc.	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed, deformation and etc.	
4	Color tone	Color unevenness, refer to limited sample	Minor
5	Spot Line defect	Light dot, Dim spot (Note 1) Polarizer Air Bubble; Polarizer accidented spot and etc.	
6	Soldering Appearance	Good soldering, peeling off is not allowed.	
7	LCD/Polarizer/CTP	Black/White spot/line, scratch, crack, etc.	

Note 1:

a) Light dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.

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

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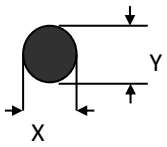
8.3.4 Criteria & Classification

Units: mm

<table>
<tr><th>Class</th><th>Item</th><th colspan="5">Criteria</th></tr>
<tr><td rowspan="20">Minor</td><td rowspan="20">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, stain, 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 ≧ 10mm)</td></tr>
<tr><td>0.25<∅≤0.40</td><td colspan="2">2 (distance ≧ 10mm)</td></tr>
<tr><td>0.4<∅</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>∅≤0.15</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.15<∅≤0.25</td><td colspan="2">3 (distance ≧ 10mm)</td></tr>
<tr><td>0.25<∅≤0.40</td><td colspan="2">2 (distance ≧ 10mm)</td></tr>
<tr><td>0.4<∅</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 ≧ 10mm)</td></tr>
<tr><td>0.5<∅</td><td colspan="2">0</td></tr>
<tr><td colspan="5">4) Pixel Bad Points (light dot, dim dot, colour dot)</td></tr>
<tr><td>Item</td><td>Zone A</td><td colspan="3">Acceptable Quantity</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>Dark Dot</td><td>Random</td><td colspan="3">N≤2</td></tr>
</table>

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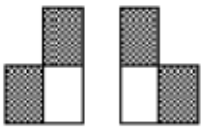
<table>
<tr><th>Class</th><th>Item</th><th colspan="3">Criteria</th></tr>
<tr><td rowspan="5"></td><td rowspan="5"></td><td rowspan="2"></td><td>2 dots adjacent</td><td>N≤0</td></tr>
<tr><td>3 dots adjacent</td><td>N≤0</td></tr>
<tr><td>Distance</td><td>1. Minimum Distance Between Bright dots.
2. Minimum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

2 dot adjacent

2 dot adjacent

2 dot adjacent (vertical)
 
2 dot adjacent (slant)</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 ≧ 10mm)</td></tr>
<tr><td>0.4<∅</td><td colspan="2">0</td></tr>
</table>

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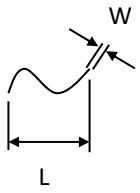
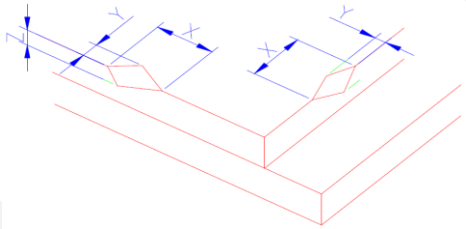
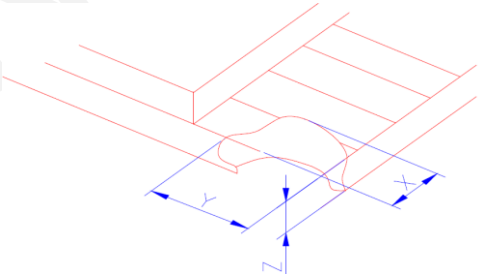
<table>
<tr><th>Class</th><th>Item</th><th colspan="5">Criteria</th></tr>
<tr><td rowspan="6">Minor</td><td rowspan="6">Line Defect (LCD/ Polarizer backlight black/white line, scratch, stain)</td><td colspan="5">Line type: as per following drawing
 
</td></tr>
<tr><td rowspan="2">Width</td><td rowspan="2">Length</td><td colspan="3">Acceptable quantity</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td>W≤0.05</td><td>Ignore</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.05<W≤0.06</td><td>L ≤ 4.0</td><td colspan="2">N ≤ 3</td></tr>
<tr><td>0.06<W≤0.08</td><td>L ≤ 3.0</td><td colspan="2">N ≤ 2</td></tr>
<tr><td>0.08<W</td><td colspan="4">Define as spot defect</td></tr>
<tr><td>Minor</td><td>LCD Crack/Broken</td><td colspan="5">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>

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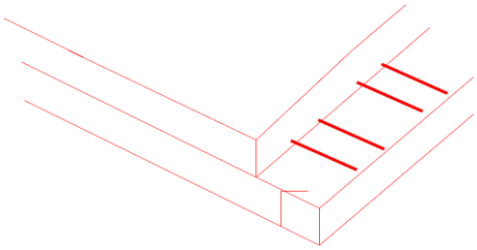
Class	Item	Criteria
Major	LCD Crack	The LCD with extensive crack is not acceptable. 
Major	Electronic Components SMT	Not allow missing parts, solderless connection, cold solder joint, mismatch, The positive and negative polarity opposite
Minor	Display colour & Brightness	1) Colour: Measuring the colour coordinates in accordance with the datasheet or samples. 2) Brightness: Measuring the brightness of white screen in accordance with the datasheet or samples.
Minor	LCD Mura/Waving/ Hot Spot	Not visible through 5% ND filter in 50% gray or judge by limit sample if necessary.

Class	Item	Criteria			
Minor	CTP Related	1) CTP Cover Sensor Accidented Black/White Spot			
		Size\Zone	Acceptable Qty		
			A	B	C
		∅≤0.1	Ignore		Ignore
		0.1<∅≤0.2	3（distance≧10mm）		
		0.20<∅≤0.25	2（distance≧10mm）		
		0.25<∅	0		
		2) CTP Cover Scratch			
		Width	Length	Acceptable Qty	
				A	B	C
		Φ≤0.05	Ignore	Ignore	
		0.05<W≤0.06	L≤4.0	N≤3	
		0.06<W≤0.08	L≤3.0	N≤2	
		0.08<W	Define as spot defect		

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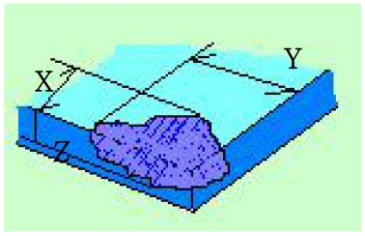
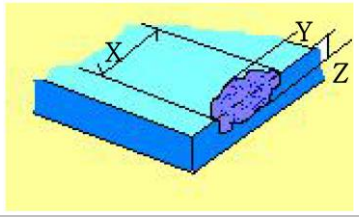
<table>
<tr><th>Class</th><th>Item</th><th colspan="3">Criteria</th></tr>
<tr><td rowspan="13"></td><td rowspan="13"></td><td colspan="3">3) CTP Cover Pinhole / Lack of ink</td></tr>
<tr><td rowspan="2">Size\Zone</td><td colspan="2">Acceptable Qty</td></tr>
<tr><td colspan="2">C</td></tr>
<tr><td>∅≤0.1</td><td colspan="2">Ignore</td></tr>
<tr><td>0.1<∅≤0.25</td><td colspan="2">3 (distance ≧ 10mm)</td></tr>
<tr><td>0.25<∅≤0.3</td><td colspan="2">2 (distance ≧ 10mm)</td></tr>
<tr><td>0.3<∅</td><td colspan="2">0</td></tr>
<tr><td colspan="3">4) CTP Bonding Bubble / Accidented Spot</td></tr>
<tr><td rowspan="2">Size\Zone</td><td colspan="2">Acceptable Qty</td></tr>
<tr><td>A</td><td>B</td></tr>
<tr><td>∅≤0.1</td><td colspan="2">Ignore</td></tr>
<tr><td>0.1<∅≤0.2</td><td colspan="2">3 (distance≧10mm）</td></tr>
<tr><td>0.2<∅≤0.25</td><td colspan="2">2 (distance≧10mm）</td></tr>
<tr><td>0.25<∅</td><td colspan="2">0</td></tr>
<tr><td colspan="3">Assembly Deflection: beyond the edge of backlight ≤0.2mm</td></tr>
<tr><td rowspan="2">Minor</td><td rowspan="2">CTP Related</td><td colspan="3">TP cover broken X: length, Y: width, Z: height
X≤0.5mm; Y≤0.5mm; Z<Cover thickness
*Circuitry broken is not allowed.
  </td></tr>
<tr><td colspan="3">TP cover broken X: length, Y: width, Z: height
X≤0.3mm; Y≤0.3mm; Z<LCD thickness
*Circuitry broken is not allowed.
  </td></tr>
</table>

Criteria (functional items)

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

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8.4 Dealing with Customer Complaints

8.4.1 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.

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.

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9. Reliability Specification

9.1 Reliability Tests

Test Item	Test Condition	Evaluation and Assessment
High Temperature Operation	70°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	-20°C, 96 hrs	
High Temperature Storage	80°C, 96 hrs	
Low Temperature Storage	-30°C, 96 hrs	
High Temperature & High Humidity Storage	+60℃, 90％RH, 96HR	
Thermal Shock (Non-operation)	-10℃,30 min ↔ 60℃,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.

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.

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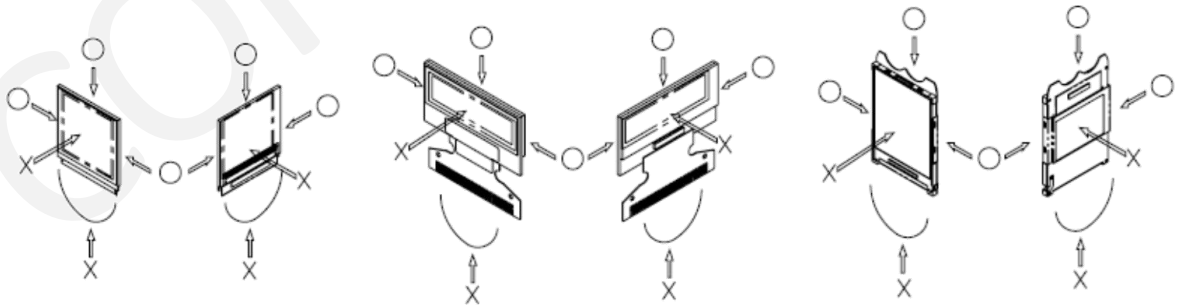
10. Handling Precautions

10.1 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.

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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.

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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.

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