DMT080XGHLCMX-1A

PRODUCT SPECIFICATION

Version 0.3
Mar 17, 2023

TBD

Customer's Approval	
Signature	*Date*

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Approved by *Kenny Lin*

Revision History

VERSION	DATE	DESCRIPTION	AUTHOR
0.1	Nov 15, 2022	Preliminary	Victoria Ho
0.2	Jan 13, 2023	P9, P30 TBD Data finalized	Kenny Lin
0.3	Mar 17, 2023	LVDS Timing	Kenny Lin

Legal Notice

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1. General Description

1.1 Introduction

This is a 8” 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 1024 x 768 and can display up to 16.7M colours. The display module supports 6/8-bit LVDS interface and tape bonding touch panel.

1.2 Main Features

Item	Contents
Display Type	TFT LCD
Screen Size	8” Diagonal
Display Format	1024 x RGB x 768 Dots
No. of Colour	16.7M
Overall Dimensions	199.0 (W) x 157.0 (H) x 11.68 (D) mm
Active Area	162.05 (W) x 121.54 (H) mm
Mode	Normally Black / Transmissive / IPS
Viewing Direction	All round
Interface	6/8-bit LVDS
Backlight Type	LED, White, 44 dual chips
Operating Temperature	-20°C ~ +70°C
Storage Temperature	-30°C ~ +80°C
ROHS	Compliant to RoHS 2.0

1.3 CTP Features

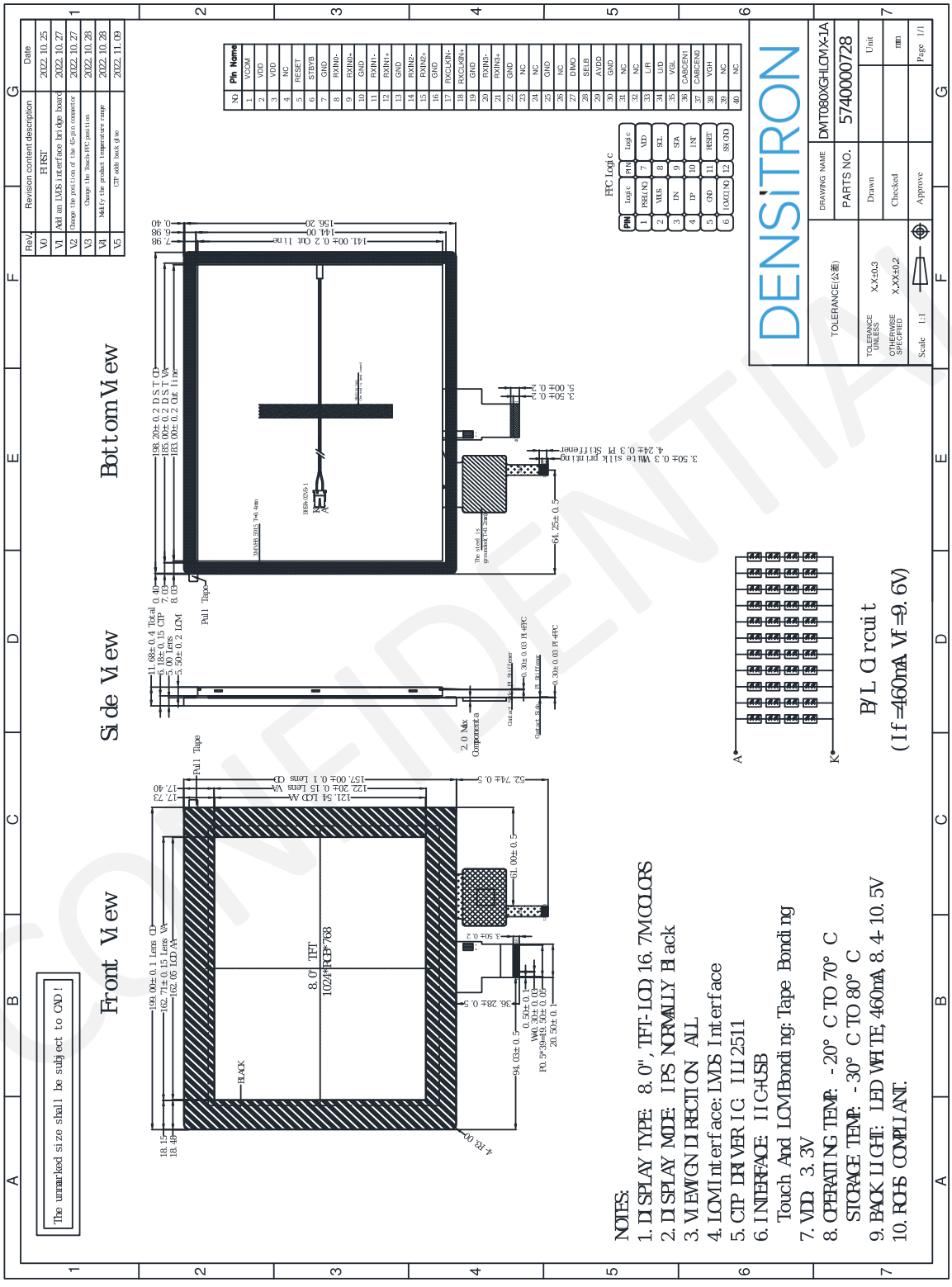
Item	Contents
Touch Panel	CTP
Touch Interface	I^2C + USB
Touch Driver IC	ILI2511
Bonding Type	Tape Bonding
Structure	G+G
Slave Address	0x41(7bit)
Touch Mode	Ten Points

2. Mechanical Specification

2.1 Mechanical Characteristics

Item	Characteristic	Unit
Display Format	1024 x RGB x 768	Dots
Overall Dimensions	199.0 (W) x 157.0 (H) x 11.68 (D) mm	mm
Active Area	162.05 (W) x 121.54 (H) mm	mm
Pixel Pitch	0.15825 x 0.15825	mm
Weight	631	g

2.2 Mechanical Drawing



3. Electrical Specification

3.1 Absolute Maximum Ratings

Item	Symbol	Min	Max	Unit	Note
Digital Supply Voltage	VDD	-0.5	5.0	V	1
Operating Temperature	T_{OP}	-20	+70	°C	-
Storage Temperature	T_{ST}	-30	+80	°C	-

Note: If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum rating.

3.2 DC Electrical Characteristics

Item	Symbol	Min	Typ.	Max	Unit	Note
Digital Supply Voltage	VDD	3.0	3.3	3.6	V	-
Normal Mode Current	IDD	-	190	380	mA	-
Level Input Voltage	V_{IH}	0.7*VDD	-	VDD+3	V	-
	V_{IL}	GND-0.3	-	0.3*VDD	V	-
Level Output Voltage	V_{OH}	VDD-0.4	-	-	V	-
	V_{OL}	GND	-	GND+0.4	V	-

3.3 Interface Pin Assignment

3.3.1 TFT PIN Definition

No.	Symbol	I/O	Function
1	VCOM	P	Common Voltage
2	VDD	P	Power Voltage for digital circuit
3	VDD	P	Power Voltage for digital circuit
4	NC	-	No connection
5	Reset	I	Global reset pin
6	STBYB	I	Standby mode, Normally pulled high STBYB = “1”, normal operation STBYB = “0”, timing controller, source driver will turn off, all output are High-Z
7	GND	P	Ground
8	RXIN0-	I	- LVDS differential data input
9	RXIN0+	I	+ LVDS differential data input
10	GND	P	Ground
11	RXIN1-	I	- LVDS differential data input
12	RXIN1+	I	+ LVDS differential data input
13	GND	P	Ground
14	RXIN2-	I	- LVDS differential data input
15	RXIN2+	I	+ LVDS differential data input
16	GND	P	Ground
17	RXCLKIN-	I	- LVDS differential clock input
18	RXCLKIN+	I	+ LVDS differential clock input
19	GND	P	Ground
20	RXIN3-	-	- LVDS differential data input
21	RXIN3+	-	+ LVDS differential data input
22	GND	P	Ground
23	NC	-	No connection
24	NC	-	No connection
25	GND	P	Ground
26	NC	-	No connection

No.	Symbol	I/O	Function
27	DIMO	O	Backlight CABC controller signal output
28	SELB	I	6-bit/8-bit mode select
29	AVDD	P	Power for Analog Circuit
30	GND	P	Ground
31	NC	-	No connection
32	NC	-	No connection
33	L/R	I	Horizontal inversion
34	U/D	I	Vertical inversion
35	VGL	P	Gate OFF Voltage
36	CABCEN1	I	CABC H/W enable
37	CABCEN0	I	CABC H/W enable
38	VGH	P	Gate ON Voltage
39	NC	-	No connection
40	NC	-	No connection

I: input, O: output, P: Power

Note 1: If LVDS input data is 6 bits, SELB must be set to High.

If LVDS input data is 8 bits, SELB must be set to Low.

Note 2: When CABC_EN=”00”, CABC OFF.

When CABC_EN=”01”, user interface image.

When CABC_EN=”10”, still picture.

When CABC_EN=”11”, moving image.

When CABC off, don’t connect DIMO, else connect it to backlight.

Note 3: When L/R=”0”, set right to left scan direction.

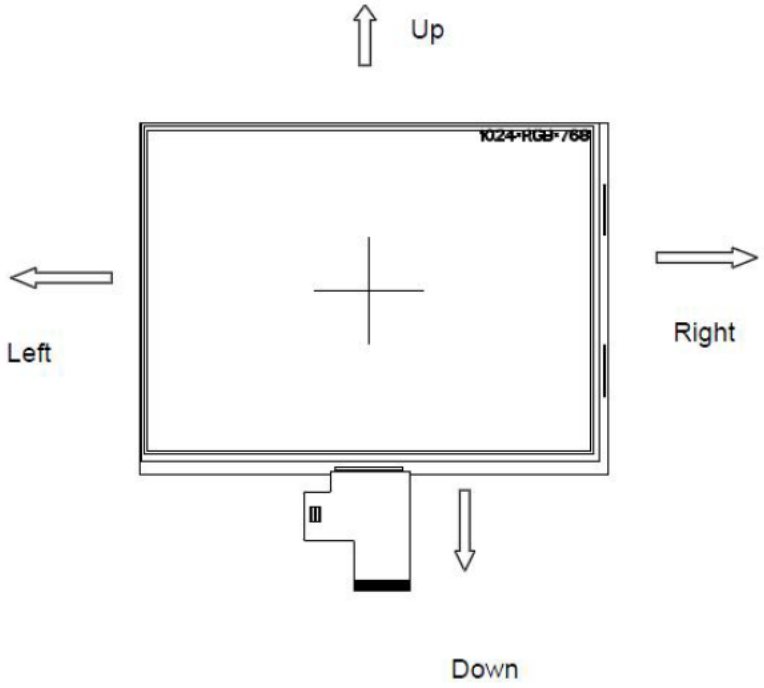
When L/R=”1”, set left to right scan direction.

When U/D=”0”, set top to bottom scan direction.

When U/D=”1”, set bottom to top scan direction.

Note: Definition of scanning direction.

Refer to the figure as below:



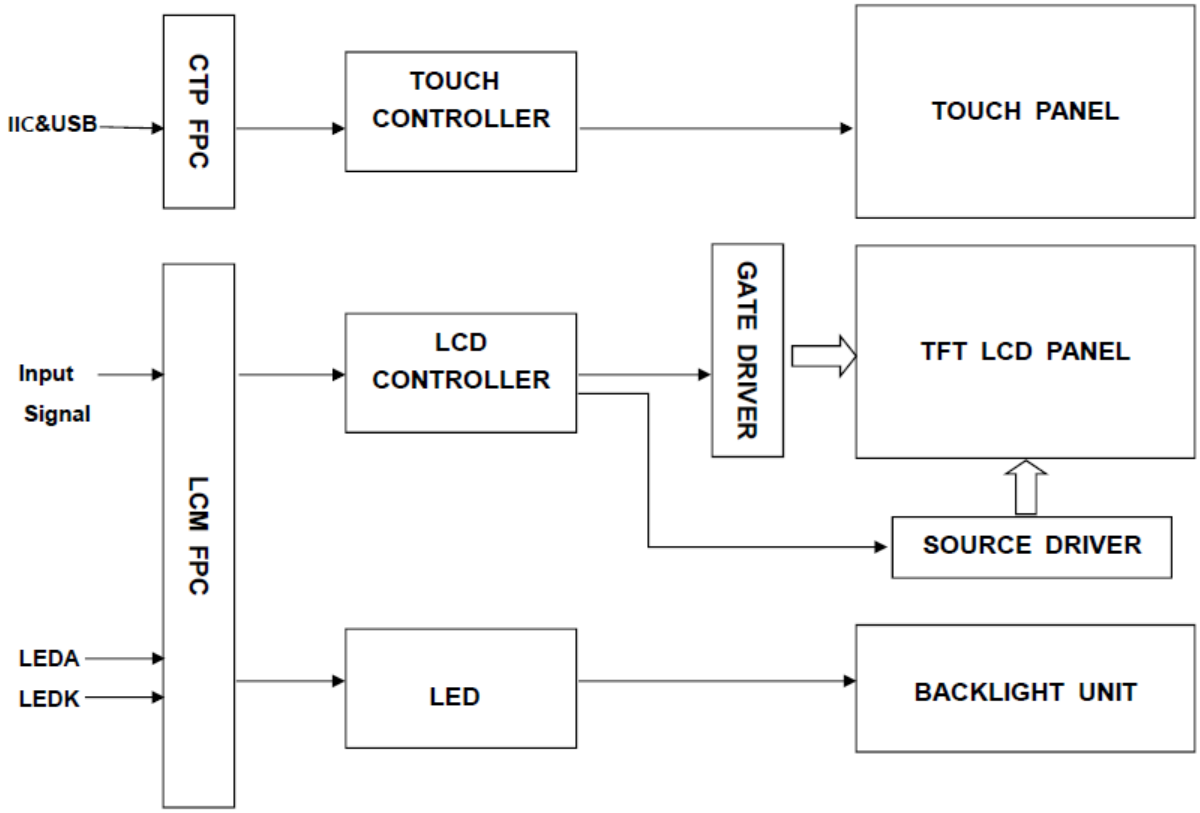
3.3.2 CTP PIN Definition

No.	Symbol	I/O	Function
1	PSEL	-	No Connection
2	VBUS	P	VBUS sensor input, the pin should be connected to USB 4.5~5.5V power supply. This pin must be floating or connected to VDD3 when USB Power is not adopted. A 1μF ceramic capacitor to ground is required.
3	DN	I/O	USB D-
4	DP	P	USB D+
5	GND	P	Ground
6	IOVCC	P	I/O power supply voltage. (I^2C Interface select)
7	VDD	P	Supply voltage. (I^2C Interface select)
8	SCL	I	I^2C clock input. (I^2C Interface select)
9	SDA	P	I^2C data input and output (I^2C Interface select)
10	INT	I	External interrupt to the host. (I^2C Interface select)
11	RST	I	External Reset, Low is active. (I^2C Interface select)
12	SS	P	Ground. (I^2C Interface select)

Note: A magnetic bead has to be added to the host for the FPC to work in coexistence mode.

1. To work in USB mode, the connection is as below. NC unconnected. Magnetic bead L1 should be connected to USB_5V. (J1 is one of the pins of FPC)
2. To work in IIC mode, the connection is as below. NC unconnected. Magnetic bead L2 should be connected to VDD. (J1 is one of the pins of FPC)

3.4 Block Diagram

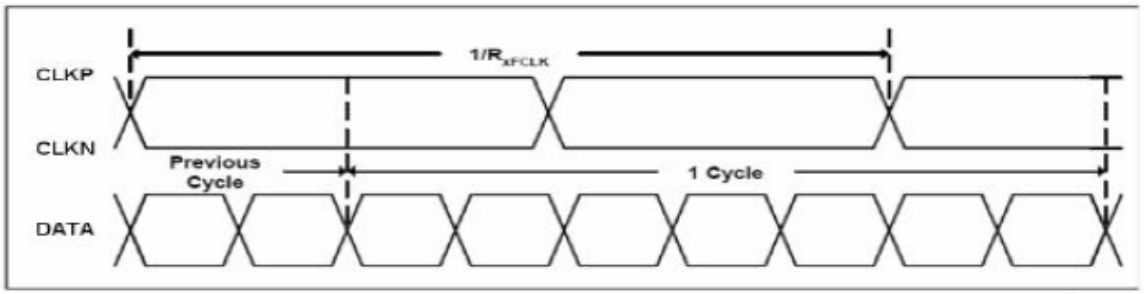


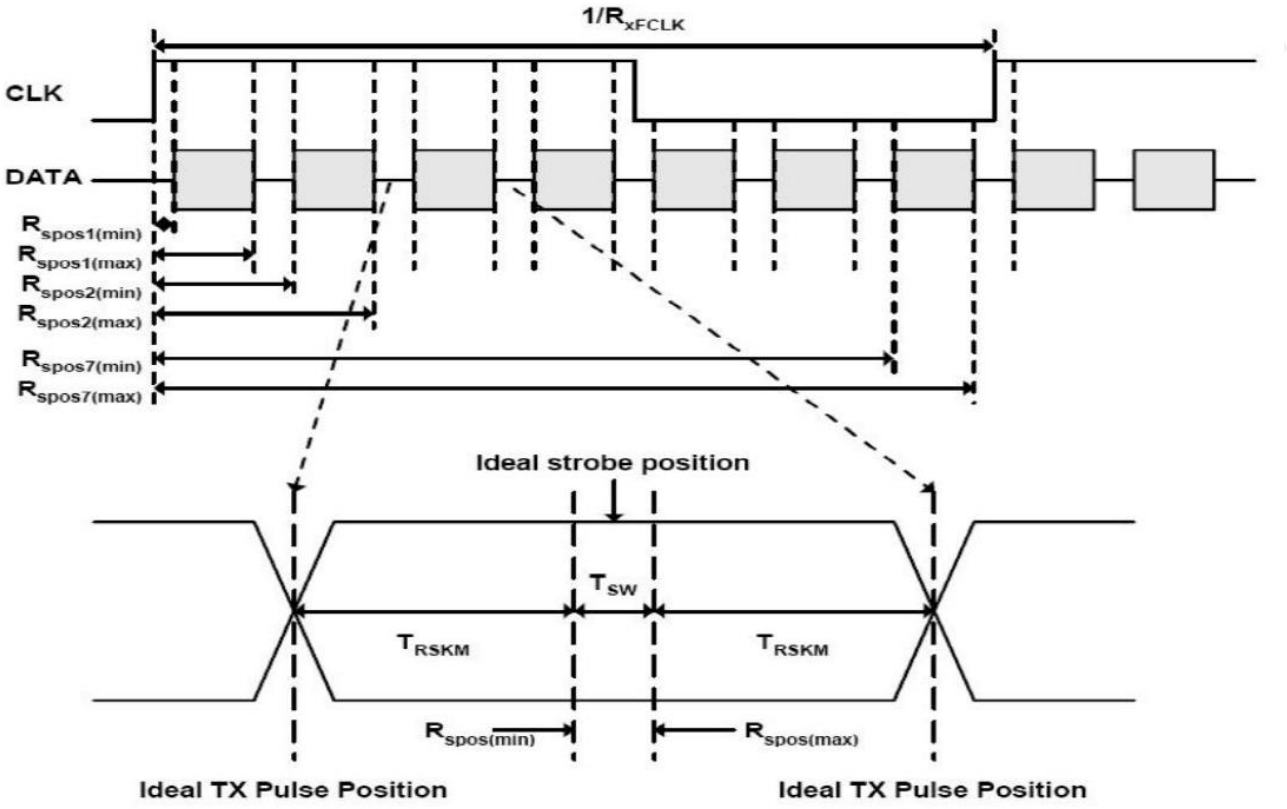
3.5 Timing Characteristics

3.5.1 AC Electrical Characteristics

Item	Symbol	Min	Typ.	Max	Unit	Note
Clock Frequency	R_{xFCLK}	20	-	71	MHz	
Input data skew margin	T_{RSKM}	500	-	-	ps	
Clock high time	T_{LVCH}	-	$4/(7*R_{xFCLK})$	-	ns	-
Clock low time	T_{LVCL}	-	$3/(7*R_{xFCLK})$	-	ns	-

3.5.2 Input Clock and Data Timing Diagram

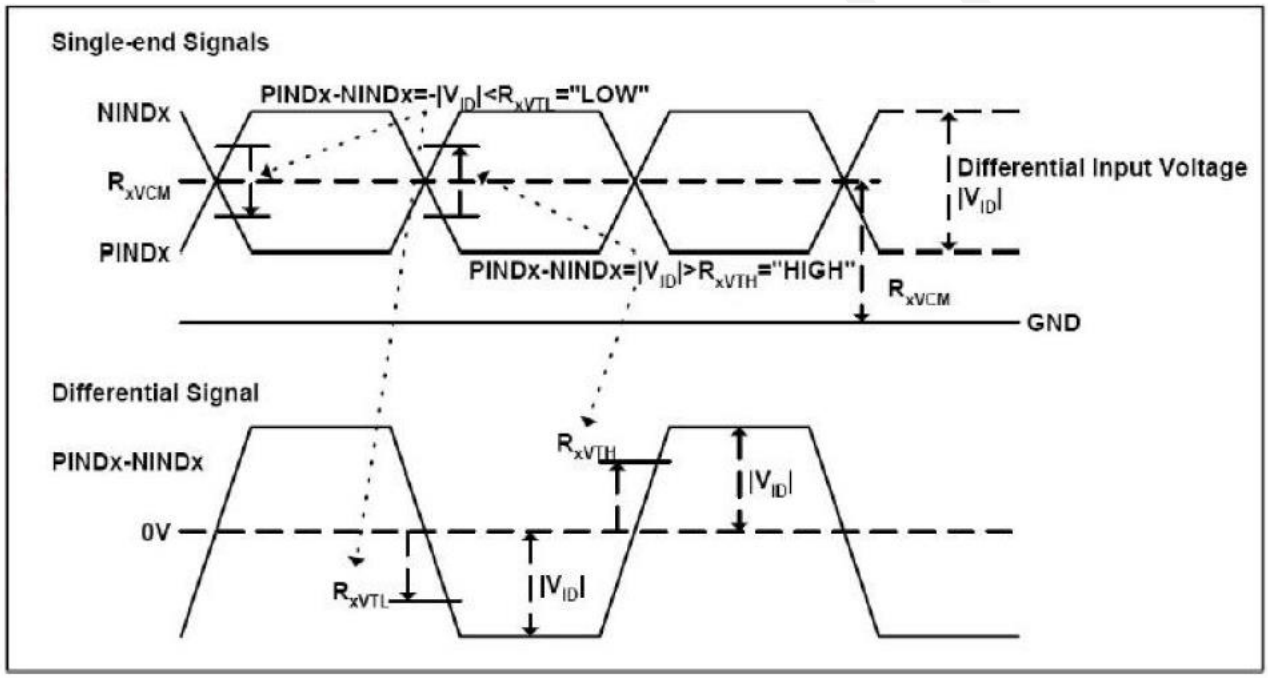




T_{RSKM}: Receiver strobe margin
R_{SPOS}: Receiver strobe position
T_{SW} : Strobe width (Internal data sampling window)

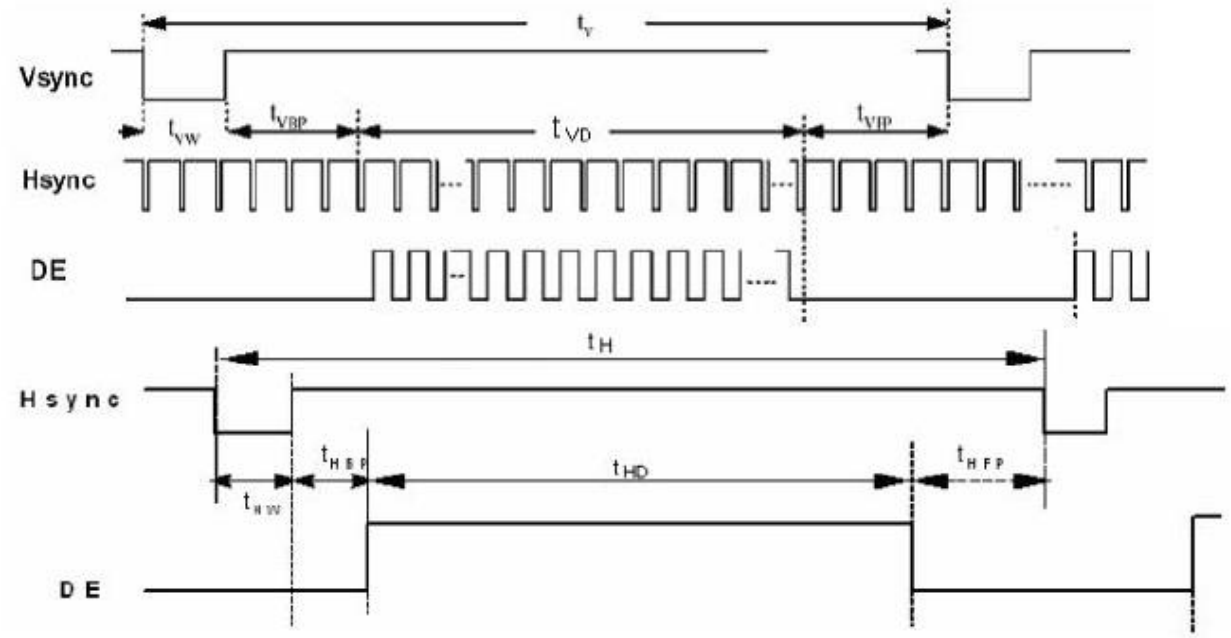
3.5.3 DC Electrical Characteristics

Item	Symbol	Min	Typ.	Max	Unit	Note
Differential input high Threshold voltage	R_{xVTH}	-	-	+0.1	V	R_{xVCM}=1.2V
Differential input low Threshold voltage	R_{xVTH}	-0.1	-	-	V	
Input voltage range (singled-end)	R_{xVIN}	0	-	2.4	V	
Differential input common mode voltage	R_{xVCM}	$\|V_{ID}\|/2$		2.4-$\|V_{ID}\|/2$	V	
Differential voltage	$\|V_{ID}\|$	0.2	-	0.6	V	
Differential input leakage current	RV_{xliz}	-10	-	+10	uA	



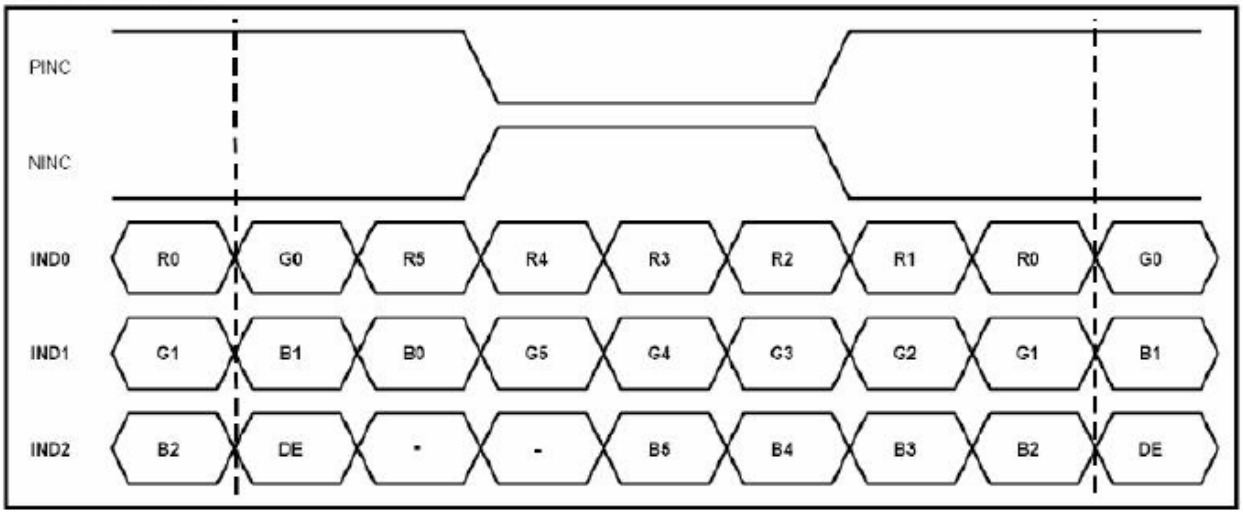
3.5.4 Timing Characteristics

Item	Symbol	Min	Typ.	Max	Unit	Note
Clock Frequency	fclk	52	65	71	MHz	
Horizontal display area	thd		1024		-	
HS period time	th	1114	1344	1400	DCLK	
HS Blacking	thb+thfp	90	320	376	DCLK	
Vertical display area	tvd		768		-	
VS period time	tv	778	806	845	H	
VS Blacking	tvb+tvfp	10	38	77	H	
Frame Rate		--	60	--	Hz	

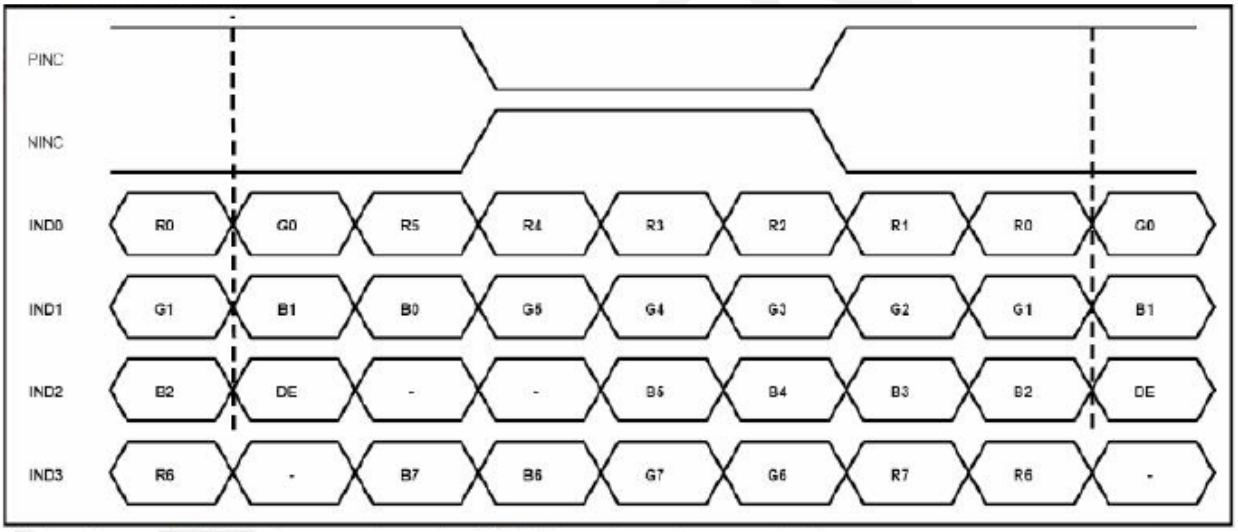


3.5.5 Data Input Format

6-bit LVDS input



8-bit LVDS input



Note: Support DE timing mode only SYNC mode not supported

4. Electrical Specification Touch

4.1 Electrical Characteristics

4.1.1 Absolute Maximum Ratings

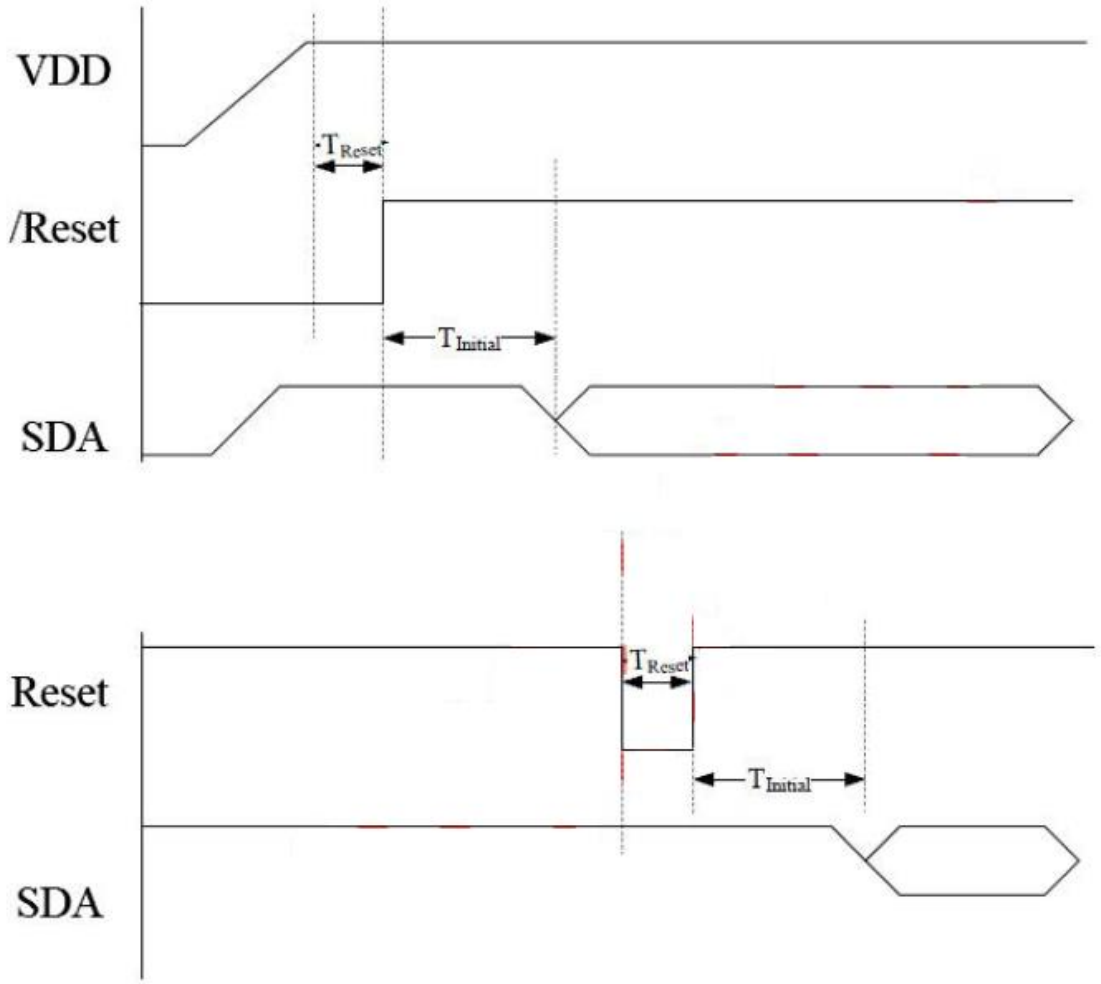
Item	Symbol	Min.	Max.	Unit	Note
USB Power Supply Voltage	VBUS	-0.3	3.6	V	
Operating temperature	T_{OP}	-20	+70	°C	
Storage temperature	T_{ST}	-30	+80	°C	

Note: If used beyond the absolute maximum ratings, ILI2511 may be permanently damaged. It is strongly recommended that the device be used within the electrical characteristics in normal operations. If exposed to the condition not within the electrical characteristics, it may affect the reliability of the device.

4.1.2 DC Electrical Characteristics

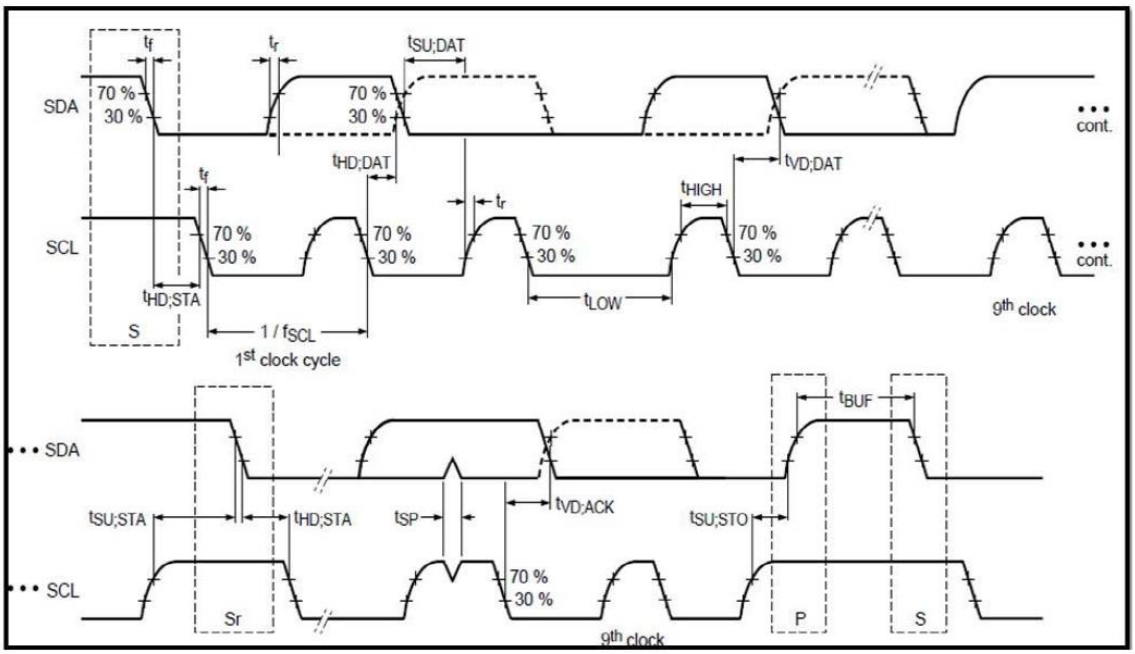
Item	Symbol	Min.	Typ.	Max.	Unit	Note
Power Supply Voltage	VDD	3.0	3.3	3.6	V	
Operation current	I_{OP}	-	100	-	mA	Active Mode
Input Low Voltage	VIL1	0	-	0.3VDD	mA	
Input High Voltage	VIH1	0.6VDD	-	VDD+0.5	mA	
Hysteresis voltage	VIHY	-	0.2VDD	-	µA	
Input Low Voltage, XT_In	VIL2	0	-	0.6	Ma	
Input High Voltage, XT_In	VIH2	2.6	-	VDD+0.2	V	
Negative going threshold, /Reset	VILS	0	-	0.2VDD	V	
Positive going threshold, /Reset	VIHS	0.6VDD	-	VDD+0.5	V	
Output High Voltage	VOH	0.7VDD	-	-	V	VDD=3.3V, IOH=8mA
Output Low Voltage	VOL	-	-	0.3VDD	V	VDD=3.3V, IOL=10mA

4.1.3 Power Consumption



Item	Symbol	Min.	Max.	Unit
After powering-on or resetting the device, the device needs Initial time to configure the system	$T_{Initial}$	100	-	Ms
/Reset pin low hold time	T_{Reset}	50	-	µs

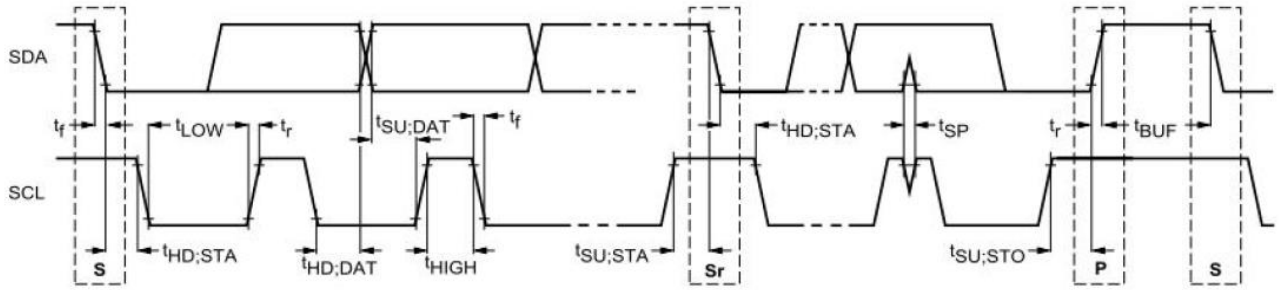
4.1.4 AC Characteristics



I²C AC Characteristics

Item	Symbol	Standard-mode		Fast-mode		Unit
		Min.	Max	Min.	Max	
SCL clock frequency	f_{SCL}	0	100	0	400	kHz
Hold time START condition	$t_{HD;\ STA}$	4.0	-	0.6	-	µs
LOW period of the SCL clock	t_{Low}	4.7	-	1.3	-	µs
HIGH period of the SCL clock	t_{High}	4.0	-	0.6	-	µs
Set-up time for a repeated START condition	$t_{SU;STA}$	4.7	-	0.6	-	µs
Data hold time	$t_{HD;DAT}$	300	-	300	-	ns
Data set-up time	$t_{SU;DAT}$	250	-	100	-	ns
Rise time of both SDA and SCL signals (30% to 70%)	t_r	-	1000	20	300	ns
Fall time of both SDA and SCL signals (70% to 30%)	t_f	-	300	20	300	ns
Set-up time for STOP condition	$t_{SU;STO}$	4.0	-	0.6	-	µs
Bus free time between a STOP and START condition	t_{BUF}	4.7	-	1.3	-	µs
Capacitive load for each bus line	C_b	-	400	-	400	pF
Noise margin at the LOW level for each connected device	V_{nL}	$0.1V_{DD}$	-	$0.1V_{DD}$	-	V
Noise margin at the HIGH level for each connected device	V_{nH}	$0.2V_{DD}$	-	$0.2V_{DD}$	-	V

4.1.5 I/O Ports Circuits



The timing of I²C Interface

Characteristics of the SDA and SCL bus lines

Item	Symbol	Standard-mode			Fast-mode		
		Min.	Max	Unit	Min.	Max	Unit
SCL clock frequency	f_{SCL}	0	100	kHz	0	400	kHz
Hold time START condition	$t_{HD;STA}$	4.0	-	µs	0.6	-	µs
LOW period of the SCL clock	t_{Low}	4.7	-	µs	1.3	-	µs
HIGH period of the SCL clock	t_{High}	4.0	-	µs	0.6	-	µs
Set-up time for a repeated START condition	$t_{SU;STA}$	4.7	-	µs	0.6	-	µs
Data hold time	$t_{HD;DAT}$	5.0	-	µs	0	0.9	µs
Data set-up time	$t_{SU;DAT}$	250	-	ns	100	-	ns
Rise time of both SDA and SCL signals	t_r	-	1000	ns	-	300	ns
Fall time of both SDA and SCL signals	t_f	-	300	ns	-	300	ns
Set-up time for STOP condition	$t_{SU;STO}$	4.0	-	µs	0.6	-	µs
Bus free time between a STOP and START condition	t_{BUF}	4.7	-	µs	1.3	-	µs

4.1.6 I²C Interface Data Structure

Device Address

The device addresses are 7-binary bits long and are conventionally expressed as 4 bits followed by 3bits followed by tge letter'b', 1000 001b. These addresses occupy the high seven bits of an eight-bit field on the bus.

MSB							LSB
1	0	0	0	0	0	1	0/1
Device Address							R/W

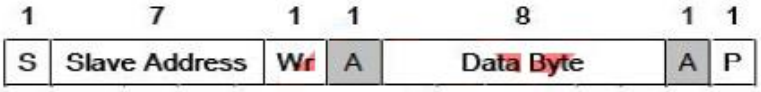
7-bit Device Address: 0x41

8-bit Device Read Address: 0x83

8-bit Device Write Address: 0x82

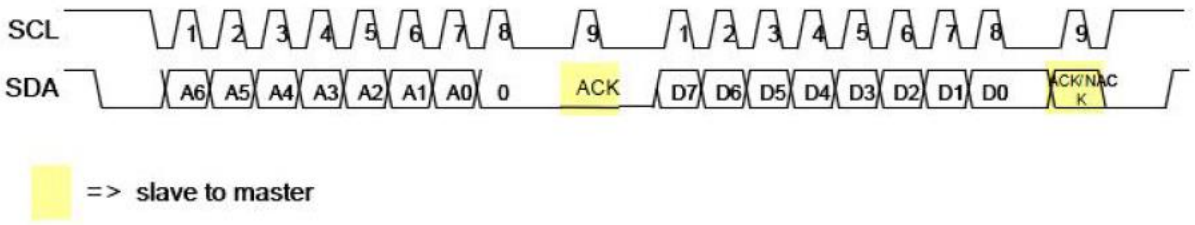
Data Transfer

Data is transferred over the I²C bus with 8-bit address and 8-bit data. The related protocol and timing diagram are shown as below:

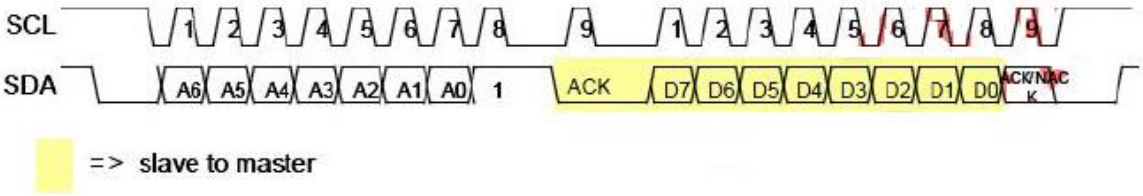


S	Start Condition
Sr	Repeated Start Condition
Rd	Read (bit value of 1)
Wr	Write (bit value of 0)
A/NA	Acknowledge (this bit position may be '0' for an ACK or '1' for a NACK)
P	Stop Condition
	Master-to-Slave
	Slave-to-Master
---	Continue

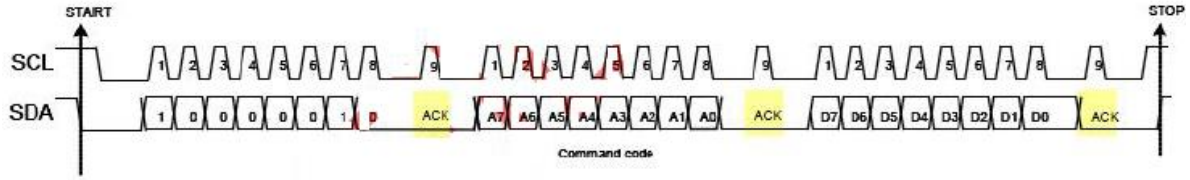
I²C Write timing



I²C Read timing



Byte Write

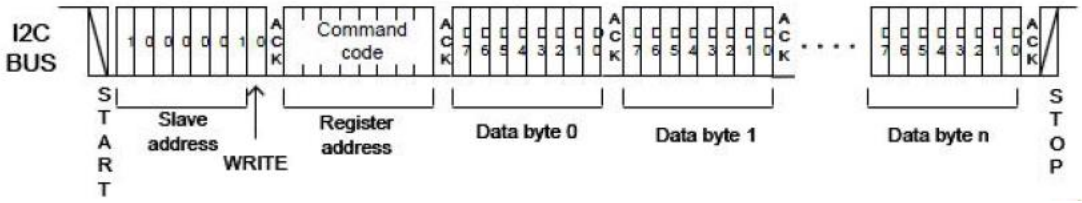


S	Slave Address	Wr	A	Command Code	A	Data Byte	A	P

Byte Read

S	Slave Address	Wr	A	Command Code	A	Sr	Slave Address	Rd	A	Data Byte	A	P

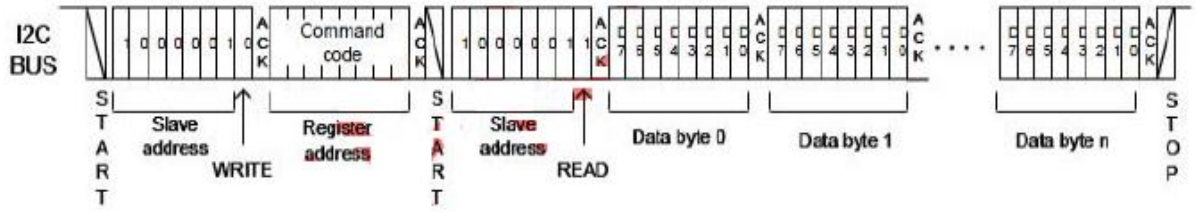
Multi-Byte Write



S	Slave Address	Wr	A	Command Code	A	Data Byte 0	A	Data Byte 1	A

Data Byte 2	A	----	A	Data Byte N	A	P

Multi-Byte Read



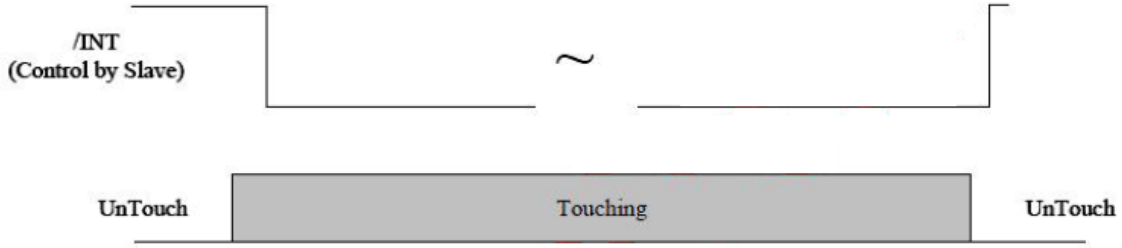
S	Slave Address	Wr	A	Command Code	A	Sr	Slave Address	Rd	A	Data Byte 0	A

Data Byte 1	A	----	A	Data Byte N	NA	P

4.1.7 Interrupt Pin (INT) Control

ILI Touch device uses interrupt pin to signal the host when detecting touch events on the sensor. When a finger touches on the sensor surface, the $\overline{INT}$ pin will be pull low. ILI Touch device supports two different type control method.

Method 1(Polling): The $\overline{INT}$ will continue to be low until the finger leaves the sensor surface.



Method 2(Interrupt): The $\overline{INT}$ will continue to be pull low until host read 0x10 command.

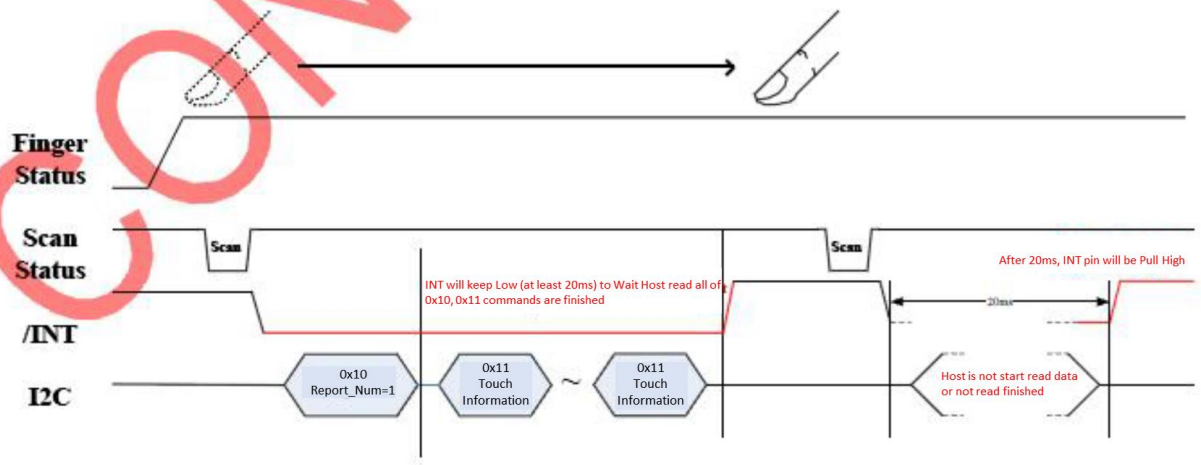


Fig 10: Method 2: $\overline{INT}$ Pin Control Diagram (Finger Touch)

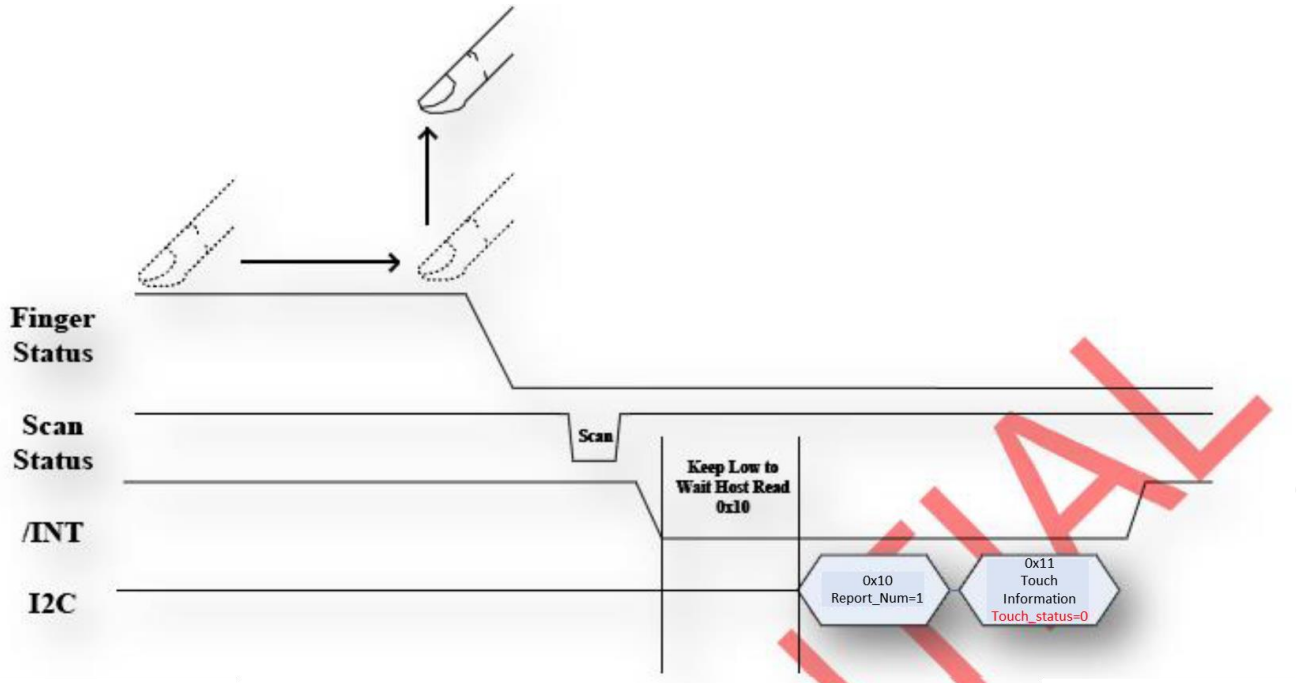


Fig 11: Method 2: $\overline{INT}$ Pin Control Diagram (Finger Release)

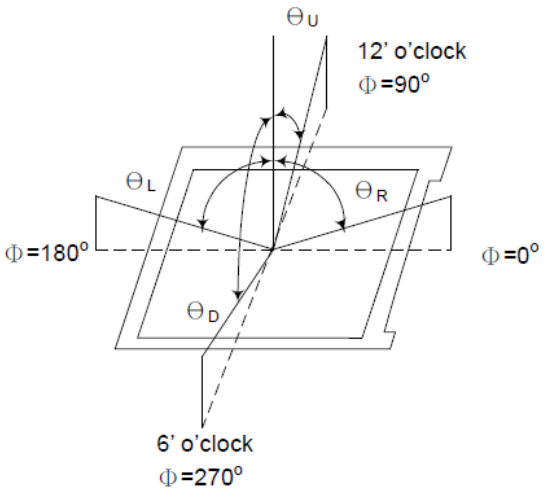
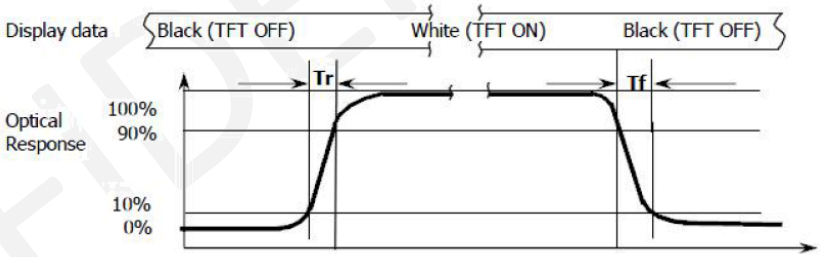
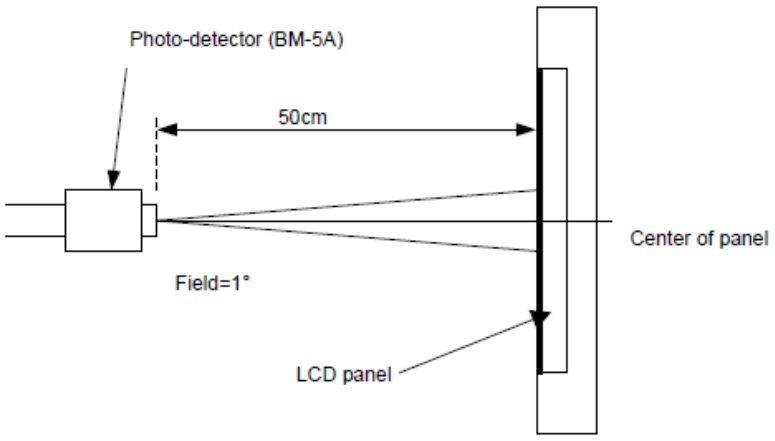
Mnemonics	Description
S	I^2C Start or I^2C Restart
A[6:0]	Slave address
R/W	READ/WRITE bit, '1' for read, '0' for write
A(N)	ACK(NACK) bit
P	STOP: the indication of the end of a packet (if this bit is missing, Swill indication the end of the current packet and the beginning of the next packet)

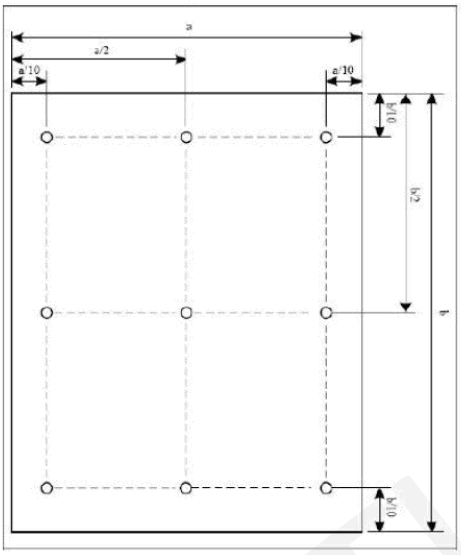
5. Optical Specification

5.1 Optical Characteristics

Characteristics		Symbol	Conditions	Min	Typ.	Max	Unit	Note
Contrast Ratio		CR	θ=0 Normal Viewing Angle	800	1000	-	-	1, 2
Response time		TR + TF		-	25	50	msec	1, 3
Color Gamut		S(%)	-	42	47	-	-	
Viewing Angle	Left	θ_x-	CR≥10	75	85	-	-	1, 4
	Right	θ_x+		75	85	-		
	Up	θ_Y+		75	85	-		
	Down	θ_Y-		75	85	-		
Colour Chromaticity	Red	Rx	θ=0 Normal Viewing Angle	-0.04	0.5662	+0.04	-	1, 4 CF-glass
		Ry			0.3394			
	Green	Gx			0.2985			
		Gy			0.5489			
	Blue	Bx			0.1486			
		By			0.1029			
	White	Wx			0.2708			
		Wy			0.3012			
LCM Luminance		L_V	IL=460mA	700	800	-	cd/m^2	4
Uniformity		AVg	-	80	-	-	%	4

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

Note	Item	Test method
1	Definition of Viewing Angle	
2	Definition of Contrast Ratio (CR)	Measured at the center point of panel $CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$
3	Definition of Response Time	
4	Definition of Optical Measurement Setup	
5	Definition of Luminance and Uniformity	Luminance Uniformity of these 9 points is defined as below:

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

6. LED Backlight Specification

6.1 LED Backlight Characteristics

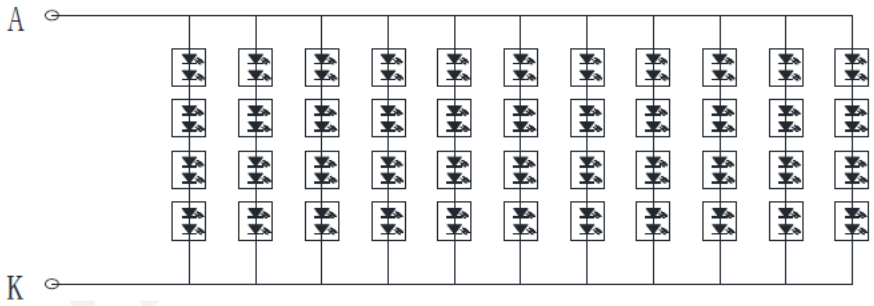
The back-light system is edge-lighting type with 44 Dual chips white LED.

Item	Symbol	Condition	Min	Typ.	Max	Unit	Note
Forward Current	I_F	-	340	460	550	mA	-
Forward Voltage	V_F	-	8.4	9.6	10.5	V	-
LED Lifetime	Hr	-	-	50000	-	Hour	1, 2

Note 1: LED lifetime (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25±3 ℃, typical IL 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 decrease to 50% original brightness at Ta=25℃ and IL=460mA. The LED lifetime could be decreased if operating IL is larger than 460mA. The constant current driving method is suggested.

6.2 Internal Circuit Diagram



B/L Circuit

(If = 460 mA. Vf = 9.6 V)

7. Packaging

TBD

8. Quality Assurance Specification

8.1 Conformity

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

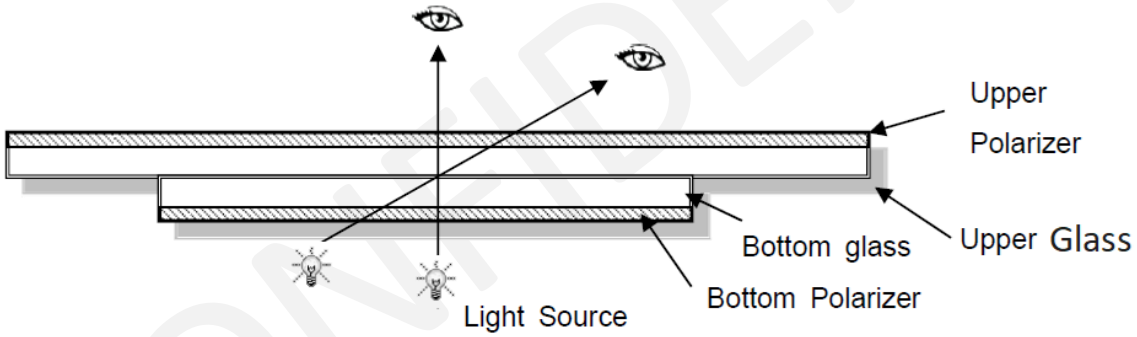
8.2 Environment Required

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 700Lux)
Viewing distance:	30 - 50cm

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

Inspection table or jig must be anti-electrostatic.

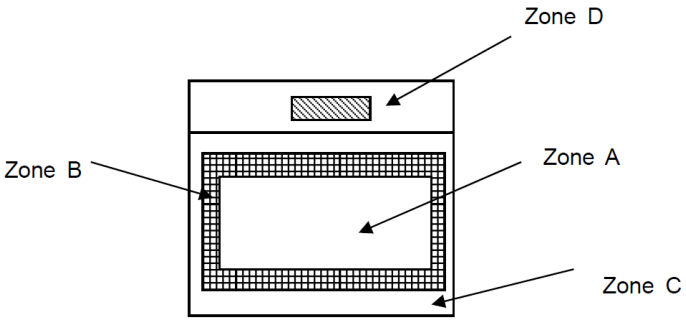


8.3 Delivery Assurance

8.3.1 Delivery Inspection Standards

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

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

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 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 and etc.	
7	LCD/Polarizer/CTP	Black/White spot/line, scratch, crack, etc.	

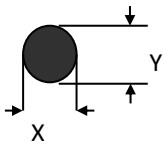
Note 1:

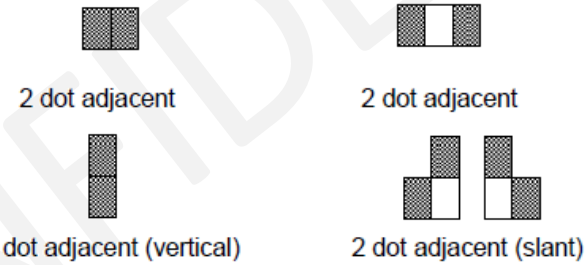
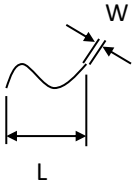
a) Light dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.

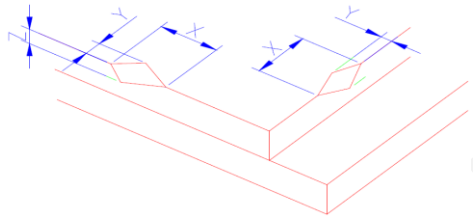
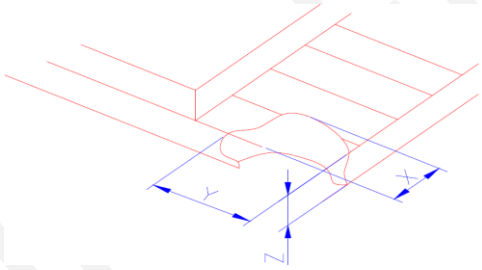
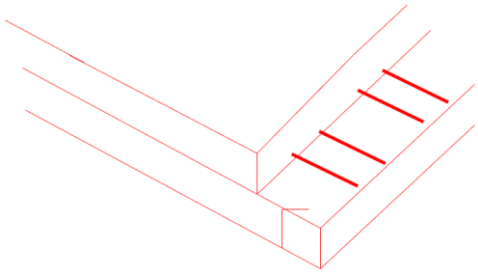
b) Dim dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.

8.3.4 Criteria & Classification

Units: mm

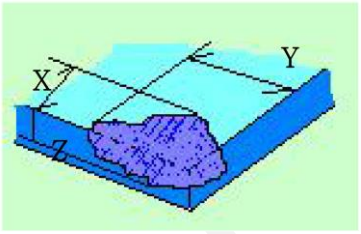
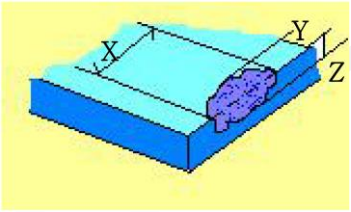
<table>
<tr><th>Class</th><th>Item</th><th colspan="5">Criteria</th></tr>
<tr><td rowspan="25">Minor</td><td rowspan="25">Spot Defect</td><td colspan="5">Round type: as per following drawing, ∅ = (X+Y)/2  </td></tr>
<tr><td colspan="5">1) Light Dot (LCD/TP/Polarizer black/white spot, light dot, pinhole, dent, stain)</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, color 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≤3</td></tr>
</table>

<table>
<tr><th>Class</th><th>Item</th><th colspan="4">Criteria</th></tr>
<tr><td rowspan="11"></td><td rowspan="11"></td><td rowspan="2"></td><td>2 dots adjacent</td><td colspan="2">N≤0</td></tr>
<tr><td>3 dots adjacent</td><td colspan="2">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 colspan="2">5mm</td></tr>
<tr><td colspan="2">Total bright and dark dot</td><td colspan="2">N≤4</td></tr>
<tr><td colspan="5">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="5">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">2 (distance ≧ 10mm)</td></tr>
<tr><td>0.4<∅</td><td colspan="2">0</td></tr>
<tr><td rowspan="3">Minor</td><td rowspan="3">Line Defect (LCD/TP/ Polarizer backlight black/white line, scratch, stain)</td><td colspan="4">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>
</table>

<table>
<tr><th>Class</th><th>Item</th><th colspan="4">Criteria</th></tr>
<tr><td rowspan="4"></td><td rowspan="4"></td><td>W≤0.05</td><td>Ignore</td><td>Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.05<W≤0.06</td><td>L ≤ 5.0</td><td>N ≤ 3</td></tr>
<tr><td>0.06<W≤0.08</td><td>L ≤ 4.0</td><td>N ≤ 2</td></tr>
<tr><td>0.08<W</td><td colspan="3">Define as spot defect</td></tr>
<tr><td>Minor</td><td>LCD
Crack/Broken</td><td colspan="4">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>
<tr><td>Major</td><td>LCD Crack</td><td colspan="4">The LCD with extensive crack is not acceptable.
  </td></tr>
<tr><td>Minor</td><td>Electronic
Components
SMT</td><td colspan="4">Not allow missing parts, solderless connection, cold solder joint, mismatch, The positive and negative polarity opposite</td></tr>
</table>

Class	Item	Criteria
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.
	LCD Mura	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
		∅≤0.15	Ignore		Ignore
		0.15<∅≤0.25	4（distance≧10mm）		
		0.25<∅≤0.35	3（distance≧10mm）		
		0.35<∅	0		
		2) CTP Cover Scratch			
		Width	Length	Acceptable Qty		
				A	B	C
		∅≤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			
		3) CTP Cover Pinhole/Lack of Ink			
		Size\Zone	Acceptable Quantity		
			C		
		∅≤0.2	Ignore		
		0.2<∅≤0.3	4(distance≧10mm)		
		0.3<∅≤0.4	2(distance≧10mm)		
		∅>0.4	0		
		4) CTP Bonding Bubble/Accidented Spot			
		Size (mm)	Acceptable Quantity		
			A	B	
		∅≤0.1	Ignore		
		0.1<∅≤0.2	3(distance≧10mm）		
		0.2<∅≤0.3	2(distance≧10mm）		

Class	Item	Criteria	
		∅>0.3	0
		Assembly Deflection: beyond the edge of backlight ≤0.2mm	
Minor	CTP Related	CTP cover broken X: length, Y: width, Z: height X≤0.5mm; Y≤0.5mm; Z<Cover thickness *Circuitry broken is not allowed.	
		CTP edge broken X: length, Y: width, Z: height X≤0.3mm; Y≤0.3mm; Z<cover thickness *Circuitry broken is not allowed.	

Criteria (functional items)

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

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.

9. Reliability Specification

9.1 Reliability Tests

Test Item	Test Condition	Inspection after Test
High Temperature Operation	70℃, 96H	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℃, 96HR	
High Temperature Storage	80℃, 96HR	
Low Temperature Storage	-30℃, 96HR	
High Temperature & High Humidity Operating	+60℃, 90% RH ,96 hours.	
Thermal Shock (Non-Operation)	-20℃, 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,80 ㎝ (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.

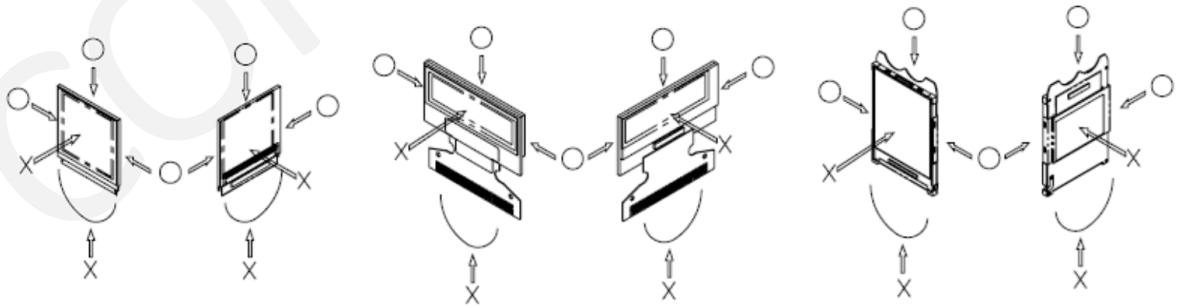
9.1.1 Inspection Check Standard

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.

10. Handling Precautions

10.1 Handling Precautions

1) Since the display panel is being made of glass, do not apply mechanical impacts such as dropping from a high position.
2) If the display panel is broken by some accident and the internal organic substance leaks out, be careful not to inhale nor lick the organic substance.
3) If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water
4) If pressure is applied to the display surface or its neighbourhood of the display module, the cell structure may be damaged and be careful not to apply pressure to these sections.
5) The polarizer covering the surface of the display module is soft and easily scratched. Please be careful when handling the display module.
6) When the surface of the polarizer of the display module has soil, clean the surface. It takes advantage of by using following adhesion tape.
   a. Scotch Mending Tape No. 810 or an equivalent
   b. Never try to breathe upon the soiled surface nor wipe the surface using cloth containing solvent such as ethyl alcohol, since the surface of the polarizer will become cloudy.
   c. Also, pay attention that the following liquid and solvent may spoil the polarizer:
      - Water
      - Ketone
      - Aromatic Solvents
7) Hold the display module very carefully when placing it into the system housing. Do not apply excessive stress or pressure to display module. And, do not over bend the film with electrode pattern layouts. These stresses will



influence the display performance. Also, secure sufficient rigidity for the outer cases.
8) Do not apply stress to the LSI chips and the surrounding molded sections.
9) Do not disassemble nor modify the display module.
10) Do not apply input signals while the logic power is off.
11) Pay sufficient attention to the working environments when handing display modules to prevent occurrence of element breakage accidents by static electricity.

a. Be sure to make human body grounding when handling display modules.
b. Be sure to ground tools to use or assembly such as soldering irons.
c. To suppress generation of static electricity, avoid carrying out assembly work under dry environments.
d. Protective film is being applied to the surface of the display panel of the display module. Be careful since static electricity may be generated when exfoliating the protective film.

12) Protection film is being applied to the surface of the display panel and removes the protection film before assembling it. If the display module has been stored for a long period of time, residue adhesive material of the protection film may remain on the surface of the display panel after removed of the film. In such case, remove the residue material by the method introduced in the above Section 5).
13) If electric current is applied when the display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful to avoid the above.

10.2 Storage Precautions

1) When storing display modules, put them in static electricity preventive bags avoiding exposure to direct sun light nor to lights of fluorescent lamps, etc. and, also, avoiding high temperature and high humidity environments or low temperature (less than 0°C) environments. (We recommend you to store these modules in the packaged state when they were shipped from Densitron) At that time, be careful not to let water drops adhere to the packages or bags nor let dewing occur with them.
2) If electric current is applied when water drops are adhering to the surface of the display module, when the display module is being dewed or when it is placed under high humidity environments, the electrodes may be corroded and be careful about the above.

10.3 Designing Precautions

1) The absolute maximum ratings are the ratings which cannot be exceeded for display module, and if these values are exceeded, panel damage may be happen.
2) To prevent occurrence of malfunctioning by noise, pay attention to satisfy the VIL and VIH specifications and, at the same time, to make the signal line cable as short as possible.
3) We recommend you to install excess current preventive unit (fuses, etc.) to the power circuit (VDD). (Recommend value: 0.5A)
4) Pay sufficient attention to avoid occurrence of mutual noise interference with the neighbouring devices.
5) As for EMI, take necessary measures on the equipment side basically.
6) When fastening the display module, fasten the external plastic housing section.
7) If power supply to the display module is forcibly shut down by such errors as taking out the main battery while the display panel is in operation, we cannot guarantee the quality of this display module.

10.4 Operation Precautions

1) It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life.
2) Direct current causes an electrochemical reaction with remarkable deterioration of the display quality. Give careful consideration to prevent direct current during ON/OFF timing and during operation.
3) Response time is extremely delayed at temperatures lower than the operating temperature range while, at high temperatures, displays become dark. However, this phenomenon is reversible and does not mean a malfunction or a display that has been permanently damaged.
4) To protect display modules from performance drops by static electricity rapture, etc., do not touch the following sections whenever possible while handling the display modules.
   a. Pins and electrodes
   b. Pattern layouts such as the FPC
5) When the driver is being exposed (COG), semiconductor elements change their characteristics when light is radiated according to the principle of the solar battery. Consequently, if the driver is exposed to light, malfunctioning may occur.
   a. Design the product and installation method so that the driver may be shielded from light in actual usage.
   b. Design the product and installation method so that the driver may be shielded from light during the inspection processes.
6) Although the display module stores the operation state data by the commands and the indication data, when excessive external noise, etc. enters into the module, the internal status may be changed. It therefore is necessary to take appropriate measures to suppress noise generation or to protect from influences of noise on the system design.
7) We recommend you to construct its software to make periodical refreshment of the operation statuses (re-setting of the commands and re-transference of the display data) to cope with catastrophic noise.

10.5 Other Precautions

1) Request the qualified companies to handle industrial wastes when disposing of the display modules. Or, when burning them, be sure to observe the environmental and hygienic laws and regulations.