DMT035QWNXCSI-2A
PRODUCT SPECIFICATION

Version 1.0
Jul 04, 2023

Customer's Approval	
Signature	*Date*

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Approved by *Eric Wan*

Revision History

VERSION	DATE	DESCRIPTION	AUTHOR
1.0	Jul 04, 2023	Preliminary	Yvette Hsieh

Legal Notice

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1. General Description

1.1 Introduction

This is a 3.5” 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 320 x 480 and can display up to 262K colours. The display module supports 8/9/16/18-bit MCU interface, 3/4 SPI + 16/18-bit RGB interface, 3-/4-line serial interface, and tape bonding touch panel.

1.2 Main Features

Item	Contents
Display Type	TFT LCD
Screen Size	3.5” Diagonal
Display Format	320 x RGB x 480 Dots
No. of Colour	65K/262K
Overall Dimensions	55.30 (W) x 84.76 (H) x3.43 (D) mm
Active Area	48.96 (W) x 73.44 (H) mm
Mode	Normally Black / Transmissive
Surface Treatment	Glare (6H)
Viewing Direction	All round
Interface	8/9/16/18-bit MCU, 3/4 SPI + 16/18-bit RGB, 3-/4-line serial
Driver IC	ILI9488
Backlight Type	LED, White, 8 chips
Touch Panel	CPT
Touch Interface	I^2C
Bonding Type	Tape Bonding
Operating Temperature	-20°C ~ +70°C
Storage Temperature	-30°C ~ +80°C
ROHS	Compliant to RoHS 2.0

1.3 Touch Features

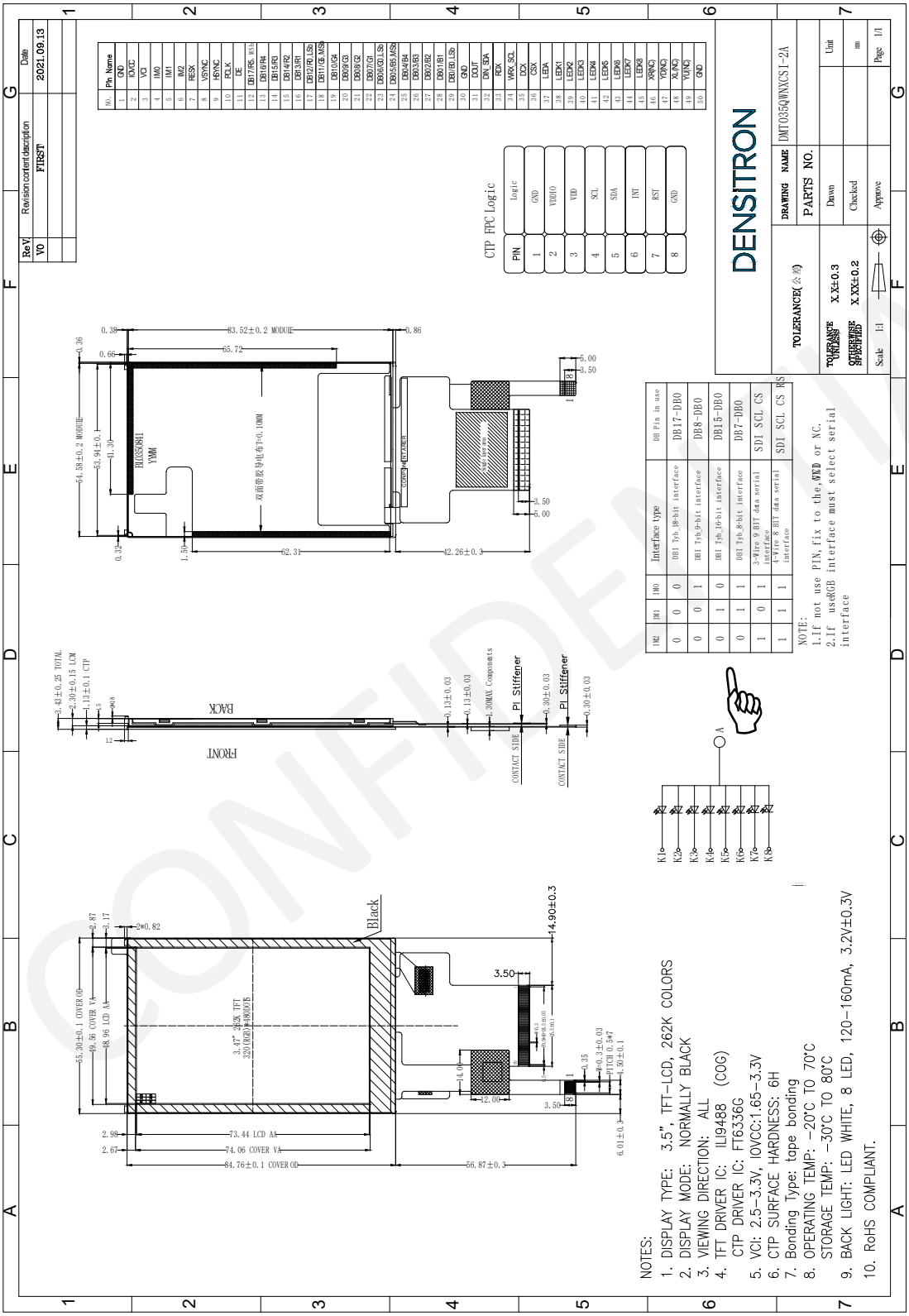
Item	Contents
Structure	G+G
Controller IC	FT6336G
Interface	I^2C
Slave Address	0x38(7bit)/8bit:0x70(Write) 0x71(Read)
Touch mode	Single point and Gestures

2. Mechanical Specification

2.1 Mechanical Characteristics

Item	Characteristic	Unit
Display Format	320 x RGB x 480	Dots
Overall Dimensions	55.30 (W) x 84.76 (H) x3.43 (D)	mm
Active Area	48.96 (W) x 73.44 (H)	mm
Dot Pitch	0.153 (W) x 0.153 (H)	mm
Weight	32	g
IC Controller/Driver	ILI9488	

2.2 Mechanical Drawing



3. Electrical Specification

3.1 Absolute Maximum Ratings

(Ta = 25°C, VSS = 0V)

Item	Symbol	Min	Max	Unit	Note
Digital Supply Voltage	VCI	-0.3	4.6	V	-
Digital Interface Supply Voltage	IOVCC	-0.3	4.6	V	-
Operating Temperature	T_{OP}	-20	+70	°C	2, 3
Storage Temperature	T_{ST}	-30	+80	°C	2, 3

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

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

Note 3: Please refer to item of RELIABILITY.

3.2 Electrical Characteristics

Item	Symbol	Min	Typ	Max	Unit	Note
Digital Supply Voltage	VCI	2.4	3.3	3.6	V	-
Digital Interface Supply Voltage	IOVCC	1.65	1.8	3.3	V	-
Normal Mode Current Consumption	IDD	-	8	16	mA	-
Level Input Voltage	V_{IH}	0.7 IOVCC	-	IOVCC	V	-
	V_{IL}	GND	-	0.3 IOVCC		
Level Output Voltage	V_{OH}	0.8 IOVCC	-	IOVCC	V	-
	V_{OL}	GND	-	0.2 IOVCC		

3.3 Interface Pin Assignment

3.3.1 TFT Pin Define

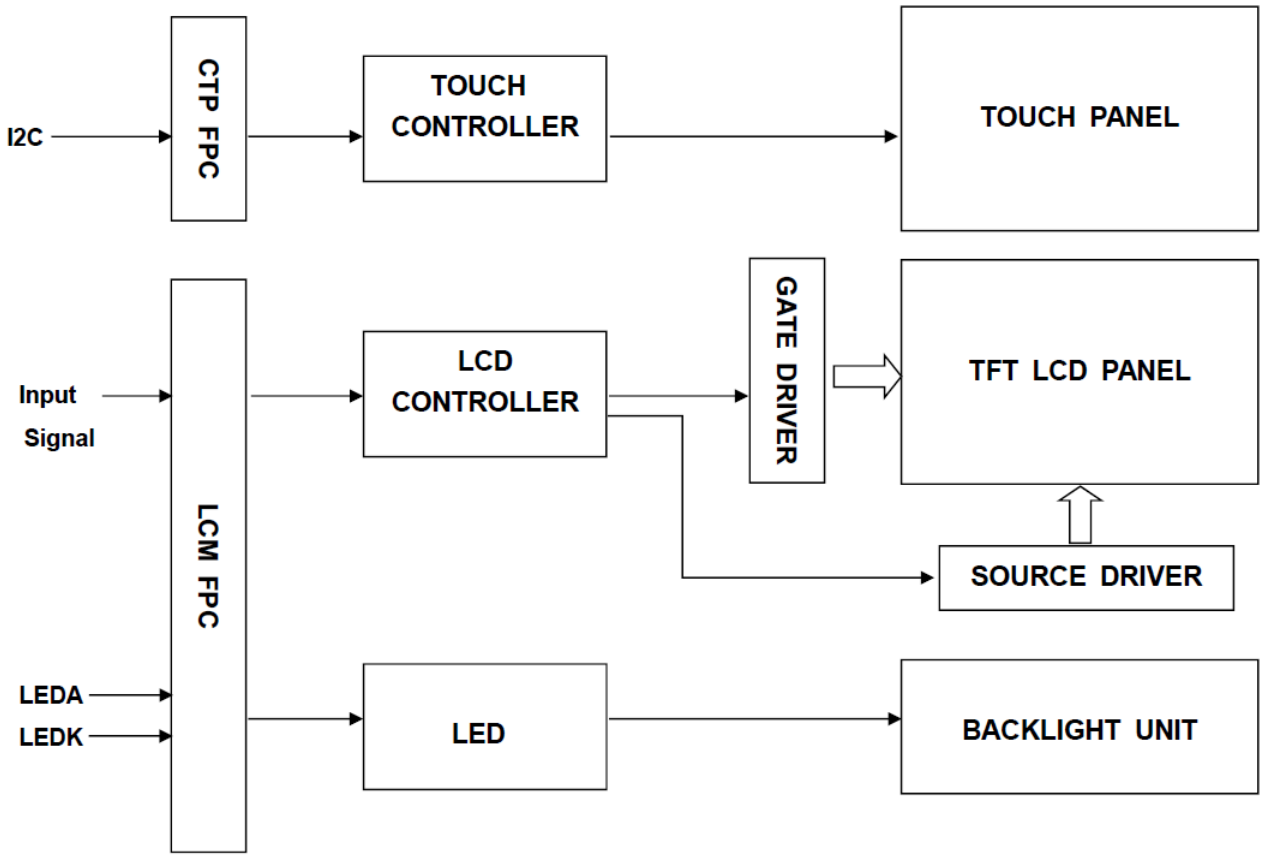
<table>
<tr><th>No.</th><th>Symbol</th><th>I/O</th><th>Function</th></tr>
<tr><td>1</td><td>GND</td><td>P</td><td>Ground.</td></tr>
<tr><td>2</td><td>IOVCC</td><td>P</td><td>Supply voltage for IO (1.65~3.3 V)</td></tr>
<tr><td>3</td><td>VCI</td><td>P</td><td>Supply voltage (3.3 V)</td></tr>
<tr><td>4</td><td>IM0</td><td>I</td><td rowspan="3"><table>
<tr><th>IM2</th><th>IM1</th><th>IM0</th><th>Interface Type</th><th>DB Pin in use</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>DBI Tyb_ 18-bit interface</td><td>DB17-DB0</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>DBI Tyb_9-bit interface</td><td>DB8-DB0</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>DBI Tyb_16-bit interface</td><td>DB15-DB0</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>DBI Tyb_8-bit interface</td><td>DB7-DB0</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>3-wire 9-bit data serial interface</td><td>SDA SCL CS</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>4-wire 8-bit data serial interface</td><td>SDA SCL CS RS</td></tr>
</table></td></tr>
<tr><td>5</td><td>IM1</td><td>I</td></tr>
<tr><td>6</td><td>IM2</td><td>I</td></tr>
<tr><td>7</td><td>RESX</td><td>I</td><td>This signal will reset the device and must be applied to properly initialize the chip.</td></tr>
<tr><td>8</td><td>VSYNC</td><td>I</td><td>Frame synchronizing signal for RGB interface operation. Fix this pin at IOVCC or GND when not in use.</td></tr>
<tr><td>9</td><td>HSYNC</td><td>I</td><td>Line synchronizing signal for RGB interface operation. Fix this pin at IOVCC or GND when not in use.</td></tr>
<tr><td>10</td><td>PCLK</td><td>I</td><td>Dot clock signal for RGB interface operation. Fix this pin at IOVCC or GND when not in use.</td></tr>
<tr><td>11</td><td>DE</td><td>I</td><td>Data Enable signal for RGB interface operation. Fix this pin at IOVCC or GND when i not in use.</td></tr>
<tr><td>12-29</td><td>DB17-DB0</td><td>I/O</td><td>18-bit parallel bi-directional data bus for MCU system and RGB interface mode. Fix this pin to GND level when not in use.</td></tr>
<tr><td>30</td><td>GND</td><td>P</td><td>Ground.</td></tr>
<tr><td>31</td><td>DOUT</td><td>O</td><td>Serial data output pin in serial bus system interface. If it’s not in use, please open this pin.</td></tr>
<tr><td>32</td><td>DIN_SDA</td><td>I</td><td>Serial input signal. The data is applied on the rising edge of the SCL signal. If not in use, please fix this pin at IOVCC or GND.</td></tr>
<tr><td>33</td><td>RDX</td><td>I</td><td>Serves as a READ signal and MCU READ DATA at the rising edge. Fix this pin at IOVCC or GND when not in use.</td></tr>
<tr><td>34</td><td>WR (SPI-SCL)</td><td>I</td><td>DBI Type B: WRX pin, serving as WRITE signal.
DBI Type C: SCL pin, serving as Serial Clock when it operates in the serial interface.</td></tr>
</table>

No.	Symbol	I/O	Function
35	DCX (RS)	I	Display data / command selection pin
36	CSX	I	Chip select input pin (“Low” Enable). Fix this pin at IOVCC or GND when not in use.
37	LEDA	P	Anode pin of backlight
38	LEDK1	P	Cathode pin of backlight
39	LEDK2	P	Cathode pin of backlight
40	LEDK3	P	Cathode pin of backlight
41	LEDK4	P	Cathode pin of backlight
42	LEDK5	P	Cathode pin of backlight
43	LEDK6	P	Cathode pin of backlight
44	LEDK7	P	Cathode pin of backlight
45	LEDK8	P	Cathode pin of backlight
46	XR (NC)	A/D	Touch panel Right glass terminal
47	YD (NC)	A/D	Touch panel Bottom film terminal
48	XL (NC)	A/D	Touch panel Left glass terminal
49	YU (NC)	A/D	Touch panel Top film terminal
50	GND	P	Ground.

3.3.2 CTP Pin Define

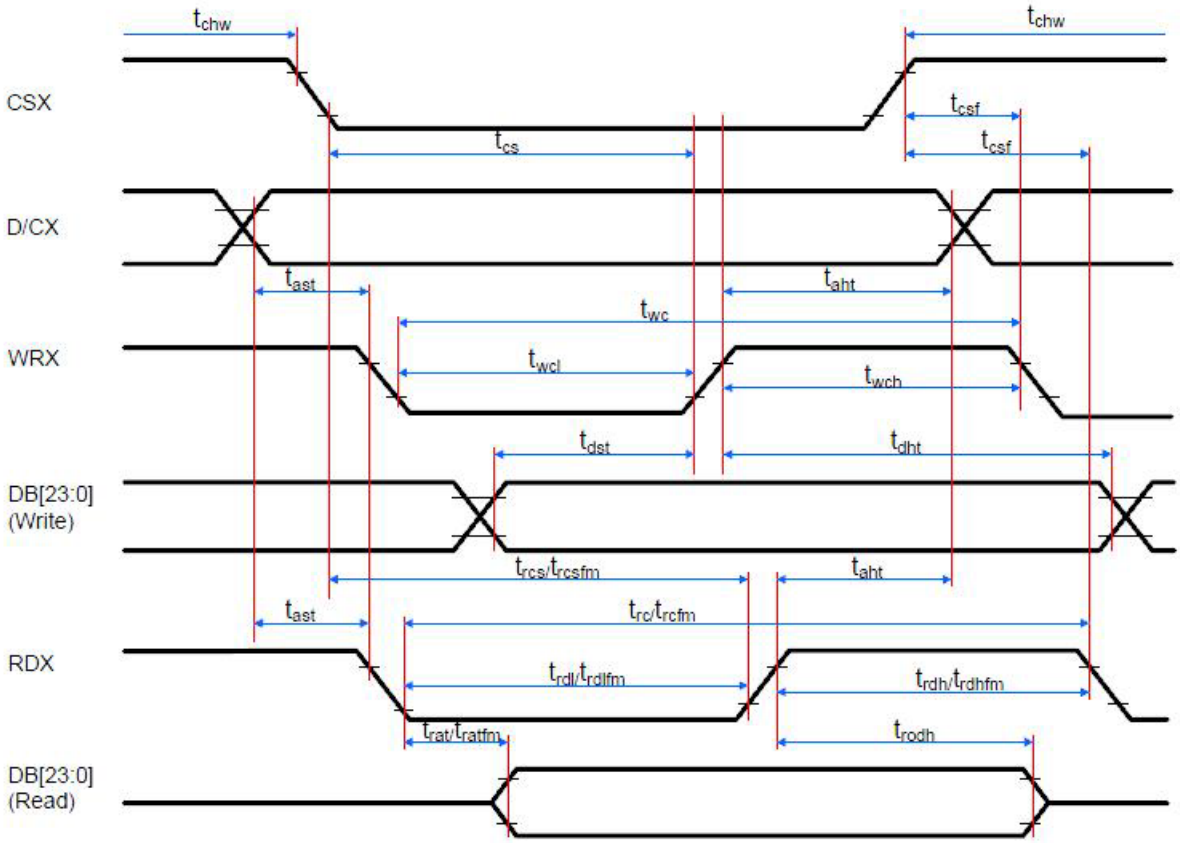
NO.	Symbol	I/O	Function
1	GND	P	Ground.
2	VDDIO	P	I/O power supply voltage.
3	VDD	P	Supply voltage.
4	SCL	I	I^2C clock input.
5	SDA	I/O	I^2C data input and output
6	INT	I	External interrupt to the host.
7	RST	I	External Reset, Low is active.
8	GND	P	Ground.

3.4 Block Diagram



3.5 Timing Characteristics

3.5.1 Display Parallel 8/16-bit Interface Timing Characteristics (8080 system)

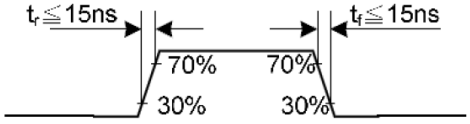


Signal	Symbol	Parameter	Min	Max	Unit	Conditions
DCX	tast	Address setup time	0	-	ns	-
	that	Address hold time (Write/Read)	0	-	ns	-
CSX	tchw	CSX "H" pulse width	0	-	ns	-
	tcs	Chip Select setup time (Write)	15	-	ns	-
	trcs	Chip Select setup time (Read ID)	45	-	ns	-
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	-
	tcsf	Chip Select wait time (Write/Read)	0	-	ns	-
WRX	twc	Write cycle	40	-	ns	-
	twrh	Write Control pulse H duration	15	-	ns	-
	twrl	Write Control pulse L duration	15	-	ns	-
RDX (FM)	trcfm	Read Cycle (FM)	450	-	ns	When read from Frame Memory
	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
RDX (ID)	trc	Read Cycle (ID)	160	-	ns	When read ID data
	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
DB [23:0] DB [17:0] DB [15:0] DB [8:0] DB [7:0]	tdst	Write data setup time	10	-	ns	For maximum, CL=30pF. For minimum, CL=8pF.
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	40	ns	
	tratfm	Read access time	-	340	ns	
	trod	Read output disable time	20	80	ns	

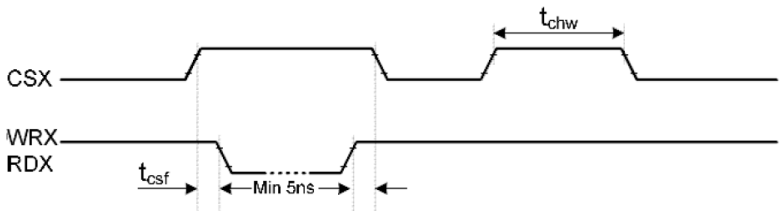
Note 1: Ta = -30 to 70°C, IOVCC = 1.65V to 3.3V, VCI = 2.5V to 3.3V, AGND = DGND = 0V.

Note 2: Logic high and low levels are specified as 30% and 70% of IOVCC for input signals.

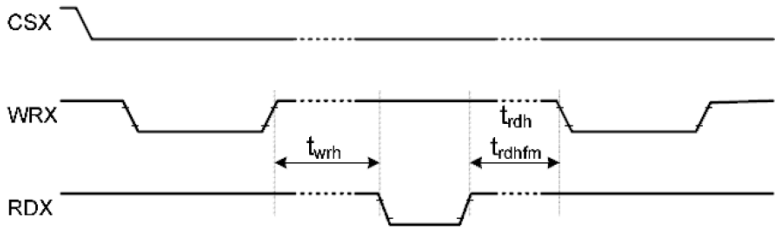
Note 3: Rising time and falling time of the input signal:



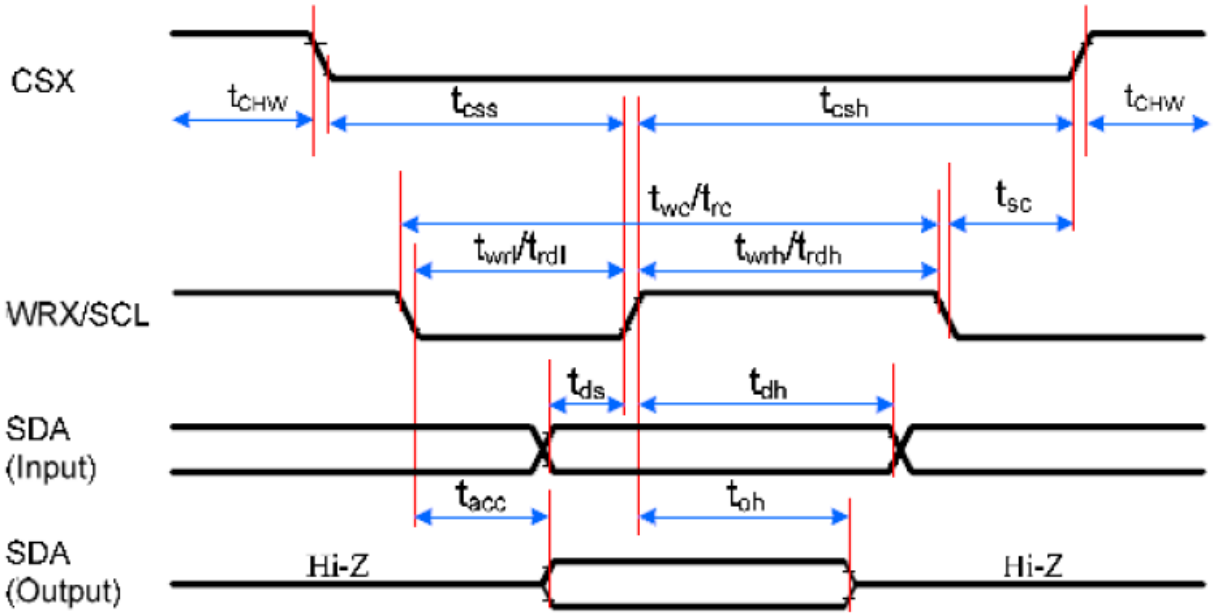
Note 4: The CSX timing:



Note 5: The Write to Read or the Read to Write timing:

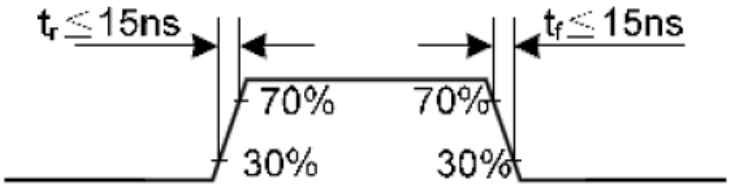


3.5.2 Display Serial Interface Timing Characteristics (3-line SPI system)

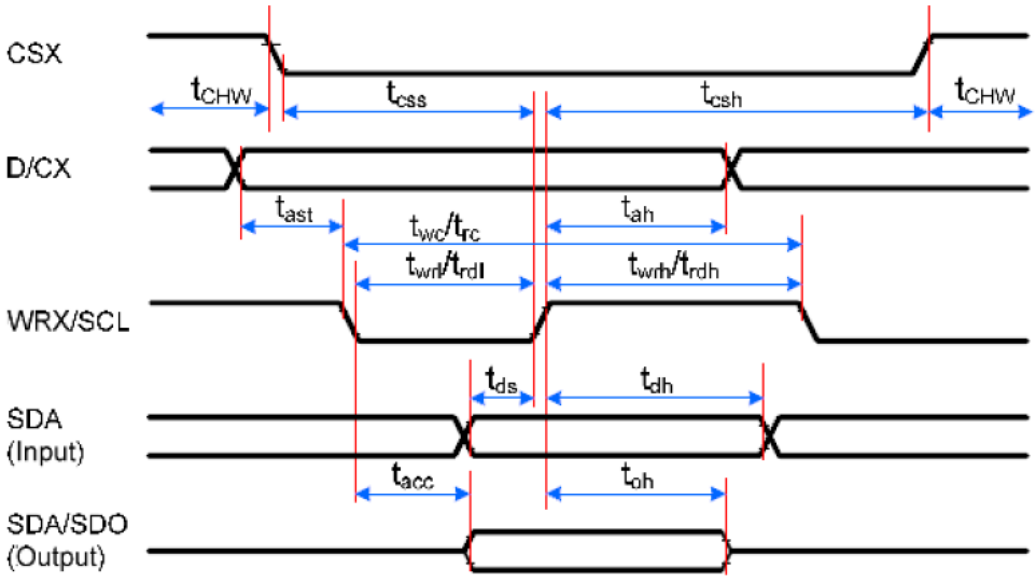


Signal	Symbol	Parameter	Min	Max	Unit	Conditions
CSX	tsc	SCL-CSX	15	-	ns	-
	tchw	CSX H Pulse Width	40	-	ns	-
	tcss	Chip select time (Write)	60	-	ns	-
	tcsh	Chip select hold time (Read)	65	-	ns	-
SCL	twc	Serial clock cycle (Write)	66	-	ns	-
	twrh	SCL H pulse width (Write)	15	-	ns	-
	twrl	SCL L pulse width (Write)	15	-	ns	-
	trc	Serial clock cycle (Read)	150	-	ns	-
	trdh	SCL H pulse width (Read)	60	-	ns	-
	trdl	SCL L pulse width (Read)	60	-	ns	-
SDA (Input)	tds	Data setup time (Write)	10	-	ns	-
	tdh	Data hold time (Write)	10	-	ns	-
SDA/SDO (Output)	tacc	Access time (Read)	10	50	ns	For maximum, CL=30pF. For minimum, CL=8Pf.
	toh	Output disable time (Read)	15	50	ns	

Note 1: Ta = -30 to 70°C, IOVCC = 1.65V to 3.6V, VCI = 2.5V to 3.6V, AGND = DGND = 0V, T = 10+/-0.5ns



3.5.3 Display Serial Interface Timing Characteristics (4-line SPI system)

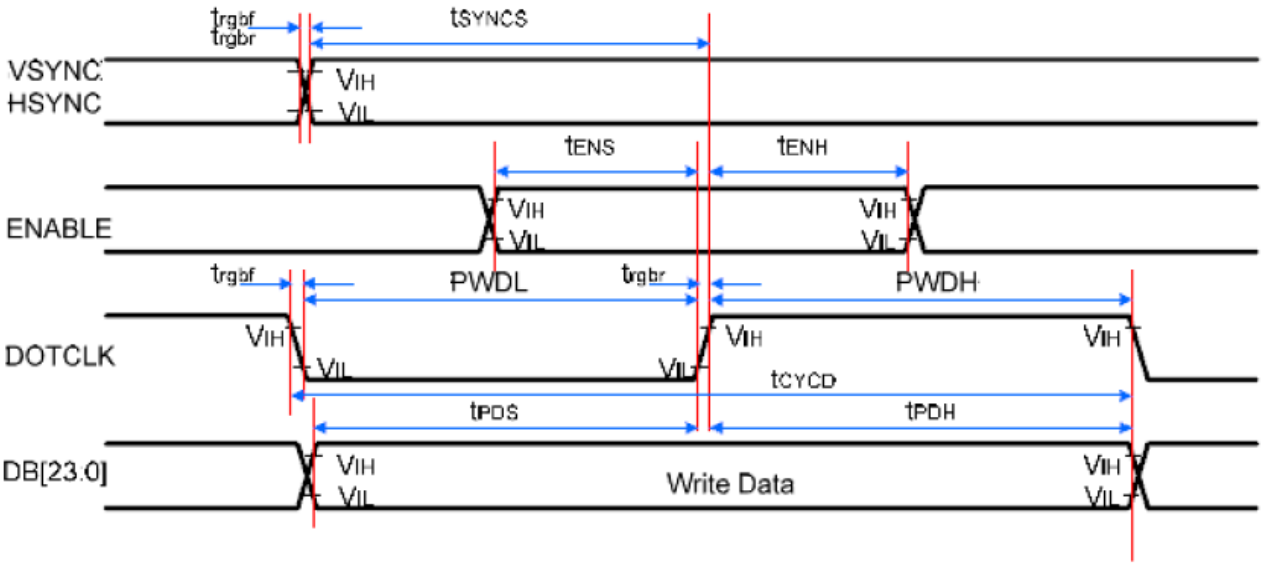


Signal	Symbol	Parameter	Min	Max	Unit	Conditions
CSX	tcss	Chip select time (Write)	15	-	ns	-
	tcsh	Chip select hold time (Read)	15	-	ns	-
	tchw	CS H Pulse Width	40	-	ns	-
SCL	twc	Serial clock cycle (Write)	50	-	ns	-
	twrh	SCL H pulse width (Write)	10	-	ns	-
	twrl	SCL L pulse width (Write)	10	-	ns	-
	trc	Serial clock cycle (Read)	150	-	ns	-
	trdh	SCL H pulse width (Read)	60	-	ns	-
	trdl	SCL L pulse width (Read)	60	-	ns	-
D/CX	tas	D/CX setup time	10	-	ns	-
	tah	D/CX hold time (Write/Read)	10	-	ns	-
SDA (Input)	tds	Data setup time (Write)	10	-	ns	-
	tdh	Data hold time (Write)	10	-	ns	-
SDA/SDO (Output)	tacc	Access time (Read)	10	50	ns	For maximum, CL=30pF
	tod	Output disable time (Read)	15	50	ns	For minimum, CL=8pF

Note 1: Ta = -30 to 70°C, IOVCC = 1.65V to 3.3V, VCI = 2.5V to 3.3V, AGND = DGND = 0V, T = 10+/-0.5ns

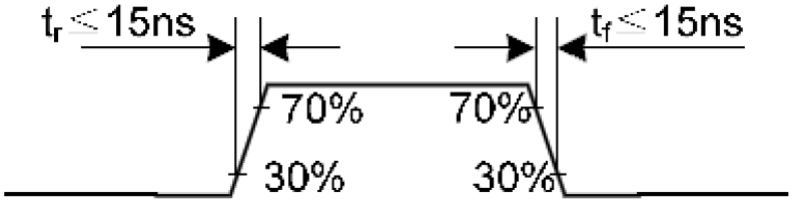
Note 2: Signal rising and falling timings are not included.

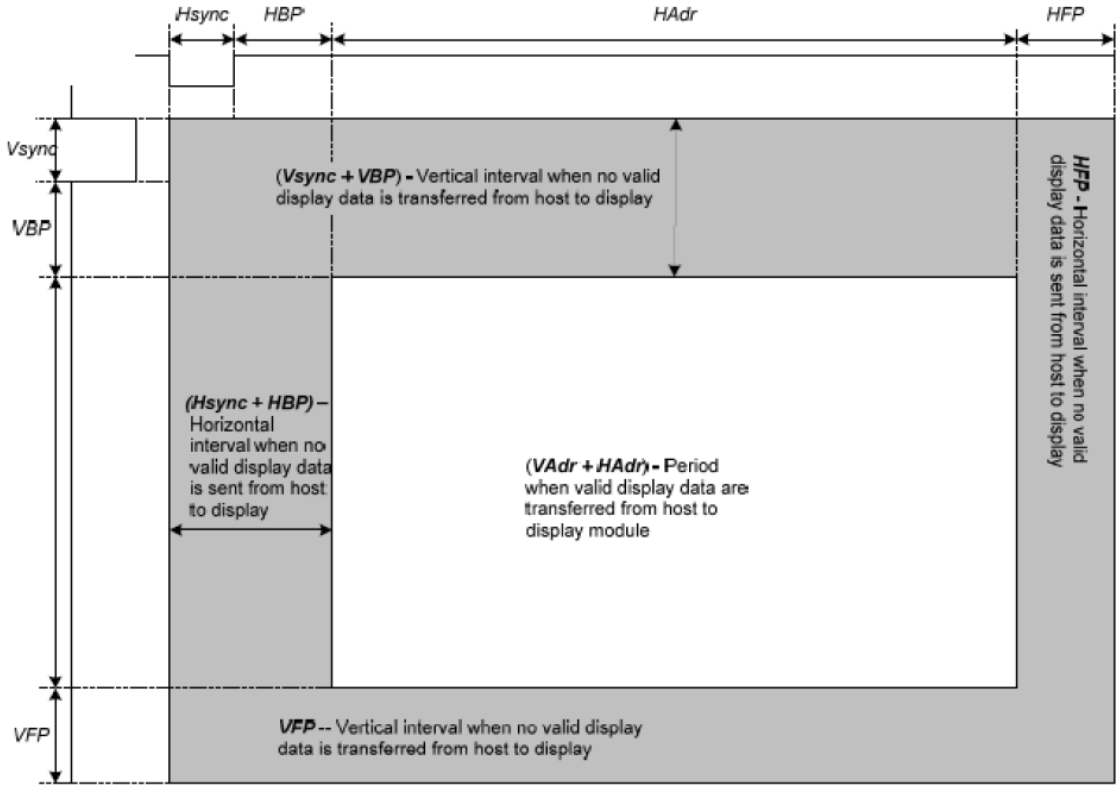
3.5.4 Parallel RGB Interface Timing Characteristics



Signal	Symbol	Parameter	Min	Max	Unit	Conditions
VSYNC/ HSYNC	t_{SYNCS}	VSYNC/HSYNC setup time	15	-	ns	16-/18-/24-bit bus RGB interface mode
	t_{SYNCH}	VSYNC/HSYNC hold time	15	-	ns	
ENABLE	t_{ENS}	ENABLE setup time	15	-	ns	
	t_{ENH}	ENABLE hold time	15	-	ns	
DB [23:0]	t_{POS}	Data setup time	15	-	ns	
	t_{PDH}	Data hold time	15	-	ns	
DOTCLK	PWDH	DOTCLK high-level period	20	-	ns	
	PWDL	DOTCLK low-level period	20	-	ns	
	t_{CYCD}	DOTCLK cycle time	50	-	ns	
	t_{rgbr}, t_{rgbf}	DOTCLK, HSYNC, VSYNC rise/fall time	-	15	ns	

Note 1: Ta = -30 to 70°C, IOVCC = 1.65V to 3.3V, VCI = 2.5V to 3.3V, AGND = DGND = 0V





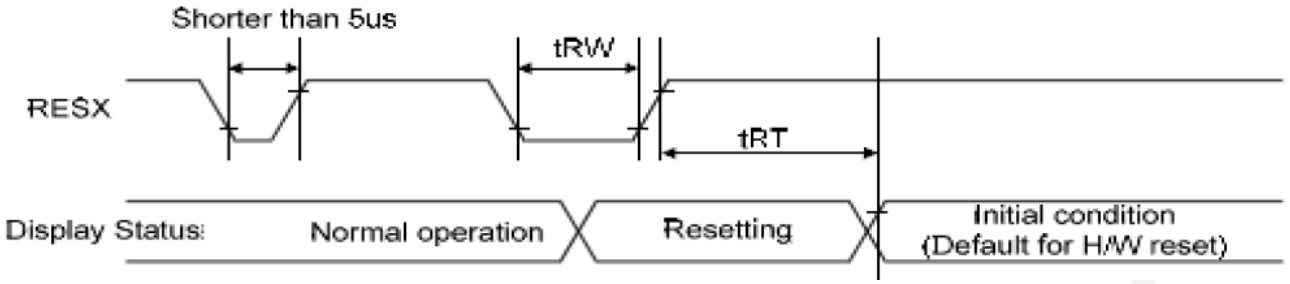
Parameter	Symbol	Min.	Typ.	Max.	Unit
PCLK Cycle	$PCLK_{CYC}$	100	80	66.6	ns
Horizontal Synchronization	Hsync	3	3	-	PCLK
Horizontal Back Porch	HBP	3	3	-	PCLK
Horizontal Address	HAdr	-	320	-	PCLK
Horizontal Front Porch	HFP	3	3	-	PCLK
Vertical Synchronization	Vsync	2	2	-	Line
Vertical Back Porch	VBP	2	2	-	Line
Vertical Address	VAdr	-	480	-	Line
Vertical Front Porch	VFP	2	2	-	Line
Vertical Frequency (*)	-	50	60	80	Hz
Horizontal Frequency (*)	-	-	33	-	KHz
PCLK Frequency (*)	-	10	12.5	15	MHz

Note 1: Vertical period (one frame) shall be equal to the sum of Vsync + VBP + VAdr + VFP.

Note 2: Horizontal period (one line) shall be equal to the sum of Hsync + HBP + HAdr + HFP.

Note 3: Control signals PCLK and Hsync shall be transmitted as specified at all times while valid pixels are transferred between the host processor and the display module.

3.5.5 Reset Timing Characteristics



Reset Timing

Signal	Symbol	Parameter	Min	Max	Unit	Note
RESX	tRW	Reset pulse duration	10	-	us	-
	tRT	Reset cancel	-	5	ms	1, 5
			-	120	ms	1, 6, 7

Note 1: The reset cancel also includes the required time for loading ID bytes, VCOM setting and other settings from the EEPROM to registers. After a rising edge of RESX, this loading is done within 5 ms after the H/W reset cancel (tRT).

Note 2: According to the table below, a spike due to an electrostatic discharge on the RESX line does not cause irregular system reset.

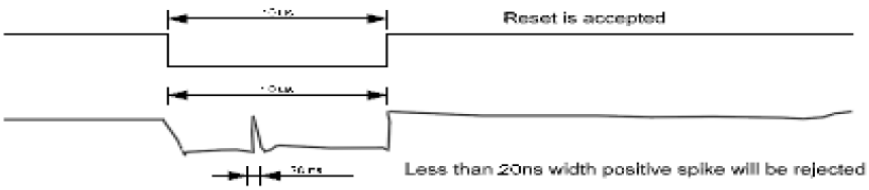
Reset Description

RESX Pulse	Action
Shorter than 5us	Reset rejected
Longer than 9us	Reset
Between 5us and 9us	Reset starts

Note 3: During the Reset period, the display will be blanked (When Reset starts in the Sleep Out mode, the display will enter the blanking sequence in at least 120 ms. The display remains the blank state in the Sleep In mode) and then return to the default condition for the Hardware Reset.

Note 4: Spike Rejection can also be applied during a valid reset pulse, as shown below:

Positive Noise Pulse during Reset Low



4. Electrical Specification Touch

4.1 Electrical Characteristics

4.1.1 Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	VDD	-0.3	3.6	V	1
I/O Digital Voltage	VDDIO	1.8	3.6	V	1
Operating Temperature	T_{OP}	-20	+70	℃	-
Storage Temperature	T_{ST}	-30	+80	℃	-

Note 1: If used beyond the absolute maximum ratings, FT6336G may be permanently damaged. It is strongly recommanded 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

(Ta=25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Digital Supply Voltage	VDD	-	2.8	3.3	3.6	V	-
I/O Digital Supply Voltage	VDDIO	-	1.8	3.3	3.6	V	-
Normal Operation Mode Current Consumption	I_{opr}	VDD=2.8V Ta=25°C MCLK=17.5Mhz	-	4	-	mA	-
Monitor Mode Current Consumption	I_{mon}		-	1.5	-	mA	-
Sleep Mode Current Consumption	I_{slp}		-	50	-	μA	-
Level Input Voltage	V_{IH}	-	$0.7V_{DDIO}$	-	V_{DDIO}	V	-
	V_{IL}	-	-0.3	-	$0.3V_{DDIO}$	V	-
Level Output Voltage	V_{OH}	I_{OH}=-0.1mA	$0.7V_{DDIO}$	-	-	V	-
	V_{OL}	I_{OH}=0.1mA	-	-	$0.3V_{DDIO}$	V	-

4.2 AC Electrical Characteristics

AC Characteristics of Oscillators

Item	Symbol	Test Condition	Min	Typ.	Max	Unit	Note
OSC clock 1	fosc1	VDDA= 2.8V； Ta=25°C	34.65	35	35.35	MHz	-

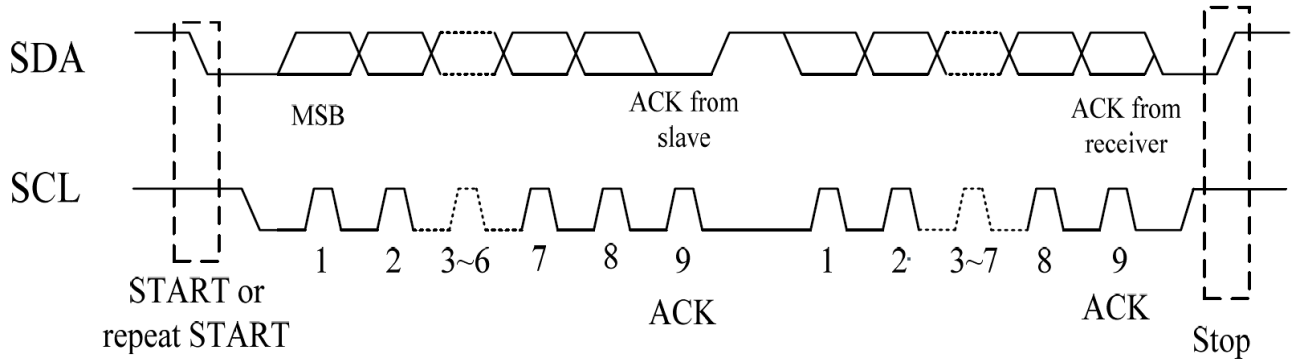
AC Characteristics of sensor

Item	Symbol	Test Condition	Min	Typ.	Max	Unit	Note
Sensor acceptable clock	ftx	VDDA = 2.8V； Ta = 25°C	0	100	300	kHz	-
Sensor output rise time	Ttxr	VDDA = 2.8V； Ta = 25°C	-	100	-	ns	-
Sensor output fall time	Ttxf	VDDA = 2.8V； Ta = 25°C	-	80	-	ns	-
Sensor input voltage	Trxi	VDDA = 2.8V； Ta = 25°C	-	5	-	V	-

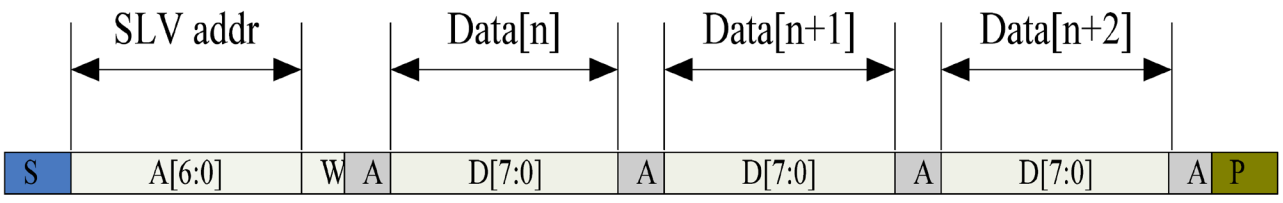
4.2.1 I²C Interface

The I²C is always configured in the Slave mode. The data transfer format is shown as below:

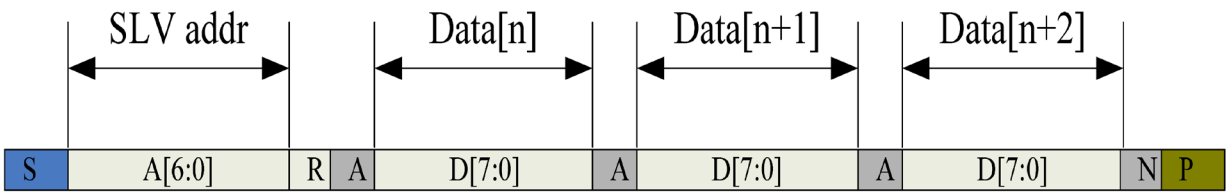
I²C Serial Data Transfer Format



I2C master write, slave read



I2C master read, slave write



Below table lists the meanings of the mnemonics used in above figures.

Mnemonics Description

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)
P	STOP: the indication of the end of a packet (if this bit is missing, S will indicate the end of the current packet and the beginning of the next packet)

I^2C Timing Characteristics

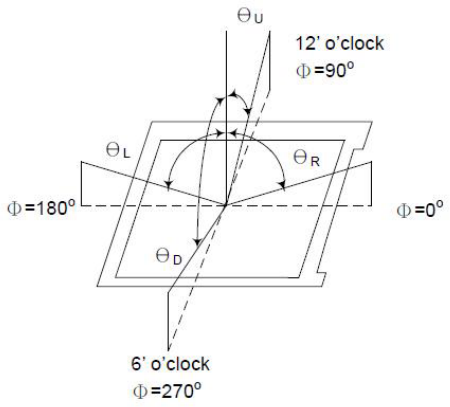
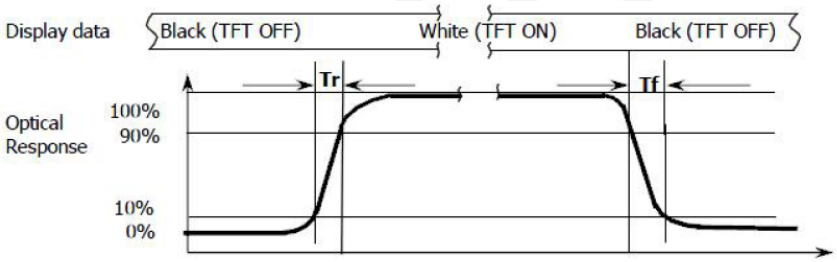
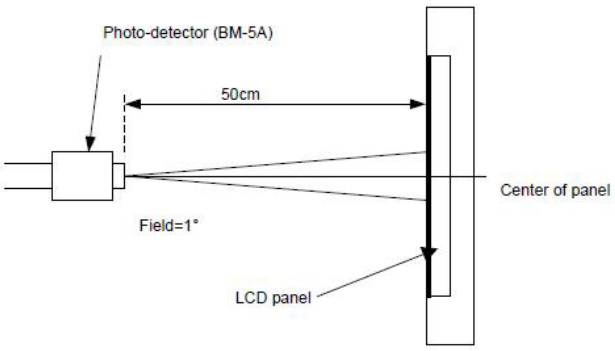
Parameter	Min	Max	Unit
SCL frequency	10	400	KHz
Bus free time between a STOP and START condition	4.7	-	us
Hold time (repeated) START condition	4.0	-	us
Data setup time	250	-	ns
Setup time for a repeated START condition	4.7	-	us
Setup Time for STOP condition	4.0	-	us

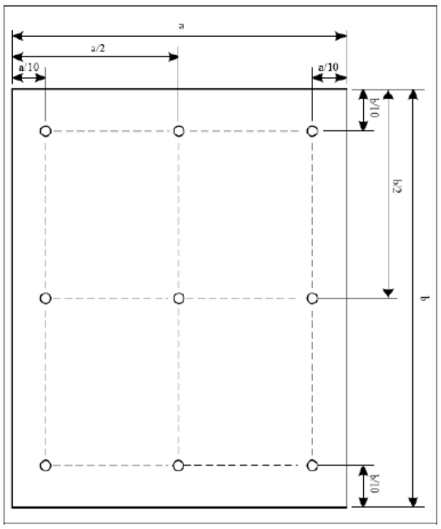
5. Optical Specification

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		$T_R + T_F$		-	35	50	msec	1, 3
Color Gamut		S (%)	-	58	63	-	%	-
Viewing Angle	Left	θ_x-	CR>10	-	80	-	deg	1, 4
	Right	θ_x+		-	80	-		
	Up	θ_Y+		-	80	-		
	Down	θ_Y-		-	80	-		
Colour Chromaticity	Red	Rx	θ = 0° Normal viewing angle	0.590	0.630	0.670	-	1, 4 CA-310
		Ry		0.308	0.348	0.388		
	Green	Gx		0.276	0.316	0.356		
		Gy		0.531	0.571	0.611		
	Blue	Bx		0.106	0.146	0.186		
		By		0.017	0.057	0.097		
	White	Wx		0.277	0.317	0.357		
		Wy		0.318	0.358	0.398		
Luminance		Lv	I_F = 120mA	400	-	-	cd/m^2	5
			I_F = 160mA	500	550	-		
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	
2	Definition of Contrast Ratio (CR)	Contrast ratio (CR) = Luminance measured when LCD is at "white state" / Luminance measured when LCD is at "black state"
3	Definition of Response Time	
4	Definition of Optical Measurement Setup	

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

6. LED Backlight Specification

6.1 LED Backlight Characteristics

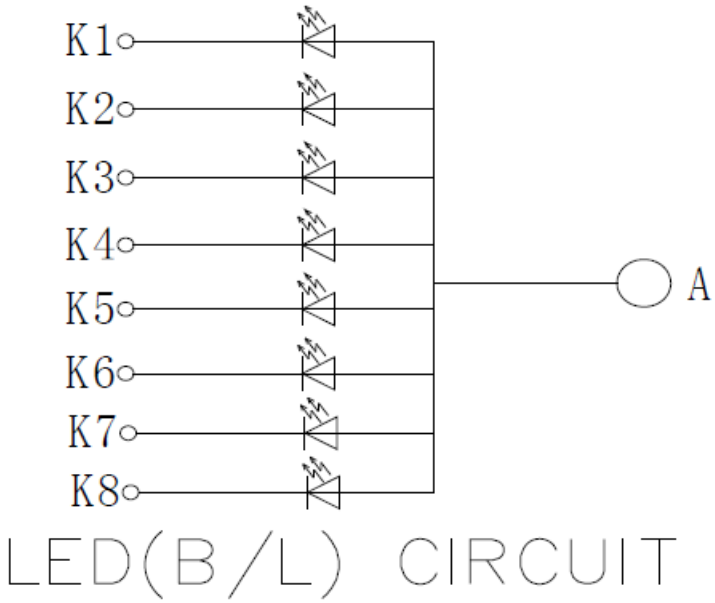
The back-light system is edge-lighting type with 8 chips White LED

Item	Symbol	Min	Typ	Max	Unit	Note
Forward Current	I_F	120	160	-	Ma	-
Forward Voltage	V_F	-	3.2	-	V	-
LED Lifetime	Hr	50000	-	-	Hour	2

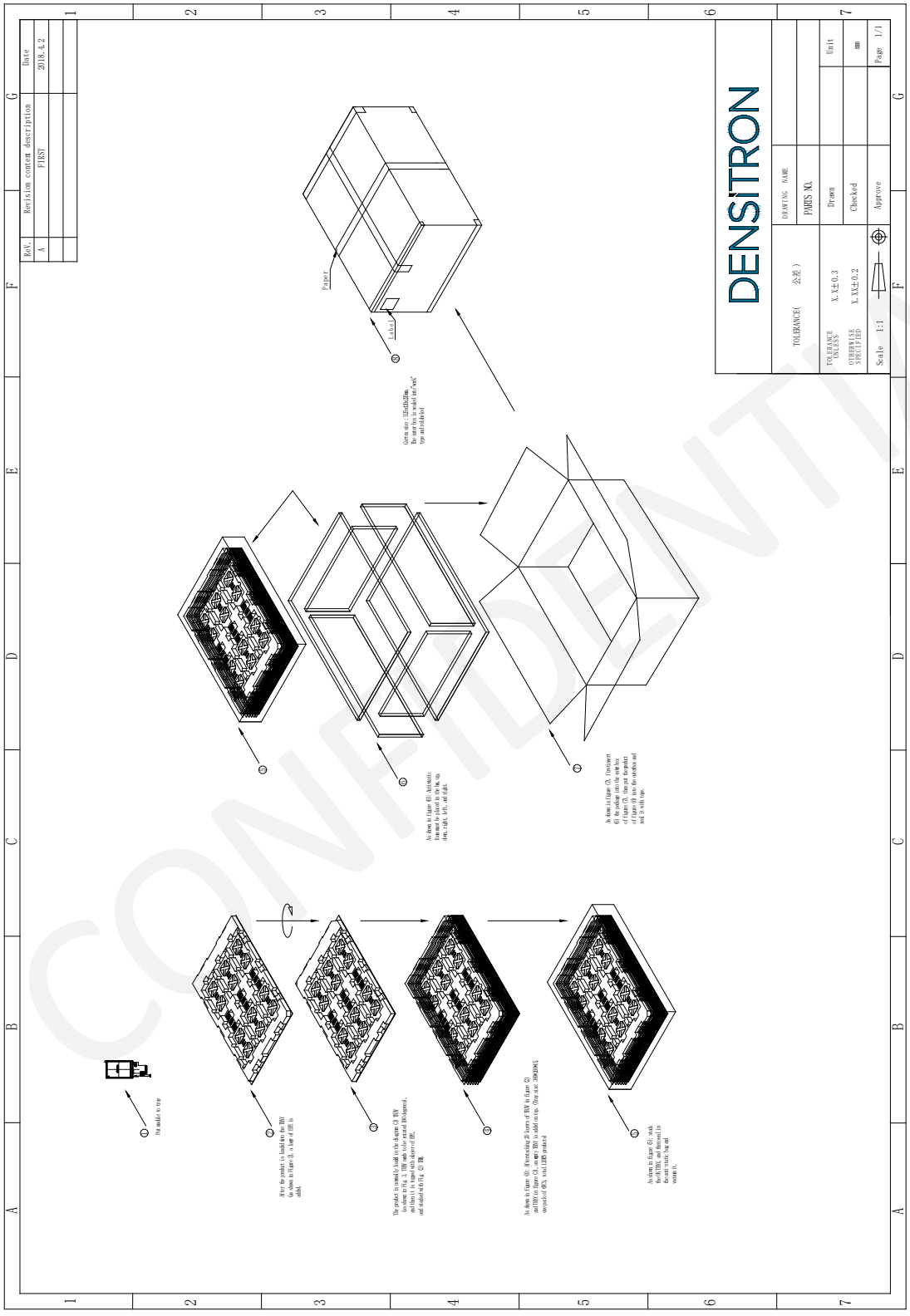
Note 1: LED lifetime (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25±3℃, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note 2: The “LED lifetime” is defined as the module brightness decreases to 50% original brightness at Ta=25℃ and IL =160mA. The LED lifetime could be decreased if operating IL is larger than 160mA. The constant current driving method is suggested.

6.2 Internal Circuit Diagram



7. Packaging



8. Quality Assurance Specification

8.1 Conformity

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

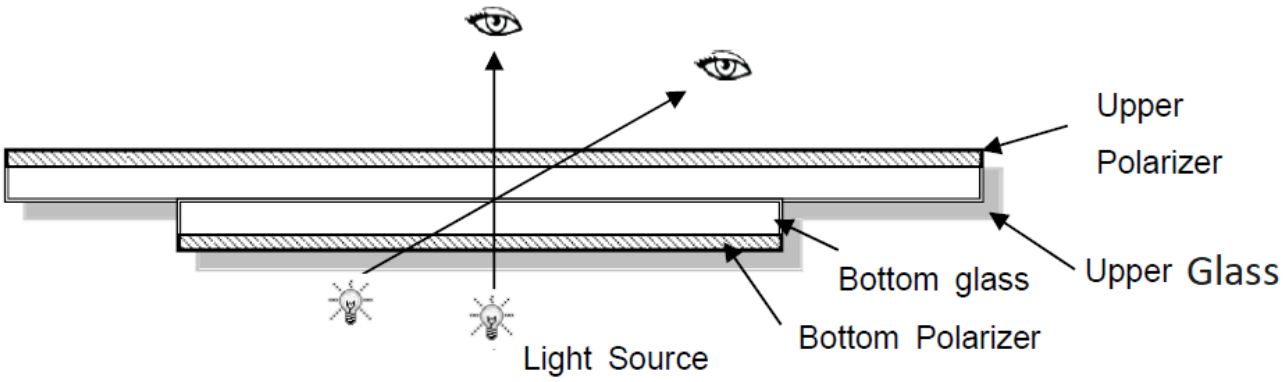
8.2 Environment Required

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.

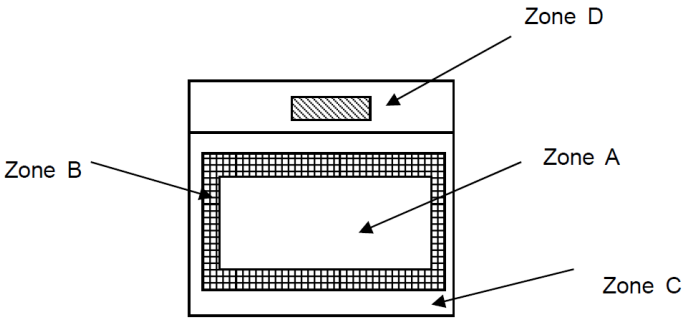


8.3 Delivery Assurance

8.3.1 Delivery Inspection Standards

Class II, Normal Inspection, GB/T 2828-2003

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

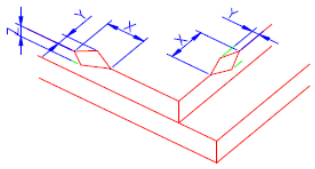
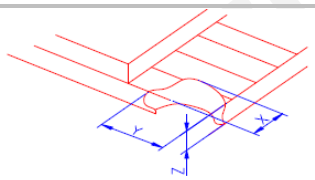
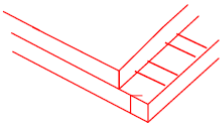
Major defect	Minor defect
0.65	1.5

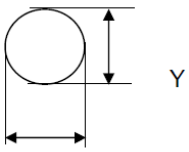
LCD: Liquid Crystal Display, TP: Touch Panel, LCM: Liquid Crystal Module

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/TP	Black/White spot/line, scratch, crack, etc.	

8.3.4 Criteria & Classification

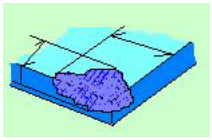
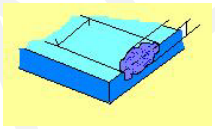
Units: mm

<table>
<tr><th>No</th><th>Item</th><th>Criteria</th></tr>
<tr><td rowspan="3">1.0 LCD Crack/Broken
X: Length
Y: Width
Z: Height
L: Length of ITO,
T: Height of LCD</td><td>The edge of LCD broken</td><td> 
<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≤ 3</td><td>< Inner border line of the seal</td><td>≤ T</td></tr>
</table></td></tr>
<tr><td>LCD corner broken</td><td> 
<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≤ 3</td><td>< L</td><td>≤ T</td></tr>
</table></td></tr>
<tr><td>LCD crack</td><td> 
Crack Not allowed</td></tr>
</table>

<table>
<tr>
<td>2.0</td>
<td>Spot defect
 

Φ=(X+Y)/2</td>
<td>
1. light dot (LCD/TP/Polarizer black/white spot, light dot, pinhole, dent, stain)
<table>
<tr><th rowspan="2">Size</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤0.10</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.10<Φ≤0.25</td><td colspan="2">3(distance≧10mm)</td></tr>
<tr><td>0.25<Φ≤0.3</td><td colspan="2">2</td></tr>
<tr><td>Φ>0.35</td><td colspan="2">0</td></tr>
</table>
2. Dim spot （LCD/TP/Polarizer dim dot, light leakage、 dark spot）
<table>
<tr><th rowspan="2">Size</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤0.1</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.10<Φ≤0.25</td><td colspan="2">3(distance≧10mm)</td></tr>
<tr><td>0.25<Φ≤0.3</td><td colspan="2">2</td></tr>
<tr><td>Φ>0.35</td><td colspan="2">0</td></tr>
</table>
3. Polarizer accidented spot
<table>
<tr><th rowspan="2">Size</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤0.2</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.3<Φ≤0.5</td><td colspan="2">2(distance≧10mm)</td></tr>
<tr><td>Φ>0.5</td><td colspan="2">0</td></tr>
</table>
4. Pixel bad points （light dot，Dim dot, color dot）
<table>
<tr><th rowspan="2">Size</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤0.1</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.15<Φ≤0.25</td><td colspan="2">2(distance≧10mm)</td></tr>
<tr><td>Φ>0.3</td><td colspan="2">0</td></tr>
</table>
5. Polarizer Bubble
<table>
<tr><th rowspan="2">Size</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤0.2</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.3<Φ≤0.4</td><td colspan="2">3(distance≧10mm)</td></tr>
<tr><td>0.5<Φ≤0.6</td><td colspan="2">2</td></tr>
<tr><td>0.6<Φ</td><td colspan="2">0</td></tr>
</table>
</td>
</tr>
<tr>
<td>3.0</td>
<td>Line defect (LCD/ TP /Polarizer backlight black/white line,</td>
<td>
<table>
<tr><th>Width</th><th>Length</th><th>Acceptable Qty</th></tr>
</table>
</td>
</tr>
</table>

<table>
<tr><td></td><td>scratch, stain)</td><td>
<table>
<tr><th></th><th></th><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤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>0.07<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>
</table>
</td></tr>
<tr><td>4.0</td><td>Electronic Components SMT</td><td>Not allow missing parts, solderless connection, cold solder joint, mismatch. The positive and negative polarity opposite</td></tr>
<tr><td>5.0</td><td>Display color& Brightness</td><td>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 rowspan="4">6.0</td><td rowspan="4">CTP Related</td><td>sensor accidented black/white
<table>
<tr><th rowspan="2">Size Φ</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤0.1</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.1<Φ≤0.2</td><td colspan="2">3（distance≧10mm）</td></tr>
<tr><td>0.20<Φ≤0.25</td><td colspan="2">2</td></tr>
<tr><td>Φ＞0.3</td><td colspan="2">0</td></tr>
</table>
</td></tr>
<tr><td>CTP Cover scratch
<table>
<tr><th rowspan="2">Width</th><th rowspan="2">Ignore (mm)</th><th colspan="3">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤0.05</td><td>Ignore</td><td colspan="3">Ignore</td></tr>
<tr><td>0.05<W≤0.06</td><td>L≤4.0</td><td colspan="3">N≤3</td></tr>
<tr><td>0.07<W≤0.08</td><td>L≤3.0</td><td colspan="3">N≤2</td></tr>
<tr><td>0.08<W</td><td colspan="4">Define as spot defect</td></tr>
</table>
</td></tr>
<tr><td>CTP Cover Pinhole/ Lack of ink
<table>
<tr><th rowspan="2">Size</th><th>Acceptable Qty</th></tr>
<tr><th>C</th></tr>
<tr><td>Φ≤0.1</td><td>Ignore</td></tr>
<tr><td>0.1<Φ≤0.2</td><td>3(distance≧10mm)</td></tr>
<tr><td>0.25<Φ≤0.3</td><td>2</td></tr>
<tr><td>Φ>0.35</td><td>0</td></tr>
</table>
</td></tr>
<tr><td>CTP Bonding bubble/ accidented spot
<table>
<tr><th rowspan="2">Size</th><th colspan="2">Acceptable Qty</th></tr>
<tr><th>A</th><th>B</th></tr>
<tr><td>Φ≤0.1</td><td colspan="2">Ignore</td></tr>
<tr><td>0.15<Φ≤0.2</td><td colspan="2">3(distance≧10mm)</td></tr>
<tr><td>0.2<Φ≤0.25</td><td colspan="2">2</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td></td><td></td><td><table><tr><td>Φ>0.25</td><td>0</td></tr></table></td></tr>
<tr><td></td><td></td><td>Assembly deflection</td><td>beyond the edge of backlight ≤0.2mm</td></tr>
<tr><td></td><td></td><td>TP cover broken.
X：length
Y：width
Z：height</td><td><table><tr><th>X</th><th>Y</th><th>Z</th></tr><tr><td>X≤0.5mm</td><td>Y≤0.5mm</td><td>Z<cover thickness</td></tr></table>Circuitry broken is not allowed.
  </td></tr>
<tr><td></td><td></td><td>TP cover broken.
X：length
Y：width
Z：height</td><td><table><tr><th>X</th><th>Y</th><th>Z</th></tr><tr><td>X≤0.3mm</td><td>Y≤0.3mm</td><td>Z<LCD thickness</td></tr></table>  </td></tr>
</table>

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

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 reasonable time and update the status to 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°C, 96 hours	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 hours	
High Temperature Storage	80°C, 96 hours	
Low Temperature Storage	-30°C, 96 hours	
High Temperature & High Humidity Storage	+60°C, 90% RH ,96 hours.	
Thermal Shock (Non-operation)	-10°C, 30 min ↔ +60°C, 30 min, Change time: 5min 20CYC.	
ESD test	C=150pF, R=330, 5points/panel Air: ±8KV, 5times; Contact: ±6KV, 5 times. (Environment: 15°C ~35°C, 30%~60%).	
Vibration (Non-operation)	Frequency range: 10~55Hz, Stroke: 1.5mm Sweep: 10Hz~55Hz~10Hz 2 hours for each direction of X.Y.Z. (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 5~10 pieces.

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.

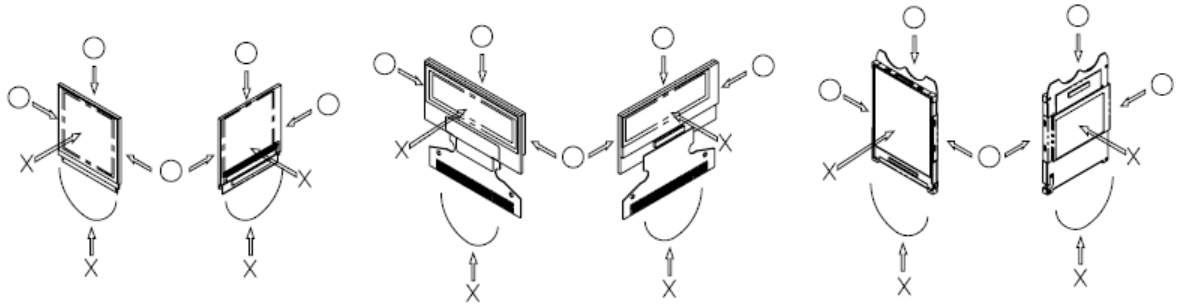
Note 5: Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

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

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.

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.