

Display Elektronik GmbH

DATA SHEET

TFT MODULE

DEM 320240S1 TMH-PW-N

(C-TOUCH)

2,3“ TFT

Product Specification

Version: 1

24.07.2024

Revision History

Date	Rev. No.	Page	Summary
20.07.2024	0	ALL	FIRST ISSUE
24.07.2024	1	4	Update IC no., Weight

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*** Description**

This is a color active matrix TFT (Thin Film Transistor) LCD (liquid crystal display) that uses amorphous silicon TFT as a switching device. This model is composed of a Transmissive type TFT-LCD Panel, driver Circuit, Capacitance Touch Panel, Backlight Unit. The resolution of this 2.3'TFT-LCD contains 320x240 pixels, and can display up to 65k/262k colors.

*** Features**

General Information Items	Specification	Unit	Note
	Main Panel		
Display Area(AA)	46.75 x 35.06 (2.3 Inch)	mm	-
CTP View Area	47.35 x 35.66	mm	
Driver Element	TFT Active Matrix	-	-
Display Colors	65k / 262k	colors	-
Number of Pixels	320 x RGB x 240	dots	-
TFT Pixel Arrangement	RGB Vertical Stripe	-	-
Pixel Pitch	0.146(H) x 0.146(V)	mm	-
Viewing Angle	12:00	o'clock	-
TFT Controller IC	ILI9342C (Ilitek)	-	-
Display Interface	8/9/16/18 BIT-MCU 3/4-Line SPI+16/18 BIT-RGB 3/4-Line SPI	-	-
Display Mode	TN,Transmissive, Normally White	-	-
Operating Temperature	-20 ~ +70	°C	-
Storage Temperature	-30 ~ +80	°C	-

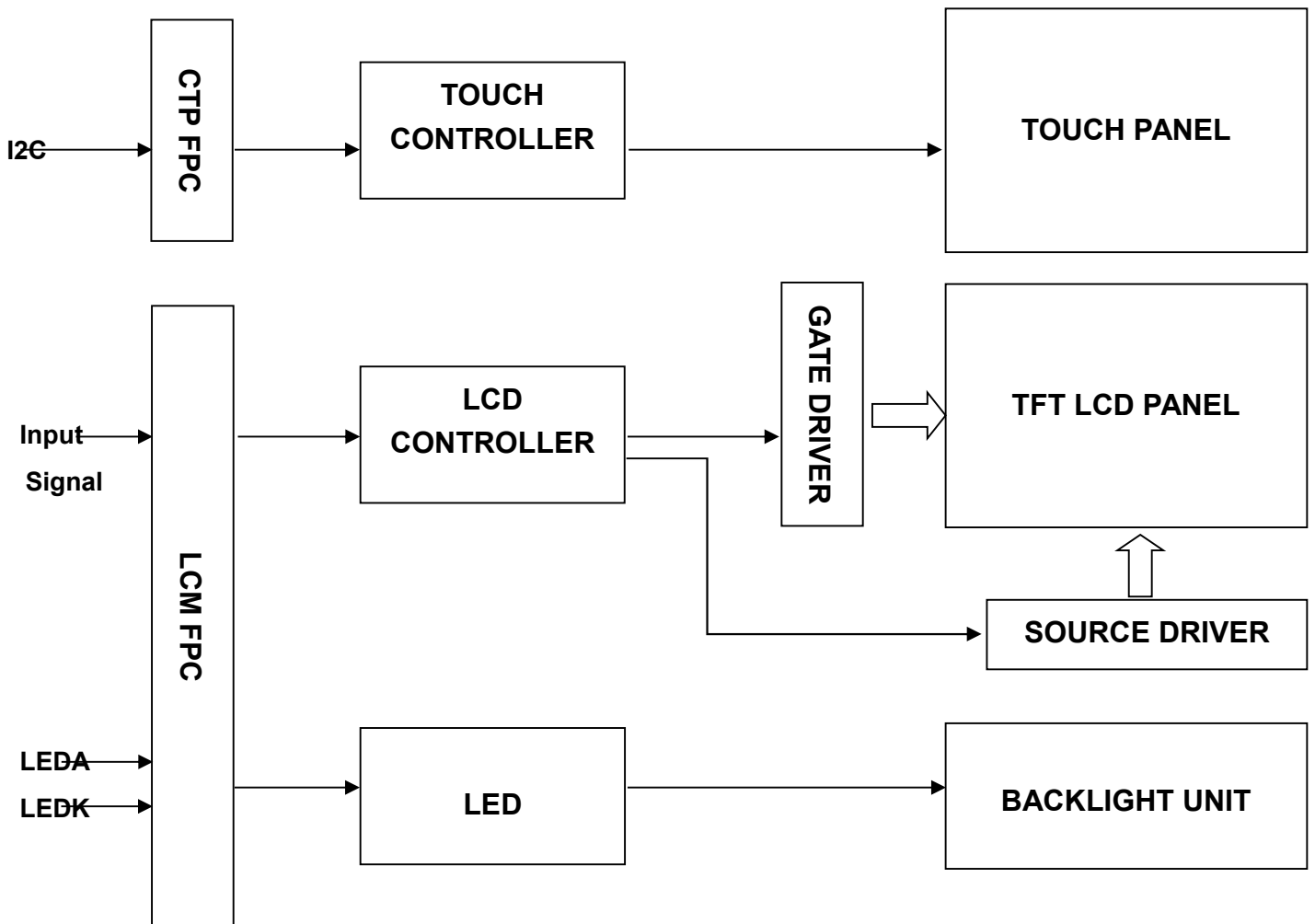
*** CTP Features**

General Information Items	Specification	Unit	Note
	Main Panel		
Resolution	320(H) x 240(V)	-	-
Structure	G+G	-	-
Controller IC	FT6336G (Focaltech)	-	-
Interface	I2C	-	-
Slave Adress	0x38(7bit)/8bit:0x70(Write) 0x71(Read)	-	-
Touch Mode	Single Point	-	-
Logic Level	1.8 or 3.3	V	Set by VDDIO

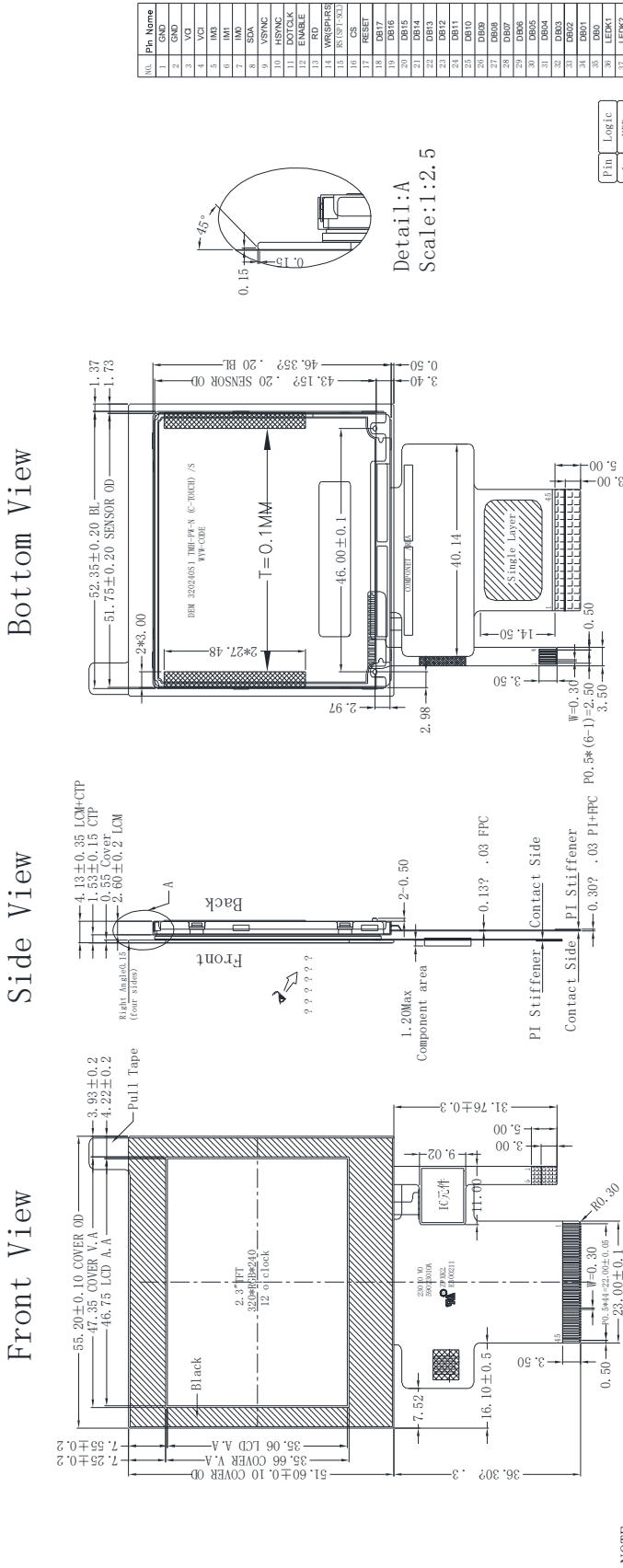
*** Mechanical Information**

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal(H)	-	55.20	-	mm	-
	Vertical(V)	-	51.60	-	mm	-
	Depth(D)	-	4.13	-	mm	-
Weight		-	15	-	g	-

1. Block Diagram



2. Outline Dimension



Pin Name

1	GND
2	GND
3	SCL
4	VCC
5	IMS
6	IMT
7	IMQ
8	SDA
9	VSYND
10	HSYND
11	EN
12	ENABLE
13	RD
14	WRSPHARS
15	RS (SP+SA)
16	CS
17	RESET
18	DB17
19	DB15
20	DB14
21	DB14
22	DB13
23	DB11
24	DB10
25	DB09
26	DB08
27	DB07
28	DB06
29	DB05
30	DB04
31	DB04
32	DB03
33	DB02
34	DB01
35	LEDK1
36	LEDK2
37	LEDK3
38	LEDK4
39	LEDK4
40	LEDA
41	XRNG2
42	XRNG1
43	XLRD
44	XLRNC
45	GND

Pin Logic

1	VDD
2	SCL
3	SDA
4	INT
5	RST
6	GND

RGB Interface

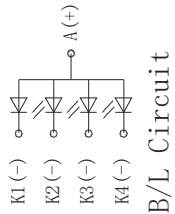
16 BIT RGB Interface	DB17-DB00
18 BIT RGB Interface	DB17-DB00

NOTE: RGB Interface
16 BIT RGB Interface DB17-DB00
18 BIT RGB Interface DB17-DB00
NOTE: If used RGB mode must select serial interface!

NOTE: MCU Interface SET for IM PINS.

IM	IM	Interface Type	IM Pin is use
0	0	IMT Typ. 8-bit Interface	DB17-DB00
0	1	IMT Typ. 8-bit Interface	DB05-DB00
0	1	IMT Typ. 8-bit Interface	DB17-DB00
1	1	IMT Typ. 8-bit Interface	SDA, SCL, CS, RS
1	1	IMT Typ. 8-bit Interface	SDA, SCL, CS, RS

NOTE: If not use PINS fix to the GND, IOVCC or MC.



- NOTE:
- DISPLAY TYPE: 2.3" TFT-LCD, 65K/262K COLORS
 - DISPLAY MODE: T/M NORMALLY WHITE
 - VIEWING DIRECTION: FREE
 - LCM DRIVER IC: IL19342C (COG)
LCM Interface: 8/16BIT MCU 3/4SPI+16/18BIT RGB
 - Touch Mode: CTP
Touch Driver IC: FT6336G
Touch Interface: IIC
Touch And LCM Bonding Technology: Tape Bonding
 - VDD: 3.3V (TYP.), IOVCC: 1.8-3.3V
 - OPERATING TEMP: -20° C TO 70° C
STORAGE TEMP: -30° C TO 80° C
 - BACK LIGHT: LED WHITE, 4 LED, 60-80mA, 3.2±0.3V
 - RoHS COMPLIANT.

3. Input Terminal Pin Assignment

3.1 TFT

NO	SYMBOL	DISCRIPTION	I/O
1	GND	Ground.	P
2	GND	Ground.	P
3	VCI	Supply voltage (3.3V).	P
4	VCI	Supply voltage (3.3V).	P
5	IM3	MPU Parallel interface bus and serial interface select.	I
6	IM1	If use RGB Interface must select serial interface.	I
7	IM0	Fix this pin at VCI an GND.	I
8	SDA	The data is applied on the rising edge of the SCL signal. If not used, fix this pin at VCI or GND when not in use.	I
9	VSYNC	Frame synchronizing signal for RGB interface operation. fix this pin at VCI or GND when not in use.	I
10	HSYNC	Line synchronizing signal for RGB interface operation. fix this pin at VCI or GND when not in use.	I
11	DOTCLK	Dot clock signal for RGB interface operation. fix this pin at VCI or GND when not in use.	I
12	ENABLE	Data enable signal for RGB interface operation. fix this pin at VCI or GND when not in use.	I
13	RD	Serves as a read signal and MCU read data at the rising edge. fix this pin at VCI or GND when not in use.	I
14	WR(SPI_RS)	Serves as a write signal and writes data at the rising edge. 4-line system (D/CX): Serves as command or parameter select. fix this pin at VCI or GND when not in use.	I
15	RS(SPI_SCL)	This pin is used to select "Data or Command" in the parallel interface. When D/CX= '1', data is selected. When D/CX = '0', command is select ed. This pin is used serial interface clock in 3-wire 9-bit / 4-wire 8-bit serial data interface. fix this pin at VCI or GND when not in use.	I
16	CS	Chip select input pin ("Low" enable). fix this pin at VCI or GND when not in use.	I
17	RESET	This signal will reset the device and must be applied to properly in itialize the chip.	I

18 - 35	DB17-DB0	18-bit parallel bi-directional data bus for MCU system and RGB interface mode. Fix to GND level when not in use	I/O
36	LEDK1	Cathode pin OF backlight	P
37	LEDK2	Cathode pin OF backlight	P
38	LEDK3	Cathode pin OF backlight	P
39	LEDK4	Cathode pin OF backlight	P
40	LEDA	Anode pin of backlight	P
41	XR(NC)	Touch panel Right Glass Terminal	A/D
42	YD(NC)	Touch panel Bottom Film Terminal	A/D
43	XL(NC)	Touch panel LIFT Glass Terminal	A/D
44	YU(NC)	Touch panel Top Film Terminal	A/D
45	GND	Ground.	P

3.2 CTP

NO.	SYMBOL	DISCRIPTION	I/O
1	VDD	Supply voltage.	P
2	SCL	I2C clock input.	I
3	SDA	I2C data input and output	I/O
4	INT	External interrupt to the host.	I
5	RST	External Reset, Low is active.	I
6	GND	Ground.	P

4. LCD Optical Characteristics

4.1 Optical specification

Item	Symbol	Condition	Min.	Typ.	Max.	Unit.	Note	
Contrast Ratio	CR	$\Theta=0$	400	500			(1)(2)	
Response Time	Rising		T_R	--	4	8	msec	(1)(3)
	Falling		T_F	--	12	24		
Color Gamut	S(%)	-	--	50	--	%		
Color Filter Chromaticity	White	W_X	-	0.04	0.303	+0.04	-	(1)(4)
		W_Y	-		0.324			
	Red	R_X	-		0.609			
		R_Y	-		0.330			
	Green	G_X	-		0.287			
		G_Y	-		0.527			
	Blue	B_X	-		0.147			
		B_Y	-		0.138			
Viewing Angle	Hor.	Θ_L	CR>10	--	70	--	-	(1)(4)
		Θ_R		--	70	--		
	Ver.	Θ_U		--	70	--		
		Θ_D		--	50	--		
Option View Direction	12 o'clock						-	

*The data comes from the LCD specification.

Measuring Condition

Measuring surrounding: dark room

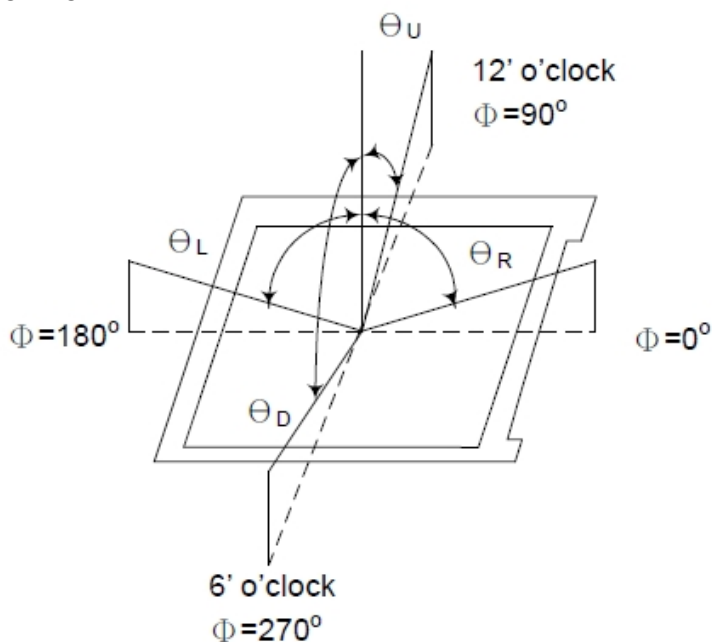
Ambient temperature: 25°C ± 2°C

15min. warm-up time

Measuring Equipment

FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.

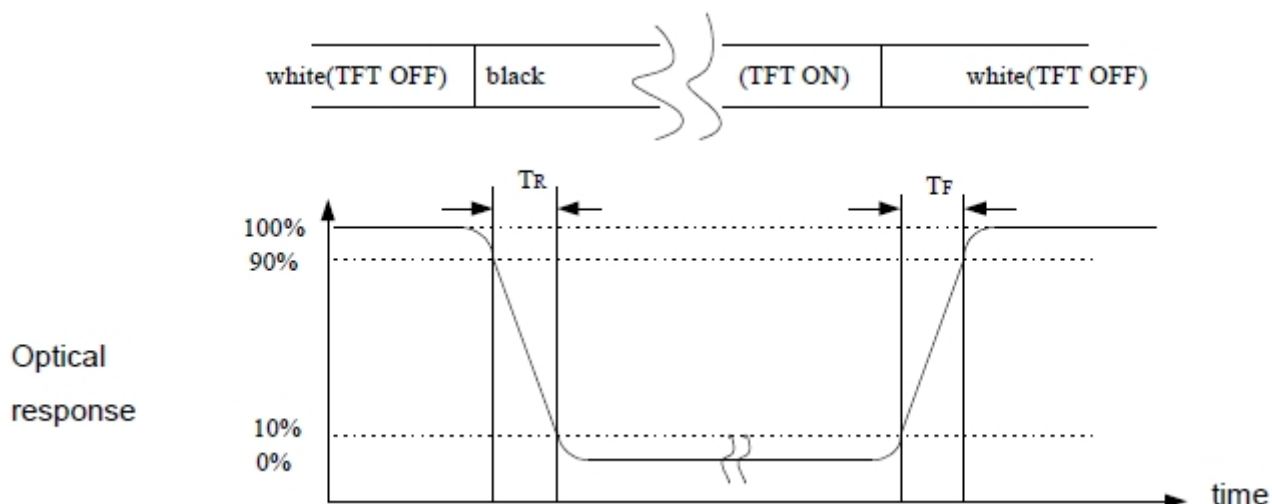
Note (1): Definition of Viewing Angle:



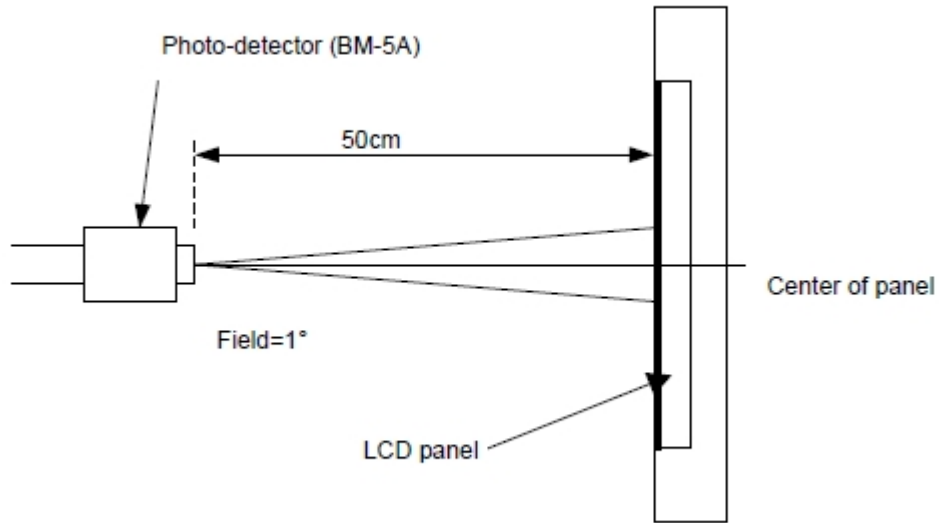
Note (2): Definition of Contrast Ratio (CR): measured at the center point of panel

$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

Note (3): Response Time



Note (4): Definition of optical measurement setup



5. Electrical Characteristics

5.1 Absolute Maximum Rating (Ta=25 VSS=0V)

Characteristics	Symbol	Min.	Max.	Unit
Digital Supply Voltage	VDD	-0.3	4.6	V
Digital interface Supply Voltage	VDDIO	-0.3	VDD	V
Operating Temperature	T _{OP}	-20	+70	°C
Storage Temperature	T _{ST}	-30	+80	°C

5.2 DC Electrical Characteristics

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Digital Supply Voltage	VDD	3.0	3.3	4.2	V	
Digital Interface Supply Voltage	VDDIO	1.65	3.3	4.2	V	
Normal Mode Current Consumption	IDD	--	8	16	mA	
Level Input Voltage	V _{IH}	0.7VDDIO	--	VDDIO	V	
	V _{IL}	GND	--	0.3VDDIO	V	
Level Output Voltage	V _{OH}	0.8VDDIO	--	VDDIO	V	
	V _{OL}	GND	--	0.2VDDIO	V	

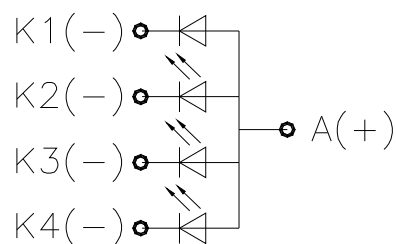
5.3 LED Backlight Characteristics

The Backlight System is edge-lighting type with 4 Chips White LED

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Current	I_F	60	80	--	mA	
Forward Voltage	V_F	--	3.2	--	V	
LCM Luminance	L_V	280	--	--	cd/m ²	$I_f=80\text{mA}$
LED Lifetime	Hr	50000	--	--	Hour	Note1,2
Uniformity	AVg	80	--	--	%	

Note (1) LED Lifetime (Hr) can be defined as the time in which it continues to operate under the condition: $T_a=25^\circ\text{C} \pm 3^\circ\text{C}$, typical IL value indicated in the above table until the brightness becomes less than 50%.

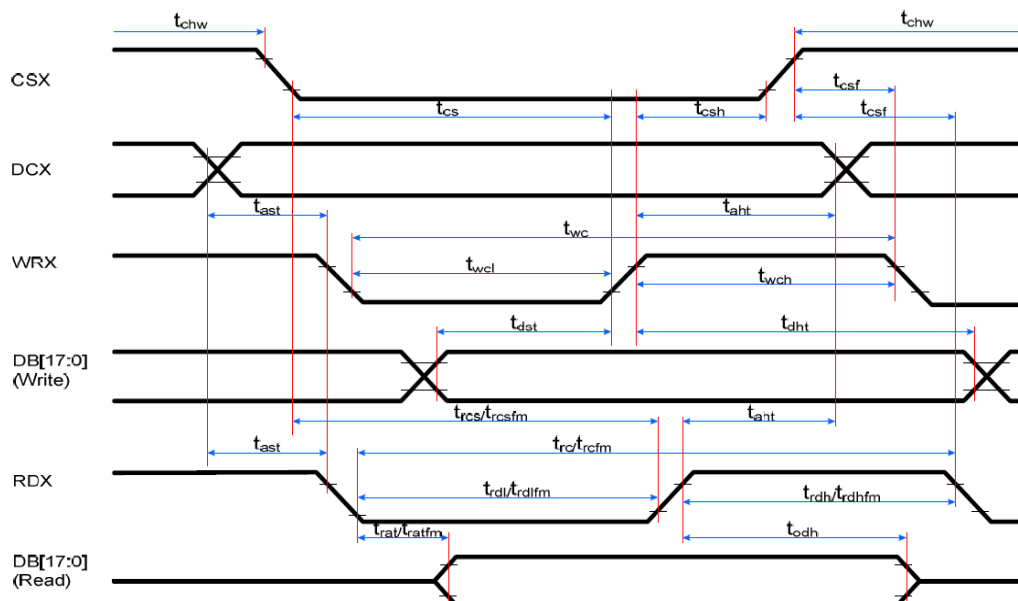
Note (2) The "LED Lifetime" is defined as the module brightness decrease to 50% original brightness at $T_a=25^\circ\text{C}$ and $I_L=80\text{mA}$. The LED lifetime could be decreased if operating I_L is larger than typ. 80mA. The constant current driving method is suggested.



BLU CIRCUIT DIAGRAM

6. TFT AC Characteristic

6.1 DBI Type B Timing Characteristics

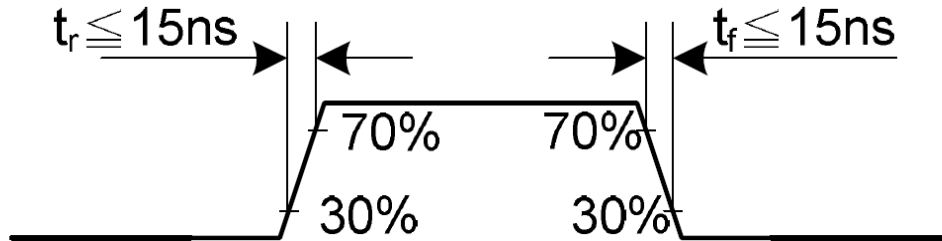


	Sym	Parameter	Spec		Unit	Description
			M	M		
DCX	t_{ast}	Address setup time	0	--	m	
	t_{hat}	Address hold time (Write/Read)	1	--	u	
CSX	t_{chw}	CSX "H" pulse width	0	--	n	
	t_{cs}	Chip Select setup time (Write)	1	--	%	
	t_{rcs}	Chip Select setup time (Read ID)	4	--	n	
	t_{rcsf}	Chip Select setup time (Read FM)	3	--	n	
	t_{csf}	Chip Select Wait time (Write/Read)	1	--	n	
WRX	t_{wc}	Write cycle	6	--	n	
	t_{wrh}	Write Control pulse H duration	1	--	n	
	t_{wrl}	Write Control pulse L duration	1	--	n	
RDX(FM)	t_{rcfm}	Read Cycle (FM)	4	--	n	When read from Frame Memory
	t_{rdhf}	Read Control H duration (FM)	9	--	n	
	t_{rdlf}	Read Control L duration (FM)	3	--	n	
RDX(ID)	t_{rc}	Read cycle (ID)	1	--	n	When read ID data
	t_{rdh}	Read Control pulse H duration	9	--	n	
	t_{rdl}	Read Control pulse L duration	4	--	n	
DB[23:0], DB[17:0], DB[15:0], DB[0:15]	t_{dst}	Write data setup time	1	--	n	For maximum, CL=30pF For minimum,
	t_{dht}	Write data hold time	1	--	n	
	t_{rat}	Read access time	--	4	n	
	t_{ratf}	Read access time	--	3	n	
	t_{rod}	Read output disable time	2	8	n	

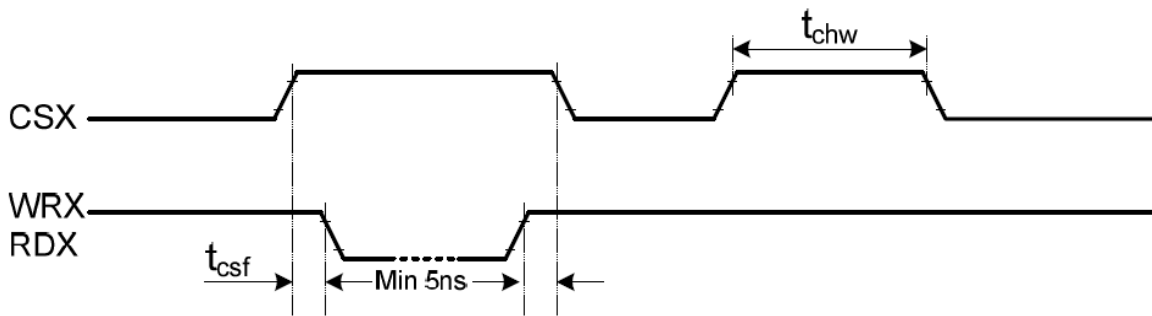
Note: 1. $T_a = -30$ to 70 °C, $IOVCC = 1.65V$ to $3.3V$, $VCI = 2.5V$ to $3.3V$, $AGND = DGND = 0V$

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

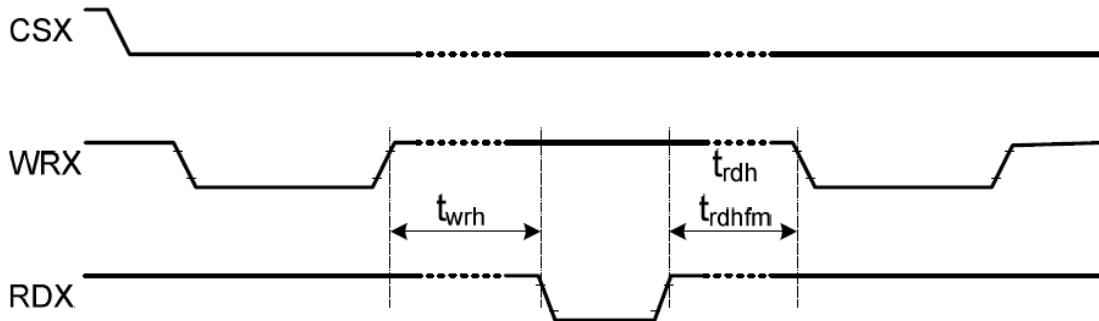
3. Input signal rising time and falling time.:



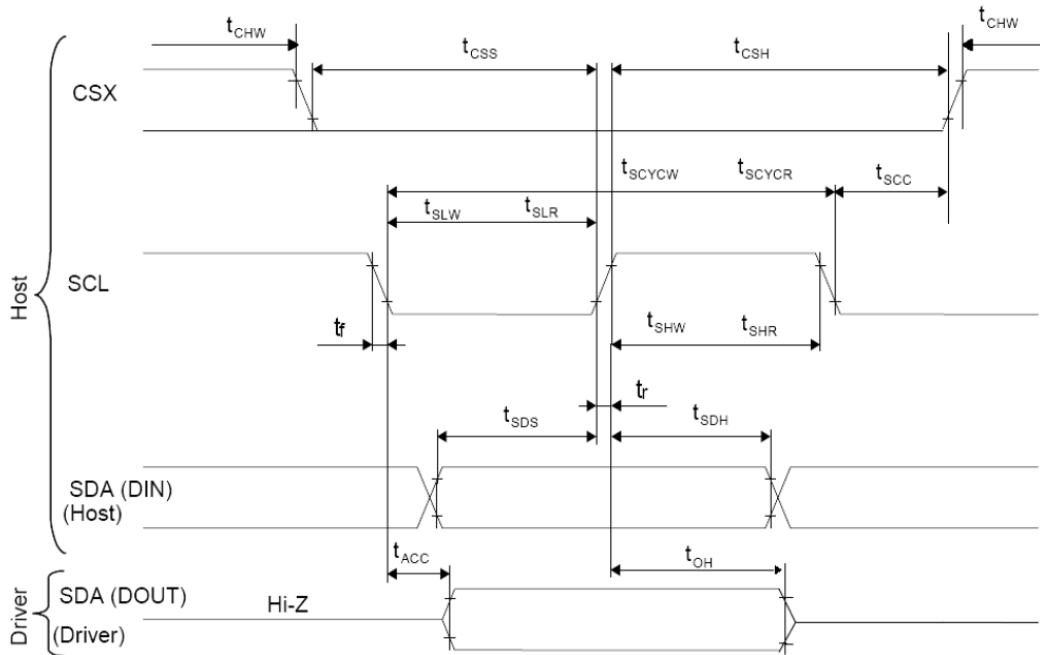
4. The CSX timing:



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

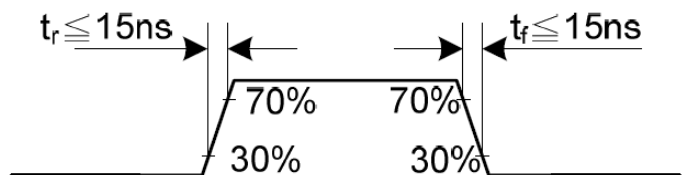


6.2 Display Serial Interface Timing Characteristics (3-line SPI system)

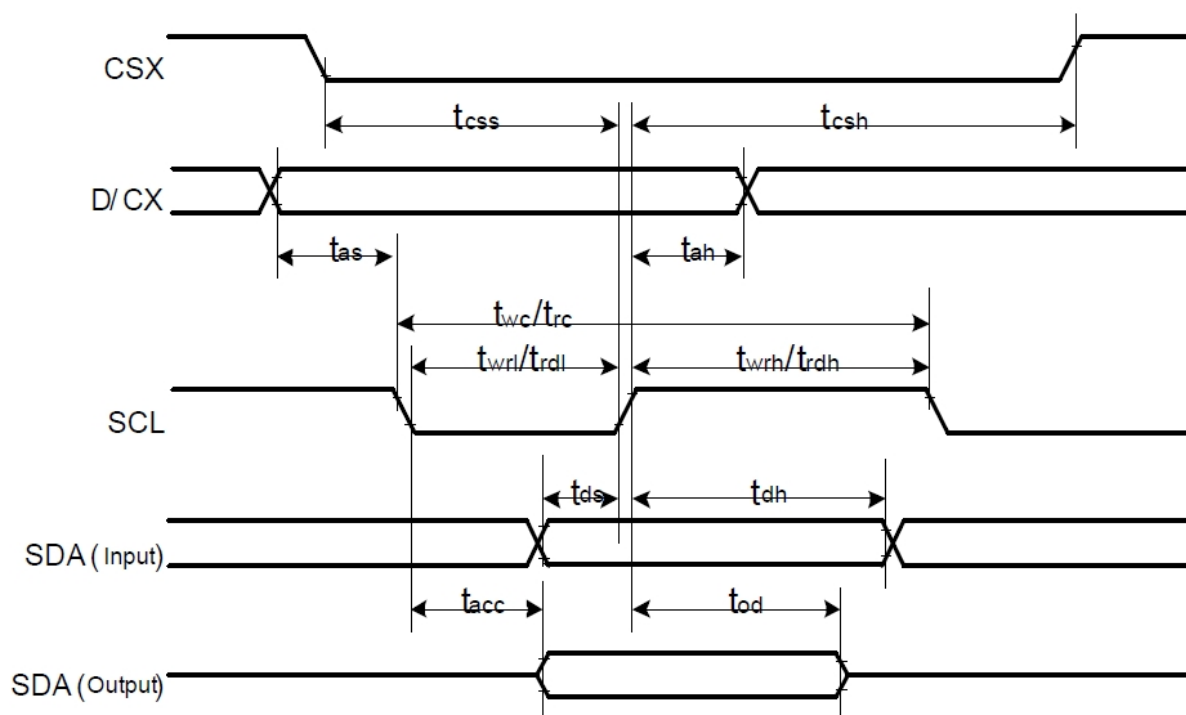


Signal	Symbol	Parameter	Spec		U ni	Description
			M	M		
CSX	t_{scc}	SCL-CSX	2	--	n	
	t_{chw}	CSX H Pulse Width	4	--	n	
	t_{css}	CSX-SCL Time(write)	3	--	n	
	t_{csh}		3			
SCL	t_{scycw}	Serial clock cycle (Write)	6	--	n	
	t_{shw}	SCL H pulse width (Write)	1	--	n	
	t_{slw}	SCL L pulse width (Write)	1	--	n	
	t_{scycr}	Serial clock cycle (Read)	1	--	n	
	t_{shr}	SCL H pulse width (Read)	6	--	n	
	t_{slr}	SCL L pulse width (Read)	6	--	n	
SDA (Input)	t_{sds}	Data setup time(Write)	3	--	n	
	t_{sdh}	Data hold time(Write)	3	--	n	
SDA/SD O	t_{acc}	Access time(Read)	1	--	n	
	t_{oh}	Output disable time(Read)	1	5	n	

NOTES: $T_a = -30$ to 70 °C, $IOVCC = 1.65V$ to $3.6V$, $VCI = 2.5V$ to $3.6V$, $AGND = DGND = 0V$, $T = 10 \pm 0.5ns$



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

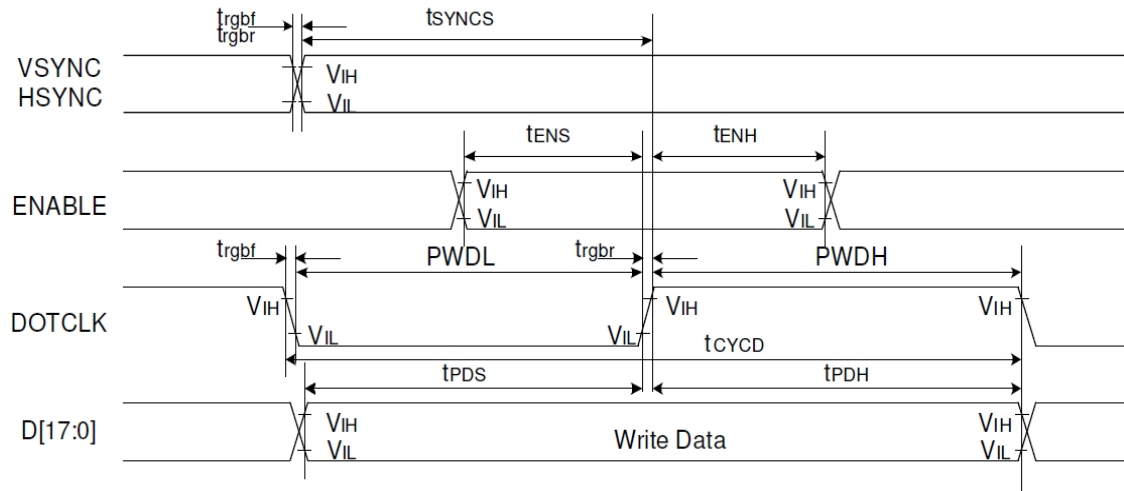


Signal	Symbol	Parameter	Spec		U ni	Description
			M	M		
CSX	t_{css}	Chip select time (Write)	3	--	n	
	t_{csh}	Chip select hold time (Read)	3	--	n	
SCL	t_{wc}	Serial clock cycle (Write)	1	--	n	
	t_{wrhf}	SCL H pulse width (Write)	3	--	n	
	t_{wrl}	SCL L pulse width (Write)	3	--	n	
	t_{rc}	Serial clock cycle (Read)	1	--	n	
	t_{rdh}	SCL H pulse width (Read)	6	--	n	
	t_{rdl}	SCL L pulse width (Read)	6	--	n	
D/CX	t_{as}	D/CX setup time	1	--	n	
	t_{ah}	D/CX hold time (Write/Read)	1	--	n	
SDA (Input)	t_{ds}	Read cycle (ID)	1	--	n	
	t_{dh}	Read Control pulse H duration	1	--	n	
SDA/SD O	t_{acc}	Write data setup time	1	5	n	For maximum CL=30pF
	t_{od}	Write data hold time	1	5	n	

1. $T_a = -30$ to 70 °C, $IOVCC = 1.65V$ to $3.3V$, $VCI = 2.5V$ to $3.3V$, $AGND = DGND = 0V$, $T = 10 \pm 0.5ns$.

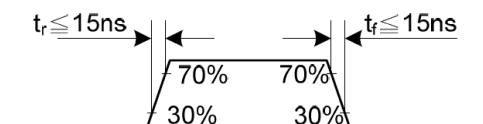
2. Does not include signal rising and falling times.

6.4 Parallel 18/16/6-bit RGB Interface Timing Characteristics

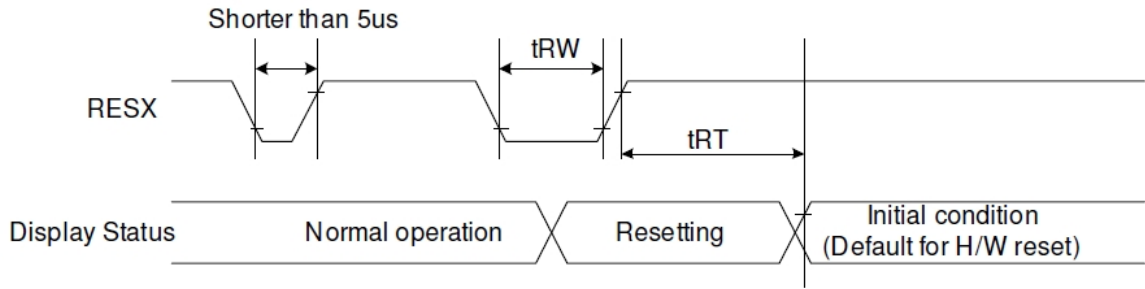


Signal	Symbol	Parameter	Spec		U ni	Description	
			M	M			
VSYNC/H SYNC	t_{SYNCS}	VSYNC/HSYNC setup time	1	--	n	16-/18-bit bus RGB interface mode	
	t_{SYNCH}	VSYNC/HSYNC hold time	1	--	n		
ENABLE	t_{ENS}	ENABLE setup time	1	--	n		
	t_{ENH}	ENABLE hold time	1	--	n		
DB[23:0]	t_{POS}	Data setup time	1	--	n		
	t_{POH}	Data hold time	1	--	n		
DOTCLK	PWDH	DOTCLK high-level period	3	--	n		
	PWDL	DOTCLK low-level period	3	--	n		
	t_{CYCD}	DOTCLK cycle time	1	--	n		
	t_{rgbr}, t_{rgbf}	DOTCLK,HSYNC,VSYNC	--	1	n		
VSYNC/H SYNC	t_{SYNCS}	VSYNC/HSYNC setup time	1	--	n		6-bit bus RGB interface mode
	t_{SYNCH}	VSYNC/HSYNC hold time	1	--	n		
ENABLE	t_{ENS}	ENABLE setup time	1	--	n		
	t_{ENH}	ENABLE hold time	1	--	n		
DB[23:0]	t_{POS}	Data setup time	1	--	n		
	t_{POH}	Data hold time	1	--	n		
DOTCLK	PWDH	DOTCLK high-level period	2	--	n		
	PWDL	DOTCLK low-level period	2	--	n		
	t_{CYCD}	DOTCLK cycle time	5	--	n		
	t_{rgbr}, t_{rgbf}	DOTCLK,HSYNC,VSYNC	--	1	n		

NOTES: $T_a = -30$ to 70 °C, $IOVCC = 1.65V$ to $3.6V$, $VCI = 2.5V$ to $3.6V$, $AGND = DGND = 0V$, $T = 10 \pm 0.5ns$



6.5 Reset Timing



Signal	Symbol	Parameter	Min	Max	Unit
RESX	tRW	Reset pulse duration	10		uS
	tRT	Reset cancel		5 (note 1,5)	mS
				120 (note 1,6,7)	mS

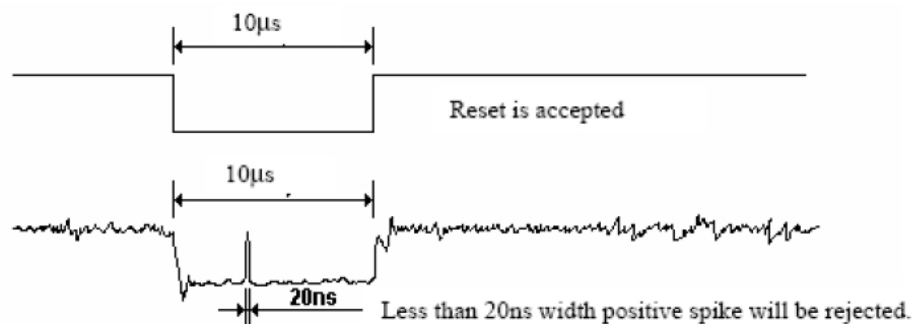
Note 1: The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NV memory to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.

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

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 10us	Reset
Between 5us and 10us	Reset starts

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

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



Note 5: When Reset applied during Sleep In Mode.

Note 6: When Reset applied during Sleep Out Mode.

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

7. CTP Specification

7.1 Electrical Characteristics

7.1.1 Absolute Maximum Rating

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	°C	-
Storage Temperature	T _{ST}	-30	+80	°C	-

NOTES:

- If used beyond the absolute maximum ratings, FT6336G 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.

7.1.2 DC Electrical Characteristics (Ta=25°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
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	-	uA
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

7.2 CTP AC Characteristics

Table 4-1 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	

Table 4-2 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	

7.2.1 I2C Interface

The I2C is always configured in the Slave mode. The data transfer format is shown in Figure4-1:

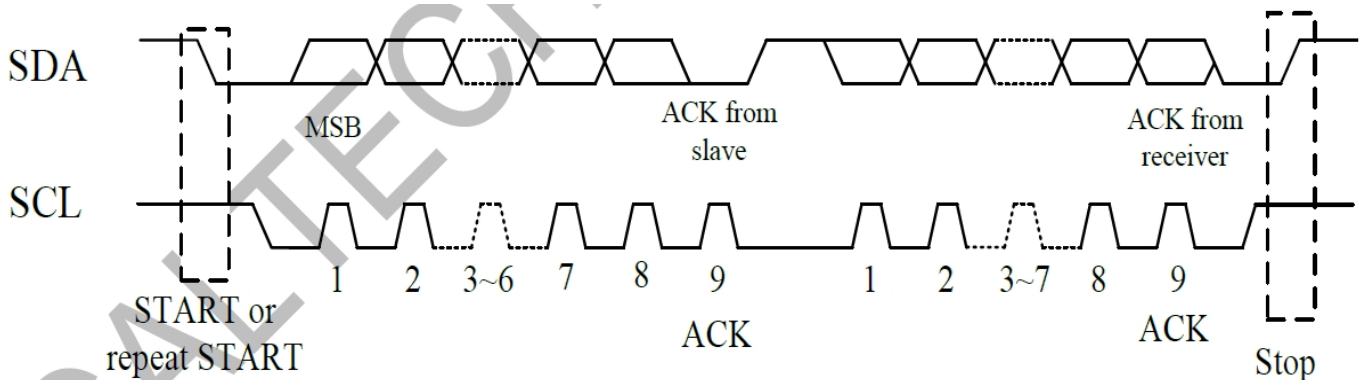


Figure 4-1 I2C Serial Data Transfer Format

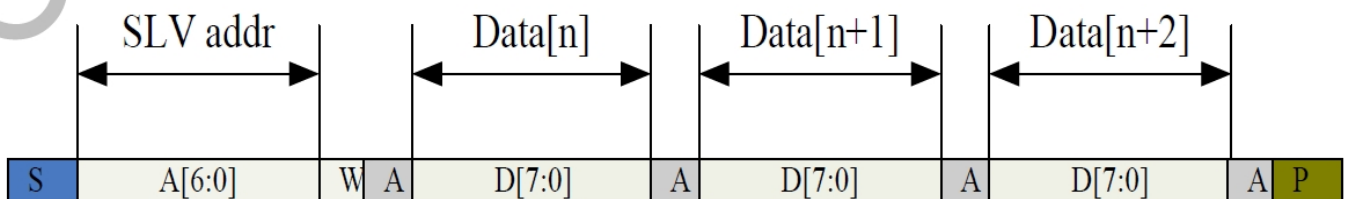


Figure 4-2 I2C master write, slave read

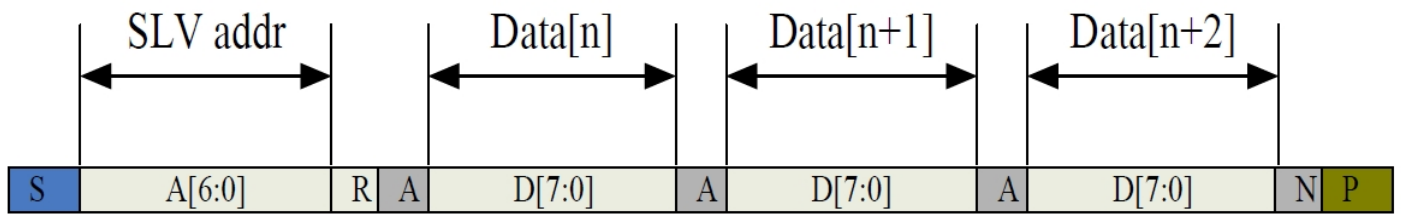


Figure 4-3 I2C master read, slave write

Table4-3 lists the meanings of the mnemonics used in the above figures.

Table 4-3 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 packet and the beginning of the next packet)

I2C Slave address is 0x38.

I2C Interface Timing Characteristics is shown in Table4-4.

Table 4-4 I2C 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

8 LCD Module Out-Going Quality Level

8.1 VISUAL & FUNCTION INSPECTION STANDARD

8.1.1 Inspection conditions

Inspection performed under the following conditions is recommended.

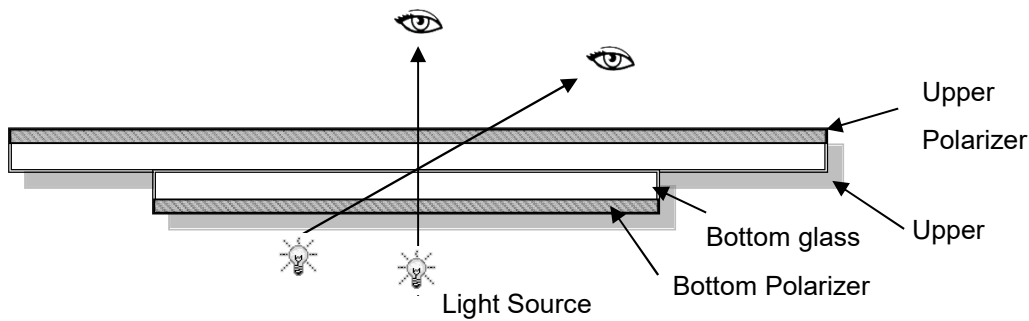
Temperature: 25°C ± 5°C

Humidity: 65% ± 10%RH

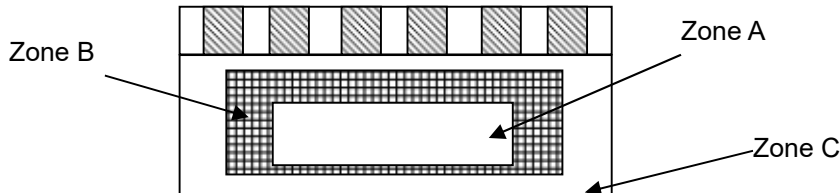
Viewing Angle: Normal viewing Angle.

Illumination: Single fluorescent lamp (300 to 700Lux)

Viewing distance: 30-50cm



8.1.2 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) which can not be seen after assembly by customer .)

Note:

As a general rule ,visual defects in Zone C can be ignored when it doesn't effect product function or appearance after assembly by customer.

8.1.3 Sampling Plan

According to GB/T 2828-2012; , normal inspection, Class II

AQL:

Major defect	Minor defect
0.65	1.5

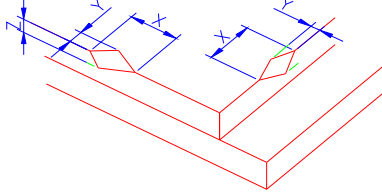
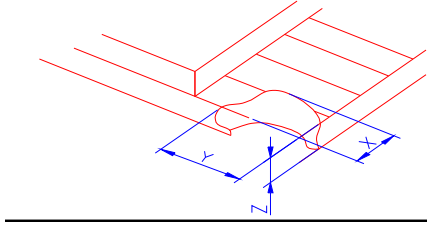
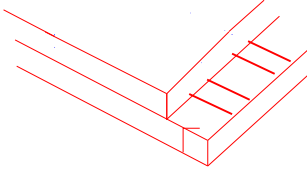
LCD: Liquid Crystal Display, LCM: Liquid Crystal Module, CTP: Capacitive Touch Panel

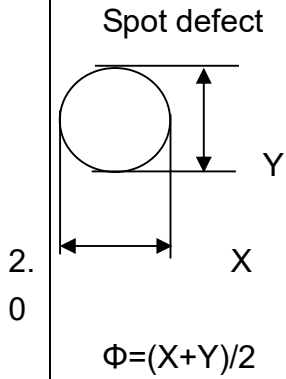
No	Items to be inspected	Criteria	Classification of defects
1	Functional defects	1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting. etc	Major
2	Missing	Missing components and etc	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed, deformation and etc	
4	Color tone	Color unevenness, refer to limited sample	Minor
5	Spot/Line defect	Light dot, Dim spot, (Note1) 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.	

Note1:

- 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.

8.1.4 Criteria (Visual)

Number	Items	Criteria(mm)						
1.0 LCD Crack/Broken NOTE: X: Length Y: Width Z: Height L: Length of ITO, T: Height of LCD	(1) The edge of LCD broken	 <table border="1" data-bbox="754 651 1457 801"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td><Inner border line of the seal</td> <td>≤T</td> </tr> </tbody> </table>	X	Y	Z	≤3.0mm	<Inner border line of the seal	≤T
	X	Y	Z					
	≤3.0mm	<Inner border line of the seal	≤T					
(2)LCD corner broken	 <table border="1" data-bbox="834 1111 1377 1211"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td>≤L</td> <td>≤T</td> </tr> </tbody> </table>	X	Y	Z	≤3.0mm	≤L	≤T	
X	Y	Z						
≤3.0mm	≤L	≤T						
(3) LCD crack	 <p style="text-align: center;">Crack Not allowed</p>							



2.
0

① light dot (black/white spot , pinhole, stain, etc.)

Zone Size (mm)	Acceptable Qty		
	A	B	C
$\Phi \leq 0.15$	Ignore		Ignore
$0.15 < \Phi \leq 0.25$	3(distance ≥ 6 mm)		
$0.25 < \Phi \leq 0.4$	2(distance ≥ 6 mm)		
$\Phi > 0.4$	0		

② Dim spot (light leakage, dent, dark spot, etc)

Zone Size (mm)	Acceptable Qty		
	A	B	C
$\Phi \leq 0.15$	Ignore		Ignore
$0.15 < \Phi \leq 0.25$	3(distance ≥ 6 mm)		
$0.25 < \Phi \leq 0.4$	2(distance ≥ 6 mm)		
$\Phi > 0.4$	0		


③ Polarizer accidented spot

Zone Size (mm)	Acceptable Qty		
	A	B	C
$\Phi \leq 0.2$	Ignore		Ignore
$0.2 < \Phi \leq 0.5$	2(distance ≥ 6 mm)		
$\Phi > 0.5$	0		

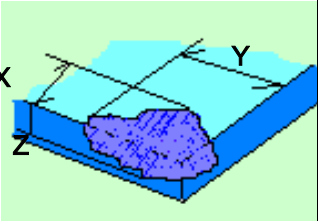
④ Polarizer Bubble

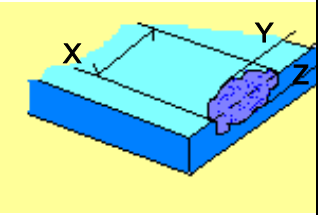
Zone Size (mm)	Acceptable Qty		
	A	B	C
$\Phi \leq 0.2$	Ignore		Ignore
$0.2 < \Phi \leq 0.4$	3(distance ≥ 6 mm)		
$\Phi > 0.4$	0		

<p>3. 0</p>	<p>LCD Pixel defect</p>	<p>Pixel bad points</p> <table border="1" data-bbox="539 293 1497 1041"> <thead> <tr> <th data-bbox="539 293 730 344">Item</th> <th data-bbox="730 293 1246 344">Zone A</th> <th data-bbox="1246 293 1497 344">Acceptable</th> </tr> </thead> <tbody> <tr> <td data-bbox="539 344 730 506" rowspan="3">Bright dot</td> <td data-bbox="730 344 1246 398">Random</td> <td data-bbox="1246 344 1497 398">N≤2</td> </tr> <tr> <td data-bbox="730 398 1246 452">2 dots adjacent</td> <td data-bbox="1246 398 1497 452">N≤0</td> </tr> <tr> <td data-bbox="730 452 1246 506">3 dots adjacent</td> <td data-bbox="1246 452 1497 506">N≤0</td> </tr> <tr> <td data-bbox="539 506 730 674" rowspan="3">Dark dot</td> <td data-bbox="730 506 1246 560">Random</td> <td data-bbox="1246 506 1497 560">N≤2</td> </tr> <tr> <td data-bbox="730 560 1246 613">2 dots adjacent</td> <td data-bbox="1246 560 1497 613">N≤0</td> </tr> <tr> <td data-bbox="730 613 1246 674">3 dots adjacent</td> <td data-bbox="1246 613 1497 674">N≤0</td> </tr> <tr> <td data-bbox="539 674 730 983">Distance</td> <td data-bbox="730 674 1246 983"> 1. Minimum Distance Between Bright dots. 2. Minimum Distance Between dark dots 3. Minimum Distance Between dark and bright dot. </td> <td data-bbox="1246 674 1497 983">5mm</td> </tr> <tr> <td colspan="2" data-bbox="539 983 1246 1041">Total bright and dark dot</td> <td data-bbox="1246 983 1497 1041">N≤4</td> </tr> </tbody> </table> <p data-bbox="571 1048 655 1081">Note:</p> <p data-bbox="523 1104 1469 1193">A) Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.</p> <p data-bbox="523 1211 1493 1301">B) Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue picture.</p> <p data-bbox="523 1355 1019 1393">C) 2 dot adjacent = 1 pair = 2 dots</p> <p data-bbox="571 1404 687 1440">Picture:</p> <div data-bbox="703 1491 778 1552"> </div> <p data-bbox="571 1597 780 1632">2 dot adjacent</p> <div data-bbox="1110 1491 1225 1552"> </div> <p data-bbox="1018 1597 1225 1632">2 dot adjacent</p> <div data-bbox="711 1659 754 1771"> </div> <p data-bbox="571 1787 911 1823">2 dot adjacent (vertical)</p> <div data-bbox="1118 1659 1302 1771"> </div> <p data-bbox="1050 1787 1358 1823">2 dot adjacent (slant)</p>	Item	Zone A	Acceptable	Bright dot	Random	N≤2	2 dots adjacent	N≤0	3 dots adjacent	N≤0	Dark dot	Random	N≤2	2 dots adjacent	N≤0	3 dots adjacent	N≤0	Distance	1. Minimum Distance Between Bright dots. 2. Minimum Distance Between dark dots 3. Minimum Distance Between dark and bright dot.	5mm	Total bright and dark dot		N≤4
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Distance	1. Minimum Distance Between Bright dots. 2. Minimum Distance Between dark dots 3. Minimum Distance Between dark and bright dot.	5mm																							
Total bright and dark dot		N≤4																							

4.0	Line defect (LCD /Polarizer backlight black/white line, scratch, stain)  W: width, L : length N : Count	<table border="1"> <thead> <tr> <th rowspan="2">Width(mm)</th> <th rowspan="2">Length (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.03$</td> <td>Ignore</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.03 < W \leq 0.04$</td> <td>$L \leq 3.0$</td> <td colspan="3">$N \leq 2$</td> </tr> <tr> <td>$0.04 < W \leq 0.05$</td> <td>$L \leq 2.0$</td> <td colspan="3">$N \leq 1$</td> </tr> <tr> <td>$W > 0.05$</td> <td colspan="4">Define as spot defect</td> </tr> </tbody> </table>	Width(mm)	Length (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.03$	Ignore	Ignore			$0.03 < W \leq 0.04$	$L \leq 3.0$	$N \leq 2$			$0.04 < W \leq 0.05$	$L \leq 2.0$	$N \leq 1$			$W > 0.05$	Define as spot defect			
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$0.04 < W \leq 0.05$	$L \leq 2.0$	$N \leq 1$																												
$W > 0.05$	Define as spot defect																													
5.0	Electronic Components SMT.	Not allow missing parts, solderless connection, cold solder joint, mismatch, The positive and negative polarity opposite																												
6.0	Display color& Brightness.	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.																												
7.0	LCD Mura/Waving / Hot spot	Not visible through 5% ND filter in 50% gray or judge by limit sample if necessary.																												

8.0	CTP Related	CTP Cover sensor accident black/white spot	<table border="1"> <thead> <tr> <th rowspan="2">Size Φ(mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.1$</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.1 < \Phi \leq 0.2$</td> <td colspan="3">0 (distance $> 0.5mm$)</td> </tr> <tr> <td>$0.20 < \Phi \leq 0.25$</td> <td colspan="3">0 (distance $> 0.5mm$)</td> </tr> <tr> <td>$\Phi > 0.25$</td> <td colspan="3">0</td> </tr> </tbody> </table>	Size Φ (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.1$	Ignore			$0.1 < \Phi \leq 0.2$	0 (distance $> 0.5mm$)			$0.20 < \Phi \leq 0.25$	0 (distance $> 0.5mm$)			$\Phi > 0.25$	0		
			Size Φ (mm)		Acceptable Qty																					
				A	B	C																				
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		<p>CTP Cover scratch</p>	<table border="1"> <thead> <tr> <th rowspan="2">Width(mm)</th> <th rowspan="2">Ignore e(mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.03$</td> <td>Ignore</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.03 < W \leq 0.04$</td> <td>$L \leq 3.0$</td> <td colspan="3">$N \leq 2$</td> </tr> <tr> <td>$0.04 < W \leq 0.05$</td> <td>$L \leq 2.0$</td> <td colspan="3">$N \leq 1$</td> </tr> <tr> <td>$0.05 < W$</td> <td colspan="4">Define as spot defect</td> </tr> </tbody> </table>	Width(mm)	Ignore e(mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.03$	Ignore	Ignore			$0.03 < W \leq 0.04$	$L \leq 3.0$	$N \leq 2$			$0.04 < W \leq 0.05$	$L \leq 2.0$	$N \leq 1$			$0.05 < W$	Define as spot defect			
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$0.05 < W$	Define as spot defect																														
		<p>CTP Cover Pinhole/ Lack of ink</p>	<table border="1"> <thead> <tr> <th rowspan="2">Zone</th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td></td> <td>C</td> </tr> <tr> <td>$\Phi \leq 0.1$</td> <td>Ignore</td> </tr> <tr> <td>$0.1 < \Phi \leq 0.25$</td> <td>3(distance ≥ 6mm)</td> </tr> <tr> <td>$0.25 < \Phi \leq 0.3$</td> <td>2(distance ≥ 6mm)</td> </tr> <tr> <td>$\Phi > 0.3$</td> <td>0</td> </tr> </tbody> </table>	Zone	Acceptable Qty		C	$\Phi \leq 0.1$	Ignore	$0.1 < \Phi \leq 0.25$	3(distance ≥ 6 mm)	$0.25 < \Phi \leq 0.3$	2(distance ≥ 6 mm)	$\Phi > 0.3$	0																
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		<p>CTP Bonding bubble/ accidental spot</p>	<table border="1"> <thead> <tr> <th rowspan="2">Size Φ(mm)</th> <th colspan="2">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.1$</td> <td colspan="2">Ignore</td> </tr> <tr> <td>$0.1 < \Phi \leq 0.2$</td> <td colspan="2">3(distance ≥ 6mm)</td> </tr> <tr> <td>$0.2 < \Phi \leq 0.25$</td> <td colspan="2">2(distance ≥ 6mm)</td> </tr> <tr> <td>$\Phi > 0.25$</td> <td colspan="2">0</td> </tr> </tbody> </table>	Size Φ (mm)	Acceptable Qty		A	B	$\Phi \leq 0.1$	Ignore		$0.1 < \Phi \leq 0.2$	3(distance ≥ 6 mm)		$0.2 < \Phi \leq 0.25$	2(distance ≥ 6 mm)		$\Phi > 0.25$	0												
Size Φ (mm)	Acceptable Qty																														
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$\Phi > 0.25$	0																														
		<p>Assembly deflection</p>	<p>beyond the edge of backlight ≤ 0.2mm</p>																												
		<p>CTP cover broken</p> <p>X : length</p> <p>Y : width</p> <p>Z : height</p>	<table border="1"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>$X \leq 0.5$mm</td> <td>$Y \leq 0.5$mm</td> <td>$Z < \text{cover thickness}$</td> </tr> </tbody> </table> <p>* Circuitry broken is not allowed.</p> 	X	Y	Z	$X \leq 0.5$ mm	$Y \leq 0.5$ mm	$Z < \text{cover thickness}$																						
X	Y	Z																													
$X \leq 0.5$ mm	$Y \leq 0.5$ mm	$Z < \text{cover thickness}$																													

		CTP cover broken	X	Y	Z	
			X ≤ 0.3mm	Y ≤ 0.3mm	Z < cover thickness	
		X : length				
		Y : width				
		Z : height				
			* Circuitry broken is not allowed.			

Criteria (functional items)

Number	Items	Criteria (mm)
1	No display	Not allowed
2	Missing segment	Not allowed
3	Short	Not allowed
4	Backlight no lighting	Not allowed
5	CTP no function	Not allowed

9. Reliability Test Result

Remark:

Item	Condition	Inspection after test
High Temperature	70°C,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 Operating	-20°C, 96HR	
High Temperature Storage	80°C, 96HR	
Low Temperature Storage	-30°C, 96HR	
High Temperature & High Humidity Operating	+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)	

1. The test samples should be applied to only one test item.
2. Sample size for each test item is 5~10pcs.
3. For Damp Proof Test, Pure water(Resistance > 10MΩ) should be used.
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.
5. Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.
6. The color fading mura of polarizing filter should not care.

10. Cautions and Handling Precautions

10.1 Handling and Operating the Module

- (1) When the module is assembled, it should be attached to the system firmly.
Do not warp or twist the module during assembly work.
- (2) Protect the module from physical shock or any force. In addition to damage, this may cause improper operation or damage to the module and back-light unit.
- (3) Note that polarizer is very fragile and could be easily damaged. Do not press or scratch the surface.
- (4) Do not allow drops of water or chemicals to remain on the display surface.
If you have the droplets for a long time, staining and discoloration may occur.
- (5) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (6) The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane.
Do not use ketene type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs, or clothes, it must be washed away thoroughly with soap.
- (8) Protect the module from static; it may cause damage to the CMOS ICs.
- (9) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (10) Do not disassemble the module.
- (11) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (12) Pins of I/F connector shall not be touched directly with bare hands.
- (13) Do not connect, disconnect the module in the "Power ON" condition.
- (14) Power supply should always be turned on/off by the item 6.1 Power On Sequence & 6.2 Power Off Sequence

10.2 Storage and Transportation.

- (1) Do not leave the panel in high temperature, and high humidity for a long time.
It is highly recommended to store the module with temperature from 0 to 35°C and relative humidity of less than 70%
- (2) Do not store the TFT-LCD module in direct sunlight.
- (3) The module shall be stored in a dark place. When storing the modules for a long time, be sure to adopt effective measures for protecting the modules from strong ultraviolet radiation, sunlight, or fluorescent light.
- (4) It is recommended that the modules should be stored under a condition where no condensation is allowed. Formation of dewdrops may cause an abnormal operation or a failure of the module.
In particular, the greatest possible care should be taken to prevent any module from being operated where condensation has occurred inside.
- (5) This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.