CRYSTAL CLEAR TECHNOLOGY

Product Specification

T240A06X00

(REVISION 2)

Crystal Clear Technology Sdn. Bhd.
16 Jalan TP5, Taman Perindustrian Sime UEP,
47600 Subang Jaya, Selangor DE
Tel: +603-80247099
Website: www.cct.com.my

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	1. Capacitive Touch Panel Specification	

2.0 Records of Revision

Rev	Date	Item	Page	Comment	Originator	Checked By
1.0	25.07.17			Initial Release	SCChong	Azhar
2.0	30.11.17	3	4	Add pixel pitch		
		5.2	6	Change backlight specification and brightness		
				Add Attachment – CTP Spec	Azhar	Azhar

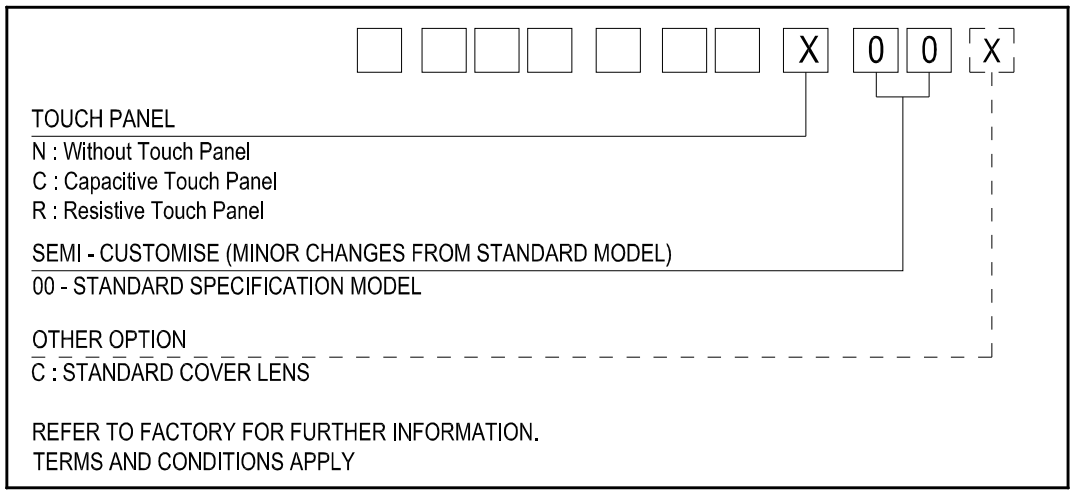
3.0 General Specification

T240A06X00 is 2.4” color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, driver ICs control circuit and LED backlight. This product compliant with RoHS environmental requirement.

Item	Contents	Unit	Note
LCD Type	2.4” TFT	-	
Display color	16.7M		1
Viewing Direction (Optimum View)	All	O ’Clock	
Module size	42.72 x 59.46 x 2.36	mm	2
Active Area(W×H)	36.72 x 48.96	mm	
Number of Dots	240(RGB)×320	dots	
Pixel pitch	0.153 x 0.153	mm	
Contrast Ratio	800 : 1	-	
Controller	ST7789V	-	
Backlight	4 White LEDs	pcs	
Brightness	350	cd/m2	
Interface Mode	MCU 8-bit / 3-SPI / 4 SPI	-	
Surface Finishing	Hard Coating	-	

Note1: Color tone is slightly changed by temperature and driving voltage.
Note2: FPC or wire are not included.
Note3: Brightness on LCD surface. Module with CTP or RTP, brightness will be about 20% (max) lower on the touch panel surface.

AVAILABLE OPTION



4.0 Absolute Maximum Ratings

4.1 Electrical Absolute Maximum ratings (Vss = 0V, Ta = 25°C)

Item	Symbol	Min.	Max.	Unit	Note
Power Supply	VDD	-0.3	4.6	V	1, 2
Digital Input Voltage	VDDIO	-0.3	4.6	V	
Humidity	-	-	90	%RH	

Notes:

1. If the module is above these absolute maximum ratings. It may become permanently damaged.
2. V_{CC} >V_{SS} must be maintained.
3. Please be sure users are grounded when handing LCD Module.

4.2 Environmental Absolute Maximum Ratings

Item	Storage		Operating		Note
	MIN.	MAX.	MIN.	MAX.	
Ambient Temperature	-30℃	80℃	-20℃	70℃	1,2
Humidity	-	-	-	-	3

1. The response time will become lower when operated at low temperature.
2. Background color changes slightly depending on ambient temperature. The phenomenon is reversible.
3. Ta<=40°C and 85%RH MAX.
   (Ta>=40°C. Absolute humidity must be lower than the humidity of 85%RH at 40°C)

5.0 Electrical Characteristics and Instruction Code

5.1 Electrical Characteristics (Vss = 0V, Ta = 25°C)

a. Typical operating condition

Parameter		Symbol	Min	Typ	Max	Unit	Note
Supply Voltage		VDD	2.6	2.8	3.3	V	
Interface Operation Voltage		VDDIO	1.65	1.8	3.3	V	
Digital Input Voltage	H level	V_{IH}	0.7VDDIO	-	VDDIO	V	
	L level	V_{IL}	VSS	-	0.3VDDIO	V	
Digital output Voltage	H level	V_{OH}	0.8VDDIO	-	VDDIO	V	
	L level	V_{OL}	VSS	-	0.2VDDIO	V	

b. Current Consumption

Parameter	Symbol	Condition	Typ	Max.	Unit	Remarks
Current for FOG	IDD	VDD=3.3V	TBD	TBD	mA	
Current for LCM	PIBB	PVDD1=3.3V	TBD	TBD	mA	

5.2 LED Backlight Specification (Vss = 0V, Ta = 25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Supply Voltage	V_{LED}	-	2.8	-	3.4	V	1
Supply Current	If	-	-	100	-	mA	2
Led lifetime			50000				3

Note:
1. V_{LED}=V_{LED} (+)-V_{LED} (-).
2. It is recommended that customer supply constant current to prolong the led lifetime and optimum led performance
3. Definition of Lifetime: Luminance < 50% of initial Luminance
   (Test condition: Ta = 25ºC, Constant current supply (typical Value))

5.3 Interface Signal

Pin No.	Symbol	I/O	Function
1	NC		No Connection
2	VLED-	P	LED back light(Cathode)
3	VLED+	P	LED back light(Anode)
4	IM0	I	The MCU interface mode select
5	IM1	I	The MCU interface mode select
6	IM2	I	The MCU interface mode select
7	VDD	P	Power Supply
8	VDDIO	P	Interface Operating Voltage
9	TE	O	Tearing effect signal is used to synchronize MCU to frame memory
10	SDA	I/O	SPI interface input/output pin If not used, please fix this pins at VDDIO or GND
11	CS	I	Chip select pin
12	RESET	I	Reset pin
13	RS/SCL	I	Display data/command selection pin in parallel interface Used to be serial interface clock
14	WR	I	Write enable in MCU parallel interface If not used, please fix this pins at VDDIO or GND
15	RD	I	Read enable in parallel interface If not used, please fix this pins at VDDIO or GND
16 -23	D7 – D0	I/O	DB[7:0] are used as MCU parallel interface data bus If not used, please fix this pins at VDDIO or GND
24	GND	P	Ground

The MCU interface mode select:

IM2	IM1	IM0	MCU Interface Mode
0	0	0	8080 8-bit parallel
1	0	1	3-line 9-bit
1	1	0	4-line 8-bit

6.0 Optical Characteristics

The following items are measured under stable conditions. The optical characteristics should be measured in dark room or equivalent state with the methods shown in Note 1, Note2 and Note3.

Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
Response time		T_R	Θ=0	-	20	30	ms	Note 4,6
		T_F		-	10	15	ms	
Contrast ratio		CR	At optimized viewing angle	-	800	-	-	Note 5,6
Viewing Angle	Hor.	$Θ_R$	CR≧ 10	-	85	-	Degree	Note 6,7
		$Θ_L$		-	85	-		
	Ver.	$φ_H$		-	85	-		
		$φ_L$		-	85	-		
White Chromaticity shift		X	Θ=0	0.25	0.29	0.32	-	
		Y		0.24	0.28	0.32		
Brightness			Θ=0	200	250			

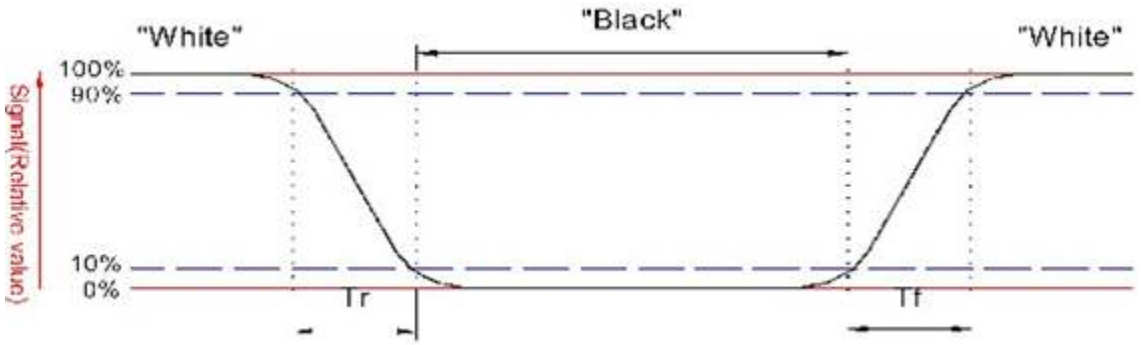
Note1: Ambient temperature=25℃

Note2: To be measured in the dark room.

Note3: To be measured on the center area of panel with a field angle of 1℃ by Topcon luminance meter BM-7, after 10 minutes operation.

Note4: Definition of response time:

The output signals of photo detector are measured when the input signals are changed from “black” to” white” (falling time) and from “white” to” black” (rising time),respectively. The response time is defined as the time interval between the 10％ and 90％ of amplitudes. Refer to figure as below.



Note5: Definition of contrast ratio:

Contrast ratio is calculated with the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Brightness measured when LCD is at “white state”}}{\text{Brightness measured when LCD is at “black state”}}$$

Note6: White Vi = $\overline{Vi50}$ +1.5V

Black Vi = Vi50 ± 2.0V

“±”means that the analog input signal swings in phase with COM signal.

“+”means that the analog input signal swings out of phase with COM signal.

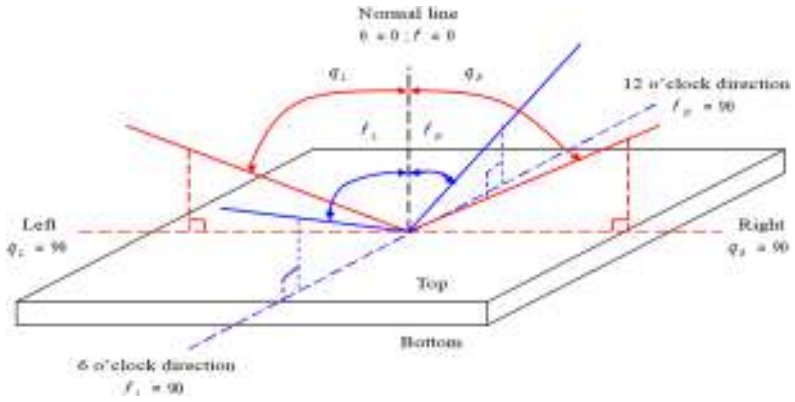
Vi50: The analog input voltage when transmission is 50％

The 100％ transmission is defined as the transmission of LCD panel when all

The input terminals of module are electrically opened.

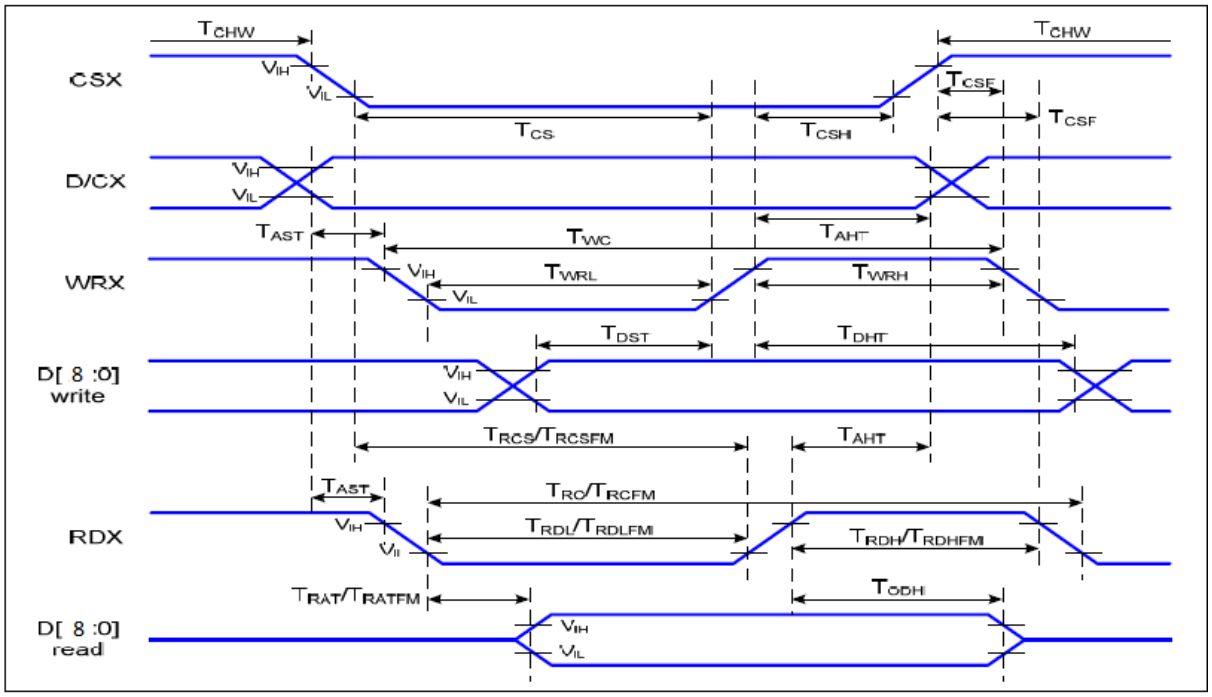
Note7: Definition of viewing angle:

Refer to figure as below.



7.0 AC Characteristics

7.1 8080 Series MCU Parallel Interface Characteristics: 8-bit Bus



VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta= -30 to 70 ℃

Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	T_{AST}	Address setup time	0		ns	-
	T_{AHT}	Address hold time (Write/Read)	10		ns	
CSX	T_{CHW}	Chip select "H" pulse width	0		ns	-
	T_{CS}	Chip select setup time (Write)	15		ns	
	T_{RCS}	Chip select setup time (Read ID)	45		ns	
	T_{RCSFM}	Chip select setup time (Read FM)	355		ns	
	T_{CSF}	Chip select wait time (Write/Read)	10		ns	
	T_{CSH}	Chip select hold time	10		ns	
WRX	T_{WC}	Write cycle	66		ns	
	T_{WRH}	Control pulse "H" duration	15		ns	
	T_{WRL}	Control pulse "L" duration	15		ns	
RDX (ID)	T_{RC}	Read cycle (ID)	160		ns	When read ID data
	T_{RDH}	Control pulse "H" duration (ID)	90		ns	
	T_{RDL}	Control pulse "L" duration (ID)	45		ns	
RDX (FM)	T_{RCFM}	Read cycle (FM)	450		ns	When read from frame memory
	T_{RDHFM}	Control pulse "H" duration (FM)	90		ns	
	T_{RDLFM}	Control pulse "L" duration (FM)	355		ns	
D[8 :0]	T_{DST}	Data setup time	10		ns	For CL=30pF

	T_{DHT}	Data hold time	10		ns	
	T_{RAT}	Read access time (ID)		40	ns	
	T_{RATFM}	Read access time (FM)		340	ns	
	T_{ODH}	Output disable time	20	80	ns	

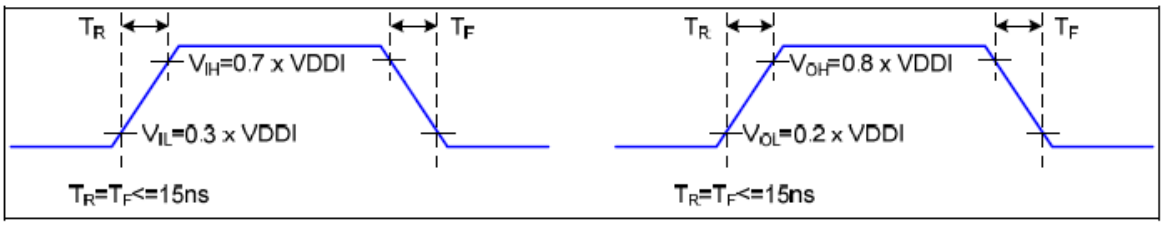


Figure Rising and Falling Timing for I/O Signal

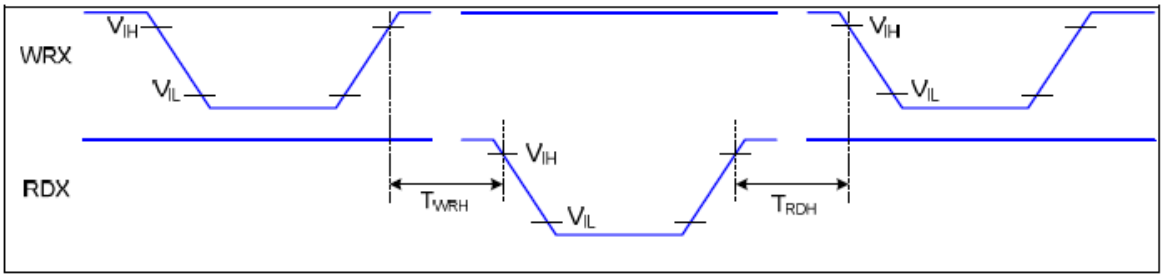
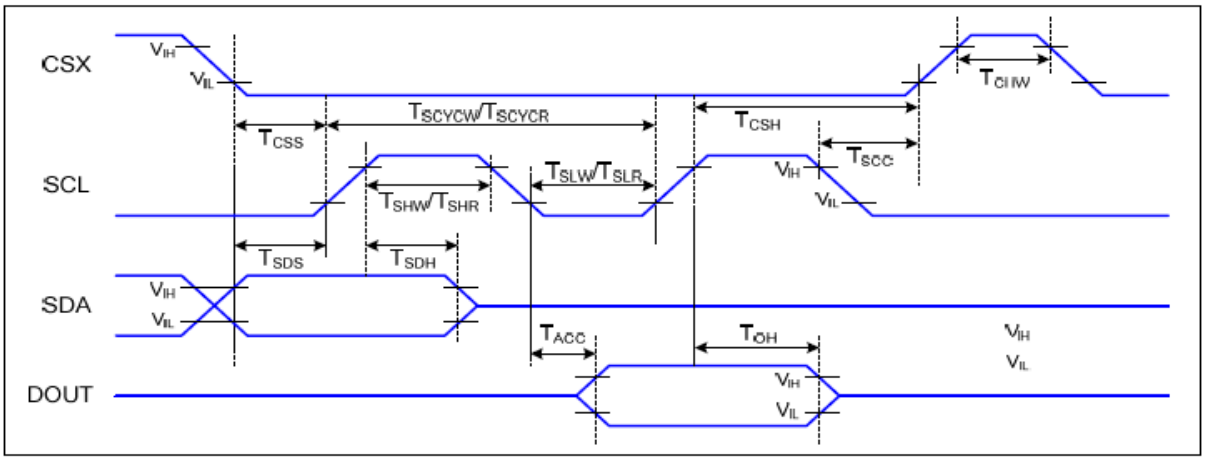


Figure Write-to-Read and Read-to-Write Timing

Note: The rising time and falling time (Tr, Tf) of input signal and fall time are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

7.2 Serial Interface Characteristics (3-line serial)



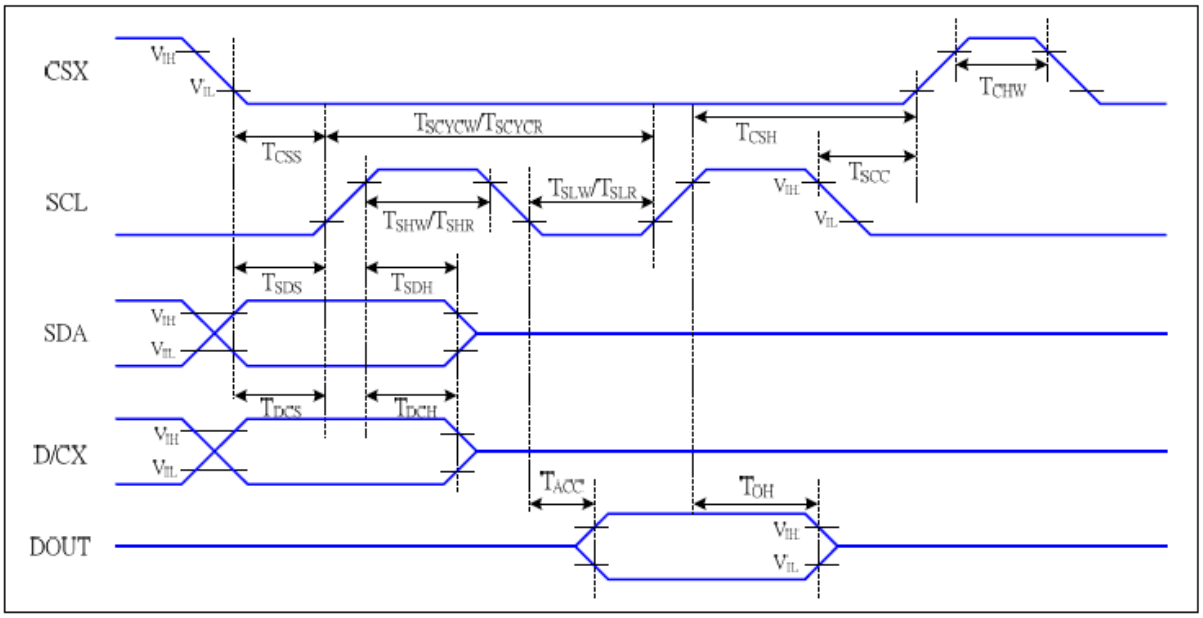
VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=-30 to 70 ℃

Signal	Symbol	Parameter	Min	Max	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (write)	15		ns	
	T_{CSS}	Chip select setup time (read)	60		ns	
	T_{SCC}	Chip select hold time (read)	65		ns	
	T_{CHW}	Chip select "H" pulse width	40		ns	
SCL	T_{SCYCW}	Serial clock cycle (Write)	66		ns	
	T_{SHW}	SCL "H" pulse width (Write)	15		ns	
	T_{SLW}	SCL "L" pulse width (Write)	15		ns	
	T_{SCYCR}	Serial clock cycle (Read)	150		ns	
	T_{SHR}	SCL "H" pulse width (Read)	60		ns	
	T_{SLR}	SCL "L" pulse width (Read)	60		ns	
SDA (DIN)	T_{SDS}	Data setup time	10		ns	
	T_{SDH}	Data hold time	10		ns	
DOUT	T_{ACC}	Access time	10	50	ns	For maximum CL=30pF
	T_{OH}	Output disable time	15	50	ns	For minimum CL=8pF

Table 5 3-line serial Interface Characteristics

Note : The rising time and falling time (Tr, Tf) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

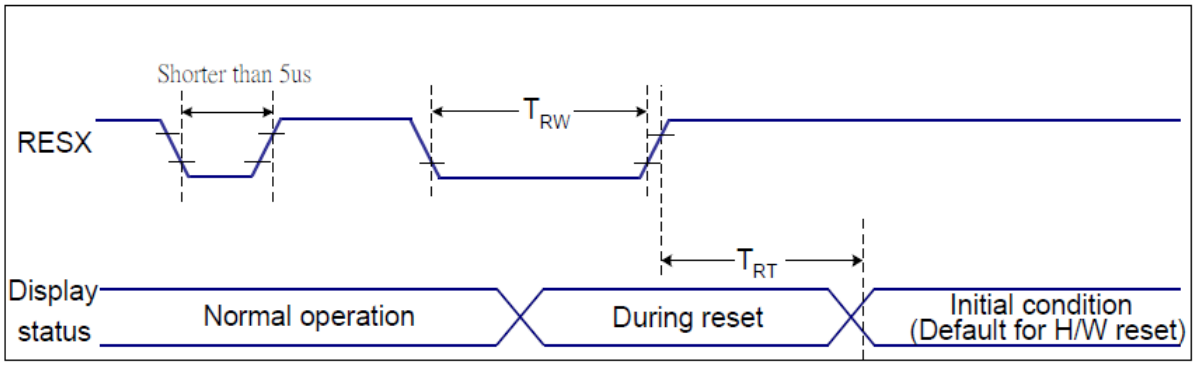
7.3 Serial Interface Characteristics (4-line serial)



VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=-30 to 70 ℃

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (write)	15		ns	
	T_{CSS}	Chip select setup time (read)	60		ns	
	T_{SCC}	Chip select hold time (read)	65		ns	
	T_{CHW}	Chip select "H" pulse width	40		ns	
SCL	T_{SCYCW}	Serial clock cycle (Write)	66		ns	-write command & data ram
	T_{SHW}	SCL "H" pulse width (Write)	15		ns	
	T_{SLW}	SCL "L" pulse width (Write)	15		ns	
	T_{SCYCR}	Serial clock cycle (Read)	150		ns	-read command & data ram
	T_{SHR}	SCL "H" pulse width (Read)	60		ns	
	T_{SLR}	SCL "L" pulse width (Read)	60		ns	
D/CX	T_{DCS}	D/CX setup time	10		ns	
	T_{DCH}	D/CX hold time	10		ns	
SDA (DIN)	T_{SDS}	Data setup time	10		ns	
	T_{SDH}	Data hold time	10		ns	
DOUT	T_{ACC}	Access time	10	50	ns	For maximum CL=30pF
	T_{OH}	Output disable time	15	50	ns	For minimum CL=8pF

7.4 Reset Timing



VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=-30 – 70

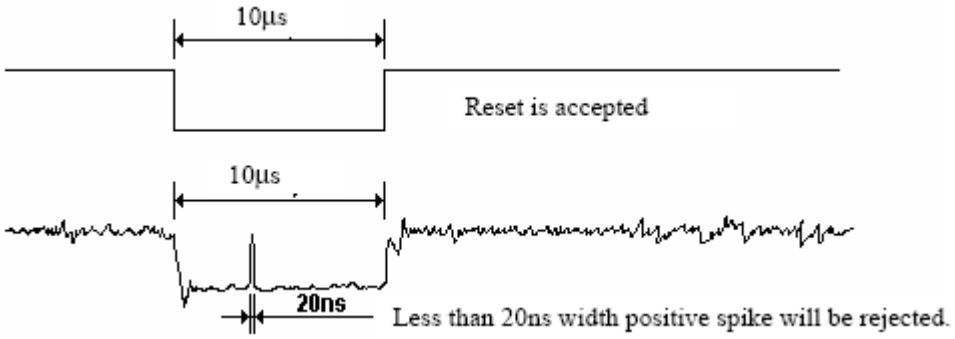
Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1, 5)	ms
				120 (Note 1, 6, 7)	ms

Notes:

1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other setting from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) whithin 5ms after arising edge of RESX.
2. Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below:

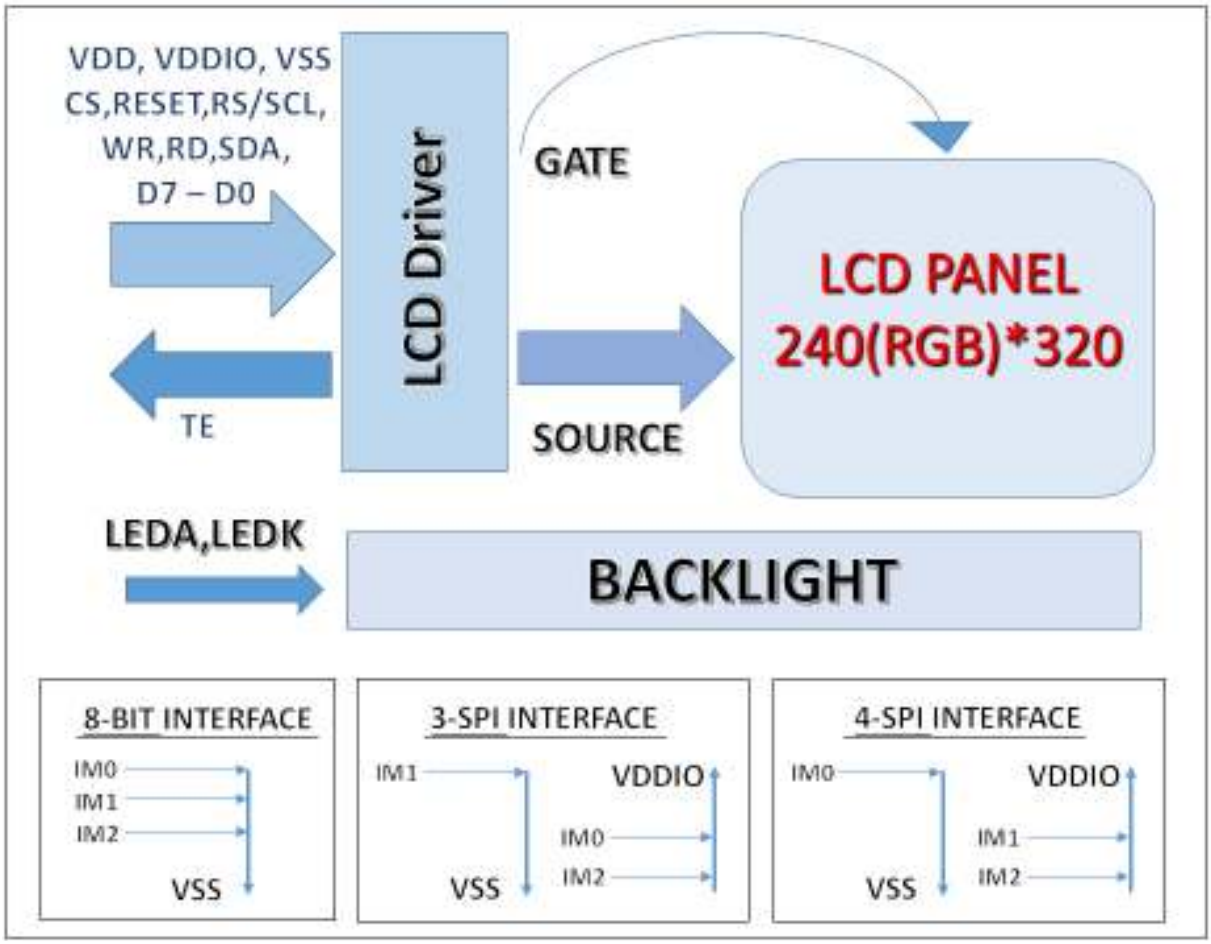
RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9us	Reset starts

3. During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120ms, when Reset Starts in Sleep Out-mode. The display remains the blank state in Sleep In-mode.) and then return to default condition for Hardware Reset.
4. Spike Rejection also applies during a valid reset pulses as shown below:



5. When Reset applied during Sleep In Mode.
6. When Reset applied during Sleep Out Mode.
7. It is necessary to wait 5ms after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120ms.

8.0 Block Diagram

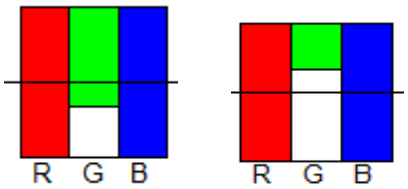


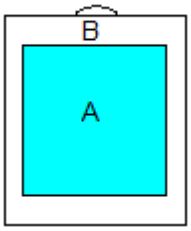
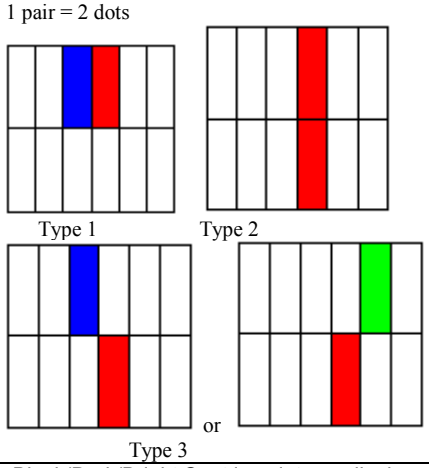
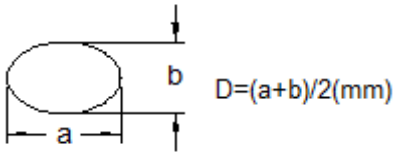
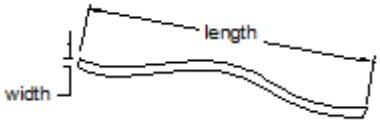
9.0 Reliability Test Condition

Item		Test Condition
Operating	High Temperature	70degC, 240 hrs
	Low Temperature	-20degC,240 hrs
Storage	High Temperature	80degC, 240hrs and recovery for 2hrs
	Low Temperature	-30degC, 240hrs and recovery for 2hrs
	High Temperature and High Humidity	50degC, 90%RH, 240hrs and recovery for 2 hrs
Thermal	Cycle	RT → -30degC → Rt → 80degC → RT 0min 30min 5min 30min 5min 50 cycles (Power off)
	Shock	RT → -30degV → 80degC 0min 30min 30min 50 cycles (Power off)

Note: RT means Room temperature

10.0 Inspection Criteria

<table>
<tr><th>No</th><th>Defect</th><th>Definition of defect</th><th>Inspection Criteria</th></tr>
<tr><td rowspan="3">1</td><td>a) Definition of dot</td><td>The size of defective dot over ½ of whole is regards as one defective dot.
Smaller than ½ Larger than ½
 

'No dot defect' (ignore) '1 dot defect' (counted)</td><td>A – Viewing Area
B – Outside viewing area
 
</td></tr>
<tr><td>b) Bright Dot</td><td>Dot appear bright and unchanged in size when LCD panel is displaying black pattern</td><td rowspan="2"><table><tr><td>Defect</td><td>A</td><td>B</td></tr><tr><td>Bright Dot</td><td>1</td><td rowspan="3">NC</td></tr><tr><td>Dark Dot</td><td>2</td></tr><tr><td>Total</td><td>3</td></tr></table>NC – Not Count</td></tr>
<tr><td>c) Dark Dot</td><td>Dot appear dark and unchanged in size when LCD panel is displaying pure color (RED, GREEN or BLUE) pattern</td></tr>
<tr><td>d) 2 dot adjacent</td><td>1 pair = 2 dots
 
</td><td><table><tr><td>Defect</td><td>Acc. Count</td></tr><tr><td>2 Bright dot Adjacent</td><td>0</td></tr><tr><td>2 Dark dot Adjacent</td><td>1</td></tr></table></td></tr>
<tr><td>2</td><td>Black spot
White Spot
Bright spot
Pin Hole
Foreign Particle</td><td>-Black/Dark/Bright Spot is points on display which appear dark/bright and usually result from contamination
- These defect do not vary in size intensity (contrast) when contras is varied.
 
</td><td><table><tr><td>Defect Category</td><td>A</td><td>B</td></tr><tr><td>D ≤ 0.10</td><td>NC</td><td rowspan="4">NC</td></tr><tr><td>0.10 ≤ D ≤ 0.15</td><td>2</td></tr><tr><td>0.15 ≤ D ≤ 0.20</td><td>1</td></tr><tr><td>D ≥ 0.2</td><td>0</td></tr></table></td></tr>
<tr><td>3</td><td>Black Line
White line
Particle between POL and Glass
Scratch on Glass</td><td> 
</td><td><table><tr><td>Defect Category</td><td>A</td><td>B</td></tr><tr><td>W ≤ 0.03</td><td>NC</td><td rowspan="3">NC</td></tr><tr><td>0.03 ≤ W ≤ 0.05, L ≤2.0</td><td>2</td></tr><tr><td>W ≥ 0.05</td><td>0</td></tr></table></td></tr>
<tr><td>4</td><td>POL Bubble
POL Dented</td><td></td><td><table><tr><td>Defect Category</td><td>A</td><td>B</td></tr><tr><td>D ≤ 0.20</td><td>NC</td><td rowspan="4">NC</td></tr><tr><td>0.20 ≤ D ≤ 0.30</td><td>3</td></tr><tr><td>0.30 ≤ D ≤ 0.50</td><td>2</td></tr><tr><td>D ≥ 0.5</td><td>0</td></tr></table></td></tr>
<tr><td>5</td><td>Mura
(50% Grey)</td><td></td><td>Judged by Limit sample</td></tr>
</table>

11.0 Precaution and Limited Warranty

1. Handing Precautions
   a. The display panel is made of glass and polarizer. As glass is fragile. It tends to chip during handling especially on the edges. Please avoid dropping or jarring. Do not subject it to a mechanical shock of impact or by dropping it.
   b. If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance is in contact with your skin or clothes, wash it off using soap and water.
   c. Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary. Do not touch the display with bare hands. This will stain the display area and degrade the insulation between terminals. Scratch and dents may occur on polarizer too.
   d. The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully. Do not touch, push or rub the exposed polarizers with anything harder than a HB pencil lead (glass, tweezers, etc.). Do not put or attach anything on the display area to avoid leaving marks on it. Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizer. After products are tested at low temperature they must be warmed up in a container before coming in to contact with room temperature air.
   e. If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents
      - Isopropyl alcohol
      - Ethyl alcohol
      - Do not scrub hard to avoid damaging the display surface.
   f. Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.
      - Water
      - Ketone
      - Aromatic solvents
      - Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or colour fading. Avoid contact with oil and fats.
   g. Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.
   h. Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.
   i. Do not attempt to disassemble or process the LCD module.
   j. NC terminal should be open. Do not connect anything.
   k. If the logic circuit power is off, do not apply the input signals.
   l. Electro-Static Discharge Control. Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
      - Before removing LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential. Be sure to ground the body when handling the LCD modules.
      - Tools required for assembly, such as soldering irons, must be properly grounded. Make certain the AC power source for the soldering iron does not leak. When using an electric screwdriver to attach LCM, the screw driver should be of ground potentiality to minimize as much as possible any

transmission of electromagnetic waves produced sparks coming from the commutator of the motor.
- To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions. To reduce the generation of static electricity be careful that the air in the work environment is not too dry. A relative humidity of 50%-60% is recommended. As far as possible make the electric potential of your work clothes and that of the work bench the ground potential.
- The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

m. Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.
- Do not alter, modify or change the shape of the tab on the metal frame.
- Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
- Do not damage or modify the pattern writing on the printed circuit board.
- Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.
- Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
- Do not drop, bend or twist the LCM.

2. Storage Precautions

When storing the LCD modules, the following precaution are necessary.

a. Store them in a sealed polyethylene bag. If properly sealed, there is no need for the desiccant.
b. Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0□C and 35□C, and keep the relative humidity between 40%RH and 60%RH.
c. The polarizer surface should not come in contact with any other objects.

3. Others

a. Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.
b. If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.
c. To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc. Exercise care to avoid holding the following sections when handling the modules.

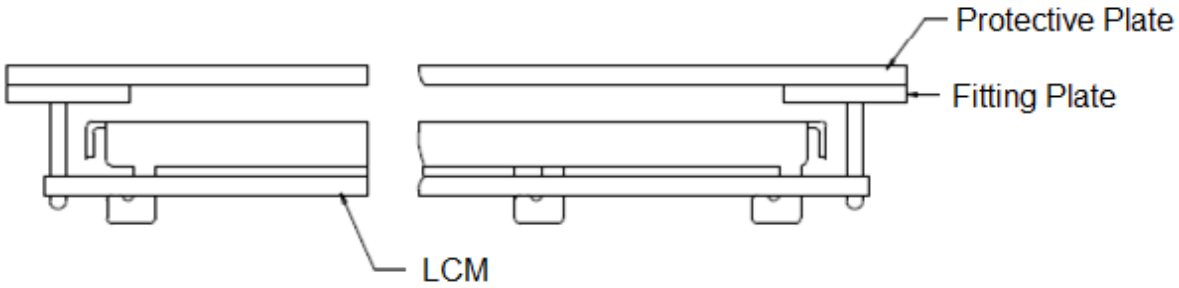
Exposed area of the printed circuit board.
Terminal electrode sections.

4. Using LCD Modules

a. Installing LCD Modules

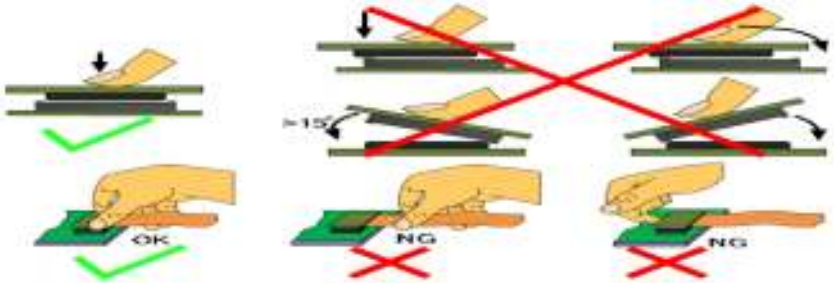
The hole in the printed circuit board is used to fix LCM as shown in the picture below.
Attend to the following items when installing the LCM.

b. Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



c. When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be 0.1mm.

d. Precaution for assemble the module with BTB connector:
Please note the position of the male and female connector position, don't assemble or assemble like the method which the following picture shows



5. Precaution for soldering the LCM

	Manual soldering	Machine drag soldering	Machine press soldering
No RoHS Product	290°C ~350°C. Time: 3-5S.	330°C ~350°C. Speed: 4-8 mm/s.	300°C ~330°C. Time: 3-6S. Press: 0.8~1.2Mpa
RoHS Product	340°C ~370°C. Time: 3-5S.	350°C ~370°C. Time: 4-8 mm/s.	330°C ~360°C. Time: 3-6S. Press: 0.8~1.2Mpa

a. If soldering flux is used, be sure to remove any remaining flux after finishing the soldering operation (This does not apply in the case of a non-halogen type of flux). It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.

b. When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.

c. When removing the electroluminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PC board could be damaged.

6. Precautions for Operation
   a. Viewing angle varies with the change of liquid crystal driving voltage (VLCD). Adjust VLCD to show the best contrast.
   b. It is recommended to drive LCD's within the specified voltage limit since over limit will cause shorter LCD life. An electrochemical reaction due to direct current causes LCD-deterioration. Avoid the use of direct current drive.
   c. Response time will be extremely delayed at lower temperature compared to room operating temperature range and on the other hand, at higher temperature LCD shows dark color in them. However those phenomena do not mean malfunction. The LCD will return to normal performance when ambient temperature revert to room condition.
   d. If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and on.
   e. A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit.
   f. Input logic voltage before apply analogue high voltage such as LCD driving voltage when power on. Remove analogue high voltage before logic voltage when power off the module. Input each signal after the positive/negative voltage becomes stable.
   g. Please keep the temperature within the specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.

7. Safety
   a. It is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.
   b. If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

8. Limited Warranty

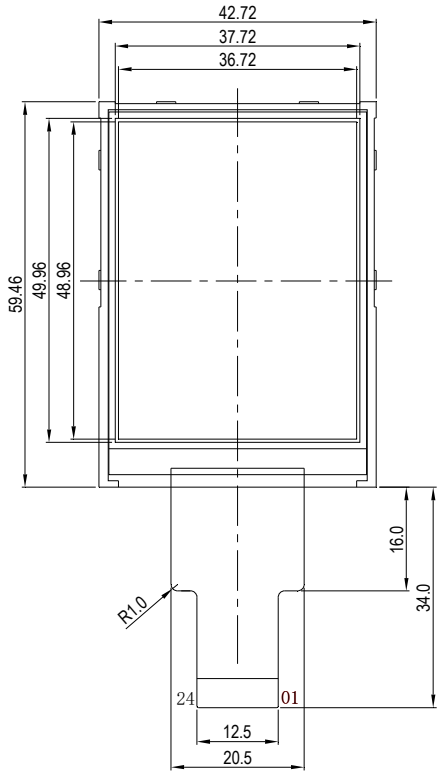
   Unless otherwise agreed between Crystal Clear Technology and customer, Crystal Clear Technology will replace or repair any of its LCD and LCM which is found to be defective electrically and visually when inspected in accordance with Crystal Clear Technology acceptance standards, for a period of one year from date of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of Crystal Clear Technology is limited to repair and/or replacement on the terms set forth above. Crystal Clear Technology will not responsible for any subsequent or consequential events.

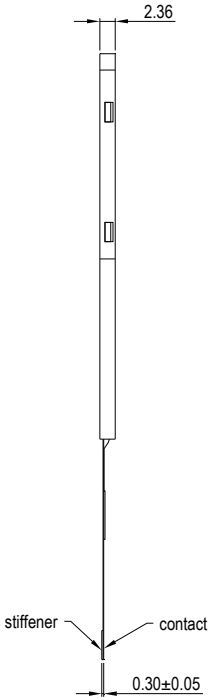
9. Return LCM under Warranty

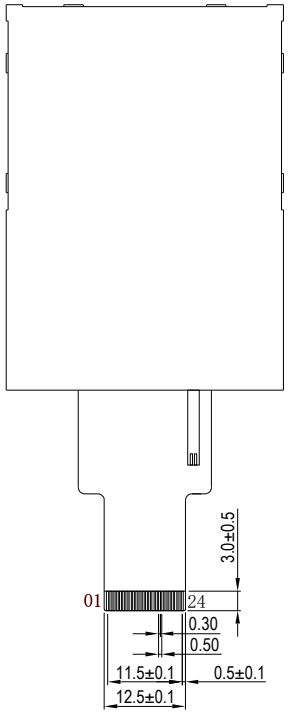
   No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are:
   - Broken LCD glass
   - PCB eyelet's damaged or modified
   - PCB conductors damaged
   - Circuit modified in any way, including addition of components.
   - PCB tampered with by grinding, engraving or painting varnish.
   - Soldering to, or modifying the bezel in any manner.

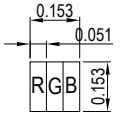
   Module repairs will be invoiced to customer upon mutual agreement. Modules must be returned with sufficient description of failure or defects. Any connectors or cable installed by customer must be removed completely without damaging the PCB eyelet's, conductors and terminals.

2 CHANGE BACKLIGHT CIRCUIT
AZHAR 30-11-2017

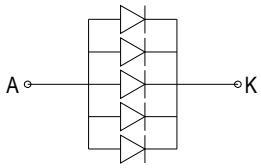








No:	PIN NAME
1	NC
2	LEDK
3	LEDA
4	IM0
5	IM1
6	IM2
7	VDD 2.8V
8	VDDIO 1.8V
9	TE
10	SDA
11	/CS
12	/RESET
13	RS/SCL
14	WR
15	RD
16	D7
17	D6
18	D5
19	D4
20	D3
21	D2
22	D1
23	D0
24	GND



BACKLIGHT CIRCUIT

NOTE:
1. GENERAL TOLERANCE TO BE ±0.3
2. OPERATING TEMPERATURE: -20°C TO +70°C
3. STORAGE TEMPERATURE : -30°C TO +80°C

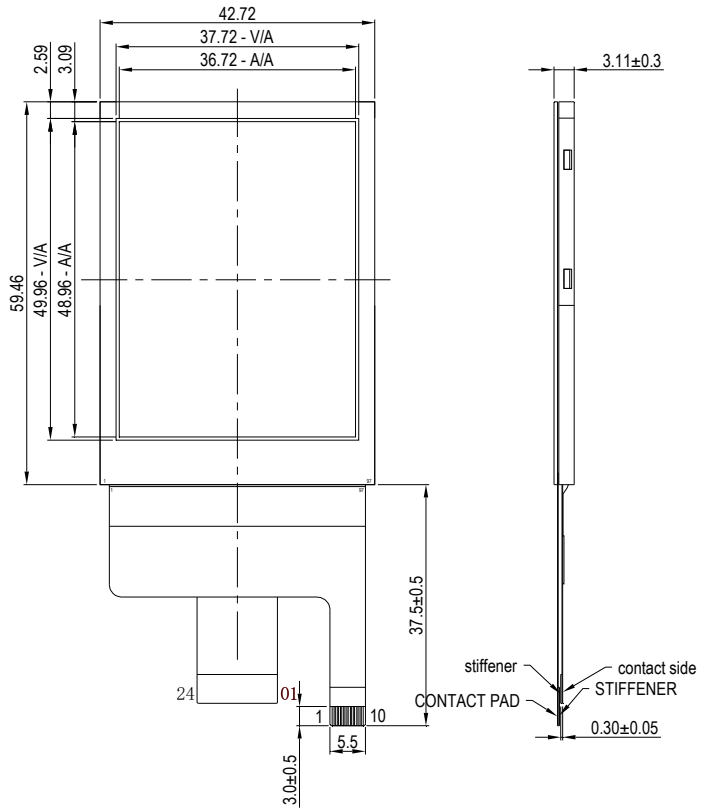
MODEL NAME	NO	MATERIAL	REMARKS
	1		

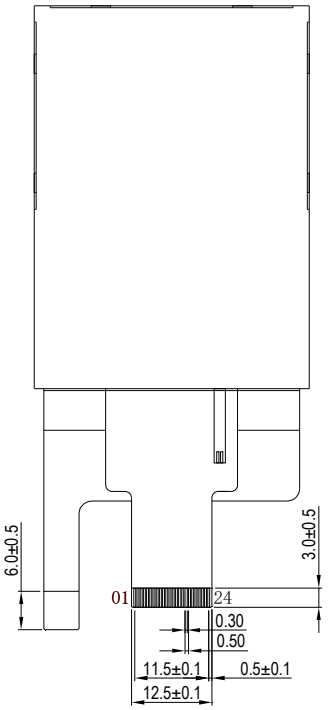
CRYSTAL CLEAR TECHNOLOGY SDN BHD
16, JLN TP5, TMN PERINDUSTRIAN SIME UEP,
47500 SUBANG JAYA, SELANGOR DARUL EHSAN

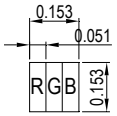
PART NAME: 2.4 INCH TFT MODULE

APPROVED	CHECKED	DRAWN	UNIT : MM	DRAWING NUMBER	SHEET	REV.
		AZHAR 25-07-2017	NTS	T240A06N00	1/1	2

2 CHANGE BACKLIGHT CIRCUIT
AZHAR 30-11-2017



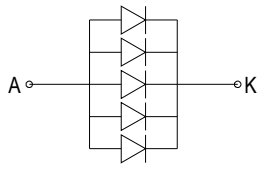




CTP PIN OUT

NO	SYMBOL
1	/RES
2	VDD
3	GND
4	/IRQ
5	SDA
6	SCL
7	NC
8	NC
9	NC
10	NC

No:	PIN NAME
1	NC
2	LEDK
3	LEDA
4	IMO
5	IM1
6	IM2
7	VDD 2.8V
8	VDDIO 1.8V
9	TE
10	SDA
11	/CS
12	/RESET
13	RS/SCL
14	WR
15	RD
16	D7
17	D6
18	D5
19	D4
20	D3
21	D2
22	D1
23	D0
24	GND



BACKLIGHT CIRCUIT

NOTE:
1. GENERAL TOLERANCE TO BE ±0.3
2. OPERATING TEMPERATURE: -20°C TO +70°C
3. STORAGE TEMPERATURE : -30°C TO +80°C

MODEL NAME	NO	MATERIAL	REMARKS
	1		

CRYSTAL CLEAR TECHNOLOGY SDN BHD
16, JLN TP5, TMN PERINDUSTRIAN SIME UEP,
47500 SUBANG JAYA, SELANGOR DARUL EHSAN

PART NAME: 2.4 INCH TFT MODULE

APPROVED	CHECKED	DRAWN	UNIT : MM	DRAWING NUMBER	SHEET	REV.
		AZHAR 25-07-2017	NTS	T240A06C00	1/1	2

Crystal Clear Technology

Product Specification

TP0121-01

Crystal Clear Technology sdn. bhd.

16Jalan TP5—Taman Perindustrian Sime UEP
47600 Subang Jaya—Selangor DE
Malaysia. T: +603 80247099 F: +603 80247098

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1.0 INTRODUCTION

The purpose of this specification is defined the general provision and quality requirement apply to 3.5 inch Capacitive Touch module integrated by Crystal Clear Technology. This document, together with the module drawing, is the highest level specification for this product. When users touch module by finger, the module can send coordinates of point at the contact point to host. The finger position information is sent to host by I2C bus which is determined by host through IRQ line.

2.0 GENERAL DESCRIPTION

This document contains the Capacitive Touch module specification. The maximum rating, characteristics, hardware, and inspection of the module are described in the subsequent sections. I2C protocol will be introduced in detail.

2.1 Touch sensor characteristics

- Technology: Use the character of capacitive among the touch electrodes on touch panel to identify the positions of touch signals
- Touch method: Ten fingers multi touch with pressure sensing
- Interface: I2C

2.2 General Specification

Item	Specification	Unit
Screen Diagonal	3.5	inch
Module Outline	59.46(H) x 42.72(V) x 0.55(T) (Excluded FPC)	mm
Touch Area	48.96(H) x 36.72(V)	mm
Controller	ST1633i	-
Cover Lens Material	None	-
Transparency	85	%

3.0 ABSOLUTE MAXIMUM RATING

Absolute Maximum rating of touch panel module is as following

Symbol	Parameter	Value	Unit
V_{DD}	Supply Voltage	-0.3 to +6.0	V
T_A	Operating Temperature	-20 to +70	°C
T_{STG}	Storage Temperature	-30 to +80	°C

Note: If the module exceeds the absolute maximum ratings, it may be damaged permanently. Also, if the module operated with the absolute maximum ratings for a long time, its reliability may drop.

4.0 ELECTRICAL CHARACTERISTICS

DC Characteristics (unless otherwise specie, Voltage referenced to Ground, T_A = -20°C to 70°C

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
VDD	Power Supply		2.7	-	3.6	V
INML	Operating Current		-	16.1	24.0	mA
IIDLE	Idle Current		-	8.1	12.2	mA
IPD	Power Down Current		-	-	20.0	uA
VIH	Logic High Input Voltage	VDD=3.3V	0.85VDD	-	-	V
VIL	Logic Low Input Voltage		-	-	0.15VDD	V
RPU	Input Pull Up Resistor		50	-	60	KΩ
IDRV	Output Driving Current	VOH=0.8VDD	6	-	-	mA
ISINK	Output Sinking Current	VOL=0.2VDD	10	-	-	mA
VLVR	Low Voltage Reset		-	-	2.3	V

5.0 PIN DEFINITION

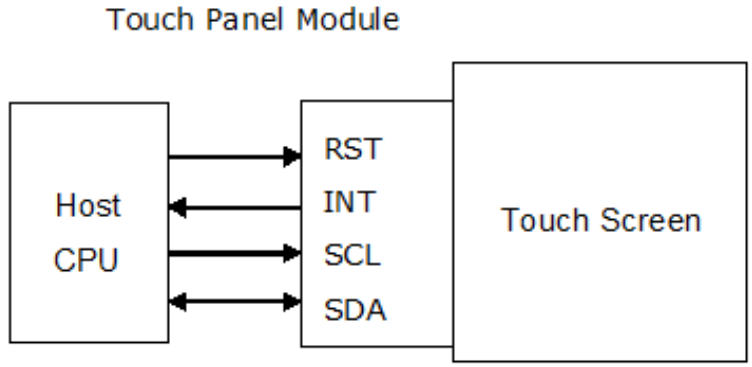
NO.	SYMBOL	I/O	FUNCTION
1	RST	I	Sensor system global reset
2	VDD	P	Power supply
3	GND	P	Ground
4	IRQ	O	Sensor data ready request
5	SDA	I/O	I2C serial data
6	SCL	I	I2C serial clock
7	NC	-	No connect for user
8	NC	-	No connect for user
9	NC	-	No connect for user
10	NC	-	No connect for user

6.0 I2C INTERFACE

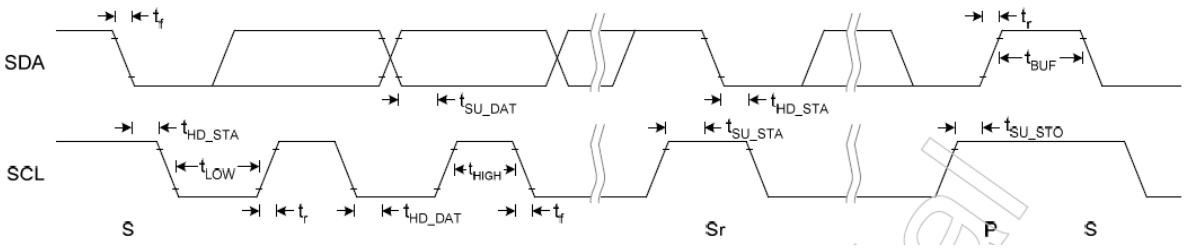
Touch panel is used as I2C Slave Device, I2C Slave address is 0x55

6.1 Interface Diagram

The system block diagram is as shown in below. There are three communication pins connected between CPU and Touch Panel Module which are including external interrupt INT, I2C pins SCL and SDA. The INT is active low while the touch state is calculated by Touch Panel Module and the touch information can be translated via I2C communication interface.



6.2 Timing Characteristic

Conditions: V_{DD} - GND = 3.3V, T_A = 25°C

Symbol	Parameter	Min	Typ	Max	Unit
f_{SCL}	SCL clock frequency	0	-	400	kHz
t_{LOW}	Low period of the SCL clock	1.3	-	-	us
t_{HIGH}	High period of the SCL clock	0.6	-	-	us
t_f	Signal falling time	-	-	300	ns
t_r	Signal rising time	-	-	300	ns
t_{SU_STA}	Set up time for a repeated START condition	0.6	-	-	us
T_{HD_STA}	Hold time (repeated) START condition. After this period, the first clock pulse is generated	0.6	-	-	us
t_{SU_DAT}	Data set up time	100	-	-	ns
t_{HD_DAT}	Data hold time	0	-	0.9	us
t_{SU_STO}	Set up time for STOP condition	0.6	-	-	us
t_{BUF}	Bus free time between a STOP and START condition	1.3	-	-	us
C_b	Capacitive load for each bus line	-	-	400	pF