CRYSTAL CLEAR TECHNOLOGY

Product Specification

T177B04N00

(REVISION 1)

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2.0 Records of Revision

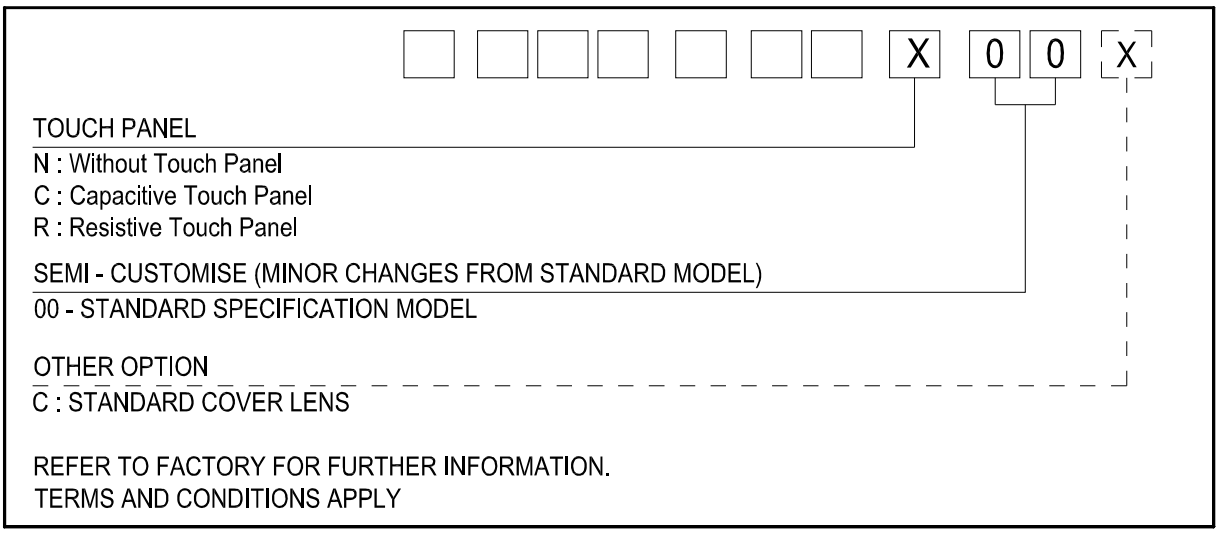
Rev	Date	Item	Page	Comment	Originator	Checked By
1.0	23.01.17			Initial Release	Azhar	Liew

3.0 General Specification

T177B04N00 is 1.77" color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, driver ICs control circuit, LED backlight and Touch Panel. This display area contains 128 x 160 pixels. This product compliant with RoHS environmental requirement.

Item	Contents	Unit	Note
LCD Type	1.77 " TFT	-	
Display color	65k		1
Viewing Direction (Optimum)	6	O'clock	
Module size	34.0 X 43.7 X 2.55	mm	2
Active Area(W×H)	28.03 X 35.04	mm	
Number of Dots	128×RGB×160	dots	
Controller	ST7735S or equivalent	-	
Interface Type	MCU-8Bit	-	
Input Voltage	2.8	V	
Power Consumption (without Backlight)	6	mw	
Backlight	2-LEDs (white)	pcs	
System Interface Mode	Parallel/Serial	-	

Note 1: Color tone is slightly changed by temperature and driving voltage.
Note 2: FPC or wire are not included.



4.0 Absolute Maximum Ratings

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

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	VCC	-0.3	4.8	V	1, 2
Logic Signal Input /Output Voltage	VIOVCC	-0.3	VCC+0.3	V	
Operating Temperature	TOP	-20	70	℃	
Storage Temperature	TST	-30	80	℃	
Current of LED	ILED	0	30	mA/led	

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.

4.2 Environmental Absolute Maximum Ratings

Item	Storage		Operating		Note
	MIN.	MAX.	MIN.	MAX.	
Ambient Temperature	-20℃	70℃	-10℃	60℃	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<=60°C and 85%RH MAX.
   (Ta>=60°C. Absolute humidity must be lower than the humidity of 90%RH at 60°C)

5.0 Electrical Characteristics and Instruction Code

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

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Note
Power supply		VCC/VCI	Ta=25℃	2.7	3.8	3.9	V	
Input Current		IDD		-	2	4	mA	
Input voltage	'H'	VIH		0.78VCC	-	VCC	V	
	'L'	VIL		-0.3	-	0.2 VCC	V	
Output Voltage H		VOH		0.8VCC	-	VCC	V	
Output Voltage L		VOL		GND	-	0.2VCC	V	

Note:
1: When an optimum contrast is obtained in transmissive mode.
2: Tested in 1X1 chessboard pattern.

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

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Supply Voltage	V_{LED}	-	2.9	3.1	3.3	V	1
Supply Current	If	-	-	30	-	mA	2
Luminance	Lv	If = 30mA	-	3000	-	cd/m2	
Number Of LED	-	-	-	2	-	Piece	
Connection Mode	P	-	-	Parallel	-		

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

5.3 Interface Signal

Pin No.	Symbol	I/O	Function
1	SPI4W		0:3-Lline Enable 1:4 line Enable
2	RDX		Read Signal
3	D/CX_SCL		Register Selection Signal
4	DB0_SDA		Data Bus
5	DV1		Data Bus
6	DB2		Data Bus
7	DB3		Data Bus
8	DB4		Data Bus
9	DB5		Data Bus
10	DB6		Data Bus
11	DB7		Data Bus
12	RESX		Reset Signal
13	CSX		Chip Selection Pin
14	IM2		0: Serial Interface; 1: Parallel Interface
15	WRX/D/CX		Write Signal
16	IOVCC	1.8V	I/O Power Supply
17	VCC	2.8V	Power supply Power Supply
18	GND	0V	Ground
19	LEDA	/	Anode of Backlight LED
20	LEDK	/	Cathode of Backlight LED

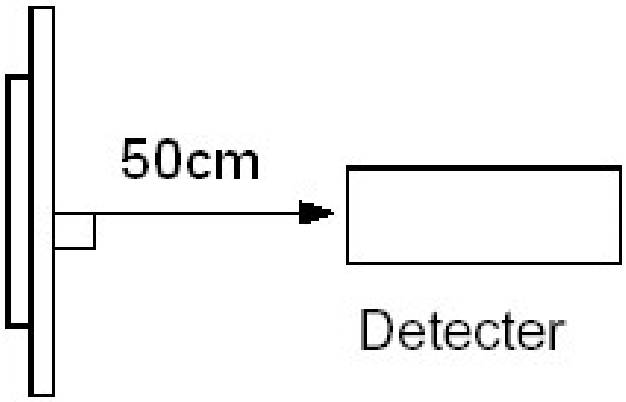
6.0 Optical Characteristics

Item	Symbol	**Condition**	Min.	Typ.	Max.	Unit	Note
Brightness	Bp	θ=0° Φ=0°	220	250	-	Cd/m^2	1
Uniformity	⊿Bp		80	-	-	%	1,2
Viewing Angle	Ø = 90°	Cr≥10		20	-	Deg	3
	Ø = 270°			55	-		
	Ø = 0°			55	-		
	Ø = 180°			55	-		
Contrast Ratio	Cr	θ=0° Φ=0°	200	300	-	-	4
Response Time	$T_r + T_f$		-	30	60	ms	5
NTSC Ratio	S		45	60	-	%	

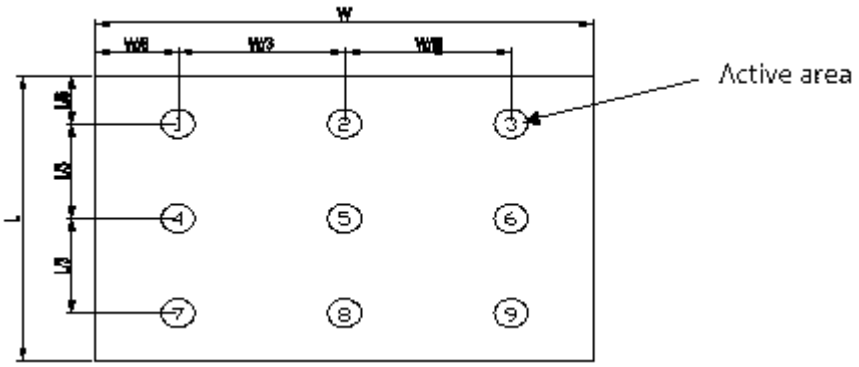
Note: The parameter is slightly changed by temperature, driving voltage and materiel

Note 1: The data are measured after LEDs are turned on for 5 minutes. LCM displays full white. The brightness is the average value of 9 measured spots. Measurement equipment PR-705 (Φ8mm)
Measuring condition:
- Measuring surroundings: Dark room.
- Measuring temperature: Ta=25℃.
- Adjust operating voltage to get optimum contrast at the center of the display.

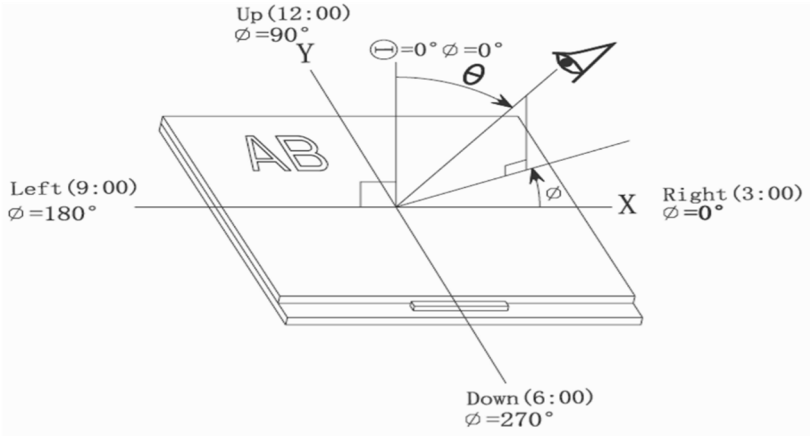
Measured value at the center point of LCD panel after more than 5 minutes while backlight turning on.



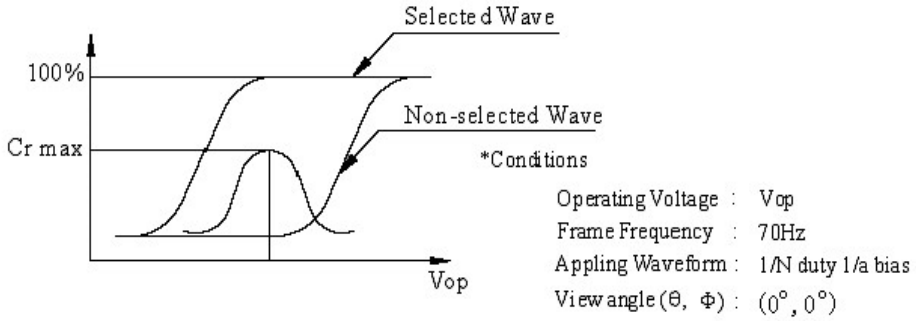
Note 2: The luminance uniformity is calculated by using following formula.
⊿Bp = Bp (Min.) / Bp (Max.)×100 (%)
Bp (Max.) = Maximum brightness in 9 measured spots Bp (Min.) = Minimum brightness in 9 measured spots.



Note 3: The definition of viewing angle:
Refer to the graph below marked by *θ* and *Φ*



Note 4: Definition of contrast ratio. (Test LCD using DMS501)

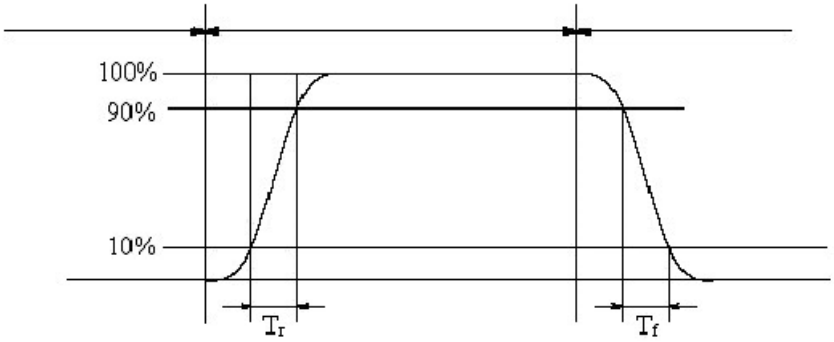


$$\textit{Contrast ratio}\ (Cr) = \frac{\textit{Brightness of selected dots}}{\textit{Brightness of non-selected dots}}$$

Note 5: Definition of Response time. (Test LCD using DMS501):

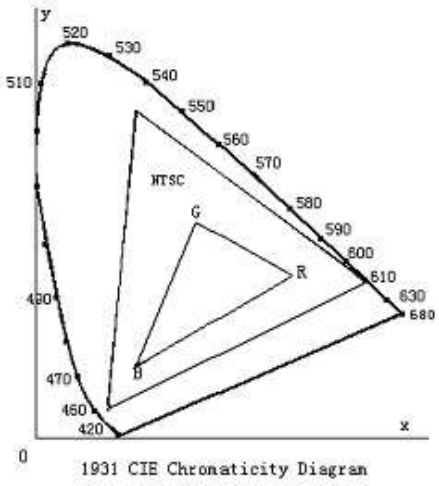
The output signals of photo detector are measured when the input signals are changed from “black” to “white”(falling time) and from “white” to “black”(rising time),

respectively. The response time is defined as the time interval between the 10% and 90% of amplitudes. Refer to figure as below.



The Definition of response time

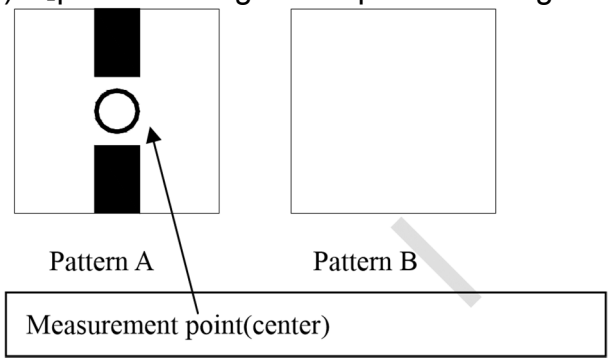
Note 6: Definition of Color of CIE Coordinate and NTSC Ratio.



1931 CIE Chromaticity Diagram

Note 7: Definition of cross talk.

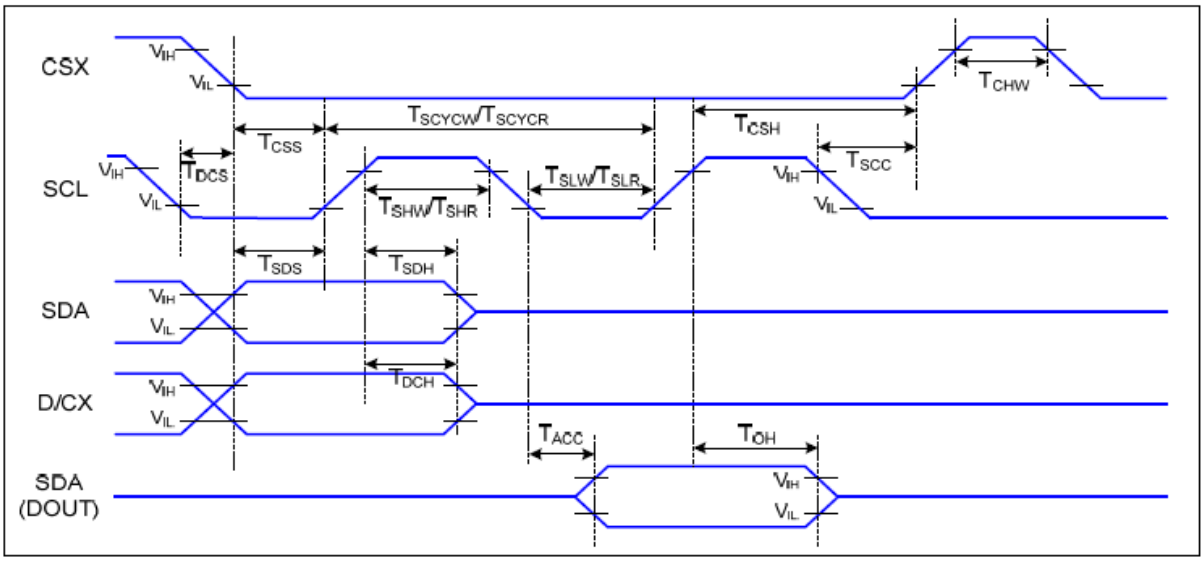
Cross talk ratio (%) =[pattern A Brightness-pattern B Brightness]/pattern A



Electric volume value = 3F+/-3Hex

7.0 AC Characteristics

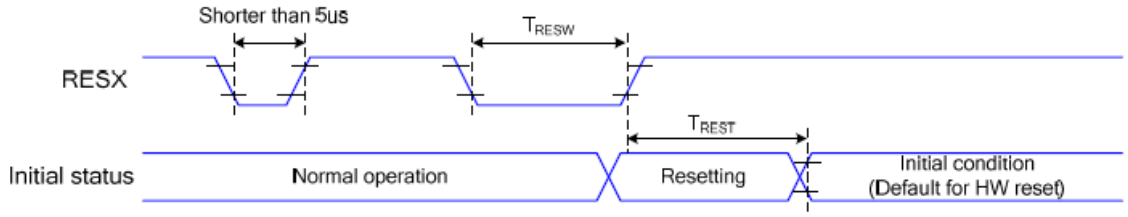
7.1 Serial Interface Characteristics (4-line Serial)



Ta=25 ℃, VDDI=1.65~3.7V, VDD=2.5~4.8V

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	TCSS	Chip Select Setup Time (Write)	45		ns	
	TCSH	Chip Select Hold Time (Write)	45		ns	
	TCSS	Chip Select Setup Time (Read)	60		ns	
	TSCC	Chip Select Hold Time (Read)	65		ns	
	TCHW	Chip Select "H" Pulse Width	40		ns	
SCL	TSCYCW	Serial Clock Cycle (Write)	66		ns	-Write Command & Data Ram
	TSHW	SCL "H" Pulse Width (Write)	15		ns	
	TSLW	SCL "L" Pulse Width (Write)	15		ns	
	TSCYCR	Serial Clock Cycle (Read)	150		ns	-Read Command & Data Ram
	TSHR	SCL "H" Pulse Width (Read)	60		ns	
	TSLR	SCL "L" Pulse Width (Read)	60		ns	
D/CX	TDCS	D/CX Setup Time	10		ns	
	TDCH	D/CX Hold Time	10		ns	
SDA (DIN) (DOUT)	TSDS	Data Setup Time	10		ns	For Maximum CL=30pF For Minimum CL=8pF
	TSDH	Data Hold Time	10		ns	
	TACC	Access Time	10	50	ns	
	TOH	Output Disable Time	15	50	ns	

7.2 Reset Timing



Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	tRESW	Reset Pulse Duration	10	-	us
	tREST	Reset Cancel	-	5	ms
				120	ms

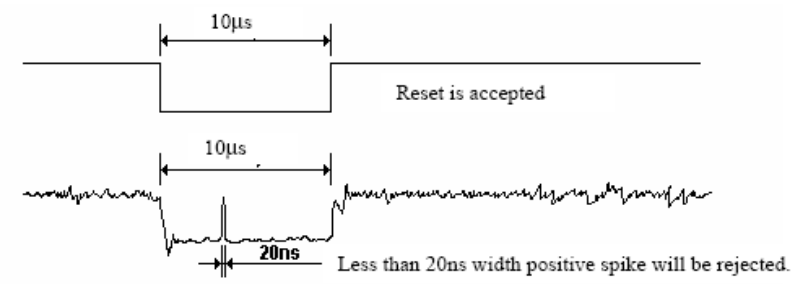
Table 14 Reset Timing

Notes:

1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) 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.
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 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.
4. Spike Rejection also applies during a valid reset pulse 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 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

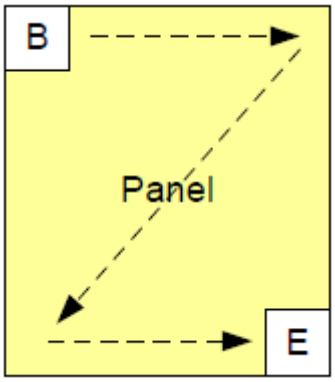
8.0 Initial Code Setting

```
write_command(0x01);    // Software Reset
delay(120);

write_command(0x11);    // Sleep Out and Booster ON
delay(120);

write_command(0x13);    // Partial Off (Normal)

write_command(0x20);    // Display Normal

write_command(0xB1);    // Frame Rate Control
write_data(0x05);
write_data(0x3C);
write_data(0x3C);

write_command(0xB2);    //Frame Rate Control
write_data(0x05);
write_data(0x3C);
write_data(0x3C);

write_command(0xB3);    //Frame Rate Control
write_data(0x05);
write_data(0x3C);
write_data(0x3C);
write_data(0x05);
write_data(0x3C);
write_data(0x3C);

write_command(0xB4);    //Display Inversion Control
write_data(0x03);

write_command(0xC0);    //Power Control 1
write_data(0x0E);
write_data(0x0E);
write_data(0x04);

write_command(0xC1);    //Power Control 2
write_data(0xC0);

write_command(0xC2);    //Power Control 3
write_data(0x0D);
write_data(0x00);
write_command(0xC3);    //Power Control 4
write_data(0x8D);
write_data(0x2A);
```

```
write_command(0xC4);    //Power Control 5
write_data(0x8D);
write_data(0xEE);

write_command(0xC5);    //VCOM Control 1
write_data(0x0C);

write_command(0x36);    //Memory Data Access Control
write_data(0xD0);

write_command(0xE0);    //Gamma Adjustment
write_data(0x0C);
write_data(0x1C);
write_data(0x0F);
write_data(0x18);
write_data(0x36);
write_data(0x2F);
write_data(0x27);
write_data(0x2A);
write_data(0x27);
write_data(0x25);
write_data(0x2D);
write_data(0x3C);
write_data(0x00);
write_data(0x05);
write_data(0x03);
write_data(0x10);

write_command(0xE1);    //Gamma Adjustment
write_data(0x0C);
write_data(0x1A);
write_data(0x09);
write_data(0x09);
write_data(0x26);
write_data(0x22);
write_data(0x1E);
write_data(0x25);
write_data(0x25);
write_data(0x25);
write_data(0x2E);
write_data(0x3B);
write_data(0x00);
write_data(0x05);
write_data(0x03);
write_data(0x10);

write_command(0x3A);    //Interface Pixel Format
write_data(0x05);
write_command(0x29);    //Display On
```

8.2 Memory Data Write/Read Direction

When writing the data, the counter will indicates where in the physical memory the data is to be written is controlled by “Memory Data Access Control “ Command, bit B5 (MV), B6 (MX), B7 (MY) as described below:



When 128RGBx160 (GM= “11”)

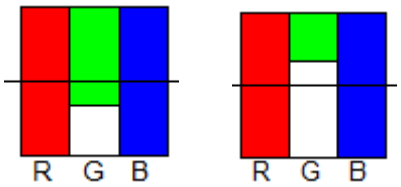
MV	MX	MY	CASET	RASET
0	0	0	Direct to Physical Column Pointer	Direct to Physical Row Pointer
0	0	1	Direct to Physical Column Pointer	Direct to (159-Physical Row Pointer)
0	1	0	Direct to (127-Physical Column Pointer)	Direct to Physical Row Pointer
0	1	1	Direct to (127-Physical Column Pointer)	Direct to (159-Physical Row Pointer)
1	0	0	Direct to Physical Row Pointer	Direct to Physical Column Pointer
1	0	1	Direct to (159-Physical Row Pointer)	Direct to Physical Column Pointer
1	1	0	Direct to Physical Row Pointer	Direct to (127-Physical Column Pointer)
1	1	1	Direct to (159-Physical Row Pointer)	Direct to (127-Physical Column Pointer)

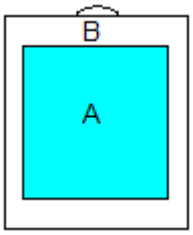
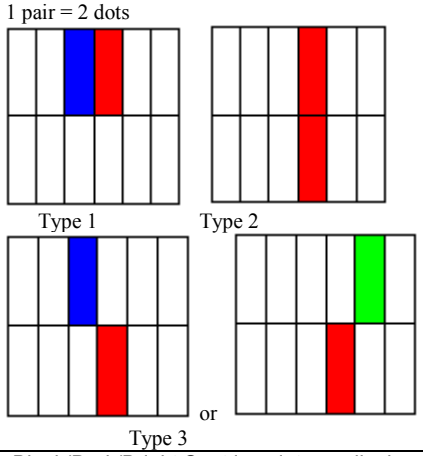
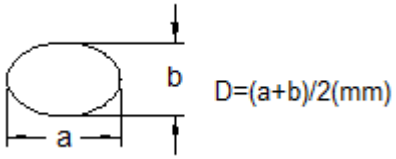
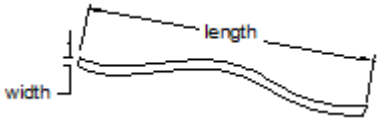
9.0 Reliability Test Condition

Item		Test Condition
Operating	High Temperature	70degC, 96 hrs
	Low Temperature	-20degC,96 hrs
Storage	High Temperature	8degC, 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 → -30degV → 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 color 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.

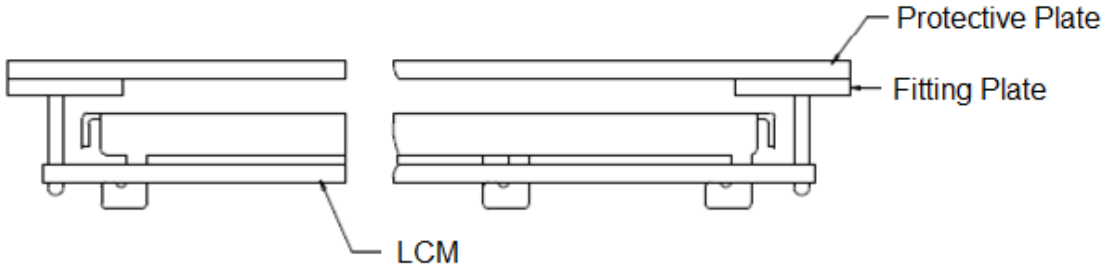
Exposed area of the printed circuit board.
Terminal electrode sections.

4. Using LCD Modules

a. Installing LCD Modules

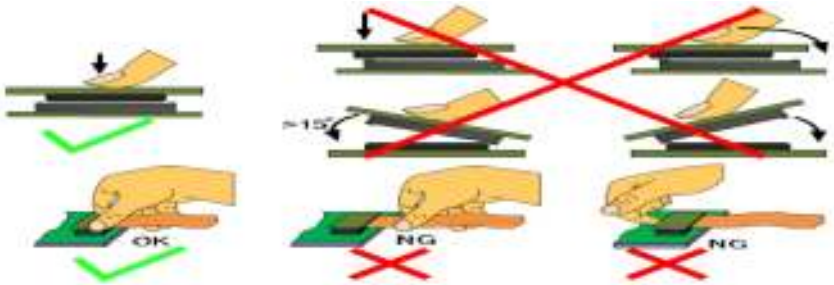
The hole in the printed circuit board is used to fix LCM as shown in the picture below.
Attend to the following items when installing the LCM.

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

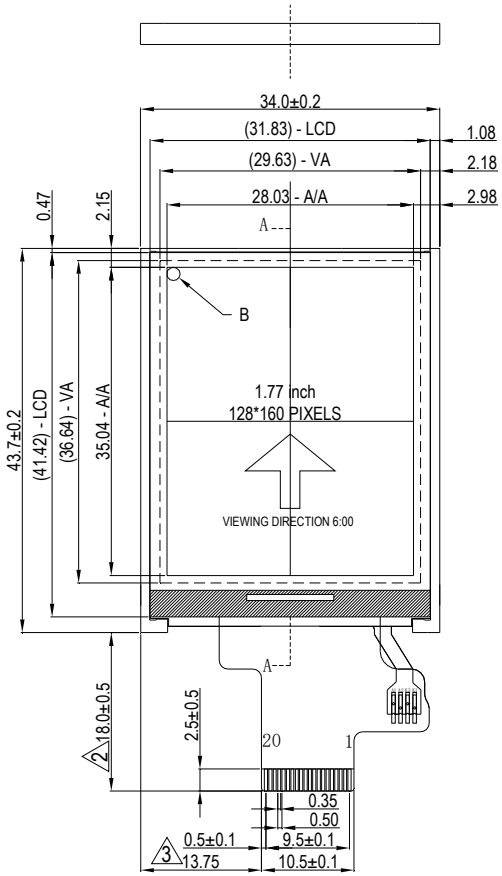
   Unless otherwise agreed between Crystal Clear Technology and customer, Crystal Clear Technology will replace or repair any of its LCD and LCM which is found to be defective electrically and visually when inspected in accordance with Crystal Clear Technology acceptance standards, for a period of one year 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.

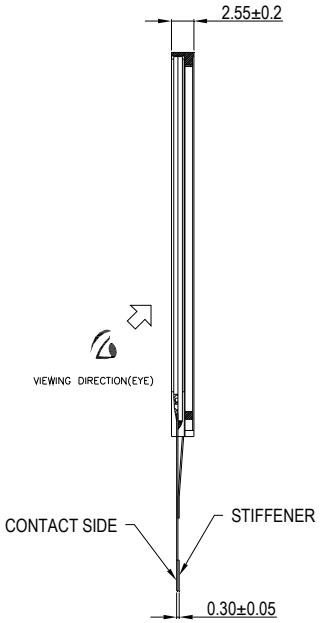
9. Return LCM under Warranty

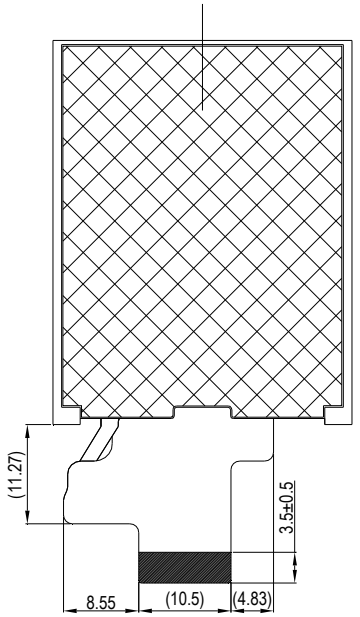
   No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are:
   - Broken LCD glass
   - PCB eyelet's damaged or modified
   - PCB conductors damaged
   - Circuit modified in any way, including addition of components.
   - PCB tampered with 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 FPC LENGTH
14-04-2016 AZHAR
3 CHANGE FPC SHAPE
14-04-2016 AZHAR
4 CHANGE PIN 18 TO GND
11-05-2016 AZHAR



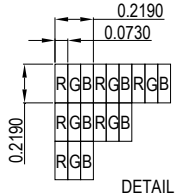




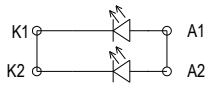
PIN DEFINATION

PIN No.	SYMBOL
1	SPI4W
2	RDX
3	D/CX_SCL
4	DB0_SDA
5	DB1
6	DB2
7	DB3
8	DB4
9	DB5
10	DB6
11	DB7
12	RESX
13	CSX
14	IM2
15	WRX_D/CX
16	IOVCC
17	VCC
4 18	GND
19	LEDA
20	LEDK

NOTE:
1. DISPLAY TYPE : TFT
2. VIEWING DIRECTION : 6 O'CLOCK
   GREY SCAN : 12 O'CLOCK
3. POLARIZER : TRANSMISSIVE
4. OPERATING TEMPERATURE :-20°C TO 70°C
5. STORGE TEMPERATURE : -30°C TO 80°C
6. DRIVER IC : ST7735S
7. BACKLIGHT : 2 WHITE LEDS
8. GENERAL TOLERANCE TO BE ±0.3



DETAIL B
(FOR REFERENCE ONLY)



BACKLIGHT CIRCUIT

CRYSTAL CLEAR TECHNOLOGY SDN BHD

APPROVED	CHECKED	DRAWN	UNIT : MM
		AZHAR 13-04-2016	NTS

PART NAME: MECHANICAL SPECIFICATION

DRAWING NUMBER: T177B04N00

SHEET: 1/1

REV.: 4