Product Specification

Product Name: IE0130B240240

Product Code: IE0130B

Customer
Approved by Customer
Approved Date:

Designed By	Check By	Approved By	
		R&D	QA

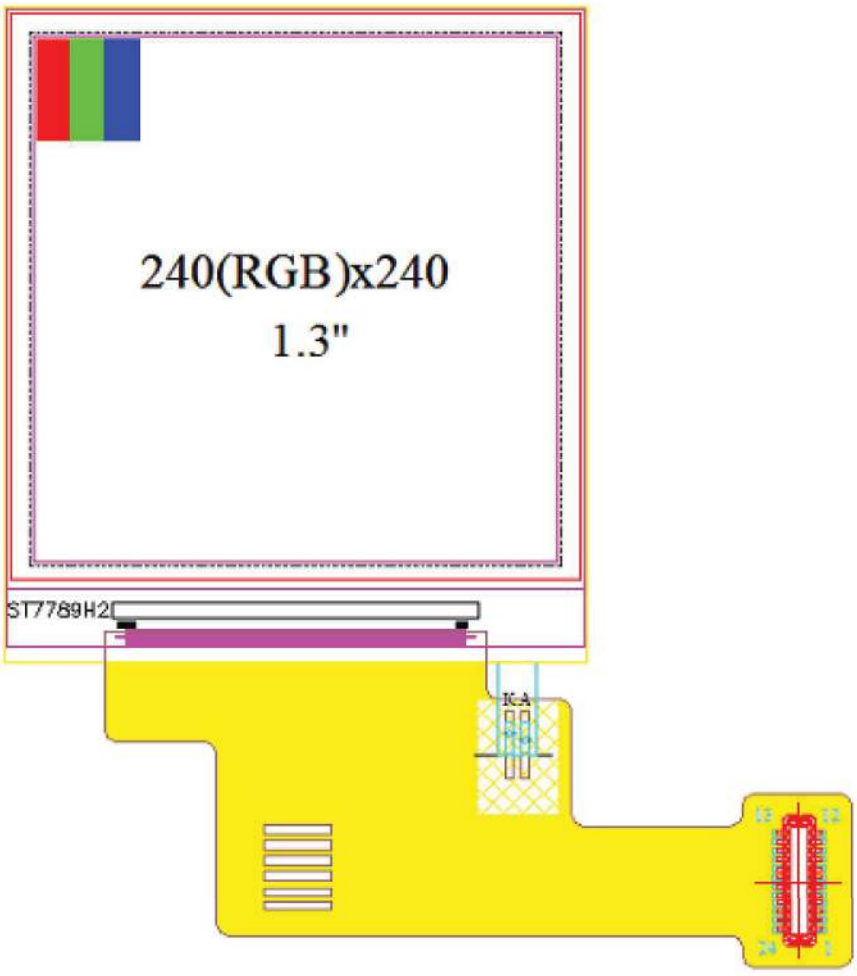
RECORDS OF REVISION

Date	Rev.	Description	Note	Page
2015/9/22	V0	Initial Released		

1 GENERAL DESCRIPTION

1.1 Introduction

1.3 240*240 is a color active matrix TFT-LCD Model using amorphous silicon TFT's (Thin Film Transistors) as an active switching devices. It is a transmissive type display operating in the normal black. This TFT-LCD has a 1.3 inch diagonally measured active area with 240 horizontal by 240 vertical pixel array. Each pixel is divided into Red, Green, Blue dots which are arranged in vertical stripe and this panel can display 262K colors.

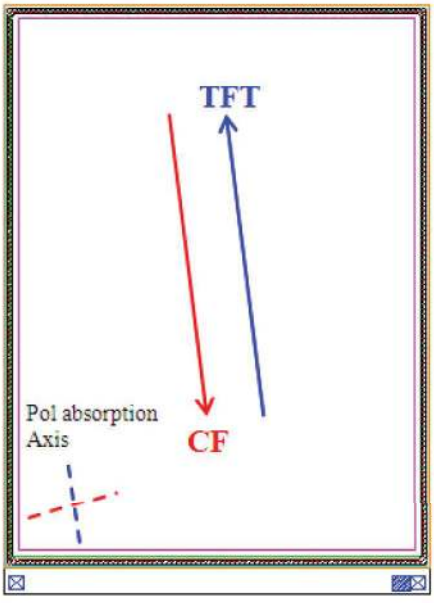


1.2 General Specifications (H: horizontal length, V: vertical length)

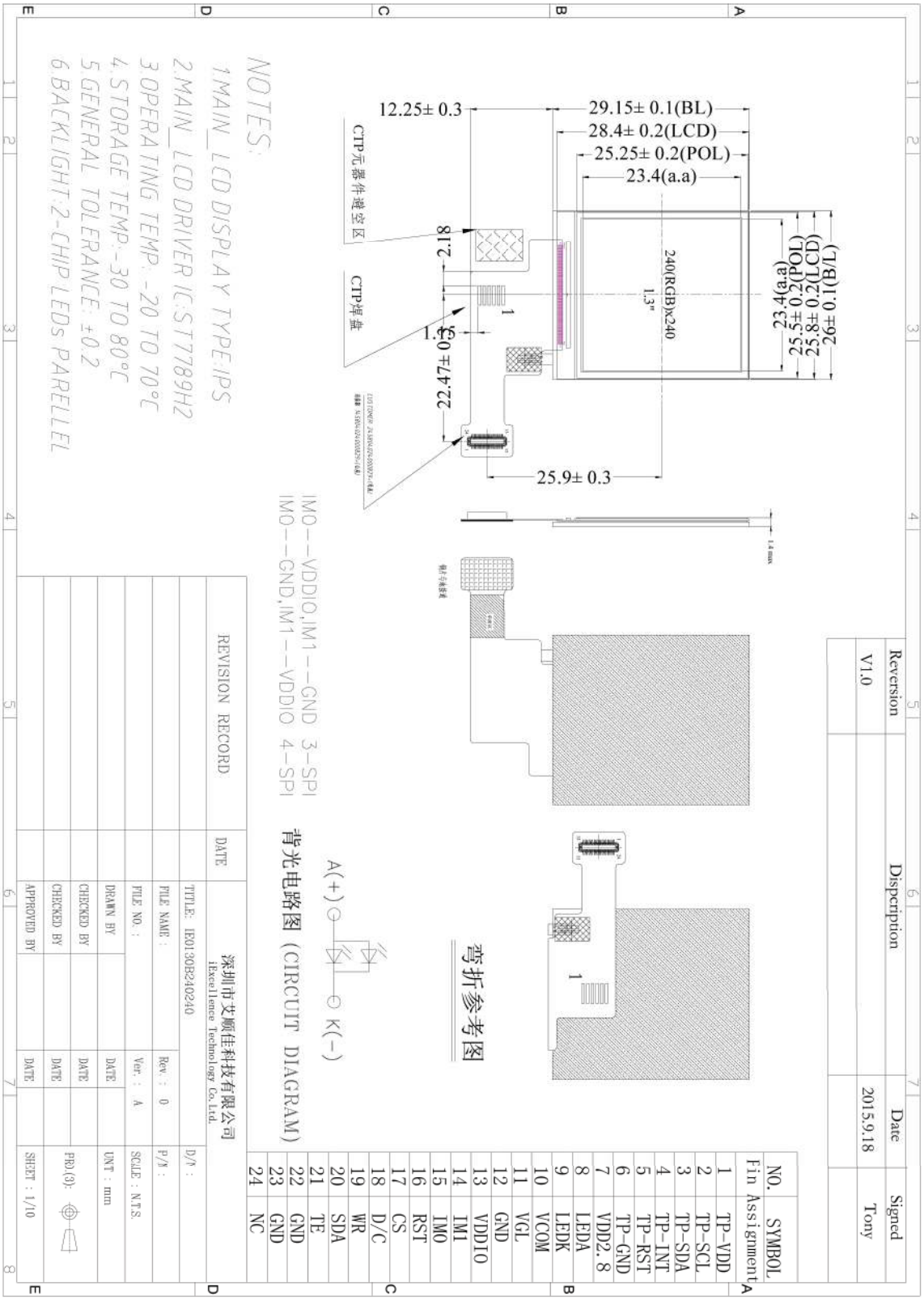
Parameter	Specification	Unit	Remark
Part No.	IE0130B		
SIZE	1.3 "TFT		
Active Area	23.40(H) × 23.40(V)	mm	
Number of Pixels	240(H) RGB × 240(V)	pixels	
Dimensional Outline	26.0(H) ×29.15(V) ×1.40(D)	mm	Module
PPI	260		
Display Colors	262K	colors	
Viewing Direction (Human Eye)	80/80/80/80		Note 1,2
Operating Temperature	-10℃ ～+50℃		
Storage Temperature	-20℃ ～+70℃		
Weight	TBD		

Note:

1. At the U/D/L/R direction, the viewing angle is same;
2. The TFT and CF Rubbing Direction;



2 Mechanical Drawings

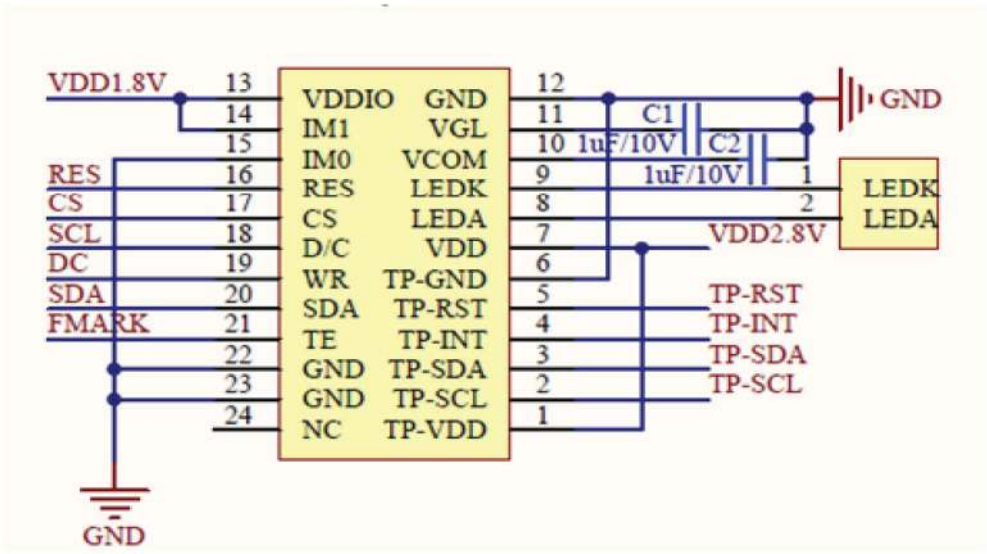


3 Module Interface

NO	SYMBOL	FUNCTION
1	TP_VDD	Analog power supply of Touch Panel. If no used，let this pin open.
2	TP_SCL	I²C clock signal of Touch Panel；If no used，let this pin open.
3	TP_SDA	I²C data signal of Touch Panel；If no used，let this pin open.
4	TP_INT	Interrupt signal to main processor of Touch Panel；If no used，let this pin open.
5	TP_RST	System reset of Touch Panel；If no used，let this pin open.
6	TP_GND	Power Ground of Touch Panel；If no used，let this pin open.
7	VDD_2.8V	Power Supply for Analog, VDD_2.8V=2.4V~3.3V.
8	LEDA	LED Anode
9	LEDK	LED Cathode
10	VCOM	A power supply for the TFT-LCD common electrode.
11	VGL	Power output(Negative) pin for gate driver
12	GND	Power Ground
13	VDDIO	Power Supply for I/O system. IOVCC=1.65V~3.3V
14	IM1	when IM0=0,IM1=1,4-SPI;when IM0=1,IM1=0, 3-line SPI or 2 data lane serial I/F.
15	IM0	
16	RST	This signal will reset the device and it must be applied to properly initialize the chip. Signal is active low.
17	CS	Chip selection pin; Low enable, High disable.
18	D/C	This pin is used to be serial interface clock.
19	WR	Display data/command selection pin in 4-line serial interface. Second Data lane in 2 data lane serial interface.
20	SDA	SPI interface input/output pin. The data is latched on the rising edge of the SCL signal.
21	TE	Tearing effect signal is used to synchronize MCU to frame memory writing.
22, 23	GND	Power Ground
24	NC	No Connect

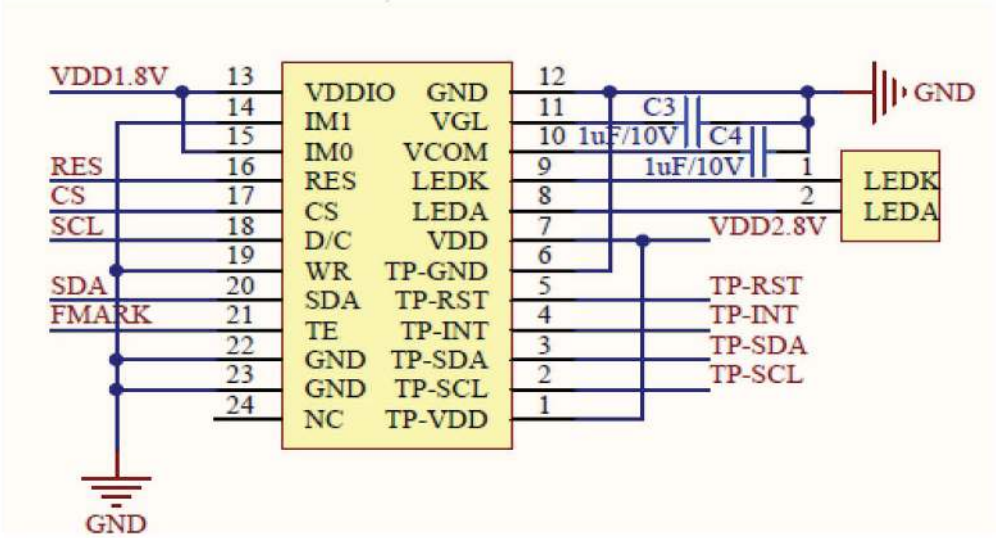
4 Application Circuit

4.1 4-Line SPI Interface



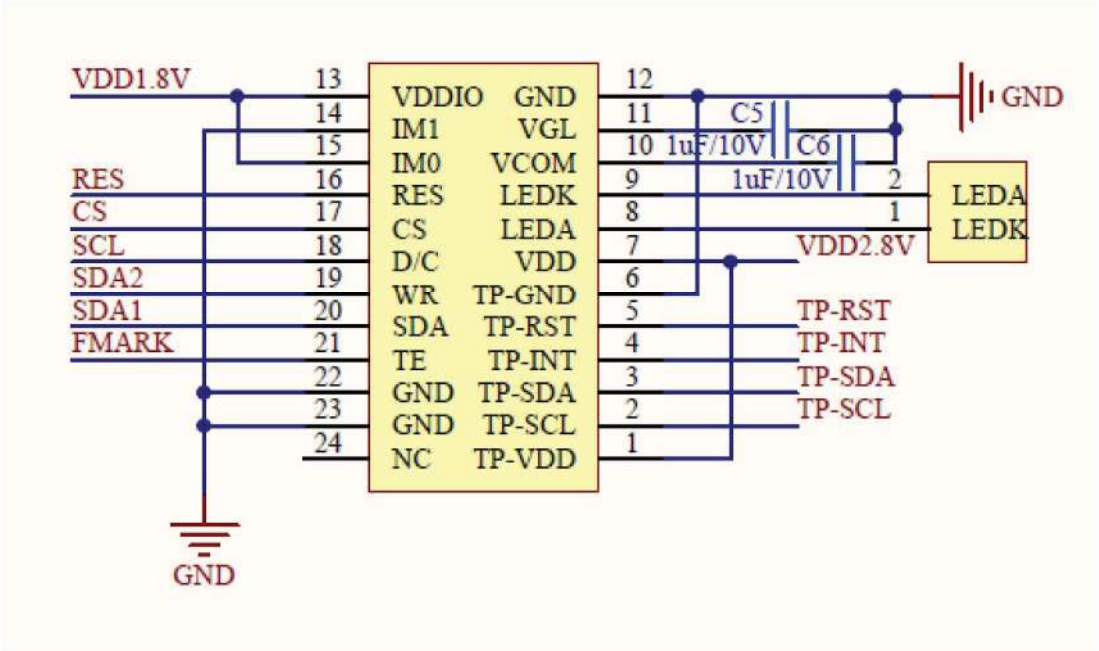
4-SPI

4.2 3-Line SPI Interface



3-SPI

4.3 2 data lane Interface



2 data lane

(To enter this interface，command E7h need set 10h)

5 ELECTRICAL SPECIFICATION

5.1 DC characteristics

Item	Symbol	Unit	Condition	Min.	Typ	Max.	Note
Power and Operation Voltage							
Analog Operating Voltage	VIC	V	Operation Voltage	2.5	2.8	3.3	Note2
Logic Operating Voltage	VDDI	V	I/O Supply Voltage	1.7	2.8	3.3	Note2
Digital Operating Voltage	VCORE	V	Digita Supply Voltage	-	1.5	-	Note2
Driver Supply Voltage	-	V	-	-	-	32	Note3
Input and Output							
Logic Hight level Input Voltage	VIH	V	-	0.7*VDDI	-	VDDI	Note1,2,3
Logic Low level Input Voltage	VIL	V	-	VSS	-	0.3*VDDI	Note1,2,3
Logic Hight level Output Voltage	VOH	V	IOL=1.0mA	0.8*VDDI	-	VDDI	Note1,2,3
Logic Low level Output Voltage	VOL	V	IOL=1.1mA	VSS	-	0.2*VDDI	Note1,2,3
Logic Hight level Input Current	IIH	uA	-	-	-	1	Note1,2,3
Logic Low level Input Current	IIL	uA	-	-1.0	-	-	Note1,2,3
Logic Input Leakage Current	ILEA	uA	VIN=VDDI or VSS	-0.1	-	0.1	Note1,2,3

Note:

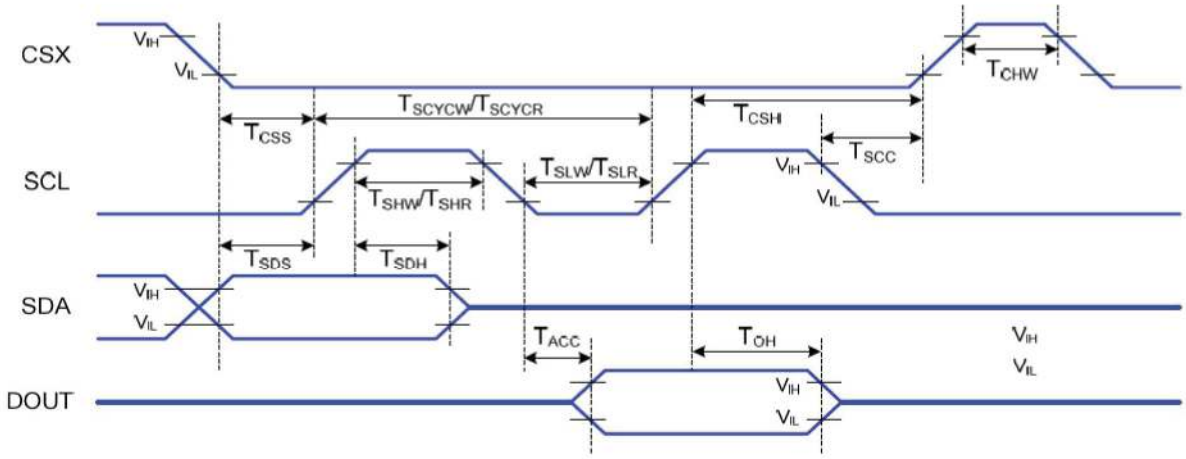
1:VDDI=1.65 to 3.3V,VCI=2.5 to 3.3V,AGND=VSS=0V,Ta=-30 to 70(to +85 no damage)℃

2:Please supply digital VDDI voltage equal or less than analog VCI voltage.

3:CSX,RDX,WRX,D[17:0],D/CX,RESX,TE,DOTCLK,VSYNC,HSYNC,DE,SDA,SCL,IM3,IM2,IM1,IM0,and Test pins.

5.2 AC Characteristics

5.2.1 Serial Interface Characteristics (3-line serial):



3-line serial Interface Timing Characteristics

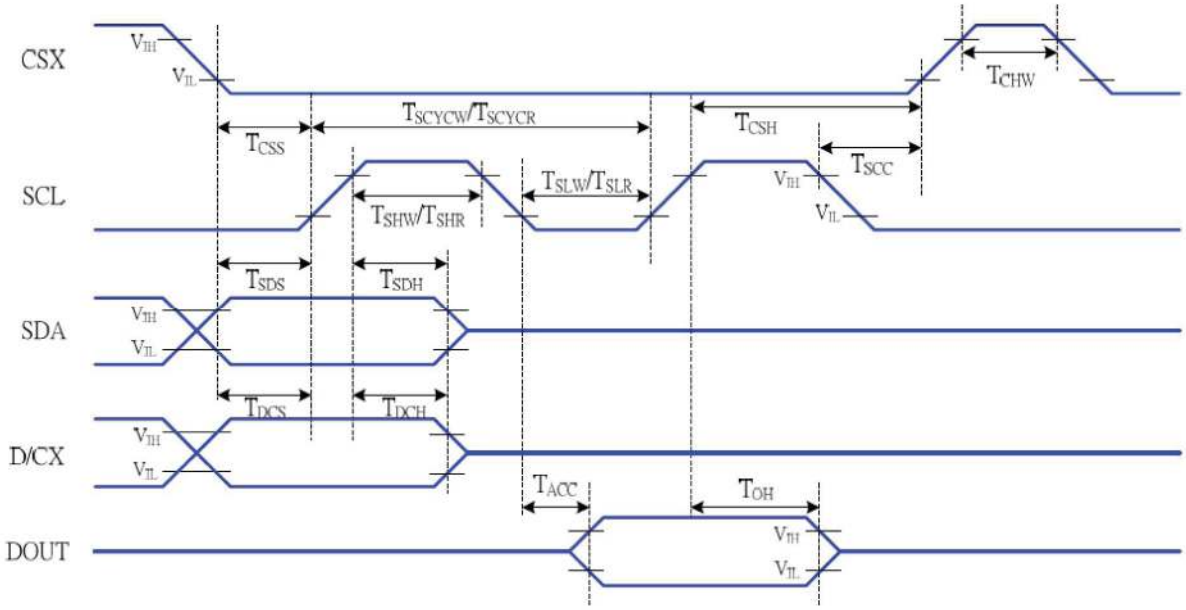
VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=-30 to 70 ℃

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)	16		ns	
	T_{SHW}	SCL "H" pulse width (Write)	7		ns	
	T_{SLW}	SCL "L" pulse width (Write)	7		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	7		ns	
	T_{SDH}	Data hold time	7		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

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.

5.2.2 Serial Interface Characteristics (4-line serial):



4-line serial Interface Timing Characteristics

(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)	16		ns	-write command & data ram
	T_{SHW}	SCL "H" pulse width (Write)	7		ns	
	T_{SLW}	SCL "L" pulse width (Write)	7		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	7		ns	
	T_{SDH}	Data hold time	7		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

4-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.

5.3 Backlight Driving Conditions

Parameter	Symbol	Min	Typ	Max	Unit	Remark
LED Forward Voltage	V_F		3.0		V	-
LED Forward Current	I_F		10		mA	-
Led Power Consumption	P_{LED}		60		mW	Note 1

Notes:

1,Calculator Value for reference ILED×VLED×LED Quantity= PLED

2,The LED Life-time define as the estimated time to 50% degradation of initial luminous.

5.4 Cell Power Consumption

Parameter	Symbol	Typ	Max	Unit	Remark
Normal mode	I_{VDDI}+ I_{VCI}	7	9	mA	Note
Sleep mode	I_{VDDI}+ I_{VCI}	25	40	uA	-

Note: Frame rate=60HZ, Color bar pattern, 25℃.

6 Power ON/OFF Sequence

VDDI and VDD can be applied in any order.

VDD and VDDI can be power down in any order.

During power off, if LCD is in the Sleep Out mode, VDD and VDDI must be powered down minimum 120msec after RESX has been released.

During power off, if LCD is in the Sleep In mode, VDDI or VDD can be powered down minimum 0msec after RESX has been released.

CSX can be applied at any timing or can be permanently grounded. RESX has priority over CSX.

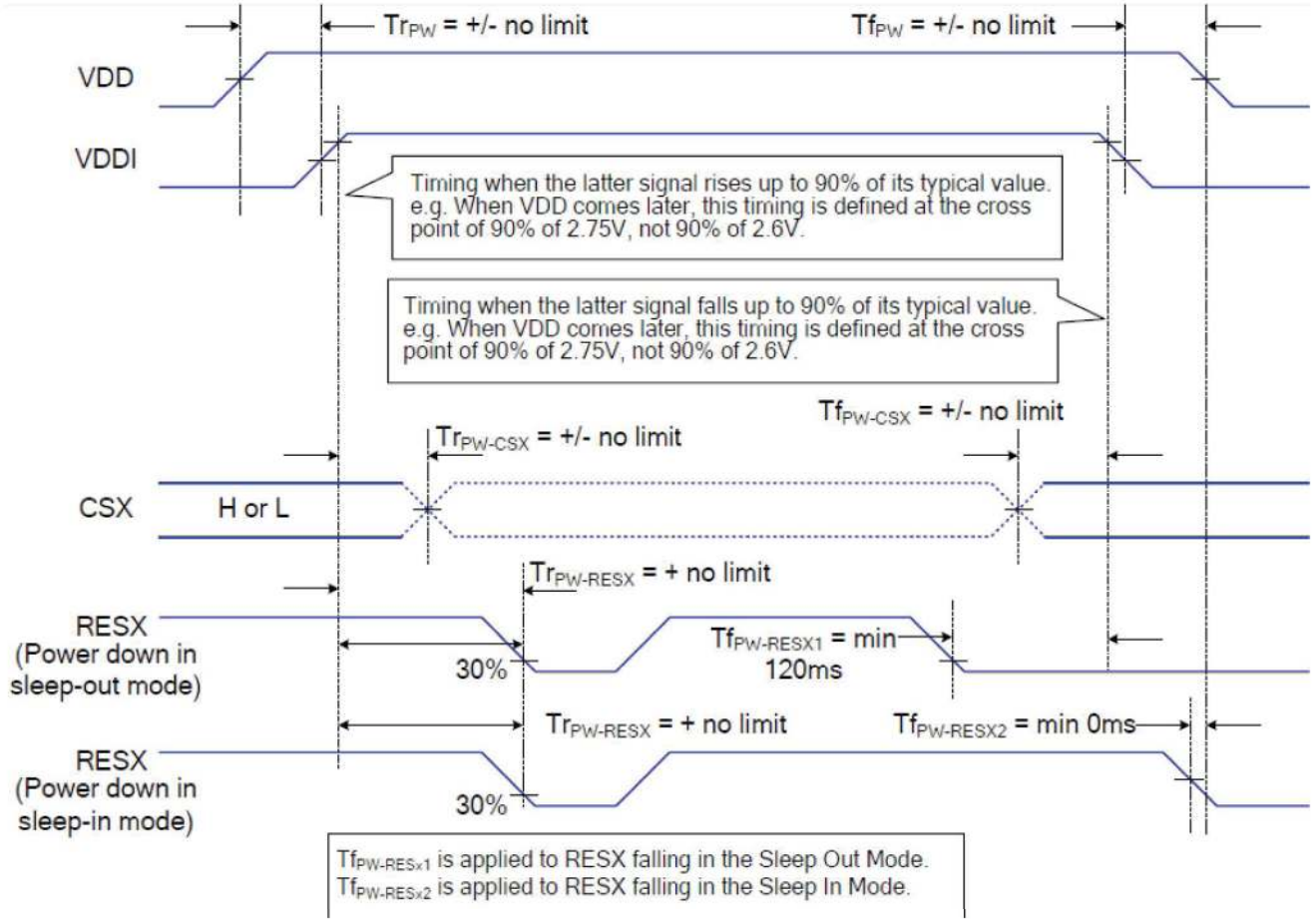
Note 1: There will be no damage to the display module if the power sequences are not met.

Note 2: There will be no abnormal visible effects on the display panel during the Power On/Off Sequences.

Note 3: There will be no abnormal visible effects on the display between end of Power On Sequence and before receiving Sleep Out command. Also between receiving Sleep In command and Power Off Sequence.

Note 4: If RESX line is not held stable by host during Power On Sequence as defined in the sequence below, then it will be necessary to apply a Hardware Reset (RESX) after Host ower On Sequence is complete to ensure correct operation. Otherwise function is not guaranteed.

The power on/off sequence is illustrated below



7 OPTICAL SPECIFICATIONS

7.1 Overview

The test of Optical specifications shall be measured in a dark room(ambient luminance≤1 lux and temperature = 25±2℃) with the equipment of Luminance meter system (Topcon SR-UL1R and Westar TRD-100A) and test unit shall be located at an approximate distance 50cm from the LCD surface at a viewing angle of θ and Φ equal to 0°.The center of the measuring spot on the Display surface shall stay fixed.

The backlight should be operating for 30 minutes prior to measurement.

7.2 Optical Specifications

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Threshold Voltage		Vsat		4.1	4.3	4.5	V	Fig.1
		Vth		1.6	1.8	2.0	V	
Viewing Angle	Horizontal	Θ3	CR>10		80		°	Note 1
		Θ9			80		°	
	Vertical	Θ12			80		°	
		Θ6			80		°	
Contrast Ratio		CR	Θ= 0°	600	800			Note 2
Luminance		cd/m2	Θ = 0°	300	320	350		
Transmittance		T(%)	Θ= 0°	4.1	4.59			Note 3
NTSC		%	Θ= 0°		50			
Reproduction Of color	Red	Rx	Θ= 0°	0.610	0.625	0.640		Note 4 *Color filter Glass with OC
		Ry		0.295	0.310	0.325		
	Green	Gx		0.280	0.295	0.310		
		Gy		0.503	0.518	0.533		
	Blue	Bx		0.127	0.142	0.157		
		By		0.128	0.143	0.158		
White		Wx	Θ= 0°		TBD			
		Wy			TBD			
Response Time		Tr+Tf	Θ= 0°		35	50	ms	Note 5

Note:

1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with
respect to the optical axis which is normal to the LCD surface (See FIG.1).
2. Contrast measurements shall be made at viewing angle of $\Theta = 0^\circ$ and at the center of the LCD
surface. Luminance shall be measured with all pixels in the view field set first to white, then to the

dark (black) state. (See FIG. 1) Luminance Contrast Ratio (CR) is defined mathematically.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

3. Surface luminance is the center point across the LCD surface 50cm from the surface with all
pixels displaying white. This measurement shall be taken at the locations shown in FIG. 2.
4. Uniformity measurement shall be taken at the locations shown in FIG. 2&3, for a total of the
measurements per display, measure surface luminance of these nine points across the LCD surface

50cm from the surface with all pixels displaying white.

$$\text{Uniformity} = \frac{\text{Min Luminance of 9 points}}{\text{Max Luminance of 9 points}} \times 100\%$$

5. The color chromaticity coordinates specified in Table1 shall be calculated from The spectral data
measured with all pixels first in red, green, blue and white. Measurements shall be made at the
center of the Module.
6. The electro-optical response time measurements shall be made as FIG.4 by switching the "data"
input signal ON and OFF.

The times needed for the luminance to change from 10% to 90% is Tr and 90% to 10% is Tf.

Figure 1. The definition of Vth & Vsat

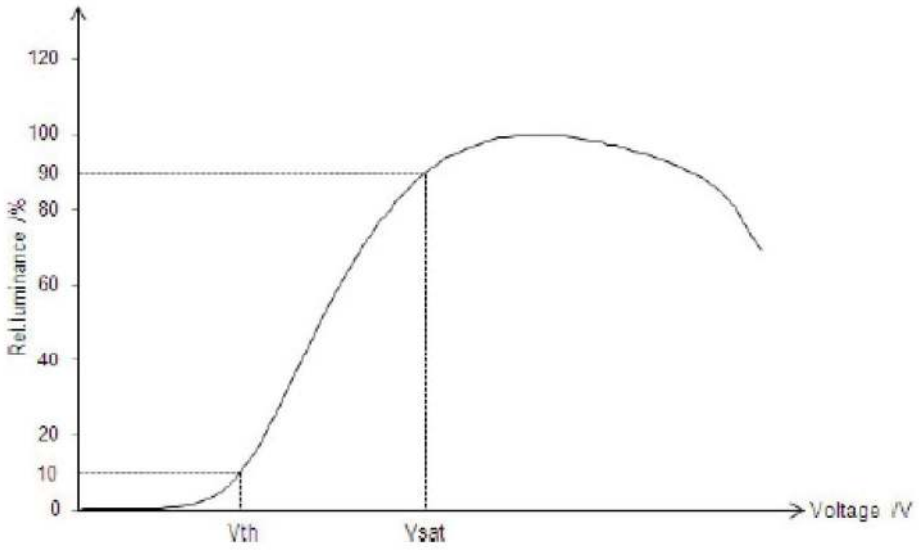


Figure 2. Measurement Set Up

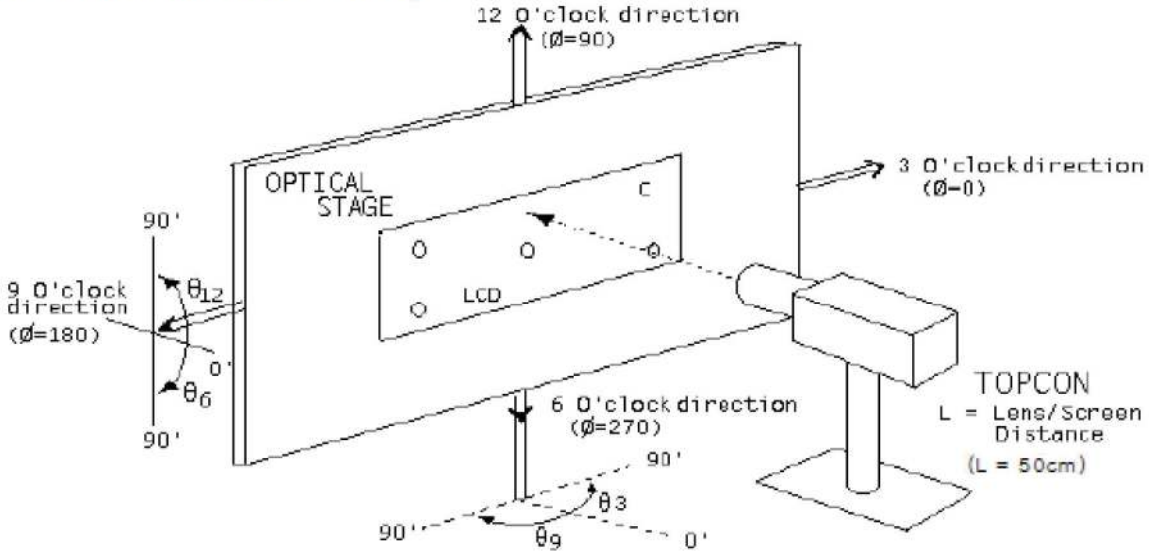


Figure 3. Uniformity Measurement Locations

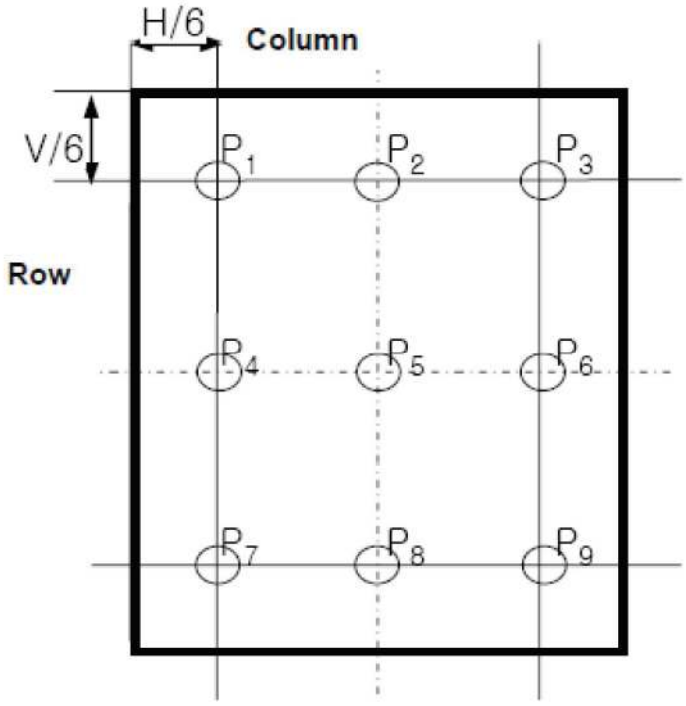
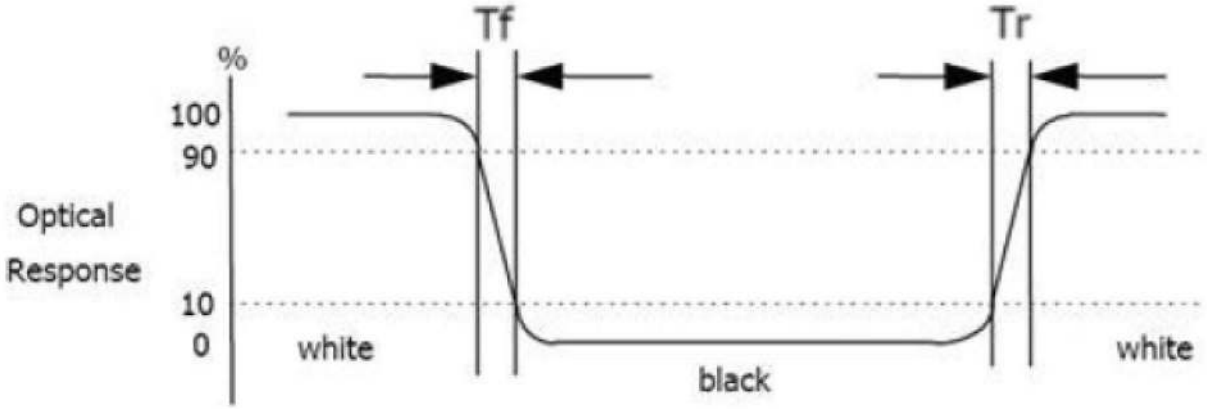


Figure 4. Response Time Testing



8 Display Command

Please refer to ST7789H2 DATASHEET.

9 Recommended Software Initialization

```
void Init_IC()
{
WriteComm(0x11);
   delay_ms(60);
WriteComm(0x36);
WriteData (0x00);
WriteComm(0x3a);
WriteData (0x05);
WriteComm(0x21);
WriteComm(0xE7);
WriteData (0x00);   //2 data;00-1data
WriteComm(0x2a);
WriteData (0x00);
WriteData (0x00);
WriteData (0x01);
WriteData (0x3f);
WriteComm(0x2b);
WriteData (0x00);
WriteData (0x00);
WriteData (0x01);
WriteData (0x3f);
//---ST7789V Frame rate setting------//
WriteComm(0xb2);
WriteData (0x0c);
WriteData (0x0c);
WriteData (0x00);
WriteData (0x33);
WriteData (0x33);
WriteComm(0xb7);
WriteData (0x35);
```

```
//--------ST7789V Power setting--------//
WriteComm(0xbb);
WriteData (0x1f);
WriteComm(0xc0);
WriteData (0x2c);
WriteComm(0xc2);
WriteData (0x01);
WriteComm(0xc3);
WriteData (0x12);
WriteComm(0xc4);
WriteData (0x20);
WriteComm(0xc6);
WriteData (0x0f);
WriteComm(0xd0);
WriteData (0xa4);
WriteData (0xa1);
```

```
//--------------ST7789V
WriteComm(0xe0);
WriteData (0xd0);
WriteData (0x08);
WriteData (0x11);
WriteData (0x08);
WriteData (0x0c);
WriteData (0x15);
WriteData (0x39);
WriteData (0x33);
WriteData (0x50);
WriteData (0x36);
WriteData (0x13);
WriteData (0x14);
WriteData (0x29);
WriteData (0x2d);
WriteComm(0xe1);
WriteData (0xd0);
WriteData (0x08);
WriteData (0x10);
```

```
WriteData (0x08);
WriteData (0x06);
WriteData (0x06);
WriteData (0x39);
WriteData (0x44);
WriteData (0x51);
WriteData (0x0b);
WriteData (0x16);
WriteData (0x14);
WriteData (0x2f);
WriteData (0x31);
WriteComm(0x29);
}
```

10 RELIABILITY TEST

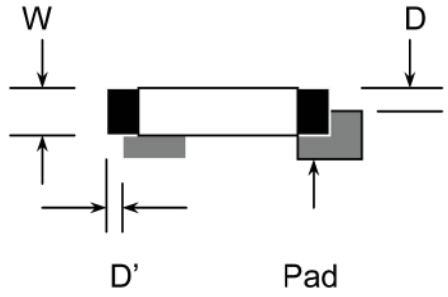
10.1 Reliability Test Condition

NO	Item	Test Condition	
1	High Temperature Storage	Storage at 70 ± 2°C 96~100 hrs Surrounding temperature, then storage at normal condition 4hrs	
2	Low Temperature Storage	Storage at -30 ± 2°C 96~100 hrs Surrounding temperature, then storage at normal condition 4hrs	
3	High Temperature /Humidity Storage	1.Storage 96~100 hrs 50 ± 2°C, 85%RH surrounding temperature, then storage at normal condition 4hrs. (Excluding the polarizer). or 2.Storage 96~100 hrs 40 ± 2°C, 85%RH surrounding temperature, then storage at normal condition 4 hrs.	
4	Temperature Cycling	-10°C → 25°C → 60°C → 25°C (30mins) (5mins) (30mins) (5mins) 10 Cycle	
5	Vibration	10~55Hz (1 minute) 1.5mm X,Y and Z direction * (each 2hrs)	
6	ESD Test	Air Discharge: Apply 6 KV with 5 times discharge for each polarity +/-	Contact Discharge: Apply 250V with 5 times discharge for each polarity +/-
		Testing location: Around the face of LCD	Testing location: 1.Apply to bezel. 2.Apply to Vdd, Vss.
7	Drop Test	Packing Weight (Kg)	Drop Height (cm)
		0 ~ 45.4	122
		45.4 ~ 90.8	76
		90.8 ~ 454	61
		Over 454	46

10.2 Inspection Specification

Table Normal Inspection Single Sampling Level II, Equipment : Gauge , MIL-STD , Sona Tester , Sample
IQC Defect Level : Major Defect AQL 0.65; Minor Defect AQL 1.5
FQC Defect Level : 100% Inspection
OUT Going Defect Level : Sampling
Specification :

NO	Item	Specification	Judge	Level
1	Part Number	The part number is inconsistent with work order of production	N.G.	Major
2	Quantity	The quantity is inconsistent with work order of production	N.G.	Major
3	Electronic characteristics of LCM A=(L + W)／2	The display lacks of some patterns.	N.G.	Major
		Missing line.	N.G.	Major
		The size of missing dot, A is > 1/2 Dot size	N.G.	Major
		There is no function.	N.G.	Major
		Output data is error	N.G.	Major
4	Appearance of LCD A=(L + W)／2 Dirty particle (Including scratch、bubble)	Material is different with work order of production	N.G.	Major
		LCD is assembled in inverse direction	N.G.	Major
		Bezel is assembled in inverse direction	N.G.	Major
		Shadow is within LCD viewing area + 0.5 mm	N.G.	Major
		The diameter of dirty particle, A is > 0.4 mm	N.G.	Minor
		Dirty particle length is > 3.0mm, and 0.01mm < width ≤ 0.05mm	N.G.	Minor
		Display is without protective film	N.G.	Minor
		Conductive rubber is over bezel 1mm	N.G.	Minor
		Polarizer exceeds over viewing area of LCD	N.G.	Minor
		Area of bubble in polarizer, A > 1.0mm, the number of bubble is > 1 piece.	N.G.	Minor
		0.4mm < Area of bubble in polarizer, A < 1.0mm, the number of bubble is > 4 pieces.	N.G.	Minor
5	Appearance of PCB A=(L + W)／2	Burned area or wrong part number is on PCB	N.G.	Major
		The symbol, character, and mark of PCB are unidentifiable.	N.G	Minor
		The stripped solder mask , A is > 1.0mm	N.G.	Minor
		0.3mm < stripped solder mask or visible circuit, A < 1.0mm, and the number is ≥ 4 pieces	N.G.	Minor
		There is particle between the circuits in solder mask	N.G	Minor
		The circuit is peeled off or cracked	N.G	Minor
		There is any circuits risen or exposed.	N.G	Minor
		0.2mm < Area of solder ball, A is ≤ 0.4mm The number of solder ball is ≥ 3 pieces	N.G	Minor
		The magnitude of solder ball, A is > 0.4mm.	N.G	Minor

NO	Item	Specification	Judge	Level
6	Appearance of molding A=(L + W)/2	The shape of modeling is deformed by touching.	N.G.	Major
		Insufficient epoxy: Circuit or pad of IC is visible	N.G.	Minor
		Excessive epoxy: Diameter of modeling is > 20mm or height is > 2.5mm	N.G.	Minor
		The diameter of pinhole in modeling, A is > 0.2mm.	N.G.	Minor
7	Appearance of frame A=(L + W)/2	The folding angle of frame must be > 45°+ 10°	N.G.	Minor
		The area of stripped electroplate in top-view of frame, A is > 1.0mm.	N.G.	Minor
		Rust or crack is (Top view only)	N.G.	Minor
		The scratched width of frame is > 0.06mm. (Top view only)	N.G.	Minor
8	Electrical characteristic of backlight A=(L + W)/2	The color of backlight is nonconforming	N.G.	Major
		Backlight can't work normally.	N.G.	Major
		The LED lamp can't work normally	N.G.	Major
		The unsoldering area of pin for backlight, A is > 1/2 solder joint area.	N.G.	Minor
		The height of solder pin for backlight is > 2.0mm	N.G.	Minor
10	Assembly parts A=(L + W)/2	The mark or polarity of component is unidentifiable.	N.G.	Minor
		The height between bottom of component and surface of the PCB is floating > 0.7mm	N.G.	Minor
		D > 1/4W 	N.G.	Minor
		End solder joint width, D' is > 50% width of component termination or width of pad	N.G.	Minor
		Side overhang, D is > 25% width of component termination.	N.G.	Minor
		Component is cracked, deformed, and burned, etc.	N.G.	Minor
		The polarity of component is placed in inverse direction.	N.G.	Minor
		Maximum fillet height of solder extends onto the component body or minimum fillet height is < 0.5mm.	N.G.	Minor

11 PACKING METHOD

TBD

12 HANDDLING & CAUTIONS

12.1 Mounting Method

● The panel of the LCM consists of two thin glasses with polarizer which easily get damaged. So extreme care should be taken when handling the LCM.

● Excessive stress or pressure on the glass of the LCM should be avoided. Care must be taken to insure that no torsional or compressive forces are applied to the LCM unit when it is mounted.

● If the customer's set presses the main parts of the LCM, the LCM may show the abnormal display. But this phenomenon does not mean the malfunction of the LCM and should be pressed by the way of mutual agreement.

● To determine the optimum mounting angle, refer to the viewing angle range in the specification for each model.

● Mount a LCM with the specified mounting parts.

12.2 Caution of LCM Handling and Cleaning

● Since the LCM is made of glass, do not apply strong mechanical impact or static load onto it. Handling with care since shock, vibration, and careless handling may seriously affect the product. If it falls from a high place or receives a strong shock, the glass maybe broken.

● The polarizer on the surface of panel are made from organic substances. Be very careful for chemicals not to touch the polarizer or it leads the polarizer to be deteriorated.

● If the use of a chemical is unavoidable, use soft cloth with solvent recommended below to clean the LCM's surface with wipe lightly.

-IPA (Isopropyl Alcohol), Ethyl Alcohol, Tri-chloro, tri-florothane.

● Do not wipe the LCM's surface with dry or hard materials that will damage the polarizer and others. Do not use the following solvent—Water, acetone, Aromatics.

● It is recommended that the LCM be handled with soft gloves during assembly, etc. The polarizer on the LCM's surface are vulnerable to scratch and thus to be damaged by shape particles.

● Do not drop water or any chemicals onto the LCM's surface.

● A protective film is supplied on the LCM and should be left in place until the LCM is required for operation.

● The ITO pad area needs special careful caution because it could be easily corroded. Do not

contact the ITO pad area with HCFC, Soldering flux, Chlorine, Sulfur, saliva or fingerprint. To prevent from the ITO corrosion, customers are recommended that the ITO area would be covered by UV or silicon.

- Please clean the LCD without ultrasonic to avoid line open.

12.3 Caution Against Static Charge

- The LCM use C-MOS LSI drivers, so customers are recommended that any unused input terminal would be connected to Vdd or Vss, do not input any signals before power is turn on, and ground you body, work/assembly area, assembly equipments to protect against static electricity.
- Remove the protective film slowly, keeping the removing direction approximate 30-degree not vertical from panel surface, if possible, under ESD control device like ion blower, and the humidity of working room should be kept over 50%RH to reduce the risk of static charge.
- Avoid the use work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.
- In handling the LCM, wear non-charged material gloves. And the conducting wrist to the earth and the conducting shoes to the earth are necessary.

12.4 Caution For Operation

- It is indispensable to drive the LCM within the specified voltage limit since the higher voltage than the limit causes LCM's life shorter. An electro-chemical reaction due to DC causes undesirable deterioration of the LCM so that the use of DC drive should avoid.
- Do not connect or disconnect the LCM to or from the system when power is on.
- Never use the LCM under abnormal conditions of high temperature and high humidity.
- When expose to drastic fluctuation of temperature(hot to cold or cold to hot), the LCM may be affected; specifically, drastic temperature fluctuation from cold to hot, produces dew on the LCM's surface which may affect the operation of the polarizer on the LCM.
- Response time will be extremely delay at lower temperature than the operating temperature range and on the other hand LCM may turn black at temperature above its operational range. However those phenomenon do not mean malfunction or out of order with the LCM. The LCM will revert to normal operation once the temperature returns to the recommended temperature range for normal operation.
- Do not display the fixed pattern for a long time because it may develop image sticking due to

the LCM structure. If the screen is displayed with fixed pattern, use a screen saver.

- Do not disassemble and/or re-assemble LCM module

12.5 Packaging

- Modules use LCM element, and must be treated as such.

-Avoid intense shock and falls from a height.

-To prevent modules from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity for long periods.

12.6 Storage

- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit. Relative humidity of the environment should therefore be kept below 60%RH.
- Original protective film should be used on LCM's surface (polarizer). Adhesive type protective film should be avoided, because it may change color and/or properties of the polarizer.
- Do not store the LCM near organic solvents or corrosive gasses.
- Keep the LCM safe from vibration, shock and pressure.
- Black or white air-bubbles may be produced if the LCM is stored for long time in the lower temperature or mechanical shocks are applied onto the LCM.
- In the case of storing for a long period of time for the purpose or replacement use, the following ways are recommended.

-Store in a polyethylene bag with sealed so as not to enter fresh air outside in it.

-Store in a dark place where neither exposure to direct sunlight nor light is.

-Keep temperature in the specified storage temperature range.

-Store with no touch on polarizer surface by the anything else. If possible, store the LCM in the packaging situation when it was delivered.

12.7 Safety

- For the crash damaged or unnecessary LCM, it is recommended to wash off liquid crystal by either of solvents such as acetone and ethanol an should be burned up later.
- In the case of LCM is broken, watch out whether liquid crystal leaks out or not. If your hands touch the liquid crystal, wash your hands cleanly with water and soap as soon as possible.
- If you should swallow the liquid crystal, first, wash your mouth thoroughly with water, then

drink a lot of water and induce vomiting, and then, consult a physician.

- If the liquid crystal get in your eyes, flush your eyes with running water for at least fifteen minutes.
- If the liquid crystal touches your skin or clothes, remove it and wash the affected part of your skin or clothes with soap and running water.