YEEBO LCD Limited

LCM Specialist

SPECIFICATION
FOR CTP MODULE

MODULE NO: YB-TG240240C02B-C-A

Doc.Version:01

Customer Approval:

☐ Accept	☐ Reject

YEEBO	NAME	SIGNATURE	DATE
Prepare	Mechanical Engineer		2017-8-20
Check	Electronic Engineer		2017.08.24
Verify			
Approval			2017-8-24

☐APPROVAL FOR SPECIFICATIONS ONLY

■APPROVAL FOR SPECIFICATIONS AND SAMPLE

WIMRD005-02-C

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1. Revision History

Sample Version	DOC. Version	DATE	DESCRIPTION		CHANGED BY
A1	00	2017-3-21	FULL SPEC	First sample submission	Chen
A1	01	2017-8-23	FULL SPEC	Modify glass material(Dragontrail to soda-lime glass)	Chen

2. Table of Contents:

3. Module Numbering System:

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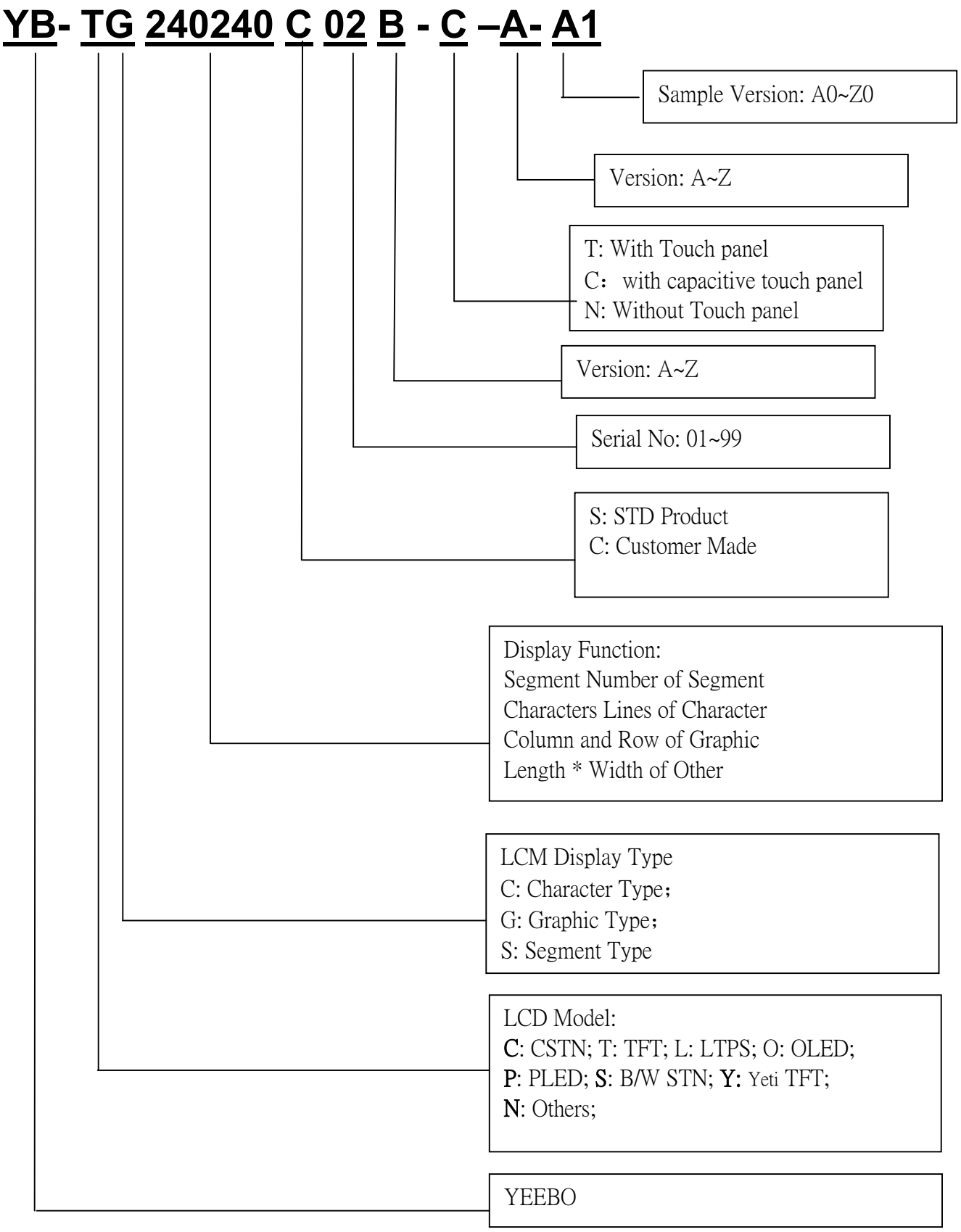
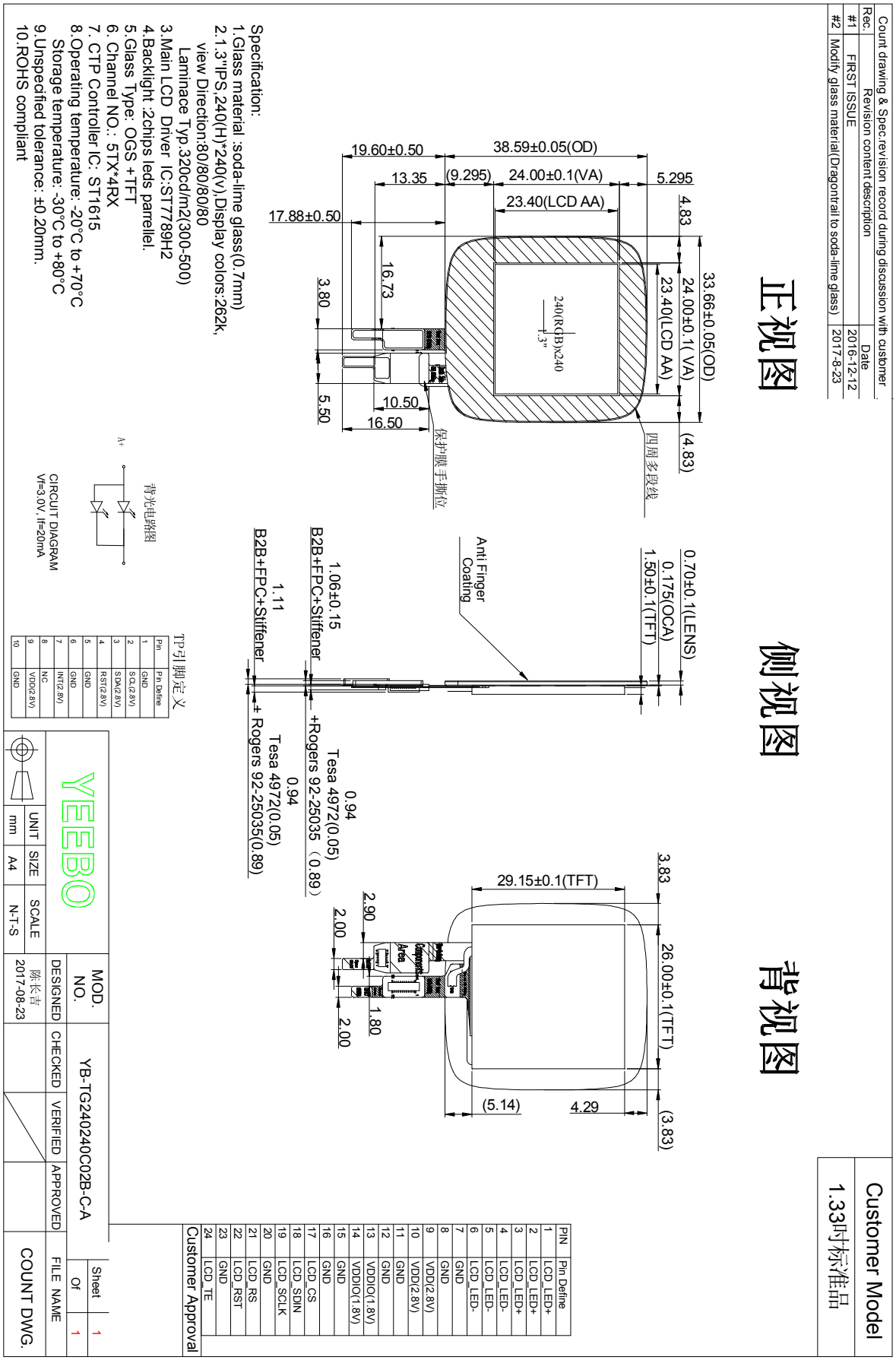


4. General Specification:

ITEM	CONTENTS
Module Size	33.66(W) *38.59(H) * 2.375(T) mm
Display Size(Diagonal)	1.3inch
Display Format	240 (RGB)* 240 Pixels
View Area	24.0 (W) * 24.0(H) mm
Active Area	23.4(W) *23.4(H) mm
LCD Type	TFT (262K)/ Trans missive / Normal Black
Viewing Direction	80/80/80/80
TFT Controller IC	ST7789H2
CTP Controller IC	ST1615
CTP Surface Hardness	>6H
Weight(g)	≈4.96

5. Module drawing:



6 Module Interface

6.1 TFT module interface

NO	SYMBOL	FUNCTION
1	LEDA	LED Anode
2	LEDA	LED Anode
3	LEDA	LED Anode
4	LEDK	LED Cathode
5	LEDK	LED Cathode
6	LEDK	LED Cathode
7	GND	Power Ground
8	GND	Power Ground
9-10	VDD	Power Supply for Analog, VDD_2.8V=2.4V~3.3V.
11-12	GND	Power Ground
13-14	VDDIO	Power Supply for I/O system. IOVCC=1.65V~3.3V
15-16	GND	Power Ground
17	CS	Chip selection pin; Low enable, High disable.
18	SDA	SPI interface input/output pin. The data is latched on the rising edge of the SCL signal.
19	SCL	This pin is used to be serial interface clock.
20	GND	Power Ground
21	RS	Display data/command selection pin
22	RES	This signal will reset the device and it must be applied to properly initialize the chip. Signal is active low.
23	GND	Power Ground
24	TE	TE-Tearing effect signal is used to synchronize mcu to frame memory.

6.2 CTP Interface

NO	SYMBOL	FUNCTION
1	GND	Power Ground
2	SCL	I2C serial clock
3	SDA	I2C serial date
4	RST	System reset signal input, active low
5	GND	Power Ground
6	GND	Power Ground
7	INT	Indicate coordinate data ready
8	NC	No connect
9	VDD	Power supply, connect to 1uF capacitor
10	GND	Power Ground

7 ELECTRICAL SPECIFICATIONS

7.1 DC characteristics

Item	Symbol	Unit	Condition	Min.	Type	Max.	Note
Power and Operation Voltage							
Analog Operating Voltage	VIC	V	Operation Voltage	2.4	2.8	3.3	Note2
Logic Operating Voltage	VDDI	V	I/O Supply Voltage	1.65	2.8	3.3	Note2
Digital Operating Voltage	VCORE	V	Digital Supply Voltage	-	1.5	-	Note2
Driver Supply Voltage	-	V	-	-	-	32	Note3
Input and Output							
Logic High 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 High 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 High level Input Current	IIH	auk	-	-	-	1	Note1,2,3
Logic Low level Input Current	IIL	auk	-	-1.0	-	-	Note1,2,3
Logic Input Leakage Current	ILEA	auk	VIN=VDDI or VSS	-0.1	-	0.1	Note1,2,3

Note:

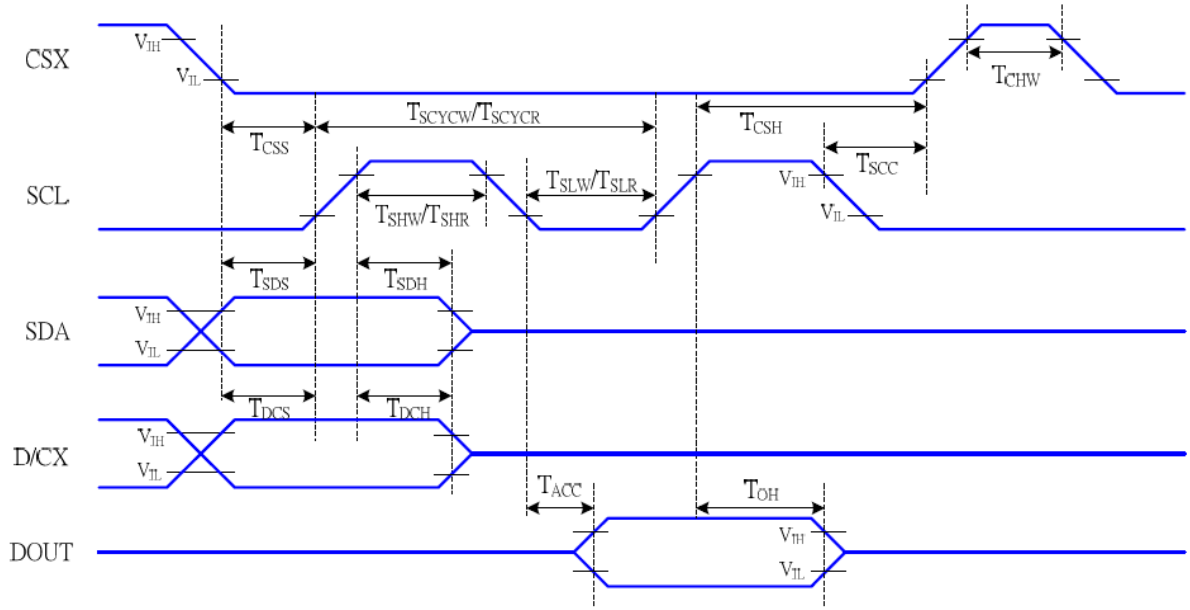
1:VDDI=1.65 to 3.3V,VCI=2.4 to 3.3V,AGND=VSS=0V,Ta=-30 to 70(to +85 no damage)℃

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.

7.2 AC Characteristics

7.2.1 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 (Try, Ft.) 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 TP ELECTRICAL SPECIFICATIONS

Item	Specification					Remarks
6-1 Supply voltage for logic	Symbol	Min	Typ	Max	Unit	-
	V_{DD}	2.7	-	3.6	V	
6-2 Insulation resistance	≧20M Ω(DC 25V)					-
6-3 Linearity	Center of VA≦2.0mm(Ø8mm) Edge of VA≦4.0mm(Ø8mm) Test size: Ø8.0mm The height of hover=20mm					Use Linear Teste

6-4 Timing Characteristics

I²C interface

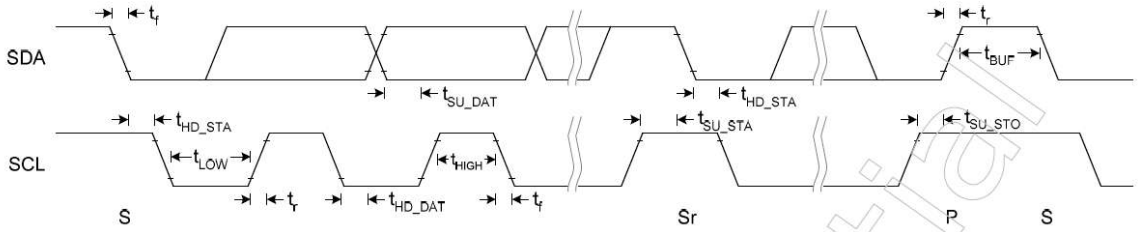


Figure 5-1 I2C Fast Mode Timing

Conditions: VDD = 3.3V, GND = 0V, T_A = 25°C

Symbol	Parameter	Rating			Unit
		Min.	Typ.	Max.	
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

7.4 Backlight Driving Conditions

Parameter	Symbol	Min	Type	Max	Unit	Remark
LED Forward Voltage	V_F		3.0		V	-
LED Forward Current	I_F		20		mA	-
Led Power Consumption	P_{LED}		60		mow	Note 1

Notes:

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

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

7.5Cell Power Consumption

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

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

8 Powers 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.

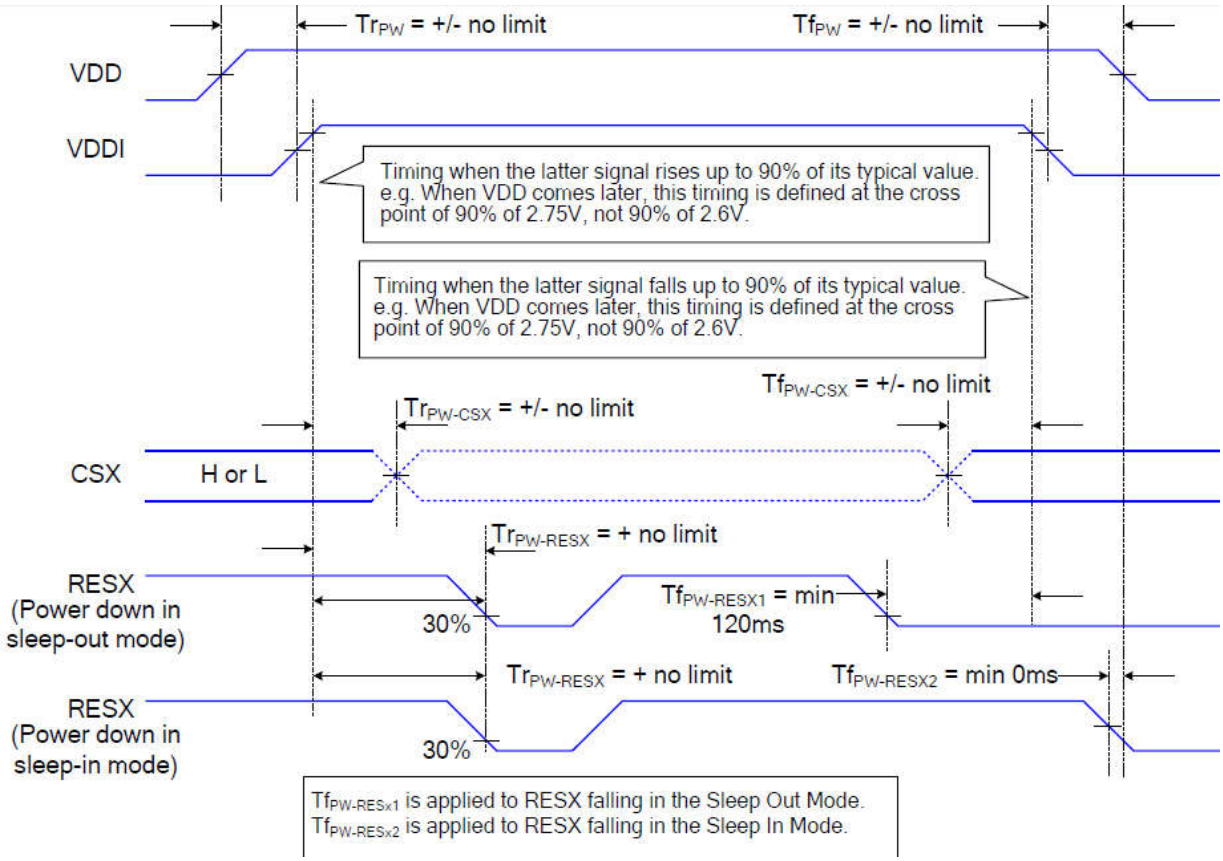
Note 1: There will be no damage to the display module if the power sequences are not met.

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 owner On Sequence is complete to ensure correct operation. Otherwise function is not guaranteed.

The power on/off sequence is illustrated below



9 OPTICAL SPECIFICATIONS

9.1 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.

9.2 Optical Specifications

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Threshold Voltage		Vast		4.1	4.3	4.5	V	Fig.1
		VT		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
		Rye		0.295	0.310	0.325		
	Green	Go		0.280	0.295	0.310		
		Gee		0.503	0.518	0.533		
	Blue	Box		0.127	0.142	0.157		
		By		0.128	0.143	0.158		
White		Wax	Θ= 0°		TBD			
		WY			TBD			
Response Time		Trot	Θ= 0°		35	50	mm s	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 Θ = 0° 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, and 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 trying and 90% to 10% is Ft.

Figure 1. The definition of Vth & Vsat

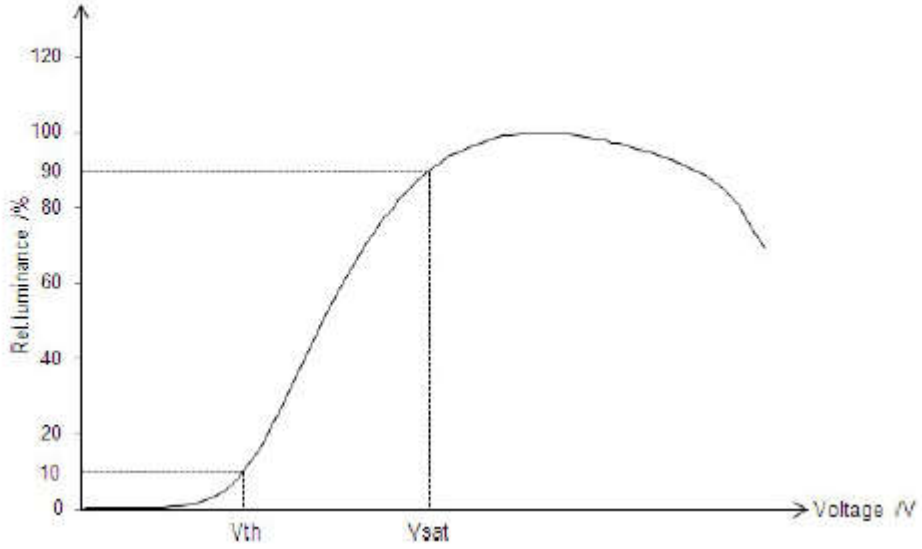


Figure 2. Measurement Set Up

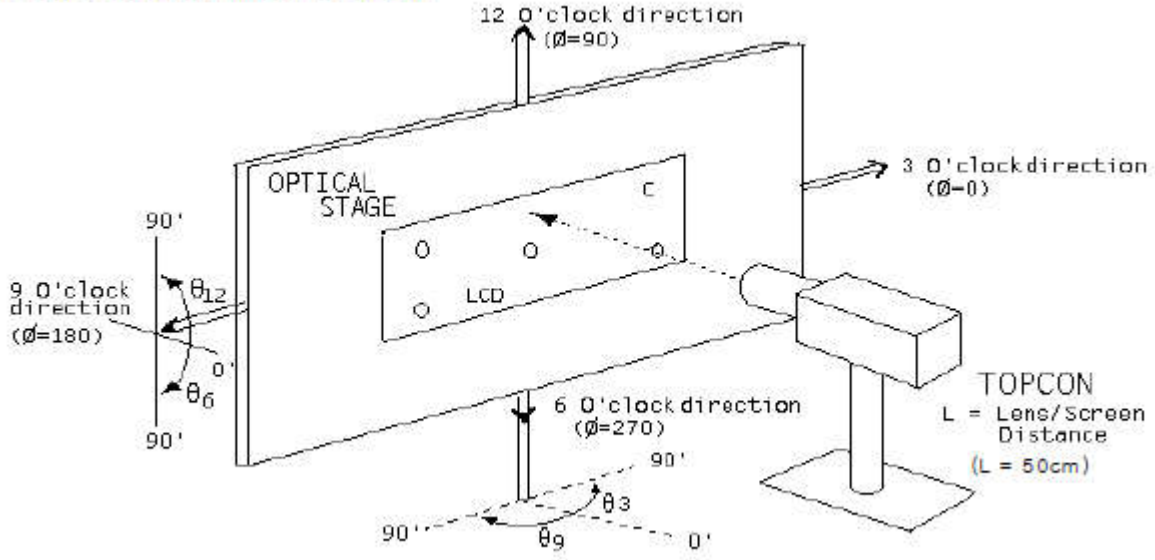


Figure 3. Uniformity Measurement Locations

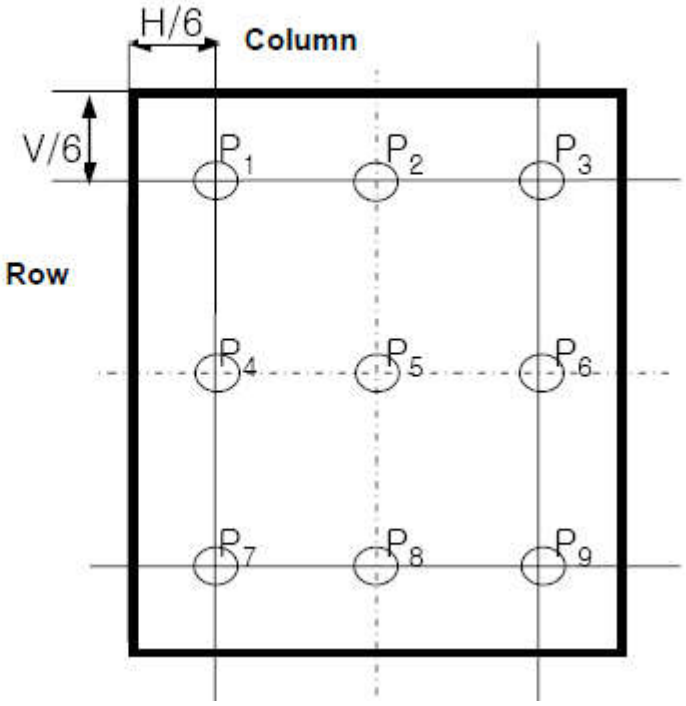
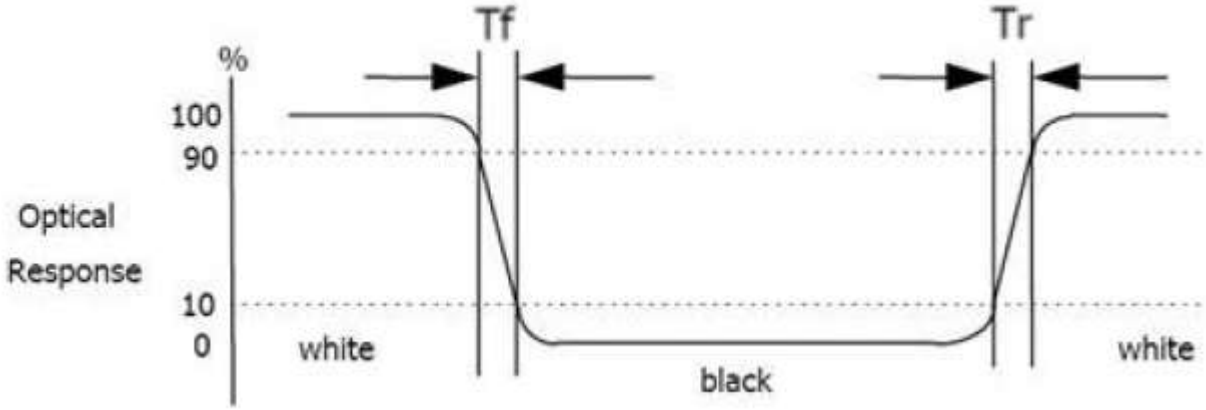


Figure 4. Response Time Testing



10. Specification of Quality Assurance:

10-1. Purpose

This standard for Quality Assurance should affirm the quality of LCD module products to supply to purchaser by YEEBO CORPORATION (Supplier).

10-2. Standard for Quality Test

a. Inspection:
Before delivering, the supplier should take the following tests, and affirm the quality of product.

b. Electro-Optical Characteristics:
According to the individual specification to test the product.

c. Test of Appearance Characteristics:
According to the individual specification to test the product.

d. Test of Reliability Characteristics:
According to the definition of reliability on the specification for testing products.

e. Delivery Test:
Before delivering, the supplier should take the delivery test.

(i) Test method: According to MIL-STD105E.General Inspection Level Ⅱ take a single time.

(ii) The defects classify of AQL as following:
Major defect: AQL = 0.65%
Minor defect: AQL = 2.5%
Total defects: AQL = 2.5%

10-3. Non- conforming Analysis & Deal With Manners

a. Non- conforming Analysis:

(i) Purchaser should supply the detail data of non- conforming sample and the non-conforming.

(ii) After accepting the detail data from purchaser, the analysis of non- conforming should be finished in two weeks.

(iii) If supplier can not finish analysis on time, must announce purchaser before 3 days.

b. Disposition of non- conforming:

(i) If find any product defect of supplier during assembly time, supplier must change the good product for every defect after recognition.

(ii) Both supplier and customer should analyze the reason and discuss the disposition of non-conforming when the reason of nonconforming is not sure.

10-4. Agreement items

Both sides should discuss together when the following problems happen.

a. There is any problem of standard of quality assurance, and both sides should think that must be modified.
b. There is any argument item which does not record in the standard of quality assurance.
c. Any other special problem.

10-5. Standard of The Product Appearance Test

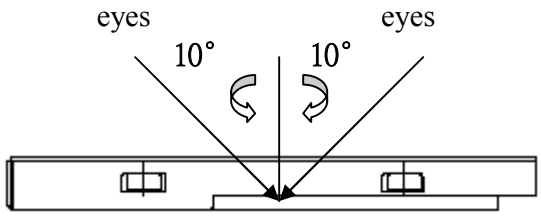
a. Manner of appearance test:

(i) The test must be under 20W × 2 or 40W fluorescent light, and the distance of view must be at 30±5cm.

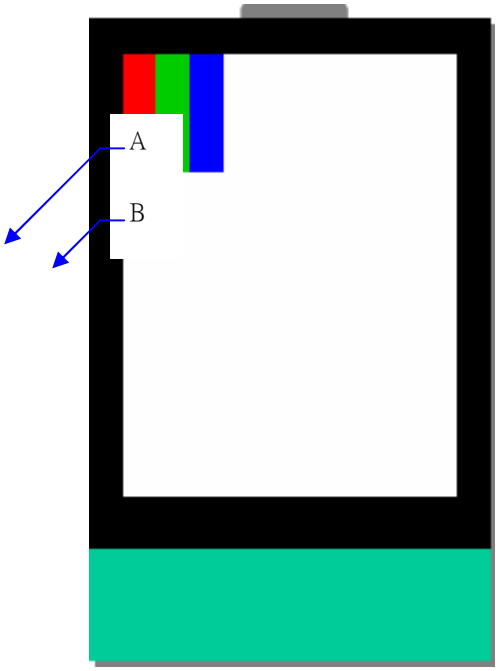
(ii) When test the model of transmissive product must add the reflective plate.

(iii)The test direction is base on around 10° of vertical line.

(iiii)Temperature: 25±5℃ Humidity: 60±10%RH



(iv) Definition of area:



A. Area: Viewing area.

B. Area: Out of viewing area.
(Outside viewing area)

b. Basic principle:

(i) It will accord to the AQL when the standard can not be described.

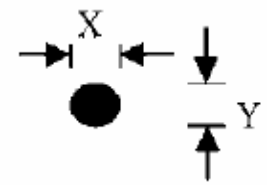
(ii) The sample of the lowest acceptable quality level must be discussed by both supplier and customer when any dispute happened.

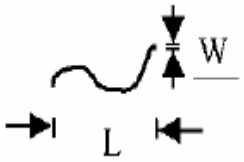
(iii) Must add new item on time when it is necessary.

c. Standard of inspection: (Unit: mm)

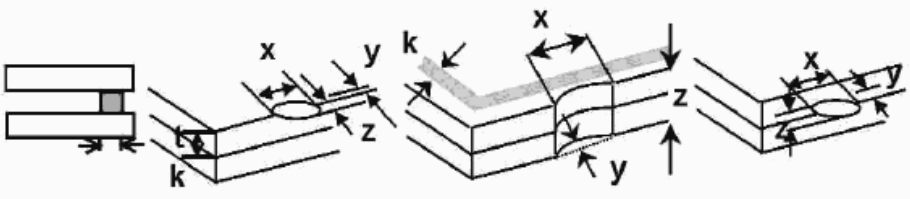
10-6. Inspection specification

Defect out of viewing area can be neglected.

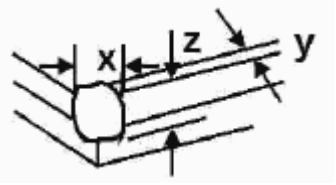
<table>
<tr><th>NO</th><th>Item</th><th>Criterion</th><th>AQL</th></tr>
<tr><td>01</td><td>Electrical Testing</td><td>1.1 Missing vertical, horizontal segment, segment contrast defect.
1.2 Missing character, dot or icon.
1.3 Display malfunction.
1.4 No function or no display.
1.5 Current consumption exceeds product specifications.
1.6 LCD viewing angle defect.
1.7 Mixed product types.
1.8 Flicker</td><td>0.65</td></tr>
<tr><td>02</td><td>Black or White spots or Bright spots or Color spots on LCD (Display only)</td><td>2.1 White and black or color spots on display ≦ 0.25mm, no more than Five spots.
2.2 Densely spaced: No more than three spots within 3mm.</td><td>2.5</td></tr>
<tr><td rowspan="2">03</td><td rowspan="2">LCD and Touch Panel black spots, white spots, contamination (non – display)</td><td>3.1 Round type: As following drawing
Φ = (X+Y) / 2
 

<table>
<tr><th>Size(mm)</th><th>Acceptable Q'ty</th></tr>
<tr><td>Φ≦0.10</td><td>Accept no dense</td></tr>
<tr><td>0.10< Φ≦0.20</td><td>2</td></tr>
<tr><td>0.20< Φ≦0.25</td><td>2</td></tr>
<tr><td>0.25< Φ≦0.30</td><td>1</td></tr>
<tr><td>0.30< Φ</td><td>0</td></tr>
</table>
* Densely spaced: No more than two spots within 3mm.</td><td>2.5</td></tr>
<tr><td>3.2 Line type: (As following drawing)
 

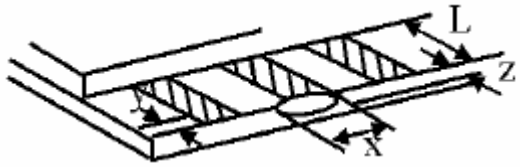
<table>
<tr><th>Length(mm)</th><th>Width(mm)</th><th>Acceptable Q'ty</th></tr>
<tr><td>---</td><td>W≦0.02</td><td>Accept no dense</td></tr>
<tr><td>L≦3.0</td><td>0.02<W≦0.05</td><td rowspan="2">2</td></tr>
<tr><td>L≦2.5</td><td>0.03<W≦0.08</td></tr>
<tr><td>---</td><td>0.08<W</td><td>Rejection</td></tr>
</table>
* Densely spaced: No more than two lines within 3mm.</td><td>2.5</td></tr>
</table>

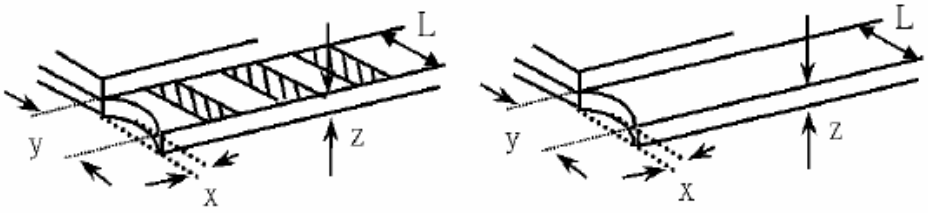
<table>
<tr><th>NO</th><th>Item</th><th>Criterion</th><th>AQL</th></tr>
<tr><td>04</td><td>Polarizer bubbles</td><td>If bubbles are visible, judge using black spot specifications, not easy to find, must check in specify direction
<table>
<tr><td>Size Φ(mm)</td><td>Acceptable Q'ty</td></tr>
<tr><td>Φ≦0.20</td><td>Accept no dense</td></tr>
<tr><td>0.20< Φ≦0.50</td><td>3</td></tr>
<tr><td>0.50< Φ≦1.00</td><td>2</td></tr>
<tr><td>1.00< Φ</td><td>0</td></tr>
<tr><td>Total Q’ty</td><td>3</td></tr>
</table></td><td>2.5</td></tr>
<tr><td>05</td><td>Scratches</td><td>Follow NO.3 -2 Line Type.</td><td></td></tr>
<tr><td>06</td><td>Chipped glass</td><td>Symbols:
x: Chip length y: Chip width z: Chip thickness
k: Seal width t: Glass thickness a: LCD side length
L: Electrode pad length
6.1 General glass chip:
6.1.1 Chip on panel surface and crack between panels:
 

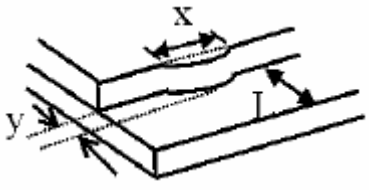
<table>
<tr><td>z: Chip thickness</td><td>y: Chip width</td><td>x: Chip length</td></tr>
<tr><td>Z≦1/2t</td><td>Not over viewing area</td><td>x≦1/8a</td></tr>
<tr><td>1/2t< z≦2t</td><td>Not exceed 1/3k</td><td>x≦1/8a</td></tr>
</table>
⊙ Unit: mm
⊙ If there are 2 or more chips, x is the total length of each chip

6.1.2 Corner crack:
 

<table>
<tr><td>z: Chip thickness</td><td>y: Chip width</td><td>x: Chip length</td></tr>
<tr><td>Z≦1/2t</td><td>Not over viewing area</td><td>x≦1/8a</td></tr>
<tr><td>1/2t< z≦2t</td><td>Not exceed 1/3k</td><td>x≦1/8a</td></tr>
</table>
⊙ Unit: mm
⊙ If there are 2 or more chips, x is the total length of each chip</td><td>2.5</td></tr>
</table>

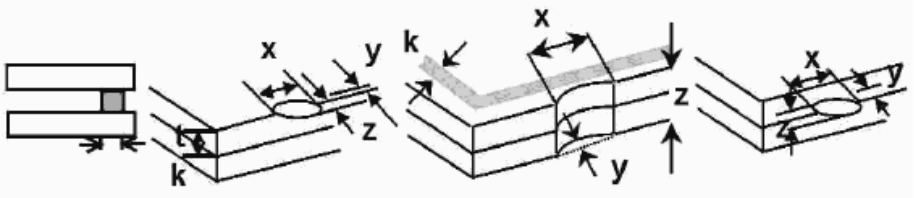
<table>
<tr><th>NO</th><th>Item</th><th>Criterion</th><th>AQL</th></tr>
<tr><td>07</td><td>Glass crack</td><td>
Symbols:
x: Chip length y: Chip width z: Chip thickness
k: Seal width t: Glass thickness a: LCD side length
L: Electrode pad length
7.2 Protrusion over terminal:
7.2.1 Chip on electrode pad:


<table>
<tr><td>y: Chip width</td><td>x: Chip length</td><td>z: Chip thickness</td></tr>
<tr><td>y≦0.5mm</td><td>x≦1/8a</td><td>0< z≦t</td></tr>
</table>
7.2.2
Non-conductive portion:


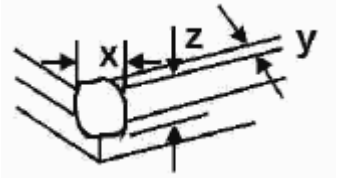
<table>
<tr><td>y: Chip width</td><td>x: Chip length</td><td>z: Chip thickness</td></tr>
<tr><td>y≦L</td><td>x≦1/8a</td><td>0< z≦t</td></tr>
</table>
⊙ If there chipped area touches the ITO terminal, over 2/3 of the ITO must remain and be inspected according to electrode terminal specifications.
⊙ If the product will be heat sealed by the customer, the alignment mark must mot be damaged.
7.2.3 Substrate protuberance and internal crack


<table>
<tr><td>y: width</td><td>x: length</td></tr>
<tr><td>y≦1/3L</td><td>X≦a</td></tr>
</table>
</td><td>2.5</td></tr>
</table>

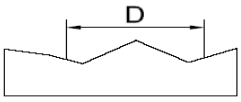
NO	Item	Criterion	AQL
08	Cracked glass	The LCD with extensive crack is not acceptable.	2.5
09	Backlight elements	9.1 Illumination source flickers when lit. 9.2 Spots or scratches that appear when lit must be judged. Using LCD spot, lines and contamination standards. 9.3 Backlight doesn't light or color is wrong.	2.5 2.5 0.65
10	Bezel	Bezel must comply with product specifications.	2.5
11	PCB、COB	11.1 COB seal may not have pinholes larger than 0.2mm or contamination. 11.2 COB seal surface may not have pinholes through to the IC. 11.3 The height of the COB should not exceed the height indicated in the assembly diagram. 11.4 There may not be more than 2mm of sealant outside the seal area on PCB. And there should be no more than three places. 11.5 Parts on PCB must be the same as on the production characteristic chart, There should be no wrong parts, missing parts or excess parts. 11.6 The jumper on the PCB should conform to the product characteristic chart.	2.5 2.5 2.5 2.5 0.65 0.65
12	FPC	12.1 FPC terminal damage ≦ 1/2 FPC terminal width and can not affect the function, we judge accept. 12.2 FPC alignment hole damage ≦ 1/2 alignment area and can not affect the function, we judge accept.	2.5 2.5
13	Soldering	13.1 No cold solder joints, missing solder connections, oxidation or icicle. 13.2 No short circuits in components on PCB or FPC.	2.5 0.65

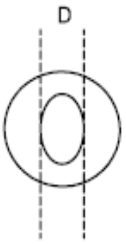
<table>
<tr><th>NO</th><th>Item</th><th>Criterion</th><th>AQL</th></tr>
<tr><td>14</td><td>Touch Panel Chipped glass</td><td>
Symbols:
x: Chip length y: Chip width z: Chip thickness
k: Seal width t: Touch Panel Total thickness a: LCD side length
L: Electrode pad length
14.1 General glass chip:
14.1.1 Chip on panel surface and crack between panels:


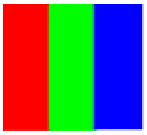
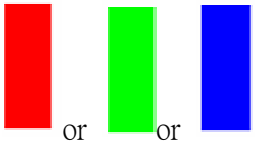
<table>
<tr><th>z: Chip thickness</th><th>y: Chip width</th><th>x: Chip length</th></tr>
<tr><td>Z≦t</td><td>≦1/2 k and not over viewing area</td><td>x≦1/8a</td></tr>
</table>
⊙ Unit: mm
⊙ If there are 2 or more chips, x is the total length of each chip

14.1.2 Corner crack:


<table>
<tr><th>z: Chip thickness</th><th>y: Chip width</th><th>x: Chip length</th></tr>
<tr><td>z≦t</td><td>≦1/2 k a d not over viewing area</td><td>x≦1/8a</td></tr>
</table>
⊙ Unit: mm
⊙ If there are 2 or more chips, x is the total length of each chip
</td><td>2.5</td></tr>
</table>

<table>
<tr><th>NO</th><th>Item</th><th>Criterion</th><th>AQL</th></tr>
<tr><td>15</td><td>Touch Panel(Fish eye、dent and bubble on film)</td><td>
<table>
<tr><th>SIZE(mm)</th><th>Acceptable Q’ty</th></tr>
<tr><td>Φ≦0.2</td><td>Accept no dens</td></tr>
<tr><td>0.2< D ≦0.4</td><td>5</td></tr>
<tr><td>0.4< D ≦0.5</td><td>2</td></tr>
<tr><td>0.5< D</td><td>0</td></tr>
</table>




</td><td>2.5</td></tr>
<tr><td>16</td><td>Touch Panel Newton ring</td><td>Newton ring dimension ≦ 1/2 touch panel area and not affect font and line distortion(≦2.5%) , it is acceptable.</td><td>2.5</td></tr>
<tr><td>17</td><td>Touch Panel Linearity</td><td>Less than 2.5% is acceptable.</td><td>2.5</td></tr>
<tr><td>18</td><td>LCD Ripple</td><td>Touch the touch panel , can not see the LCD ripple.
Pen: R 1.0mm silicon rubber.
Operation Force: 80g</td><td>2.5</td></tr>
<tr><td>19</td><td>General appearance</td><td>19.1 Pin type must match type in specification sheet.
19.2 LCD pin loose or missing pins.
19.3 Product packaging must the same as specified on packaging specification sheet.
19.4 Product dimension and structure must conform to product specification sheet.</td><td>0.65
0.65
0.65
0.65</td></tr>
<tr><td>20</td><td>Touch Panel+LCD</td><td>Pressure produced by water ripple negligible</td><td></td></tr>
<tr><td>21</td><td>Definition of Pixel</td><td>Pixel : Group of Three Sub-pixels (Red, Green ,Blue):
 
Dot : Red or Green or Blue
 
or or
Dot : Any sub-pixel
Bright Dot Defects
Dots (sub-pixels) on display which is bright in the picture and visible at Black Pattern.</td><td></td></tr>
</table>

Dark Dot Defects
Dots(sub-pixels) on display which is dark in the picture and visible at Red/Green/Black/White Pattern.
Neighbor Dot Defects
Two or three neighbor dots (dot: sub-pixel) cluster(R&G,G&B,B&R,or R&G&B).Dot Defects Inspection Criteria
NOTE : Dot out of VA can be ignored.

Items	Inspection Criteria	
	Details	Allowed quantity
Bright Dot	Not Neighbor Dot	2
Dark Dot	Not Neighbor Dot	3
Total acceptable Qty		5

- Size of dot defect is larger than half of one sub-pixel.

11Display Command

Please refer to ST7789H2 DATASHEET.

12. Recommended Software Initialization

```
void Iritic()
{
WriteComm(0x11);
   delays(60);
WriteComm(0x36);
Write Data (0x00);
WriteComm(0x3a);
Write Data (0x05);
WriteComm(0x21);
WriteComm(0xE7);
WriteData (0x00);     //2 data;00-1data
WriteComm(0x2a);
Write Data (0x00);
Write Data (0x00);
Write Data (0x01);

//--------ST7789V Power setting--------//
WriteComm(0xbb);
Write Data (0x1f);
WriteComm(0xc0);
Write Data (0x2c);
Write Data (0x3f);
WriteComm(0x2b);
Write Data (0x00);
Write Data (0x00);
Write Data (0x01);
Write Data (0x3f);
//---ST7789V Frame rate setting------//
WriteComm(0xb2);
Write Data (0x0c);
Write Data (0x0c);
Write Data (0x00);
Write Data (0x33);
Write Data (0x33);
WriteComm(0xb7);
Write Data (0x35);
//--------------ST7789V
WriteComm(0xe0);
Write Data (0xd0);
Write Data (0x08);
Write Data (0x11);
Write Data (0x08);
```

```
WriteComm(0xc2);
Write Data (0x01);
WriteComm(0xc3);
Write Data (0x12);
WriteComm(0xc4);
Write Data (0x20);
WriteComm(0xc6);
Write Data (0x0f);
WriteComm(0xd0);
Write Data (0xa4);
Write Data (0xa1);


Write Data (0x08);
Write Data (0x06);
Write Data (0x06);
Write Data (0x39);
Write Data (0x44);
Write Data (0x51);
Write Data (0x0c);
Write Data (0x15);
Write Data (0x39);
Write Data (0x33);
Write Data (0x50);
Write Data (0x36);
Write Data (0x13);
Write Data (0x14);
Write Data (0x29);
Write Data (0x2d);
WriteComm(0xe1);
Write Data (0xd0);
Write Data (0x08);
Write Data (0x10);
Write Data (0x0b);
Write Data (0x16);
Write Data (0x14);
Write Data (0x2f);
Write Data (0x31);
WriteComm(0x29);
}
```

13.RELIABILITY TEST

13.1 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 Add, 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

13.2 Inspection Specification

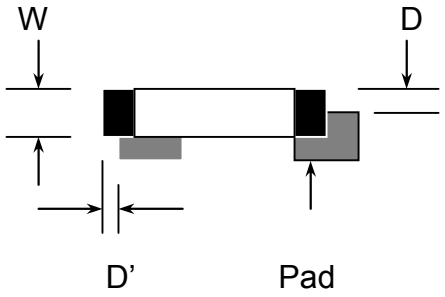
Table Normal Inspection Single Sampling Level II, Equipment: Gauge, MIL-STD, Sonar Tester, and Sample

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, and 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 are any circuits raised 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

14PACKING METHOD

Blister tray packaging

15. HANDDLING & CAUTIONS

15.1 Mounting Method

● The panel of the LCM consists of two thin glasses with polarizer which easily gets 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.

15 .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 is 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 cleaning the LCM's surface with wipe lightly.

-IPA (Isopropyl Alcohol), Ethyl Alcohol, Tri-chloral, 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.

15.3 Cautions against Static Charge

● The LCM use C-MOS LSI drivers, so customers are recommended that any unused input terminal would be connected to Add or Voss, do not input any signals before power is turn on, and ground your body, work/assembly area, assembly equipment's 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.

15.4 Cautions 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 delayed 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

15.5 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.

15.6 Storage

● 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.

15.7 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 and 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 gets 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.