

Shenzhen Leadtek Electronics Co.,Ltd

PRODUCT SPECIFICATION

TFT-LCD MODULE

Module No: LTK020MNXLM14-V0

☒ Preliminary Specification

☐ Approval Specification

Designed by	Checked by	Approved by
<i>jona</i>	<i>tom</i>	<i>lan</i>

Final Approval by Customer

Approved by	Comment

※The specification of "TBD" should refer to the measured value of sample . If there is difference between the design specification and measured value, we naturally shall negotiate and agree to solution with customer.

Records of Revision

Date	Rev.	Description	Page	Remarks
2022/7/22	V0	Initial Released		

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1 General Description

This display module is a transmissive type color active matrix TFT(Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This module is composed of a TFT LCD module, a driver circuit, and a back-light unit. The resolution of a 2.0" contains 480(RGB)X360 dots and can display up to 16.7M colors.

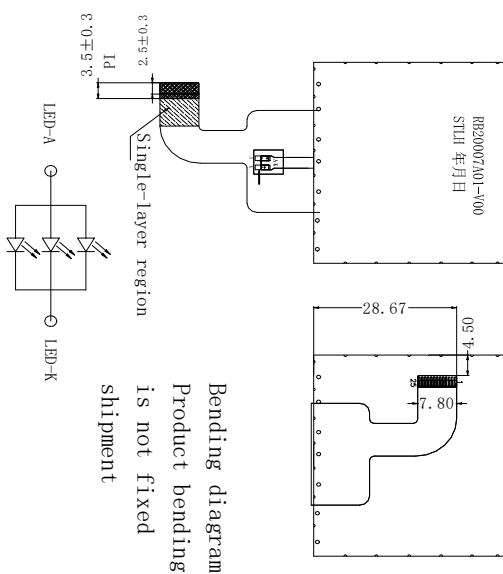
2 Module Parameter

Features	Details	Unit
Display Size(Diagonal)	2.0	inch
LCD type	α -Si TFT	-
Display Mode	IPS / Transmissive / Normally Black	-
Resolution	480xRGB x 360	-
View Direction	All	Best image
Module Outline	44.25(H) × 38.70(V) × 1.96(T) (Note 1)	mm
TP Outline	N/A	mm
TP Viewing Area	N/A	mm
TP Active Area	N/A	mm
Active Area	40.82(H) × 30.62(V)	mm
Viewing Area	N/A	mm
Display Colors	16.7M	-
Interface	MIPI	-
Driver IC	ST7701S	-
Operating Temperature	-20~60	°C
Storage Temperature	-30~70	°C
Weight	TBD	g

Note 1: Excluding hooks, posts , FPC/FPC tail etc.

NOTES:

-



Bending diagram
Product bending
is not fixed
shipment

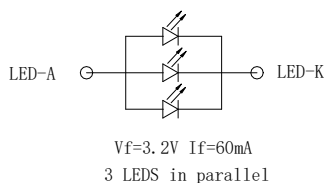
1	RST
2	NC
3	NC
4	GND
5	DS1 TE
6	DAT00 N
7	LEDA
8	DAT00 P
9	LEDA
10	GND
11	LEDR
12	CLK N
13	LEDR
14	CLK P
15	VDDV8
16	GND
17	GND
18	V010V8
19	NC
20	V010V8
21	NC
22	NC
23	NC
24	NC
25	NC

REVISION RECORD		DATE		 LEADTEK COMPANY LIMITED	
NEW RELEASED		2022/06/29			
△		DRAW TYPE :		DRAW NO. : LTR0200NN1M14	
△		Ver. : 00	SCALE : NTS.		
△		DATE	UNIT : mm		
△	DRAWN	DATE	PRO (3):		
△	CHECKED	DATE	SHEET : 1/1		
△	APPROVED	DATE			

4 Module Interface

NO	SYMBOL	FUNCTION
1	RST	This signal will reset the device and it must be applied to properly initialize the chip. Signal is active low.
2	NC	DUMMY
3	NC	DUMMY
4	GND	GND
5	DSI_TE	Tearing effect signal is used to synchronize MCU to frame memory writing.
6	DATA0_N	MIPI Data Lane
7	LEDA	LED Anode
8	DATA0_P	MIPI Data Lane
9	LEDA	LED Anode
10	GND	GND
11	LEDK	LED Cathode
12	CLKN	MIPI Clk
13	LEDK	LED Cathode
14	CLKP	MIPI Clk
15	VDD2V8	Power Supply for Analog, VDD=2.4V~3.3V.
16	GND	GND
17	GND	GND
18	VIO18	Power Supply for I/O system. VDDIO=1.65V~3.3V
19	NC	DUMMY
20	VIO18	Power Supply for I/O system. VDDIO=1.65V~3.3V
21	NC	DUMMY
22	NC	DUMMY
23	NC	DUMMY
24	NC	DUMMY
25	NC	DUMMY

5 Application Circuit



Note: constant current circuit for every LED, and though LED lamp current is less than 20mA. Recommend between 15mA and 20 mA for every LED.

6 Absolute Maximum Ratings

VSS=0V, Ta=25°C

Item		Symbol	Min.	Max.	Unit
Supply Voltage	Power supply	VDD	-0.3	+4.6	V
	Analog	-	-	-	V
	IO	IOVDD	-0.3	+4.6	V
Input Voltage		Vi	-0.3	IOVDD+0.3	V
Storage temperature		T _{stg}	-30	+70	°C
Operating temperature		T _{op}	-20	+60	°C
Storage humidity		H _{stg}	10	Note 1	%RH
Operating humidity		H _{op}	10	Note 1	%RH

Note 1: 90%RH max, If Ta is below 50°C; 60%RH max, If Ta is over 60°C.

7 Electrical Specification

DC Characteristics

Item		Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	Power supply	VDD	2.4	2.8	3.3	V
	Analog	VCI	2.4	2.8	3.3	V
	IO	IOVDD	1.65	1.8/2.8	3.3	V
Logic Low input voltage		V _{IL}	-0.3IOVDD	-	0.3IOVDD	V
Logic High input voltage		V _{IH}	0.7IOVDD	-	IOVDD	V
Logic Low output voltage		V _{OL}	-	-	0.2IOVDD	V
Logic High output voltage		V _{OH}	0.8IOVDD	-	-	V
Current Consumption	Normal display	Ivdd	-	65	-	mA
	Standby mode	Ivdd	-	40	-	uA
Frame Frequency		f _{FR}	-	60	-	Hz

8 AC Characteristics

Reset timing and interface timing:

Please refer to IC datasheet.

9 Command Table

Please refer to IC datasheet.

10 Recommended Setting and Initialization Flow for Reference

Please refer to attached file.

11 Optical Specifications

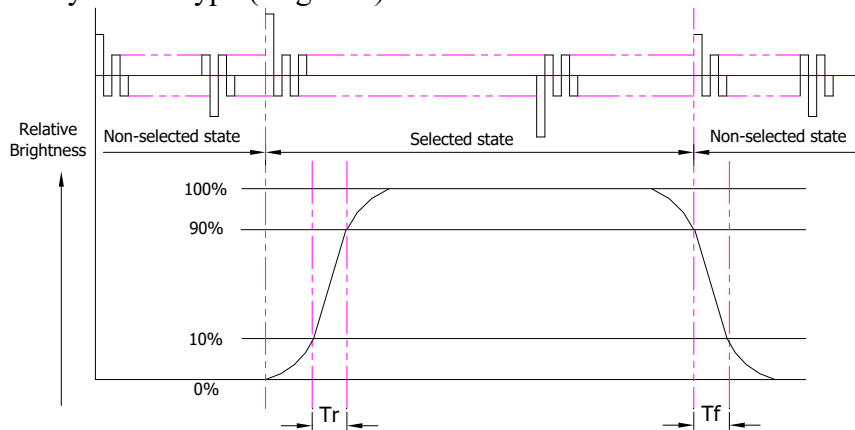
11.1 Optical Specifications

Ta=25°C, VDD=2.8V, TN LC+ Polarizer

Backlight On (Transmissive Mode)	Item		Symbol	Condition	Specification			Unit
					Min.	Typ.	Max.	
	Luminance on surface(I_f =15mA)		L_v	Normally viewing angle $\theta_x=\theta_y=0^{\circ}$	500	550	-	cd/m ²
	Contrast ratio		CR		800	1000	-	-
	Response time		T_{R+Tf}		-	35	45	ms
	Chromaticity Transmissive	Red	X_R	-	TBD	TBD	TBD	-
			Y_R		TBD	TBD	TBD	-
		Green	X_G		TBD	TBD	TBD	-
			Y_G		TBD	TBD	TBD	-
		Blue	X_B		TBD	TBD	TBD	-
			Y_B		TBD	TBD	TBD	-
		White	X_W		0.280	0.310	0.340	-
			Y_W		0.302	0.332	0.362	-
	Viewing Angle	Horizontal	θ_{x+}	Center CR≥10	75	80	-	Deg.
			θ_{x-}		75	80	-	
Vertical		θ_{y+}	75		80	-		
		θ_{y-}	75		80	-		
	NTSC Ratio(Gamut)		-	-	55	60	-	%

11.2 Definition of Response Time

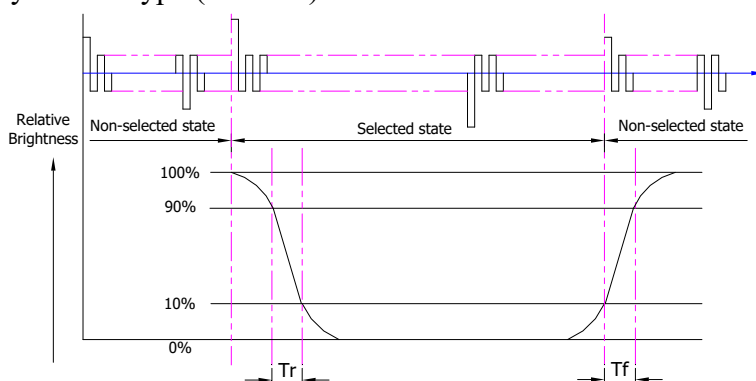
11.2.1 Normally Black Type (Negative)



T_r is the time it takes to change from non-selected state with relative luminance 10% to selected state with relative luminance 90%;

T_f is the time it takes to change from selected state with relative luminance 90% to non-selected state with relative luminance 10%.

11.2.2 Normally White Type (Positive)



T_r is the time it takes to change from non-selected state with relative luminance 90% to selected state with relative luminance 10%;

T_f is the time it takes to change from selected state with relative luminance 10% to non-selected state with relative luminance 90%;

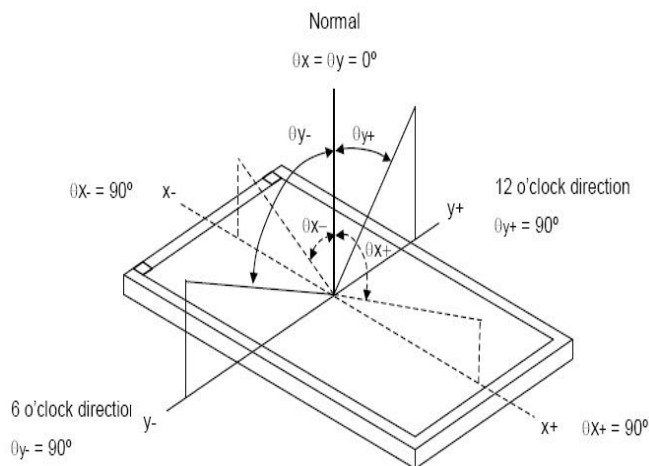
11.3 Definition of Contrast Ratio

Contrast is measured perpendicular to display surface in reflective and transmissive mode. The measurement condition is:

Measuring Equipment	BM-7 or EQUI
Measuring Point Diameter	3mm//1mm
Measuring Point Location	Active Area centre point
Test pattern	A: All Pixels white B: All Pixel black
Contrast setting	Maximum

Definitions: CR (Contrast) = Luminance of White Pixel / Luminance of Black Pixel

11.4 Definition of Viewing Angles



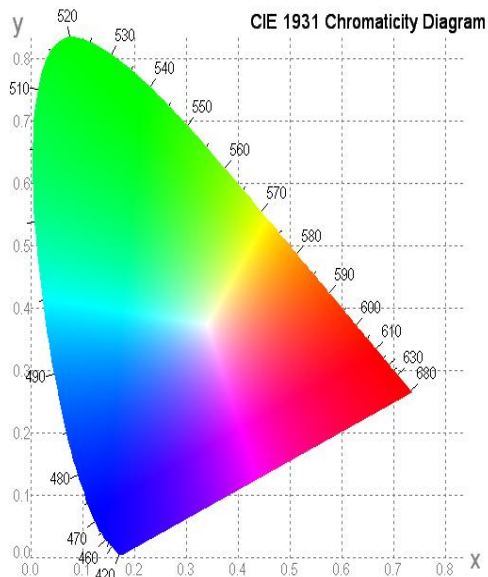
Measuring machine: LCD-5100 or EQUI

11.5 Definition of Color Appearance

R,G,B and W are defined by (x, y) on the IE chromaticity diagram

NTSC=area of RGB triangle/area of NTSC triangleX100%

Measuring picture: Red, Green, Blue and White (Measuring machine: BM-7)



11.6 Definition of Surface Luminance, Uniformity and Transmittance

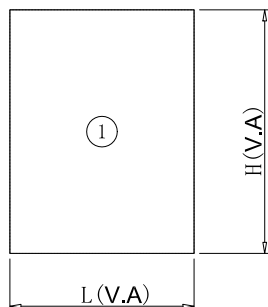
Using the transmissive mode measurement approach, measure the white screen luminance of the display panel and backlight.

11.6.1 Surface Luminance: LV = average (LP1:LP1)

11.6.2 Uniformity = Minimal (LP1:LP1) / Maximal (LP1:LP1) * 100%

11.6.3 Transmittance = LV on LCD / LV on Backlight * 100%

Note :Measuring machine:BM-7



12 Quality Assurance

12.1 Purpose

This standard for Quality Assurance assures the quality of LCD module products supplied to customer by Leadtek-DISPLAY display.

12.2 Agreement Items

Leadtek-DISPLAY and customer shall negotiate if the following situation occurs:

12.2.1 Discrepancies between Leadtek-DISPLAY's QA standards and customer's QA standards. 12.2.2 Additional requirement to be added in product specification.

12.2.3 Any other special problem.

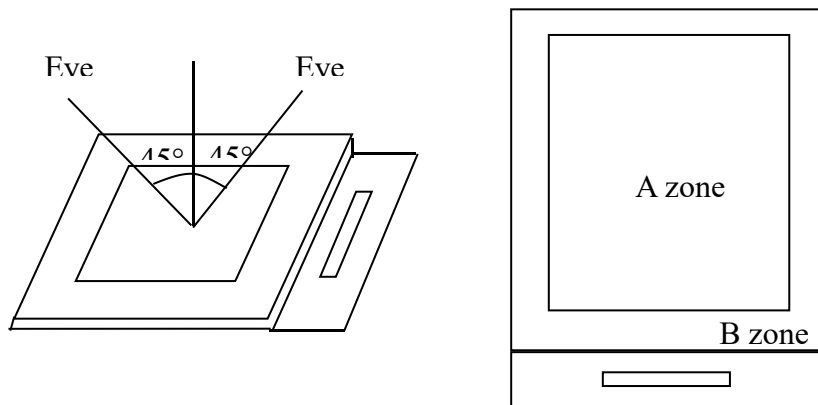
12.3 Standard of the Product Visual Inspection

12.3.1 Appearance inspection:

12.3.1.1 The inspection must be under illumination about 1000 – 1500 lx, and the distance of view must be at 30cm ± 2cm.

12.3.1.2 The viewing angle should be 45° from the vertical line without reflection light or follows customer's viewing angle specifications.

12.3.1.3 Definition of area: A Zone: Active Area, B Zone: Viewing Area.



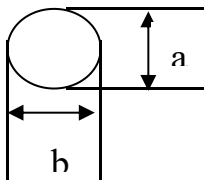
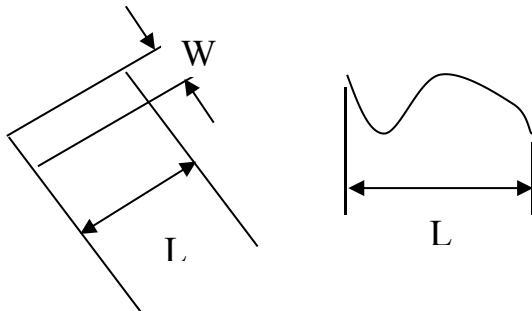
12.3.2 Basic principle:A set of sample to indicate the limit of acceptable quality level must be discussed by both Leadtek-DISPLAY and customer when there is any dispute happened.

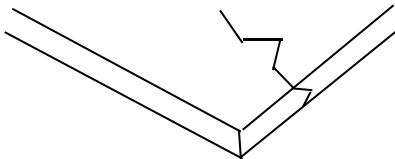
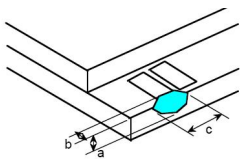
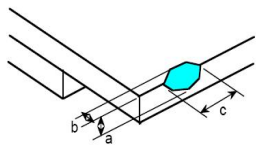
12.4 Inspection Specification

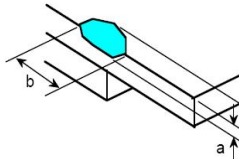
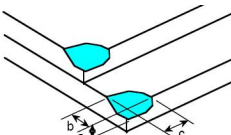
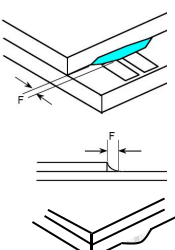
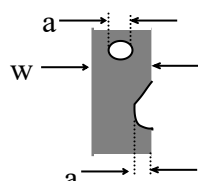
Sampling plan according to GB/T2828.1-2012/ISO 2859-1: 1999 and ANSI/ASQC Z1.4-1993,normal level 2 and based on:

Major defect: AQL 0.4

Minor defect: AQL 1.0

No.	Item	Criteria (Unit: mm)																
01	Black / White spot Foreign material (Round type) Pinholes Stain Particles inside cell. (Minor defect)	 $\varphi = (a + b) / 2$	<table><tr><th>Size \ Area</th><th>Acc. Qty</th></tr><tr><td>$\varphi \leq 0.10$</td><td>Ignore</td></tr><tr><td>$0.10 < \varphi \leq 0.15$</td><td>2</td></tr><tr><td>$0.15 < \varphi \leq 0.20$</td><td>1</td></tr><tr><td>$0.20 < \varphi$</td><td>0</td></tr><tr><td>Total</td><td>2 (no include $\varphi \leq 0.10$)</td></tr></table>	Size \ Area	Acc. Qty	$\varphi \leq 0.10$	Ignore	$0.10 < \varphi \leq 0.15$	2	$0.15 < \varphi \leq 0.20$	1	$0.20 < \varphi$	0	Total	2 (no include $\varphi \leq 0.10$)			
		Size \ Area	Acc. Qty															
$\varphi \leq 0.10$	Ignore																	
$0.10 < \varphi \leq 0.15$	2																	
$0.15 < \varphi \leq 0.20$	1																	
$0.20 < \varphi$	0																	
Total	2 (no include $\varphi \leq 0.10$)																	
		Distance between 2 defects should more than 5mm apart.																
02	Black and White line Scratch Foreign material (Line type) (Minor defect)		<table><tr><th>Length</th><th>Width</th><th>Acc. Qty</th></tr><tr><td>/</td><td>$W \leq 0.03$</td><td>Ignore</td></tr><tr><td>$L \leq 2$</td><td>$0.03 < W \leq 0.05$</td><td>1</td></tr><tr><td>/</td><td>$0.05 < W$</td><td>0</td></tr><tr><td colspan="2">Total</td><td>1</td></tr></table>	Length	Width	Acc. Qty	/	$W \leq 0.03$	Ignore	$L \leq 2$	$0.03 < W \leq 0.05$	1	/	$0.05 < W$	0	Total		1
		Length	Width	Acc. Qty														
/	$W \leq 0.03$	Ignore																
$L \leq 2$	$0.03 < W \leq 0.05$	1																
/	$0.05 < W$	0																
Total		1																

No.	Item	Criteria (Unit: mm)										
		Distance between 2 defects should more than 5mm apart. Scratches not viewable through the back of the display are acceptable.										
03	Glass Crack (Minor defect)	 LCD with extensible crack line is unacceptable(When press the cracked LCD area, the line will expand, we define it is extensible crack line)										
04	Glass Chipping Pad Area: (Minor defect)	 <table><tr><th>Length and Width</th><th>Acc. Qty</th></tr><tr><td>$c < 5.0, b < 0.4$</td><td>Ignore</td></tr></table>	Length and Width	Acc. Qty	$c < 5.0, b < 0.4$	Ignore						
Length and Width	Acc. Qty											
$c < 5.0, b < 0.4$	Ignore											
05	Glass Chipping Rear of Pad Area: (Minor defect)	 <table><tr><th>Length and Width</th><th>Acc. Qty</th></tr><tr><td>$c > 3.0, b < 1.0$</td><td>1</td></tr><tr><td>$c < 3.0, b < 1.0$</td><td>2</td></tr><tr><td>$c < 3.0, b < 0.5$</td><td>4</td></tr><tr><td colspan="2">$a < \text{Glass Thickness}$</td></tr></table>	Length and Width	Acc. Qty	$c > 3.0, b < 1.0$	1	$c < 3.0, b < 1.0$	2	$c < 3.0, b < 0.5$	4	$a < \text{Glass Thickness}$	
Length and Width	Acc. Qty											
$c > 3.0, b < 1.0$	1											
$c < 3.0, b < 1.0$	2											
$c < 3.0, b < 0.5$	4											
$a < \text{Glass Thickness}$												

No.	Item	Criteria (Unit: mm)								
06	Glass Chipping Except Pad Area: (Minor defect) 	<table><tr><th>Length and Width</th><th>Acc. Qty</th></tr><tr><td>$c \leq 0.6, b < 5.0$</td><td>Ignore</td></tr><tr><td colspan="2">$a < \text{Glass Thickness}$</td></tr></table>	Length and Width	Acc. Qty	$c \leq 0.6, b < 5.0$	Ignore	$a < \text{Glass Thickness}$			
Length and Width	Acc. Qty									
$c \leq 0.6, b < 5.0$	Ignore									
$a < \text{Glass Thickness}$										
07	Glass Corner Chipping: (Minor defect) 	<table><tr><th>Length and Width</th><th>Acc. Qty</th></tr><tr><td>$c < 2.0, b < 1.5$</td><td>Ignore</td></tr><tr><td>$c < 1.5, b < 2$</td><td>Ignore</td></tr><tr><td colspan="2">$a < \text{Glass Thickness}$</td></tr></table>	Length and Width	Acc. Qty	$c < 2.0, b < 1.5$	Ignore	$c < 1.5, b < 2$	Ignore	$a < \text{Glass Thickness}$	
Length and Width	Acc. Qty									
$c < 2.0, b < 1.5$	Ignore									
$c < 1.5, b < 2$	Ignore									
$a < \text{Glass Thickness}$										
08	Glass Burr: (Minor defect) 	Glass burr don't affect assemble and module dimension. <table><tr><th>Length</th><th>Acc. Qty</th></tr><tr><td>$F < 0.5$</td><td>Ignore</td></tr></table>	Length	Acc. Qty	$F < 0.5$	Ignore				
Length	Acc. Qty									
$F < 0.5$	Ignore									
09	FPC Defect: (Minor defect) 	9.1 Dent, pinhole width $a < w/2$. (w: circuitry width.) 9.2 Open circuit is unacceptable. 9.3 No oxidation, contamination and distortion.								

No.	Item	Criteria (Unit: mm)											
10	Screen deformation 	Test for insertion of plug gauge at highest warping point: (0.96-3.1inches does not contain3.1) $H \leq 0.25\text{MM}$ The client has special requirements,according to drawing											
11	Bubble on Polarizer (Minor defect)	<table><tr><th>Diameter</th><th>Acc. Qty</th></tr><tr><td>$\varphi \leq 0.15$</td><td>Ignore</td></tr><tr><td>$0.15 < \varphi \leq 0.20$</td><td>2</td></tr><tr><td>$0.20 < \varphi \leq 0.30$</td><td>1</td></tr><tr><td>$0.3 < \varphi$</td><td>None</td></tr></table>		Diameter	Acc. Qty	$\varphi \leq 0.15$	Ignore	$0.15 < \varphi \leq 0.20$	2	$0.20 < \varphi \leq 0.30$	1	$0.3 < \varphi$	None
Diameter	Acc. Qty												
$\varphi \leq 0.15$	Ignore												
$0.15 < \varphi \leq 0.20$	2												
$0.20 < \varphi \leq 0.30$	1												
$0.3 < \varphi$	None												
12	Dent on Polarizer (Minor defect)	<table><tr><th>Diameter</th><th>Acc. Qty</th></tr><tr><td>$\varphi \leq 0.15$</td><td>Ignore</td></tr><tr><td>$0.15 < \varphi \leq 0.20$</td><td>2</td></tr><tr><td>$0.20 < \varphi \leq 0.30$</td><td>1</td></tr><tr><td>$0.3 < \varphi$</td><td>None</td></tr></table>		Diameter	Acc. Qty	$\varphi \leq 0.15$	Ignore	$0.15 < \varphi \leq 0.20$	2	$0.20 < \varphi \leq 0.30$	1	$0.3 < \varphi$	None
Diameter	Acc. Qty												
$\varphi \leq 0.15$	Ignore												
$0.15 < \varphi \leq 0.20$	2												
$0.20 < \varphi \leq 0.30$	1												
$0.3 < \varphi$	None												
13	Bezel	13.1 No rust, distortion on the Bezel. 13.2 No visible fingerprints, stains or other contamination.											
14	Touch Panel	D: Diameter W: width L: length 14.1 Spot: $D \leq 0.20$ is acceptable $0.20 < D \leq 0.3$, acceptable QTY, 3 2dots are acceptable and the distance between defects should more than 5mm. $D > 0.3$ is unacceptable 14.2 Dent: $D > 0.30$ is unacceptable 14.3 Scratch: $W \leq 0.03$, $L \leq 10$ is acceptable, $0.03 < W \leq 0.10$, $L \leq 10$,acceptable QTY, 3 Distance between 2 defects should more than 5 mm. $W > 0.10$ is unacceptable.											

No.	Item	Criteria (Unit: mm)
15	PCB	15.1 No distortion or contamination on PCB terminals. 15.2 All components on PCB must same as documented on the BOM/component layout. 15.3 Follow IPC-A-600F.
16	Soldering	Follow IPC-A-610C standard
17	Electrical Defect (Major defect)	The below defects must be rejected. 17.1 Missing vertical / horizontal segment, 17.2 Abnormal Display. 17.3 No function or no display. 17.4 Current exceeds product specifications. 17.5 LCD viewing angle defect. 17.6 No Backlight. 17.7 Dark Backlight. 17.8 Touch Panel no function. 17.9 Dark Dot –one Allowed. 17.10 Bright Dot – one Allowed. Remark: 1. A pixel defect is acceptable if one color is none functional and causes a bright dot. The display may have one case where one color is out and cause a dark dot. 2. Bright dot caused by scratch and foreign object accords to item1.
18	Leak	Yellow light,OK; White light,According to the limit sample

Remark: Visual and cosmetic defects are rejectable only if these fall within the LCD viewing area.

12.5 Classification of Defects

Visual defects (Except no / wrong label) are treated as minor defect and electrical defect is major.

12.6 Identification/marketing criteria

Any unit with illegible / wrong /double or no marking/ label shall be rejected.

12.7 Packing

12.7.1 There should be no damage of the outside carton box, each packaging box should has label in the correct location per packing drawing requirement.

12.7.2 All direct package materials shall offer ESD protection.

13 Reliability Specification

Item	Condition	Cycle Time	Quantity	Remark
Constant Temp. and Constant Humidity Operation Test	$+40 \pm 3^{\circ}\text{C}$, $90 \pm 3\%\text{RH}$	96hrs	--	*1
High Temp. Operation Test	$+70 \pm 3^{\circ}\text{C}$	96hrs	--	
Low Temp. Operation Test	$-20 \pm 3^{\circ}\text{C}$	96hrs	--	
Thermal Shock Test	$-20 \pm 3^{\circ}\text{C}$ (30min) $+70 \pm 3^{\circ}\text{C}$ (30min)	10cycles	--	
ESD Test(end product)	150pF, 330 Ω , $\pm 2\text{KV}$, Contact	10times	--	*2, *3
	150pF, 330 Ω , $\pm 6\text{KV}$, Air			
Vibration Test (for packaging)	Frequency: 10Hz to 55Hz to 10Hz, Swing: 1.5mm, time: X, Y, Z each 2H.	6hrs	One inner carton	*4

Note 1. For humidity test, DI water should be used.

Inspection Standard: Inspect after 1-2hrs storage at room temperature, the sample shall be free from the following defects:

- Air bubble in the LCD
- Seal Leakage
- Non-display
- Missing Segment
- Glass Crack
- IDD is greater than twice initial value.
- Others as per QA Inspection Criteria

Note 2. No defect is allowed after testing

The End Product ESD value is only indicative and depends on customer ESD protection design for the whole system.

Note 3. ESD should be applied to LCD glass panel, not other areas (such as on IC and so on)
IDD should be within twice initial value.

In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.

Note 4. Only upon request.

14 Precautions and Warranty

14.1 Safety

14.1.1 The liquid crystal in the LCD is poisonous. Do not put it in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and water.

14.1.2 Since the liquid crystal cells are made of glass, do not apply strong impact on them. Handle with care.

14.2 Handling

14.2.1 Reverse and use within ratings in order to keep performance and prevent damage.

14.2.2 Do not wipe the polarizer with dry cloth, as it might cause scratch. If the surface of the LCD needs to be cleaned, wipe it swiftly with cotton or other soft cloth soaked with petroleum IPA, do not use other chemicals.

14.3 Operation

14.3.1 Do not drive LCD with DC voltage

14.3.2 Response time will increase below lower temperature

14.3.3 Display may change color with different temperature

14.3.4 Mechanical disturbance during operation, such as pressing on the display area, may cause the segments to appear “fractured”.

14.4 Static Electricity

14.4.1 CMOS LSIs are equipped in this unit, so care must be taken to avoid the electro-static charge, by ground human body, etc.

14.4.2 The normal static prevention measures should be observed for work clothes and benches.

14.4.3 The module should be kept into anti-static bags or other containers resistant to static for storage.

14.5 Limited Warranty

14.5.1 Unless otherwise agreed between Leadtek-DISPLAY and customer, Leadtek-DISPLAY will replace or repair any of its LCD and LCM which Leadtek-DISPLAY found to be defective electrically and visually when inspected in accordance with Leadtek-DISPLAY Quality Standards, for a period of one year from date of shipment.

14.5.2 The warranty liability of Leadtek-DISPLAY is limited to repair and/or replacement. Leadtek-DISPLAY will not be responsible for any consequential loss.

14.5.3 If possible, we suggest you use up all modules in six months. If the module storage time

over twelve months, we suggest that recheck it before the module be used.

15 Packaging

TBD

16 Prior Consult Matter

1. For Leadtek-DISPLAY standard products, we keep the right to change material, process for improving the product property without prior notice to our customer.

2. For OEM products, if any changes are needed which may affect the product property, we will consult with our customer in advance.

3. If you have special requirement about reliability condition, please let us know before you start the test on our samples.

Reference

Item	Description	Revision
ST7701S	IC Data sheet	ST7701S_SPEC_ V1.1
R200607	LCM assembly drawing	V0