

## Product Specification

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### Thin-Film-Transistor LCD Module Model:XTPQ20NN06-01

Acceptance

Approved and Checked by

Approved by	Checked by		Made by



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### 1. General Description and Features

XTPQ20NN06-01 is a TM (Transmissive) type color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This model is composed of a TFT-LCD module, a driver circuit and a back-light unit. The resolution of a 2.0" contains 176RGBx220dots and can display up to 262K colors. The following table described the features of XTPQ20NN06-01

#### LCD Module

Item	Specification	Unit
Screen Size	2.0inches	Diagona
Display Resolution	176RGB(H)x220(V)	Dot
Active Area	31.68 (H) x 39.6 (V)	mm
Outline Dimension	38 (W) x 51.8(H) x 2.4 MAX (D)	mm
Display Mode	Normally white/Transmissive	--
Pixel Arrangement	RGB-Vertical Stripe	--
Display Color	262K	--
Direction ionGray scale invers	12 o'clock	
Viewing Direction	6 o'clock	--
Drive IC	ST7775R	--

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### 2. Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	--	38	--	mm	--
	Vertical (V)	--	51.3	--	mm	(1)
	Thickness (T)	--	2.4MAX	--	mm	(2)
Weight		--	N/A	--	g	--

Note (1) Not include FPC.

Refer to the Outline Dimension for further information.

(2) Back-light unit are included.

### 3. Electrical Specifications

#### 3.1 Absolute Max. Ratings

##### 3.1.1 Absolute Ratings of Environment

If the operating condition exceeds the following absolute maximum ratings, the TFT LCD module may be damaged permanently.

(Ta=25±2°C, V<sub>SS</sub>=GND=0)

Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	T <sub>STG</sub>	-20	70	°C	(1)
Operating temperature	T <sub>OPR</sub>	-30	80	°C	(1,2,3)

Note (1) 95 % RH Max. ( 40 °C ≥ Ta ). Maximum wet-bulb temperature at 39 °C or less. (Ta > 40 °C)  
No condensation.

Note (2) In case of below 0°, the response time of liquid crystal (LC) becomes slower and the color of panel becomes darker than normal one. Level of retardation depends on temperature, because of LC's character

Note (3) Only operation is guaranteed at operating temperature. Contrast, response time, another display quality are evaluated at +25°C.

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### 3.2 Electrical Absolute Rating

#### 3.2.1 TFT-LCD Module

(Voltage Referenced to VSS)

Item	Symbol	Value		Unit	Condition
		Min.	Max.		
Digital Power Supply Voltage	VDD	VSS-0.3	4.6	V	--

#### 3.2.2 Back-Light Unit

(Ta=25±2°C)

Item	Symbol	Min.	Max.	Unit	Note
current	I <sub>f</sub>	--	30	mA	(1)
voltage	V <sub>R</sub>	--	5.0	V	(1)

Note (1) Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded. Functional operation should be restricted to the conditions described under normal operating conditions.

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### 4 Electrical Characteristics

#### 4.1 Backlight Unit

The back-light system is an edge-lighting type with six white LEDs (Light Emitting Diode).

(Ta=25±2°C)

Item	Symbol	Value			Unit	Condition
		Min.	Typ.	Max.		
LED Voltage	V <sub>F</sub>	2.7	3.0	3.3	V	If=40mA
LED Current	I <sub>F</sub>	-	40	-	mA	
Power Consumption	P <sub>BL</sub>	-	-	-	mW	
Brightness through TFT	L <sub>v</sub>	250	280	350	nit	If=40mA
Color coordinate(TFT Surface)	Y	0.25<x<0.29				
	X	0.25<x<0.29				
Uniformity(TFT Surface)		>=80%				

Note (1)  $P_{BL} = V_F \times I_F$

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### 5 Input Terminal Pin Assignment

PIN.NO	SYMBOL	I/O/P	FUNCTI	MEMARK
1	SCLK	I	-Dot clock signal for RGB interface operation. DPL = "0": Input data on the rising edge of DOTCLK DPL = "1": Input data on the falling edge of DOTCLK -If not used, please fix this pin at DGND level.	
2	SI	I	-SPI interface input pin. -The data is latched on the rising edge of the SCL signal. -In the 24-bit serial peripheral interface, this pin is used as input Pin. -In the 8/9-bit serial peripheral interface, this pin is used as bi-directional data pin. -If not used, please fix this pin at DGND level.	
3	SCS	I	-Chip selection pin Low enable. High disable.	
4	A+	P	<b>POWER FOR BACKLIHT(ANODE)</b>	
5	RST	I	-This signal will reset the device and it must be applied to properly initialize the chip. -Signal is active low.	
6	IOVCC	I	Power Supply for I/O System.	
7	VDD	P	<b>POWER SUPPLY</b>	
8	K-	P	<b>POWER FOR BACKLIHT(CATHODE)</b>	
9	DCX	I	-Display data/command selection pin in MCU interface. DCX='1': display data or parameter. DCX='0': command data. -If not used, please fix this pin at VDDI or DGND level.	
10	VSS	P	<b>POWER GROUND</b>	

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### 6 LCD Optical Characteristics

Item	Symbol	Condition	Specification			Unit	Remark
			Min.	Typ.	Max.		
Response time	Tr+Tf	$\theta = 0^\circ$	-	20	40	ms	Note 6
Contrast ratio	CR	$\theta = 0^\circ$	200	300	-		Note 3,7
Viewing angle	Top	$CR \geq 10$	40	45	-	deg.	Note 3,7,8
	Bottom	$CR \geq 10$	15	20	-		
	Left	$CR \geq 10$	40	45	-		
	Right	$CR \geq 10$	40	45	-		
CF Color chromaticity(CIE)	Wx	$\theta = 0^\circ$	-0.02	<b>0.27</b>	+0.02		Note 4
	Wy			<b>0.27</b>			
	Rx			0.610			
	Ry			0.329			
	Gx			0.299			
	Gy			0.567			
	Bx			0.143			
	By			0.111			
Cross talk	ct				2%		Note 10
Transmittance	Trans	-	4.95%	5.5%	-		Note 5

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Note 1: Ambient temperature = 25°C.

Note 2: To be measured in dark room after LED backlight warm up 5 minutes.

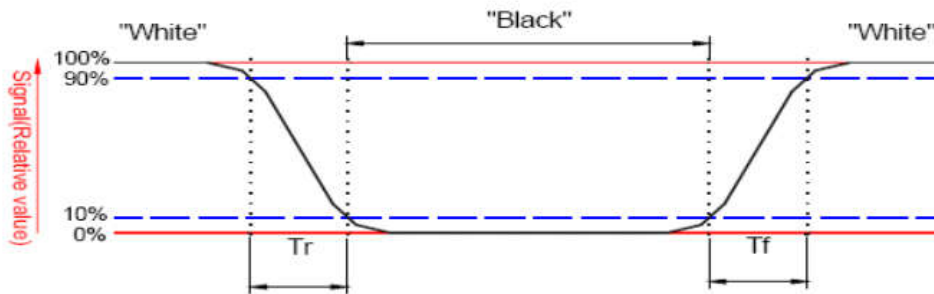
Note 3: To be measured with a viewing cone of 2° by Topcon luminance meter BM-5A.

Note 4: To be measured with Otsuta chromaticity meter LCF-2100M,CF only measure with C light

Note 5: CDY shipping status is cell without polarizer. Transmittance of Specification is cell with polarizer

Note 6: Definition of response time:

The output signals of TRD-100 are measured when the input signals are changed to "White" (falling time) and from "White" to "Black" (rising time), respectively. The interval is between the 10% and 90% of amplitudes. Refer to figure as below.



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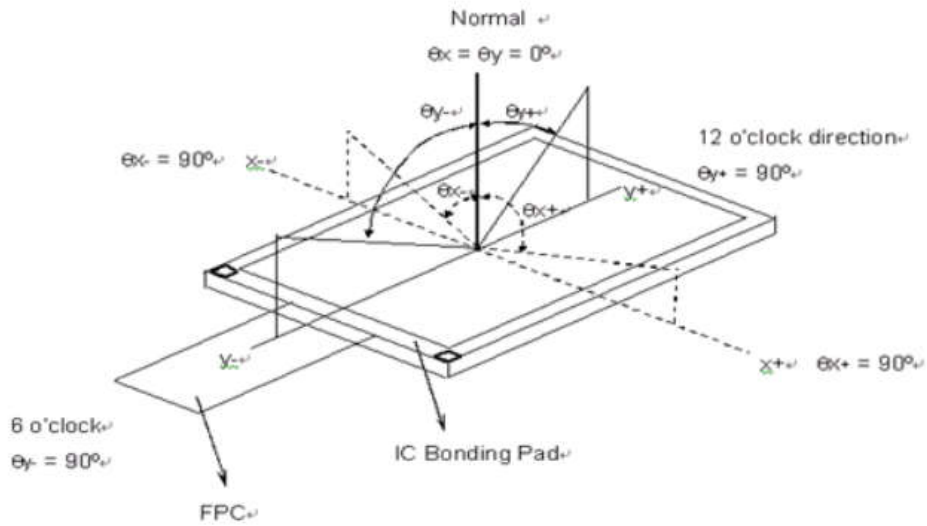
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Note 7: Definition of contrast ratio:

Contrast ratio is calculated by the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Brightness on the "white" state}}{\text{Brightness on the "black" state}}$$

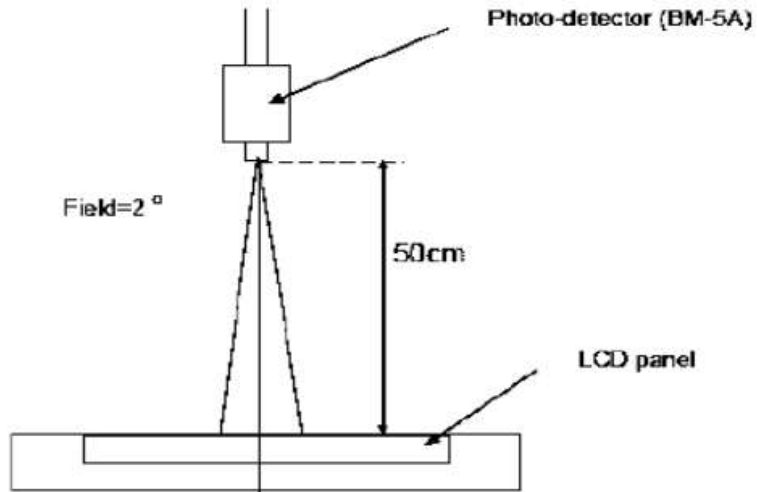
Note 8: Definition of viewing angle



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Note 9: Optical characteristic measurement setup.



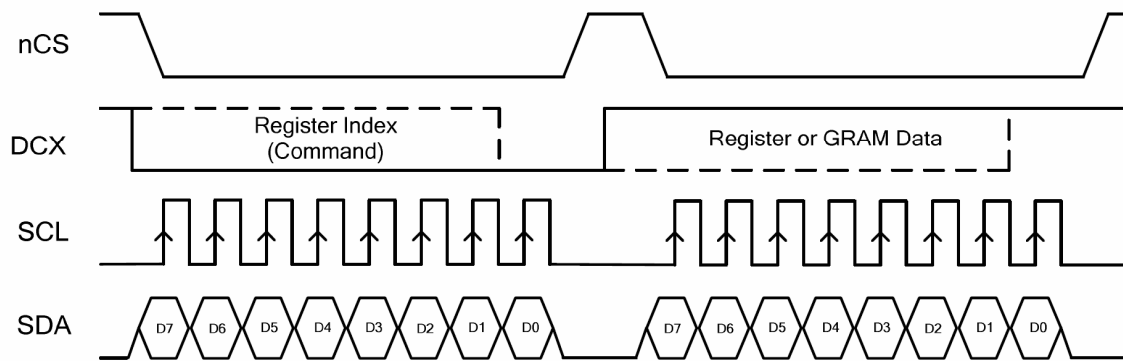
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## 7 Interface Timing

This SPI mode uses a 4-wire 8-bit serial interface. The chip-select CSX (active low) enables and disables the serial interface. DCX is the command or data select signal, SCL is the serial data clock and SDA is serial data. Serial data must be input to SDA in the sequence D7 to D0. The ST7775R reads the data at the rising edge of SCL signal. The DCX signal indicates data/command. When DCX = "1", D7 to D0 bits are display RAM data or command parameters. When DCX = "0" D7 to D0 bits are commands.

Register Write Mode:



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### 8 Reliability Condition for LCD

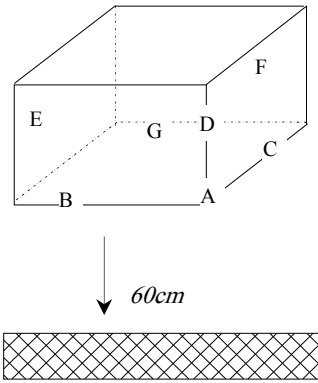
No change on display and in operation under the following test condition.

Condition: Unless otherwise specified, tests will be conducted under the following condition.

Temperature: 20±5°C                      Humidity: 65±5%RH

Tests will be not conducted under functioning state.

No.	Parameter	Condition	Notes
1	High Temperature Operating	70°C±2°C, 240hrs (Operation state)	--
2	Low Temperature Operating	-20°C±2°C, 240hrs (Operation state)	--
3	High Temperature Storage	80°C±2°C, 240hrs	--
4	Low Temperature Storage	-30°C±2°C, 240hrs	--
5	High Temperature and High Humidity Operation Test	60°C±2°C, 90%, 240hrs	--
6	Vibration Test	Total fixed amplitude: 1.5mm Vibration Frequency: 10±5Hz One cycle 60 seconds to 3 direction of X, Y, Z each 15 minutes.	--

7.	Drop Test	<p>To be measured after dropping from 60cm high on the concrete surface in packing state.</p> <div style="text-align: center;">  <p style="text-align: right; margin-right: 20px;"> <i>Dropping method corner dropping</i>  <i>A corner: once</i>  <i>Edge dropping</i>  <i>B, C, D edge: once</i>  <i>Face dropping</i>  <i>E, F, G face: once</i> </p> </div> <p style="text-align: center;"><i>Concrete Surface</i></p>	--
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- Notes:
1. No dew condensation to be observed.
  2. The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.
  3. Vibration test will be conducted to the product itself without putting I in a container.

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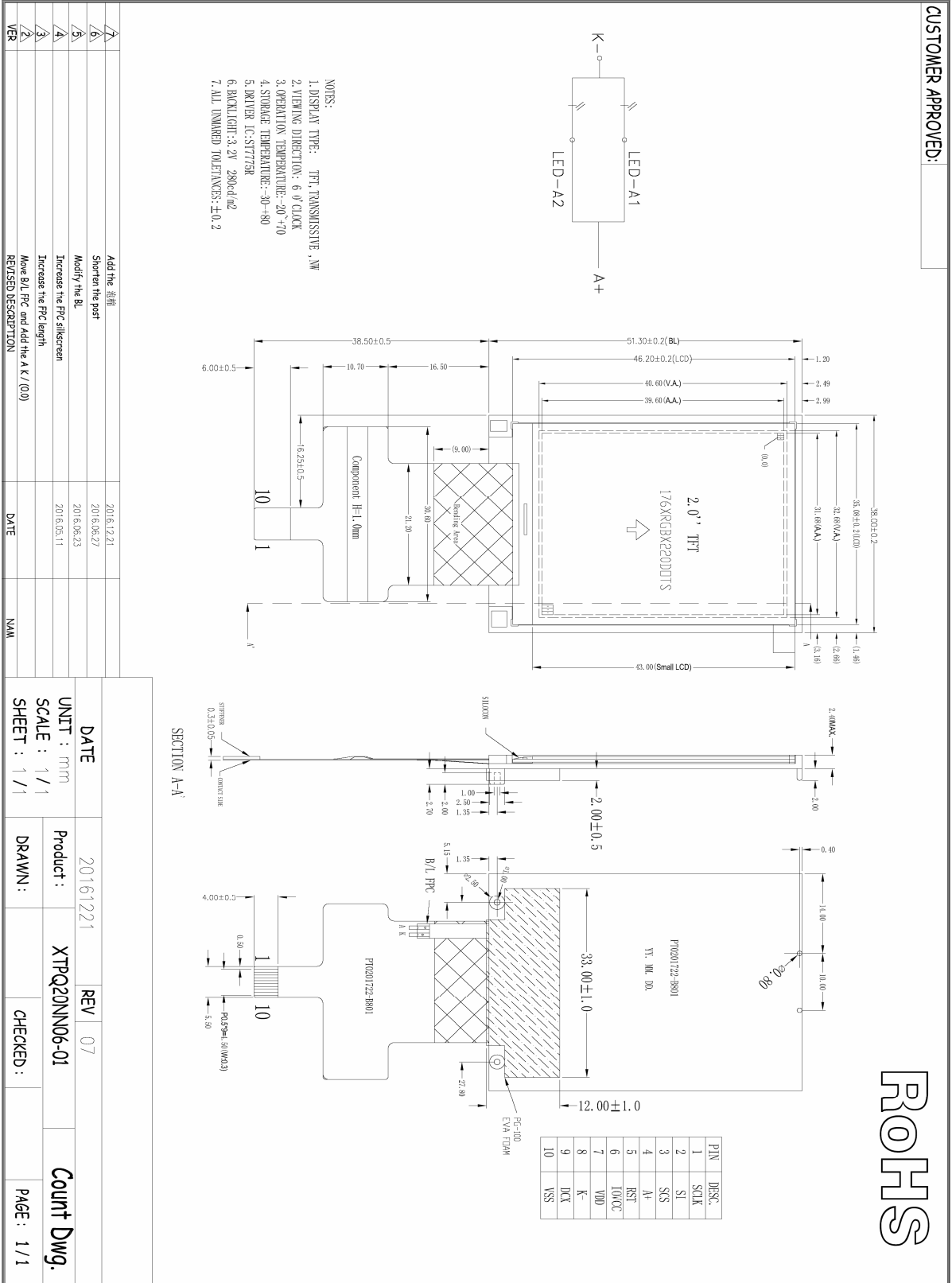
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## 9 Dimensional outlines



ROHS

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### 10 Incoming Inspection Standards

#### 11.1 VISUAL & FUNCTION INSPECTION STANDARD

##### 11.1.1 Inspection conditions

Inspection performed under the following conditions is recommended.

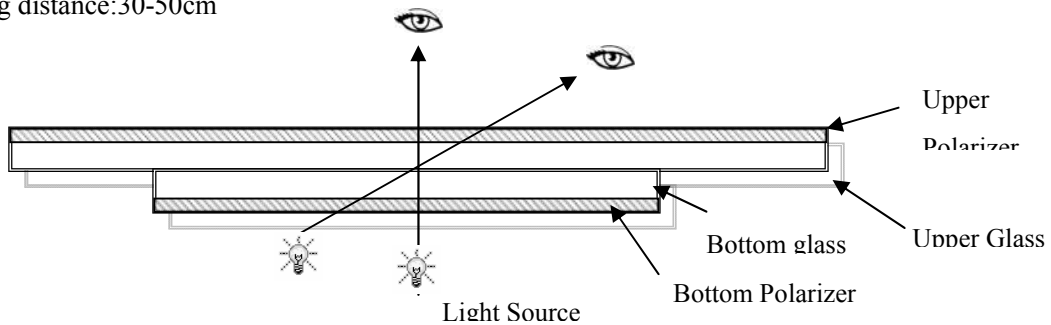
Temperature : 25±5°C

Humidity : 65%±10%RH

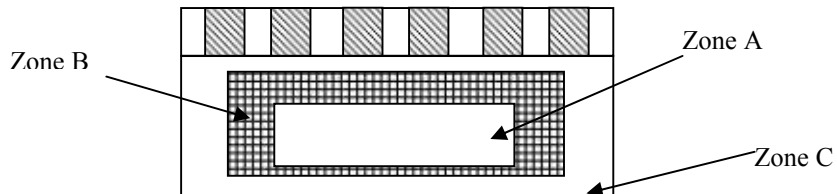
Viewing Angle : Normal viewing Angle.

Illumination: Single fluorescent lamp (300 to 700Lux)

Viewing distance:30-50cm



##### 11.1.2 Definition



Zone A : Effective Viewing Area(Character or Digit can be seen)

Zone B : Viewing Area except Zone A

Zone C : Outside (Zone A+Zone B) which can not be seen after assembly by customer .)

Note:

As a general rule ,visual defects in Zone C can be ignored when it doesn't effect product function or appearance after assembly by customer.

##### 11.1.3 Sampling Plan

According to GB/T 2828-2003 ; , normal inspection, Class II

AQL:

Major defect	Minor defect
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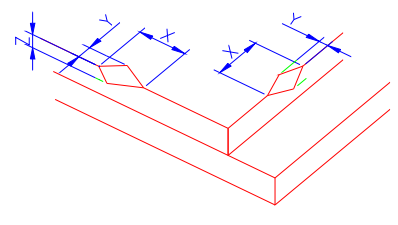
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0.65	1.5
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LCD: Liquid Crystal Display , TP: Touch Panel , LCM: Liquid Crystal Module

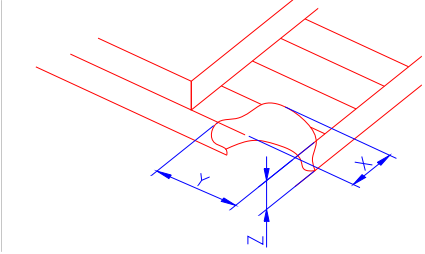
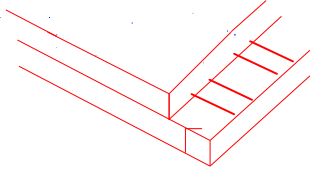
No	Items to be inspected	Criteria	Classification of defects
1	Functional defects	1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting. 4) TP no function	Major
2	Missing	Missing component	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed	
4	Color tone	Color unevenness, refer to limited sample	Minor
5	Soldering appearance	Good soldering , Peeling off is not allowed.	
6	LCD/Polarizer/TP	Black/White spot/line, scratch, crack, etc.	

### 11.1.4 Criteria (Visual)

Number	Items	Criteria(mm)						
1.0 LCD Crack/Broken	(1) The edge of LCD broken							
NOTE: X: Length Y: Width		<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="width: 33%; text-align: center;">X</td> <td style="width: 33%; text-align: center;">Y</td> <td style="width: 33%; text-align: center;">Z</td> </tr> <tr> <td style="text-align: center;"><math>\leq 3.0\text{mm}</math></td> <td style="text-align: center;">&lt;Inner border line of the seal</td> <td style="text-align: center;"><math>\leq T</math></td> </tr> </table>	X	Y	Z	$\leq 3.0\text{mm}$	<Inner border line of the seal	$\leq T$
X	Y	Z						
$\leq 3.0\text{mm}$	<Inner border line of the seal	$\leq T$						

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<p>Z: Height L: Length of ITO, T: Height of LCD</p>	<p>(2)LCD corner broken</p>	 <table border="1" style="margin: 10px auto; border-collapse: collapse;"> <thead> <tr> <th style="padding: 5px;">X</th> <th style="padding: 5px;">Y</th> <th style="padding: 5px;">Z</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;"><math>\leq 3.0\text{mm}</math></td> <td style="padding: 5px;"><math>\leq L</math></td> <td style="padding: 5px;"><math>\leq T</math></td> </tr> </tbody> </table>	X	Y	Z	$\leq 3.0\text{mm}$	$\leq L$	$\leq T$
X	Y	Z						
$\leq 3.0\text{mm}$	$\leq L$	$\leq T$						
	<p>(3) LCD crack</p>	 <p style="text-align: center;">Crack Not allowed</p>						

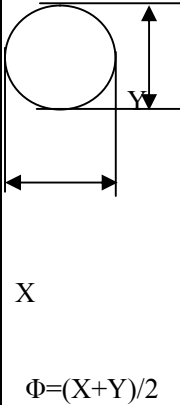
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Number	Items	Criteria (mm)
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2.0	Spot defect	<p>① light dot (LCD/TP/Polarizer black/white spot , light dot, pinhole, dent, stain)</p>  <p style="margin-left: 20px;"><math>\Phi = (X+Y)/2</math></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="text-align: center;">Zone Size (mm)</th> <th colspan="3" style="text-align: center;">Acceptable Qty</th> </tr> <tr> <th style="text-align: center;">A</th> <th style="text-align: center;">B</th> <th style="text-align: center;">C</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><math>\Phi \leq 0.10</math></td> <td colspan="3" style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;"><math>0.10 &lt; \Phi \leq 0.15</math></td> <td colspan="3" style="text-align: center;">3( distance <math>\geq 10\text{mm}</math>)</td> </tr> <tr> <td style="text-align: center;"><math>0.15 &lt; \Phi \leq 0.2</math></td> <td colspan="3" style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;"><math>0.2 &lt; \Phi</math></td> <td colspan="3" style="text-align: center;">0</td> </tr> </tbody> </table> <p>② Dim spot (LCD/TP/Polarizer dim dot, light leakage, dark spot)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="text-align: center;">Zone Size (mm)</th> <th colspan="3" style="text-align: center;">Acceptable Qty</th> </tr> <tr> <th style="text-align: center;">A</th> <th style="text-align: center;">B</th> <th style="text-align: center;">C</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><math>\Phi \leq 0.1</math></td> <td colspan="3" style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;"><math>0.1 &lt; \Phi \leq 0.2</math></td> <td colspan="3" style="text-align: center;">2( distance <math>\geq 10\text{mm}</math>)</td> </tr> <tr> <td style="text-align: center;"><math>0.2 &lt; \Phi \leq 0.3</math></td> <td colspan="3" style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;"><math>\Phi &gt; 0.3</math></td> <td colspan="3" style="text-align: center;">0</td> </tr> </tbody> </table> <p>③ Polarizer accidented spot</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="text-align: center;">Zone Size (mm)</th> <th colspan="3" style="text-align: center;">Acceptable Qty</th> </tr> <tr> <th style="text-align: center;">A</th> <th style="text-align: center;">B</th> <th style="text-align: center;">C</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><math>\Phi \leq 0.2</math></td> <td colspan="3" style="text-align: center;">Ignore</td> </tr> <tr> <td style="text-align: center;"><math>0.2 &lt; \Phi \leq 0.5</math></td> <td colspan="3" style="text-align: center;">2( distance <math>\geq 10\text{mm}</math>)</td> </tr> <tr> <td style="text-align: center;"><math>\Phi &gt; 0.5</math></td> <td colspan="3" style="text-align: center;">0</td> </tr> </tbody> </table>	Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.10$	Ignore			$0.10 < \Phi \leq 0.15$	3( distance $\geq 10\text{mm}$ )			$0.15 < \Phi \leq 0.2$	1			$0.2 < \Phi$	0			Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.1$	Ignore			$0.1 < \Phi \leq 0.2$	2( distance $\geq 10\text{mm}$ )			$0.2 < \Phi \leq 0.3$	1			$\Phi > 0.3$	0			Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.2$	Ignore			$0.2 < \Phi \leq 0.5$	2( distance $\geq 10\text{mm}$ )			$\Phi > 0.5$	0		
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	Line defect (LCD/TP /Polarizer black/white line, scratch, stain)	<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th rowspan="2">Width(mm)</th> <th rowspan="2">Length(mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.03</math></td> <td>Ignore</td> <td colspan="2">Ignore</td> <td rowspan="3">Ignore</td> </tr> <tr> <td><math>0.03 &lt; W \leq 0.05</math></td> <td><math>L \leq 3.0</math></td> <td colspan="2"><math>N \leq 2</math></td> </tr> <tr> <td><math>0.05 &lt; W \leq 0.08</math></td> <td><math>L \leq 2.0</math></td> <td colspan="2"><math>N \leq 2</math></td> </tr> <tr> <td><math>0.08 &lt; W</math></td> <td colspan="4">Define as spot defect</td> </tr> </tbody> </table>	Width(mm)	Length(mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.03$	Ignore	Ignore		Ignore	$0.03 < W \leq 0.05$	$L \leq 3.0$	$N \leq 2$		$0.05 < W \leq 0.08$	$L \leq 2.0$	$N \leq 2$		$0.08 < W$	Define as spot defect			
Width(mm)	Length(mm)	Acceptable Qty																										
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$0.05 < W \leq 0.08$	$L \leq 2.0$	$N \leq 2$																										
$0.08 < W$	Define as spot defect																											
3.0	Polarizer Bubble	<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.2</math></td> <td colspan="2">Ignore</td> <td rowspan="4">Ignore</td> </tr> <tr> <td><math>0.2 &lt; \Phi &lt; 0.4</math></td> <td colspan="2">2(distance <math>\geq 10</math>mm)</td> </tr> <tr> <td><math>0.4 &lt; \Phi &lt; 0.6</math></td> <td colspan="2">1</td> </tr> <tr> <td><math>0.6 &lt; \Phi</math></td> <td colspan="2">0</td> </tr> </tbody> </table>	Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.2$	Ignore		Ignore	$0.2 < \Phi < 0.4$	2(distance $\geq 10$ mm)		$0.4 < \Phi < 0.6$	1		$0.6 < \Phi$	0							
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4.0	SMT	According to IPC-A-610C class II standard . Function defect and missing part are major defect ,the others are minor defect.																										