Specification for Approval

Customer:_____

Model Name:_____

Supplier Approval			Customer approval
R&D Designed	R&D Approved	QC Approved	
Peter	Peng Jun		

Revision Record

REV NO.	REV DATE	CONTENTS	Note
A	2017-05-23	NEW ISSUE	

Table of Contents

1. General Description and Features

AM-1024600-070R 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 7.0" contains 1024RGBx600 dots and can display up to 16.7M colors. The following table described the features of AM-1024600-070R.

LCD Module

Item	Specification	Unit
Screen Size	7.0inches	Diagonal
Display Resolution	1024RGB(H)x600(V)	Dot
Active Area	154.21 (H) x 85.92 (V)	mm
Outline Dimension	164.9(W) x 100(H) x 3.5 (D)	mm
Display Mode	Normally white/Transmissive	--
Pixel Arrangement	RGB-Vertical Stripe	--
Display Color	16.7M	--
Gray scale inversion Direction ion	12 o'clock	
Viewing Direction	6 o'clock	--
Surface luminance	230cd/㎡	--

2. Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	--	164.9	--	mm	--
	Vertical (V)	--	100	--	mm	(1)
	Thickness (T)	--	3.5	--	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_{SS}=GND=0)

Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	T_{STG}	-30	80	°C	(1)
Operating temperature	T_{OPR}	-20	70	°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.

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	5.0	V	--

Item		Symbol	Rating			Unit	Remark
			Min	Typ	Max		
Digital Power Supply Voltage	Logic	VCC	3.0	3.3	3.6	V	Note1
Analog Power Supply Voltage	Analog	AVDD	9.4	9.6	9.8		
Gate On Power Supply Voltage		VGH	17	18	19		
Gate Off Power Supply Voltage		VGL	-6.6	-6	-5.4		
Common Power Supply Voltage		VCOM	2.8	3.0	3.2		
Input Voltage	L level	VIL	GND	---	0.3*DVDD	V	VCC= 3.0 ~ 3.6V
	H level	VIH	0.7* DVDD	---	DVDD	V	
LCD Drive Power current		ILCD	---	---	45	mA	VCC= 3.3V

3.2.2 Back-Light Unit

(Ta=25±2°C)

Item	Symbol	Min.	Max.	Unit	Note
current	I_f	--	30	mA	(1)
voltage	V_R	--	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.

4. Electrical Characteristics

4.1 Backlight Unit

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

(Ta=25±2°C)

Item	Symbol	Value			Unit	Condition
		Min.	Typ.	Max.		
LED Voltage	VF	8.4	9.2	10.2	V	
LED Current	IF	-	100	140	mA	
Power Consumption	P_{BL}	-	-	-	mW	

Note (1) Where I_F = 120MA, V_F = 9.6V Brightness=225nit

5. Input Terminal Pin Assignment

Display			
1	LED+ / A+	**26**	G1
2	LED+ / A+	**27**	G0
3	LED- / K-	**28**	R7
4	LED- / K-	**29**	R6
5	GND	**30**	R5
6	VCOM	**31**	R4
7	DVDD	**32**	R3
8	MODE	**33**	R2
9	DE	**34**	R1
10	LCD_VSYNC	**35**	R0
11	LCD_HSYNC	**36**	GND
12	B7	**37**	LCD_PCLK
13	B6	**38**	GND
14	B5	**39**	SHLR
15	B4	**40**	UPDN
16	B3	**41**	VDDG
17	B2	**42**	VEEG
18	B1	**43**	AVDD
19	B0	**44**	/RST
20	G7	**45**	NC
21	G6	**46**	VCOM
22	G5	**47**	DITH
23	G4	**48**	GND
24	G3	**49**	NC
25	G2	**50**	NC

MODE: H = DE mode (default)
L = HSD/VSD mode
DITH: H = 6bit resolution (last 2 bit of input data truncated)
L = 8bit resolution (default setting)
L/R: 0 = right to left scan direction
1= left to right scan direction
U/D: 0 = top to bottom scan direction
1 = bottom to top scan direction

6. Optical Characteristics

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle range	Horizontal	Θ_3	CR > 10	-	80	-	Deg.	WV-Pol Note 1
		Θ_9		-	80	-	Deg.	
	Vertical	Θ_{12}		-	60	-	Deg.	
		Θ_6		-	70	-	Deg.	
Luminance Contrast ratio		CR	Θ = 0°	600	800	-		Note 2
Cell Transmittance		Tr		3.9	4.2	-	%	Base on C Light Note 3
White Chromaticity		x_w		TYP. - 0.03	0.303	TYP. + 0.03		Note 4 Base on MDL
		y_w			0.339			
Reproduction of color (C light)	Red	R_x			0.605			
		R_y			0.326			
	Green	G_x			0.297			
		G_y			0.568			
	Blue	B_x			0.144			
		B_y			0.175			
Color Gamut (C light)				-	50	-	%	
Response Time (Rising + Falling)		T_{RT}	Ta= 25° C Θ = 0°	-	25	40	ms	Note 5

Note :

1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angles 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 FIGURE 5).

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 FIGURE 5) Luminance Contrast Ratio (CR) is defined mathematically.

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

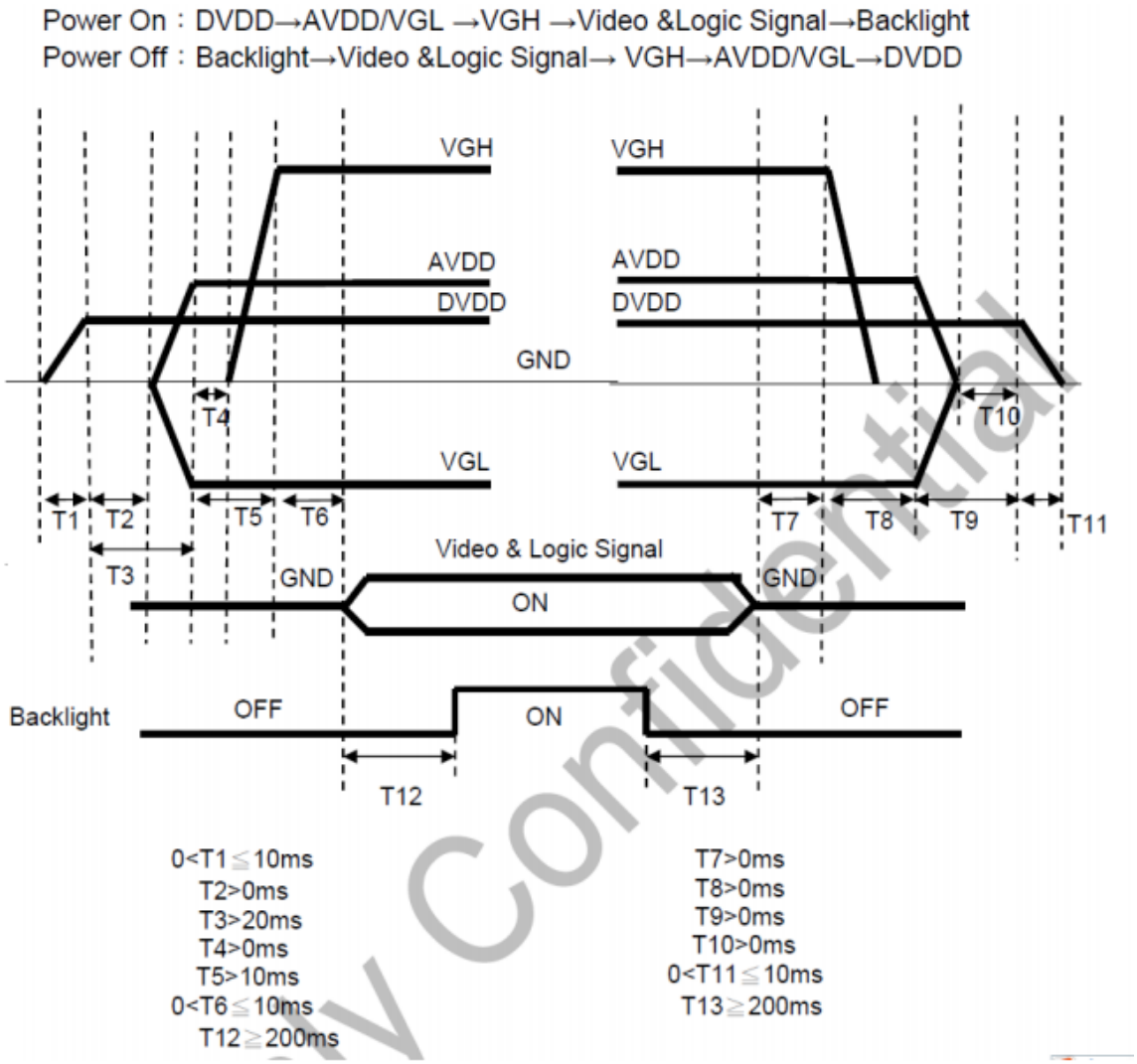
3. Transmittance is the Value with Polarizer.

4. The color chromaticity coordinates specified in Table 6 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 panel.

5. The electro-optical response time measurements shall be made as FIGURE 6 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 Td.

7. Timing Characteristics

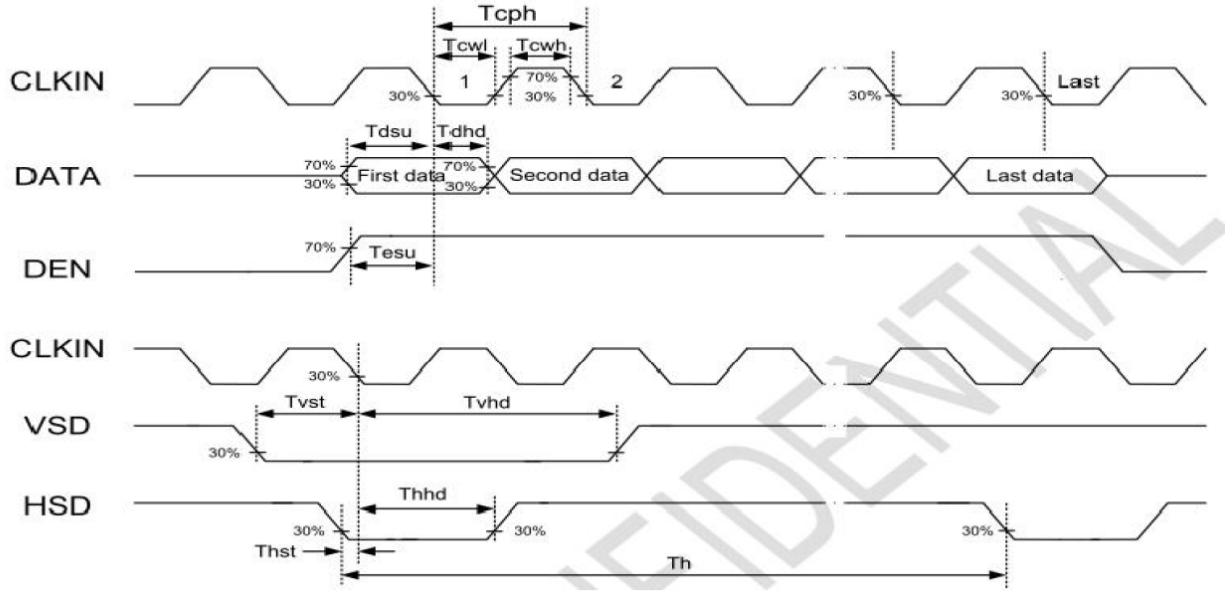
7.1 Power Signal Sequence



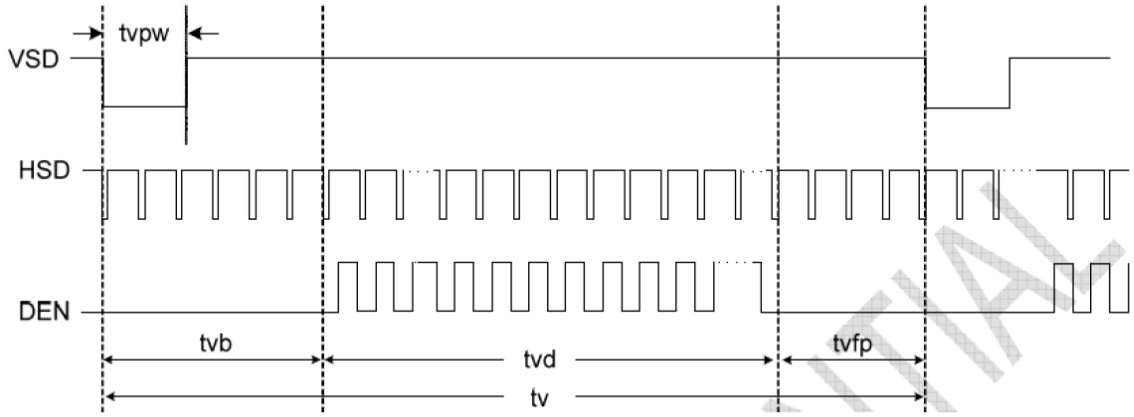
7.2 Interface Timing

	ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	Note
DE MODE	Dot Clock	1/tCLK	45	51.2	57	MHz	
	DCLK Pulse Duty	Tcwh	40	50	60	%	
	Horizontal Total Time	tH	1324	1344	1364	tCLK	
	Horizontal Effective Time	tHA		1024		tCLK	
	Horizontal Blank Time	tHB	300	320	340	tCLK	
	Vertical Total Time	tV	625	635	645	tH	
	Vertical Effective Time	tVA		600		tH	
	Vertical Blank Time	tVB	25	35	45	tH	
SYNC MODE	Horizontal Total Time	TH	1324	1344	1364	tCLK	
	Horizontal Pulse Width	Thpw		20	-	tCLK	thb + thpw =160DCLK is fixed
	Horizontal Back Porch	Thb		140	-	tCLK	
	Horizontal Front Porch	Thfp	140	160	180	tCLK	
	Horizontal Effective Time	THA		1024		tCLK	
	Vertical Total Time	TV	625	635	645	tH	
	Vertical Pulse Width	Tvpw		3	-	th	tvpw + tvb =23th is fixed
	Vertical Back Porch	Tvb	-	20	-	th	
	Vertical Front Porch	Tvfp	2	12	22	th	
	Vertical Valid	Tvd		600		th	

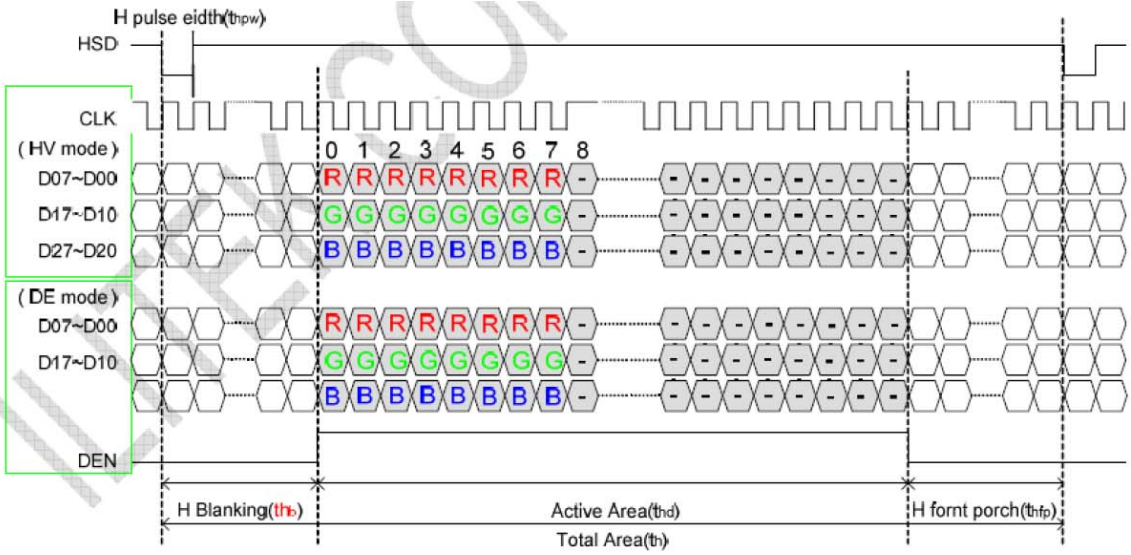
Parameter	Symbol	Spec.			Unit	Condition
		Min.	Typ.	Max.		
DVDD Power On Slew Rate	TPOR	-	-	20	ms	From 0V to 90% DVDD
RSTB Pulse Width	TRst	50	-	-	us	DCLK=65MHz
DCLK Cycle Time	Tcph	14	-	-	ns	
DCLK Pulse Duty	Tcwh	40	50	60	%	
VSD Setup Time	Tvst	5	-	-	ns	
VSD Hold Time	Tvhd	5	-	-	ns	
HSD Setup Time	Thst	5	-	-	ns	
HSD Hold Time	Thhd	5	-	-	ns	
Data Setup Time	Tdsu	5	-	-	ns	D0[7:0],D1[7:0],D2[7:0] to DCLK
Data Hold Time	Tdhd	5	-	-	ns	D0[7:0],D1[7:0],D2[7:0] to DCLK
DEN Setup Time	Tesu	5	-	-	ns	
DEN Hold Time	Tehd	5	-	-	ns	



Vertical input timing



Horizontal input timing



DE Mode

Parameter	Symbol	Value			Unit
		Min	Typ.	Max	
DCLK frequency Frame rate = 60Hz	fclk	40.8	51.2	67.2	MHz
Horizontal display area	thd		1024		DCLK
HSYNC period time	th	1114	1344	1400	DCLK
HSYNC blanking	thb+thfp	90	320	376	DCLK
Vertical display area	tvd		600		H
VSYNC period time	tv	610	635	800	H
VSYNC blanking	tvb+tvfp	10	35	200	H

HV Mode

a. Horizontal input timing

Parameter		Symbol	Value			Unit
Horizontal display area		thd		1024		DCLK
DCLK frequency Frame rate = 60Hz		fclk	Min	Typ.	Max	
			44.9	51.2	63	MHz
1 Horizontal Line		th	1200	1344	1400	DCLK
HSYNC pulse width	Min	thpw		1		DCLK
	Typ.			-		
	Max			140		
HSYNC blanking		thb	160	160	160	
HSYNC front porch		thfp	16	160	216	

b. Vertical input timing

Parameter	Symbol	Value			Unit
		Min	Typ.	Max	
Vertical display area	tvd		600		H
VSYNC period time	tv	624	635	750	H
VSYNC pulse width	tvpw	1	-	20	H
VSYNC blanking	tvb	23	23	23	H
VSYNC front porch	tvfp	1	12	127	H

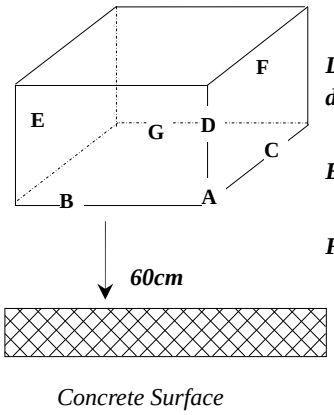
8. Reliability Condition for LCD

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.

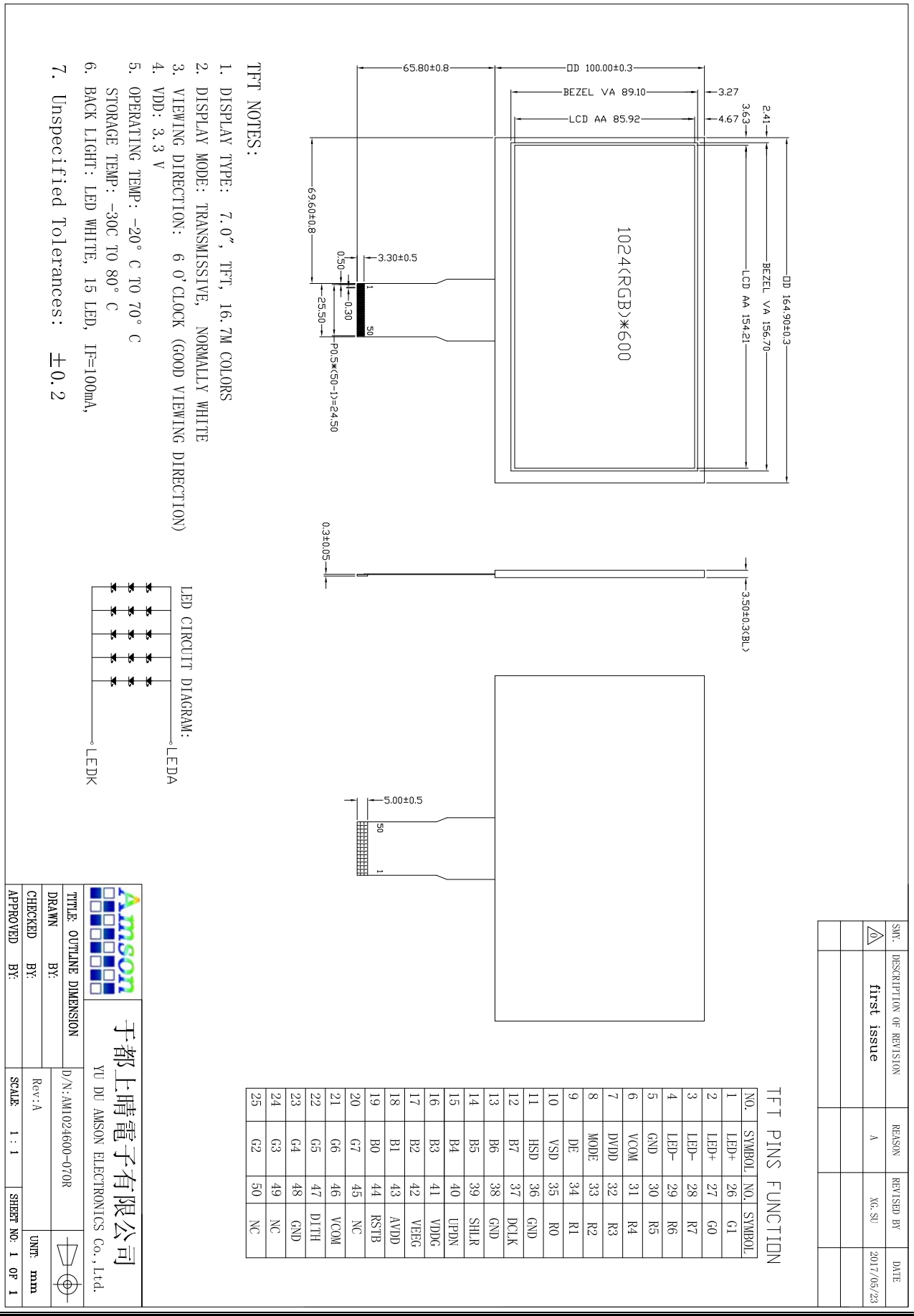
No.	Parameter	Condition	Notes
1	High Temperature Operating	70°C±2°C, 240hrs (Operation state)	--
2	Low Temperature Operating	-20°C±2°C, 240hrs (Operation state)	--
3	High Temperature Storage	80°C±2°C, 240hrs	--
4	Low Temperature Storage	-30°C±2°C, 240hrs	--
5	High Temperature and High Humidity Operation Test	60°C±2°C, 90%, 240hrs	--
6	Vibration Test	Total fixed amplitude: 1.5mm Vibration Frequency: 10~55Hz One cycle 60 seconds to 3 direction of X, Y, Z each 15 minutes.	--
7.	Drop Test	To be measured after dropping from 60cm high on the concrete surface in packing state.  *Dropping method corner dropping* *A corner: once* *Edge dropping* *B, C, D edge: once* *Face dropping* *E, F, G face: once*	--

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.

9. Dimensional outlines

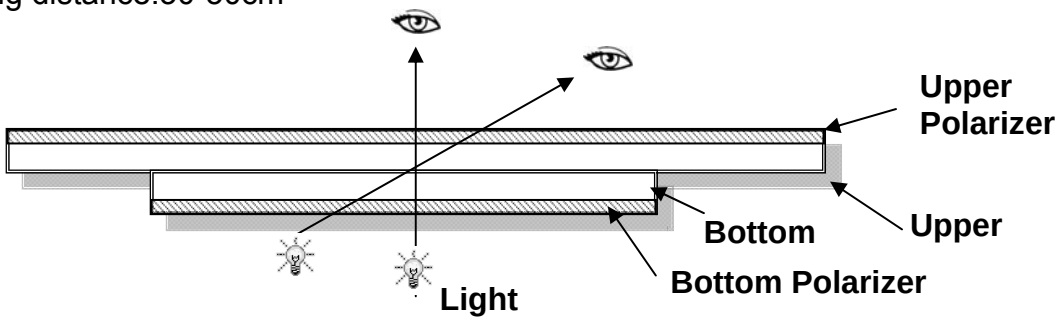


10. Incoming Inspection Standards

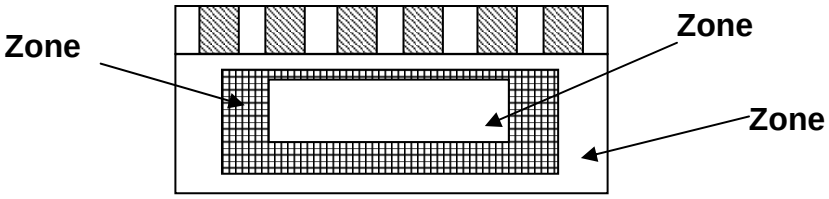
10.1 VISUAL & FUNCTION INSPECTION STANDARD

10.1.1 Inspection conditions

Inspection performed under the following conditions is recommended.
Temperature : 25±5℃
Humidity : 65%±10%RH
Viewing Angle : Normal viewing Angle.
Illumination: Single fluorescent lamp (300 to 700Lux)
Viewing distance:30-50cm



10.1.2 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.

10.1.3 Sampling Plan

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

Major defect	Minor defect
0.65	1.5

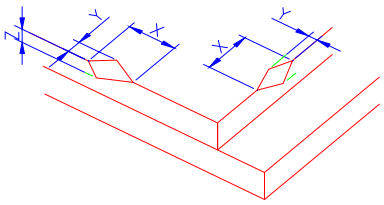
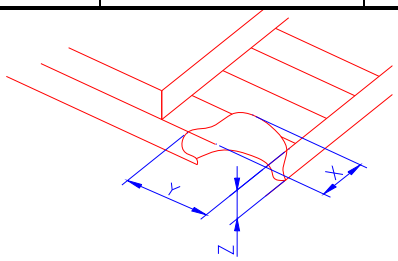
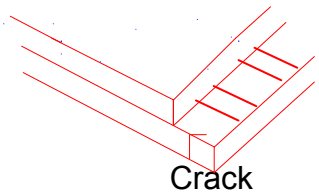
LCD: Liquid Crystal Display , TP: Touch Panel , LCM: Liquid Crystal Module

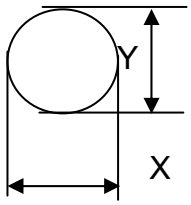
No	Items to be inspected	Criteria	Classification of defects
1	Functional defects	1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting. 4) TP no function	Major
2	Missing	Missing component	
3	Outline dimension	Overall outline dimension beyond the drawing 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.	

10.1.4 Criteria (Visual)

<table>
<tr><th>Number</th><th>Items</th><th>Criteria(mm)</th></tr>
<tr><td rowspan="3">1.0 LCD Crack/Broken

NOTE:
X: Length
Y: Width
Z: Height
L: Length of ITO,
T: Height of LCD</td><td>(1) The edge of LCD broken</td><td> 
<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≤3.0mm</td><td><Inner border line of the seal</td><td>≤T</td></tr>
</table></td></tr>
<tr><td>(2)LCD corner broken</td><td> 
<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≤3.0mm</td><td>≤L</td><td>≤T</td></tr>
</table></td></tr>
<tr><td>(3) LCD crack</td><td> 
Crack
Not allowed</td></tr>
</table>

<table>
<tr><th>Number</th><th>Items</th><th>Criteria (mm)</th></tr>
<tr><td>2.0</td><td>Spot defect
 

Φ=(X+Y)/2</td><td>① light dot（LCD/TP/Polarizer black/white spot , light dot, pinhole, dent, stain）
<table>
<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>
<tr><td>Φ≤0.10</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.10<Φ≤0.15</td><td colspan="2">3(distance≧10mm)</td></tr>
<tr><td>0.15<Φ≤0.2</td><td colspan="2">1</td></tr>
<tr><td>0.2<Φ</td><td colspan="2">0</td></tr>
</table>
②Dim spot（LCD/TP/Polarizer dim dot, light leakage、dark spot）
<table>
<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>
<tr><td>Φ≤0.1</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.1<Φ≤0.2</td><td colspan="2">2(distance≧10mm)</td></tr>
<tr><td>0.2<Φ≤0.3</td><td colspan="2">1</td></tr>
<tr><td>Φ＞0.3</td><td colspan="2">0</td></tr>
</table>
③ Polarizer accidented spot
<table>
<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>
<tr><td>Φ≤0.2</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.2<Φ≤0.5</td><td colspan="2">2(distance≧10mm)</td></tr>
<tr><td>Φ>0.5</td><td colspan="2">0</td></tr>
</table></td></tr>
<tr><td></td><td>Line defect (LCD/TP /Polarizer black/white line, scratch, stain)</td><td>
<table>
<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>
<tr><td>Φ≤0.03</td><td>Ignore</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.03<W≤0.05</td><td>L≤3.0</td><td colspan="2">N≤2</td></tr>
<tr><td>0.05<W≤0.08</td><td>L≤2.0</td><td colspan="2">N≤2</td></tr>
<tr><td>0.08<W</td><td colspan="4">Define as spot defect</td></tr>
</table></td></tr>
</table>

<table>
<tr>
<td>3.0</td>
<td>Polarizer Bubble</td>
<td>
<table>
<tr><td rowspan="2">Zone
Size (mm)</td><td colspan="3">Acceptable Qty</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td>Φ≤0.2</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.2<Φ≤0.4</td><td colspan="2">2(distance≧10mm)</td></tr>
<tr><td>0.4<Φ≤0.6</td><td colspan="2">1</td></tr>
<tr><td>0.6<Φ</td><td colspan="2">0</td></tr>
</table>
</td>
</tr>
<tr>
<td>4.0</td>
<td>SMT</td>
<td>According to IPC-A-610C class Ⅱ standard. Function defect and missing part are major defect, the others are minor defect.</td>
</tr>
</table>