PHOENIX DISPLAY INTERNATIONAL, INC.

PHOENIX DISPLAY INTERNATIONAL, INC

SPECIFICATION FOR LCD MODULE

CUSTOMER	
PART NUMBER	PDIS156MWU01ES
DESCRIPTION	15.6" 1920 (RG) x 1080 Dots
VERSION	1.0
ISSUE DATE	21-May-19

COMPANY ADDRESS:
Phoenix Display International, Inc.
6150 W. Gila Springs Place Unit 2
Chandler, AZ 85226
USA
www.phoenixdisplay.com
(630) 359-5700 office
(630) 359-5701 fax

Table of Contents

1. Record of Revision.....3

2. General Specifications.....4

3. Input/Output Terminals..... 5

4. Absolute Maximum Rating.....6

5.Electrical Characteristics.....6

6. Interface Timing.....8

7. Optical Characteristics..... 13

8. Environmental / Reliability Tests..... 16

9. Mechanical Drawing..... 17

10. Packing.....18

11. TFT-LCD Module Inspection Criteria..... 19

12. Precautions for Use of LCD modules.....24

1. Record of Revision

Rev	Issued Date	Description	Editor
1.0	2019/5/21	First Release	Yigui.Han

2. General Specifications

Feature		Spec
Characteristics	Size	15.6 inch
	Resolution	1920(horizontal)*1080(Vertical)
	Interface	EDP
	Connect type	Connector
	Display Colors	262k
	Technology type	a-Si
	Pixel pitch (mm)	0.179*0.179
	Pixel Configuration	R.G.B.-Stripe
	Display Mode	Normally Black
	LCD Driver IC	TBD
	Viewing Direction	ALL
Mechanical	LCM (W x H x D) (mm)	360.00*222.23*6.4
	Active Area(mm)	344.16 *193.59
	Weight (g)	TBD
	LED Numbers	60 LEDs

Note 1: Requirements on Environmental Protection: RoHs
Note 2: LCM weight tolerance: +/- 5%

3. Input/Output Terminals

1	NC	Not Connect
2	GND	Power ground
3	EDP_D1-	Complement Signal Link Lane 1
4	EDP_D1+	True Signal Line 1
5	GND	Power ground
6	EDP_D0-	Complement Signal Link Lane 0
7	EDP_D0+	True Signal Line 0
8	GND	Power ground
9	ETX_AUX+	True Signal Auxiliary Ch.
10	ETX_AUX-	Complement Signal Auxiliary Ch.
11	GND	Power ground
12	VDD3.3	Power Supply +3.3V
13	VDD3.3	Power Supply +3.3V
14	NC	Not Connect
15	GND	Power ground
16	GND	Power ground
17	HPD	HPD Signal Pin
18	GND	Power ground
19	GND	Power ground
20	GND	Power ground
21	GND	Power ground
22-30	NC	Not Connect

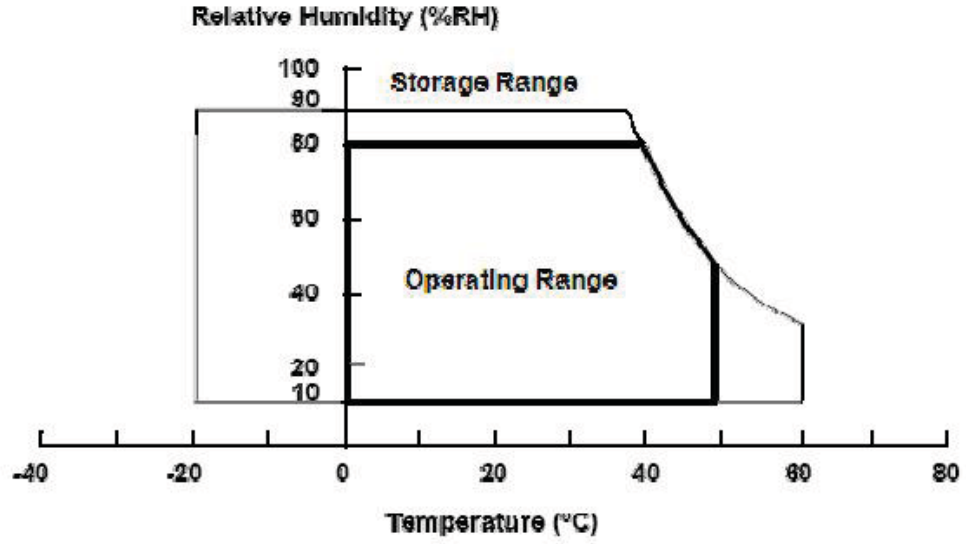
4.Absolute Maximum Rating

Table 1 Absolute Ratings of Enviroment

Item	Symbol	Min.	Max.	Unit	Conditions
Supply Voltage	V_{DD}	-0.3	4.0	V	-
Input Signal	V_S	-0.3	2.4	V	eDP Signals
Operating Temperature	TOP	0	50	℃	Note
Operating Humidity	HOP	10	80	%RH	Note
Storage Temperature	TST	-20	60	℃	Note
Storage Humidity	HST	10	90	%RH	Note

Note : (A)Maximum Wet-Bulb temperature should be 39℃ and no condensation of water.
(B)When you apply the LCD module for OA system. Please make sure to keep the temperature of LCD module under 60℃.
(C)Storage /Operating temperature & humidity:

Figure 2 Absolute Ratings of Environment of the LCD Module



5.Electrical Characteristics

5.1 Driving TFT LCD Panel

Item		Symbol	MIN	TYP	MAX	Unit	Remark
Supply Voltage		V_{DD}	3.0	3.3	3.6	V	
VDD Current		I_{VDD}	-	180	260	mA	
Inrush Current		I_{Rush}	-	-	2	A	
Input Signal Voltage	Low Leve	V_{IL}	GND	-	0.3x VDD	V	
	High Level	V_{IH}	0.7x VDD	-	VDD	V	
Output Signal Voltage	Low Leve	V_{IL}	-	-	VSS+0.4	V	
	High Level	V_{IH}	VDD-0.4	-	-	V	
(Panel+LSI) Power Consumption		Black Mode (60Hz)	-	-		nW	
		Standby	-	-	-	uW	

5.2 LED Driving Conditions

Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	I_F	-	360	-	mA	
Forward Voltage	V_F	28	30	33	V	
Backlight Power consumption	W_{BL}	-	10.8	-	W	
LED Lifetime		10000	25000	-	Hrs	

Note 1: Each LED: IF =60 mA, VF =3.2+/0.3V.
Note 2: Optical performance should be evaluated at Ta=25℃ only.
Note 3: If LED is driven by high current, high ambient temperature & humidity condition. The life Time of LED will be reduced. Operating life means brightness goes down to 50% initial brightness. Typical operating life time is estimated data.

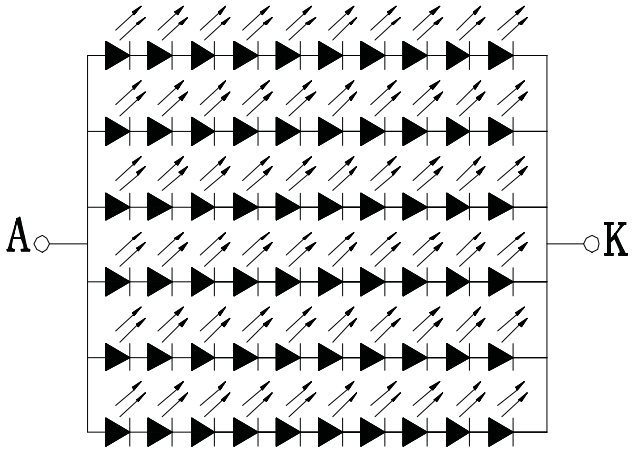


Figure: LED connection of backlight(Constant Current)

6.Interface Timing

6.1 Timing Characteristics

Basically,interface timings should match the 1920 x 1080 /60Hz manufacturing guide line timing.

Parameter	Symbol	Unit	Min.	Typ.	Max.
Signal Clock Frequency	f_{dck}	MHz	132	138.5	140
H Total Time	T_{hp}	clocks	2020	2080	2400
H Active Time	HA	clocks		1920	
H Blanking	T_{hfp}	clocks	-	160	-
H Frequency	f_h	kHz	65	66	72
V Total Time	T_{vp}	lines	1090	1111	1200
V Active Time	VA	lines		1080	
V Blanking	T_{vfp}	lines	-	31	-
V Frequency	f_v	Hz	55	60	65

6.2 Signal Electrical Characteristics

Input signals shall be low or High-impedance state when VDD is off.

It is recommended to refer the specifications of VESA Display Port Standard V1.2 in detail.

Table 8 Display Port Main Link

Parameter	Description	Min.	Typ.	Max.	Unit
V_{CM}	Differentia Common Mode Voltage	0	-	2.0	V
$V_{Diff\ P-P}$ Level 1	Differential Peak to Peak Voltage Level 1	0.34	0.40	0.46	V
$V_{Diff\ P-P}$ Level 2	Differential Peak to Peak Voltage Level 2	0.51	0.60	0.68	V
$V_{Diff\ P-P}$ Level 3	Differential Peak to Peak Voltage Level 3	0.69	0.80	0.92	V
$V_{Diff\ P-P}$ Level 4	Differential Peak to Peak Voltage Level 4	1.02	1.20	1.38	V

Note: Fallow as VESA display port standard V1.2 at both 1.62 and 2.7Gbps link rates.

Figure 8 Display Port Main Link Signal

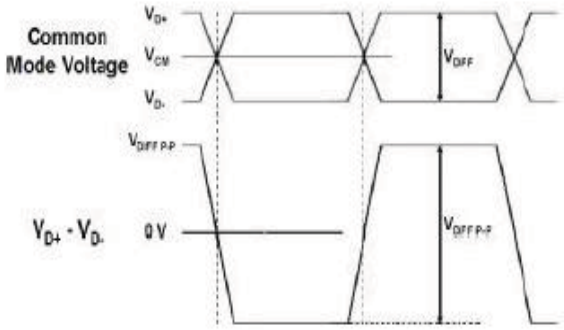


Figure 9 Display Port AUX_CH Signal

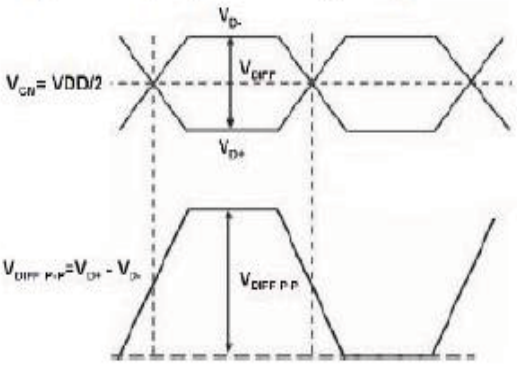


Table 9 Display Port AUX_CH

Parameter	Description	Min.	Typ.	Max.	Unit
V_{CM}	Differentia Common Mode Voltage	0	VDD/2	2	V
$V_{Diff\ P-P}$	Differential Peak to Peak Voltage	0.39	-	1.38	V

Note: Fallow as VESA display port standard V1.2.

Table 10 Display Port V_{HPD}

Parameter	Description	Min.	Typ.	Max.	Unit
V_{HPD}	HPD Voltage	2.25	-	3.60	V

Note: Fallow as VESA display port standard V1.2.

Figure 10 Display Port Interface Power Up/Down Sequence, Normal System Operation

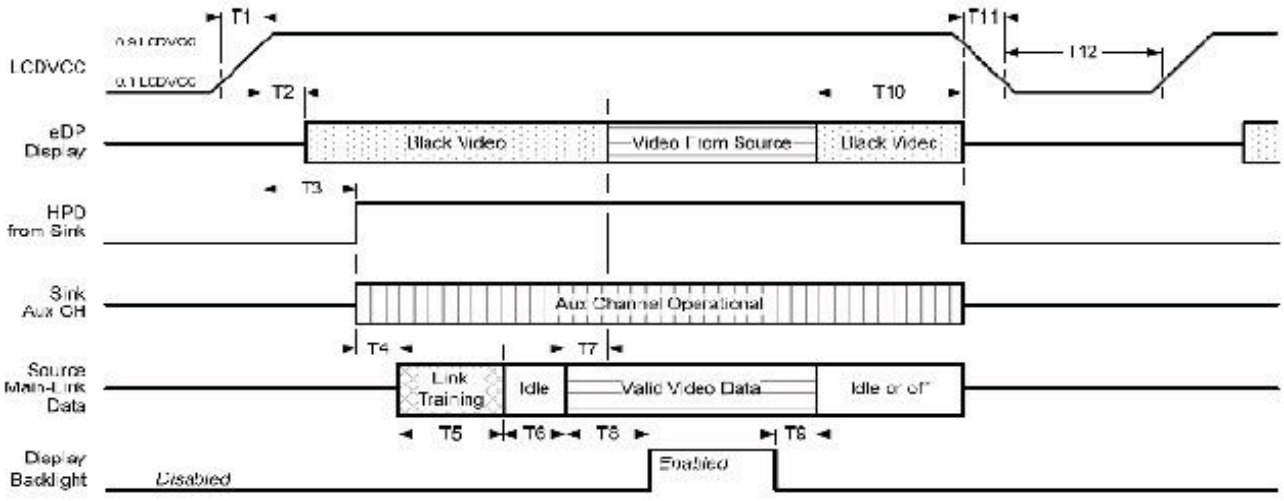
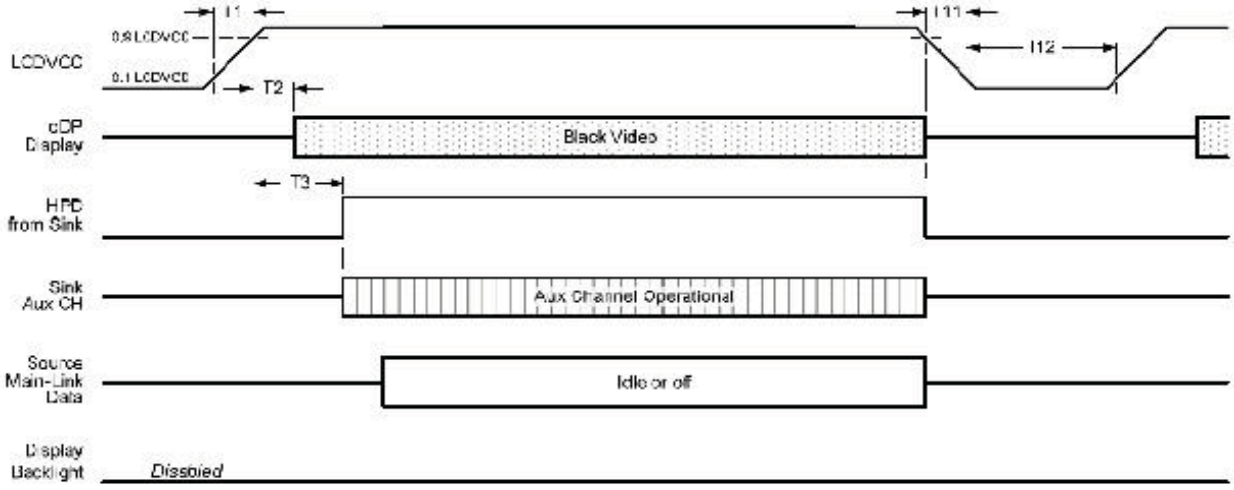


Figure 11 Display Port Interface Power Up/Down Sequence, Aux Channel Transaction Only

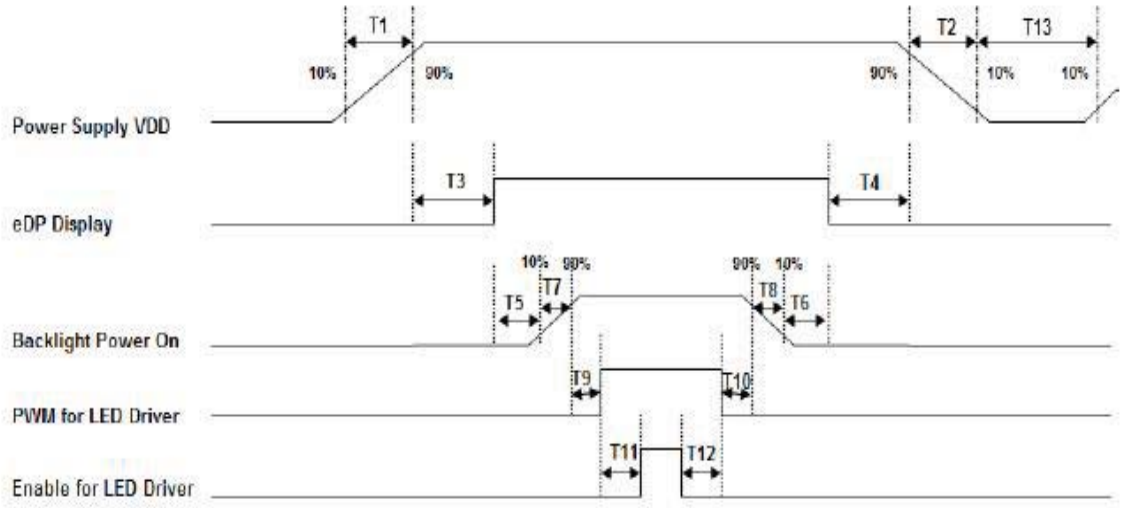


6.3 eDP Panel Power Sequence Timing Parameters

Timing Parameter	Description	Reqd. By	Limits		Notes
			Min.	Max.	
T1	Power rail rise time, 10% to 90%	Source	0.5ms	10ms	-
T2	Delay from LCD VCC to black video generation	Sink	0ms	200ms	Prevents display noise until valid video data is received from the Source.(see note 1 below)
T3	Delay from LCD VCC to HPD high	Sink	0ms	200ms	Sink Aux Channel must be operational upon HPD high.
T4	Delay from HPD high to link training initialization	Source	-	-	Allows for Source to read Link capability and initialize.
T5	Link training duration	Source	-	-	Dependant on Source link training protocol.
T6	Link idle	Source	-	-	Min accounts for required BS-Idle pattern. Max allows for Source frame synchronization.
T7	Delay from valid video data from Source to video on display	Sink	0ms	50ms	Max allows Sink validate video data and timing.
T8	Delay from valid video from Source to backlight enable	Source	-	-	Source must assure display video is stable.
T9	Delay from backlight disable to end of valid video data	Source	-	-	Source must assure backlight is no longer illuminated.(see note 1 below)
T10	Delay from end of valid video data from Source to power off	Source	0ms	500ms	-
T11	Power rail fall time, 90% to 10%	Source	-	10ms	-
T12	Power off time	Source	500ms	-	-

6.4 Power ON/OFF Sequence

VDD power on/off sequence is as follows. Interface signals are also shown in the chart. Signals from any system shall be Hi-Z state or low level when VDD is off.



Parameter	Unit	Min.	Max.
T1	ms	0.5	10
T2	ms	0	10
T3	ms	0	200
T4	ms	0	50
T5	ms	300	-
T6	ms	200	-
T7	ms	0.5	10
T8	ms	0	10
T9	ms	10	-
T10	ms	10	-
T11	ms	10	-
T12	ms	0	-
T13	ms	500	-

7. Optical Characteristics

Items		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark	Note
Response time		Tr+Tf	-	-	25	30	ms	FIG.1	Note4
Contrast Ratio		CR		700	1000	-	-	FIG.2	Note1
Surface luminance		LV	θ =0°	800	1000	-	cd/m2	FIG.2	Note2
Luminance uniformity		Yu	θ =0°	70	75	-	%	FIG.2	Note3
NTSC		-	θ =0°	-	45	-	%	FIG.2	Note5
Viewing angle		θ_T	Center CR≥10	80	89	-	deg	FIG.3	Note6
		θ_B		80	89	-	deg	FIG.3	
		θ_L		80	89	-	deg	FIG.3	
		θ_R		80	89	-	deg	FIG.3	
Chromaticity	Red	R_X	θ =0° ∅=0° Ta=25°	0.540	0.590	0.640	-	FIG.2 CIE1931	Note5
		R_Y		0.300	0.350	0.400	-		
	Green	G_X		0.280	0.330	0.380	-		
		G_Y		0.505	0.555	0.605	-		
	Blue	B_X		0.103	0.153	0.203	-		
		B_Y		0.069	0.119	0.169	-		
	White	W_X		0.276	0.326	0.376	-		
		W_Y		0.302	0.352	0.402	-		

Note1. Definition of contrast ratio

Contrast ratio(Cr) is defined mathematically by the following formula. For more information see FIG.2.

$$\text{Contrast ratio} = \frac{\text{Luminance measured when LCD on the “White” state}}{\text{Luminance measured when LCD on the “Black” state}}$$

For contrast ratio, Surface Luminance, Luminance uniformity and CIE,the testing data is base on TOPCON’s BM-5 or BM-7 photo detector or compatible.

Note2. Definition of surface luminance.

Surface luminance is the luminance with all pixels displaying white. For more information see FIG.2.

Lv = Average Surface Luminance with all white pixels(P1,P2,P3, ...,Pn)

Note3. Definition of luminance uniformity

The luminance uniformity in surface luminance is determined by measuring luminance at each test position 1 through n, and then dividing the maximum luminance of n points luminance by minimum luminance of n points luminance.For more information see FIG.2.

$$YU = \frac{\text{Minimum surface luminance with all white pixels (P1,P2,P3,.....,Pn)}}{\text{Maximum surface luminance with all white pixels (P1,P2,P3,.....,Pn)}}$$

Note4. Definition of response time

The response time is defined as the LCD optical switching time interval between "White" state and "Black"state.Rise time (Tr) is the time between photo detector output intensity changed from 90% to 10%. And fall time (Tf) is the time between photo detector output intensity changed from 10% to 90%.

For additional information see FIG1.

Note5. Definition of color chromaticity (CIE1931)

CIE (x,y) chromaticity,The x,y value is determined by screen active area center position P5.For more information see FIG.2.

Note6. Definition of viewing angle

Viewing angle is the angle at which the contrast ratio is greater than 10. Angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG.3.

For viewing angle and response time testing, the testing data is base on Autronic-Melchers' s ConoScope or DMS series Instruments or compatible

FIG.1.The definition of response Time

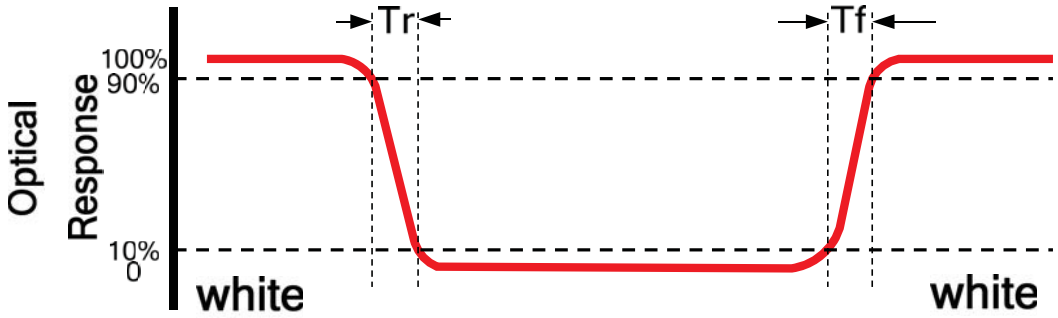


FIG.2. Measuring method for contrast ratio, surface luminance, luminance uniformity, CIE (x,y) chromaticity

Size : S≤5"(see Figure a) A : 5 mm B : 5 mm
H,V : Active area
Light spot size ∅=5mm(BM-5) or ∅=7.7mm (BM-7)50cm distance or compatible distance from the LCD surface to detector lens.
test spot position : see Figure a.
measurement instrument : TOPCON's luminance meter BM-5 or BM-7 or compatible (see Figure c).

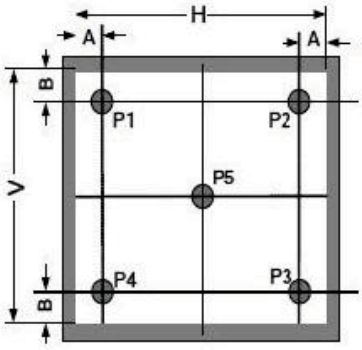


Figure a

Size : 5”＜S≤12.3”(see Figure b) H,V : Active area

Light spot size ∅=5mm(BM-5) or ∅=7.7mm (BM-7)50cm distance or compatible distance from the LCD surface to detector lens.

test spot position : see Figure b.

measurement instrument : TOPCON’s luminance meter BM-5 or BM-7 or compatible (see Figure c).

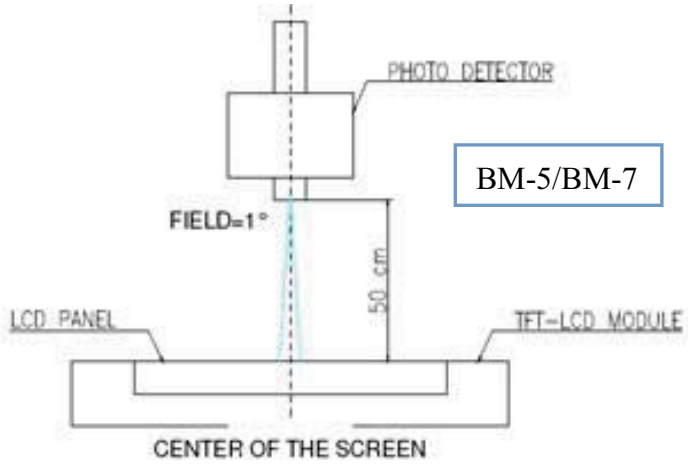


Figure c

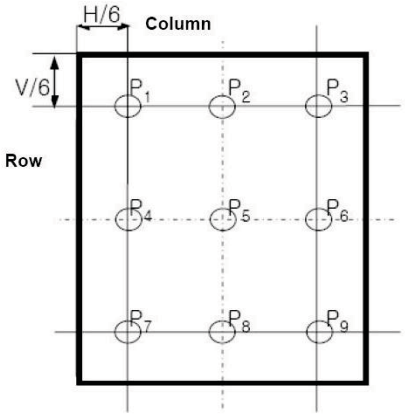
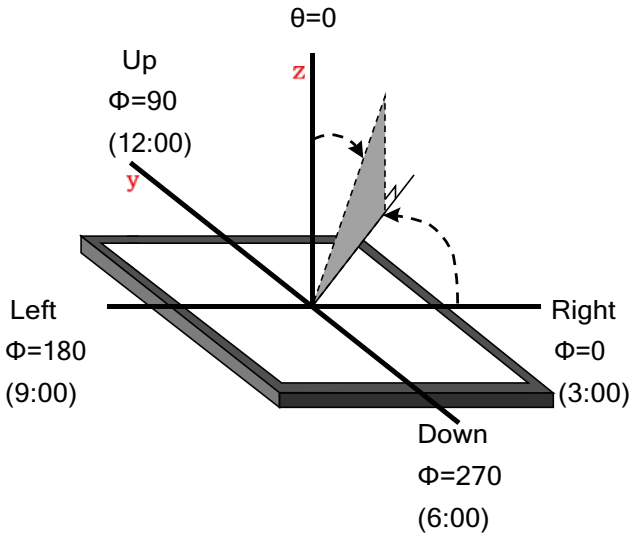


Figure b

FIG.3.The definition of viewing angle

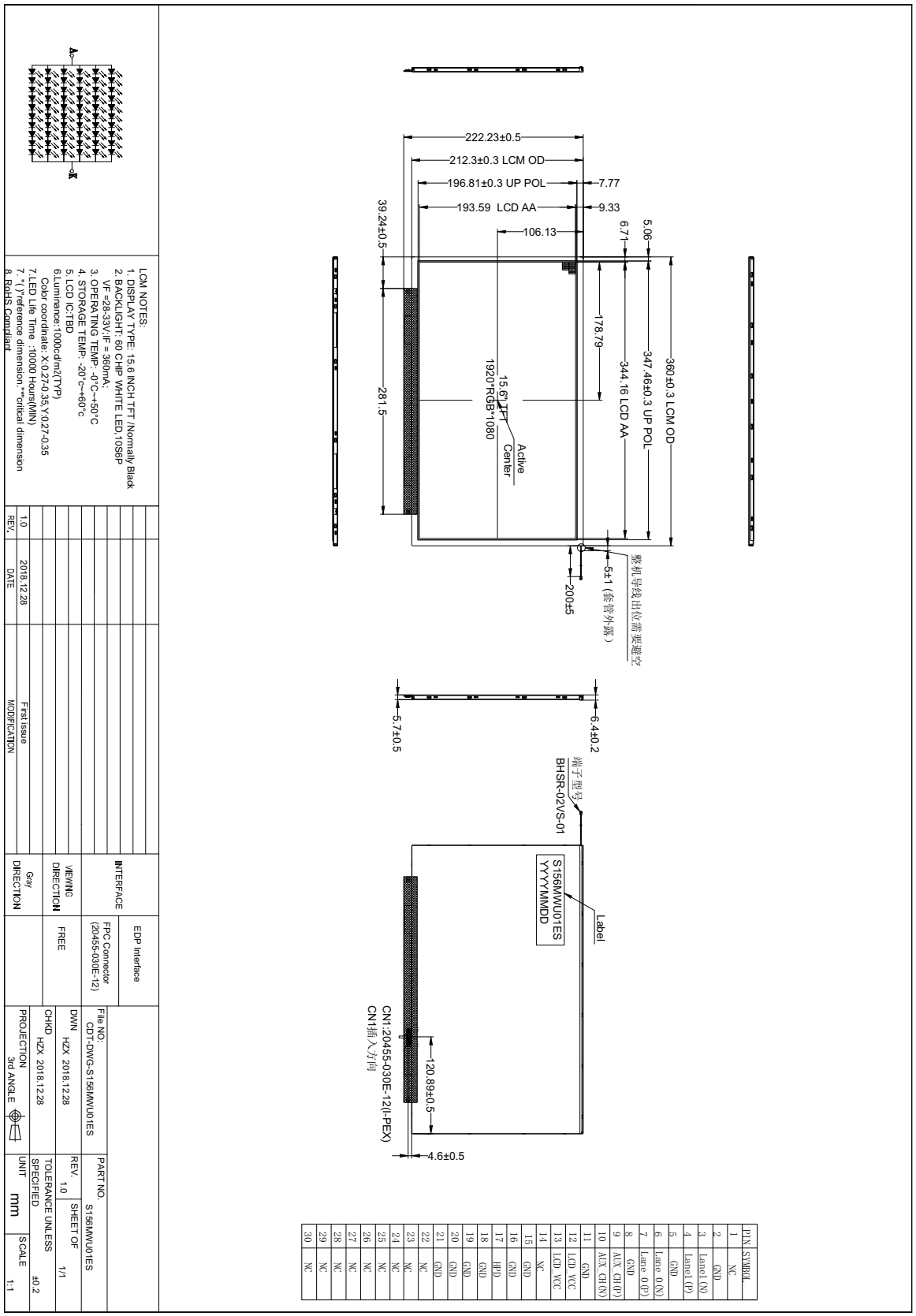


8. Environmental / Reliability Tests

No	Test Item	Condition	Remarks
1	High Temperature Operation	Ts= +50℃, 96hrs	Note 1 IEC60068-2-2, GB2423. 2-89
2	Low Temperature Operation	Ta= -0℃, 96hrs	Note 2 IEC60068-2-1 GB2423.1-89
3	High Temperature Storage	Ta= +60℃, 96hrs	IEC60068-2-2 GB2423. 2-89
4	Low Temperature Storage	Ta= -20℃, 96hrs	IEC60068-2-1 GB/T2423.1-89
5	High Temperature & Humidity Storage	Ta= +40℃, 90% RH max,96 hours	IEC60068-2-3 GB/T2423.3-2006
6	Thermal Shock (Non-operation)	-20℃ 20 min ~ +60℃ 30 min Change time: 5min, 30 Cycle	Start with cold temperature, end with high temperature IEC60068-2-14, GB2423.22-87
7	Electro Static Discharge (Operation)	C=150pF, R=330 Ω, 5 points/panel Air:±8KV, 5 times; Contact: ±4KV, 5 times; (Environment: 15℃ ~ 35℃, 30% ~ 60%, 86Kpa ~ 106Kpa)	IEC61000-4-2 GB/T17626.2-1998
8	Package Drop Test	Height: 80 cm, 1 corner, 3 edges, 6 surfaces	IEC60068-2-32 GB/T2423.8-1995

Note: 1. Ts is the temperature of panel's surface.
2. Ta is the ambient temperature of sample.
3. The size of sample is 5pcs.

9. Mechanical Drawing



10.Packing

Packing Method

TBD

11.TFT-LCD Module Inspection Criteria

11.1 Scope

The incoming inspection standards shall be applied to TFT －LCD Modules (hereinafter Called "Modules") that supplied by CDTech Technology LTD.

11.2 Incoming Inspection

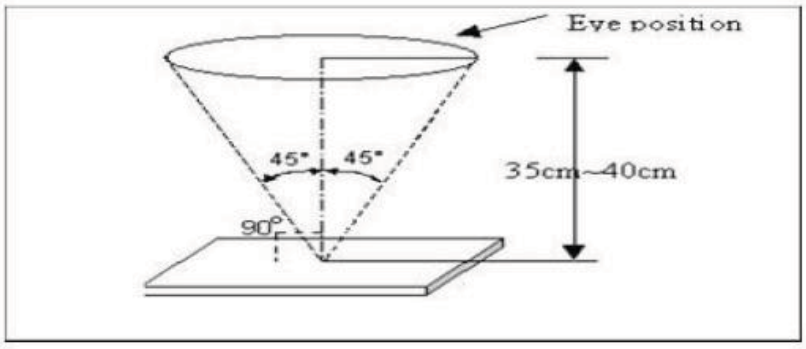
The customer shall inspect the modules within twenty calendar days of the delivery date（the “inspection period）at its own cost. The result of the inspection（acceptance or rejection）shall be recorded in writing, and a copy of this writing will be promptly sent to The seller, If the results of the inspecting from buyer does not send to the seller within twenty Calendar days of the delivery date. The modules shall be regards as acceptance. Should the customer fail to notify the seller within the inspection period, the buyers Right to reject the modules shall be lapsed and the modules shall be deemed to have Been accepted by the buyer

11.3 Inspection Sampling

3.1. Lot size: Quantity per shipment lot per model
3.2. Sampling type: Normal inspection, Single sampling
3.3. Inspection level: II
3.4. Sampling table: MIL-STD-105E
3.5. Acceptable quality level （AQL ）
Major defect: AQL=0.65 Minor defect: AQL=1.00

11.4 Inspection Conditions

4.1 Ambient conditions:
a. Temperature: Room temperature 25±5℃
b. Humidity: (60±10) ％RH
c. Illumination: Single fluorescent lamp non-directive (300 to 700 Lux)
4.2 Viewing distance
The distance between the LCD and the inspector’s eyes shall be at least 35±5 ㎝.
4.3 Viewing Angle
U/D: 45 ° /45°, L/R: 45° /45°



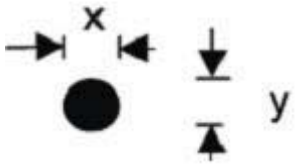
11.5 Inspection Criteria

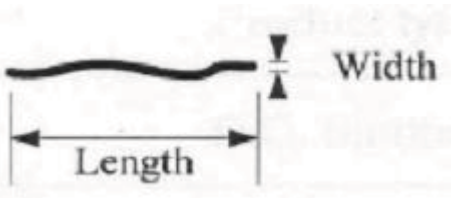
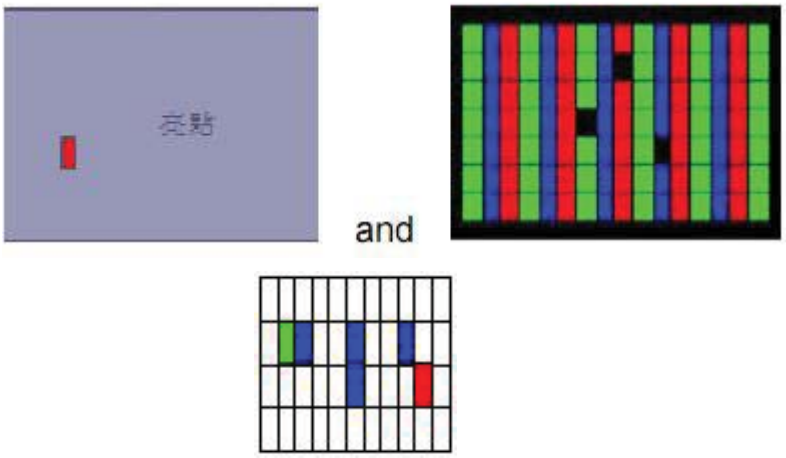
Defects are classified as major defects and minor defects according to the degree of Defectiveness defined herein.

11.5.1 Major defect

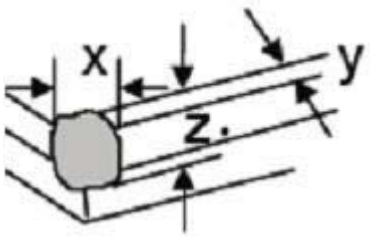
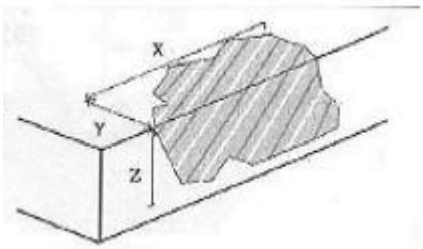
Item No	Items to be inspected	Inspection Standard
5.1.1	All functional defects	1) No display 2) Display abnormally 3) Short circuit 4) line defect
`5.1.2	Missing	Missing function component
5.1.3	Crack	Glass Crack

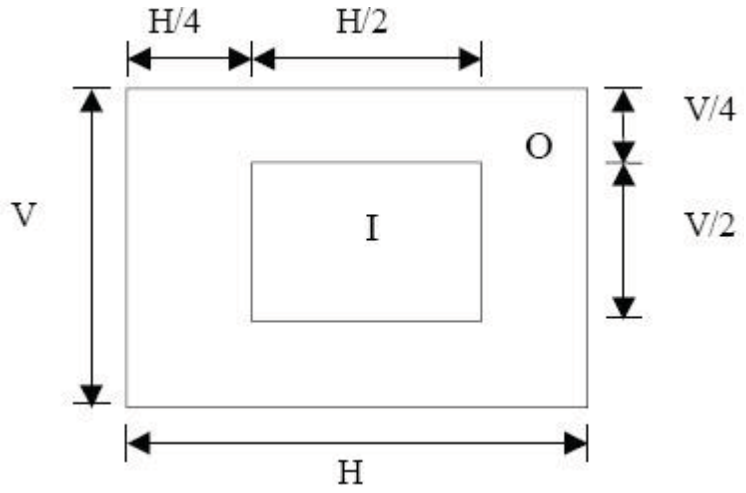
11.5.2 Minor defect

Item No	Items to be inspected	Inspection standard	
5.2.1	Spot Defect Including Black spot White spot Pinhole Foreign particle Polarizer dirt	For dark/white spot is defined $\varphi = (x+y) / 2$  	
		Size φ(mm)	Acceptable Quantity
		Φ<0.2	Ignore
		0.2 ≤Φ≤0.5	N≤4
		Φ>0.5	Not allowed

<table>
<tr><td rowspan="4">5.2.2</td><td rowspan="4">Line Defect
Including Black line
White line Scratch</td><td colspan="2">Define:

</td></tr>
<tr><td>Width(mm)
Length(mm)</td><td>Acceptable Quantity</td></tr>
<tr><td>W<0.05</td><td>Ignore</td></tr>
<tr><td>0.05≤W≤0.1
0.3≤L≤3.0</td><td>N≤5</td></tr>
<tr><td>5.2.3</td><td>Polarizer
Dent/Bubble</td><td>L>3.0</td><td>Not allowed</td></tr>
<tr><td rowspan="4">5.2.3</td><td rowspan="4">Polarizer
Dent/Bubble</td><td>Sizeφ(mm)</td><td>Acceptable Quantity</td></tr>
<tr><td>Φ<0.2</td><td>Ignore</td></tr>
<tr><td>0.2 ≤Φ≤0.5</td><td>N≤4</td></tr>
<tr><td>Φ>0.5</td><td>Not allowed</td></tr>
<tr><td rowspan="6">5.2.4</td><td rowspan="6">Electrical Dot
Defect</td><td colspan="2">Bright and Black dot define:


Two Adjacent Dot</td></tr>
<tr><td colspan="2">Inspection pattern: Full white、Full black、Red、green and blue screens</td></tr>
<tr><td rowspan="2">Item</td><td colspan="3">Acceptable Quantity</td></tr>
<tr><td>Single Dot</td><td>Adjacent 2dots</td><td>Note</td></tr>
<tr><td>Black dot defect</td><td>5</td><td>1</td><td>5</td></tr>
<tr><td>Bright dot defect</td><td>4</td><td>0</td><td>4</td></tr>
<tr><td>Total Dot</td><td colspan="2"></td><td>7</td></tr>
</table>

<table>
<tr><td rowspan="6">5.2.5</td><td rowspan="6">Glass defect</td><td colspan="2">1.Corner Fragment:
</td></tr>
<tr><td>Size(mm)</td><td>Acceptable Quantity</td></tr>
<tr><td>X≤3mm
Y≤1mm
Z≤T</td><td>Ignore
T： Glass thickness
X: Length
Y: Width
Z: thickness</td></tr>
<tr><td colspan="2">2. Side Fragment:
</td></tr>
<tr><td>Size(mm)</td><td>Acceptable Quantity</td></tr>
<tr><td>X≤5.0mm
Y ≤1mm
Z≤T</td><td>T： Glass thickness
X: Length
Y: Width
Z: thickness</td></tr>
</table>



I area & O area

Note: 1). Dot defect is defined as the defective area of the dot area is larger than 50% of the dot area.

2). The distance between two bright dot defects (red, green, blue, and white) should be larger than 15mm.

3). The distance between black dot defects or black and bright dot defects should be more than 5mm apart.

4). Polarizer bubble is defined as the bubble appears on active display area. The defect of polarizer bubble shall be ignored if the polarizer bubble appears on the outside of active display area.

11.6 Mechanics specification

As for the outside dimension, weight of the modules, please refer to product specification For more details

12.Precautions for Use of LCD modules

12.1 Handling Precautions

12.1.1. The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

12.1.2. If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

12.1.3. Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

12.1.4. The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

12.1.5. If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

- Isopropyl alcohol
- Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

- Water
- Ketene

12.1.6. Do not attempt to disassemble the LCD Module.

12.1.7. If the logic circuit power is off, do not apply the input signals.

12.1.8. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

12.1.8.1. Be sure to ground the body when handling the LCD Modules.

12.1.8.2. Tools required for assembly, such as soldering irons, must be properly ground.

12.1.8.3. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

12.1.8.4. The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

12.2 Storage Precautions

12.2.1. When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

12.2.2. The LCD modules should be stored under the storage temperature range If the LCD modules will be stored for a long time, the recommend condition is:

Temperature : 0℃ ～ 40℃ Relatively humidity: ≤80%

12.2.3. The LCD modules should be stored in the room without acid, alkali and harmful gas.

12.3 Transportation Precautions

The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.