PHOENIX DISPLAY INTERNATIONAL, INC.

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SPECIFICATION FOR LCD MODULE

CUSTOMER	
PART NUMBER	PDI109-28CM1-32A
DESCRIPTION	10.1" TFT 1280 x 800
VERSION	1
ISSUE DATE	05-21-2015

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Document Revision History				
Change No.	Date	Subject And Reason	Version No.	Responser
1	2015.05.21	New	01	Zhengdong Xiao

1.0 General Description

Item	Specification	Remark
LCD size	10.1 inch (Diagonal)	
Driver element	a-si TFT active matrix	
Resolution	1280× 3(RGB)×800	
Display area	Normally Black, Transmissive	
Dot pitch	0.0565(W)× 0.1695(H) mm	
Active area	216.96(W) × 135.6 (H) mm	
Outline Dimension	229.46 (H) x149.1 (V) x2.7 (D) mm	Note1
Surface Treatment	Hard Coating(3H)	
Color arrangement	RGB-strip	
Interface	LVDS	
Weight	180g(Max)	

Note1:Refer to Mechanical Drawing
Note2:Including T-con Board Power consumption

2.0 Pin Assignment

A 40pin connector is used for the module electronics interface. The recommended model is F62240-H1210A manufactured by Vigorconn.

Pin No.	Symbol	I/O	Function	Remark
1	VCOM	P	Common Voltage	
2	VDD	P	Power Supply	
3	VDD	P	Power Supply	
4	NC	---	No connection	
5	NC	---	No connection	
6	NC	---	No connection	
7	GND	P	Ground	
8	Rxin0-	I	-LVDS Differential Data Input	R0-R5, G0
9	Rxin0+	I	+LVDS Differential Data Input	
10	GND	P	Ground	
11	Rxin1-	I	-LVDS Differential Data Input	G1~G5, B0,B1
12	Rxin1+	I	+LVDS Differential Data Input	
13	GND	P	Ground	
14	Rxin2-	I	-LVDS Differential Data Input	B2-B5,HS,VS, DE
15	Rxin2+	I	+LVDS Differential Data Input	
16	GND	P	Ground	
17	RxCLK-	I	-LVDS Differential Clock Input	LVDS CLK
18	RxCLK+	I	+LVDS Differential Clock Input	
19	GND	P	Ground	
20	Rxin3-	I	-LVDS Differential Data Input	R6, R7, G6, G7, B6, B7
21	Rxin3+	I	+LVDS Differential Data Input	
22	GND	P	Ground	
23	NC	---	No connection	
24	NC	---	No connection	
25	GND	P	Ground	
26	NC	---	No connection	

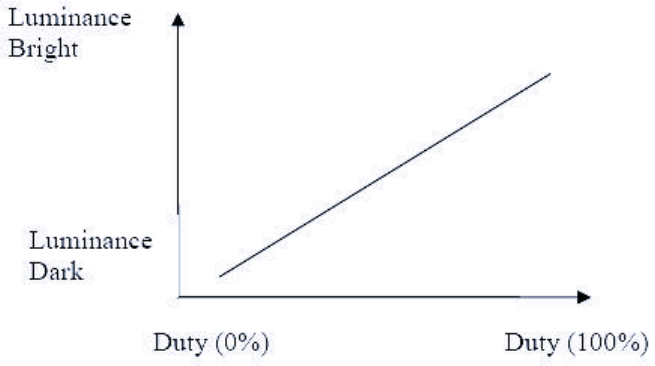
27	LED_PWM	O	CABC controller signal output for backlight	Note2
28	NC	---	No connection	
29	AVDD	P	Power for Analog Circuit	
30	GND	P	Ground	
31	LED-	P	LED Cathode	
32	LED-	P	LED Cathode	
33	NC	---	No connection	
34	NC	---	No connection	
35	VGL	P	Gate OFF Voltage	
36	NC	---	No connection	
37	CABC_EN	I	CABC Enable Input	Note1
38	VGH	P	Gate ON Voltage	
39	LED+	P	LED Anode	
40	LED+	P	LED Anode	

I: input, O: output, P: Power

Note1: The setting of CABC function are as follows.

Pin	Enable	Disable
CABC_EN	High Voltage	Low Voltage or open

Note2: LED_PWM is used to adjust backlight brightness.



3. Operation Specifications

3.1. Absolute Maximum Ratings

(Note 1)

Item	Symbol	Values		Unit	Remark
		Min.	Max.		
Power voltage	VDD	-0.3	3.9	V	
	AVDD	-0.3	14	V	
	V_{GH}	-0.3	42.0	V	
	V_{GL}	-19	0.3	V	
	V_{GH}-V_{GL}	12	40.0	V	
Operation Temperature	T_{OP}	-0	50	℃	
Storage Temperature	T_{ST}	-20	60	℃	

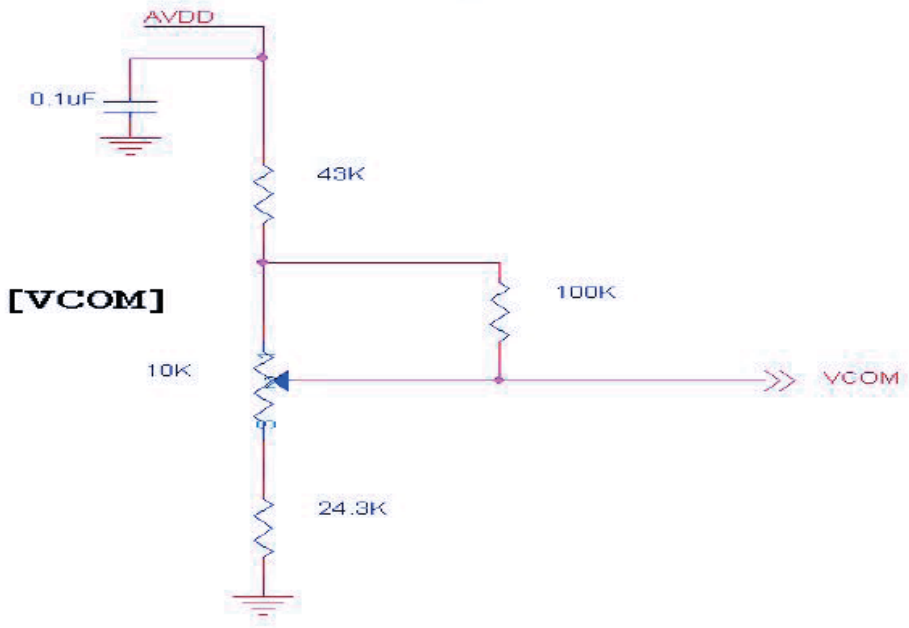
Note 1: The absolute maximum rating values of this product are not allowed to be exceeded at any times. Should a module be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme case, the module may be permanently destroyed.

3.2. Typical Operation Conditions

(Note 1)

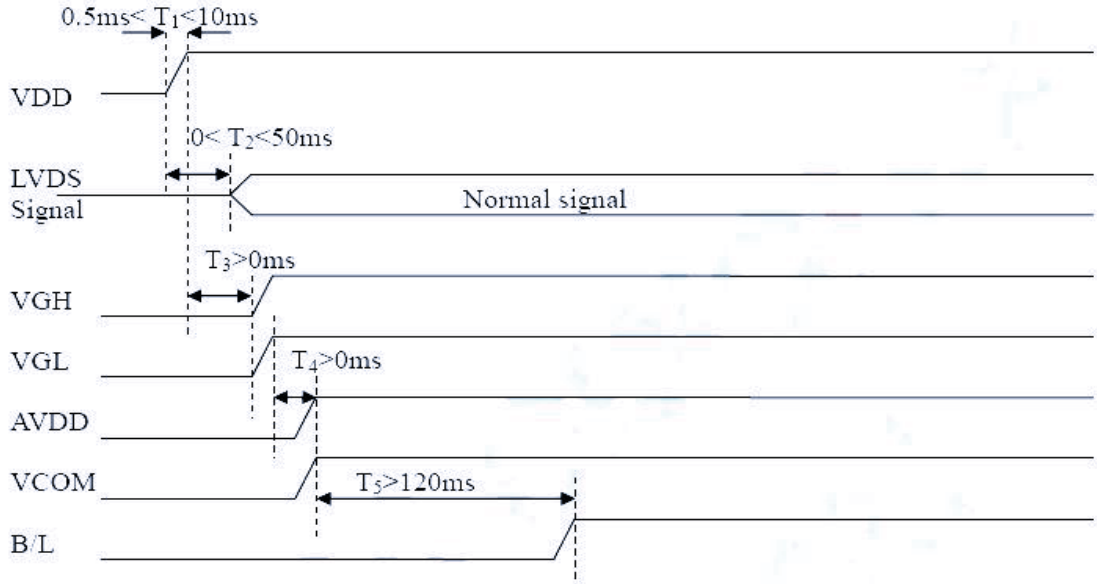
Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Power voltage	VDD	2.3	2.5	2.7	V	Note 2
	AVDD	8.0	8.2	8.4	V	
	V_{GH}	21.7	22	22.3	V	
	V_{GL}	-7.3	-7	-6.7	V	
Input signal voltage	VCOM	3.0	3.3	3.6	V	Note 4
Input logic high voltage	V_{IH}	0.8 VDD	-	3.6	V	Note 3
Input logic low voltage	V_{IL}	0	-	0.2 DV_{DD}	V	

Note 1: Be sure to apply VDD and V_{GL} to the LCD first, and then apply V_{GH}.
Note 2: VDD setting should match the signals output voltage (refer to Note 3) of customer's system board.
Note 4: Typical VCOM is only a reference value, it must be optimized according to each LCM. Be sure to use VR.

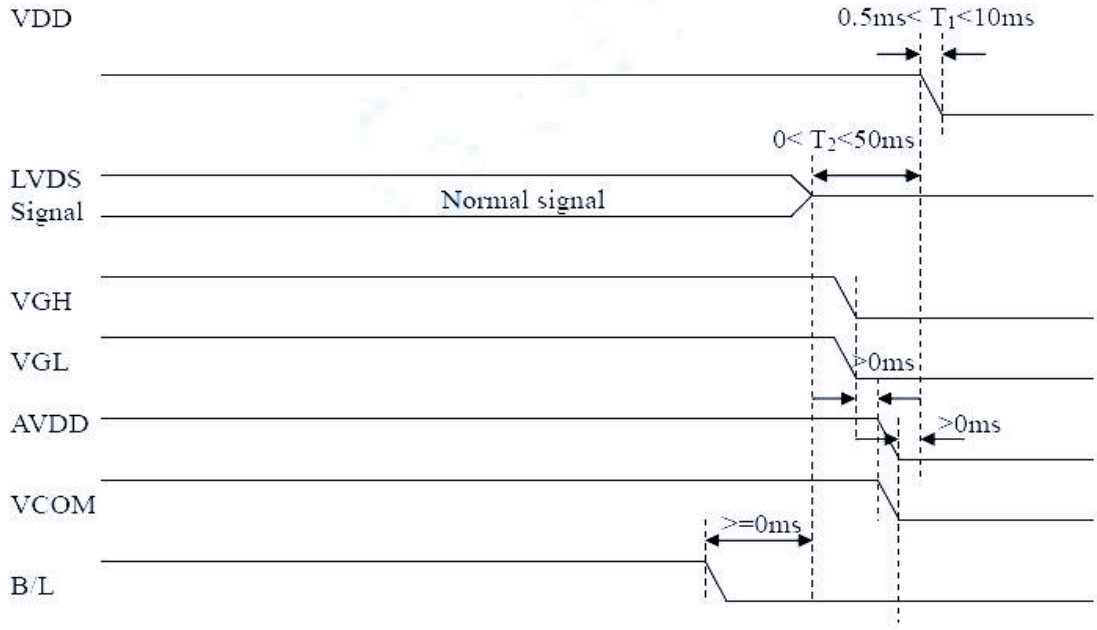


3.3. Power Sequence

a. Power on:



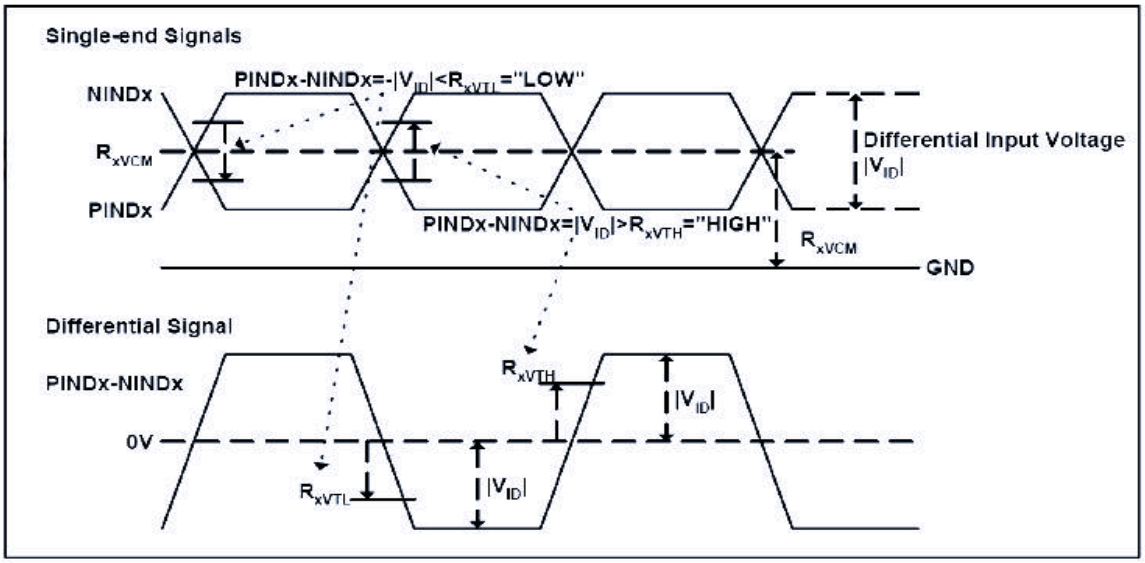
b. Power off:



3.4. LVDS Signal Timing Characteristics

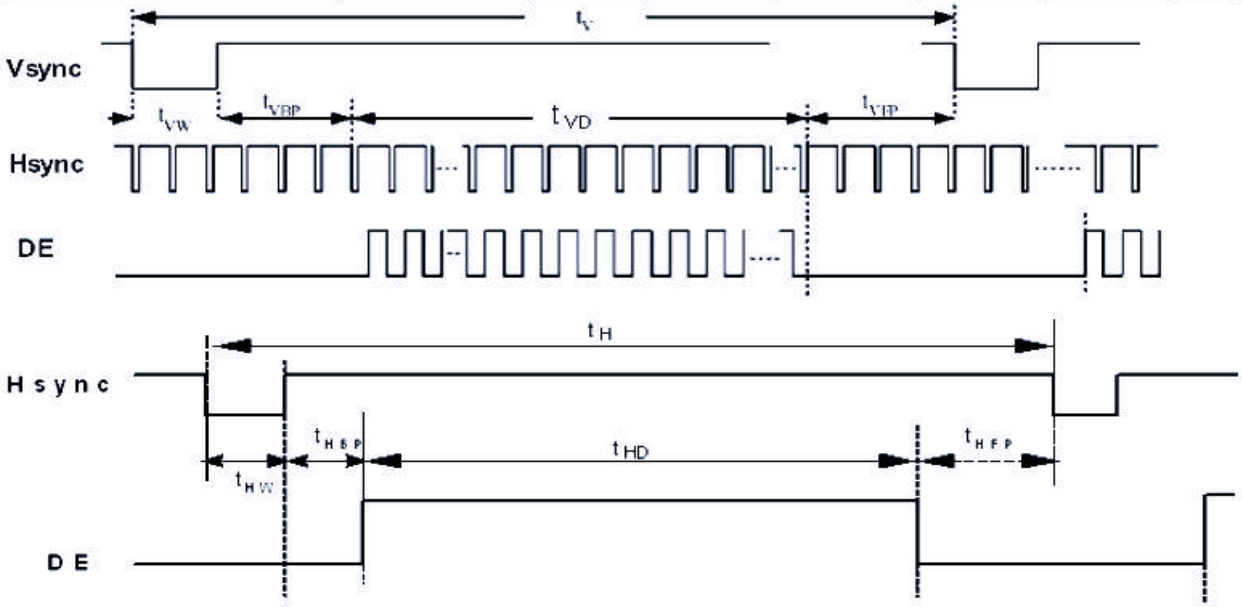
3.4.1. AC Electrical Characteristics

Parameter	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
LVDS Differential input high Threshold voltage	R_{xVTH}	-	-	+100	mV	R_{XVCM}=1.2V
LVDS Differential input low Threshold voltage	R_{xVTL}	-100	-	-	mV	
LVDS Differential input common mode voltage	R_{xVCM}	0.7	-	1.6	V	
LVDS Differential voltage	$\|V_{ID}\|$	100	-	600	mV	

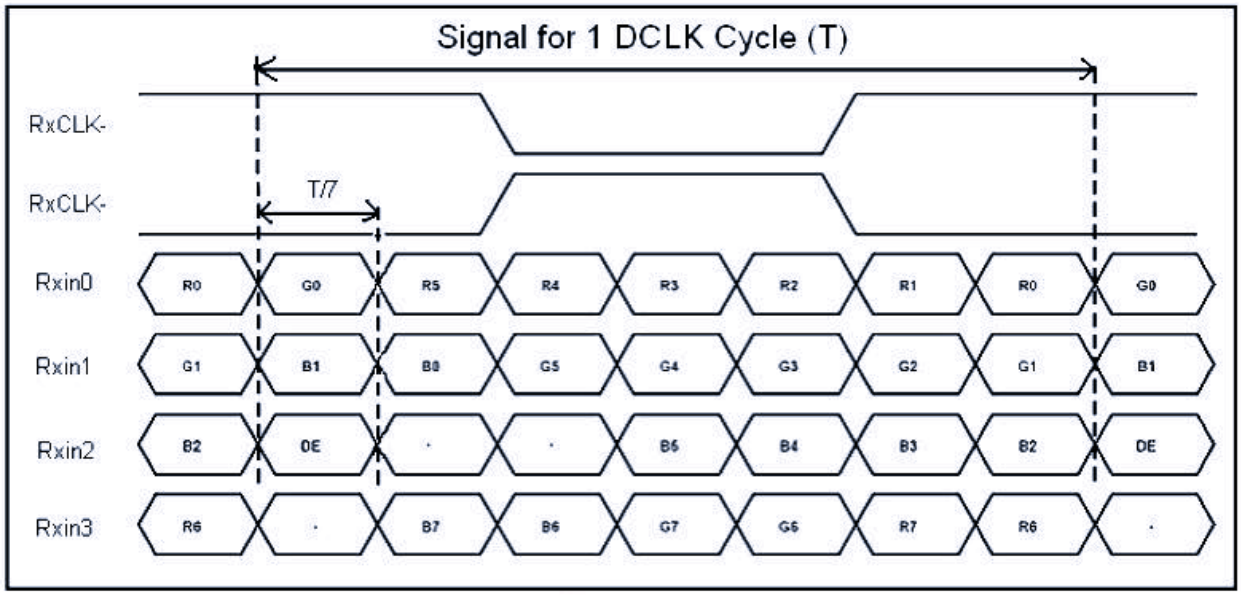


3.4.2. Timing Table

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Clock Frequency	1/Tc	(68.9)	71.1	(73.4)	MHz	Frame rate =60Hz
Horizontal display area	tHD		1280		Tc	
HS period time	tH	(1410)	1440	(1470)	Tc	
HS Width +Back Porch +Front Porch	tHW+ tHBP +tHFP	(60)	160	(190)	Tc	
Vertical display area	tVD		800		tH	
VS period time	tv	(815)	823	(833)	tH	
VS Width +Back Porch +Front Porch	tvw+ tvBP +tvFP	(15)	23	(33)	tH	



3.4.3. LVDS Data Input Format



4.0 Optical specification

Item	Symbol	Condition	Min.	Typ.	Max	Unit	Remark
Viewing Angle (CR≧10)	θL	Φ =180 ° (9 o' clock)	75	85	--	degree	Note1
	θR	Φ=0° (3 o' clock)	75	85	--		
	θT	Φ=90° (12 o' clock)	75	85	--		
	θB	Φ=270° (6 o' clock)	75	85	--		
Response time	Ton	Normal θ =Ø= 0°	--	10	20	msec	Note3
	Toff		--	20	30	msec	Note3
Contrast ratio	CR		600	800	--	--	Note4
Color Chromacicity	WX		0.27	0.29	0.32	°	
	WY		0.31	0.33	0.36	°	
Luminance Uniformity	Yu		75	--	--	%	
LCM luminance (Center)	YL	I=144mA	300	320	--	cd/m²	
Panel transmission	%		5.4%	5.6%	-	-	

Test Conditions:

1. DV_{DD}=3.3V, the ambient temperature is 25℃..
2. The test systems refer to Note 2.
3. The optical specificaitons are measured base on Chimei-innolux LCM

Note 1: Definition of viewing angle range

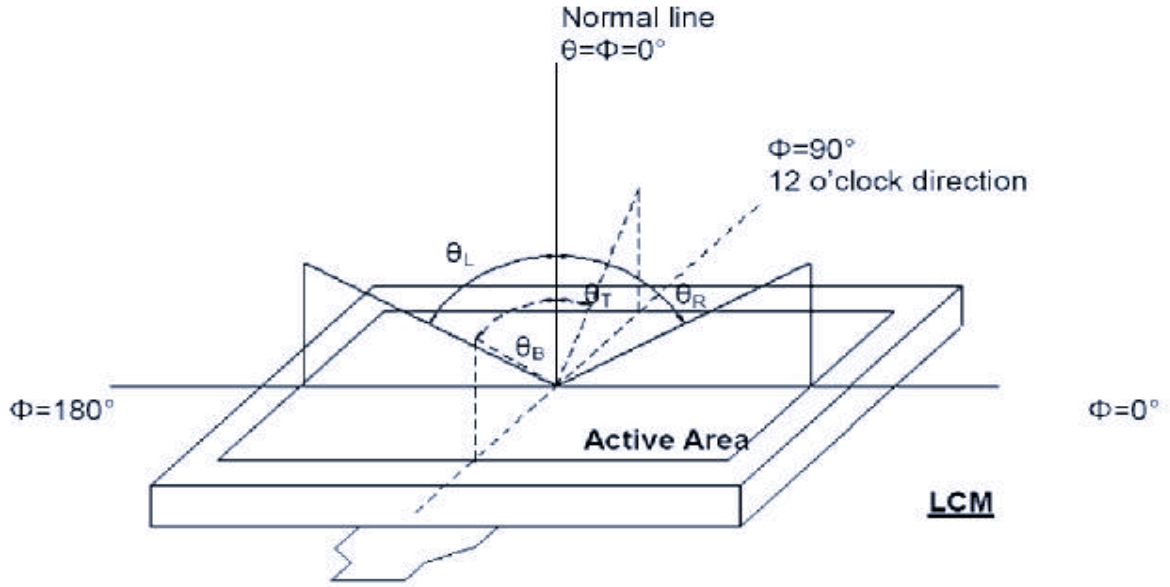


Fig. 4-1 Definition of viewing angle

Note 2: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 30 minutes operation, the optical properties are measured at the center point of the LCD screen. (Viewing angle is measured by ELDIM-EZ contrast/Height :1.2mm, Response time is measured by Photo detector TOPCON BM-7, other items are measured by BM-5A/ Field of view: 1 /Height: 500mm.)

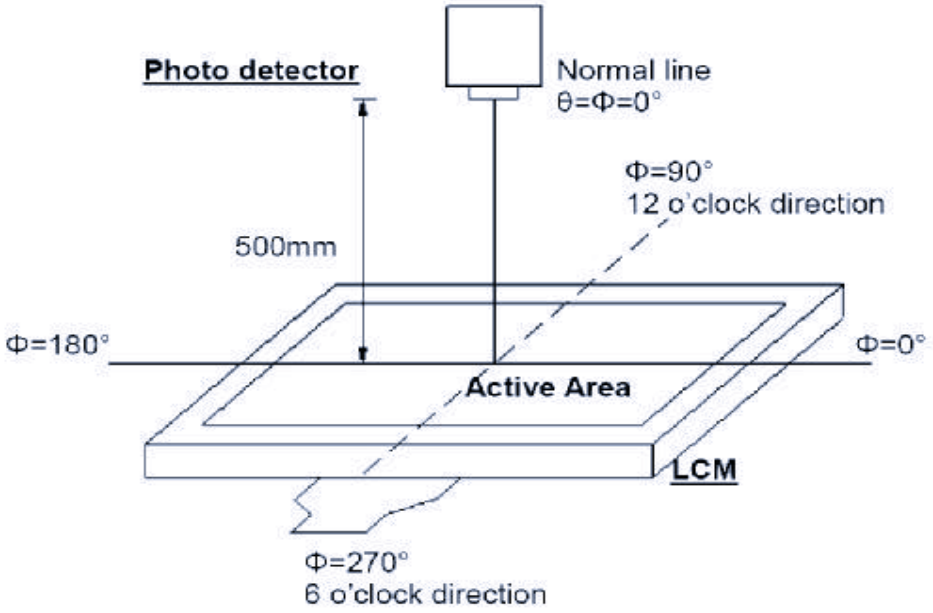


Fig. 4-2 Optical measurement system setup

Note 3: Definition of Response time

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

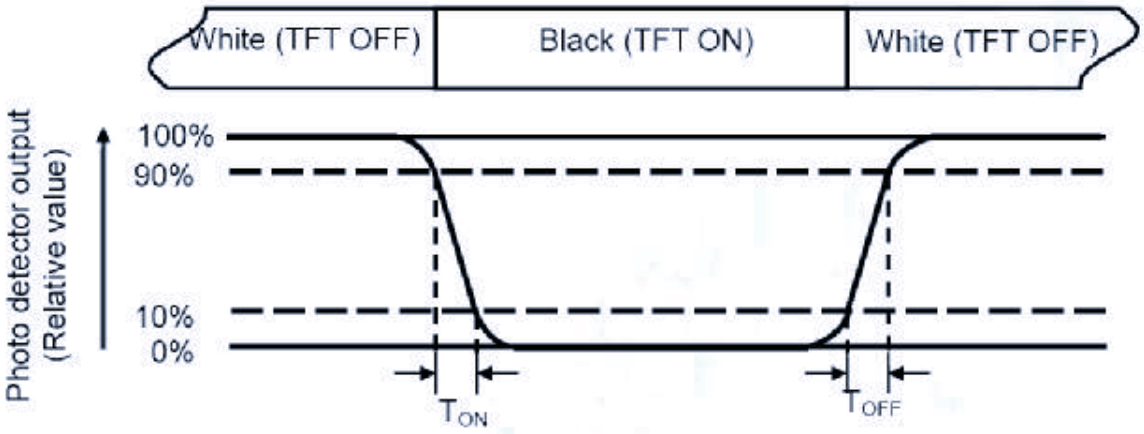


Fig. 4-3 Definition of response time

Note 4: Definition of contrast ratio

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

Note 5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note 6: All input terminals LCD panel must be ground while measuring the center area of the panel.

5.0Reliability

5.1Mtbf

The LCD module shall be designed to meet a minimum MTBF value of 50000 hours with normal envirnment.

5.2Test condition

No.	Test items	Conditions	Remark
1	High temperature storage	60±3℃ , T=240hrs	-
2	Low temperature storage	-20±3℃ , T=240hrs	-
3	High temperature & high humidity operation	40℃ ,Humidity 90%RH , 240hrs	-
4	High temperature operation	50±3℃ , T=240hrs	-
5	Low temperature operation	0±3℃ , T=240hrs	-
6	Vibration Teat(Packing)	Sweep frequency 10~55~10Hz/min Amplitude:1.50mm Test direction:X,Y,Z/3 axis Duration 30min/each axis	-
7	Thermal Shock	-20℃ ,30 min~60℃ ,30min(100 cycle)	Static
8	ESD	Contact : 4KV, Air : 8KV	
Criterion: There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.			

6.0 Inspection standards

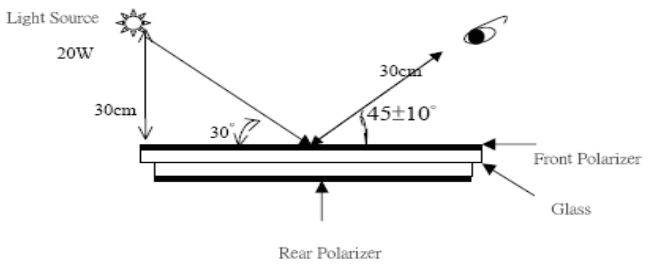
1.AQL(Acceptable Quality Level
AQL of major and minor defect.

	MAJOR DEFECT	MINOR DEFECT
AQL	0.65	1.5

2. Basic conditions for inspection

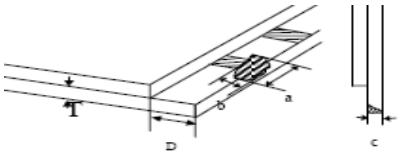
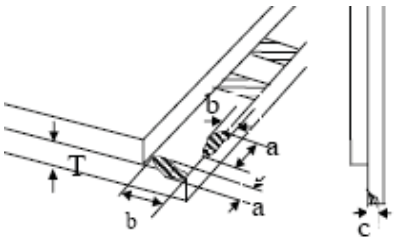
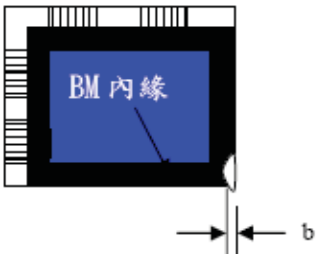
The LCM face to us, in normal environment, the lux is 1000±200.(Darkroom's lux: 100±50),About an angle of incidence 30,a distance of 30 cm with an angle of 45 degree to check the products without uncovering the film!

(As shown below)



6.1 Visual inspection criterion in immobility

6.1.1Glass defect

NO	Defect item	Criteria	Remark
1	Dimension Unconformity (Major defect)	By Engineering Drawing	
2	Cracks (Major defect)	1. Linear cracks panel 【Reject】 2. Nonlinear crack contrast by limited sample	
3	Glass extrude the conductive area (minor defect)	a: disregards and no influence assemblage. 1) b≤1/3Pin width(non bonding area) 【Accept】 2)bonding area≤0.5mm 【Accept】	A: Length, b: Width
4	Pin-side ,conductive area damaged (minor defect)	(a c: disregards) b≤1/3of effective length for bonding electrode 【Accept】	a: length, b: Width, c: Thickness 
5	Pin-side,non-conductive area damaged (minor defect)	1)Damage area don't touch the ITO (Inclueling contraposition mark, except scribing mark) 【Accept】 2)C<T b≦BM1/3of width 【Accept】 3)c=T b not touch the seal glue 【Accept】 4)a disregards	a: Length, b: Width c: Thickness 
6	Non-pin-side damage (minor defect)	c<T 1)b exceeds 1/3Bm 【Reject】 c=T b not touch the seal glue 【Reject】	c: Thickness b: width of damage 

6.1.2LCD appearance defect(View area)

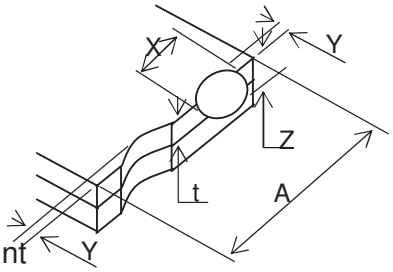
No.	Item	Criterion	Zone	Note
1	Stains, Black or White particles.	Line shape: 0.07mm<W≤ 0.1mm, 3.0mm ≤L≤ 5.0mm, N≦4. Round shape: D≤ 0.3mm, N≦6. 0.3mm <D≤ 0.5mm, N≦6. Minimum Space: 10mm. Any defect wiped out easily by cotton swab with alcohol is acceptable.	A	-
2	Small bright dot (≦1/2 sub-pixel)	ND6% not observed, not count, (N≦3 in 40mm). Observed, N≦5.	A	-
3	Micro bright dot (full sub-pixel)	ND6% not observed, not count. Observed, judgment by Bright sub-pixel.	A	-
4	Polarizer Scratches,	0.05mm＜W≦0.1mm, 2.0mm＜L≦5.0mm, N≦4	A	-
5	Bubbles, Dents, Fish Eye	D≦0.1mm, N≦3 within 10mm diameter circle area 0.1mm＜D≦0.3mm, N≦2	A	-
6	Display quality	• Viewing angle defect. • Missing lines. • Malfunction. • Contrast ratio defect. • Power consumption exceeds specification.	A	-
7	Color tone, Color uniformity	To be judged by Arima Display Corporation.	A	-
8	Mura	Not visible through transmission ND 6% Filter in 50% Gray display pattern. Or, to be judged by Limit Sample.	A	-
9	FPC	Malfunction, ACF bonding separated or no closed with Frame side not permitted	C	-
10	Frame bezel	Separation or Slack not permitted	C	-
11	Metal frame Surface	Scratches, Stains or Traces not malfunction is available	C	-
12	Backlight	Scratches, Stains or Traces not malfunction is available Flicker not permitted	A	-
13	Backlight bright dot / spot defect	D≦0.3mm, N≦3	A	-
14	Light leakage	Vertical±45° not permitted	A	-

<table>
<tr>
<td>15</td>
<td>Electrical
sub-pixel defect</td>
<td>
<table>
<tr><th>Symptom</th><th>Judgment criteria</th><th>Note</th></tr>
<tr><td>Bright sub-pixel</td><td>3</td><td>1</td></tr>
<tr><td>Dark sub-pixel</td><td>3</td><td>1</td></tr>
<tr><td>2 Bright sub-pixel adjacent</td><td>0</td><td>1, 2</td></tr>
<tr><td>2 Dark sub-pixel adjacent</td><td>1</td><td>1, 2</td></tr>
<tr><td>Distance between Dark- Dark</td><td>≧5mm</td><td></td></tr>
<tr><td>Distance between
Bright - Bright
or Bright – Dark</td><td>≧5mm</td><td></td></tr>
<tr><td>Total Bright and Dark Sub-pixels</td><td>≦5</td><td></td></tr>
</table>
Note (1) Bright (dark) area is more than 50% of one sub-pixel.
Note (2) 2 sub-pixel adjacent=1pair=2 sub-pixels

2 sub-pixel adjacent

2 sub-pixel adjacent

2 sub-pixel adjacent(verticle)

2 sub-pixeladjacent(slant)
</td>
<td>A</td>
<td>-</td>
</tr>
<tr>
<td>16</td>
<td>Glass Chipping</td>
<td>


Y≦0.1mm, Z≦1/2, not count

0.1mm< Y ≤ 0.2mm, X ≤ 0.5mm, Z≦1/2, N≦2 one side.
Minimum Space: 10mm.

0.2mm＜Y, not permitted
</td>
<td>B</td>
<td>-</td>
</tr>
<tr><td>17</td><td>Connector</td><td>Malfunction or Damage, not permitted</td><td>C</td><td></td></tr>
<tr><td>18</td><td>Label</td><td>No label, Broken or print abnormal.</td><td>C</td><td></td></tr>
<tr><td>19</td><td>PCBA</td><td>Follow IPC-A-610E</td><td>C</td><td>-</td></tr>
</table>

7. Handling Precautions

7.1 Mounting method

A panel of LCD module made by our company consists of two thin glass plates with polarizers that easily get damaged.
When doing the mounting of the LCD module, extreme care should be used when handling the LCD modules.

7.2Cautions of LCD handling and cleaning

When cleaning the display surface, use soft cloth with solvent (recommended below) and wipe lightly.
-Isopropyl alcohol
-Ethyl alcohol
-Trichlorotriflorothane
Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.
Do not use the following solvent:
-Water
-Ketene
-Aromati

7.3 Caution against static charge

The LCD module use C-MOS LSI drivers. So we recommend you:
Connect any unused input terminal to V_{dd} or V_{ss}. Do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity

7.4 Packaging

-Module employs LCD elements, 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 direct to sunshine or high temperature/humidity

7.5 Caution for operation

-It is an indispensable condition to drive LCD module within the limits of the specified voltage since the higher voltage over the limits may cause the shorter life of LCD module.
-An electrochemical reaction due to DC (direct current) causes LCD undesirable deterioration so that the uses of DC (direct current) drive should be avoided.
-Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD module may show dark color in them. However those phenomena do not mean malfunction or out of order of LCD module, which will come back in the specified operating temperature

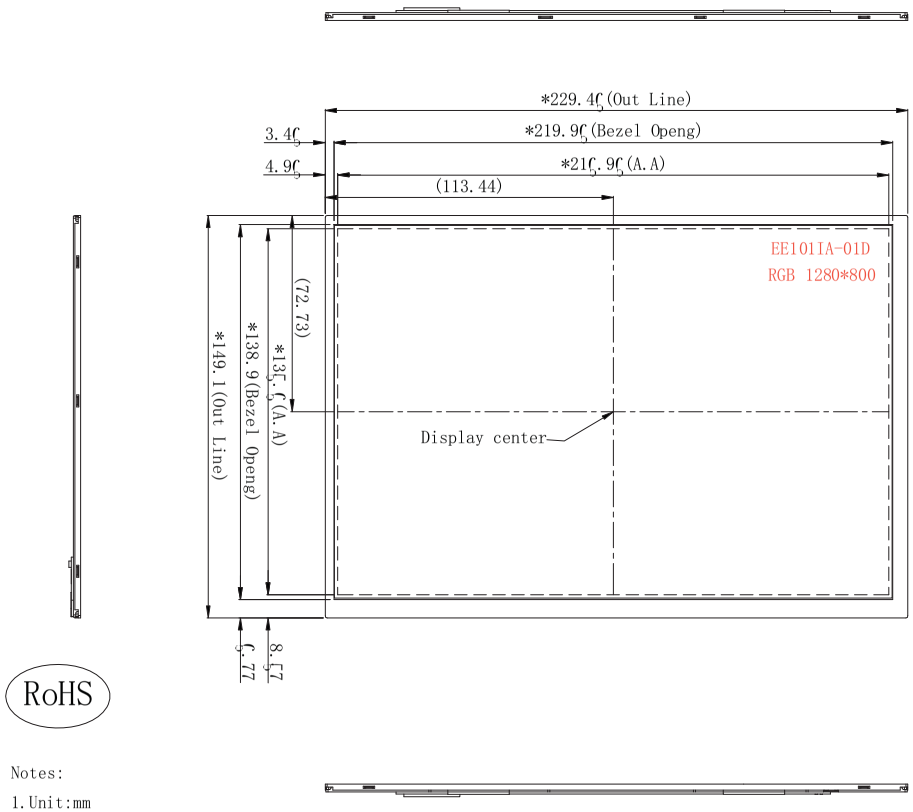
7.6 Storage

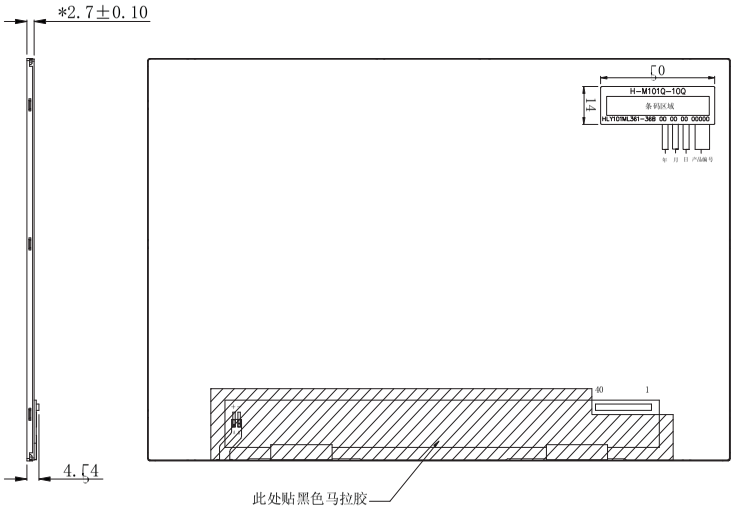
In the case of storing for a long period of time, the following ways are recommended:
-Storage in polyethylene bag with the opening sealed so as not to enter fresh air outside in it. And with not desiccant.
-Placing in a dark place where neither exposure to direct sunlight nor light is. Keeping the storage temperature range.
-Storing with no touch on polarizer surface by any thing else

7.7 Safety

-It is recommendable to crash damaged or unnecessary LCD into pieces and to wash off liquid crystal by either of solvents such as acetone and ethanol, which should be burned up later.
-When any liquid leaked out of a damaged glass cell comes in contact with your hands, please wash it off well at once with soap and water.

8.0 Outline dimension





RoHS

Notes:

1. Unit:mm
2. Do not scale drawing.
3. All radii without dimension R0.2
4. Luminous instensity(9 AVG):
   300/m^2(Min); 350cd/m^2(Typ);
5. Uniformity : 75%(Min)
   VF: 11.2 (MIN), 11.6v (TYP), 12.4(MAX), IF:144mA
6. The color coordinates:

	MIN	TYP	MAX
x	0.27	0.29	0.32
y	0.31	0.33	0.35

7. ⚠ Modification rev.number
8. draft angle 1.0°
9. Genral Tolerance:±0.2
10. Mark mold cavity indentification in recess approximately where indicated.
11. "*" For important dimension;( ) for reference dimention
12. RoHs must be complied.(Use Lead-free process)

9.0Packing form

