

SPECIFICATION

Customer Part Number: TBD

Tianma Part Number: P0650VGF1MA01

Product Description: 6.5" 640xRGBx480 TFT-LCD Module

[☒] Target Specification
[☐] Preliminary Specification
[☐] Final Specification

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* This cover page is for your Comments and Signatures back to TIANMA.

REVISION HISTORY

CONTENTS

1. SUMMARY	1
2. GENERAL SPECIFICATION	1
3. INPUT / OUTPUT TERMINALS	2
3.1 CN1 Pin assignment (LCD Interface)	2
3.2 CN2 Pin assignment (BL Interface)	3
4. ABSOLUTE MAXIMUM RATINGS	4
5. ELECTRICAL CHARACTERISTICS	5
5.1 DC Typical Operation Conditions	5
5.2 AC Typical Operation Conditions	6
5.3 LCD Module Block Diagram	7
6. INTERFACE TIMING CHARACTERISTICS	8
6.1 24 bit RGB mode for 640RGB x 480	8
6.2 Power On Sequence	9
6.3 Power Off Sequence	9
7. OPTICAL CHARACTERISTICS	10
8. RELIABILITY TEST	13
9. MECHANICAL DRAWING	15
10. PRODUCT INSPECTION CRITERIA	16
11. PACKING INSTRUCTION	17
12. APPENDIX	18
13. PRECAUTIONS FOR USE OF LCD MODULE	19
13.1 Handling Precautions	19
13.2 Storage precautions	19
13.3 Transportation Precautions	19

1. Summary

This is a 6.5 inch TFT-LCD (Thin Film Transistor Liquid Crystal Display) module with normal-black technology. It is composed of a TFT-LCD panel, LCD Driver IC, PCB, and a LED backlight unit. This product is designed for automotive and other high reliability electronic products and complies with *RoHS* directive.

2. General Specification

Items	Specification	Remark
Diagonal Size	6.5 inch	--
Resolution	640 x RGB x 480	--
Active Area(mm)	132.48×99.36	--
Pixel Pitch (mm)	0.207×0.207	--
Pixel Configuration	R.G.B. Vertical Stripe	--
Technology Type	a-Si	--
Display Mode	Normally Black	--
Landscape or Portrait	Landscape	--
Surface Treatment (Top Polarizer)	AG	--
Interface	RGB 24bit	--
Color Depth	16.7M	--
Dimension (H x V x D) (mm)	154.00x 121.00 x 7.10(Typ.)	Note1
Weight (g)	TBD	Note2

Table 2.1 General TFT Specifications

Note1: The dimensions do not include the length of FPC, screw and component height etc.. For detail dimension, please refer to the module outline drawing.

Note2: The weight does not include the weight of protective film.

3. Input / Output Terminals

3.1 CN1 Pin assignment (LCD Interface)

Mating connector type: 20593-040E-01C

No	Symbol	I/O	Pin Function Description	Remark
1	GND	P	GND	
2	DCLK	I	Clock input for RGB mode , Latch data at clock falling edge.	
3	GND	P	GND	
4	HD	I	Line synchronous signal (HS) for SYNC mode , customer not use,please connect to VCC.	
5	VD	I	Frame synchronous signal (VS) for SYNC mode , customer not use,please connect to VCC.	
6	GND	P	GND	
7	R0	I	Red data signal	
8	R1	I	Red data signal	
9	R2	I	Red data signal	
10	R3	I	Red data signal	
11	R4	I	Red data signal	
12	R5	I	Red data signal	
13	R6	I	Red data signal	
14	R7	I	Red data signal	
15	GND	P	GND	
16	G0	I	Green data signal	
17	G1	I	Green data signal	
18	G2	I	Green data signal	
19	G3	I	Green data signal	
20	G4	I	Green data signal	
21	G5	I	Green data signal	
22	G6	I	Green data signal	
23	G7	I	Green data signal	
24	GND	P	GND	
25	B0	I	Blue data signal	
26	B1	I	Blue data signal	
27	B2	I	Blue data signal	
28	B3	I	Blue data signal	
29	B4	I	Blue data signal	
30	B5	I	Blue data signal	
31	B6	I	Blue data signal	
32	B7	I	Blue data signal	
33	GND	P	GND	
34	DENA	I	Data enable signal (DE) for DE mode , If not use,please connect to VCC.	
35	NC	N	Tianma internal used,Custom must floating.	
36	VCC	P	3.3 V Power Supply	
37	VCC	P	3.3 V Power Supply	
38	NC	N	Tianma internal used,Custom must floating.	
39	NC	N	Tianma internal used,Custom must floating.	
40	SC	I	Scan direction control (Low=Normal, High=Reverse)	Note 2

Note1: I/O definition:

I----Input O----Output P----Power/Ground N----NC

Note2:

SC	Function	Remark
L	Left→Right, Top→Bottom	Default
H	Right→Left, Bottom→Top	-



Type 1 (Default SC="L")



Type 2 (SC="H")

3.2 CN2 Pin assignment (BL Interface)

Backlight-side connector: SM06B-SHLS-TF(LF)(SN) (JST)

Corresponding connector: SHLP-06V-S-B (JST)

No	Symbol	I/O	Description	Remark
1	NC	N	This pin should be open.	
2	NC	N	This pin should be open.	
3	LED C1	P	LED cathode 1	
4	LED A1	P	LED anode 1	
5	LED A2	P	LED anode 2	
6	LED C2	P	LED cathode 2	

I/O definition:

I----Input O----Output I/O----Input/Output P----Power/Ground N—No Connect

4. Absolute Maximum Ratings

GND=0V, Ta = 25°C

Item	Symbol	Min	Max	Unit	Remark
Power Supply Voltage	VCC	-0.3	5.0	V	
Logic Input Signal Voltage	VCC	-0.3	5.0	V	Note1

Table 4.1 Absolute Maximum Rating

Note1: Logic Input Signal Voltage includes R0~R7,G0~G7,B0~B7,DCLK,HD,VD,DENA,SC.

Note2: Ta means the ambient temperature.

It is necessary to limit the relative humidity to the specified temperature range.
Condensation on the module is not allowed.

5. Electrical Characteristics

5.1 DC Typical Operation Conditions

GND=0V, Ta=25°C

Item	Symbol	Min	Typ	Max	Unit	Remark
Power Supply Voltage	VCC	3.0	3.3	3.6	V	
Input Signal Voltage	Low Level	VIL	GND	--	0.3*VCC	Note1
	High Level	VIH	0.7*VCC	--	VCC	
(Panel+ LSI) Power Consumption	White Mode (60Hz)	--	TBD	--	mW	Note2

Note1: Input Signal Voltage includes R0~R7,G0~G7,B0~B7,DCLK,HD,VD,DENA,SC.

Note2: VCC=3.3V

Note3: Tianma only guarantees the optical effect of VCC = 3.3V.

Item	Symbol	Min	Typ	Max	Unit	Remark
Forward Current	I _F	-	200		mA	Note1
Forward Voltage	V _{BL}	16.2	18.0	19.80	V	Note2
Backlight Power Consumption	W _{BL}	3240	3600	3960	W	Note2
Lifetime	-	-	100000	-	Hrs	Note3

Table 5.1.1 LED Backlight Characteristics

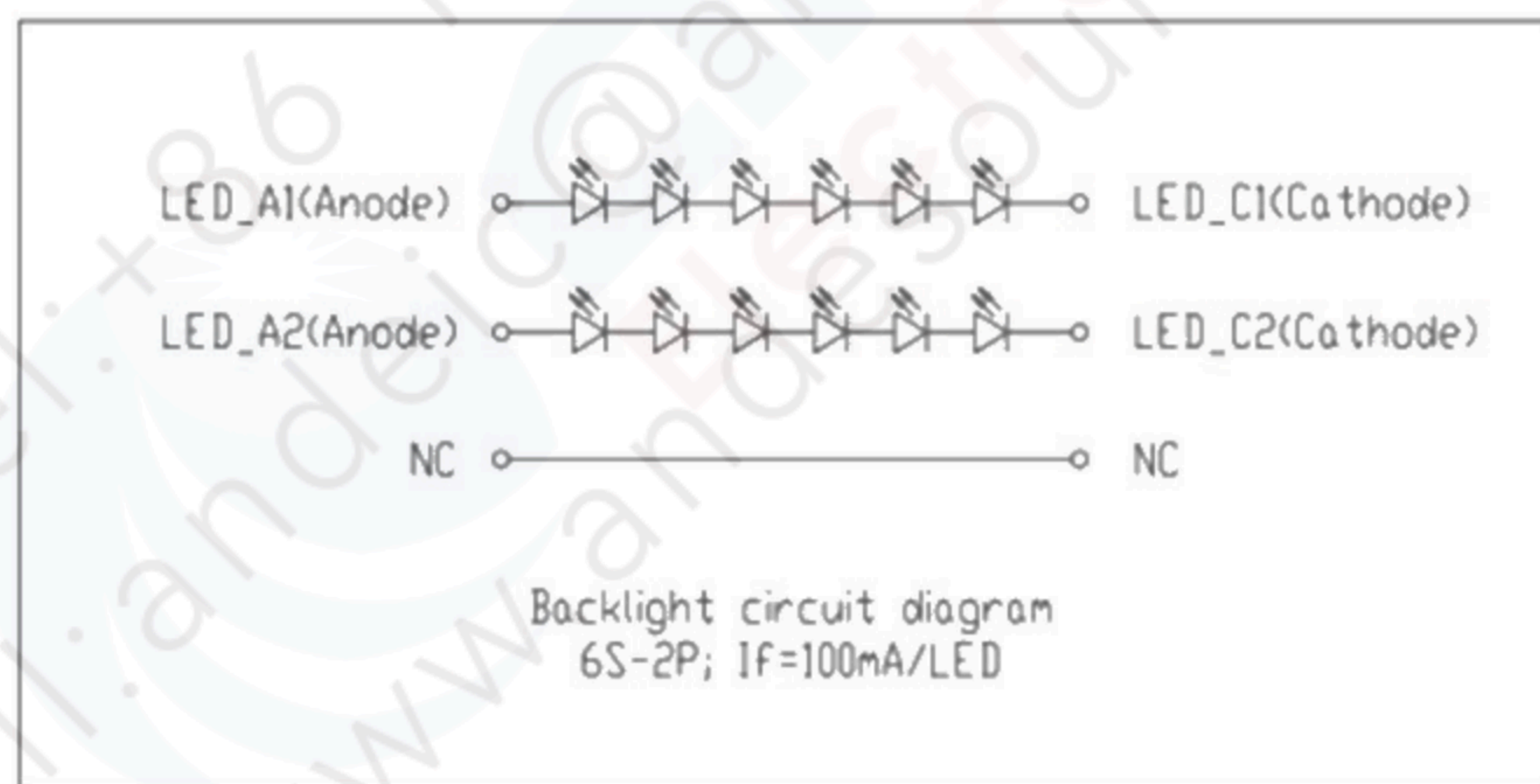


Table 5.1.2 LED Connection of Backlight

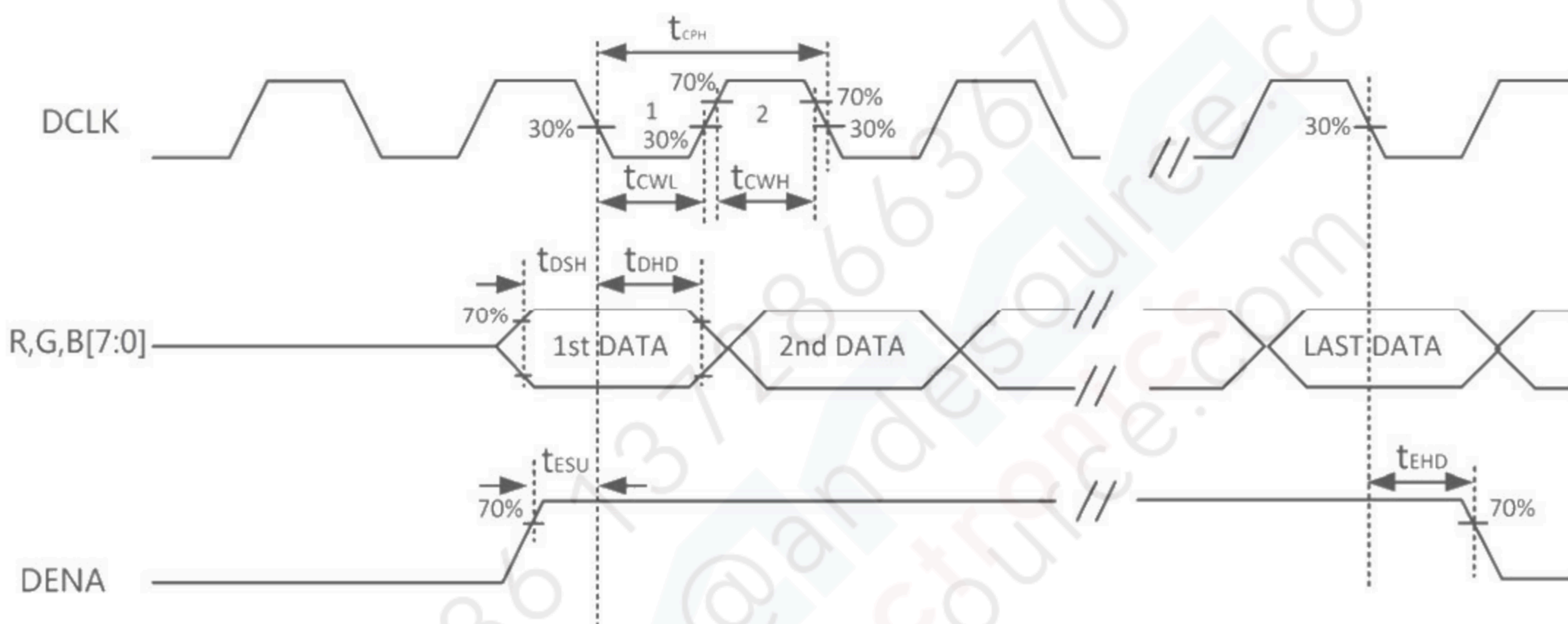
Note1: I_F is defined for one channel LEDs. There are total of 12 LED channels in the backlight unit. While the LCM is operating, a stable forward current should be supplied. The forward current max value is only for inrush current.

Note2: I_F =100mA.

Note3: Optical performance should be evaluated at Ta=25°C only. Operating lifetime means the brightness will decrease to 80% of the original brightness.

5.2 AC Typical Operation Conditions

Parameter	Symbol	Min	Typ.	Max.	Unit	Conditions
DCLK cycle time	t_{CPH}	16.7			ns	
DCLK pulse high duty	t_{CWH}	40	50	60	%	
DCLK pulse low duty	t_{CWL}	40	50	60	%	
Data setup time	t_{DSH}	4	-	-	ns	R[7:0], G[7:0], B[7:0] to DCLK
Date hold time	t_{DHD}	2	-	-	ns	R[7:0], G[7:0], B[7:0] to DCLK
DENA setup time	t_{ESU}	4	-	-	ns	
DENA hold time	t_{EHD}	2	-	-	ns	



5.3 LCD Module Block Diagram

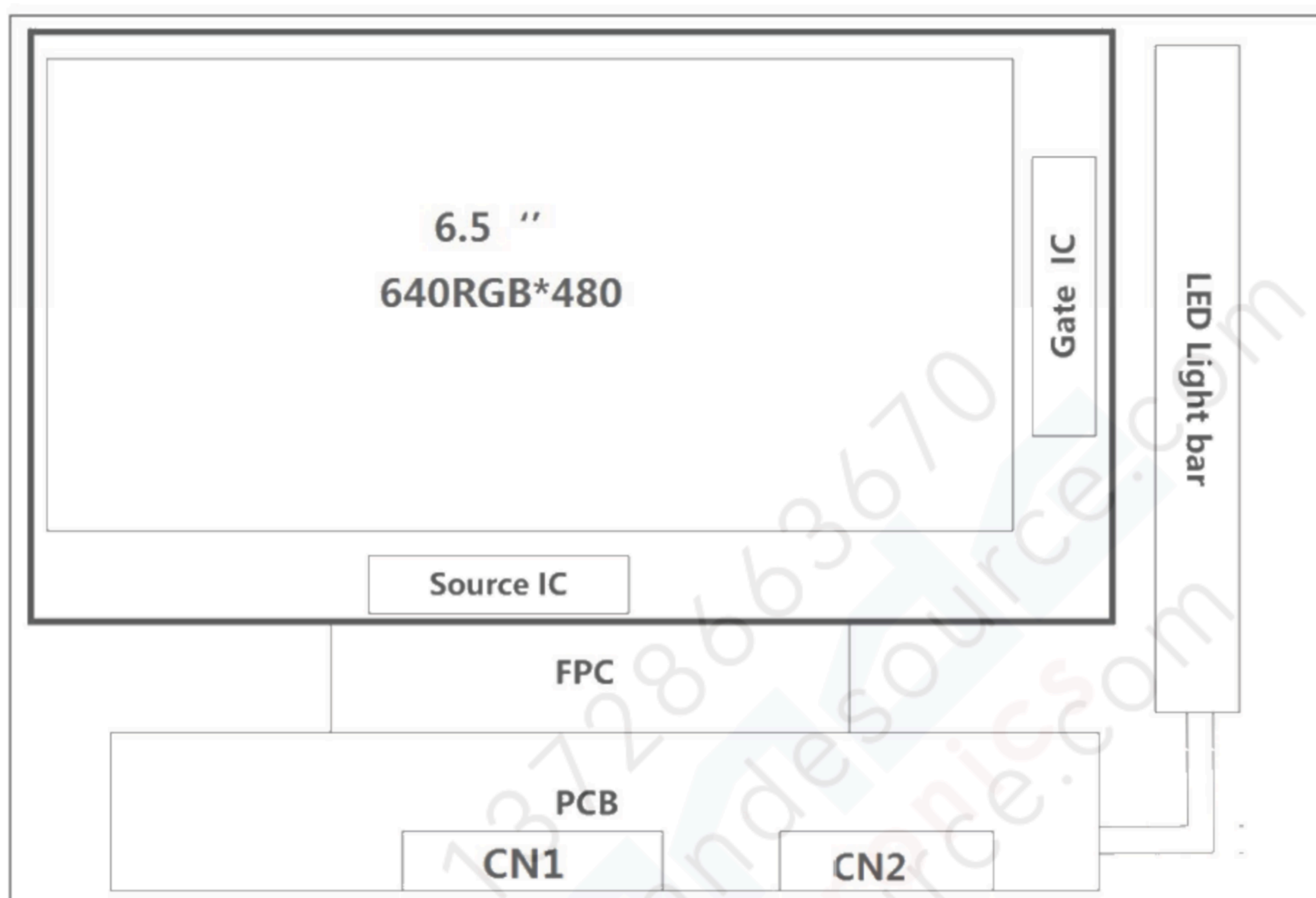


Figure 5.3 LCD Module Block Diagram

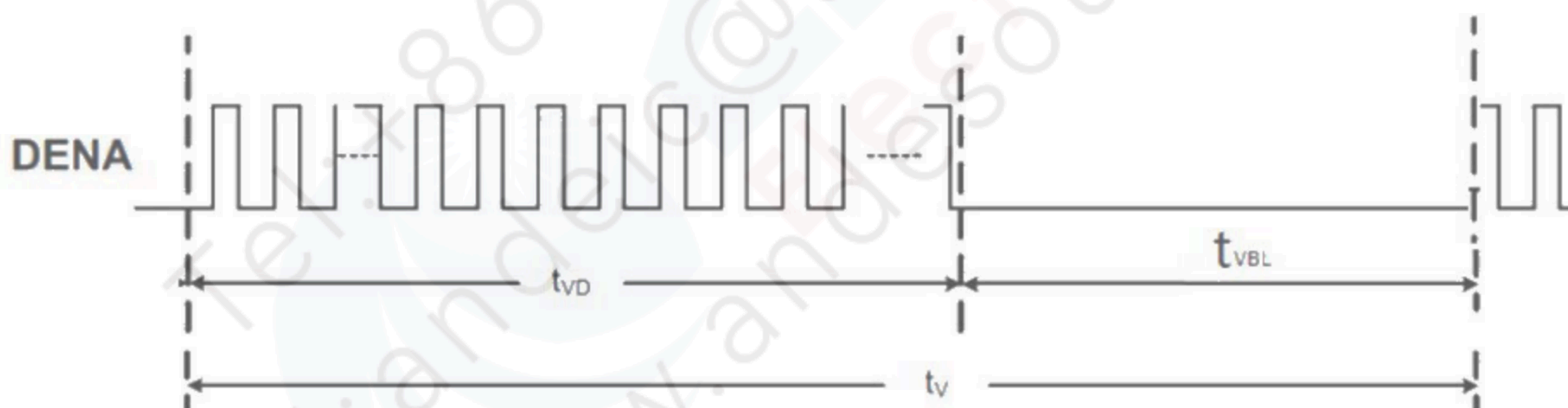
6. Interface Timing Characteristics

6.1 24 bit RGB mode for 640RGB x 480

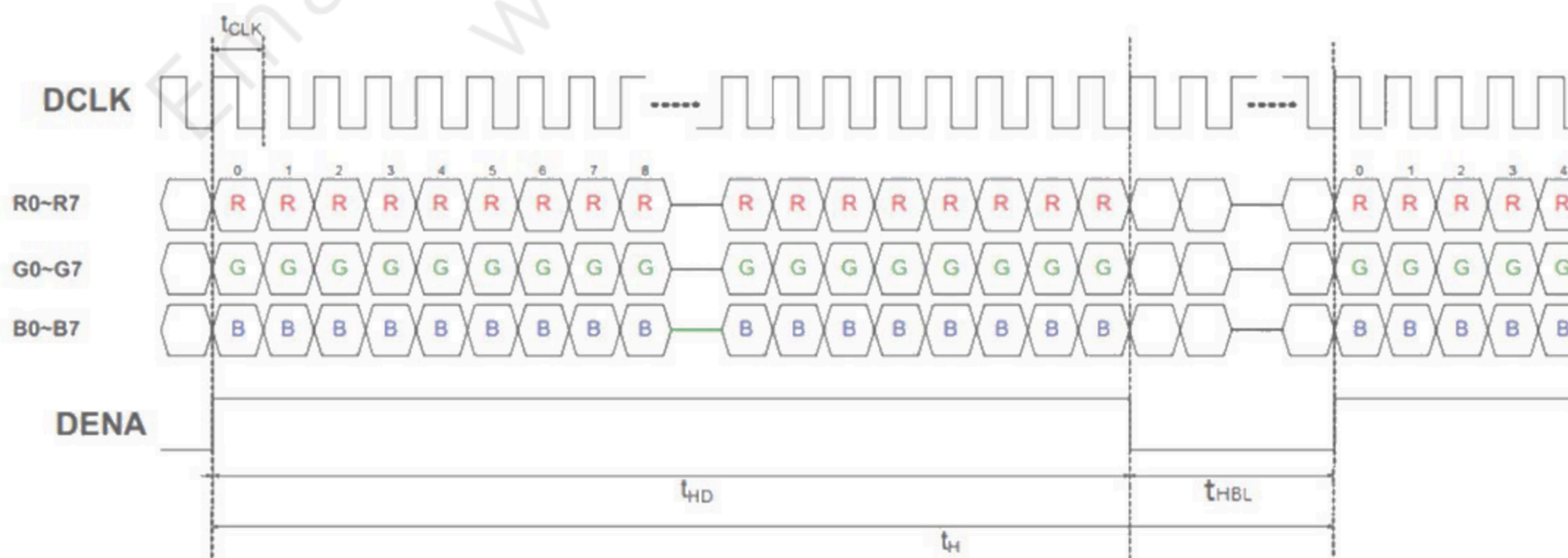
(VCC=3.3V, GND= 0V, Ta=25°C)

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
CLK frequency	t_{CLK}	-	20.71	51.1	Mhz
Horizontal display area	t_{HD}	640			t_{CLK}
Horizontal blanking area	t_{HBL}	26	34	506	t_{CLK}
Horizontal period	t_H	666	674	1146	t_{CLK}
Vertical display area	t_{VD}	480			t_H
Vertical blanking area	t_{VBL}	13	32	206	t_H
Vertical period	t_V	493	512	686	t_H
Frame rate	FR	50	60	65	Hz

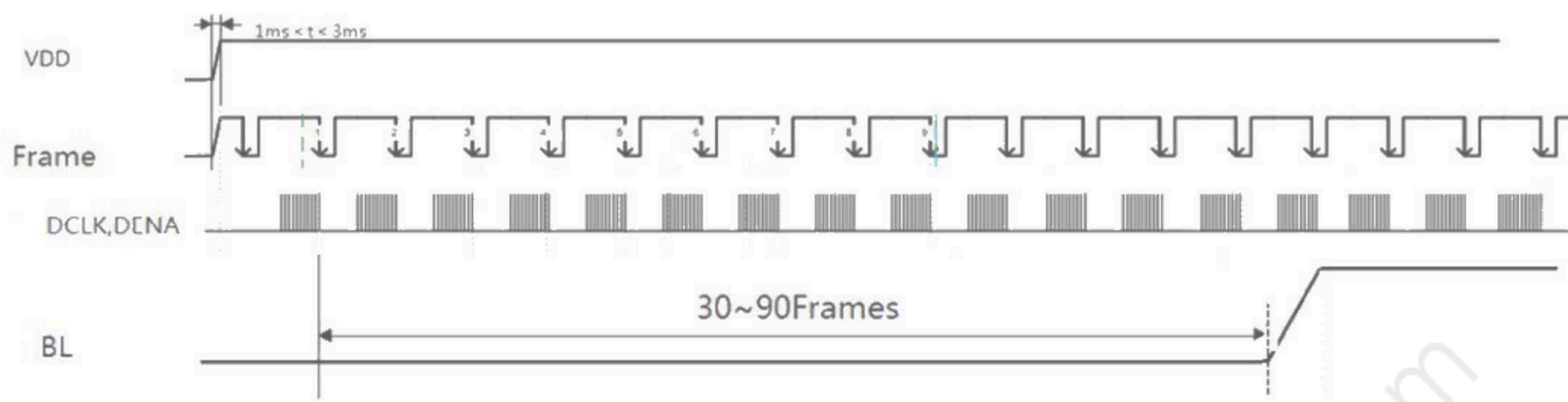
Vertical input timing



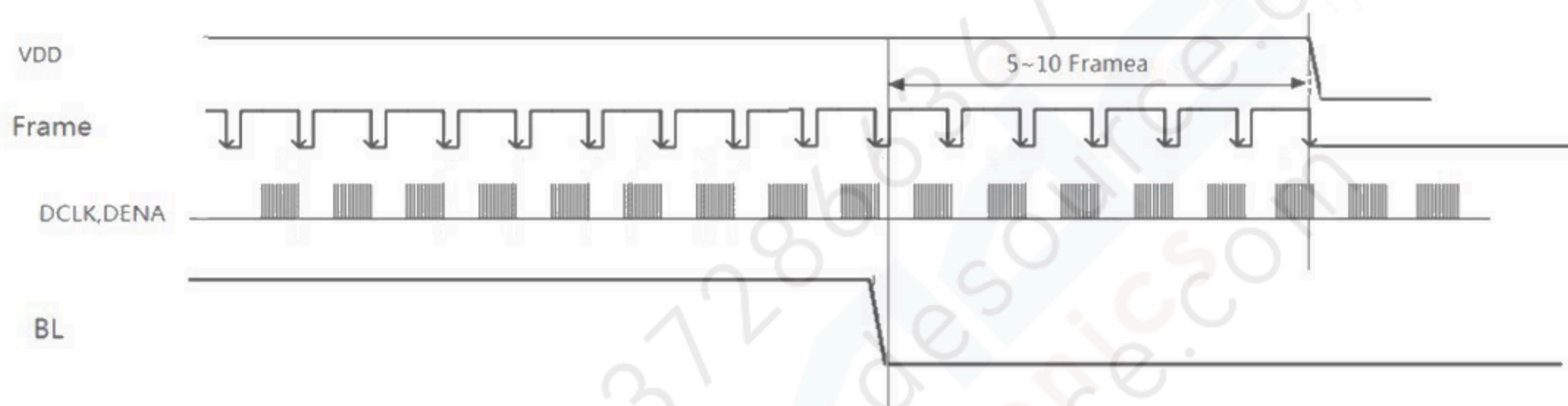
Horizontal input timing



6.2 Power On Sequence



6.3 Power Off Sequence



7. Optical Characteristics

Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
Viewing Angle		θU	CR≥25	75	85	--	°	Note 1&2&3
		θD		75	85	--		
		θL		75	85	--		
		θR		75	85	--		
Contrast Ratio		CR	Vertical,25°C	400	800	--	--	Note 1&2&3
Response Time		Tr+Tf	25°C	--	30	35	ms	Note 1&4
Chromaticity	White	X	CIE1931-XYZ	(0.259)	(0.309)	(0.359)	--	Note 1&5
		Y		(0.284)	(0.334)	(0.384)		
	Red	X			TBD			
		Y			TBD			
	Green	X			TBD			
		Y			TBD			
	Blue	X			TBD			
		Y			TBD			
	NTSC					65		
Luminance		L	25°C	900	1200	--	cd/m ²	Note 1&8
Uniformity		White	25°C,9points	75%	80%-	--	%	Note 1&9

Test Conditions:

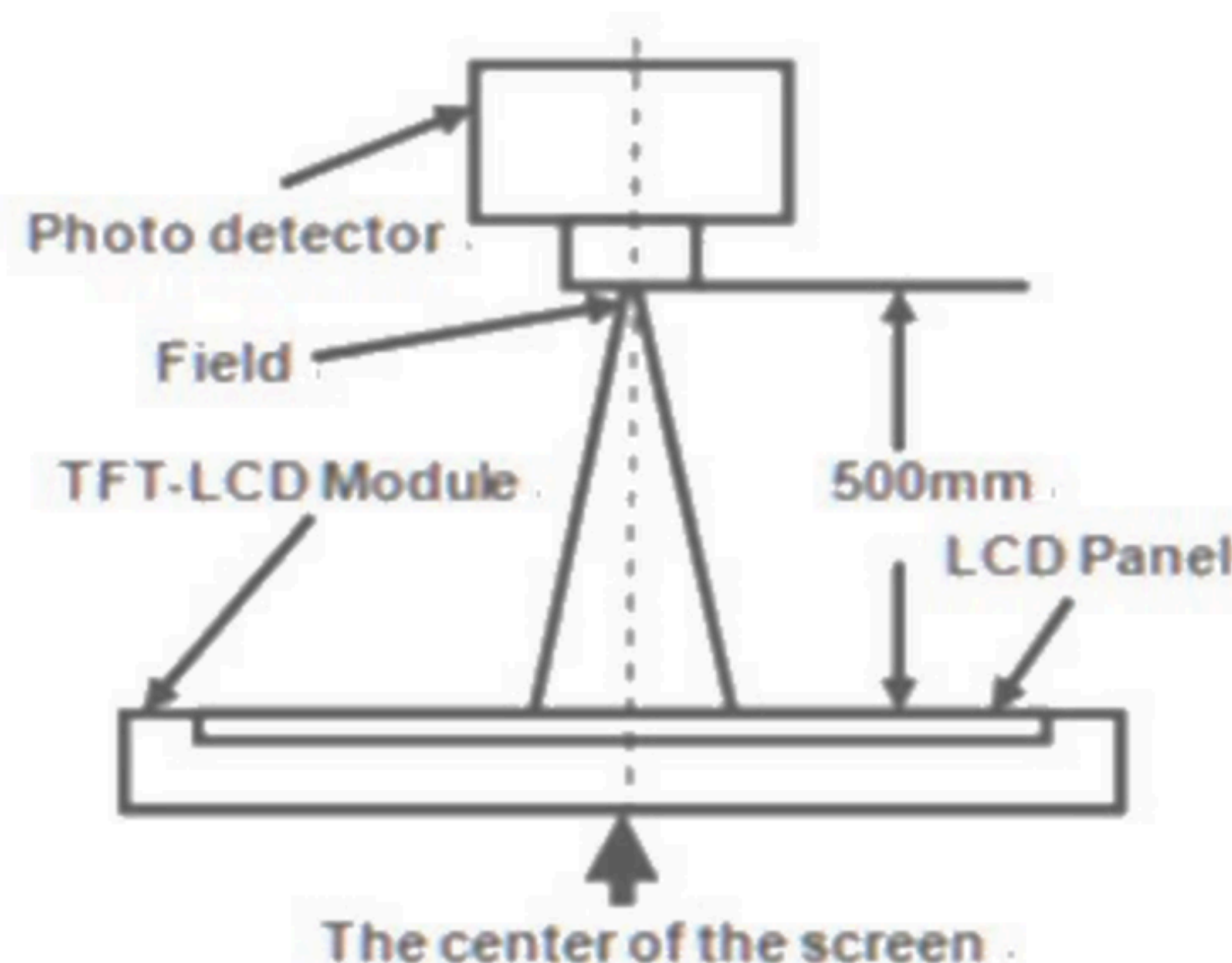
1. $I_F = 120\text{mA}$ (one channel), the ambient temperature is 25°C.
2. The test systems refer to Note 1 and Note 2.

Note1: Definition of optical measurement system

Measured at the center of the panel by SR-3

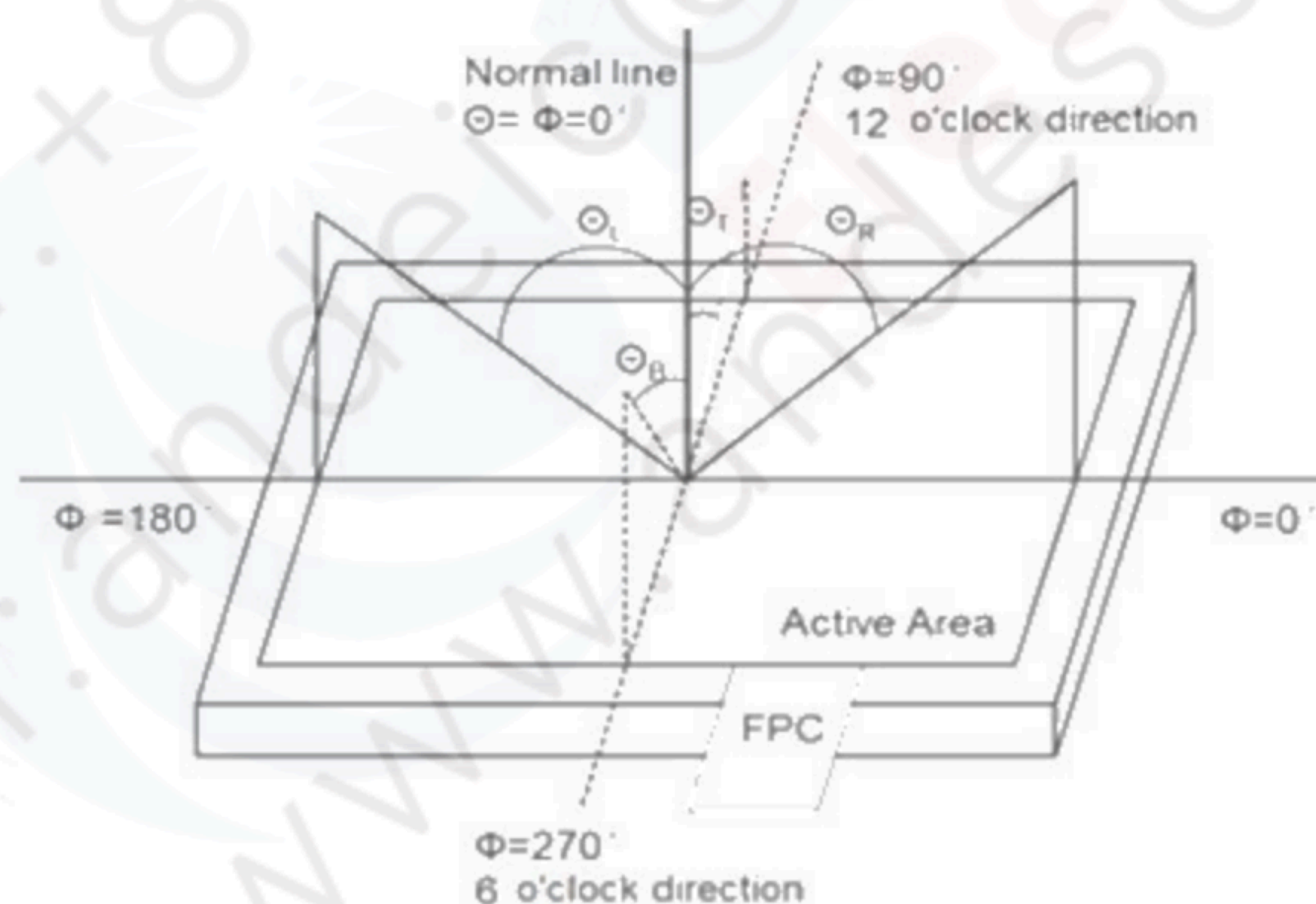
Measuring condition:

- Measuring surroundings: Dark room.
- Measuring temperature: $T_a = +25^\circ\text{C}$.
- Adjust operating voltage to get optimum contrast at the center of the display.
- Measured value at the center point of LCD panel after more than 10 minutes while backlight is turned on.



Item	Photo detector	Field	High
Contrast Ratio	SR-3A	1°	H=500mm
Luminance			
Chromaticity			
Luminance Uniformity	SR-3A	1°	H=500mm
Contrast Plot	EZ-Contrast	6mm	H=1mm/H≈80mm
Response Time	LCD 5200	3mm	H=200mm
Reflectivity	CM-3600A	8mm/25.4mm	H=0mm

Note2: Definition of viewing angle range and measurement system



Note3: Definition of contrast ratio:

$$\text{Contrast Ratio(CR)} = \frac{\text{Luminance When LCD is White}}{\text{Luminance When LCD is Black}}$$

Contrast Ratio is measured in the optimum common electrode voltage

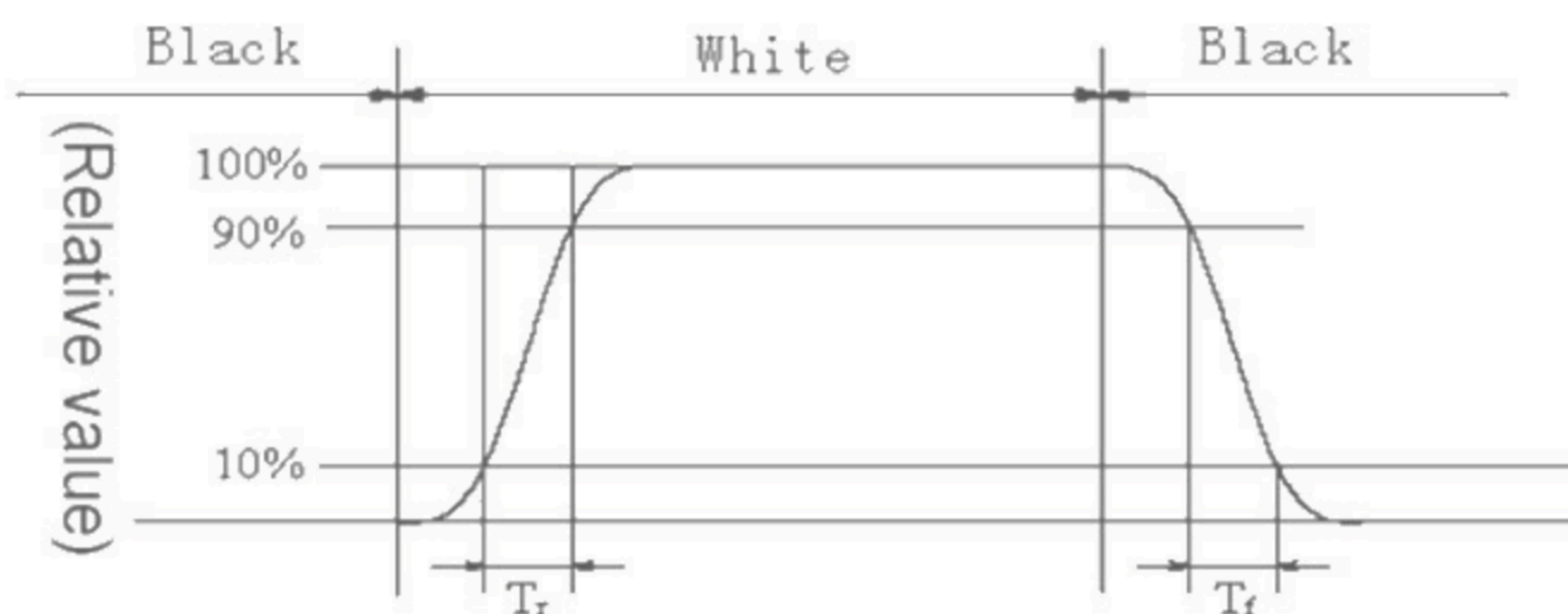
Note4: Definition of response time:

The response time is defined as the LCD optical switching time interval between "White" state and "Black" state.

Rise time (T_{ON}) is the time between photo detector output intensity changed from 10% to 90%.

And fall time (T_{OFF}) is the time between photo detector output intensity changed from 90% to 10%.

Please see the illustration below:



Note5: Definition of color chromaticity (CIE1931)

Color coordinates measured at the center point of the LCD.

Note6: Definition of Luminance

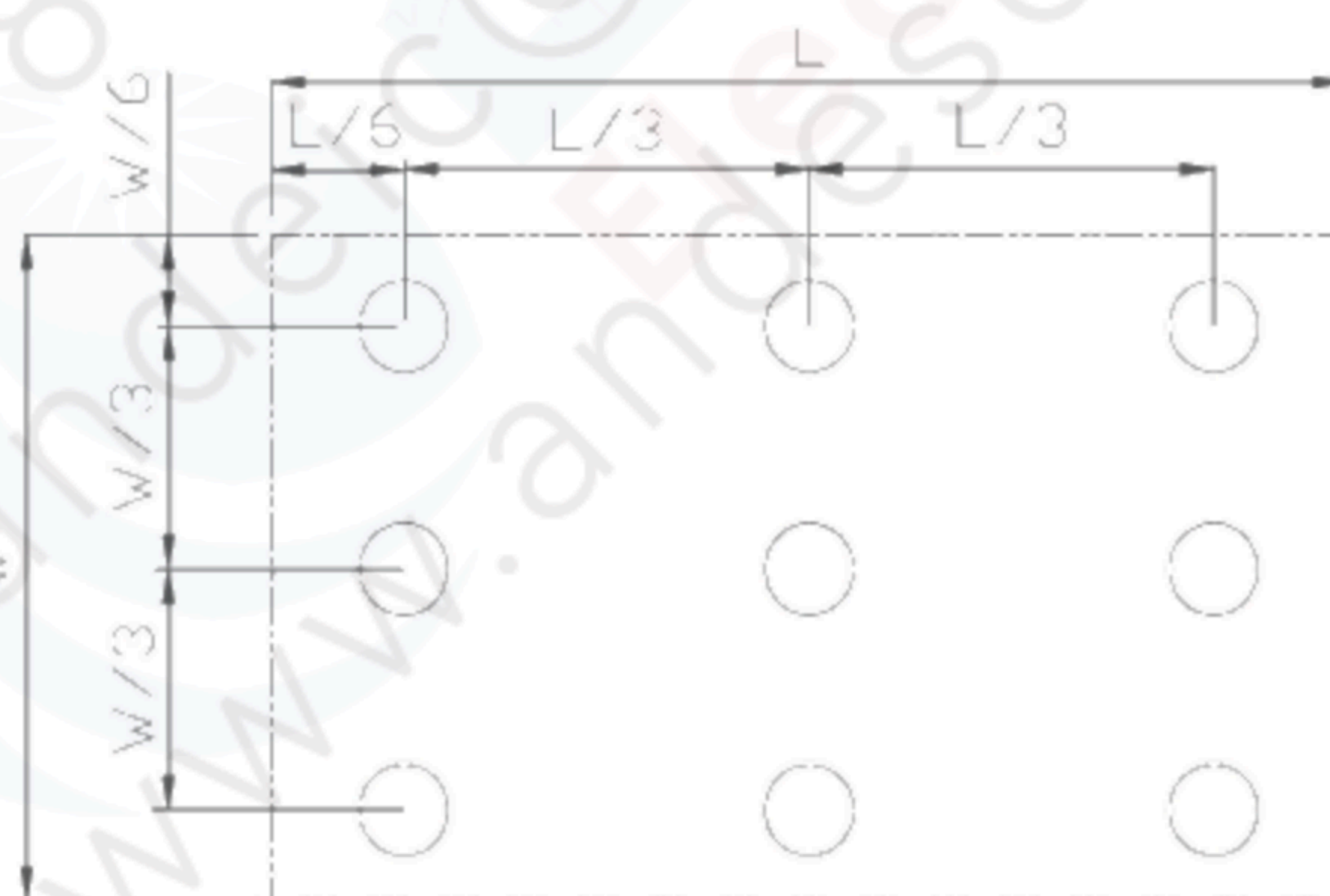
Measure the luminance at white state at the center point.

Note7: Definition of Luminance Uniformity

The luminance uniformity is calculated by using the following formula.

$$\text{Luminance uniformity (Lu)} = \frac{\text{Minimum luminance from (1) to (9)}}{\text{Maximum luminance from (1) to (9)}}$$

Luminance is measured at the 9 points shown below.



8. Reliability Test

Contents of Reliability Test

No	Test Item	Test condition	Criterion
1	High Temperature Storage	Ta= +80℃, 240 hours	Note1, Note2, Note4, IEC60068-2-1,GB2423.2
2	Low Temperature Storage	Ta= -30℃, 240hrs	Note1, Note2, Note4 IEC60068-2-1,GB2423.1
3	High Temperature Operation	Ta= +80℃, 240 hours	Note1, Note2, Note4, Note7 IEC60068-2-1,GB2423.2
4	Low Temperature Operation	Ta= -30℃, 240hrs	Note1, Note2, Note4 IEC60068-2-1,GB2423.1
5	High Temperature & Humidity Operation (operational)	Ta = +40℃, 90% RH max,240 hours	Note1, Note2, Note4 IEC60068-2-78,GB/T2423.3
6	Thermal Shock (non-operational)	-30℃ 60 min~+80℃ 60 min, Change time:5min,20cycles	Note1, Note2, Note4 Start with cold temperature End with high temperature, IEC60068-2-14,GB2423.22
7	Vibration Test (non-operational)	vibration level :9.8m/s ² (1G) waveform: sinusoidal Frequency range: 5to 500Hz Frequency sweep rate:0.5 octave/min Duration : one sweep from 5 to 500Hz in each of three mutually perpendicular axis(each x,y,z axis: 1hour, total 3 hours) shock level :1470m/s ² (150G) waveform: half sinusoidal wave ,2ms	Note1, Note2 Not apply to FOG project
8	Shock Test (non-operational)	Number of shocks: one shock input in each direction of three mutually perpendicular axes for a total of six shock inputs	Note1, Note2 IEC 60068-2-27 Not apply to FOG project
9	ESD (operational)	1.C=150pF, R=330Ω, Contact:±8kv, 5 点,10 次/点. 2.200pF,Oohm,±200v,10times at 1sec interval (non-operation)	Note1, Note2, Note3
10	Image Sticking	Continuously display the test pattern shown in the figure below for two hours, The display a completely white screen. The previous image shall not persist more than two seconds at 25℃	Note6

Note1: After completion of the test, the sample shall be free from the following defects:

- 1) Air bubble in the LCD
- 2) Seal leak
- 3) Non-display
- 4) Missing segments
- 5) Glass crack

6) Yellowish appearance will not be taken into consideration after RA tests

Note2: Use sample for only one reliability test.

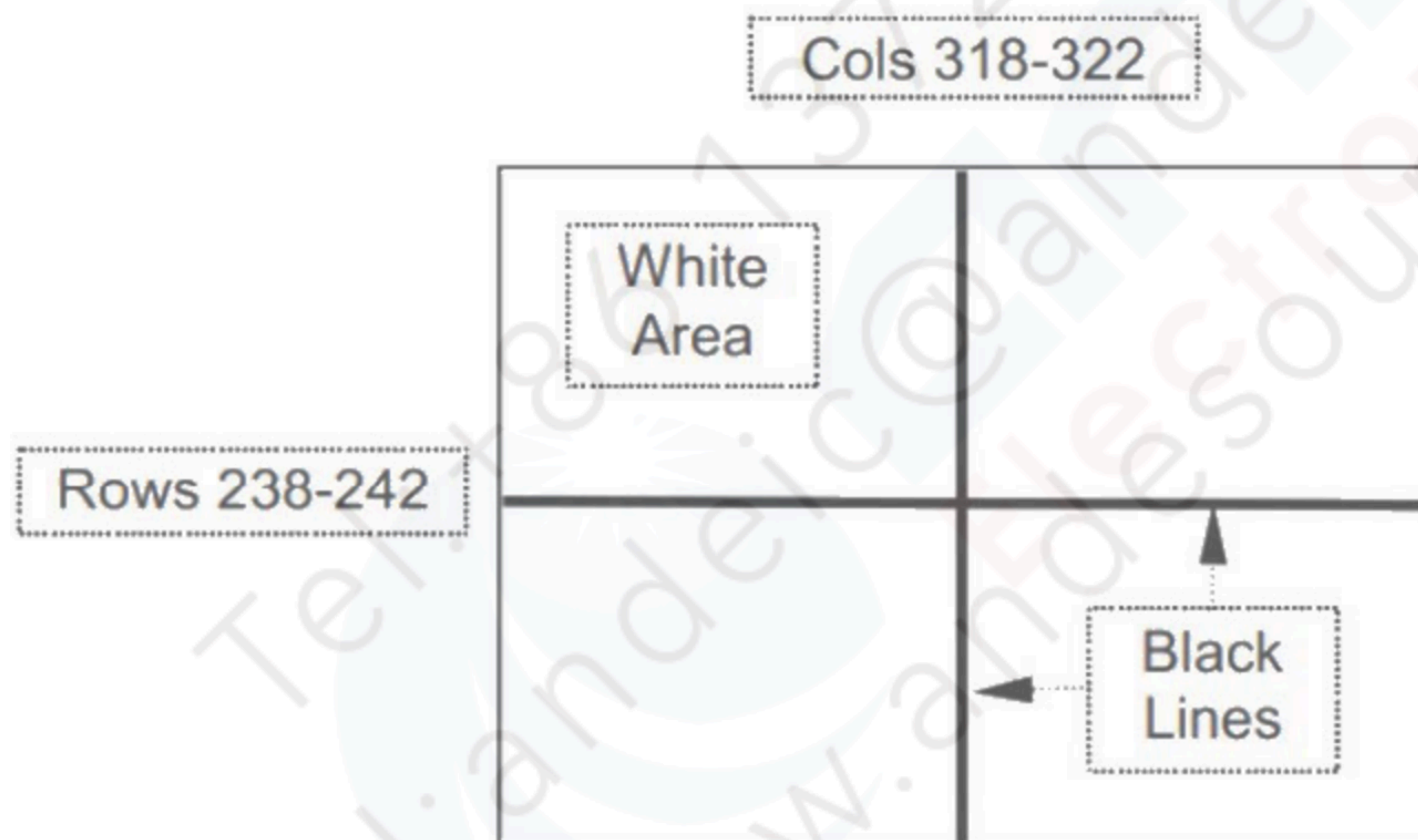
Note3: In case of an abnormal display caused by discharge, if it can recover to normal state after reset, it is considered "PASS". The use of an ionizer (antistatic blower) is recommended during this test. When removing the protection film from LCM panel, do it at a slow speed (preferably more than one second) and blow with ionizer toward the peeling face to minimize ESD which may damage the electrical circuit.

Note4: For duration test in the chamber

- Keep a small distance between each sample and don't place the samples close to the wall or the wick. Don't open the chamber unless absolutely necessary.
- During the test, avoid moisture condensation on the polarizer.
- After taking the samples out of the chamber and returning to room temperature and humidity, wait at least two hours before inspecting and measuring data.
- Perform de-rating during high temp. operation test.

Note5: Polarizer color minor change (Such as yellowish) will consider as pass if the optical test data is within spec.

Note6: Image Sticking pattern

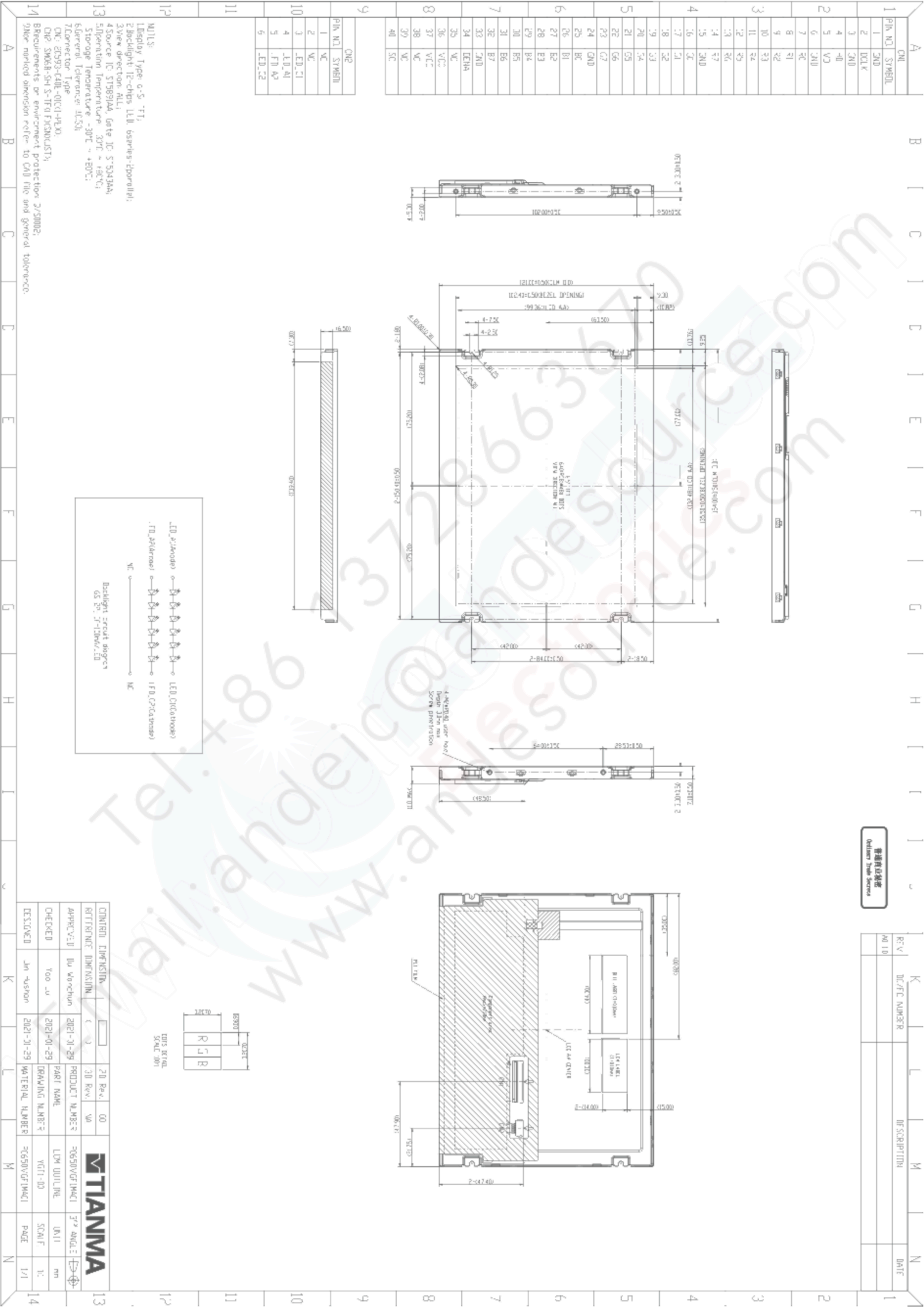


TEST PATTERN FOR IMAGE STICKING TEST

Note7: LED forward current should follow the De-rating curve and the NTC resistance should not be below 1.268KΩ.

Note8: Tianma suggests that EMC related test to be carried out on customer's unit and Tianma will assist to improve EMC performance if required.

9. Mechanical Drawing



10. Product Inspection Criteria

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11. Packing Instruction

TBD

12. Appendix

TBD

13. Precautions for Use of LCD Module

13.1 Handling Precautions

- (1) The display panel is made of glass. Do not subject it to mechanical shock by dropping it, etc.
- (2) If the display panel is damaged and the liquid crystal fluid inside it leaks out be sure not to get any in your mouth. If the fluid comes into contact with your skin or clothes promptly wash it off using soap and water.
- (3) Do not apply excessive force to the display surface or the bezel since this may cause the color tone to vary.
- (4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle the polarizer carefully.
- (5) If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is still not completely clear use a moist cloth with one of the following solvents:
 - Isopropyl alcohol

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

- Water
 - Ketone
 - Aromatic solvents
- (6) POL surface temperature shall not exceed 95℃ when the product is used or tested.
 - (7) The storage or use environment must not contain an acid or base environment. for example, NH₃, SO₂...
 - (8) Do not attempt to disassemble the LCD Module.
 - (9) If the logic circuitry is powered off, do not apply the input signals.
 - (10) To prevent destruction of the module by static electricity, be careful to maintain an optimum work environment.
 - (11) Be sure to ground your body when handling the LCD Modules.
 - (12) Tools used for assembly, such as soldering irons, must be properly grounded.
 - (13) To reduce the amount of static electricity generated, do not conduct assembly or other work under very low humidity conditions.
 - (14) The LCD Module is covered with a film to protect the display surface. Be careful when peeling off this protective film since static electricity may be generated.

13.2 Storage precautions

- (1) When storing the LCD modules avoid exposure to direct sunlight or to the light of fluorescent lamps.
- (2) The LCD modules should be stored within the rated storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:
Temperature: 15 ~ 35 degree C (or at least Temp. 10 ~ 40 degree C / Humidity 25% ~ 75%), for National Std. recommendation
- (3) The LCD modules should be stored in a room without acid, alkali or other harmful gases.

13.3 Transportation Precautions

The LCD modules should not be dropped or subject to violent mechanical shock during transportation. Also they should avoid excessive pressure, water, high humidity and direct sunlight.