

SPECIFICATION

[] Preliminary Specification
[●] Final Specification

Description **15.6” 1366xRGBx768 TFT-LCD Module**
Part Number **P1560WXN1MB00**

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1. Summary

1.1 General Description

This is a 15.6 inch a-Si TFT-LCD module with Normal-White technology. It is composed of a TFT-LCD panel, a LCD driver circuit board, a LED backlight unit.

1.2 Features

- Interface: 1 port LVDS, 8bit
- Compliant with the European RoHS Directive (2011/65/EU) and Delegated Directive (2015/863/EU, Amending Annex II of 2011/65/EU)

2. General Specifications

Feature		Spec	Unit
Display Spec	Size	15.6 inch	
	Resolution	1366(RGB)x768	
	Pixel Pitch	0.252x0.252	mm
	TFT Active Area	344.232x193.536	mm
	Technology Type	a-Si	
	Pixel Configuration	R.G.B Vertical Stripe	
	Display Mode	TN, Normally White	
	Viewing Direction	12 o'clock(Source IC on 12 o'clock)	
	Gray Scale Inversion Direction	6 o'clock	
Mechanical Characteristics	LCM (W x H x D)	363.8x215.9x10.42(Typ)	mm
	Weight	0.801	Kg
Optical Characteristics	Luminance	400(Typ)	cd/m ²
	Contrast Ratio	900:1(Typ)	
	NTSC	60(Typ)	%
	Response time	18(Typ)	ms
	Viewing Angle	80/80/80/80(TN)	degree
Electrical Characteristics	Interface	1 port LVDS, 8 bit	
	Color Depth	16.7 Million	color
	Power Consumption	LCD: 1914 typ(Black pattern) Backlight: 7848 typ	mW

Table 2.1 General TFT Specifications

3. Input / Output Terminals

3.1 CN1 Pin assignment (LCD Interface)

Connector Information	
Connector	185083-20121-3
Matched connector	DF14-20S-1.25C or compatible

Table 3.1.1 Connector information

No	Symbol	I/O	Description	Comment
1	VCC	P	Power supply	
2	VCC	P	Power supply	
3	GND.	P	Ground	
4	NC	-	Keep this pin Open	
5	D0-	I	Pixel data	
6	D0+	I	Pixel data	
7	GND	P	Ground	
8	D1-	I	Pixel data	
9	D1+	I	Pixel data	
10	GND	P	Ground	
11	D2-	I	Pixel data	
12	D2+	I	Pixel data	
13	GND	P	Ground	
14	CLK-	I	Pixel clock	
15	CLK+	I	Pixel clock	
16	GND	P	Ground	
17	D3-	I	Pixel data	
18	D3+	I	Pixel data	
19	NC	-	Keep this pin Open	
20	NC	-	Keep this pin Open	

Table 3.1.2 Pin Assignment for LCD Interface

Note1: I/O definition: I---Input, O---Output, P---Power/Ground

Note2: All of the GND pins should be connected to the system ground.

3.2 CN2 Pin assignment (Backlight)

Connector Information	
Connector	MSB24038P6
Matching connector	P24038P6 or compatible

Table 3.2.1 Connector information

No	Symbol	I/O	Description	Comment
1	PWM	I	Backlight dimming control(default: NC is 100% duty)	-
2	BRTC	I	Backlight on/off control (High: On, Low or NC is Off)	-
3	GND	P	Power ground	-
4	GND	P	Power ground	-
5	VDD	P	Power supply	-
6	VDD	P	Power supply	-

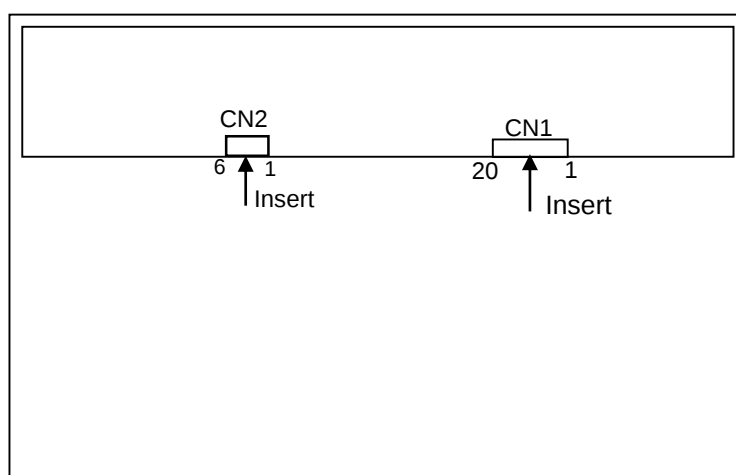
Table 3.2.2 Pin Assignment for backlight interface

Note1: I/O definition: I---Input, O---Output, P---Power/Ground

Note2: All of the GND pins should be connected to the system ground.

3.3 Positions of plug and socket

Rear side



4. Absolute Maximum Ratings

Item	Symbol	MIN	MAX	Unit	Remark
Power Voltage(LCD)	VCC	-0.3	3.46	V	Note1
Power Voltage(LED)	VDD	-0.3	13	V	
Input voltage(Display signal)	V _D Note4	-0.3	VCC	V	
Input voltage(Backlight)	BRTC PWM	-0.3	4	V	
Operating Temperature	Top	-20	70	°C	-
Storage Temperature	Tst	-30	80	°C	-
Relative Humidity Note2	RH	--	≤95	%	Ta≤40°C
		--	≤85	%	40°C < Ta≤50°C
		--	≤55	%	50°C < Ta≤60°C
		--	≤36	%	60°C < Ta≤70°C
		--	≤24	%	70°C < Ta≤80°C
Absolute Humidity Note 2	AH	--	≤70	g/m ³	Ta>70°C

Table 4.1 Absolute Maximum Ratings

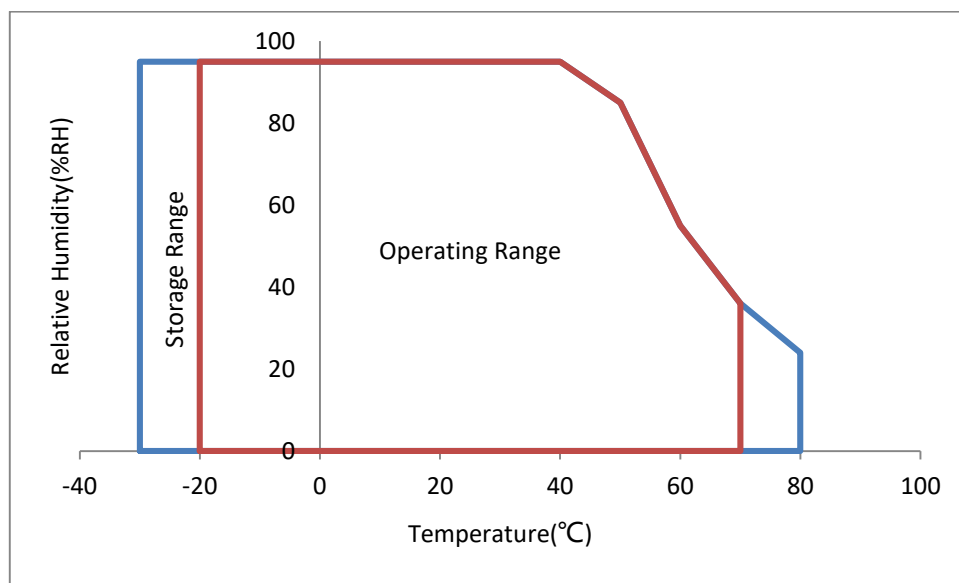


Table 4.2 Absolute Maximum Ratings chart

Note1: Input voltage include all input data.

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.

Note3: The absolute maximum rating values of this product are not allowed to be exceeded at any times. A module should be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme condition, the module may be permanently destroyed

Note4: V_D include D0+/-, D1+/-, D2+/-, D3+/-, CLK+/-

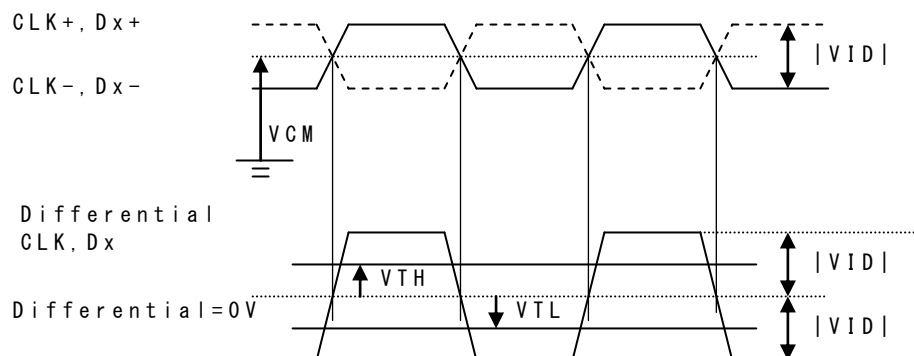
5. Electrical Characteristics

5.1 DC Characteristics for Panel Driving

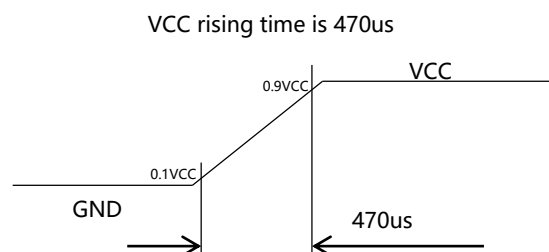
Item		Symbol	MIN	TYP	MAX	Unit	Remark
Power supply Voltage		VCC	3.14	3.3	3.46	V	
Power supply ripple		Vp-p	-	-	100	mV	
Power supply current		ICC	-	580	-	mA	Black Pattern At VCC=3.3V
Differential input voltage		Vid	100	-	600	mV	
Differential input common voltage		Vcm	-	1.2	-	V	
Differential input threshold voltage	Low Level	VTL	-100	-	-	mV	
	High Level	VTH	-	-	100	mV	
Power Consumption	60Hz	P	-	1914	-	mW	Black pattern
Terminating resistance	RT	-	-	100	-	Ω	
Inrush		-	-	-	1.5	A	Note1

Table 5.1.1 Operating Voltages

LVDS DC electrical characteristics



Note1: Inrush: 1.5A (Max)/470us



5.2 DC Characteristics for Backlight Driving

Parameter		Symbol	min.	typ.	max.	Unit	Remarks
Power supply voltage		VDD	11	12	13	V	Note1
Power supply current		IDD	-	654	780 Note2	mA	At the maximum luminance Control At VDD=12V
Permissible ripple voltage		VRPD	-	-	200	mVp-p	for VDD Note3, Note4, Note5
Input voltage for PWM signal	High	VDFH1	1.2	-	-	V	-
	Low	VDFL1	-	-	0.52		
Input voltage for BRTC signal	High	VDFH2	1.5	-	-		
	Low	VDFL2	-	-	0.8		
PWM frequency		f _{PWM}	100	-	10k	Hz	Note6, Note8
PWM duty ratio		DR _{PWM}	0.2	-	100	%	Note7, Note9, Note10, Note12
PWM pulse width		tPWH	10	-	-	μs	Note9, Note10
LED life time		Hr	-	50000	-	Hour	Note 11
Inrush current		-	-	-	1.5	A	Note13

Table 5.2.1 LED Backlight Characteristics

Note1: When designing of the power supply, take the measures for prevention of surge voltage.

Note2: This value excludes peak current such as overshoot current.

Note3: This product works even if the ripple voltage levels are over the permissible values, but there might be noise on the display image.

Note4: The permissible ripple voltage includes spike noise.

Note5: The power supply lines (VDD and GND) may have ripple voltage during luminance control of LED. There is the possibility that the ripple voltage produces acoustic noise and signal wave noise in audio circuit and so on.

Note6: A recommended f_{PWM} value is as follows.

$$f_{PWM} = \frac{2n-1}{4} \times f_v$$

(n=integer, f_v =frame frequency of LCD module)

Note7:

$$DR_{PWM} = \frac{t_{PWH}}{t_{PW}}$$

(tPWH: PWM pulse width, tPW: PWM dimming cycle(=1/f_{PWM}))

Note8: Depending on the frequency used, some noise may appear on the screen, please conduct a thorough evaluation.

Note9: While the BRTC signal is high, do not set the tPWH (PWM pulse width) is less than minimum value. It may cause abnormal working of the backlight. In this case, turn the backlight off and then on again by BRTC signal.

Note10: Regardless of the PWM frequency, both PWM duty ratio and PWM pulse width must be always more than the minimum values.

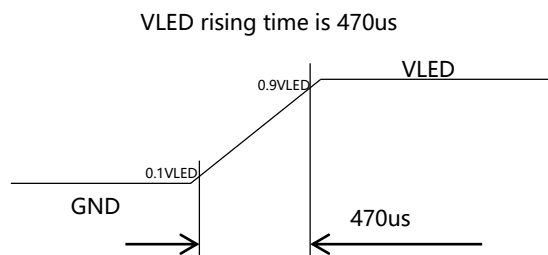
Note11: Optical performance should be evaluated at Ta=25°C. Only If LED is driven by high current, high ambient temperature & humidity condition. The life time of LED will be reduced. Operating life means brightness goes down to 50% of initial brightness. Typical operating life time is an estimated data

Note12: The minimum duty in Table 1 is based on the application circuit and does not consider the deviation of current linearity

Table 1.

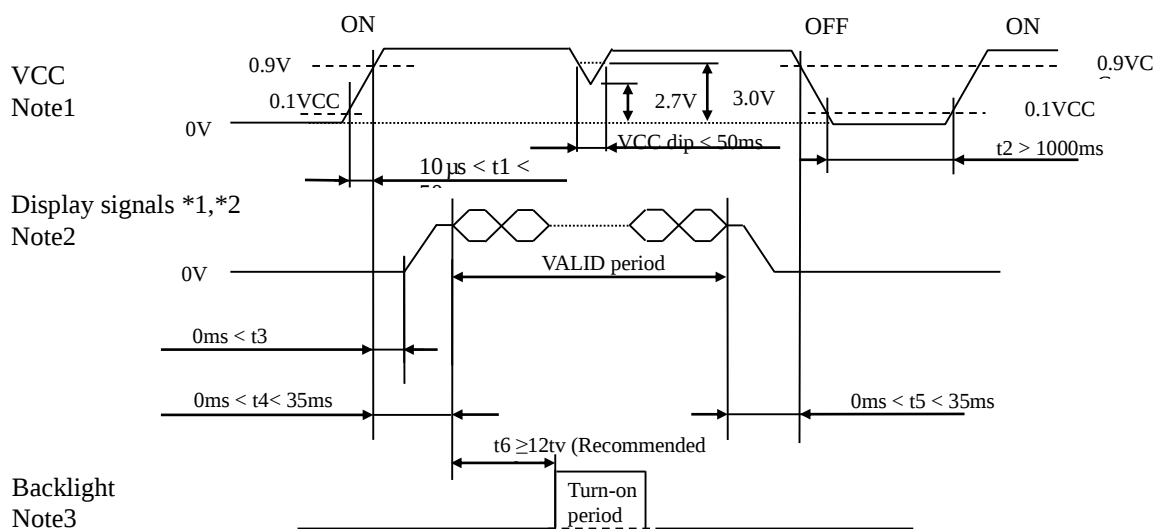
Dimming Frequency (Hz)	Duty (Min.)	Duty (Max.)
$100 < f_{PWM} \leq 500$	0.2%	100%
$500 < f_{PWM} \leq 1k$	0.4%	100%
$1k < f_{PWM} \leq 2k$	0.8%	100%
$2k < f_{PWM} \leq 5k$	1.5%	100%
$5k < f_{PWM} \leq 10k$	3%	100%

Note13: Inrush: 1.5A (Max)/470us



5.3 Recommended Power ON/OFF Sequence

LCM Power ON/OFF Sequence



*1: DA0+/-, DA1+/-, DA2+/-, DA3+/-, CLK+/-

*2: These signals should be measured at the terminal of 100Ω resistance.

Note1: If there is a voltage variation (voltage drop) at the rising edge of VCC below 3.0V, there is a possibility that a product does not work due to a protection circuit.

Note2: Display signals (D0+/-, D1+/-, D2+/-, D3+/- and CLK+/-) must be set to Low or High-impedance, except the VALID period (See above sequence diagram), in order to avoid the circuitry damage.

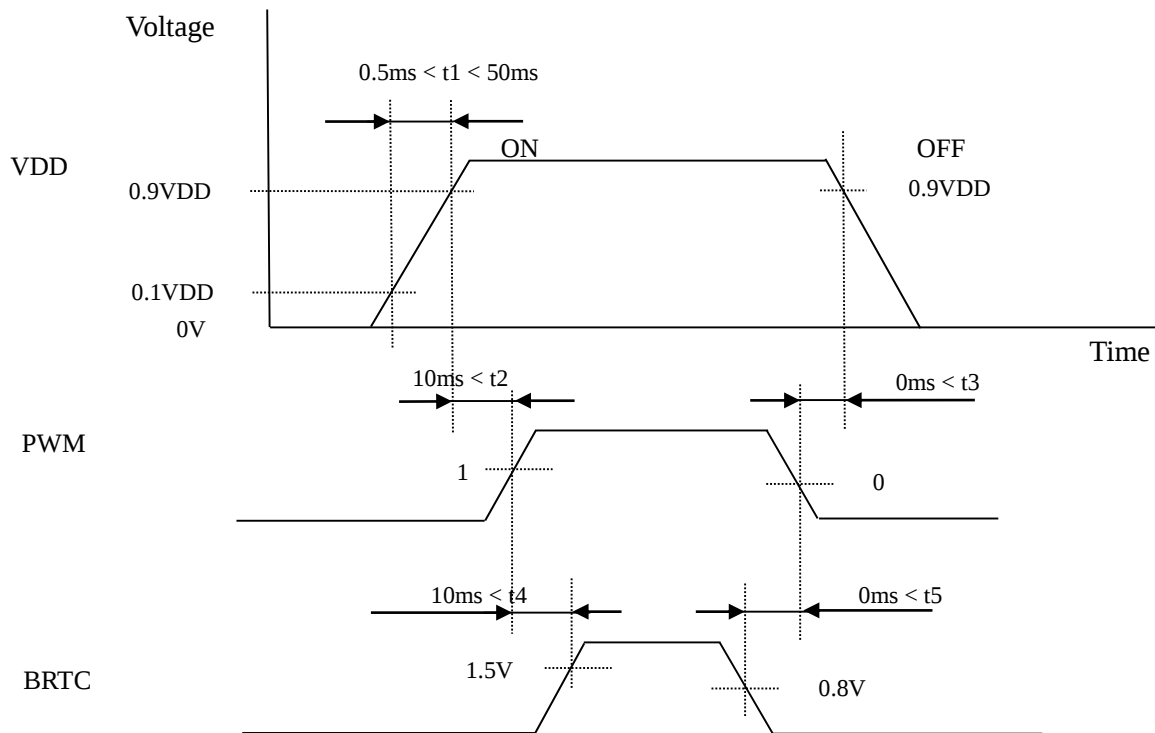
If some of display and function signals of this product are cut while this product is working, even if the signal input to it once again, it might not work normally. If a customer stops the display and

function signals, VCC also must be shut down.

Note3: In order to avoid unstable data display, the backlight is recommended to turn on within the VALID period of display and function signals.

Recommended value: $t_6 \geq 12t_v$ (t_v is vertical cycle (Please refer to 6.1 Timing characteristics))

LED driver Sequence



5.4 LCD Module Block Diagram

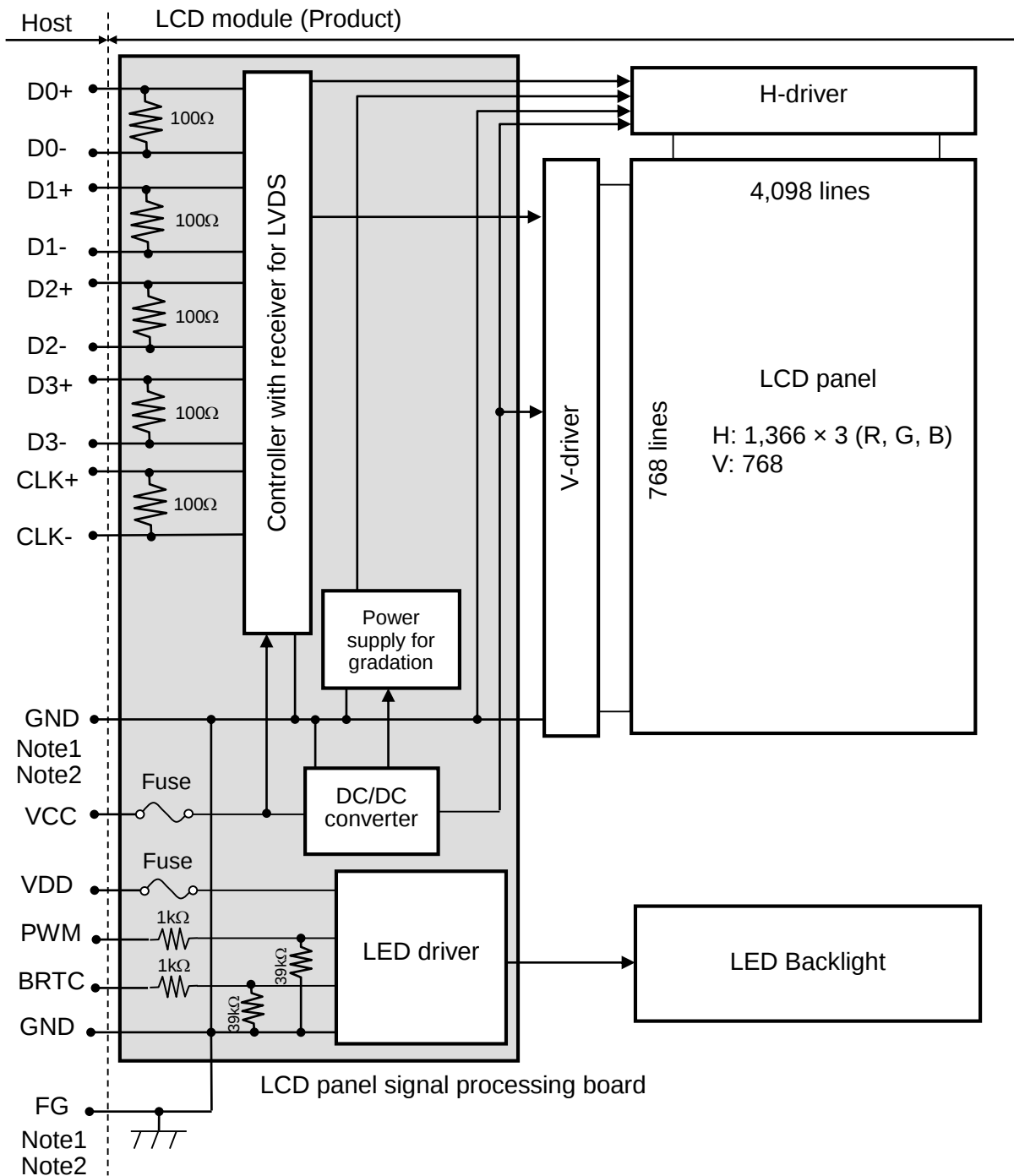


Figure 5.5.1 LCD Module Block Diagram

Note1: Relation between GND (Signal ground and LED driver ground) and FG (Frame ground) in the LCD module is as follows.

GND- FG	Connected
---------	-----------

Note2: GND and FG must be connected to customer equipment's ground, and it is recommended that these grounds to be connected together in customer equipment.

6. Interface Timing Characteristics

6.1 LVDS signal timing characteristics

(Note 1)

Parameter			Symbol	min.	typ.	max.	Unit	Remarks
CLK	Frequency		1/tc	-	76.5	-	MHz	13.072ns (typ.)
DE	Horizontal	Cycle	th	-	20.470	-	μs	-
				-	1,566	-	CLK	
		Display period	thd	1,366			CLK	-
	Vertical (One frame)	Cycle	tv	-	16.66	-	ms	
				-	814	-	H	
		Display period	tvd	768			H	-
Frame rate			F	60			Hz	

Table 6.1.1 Input Timing Parameters Requirement

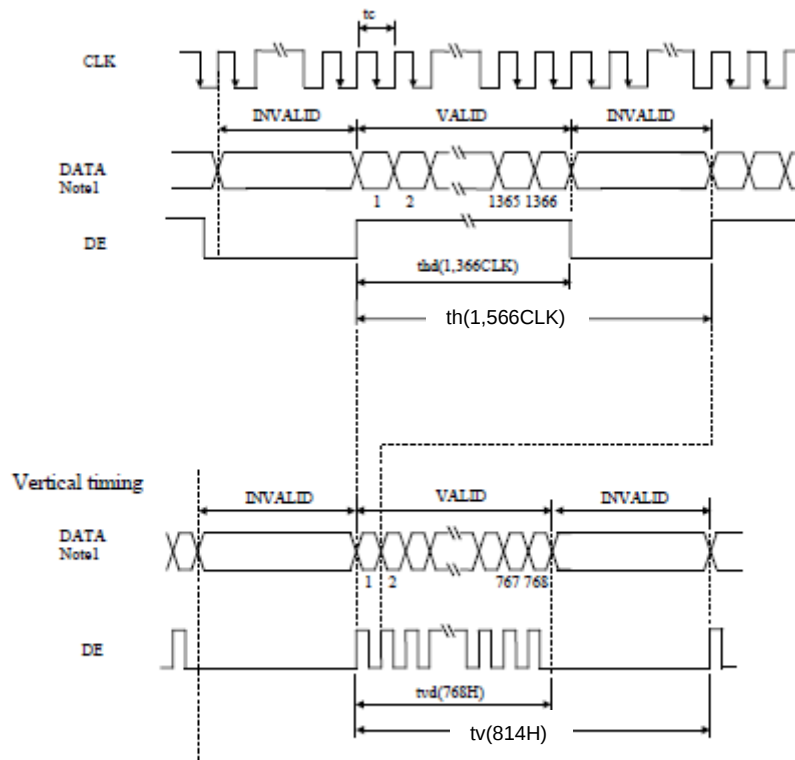
Note1: Definition of parameters is as follows.

tc= 1CLK, th= 1H

Note2: See the data sheet of LVDS transmitter.

Note3: Vertical cycle (tv) should be specified in integral multiple of Horizontal cycle (th).

Horizontal timing



Note1: DATA = R0-R7, G0-G7, B0-B7 or R0-R5, G0-G5, B0-B5

Figure 6.1.1 Clock and Data Input Timing Diagram

6.2 LVDS data input Format

8-bit mode data input

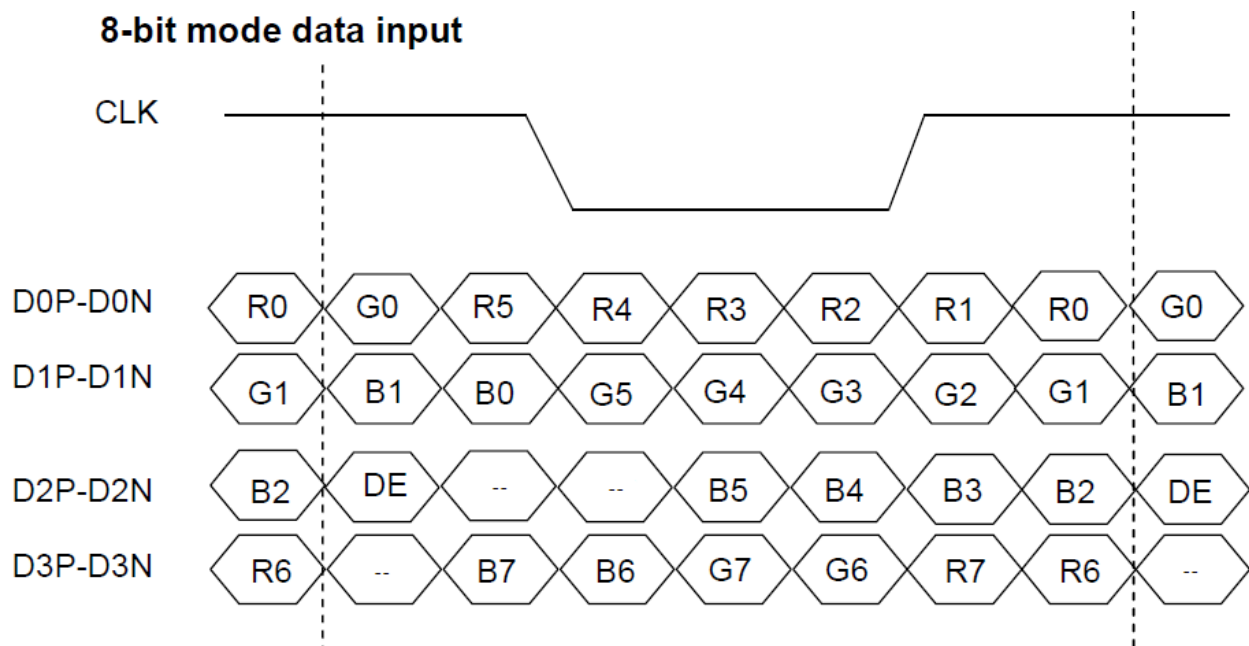


Table 6.2.1 Data Input Format(VESA)

Note1: This LCD module supports DE mode only.

Note2: D0P-D0N:D0+/-, D1P-D1N:D1+/-, D2P-D2N:D2+/-, D3P-D3N:D3+/-, CLK:CLK+/-

7. Optical Characteristics

Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles		θT	CR ≥ 10	70	80		degree	Note2,3
		θB		70	80			
		θL		70	80			
		θR		70	80			
Contrast Ratio		CR	θ=0°	540	900			Note 3
Response Time		T _{ON}	25℃		18	26	ms	Note 4
		T _{OFF}						
Chromaticity	White	x	Backlight is on	0.263	0.313	0.363		Note 1,5
		y		0.279	0.329	0.379		
	Red	x		0.575	0.625	0.675		Note 1,5
		y		0.308	0.358	0.408		
	Green	x		0.284	0.334	0.384		Note 1,5
		y		0.557	0.607	0.657		
	Blue	x		0.100	0.150	0.200		Note 1,5
		y		0.034	0.084	0.134		
Uniformity		U		70	80		%	Note 6
NTSC		-		55	60		%	Note 5
Luminance		L		280	400		cd/m ²	Note 7

Table 7.1 Optical Parameters

Test Conditions:

1. IDD= 654 mA, and the ambient temperature is 25°C.
2. The test systems refer to Note1 and Note2.

Note1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 Minutes operation, the optical characteristics are measured at the center point of the LCD screen.

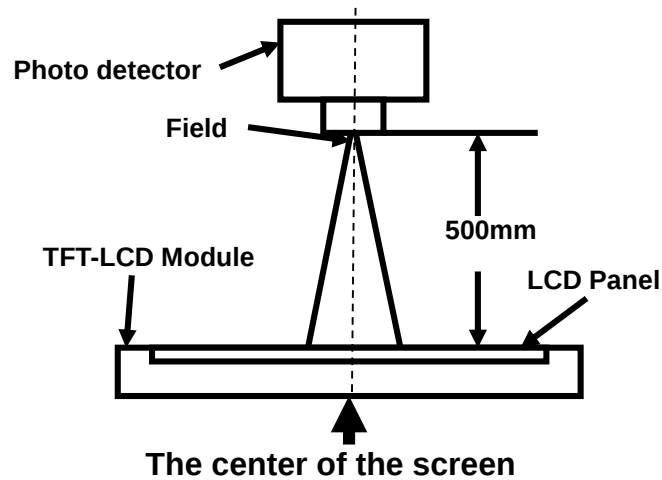


Fig1.Measurement Set Up

Note2: Definition of viewing angle range and measurement system. Viewing angle is measured at the center point of the LCD .

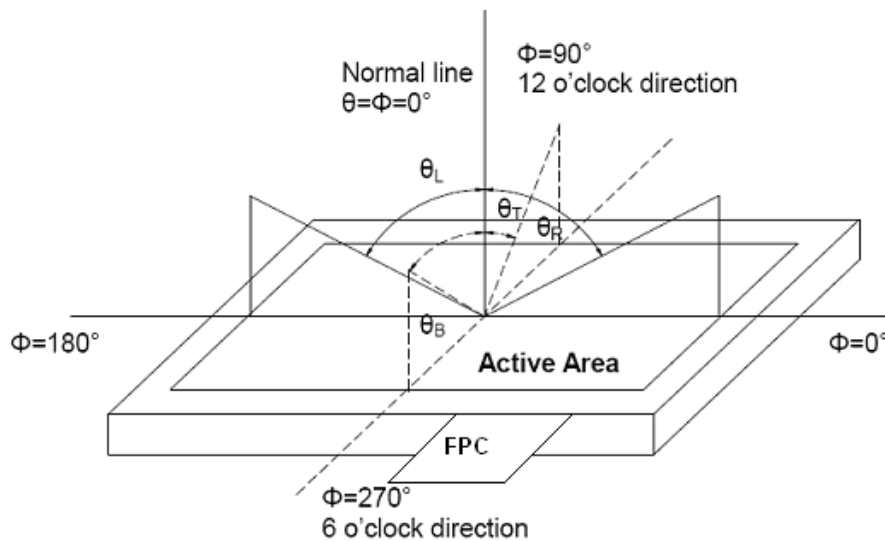


Fig2. Measurement viewing angle

Note3: Definition of contrast ratio

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

Note4: Definition of Response time

For TN LCM, the response time is defined as the LCD optical switching time interval between "White" state and "Black" state. Rise time (T_r) is the time between photo detector output intensity changed from 90% to 10%. And fall time (T_f) is the time between photo detector output intensity changed from 10% to 90%.

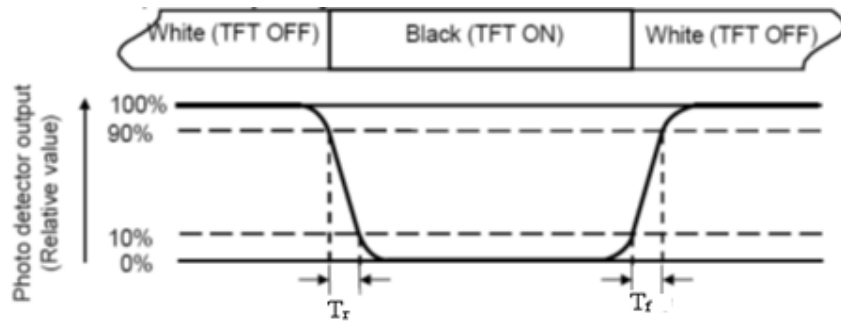


Fig4.Response Time Testing(TN)

Note5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note6: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer Fig.5). Every measuring point is placed at the center of each measuring area.

Luminance Uniformity (U) = L_{min} / L_{max}

L_{max} : The measured Maximum luminance of all measurement position.

L_{min} : The measured Minimum luminance of all measurement position.

L-----Active area length; W----- Active area width

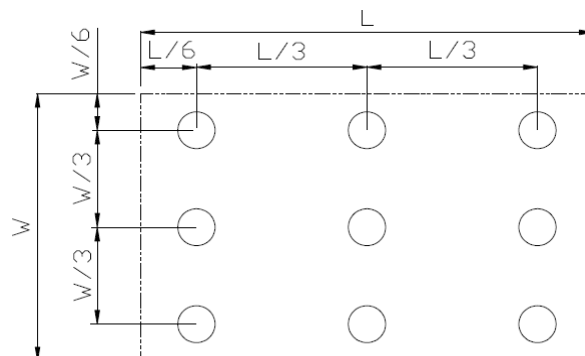


Fig5. Luminance Uniformity Measurement Locations(9 points)

Note7: Definition of Luminance:

Measure the luminance of white state at center point.

8. Reliability Test

No	Test Item	Condition	Remarks Note1
1	High Temperature Operation	$70 \pm 3^{\circ}\text{C}$, 240hours	No display malfunctions
2	Heat cycle (Operation)	① $-20 \pm 3^{\circ}\text{C}$...1hour ② $70 \pm 3^{\circ}\text{C}$...1hour ③ 50cycles, 4 hours/cycle	
3	High Temperature & High Humidity Operation	$60 \pm 2^{\circ}\text{C}$, RH= 90%, 240hours	
4	Thermal Shock (non-operation)	① $-20 \pm 3^{\circ}\text{C}$...30minutes + $80 \pm 3^{\circ}\text{C}$...30minutes ② 100cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes.	
5	ESD(Operation)	① 150pF, $150\ \Omega$, $\pm 10\text{KV}$ ② 9 places on a panel surface Note2 ③ 10 times each place at 1 sec interval	
6	Vibration (Non-operation)	① 5 to 100Hz, 11.76m/s^2 ② 1 minute/cycle ③ $\pm X$, $\pm Y$, $\pm Z$ directions ④ 50 times each direction	No display malfunctions No physical damages
7	Shock (Non-operation)	① 294m/s^2 , 11ms ② $\pm X$, $\pm Y$, $\pm Z$ directions ⑤ 3 times each direction	

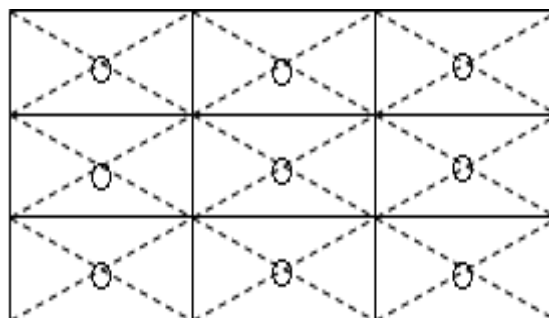
Table 8.1 RA test condition

Note1: Temperature is the ambient temperature of sample

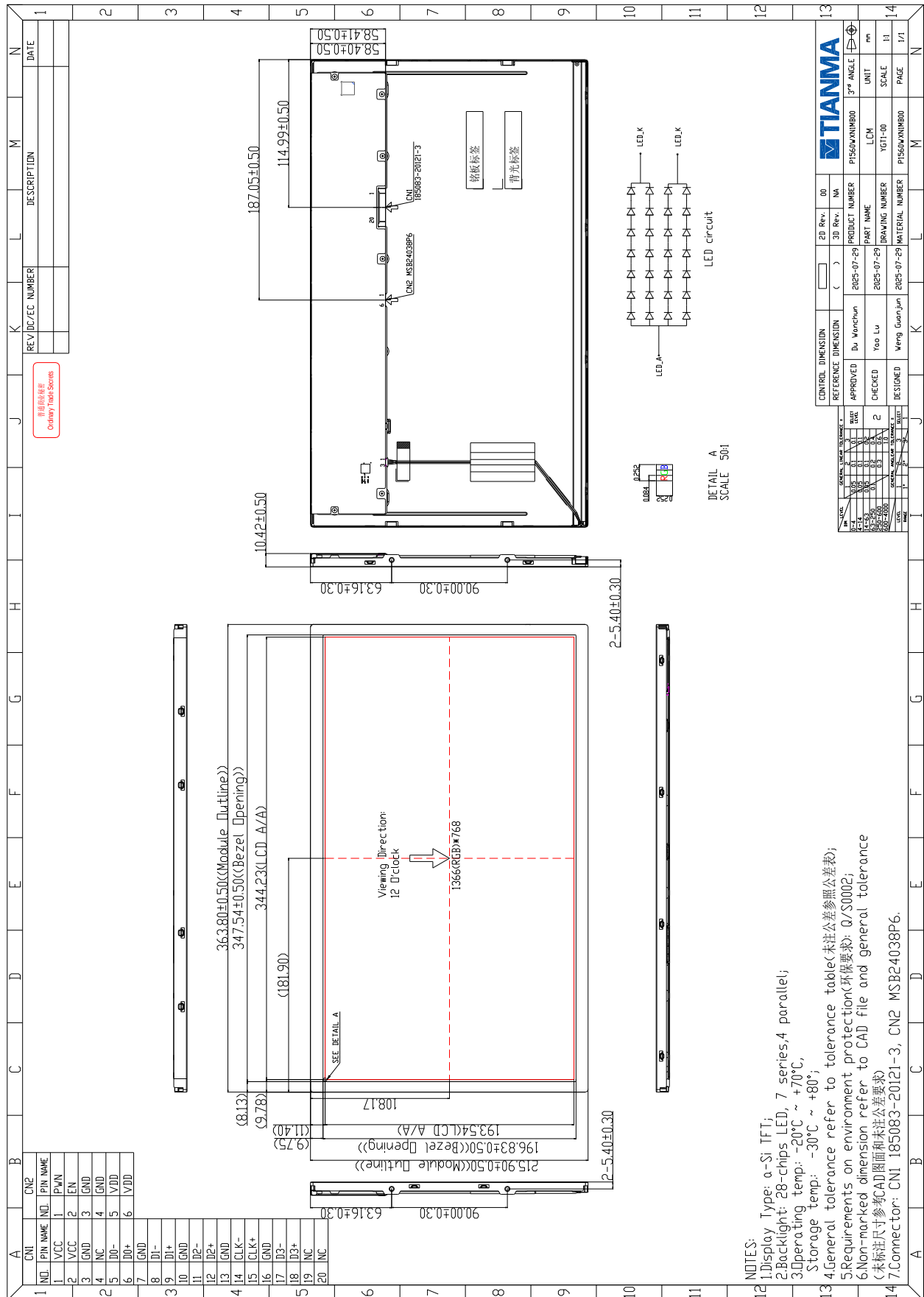
Note2: Before cosmetic and function test, the product must have enough recovery time, at least 24 hours at room temperature.

Note3: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product's function only be guaranteed, but not for all of the cosmetic specification.

Note4: See the following figure for discharge points.



9. Mechanical Drawing

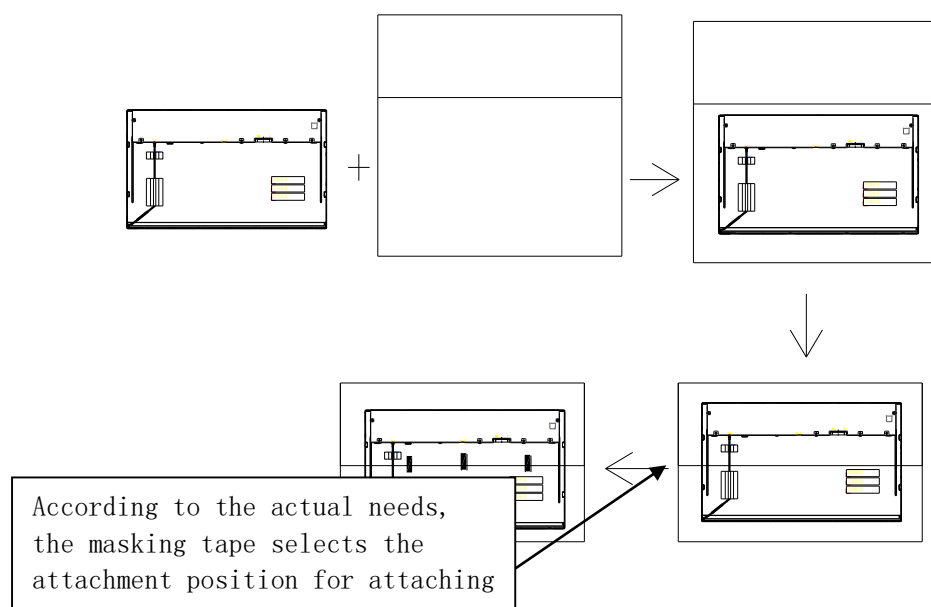


10. Packing Instruction

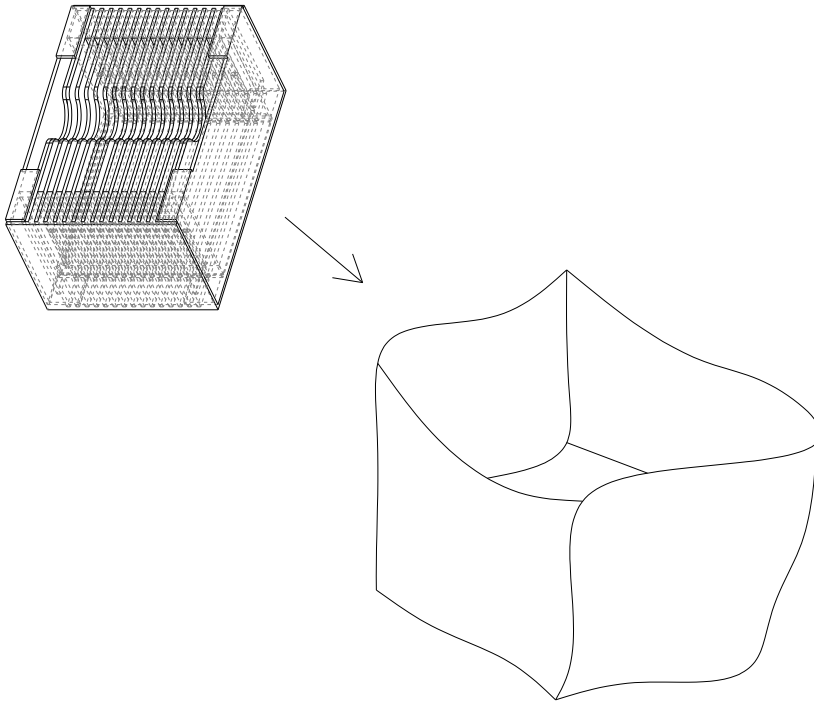
No	Item	Model (Material)	Dimensions(mm)	Unit Weight(Kg)	Quantity	Remark
1	LCM module	P1560WXN1MB00	363.8×215.9×10.42	0.801	10	8.01
2	Paper card	Corrugated Paper	527×348×265	1.700	1	
3	Dust-proof Bag	PE	700×545×0.05	0.021	1	
4	Carton	Corrugated Paper	544×365×312.5	1.11	1	
5	Paper board	Corrugated Paper	527×348×7	0.130	1	
6	Paper holder	Corrugated Paper	276×375×17	0.035	1	
7	Label	Label	100×52	0.001	1	
8	Tape	Tape	485×330×5	0.001	30	0.03
9	ESD bubble bag	PE	395×327×6	0.012	10	0.12
10	Total weight	11.157±5% Kg				

1、The label of the module is below, put the module into a bubble bag, fold it and attach the masking tape.

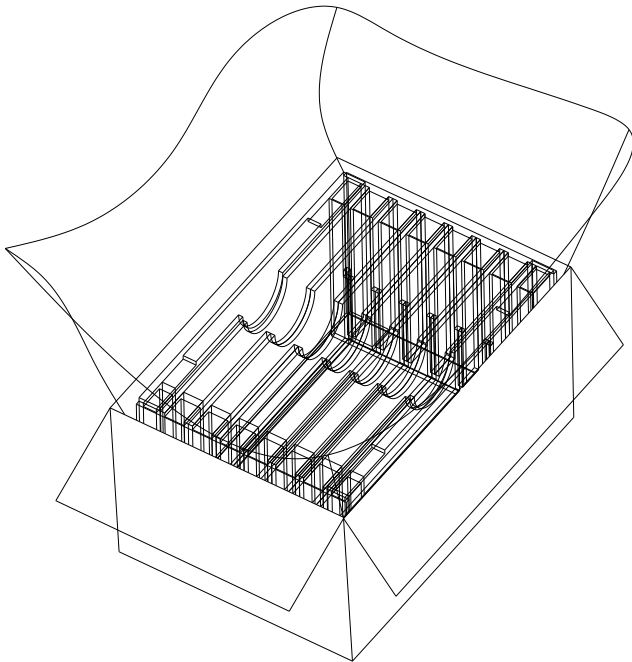
The label of the module is on the inside of the bubble bag



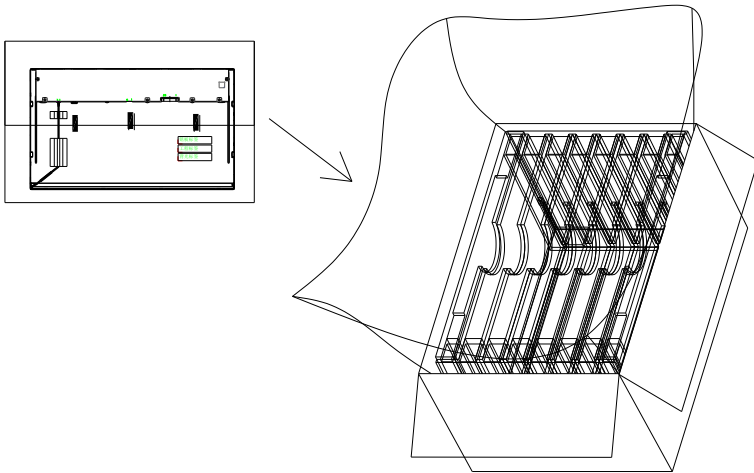
2、Place the paper card in a dust bag



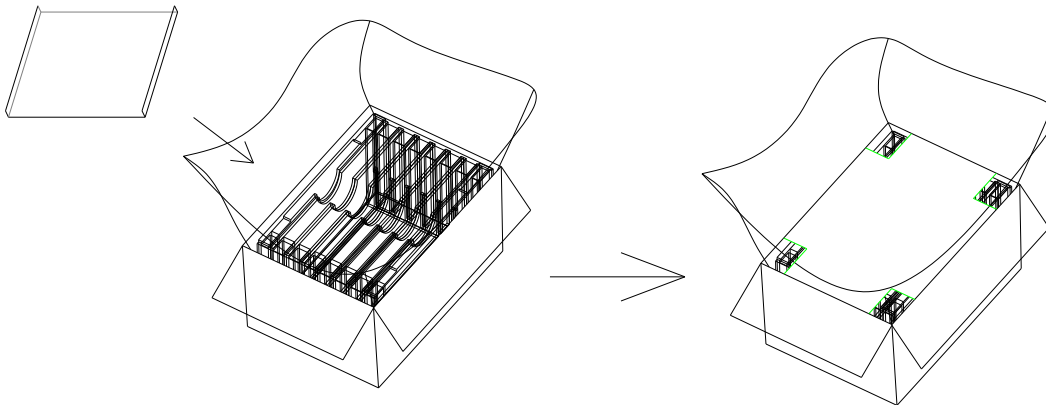
3、Put the combination of the paper card and dust bag in Step 2 into the cardboard box



4、 Put the modules into cartons, and each carton is loaded with 10 modules

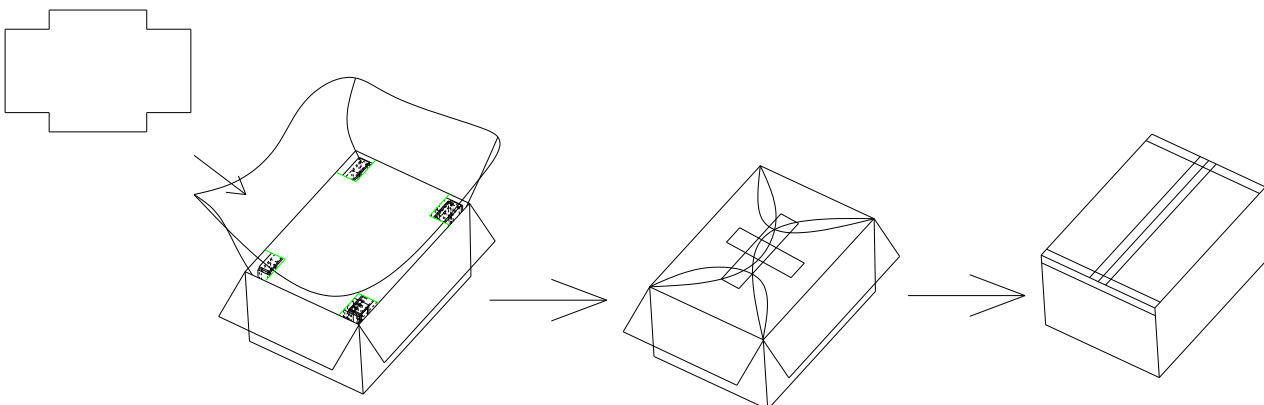


5、 Load the paper holder into the paper card of the carton and cover it on the paper card



6、 Put the cardboard into the paper card in the carton, and on top of the paper holder, fold the excess part of the dust bag.

Attach and fix with tape, fold and close the carton lid



7、The box will be sealed with tape and labeled



11. Precautions for Use of LCD Modules

11.1 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) 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
 - Ethyl alcohol
- (5) Do not disassemble the LCD Module.
- (6) If powered off, do not apply the input signals.
- (7) To prevent destruction of the module by static electricity, be careful to maintain an optimum work environment.
- (8) Be sure to ground your body when handling the LCD Modules.
- (9) Tools used for assembly, must be properly grounded.
- (10) To reduce the amount of static electricity generated, do not conduct assembly or other work under very low humidity conditions.
- (11) The LCD Module is covered with a film to protect the display surface, remove film slowly under the ionizer.

11.2 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. The recommend condition is: Temperature: 0 ~ 35 °C at normal humidity.
- (3) The LCD modules should be stored in a room without acid, alkali or other harmful gas.

11.3 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.

11.4 Screen saver Precautions

Not display the fixed pattern for a long time. Use a screen saver, if the fixed pattern is displayed on the screen

11.5 Safety Precautions

- (1) When you waste damaged or unnecessary LCDs, it is recommended to crush LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned
- (2) Be sure to turn off the power supply when inserting or disconnecting the LED backlight cable.