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Apollo Display Technologies

G150XGE-L04-V570

15" High Brightness TFT Display

CH-03-042

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Revision History

Version and Date	Page	description
1.0 2015/09/25	All	Preliminary Edition

1. General Description

1.1 Overview

G150XGE-L04-V570 is a 15.0" TFT Liquid Crystal Display module with LED Backlight units and 20 pins LVDS interface. This module supports 1024 x 768 XGA mode and can display 16.2M/262k colors.

The PSWG is to establish a set of displays with standard mechanical dimensions and select electrical interface requirements for an industry standard 15.0" XGA LCD panel.

1.2 Features

- XGA (1024 x 768 pixels) resolution
- DE (Data Enable) only mode
- LVDS Interface with 1pixel/clock
- PSWG (Panel Standardization Working Group)
- Wide operating temperature.
- RoHS compliance

1.3 Applikation

- TFT LCD Monitor
- Factory Application
- Amusement

1.4 General Specification

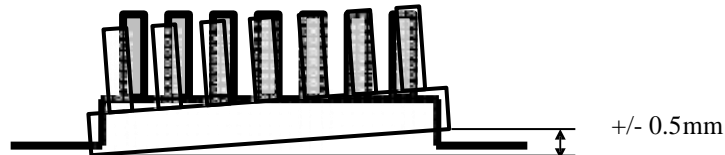
Item	Specification	Unit	Note
Active Area	304.1 (H) x 228.1(V) (15.0" diagonal)	mm	(1)
Bezel Opening Area	307.4(H) x 231.3(V)	mm	
Driver Element	a-Si TFT active matrix	-	-
Pixel Number	1024 x R.G.B x 768	pixel	-
Pixel Pitch	0.297(H) x 0.297(W)	mm	-
Pixel Arrangement	RGB vertical Stripe	-	-
Display Colors	16.7M / 262K	color	-
Display Mode	Normally White	-	-
Surface Treatment	Hard Coating (3H), Anti-Glare (Haze 25)	-	-
Module Power Consumption	10.6 (Black pattern)	W	Typical

1.5 Mechanical Specifications

Item	Min.	Typ.	Max.	Unit	Note	
Module Size	Horizontal(H)	326	326.5	327	mm	(1)
	Vertical(V)	253	253.5	254	mm	
	Depth(D)	-	11.5	12.0	mm	(1)(2)
Weight	-	1084	1134	g	-	

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

(2) Connector mounting position



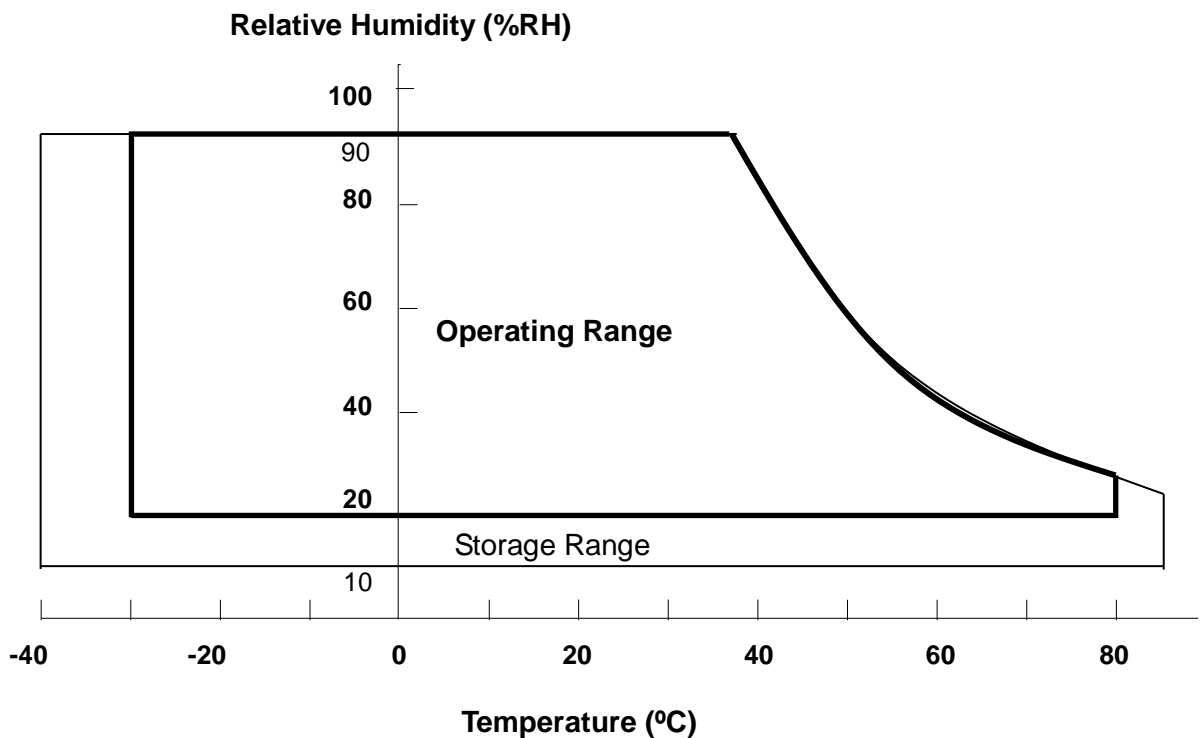
2. Absolute Maximum Ratings

2.1 Absolute Ratings of Environment

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Operating Ambient Temperature	T_{OP}	-30	+80	°C	
Storage Temperature	T_{ST}	-30	+85	°C	

Note (1) Temperature and relative humidity range is shown in the figure below.

- (2) 90 %RH Max. ($T_a < 40^\circ\text{C}$).
- (3) Wet-bulb temperature should be 39°C Max.
- (4) No condensation.



2.2 Electrical Absolute Ratings TFT LCD Module

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	VCC	-0.3	4	V	(1)

3. Electrical Characteristics

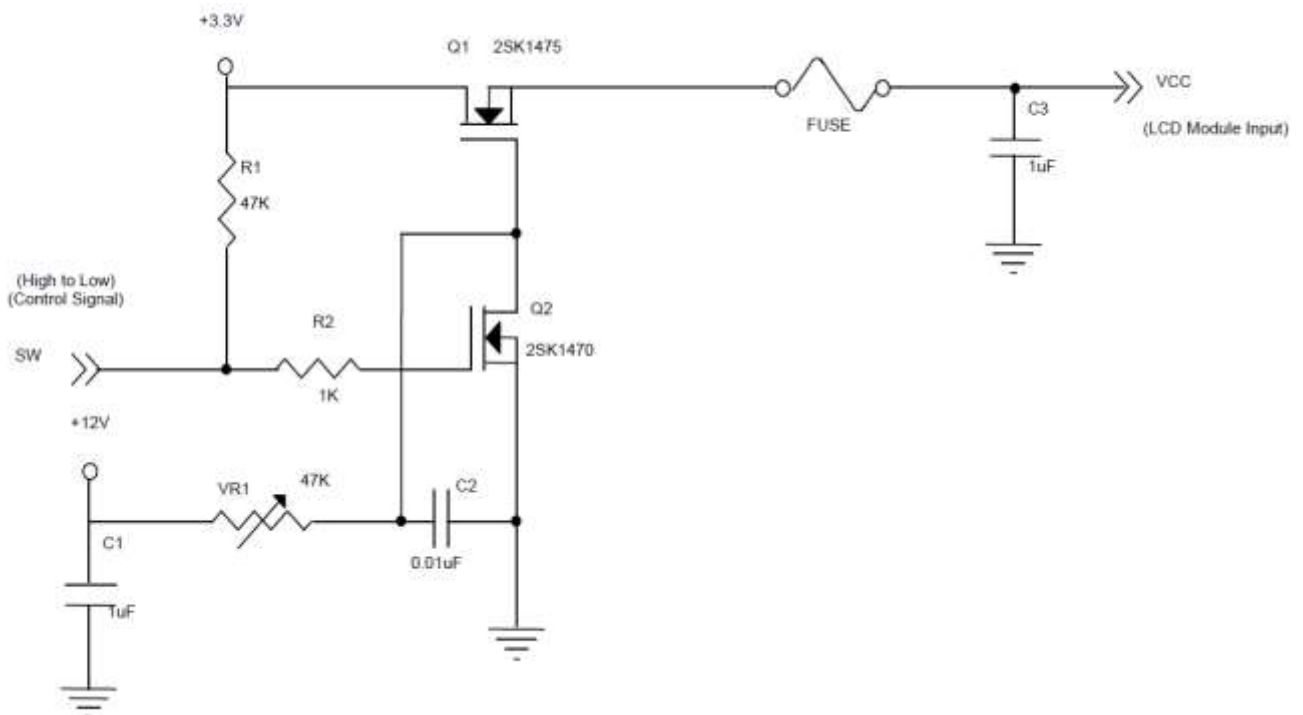
3.1 TFT LCD MODULE

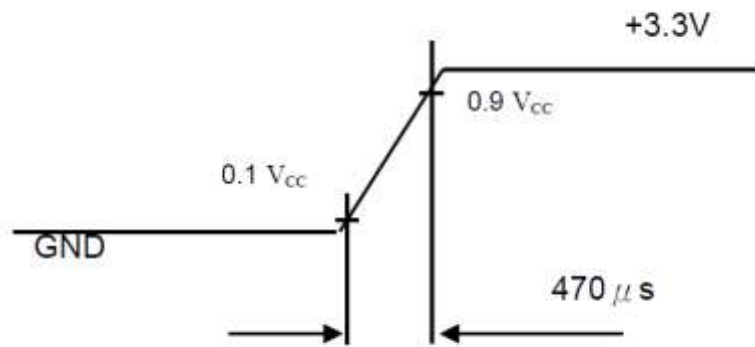
Ta = 25 ± 2 °C

Parameter	Symbol	Value			Unit	Note	
		Min.	Typ.	Max.			
Power Supply Voltage	Vcc	3.0	3.3	3.6	V	at Vcc=3.3V	
Ripple Voltage	V _{RP}	-	50		mV	-	
Rush Current	I _{RUSH}	-	-	1.5	A	(2)	
Initial Stage Current	I _{IS}	-	-	1.0	A	(2)	
Power Supply Current	White	I _{CC}	-	400	500	mA	(3)a, at Vcc=3.3V
	Black		-	550	650	mA	(3)b, at Vcc=3.3V
LVDS Differential Input High Threshold	V _{TH} (LVDS)	-	-	+100	mV	V _{CM} =1.2V	
LVDS Differential Input Low Threshold	V _{TL} (LVDS)	-100	-	-	mV	V _{CM} =1.2V	
LVDS Common Mode Voltage	V _{CM}	1.125	-	1.375	V		
LVDS Differential Input Voltage	V _{ID}	100	-	600	mV		
Terminating Resistor	R _T	-	100	-	Ohm		

Note (1) The assembly should be always operated within above ranges.

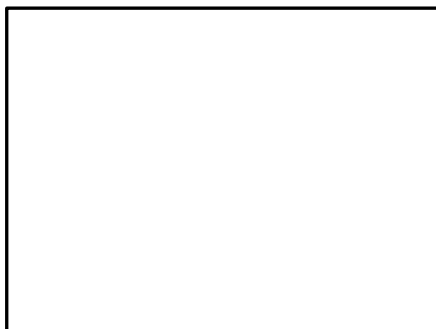
Note (2) Measurement Conditions:





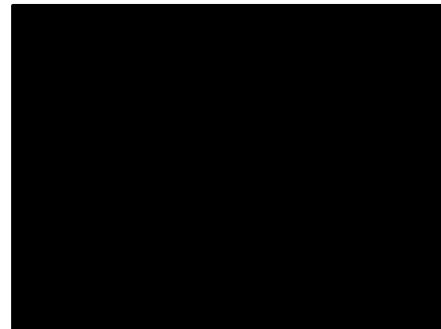
Note (3) The specified power supply current is under the conditions at $V_{DD}=3.3V$, $T_a=25 \pm 2^\circ C$, DC Current and $f_v = 60 \text{ Hz}$, whereas a power dissipation check pattern below is displayed.

a. White Pattern



Active Area

b. Black Pattern



Active Area

3.2. Backlight Unit

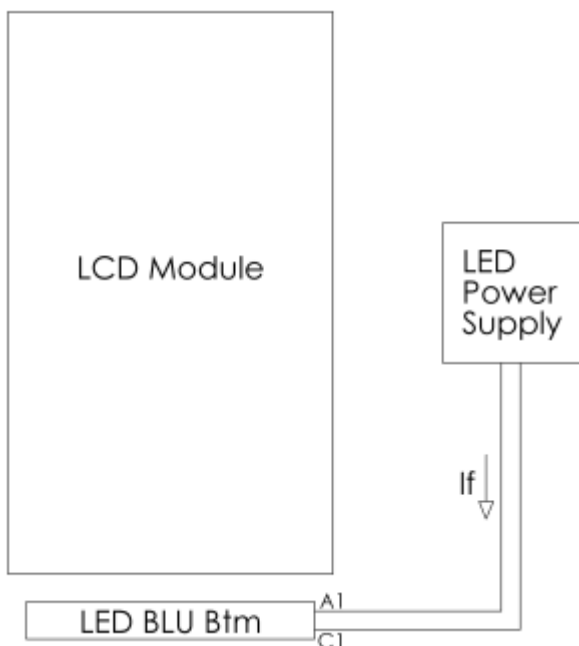
Apollo LED Backlight Unit (BLU)		140000-0					$T_a = 25 \pm 2^\circ\text{C}$	
Parameter	Symbol	Min.	Typ.	Max.	Unit	Note		
BLU Input Voltage	V_f	7.4	8.45	8.5	V_{DC}	4,6		
BLU Forward Current	I_f	-	1400	1430	mA_{DC}	2,3,5		
BLU Power Consumption	P_{LED}	-	11.8	12.2	W	1,2		
BLU Lifetime	L_L	-	100,000	-	Hrs	1		

Notes:

- (1) The lifetime of the LED BLU is defined as the number of hours it continues to operate at $T_a = 25 \pm 2^\circ\text{C}$ and $I_f = 1400\text{mA}_{DC}$ until the luminance is 50% of its original value. Operating the BLU at $T_a > 25 \pm 2^\circ\text{C}$ or applying power $> 12.3\text{W}$ will reduce the lifetime and cause color shifting.
- (2) Specified values are for a single LED BLU connector, this module contains one BLU connector.
- (3) Specified current equals input to a single LED BLU connector at 100% duty cycle.
- (4) Specified voltage is input to LED BLU at typical and maximum current values & 100% duty cycle.
- (5) It is recommended to dim LED BLU using PWM and to synchronize PWM with frame frequency.
- (6) $V_f = \Delta_{BLU1}^{BLU1} (V_A - V_C)$

Connector Name	LED BLU Connector
Connector Quantity	1
Connector Manufacturer P/N	Molex 22-01-3027
Connector Mate	Molex 22-05-3021
BLU Wire Length	10"

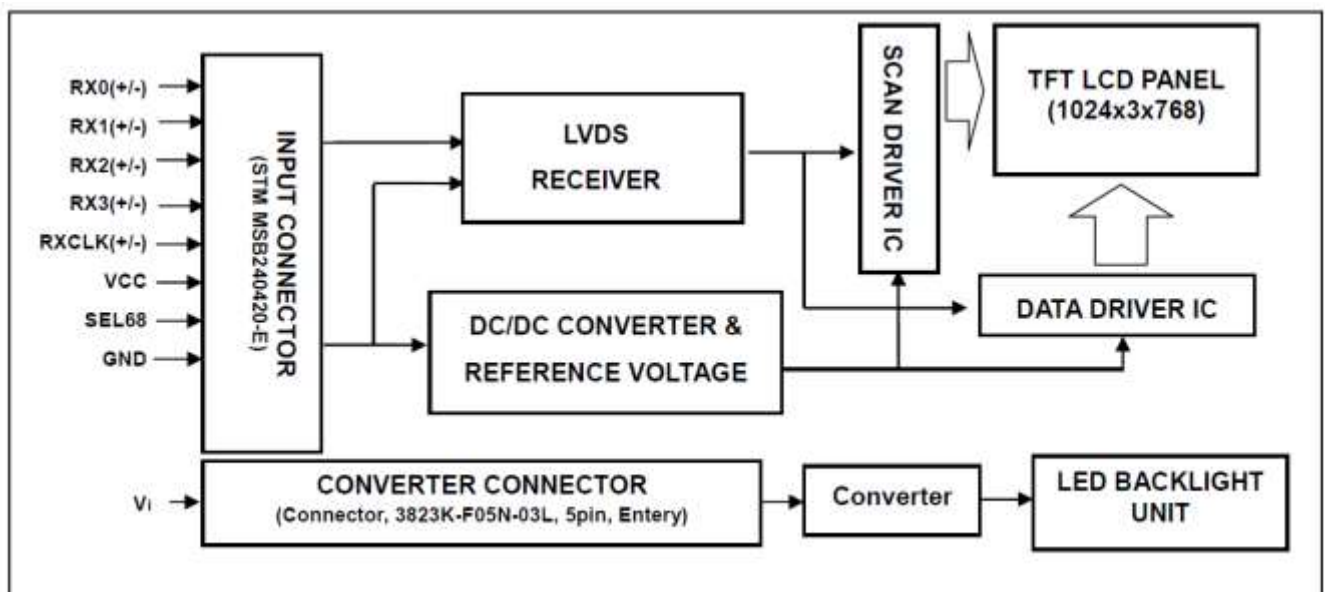
LED BLU CONN PIN ASSIGNMENT			
Pin	Name	Description	Color
1	LED+	Anode	Red
2	LED-	Cathode	Black



Recommended backlight power supply

PART NUMBER	MANUFACTURER
SmartLED: IN-50-012 – 700mA x 2 Channel, Analog Dimming IN-51-012 – 700mA x 2 Channel, PWM Dimming Cable CBL-390A	Apollo Display Technologies Corp.

4. Block Diagram TFT LCD Module



5. Input Terminal Pin Assignment

5.1 TFT LCD Module

Pin No.	Symbol	Function	Polarity	Note
1	VCC	Power Supply +3.3V(typical)		
2	VCC	Power Supply +3.3V(typical)		
3	GND	Ground		
4	LR/UD	Reverse Scan Control H or NC = Normal Mode. L = Horizontal/ Vertical Reverse Scan.		
5	RX0-	LVDS Differential Data Input	Negative	
6	RX0+	LVDS Differential Data Input	Positive	
7	GND	Ground		
8	RX1-	LVDS Differential Data Input	Negative	
9	RX1+	LVDS Differential Data Input	Positive	
10	GND	Ground		
11	RX2-	LVDS Differential Data Input	Negative	
12	RX2+	LVDS Differential Data Input	Positive	
13	GND	Ground		
14	RXCLK-	LVDS Differential Data Input	Negative	
15	RXCLK+	LVDS Differential Data Input	Positive	
16	GND	Ground		
17	RX3-	LVDS Differential Data Input	Negative	
18	RX3+	LVDS Differential Data Input	Positive	
19	GND	Ground		
20	SEL68	LVDS 6/8 bit select function control, High -7 6bit Input Mode Low or NC -7 8bit Input Mode		Note (3)

Note (1) Connector Part No.: STM MSB240420G, Entery 3804K-F20N-10L or equivalent.

Note (2) User's connector Part No.: STM P240420, Entery H204K-D20N-02B or equivalent.

Note (3) "Low" stands for 0V. "High" stands for 3.3V. "NC" stands for "No Connection".

5.2 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color versus data input.

Color		Data Signal																						
		Red								Green								Blue						
		R7	R6	R5	R4	R3	R2	R1	R0	R7	R6	G5	G4	G3	G2	G1	G0	R7	R6	B5	B4	B3	B2	B1
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale Of Red	Red(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red(1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	
	Red(252)	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red(252)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red(252)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Gray Scale Of Green	Green(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	
	Green(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	
	Green(252)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	
	Green(252)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	
	Green(252)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	
Gray Scale Of Blue	Blue(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	
	Blue(252)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	
	Blue(252)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	
	Blue(252)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	

Note (1) 0: Low Level Voltage, 1: High Level Voltage

6. Interface Timing

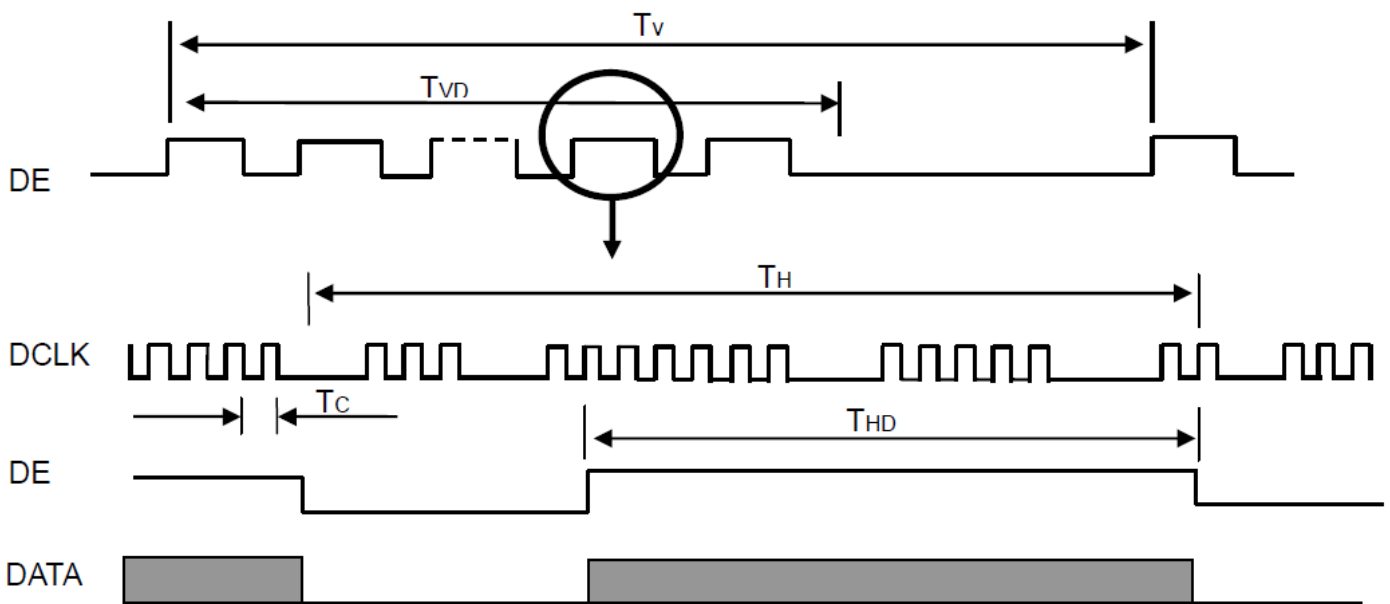
6.1 Input Signal Timing Specifications

The input signal timing specifications are shown as the following table and timing diagram.

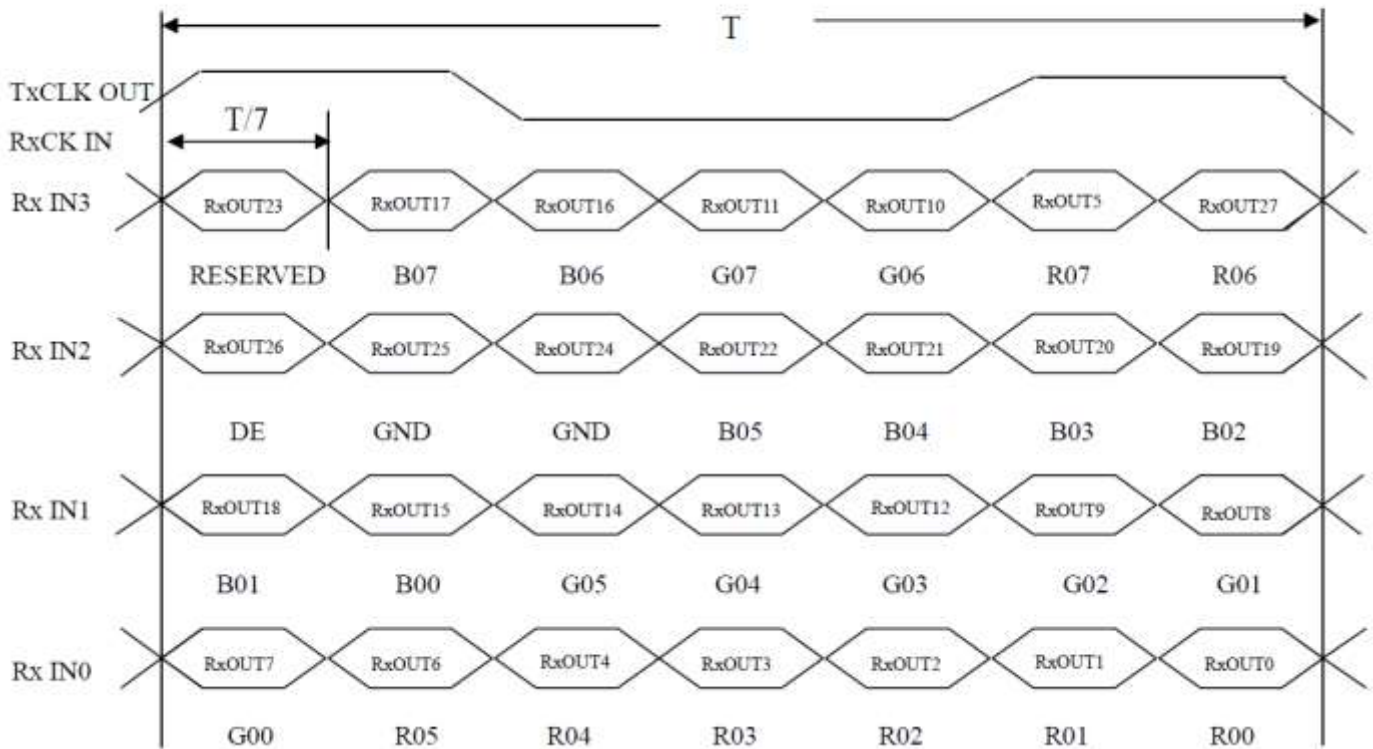
Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
DCLK	Pixel Clock	$1/T_C$	53.35	65	80	MHz	-
DE	Vertical Total Time	T_V	780	806	1200	T_H	-
	Vertical Address Time	T_{VD}	768	768	768	T_H	-
	Horizontal Total Time	T_H	1140	1344	1600	T_C	-
	Horizontal Address Time	T_{HD}	1024	1024	1024	T_C	-

Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

INPUT SIGNAL TIMING DIAGRAM

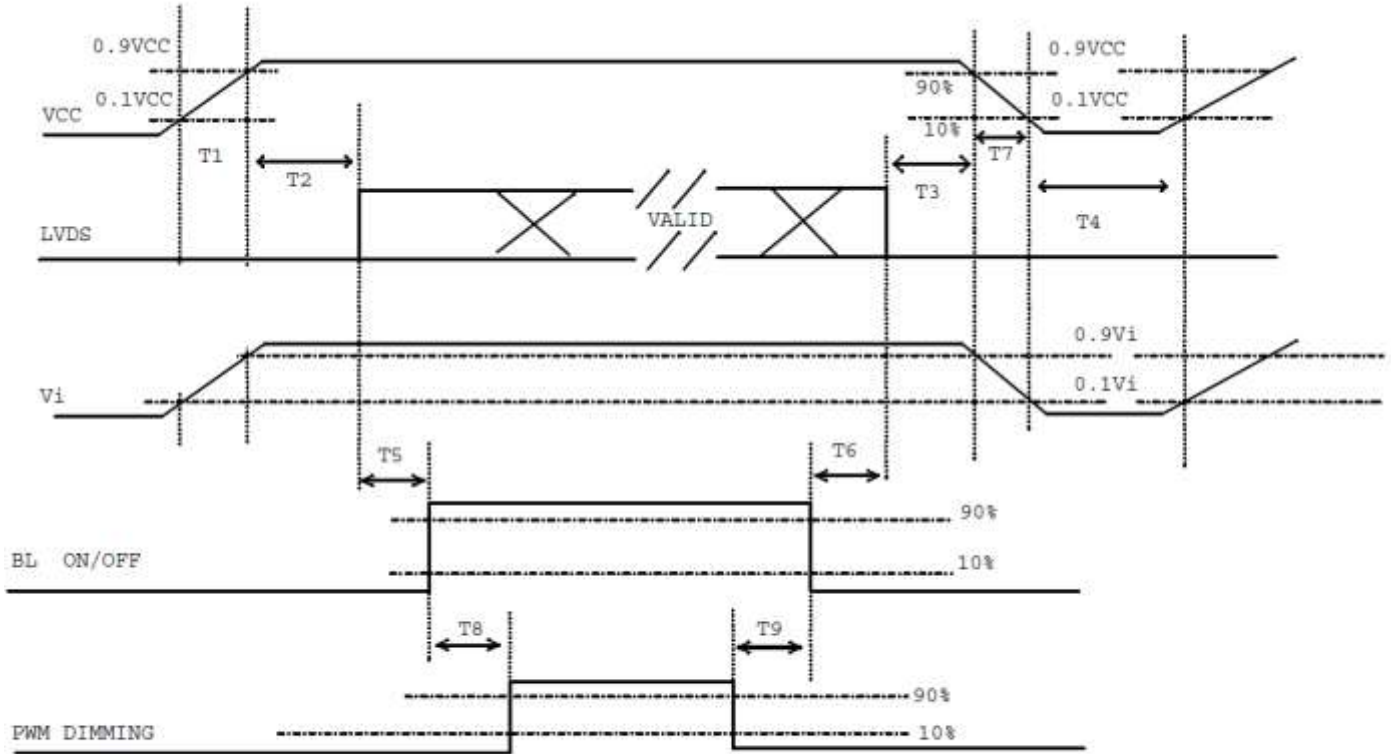


TIMING DIAGRAM of LVDS



6.2 Power ON/OFF Sequence

To prevent a latch-up or DC operation of LCD assembly, the power on/off sequence should be as the diagram below.



Power ON/OFF sequence

Note (1) Please avoid floating state of interface signal at invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD VCC to 0 V.

Note (3) The Backlight converter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight converter power must be turned off before the power supply for the logic and the interface signal is invalid.

Parameter	Value			Units
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	0	-	50	ms
T4	500	-	-	ms
T5	200	-	-	ms
T6	200	-	-	ms
T7	5	-	300	ms
T8	10	-	-	ms
T9	10	-	-	ms

6.3 Scanning Direction

The following figures show the image see from the front view. The arrow indicates the direction of scan.

Fig.1 Normal Scan



Fig.2 Reverse Scan



Fig. 1 Normal scan (pin 4, LR/UD = High or NC)

Fig. 2 Reverse scan (pin 4, LR/UD = Low)

7. Optical Characteristics

7.1 Test Conditions

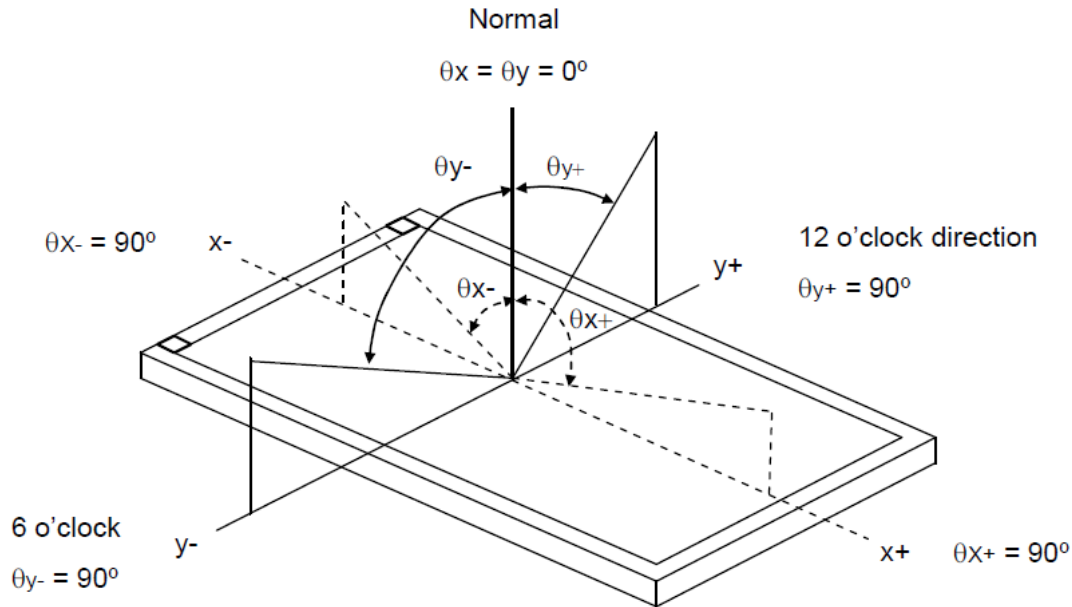
Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V _{CC}	3.3	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
Converter Voltage	V _i	12	V
Converter Duty		100%	

7.2 Optical Specifications

The relative measurement methods of optical characteristics are shown in 7.2. The following items should be measured under the test conditions described in 7.1 and stable environment shown in Note (5).

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note	
Color Chromaticity	Red	R _x	Typ - 0.05	0.604	Typ+ 0.05	-	(1), (5)	
		R _y		0.356				
	Green	G _x		0.338				
		G _y		0.590				
	Blue	B _x		0.148				
		B _y		0.098				
	White	W _x		0.313				
		W _y		0.329				
Center Luminance of White	L _c		800	1000		cd/m ²	(4), (5)	
Contrast Ratio	CR		450	700		-	(2), (5)	
Response Time	T _R	θ _x =0°, θ _y =0°	-	5	10	ms	(3)	
	T _F		-	11	16			
White Variation	δW	θ _x =0°, θ _y =0° USB2000	-	1.25	1.43	-	(5), (6)	
Viewing Angle	Horizontal	θ _{x+}	CR ≥ 10 USB2000	70	80	-	Deg.	(1), (5)
		θ _{x-}		70	80	-		
	Vertical	θ _{y+}		55	70	-		
		θ _{y-}		60	70	-		

Note (1) Definition of Viewing Angle (θ_x, θ_y):



Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{255} / L_0$$

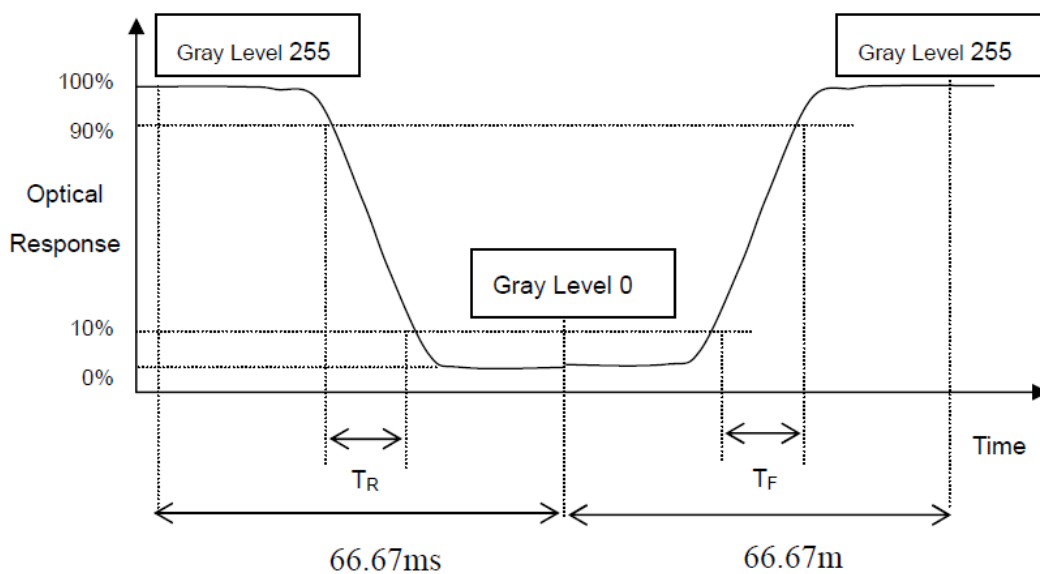
L255: Luminance of gray level 255

L0: Luminance of gray level 0

$$\text{CR} = \text{CR} (5)$$

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (6).

Note (3) Definition of Response Time (T_R, T_F):



Note (4) Definition of Luminance of White (L_C):

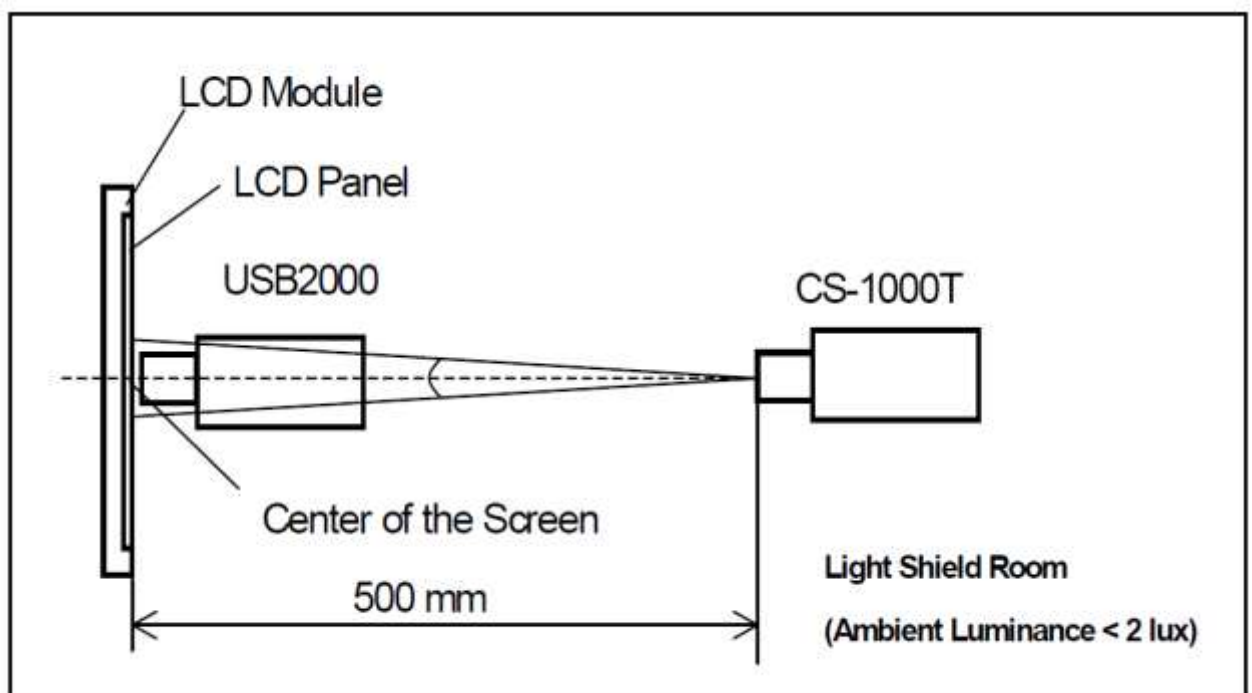
Measure the luminance of gray level 255 at center point

$$L_C = L(5)$$

$L(x)$ is corresponding to the luminance of the point X at Figure in Note (6).

Note (5) Measurement Setup:

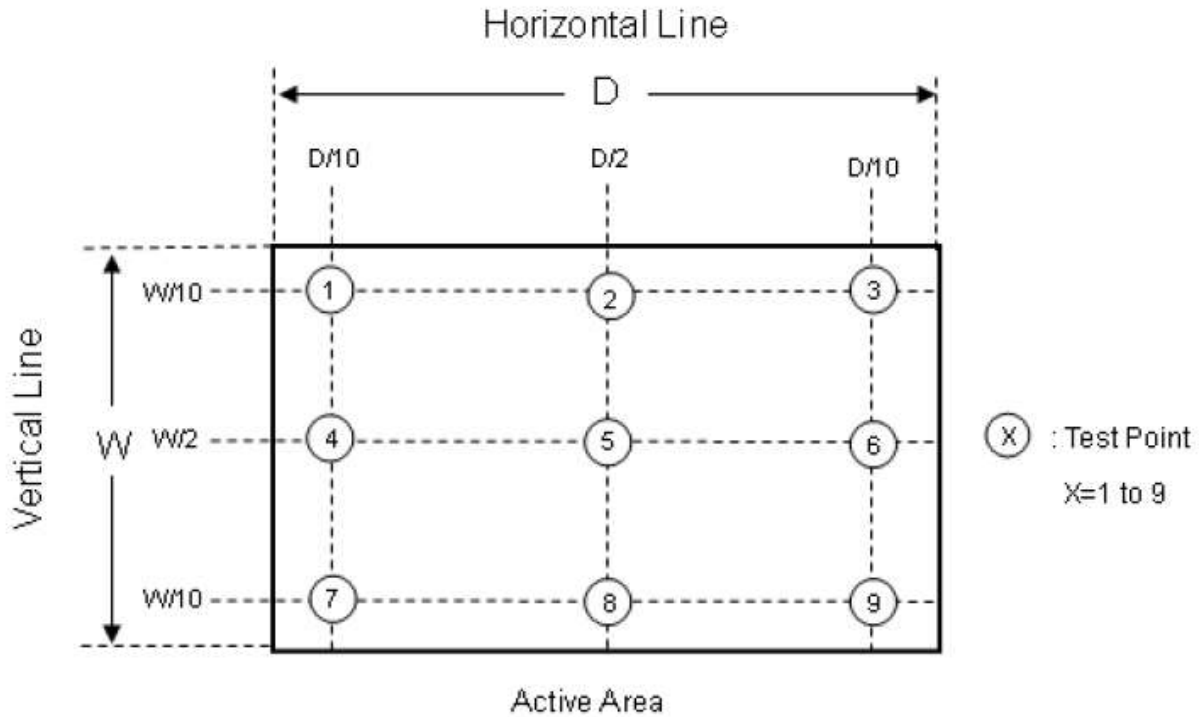
The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



Note (6) Definition of White Variation (δW):

Measure the luminance of gray level 63 (255) at 9 points

$$\delta W = \frac{\text{Maximum [L (1), L (2), L (3), L (4), L (5), L (6), L (7), L (8), L (9)]}}{\text{Minimum [L (1), L (2), L (3), L (4), L (5), L (6), L (7), L (8), L (9)]}}$$



8. Reliability Test Criteria

Test Item	Test Condition	Note
High Temperature Storage Test	85°C, 240 hours	(1), (2)
Low Temperature Storage Test	-40°C, 240 hours	
Thermal Shock Storage Test	-30°C, 0.5 hour \leftrightarrow 80°C, 0.5 hour; 100cycles, 1 hour/cycle	
High Temperature Operation Test	80°C, 240 hours	
Low Temperature Operation Test	-30°C, 240 hours	
High Temperature & High Humidity Operation Test	60°C, RH 90%, 240 hours	
ESD Test (Operation)	150pF, 330Ω, 1 sec/cycle Condition 1 : panel contact, ± 8 KV Condition 2 : panel non-contact ± 15 KV	(2)
Shock (Non-Operating)	50G, 11ms, half sine wave, 1 time for $\pm X, \pm Y, \pm Z$ direction	(2), (3)
Vibration (Non-Operating)	1.5G, 10 ~ 300 Hz sine wave, 10 min/cycle, 3 cycles each X, Y, Z direction	(2), (3)

Note (1) No condensation of water.

Note (2) No display malfunction.

Note (3) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.

Note (4) Temperature of panel display surface area should be 90°C Max.

9. Packaging

9.1 Packing Specifications

- (1) 15pcs LCD modules / 1 Box
- (2) Box dimensions: 511 (L) X 420 (W) X 360 (H) mm
- (3) Weight: approximately 12.02Kg (15 modules per box)

9.2 Packing Method

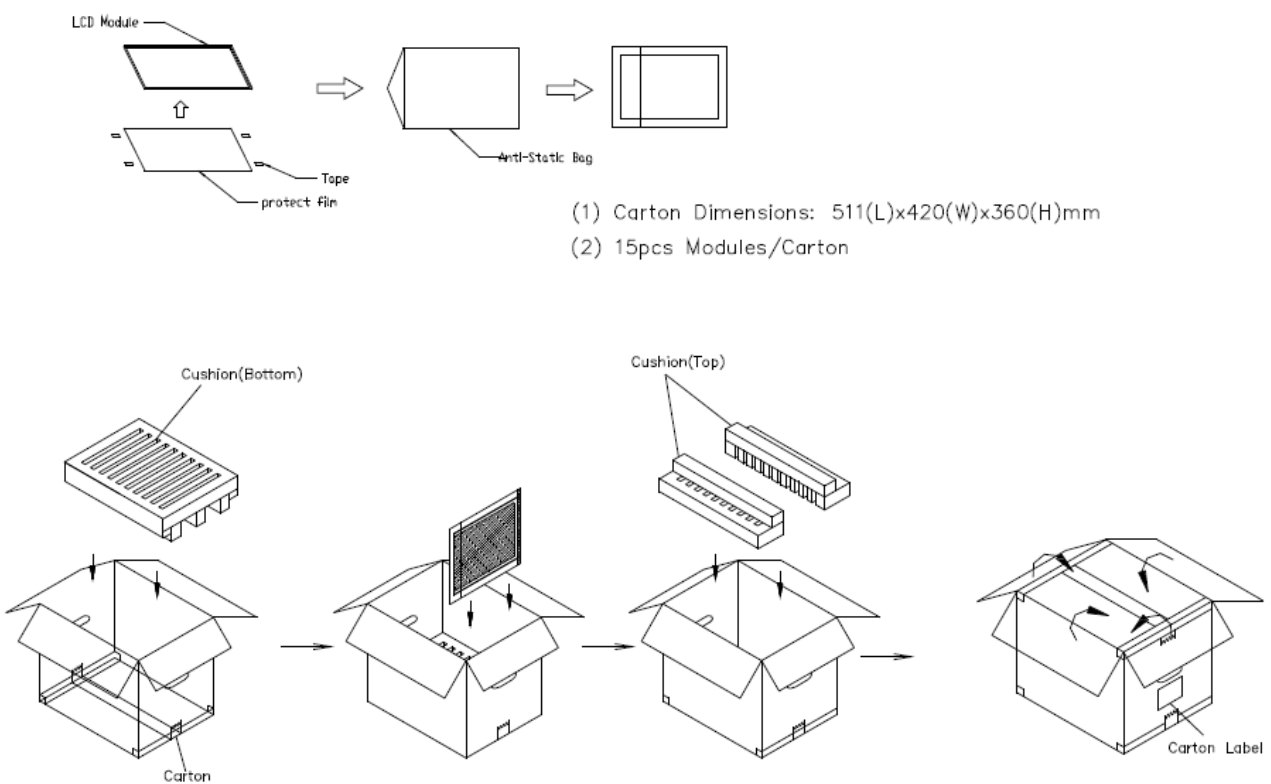


Figure. 9-1 Packing method

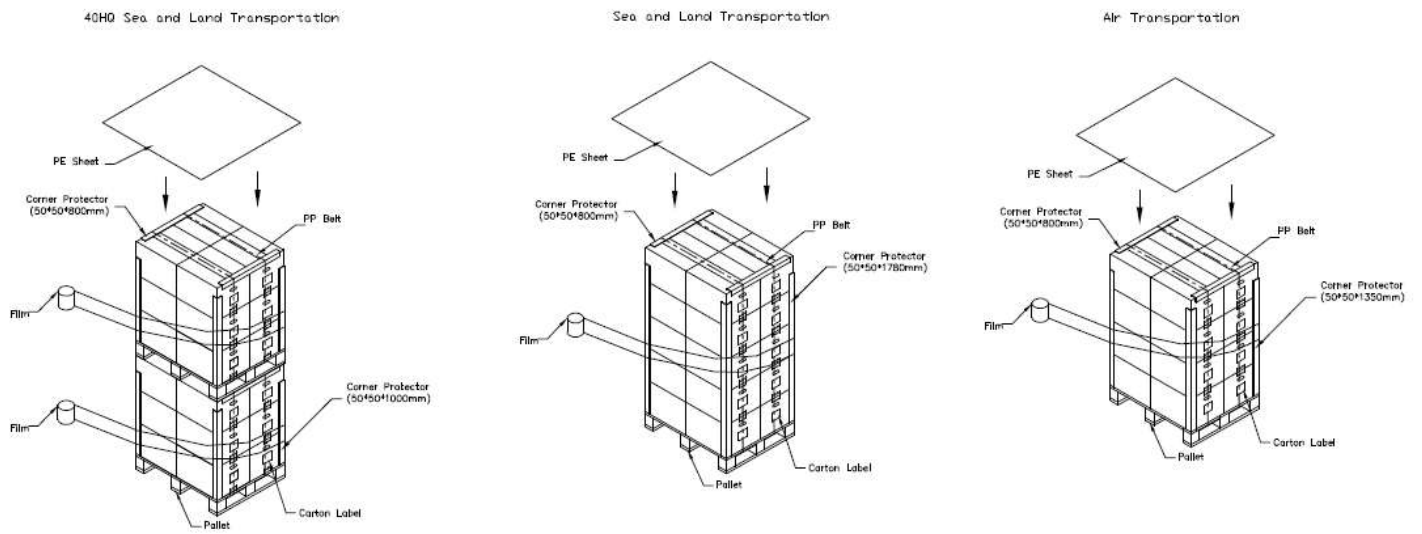


Figure. 9-2 Packing method

9.3 Unpacking Method

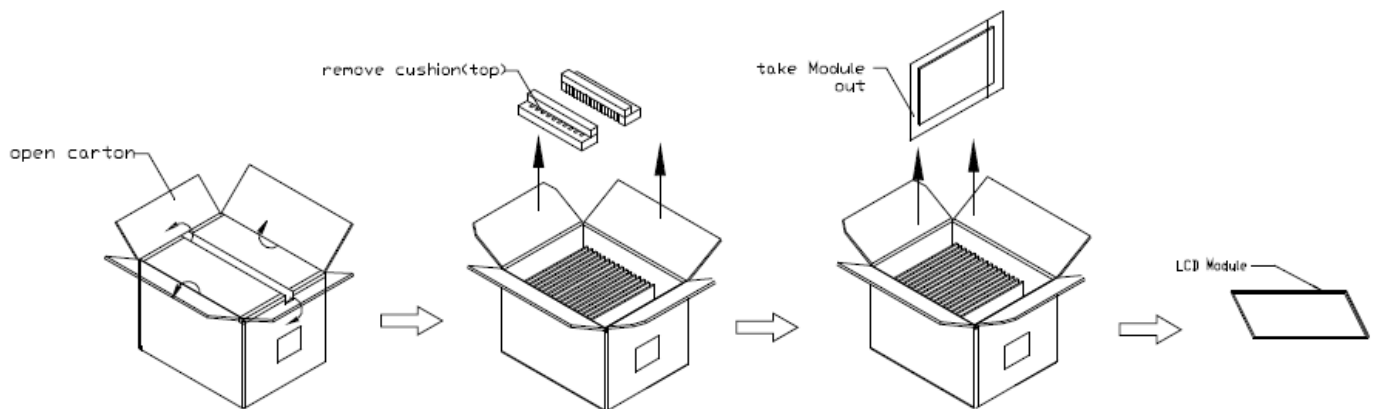
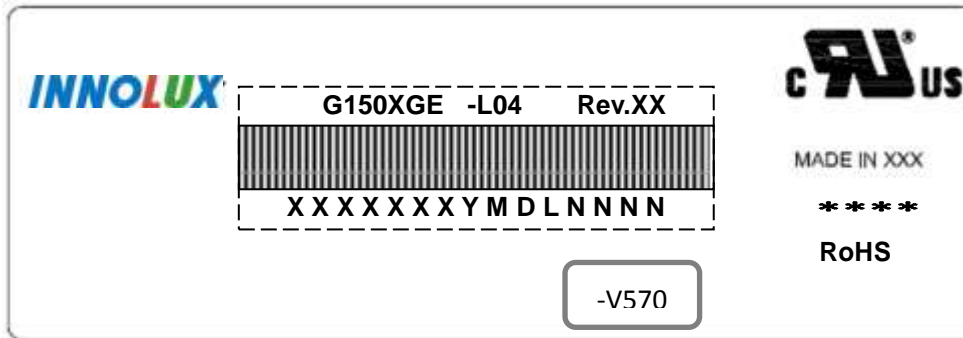


Figure. 9-3 UN-Packing method

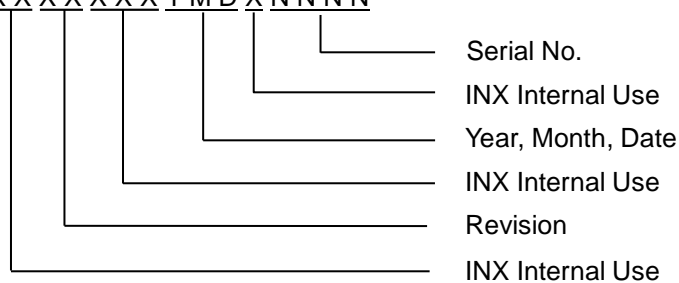
10. Definition of Labels

10.1 Module Label

The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.



- (a) Model Name: G150XGE -L04
- (b) Revision: Rev. XX, for example: A1, B1, C1, C2 ...etc.
- (c) * * * * : Factory ID
- (d) Serial ID: XXXXXXXYMDXNNNN



Serial ID includes the information as below:

- (a) Manufactured Date: Year: 1~9, for 2011~2019
 Month: 1~9, A~C, for Jan. ~ Dec.
 Day: 1~9, A~Y, for 1st to 31st, exclude I , O and U
- (b) Revision Code: cover all the change
- (c) Serial No.: Manufacturing sequence of product

11. Precautions

11.1 Assembly and Handling Precautions

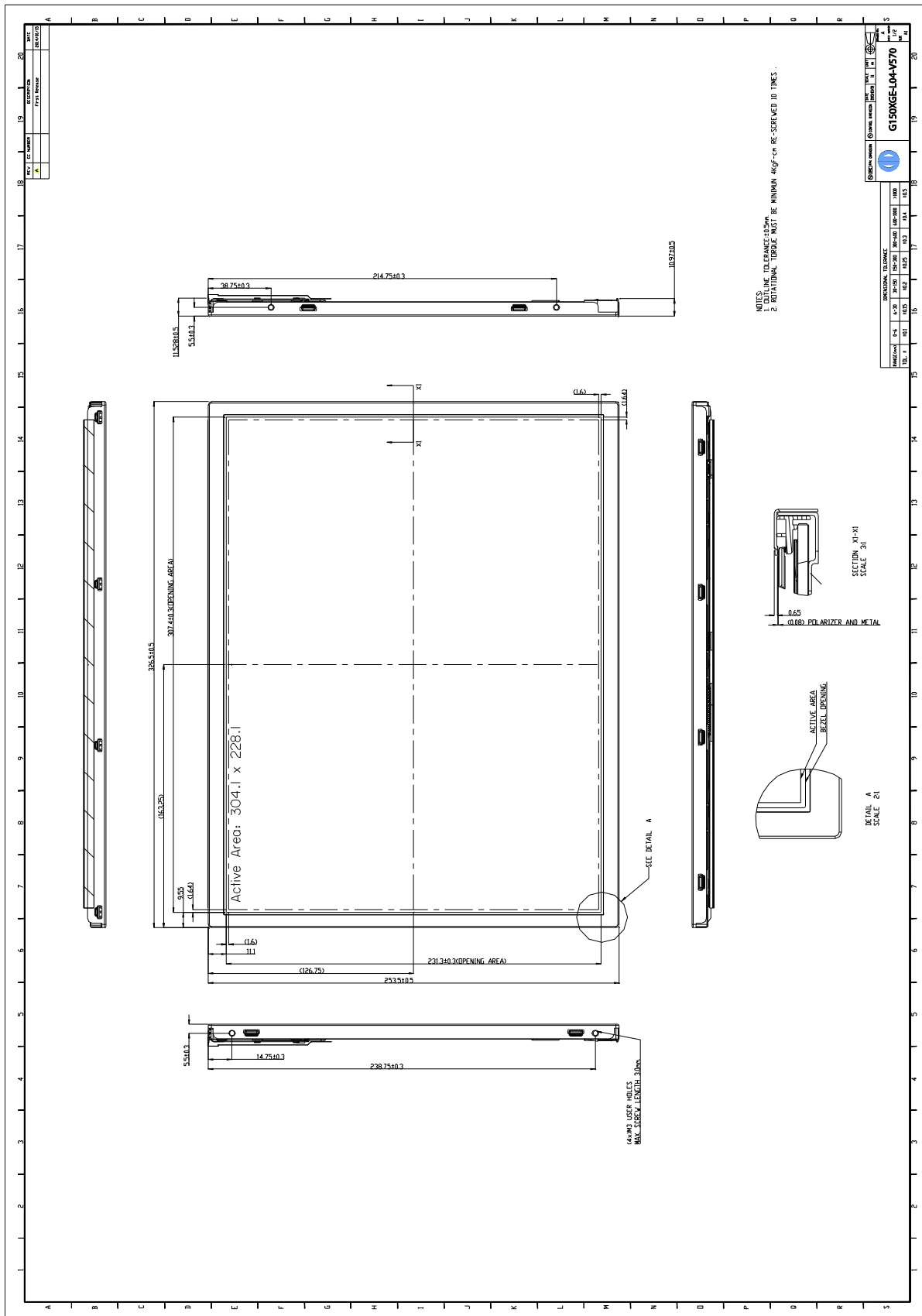
- (1) Do not apply rough force such as bending or twisting to the module during assembly.
- (2) To assemble or install module into user's system can be only in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- (3) It's not permitted to have pressure or impulse on the module because the LCD panel and Backlight will be damaged.
- (4) Always follow the correct power sequence when LCD module is connecting and operating. This can prevent damage to the CMOS LSI chips during latch-up.
- (5) Do not pull the I/F connector in or out while the module is operating. (6) Do not disassemble the module.
- (7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
- (8) It is dangerous that moisture come into or contacted the LCD module, because moisture may damage LCD module when it is operating.
- (9) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.
- (10) When ambient temperature is lower than 10°C may reduce the display quality. For example, the response time will become slowly.
- (11) Do not keep same pattern in a long period of time. It may cause image sticking on LCD.

11.2 SAFETY PRECAUTIONS

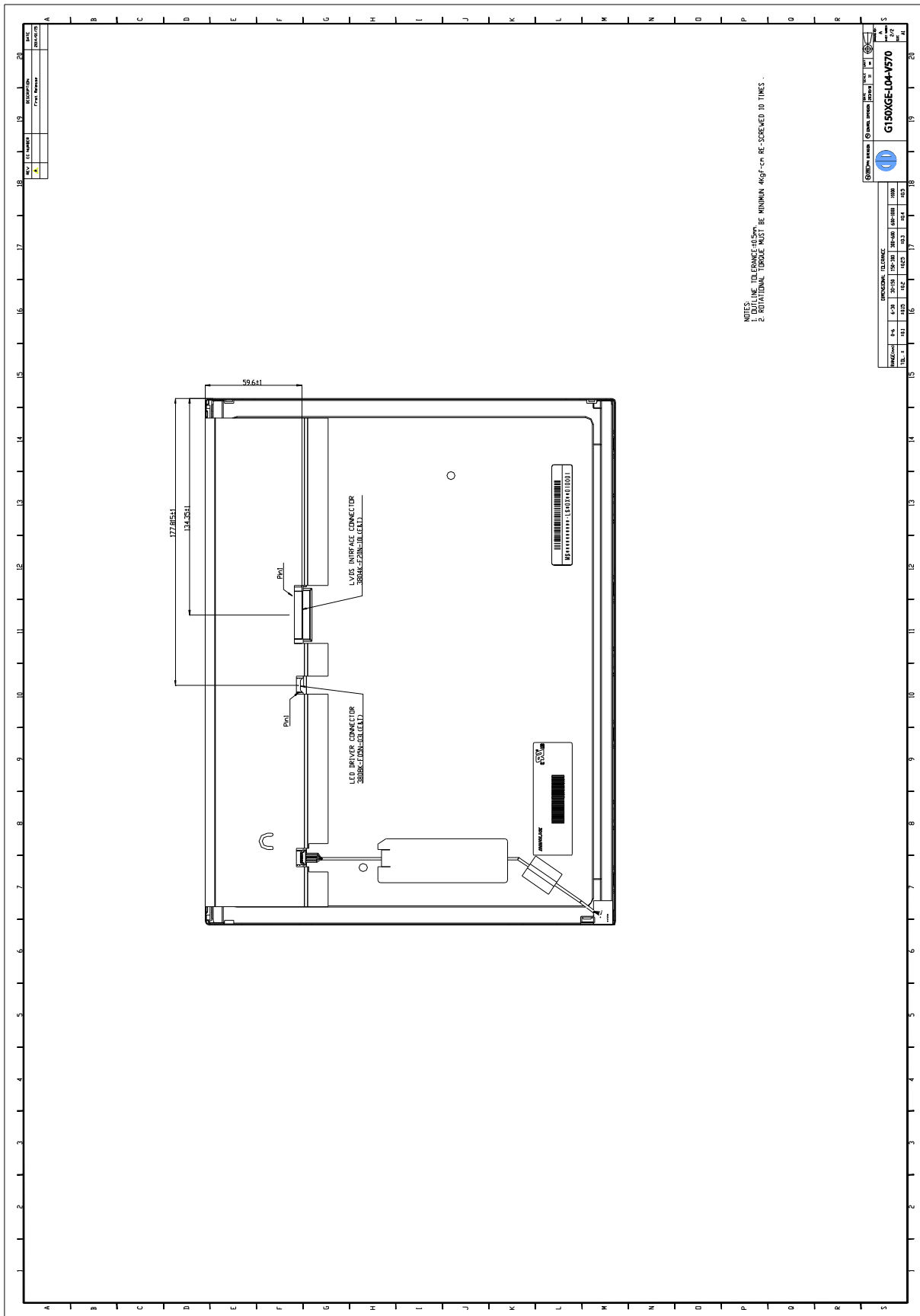
- (1) Do not disassemble the module or insert anything into the Backlight unit.
- (2) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
- (3) After the module's end of life, it is not harmful in case of normal operation and storage.

12. Mechanical Characteristics

12.1 LCM Outline Dimensions (Front View)



12.2 LCM Outline Dimensions (Rear View)



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