



LITEMAX

ULF/ULH2153-K
21.5" LED B/L LCD

User Manual

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Record of Revision

Version and Date	Page	Old Description	New Description	Remark
Dec/12/2025	all		Initial release	

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1 General Description

The ULF/ULH2153-K is a 21.5 inch industrial grade LCD, with brightness 500 nits, it produces sharp images, crisp text and lifelike colors. The Ubipixel LED backlight technology ensures high reliability and low power consumption, suitable for indoor application, kiosk, factory automation, military, transportation and gaming application.

1.1 Key Features

- Brightness 500nits
- Resolutions: 1920 x 1080
- LED Backlight
- Aspect ratio of 16:9
- Low power consumption
- BL MTBF: 30,000 hours

1.2 General Specifications

Model Name	ULF/ULH2153-K
Description	21.5" TFT LCD, 500 nits LED Backlight, 1920 x 1080
Screen Size	21.5"
Display Area (mm)	476.64(H) x 268.11(V)
Brightness	500 cd/m ²
Resolution	1920x1080
Aspect Ratio	16:9
Contrast Ratio	4200:1
Pixel Pitch (mm)	0.24825(H) x 0.24825(V)
Pixel Per Inch (PPI)	102
Viewing Angle	178°(H),178°(V)
Color Saturation (NTSC)	83%
Display Colors	16.7M
Response Time (Typical)	7ms
Panel Interface	LVDS
Input Interface	HDMI, DP
Input Power	DC12V
Power Consumption	14W (17W with AD Control Board)
OSD Key	4 Keys (Power Switch, Menu, +, -)
OSD Control	Brightness, Color, Contrast, Auto Tuning, H/V Position...etc
Dimensions (mm)	495.6(W) x 292.2(H) x 10.57(D)
Bezel Size(U/B/L/R)	12.05/12.05/9.48/9.48 mm
Weight (Net)	2.9 kg
Operating Temperature	0 °C ~ 50 °C
Storage Temperature	-20 °C ~ 60 °C

ULF= Panel + LED Driving Board

ULH= Panel + LED Driving Board + AD Control Board

1.3 Absolute Maximum Ratings

Absolute Electrical Ratings

The followings are maximum values which, if exceeded, may cause damage to the unit.

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	V _{CC}	-0.3	6	V	(1)
Input Signal Voltage	V _{in}	-0.3	3.6	V	(1)

Note:

- (1) Within Ta=25±2°C

Absolute Ratings of Environment

Temperature and relative humidity range are shown as below.

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	TST	-20	60	°C	(1)
Operating Temperature	TOP	0	50	°C	(1), (2)
Panel Surface Temperature of Display Area	PST		65	°C	(3)

Note:

- (1)
 - a. 90 % RH Max. (Ta ≤ 40°C).
 - b. Web-bulb temperature should be 39°C Max. (Ta > 40°C)
 - c. No condensation
 - d. Operating condition with a assemble module
- (2) Any point on the Driver surface must be less than 120°C under any condition. If the surface temperature is out of the spec, thermal solutions should be applied to avoid be damaged.
- (3) Surface temperature of display area is measured at 50°C dry condition.

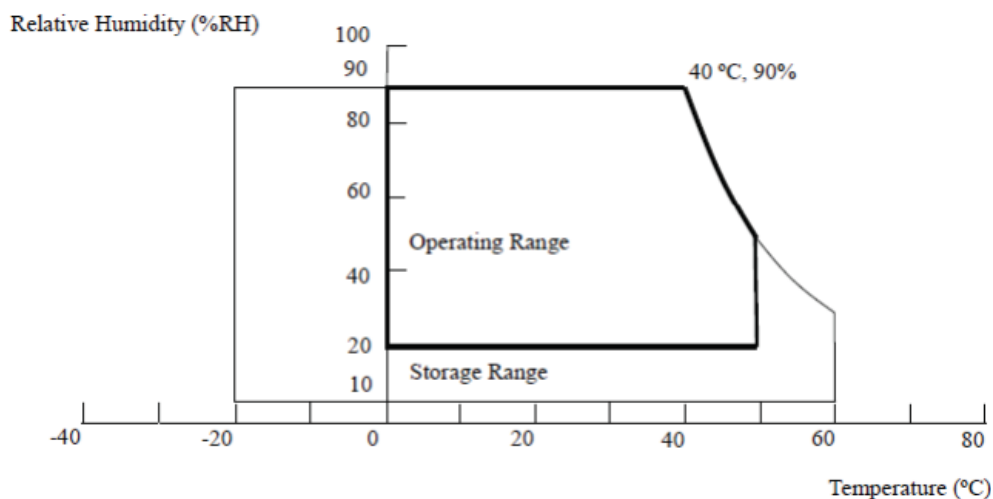


Fig. Operating and storage environment

2 Electrical Specifications

2.1 Electrical Characteristics

Power Consumption

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V_{CC}	4.5	5	5.5	V	(2)
Rush Current		I_{RUSH}	-	-	4	A	(3)
Power Supply Current	White Pattern	I_{CC}	-	0.72	0.94	A	(4)
	Horizontal Stripe	I_{CC}	-	0.92	1.20	A	
	Black Pattern	I_{CC}	-	0.72	0.94	A	
Power Consumption		PLCD		3.6	4.68	Watt	White Pattern

Note:

- (1) Ambient temperature: $25 \pm 2^{\circ}\text{C}$
- (2) The ripple voltage should be controlled less than 10% of V_{CC} .
- (3) Measurement condition: V_{CC} rising time = $470\mu\text{s}$.

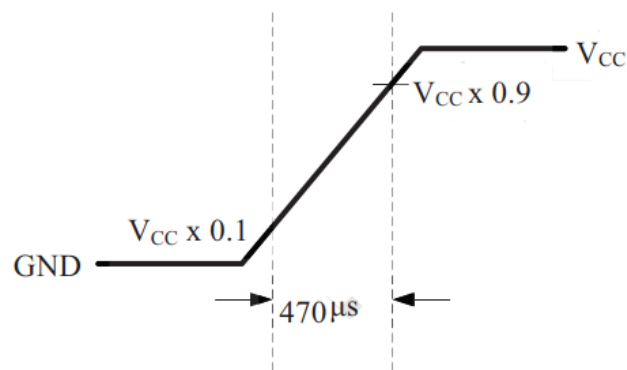
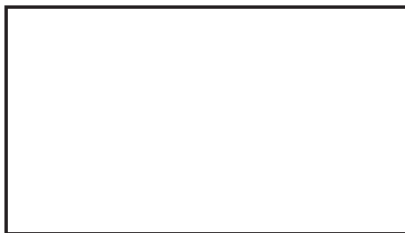


Fig. VCC rising time condition

- (4) Measurement condition: $V_{CC} = 5.0$, $T_a = 25 \pm 2^{\circ}\text{C}$, $F = 60\text{ Hz}$. The test patterns are shown as below.

A. White Pattern



C. Black Pattern



B. Horizontal Pattern

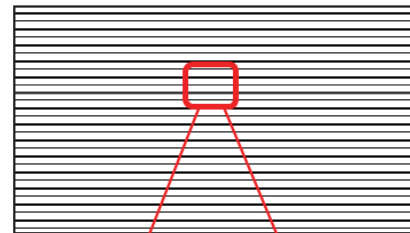


Fig. Test patterns

Backlight Unit

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
LED Light Bar Power Supply Voltage	VL	43.2	48	51.2	V	(1)(2)(3)
LED Light Bar Power Supply Current	IL	-	240	-	mA	(Duty100%)
Power consume	W	10.37	11.52	12.29	W	

Note (1) LED current is measured by utilizing a high frequency current meter

Note (2) For better LED light bar driving quality, it is recommended to utilize the adaptive boost converter with current balancing function to drive LED light-bar.

Note (3) Recommended B/L: 16S4P

LVDS Characteristics

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
LVDS Interface	Differential Input High Threshold Voltage	V_{TH}	+100	-	-	mV	(1)
	Differential Input Low Threshold Voltage	V_{TL}	-	-	-100	mV	
	Common Input Voltage	V_{CM}	1.0	1.2	1.4	V	
	Differential input voltage	$ V_{ID} $	200	-	600	mV	
	Terminating Resistor	R_T	80	100	120	ohm	
CMOS Interface	Input High Threshold Voltage	V_{IH}	2.7	-	3.3	V	
	Input Low Threshold Voltage	V_{IL}	0	-	0.6	V	

Note:

(1) The LVDS input signal has been defined as follows:

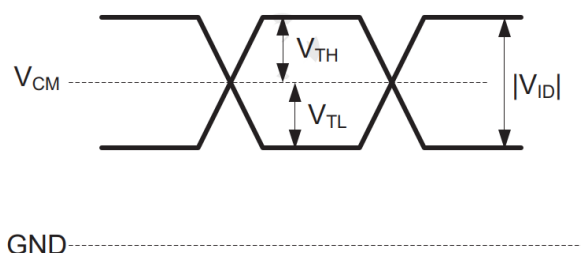


Fig. LVDS Input signal

LVDS Format

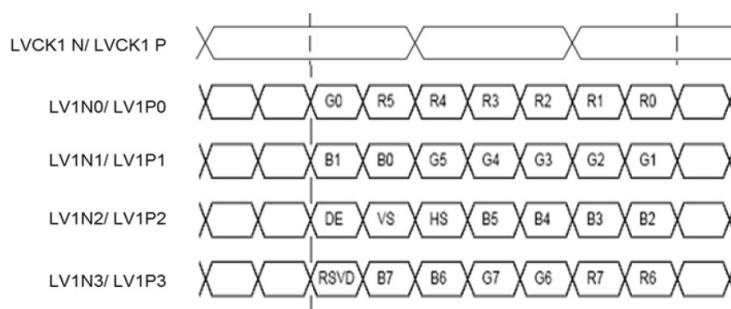


Fig. VESA format

2.2 Interface Connection

Interface Pin Assignment

CN1: 3-10122314-0 (XDYT) or equivalent 1mm pitch 30 pins [Note (1)].

Pin No.	Symbol	Description	Note
1	ORX0N	LVDS Data1(0) -	
2	ORX0P	LVDS Data1(0) +	
3	ORX1N	LVDS Data1(1) -	
4	ORX1P	LVDS Data1(1) +	
5	ORX2N	LVDS Data2(2) -	
6	ORX2P	LVDS Data2(2) +	
7	GND	Power Ground	
8	ORXCN	LVDS clock1 -	
9	ORXCP	LVDS clock1 +	
10	ORX3N	LVDS Data1(3) -	
11	ORX3P	LVDS Data1(3) +	
12	ERX0N	LVDS Data2(0) -	
13	ERX0P	LVDS Data2(0) +	
14	GND	Power Ground	
15	ERX1N	LVDS Data2(1) -	
16	ERX1P	LVDS Data2(1) +	
17	GND	Power Ground	
18	ERX2N	LVDS Data2(2) -	
19	ERX2P	LVDS Data2(2) +	
20	ERXCN	LVDS clock2 -	
21	ERXCP	LVDS clock2 +	
22	ERX3N	LVDS Data2(3) -	
23	ERX3P	LVDS Data2(3) +	
24	NC	No Connection	(2)
25	NC	No Connection	(2)
26	NC	No Connection	(2)
27	NC	No Connection	(2)
28	VIN5	Power supply +5.0V	
29	VIN5	Power supply +5.0V	
30	VIN5	Power supply +5.0V	

Note:

(1) Following finger shows the LVDS pin1 diagram.

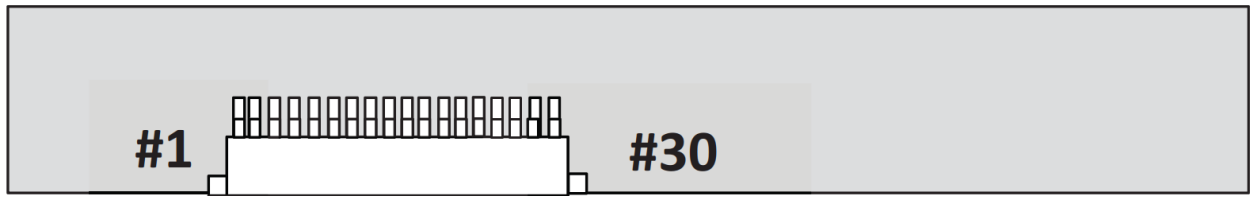


Fig. LVDS connector direction sketch map

(2) For LITEMAX used only, please leave it open.

2.3 Timing Spec

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

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	F_{clk}	50	74.25	96	MHz	(1)
	Input cycle to cycle jitter	$Trcl$	—	—	200	ps	(2)
	Spread spectrum modulation range	F_{clk_mod}	$F_{clk}-2\%$	—	$F_{clk}+2\%$	MHz	(3)
	Spread spectrum modulation frequency	FSSM	—	—	200	KHz	
LVDS Receiver Data	Receiver Skew Margin	TRSM	-400	-	400	ps	(4)
Vertical Term	Frame Rate	F	48	60	75	Hz	
	Total	T_V	1096	1125	1836	T_H	$T_V = T_{VD} + T_{VB}$
	Active Display	T_{VD}		1080		T_H	
	Blank	T_{VB}	16	45	756	T_H	
Horizontal Term	Total	T_H	1050	1100	1678	T_{CLK}	$T_H = T_{HD} + T_{HB}$
	Active Display	T_{HD}	960			T_{CLK}	
	Blank	T_{HB}	90	140	718	T_{CLK}	

Attention:

The module is operated in DE only mode, H sync and V sync input signal have no effect on normal operation.

Note:

- (1) Please make sure the range of pixel clock follows the following equations:

$$F_{clk(max)} = F_{max} \times T_V \times T_H$$

$$F_{min} \times T_V \times T_H \geq F_{clk(min)}$$

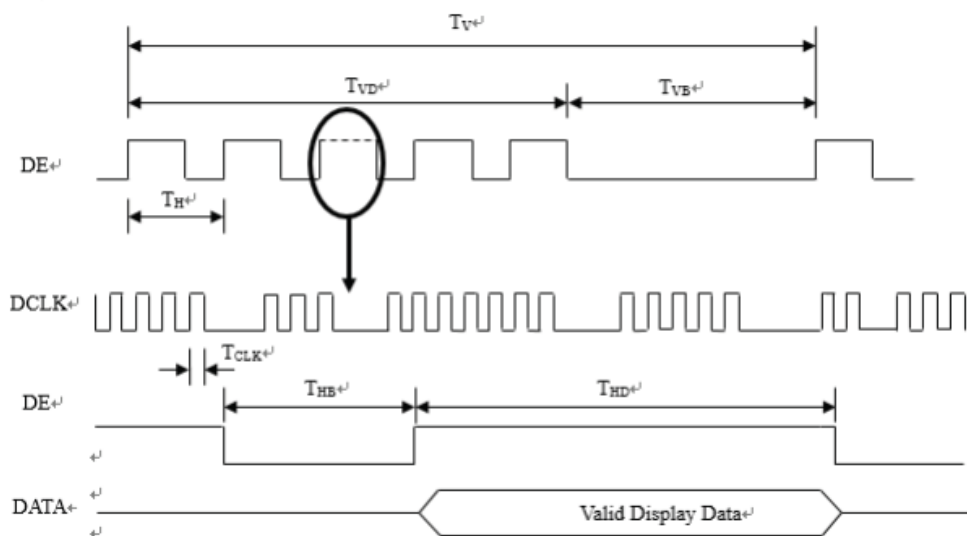


Fig. Signal timing diagram

- (2) The input clock cycle-to-cycle is defined as below figures.

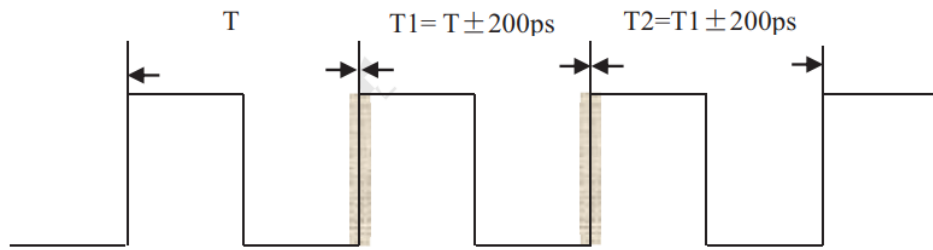


Fig. Jitter

- (3) The SSCG (Spread Spectrum Clock Generator) is defined as the following figure. The LVDS SSM's suggestion is off by default, SOC board must test all validation if SOC board open the LVDS SSM.

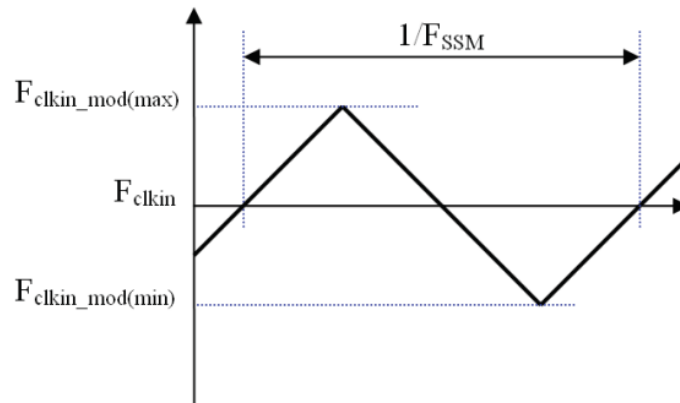


Fig. SSCG

- (4) The LVDS timing diagram and setup/hold time is defined and showed as the following figure.

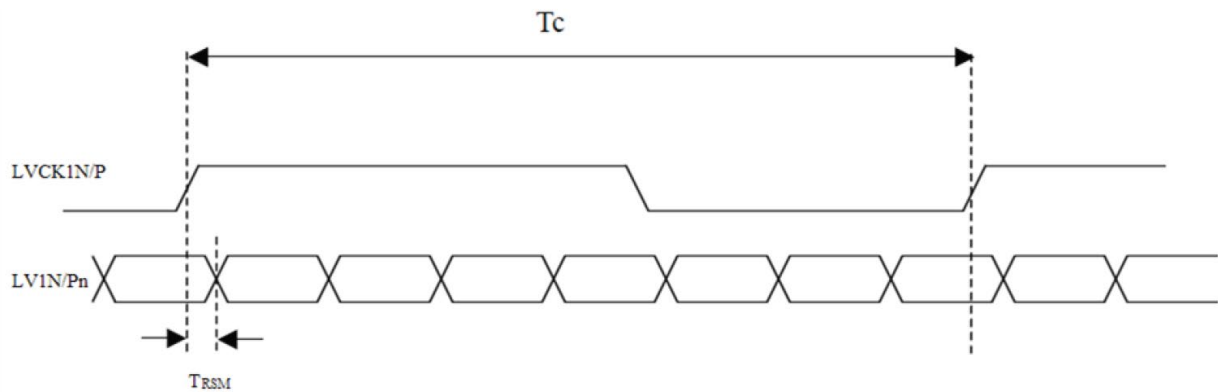


Fig. LVDS receive interface timing diagram

2.4 Power On/Off Sequence

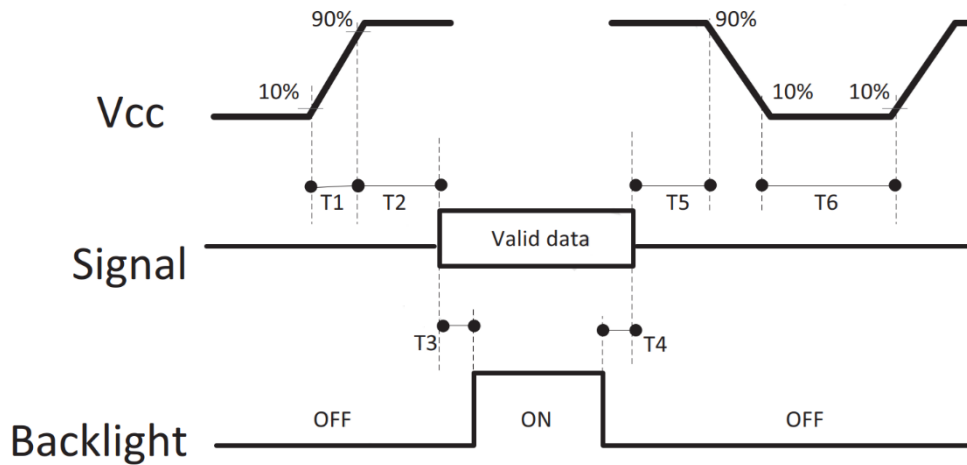


Fig. Power on/off signal sequence

Parameter	Values			Unit
	Min.	Typ.	Max.	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	500	-	-	ms
T4	100	-	-	ms
T5	0	-	50	ms
T6	1000	-	-	ms

Attention:

- (1) The supply voltage of the external system for the module input should be the same as the definition.
- (2) To avoid some abnormal display noise, we suggest "VCC" falling time to follow "T6" definition.
- (3) The product should be always operated within above ranges.
- (4) In case of VCC is off level, please keep the level of input signals on the low or keep high impedance.

2.5 Flicker Adjustment

Flicker must be optimized after module assembly and aging. Its patterns are as follow:
sub pixel checker under 50% gray level.

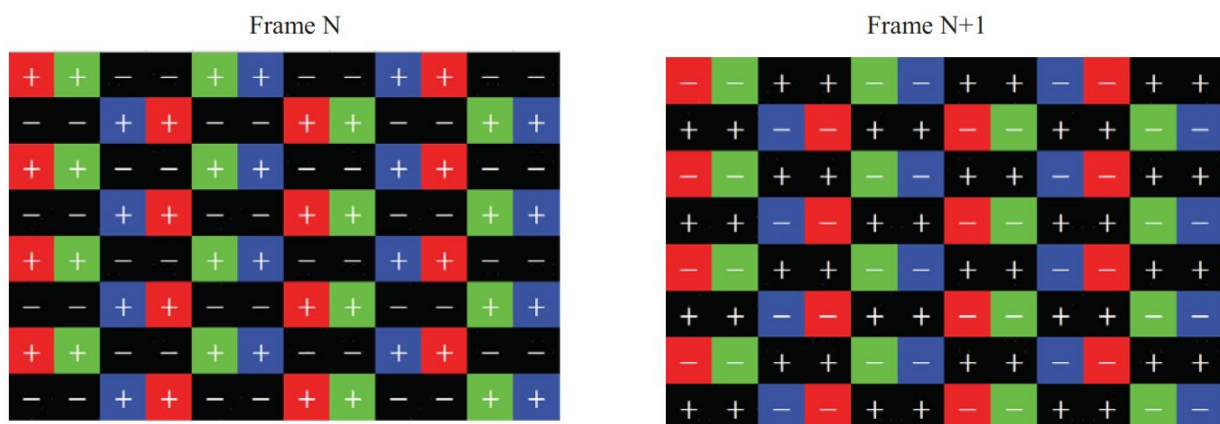


Fig. Flicker pattern

2.6 Driver IC ESD Spec

If the LCD module is designed with the Plastic Bezel, we suggest ESD protection solutions should be applied to avoid IC damaged, as shown in Figure down below.

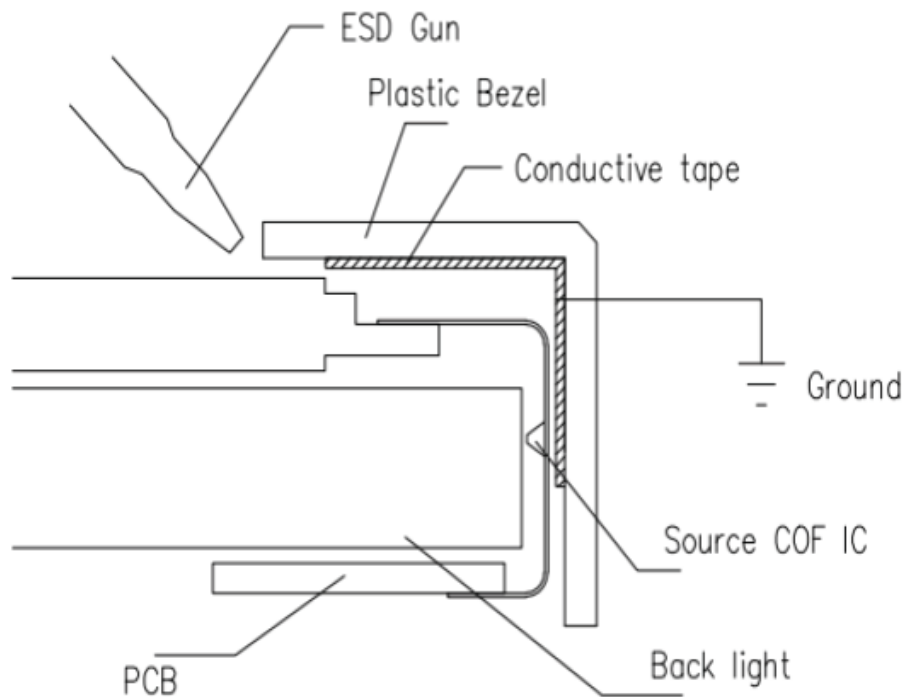


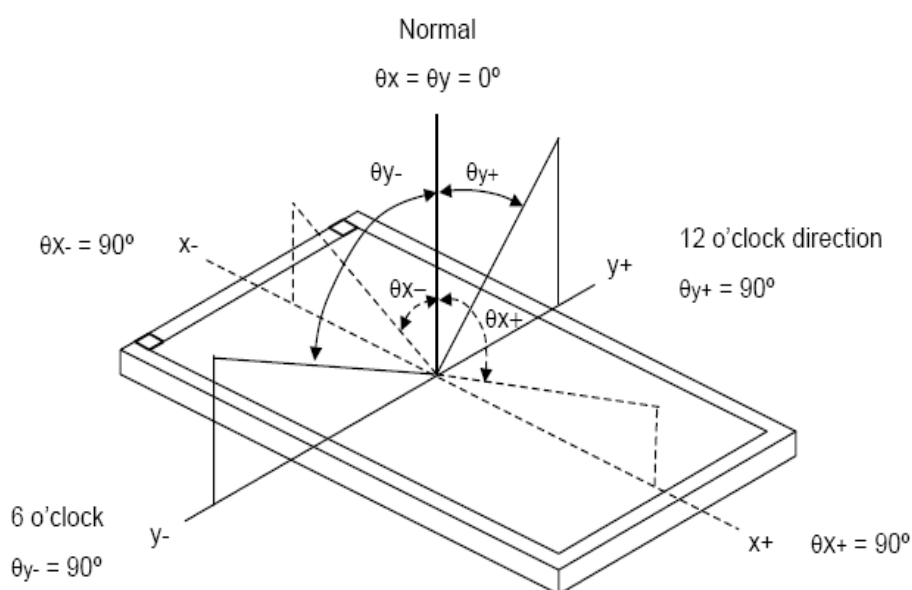
Fig. Source COF IC ESD protection

3 Optical Specification

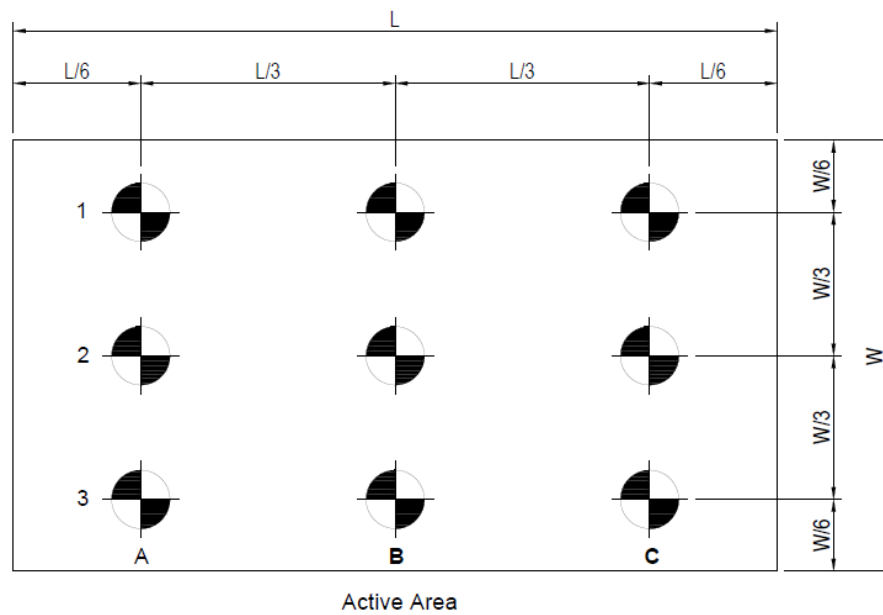
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Color chromaticity	Red	Rx	$\theta_x=0$ $\theta_y=0$ CA-410	0.610	0.640	0.670	-	Test Mode: (2) (3)
		Ry		0.305	0.335	0.365	-	
	Green	Gx		0.272	0.302	0.332	-	
		Gy		0.584	0.614	0.644	-	
	Blue	Bx		0.120	0.150	0.180	-	
		By		0.022	0.052	0.082	-	
	White	Wx		0.250	0.280	0.310	-	
		Wy		0.275	0.305	0.335	-	
Center Luminance of White		Lc	$\theta_x=0$	450	500	650	cd/m ²	
Uniform		Lu	$\theta_y=0$ CA-410		89		%	
Contrast Ratio		CR	$\theta_x=0$	3780:1	4200:1		-	Test Mode: (4)
Color Saturation		NTSC	$\theta_y=0$ Klein K-10		83		%	
Viewing Angle	Horizontal	θ_{x+}	$CR \geq 10$		89		Deg	Test Mode: (1)
		θ_{x-}			89			
	Vertical	θ_{y+}			89			
		θ_{y-}			89			

Test Mode :

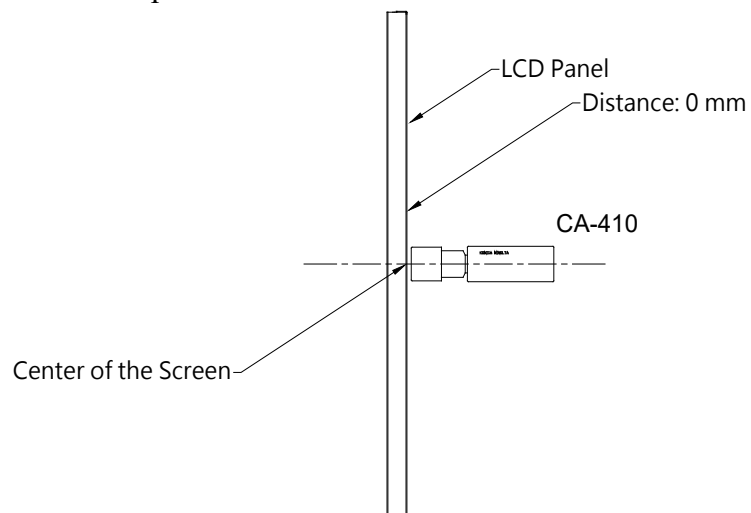
(1) Definition of Viewing Angle (θ_x , θ_y):



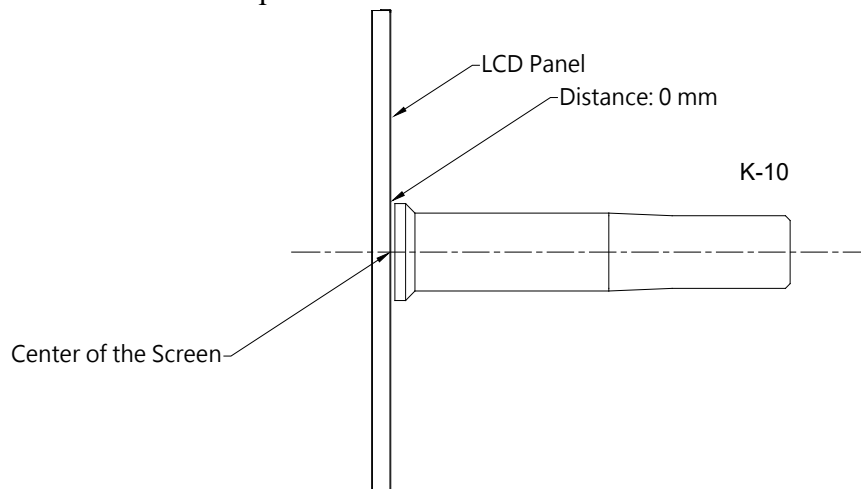
(2) Definition of Test Point:



(3) CA-410 Measurement Setup:



(4) Klein K-10 Measurement Setup:



4 LED Driving Board Electrical Characteristics

4.1 LED Driving Board Operating Characteristics

Item	Symbol	Conditions	MIN.	TYP.	MAX.	Unit	Remark
Input Voltage	V _{in}		10.0	12.0	14.0	V	
Input Current (Low Brightness)	I _{inL}	V _{IN} =12V, V _{adj} =5V	0	-----	-----	mA	
Input Current (High Brightness)	I _{inH}	V _{IN} =12V, V _{adj} =0V	1.08	0.98	0.88	A	
LED Current (Low Brightness)	I _{outL}	V _{IN} =12V, V _{adj} =5V	0.0	-----	-----	A _{rms}	
LED Current (High Brightness)	I _{outH}	V _{IN} =12V, V _{adj} =0V	-----	0.25	-----	A	
Working Frequency	F _{req}	V _{IN} =12V, V _{adj} =0V	-----	324	-----	KHz	
PWM Frequency	F _{req}	V _{IN} =12V	200	210	220	HZ	
Brightness Control	V _{adj}	Connection of PWM	0	-----	100	%	Duty
ON/OFF Control	V _{on/off}	Normal Operation	2	-----	5	V	
Output Voltage	V _{out}	V _{IN} =12V, V _{adj} =0V	-----	45.6	-----	V	
Efficiency	η	V _{IN} =12V, V _{adj} =0V	-----	96.9	-----	%	

4.2 LED Driving Board Connector Pin Assignment

1. Input Connector: J1(JST S 8B-PH-SM3-TB or Compatible)

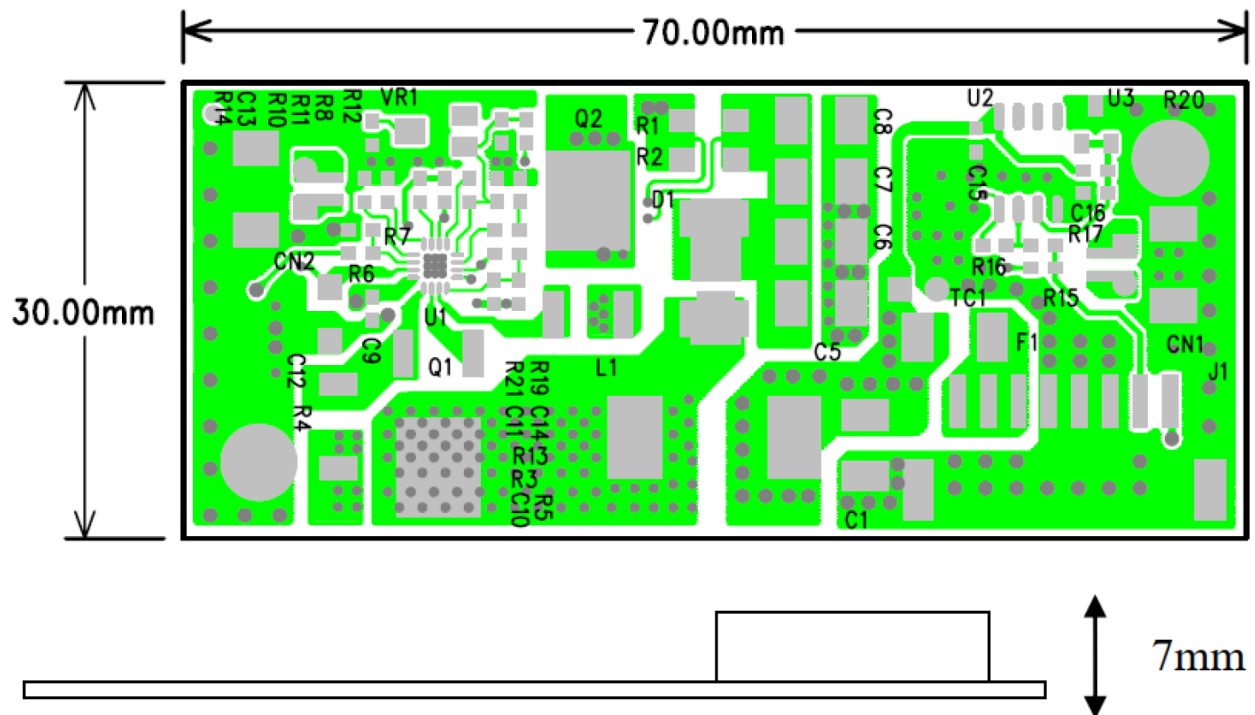
PIN No	Symbol	Description
1	V _{in}	DC+12V
2	V _{in}	DC+12V
3	V _{in}	DC+12V
4	GND	Ground
5	GND	Ground
6	GND	Ground
7	Brightness	PWM Control
8	Control	ON/OFF Control 0.8V(OFF) 2~5V(ON)

2. Output Connector: CN1(JST S2B-EH or Compatible)

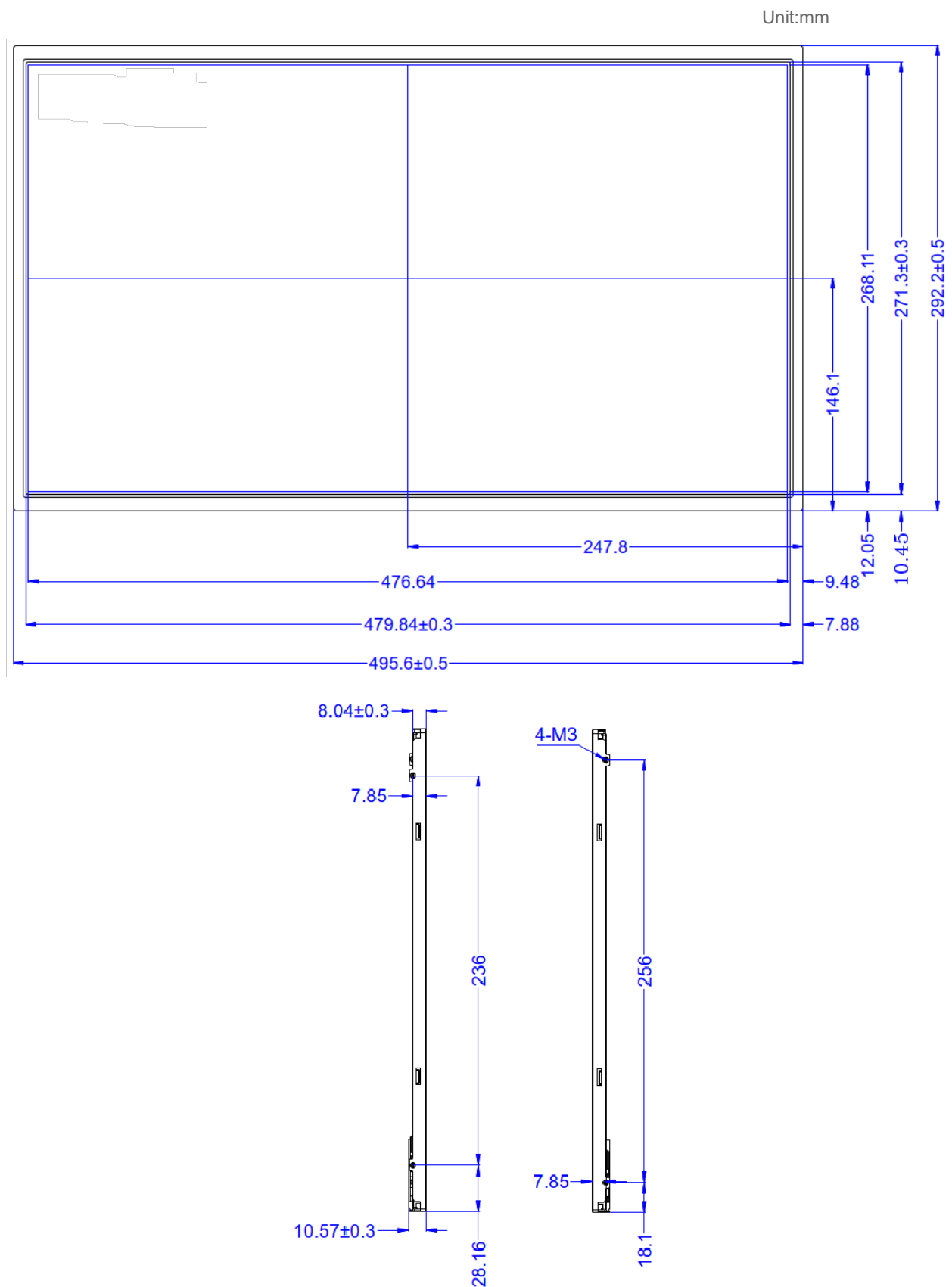
PIN NO	Symbol	Description
1	Output	LED High Voltage(+)
2	Output	LED Low Voltage (-)

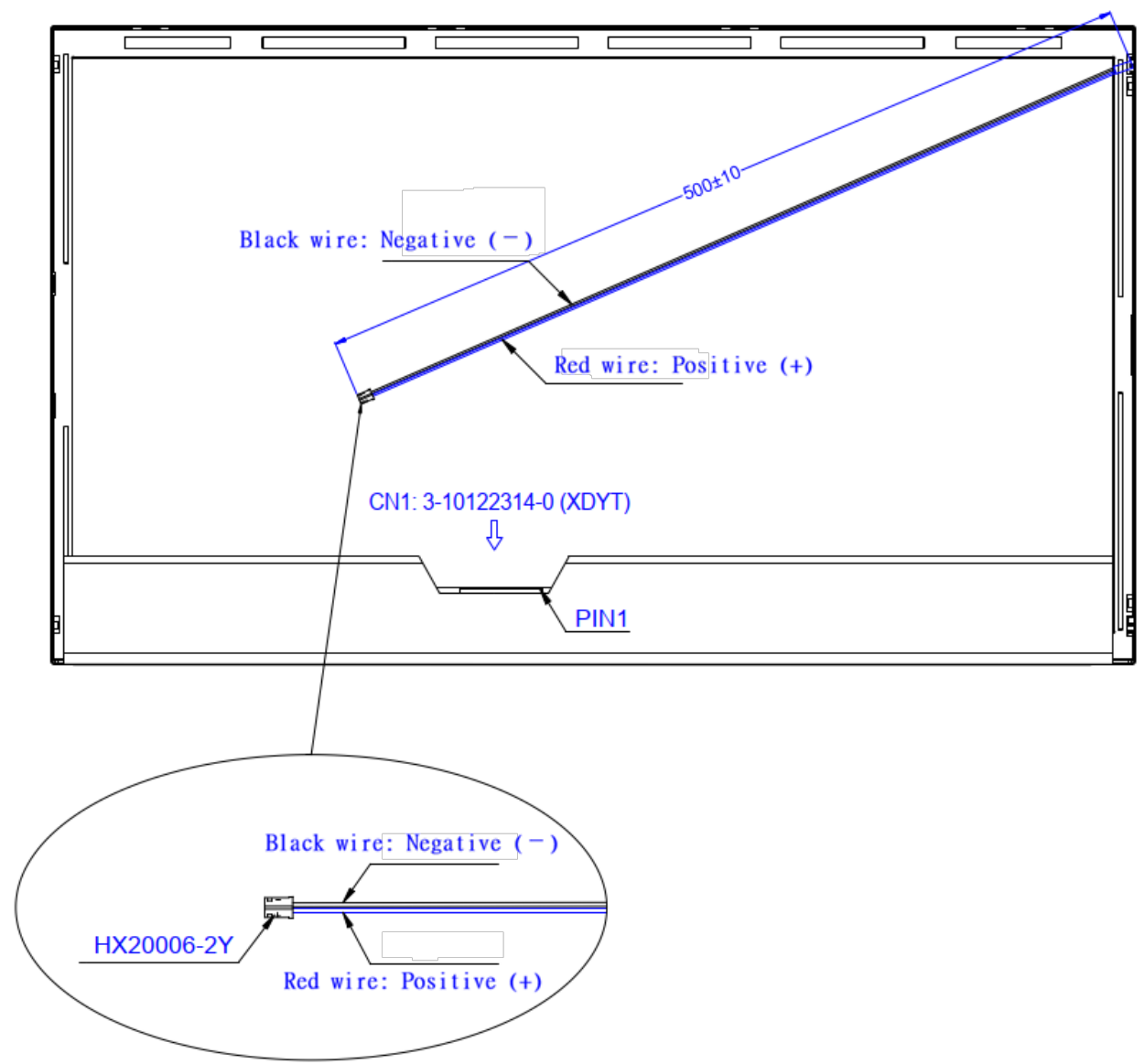
4.3 LED Driving Board Mechanical Characteristics

Dimension: 70mm*30mm*7mm



5 Mechanical Drawing





Notes:

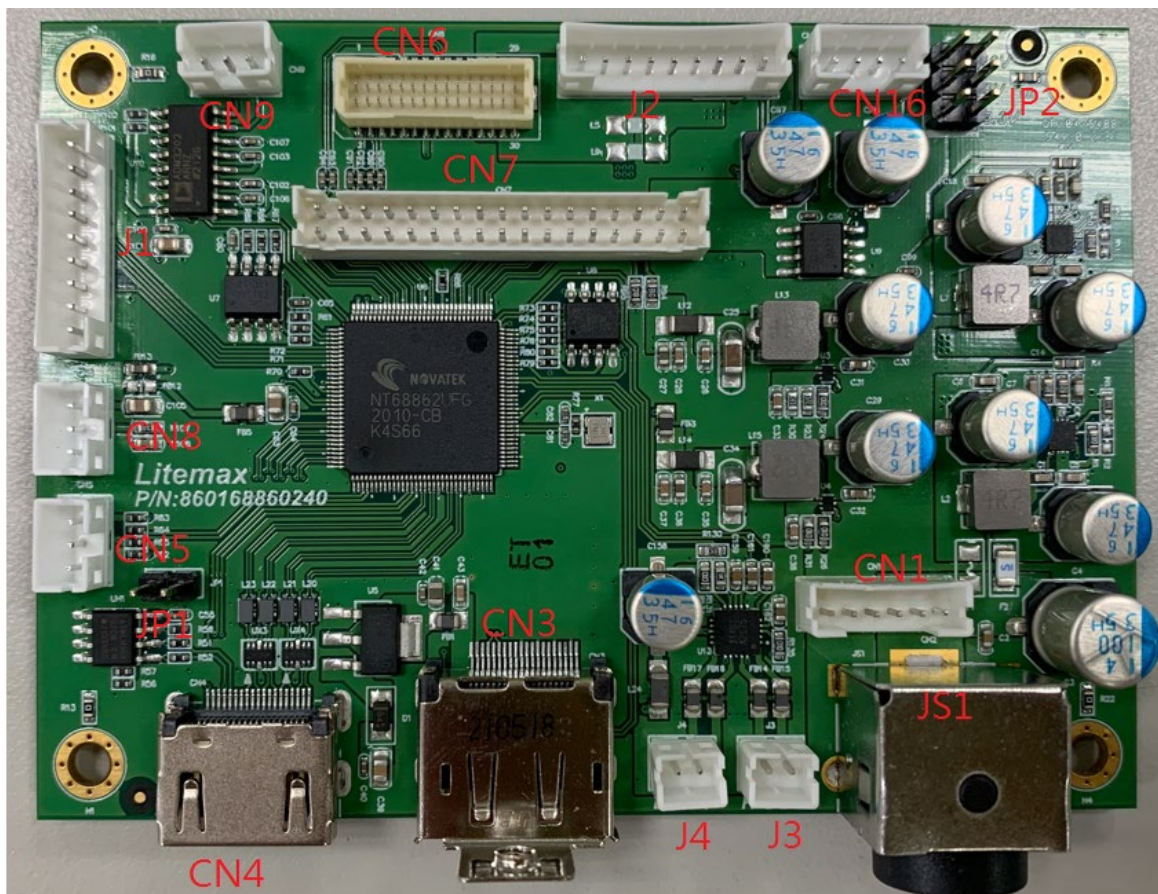
1. Unit: mm.
2. Do not scale drawing.
3. All radii without dimension R0.2.
4.  Modification Mark.
5. draft angle: 1°
6. UnSpecified Tolerance is ± 0.2
7. All materials comply with RoHS

6 AD68862HP Board & OSD Functions

We developed this A/D board to support industrial high brightness and commercial applications. This A/D board has many functions. It has a HDMI and Display Port input. Rev.1 is European RoHS compliant.

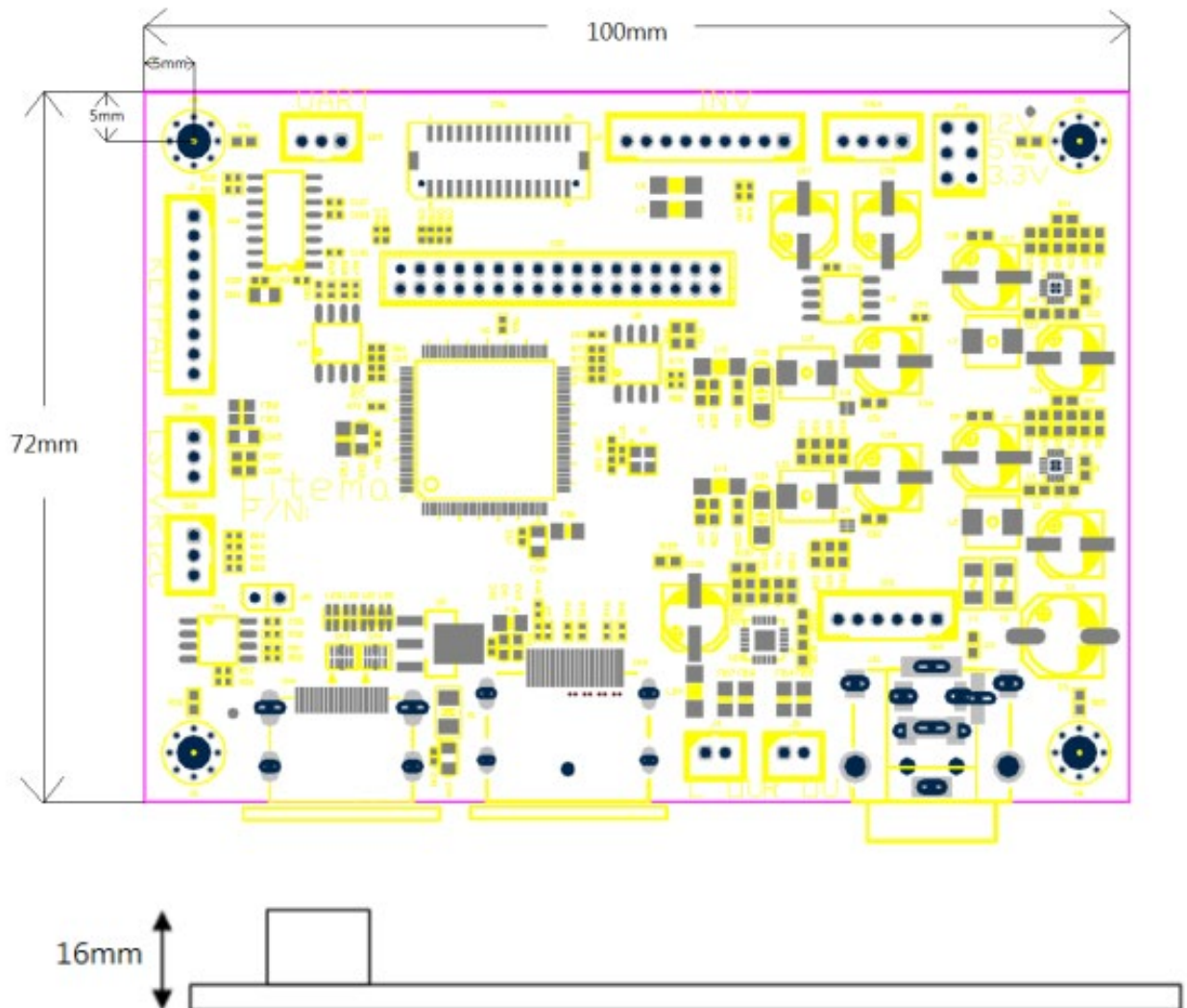
General Description

- Max resolution 1920 x 1080 60Hz
- One DP 1.2 , supports 1920 x 1080 60Hz
- One HDMI 1.4 , supports 1920 x 1080 60Hz
- Embedded MCU with ADC port for VR, Light Sensor application. (Optional)
- Embedded OSD.
- Support panel voltage 3.3/ 5/ 12 V
- Support eDP panel.
- Support Dual/Single LVDS
- Support 2.8W speaker x 2 (Optional)
- Size 100mm*72mm
- Support output voltage 12V(1A) or 5V(1A)



Outline Dimensions

AD68862HP 100 mm x 72mm



AD68862HP Board Pin Define

CN6: eDP output(Wafer 1.0mm, 15*2P)

Pin	Function	Pin	Function
1	TX0P	16	TXAUX-
2	TX0N	17	TX_HPDP
3	TX1P	18	GND
4	TX1N	19	VCC
5	GND	20	VCC
6	GND	21	DIM_EDP
7	NC	22	ON/OFF_EDP
8	NC	23	INVGND
9	GND	24	INVGND
10	GND	25	INVGND
11	NC	26	GND
12	NC	27	12INV
13	GND	28	12INV
14	GND	29	12INV
15	TXAUX+	30	12INV

CN7: LVDS output(Wafer 2.0mm,17x2P)

Pin	Function	Pin	Function
1	RXO0-	18	RXE1+
2	RXO0+	19	RXE2-
3	RXO1-	20	RXE2+
4	RXO1+	21	RXEC-
5	RXO2-	22	RXEC+
6	RXO2+	23	RXE3-
7	RXOC-	24	RXE3+
8	RXOC+	25	NC
9	RXO3-	26	NC
10	RXO3+	27	GND
11	NC	28	GND
12	NC	29	+3.3V
13	GND	30	GND
14	GND	31	VCC
15	RXE0-	32	VCC
16	RXE0+	33	VCC
17	RXE1-	34	VCC

CN3: DP input

Pin	Function	Pin	Function
1	ML_Lane3(n)	11	GND
2	GND	12	ML_Lane0(p)
3	ML_Lane3(p)	13	CONFIG1
4	ML_Lane2(n)	14	CONFIG2
5	GND	15	AUX_CH(p)
6	ML_Lane2(p)	16	GND
7	ML_Lane1(n)	17	AUX_CH(n)
8	GND	18	Hot_Plug
9	ML_Lane1(p)	19	Return
10	ML_Lane0(n)	20	DP_PWR

CN4: HDMI input

Pin	Function	Pin	Function	Pin	Function
1	RX2+	9	RX0-	17	GND
2	GND	10	TMDS Clock+	18	HDMI +5V
3	RX2-	11	HDMI DET	19	HPD
4	RX1+	12	TMDS Clock-		
5	GND	13	NC		
6	RX1-	14	NC		
7	RX0+	15	HDMI_SCL		
8	GND	16	HDMI_SDA		

CN1: Power input (Wafer 2.0mm pitch 6 pin)

Pin	Function	Pin	Function
1	Power Input	4	GND
2	Power Input	5	GND
3	Power Input	6	GND

JS1: Power input (Power Din 4 pin)

Pin	Function	Pin	Function
1	Power Input	3	GND
2	Power Input	4	GND

CN2: Power input (Power Jack 3 pin)

Pin	Function	Pin	Function
1	Power Input	3	GND
2	GND		

CN16: Power output (Wafer 2.0mm pitch 4 pin)

Pin	Function	Pin	Function
1	+5V(1A)	3	+12V(1A)
2	GND	4	GND

J2: Backlight Power and Control (Wafer 2.0mm pitch 9 pin)

Pin	Function	Pin	Function
1	DC/PWM SEL	6	GND
2	Enable	7	12V (Note3)
3	Dimming	8	12V (Note3)
4	GND	9	12V (Note3)
5	GND		

Note3: Pin 7,8,9 are for 12V version only. If you choose 24V version, these 3 pin are NC.

J1: Keypad (Wafer 2.0mm pitch 9 pin)

Pin	Function	Pin	Function
1	POWER KEY	6	MENU KEY
2	GREEN LED	7	NC
3	RED LED	8	GND
4	DOWN KEY	9	NC
5	UP KEY		

CN8: Light sensor (Wafer 2.0mm pitch 3 pin)

Pin	Function	Pin	Function
1	3.3V	3	GND
2	Sensor Out		

JP2: Panel power selection (2.54mm pitch 2x3 jump)

Pin	Function	Pin	Function
1-2 close	3.3V	5-6 close	12V
3-4 close	5V		

CN9: UART (Wafer 2.0mm pitch 3 pin)

Pin	Function	Pin	Function
1	TX	3	GND
2	RX		

CN5: I2C (Wafer 2.0mm pitch 3 pin)

Pin	Function	Pin	Function
1	SDA	3	GND
2	SCL		

J3: Audio out R (Wafer 2.0mm pitch 2 pin)(2.8W 4ΩLoad)

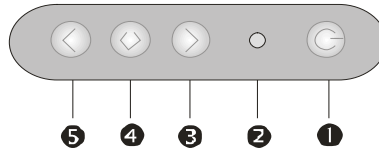
Pin	Function	Pin	Function
1	ROUTP	2	ROUTN

J4: Audio out L (Wafer 2.0mm pitch 2 pin) (2.8W 4ΩLoad)

Pin	Function	Pin	Function
1	LOUTP	2	LOUTN

6.1 OSD Function

MEMBRANE CONTROL BUTTOM



- ❶ **POWER SWITCH:** Pushing the power switch will turn the monitor on. Pushing it again to turn the monitor off.
- ❷ **Power LED:** Power ON-Green / Power OFF-No.
- ❸ **Up Key >:** Increase item number or value of the selected item.
- ❹ **Menu Key:** Enter to the OSD adjustment menu. It also used for go back to previous menu for sub-menu, and the change data don't save to memory.
- ❺ **Down Key <:** Decrease item number or item value when OSD is on.

Screen Adjustment Operation Procedure

1. Entering the screen adjustment

The setting switches are normally at stand-by. Push the **Menu Key** once to display the main menu of the screen adjustment. The adjustable items will be displayed in the main menu.

2. Entering the settings

Use the **Down Key <** and **Up Key >** buttons to select the desired setting icon and push the **SELECT** button to enter sub-menu.

3. Change the settings

After the sub-menu appears, use the **Down Key <** and **Up Key >** buttons to change the setting values.

4. Save

After finishing the adjustment, push the **SELECT** button to memorize the setting.

5. Return & Exit the main menu

Exit the screen adjustment; push the "MENU" button. When no operation is done around 10 sec (default OSD timeout), it goes back to the stand-by mode and no more switching is accepted except MENU to restart the setting.

6.2 OSD Menu

Here are some instructions for you to use the OSD (On Screen Display). By pressing the “menu”, you will see the below picture.

Timing shows resolution and V-frequency of the panel. This 2 information is not changeable by user.



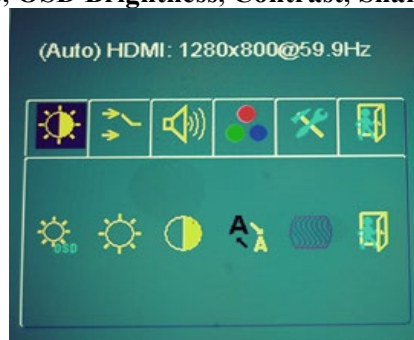
There are 6 sub menus within the OSD user interface:

Brightness, Signal Select, Sound, Color, Tools, and Exit.



Brightness

When you press the “menu” button, you enter the “Brightness” sub directory. In this directory, you will see 6 selections: **Brightness Mode, OSD Brightness, Contrast, Sharpness, Auto Tune, Exit.**



Brightness Mode :

press “menu” once, you can go into the Brightness Mode.



VR: (OPTION)

press this Icon to activate the VR control of brightness.



Ambient light sensor: (OPTION)

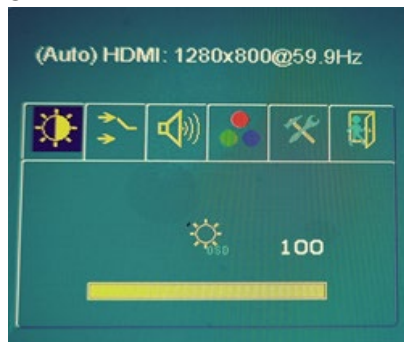
press this Icon, must to accompany with Litemax ambient light sensor to auto dimming.





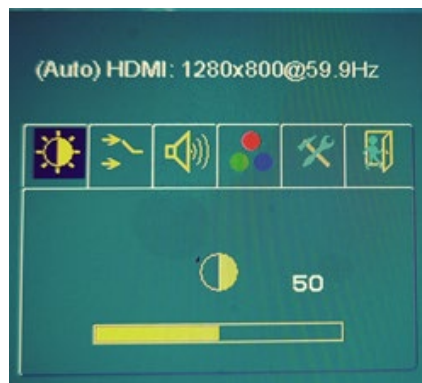
OSD Brightness :

Press the “menu” once, to adjust the brightness. Press “left” to dim down the brightness to “0”, press “right” to increase the brightness to “100”



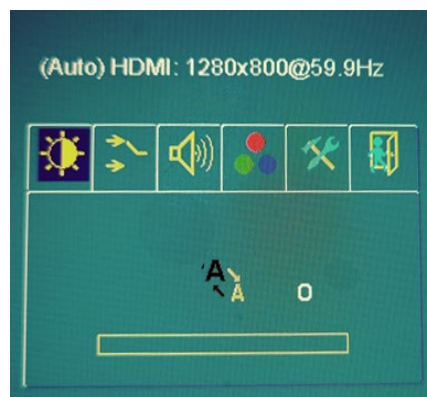
Contrast :

Press “Menu” once, you can adjust the contrast from “0” to “100” by pressing the “Left” and “Right”.



Sharpness :

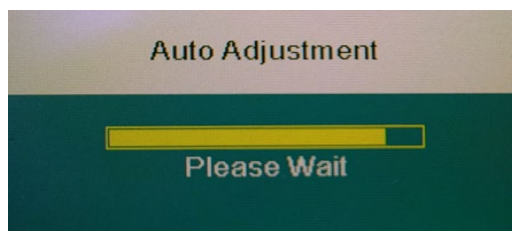
Press “Menu” once, you can adjust the Sharpness from “0” to “4” by pressing the “Left” and “Right”.





Auto Tune : (VGA only)

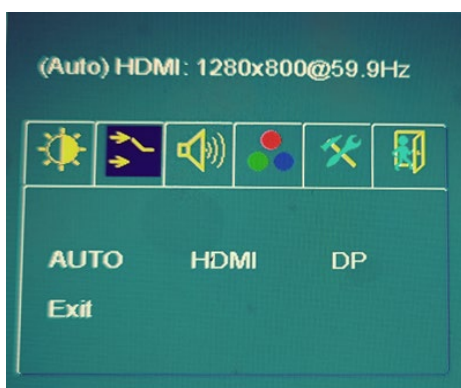
Press “Menu” once, you can activate the Auto Tune.



Exit: back to the beginning menu.



Input Signal: (default auto detect)



AUTO

AUTO: auto detect

HDMI

HDMI: HDMI input

DP

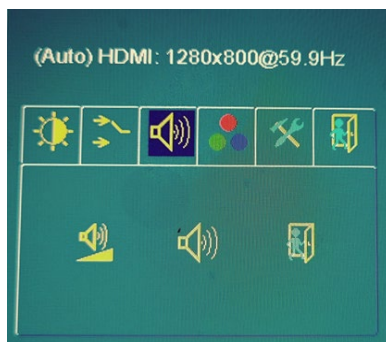
DP: DisplayPort input

Exit

Exit: back to the beginning menu.



Audio:



Audio Volume: Audio volume adjustment, from “0” to “100”.



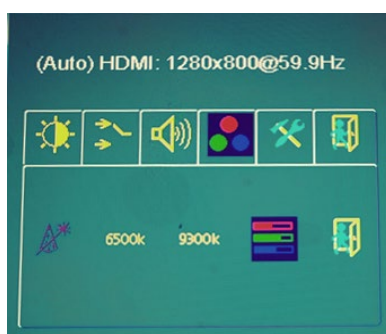
UnMute/Mute: You can mute the speaker by pressing this option.



Exit: back to the beginning menu.



Color:



Auto Color (VGA only) :

By navigating over to the “Auto Color” option, optimal color performance is invoked.



Color Tempture_6500K: Warm color scheme.



Color Tempture_9300K: Cold color scheme.



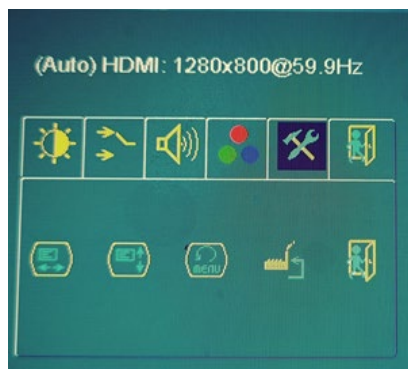
Color Temperature User Define: Default is 100 for “R”, “G”, and “B”. Range is “0” to “255”.



Exit: back to the beginning menu.



Other Setting:



HPos: You can shift the screen horizontally using this function.



VPos: You can shift the screen vertically using this function.



Rotation: You can rotate the screen to 0° (No) 、 270° (Yes).



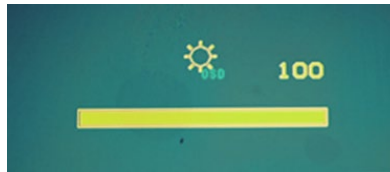
Load Default: You can load the default data using this function.



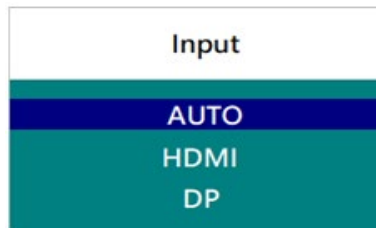
Exit: back to the beginning menu.

< Hot Key >

Left click to display brightness adjustment.

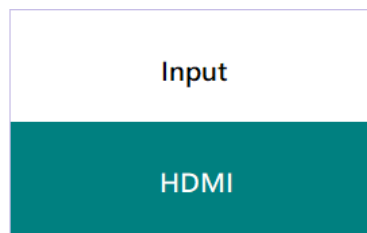


Right click to display Input Source Menu.



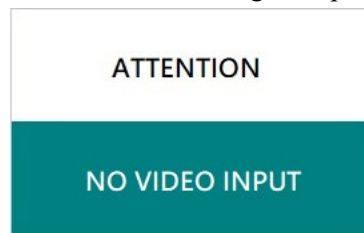
<Others>

Signal Information will be displayed after powering on or switching the signal.



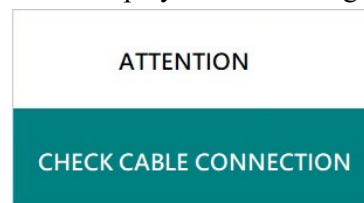
(Signal Information)

NO VIDEO INPUT will be displayed when there is no signal input.



(No Video Input)

CHECK CABLE CONNECTION will be displayed when the signal cable is not connected.



(Check Cable Connection)

7 Precautions

7.1 Handling and Mounting Precautions

- (1) The module should be assembled into the system firmly by using every mounting hole. Do not apply rough force such as bending or twisting to the LCD during assembly.
- (2) You should consider the mounting structure so that uneven force (ex. Twisted stress, Concentrated stress) is not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the LCD module.
- (3) While assembling or installing LCD modules, it can only be in the clean area. The dust and oil may cause electrical short or damage the polarizer.
- (4) Use fingerstalls or soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (5) Do not press or scratch the surface harder than a HB pencil lead on the panel because the polarizer is very soft and easily be scratched.
- (6) Please attach the surface transparent protection film to the surface in order to protect the polarizer. Transparent protection film should have sufficient strength in order to resist external force.
- (7) When the transparent protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- (8) If the surface of the polarizer is dirty, please clean it by some absorbent cotton or soft cloth. Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanently damage the polarizer due to chemical reaction.
- (9) Wipe off water droplets or oil immediately. Staining and discoloration may occur if they left on panel for a long time.
- (10) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contacting with hands, legs or clothes, it must be washed away thoroughly with soap.
- (11) Protect the LCD module from static electricity, it may cause damage to the C-MOS Gate Array IC.
- (12) Do not disassemble the module.
- (13) Do not pull or fold the lamp wire.
- (14) Pins of I/F connector should not be touched directly with bare hands.

7.2 Storage Precautions

- (1) High temperature or humidity may reduce the performance of LCD module. Please store LCD module within the specified storage conditions.
- (2) If possible store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- (3) It is dangerous that moisture come into or contacted the LCD module, because the moisture may damage LCD module when it is operating.
- (4) The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.

7.3 Operation Precautions

- (1) Do not pull the I/F connector in or out while the LCD module is operating.
- (2) Always follow the correct power on/off sequence when LCD module is connecting and operating. This can prevent the CMOS LSI chips from damage during latch-up.
- (3) Response time depends on the temperature. (In lower temperature, it becomes longer.)
- (4) Brightness depends on the temperature. (In lower temperature, it becomes lower.)
- (5) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- (6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods are very important to minimize the interference.
- (7) Please do not give any mechanical and/or acoustical impact to module. Otherwise, module can't be operated its full characteristics perfectly.
- (8) Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.
- (9) Do not display the fixed pattern for a long time because it may cause image sticking.
- (10) In order to prevent image sticking, periodical power-off or screen save is needed after fixed pattern long time display.
- (11) Black image or moving image is strongly recommended as a screen save.
- (12) Static information display recommended to use with moving image. Cycling display between 10 minutes' information (static) display and 10 seconds' moving image.
- (13) Background and character (image) color change is recommended. Use different colors for background and character, respectively. And change colors themselves periodically.
- (14) LCD system is required to place in well-ventilated environment. Adapting active cooling system is highly recommended.
- (15) Product reliability and functions are only guaranteed when the product is used under right operation usages.
- (16) If product will be used in extreme conditions, such as high temperature/ humidity, shock and vibration it is strongly recommended to contact Litemax for filed application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at airports, transit stations, taxi-top, in vehicle and controlling systems.

8 Disclaimer

All information in this document are subject to change, please constant LiteMax for any new design.