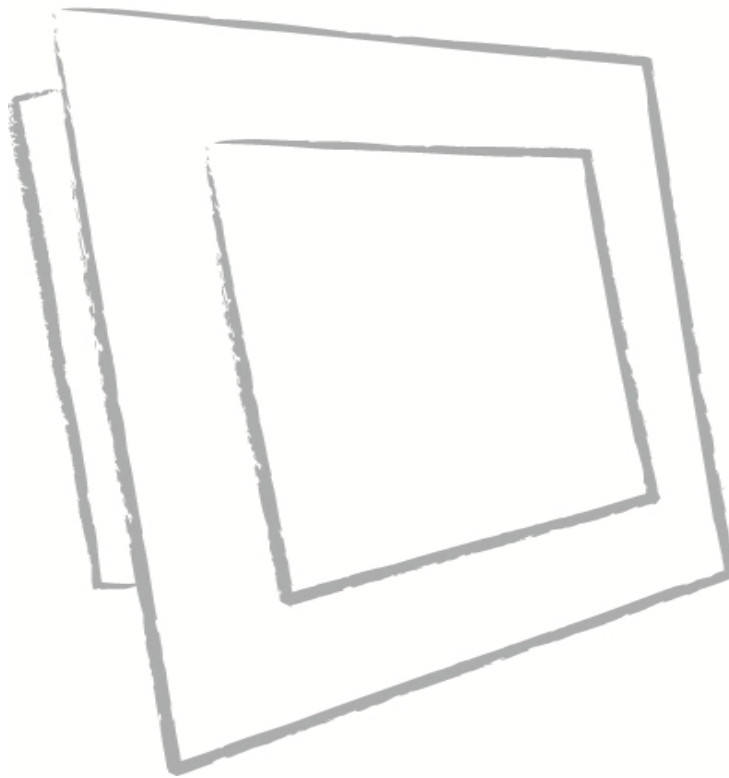


User's Manual

- Model OF1905-EN30C-RT



smart touch
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Safety Instruction

Read and follow these instructions when connecting and using your LCD monitor:

Operation:

1. Keep the monitor out of direct sunlight and away from stoves or any other heat source.
2. Remove any object that could fall into ventilation holes or prevent proper cooling of the monitor's electronics.
3. Do not block the ventilation holes on the cabinet.
4. When positioning the monitor, make sure the power plug and outlet are easily accessible.
5. If turning off the monitor by detaching the power cable or DC power cord, wait for seconds before attaching the power cable or DC power cord for normal operation.
6. Do not subject the LCD monitor to severe vibration or high impact conditions during operation.
7. Do not knock or drop the monitor during operation or transportation.

Maintenance:

8. To protect your display from possible damage, do not put excessive pressure on the LCD panel. When moving your monitor, grasp the frame to lift; do not lift the monitor by placing your hand or fingers on the LCD panel.
9. Unplug the monitor if you are not going to use it for an extensive period of time.
10. Unplug the monitor if you need to clean it with a slightly damp cloth. The screen may be wiped with a dry cloth when the power is off. However, never use organic solvent, such as, alcohol, or ammonia-based liquids to clean your monitor.
11. To avoid the risk of shock or permanent damage to the set, do not expose the monitor to dust, rain, water, or excessive moisture environment.
12. If your monitor gets wet, wipe it with dry cloth as soon as possible.
13. If foreign substance or water gets in your monitor, please turn the power off immediately and disconnect the power cord. Then, remove the foreign substance or water, and send it to the maintenance center.
14. Do not store or use the LCD monitor in locations exposed to heat, direct sunlight or extreme cold.
15. In order to maintain the best performance of your monitor and use it for a longer lifetime, please use the monitor in a location that falls within the following temperature and humidity ranges. Temperature: 5-35°C 41-95°F



Product Installation

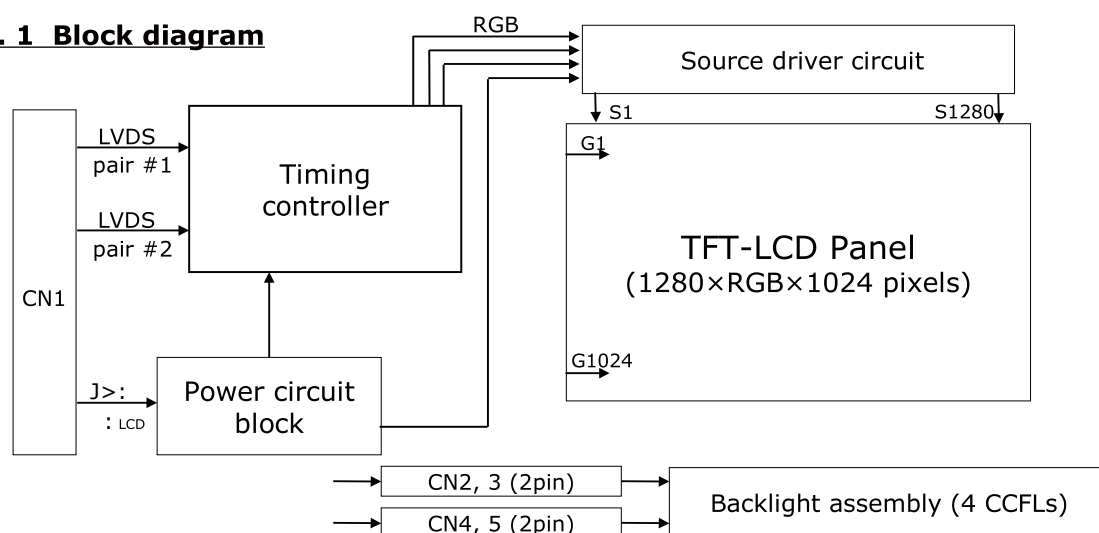
1. Switch off the power on both your monitor and your computer. The Power Switch is located in the right of the monitor.
2. Connect the power cord to the AC outlet, and connect the power to the monitor through the AC/DC adapter.
3. VGA Signal-Plug one end of the 15-pin signal cable to the video signal connector at the rear of the PC system and the other end to the monitor. Secure the connectors with the screws on the cable connector at both ends.
4. (Optional) DVI Signal-Plug one end of the DVI signal cable to the video signal connector at the rear of the PC system and the other end to the monitor. Secure the connectors with the screws on the cable connector at both ends.
5. (Optional) HDMI Signal-Plug one end of the HDMI signal cable to the video signal connector at the rear of the PC system and the other end to the monitor. Secure the connectors with the screws on the cable connector at both ends.
6. (Optional) RS232 Connection- Plug one end of RS232 cable to com-port connector on your PC system and the other end to the monitor. Secure the connectors with the screws on the cable connector at both ends.

Panel Specification

1. General description

LM190E08-TLGE is a Color Active Matrix Liquid Crystal Display with an integral Cold Cathode Fluorescent Lamp(CCFL) backlight system. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally white mode. It has a 19.0 inch diagonally measured active display area with SXGA resolution (1024 vertical by 1280 horizontal pixel array) Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 8-bit gray scale signal for each dot, thus, presenting a palette of more than 16,7M colors with Advanced-FRC(Frame Rate Control). It has been designed to apply the interface method that enables low power, high speed, low EMI. FPD Link or compatible must be used as a LVDS(Low Voltage Differential Signaling) chip. It is intended to support applications where thin thickness, wide viewing angle, low power are critical factors and graphic displays are important. In combination with the vertical arrangement of the sub-pixels, the LM190E08-TLGE characteristics provide an excellent flat panel display for office automation products such as monitors.

FIG. 1 Block diagram



General features

Active screen size	19.0 inches (481.9mm) diagonal
Outline Dimension	396.0(H) x 324.0(V) x 15.5(D) mm(Typ.)
Pixel Pitch	0.098*RGB(H)mm x 0.294(V)mm
Pixel Format	1280 horizontal By 1024 vertical Pixels. RGB stripe arrangement
Interface	LVDS 2Port
Color depth	16.7M colors
Luminance, white	300 cd/m ² (Center 1Point, typ)
Viewing Angle (CR>10)	R/L 170(Typ.), U/D 160(Typ.)
Power Consumption	Total 24.8 W(Typ.), (4.2W@V _{LCD} , 20.6W@I _{BL} =7.5mA)
Weight	1,950g (Typ.)
Display operating mode	Transmissive mode, normally White
Surface treatments	Hard coating (3H), Anti-glare treatment of the front polarizer

Panel Specification

2. Absolute maximum ratings

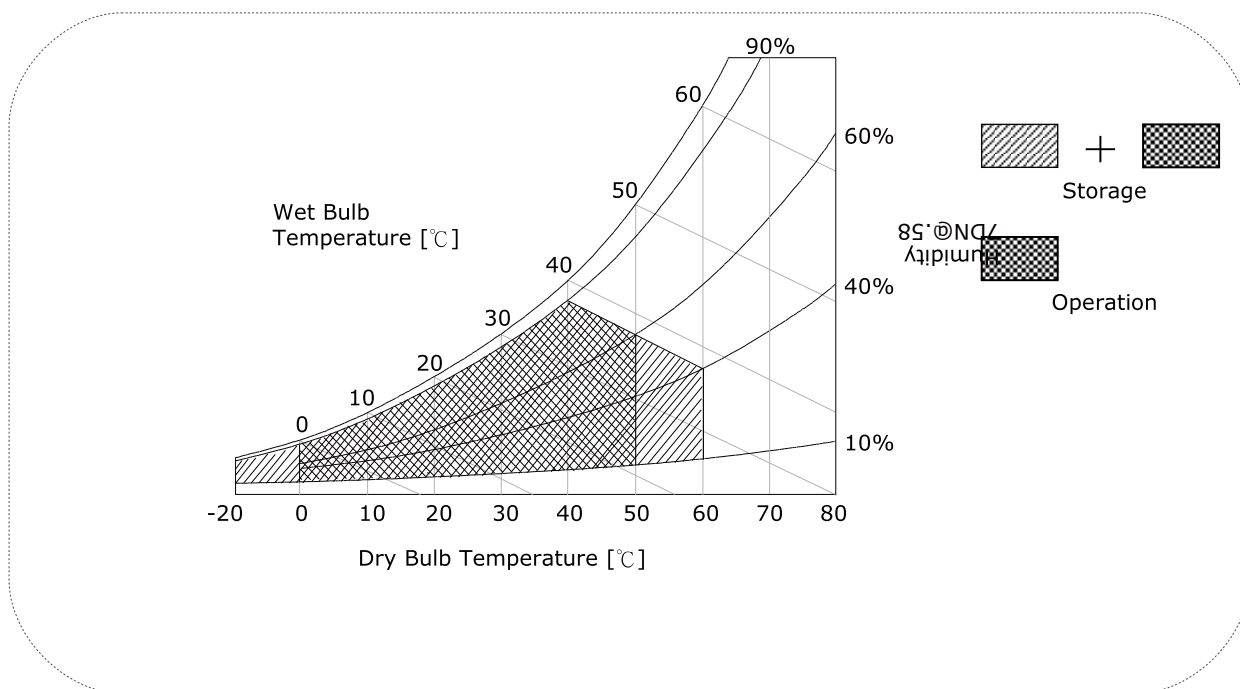
The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

Table 1. Absolute maximum ratings

Parameter	Symbol	Values		Units	Notes
		Min	Max		
Power Supply Input Voltage	V_{LCD}	-0.3	+6.0	Vdc	
Storage Temperature	T_{ST}	-20	60	°C	At 25°C
Storage Humidity	5_{ST}	10	90	N.5	

Note : 1. Temperature and relative humidity range are shown in the figure below.
Wet bulb temperature should be 39 °C Max, and no condensation of water.

FIG. 2 Temperature and relative humidity



Panel Specification

3. Electrical specifications

3-1. Electrical characteristics

It requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second input power for the CCFL/Backlight, is typically generated by an inverter. The inverter is an external unit to the LCDs.

Table 2. Electrical characteristics

Parameter	Symbol	Values			Unit	Notes
		Min	Typ	Max		
MODULE :						
Power Supply Input Voltage	: _{LCD}	4.5	5.0	5.5	Vdc	
Permissive Power Input Ripple	: _{LCD}	F	F	0.2	:	<
Power Supply Input Current	1 _{LCD-MOSAIC}	F	840	966	mA	1
	1 _{LCD-BLACK}	F	980	1127	mA	;
Power Consumption	0 _{LCD}	F	4.2	4.83	Watt	1
Inrush current	1 _{RUSH}	F	F	3.0	A	<

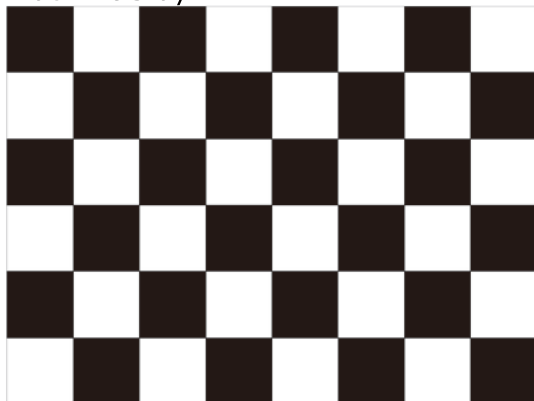
Note :

1. The specified current and power consumption are under the $V_{LCD}=5.0V$, $25 \pm 2^{\circ}C$, $f_i=60Hz$ condition whereas mosaic pattern(8 x 6) is displayed and f_i is the frame frequency.
2. The current is specified at the maximum current pattern.
3. Permissive power ripple should be measured under $VCC=5.0V$, $25^{\circ}C$, f_v (frame frequency)=75Hz condition and At that time, we recommend the bandwidth configuration of oscilloscope is to be under 20MHz.
4. The duration of rush current is about 5ms and rising time of power Input is $500\mu s \pm 20\%$.

FIG.3 pattern for Electrical characteristics

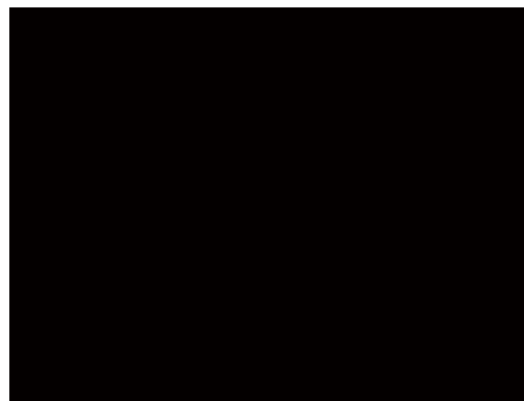
power consumption measurement

White : 255Gray
Black : 0Gray



Mosaic Pattern(8 x 6)

power input ripple



Full Black Pattern

Panel Specification

Table 3. Electrical characteristics

Parameter		Sym bol	Values			Unit	Notes
			Min	Typ	Max		
LAMP :							
Operating Voltage		\dot{V}_{BL}	?A> (8.0mA)	685 (7.5mA)	790 (3.0mA)	\dot{V}_{RMS}	1, 2
Operating Current		I_{BL}	3.0	7.5	8.0	mA_{RMS}	1
Established Starting Voltage		Vs					1, 3
	at 25 °C				1,100	\dot{V}_{RMS}	
	at 0 °C				1,400	\dot{V}_{RMS}	
Operating Frequency		f_{BL}	40	F	70	I5E	=
Discharge Stabilization Time		T _s	F	F	<	Min	1, 5
Power Consumption		P_{BL}		20.55	22.61	Watt	?
Life Time			50,000	F		Hrs	1, 7

Note :

The design of the inverter must have specifications for the lamp in LCD Assembly.

The performance of the Lamp in LCM, for example life time or brightness, is extremely influenced by the characteristics of the DC-AC inverter. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter.

When you design or order the inverter, please make sure unwanted lighting caused by the mismatch of the lamp and the inverter (no lighting, flicker, etc) never occurs. When you confirm it, the LCD-Assembly should be operated in the same condition as installed in you instrument.

- ※ Do not attach a conducting tape to lamp connecting wire. If the lamp wire attach to a conducting tape, TFT-LCD Module has a low luminance and the inverter has abnormal action.
Because leakage current is occurred between lamp wire and conducting tape.

- Specified values are for a single lamp.
- Operating voltage is measured at $25 \pm 2^\circ\text{C}$. The variance of the voltage is $\pm 10\%$.
- The voltage above V_s should be applied to the lamps for more than 1 second for start-up.
(Inverter open voltage must be more than lamp starting voltage.)

Otherwise, the lamps may not be turned on. The used lamp current is the lamp typical current.

- Lamp frequency may produce interface with horizontal synchronous frequency and as a result this may cause beat on the display. Therefore lamp frequency shall be as away possible from the horizontal synchronous frequency and from its harmonics in order to prevent interference.
- Let's define the brightness of the lamp after being lighted for 5 minutes as 100%.
 T_s is the time required for the brightness of the center of the lamp to be not less than 95%.
- The lamp power consumption shown above does not include loss of external inverter.
The used lamp current is the lamp typical current. ($P_{BL} = V_{BL} \times I_{BL} \times N_{Lamp}$)
- The life is determined as the time at which brightness of the lamp is 50% compared to that of initial value at the typical lamp current on condition of continuous operating at $25 \pm 2^\circ\text{C}$.

Panel Specification

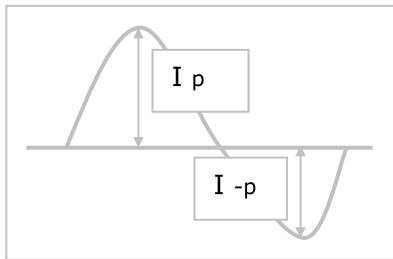
Note :

8. The output of the inverter must have symmetrical(negative and positive) voltage waveform and symmetrical current waveform (Unsymmetrical ratio is less than 10%). Please do not use the inverter which has unsymmetrical voltage and unsymmetrical current and spike wave. Requirements for a system inverter design, which is intended to have a better display performance, a better power efficiency and a more reliable lamp, are following. It shall help increase the lamp lifetime and reduce leakage current.

a. The asymmetry rate of the inverter waveform should be less than 10%.

b. The distortion rate of the waveform should be within $\sqrt{2} \pm 10\%$.

* Inverter output waveform had better be more similar to ideal sine wave.



* Asymmetry rate:

$$| I_p - I_{-p} | / I_{rms} \times 100\%$$

* Distortion rate

$$I_p \text{ (or } I_{-p}) / I_{rms}$$

9. The inverter which is combined with this LCM, is highly recommended to connect coupling(ballast) condenser at the high voltage output side. When you use the inverter which has not coupling(ballast) condenser, it may cause abnormal lamp lighting because of biased mercury as time goes.

10. In case of edge type back light with over 4 parallel lamps, input current and voltage wave form should be synchronized

Panel Specification

3-2. Interface connections

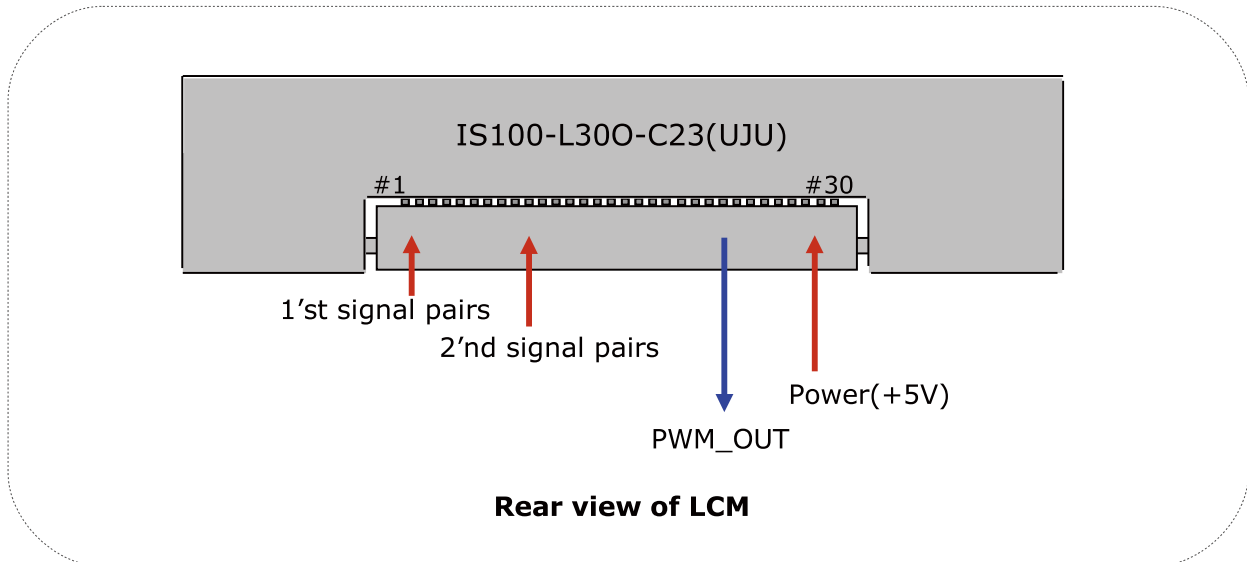
LCD connector(CN1) : IS100-L300-C23 (UJU) , 187034-30091 (P-TWO)

Table 4. Module connector(CN1) pin configuration

Pin No	Symbol	Description
1	RX00-	Minus signal of 1st channel 0 (LVDS)
;	RX00+	Plus signal of 1st channel 0 (LVDS)
<	RX01-	Minus signal of 1st channel 1 (LVDS)
=	RX01+	Plus signal of 1st channel 1 (LVDS)
>	RX02-	Minus signal of 1st channel 2 (LVDS)
?	RX02+	Plus signal of 1st channel 2 (LVDS)
A	GND	Ground (AGP)
8	RXOC-	Minus signal of 1st clock channel (LVDS)
9	RXOC+	Plus signal of 1st clock channel (LVDS)
10	RX03-	Minus signal of 1st channel 3 (LVDS)
11	RX03+	Plus signal of 1st channel 3 (LVDS)
12	RXE0-	Minus signal of 2nd channel 0 (LVDS)
13	RXE0+	Plus signal of 2nd channel 0 (LVDS)
14	GND	Ground
15	RXE1-	Minus signal of 2nd channel 1 (LVDS)
16	RXE1+	Plus signal of 2nd channel 1 (LVDS)
17	GND	Ground
18	RXE2-	Minus signal of 2nd channel 2 (LVDS)
19	RXE2+	Plus signal of 2nd channel 2 (LVDS)
20	RXEC-	Minus signal of 2nd clock channel (LVDS)
21	RXEC+	Plus signal of 2nd clock channel (LVDS)
;;	RXE3-	Minus signal of 2nd channel 3 (LVDS)
; <	RXE3+	Plus signal of 2nd channel 3 (LVDS)
; =	GND	Ground
; >	NC	No Connection (For LCD internal use only.)
; ?	NC	No Connection (For LCD internal use only.)
; A	NC	No Connection (For LCD internal use only.)
28	: LCD	Power Supply (5.0V)
29	: LCD	Power Supply (5.0V)
30	: LCD	Power Supply (5.0V)

Panel Specification

FIG. 4 Connector diagram



Note:

1. NC: No Connection.
2. All GND(ground) pins should be connected together and to Vss which should also be connected to the LCD's metal frame.
3. All V_{LCD} (power input) pins should be connected together.
4. Input Level of LVDS signal is based on the IEA 664 Standard.
5. PWM_OUT is a reference signal for inverter control.
This PWM signal is synchronized with vertical frequency.
Its frequency is 3 times of vertical frequency, and its duty ratio is 50%.
If the system don't use this pin, do not connect.

Panel Specification

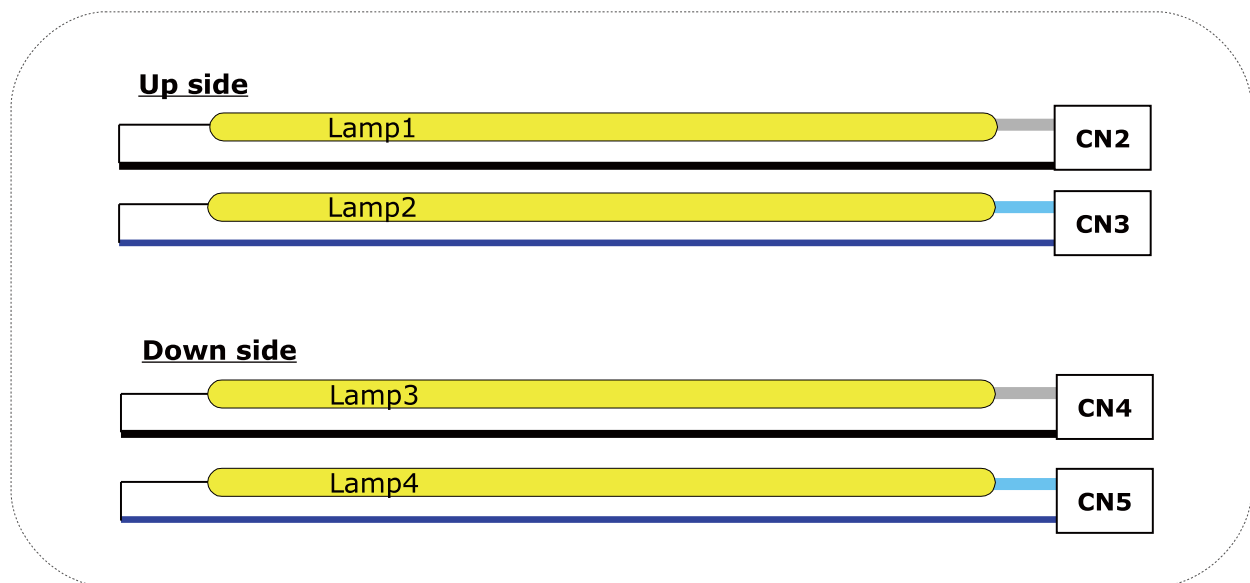
The backlight interface connector is a model 35001HS-02LD manufactured by YEONHO. The mating connector part number are 35001WR-02L(2pin) or equivalent. The pin configuration for the connector is shown in the table below.

Table 5. Backlight connector pin configuration(CN2,CN3,CN4,CN5)

Pin	Symbol	Description	Notes
1	5:	High Voltage for Lamp	1
;	LV	Low Voltage for Lamp	;

Notes: 1. The high voltage power terminal is colored gray, sky blue.
2. The low voltage pin color is black, blue.

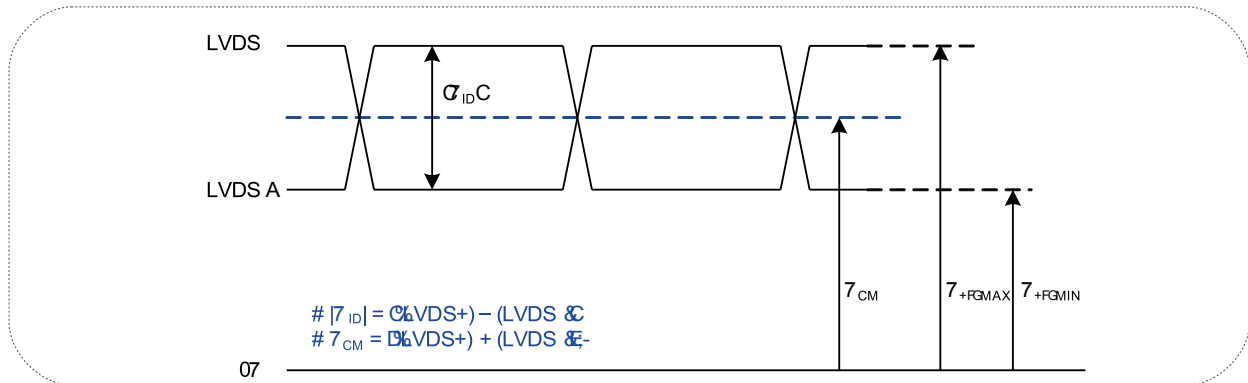
FIG. 5 Backlight connector diagram



Panel Specification

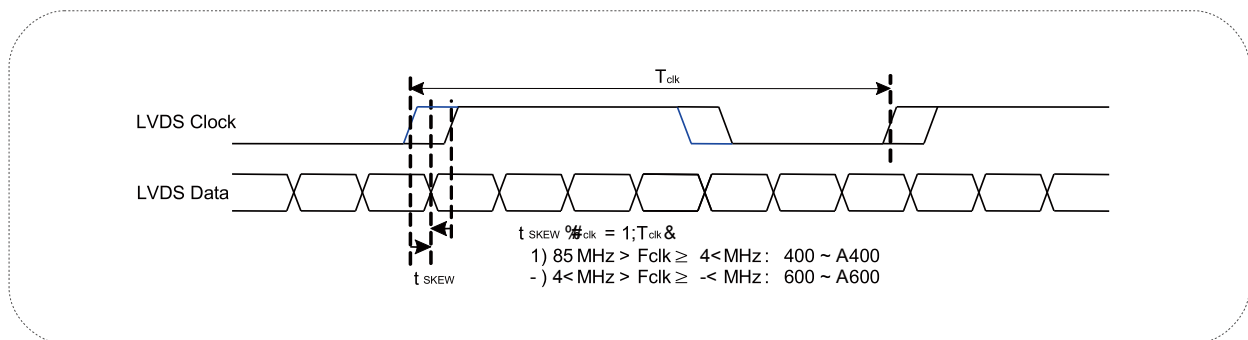
3-3. LVDS characteristics

3-3-1. DC Specification



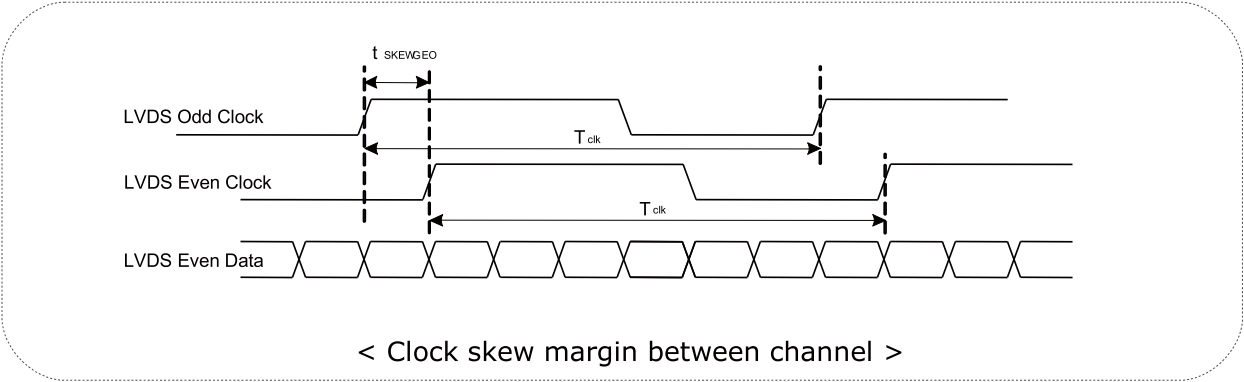
Description	Symbol	Min	Max	Unit	Notes
LVDS Differential Voltage	V_{ID}	200	600	mV	F
LVDS Common mode Voltage	V_{CM}	0.6	1.8	V	F
LVDS Input Voltage Range	V_{IN}	0.3	2.1	V	F

3-3-2. AC Specification

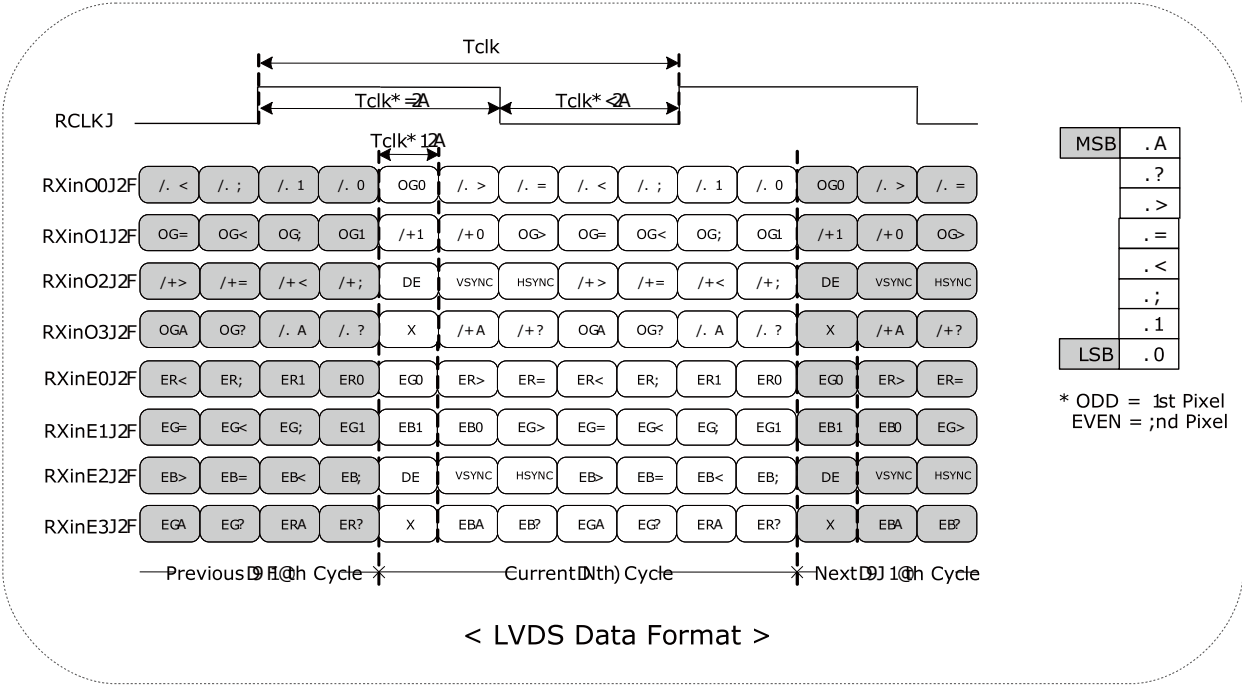


Description	Symbol	Min	Max	Unit	Notes
LVDS Clock to Data Skew Margin	t_{SKEW}	400	+ 400	ps	85MHz > Fclk ≥ 65MHz
	t_{SKEW}	600	+ 600	ps	65MHz > Fclk ≥ 25MHz
LVDS Clock to Clock Skew Margin (Even to Odd)	t_{SKEW_EO}	- 1/7	+ 1/7	T_{clk}	F

Panel Specification



3-3-3. LVDS Data format



< LVDS Data Format >

Panel Specification

Table 6. Required signal assignment for Flat Link(NS:DS90CF383) transmitter

Pin #	Pin Name	Require Signal	Pin #	Pin Name	Require Signal
1	VCC	Power Supply for TTL Input	29	GND	Ground pin for TTL
;	D5	TTL Input (R7)	30	D26	TTL Input (DE)
<	D6	TTL Input (R5)	31	T _x CLKIN	TTL Level clock Input
=	D7	TTL Input (G0)	<;	PWR DWN	Power Down Input
>	GND	Ground pin for TTL	<<	PLL GND	Ground pin for PLL
?	D8	TTL Input (G1)	<=	PLL VCC	Power Supply for PLL
A	D9	TTL Input (G2)	<>	PLL GND	Ground pin for PLL
8	D10	TTL Input (G6)	<?	LVDS GND	Ground pin for LVDS
9	VCC	Power Supply for TTL Input	<A	T _x OUT3 +	Positive LVDS differential data output 3
10	D11	TTL Input (G7)	38	T _x OUT3 –	Negative LVDS differential data output 3
11	D12	TTL Input (G3)	39	T _x CLKOUT +	Positive LVDS differential clock output
12	D13	TTL Input (G4)	40	T _x CLKOUT –	Negative LVDS differential clock output
13	GND	Ground pin for TTL	41	T _x OUT2 +	Positive LVDS differential data output 2
14	D14	TTL Input (G5)	=;	T _x OUT2 –	Negative LVDS differential data output 2
15	D15	TTL Input (B0)	=<	LVDS GND	Ground pin for LVDS
16	D16	TTL Input (B6)	==	LVDS VCC	Power Supply for LVDS
17	VCC	Power Supply for TTL Input	=>	T _x OUT1 +	Positive LVDS differential data output 1
18	D17	TTL Input (B7)	=?	T _x OUT1 –	Negative LVDS differential data output 1
19	D18	TTL Input (B1)	=A	T _x OUT0 +	Positive LVDS differential data output 0
20	D19	TTL Input (B2)	48	T _x OUT0 –	Negative LVDS differential data output 0
21	GND	Ground pin for TTL Input	49	LVDS GND	Ground pin for LVDS
;;	D20	TTL Input (B3)	50	D27	TTL Input (R6)
;<	D21	TTL Input (B4)	51	D0	TTL Input (R0)
;;=	D22	TTL Input (B5)	>;	D1	TTL Input (R1)
;>	D23	TTL Input (RSVD)	><	GND	Ground pin for TTL
;>?	VCC	Power Supply for TTL Input	>=	D2	TTL Input (R2)
;>A	D24	TTL Input (HSYNC)	>>	D3	TTL Input (R3)
28	D25	TTL Input (VSYNC)	>?	D4	TTL Input (R4)

Notes : Refer to LVDS Transmitter Data Sheet for detail descriptions.

Panel Specification

3-4. Signal timing specifications

This is the signal timing required at the input of the User connector. All of the interface signal timing should be satisfied with the following specifications for it's proper operation.

Table 7. Timing table

Parameter		Symbol	Min.	Typ.	Max.	Unit	Notes
D_{CLK}	Period	t_{CLK}	14.4	18.5	23.2	ns	Pixel frequency : Typ.108MHz
	Frequency	f_{CLK}	43.2	54.0	69.3	MHz	
Horizontal	Horizontal Valid	$t_{5:}$	640	640	640	t_{CLK}	
	H Period Total	t_{50}	?A;	844	1022		
	Hsync Frequency	f_5	51.2	64.0	82.1	I5E	
Vertical	Vertical Valid	$t_{:}$	1024	1024	1024	t_{50}	
	V Period Total	$t_{:0}$	1032	1066	1536		
	Vsync Frequency	$f_{:}$	48	60	AA	5E	
DE (Data Enable)	DE Setup Time	t_{SI}	=	F	F	ns	For D_{CLK}
	DE Hold Time	t_{51}	=	F	F		
Data	Data Setup Time	t_{SD}	=	F	F	ns	For D_{CLK}
	Data Hold Time	t_{HD}	=	F	F		

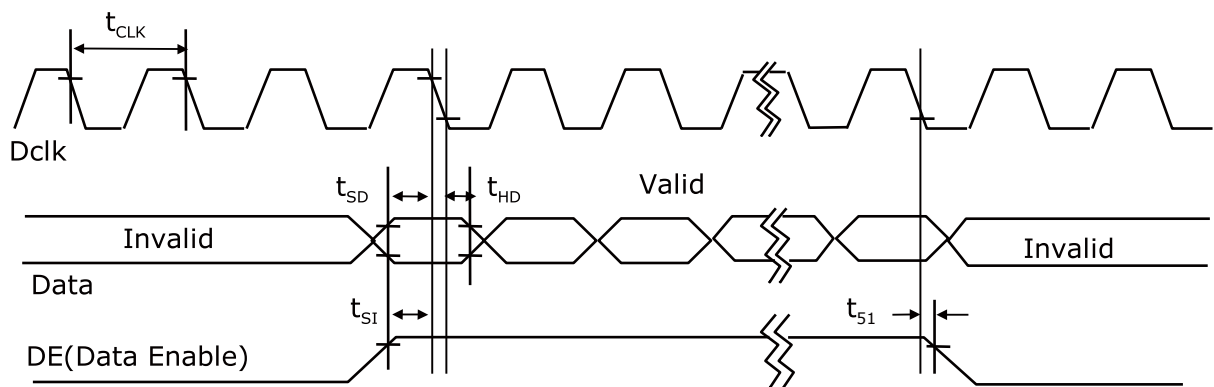
Note:

1. LM190E08-TLGE is DE Only mode operation. The input of Hsync & Vsync signal does not have an effect on LCD normal operation.
2. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rates.
3. Horizontal period should be even.

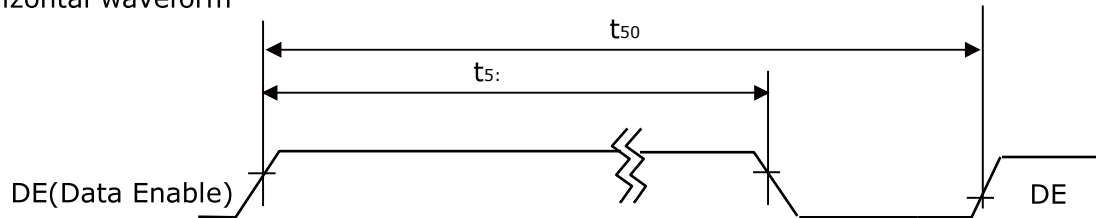
Panel Specification

3-5. Signal timing waveforms

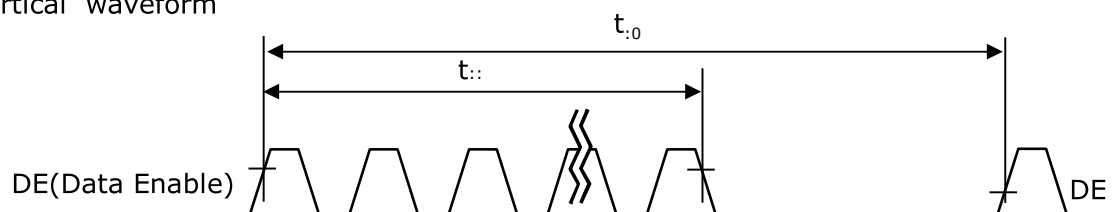
1. DCLK, DE, DATA waveforms



2. Horizontal waveform



3. Vertical waveform



Panel Specification

3-6. Color input data reference

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

Table 8. Color data reference

[illegible]

Panel Specification

3-7. Power sequence

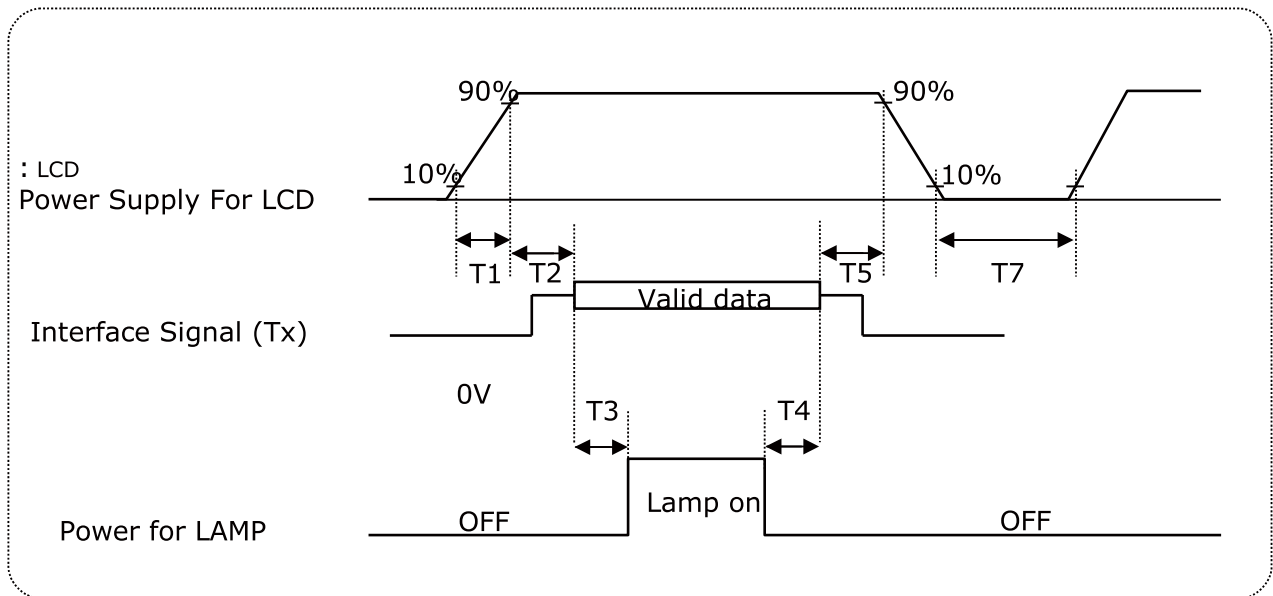


Table 9. Power sequence

Parameter	Values			Units
	Min	Typ	Max	
T1	0.5	F	10	ms
T2	0.01	F	50	ms
T3	200	F	F	ms
T4	200	F	F	ms
T5	0.01	F	50	ms
T7	500	F	F	ms

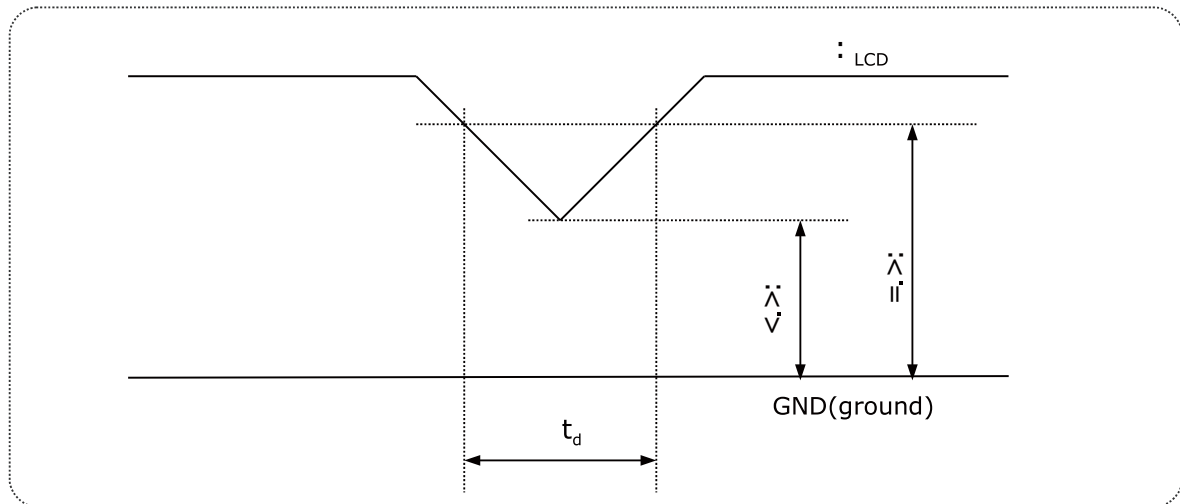
Notes :

1. Please avoid floating state of interface signal at invalid period.
2. When the interface signal is invalid, be sure to pull down the power supply for LCD V_{LCD} to 0V.
3. Lamp power must be turn on after power supply for LCD an interface signal are valid.

Panel Specification

3-8. V_{LCD} Power dip condition

FIG. 6 Power dip condition



1) Dip condition

$$3.5V \leq V_{LCD} < 4.5V, t_d \leq 20ms$$

2) $V_{LCD} < 3.5V$

: V_{LCD} -dip conditions should also follow the Power On/Off conditions for supply voltage.

Panel Specification

4. Optical specification

Optical characteristics are determined after the unit has been 'ON' for 30 minutes in a dark environment at 25°C. The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0°.

FIG. 7 presents additional information concerning the measurement equipment and method.

FIG. 7 Optical characteristic measurement equipment and method

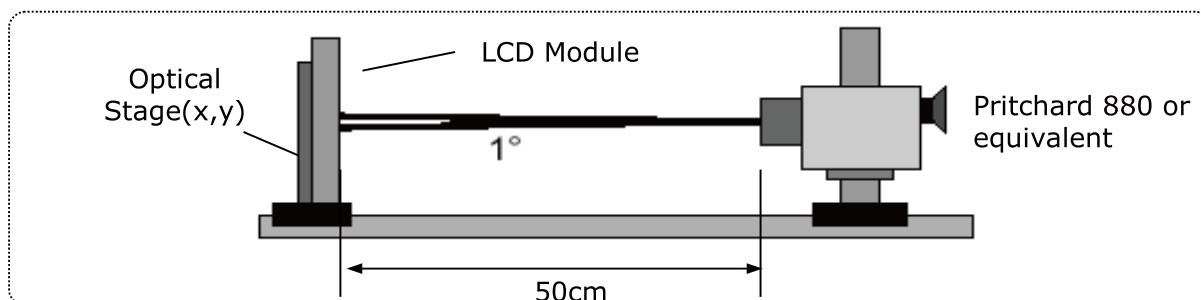


Table 10. Optical characteristics

$T_a = 25^\circ\text{C}$, $V_{\text{LCD}} = 5.0\text{V}$, $f = 60\text{Hz}$, $f_{\text{CLK}} = 54\text{MHz}$, $I_{\text{BL}} = 7.5\text{mA}$

Parameter		Symbol		Values			Units	Notes
				Min	Typ	Max		
Contrast Ratio		CR		500	800	F		1
Surface Luminance, white		L ₅		250	300	F	cd/m ²	;
Luminance Variation		δ _{WHITE}	9P	A>			N	<
Response Time	Rise Time	Tr		F	1.3	2.6	ms	=
	Decay Time	Tr _D		F	3.7	7.4	ms	=
Color Coordinates [CIE1931]	RED	.*		Typ -0.03	0.641	Typ +0.03		
		Ry			0.335			
	GREEN	Gx			0.298			
		Gy			0.608			
	BLUE	+*			0.147			
		By			0.070			
	WHITE	*			0.313			
		Wy			0.329			
Viewing Angle (CR>5)								
	x axis, right(ϕ=0°)	θr		A>	88		Degree	>
	x axis, left (ϕ=180°)	θl		A>	88			
	y axis, up (ϕ=90°)	θu		70	85			
	y axis, down Dϕ=270°)	θd		70	85			
Viewing Angle (CR>10)								
	x axis, right(ϕ=0°)	θr		70	85		Degree	>
	x axis, left (ϕ=180°)	θl		70	85			
	y axis, up (ϕ=90°)	θu		60	A>			
	y axis, down (ϕ=270°)	θd		70	85			
Crosstalk						1.5	N	
Luminance uniformity – Angular dependence (TCO'03)		LR		F	F	1.7		?
Color grayscale linearity		Δu'v'			0.018			8

Panel Specification

Notes :

1. Contrast ratio(CR) is defined mathematically as :It is measured at center point(1)

$$\text{Contrast ratio} = \frac{\text{Surface luminance with all white pixels}}{\text{Surface luminance with all black pixels}}$$

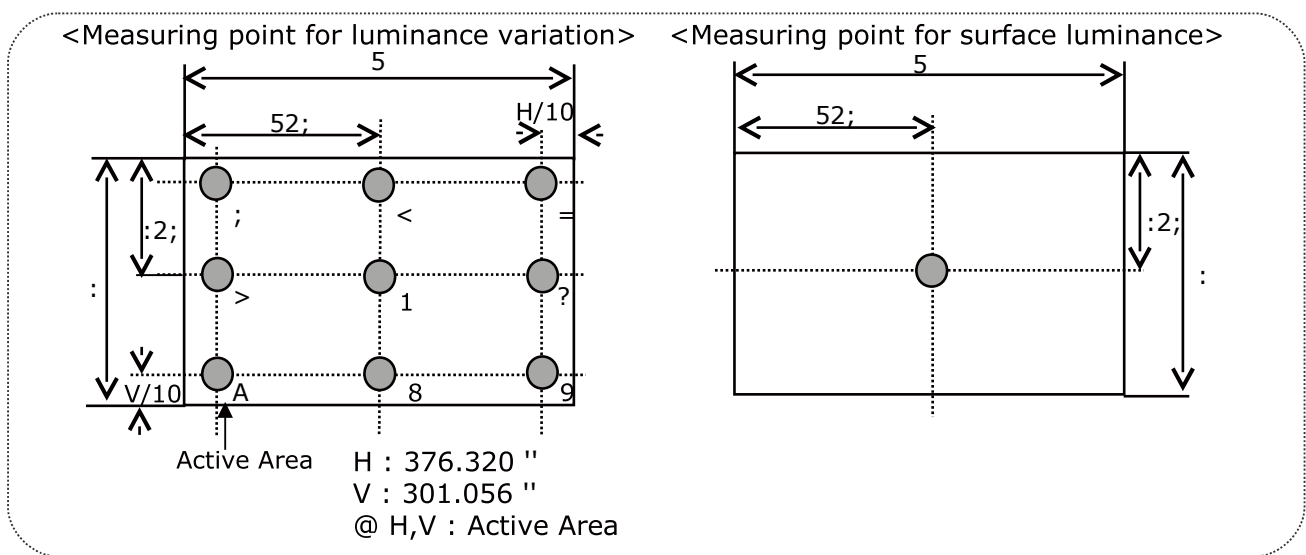
2. Surface luminance is the luminance value at center 1 point(1) across the LCD surface 50cm from the surface with all pixels displaying white. For more information see FIG 8.

3. The variation in surface luminance , δ_{WHITE} is defined as

$$\delta_{\text{WHITE}} = \frac{\text{Minimum (P1,P2P9)}}{\text{Maximum (P1,P2P9)}} * 100$$

For more information see Figure 8.

FIG. 8 Luminance measuring point



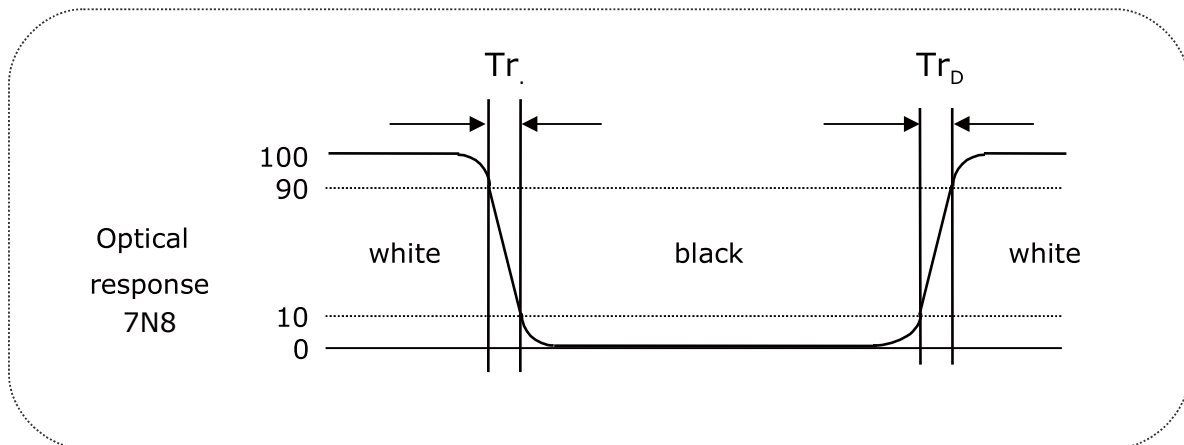
Panel Specification

Notes :

4. Response time is the time required for the display to transition from black to white (Decay Time, Tr_D) and from white to black (Rise Time, Tr_r)
The sampling rate is 2,500 sample/sec. For additional information see FIG. 9.

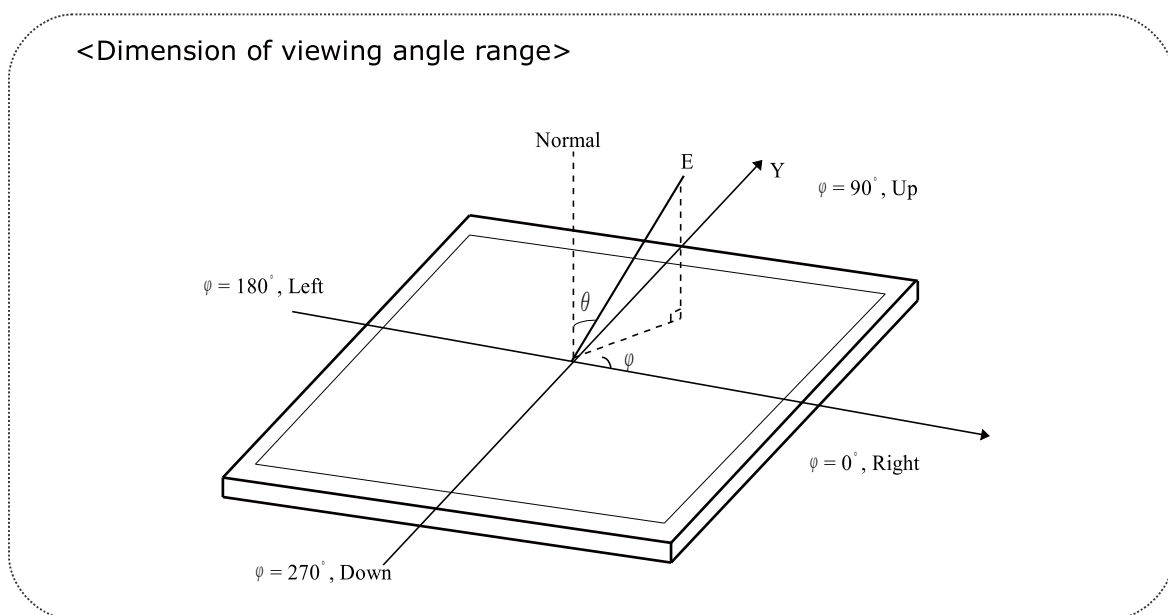
The response time is defined as the following figure and shall be measured by switching the input signal for each gray to gray.

FIG. 9 Response time



5. Viewing angle is the angle at which the contrast ratio is greater than 10 or 5. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG. 10 .

FIG. 10 Viewing angle



Panel Specification

Notes :

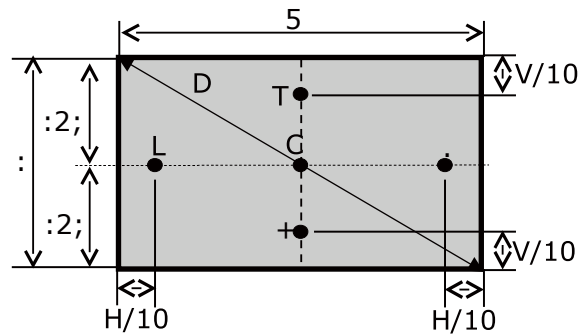
6. Luminance Uniformity - angular – dependence (LR& TB)

TCO '03 Luminance uniformity – angular dependence, is the capacity of the VDU to present the same Luminance level independently of the viewing direction. The angular-dependent luminance uniformity is calculated as the ratio of maximum luminance to minimum luminance in the specified measurement areas.

- Test pattern : 80% white pattern
- Test point : 2-point
- Test distance : $D * 1.5 = 72.39 \text{ cm}$
- Test method : $L_c = ((L_{\text{max.}+30\text{deg.}} / L_{\text{min.}+30\text{deg.}}) + (L_{\text{max.}-30\text{deg.}} / L_{\text{min.}-30\text{deg.}})) / 2$
 $T_B = ((L_{\text{max.}+15\text{deg.}} / L_{\text{min.}+15\text{deg.}}) @$

FIG. 11 Luminance Uniformity angular dependence

< Luminance uniformity - angular dependence measuring point >



7. Gray scale specification

Table 11. Gray scale

Gray level	Luminance [%] (Typ)
L0	0.14
L31	1.23
L63	4.98
L95	12.30
L127	23.58
L159	40.03
L191	61.30
L223	84.03
L255	100

Panel Specification

Notes :

8. Color grayscale linearity , $\Delta u'v'$ is defined as

$$\sqrt{(\Delta u')^2 + (\Delta v')^2}$$

Where indices A and B are the two gray levels found to have the largest color differences between them.

i.e. get the largest $\Delta u'$ and $\Delta v'$ of each 6pairs of u' and v' and calculate $\Delta u'v'$.

FTest pattern : 100% full white pattern with a test pattern as shown FIG.12

Squares of 40mm by 40mm in size, filled with 255, 225, 195, 165, 135 and 105 grayscale steps should be arranged in the center of the screen.

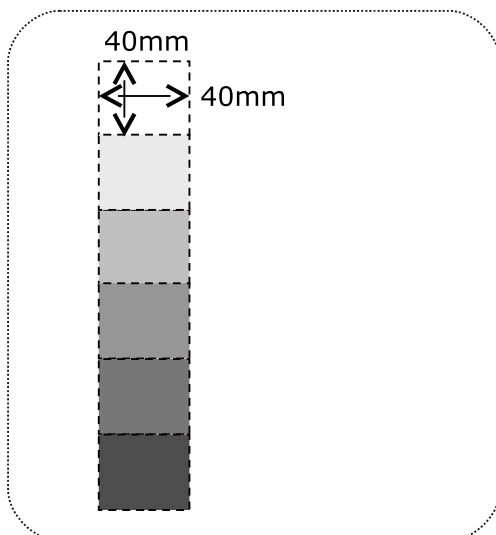
FTest method

First gray step : move a square of 255 gray level should be moved into the center of the screen and measure luminance and u' and v' coordinates.

Next gray step : move a 255 gray square into the center and measure both luminance and u' and v' coordinates.

The same procedure shall then be repeated for gray steps 195, 165, 135 and 105.

FIG. 12 Color grayscale linearity



Panel Specification

5. Mechanical characteristics

The contents provide general mechanical characteristics. In addition the figures in the next page are detailed mechanical drawing of the LCD.

Table 12. Mechanical characteristics

Outline dimension	Horizontal	396.0 mm
	Vertical	324.0 mm
	Depth	15.5 mm
Bezel area	Horizontal	380.3 mm
	Vertical	305.0 mm
Active display area	Horizontal	376.320 mm
	Vertical	301.056 mm
Weight	1,950g (Typ.) 2,050g (Max)	
Surface treatment	Hard coating(3H) Anti-glare treatment of the front polarizer	

Notes : Please refer to a mechanic drawing in terms of tolerance at the next page.

Panel Specification

6. Reliability

Table 13. Environment test conditions

9#	Test Item	Condition
1	High temperature storage test	Ta= 60°C 240hrs
;	Low temperature storage test	Ta= -20°C 240hrs
<	High temperature operation test	Ta= 50°C 50%RH 240hrs
=	Low temperature operation test	Ta= 0°C 240hrs
>	Vibration test (non-operating)	Wave form : random Vibration level : 1.0GRMS Bandwidth : 10-300Hz Duration : X,Y,Z, 20 min One time each direction
?	Shock test (non-operating)	Shock level : 120G Waveform : half sine wave, 2msec Direction : ±X, ±Y, ±Z One time each direction
A	Altitude operating storage / shipment	0 - 10,000 feet(3,048m) 0 - 40,000 feet(12,192m)

{ Result evaluation criteria }

There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.

Panel Specification

7. International standards

7-1. Safety

- a) UL 60950-1:2003, First Edition, Underwriters Laboratories, Inc.,
Standard for Safety of Information Technology Equipment.
- b) CAN/CSA C22.2, No. 60950-1-03 1st Ed. April 1, 2003, Canadian Standards Association,
Standard for Safety of Information Technology Equipment.
- c) EN 60950-1:2001, First Edition,
European Committee for Electro-technical Standardization(CENELEC)
European Standard for Safety of Information Technology Equipment.
- d) RoHS, Directive 2002/95/EC of the European Parliament and of the council of 27
January 2003

7-2. EMC

- a) ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage
Electrical and Electrical Equipment in the Range of 9kHz to 40GHz. "American National
Standards Institute(ANSI),1992
- b) C.I.S.P.R "Limits and Methods of Measurement of Radio Interface Characteristics of
Information Technology Equipment." International Special Committee on Radio
Interference.
- c) EN 55022 "Limits and Methods of Measurement of Radio Interface Characteristics of
Information Technology Equipment." European Committee for Electro-technical
Standardization.(CENELEC), 1998 (Including A1: 2000)

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8. Precautions

Please pay attention to the followings when you use this TFT LCD module.

8-1. Mounting Precautions

- (1) You must mount a module using holes arranged in four corners or four sides.
- (2) You should consider the mounting structure so that uneven force (ex. Twisted 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 module.
- (3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to the resist external force.
- (4) You should adopt radiation structure to satisfy the temperature specification.
- (5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- (6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth.
(Some cosmetics are detrimental to the polarizer.)
- (7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- (8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (9) Do not open the case because inside circuits do not have sufficient strength.

8-2. Operating precautions

- (1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage : $V = \pm 200\text{mV}$ (Over and under shoot voltage)
- (2) Response time depends on the temperature. (In lower temperature, it becomes longer.)
- (3) Brightness depends on the temperature. (In lower temperature, it becomes lower.)
And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer.
- (4) 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.
- (5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference.
- (7) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can not be operated its full characteristics perfectly.
- (8) A screw which is fastened up the steels should be a machine screw (if not, it causes metal foreign material and deal LCM a fatal blow)
- (9) Please do not set LCD on its edge.

Panel Specification

8-3. Electrostatic discharge control

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.

8-4. Precautions for strong light exposure

Strong light exposure causes degradation of polarizer and color filter.

8-5. Storage

When storing modules as spares for a long time, the following precautions are necessary.

- (1) 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.
- (2) 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.

8-6. Handling precautions for protection film


AD Board Specification

LCD monitor GTR24 OSD operation

Control Functions

The Monitor control functions are located on the lower side of the panel.

The control key description

1. MENU : Activate the on-screen-display function
2. ▽ : Down / Brightness control
3. △ : Up / Brightness control
4. Auto : AUTO-ADJUSTMENT
5.  : Power Switch

Description

1. Menu

Press the Menu key to activate the on screen display screen. It is a toggle key. Press twice to turn off the OSD. After 30 sec. idle time, the OSD screen will automatically turn off.

2. ▽ & △ : Select key

The two keys have two sets of functions:

- When OSD screen is not activated, the two keys are used to adjust the Backlight.
- When OSD screen is activated (When "Menu" key is pressed), the two keys are used to select the wanted adjustment items

3. Auto

Press Auto Key to get the optimized quality.

4. : Power switch

Use the power switch to turn ON or OFF power. We recommend turning your system power on first, then the LCD monitor.

AD Board Specification

ADJUSTING THE MONITOR

The LCD monitor is designed to work with a range of compatible video adapters on the market. Due to the possible deviations between these video adapters, you may make some adjustment to fit the monitor for adapter used.

ADJUSTMENT PROCEDURE

First, you must activate the OSD screen through pressing the MENU key, the screen will show in the center of screen as below:

OSD SCREEN



- Use the ▽ & △ key to select the required adjustment item up or down.
- Use Menu key to do the desired function or go into the second menu item to do the further change.
- Use the ▽ & △ key to select the Exit **EXIT** item to turn off OSD. Or After 30 sec. idle time, the OSD screen will automatically turn off.

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AUTO-ADJUSTMENT

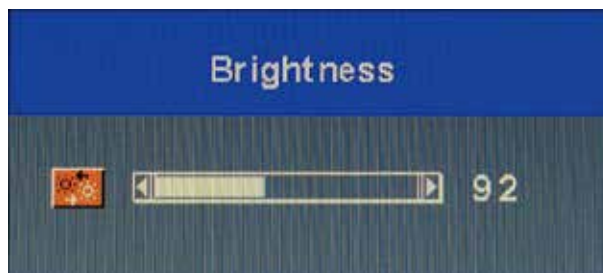
WE STRONGLY RECOMMEND THAT YOU USE THIS ITEM TO GET THE OPTIMIZED VISUAL QUALITY.

- Use the ▽ & △ key to select auto-adjustment, and then press Menu Key to get the optimized quality.
- Or press Auto Key to get the optimized directly.




BRIGHTNESS ADJUSTMENT

- Use the ▽ & △ key to select the Brightness  item, press Menu Key to change the brightness value.
- Use the ▽ & △ key to adjust the Brightness.
- Then press menu key to confirm.



ADJUST THE CONTRAST VALUE

- Use the ▽ & △ key to select the CONTRAST  item, then press Menu Key to get the best contrast optimization.
- Use the ▽ & △ key to adjust contrast value.

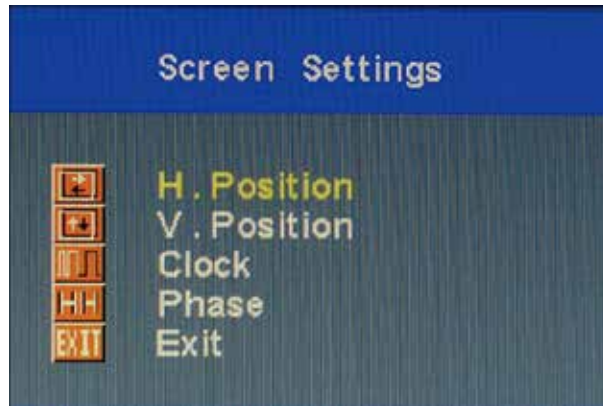


Screen Settings

- Use the ▽ & △ key to select the Screen Settings  item, then press Menu Key to get the

AD Board Specification

best Screen Settings optimization.



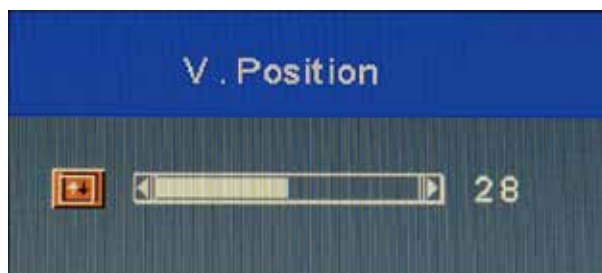
● H.Position

- Use the ▽ & △ key to select the H.Position item, then press Menu Key to get the best optimization.
- Use the ▽ & △ key to adjust H.Position value.
- Then press menu key to confirm.



● V.Position

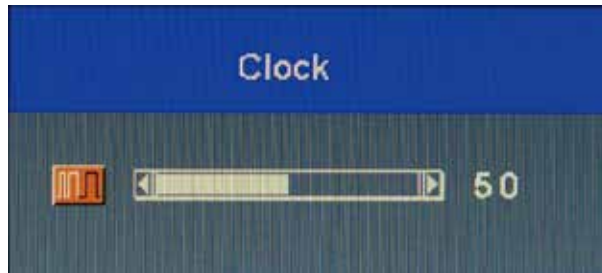
- Use the ▽ & △ key to select the V.Position item, then press Menu Key to get the best optimization.
- Use the ▽ & △ key to adjust V.Position value.
- Then press menu key to confirm.



● Clock

- Use the ▽ & △ key to select the Clock item, then press Menu Key to get the best optimization.
- Use the ▽ & △ key to adjust increase or decrease video H Size of the picture.
- Then press menu key to confirm.

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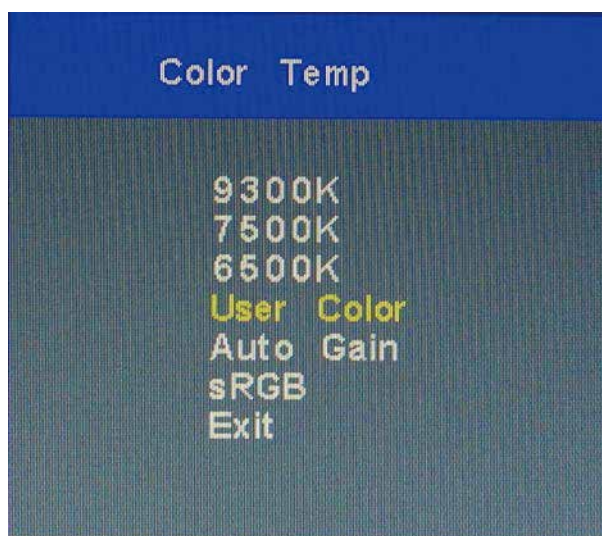
● Phase

- Use the ▽ & △ key to select the Phase item, then press Menu Key to get the best optimization.
- Use the ▽ & △ key to adjust increase or decrease video Quality of the picture.
- Then press menu key to confirm.



Color Temperture

- Use the ▽ & △ key to select the Color Temp  item, then press Menu Key to get the language selection.
- Use the ▽ & △ key to select the adjust the display color of the picture.



- Use the ▽ & △ key to select temperature 9300K, 7500K and 6500K of the picture.

● User Color

- Use the ▽ & △ key to select User Color, then press Menu Key to get the best color optimization.
- Use the ▽ & △ key to select Red, Green & Blue to adjust the display user color of the picture.

AD Board Specification




- **Auto Gain**

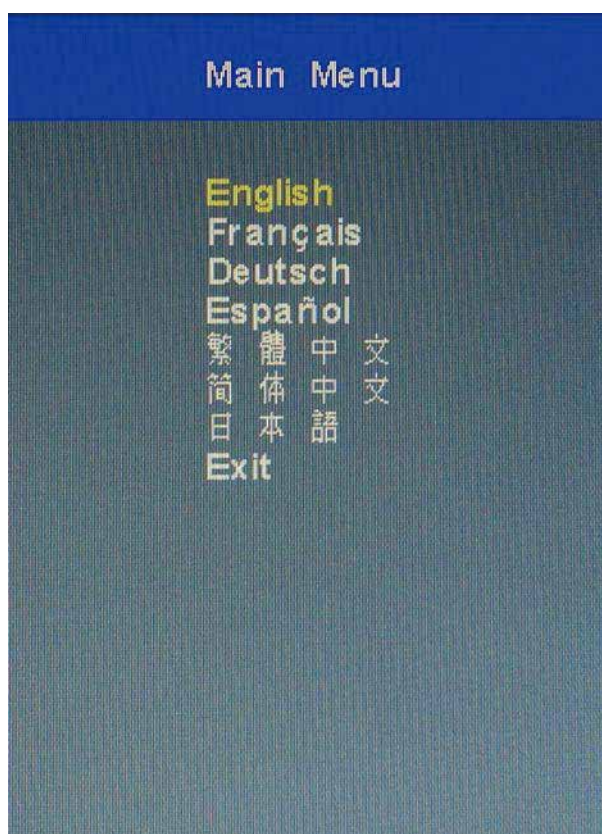
- Use the ▽ & △ key to select Auto Gain, then press Menu Key to get the best color optimization that will be activated the auto adjusting input video color level for the picture.

- **sRGB**

- Use the ▽ & △ key to select SRGB, then press Menu Key to get the best color optimization.


Language Setting

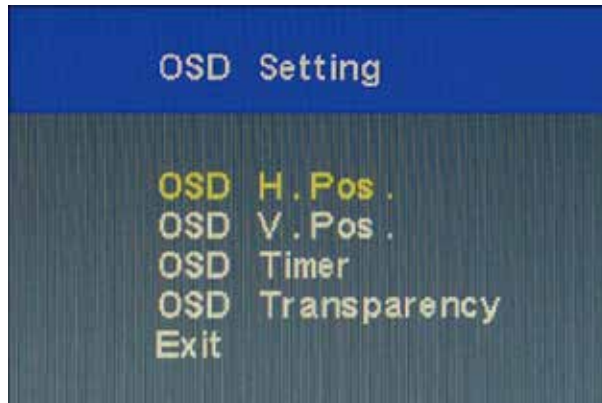
- Use the ▽ & △ key to select the Language  item, then press Menu Key to get the language selection.
- Use the ▽ & △ key to select the Language.
- Then press Menu key to confirm.




AD Board Specification

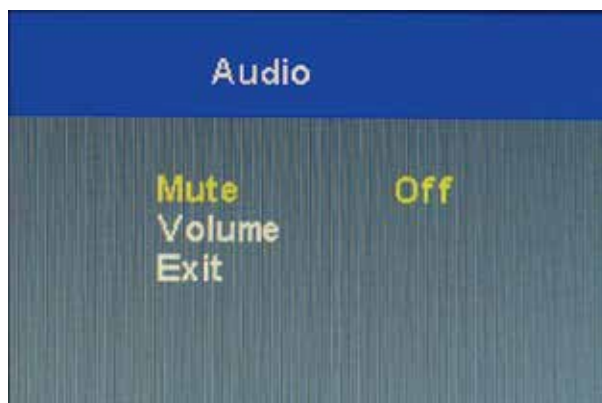
OSD Setting

- Use the ▽ & △ key to select the OSD Setting  item, then press Menu Key to get the OSD setting selection.
- You could set up the property of Position, Display Timer, and Transparency of OSD menu.



Volume

- Use the ▽ & △ key to select the Volume  item, then press Menu Key to get the Volume setting.
- Use the ▽ & △ key to select Volume and mute on/off.
- Use menu key to select Mute on / off
- Then select Exit to the last page.



Recall

- Use the ▽ & △ key to select the Recall  item, then press Menu Key to get the default setting.

Trouble Shooting

If your monitor fails to operate correctly, consult the following chart for possible solution before calling for repairs/RMA.

Condition	Possible Solution
The screen is not synchronized?	<ol style="list-style-type: none">1. Check if the signal cable is firmly seated in the socket.2. Check if the output level matches the input level of your computer.3. Make sure the signal timings of the computer system are within the specification of the monitor.4. If your computer was working with a CRT monitor, you should check the current signal timing and turn off your computer before you connect the VGA Cable to this monitor.
The Picture does not appear?	<ol style="list-style-type: none">5. Make sure the power cord is plugged into the power outlet and into the back of the monitor.6. Check if the signal cable is firmly seated in the socket.7. Check if the Power is ON at the computer8. Check if the brightness control is at the appropriate position, not at the minimum.
The position of the screen is not in the center?	<ol style="list-style-type: none">9. Press the Auto button. Adjust the image position using the Horizontal Position and/or Vertical Position in OSD Main Controls.
The screen is too bright/dark.	<ol style="list-style-type: none">10. Check if the brightness or contrast control is at the appropriate position, not at the Maximum/Minimum.