SPECIFICATION
FOR
APPROVAL

( ) **Preliminary Specification**
(●) **Final Specification**

Title	19.0” WXGA TFT LCD

BUYER	
MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LC190WX1
SUFFIX	TLG1

*When you obtain standard approval,
please use the above model name without suffix

APPROVED BY	SIGNATURE / DATE
/	
/	
/	

Please return 1 copy for your confirmation with your signature and comments.

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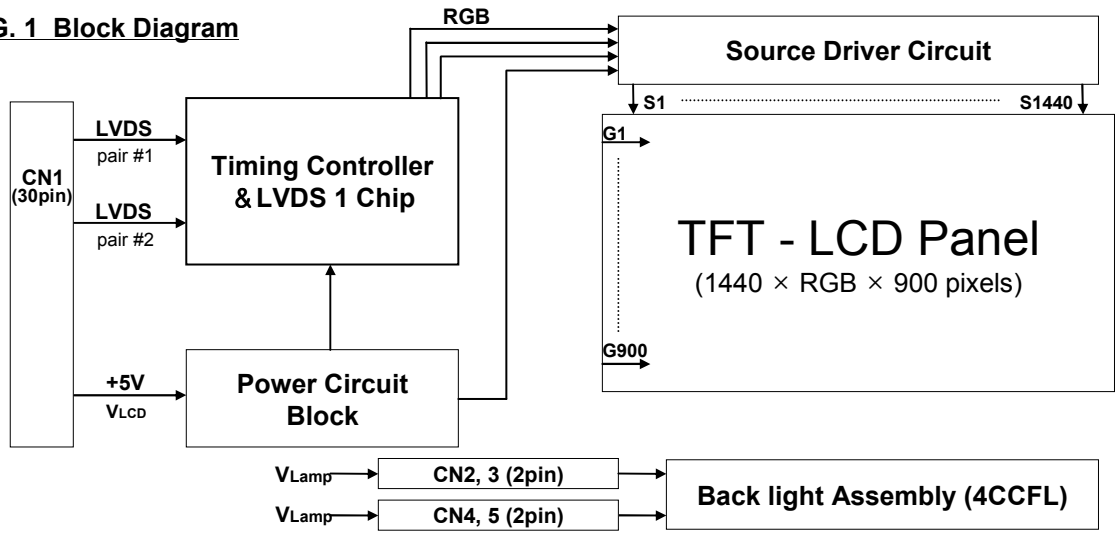
RECORD OF REVISIONS

Revision No.	Revision Date	Page	Description
1.0	Dec. 30, 2008	-	Final Draft

1. General Description

LC190WX1-TLG1 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 WXGA+ resolution (900 vertical by 1440 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.

FIG. 1 Block Diagram



General Features

Active screen size	18.95 inches (481.33mm) diagonal (Aspect ratio 16:10)
Outline Dimension	428.0(H) x 278.0(V) x 16.5(D) mm(Typ.)
Pixel Pitch	0.2835(H)mm x 0.2835(V)mm
Pixel Format	1440 horizontal By 900 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 23.12 Watt(Typ.), (3.6 W@V_{LCD} , 19.52 W@[Lamp=6.5mA])
Weight	1,720g(Typ.)
Display operating mode	Transmissive mode, normally White
Surface treatments	Hard coating (3H), Anti-glare treatment of the front polarizer

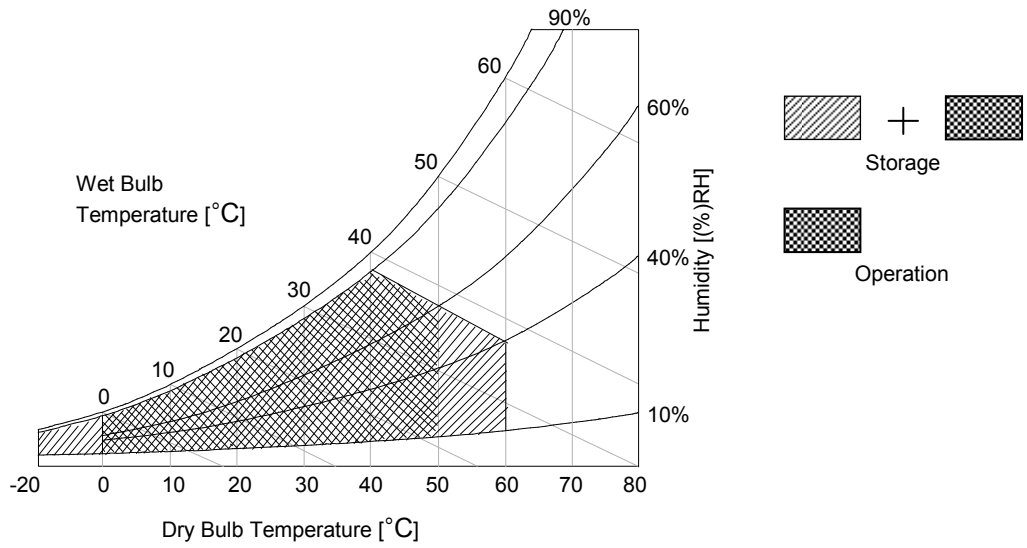
2. Absolute Maximum Ratings

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

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Value		Unit	Remark
			Min	Max		
Power Input Voltage	LCD circuit	V_{LCD}	-0.3	+6.0	V [DC]	at 25℃
B/L Input voltage	Operating Voltage (one side)	V_{OP}	735	853	V[RMS]	at 25 °C ± 2°C Burst Dimming Duty 100%
Operating Temperature		T_{OP}	0	+50	°C	Note 1
Storage Temperature		T_{ST}	-20	+60	°C	
Operating Ambient Humidity		H_{OP}	10	90	%RH	
Storage Humidity		H_{ST}	10	90	%RH	

Notes : 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.
2. Gravity mura can be guaranteed under 40℃ condition.



3. Electrical Specifications

3-1. Electrical Characteristics

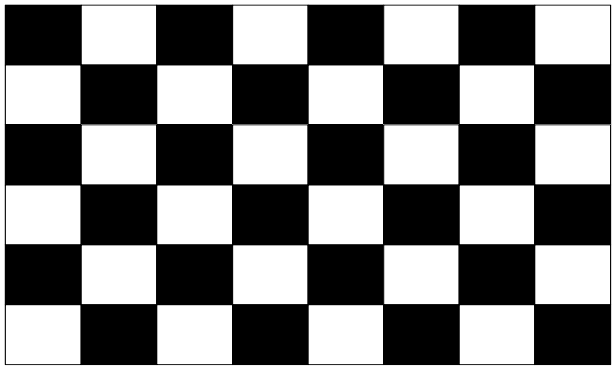
It requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second input power for the CCFL/Backlight, is typically generated by an inverter. The inverter is an external unit to the LCDs.

Table 2. ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Value			Unit	Note
		Min	Typ	Max		
Circuit :						
Power Input Voltage	V_{LCD}	4.5	5.0	5.5	V_{DC}	
Power Input Current	I_{LCD}	-	720	936	mA	1
		-	830	1079	mA	2
Power Consumption	P_{LCD}	-	3.6	4.68	Watt	1
Rush current	I_{RUSH}	-	-	3.0	A	3

Notes : 1. The specified current and power consumption are under the V_{LCD}=12.0V, 25 ± 2°C, f_V=60Hz condition whereas mosaic pattern(8 x 6) is displayed and f_V is the frame frequency.
2. The current is specified at the maximum current pattern (black pattern).
3. The duration of rush current is about 2ms and rising time of power input is 0.5ms ± 20%.

White : 255Gray
Black : 0Gray



Mosaic Pattern(8 x 6)

Table 3. Electrical Characteristics

Parameter		Symbol	Values			Unit	Notes
			Min	Typ	Max		
LAMP :							
Operating Voltage		V_{BL}	735(7.0mA)	750(6.5mA)	853(3.0mA)	V_{RMS}	1, 2
Operating Current		I_{BL}	3.0	6.5	7.0	mA_{RMS}	1
Established Starting Voltage		Vs					1, 3
	at 25 °C				1250	V_{RMS}	
	at 0 °C				1550	V_{RMS}	
Operating Frequency		f_{BL}	40	-	80	kHz	4
Discharge Stabilization Time		T_S	-	-	3	Min	1, 5
Power Consumption		P_{BL}		19.52	21.47	Watt	6
Life Time			50,000	-		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.

1. Specified values are for a single lamp.
2. Operating voltage is measured at 25 ± 2°C. The variance of the voltage is ± 10%.
3. 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.

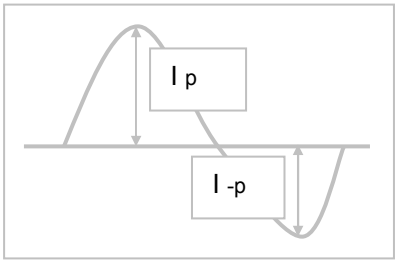
4. Lamp frequency may produce interface with horizontal synchronous frequency and as a result this may cause beat on the display. Therefore lamp frequency shall be as away possible from the horizontal synchronous frequency and from its harmonics in order to prevent interference.
5. Let's define the brightness 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%.
6. The lamp power consumption shown above does not include loss of external inverter.
   The used lamp current is the lamp typical current. ($P_{BL} = V_{BL} \times I_{BL} \times N_{Lamp}$)
7. 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 ± 2°C.

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 $\sqrt{2}$ ±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 (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 edgy type back light with over 4 parallel lamps, input current and voltage wave form should be synchronized

3-2. Interface Connections

This LCD employs Two interface connections, a 30 pin connector is used for the module electronics and 2Pin / 2Pin Connector is used for the scanning backlight system.

3-2-1. LCD Module

LCD connector(CN1) : 187024-30091 (P-TWO) , IS100-L30B-C23 (UJU)
Mating connector : FI-X30H and FI-X30HL (JAE) or Equivalent

Table 4. MODULE CONNECTOR(CN1) PIN CONFIGURATION

Pin No.	Symbol	Description	Note
1	RXO0-	Minus signal of 1st channel 0 (LVDS)	
2	RXO0+	Plus signal of 1st channel 0 (LVDS)	
3	RXO1-	Minus signal of 1st channel 1 (LVDS)	
4	RXO1+	Plus signal of 1st channel 1 (LVDS)	
5	RXO2-	Minus signal of 1st channel 2 (LVDS)	
6	RXO2+	Plus signal of 1st channel 2 (LVDS)	
7	GND	Ground	2
8	RXOC-	Minus signal of 1st clock channel (LVDS)	
9	RXOC+	Plus signal of 1st clock channel (LVDS)	
10	RXO3-	Minus signal of 1st channel 3 (LVDS)	
11	RXO3+	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 clock channel 2(LVDS)	
19	RXE2+	Plus signal of 2nd clock channel 2 (LVDS)	
20	RXEC-	Minus signal of 2nd clock channel (LVDS)	
21	RXEC+	Plus signal of 2nd clock channel (LVDS)	
22	RXE3-	Minus signal of 2nd channel 3 (LVDS)	
23	RXE3+	Plus signal of 2nd channel 3 (LVDS)	
24	GND	Ground	
25	NC	No Connection (For LCD internal use only)	1
26	NC	No Connection (For LCD internal use only)	1
27	PWM_OUT	Reference signal for burst frequency inverter control	5
28	VLCD	Power Supply +5.0V	3
29	VLCD	Power Supply +5.0V	3
30	VLCD	Power Supply +5.0V	3

Notes: 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.

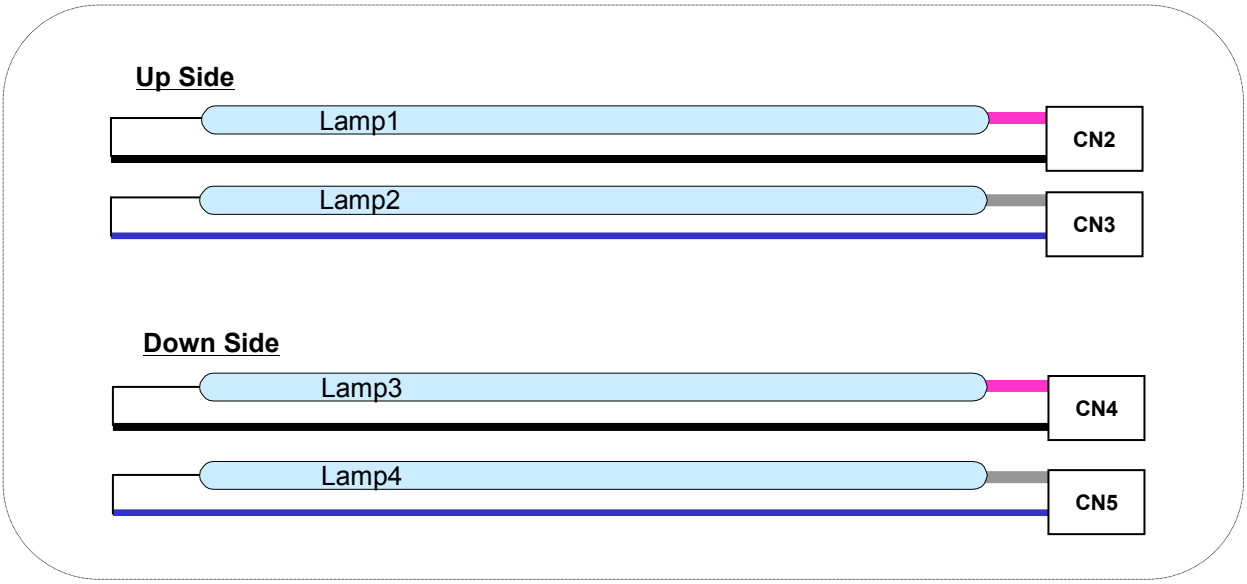
3-2-2. Backlight Module

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	HV	High Voltage for Lamp	1
2	LV	Low Voltage for Lamp	2

Note : 1. The high voltage power terminal is colored Pink, Gray.
2. The low voltage pin color is Black, Blue.
3. The backlight ground should be common with LCD metal frame.



3-3. Signal Timing Specifications

Table 6 shows the signal timing required at the input of the LVDS transmitter. All of the interface signal timing should be satisfied with the following specification for normal operation.

Table 6. TIMING TABLE (DE Only Mode)

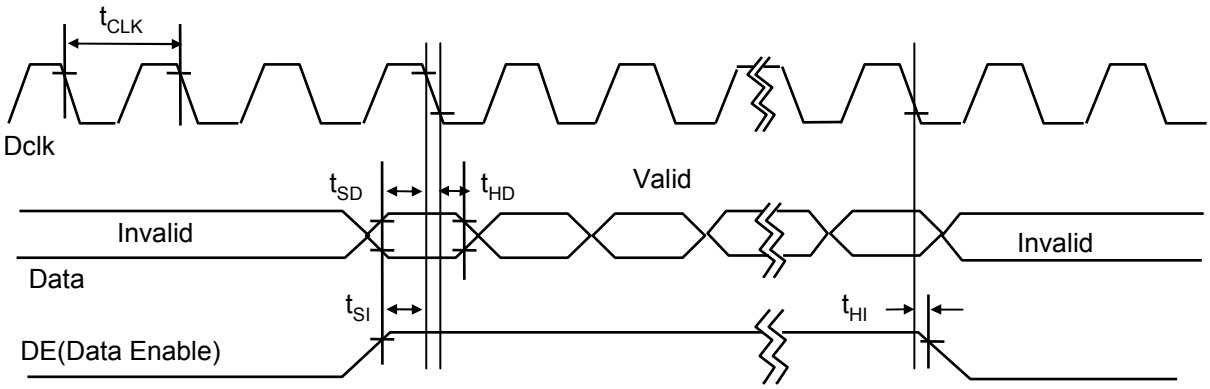
Parameter		Symbol	Min.	Typ.	Max.	Unit	Notes
D_{CLK}	Period	t_{CLK}	14.5	19.3	25.2	ns	Pixel frequency : Typ. 103.8MHz
	Frequency	f_{CLK}	39.7	51.9	69.0	MHz	
Horizontal	Horizontal Valid	t_{HV}	720	720	720	t_{CLK}	
	H Period Total	t_{HP}	880	920	972		
	Hsync Frequency	f_H	45.1	56.4	71.0	kHz	
Vertical	Vertical Valid	t_{VV}	900	900	900	t_{HP}	
	V Period Total	t_{VP}	920	940	1025		
	Vsync Frequency	f_V	49	60	75	Hz	
DE (Data Enable)	DE Setup Time	t_{SI}	4	-	-	ns	For D_{CLK}
	DE Hold Time	t_{HI}	4	-	-		
Data	Data Setup Time	t_{SD}	4	-	-	ns	For D_{CLK}
	Data Hold Time	t_{HD}	4	-	-		

Note:

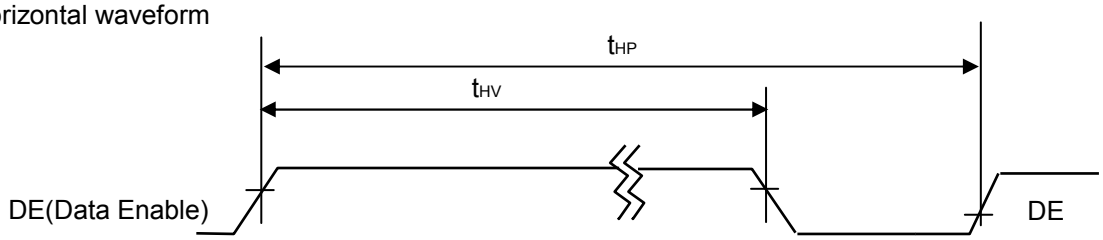
1. DE Only mode operation. The input of Hsync & Vsync signal does not have an effect on LCD normal operation.
2. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rates.
3. Horizontal period should be even.

3-4. Signal Timing Waveforms

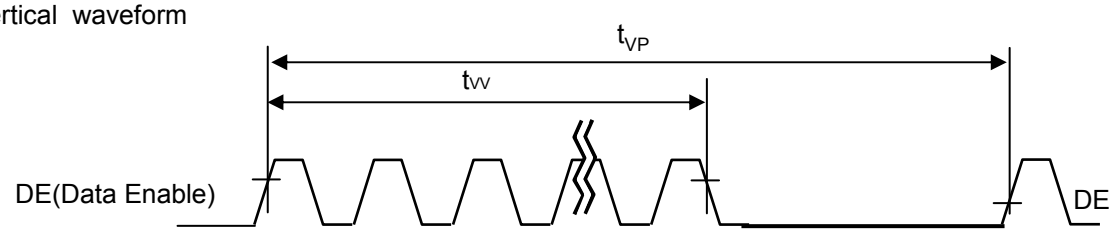
1. DCLK , DE, DATA waveforms



2. Horizontal waveform



3. Vertical waveform



3-5. Color Data Reference

The brightness of each primary color(red,green,blue) is based on the 8-bit gray scale data input for the color. The higher binary input, the brighter the color. Table 7 provides a reference for color versus data input.

Table 7. COLOR DATA REFERENCE

Color		Input Color Data																							
		RED								GREEN								BLUE							
		MSB							LSB	MSB							LSB	MSB							LSB
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green (255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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	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	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	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	1
RED	RED (000) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (001)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	...					...								...								...			
	RED (254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN (000) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN (001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	...					...								...								...			
	GREEN (254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	GREEN (255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
BLUE	BLUE (000) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BLUE (001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	...					...								...								...			
	BLUE (254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	BLUE (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

3-6. Power Sequence

3-6-1. LCD Driving circuit

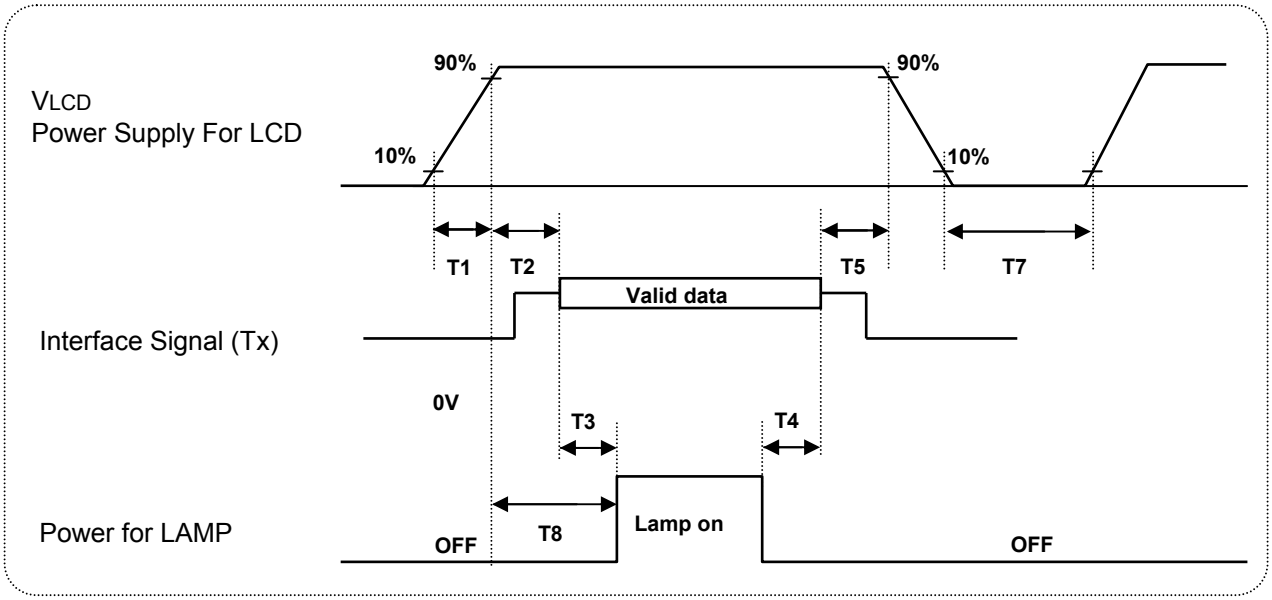


Table 8. POWER SEQUENCE

Parameter	Values			Units	Notes
	Min	Typ	Max		
T1	0.5	-	10	ms	
T2	0.01	-	50	ms	5
T3	500	-	-	ms	3, 5
T4	200	-	-	ms	3
T5	0.01	-	50	ms	
T7	1	-	-	s	4
T8	T2+T3	-	3	s	5

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. The T3/T4 is recommended value, the case when failed to meet a minimum specification abnormal display would be shown. There is no reliability problem.
4. T7 should be measured after the Module has been fully discharged between power off and on period.
5. T2+T3 < T8 MAX VALUE.

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 and equal to 0 °.
FIG. 1 shows additional information concerning the measurement equipment and method.

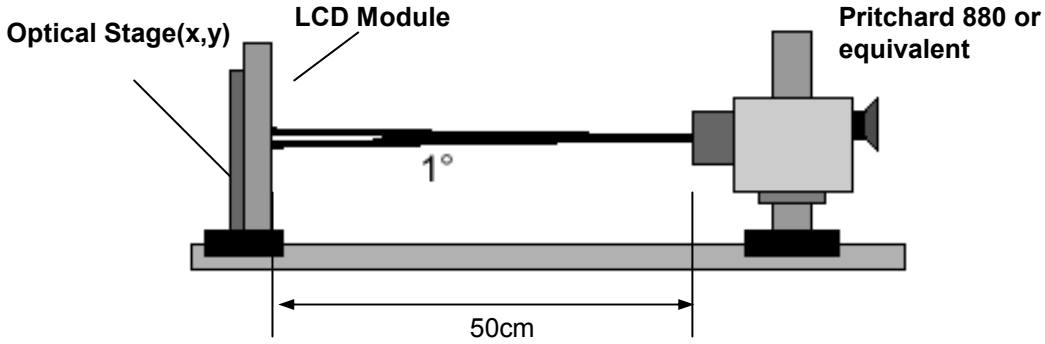


FIG. 1 Optical Characteristic Measurement Equipment and Method

Table 9. OPTICAL CHARACTERISTICS Ta= 25°C, V_{LCD}=5.0V, fv=60Hz, f_{CLK}=51.9MHz, I_{BL}=6.5mA

Parameter		Symbol	Value			Unit	Note
			Min	Typ	Max		
Contrast Ratio		CR	700	1000	-		1
Surface Luminance, white		L_{WH}	250	300	-	cd/m^2	2
Luminance Variation		δ_{WHITE} 5P	75			%	3
Response Time	Rise Time	Tr_R	-	1.3	2.6	ms	4
	Decay Time	Tr_D	-	3.7	7.4	ms	4
Color Coordinates [CIE1931]	RED	Rx	Typ -0.03	0.641	Typ +0.03		
		Ry		0.335			
	GREEN	Gx		0.298			
		Gy		0.611			
	BLUE	Bx		0.147			
		By		0.070			
	WHITE	Wx		0.313			
		Wy		0.329			
Viewing Angle (CR>10)							
	x axis, right(ϕ=0°)	θr	70	85	-	degree	5
	x axis, left (ϕ=180°)	θl	70	85	-		
	y axis, up (ϕ=90°)	θu	60	75	-		
	y axis, down (ϕ=270°)	θd	70	85	-		
Gray Scale			-	-	-		6
Cross Talk					1.5	%	

Note :1. Contrast Ratio(CR) is defined mathematically as :

$$CR = \frac{\text{Surface Luminance at all white pixels}}{\text{Surface Luminance at all black pixels}}$$

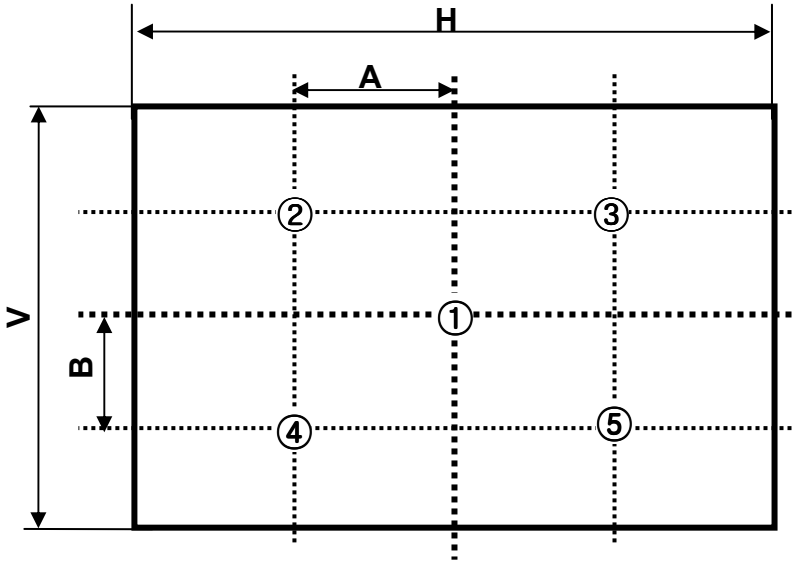
It is measured at center 1-point.

2. Surface luminance is the luminance value at center 1-point across the LCD surface 50cm from the surface with all pixels displaying white. For more information see the FIG. 2.
3. The variation in surface luminance , δ WHITE is defined as :
   δ WHITE(5P) = Maximum(L_{on1},L_{on2}, L_{on3}, L_{on4}, L_{on5}) / Minimum(L_{on1},L_{on2}, L_{on3}, L_{on4}, L_{on5})
   Where L_{on1} to L_{on5} are the luminance with all pixels displaying white at 5 locations .
   For more information, see the FIG. 2.
4. Response time is the time required for the display to transition from black to white (Decay Time, TrD) and from white to black (Rise Time, TrR)
   The sampling rate is 2,500 sample/sec. For additional information see FIG. 3.
5. Viewing angle is the angle at which the contrast ratio is greater than 10. 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 module surface. For more information, see the FIG. 4.
6. Gray scale specification
   For more information, see the Table 10.

Table 10. GRAY SCALE SPECIFICATION

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

Measuring point for surface luminance & measuring point for luminance variation.



A : H / 4 mm
B : V / 4 mm
@ H,V : Active Area

FIG. 2 5 Points for Luminance Measure

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

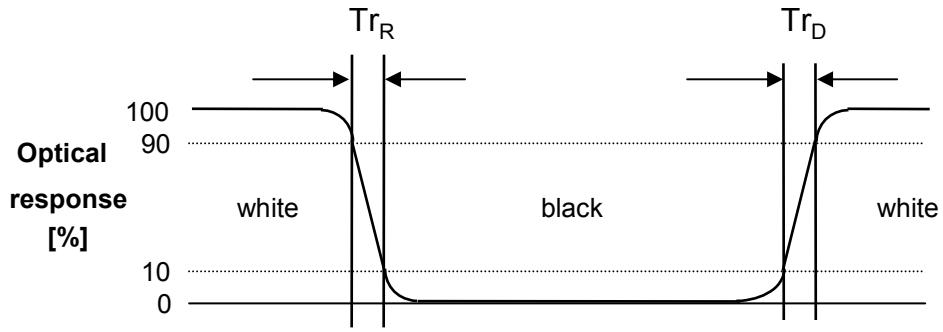


FIG. 3 Response Time

Dimension of viewing angle range

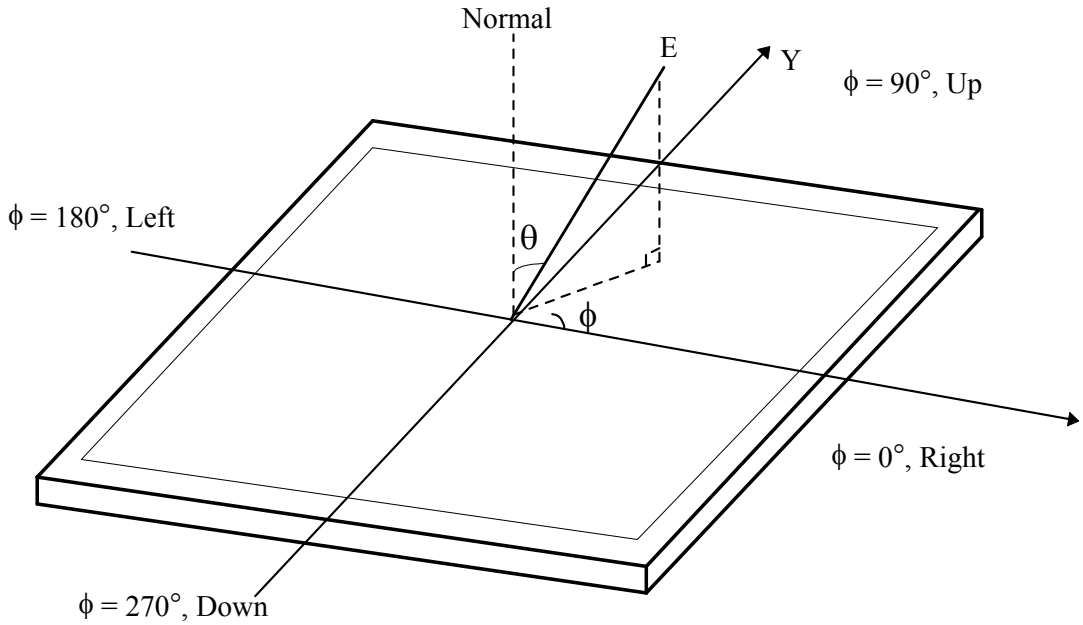


FIG. 4 Viewing Angle

5. Mechanical Characteristics

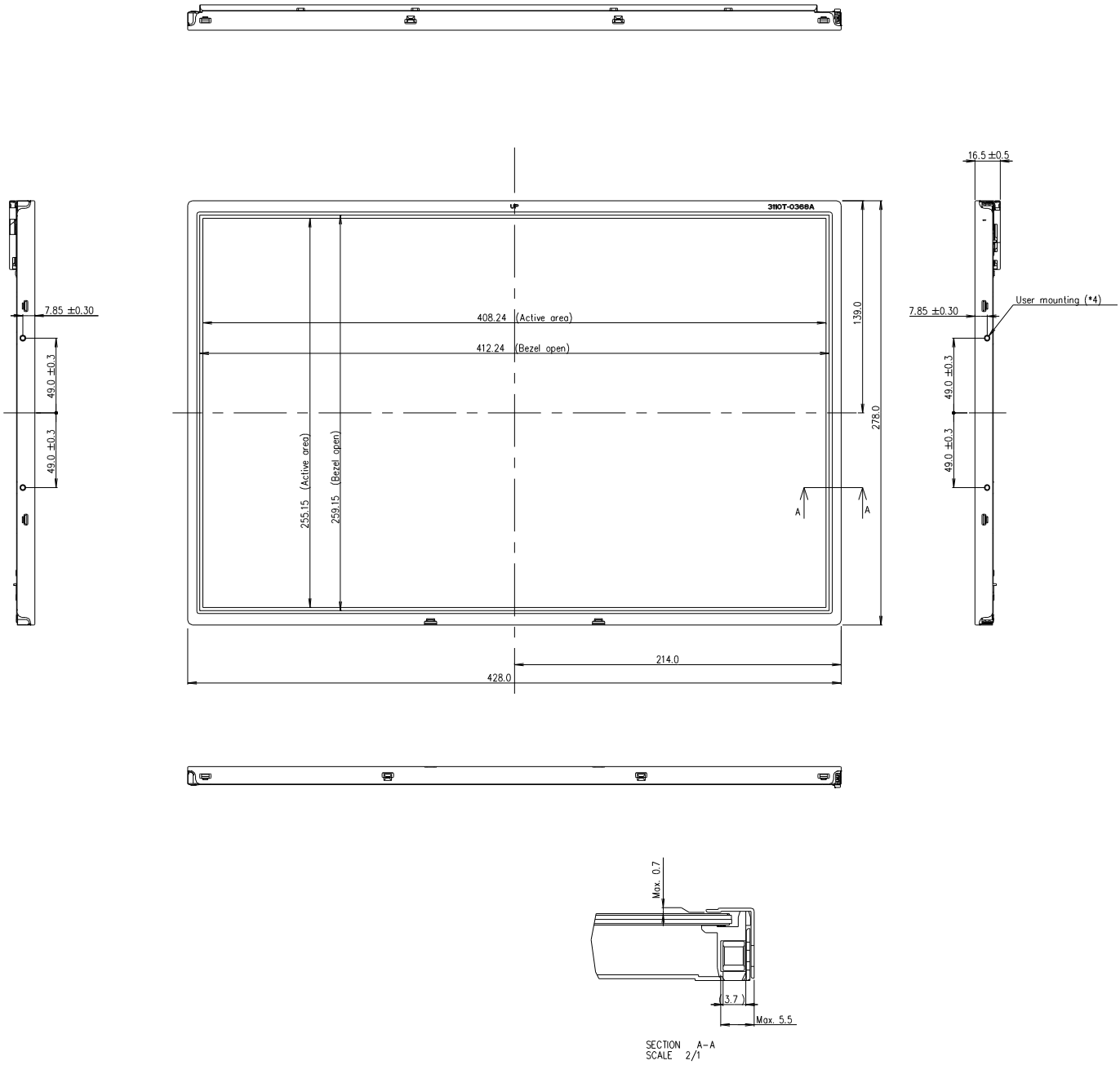
Table 11 provides general mechanical characteristics.

Table 11. MECHANICAL CHARACTERISTICS

Item	Value	
Outline Dimension	Horizontal	428.0 mm
	Vertical	278.0 mm
	Depth	16.5 mm
Bezel Area	Horizontal	412.24 mm
	Vertical	259.15 mm
Active Display Area	Horizontal	408.24 mm
	Vertical	255.15 mm
Weight	1,720g (Typ.) 1,800g (Max)	
Surface treatment	Hard coating(3H) Anti-glare treatment of the front polarizer	

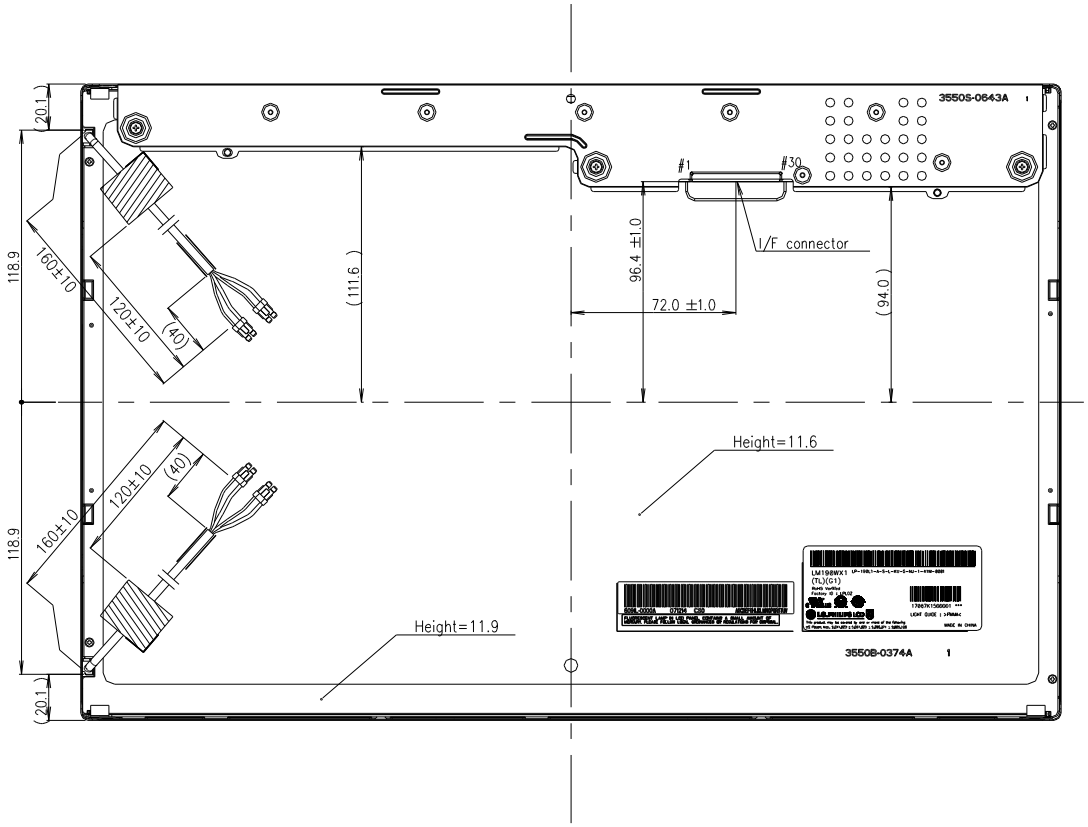
Note : Please refer to a mechanic drawing in terms of tolerance at the next page.

<FRONT VIEW>

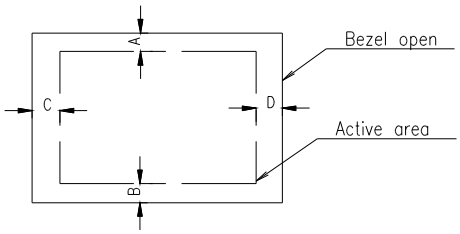

3110T-0368A
7.85 ±0.30
49.0 ±0.3
49.0 ±0.3
408.24 (Active area)
412.24 (Bezel open)
255.15 (Active area)
259.15 (Bezel open)
139.0
278.0
214.0
428.0
A
A
16.5 ±0.5
7.85 ±0.30
User mounting (*4)
49.0 ±0.3
49.0 ±0.3

Max. 0.7
3.7
Max. 5.5
SECTION A-A
SCALE 2/1

<REAR VIEW>



Notes
1. Backlight : 4 Cold Cathode Fluorescent Lamps
2. I/F Connector Specification :187024-30091(P-TWO), IS100-L30B-C23(UJU)
3. Lamp Connector Specification
 - 35001HS-02LD(Yeonho) <2pin>
4. Torque of user hole : 3.0~4.0kgf-cm
5. Tilt and partial disposition tolerance of display area as following
 (1) Y-Direction : IA-BI <= 1.0
 (2) X-Direction : IC-DI <= 1.0



6. Gap Between Top case and Glass : Max 0.7mm
7. Lamp(CCFL) lot No. is marked at backlight connector
8. Do not wind conductive tape around the backlight wires
9. Unspecified tolerances to be ±0.5mm

6. Reliability

Table 12. ENVIRONMENT TEST CONDITION

No.	Test Item	Condition
1	High temperature storage test	Ta= 60°C 240h
2	Low temperature storage test	Ta= -20°C 240h
3	High temperature operation test	Ta= 50°C 50%RH 240h
4	Low temperature operation test	Ta= 0°C 240h
5	Vibration test (non-operating)	Wave form : random Vibration level : 1.0Grms Bandwidth : 10-300Hz Duration : X,Y,Z, 20 min One time each direction
6	Shock test (non-operating)	Shock level : 120Grms Waveform : half sine wave, 2ms Direction : ±X, ±Y, ±Z One time each direction
7	Altitude operating storage / shipment	0 - 10,000 ft(3,048m) 0 - 40,000 ft(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.

7. International Standards

7-1. Safety

a) UL 60065, 7th Edition, dated June 30, 2003, Underwriters Laboratories, Inc., Standard for Audio, Video and Similar Electronic Apparatus.
b) CAN/CSA C22.2, No. 60065:03, Canadian Standards Association, Standard for Audio, Video and Similar Electronic Apparatus.
c) IEC60065:2001, 7th Edition CB-scheme and EN 60065:2002, Safety requirements for Audio, Video and Similar Electronic Apparatus..

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) CISPR13 "Limits and Methods of Measurement of Radio interference characteristics of Sound and Television broadcast receivers and associated equipment"
CISPR22 "Limits and Methods of Measurement of Radio interference characteristics of Information Technology Equipment" International Special Committee on Radio Interference.
c) EN55013 "Limits and Methods of Measurement of Radio interference characteristics of Sound and Television broadcast receivers and associated equipment"
EN55022 "Limits and Methods of Measurement of Radio interference characteristics of Information Technology Equipment" European Committee for Electro Technical Standardization.(CENELEC), 1988(Including A1:2000)

8. Packing

8-1. Designation of Lot Mark

a) Lot Mark

A	B	C	D	E	F	G	H	I	J	K	L	M

A,B,C : SIZE(INCH)
D : YEAR
E : MONTH
F : PANEL CODE
G : FACTORY CODE
H : ASSEMBLY CODE
I,J,K,L,M : SERIAL NO.

Note

1. YEAR

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Mark	1	2	3	4	5	6	7	8	9	0

2. MONTH

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mark	1	2	4	4	5	6	7	8	9	A	B	C

b) Location of Lot Mark

Serial NO. is printed on the label. The label is attached to the backside of the LCD module.
This is subject to change without prior notice.

8-2. Packing Form

a) Package quantity in one box : 8 pcs

b) Box Size : 485mm X 280mm X 330mm.

9. Precautions

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

9-1. Mounting Precautions

(1) You must mount a module using specified mounting holes (Details refer to the drawings).
(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 benzine. 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.

9-2. Operating Precautions

(1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage :
V=±200mV(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't be operated its full characteristics perfectly.
(8) A screw which is fastened up the steels should be a machine screw.
(if not, it can causes conductive particles and deal LCM a fatal blow)
(9) Please do not set LCD on its edge.
(10) Partial darkness may happen during 3~5 minutes when LCM is operated initially in condition that luminance is under 40% at low temperature (under 5℃). This phenomenon which disappears naturally after 3~5 minutes is not a problem about reliability but LCD characteristic

9-3. 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.

9-4. Precautions for Strong Light Exposure

Strong light exposure causes degradation of polarizer and color filter.

9-5. 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.

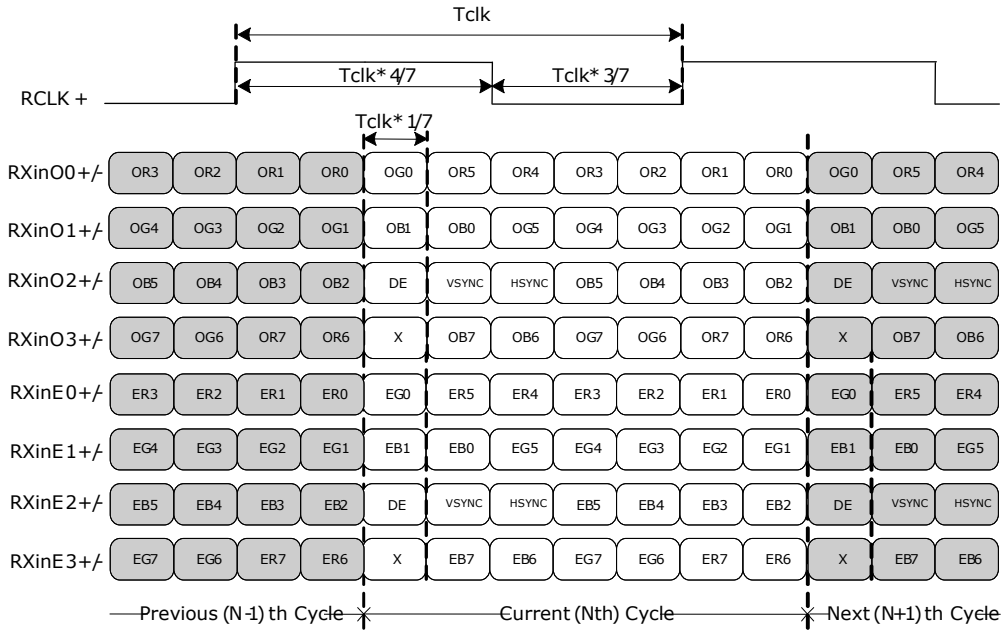
9-6. Handling Precautions for Protection Film

(1) The protection film is attached to the bezel with a small masking tape.
When the 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.
(2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the bezel after the protection film is peeled off.
(3) You can remove the glue easily. When the glue remains on the bezel surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

 # APPENDIX-I

LVDS Data-Mapping info. (8bit)

■ LVDS Data-mapping (VESA format)



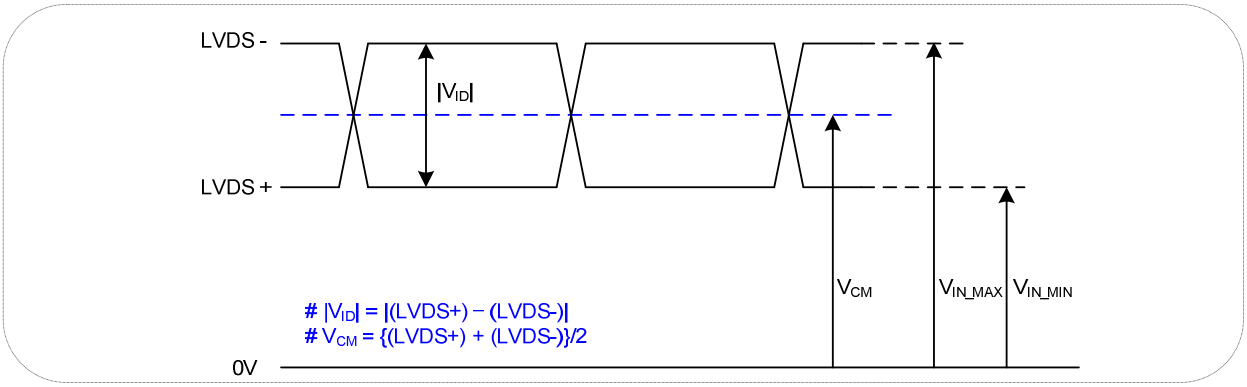
< LVDS Data Format >

MSB	R7
	R6
	R5
	R4
	R3
	R2
	R1
LSB	R0

* ODD = 1st Pixel
EVEN = 2nd Pixel

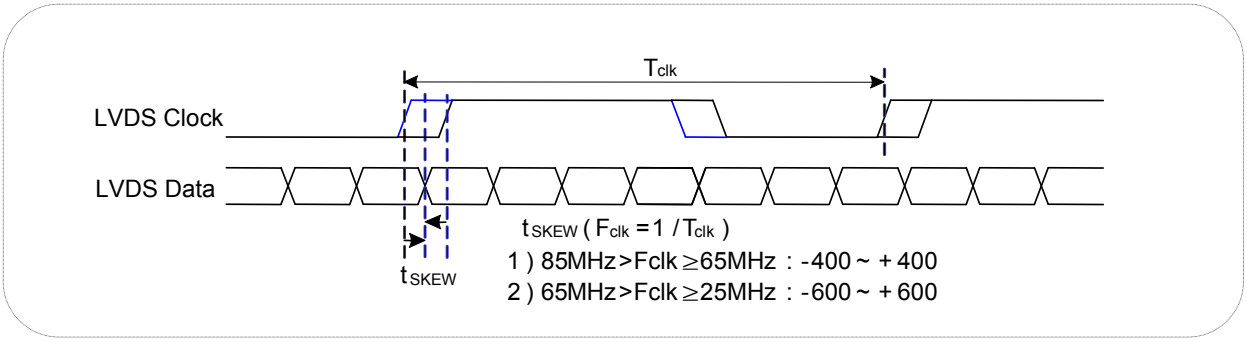
APPENDIX- II

1. DC Specification

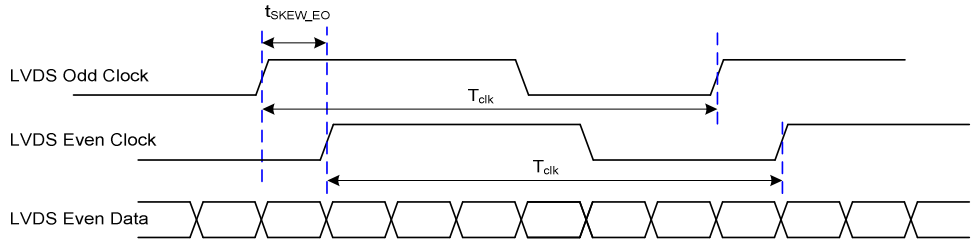


Description	Symbol	Min	Max	Unit	Notes
LVDS Differential Voltage	$\|V_{ID}\|$	200	600	mV	-
LVDS Common mode Voltage	V_{CM}	0.6	1.8	V	-
LVDS Input Voltage Range	V_{IN}	0.3	2.1	V	-

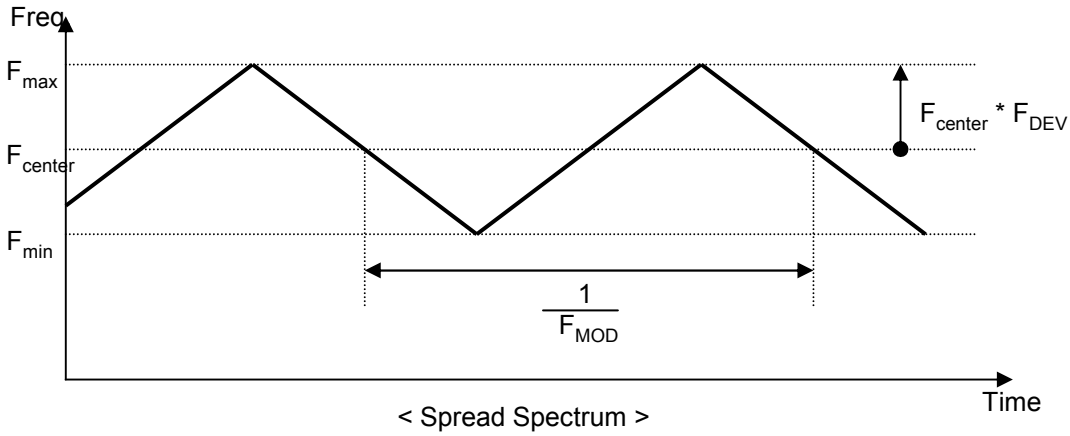
2. AC Specification



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}	-
Maximum deviation of input clock frequency during SSC	F_{DEV}	-	± 3	%	-
Maximum modulation frequency of input clock during SSC	F_{MOD}	-	200	KHz	-



< Clock skew margin between channel >



< Spread Spectrum >