SPECIFICATION
FOR
APPROVAL

( ) Preliminary Specification
(◆) Final Specification

Title	15.6" HD TFT LCD

BUYER	HP
MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LM156WH1
SUFFIX	TLE1

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

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
0.1	Oct. 17. 2008	-	First Draft (Preliminary Specification)
0.2	Dec.19.2008	18	Update for color coordinates
		24	Update for Rear view
0.3	Jan.05.2009	14	Update for Dclk(Min, Max)
1.0	Jan.21.2009		Final specification

1. General Description

The LM156WH1-TLE1 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. This TFT-LCD has 15.6 inches diagonally measured active display area with HD resolution(768 vertical by 1366 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 6-bit gray scale signal for each dot, thus, presenting a palette of more than 262,144 colors.

The LM156WH1-TLE1 has been designed to apply the interface method that enables low power, high speed, low EMI.

The LM156WH1-TLE1 is intended to support applications where thin thickness, low power are critical factors and graphic displays are important. In combination with the vertical arrangement of the sub-pixels, the LM156WH1-TLE1 characteristics provide an excellent flat display for office automation products such as Monitors.

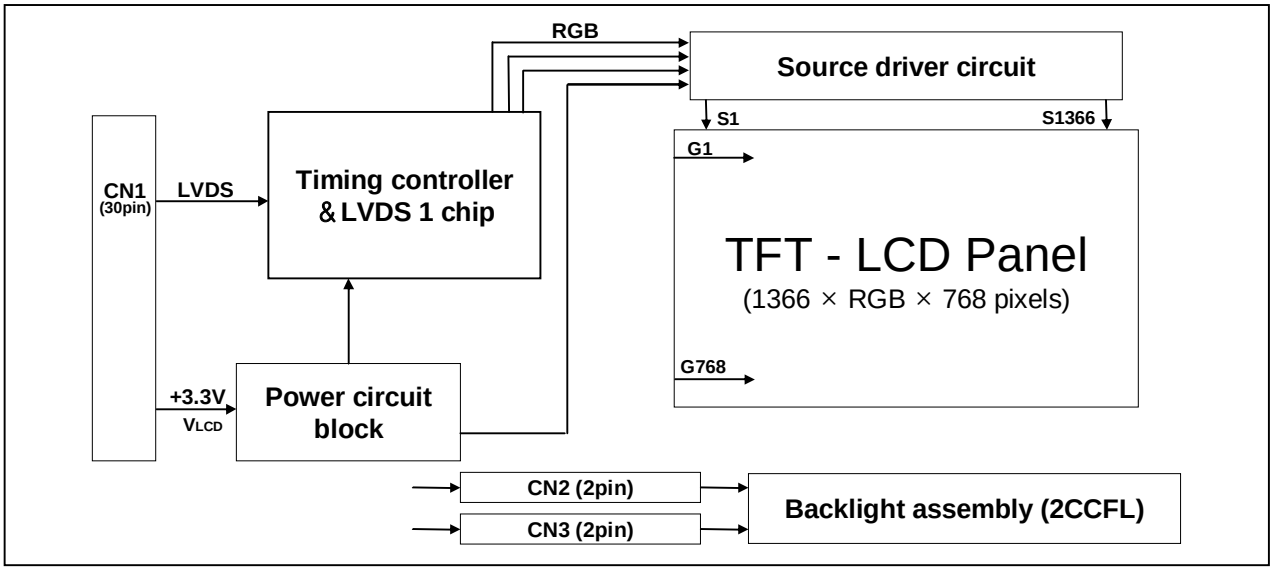


Figure 1. Block diagram

General Features

Active Screen Size	15.6 inches diagonal
Outline Dimension	363.8(H, typ) × 215.9(V, typ) × 12.0(D,typ) [mm]
Pixel Pitch	0.252mm × 0.252 mm
Pixel Format	1366 horiz. By 768 vert. Pixels RGB strip arrangement
Color Depth	6-bit, 262,144 colors
Luminance, White	200 cd/m^2(Typ.Center 1 point)
Power Consumption	Total 12.35 Watt(Typ.) @ LCM circuit 1.55 Watt(Typ.), B/L input 10.80 Watt(Typ.)
Weight	950g (Typ.)
Display Operating Mode	Transmissive mode, normally white
Surface Treatment	Hard Coating(3H), Anti-Glare treatment of the front polarizer
RoHS Comply	Yes

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 Input Voltage	VCC	-0.3	4.0	Vdc	at 25 ± 5°C
Operating Temperature	TOP	0	50	°C	1
Storage Temperature	HST	-20	60	°C	1
Operating Ambient Humidity	HOP	10	90	%RH	1
Storage Humidity	HST	10	90	%RH	1

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.

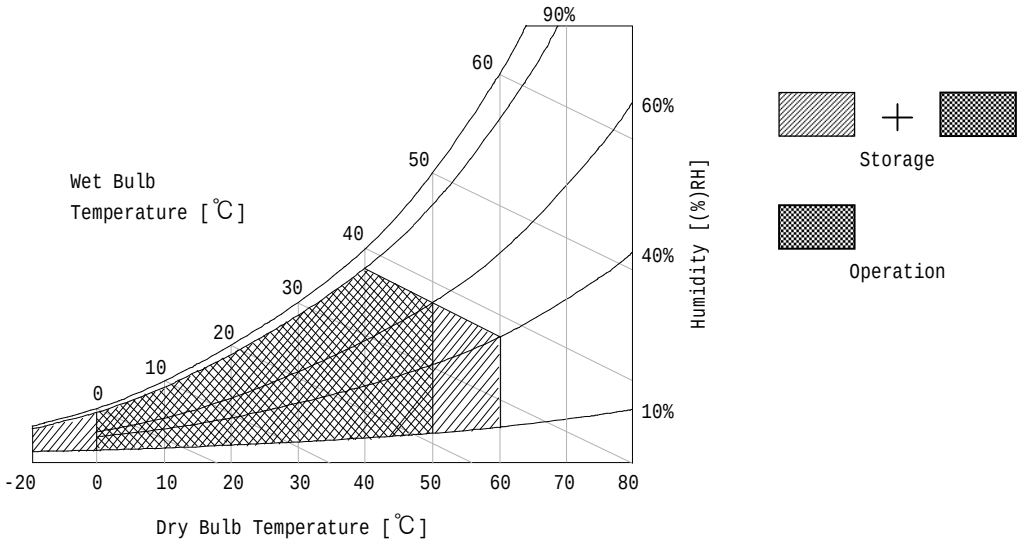


Figure 2. Temperature and relative humidity

3. Electrical specifications

3-1. Electrical characteristics

The LM156WH1-TLE1 requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. Another which powers the CCFL, is typically generated by an inverter. The inverter is an external unit to the LCD.

Table 2_1. ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Values			Unit	Notes
		Min	Typ	Max		
MODULE :						
Power Supply Input Voltage	V_{LCD}	3.0	3.3	3.6	Vdc	
Power Supply Input Current	I_{LCD_MOSAIC}	-	470	540	mA	1
	I_{LCD_BLACK}	-	580	670	mA	2
Power Consumption	P_{LCD}	-	1.55	1.78	Watt	1
Rush current	I_{RUSH}	-	-	2	A	3

Note :
1. The specified current and power consumption are under the V_{LCD}=3.3V, 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.
3. The duration of rush current is about 2ms and rising time of power Input is 500us ± 20%.(min.).

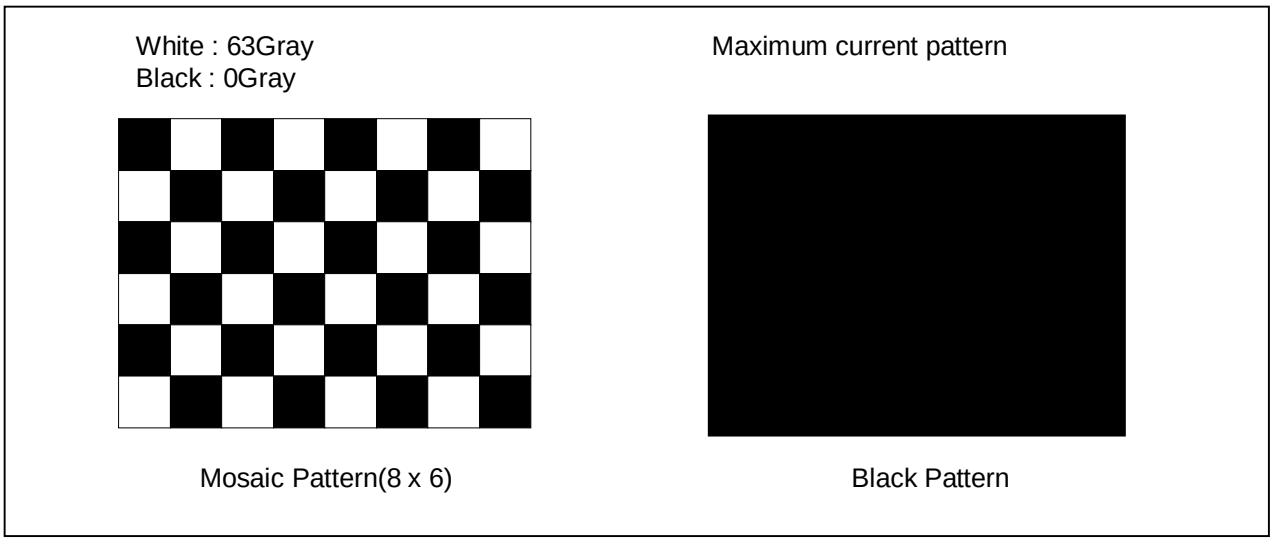


Figure 3. Current Pattern

Table 2_2. ELECTRICAL CHARACTERISTICS

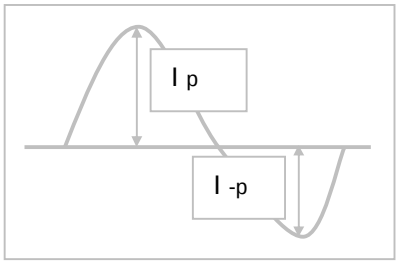
Parameter	Symbol	Values			Unit	Notes
		Min	Typ	Max		
LAMP :						
Operating Voltage	V_{BL}	590 (9.5mA)	600 (9.0mA)	780 (2.5mA)	V_{RMS}	1, 2
Operating Current	I_{BL}	2.5	9.0	9.5	mA_{RMS}	1
Established Starting Voltage	Vs					1, 3
at 25 °C				1100	V_{RMS}	
at 0 °C				1300	V_{RMS}	
Operating Frequency	f_{BL}	40	60	70	kHz	4
Discharge Stabilization Time	Ts			3	Min	1, 5
Power Consumption	P_{BL}		10.8	11.88	W	6
Life Time		35,000			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.

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 (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

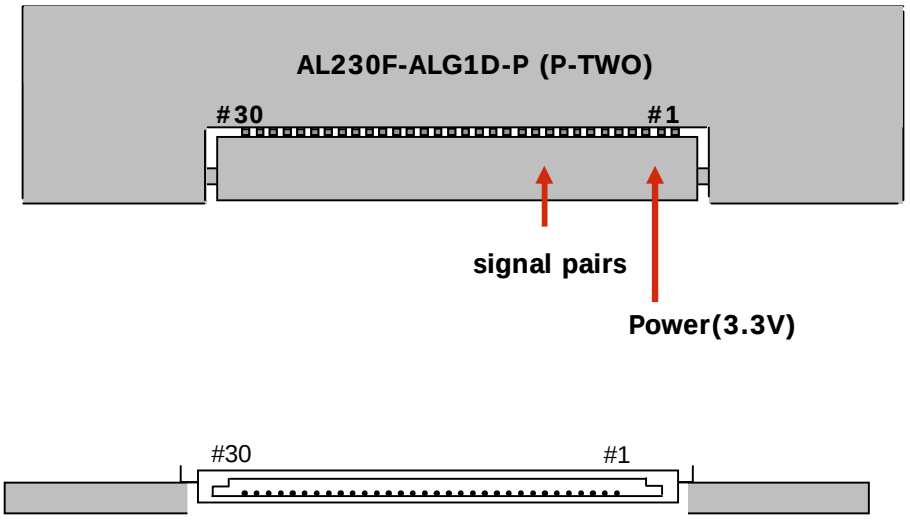
a) LCD connector(CN1) : AL230F-ALG1D-P (Manufactured by P-TWO), and IS100-L30R-C23(UJU)

b) Mating connector : FI-X30H and FI-X30HL (Manufactured by JAE) or Equivalent

c) Interface chips(System) : THC63LVDF823A or equivalent
* Pin to Pin compatible with LVDS

Table 3. Module connector pin configuration

Pin	Symbol	Description
1	GND	Ground
2	VCC	Power Supply, 3.3V Typ.
3	VCC	Power Supply, 3.3V Typ.
4	NC	No connection
5	NC	No connection(For LCD internal use only)
6	NC	No connection(For LCD internal use only)
7	NC	No connection(For LCD internal use only)
8	Odd_R_{IN} 0-	Negative LVDS differential data input
9	Odd_R_{IN} 0+	Positive LVDS differential data input
10	GND	Ground
11	Odd_R_{IN} 1-	Negative LVDS differential data input
12	Odd_R_{IN} 1+	Positive LVDS differential data input
13	GND	Ground
14	Odd_R_{IN} 2-	Negative LVDS differential data input
15	Odd_R_{IN} 2+	Positive LVDS differential data input
16	GND	Ground
17	Odd_CLKIN-	Negative LVDS differential clock input
18	Odd_CLKIN+	Positive LVDS differential clock input
19	GND	Ground
20	NC	No Connection
21	NC	No Connection
22	NC	No Connection
23	NC	No Connection
24	NC	No Connection
25	NC	No Connection
26	NC	No Connection
27	NC	No Connection
28	NC	No Connection
29	NC	No Connection
30	NC	No Connection



Rear view of LCM

[Figure 4] Connector diagram

Notes: 1. All GND(ground) pins should be connected together and should also be connected to the LCD's metal frame.

2. All V_{CC}(power input) pins should be connected together.

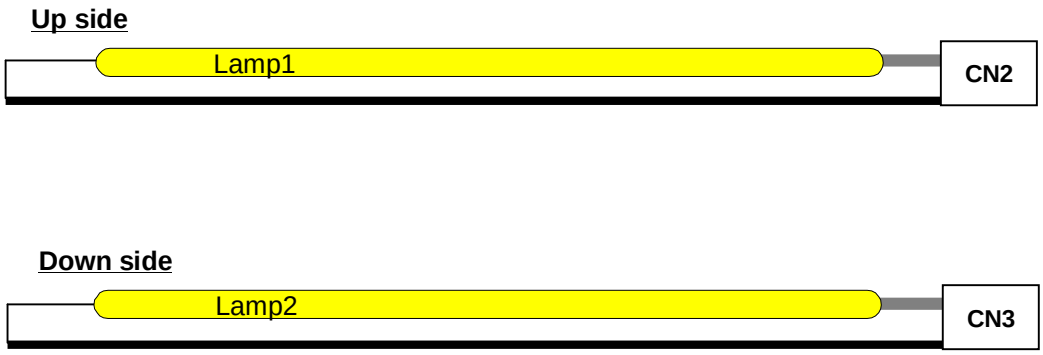
3. All NC pins should be separated from other signal or power.

The backlight interface connector is a model 35001HS-02LD(YEONHO).
The mating connector part number is **35001WR-02L or equivalent**.
The pin configuration for the connector is shown in the table 4.

Table 4. Backlight connector pin configuration

Pin	Symbol	Description	Notes
1	HV	High Voltage for lamp	1
2	LV	Low Voltage for lamp	1,2

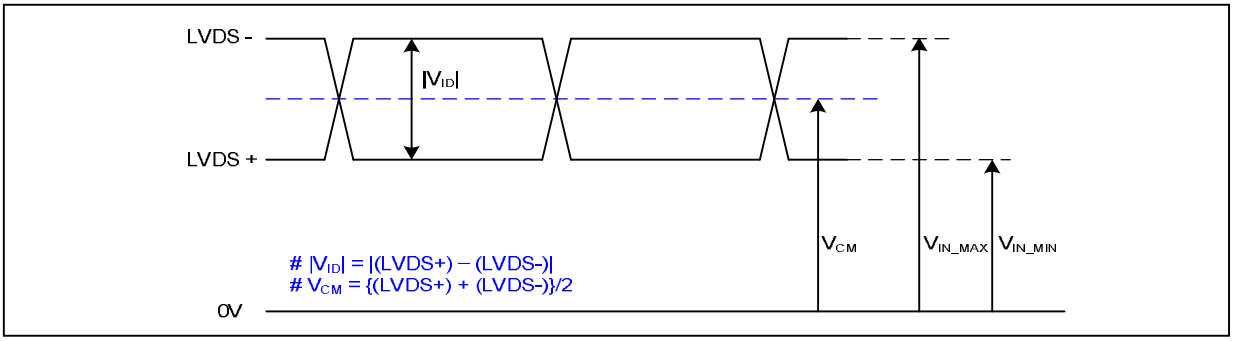
Notes : 1. The high voltage side terminal is colored gray. The low voltage side terminal is black.
2. The backlight ground should be common with LCD metal frame.



[Figure 5] Backlight connector view

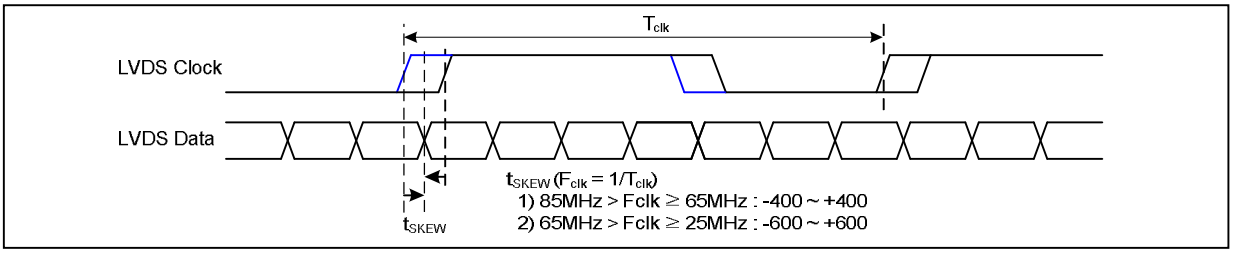
LVDS Input characteristics

1. DC Specification

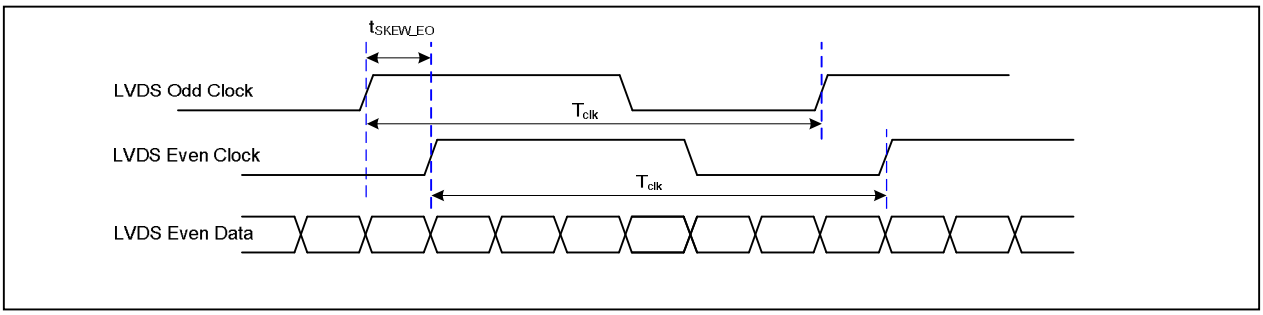


Description	Symbol	Min	Max	Unit	Notes
LVDS Differential Voltage	$\|V_{ID}\|$	100	600	mV	-
LVDS Common mode Voltage	V_{CM}	0.6	1.8	V	-
LVDS Input Voltage Range	V_{IN}	0.3	2.1	V	-

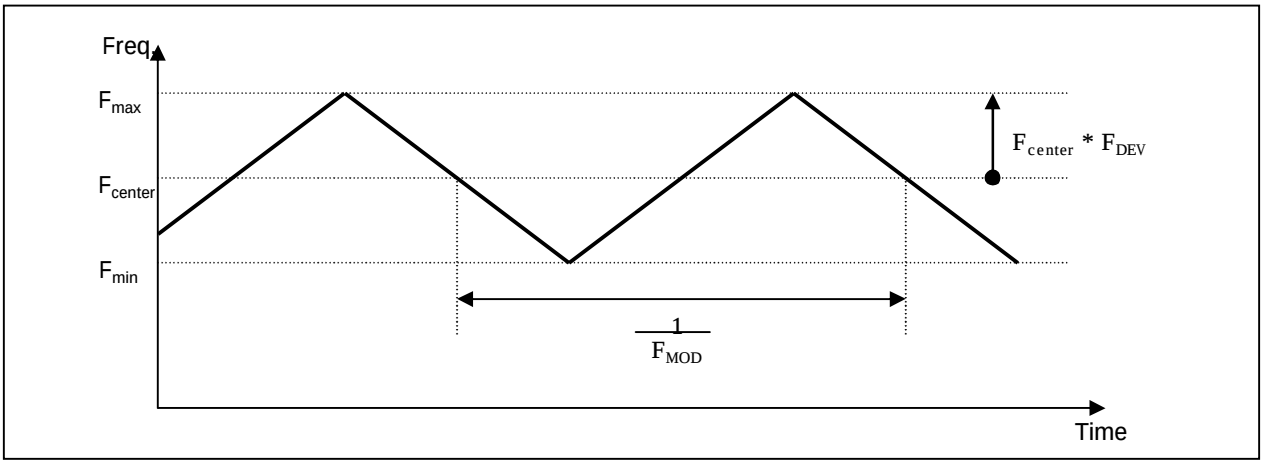
2. AC Specification



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 >



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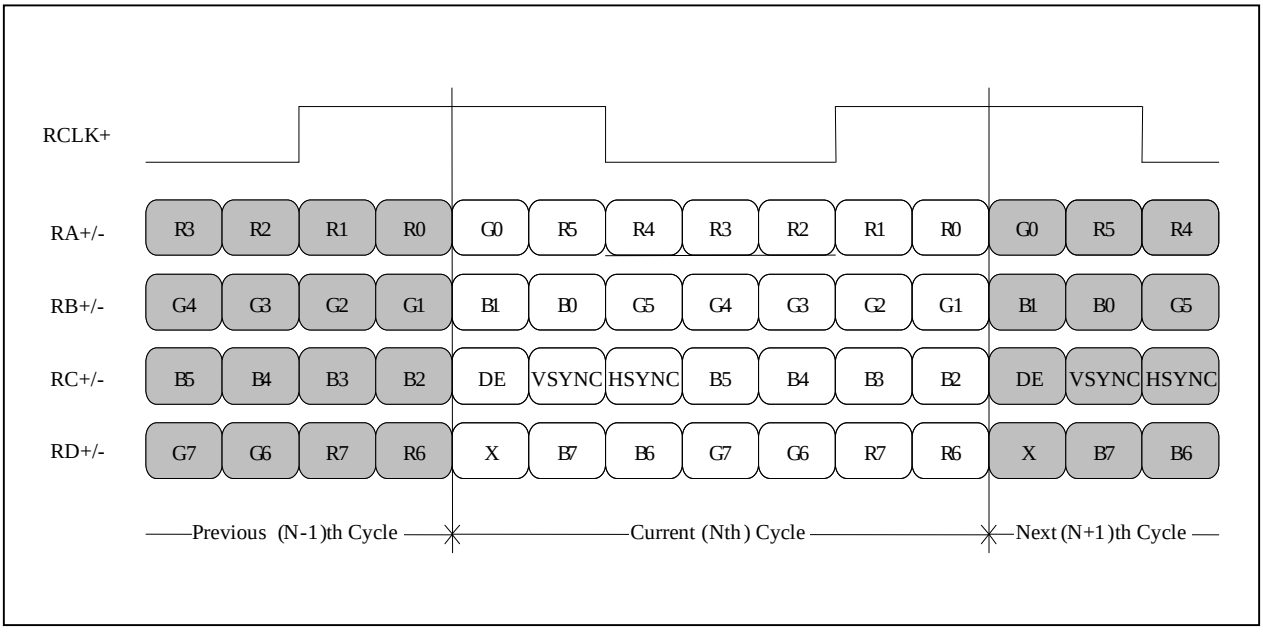
3. Data Format

1) LVDS 2 Port



< LVDS Data Format >

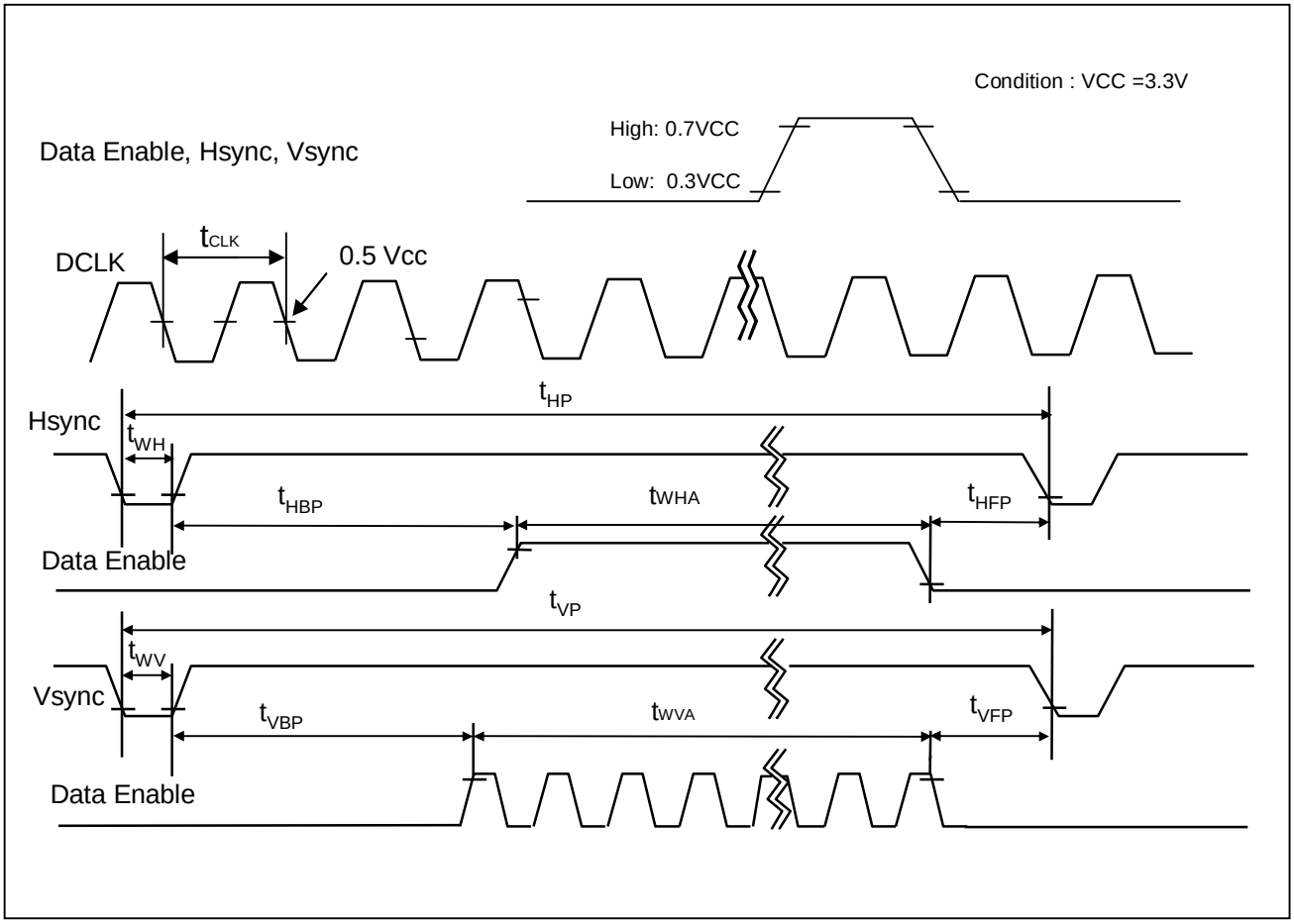
3-3. Signal Timing Specifications

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 and specifications of LVDS Tx/Rx for its proper operation.

Table 5. Timing table

ITEM	Symbol		Min	Typ	Max	Unit	Note
DCLK	Frequency	f_{CLK}	68.7	72.3	76.2	MHz	
Hsync	Period	t_{HP}	1470	1526	1586	tCLK	
	Width	t_{WH}	23	32	40		
	Width-Active	t_{WHA}	1366	1366	1366		
Vsync	Period	t_{VP}	779	790	801	tHP	
	Width	t_{WV}	2	5	8		
	Width-Active	t_{WVA}	768	768	768		
Data Enable	Horizontal back porch	t_{HBP}	72	80	124	tCLK	
	Horizontal front porch	t_{HFP}	8	48	48		
	Vertical back porch	t_{VBP}	8	14	20	tHP	
	Vertical front porch	t_{VFP}	1	3	5		

3-4. Signal Timing Waveforms



[Figure 6] Signal timing waveforms

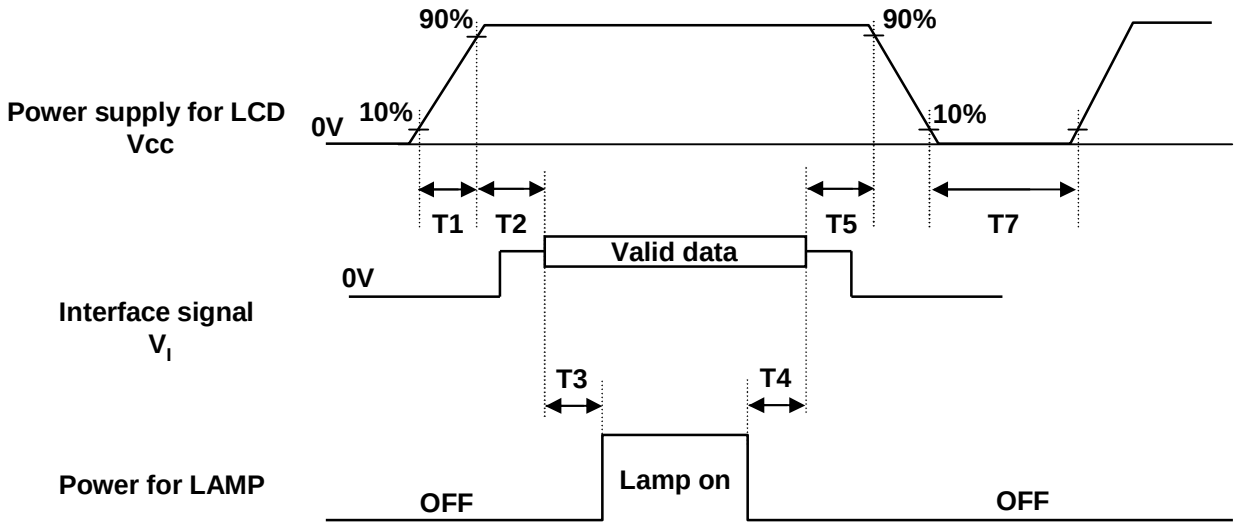
3-5. Color Input Data Reference

The brightness of each primary color (red,green and blue) is based on the 6-bit 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 6. Color data reference

Color		Input Color Data																	
		RED						GREEN						BLUE					
		MSB					LSB	MSB					LSB	MSB					LSB
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	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
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	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
RED	RED (00)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (01)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	…			…						…						…			
	RED (62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN (00)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN (01)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	...			…						…						…			
	GREEN (62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	GREEN (63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
BLUE	BLUE (00)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BLUE (01)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	…			…						…						…			
	BLUE (62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	BLUE (63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

3-6. Power Sequence



[Figure 7] Power sequence

Table 7. Power sequence time delay

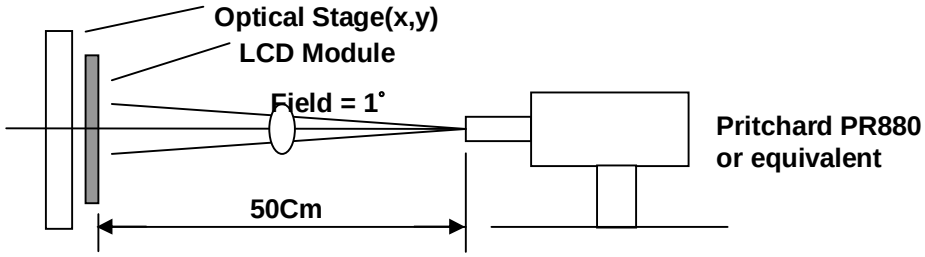
Parameter	Values			Units
	Min.	Typ.	Max.	
T_1	0.5	-	10	ms
T_2	0.01	-	50	ms
T_3	200	-	-	ms
T_4	200	-	-	ms
T_5	0.01	-	50	ms
T_7	1	-	-	s

Note)
1. Valid Data is Data to meet “3-3. LVDS Signal Timing Specifications”
2. Please avoid floating state of interface signal at invalid period.
3. When the interface signal is invalid, be sure to pull down the power supply for LCD VCC to 0V.
4. Lamp power must be turn on after power supply for LCD and interface signal are valid.

4. Optical Specifications

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

Figure. 8 presents additional information concerning the measurement equipment and method.



[Figure 8] Optical characteristic measurement equipment and method

Table 8. Optical characteristics (Ta=25 °C, V_{CC}=3.3V, f_V=60Hz Dclk=72.3MHz, I_{BL}=9.0mArms)

Parameter	Symbol	Values			Units	Notes
		Min.	Typ.	Max.		
Contrast ratio	CR	400	600	-		1
Surface luminance, white	L_{WH}	160	200	-	cd/m^2	2
Luminance uniformity	$\triangle L_9$	-	-	1.5		3
Response time	Tr		8	16	Ms	4
Rise time	TrR		2	5		
Decay time	TrD		6	11		
Color gamut (CIE1976)			60		%	
CIE color coordinates						
Red	XR		0.606			
	YR		0.329			
Green	XG		0.325			
	YG	Typ -0.03	0.582	Typ +0.03		
Blue	XB		0.152			
	YB		0.087			
White	XW		0.313			
	YW		0.329			
Viewing angle (by CR ≥ 10)					degree	5
X axis, right(ϕ=0°)	θr	40	45			
X axis, left (ϕ=180°)	θl	40	45			
Y axis, up (ϕ=90°)	θu	10	15			
Y axis, down (ϕ=270°)	θd	30	35			
Crosstalk				1.5		Figure 12

Notes : 1. Contrast ratio(CR) is defined mathematically as :

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

2. Surface luminance is the center point across the LCD surface 50cm from the surface with all pixels displaying white. For more information see [Figure 9].
When I_{BL}=9.0mA, L_{WH}=160cd/m^2(Min.) 200cd/m^2(Typ.)

3. The uniformity in surface luminance , $\triangle L_9$ is determined by measuring L_{ON} at any point in test area. But the management of $\triangle L_9$ is determined by measuring Lon at each test position 1 through 9, and then dividing the maximum L_{ON} of 9 points luminance by minimum L_{ON} of 9 points luminance. For more information see [Figure 9].
$\triangle$L9= Maximum (LON1,LON2, ….. LON9) ÷ Minimum (LON1,LON2, ….. LON9)

4. Response time is the time required for the display to transition from white to black(Rise Time, Tr_R) and from black to white(Decay Time, Tr_D). For additional information see [Figure 10].
The sampling rate is 2,500 sample/sec.

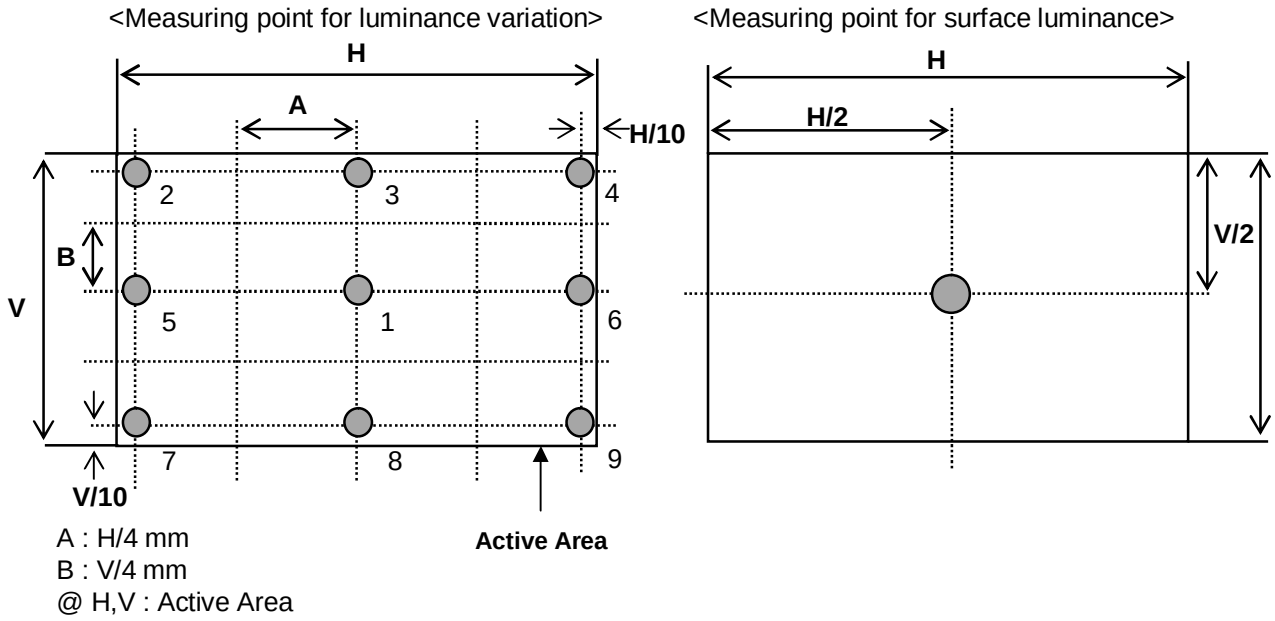
5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see Figure 11 .

6. Gray scale specification

Table 9. Gray scale

Gray Level	Luminance [%] (Typ)
L0	0
L7	1.5
L15	5.4
L23	12.2
L31	21.0
L39	34.8
L47	52.5
L55	74.2
L63	100

Figure 9. Luminance measuring point



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

Figure 10. Response time

The response time is defined as the following Figure and shall be measured by switching the input signal for “black” and “white”.

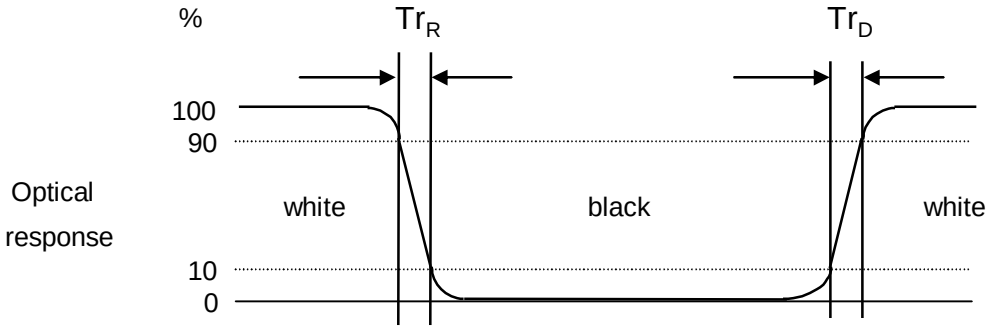


Figure 11. Viewing angle

<Dimension of viewing angle range>

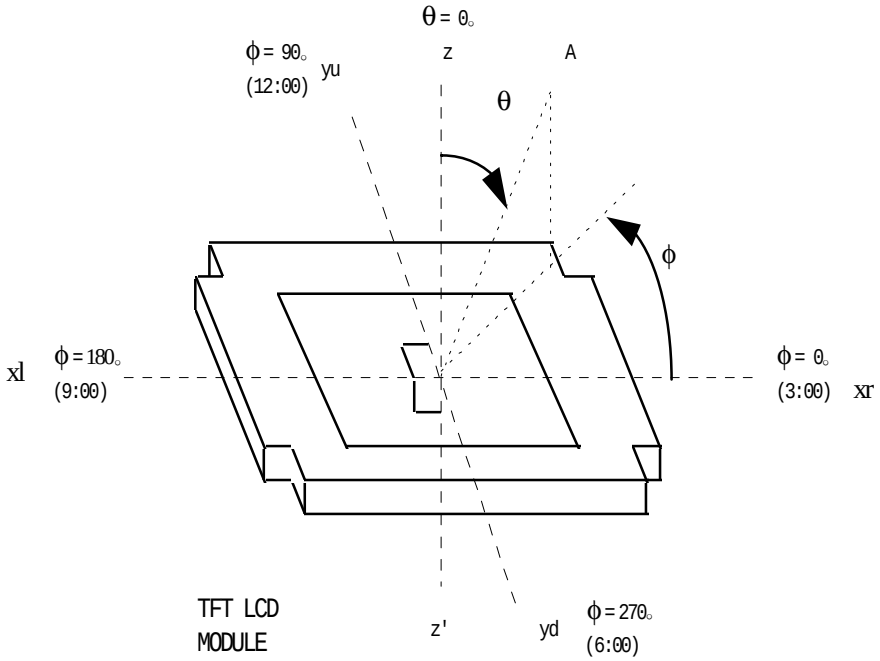
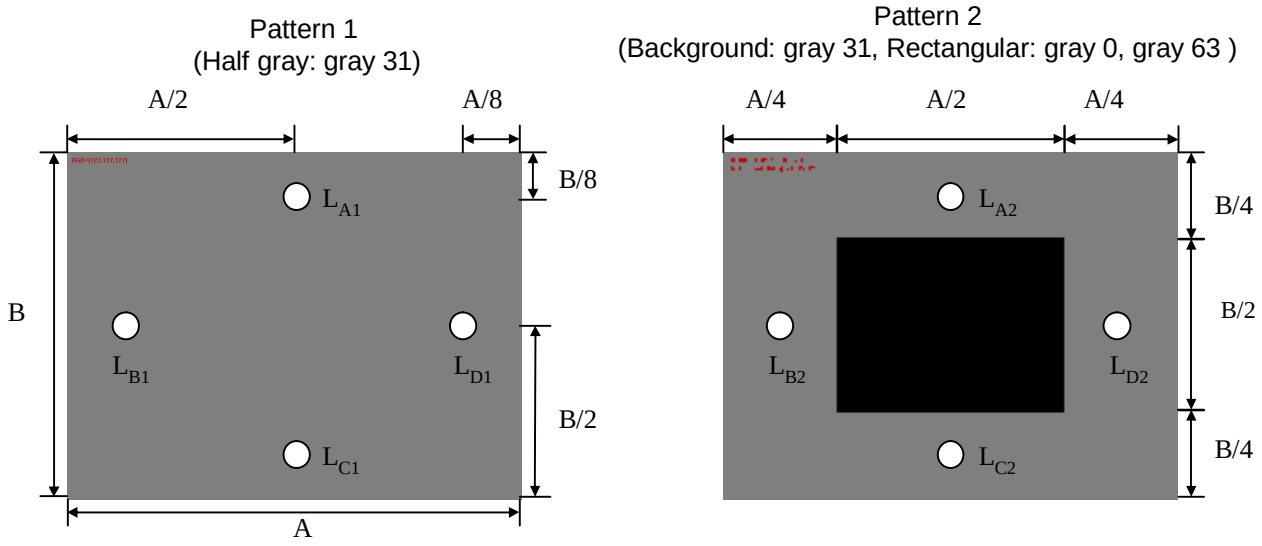


Figure 12. Crosstalk

The equation of crosstalk : ($|L_{A[or\ C]2}-L_{A[or\ C]1}|/L_{A[or\ C]1}$) ×100(%) [Vertical],
($|L_{B[or\ D]2}-L_{B[or\ D]1}|/L_{B[or\ D]1}$) ×100(%) [Horizontal]



5. Mechanical Characteristics

Table 10. provides general mechanical characteristics for the model LM156WH1-TLE1. Please refer to Figure 13,14 regarding the detailed mechanical drawing of the LCD.

Table 10. Mechanical characteristics

Outside dimensions	Horizontal	363.8mm
	Vertical	215.9mm
	Depth	12.0mm
Bezel area	Horizontal	347.5mm
	Vertical	196.8mm
Active display area	Horizontal	344.232mm
	Vertical	193.536mm
Weight(approximate)	950g(Typ.), 1,000g(Max.)	
Surface Treatment	Hard coating(3H) Anti-glare treatment of the front polarizer	

Figure 13. Front view

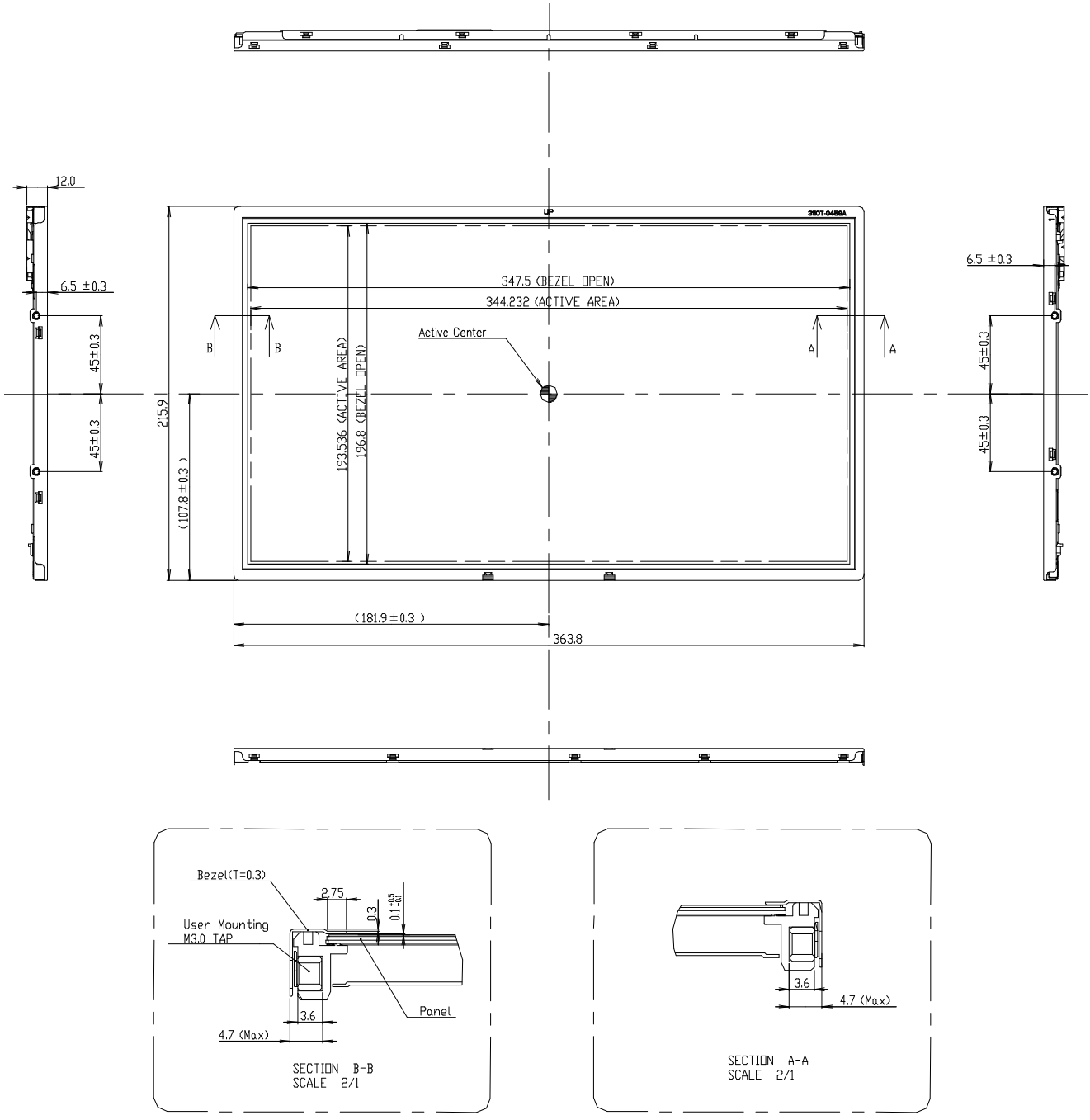
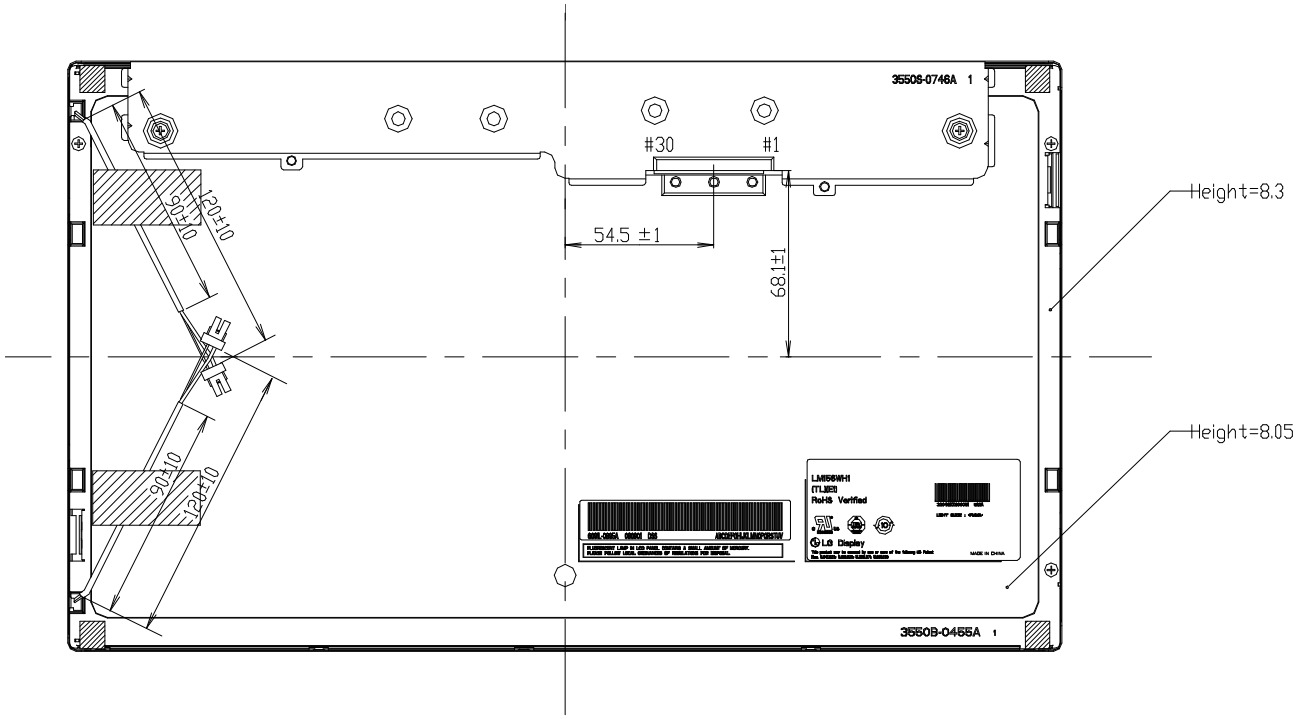
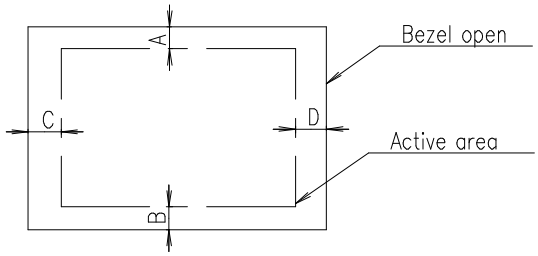


Figure 14. Rear view



Notes
1. Backlight : 2 Cold Cathode Fluorescent Lamps
2. Lamp Connector Specification
   – 35001HS-02LD(Yeonho) <2pin> or equivalent
3. I/F Connector Specification : AL230F-ALG1D-P or equivalent
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. Lamp(CCFL) lot No. is marked at backlight connector
7. Do not wind conductive tape around the backlight wires
8. Unspecified tolerances to be ±0.5mm

6. Reliability

Table 11. Environment test condition

No.	Test item	Conditions
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 : 1.0G RMS Bandwidth : 10-300Hz Duration : X,Y,Z, 30 min One time each direction
6	Shock test (non-operating)	Shock level : 120G Waveform : half sine wave, 2ms Direction : ±X, ±Y, ±Z One time each direction
7	Altitude storage / shipment	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.

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 Electrotechnical 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 Electrotechnical Standardization.(CENELEC), 1998
(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 ~ 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	3	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 : 14EA(2ea/slot X 7)

b) Box Size : 371 X 322 X 432

9. Precautions

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

9-1. 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 a 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 describe 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 determined 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.

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 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)

9-3. 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 or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.