

## ***TFT-Display Datenblatt***

Modell LM215WF2-SLB1

### **Kurzdaten**

Hersteller	LG Display
Diagonale	21,5" / 54,6cm
Format	16:9
Auflösung	1920x1080
Backlight	4xCCFL/250cd/m <sup>2</sup>
Temperatur	0...+50°C (Betrieb)

Product Specification

## SPECIFICATION FOR APPROVAL

(●) Preliminary Specification  
( ) Final Specification

Title	21.5" Full HD TFT LCD
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BUYER	TPVAOC
MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LM215WF2
SUFFIX	SLB1

\*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.

APPROVED BY	SIGNATUR E DATE
Hans. Kim / G.Manager	_____
<b>REVIEWED BY</b>	
J. K. Lee / Manager [C]	_____
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D. H. Kang / Manager [P]	_____
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**MNT Products Engineering Dept.**  
**LG Display Co., Ltd**

**Product Specification**
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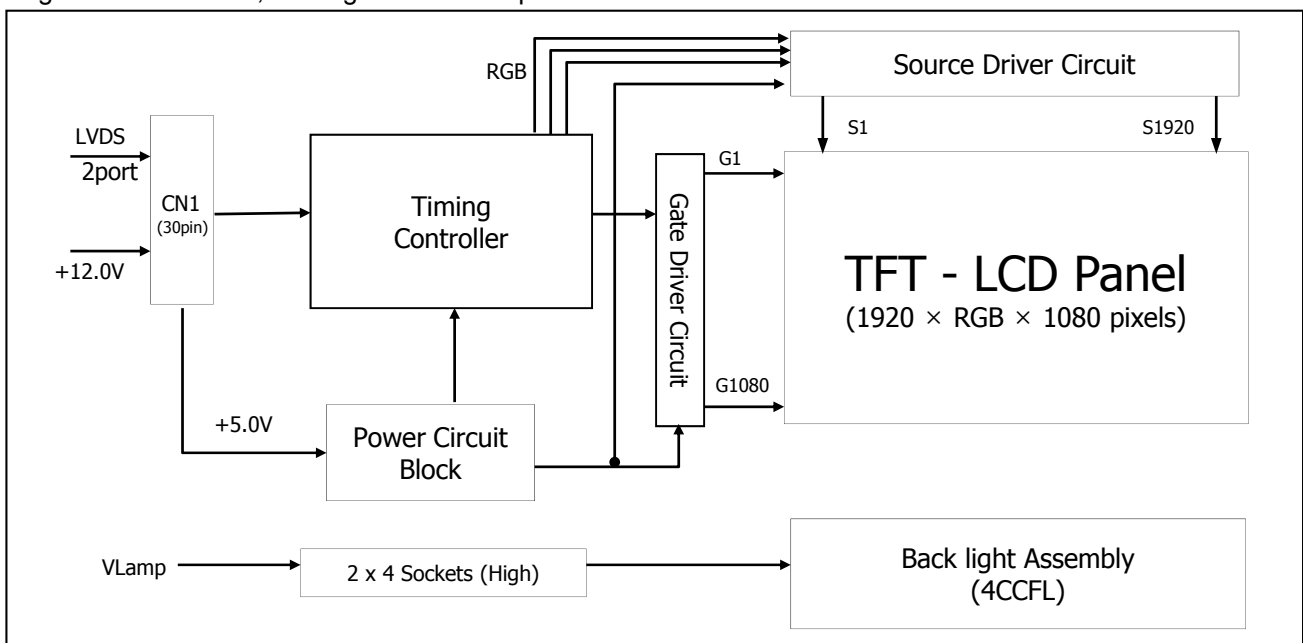
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**Product Specification**

**1. General Description**

LM215WF2 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 black mode. It has a 21.5 inch diagonally measured active display area with FHD resolution (1080 vertical by 1920horizontal 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 A-FRC(Advanced Frame Rate Control). It has been designed to apply the 8Bit 2 port LVDS interface. It is intended to support displays where high brightness, super wide viewing angle, high color saturation, and high color are important.



**[ Figure 1 ] Block diagram**

**General Features**

Active Screen Size	21.46 inches(545.22mm) diagonal
Outline Dimension	495.6(H) x 292.2(V) x 16.5(D) mm (Typ.)
Pixel Pitch	0.2475 mm x 0.2475mm
Pixel Format	1920 horiz. By 1080 vert. Pixels RGB stripes arrangement
Color Depth	16,7M colors
Luminance, White	250 cd/m <sup>2</sup> ( 1point)
Viewing Angle(CR>10)	View Angle Free (R/L 178(Typ.), U/D 178(Typ.))
Power Consumption	Total 28.26 Watt (Typ.) ( 4.26 Watt @VLCD, 24 Watt @250cd/m <sup>2</sup> ]
Weight	2450 g (typ.)
Display Operating Mode	Transmissive mode, normally black
Surface Treatment	Hard coating(3H), Glare treatment of the front polarizer



**Product 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, 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			
<b>MODULE :</b>							
Power Supply Input Voltage	V <sub>LCD</sub>	11.4	12	12.6	V <sub>dc</sub>		
Permissive Power Input Ripple	V <sub>RF</sub>	-	-	100	mV	13	
Power Supply Input Current	I <sub>LCD</sub>	300	355	410	mA	1	
		370	440	510	mA	2	
Differential Impedance	Z <sub>m</sub>	90	100	110	ohm		
Power Consumption	PLCD	-	4.26	4.92	Watt	1	
	PLCD	-	5.28	6.12	Watt	2	
Rush current	I <sub>RUSH</sub>	-	-	3	A	3	
<b>LAMP :</b>							
Operating Voltage	V <sub>BL</sub>	780 (8.0mA)	800 (7.5mA)	1000 (2.5mA)	V <sub>RMS</sub>	4, 5	
Operating Current	I <sub>BL</sub>	2.5	7.5	8.0	mA <sub>RMS</sub>	4	
Established Starting Voltage	V <sub>s</sub>					4, 6	
		at 25 °C			1250	V <sub>RMS</sub>	
		at 0 °C			1550	V <sub>RMS</sub>	
Operating Frequency	f <sub>BL</sub>	40	-	70	kHz	7	
Discharge Stabilization Time	T <sub>s</sub>			3	Min	4, 8	
Power Consumption	P <sub>BL</sub>		24	26.4	Watt	9	
Life Time		50,000			Hrs	4, 10	

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

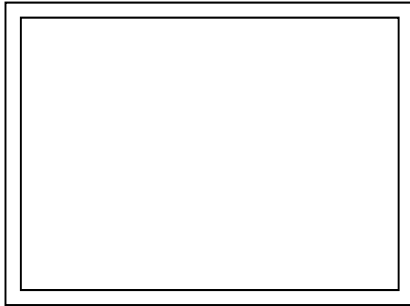
The performance of the Lamp in LCM, for example life time or brightness, is extremely influenced by the characteristics of the DC-AC inverter. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter.

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.

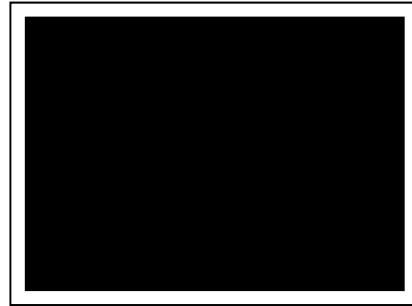


Product Specification

- **Permissive Power input ripple** ( $V_{LCD} = 12.0V$ ,  $25^{\circ}C$ ,  $fV$ (frame frequency)=MAX condition)

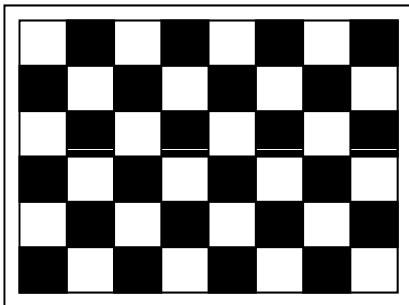


**White pattern**

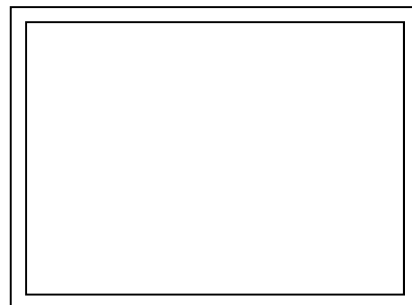


**Black pattern**

- **Power consumption** ( $V_{LCD} = 12V$ ,  $25^{\circ}C$ ,  $fV$  (frame frequency)=60Hz condition)



**Typical power Pattern**



**Maximum power Pattern**

[ Figure 3 ] Mosaic pattern & White Pattern for power consumption measurement

**Product Specification**

**3-2. Interface Connections**

**3-2-1. LCD Module**

-LCD Connector(CN1) : IS100-L30B-C23(UJU), GT103-30S-H23 (LSC)  
 - Mating Connector : FI-XC30C2L (Manufactured by JAE) or Equivalent

**Table 3 MODULE CONNECTOR(CN1) PIN CONFIGURATION**

No	Symbol	Description	No	Symbol	Symbol
1	FR0M	Minus signal of odd channel 0 (LVDS)	16	SR1P	Plus signal of even channel 1 (LVDS)
2	FR0P	Plus signal of odd channel 0 (LVDS)	17	GND	Ground
3	FR1M	Minus signal of odd channel 1 (LVDS)	18	SR2M	Minus signal of even channel 2 (LVDS)
4	FR1P	Plus signal of odd channel 1 (LVDS)	19	SR2P	Plus signal of even channel 2 (LVDS)
5	FR2M	Minus signal of odd channel 2 (LVDS)	20	SCLKINM	Minus signal of even clock channel (LVDS)
6	FR2P	Plus signal of odd channel 2 (LVDS)	21	SCLKINP	Plus signal of even clock channel (LVDS)
7	GND	Ground	22	SR3M	Minus signal of even channel 3 (LVDS)
8	FCLKINM	Minus signal of odd clock channel (LVDS)	23	SR3P	Plus signal of even channel 3 (LVDS)
9	FCLKINP	Plus signal of odd clock channel (LVDS)	24	GND	Ground
10	FR3M	Minus signal of odd channel 3 (LVDS)	25	NC	No Connection (I2C Serial interface for LCM)
11	FR3P	Plus signal of odd channel 3 (LVDS)	26	NC	No Connection.(I2C Serial interface for LCM)
12	SR0M	Minus signal of even channel 0 (LVDS)	27	PWM_OUT	For Control Burst frequency of Inverter
13	SR0P	Plus signal of even channel 0 (LVDS)	28	V <sub>LCD</sub>	Power Supply +12.0V
14	GND	Ground	29	V <sub>LCD</sub>	Power Supply +12.0V
15	SR1M	Minus signal of even channel 1 (LVDS)	30	V <sub>LCD</sub>	Power Supply +12.0V

- Note: 1. All GND(ground) pins should be connected together and to Vss which should also be connected to the LCD's metal frame.  
 2. All V<sub>LCD</sub> (power input) pins should be connected together.  
 3. Input Level of LVDS signal is based on the IEA 664 Standard.  
 4. PWM\_OUT signal controls the burst frequency of a inverter.  
 This signal is synchronized with vertical frequency.  
 It's frequency is 3 times of vertical frequency, and it's duty ratio is 50%.  
 If you don't use this pin, it is no connection.

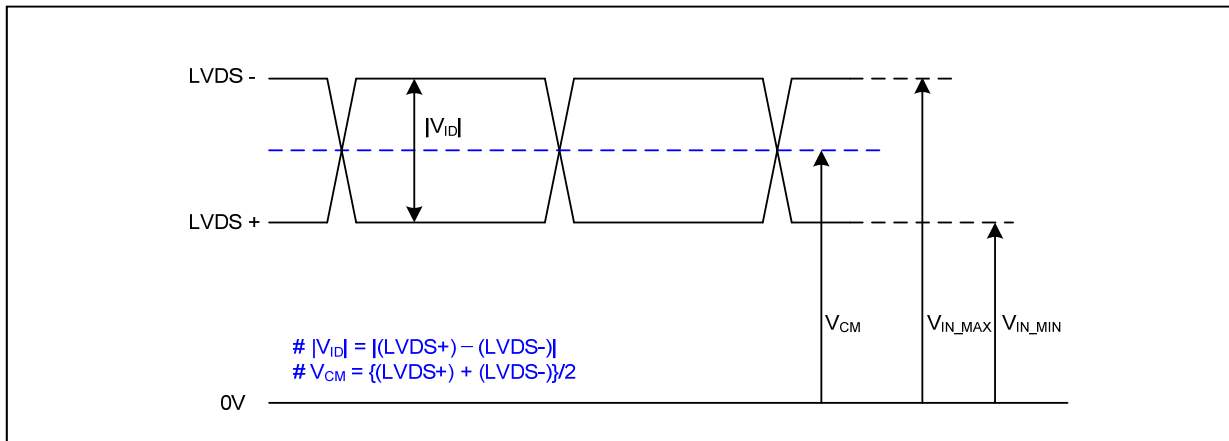
**[ Figure 4 ] User Connector diagram**



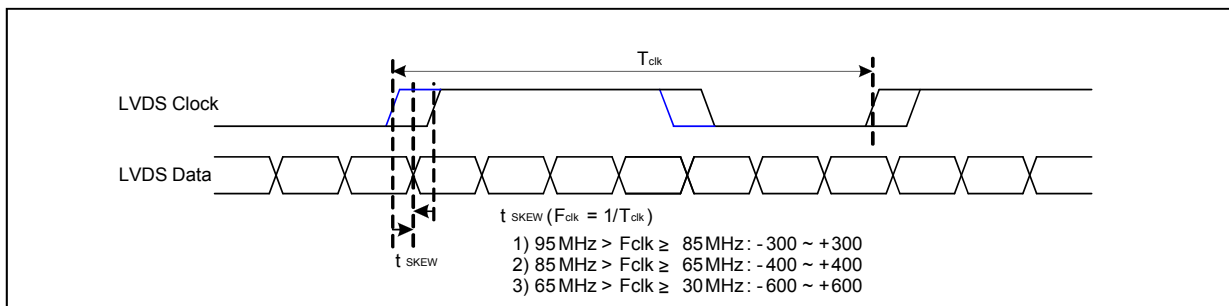
**Product Specification**
**Table 4. REQUIRED SIGNAL ASSIGNMENT FOR Flat Link (TI:SN75LVDS83) Transmitter**

Pin #	Pin Name	Require Signal	Pin #	Pin Name	Require Signal
1	Vcc	Power Supply for TTL Input	29	GND	Ground pin for TTL
2	D5	TTL Input (R7)	30	D26	TTL Input (DE)
3	D6	TTL Input (R5)	31	T <sub>x</sub> CLKIN	TTL Level clock Input
4	D7	TTL Input (G0)	32	PWR DWN	Power Down Input
5	GND	Ground pin for TTL	33	PLL GND	Ground pin for PLL
6	D8	TTL Input (G1)	34	PLL Vcc	Power Supply for PLL
7	D9	TTL Input (G2)	35	PLL GND	Ground pin for PLL
8	D10	TTL Input (G6)	36	LVDS GND	Ground pin for LVDS
9	Vcc	Power Supply for TTL Input	37	TxOUT3+	Positive LVDS differential data output 3
10	D11	TTL Input (G7)	38	TxOUT3-	Negative LVDS differential data output 3
11	D12	TTL Input (G3)	39	T <sub>x</sub> CLKOUT+	Positive LVDS differential clock output
12	D13	TTL Input (G4)	40	T <sub>x</sub> CLKOUT-	Negative LVDS differential clock output
13	GND	Ground pin for TTL	41	T <sub>x</sub> OUT2+	Positive LVDS differential data output 2
14	D14	TTL Input (G5)	42	T <sub>x</sub> OUT2-	Negative LVDS differential data output 2
15	D15	TTL Input (B0)	43	LVDS GND	Ground pin for LVDS
16	D16	TTL Input (B6)	44	LVDS Vcc	Power Supply for LVDS
17	Vcc	Power Supply for TTL Input	45	T <sub>x</sub> OUT1+	Positive LVDS differential data output 1
18	D17	TTL Input (B7)	46	T <sub>x</sub> OUT1-	Negative LVDS differential data output 1
19	D18	TTL Input (B1)	47	T <sub>x</sub> OUT0+	Positive LVDS differential data output 0
20	D19	TTL Input (B2)	48	T <sub>x</sub> OUT0-	Negative LVDS differential data output 0
21	GND	Ground pin for TTL Input	49	LVDS GND	Ground pin for LVDS
22	D20	TTL Input (B3)	50	D27	TTL Input (R6)
23	D21	TTL Input (B4)	51	D0	TTL Input (R0)
24	D22	TTL Input (B5)	52	D1	TTL Input (R1)
25	D23	TTL Input (RSVD)	53	GND	Ground pin for TTL
26	Vcc	Power Supply for TTL Input	54	D2	TTL Input (R2)
27	D24	TTL Input (HSYNC)	55	D3	TTL Input (R3)
28	D25	TTL Input (VSYNC)	56	D4	TTL Input (R4)

Notes : 1. Refer to LVDS Transmitter Data Sheet for detail descriptions.  
2. 7 means MSB and 0 means LSB at R,G,B pixel data

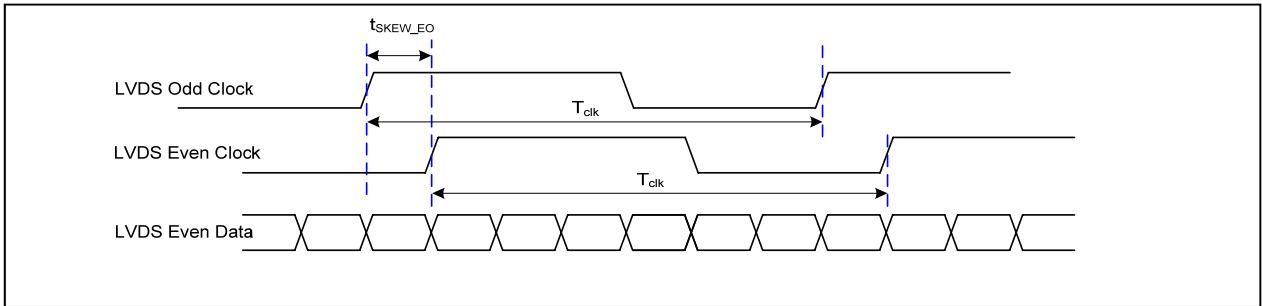
**Product Specification**
**LVDS Input characteristics**
**1. DC Specification**


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	$t_{SKEW}$	- 300	+ 300	ps	$95\text{MHz} > F_{clk} \geq 85\text{MHz}$
	$t_{SKEW}$	- 400	+ 400	ps	$85\text{MHz} > F_{clk} \geq 65\text{MHz}$
	$t_{SKEW}$	- 600	+ 600	ps	$65\text{MHz} > F_{clk} \geq 30\text{MHz}$
LVDS Clock to Clock Skew Margin (Even to Odd)	$t_{SKEW\_EO}$	- 1/7	+ 1/7	$T_{clk}$	-

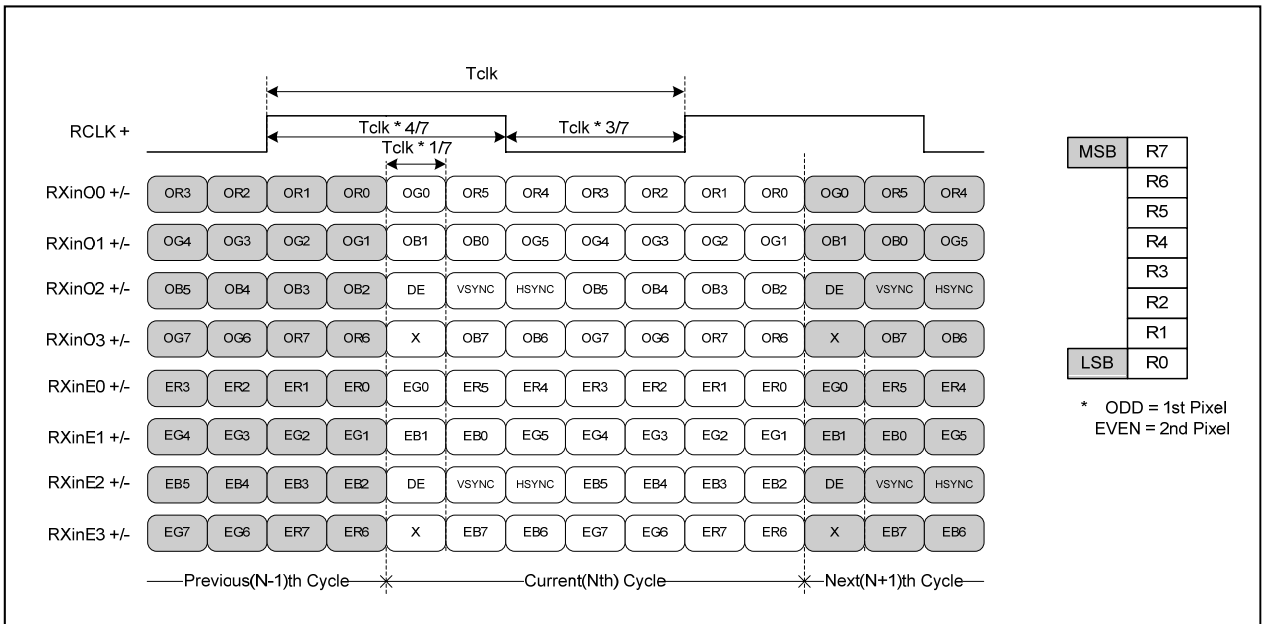
**Product Specification**



< Clock skew margin between channel >

**3. Data Format**

1) LVDS 2 Port



< LVDS Data Format >



**Product Specification**
**3-3. Signal Timing Specifications**

This is signal timing required at the input of the TMDS transmitter. All of the interface signal timing should be satisfied with the following specifications for its proper operation.

**Table 6. TIMING TABLE**

ITEM	Symbol		Min	Typ	Max	Unit	Note
DCLK	Period	tCLK	11.76	13.89	15.38	ns	
	Frequency	-	60	72	87.5	MHz	
Horizontal	total	tHP	1000	1088	1120	tCLK	
	Frequency	fH	64	66	83	KHz	
	Blanking		40	128	160	tCLK	
	valid	tWH	960	960	960	tCLK/2	
Vertical	total	tVP	1090	1100	1160	tHP	
	Frequency	fV	50	60	75	Hz	
	Blanking		10	20	80	tHP	
	valid	tWV	1080	1080	1080	tHP	

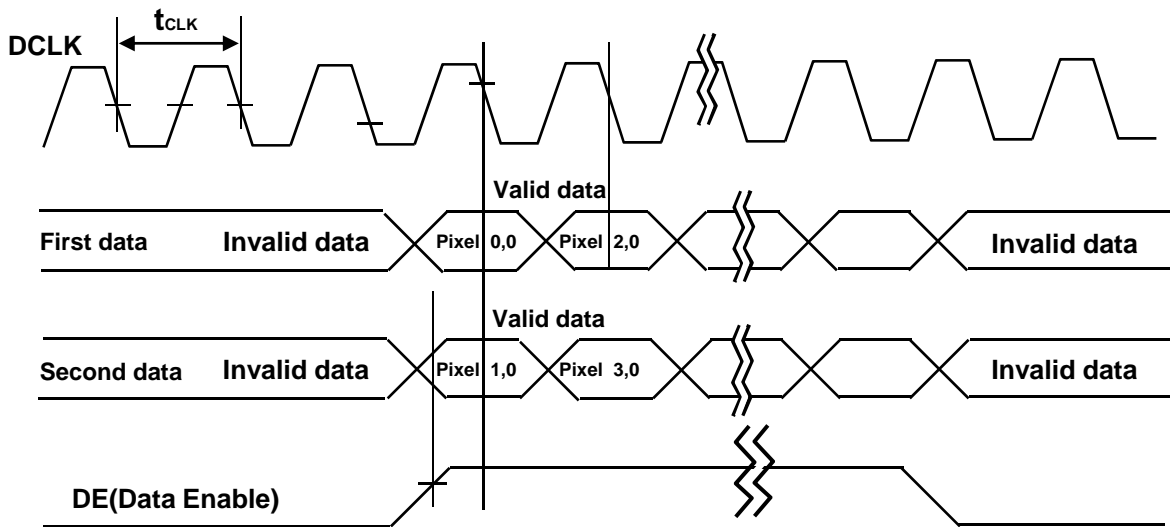
Note:

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.

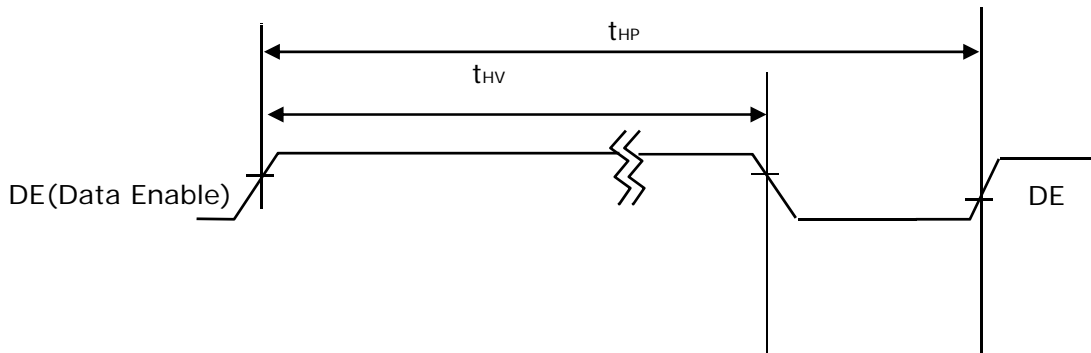
Product Specification

**3-4. Signal Timing Waveforms**

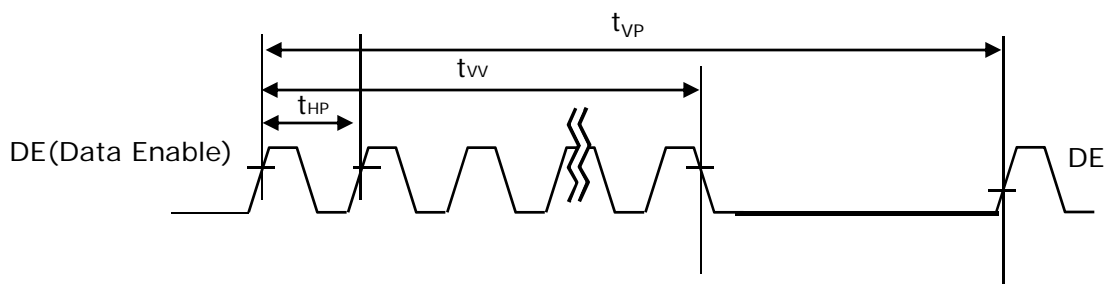
**1. DCLK, DE, DATA waveforms**



**2. Horizontal waveform**



**3. Vertical waveform**



**Product Specification**
**3-5. Color Input Data Reference**

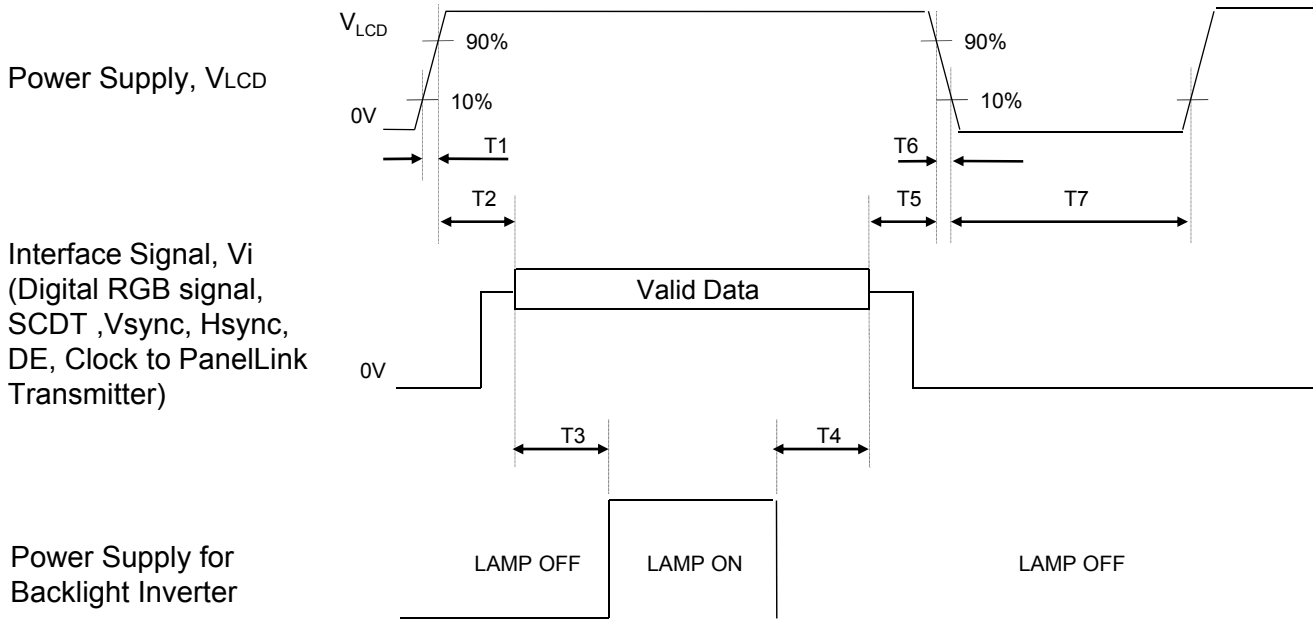
The Brightness of each primary color(red,green,blue) is based on the 8-bit gray scale data input for the color; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

**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

Product Specification

**3-6. Power Sequence**



**[ Figure 6 ] Power sequence**

**Table 8. POWER SEQUENCE**

Parameter	Values			Units
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0.01	-	50	ms
T3	500	-	-	ms
T4	200	-	-	ms
T5	0.01	-	50	ms
T7	1000	-	-	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 and interface signal are valid.

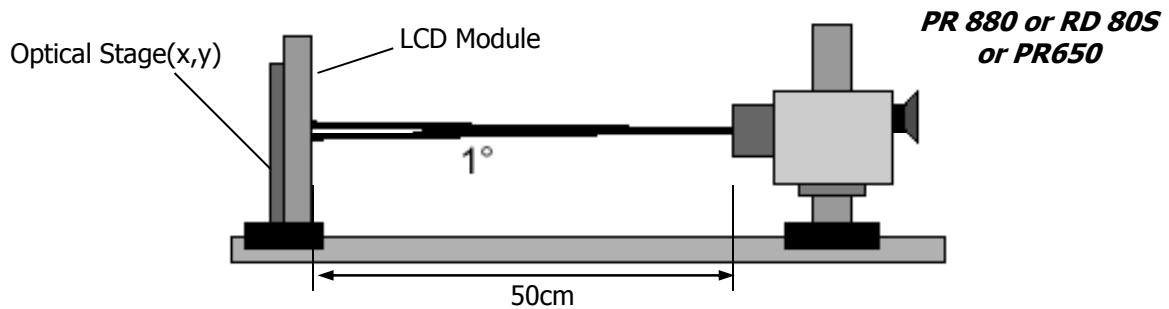


**Product Specification**

### 4. Optical Specifications

Optical characteristics are determined after the unit has been 'ON' for approximately 30 minutes in a dark environment at  $25 \pm 2^\circ\text{C}$ . The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of  $\Phi$  and  $\theta$  equal to  $0^\circ$  and aperture 1 degree.

FIG. 1 presents additional information concerning the measurement equipment and method.



**FIG. 1 Optical Characteristic Measurement Equipment and Method**

**Table 9. OPTICAL CHARACTERISTICS** ( $T_a=25^\circ\text{C}$ ,  $V_{LCD}=12\text{V}$ ,  $f_v=60\text{Hz}$  Dclk=144MHz, IBL=7.5mA)

Parameter	Symbol	Values			Units	Notes	
		Min	Typ	Max			
Contrast Ratio	CR	600	1000	-		1	
Surface Luminance, white	$L_{WH}$	200	250	-	cd/m <sup>2</sup>	2	
Luminance Variation	$\delta_{WHITE}$	75	-	-	%	3	
<b>Response Time</b>	<b>Gray To Gray</b>	$T_{GTG\_AVG}$	-	14	25	ms	4
<b>Color Coordinates</b> [CIE1931] <i>(By PR650)</i>	RED	Rx	Typ -0.03	TBD	Typ +0.03		
		Ry		TBD			
	GREEN	Gx		TBD			
		Gy		TBD			
	BLUE	Bx		TBD			
		By		TBD			
	WHITE	Wx		0.313			
	Wy	0.329					
<b>Color Shift</b> <i>(Avg. <math>\Delta u'v' &lt; 0.2</math>)</i>	<b>Horizontal</b>	$\theta_{CST\_H}$	-	140	-	Degree	5
	<b>Vertical</b>	$\theta_{CST\_V}$	-	100	-		
Viewing Angle (CR>10)							
General	Horizontal	$\theta_H$	170	178	-	Degree	6
	Vertical	$\theta_V$	170	178	-		
<b>GSR @ 60dgree</b> <i>(Gamma shift rate)</i>	<b>Horizontal</b>	$\delta_{Gamma\_H}$	-	-	20	%	7
	<b>Vertical</b>	$\delta_{Gamma\_V}$	-	-	20		
<b>WPT (White Point Tracking)</b>		-	-300	G255 CCT	+700	K	8
<b>Color gamut (CG, CIE1976)</b>			-	82	-	%	
Gray Scale				2.2			9

**Product Specification**

Notes 1. Contrast Ratio(CR) is defined mathematically as : **(By PR880)**

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

It is measured at center point(Location P1)

2. Surface luminance(L<sub>WH</sub>)is luminance value at Center 1 point(P1) across the LCD surface 50cm from the surface with all pixels displaying white. For more information see FIG 2. (By PR880)
3. The variation in surface luminance , δ WHITE is defined as : **(By PR880)**

$$\delta_{WHITE} = \frac{\text{Minimum}(L_{P1}, L_{P2}, \dots, L_{P9})}{\text{Maximum}(L_{P1}, L_{P2}, \dots, L_{P9})} \times 100$$

Where L1 to L9 are the luminance with all pixels displaying white at 9 locations.  
For more information see FIG 2.

4. Gray to gray response time is the time required for the display to transition from gray to gray. For additional information see Table 10. **(By RD80S)**
5. Color shift is the angle at which the average color difference for all Macbeth is lower than 0.02. For more information see FIG 3 and FIG 4. **(By EZ Contrast)**
  - Color difference (Δu'v')

$$u' = \frac{4x}{-2x + 12y + 3} \quad v' = \frac{9y}{-2x + 12y + 3} \quad \Delta u'v' = \sqrt{(u'_1 - u'_2)^2 + (v'_1 - v'_2)^2}$$

$$Avg(\Delta u'v') = \frac{\sum_{i=1}^{24} (\Delta u'v')_i}{24}$$

u'1, v'1 : u'v' value at viewing angle direction  
 u'2, v'2 : u'v' value at front (θ=0)  
 i : Macbeth chart number (Define 23 page)

- Pattern size : 25% Box size
- Viewing angle direction of color shift : Horizontal, Vertical

6. 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 FIG 4. **(By PR880)**
7. GSR is the rate of gamma shift at up, down, left and right 60 degree viewing angle compare with center gamma. For more information see FIG 5 and FIG 6 **(By EZ Contrast)**
  - GSR (δ<sub>Gamma</sub>) is defined as :

$$GSR = \left( 1 - \frac{\text{View angle Gamma Value (Up, Down, Reft, Light 60 Degree)}}{\text{Center Gamma Value (0 Degree)}} \right) \times 100$$

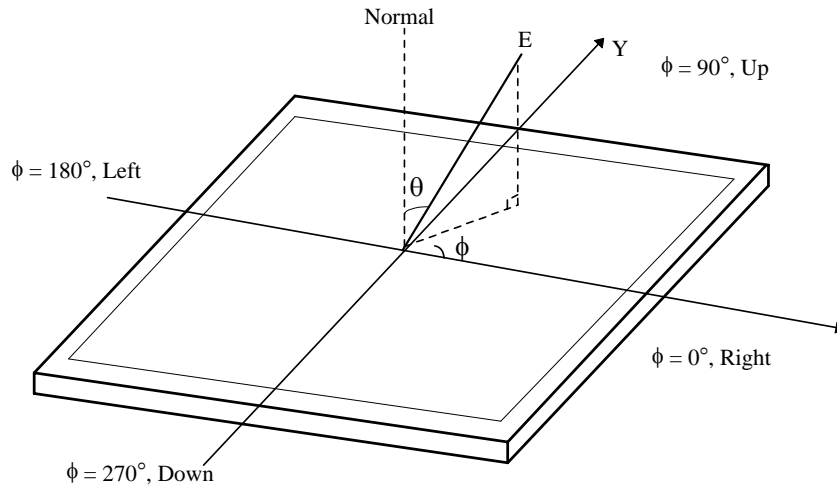
8. WPT (White Point Tracking) is the variation of color temperature between G255 and G63. **(By PR650)**



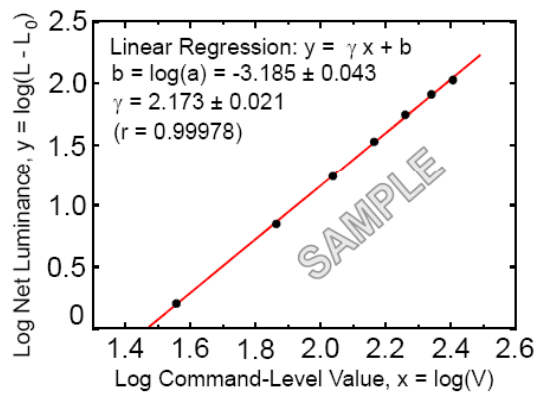
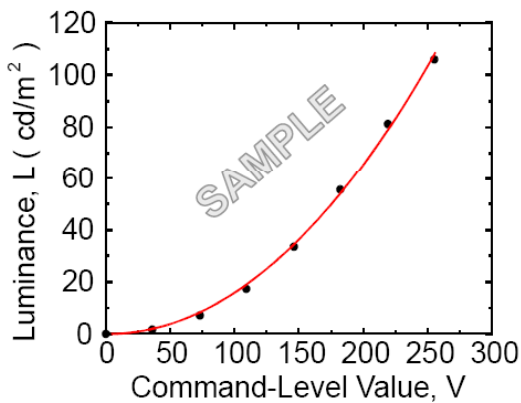


Product Specification

Dimension of viewing angle range.



[ FIG 12 ] Viewing angle



[ FIG 13 ] Sample Luminance vs. gray scale (using a 256 bit gray scale) [ FIG 14 ] Sample Log-log plot of luminance vs. gray scale

$$L = aV^r + L_b$$

$$\log(L - L_b) = r \log(V) + \log(a)$$

Here the Parameter  $a$  and  $\gamma$  relate the signal level  $V$  to the luminance  $L$ .  
 The GAMMA we calculate from the log-log representation (FIG. 7)

**Product Specification**
**Table 10. Gray Scale Specification**

Gray Level	Relative Luminance [%] (Typ.)
0	0.11
31	1.08
63	4.72
95	11.49
127	21.66
159	35.45
191	53.00
223	74.48
255	100

**Product 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.

Outline Dimension	Horizontal	495.6mm
	Vertical	292.2mm
	Depth	16.5mm
Bezel Area	Horizontal	479.84mm
	Vertical	272.31mm
Active Display Area	Horizontal	475.2mm
	Vertical	267.3mm
Weight	Typ : 2450 g , Max : 2600 g	
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.





**Product Specification**
**6. Reliability**

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 : 1.00G RMS Bandwidth : 10-300Hz Duration : X, Y, Z, 10 min One time each direction
6	Shock test (non-operating)	Shock level : 100G Waveform : half sine wave, 2ms Direction : ±X, ±Y, ±Z One time each direction
7	Humidity condition Operation	Ta= 40 °C ,90%RH
8	Altitude storage / shipment	0 - 40,000 feet(12192m)
9	Maximum Storage Humidity for 4 corner light leakage Mura.	Max 70%RH , Ta=40°C

## 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 1<sup>st</sup> 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.

### 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 )

### 7-3. Environment

- a) RoHS. Directive 2002/95/EC of the European Parliament and of the Council on the reduction of the use of certain hazardous substances in electrical and electronic equipment. January 2003

**Product Specification**
**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)  
 E : MONTH

 D : YEAR  
 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 : TBD

b) Box Size : TBD

**Product Specification****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 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 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.

**9-2. 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 minimize 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 causes metallic foreign material and deal LCM a fatal blow)
- (9) Please do not set LCD on its edge.
- (10) When LCMs are used for public display defects such as Yogure, image sticking can not be guarantee.

### **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.