LG Display

LC320EUD

Product Specification

SPECIFICATION
FOR
APPROVAL

(　) **Preliminary Specification**

(●) **Final Specification**

Title	32.0" WUXGA TFT LCD

BUYER	General
MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LC320EUD
SUFFIX	SCA1

*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	SIGNATURE DATE
P.Y. Kim / Team Leader	
REVIEWED BY	
T.H. Lee / Project Leader	
PREPARED BY	
Y.H. Lee / Engineer	

**TV Product Development Dept.
LG Display Co., Ltd.**

Ver. 1.0

LC320EUD

Product Specification

CONTENTS

Ver. 1.0

Product Specification

RECORD OF REVISIONS

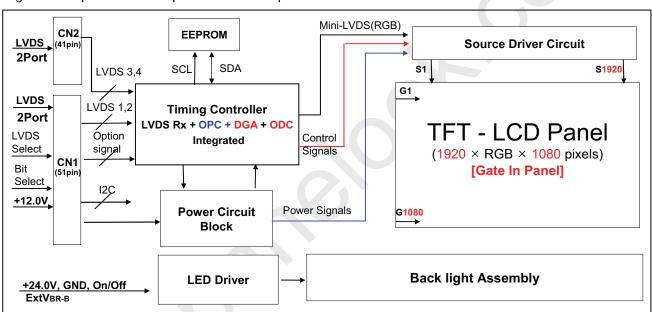| Revision No.	Revision Date	Page	Description
1.0	Feb, 25, 2010	-	**Final Specifications**

Ver. 1.0

LC320EUD

Product Specification

1. General Description

The LC320EUD is a Color Active Matrix Liquid Crystal Display with an integral Light Emitting Diode (LED) backlight system. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive display type which is operating in the normally black mode. It has a 31.55 inch diagonally measured active display area with WUXGA resolution (1080 vertical by 1920 horizontal pixel array). Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arrayed in vertical stripes. Gray scale or the luminance of the sub-pixel color is determined with a 10-bit gray scale signal for each dot. Therefore, it can present a palette of more than 1.06Bilion colors.
It has been designed to apply the 10-bit 4-port LVDS interface.
It is intended to support LCD TV, PCTV where high brightness, super wide viewing angle, high color gamut, high color depth and fast response time are important.

General Features

Active Screen Size	31.55 inches(801.31mm) diagonal
Outline Dimension	741.4(H) × 435.8 (V) X 10.8(B)/23.6(D) mm (Typ.)
Pixel Pitch	0.36375 mm x 0.36375 mm
Pixel Format	1920 horiz. by 1080 vert. Pixels, RGB stripe arrangement
Color Depth	10bit(D), 1.06Billon colors
Luminance, White	450 cd/m^2 (Center 1point ,Typ.)
Viewing Angle (CR>10)	Viewing angle free (R/L 178 (Min.), U/D 178 (Min.))
Power Consumption	Total 81.32W (Typ.) [Logic= 7.32W, LED Driver=74W (ExtVbr_B=100%)] (TBD)
Weight	6.9 Kg (Typ. TBD)
Display Mode	Transmissive mode, Normally black
Surface Treatment	Hard coating(3H), Anti-glare treatment of the front polarizer (Haze 10%)

Ver. 1.0

LC320EUD

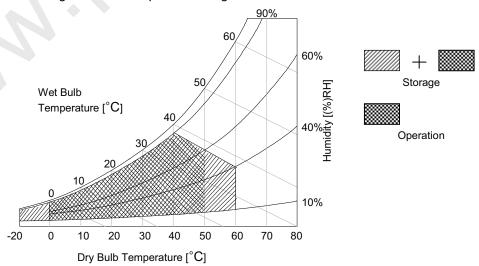## Product Specification

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	Note
			Min	Max		
Power Input Voltage	LCD Circuit	V_{LCD}	-0.3	+14.0	V_{DC}	1
	Driver	V_{BL}	-0.3	+27.0	V_{DC}	
Driver Control Voltage	ON/OFF	V_{OFF} / V_{ON}	-0.3	+5.5	V_{DC}	
	Brightness	$EXTV_{BR-B}$	0.0	+5.5	V_{DC}	
T-Con Option Selection Voltage		V_{LOGIC}	-0.3	+4.0	V_{DC}	
Operating Temperature		T_{OP}	0	+50	°C	2,3
Storage Temperature		T_{ST}	-20	+60	°C	
Panel Front Temperature		T_{SUR}	-	+68	°C	4
Operating Ambient Humidity		H_{OP}	10	90	%RH	2,3
Storage Humidity		H_{ST}	10	90	%RH	

Note1. Ambient temperature condition (Ta = 25 ± 2 °C)
2. Temperature and relative humidity range are shown in the figure below.
 Wet bulb temperature should be Max 39°C, and no condensation of water.
3. Gravity mura can be guaranteed below 40°C condition.
4. The maximum operating temperatures is based on the test condition that the surface temperature of display area is less than or equal to 68°C with LCD module alone in a temperature controlled chamber. Thermal management should be considered in final product design to prevent the surface temperature of display area from being over 68℃. The range of operating temperature may degraded in case of improper thermal management in final product design.

Product Specification

3. Electrical Specifications

3-1. Electrical Characteristics
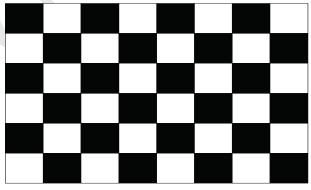
It requires two power inputs. One is employed to power for the LCD circuit. The other Is used for the LED backlight and LED Driver circuit.

Table 2. ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Value			Unit	Note
		Min	Typ	Max		
Circuit :						
Power Input Voltage	V_{LCD}	10.8	12.0	13.2	V_{DC}	
Power Input Current	I_{LCD}	-	610	790	mA	1
		-	800	1040	mA	2
Power Consumption	P_{LCD}		7.32	9.49	Watt	1
Rush current	I_{RUSH}	-	-	5.0	A	3

Note 1. The specified current and power consumption are under the V_{LCD}=12.0V, Ta=25 ± 2°C, f_V=120Hz 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 0.5ms (min.).

White : 1023 Gray
Black :   0 Gray

Mosaic Pattern(8 x 6)

Product Specification

Table 3. ELECTRICAL CHARACTERISTICS (Continue)

Parameter			Symbol	Values			Unit	Notes
				Min	Typ	Max		
LED Driver :								
Power Supply Input Voltage			VBL	22.8	24.0	25.2	Vdc	1
Power Supply Input Current			IBL_A	-	3.1	3.3	A	Ext V$_{BR-B}$ = 100%
Power Supply Input Current (In-Rush)			Irush	-	-	5.3	A	V$_{BL}$ = 22.8V Ext V$_{BR-B}$ = 100% 4
Power Consumption			PBL	-	74	79	W	Ext V$_{BR-B}$ = 100%
	On/Off	On	V on	2.5	-	5.0	Vdc	
		Off	V off	-0.3	0.0	0.8	Vdc	
	Brightness Adjust		ExtV$_{BR-B}$	10	-	100	%	On Duty
	PWM Frequency for NTSC & PAL	PAL			100		Hz	3
		NTSC			120		Hz	3
	Pulse Duty Level (PWM)	High Level		2.5	-	5.0	Vdc	HIGH : on duty LOW : off duty
		Low Level		0.0	-	0.8	Vdc	
LED :								
Life Time				30,000	50,000		Hrs	2

Notes :
1. Electrical characteristics are determined after the unit has been 'ON' and stable for approximately 60 minutes at 25±2°C. The specified current and power consumption are under the typical supply Input voltage 24Vand V$_{BR}$ (ExtV$_{BR-B}$: 100%), it is total power consumption.
2. The life time(MTTF) is determined as the time which luminance of the LED is 50% compared to that of initial value at the typical LED current (ExtVBR-B :100%) on condition of continuous operating in LCM state at 25±2°C.
3. LGD recommend that the PWM freq. is synchronized with One time harmonic of Vsync signal of system. Though PWM frequency is over 120Hz (max 252Hz), function of LED Driver is not affected.
4. The duration of rush current is about 10ms.
5. Even though inrush current is over the specified value, there is no problem if I^{2}T spec of fuse is satisfied.

Product Specification

3-2. Interface Connections

This LCD module employs two kinds of interface connection, 51-pin connector and 41-pin connector are used for the module electronics and 14-pin connector is used for the integral backlight system.

3-2-1. LCD Module

- LCD Connector : FI-R51S-HF(manufactured by JAE) or KN25-51P-0.5SH(manufactured by Hirose)
  (CN1)   Refer to below and next Page table
- Mating Connector : FI-R51HL(JAE) or compatible

Table 4-1. MODULE CONNECTOR(CN1) PIN CONFIGURATION

No	Symbol	Description	No	Symbol	Description
1	NC	No Connection	27	**Bit Select**	**'H' or NC= 10bit(D) , 'L' = 8bit**
2	NC	No Connection	28	R2AN	SECOND LVDS Receiver Signal (A-)
3	NC	No Connection	29	R2AP	SECOND LVDS Receiver Signal (A+)
4	NC	No Connection (Reserved for LGD)	30	R2BN	SECOND LVDS Receiver Signal (B-)
5	NC	No Connection (Reserved for LGD)	31	R2BP	SECOND LVDS Receiver Signal (B+)
6	NC	No Connection (Reserved for LGD)	32	R2CN	SECOND LVDS Receiver Signal (C-)
7	**LVDS Select**	**'H' =JEIDA , 'L' or NC = VESA**	33	R2CP	SECOND LVDS Receiver Signal (C+)
8	VBR EXT	External VBR (From System)	34	GND	Ground
9	OPC OUT	OPC output (From LCM)	35	R2CLKN	SECOND LVDS Receiver Clock Signal(-)
10	OPC Enable	'H' = Enable , 'L' or NC = Disable	36	R2CLKP	SECOND LVDS Receiver Clock Signal(+)
11	GND	Ground	37	GND	Ground
12	R1AN	FIRST LVDS Receiver Signal (A-)	38	R2DN	SECOND LVDS Receiver Signal (D-)
13	R1AP	FIRST LVDS Receiver Signal (A+)	39	R2DP	SECOND LVDS Receiver Signal (D+)
14	R1BN	FIRST LVDS Receiver Signal (B-)	40	R2EN	SECOND LVDS Receiver Signal (E-)
15	R1BP	FIRST LVDS Receiver Signal (B+)	41	R2EP	SECOND LVDS Receiver Signal (E+)
16	R1CN	FIRST LVDS Receiver Signal (C-)	42	NC	No Connection
17	R1CP	FIRST LVDS Receiver Signal (C+)	43	NC	No Connection
18	GND	Ground	44	**GND**	**Ground**
19	R1CLKN	FIRST LVDS Receiver Clock Signal(-)	45	GND	Ground
20	R1CLKP	FIRST LVDS Receiver Clock Signal(+)	46	GND	Ground
21	GND	Ground	47	NC	No connection
22	R1DN	FIRST LVDS Receiver Signal (D-)	48	VLCD	Power Supply +12.0V
23	R1DP	FIRST LVDS Receiver Signal (D+)	49	VLCD	Power Supply +12.0V
24	R1EN	FIRST LVDS Receiver Signal (E-)	50	VLCD	Power Supply +12.0V
25	R1EP	FIRST LVDS Receiver Signal (E+)	51	VLCD	Power Supply +12.0V
26	NC	No Connection	-	-	-

Note   1. All GND(ground) pins should be connected together to the LCD module's metal frame.
2. All VLCD (power input) pins should be connected together.
3. All Input levels of LVDS signals are based on the **EIA 644** Standard.
4. Specific pins(pin No. **#2~#6**) are used for internal data process of the LCD module.
   These pins should be no connection.
5. Specific pins(pin No. **# 8~#10**) are used for OPC function of the LCD module.
   If not used, these pins are no connection
6. LVDS pin (pin No. **#24,25,40,41**) are used for 10Bit(D) of the LCD module.
   If used for 8Bit(R), these pins are no connection.
7. Specific pin No. **#44** is used for "No signal detection" of system signal interface.
   It should be GND for NSB(No Signal Black) during the system interface signal is not.
   If this pin is "H", LCD Module displays AGP(Auto Generation Pattern).

LC320EUD

Product Specification

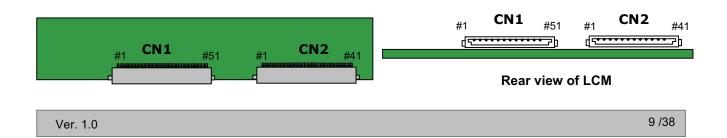-LCD Connector   : FI-RE41S-HF (manufactured by JAE) or KN25-41P-0.5SH (manufactured by Hirose)
(CN2)
- Mating Connector : FI-RE41HL

Table 4-2. MODULE CONNECTOR(CN2) PIN CONFIGURATION

No	Symbol	Description	No	Symbol	Description
1	NC	No connection(Reserved)	22	RE3N	THIRD LVDS Receiver Signal (E-)
2	NC	No connection	23	RE3P	THIRD LVDS Receiver Signal (E+)
3	NC	No connection	24	GND	Ground
4	NC	No connection	25	GND	Ground
5	NC	No connection	26	RA4N	FORTH LVDS Receiver Signal (A-)
6	NC	No connection	27	RA4P	FORTH LVDS Receiver Signal (A+)
7	NC	No connection	28	RB4N	FORTH LVDS Receiver Signal (B-)
8	NC	No connection	29	RB4P	FORTH LVDS Receiver Signal (B+)
9	GND	Ground	30	RC4N	FORTH LVDS Receiver Signal (C-)
10	RA3N	THIRD LVDS Receiver Signal (A-)	31	RC4P	FORTH LVDS Receiver Signal (C+)
11	RA3P	THIRD LVDS Receiver Signal (A+)	32	GND	Ground
12	RB3N	THIRD LVDS Receiver Signal (B-)	33	RCLK4N	FORTH LVDS Receiver Clock Signal(-)
13	RB3P	THIRD LVDS Receiver Signal (B+)	34	RCLK4P	FORTH LVDS Receiver Clock Signal(+)
14	RC3N	THIRD LVDS Receiver Signal (C-)	35	GND	Ground
15	RC3P	THIRD LVDS Receiver Signal (C+)	36	RD4N	FORTH LVDS Receiver Signal (D-)
16	GND	Ground	37	RD4P	FORTH LVDS Receiver Signal (D+)
17	RCLK3N	THIRD LVDS Receiver Clock Signal(-)	38	RE4N	FORTH LVDS Receiver Signal (E-)
18	RCLK3P	THIRD LVDS Receiver Clock Signal(+)	39	RE4P	FORTH LVDS Receiver Signal (E+)
19	GND	Ground	40	GND	Ground
20	RD3N	THIRD LVDS Receiver Signal (D-)	41	GND	Ground
21	RD3P	THIRD LVDS Receiver Signal (D+)	-		

Note :   1. All GND(ground) pins should be connected together to the LCD module's metal frame.
       2. LVDS pin **(pin No. #22,23,38,39)** are used for 10Bit(D) of the LCD module.
         If used for 8Bit(R), these pins are no connection.

Rear view of LCM

LC320EUD

Product Specification

3-2-2. Backlight Module

Master
- LED Driver Connector : 20022WR-14B1(Yeonho) or Equivalent
- Mating Connector : 20022HS-14 or Equivalent
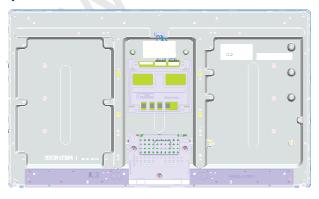
Table 5. LED DRIVER CONNECTOR PIN CONFIGURATION
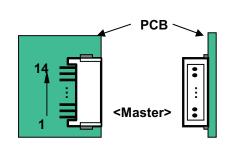
Pin No	Symbol	Description	Master	Note
1	V_{BL}	Power Supply +24.0V	V_{BL}	
2	V_{BL}	Power Supply +24.0V	V_{BL}	
3	V_{BL}	Power Supply +24.0V	V_{BL}	
4	V_{BL}	Power Supply +24.0V	V_{BL}	
5	V_{BL}	Power Supply +24.0V	V_{BL}	
6	GND	Backlight Ground	GND	
7	GND	Backlight Ground	GND	
8	GND	Backlight Ground	GND	1
9	GND	Backlight Ground	GND	
10	GND	Backlight Ground	GND	
11	NC	No connection	OPEN or GND	
12	$V_{ON/OFF}$	Backlight ON/OFF control	$V_{ON/OFF}$	
13	EXTVBR-B	External PWM	EXTVBR-B	2
14	GND	Backlight Ground	GND	3

Notes : 1. GND should be connected to the LCD module's metal frame.
      2. High : on duty / Low : off duty, Pin#13 can be opened. (if Pin #13 is open , EXTVBR-B is 100%)
      3. #14 of Input CNT Must be Connected to Backlight Ground.
      4. Each impedance of pin #12 and 13 is over 50 [KΩ] and over 50 [KΩ].

◆ **Rear view of LCM**

Product Specification

3-3. Signal Timing Specifications

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

Table 6-1. TIMING TABLE for NTSC (DE Only Mode)

ITEM		Symbol	Min	Typ	Max	Unit	Note
Horizontal	Display Period	t_{HV}	480	480	480	tCLK	1920 / 4
	Blank	t_{HB}	40	70	200	tCLK	1
	Total	t_{HP}	520	550	680	tCLK	
Vertical	Display Period	t_{VV}	1080	1080	1080	Lines	
	Blank	t_{VB}	16	45	86	Lines	1
	Total	t_{VP}	1096	1125	1166	Lines	
Frequency	DCLK	f_{CLK}	66.97	74.25	78.00	MHz	
	Horizontal	f_H	121.8	135	140	KHz	2
	Vertical	f_V	108	120	122	Hz	2

Table 6-2 TIMING TABLE for DVB/PAL (DE Only Mode)

ITEM		Symbol	Min	Typ	Max	Unit	Note
Horizontal	Display Period	t_{HV}	480	480	480	tCLK	1920 / 4
	Blank	t_{HB}	40	70	200	tCLK	1
	Total	t_{HP}	520	550	680	tCLK	
Vertical	Display Period	t_{VV}	1080	1080	1080	Lines	
	Blank	t_{VB}	228	270	300	Lines	1
	Total	t_{VP}	1308	1350	1380	Lines	
Frequency	DCLK	f_{CLK}	66.97	74.25	78.00	MHz	
	Horizontal	f_H	121.8	135	140	KHz	2
	Vertical	f_V	95	100	104	Hz	2

Note   1. The Input of HSYNC & VSYNC signal does not have an effect on normal operation(DE Only Mode). If you use spread spectrum for EMI, add some additional clock to minimum value for clock margin.

2. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rate and the horizontal frequency.
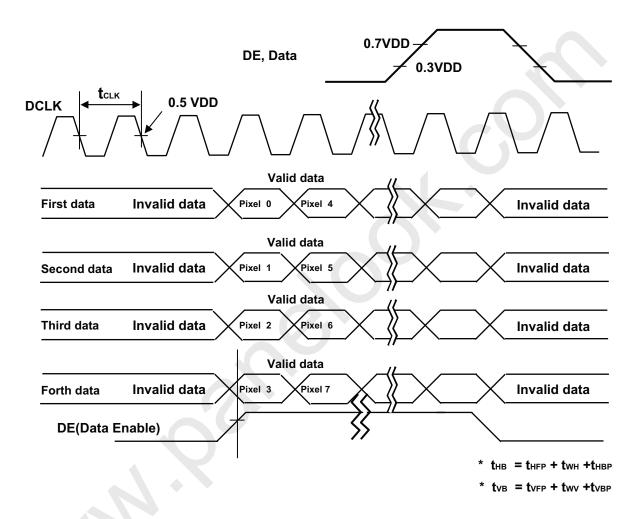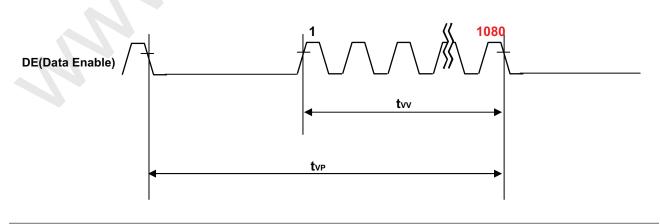
Product Specification

3-4. LVDS Signal Specification

3-4-1. LVDS Input Signal Timing Diagram

$$* \quad t_{HB} = t_{HFP} + t_{WH} + t_{HBP}$$

$$* \quad t_{VB} = t_{VFP} + t_{WV} + t_{VBP}$$
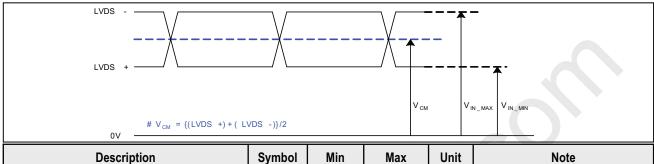
Product Specification
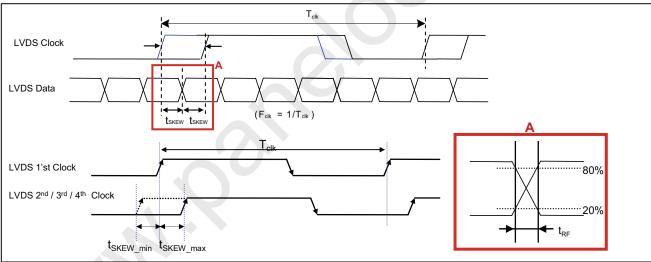
3-4-2. LVDS Input Signal Characteristics

1) DC Specification

LVDS -

LVDS +

V_{CM} V_{IN_MAX} V_{IN_MIN}

$V_{CM} = \{(LVDS +) + (LVDS -)\}/2$

0V

Description	Symbol	Min	Max	Unit	Note
LVDS Common mode Voltage	V_{CM}	1.0	1.5	V	-
LVDS Input Voltage Range	V_{IN}	0.7	1.8	V	-
Change in common mode Voltage	$\triangle VCM$		250	mV	-

2) AC Specification

T_{clk}

LVDS Clock

A

LVDS Data

$(F_{clk} = 1/T_{clk})$

t_{SKEW} t_{SKEW}

A

80%

20%

T_{clk}

LVDS 1'st Clock

LVDS 2nd / 3rd / 4th Clock

t_{RF}

t_{SKEW_min} t_{SKEW_max}
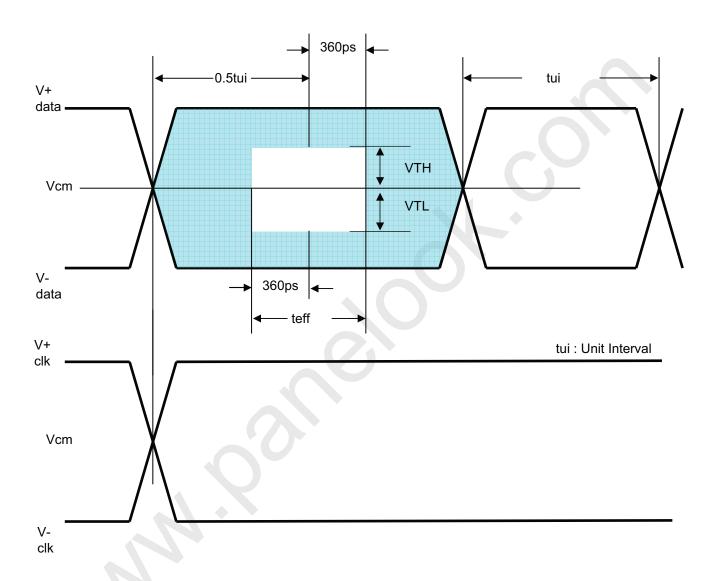
Description		Symbol	Min	Max	Unit	Note
LVDS Differential Voltage	High Threshold	V_{TH}	100	300	mV	3
	Low Threshold	V_{TL}	-300	-100	mV	
LVDS Clock to Data Skew Margin		t_{SKEW}		$|(0.25*T_{clk})/7|$	ps	-
LVDS Clock/DATA Rising/Falling time		t_{RF}	260	$(0.3*T_{clk})/7$	ps	2
Effective time of LVDS		t_{eff}	± 360		ps	-
LVDS Clock to Clock Skew Margin (Even to Odd)		t_{SKEW_EO}		$1/7* T_{clk}$	T_{clk}	-

Note   1. All Input levels of LVDS signals are based on the EIA 644 Standard.

2. If t_{RF} isn't enough, t_{eff} should be meet the range.

3. LVDS Differential Voltage is defined within t_{eff}

LC320EUD

Product Specification

360ps

0.5tui

tui

V+
data

Vcm

VTH

VTL

V-
data

360ps

teff

V+
clk

tui : Unit Interval

Vcm

V-
clk

Product Specification

3-5. Color Data Reference

The brightness of each primary color(red,green,blue) is based on the 10bit 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

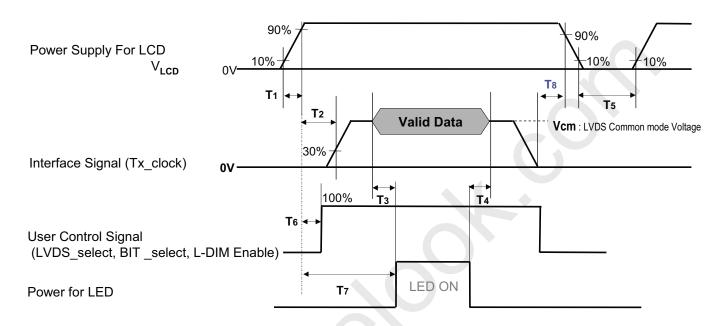| Color		Input Color Data																													
		RED										GREEN										BLUE									
		MSB									LSB	MSB									LSB	MSB									LSB
		R9	R8	R7	R6	R5	R4	R3	R2	R1	R0	G9	G8	G7	G6	G5	G4	G3	G2	G1	G0	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red（1023）	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green（1023）	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
	Blue（1023）	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	0	0	1	1	1	1	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	1	1	0	0	0	0	0	0	0	0	0	0	1	1	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	1	1	1	1	0	0	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	1	1	1	1	1	1
RED	RED（0000）	0	0	0	0	0	0	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（0001）	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	…				…										…										…						
	RED（1022）	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED（1023）	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN（0000）	0	0	0	0	0	0	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（0001）	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	…				…										…										…						
	GREEN（1022）	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
	GREEN（1023）	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
BLUE	BLUE（0000）	0	0	0	0	0	0	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（0001）	0	0	0	0	0	0	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（1022）	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0
	BLUE（1023）	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1

Product Specification

3-6. Power Sequence

3-6-1. LCD Driving circuit

Table 8. POWER SEQUENCE

Parameter	Value			Unit	Notes
	Min	Typ	Max		
T1	0.5	-	20	ms	
T2	0	-	-	ms	4
T3	200	-	-	ms	3
T4	200	-	-	ms	3
T5	1.0	-	-	s	5
T6	-	-	T2	ms	4
T7	0.5		-	s	
T8	100		-	ms	6

Note :1. Please avoid floating state of interface signal at invalid period.

2. When the power supply for LCD (VLCD) is off, be sure to pull down the valid and invalid data 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. If the on time of signals(Interface signal and user control signals) precedes the on time of Power(V_{LCD}), it will be happened abnormal display. When T6 is NC status, T6 doesn't need to be measured.

5. T5 should be measured after the Module has been fully discharged between power off and on period.

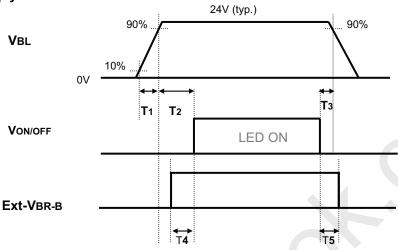6. It is recommendation specification that T8 has to be 100ms as a minimum value.

LC320EUD

Product Specification

3-6-2. Sequence for LED Driver

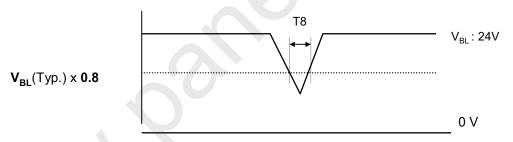#### Power Supply For LED Driver

3-6-3. Dip condition for LED Driver

Table 9. Power Sequence for LED Driver

Parameter	Values			Units	Remarks
	Min	Typ	Max		
T1	20	-	-	ms	1
T2	500	-	-	ms	
T3	10		-	ms	
T4	0	-	-	ms	
T5	0	-	-	ms	
T6	-	-	10	ms	V_{BL}(Typ) x 0.8

Notes : 1. T1 describes rising time of 0V to 24V and this parameter does not applied at restarting time.
Even though T1 is over the specified value, there is no problem if I^2T spec of fuse is satisfied.

LC320EUD

Product Specification

4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable in a dark environment at 25±2°C. The values are specified at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0 °.

It is presented additional information concerning the measurement equipment and method in FIG. 1.

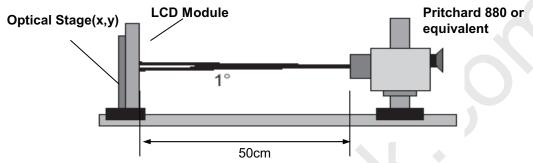**FIG. 1 Optical Characteristic Measurement Equipment and Method**

Table 10. OPTICAL CHARACTERISTICS

Ta= 25±2°C, V_{LCD}=12.0V, fv=120Hz, Dclk=74.25MHz, **EXTV**BR-B =100%

Parameter		Symbol		Value			Unit	Note
				Min	Typ	Max		
Contrast Ratio		CR		900	1300	-		1
Surface Luminance, white		L_{WH}		360	450	-	cd/m^2	2
Luminance Variation		δ WHITE	5P	-	-	1.3		3
Response Time	Gray-to-Gray	G to G		-	5	8	ms	4,5
	MPRT	MPRT		-	8	12	ms	
	Uniformity	δ MPRT		-	-	1		
	Uniformity	δ G TO G		-	-	1		
Color Coordinates [CIE1931]	RED	Rx		Typ -0.03	0.651	Typ +0.03		
		Ry			0.332			
	GREEN	Gx			0.308			
		Gy			0.597			
	BLUE	Bx			0.149			
		By			0.059			
	WHITE	Wx			0.279			
		Wy			0.292			
Color Temperature					10,000		K	
Color Gamut					72		%	
Viewing Angle (CR>10)								
	x axis, right(φ=0°)	θr		89	-	-	degree	6
	x axis, left (φ=180°)	θl		89	-	-		
	y axis, up (φ=90°)	θu		89	-	-		
	y axis, down (φ=270°)	θd		89	-	-		
Gray Scale				-	-	-		7

Ver. 1.0

LC320EUD

Product Specification

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

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

It is measured at center 1-point.

2. Surface luminance are determined after the unit has been 'ON' and 1 Hour after lighting the backlight in a dark environment at $25\pm2°C$. 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 transit from G(N) to G(M) (Rise Time, Tr_R) and from G(M) to G(N) (Decay Time, Tr_D). For additional information see the FIG. 3. (N<M)
   ※ G to G Spec stands for average value of all measured points.
   Photo Detector : RD-80S / Field : 2°

5. MPRT is defined as the 10% to 90% blur-edge width Bij(pixels) and scroll speed U(pixels/frame)at the moving picture. For more information, see FIG 4.

6. Gray to Gray / MPRT Response time uniformity is Reference data. Appendix IV-1 / IV-2.

7. 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. 5.

8. Gray scale specification
   Gamma Value is approximately 2.2. For more information, see the Table 11.

Table 11. GRAY SCALE SPECIFICATION

Gray Level	Luminance [%] (Typ)
L0	0.077
L15	0.28
L31	1.05
L47	2.50
L63	4.69
L79	7.67
L95	11.47
L111	16.11
L127	21.64
L143	28.07
L159	35.43
L175	43.73
L191	52.99
L207	63.23
L223	74.47
L239	86.72
L255	100

Ver. 1.0

Product Specification

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

A : H / 4 mm
B : V / 4 mm
@ H,V : Active Area
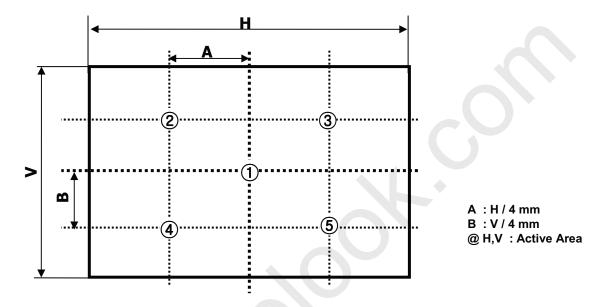
FIG. 2 5 Points for Luminance Measure

Response time is defined as the following figure and shall be measured by switching the input signal for "Gray(N)" and "Gray(M)".

Optical Response

TrR   TrD

100
90

10
0

Gray(N)   Gray(M)   Gray(N)

N,M = Black~White, N<M
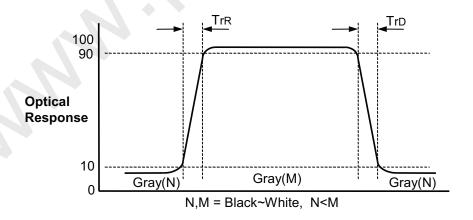
FIG. 3 Response Time

Ver. 1.0

LC320EUD

Product Specification

MPRT is defined as the 10% to 90% blur-edge with Bij(pixels) and scroll speed U(pixels/frame)at the moving picture.

$$M = \frac{1}{U} Bij \ (i \neq j)$$

Example) Bij = 12pixels, U = 10pixels / 120Hz

M = 12pixels / (10pixels / 120Hz)
= 12pixels / {10pixels / (1/120)s}
= 12 / 1,200 s
= 10 ms
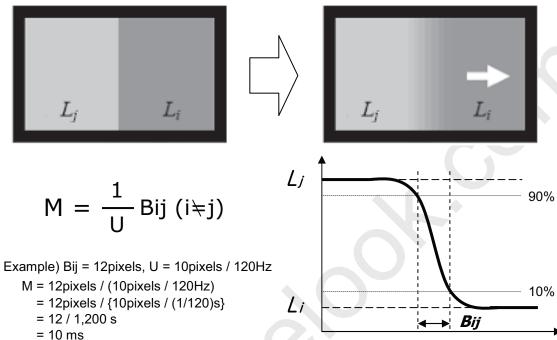
FIG. 4 MPRT

Dimension of viewing angle range
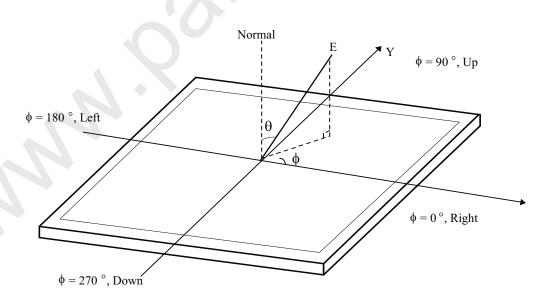
FIG. 5 Viewing Angle

Ver. 1.0

Product Specification

5. Mechanical Characteristics

Table 12 provides general mechanical characteristics.

Table 12. MECHANICAL CHARACTERISTICS

Item	Value	
Outline Dimension	Horizontal	741.4 mm
	Vertical	435.8 mm
	Depth	10.8 mm
Bezel Area	Horizontal	705.4 mm
	Vertical	399.8 mm
Active Display Area	Horizontal	698.40 mm
	Vertical	392.85 mm
Weight	6.9 Kg (Typ.) , 7.6 Kg (Max.)	
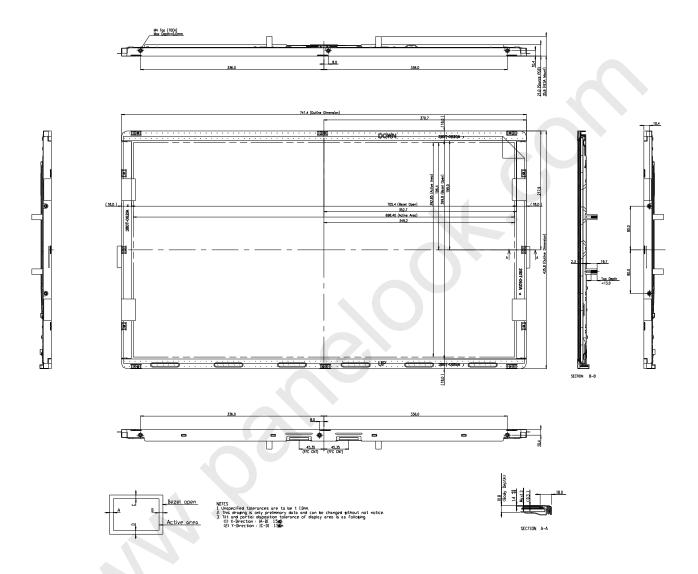
Note : Please refer to a mechanic drawing in terms of tolerance at the next page.

LC320EUD

Product Specification

[FRONT VIEW]

LC320EUD
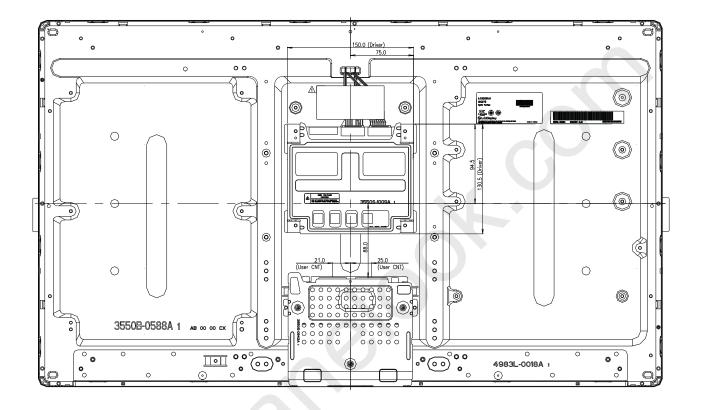
Product Specification

[REAR VIEW]

LC320EUD

Product Specification

6. Reliability

Table 13. 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, 30 min Each direction per 10 min
6	Shock test (non-operating)	Shock level : 100Grms Waveform : half sine wave, 2ms Direction : ±X, ±Y, ±Z One time each direction
7	Humidity condition Operation	Ta= 40 °C ,90%RH
8	Altitude operating storage / shipment	0 - 15,000 ft 0 - 40,000 ft

Note : Before and after Reliability test, LCM should be operated with normal function.

LC320EUD

Product Specification

7. International Standards

7-1. Safety

a) UL 60065, Seventh Edition, Underwriters Laboratories Inc.
   Audio, Video and Similar Electronic Apparatus - Safety Requirements.

b) CAN/CSA C22.2 No.60065:03, Canadian Standards Association.
   Audio, Video and Similar Electronic Apparatus - Safety Requirements.

c) EN 60065:2002 + A11:2008, European Committee for Electrotechnical Standardization (CENELEC).
   Audio, Video and Similar Electronic Apparatus - Safety Requirements.

d) IEC 60065:2005 + A1:2005, The International Electrotechnical Commission (IEC).
   Audio, Video and Similar Electronic Apparatus - Safety Requirements.
   (Including report of IEC60825-1:2001 clause 8 and clause 9)

    Notes
      1. Laser (LED Backlight) Information

Class 1M LED Product IEC60825-1 : 2001 Embedded LED Power (Class1M) Power : 6.5896 mW (Max.) Wavelength : 277 ~526 (nm) Width : 1.6 x 0.6 (mm)

      2. Caution
       : LED inside.
        Class 1M laser (LEDs) radiation when open.
        Do not open while operating.

7-2. EMC

a) ANSI C63.4 "American National Standard for Methods of Measurement of Radio-Noise
   Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."
   American National Standards Institute (ANSI), 2003.
b) CISPR 22 "Information technology equipment – Radio disturbance characteristics – Limit and
   methods of measurement." International Special Committee on Radio Interference
   (CISPR), 2005.
c) CISPR 13 "Sound and television broadcast receivers and associated equipment – Radio disturbance
   characteristics – Limits and method of measurement." International Special Committee on Radio
   Interference (CISPR), 2006.

7-3. Environment

a) RoHS, Directive 2002/95/EC of the European Parliament and of the council of 27 January 2003

Ver. 1.0

LC320EUD

Product Specification

8. Packing

8-1. Information of LCM Label

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	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 Pallet : 6 pcs

b) Pallet Size : 1140 mm X 870 mm X 1161 mm.

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 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) The conductive material and signal cables are kept away from LED driver inductor to prevent abnormal display, sound noise and temperature rising.

Product Specification

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.

Ver. 1.0
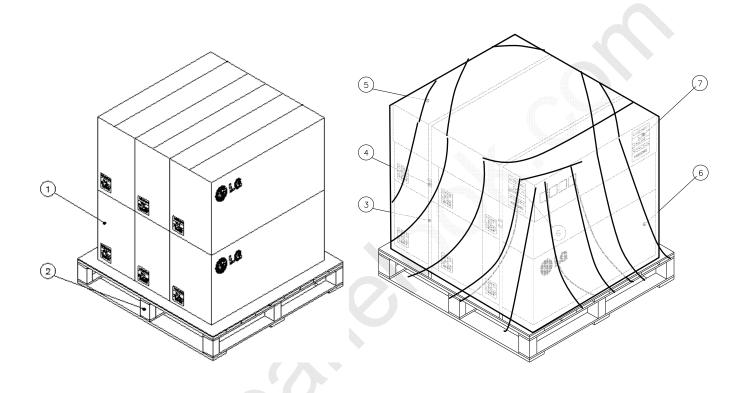
Product Specification

APPENDIX-I-1

■ LC320EUD-SCA1 - Pallet Ass'y

NO.	DESCRIPTION	MATERIAL
1	PACKING ASS'Y	
2	PALLET	Plywood
3	BAND	PP
4	CLIP, BAND	STEEL
5	Angle Cover	PAPER
6	WRAP	LDPE
7	LABEL	ART 100X70

Ver. 1.0
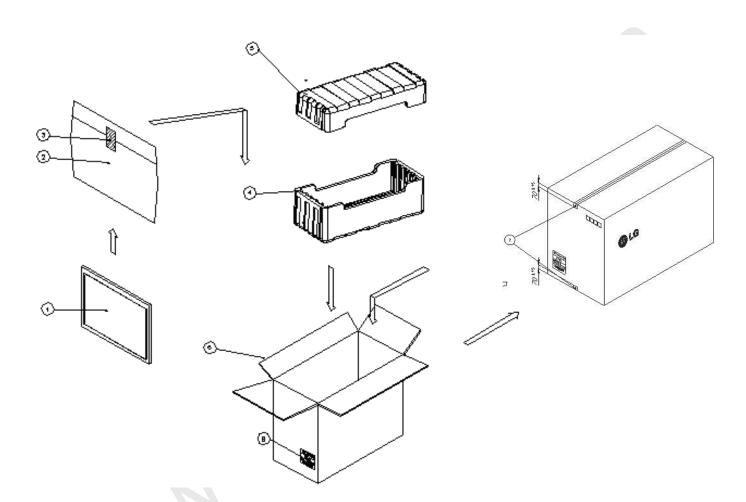
Product Specification

APPENDIX-I-2

■ LC320EUD-SCA1 - Packing Ass'y
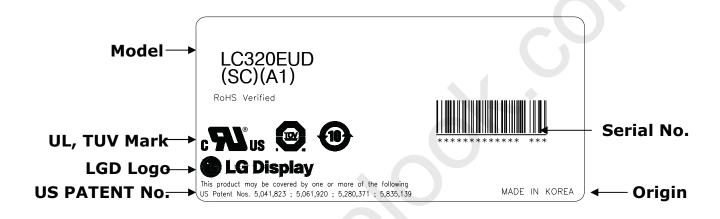
NO.	DESCRIPTION	MATERIAL
1	LCD Module	
2	BAG	AL
3	TAPE	MASKING 20MMX50M
4	Packing	EPS
5	Packing	EPS
6	BOX	PAPER_DW3
7	TAPE	OPP 70MMX300M
8	Label	ART 100X70

Ver. 1.0

Product Specification

APPENDIX-II-1

■ LC320EUD-SCA1 - LCM Label

Model → LC320EUD (SC)(A1)
RoHS Verified

UL, TUV Mark →

LGD Logo → LG Display

US PATENT No. → This product may be covered by one or more of the following US Patent Nos. 5,041,823 ; 5,061,920 ; 5,280,371 ; 5,835,139

Serial No. ←

Origin ← MADE IN KOREA
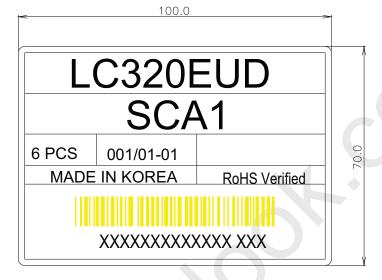
Product Specification

APPENDIX-II-2

■ LC320EUD-SCA1 - Pallet Label

100.0

LC320EUD
SCA1

| 6 PCS | 001/01-01 | |
| MADE IN KOREA | | RoHS Verified |

XXXXXXXXXXXX XXX

70.0

LC320EUD

| Product Specification |

APPENDIX- III-1

■ Required signal assignment for Flat Link (Thine : THC63LVD103) Transmitter(Pin7="**L**")

Host System 30 Bit	THC63LVD103 or Compatible
RED0	33
RED1	34
RED2	35
RED3	36
RED4	37
RED5	38
RED6	59
RED7	61
RED8	4
RED9	5
GREEN0	40
GREEN1	41
GREEN2	42
GREEN3	44
GREEN4	45
GREEN5	46
GREEN6	62
GREEN7	63
GREEN8	6
GREEN9	8
BLUE0	48
BLUE1	49
BLUE2	50
BLUE3	52
BLUE4	53
BLUE5	54
BLUE6	64
BLUE7	1
BLUE8	9
BLUE9	11
Hsync	55
Vsync	57
Data Enable	58
CLOCK	12

FI-RE51S-HF

THC63LVD103		FI-RE51S-HF			Timing Controller
TA-	31	12			RO0N
TA+	30	13	100Ω		RO0P
TB-	29	14			RO1N
TB+	28	15	100Ω		RO1P
TC-	25	16			RO2N
TC+	24	17	100Ω		RO2P
TCLK-	23	19			ROCLKN
TCLK+	22	20	100Ω		ROCLKP
TD-	21	22			RO3N
TD+	20	23	100Ω		RO3P
TE-	19	24			RO4N
TE+	18	25	100Ω		RO4P
		7			**VESA**/ JEIDA

GND

LCM Module

Note: 1. The LCD module uses a 100 Ohm[Ω] resistor between positive and negative lines of each receiver input.
    2. Refer to LVDS Transmitter Data Sheet for detail descriptions. (THC63LVD103 or Compatible)
    3. '9' means MSB and '0' means LSB at R,G,B pixel data.

LC320EUD

Product Specification

APPENDIX- III-1

■ Required signal assignment for Flat Link (Thine : THC63LVD103) Transmitter(Pin7="H")

Host System 30 Bit	THC63LVD103 or Compatible
RED0	4
RED1	5
RED2	59
RED3	61
RED4	33
RED5	34
RED6	35
RED7	36
RED8	37
RED9	38
GREEN0	6
GREEN1	8
GREEN2	62
GREEN3	63
GREEN4	40
GREEN5	41
GREEN6	42
GREEN7	44
GREEN8	45
GREEN9	46
BLUE0	9
BLUE1	11
BLUE2	64
BLUE3	1
BLUE4	48
BLUE5	49
BLUE6	50
BLUE7	52
BLUE8	53
BLUE9	54
Hsync	55
Vsync	57
Data Enable	58
CLOCK	12

FI-RE51S-HF

Timing Controller

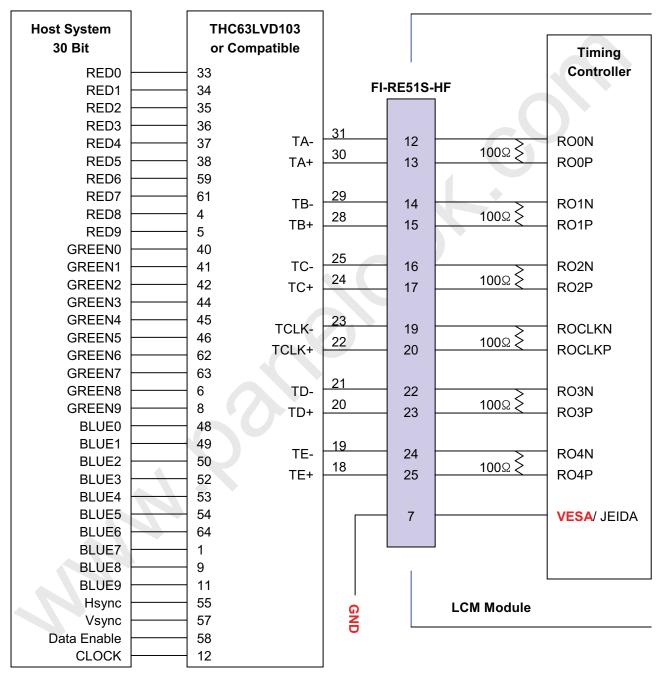|		FI-RE51S-HF		Timing Controller
TA-	31	12	100Ω	RO0N
TA+	30	13		RO0P
TB-	29	14		RO1N
TB+	28	15	100Ω	RO1P
TC-	25	16		RO2N
TC+	24	17	100Ω	RO2P
TCLK-	23	19		ROCLKN
TCLK+	22	20	100Ω	ROCLKP
TD-	21	22		RO3N
TD+	20	23	100Ω	RO3P
TE-	19	24		RO4N
TE+	18	25	100Ω	RO4P
		7		VESA /**JEIDA**

VCC

LCM Module

Note :1. The LCD module uses a 100 Ohm[Ω] resistor between positive and negative lines of each receiver input.
2. Refer to LVDS Transmitter Data Sheet for detail descriptions. (THC63LVD103 or Compatible)
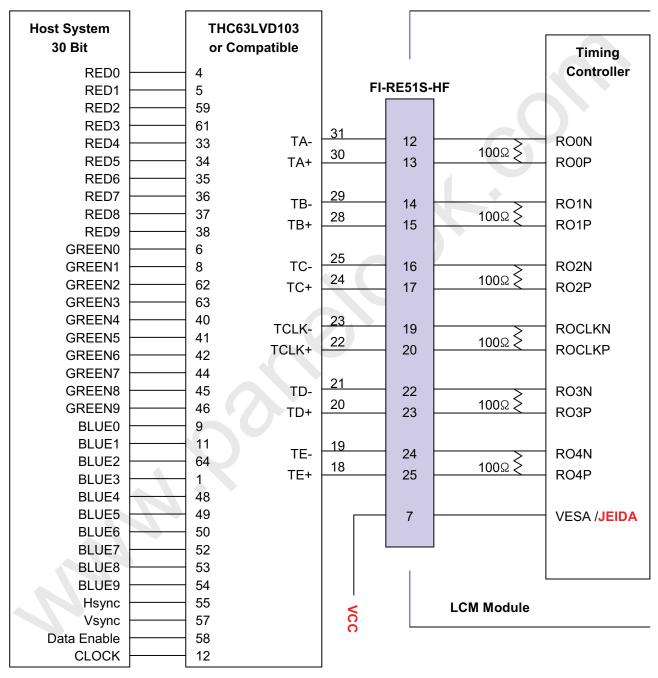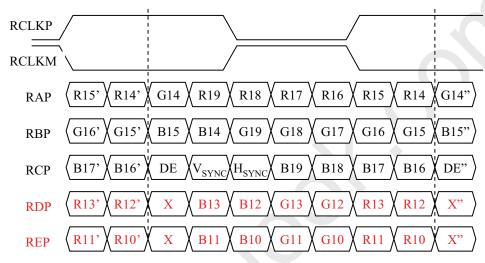3. '9' means MSB and '0' means LSB at R,G,B pixel data.

Ver. 1.0

LC320EUD

Product Specification

APPENDIX- III-2

■ LVDS Data-Mapping Information (**10 Bit**)

1) LVDS Select : "**H**" Data-Mapping (**JEIDA format**)

RAP	R15'	R14'	G14	R19	R18	R17	R16	R15	R14	G14"
RBP	G16'	G15'	B15	B14	G19	G18	G17	G16	G15	B15"
RCP	B17'	B16'	DE	V_{SYNC}	H_{SYNC}	B19	B18	B17	B16	DE"
RDP	R13'	R12'	X	B13	B12	G13	G12	R13	R12	X"
REP	R11'	R10'	X	B11	B10	G11	G10	R11	R10	X"

2) LVDS Select : "**L**" Data-Mapping (**VESA format**)

RAP	R11'	R10'	G10	R15	R14	R13	R12	R11	R10	G10"
RBP	G12'	G11'	B11	B10	G15	G14	G13	G12	G11	B15"
RCP	B13'	B12'	DE	V_{SYNC}	H_{SYNC}	B15	B14	B13	B12	DE"
RDP	R17'	R16'	X	B17	B16	G17	G16	R17	R16	X"
REP	R19'	R18'	X	B19	B18	G19	G18	R19	R18	X"

Product Specification
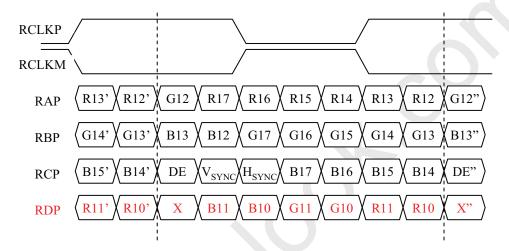
APPENDIX- III-2
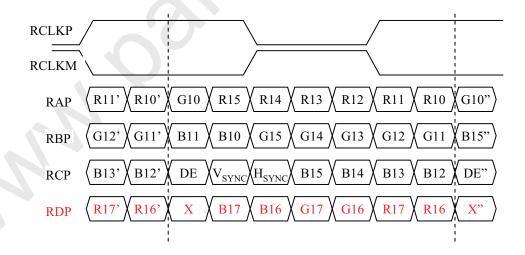
■ LVDS Data-Mapping Information (**8 Bit**)

1) LVDS Select : "**H**" Data-Mapping (**JEIDA format**)

RAP	R13'	R12'	G12	R17	R16	R15	R14	R13	R12	G12"
RBP	G14'	G13'	B13	B12	G17	G16	G15	G14	G13	B13"
RCP	B15'	B14'	DE	V$_{SYNC}$	H$_{SYNC}$	B17	B16	B15	B14	DE"
RDP	R11'	R10'	X	B11	B10	G11	G10	R11	R10	X"

2) LVDS Select : "**L**" Data-Mapping (**VESA format**)

RAP	R11'	R10'	G10	R15	R14	R13	R12	R11	R10	G10"
RBP	G12'	G11'	B11	B10	G15	G14	G13	G12	G11	B15"
RCP	B13'	B12'	DE	V$_{SYNC}$	H$_{SYNC}$	B15	B14	B13	B12	DE"
RDP	R17'	R16'	X	B17	B16	G17	G16	R17	R16	X"

Product Specification

APPENDIX- III-3

■ **Option Pin** Circuit Block Diagram

1) Circuit Block Diagram of **LVDS Format** Selection pin

LVDS Select Pin : Pin 9

LVDS Select
(Pin 9)

1KΩ

LVDS Select

50~100KΩ

ASIC
(TCON)

System Side   **LCM Side**