SPECIFICATION
FOR
APPROVAL

(   )　Preliminary Specification

(●)　Final Specification

Title	32.0" WXGA TFT LCD

BUYER	General
MODEL	

SUPPLIER	LG.Display Co., Ltd.
*MODEL	LC320WXN
SUFFIX	SCA1 (RoHS Verified)

*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	
S. W Yu / Project Leader	
PREPARED BY	
Y. D Lee / Engineer	

**TV Products Development Dept.
LG. Display LCD Co., Ltd**

CONTENTS

RECORD OF REVISIONS

| Revision No.	Revision Date	Page	Description
0.0	Sep, 25, 2009	-	Preliminary Specification (First Draft)
1.0	Jan,11,2009	-	Final Specification

Product Specification

1. General Description

The LC320WXN is a Color Active Matrix Liquid Crystal Display with an integral External Electrode Fluorescent Lamp(EEFL) 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 31.51 inch diagonally measured active display area with WXGA resolution (768 vertical by 1366 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 8-bit gray scale signal for each dot. Therefore, it can present a palette of more than 16.7M (true) colors.

It has been designed to apply the 8-bit 1-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.
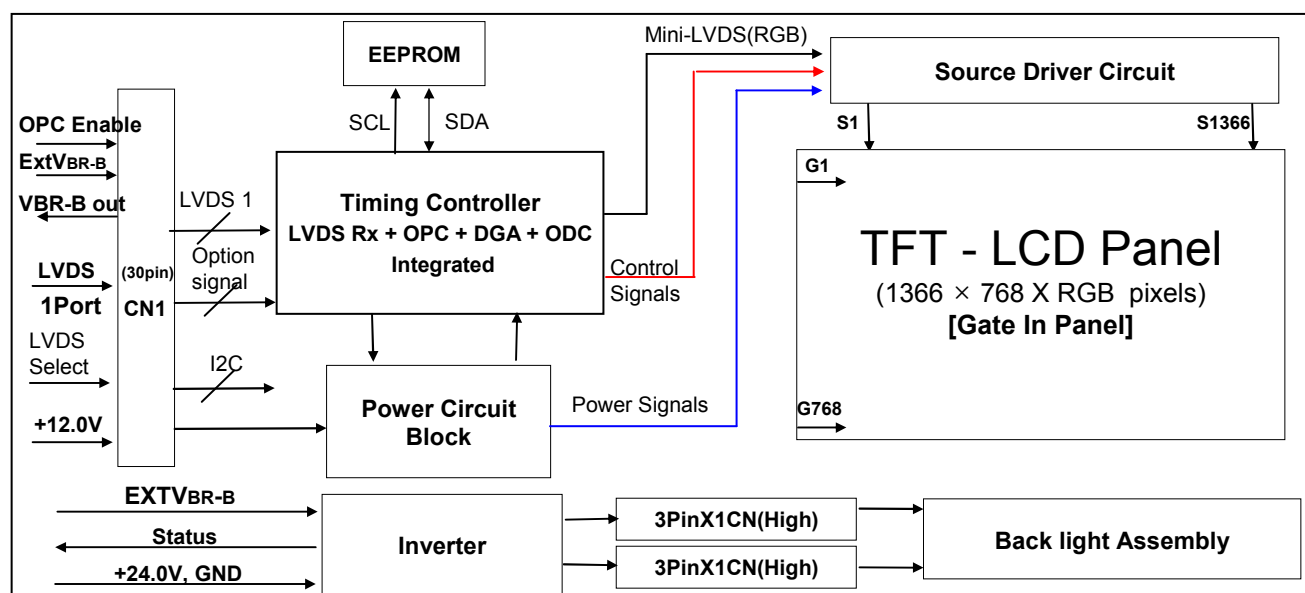
General Features

Active Screen Size	31.51 inches(800.4mm) diagonal
Outline Dimension	760.0(H) x 450.0 (V) x 48.0 mm(D) (Typ.)
Pixel Pitch	0.51075 mm x 0.17025 mm x RGB
Pixel Format	1366 horiz. by 768 vert. Pixels, RGB stripe arrangement
Color Depth	8bit , 16.7M 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 83.6 W (Typ.) (Logic=3.6 W, Inverter=80W)
Weight	5.0Kg (Typ.)
Display Mode	Transmissive mode, Normally black
Surface Treatment	Hard coating(3H), Anti-glare treatment of the front polarizer (Haze 10%)

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

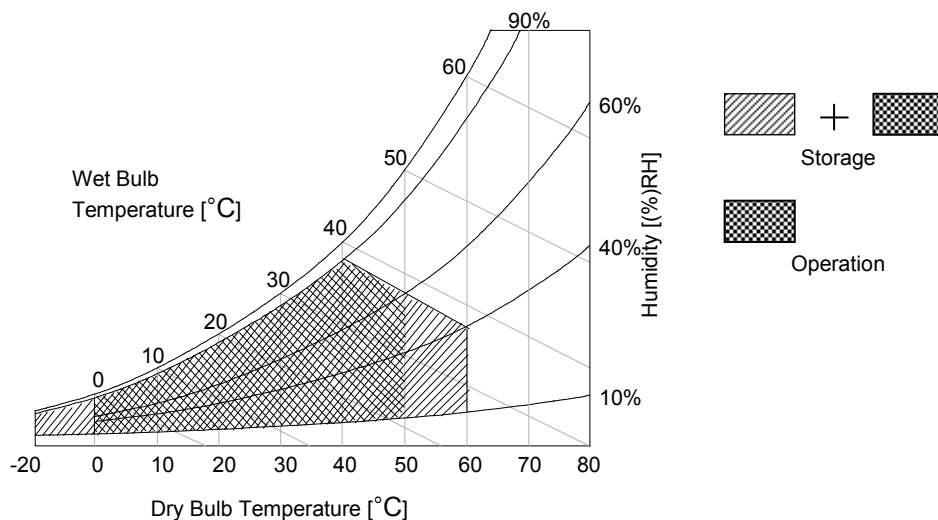| Parameter		Symbol	Value		Unit	Note
			Min	Max		
Power Input Voltage	LCD Circuit	V_{LCD}	-0.3	+14.0	V_{DC}	
	Inverter	V_{BL}	-0.3	+ 27.0	V_{DC}	
Inverter Control Voltage	ON/OFF	V_{OFF} / V_{ON}	-0.3	+5.5	V_{DC}	1
	Brightness	V_{BR}	0.0	+5.0	V_{DC}	
T-Con Option Selection Voltage		V_{LOGIC}	-0.3	+4.0	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.

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 EEFL backlight and inverter circuit.

Table 2. ELECTRICAL CHARACTERISTICS

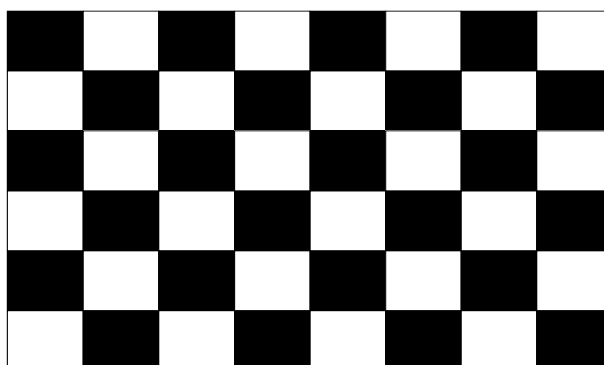| Parameter	Symbol	Value			Unit	Note
		Min	Typ	Max		
Circuit :						
Power Input Voltage	V_{LCD}	10.8	12.0	13.2	V_{DC}	
Power Input Current	I_{LCD}	-	300	390	mA	1
		-	350	455	mA	2
Power Consumption	P_{LCD}		3.60	4.68	Watt	1
Rush current	I_{RUSH}	-	-	3.0	A	3

Note 1. The specified current and power consumption are under the V_{LCD}=12.0V, Ta=25 $\pm$ 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 0.5ms (min.).

White : 255 Gray
Black :   0 Gray

Mosaic Pattern(8 x 6)

Product Specification

Table 3. ELECTRICAL CHARACTERISTICS (Continue)

Parameter			Symbol	Values			Unit	Note
				Min	Typ	Max		
Inverter :								
Power Supply Input Voltage			V_{BL}	22.8	24.0	25.2	V_{DC}	1
Power Supply Input Current	After Aging		I_{BL_A}	-	3.3	3.65	A	1
	Before Aging		I_{BL_B}	-	3.4	3.8	A	2
Power Supply Input Current (In-Rush)			I_{RUSH}	-	-	6.0	A	V_{BL} = 22.8V **EXTV**BR-B = 100% 6
Power Consumption			P_{BL}	-	80		W	1
Input Voltage for Control System Signals	On/Off	On	V_{ON}	2.5	-	5.0	V_{DC}	
		Off	V_{OFF}	-0.3	0.0	0.8	V_{DC}	
	Brightness Adjust		**EXTV**BR-B	25	-	100	%	On Duty 7
	PWM Frequency for NTSC & PAL	PAL			100		Hz	5
		NTSC			120		Hz	5
	Pulse Duty Level (PWM) (Burst mode)	High Level		2.5	-	5.0	V_{DC}	High: Lamp on Low : Lamp off
		Low Level		0.0	-	0.8	V_{DC}	
Lamp:								
Discharge Stabilization Time			Ts			3	min	3
Life Time				50,000	60,000		Hrs	4

Note 1. Electrical characteristics are determined after the unit has been 'ON' and stable for approximately 120 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. Electrical characteristics are determined within 30 minutes at 25±2°C.
    The specified currents are under the typical supply Input voltage 24V.
  3. The brightness of the lamp after lighted for 5minutes is defined as 100%.
    TS is the time required for the brightness of the center of the lamp to be not less than 95% at typical current.
    The screen of LCD module may be partially dark by the time the brightness of lamp is stable after turn on.
  4. Specified Values are for a single lamp which is aligned horizontally.
    The life time is determined as the time which luminance of the lamp is 50% compared to that of initial value at the typical lamp current (**EXTV**BR-B :100%), on condition of continuous operating at 25± 2°C
  5. LGD recommend that the PWM freq. is synchronized with two times harmonic of Vsync signal of system.
  6. The duration of rush current is about 10ms.
  7. **EXTV**BR-B is based on input PWM duty of the inverter.

Product Specification

3-2. Interface Connections

This LCD module employs two kinds of interface connection, 30-pin connector is used for the module electronics and 14-pin connector is used for the integral backlight system.

3-2-1. LCD Module

- LCD Connector : FI-X30SSL-HF(manufactured by JAE) or IS100-L30B-C23(manufactured by UJU)
  (CN1)　　　　　Refer to below table
- Mating Connector : FI-X30C2L(manufactured by JAE) or compatible

Table 4. MODULE CONNECTOR(CN1) PIN CONFIGURATION

Pin No.	Symbol	Description	Note
1	V_{LCD}	Power Supply +12.0V	
2	V_{LCD}	Power Supply +12.0V	
3	V_{LCD}	Power Supply +12.0V	
4	V_{LCD}	Power Supply +12.0V	
5	GND	Ground	
6	GND	Ground	
7	GND	Ground	
8	GND	Ground	
9	LVDS Select	'H' =JEIDA , 'L' or NC = VESA	**Appendix III-1,-2**
10	OPC_Enable	'H' = Enable , 'L' = Disable	
11	GND	Ground	
12	RA-	LVDS Receiver Signal(-)	
13	RA+	LVDS Receiver Signal(+)	
14	GND	Ground	
15	RB-	LVDS Receiver Signal(-)	
16	RB+	LVDS Receiver Signal(+)	
17	GND	Ground	
18	RC-	LVDS Receiver Signal(-)	
19	RC+	LVDS Receiver Signal(+)	
20	GND	Ground	
21	RCLK-	LVDS Receiver Clock Signal(-)	
22	RCLK+	LVDS Receiver Clock Signal(+)	
23	GND	Ground	
24	RD-	LVDS Receiver Signal(-)	
25	RD+	LVDS Receiver Signal(+)	
26	GND	Ground	
27	OPC OUT	OPC output (From LCM)	
28	Ext V_{BR-B}	External VBR (From System)	
29	GND	Ground	
30	GND	Ground	

Note　　1. All GND(ground) pins should be connected together to the LCD module's metal frame.
　　　　　2. All V_{LCD} (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. **# 10 & #27~#28**) are used for OPC function of the LCD module.
　　　　　　If not used, these pins are no connection. (Please see the **Appendix III-4** for more information.)

Product Specification

3-2-2. Backlight Module

[Master]
-Inverter Connector : 20022WR-14B1(Yeonho)
                            or Equivalent
- Mating Connector : 20022HS-14 or Equivalent

Table 5. INVERTER CONNECTOR PIN CONFIGULATION

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	NC	
12	$V_{ON/OFF}$	Backlight ON/OFF control	$V_{ON/OFF}$	
13	$EXTV_{BR-B}$	External PWM	$EXTV_{BR-B}$	
14	Status	Lamp Status	Status	2

Note   1. GND should be connected to the LCD module's metal frame.

2. Normal : Low (under 0.7V) / Abnormal : High (upper 3.0V)

Please see **Appendix IV-1** for more information.

3. The impedance of pin #12 is over 100[KΩ] & the impedance of Pin #13 is over 50[KΩ].

◆ **Rear view of LCM**

\<Master\>
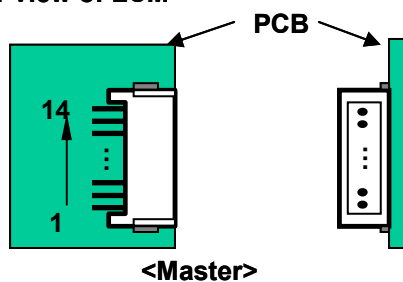
3-3. Signal Timing Specifications

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}	-	1366	-	tclk	
	Blank	t_{HB}	90	162	410	tclk	
	Total	t_{HP}	1456	1528	1776	tclk	
Vertical	Display Period	t_{VV}	-	768	-	t_{HP}	
	Blank	t_{VB}	8	22	240	t_{HP}	
	Total	t_{VP}	776	790	1008	t_{HP}	
Frequency	DCLK	f_{CLK}	63.0	72.4	80.0	MHz	
	Horizontal	f_H	45	47.4	55	KHz	
	Vertical	f_V	57	60	63	Hz	

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

ITEM		Symbol	Min	Typ	Max	Unit	Note
Horizontal	Display Period	t_{HV}	-	1366	-	tclk	
	Blank	t_{HB}	90	162	410	tclk	
	Total	t_{HP}	1456	1528	1776	tclk	
Vertical	Display Period	t_{VV}	-	768	-	t_{HP}	
	Blank	t_{VB}	126	180	295	t_{HP}	
	Total	t_{VP}	894	948	1063	t_{HP}	
Frequency	DCLK	f_{CLK}	63.0	72.4	80.0	MHz	
	Horizontal	f_H	45	47.4	55	KHz	
	Vertical	f_V	47	50	53	Hz	

Note   The Input of HSYNC & VSYNC signal does not have an effect on normal operation(DE Only Mode). The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rate.
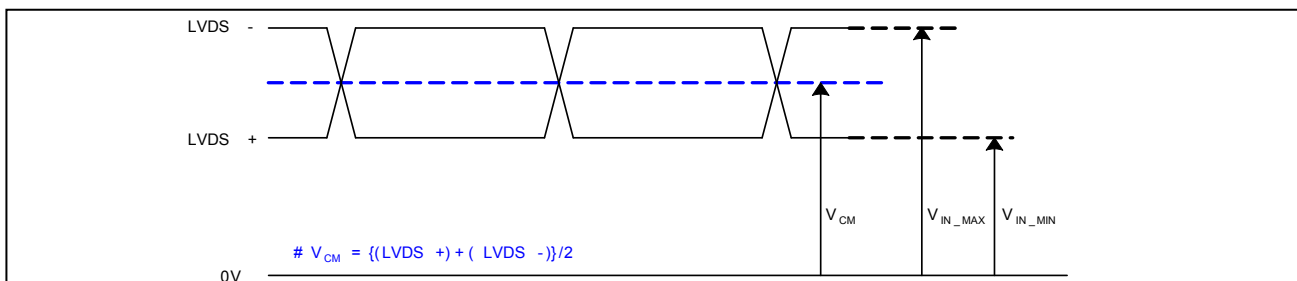
3-4. LVDS Signal Specification

3-4-1. LVDS Input Signal Timing Diagram
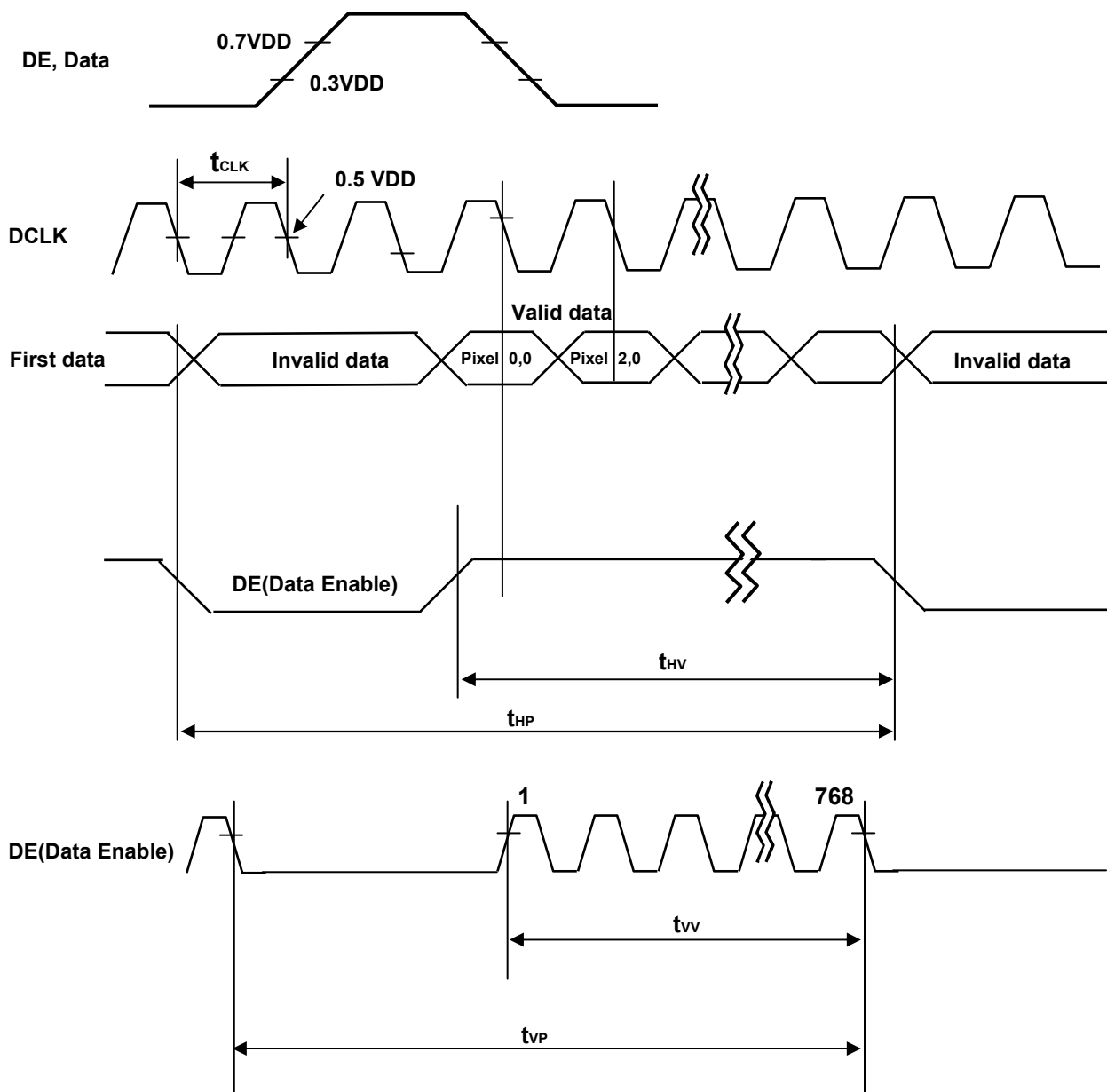
3-4-2. LVDS Input Signal Characteristics

1) DC Specification

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

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

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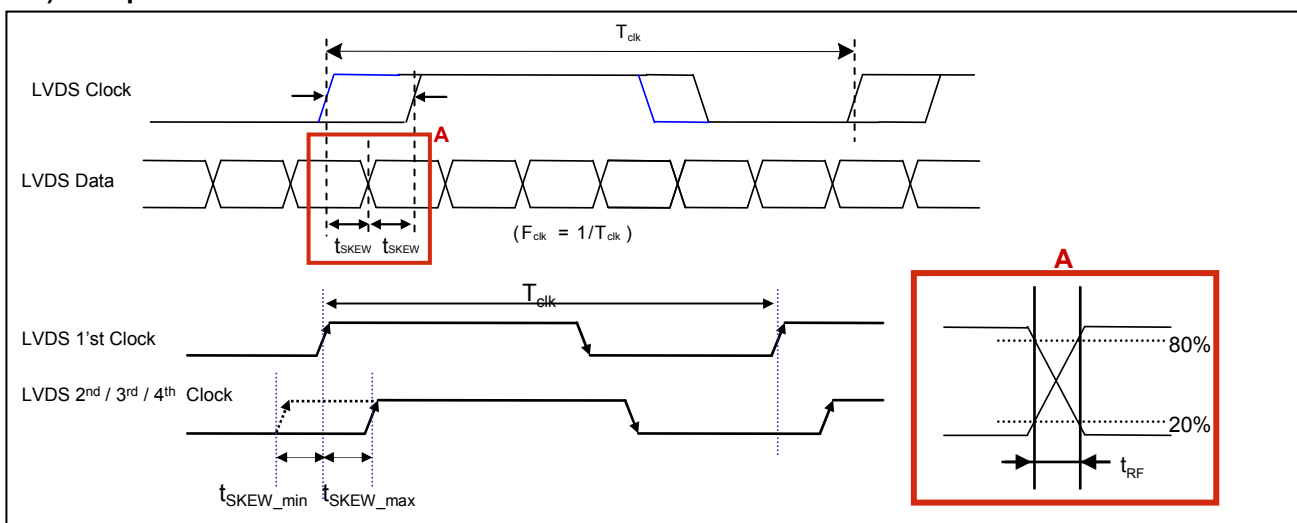
Description		Symbol	Min	Max	Unit	Note
LVDS Differential Voltage	High Threshold	V_{TH}	100	300	mV	3
	Low Threshold	V_{TL}	-300	-100	mV	
LVDS Clock to Data Skew Margin		t_{SKEW}		$|(0.25*T_{clk})/7|$	ps	-
LVDS Clock/DATA Rising/Falling time		t_{RF}	260	$(0.3*T_{clk})/7$	ps	2
Effective time of LVDS		t_{eff}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

360ps

0.5tui

V+
data

Vcm

VTH

VTL

V-
data

360ps

teff

tui

V+
clk

tui : Unit Interval

Vcm

V-
clk
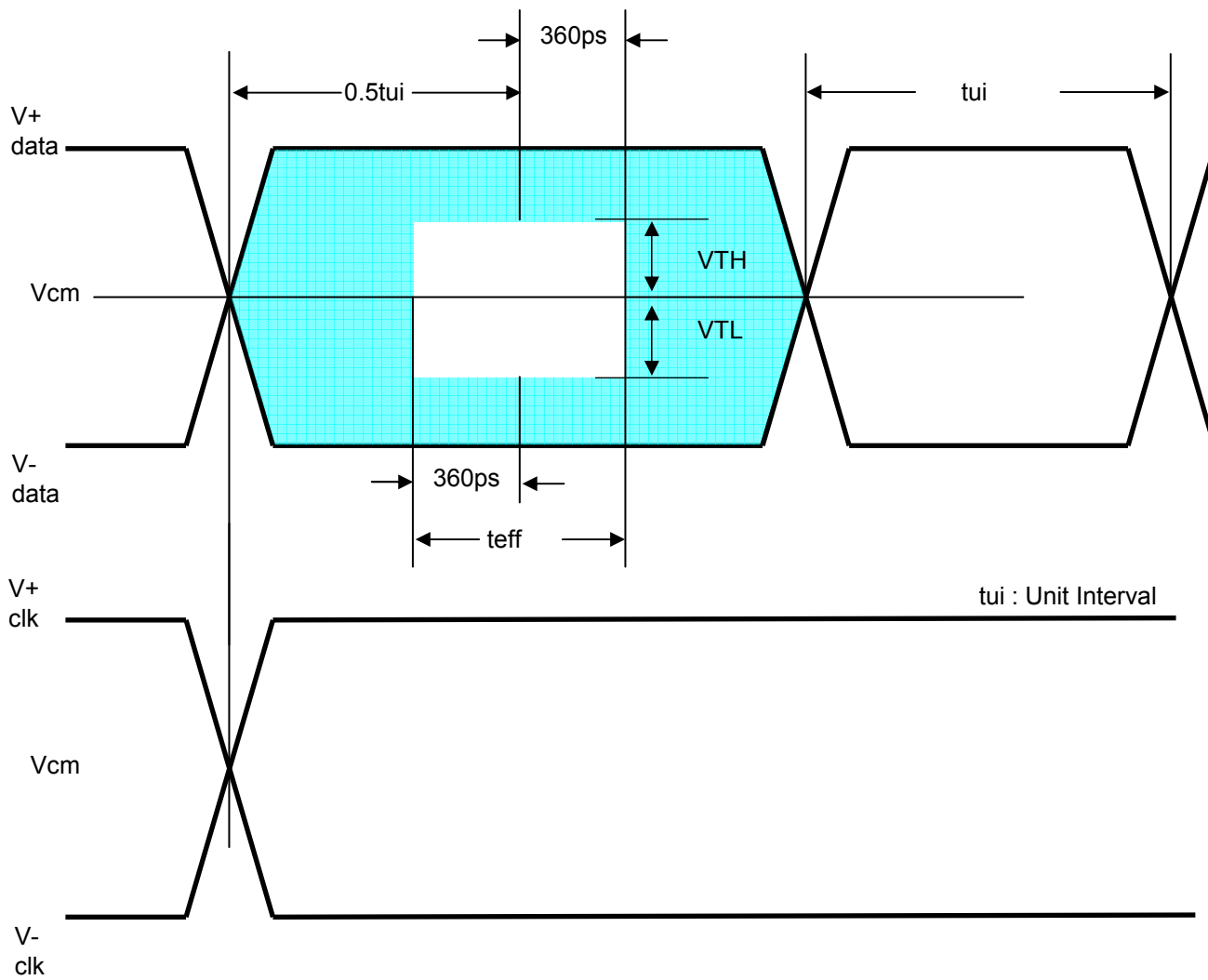
3-5. Color Data Reference

The brightness of each primary color(red,green,blue) is based on the 8bit 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 MSB							LSB	GREEN MSB							LSB	BLUE MSB							LSB	
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green (255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RED	RED (000) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (001)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	...				...								...								...				
	RED (254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN (000) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN (001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	...				...								...								...				
	GREEN (254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	GREEN (255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
BLUE	BLUE (000) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BLUE (001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	...				...								...								...				
	BLUE (254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	BLUE (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

3-6. Power Sequence

3-6-1. LCD Driving circuit
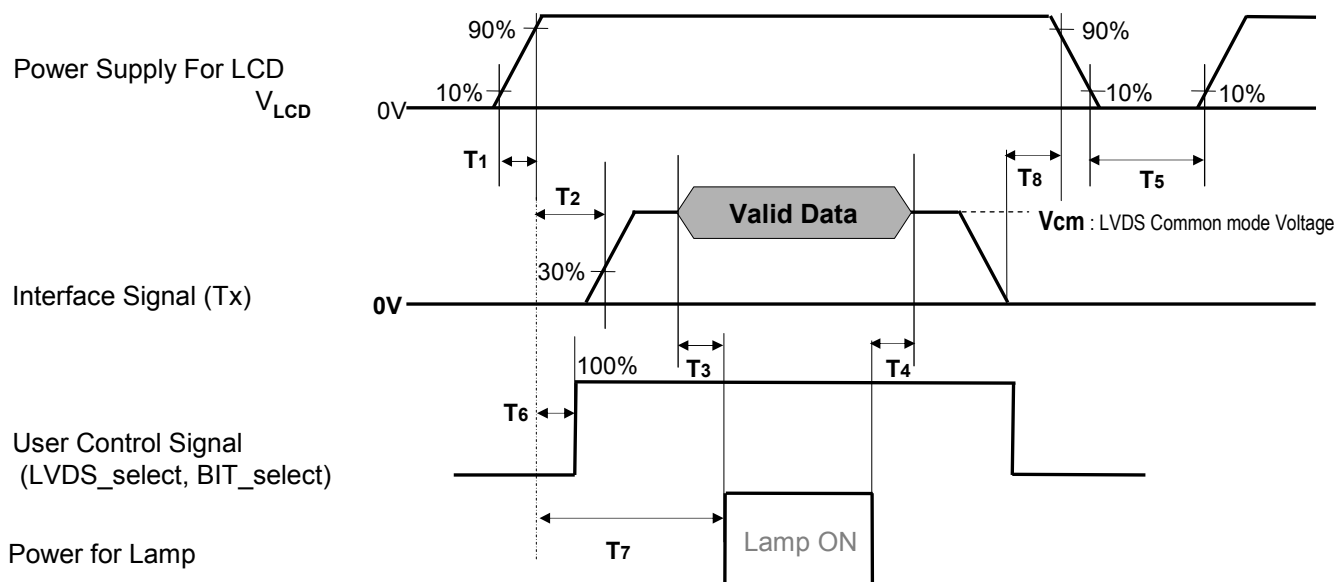
Table 8. POWER SEQUENCE

Parameter	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.

3-6-2. Sequence for Inverter

Power Supply For Inverter
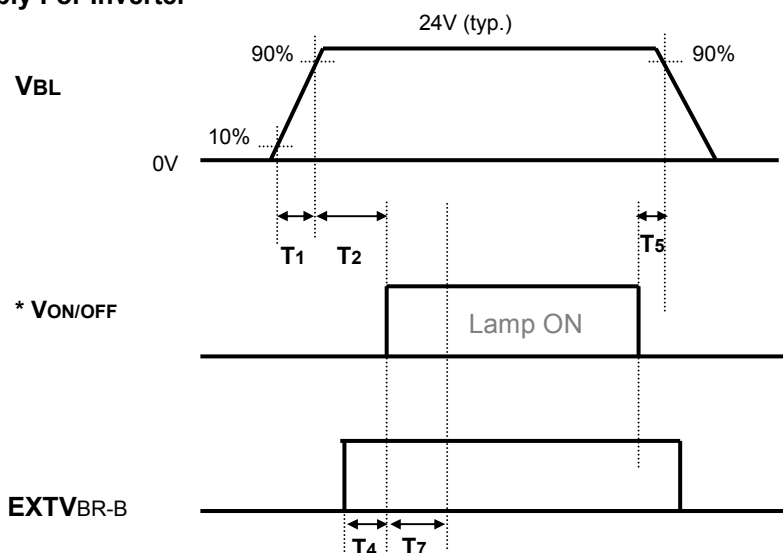
3-6-3. Dip condition for Inverter
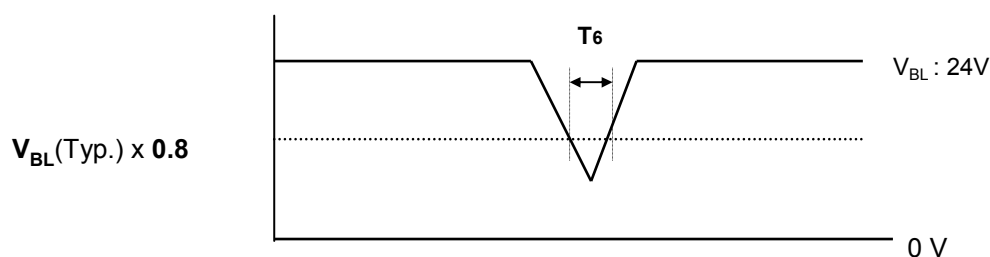
Table 9. Power Sequence for Inverter

Parameter	Values			Units	Note
	Min	Typ	Max		
T₁	20	-	-	ms	1
T₂	500	-	-	ms	
T₄	0		-	ms	2
T₅	10	-	-	ms	
T₆	-	-	10	ms	V_{BL}(Typ) x **0.8**
T₇	1000	-	-	ms	3

Notes : 1. T1 describes rising time of 0V to 24V and this parameter does not applied at restarting time.

2. T4(max) is less than T2.

3. It is the recommendation to input Max Duty to Inverter** for EXTVBR-B during T7 period.

   **When OPC Function is applied, the Max Duty is input to T-Con.

   * The recommendation of VON/OFF rising time is under 10ms.

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.
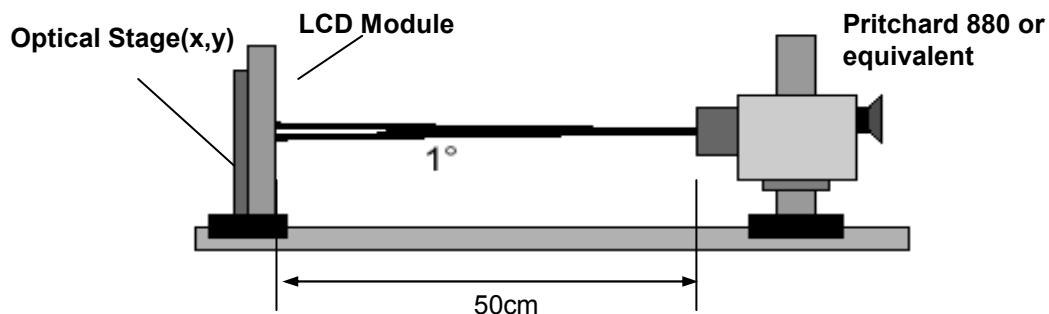
FIG. 1 Optical Characteristic Measurement Equipment and Method

Table 10. OPTICAL CHARACTERISTICS

Ta= 25±2°C, V_{LCD}=12.0V, fv=60Hz, Dclk=72.4MHz, **EXTV**BR-B =100%

Parameter		Symbol		Value			Unit	Note
				Min	Typ	Max		
Contrast Ratio		CR		900	1200			1
Surface Luminance, white		L_{WH}		380	450		cd/m^2	2
Luminance Variation		δ_{WHITE}	5P			1.3		3
Response Time	Gray-to-Gray	G to G		-	8	12	ms	4
	Uniformity	$\delta_{G\,TO\,G}$		-	-	1	ms	5
Color Coordinates [CIE1931]	RED	Rx		Typ -0.03	0.636	Typ +0.03		
		Ry			0.335			
	GREEN	Gx			0.291			
		Gy			0.603			
	BLUE	Bx			0.146			
		By			0.061			
	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

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. Gray to Gray Response time uniformity is Reference data. Please see **Appendix V**.

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 module surface. For more information, see the FIG. 4.

7. 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	0.08
L15	0.27
L31	1.04
L47	2.49
L63	4.68
L79	7.66
L95	11.5
L111	16.1
L127	21.6
L143	28.1
L159	35.4
L175	43.7
L191	53.0
L207	63.2
L223	74.5
L239	86.7
L255	100

Measuring point for surface luminance & luminance variation

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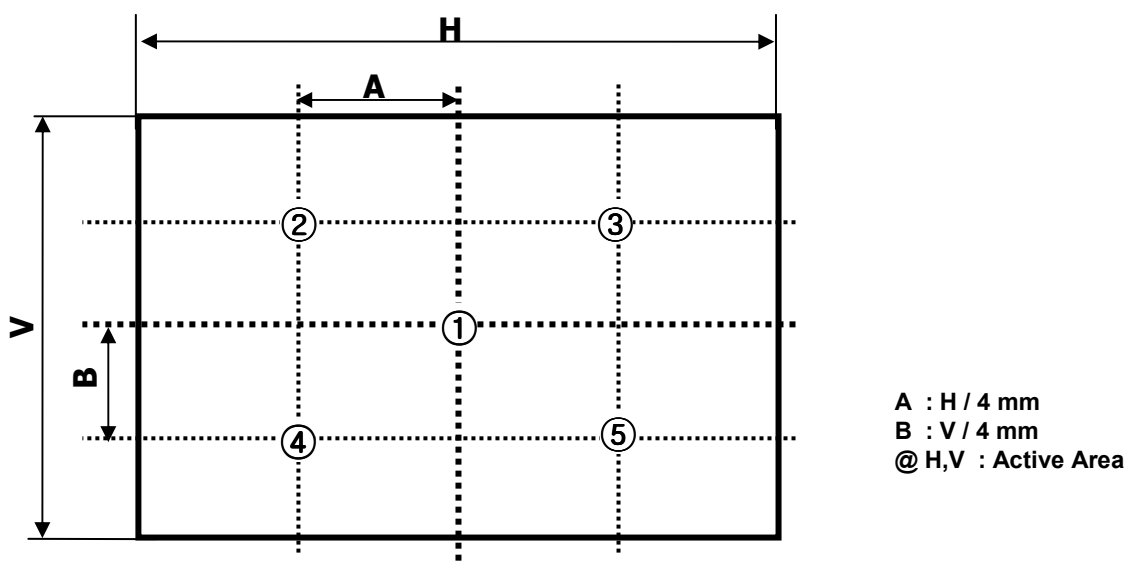B : V / 4 mm
@ H,V : Active Area

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)".
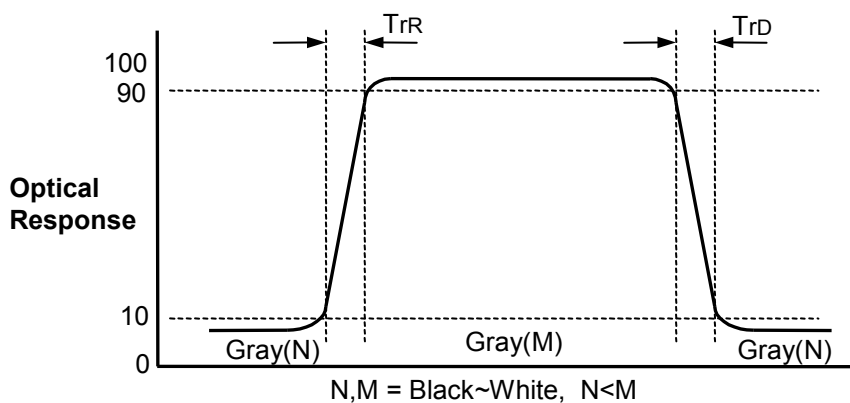

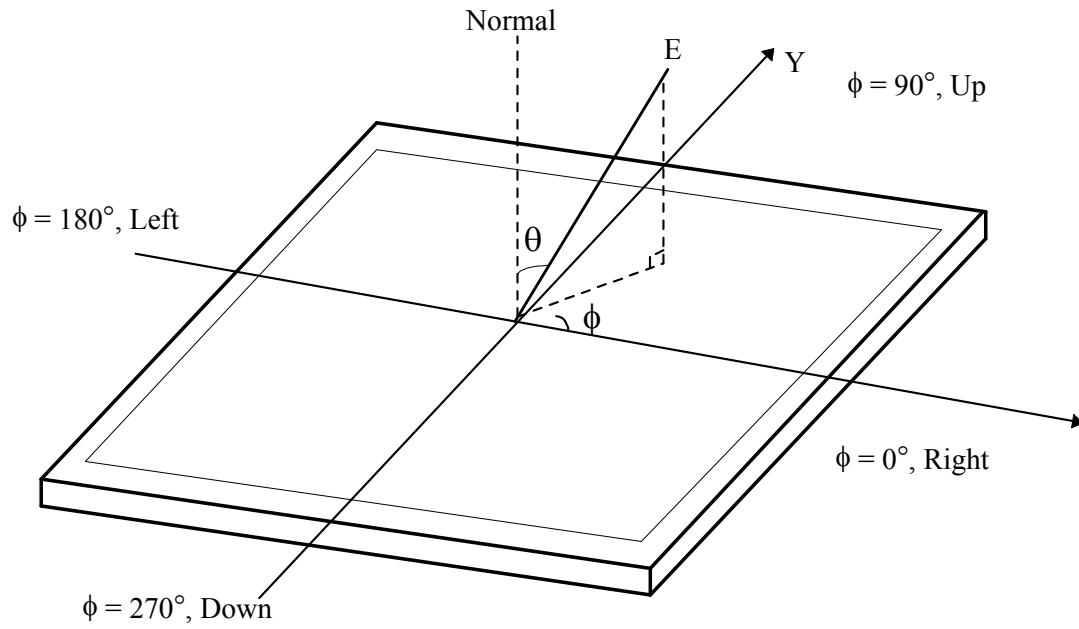**FIG. 3 Response Time**

Dimension of viewing angle range

FIG. 4 Viewing Angle

Product Specification

5. Mechanical Characteristics

Table 12 provides general mechanical characteristics.

Table 12. MECHANICAL CHARACTERISTICS

Item		Value
Outline Dimension	Horizontal	760.0 mm
	Vertical	450.0 mm
	Depth	48.0 mm
Bezel Area	Horizontal	703.8 mm
	Vertical	398.4 mm
Active Display Area	Horizontal	697.685 mm
	Vertical	392.256 mm
Weight	5.0 Kg (Typ.) ,5.3Kg (Max.)	

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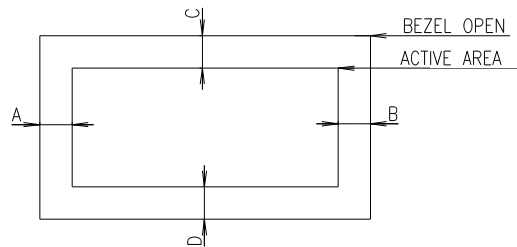
Product Specification

[FRONT VIEW]
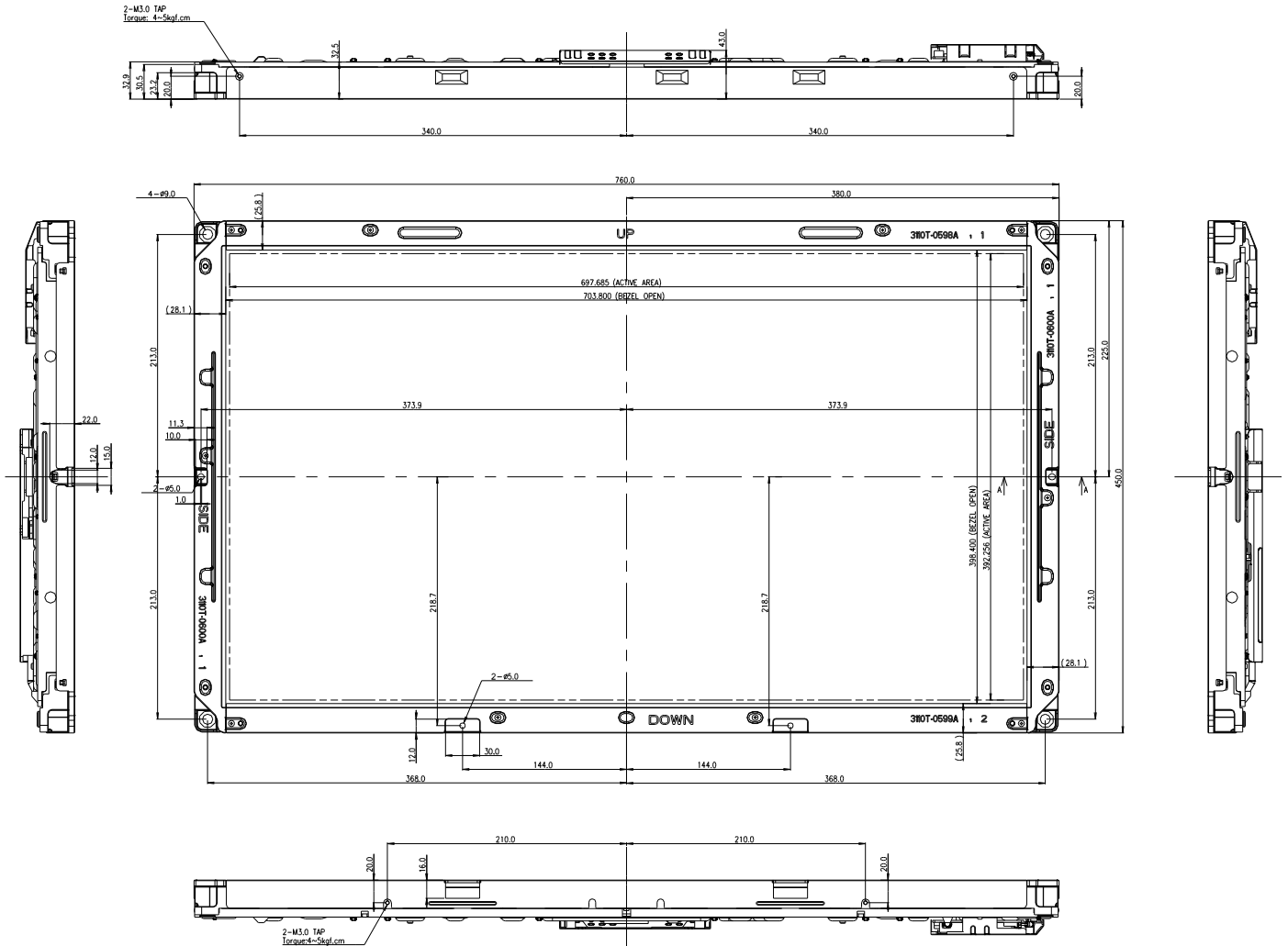
NOTES
1. Unspecified tolerances are to be ±1.0mm.
2. Tilt and partial disposition tolerance of display area
   are as following.
   (1) X-Direction : IA-BI ≤ 1.5mm
   (2) Y-Direction : IC-DI ≤ 1.5mm

SECTION A-A
SCALE 2/1

BEZEL OPEN
ACTIVE AREA

Product Specification

[REAR VIEW]
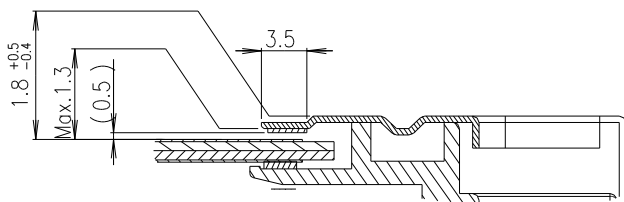
6. Reliability

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.

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.

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

| 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 : 30 pcs

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

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 transformers to prevent abnormal display, sound noise and temperature rising.

(11) Partial darkness may happen during 3~5 minutes when LCM is operated initially in condition that luminance is under 40% at low temperature (under 5℃). This phenomenon which disappears naturally after 3~5 minutes is not a problem about reliability but LCD characteristic.

(12) Partial darkness may happen under the long-term operation of any dimming without power on/off. This phenomenon which disappears naturally after 5 minutes is not a problem about reliability but LCD characteristics.

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.

9-7. Packing design precautions for panel damage

(1) We recommend to apply the 1 Piece integration packing or 3 piece (for supporting Cover Bottom) division packing, because Panel Crack or Panel missing can be occurred in Set Packing Design, when TV Set is dropping or falling in the tilt from transportation environment, (refer to Appendix VII)
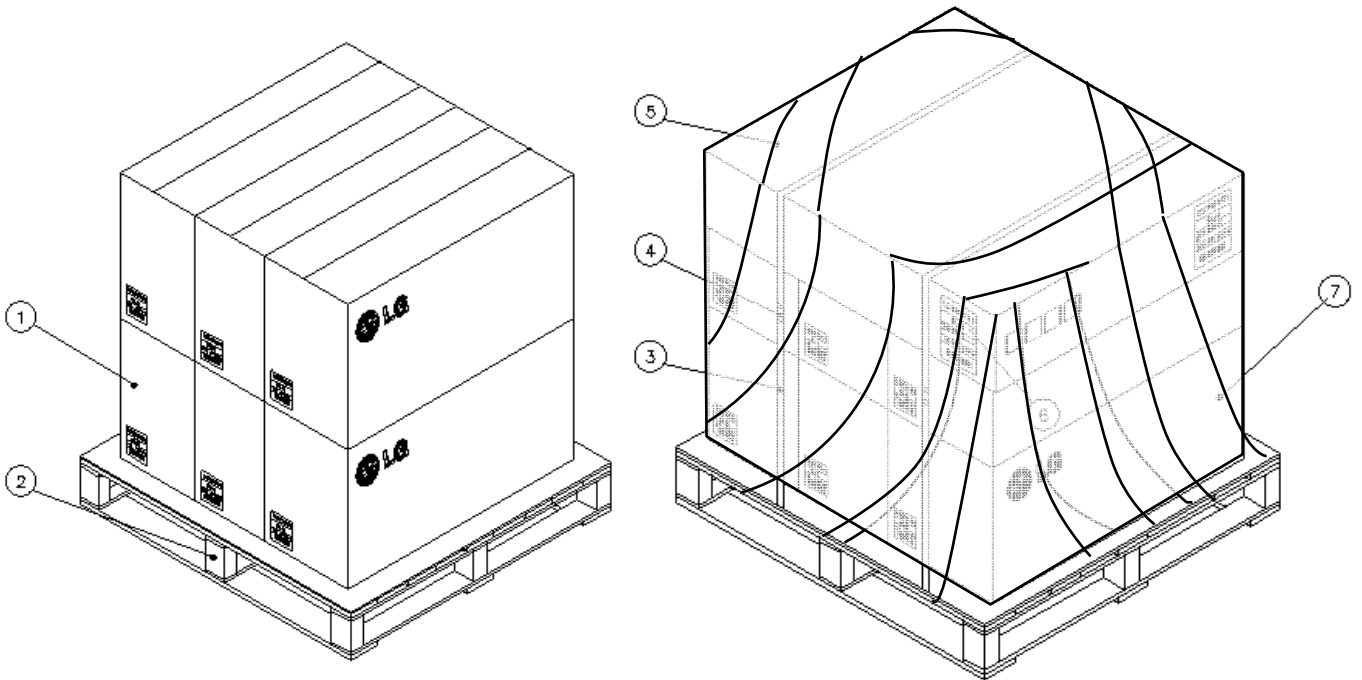
APPENDIX-I-1

■ LC320WXN-SCA1 – Packing Ass'y
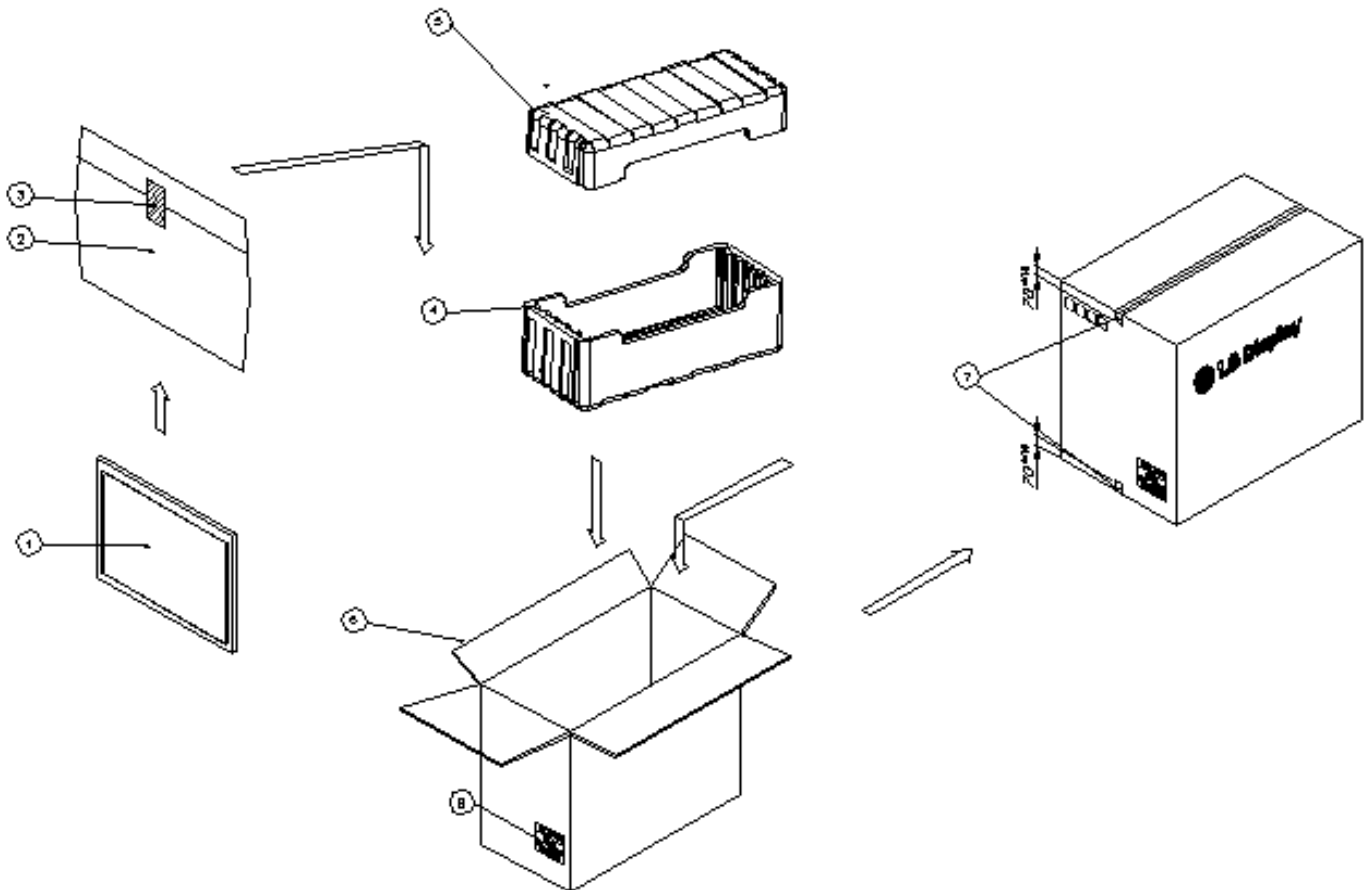
NO.	DESCRIPTION	MATERIAL
1	LCD Module	
2	BAG	AL
3	TAPE	MASKING 20MMX50M
4	Packing,Top	EPS
5	Packing,Bottom	EPS
6	BOX	PAPER_DW3
7	TAPE	OPP 70MMX300M
8	Label	ART 100X70

APPENDIX-I-2

■ LC320WXN-SCA1 – Pallet Ass'y

Box quantity per pallet: 6ea
Pallet size: L1140 x W870 x H1161

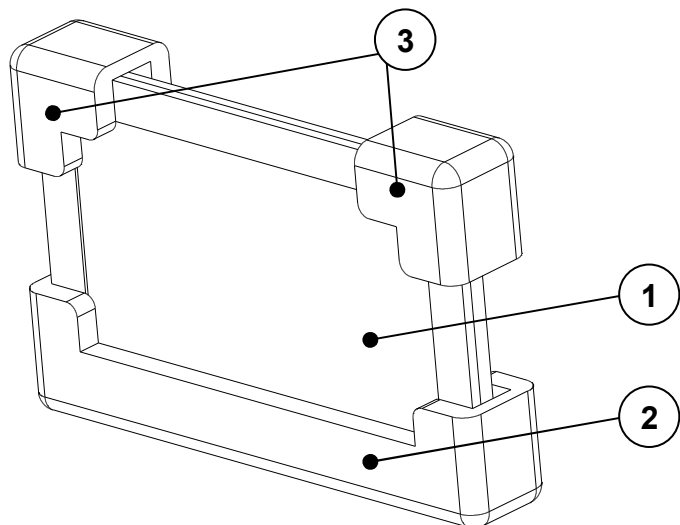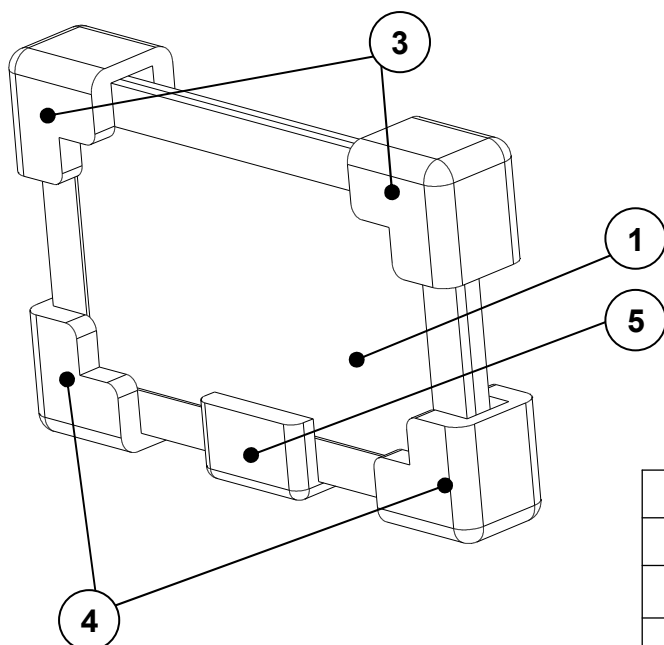| NO.	DESCRIPTION	MATERIAL
1	PACKING ASS'Y	
2	PALLET	Plywood
3	BAND	PP
4	CLIP, BAND	STEEL
5	ANGLE, PACKING	PAPER (SWR4)
6	LABEL	PAPER

APPENDIX-I-3

■ Recommendation structure for SET Packing Ass'y :
Recommend structure that extend SET lower column department holder with Case1 or Case 2

● Case 1. : 1 Piece Bottom Packing Type

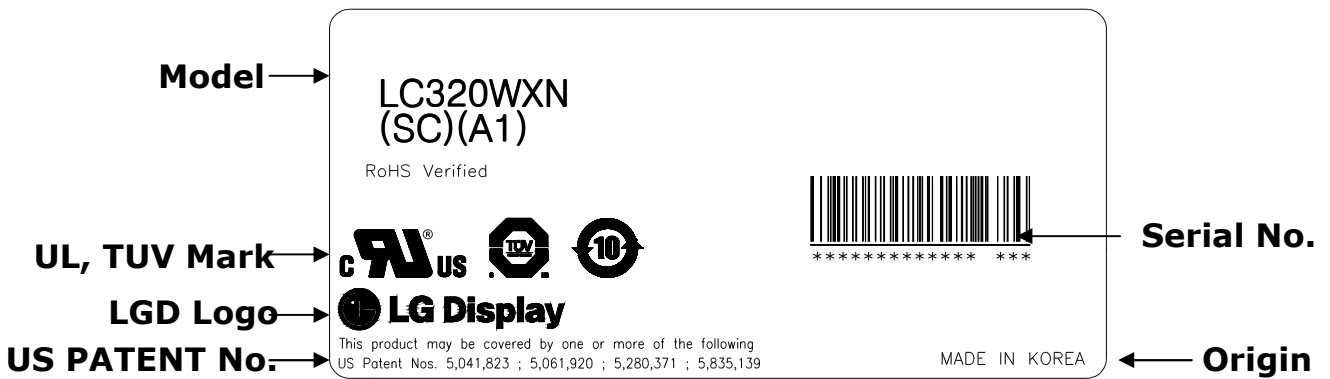● Case 2. : 3 Piece Bottom Packing Type (Add Center Packing)

NO.	DESCRIPTION
1	SET MODULE
2	SET PACKING, BOTTOM
3	SET PACKING, TOP L_R
4	SET PACKING, BOTTOM R_L
5	SET PACKING, BOTTOM _ CENTER

APPENDIX- II-1

■ LC320WXN-SCA1-LCM Label

Model →

LC320WXN
(SC)(A1)

RoHS Verified

Serial No.

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

MADE IN KOREA ← **Origin**

■ Serial No. (See CAS 25page for more information)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |

Inch — (1,2,3)

Year — (4) Month — (5)

M Ass'y Factory code — (6)

Serial No. — (7-13)
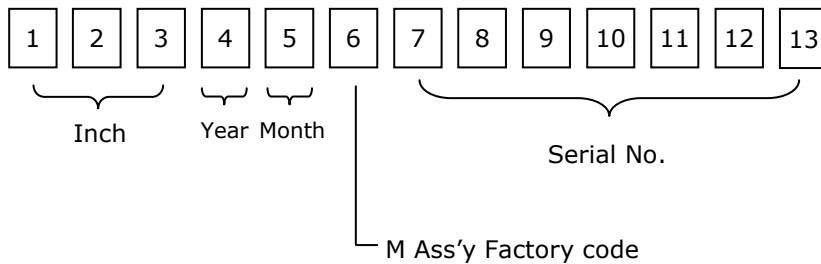
APPENDIX- II-2

■ LC320WXN-SCA1-Pallet Label

LC320WXN		
SCA1		
30 PCS	001/01−01	
MADE IN KOREA		RoHS Verified

■ LC320WXN-SCA1-Box Label

LC320WXN		
SCA1		
5 PCS	001/01−01	
MADE IN KOREA		RoHS Verified

APPENDIX- III-1

■ Required signal assignment for Flat Link (DS90C385) Transmitter(Pin9="L")
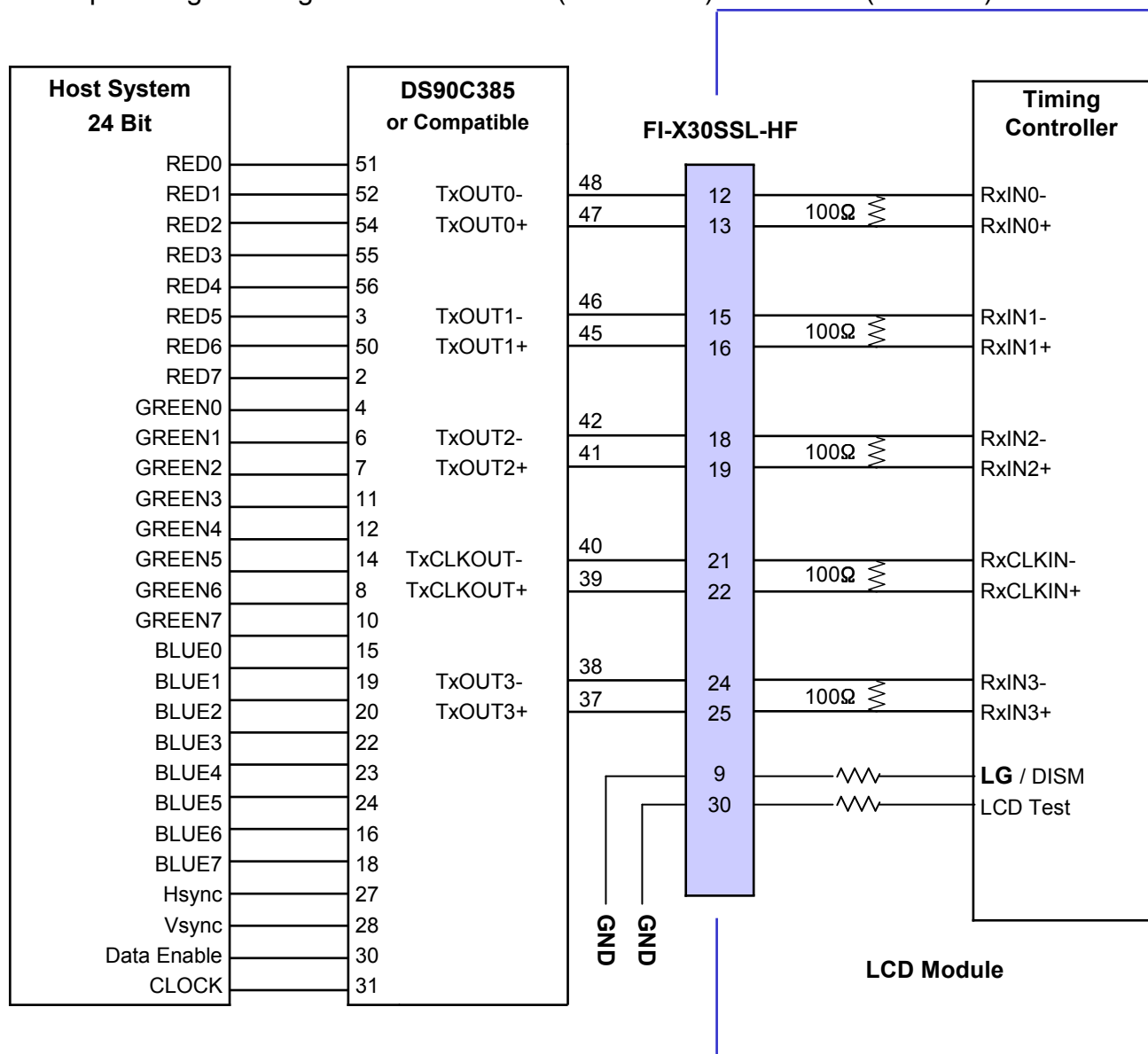
| Host System 24 Bit		DS90C385 or Compatible		FI-X30SSL-HF			Timing Controller
RED0	51		48	12			RxIN0-
RED1	52	TxOUT0-	47	13	100Ω		RxIN0+
RED2	54	TxOUT0+					
RED3	55						
RED4	56		46	15			RxIN1-
RED5	3	TxOUT1-	45	16	100Ω		RxIN1+
RED6	50	TxOUT1+					
RED7	2						
GREEN0	4		42	18			RxIN2-
GREEN1	6	TxOUT2-	41	19	100Ω		RxIN2+
GREEN2	7	TxOUT2+					
GREEN3	11						
GREEN4	12		40	21			RxCLKIN-
GREEN5	14	TxCLKOUT-	39	22	100Ω		RxCLKIN+
GREEN6	8	TxCLKOUT+					
GREEN7	10						
BLUE0	15		38	24			RxIN3-
BLUE1	19	TxOUT3-	37	25	100Ω		RxIN3+
BLUE2	20	TxOUT3+					
BLUE3	22			9			**LG** / DISM
BLUE4	23			30			LCD Test
BLUE5	24						
BLUE6	16						
BLUE7	18			GND	GND		
Hsync	27						
Vsync	28					LCD Module	
Data Enable	30						
CLOCK	31						

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. (DS90C385 or Compatible)
    3. '7' means MSB and '0' means LSB at R,G,B pixel data.

APPENDIX- III-1

■ Required signal assignment for Flat Link (DS90C385) Transmitter(Pin9="**H**")
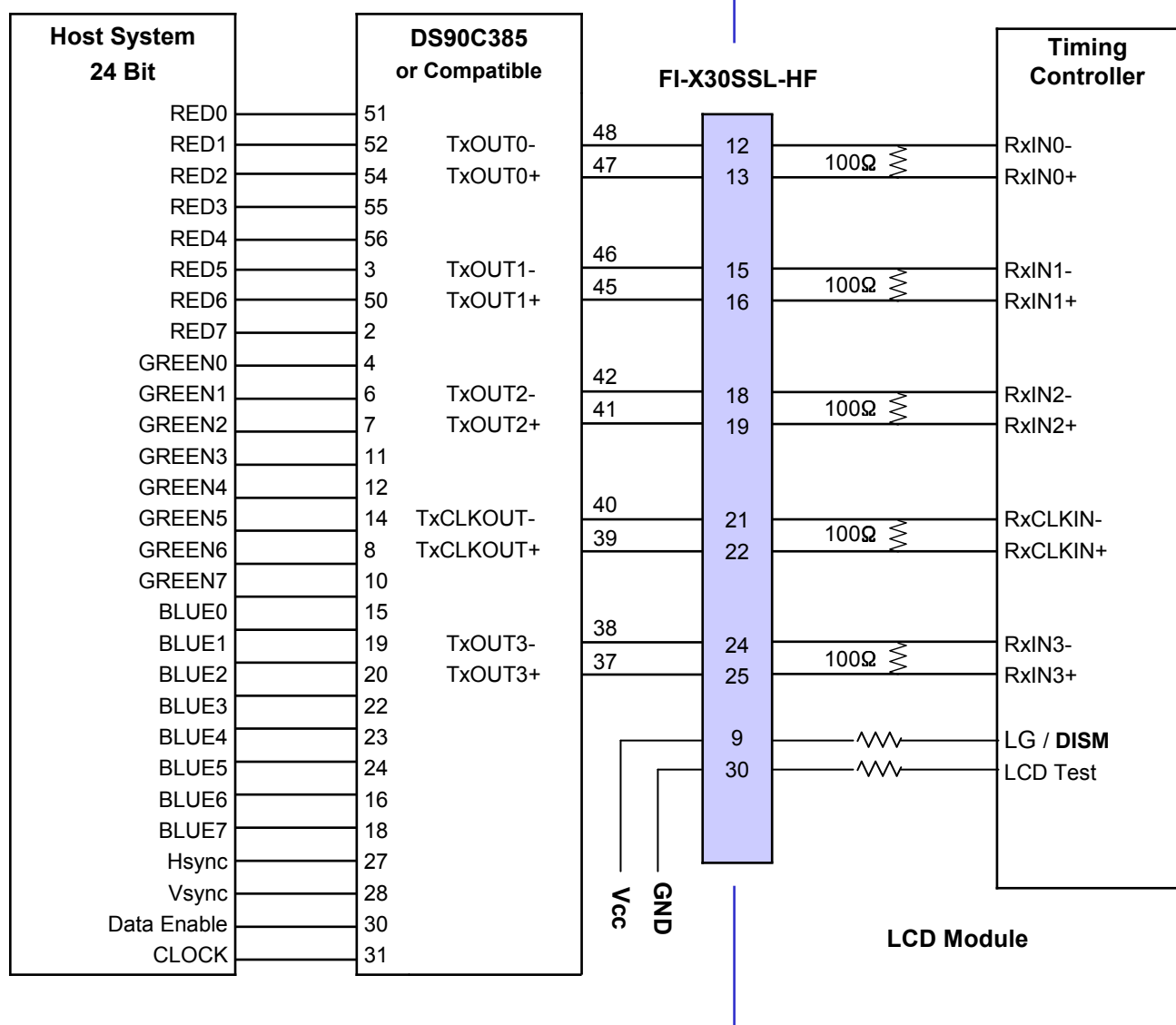
Note: 1. The LCD Module uses a 100 Ohm[Ω] resistor between positive and negative lines of each receiver input.
2. Refer to LVDS Transmitter Data Sheet for detail descriptions. (DS90C385 or Compatible)
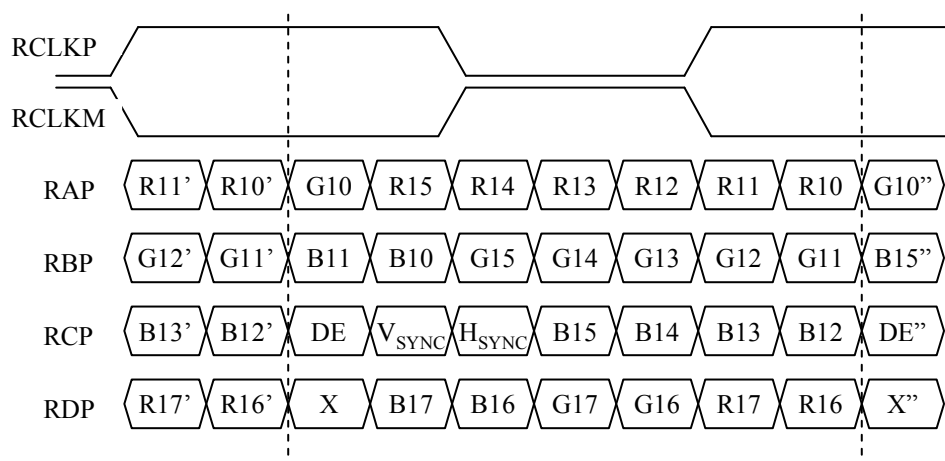3. '7' means MSB and '0' means LSB at R,G,B pixel data.

APPENDIX- III-2

■ LVDS Data-Mapping Information (**8 Bit**)
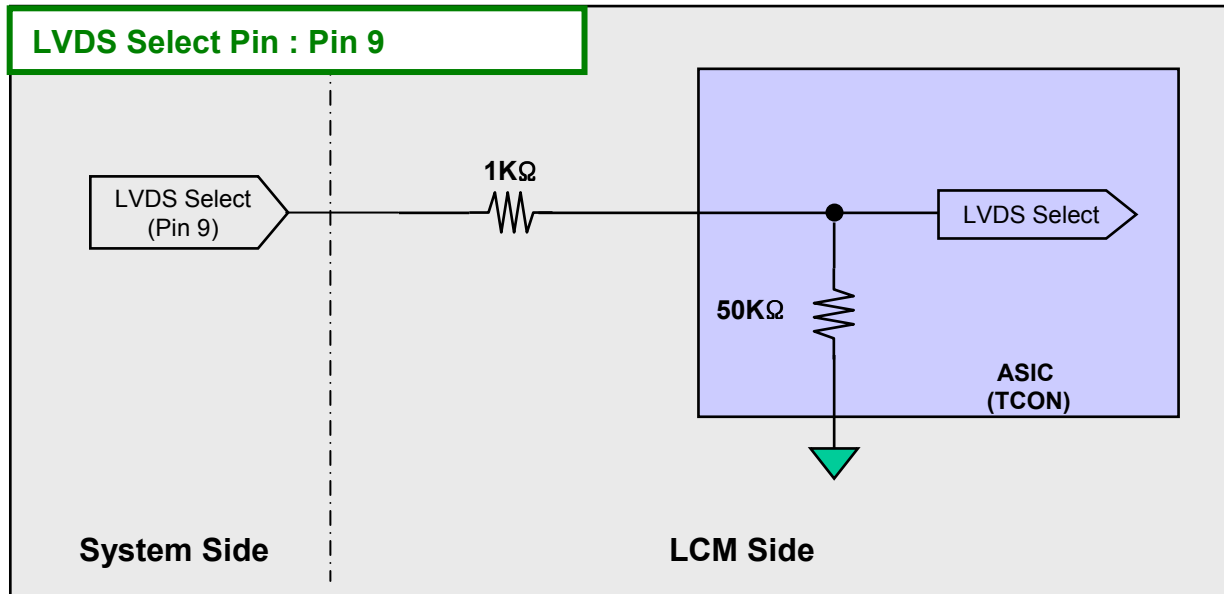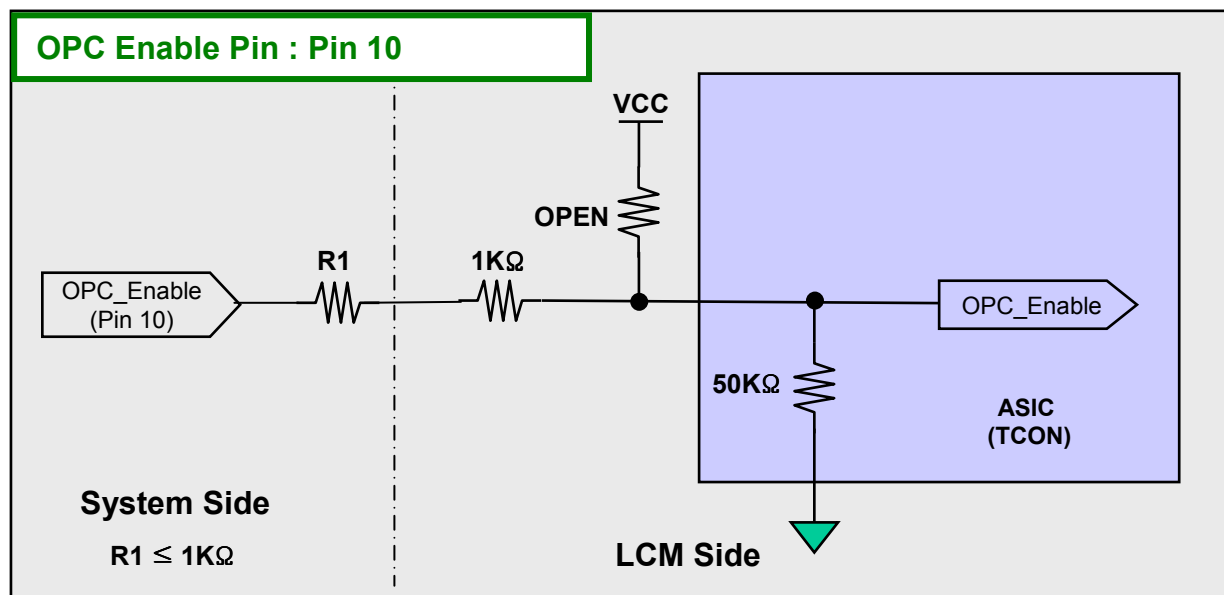
1) LVDS Select : "**H**" Data-Mapping (**JEIDA format**)
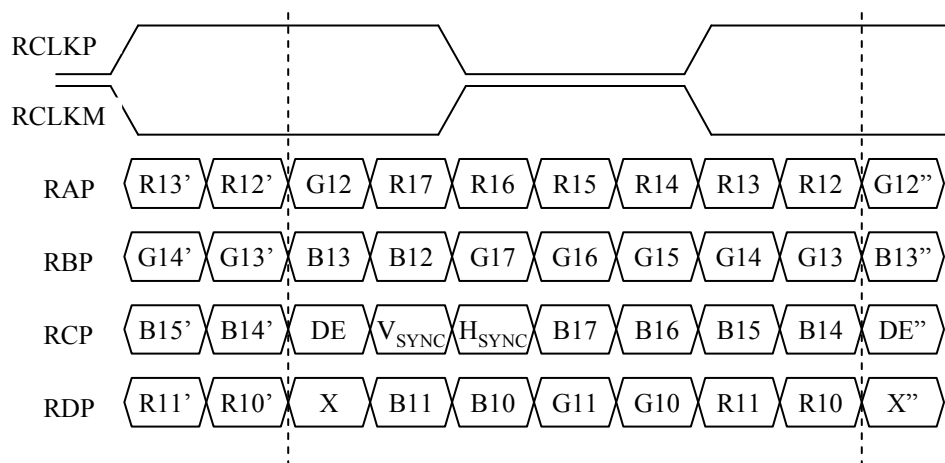
2) LVDS Select : "**L**" Data-Mapping (**VESA format**)
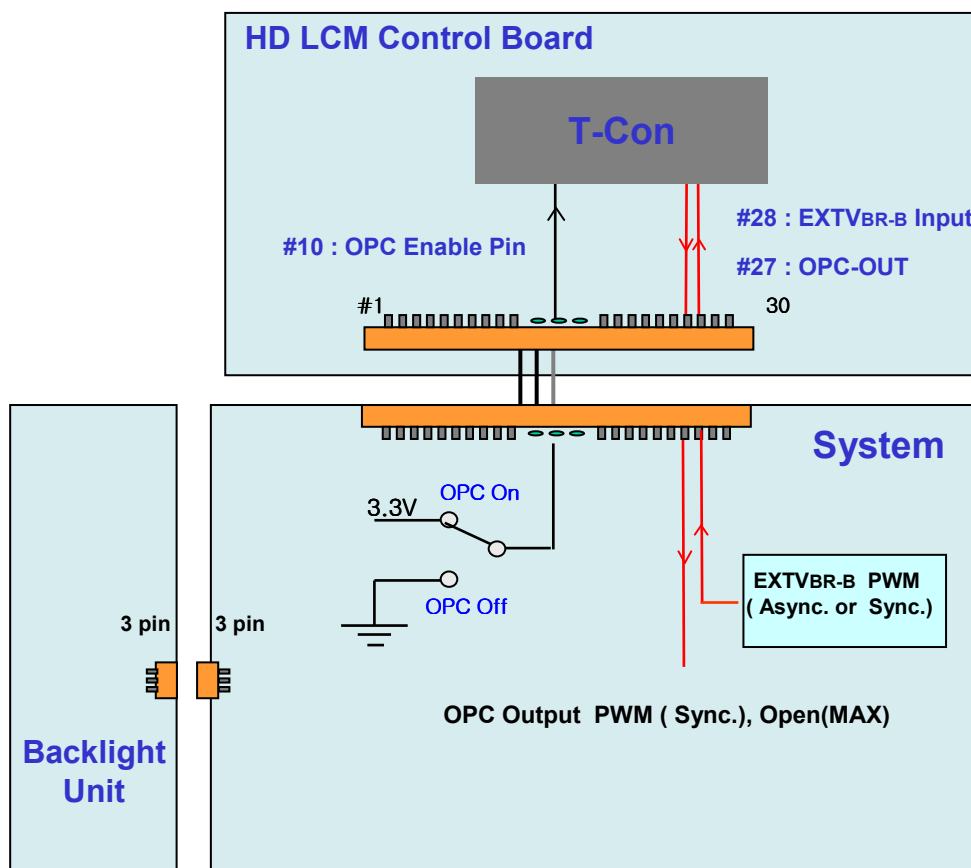
APPENDIX- III-3

■ **Option Pin** Circuit Block Diagram

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


2) Circuit Block Diagram of **OPC Enable** Selection pin

APPENDIX- III-4

■ **EXTV**BR-B & **OPC** Design Guide

１) When OPC Enable is "L", OPC Output = System Dimming.

2) OPC Output(PWM Signal) is synchronized with V-Sync Freq. of System in T-Con Board.

３) Regardless of OPC, System should always give dimming Signal (**EXTV**BR-B) to T-con.

4) PWM Specification (VCC = 3.3V) @ OPC
   a) PWM High Voltage Range : 2.5 V ~ 3.6 V
   b) PWM Low Voltage Range : 0.0 V ~ 0.8 V

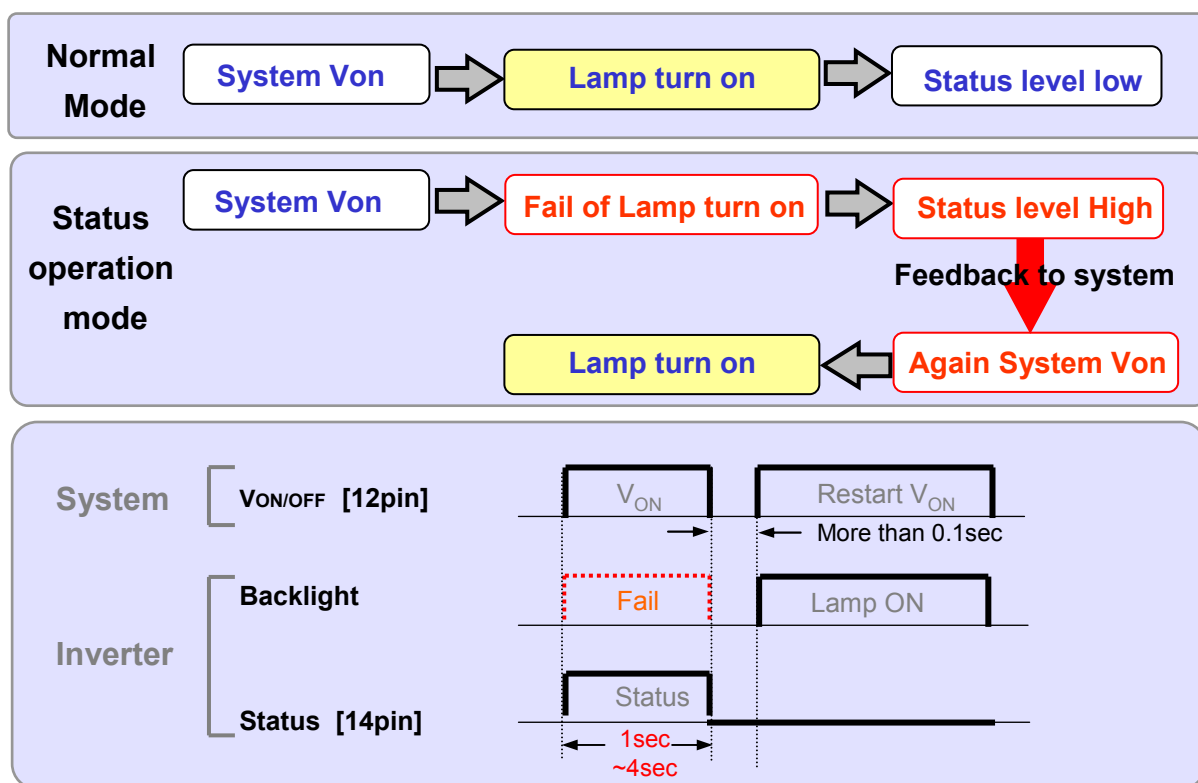| Input Frequency	MAX 1Khz (Recommendation: 50~300Hz)
Rising Time	MAX 10.0 µs
Falling Time	MAX 10.0 µs

| Product Specification |
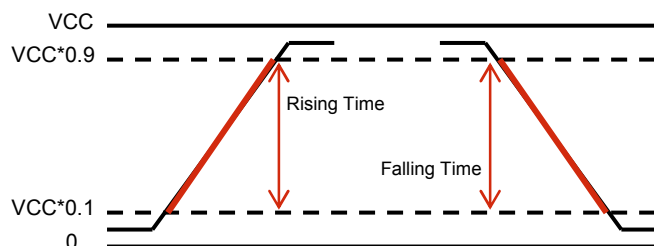
APPENDIX- IV-1

■ Inverter 14th Pin (**Status**) Design Guide

1) Function of Status pin

 - Purpose : Preventing of backlight off by restarting the inverter technically

 - How to : When inverter is abnormal operation, TV system inputs the Von signal

in the inverter once more to turn on the lamp safely

 - Attention : Restart system's Von signal when status pin is high for some time (min:1sec , max:4sec).

(The turn on time of lamp can be late such as the low temperature or the storage time)

2) Status operation modes in TV set

| **Normal Mode** | **System Von** ⇒ **Lamp turn on** ⇒ **Status level low** |

Status operation mode	**System Von** ⇒ **Fail of Lamp turn on** ⇒ **Status level High**
	Feedback to system
	Lamp turn on ⇐ **Again System Von**

System	V$_{ON/OFF}$ **[12pin]**	V$_{ON}$ Restart V$_{ON}$ More than 0.1sec
Inverter	**Backlight**	Fail Lamp ON
	Status [14pin]	Status 1sec ~4sec

3) Inverter pin map

| Pin No	Symbol	Description	Inv.
11	NC	No Connection	NC
12	V$_{ON/OFF}$	0.0V ~ 5.0V	On/Off
13	**EXTV$_{BR-B}$**	Burst Dimming Control PWM signal input	External PWM
14	Status	**Normal : Under 0.7V / Abnormal : Upper 3.0V**	**status**

Product Specification

APPENDIX- IV-2

■ **Mega DCR** Using Condition (1)

● The Deep Dimming means using the input PWM duty less than Min duty.
   The input PWM duty (Min & Max duty) refer to the table 3 on the page 6.

The Deep Dimming must be used very carefully due to limitation of lamp characteristics and specification.

1) For stable lamp on, its duty condition should follow below the condition.
   After Inverter ON signal, T0 duration should be sustained.

Output current

T0 = Min 1 [sec]	Min 3[min]

|	
Max duty	Duty (Min ~ Max duty)

LAMP ON

Inverter ON signal
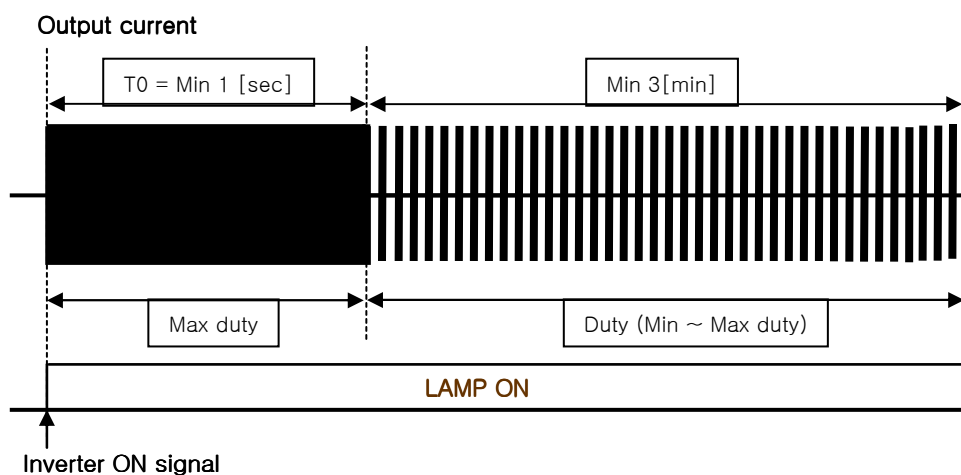
2) B/L may not satisfy some of LCM specification at the Deep Dimming.

- Duration : The Deep Dimming must be limited within 10 minutes.

- Ratio : The operation time of the Deep Dimming must be less than 1/5 time of the Normal
            Duty (Min ~ Max duty) operation in a certain period to prevent unwanted operation.

- FOS : Partial darkness or darkness of center area during the Deep Dimming might be happened
            due to insufficient lamp current.

- Warm up : The Normal Duty (Min ~ Max duty) must be used 3 min after the lamps "ON". In case of low
             temperature, more warm up time may be needed.

APPENDIX- IV-2

■ **Mega DCR** Using Condition (2)

Output current
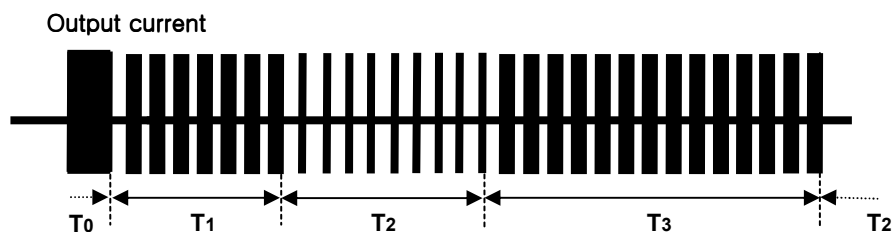
Parameter	Value			Unit	Condition
	Min	Typ	Max		
T₁	3	-	-	min	Min ~ Max duty
T₂	-	-	10	min	0 ~ Min duty
T₃	T₂ x 5	-	-	min	Min ~ Max duty

3) Following the recommended conditions as aforementioned, there is no difference of lamp

lifetime between conventional method and new one.

APPENDIX- V

■ Gray to Gray Response Time Uniformity ($\delta_{G\,TO\,G}$)

This is only the reference data of G to G and uniformity for LC320WXN-SCA1 model.

1. G to G Response Time :
   Response time is defined as Figure3 and shall be measured by switching the input signal for "Gray (N)" and "Gray(M)".(32Gray Step at 8bit)

2. G to G Uniformity
   The variation of G to G Uniformity , $\delta_{G\,to\,G}$ is defined as :

$$\text{G to G Uniformity} = \frac{Maximum(GtoG) - Typical(GtoG)}{Typical(GtoG)} \leq 1$$

*Maximum (GtoG) means maximum value of measured time (N, M = 0 (Black) ~ 255(White), 32 gray step).

	0Gray	32Gray	64Gray	...	223Gray	255Gray
0Gray		TrR:0G→32G	TrR:0G→64G	...	TrR:0G→223G	TrR:0G→255G
32Gray	TrD:32G→0G		TrR:32G→64G	...	TrR:32G→223G	TrR:32G→255G
64Gray	TrD:64G→0G	TrD:64G→32G		...	TrR:64G→223G	TrR:64G→255G
...	...	...	...	...	...	...
223Gray	TrD:223G→0G	TrD:223G→32G	TrD:223G→64G	...		TrR:223G→255G
255Gray	TrD:255G→0G	TrD:255G→32G	TrD:255G→64G	...	TrD:255G→223G	

3. Sampling Size : 2 pcs

4. Measurement Method : Follow the same rule as optical characteristics measurement.

5. Current Status

   Below table is actual data of production on Dec. 17.2009 (LGD RV Event Sample)

Sample	G to G Response Time [ms]		Uniformity
	Min.	Max.	
# 1	6.0	10.2	0.93
# 2	6.3	10.3	0.91