HY-LINE®
COMPUTER COMPONENTS

TFT-Display Datenblatt

Modell   LC470WUN-SCA1

Kurzdaten

Hersteller	LG Display
Diagonale	47.0" / 119,4 cm
Format	16:9
Auflösung	1920x1080
Backlight	CCFL/500cd/m²
Touchscreen	nein
Temperatur	0…+50°C (Betrieb)

SPECIFICATION
FOR
APPROVAL

(   )   Preliminary Specification

(●)   Final Specification

Title	47.0" WUXGA TFT LCD

BUYER	General
MODEL	

SUPPLIER	LG.Display Co., Ltd.
*MODEL	LC470WUN
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
J. T Kim / Team Leader	
REVIEWED BY	
S. S Lee / Project Leader	
PREPARED BY	
D. K Yang / Engineer	

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

CONTENTS

RECORD OF REVISIONS

| Revision No.	Revision Date	Page	Description
0.0	Nov, 02, 2009	-	Preliminary Specification(First Draft)
0.1	Dec, 03, 2009	9, 17	Updated Table 5, 10
		23	Updated 2D
		31	Updated Appendix
1.0	Dec, 29, 2009	15	Updated Power Sequence
		17, 18	Updated Table 10, 11
		41	Added Appendix

Product Specification

1. General Description

The LC470WUN 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 46.96 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 (true) colors.

It has been designed to apply the 10-bit 2-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.
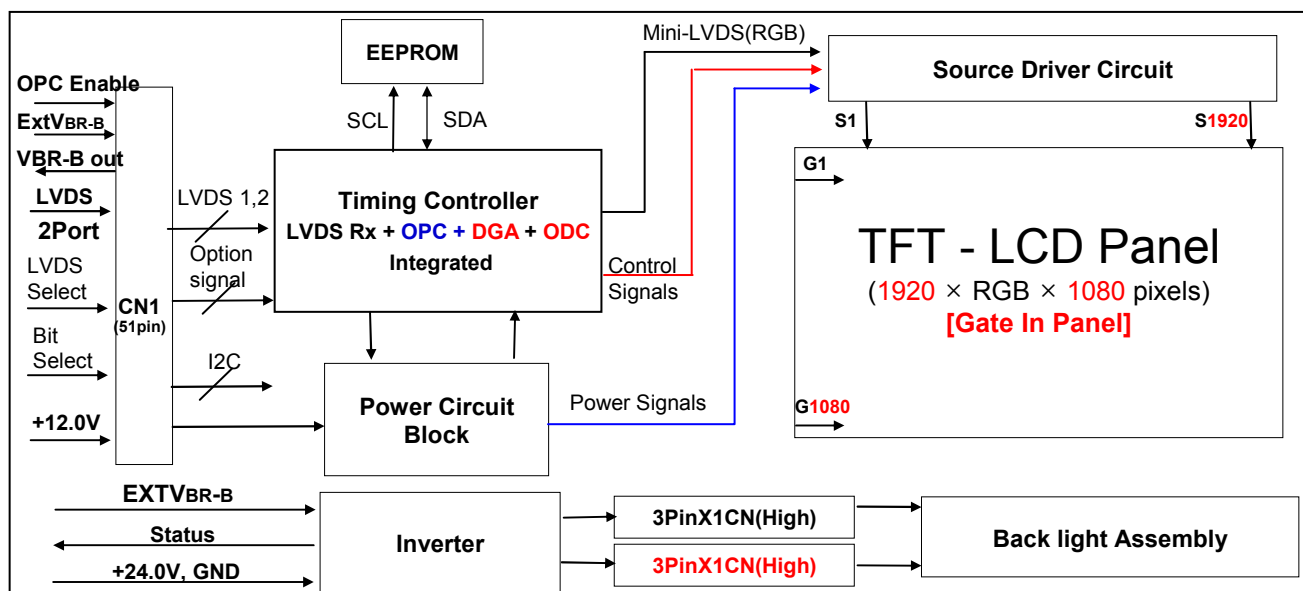
General Features

Active Screen Size	46.96 inches(1192.87mm) diagonal
Outline Dimension	1096.0(H) x 640.0 (V) x 53.0 mm(D) (Typ.)
Pixel Pitch	0.5415 mm x 0.5415 mm
Pixel Format	1920 horiz. by 1080 vert. Pixels, RGB stripe arrangement
Color Depth	10bit(D) , 1.06Billon colors
Luminance, White	500 cd/m^2 (Center 1point ,Typ.)
Viewing Angle (CR>10)	Viewing angle free (R/L 178 (Min.), U/D 178 (Min.))
Power Consumption	Total 201.8 W (Typ.) (Logic=6.8 W, Inverter=195W)
Weight	12.5Kg (Typ.)
Display Mode	Transmissive mode, Normally black
Surface Treatment	Hard coating(3H), Anti-glare treatment of the front polarizer (Haze 10%)

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

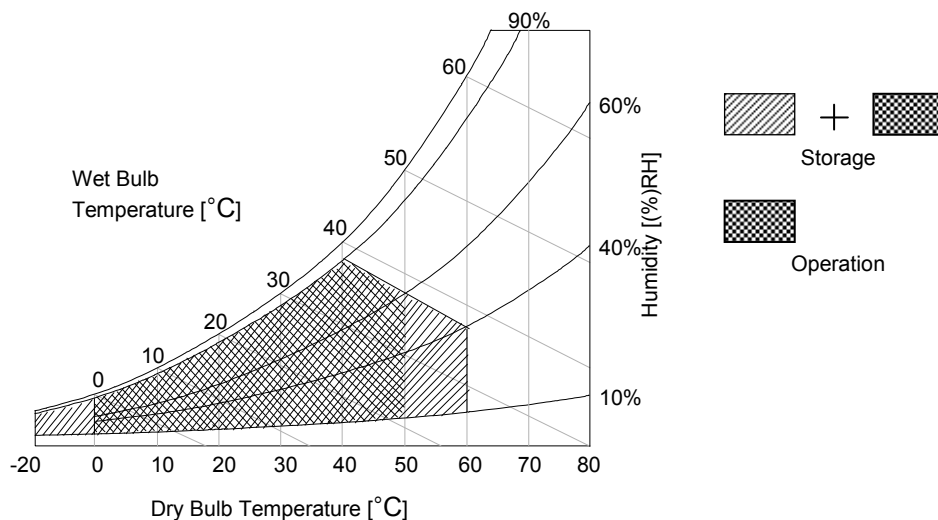| Parameter		Symbol	Value		Unit	Note
			Min	Max		
Power Input Voltage	LCD Circuit	V_{LCD}	-0.3	+14.0	V_{DC}	1
	Inverter	V_{BL}	-0.3	+ 27.0	V_{DC}	
Inverter Control Voltage	ON/OFF	V_{OFF} / V_{ON}	-0.3	+5.5	V_{DC}	
	Brightness	V_{BR}	0.0	+5.0	V_{DC}	
T-Con Option Selection Voltage		V_{LOGIC}	-0.3	+4.0	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}	-	560	730	mA	1
		-	870	1150	mA	2
Power Consumption	P_{LCD}		6.72	8.76	Watt	1
Rush current	I_{RUSH}	-	-	5.0	A	3

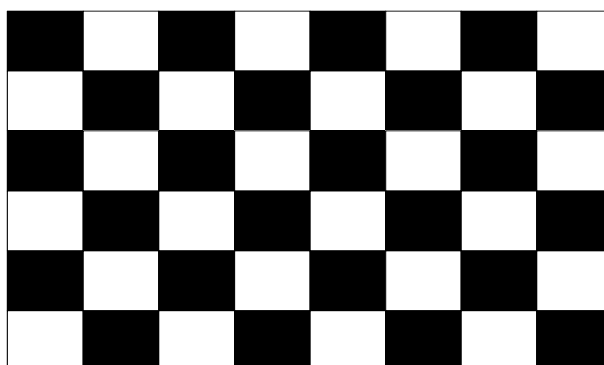Note 1. The specified current and power consumption are under the V_{LCD}=12.0V, Ta=25 ± 2°C, f_V=60Hz condition whereas mosaic pattern(8 x 6) is displayed and f_V is the frame frequency.
 2. The current is specified at the maximum current pattern.
 3. The duration of rush current is about 2ms and rising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

White : 1023 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}	-	8.2	9.0	A	1
	Before Aging		I_{BL_B}	-	9.0	9.9	A	2
Power Supply Input Current (In-Rush)			I_{RUSH}	-	-	15	A	V_{BL} = 22.8V **EXTV**BR-B = 100% 6
Power Consumption			P_{BL}	-	195	214	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, 51-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-R51S-HF(manufactured by JAE) or KN25-51P-0.5SH(manufactured by Hirose)
  (CN1)   Refer to below table
- Mating Connector : FI-R51HL(JAE) or compatible

Table 4. 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	**EXTV$_{BR-B}$**	External VBR (From System)	34	GND	Ground
9	**VBR-B 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 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. **#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. (Please see the **Appendix III-4** for more information.)
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).

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	2
12	$V_{ON/OFF}$	Backlight ON/OFF control	$V_{ON/OFF}$	
13	EXTVBR-B	External PWM	**External PWM**	
14	Status	Lamp Status	Status	3

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. Each impedance of pin #12,#13 is over **50[KΩ], 50[KΩ],**

◆ **Rear view of LCM**
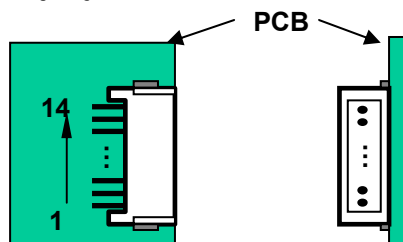
Product Specification

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}	-	960	-	tclk	
	Blank	t_{HB}	100	140	240	tclk	
	Total	t_{HP}	1060	1100	1200	tclk	2200/2
Vertical	Display Period	t_{VV}	-	1080	-	t_{HP}	
	Blank	t_{VB}	11	45	69	t_{HP}	
	Total	t_{VP}	1091	1125	1149	t_{HP}	
Frequency	DCLK	f_{CLK}	70	74.25	77	MHz	148.5/2
	Horizontal	f_H	65	67.5	70	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}	-	960	-	tclk	
	Blank	t_{HB}	100	140	240	tclk	
	Total	t_{HP}	1060	1100	1200	tclk	2200/2
Vertical	Display Period	t_{VV}	-	1080	-	t_{HP}	
	Blank	t_{VB}	228	270	300	t_{HP}	
	Total	t_{VP}	1308	1350	1380	t_{HP}	
Frequency	DCLK	f_{CLK}	70	74.25	77	MHz	148.5/2
	Horizontal	f_H	65	67.5	70	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.
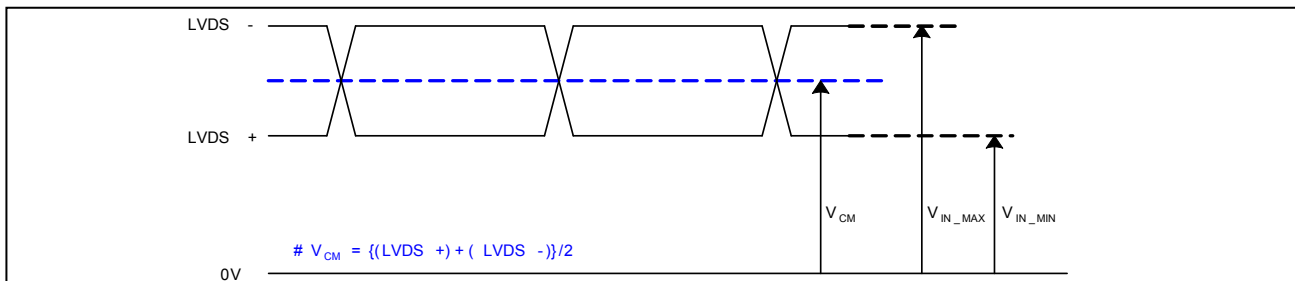
3-4. LVDS Signal Specification

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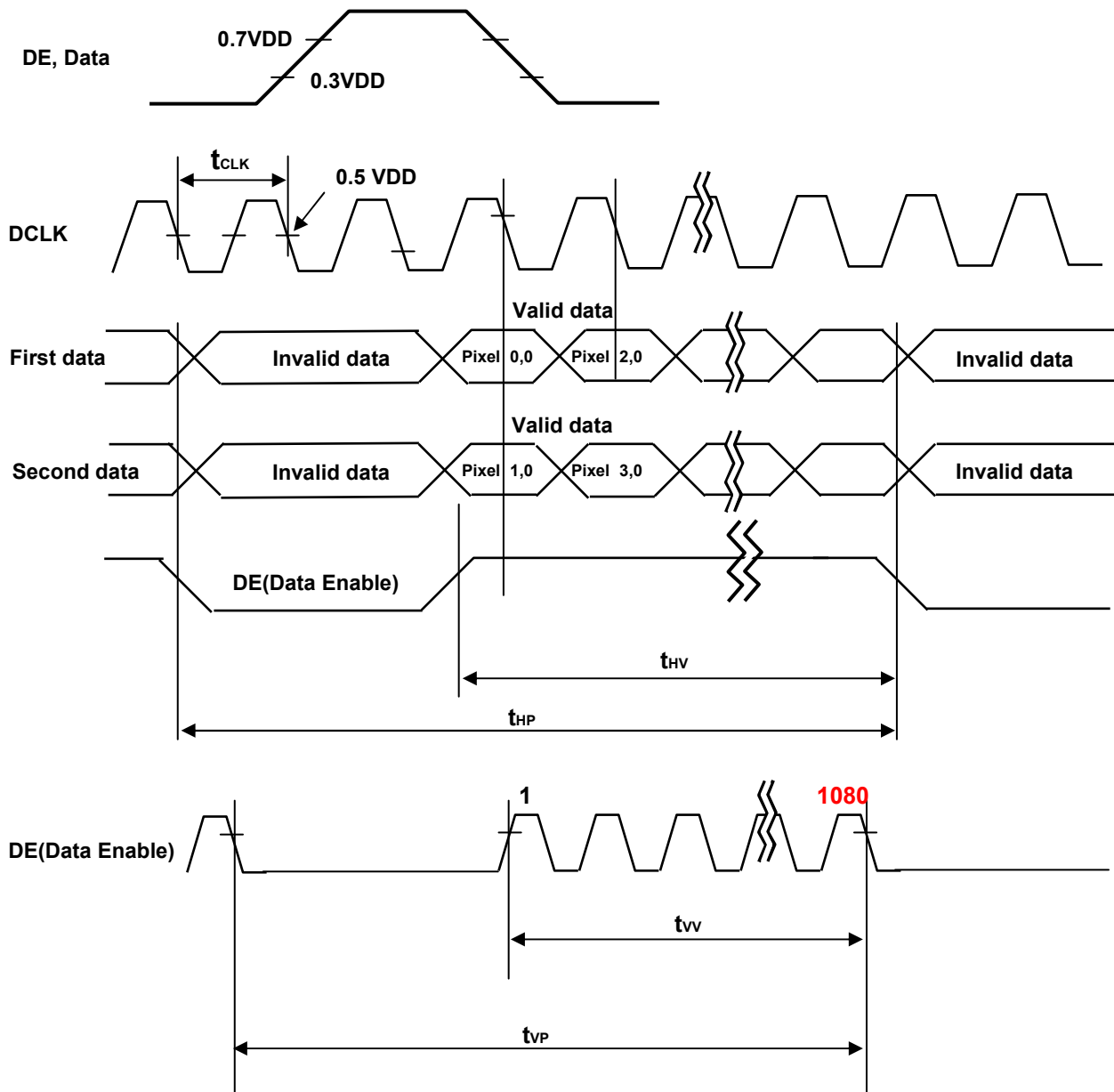
3-4-2. LVDS Input Signal Characteristics

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

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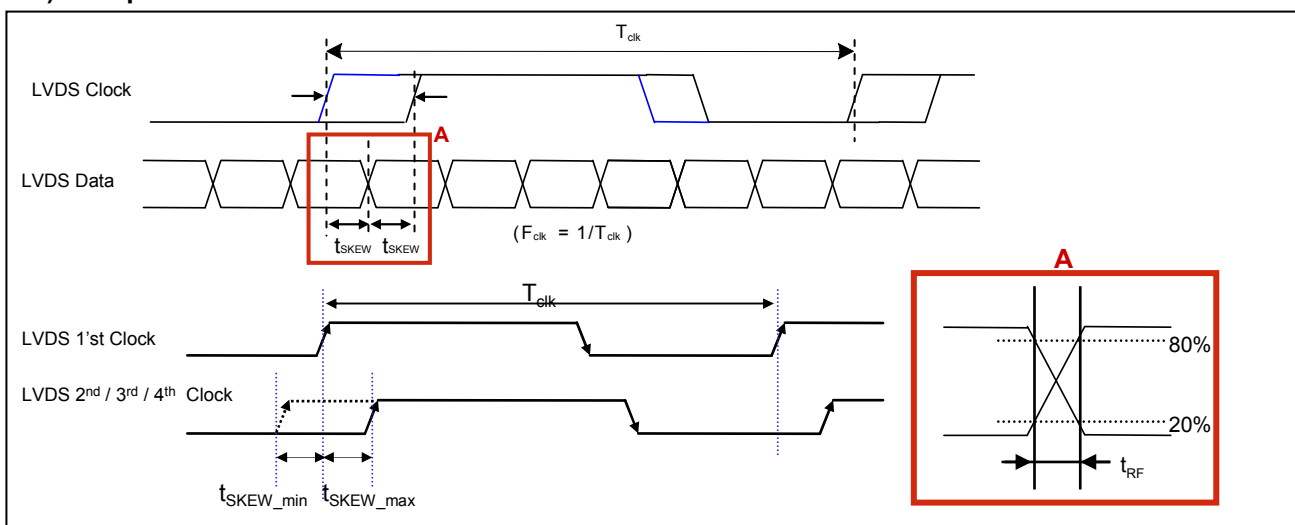
Description		Symbol	Min	Max	Unit	Note
LVDS Differential Voltage	High Threshold	V_{TH}	100	300	mV	3
	Low Threshold	V_{TL}	-300	-100	mV	
LVDS Clock to Data Skew Margin		t_{SKEW}		$|(0.25*T_{clk})/7|$	ps	-
LVDS Clock/DATA Rising/Falling time		t_{RF}	260	$(0.3*T_{clk})/7$	ps	2
Effective time of LVDS		t_{eff}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

tui

V+
data

Vcm

VTH

VTL

V-
data

360ps

teff

V+
clk

tui : Unit Interval

Vcm

V-
clk
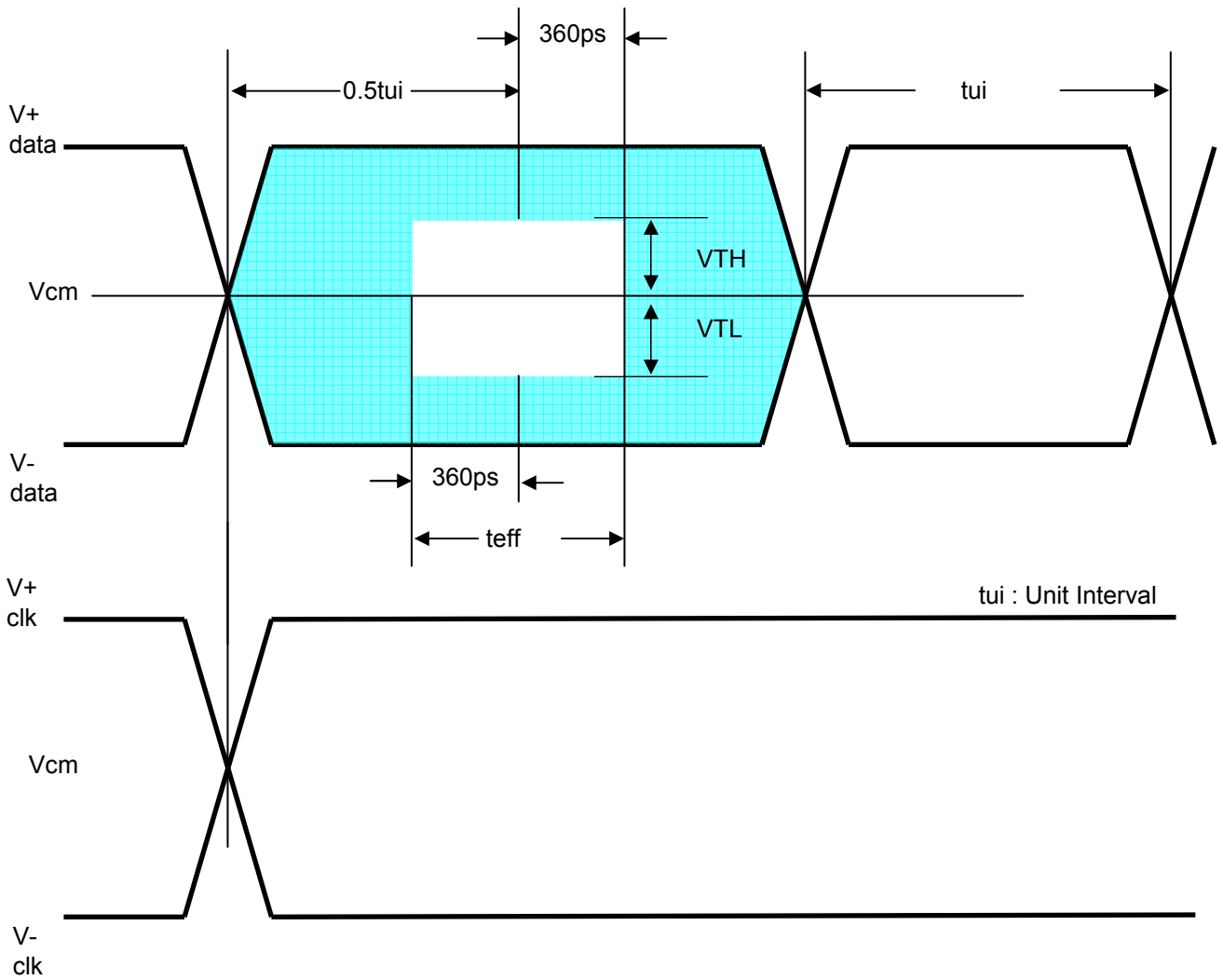
Product Specification

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 MSB　　　　　　　　　　LSB R9 R8 R7 R6 R5 R4 R3 R2 R1 R0	**GREEN** MSB　　　　　　　　　　LSB G9 G8 G7 G6 G5 G4 G3 G2 G1 G0	**BLUE** MSB　　　　　　　　　　LSB 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**

3-6. Power Sequence

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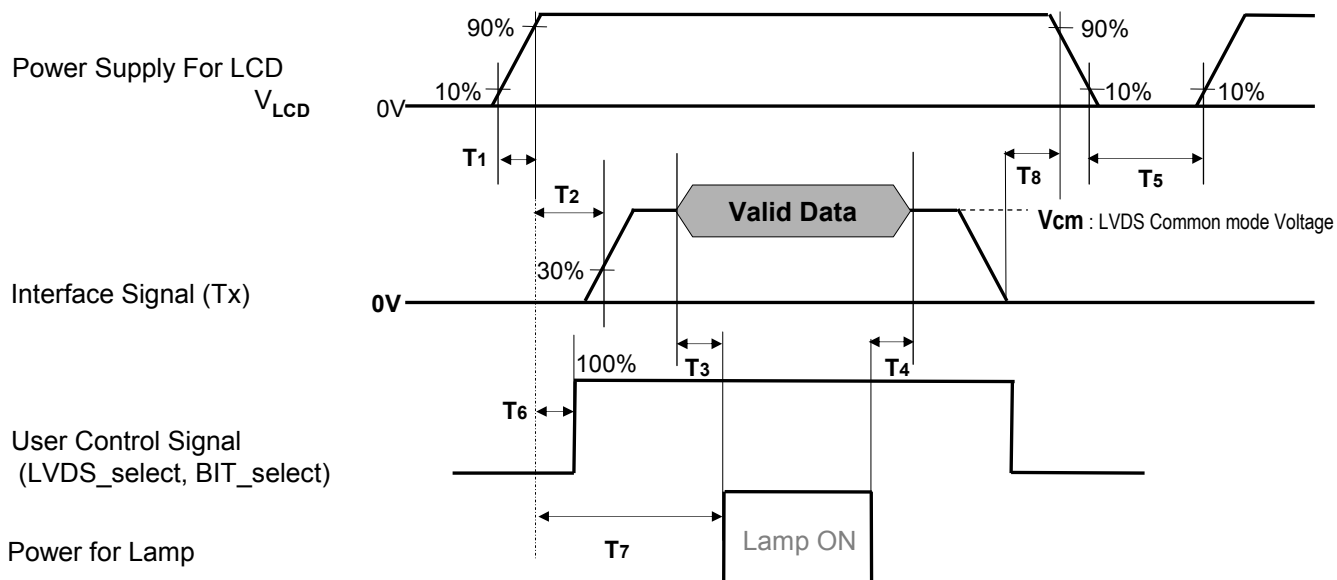
Table 8. POWER SEQUENCE

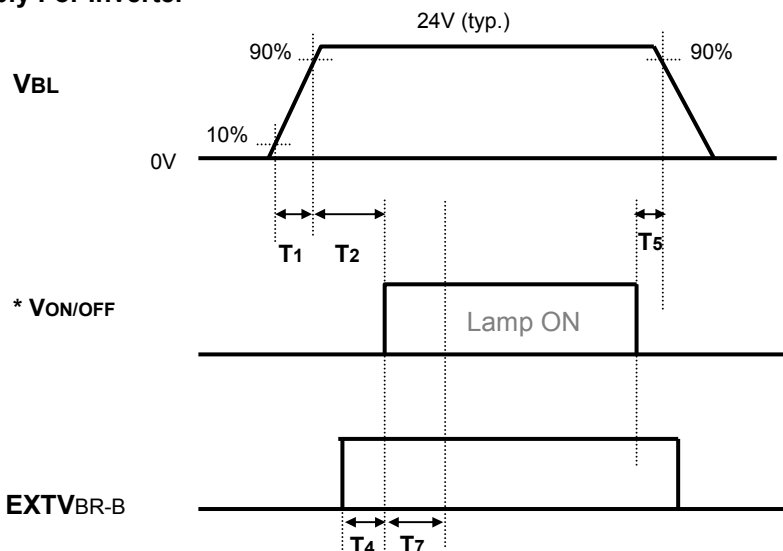| Parameter	Value			Unit	Notes
	Min	**Typ**	**Max**		
T1	0.5	-	20	ms	
T2	0	-	-	ms	4
T3	200	-	-	ms	3
T4	200	-	-	ms	3
T5	1.0	-	-	s	5
T6	-	-	T2	ms	4
T7	0.5	-	-	S	
T8	100	-	-	ms	6

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
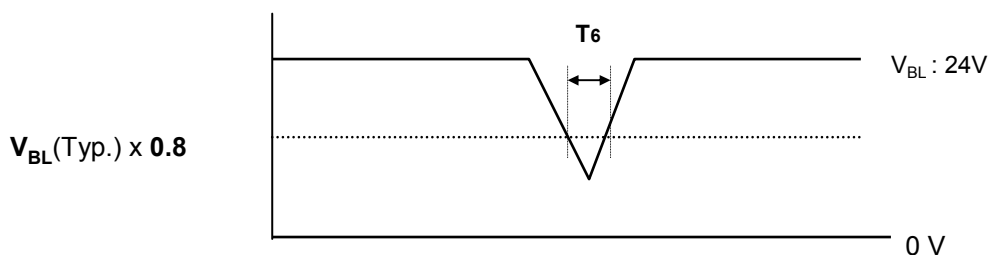
Table 9. Power Sequence for Inverter

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.
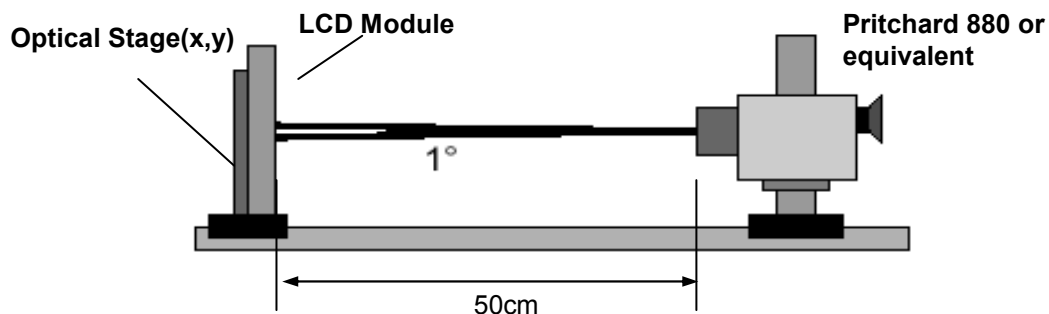

FIG. 1 Optical Characteristic Measurement Equipment and Method

Table 10. OPTICAL CHARACTERISTICS

Ta= 25±2°C, V_{LCD}=12.0V, fv=60Hz, Dclk=74.25MHz, EXTV$_{BR-B}$ =100%

Parameter		Symbol		Value			Unit	Note
				Min	Typ	Max		
Contrast Ratio		CR		1100	1450			1
Surface Luminance, white		L_{WH}		400	500		cd/m^2	2
Luminance Variation		δ WHITE	5P			1.3		3
Response Time	Gray-to-Gray	G to G		-	5	8	ms	4
	Uniformity	δ G TO G		-	-	1	ms	5
Color Coordinates [CIE1931]	RED	Rx			0.639			
		Ry			0.334			
	GREEN	Gx			0.290			
		Gy		Typ -0.03	0.606	Typ +0.03		
	BLUE	Bx			0.146			
		By			0.058			
	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	-	-		
	x axis, left (φ=180°)	θl		89	-	-		
	y axis, up (φ=90°)	θu		89	-	-	degree	6
	y axis, down (φ=270°)	θd		89	-	-		
Gray Scale				-	-	-		7

Product Specification

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

CR(Contrast Ratio) = Maximum CRn (n=1, 2, 3, 4, 5)

$$CRn = \frac{\text{Surface Luminance at position n with all white pixels}}{\text{Surface Luminance at position n with all black pixels}}$$

n = the Position number(1, 2, 3, 4, 5). For more information,

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	0.07
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
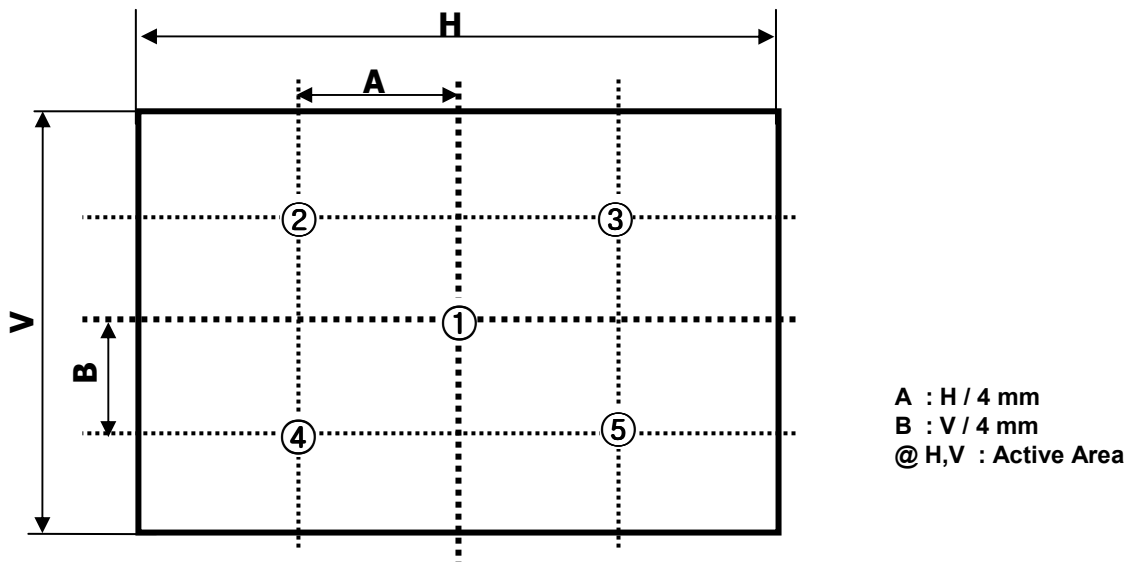
FIG. 2 5 Points for Luminance Measure

Response time is defined as the following figure and shall be measured by switching the input signal for "Gray(N)" and "Gray(M)".
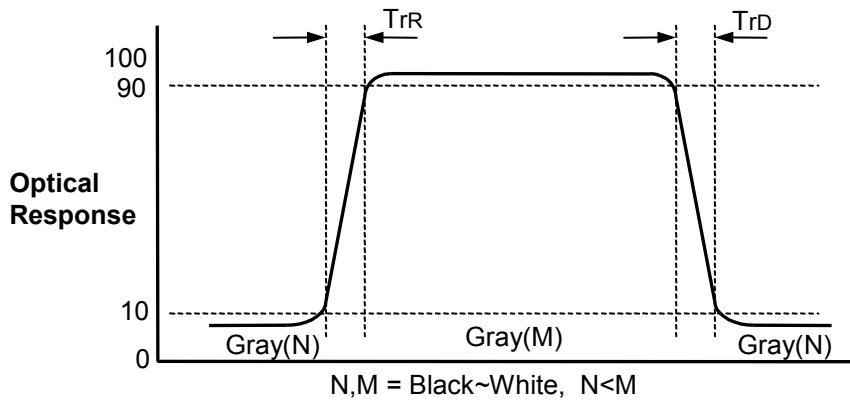
FIG. 3 Response Time

Dimension of viewing angle range
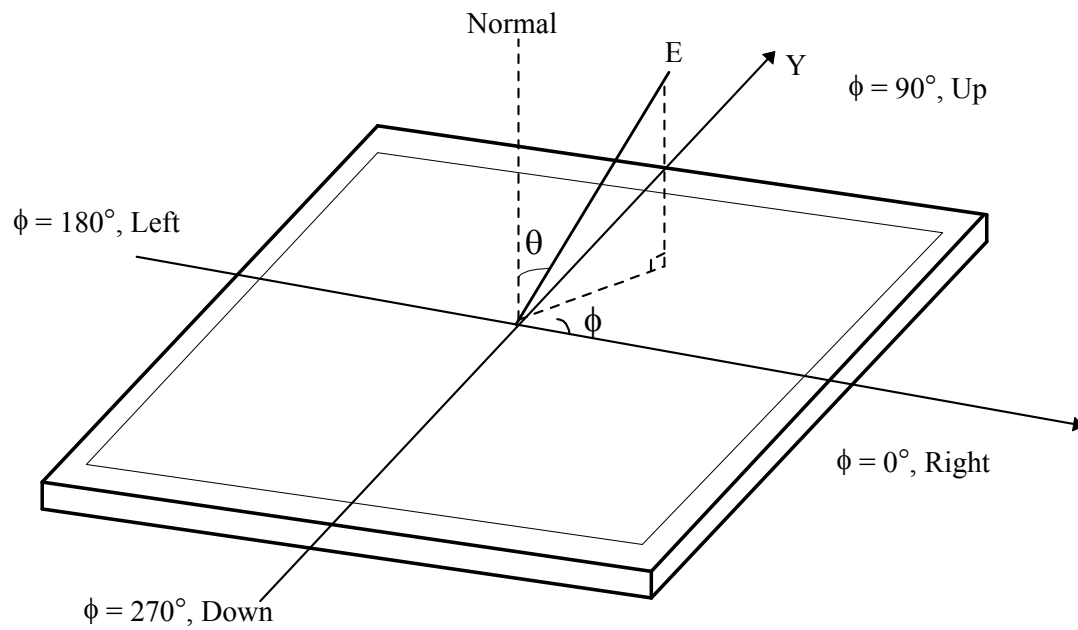
FIG. 4 Viewing Angle

Product Specification

5. Mechanical Characteristics

Table 12 provides general mechanical characteristics.

Table 12. MECHANICAL CHARACTERISTICS

Item	Value	
Outline Dimension	Horizontal	1096.0 mm
	Vertical	640.0 mm
	Depth	53.0 mm
Bezel Area	Horizontal	1049.0 mm
	Vertical	593.0 mm
Active Display Area	Horizontal	1039.68 mm
	Vertical	584.82 mm
Weight	12.5 Kg (Typ.) , 13.0Kg (Max.)	

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

[FRONT VIEW]
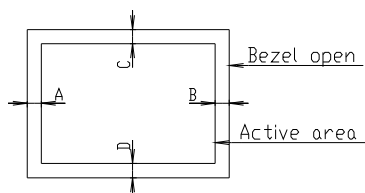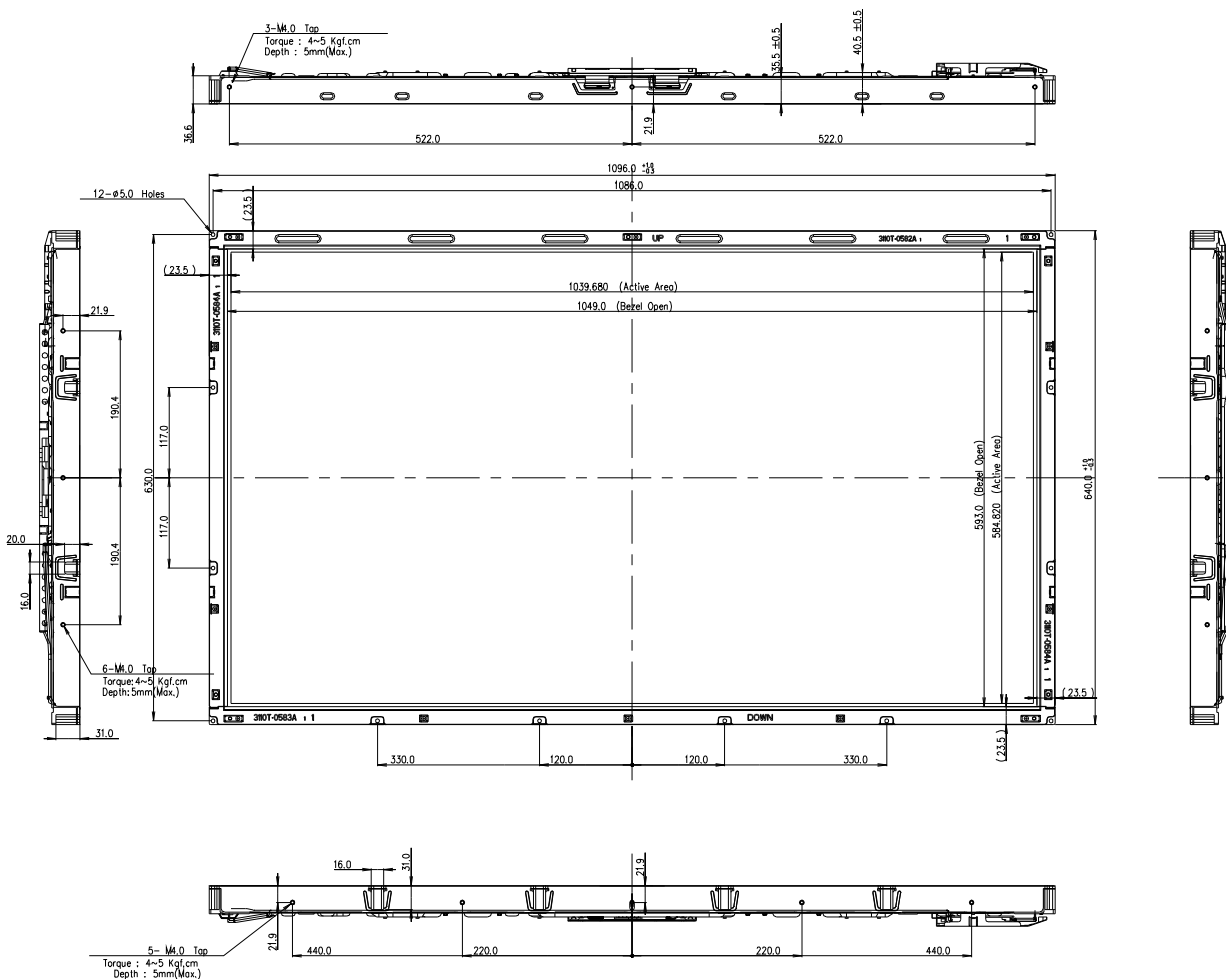
NOTES
1. Unspecified tolerances are to be ±1.0mm.
2. The length of mounting screw is MAX 5.0mm.
3. Tilt and partial disposition tolerance of display area
   are as following.
   (1) X-Direction : IA-BI $\leq$ 1.5mm
   (2) Y-Direction : IC-DI $\leq$ 1.5mm

SECTION A-A
SCALE 1/1
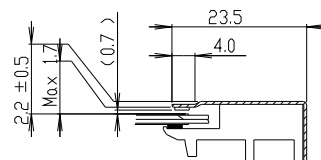
[REAR VIEW]
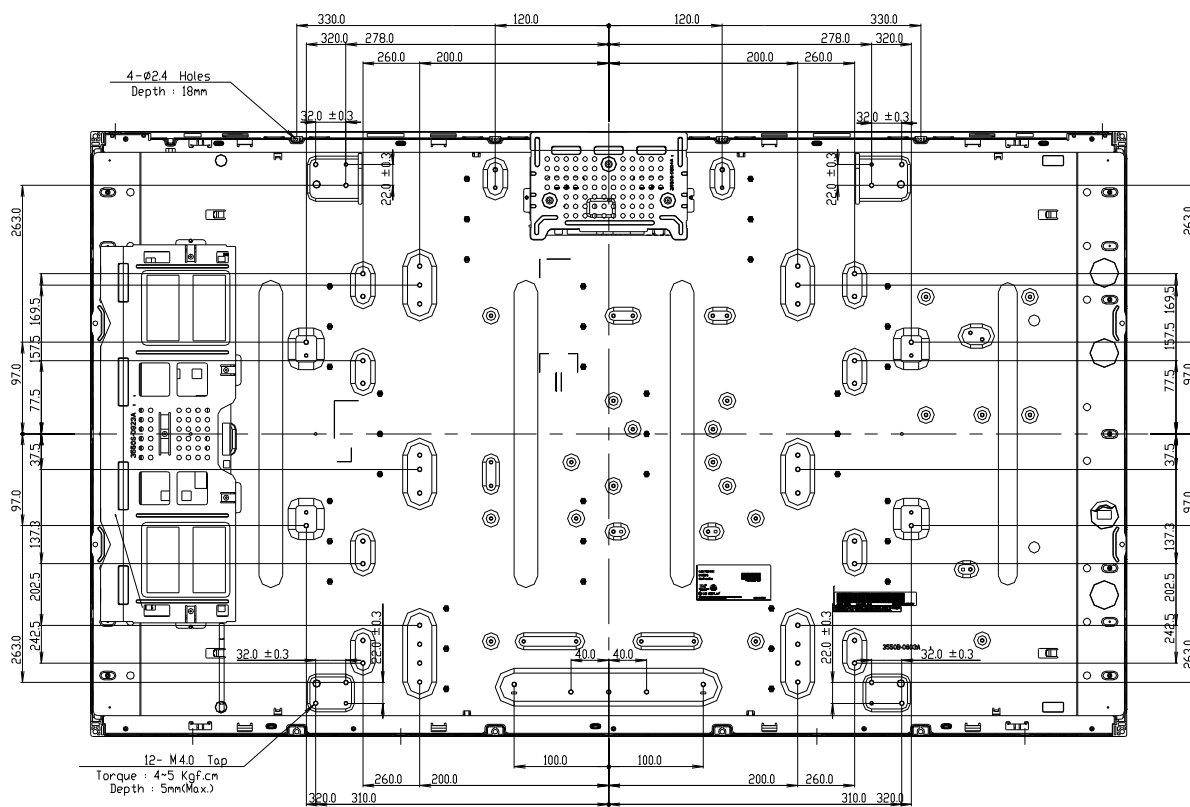
6. Reliability

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 : 50Grms Waveform : half sine wave, 11ms 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 : 12 pcs

b) Pallet Size : 1300 mm X 1140 mm X 117.5 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.

Product Specification

(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.

APPENDIX-I

■ LC470WN-SCA1 – Pallet Ass'y
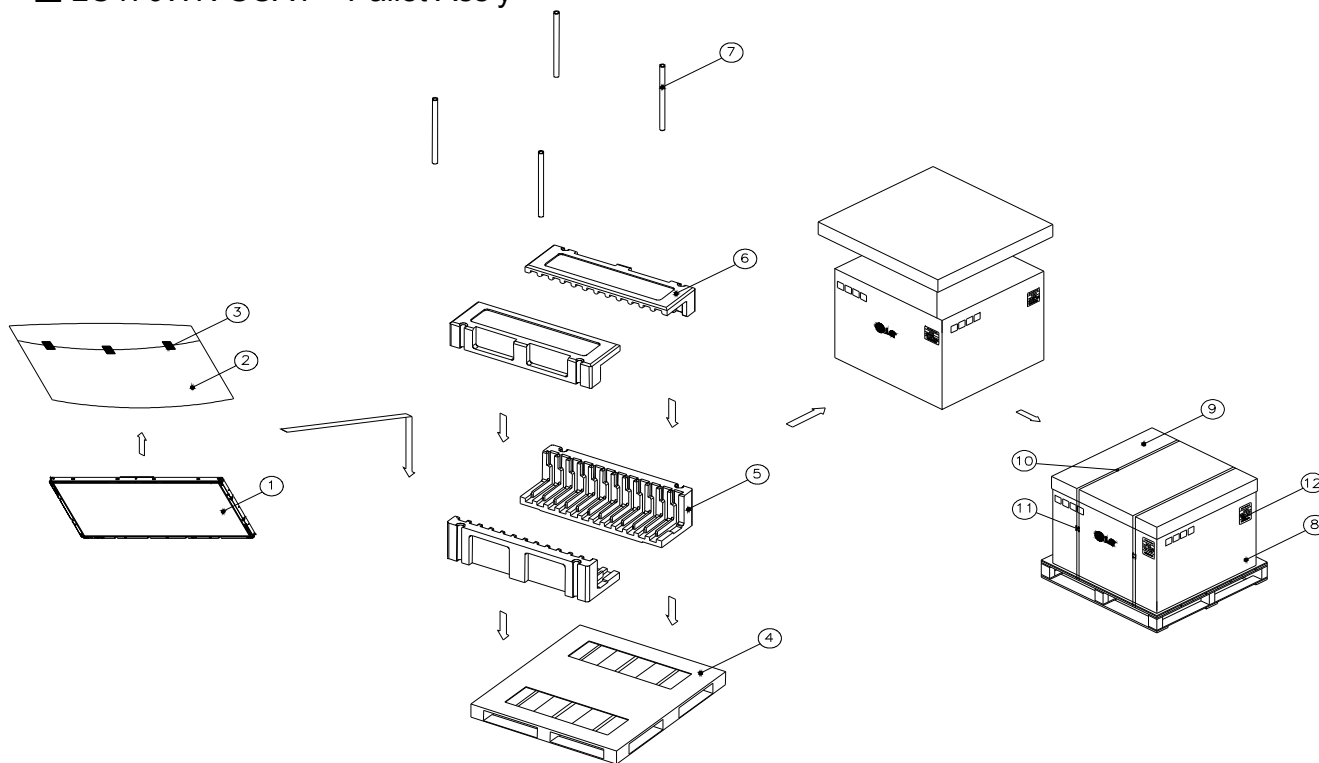
NO.	DESCRIPTION	MATERIAL
1	LCD Module	
2	BAG	47INCH
3	TAPE	MASKING 20MMX50M
4	PALLET	Plywood 1300X1140X117.5mm
5	PACKING,BOTTOM	EPS
6	PACKING,TOP	EPS
7	ANGLE,POST	PAPER
8	ANGLE,PACKING	PAPER
9	ANGLE.COVER	PAPER
10	BAND,CLIP	STEEL or PP
11	BAND	PP
12	LABEL	YUPO 80G 100X70

APPENDIX- II-1

■ LC470WUN-SCA1-LCM Label

Model →

LC470WUN
(SC)(A1)

RoHS Verified

UL, TUV Mark →

c ℟ us ⓣⓤⓥ ⑩

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.**

MADE IN KOREA ← **Origin**
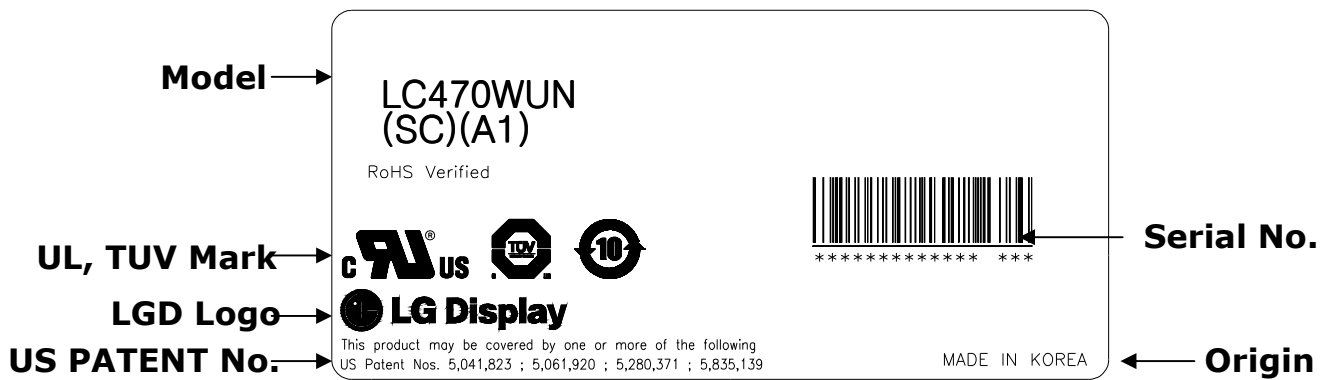
■ **Serial No. (See CAS 26 page for more information)**

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

Inch — (1 2 3)

Year (4) Month (5)

Serial No. — (7 8 9 10 11 12 13)

M Ass'y Factory code — (6)
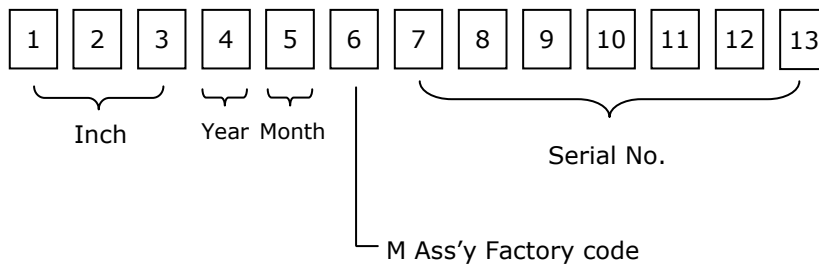
APPENDIX- II-2

■ LC470WUN-SCA1-Pallet Label

Product Specification

APPENDIX- III-1

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

Host System 30 Bit	THC63LVD103 or Compatible		FI-RE51S-HF			Timing Controller
RED0	33					
RED1	34					
RED2	35					
RED3	36					
RED4	37	TA- 31	12		100Ω	RO0N
RED5	38	TA+ 30	13			RO0P
RED6	59					
RED7	61	TB- 29	14		100Ω	RO1N
RED8	4	TB+ 28	15			RO1P
RED9	5					
GREEN0	40	TC- 25	16		100Ω	RO2N
GREEN1	41	TC+ 24	17			RO2P
GREEN2	42					
GREEN3	44					
GREEN4	45	TCLK- 23	19		100Ω	ROCLKN
GREEN5	46	TCLK+ 22	20			ROCLKP
GREEN6	62					
GREEN7	63	TD- 21	22		100Ω	RO3N
GREEN8	6	TD+ 20	23			RO3P
GREEN9	8					
BLUE0	48	TE- 19	24		100Ω	RO4N
BLUE1	49	TE+ 18	25			RO4P
BLUE2	50					
BLUE3	52					
BLUE4	53		7			**VESA**/ JEIDA
BLUE5	54					
BLUE6	64					
BLUE7	1					
BLUE8	9					
BLUE9	11	GND			LCM Module	
Hsync	55					
Vsync	57					
Data Enable	58					
CLOCK	12					

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.

HY-LINE Computer Components / www.hy-line.de/computer

Product Specification

APPENDIX- III-1

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

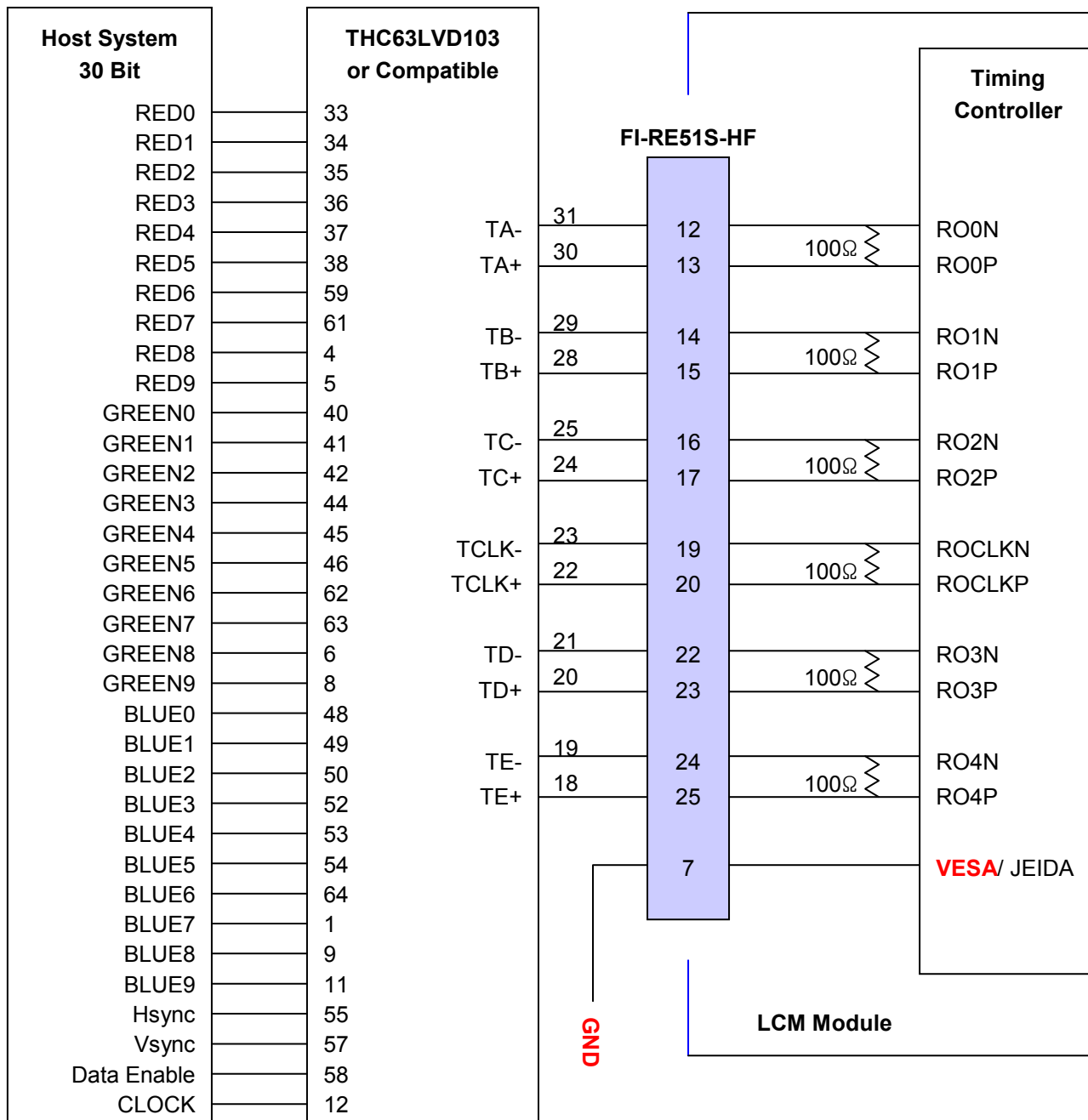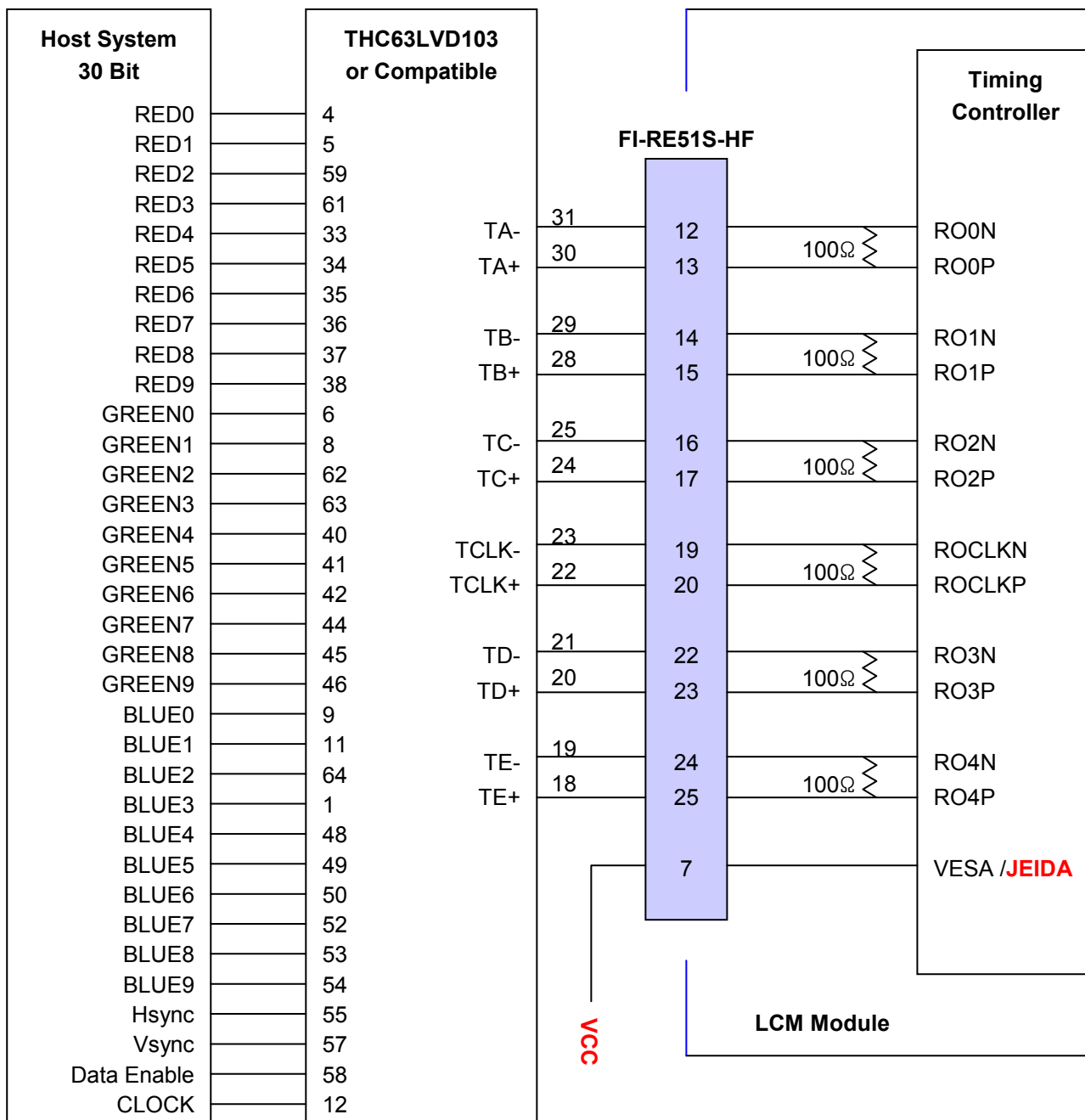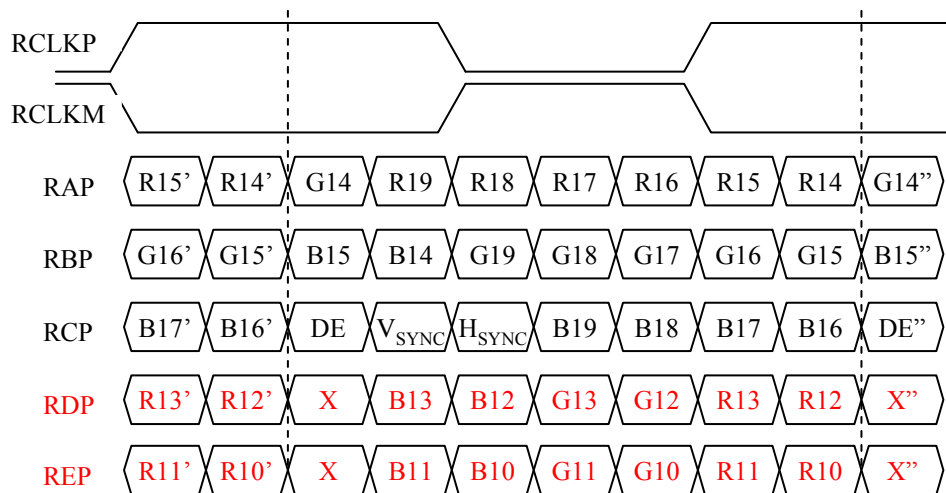| Host System 30 Bit		THC63LVD103 or Compatible			FI-RE51S-HF			Timing Controller
RED0		4						
RED1		5						
RED2		59						
RED3		61						
RED4		33	TA-	31	12			RO0N
RED5		34	TA+	30	13	100Ω		RO0P
RED6		35						
RED7		36	TB-	29	14			RO1N
RED8		37	TB+	28	15	100Ω		RO1P
RED9		38						
GREEN0		6	TC-	25	16			RO2N
GREEN1		8	TC+	24	17	100Ω		RO2P
GREEN2		62						
GREEN3		63						
GREEN4		40	TCLK-	23	19			ROCLKN
GREEN5		41	TCLK+	22	20	100Ω		ROCLKP
GREEN6		42						
GREEN7		44	TD-	21	22			RO3N
GREEN8		45	TD+	20	23	100Ω		RO3P
GREEN9		46						
BLUE0		9	TE-	19	24			RO4N
BLUE1		11	TE+	18	25	100Ω		RO4P
BLUE2		64						
BLUE3		1						
BLUE4		48						
BLUE5		49			7			VESA /**JEIDA**
BLUE6		50						
BLUE7		52						
BLUE8		53						
BLUE9		54						
Hsync		55			**VCC**			**LCM Module**
Vsync		57						
Data Enable		58						
CLOCK		12						

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.

APPENDIX- III-2
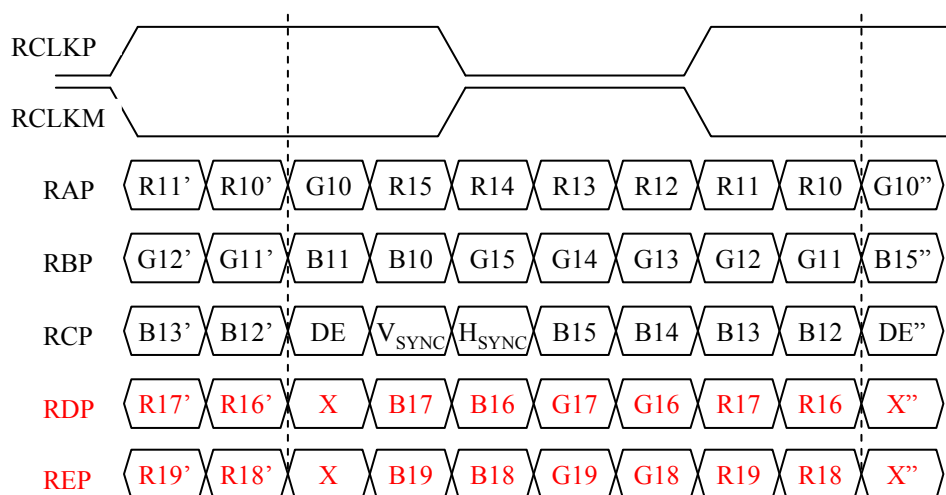
■ LVDS Data-Mapping Information (**10 Bit**)

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

RCLKP									
RCLKM									
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**)

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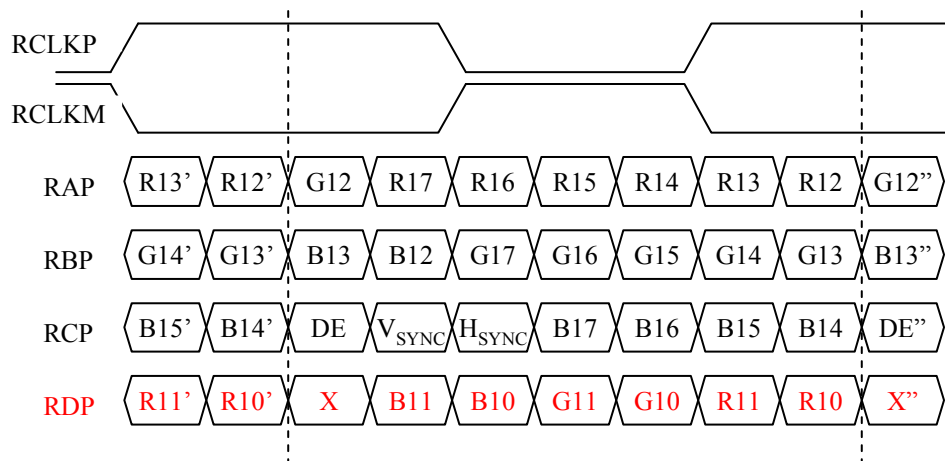
1) LVDS Select : "**H**" Data-Mapping (**JEIDA format**)

RCLKP										
RCLKM										
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**)

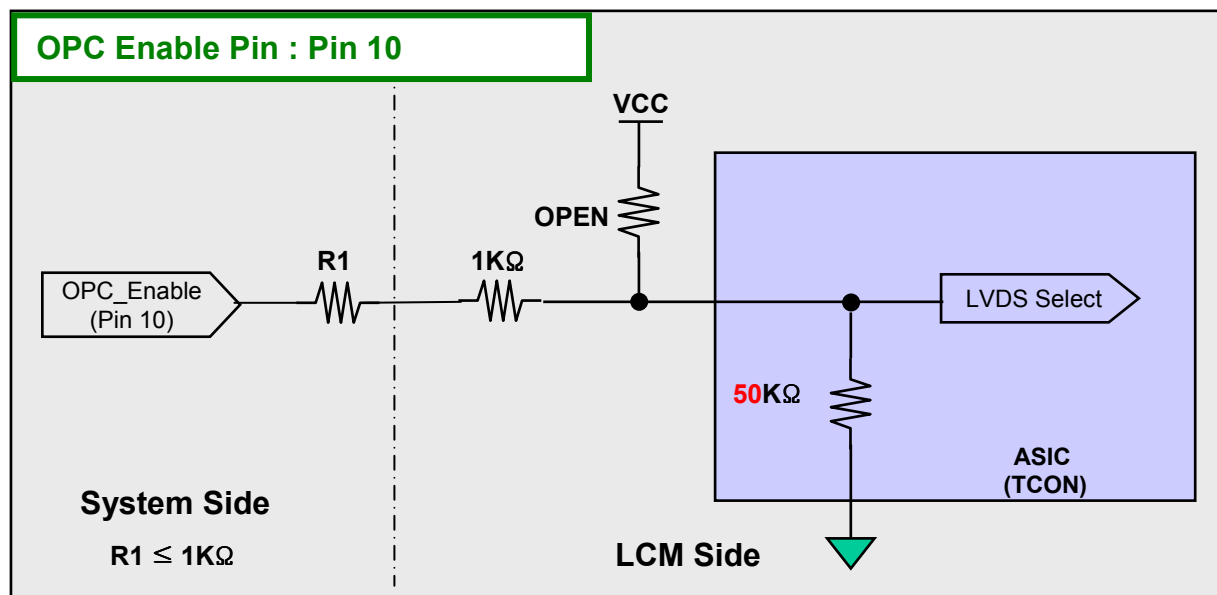| RCLKP										
RCLKM										
RAP	R11'	R10'	G10	R15	R14	R13	R12	R11	R10	G10"
RBP	G12'	G11'	B11	B10	G15	G14	G13	G12	G11	B15"
RCP	B13'	B12'	DE	V$_{SYNC}$	H$_{SYNC}$	B15	B14	B13	B12	DE"
RDP	R17'	R16'	X	B17	B16	G17	G16	R17	R16	X"
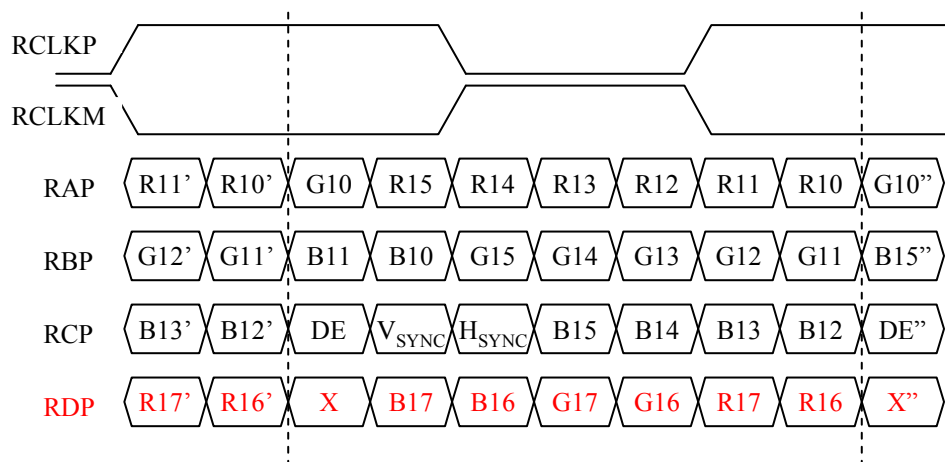
APPENDIX- III-3

■ **Option Pin** Circuit Block Diagram

1) Circuit Block Diagram of **LVDS Format** Selection pin
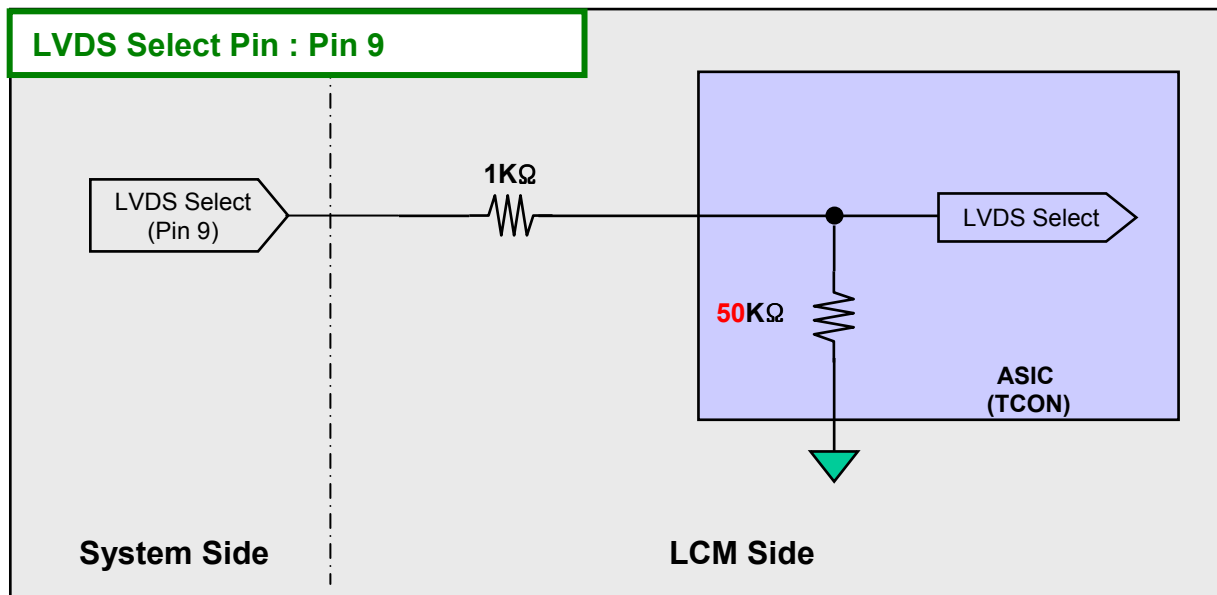
2) Circuit Block Diagram of **OPC Enable** Selection pin

APPENDIX- III-4

■ EXTVBR-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 (EXTVBR-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
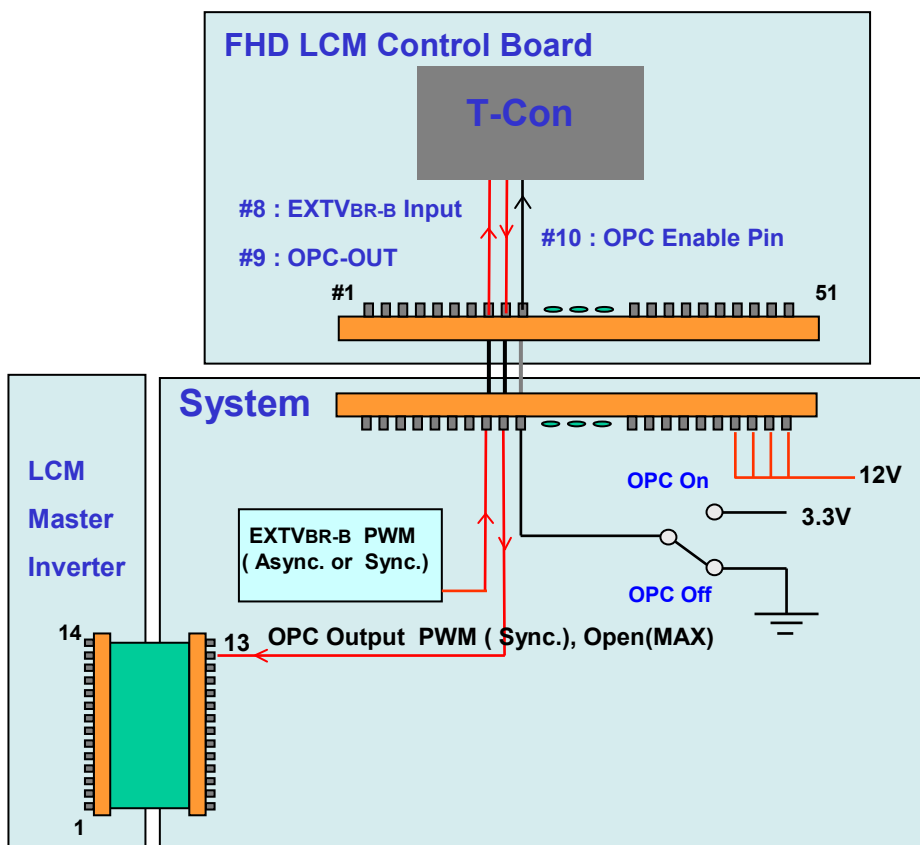
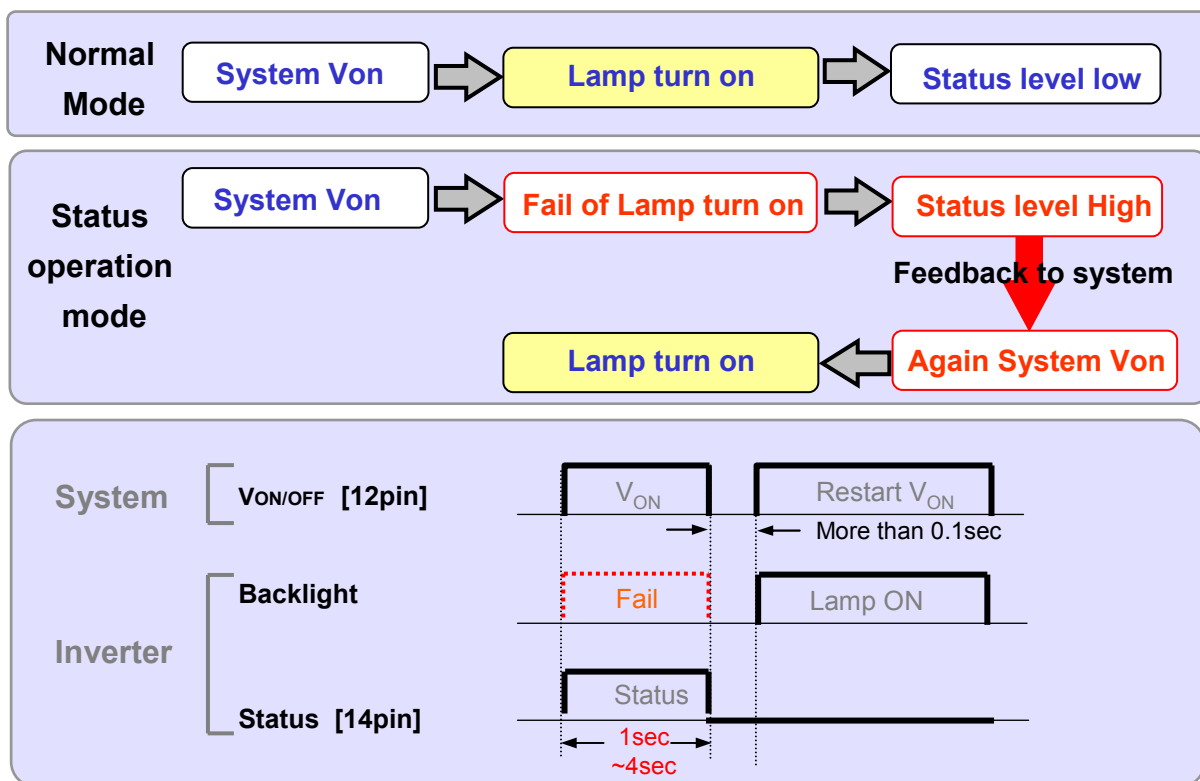| Input Frequency	MAX 1Khz (Recommendation: 50~300Hz)
Rising Time	MAX 10.0 μs
Falling Time	MAX 10.0 μs
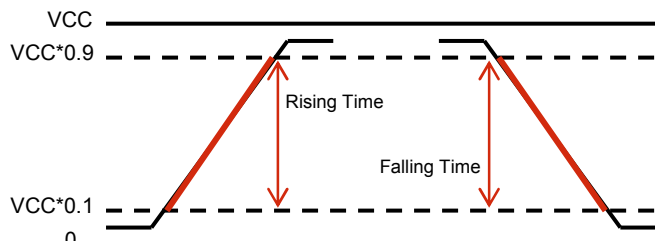
Product Specification

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
			Lamp turn on	⇐	**Feedback to system** ⬇ Again System Von

System Vᴏɴ/ᴏғғ [12pin]   Vᴏɴ   Restart Vᴏɴ   ← 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	Vᴏɴ/ᴏғғ	0.0V ~ 5.0V	On/Off
13	**EXTVBR-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 7.

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]

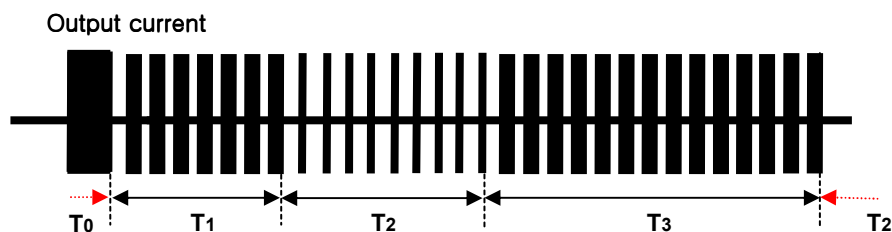| Max duty		Duty (Min ~ Max duty)

LAMP ON

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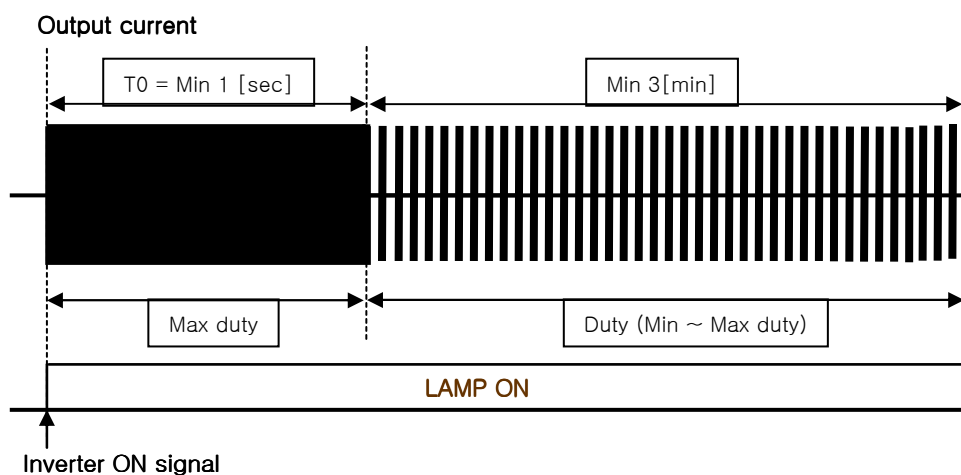
 2) B/L may not satisfy some of LCM specification at the Deep Dimming.

  - 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 LC470WUN-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. 02. 2009 (LGD RV Event Sample)**

Sample	G to G Response Time [ms]		Uniformity
	Min.	Max.	
# 1	3.1	8.3	0.54
# 2	3.1	8.4	0.55