SPECIFICATION
FOR
APPROVAL

(●) **Preliminary Specification**

(   ) **Final Specification**

Title	42.0" WUXGA TFT LCD

BUYER	General
MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LD420EUN
SUFFIX	UHA1 (RoHS Verified)

APPROVED BY	SIGNATURE DATE
/	
/	
/	

Please return 1 copy for your confirmation with your signature and comments.

APPROVED BY	SIGNATURE DATE
H. J. Song / Team Leader	
REVIEWED BY J.K.Kim / Project Leader	
PREPARED BY D.U.Lee / Engineer	

PD Product Design Dept.
LG Display Co., Ltd

CONTENTS

RECORD OF REVISIONS

| Revision No.	Revision Date	Page	Description
0.1	Jun. 11, 2014	-	Preliminary Specification (First Draft)
0.2	Jul. 28. 2014	6 ~ 7	Update Electrical Characteristics
0.3	Aug,11,2014	28 ~ 30	Update 9. Precautions
		32	Production site addition
0.4	Aug. 22. 2014	23~24	Update 5. Mechanical Characteristics
		4, 5, 7, 9, 17, 18	Update LED driver spec.
1.0	Oct. 4. 2014	-	Final specification
1.1	Oct. 30. 2014	25	Update 6.Reliability

Product Specification

1. General Description

The LD420EUN is a Color Active Matrix Liquid Crystal Display with an integral Light Emitting Diode (LED) backlight system. The matrix employs a-Si Thin Film Transistor as the active element.

It is a transmissive display type which is operating in the normally black mode. It has a 41.92 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 1.07Bilion colors.

It has been designed to apply the 10-bit 2-port LVDS interface.

It is intended to support Public Display where high brightness, super wide viewing angle, high color gamut, high color depth and fast response time are important.
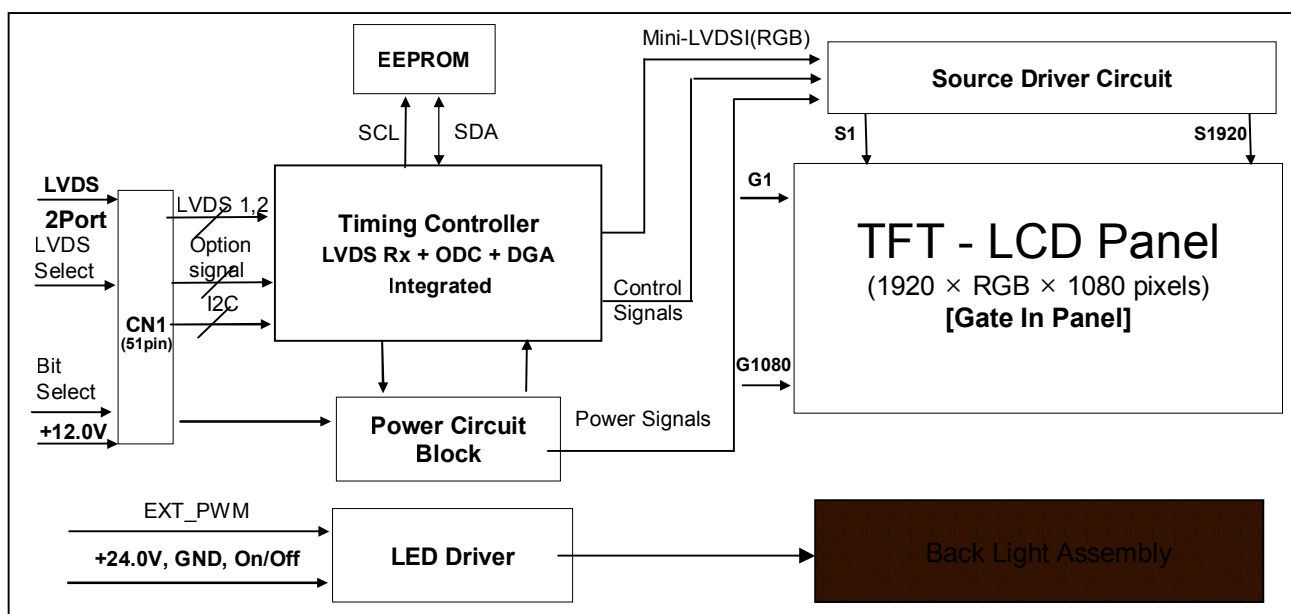
General Features

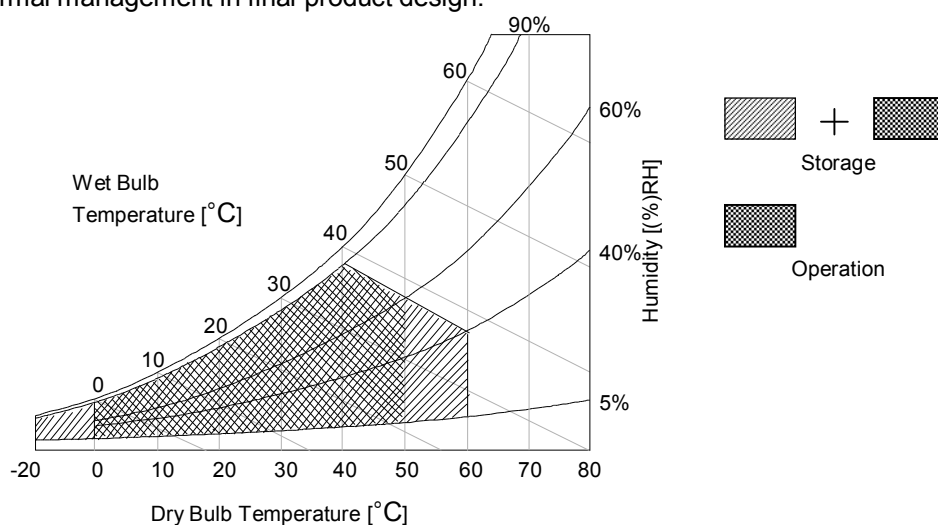|	
Active Screen Size	41.92 inches(1064.67mm) diagonal
Outline Dimension	945.74(H) X 539.76(V) X 12.7(B) / 31.2(V) mm (Typ.)
Pixel Pitch	0.4833 mm x 0.4833 mm
Pixel Format	1920 horiz. by 1080 vert. Pixels, RGB stripe arrangement
Color Depth	10bit(D), 1.07 Bilion colors
Luminance, White	700 cd/m^2 (Center 1point ,Typ.)
Viewing Angle (CR>10)	Viewing angle free (R/L 178 (Min.), U/D 178 (Min.))
Power Consumption	Total 81.06W (Typ.) [Logic= 6.72W, LED Driver=74.34W(ExtVbr_B=100%)]
Weight	9.8Kg (Typ.), 10.3Kg(Max.)
Display Mode	Transmissive mode, Normally black
Surface Treatment	Hard coating(3H), Anti-glare treatment of the front polarizer (Haze 10%)
Possible Display Type	Landscape and Portrait Enabled

2. Absolute Maximum Ratings

The following items are maximum values which, if exceeded, may cause faulty operation or permanent damage to the LCD module.

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Value		Unit	Notes
			Min	Max		
Power Input Voltage	LCD Circuit	V_{LCD}	-0.3	+14.0	V_{DC}	1
	Driver	V_{BL}	-0.3	+ 27.0	V_{DC}	
Driver Control Voltage	ON/OFF	V_{OFF} / V_{ON}	-0.3	+3.9	V_{DC}	
	Brightness	**EXTV**$_{BR-B}$	-0.3	+5.5	V_{DC}	
	Status	Status	-0.3	+3.9		
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}	5	90	%RH	

Notes 1. Ambient temperature condition (Ta = 25 $\pm$ 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 be 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 LED backlight and LED Driver circuit.

Table 2. ELECTRICAL CHARACTERISTICS

Parameter	5Symbol	Value			Unit	Note
		Min	Typ	Max		
Circuit :						
Power Input Voltage	V_{LCD}	10.8	12.0	13.2	V_{DC}	5
Power Input Current	I_{LCD}	-	560	728	mA	1
		-	750	975	mA	2
Power Consumption	P_{LCD}	-	6.72	8.74	Watt	1
Rush current	I_{RUSH}	-	-	8.0	A	3

Notes
1. The specified current and power consumption are under the V_{LCD}=12.0V, Ta=25 $\pm$ 2°C, f_V=60Hz condition, and 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.).
4. Ripple voltage level is recommended under $\pm$5% of typical voltage
5. Maximum of Power Input Voltage is included with ripple.

White : 1023 Gray
Black :   0 Gray
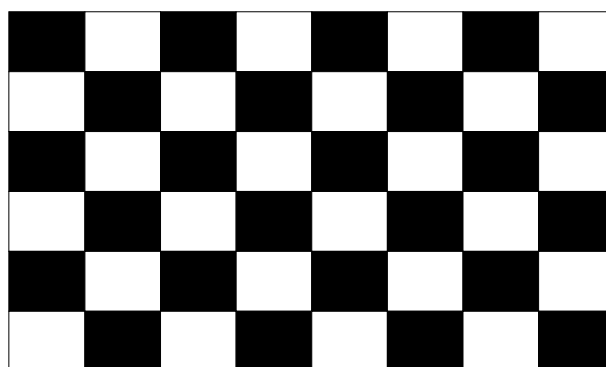
Mosaic Pattern(8 x 6)

Product Specification

Table 3. ELECTRICAL CHARACTERISTICS (Continue)

Parameter			Symbol	Values			Unit	notes
				Min	Typ	Max		
LED Driver :								
Power Supply Input Voltage			VBL	21.6	24.0	26.4	Vdc	1
Power Supply Input Current			IBL	-	3.1	3.41	A	1
Power Supply Input Current (In-Rush)			In-rush	-	-	3.91	A	V_{BL} = 21.6V ExtV$_{BR-B}$ = 100% 4
Power Consumption			PBL	-	74.34	81.9	W	1
Input Voltage for Control System Signals	On/Off	On	V on	2.5	-	3.6	Vdc	
		Off	V off	-0.3	0.0	0.7	Vdc	
	Brightness Adjust		ExtV$_{BR-B}$	5	-	100	%	On Duty 6
				1	-	100	%	
	ExtV$_{BR-B}$ Frequency	PAL			100		Hz	3
		NTSC			120		Hz	3
	Pulse Duty Level (PWM)	High Level		2.5	-	3.6	Vdc	HIGH : on duty LOW : off duty
		Low Level		0.0	-	0.7	Vdc	
LED :								
Life Time				50,000	60,000	-	Hrs	2

notes :
1. Electrical characteristics are determined after the unit has been 'ON' and stable for approximately 60 minutes at 25±2°C. The specified current and power consumption are under the typical supply Input voltage 24Vand VBR (ExtV$_{BR-B}$: 100%), it is total power consumption.
2. The life time (MTTF) is determined as the time which luminance of the LED is 50% compared to that of initial value at the typical LED current (ExtVBR-B :100%) on condition of continuous operating in LCM state at 25±2°C.
3. LGD recommend that the PWM freq. is synchronized with Two time harmonic of V_sync signal of system. Though PWM frequency is over 120Hz (max 252Hz), function of LED Driver is not affected.
4. The duration of rush current is about 200ms. This duration is applied to LED on time.
5. Even though inrush current is over the specified value, there is no problem if I^2T spec of fuse is satisfied.
6. ExtV$_{BR-B}$ signal have to input available duty range and sequence.
  After Driver ON signal is applied, ExtV$_{BR-B}$ should be sustained from 5% to 100% more than 500ms.
    After that, ExtV$_{BR-B}$ 1% and 100% is possible
 For more information, please see 3-6-2. Sequence for LED Driver.

	Product Specification

3-2. Interface Connections

This LCD module employs two kinds of interface connection, 51-pin connector is used for the module electronics.

3-2-1. LCD Module

- LCD Connector(CN1): FI-RE51S-HF(manufactured by JAE) or GT05P-51S-H38(manufactured by LSM) or
  IS050-C51B-C39(manufactured by UJU)
- Mating Connector : FI-R51HL(JAE) or compatible

Table 4. MODULE CONNECTOR(CN1) PIN CONFIGURATION

No	Symbol	Description	No	Symbol	Description
1	NC	Note 4	27	Bit Select	'H' = 10bit(D) , 'L' or NC = 8bit
2	NC	Note 4	28	R2AN	SECOND LVDS Receiver Signal (A-)
3	NC	Note 4	29	R2AP	SECOND LVDS Receiver Signal (A+)
4	NC	Note 4	30	R2BN	SECOND LVDS Receiver Signal (B-)
5	NC	Note 4	31	R2BP	SECOND LVDS Receiver Signal (B+)
6	NC	Note 4	32	R2CN	SECOND LVDS Receiver Signal (C-)
7	LVDS Select	'H' =JEIDA , 'L' or NC = VESA	33	R2CP	SECOND LVDS Receiver Signal (C+)
8	NC	Note 4	34	GND	Ground
9	NC	Note 4	35	R2CLKN	SECOND LVDS Receiver Clock Signal(-)
10	NC	Note 4	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 or GND	No Connection or Ground
17	R1CP	FIRST LVDS Receiver Signal (C+)	43	NC or GND	No Connection or Ground
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 or GND	NC or Ground	-	-	-

notes
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. **#1~#6 & #8~#9** NC (No Connection): These pins are used only for LGD (Do not connect)
5. 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.
6. Specific pin No. **#44** is used for "No signal detection" of system signal interface.
   It should be GND for NSB (No Signal Black) while the system interface signal is not.
   If this pin is "H", LCD Module displays AGP (Auto Generation Pattern).

3-2-2. Backlight Module

Master

-LED Driver Connector

: 20022WR - H14B2(Yeonho) or Compatible

- Mating Connector

: 20022HS - 14B2 (Yeonho) or Compatible

Table 5-1. LED DRIVER CONNECTOR PIN CONFIGURATION

| Pin No	Symbol	Description	Note
1	V_{BL}	Power Supply +24.0V	
2	V_{BL}	Power Supply +24.0V	
3	V_{BL}	Power Supply +24.0V	
4	V_{BL}	Power Supply +24.0V	
5	V_{BL}	Power Supply +24.0V	
6	GND	Backlight Ground	
7	GND	Backlight Ground	
8	GND	Backlight Ground	1
9	GND	Backlight Ground	
10	GND	Backlight Ground	
11	Status	Back Light Status	2
12	$V_{ON/OFF}$	Backlight ON/OFF control	4
13	NC	Don't care	
14	EXTVBR-B	External PWM	3

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

2. Normal : Low (under 0.7V) / Abnormal : Open

3. High : on duty / Low : off duty, Pin#14 can be opened. (if Pin #14 is open , EXTVBR-B is 100%)

4. Each impedance of pin #12 and 14 is over 50 [KΩ] .

◆ Rear view of LCM

PCB

1 ⟶ 14

1 ⟶ 14

<Master>
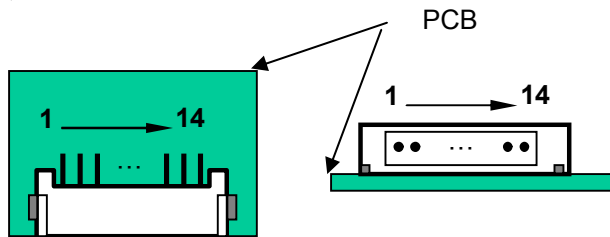
◆ Status
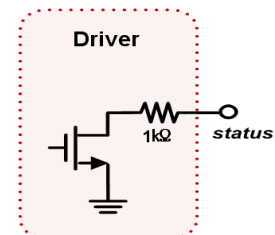
3-3. Signal Timing Specifications

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. TIMING TABLE (DE Only Mode)

ITEM		Symbol	Min	Typ	Max	Unit	notes
Horizontal	Display Period	t_{HV}	960	960	960	tCLK	1920 / 2
	Blank	t_{HB}	100	140	240	tCLK	1
	Total	t_{HP}	1060	1100	1200	tCLK	
Vertical	Display Period	t_{VV}	1080	1080	1080	Lines	
	Blank	t_{VB}	20	45	300	Lines	1
	Total	t_{VP}	1100	1125	1380	Lines	

ITEM		Symbol	Min	Typ	Max	Unit	notes
Frequency	DCLK	f_{CLK}	60.00	74.25	78.00	MHz	
	Horizontal	f_H	57.3	67.5	70	KHz	2
	Vertical	f_V	47	60	63	Hz	2

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

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

 3. Spread Spectrum Rate (SSR) for 50KHz ~ 100kHz Modulation Frequency(FMOD) is calculated by (7 – 0.06*Fmod), where Modulation Frequency (FMOD) unit is KHz.
LVDS Receiver Spread spectrum Clock is defined as below figure

※ Timing should be set based on clock frequency.
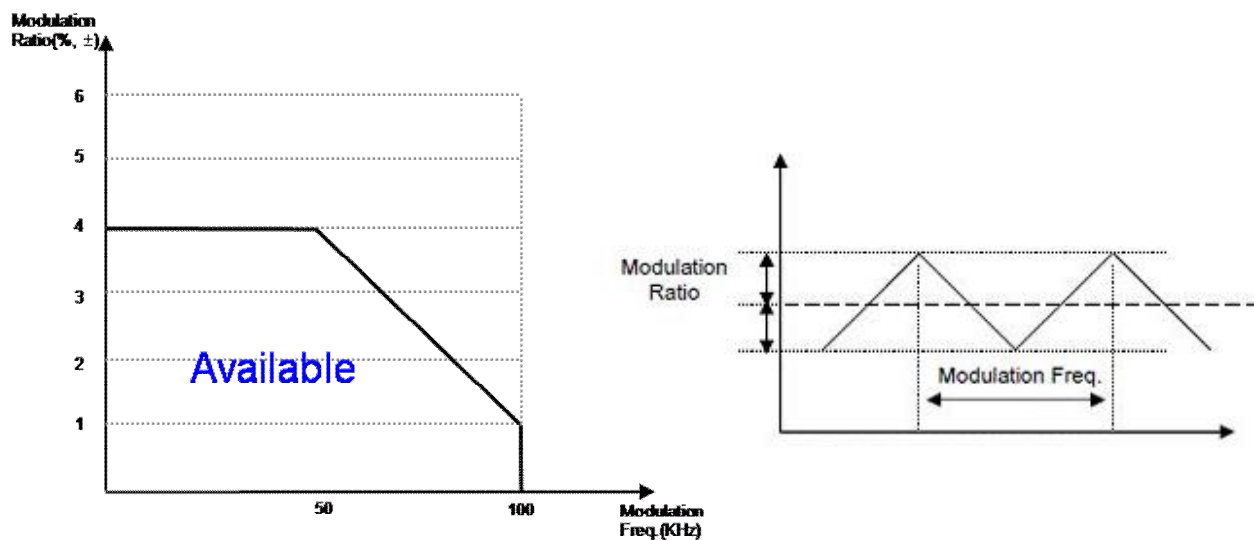
※ Please pay attention to the followings when you set Spread Spectrum Rate(SSR) and Modulation Frequency(FMOD)

1. Please set proper Spread Spectrum Rate(SSR) and Modulation Frequency (FMOD) of TV system LVDS output.

2. Please check FOS after you set Spread Spectrum Rate(SSR) and Modulation Frequency(FMOD) to avoid abnormal display. Especially, harmonic noise can appear when you use Spread Spectrum under FMOD 30 KHz.

3-4. LVDS Signal Specification

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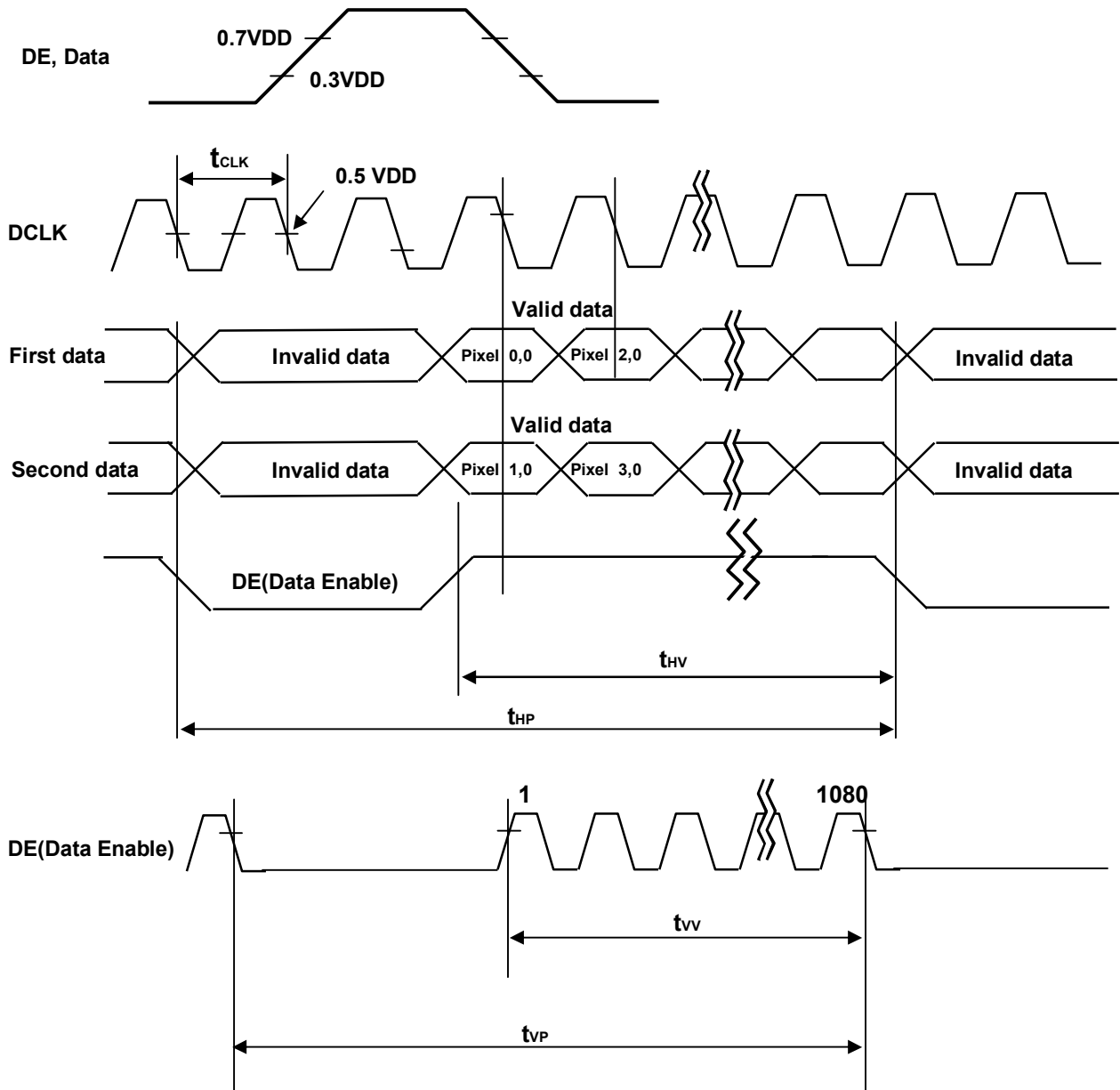
3-4-2. LVDS Input Signal Characteristics

1) DC Specification

$V_{CM} = \{(LVDS\ +) + (\ LVDS\ -)\}/2$
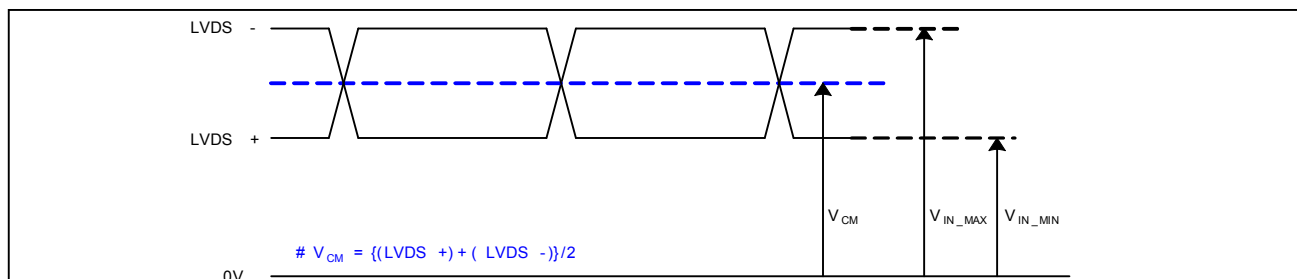
Description	Symbol	Min	Max	Unit	notes
LVDS Common mode Voltage	V_{CM}	1.0	1.5	V	-
LVDS Input Voltage Range	V_{IN}	0.7	1.8	V	-
Change in common mode Voltage	$\triangle VCM$	-	250	mV	-

2) AC Specification

$(F_{clk} = 1/T_{clk})$
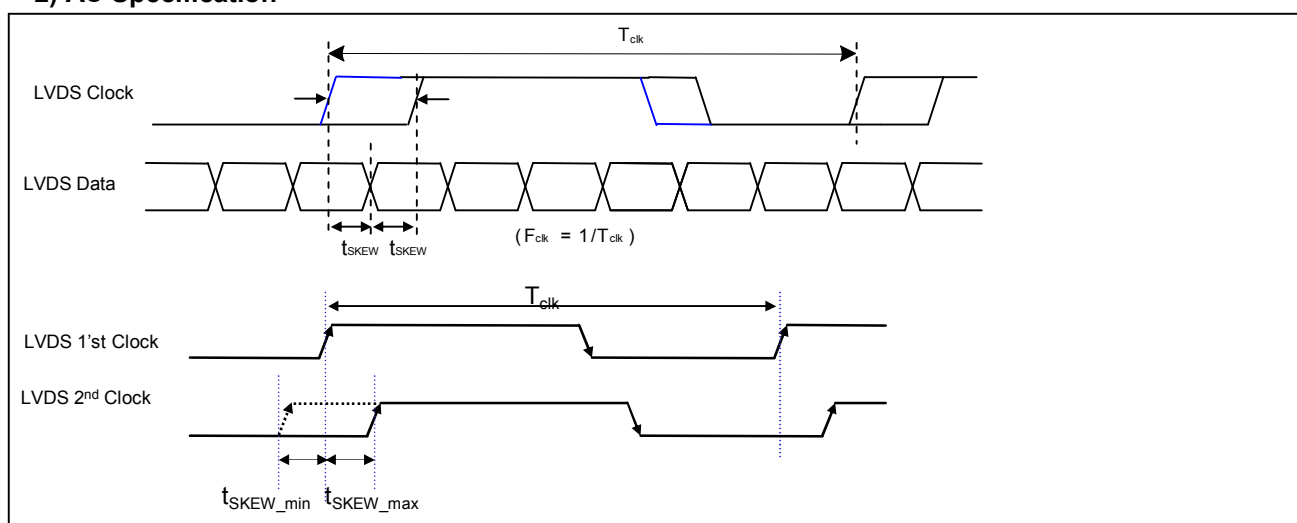
Description	Symbol	Min	Max	Unit	notes
LVDS Differential Voltage	V_{TH}	100	600	mV	Tested with Differential Probe
	V_{TL}	-600	-100	mV	2
LVDS Clock to Data Skew	t_{SKEW}	-	$\|(0.25*T_{clk})/7\|$	ps	-
Effective time of LVDS	t_{eff}	$\|\pm360\|$	-	ps	-
LVDS Clock to Clock Skew (Even to Odd)	t_{SKEW_EO}	-	$\|1/7*\ T_{clk}\|$	ps	-

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

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

Product Specification

LVDS Data

0.5tui

tui

360ps

0V
(Differential)

VTH

VTL

360ps

teff

LVDS CLK

tui : Unit Interval

0V
(Differential)
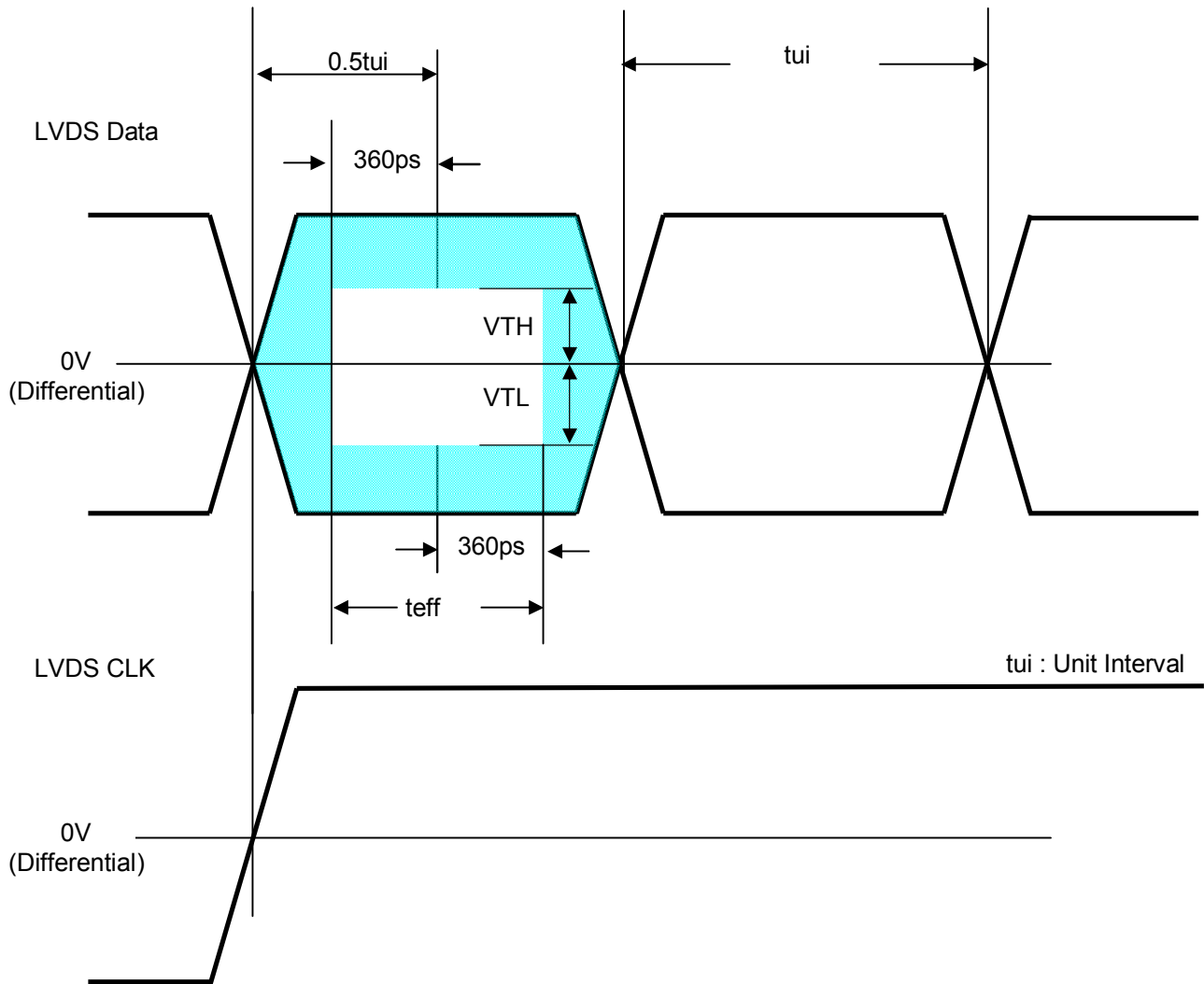
* This accumulated waveform is tested with differential probe

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
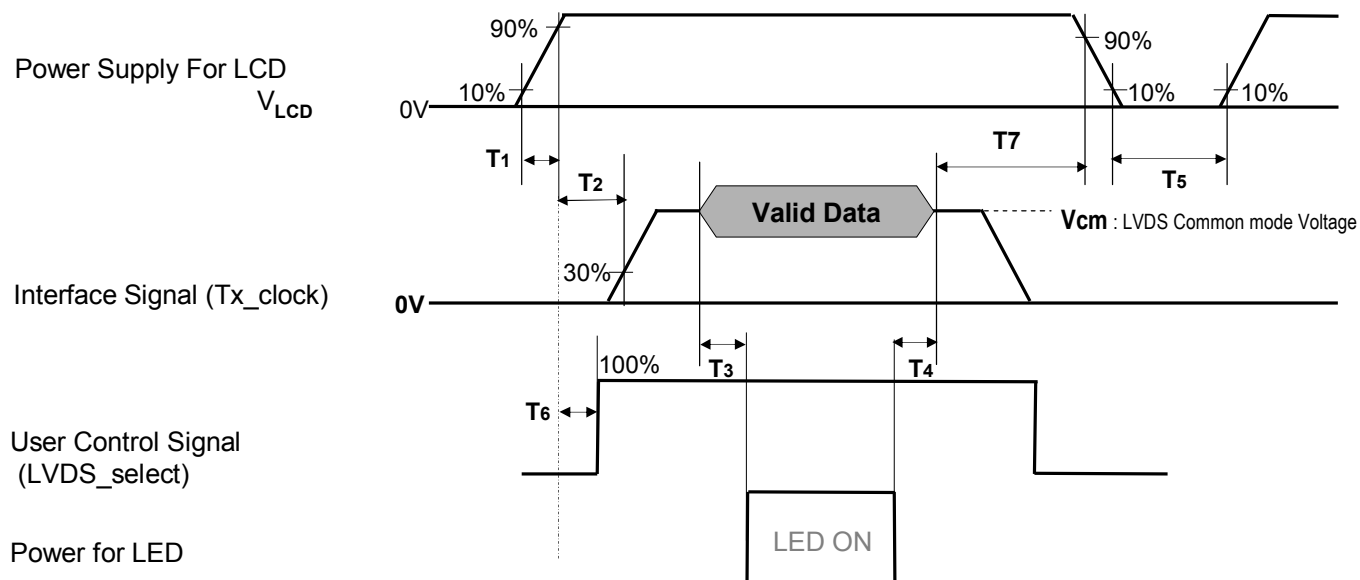
Table 8. POWER SEQUENCE

Parameter	Value			Unit	Notes
	Min	**Typ**	**Max**		
T1	0.5	-	20	ms	1
T2	0	-	-	ms	2
T3	400	-	-	ms	3
T4	100	-	-	ms	3
T5	1.0	-	-	s	4
T6	0	-	T2	ms	5
T7	0	-	-	ms	6

Note :
1. Even though T1 is over the specified value, there is no problem if I2T spec of fuse is satisfied.
2. If T2 is satisfied with specification after removing LVDS Cable, there is no problem.
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. T5 should be measured after the Module has been fully discharged between power off and on period.
5. 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.
6. It is recommendation specification that T7 has to be 0ms as a minimum value.
※ Please avoid floating state of interface signal at invalid period.
※ When the power supply for LCD (VLCD) is off, be sure to pull down the valid and invalid data to 0V.

3-6-2. Sequence for LED Driver

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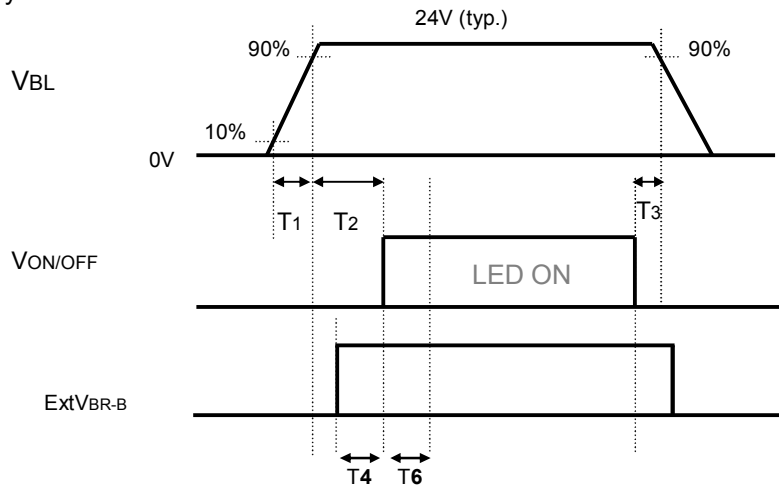
3-6-3. Dip condition for LED Driver
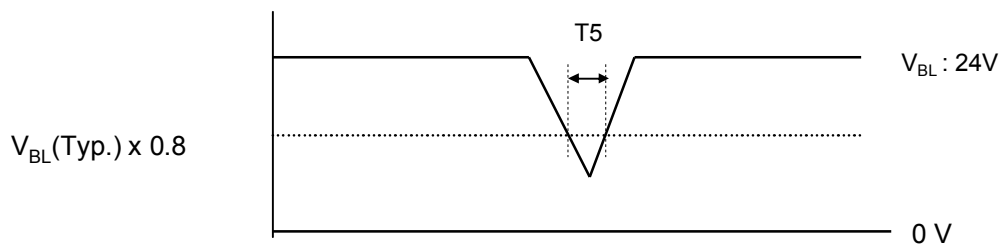
Table 9. Power Sequence for LED Driver

Parameter	Values			Units	Remarks
	Min	Typ	Max		
T1	20	-	-	ms	1
T2	500	-	-	ms	
T3	10	-	-	ms	
T4	0	-	-	ms	
T5	-	-	10	ms	V_{BL}(Typ) x 0.8
T6	500	-	-	ms	2

Notes : 1. T1 describes rising time of 0V to 24V and this parameter does not applied at restarting time.
Even though T1 is over the specified value, there is no problem if I^2T spec of fuse is satisfied.
2. In T6 section, ExtV$_{BR-B}$ should be sustained from 5% to 100% .

Product Specification

4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable in a dark environment at 25±2°C. The values are specified at 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0 °. FIG. 1 shows additional information concerning the measurement equipment and method.

Optical Stage(x,y)   **LCD Module**   **Pritchard 880 or equivalent**

1°

50cm
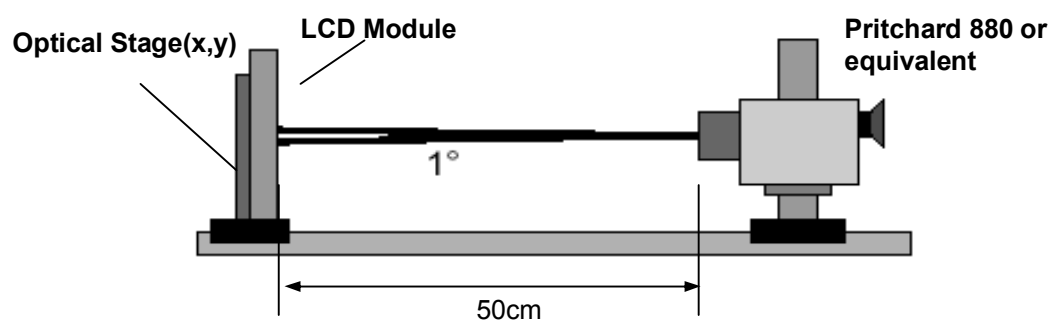
FIG. 1 Optical Characteristic Measurement Equipment and Method

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	notes
				Min	Typ	Max		
Contrast Ratio		CR		900	1300	-		1
Surface Luminance, white		L_{WH}		560	700	-	cd/m^2	2
Luminance Variation		δ_{WHITE}	9P	65		-	%	3
Response Time	Gray-to-Gray	G ot G		-	8	12	ms	4
	Uniformity	$\delta_{G\,TO\,G}$		-	-	1		5
Color Coordinates [CIE1931]	RED	Rx			0.651			
		Ry			0.334			
	GREEN	Gx			0.309			
		Gy		Typ -0.03	0.601	Typ +0.03		
	BLUE	Bx			0.151			
		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	-	-	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 :

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

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(9P) = Minimum ($L_{on1}, L_{on2} \sim L_{on8}, L_{on9}$) / Maximum ($L_{on1}, L_{on2} \sim L_{on8}, L_{on9}$)*100
   Where L_{on1} to L_{on9} are the luminance with all pixels displaying white at 9 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. 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.

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

Table 11. Gray scale specification

	계조	상대휘도(%) OPC OFF 상대휘도(%)			비 고
		최 소	정 격	최 대	
0	L0	-	0.07	0.29	
1	L63	0.11	0.27	1.15	
2	L127	0.32	1.04	2.26	
3	L191	0.83	2.49	4.45	
4	L255	1..90	4.68	7.98	
5	L319	3..97	7.66	11.96	
6	L383	6..26	11.5	16.96	
7	L447	9.41	16.1	23.11	
8	L511	13.0	21.6	30.53	
9	L575	18.5	28.1	38.81	
10	L639	24.2	35.4	47.78	
11	L703	30.7	43.7	56.99	
12	L767	38.9	53.0	67.14	
13	L831	49.2	63.2	77.38	
14	L895	60.5	74.5	87.50	
15	L959	77.3	86.7	95.34	
16	L1023	100	100	100	

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

A : H / 9 mm
B : V / 9 mm
@ H,V : Active Area
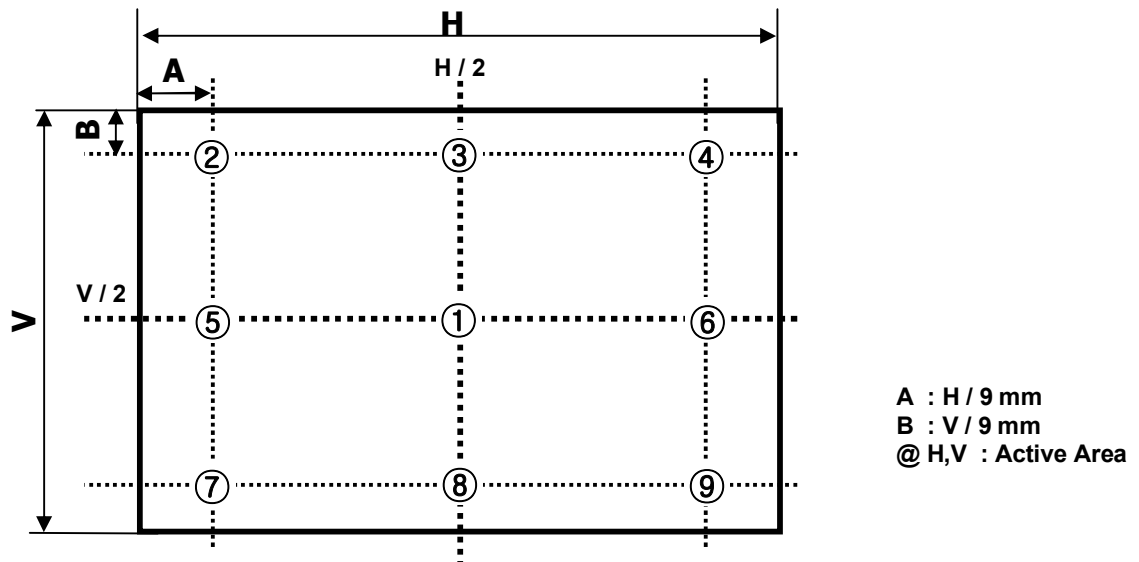
FIG. 2 9 Points for Luminance Measure

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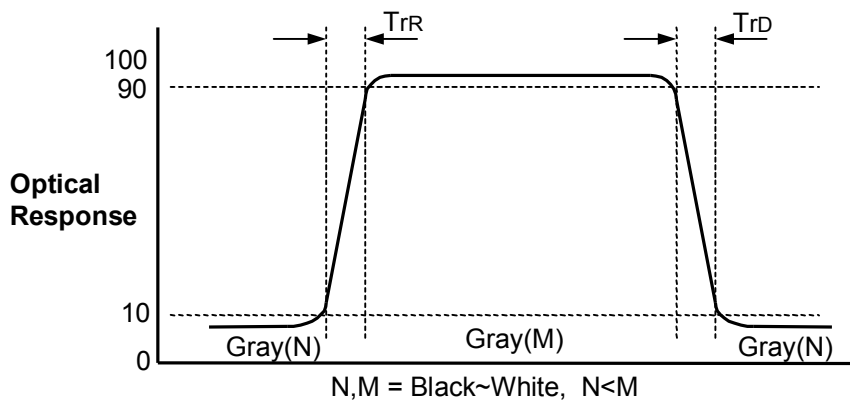
FIG. 3 Response Time

Product Specification

Dimension of viewing angle range
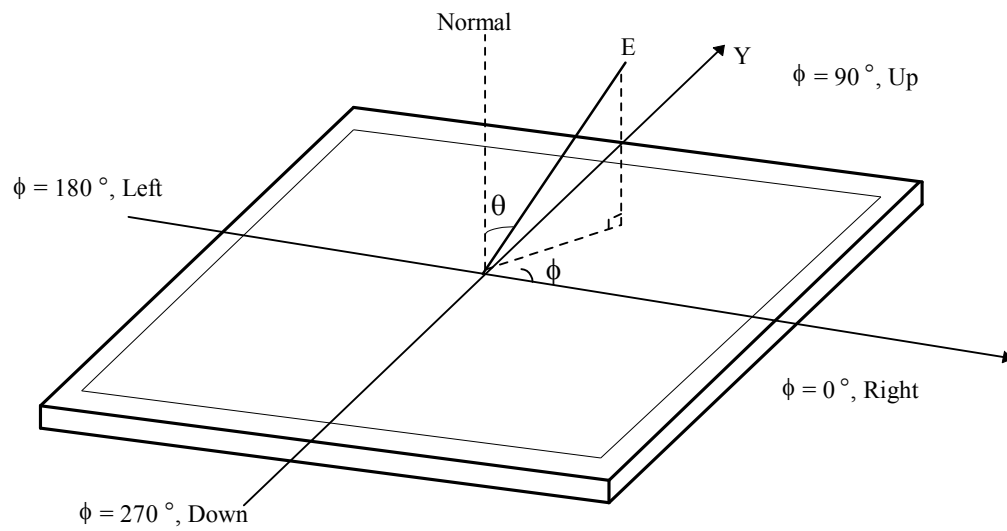
FIG. 4 Viewing Angle

Product Specification

5. Mechanical Characteristics

Table 12 provides general mechanical characteristics.

Table 12. MECHANICAL CHARACTERISTICS

Item	Value	
Outline Dimension	Horizontal	945.74 mm
	Vertical	539.76 mm
	Depth	12.7 mm
Bezel Area	Horizontal	933.94mm
	Vertical	527.96mm
Active Display Area	Horizontal	927.94 mm
	Vertical	521.96 mm
Weight	9.8 Kg (Typ.) 10.3 kg (Max.)	

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

Product Specification

[FRONT VIEW]

SET : TOP

945.74(Outline Dimension)
472.87(Outline Dimension)
933.94(Bezel Open)
466.97(Bezel Open)
927.94(Active Area)
463.97(Active Area)
521.96(Active Area)
260.98(Active Area)
527.96(Bezel Open)
263.98(Bezel Open)
269.88(Outline Dimension)
539.76(Outline Dimension)

24.30(T-con Cover Shield)
24.10(Source Cover Shield)
31.2(VESA)

SET : DOWN

1.5±0.5
Max 1.4
0.4
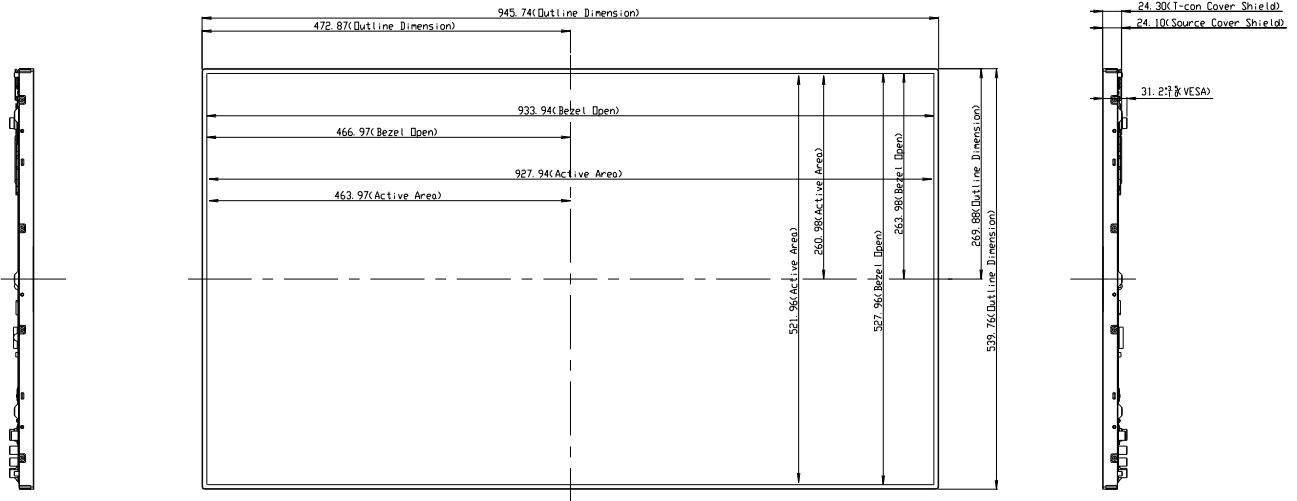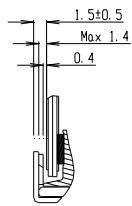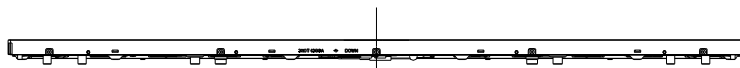
NOTES V2.0
1. UNSPECIFIED TOLERANCE IS ±1.0mm.
2. TILT AND PARTIAL DISPOSITION TOLERANCE OF DISPLAY AREA AS FOLLOWING.
 (a) X-DIRECTION : lA-Bl ≦ 1.5mm.
 (b) Y-DIRECTION : lC-Dl ≦ 1.5mm.
3. Max. TORQUE : REFER TO TABLE.
4. Max. DEPTH : REFERTO TABLE.
5. THE SAME FEATURE MEANS THEE SAME DIMENSION.

C7.000
ACTIVE AREA
BEZEL OPEN
A7.000
B7.000
D7.000
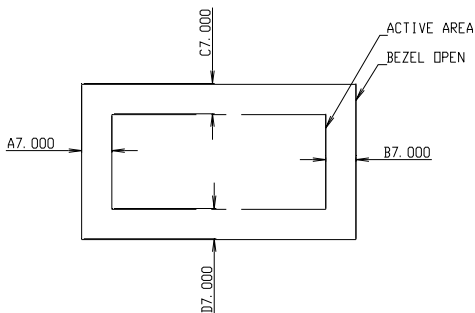
Date	Version
Aug. 12. 2014	V1.0
Aug. 22. 2014	V2.0

Product Specification

[REAR VIEW]

Set : Top
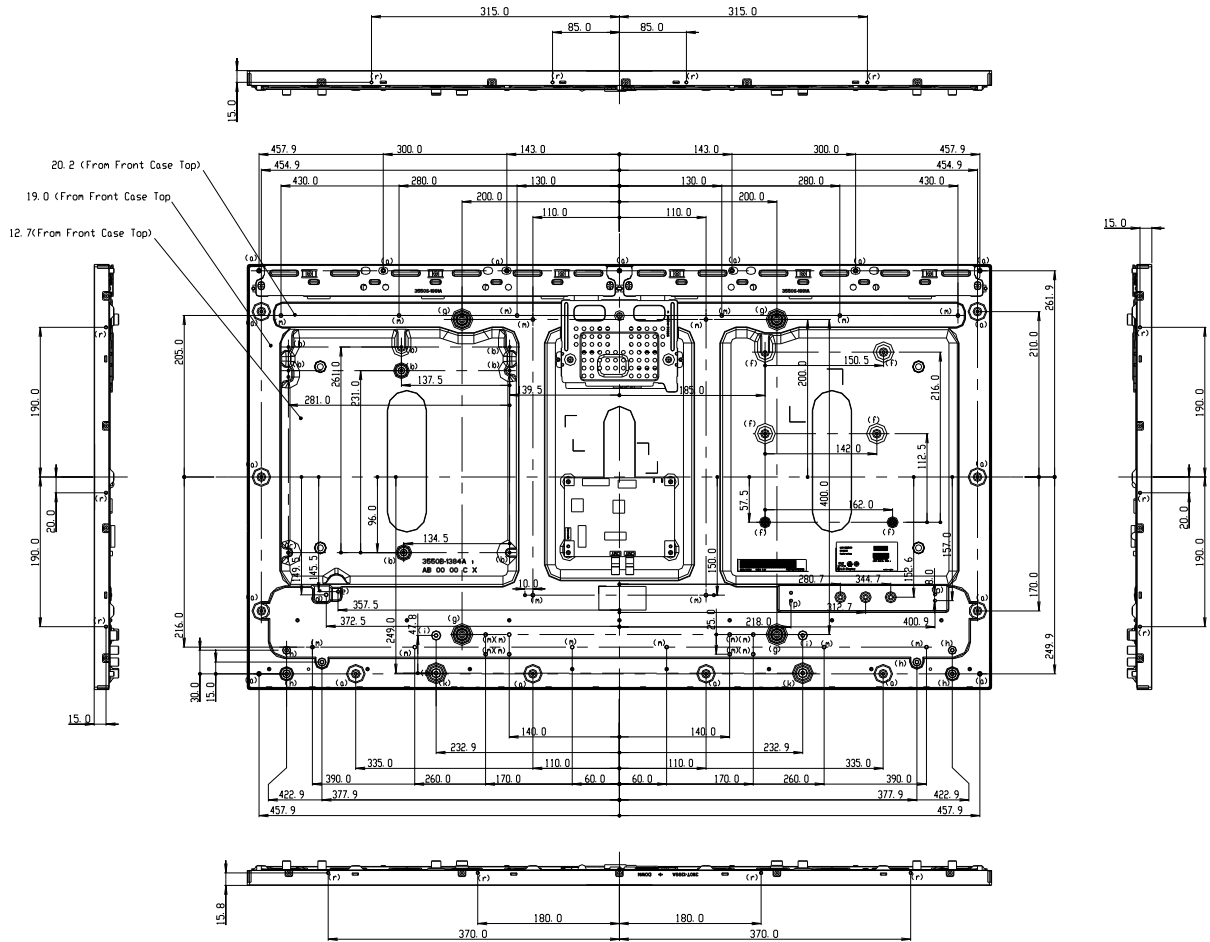
Set : Down

ITEM	TAP	UDM Height (mm)	Max Depth (mm)	Torque (kgf.cm)	Notes
(a)	M3.0	6.1	4.0	MAX 8.0	
(b)	M3.0	5.0	4.0	MAX 8.0	
(c)	M4.0	5.0	4.0	MAX 8.0	
(d)	M4.0	5.7	4.0	MAX 8.0	
(e)	M3.0	8.8	8.0	MAX 8.0	
(f)	M3.0	6.0	5.5	Max 8.0	
(g)	M6.0	11.0	10.0	MAX 15.0	
(h)	M4.0	11.0	8.5	MAX 8.0	
(i)	M4.0	9.0	5.5	MAX 8.0	
(k)	M4.0	12.2	5.5	MAX 8.0	
(m)	M4.0	–	4.5	MAX 8.0	
(p)	M3.0	–	4.5	MAX 8.0	
(r)	M3.0	–	8.5	MAX 8.0	

	Product Specification

6. Reliability

Table 13. ENVIRONMENT TEST CONDITION

No.	Test Item	Condition
1	High temperature storage test	Ta= 60°C 90% 240h
2	Low temperature storage test	Ta= -20°C 240h
3	High temperature operation test	Ta= 50°C 50%RH 500h
4	Low temperature operation test	Ta= 0°C 500h
5	Vibration test (non-operating)	Wave form : random Vibration level : 0.7Grms Bandwidth : 10-300Hz Duration : X,Y,Z, Each direction per 10 min
6	Shock test (non-operating)	Shock level : 20Grms Waveform : half sine wave, 14ms Direction : ±X, ±Y, ±Z One time each direction
7	Humidity condition Operation	Ta= 40 °C ,90%RH
8	Altitude operating storage / shipment	0 - 16,400 ft 0 - 40,000 ft

Note : 1. Before and after Reliability test, LCM should be operated with normal function.

2. These conditions are for LGD's internal test. Please refer to Absolute Maximum Ratings (Table1)

for guaranteed condition.

Product Specification

7. International Standards

7-1. Safety

a) UL 60065, 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, European Committee for Electrotechnical Standardization (CENELEC).

Audio, Video and Similar Electronic Apparatus - Safety Requirements.

d) IEC 60065, The International Electrotechnical Commission (IEC).

Audio, Video and Similar Electronic Apparatus - Safety Requirements.

7-2. Environment

a) RoHS, Directive 2011/65/EU of the European Parliament and of the council of 8 June 2011

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	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Mark	A	B	C	D	E	F	G	H	J	K

2. MONTH

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mark	1	2	3	4	5	6	7	8	9	A	B	C

b) Location of Lot Mark

Serial NO. is printed on the label. The label is attached to the backside of the LCD module.
This is subject to change without prior notice.

8-2. Packing Form

a) Package quantity in one Pallet : 22 pcs

b) Pallet Size : 1300 mm(W) X 1140 mm(D) X 772 mm(H)

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, Concentrated 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.

(10) Touching the LED Driver might cause an electric shock and damage to LED Driver. Please always use antistatic tools when handling the LED Driver

9-2. Operating Precautions

(1) Response time depends on the temperature.(In lower temperature, it becomes longer.)

(2) 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

(3) 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.

(4) When fixed patterns are displayed for a long time, remnant image is likely to occur.

(5) 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.

(6) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can't be operated its full characteristics perfectly.

(7) 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)

(8) Please do not set LCD on its edge.

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

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.
(3) Storage condition is guaranteed under packing conditions.
(4) The phase transition of Liquid Crystal in the condition of the low or high storage temperature will be recovered when the LCD module returns to the normal condition.

9-6. Appropriate Condition for Commercial Display

- Generally large-sized LCD modules are designed for consumer applications (TV).
  Accordingly, a long-term display like in Commercial Display application, can cause uneven display including image sticking. To optimize module's lifetime and function, several operating usages are required.

1. Normal operating condition
   - Temperature: 0 ~ 40℃
   - Operating Ambient Humidity : 10 ~ 90 %
   - Display pattern: dynamic pattern (Real display)
   Note) Long-term static display can cause image sticking.

2. Operating usages under abnormal condition
   a. Ambient condition
     - Well-ventilated place is recommended to set up Commercial Display system.
   b. Power and screen save
     - Periodical power-off or screen save is needed after long-term display.

Product Specification

3. Operating usages to protect against image sticking due to long-term static display
  a. Suitable operating time: under 18 hours a day.
  b. Static information display recommended to use with moving image.
   - Cycling display between 5 minutes' information(static) display and 10 seconds' moving image.
  c. Background and character (image) color change
   - Use different colors for background and character, respectively.
   - Change colors themselves periodically.
  d. Avoid combination of background and character with large different luminance.
 1) Abnormal condition just means conditions except normal condition.
 2) Black image or moving image is strongly recommended as a screen save.

4. Lifetime in this spec. is guaranteed only when Commercial Display is used according to operating usages.
5. Module should be turned clockwise based on front view when used in portrait mode.

APPENDIX-I

■ Pallet Ass'y
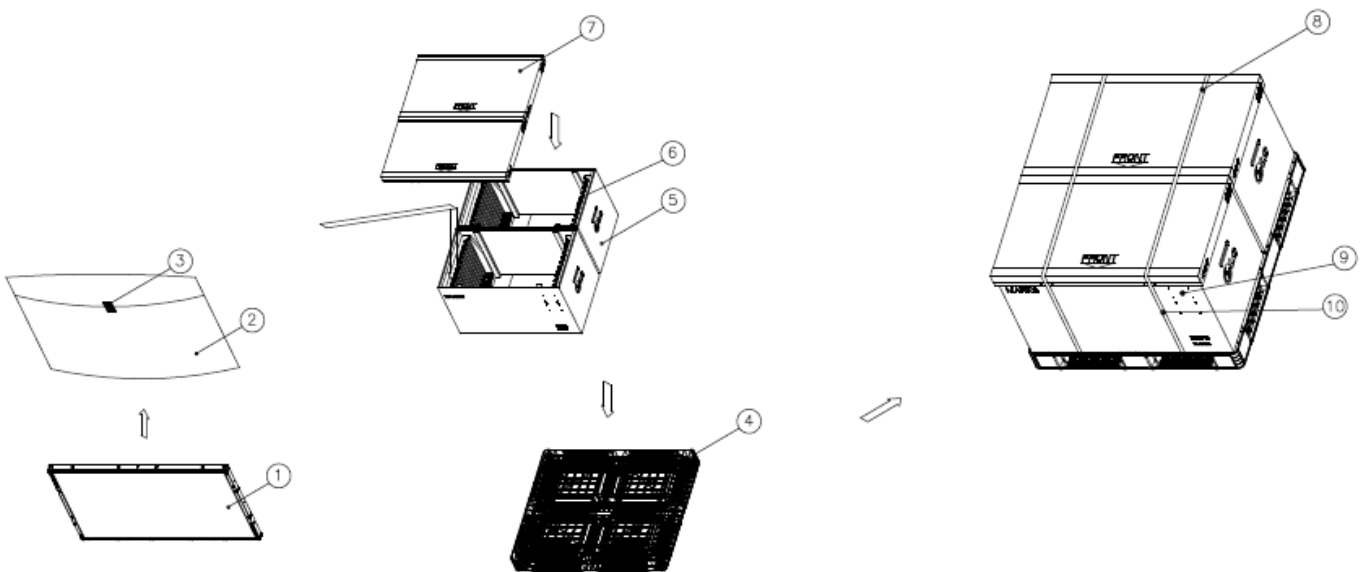
NO.	DESCRIPTION	MATERIAL
1	LCD Module	LD420EUN-UHA1
2	BAG	AL
3	TAPE	MASKING 20MMX50M
4	PALLET	Plastic 1300X1140X120.0mm
5	PACKING,BOTTOM	PAPER
6	PACKING,BOTTOM PAD	EPS
7	PACKING,TOP	PAPER
8	BAND	PP
9	LABEL	YUPO 80G 100X70
10	BAND CLIP	STEEL OR PP

Product Specification

APPENDIX- II-1

■ LCM Label

■ Production site

  - LG Display (Paju, New Optics) Co., LTD

notes 1.The origin of LCM Label will be changed according to the production site.

Product Specification

APPENDIX- II-2

■ Pallet Label

100.0

LD420EUN UHA1	
22 PCS	001/01-01	
MADE IN KOREA	RoHS Verified

70.0

XXXXXXXXXXXX XXX

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		RO0N
RED5	38	TA+ 30	13	100Ω	RO0P
RED6	59				
RED7	61	TB- 29	14		RO1N
RED8	4	TB+ 28	15	100Ω	RO1P
RED9	5				
GREEN0	40	TC- 25	16		RO2N
GREEN1	41	TC+ 24	17	100Ω	RO2P
GREEN2	42				
GREEN3	44				
GREEN4	45	TCLK- 23	19		ROCLKN
GREEN5	46	TCLK+ 22	20	100Ω	ROCLKP
GREEN6	62				
GREEN7	63	TD- 21	22		RO3N
GREEN8	6	TD+ 20	23	100Ω	RO3P
GREEN9	8				
BLUE0	48	TE- 19	24		RO4N
BLUE1	49	TE+ 18	25	100Ω	RO4P
BLUE2	50				
BLUE3	52		7		**VESA**/ JEIDA
BLUE4	53				
BLUE5	54				
BLUE6	64				
BLUE7	1				
BLUE8	9				
BLUE9	11				
Hsync	55		GND		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.

Product Specification

APPENDIX- III-2

■ Required signal assignment for Flat Link (Thine : THC63LVD103) Transmitter(Pin7= **"H"**)
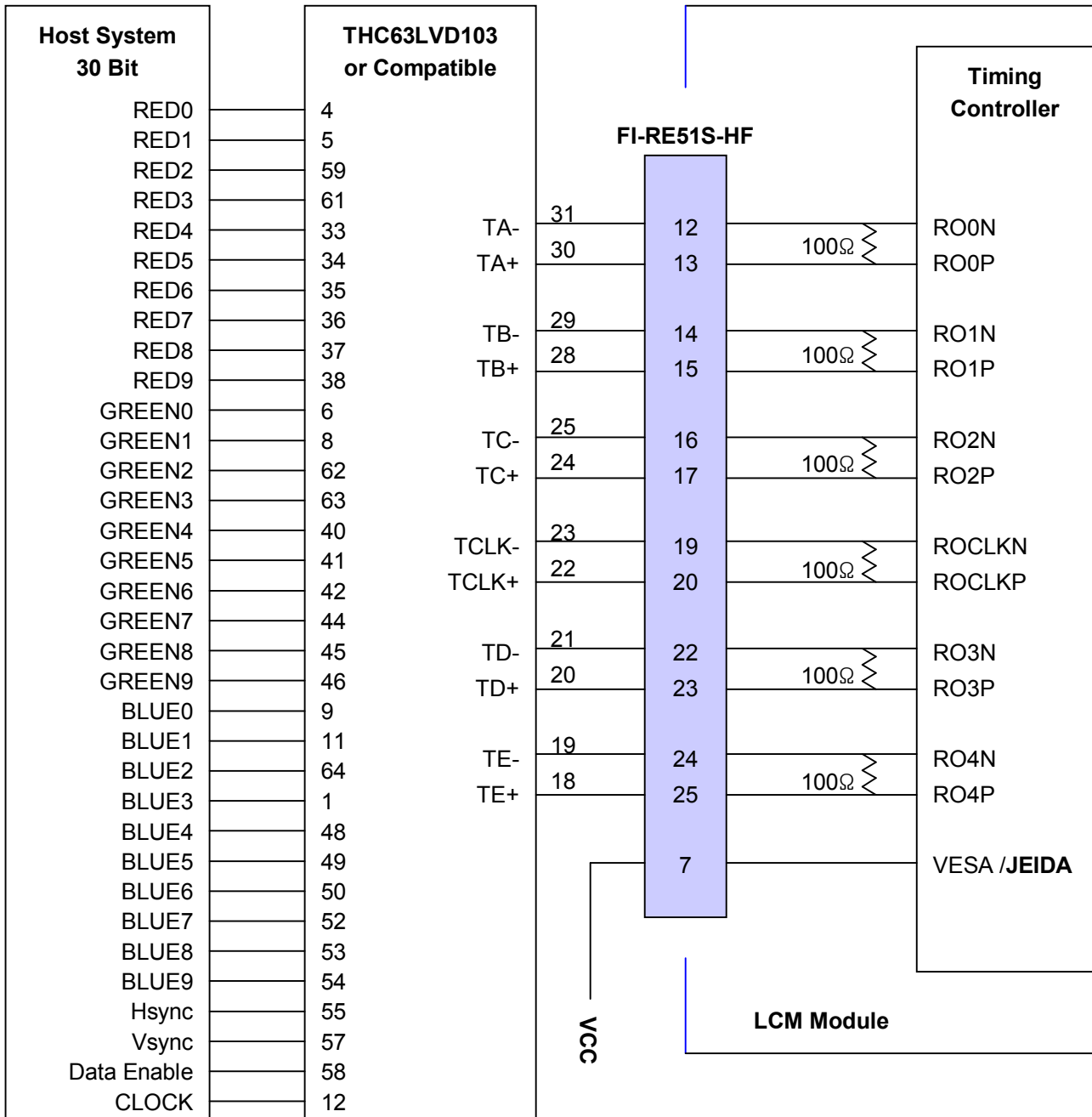
Host System 30 Bit	THC63LVD103 or Compatible		FI-RE51S-HF		Timing Controller
RED0	4				
RED1	5				
RED2	59				
RED3	61				
RED4	33	TA- 31	12		RO0N
RED5	34	TA+ 30	13	100Ω	RO0P
RED6	35				
RED7	36	TB- 29	14		RO1N
RED8	37	TB+ 28	15	100Ω	RO1P
RED9	38				
GREEN0	6	TC- 25	16		RO2N
GREEN1	8	TC+ 24	17	100Ω	RO2P
GREEN2	62				
GREEN3	63				
GREEN4	40	TCLK- 23	19		ROCLKN
GREEN5	41	TCLK+ 22	20	100Ω	ROCLKP
GREEN6	42				
GREEN7	44				
GREEN8	45	TD- 21	22		RO3N
GREEN9	46	TD+ 20	23	100Ω	RO3P
BLUE0	9				
BLUE1	11	TE- 19	24		RO4N
BLUE2	64	TE+ 18	25	100Ω	RO4P
BLUE3	1				
BLUE4	48				
BLUE5	49		7		VESA /**JEIDA**
BLUE6	50				
BLUE7	52				
BLUE8	53				
BLUE9	54				
Hsync	55				
Vsync	57		VCC	LCM Module	
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- IV

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

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

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

RCLKP / RCLKM

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

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

RCLKP / RCLKM
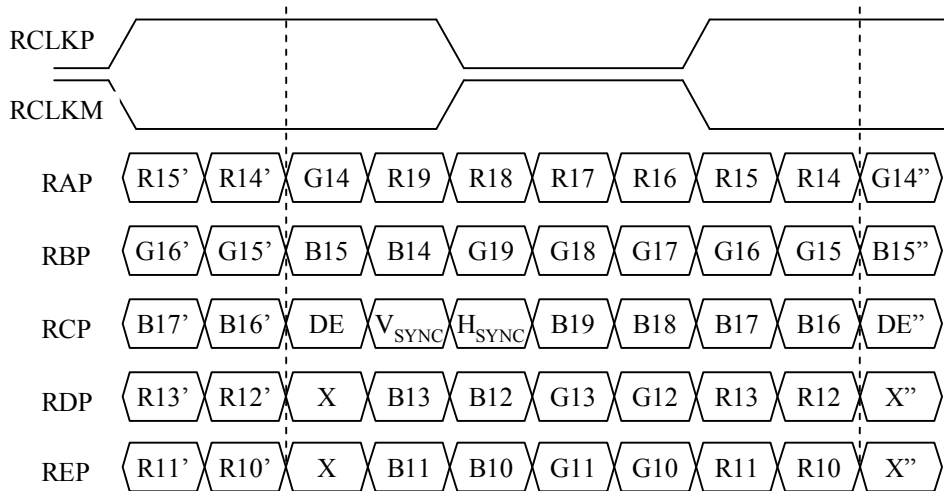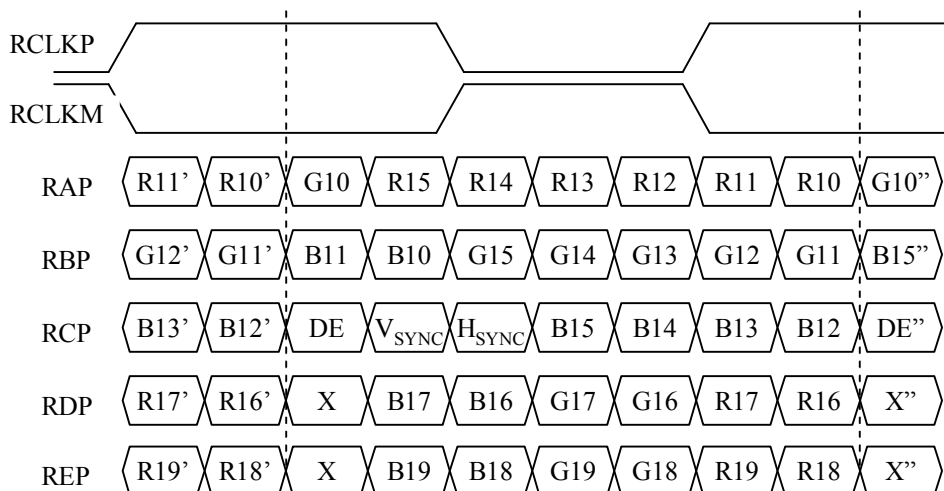
APPENDIX- IV

■ LVDS Data-Mapping Information (**8 Bit**)

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

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

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

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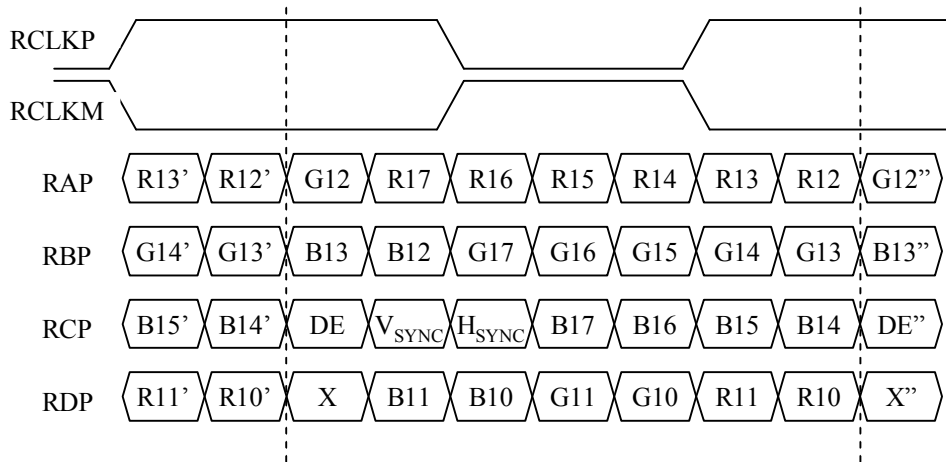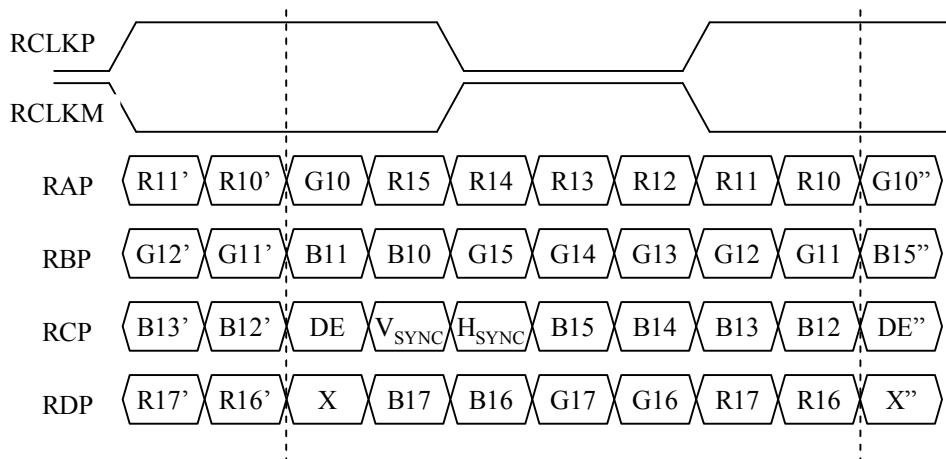
APPENDIX- V

■ **Option Pin** Circuit Block Diagram

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

```
┌─────────────────────────────────────────────────────────────────────┐
│  ┌──────────────────────────┐                                        │
│  │ LVDS Select Pin : Pin 7  │                                        │
│  └──────────────────────────┘                                        │
│                                   ┌──────────────────────────────┐   │
│                            1KΩ    │                              │   │
│         ┌──────────┐      ─/\/\─  │        •──────► LVDS Select   │   │
│         │ LVDS Select │            │        │                      │   │
│         │  (Pin 7)   │            │        │                      │   │
│         └──────────┘            │        │                      │   │
│                                   │   95kΩ ≷                      │   │
│                                   │        │                      │   │
│                                   │        ▽           ASIC       │   │
│                                   │                   (TCON)      │   │
│                                   └──────────────────────────────┘   │
│                                                                       │
│   **System Side**              **LCM Side**                           │
└─────────────────────────────────────────────────────────────────────┘
```
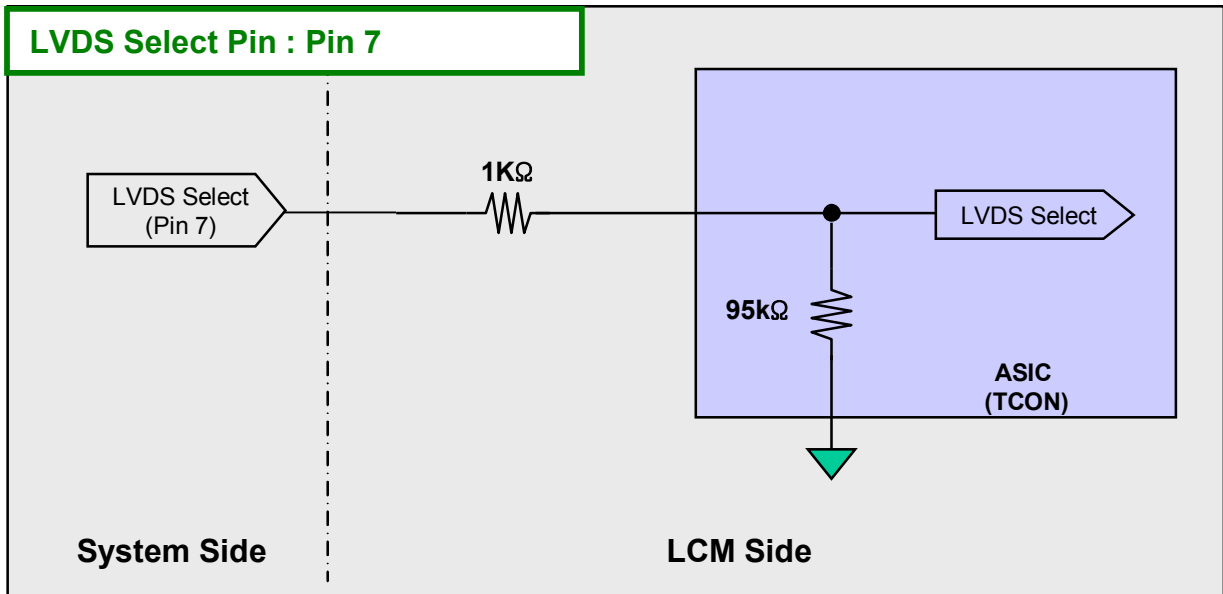
2) Circuit Block Diagram of **Bit** Selection pin

```
┌─────────────────────────────────────────────────────────────────────┐
│  ┌──────────────────────────┐                                        │
│  │ Bit Select Pin : Pin 27  │                                        │
│  └──────────────────────────┘                                        │
│                                   ┌──────────────────────────────┐   │
│                                   │            VCC               │   │
│                                   │            │                 │   │
│                                   │      93kΩ  ≷                 │   │
│                            1KΩ    │            │                 │   │
│         ┌──────────┐      ─/\/\─  │            •──────► Bit Select│   │
│         │ Bit Select │            │                              │   │
│         │  (Pin 27)  │            │                   ASIC       │   │
│         └──────────┘            │                   (TCON)      │   │
│                                   └──────────────────────────────┘   │
│                                                                       │
│   **System Side**              **LCM Side**                           │
└─────────────────────────────────────────────────────────────────────┘
```