SPECIFICATION
FOR
APPROVAL

(•) **Preliminary Specification**

( ) **Final Specification**

Title	47.0” WUXGA TFT LCD

BUYER	General
MODEL	

SUPPLIER	LG DISPLAY Co., Ltd.
*MODEL	LD470DUN
SUFFIX	TFB1(RoHS Verified)

*When you obtain standard approval,
please use the above model name without suffix

APPROVED BY	SIGNATURE DATE
/	
/	
/	

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

APPROVED BY	SIGNATURE DATE
/ Team Leader	
REVIEWED BY	
/Project Leader	
PREPARED BY	
/ Engineer	

PD Product Design Dept.
LG Display Co., Ltd

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RECORD OF REVISIONS

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0.1	Feb 04,2013	-	Preliminary Specification (First Draft)
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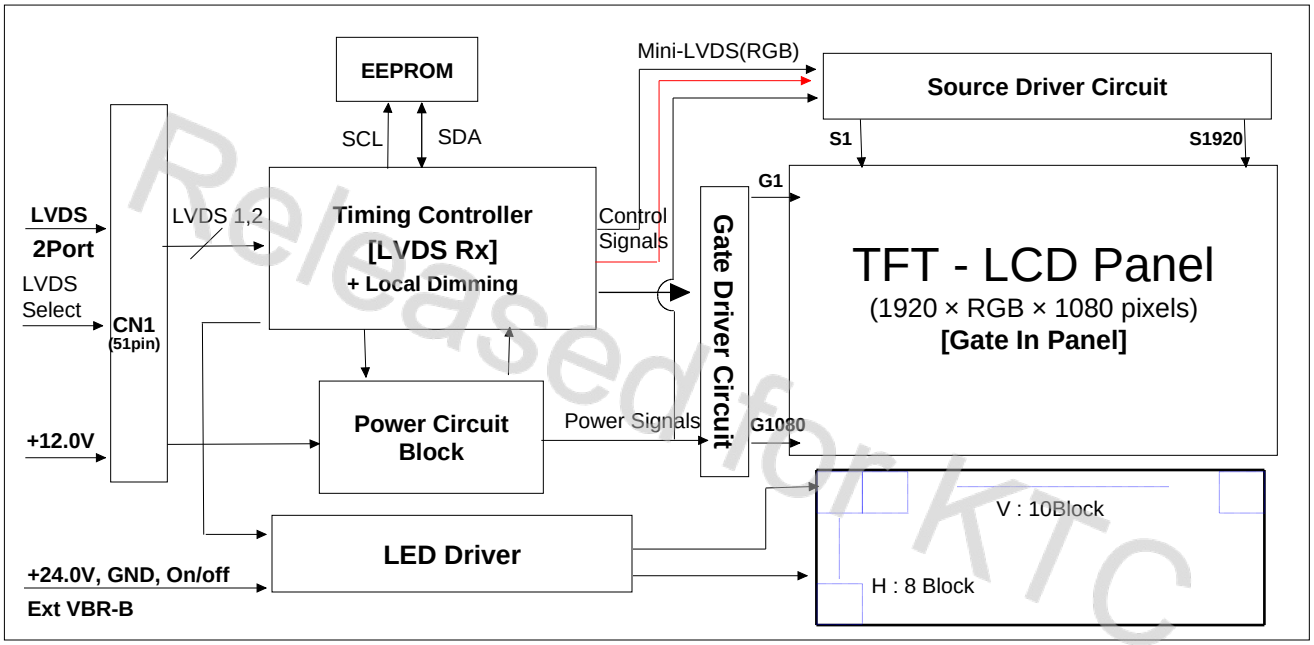
1. General Description

The LD470DUN is a Color Active Matrix Liquid Crystal Display with an integral Light Emitting Diode (LED) Local Block 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 54.64 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 than1.06Bilion 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 colorgamut, high color depth and fast response time are important.



General Features

Active Screen Size	46.96 inches(1192.87mm) diagonal
Outline Dimension	1044.9(H) x 590.0(V) x 52.5mm(D) (Typ.)
Pixel Pitch	0.5415(H) X 0.5415(V)
Pixel Format	1920 horiz. by 1080 vert. Pixels, RGB stripe arrangement
Color Depth	10Bit (D), 1.06 Billion 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 88.9W (Typ.) [Logic=10.9 W, Backlight= 78W(@EXTVBR-B = 100%)
Weight	13,500 g (Typ.)
Display Mode	Transmissive mode, Normally black
Surface Treatment	Hard coating(3H), Anti-reflection treatment of the front polarizer (Reflectance〈 2%)
Possible Display Type	Landscape and Portrait Enabled

2. Absolute Maximum Ratings

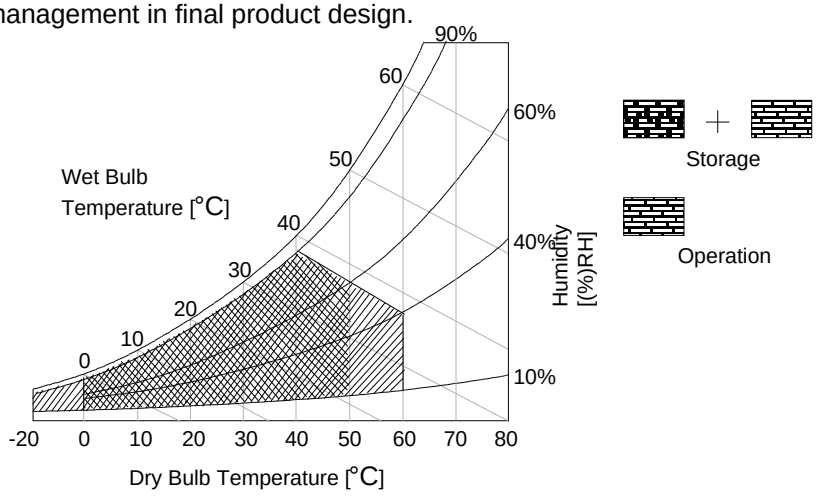
The following items are maximum values which, if exceeded, may cause faulty operation or permanent damage to the LCD module.

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Value		Unit	Note
			Min	Max		
Power Input Voltage	LCD Circuit	V_{LCD}	-0.3	+14.0	V_{DC}	1
	Driver	V_{BL}	-0.3	+ 27.0	V_{DC}	
Driver Control Voltage	ON/OFF	VON/OFF	-0.3	+3.9	V_{DC}	
	Brightness	EXTVBR-B	0.0	+3.9	V_{DC}	
	Status	Status	-0.3	+5.5	V_{DC}	
T-Con Option Selection Voltage		V_{LOGIC}	-0.3	+4.0	V_{DC}	
Operating Temperature		T_{OP}	0	+50	°C	2,3
Storage Temperature		T_{ST}	-20	+60	°C	
Panel Front Temperature		T_{SUR}	-	+68	°C	4
Operating Ambient Humidity		H_{OP}	10	90	%RH	2,3
Storage Humidity		H_{ST}	10	90	%RH	

Note.

1. 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 be degraded in case of improper thermal management in final product design.



3. Electrical Specifications

3-1. Electrical Characteristics

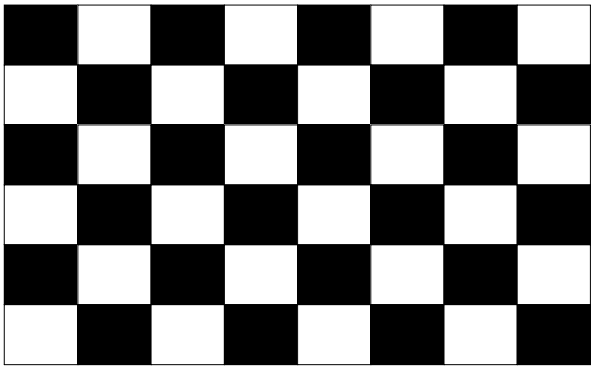
It requires two power inputs. One is employed to power for the LCD circuit. The other Is used for the LED backlight and LED Driver circuit.

Table 2. ELECTRICAL CHARACTERISTICS

Parameter	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}	-	914	1188	mA	1
		-	1201	1561	mA	2
Power Consumption	P_{LCD}	-	10.9	14.17	Watt	1
Rush current	I_{RUSH}	-	-	5	A	3

Notes: 1. The specified current and power consumption are under the V_{LCD}=12.0V, 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 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 ±5% of typical voltage

White : 1023Gray
Black : 0Gray



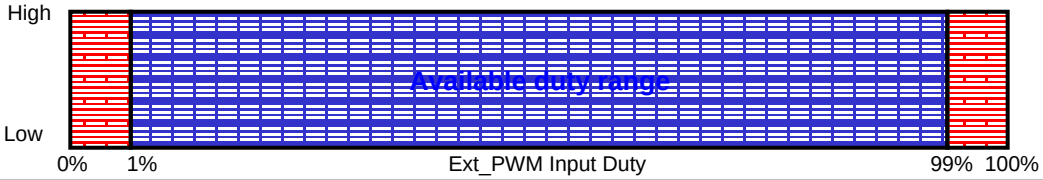
Mosaic Pattern(8 x 6)

Table 3. ELECTRICAL CHARACTERISTICS (Continue)

Parameter			Symbol	Values			Unit	Notes
				Min	Typ	Max		
LED Driver :								
Power Supply Input Voltage			VBL	22.8	24.0	25.2	Vdc	1
Power Supply Input Current			IBL	-	3.25	3.75	A	Ext V_{BR-B} = 100%
Power Supply Input Current (In-Rush)			Inrush	-	-	4.73	A	V_{BL} = 22.8V Ext V_{BR-B} = 100% 4
Power Consumption			PBL	-	78	90	W	Ext V_{BR-B} = 100%
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		ExtVBR-B	1	-	100	%	On Duty, 6
	PWM Frequency for NTSC & PAL		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	
	VSYNC, SIN, SCLK , Reverse (Local Dimming)		High Level	2.7	3.3	3.6	Vdc	
			Low Level	-0.3	0.0	0.4	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 V_{BR} (ExtV_{BR-B} : 100%), it is total power consumption.
2. The life time (MTTF) is determined as the time which luminance of the LED is 50% compared to that of initial value at the typical LED current (ExtVBR-B :100%) on condition of continuous operating in LCM state at 25±2°C.
3. LGD recommend that the PWM freq. is synchronized with Two times 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 $\int I^2 T$ spec of fuse is satisfied.
6. Ext_PWM Signal have to input available duty range.
   Between 99% and 100% ExtV_{BR-B} duty have to be avoided. (99% < ExtV_{BR-B} < 100%)
   But ExtV_{BR-B} 0% and 100% is possible.



3-2. Interface Connections

This LCD module employs two kinds of interface connection, a 51-pin connector is used for the module electronics and Master 14-pin and Slave 12-pin connectors are used for the integral backlight system.

3-2-1. LCD Module

- LCD Connector(CN1): FI-RE51S-HF or Equivalent, Refer to below table.
- Mating Connector : FI-RE51HL

Table 4. MODULE CONNECTOR(CN1) PIN CONFIGURATION

No	Symbol	Description	No	Symbol	Description
1	GND	Ground	27	Bit Select	'H' = 10bit(D) , 'L' = 8bit
2	NC	No Connection	28	RE0N	SECOND LVDS Receiver Signal (A-)
3	NC	No Connection	29	RE0P	SECOND LVDS Receiver Signal (A+)
4	NC	No Connection (Reserved for LGD)	30	RE1N	SECOND LVDS Receiver Signal (B-)
5	NC	No Connection (Reserved for LGD)	31	RE1P	SECOND LVDS Receiver Signal (B+)
6	NC	No Connection (Reserved for LGD)	32	RE2N	SECOND LVDS Receiver Signal (C-)
7	LVDS Select	'H' =JEIDA , 'L' = VESA	33	RE2P	SECOND LVDS Receiver Signal (C+)
8	NC	No Connection	34	GND	Ground
9	NC	No Connection	35	RECLKN	SECOND LVDS Receiver Clock Signal(-)
10	Local Dimming	'H' =Enable only	36	RECLKP	SECOND LVDS Receiver Clock Signal(+)
11	GND	Ground	37	GND	Ground
12	RO0N	FIRST LVDS Receiver Signal (A-)	38	RE3N	SECOND LVDS Receiver Signal (D-)
13	RO0P	FIRST LVDS Receiver Signal (A+)	39	RE3P	SECOND LVDS Receiver Signal (D+)
14	RO1N	FIRST LVDS Receiver Signal (B-)	40	RE4N	SECOND LVDS Receiver Signal (E-)
15	RO1P	FIRST LVDS Receiver Signal (B+)	41	RE4P	SECOND LVDS Receiver Signal (E+)
16	RO2N	FIRST LVDS Receiver Signal (C-)	42	NC	No Connection
17	RO2P	FIRST LVDS Receiver Signal (C+)	43	NC	No Connection
18	GND	Ground	44	NC	No Connection
19	ROCLKN	FIRST LVDS Receiver Clock Signal(-)	45	GND	Ground
20	ROCLKP	FIRST LVDS Receiver Clock Signal(+)	46	GND	Ground
21	GND	Ground	47	GND	Ground
22	RO3N	FIRST LVDS Receiver Signal (D-)	48	VLCD	Power Supply +12.0V
23	RO3P	FIRST LVDS Receiver Signal (D+)	49	VLCD	Power Supply +12.0V
24	RO4N	FIRST LVDS Receiver Signal (E-)	50	VLCD	Power Supply +12.0V
25	RO4P	FIRST LVDS Receiver Signal (E+)	51	VLCD	Power Supply +12.0V
26	NC	No Connection	-	-	-

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. Specific pins(pin No. **#2~#6**) are used for internal data process of the LCD module. These pins should be no connection.
5. It may be happened to Abnormal Display during the system interface signal is not
6. If Specific pin No. #7, #10, #27 is "NC", LCD Module may be happened to Abnormal Display

3-2-2. Backlight Module

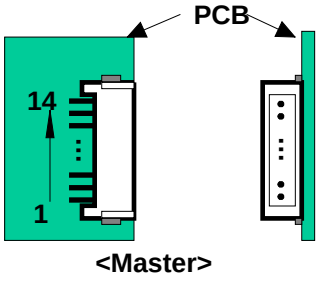
Master
-LED Driver Connector
: 20022WR-H14B2(Yeonho) / 20022WR-H12B2(Yeonho)
- Mating Connector
: 20022HS-14B2 / 20022HS-12B2

Table 5. LED DRIVER CONNECTOR PIN CONFIGULATION

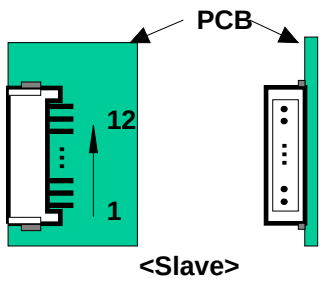
Pin No	Symbol	Description	14PIN	12PIN	Note
1	VBL	Power Supply +24.0V	VBL	VBL	
2	VBL	Power Supply +24.0V	VBL	VBL	
3	VBL	Power Supply +24.0V	VBL	VBL	
4	VBL	Power Supply +24.0V	VBL	VBL	
5	VBL	Power Supply +24.0V	VBL	VBL	
6	GND	Backlight Ground	GND	GND	
7	GND	Backlight Ground	GND	GND	
8	GND	Backlight Ground	GND	GND	1
9	GND	Backlight Ground	GND	GND	
10	GND	Backlight Ground	GND	GND	
11	Status	Status	Status	Don't Care	2
12	VON/OFF	Backlight ON/OFF control	VON/OFF	Don't Care	
13	EXTVBR-B	External PWM	EXTVBR-B	-	3
14	GND	Backlight Ground	GND	-	1

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 #13 is over 50 [KΩ] .

◆ **Rear view of LCM**

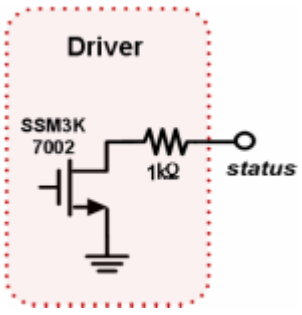


<Master>



<Slave>

◆ 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 6-1. 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	

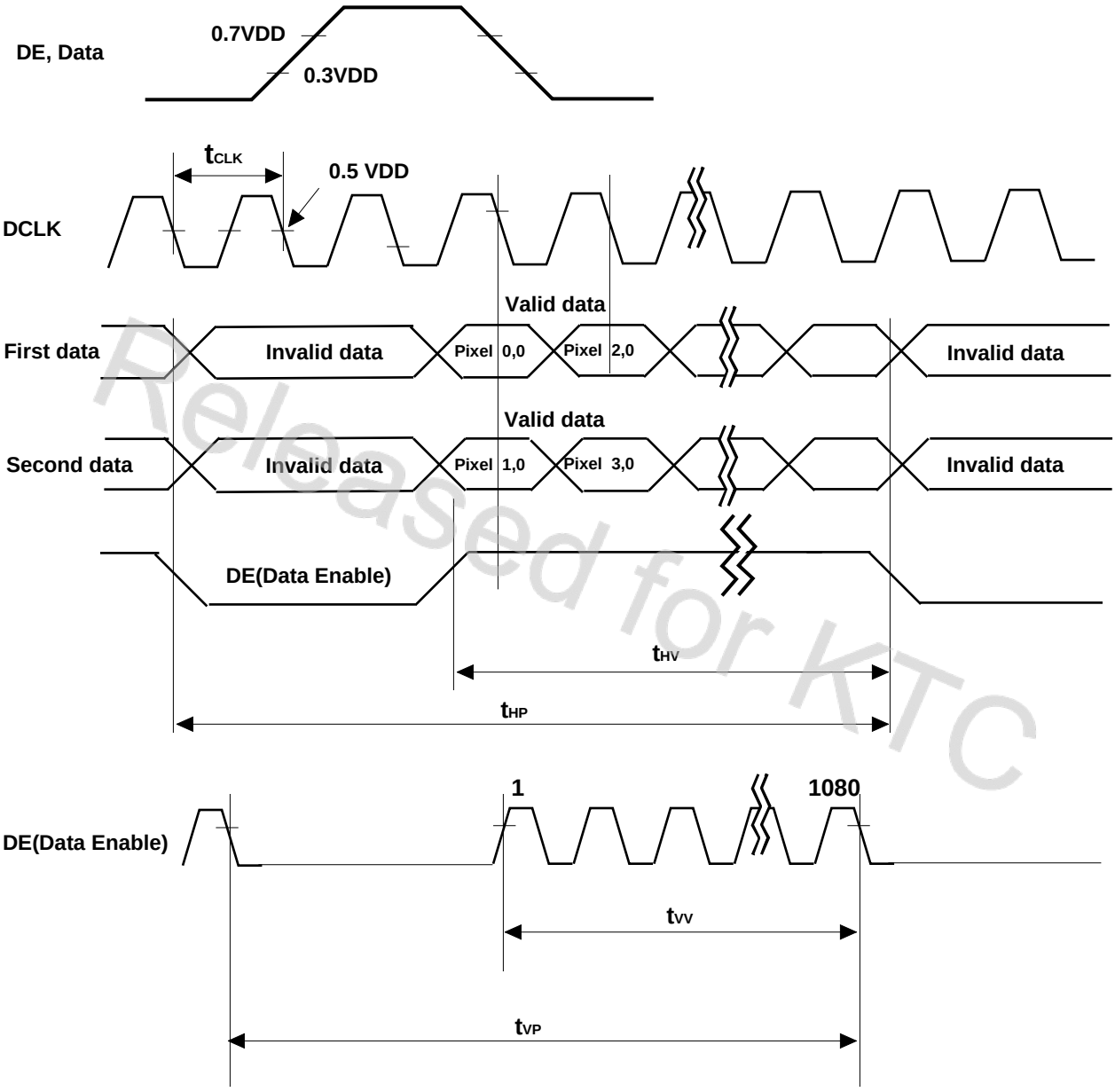
Table 6-2. TIMING TABLE for PAL (DE Only Mode)

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.

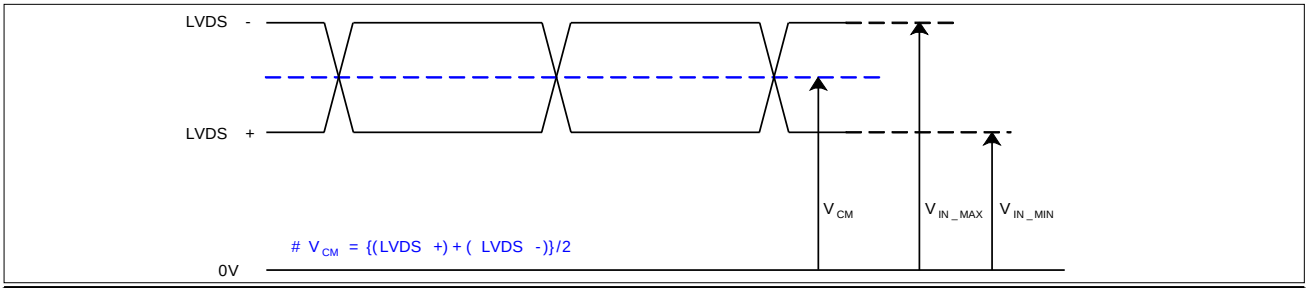
3-4. LVDS Signal Specification

3-4-1. LVDS Input Signal Timing Diagram



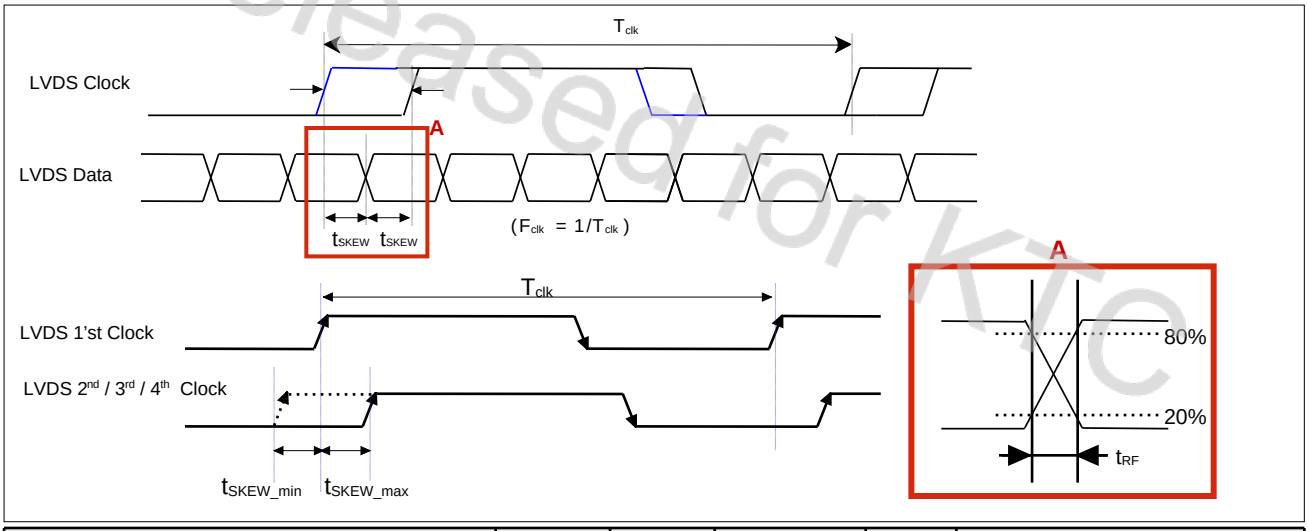
3-4-2. LVDS Input Signal Characteristics

1) DC Specification



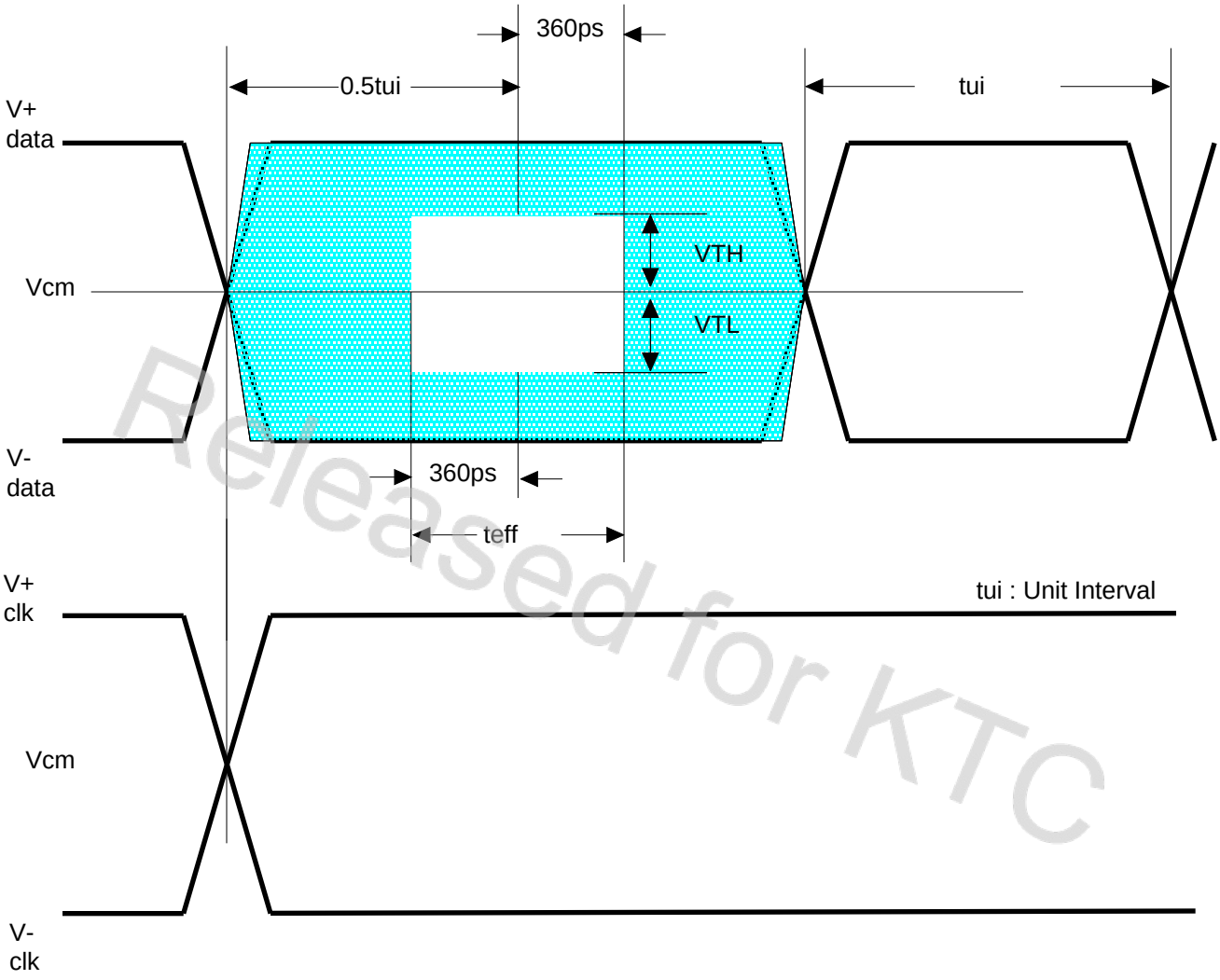
Description	Symbol	Min	Max	Unit	Note
LVDS Common mode Voltage	V_{CM}	1.0	1.5	V	-
LVDS Input Voltage Range	V_{IN}	0.7	1.8	V	-
Change in common mode Voltage	ΔVCM		250	mV	-

2) AC Specification



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}		$\lvert(0.25*T_{clk})/7\rvert$	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}



3-5. Color Data Reference

The brightness of each primary color(red,green,blue) is based on the 10-bit gray scale data input for the color. The higher binary input, the brighter the color. Table 8 provides a reference for color versus data input.

Table 8. COLOR DATA REFERENCE

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

3-6. Power Sequence

3-6-1. LCD Driving circuit

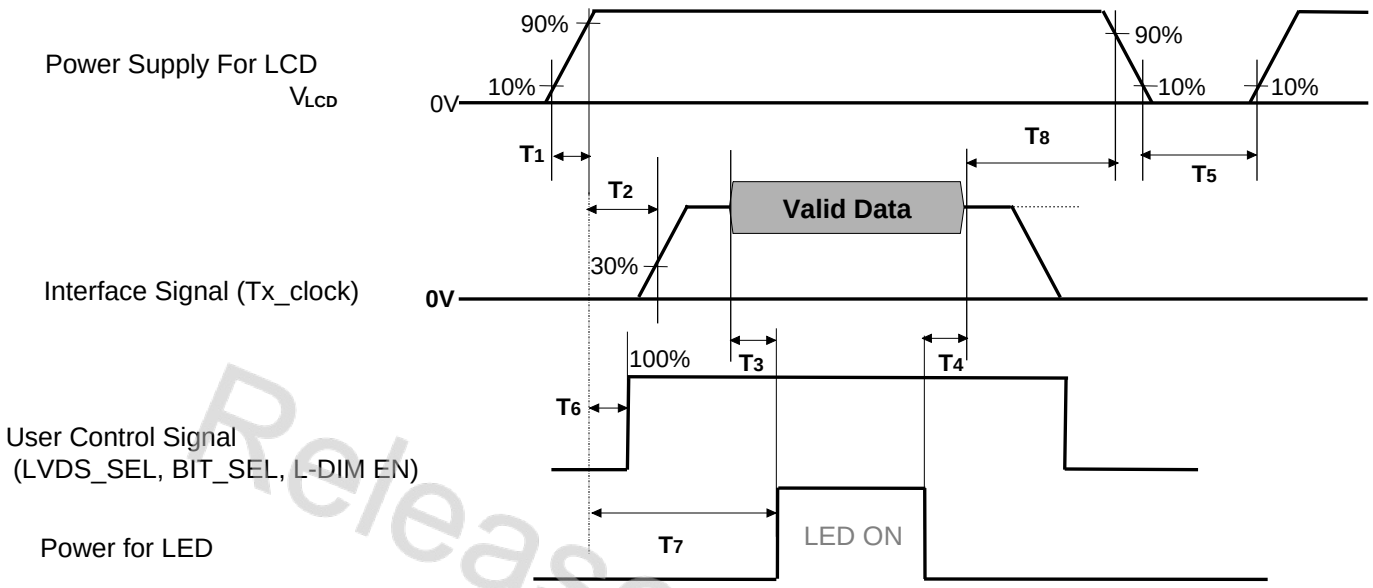


Table 8. POWER SEQUENCE

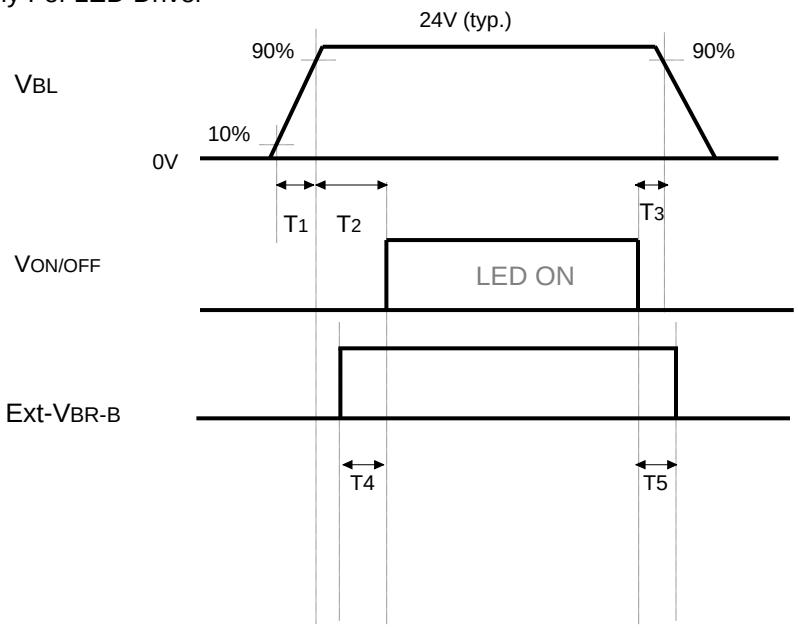
Parameter	Value			Unit	notes
	Min	Typ	Max		
T1	0.5	-	20	ms	1
T2	0	-	400	ms	2
T3	200	-	-	ms	3
T4	200	-	-	ms	3
T5	1.0	-	-	s	4
T6	-	-	T2	ms	5
T7	0.5	-	-	s	6
T8	100	-	-	ms	7

notes :
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. If there is no abnormal display, no problem.
7. It is recommendation specification that T8 has to be 100ms 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 Inverter

Power Supply For LED Driver



3-6-3. Deep condition for Inverter

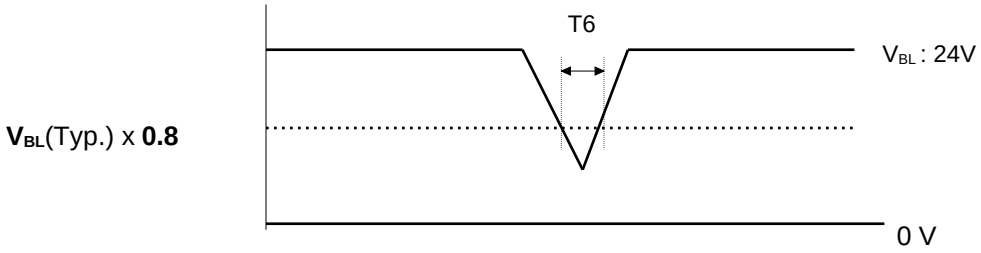


Table 9. Power Sequence for LED DRIVER

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

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

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 specified are at an approximate distance 50cm from the LCD surface at a viewing angle of and equal to 0 °.
FIG. 1 shows additional information concerning the measurement equipment and method.

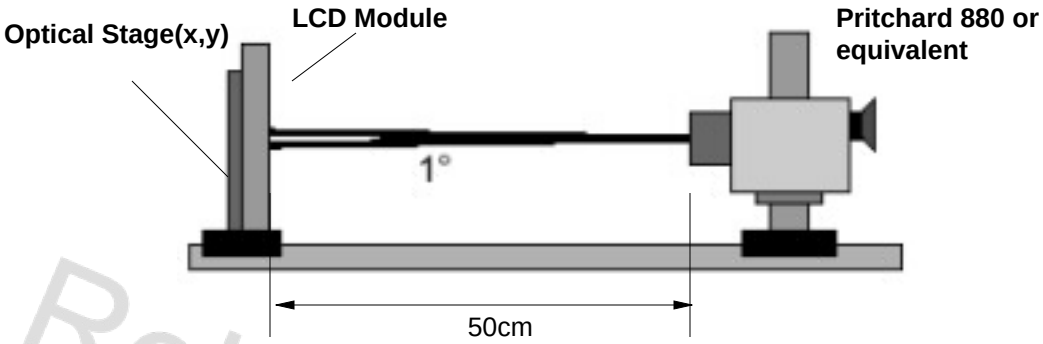


FIG. 1 Optical Characteristic Measurement Equipment and Method

Table 11. OPTICAL CHARACTERISTICS

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

Parameter		Symbol	Value			Unit	Note
			Min	Typ	Max		
Contrast Ratio		CR	1000	1400	-		1
Surface Luminance, white		L_{WH}	400	500	-	cd/m^2	2
Luminance Variation		$_{WHITE}$ 9P	70	80			3
Response Time	Gray-to-Gray	G to G	-	12	15	ms	4
Color Coordinates [CIE1931]	RED	Rx	Typ -0.03	0.649	Typ +0.03		
		Ry		0.333			
	GREEN	Gx		0.308			
		Gy		0.590			
	BLUE	Bx		0.153			
		By		0.064			
	WHITE	Wx		0.279			
		Wy		0.292			
Color Temperature				10,000		K	
Color Gamut				68		%	
Viewing Angle (CR>10)							
	x axis, right(=0°)	r	89	-	-	degree	5
	x axis, left (=180°)	l	89	-	-		
	y axis, up (=90°)	u	89	-	-		
	y axis, down (=270°)	d	89	-	-		
Gray Scale			-	-	-		6

Notes :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, see FIG 2.

2. Surface luminance are determined after the unit has been 'ON and 60min after lighting the backlight in a dark environment at 25±2°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 , WHITE is defined as :

WHITE(9P) = Minimum(Lon1,Lon2, Lon3,…, Lon8, Lon9) / Maximum(Lon1,Lon2, Lon3,…, Lon8, Lon9)*100(%)

Where Lon1 to Lon9 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 transition 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 is average of measured time (N, M = 0 (Black) ~ 1023(White), 128 gray step).

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.

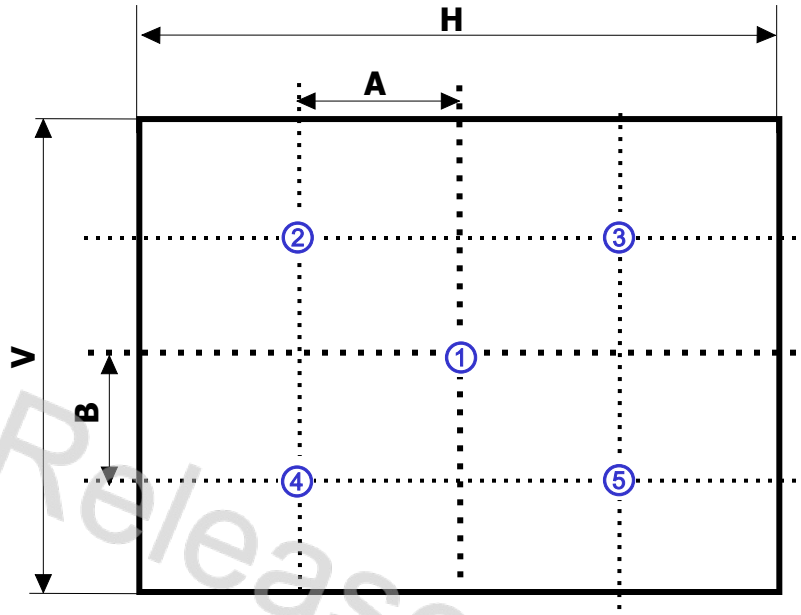
6. Gray scale specification

Gamma Value is approximately 2.2. For more information, see the Table 12.

Table 12. GRAY SCALE SPECIFICATION

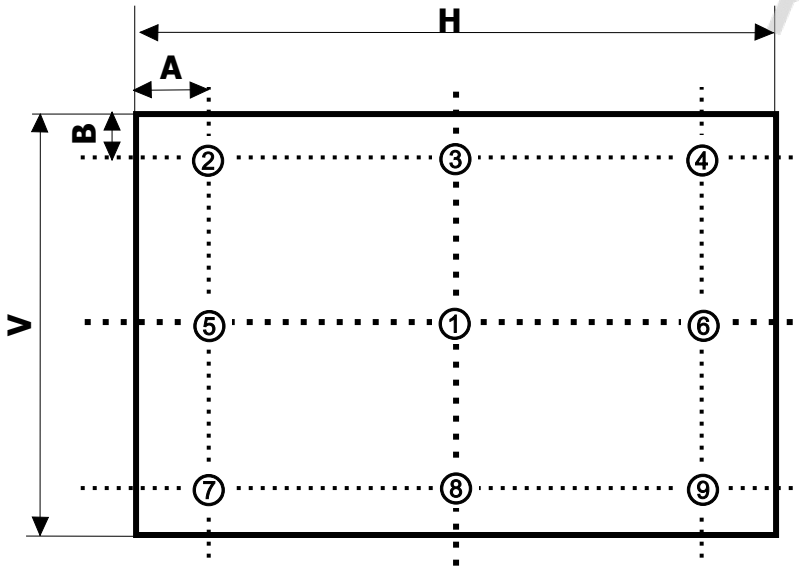
Gray Level	Luminance [%] (Typ.)
L0	0.07
L63	0.27
L127	1.04
L191	2.49
L255	4.68
L319	7.66
L383	11.5
L447	16.1
L511	21.6
L575	28.1
L639	35.4
L703	43.7
L767	53.0
L831	63.2
L895	74.5
L959	86.7
L1023	100

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



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

FIG. 2 5 Points for CR Measure



A : H / 9 mm
B : V / 9 mm
@ H,V : Active Area

FIG. 3 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)".

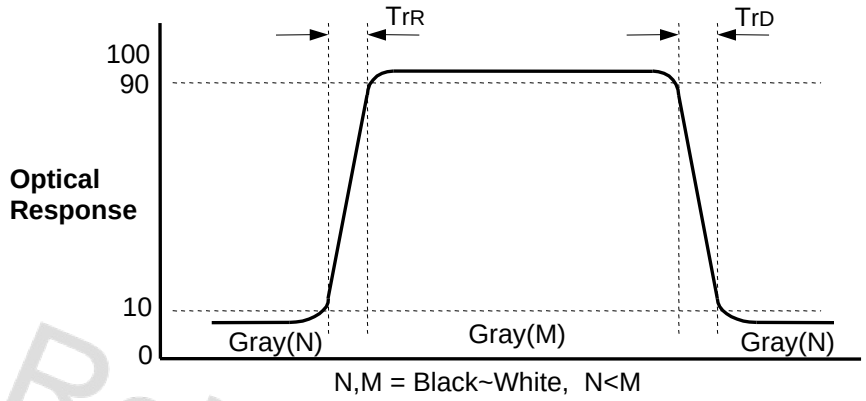


FIG. 4 Response Time

Dimension of viewing angle range

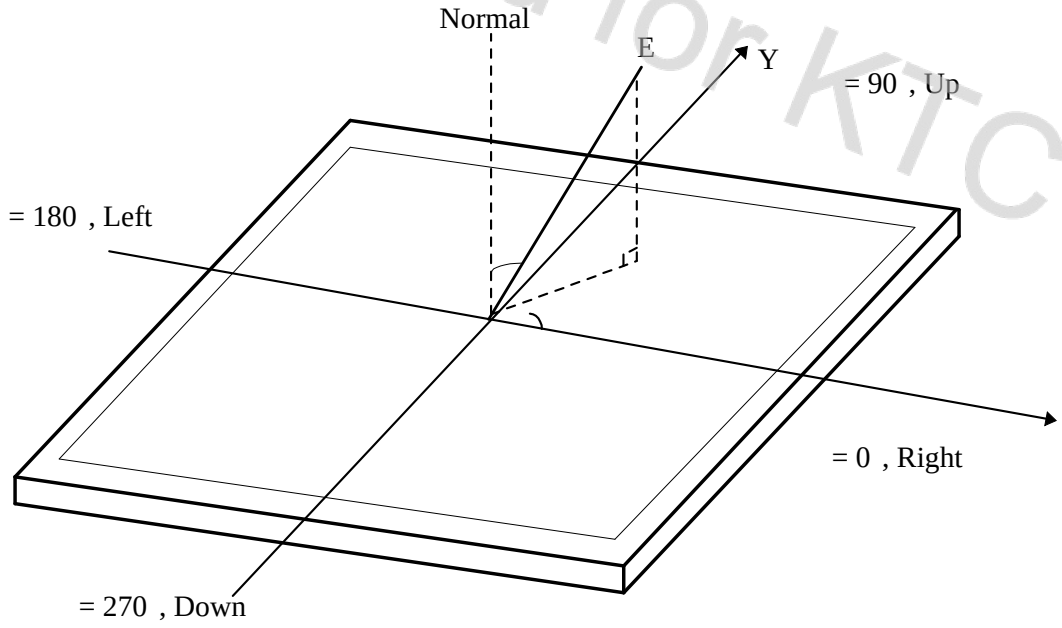


FIG. 5 Viewing Angle

5. Mechanical Characteristics

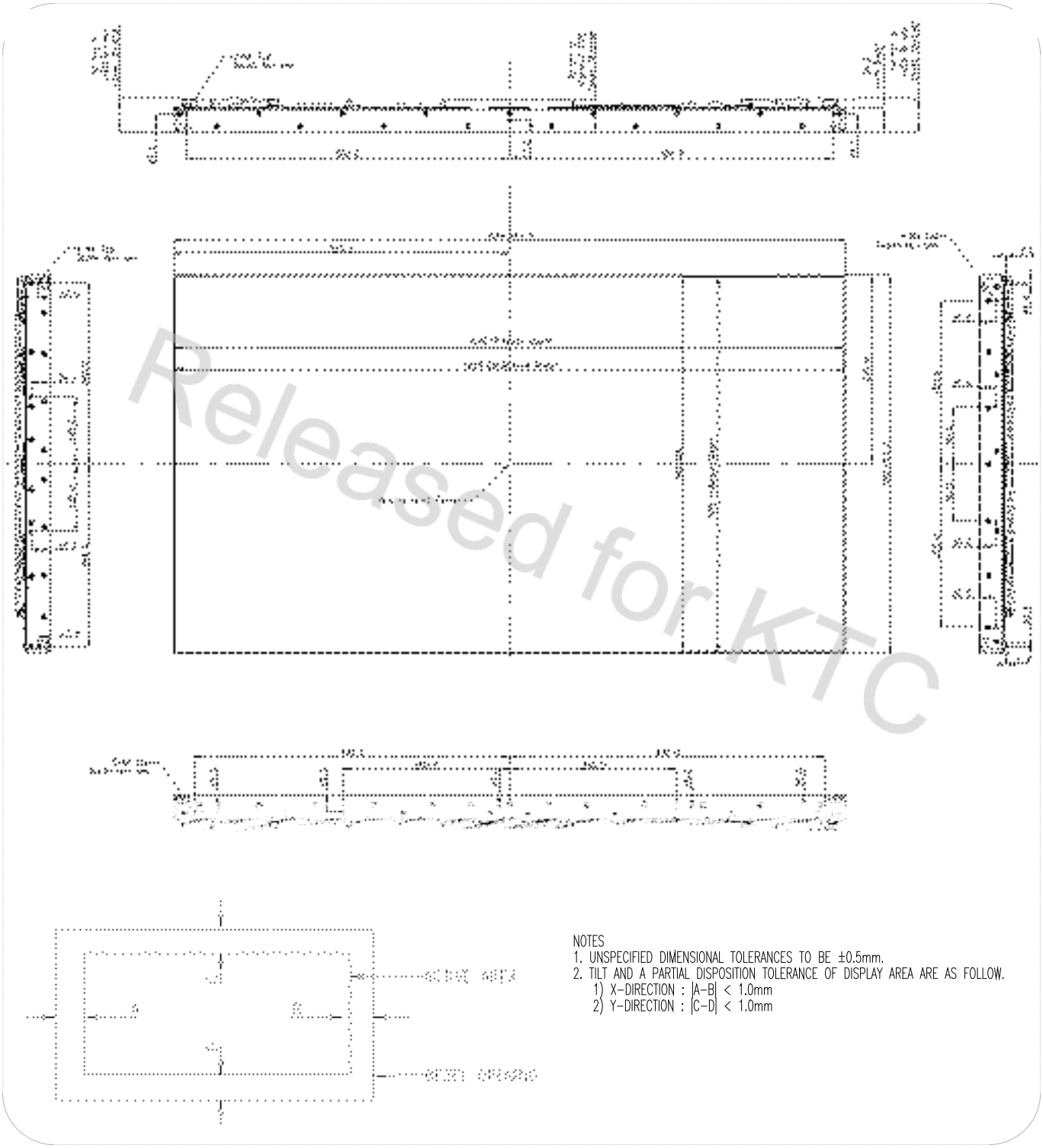
Table 13 provides general mechanical characteristics.

Table 13. MECHANICAL CHARACTERISTICS

Item	Value	
Outline Dimension	Horizontal	1044.9 mm
	Vertical	590.0 mm
	Depth	52.5 mm
Bezel Area	Horizontal	1040.0mm
	Vertical	585.1 mm
Active Display Area	Horizontal	1039.68 mm
	Vertical	584.82 mm
Weight	13,500 g (Typ.) , 14,500 g (Max.)	

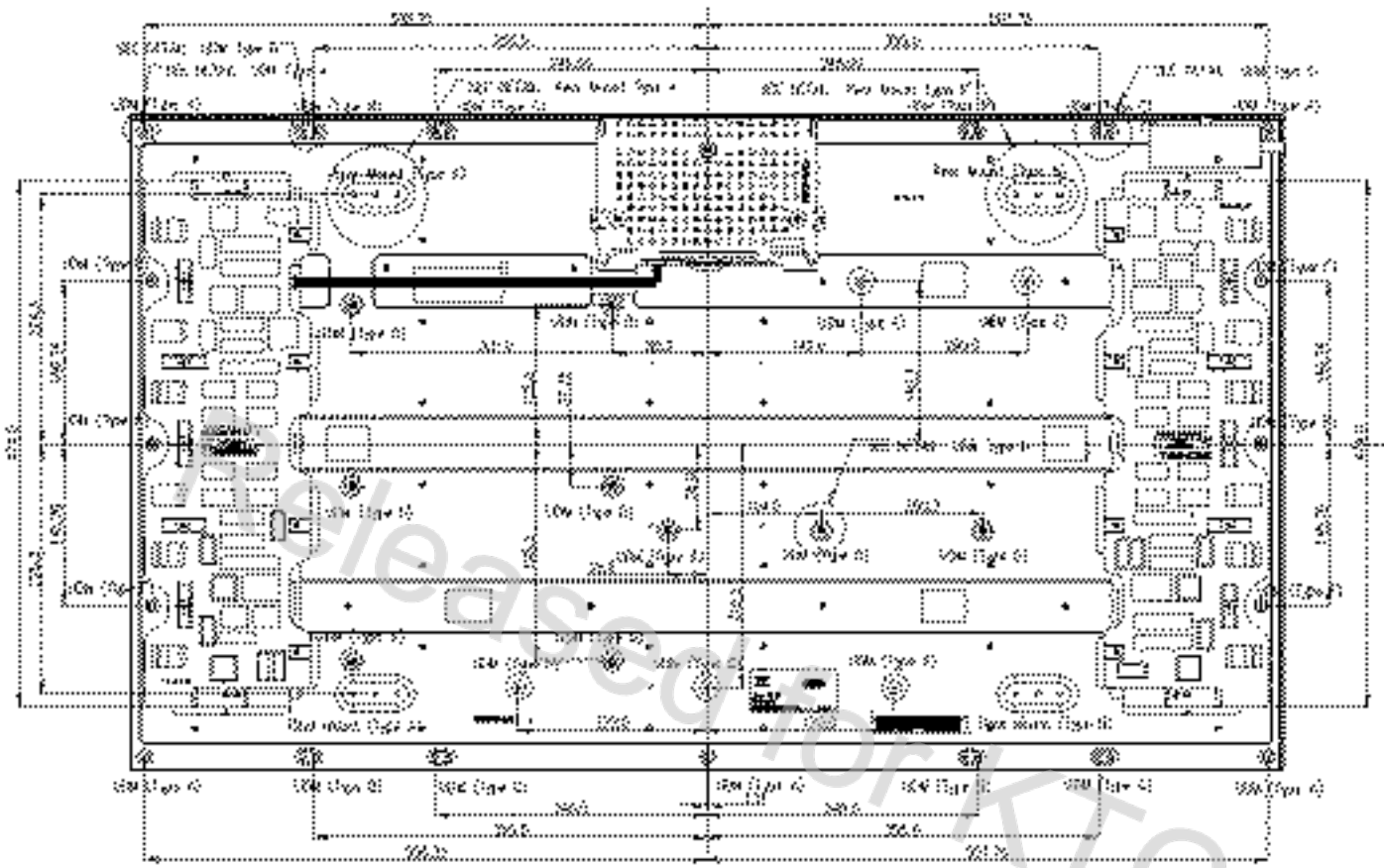
Note : Please refer to a mechanic drawing in terms of tolerance at the next page.

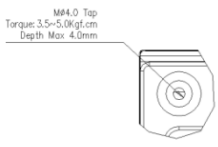
[FRONT VIEW]



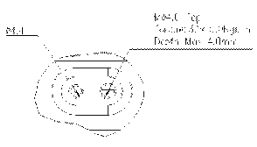
NOTES
1. UNSPECIFIED DIMENSIONAL TOLERANCES TO BE ±0.5mm.
2. TILT AND A PARTIAL DISPOSITION TOLERANCE OF DISPLAY AREA ARE AS FOLLOW.
   1) X-DIRECTION : |A-B| < 1.0mm
   2) Y-DIRECTION : |C-D| < 1.0mm

<REAR VIEW>

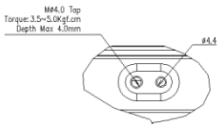




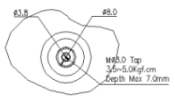
DETAIL UDM Type A
SCALE 1/1



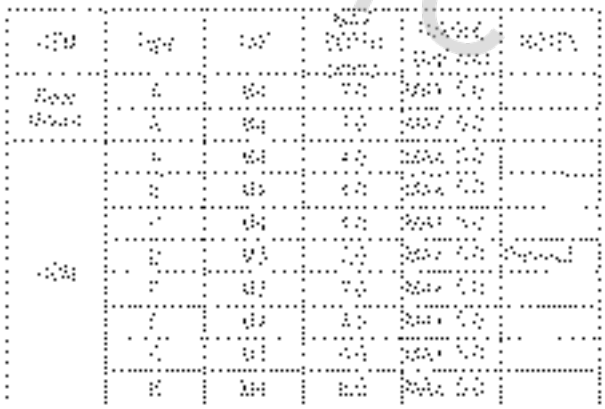
DETAIL UDM Type B
SCALE 1/1

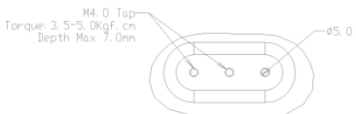


DETAIL UDM Type C
SCALE 1/1



DETAIL UDM Type D
SCALE 1/1





DETAIL Rear Mount Type A
SCALE 1/2

DETAIL Rear Mount Type B
SCALE 1/2

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 : 0.5 Grms Bandwidth : 10-300Hz Duration : X,Y,Z, 10min One LCM one direction
6	Shock test (non-operating)	Shock level : 10 Grms Waveform : half sine wave, 15ms 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 60950-1, Underwriters Laboratories Inc.
Information Technology Equipment - Safety - Part 1 : General Requirements.

b) CAN/CSA C22.2 No.60950-1-07, Canadian Standards Association.
Information Technology Equipment - Safety - Part 1 : General Requirements.

c) EN 60950-1, European Committee for Electrotechnical Standardization (CENELEC).
Information Technology Equipment - Safety - Part 1 : General Requirements.

d) IEC 60950-1, The International Electrotechnical Commission (IEC).
Information Technology Equipment - Safety - Part 1 : General 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

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 box : 10 pcs

b) Pallet Ass'y Size : 1440mm(W) X 1140mm(D) X 950mm(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) is not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
(3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to the resist external force.
(4) You should adopt radiation structure to satisfy the temperature specification.
(5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
(6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment.
Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics are detrimental to the polarizer.)
(7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzine. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
(8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
(9) Do not open the case because inside circuits do not have sufficient strength.

9-2. Operating Precautions

(1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage : V=±200mV(Over and under shoot voltage)
(2) Response time depends on the temperature.(In lower temperature, it becomes longer.)
(3) Brightness depends on the temperature. (In lower temperature, it becomes lower.) And in lower temperature, response time(required time that brightness is stable after turned on) becomes longer
(4) Be careful for condensation at sudden temperature change.Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
(5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
(6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference.
(7) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can't be operated its full characteristics perfectly.
(8) A screw which is fastened up the steels should be a machine screw.
(if not, it can causes conductive particles and deal LCM a fatal blow)
(9) Please do not set LCD on its edge.
(10) The conductive material and signal cables are kept away from LED driver inductor to prevent abnormal display, sound noise and temperature rising.

9-3. Electrostatic Discharge Control

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

9-4. Precautions for Strong Light Exposure

Strong light exposure causes degradation of polarizer and color filter.

9-5. Storage

When storing modules as spares for a long time, the following precautions are necessary.

(1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
(2) The polarizer surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they were shipped.

9-6. Handling Precautions for Protection Film

(1) The protection film is attached to the bezel with a small masking tape.
When the protection film is peeled off, static electricity is generated between the film and polarizer.
This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
(2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the bezel after the protection film is peeled off.
(3) You can remove the glue easily. When the glue remains on the bezel surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

9-7. Appropriate Condition for Public Display

- Generally large-sized LCD modules are designed for consumer applications (TV).
Accordingly, a long-term display like in Public Display (PD) 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.

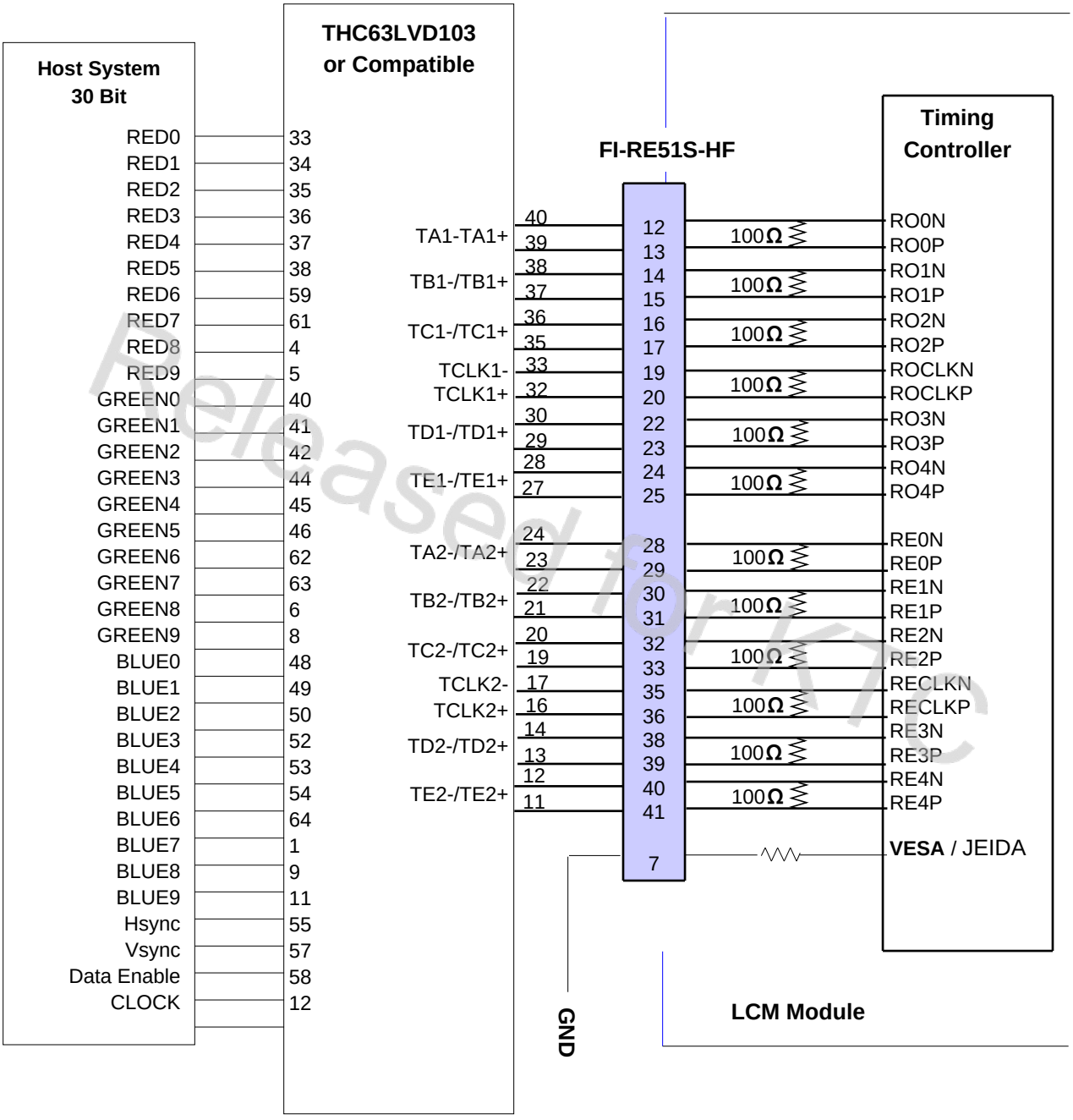
2. Operating usages under abnormal condition
a. Ambient condition
- Well-ventilated place is recommended to set up PD system.
b. Power and screen save
- Periodical power-off or screen save is needed after long-term display.

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 PD is used according to operating usages.
5. Module should be turned clockwise based on front view when used in portrait mode.

APPENDIX-I-1

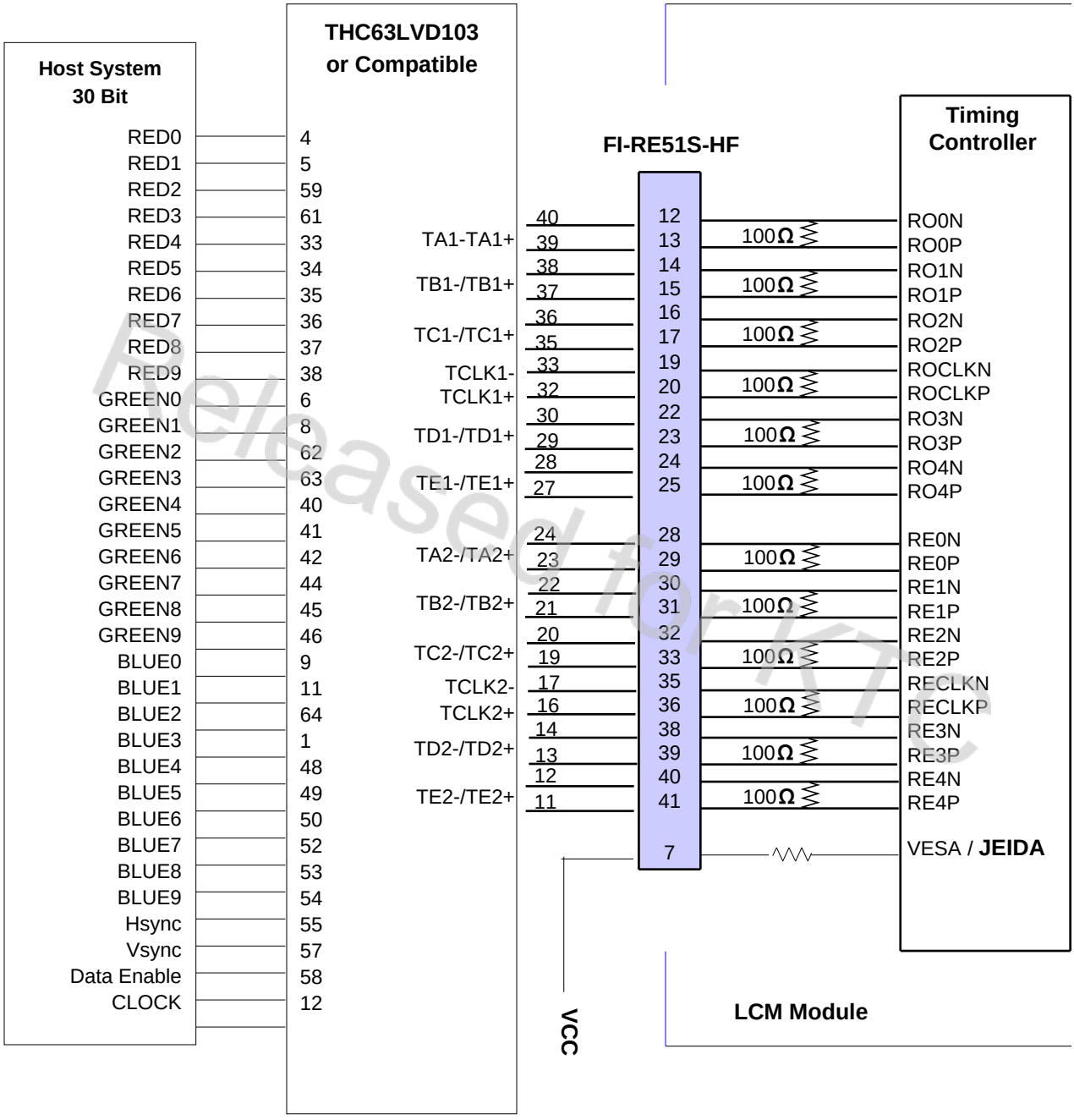
■Required signal assignment for Flat Link (Thine : THC63LVD103) Transmitter(Pin7="L or NC")



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-I-2

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

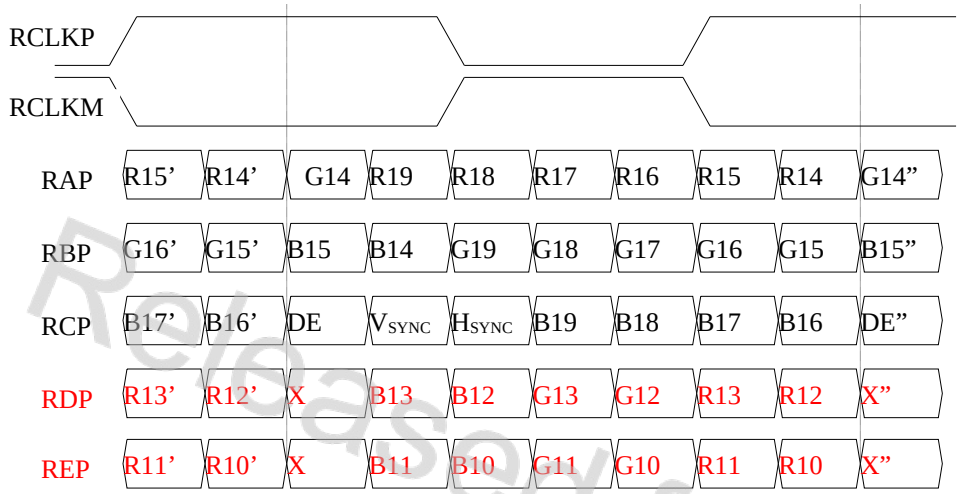


Note :1. The LCD module uses a 100 Ohm[Ω] resistor between positive and negative lines of each receiver input.
2. Refer to LVDS Transmitter Data Sheet for detail descriptions. (THC63LVD103 or Compatible)
3. '9' means MSB and '0' means LSB at R,G,B pixel data.

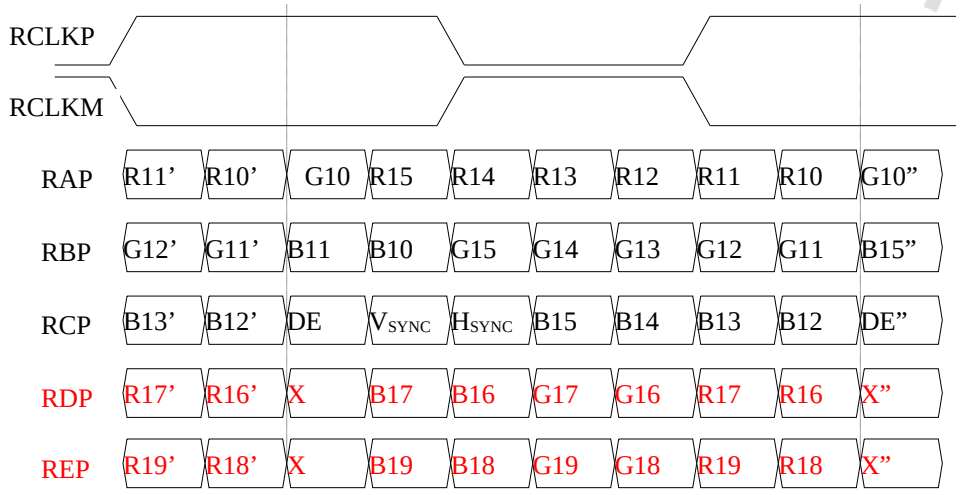
 # APPENDIX- II

LVDS Data-Mapping info. (10bit)

■ LVDS Select : “H” Data-Mapping (JEIDA format)

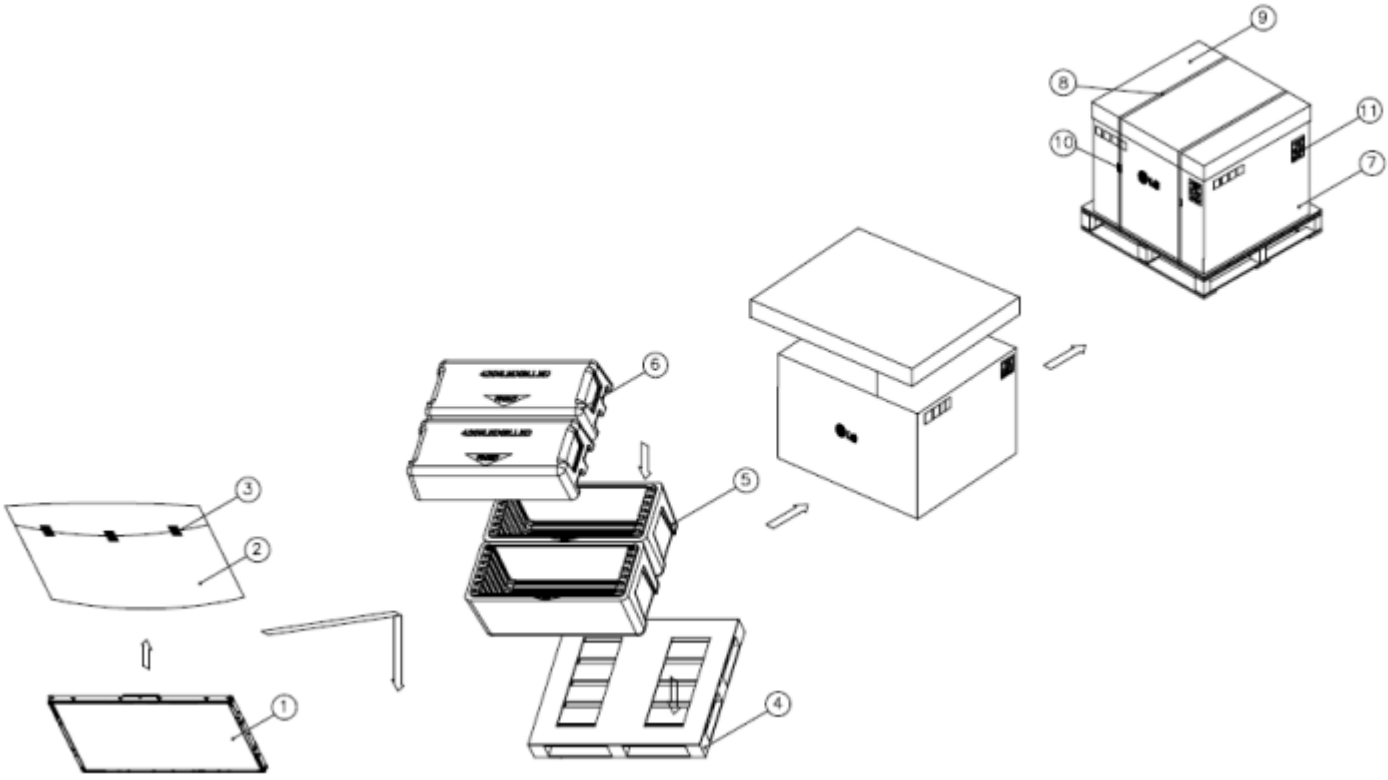


■ LVDS Select : “L” Data-Mapping (VESA format)



APPENDIX-III

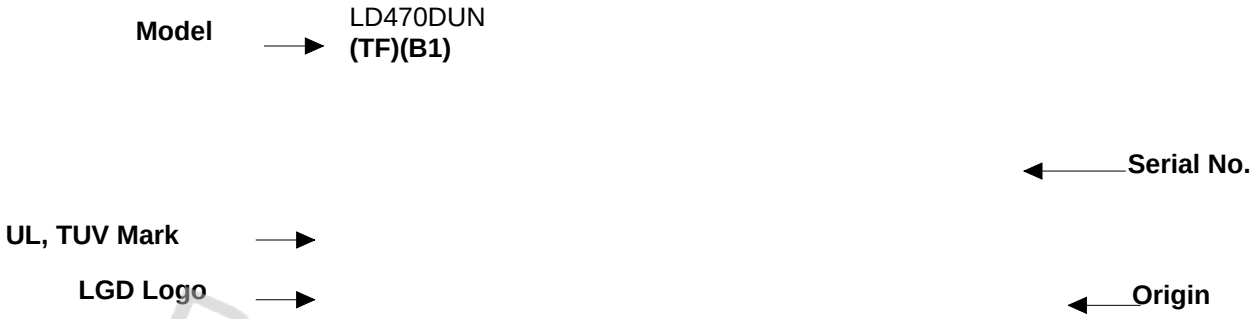
■Pallet Ass'y



NO.	DESCRIPTION	MATERIAL
1	LCD Module	
2	BAG	AL
3	TAPE	MASKING 20mmX50mm
4	PALLET	Plywood 1440X1140X120mm
5	PACKING,BOTTOM	EPS
6	PACKING,TOP	EPS
7	ANGLE,PACKING	PAPER
8	BAND	PP
9	ANGLE,COVER	PAPER
10	BAND,CLIP	STEEL or PP
11	LABEL, PALLET	YUPO 80G 100mmX70mm

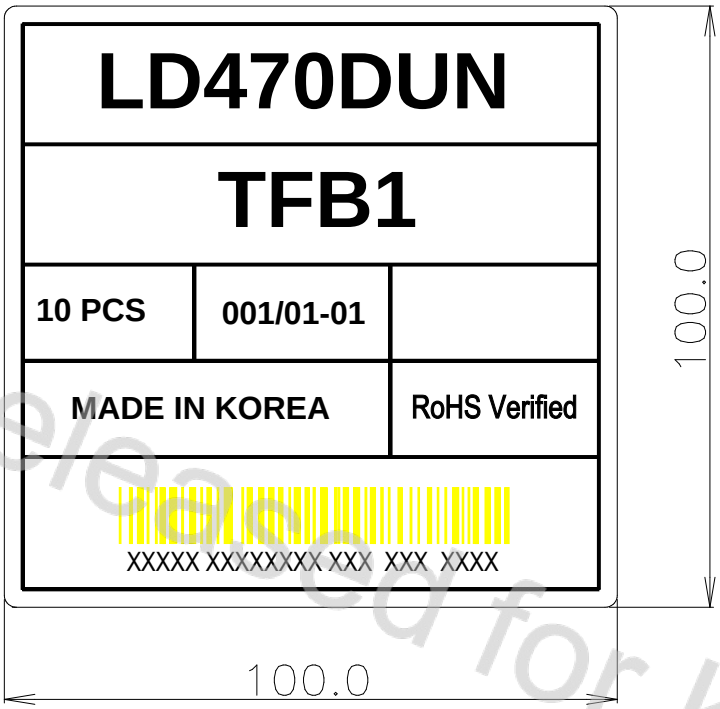
APPENDIX-IV

■LCM Label



APPENDIX- V

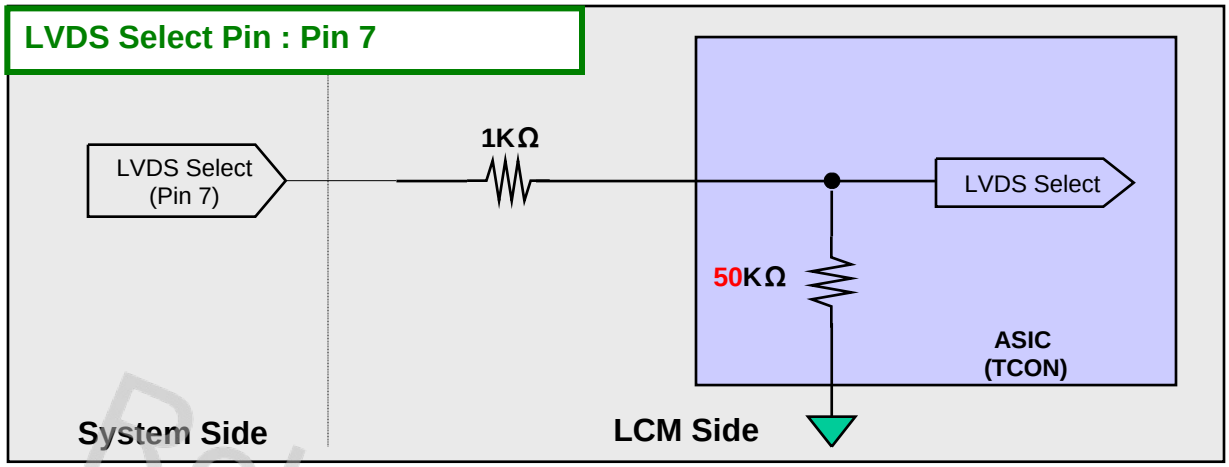
■Pallet Label



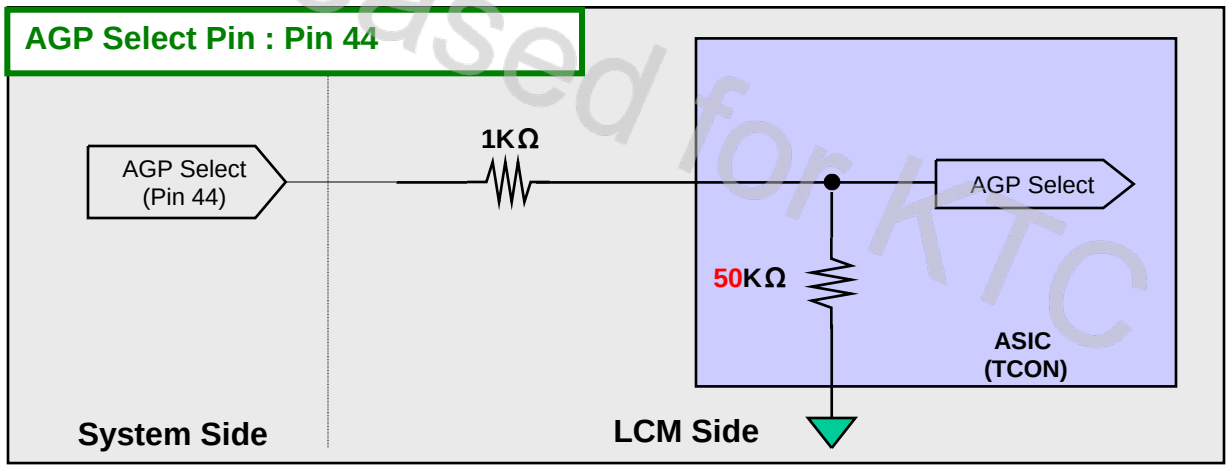
APPENDIX- VI

■Option Pin Circuit Block Diagram

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



2) Circuit Block Diagram of **AGP Option** Selection pin



APPENDIX- Ⅶ

■EXTVBR-B & Local Dimming Design Guide

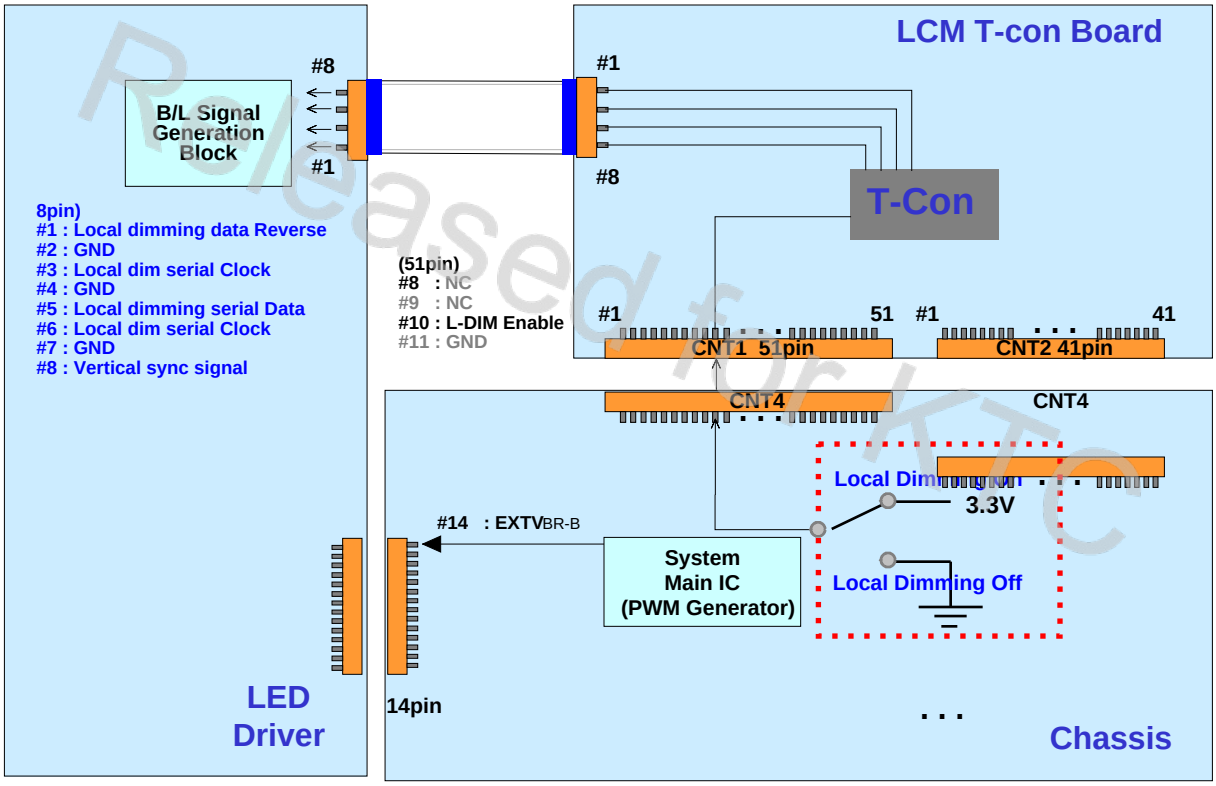
1) When L-Dim Enable is "L", Vertical Sync Signal = System Dimming with 100Hz or 120Hz frequency.

2) Local Dimming signals are synchronized with V-Sync Freq. of System in T-Con Board.

3) EXTVBR-B Specification (VCC = 3.3V) @ Local Dimming

a) High Voltage Range : 2.5 V ~ 3.6 V

b) Low Voltage Range : 0.0 V ~ 0.8 V



<With Driver Model>

EXTVBR-B Frequency	100 Hz for PAL 120 Hz for NTSC
Rising Time	MAX 10.0 μs
Falling Time	MAX 10.0 μs