LG Display

LC215WUE
Liquid Crystal Display

Product Specification

SPECIFICATION
FOR
APPROVAL

( ) Preliminary Specification
(●) Final Specification

Title	21.5" Full HD TFT LCD

BUYER	General
MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LC215WUE
SUFFIX	TBA1(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
H.S. SONG / Team Leader	
REVIEWED BY	
S.S. KIM / Project Leader	
PREPARED BY	
Y.J. KIM / Engineer	

TV Products Development Dept.
LG Display Co., Ltd

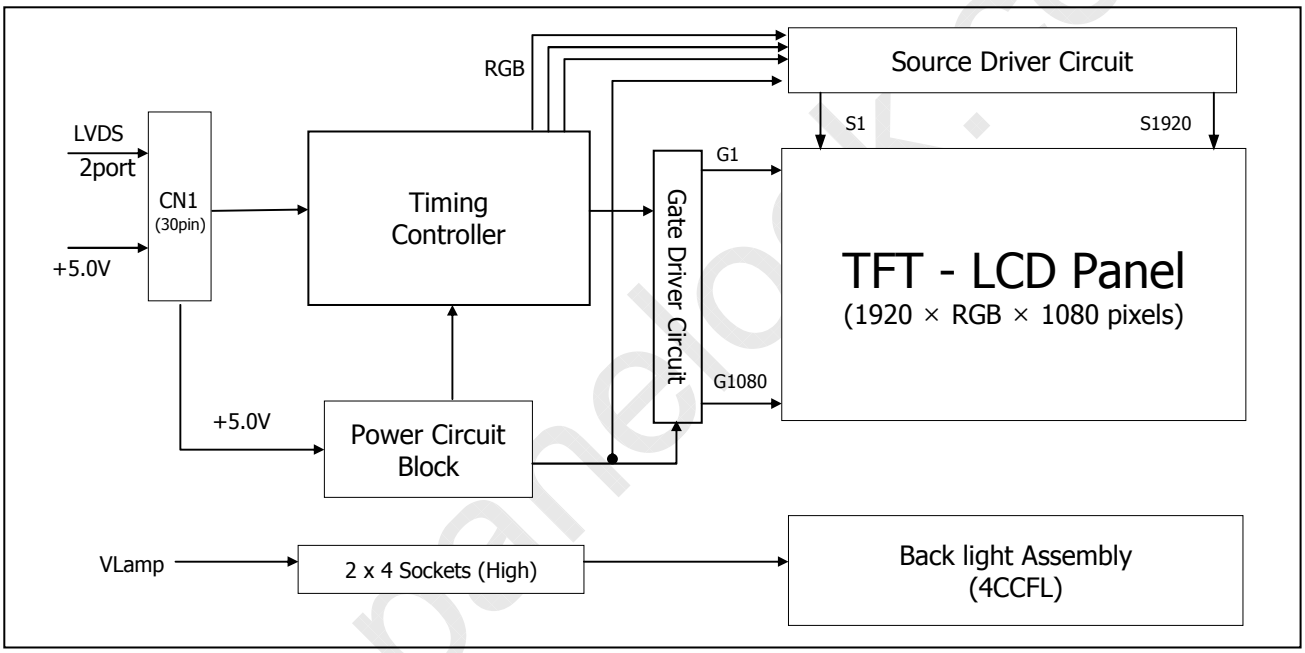
Contents

RECORD OF REVISIONS

Revision No	Revision Date	Page	Description
0.1	OCT. 14, 2008	-	First Draft(Preliminary)
1.0	Apr. 22, 2009	-	Final Draft

1. General Description

LC215WUE is a Color Active Matrix Liquid Crystal Display with an integral Cold Cathode Fluorescent Lamp(CCFL) backlight system. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally white mode. It has a 21.5inch diagonally measured active display area with Full HD resolution (1080 vertical by 1920 horizontal pixel array) Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 8-bit gray scale signal for each dot, thus, presenting a palette of more than 16,7M(True) colors.
It has been designed to apply the 8Bit 2 port LVDS interface.
It is intended to support displays where high brightness, super wide viewing angle, high color saturation, and high color are important.



[Figure 1] Block diagram

General Features

Active Screen Size	21.53 inches(546.86mm) diagonal
Outline Dimension	495.6(H) x 292.2(V) x 16.5(D) mm (Typ.)
Pixel Pitch	82.75㎛ x 248.25㎛
Pixel Format	1920 horiz. By 1080 vert. Pixels RGB stripes arrangement
Color Depth	8-bit(D), 16.7 M colors
Luminance, White	400 cd/m^2 (Center 1 points)
Viewing Angle(CR>10)	View Angle Free (R/L 170(Typ.), U/D 160(Typ.))
Power Consumption	Total 28.5W(typ)/logic(4.5W), Inverter(24W) @ lamp current 7.5㎃
Weight	2100g (typ.)
Display Operating Mode	Transmissive mode, normally white
Surface Treatment	Hard coating(3H), Anti-glare treatment of the front polarizer

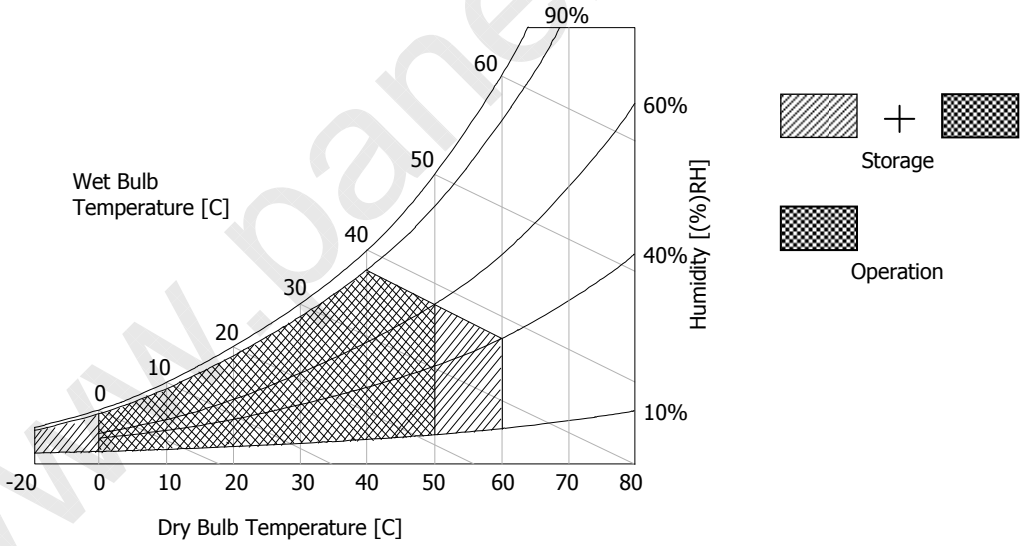
2. Absolute Maximum Ratings

The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Values		Units	Notes
		Min	Max		
Power Input Voltage	VLCD	-0.3	+6.0	Vdc	at 25 ± 2°C
Operating Temperature	TOP	0	+50	°C	Note 1
Storage Temperature	TST	-20	+60	°C	
Operating Ambient Humidity	HOP	10	90	%RH	
Storage Humidity	HST	10	90	%RH	

Note : 1. Temperature and relative humidity range are shown in the figure below.
Wet bulb temperature should be Max. 39 °C and no condensation of water.
2. Gravity mura can be guaranteed below 40℃ condition.



3. Electrical Specifications

3-1. Electrical Characteristics

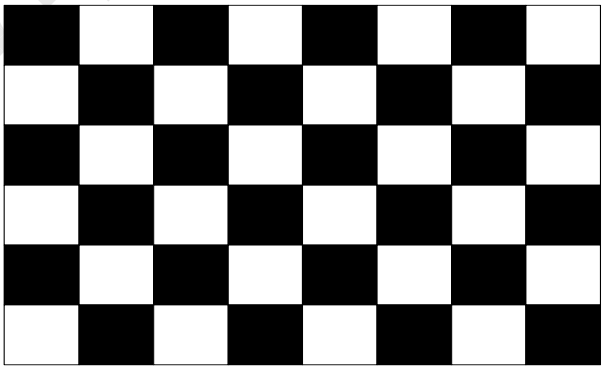
It requires two power inputs. One is employed to power for the LCD circuit. The other is used for the CCFL backlight circuit.

Table 2. ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Value			Unit	Note
		Min	Typ	Max		
MODULE :						
Power Input Voltage	VLCD	4.5	5.0	5.5	VDC	
Power Input Current	ILCD	-	700	805	mA	1
		-	900	1035	mA	2
Power Consumption	PLCD	-	3.5	4.03	Watt	1
Rush current	IRUSH	-	-	3.0	A	3

Note :
1. The specified current and power consumption are under the V_{LCD}=5.0V, 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 the maximum current pattern.
3. The duration of rush current is about 2ms and rising time of power Input is 0.5ms(min.).

White : 255 Gray
Black : 0 Gray



Mosaic Pattern(8 x 6)

Table 3. Electrical characteristics

Parameter	Symbol	Values			Unit	Notes
		Min	Typ	Max		
LAMP :						
Operating Voltage	V_{BL}	780	800	1000	V_{RMS}	1, 2
Operating Current	I_{BL}	2.5	7.5	8.0	mA_{RMS}	1
Established Starting Voltage	Vs					1, 3
at 25 °C				1250	V_{RMS}	
at 0 °C				1550	V_{RMS}	
Operating Frequency	f_{BL}	40	-	60	kHz	4
Discharge Stabilization Time	T_S	-	-	3.0	Min	1, 5
Power Consumption	P_{BL}		24	26.4	Watt	6
Life Time		50,000	-		Hrs	1, 7

Note :

The design of the inverter must have specifications for the lamp in LCD Assembly**.**
The performance of the Lamp in LCM, for example life time or brightness, is extremely influenced by the characteristics of the DC-AC inverter. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter.
When you design or order the inverter, please make sure unwanted lighting caused by the mismatch of the lamp and the inverter (no lighting, flicker, etc) never occurs. When you confirm it, the LCD–Assembly should be operated in the same condition as installed in you instrument.

※ Do not attach a conducting tape to lamp connecting wire. If the lamp wire attach to a conducting tape, TFT-LCD Module has a low luminance and the inverter has abnormal action.
Because leakage current is occurred between lamp wire and conducting tape.

1. Specified values are for a single lamp.
2. Operating voltage is measured at 25 ± 2°C. The variance of the voltage is ± 10%.
3. The voltage above V_S should be applied to the lamps for more than 1 second for start-up.
   (Inverter open voltage must be more than lamp starting voltage.)

Otherwise, the lamps may not be turned on. The used lamp current is the lamp typical current.

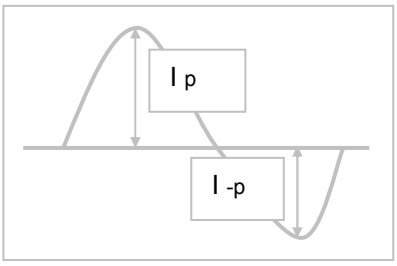
4. Lamp frequency may produce interference with horizontal synchronous frequency. As a result, the may cause beat on the display. Therefore, lamp frequency shall be away as much as possible from the horizontal synchronous frequency and its harmonics range in order to prevent interference.
5. Let's define the brightness of the lamp after being lighted for 5 minutes as 100%.
   T_S is the time required for the brightness of the center of the lamp to be not less than 95%.
6. The lamp power consumption shown above does not include loss of external inverter.
   The used lamp current is the lamp typical current. ($P_{BL} = V_{BL} \times I_{BL} \times N_{Lamp}$)
7. The life is determined as the time at which brightness of the lamp is 50% compared to that of initial value at the typical lamp current on condition of continuous operating at 25 ± 2°C.

Note :

8. The output of the inverter must have symmetrical(negative and positive) voltage waveform and symmetrical current waveform (Unsymmetrical ratio is less than 10%). Please do not use the inverter which has unsymmetrical voltage and unsymmetrical current and spike wave. Requirements for a system inverter design, which is intended to have a better display performance, a better power efficiency and a more reliable lamp, are following.It shall help increase the lamp lifetime and reduce leakage current.

   a. The asymmetry rate of the inverter waveform should be less than 10%.
   b. The distortion rate of the waveform should be within $\sqrt{2} \pm 10\%$.

   * Inverter output waveform had better be more similar to ideal sine wave.



* Asymmetry rate:

$| I_p - I_{-p} | / I_{rms} \times 100\%$

* Distortion rate

I_p (or I_{-p}) / I_{rms}

9. The inverter which is combined with this LCM, is highly recommended to connect coupling(ballast) condenser at the high voltage output side. When you use the inverter which has not coupling(ballast) condenser, it may cause abnormal lamp lighting because of biased mercury as time goes.
10. In case of edgy type back light with over 4 parallel lamps, input current and voltage wave form should be same phased (continuous lamps).

3-2. Interface Connections

3-2-1. LCD Module

- LCD Connector(CN1). : IS100-L30B-C23 (UJU), FI-XB30SL-HF11(JAE)
- Mating Connector : FI-XC30C2L (Manufactured by JAE) or Equivalent

Table 4 MODULE CONNECTOR(CN1) PIN CONFIGURATION

No	Symbol	Description	No	Symbol	Description
1	R1AN	FIRST LVDS Receiver Signal (A-)	16	R2BP	SECOND LVDS Receiver Signal (B+)
2	R1AP	FIRST LVDS Receiver Signal (A+)	17	GND	Ground
3	R1BN	FIRST LVDS Receiver Signal (B-)	18	R2CN	SECOND LVDS Receiver Signal (C-)
4	R1BP	FIRST LVDS Receiver Signal (B+)	19	R2CP	SECOND LVDS Receiver Signal (C+)
5	R1CN	FIRST LVDS Receiver Signal (C-)	20	R2CLKN	SECOND LVDS Receiver Clock Signal(-)
6	R1CP	FIRST LVDS Receiver Signal (C+)	21	R2CLKP	SECOND LVDS Receiver Clock Signal(+)
7	GND	Ground	22	R2DN	SECOND LVDS Receiver Signal (D-)
8	R1CLKN	FIRST LVDS Receiver Clock Signal(-)	23	R2DP	SECOND LVDS Receiver Signal (D+)
9	R1CLKP	FIRST LVDS Receiver Clock Signal(+)	24	GND	Ground
10	R1DN	FIRST LVDS Receiver Signal (D-)	25	NC	NC (reserved I2C communication)
11	R1DP	FIRST LVDS Receiver Signal (D+)	26	NC	NC (reserved I2C communication)
12	R2AN	SECOND LVDS Receiver Signal (A-)	27	PWM	PWM_OUT for control burst frequency of Inverter
13	R2AP	SECOND LVDS Receiver Signal (A+)	28	VLCD	Power +5V
14	GND	Ground	29	VLCD	Power +5V
15	R2BN	SECOND LVDS Receiver Signal (B-)	30	VLCD	Power +5V

Note: 1. All GND(ground) pins should be connected together and to Vss which should also be connected to the LCD's metal frame.
2. All VLCD (power input) pins should be connected together.
3. Input Level of LVDS signal is based on the IEA 664 Standard.

[Figure 4] User Connector diagram

3-2-2. Backlight Module

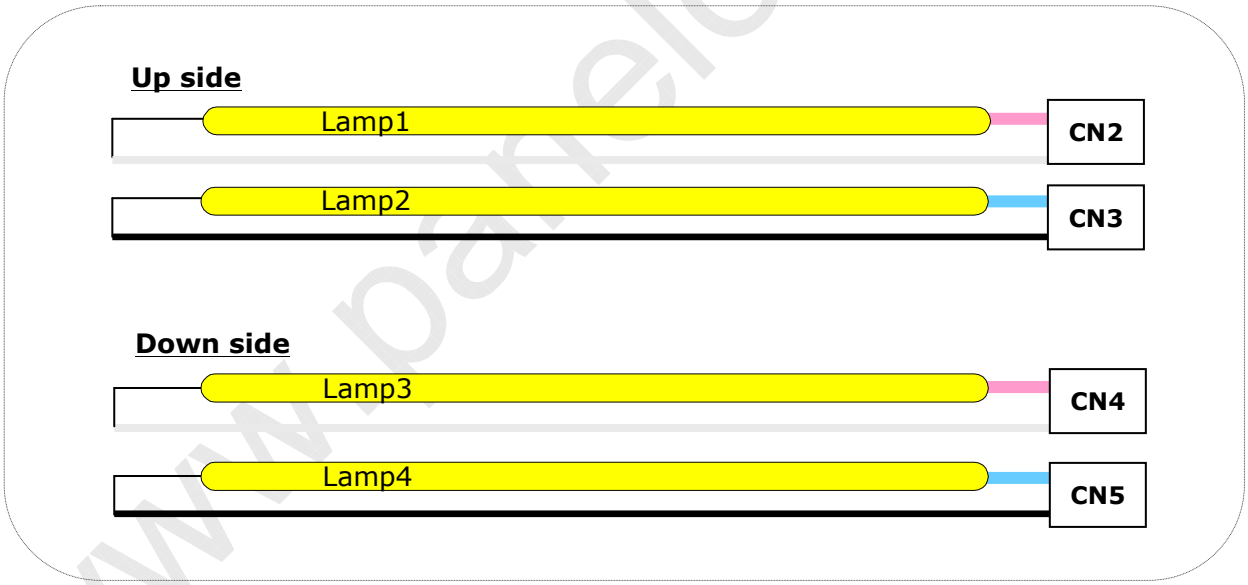
The backlight interface connector is a model 35001HS-02LD manufactured by YEONHO.
The mating connector part number are 35001WR-02L(2pin) or equivalent.
The pin configuration for the connector is shown in the table below.

Table 5. Backlight connector pin configuration(CN2,CN3,CN4,CN5)

Pin	Symbol	Description	Notes
1	HV	High Voltage for Lamp	1
2	LV	Low Voltage for Lamp	2

Notes: 1. The high voltage power terminal is colored pink, sky blue.
2. The low voltage pin color is white, black.

FIG. 5 Backlight connector diagram



3-3. Signal Timing Specifications

This is the signal timing required at the input of the User connector. All of the interface signal timing should be satisfied with the following specifications for it's proper operation.

Table 6. TIMING TABLE

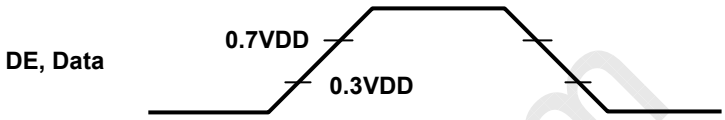
[DE (Data Enable) Only]

ITEM	Symbol		Min	Typ	Max	Unit	Note
DCLK	Period	t_{CLK}	12.12	13.89	15.38	ns	
	Frequency	-	65	72	82.5	MHz	
Horizontal	total	t_{HP}	1008	1088	1300	t_{CLK}	
	Frequency	f_H	55	66	77	KHz	
	Blanking		48	128	340	t_{CLK}	
	valid	t_{WH}	960	960	960	$t_{CLK/2}$	
Vertical	total	t_{VP}	1090	1100	1250	t_{HP}	
	Frequency	f_V	47	60	63	Hz	PAL : 47~53Hz NTSC : 57~63Hz
	Blanking		10	20	170	t_{HP}	
	valid	t_{WV}	1080	1080	1080	t_{HP}	

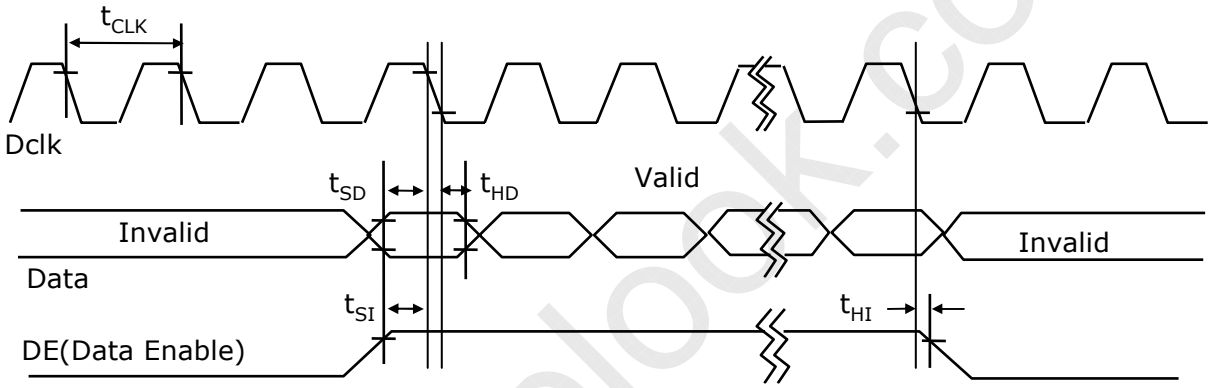
Note:

1. DE Only mode operation. The input of Hsync & Vsync signal does not have an effect on LCD normal operation.
2. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rates.
3. Horizontal period should be even.

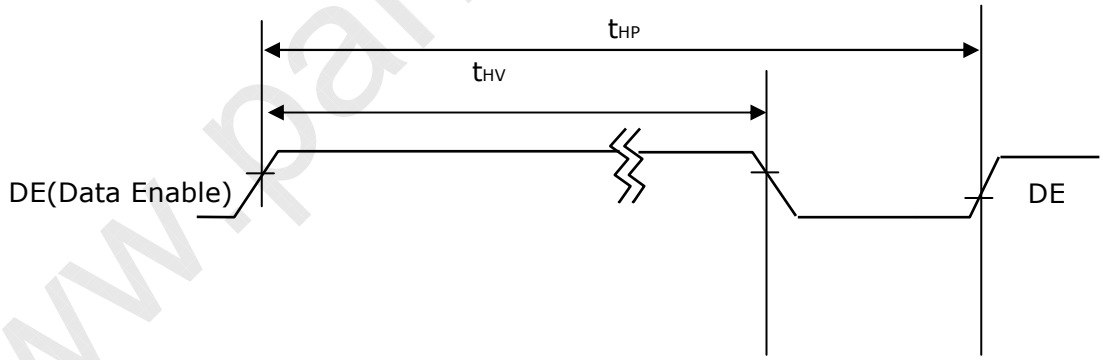
3-4. Signal Timing Waveforms



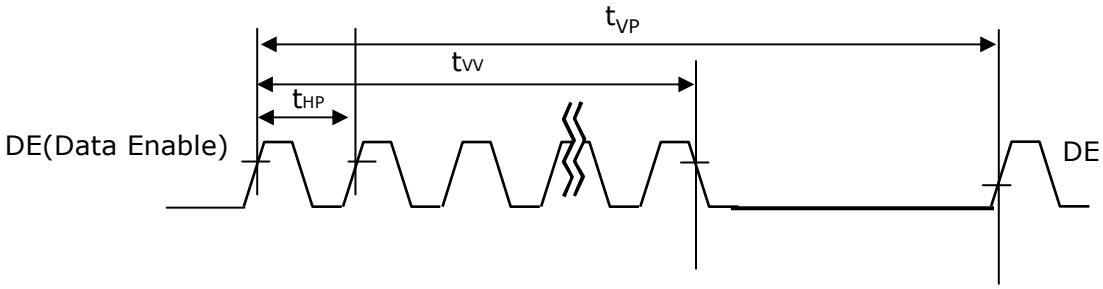
1. DCLK , DE, DATA waveforms



2. Horizontal waveform



3. Vertical waveform



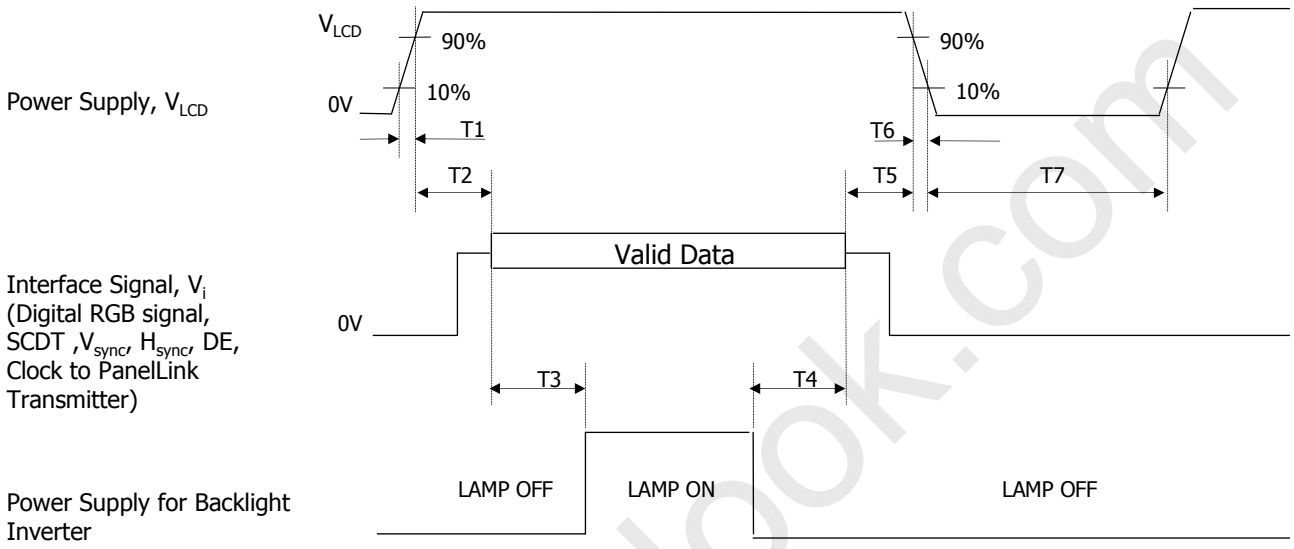
3-5. Color Input Data Reference

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

Table 6. COLOR DATA REFERENCE

Color		Input Color Data																							
		RED MSB							LSB	GREEN MSB							LSB	BLUE MSB							LSB
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green (255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RED	RED (000) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (001)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	...				...								...								...				
	RED (254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED (255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN (000) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN (001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	...				...								...								...				
	GREEN (254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	GREEN (255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
BLUE	BLUE (000) Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BLUE (001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	...				...								...								...				
	BLUE (254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	BLUE (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

3-6. Power Sequence



[Figure 6] Power sequence

Table 7. POWER SEQUENCE

Parameter	Values			Units
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0.01	-	50	ms
T3	500	-	-	ms
T4	200	-	-	ms
T5	0.01	-	50	ms
T6	-	-	-	ms
T7	1		-	s

Notes : 1. Please avoid floating state of interface signal at invalid period.
2. When the interface signal is invalid, be sure to pull down the power supply for LCD V_{LCD} to 0V.
3. Lamp power must be turn on after power supply for LCD and interface signal are valid.

4. Optical Specifications

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 Φ and θ equal to 0 °.
FIG. 1 presents additional information concerning the measurement equipment and method.

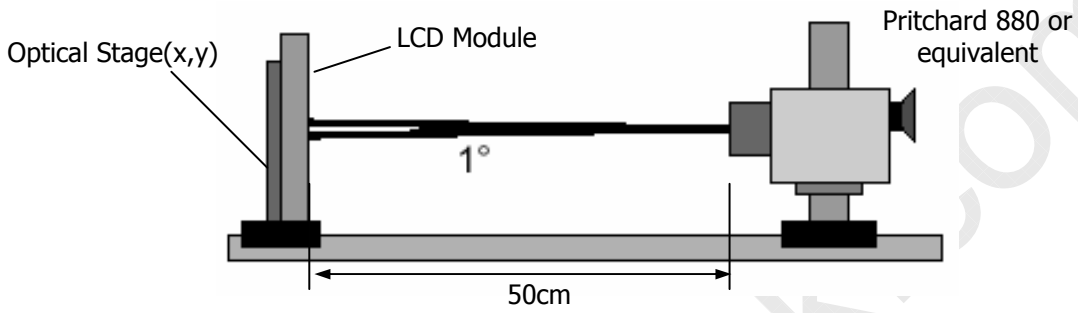


FIG. 1 Optical characteristic measurement equipment and method

Table 11. OPTICAL CHARACTERISTICS (Ta=25 °C, V_{LCD}=5.0V, f_V=60Hz Dclk=72MHz, I_{BL}=7.5mA)

Parameter		Symbol	Values			Units	Notes	
			Min	Typ	Max			
Contrast Ratio		CR	700	1000			1	
Surface Luminance, white		L_{WH}	300	400		cd/m^2	2	
Luminance Variation		δ_{WHITE}	75			%	3	
Response Time	Rise Time	Tr_R	-	1.3	2.6	ms	4	
	Decay Time	Tr_D	-	3.7	7.4	ms		
	total	T		5		ms		
Color Coordinates [CIE1931]	RED	Rx	Typ -0.03	0.642	Typ +0.03			
		Ry		0.336				
	GREEN	Gx		0.300				
		Gy		0.617				
	BLUE	Bx		0.147				
		By		0.066				
	WHITE	Wx		0.314				
		Wy		0.324				
Viewing Angle (CR>10)								
	x axis, right(ϕ=0°)	θr		70	85	-	degree	5
	x axis, left (ϕ=180°)	θl		70	85	-		
	y axis, up (ϕ=90°)	θu		60	70	-		
	y axis, down (ϕ=270°)	θd		70	85	-		
Gray Scale				-	2.2	-		6

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

$$CR = \frac{\text{Surface Luminance at all white pixels}}{\text{Surface Luminance at all black pixels}}$$

It is measured at center 1-point.

2. Surface luminance is determined after the unit has been 'ON' and 1Hour 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 , 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 black to white (Decay time, Tr_D) and from white to black (Rise Time, Tr_R). For additional information see the FIG. 3.

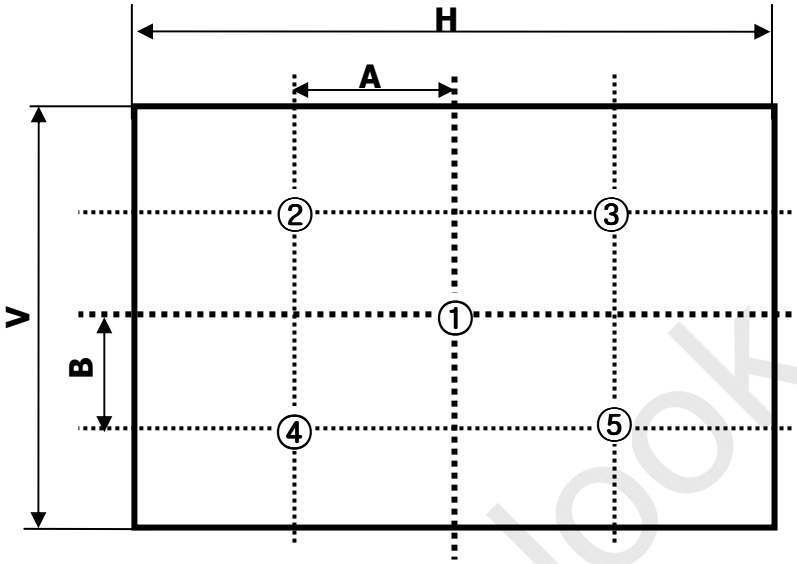
5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD module surface. For more information, see the FIG. 4.

6. Gray scale specification
Gamma Value is approximately 2.2. For more information, see the Table 10.

Table 10. GRAY SCALE SPECIFICATION

Gray Level	Relative Luminance [%] (Typ.)
0	0.11
31	1.1
63	4.7
95	11.5
127	21.7
159	35.5
191	53.0
223	74.5
255	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 Luminance Measure

Response time is defined as the following figure and shall be measured by switching the input signal for each gray to gray.

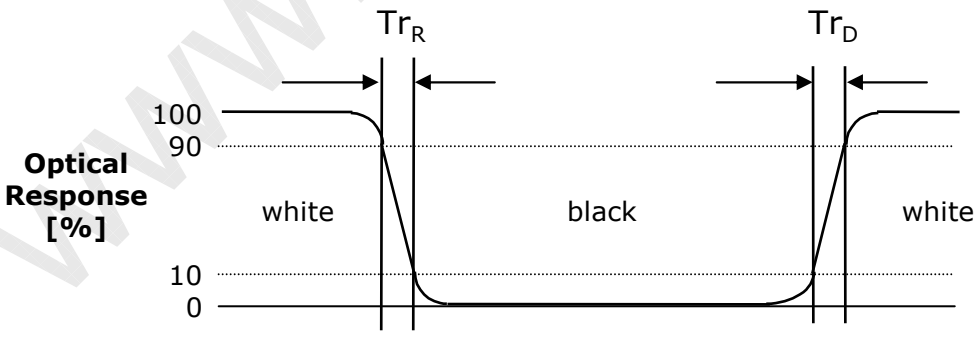


FIG. 3 Response Time

Dimension of viewing angle range

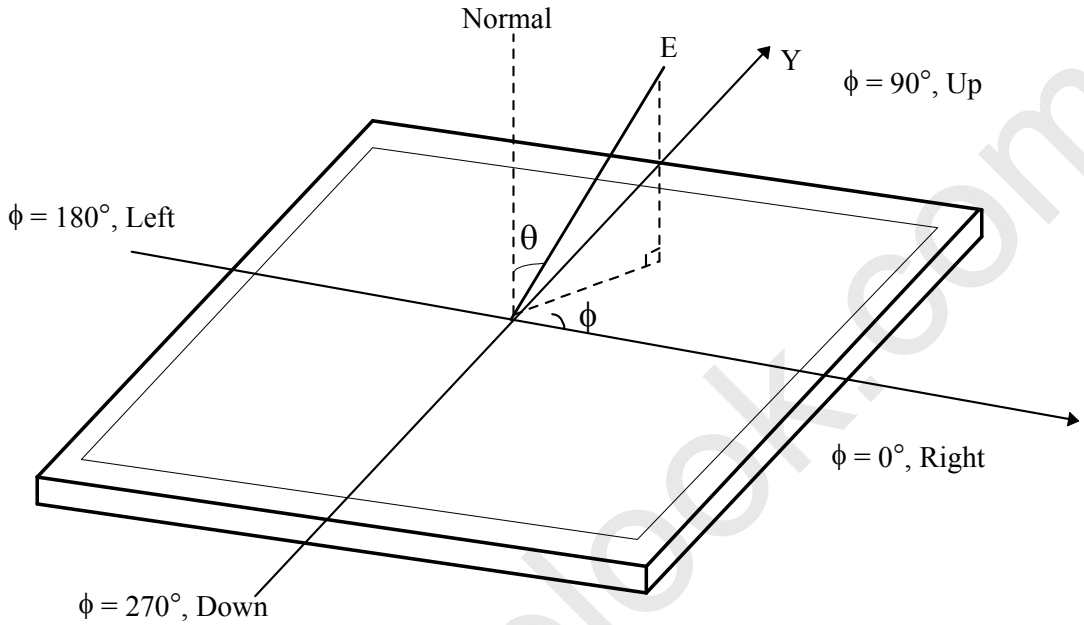


FIG. 4 Viewing Angle

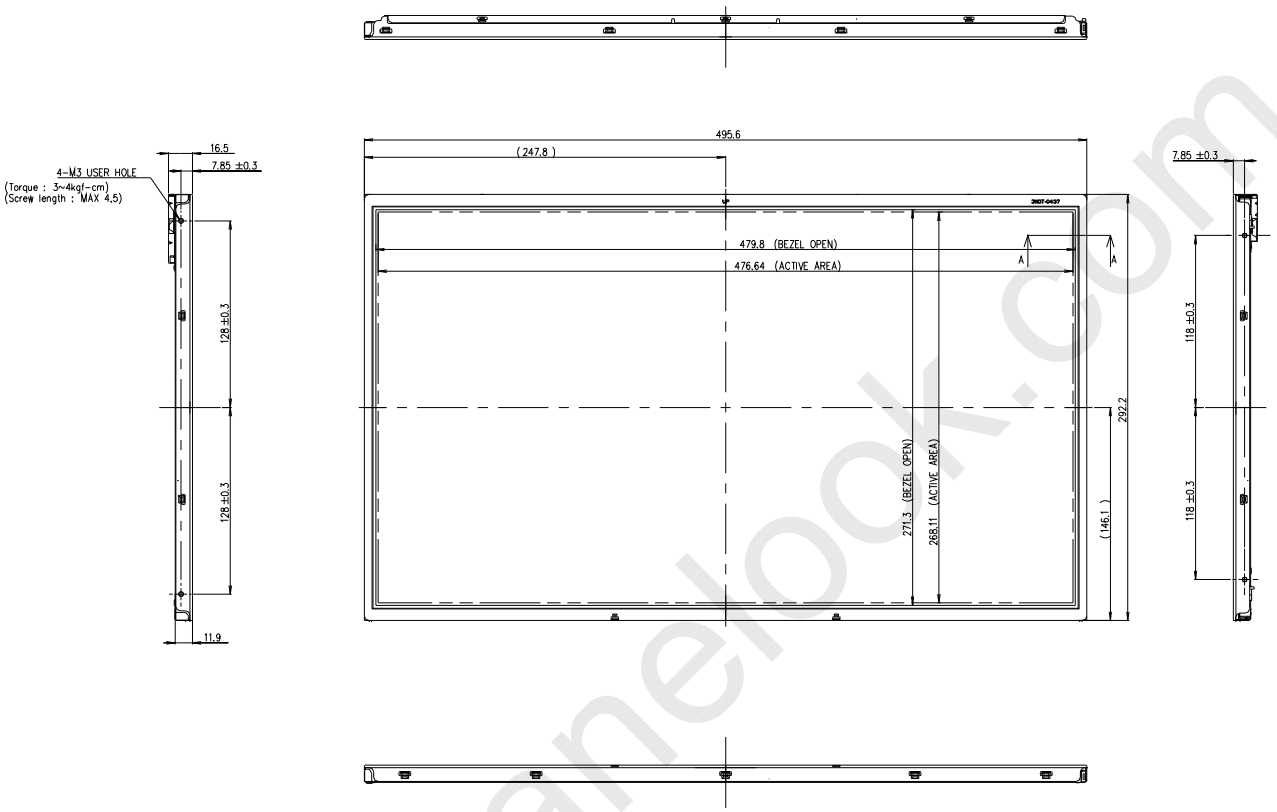
5. Mechanical Characteristics

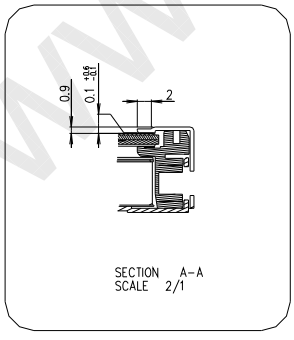
The contents provide general mechanical characteristics. In addition the figures in the next page are detailed mechanical drawing of the LCD.

Outline Dimension	Horizontal	495.6mm
	Vertical	292.2mm
	Depth	18.5mm
Bezel Area	Horizontal	479.8mm
	Vertical	271.3mm
Active Display Area	Horizontal	476.64mm
	Vertical	268.11mm
Weight	2100g(typ)	

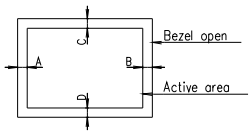
Notes : Please refer to a mechanic drawing in terms of tolerance at the next page.

<FRONT VIEW>



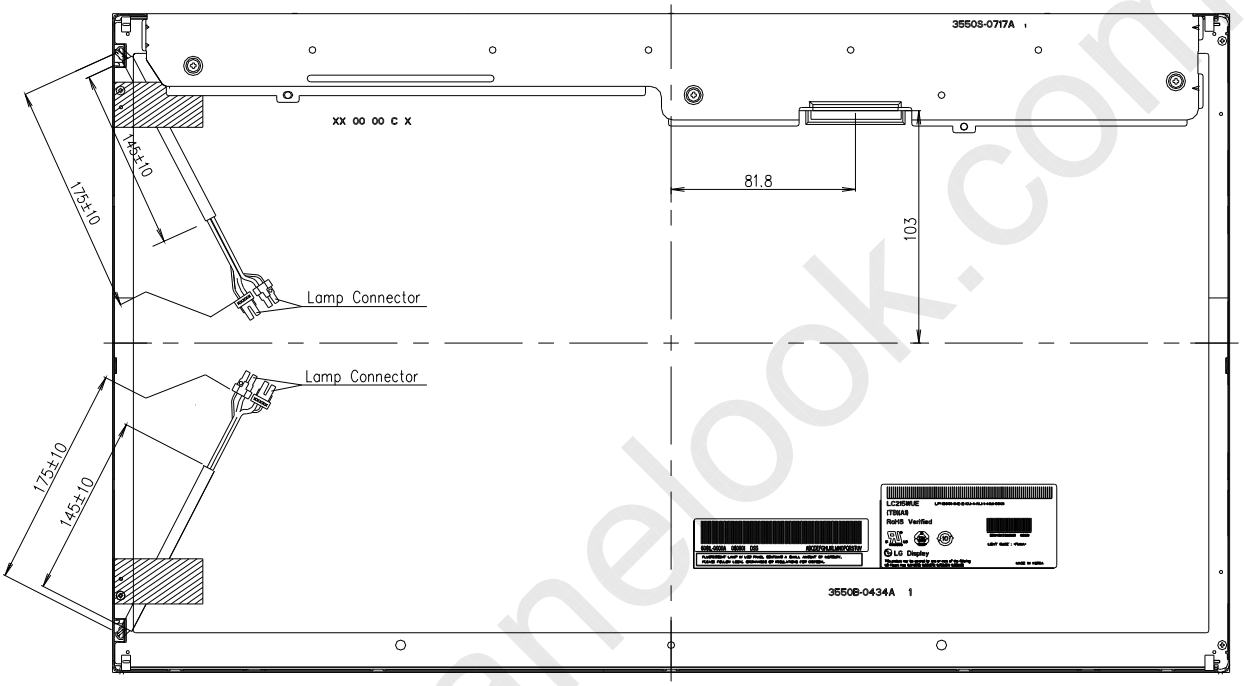


NOTES
1. Unspecified tolerances are to be ±0.5mm.
2. This drawing is only preliminary data and can be changed without notice.
3. Tilt and partial disposition tolerance of display area is as following.
   (1) X-Direction : |A-B| ≤ 1.0mm
   (2) Y-Direction : |C-D| ≤ 1.0mm



4. Backlight wires and contraction tubes are excluded from outline dimension.
5. Do not wind conductive tape around the backlight wires.

<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, Each direction per 20min
6	Shock test (non-operating)	Shock level : 120Grms Waveform : half sine wave, 2ms Direction : ±X, ±Y, ±Z Each direction per 20min
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, 7th Edition, dated June 30, 2003, Underwriters Laboratories, Inc., Standard for Audio, Video and Similar Electronic Apparatus.
b) CAN/CSA C22.2, No. 60065:03, Canadian Standards Association, Standard for Audio, Video and Similar Electronic Apparatus.
c) IEC60065:2001, 7th Edition CB-scheme and EN 60065:2002, Safety requirements for Audio, Video and Similar Electronic Apparatus..

7-2. EMC

a) ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9kHZ to 40GHz. "American National Standards Institute(ANSI), 1992
b) CISPR13 "Limits and Methods of Measurement of Radio interference characteristics of Sound and Television broadcast receivers and associated equipment"
CISPR22 "Limits and Methods of Measurement of Radio interference characteristics of Information Technology Equipment" International Special Committee on Radio Interference.
c) EN55013 "Limits and Methods of Measurement of Radio interference characteristics of Sound and Television broadcast receivers and associated equipment"
EN55022 "Limits and Methods of Measurement of Radio interference characteristics of Information Technology Equipment" European Committee for Electro Technical Standardization (CENELEC), 1988(Including A1:2000)

8. Packing

8-1. Designation of Lot Mark

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	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 : 7pcs

b) Box Size : 370mm x 320mm x 580mm

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 holes arranged in four corners or four sides.
(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 benzene. 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 causes metallic foreign material and deal LCM a fatal blow)
(9) Please do not set LCD on its edge.
(10) 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.

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.

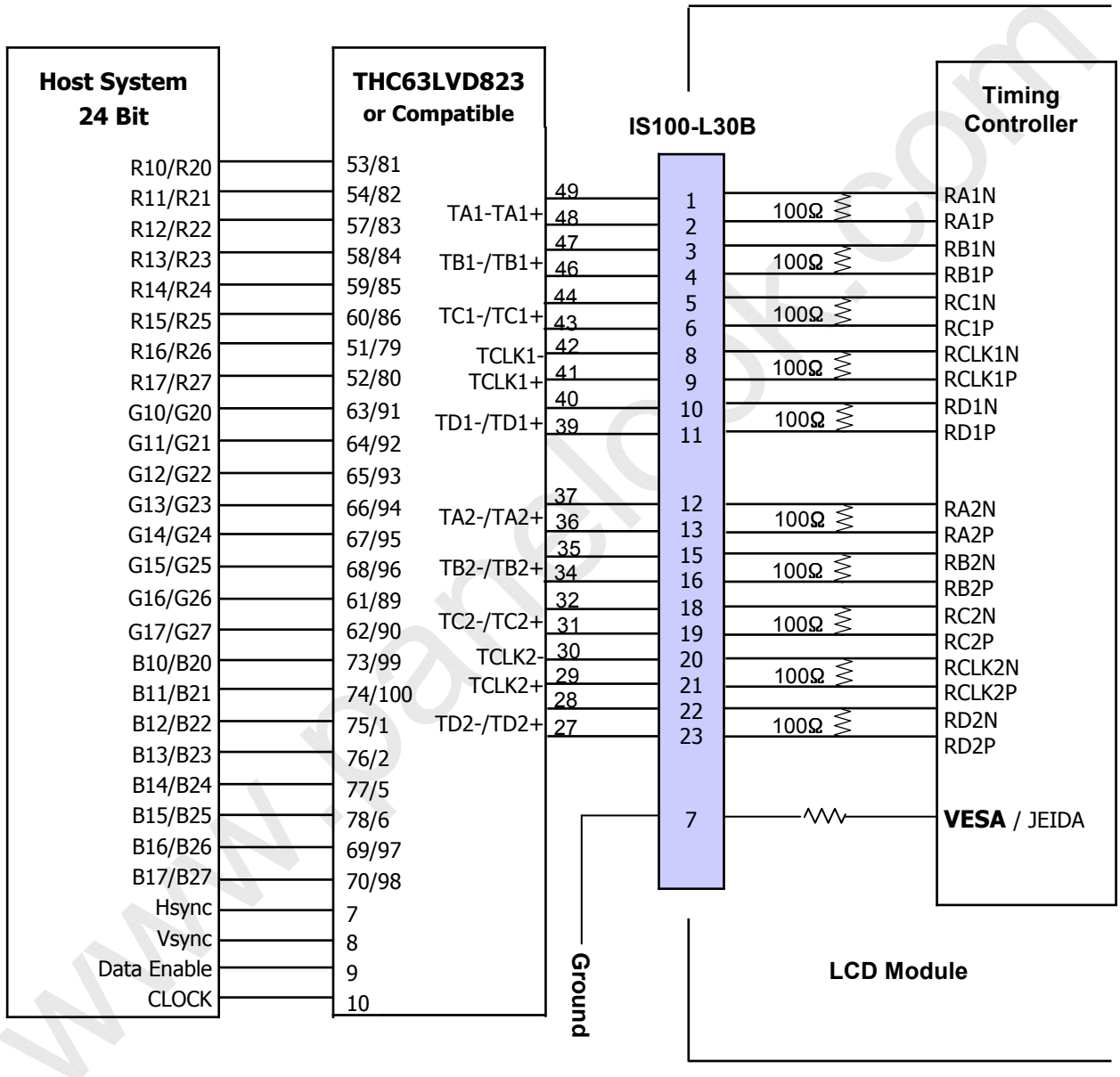
(1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
(2) The polarizer surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they were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

■ **Required signal assignment for Flat Link (Thine : THC63LVD823) Transmitter (Pin7="L or NC")**

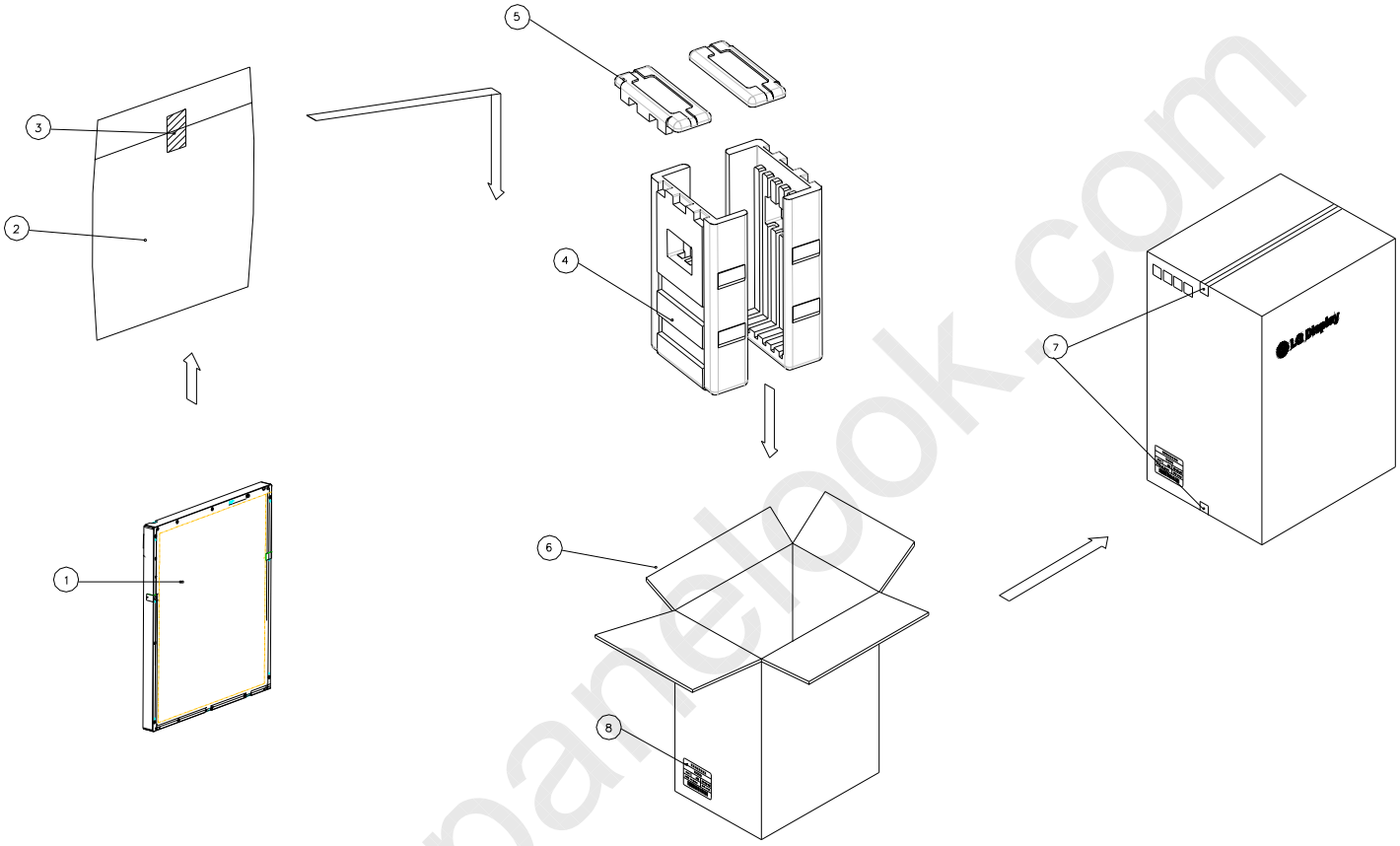


Notes:

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. (THC63LVD823 or Compatible)
3. '7' means MSB and '0' means LSB at R,G,B pixel data.

APPENDIX- II

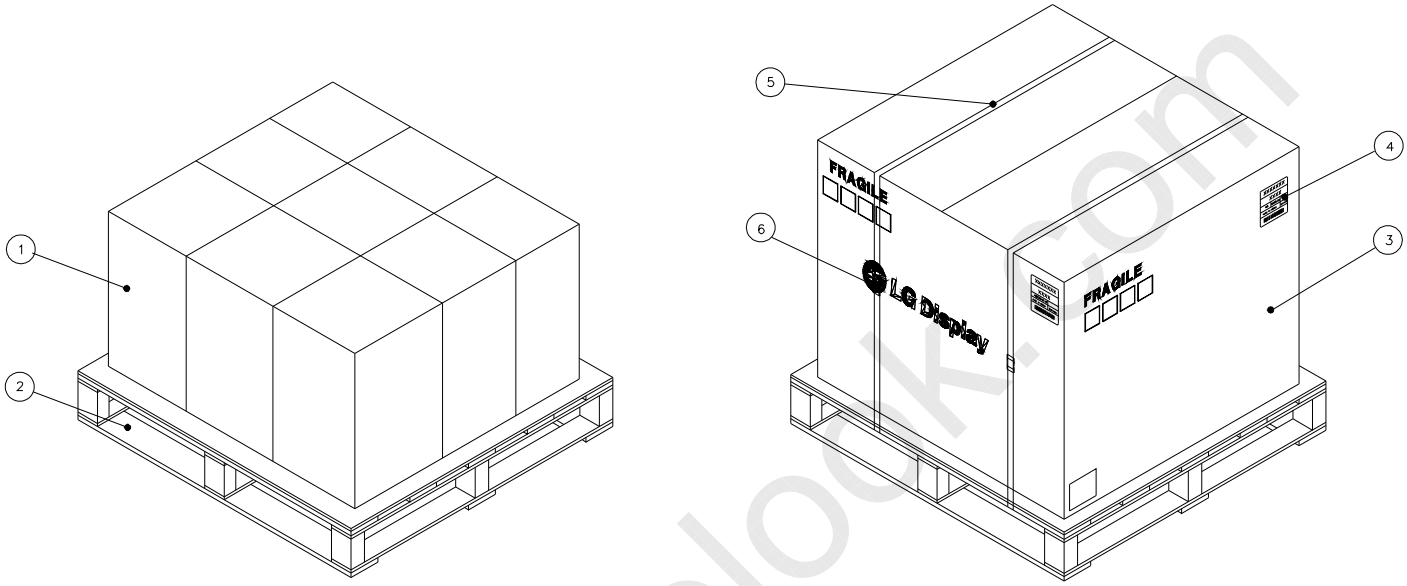
■ Packing Ass'y



NO.	DESCRIPTION	MATERIAL
1	LCM	
2	BAG	PE
3	TAPE	OPP
4	PACKING, BOTTOM	EPS
5	PACKING, TOP	EPS
6	BOX	PAPER, SW
7	TAPE	OPP
8	LABEL	ART

 # APPENDIX- III

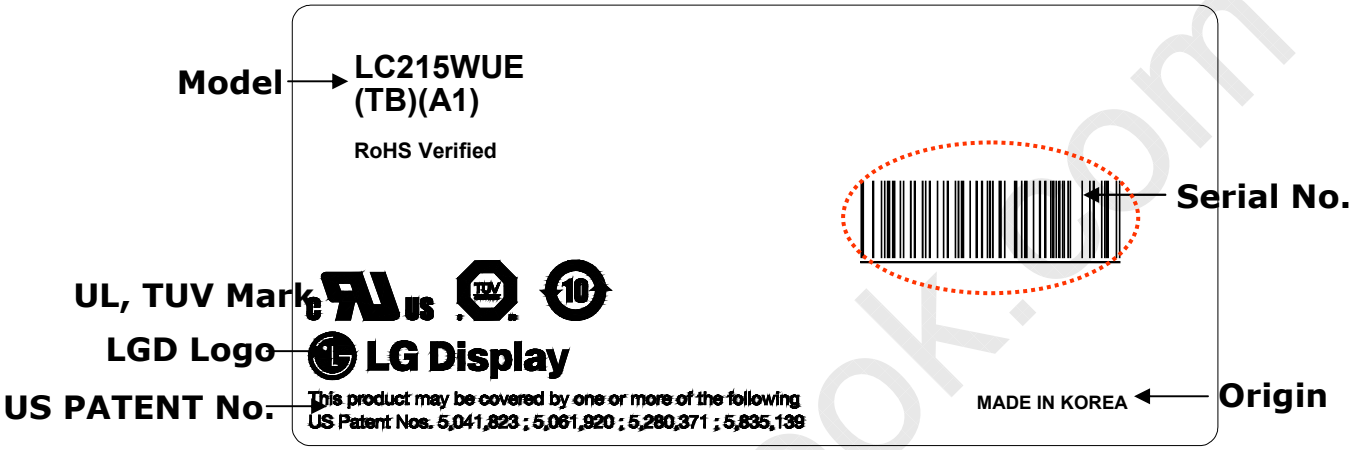
■ Pallet Ass'y



NO.	DESCRIPTION	MATERIAL
1	PACKING ASS'Y	
2	PALLET	Paper_1140X990X117.5
3	ANGLE, PACKING	SWR4
4	LABEL	YUPO PAPER
5	BAND	PP
6	BAND, CLIP	CLIP 18MM

APPENDIX- IV

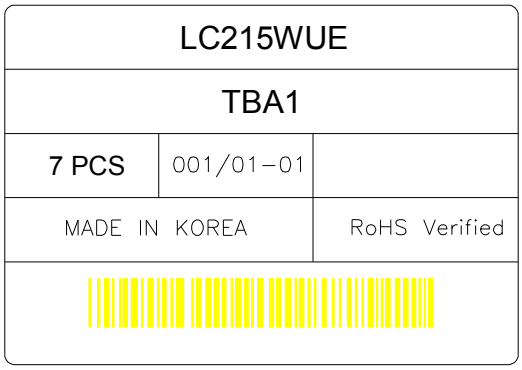
■ LCM Label



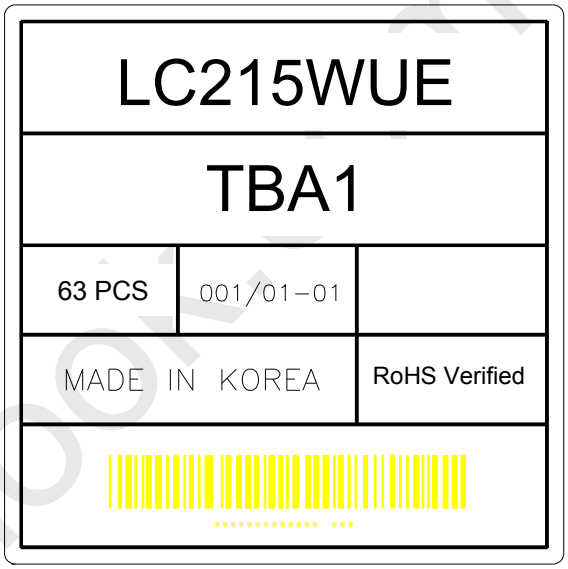
APPENDIX- V

■ Box Label and Pallet Label

■ Box Label



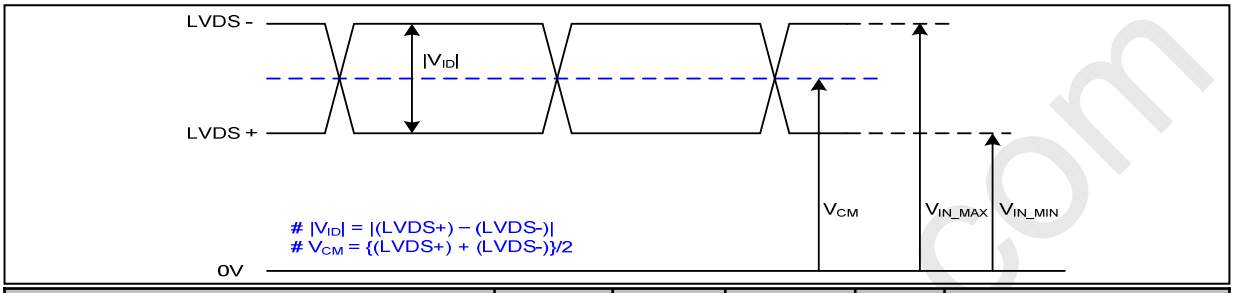
■ Pallet Label



 # APPENDIX- VI-1

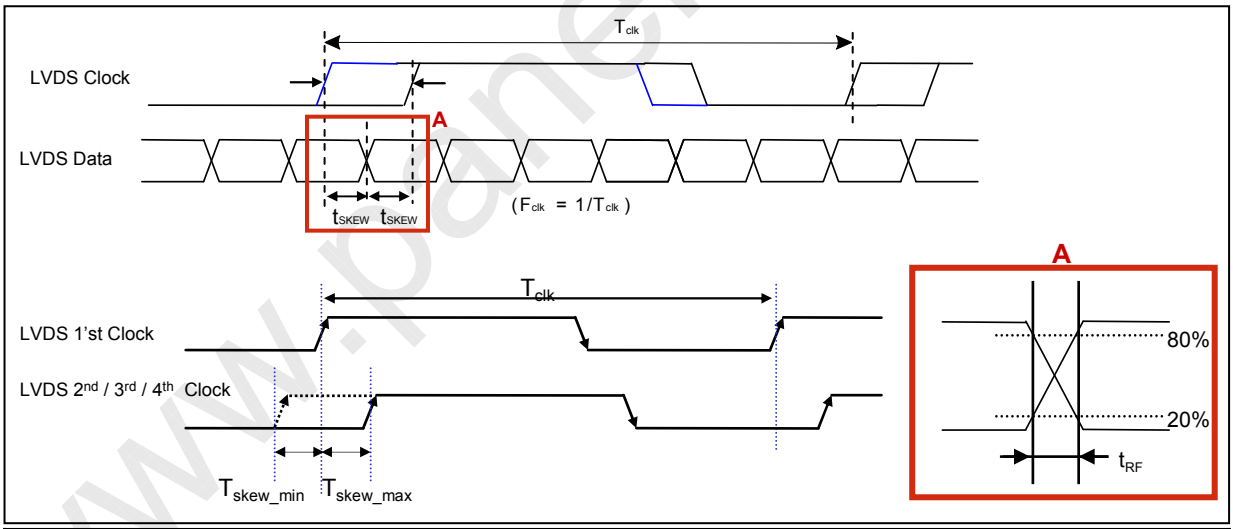
LVDS Input characteristics

1. DC Specification



Description	Symbol	Min	Max	Unit	Notes
LVDS Single end Voltage	$\|V_{ID}\|$	200	600	mV	-
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	ΔV_{CM}		250	mV	-

2. AC Specification

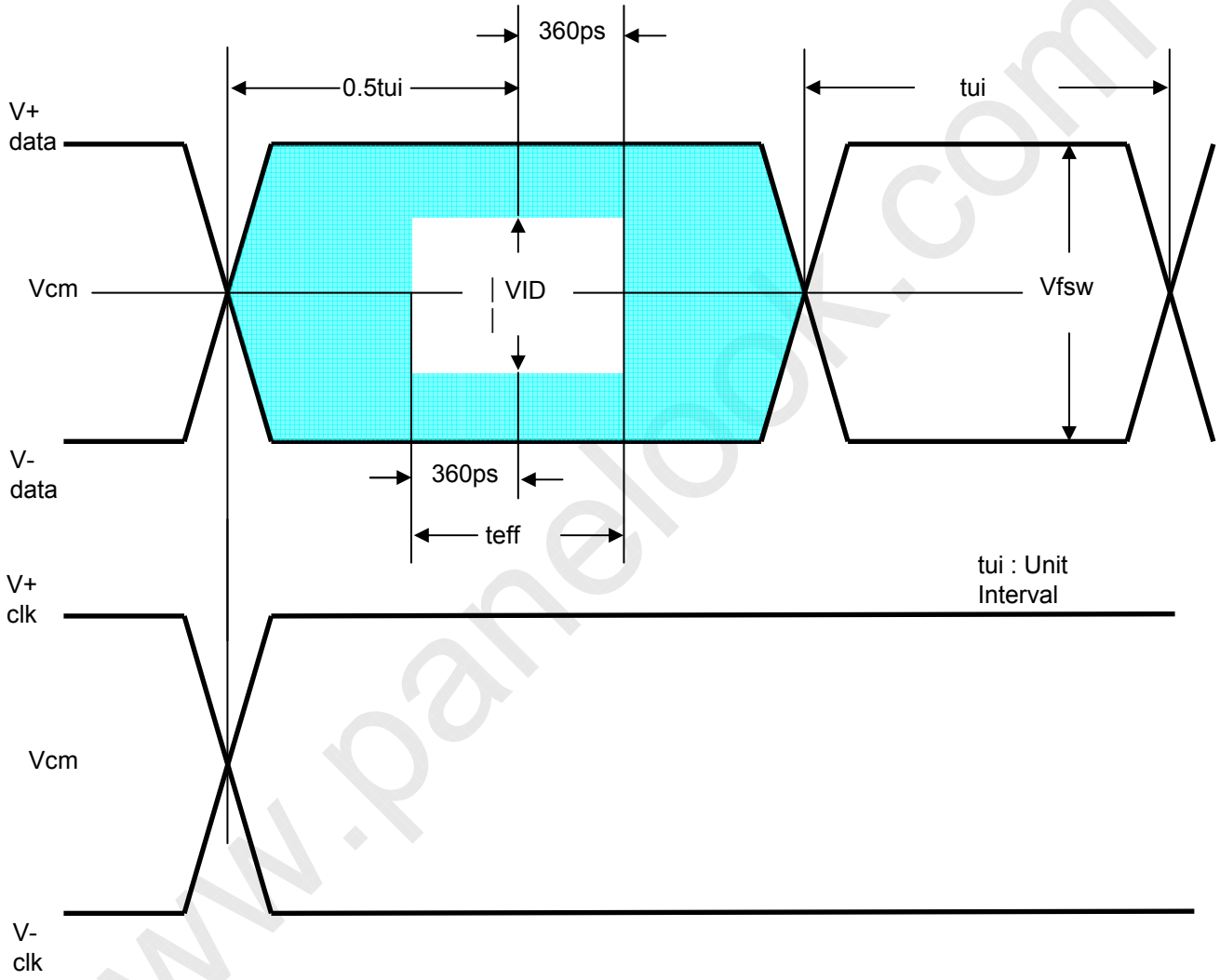


Description	Symbol	Min	Max	Unit	Notes
LVDS Clock to Data Skew Margin	t_{SKEW}		$\|(0.25*T_{clk})/7\|$	ps	-
LVDS Clock/DATA Rising/Falling time	t_{RF}	260	$(0.3*T_{clk})/7$	ps	2
Effective time of LVDS	t_{eff}	±360		ps	-
LVDS Clock to Clock Skew Margin (Even to Odd)	t_{SKEW_EO}		$1/7* T_{clk}$	T_{clk}	-

Notes : 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.

 # APPENDIX- VI-2

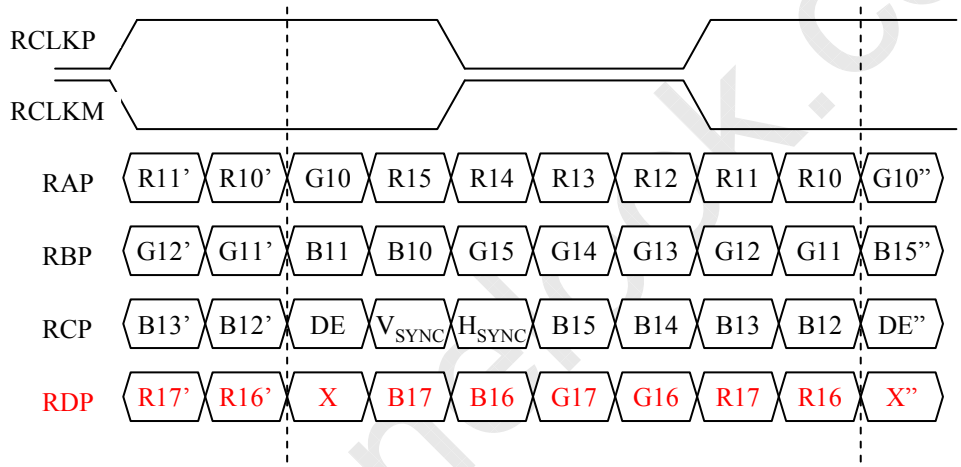
LVDS Input characteristics



 # APPENDIX- VII

LVDS Data-Mapping info. (8bit)

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



< LVDS Data Format >