

- Tentative Specification  
 Preliminary Specification  
 Approval Specification

**MODEL NO.: V315B5**  
**SUFFIX:L13**

<b>Customer :</b>	
<b>APPROVED BY</b>	<b>SIGNATURE</b>
Name / Title _____	_____
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<hr/> Please return 1 copy for your confirmation with your signature and comments.	

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**REVISION HISTORY**

Version	Date	Page (New)	Section	Description
Ver 2.0	Jan 19, 11'	All	All	Approval Specification was first issued.

## 1. GENERAL DESCRIPTION

### 1.1 OVERVIEW

V315B5- L13 s a 31.5" TFT Liquid Crystal Display module with 4U-type CCFL Backlight unit and 1ch-LVDS interface. This module supports 1366 x 768 WXGA format and can display 16.7M (8-bit/color) colors. The inverter module for backlight is built-in.

### 1.2 FEATURES

- High brightness (450 nits)
- Ultra-high contrast ratio (3500:1)
- Fast response time (gray to gray average 8.5ms)
- High color saturation NTSC 72%
- Ultra wide viewing angle : 176(H)/176(V)(CR $\geq$ 20)with Super MVA technology
- DE (Data Enable) only mode
- LVDS (Low Voltage Differential Signaling) interface
- Color reproduction (nature color)
- Low color shift function

### 1.3 APPLICATION

- TFT LCD TVs
- Multi-Media Display

### 1.4 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Active Area	697.6845 (H) x 392.256 (V) (31.51" diagonal)	mm	(1)
Bezel Opening Area	703.8 (H) x 399.0 (V)	mm	
Driver Element	a-si TFT active matrix	-	
Pixel Number	1366 x R.G.B. x 768	pixel	
Pixel Pitch (Sub Pixel)	0.17025(H) x 0.51075 (V)	mm	
Pixel Arrangement	RGB vertical stripe	-	
Display Colors	16.7M	color	
Display Operation Mode	Transmissive mode / Normally black	-	
Surface Treatment	Anti-Glare coating (Haze 11%),Hard coating (3H)	-	

### 1.5 MECHANICAL SPECIFICATIONS

Item	Min.	Typ.	Max.	Unit	Note	
Module Size	Horizontal(H)	759	760	761	mm	(1)
	Vertical(V)	449	450	451	mm	(1)
	Depth(D)	31.5	32.5	33.5	mm	To Rear
	Depth(D)	46.9	47.9	48.9	mm	To Inverter Cover
Weight		5189			g	

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

## 2. ABSOLUTE MAXIMUM RATINGS

### 2.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	T <sub>ST</sub>	-20	+60	°C	(1)
Operating Ambient Temperature	T <sub>OP</sub>	0	+50	°C	(1), (2)
Shock (Non-Operating)	S <sub>NOF</sub>	-	50	G	(3), (5)
Vibration (Non-Operating)	V <sub>NOF</sub>	-	1.0	G	(4), (5)

Note (1) Temperature and relative humidity range is shown in the figure below.

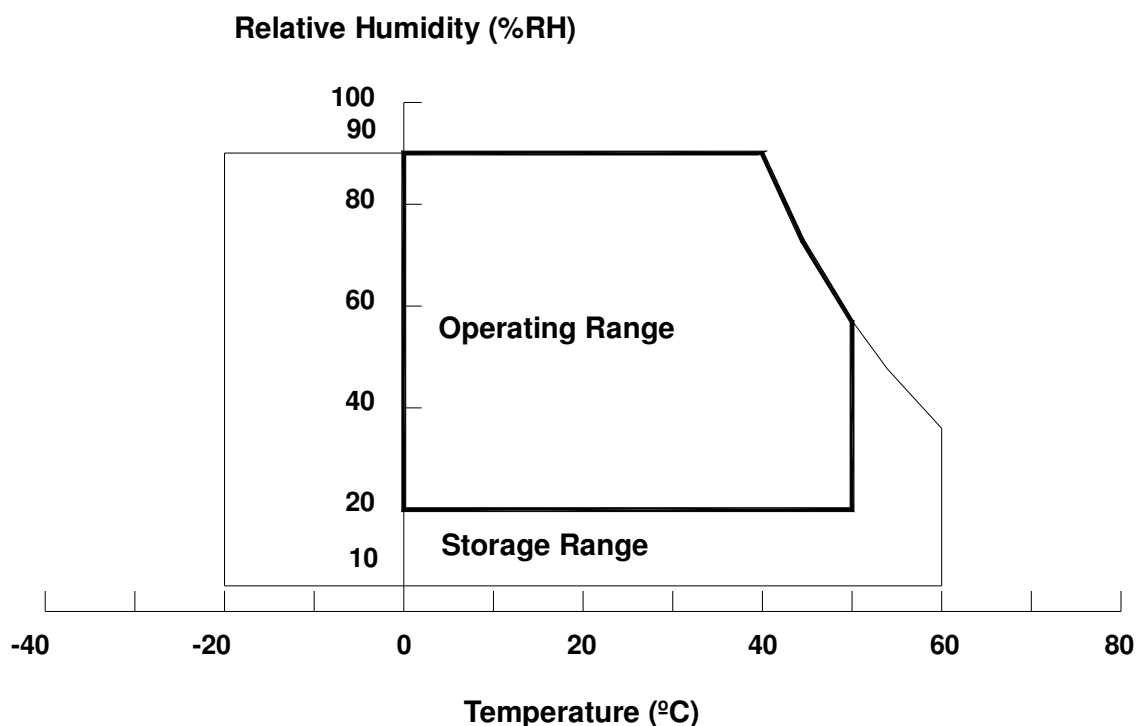
- (a) 90 %RH Max. ( $T_a \leq 40$  °C).
- (b) Wet-bulb temperature should be 39 °C Max. ( $T_a > 40$  °C).
- (c) No condensation.

Note (2) The maximum operating temperature is based on the test condition that the surface temperature of display area is less than or equal to 65 °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 65 °C. The range of operating temperature may degrade in case of improper thermal management in final product design.

Note (3) 11 ms, half sine wave, 1 time for  $\pm X$ ,  $\pm Y$ ,  $\pm Z$ .

Note (4) 10 ~ 200 Hz, 10 min, 1 time each X, Y, Z.

Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.



## 2.2 Package storage

When storing modules as spares for a long time, the following precaution is necessary.

- (a) Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35°C at normal humidity without condensation.
- (b) The module shall be stored in dark place. Do not store the TFT-LCD module in direct sunlight or fluorescent light.

## 2.3 ELECTRICAL ABSOLUTE RATINGS

### 2.3.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	V <sub>CC</sub>	-0.3	13.5	V	(1)
Input Signal Voltage	V <sub>IN</sub>	-0.3	3.6	V	

### 2.3.2 BACKLIGHT UNIT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Lamp Voltage	V <sub>W</sub>	—	3000	V <sub>RMS</sub>	
Power Supply Voltage	V <sub>BL</sub>	0	30	V	(1)
Control Signal Level	—	-0.3	7	V	(1), (3)

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Functional operation should be restricted to the conditions described under normal operating conditions.

Note (2) No moisture condensation or freezing.

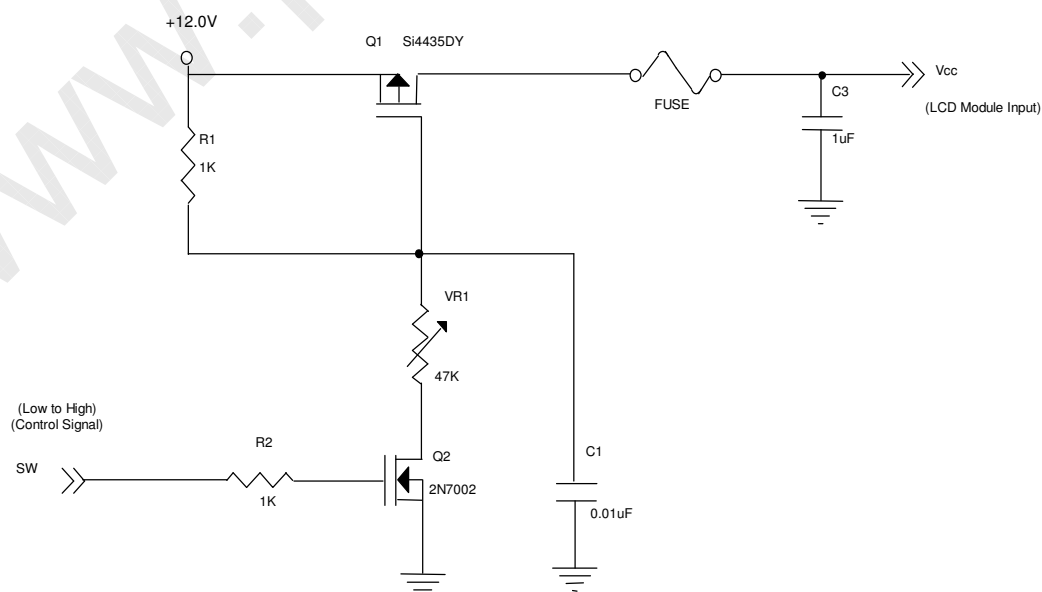
Note (3) The control signals include On/Off Control, External PWM Control and DET\_5V signal for inverter status output.

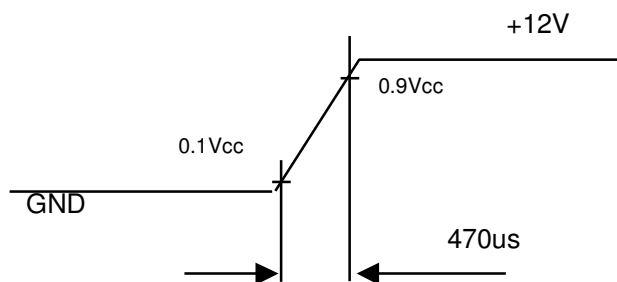
**3. ELECTRICAL CHARACTERISTICS**
**3.1 TFT LCD MODULE**
 $T_a = 25 \pm 2 \text{ }^\circ\text{C}$ 

Parameter	Symbol	Value			Unit	Note	
		Min.	Typ.	Max.			
Power Supply Voltage	$V_{CC}$	10.8	12	13.2	V	(1)	
Rush Current	$I_{RUSH}$	—	—	3.3	A	(2)	
Power Supply Current	White Pattern	—	0.56	—	A	(3)	
	Horizontal Stripe	—	0.72	0.87	A		
	Black Pattern	—	0.40	—	A		
LVDS interface	Differential Input High Threshold Voltage	$V_{LVTH}$	+100	—	—	mV	(4)
	Differential Input Low Threshold Voltage	$V_{LVTL}$	—	—	-100	mV	
	Common Input Voltage	$V_{CM}$	1.0	1.2	1.4	V	
	Differential input voltage (single-end)	$ V_{ID} $	200	—	600	mV	
	Terminating Resistor	$R_T$	—	100	—	ohm	
CMOS interface	Input High Threshold Voltage	$V_{IH}$	2.7	—	3.3	V	
	Input Low Threshold Voltage	$V_{IL}$	0	—	0.7	V	

Note (1) The module should be always operated within above ranges.

Note (2) Measurement Conditions:



**Vcc rising time is 470us**


Note (3) The specified power supply current is under the conditions at  $V_{cc} = 12V$ ,  $T_a = 25 \pm 2 \text{ }^\circ\text{C}$ ,  $f_v = 60 \text{ Hz}$ , whereas a power dissipation check pattern below is displayed.

a. White Pattern



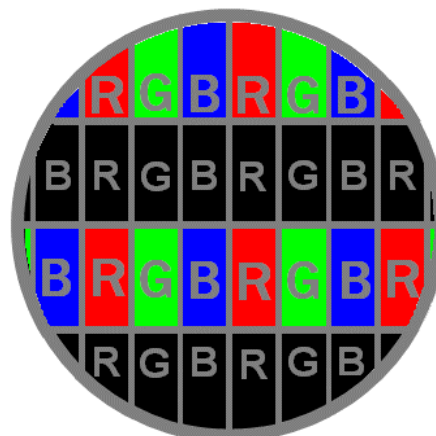
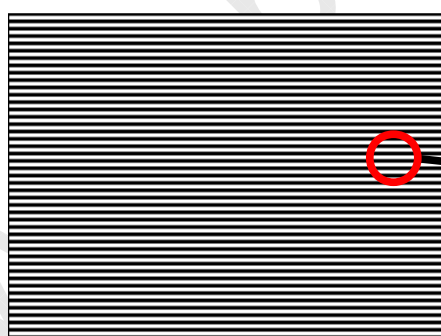
Active Area

b. Black Pattern



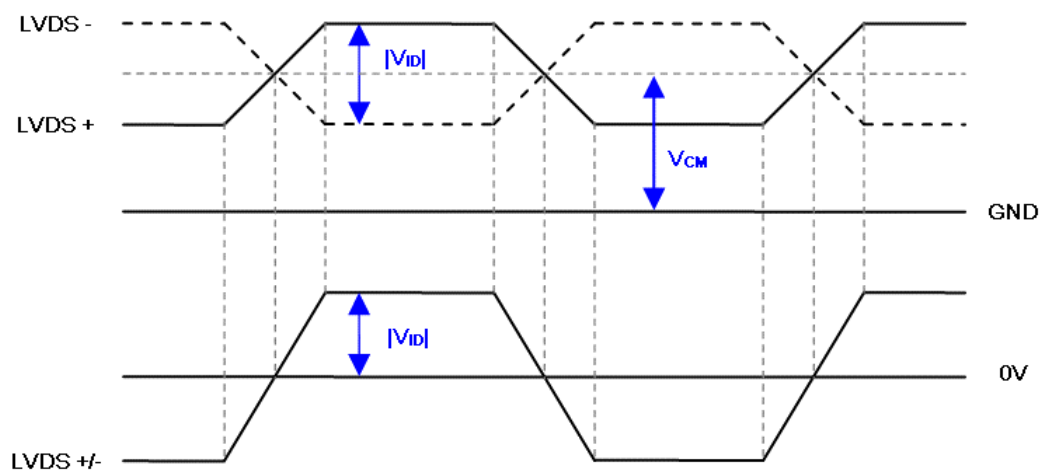
Active Area

c. Horizontal Strip Pattern



Note (4) The LVDS input characteristics are as follows:





## 3.2 CCFL (Cold Cathode Fluorescent Lamp) CHARACTERISTICS (Ta = 25 ± 2 °C)

### 3.2.1 CCFL (Cold Cathode Fluorescent Lamp) CHARACTERISTICS (Ta = 25 ± 2 °C)

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Lamp Input Voltage	V <sub>L</sub>	-	1560	-	V <sub>RMS</sub>	
Lamp Current	I <sub>L</sub>	11.8	12.3	12.8	mA <sub>RMS</sub>	(1)
Lamp Turn On Voltage	V <sub>S</sub>	-	-	2710	V <sub>RMS</sub>	Ta = 0 °C (2)
		-	-	2260	V <sub>RMS</sub>	Ta = 25 °C (2)
Operating Frequency	F <sub>L</sub>	40	-	70	KHZ	
Lamp Life Time	L <sub>BL</sub>	50,000	60,000	-	Hrs	(4)

### 3.2.2 INVERTER CHARACTERISTICS (Ta = 25 ± 2 °C)

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Total Power Consumption	P <sub>BL</sub>	-	74	78	W	(5), (6), I <sub>L</sub> = 12.3mA
Power Supply Voltage	V <sub>BL</sub>	22.8	24	25.2	V <sub>DC</sub>	
Power Supply Current	I <sub>BL</sub>	-	3.08	3.25	A	Non Dimming
Input Ripple Noise	-	-	-	912	mV <sub>P-P</sub>	V <sub>BL</sub> = 22.8V
Oscillating Frequency	F <sub>W</sub>	60	63	66	kHz	(3)
Dimming frequency	F <sub>B</sub>	150	160	170	Hz	
Minimum Duty Ratio	D <sub>MIN</sub>	10	20	-	%	(7)

Note (1) Lamp current is measured by utilizing AC current probe and its value is average by measuring master and slave board.

Note (2) The lamp starting voltage V<sub>S</sub> should be applied to the lamp for more than 1 second after startup. Otherwise the lamp may not be turned on.

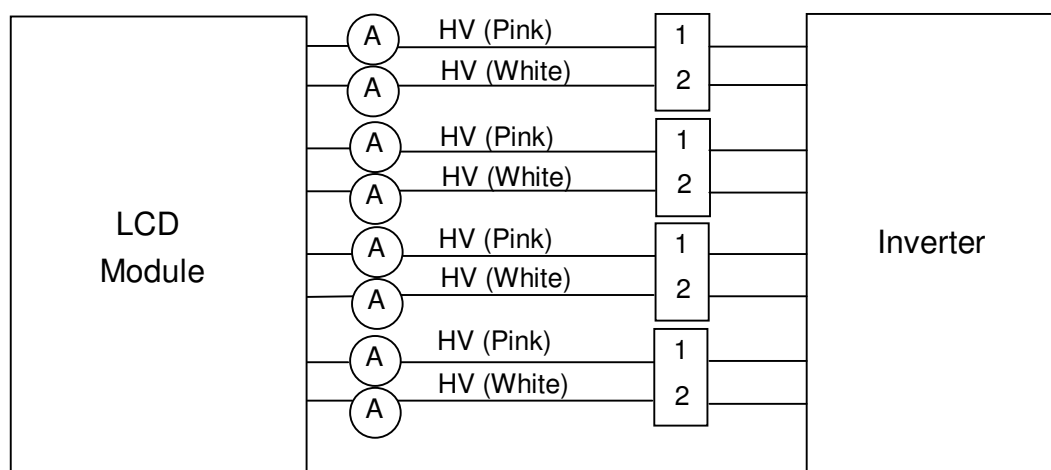
Note (3) The lamp frequency may produce interference with horizontal synchronous frequency of the display input signals, and it may result in line flow on the display. In order to avoid interference, the lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible.

Note (4) The life time of a lamp is defined as when the brightness is larger than 50% of its original value and the effective discharge length is longer than 80% of its original length (Effective discharge length is defined as an area that has equal to or more than 70% brightness compared to the brightness at the center point of lamp.) as the time in which it continues to operate under the condition at Ta = 25 ± 2 °C and I<sub>L</sub> = 11.8~ 12.8mA<sub>RMS</sub>.

Note (5) The power supply capacity should be higher than the total inverter power consumption P<sub>BL</sub>. Since the pulse width modulation (PWM) mode was applied for backlight dimming, the driving current changed as PWM duty on and off. The transient response of power supply should be considered for the changing loading when inverter dimming.

Note (6) The measurement condition of Max. value is based on 31.5" backlight unit under input voltage 24V, average lamp current 12.6 mA and lighting 30 minutes later.

Note (7) 10% minimum duty ratio is only valid for electrical operation



### 3.2.3 INVERTER INTERFACE CHARACTERISTICS

ITEM	SYMBOL	TEST CONDITION	MIN	TYPE	MAX	UNIT	NOTE	
DET_5V	DET_5V	—	4.5	5.0	5.5	V	Abnormal	
		—	0	—	0.8	V	Normal	
On/Off Control Voltage	ON	V <sub>BLON</sub>	—	3.3	—	5.3	V	
	OFF		—	0	—	0.8	V	
External PWM Control Voltage	HI	V <sub>EPWM</sub>	—	3.5	—	5.3	V	Duty on
	LO		—	0	—	0.8	V	Duty off
Control Signal Rising Time	Tr	—	—	—	100	ms		
Control Signal Falling Time	Tf	—	—	—	100	ms		
VBL Rising Time	Tr1	—	30	—	—	ms	10%-90%V <sub>BL</sub>	
VBL Falling Time	Tf1	—	30	—	—	ms		
PWM Signal Rising Time	T <sub>PWMR</sub>	—	—	—	100	us		
PWM Signal Falling Time	T <sub>PWMF</sub>	—	—	—	100	us		
Input impedance	R <sub>IN</sub>	—	1	—	—	MΩ		
PWM Delay Time	T <sub>PWM</sub>	—	100	—	—	mS		
BLON Delay Time	T <sub>on</sub>	—	300	—	—	mS		
	T <sub>on1</sub>	—	300	—	—	mS		
BLON Off Time	T <sub>OFF</sub>	—	300	—	—	mS		

Note (1) The Dimming signal should be valid before backlight turns on by BLON signal. It is inhibited to change the internal/external PWM signal during backlight turn on period.

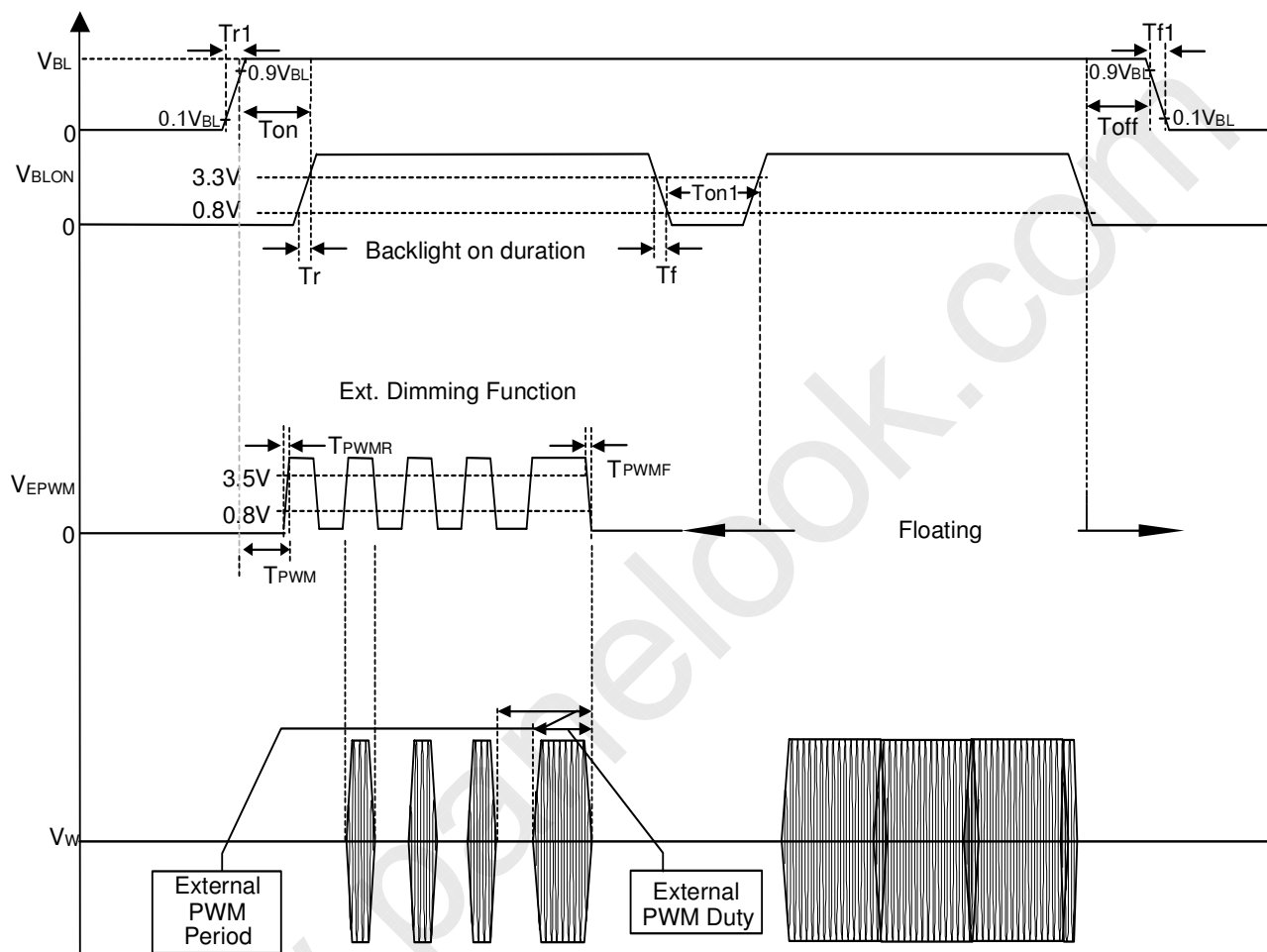
Note (2) The power sequence and control signal timing are shown in the following figure. For a certain reason, the inverter has a possibility to be damaged with wrong power sequence and control

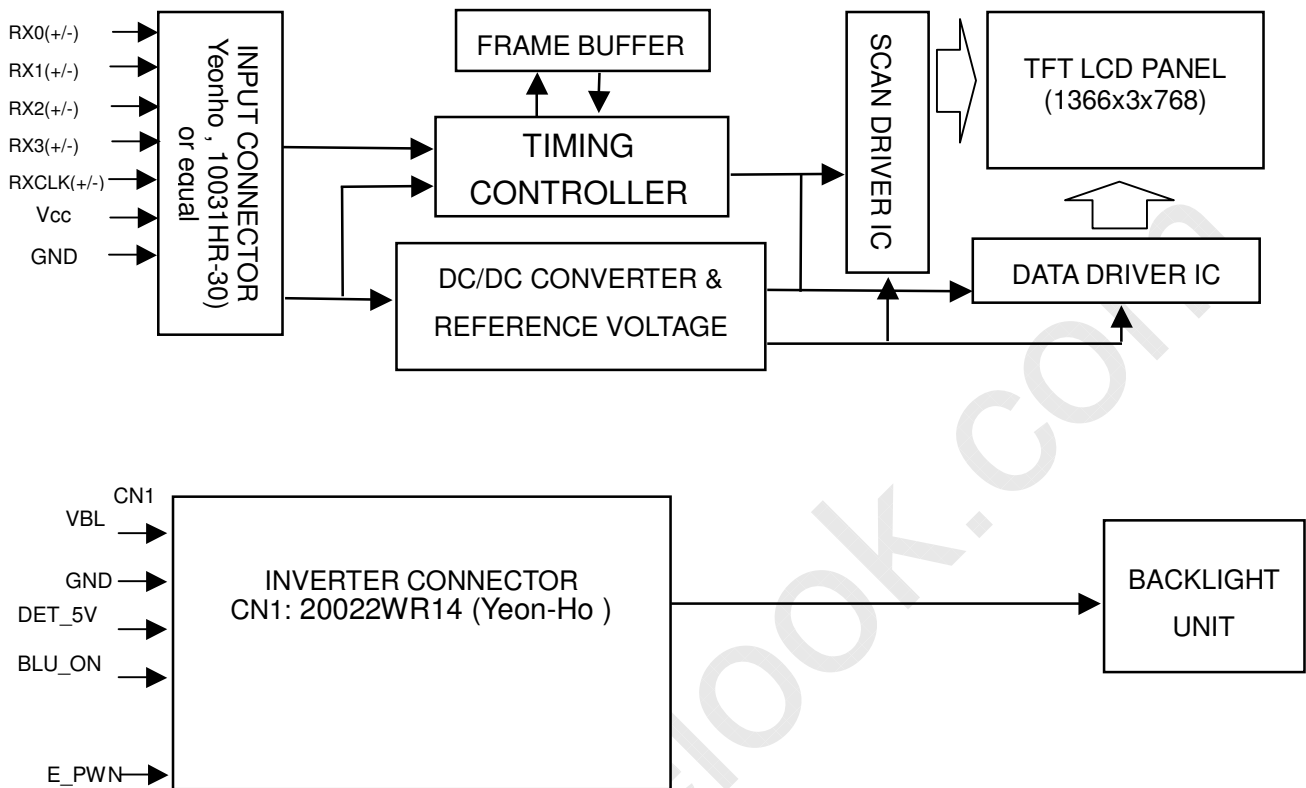
signal timing.

Note (3) While system is turned ON or OFF, the power sequences must follow as below descriptions:

Turn ON sequence: VBL → PWM signal → BLON

Turn OFF sequence: BLOFF → PWM signal → VBL



**4. BLOCK DIAGRAM**
**4.1 TFT LCD MODULE**


## 5. INTERFACE PIN CONNECTION

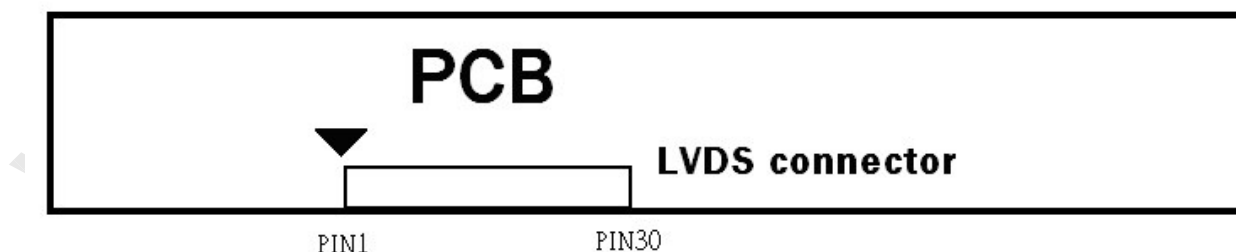
### 5.1 TFT LCD MODULE

#### CNF1 Connector Pin Assignment

Pin No.	Symbol	Description	Note
1	NC	No connection	(3)
2	SCL	EEPROM Serial Clock	
3	SDA	EEPROM Serial Data	
4	GND	Ground	
5	RX0-	Negative transmission data of pixel 0	
6	RX0+	Positive transmission data of pixel 0	
7	GND	Ground	
8	RX1-	Negative transmission data of pixel 1	
9	RX1+	Positive transmission data of pixel 1	
10	GND	Ground	
11	RX2-	Negative transmission data of pixel 2	
12	RX2+	Positive transmission data of pixel 2	
13	GND	Ground	
14	RXCLK-	Negative of clock	
15	RXCLK+	Positive of clock	
16	GND	Ground	
17	RX3-	Negative transmission data of pixel 3	
18	RX3+	Positive transmission data of pixel 3	
19	GND	Ground	
20	NC	No connection	(3)
21	SELLVDS	Select LVDS data format	(2)(4)
22	WP	EEPROM Write Protection	
23	GND	Ground	
24	GND	Ground	
25	GND	Ground	
26	VCC	Power supply: +12V	
27	VCC	Power supply: +12V	
28	VCC	Power supply: +12V	
29	VCC	Power supply: +12V	
30	VCC	Power supply: +12V	

Note (1) Connector type: 10031HR-30 (Yeonho) or compatible

LVDS connector pin order defined as follows



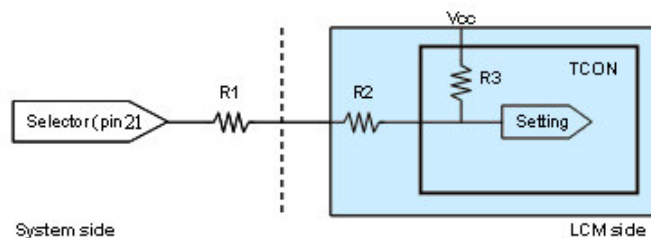
Note (2) HIGH = Connect to +3.3V or OPEN : VESA, LOW = connect to GND : JEIDA LVDS format

Please refer to 5.4 LVDS INTERFACE

Note (3) Reserved for internal use. Left it open.

Note (4) LVDS signal pin connected to the LCM side has the following diagram.

R1 in the system side should be less than 1K Ohm. ( $R1 < 1K \text{ Ohm}$ )



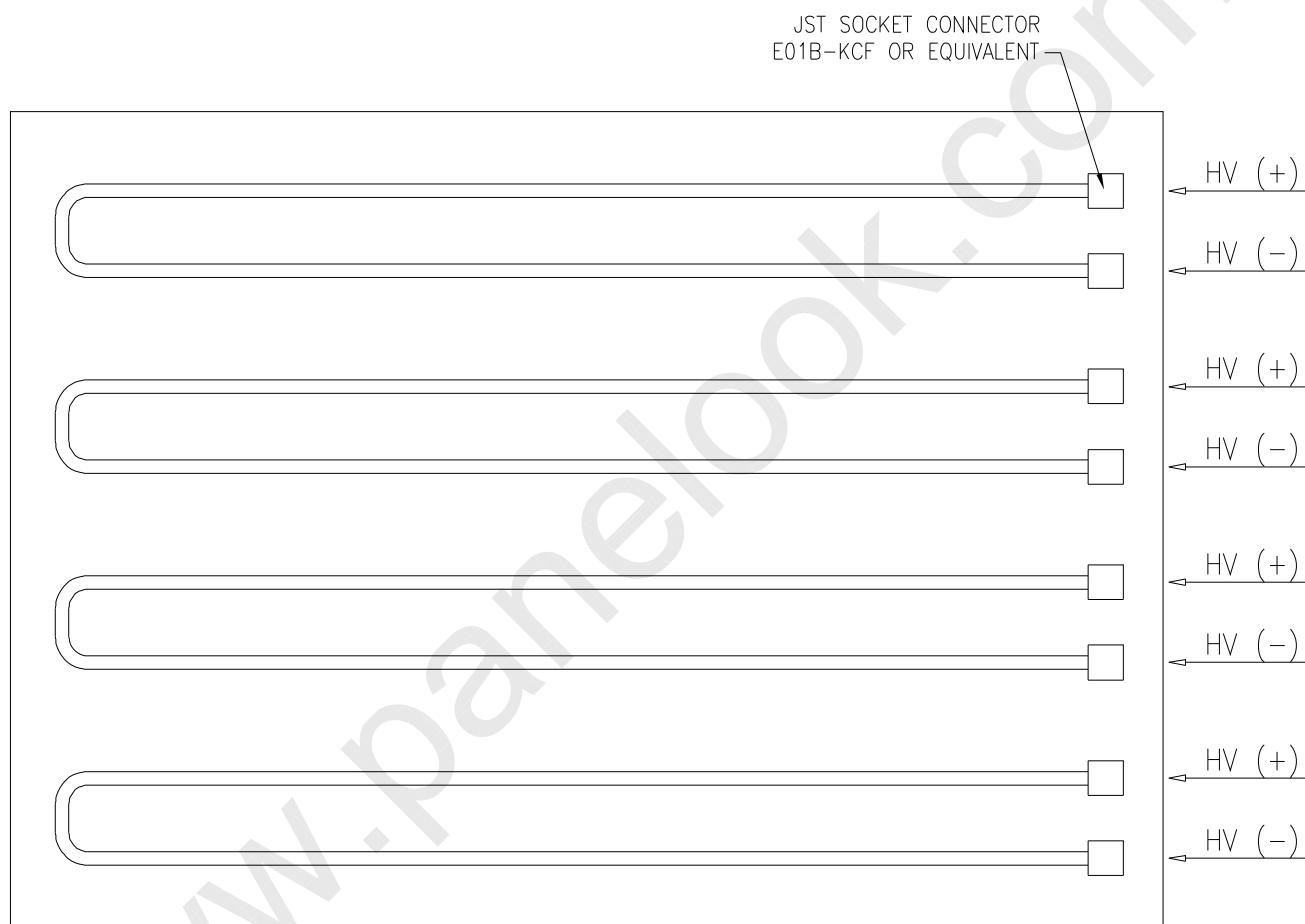
**5.2 BACKLIGHT UNIT**

The pin configuration for the housing and leader wire is shown in the table below.

CN2-CN5 (Socket Connector): E01B-KCF or equivalent

Pin No.	Symbol	Description	Remark
1	HV	High Voltage	
	HV	High Voltage	

Note (1) The backlight interface housing for high voltage side is a model E01B-KCF, manufactured by JST or equivalent.

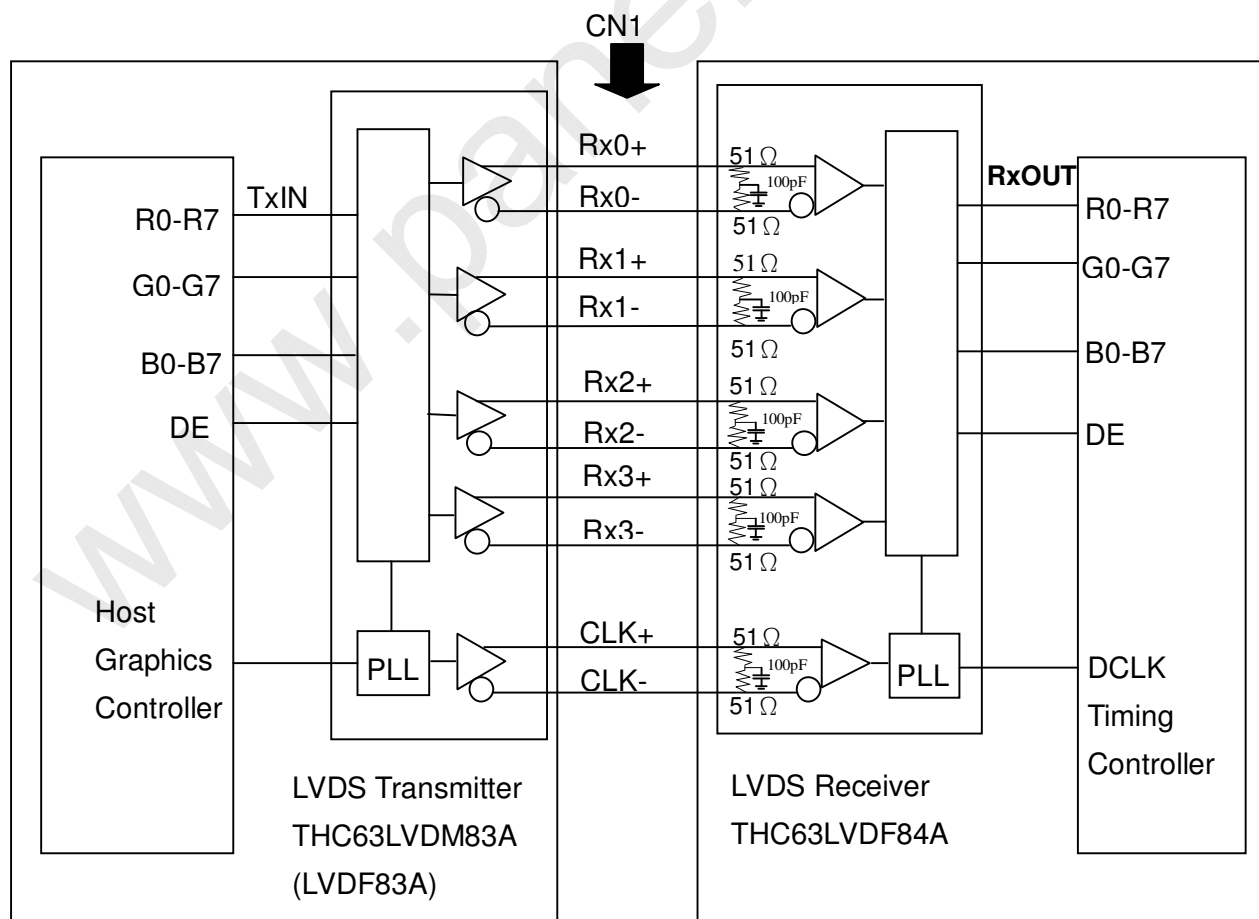




**5.3 INVERTER UNIT**

CN1(Header): 2002WR14 (Yeon-Ho )

Pin No.	Symbol	Description
1	VBL	+24V Power input
2		
3		
4		
5		
6	GND	Ground
7		
8		
9		
10		
11	DET_5V	Check Lamp Ignition.
12	BLU_ON	BL ON/OFF
13	N.C.	No connect.
14	E_PWM	External PWM Control

**5.3 BLOCK DIAGRAM OF INTERFACE**


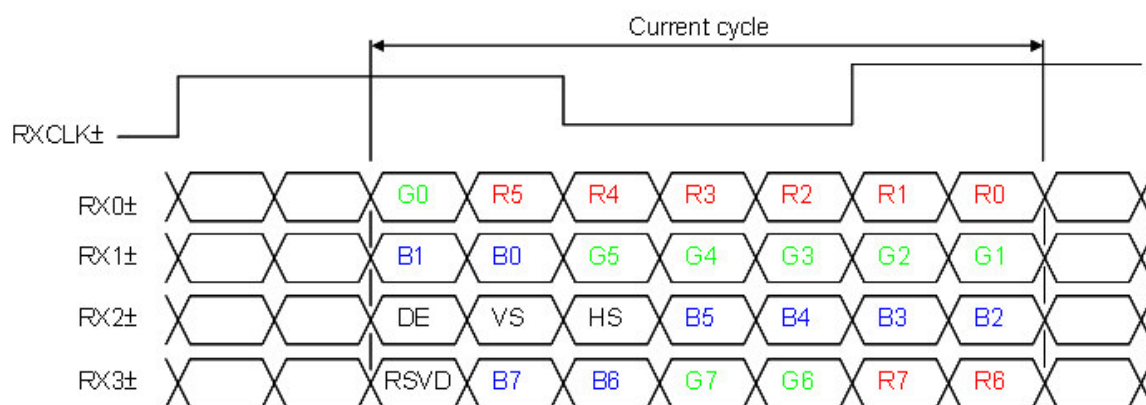
R0~R7 : Pixel R Data ,  
 G0~G7 : Pixel G Data ,  
 B0~B7 : Pixel B Data ,  
 DE : Data enable signal

Note (1) The system must have the transmitter to drive the module.

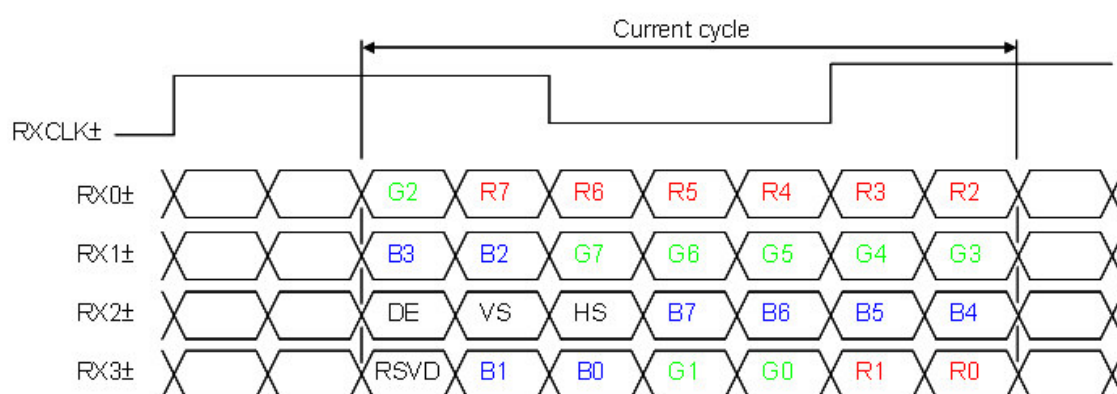
Note (2) LVDS cable impedance shall be 50 ohms per signal line or about 100 ohms per twist-pair line when it is used differentially.

## 5.4 LVDS INTERFACE

VESA LVDS format : (SELLVDS pin=H or open)



JEDIA LVDS format : (SELLVDS pin=L)



R0~R7: Pixel R Data (7; MSB, 0; LSB)

G0~G7: Pixel G Data (7; MSB, 0; LSB)

B0~B7: Pixel B Data (7; MSB, 0; LSB)

DE: Data enable signal

Notes(1) RSVD(reserved)pins on the transmitter shall be "H" or ("L" or OPEN)

### 5.5 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and 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 the assignment of color versus data input.

Color		Data Signal																						
		Red								Green								Blue						
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue	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
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	Yellow	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
Gray Scale Of Red	Red(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red(1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
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	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	Red(253)	1	1	1	1	1	1	0	1	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	
	Red(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Gray Scale Of Green	Green(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	
	Green(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
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	Green(253)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	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	
	Green(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	
Gray Scale Of Blue	Blue(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	Blue(253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	
	Blue(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	
	Blue(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	

Note (1) 0: Low Level Voltage, 1: High Level Voltage

## 6. INTERFACE TIMING

### 6.1 INPUT SIGNAL TIMING SPECIFICATIONS

The input signal timing specifications are shown as the following table and timing diagram.

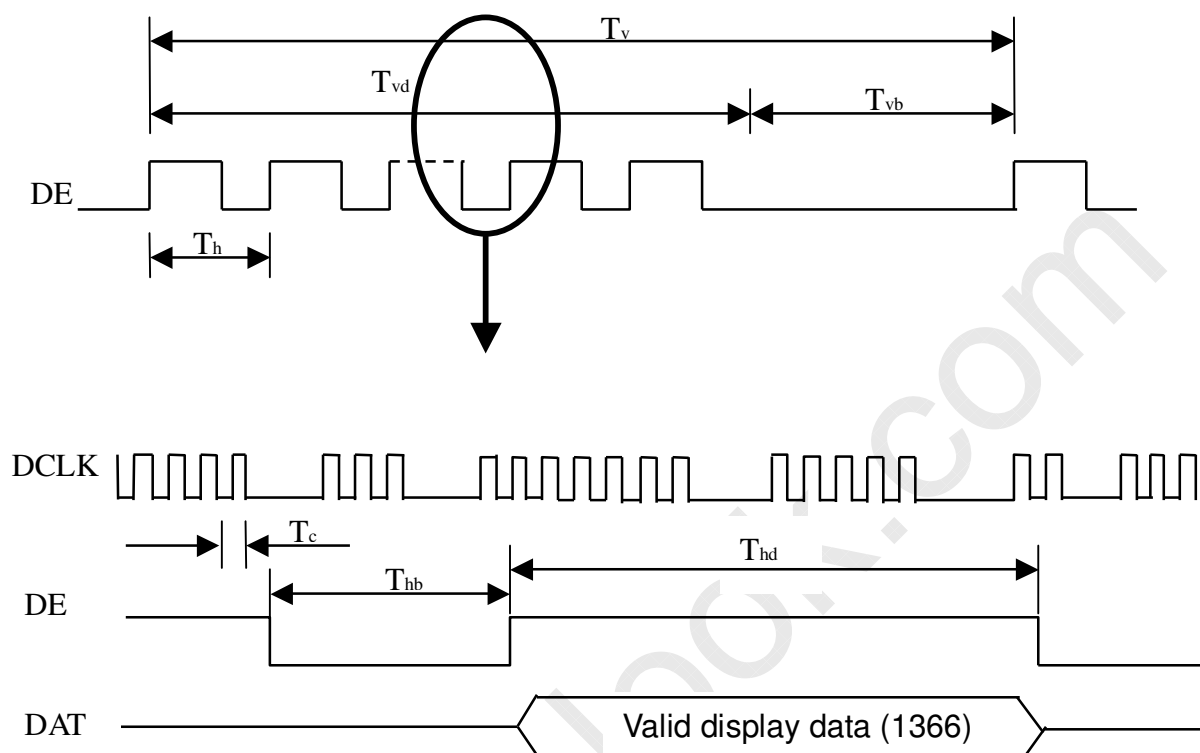
Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Receiver Clock	Frequency	$F_{clk_{in}}$ (=1/TC)	60	76	82	MHz	
	Input cycle to cycle jitter	$T_{rcj}$	—	—	200	ps	(3)
	Spread spectrum modulation range	$F_{clk_{in\_mod}}$	$F_{clk_{in}}-2\%$	—	$F_{clk_{in}}+2\%$	MHz	(4)
	Spread spectrum modulation frequency	$F_{SSM}$			200	KHz	
LVDS Receiver Data	Setup Time	$T_{lvsu}$	600	—	—	ps	(5)
	Hold Time	$T_{lvhd}$	600	—	—	ps	
Vertical Active Display Term	Frame Rate	$F_{r5}$	47	50	53	Hz	
		$F_{r6}$	57	60	63	Hz	
	Total	$T_v$	778	806	888	Th	$T_v=T_{vd}+T_{vb}$
	Display	$T_{vd}$	768	768	768	Th	—
	Blank	$T_{vb}$	10	38	120	Th	—
Horizontal Active Display Term	Total	$T_h$	1442	1560	1936	$T_c$	$T_h=T_{hd}+T_{hb}$
	Display	$T_{hd}$	1366	1366	1366	$T_c$	—
	Blank	$T_{hb}$	76	194	570	$T_c$	—

Note (1) Please make sure the range of pixel clock has follow the below equation :

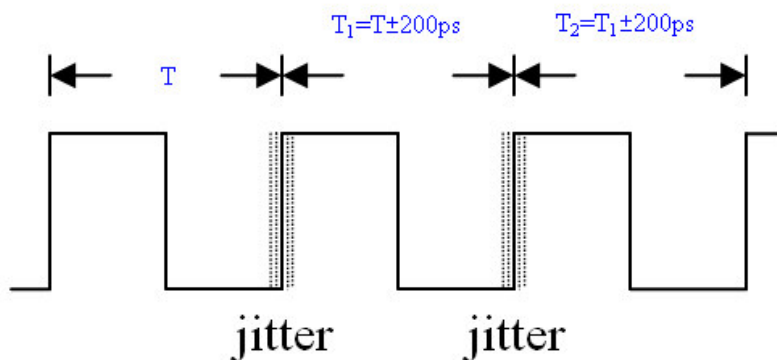
$$F_{clk_{in}(max)} \geq F_{r6} \times T_v \times T_h$$

$$F_{r5} \times T_v \times T_h \geq F_{clk_{in}(min)}$$

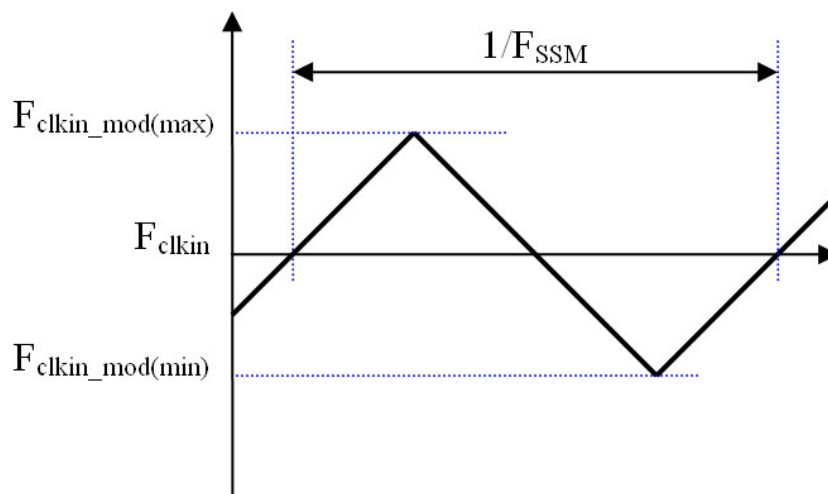
Note (2) This module is operated in DE only mode and please follow the input signal timing diagram below :

**INPUT SIGNAL TIMING DIAGRAM**


Note (3) The input clock cycle-to-cycle jitter is defined as below figures.  $Trcl = |T_1 - T_1|$

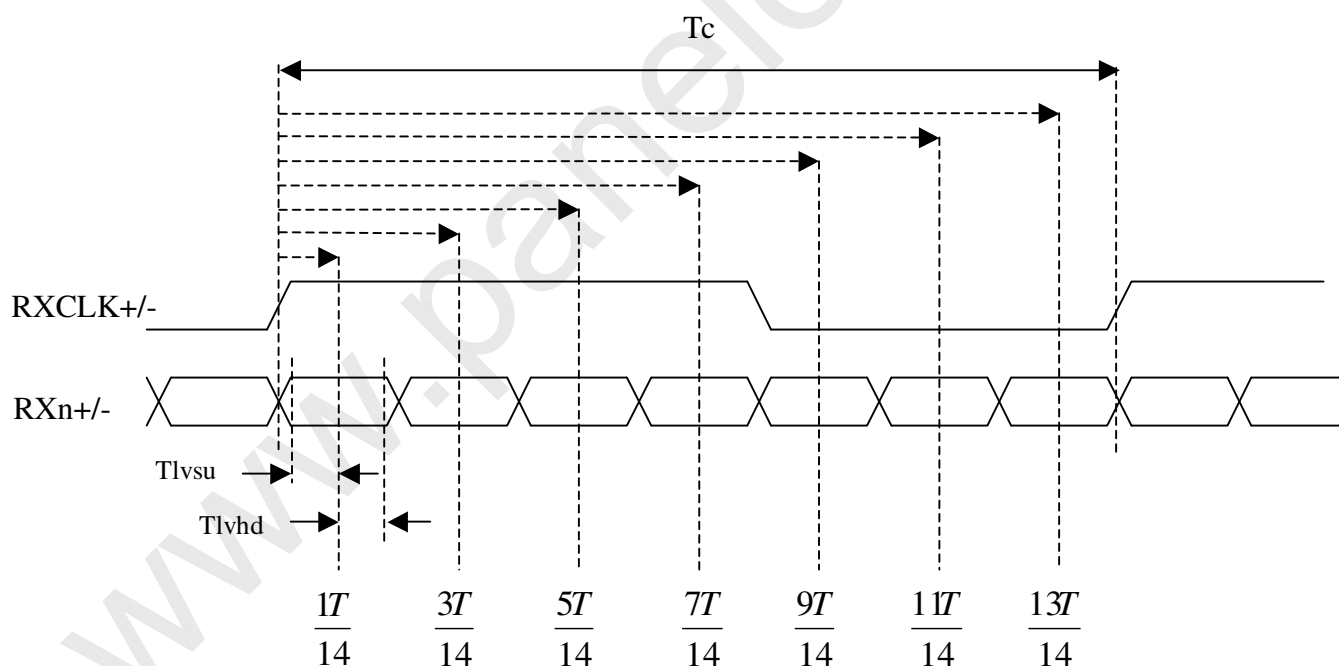


Note (4) The SSCG (Spread spectrum clock generator) is defined as below figures.



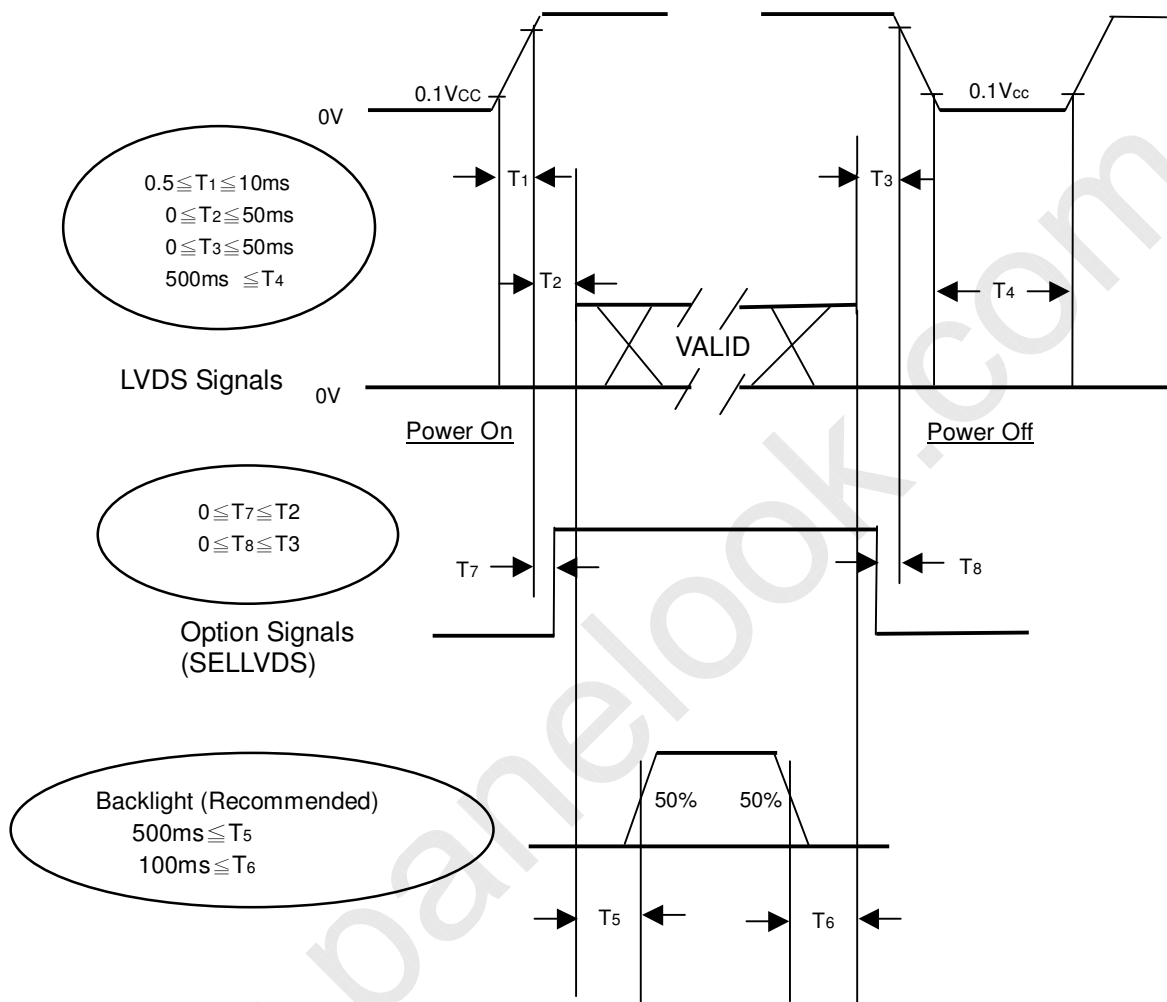
Note (5) The LVDS timing diagram and setup/hold time is defined and showing as the following figures.

### LVDS RECEIVER INTERFACE TIMING DIAGRAM



## 6.2 POWER ON/OFF SEQUENCE

To prevent a latch-up or DC operation of LCD module, the power on/off sequence should be as the diagram below.



**Power ON/OFF Sequence**

Note (1) The supply voltage of the external system for the module input should follow the definition of Vcc.

Note (2) Apply the lamp voltage within the LCD operation range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal screen.

Note (3) In case of Vcc is in off level, please keep the level of input signals on the low or high impedance. If  $T_2 < 0$ , that maybe cause electrical overstress failures.

Note (4) T4 should be measured after the module has been fully discharged between power off and on period.

Note (5) Interface signal shall not be kept at high impedance when the power is on.

## 7. OPTICAL CHARACTERISTICS

### 7.1 TEST CONDITIONS

Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V <sub>CC</sub>	12.0	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
Lamp Current	I <sub>L</sub>	12.3±0.5	mA
Oscillating Frequency (Inverter)	F <sub>w</sub>	63±3	KHz
Frame rate	Fr	60	Hz

### 7.2 OPTICAL SPECIFICATIONS

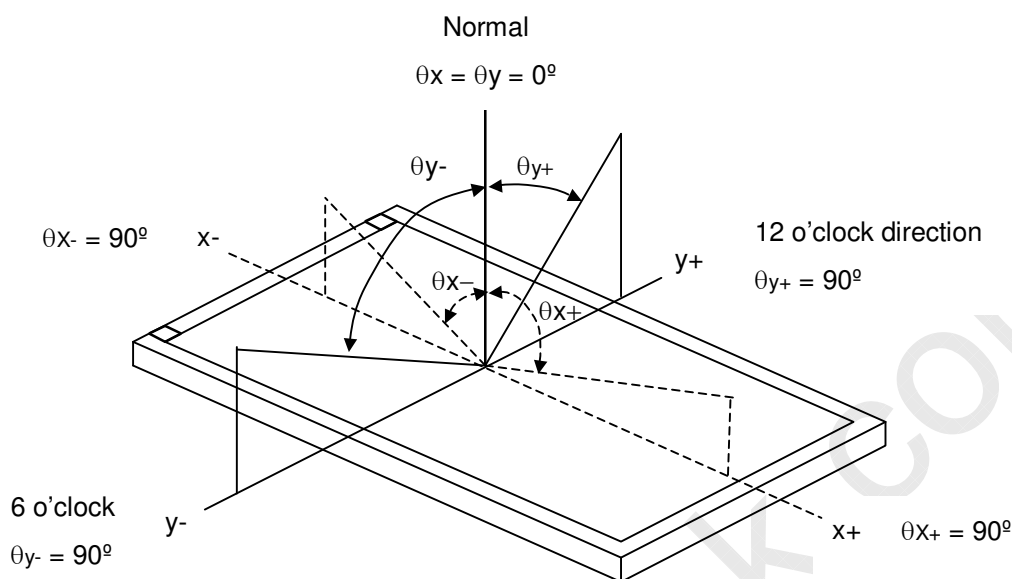
The relative measurement methods of optical characteristics are shown in 7.2. The following items should be measured under the test conditions described in 7.1 and stable environment shown in Note (6).

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note	
Contrast Ratio		CR	Viewing Angle at Normal Direction $\theta_x=0^\circ, \theta_y=0^\circ$	2600	3500	-	-	(2)	
Response Time		Gray to gray average		-	8.5	14	ms	(3)	
Center Luminance of White		L <sub>C</sub>		360	450	-	cd/m <sup>2</sup>	(4)	
White Variation		δW		-	-	1.3	-	(7)	
Cross Talk		CT		-	-	4.0	%	(5)	
Color Chromaticity	Red	R <sub>x</sub>		Typ -0.03	0.648	Typ +0.03	-	(6)	
		R <sub>y</sub>					-		
	Green	G <sub>x</sub>					0.331		-
		G <sub>y</sub>					0.272		-
	Blue	B <sub>x</sub>					0.601		-
		B <sub>y</sub>	0.143				-		
	White	W <sub>x</sub>	0.064				-		
		W <sub>y</sub>	0.280				-		
Color Gamut		CG	-	72	-	%	NTSC		
Viewing Angle	Horizontal	θ <sub>x+</sub>	CR≥20	80	88	-	Deg.	(1)	
		θ <sub>x-</sub>		80	88	-			
	Vertical	θ <sub>y+</sub>		80	88	-			
		θ <sub>y-</sub>		80	88	-			



Note (1) Definition of Viewing Angle ( $\theta_x, \theta_y$ ):

Viewing angles are measured by Autronic Conoscope Cono-80.



Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

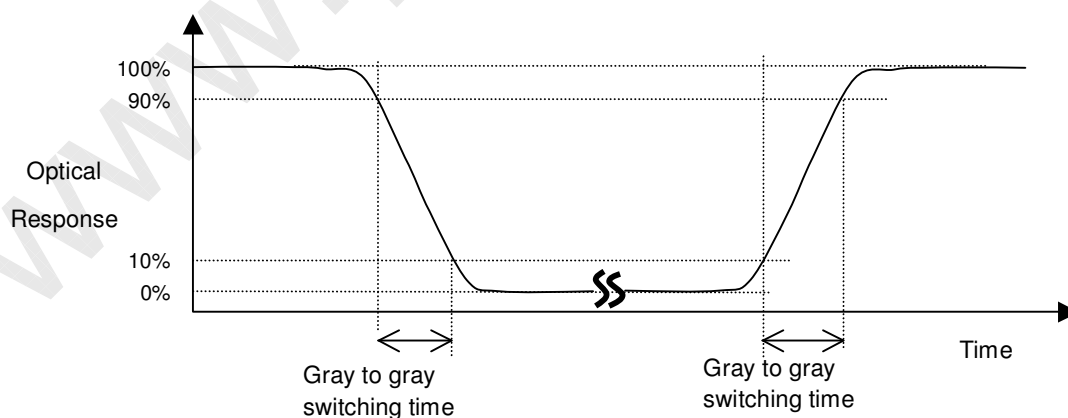
$$\text{Contrast Ratio (CR)} = L_{255} / L_0$$

L255: Luminance of gray level 255

L 0: Luminance of gray level 0

CR = CR (5), where CR (X) is corresponding to the Contrast Ratio of the point X at the figure in Note (7).

Note (3) Definition of Gray to Gray Switching Time :



The driving signal means the signal of luminance 0%, 20%, 40%, 60%, 80%, 100%.

Gray to gray average time means the average switching time of luminance 0%,20%,

40%, 60%, 80%, 100% to each other.

Note (4) Definition of Luminance of White ( $L_C$ ,  $L_{AVE}$ ):

Measure the luminance of gray level 255 at center point and 5 points

$$L_C = L(5)$$

$$L_{AVE} = [L(1) + L(2) + L(3) + L(4) + L(5)] / 5$$

where  $L(x)$  is corresponding to the luminance of the point  $X$  at the figure in Note (7).

Note (5) Definition of Cross Talk (CT):

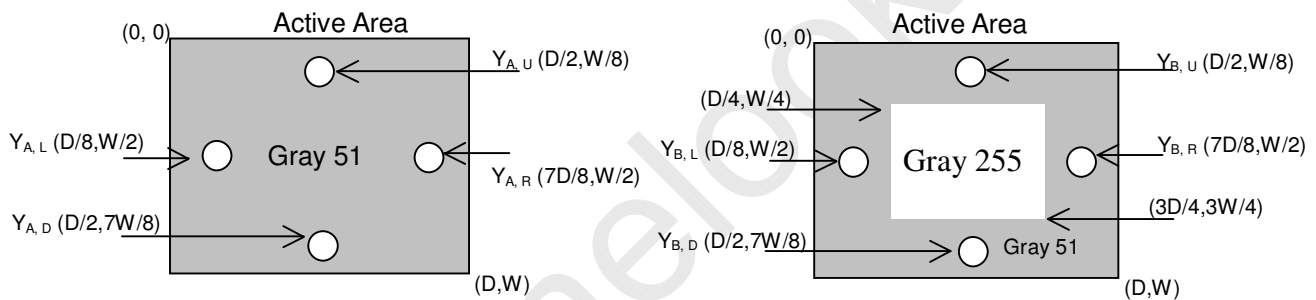
$$CT = |Y_B - Y_A| / Y_A \times 100 (\%)$$

Where:

(a)

$Y_A$  = Luminance of measured location without gray level 255 pattern ( $\text{cd}/\text{m}^2$ )

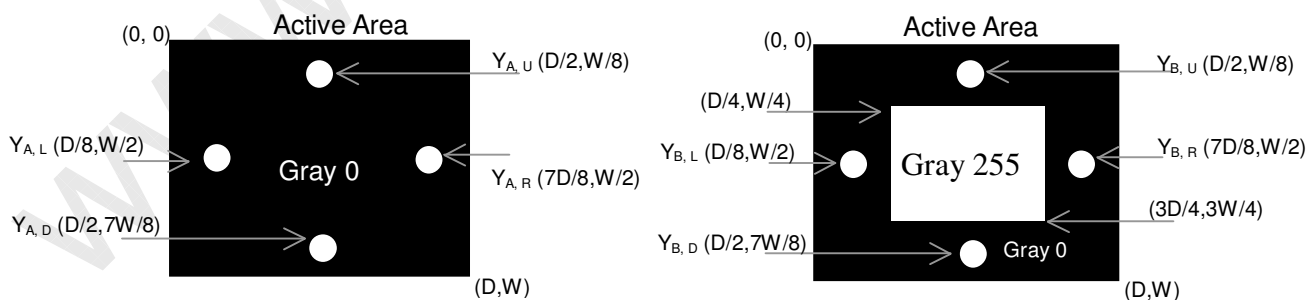
$Y_B$  = Luminance of measured location with gray level 255 pattern ( $\text{cd}/\text{m}^2$ )



(b)

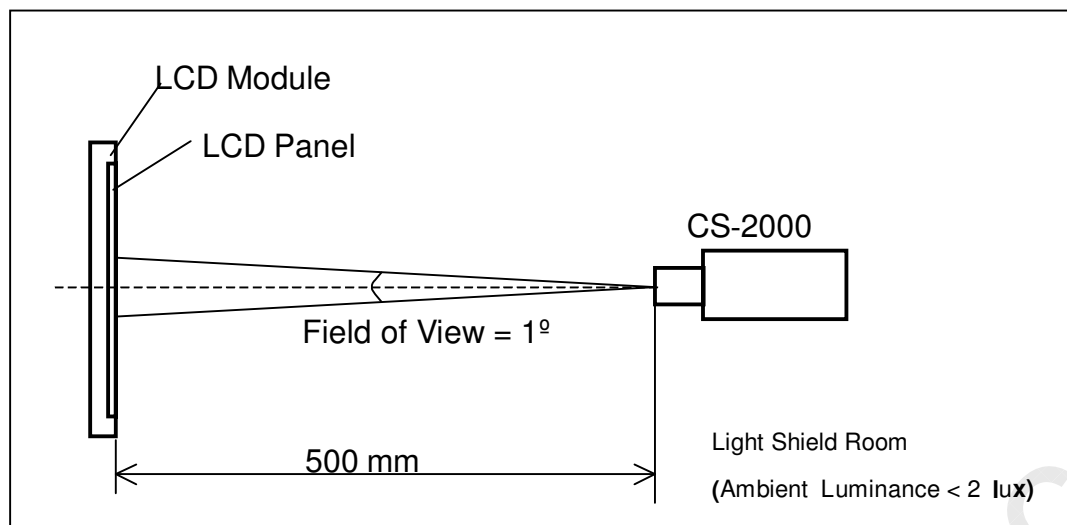
$Y_A$  = Luminance of measured location without gray level 255 pattern ( $\text{cd}/\text{m}^2$ )

$Y_B$  = Luminance of measured location with gray level 255 pattern ( $\text{cd}/\text{m}^2$ )



Note (6) Measurement Setup:

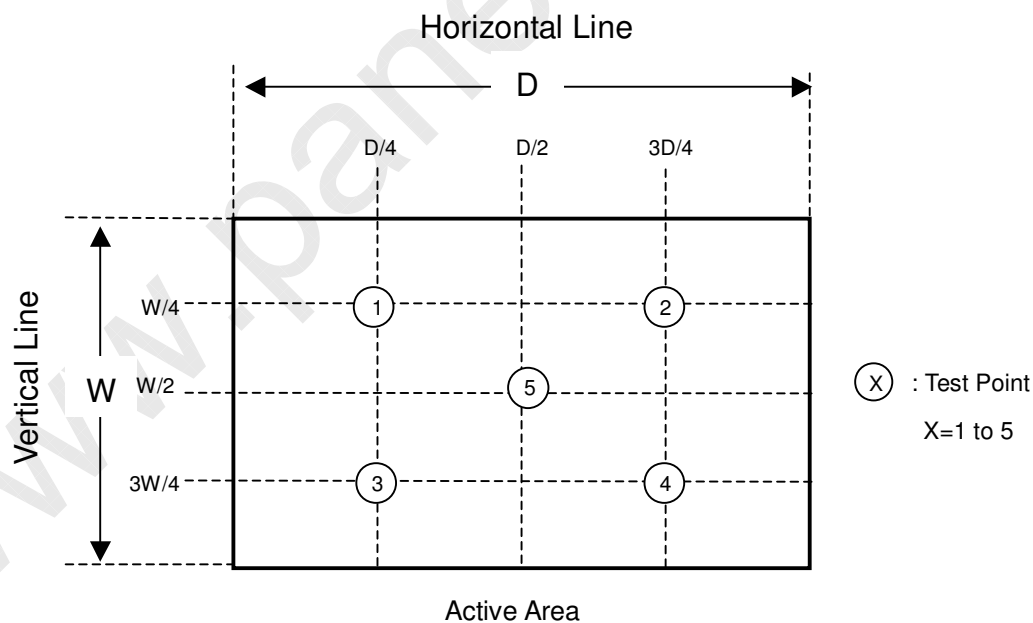
The LCD module should be stabilized at given temperature for 1 hour to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 1 hour in a windless room.



Note (7) Definition of White Variation ( $\delta W$ ):

Measure the luminance of gray level 255 at 5 points

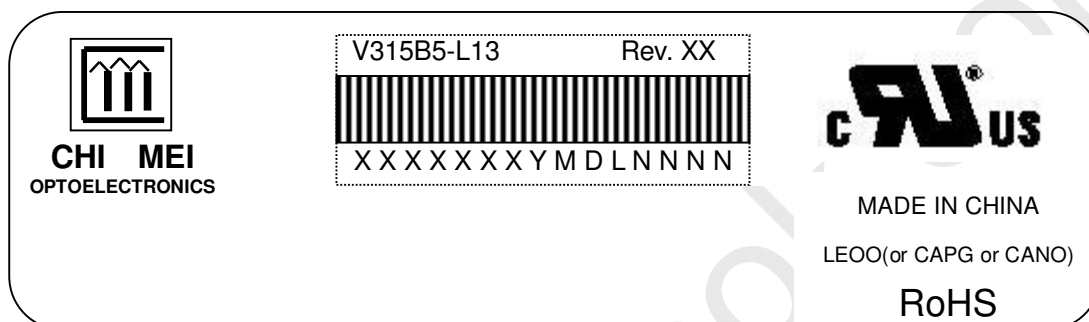
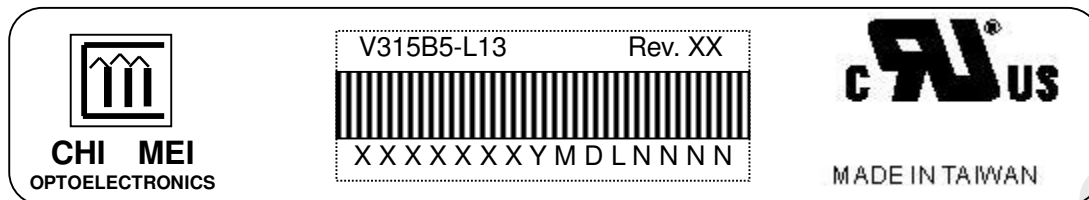
$$\delta W = \text{Maximum} [L (1), L (2), L (3), L (4), L (5)] / \text{Minimum} [L (1), L (2), L (3), L (4), L (5)]$$



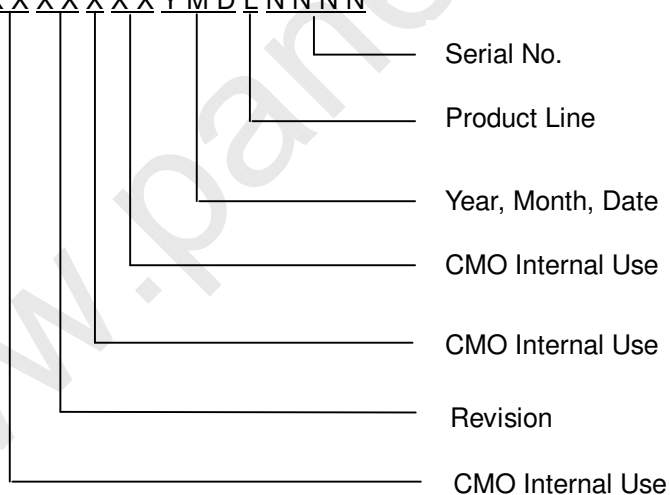
## 8. DEFINITION OF LABELS

### 8.1 CMO MODULE LABEL

The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.



- (a) Model Name: V315B5-L13
- (b) Revision: Rev. XX, for example: A0, A1... B1, B2... or C1, C2...etc.
- (c) Serial ID: XXXXXXXXXYMDLNNNN



## 9. PACKAGING

### 9.1 PACKING SPECIFICATIONS

- (1) 5 LCD TV modules / 1 Box
- (2) Box dimensions : 826(L) X 376 (W) X 540 (H)
- (3) Weight : approximately 30Kg (5 modules per box)

### 9.2 PACKING METHOD

Figures 9-1 and 9-2 are the packing method

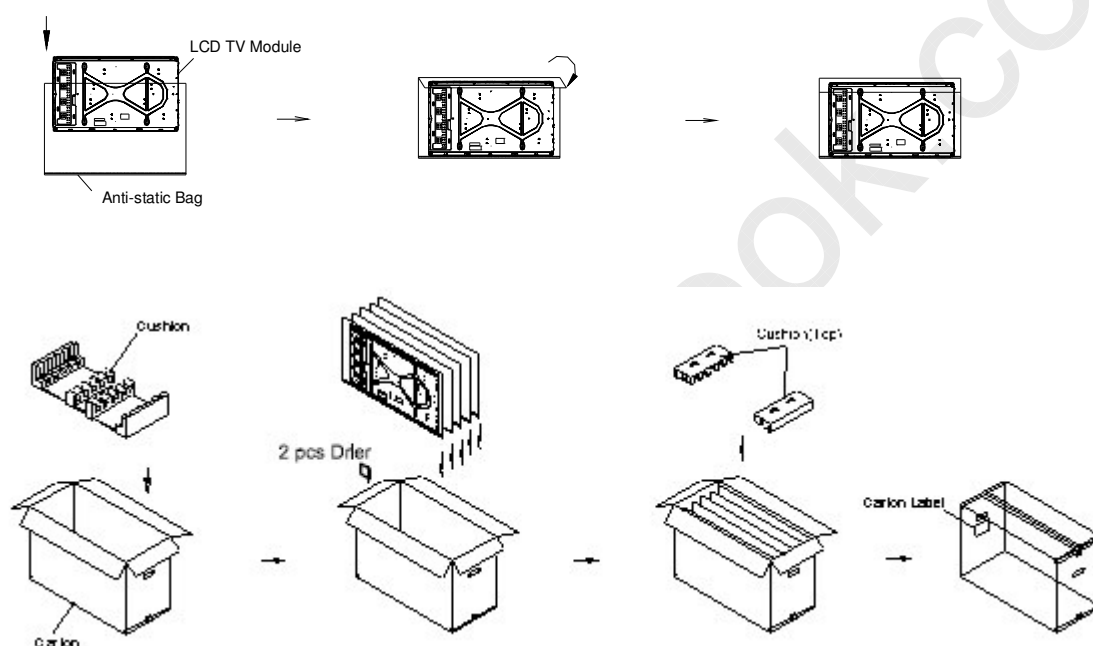
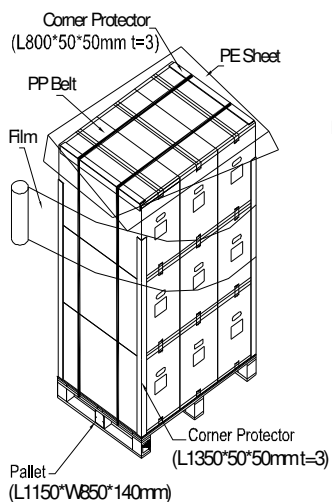
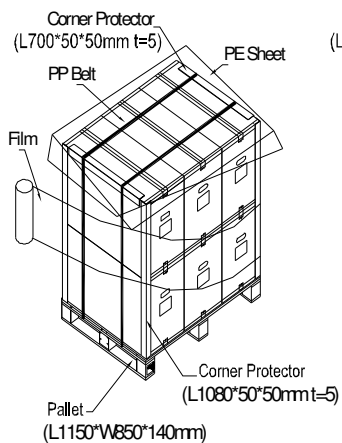


Figure.9-1 packing method

Sea / Land Transportation  
 (40ft Container)  
 Gross:285kg



Air Transportation  
 Gross:195kg



Sea / Land Transportation  
 (40ft HQ Container)  
 Gross:390kg

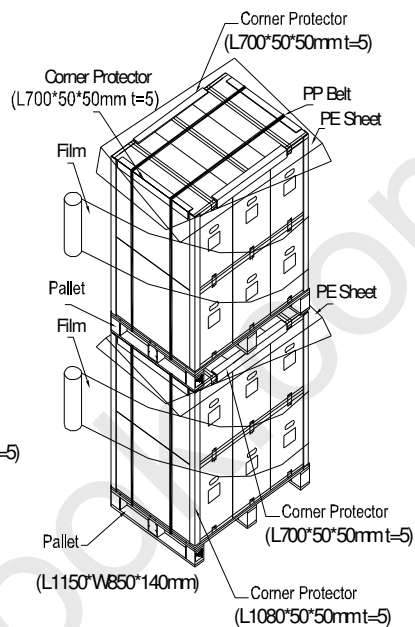


Figure.9-2 packing method

## 10. PRECAUTIONS

### 10.1 ASSEMBLY AND HANDLING PRECAUTIONS

- (1) Do not apply rough force such as bending or twisting to the module during assembly.
- (2) It is recommended to assemble or to install a module into the user's system in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- (3) Do not apply pressure or impulse to the module to prevent the damage of LCD panel and backlight.
- (4) Always follow the correct power-on sequence when the LCD module is turned on. This can prevent the damage and latch-up of the CMOS LSI chips.
- (5) Do not plug in or pull out the I/F connector while the module is in operation.
- (6) Do not disassemble the module.
- (7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
- (8) Moisture can easily penetrate into LCD module and may cause the damage during operation.
- (9) High temperature or humidity may deteriorate the performance of LCD module. Please store LCD modules in the specified storage conditions.
- (10) When ambient temperature is lower than 10°C, the display quality might be reduced. For example, the response time will become slow, and the starting voltage of CCFL will be higher than that of room temperature.

### 10.2 SAFETY PRECAUTIONS

- (1) The startup voltage of a backlight is over 1000 Volts. It may cause an electrical shock while assembling with the inverter. Do not disassemble the module or insert anything into the backlight unit.
- (2) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
- (3) After the module's end of life, it is not harmful in case of normal operation and storage.

11. MECHANICAL CHARACTERISTICS

