TFT LCD Tentative Specification

MODEL NO.: V216B1- LN1

LCD TV Head Division	
AVP	

QRA Dept.	TVHD / PDD		
	DDIII	DDII	DDI
Approval	Approval	Approval	Approval

LCD TV Marketing and Product Management Division	
Product Manager	

1. GENERAL SPECIFICATIONS

1.1 OVERVIEW

The V216B1-LN1 model is a 21.6 inch wide TFT-LCD module with a 4-CCFL Backlight Unit and a 55-pin 1-path RSDS interface. This module supports 1366 x 768 (16:9 wide screen) mode and displays up to 16.7 millions colors. The inverter module for the Backlight Unit is not built in.

1.2 GENERAL

Item	Specification	Unit	Note
Active Area	477.417 (H) x 268.416 (V) (21.6" diagonal)	mm	
Bezel Opening Area	481.5 (H) x 272.5 (V)	mm	
Driver Element	a-si TFT active matrix	-	
Pixel Number	1366 x R.G.B. x 768	pixel	
Pixel Pitch (Sub Pixel)	0.1165 (H) x 0.3495 (V)	mm	
Pixel Arrangement	RGB vertical stripe	-	
Display Colors	16.7 millions	color	
Display Operation Mode	Transmissive mode / Normally White	-	
Surface Treatment	Hard coating (3H), AG (Haze 25%)	-	

1.3 MECHANICAL

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal(H)	500.3	501	501.7	mm	
	Vertical(V)	296.4	297	297.6	mm	
	Depth(D)	16.8	17.3	17.8	mm	To PCB cover
Weight		Na	2300	Na	g	

2. ABSOLUTE MAXIMUM RATINGS

2.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	T_{ST}	-20	+60	ºC	(1)
Operating Ambient Temperature	T_{OP}	0	+50	ºC	(1), (2)
Shock (Non-Operating)	S_{NOP}	-	50	G	(3), (5)
Vibration (Non-Operating)	V_{NOP}	-	1.0	G	(4), (5)

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

(a) 90% RH Max. (Ta ≦ 40 ºC).

(b) Wet-bulb temperature should be 39 ºC Max. (Ta > 40 ºC).

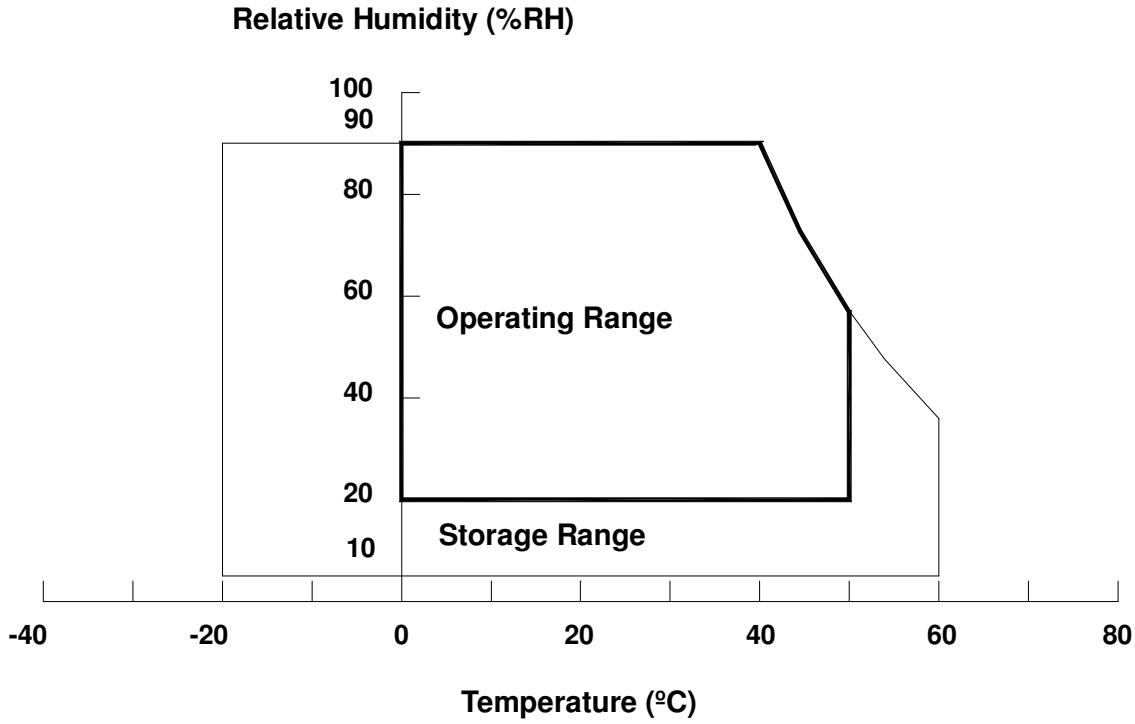
(c) No condensation.

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 ºC 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 ºC. 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 ± X, ± Y, ± 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 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	VAA	-0.3	14.0	V	
	VGH	-0.3	30.0	V	
	VGL	-10.0	-0.3	V	
Input Signal Voltage	VIN	-0.3	3.6	V	

2.3 BACKLIGHT UNIT

Item	Symbol	Test Condition	Min.	Type	Max.	Unit	Note
Lamp Voltage	V_W	Ta = 25 ℃	—	—	3000	V_{RMS}	

3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

Ta = 25 ± 2 ºC

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V_{GH}	22	23	24	V	
		V_{GL}	-6.0	-5.5	-5.0	V	
		V_{AA}	11.85	12.1	12.35	V	
		V_{DD}	3.2	3.3	3.4	V	
Power Supply Current		I_{GH}	-	10	-	mA	
		I_{GL}	-	3	-	mA	
		I_{AA}	-	190	250	mA	
		I_{VDD}	-	110	-	mA	
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) IAA value is maximum at black pattern

Note (2) The module should be always operated within above ranges.

3.2 RSDS CHARACTERISTICS

Ta = -10~+85 ºC

Item	Symbol	Condition	Value			Unit
			Min	Typ	Max	
RSDS high input Voltage	$V_{DIFFRSDS}$	V_{CMRSDS} = +1.2 V (1)	100	200	-	mV
RSDS low input Voltage	$V_{DIFFRSDS}$	V_{CMRSDS} = +1.2 V (1)	-	-200	-100	mV
RSDS common mode input voltage range	V_{CMRSDS}	$V_{DIFFRSDS}$ = 200mV (2)	VSSD+0.1	Note(3)	VDDD-1.2	V
RSDS Input leakage current	I_{DL}	$D_{xx}P$, $D_{xx}N$,CLKO ,CLPN	-10	-	10	μA

Note (1) V_{CMRSDS} = (VCLKP + VCLKN)/2 or V_{CMRSDS} = ($VD_{XX}P$ + $VD_{XX}N$)/2

Note (2) $V_{DIFFRSDS}$ = VCLKP - VCLKN or $V_{DIFFRSDS}$ = $VD_{XX}P$ - $VD_{XX}N$

Note (3) V_{CMRSDS} = 1.2V(VDDD = 3.3V)

3.3 CCFL (Cold Cathode Fluorescent Lamp) CHARACTERISTICS (Ta = 25 ± 2 ºC)

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Lamp Voltage	V_W	-	(800)	-	V_{RMS}	I_L = 7.0mA
Lamp Current	I_L	6.5	7.0	7.5	mA_{RMS}	
Lamp Turn On Voltage	Vs			(1225)	V_{RMS}	(2), Ta = 25 ºC
				(1425)	V_{RMS}	(2), Ta = 0 ºC
Operating Frequency	F_L	40		80	KHz	(3)
Lamp Life Time	L_{BL}	50000			Hrs	(4)

Note (1) The waveform of the voltage output of inverter must be area-symmetric and the design of the inverter must have specifications for the modularized lamp. The performance of the Backlight, such as lifetime or brightness, is greatly influenced by the characteristics of the DC-AC inverter for the lamp. All the parameters of an inverter should be carefully designed to avoid producing too much current leakage from high voltage output of the inverter. When designing or ordering the inverter please make sure that a poor lighting caused by the mismatch of the Backlight and the inverter (miss-lighting, flicker, etc.) never occurs. If the above situation is confirmed, the module should be operated in the same manners when it is installed in your instrument.

Note (2) The lamp starting voltage V_S 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℃ and I_L = 7.0 mArms.

4. BLOCK DIAGRAM

4.1 TFT LCD MODULE

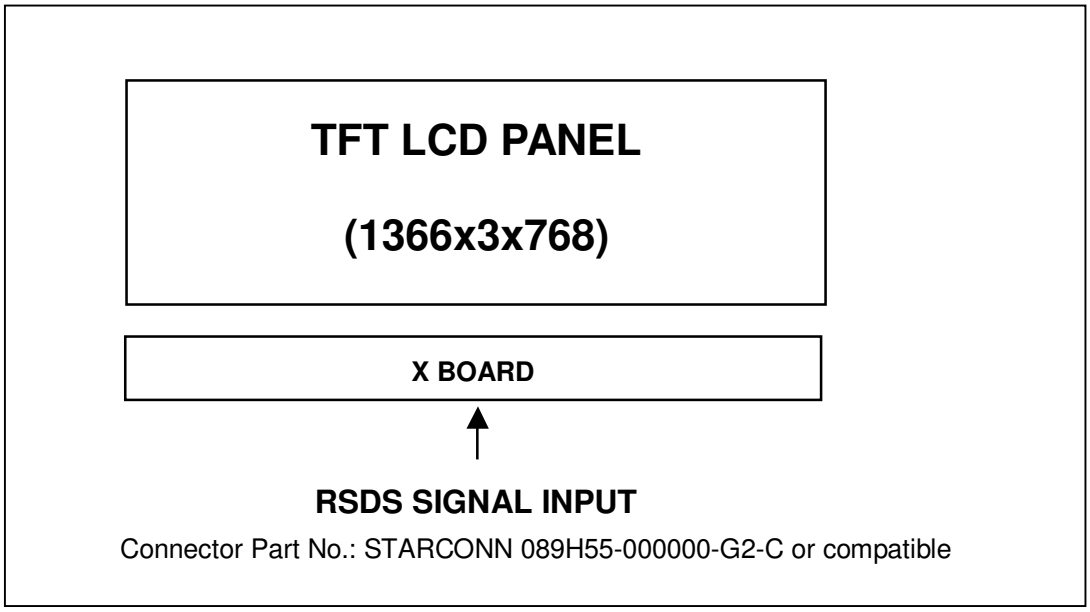


Figure.4-1 TFT LCD module block diagram

5. INTERFACE PIN CONNECTION

5.1 TFT LCD MODULE

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	GND	Ground	29	GM8	Gamma voltage 8
2	B2P	RSDS data signal (Blue 2)	30	GM7	Gamma voltage 7
3	B2N	RSDS data signal (Blue 2)	31	GM6	Gamma voltage 6
4	B1P	RSDS data signal (Blue 1)	32	GM5	Gamma voltage 5
5	B1N	RSDS data signal (Blue 1)	33	GM4	Gamma voltage 4
6	B0P	RSDS data signal (Blue 0)	34	GM3	Gamma voltage 3
7	B0N	RSDS data signal (Blue 0)	35	GM2	Gamma voltage 2
8	G2P	RSDS data signal (Green 2)	36	GM1	Gamma voltage 1 (highest)
9	G2N	RSDS data signal (Green 2)	37	GND	Ground
10	G1P	RSDS data signal (Green 1)	38	VDD	Driver IC logic power supply
11	G1N	RSDS data signal (Green 1)	39	VDD	Driver IC logic power supply
12	G0P	RSDS data signal (Green 0)	40	VAA	Source IC analog power supply
13	G0N	RSDS data signal (Green 0)	41	VAA	Source IC analog power supply
14	CLKP	RSDS clock	42	VAA	Source IC analog power supply
15	CLKN	RSDS clock	43	TP1	Source IC data latch
16	R2P	RSDS data signal (Red 2)	44	POL	Source IC output polarity
17	R2N	RSDS data signal (Red 2)	45	STH	Horizontal start pulse
18	R1P	RSDS data signal (Red 1)	46	NC	No connection
19	R1N	RSDS data signal (Red 1)	47	NC	No connection
20	R0P	RSDS data signal (Red 0)	48	STV	Vertical start pulse
21	R0N	RSDS data signal (Red 0)	49	CKV	Gate IC clock
22	GND	Ground	50	OE	Gate IC output enable
23	GM14	Gamma voltage 14 (lowest)	51	/XAO	Force Gate IC output to Vgh level
24	GM13	Gamma voltage 13	52	VGL	Gate IC power supply
25	GM12	Gamma voltage 12	53	GND	Ground
26	GM11	Gamma voltage 11	54	VGH	Gate IC power supply
27	GM10	Gamma voltage 10	55	GND	Ground
28	GM9	Gamma voltage 9			

Note (1) Connector part no.: STARCONN 089H55-000000-G2-C (0.5mm FFC) or compatible

5.2 BACKLIGHT UNIT

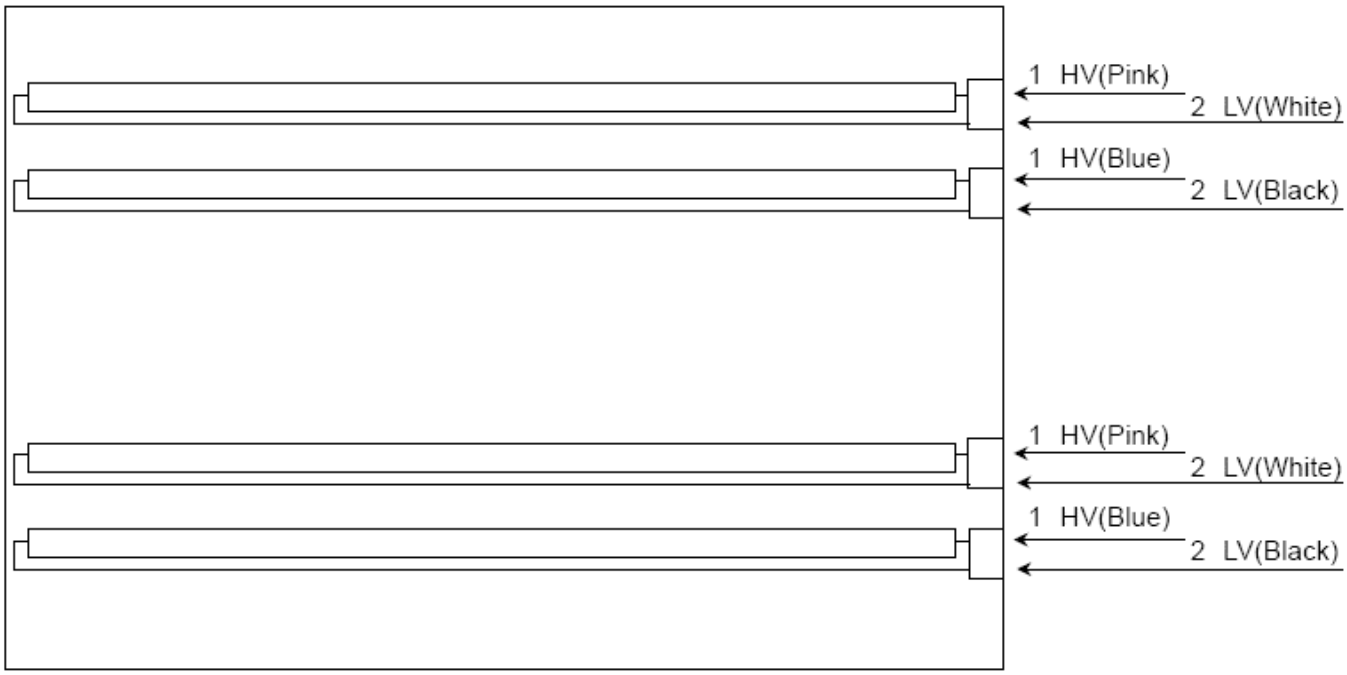


Figure 5.-1 Backlight unit

5.3 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 6-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					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Colors	Black	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	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	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
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
	Red(1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(63)	1	1	1	1	1	1	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
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(61)	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green(63)	0	0	0	0	0	0	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
	Blue(1)	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	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

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

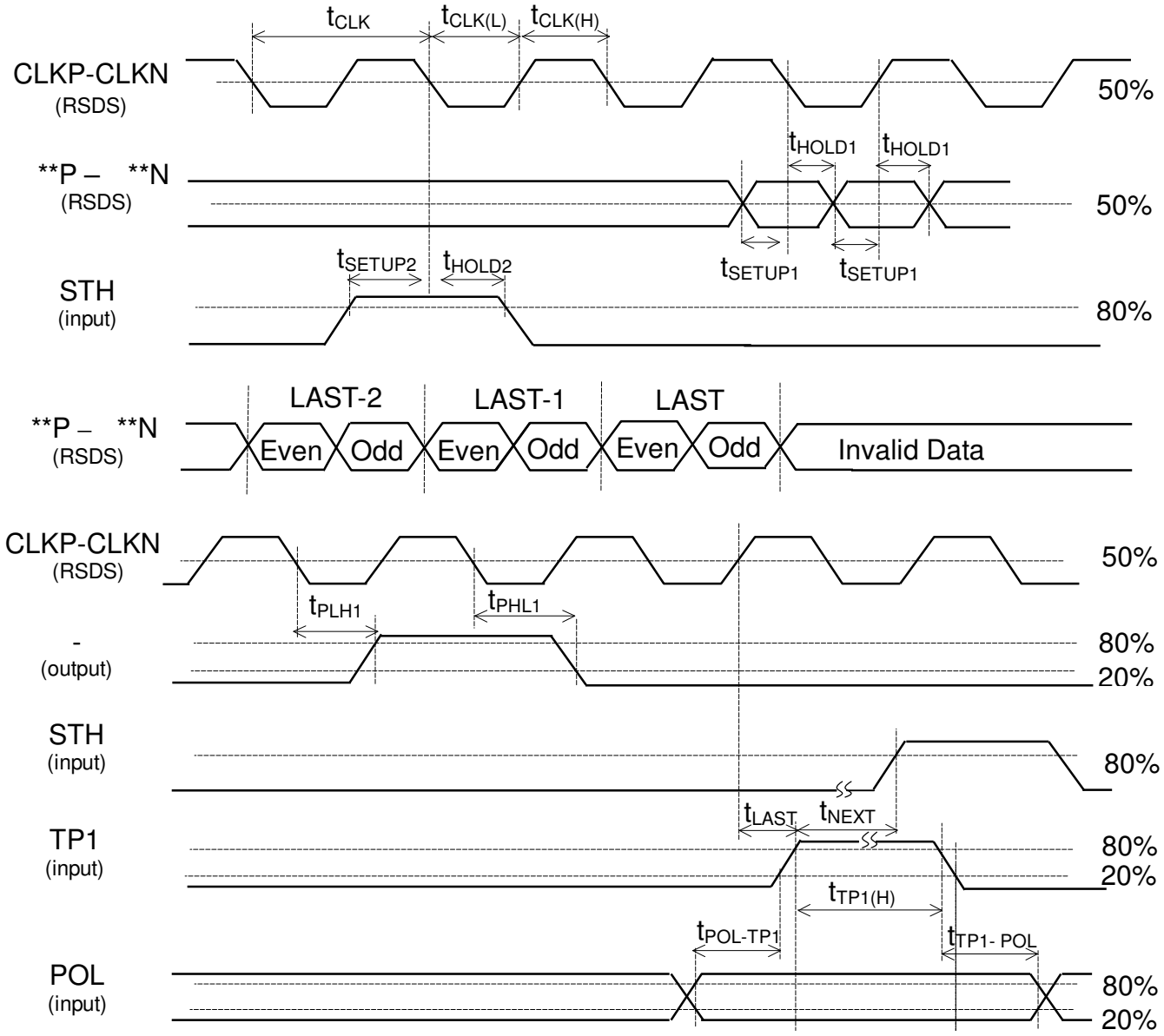
6. INTERFACE TIMING

6.1 INPUT SIGNAL TIMING SPECIFICATIONS

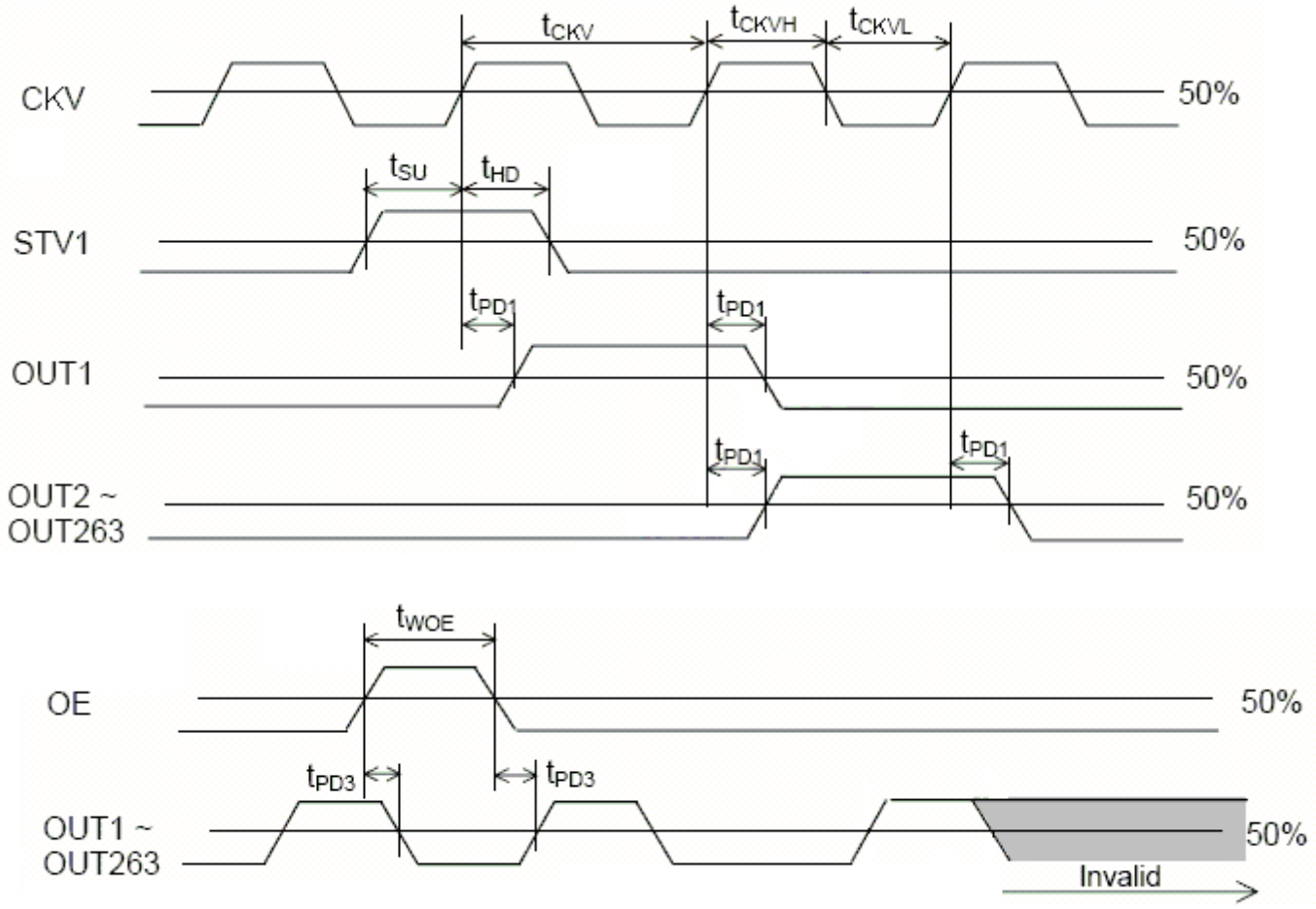
(a) Timing Spec

	Parameter	Symbol	Condition	Spec			Unit
				Min.	Typ.	Max.	
HD	Clock pulse width	t_{CLK}	-	12.5	-	-	ns
	Clock pulse low period	$t_{CLK(L)}$	-	5	-	-	ns
	Clock pulse high period	$t_{CLK(H)}$	-	5	-	-	ns
	Data setup time	t_{SETUP1}	-	4	-	-	ns
	Data hold time	t_{HOLD1}	-	1.5	-	-	ns
	Start pulse setup time	t_{SETUP2}	-	2.3	-	-	ns
	Start pulse hold time	t_{HOLD2}	-	2	-	-	ns
	TP1 high period	$t_{TP1(H)}$	-	15	-	-	CLKP
	Last data CLK to TP1 high	t_{LAST}	-	1	-	-	CLKP
	TP1 high to STH high	t_{NEXT}	-	6	-	-	CLKP
	POL to TP1 setup time	$t_{POL-TP1}$	POL toggle to TP1 rising	3	-	-	ns
	TP1 to POL hold time	$t_{TP1-POL}$	TP1 falling to POL toggle	2	-	-	ns
VD	CKV period	t_{CKV}	-	5	-		μs
	CKV pulse width	t_{CKVH}, t_{CKVL}	50% duty cycle	2.5	-		μs
	OE pulse width	t_{WOE}	-	1	-		μs
	Data setup time	t_{SU}	-	0.7	-		μs
	Data hold time	t_{HD}	-	0.7	-		μs
	CKV to output delay time	t_{PD1}	CL=300pF	-	-	1	μs
	OE to output delay time	t_{PD3}	CL=300pF	-	-	0.8	μs

(b) Horizontal Timing Chart



(c) Vertical Timing Chart



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.

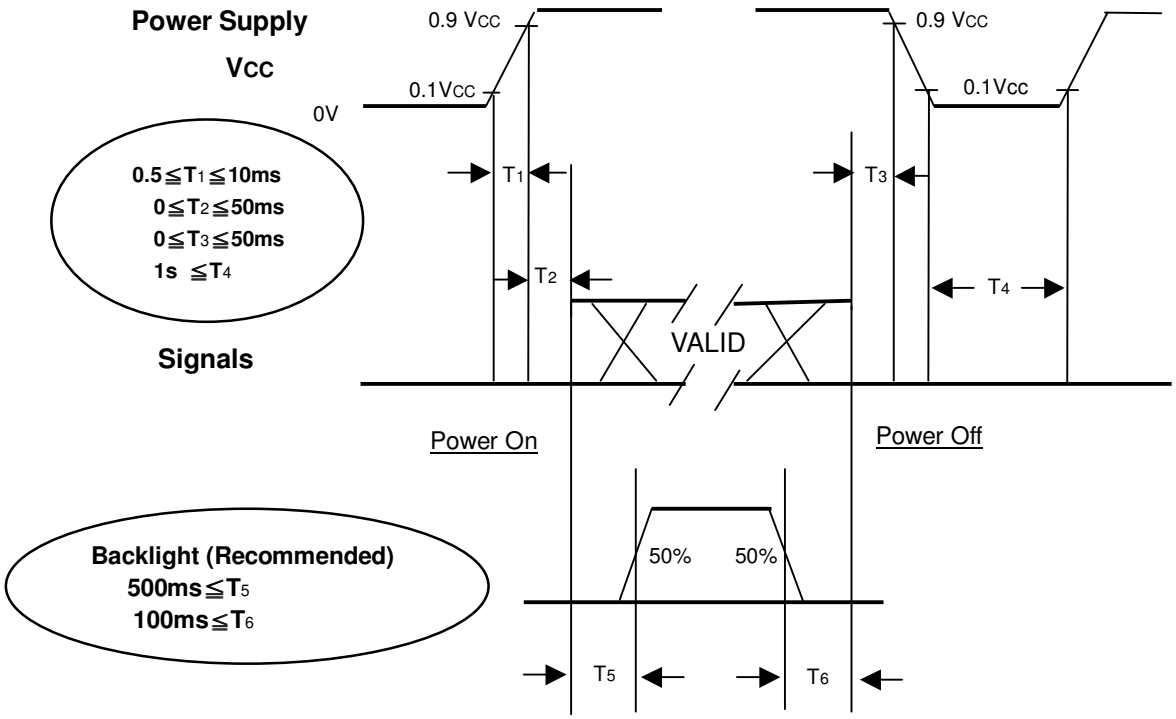


Figure.6-1 Power ON/OFF Sequence

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.

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.

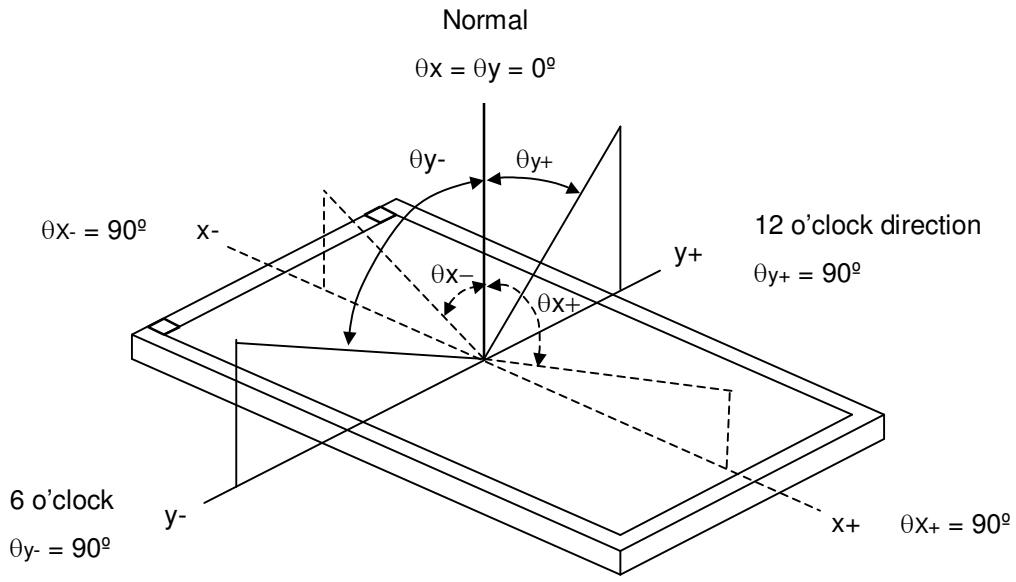
7. OPTICAL CHARACTERISTICS

7.1 OPTICAL CHARACTERISTICS

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	θ_x=0°, θ_Y =0° Viewing Angle at Normal Direction	600	800		-	(2)
Response Time		T_R			1.3	2.2	ms	(3)
		T_F			3.7	5.8		
Center Luminance of White		L_C		300	400			(4)
White Variation		δW				1.3	-	(7)
Cross Talk		CT				4	%	(5)
Color Chromaticity	Red	Rx		Typ. -0.03	(0.644)	Typ. +0.03	-	(6)
		Ry			(0.331)		-	
	Green	Gx			(0.273)		-	
		Gy			(0.588)		-	
	Blue	Bx			(0.151)		-	
		By			(0.061)		-	
	White	Wx			(0.285)		-	
		Wy			(0.293)		-	
	Color Gamut	CG		68	72		%	NTSC Ratio
Viewing Angle	Horizontal	θ_x+	CR≥10	75	85		Deg.	(1)
		θ_x-		75	85			
	Vertical	θ_Y+		70	80			
		θ_Y-		70	80			

Note (1) Definition of Viewing Angle (θx, θy):

Viewing angles are measured by EZ-Contrast 160R (Eldim)



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

The contrast ratio can be calculated by the following expression.

Contrast Ratio (CR) = L255 / L0

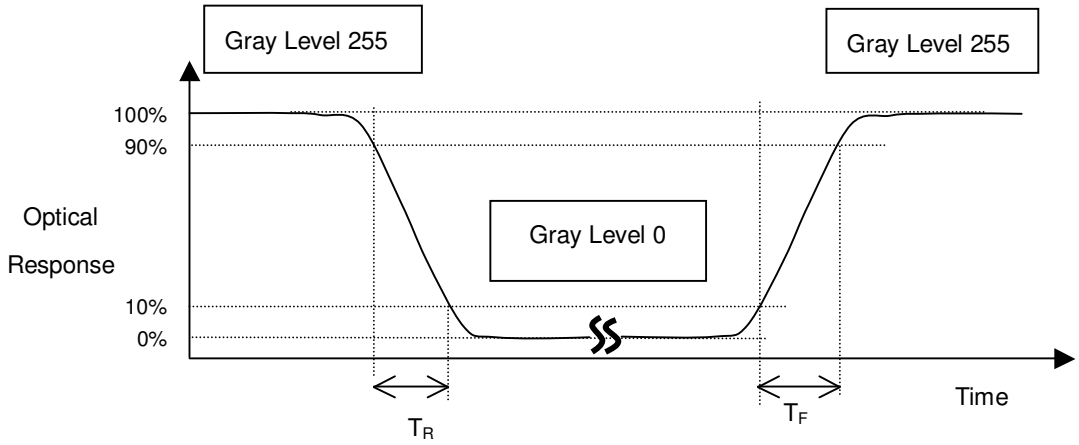
L255: Luminance of gray level 255

L 0: Luminance of gray level 0

CR = CR (5),

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

Note (3) Definition of Response Time (T_R, T_F):



Note (4) Definition of Luminance of White (L_C):

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

L_C = L (5)

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

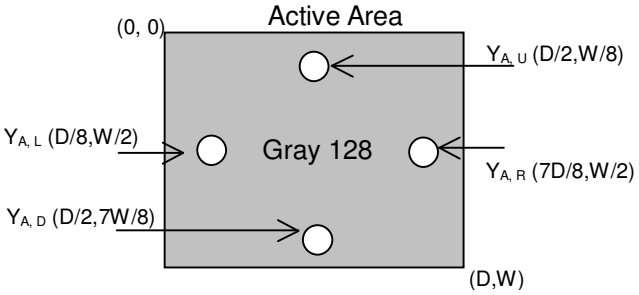
Note (5) Definition of Cross Talk (CT):

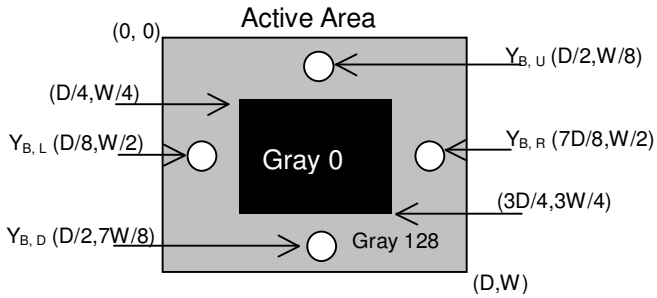
$CT = | Y_B - Y_A | / Y_A \times 100$ (%)

Where:

Y_A = Luminance of measured location without gray level 0 pattern (cd/m^2)

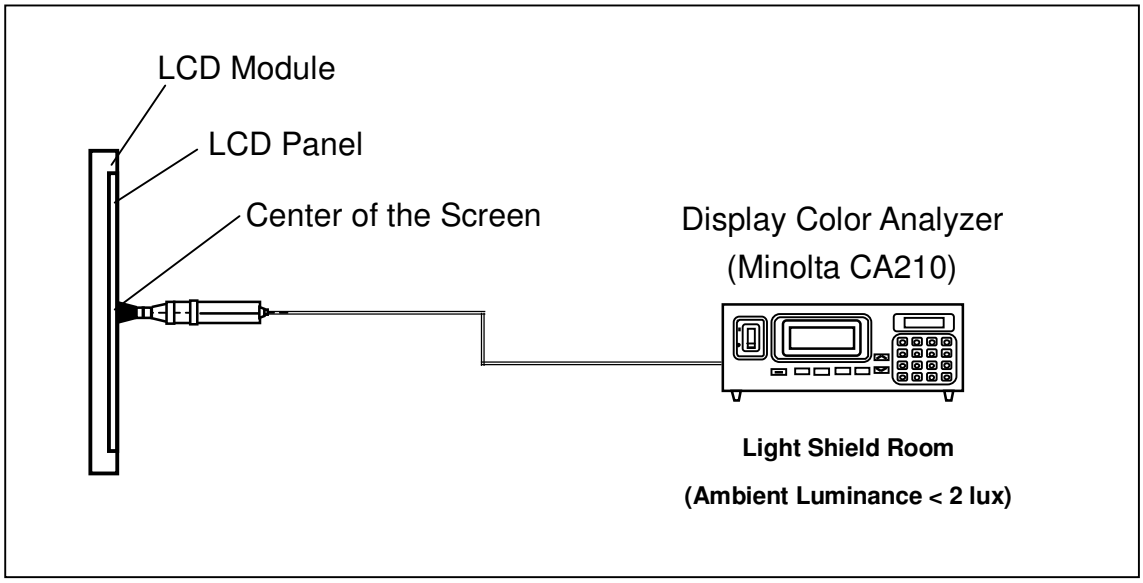
Y_B = Luminance of measured location with gray level 0 pattern (cd/m^2)





Note (6) Measurement Setup:

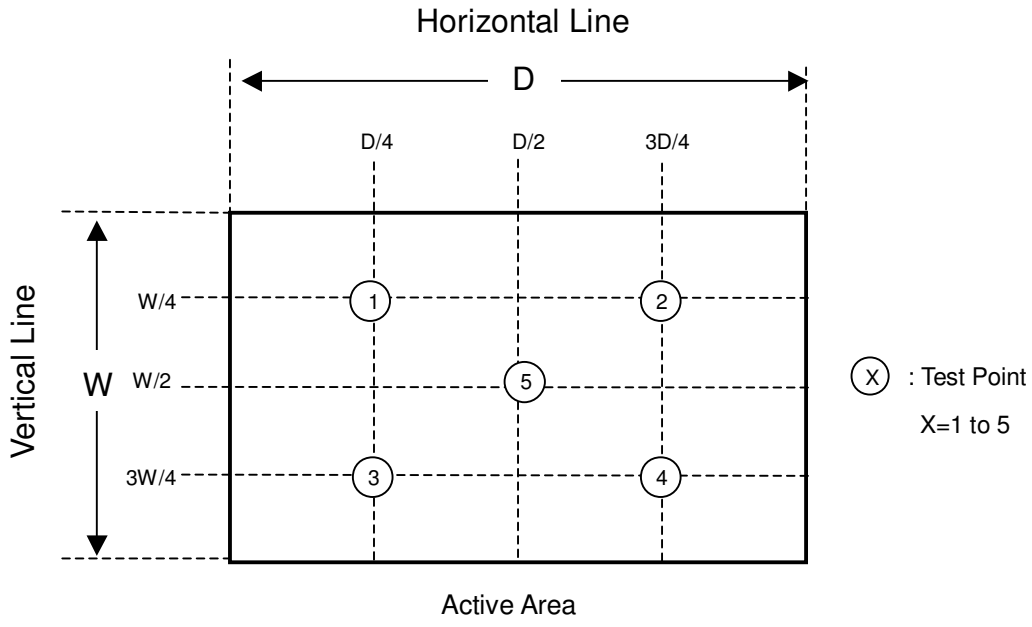
The LCD module should be stabilized at given temperature for 1 hour to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 1 hour in a windless room.



Note (7) Definition of White Variation (δW):

Measure the luminance of gray level 255 at 5 points

δW = Maximum [L (1), L (2), L (3), L (4), L (5)] / Minimum [L (1), L (2), L (3), L (4), L (5)]



7.2 TEST CONDITIONS

Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V_{CC}	5.0	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
Inverter Current	I_L	7.0	mA
Inverter Driving Frequency	F_L	50	KHz
Inverter	Ampower (27-D024817)		

8. PACKAGING

8.1 PACKING SPECIFICATIONS

(1) 10 LCD TV modules / 1 Box

(2) Box dimensions : 563(L) X 408 (W) X 530 (H)

(3) Weight : approximately25Kg (10 modules per box)

8.2 PACKING METHOD

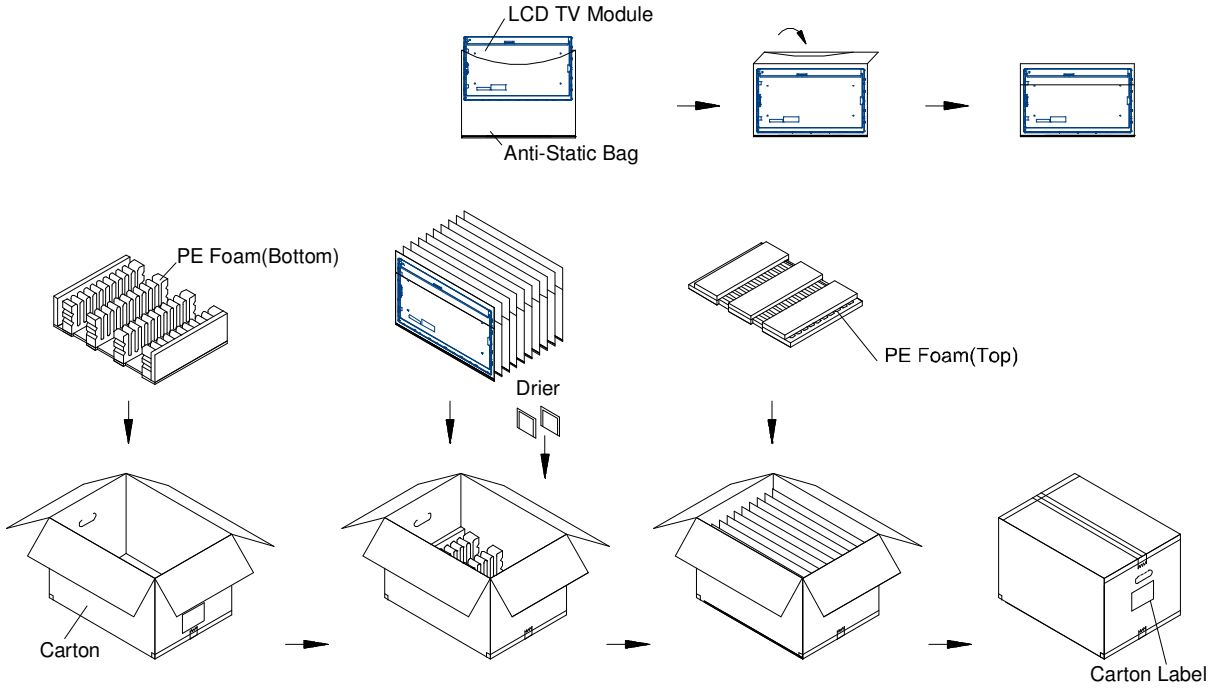
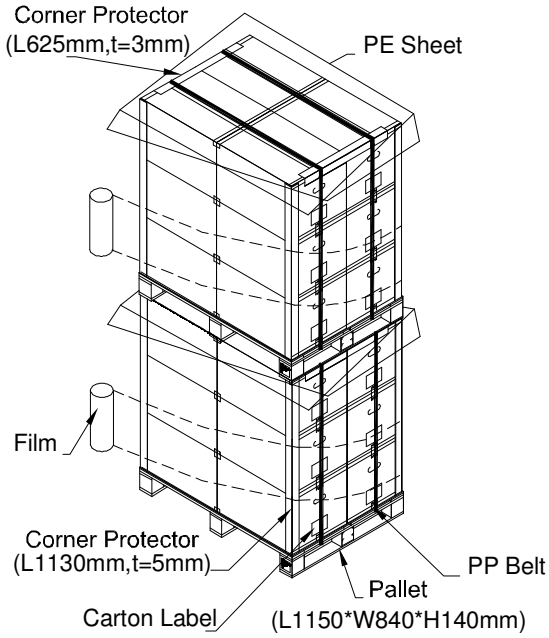
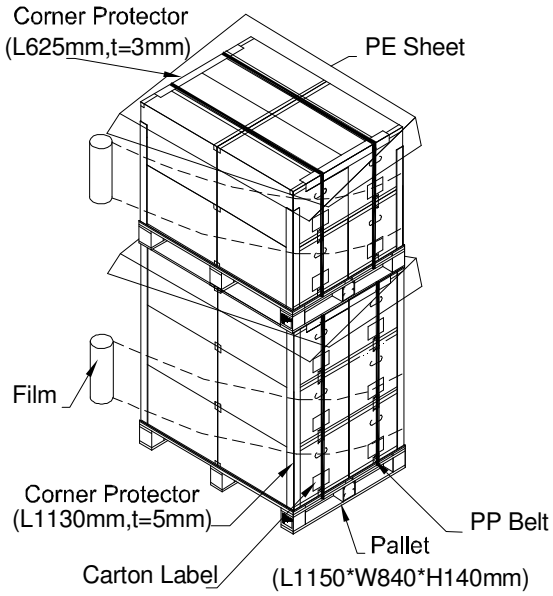


Figure.8-1 packing method

Sea / Land Transportation
(40ft HQ Container)
Pallet Stack:L840*W1150*H2530mm
Gross:630kg



Sea / Land Transportation
(40ft Container)
Pallet Stack:L840*W1150*H2155mm
Gross:530kg



Air Transportation

Pallet Stack:L840*W1150*H1265m
Gross:315kg

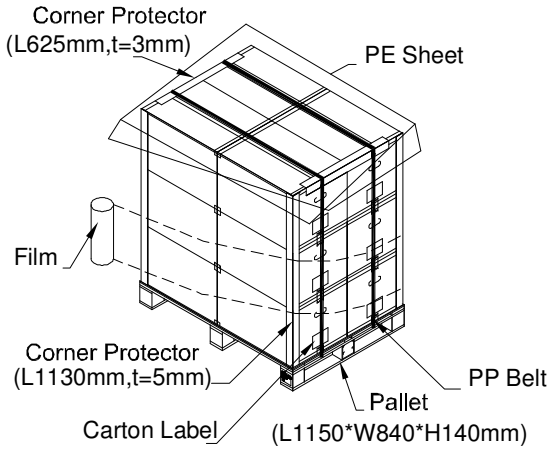


Figure.8-2 packing method