TFT LCD Preliminary Specification

MODEL NO.: V296W1 - L01

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REVISION HISTORY

Version	Date	Page (New)	Section	Description
Ver 0.1	Sep.16,'02	All	All	Tentative Specification was second issued.
Ver 0.2	Jan.14,'03	4	1.5	Module Size , Depth (D) W/ INV 43 mm →43.5 mm
		6	3.1	Power Supply Voltage Min : TBD → 4.5V Max : TBD → 5.5V Ripple Voltage Typ : TBD → 200mV Power Supply Current White Typ : 2.2 → 1.83 A Black Typ : 1.4 → 0.98 A Vertical Stripe Typ : 2.5 → 1.4A
		15	6.1	Clock Frequency Min 75 → 62 MHz Vertical Active Display Term : Total Max : 900 → 850Th
		22		Drawing : Front Side Up / Button : Add 3 side mount holes for each side Left / Right : Add 2 side mount holes for each side
		23		Drawing : Rear Side Inverter Cover : material : plastic → metal Height (W/ Inverter) : 43 → 43.5 mm
		24		Drawing : Inverter Outline
Ver 1.0	Feb.14,'03	5	1.4	Pixel Pitch: add (Sub Pixel) Surface Treatment : Hardness : 2H, Haze : 40% Anti-reflective coating < 2% reflection → Anti-glare with anti-reflective coating Hard coating (2H), Haze : 40% Reflection rate : < 2%
		7	3.1	Ripple Voltage Typ.: 200 → - Max.: TBD → 200 Rush Current Max. : 2.5 → 3.0 A Power Supply Current White Typ. : 1.83 → 1.5 A Black Typ. : 0.98 → 0.8 A Vertical Stripe Typ. : 1.4 → 1.2 A
		9	3.2	Lamp Input Voltage Min.: TBD → 1053 Typ.: 1250 → 1170 Max.: TBD → 1287 Lamp Current Min.: TBD → 4.2 Max.: TBD → 4.8 Lamp Turn On Voltage Min.: - → 1560 Typ.: 1700 → - Max.: TBD → 3000 Note: add Ta = 25 ºC

				Add another row for Lamp Turn On Voltage (Ta = 0 ºC) Min.: 1870 Typ.: - Max.: 3000 Note: Ta = 0 ºC
				Operating Frequency Min.: 55 → 57 Max.: 69 → 67
				Power Consumption Typ.: 100 → 105
		10	-	Note(4): $P_L = \sum$ lamp1-lamp16 $I_L \times V_L$ → $P_L = (\sum$ lamp1-lamp16 $I_L \times V_L)/0.8$, P_L is based on the inverter efficiency, which is 80%.
			-	Note(5): Definition revised
		18	7.2	Center Luminance of White Min.: TBD → (450) Average Luminance of White Min.: TBD → (400) Color Chromaticity Rx Min. : → 0.614 Typ. : TBD → 0.644 Max. : → 0.674 Ry Min. : → 0.301 Typ. : TBD → 0.331 Max. : → 0.361 Gx Min. : → 0.240 Typ. : TBD → 0.270 Max. : → 0.300 Gy Min. : → 0.571 Typ. : TBD → 0.601 Max. : → 0.631 Bx Min. : → 0.112 Typ. : TBD → 0.142 Max. : → 0.172 By Min. : → 0.044 Typ. : TBD → 0.074 Max. : → 0.114 Wx Min. : → 0.255 Max. : → 0.315 Wy Min. : → 0.263 Max. : → 0.323

1. GENERAL DESCRIPTION

1.1 OVERVIEW

V296W1- L01 is a 30" TFT Liquid Crystal Display module with 16-CCFL Backlight unit and 1ch-LVDS interface. This module supports 1280 x 768 WXGA format and can display true 16.7M colors (8-bit/color). The inverter module for backlight is optionally build-in.

1.2 FEATURES

-Ultra wide viewing angle – Super MVA technology

-High brightness (500 nits)

- High contrast ratio (500:1)

- Fast response time

- High color saturation NTSC 75%

- WXGA (1280 x 768 pixels) resolution

- DE (Data Enable) only mode

- LVDS (Low Voltage Differential Signaling) interface

1.3 APPLICATION

- TFT LCD TVs

1.4 GENERAL SPECIFICATI0NS

Item	Specification	Unit	Note
Active Area	643.2(H) x 385.92 (V) (29.53" diagonal)	mm	(1)
Bezel Opening Area	648.8 (H) x 391.52 (V)	mm	
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1280 x R.G.B. x 768	pixel	-
Pixel Pitch (Sub Pixel)	0.1675 (H) x 0.5025 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	16.7M	color	-
Display Operation Mode	Transmissive mode / Normally black	-	-
Surface Treatment	Anti-glare with anti-reflective coating Hard coating (2H), Haze : 40% Reflection rate : < 2%	-	-

1.5 MECHANICAL SPECIFICATIONS

Item			Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal(H)			683.6		mm	(1), (2)
	Vertical(V)			433.6		mm	
	Depth(D)	W/O INV	-		39	mm	
		W/I INV			43	mm	
Weight			-	5500		g	-

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

Note (2) Module Depth does not include connectors.

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}	-	(100)	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).

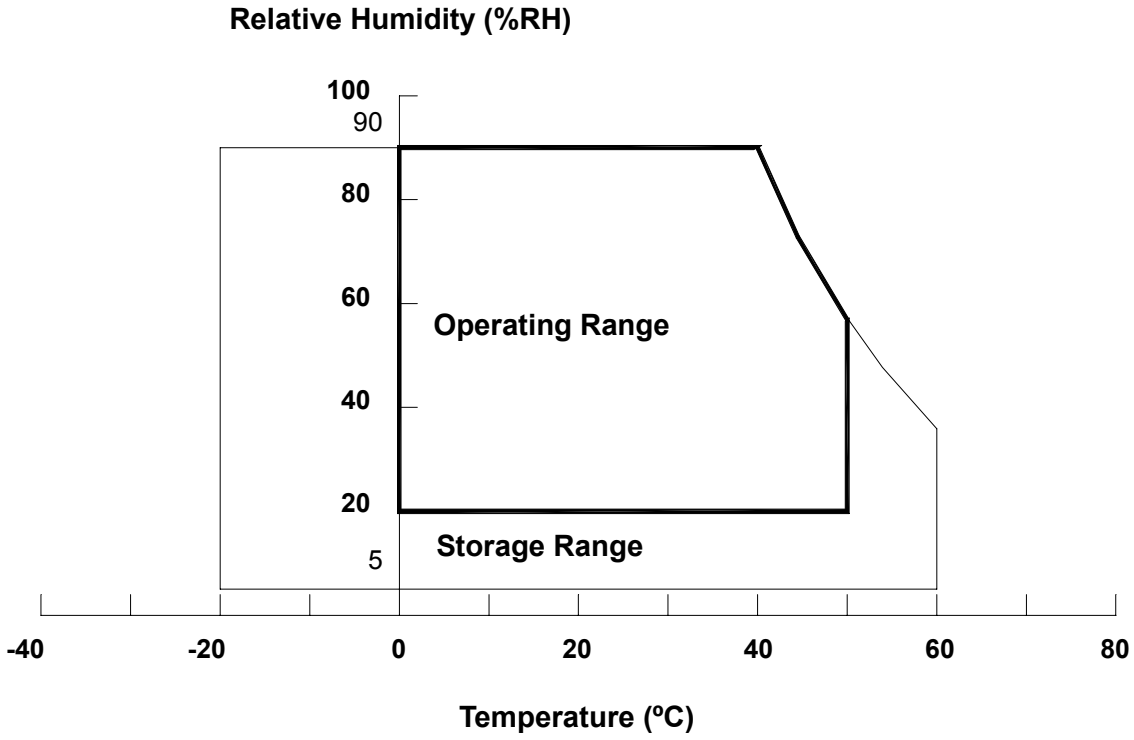
(c) No condensation.

Note (2) The temperature of panel display area surface should be 0 ºC Min. and 60 ºC Max.

Note (3) 2 ms, half sine wave, 1 time for ± X, ± Y, ± Z.

Note (4) 10 ~ 500 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 ELECTRICAL ABSOLUTE RATINGS

2.2.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	Vcc	-0.3	+6.0	V	(1)
Logic Input Voltage	V_{IN}	-0.3	4.3	V	

2.2.2 BACKLIGHT UNIT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Lamp Voltage	V_L	-	2.5K	V_{RMS}	(1), (2), I_L = 6.0 mA
Lamp Current	I_L	-	6.5	mA_{RMS}	(1), (2)
Lamp Frequency	F_L	-	80	KHz	

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for lamp (Refer to 3.2 for further information).

3. ELECTRICAL CHARACTERISTICS

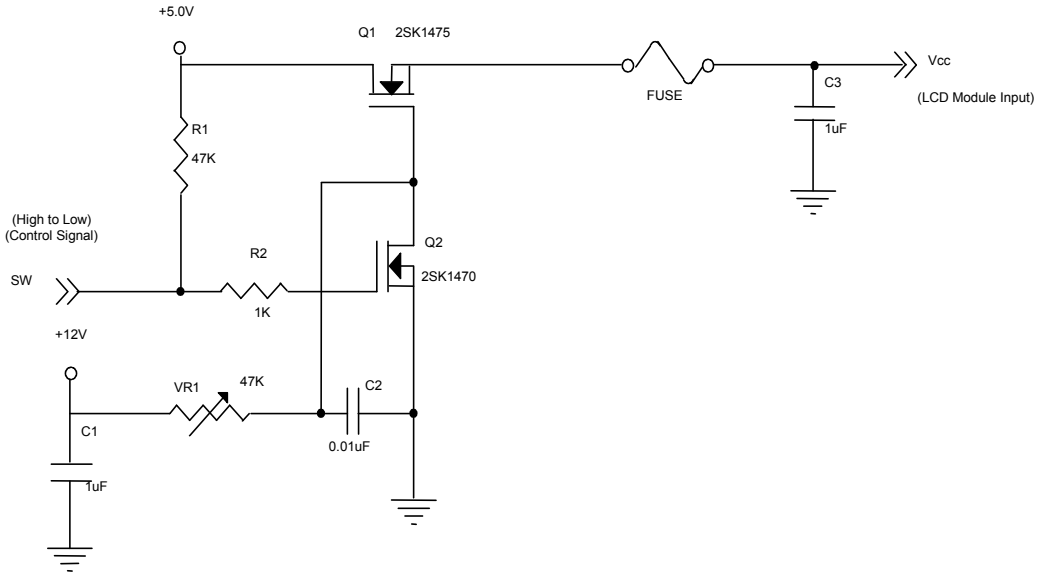
3.1 TFT LCD MODULE

Ta = 25 ± 2 ºC

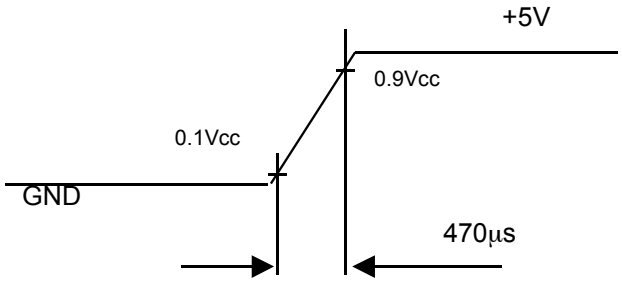
Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		Vcc	4.5	5.0	5.5	V	-
Ripple Voltage		V_{RP}	-	-	200	mV	-
Rush Current		I_{RUSH}	-	-	3.0	A	(2)
Power Supply Current	White	Icc	-	1.5	-	A	(3)a
	Black		-	0.8	-	A	(3)b
	Vertical Stripe		-	1.2	-	A	(3)c
LVDS differential input high threshold voltage		V_{TH}	-	-	+100	mV	
LVDS differential input low threshold voltage		V_{TL}	-100	-	-	mV	
LVDS common input voltage		Vic	1.125	1.25	1.375	V	
Terminating Resistor		RT	-	100	-	ohm	

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

Note (2) Measurement Conditions:

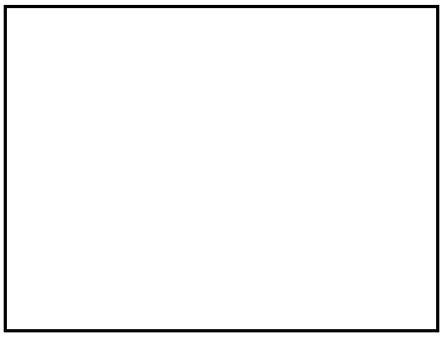


Vcc rising time is 470μs



Note (3) The specified power supply current is under the conditions at Vcc = 5 V, Ta = 25 ± 2 ºC, f_v = 60 Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern

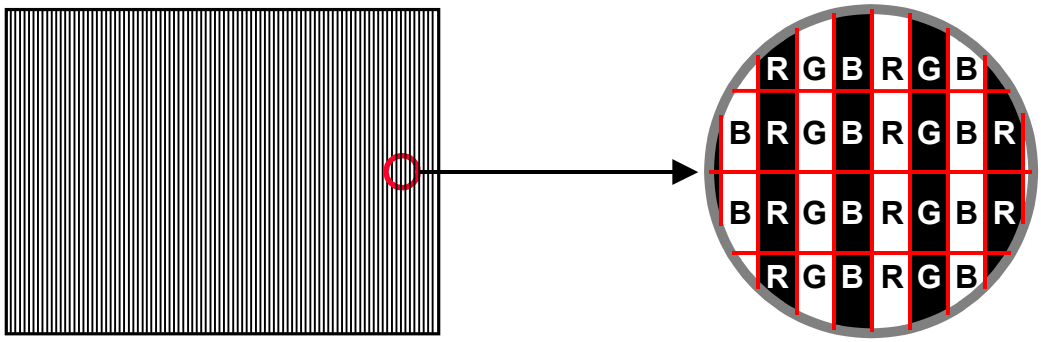


Active Area

b. Black Pattern

Active Area

c. Vertical Stripe Pattern



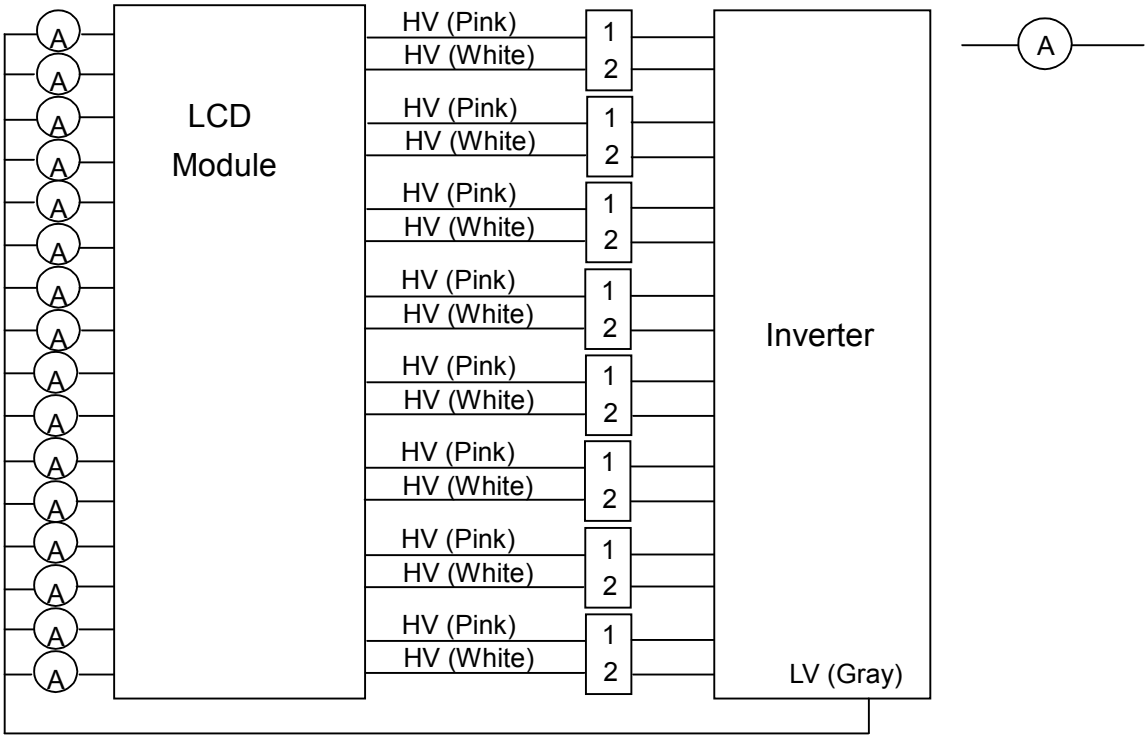
Active Area

3.2 BACKLIGHT UNIT

Ta = 25 ± 2 ºC

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Lamp Input Voltage	V_L	1053	1170	1287	V_{RMS}	I_L = (4.5) mA
Lamp Current	I_L	4.2	4.5	4.8	mA_{RMS}	(1)
Lamp Turn On Voltage	V_S	1560	-	3000	V_{RMS}	(2), Ta = 25 ºC
		1870	-	3000	V_{RMS}	(2), Ta = 0 ºC
Operating Frequency	F_L	57	62	67	KHz	(3)
Lamp Life Time	L_{BL}	50K	-	-	Hrs	(5)
Power Consumption	P_L	-	105	-	W	(4), I_L = (4.5) mA

Note (1) Lamp current is measured by utilizing high frequency current meters as shown below:



Note (2) The voltage shown above 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 from the display, and this may cause 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) $P_L = (\sum \text{lamp1-lamp16}\ I_L \times V_L)/0.8$, P_L is based on the inverter efficiency, which is 80%.

Note (5) The lifetime of a lamp is defined as the time in which it continues to operate under the condition Ta = 25 $\pm 2\ ^{o}C$ and I_L = (4.2) ~ (4.8) mArms until one of the following events occurs:

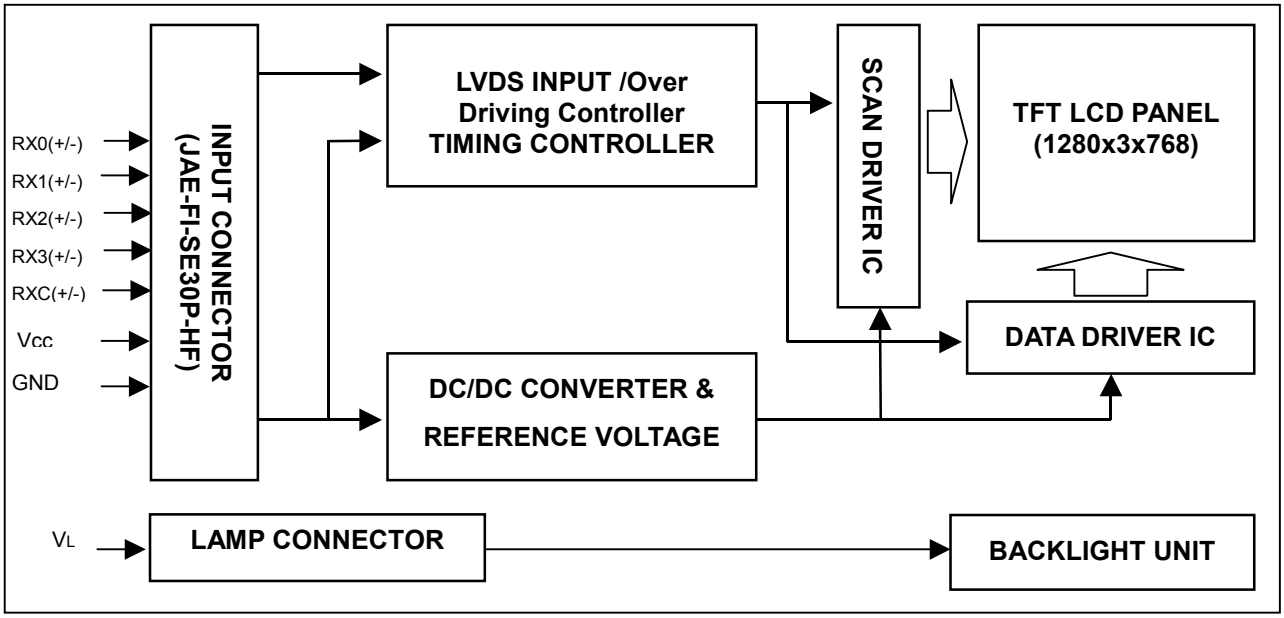
(a) When the brightness becomes equal or less than 50% of its original value.

(b) When the effective discharge length becomes equal or lower than 80% of its original value. (Effective discharge length is defined as an area that has equal or more than 70% brightness compared to the brightness at the center point.)

Note (6) 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.

4. BLOCK DIAGRAM

4.1 TFT LCD MODULE

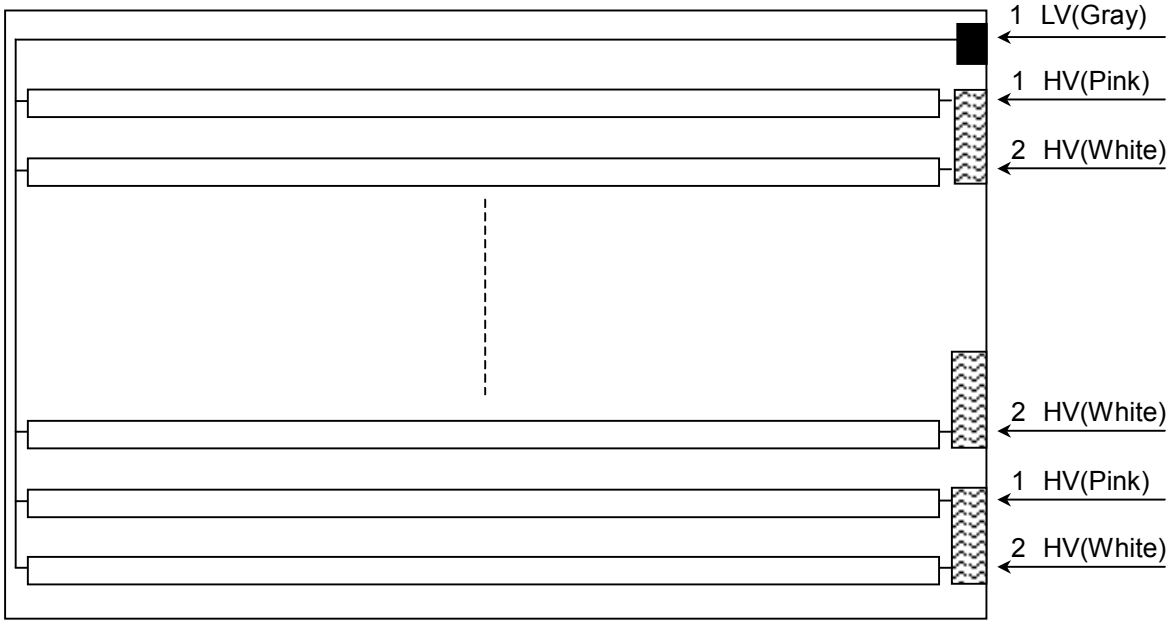


4.2 BACKLIGHT UNIT

Lamp connector

HV : BHR-03-VS-1(JST) *8

LV : ZHR-2 (JST) *1



5. INPUT TERMINAL PIN ASSIGNMENT

5.1 TFT LCD MODULE

Pin	Name	Description
1	NC	No Connection
2	NC	No Connection
3	NC	No Connection
4	NC	No Connection
5	NC	No Connection
6	NC	No Connection
7	NC	No Connection
8	GND	Ground
9	RX3+	Positive LVDS differential data input. Channel 3
10	RX3-	Negative LVDS differential data input. Channel 3
11	RXCLK+	Positive LVDS differential clock input.
12	RXCLK-	Negative LVDS differential clock input.
13	GND	Ground
14	GND	Ground
15	RX2+	Positive LVDS differential data input. Channel 2
16	RX2-	Negative LVDS differential data input. Channel 2
17	RX1+	Positive LVDS differential data input. Channel 1
18	RX1-	Negative LVDS differential data input. Channel 1
19	RX0+	Positive LVDS differential data input. Channel 0
20	RX0-	Negative LVDS differential data input. Channel 0
21	GND	Ground
22	GND	Ground
23	GND	Ground
24	GND	Ground
25	GND	Ground
26	VCC	+5.0V power supply
27	VCC	+5.0V power supply
28	VCC	+5.0V power supply
29	VCC	+5.0V power supply
30	VCC	+5.0V power supply

Note (1) Connector Part No.: FI-SE30P-HF (JAE)

Note (2) The first pixel is even.

5.2 BACKLIGHT UNIT

Pin	Symbol	Description	Color
1	HV	High Voltage	Pink
2	HV	High Voltage	White

Note (1) Connector Part No.: BHR-03VS-1 (JST) or equivalent

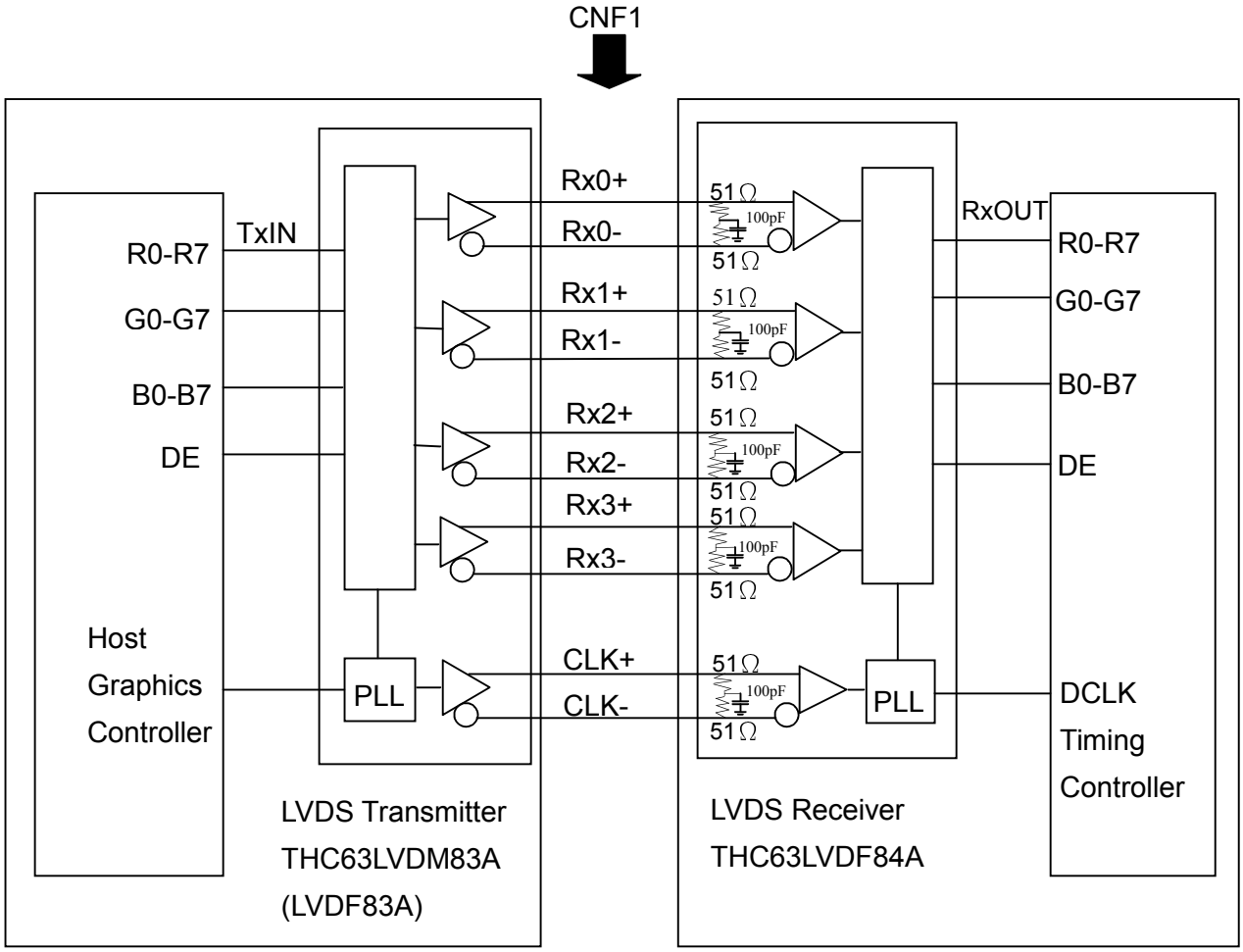
Note (2) User's connector Part No.: SM02(8.0)B-BHS-1TB (JST) or equivalent

Pin	Symbol	Description	Color
1	LV	Low Voltage	Gray
2	NC	No Connection	

Note (1) Connector Part No.: ZHR-2 (JST) or equivalent

Note (2) User's connector Part No.: S2B-ZR-SM3A-TF (JST) or equivalent

5.3 BLOCK DIAGRAM OF INTERFACE



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

Notes: 1) The system must have the transmitter to drive the module.
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

	SIGNAL	TRANSMITTER THC63LVDM83A		INTERFACE CONNECTOR		RECEIVER THC63LVDF84A		TFT CONTROL INPUT
		PIN	INPUT	Host	TFT-LCD	PIN	OUTPUT	
24bit	R0	51	TxIN0	TA OUT0+	Rx 0+	27	Rx OUT0	R0
	R1	52	TxIN1			29	Rx OUT1	R1
	R2	54	TxIN2			30	Rx OUT2	R2
	R3	55	TxIN3			32	Rx OUT3	R3
	R4	56	TxIN4			33	Rx OUT4	R4
	R5	3	TxIN6	TA OUT0-	Rx 0-	35	Rx OUT6	R5
	G0	4	TxIN7			37	Rx OUT7	G0
	G1	6	TxIN8			38	Rx OUT8	G1
	G2	7	TxIN9			39	Rx OUT9	G2
	G3	11	TxIN12	TA OUT1+	Rx 1+	43	Rx OUT12	G3
	G4	12	TxIN13			45	Rx OUT13	G4
	G5	14	TxIN14			46	Rx OUT14	G5
	B0	15	TxIN15	TA OUT1-	Rx 1-	47	Rx OUT15	B0
	B1	19	TxIN18			51	Rx OUT18	B1
	B2	20	TxIN19			53	Rx OUT19	B2
	B3	22	TxIN20			54	Rx OUT20	B3
	B4	23	TxIN21	TA OUT2+	Rx 2+	55	Rx OUT21	B4
	B5	24	TxIN22			1	Rx OUT22	B5
	DE	30	TxIN26			6	Rx OUT26	DE
	R6	50	TxIN27	TA OUT2-	Rx 2-	7	Rx OUT27	R6
	R7	2	TxIN5			34	Rx OUT5	R7
	G6	8	TxIN10			41	Rx OUT10	G6
	G7	10	TxIN11			42	Rx OUT11	G7
	B6	16	TxIN16	TA OUT3+	Rx 3+	49	Rx OUT16	B6
	B7	18	TxIN17			50	Rx OUT17	B7
	RSVD 1	25	TxIN23			2	Rx OUT23	Not connect
	RSVD 2	27	TxIN24	TA OUT3-	Rx 3-	3	Rx OUT24	Not connect
	RSVD 3	28	TxIN25			5	Rx OUT25	Not connect
	DCLK	31	TxCLK IN	TxCLK OUT+ TxCLK OUT-	RxCLK IN+ RxCLK IN-	26	RxCLK OUT	DCLK

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 : Display timing signal

Notes: (1)RSVD(reserved)pins on the transmitter shall be “H” or “L”.

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	R7	R6	G5	G4	G3	G2	G1	G0	R7	R6	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	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	0
	Green	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	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
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	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	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	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	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
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	0	0
	Green(1)	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(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	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	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
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	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	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	0	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	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

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

6. INTERFACE TIMING

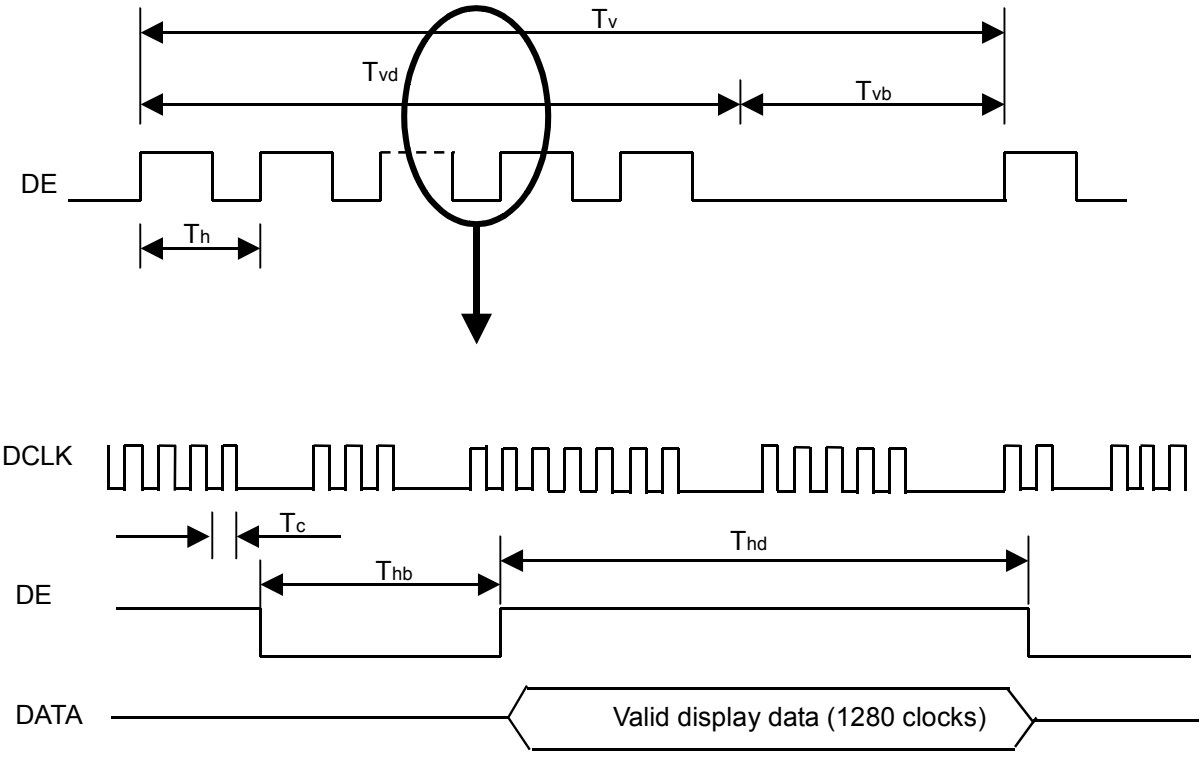
6.1 INPUT SIGNAL TIMING SPECIFICATIONS

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

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Clock	Frequency	1/Tc	62	81	82	MHZ	-
Vertical Active Display Term	Frame Rate	Fr	-	60	-	Hz	Tv=Tvd+Tvb
	Total	Tv	780	806	850	Th	-
	Display	Tvd	768	768	768	Th	-
	Blank	Tvb	12	38	82	Th	-
Horizontal Active Display Term	Total	Th	1450	1688	2000	Tc	Th=Thd+Thb
	Display	Thd	1280	1280	1280	Tc	-
	Blank	Thb	170	408	720	Tc	-

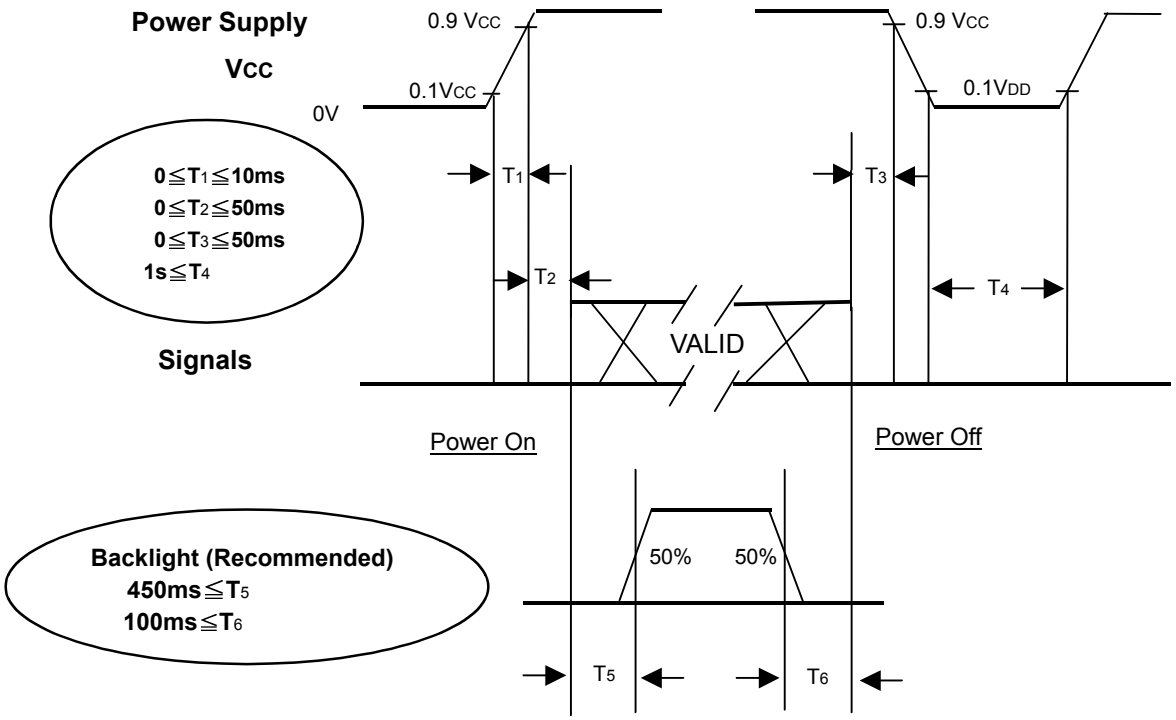
Note: Because of this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

INPUT SIGNAL 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 be the same as the definition of Vcc.

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

(3) In case of VCC = off level, please keep the level of input signals on the low or keep a high impedance.

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

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

7. OPTICAL CHARACTERISTICS

7.1 TEST CONDITIONS

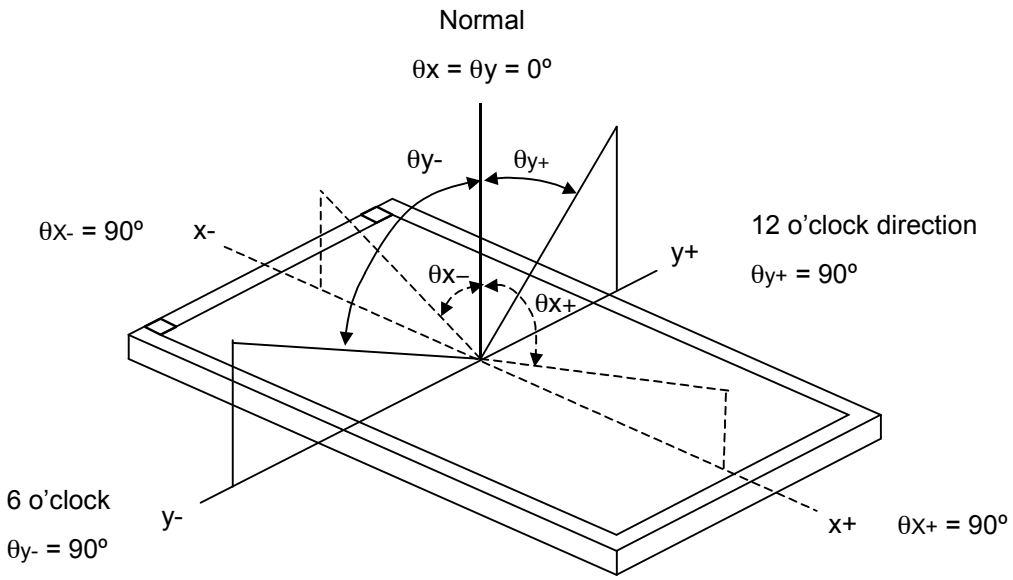
Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V_{CC}	5.0	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
Inverter Current	I_L	4.5	mA
Inverter Driving Frequency	F_L	55	KHz
Inverter	--		

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 (7).

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	θ_x=0°, θ_Y =0° Viewing Normal Angle	-	(500)	-	-	Note(2)
Response Time		T_R		-	15	-	ms	Note(3)
		T_F		-	10	-	ms	
		Gray to gray			16.6	-	ms	Note(4)
Center Luminance of White		L_C		(450)	(500)	-	cd/m^2	Note(5)
Average Luminance of White		L_{AVE}		(400)	(450)	-	cd/m^2	
White Variation		δW		-	-	1.6	-	Note(8)
Cross Talk		CT		-	-	4.0	%	Note(6)
Color Chromaticity	Red	Rx		(0.614)	(0.644)	(0.674)	-	
		Ry		(0.301)	(0.331)	(0.361)	-	
	Green	Gx		(0.240)	(0.270)	(0.300)	-	
		Gy		(0.571)	(0.601)	(0.631)	-	
	Blue	Bx		(0.112)	(0.142)	(0.172)	-	
		By		(0.044)	(0.074)	(0.114)	-	
	White	Wx		0.255	0.285	0.315	-	9, 300K
		Wy		0.263	0.293	0.323	-	
	Color Gamut	CG			75		%	NTSC Ratio
Viewing Angle	Horizontal	θ_x+	CR≥10		85	-	Deg.	Note(1) No gray scale inversion
		θ_x-			85	-		
	Vertical	θ_Y+			85	-		
		θ_Y-			85	-		

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



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

The contrast ratio can be calculated by the following expression.

Contrast Ratio (CR) = L255 / L0

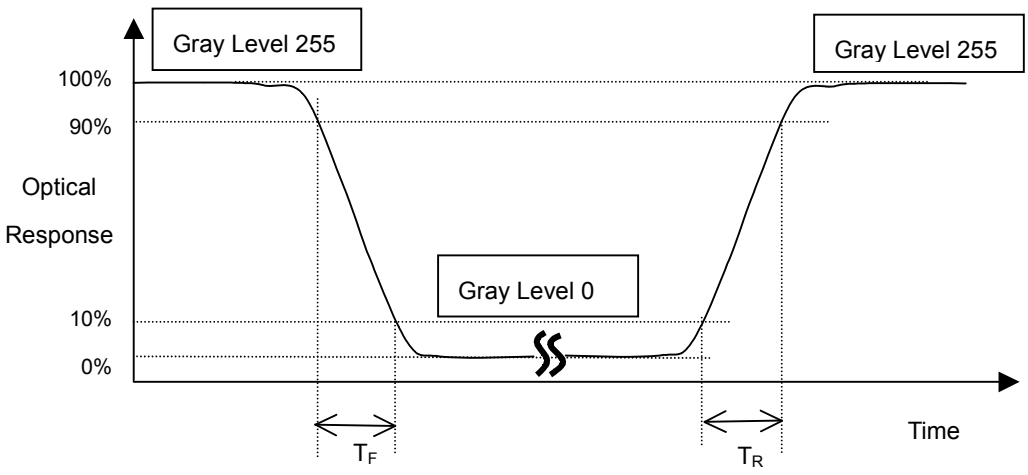
L255: Luminance of gray level 255

L 0: Luminance of gray level 0

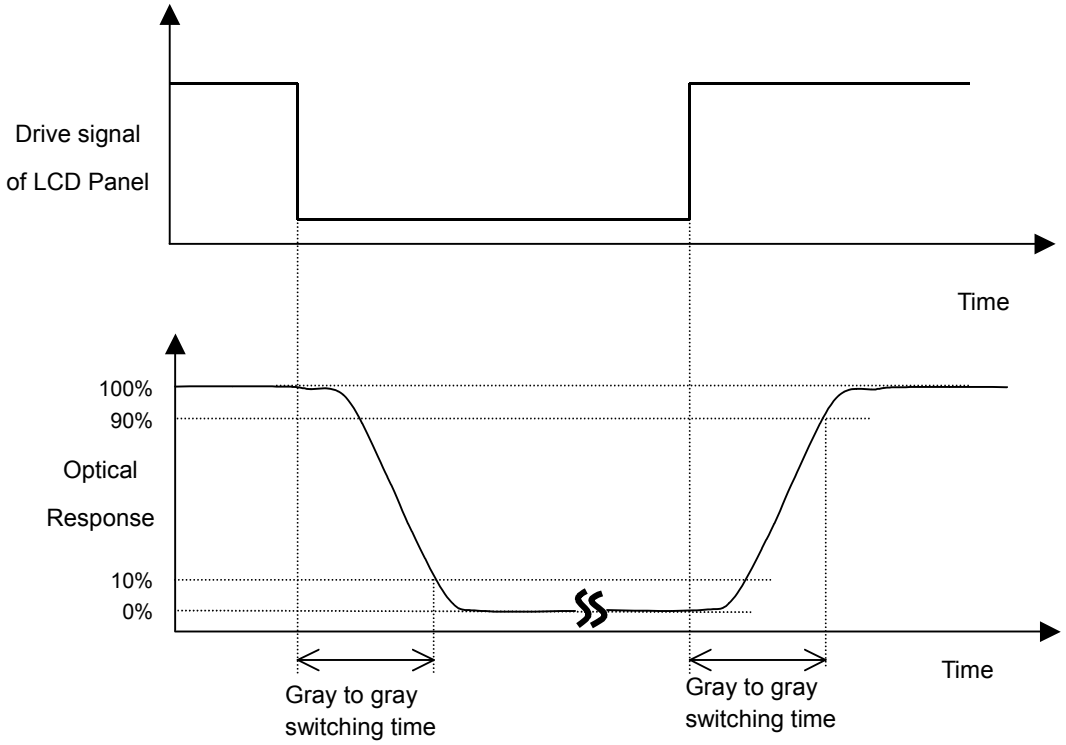
CR = CR (5)

CR (X) is corresponding to the Contrast Ratio of the point X at the figure in Note (8).

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



Note (4) Definition of Gray to Gray Switching Time:



Note (5) 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

L (x) is corresponding to the luminance of the point X at the figure in Note (8).

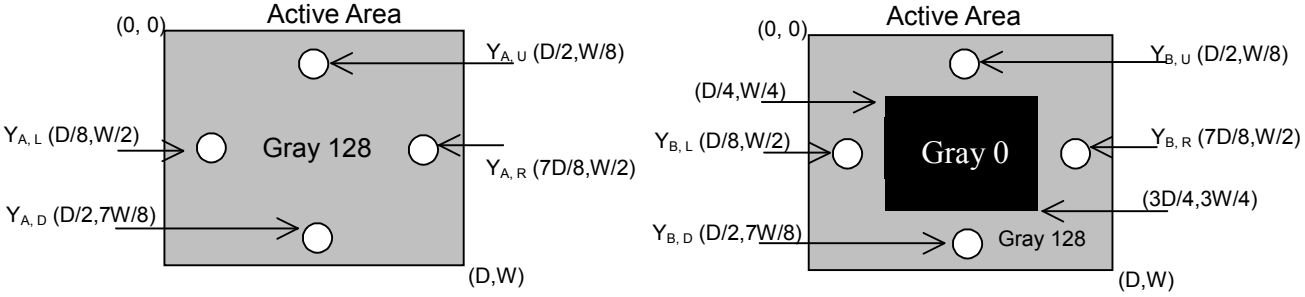
Note (6) Definition of Cross Talk (CT):

CT = | Y_B – Y_A | / Y_A × 100 (%)

Where:

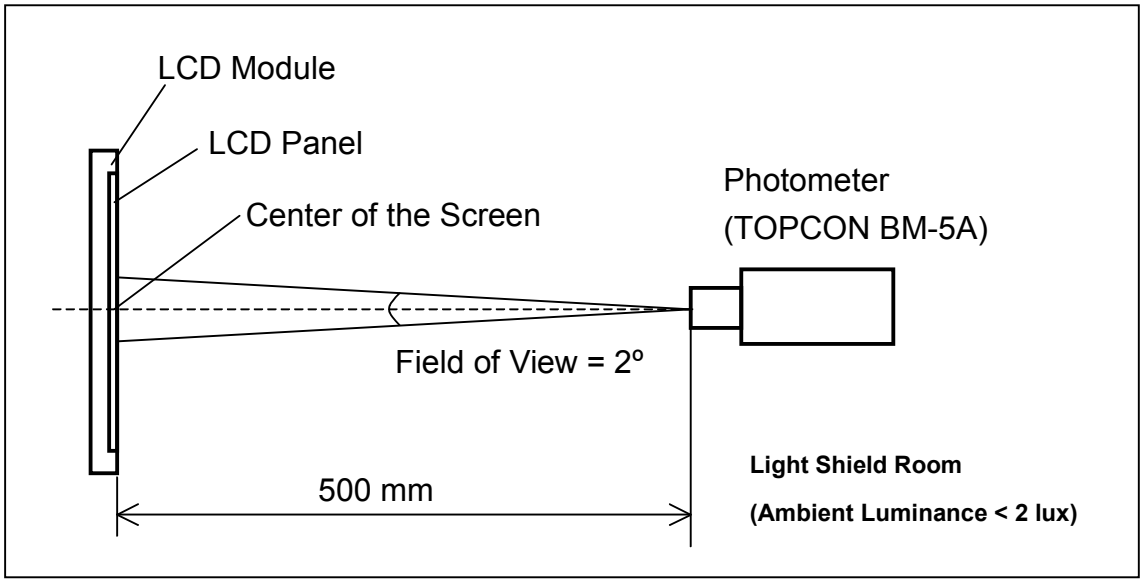
Y_A = Luminance of measured location without gray level 0 pattern (cd/m^2)

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



Note (7) Measurement Setup:

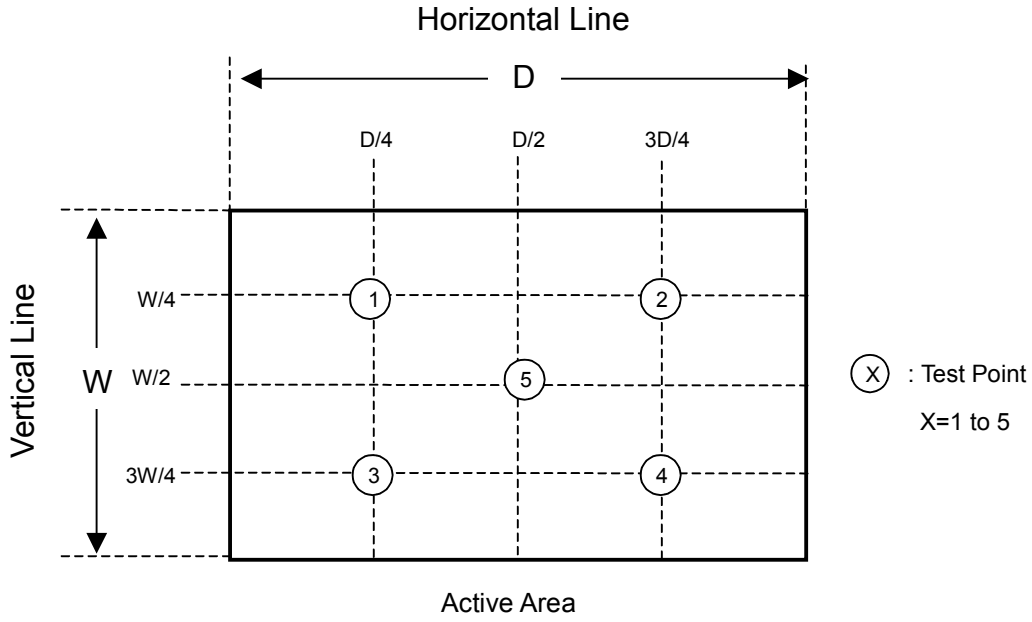
The LCD module should be stabilized at given temperature for 30 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 30 minutes in a windless room.



Note (8) 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)]



8. PRECAUTIONS

8.1 ASSEMBLY AND HANDLING PRECAUTIONS

(1) Do not apply rough force such as bending or twisting to the module during assembly.

(2) To assemble or install module into user's system can be only in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.

(3) It's not permitted to have pressure or impulse on the module because the LCD panel and Backlight will be damaged.

(4) Always follow the correct power sequence when LCD module is connecting and operating. This can prevent damage to the CMOS LSI chips during latch-up.

(5) Do not pull the I/F connector in or out while the module is operating.

(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) It is dangerous that moisture come into or contacted the LCD module, because moisture may damage LCD module when it is operating.

(9) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.

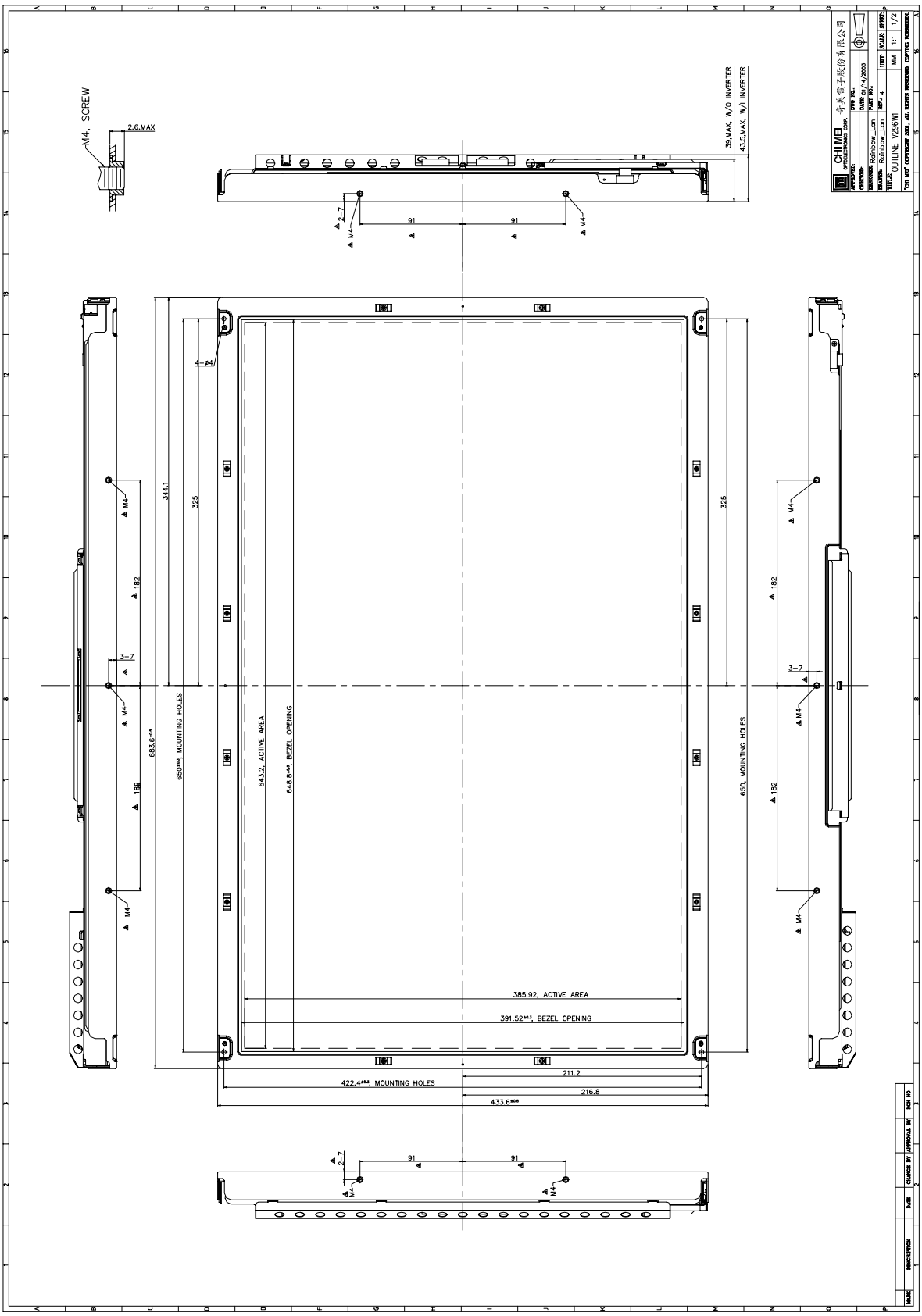
(10) When ambient temperature is lower than 10ºC may reduce the display quality. For example, the response time will become slowly, and the starting voltage of CCFL will be higher than room temperature.

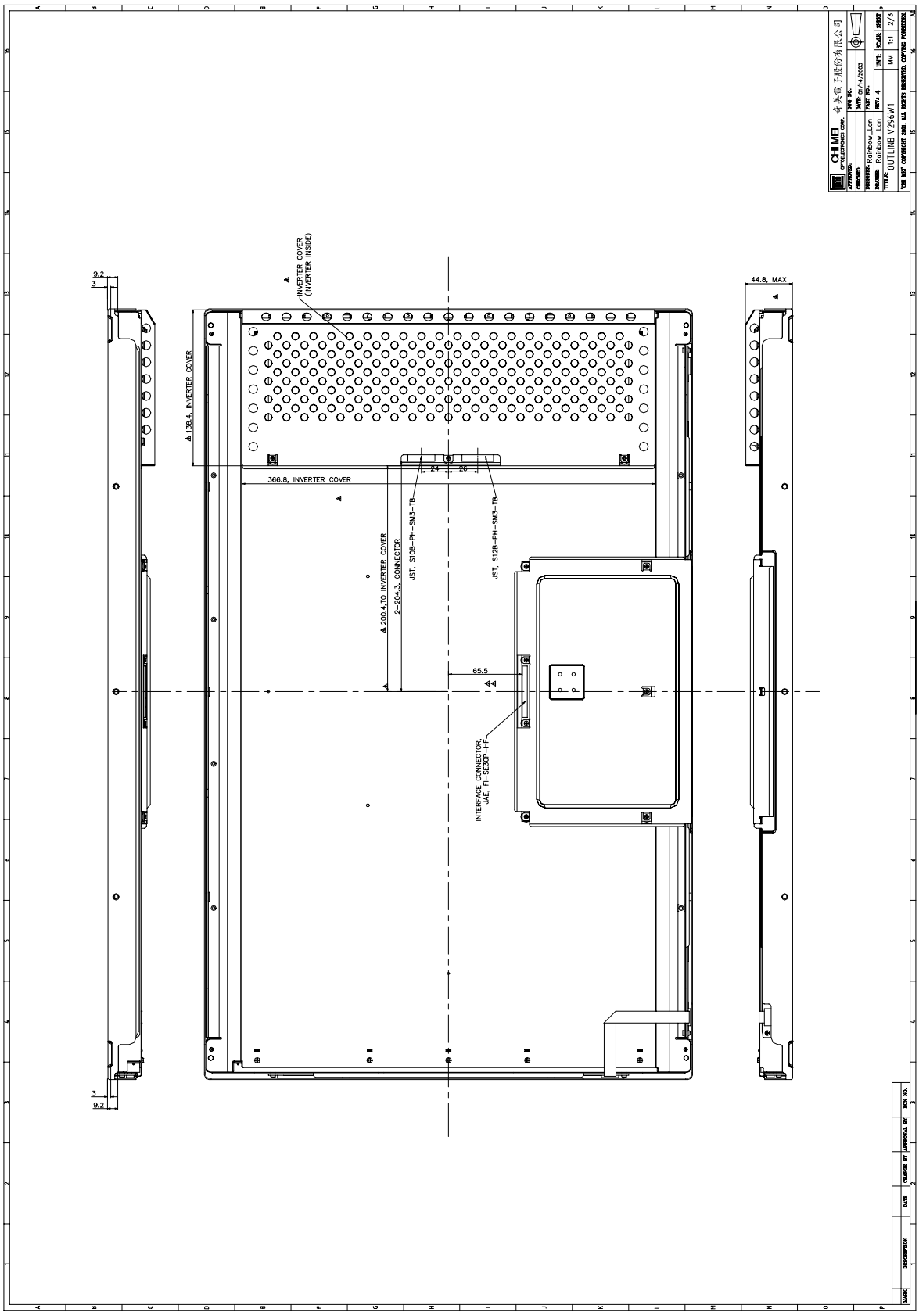
8.2 SAFETY PRECAUTIONS

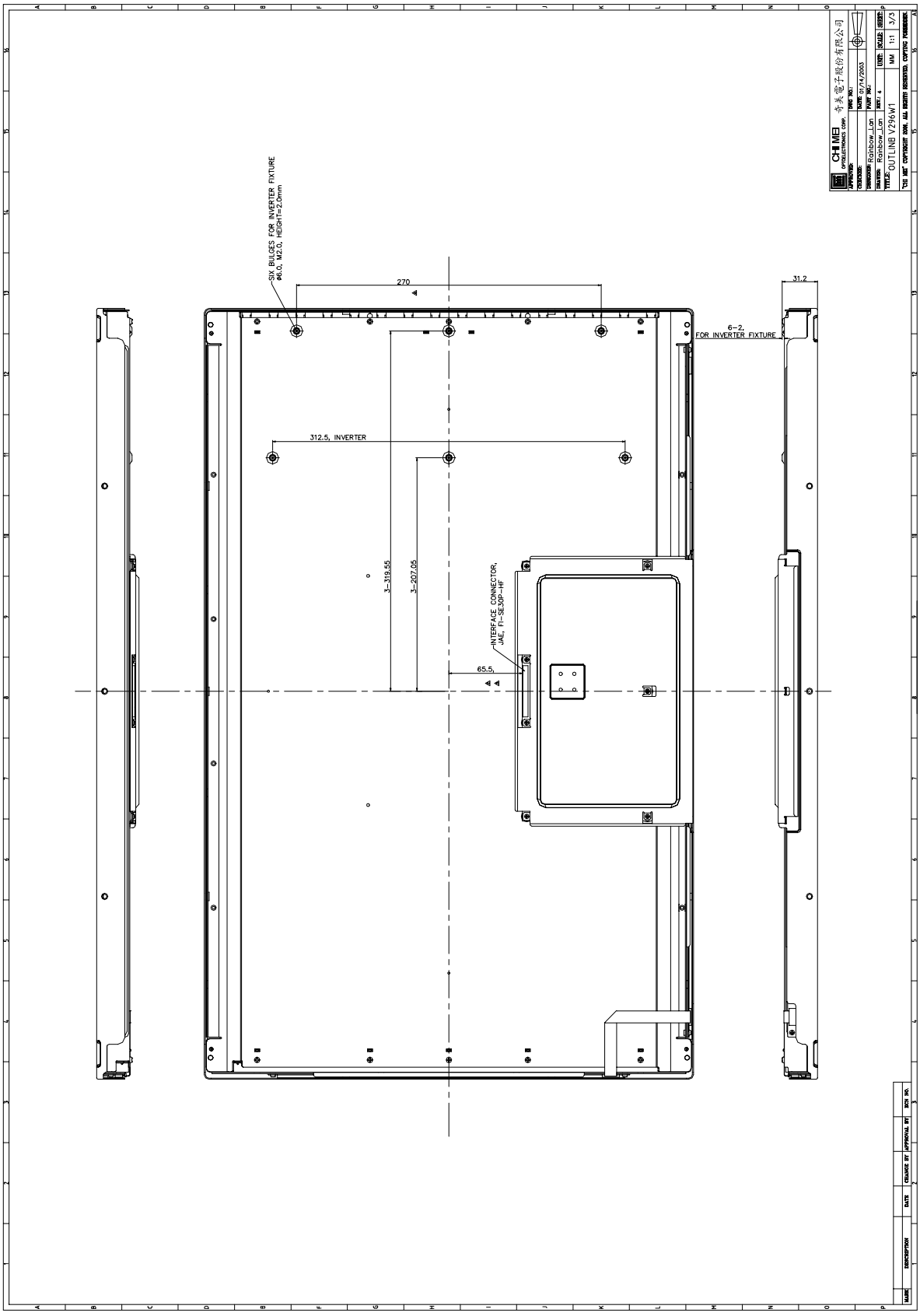
(1) The startup voltage of Backlight is approximately 1000 Volts. It may cause electrical shock while assembling with inverter. Do not disassemble the module or insert anything into the Backlight unit.

(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.







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