DATA IMAGE CORPORATION

TFT Module Specification

PRELIMINARY

ITEM NO.: FG120110DSCWJG01

Table of Contents

Customer Companies	R&D Dept.	Q.C. Dept.	Eng. Dept.	Prod. Dept.
	ALEX	ERIC	PAUL	HELEN
Approved by	Version:	Issued Date:	Sheet Code:	Total Pages:
	2	2006/10/13		21

2. RECORD OF REVISION

Rev	Date	Item	Page	Comment
1	21/AUG/06			Initial PRELIMINARY
2	13/OCT/06	13	19-20	Add OUTLINE DRAWING

3. GENERAL DESCRIPTION

3.1 OVERVIEW

The FG120110D is a 12.1" TFT-LCD module with a 2-CCFL Backlight Unit and a 20-pin 1ch-LVDS interface. This module supports 1024 x 768 XGA mode and displays 262,144 colors. The inverter module for the Backlight Unit is not built in.

3.2 FEATURES

- Wide viewing angle
- High contrast ratio
- Fast response time
- High color saturation
- XGA (1024 x 768 pixels) resolution
- Wide operating temperature
- DE (Data Enable) mode
- LVDS (Low Voltage Differential Signaling) interface
- RoHS Compliance

3.3 APPLICATION

- TFT LCD Monitor
- TFT LCD TV
- Factory Application
- Amusement
- Vehicle

3.4 GENERAL Specifications

Parameter	Specifications	Unit
Diagonal Size	(12.1" diagonal)	inch
Active Area	245.76(H) x 184.32(V)	pixel
Bezel Opening Area	249.00(H) x 187.50(V)	mm
Driver Element	a-si TFT active matrix	mm
Pixel Number	1024 x R.G.B. x 768	pixel
Pixel Pitch	0.240(H) x 0.240(V)	mm
Pixel	RGB vertical stripe	--
Display Colors	262,144	color
Transmissive Mode	Normally black	--
Surface Treatment	Hard coating (3H), Anti-glare (Haze 25%)	--

3.5 MECHANICAL SPECIFICATIONS

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	260.0	260.5	261.0	mm	(1)
	Vertical (V)	203.5	204.0	204.5	mm	
	Depth (D)	11.7	12.2	12.7	mm	
Weight		-	-	660	g	-
I/F connector mounting position		The mounting inclination of the connector makes the screen center within ±0.5mm as the horizontal.				(2)

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.
Note (2) Connector mounting position

4. ABSOLUTE MAXIMUM RATINGS

4.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Operating Ambient Temperature	TOP	-30	+70	ºC	(0), (1), (2)
Storage Temperature	TST	-40	+80	ºC	(0), (1)

Test Item	Test Condition	Note
High Temperature Storage Test	80ºC, 240 hours	(1) (2)
Low Temperature Storage Test	-40ºC, 240 hours	
Thermal Shock Storage Test	-40ºC, 0.5hour←→80℃, 0.5hour; 100cycles, 1hour/cycle	
High Temperature Operation Test	70ºC, 240 hours	
Low Temperature Operation Test	-30ºC, 240 hours	
High Temperature & High Humidity Operation Test	60ºC, RH 90%, 240hours	
Heat Cycle Operation Test	-30ºC, 1hour←→70ºC, 1hour; 50cycles, 4hour/cycle	
ESD Test (Operation)	150pF, 330Ω, 1sec/cycle Condition 1 : panel contact, ±8KV Condition 2 : panel non-contact ±15KV	(2)
Shock (Non-Operating)	220G, 2ms, half sine wave, 1 time for ± X, ± Y, ± Z.	(2)(3)
Vibration (Non-Operating)	1.5G, 10 ~ 300 Hz, 10min/cycle, 3 cycles each X, Y, Z	(2)(3)

Note (0) All test conditions are as above table.
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) No display malfunctions.
Note (3) 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.
Note (4) Temperature of panel display surface area should be 80 ºC Max.

4.2 ELECTRICAL ABSOLUTE RATINGS

4.2.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	Vcc	-0.3	+4.0	V	(1)
Logic Input Voltage	V_{IN}	-0.3	2.7	V	

4.2.2 BACKLIGHT UNIT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Lamp Voltage	V_L	-	2.5K	V_{RMS}	(1), (2), I_L= (8.0) mA
Lamp Current	I_L	2.0	8.5	mA_{RMS}	(1), (2)
Lamp Frequency	F_L	(45)	(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 5.2 for further information).

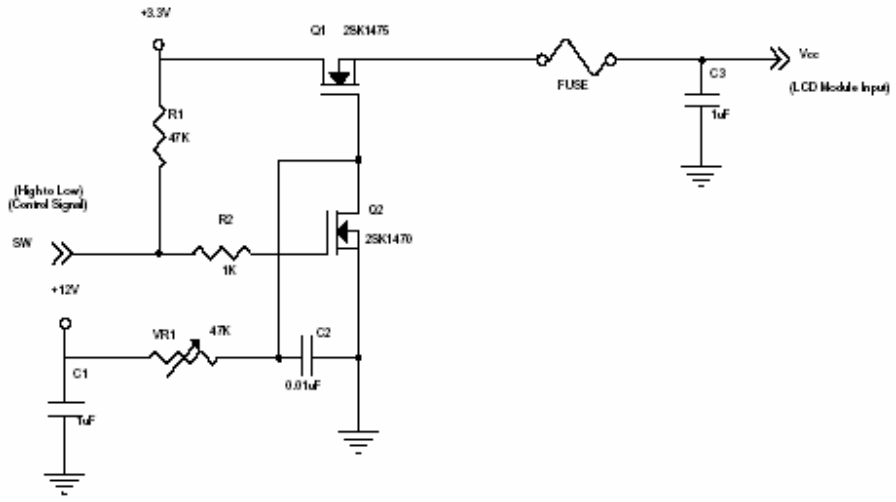
5. ELECTRICAL CHARACTERISTICS

5.1 TFT LCD MODULE

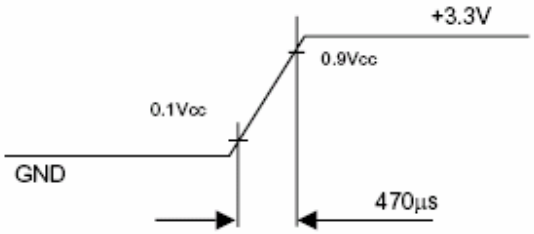
Ta = 25 ± 2 ºC

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		Vcc	3.0	3.3	3.6	V	-
Ripple Voltage		V_{RP}			100	mV	-
Rush Current		I_{RUSH}			1.0	A	(2)
Power Supply Current	White	-		(400)		mA	(3)a
	Black			(730)		mA	(3)b
LVDS differential input voltage		Vid	-100		+100	mV	
LVDS common input voltage		Vic		1.2		V	

Note (1) The module is recommended to operate within specification ranges listed above for normal function.
Note (2) Measurement Conditions:

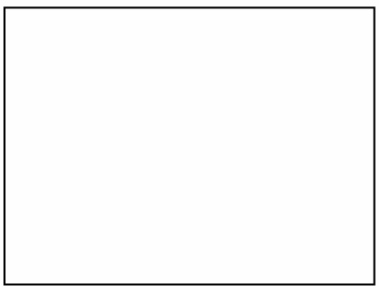


Vcc rising time is 470μs



Note (3) The specified power supply current is under the conditions at Vcc = 3.3 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

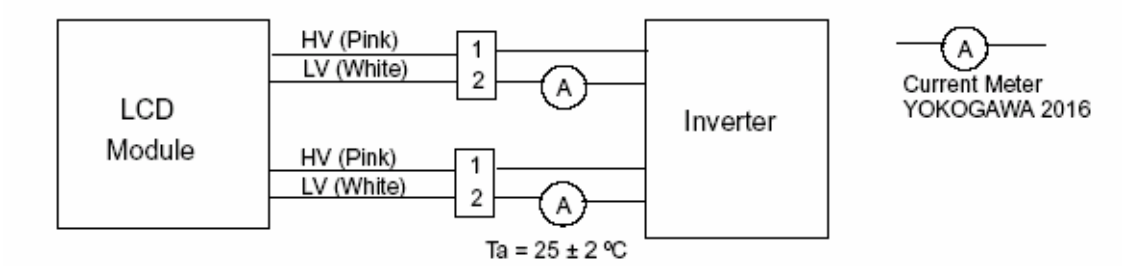
Active Area

5.2 BACKLIGHT UNIT

Ta = 25 ± 2 ºC

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Lamp Input Voltage	V_L	450	500	550	V_{RMS}	I_L= 8.0 mA
Lamp Current	I_L	2.0	8.0	8.5	mA_{RMS}	(1)
Lamp Turn On Voltage	V_S	-	-	1010 (25 ºC)	V_{RMS}	(2)
		-	-	1200 (0 ºC)	V_{RMS}	(2)
Operating Frequency	F_L	45	-	80	KHz	(3)
Power Consumption	P_L	-	4.0	-	W	(4), I_L= 8.0 mA
Lamp Life Time	L_{BL}	50,000	-	-	Hrs	(5) ,I_L= 8.0 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 normally.

Note (3) The lamp frequency may produce interference with horizontal synchronization frequency from the display, which might cause line flow on the display. In order to avoid interference, the lamp frequency should be detached from the horizontal synchronization frequency and its harmonics as far as possible.

Note (4) $P_L = I_L \times V_L$

Note (5) The lifetime of lamp can be defined as the time in which it continues to operate under the condition Ta = 25 ±2 ^oC and I_L = 2.0 ~ 8.0 mArms until one of the following events occurs:

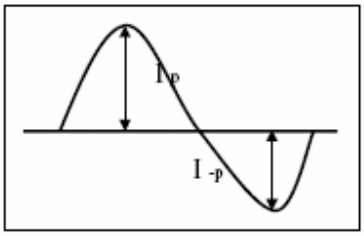
(a) When the brightness becomes or lower than 50% of its original value.

(b) When the effective ignition length becomes or lowers than 80% of its original value. (Effective ignition length is defined as an area that has less than 70% brightness compared to the brightness in 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.

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. Lamp frequency may produce interface with horizontal synchronous frequency and as a result this may cause beat on the display. Therefore lamp frequency shall be as away possible from the horizontal synchronous frequency and from its harmonics in order to prevent interference. Requirements for a system inverter design, which is intended to have a better display performance, a better power efficiency and a more reliable lamp. It shall help increase the lamp lifetime and reduce its leakage current.

a. The asymmetry rate of the inverter waveform should be 10% below;
b. The distortion rate of the waveform should be within $\sqrt{2} \pm 10\%$;
c. The ideal sine wave form shall be symmetric in positive and negative polarities.



* Asymmetry rate:

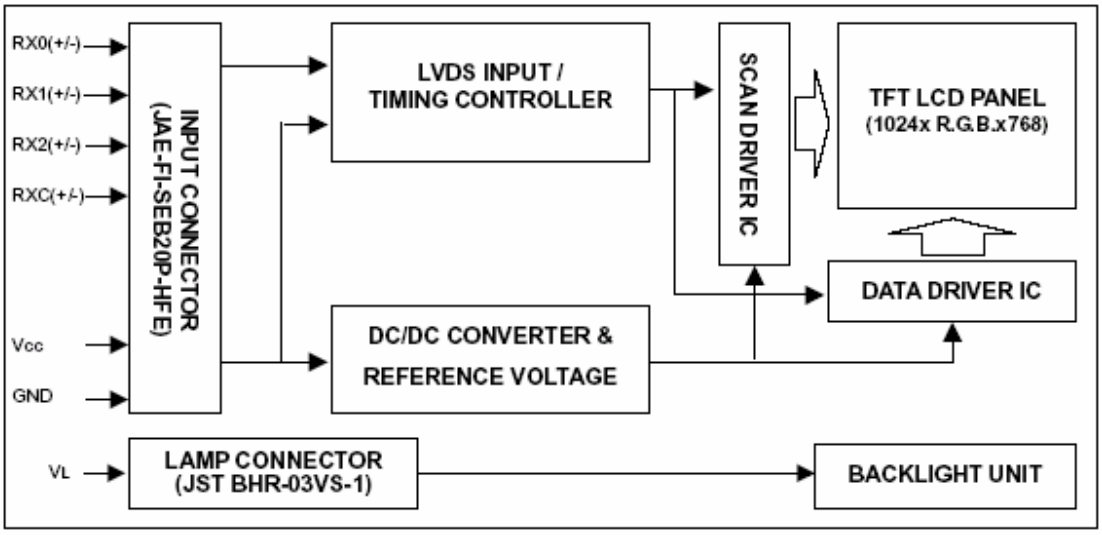
$$| I_p - I_{-p} | / I_{rms} * 100\%$$

* Distortion rate

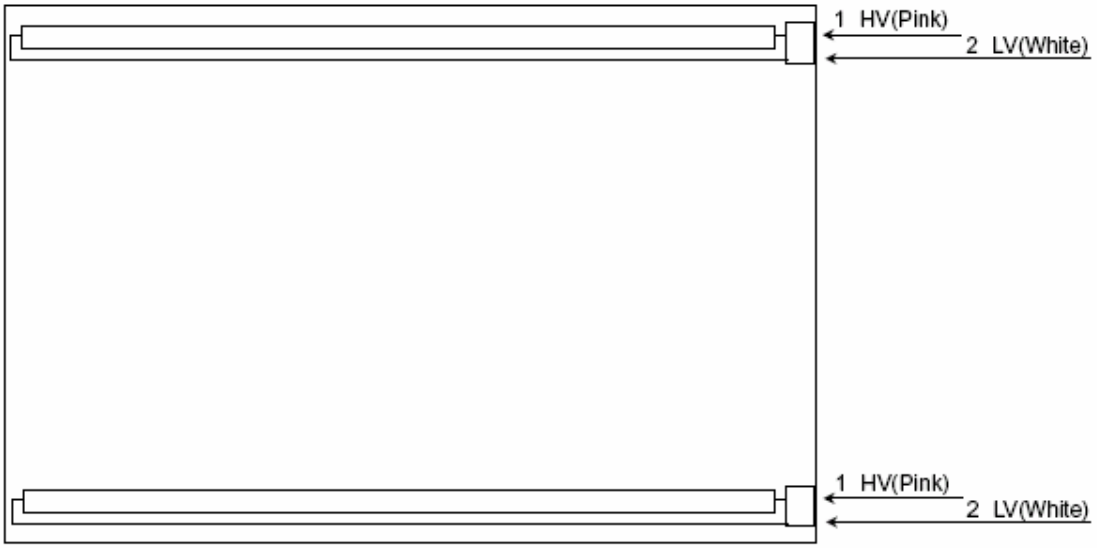
$$I_p \text{ (or } I_{-p}) / I_{rms}$$

6. BLOCK DIAGRAM

6.1 TFT LCD MODULE



6.2 BACKLIGHT UNIT



7. INPUT TERMINAL PIN ASSIGNMENT

7.1 TFT LCD MODULE

Pin	Name	Description	Remark
1	VCC_IN	Power Supply (5.0 V / 3.3 V)	
2	VCC_IN	Power Supply (5.0 V / 3.3 V)	
3	GND	Ground	
4	GND	Ground	
5	RX0-	Differential Data Input, CH0 (Negative)	R0 ~ R5, G0
6	RX0+	Differential Data Input, CH0 (Positive)	
7	GND	Ground	
8	RX1-	Differential Data Input, CH1 (Negative)	G1 ~ G5, B0, B1
9	RX1+	Differential Data Input , CH1 (Positive)	
10	GND	Ground	
11	RX2-	Differential Data Input , CH2 (Negative)	B2 ~ B5, DE, Hsync, Vsync
12	RX2+	Differential Data Input , CH2 (Positive)	
13	GND	Ground	
14	CLK-	Differential Clock Input (Negative)	LVDS Level Clock
15	CLK+	Differential Clock Input (Positive)	
16	GND	Ground	
17	NA	Non-connection	
18	NA	Non-connection	
19	GND	Ground	
20	GND	Ground	

Note (1) Connector Part No.: JAE-FI-SEB20P-HFE or equivalent.
Note (2) Mating Connector Part No.: JAE-FI-SE20M, FI-S20S or equivalent.
Note (3) The first pixel is odd.
Note (4) Input signal of even and odd clock should be the same timing.

7.2 BACKLIGHT UNIT

Pin	Symbol	Description	Remark
1	HV	High Voltage	Pink
2	NA	NA	
3	LV	Low Voltage	White

Note (1) Connector Part No.: JST BHR-03VS-1 or equivalent
Note (2) User's connector Part No.: JST SM03(4.0)B-BHS-1-TB or equivalent

7.3 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.

		Data Signal																	
		Red						Green						Blue					
Color		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

8. INTERFACE TIMING

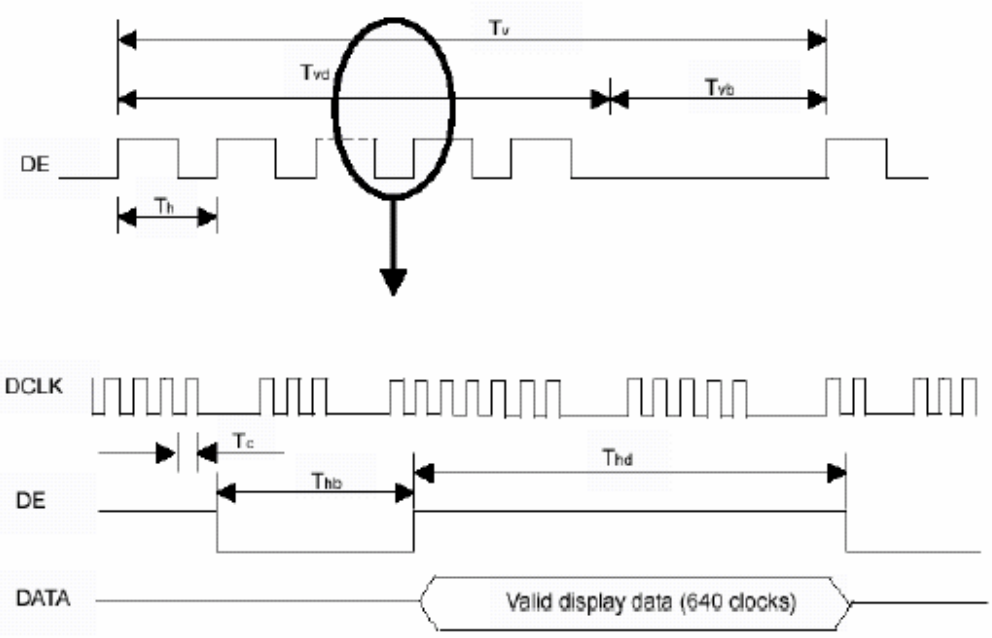
8.1 INPUT SIGNAL TIMING SPECIFICATIONS

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

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
DCLK	Frequency	Fc	57.5	64.9	74.4	MHz	
	Period	Tc	13.4	15.4	17.3	ns	
Vertical Active Display Term	Frame Rate	Fr	56	60	75	Hz	
	Total	Tv	774	806	848	Th	Tv=Tvd+Tvb
	Display	Tvd	768	768	768	Th	
	Blank	Tvb	Tv-Tvd	38	Tv-Tvd	Th	
Horizontal Active Display Term	Total	Th	1240	1344	1464	Tc	Th=Thd+Thb
	Display	Thd	1024	1024	1024	Tc	
	Blank	Thb	Th-Thd	320	Th-Thd	Tc	

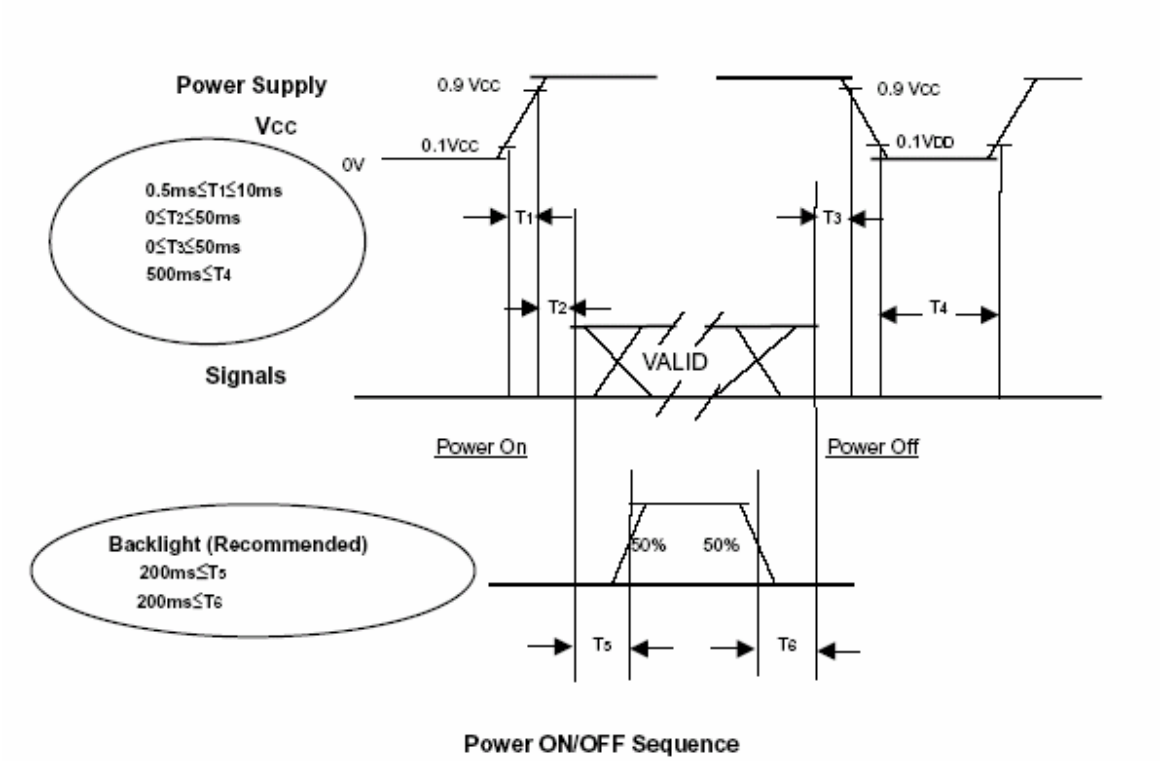
Note：(1) Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

INPUT SIGNAL TIMING DIAGRAM



8.2 POWER ON/OFF SEQUENCE

To prevent a latch-up or DC operation of LCD module, the power on/off sequence should follow the conditions shown in the following diagram.



Power ON/OFF Sequence

Note (1) Please avoid floating state of interface signal at invalid period.
Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD Vcc to 0 V.
Note (3) The Backlight inverter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight inverter power must be turned off before the power supply for the logic and the interface signal is invalid.

9. OPTICAL CHARACTERISTICS

9.1 TEST CONDITIONS

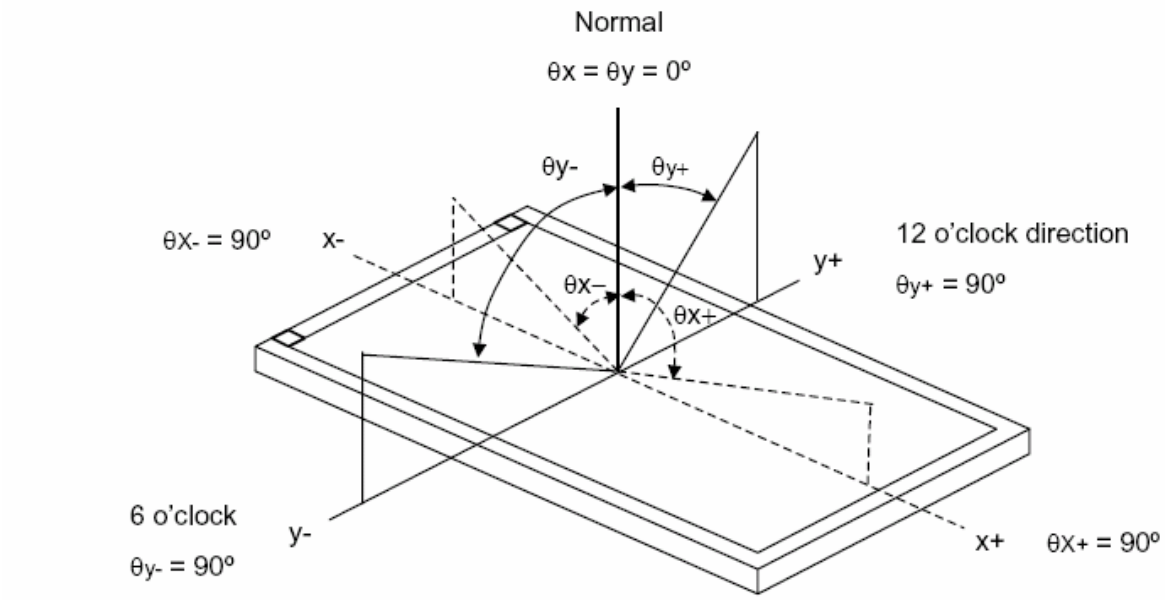
Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	oC
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V_{CC}	5.0	V
Input Signal	According to typical value in "5. ELECTRICAL CHARACTERISTICS"		
Inverter Current	I_L	8.0	mA
Inverter Driving Frequency	F_L	61	KHz
Inverter	Sumida H05-5052		

9.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 9.2. The following items should be measured under the test conditions described in 9.1 and stable environment shown in Note (5).

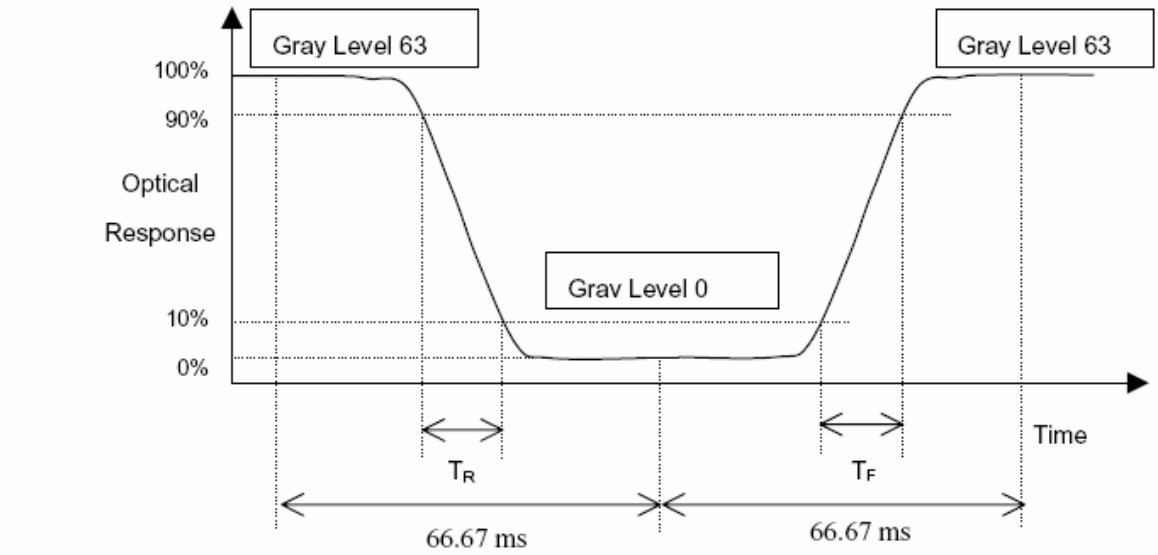
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Color Chromaticity	Red	Rx	θ_x=0°, θ_Y=0° CS-1000	Typ -0.03	(0.597)	Typ + 0.03	-	(1), (5)
		Ry			(0.340)		-	
	Green	Gx			(0.321)		-	
		Gy			(0.534)		-	
	Blue	Bx			(0.150)		-	
		By			(0.128)		-	
	White	Wx			(0.313)		-	
		Wy			(0.329)		-	
Center Luminance of White		L_C		(380)	(450)	---	cd/m2	(4), (5)
Contrast Ratio		CR		(500)	(700)	---	-	(2), (5)
Response Time		T_R	θ_x=0°, θ_Y=0°	---	(6)	(11)	ms	(3)
		T_F		--	(17)	(22)	ms	
White Variation		δW	θ_x=0°, θ_Y=0°	---	(1.25)	(1.4)	-	(5), (6)
Viewing Angle	Horizontal	θ_x+	CR≥10	(70)	(80)	---	Deg.	(1), (5)
		θ_x-		(70)	(80)	---	Deg.	
	Vertical	θ_Y+		(70)	(80)	---	Deg.	
		θ_Y-		(70)	(80)	---	Deg.	

Note (1) Definition of Viewing Angle (θ x, θ y):



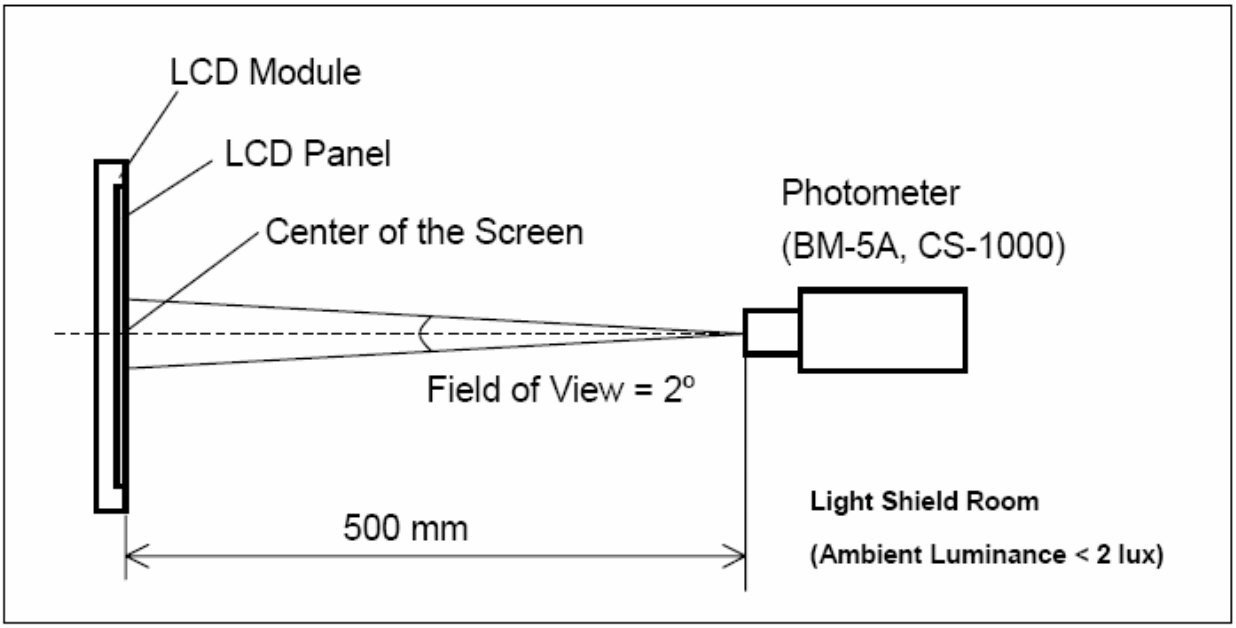
Note (2) Definition of Contrast Ratio (CR):
The contrast ratio can be calculated by the following expression.
Contrast Ratio (CR) = L63 / L0
L63: Luminance of gray level 63
L 0: Luminance of gray level 0
CR = CR (5)
CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (6).

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



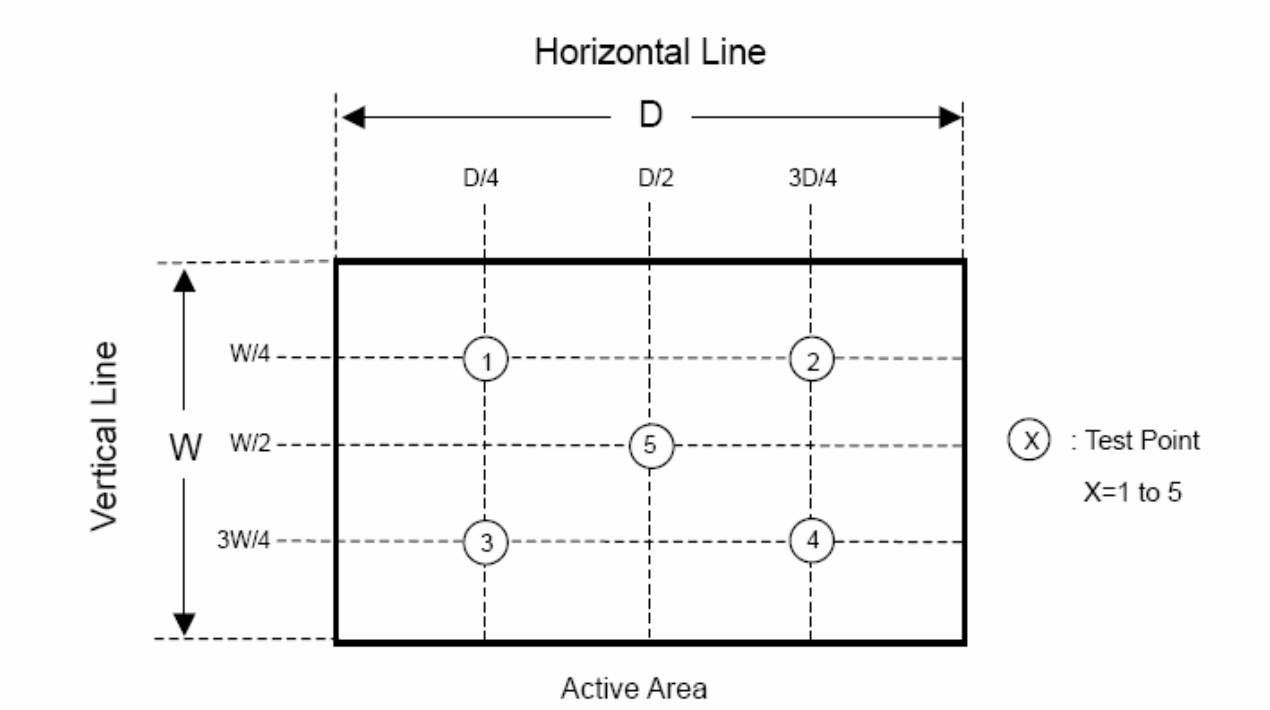
Note (4) Definition of Luminance of White (L_C):
Measure the luminance of gray level 63 at center point
L_C = L (5)
L (x) is corresponding to the luminance of the point X at Figure in Note (6).
Note (5) Measurement Setup:

The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.

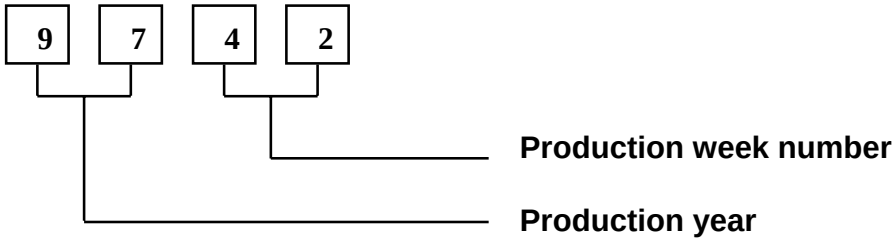


Note (6) Definition of White Variation (δ W):
Measure the luminance of gray level 63 at 5 points

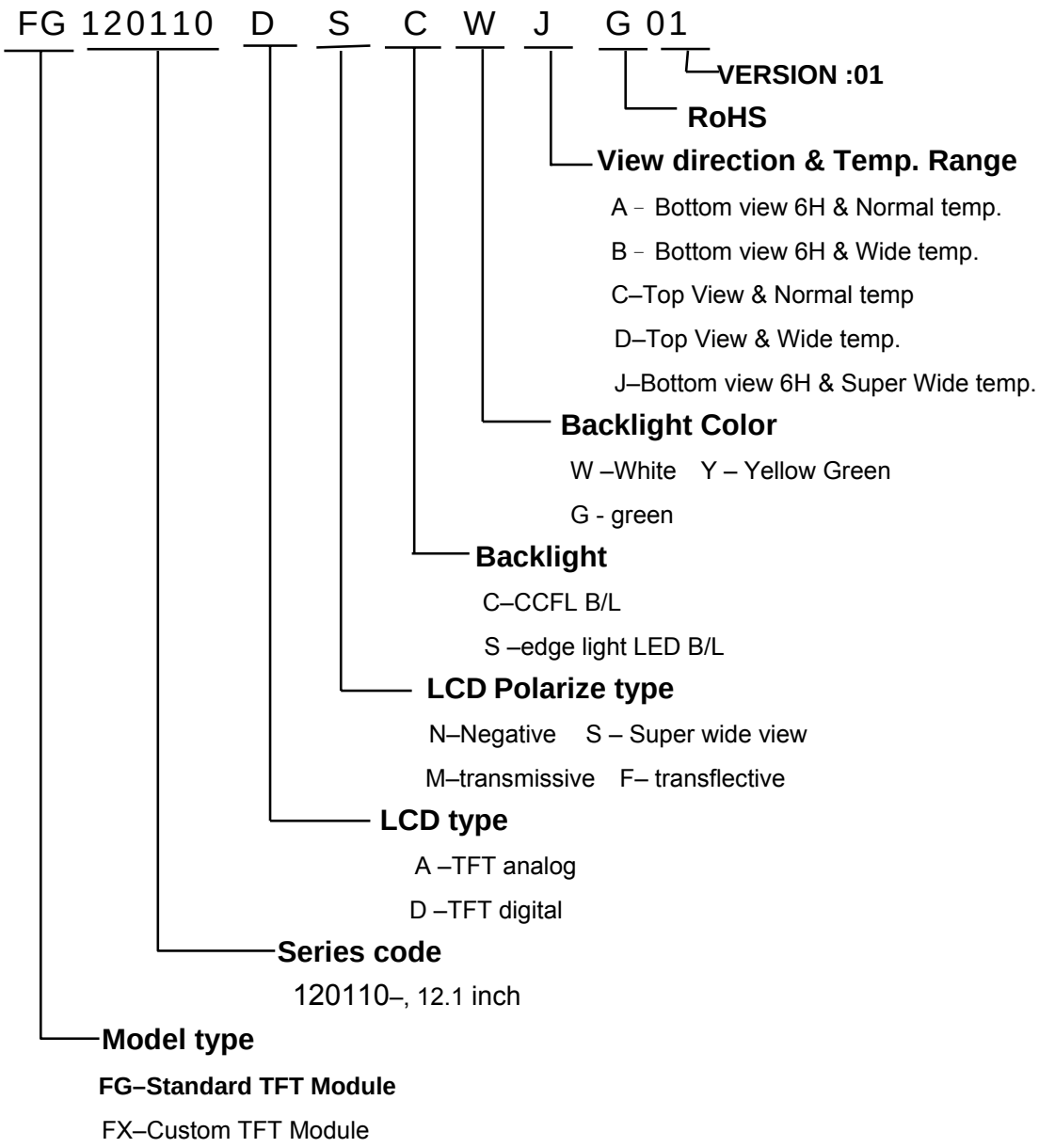
$$\delta W = \frac{\text{Maximum [L (1), L (2), L (3), L (4), L (5)]}}{\text{Minimum [L (1), L (2), L (3), L (4), L (5)]}}$$



10. LOT NUMBERING SYSTEM



11. LCM NUMBERING SYSTEM



12. PRECAUTIONS IN USE LCM

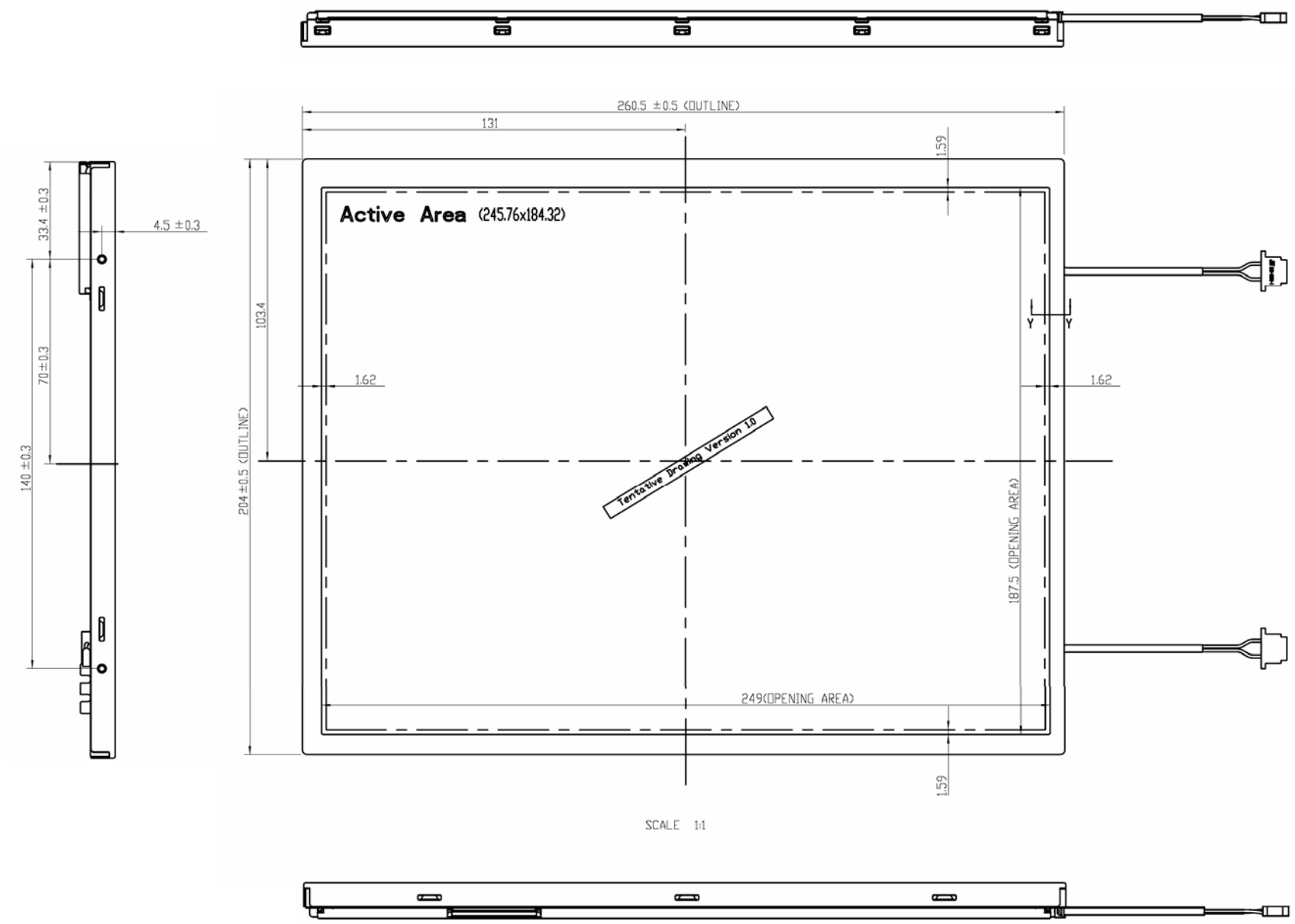
12.1 ASSEMBLY AND HANDLING PRECAUTIONS

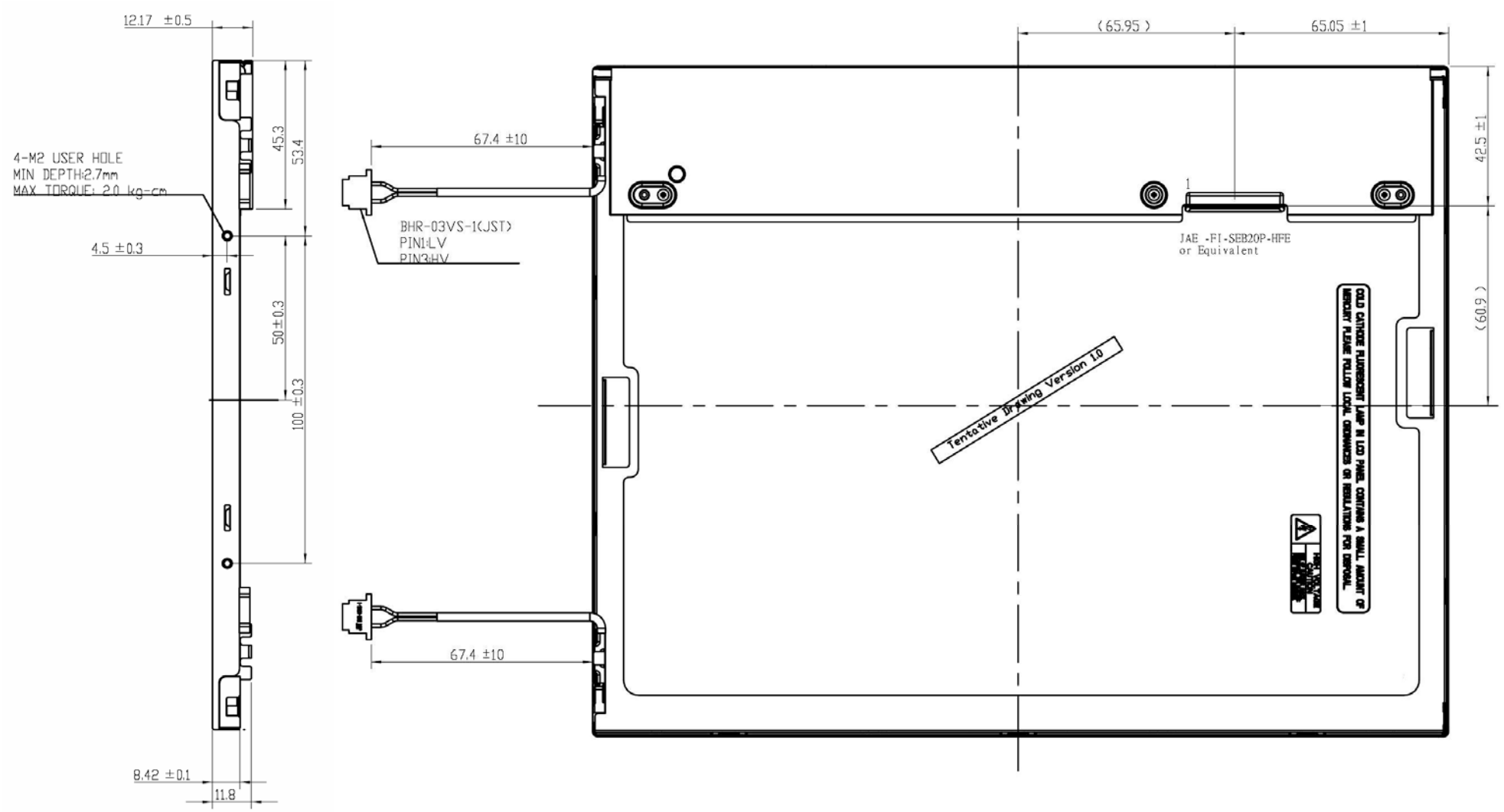
(1) Do not apply rough force such as bending or twisting to the module during assembly.
(2) To assemble or install module into user's system can be only in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
(3) It's not permitted to have pressure or impulse on the 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.

12.2 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.

13. OUTLINE DRAWING





NOTES:
1.OUTLINE TOLERANCE: ±0.5mm.
2."✱" MARKS THE DESIGN CRITICAL DIMENSION.
3." Ⓟ" MARKS THE PROCESS CRITICAL DIMENSION.
4.MAX SCREW LENGTH:2.7 mm.
5.MAX SCREW TORQUE:2.0kg-cm.

14.PACKAGE INFORMATION