First Edition
Dec 23, 2004

Final Revision

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LCD Module Technical Specification

Type No. **T-51944D104J-FW-A-AA**

Approved by (Quality Assurance Division)

Checked by (ACI Engineering Division)

Prepared by (ACI Engineering Division)

1. APPLICATION

This specification applies to color TFT-LCD module, T-51944D104J-FW-A-AA.

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OPTREX classifies the usage of the TFT-LCD module as follows. Please confirm the usage before using the product.

(1) Standard Usage
    Computers, office equipment, factory automation equipment, test and measurement equipment, communications, transportation equipment(automobiles, ships, trains, etc.), provided, however, that operation is not influenced by TFT-LCD directly.
(2) Special Usage
    Medical equipment, safety equipment, transportation equipment, provided, however, that TFT-LCD is necessary to its operation.
(3) Specific Usage
    Cockpit Equipment, military systems, aerospace equipment, nuclear reactor control systems, life support systems and any other equipment. OPTREX should make a contract that stipulate apportionment of responsibilities between OPTREX and our customer.

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Please contact and consult a OPTREX sales representative for any questions regarding this product.

2. OVERVIEW

T-51944D104J-FW-A-AA is 10.4" color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, driver ICs, control circuit, and backlight unit.

By applying 6 bit or 8 bit digital data, 800 × 600, 260 K-color or 16.7 M-color images are displayed on the 10.4" diagonal screen. Input power voltage is 3.3V for LCD driving.

The type of data and control signals are digital and transmitted via LVDS interface per Typ. 40 MHz clock cycle.

Inverter for backlight is not included in this module. General specifications are summarized in the following table:

ITEM	SPECIFICATION
Display Area (mm)	211.2 × 158.4 (10.39-inch diagonal)
Number of Dots	800 × 3 (H) × 600 (V)
Pixel Pitch (mm)	0.264 (H) × 0.264 (V)
Color Pixel Arrangement	RGB vertical stripe
Display Mode	Normally white TN
Number of Color	260 K(6 bit/color), 16.7 M(8 bit/color)
Brightness (cd/m^2)	400
Wide Viewing Angle Technology	Optical Compensation Film
Viewing Angle (CR ≥ 10)	-70~70° (H) -60~50° (V)
Surface Treatment	Anti-glare and hard-coating 3H
Electrical Interface	LVDS(6 bit/8 bit)
Optimum Viewing Angle (Contrast ratio)	6 o'clock
Module Size (mm)	243.0 (W) × 181.6 (H) × 12.2 (D)
Module Mass (g)	570
Backlight Unit	CCFL, 2-tubes, edge-light, replaceable

Characteristic value without any note is typical value.

3. ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	MIN.	MAX	UNIT
Power Supply Voltage for LCD	VCC	0	4.0	V
Logic Input Voltage	VI	0	VCC+0.3	V
Lamp Voltage	VL	0	1500	Vrms
Lamp Current	IL	0	9	mArms
Lamp Frequency	FL	40	100	kHz
Operation Temperature (Panel) Note 1,2)	$T_{op(Panel)}$	-20	70	°C
Operation Temperature (Ambient) Note 2)	$T_{op(Ambient)}$	-20	70	°C
Storage Temperature Note 2)	T_{stg}	-20	80	°C

[Note]
1) Measured at the center of active area and at the center of panel back surface
2) Top,Tstg ≤ 40°C : 90%RH max. without condensation
   Top,Tstg > 40°C : Absolute humidity shall be less than the value of 90%RH at 40°C without
   condensation.

4. ELECTRICAL CHARACTERISTICS
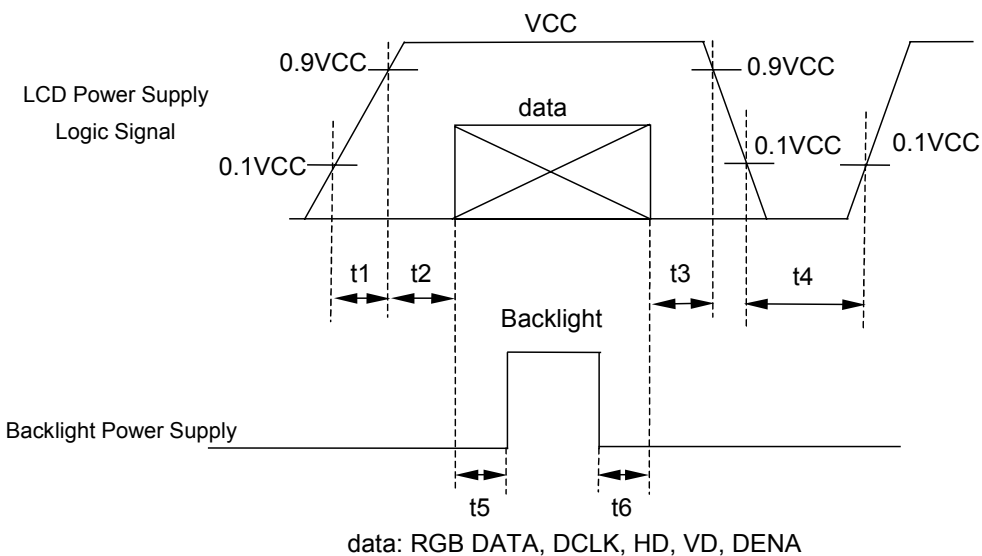(1) TFT-LCD

Ambient temperature: Ta = 25℃

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	Remarks
Power Supply Voltage for LCD	VCC	3.0	3.3	3.6	V	*1)
Power Supply Current for LCD	ICC	--	270	430	mA	*2)
Permissive Input Ripple Voltage	VRP	--	--	100	mVp-p	VCC = +3.3V

*1) Power and signals sequence:

   t1 ≤ 10 ms   200 ms ≤ t4
   0 < t2 ≤ 50 ms   200 ms ≤ t5
   0 < t3 ≤ 50 ms   0 ≤ t6

data: RGB DATA, DCLK, HD, VD, DENA

VCC-dip conditions:
       1) When 2.7 V ≤ VCC < 3.0 V, td ≤ 10 ms
      2) When VCC < 2.7 V
         VCC-dip conditions should also follow the power and signals sequence.
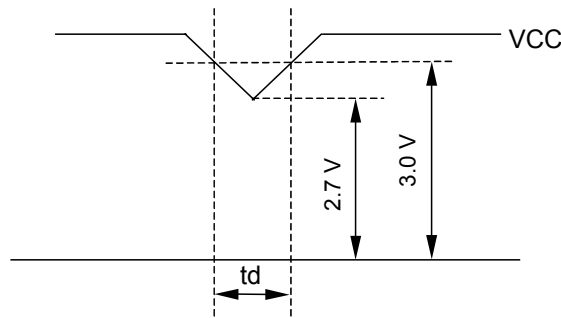
*2) Typical current condition:
       64-gray-bar pattern
       600 line mode
       VCC = +3.3 V , f_H=37.9 kHz, f_V=60 Hz, f_{CLK}= 40 MHz

(2) Backlight

Ta = 25℃

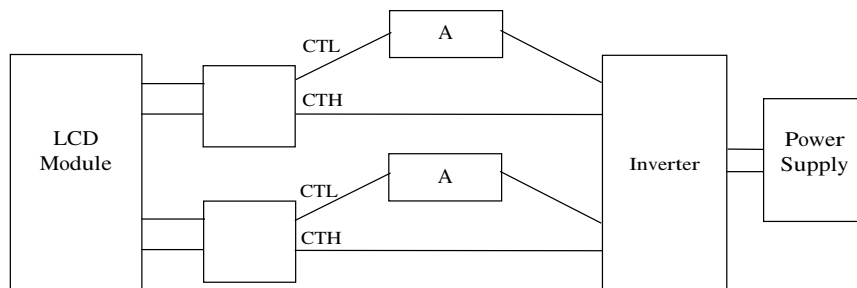| ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	Remarks
Lamp Voltage	VL	--	470	--	Vrms	IL = 6.5 mArms
Lamp Current	IL	3.0	6.5	7.5	mArms	*1),*5)
Lamp Frequency	FL	40	--	100	kHz	*2)
Starting Lamp Voltage	VS	900	--	--	Vrms	Ta = 25°C
		1350	--	--	Vrms	Ta = 0°C
		1440	--	--	Vrms	Ta = −20°C
Lamp Life Time	LT	50,000	--	--	h	*3),*4) IL = 6.5 mArms, Continuous operation

*1) Lamp Current measurement method (The current meter is inserted in low voltage line.)

*2) Lamp frequency of inverter may produce interference with horizontal synchronous frequency, and this may cause horizontal beat on the display. Therefore, please adjust lamp frequency, and keep inverter as far from module as possible or use electronic shielding between inverter and module to avoid the interference.

*3) Lamp life time is defined as the time either when the brightness becomes 50% of the initial value, or when the starting lamp voltage does not meet the value specified in this table.

*4) The life time of the backlight depends on the ambient temperature. The life time will decrease under low/high temperature.

*5) Please use the inverter which has symmetrical current wave form as follows,

The degree of unbalance: less than 10%

The ratio of wave height: less than $\sqrt{2} \pm 10\%$

I_{PH}
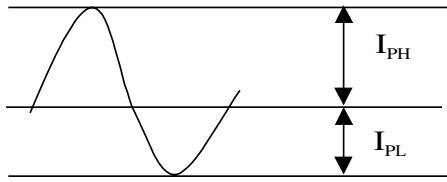
I_{PH}: High side peak

I_{PL}

I_{PL}: Low side peak

The degree of unbalance = $|I_{PH} - I_{PL}| / Irms \times 100(\%)$

The ratio of wave height = I_{PH}(or I_{PL}) / Irms

CURRENT WAVE FORM

5. INTERFACE PIN CONNECTION

(1) CN 1(Interface Signal)

Used connector: FI-SEB20P-HFE(JAE)

Corresponding connector: FI-S20S[for discrete Wire], FI-SE20M[for SMT]

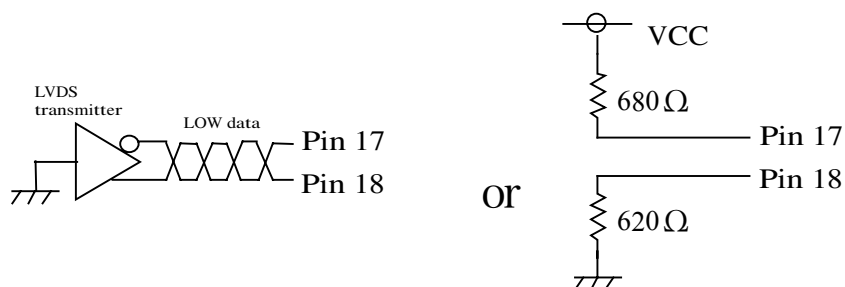| Pin No.	Symbol	Function(ISP 6 bit compatibility mode)		Function(ISP 8 bit compatibility mode)
		6 bit input	8 bit input	
1	VCC	+3.3 V Power supply		←
2	VCC	+3.3 V Power supply		←
3	GND	GND		←
4	GND	GND		←
5	Link 0-	R0, R1, R2, R3, R4, R5, G0	R2, R3, R4, R5, R6, R7, G2	R0, R1, R2, R3, R4, R5, G0
6	Link 0+	R0, R1, R2, R3, R4, R5, G0	R2, R3, R4, R5, R6, R7, G2	R0, R1, R2, R3, R4, R5, G0
7	GND	GND		←
8	Link 1-	G1, G2, G3, G4, G5, B0, B1	G3, G4, G5, G6, G7, B2, B3	G1, G2, G3, G4, G5, B0, B1
9	Link 1+	G1, G2, G3, G4, G5, B0, B1	G3, G4, G5, G6, G7, B2, B3	G1, G2, G3, G4, G5, B0, B1
10	GND	GND		←
11	Link 2-	B2, B3, B4, B5, HD, VD, DENA	B4, B5, B6, B7, HD, VD, DENA	B2, B3, B4, B5, HD, VD, DENA
12	Link 2+	B2, B3, B4, B5, HD, VD, DENA	B4, B5, B6, B7, HD, VD, DENA	B2, B3, B4, B5, HD, VD, DENA
13	GND	GND		←
14	CLKIN-	Clock -		←
15	CLKIN+	Clock +		←
16	GND	GND		←
17	Link3-	See: *2)	R0, R1, G0, G1, B0, B1	R6, R7, G6, G7, B6, B7
18	Link3+	See: *2)	R0, R1, G0, G1, B0, B1	R6, R7, G6, G7, B6, B7
19	MODE	Low=ISP 6 bit compatibility mode		High=ISP 8 bit compatibility mode
20	SC	Reverse scan control (Low : Normal , High : Reverse)		←

*1) The shielding case is connected with GND.

*2) Recommended wiring of Pin 17,18 (6 bit input)

(2) CN 2(Backlight)

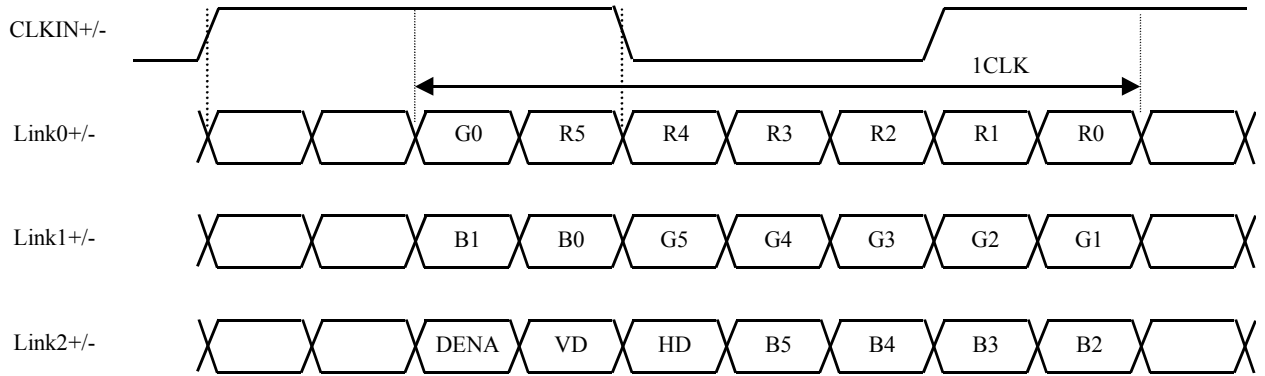Backlight-side connector: BHR-02(8.0)VS-1N (JST)

Inverter-side connector: SM02(8.0)B-BHS(JST)

Pin No.	Symbol	Function
1	CTH	VBLH (High voltage)
2	CTL	VBLL (Low voltage)

[Note] VBLH - VBLL = VL

(3) ISP data mapping

a. ISP 6 bit compatibility mode(6 bit input)

CLKIN+/-									1CLK			
Link0+/-			G0	R5	R4	R3	R2	R1	R0			
Link1+/-			B1	B0	G5	G4	G3	G2	G1			
Link2+/-			DENA	VD	HD	B5	B4	B3	B2			

b. ISP 6 bit compatibility mode(8 bit input)

CLKIN+/-									1CLK			
Link0+/-			G2	R7	R6	R5	R4	R3	R2			
Link1+/-			B3	B2	G7	G6	G5	G4	G3			
Link2+/-			DENA	VD	HD	B7	B6	B5	B4			
Link3+/-				B1	B0	G1	G0	R1	R0			

c. ISP 8 bit compatibility mode

CLKIN+/-									1CLK			
Link0+/-			G0	R5	R4	R3	R2	R1	R0			
Link1+/-			B1	B0	G5	G4	G3	G2	G1			
Link2+/-			DENA	VD	HD	B5	B4	B3	B2			
Link3+/-				B7	B6	G7	G6	R7	R6			
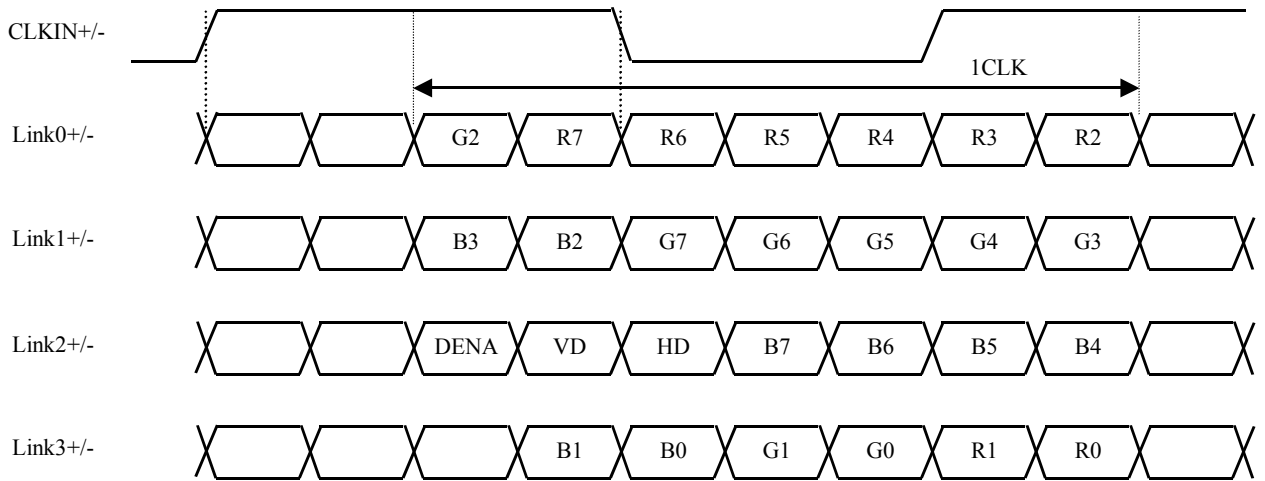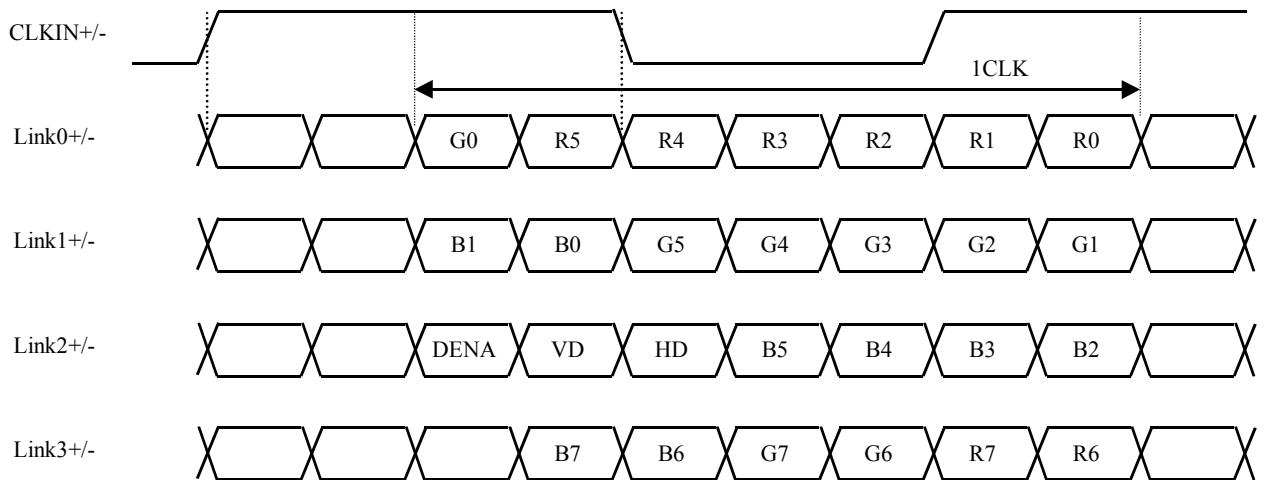
6. INTERFACE TIMING

LVDS transmitter input signal

(1) Timing Specifications

ITEM		SYMBOL	MIN	TYP	MAX	UNIT
DCLK	Frequency	f_{CLK}	35	40	42	MHz
	Period	t_{CLK}	23.8	25	28.6	ns
DENA	Horizontal Active Time	t_{HA}	800	800	800	t_{CLK}
	Horizontal Front Porch	t_{HFP}	0	40	--	t_{CLK}
	Horizontal Back Porch	t_{HBP}	10	216	--	t_{CLK}
	Vertical Active Time	t_{VA}	600	600	600	t_H
	Vertical Front Porch	t_{VFP}	1	4	--	t_H
	Vertical Back Porch	t_{VBP}	2	27	--	t_H
HD	Frequency	f_H	35.2	37.9	39.2	kHz
	Period	t_H	25.5	26.4	28.4	μs
	Low Width	t_{WHL}	5	128	--	t_{CLK}
VD	Frequency	f_V	55	60	64.2	Hz
	Period	t_V	15.6	16.7	18.2	ms
	Low Width	t_{WVL}	1	4	--	t_H

[Note]

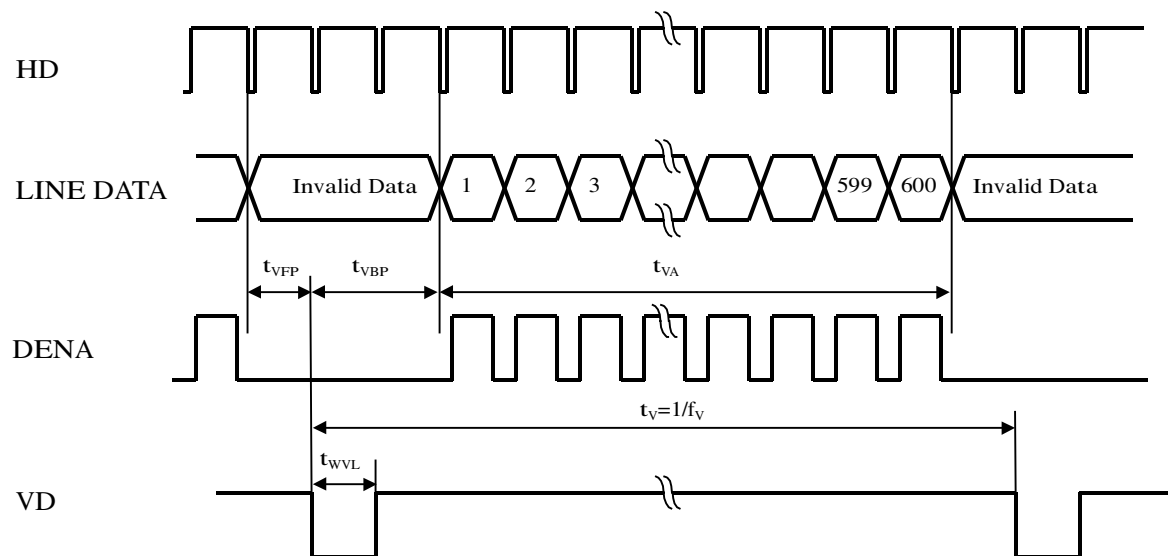1) Polarities of HD and VD are negative in this specification.

2) DENA (Data Enable) should always be positive polarity as shown in the timing specification.

3) DCLK should appear during all invalid period, and HD should appear during invalid period of frame cycle.

4) LVDS timing follows the timing specifications of LVDS receiver IC: THC63LVDF84B(Thine).

5) $t_{HFP} + t_{HBP} \geq 20\ t_{CLK}$

(2) Timing Chart

a. Horizontal Timing Chart

DCLK

DATA (R,G,B)
Invalid Data   1   2   3   799   800   Invalid Data
First Data
Last Data

t_{HFP} t_{HBP} t_{HA}

DENA

$t_H = 1/f_H$

t_{WHL}

HD

b. Vertical Timing Chart

HD

LINE DATA
Invalid Data   1   2   3   599   600   Invalid Data

t_{VFP} t_{VBP} t_{VA}

DENA

$t_V = 1/f_V$

t_{WVL}

VD
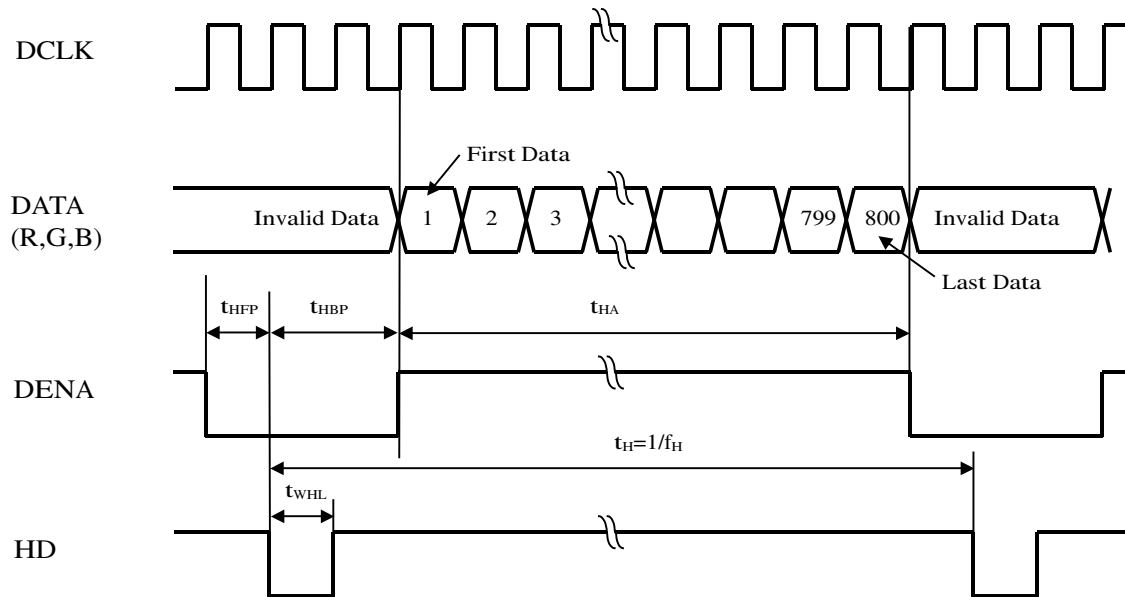
(3) Color Data Assignment

a. 6 bit input

COLOR		R5 MSB	R4	R3	R2	R1	R0 LSB	G5 MSB	G4	G3	G2	G1	G0 LSB	B5 MSB	B4	B3	B2	B1	B0 LSB
		R DATA						G DATA						B DATA					
BASIC COLOR	BLACK	0	0	0	0	0	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
	GREEN(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	BLUE(63)	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
RED	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(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
GREEN	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(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
BLUE	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(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) Definition of gray scale
Color (n) --- n indicates gray scale level.
Higher n means brighter level.
2) Data
1:High, 0: Low

b. 8 bit input

COLOR		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
		MSB							LSB	MSB							LSB	MSB							LSB
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	BLUE(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	MAGENTA	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RED	RED(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
	RED(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN(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
	GREEN(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
BLUE	BLUE(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(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) Definition of gray scale

Color (n) --- n indicates gray scale level.
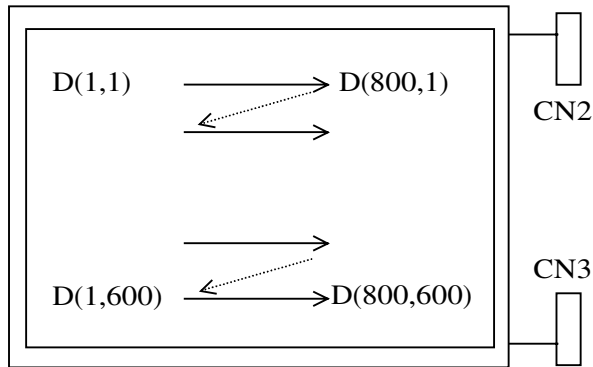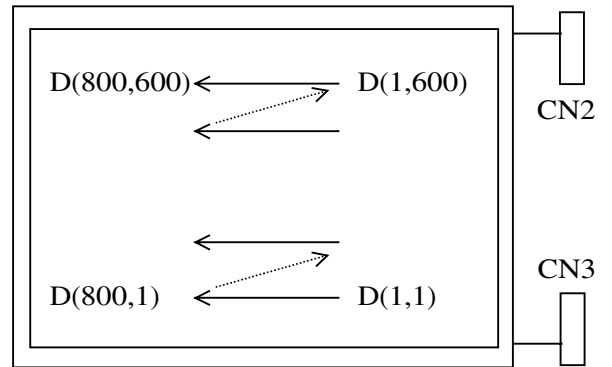
Higher n means brighter level.

2) Data

1:High, 0: Low

(4) Display Position and Scan Direction

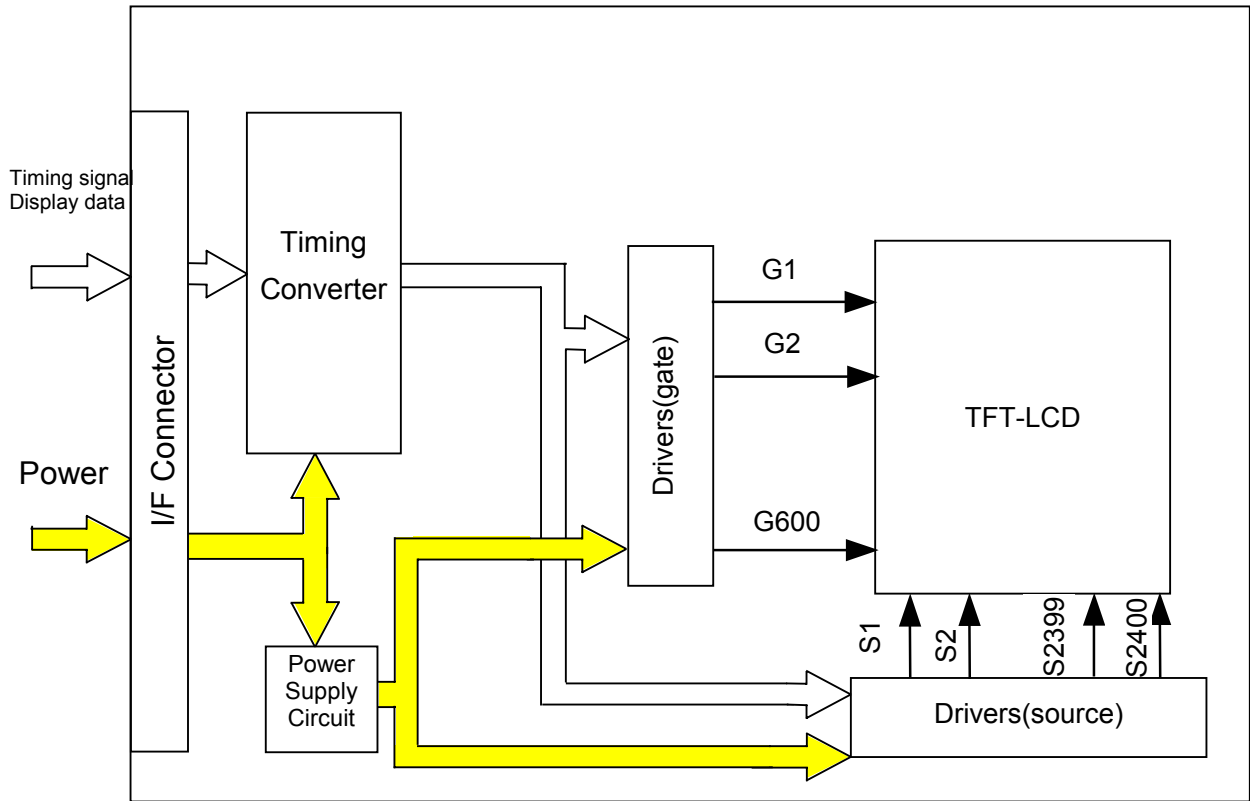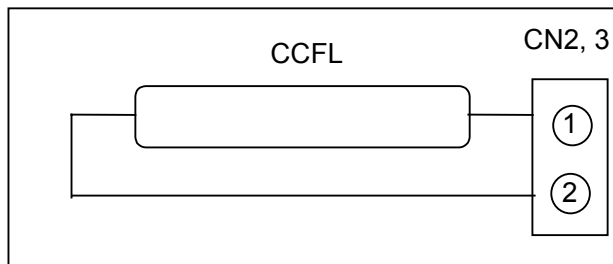D(X,Y) shows the data number of input signal for LCD panel signal processing PCB.
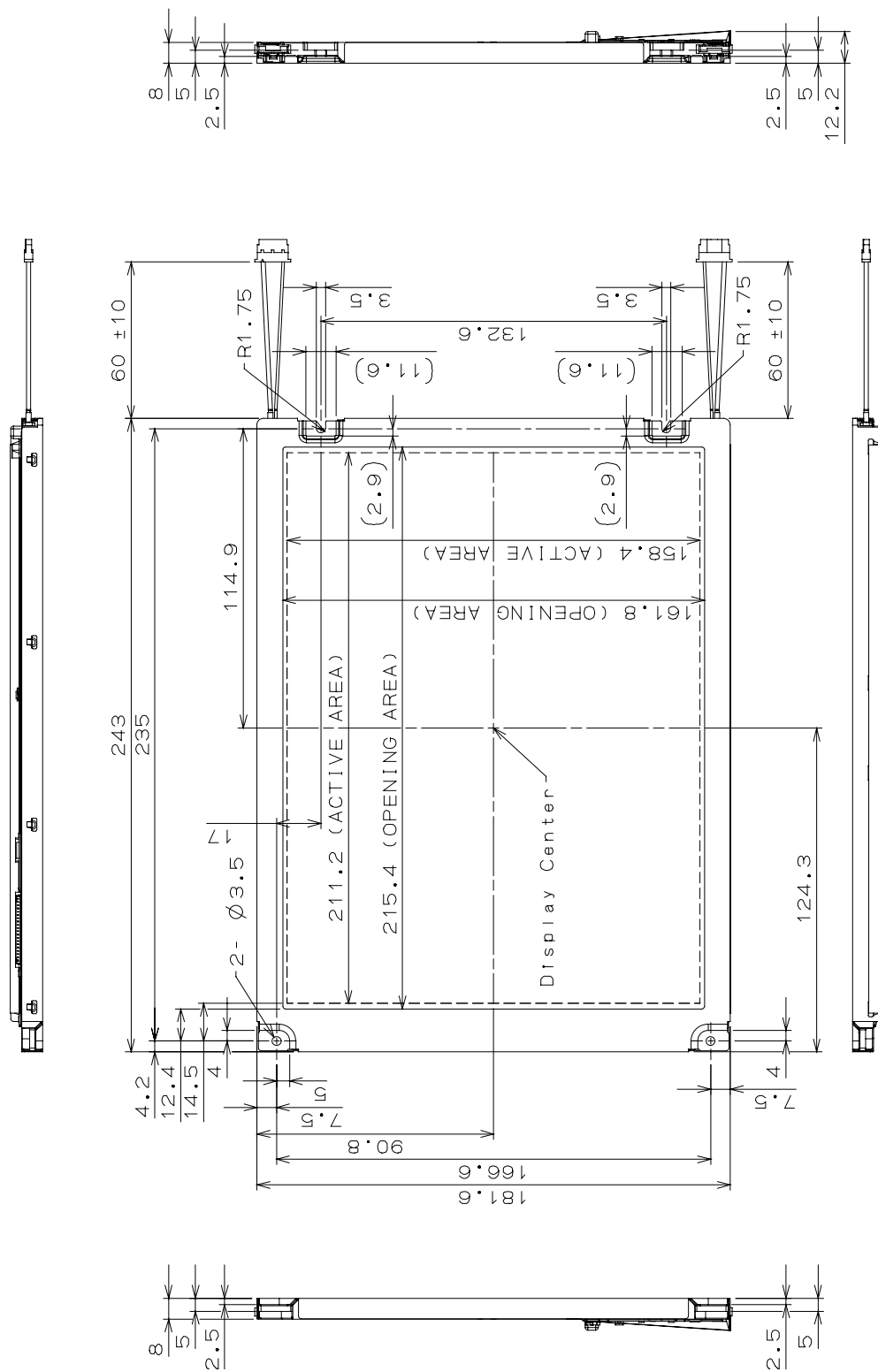
SC: Low or Open

D(1,1) ——————→ D(800,1)
         ←—————
                 —————→

         —————→
D(1,600) ←————→ D(800,600)

CN2

CN3

SC: High

D(800,600) ←————→ D(1,600)
              ←—————

         ←—————
D(800,1) ←————— D(1,1)

CN2

CN3

7. BLOCK DIAGRAM

BACKLIGHT

8. MECHANICAL SPECIFICATIONS

(1) Front Side

1)Tolerance is ±0.5mm unless noted
2)Except for chickness of PET film

60 ±10

R1.75

3.5

132.6

(11.6)

(11.6)

3.5

R1.75

60 ±10

(2.9)

(2.9)

158.4 (ACTIVE AREA)

161.8 (OPENING AREA)

114.9

243

235

211.2 (ACTIVE AREA)

215.4 (OPENING AREA)

Display Center

124.3

17

2- Ø3.5

4.2
12.4
14.5
4

7.5

5

90.8

166.6

181.6

4

7.5

8
5
2.5

2.5
5
12.2

2.5
5
8

2.5
5

(Unit: mm)

(2) Rear Side

LABEL AREA

38.7

12.35

227.85

(77.4)

CN1

20

(35.2)

CN2

1:HOT

2:COLD

CN3

2:COLD

1:HOT

(62.8)

1)Tolerance is ±0.5mm unless noted
2)Except for thickness of PET film

CN1:FI-SEB20P-HFE(JAE)
CN2,CN3:BHR-02(8.0)VS-1N(JST)

(Unit:mm)

[Note]
      We recommend you referring to the detailed drawing for your design.
      Please contact our company sales representative when you need the detailed drawing.

9. OPTICAL CHARACTERISTICS

Ta=25°C, VCC=3.3V, Input Signals: Typ. Values shown in Section 6

ITEM		SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	Remarks
Contrast Ratio		CR	$\theta = \phi = 0°$	350	500	--	--	*1)*2)*6)
Luminance		Lw	$\theta = \phi = 0°$	320	400	--	cd/m^2	*1)*3)*6)
Luminance Uniformity		ΔLw	$\theta = \phi = 0°$	--	--	30	%	*1)*4)*6)
Response Time	tr		$\theta = \phi = 0°$	--	10	--	ms	*1)*5)*6)
	tf		$\theta = \phi = 0°$	--	30	--	ms	*1)*5)*6)
Viewing Angle	Horizontal	ϕ	CR $\geq$ 10	-60~60	-70~70	--	°	*1)*6)
	Vertical	θ		-50~40	-60~50	--	°	*1)*6)
	Horizontal	ϕ	CR $\geq$ 5	-70~70	-80~80	--	°	*1)*6)
	Vertical	θ		-70~55	-80~65	--	°	*1)*6)
Image sticking		tis	2 h	--	--	2	s	*7)
Color Coordinates	Red	Rx	$\theta = \phi = 0°$	0.545	0.575	0.605	--	*1)*6)
		Ry		0.298	0.328	0.358		
	Green	Gx		0.296	0.326	0.356		
		Gy		0.505	0.535	0.565		
	Blue	Bx		0.133	0.163	0.193		
		By		0.130	0.160	0.190		
	White	Wx		0.283	0.313	0.343		
		Wy		0.299	0.329	0.359		

[Note]

These items are measured using CS1000(MINOLTA) for color coordinates, EZContrast(ELDIM) for viewing angle, and CS1000 or BM-5A(TOPCON) for others under the dark room condition (no ambient light) after more than 30 minutes from turning on the lamp unless noted.

Condition: IL = 6.5 mArms, FL=55kHz

*1) Measurement Point

Contrast Ratio, Luminance, Response Time, Viewing Angle, Color Coordinates: Display Center
Luminance Uniformity: point 1~5 shown in a figure below
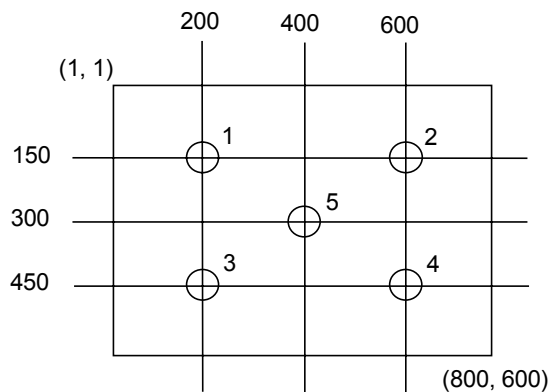
*2) Definition of Contrast Ratio

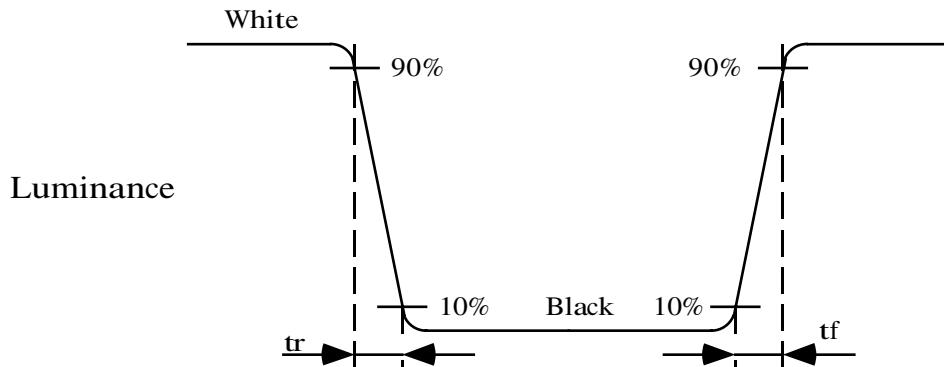CR=ON (White) Luminance / OFF(Black) Luminance

*3) Definition of Luminance
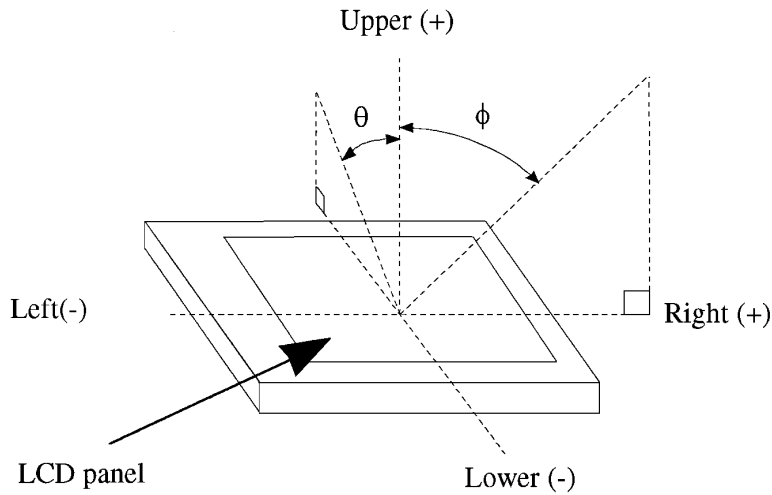
Lw= ON (White) Luminance

*4) Definition of Luminance Uniformity
$$\Delta Lw=[Lw(MAX)/Lw(MIN)-1] \times 100$$

*5) Definition of Response Time

White

90%   90%

Luminance

10%   Black   10%

tr   tf

*6) Definition of Viewing Angle(θ , φ)

Upper (+)

θ   φ

Left(-)   Right (+)

LCD panel   Lower (-)

*7) Image sticking:

Continuously display the test pattern shown in the figure below for two-hours. Then display a completely white screen. The previous image shall not persist more than two seconds at 25°C.

Cols 398-402

White
Area

Rows 298-302

Black
Lines
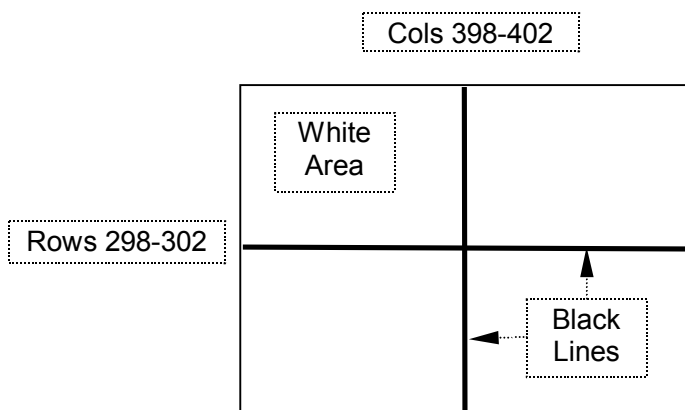
TEST PATTERN FOR IMAGE STICKING TEST

10. RELIABILITY TEST CONDITION

(1) Temperature and Humidity

TEST ITEM	CONDITIONS
HIGH TEMPERATURE HIGH HUMIDITY OPERATION	40°C, 90%RH, 240 h (No condensation)
HIGH TEMPERATURE STORAGE	80°C, 240 h
LOW TEMPERATURE STORAGE	-20°C, 240 h
THERMAL SHOCK (NON-OPERATION)	BETWEEN -20°C (1h) and 80°C(1h), 100 CYCLES

(2) Shock & Vibration

ITEM	CONDITIONS
SHOCK (NON-OPERATION)	Shock level: 1470 m/s^2 (150G) Waveform: half sinusoidal wave, 2 ms Number of shocks: one shock input in each direction of three mutually perpendicular axes for a total of six shock inputs
VIBRATION (NON-OPERATION)	Vibration level: 9.8 m/s^2 (1.0G) Waveform: sinusoidal Frequency range: 5 to 500 Hz Frequency sweep rate: 0.5 octave /min Duration: one sweep from 5 to 500 Hz in each of three mutually perpendicular axis(each x,y,z axis: 1 hour, total 3 hours)

(3) Judgment standard

The judgment of the above tests should be made as follow:

Pass: Normal display image, no damage of the display function. (ex. no line defect)
Partial transformation of the module parts should be ignored.
Fail: No display image, damage of the display function. (ex. line defect)

11. INSPECTION STANDARDS

Inspection condition is as follows:

- Viewing distance: approximately 35 cm.
- Viewing angle: normal to the LCD panel ±10° horizontal and vertical.
- Ambient temperature: approximately 25°C.
- Ambient light: 300 - 500 lx.

Bright Dot is defined as follows:

Visible through 5% transmission ND filter under the condition that black image (color 0) is on the display.

DEFECT TYPE		LIMIT	
VISUAL DEFECT	SCRATCH	0.01 mm < W ≤ 0.05 mm L ≤ 10 mm	N ≤ 4
		0.01 mm < W 10 mm < L	N = 0
		0.05 mm < W	N = 0
	DENT	0.2 mm < φ ≤ 0.4 mm	N ≤ 4
		0.4 mm < φ	N = 0
	BLACK SPOT BUBBLE	0.2 mm < φ ≤ 0.4 mm	N ≤ 5
		0.4 mm < φ	N = 0
	LINT	L ≤ 3 mm W ≤ 0.1 mm	N ≤ 4
		3 mm < L W ≤ 0.1 mm	N = 0
		0.1 mm < W	ACCORDING TO BLACK SPOT
ELECTRICAL DEFECT	BRIGHT DOT	N ≤ 5	
	DARK DOT	N ≤ 5	
	TOTAL DOT	N ≤ 8	
	TWO ADJACENT DOT BRIGHT DOT DARK DOT	≤ 2 PAIRS ≤ 2 PAIRS	
	THREE OR MORE ADJACENT DOT	NOT ALLOWED	
	LINE DEFECT	NOT ALLOWED	

*1) W: width,L: length,φ : diameter,N: number

*2) DEFINITION OF ADJACENT
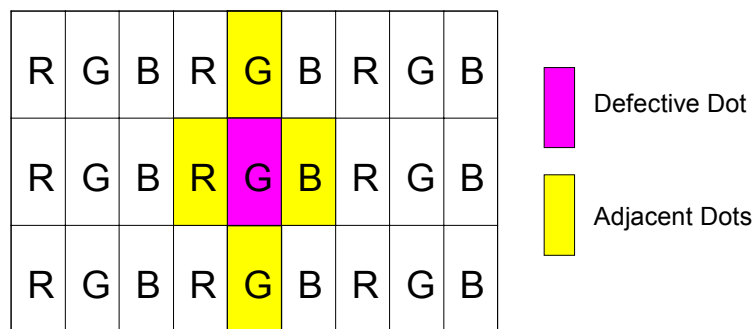
The defects that are not defined above and considered to be problem shall be reviewed and discussed by both parties.

12. HANDLING PRECAUTIONS FOR TFT-LCD MODULE

Please pay attention to the followings in handling TFT-LCD products;

(1) ASSEMBLY PRECAUTION

a. Please use the mounting hole on the module in installing and do not bending or wrenching LCD in assembling. And please do not drop, bend or twist LCD module in handling.

b. Please design display housing in accordance with the following guide lines.

  (a) Housing case must be designed carefully so as not to put stresses on LCD all sides and not to wrench module. The stresses may cause non-uniformity even if there is no non-uniformity statically.

  (b) Keep sufficient clearance between LCD module back surface and housing when the LCD module is mounted. Approximately 1.0mm of the clearance in the design is recommended taking into account the tolerance of LCD module thickness and mounting structure height on the housing.

  (c) When some parts, such as, FPC cable and ferrite plate, are installed underneath the LCD module, still sufficient clearance is required, such as 0.5mm. This clearance is, especially, to be reconsidered when the additional parts are implemented for EMI countermeasure.

  (d) Design the inverter location and connector position carefully so as not to give stress to lamp cable, or not to interface the LCD module by the lamp cable.

  (e) Keep sufficient clearance between LCD module and the others parts, such as inverter and speaker so as not to interface the LCD module. Approximately 1.0mm of the clearance in the design is recommended.

  (f) To avoid local elevation/decrease of temperature, considering location of heating element, heat release, thermal design should be done.

c. Please do not push or scratch LCD panel surface with anything hard. And do not soil LCD panel surface by touching with bare hands. (Polarizer film, surface of LCD panel is easy to be flawed.)

d. Please do not press any parts on the rear side such as source TCP, gate TCP, control circuit board and FPCs during handling LCD module. If pressing rear part is unavoidable, handle the LCD module with care not to damage them.

e. Please wipe off LCD panel surface with absorbent cotton or soft cloth in case of it being soiled.

f. Please wipe off drops of adhesives like saliva and water on LCD panel surface immediately. They might damage to cause panel surface variation and color change.

g. Please do not take a LCD module to pieces and reconstruct it. Resolving and reconstructing modules may cause them not to work well.

h. Please do not touch metal frames with bare hands and soiled gloves. A color change of the metal frames can happen during a long preservation of soiled LCD modules.

i Please handle metal frame carefully because edge of metal frame is very sharp.

j. Please pay attention to handling lead wire of backlight so that it is not tugged in connecting with inverter.

k. Be sure to connect the cables and the connecters correctly.

l. Please connect the metal frame of LCD module to GND in order to minimize the effect of external noise and EMI.

(2) OPERATING PRECAUTIONS

a. Please be sure to turn off the power supply before connecting and disconnecting signal input cable.

b. Please do not change variable resistance settings in LCD module. They are adjusted to the most suitable value. If they are changed, it might happen LCD does not satisfy the characteristics specification.

c. LCD backlight takes longer time to become stable of radiation characteristics in low temperature than in room temperature.

d. The interface signal speed is very high. Please pay attention to transmission line design and other high speed signal precautions to satisfy signal specification.

e. A condensation might happen on the surface and inside of LCD module in case of sudden change of ambient temperature.

f. Please pay attention not to display the same pattern for very long time. Image might stick on LCD. Even if image sticking happens, it may disappear as the operation time proceeds.

g. Please obey the same safe instructions as ones being prepared for ordinary electronic products.

(3) PRECAUTIONS WITH ELECTROSTATICS

a. This LCD module use CMOS-IC on circuit board and TFT-LCD panel, and so it is easy to be affected by electrostatics. Please be careful with electrostatics by the way of your body connecting to the ground and so on.

b. Please remove protection film very slowly from the surface of LCD module to prevent from electrostatics occurrence.

(4) STORAGE PRECAUTIONS

a. Please do not leave the LCDs in the environment of high humidity and high temperature such as 60°C90%RH.

b. Please do not leave the LCDs in the environment of low temperature; below –20°C.

(5) SAFETY PRECAUTIONS

a. When you waste damaged or unnecessary LCDs, it is recommended to crush LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.

b. If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

c. Be sure to turn off the power supply when inserting or disconnecting the cable.

d. Inverter should be designed carefully so as not to keep working in case of detecting over current or open circuit on the lamp.

(6) OTHERS

a. A strong incident light into LCD panel might cause display characteristics changing inferior because of polarizer film, color filter, and other materials becoming inferior. Please do not expose LCD module direct sunlight and strong UV rays.

b. Please pay attention to a panel side of LCD module not to contact with other materials in preserving it alone.

c. For the packaging box, please pay attention to the followings;

   (a) Packaging box and inner case for LCD are designed to protect the LCDs from the damage or scratching during transportation. Please do not open except picking LCDs up from the box.

   (b) Please do not pile them up more than 5 boxes. (They are not designed so.) And please do not turn over.

   (c) Please handle packaging box with care not to give them sudden shock and vibrations. And also please do not throw them up.

   (d) Packaging box and inner case for LCDs are made of cardboard. So please pay attention not to get them wet. (Such like keeping them in high humidity or wet place can occur getting them wet.)

Packaging specification

1. Packaging box

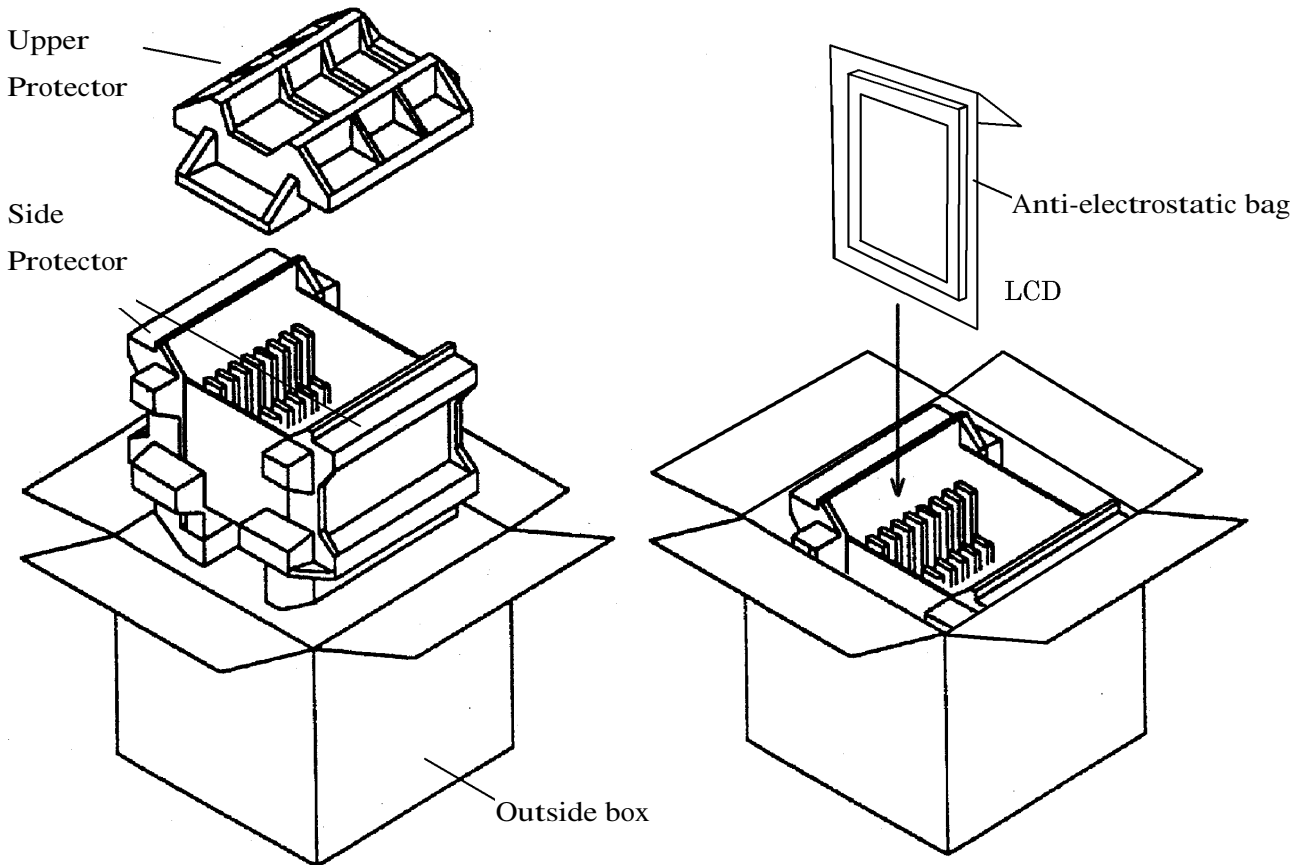|	
material:	cardboard, polyethylene form（Anti-electrostatic spec.）
construction:	See Fig. 1
max. packaging number:	10 pcs.
dimension:	457(W) × 302(D) × 422(H) [mm]
mass(including 10 modules):	7.0 kg
label:	Labels are put on the box.(See Fig. 2, 3, 4,)

Fig.1　Illustration of packaging box structure

Product name	Packaging number
Bar-code	Bar-code
Serial No.	Serial No.
Bar-code	Bar-code
Serial No.	Serial No.
Bar-code	Bar-code
Serial No.	Serial No.
Bar-code	Bar-code
Serial No.	Serial No.
Bar-code	Bar-code
Serial No.	Serial No.
Bar-code	Bar-code

Fig.2   Label 1

Shipper	Box No.
	Mass
Shipping No. Bar-code	
Shipping No. Bar-code	
Packaging No. Bar-code	
Shipping No. Bar-code	
Products name Bar-code	

Fig.3   Label 2

Consignee

Product name

Product name of consignee

Order No.

Box No.

Place of production

Bar-code

Shipping date

Fig.4   Label 3

OPTREX

TFT - LCD: AA104SG01

T-944D104J-FW-A-AA

P / O NO.   123456789

C / S   001 OF 005

MADE IN JAPAN

001   JA1BK4144

2001/11/15

Fig.5   Sample of Label 3

Label 3
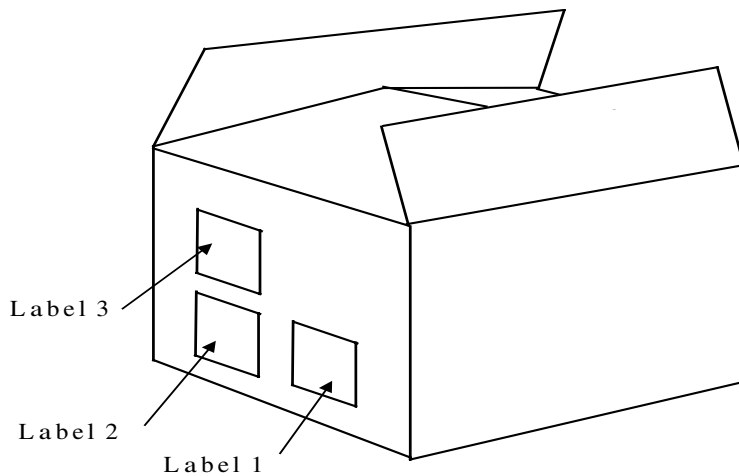
Label 2

Label 1

Fig.6   Location of labels

2. Location of label on the packaging box

Labels are put on the box.(See Fig.6)

3. Packaging form of product

(1) Each of LCD modules is packed in anti-electrostatic bag(Fig.7).
(2) The packaging box accumulates maximum 10 modules.
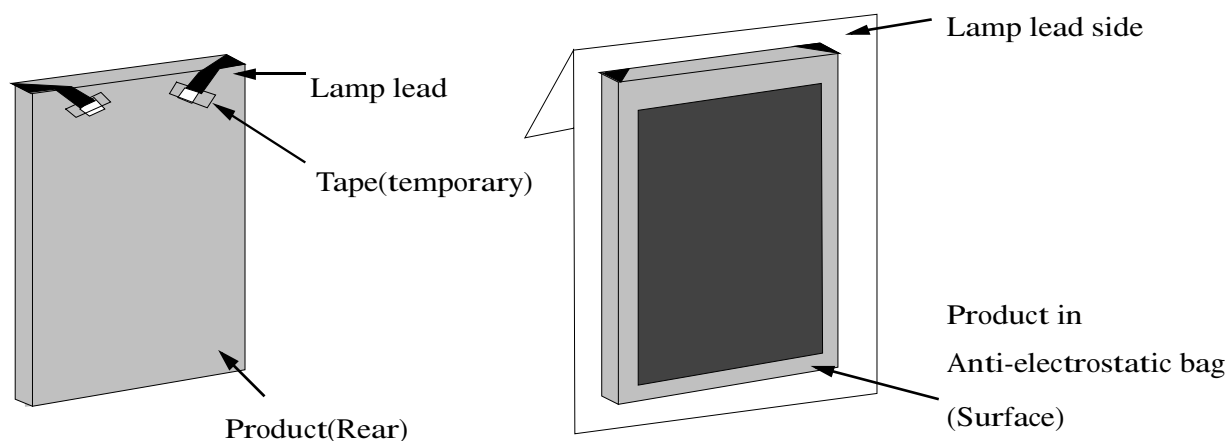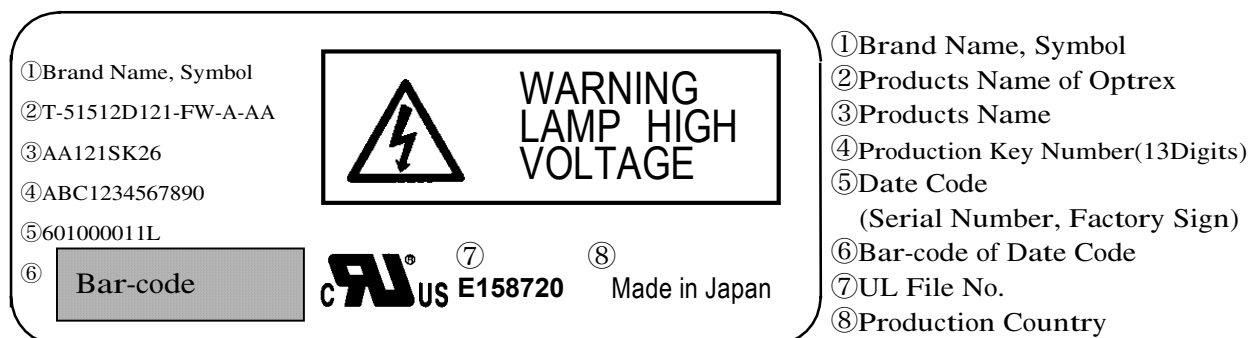(3) Upper protector is put on the products, and shut the box.

Lamp lead side

Lamp lead

Tape(temporary)

Product in

Anti-electrostatic bag

(Surface)

Product(Rear)

Fig.7

4. Cautions of shipping & storage

(1) Do not turn the packaging upside down while storage and transportation. The boxes should not be piled up more than 5.
(2) Handle with care. Keep off from rain & dew.
(3) Keep off from direct sunlight exposure. Please store under room temperature & low humidity in original packaging condition when they were shipped.
(4) Keep other cautions described in handling manual.

Products Number Labeling Forms

Products number label is constructed as below;

①Brand Name, Symbol
②T-51512D121-FW-A-AA
③AA121SK26
④ABC1234567890
⑤601000011L
⑥ Bar-code

⚠ WARNING LAMP HIGH VOLTAGE

cⓊus ⑦ E158720   ⑧ Made in Japan

①Brand Name, Symbol
②Products Name of Optrex
③Products Name
④Production Key Number(13Digits)
⑤Date Code
  (Serial Number, Factory Sign)
⑥Bar-code of Date Code
⑦UL File No.
⑧Production Country

① Brand Name, Symbol

OPTREX

② Products Name of Optrex
   ex. T51512D121-FW-A-AA

③ Products Name
   ex.1: AA121SK26   ex.2: AA150XA03   B

④ Production Key Number(13Digits)
   (ID Number for Production Control)

⑤ Date Code（Serial Number, Factory Sign）

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
1 2 3 4 5 6 7 8 9 10

└─ Factory Sign
└─ Serial Number on Every Production Week
     (00001 ～ 99999)
└─ Production Week Number(01 ～53)
└─ Production Year Number
     (Last 1 Digit of AD Year Number)
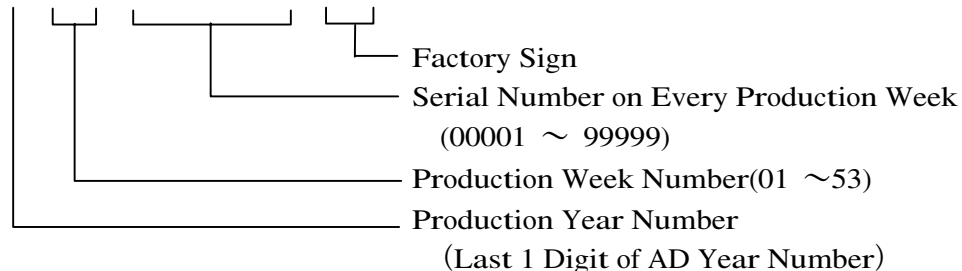
・Date Code is constructed by 9 Digits as below;
   1st Digit   ：Production Year Number（Last 1 Figure of AD Year）
   2nd～3rd Digit ： Production Week Number in a Year
                  （A Year is divided to 53 weeks from Monday to Saturday）
   4th～8th Digit ：Serial Number on Every Production Weeks.
                  （ 00001 ～ 99999 ）
                  These are numbered in order according to Production Name.
   9th～10th Digit：Factory Sign (on the Module Test Process)
               (1L: Shisui Factory Line,
                1Y: YACHIYO SANYO Industries Line,
                1W: CPT Fab-1, 1R: CPT Fab-2, 1U: CPT Wujiang-LCM-1,
                1V:CPT Wujiang-LCM-2）

⑥Bar-code(Date Code)

Bar-code Line for computer reading Date Code mentioned as above.

⑦UL File No.

MDTI: E158720, CPT: E194548

⑧Production Country

MDTI: Made in Japan, CPT: Made in Taiwan/China

LAMP UNIT for 10.4"SVGA

APPLICATION

This technical literature applies to the replaceable lamp unit that is the maintenance parts for 10.4"SVGA TFT-LCD module industrial use (model name: T-51944D104J-FW-A-AA).

MECHANICAL CHARACTERISTICS

Item	Specification	Remarks
Outline Dimension of Reflector	228.5 ±0.2 × 5.4 ±0.1 × 4.6±0.1 (mm)	Except Wire and Lamp Rubber Cushion
Mass	12 (g)(MAX)	
Lamp Diameter	ϕ2.4 – 1.8 ±0.1 (mm)	

See DRAWING OF OUTLINE DIMENTIONS

ENVIRONMENTAL CONDITIONS

Item	Operation		Non Operation		Remarks
	MIN	MAX	MIN	MAX	
Ambient Temperature	-20°C	70°C	-20°C	80°C	No Condensation

Ta $\leq$ 40°C : 90% RH max. without condensation

Ta > 40°C : Absolute humidity shall be less than the value of 90% RH at 40°C.

ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	MIN	TYP	MAX	Unit	Remarks
Lamp Current	IL	Ta = 25°C	3.0	6.5	7.5	mArms	
Lamp Voltage	VL	Ta = 25°C	-	470	-	Vrms	
Starting Lamp Voltage	VS	Ta = 25°C	900	-	-	Vrms	
		Ta = 0°C	1350	-	-	Vrms	
		Ta = -20°C	1440	-	-	Vrms	
Lamp Frequency	FL	Ta = 25°C IL = 6.5 mArms	40	-	100	kHz	

*1) These values are shown by Elevam using E-12324B inverter.

*2) Lamp Current measurement method (The current meter is inserted in low voltage line.)
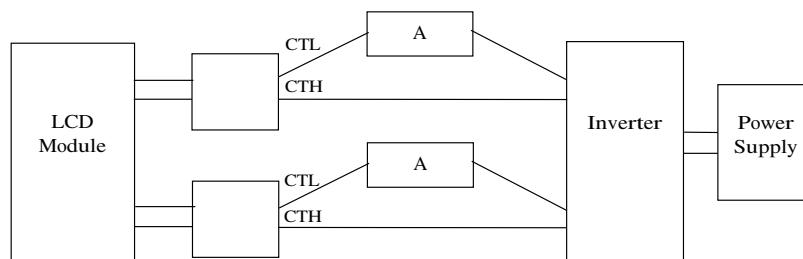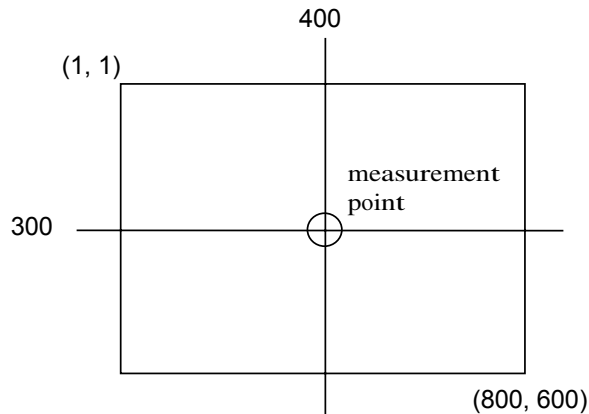
OPTICAL CHARACTERISTICS

Ta=25°C, 60±10%RH

Item	Symbol	MIN	TYP	MAX	Unit	Remarks
Luminance	Lw	320	400	-	cd/m^2	measurement point shown in the figure below
Color Coodinates (White)	Wx	0.283	0.313	0.343	-	
	Wy	0.299	0.329	0.359	-	

[Conditions]

IL = 6.5 mArms, Inverter frequency: 55 kHz

[Measurement Point]

These items are measured when lamp unit are assembled into T-51944D104J-FWA-AA, and using CS1000(MINOLTA) for color coordinates, and CS1000 or BM-5A(TOPCON) for Luminance under the dark room condition (no ambient light) after more than 30 minutes from turning on the lamp unless noted.

LIFE TIME OF THE LAMP UNIT

Environmental Conditions are as follows:

Ambient temperature is 25±5°C.

Lamp Current is 6.5 mArms.

Continuous Operation	50,000 hours
Number of turning on and off	100,000 times (30sec ON-OFF)

(1) Lamp life time is defined as the time either when the brightness becomes 50% of the initial value, or when the starting lamp voltage does not meet the value specified in the table of section 4.

(2) The life time of the backlight depends on the ambient temperature. The life time will decrease under low/high temperature.

INTERFACE PIN CONNECTION

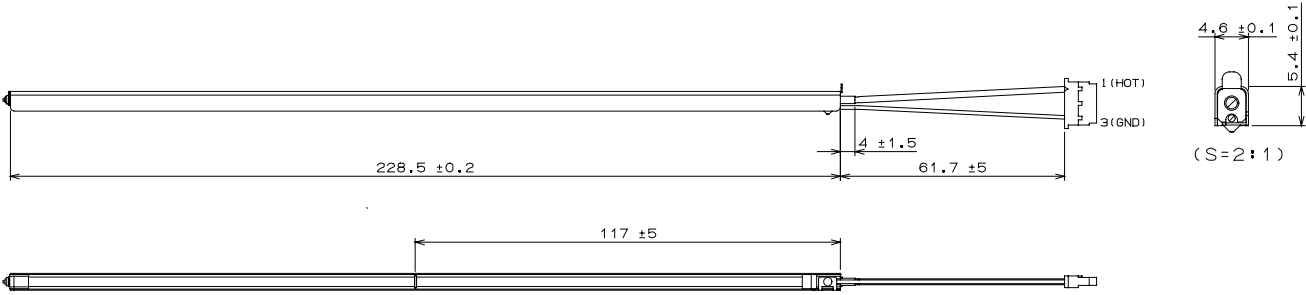Backlight-side connector: BHR-02(8.0)VS-1N(JST)

Inverter-side connector: SM02(8.0)B-BHS(JST)

Pin No.	Symbol	Function
1	CTH	VBLH (High voltage)
2	CTL	VBLL (Low voltage)

[Note]

VBLH - VBLL = VL

DRAWING OF OUTLINE DIMENTIONS

228.5 ±0.2

4 ±1.5

61.7 ±5

1(HOT)

3(GND)

4.6 ±0.1

5.4 ±0.1

(S=2:1)

117 ±5

METHOD OF REPLACING THE LAMP UNIT

(1) <u>Precautions</u>

   Please pay attention to the following items while replacing the Lamp Unit.

   a. Please do not damage the LCD Panel Surface, and do not touch it with bare hands.
      (Wearing gloves is recommended.)

   b. Please be careful with electrostatics, and work in clean environment to prevent entering dust and/or foreign matters that will cause bad display image.
      (Using clean bench or similar environment is recommended.)

   c. Please be careful of the edge of the frame metal.

(2) <u>Method of replacing the Lamp Unit</u>

   1) Put the TFT-LCD Module on the table.(LCD Panel Surface is upside.)

Top

Please check the LCD Panel Surface for scratch, dust, and foreign matters.

Bottom
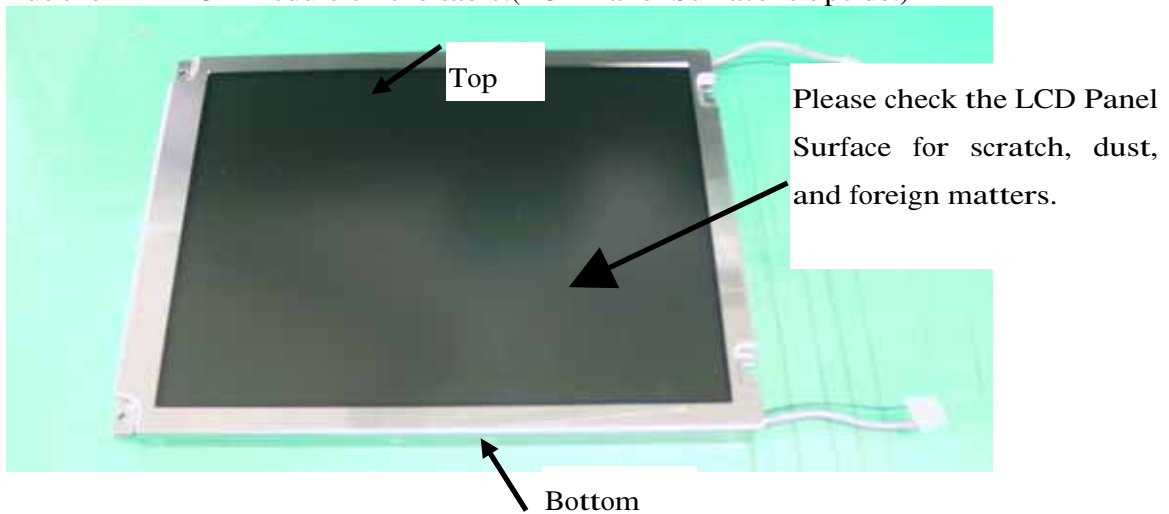
<u>Picture 1</u>

   2) Turn the TFT-LCD Module upside down.

Please check the cable for dust and foreign matters.
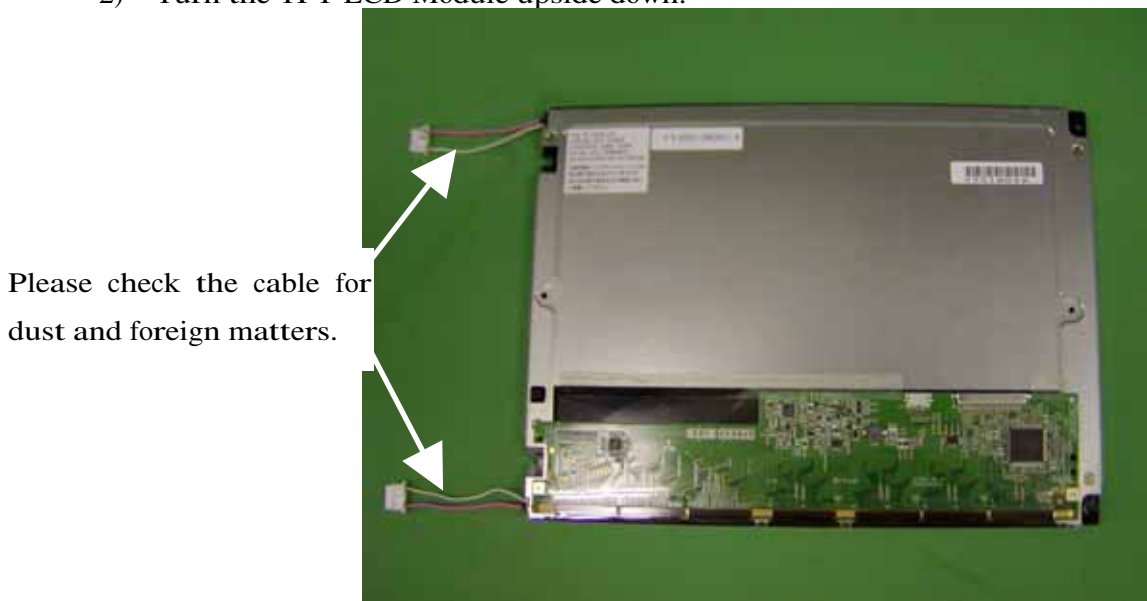
<u>Picture 2</u>

3) Stand the TFT-LCD Module up and push out the black latch that fastens the Lamp Unit.

Top

Please push out the black latch.
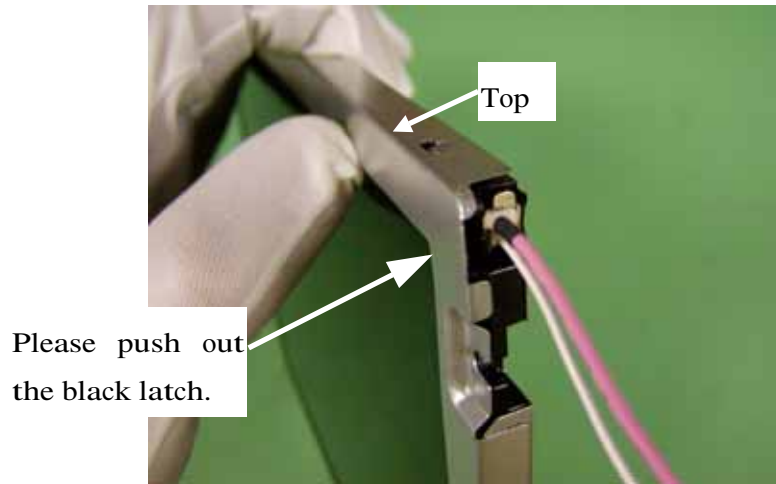
Picture 3

4) Pull the cable slowly and remove the Lamp Unit.

Picture 4   Picture 5

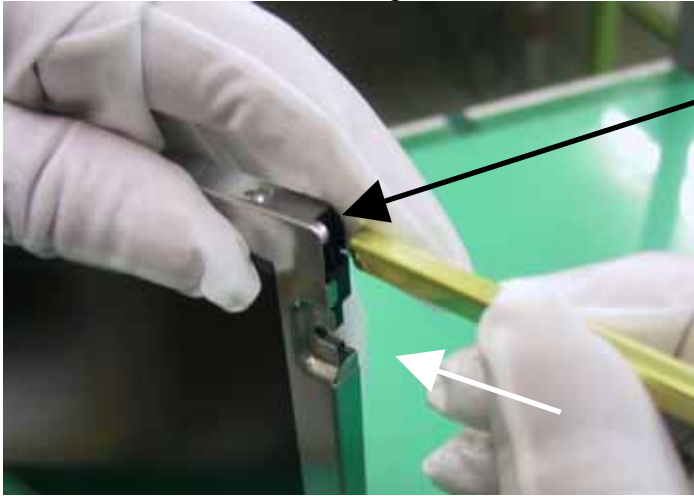5) Remove the other Lamp Unit at the opposite(bottom) side of LCD Module in the same way. See. 3) and 4)

6) Picture 6 shows the TFT-LCD Module after removing the Lamp Units.

Picture 6

7) Prepare to insert the new Lamp Unit.
   - Open the package and take the new Lamp Unit out.
   - Check the new Lamp Unit for dust and foreign matters.

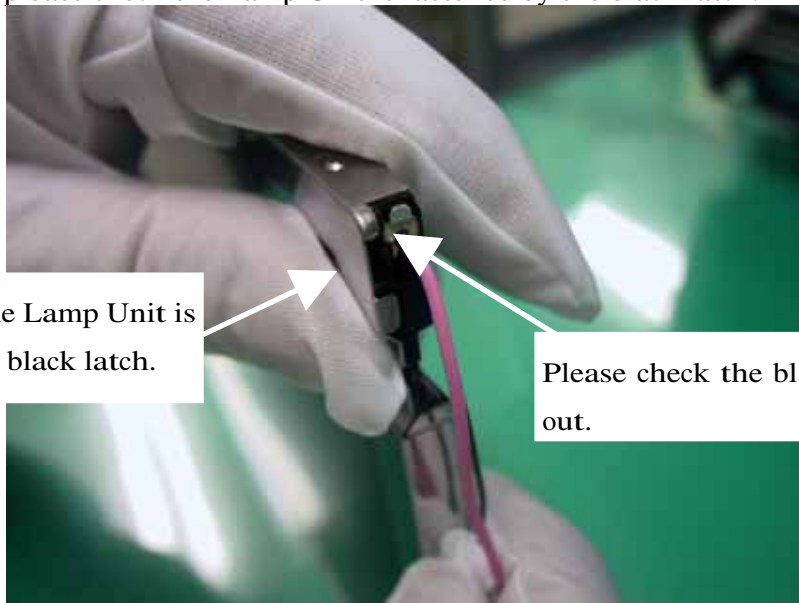8) Stand the TFT-LCD Module up and insert the new Lamp Unit.

Fold down the black film to keep the end of the black film out.
Push the black latch out, and insert the new Lamp Unit.
(Set the Lamp opening face down.)

Picture 7

Please do not insert it in the wrong position.

9) After inserting, please check the Lamp Unit is fastened by the black latch.

Please check the Lamp Unit is fastened by the black latch.

Please check the black film is out.

Picture 8

10) Insert the other Lamp Unit to the opposite(bottom) side of the LCD module in the same way. See. 8) to 9)

11) After replacing the Lamp Unit, please check the following items.
   - Appearance of TFT-LCD Module is not changed after replacing Lamp Unit.
     (See. Picture 1 and Picture 2)
   - There is no damage, dust, or foreign matters on the LCD Panel Surface.
   - Install the TFT-LCD Module then check turning on the lamps.