First Edition
Aug 22, 2003
Final Revision
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LCD Module Technical Specification

Type No. **T-51784D150-FW-A-AA**

Approved by (Quality Assurance Division)

Checked by (ACI Engineering Division)

Prepared by (Module Coordination Group)

1. OVERVIEW

T-51784D150-FW-A-AA is 15.0" color TFT-LCD (Thin Film Transistor Liquid Crystal Display) modules composed of LCD panel, driver ICs, control circuit, and backlight unit.
By applying 8bit digital data, 1024 × 768, 16.7M-color images are displayed on the 15.0" diagonal screen. Input power voltages are 5.0 V for LCD driving.

The type of data and control signals are digital, and 2 pixel data are transmitted per Typ. 32.5 MHz clock cycle.
General specifications are summarized in the following table:

ITEM	SPECIFICATION
Display Area (mm)	304.1 (H) × 228.1 (V) (15.0-inch diagonal)
Number of Dots	1024 × 3 (H) × 768 (V)
Pixel Pitch (mm)	0.297 (H) × 0.297 (V)
Color Pixel Arrangement	RGB vertical stripe
Display Mode	Normally white TN
Number of Color	16.7 M(8 bits/color)
Brightness	450 cd/m² (Typ.)
Wide Viewing Angle Technology	Optical Compensation Film
Viewing Angle	-75~75° (H) -60~50° (V)
Surface Treatment	Anti-glare and hard-coating 3H
Electrical Interface	CMOS(VI = 3~5 V, 2 pixel / clock)
Optimum Viewing Angle(Contrast ratio)	6 o'clock
Module Size (mm)	326.0 (W) × 255.0 (H) × 15.9(D)
Module Mass (g)	1350
Backlight Unit	CCFL, 4-tubes, edge-light

Characteristic value without any note is typical value.

The LCD product described in this specification is designed and manufactured for the standard use in OA equipment and consumer products, such as computers, communication equipment, industrial robots, AV equipment and so on.
Do not use the LCD product for the equipment that require the extreme high level of reliability, such as aerospace applications, submarine cables, nuclear power control systems and medical or other equipment for life support.
OPTREX assumes no responsibility for any damage resulting from the use of the LCD product in disregard of the conditions and handling precautions in this specification.
If customers intend to use the LCD product for the above items or other no standard items, please contact our sales persons in advance.

2. ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	MIN.	MAX.	UNIT
Power Supply Voltage for LCD	VCC	0	7.0	V
Logic Input Voltage	VI	-0.5	6.1	V
Lamp Voltage	VL	0	2500	Vrms
Lamp Current	IL	0	9.0	mArms
Lamp Frequency	FL	--	100	kHz
Operation Temperature *)	T_{op}	0	50	°C
Storage Temperature *)	T_{stg}	-20	60	°C

[Note]

*) 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.

3. ELECTRICAL CHARACTERISTICS

(1) TFT- LCD

Ambient Temperature : Ta = 25°C

ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	Remarks
Power Supply Voltages for LCD		VCC	4.5	5.0	5.5	V	*1)
Power Supply Currents for LCD		ICC	--	700	900	mA	*2)
Permissive Input Ripple Voltage		VRP	--	--	100	mVp-p	VCC = +5.0 V
Logic Input Voltage	High	VIH	2.2	3.3	5.5	V	
	Low	VIL	0	--	0.8	V	

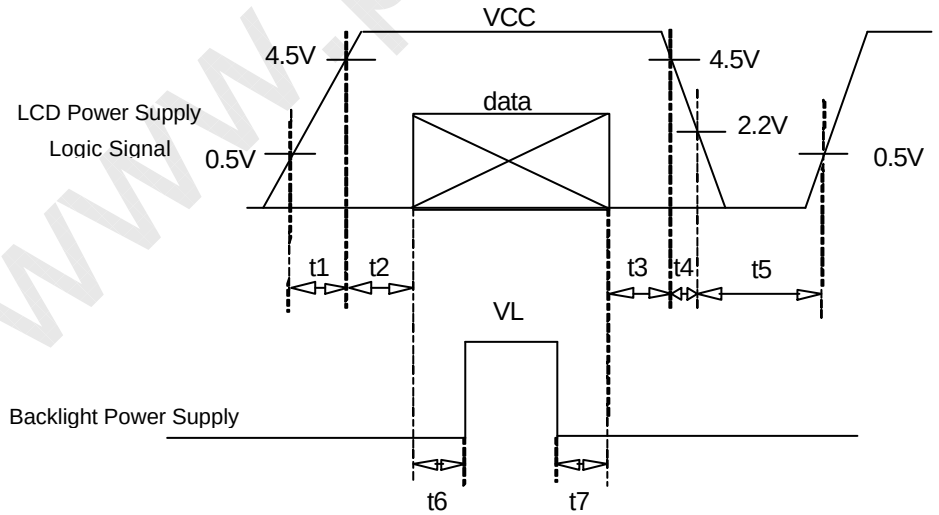
*1) Power and signals sequence:

t1 ≤ 10 ms　　1 s ≤ t5

0 < t2 ≤ 10 ms　　200 ms ≤ t6

0 < t3 ≤ 1 s　　0 ≤ t7

0 < t4 ≤ 50 ms

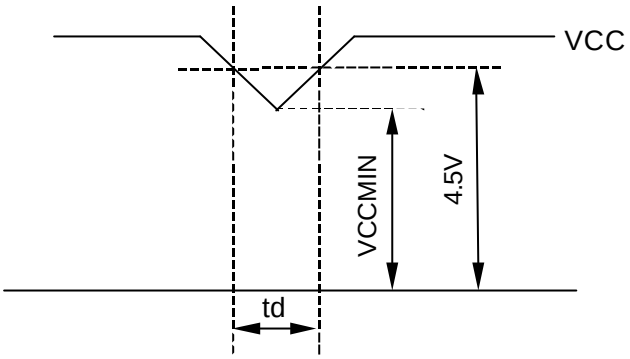


Data: RGB DATA, DCLK, HD, VD, DENA,

VCC-dip conditions:

1) When VCCMIN ≥ 3.6 V, td ≤ 10 ms
2) When VCCMIN < 3.6 V

VCC-dip conditions should also follow the power and signals sequence.

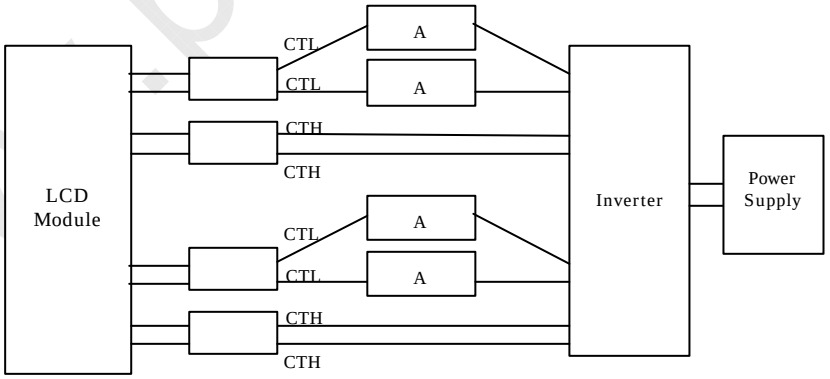


*2) Typical current condition:
256- gray- bar-pattern
768 line mode
VCC = 5.0 V, f_H = 48.4 kHz, f_V = 60 Hz, f_{CLK} = 32.5 MHz

(2) Backlight Ta = 25°C

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	Remarks
Lamp Voltage	VL	--	595	--	Vrms	IL = 6.5 mArms
Lamp Current	IL	3.5	6.5	7.0	mArms	*1), *4)
Lamp Frequency	FL	40	--	70	kHz	*2)
Starting Lamp Voltage	VS	1350	--	--	Vrms	Ta = 0°C
		1000	--	--	Vrms	Ta = 25°C
Lamp Life Time	LT	--	50000	--	h	*3), IL = 6.5 mArms, Continuous Operation

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



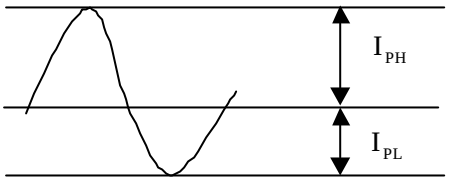
*2) Lamp frequency of inverter may produce interference with horizontal synchronous frequency, and this may cause horizontal beat on the display. Therefore, please adjust lamp frequency, and keep inverter as far from module as possible or use electronic shielding between inverter and module to avoid 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) 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 $\sqrt{2}$ ±10%



I_{PH}: High side peak

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

4. INTERFACE PIN CONNECTION

(1) CN 1(Data Signal and Power Supply)

Used Connector: IL-FHR-BF40S-HF (JAE)

Pin No.	Symbol	Function
1	GND	
2	VCC	
3	VCC	
4	RO0	Red odd data(LSB)
5	RO1	Red odd data
6	RO2	Red odd data
7	RO3	Red odd data
8	GND	
9	RO4	Red odd data
10	RO5	Red odd data
11	RO6	Red odd data
12	RO7	Red odd data(MSB)
13	GND	
14	GO0	Green odd data(LSB)
15	GO1	Green odd data
16	GO2	Green odd data
17	GO3	Green odd data
18	GND	
19	GO4	Green odd data
20	GO5	Green odd data
21	GO6	Green odd data
22	GO7	Green odd data(MSB)
23	GND	
24	BO0	Blue odd data(LSB)
25	BO1	Blue odd data
26	BO2	Blue odd data
27	BO3	Blue odd data
28	GND	
29	BO4	Blue odd data
30	BO5	Blue odd data
31	BO6	Blue odd data
32	BO7	Blue odd data(MSB)
33	GND	
34	NC	This pin should be open.
35	HD	Horizontal Sync
36	VD	Vertical Sync
37	DENA	Data enable
38	GND	
39	DCLK	Dot Clock
40	GND	

(2) CN 2 (Data signal)

Used Connector: IL-FHR-BF36S-HF (JAE)

Pin No.	Symbol	Function
1	GND	
2	TEST	This pin should be open. Test signal output for only internal test use.
3	TEST	This pin should be open. Test signal output for only internal test use.
4	TEST	This pin should be open. Test signal output for only internal test use.
5	GND	
6	GND	
7	RE0	Red even data(LSB)
8	RE1	Red even data
9	RE2	Red even data
10	RE3	Red even data
11	GND	
12	RE4	Red even data
13	RE5	Red even data
14	RE6	Red even data
15	RE7	Red even data(MSB)
16	GND	
17	GE0	Green even data(LSB)
18	GE1	Green even data
19	GE2	Green even data
20	GE3	Green even data
21	GND	
22	GE4	Green even data
23	GE5	Green even data
24	GE6	Green even data
25	GE7	Green even data(MSB)
26	GND	
27	BE0	Blue even data(LSB)
28	BE1	Blue even data
29	BE2	Blue even data
30	BE3	Blue even data
31	GND	
32	BE4	Blue even data
33	BE5	Blue even data
34	BE6	Blue even data
35	BE7	Blue even data(MSB)
36	GND	

(3) CN 3, 4(Backlight)

Backlight-side connector: BHSR-02VS-1(JST)

Inverter-side connector: SM02B-BHSS-1-TB

Pin No.	Symbol	Function
1, 2	CTH	VBLH（High Voltage）

[Note] VBLH-VBLL = VL

(4) CN 5, 6(Backlight)

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

Inverter-side connector: SM02(4.0)B-BHS-1-TB

Pin No.	Symbol	Function
1, 2	CTL	VBLL（Low Voltage）

[Note] VBLH-VBLL = VL

5. INTERFACE TIMING

(1) Timing Specifications

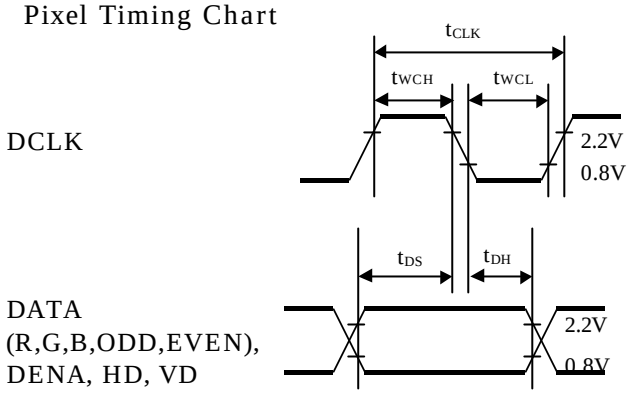
ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT
DCLK *1) *4)	Frequency	f_{CLK}	30	32.5	40	MHz
	Period	t_{CLK}	25.0	30.8	33.3	ns
	Low Width	t_{WCL}	5	--	--	ns
	High Width	t_{WCH}	5	--	--	ns
DATA *1) (R,G,B,DENA, HD, VD)	Set up time	t_{DS}	3	--	--	ns
	Hold time	t_{DH}	6	--	--	ns
DENA *3)	Horizontal Active Time	t_{HA}	512	512	512	t_{CLK}
	Horizontal Front Porch	t_{HFP}	16	24	--	t_{CLK}
	Horizontal Back Porch	t_{HBP}	28	33	--	t_{CLK}
	Vertical Active Time	t_{VA}	768	768	768	t_H
	Vertical Front Porch	t_{VFP}	2	3	--	t_H
	Vertical Back Porch	t_{VBP}	4	35	--	t_H
HD *2)*4)	Frequency	f_H	--	48.4	62.5	kHz
	Period	t_H	16	20.7	--	µs
	Low Width	t_{WHL}	4	8	--	t_{CLK}
VD *2)	Frequency	f_V	55	60	75	Hz
	Period	t_V	13.3	16.7	18.2	ms
	Low Width	t_{WVL}	2	6	--	t_H

[Note]

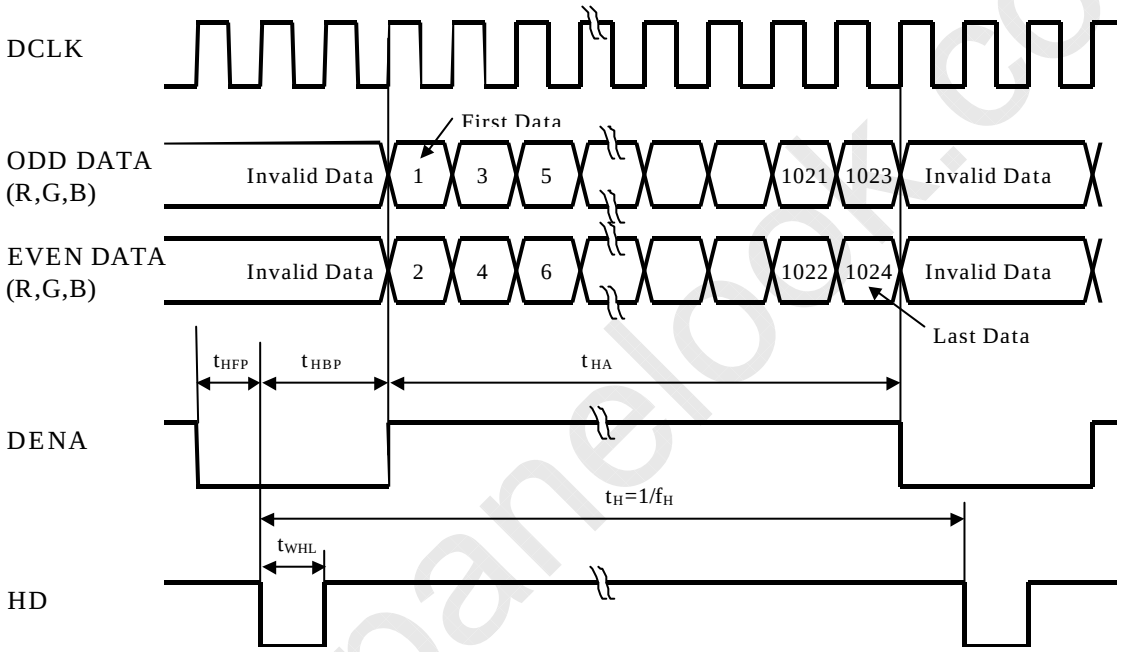
*1) DATA is latched at fall edge of DCLK in this specification.
*2) Polarities of HD and VD are negative in this specification.
*3) DENA (Data Enable) should always be positive polarity as shown in the timing specification.
*4) DCLK should appear during all invalid period, and HD should appear during invalid period of frame cycle.

(2) Timing Chart

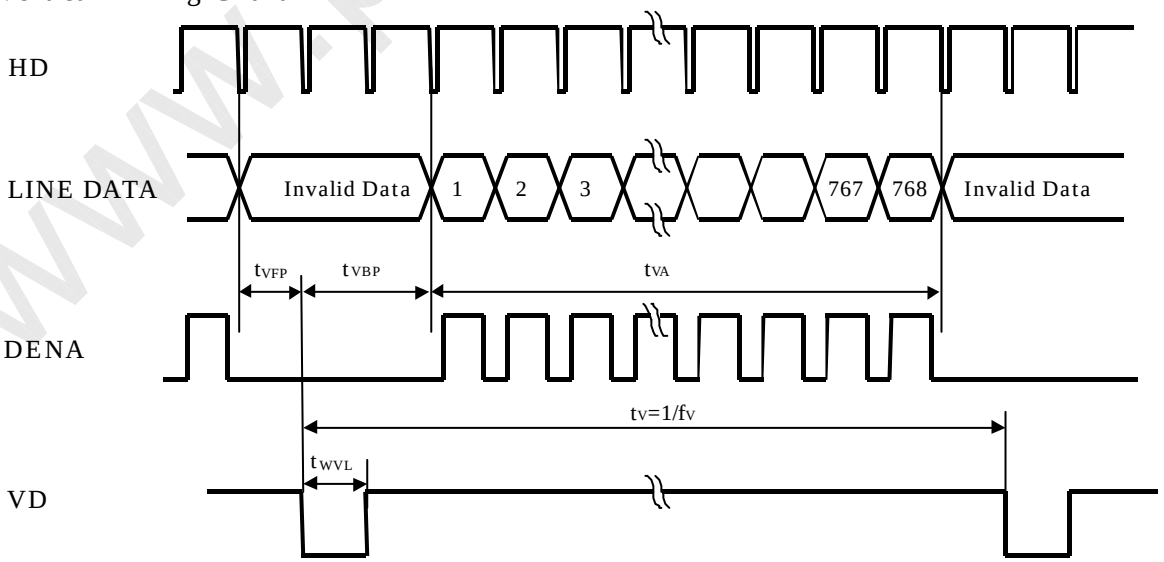
a. Pixel Timing Chart



b. Horizontal Timing Chart



c. Vertical Timing Chart



(3) Color Data Assignment

COLOR	INPUT DATA	R DATA								G DATA								B DATA							
		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(0)	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
	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
GREEN	GREEN(0)	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
	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
BLUE	BLUE(0)	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(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) Definition of gray scale

Color (n) --- n indicates gray scale level.

Higher n means brighter level.

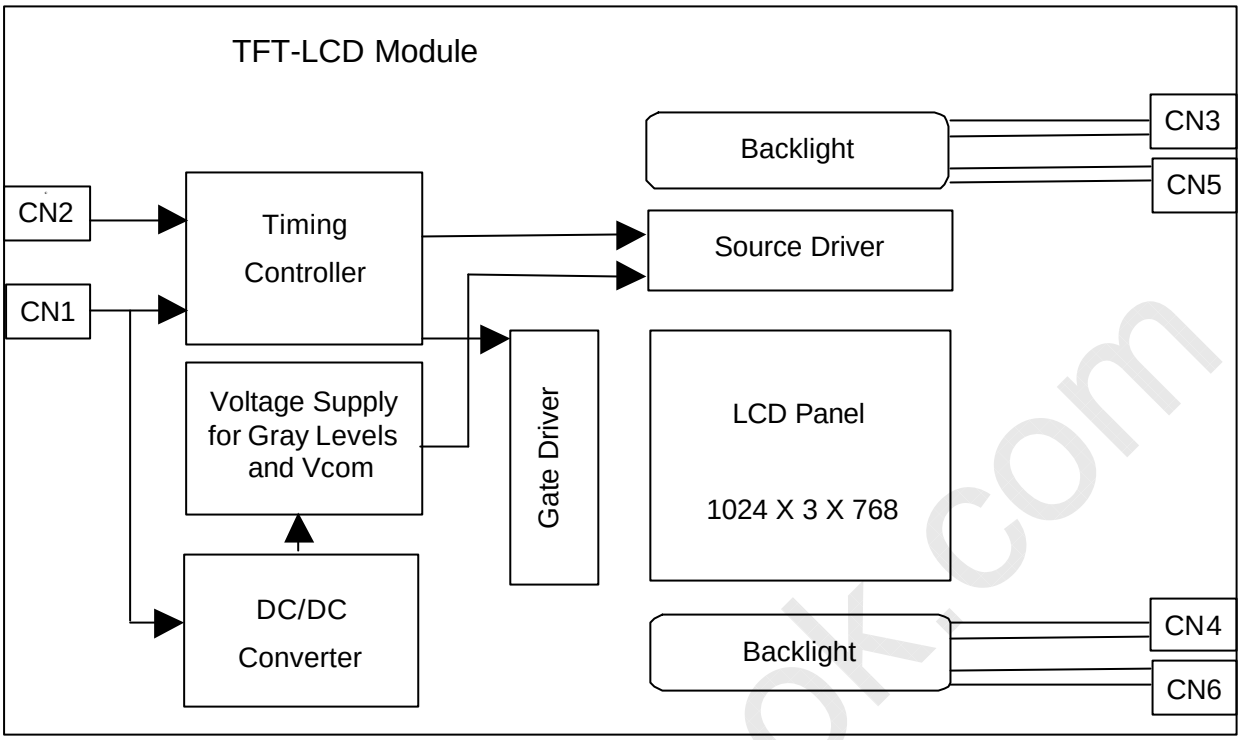
*2) Data

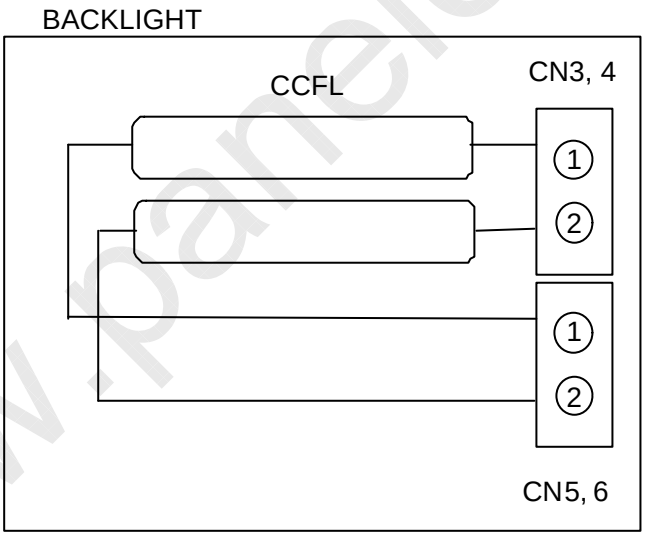
1:High, 0: Low

(4) Data Mapping

D(1, 1)	D(2, 1)	---	D(X, 1)	---	D(1023, 1)	D(1024, 1)
D(1, 2)	D(2, 2)	---	D(X, 2)	---	D(1023, 2)	D(1024, 2)
¦	¦	+	¦	+	¦	¦
D(1, Y)	D(2, Y)	---	D(X, Y)	---	D(1023, Y)	D(1024, Y)
¦	¦	+	¦	+	¦	¦
D(1,767)	D(2,767)	---	D(X,767)	---	D(1023,767)	D(1024,767)
D(1,768)	D(2,768)	---	D(X,768)	---	D(1023,768)	D(1024,768)

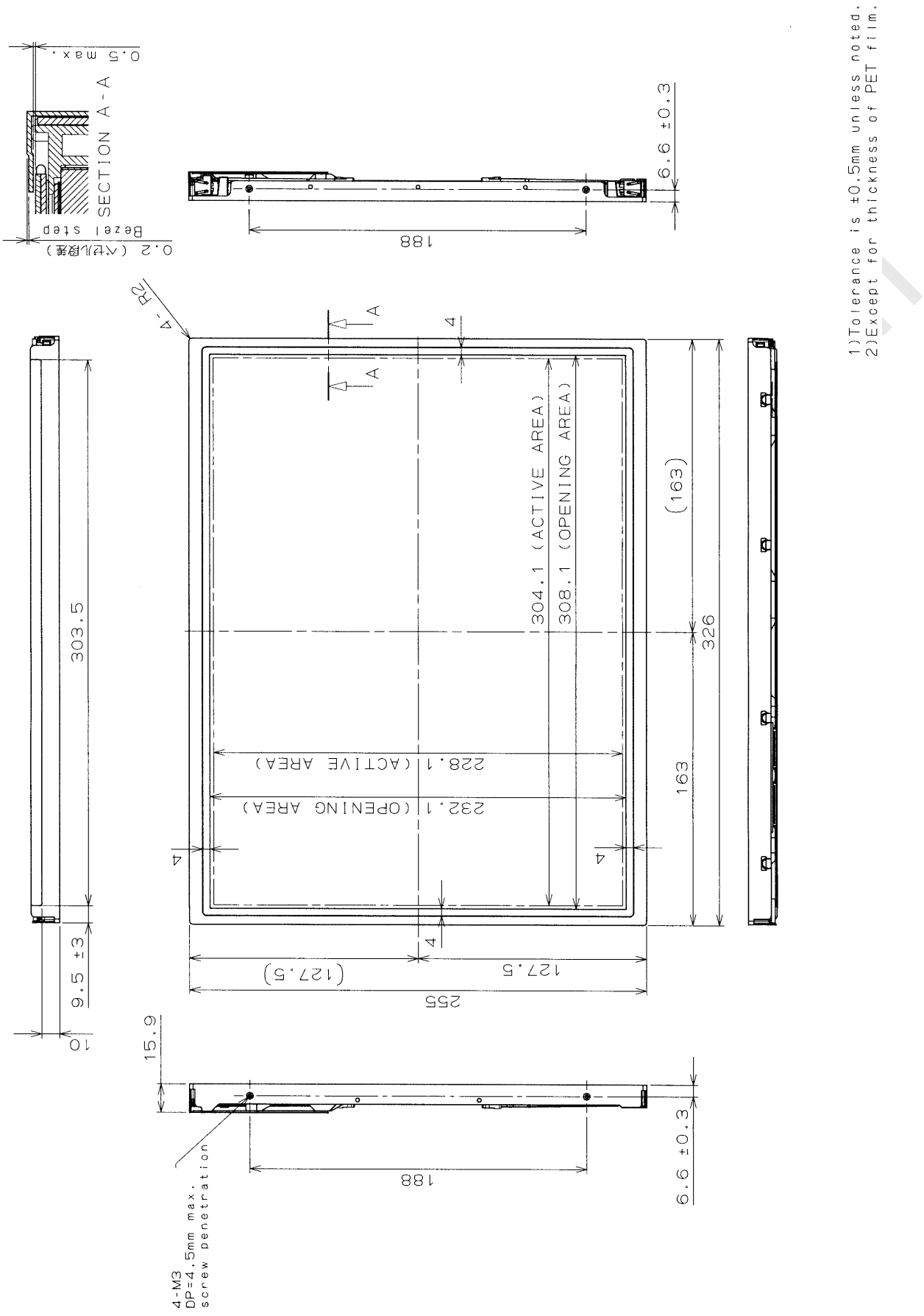
6. BLOCK DIAGRAM



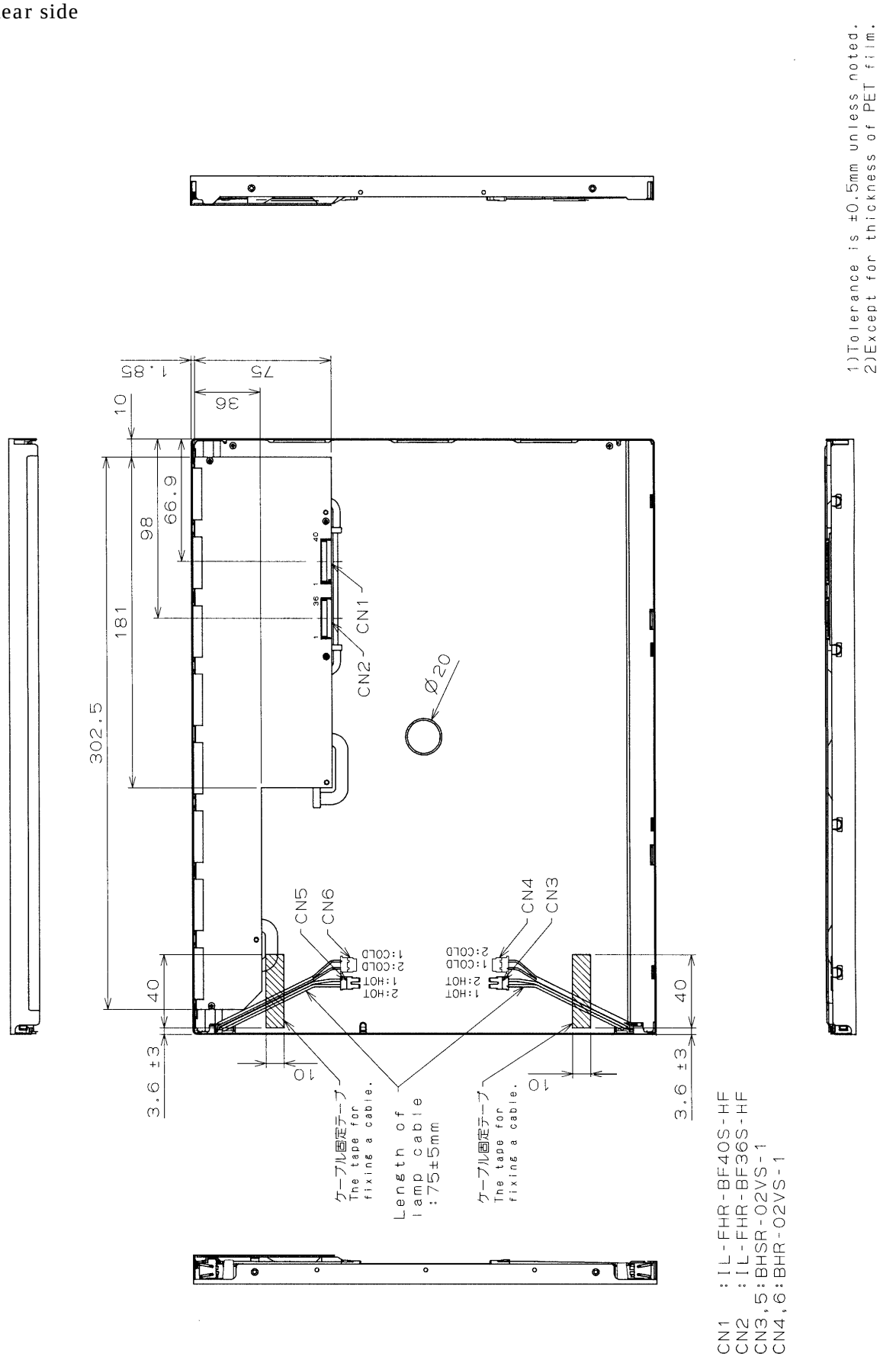


7. MECHANICAL SPECIFICATIONS

(1)Front side



(2)Rear side



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

8. OPTICAL CHARACTERISTICS

Ta = 25°C, VCC = 5.0 V, Input Signals: Typ. Values shown in Section 5

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	Remarks
Contrast Ratio		CR	θ = ϕ = 0°	350	500	--	--	*1)*3)
Luminance	Normal	Lw	θ = ϕ = 0°	360	450	--	cd/m²	*2)*3)
	Uniformity	ΔLw	θ = ϕ = 0°	--	--	30	%	*2)*3)
Response Time (White - Black)		tr	θ = ϕ = 0°	--	6	--	ms	*3)*4)
		tf	θ = ϕ = 0°	--	19	--	ms	*3)*4)
Response Time (Gray Scale Level)		trg,tfg	θ = ϕ = 0°	--	10	15	ms	*3)*5)
Viewing Angle	Horizontal	ϕ	CR ≥ 10	--	-75~75	--	°	*3)
	Vertical	θ		--	-60~50	--	°	*3)
	Horizontal	ϕ	CR ≥ 5	--	-80~80	--	°	*3)
	Vertical	θ		--	-80~70	--	°	*3)
Image Sticking		tis	2 h	--	--	2	s	*6)
Color Coordinates	Red	Rx	θ = ϕ = 0°	0.607	0.637	0.667	--	*3)
		Ry		0.297	0.327	0.357		
	Green	Gx		0.243	0.273	0.303		
		Gy		0.553	0.583	0.613		
	Blue	Bx		0.112	0.142	0.172		
		By		0.022	0.052	0.082		
	White	Wx		0.253	0.283	0.313		
		Wy		0.267	0.297	0.327		

[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, Inverter frequency: 60 kHz

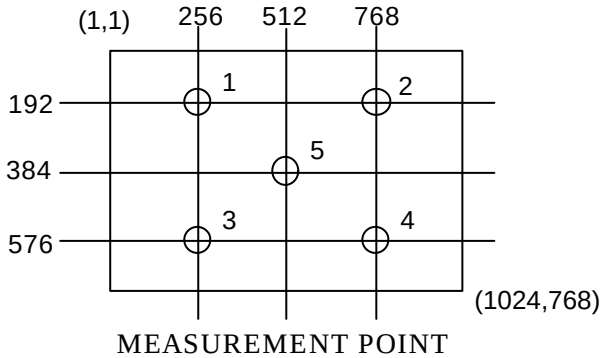
*1) Definition of Contrast Ratio

CR=ON(White) Luminance / OFF(Black) Luminance: the center of 5 points (No.5) shown in a figure below

*2) Definition of Luminance and Luminance Uniformity

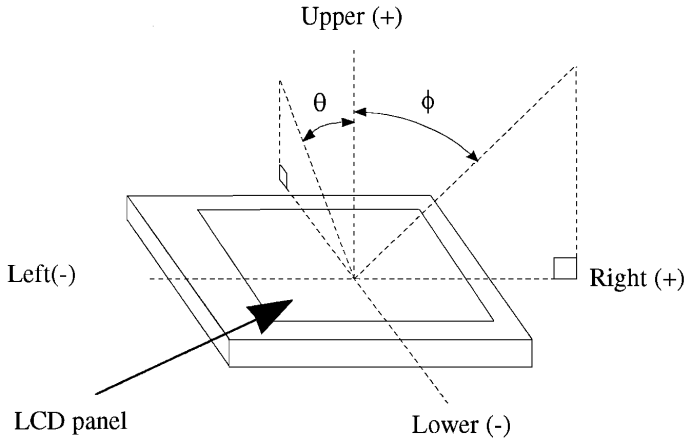
Lw=ON (White) Luminance: the center of 5 points (No.5) shown in a figure below

ΔLw=[Lw(MAX)/Lw(MIN)-1] × 100: Measure Contrast ratio and White Luminance on the below 5 points

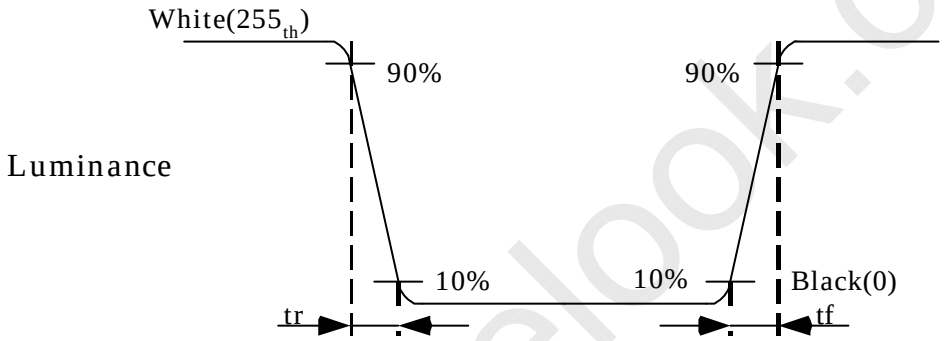


MEASUREMENT POINT

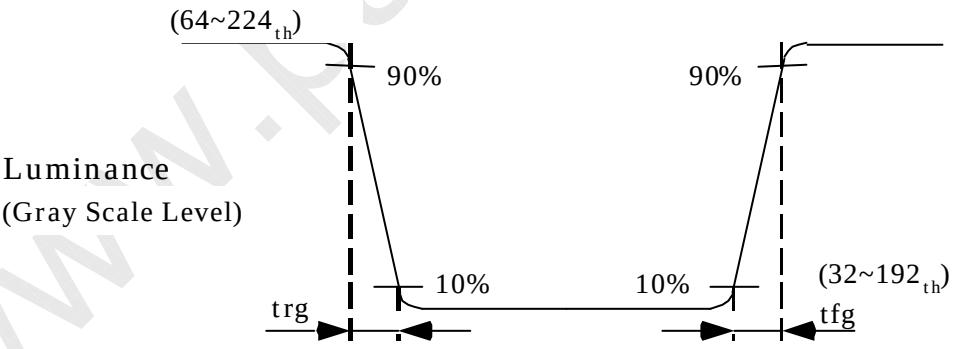
*3) Definition of Viewing Angle(θ , ϕ)



*4) Definition of Response Time (White - Black)

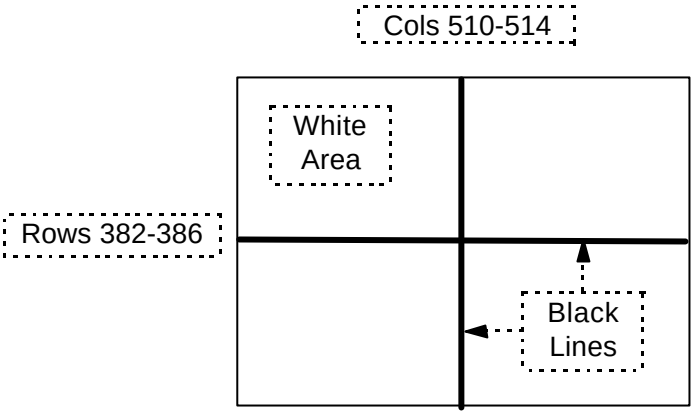


*5) Definition of Response Time(Gray Scale Level between 32_{th} and 224_{th} at intervals of 32 levels)



*6) 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.



TEST PATTERN FOR IMAGE STICKING TEST

9. 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 OPERATION	50°C, 240 h
LOW TEMPERATURE OPERATION	0°C, 240 h
THERMAL SHOCK (Non-Operation)	BETWEEN -20°C (1h) and 60°C(1h), 5 CYCLES
HIGH TEMPERATURE STORAGE	60°C, 240 h
LOW TEMPERATURE STORAGE	-20°C, 240 h

(2) Shock & Vibration

ITEM	CONDITIONS
SHOCK (NON-OPERATION)	Shock level: 980 m/s^2 (100 G) 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 (1.0 G) zero to peak 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 with no obvious non-uniformity and no line defect.
Partial transformation of the module parts should be ignored.

Fail: No display image, obvious non-uniformity, or line defects.

10. INSPECTION STANDARDS

Inspection condition is as follows:

Viewing distance is approximately 35 cm.
Viewing angle is normal to the LCD panel.
Ambient temperature is approximately 25°C.
Ambient light is from 300 to 500 lx.

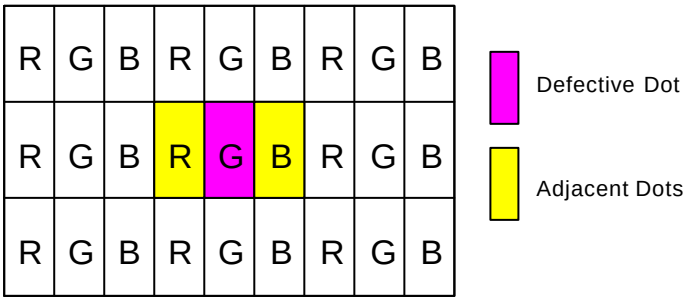
Bright Dot is defined as follows:

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	
	DISTANCE BETWEEN DEFECTS BRIGHT DOT DARK DOT	 ≥ 15 mm ≥ 15 mm	
	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.

11. HANDLING PRECAUTIONS FOR TFT-LCD MODULE

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

(1) ASSEMBLY PRECAUTION

a. Please mount the LCD module by using mounting hole with a screw clamping torque less than 0.5 Nm. Please do not bend or wrench the LCD module in assembling. Please do not drop, bend or twist the LCD module in handling. Please mount the invertor circuit board by using mounting hole of rear side with a screw clamping torque less than 0.2 Nm.

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.

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

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

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

(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
construction:	See fig. 1
max. packaging number:	10 pcs.
dimension:	488 (W) × 395 (H) × 361 (D)[mm]
mass(including 10 modules):	17.8 kg
label:	Labels are put on the box.(See fig. 2, 3, 4)

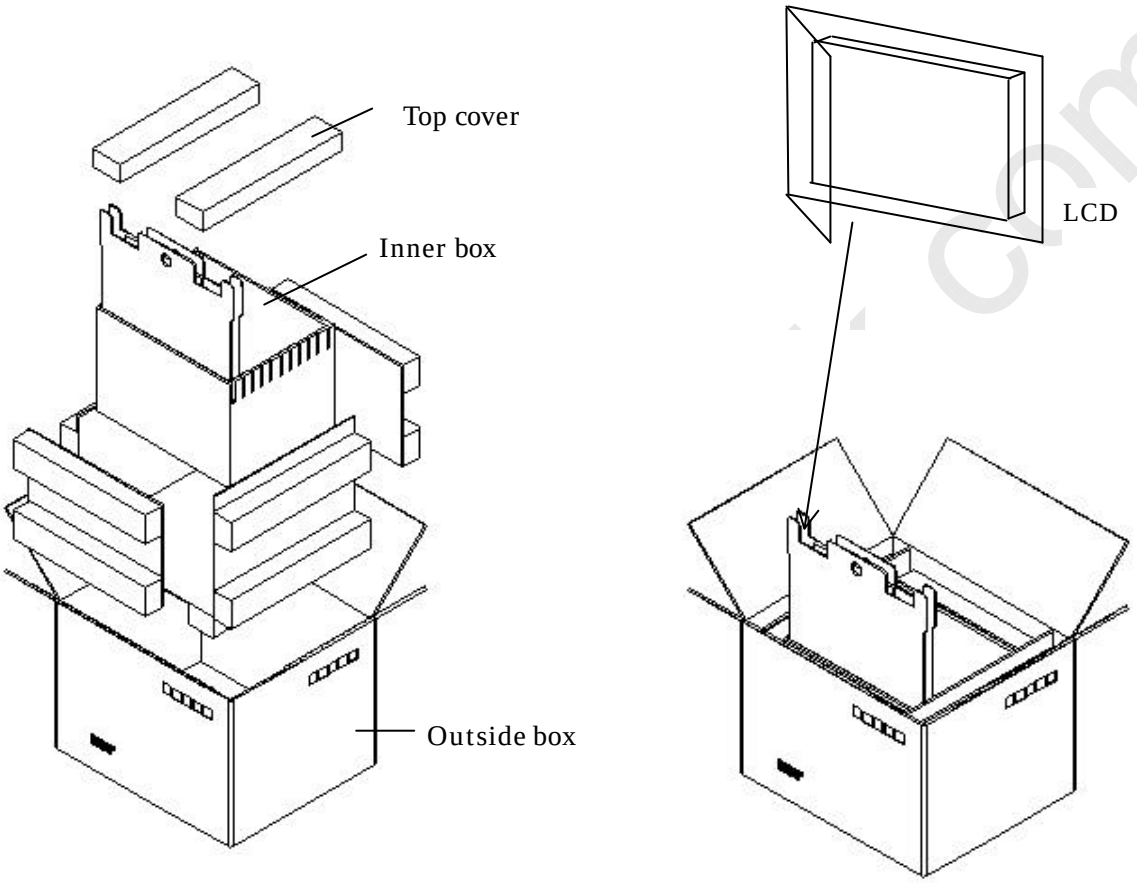


Fig. 1. Illustration of packaging box structure

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. Label1

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：AA150XK01

T-51784D150-FW-A-AA

P / O NO. 123456789

C / S 001 OF 005

MADE IN JAPAN

001 JA1BK4144

2001/11/15

Fig. 5 Sample of Label3

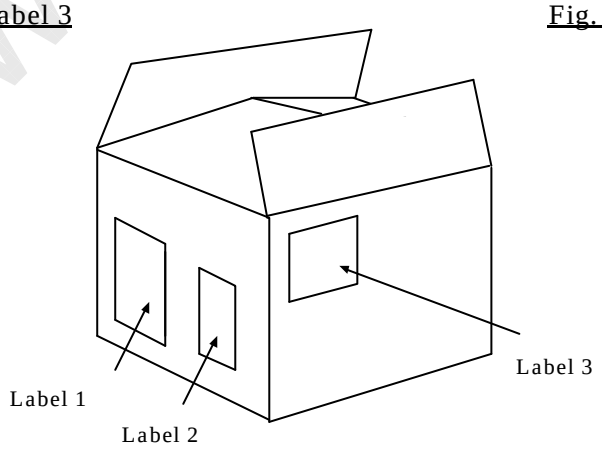


Fig. 6. Location of Labels

2. Location of label on the packaging box
   - Labels are put on the box.(See Fig.6)

3. Packaging form of product
   - Each of LCD module is packed in anti-electrostatic bag(Fig. 7)
   - Packed LCD module is put in the packaging box.(Fig. 8)
     The packaging box accumulates maximum 10 modules.
   - Upper protector is put on the products and shut the box.(Fig. 9)

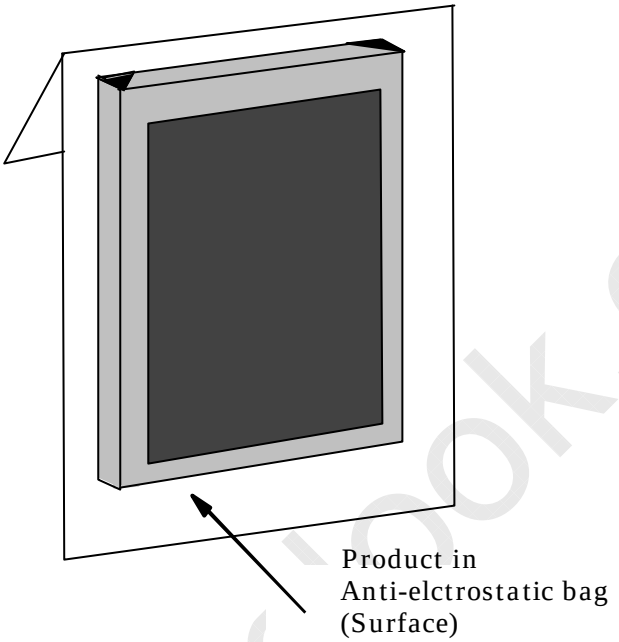


Fig. 7

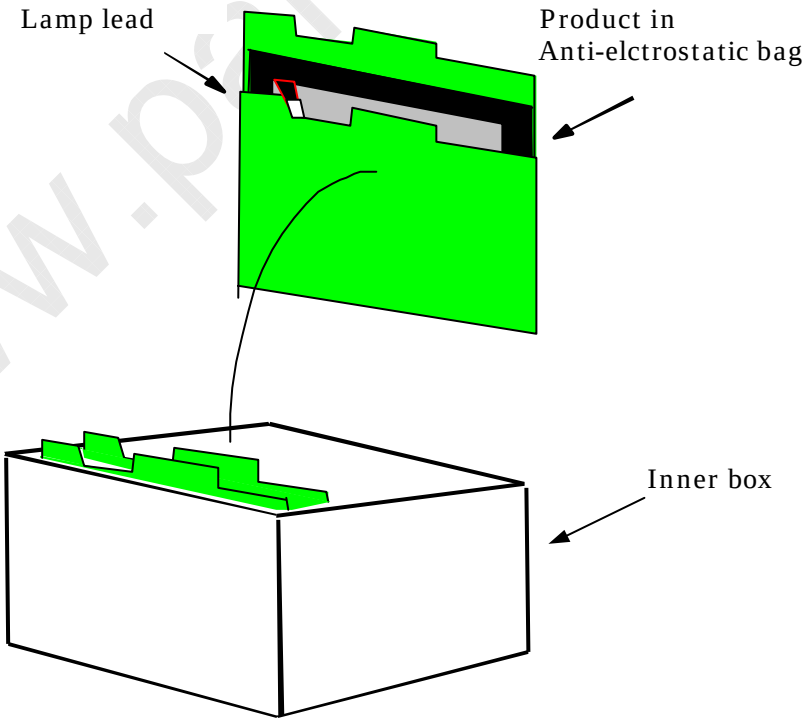


Fig. 8

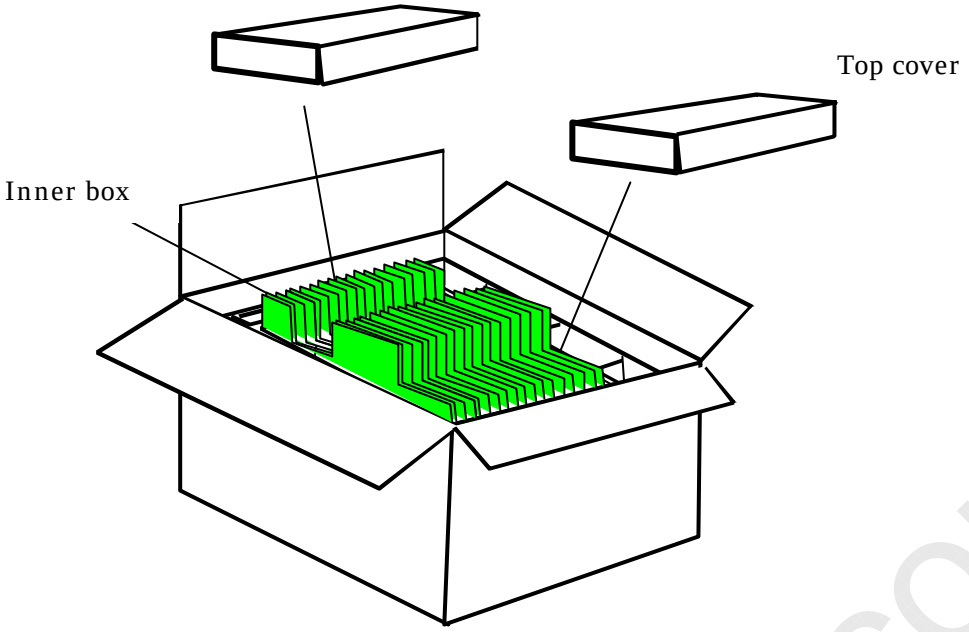


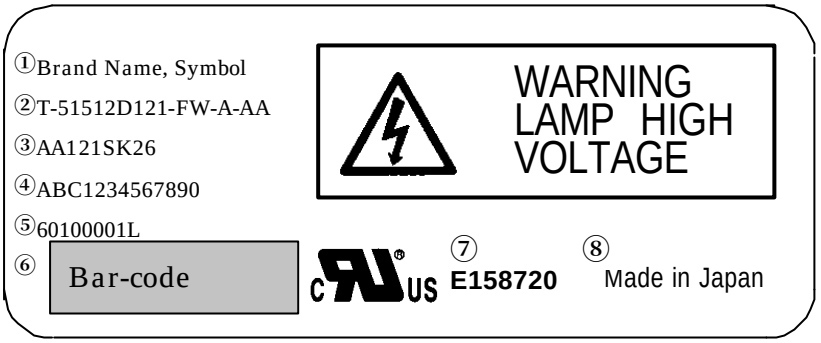
Fig. 9

4. Cautions of shipping & storage

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

Products Number Labeling Forms

Products number label is constructed as below;



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

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 Digit ：Factory Sign (on the Module Test Process)
(L: Shisui Factory Line, Y: YACHIYO SANYO Industries Line,
W: CPT Fab-1, R: CPT Fab-2 , U: CPT Wujiang-LCM)

⑥Bar-code(Date Code)

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

⑦UL File No.

ADI: E158720, CPT: E194548

⑧Production Country

ADI: Made in Japan, CPT: Made in Taiwan

LAMP UNIT for 15.0"XGA

APPLICATION

This technical literature applies to the replaceable lamp unit that is the maintenance parts for 15.0”XGA TFT-LCD module industrial use(model name:T-51784D150-FW-A-AA). (AA-L5902147(Top), AA-L5902148(Bottom))

MECHANICAL CHARACTERISTICS

Item	Specification	Remarks
Outline Dimension of Reflector	324.0±0.6 × 7.0±0.1	Except wire
Mass	22±3(g)(MAX)	With wire and connector
Lamp Diameter	ϕ 2.4-1.8 (mm)	

See DRAWING OF OUTLINE DIMENTIONS

ENVIRONMENTAL CONDITIONS

Item	Operation		Non Operation		Remarks
	MIN	MAX	MIN	MAX	
Ambient Temperature	0°C	50°C	-25°C	60°C	No Condensation

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.

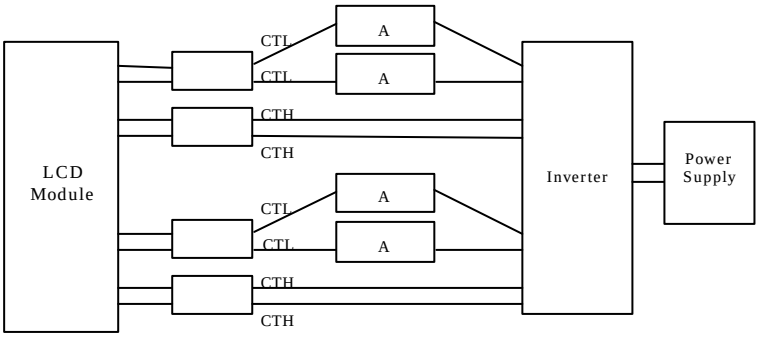
ABSOLUTE MAXIMUM RATINGS

Item	Symbol	MIN	MAX	UNIT
Lamp Current	IL	0	9.0	mArms
Lamp Voltage	VL	0	2500	Vrms
Lamp Frequency	FL	0	100	kHz

ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	MIN	TYP	MAX	Unit	Remarks
Lamp Current	IL	Ta = 25°C	3.5	6.5	8.0	mArm	
Lamp Voltage	VL	Ta = 25°C	-	595	-	Vrms	
Starting Lamp Voltage	VS	Ta = 25°C	1000	-	-	Vrms	
		Ta = 0°C	1350	-	-	Vrms	
Lamp Frequency	FL	Ta = 25℃, IL = 6.5 mArms	40	-	70	kHz	

*1) These values are shown by ALPUS Electric using ALPS-UHP061095 inverter.
*2) Lamp Current measurement method (The current meter is inserted in low voltage line.)



OPTICAL CHARACTERISTICS

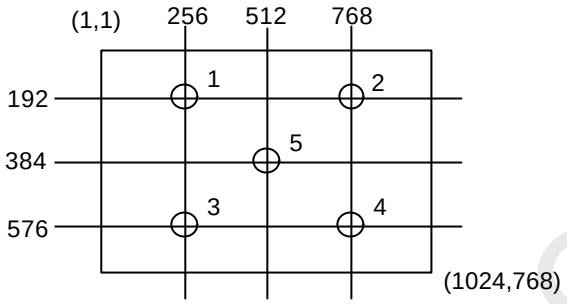
Ta=25°C, 60±10%RH

Item	Symbol	MIN	TYP	MAX	Unit	Remarks
Luminance	Lw	360	450	--	cd/m^2	Average of below 5 points
Color Coordinates (White)	Wx	0.253	0.283	0.313	-	Value of center point(5)
	Wy	0.267	0.297	0.327	-	Value of center point(5)

[Conditions]

IL=6.5 mArms, Inverter frequency: 60kHz

[Measurement Point]



These items are measured when lamp units are assembled into T-51784D150-FW-A-AA, and using CS1000(MINOLTA) for color coordinates, 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.

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 h
Number of turning on and off	100,000 times (30 sec 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.

(3) Following standards should be satisfied

- No flickers should be allowed.
- Decrease in luminous length that is caused by lamp blacking is within 11 mm from the edge of the lamp.

INTERFACE PIN CONNECTION

(1) CN 3, 4(Backlight)

Backlight-side connector: BHSR-02VS-1(JST)

Inverter-side connector: SM02B-BHSS-1-TB

Pin No.	Symbol	Function
1, 2	CTH	VBLH（High Voltage）

[Note] VBLH-VBLL = VL

(2) CN 5, 6(Backlight)

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

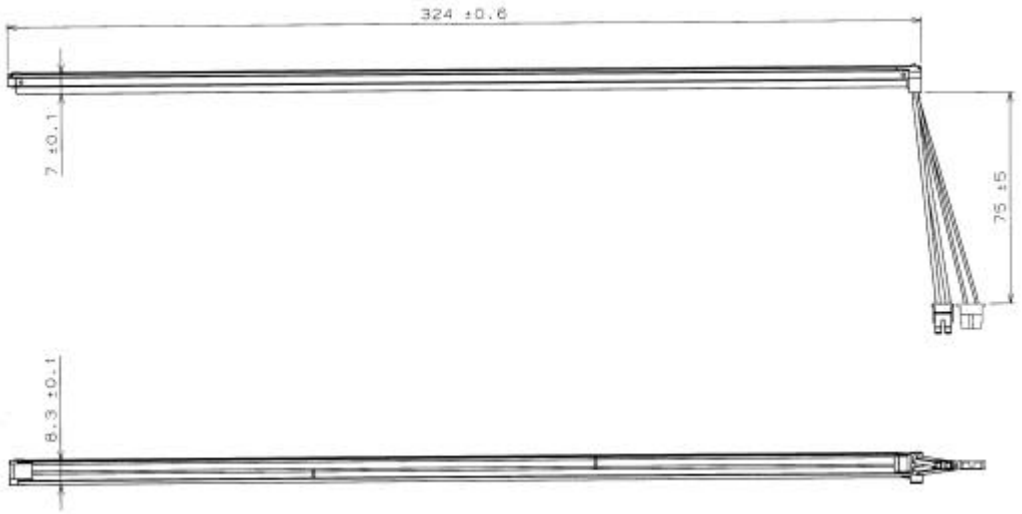
Inverter-side connector: SM02(4.0)B-BHS-1-TB

Pin No.	Symbol	Function
1, 2	CTL	VBLL（Low Voltage）

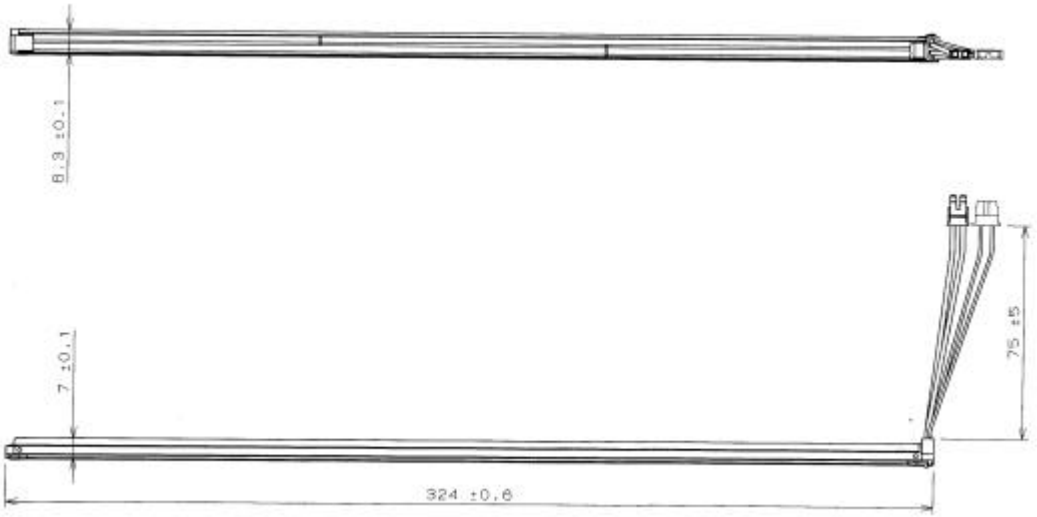
[Note] VBLH-VBLL = VL

DRAWING OF OUTLINE DIMENTIONS

(1) AA-L5902147(Top)



(2) AA-L5902148(Bottom)



METHOD OF REPLACING THE LAMP UNIT

(1) Precautions

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.)

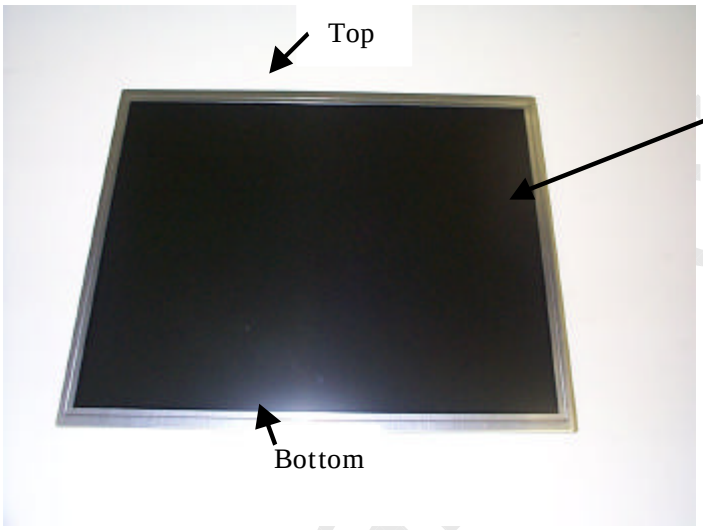
b. Please be careful with electrostatics, and work in clean environment to prevent entering dust and/or foreign matters that will cause bad display image. (Using clean bench or similar environment is recommended.)

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

d. Please replace top and bottom lamp units at the same time. Replace only one lamp unit will cause inferior display image.

(2) Method of replacing the Lamp Unit

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

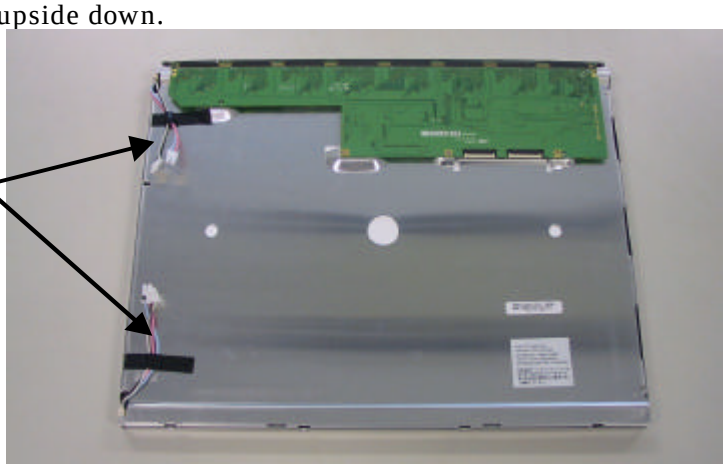


Please check the LCD Panel Surface for scratch, dust, and foreign matters.

Picture 1

2) Turn the TFT-LCD Module upside down.

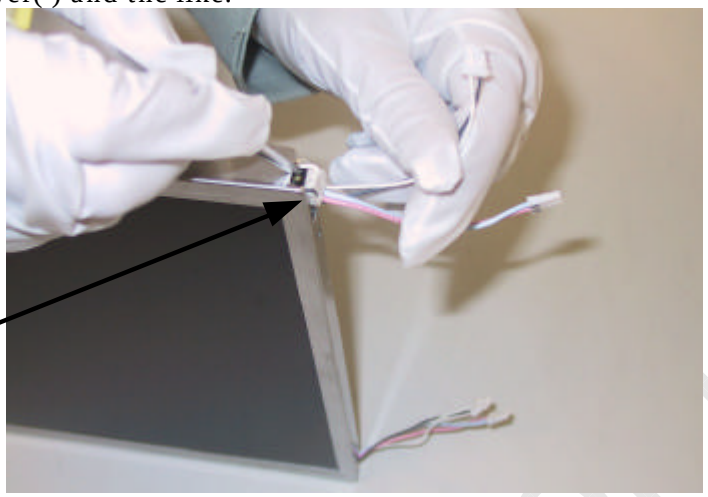
Please check the rear surface for dust and foreign matters.



Picture 2

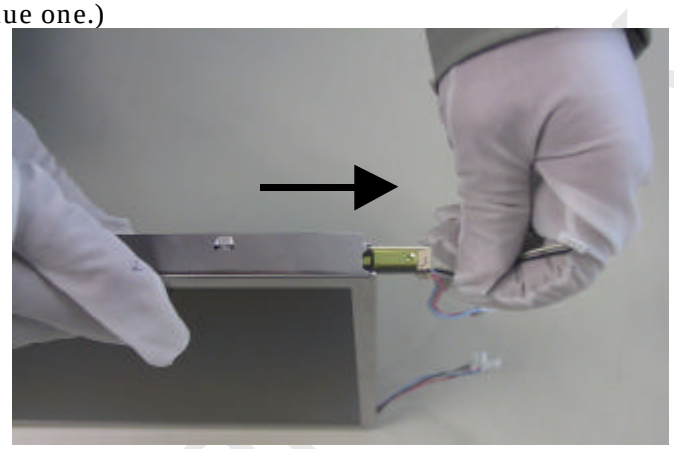
3) Stand the TFT-LCD Module up and push down the latch of rubber holder with that Lamp Unit fastens using a screw driver(-) and the like.

Push down the latch of rubber holder.



Picture 3

4) Pull the black cable and white one slowly and remove the Lamp Unit. (Do not tug at the pink cable and blue one.)



Picture 4

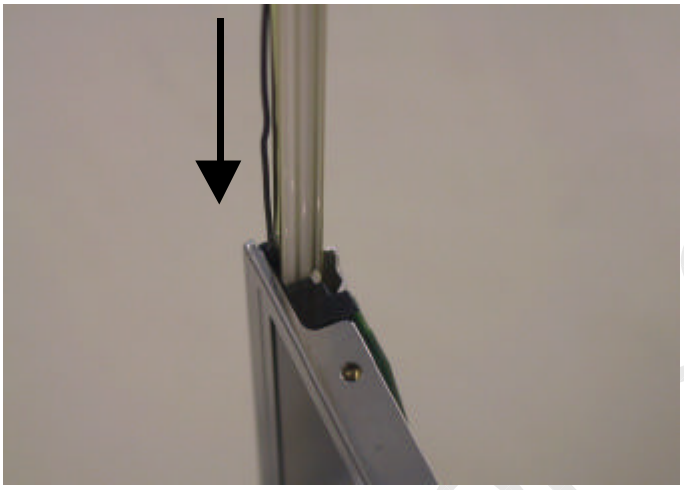
5) Remove the other Lamp Unit at the opposite(bottom) side of LCD Module in the same way. See.3) and 4)

6) Picture 5 shows the TFT-LCD Module after removing the Lamp Units.

Picture 5

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

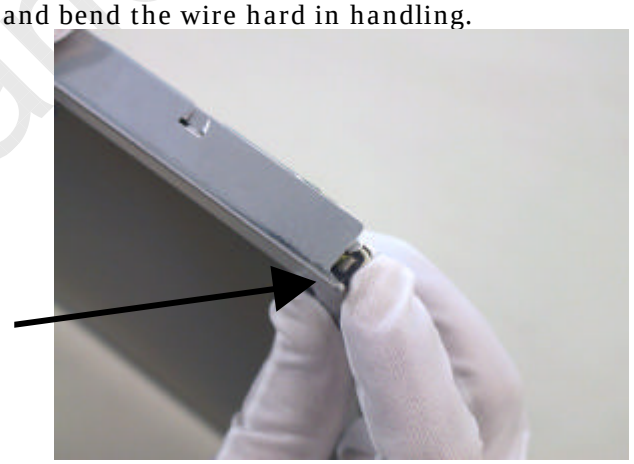
8) Stand the TFT-LCD module up and insert the new Lamp Unit.
The light guide and reflector sheet should be inside of the Lamp Unit.
Please be careful not to hurt your hands from the edge of the Lamp Unit.
Please pay attention to insert direction.



Picture 6

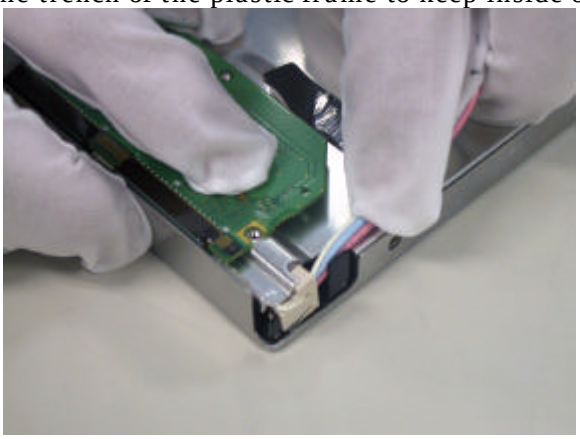
9) Please insert Lamp Unit. After inserting the Lamp Unit, please check that the Lamp Unit is fastened with the latch of rubber holder.
Please be careful not to tug at and bend the wire hard in handling.

Please check that the Lamp Unit is fastened with the latch of rubber holder.



Picture 7

10) Put the lamp cables in the trench of the plastic frame to keep inside of the module.



Picture 8

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

12) After replacing the Lamp Units, please check the following items.
- Appearance of TFT-LCD Module is not changed after replacing Lamp Units. (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.