TENTATIVE

All information in this technical data sheet is tentative and subject to change without notice.

Preliminary

9.0” QHD

TECHNICAL SPECIFICATION

T-55618D090J-LW-A-AAN

OPTREX CORPORATION.

Date: Apr.8,’10

CONTENTS

1. APPLICATION

This specification applies to color TFT-LCD module, T-55618D090J-LW-A-AAN.

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(1) Standard Usage

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(2) Special Usage

Medical equipment, safety equipment, transportation equipment, provided, however, that TFT-LCD is necessary to its operation.

(3) Specific Usage

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

2. OVERVIEW

T-55618D090J-LW-A-AAN is 9.0" color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, driver ICs, control circuit, LED driver and backlight unit.

By applying 8 bit digital data, 960 × 540, 16.7M-color images are displayed on the 9.0" 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. 33 MHz clock cycle.

General specifications are summarized in the following table:

ITEM	SPECIFICATION
Display Area (mm)	198.72 (H) × 111.78 (V) (9.0-inch diagonal)
Number of Dots	960 × 3 (H) × 540 (V)
Pixel Pitch (mm)	0.207 (H) × 0.207 (V)
Color Pixel Arrangement	RGB vertical stripe
Display Mode	Normally black IPS
Number of Color	16.7M
Luminance (cd/m^2)	400
Wide Viewing Angle Technology	Optical Compensation Film
Viewing Angle (CR ≥ 10)	–85~85°(H), –85~85°(V)
Surface Treatment	Anti-glare and hard-coating 3H
Electrical Interface	LVDS (8 bit)
Optimum Viewing Angle (Contrast ratio)	6 o'clock
Module Size (mm)	217.0 (W) × 130.0 (H) × 9.5 (D)
Module Mass (g)	(330)
Backlight Unit	LED, 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	3.7	V
Logic Input Voltage	VI	–0.3	4.5	V
Backlight Positive Power Supply	VL	–0.3	14.0	V
Backlight power control input voltage	BLEN	–0.3	14.0	V
Light Dimming Control input voltage	V_{PDIM}	–0.3	14.0	V
Operation Temperature (Panel) Note 1,2)	$T_{op(Panel)}$	–20	60	°C
Operation Temperature (Ambient) Note 2)	$T_{op(Ambient)}$	–20	60	°C
Storage Temperature Note 2)	T_{stg}	–20	70	°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

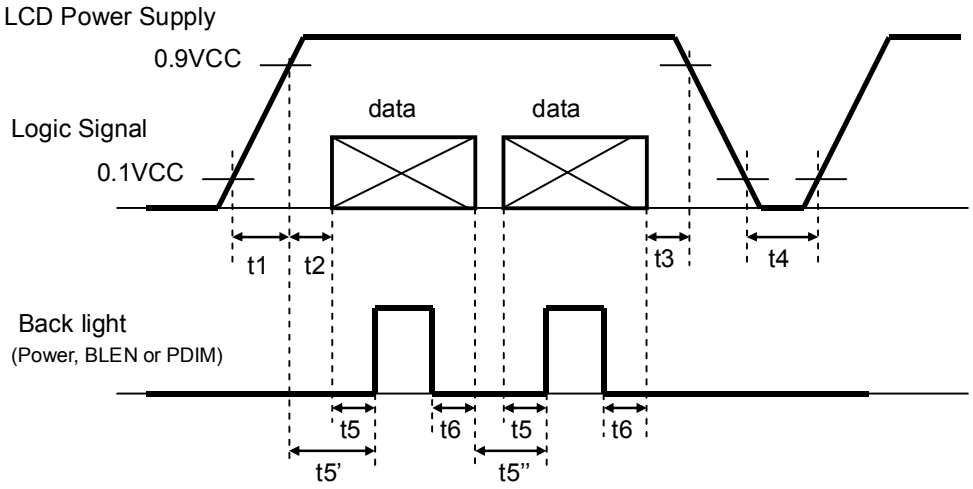
(1) TFT-LCD

Ambient temperature: Ta = 25°C

ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	Remarks
Power Supply Voltages for LCD		VCC	3.0	3.3	3.6	V	*1)
Power Supply Currents for LCD		ICC	--	(400)	(650)	mA	*2)
Permissive Input Ripple Voltage		VRP	--	--	(100)	mVp-p	VCC = +3.3V
Logic Input Voltage	High	VIH	2.0	--	VCC	V	MODE, FFD
	Low	VIL	0	--	0.8	V	MODE, FFD

*1) Power and signals sequence:

0.2ms ≤ t1 ≤ 10 ms
0 ≤ t2
0 ≤ t3
200 ms ≤ t4
200 ms ≤ t5, (400 ms) ≤ t5', (400 ms) ≤ t5"
0 ≤ t6

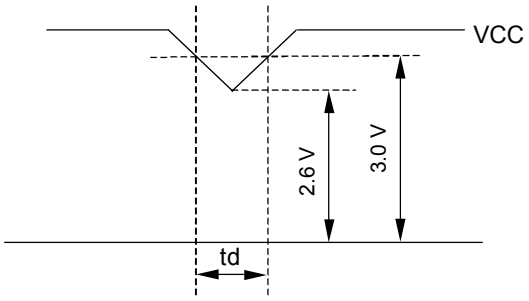


data : LVDS(RGB DATA with valid DCLK and DENA), MODE, FFD

VCC-dip conditions:

1) When 2.6 V ≤ VCC < 3.0 V, td ≤ 10 ms
2) When VCC < 2.6 V

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



*2) VCC = +3.3 V , f_H=33 kHz, f_V=60 Hz, f_{CLK}=33 MHz
Display image at typical power supply current value is 256-gray-bar pattern (8 bit), 540 line mode.

*3) Fuse

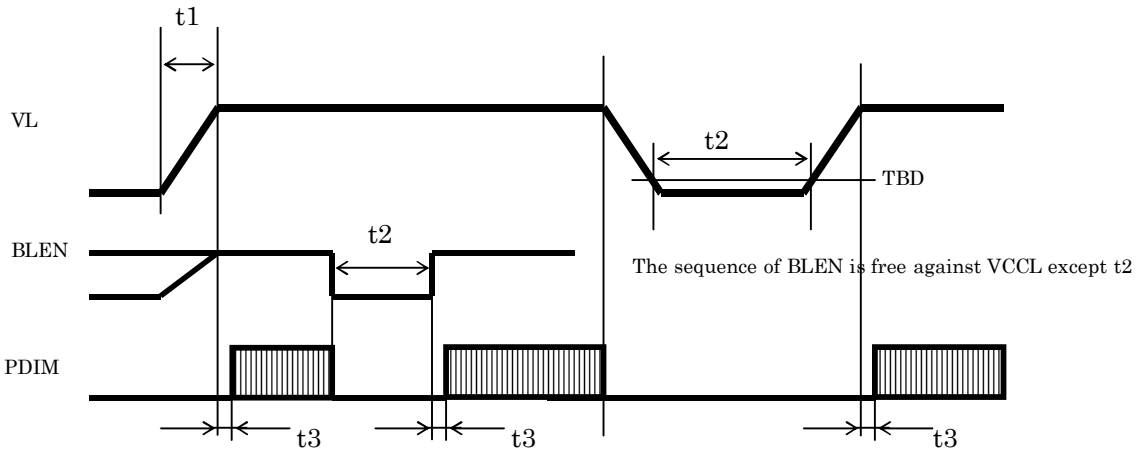
Parameter	Fuse Type Name	Supplier	Remark
VCC	FCC16162AB	Kamaya Electric Co., Ltd.	*)

*) The power supply capacity should be designed to be more than the fusing current.

(2) Backlight Ta=25°C

ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	Remarks
Power Supply Input Voltage		VL	10.8	12.0	13.2	V	*1)
Power Supply Input Current		IL	--	--	(1000)	mA	*2,4)
Power Supply Input Power		PCCL	--	(4.8)	(6.0)	W	Dimming=100%
Backlight power control input voltage	High	BLEN	2.5	--	VL	V	ON
	Low		0	--	0.4	V	OFF
Light Dimming Control input voltage	High	V_{PDIM}	2.5	--	5.5	V	ON
	Low		0	--	0.4	V	OFF
PWM frequency		f_{PDIM}	TBD	(500)	TBD	Hz	*3)
Pulse width of PDIM		t_{PDIM}	(5)	--	DC	us	*3)
LED Life Time		LT	80,000	100,000	--	h	*5)

*1) Power and signals sequence:



0.1 ≤ t1 ≤ 100 [ms]
200 ≤ t2 [ms]
(0) ≤ t3 [ms]

*2) Includes rush current. PCCL≠VCCL×ICCL

*3) lower frequency causes the flicker or the image breaking of motion picture.
Depending on the PDIM signal integrity (jitter etc.), the flicker may be visible. Please evaluate in advance.
The dimming ratio (D) can be calculated by following equation:
$D = f_{PDIM} \times t_{PDIM}$. Therefore, the minimum dimming ratio is $f_{PDIM} \times t_{PDIM(min)}$

*4) Fuse

Parameter	Fuse Type Name	Supplier	Remark
VCCL	(FCC16152AB)	(Kamaya)	*)

*) The power supply capacity should be designed to be more than the fusing current.

*5) LED life time is defined as the time when the brightness becomes 50% of the initial value.

5. INTERFACE PIN CONNECTION

(1) CN 1(Interface Signal)

Used connector: FI-SE20P-HFE (JAE)

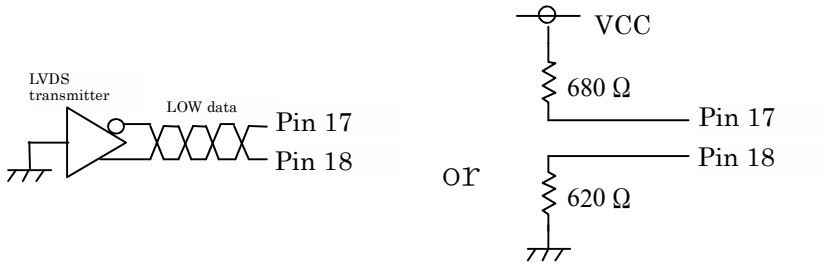
Corresponding connector: FI-S20S [for discrete Wire], FI-SE20ME [for FPC] (JAE)

Pin No.	Symbol	8 bit input	
		Function (ISP 6 bit compatibility mode)	Function (ISP 8 bit compatibility mode)
1	VCC	+3.3 V Power supply	
2	VCC	+3.3 V Power supply	
3	GND	GND	
4	GND	GND	
5	Link 0–	R2, R3, R4, R5, R6, R7, G2	R0, R1, R2, R3, R4, R5, G0
6	Link 0+	R2, R3, R4, R5, R6, R7, G2	R0, R1, R2, R3, R4, R5, G0
7	GND	GND	
8	Link 1–	G3, G4, G5, G6, G7, B2, B3	G1, G2, G3, G4, G5, B0, B1
9	Link 1+	G3, G4, G5, G6, G7, B2, B3	G1, G2, G3, G4, G5, B0, B1
10	GND	GND	
11	Link 2–	B4, B5, B6, B7, DENA	B2, B3, B4, B5, DENA
12	Link 2+	B4, B5, B6, B7, DENA	B2, B3, B4, B5, DENA
13	GND	GND	
14	CLKIN–	Clock –	
15	CLKIN+	Clock +	
16	GND	GND	
17	Link3–	R0, R1, G0, G1, B0, B1	R6, R7, G6, G7, B6, B7
18	Link3+	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	FFD	Feed Forward Driving Function on/off (Low=on, High=off)	

*1) Metal frame is connected to signal GND.

*2) All terminals should be connected.

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



(2) CN 2(Backlight)

Backlight-side connector: FI-S6P-HFE (JAE)

Corresponding connector: FI-S6S (JAE)

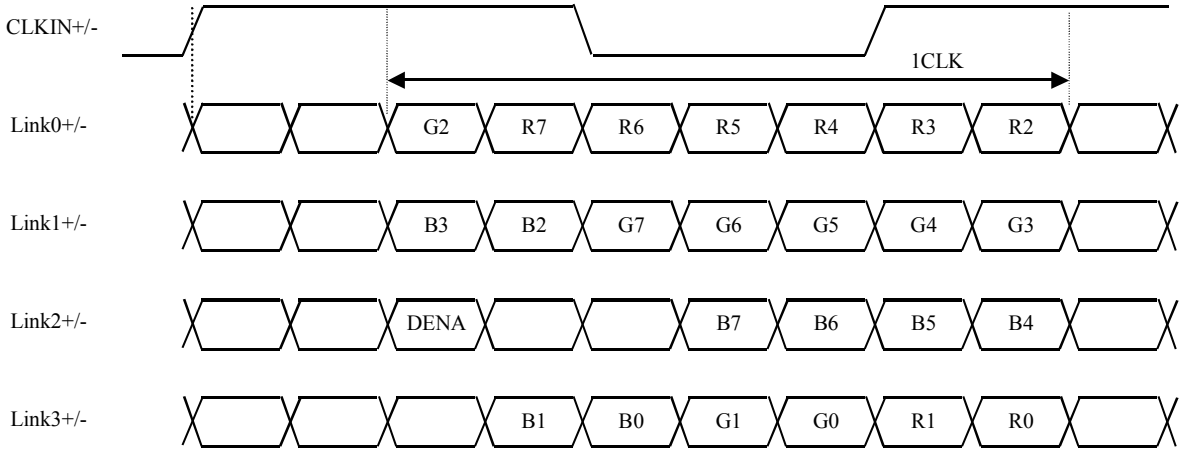
Pin No.	Symbol	Function
1	VL	Backlight Positive Power Supply
2	VL	Backlight Positive Power Supply
3	GNDL	Backlight Negative Power Supply *1)
4	GNDL	Backlight Negative Power Supply *1)
5	BLEN	Backlight power control input *2) (High active)
6	PDIM	Light Dimming Control (PWM) input (High active)

*1) GNDL is connected GND (of CN1) and the LCD frame internally.

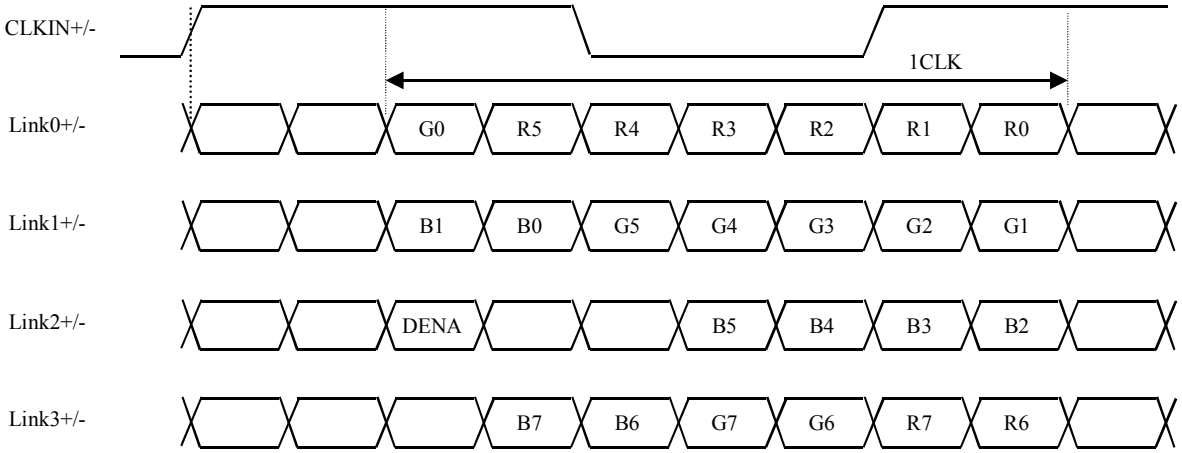
*2) BLEN is NOT designed for dimming.

(3) ISP data mapping

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



b. ISP 8 bit compatibility mode



6. INTERFACE TIMING

LVDS transmitter input signal

(1) Timing Specifications

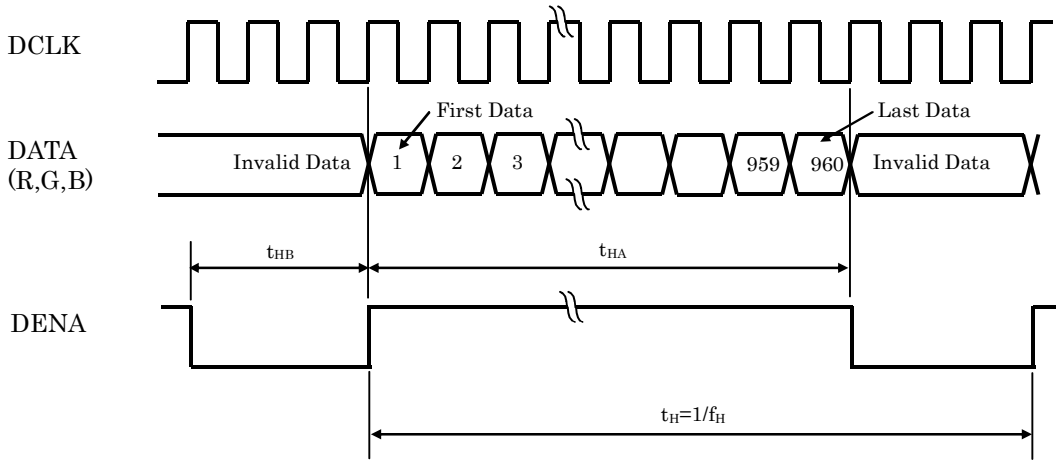
ITEM			SYMBOL	MIN	TYP	MAX	UNIT
DCLK	Frequency		f_{CLK}	20	33	42	MHz
	Period		t_{CLK}	23.8	30.3	50.0	ns
DENA	Horizontal	Active Time	t_{HA}	960	960	960	t_{CLK}
		Blanking Time	t_{HB}	20	40	--	t_{CLK}
		Frequency	f_H	26.0	33.0	42.9	kHz
		Period	t_H	23.3	30.3	38.5	μs
	Vertical	Active Time	t_{VA}	540	540	540	t_H
		Blanking Time	t_{VB}	2	10	--	t_H
		Frequency	f_V	48	60	75	Hz
		Period	t_V	13.3	16.7	20.8	ms

[Note]

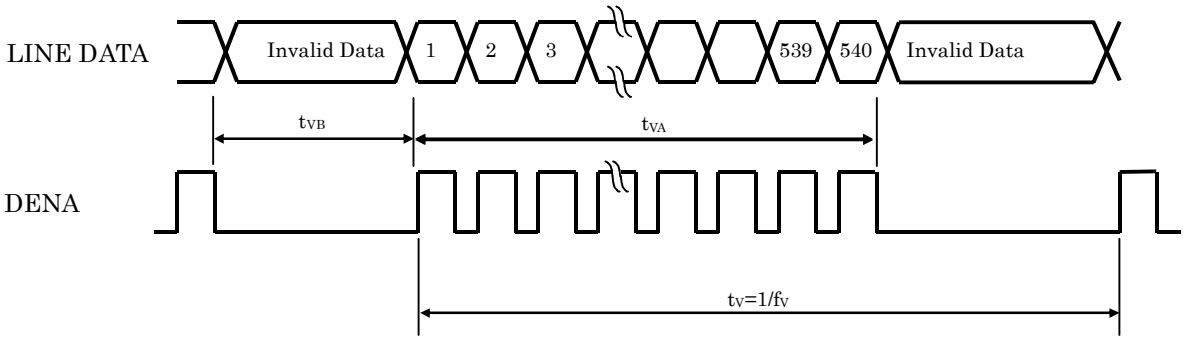
1) DENA (Data Enable) should always be positive polarity as shown in the timing specification.
2) DCLK should appear during all invalid period.
3) LVDS timing follows the timing specifications of LVDS receiver IC: THC63LVDF84B(Thine).

(2) Timing Chart

a. Horizontal Timing Chart



b. 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(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.

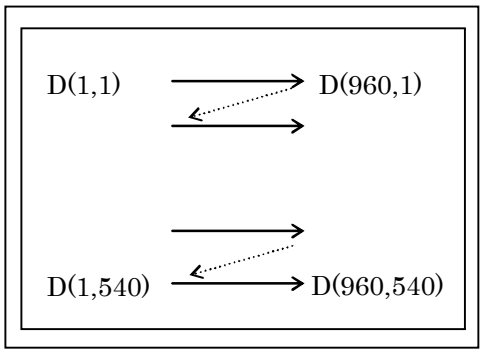
Higher n means brighter level.

2) Data

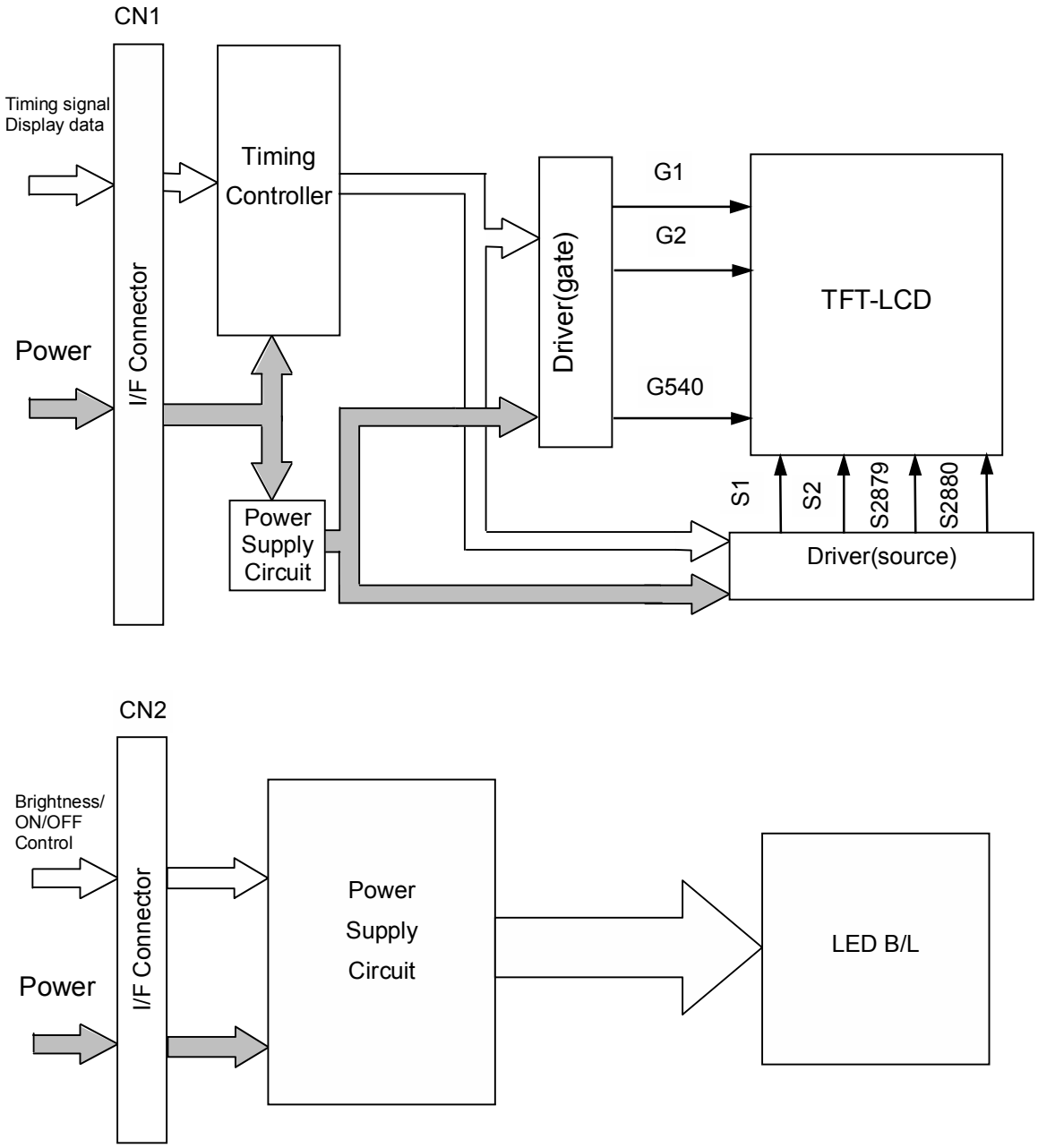
1:High, 0: Low

(4) Display Position and Scan Direction

D(X,Y) shows the data number of input signal.

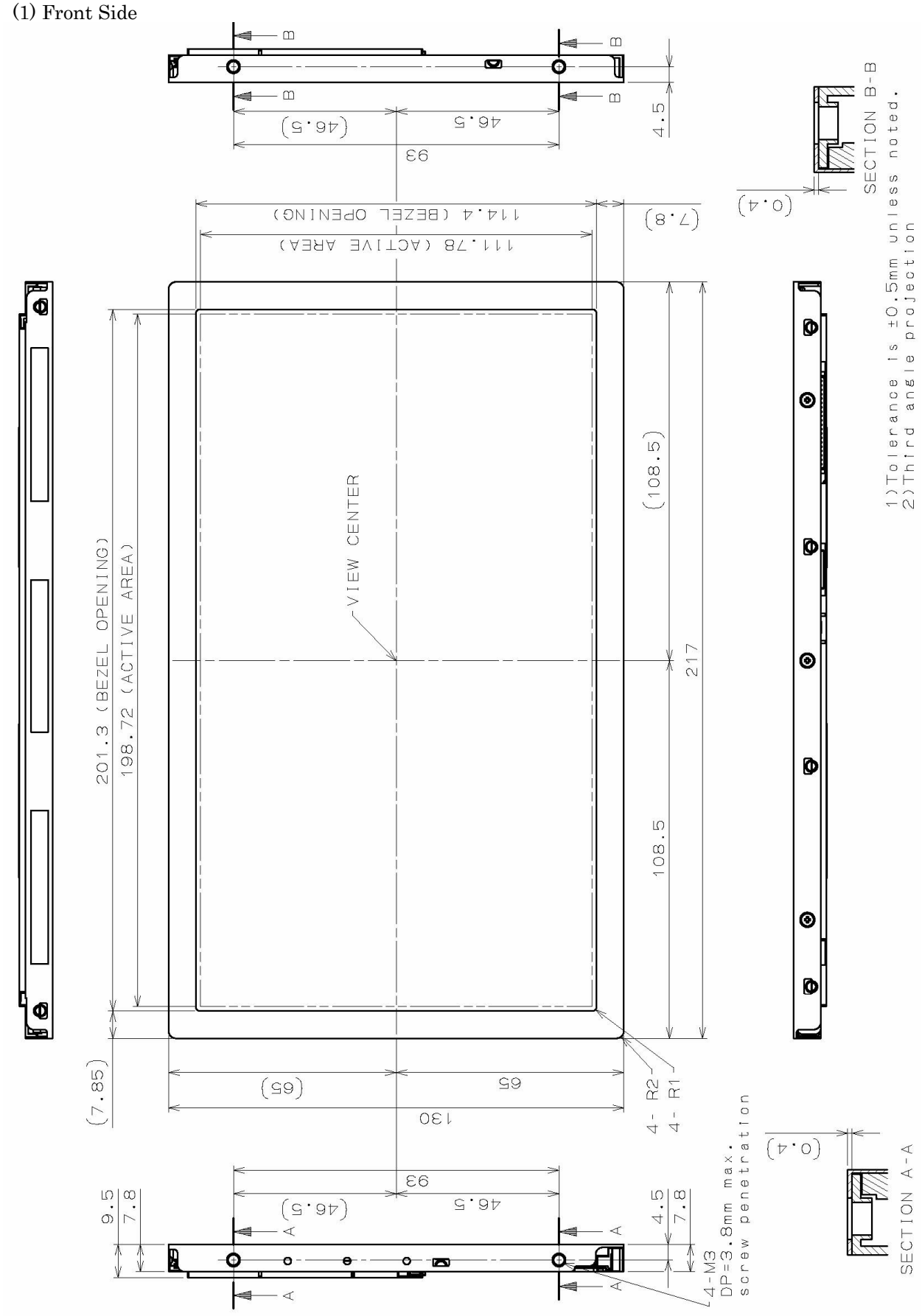


7. BLOCK DIAGRAM



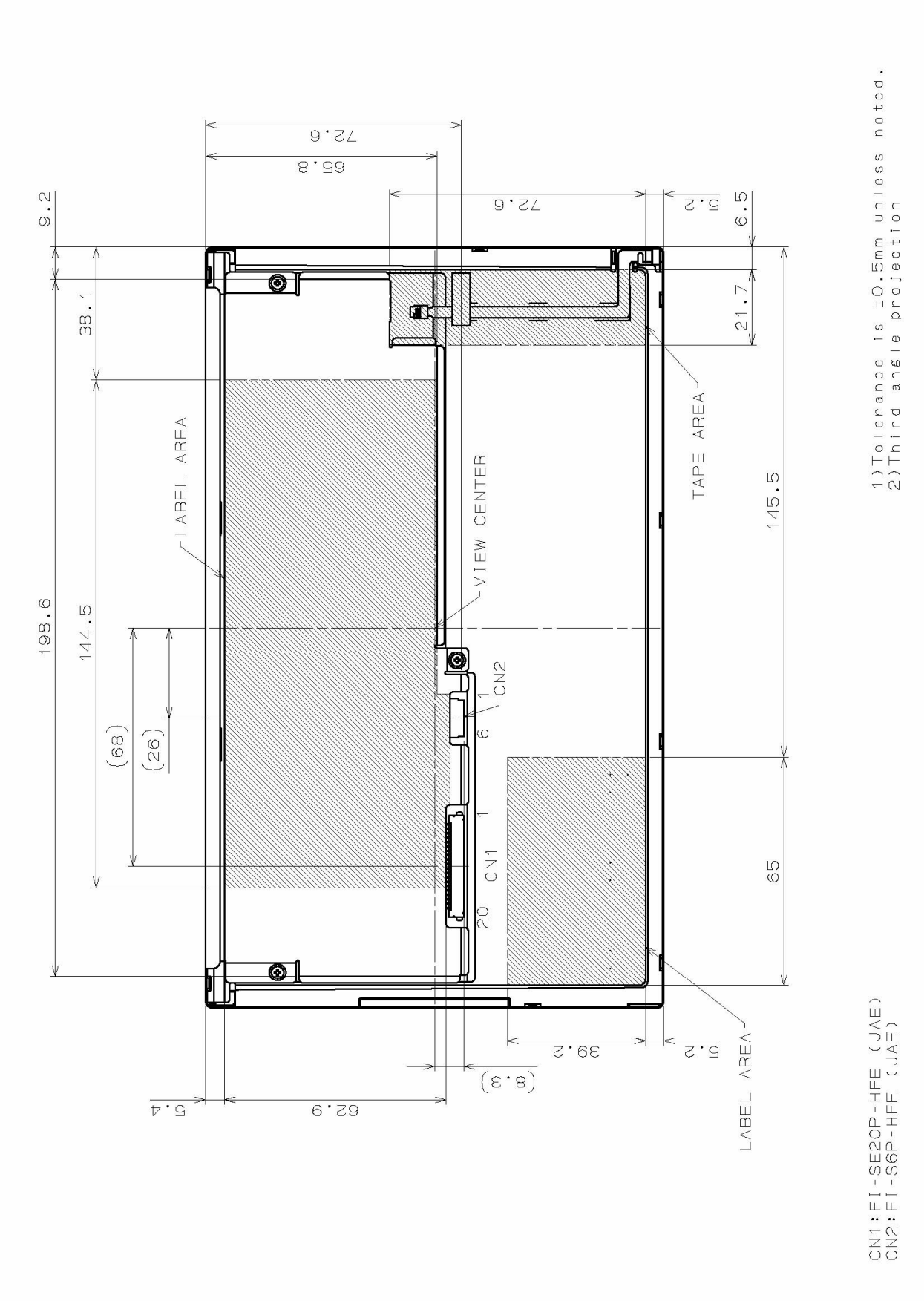
8. MECHANICAL SPECIFICATIONS

(1) Front Side



(Unit: mm)

(2) Rear Side



(Unit:mm)

9. OPTICAL CHARACTERISTICS

Ta=25°C, VCC=3.3V, VL=12.0V, Input Signals: Typ. values shown in Section 6

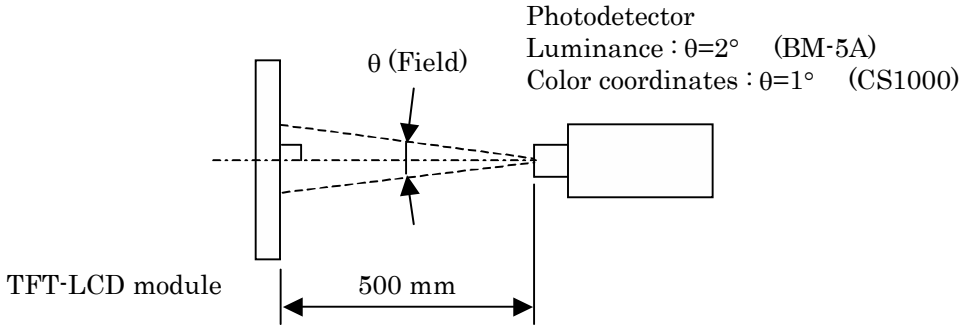
ITEM		SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	Remarks
Contrast Ratio		CR	θ_V=0°, θ_H=0°	650	1000	--	--	*1)*2)*5)
Luminance		Lw	θ_V=0°, θ_H=0°	320	400	--	cd/m²	*1)*5)
Luminance Uniformity		ΔLw	θ_V=0°, θ_H=0°	--	--	30	%	*1)*3)*5)
Response Time		tr	θ_V=0°, θ_H=0°	--	8	--	ms	*1)*4)*5)
		tf	θ_V=0°, θ_H=0°	--	8	--	ms	*1)*4)*5)
Viewing Angle	Horizontal	θ_H	CR ≥ 10	-65~65	-85~85	--	°	*1)*5)
	Vertical	θ_V		-65~65	-85~85	--	°	*1)*5)
Image sticking		tis	2 h	--	--	2	s	*6)
Color Coordinates	Red	Rx	θ_V=0°, θ_H=0°	TBD	TBD	TBD	--	*1)*5)
		Ry		TBD	TBD	TBD		
	Green	Gx		TBD	TBD	TBD		
		Gy		TBD	TBD	TBD		
	Blue	Bx		TBD	TBD	TBD		
		By		TBD	TBD	TBD		
	White	Wx		0.273	0.313	0.353		
		Wy		0.289	0.329	0.369		

[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: V_{PDIM} = 3.3 V

Measurement method for luminance and color coordinates is as follows.

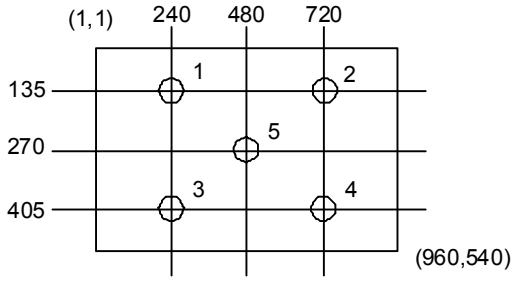


The luminance is measured according to FLAT PANEL DISPLAY MEASUREMENTS STANDARD (VESA Standard).

*1) Measurement Point

Contrast Ratio, Luminance, Response Time, Viewing Angle, Color Coordinates: Display Center

Luminance Uniformity: point 1~5 shown in a figure below



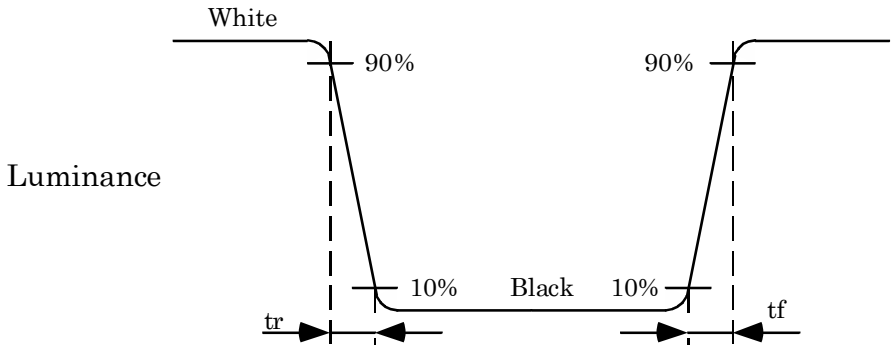
*2) Definition of Contrast Ratio

CR= Luminance with all white pixels / Luminance with all black pixels

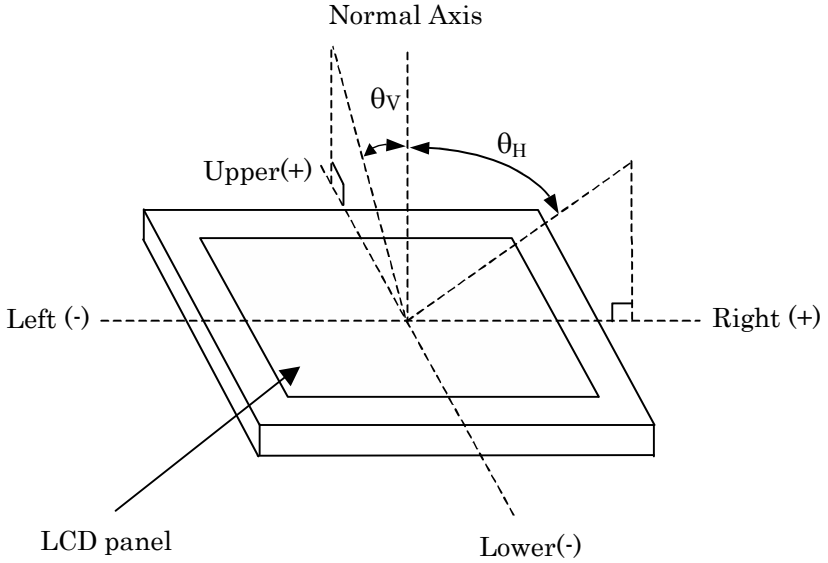
*3) Definition of Luminance Uniformity

$\Delta Lw=[Lw(MAX)/Lw(MIN)-1] \times 100$

*4) Definition of Response Time

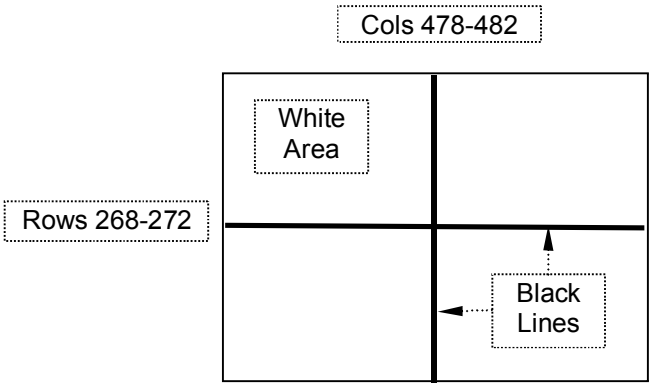


*5) Definition of Viewing Angle (θ_V, θ_H)



*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

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 OPERATION	60°C, 240 h
LOW TEMPERATURE OPERATION	–20°C, 240 h
HIGH TEMPERATURE STORAGE	70°C, 240 h
LOW TEMPERATURE STORAGE	–20°C, 240 h
THERMAL SHOCK (NON-OPERATION)	–20°C (1h) ~ 70°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. OTHER FEATURE

This LCD module complies with RoHS*) directive.

*) RoHS: Restriction of the use of certain hazardous substances in electrical and electronic equipment

12. 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.

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 and not to wrench module.

(b) Under high temperature environment, performance and life time of LED may heavily shorten. When you design with our LCD product, please consider radiating heat and ventilation for good heat management.

(c) 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.

(d) 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.

(e) Keep sufficient clearance between LCD module and the others parts, such as inverter and speaker so as not to interfere the LCD module. Approximately 1.0 mm 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 wipe off LCD panel surface with absorbent cotton or soft cloth in case of it being soiled.

e. 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.

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

g. 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.

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

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

j. Be sure to connect the cables and the connecters 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. The interface signal speed is very high. Please pay attention to transmission line design and other high speed signal precautions to satisfy signal specification.
d. A condensation might happen on the surface and inside of LCD module in case of sudden change of ambient temperature. Please take care so as not to cause any damage mentioned on (1)-d.
e. 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.
f. 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

LCD should be stored in the room temperature environment with normal humidity. The LCD inventory should be processed by first-in first-out method.

(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.

(6) OTHERS

a. A strong incident light into LCD panel may cause deterioration to polarizer film, color filter, and other materials, which will degrade the quality of display characteristics. Please do not expose LCD module under strong Ultraviolet rays for a long time.

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 handling, please see and obey with the packaging specification datasheet.

d. Please do not reuse the LED unit which is once removed.