

LCD Module Technical Specification

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Type No. **T-55465D065J-LW-A-ABN**

Customer :

Customer's Product No :

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Date :

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CONTENTS

No.	Item	Page
--	CONTENTS	2
1	APPLICATION	3
2	OVERVIEW	4
3	ABSOLUTE MAXIMUM RATINGS	5
4	ELECTRICAL CHARACTERISTICS	5
5	INTERFACE PIN CONNECTION	7
6	INTERFACE TIMING	8
7	BLOCK DIAGRAM	11
8	MECHANICAL SPECIFICATION	12
9	OPTICAL CHARACTERISTICS	14
10	RELIABILITY TEST CONDITION	17
11	INSPECTION STANDARDS	18
12	OTHER FEATURE	19
13	HANDLING PRECAUTIONS FOR TFT-LCD MODULE	19
--	PACKAGING SPECIFICATION	22
--	PRODUCTS NUMBER LABELING FORMS	26
--	LAMP UNIT for 6.5" VGA	27

Revision History

Rev.	Date	Page	Comment

1. APPLICATION

This specification applies to color TFT-LCD module, T-55465D065J-LW-A-ABN.

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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.

The product specified in this document is designed for "Standard Usage" unless otherwise specified in this document. If customers intend to use the product for applications other than those specified for "Standard Usage", they should first contact OPTREX sales representative for it's intended use in writing.

OPTREX has been making continuous effort to improve the reliability of its products. Customers should implement sufficient reliability design of their application equipments such as redundant system design, fail-safe functions, anti-failure features.

OPTREX assumes no responsibility for any damage resulting from the use of the product that does not comply with the instructions and the precautions specified in this document.

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

T-55465D065J-LW-A-ABN	OPTREX CORPORATION	Page 3/33
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2. OVERVIEW

T-55465D065J-LW-A-ABN is 6.5" 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 digital data 640×480 , 262k-color images are displayed on the 6.5" diagonal screen. Input power voltage is 3.3 V for LCD driving.

The type of data and control signals are digital and transmitted via CMOS interface per Typ. 25 MHz clock cycle.

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

ITEM	SPECIFICATION
Display Area (mm)	132.48(H) $\times$ 99.36(V) (6.5-inch diagonal)
Number of Dots	640×3 (H) $\times$ 480 (V)
Pixel Pitch (mm)	0.207 (H) $\times$ 0.207 (V)
Color Pixel Arrangement	RGB vertical stripe
Display Mode	Normally white TN
Number of Color	262k
Luminance (cd/m ²)	700
Wide Viewing Angle Technology	Optical compensation film
Viewing Angle (CR $\geq$ 10)	-80~80° (H) -60~80° (V)
Surface Treatment	Anti-reflection and hard-coating 2H
Electrical Interface	CMOS
Optimum Viewing Angle (Contrast ratio)	6 o'clock
Module Size (mm)	154.0 (W) $\times$ 121.0 (H) $\times$ 11.0 (D)
Module Mass (g)	185
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	4.0	V
Logic Input Voltage	VI	-0.3	6.0	V
Backlight (LED) Current	IF	0	180	mA
Operation Temperature (Panel) Note 1,2)	T _{op(Panel)}	-30	80	°C
Operation Temperature (Ambient) Note 2)	T _{op(Ambient)}	-30	80	°C
Storage Temperature Note 2)	T _{stg}	-30	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°C

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	--	185	280	mA	*2)
Permissive Input Ripple Voltage		VRP	--	--	100	mVp-p	VCC = +3.3V
Logic Input Voltage	High	VIH	2.0	--	5.5	V	
	Low	VIL	0	--	0.8	V	

*1) Power and signals sequence:

$$t1 \leq 10 \text{ ms}$$

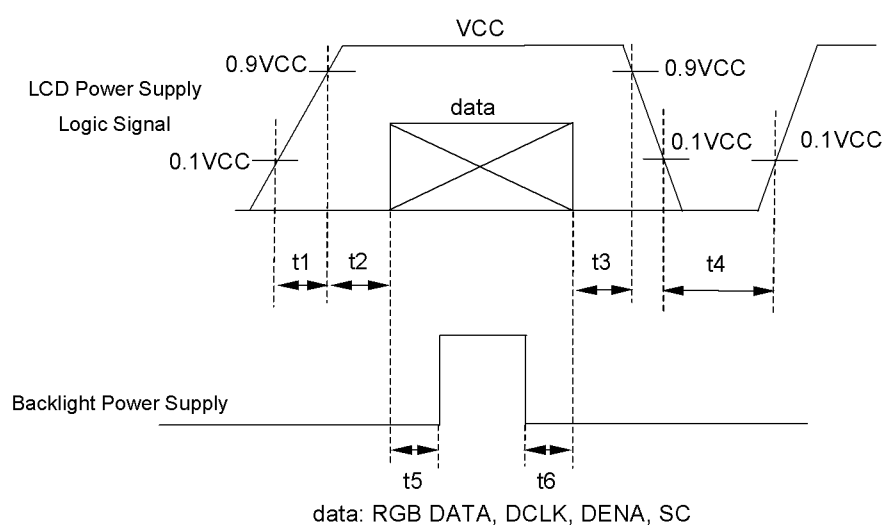
$$0 < t2 \leq 50 \text{ ms}$$

$$0 < t3 \leq 50 \text{ ms}$$

$$200 \text{ ms} \leq t4$$

$$200 \text{ ms} \leq t5$$

$$0 \leq t6$$

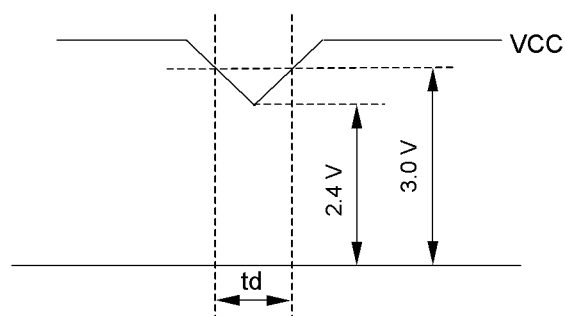


T-55465D065J-LW-A-ABN	OPTREX CORPORATION	Page 5/33
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VCC-dip conditions:

- 1) When $2.4\text{ V} \leq V_{CC} < 3.0\text{ V}$, $t_d \leq 10\text{ ms}$
- 2) When $V_{CC} < 2.4\text{ V}$

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



*2) $V_{CC} = +3.3\text{ V}$, $f_H = 31.5\text{ kHz}$, $f_V = 60\text{ Hz}$, $f_{CLK} = 25\text{ MHz}$

Display image at typical power supply current value is 64-gray-bar pattern (6 bit), 480 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

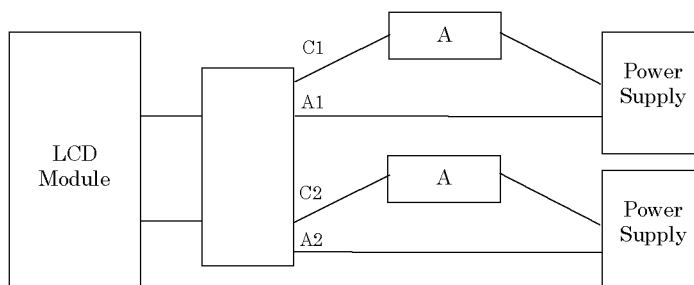
ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	Remarks
LED Voltage	VF	--	(17.7)	21.4	V	IF = 90 mA, Ta = 25°C
		--	--	21.7	V	IF = 90 mA, Ta = 0°C
		--	--	22.0	V	IF = 90 mA, Ta = -30°C
LED Current	IF	--	90	100	mA	*1), *3)
LED Life Time	LT	60,000	--	--	h	IF = 90 mA, Ta = 25°C *4), *5), Continuous operation

[Note]

*1) Constant Current Drive

*2) The Voltage deviation between strings: $|V_{f1} - V_{f2}| \leq 2\text{ V}$

*3) LED Current measurement method



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

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

T-55465D065J-LW-A-ABN	OPTREX CORPORATION	Page 6/33
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5. INTERFACE PIN CONNECTION

(1) CN 1(Interface Signal)

Used connector: DF9B-31P-1V(32) (HIROSE)

Corresponding connector: DF9-31S-1V(32) (HIROSE)

Pin No.	Symbol	Function
1	GND	
2	DCLK	Clock signal for sampling catch data signal
3	HD	Horizontal sync signal *1)
4	VD	Vertical sync signal *1)
5	GND	
6	R0	Red data signal(LSB)
7	R1	Red data signal
8	R2	Red data signal
9	R3	Red data signal
10	R4	Red data signal
11	R5	Red data signal(MSB)
12	GND	
13	G0	Green data signal(LSB)
14	G1	Green data signal
15	G2	Green data signal
16	G3	Green data signal
17	G4	Green data signal
18	G5	Green data signal(MSB)
19	GND	
20	B0	Blue data signal(LSB)
21	B1	Blue data signal
22	B2	Blue data signal
23	B3	Blue data signal
24	B4	Blue data signal
25	B5	Blue data signal(MSB)
26	GND	
27	DENA	Data enable signal (to settle the viewing area)
28	VCC	3.3 V Power Supply
29	VCC	3.3 V Power Supply
30	NC	This pin should be open.
31	SC	Scan direction control (Low=Normal, High=Reverse)

*1) HD and VD are not being used for timing control.

*2) Metal frame is connected to signal GND.

(2) CN 2(Backlight)

Backlight-side connector: SM06B-SHLS-TF(LF)(SN) (JST)

Corresponding connector: SHLP-06V-S-B (JST)

Pin No.	Symbol	Function
1	NC	This pin should be open.
2	NC	This pin should be open.
3	LED C 1	LED cathode 1
4	LED A 1	LED anode 1
5	LED A 2	LED anode 2
6	LED C 2	LED cathode 2

6. INTERFACE TIMING

(1) Timing Specifications

ITEM			SYMBOL	MIN.	TYP.	MAX.	UNIT
DCLK	Frequency		f _{CLK}	20	25	30	MHz
	Period		t _{CLK}	33.3	40	50	ns
	Low Width		t _{WCL}	10	--	--	ns
	High Width		t _{WCH}	10	--	--	ns
DATA(R,G,B), DENA	Set up time		t _{DS}	4	--	--	ns
	Hold time		t _{DH}	4	--	--	ns
DENA	Horizontal	Active Time	t _{HA}	640	640	640	t _{CLK}
		Blanking Time	t _{HB}	20	160	--	t _{CLK}
		Frequency	f _H	27	31.5	38	kHz
		Period	t _H	26.3	31.7	37.0	μs
	Vertical	Active Time	t _{VA}	480	480	480	t _H
		Blanking Time	t _{VB}	4	45	--	t _H
		Frequency	f _V	55	60	70	Hz
		Period	t _V	14.3	16.7	18.2	ms

[Note]

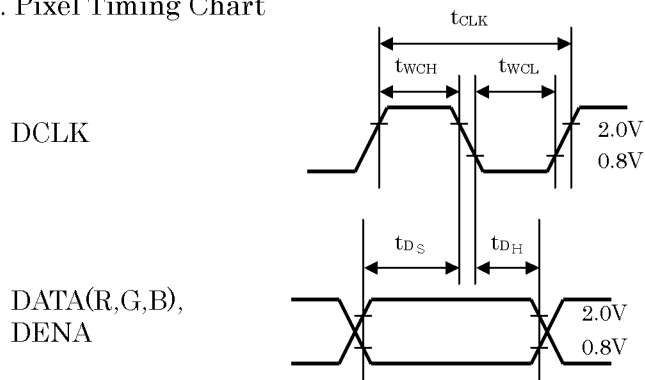
- 1) DATA is latched at fall edge of DCLK in this specification.
- 2) DENA (Data Enable) should always be positive polarity as shown in the timing specification.
- 3) DCLK should appear during all invalid period.
- 4) In case of blanking time fluctuation, please satisfy following condition.

$$t_{VBn} > t_{VBn-1} - 3(t_H)$$

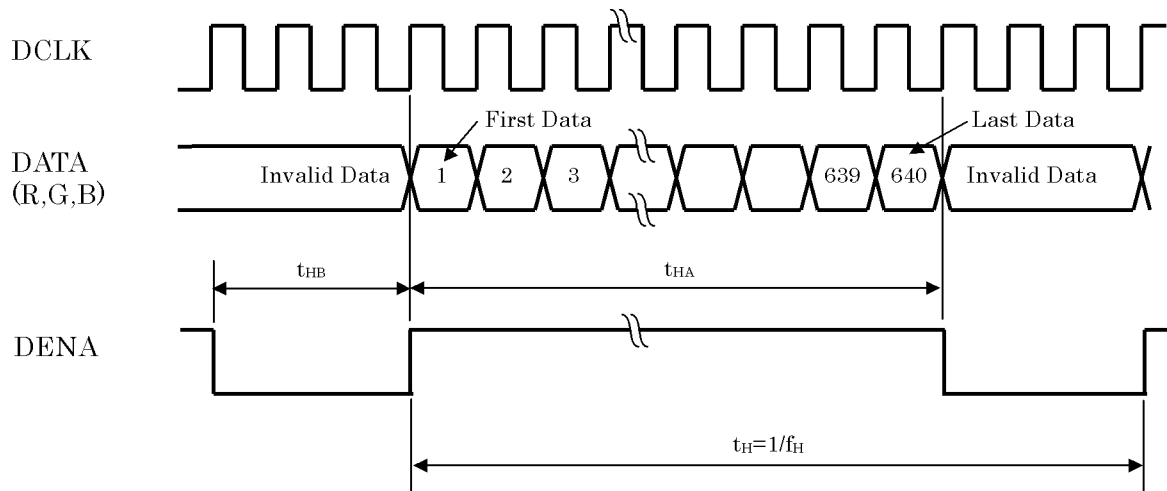
T-55465D065J-LW-A-ABN	OPTREX CORPORATION	Page 8/33
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(2) Timing Chart

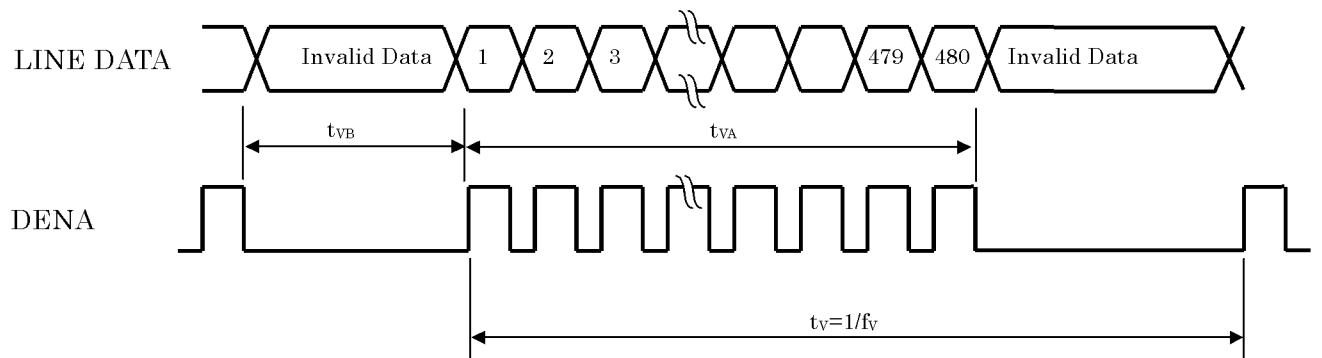
a. Pixel Timing Chart



b. Horizontal Timing Chart



c. Vertical Timing Chart



(3) Color Data Assignment

COLOR		INPUT DATA																	
		R DATA						G DATA						B DATA					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	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
	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.

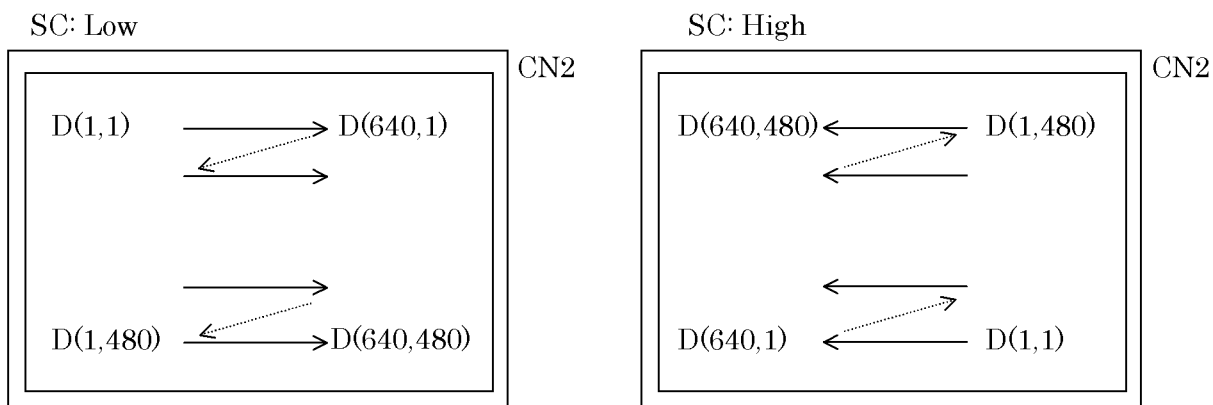
Higher n means brighter level.

2) Data

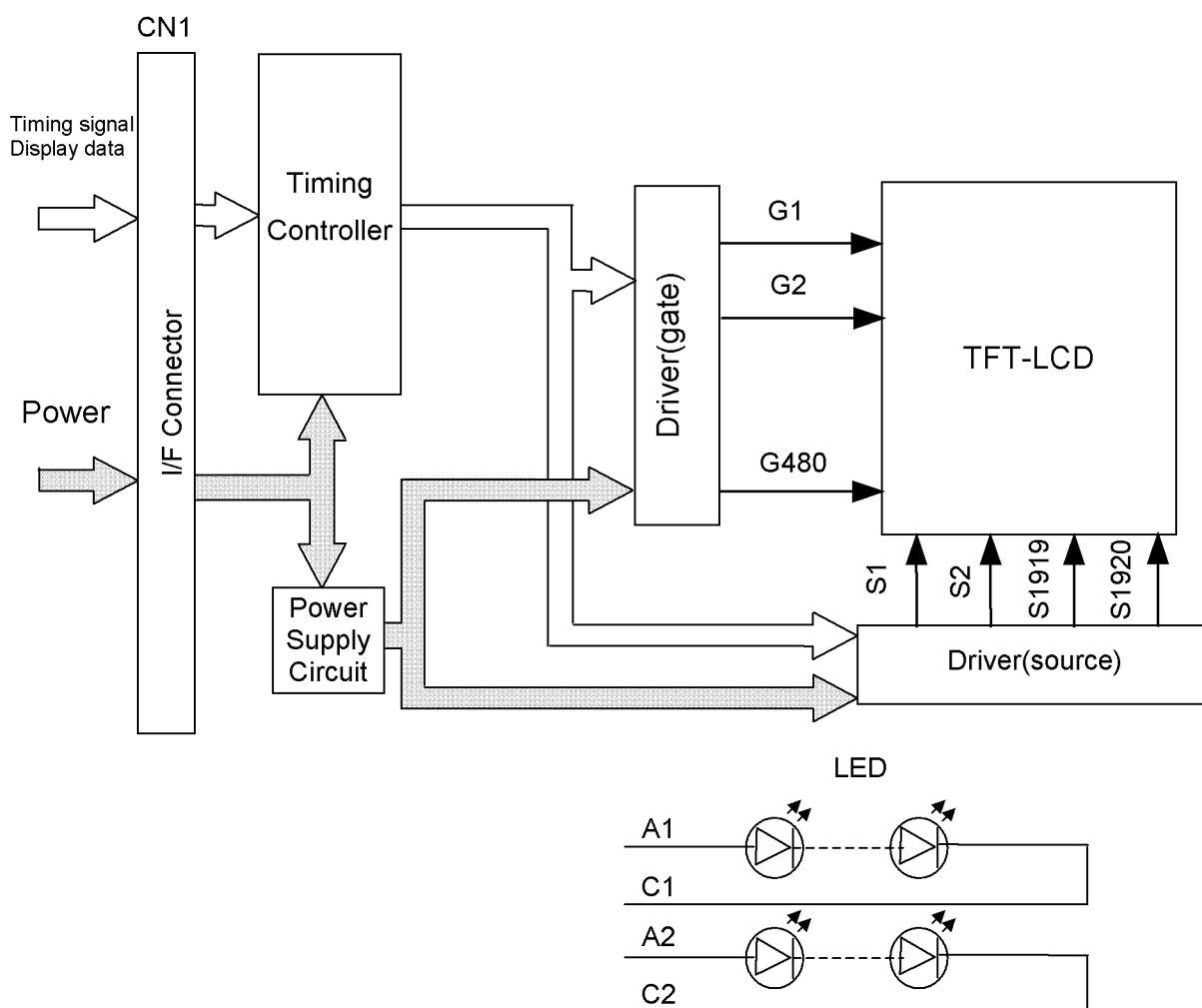
1:High, 0: Low

(4) Display Position and Scan Direction

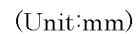
D(X,Y) shows the data number of input signal for LCD panel signal processing PCB.



7. BLOCK DIAGRAM

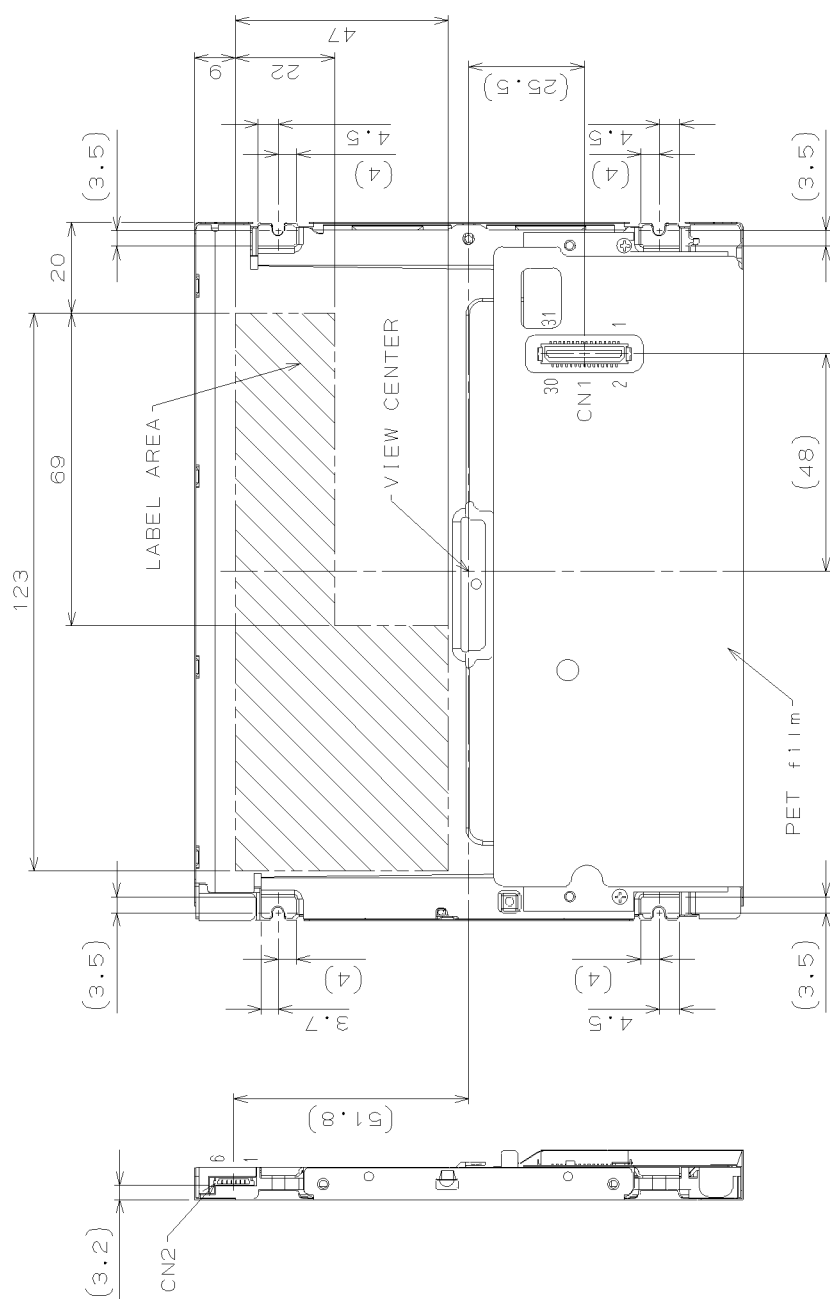


(1) Front Side



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(2) Rear Side



1) Tolerance is ± 0.5 mm unless noted.
2) Thickness of PET film is not included.
3) Third angle projection

CN1: DF9B-31P-1V(32) (HRS)
CN2: SMO6B-SHLS-TF(LF)(SN) (JST)

(Unit:mm)

T-55465D065J-LW-A-ABN	OPTREX CORPORATION	Page 13/33
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9. OPTICAL CHARACTERISTICS

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

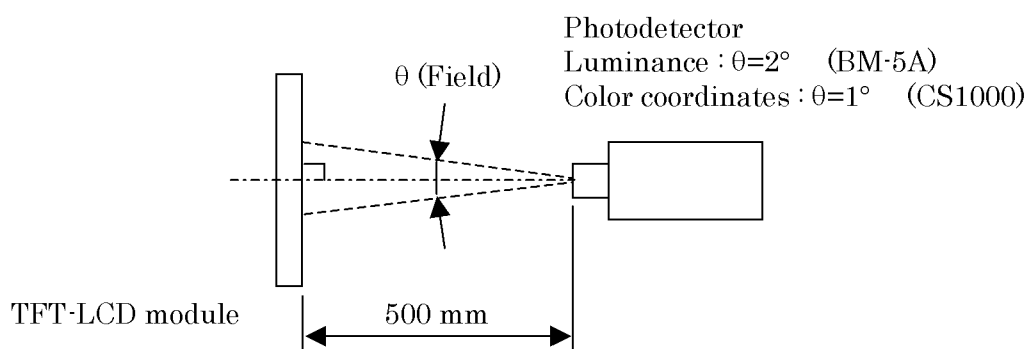
ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	Remarks
Contrast Ratio		CR	$\theta_V=0^\circ, \theta_H=0^\circ$	350	600	--	--	*1)*2)*5)
Luminance		Lw	$\theta_V=0^\circ, \theta_H=0^\circ$	560	700	--	cd/m ²	*1)*5)
Luminance Uniformity		ΔLw	$\theta_V=0^\circ, \theta_H=0^\circ$	--	--	30	%	*1)*3)*5)
Response Time		tr	$\theta_V=0^\circ, \theta_H=0^\circ$	--	6	--	ms	*1)*4)*5)
		tf	$\theta_V=0^\circ, \theta_H=0^\circ$	--	19	--	ms	*1)*4)*5)
Viewing Angle	Horizontal	θ_H	CR ≥ 10	-65~65	-80~80	--	°	*1)*5)
	Vertical	θ_V		-45~65	-60~80	--	°	*1)*5)
Image Sticking		tis	2 h	--	--	2	s	*6)
Color Coordinates	Red	Rx	$\theta_V=0^\circ, \theta_H=0^\circ$	0.516	0.556	0.596	--	*1)*5)
		Ry		0.301	0.341	0.381		
	Green	Gx		0.321	0.361	0.401		
		Gy		0.522	0.562	0.602		
	Blue	Bx		0.126	0.166	0.206		
		By		0.100	0.140	0.180		
	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 backlight unless noted.

Condition: IF=90 mA

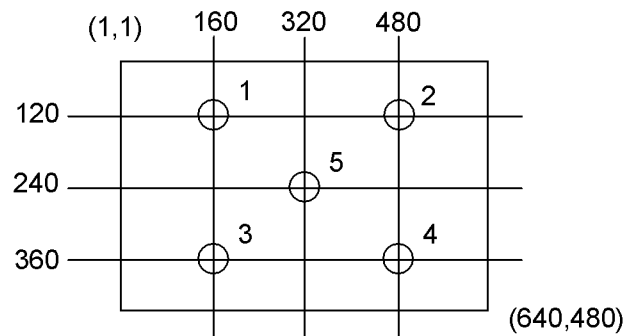
Measurement method for luminance and color coordinates is as follows.



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



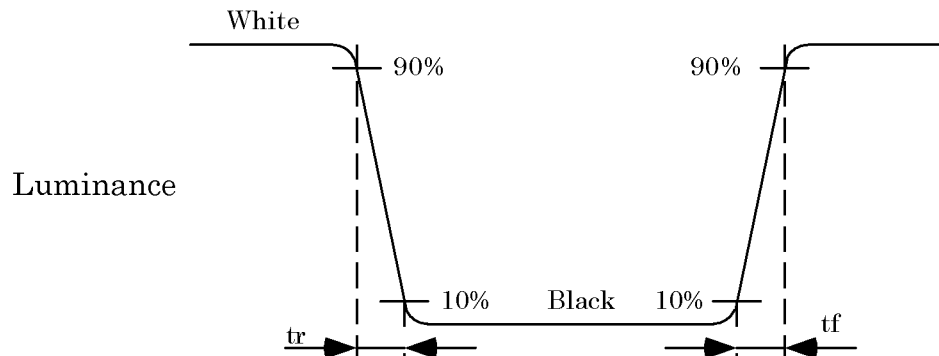
*2) Definition of Contrast Ratio

$CR = \text{Luminance with all white pixels} / \text{Luminance with all black pixels}$

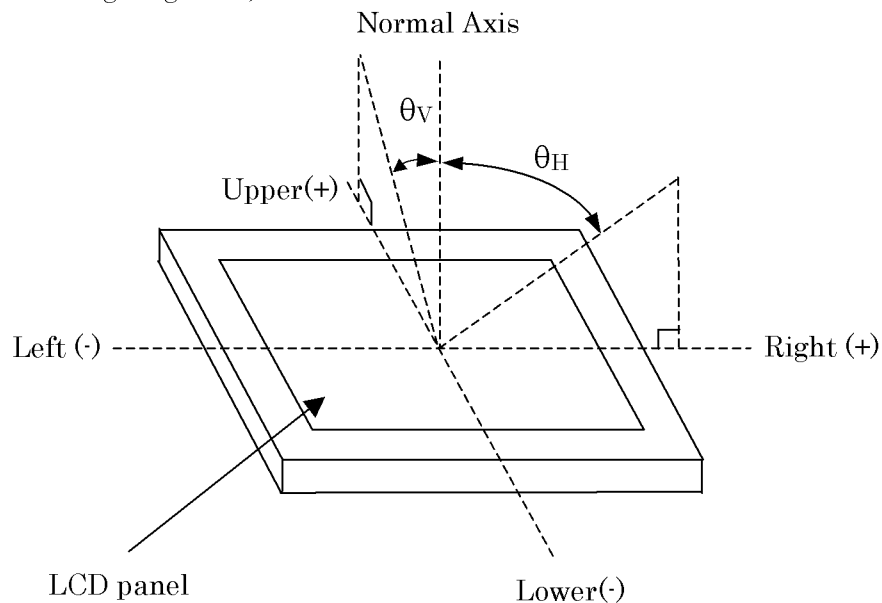
*3) Definition of Luminance Uniformity

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

*4) Definition of Response Time

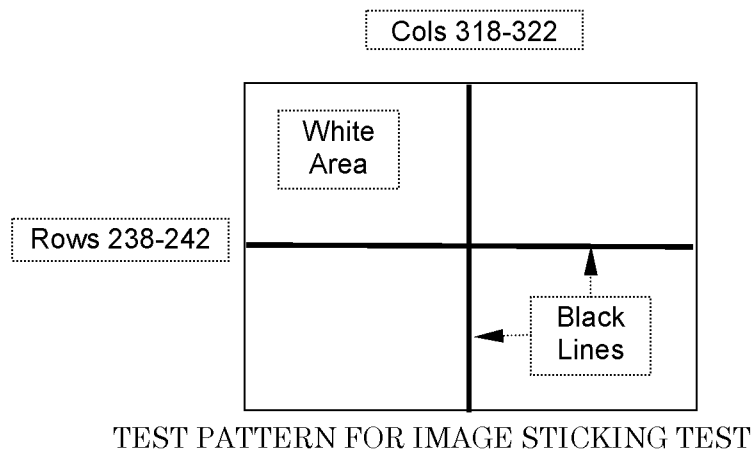


*5) Definition of Viewing Angle (θ_V , θ_H)



*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.



10. RELIABILITY TEST CONDITION

(1) Temperature and Humidity

ITEM	CONDITIONS
HIGH TEMPERATURE HIGH HUMIDITY OPERATION	40°C, 90%RH, 240 h (No condensation)
HIGH TEMPERATURE OPERATION	80°C, 240 h
LOW TEMPERATURE OPERATION	-30°C, 240 h
HIGH TEMPERATURE STORAGE	80°C, 240 h
LOW TEMPERATURE STORAGE	-30°C, 240 h
THERMAL SHOCK (NON-OPERATION)	BETWEEN -30°C (1h) and 80°C(1h), 100 CYCLES

(2) Shock & Vibration

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

T-55465D065J-LW-A-ABN	OPTREX CORPORATION	Page 17/33
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