

LCD Module Technical Specification

First Edition
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Final Revision

Type No. **T-55239GD080J-LW-AJN**

Customer : **OPTREX STANDARD**

Customer's Product No :

OPTREX CORPORATION

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APPROVED

By

Signature :

Date :

Please return this specification within two month with your signature.
If not returned within two month, specification will be considered
as having been accepted.

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Revision History

Rev.	Date	Page	Comment

T-55239GD080J-LW-AJN

OPTREX CORPORATION

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1. Application

This specification applies to TFT-LCD module (T-55239GD080J-LW-AJN).

2. General Specifications

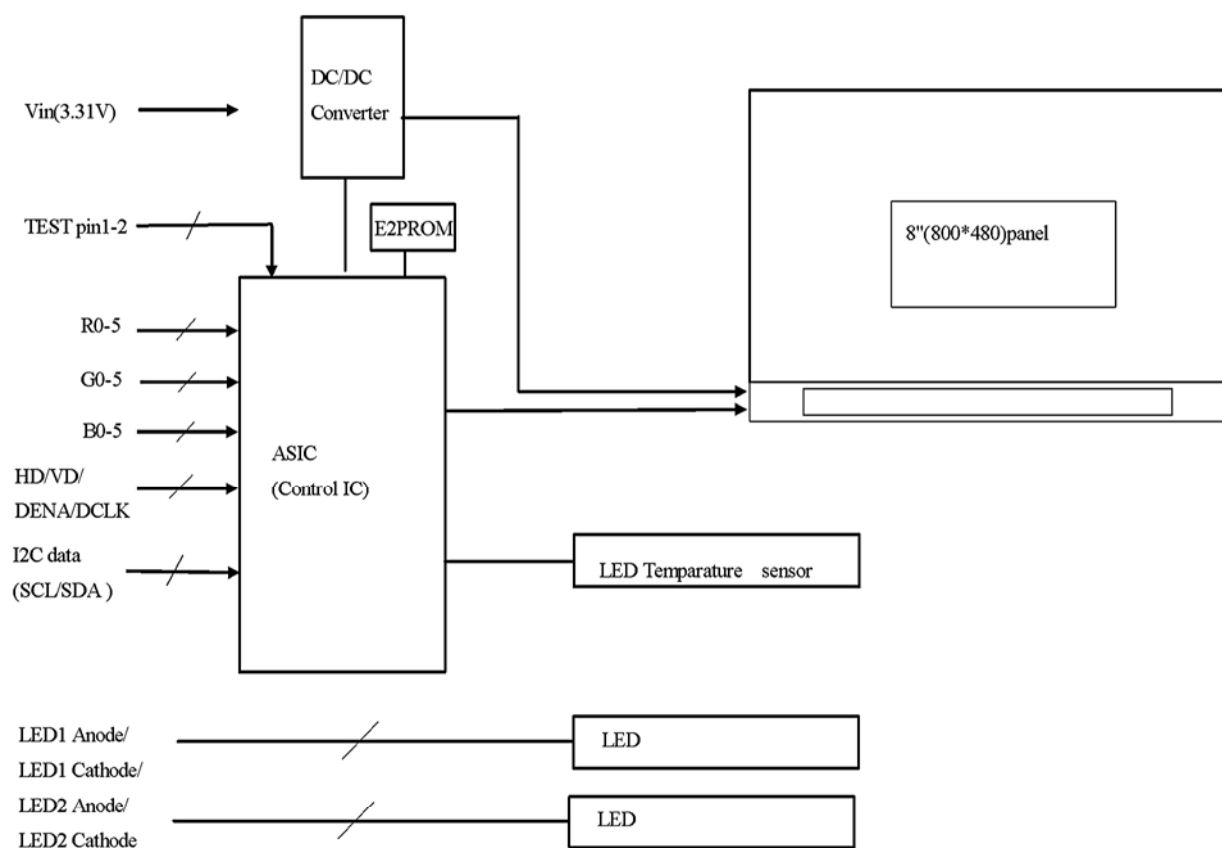
Resolution	: 800 x 3 [R.G.B] (W) x 480 (H) dots
DOT pitch	: 0.2175 x 3 [R.G.B] (W) x 0.2175 (V) mm
Pixel arrangement	: RGB-Stripe
Color depth	: 262,144 colors
Active Viewing Area	: 174.0 (W) x 104.4 (H) mm
Outline dimensions *	: 190.0 (W) x 120.36 (H) x 9.65 (D) mm * Excluding FPC.
Weight	: 460g max.
LCD type	: TFT / Normally white-mode / Transmissive
Viewing angle	: 6:00
Surface Treatment	: AGAR Coating
Interface	: CMOS with I ² C bus
Backlight	: LED Backlight / White LED : 14 chips (2-Chains)
Drawings	: Dimensional Outline T-55579AA base
Lead free	: Our product corresponds to lead free. Lead free is defined as below: 1) The solder used in the LCD module. 2) Electrical components (Terminal section) used in the LCD module. Any lead used within the electrical component does not apply to our module definition of lead free.
RoHS regulation	: To our best knowledge, this product satisfies material requirement of RoHS regulation. Our company is doing the best efforts to obtain the equivalent certificate from our suppliers.

3. Operating Conditions

Item	Conditions	Temperature Range	Remark
Operating Temperature Range	PNL Surface	-20~70°C	Note1
Storage Temperature Range	PNL Surface	-30~80°C	

Note1: Operating temperature range defines the operation only and the contrast, response time and other display optical characteristics are set at Ta=+25°C.

4. Block Diagram



5. I/O Terminal

5.1. CN1 Pin Assignment

No.	Symbol	Functional Description
1	GND	Power Supply (0V, GND)
2	GND	Power Supply (0V, GND)
3	DCLK	Clock signal for sampling catch data signal
4	GND	Power Supply (0V, GND)
5	HD	Horizontal sync signal
6	VD	Vertical sync signal
7	DENA	Data enable signal (to settle the viewing area)
8	GND	Power Supply (0V, GND)
9	R0	Red data signal(LSB)
10	R1	Red data signal
11	R2	Red data signal
12	R3	Red data signal
13	R4	Red data signal
14	R5	Red data signal(MSB)
15	GND	Power Supply (0V, GND)
16	G0	Green data signal(LSB)
17	G1	Green data signal
18	G2	Green data signal
19	G3	Green data signal
20	G4	Green data signal
21	G5	Green data signal(MSB)
22	GND	Power Supply (0V, GND)
23	B0	Blue data signal(LSB)
24	B1	Blue data signal
25	B2	Blue data signal
26	B3	Blue data signal
27	B4	Blue data signal
28	B5	Blue data signal(MSB)
29	GND	Power Supply (0V, GND)
30	3.3V PWR-SUPPLY	Power Supply for Logic
31	3.3V PWR-SUPPLY	Power Supply for Logic
32	GND	Power Supply (0V, GND)
33	SCL	Clock input of the serial interface
34	SDA	Data input of the serial interface

No.	Symbol	Functional Description
35	GND	Power Supply (0V, GND)
36	NC	Non Connection
37	TEST PIN1	Connect to 3.3V Power Supply
38	TEST PIN2	Used by supplier
39	NC	Non Connection
40	NC	Non Connection
41	LED CATHODE-1	LED Cathode Terminal
42	NC	Non Connection
43	NC	Non Connection
44	LED ANODE-1	LED Anode Terminal
45	NC	Non Connection
46	LED ANODE-2	LED Anode Terminal
47	NC	Non Connection
48	NC	Non Connection
49	LED CATHODE-2	LED Cathode Terminal
50	NC	Non Connection

6. Electrical Specifications

6.1. Absolute Maximum Ratings

Ta=-20~70°C, GND=0V

Parameter	Symbol	Conditions	Min.	Max.	Units
Logic power supply	3.3V PWR-SUPPLY (VCC)	-	-0.3	4.0	V

6.2. DC Characteristics

Ta=-20~70°C, GND=0V

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Power Supply Voltage	3.3V PWR-SUPPLY (VCC)	-	3.19	3.31	3.43	V
"High" Level Input Voltage	V _{IH}	-	0.8V _{DDD}	-	V _{CC}	V
"Low" Level Input Voltage	V _{IL}	-	0	-	0.2V _{CC}	V
Operating mode Current	I _{CC}	V _{DDD} -GND=3.3V	-	0.440	0.620	mA

6.3.Timing Specifications

Ta=-20~70°C, GND=0V

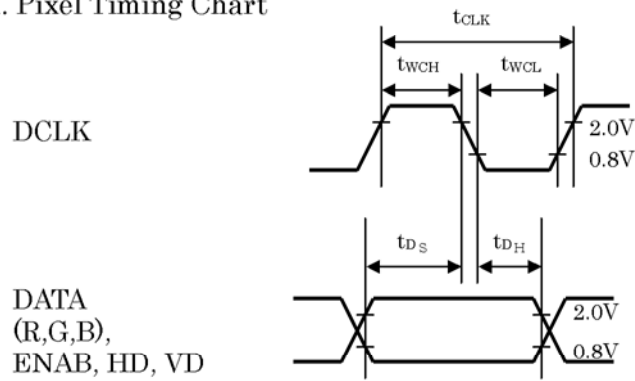
Parameter		Symbol	Min.	Typ.	Max.	Units
DCLK	Frequency	f _{CLK}	19.40	26.20	35.90	MHz
	Period	t _{CLK}	27.86	38.17	51.55	ns
	Low Width	t _{WCL}	8	19	--	ns
	High Width	t _{WCH}	8	19	--	ns
DATA (R,G,B,DENA, HD, VD)	Set up time	t _{DS}	5	--	--	ns
	Hold time	t _{DH}	5	--	--	ns
	Horizontal Front Porch	t _{HFP}	0	--	--	t _{CLK}
	Horizontal Back Porch Hsync-ENAB phase difference	t _{HBP}	10	16	--	t _{CLK}
	Vertical Front Porch	t _{VFP}	2	--	--	t _H
	Vertical Back Porch	t _{VBP}	2	2	--	t _H
HD	Frequency	f _H	24.20	--	44.32	kHz
	Cycle	t _H	22.56	--	41.32	μs
			810	--	1483	
	Low Width	t _{WHL}	5	--	256	t _{CLK}
VD	Frequency	f _V	50.0	59.84	65.0	Hz
	Period	t _V	15.4	16.7	20.0	ms
			484	--	886	
	Low Width	t _{WVL}	1	--	128	t _H
DCLK, CLK, status Time		T _{DNF}	2.0	--	--	μs
		t _{DNB}	2.0	--	--	μs
		T _{DNF}	2.0	--	--	μs
		t _{DNB}	2.0	--	--	μs
Horizontal Active Time		t _{HA}	800	800	800	t _{CLK}
Vertical Active Time		t _{VA}	480	480	480	t _H
Hsync-Vsync phase difference		t _{Vh}	-10	--	10	t _{CLK}

[Note]

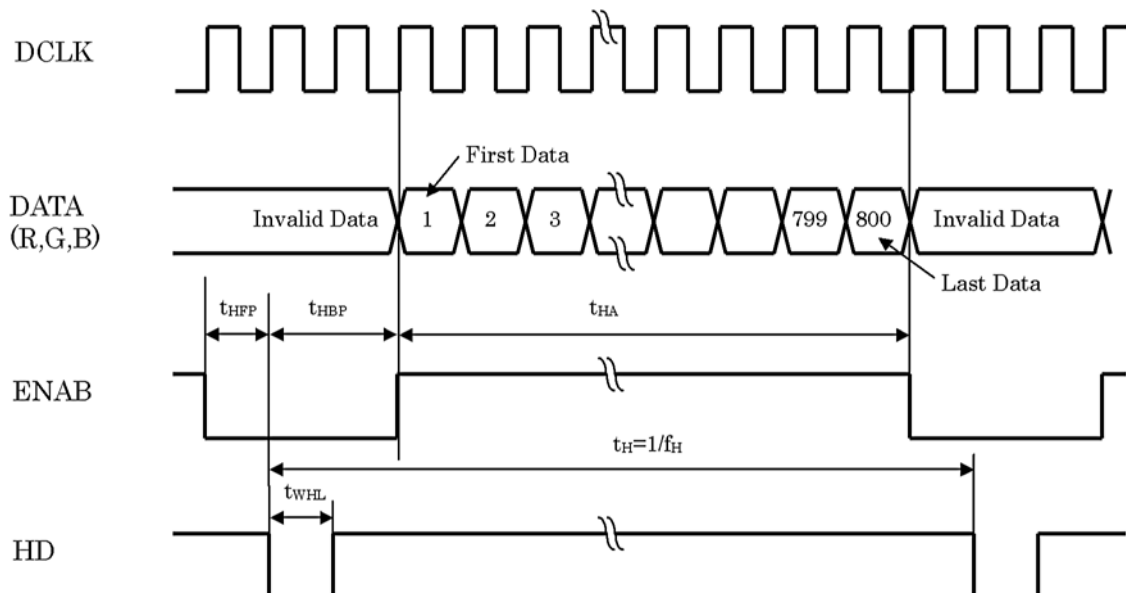
- 1) DATA is latched at fall edge of DCLK in this timing specification.
- 2) Polarities of HD and VD are negative in this specification.
- 3) DENA (Data Enable) should always be positive polarity as shown in the timing specification.
- 4) DCLK should appear during all invalid period, and HD should appear during invalid period of frame cycle.
- 5) REV should be stable during operation.
- 6) Please consider the influence of the filter circuit which is placed in the Signal Input, DCLK and Data Bus, when designing the circuit. AC Characteristic spec is based on ideal signal driving.

6.4. Timing Chart

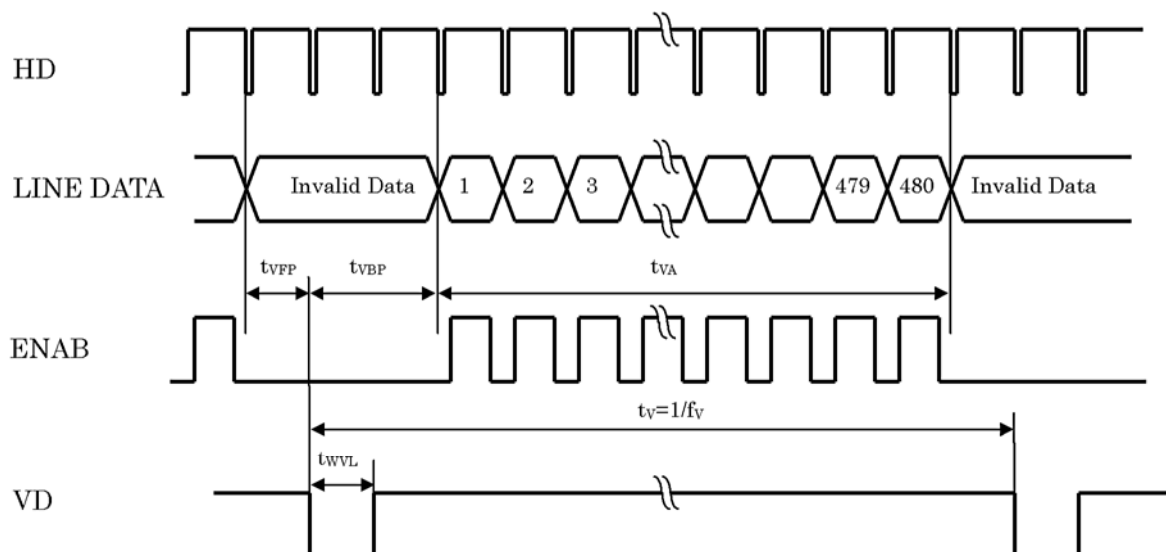
a. Pixel Timing Chart



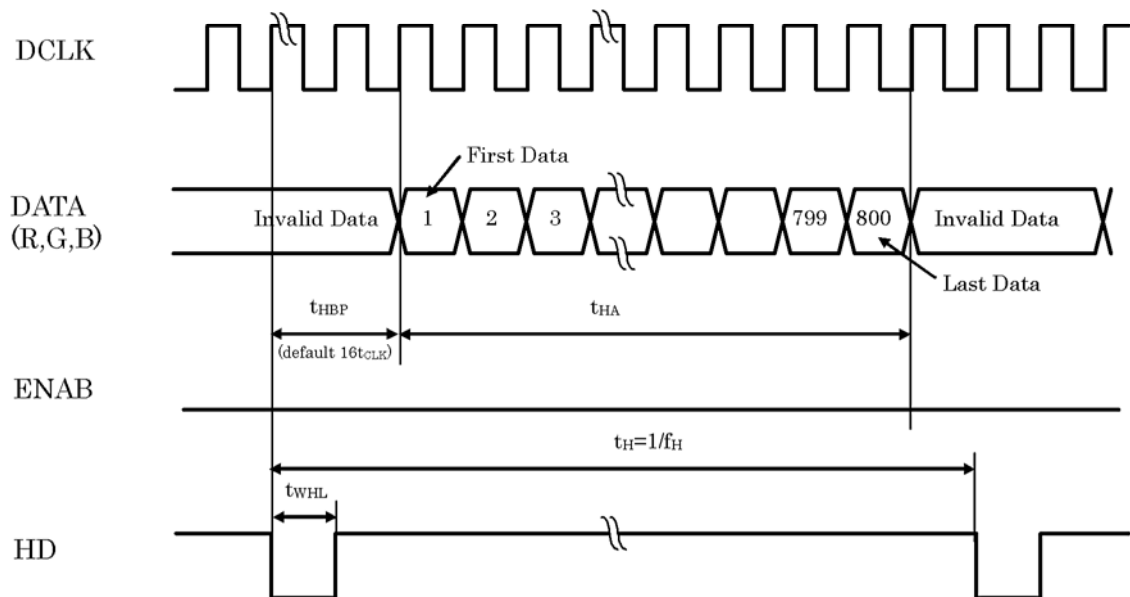
b. Horizontal Timing Chart (Burst Pulse mode)



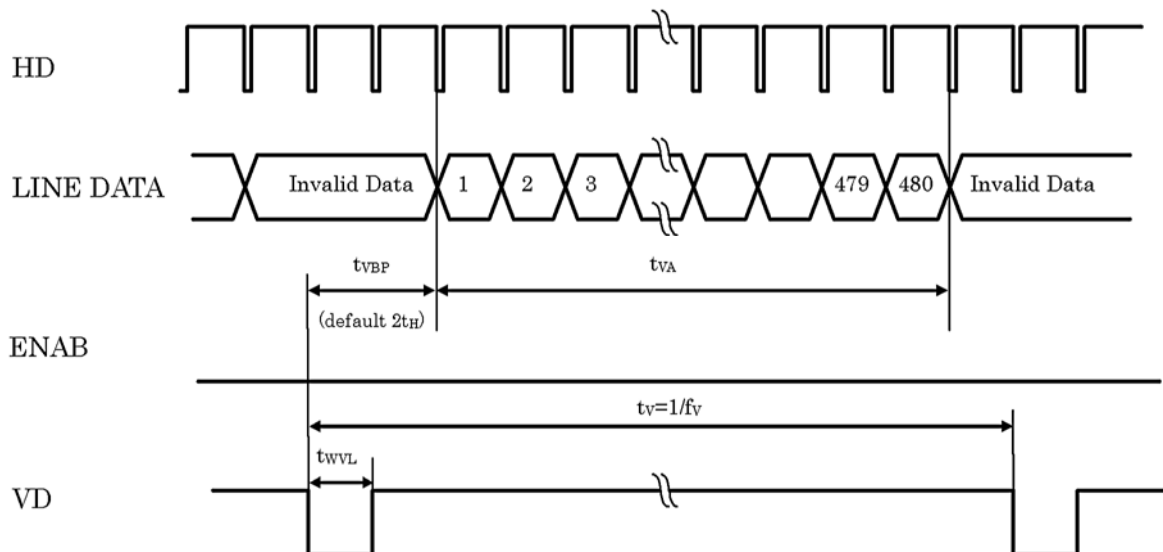
c. Vertical Timing Chart (Burst Pulse mode)



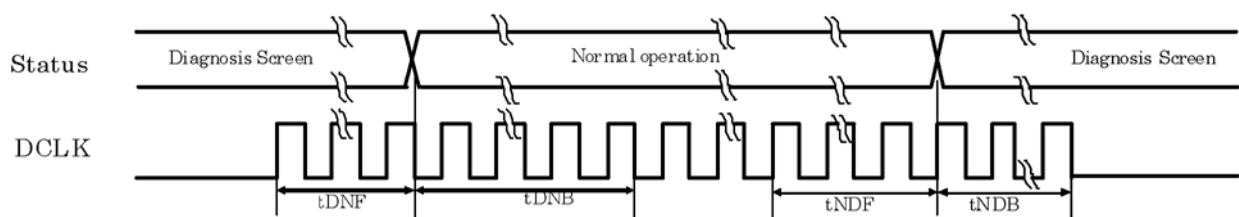
d. Horizontal Timing Chart (Active low mode)
(No DENA mode)



e. Vertical Timing Chart (Active low mode)
(No DENA mode)

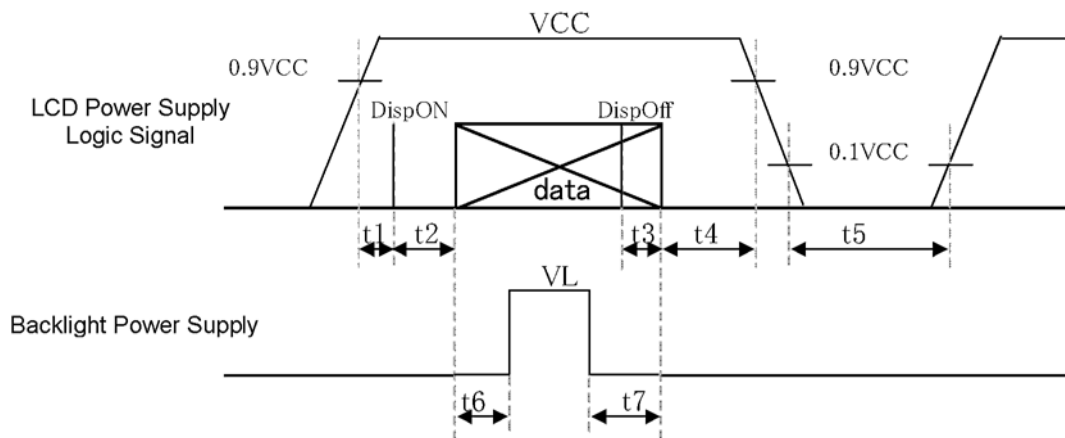


f. DCLK, Data Timing Chart



6.5. Power and signals sequence

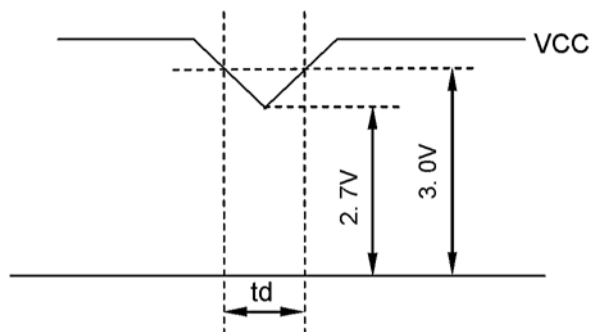
$20\text{ms} \leq t_1$, $0 < t_2 \leq 2\text{ms}$, $0 < t_3 \leq 2\text{ms}$, $0 < t_4 \leq 1000\text{ms}$, $1000\text{ms} \leq t_5$, $200\text{ms} \leq t_6$, $0 \leq t_7$



VCC dip conditions:

- 1) When $2.7\text{V} \leq \text{VCC} < 3.0\text{V}$, $t_d \leq 10\text{ ms}$
- 2) When $\text{VCC} < 2.7\text{ V}$

VCC conditions should also follow the power and signals OFF sequence.



6.6.Color Data Assignment

COLOR	INPUT DATA	R DATA						G DATA						B DATA					
		MSB			LSB			MSB			LSB			MSB			LSB		
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
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 (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	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 (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	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 (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	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.

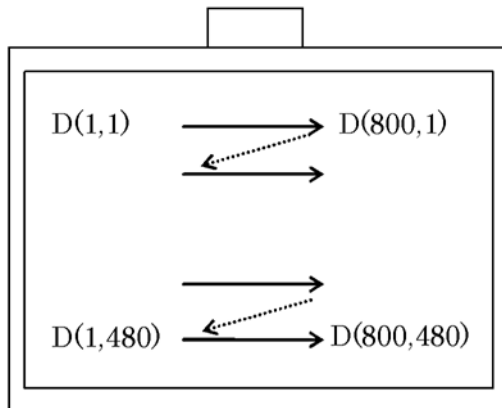
Higher n means brighter level.

2) Data 1:High, 0: Low

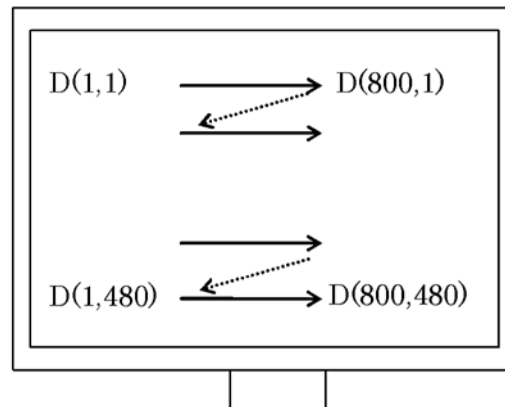
6.7.Display Position and Scan Direction

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

[SCAN Direction: active "1"]



[SCAN: Direction : active "0"]



6.8.1.I²C Command List

Slot Address	IC	Raw Command Address	MSB	DATA	LSB	Description	Group	Mode	ASST Config 2
11 00711	AS32	0001 0000	10h	*	*	Display On/Off	System	active 1 - Display on, active 0 - Display off	ASST Config 2
11 00711	AS30	0001 0001	11h	*	*	SCAN Direction	System	active 1 - top-to-bottom, active 0 - reverse	ASST Config 2
11 00711	AS32	0001 0010	12h	*	*	Diagnosis Screen	System	active 1 - on, active 0 - off	ASST Config 2
11 00711	AS30	0001 0100	14h	*	*	Type change	No DATA	2-4: NVR 2:255	ASST Config 2
11 00711	AS32	0001 0101	15h	*	*	Profile change	No DATA	10-2: NVR 2:255	ASST Config 2
11 00711	AS32	0000 0000	20h	*	*	FFD On/Off	FFD	active 1 - on, active 0 - off	ASST Config 2
11 00711	AS30	0011 0000	30h	*	*	Background color/Temp	Diagnostic	Data 4bit	ASST Config 2
11 00711	AS30	0031 0001	31h	*	*	Background color/Temp	Diagnostic	Data 4bit	ASST Config 2
11 00711	AS32	0021 0010	32h	*	*	Background color/Temp	Diagnostic	Data 4bit	ASST Config 2
11 00711	AS30	0010 0001	20h	*	*	Screen Select	Gameplay	10 - 7: no (for smooth curve), 0 - 7: yes (2.0 forward curve)	ASST Config 2
11 00711	AS30	0000 0000	42h	00h	*	LED Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	43h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	44h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	45h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	46h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	47h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	48h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	49h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	50h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	51h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	52h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	53h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	54h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	55h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	56h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	57h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	58h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	59h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	60h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	61h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	62h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	63h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	64h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	65h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	66h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	67h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	68h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	69h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	70h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	71h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	72h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	73h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	74h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	75h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	76h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	77h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	78h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	79h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	80h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	81h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	82h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	83h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	84h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	85h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	86h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	87h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	88h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	89h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	90h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	91h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	92h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	93h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	94h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	95h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	96h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	97h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	98h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	99h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2
11 00711	AS32	0000 0000	100h	00h	*	Light/Temp. Screen	Gameplay	Data 10bit	ASST Config 2

[illegible]

Table 1. Diagnosis table

IPG/SP/SD3 Command data	DCU/MDAD/Relab	DATA	CS (K6184e3)	Diagnose
00000000	00h	should be input	ignore	Normal Screen
00000001	01h	ignore	should be input	Diagnosis Screen
00000002	02h			
00000003	03h			
00000004	04h			
00000005	05h			
00000006	06h			
00000007	07h			
00000008	08h			
00000009	09h			
0000000A	0Ah			
0000000B	0Bh			
0000000C	0Ch			
0000000D	0Dh			
0000000E	0Eh			
0000000F	0Fh			

Table2. Gamma table

MSB						LSB	status
*	*	*	*	*	*	0	should not be used
*	*	*	*	*	*	0	parameter1 ($\gamma=2.8$)
*	*	*	*	*	*	1	parameter2 ($\gamma=2.2$)
*	*	*	*	*	*	1	should not be used

TABLE3 Active Command Pattern

[illegible]

6.8.2. I²C Read/Write Access Control

Write Access(Display On/Off, SCAN Direction, Diagnosis Screens, FFD On/Off, Gamma Select)^{*)}

START	Slave Address from Master	W	ACK	Command Address from Master	ACK	Data from Master	ACK	STOP
-------	------------------------------	---	-----	--------------------------------	-----	---------------------	-----	------

Read Access(Temp/Brightness/Current)^{*)}

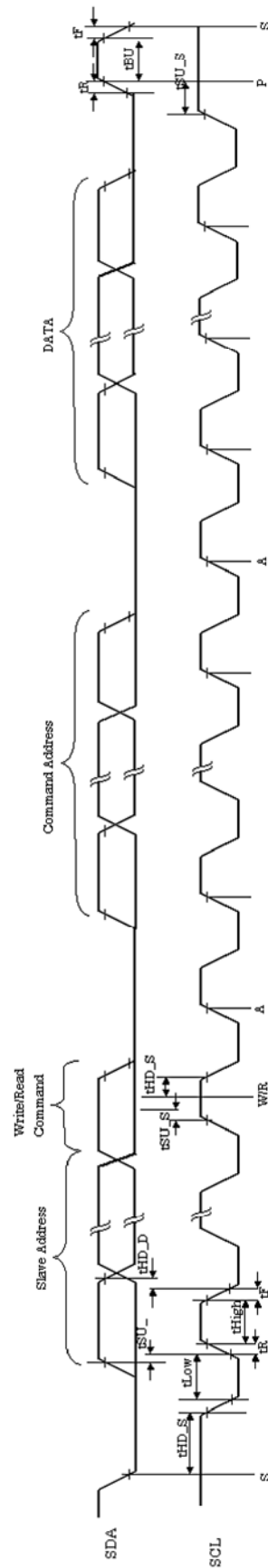
START	Slave Address from Master	W	ACK	Command Address from Master	ACK	Repeat START	Slave Address from Master	IR	ACK	DATA(8bit) from Slave	ACK	DATA(2bit) from Slave	ACK	STOP
-------	------------------------------	---	-----	--------------------------------	-----	-----------------	------------------------------	----	-----	--------------------------	-----	--------------------------	-----	------

Read Access(Display On/Off, SCAN Direction, Diagnosis Screens, FFD On/Off, Gamma Select)^{*)}

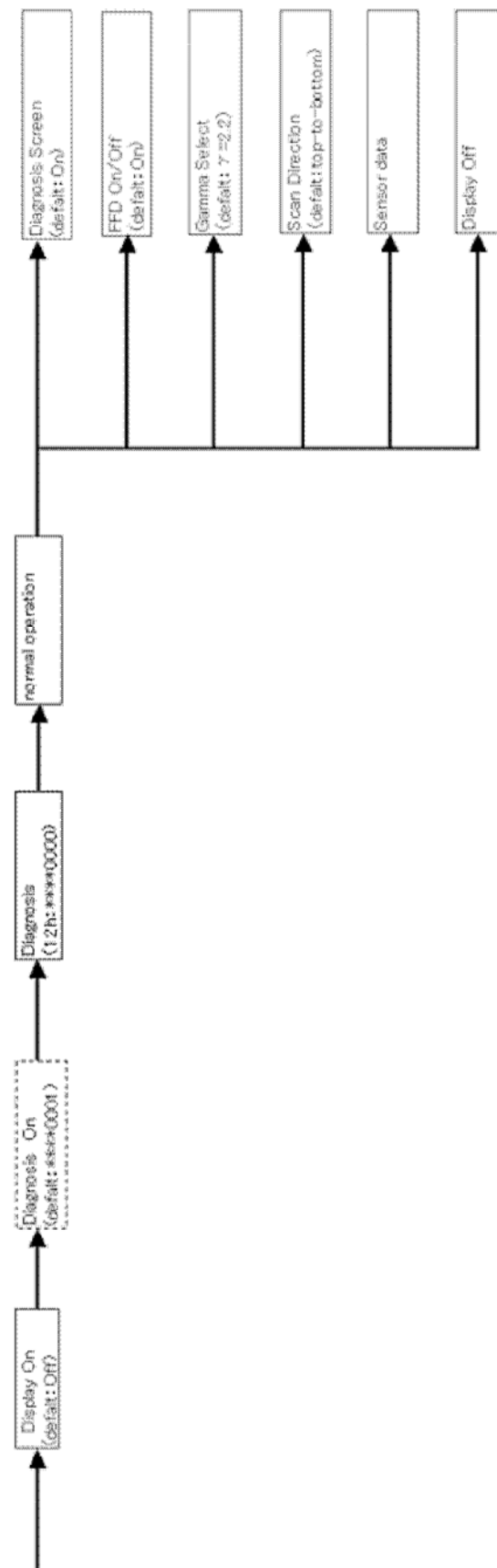
START	Slave Address from Master	W	ACK	Command Address from Master	ACK	Repeat START	Slave Address from Master	R	ACK	DATA(8bit) from Slave	ACK	STOP
-------	------------------------------	---	-----	--------------------------------	-----	-----------------	------------------------------	---	-----	--------------------------	-----	------

※ The sequential read/write is not available for I²C.^{*)}

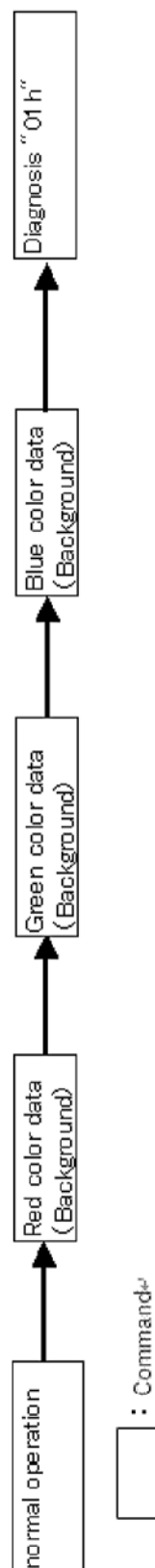
6.8.3. I²C Timing Chart



6.8.4.I²C Command Flow



6.8.5.I²C Diagnosis screen command flow



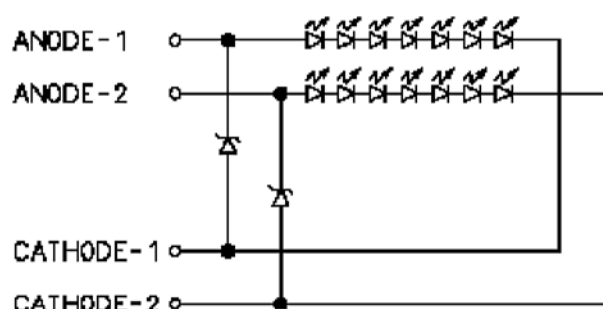
6.9. Lighting Specifications

6.9.1. Absolute Maximum Ratings

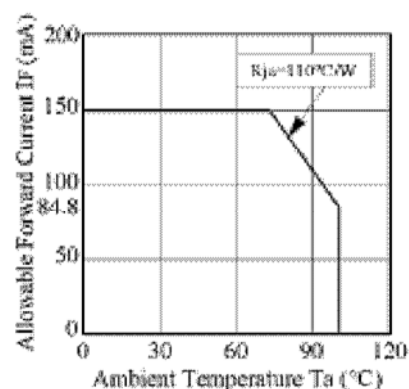
Ta=25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Forward Current	I _F	-	-	-	150	mA
Allowable Reverse Current	I _R	-	-	-	85	mA
LED Power Dissipation	P _D	-	-	-	3.78	W

【LED Circuit】



■ Ambient Temperature vs. Allowable Forward Current



6.9.2. Operating Characteristics

Ta=25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Forward Current	I _F	-	-	80	-	mA
Forward Voltage	V _F	I _F =80mA / 1 line	-	22.4	-	V
Power	P _L	1 line	-	1.8	-	W
Lifetime		Note1	-	(50000)	-	hour

Note1: The "Lifetime" is defined as: a decline of brightness to 50% of initial brightness (500cd/m²) under continual Ta=25°C.

7. Optical Specifications

7.1. Optical Characteristic

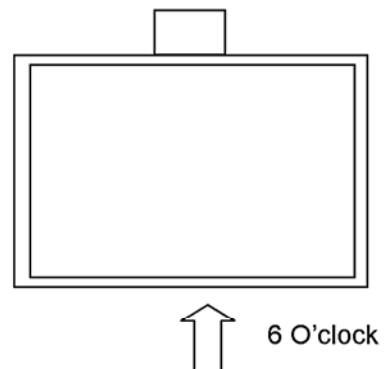
Item		Symbol	Conditions			Standard Value			Unit	Method of Measure	Remark
			θ	ϕ	C	Min.	Typ.	Max.			
(1)Brightness		B	0°	0°		-	500		Cd/m ²	(Fig.1)	Note1
(2)Contrast		CR	Optimum Viewing Angle			TBD	TBD	-	-		
(3)Color Coordinates	Red	Rx	0°	0°		-	0.63	-	-		
		Ry	0°	0°		-	0.31	-	-		
	Green	Gx	0°	0°		-	0.32	-	-		
		Gy	0°	0°		-	0.63	-	-		
	Blue	Bx	0°	0°		-	0.15	-	-		
		By	0°	0°		-	0.11	-	-		
	White	Wx	0°	0°		-	0.28	-	-		
		Wy	0°	0°		-	0.32	-	-		
	Black	BKx	0°	0°			0.23				
		BKy	0°	0°			0.22				
(4)Brightness Uniformity		-	0°	0°		-	-	1.3	-	(Fig.2)	
(5)Vertical Viewing Angle	Up	θ_U	-	0°	≥10	-	TBD	-	Degree	(Fig.3)	
	Down	θ_D	-	0°	≥10	-	TBD	-	Degree		
(6)Horizontal Viewing Angle	Left	ϕ_L	0°	-	≥10	-	TBD	-	Degree		
	Right	ϕ_R	0°	-	≥10	-	TBD	-	Degree		
(7)Response Time	Rise	τ_r	0°	0°		-	TBD	-	ms	(Fig.4)	
	Decay	τ_d	0°	0°		-	TBD	-	ms		
(8)Haze		H				-	9	-	%		

Note1: Under the condition of maximum brightness.

◆ Conditions for Measuring

- ◇ Environment: Dark room with no light or close to no light.
- ◇ Temperature: 25±5°C
- ◇ Humidity: 40~70%RH

◆ Optimal viewing angle (The angle with best contrast): 6:00



◆ Method of Brightness Measurement (Fig.1)

(1) Measuring Device

TOPCON BM-5, Measuring Field: 1°

(2) Measuring Point

Center of Display $\theta=0^\circ, \phi=0^\circ$

On condition θ : A vertical angle from measuring direction to perpendicular.

ϕ : A horizontal angle from measuring direction to perpendicular.

(3) Method of Measuring

Apply signal voltage (displayed in white) to maximize brightness and measure brightness B (cd/m^2).

The distance between BM-5's front lens to surface panel is 500mm.

Measured after backlight has been lit for more than 30 minutes.

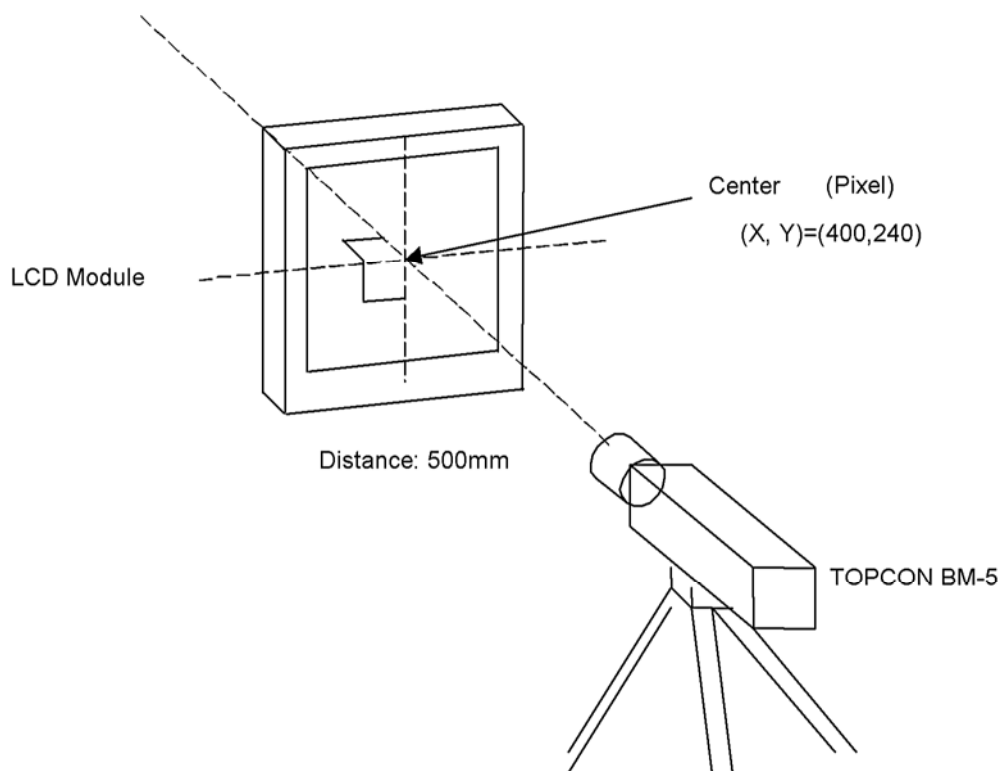


Fig. 1

◆ Method of Contrast Measurement (Fig.1)

- (1) Measuring Device
TOPCON BM-5, Measuring Field: 1°
- (2) Measuring Point
Center of display: same as Method of Brightness Measurement
- (3) Method of Measuring
 - Set LCD module to $\theta=0^\circ$, $\phi=0^\circ$.
 - Change signal voltage to measure maximum brightness Y1 and minimum brightness Y2.
 - Contrast is derived from $CR=Y1/Y2$.

◆ Definition of Brightness Uniformity (Fig.2)

Definition is calculated from the 5 points (S0-S4) on the diagram below.

$$\text{Standard value of Brightness Uniformity} = \frac{S0 \sim S4 \text{ MAX}}{S0 \sim S4 \text{ MIN}}$$

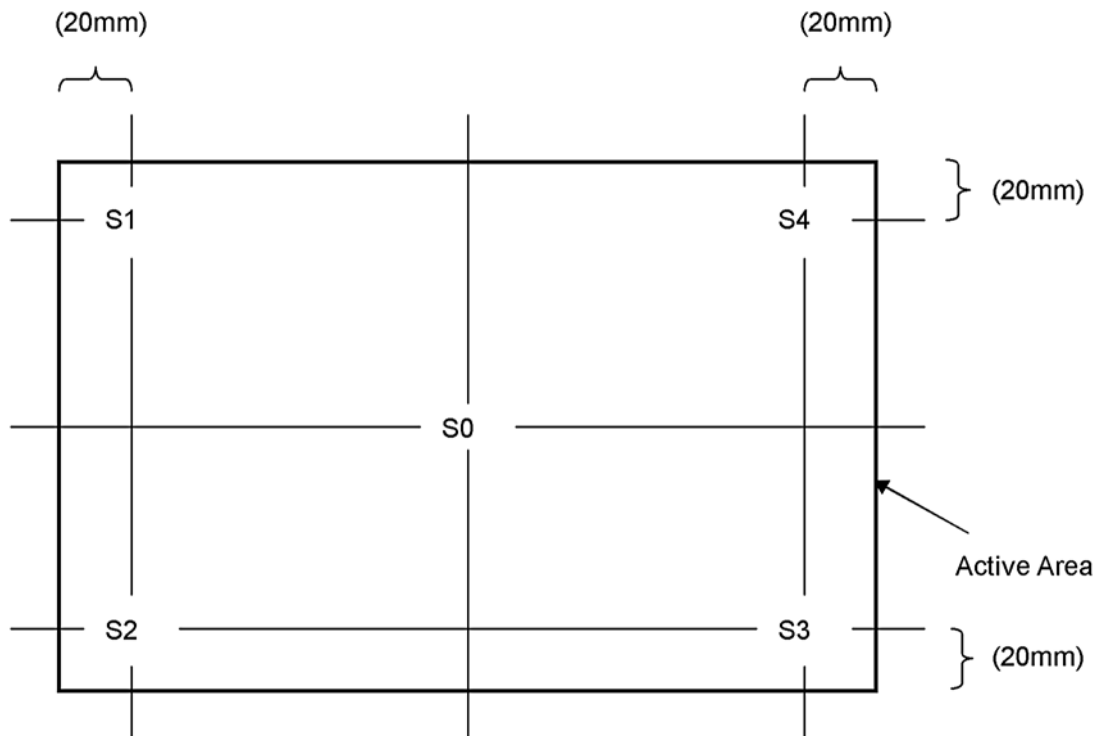


Fig. 2

◆ Method of Viewing Angle Measurement (Fig.3)

(1) Measuring Device

TOPCON BM-5, Measuring Field: 1°

ELDIM: EZ CONTRAST

(2) Measuring Point

Center of display: Same as Method of Brightness Measurement

(3) Angle of Measuring

θ : An angle vertical to perpendicular line from the viewing direction.

ϕ : An angle horizontal to perpendicular from the viewing direction.

(4) Method of Measuring

Set the module on the rotation table and measure a vertical axis direction in the state that fixed $\phi = 0$ degrees horizontal axis direction to $\theta = 90$ degrees.

(Viewing angle is measured automatically by EZ CONTRAST).

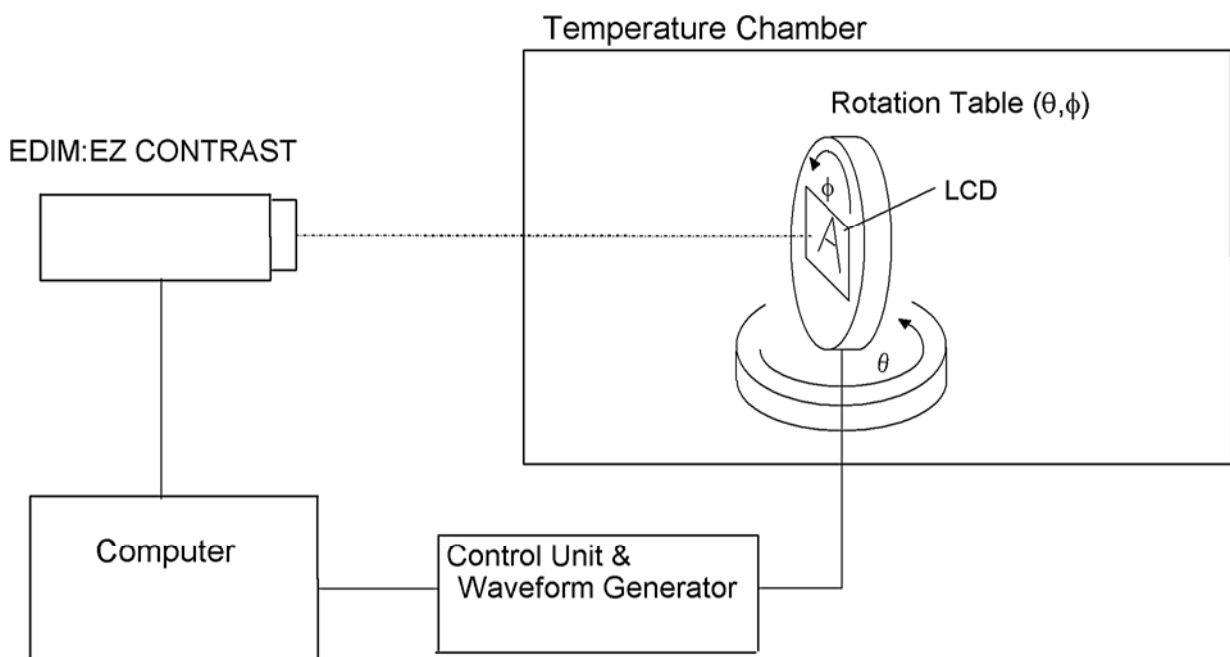


Fig. 3

◆ Measuring Response Time (Fig.4)

(1) Measuring Device

TOPCON BM-5 , Measuring Field: 1°

Tektronix Digital Oscilloscope

(2) Measuring Point

Center of display, same as Method of Brightness Measurement

(3) Method of Measuring

- Set LCD panel to $\theta=0^\circ$, and $\phi=0^\circ$.
- Input white→black→white to display by switching signal voltage.
- If the luminance is 0% and 100% immediately before the change of signal voltage, then τ_r is optical response time during the change from 90% to 10% immediately after rise of signal voltage, and τ_d is optical response time during the change from 10% to 90% immediately after decay of signal voltage.

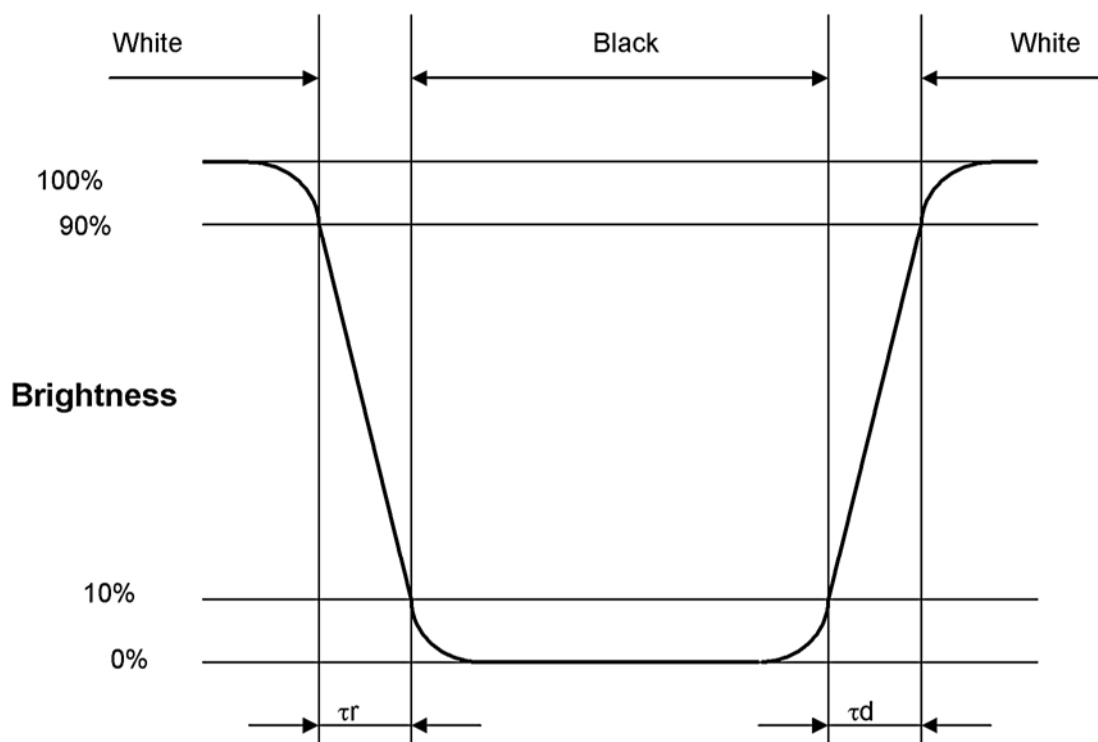


Fig. 4

8. Test

No abnormal function and appearance are found after the following tests.

Conditions: Unless otherwise specified, tests will be conducted under the following condition.

Temperature: $20\pm5^{\circ}\text{C}$

Humidity : $65\pm5\%\text{RH}$

tests will be not conducted under functioning state.

No.	Parameter	Conditions	Notes
1	High Temperature Operating	$70^{\circ}\text{C}\pm2^{\circ}\text{C}$, 96hrs (operation state)	
2	Low Temperature Operating	$-20^{\circ}\text{C}\pm2^{\circ}\text{C}$, 96hrs (operation state)	1
3	High Temperature Storage	$80^{\circ}\text{C}\pm2^{\circ}\text{C}$, 96hrs	2
4	Low Temperature Storage	$-30^{\circ}\text{C}\pm2^{\circ}\text{C}$, 96hrs	1,2
5	Damp Proof Test	$40^{\circ}\text{C}\pm2^{\circ}\text{C}$, 90~95%RH, 96hrs	1,2
6	Vibration Test	Total fixed amplitude : 1.5mm Vibration Frequency : 10~55Hz One cycle 60 seconds to 3 directions of X, Y, Z for each 15 minutes	3
7	Shock Test	To be measured after dropping from 60cm high on the concrete surface in packing state. Dropping method corner dropping A corner : once Edge dropping B,C,D edge : once Face dropping E,F,G face : once	

Note 1: No dew condensation to be observed.

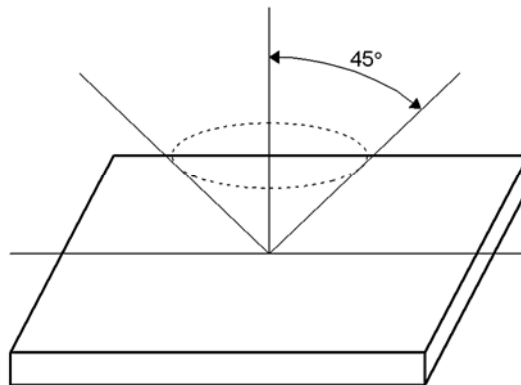
Note 2: The function test shall be conducted after 4 hours storage at the normal Temperature and humidity after removed from the test chamber.

Note 3: Vibration test will be conducted to the product itself without putting it in a container.

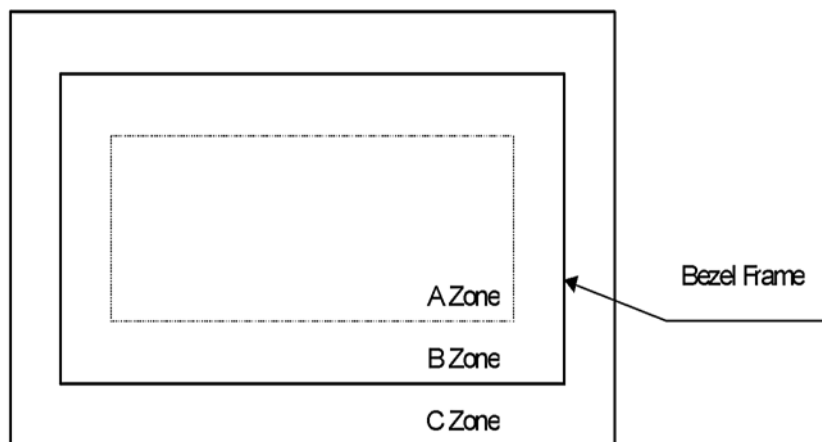
9. Appearance Standards

9.1. Inspection conditions

The distance between the eyes and the sample shall be more than 30cm.
All directions for inspecting the sample should be within 45° against perpendicular line.



9.2. Definition of applicable Zones



A Zone : Active display area

B Zone : Area from outside of "A Zone" to validity viewing area

C Zone : Rest parts

A Zone + B Zone = Validity viewing area

9.3.Standards

No.	Parameter	Criteria																									
1	Polarizer Scratches	<table><tr><th colspan="2">Zone</th><th colspan="3">Acceptable Number</th></tr><tr><th>X(mm)</th><th>Y(mm)</th><th>A</th><th>B</th><th>C</th></tr><tr><td>L ≤ 15</td><td>0.01<W≤0.05</td><td colspan="2">4</td><td>*</td></tr><tr><td>L > 15</td><td>W > 0.01</td><td colspan="2">0</td><td>*</td></tr><tr><td>-</td><td>W > 0.05</td><td colspan="2">0</td><td>*</td></tr></table> X : Length, Y : Width * : Disregard	Zone		Acceptable Number			X(mm)	Y(mm)	A	B	C	L ≤ 15	0.01<W≤0.05	4		*	L > 15	W > 0.01	0		*	-	W > 0.05	0		*
Zone		Acceptable Number																									
X(mm)	Y(mm)	A	B	C																							
L ≤ 15	0.01<W≤0.05	4		*																							
L > 15	W > 0.01	0		*																							
-	W > 0.05	0		*																							
2	DENT	<table><tr><th colspan="2">Zone</th><th colspan="3">Acceptable Number</th></tr><tr><th>Dimension (mm)</th><th></th><th>A</th><th>B</th><th>C</th></tr><tr><td>0.30 < D ≤ 0.50</td><td></td><td colspan="2">4</td><td>*</td></tr><tr><td>0.50 < D</td><td></td><td colspan="2">0</td><td>*</td></tr></table> Average Diameter(D) = (long+short) / 2 * : Disregard	Zone		Acceptable Number			Dimension (mm)		A	B	C	0.30 < D ≤ 0.50		4		*	0.50 < D		0		*					
Zone		Acceptable Number																									
Dimension (mm)		A	B	C																							
0.30 < D ≤ 0.50		4		*																							
0.50 < D		0		*																							
3	BLACK and WHITE SPOT BUBBLE	<table><tr><th colspan="2">Zone</th><th colspan="3">Acceptable Number</th></tr><tr><th>Dimension (mm)</th><th></th><th>A</th><th>B</th><th>C</th></tr><tr><td>0.30 < D ≤ 0.50</td><td></td><td colspan="2">5</td><td>*</td></tr><tr><td>0.50 < D</td><td></td><td colspan="2">0</td><td>*</td></tr></table>	Zone		Acceptable Number			Dimension (mm)		A	B	C	0.30 < D ≤ 0.50		5		*	0.50 < D		0		*					
Zone		Acceptable Number																									
Dimension (mm)		A	B	C																							
0.30 < D ≤ 0.50		5		*																							
0.50 < D		0		*																							
4	LINT	<table><tr><th colspan="2">Zone</th><th colspan="3">Acceptable Number</th></tr><tr><th>X(mm)</th><th>Y(mm)</th><th>A</th><th>B</th><th>C</th></tr><tr><td>L ≤ 3.0</td><td>W ≤ 0.15</td><td colspan="2">4</td><td>*</td></tr><tr><td>L > 3.0</td><td>W ≤ 0.15</td><td colspan="2">0</td><td></td></tr><tr><td>-</td><td>W > 0.15</td><td colspan="2">According to BLACK SPOT</td><td>*</td></tr></table> X : Length, Y : Width * : Disregard	Zone		Acceptable Number			X(mm)	Y(mm)	A	B	C	L ≤ 3.0	W ≤ 0.15	4		*	L > 3.0	W ≤ 0.15	0			-	W > 0.15	According to BLACK SPOT		*
Zone		Acceptable Number																									
X(mm)	Y(mm)	A	B	C																							
L ≤ 3.0	W ≤ 0.15	4		*																							
L > 3.0	W ≤ 0.15	0																									
-	W > 0.15	According to BLACK SPOT		*																							

No.	Parameter	Criteria																			
5	(a) Bright Dot (b) Dark Dot	<table><tr><th rowspan="2">Zone Dimension (mm)</th><th colspan="3">Acceptable Number</th></tr><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>Bright Dot</td><td colspan="2">7 ($G \leq 3$)</td><td>*</td></tr><tr><td>Dark Dot</td><td colspan="2">7</td><td>*</td></tr><tr><td>TOTAL</td><td colspan="3">10</td></tr></table>	Zone Dimension (mm)	Acceptable Number			A	B	C	Bright Dot	7 ($G \leq 3$)		*	Dark Dot	7		*	TOTAL	10		
Zone Dimension (mm)	Acceptable Number																				
	A	B	C																		
Bright Dot	7 ($G \leq 3$)		*																		
Dark Dot	7		*																		
TOTAL	10																				
6	TWO Adjacent Dot	<table><tr><th rowspan="2">Zone Dimension (mm)</th><th colspan="3">Acceptable Number</th></tr><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>Bright Dot</td><td colspan="2">3 PAIRS</td><td>*</td></tr><tr><td>Dark Dot</td><td colspan="2">3 PAIRS</td><td>*</td></tr></table>	Zone Dimension (mm)	Acceptable Number			A	B	C	Bright Dot	3 PAIRS		*	Dark Dot	3 PAIRS		*				
Zone Dimension (mm)	Acceptable Number																				
	A	B	C																		
Bright Dot	3 PAIRS		*																		
Dark Dot	3 PAIRS		*																		
7	Three or More Adjacent Dot	NOT ALLOWED																			
8	Distance between the dot defects	<table><tr><th rowspan="2">Zone Dimension (mm)</th><th colspan="3">Acceptable Number</th></tr><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>Bright Dot</td><td colspan="2">5 mm</td><td>*</td></tr><tr><td>Dark Dot</td><td colspan="2">5 mm</td><td>*</td></tr></table>	Zone Dimension (mm)	Acceptable Number			A	B	C	Bright Dot	5 mm		*	Dark Dot	5 mm		*				
Zone Dimension (mm)	Acceptable Number																				
	A	B	C																		
Bright Dot	5 mm		*																		
Dark Dot	5 mm		*																		
9	Line Defect	NOT ALLOWED																			

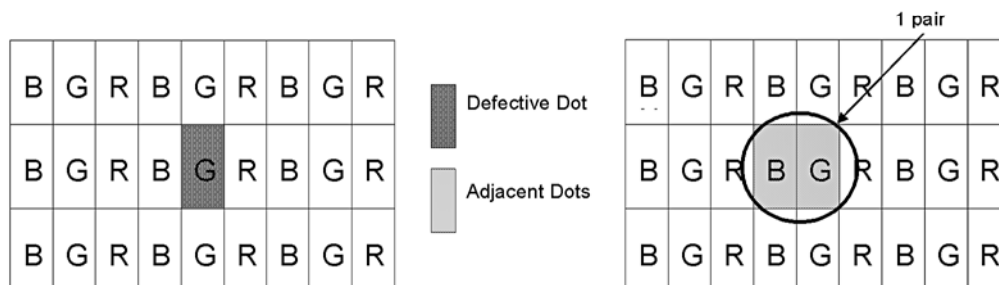
Note 1: Bright Dot is defined as follows:

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

Note 2: Dark Dot is defined as follows:

Recognizable darker than around under the condition that each R(63), G(63), B(63) image is on the display.

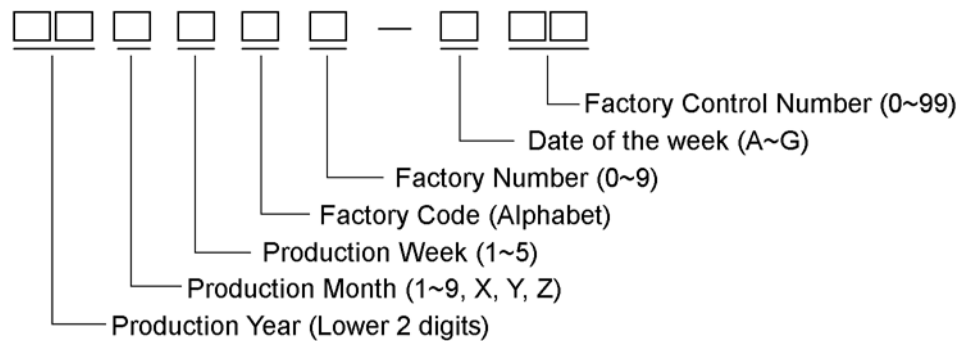
Note 3: Definition of adjacent



The defects that are not defined above and considered to be problem shall be reviewed and discussed by both parties.

10. Code System of Production Lot

The production lot of module is specified as follows.



11. Type Number

The type number of module is specified as follows.

355239AJ

12. Applying Precautions

Please contact us when questions and/or new problems not specified in this Specifications arise.

13. Precautions Relating Product Handling

The Following precautions will guide you in handling our product correctly.

- 1) Liquid crystal display devices
 - (1) The liquid crystal display panel used in the liquid crystal display module is made of plate glass. Avoid any strong mechanical shock. Should the glass break handle it with care.
 - (2) The polarizer adhering to the surface of the LCD is made of a soft material. Guard against scratching it.
- 2) Care of the liquid crystal display module against static electricity discharge.
 - (1) When working with the module, be sure to ground your body and any electrical equipment you may be using. We strongly recommend the use of anti static mats (made of rubber), to protect worktables against the hazards of electrical shock.
 - (2) Avoid the use of work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.
 - (3) Slowly and carefully remove the protective film from the LCD module, since this operation can generate static electricity.
- 3) When the LCD module must be stored for long periods of time:
 - (1) Protect the modules from high temperature and humidity.
Conditions: Temperature: 15°C~25°C, Humidity: Less than 60%RH
No dew condensation to be observed.
 - (2) Keep the modules out of direct sunlight or direct exposure to ultraviolet rays.
 - (3) Protect the modules from excessive external forces.
- 4) Use the module with a power supply that is equipped with an overcurrent protector circuit, since the module is not provided with this protective feature.
- 5) Do not ingest the LCD fluid itself should it leak out of a damaged LCD module. Should hands or clothing come in contact with LCD fluid, wash immediately with soap.
- 6) Conductivity is not guaranteed for models that use metal holders where solder connections between the metal holder and the PCB are not used. Please contact us to discuss appropriate ways to assure conductivity.
- 7) For models which use CFL:
 - (1) High voltage of 1000V or greater is applied to the CFL cable connector area. Care should be taken not to touch connection areas to avoid burns.
 - (2) Protect CFL cables from rubbing against the unit and thus causing the wire jacket to become worn.
 - (3) The use of CFLs for extended periods of time at low temperatures will significantly shorten their service life.
 - (4) After storing the product (or LCD) under low temperature and/or in dark atmosphere for a long period of time, CCFL may take longer time to reach its specified brightness.
- 8) For models which use touch panels:
 - (1) Do not stack up modules since they can be damaged by components on neighboring modules.
 - (2) Do not place heavy objects on top of the product. This could cause glass breakage.
- 9) For models which use COG, TCP, or COF:
 - (1) The mechanical strength of the product is low since the IC chip faces out unprotected from the rear. Be sure to protect the rear of the IC chip from external forces.
 - (2) Given the fact that the rear of the IC chip is left exposed, in order to protect the unit from electrical damage, avoid installation configurations in which the rear of the IC chip runs the risk of making any electrical contact.

- 10) Models which use flexible cable, heat seal, or TCP:
 - (1) In order to maintain reliability, do not touch or hold by the connector area.
 - (2) Avoid any bending, pulling, or other excessive force, which can result in broken connections.
- 11) In case of buffer material such as cushion / gasket is assembled into LCD module, it may have an adverse effect on connecting parts (LCD panel-TCP / HEAT SEAL / FPC / etc., PCB-TCP / HEAT SEAL / FPC etc., TCP-HEAT SEAL, TCP-FPC, HEAT SEAL-FPC, etc.,) depending on its materials. Please check and evaluate these materials carefully before use.
- 12) In case of acrylic plate is attached to front side of LCD panel, cloudiness (very small cracks) can occur on acrylic plate, being influenced by some components generated from polarizer film. Please check and evaluate those acrylic materials carefully before use.
- 13) Flickering due to optical interference may occur by combination of a) LCD driving frame frequency decided by either internal oscillator in driver IC or external clock input by the customer and b) lighting frequency of either backlight or other light sources. Please evaluate enough at the environment of actual use, and decide the driving condition that does not cause flickering.
- 14) Please be advised that do not apply Direct Current (DC) voltage to the LCD. If DC voltage is applied to the LCD, then it may cause poor display quality.

14. Warranty

This product has been manufactured to your company's specifications as a part for use in your company's general electronic products. It is guaranteed to perform according to delivery specifications. For any other use apart from general electronic equipment, we cannot take responsibility if the product is used in medical devices, nuclear power control equipment, aerospace equipment, fire and security systems, or any other applications in which there is a direct risk to human life and where extremely high levels of reliability are required. If the product is to be used in any of the above applications, we will need to enter into a separate product liability agreement.

- 1) We cannot accept responsibility for any defect, which may arise from additional manufacturing of the product (including disassembly and reassembly), after product delivery.
- 2) We cannot accept responsibility for any defect, which may arise after the application of strong external force to the product.
- 3) We cannot accept responsibility for any defect, which may arise due to the application of static electricity after the product has passed your company's acceptance inspection procedures.
- 4) When the product is in CFL models, CFL service life and brightness will vary according to the performance of the inverter used, leaks, etc. We cannot accept responsibility for product performance, reliability, or defect, which may arise.
- 5) We cannot accept responsibility for intellectual property of a third party, which may arise through the application of our product to your assembly with exception to those issues relating directly to the structure or method of manufacturing of our product.
- 6) Optrex will not be held responsible for any quality guarantee issue for defect products judged as Optrex-origin in 2 (two) years from Optrex production or 1(one) year from Optrex Group delivery which ever is shorter.