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		PAGE 21Pages
	SPECIFICATION	REPRENTATIVE DIVISION ENGINEERING DEPARTMENT 1 DUTY LCD DEVELOPMENT CENTER DUTY LIQUID CRYSTAL DISPLAY GROUP

DEVICE SPECIFICATION for
Passive Matrix LCD Module

Model No.

LM057QC1T01

☐CUSTOMER'S USE ONLY

DATE _____

BY _____

PRESENTED

BY _____

M.Ise
DEPARTMENT GENERAL MANAGER
ENGINEERING DEPARTMENT 1
DUTY LCD DEVELOPMENT CENTER
DUTY LIQUID CRYSTAL DISPLAYGROUP
SHARP CORPORATION

○Contents

1. Application

This data sheet is to introduce the specification of LM057QC1T01,negative Matrix type Color LCD module.

2. Construction and Outline

Construction: 320×RGB×240 dots color display module consisting of the LCD panel, PWB(printed wiring board) with electronic components mounted, TCP(tape carrier package) to connect the LCD panel and PWB electrically, plastic chassis with CCFT back light and bezel to hold them mechanically. Signal ground(Vss) is connected to the metal bezel.

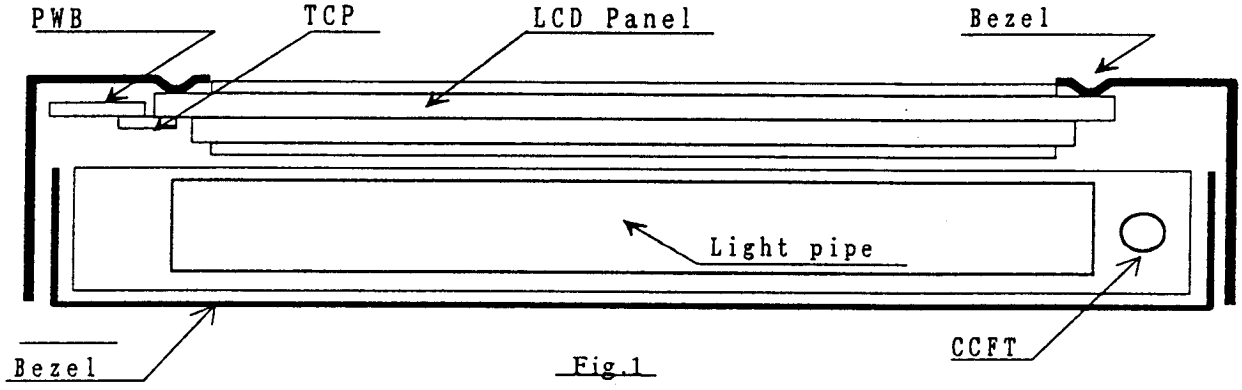


Fig.1

Outline :See Fig. 13

Connection :See Fig. 13 and Table 6

Application inspection standard

The LCD module shall meet the following inspection standard : ~~S-U-014~~ S-U-055-02 △1

3. Mechanical Specification

Table 1

Parameter	Specifications	Unit
Outline dimensions *1	154.6±0.5(W)×114.8±0.5(H)×8.3±0.5(D)	mm
Viewing area	118.2(W)×89.4(H)	mm
Active area	115.18(W)×86.38(H)	mm
Display format	320×RGB(W)×240(H)	
Dot size	0.1×RGB(W)×0.34(H)	mm
Dot spacing	0.02	mm
Base color *2	Normally black	-
Mass	Approx. 200	g

*1 Due to the characteristics of the LC material, display colors may vary with ambient temperature.

*2 Negative-type display

Display data "H" → Display ON = white

Display data "L" → Display OFF = black

4. Absolute Maximum Ratings

4-1.Electrical absolute maximum ratings

Table 2

Parameter	Symbol	MIN.	MAX.	Unit	Remark
Supply voltage(Logic)	V_{DD}-V_{SS}	0	6.0	V	Ta=25 ℃
Input voltage	V_{IN}	-0.3	V_{DD}	V	Ta=25 ℃
Supply voltage (LCD)	V_{EE}-V_{SS}	0	32	V	Ta=25 ℃

4-2.Environment Conditions

Ambient temperature , humidity conditions

Table 3

Item	Topr		Tstg		Remark
	MIN.	MAX.	MIN.	MAX.	
Ambient temperature	0 ℃	+50 ℃	-25 ℃	+60℃	Note 1)
Humidity	Note 2)				No condensation

Note 1) The display module should not be operated nor stored outside of specified temperature range.

Note 2) Ta≦40 ℃.....95 % RH Max.

Ta＞40 ℃.....Absolute humidity shall be less than Ta=40 ℃/95 % RH.

Vibration conditions

Table 4

Frequency	10 Hz～57 Hz	57 Hz～500 Hz
Vibration level	-	9.8 m/s^2
Vibration width	0.075 mm	-
Interval	10 Hz～500 Hz～10 Hz/11.0 min	

2 hours for each direction of X/Y/Z (6 hours as total)

Shock conditions

Acceleration : 490 m/s^2

Pulse width : 11 ms

3 times for each directions of ±X/±Y/±Z

5. Electrical Specifications

5-1.Electrical characteristics

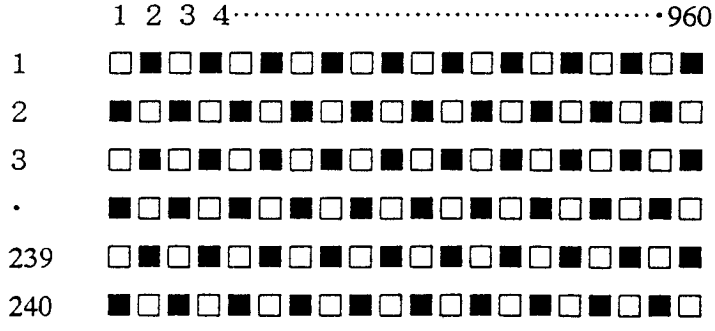
Table 5-1

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Supply voltage (Logic)	V_{DD}-V_{SS}	Ta = 0~50 ℃		4.75	5.0	5.25	V
Supply voltage (LCD) Note 1)	V_{EE}-V_{SS}	Ta = 0 ℃		-	26.8	28.7	V
		Ta = 25 ℃			26.1		
		Ta = 50 ℃		23.7	25.5		
Input signal voltage	V_{IH}	"H" level	Ta = 0~5	0.8V_{DD}	-	V_{DD}	V
	V_{IL}	"L" level	0℃	0	-	0.2V_{DD}	V
Supply current	I_{DD}	Ta =25 ℃(Note 2)		-	3.0	4.5	mA
	I_{EE}			-	8.0	12	mA
Power consumption	Pd	Ta =25 ℃(Note 2,3)		-	223	335	mW

Note 1) Frame frequency = 75 Hz.

Note 2) Frame frequency = 75 Hz, V_{EE} - Vss = 26.1V, V_{DD} = 5 V

Display pattern = checker flag pattern



Note 3) Except Lamp power consumption. (*See Page 12)

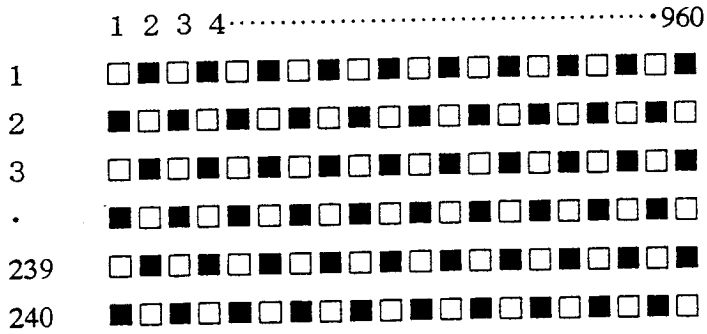
Table 5-2

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Supply voltage (Logic)	V_{DD}-V_{SS}	Ta = 0~50 ℃		3.125	3.3	3.465	V
Supply voltage (LCD) Note 1)	V_{EE}-V_{SS}	Ta = 0 ℃		-	26.8	28.7	V
		Ta = 25 ℃			26.1		
		Ta = 50 ℃		23.7	25.5		
Input signal voltage	V_{IH}	"H" level	Ta = 0~50℃	0.8V_{DD}	-	V_{DD}	V
	V_{IL}	"L" level		0	-	0.2V_{DD}	V
Supply current	I_{DD}	Ta =25 ℃(Note 2)		-	1.5	2.5	mA
	I_{EE}			-	8.0	12	mA
Power consumption	Pd	Ta =25 ℃(Note 2,3)		-	215	320	mW

Note 1) Frame frequency = 75 Hz.

Note 2) Frame frequency = 75 Hz, V_{EE} - Vss = 26.1V, V_{DD} = 3.3V

Display pattern = checker flag pattern



Note 3) Except Lamp power consumption. (*See Page 12)

5-2 Interface signals

○ LCD

Table 6 CN1 (LCD)

No.	Symbol	Description	Note
1	YD	scan start-up signal	"H"
2	LP	input latch signal	"H" → "L"
3	XCK	data input clock signal	"H" → "L"
4	DISP	display control signal	"H" display on , "L" display off
5	VDD	power supply for logic	
6	VSS	Ground potential	
7	VEE	power supply for LCD	
8	D7	Display data signal	"H" (ON) , "L"(OFF)
9	D6		
10	D5		
11	D4		
12	D3		
13	D2		
14	D1		
15	D0		

○ CCFT

Table 7 CN2 (CCFT)

No.	Symbol	Description	Note
1	VL1(HV)	High voltage line(from Inverter)	for back light
2	NC		
3	VL2(GND)	Ground line(from Inverter)	

Connectors used:

CN1 : 53216-1510 (MOLEX)

CN2 : BHR-03VS-1 (JST)

Mating connectors:

CN1 : 51021-1500 (MOLEX)

CN2 : SM02-(8.0)B-BHS-1 (JST)

(Display functions and reliabilities are not guaranteed for the usage of unspecified mating connectors.)

5-3.Interface timing

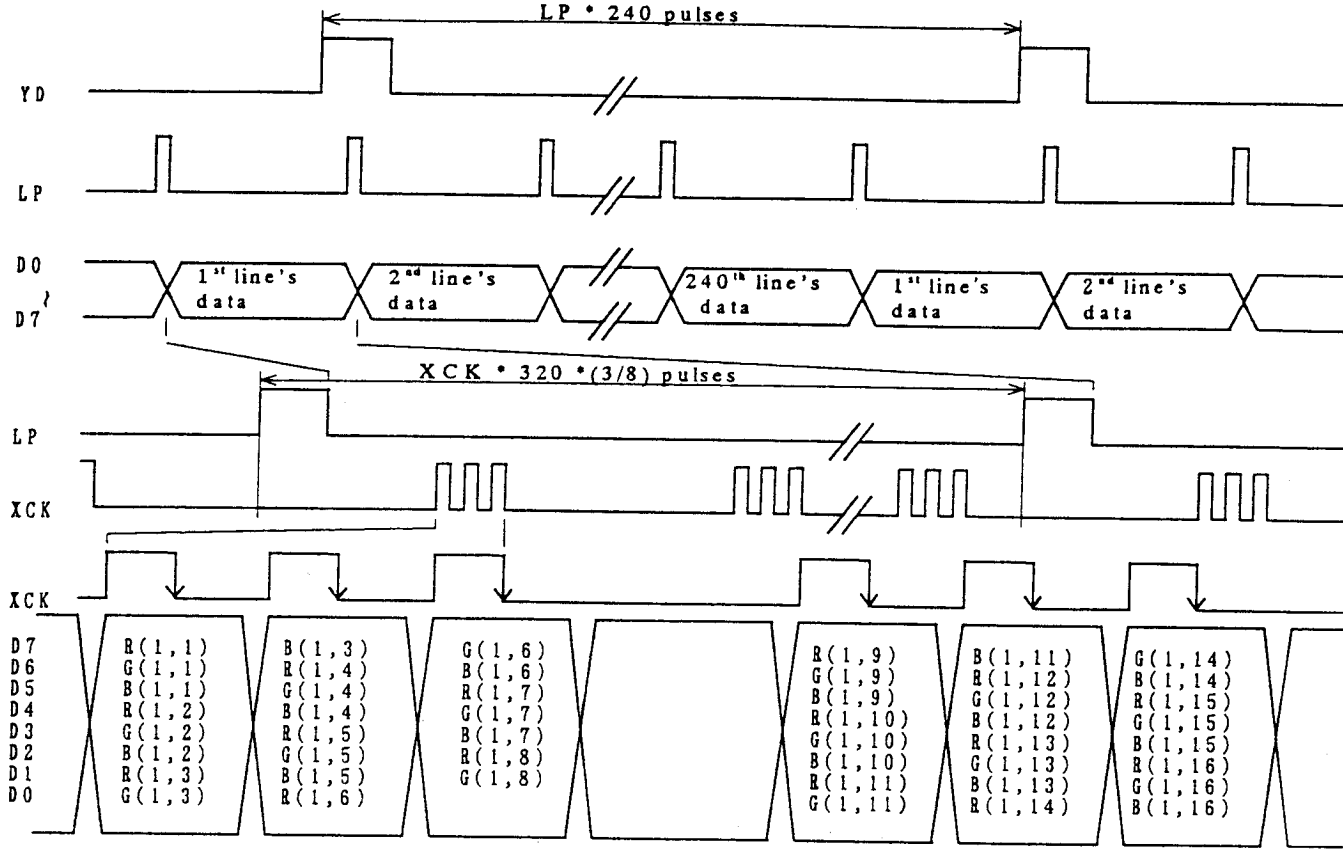


Fig.2 Interface timing

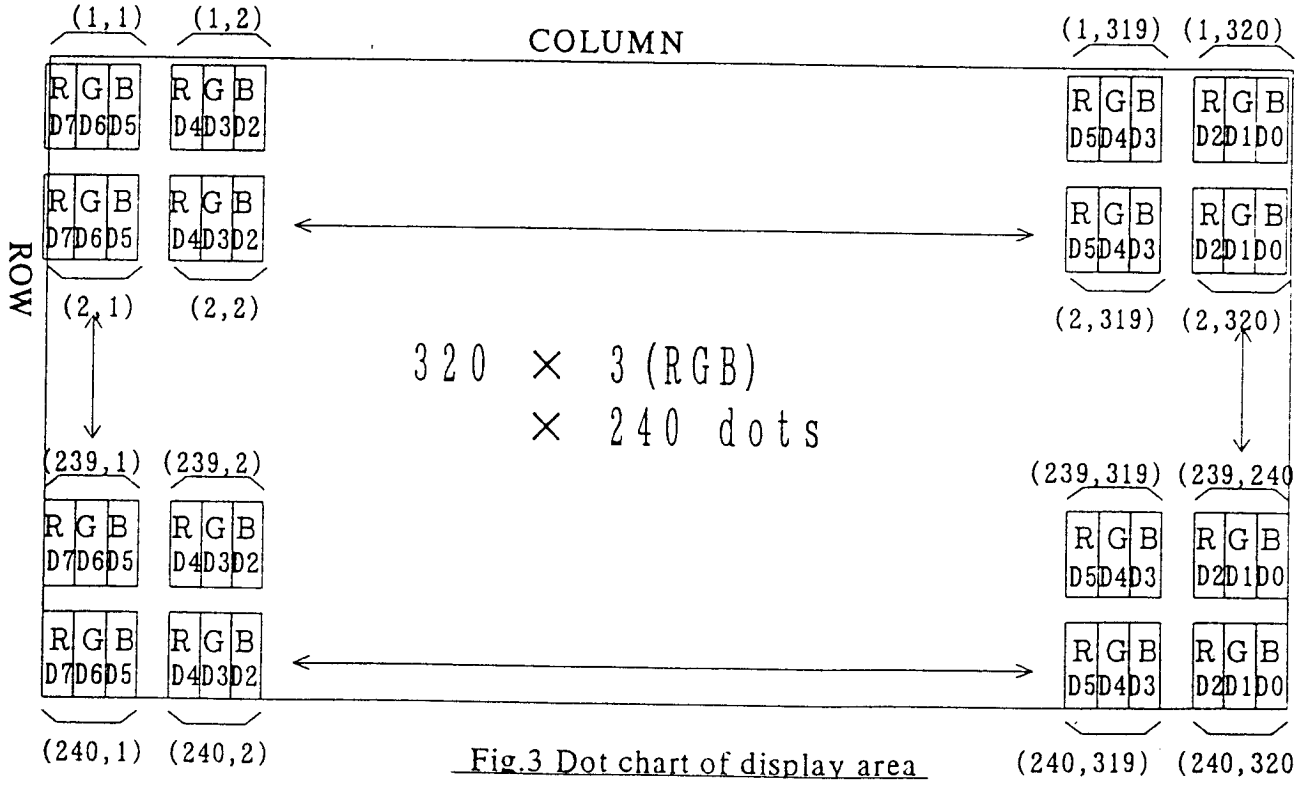


Fig.3 Dot chart of display area

Table 8 Interface timing ratings

Ta=25 ℃,VDD = 5.0 V±5 %(3.3V ±5 %)

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Flame cycle Note 1)	t_{FRM}	12.5	-	14.3	ms
XCK clock cycle Note 2)	t_{CK}	81	-	-	ns
XCK "H" level width	t_{WCKH}	35	-	-	ns
XCK "L" level width	t_{WCKL}	35	-	-	ns
LP "H" level latch clock width	t_{WLPH}	200	-	-	ns
Data set up time	t_{DS}	35	-	-	ns
Data hold time	t_{DH}	35	-	-	ns
YD "H" level set up time	t_{HYS}	100	-	-	ns
YD "H" level hold time	t_{HYH}	100	-	-	ns
YD "L" level set up time	t_{LYS}	100	-	-	ns
YD "L" level hold time	t_{LYH}	100	-	-	ns
LP↓ allowance time from XCK↑	t_{LS}	200	-	-	ns
XCK↓ allowance time from LP↑	t_{LH}	200	-	-	ns
Input signal rise/fall time*1	t_r,t_f	-	-	13	ns

Note 1) Due to the characteristics of the LCD module, "shadowing" effect becomes more visible as frame refresh frequency goes up. And also contrast ratio goes down and flickering becomes more visible as flame refresh frequency goes down. It is recommended to drive the display module according to the specified conditions.

Recommended frame refresh frequency range is 70 Hz～ 80 Hz.

Note 2)LP signal must be continuous. And also its interval time from the falling edge to the rising edge must always be same and no greater than 70 μ s.

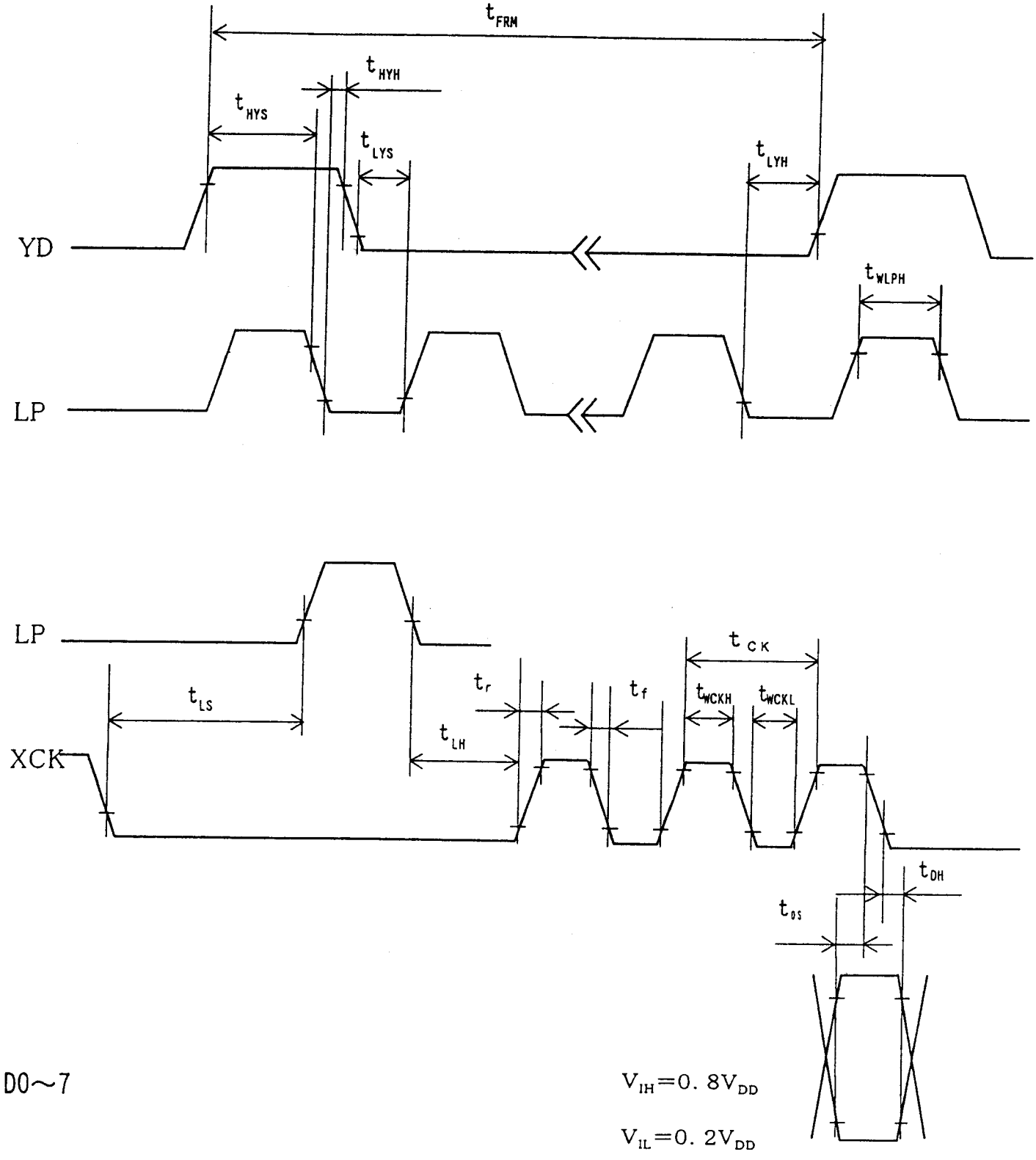


Fig.4 Interface timing chart

6. Module Driving Method

6-1. Input data and control signal

One SEG(segment=column)driver is a 240 bit output LSI, consisting of shift registers, latch circuits and LCD driver circuits.

Input data for each row (320×3[R,G,B]) will be sequentially transferred in the form of 8 bit parallel data through shift registers by data transfer clock signal (XCK). When data transfer for one row (320× 3[R,G,B]) is completed, the data will be latched in the form of 320 x 3 parallel data corresponding to each column electrodes by the falling edge of latch signal (LP), then the drive pulses will be output to 320×3 lines of column electrodes of the LCD panel by the LCD drive circuits.

At the same time, row N is selected by scan start-up signal (YD) and the contents of the data signals are displayed on the row N of the display screen according to the combinations of voltages applied to row and column electrodes. While the data row N are being displayed, data for row N+1 are transferred. After 320×3 data have been transferred, data will be latched by the falling edge of LP and output the data to the row N+1.

Each row will be sequentially selected as described above from N=1 to N=240. One frame is completed after displaying 240^{th} row. Then row scan starts from the 1st row again. YD is the scan signal which drives row electrodes.

If DC voltage is applied, it causes a chemical reaction in LC material and causes a deterioration of LC material. So, the polarities of driving pulses must be alternated by certain time period. Control signal M is the signal which changes the polarity of driving pulses.

Power consumption of the LCD module goes up as clock(XCK) frequency goes up due to the nature of CMOS LSI used in it. This display module has 8 bit parallel data input so that it works at low clock frequency and minimize power consumption. 8 bit display data are assigned to D0-7.

This display module also has a bus line system for data input to minimize the power consumption. Data input of each LSI driver works only when data is accessed

Data Input for column electrodes and Chip Select of driver LSI work as follows:

The driver LSI at the left end of the screen is selected first and 240 bits of data(30 x XCK) are transferred to it. After transferring 240 data, the adjacent right side LSI right is selected. This process is sequentially continued until data is fed to the LSI at the right end of the screen. Thus display data is transferred sequentially through 8 bit bus line from the left to the right of the screen.

As this display module does not have display refresh RAM, display data and timing control signals must be supplied continuously.

The timing chart of input signals are shown in Fig. 4 and Table 8.

7. Optical Characteristics

Table 9 Ta = 25 ℃, V_{DD}= 5.0 V(3.3V), V_{EE} = V_{CO} max

Parameter		Symbol	Condition			MIN.	TYP.	MAX.	Unit	Remark
Viewing angle range		θ_x	Co>2.0	θ_y=0 °	$\theta_x \geqq 0$ °	50	-	-	°	Note1)
					$\theta_x < 0$ °	-	-	-50	°	
		θ_y		θ_x=0 °	$\theta_y \geqq 0$ °	35	-	-	°	
					$\theta_y < 0$°	-	-	-60	°	
Contrast ratio		Co	$\theta_x = \theta_y = 0$ °			25	40	-	-	Note2)
Response time	Rise	τ r	$\theta_x = \theta_y = 0$ °			-	450	600	ms	Note3)
	Decay	τ d	$\theta_x = \theta_y = 0$ °			-	100	130	ms	
Brightness		B	$\theta_x = \theta_y = 0$ °		IL = 6.0 mA	140	180		cd/m²	Note4)
Module Chromaticity	white	x	$\theta_x = \theta_y = 0$ °			0.27	0.32	0.37	-	
		y	$\theta_x = \theta_y = 0$ °			0.28	0.33	0.38	-	

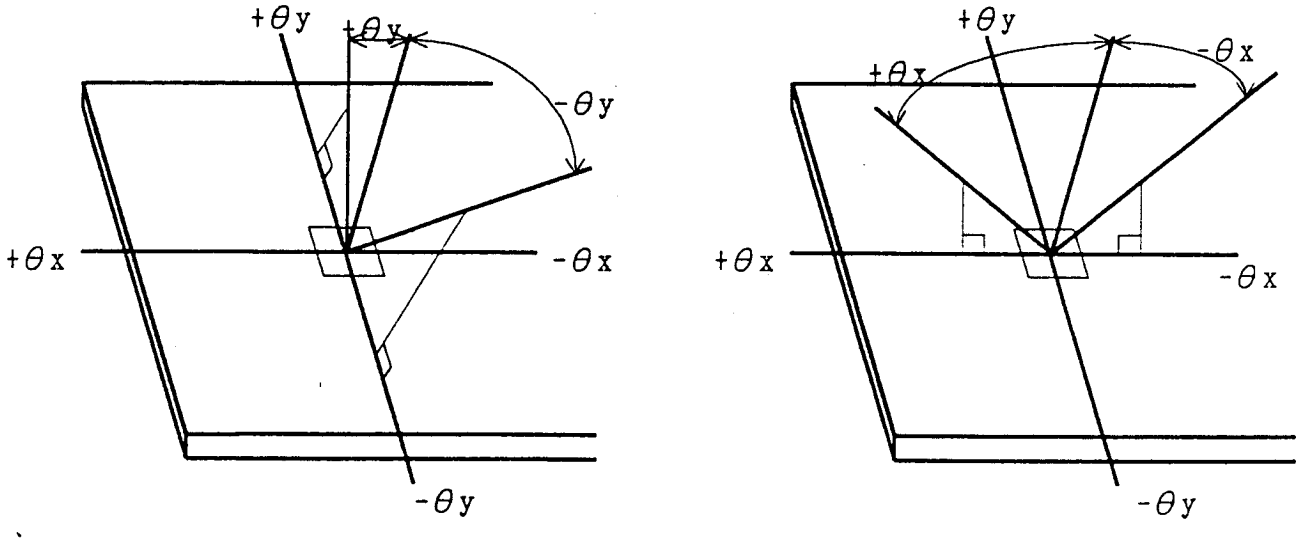


Fig.5 Definition of Viewing Angle

Note 1) The viewing angle range is defined as shown Fig.5

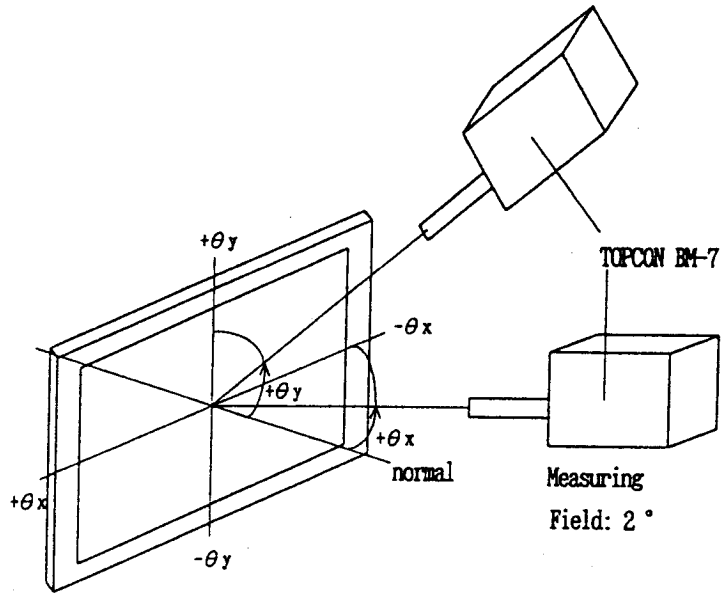
Note 2) Contrast ratio is defined as follows:

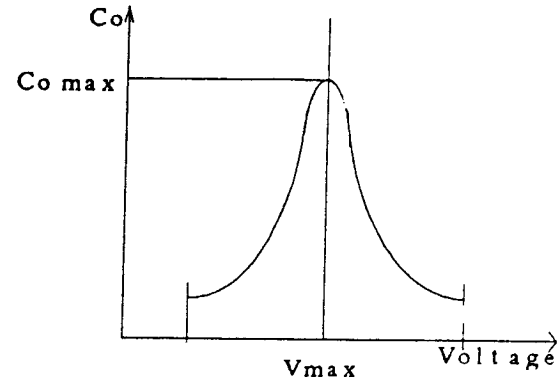
$$Co = \frac{\text{Luminance(brightness) of all pixels "White" at Vmax}}{\text{Luminance(brightness) of all pixels "Dark" at Vmax}}$$

Vmax is defined in Fig.7.

Note 3) The response speed of LCD module is defined as the response characteristics of photo-detector output shown in Fig.6 when the measured dot is turned on and off in the setting shown in Fig.8

Note4) Luminance is defined as average luminance (brightness) of measuring points (①~⑤) at Vmax. All pixels of LCD are "white".





Measuring Spot Size : ϕ 10 mm

θ x : Angle from "normal" to measuring direction along the horizontal axis.

θ y : Angle from "normal" to measuring direction along the vertical axis.

Fig.6 Optical Characteristics Test Method I

Fig.7 Definition of Vmax

(Response Speed Measurement)

Ta = 25 ℃

In the dark room

TOPCON BM7 + quartz fiber

(Measuring spot size : ϕ 10 mm, Measuring Field : 2 °)

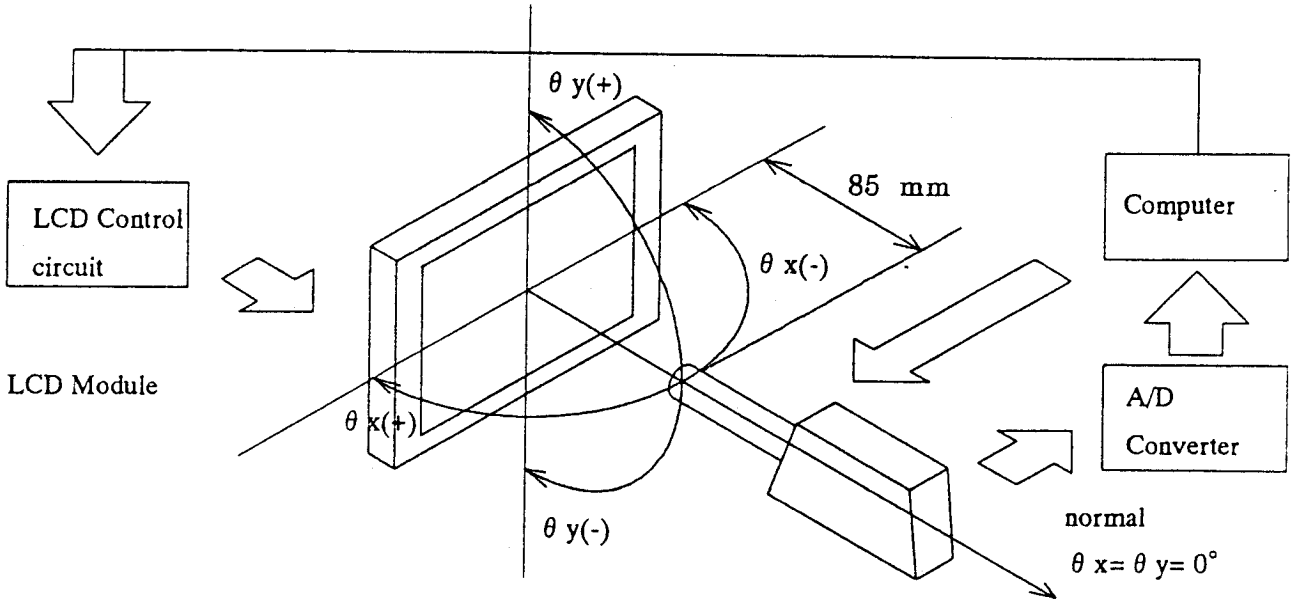
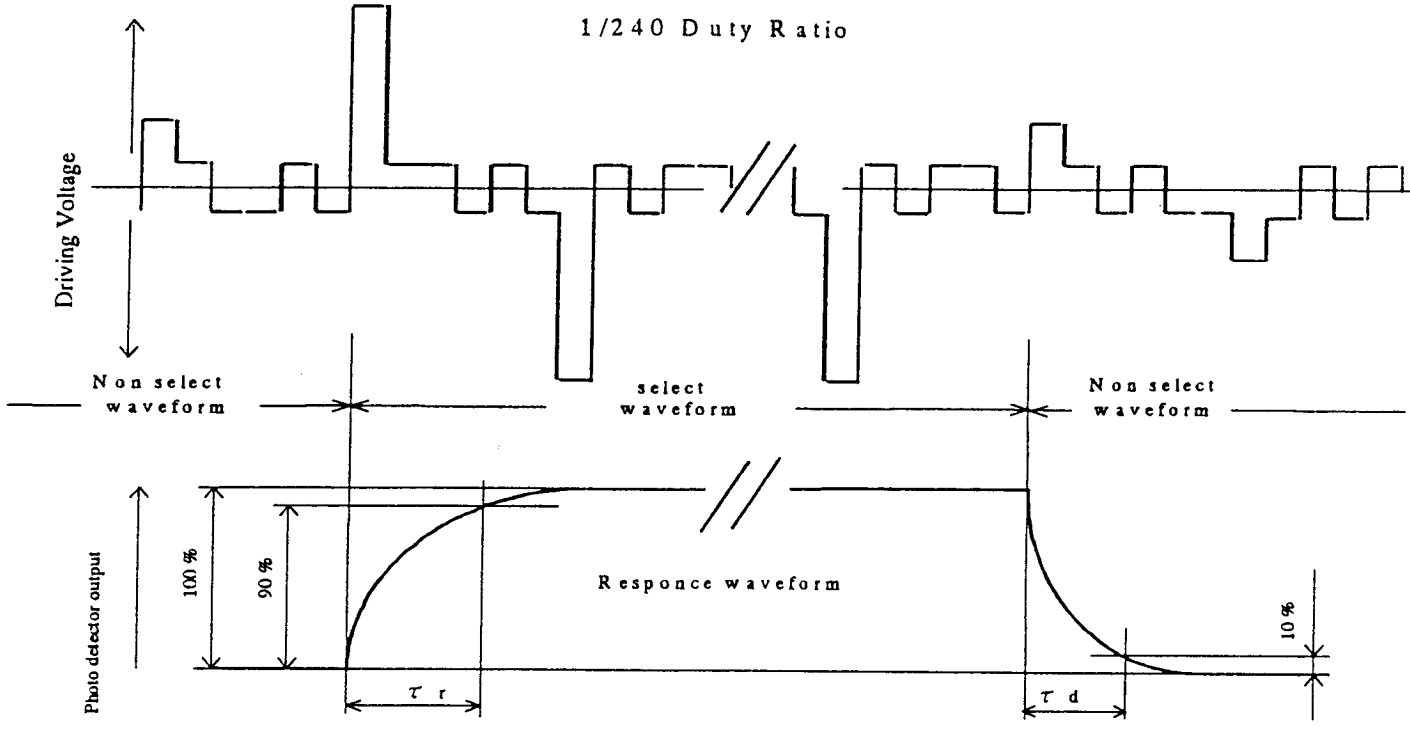


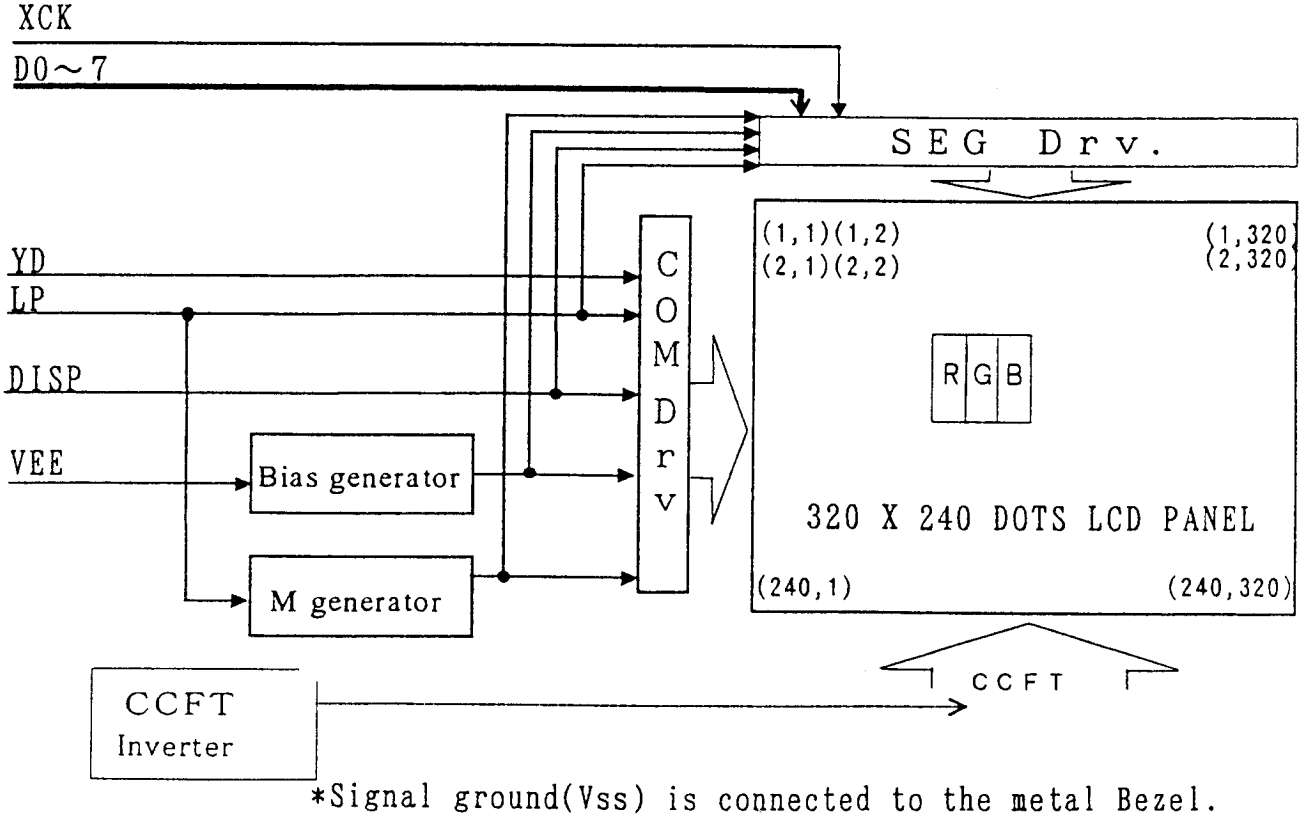
Fig. 8 Optical Characteristics Test Method II



τ r : Rise time

τ d : Decay time

Fig.9 Definition of Response time



*Signal ground(Vss) is connected to the metal Bezel.

Fig.10 Circuit block diagram

8. Characteristics of Backlight

The ratings are given based on following conditions.

1) Rating(Note)

Table 10

Parameter	MIN.	TYP.	MAX.	Unit
Brightness	140	180	-	cd/m^2

2) Measurement circuit : CXA-M10L(TDK) (at IL = 6.0 mArms)

3) Measurement equipment : BM-7 (TOPCON Corporation)

4) Measurement conditions

4-1. Measurement circuit voltage : DC = 12.0V, at primary side

4-2. LCD: All pixels WHITE, V_{DD}= 5.0 V(3.3V), V_{EE} = Vmax, D7~0 :"H"(White)
1/tFRM = 75 Hz

4-3. Ambient temperature : 25 ℃

Measurement shall be executed 30 minutes after turning on.

5)

5-1. Rating (1pc)

Table 11

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Remark
Lamp current	I_L	4	6	6.5	mArms	*1
Lamp voltage	V_L	-	400	-	Vrms	
Lamp power Consumption	P_L	-	2.4	-	W	*2
Lamp frequency	F_L	40	-	80	kHz	
Kick-off voltage	V_S	-	-	650	Vrms	Ta=25 ℃
		-	-	770	Vrms	Ta= 0 ℃, *3
Lamp life time	L_L	15 000	25 000	-	h	*4

*1 It is recommended that I_L is no greater than 6 mArms so that the effect of heat radiation from CCFT backlight on display quality is minimized.

*2 Power consumption excluded inverter efficiency loss.

*3 The output voltage of the inverter should be set to Vs adding some margin as Vs of CCFT bulb may be increased due to AC coupling leakage to the chassis of the LCD module.

*4 Average life time of CCFT bulb will be decreased when LCD is operated at low temperature.

6) Operating life

The operating life time is 25 000 hours or more at 6 mArms, 25 ±1℃

(Operating life with CXA-M10L or equivalent.)

The inverter should meet the following conditions to keep the specified life time of used lamp;

-Sine wave form, symmetric in positive and negative, no ripple or spike pulse

-Output frequency range: 40~80 kHz

Check well that CCFT works properly with enough aging time.

The operating life time is defined as the time either of following conditions are met.

-When the luminance or amount of light output is decreased to 60 % of the initials value.

-When the kick-off voltage reaches Maximum value in Table 11.

(NOTE) Ratings are defined as the average brightness inside the viewing area specified in Fig.11.

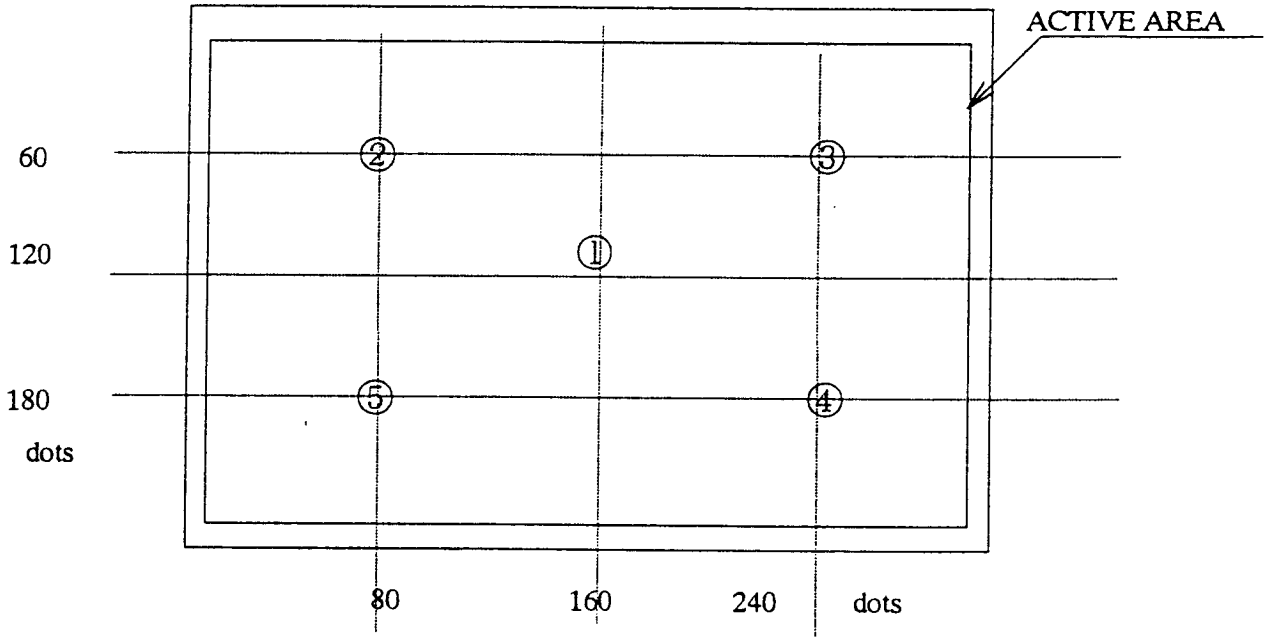


Fig.11 Measuring points (1-5)

9. Supply voltage sequence condition

The power ON/OFF sequence shown on Fig.12 must be kept to avoid latch-up of driver LSI and DC voltage charge to LCD panel.

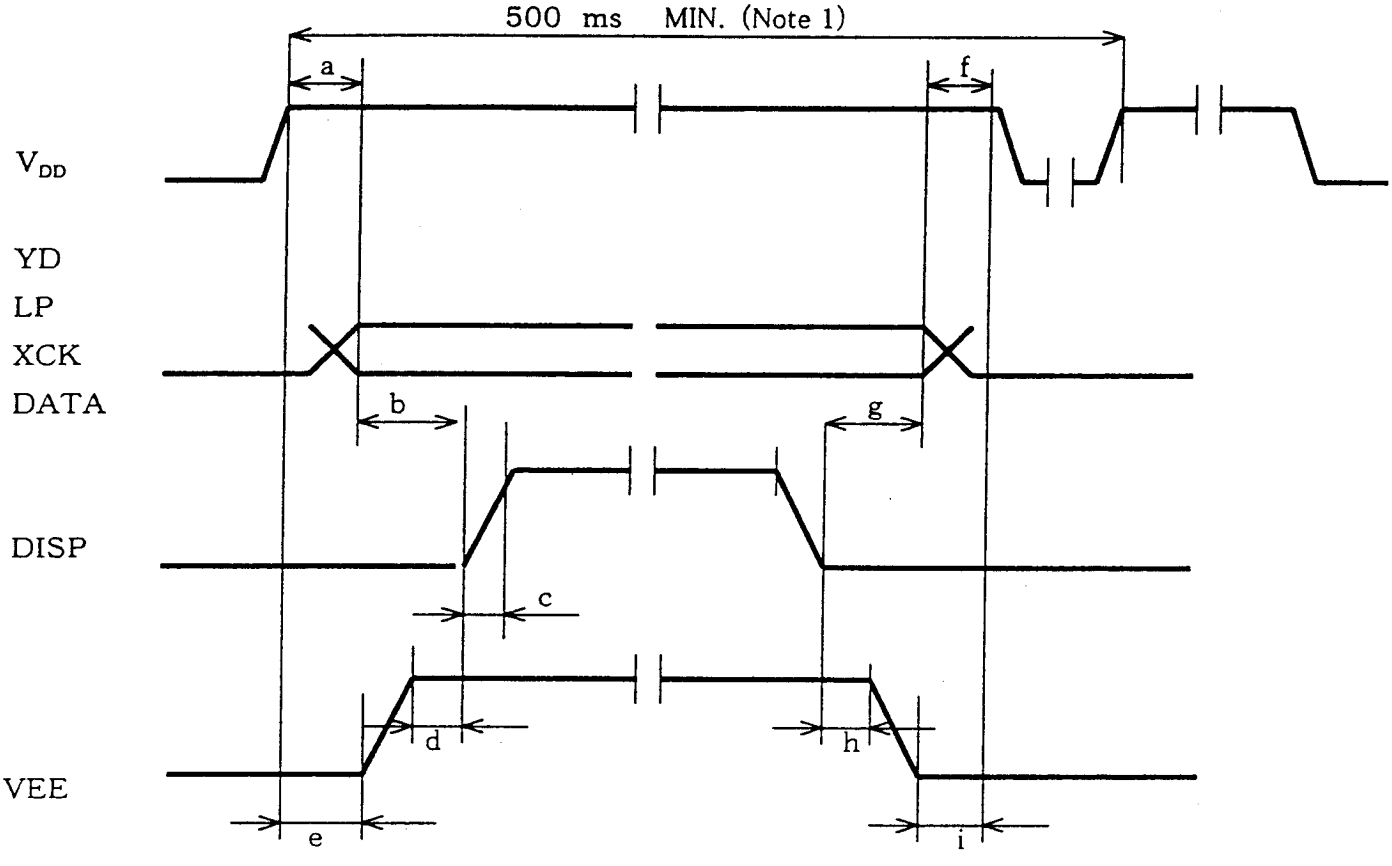


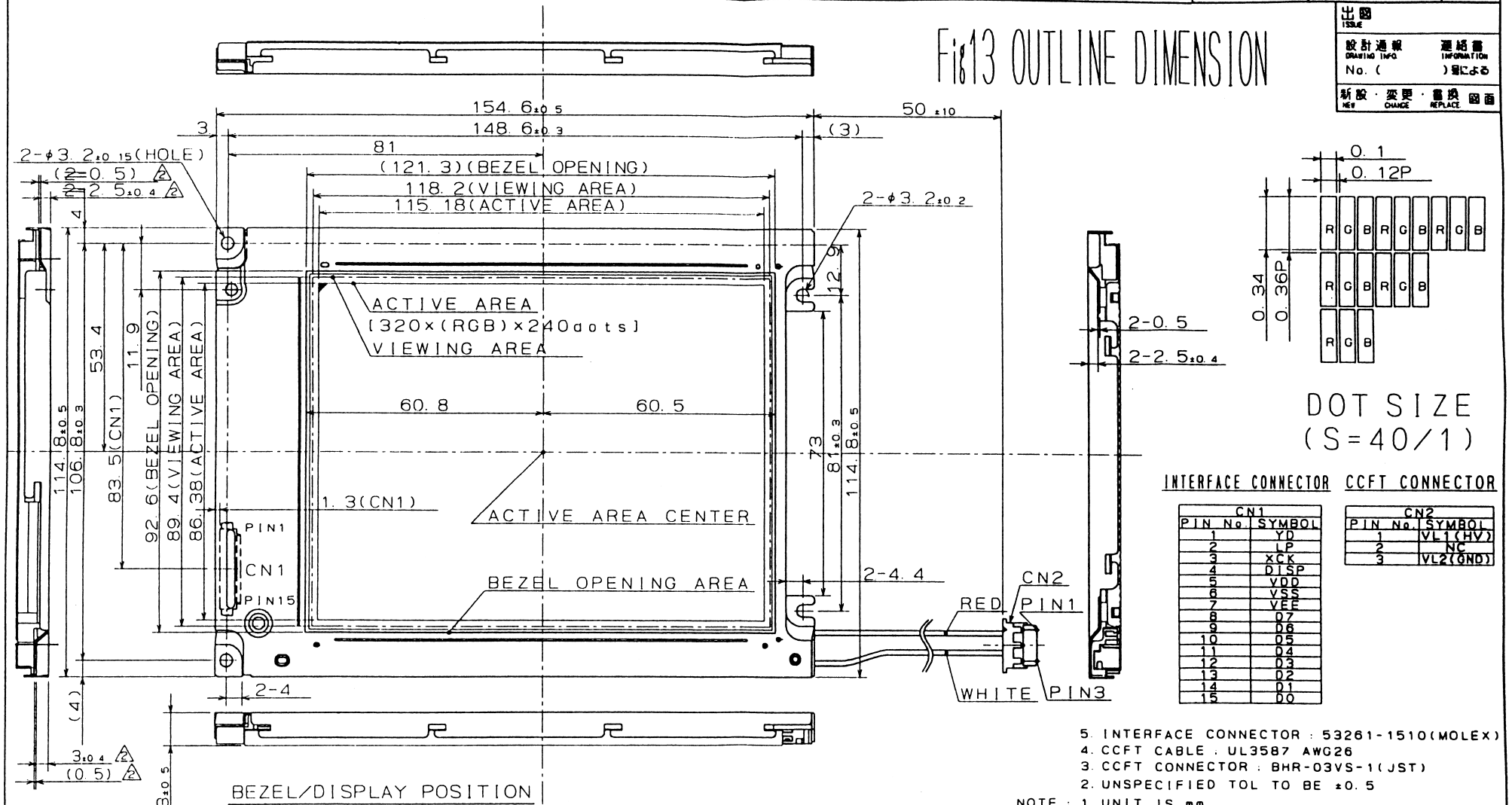
Fig.12 Sequence condition

	POWER ON	
Symbol	Allowable value	
a	0 ms MIN.	1 s MAX.
b	20 ms MIN.	-
c	-	100 ns MAX.
d	0 ms MIN.	-
e	0 ms MIN.	-

	POWER OFF	
Symbol	Allowable value	
f	0 ms MIN.	1 s MAX.
g	20 ms MIN.	-
h	20 ms MIN.	-
i	0 ms MIN.	-

Note 1) Power ON/OFF cycle time. All signals and power lines must be switched in accordance with above sequence during power ON/OFF cycle.

Fig13 OUTLINE DIMENSION



DOT SIZE
(S=40/1)

INTERFACE CONNECTOR

CN1 PIN No.	SYMBOL
1	YD
2	LP
3	XCK
4	DISP
5	VDD
6	VSS
7	VEE
8	D7
9	D6
10	D5
11	D4
12	D3
13	D2
14	D1
15	D0

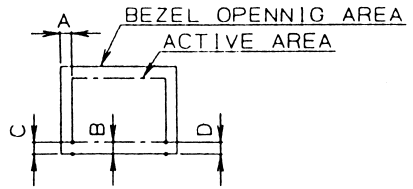
CCFT CONNECTOR

CN2 PIN No.	SYMBOL
1	VL1(HV)
2	NC
3	VL2(GND)

5. INTERFACE CONNECTOR : 53261-1510(MOLEX)
4. CCFT CABLE : UL3587 AWG26
3. CCFT CONNECTOR : BHR-03VS-1(JST)
2. UNSPECIFIED TOL TO BE ±0.5

NOTE : 1. UNIT IS mm

BEZEL/DISPLAY POSITION



1) TOLERANCE X-DIRECTION A:3.21±0.5
2) TOLERANCE Y-DIRECTION B:3.11±0.5
3) OBLIQUITY OF DISPLAY AREA IC-DI<0.5

2							
1						LM057QC1T01	
DATE	REVISE			PREPA	MODEL	NAME	LCD MODULE OUTLINE DIMENSIONS
MATERIAL	THICKNESS		FINISH		SCALE 1/1	ASSEMBLY	320x3x240 DOTS
DESIGN	DRAW	CHECK	CHECK	APPROVE	SHARP CORPORATION	PARTS CODE	
A. TAKAOKA					Engineering Department 1 Duty Panel Development Center Duty LCD Group	DATE	1998 10 8
						DRAWING No	

11. Precautions

1) When design the product with this LCD module, make sure the viewing angle matches to its purpose of usage.

Viewing angle of this LCD module is illustrated in Fig.1.

θ y MIN. < viewing angle < θ y MAX.

(For the specific values of θ y MIN., and θ y MAX., refer to the table 9)

Consider the optimum viewing conditions according to the purpose when installing the module.

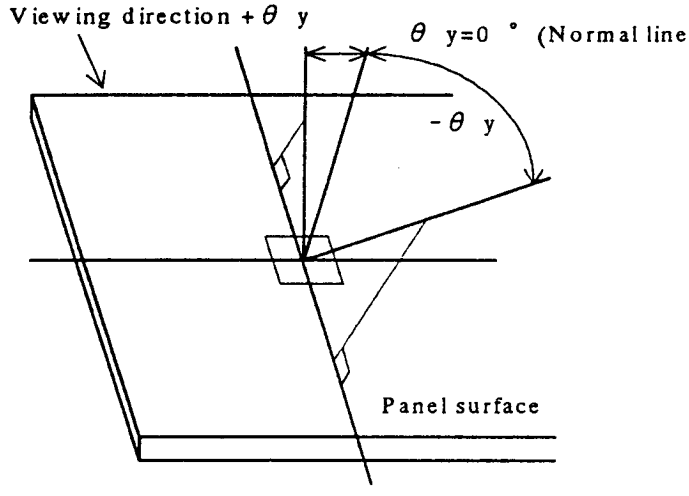


Fig.14 Definition of viewing angle

2) This LCD module must be mounted using mounting holes of metal bezel. Handle carefully when install the LCD module to avoid unnecessary stresses such as twisting or bending.

3) Although the polarizer of this LCD module has the anti-glare coating, always be careful not to scratch its surface. Use of a plastic cover is recommended to protect the surface of polarizer.

4) If the surface of LCD panel needs to be cleaned, wipe it swiftly with cotton or other soft cloth. If it is not still clean enough, blow a breath on the surface and wipe again.

5) Water droplets must be wiped off immediately as those may leave stains or cause color changes if remained for a long time.

6) As LCD panel is made of glass substrate, dropping the LCD module or banging it against hard objects may cause cracking or fragmentation.

7) As CMOS LSIs are equipped in this module, following countermeasures must be taken to avoid electrostatics charges.

1. Operator

Ware the electrostatic shielded clothes because human body may be statically charged if not ware shielded clothes.

2. Equipment

There is a possibility that the static electricity is charged to the equipment which have a function of peeling or friction action(ex: conveyer, soldering iron, working table). Earth the equipment through proper resistance(electrostatic earth:$1 \times 10^8\ \Omega$).

3. Floor

Floor is the important part to drain static electricity which is generated by operators or equipment.
There is a possibility that charged static electricity is not properly drained in case of insulating floor.
Set the electrostatic earth($1 \times 10^8\ \Omega$).

4. Humidity

Proper humidity helps in reducing the chance of generating electrostatic charges. Humidity should be kept over 50%RH.

5. Transportation/storage

The storage materials also need to be anti-static treated because there is a possibility that the human body or storage materials such as containers may be statically charged by friction or peeling.

6. Others

The laminator(protective film) is attached on the surface of LCD panel to prevent it from scratches or stains. It should be peeled off slowly using static eliminator.
Static eliminator should also be installed to the work bench to prevent LCD module from static charge.

8) Do not use any materials which emit gas from epoxy resin(hardener for amine) and silicone adhesive agent(dealcohol or deoxym) to prevent discoloration of polarizer due to gas.

9) The brightness of the LCD module may be affected by the routing of CCFT cables due to leakage to the chassis through coupling effect. The inverter circuit needs to be designed taking the level of leakage current into consideration. Thorough evaluation is needed for LCD module and inverter built into its host equipment to ensure specified brightness.

10) Avoid the exposure of the module to the direct sun-light or strong ultraviolet light for a long time.

11) If the LCD module is stored at below specified temperature, the LC material may freeze and be deteriorated. If it is stored at above specified temperature, the molecular orientation of the LC material may change to Liquid state and it may not revert to its original state. Therefore, the LCD module should always be stored within specified temperature range.

12) Disassembling the LCD module can cause permanent damage and it should be strictly avoided.

13) Procedure to insert mating connector
When the mating connector is inserted, it should be parallel to the connector on the LCD module and it should be inserted horizontally. Do not leave a gap between two connectors.

14) The module should be driven according to the specified ratings to avoid malfunction and permanent damage. Applying DC voltage causes a rapid deterioration of LC material. Make sure to apply alternating waveform by continuous application of the M signal. Especially the power ON/OFF sequence shown on Page 17 should be kept to avoid latch-up of driver LSIs and DC charge up to LCD panel.

15) LCD retains the display pattern when it is applied for long time.(Image retention)
To prevent image retention, do not apply the fixed pattern for along time.

16) Image retention is not a deterioration of LCD. It will be removed after display pattern is changed.

17) CCFT backlight should be kept OFF during VDD is "L" level.