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DEVICE SPECIFICATION for  
**PassiveMatrix** LCD Unit  
 (320x240 dots)

Model No,  
**LM32007T**

CUSTOMER'S APPROVAL

DATE \_\_\_\_\_

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**SHARP**

## RECORDS OF REVISION

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Nov. 25, 1992	page 4	①	Amendment of resistor value	K. Shimizu
Jun. 12 1993	Page. 3, 4, 7, 12	②	Amendment -	K. Shimizu
Dec. 3. 1993	Page. 2, 4	③	Addition and Alteration	Y. Inoue

1. Application

This data sheet is to introduce the specification of LM32007T  
Passive Matrix type LCD Unit.

(320x240 dot, BSTN, negative type, with backlight system by cold cathode  
fluorescent tube(CCFT).)

2. Construction and Outline

Construction : 320x240 full dot graphic display unit

Outline : See Fig. 8.

Connection : See Fig. 8. and Table. 5,6.

There shall be no **scratches**, stains, chips, distortions and other external  
drawbacks that may affect the display function.

Rejection criteria shall be noted in Inspection Standard S-U-012-01

### 3. Mechanical Specifications

Table 1

Parameter	Specification	Unit
Outline dimensions	170 (W) x 110 (E) x 8MAX (D) <b>Note1</b>	mm
Effective viewing area	121(W) x 91.6(H)	mm
Display format	320 (W) x 240 (H) full dot	
Dot size	0.33 (W) x 0.33 (H)	mm
Dot spacing	0.03	mm
Character color	White <b>Note3</b>	-
Background color	Dark Blue <b>Note2</b>	-
Weight	220	g

**Note1** : Excluded the mounting tab. (See F: g.8)

**Note2** : Due to the characteristics of the LC Material, the colors vary with environmental temperature.

**Note3** : Display data 'High' : White (ON)  
 'Low' : Dark Blue (OFF)

### 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	8.0	V	Ta=25°C
Supply voltage (LCD Driver)	$V_{DD}-V_{EE}$	0	30.0	V	
Input voltage	$V_{IN}$	0	VDD	V	
Supply voltage (CCFT)	VCCFT	0	1500	Vrms	
Supply current (CCFT)	ICCFT	0	6.5	mA rms	

4-2. Environmental Condition

2 Table 3

Item	Tstg		Topr		Remark
	MIN.	MAX.	MIN.	MAX.	
Ambient temperature	-25°C	+80°C	0°C	+45°C	
Humidity	Note 1		Note 1		No condensation
Vibration	Note 2		Note 2		3 directions (X/Y/Z)
Shock	Note 3		Note 3		6 directions (±X/±Y/±Z)

**Note 1)**  $T_a \leq 40^\circ\text{C}$  . . . . .95% RH Max  
 $T_a > 40^\circ\text{C}$ .....Absolute humidity shall be less than  
 $T_a = 40^\circ\text{C} / 95\% \text{ RH}$

**Note 2)** These test conditions are in accordance with 'IEC 68-2-6'  
 Frequency : 10 ~ 55HZ  
 Vibration width : 1.5mm  
 Interval : 10HZ ~ 55HZ ~ 10HZ  
 (1 rein]  
 2 hours for each direction of X/Y/Z (6 hours as total]

**Note 3)** Accerelation : 490m/S<sup>2</sup> (50G)  
 Pulse width : 11ms  
 3 times for each direction of ±X/±Y/±Z.

**Note 4)** Care should be taken so that the LCD Unit may not be exposed  
 the temperature ranges out of this specifications,



## 5-2. Interface signals

CN 1

Table 5

Pin No.	Symbols	Description	Level
1	V0	LCD contrast adjust voltage	
2	VEE	Power supply for LCD (-24V)	
3	D3	Display data signal	H(ON), L(OFF)
4	D2		
5	D1		
6	D0		
7	NC		
8	VSS	Signal ground (0V)	
9	VDD	Power supply for logic (+5V)	
10	CP2	Data input clock signal	H→L
11	CP1	Input data latch signal	H→L
12	s	Scan start-up signal	“H”

Used Cable : 1.25mm pitch , 12pins F.F. C

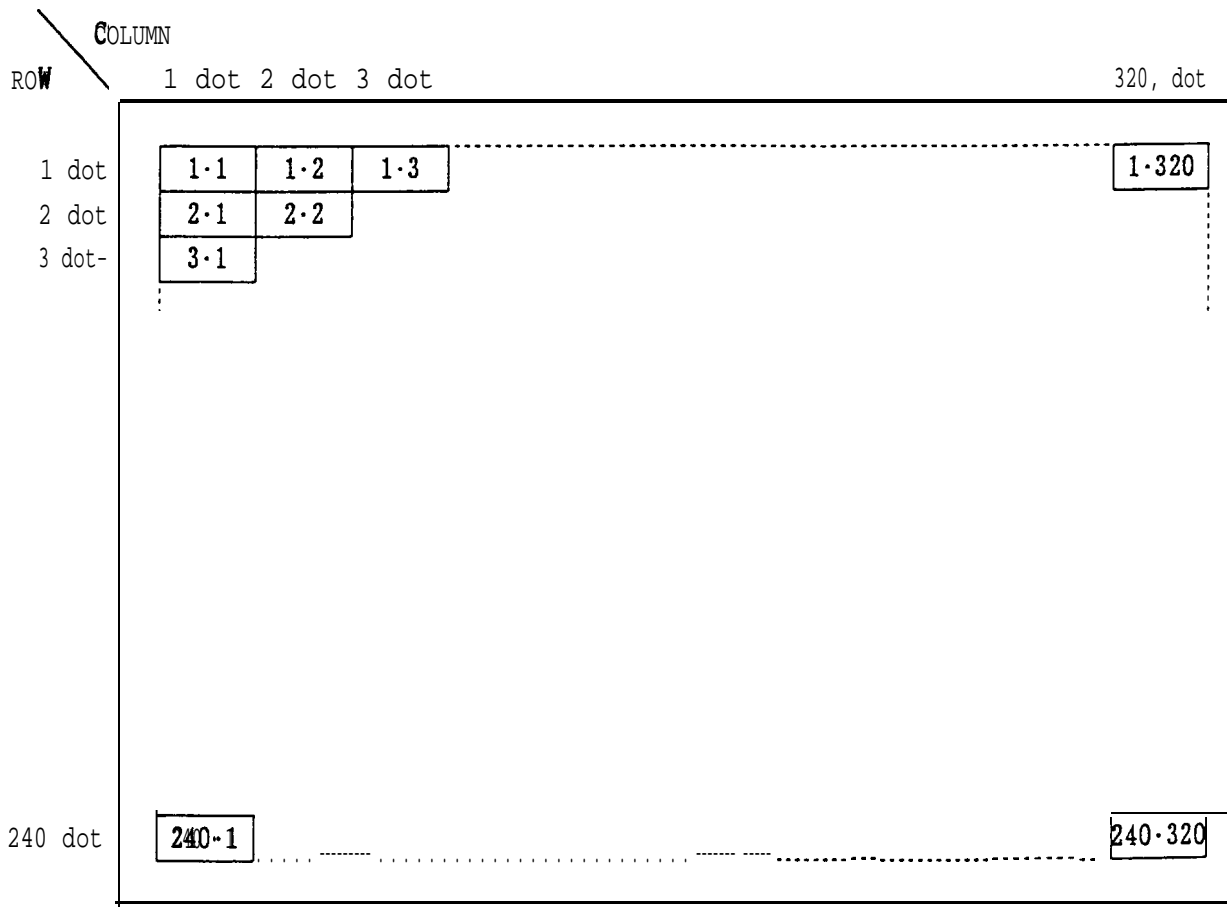
Table 6

CN2

Pin No.*1	Symbols	Description
1	VFT1	Power supply for CCFT back light
2	VFT2	Power supply for CCFT back light

Used Cable : AWG22 UL STILE 3239

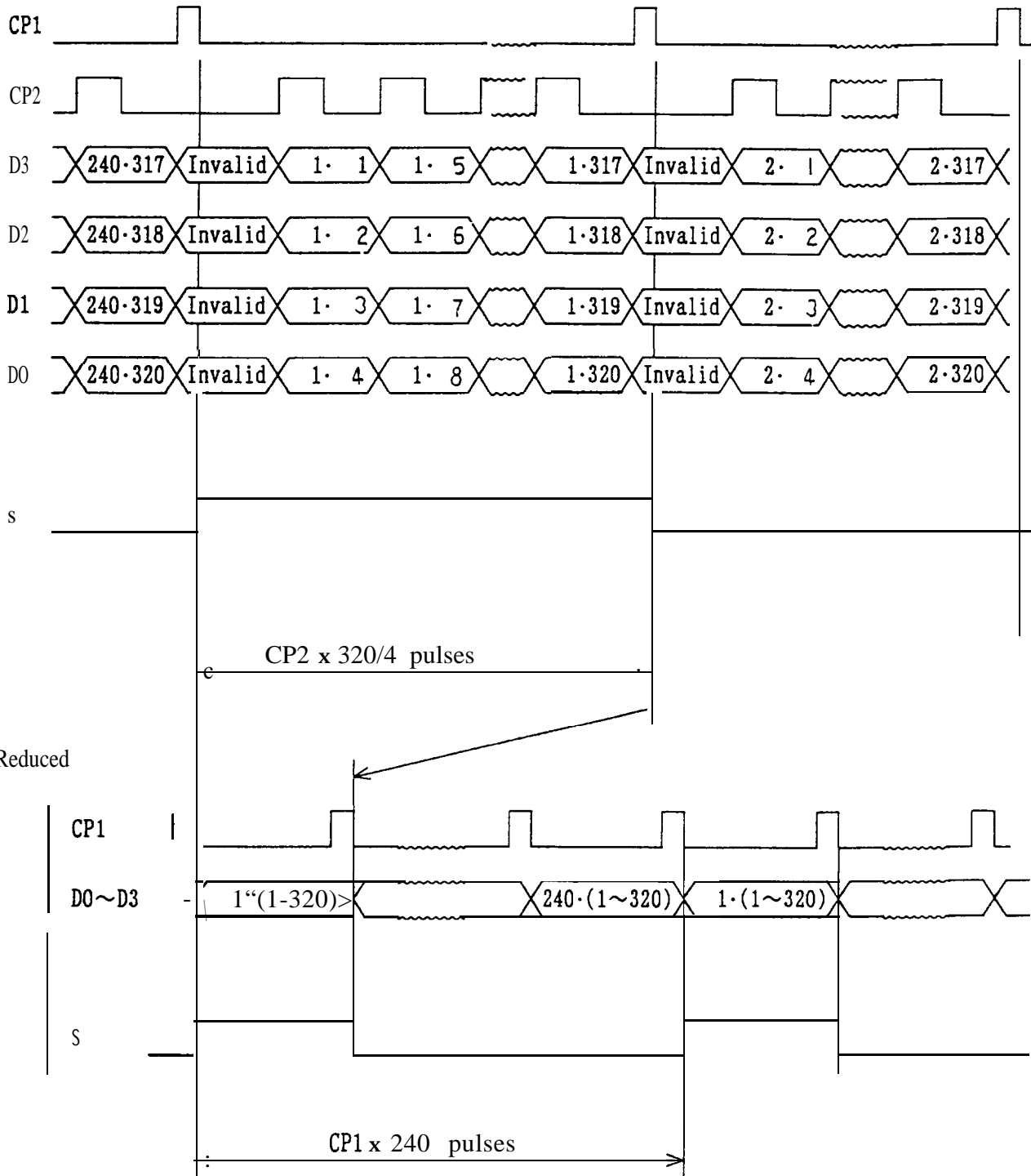
\*1 : Pin No. and its location are shown in Fig. 11.



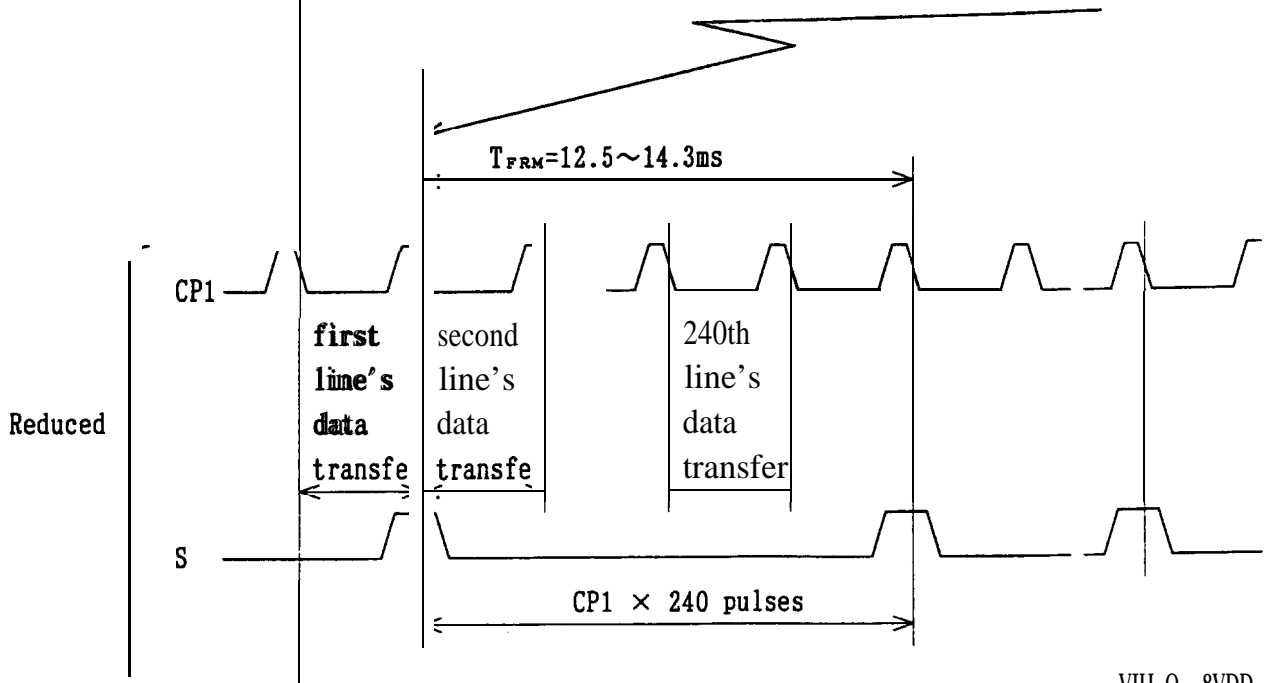
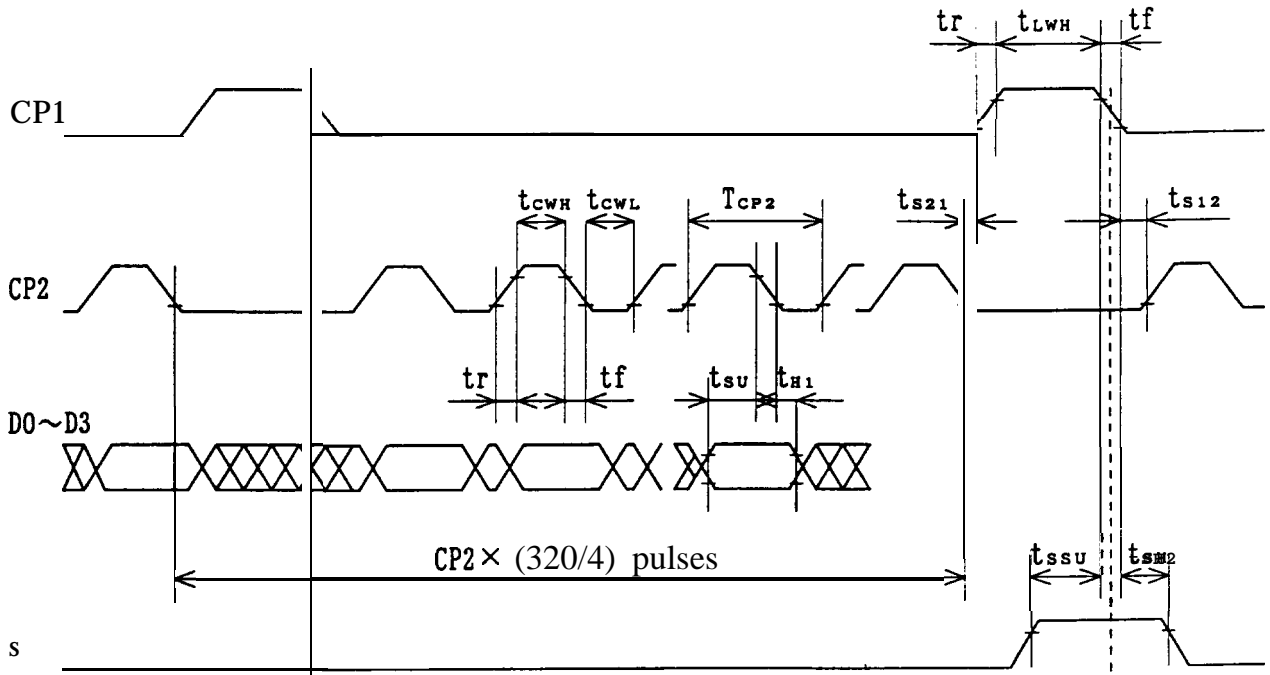
Note) 1·2 means 1st row 2nd column dot.

Fig. 1 Dot Chart of Display Area





**Fig. 2 Data Input Timing**



$V_{IH} = 0.8V_{DD}$

$V_{IL} = 0.2V_{DD}$

Fig. 3 Interface Timing Chart

Table. 6 Interface timing ratings

Item	Symbol	Rating			Unit
		MIN.	TYP.	MAX.	
Frame cycle	$T_{FRM}$	12.5		14.3	ms
CP2 clock cycle	$T_{CP2}$	152			ns
*H* level clock width	$t_{CWH}$	100			ns
“L* level clock width	$t_{CWL}$	100		—	ns
● H’ level latch clock width	$t_{LWH}$	100		—	ns
Data set up time	$t_{SU}$	80		—	ns
Data hold time	$t_{H1}$	80		—	ns
CP2 ↑ clock allowance time from CP1 ↓	$t_{S12}$	0		—	ns
CP1 ↑ clock allowance time from CP2 ↓	$t_{S21}$	0			ns
Clock rise/fall time	$t_r, t_f$			50	ns
S Signal Data set up time	$t_{SSU}$	100			ns
S Signal Data hold time	$t_{SH2}$	100			ns

## 6. Unit Driving Method

### 6-1. Circuit Configuration

Fig.8 shows the block diagram of the Unit's circuitry.

### 6-2. Display Face Configuration

The display face electrically consists of signal display segment of  $320 \times 240$  dots.

### 6-3. Input Data and Control Signal

The LCD driver is 80 bits LSI, consisting of shift registers, latch circuits and LCD driver circuits.

Display data which are externally divided into data for each row (320 dots) will be sequentially transferred in the form of 4-bit parallel data through shift registers by Clock Signal CP2 from the left top of the display face.

When data of one row (320 dots) have been inputted, then latched in the form of parallel data for 320 lines of signal electrodes by Latch Signal CP1. Then the corresponding drive signal will be transmitted to the 320 lines of column electrodes of the LCD panel by the LCD drive circuits.

At this time, scan start-up signal S has been transferred from the scan signal driver to the 1st row of scan electrodes, and the contents of the data signals are displayed on the 1st rows of the display face according to the combinations of voltages applied to the scan and signal electrodes of the LCD.

While the 1st rows of data are being displayed, the 2nd rows of data are entered. When 320 dots of data have been transferred then latched on the falling edge of CP1 clock, the display face proceeds to the 2nd rows of display.

Such data input will be repeated up to the 240th row of each display segment, from upper to lower rows, to complete one frame of display by time sharing method. Then data input proceeds to the next display face.

Scan start-up Signal S generates scan signal to drive horizontal electrodes.

The unit shall be driven at the speed of 70~80Hz/frame to avoid flickering.

Because of the characteristics of the CMOS driver LSI, the power consumption of the unit goes up as the operating frequency CP2 increases. Thus the driver LSI applies the system of transferring 4-bit parallel data through the 4 lines of shift resistors to reduce the data transfer speed CP2. Thanks to the LSI, the power consumption of the unit will be minimized.

In this circuit configuration, 4-bit display data shall be therefore inputted to data input pins of D0~D3.

Furthermore the LCD unit adopts bus line system for data input to minimize the power consumption. In this system data input terminal of each driver LSI is activated only when relevant data input is fed.

Data input for column electrodes of both the upper and the lower display segment and chip select of driver LSI are made as follows:

The driver LSI at the left end of the display face is first selected, and the adjacent driver LSI of the right side is selected when 80 dots data (20 CP2) is fed. This process is sequentially continued until data is fed to the driver LSI at the right end of the display face.

This process is simultaneously followed at the column driver LSI's of both the upper and the lower display segments. Thus data input through 4-bit bus line sequentially from the left end of the display face.

Since this graphic display unit contains no refresh RAM, it requires data and timing pulse inputs even for static display.

The timing chart of input signals are shown in Fig.3.

7. Optical Characteristics

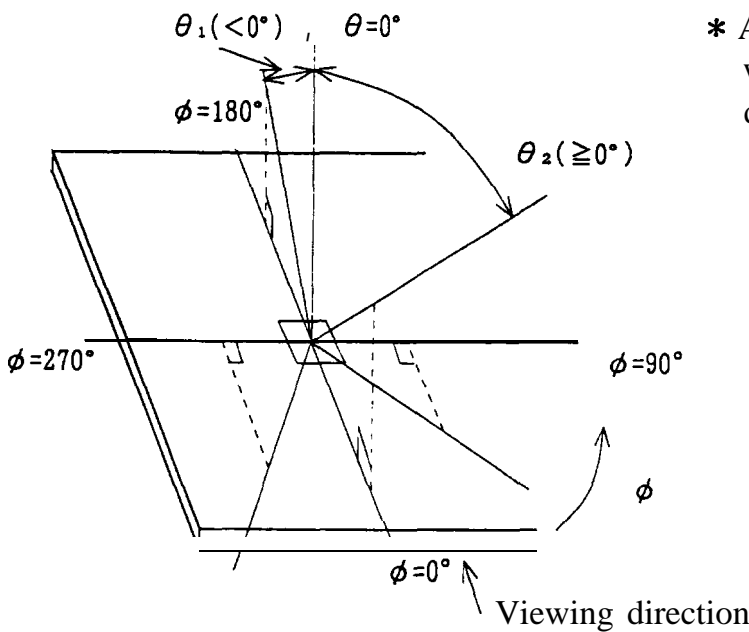
(Table 7 shows the optical characteristics when the viewing angle obtaining the maximum contrast ( $\phi$ ) is adjusted to 0 degrees.)



Table 7 VDD=5V, Ta=25°C

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark	
Viewing angle range	$\theta_2 - \theta_1$	$\phi = 0^\circ$ $\theta_1 < \theta_2$	$C_o \geq 2.0$	65	-	-	dgr.	Note 1
	$\theta_1$		$C_o = 2.0$	-	-	-30	dgr.	Note 1
	$e_2$		30	-	-	dgr.	Note 1	
	$\theta_2 - \theta_1$	$\phi = 90^\circ$ $\theta_1 < \theta_2$	$C_o \geq 2.0$	65	-	-	dgr.	Note 1
	$\theta_1$		$C_o = 2.0$	-	-	-30	dgr.	Note 1
	$e_2$		30	-	-	dgr.	Note 1	
Contrast ratio	co	$\theta = 0^\circ, \phi = 0^\circ$	7.0	10.0	-		Note 2	
Response speed	z-r	$\theta = 0^\circ, \phi = 0^\circ$	-	100	150	ms	Note 3	
	$\tau d$	$\theta = 0^\circ, \phi = 0^\circ$	-	100	150	ms	Note 3	

Note 1) The viewing angle range may be defined as shown below.



\* Angles  $\theta_1, \theta_2$  and  $\phi$  shall fall within the range over which the displayed character each be read.

Fig. 4 Definition of Viewing Angle

Note 2) Contrast ratio may be defined as follows:

Contrast ratio is calculated by using the following formula when the waveform voltage (Fig.6) is applied in optical characteristics test method (Fig.5).

$$\text{Contrast ratio} = \frac{\text{Photo-detector output voltage with select waveform being applied}}{\text{Photo-detector output voltage with non-select waveform being applied}}$$

Note 3 The response characteristics of photo-detector output are measured as shown in Fig.6, assuming that input signals are applied so as to select and deselect the dots to be measured, in the optical characteristics test method shown in Fig.5.

Note 4) Table 7 shows the optical characteristics detected when the LCD applied voltage waveforms are in the highest frequency \*.

- The most critical condition for the characteristics of LCD.

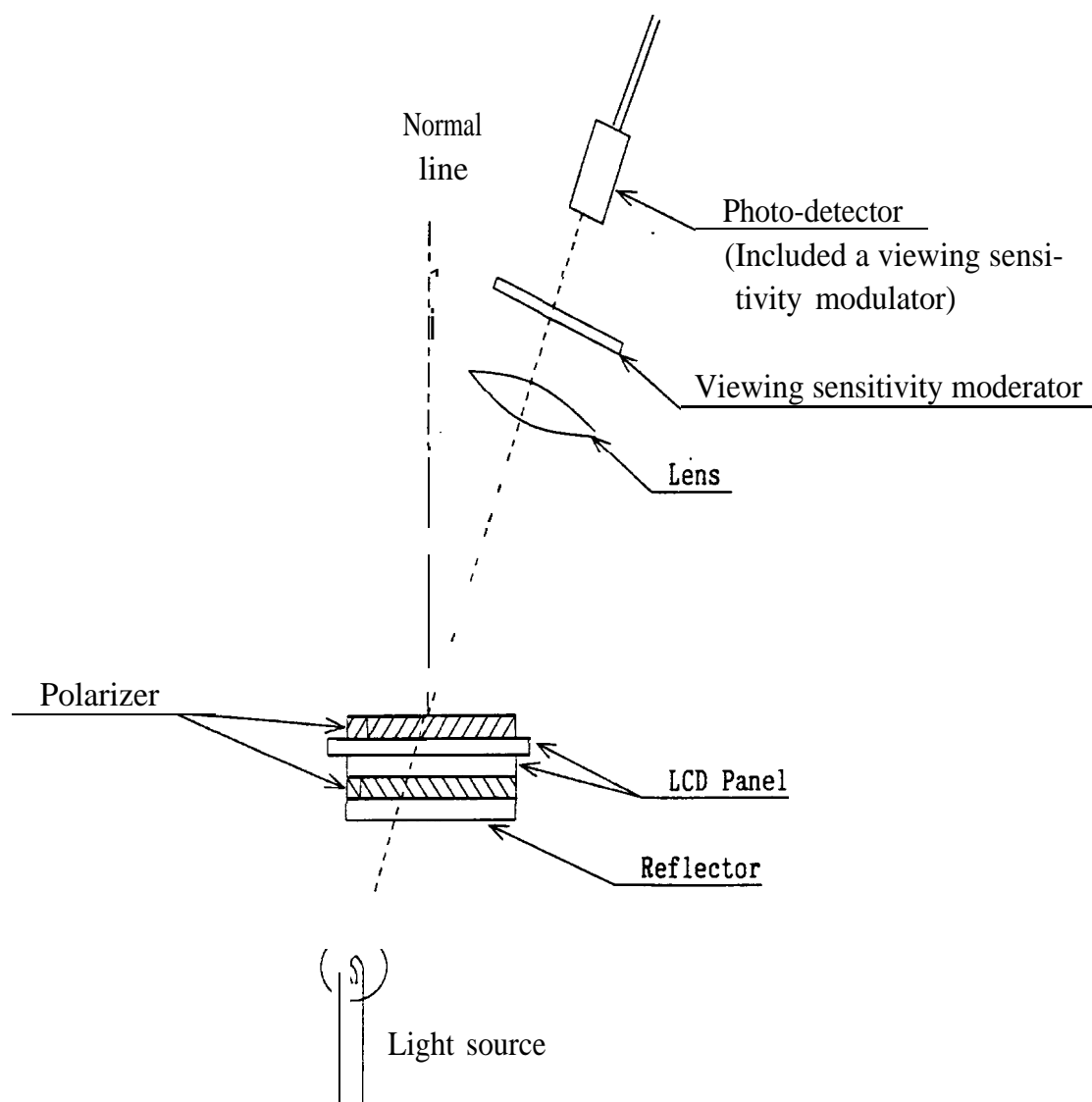
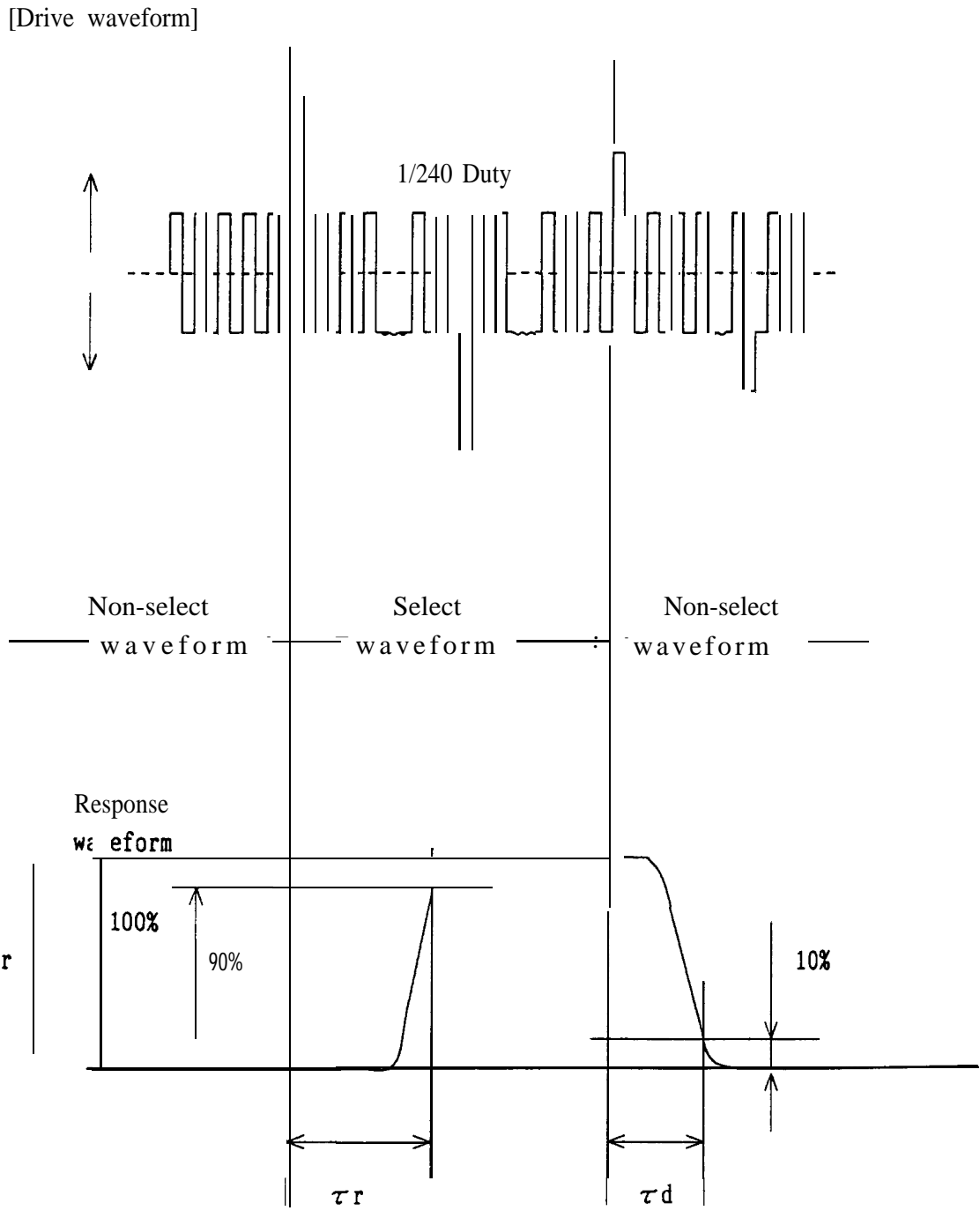


Fig. 5 Optical Characteristics Test Method



$\tau_r$ : Rise time  
 $\tau_d$ : Decay time

Fig. 6 Definition of Response Time

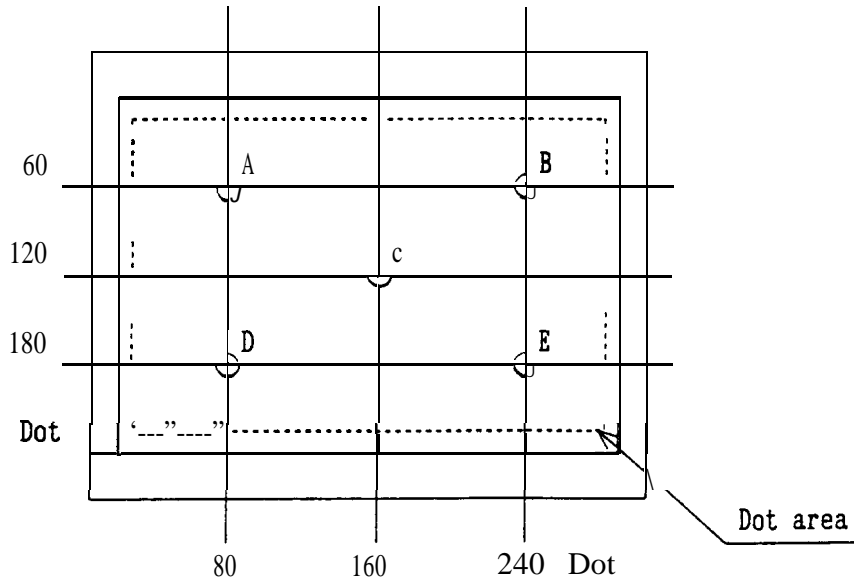


7-2. Characteristics of Backlightit

(a) Brightness

Parameter	Min.	Typ.	Max.	Unit
Brightness	<b>70</b>	<b>100</b>	-	Cd/m'

Rating are defined as the average brightness at 5 measurement points.



**Fig. 7**

(b) Measurement condition

CCFT inverter : LM000106

INPUT voltage 12.0V

IFT=5mA

LCD unit Condition : LCD is full dot ON (white)

VEE=-24V

Temperature : Ta= 25°C

Measurement equipment : BM-7 (TOPCON Corporation)

(c) Operating life time

- The operating life time is 10000 hours more under the following conditions.

CCFT inverter : ;LM000106

IFT= 5 mA<sub>rms</sub>

Ta= 25±5°C

- The operating life time is defined as having ended when any of the following conditions occur.

-When the illuminence or quantity of light has decreased to 50% of the initial value.

-When the light of CCFT goes to flicker remarkble.

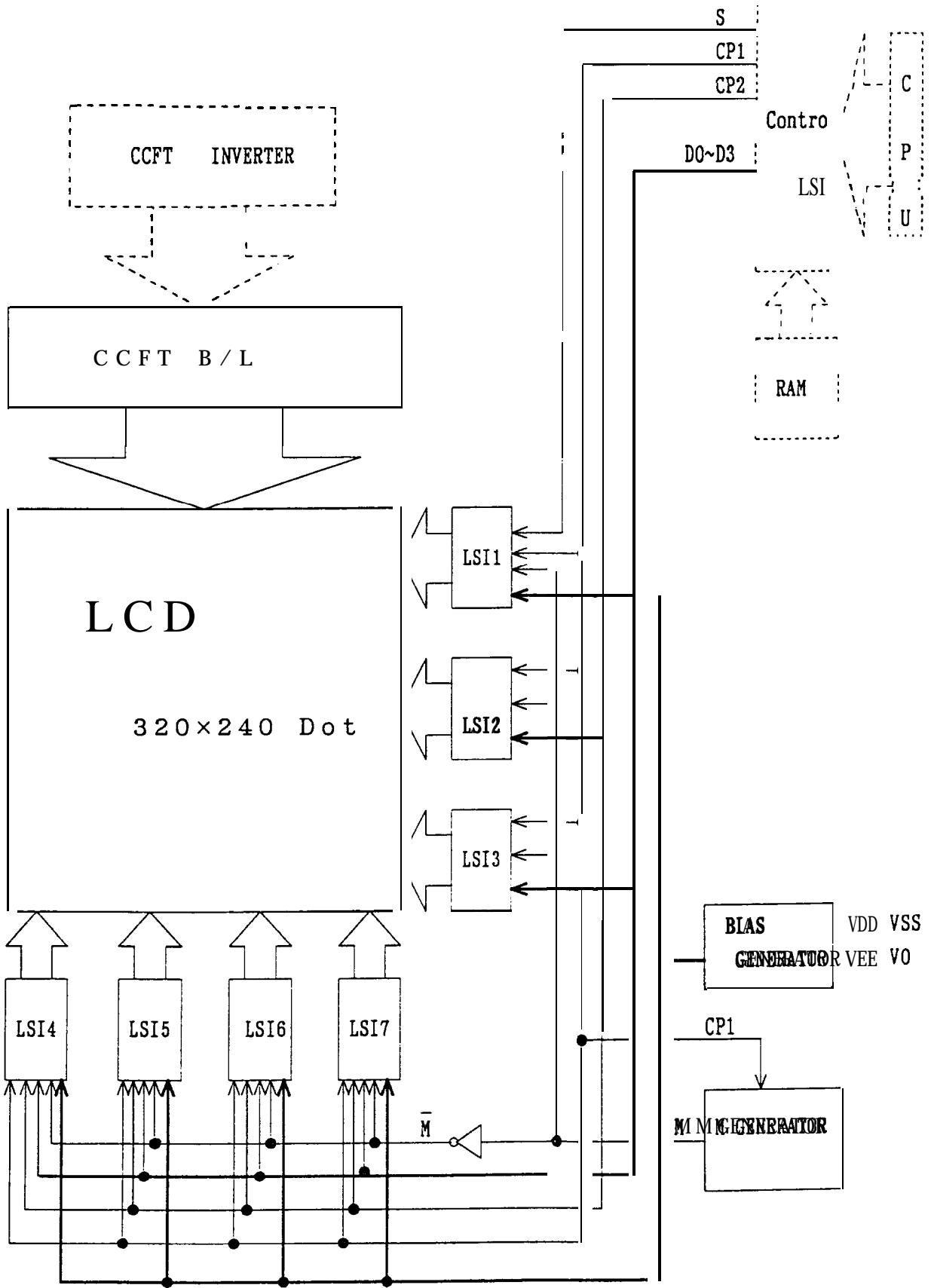


Fig. 8 Circuit Block Diagram



## 8. Precautions

### 8-1. Angle when installing the unit

This unit's viewing angle is illustrated in Fig.9.

$$\theta_1 < \text{viewing range} < \theta_2 \quad (\theta_1 < 0^\circ, \theta_2 \geq 0^\circ)$$

Please consider the optimum viewing conditions according to the purpose when installing the unit.

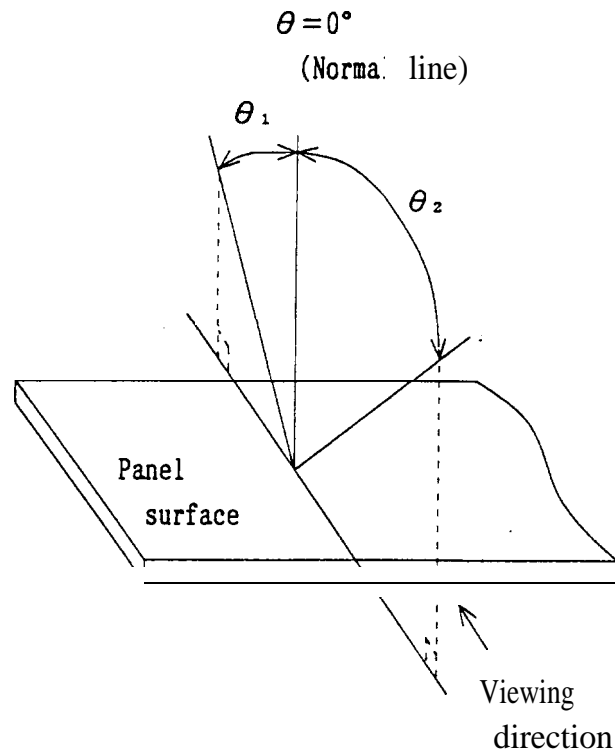


Fig. 9 Dot matrix LCD viewing angle

### 8-2. Handling cautions

This unit is installed using mounting tabs at the four corners of PCB or bezel.

When installing the unit, pay attention and handle carefully not to allow any undue stress such as twist or bend.

A transparent acrylic resin board or other type of protective panel should be attached to the front of the unit to protect the polarizer, LCD cells, etc.

### 8-3, Notes on attachment

- (1) Since the front polarizer is easily damaged, please pay attention not to scratch on its face.
- (2) If the surface of the LCD cells need to be cleaned, wipe it swiftly with cotton or other soft cloth. If still not completely clear, blow on it and wipe,
- (3) Water droplets, etc. must be wiped off immediately since they may cause color changes, stain, etc. if remained for a long time,
- (4) Since LCD is made of glass plates, dropping the unit or banging it against hard objects may cause cracking the or fragmentation,
- (5) CMOS LSIs are equipped in this unit, so care must be taken to avoid the electro-static charge, by earthing human body, etc. Take the following measures, to protect the unit from the electric discharge via mounting tabs from the main system electrified with static electricity,
  - (1) Earth the metallic case of the main system (contact of the unit and main system).
  - (2) Insulate the unit and main system by attaching insulating washers made of bakelite or nylon, etc.

### 8-4, Notes on operation

- (1) The unit should be driven according to the specified ratings to avoid malfunction of permanent damage. DC voltage drive leads to rapid deterioration of LC, so ensure that the drive is alternating waveform by continuous application of the signal M. Especially the power ON/OFF sequence shown on next page shall be followed to avoid latch-up of driver LSIs and application of DC voltage to LCD panel.

### 8-5, Others

- (1) Avoid to expose the unit to the direct sun-light, strong ultraviolet light, etc. for a long time.
- (2) If stored at temperatures below specified storage temperature, the LC may freeze and be deteriorated. If storage temperature exceed the specified rating, the molecular orientation of the LC may change to that of a liquid, and they may not return to their original state,
- (3) If the LCD panel is removed from the LCD unit, it may cause the poor contact, So please avoid to dismantle the unit,
- (4) Do' nt use any materials which emit gas from epoxy resin (amines hardener) and silicon adhesive agent (deanol or deoxym) to prevent change polarizer color owing to gas,

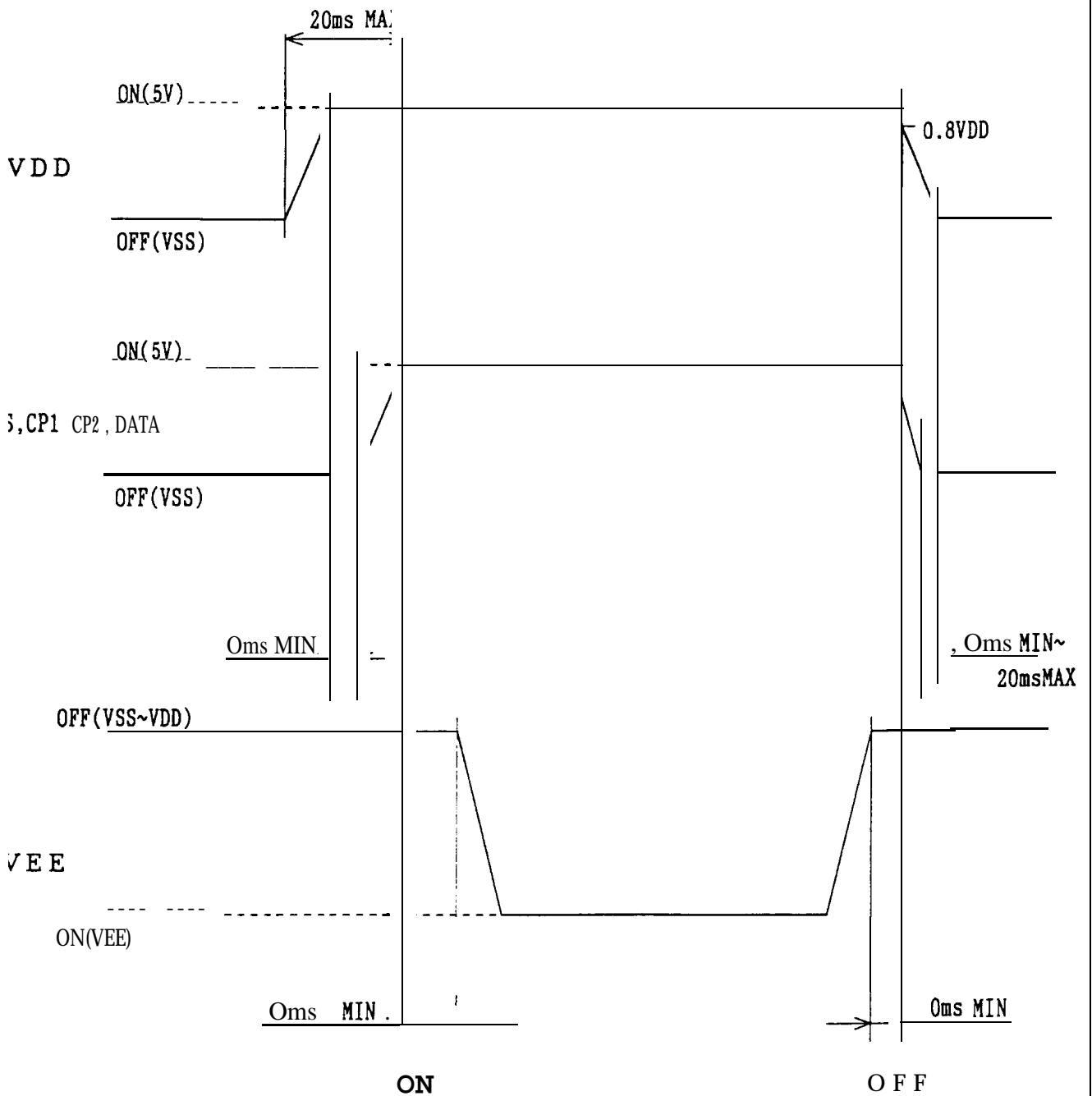


Fig. 10 Power ON/OFF sequence