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DEVICE SPECIFICATION for
 Passive **Matrix** LCD Unit
 (320x240 dots)

Model No.
LM32P1 ○

CUSTOMER'S APPROVAL

DATE _____

BY _____



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SHARP

MODEL No.

LM32P10

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1. Application

This data sheet is to introduce the specification of LM32P10,
Passive Matrix **type** LCD Unit.
(320x240 dot, Triple Super Twisted **Nematic**, negative **type**, with cold cathode
fluorescent **tube (CCFT)** backlight system,)

2. Construction and Outline

Construction : 320x240 full dot graphic **display** unit
Outline : See **Fig. 8** .
Connection : See **Fig. 8** , and **Table. 5** .

There shall be no scratches, stains, chips, distortions and other external
artifacts 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	148 (W) x 96 (H) x 8MAX (D) Note1	mm
Effective viewing area	100 (W) x 76(H)	mm
Display format	320 (W) x 240(H) full dot	
Dot size	0,28(W) x 0.28(H)	mm
Dot spacing	0.02	mm
Character color	White Note2	—
Background color	Black Note2	—
Weight	Approx. 140	g

Note1 : Excluded the mounting tab. (See Fig. 8)

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

Display Data “H” : Dot on : White
 “L” : Dot 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 °C
△ Supply voltage (LCD Driver)	$V_{DD}-V_{XX}$	0	28.5	V	
Input voltage	V_{IN}	0	V_{DD}	V	
Supply voltage (CCFT)	VCCFT	0	1500	Vrms	
Supply current (CCFT)	ICCF	0	6.5	mA rms	

4-2. Environmental Condition



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\text{ °C}$90 % RH Max
 $T_a > 40\text{ °C}$Absolute humidity shall be less than
 $T_a = 40\text{ °C} / 90\% \text{ RH}$

Note 2) These test conditions are in accordance with * [EC 82-2-6'
 Frequency : 10 ~ 55 Hz
 Vibration width : 1.5 mm
 Interval : 10HZ-55HZ-10HZ
 (1 rein)
 2 hours for each direction of X/Y/Z (6 hours as total]


Note 3) Acceleration : 490 m/s² (50 G)
 Pulse width : 11ms
 3 times for each direction of ±X/±Y/±Z.

5. Electrical Specifications

5.1 Electrical characteristics

Table 4

T_a=25 °C, V_{DD}=5 V±5 %

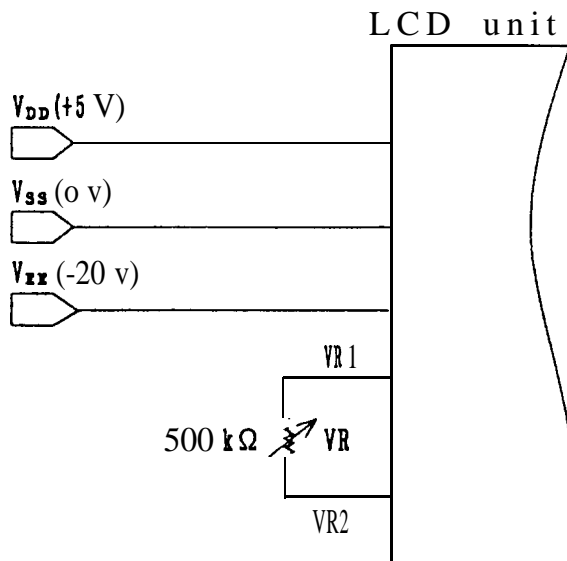
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage (Logic)	V _{DD} -V _{SS}		4.75	5.0	5.25	v
Supply voltage (LCD drive)	V _{XX} -V _{SS}	V _{DD} =5V (Note 1)	-21.0	-20.0	-19.0	v
Input signal voltage	V _{IN}	● Wlevel	0.8V _{DD}		V _{DD}	v
		'L' level	0	-	0.2V _{DD}	v
Input leakage current	I _{IL}	'H' level	-	-	20	μA
		'L' level	-20.0	-	-	μA
Supply current (Logic)	I _{DD}	V _{DD} =5 V, V _{XX} =-20 V	-	9	18	mA
Supply current (LCD)	I _{XX}	VR=250 kΩ	-	7	14	MA
Power consumption (LCD)	PdLCD	F=80 Hz (Note 2)	-	185	370	mW
Start voltage (B/L) (Note 3)	V _{FTS}	inverter			1000	V _{rms}
Supply voltage (B/L)	V _{FTL}	LM00100	225	250	275	V _{rms}
Supply current (B/L)	I _{FT}	input voltage 10V	4	5	6	mA _{rms}
Power consumption (B/L)	PdFT	adjust resistor 20 kΩ 		1.25		w

Note 1) The viewing angle(θ) where obtains the maximum contrast can be set by adjusting variable resistor between VR1 and VR2.

Refer to Fig. 4 for definition of θ.

Note 2) Display high frequency pattern,

Note 3) Start-up voltage of inverter.



5-2. Interface signals

CN1

Table 5

Pin No.	Symbols	Description	Level
1	S	Scan start-up signal	“ H ”
2	CP1	Input data latch signal	H>L
3	CP2	Data input clock signal	H>L
4	V _{DD}	Power supply for logic and LCD (+5v)	
5	V _{SS}	Ground potential(GND)	
6	V _{xx}	Power supply for LCD	-
7	DO	Display data signal	H (ON), L (OFF)
a	D1		
9	D2		
10	I D3		
11	VR1	LCD Contrast Adjust (A)	-
12	VR2	LCD Contrast Adjust (B)	

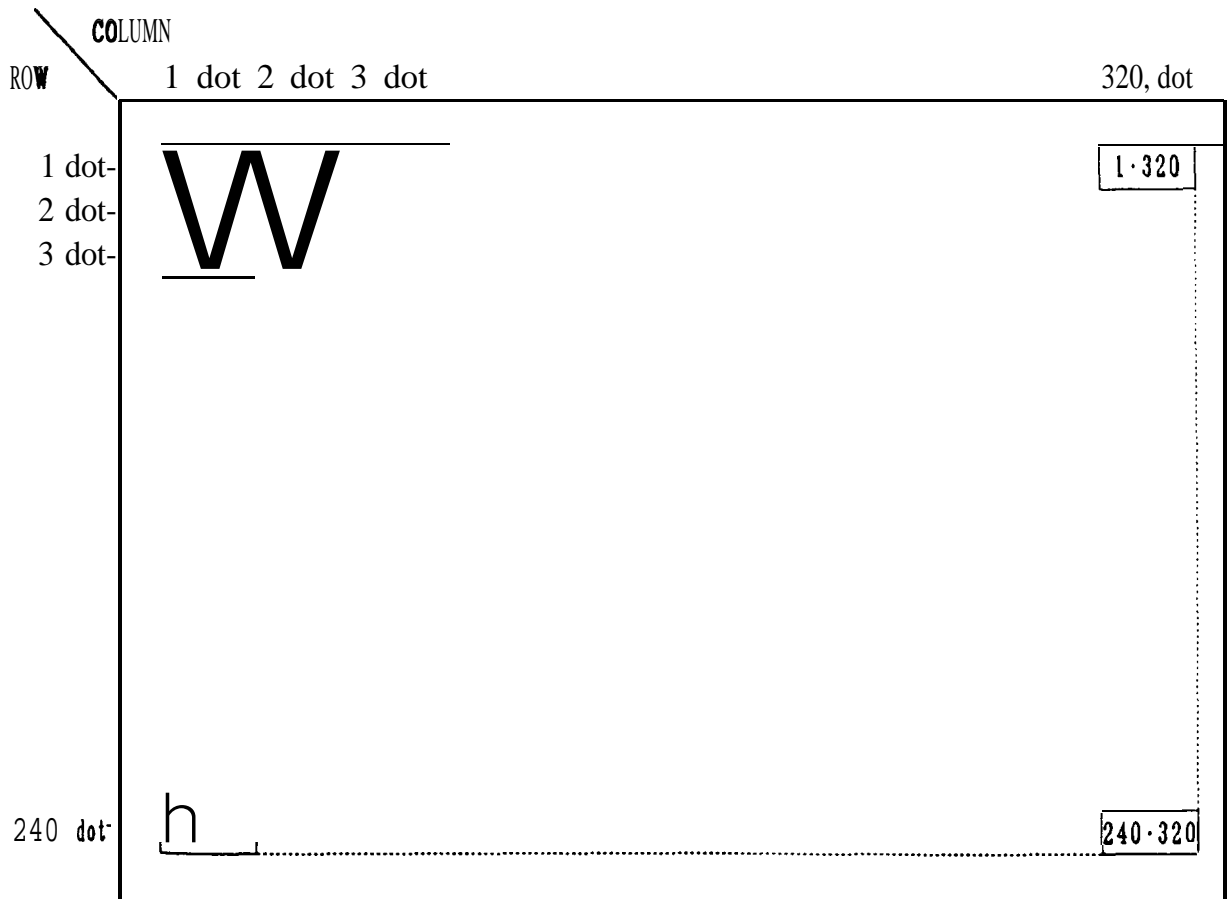
Connector : 52103 - 217 [Molex]

Mating Cable : 1.0 mm pitch, 12pins F.P.C

CN2

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

● 1 : Pin No, and its location are shown in Fig. 8,



Note) 102 means 1st row 2nd column dot.

Fig. 1 Dot Chart of Display Area

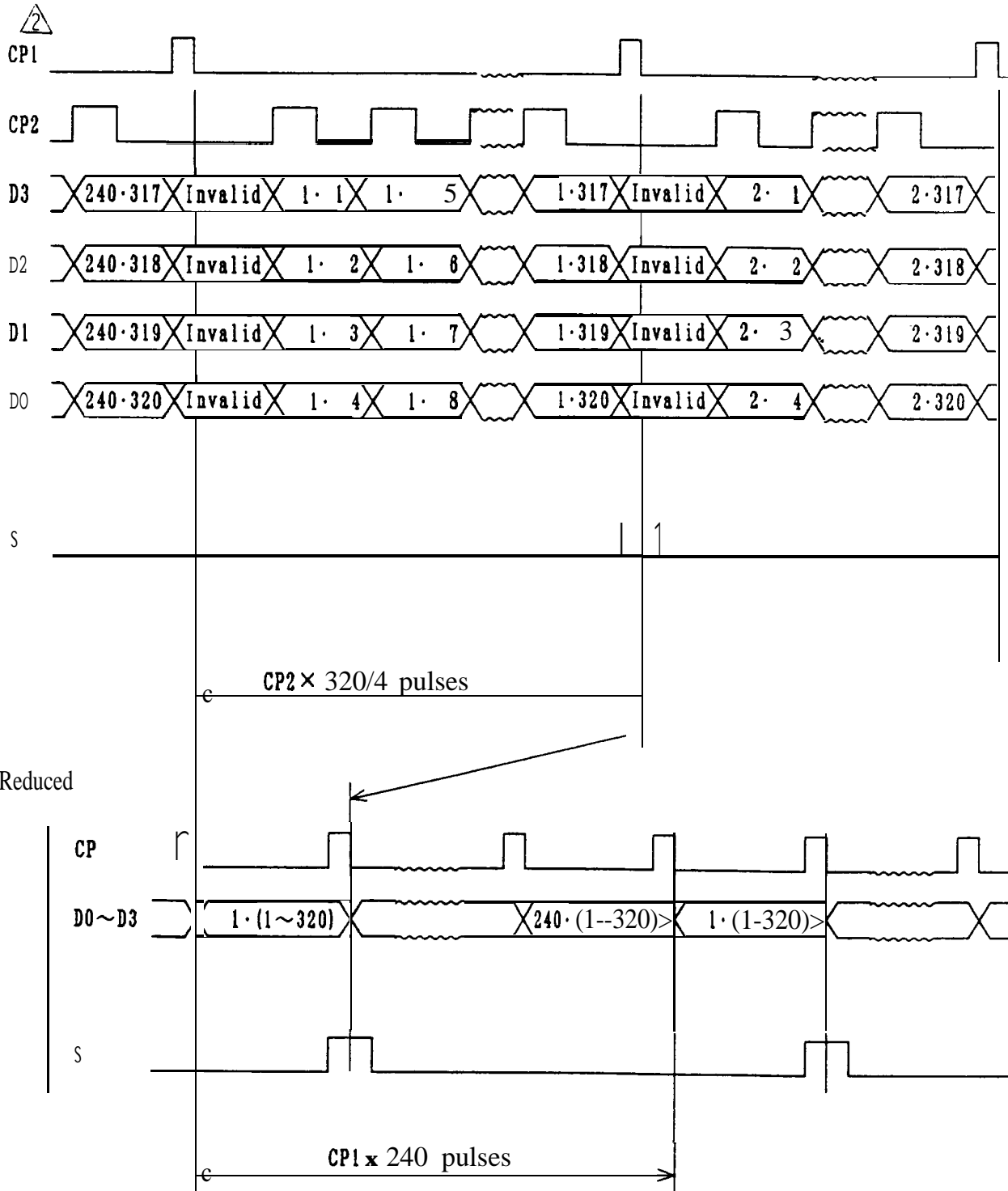


Fig. 2 Data Input Timing

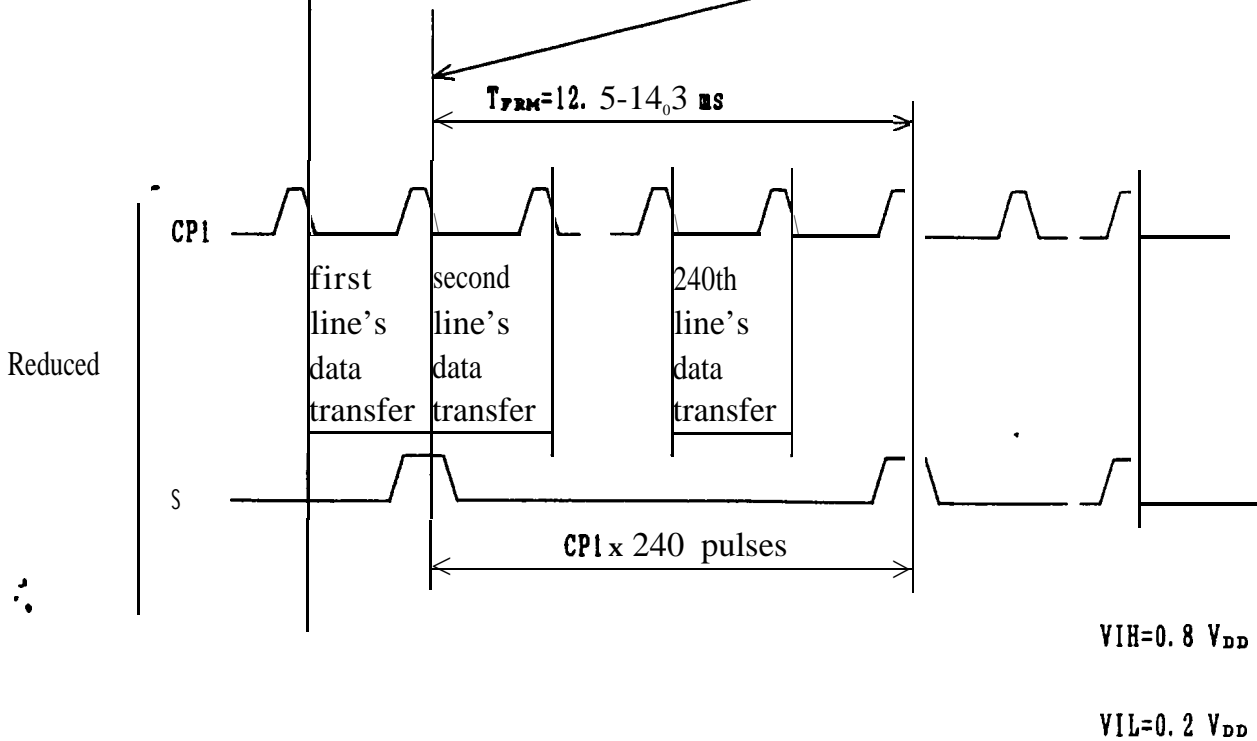
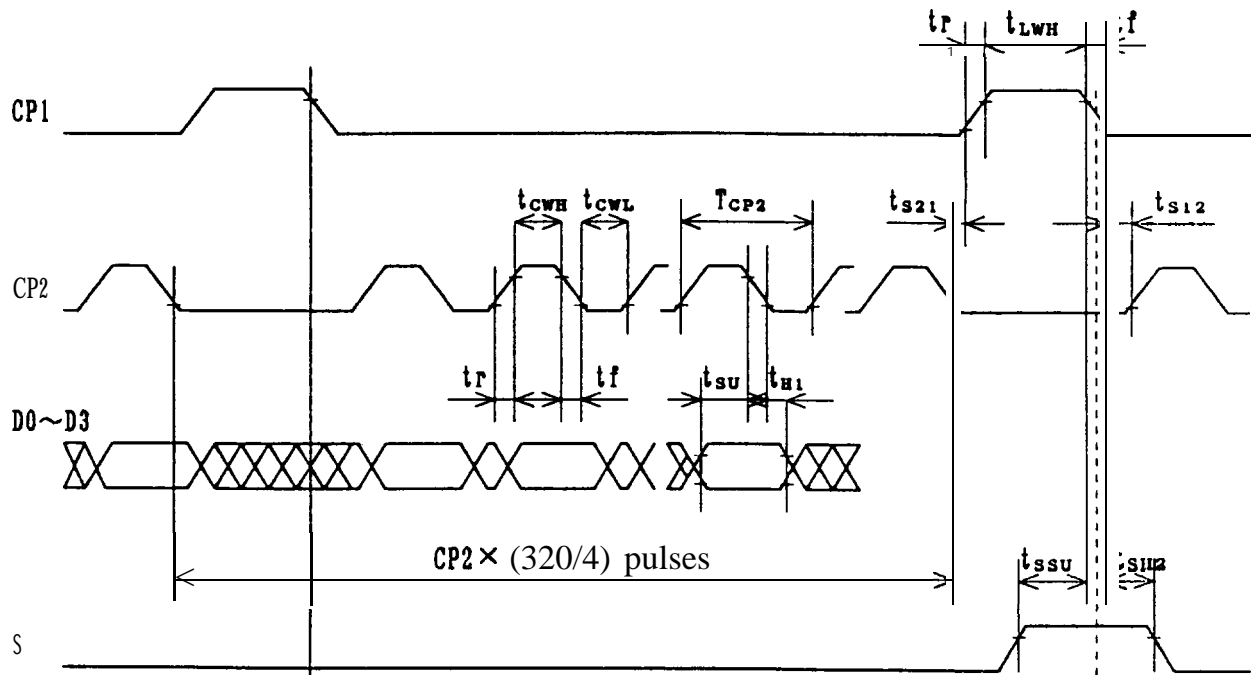


Fig. 3 Interface Timing Chart

Table. 6 Interface timing ratings

Item	Symbol	Rating			Unit
		MIN.	TYP.	MAX.	
Frame cycle	T_{FRM}	12.5		14.3	ns
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 \uparrow clock allowance time from CP1 \downarrow	t_{S12}	0		—	ns
CP1 \uparrow clock allowance time from CP2 \downarrow	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

0-1. Circuit Configuration

Fig. 7 shows the block diagram of the Unit's circuitry.

6-2. Display Face Configuration

The display face electrically consists of signal display segments of 320 × 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 row 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 row of display.

Such data input will be repeated down 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.

Since DC voltage, if applied to LCD panel, causes chemical reaction which will deteriorate LCD panel, drive waveform shall be inverted to prevent the generation of such DC voltage, To prevent this problem, AC waveform circuit generated by counting CP1(M generator) is built in this circuit,

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 (ϕ) is adjusted to 0 degrees.)

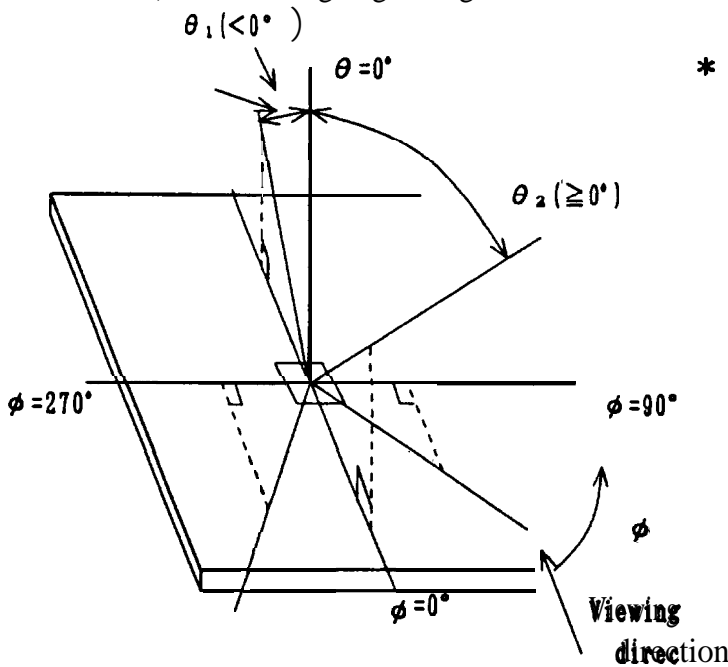


Table 7

$V_{DD}=5 V, T_a=25 \text{ }^\circ\text{C}$

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark				
Viewing angle range	$\theta_2 - \theta_1$	$\phi = 0^\circ$	$C_o \geq 4.0$	40	-	-	dgr.	Note 1			
	θ_1	$\theta_1 (\theta_2)$	$C_o = 4.0$	-	-	-20	dgr.	Note 1			
	θ_2			15	-	-	dgr.	Note 1			
	Viewing angle range	$\theta_2 - \theta_1$	$\phi = 90^\circ$	$C_o \geq 4.0$	45	-	-	dgr.	Note 1		
		θ_1			$\theta_1 (\theta_2)$	$C_o = 4.0$	-	-	-20	dgr.	Note 1
		θ_2					20	-	-	dgr.	Note 1
Contrast ratio	CO	$\theta = 0^\circ, \phi = 0^\circ$	8.0	18.0	-	"	Note 2				
Response speed	τr	$\theta = 0^\circ, \phi = 0^\circ$	-	200	300	ms	Note 3				
	τd	$\theta = 0^\circ, \phi = 0^\circ$	-	200	300	ms	Note 3				

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



* Angles θ_1, θ_2 and ϕ 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 shown the optical characteristics detected when the LCD applied voltage waveforms are in the highest frequency ●.

- The most critical condition for the characteristics of LCD.

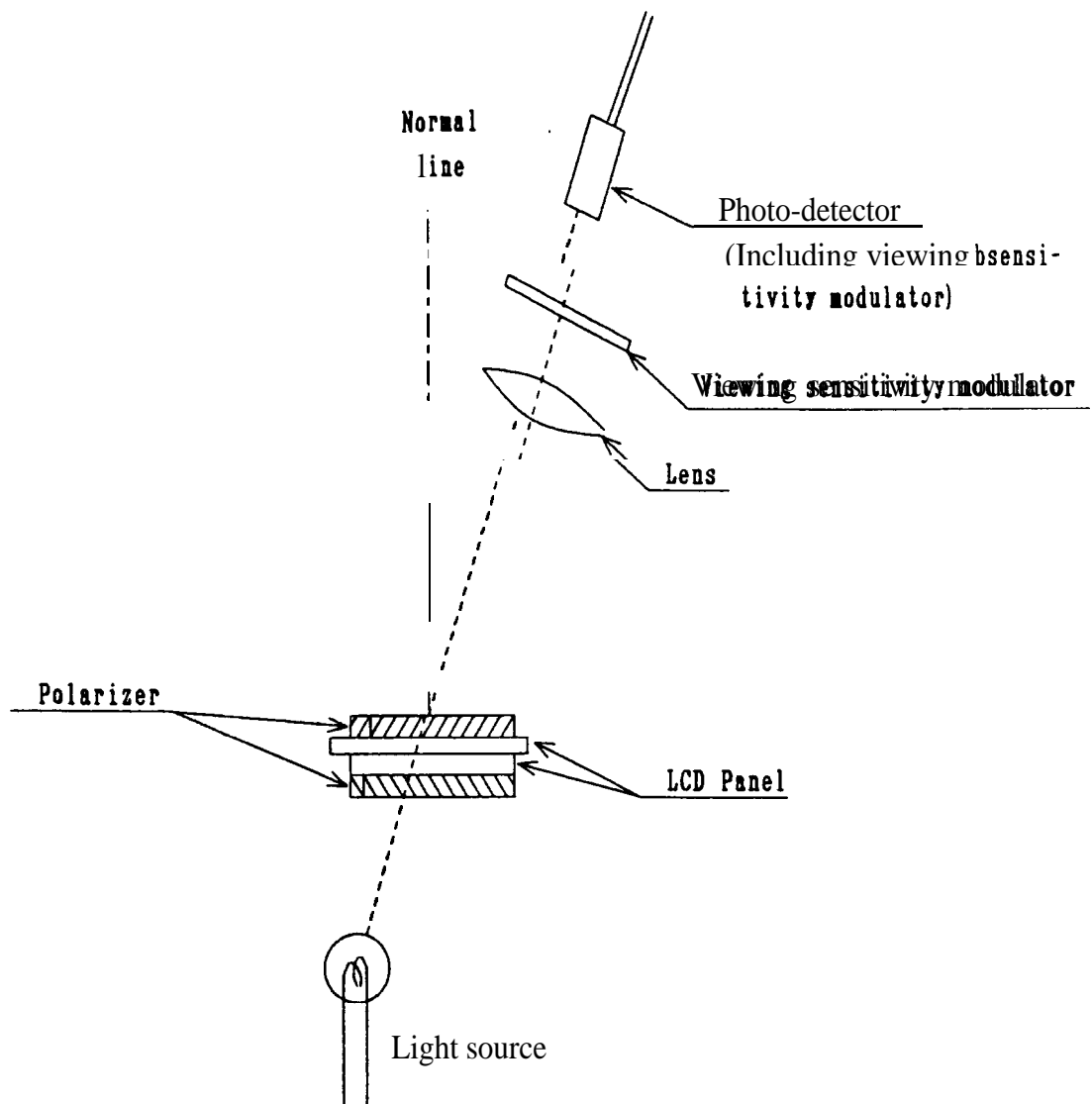


Fig. 5 Optical Characteristics Test Method

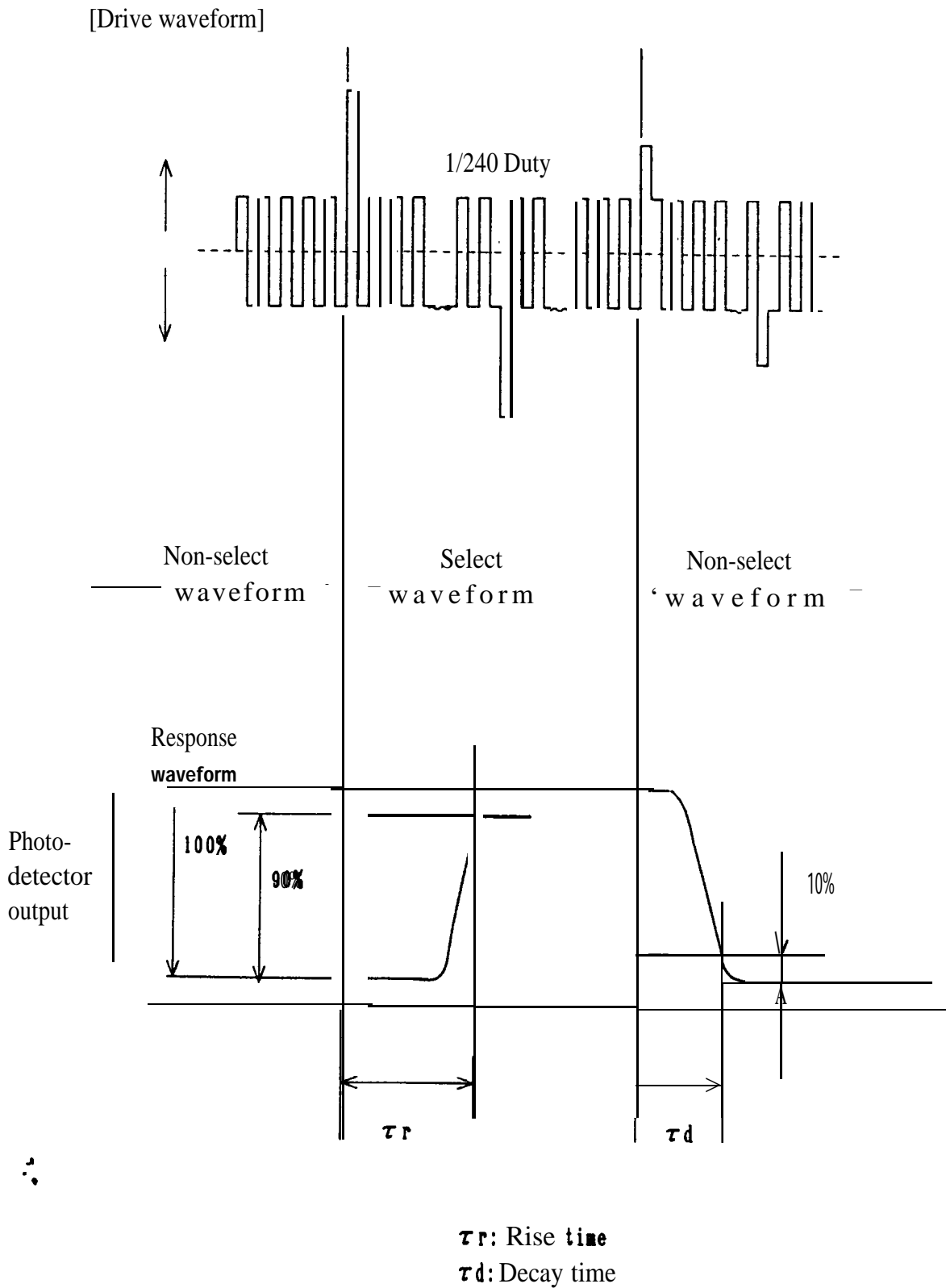


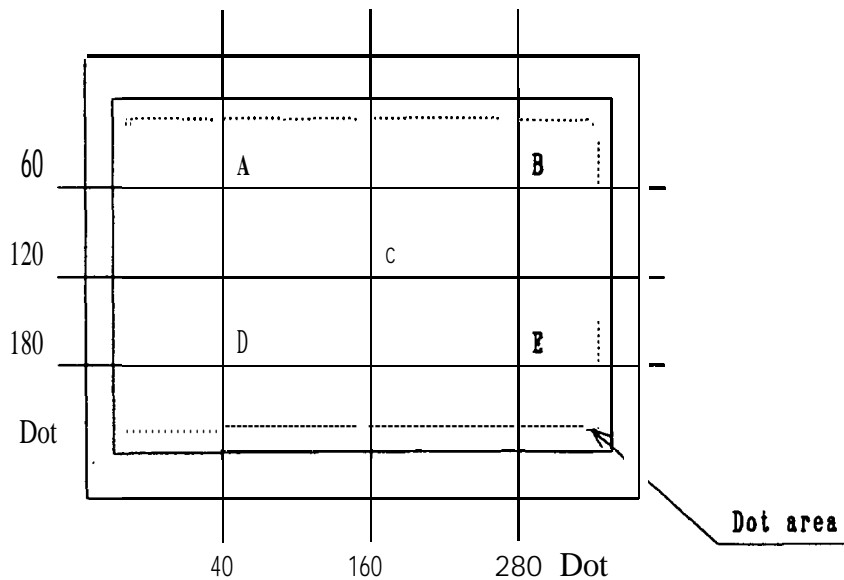
Fig. 6 Definition of Response Time

7-2. Characteristics of Backlight

(a) Brightness

Parameter	Min.	Typ.	Max.	Unit
Brightness	50	70	-	Cd/m ²

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



(b) Measurement condition

CCFT inverter : LM000106

INPUT voltage=12.0V

IFT=5 mArms

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

V_{xx}=-20.0 v

Temperature : **T_a**=25 °C, 30 minutes after turning on.

Measurement equipment : BM-7 (TOPCON Corporation)

(c) Operating life time

- The operating life time is 10,000 hours **or more** under the following conditions.

CCFT inverter is LM000106

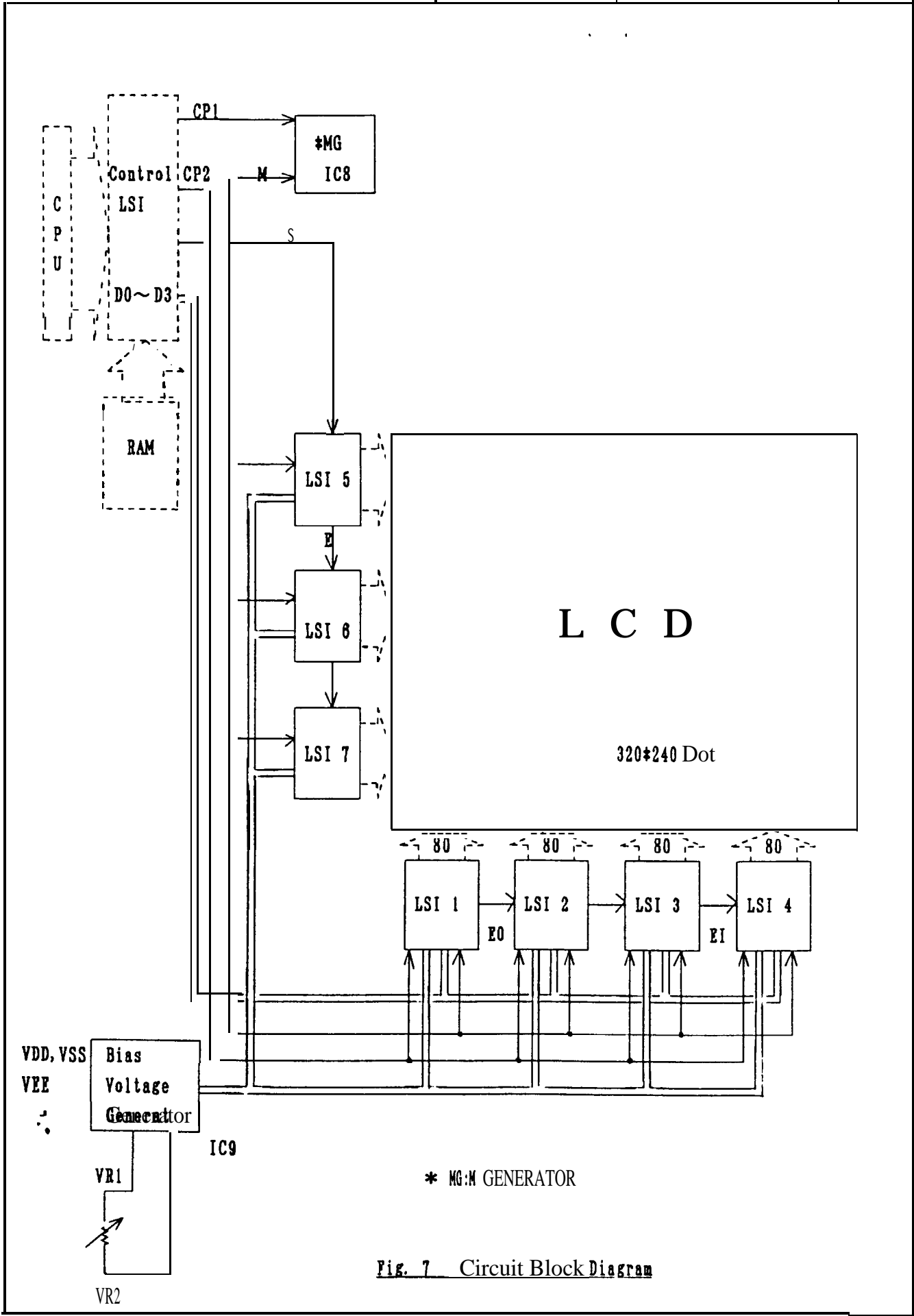
IFT=5 mArms

T_a=25±5 °C

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

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

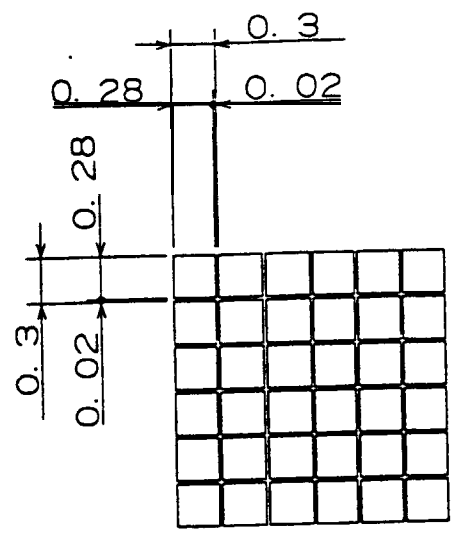
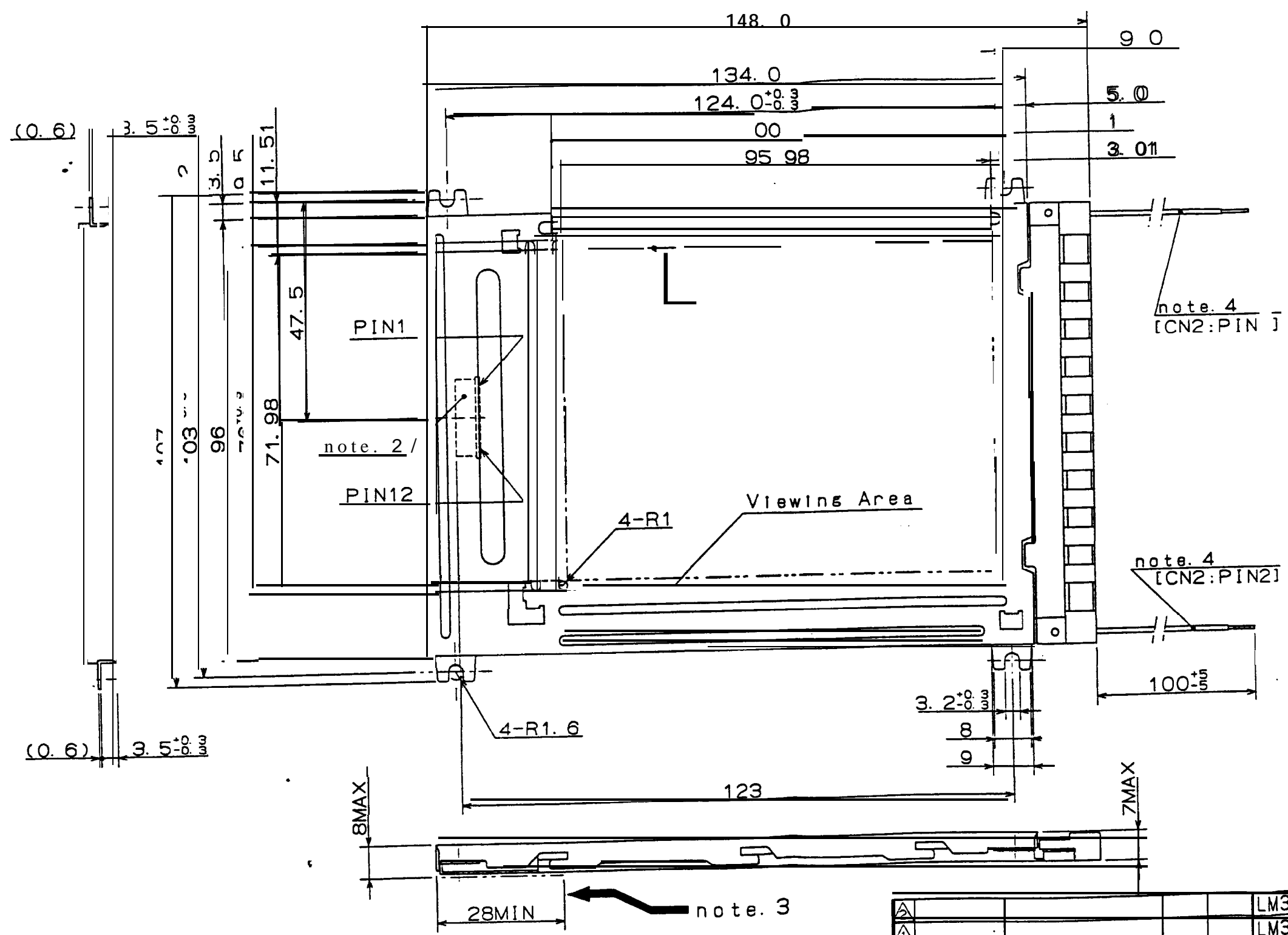
-When the **CCFT** light begins to flicker.



* MG:M GENERATOR

Fig. 7 Circuit Block Diagram

DOT SIZE (20/1)



PIN NO	SIMBOL
1	S
2	CP1
3	CP2
4	VDD
5	VSS
6	VEE
7	DO
8	D1
9	D2
10	D3
11	VR1
12	VR2

指示の公差は ±0.5とする
UNSPECIFIED TOL TO BE

- note 1. Bezel is Plated by white-zinc.
 2. Connector: 52103-1217 [Molex]
 3. Cable is a insertion of direction.
 4. back light cable: UL3239. AWG22

Fig. 8

LM32P10		NAME		LCD MODULE
LM32010P		NAME		OUTLINE DIMENSIONS
DATE	REVISED	CHANGE NO.	REVISION	
MATERIAL	THICKNESS	FINISH	SCALE	
SHARP CORPORATION			DATE	92 Jun 21
シャープ株式会社 液晶(専本)			DRAWING No.	0D32010P401
先物部門 L.C.D Group				

8. Precautions

8-1. Angle when installing the unit

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

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

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

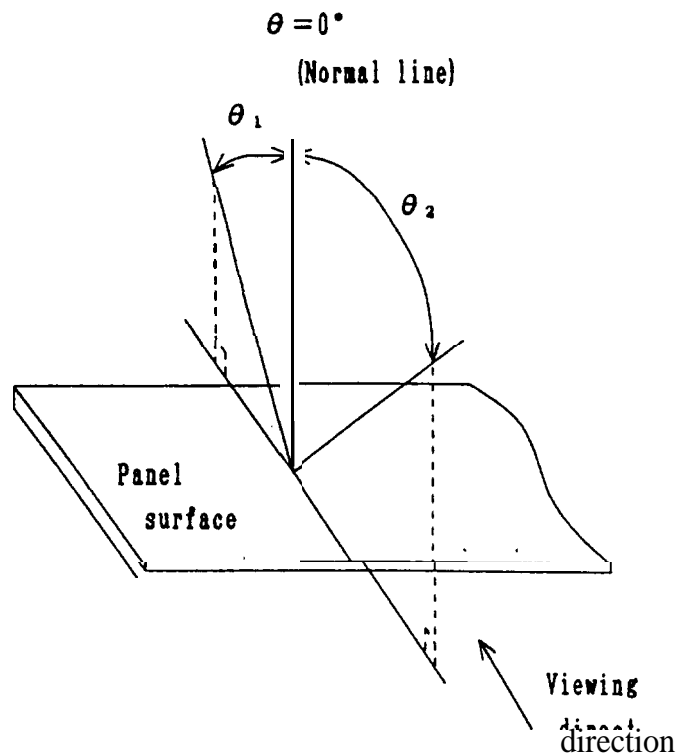


Fig. 9 Dot matrix LCD viewing angle

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, do not scratch its face,
- (2) If the surface of the LCD cells need to be cleaned, **wipe it gently** 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 **remain** for a long time,
- (4) Since LCD is made of glass plates, dropping the unit or banging it against hard objects **may** cause cracking or fragmentation.
- (5) CMOS LSIS are equipped in this unit, so care **must** be taken to avoid **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 exposing the unit to 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 deteriorate. [f storage temperatures exceed the specified rating, the molecular orientation of the **LC** may change to that of a liquid, and they **may** not revert to their original state,
- (3) If the LCD panel is removed from the LCD unit, poor **contact may result**. So please do not dismantle the unit,
- (4) Don't use any materials which emit following gas **from epoxy resin (amines hardener)** and silicon adhesive agent (**decalcohol or deoxym**) to prevent polarizer color change due to gas,

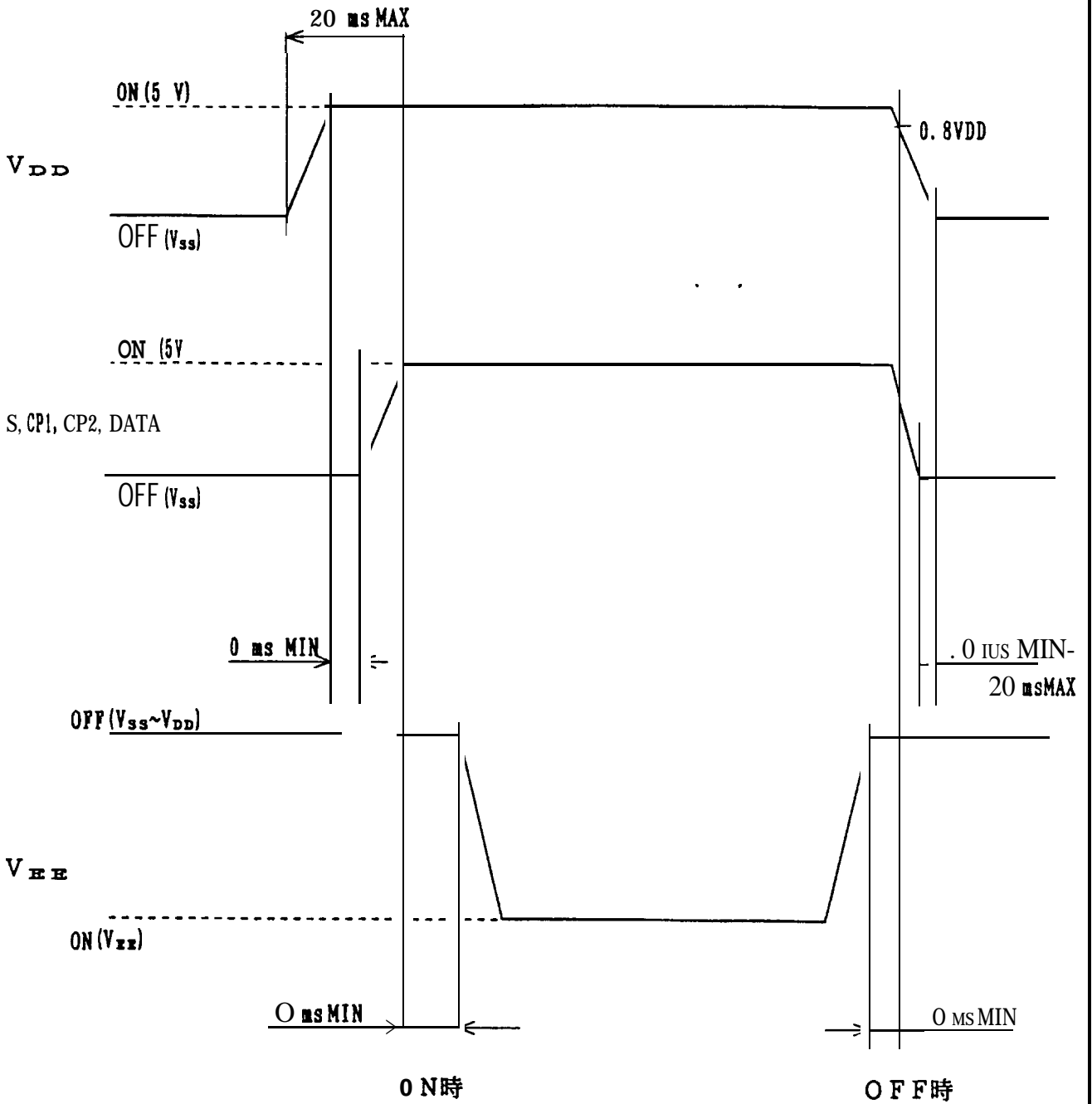


Fig. 10 Power ON/OFF sequence