

PREPARED BY: . DATE	<p style="text-align: center;">SHARP</p> <p style="text-align: center;">LIQUID CRYSTAL DISPLAY GROUP SHARP CORPORATION</p> <p style="text-align: center;">S P E C I F I C A T I O N</p>	SPEC No, LC93028 B
APPROVED BY: DATE		FILE No.
		ISSUE Jun. 22, 1993
		PAGE 20 Pages
		REPRESENTATIVE DIVISION <input checked="" type="checkbox"/> DUTY Panel Development Center

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

Model No.
LM32P07

.ICUSTOMER' S APPROVAL

DATE _____

BY _____

PRESENTED
BY *Y. Inoue*
Y. Inoue

Department General Manager
Engineering Department 2
DUTY Panel Development Center
LCD GROUP
SHARP CORPORATION

SHARP

RECORDS OF REVISION

MODEL No.

LM32P07

DOC. FIRST ISSUE

Jun. 22, 1993

IDENT. DATA No.

LC93628B

DATE	REF. PAGE PARAGRAPH DRAWING No.	REVISED No.	SUMMARY	CHECK & APPROVAL
Dec, 3,1993	Page. 2	△	Alteration	<i>Y. Iwano</i>
Dec. 3,1993	Page. 4	△	Addition and alteration	<i>Y. Iwano</i>
MAR, 16, 1994	Page. 4, Page 12	△	Amendment	<i>M. KIKU, 10</i>

1. Application

This data sheet is to introduce the specification of **LM32P07**,
Passive Matrix type LCD Unit,
(320x240 dot, TST, 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, 5,8.

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 (H) x 8MAX (D) Note1	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 Note3	—
Background color	Black Note2	—
Weight	approx 220	g

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

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

Note3 : Display data 'High' : White (ON)
'Low' : Black (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	6.0	v	Ta=25°C
Supply voltage (LCD Driver)	$V_{DD} - V_{EE}$	0	30.0	v	
Input voltage	V_{IN}	0	V_{DD}	v	
Supply voltage (CCFT)	VCCFT	0	1500	Vrms	
Supply current (CCFT)	ICCFT	0	6.5	mA rms	

A

\$ Under the LCD contrast adjust circuit of Page 4.

4-2, Environmental Condition

Table 3

Item	Tstg		Topr		Remark
	MIN.	MAX.	MIN.	MAX.	
Ambient temperature	-25°C	+60°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) 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) Acceleration : 490m/s² (50G)
 Pulse width : 1ms
 : 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. Electrical Specifications

5.1 Electrical characteristics

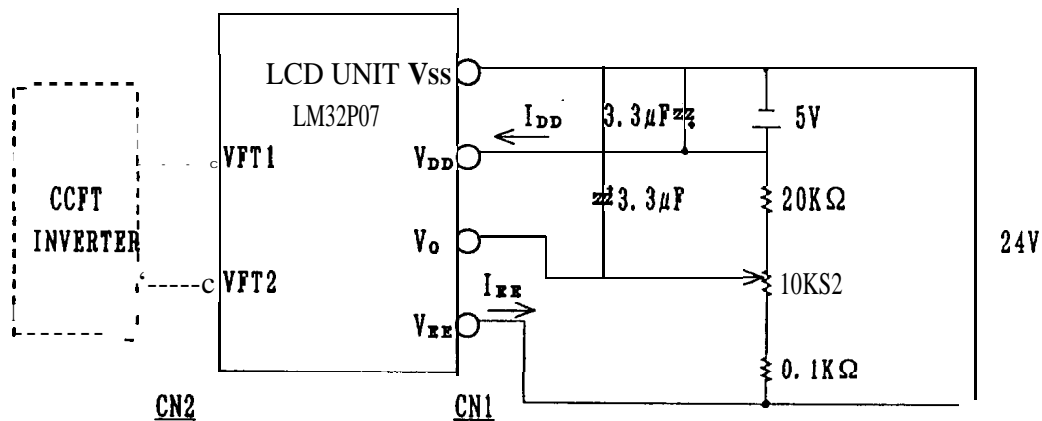
Table 4

Ta=25°C, VDD=5V±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 _{EE} -V _{SS}	V _{DD} =5V (Note 1)	-25.2	-24.0	-22.8	v
△△ LCD contrast adjust voltage	V _{DD} -V _O	V _{DD} =5V (Note 1)	17.5	21.5	25.5	V
Input signal voltage	V _{IN}	'H' level	0.8V _{DD}	-	V _{DD}	v
		'L' level	0	-	0.2V _{DD}	v
Input leakage current	I _{IL}	'N' level	-	-	20	μA
		'L' level	-20.0	-	-	μA
△△ Supply current (Logic)	I _{DD}	V _{DD} =5V, V _{EE} =-24V	-	7	9	mA
△△ Supply current (LCD)	I _{EE}	V _{DD} -V _O =21.5V	-	5.5	6.8	mA
△△ Power consumption (LCD)	P _{dLCD}	F=80Hz (Note 2)	-	167	208	mW
△△ Start voltage (B/L)	V _{FTS}	inverter	780		*780	Vrms
Supply voltage (B/L)	V _{FTL}	LM000-06	250	275	300	Vrms
Supply current (B/L)	I _{FT}	Input voltage 12v	4	5	6	mA _{rms}
Power consumption (B/L)	P _{dFT}	△	-	1.375		w

Note 1) The viewing angle(θ) with optimum contrast(6) is available by changing the LCD contrast adjust voltage (V_{DD}-V_O).
 (Refer to Fig.4 for the definition of θ.)
 Maximum and minimum value are as measured within the operating temperature range (0~45°C).
 Typical value are as measured at 25°C.

△ *start-up voltage of inverter



5-2. Interface signals

CN1

Table 5

Pin No.	Symbols	Description	Level
1	V_o	LCD contrast adjust voltage	
2	V_{EE}	Power supply for LCD (-24V)	
3	D3	Display data signal	H (ON), L (OFF)
4	D2		
5	D1		
6	D0		
7	NC		—
8	V_{SS}	Signal ground (0V)	
9	V_{DD}	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

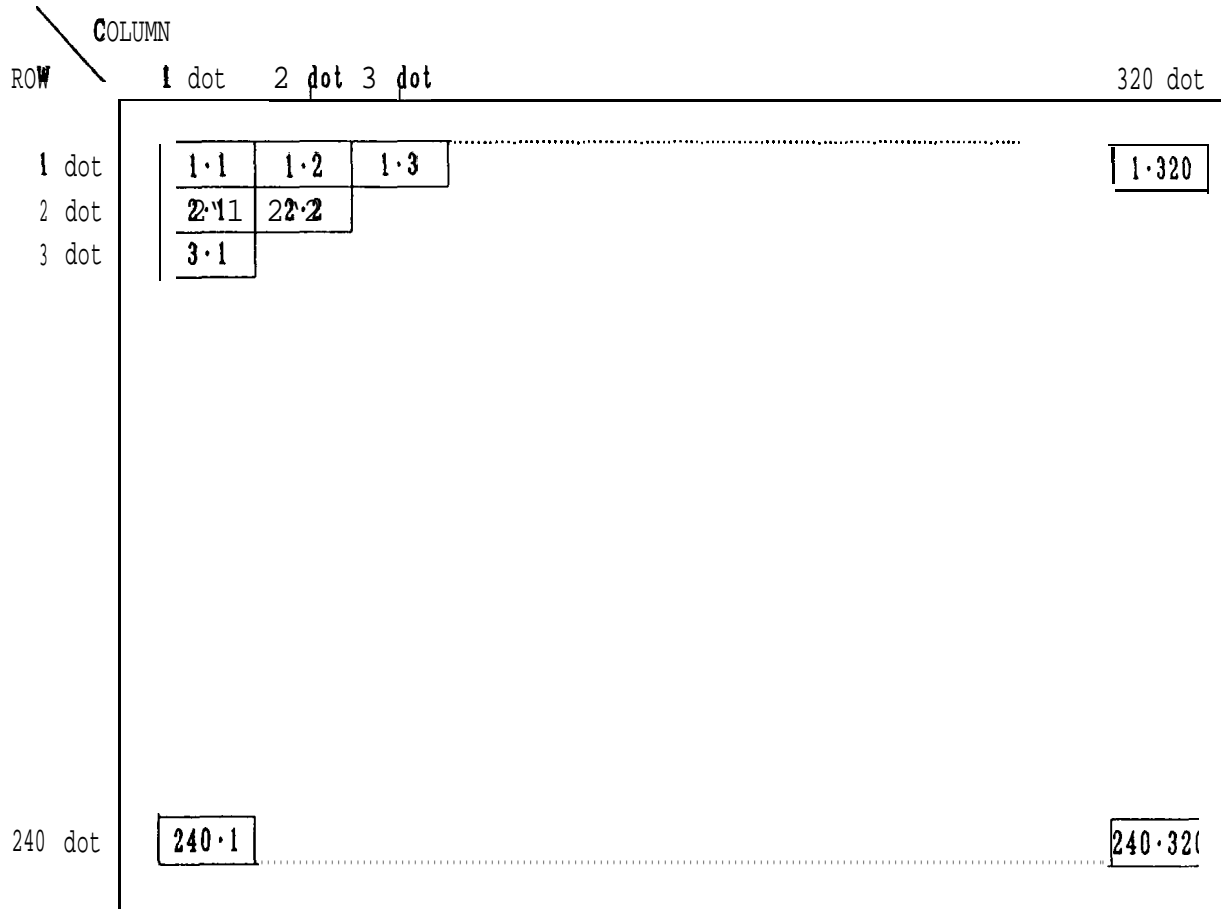
Table 6

CN2

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

Used Cable : AWG22UL 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

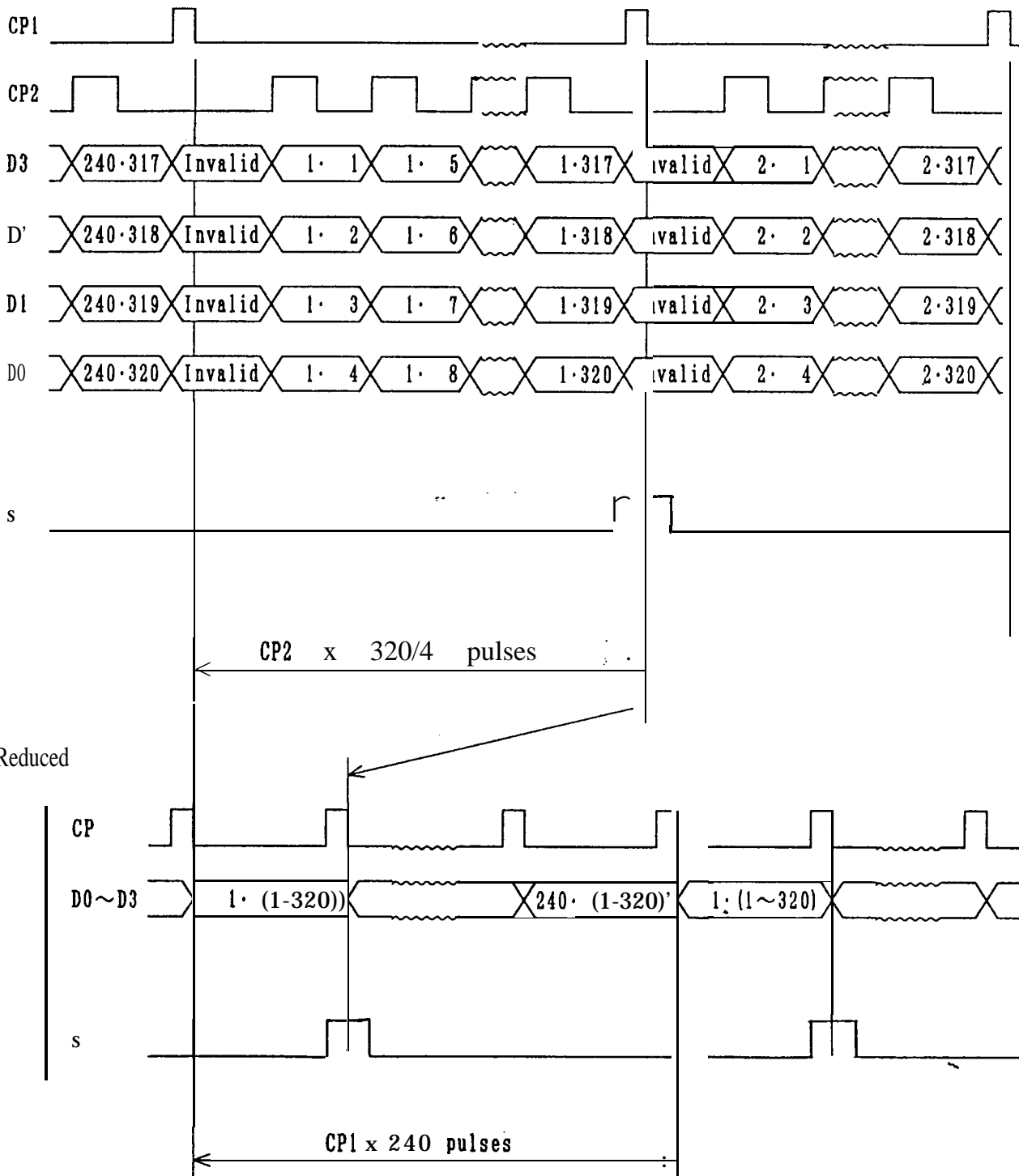
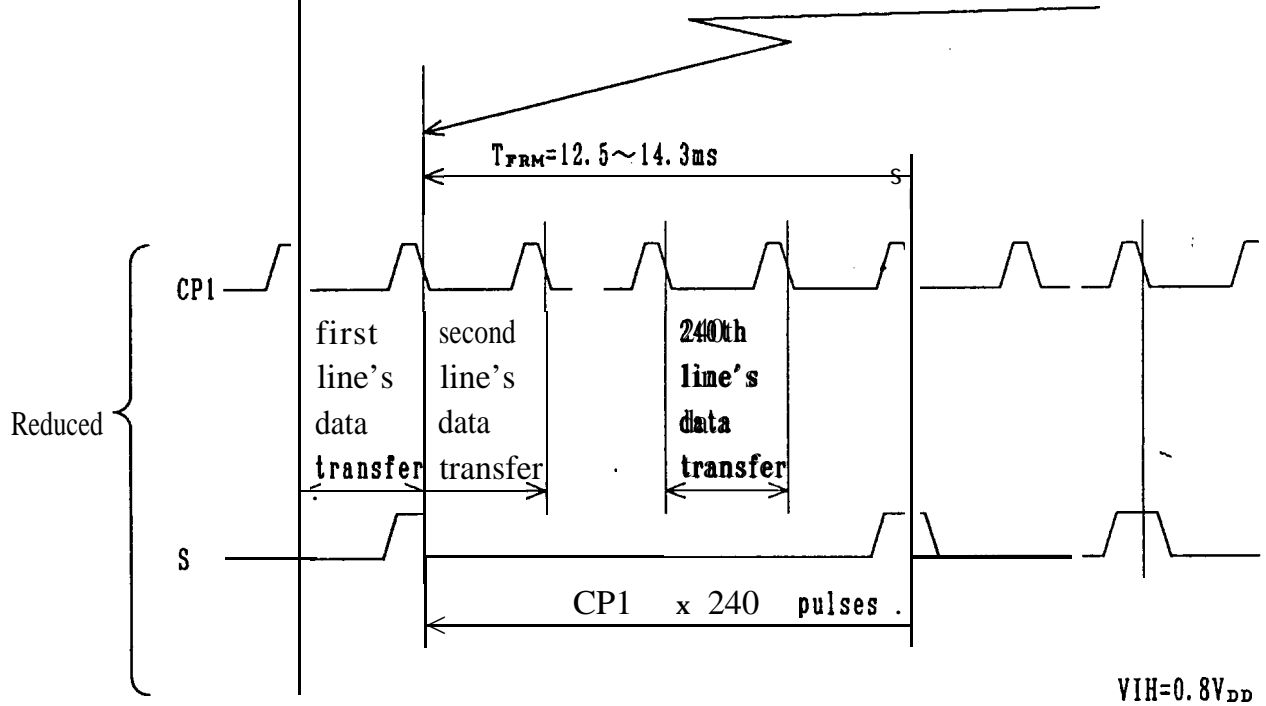
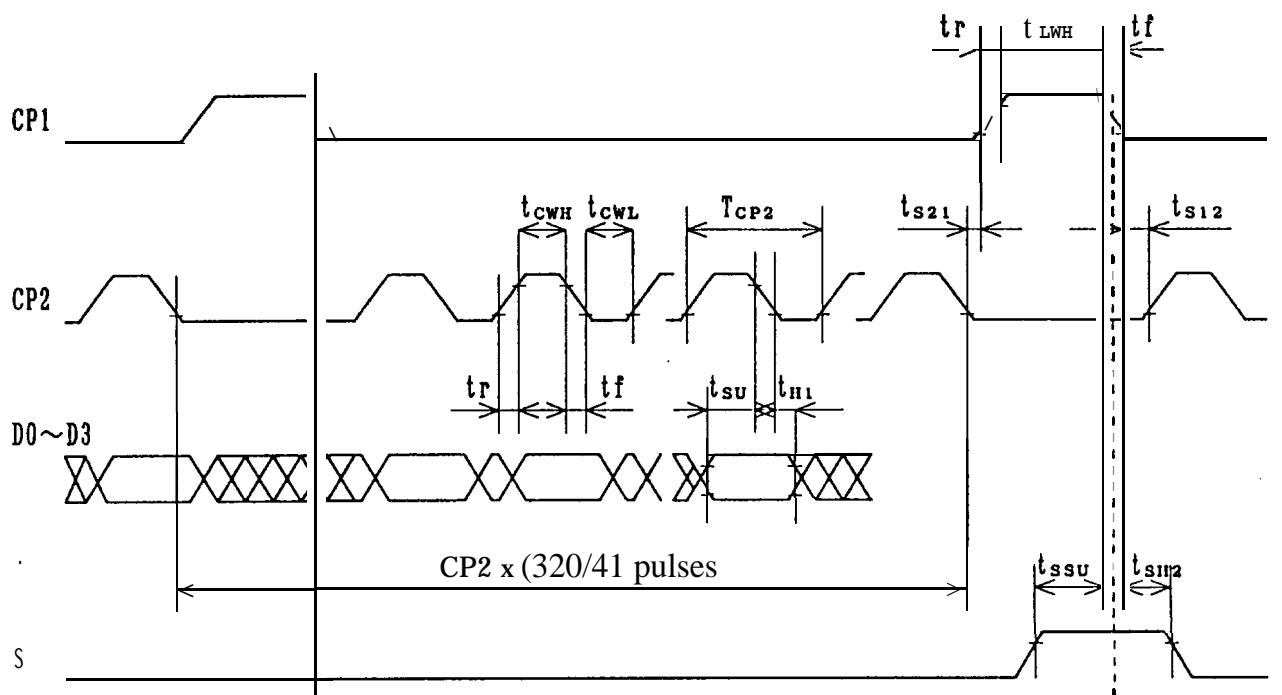


Fig. 2 Data Input Timing



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

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

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	s
CP2 clock cycle	T_{CP2}	152		=	ns
'H' level clock width	t_{CWH}	100		-	ns
'L' level clock width	t_{CWL}	100		-	ns
'N' 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	ms
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 electrical γ consists of signal display segment 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 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 $70 \sim 80\text{Hz/frame}$ 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 (ϕ) is adjusted to 0 degrees.)

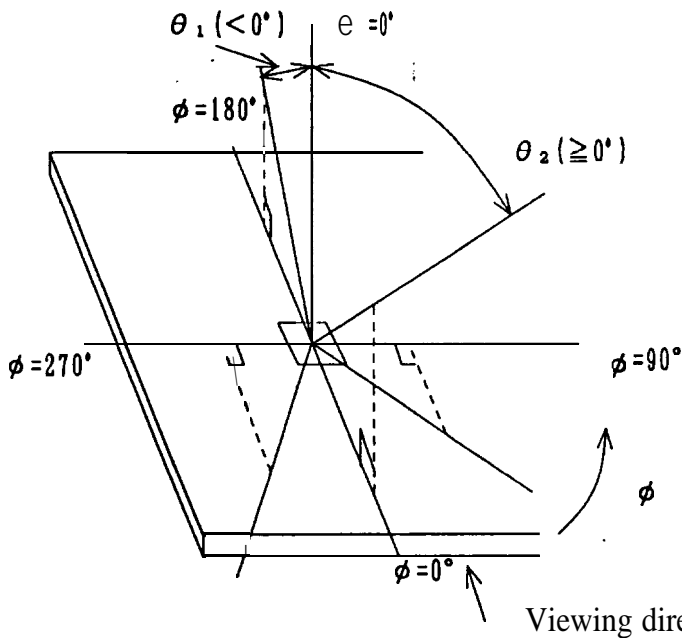
β

Table 7

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

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark	
Viewing angle range	$\theta_2 - \theta_1$	$\phi = 180^\circ$ $C_o \geq 4.0$	35	-	-	dgr.	Note 1	
	θ_1	$\theta_1 (\theta_2)$ $C_o = 4.0$	-	-	-20	dgr.	Note 1	
	θ_2		10	-	-	dgr.	Note 1	
	Viewing angle range	$\theta_2 - \theta_1$	$\phi = 270^\circ$ $C_o \geq 4.0$	50	-	-	dgr.	Note 1
		θ_1	$\theta_1 (\theta_2)$ $C_o = 4.0$	-	-	-25	dgr.	Note 1
		θ_2		25	-	-	dgr.	Note 1
Contrast ratio	C_o	$\theta = 0^\circ \setminus \phi = 180^\circ$	1080	18,0	-		Note 2	
Response speed	τr	$\theta = 0^\circ, \phi = 180^\circ$	-	70	120	's	Note 3	
	τd	$\theta = 0^\circ, \phi = 180^\circ$	-	80	130	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 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.

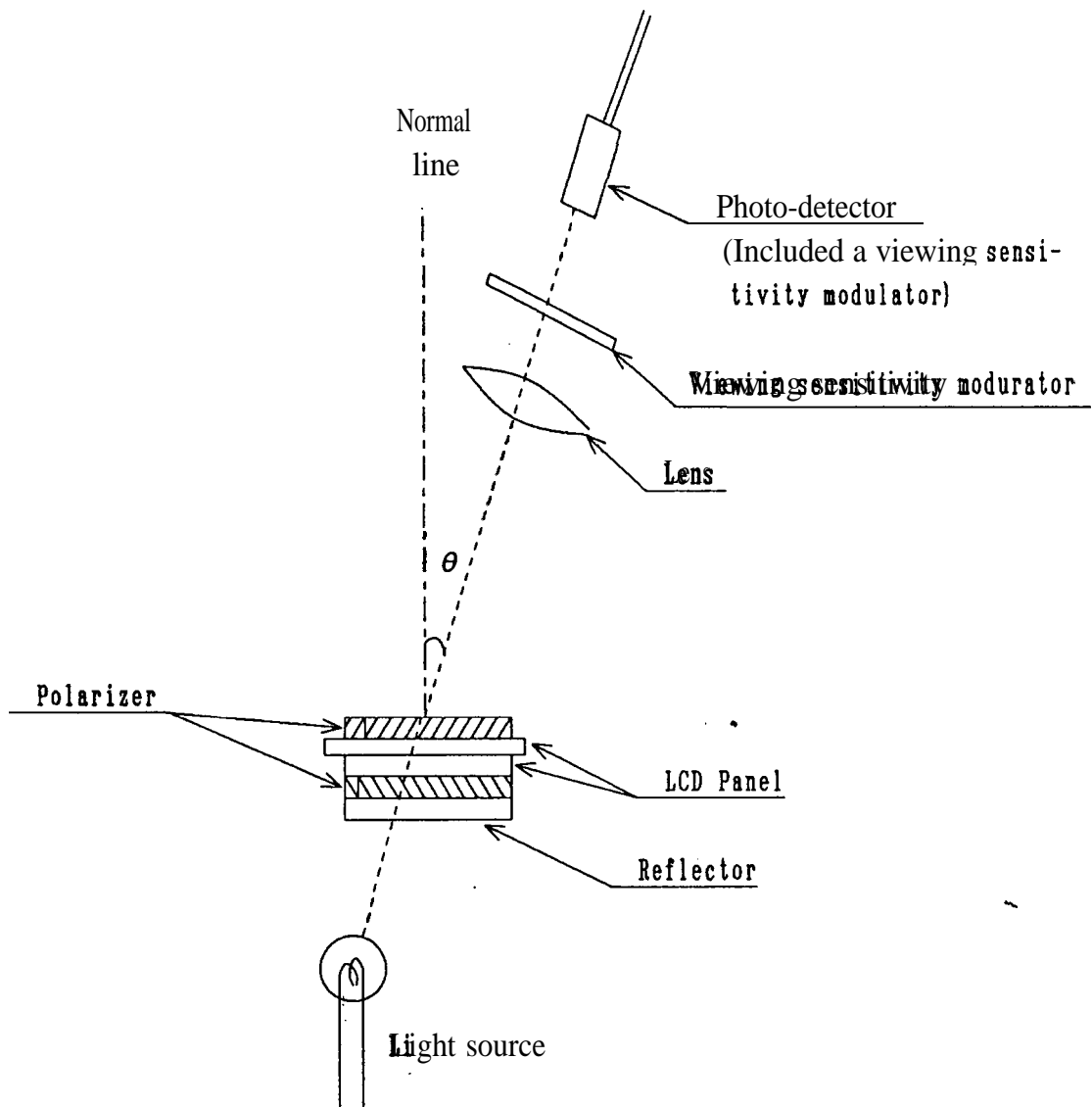
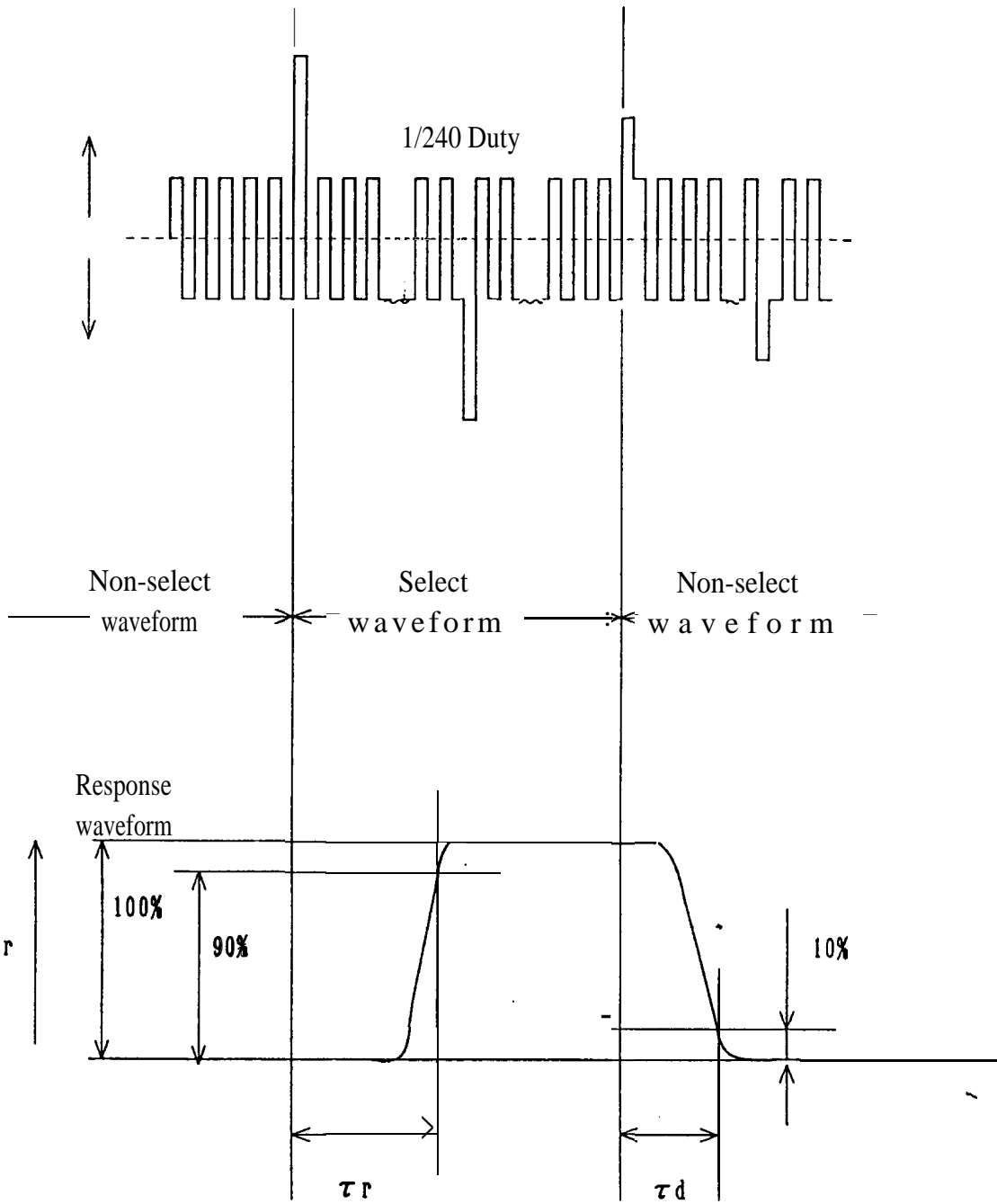


Fig. 5 Optics Characteristics Test Method

[Drive waveform]



τ_r : Rise time
 τ_d : Decay time

Fig. 6 Definition of Response Time

7-2. Characteristics of Backlightit

(a) Brightness

Parameter	Min.	Typ.	Max,	Unit
Brightness	45	60	—	Cd/m ²

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

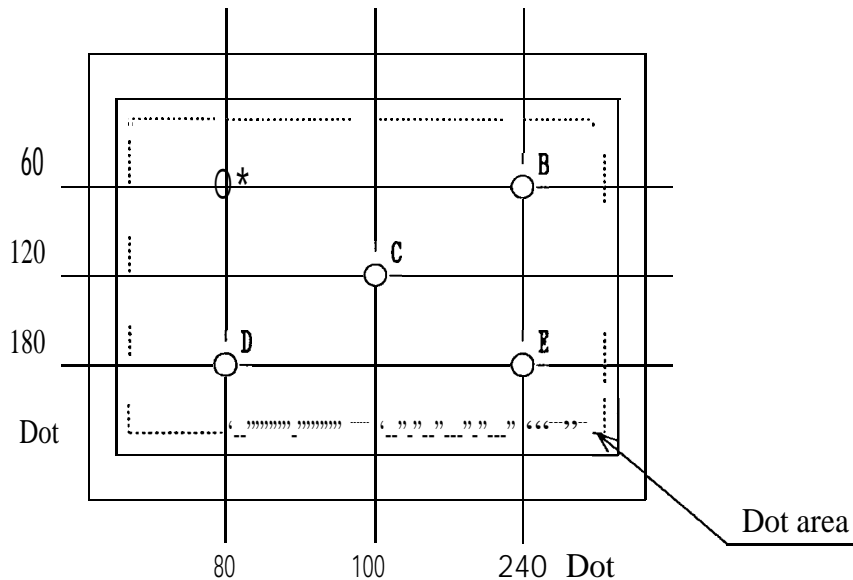


Fig. 7

(b) Measurement condition

CCFT inverter : LM000106

INPUT voltage 12.0V

$I_{PT}=5mA$

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

$V_{EE}=-24V$

Temperature : $T_a=25^{\circ}C$

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

$I_{PT}=5mA_{rms}$

$T_a=25 \pm 5^{\circ}C$

- 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 light of CCFT goes to flicker remarkable.

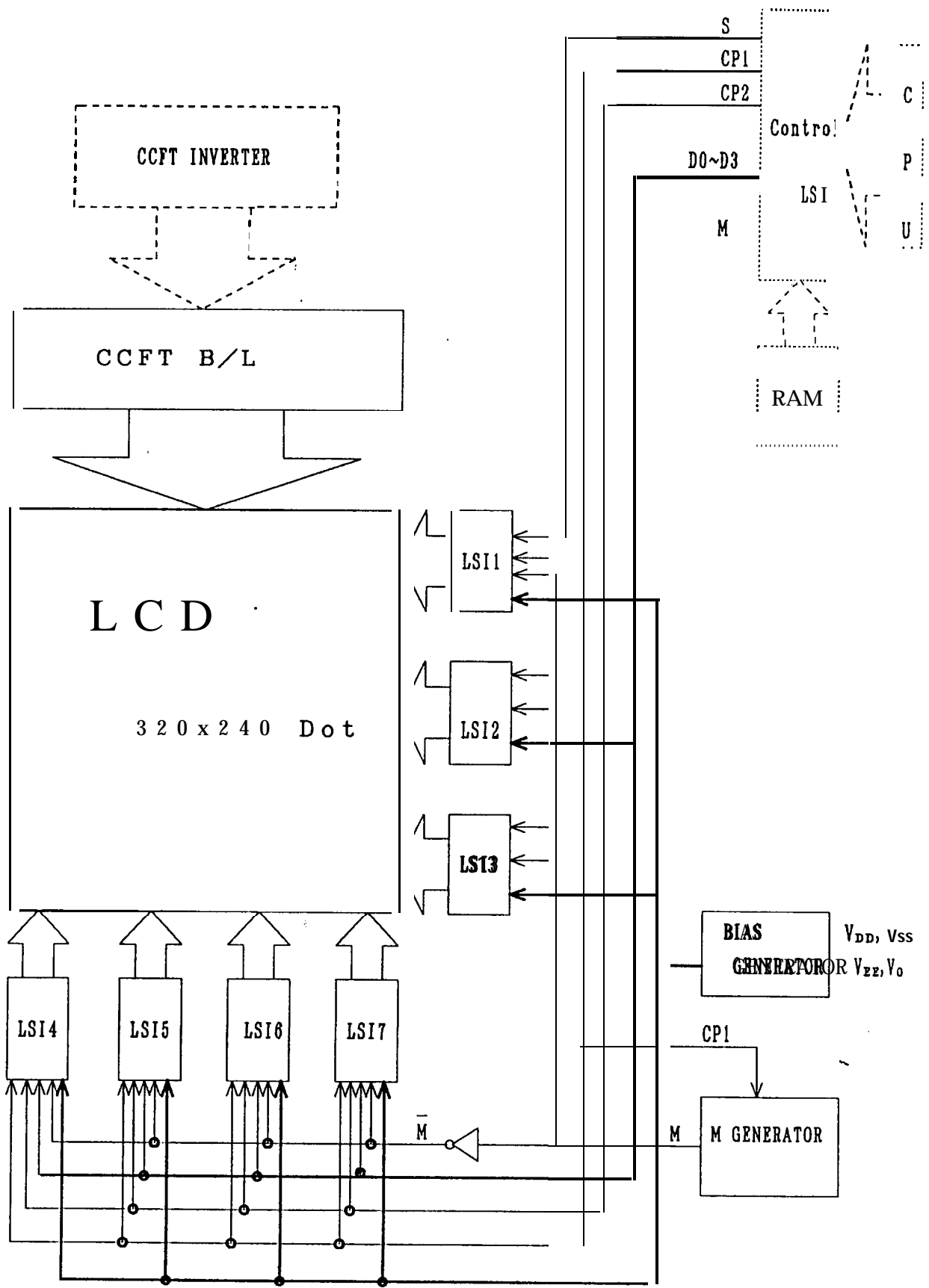


Fig. 8 Circuit Block Diagram

8, Precautions

8-1, Angle when installing the unit

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

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

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

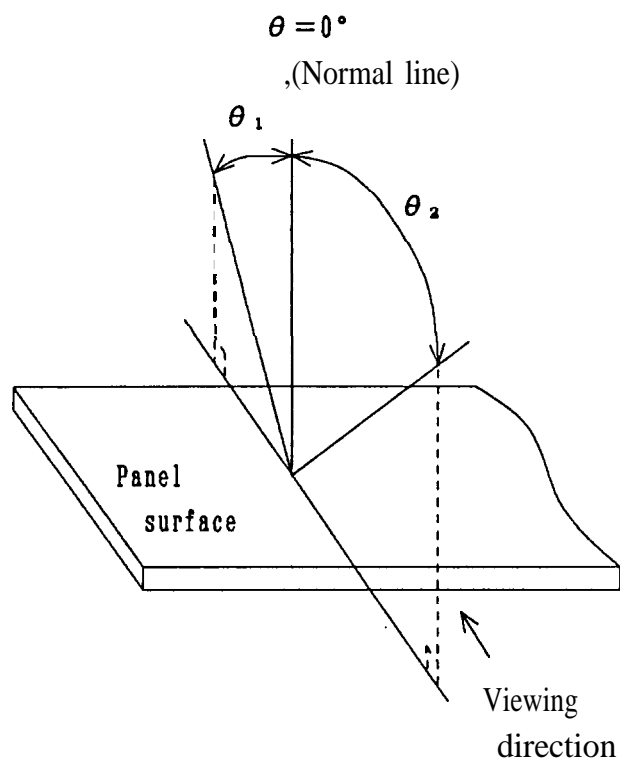


Fig. 9 Dot matrix LCD viewing angle .

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, staining, 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 **measuures**, 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 **backlite** 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 wave form by continuous application of the signal M.
- (2) **Prease** refer to Fig. 10 Power ON/OFF sequence,

8-5, Others

- (1) Avoid to expose the unit to the direct sun- ight, strong ultraviolet light, etc. for a long time,
- (2) If stored at temperatures below specified s **orage** temperature, the LC may **fleeze** and be deteriorated, If storage temperature exceed the specified rating, the molecular orientation of the LC may charge to that of a liquid, and they may not revert to their original state, As far as possible always store at normal room temperature,
- (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 following gas from epoxy resin (**amines** hardener) and silicon adhesive agent (**dealcohol** or **deoxym**) to prevent change polarizer color owing to gas,

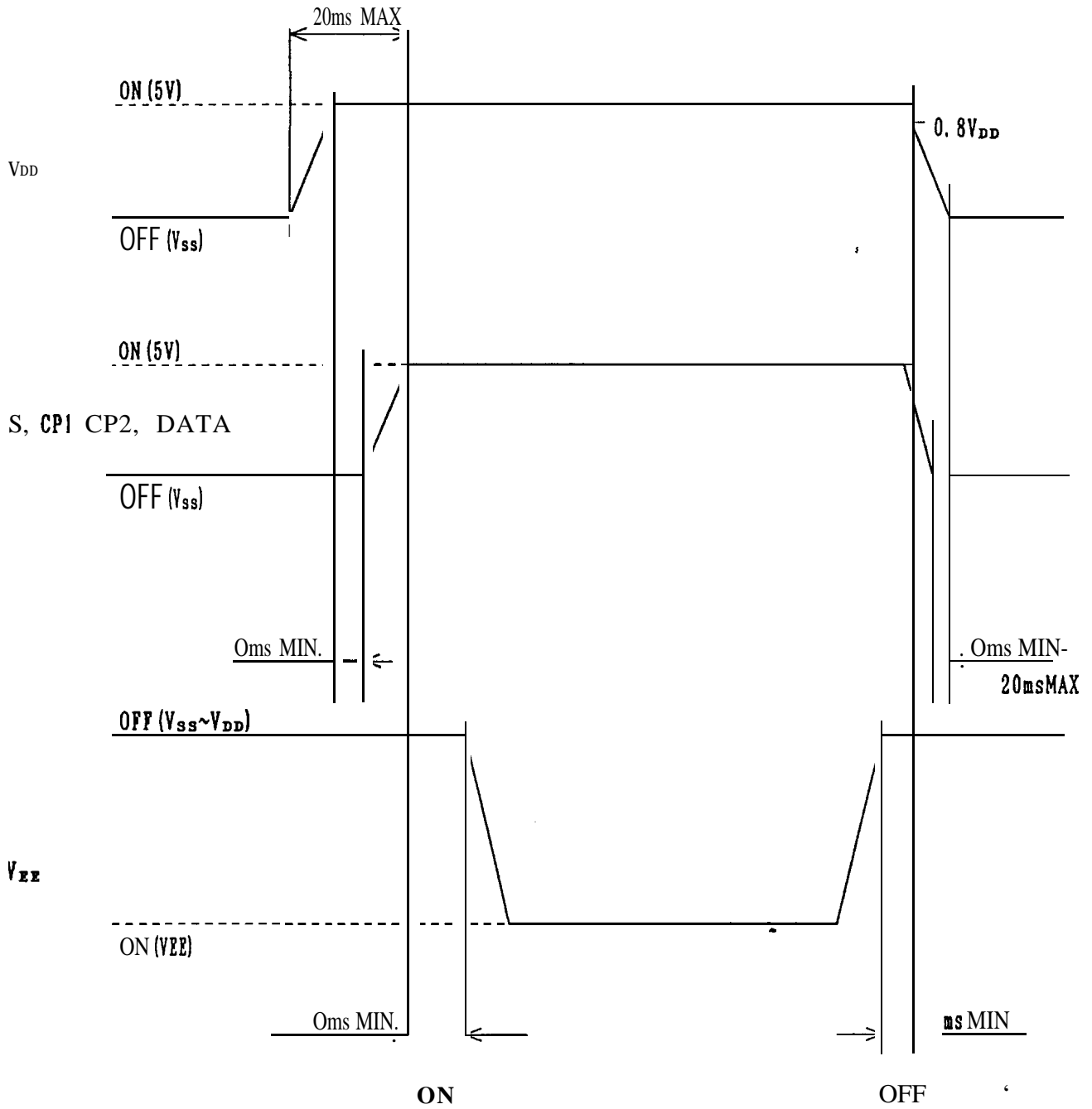
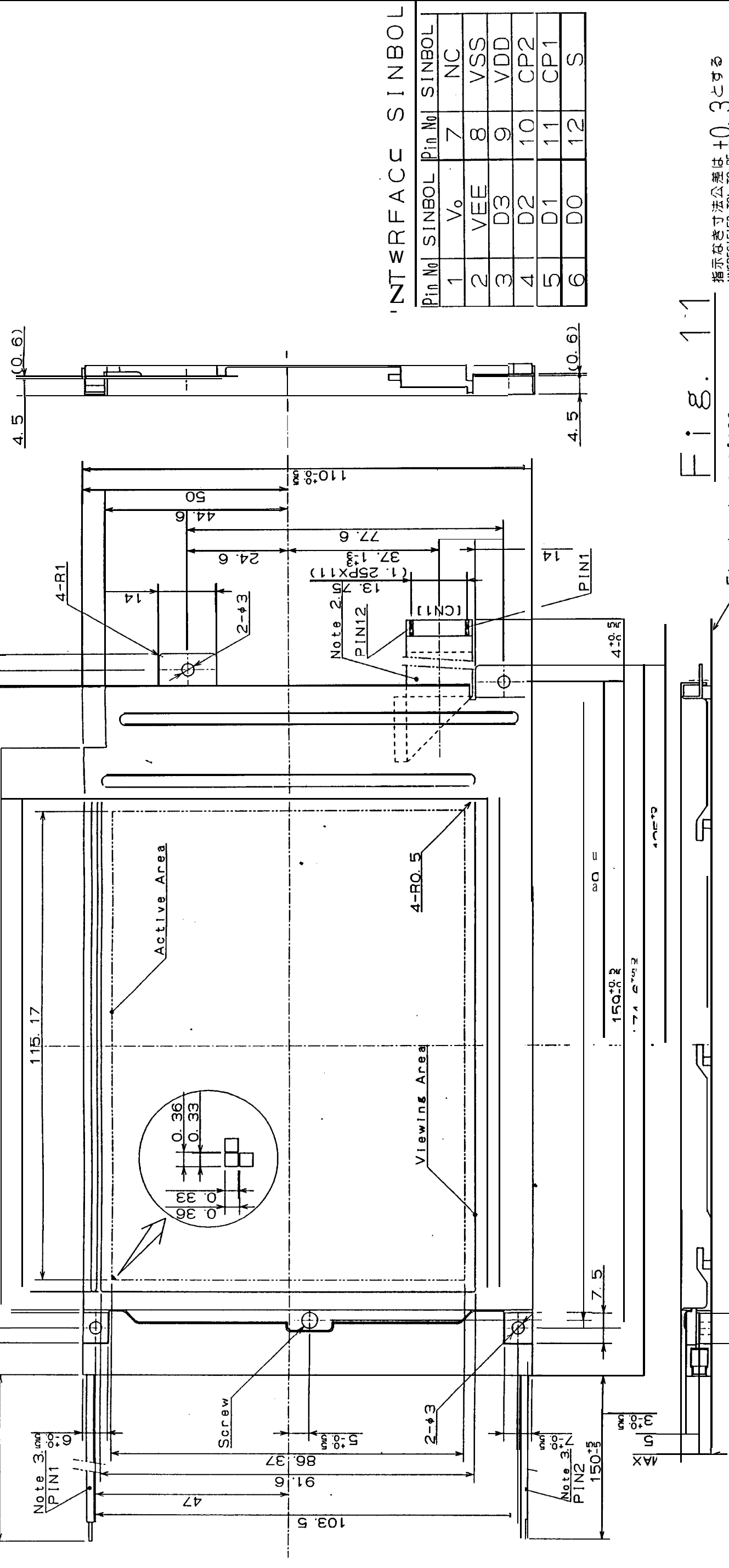


Fig. 10 Power ON/OFF sequence

ISSUE	設計通設 DRAWING INFO	連絡書 INFORMATION
	No. ()	による
NEW	新設	図面
CHANGE	変更	図面
REPLACE	替換	図面



INTERFACE SYMBOL

Pin No	SINBOL	Pin No	SINBOL
1	V ₀	7	NC
2	VEE	8	VSS
3	D3	9	VDD
4	D2	10	CP2
5	D1	11	CP1
6	D0	12	S

Fig. 11

指示なき寸法公差は±0.3とする
UNSPECIFIED TOL TO BE

年 月 日	改 定 記 事	品 名	名 称
		LM32FU1	LCD MODULE
材 質	材 質	材 質	材 質
MATERIAL	FINISH	SCALE	OUTLINE DIMENSIONS
		1/1	
製 造 廠	製 造 廠	製 造 廠	製 造 廠
SHARP CORPORATION	SHARP CORPORATION	SHARP CORPORATION	SHARP CORPORATION
製 造 日 付	製 造 日 付	製 造 日 付	製 造 日 付
1993.6.22	1993.6.22	1993.6.22	1993.6.22

- 4. unspecified tolerance
- 3. backlight cable: III-32-39 AWG#22
- 2. Flat cable (TW-VF 1.25P FUJIKURA)

Note: 1. Panel is tilted by white-7inc

M Otsu