' DEVICE SPECIFICATION FOR

Passive Matrix LCD Unit

(320 X 240 dots)

MODEL No.

LM32008F

☐ CUSTOMER' S APPROVAL

DATE _____

BY _____

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A	JAN, IO 1992	PAGE 4	⚠1	5-1 Amendment	H. Watanabe

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1. Application

This data sheet is to introduce the specification of

LH32008F,Passive Matrix "type. LCD Unit.

      (320 X 240 dot, FSTN, Reflective, positive type)

2. Construction and Outline

Construction : 320 X 240 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 drawbacks that may affect the display

function.

Rejection criteria shall be noted in Inspection Standard

S-U-012-01 .

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3. Mechanical Specifications

Table 1

Parameter	Specifications		Unit
Outline dimensions	134(W) X96(H) X 6.5MAX(D)	Note1	mm
Effective viewing area	100(W) X76(H)		mm
Display format	320(W) X240(H) full dot		
Dot size	0.28(W) X0.28(H)		mm
Dot spacing	0.02		mm
Dot color	Black	Note2	–
Background color	White	Note2	– "
Weight	approx. 105		g

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

Note2 :   Due to the characteristics of the LC Material,the

colors vary with environmental temperature.

4. Absolute Maximum Ratings

4-1. Electrical Absolute Maximum Ratings

Table 2

Parameter	Symbol	Min	Max	Unit	Remark
Supply voltage (Logic)	$V_{DD}-V_{SS}$	o	6.0	V	
Supply voltage (LCD Drive)	$V_{DD}-V_{EE}$	o	30.0	V	Ta=25℃
Input voltage	V_{IN}	o	VDD	V	

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4-2. Environmental Condition

Table 3

Item	Tstg		Topr		Remark
	MIN	MAX.	HIN.	MAX.	
Ambient temperature	-25℃	+60℃	0 ℃	+45℃	
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)   Ta $\leq$ 40℃ ·· ···· 95% RH Max

Ta > 40℃ ···· .- Absolute humidity shall be less than

Ta = 40℃ / 95% RH

Note 2)   Frequency : 10 ～ 55Hz

Vibration w. dth : 1.5mm

Interval :   0Hz ～ 55Hz ～   0HZ

(1 rein)

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

Note 3)   Accerelation : 50G

Pulse width : 11ms

3 times for each direction of ±X/±Y/±Z.

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## 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)	-21.0	-20.0	-19.0	V
Input signal voltage	V_{IN}	"H"level	$0.8V_{DD}$	—	V_{DD}	V
		"L"level	o	—	$0.2V_{DD}$	V
Input leakage current	I_{IL}	"H"level	—	—	20	µA
		"L"level	-20	—	–	µA
Supply current (Logic)	I_{DD}	V_{DD}=5V,VEE=-20V	–	8	12	mA
Supply current(LCD)	I_{EE}	VR=100kΩ △1	—	5.5	8	mA
Power consumption (LCD)	Pd	F=80Hz (Note 2)	–	150"	220˙	mW

(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 the definition of θ .

(Note 2) Display high frequency pattern.

LCD unit

V DD(+5V)
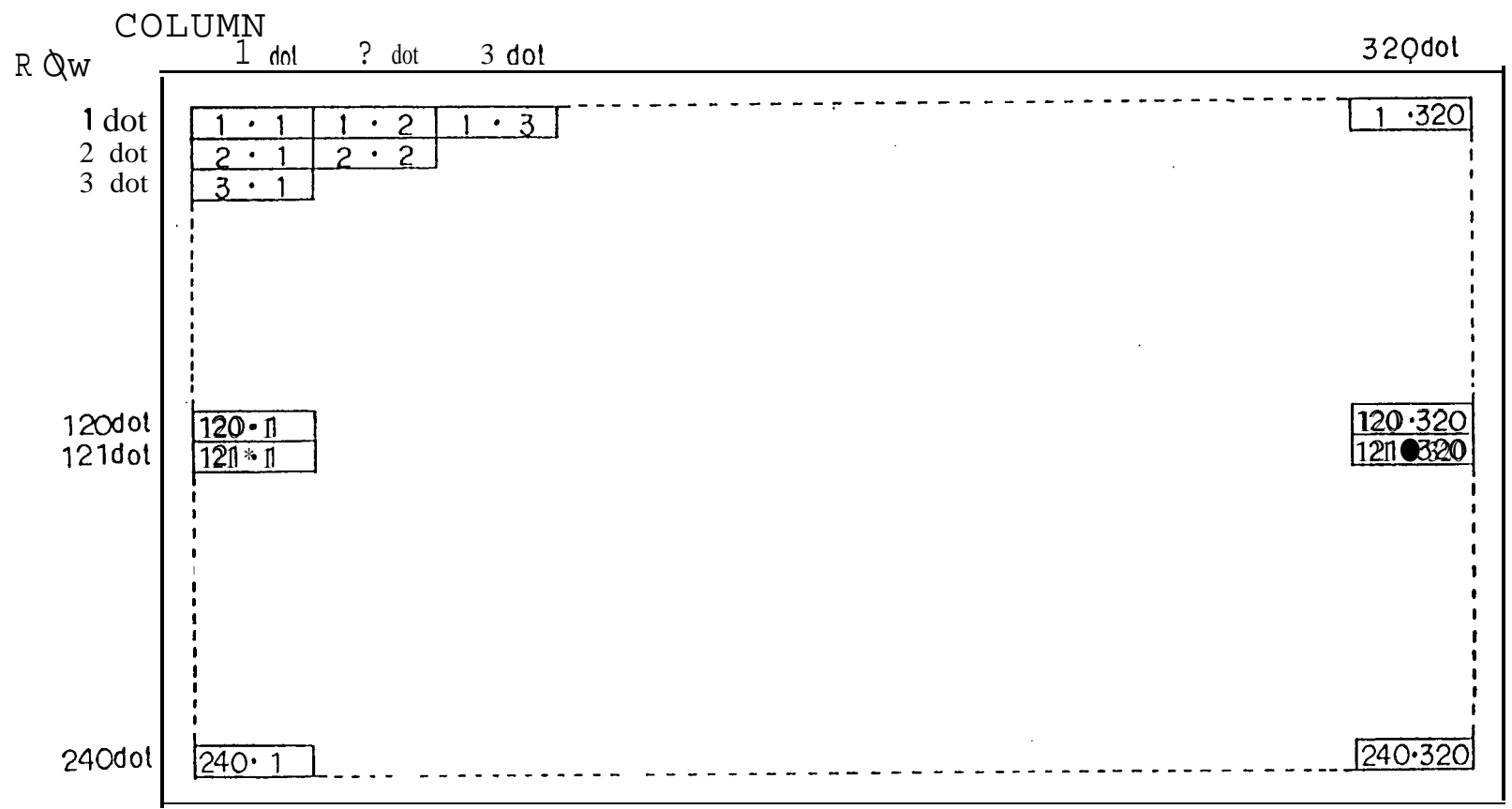
V SS(0V)

V EE(-20V)

VR1

200kΩ VR

VR2
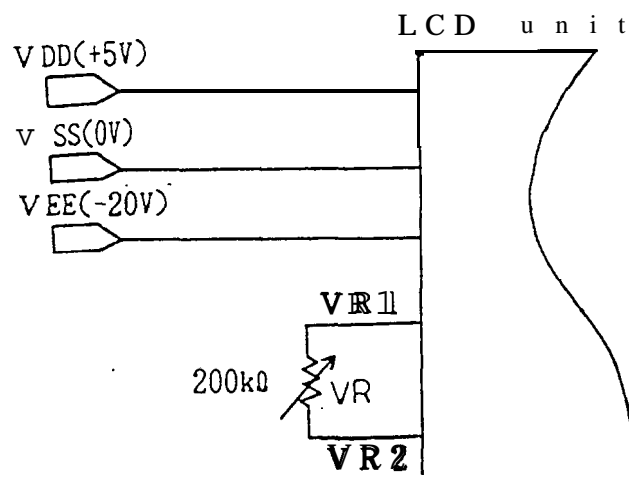
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5-2. Interface signals

Table 5

CN1

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	VDD	Power supply for logic and LCD (+5V)	—
5	Vss	Ground potential (0V)	—
6	VEE	Power supply for LCD (-20V)	—
7	D0	Display data signal	H(ON),L(OFF)
8	D1		
9	D2		
10	D3		
11	VR1	LCD Contras t-Adjust(A)	—
12	VR2	LCD Contrast Adjust(B)"	—

Used Connector : 52103-1217 [Molex]

Suitable Cable : 1.0mm pith 12pins F.F.C.

COLUMN

R Qw

1 dot   ? dot   3 dot   320dot

1 dot	1 · 1	1 · 2	1 · 3
2 dot	2 · 1	2 · 2	
3 dot	3 · 1		

1 ·320

120dot   120 · 1   120 ·320
121dot   121 * 1   121●320

240dot   240· 1   240·320

Note: 1.2 means   1st   row   2nd   column   dot.

Fig 1. Dot Chart of Display Area

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Fig. 2 Data Input Timing

CP_1

t_r t_{LWH} t_f

CP_2

t_{CWH} t_{CWL} T_{CP2} t_{S21} t_{S12}

t_r t_f t_{SU} t_H

$D0\sim 3$

t_{SU} t_H

$CP_2 \times (320/4)$ pulses

S

$T_{FRM} = 12.5 \sim 14.3ms$

CP_1

1st line's 2nd
data line's
transfer data
transfer

240th
line's
data
transfer

Reduced   S

$CP_1 \times$ **240** pulses
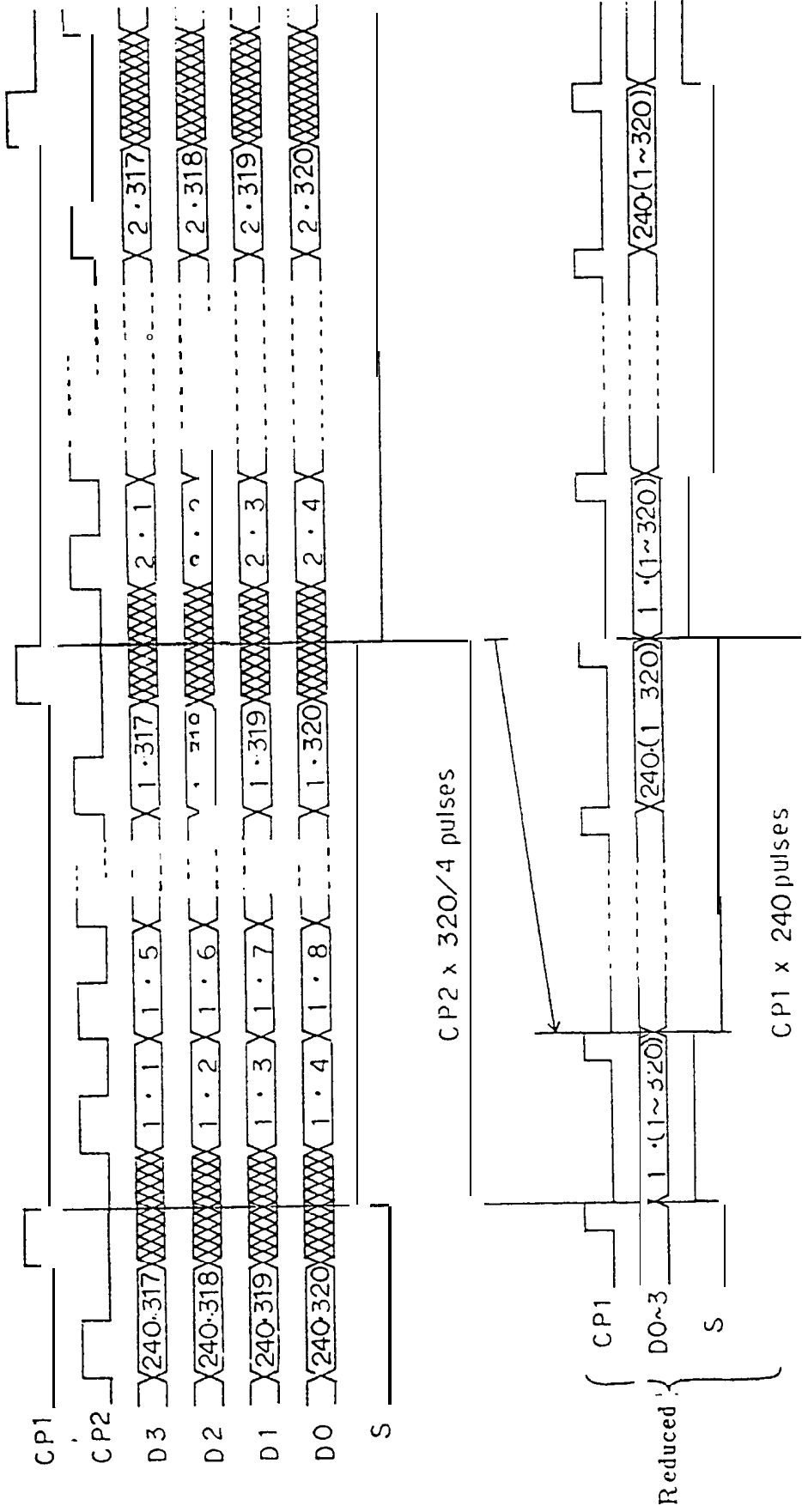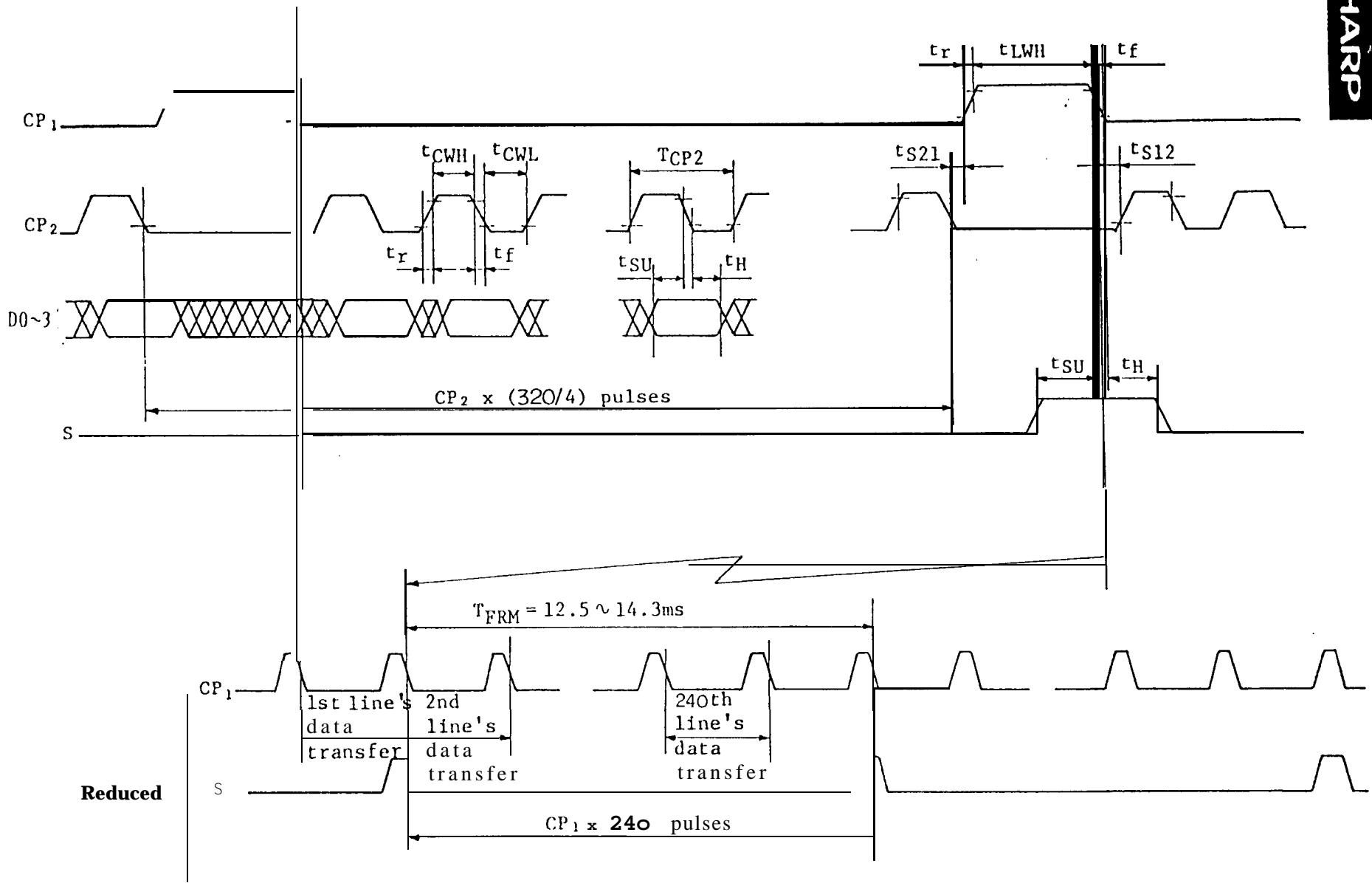
$V_{IH} = 0.8V_{DD}$

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

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	250			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 H	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	tr,tf			50	ns

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6. <u>Unit Driving Method</u>

   6.1   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
      segment of 320 X 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 CPI.   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 CPI 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.

      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.And to prevent such
      problem, AC waveform circuit genelated by counting CPI(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 transfer-
ring 4-bit palallel 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 selec-
ted,and the adjacent driver LSI of the right side is selected when
80 dots data(20CP2) 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 dis-
play face.

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

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

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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   VDD=5V, Ta=25℃

Parameter	Symbol	Condition		Min.	Typ.	Max.	Unit	Remark
Viewing angle range	$\theta_1 - \theta_2$	$\phi=180°$	C0≥2.0	45	–	–	dgr.	Note 1
	f?,	$\theta_1 < \theta_2$	C0≥2.0	"	–	-20	dgr.	Note 1
	θ_2			20	–	–	dgr.	Note 1
	$\theta_2 - \theta_1$	$\phi=135°$	C0≥2.0	45	–	–	dgr.	Note 1
	e,	225°	C0≥2.0	–	–	-20	dgr.	Note 1
	θ_2	$\theta_1 < \theta_2$		20	–	–	dgr.	Note 1
Contrast ratio	CO	$\theta=0°, \phi=180°$		3.5	6.0	–		Note 2
Response speed	Tr	$\theta=0°, \phi=180°$		–	200	300	ms	Note 3
	Td	$\theta=0°, \phi=180°$		–	300	400	ms	Note 3

Note 1) The viewing angle range may be defined as shown below.
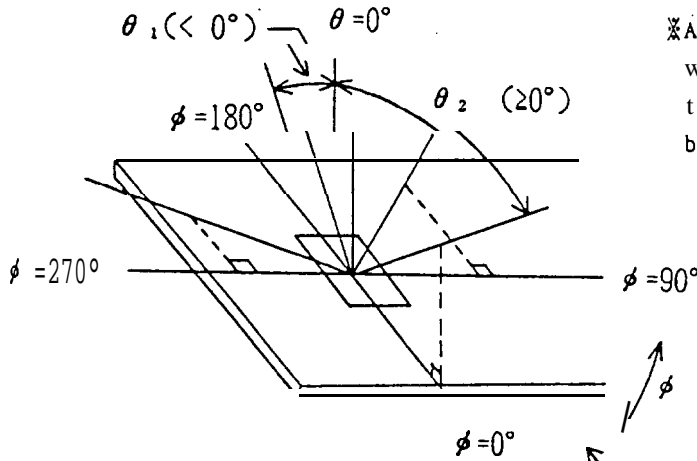
※Angles θ_1, θ_2 and ϕ shall fall within the range over which the displayed character can be read.

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).

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

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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 *.

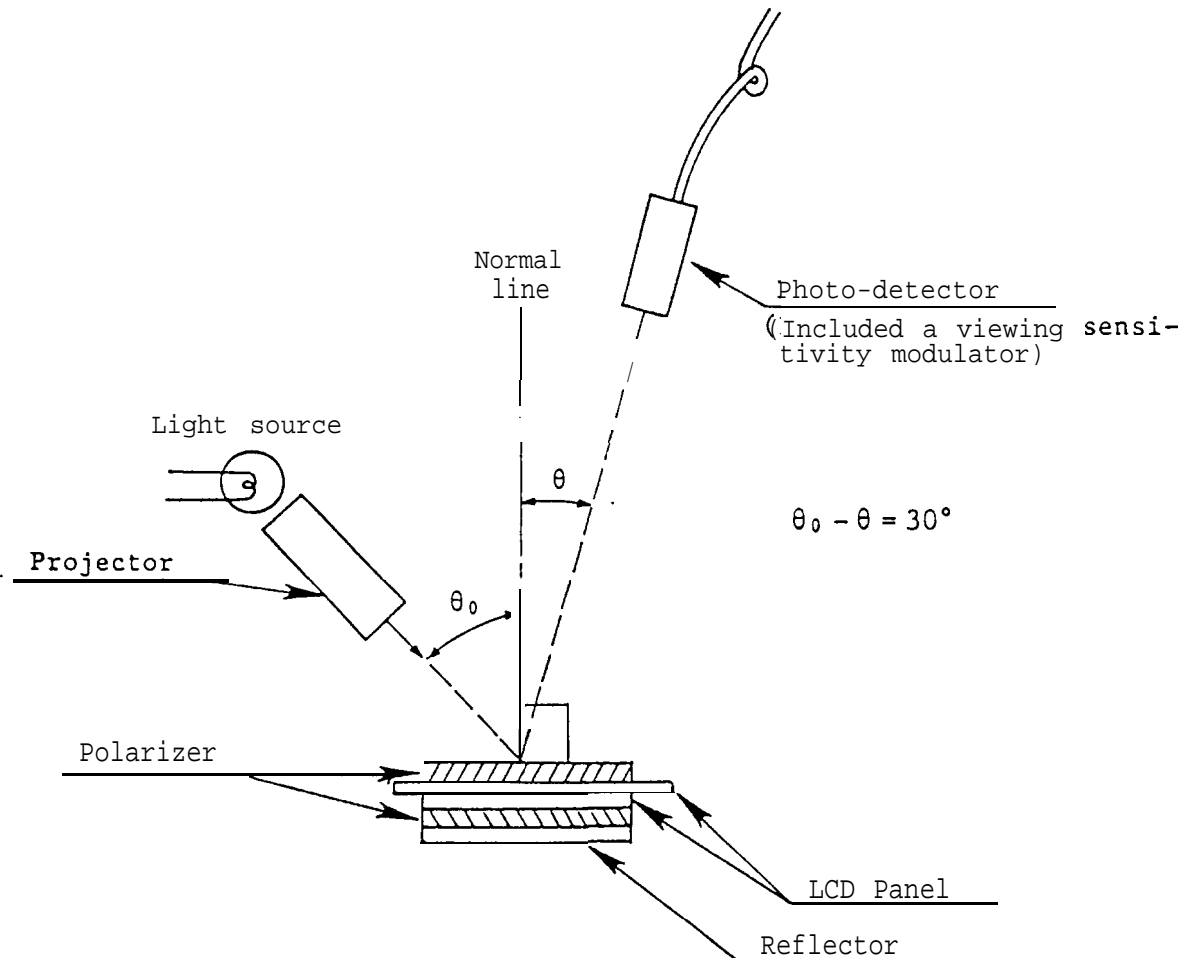* * The most critical condition for the characteristics .
of LCD.

Normal
line

Photo-detector

(Included a viewing sensi-
tivity modulator)

Light source

θ

$\theta_0 - \theta = 30°$

Projector

θ_0

Polarizer

LCD Panel

Reflector

Fig.5 Optical Characteristics Test   Method

[Drive waveform]

1/240 Duty

Non-select
waveform   Select waveform   Non-select
waveform

{ Response
waveform }

Photo-
detector
output

100% 10%

90%

T_r

T_d
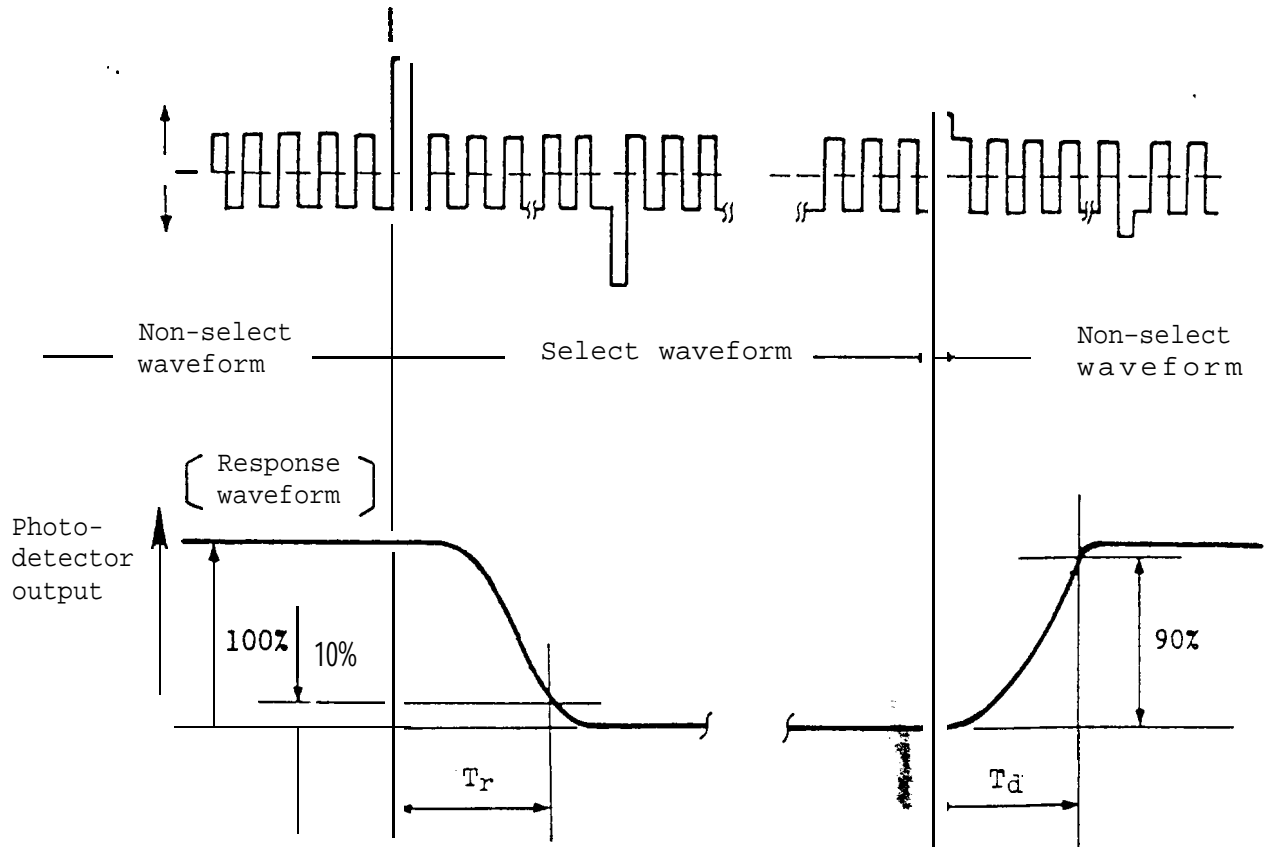
T_r : Rise time
Td : Decay time

Fig.6 Definition of Response Time
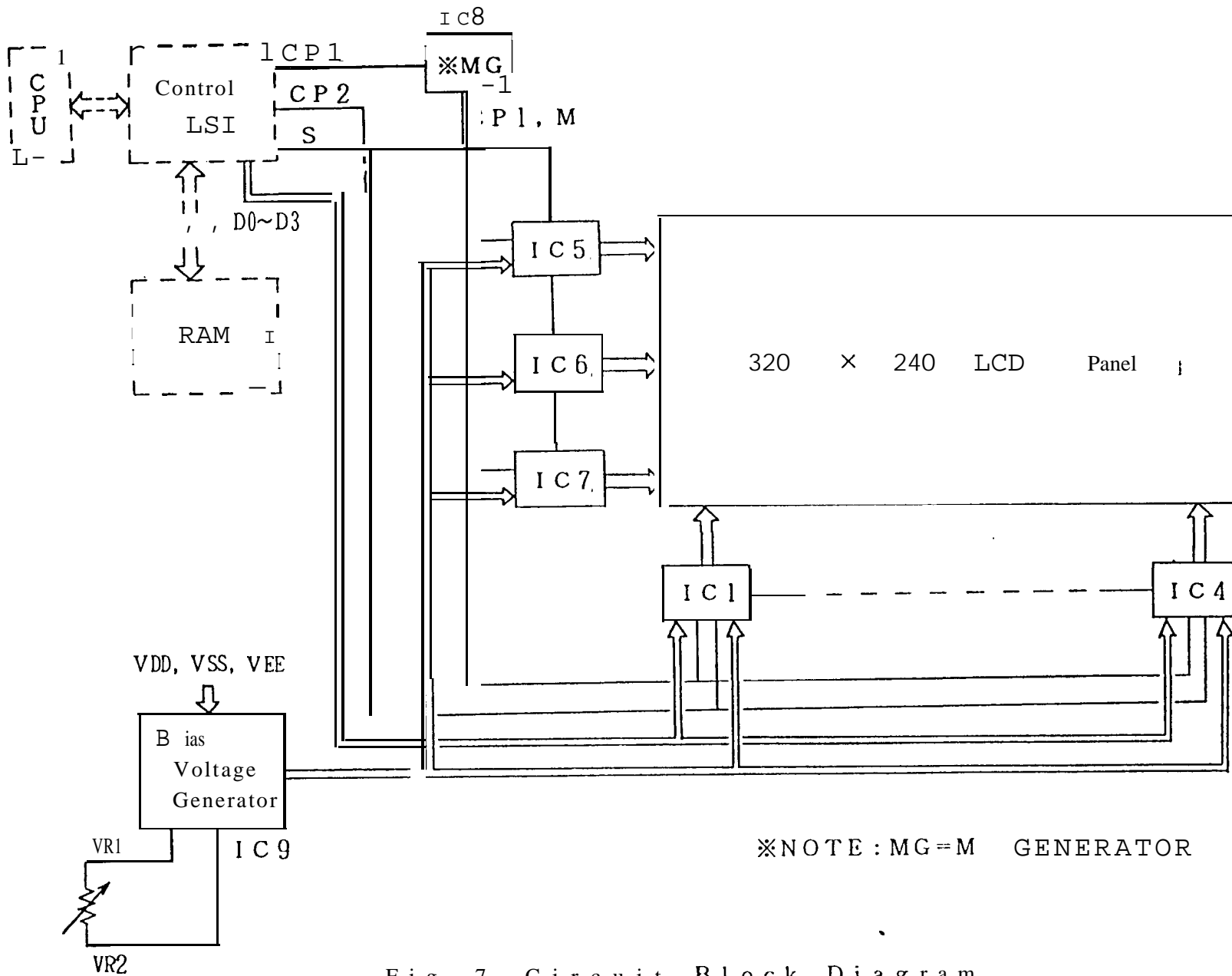
Fig. 7 Circuit Block Diagram

※NOTE : MG = M GENERATOR

DOT SIZE (20/1)

134.0 $^{+0.5}_{-0.5}$
124.0 $^{+0.3}_{-0.3}$
100.0 $^{+0.3}_{-0.3}$
95.98 (320 Dots)

5.0 $^{+0.3}_{-0.3}$
1.0 $^{+0.3}_{-0.3}$
2.0 $^{+0.3}_{-0.3}$
3.01

3.5 $^{+0.3}_{-0.3}$ (0.6)

0.3
0.28 0.02
0.28
0.3
0.02

Active Area

Viewing Area

PIN1
PIN12
note.2

n
u
C

11.51
9.5 $^{+0.3}_{-0.3}$
9.5 $^{+0.3}_{-0.3}$
3.5 $^{+0.3}_{-0.3}$
96.0 $^{+0.5}_{-0.5}$
76.0 $^{+0.3}_{-0.3}$
71.98 (240Dots)
(47.5)

103.0 $^{+0.3}_{-0.3}$
107.0 $^{+0.5}_{-0.5}$

4-R1.0
4-R1.6
16-R0.5

3.2
8.0
9.0

6.5MAX
(122.0)

3.5 $^{+0.3}_{-0.3}$ (0.6)
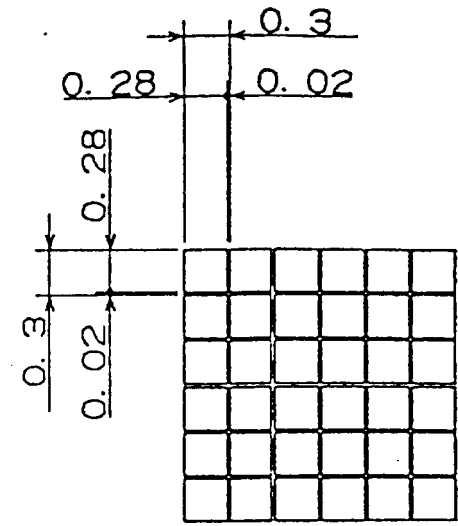
PIN NO	SYMBOL
	S
2	CP1
3	CP2
4	VDD
5	Vss
6	VEE
7	D0
8	D1
	D2
10	D3
11	VR1
12	VR2

note.3

指示なき寸法公差は ±0.7 とする
UNSPECIFIED TOL TO BE

Fig. 8
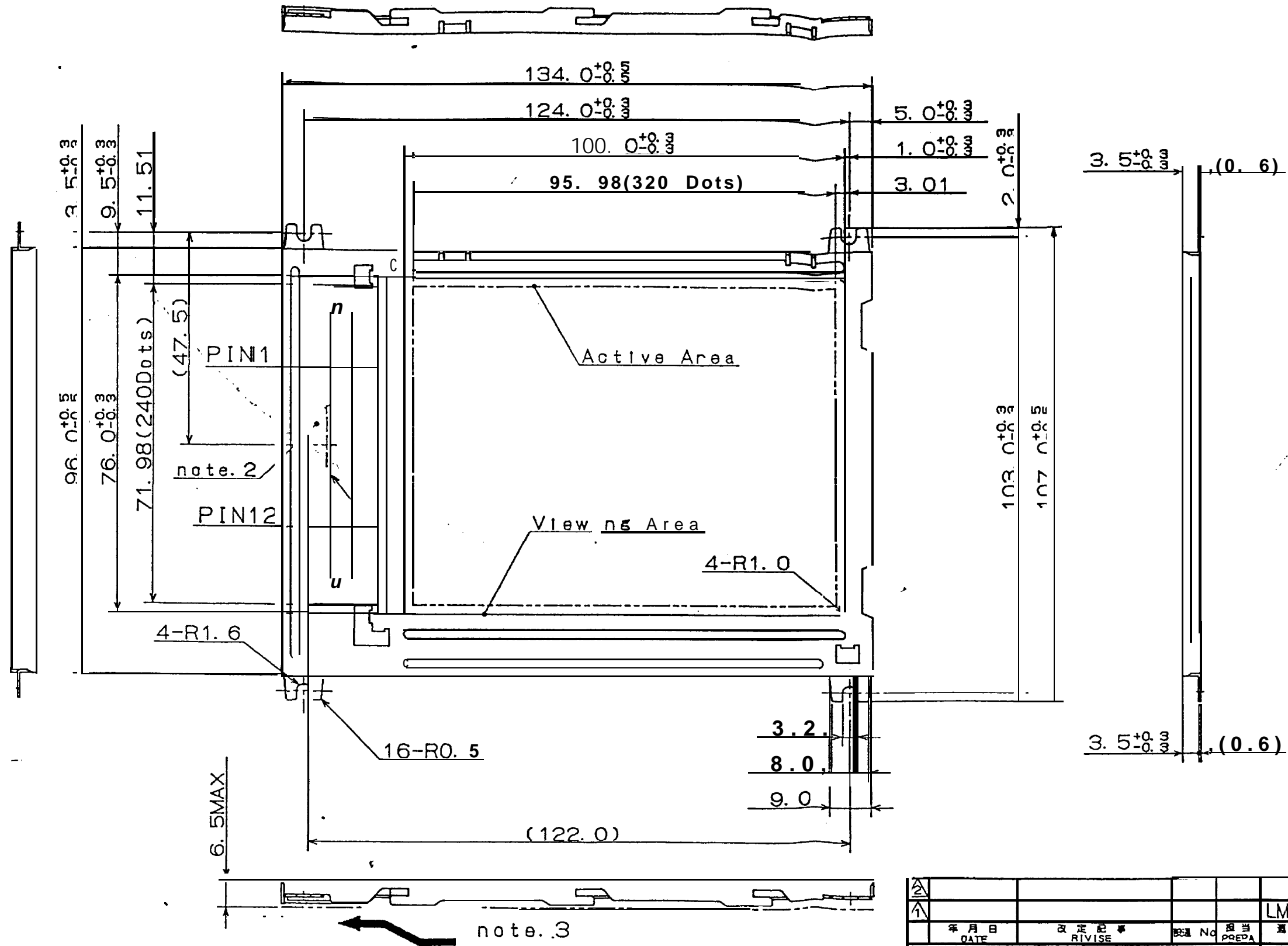
3. Inserting direction of the Flat Cable.
2. Connect or :52103-1217[Molex]
note 1. Bezel is Plated by white-Zinc.

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8. Precautions

  8.1 Angle when installing the unit

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

$$\theta_1 < \text{viewing range} < \theta_2 \ (\theta_1 < 0^* \ , \theta_2 \geqq 0^\bullet)$$

      (For the specific values of θ_1, θ_2, refer to the Table .)

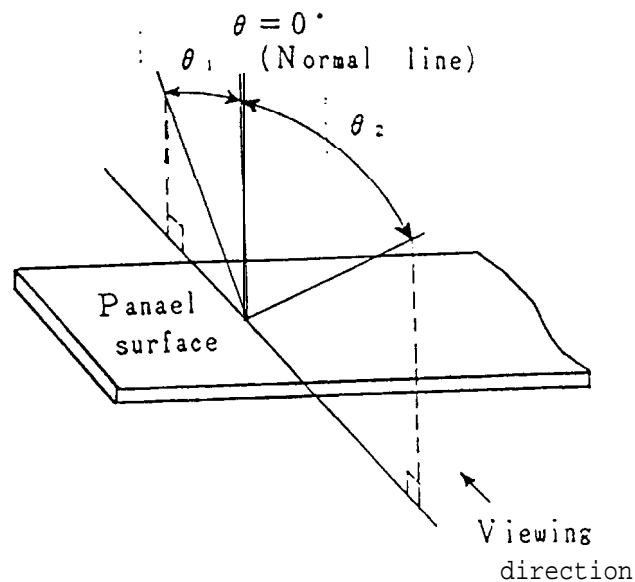   Please consider the optimum viewing conditions according to the purpose when installing the unit.

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.

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8.3 Notes on attachment

(1) Since the front polarizer is easily dameged,please pay attention not to scratch on its face.

(2) If the surface of the LCD cells needs to be cleaned,wipe its swiftly ith 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 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 he drive is alternating waveform by continuous application of the signal CP1.

(2) Prease refer to Fig.10 Power ON/OFF sequence.

8.5 Others

(1) Avoid to expose the unit to the direct sun-light,strong ultra -violet light.,etc.for a. long time.

(2) If stored at temperatures below specified storage 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.
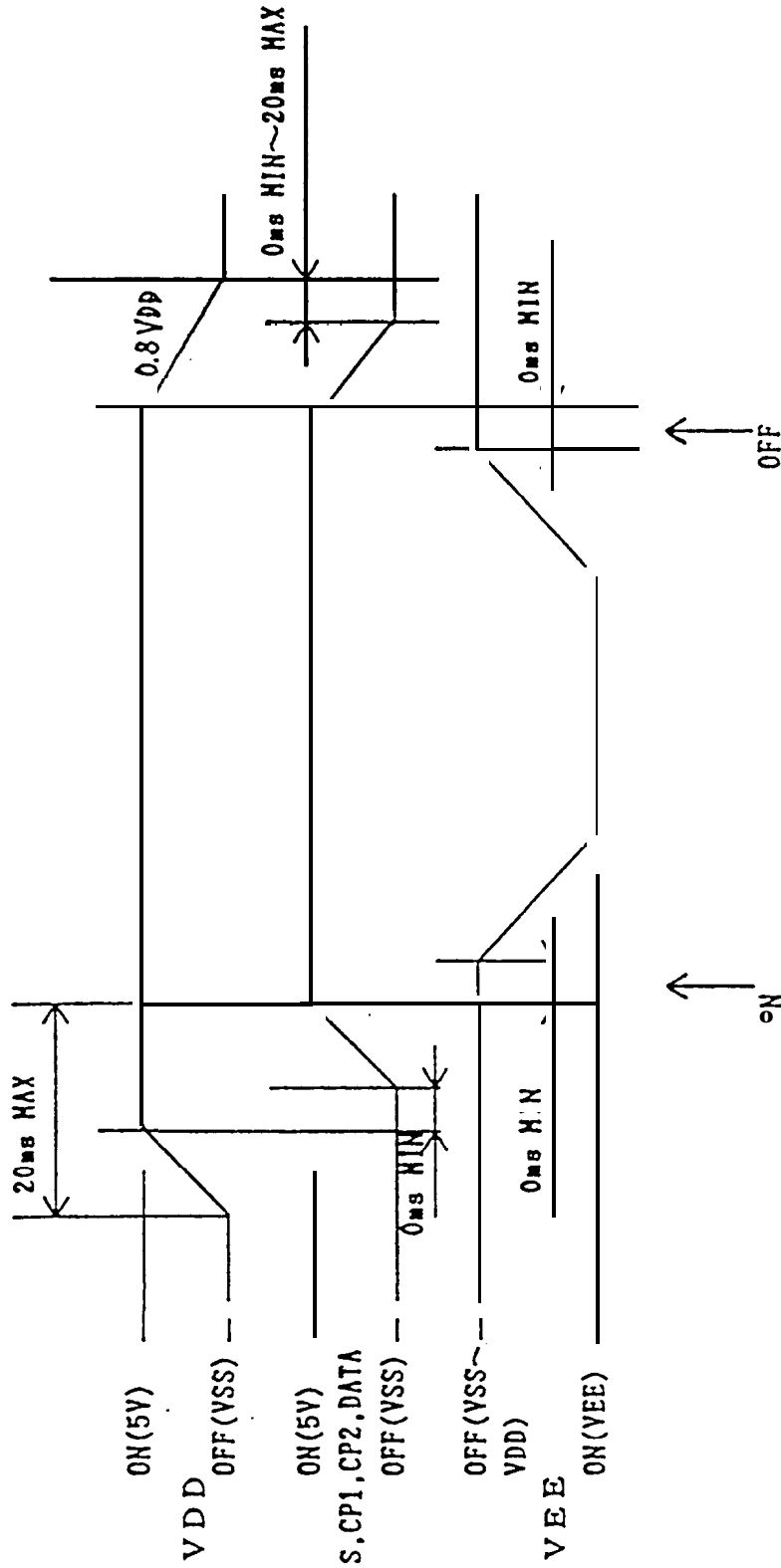
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Fig.10 Power ON/OFF sequence