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DEVICE SPECIFICATION FOR

_ 240 X 64 Dot
Graphic LCD Unit

MODEL No.

L M 24008M

☐ CUSTOMER'S APPROVAL

DATE _____

BY _____

PRESENTED

BY

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1. Application

This data sheet is to introduce the specification of the Dot-Matrix LCD Unit LM24008M.

2. Construction and Outline

Construction: 240 x 64 full dot graphic display unit.

Outline: See Fig. 6

Connection: See Fig. 6 and Table 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-008.

Option:

This unit is a transflective type.

And an optional EL backlight can be installed.

Applicable EL is LF0B08 (Standard model, White Long-life type) and LF0B09 (Standard model, Bluegreen Long-life type).



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3. Mechanical Specifications

Table 1

Parameter	Specifications	Unit
Outline dimensions	180(W) x 75(H) x 10.5(D Max)	mm
Effective viewing area	132.6(W) x 39(H)	mm
Display format	240(W) x 64(H) full dots	-
Dot size	0.48 x 0.48	mm
Dot spacing	0.05	mm
Dot color *	Dark blue	-
Background color *	Gre. Greenish (Backlight off)	-
Weight	Approx. 120	g

* 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)	$V_{DD}-V_{SS}$	0	6.0	V	Ta = 25°C
Supply voltage (LCD drive)	$V_{DD}-V_{EE}$	0	18.0	V	Ta = 25°C
Input voltage	V_{IN}	0	V_{DD}	V	Ta = 25°C

SHARP4-2. Environmental Conditions Table 3

Item	Tstg		Topr		Remark
	MIN.	MAX.	MIN.	MAX.	
Ambient temperature	-25°C	+60°C	0°	+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 ($\pm X/\pm Y/\pm Z$)

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% RH.

Note 2) Frequency: 10 ~ 55Hz

Vibration width: 1.5mm

Interval: 10Hz ~ 55Hz ~ 10Hz
(1 min)

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

Note 3) Acceleration: 100G

Pulse width: 6ms

3 times for each direction of $\pm X/\pm Y/\pm Z$.

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LM24008M

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5. Electrical Specifications

5-1. Electrical characteristics

Table 4

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

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)	-13.0	-11.0	-	V
Input signal voltage	V_{IN}	"H" level	(Note1) 0.8 V_{DD}	-	V_{DD}	V
		"L" level	0	-	(Note2) 0.2 V_{DD}	V
Input leakage current	I_{IL}	"H" level	-	-	10	μA
		"L" level	-10	-	-	μA
Supply current (Logic)	I_{DD}	$V_{EE} = -11V$ $V_{DD} = 5V$, Frame frequency = 80Hz, display high frequency pattern		6.0	9.0	mA
Supply current (LCD drive)	I_{EE}			1.5	2.5	mA
Power consumption	P_d			48.0	75.0	mW

Note) The viewing angle θ where obtains the maximum contrast can be set by adjusting above $V_{EE} - V_{SS}$. Refer to Fig. 2 for the definition of θ .

The typical value of LCD supply voltage normally means the optimum rating when set the θ at -10° . This rating varies around $\pm 0.5V$ in each unit due to the characteristics of built-in temperature compensation circuit. This circuit makes the preset viewing direction stable almost completely over the operating temperature ($0^\circ\text{C} \sim +45^\circ\text{C}$).

(Note1) $CP_1: 4.2V (V_{DD}=5V)$

(Note2) S, M: $0.8V (V_{DD}=5V)$, $CP_1: 0.4V (V_{DD}=5V)$

5-2. Input capacitance Table 5

Signal	Input capacitance
S	45 pF TYP
CP ₁	80 pF TYP
CP ₂	80 pF TYP
M	80 pF TYP
DI	30 pF TYP

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5-3. Interface signals

Table 6

Pin No.	Symbol	Description	Level
1	S	Scan start-up signal	"H"
2	CP ₁	Input data latch signal	H → L
3	CP ₂	Data input clock signal	H → L
4	DI	Display data signal	H(ON), L(OFF)
5	M	Drive waveform alternating signal	H/L
6	V _{DD}	Power supply for logic and LCD (+)	-
7	V _{SS}	Ground potential	-
8	V _{EE}	Power supply for LCD (-)	-
9	NC	-	-
10	NC	-	-

Note 1) Pin No. and its location are shown in Fig. 6.

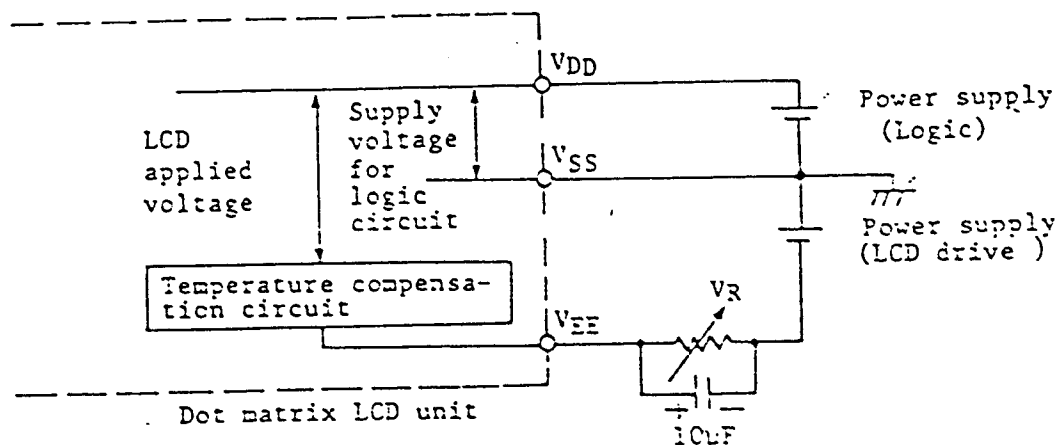
Note 2) Connector is not installed in this unit.

Recommendable connector: FCN725P010-AU/S (FUJITSU)
SLENIOR-1/2 (BURNDY)

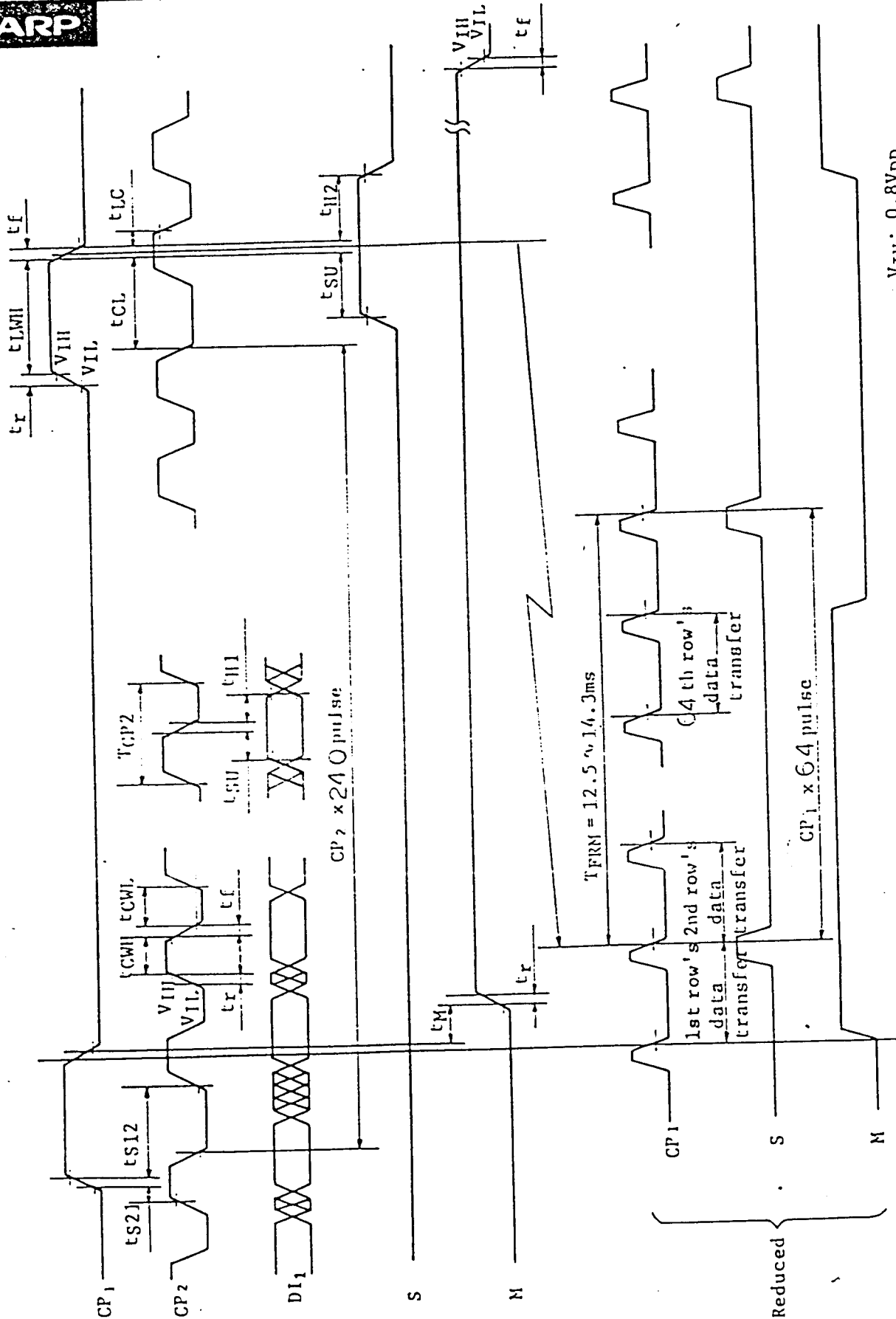
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5.4 Contrast Adjustment of LCD Display Element

This unit, with its built-in temperature compensation circuit, is capable of LCD display contrast adjustment for the change in ambient temperature. But use the externally adjustable resistor (VR) to adjust the LCD display contrast for the change in viewing angle or power supply voltage.



How to connect the adjustable resistor (example)



$V_{IH}: 0.8V_{DD}$
 $V_{IL}: 0.2V_{DD}$

Fig. 1 Interface Timing Chart

Table 7 Interface timing ratings

Item	Symbol	Rating			Unit
		MIN.	TYP.	MAX.	
Frame cycle	T _{FRM}	12.5		14.3	ms
"H" level latch clock width	t _{LWH}	400		-	ns
"H" level clock width	t _{CWH}	125		-	ns
"L" level clock width	t _{CWL}	125		-	ns
CP ₂ clock cycle	T _{CP2}	390		-	ns
Data set up time	t _{SU}	100		-	ns
Data hold time	t _{HI}	100		-	ns
CP ₁ ↑ clock allowance time from CP ₂ ↑	t _{CL}	250		-	ns
CP ₂ ↑ clock allowance time from CP ₁ ↑	t _{LC}	20		-	ns
CP ₂ ↑ clock allowance time from CP ₁ ↑	t _{S12}	175		-	ns
CP ₁ ↑ clock allowance time from CP ₂ ↑	t _{S21}	20		-	ns
M clock allowance time from CP ₁ ↑	t _M	0		100	ns
Clock rise/fall time	t _r , t _f	-		50	ns
S clock hold time	t _{II2}	800		-	ns

6. Unit Driving Method

6.1 Circuit configuration

Fig. 5 shows the block diagram of the Unit's circuitry

6.2 Display face configuration

The display face electrically consists of single display segment of 240 x 64 dots.

Display input data are entered at DI.

6.3 Input data and control signals

Input data are entered at DI sequentially row by row along with clock pulse CP₂, starting from the top left of display face.

This data input is implemented in the form of 1-bit serial data (High level + turn-on; low level + turn-off).

On the falling edge of CP₂ clock, the input data is sequentially transferred via the shift register in the signal electrode driver.

After one row of data (240 dots) are entered, they are latched in the form of parallel data corresponding to 240 lines of signal electrodes, then sent to the signal electrodes. At this time, scan start-up signal S has been transferred from the scan signal driver to the 1st row of the scan electrodes, and the contents of the data signals on DI pin are displayed on the 1st row of the display face according to the combinations of voltages applied to the scan and signal electrodes of the LCD.

While the 1st row of data are being displayed, the 2nd row of data are entered to DI pin. When 240 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.

The display input described above is repeated up to 64th row to complete the whole area of display. Then data input proceeds to the next display face.

Since DC voltage, if applied to LCD panel, causes chemical reaction which will deteriorate LCD panel, drive waveform shall be inverted at every display frame to prevent the generation of such DC voltage. Control Signal M plays such role.

Normally the repetitive frequency of the signal M shall be half of that of the signal S with the waveform of 1/2 duty ratio, coincidence to the falling edge of CP₁ clock (Data latch signal), inverting at every frame.

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

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7. Optical Characteristics (Backlight OFF, Reflective mode)

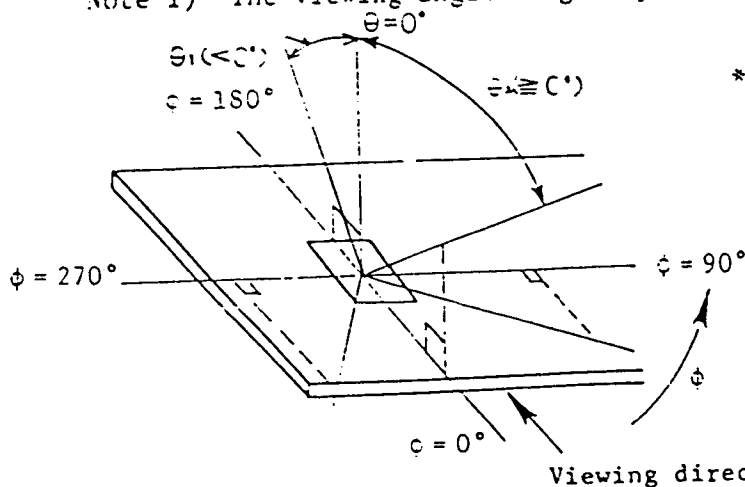
These optical characteristics are based on condition that the viewing direction is set at -10 degrees and with the maximum contrast provided.

Table 8

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

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range	$\theta_2 - \theta_1$	$\phi = 0^\circ$ $C_0 \geq 2.0$	60	-	-	dgr.	Note 1
	θ_1	$\theta_1 < \theta_2$ $C_0 = 2.0$	-	-	-40	dgr.	Note 1
	θ_2	$\theta_1 < \theta_2$ $C_0 = 2.0$	25	-	-	dgr.	Note 1
	$\theta_2 - \theta_1$	$\phi = 45^\circ$ $C_0 \geq 2.0$	60	-	-	dgr.	Note 1
	θ_1	$\phi = 315^\circ$ $\theta_1 < \theta_2$ $C_0 = 2.0$	-	-	-40	dgr.	Note 1
	θ_2	$\theta_1 < \theta_2$ $C_0 = 2.0$	25	-	-	dgr.	Note 1
Contrast ratio	C_0	$\theta = 15^\circ$	5	7	-		Note 2
Response speed	Rise	T_r	-	150	250	ms	Note 3
	Decay	T_d	-	300	450	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. 2 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. 4) is applied in the optical characteristics test method (Fig. 3).

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

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- Note 3) The response characteristics of photo-detector output are measured as shown in Fig. 4, 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. 3.
- Note 4) Table 8 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.

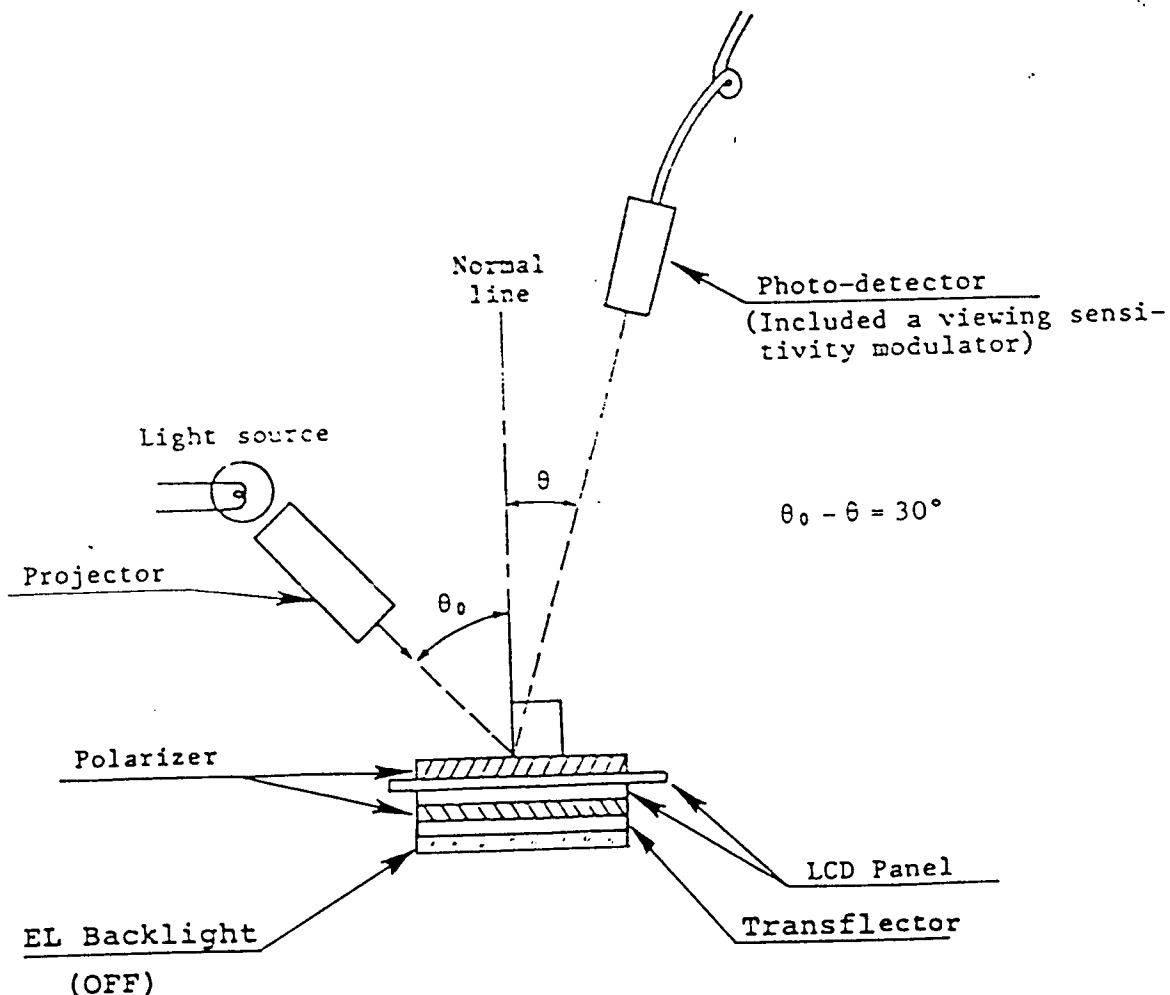
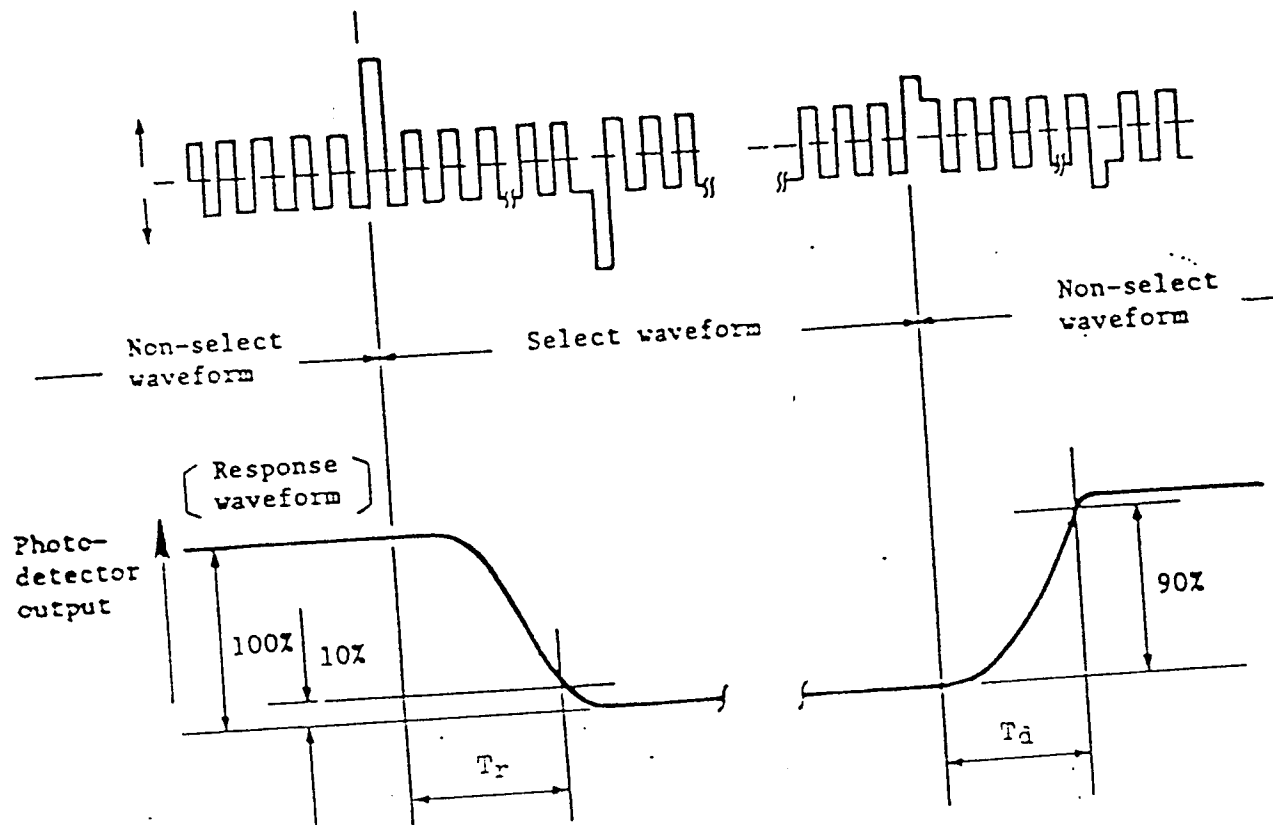


Fig. 3 Optical Characteristics Test Method

[Drive waveform]

1/64 Duty



T_r : Rise time
 T_d : Decay time

Fig. 4 Definition of Response Time

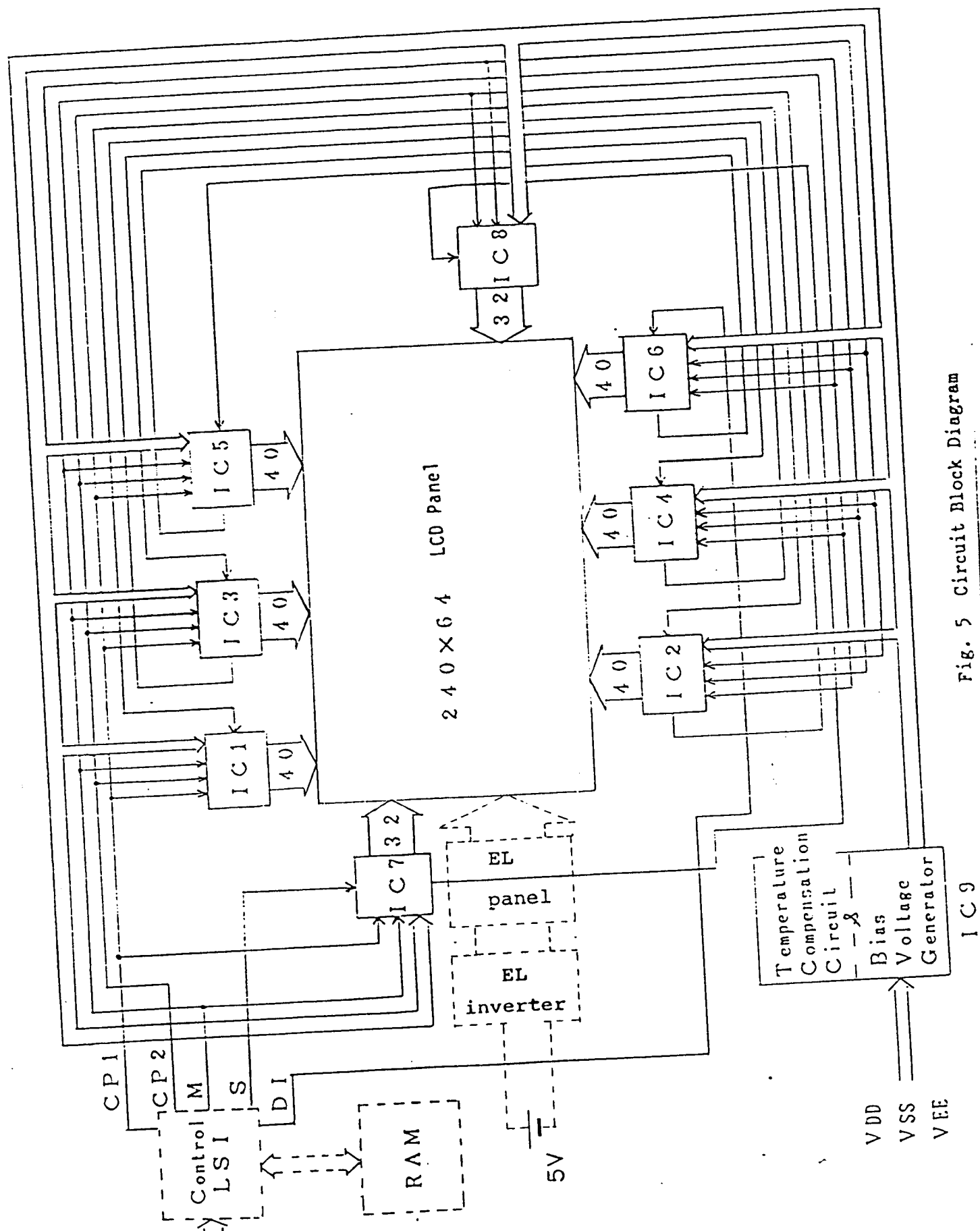


Fig. 5 Circuit Block Diagram

8. Precautions

8.1 Angle when installing the unit

This unit's viewing angle is illustrated in Fig. 7.

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

(For the specific values of θ_1 , θ_2 , refer to the Table 8.)

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

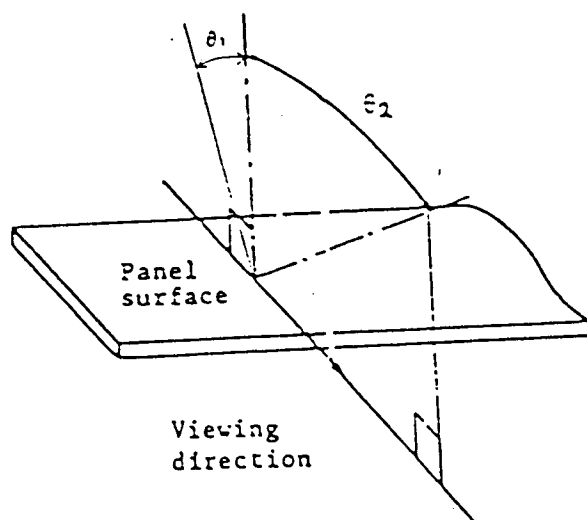


Fig. 7 Dot matrix LCD viewing angle

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 needs 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 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 or 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.
- (2) When the unit is driven by TTL, set an open collector gate and pull-up resistor.

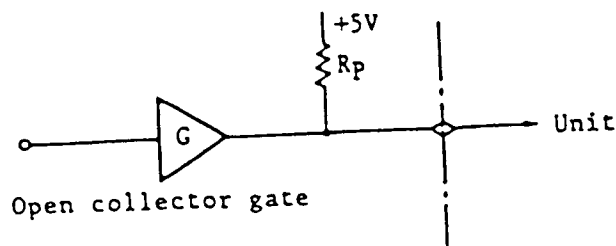
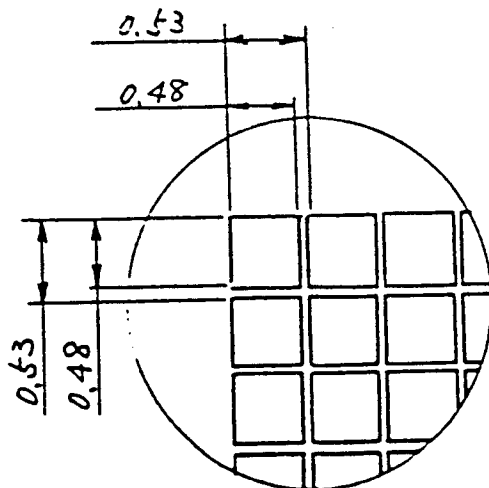
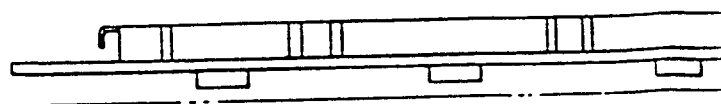
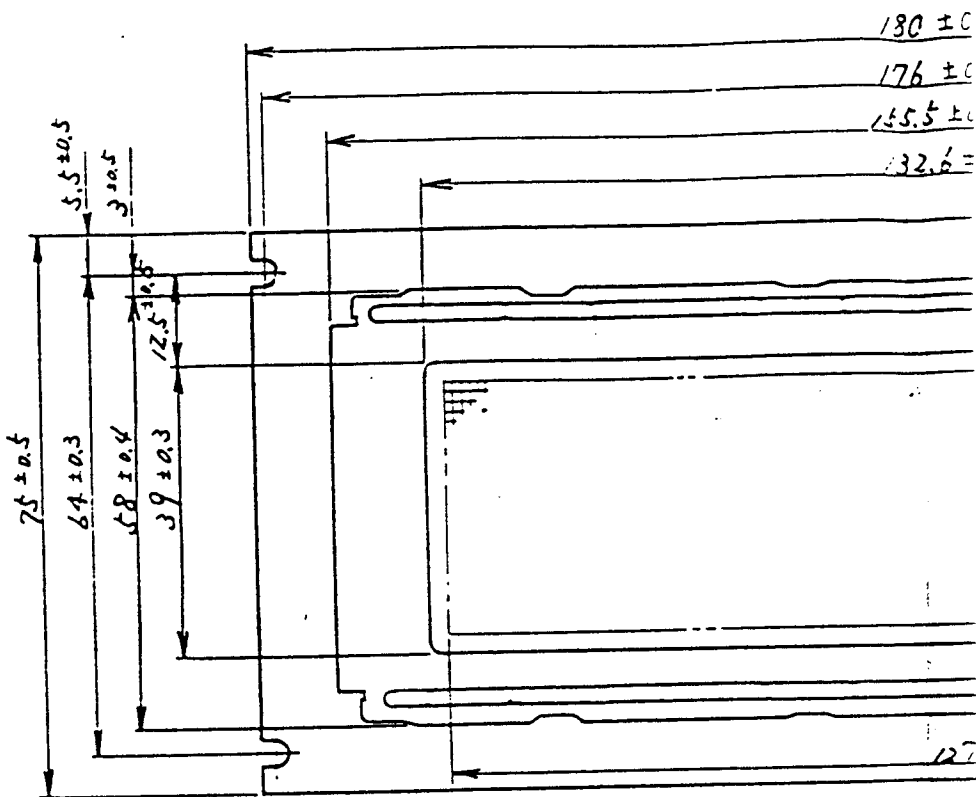


Fig. 8 TTL interface circuit

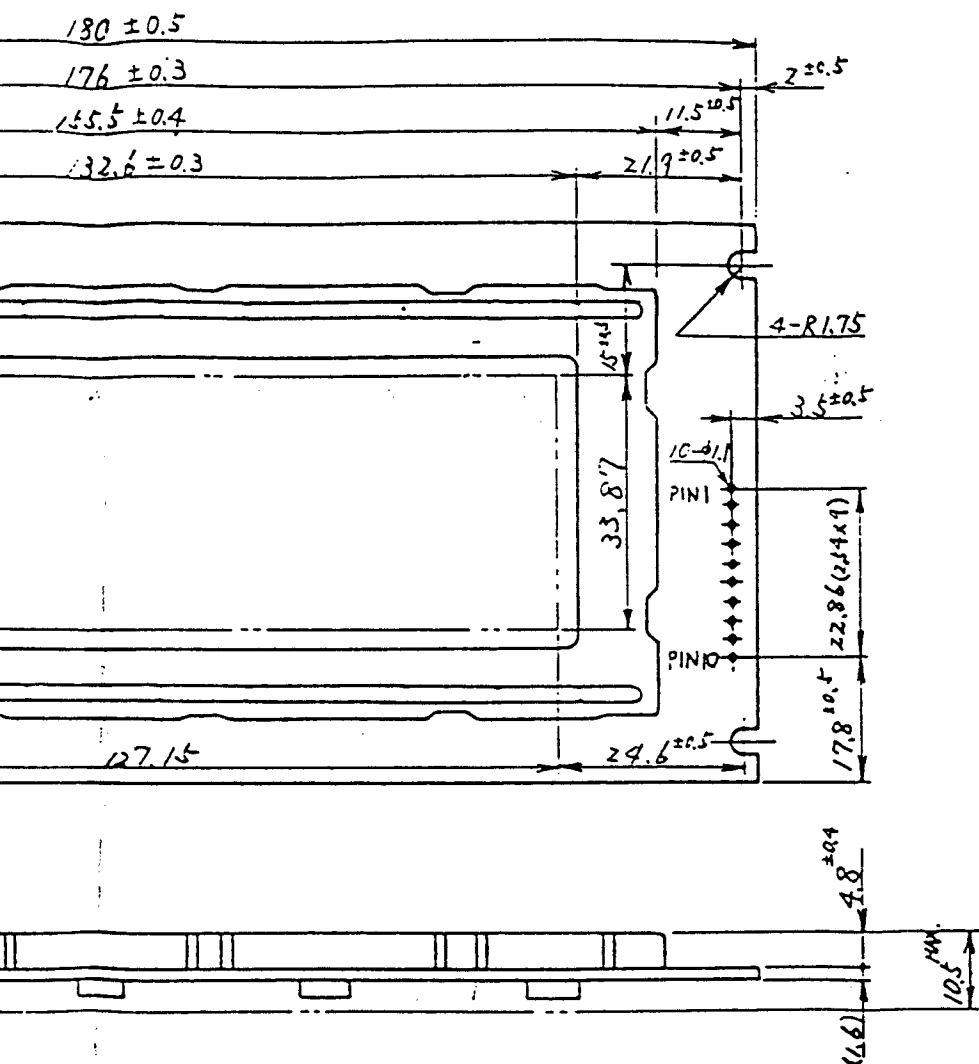
8.5 Others

- (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 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 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 on reinsertion. So please avoid to dismantle the unit.



DOT SIZE (S=20%)

4	5	6	7
符号 NO	名称 NAME	記号 SYMBOL	コード CODE
数量 PIECES	材質 MATERIAL	仕上 FINISH	備考 NOTE
担当 PREP	出図 ISSUE 19		
設計通報 DRAWING INFO.		連絡書 INFORMATION	
No. ()) 号による	
新設・変更・替換 NEW CHANGE REPLACE		☑ 面	



指示なき寸法公差は とする
UNSPECIFIED TOL TO BE

△ 19					LM 24008M	名 称 NAME	Fig.6 Outline Dimension
△ 19	年 月 日 DATE	訂 正 記 事 REVISE	設 通 号 DESIGN NO.	制 造 PREP	通 用 機 種 MODEL	記 号 SYMBOL	
材 質 MATERIAL		板 厚 THICKNESS	仕 上 FINISH		尺 度 SCALE	部 品 コード PARTS CODE	
		Bezel is White-Zinc plated.		1/1			
設 計 DESIGN	検 査 TRACE	検 査 CHECK	検 査 CHECK	承認 APPROVE	作 成 日 付 DATE		1987 · 2 · 24 ·
神 元		野 村	辻 本	甲 井	図 番 DRAWING NO.		0: D 24008M: 2010
SHARP CORPORATION							
発行部門 LCD DIVISION							