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DEVICE SPECIFICATION FOR

240X64 Dot
Graphic LCD Unit

MODEL No.

LM24008W

☐ CUSTOMER'S APPROVAL

DATE

BY

PRESENTED
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RECORDS OF REVISION

MODEL No. LM24008W

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IDENT. DATA No. LC6144CC

DATE	REF. PAGE PARAGRAPH DRAWING No.	REVISED No.	SUMMARY	CHECK & APPROVAL
Jun.4,1986	Page 4	1	0 °C ~ +50 °C → 0 °C ~ +45 °C	T. Nakamura
May.8,1987	Page 1	2	Alteration inspection standerd	H. Nakagawa
Apr.15,1988	Page 1	3	Alteration inspection standard	H. Nakagawa

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1. Application

This data sheet is to introduce the specification of the Dot-Matrix LCD Unit LM24008W.

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

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3. Mechanical Specifications

Table 1

Parameter	Specifications	Unit
Outline dimensions	180 (W) x 75 (H) x10.5(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 *	Greenish white	-
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

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4-2. 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 (±X/±Y/±Z)

Note 1) Ta ≦ 40°C ..... 95% RH Max.
Ta > 40°C ..... Absolute humidity shall be less than Ta = 40°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) Accerelation: 100G
Pulse width: 6ms
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, V_{DD} = 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)	-13.0	-11.0	-	V
Input signal voltage	V_{IN}	"H" level	(Note1) 0.8V_{DD}	-	V_{DD}	V
		"L" level	0	-	(Note2) 0.2V_{DD}	V
Input leakage current	I_{IL}	"H" level	-	-	10	μA
		"L" level	-10	-	-	μA
Supply current (Logic)	I_{DD}	V_{EE} = -11.0V, 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 ±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°C ∿ +45°C).⚠

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

(Note2) S,M:0.8V(V_{DD}=5V),CP1=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)
SLEM10R-1/2 (BURNDY)

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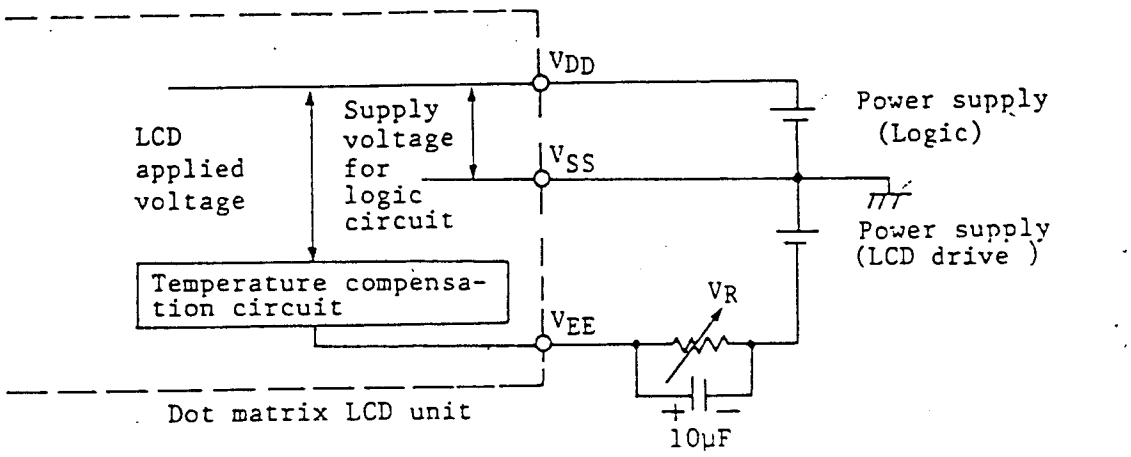
5.4 Contrast Adjustment of LCD Display Element

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)

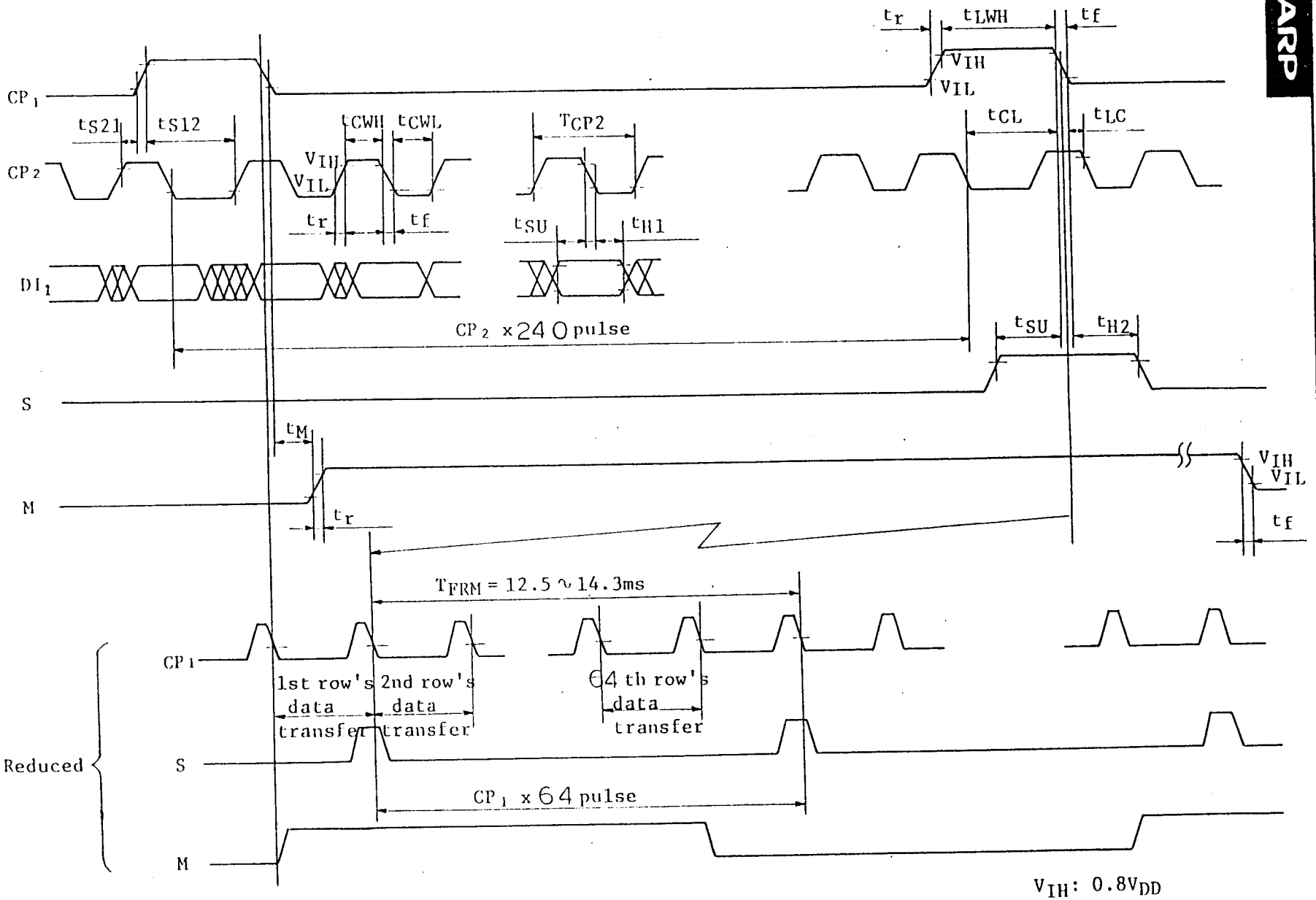


Fig. 1 Interface Timing Chart

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MODEL No. LM24008W

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_{H1}	100		-	ns
$CP_1\downarrow$ clock allowance time from $CP_2\downarrow$	t_{CL}	250		-	ns
$CP_2\downarrow$ clock allowance time from $CP_1\downarrow$	t_{LC}	20		-	ns
$CP_2\uparrow$ clock allowance time from $CP_1\uparrow$	t_{S12}	175		-	ns
$CP_1\uparrow$ clock allowance time from $CP_2\uparrow$	t_{S21}	20		-	ns
M clock allowance time from $CP_1\downarrow$	t_M	0		100	ns
Clock rise/fall time	t_r,t_f	-		50	ns
S clock hold time	t_{H2}	800		-	ns

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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 CP_2, 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 CP_2 clock, the input data is sequentially transferred via the shift register in the signal electrode driver.

After one row of data (240dots) 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 CP_1 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 CP_1 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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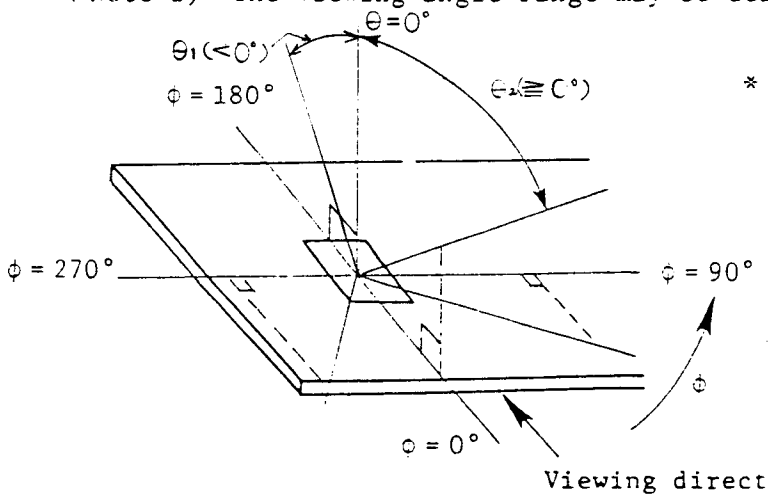
7. Optical Characteristics

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 (Ta = 25°C)

Parameter		Symbol	Condition		Min.	Typ.	Max.	Unit	Remark
Viewing angle range		$\theta_2-\theta_1$	ϕ = 0° $\theta_1 < \theta_2$	$C_0 \geq 2.0$	60	-	-	dgr.	Note 1
		θ_1		$C_0 = 2.0$	-	-	-40	dgr.	Note 1
		θ_2			25	-	-	dgr.	Note 1
		$\theta_2-\theta_1$	ϕ = 45° 315° $\theta_1 < \theta_2$	$C_0 \geq 2.0$	60	-	-	dgr.	Note 1
		θ_1		$C_0 = 2.0$	-	-	-40	dgr.	Note 1
		θ_2			25	-	-	dgr.	Note 1
Contrast ratio		C_0	θ = 15°		5	7	-		Note 2
Response speed	Rise	T_r	θ = 15°		-	150	250	ms	Note 3
	Decay	T_d	θ = 15°		-	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.

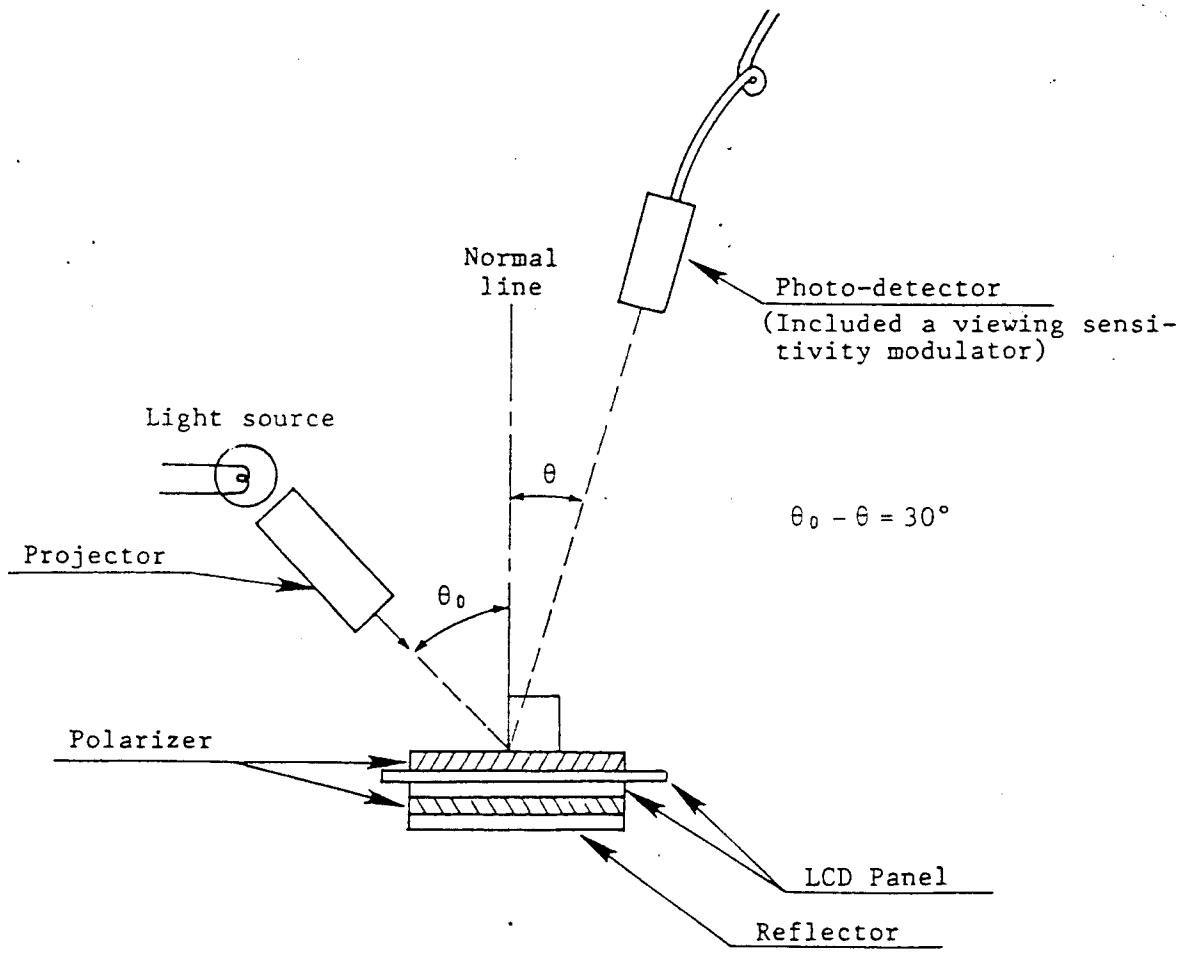
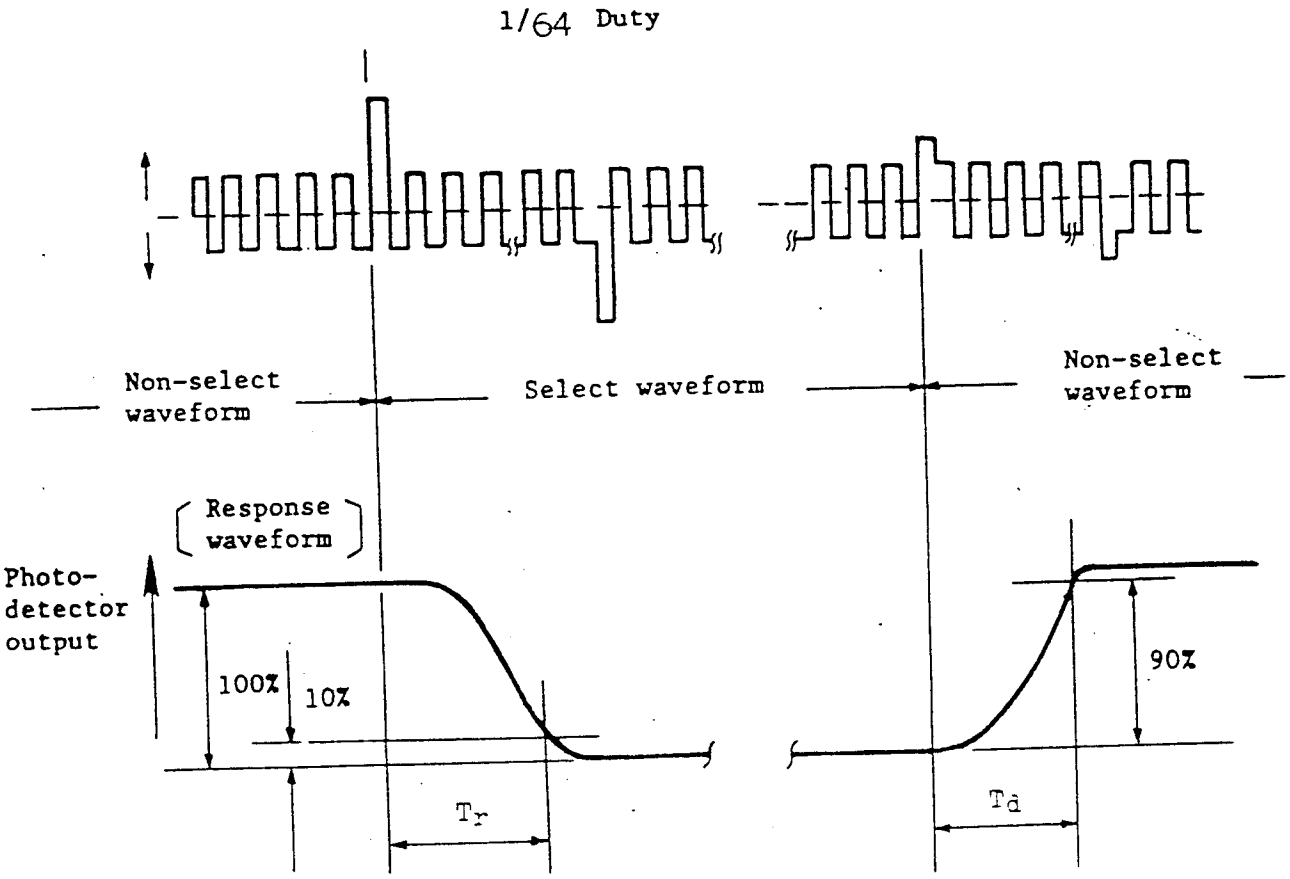


Fig. 3 Optical Characteristics Test Method

[Drive waveform]



Tr : Rise time
Td : Decay time

Fig. 4 Definition of Response Time

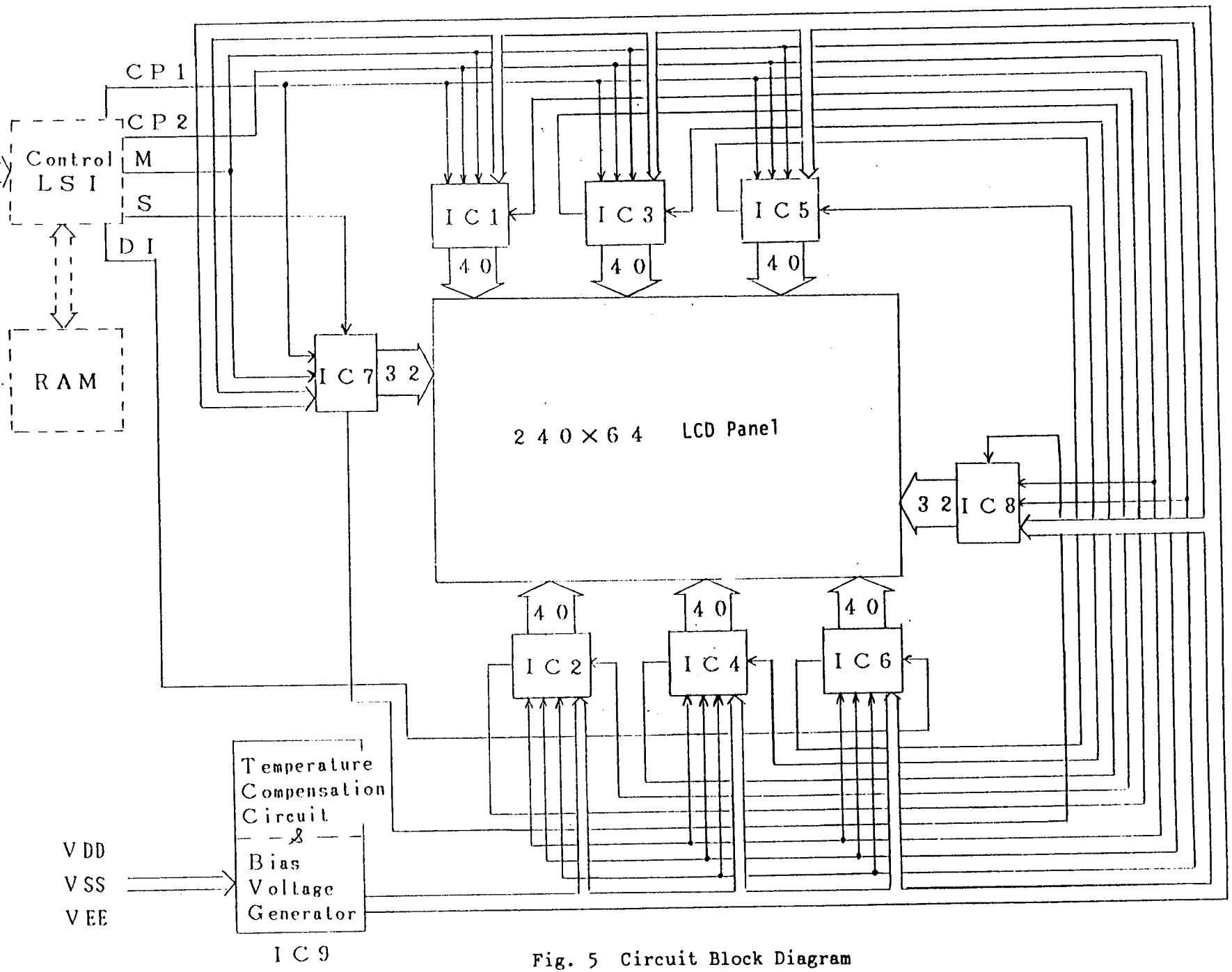


Fig. 5 Circuit Block Diagram

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8. Precautions

8.1 Angle when installing the unit

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

θ_1 < viewing range < θ_2 ($\theta_1 < 0°, \theta_2 \geqq 0°$)

(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.

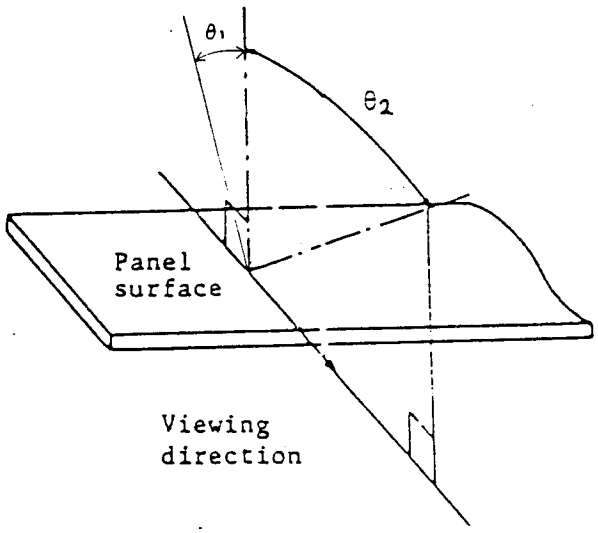

Fig. 7 Dot matrix LCD viewing angle

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.

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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 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.

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

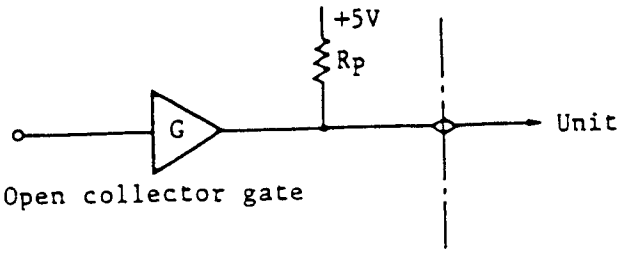
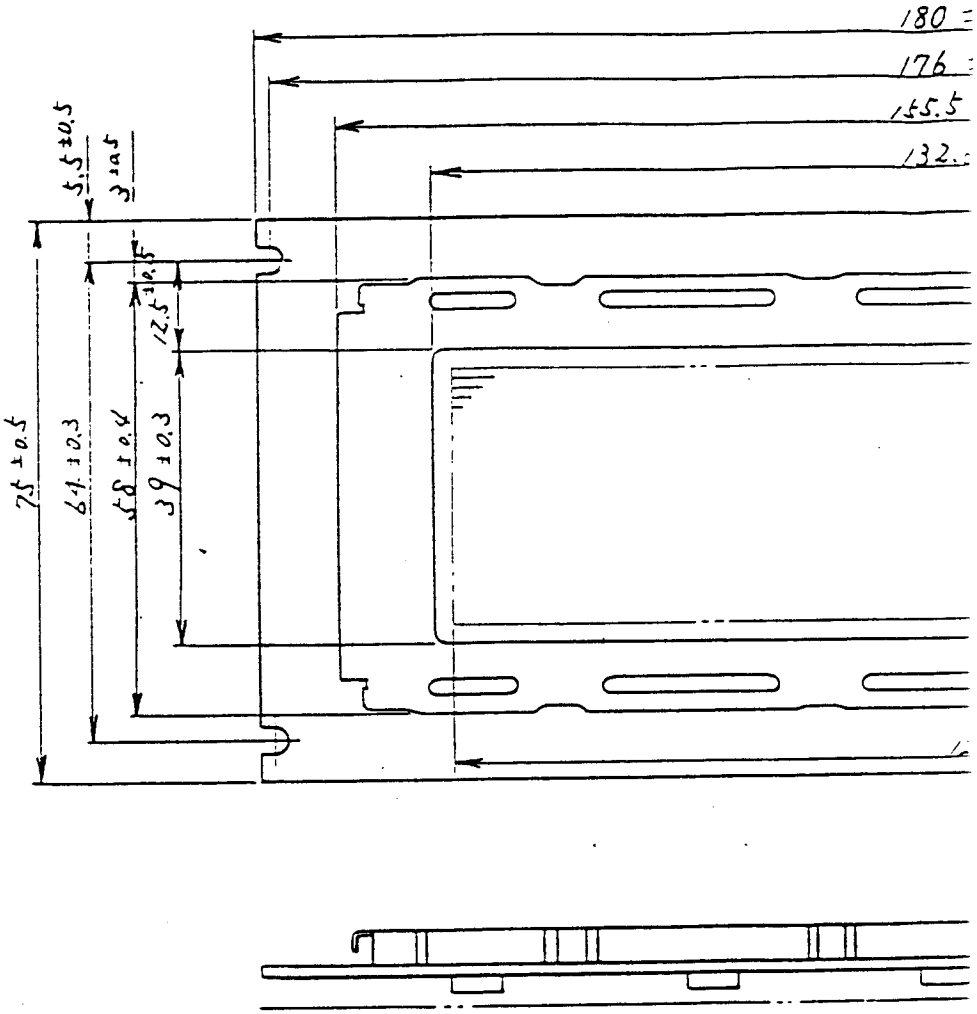
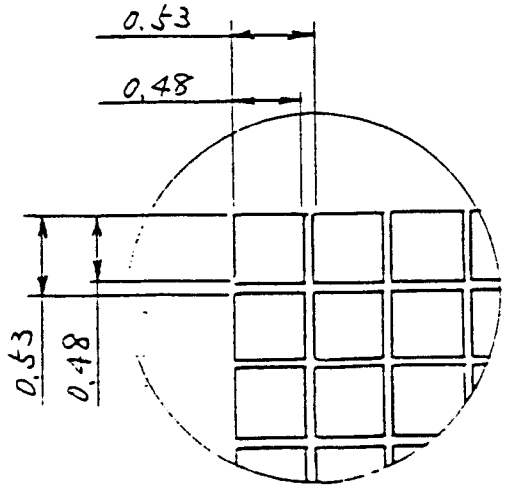


Fig. 8 TTL interface circuit





DOT SIZE (S=20%)

Fig. 6 Outline Dimensions

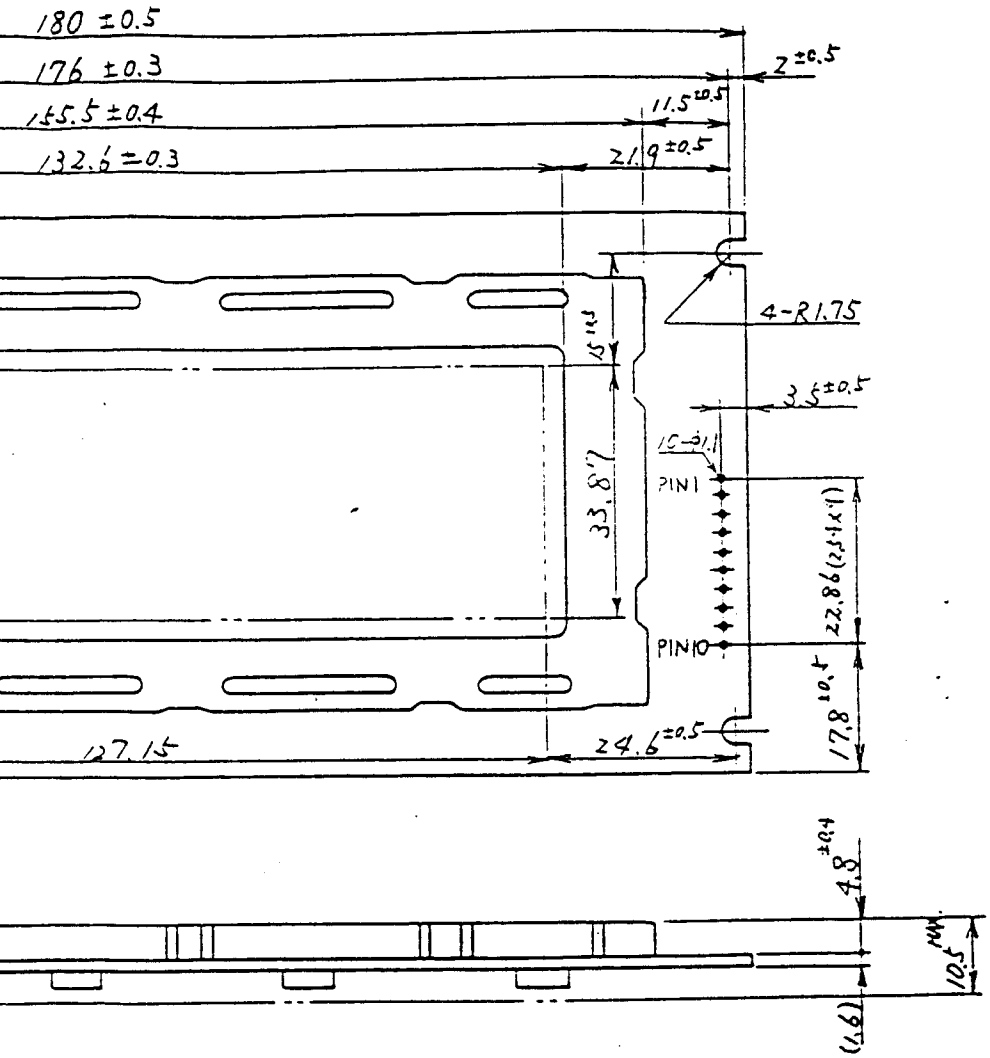
符号 NO.	名称 NAME	記号 SYMBOL	コード CODE	員数 PIECES	材質 MATERIAL	仕上 FINISH	備考 NOTE	担当 PREPA

出図 ISSUE 19 ・ ・ ・

設計通報 DRAWING INFO. 連絡書 INFORMATION

No. ( ) 号による

新設・変更・書換 NEW CHANGE REPLACE 図面



指示なき寸法公差は とする
UNSPECIFIED TOL TO BE

19 ・ ・			LM240028W	名称 NAME: LCD UNIT 外観図
19 ・ ・			LM-4006号	
年月日 DATE	訂正記事 REVISE	設通No.	機種 MODEL	
材質 MATERIAL	板厚 THICKNESS	仕上 FINISH	尺度 SCALE: 1/1	記号 SYMBOL: 240 x 64 DOTS
		ベゼルは、白色亜鉛メッキとする。		部品コード PARTS CODE:
設計 DESIGN	製図 TRACE	検図 CHECK	承認 APPROVE	作成日付 DATE: 1985・2・19
神				図番 DRAWING No.: CD24006G0010

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