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	SPECIFICATION	REPRESENTATIVE DIVISION
		☐ IC DIV.
		☐ SEMICONDUCTOR APPLICATION DIV.
		☐ DISPLAY DIV.
		☐ ELECTRONIC COMPONENTS DIV.
		☐

DEVICE SPECIFICATION FOR

240 X 128 Dots
LCD Dot-Matrix Unit
(D-STN,built in CCFT backlight)

MODEL No.

LM24010Z

☐ CUSTOMER'S APPROVAL

DATE _____

BY _____

PRESENTED
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1. Application

This data sheet is to introduce the specification of the Dot-Matrix LCD Unit LM24010Z .

(240 × 128 dot, D-STN Transmissive negative type,With backlight system by cold cathode fluorescent tube(CCFT).)

2. Construction and Outline

Construction : 240 × 128 full dot graphic display unit

Outline : See Fig. 8 .

Connection : See Fig. 8 .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-007.

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3. Mechanical Specifications

Table 1

Parameter	Specifications	Unit
Outline dimensions *1	176(W)×96(H)×22MAX(D)	mm
Effective viewing area	134(W)×76(H)	mm
Display format	240(W)×128(H) full dot	-
Dotsize	0.49(W)×0.49(H)	mm
Dot spacing	0.04	mm
Dot color *2	White	-
Background color *2	Black	-
Weight	applox. 430	g

*1 : Excluded the mounting tab and connector.(See Fig.8)

*2 : 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)	VDD-VSS	0	6.0	V	Ta=25℃
Supply voltage (LCD drive)	VDD-VEE	0	27.0	V	Ta=25℃
Input voltage	VIN	0	VDD	V	Ta=25℃

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4-2. Environmental Condition

Table 3

Item	Tstg		Topr		Remark
	MIN.	MAX.	MIN.	MAX.	
Ambient temperature	-25℃	+60℃	0°C	+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 ≦ 40℃ ·····95% RH Max

Ta > 40℃ ·····Absolute humidity shall be less than Ta = 40℃ / 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) Direction of ±X : Accerelation 80G, Pulse width 6ms, 3 times.

Direction of ±Y/±Z : Accerelation 100G, Pulse width 6ms, 3 times.

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5. Electrical Specifications

5-1. Electrical characteristics

Table 4

Ta=25℃, VDD=5V±5%

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage(Logic)	VDD-VSS		4.75	5.0	5.25	V
Supply voltage(LCD drive)	VEE-VSS	VDD=5V Note)	-21	—	—	V
Input signal voltage	VIN	"H"level	0.8VDD		VDD	V
		"L"level	0		0.2VDD	V
Input leakage current	IIL	"H"level			20	μA
		"L"level	-20			μA
Supply current(Logic)	IDD	VEE=-21V VDD=5V F=80Hz VR=0Ω display high Frequency pattern		16	20	mA
Supply current(LCD drive)	IEE			15	18	mA
Power consumption	Pd			395	478	mW

Note) The viewing angle with optimum contrast(θ) is available by changing Reference voltage for LCD drive circuit. And this Reference voltage varies by changing the resistance between terminal VR1 and VR2.
(Refer to Fig.4 for the definition of θ.)

5-2. Input capacitance

Table 5

Signal	Input capacitance
S	50pF TYP
CP1	100pF TYP
CP2	100pF TYP
D1～D4	50pF TYP

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5.3 Interface signals

Table 6

Pin No.*1	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	NC	- *2	-
5	NC	-	
6	VDD	Power supply for logic and LCD (+)	-
7	VSS	Ground potential	-
8	VEE	Power supply for LCD (-)	-
9	D1	Display data signal	H(ON),L(OFF)
10	D2		
11	D3		
12	D4		
13	GND	Power supply for CCFT *3	-
14	NC	-	-
15	Vout	Power supply for CCFT *3	-
16	VR1	Variable resister (VEE potential) *4	-
17	VR2	Variable resister (Vref potential) *4	-

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

*2 : Do`nt connect another signals.

*3 : Recommend variable resistor value : 20KΩ～30KΩ

*4 : Recommend CCFT inverter : CXA1301-1〔COPAL〕
LM000101 〔SHARP〕

*5 : Used connector : 5045-12A(MOLEX) (12pins)
5045-03A(MOLEX) (3pins)
5045-02A(MOLEX) (2pins)

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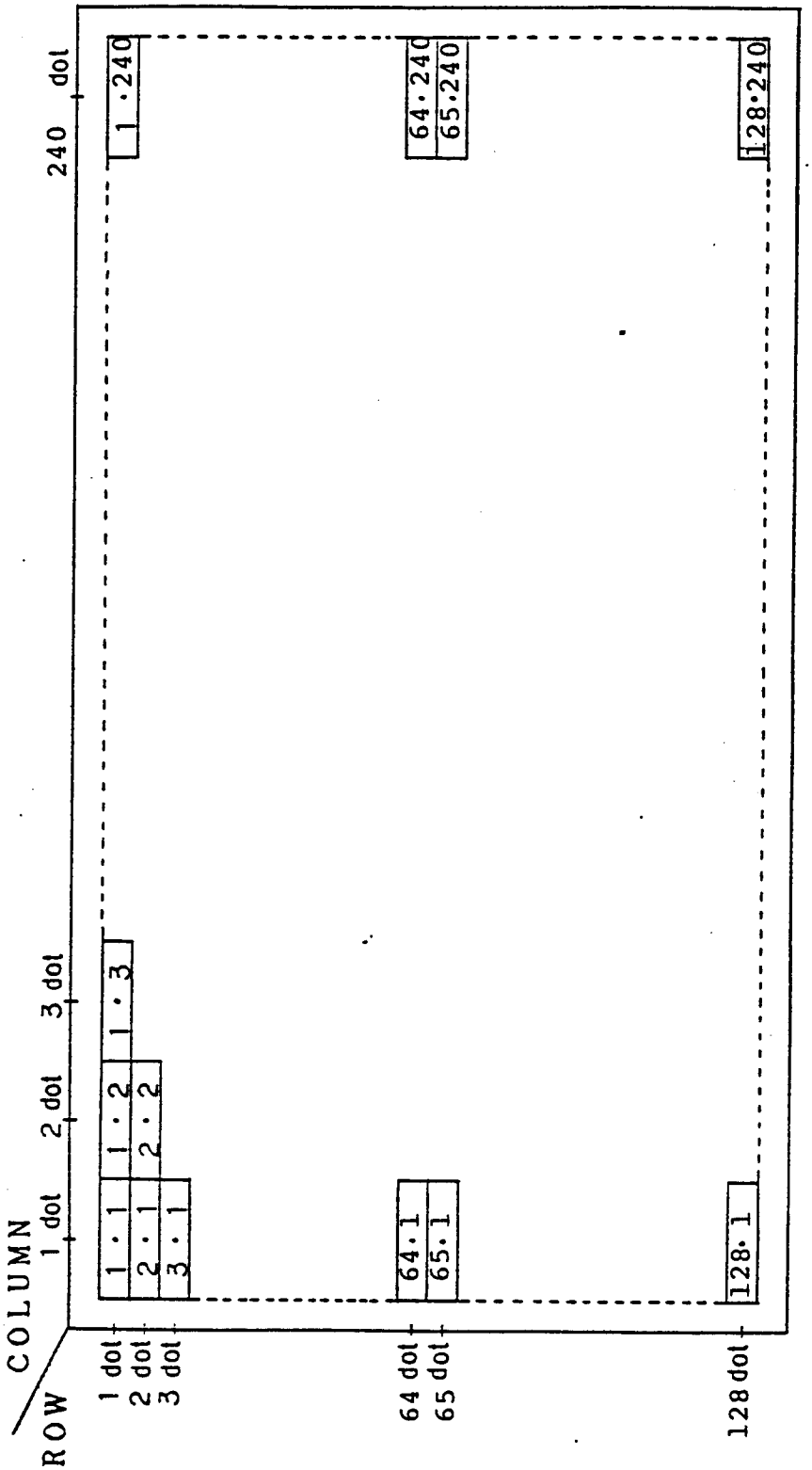

Note: 1 · 2 means 1st row 2nd column dot.

Fig 1 Dot Chart of Display Area

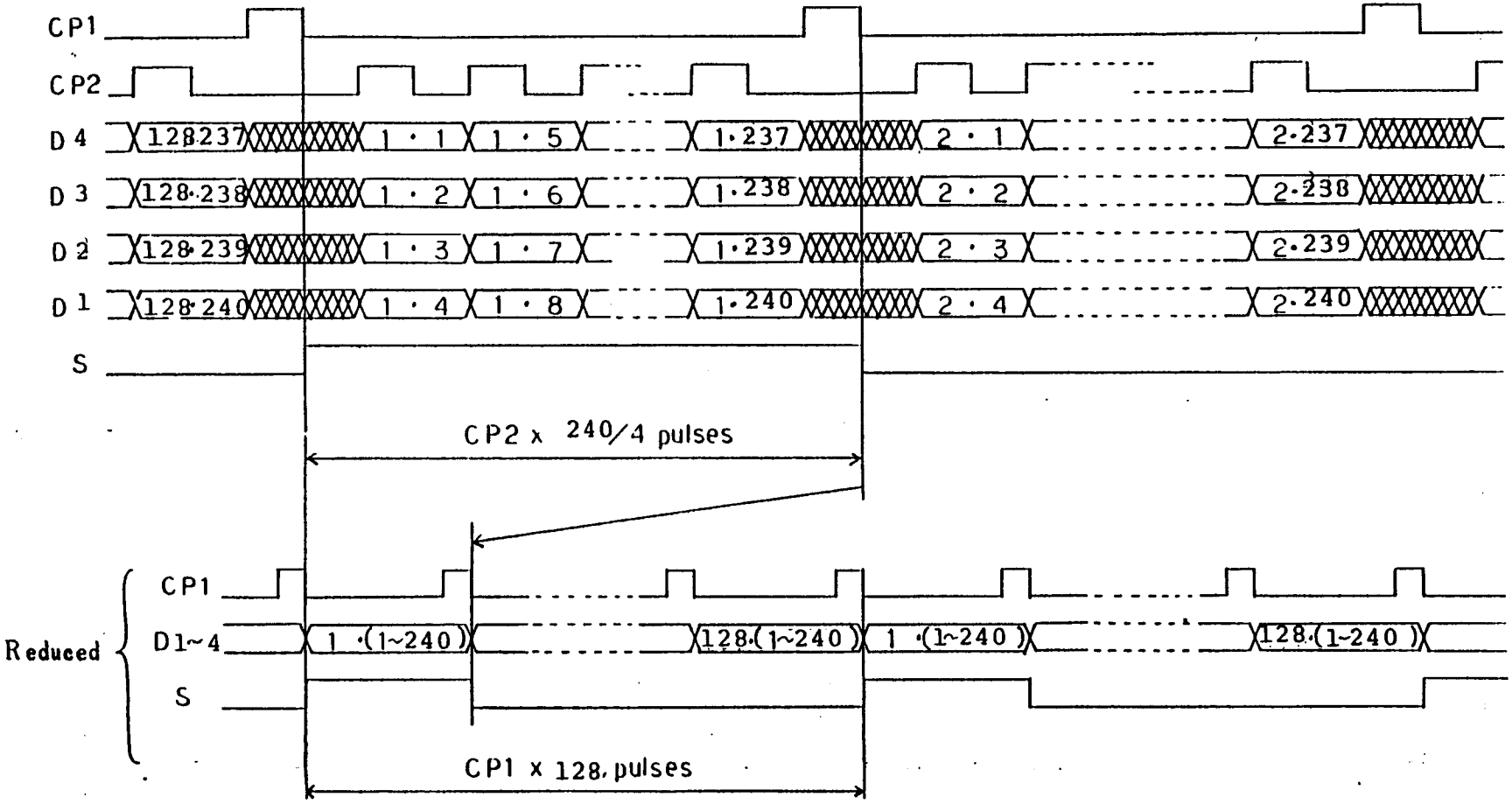

Fig 2 Data Input Timing

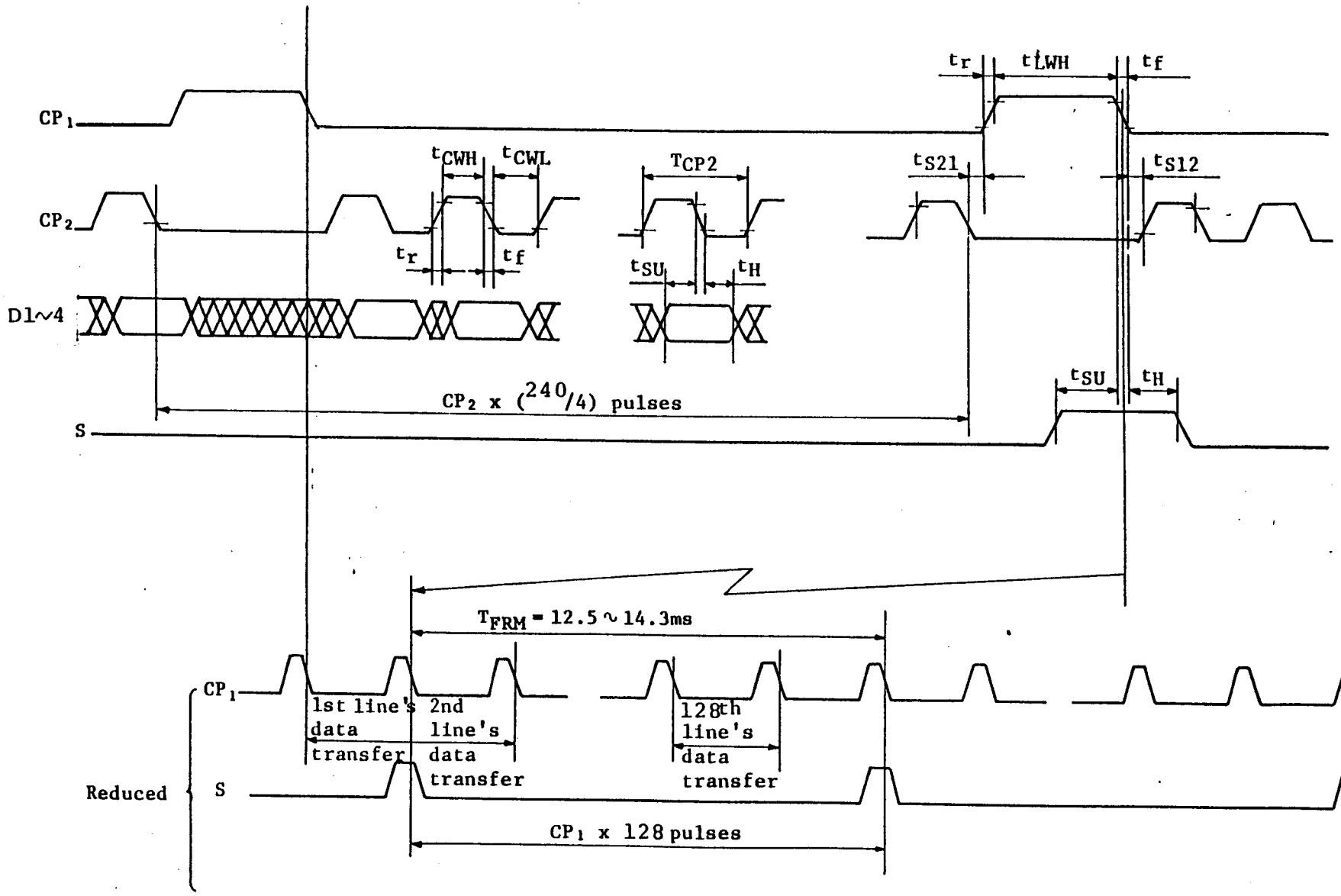

Fig. 3 Interface Timing Chart

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

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

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MODEL No. LM240102

PAGE 8

Table 7 Interface timing ratings

Item	Symbol	Rating			Unit
		MIN.	TYP.	MAX.	
Frame cycle	T_{FRM}	12.5		14.3	ms
CP_2 clock cycle	T_{CP2}	500			ns
"H" level clock width	t_{CWH}	230			ns
"L" level clock width	t_{CWL}	230			ns
"H" level latch clock width	t_{LWH}	130			ns
Date set up time	t_{SU}	100			ns
Date hold time	t_H	100			ns
$CP_2\uparrow$ clock allowance time from $CP1\downarrow$	t_{S12}	0			ns
$CP_1\uparrow$ clock allowance time from $CP2\downarrow$	t_{S21}	0			ns
Clock rise/fall time	t_r, t_f			50	ns

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6. Unit Driving Method

6.1 Circuit configuration

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

6.2 Input data and control signals

The LCD driver is 80 bits LSI,consisting of shift resisters,latch circuits and LCD drivers.

Display data which are externally divided into data for each row, (240 dots) will be sequentially transferred in the form of 4-bit parallel data through shift resisters by Clock Signal CP2 from the left top of the display face.

When data of one row (240 dots) have been inputted,then latched in the form of parallel data for 240 lines of signal electrodes by Latch Signal CP1. Then the corresponding drive signal will be transmitted to the 240 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 240 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 128th 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 at every display frame to prevent the generation of such DC voltage. And to prevent such problem. Drive AC waveform generation circuit by counted CP1(M generator) is build 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 paralell data through the 4 lines of shift resisters to reduce the data transfer speed CP2. Thanks to the LSI,the power consumption of the unit will be minimized.

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In this circuit configuration,4-bit display data shall be therefore inputted to data input pins of D1～D4.

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 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(20CP2) is fed. The 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 display segments. Thus data input for display segments must be fed through 4-bit bus line sequentially from the left end of the display 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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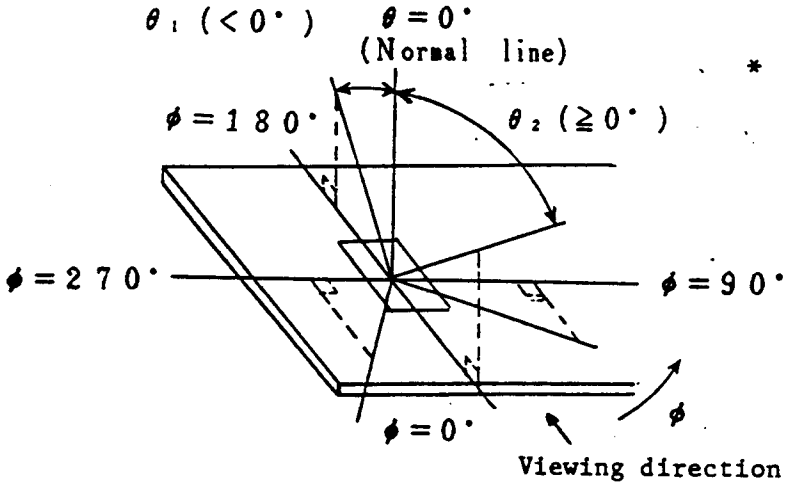
7. Optical Characteristics

V_{DD} = 5V
V_{EE} = -21 V
(Ta = 25°C)

Table 8

Parameter		Symbol	Condition		Min.	Typ.	Max.	Unit	Remark
Viewing angle range		$\theta_2-\theta_1$	$\phi = 0°$ $\theta_1 < \theta_2$	$C_0 \geq 5.0$	40	-	-	dgr.	Note 1
		θ_1		$C_0 = 5.0$	-	-	-15	dgr.	Note 1
		θ_2			20	-	-	dgr.	Note 1
		$\theta_2-\theta_1$	$\phi = 90°$ $\theta_1 < \theta_2$	$C_0 \geq 5.0$	45	-	-	dgr.	Note 1
		θ_1		$C_0 = 5.0$	-	-	-20	dgr.	Note 1
		θ_2			20	-	-	dgr.	Note 1
Contrast ratio		C_0	$\theta = 0°$		15	20	-		Note 2
Response speed	Rise	T_r	$\theta = 0°$		-	200	300	ms	Note 3
	Decay	T_d	$\theta = 0°$		-	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 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 the optical characteristics test method (Fig. 5).

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

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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 .

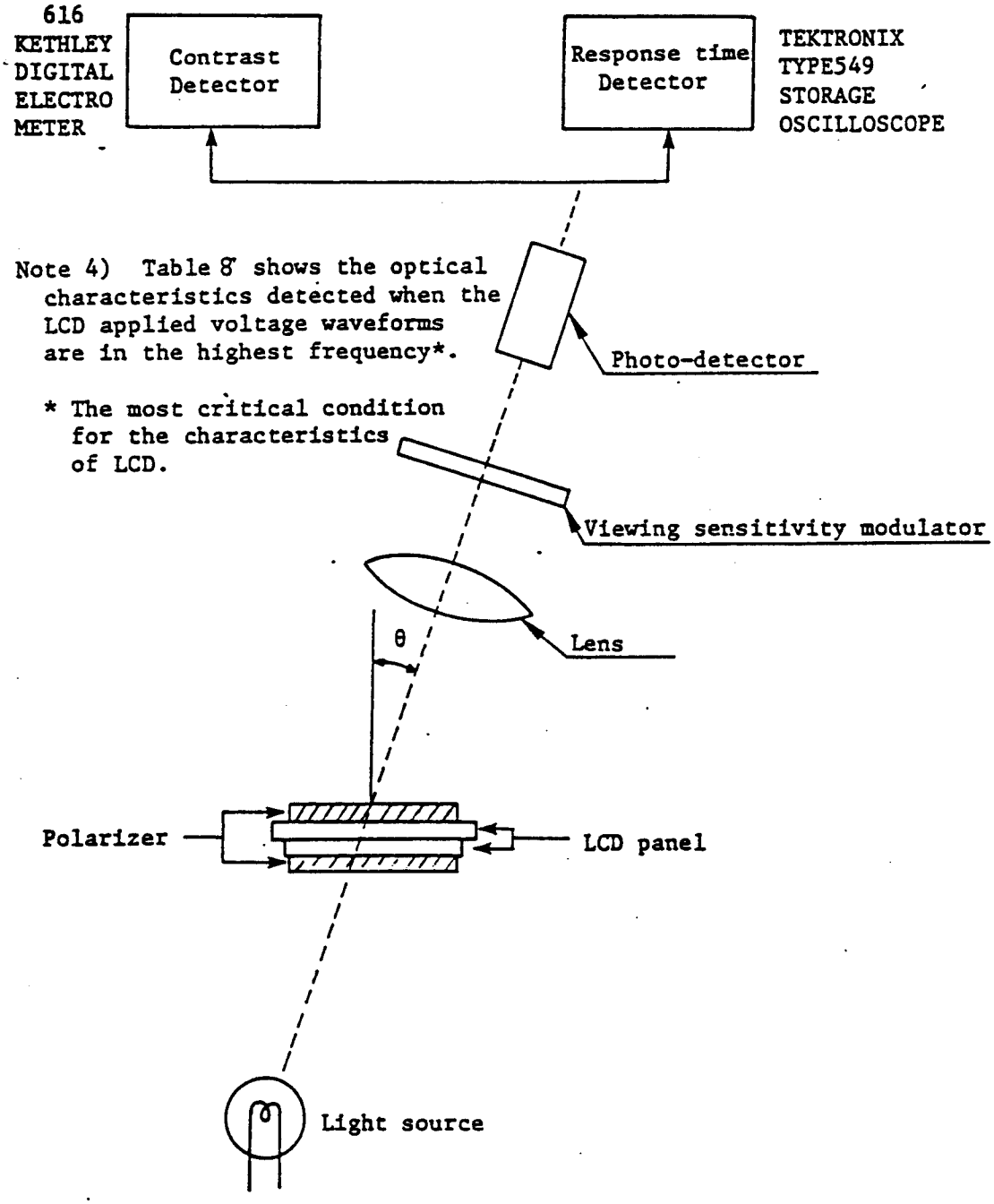

Fig. 5 Optical Characteristics Test Method

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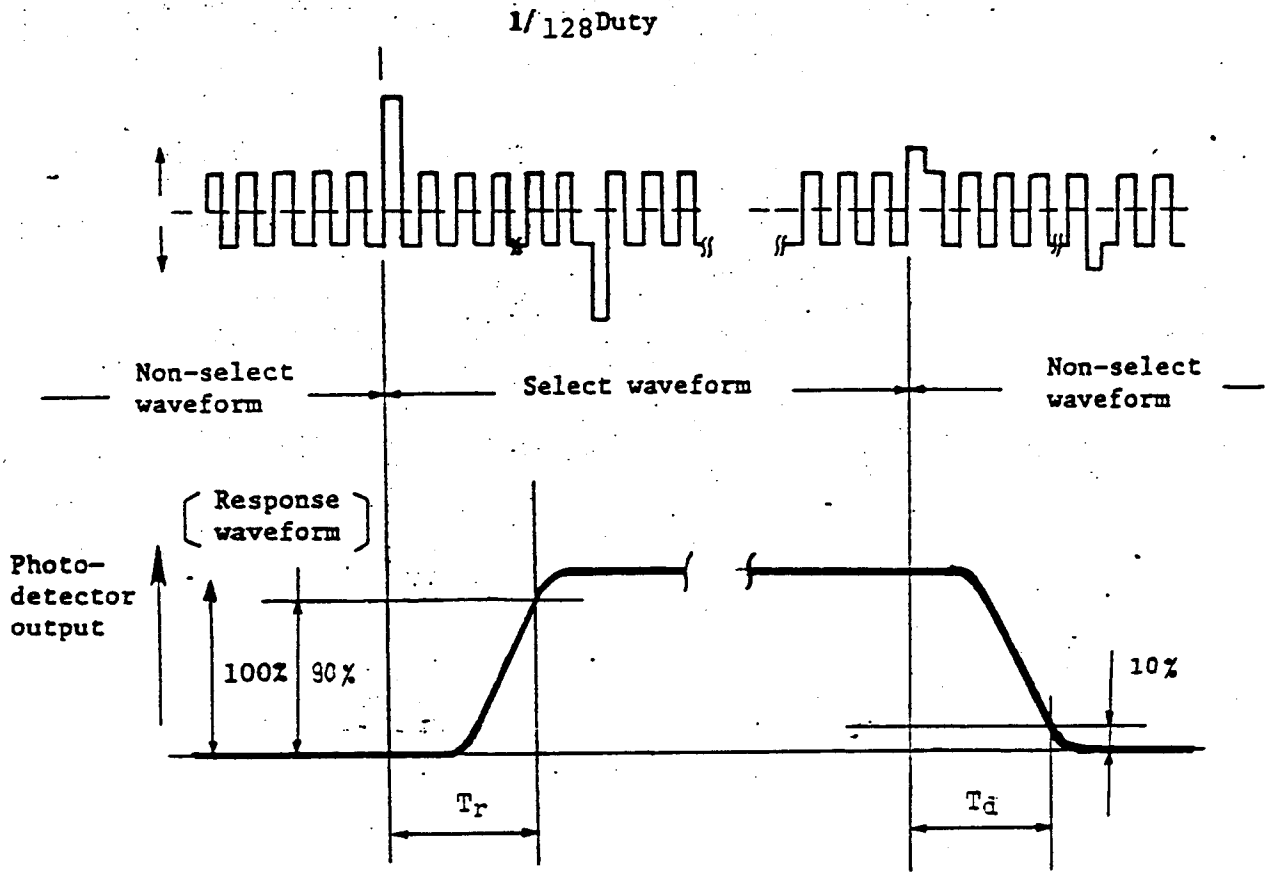
[Drive waveform]



T_r : Rise time
T_d : Decay time

Fig.6 Definition of Response Time

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8. Characteristics of Backlight

The ratings are given on condition that the following conditions are satisfied.

8-1. Rating(Following Brightness specification is based upon active area.)

Parameter	Min.	Typ.	Max.	Unit
Brightness	10.0	-	48.0	nt
Input current	-	90	99	mA

8-2. Measurement circuit(INVERTER)

CXA1301-1[COPAL]

8-3. Measurement equipment(Brightness measurement equipment)

BM-5 [Tokyo Optical Machinery Corporation]

8-4. Measurement conditions

8-4-1. Measurement circuit voltage:DC=24V at primary side

8-4-2. LCD is displayed. The maximum contrast in $\theta=0°$

8-4-3. Ambient temperature:25℃

Measurement shall be executed 30 minutes after turning on.

8-5. Life time

Life time to be 20,000hours or more with CXA1301-1(Rated current of 4.4mA).

*Definition of Life time

Life time shows following specified time period.
The brightness of lighting device will decrease to to 50% compared to initial brightness after operation for such time(Life time).

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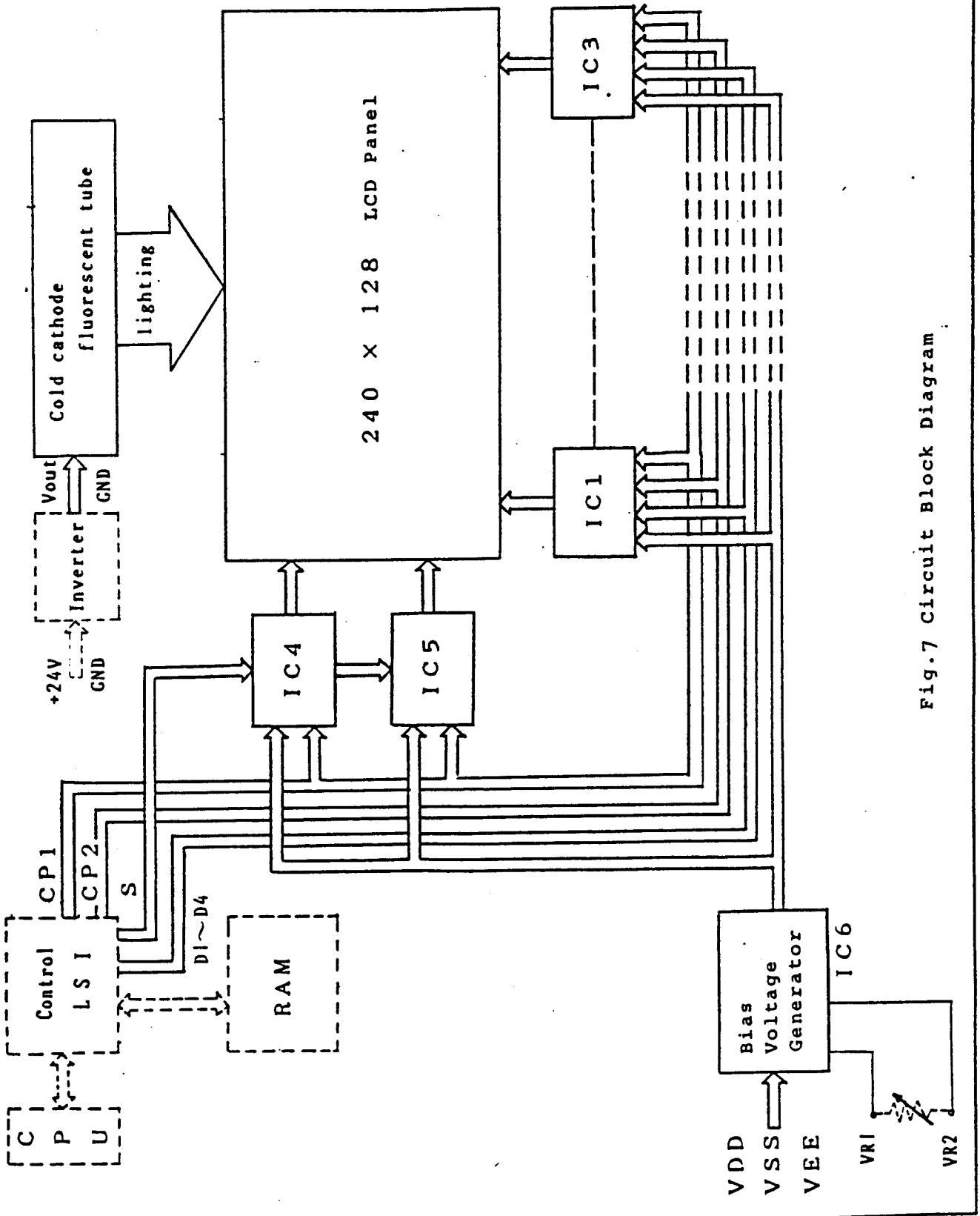
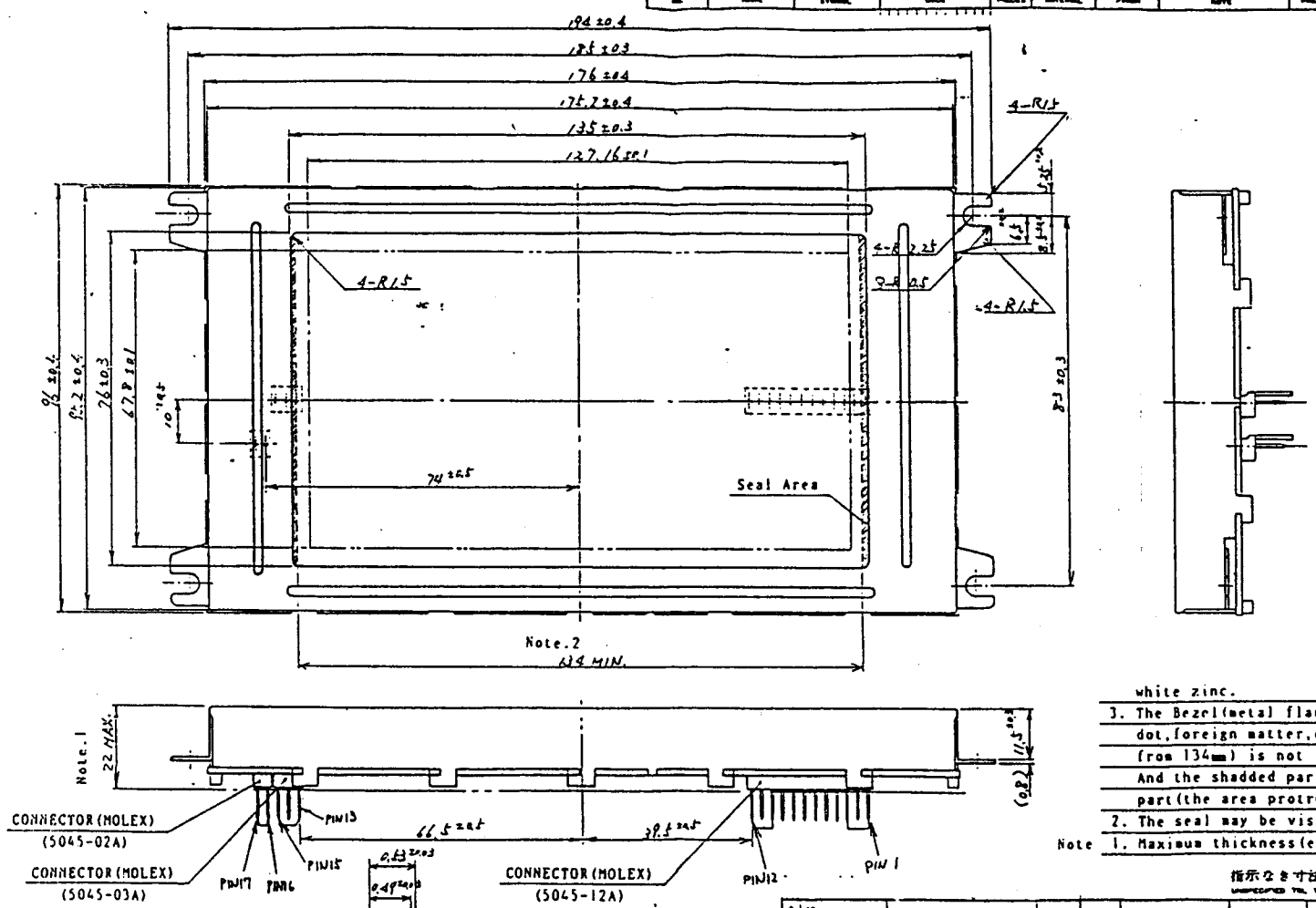


Fig.7 Circuit Block Diagram



Note
1. Maximum thickness (except connector)
2. The seal may be visible at the shadded part (the area protruding from 134mm).
3. The Bezel (metal flame) is galvanized by white zinc. And the shadded part (the area protruding from 134mm) is not inspected for black dot, foreign matter, etc.

指示なき寸法公差は ±0.1 とする

名称	LCD MODULE OUTLINE DIMENSIONS
記号	240 × 128 DOTS
部品コード	
作成日付	1988 · May 16 ·
図番	0 0 2 4 0 7 0 2 3 0 1 0
尺度	1/1
型式	LM240102

シャープ株式会社
SHARP CORPORATION
LCD DIVISION
ENGINEERING DEPT. 2

Fig. 8

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9. Precautions

9.1 Angle when installing the unit

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

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.

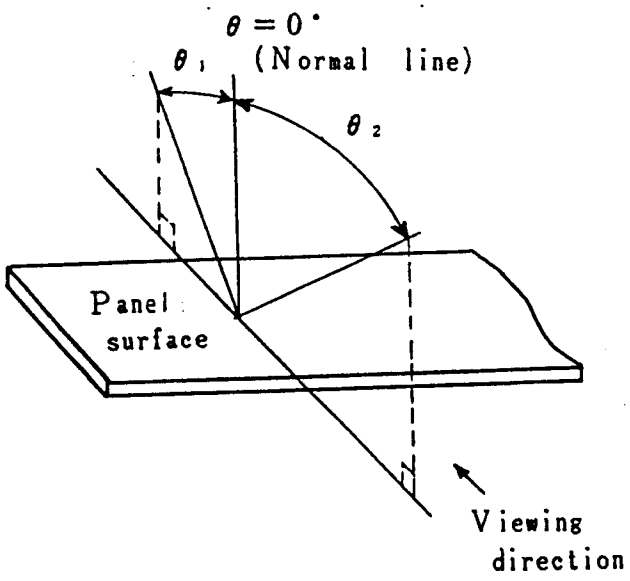

Fig. 9 Dot matrix LCD viewing angle

9.2 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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9.3 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.

9.4 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.

9.5 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.

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(Reference)

Specification of inverter for cold cathode fluorescent tube FLE65160(AE)B drive.

※. Rating

Supply voltage	(Vin)	24±10%	Vdc
Supply current	(Iin)	90±9	mA
Discharging tube current	(IL)	4.4±1	mArms
Discharging tube voltage	(VL) reference value	290±40	Vrms
Non loading output voltage	(Vo)	Min 900	Vrms
Frequency	(f)	Approx 33	KHz
Operating temperature	(Ta)	Min 0~45	℃
Storage temperature	(Ts)	Min -20~60	℃

※. Measurement circuit
Refer to Fig.10

※. Measurement conditions
Unspecified conditions to be 15℃~35℃/45%~85%RH.
(when measurement result is critical to judge,then measurement at 25℃±1℃/65%±5%RH.)

Fig.10