PREPARED BY: DATE	**SHARP**	SPEC No. LC94217A
		FILE No.
	LIQUID CRYSTAL DISPLAY GROUP	ISSUED FEB.18.1994
APPROVED BY: DATE	SHARP CORPORATION	PAGE 23 Pages
		APPLICABLE DIVISION ·
		■DUTY PANEL DEVELOPMENT CENTER
		□TFT DEVELOPMENT CENTER
	SPECIFICATION	□LCD PRODUCTS DEVELOPMENT CENTER
		□EL PRODUCTION DEPT.

SPECIFICATION FOR
Passive Matrix LCD Unit
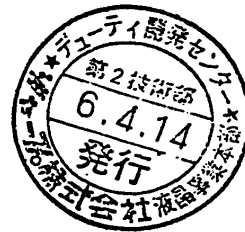
Model No.

LM64183P

□CUSTOMER'S APPROVAL

DATE _____

BY _____

PRESENTED
BY *Y. Inoue*

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LCD GROUP

	SPEC No.	MODEL No.
SHARP	LC94217A	**LM64183P**

	DOC. FIRST ISSUE
RECORDS OF REVISION	FEB.12 .1994
	IDENT. DATA No.

DATE	REF. PAGE PARAGRAPH DRAWING No.	REVISED No.	SUMMARY	CHECK & APPROVAL
APR. 12. 1994	Page. 1 2	1	REVISED (Response time)	*Y. Inoue*

1. Application

   This data sheet is to introduce the specification of LM64183P, Passive Matrix type LCD Unit.

2. Construction and Outline

   · Construction: 640×480 dots display unit consisting of an transmissive LCD panel, PWB(printed wiring board) with electric components mounted onto, TAB(tape automated bonding) to connect the LCD panel and PWB electrically, and plastic chassis with CCFT backlight and bezel to fix them mechanically.

BEZEL   LSI (TAB)

LCD (with Anti-glare treatment. Pencil hardness 3H.)

LIGHT PIPE   CCFT

PWB

BACKLIGHT HOLDER

PLASTIC CHASSIS
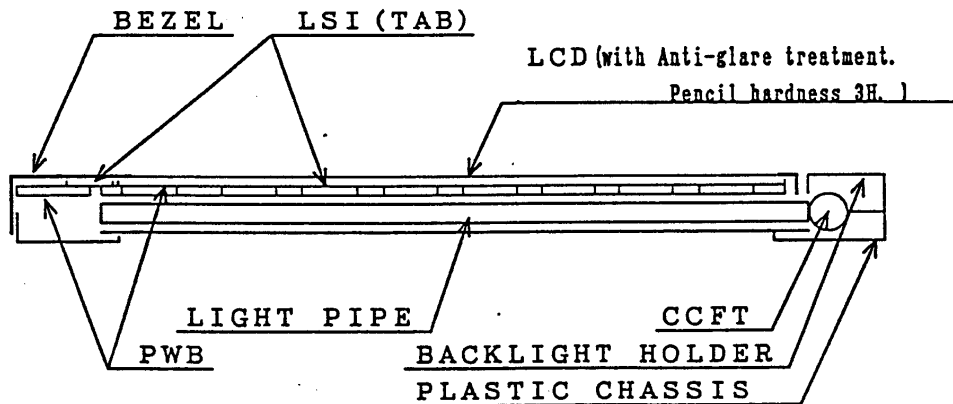
Outline   : See Fig. 10

Connection   : See Fig. 10 and Table 6

3. Mechanical Specifications

Table 1

Parameter	Specifications	Unit
Outline dimensions	253 (W) × 174 (H) × 7MAX (D)	mm
Effective viewing Area	196 (W) × 147.6 (H)	mm
Display format	640 (W) × 480 (H) full dot	—
Dot size	0.27 × 0.27	mm
Dot spacing	0.03	mm
‡1 Dot color	White‡2	—
‡1 Background color	Black‡2	—
Weight	Approx. 340	g

‡1 Due to the characteristics of the LC material, the colors vary
   with environmental temperature.

‡2 Negative-type display
   Displayed data 'H': Dots ON : White
   Displayed data 'L': Dots OFF: Black

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 ℃
Supply voltage (LCD drive)	$V_{DD}-V_{EE}$	0	28.0	V	Ta=25 ℃
Input voltage	V_{IN}	0	V_{DD}	V	Ta=25 ℃

4-2 Environmental Conditions

Table 3

Item	Tstg		Topr		Remark
	MIN.	MAX.	MIN.	MAX.	
Ambient temperature	-25 ℃	+60 ℃	0 ℃	+45 ℃	Note 4
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) These test conditions are in accordance with IEC 68-2-6'.

Frequency	10 Hz~57 Hz	57 Hz~500 Hz
Vibration level	—	9.8 m/s²
Vibration width	1.0 mm	—
Interval	10 Hz~500 Hz~10 Hz/11 min	

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

Note 3) Accerelation: 490 m/s²

Pulse width : 11 ms

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

Note 4) Care should be taken so that the LCD Unit may not be subjected to the temperature out of this specification.

5. Electrical Specifications

5-1 Electrical characterictics

Tabel 4　　Ta=25 ℃, V_{DD}=5 V±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)	$V_{EE}-V_{SS}$	Note 1) Note 2)	-22.0	-17.0	-13.1	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}	'H' level	—	—	250	μA
		'L' level	-250	—	—	μA
Supply current (Logic)	I_{DD}		—	24	34	mA
Supply current (LCD drive)	I_{EE}	Note 3)	—	15	24	mA
Power consumption	Pd		—	380	580	mW

Note 1)　The viewing angle θ at which the optimum contrast is obtained can be set
by adjusting $V_{EE}-V_{SS}$. Refer to Fig.4 for the definition of θ.

Note 2)　Max. and Min. values are specified as the Max. and Min. voltage
within the condition of operational temperature range (0~45 ℃).
Typ. values are specified as the typical voltage at 25 ℃.

Note 3) Display high frequency pattern.
V_{DD} = 5 V, V_{EE} - V_{SS} = -17.0 V, Frame frequency = 85 Hz, Display pattern = 1bit checker

Display ■□■□■□■□■□■□■□■□■□■□■□
pattern □■□■□■□■□■□■□■□■□■□■□■
　　　　■□■□■□■□■□■□■□■□■□■□■□

5-2 Input capacitance

Table 5

Signal	Input capacitance
S	40 pF TYP
CP1, DISP	250 pF TYP
CP2	200 pF TYP
DU0~DU3	200 pF TYP
DL0~DL3	200 pF TYP

5-3 Interface signals

<u>Table 6</u>

○LCD

Pin No	Symbol	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	DISP	Display control signal	Display on .."H" off.."L"
5	VDD	Power supply for logic and LCD (+5V)	
6	VSS	Ground potential	
7	VEE	Power supply for LCD (-)	
8	DU0	Display data signal (Upper half)	H(ON),L(OFF)
9	DU1		
10	DU2		
11	DU3		
12	DL0	Display data signal (Lower half)	H(ON),L(OFF)
13	DL1		
14	DL2		
15	DL3		

○CCFT

Pin No	Symbol	Description	Level
1	GND	Ground line (from Inverter)	-
2	NC	-	-
3	NC	-	-
4	HV	High voltage line (from Inverter)	-

Note) Pin No. and its location are shown in Fig. 10.

○LCD

Used   connector: 53261-1510 (MOLEX)

Mating connector: 51021-1500 (MOLEX)

○CCFT

Used   connector: M63M83-04 (MITSUMI)

Mating connector: M60-04-30-114P (MITSUMI)

M60-04-30-134P (MITSUMI)

M61M73-04 (MITSUMI)

SHARP

COLUMN

ROW   1dot   2dot   3dot   640dot

	1dot	2dot	3dot		640dot
1dot	1·1	1·2	1·3		1·640
2dot	2·1	2·2			
3dot	3·1				
240dot	240·1				240·640
241dot	241·1				241·640
480dot	480·1				480·640
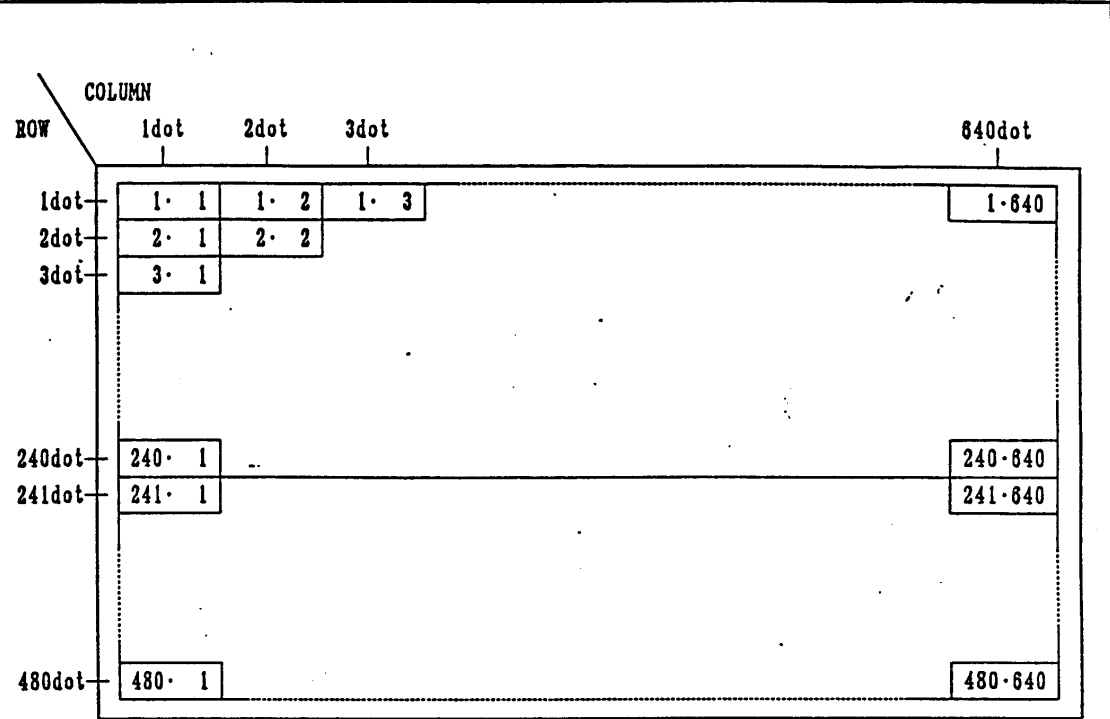
Note) 1·2 means 1st row 2nd column dot.

COLUMN

ROW   1   2   3   4   5   6   7   8   640

	1	2	3	4	5	6	7	8		640			
1dot	DU3	DU2	DU1	DU0	DU3	DU2	DU1	DU0		DU3	DU2	DU1	DU0
2dot	DU3	DU2	DU1	DU0	DU3	DU2	DU1	DU0					
3dot	DU3	DU2	DU1	DU0									
240dot	DU3	DU2	DU1	DU0						DU3	DU2	DU1	DU0
241dot	DL3	DL2	DL1	DL0						DL3	DL2	DL1	DL0
480dot	DL3	DL2	DL1	DL0						DL3	DL2	DL1	DL0
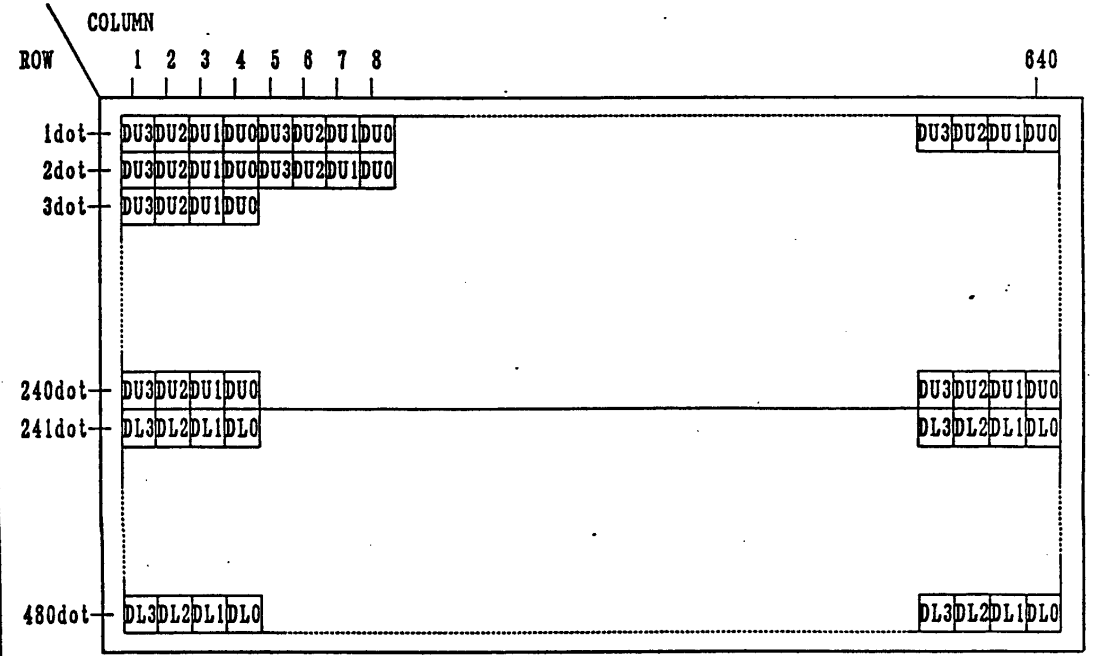
Fig. 1 Dot chart of display area

Fig. 2 Data input timing

CP1

t_r t_{LWH} t_f

CP2

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

t_r t_f t_{su} t_H

DATA

CP2 × (640/4) pulses

t_{SSU} t_{SH}

S

$T_{FRM}=8.0^{*1} \sim 16.9$ ms

CP1

Reduced

first line's data transfer | second line's data transfer | 240th line's data transfer

S

CP1 × 240 pulses

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

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

*1 See table 7

Fig.3 Interface timing chart
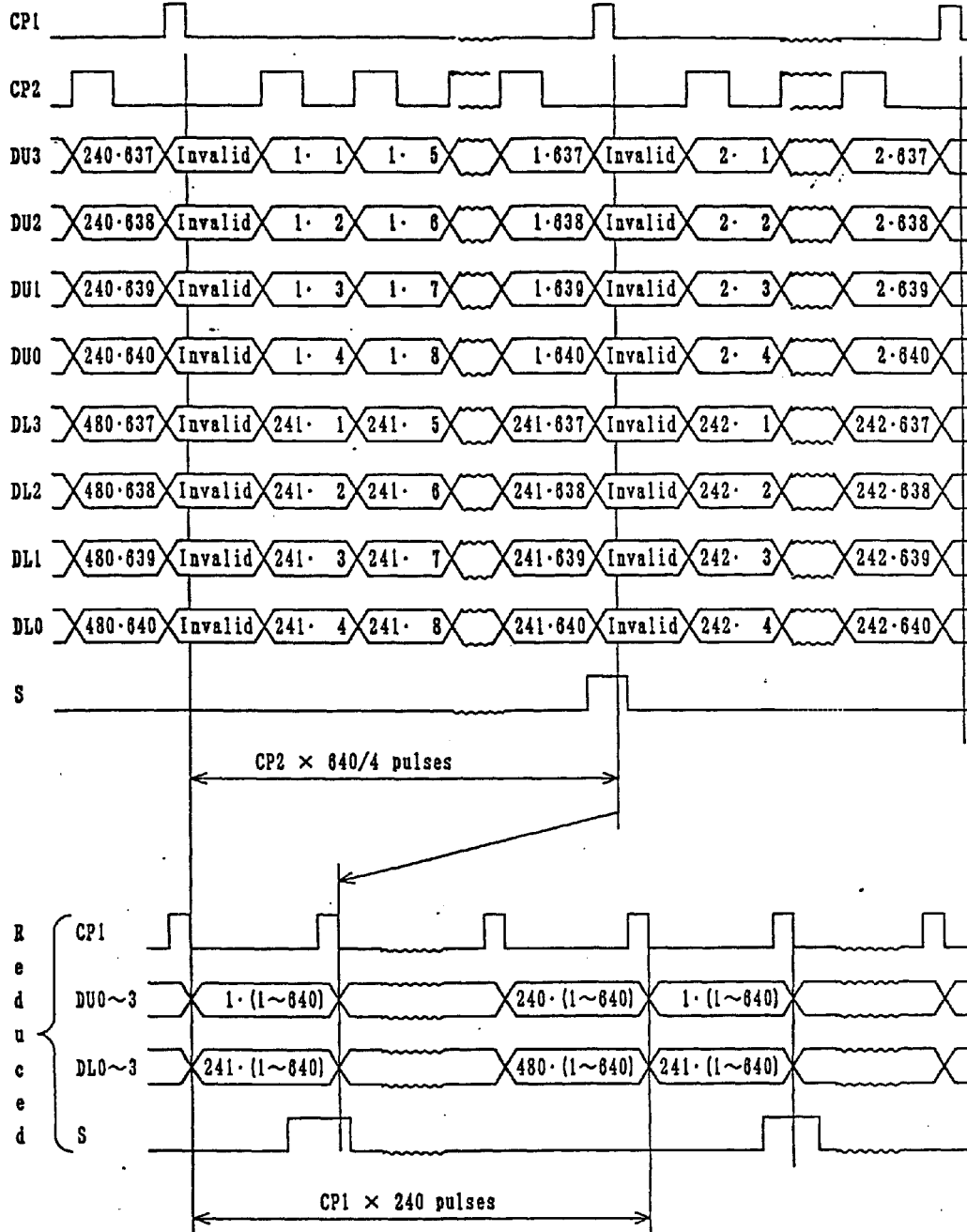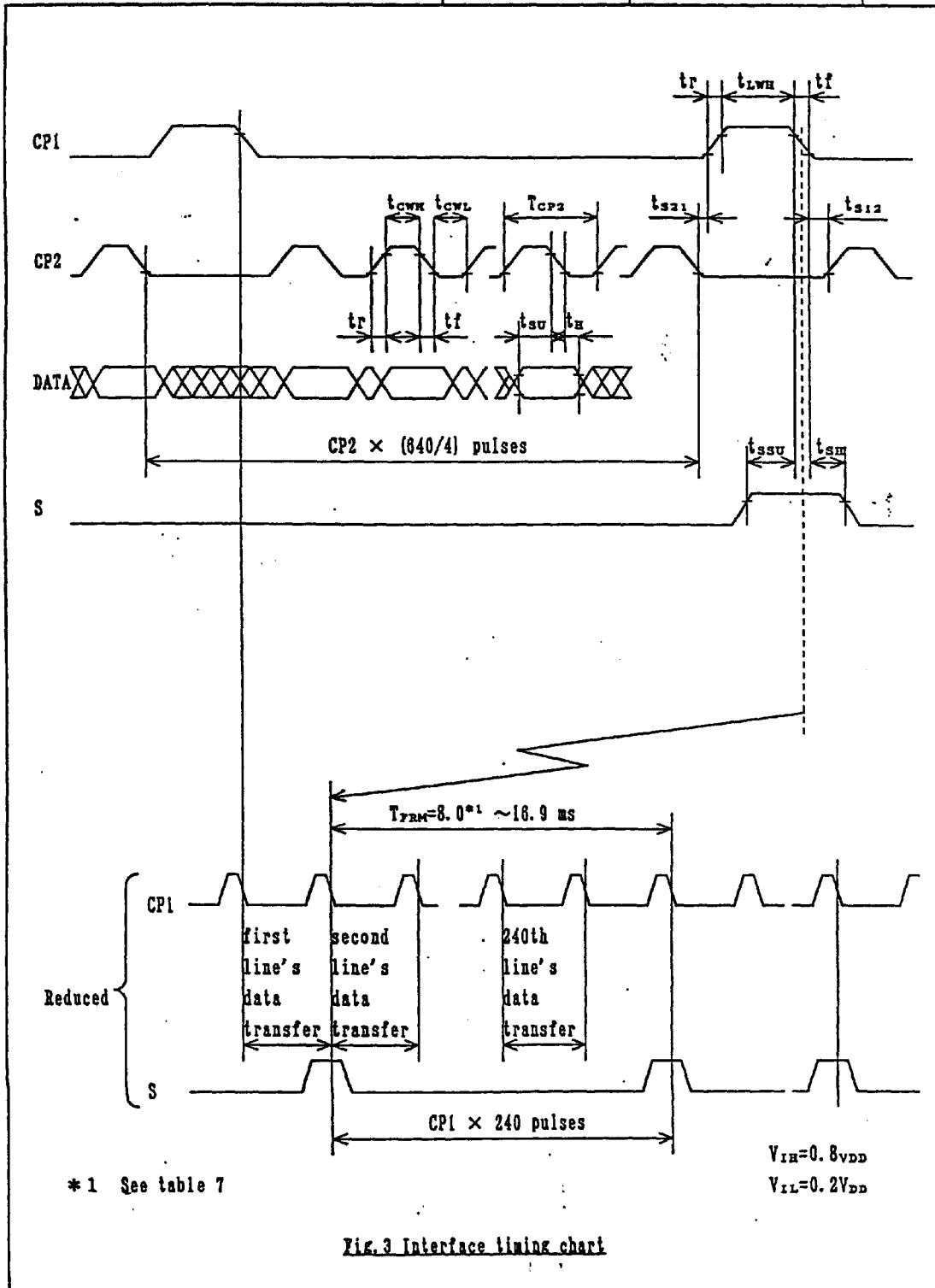
Table 7 Interface timing ratings

Item	Symbol	Rating			Unit
		MIN.	TYP.	MAX.	
Frame cycle	T_{FRM}	8.0[*1]		16.9	ms
CP2 clock cycle	T_{CP2}	152			ns
'H' level clock width	t_{CWH}	65			ns
'L' level clock width	t_{CWL}	65			ns
'H' level latch clock width	t_{LWH}	70			ns
Data set up time	t_{SU}	50			ns
Data hold time	t_H	40			ns
S set up time	t_{SSU}	100			ns
S hold time	t_{SH}	100			ns
CP2↑ clock allowance time from CP1↓	t_{S21}	0			ns
CP1↑ clock allowance time from CP2↓	t_{S12}	0			ns
Clock rise/fall time	tr, tf			t_{rf}[*2]	ns

*1 : LCD unit functions at the minimum frame cycle of 8 ms (Maximum frame frequency of 125Hz). Owing to the characteristics of LCD unit, 'shadowing' will become more eminent as frame frequency goes up, while flicker will be reduced.

According to our experiments, frame cycle of 11.7 ms Min. or frame frequency of 85 Hz Max. will demonstrate optimum display quality in terms of flicker and 'shadowing'. But since judgement of display quality is subjective and display quality such as 'shadowing' is pattern dependent, it is recommended that decision of frame cycle or frame frequency, to which power consumption of the LCD unit is propotional, be made based on your own through testing on the LCD unit with every possible patterns displayed on it.

*2 : $t_{rf} = 50$ in case $t_{CT} = (T_{CP2} - t_{CWH} - t_{CWL})/2 \geqq 50$
$t_{rf} = t_{CT}$ in case $t_{CT} = (T_{CP2} - t_{CWH} - t_{CWL})/2 < 50$

6. Unit Driving Method

6.1 Circuit configuration

Fig.9 shows the block diagram of the Unit's circuitry.

6.2 Display Face Configuration

The display face electrically consists of two (upper and lower) display segments so that the unit may offer higher contrast by reducing drive duty ratio. Each display segment (640×240 dots) is driven at 1/240 duty ratio.

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 (640dots) 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 (640dots) have been input, they will be latched in the form of parallel data for 640 lines of signal electrodes by latch signal CP1. Then the corresponding drive signal will be transmitted to the 640 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 upper and lower half 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 640 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.

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.

7. Optical Caracteristics

Ta=25 ℃, V_{DD}=5.0 V, V_{DD}-V_{EE}=Vmax

Table 8

Following spec are based upon the electrical measuring conditions,
·on which the contrast of perpendicular direction (θ x=θ y=0 °) will be MAX.

Parameter		Symbol	Condition		MIN.	TYP.	MAX.	Unit	Remark
Viewing angle range		θ x	Co>4.0	θ y=0 °	-25	–	20	dgr.	Note 1
		θ y		θ x=0 °	-15	–	25	dgr.	
Contrast ratio		Co	θ x=θ y=0 °		6	11	–	–	Note 2
Response time	Rise	τ r	θ x=θ y=0 °		–	350	450	ms	Note 3
	Decay	τ d	θ x=θ y=0 °		–	200	300	ms	

Note 1) The viewing angle range is defined as shown Fig. 4.

Note 2) Contrast ratio is defined as follows:

$$Co= \frac{\text{Luminance(brightness) all pixels 'white' at Vmax}}{\text{Luminance(brightness) all pixels 'dark' at Vmax}}$$

Vmax is defined in Fig. 6.
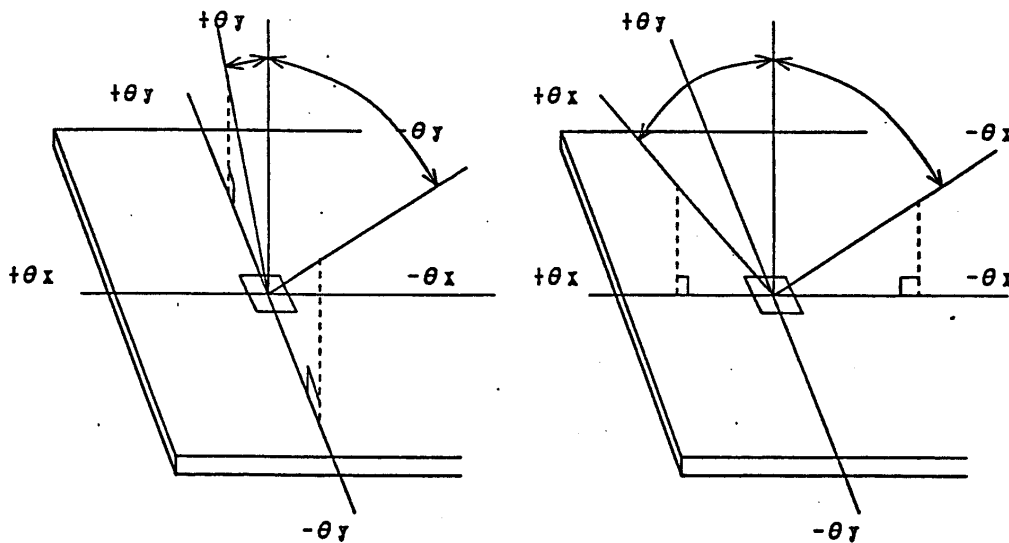
Fig. 4 Definition of Viewing Angle

Note 4) The response characteristics of photo-detector output are measured as
-shown in Fig. 7, assuming that input signals are applied so as to select
and deselect the dots to be measured, in the optical characteristics
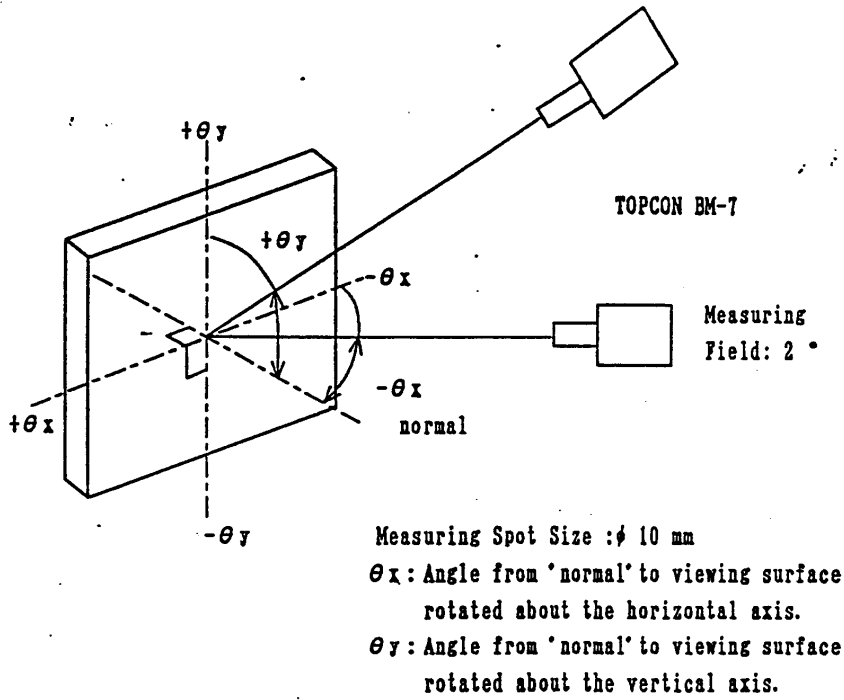test method shown in Fig. 8.

TOPCON BM-7

Measuring
Field: 2 °

Measuring Spot Size : ∮ 10 mm

θx : Angle from 'normal' to viewing surface
rotated about the horizontal axis.

θy : Angle from 'normal' to viewing surface
rotated about the vertical axis.

Fig. 5 Optical Characteristics Test Method I

Contrast

Comax

$V_{DD}-V_{EE}$ [V]
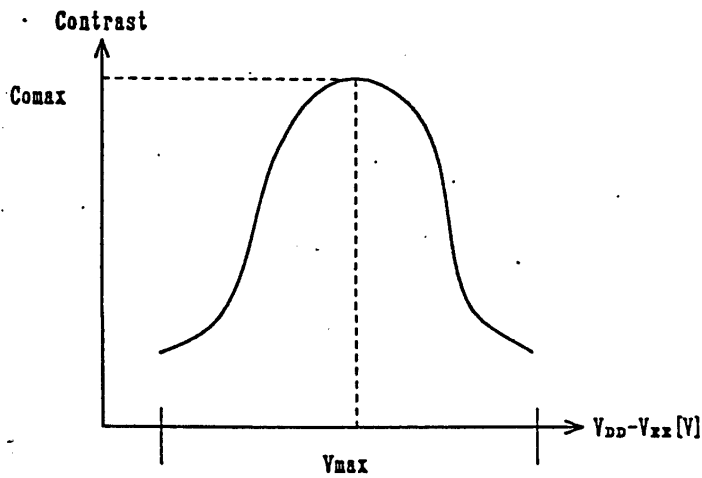
Vmax

Fig. 6 Definition of Vmax

(Response Measurument)
　Ta=25 ℃
　In dark room

TOPCON BM7 + quartz fiber
(Measurirg Spot Size: φ 10 mm ,
Measuring Field: 2 °)

Fig.7　Optical Characteristics Test Method II

[Drive waveform]

1/240Duty

Non-select waveform | Select waveform | Non-select waveform

[Responce waveform]

OUTPUT

100% 90%

10%

τr

τd

τr : Rise time
τd : Decay time
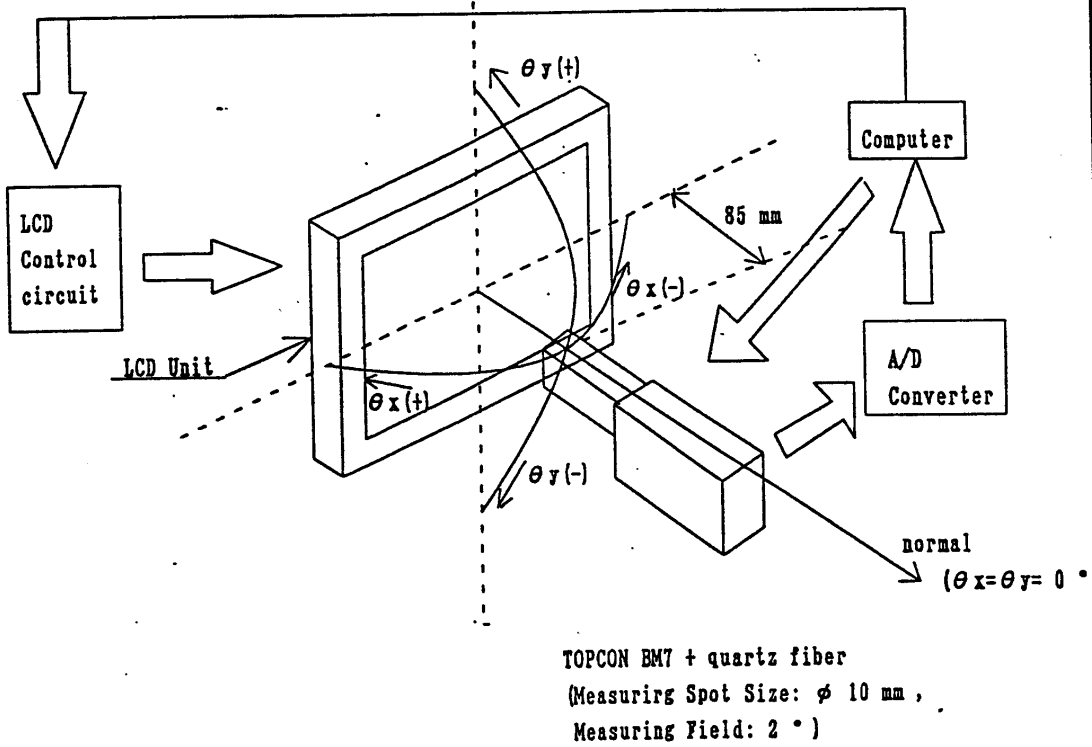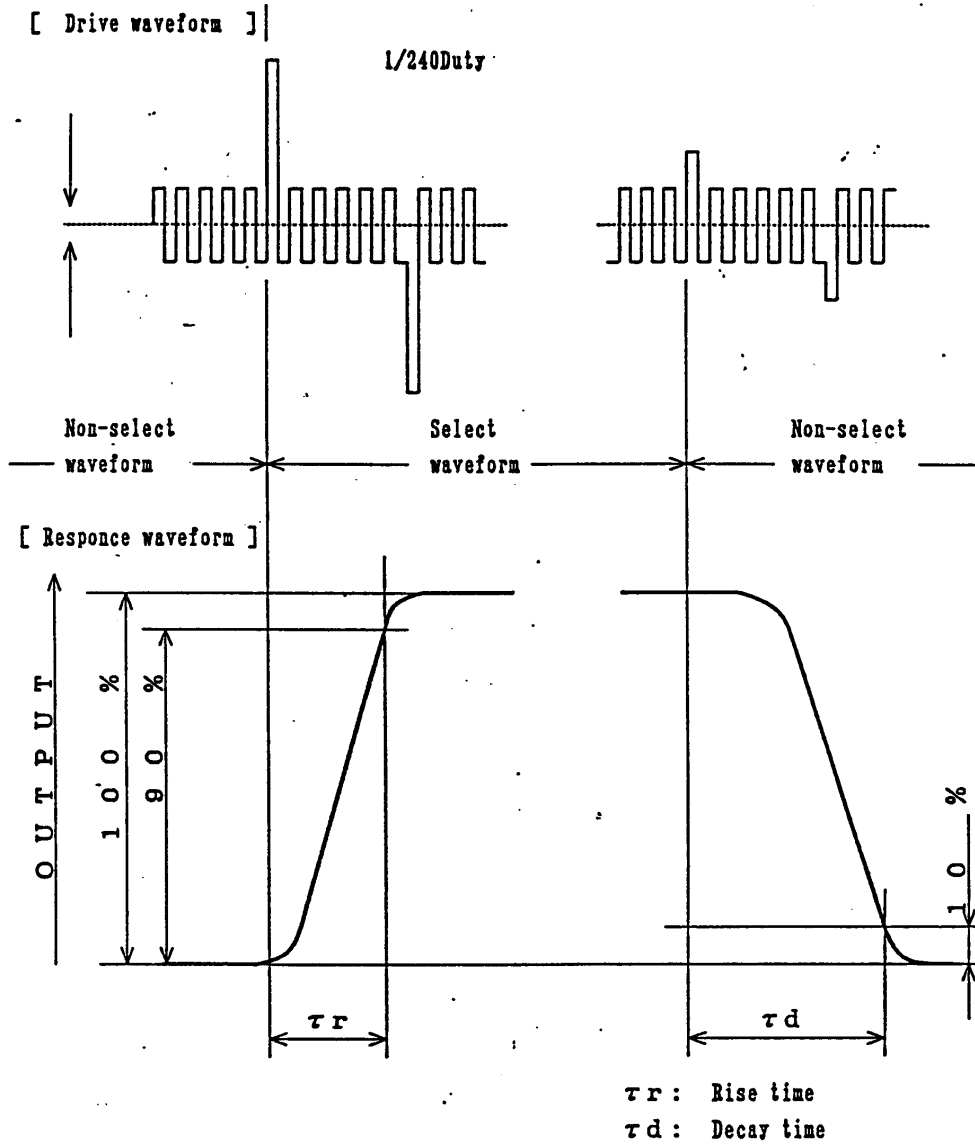
Fig.8 Difinition of Response Time

DU0~DU3
Control DL0~DL3 M
DISP
CP2
CP1
S

C P U — LSI

RAM

#1 MG

Inverter

V_DD, V_SS, V_EE

#2 BG

SEG Drivers (Upper)

COM Drivers

640×480 LCD PANEL

SEG Drivers (Lower)

CCFT B/L
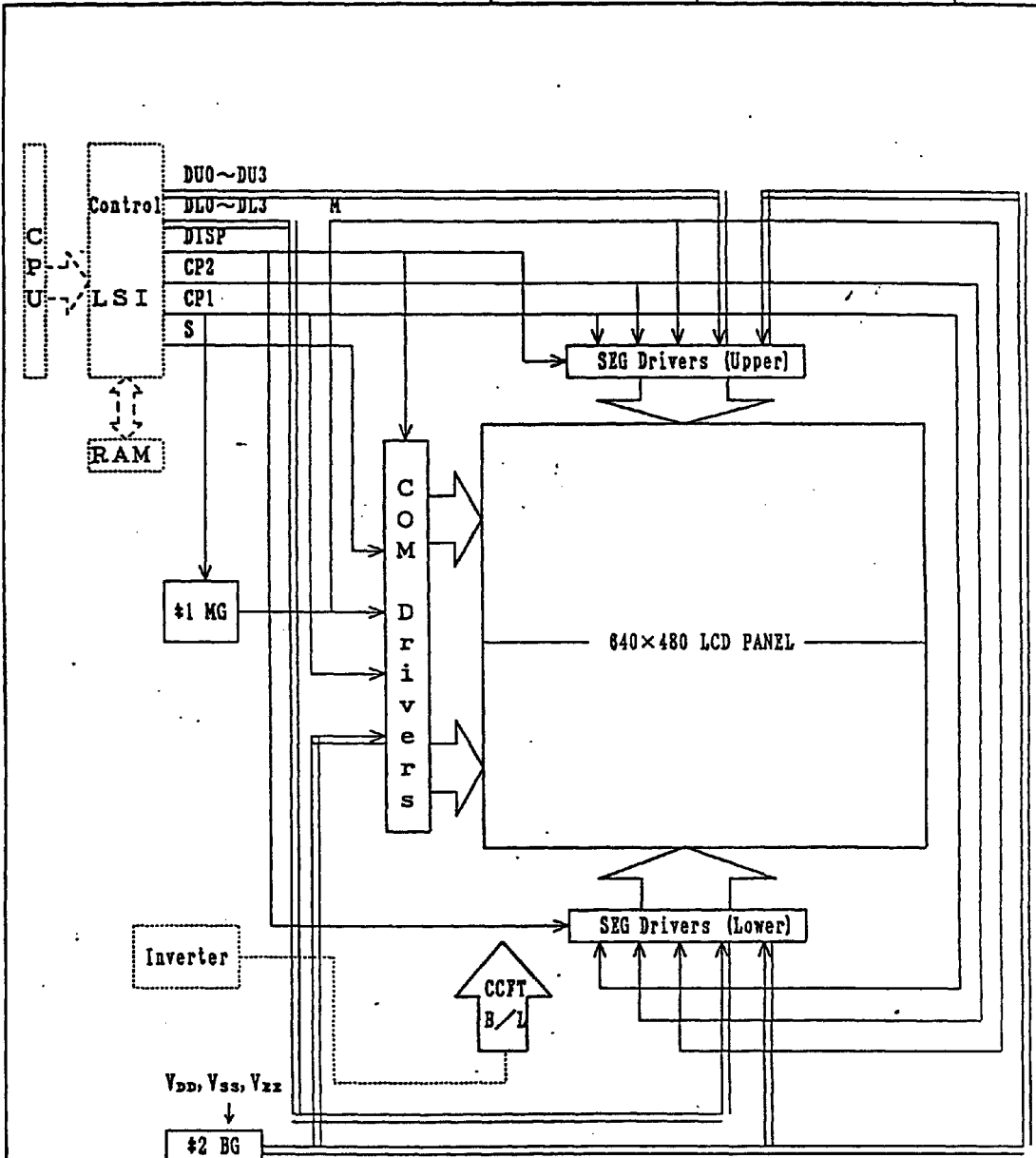
#1 MG: M GENERATOR CIRCUIT
#2 BG: BIAS GENERATOR CIRCUIT

Fig.9 Circuit block diagram

8. Characteristics of Backlight

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

1) Rating (NOTE)

Parameter	Min	Typ	Max	Unit
Brightness	50	70	—	cd/m²

2) Measurement circuit : LM000106 (SHARP) (at IL=5 mA)
3) Measurement equipment: BM-7 (TOPCON)
4) Measurement conditions

4-1 Measurement circuit voltage: DC=12 V at primary side

4-2 LCD: All digits WHITE, VDD=5 V, VDD-VEE=Vmax, DU0～DU3, DL0～DL3=' H' (WHITE)

(refer Fig. 6)

4-3 Ambient temperature: 25 ℃

Measurement shall be executed 30 minutes after turning on.

5) Used lamp

5-1 Ratings (1pc)

Parameter			Max. allowable value
Circuit voltage (VS)	1 000 V	MIN	1 500 V
Discharging tube current (IL)	5 mA	TYP	7 mA ‡
Power comsumption	1.8 W	.	—
Discharging tube voltage (VL)	360 V	TYP	—
Brightness (B)	28 000 cd/m² TYP		—

‡ It is recommended that IL be not more than 5 mA so that heat radiation of CCFT backlight may least affect the display quality.

5-2 Operating life

The operating life time is 10 000 h or more at 5 mA.
(Operating life with LM000106 or equivalent)

The inverter should meet the following conditions;
-Sine, symmetric waveform without spike in positive and negative.
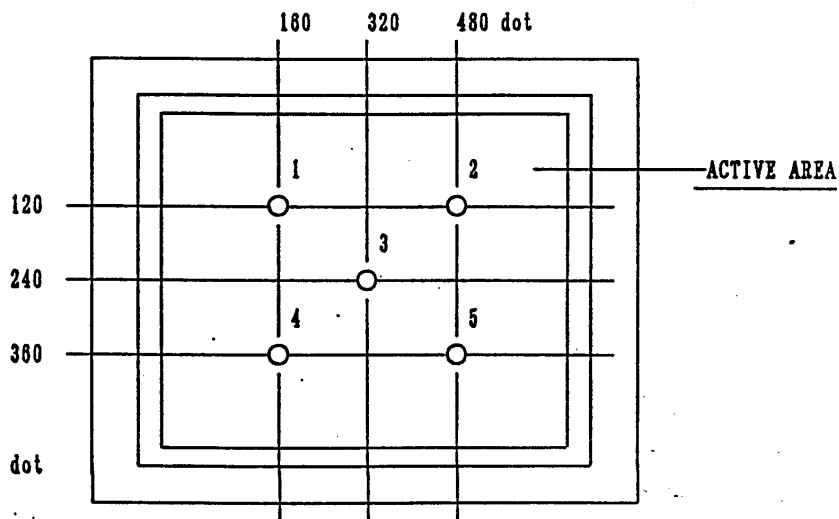
9. Precautions

1) Industrial (Mechanical) design of the product in which this LCD unit will be incorporated must be so made that the viewing angle characteristics of the LCD may be optimized.

This unit's viewing angle is illustrated in Fig. 12.

θ_{ymin} < viewing angle < θ_{ymax} (θ_{ymin}<0 °, θ_{ymax}≧0 °)

(For the specific values of θ_{ymin}, θ_{ymax}, refer to the table 8.)

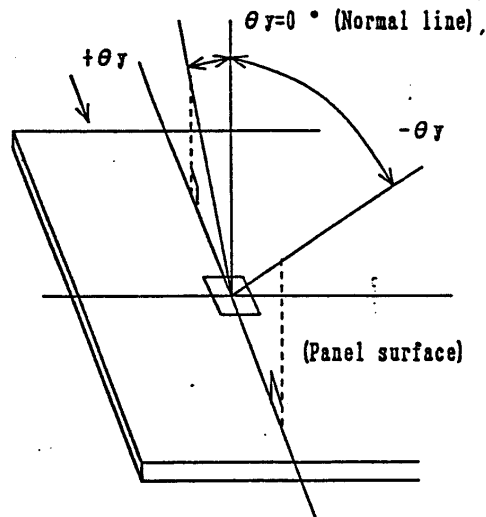Please consider the optimum viewing conditions according to the purpose when installing the unit.

Fig. 12 Dot matrix LCD viewing angle

2) This unit is installed using mounting tabs at the four corners of bezel. When installing the unit, pay attention and handle carefully not to allow any undue stress such as twist or bend.

3) Since the front polarizer is easily damaged, please pay attention not to scratch on its face.

4) 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 its and wipe.

5) Water droplets, etc. must be wiped off immediately since they may cause
color changes, staining, etc. if remained for a long time.

6) Since LCD is made of glass plates, dropping the unit or banging it against
hard objects may cause cracking or fragmentation.

7) 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 the 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) The unit should be driven according to the specified ratings to avoid
malfunction of parmanent damage. DC voltage drive leads to rapid deterio-
ration of LC, so ensure that the drive is alternating waveform by continous
application of the signal M. Especially the power ON/OFF sequence shown on
next page shall be followed to avoid latch-up of driver LSIs and
application of DC voltage to LCD panel.

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

10) 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.

11) Disassembling the LCD unit can cause permanent damege and should be strictly
avoided.

Supply voltage sequence condition
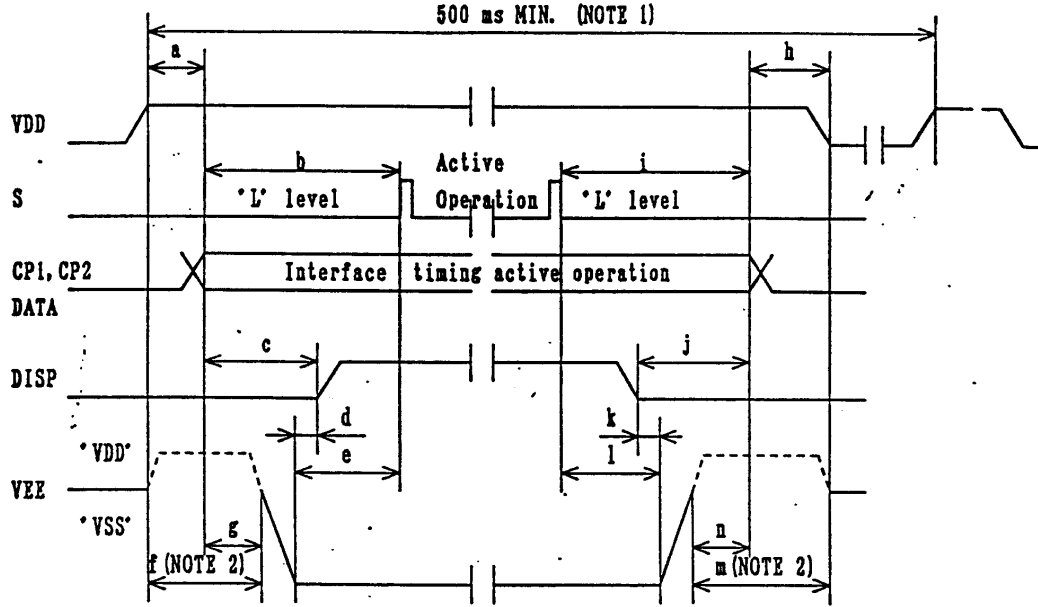
|	POWER ON			POWER OFF	
SYMBOL	With DISP control	Without DISP control	SYMBOL	With DISP control	Without DISP control
a	0 ms MIN.	0 ms MIN. 20 ms MAX.	h	0 ms MIN.	0 ms MIN. 20 ms MAX.
b	0 ms MIN.	20 ms MIN.	i	0 ms MIN.	20 ms MIN.
c	20 ms MIN.	-	j	20 ms MIN.	-
d	0 ms MIN.	-	k	0 ms MIN.	-
e	-	0 ms MIN.	1	-	0 ms MIN.
f	0 ms MIN.	(NOTE2)	m	0 ms MIN.	(NOTE2)
g	-	0 ms MIN. 100 ms MAX.	n	-	100 ms MIN. 500 ms MAX.

(NOTE 1) Power ON/OFF cycle time. All signals and power line shall be in accordance with above sequence in case of power ON/OFF.

(NOTE 2) VEE to be set at 'VDD level' or 'open'. VEE should be in accordance with the dotted line when DISP (display control signal) is not used.

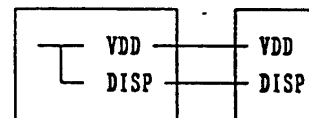(NOTE 3) Connection of DISP (pin. No. 4)

　　○With DISP control
　　　Input DISP control signal shown on this page.
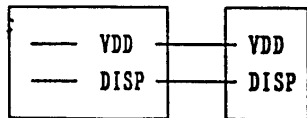
　　○Without DISP control
　　　DISP to be connected with VDD.

10. Lot number

Lot number is shown at the position mentioned in Fig.13 in accordance with the following numbering rule.

(Example)

94 B 00001 ( )

— Factory Identification Code. (Alphabet)
— Serial number (Missing number exist)
— Production month (A=JAN., B=FEB., ··· L=DEC.)
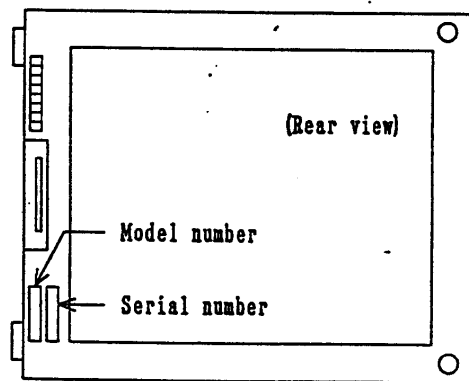— Production year

(Rear view)

Model number

Serial number

Fig. 13

11. Applicable inspection standard

The LCD unit shall meet the following inspection standard
:S-U-012-01

12. This specification describes display quality in case of no gray scale.
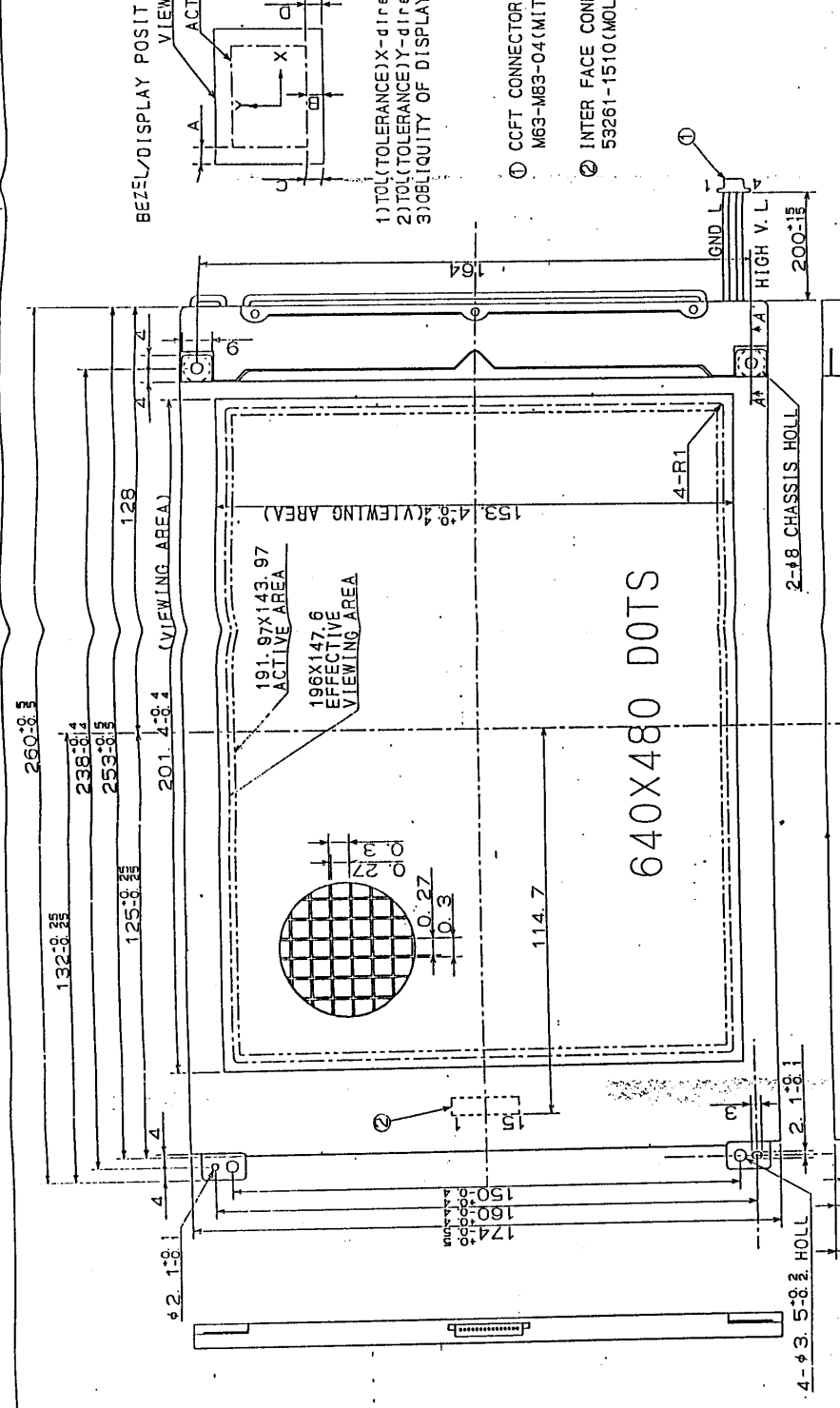Since display quality can be affected by gray scale methods, display quality
shall be carefully evaluated for the usability of the LCD UNIT in case gray
scale is displayed on the LCD UNIT.

WARNING

DON'T USE ANY MATERIALS WHICH EMIT GAS FROM EPOXY RESIN (AMINES' HARDENER)
AND SILICONE ADHESIVE AGENT (DEALCOHOL OR DEOXYM) TO PREVENT CHANGE
POLARIZER COLOR OWING TO GAS.

BEZEL/DISPLAY POSITION
VIEWING AREA
ACTIVE AREA

1)TOL(TOLERANCE)X-direction A:4.7±0.8
2)TOL(TOLERANCE)Y-direction B:4.7±0.8
3)OBLIQUITY OF DISPLAY AREA (C-D)<0.8

① CCFT CONNECTOR
   M63-M83-04(MITSUMI)
② INTER FACE CONNECTOR(15Pins)
   53261-1510(MOLEX)

LCD UNIT
OUTLINE DIMENSIONS

SHARP CORPORATION

164
128
260
132
238
253
201
125

191.97X143.97
ACTIVE AREA
196X147.6
EFFECTIVE
VIEWING AREA

(VIEWING AREA)
153.4±0.4(VIEWING AREA)

640X480 DOTS

114.7

0.3
0.27
0.3

GND
HIGH V.L
200

4-R1
2-φ8 CHASSIS HOLL

BEZEL HOLL(φ3.5)
CHASSIS
CHASSIS HOLL(φ8)
A-A' SECT
BEZEL

7 MAX
150
160
174
φ2
4-φ3.5±0.2 HOLL
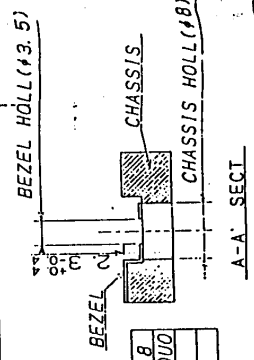
INTER FACE PIN LAYOUT

PIN#	1	2	3	4	5	6	7	8
Symbol	S	CP1	CP2	DISPOFF	VDD	VSS	VEE	DU0
PIN#	9	10	11	12	13	14	15	
Symbol	DU1	DU2	DU3	DL0	DL1	DL2	DL3	