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		PAGE .17 Pages
		APPLICABLE DIVISION
		■DUTY PANEL DEVELOPMENT CENTER
		❑ ITFT DEVELOPMENT CENTER
		❑LCD PRODUCTS DEVELOPMENT CENTER
		❑ IEL PRODUCT 10N DEPT.

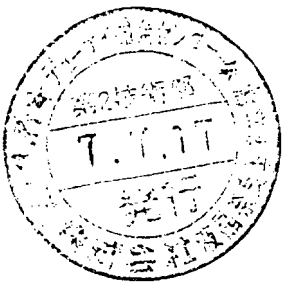
SPECIFICATION

SPECIFICATION FOR

Passive Matrix COLOR LCD Module

Model No.

L M 3 2 C 0 4 P



❑ ICUSTOMER' S APPROVAL

DATE

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RECORDS OF REVISION

SPEC No.	MODEL No.
LC 95602	LM32C04P

DOC. FIRST ISSUE
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IDENT. DATA No.

DATA	SPEC REVISED No.	REVISED No.	REF. PAGE	SUMMARY	CHECK & APPROVAL
JUL.12.1995	A	1	17	Addition (Common difference)	Y. Inoue

1. Application

This data sheet is to introduce the specification of LM32C04P, Passive Matrix type Color LCD module.

2. Construction and Outline

Construction: 320×RGB× 240 dots color display module consisting of a 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 back light and bezels to fix them mechanically. Signal ground(VSS) is connected with the metal bezels.

Outline : See Fig. 6

Connection : See Fig. 6 and Table 5

3.Mechanical Specifications

Table 1

Parameter	Specifications	Unit
Outline dimensions Note 1)	149.2 (W) X116.4(H) X24.8(D)	mm
Viewing area	115.6(w) x87,6(H)	mm
Active area	111.335(W) x83.495(H)	mm
Display format	320xRGBx240	
Dot size	0.091(W) X0.323(H)	mm
Dot spacing	0.025	mm
Base color Note 2)	Normally black Note 3)	-
Mass	Approx.320	g

Note 1) Excluded the mounting portions and connectors.

Note 2) Due to the characteristics of the LC material, the colors vary with environmental temperature.

Note 3) Negative-type display

Display data “H” : ON → transmission

Display data “L” : OFF → light isolation

4. Absolute Maximum Ratings

4-1 Electrical absolute maximum ratings

Table 2

Parameter	symbol	MIN.	MAX.	Unit	Remark
Supply voltage (Logic)	VDD-VSS	0	7	v	Ta=25 "C
Supply voltage (LCD)	VEE-VSS	0	33	V	Ta=25 ℃
Input signal voltage	VIN-VSS	0	VDD	v	Ta=25 "C

4-2 Environmental Conditions

Table 3

Item	Tstg.		Topr.		Remark
	MIN.	MAX.	MIN.	MAX.	
Ambient temperature	-25 ℃	+65 "C	0 "C	+60 ℃	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≦40 'C . . ...95 % RH Max.
Ta>40 "C.....Absolute humidity shall be less than Ta=40 ℃/95 % RH.

Note 2)

Table 4

Frequency	10 Hz-57 Hz	57 Hz-500 Hz
Vibration level		9.8 m/s^2
Vibration width	0.075 mm	
Interval	10 Hz-500 Hz-10 Hz/n min	

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

Note 3) Acceleration : 490 m/s^2
Pulse width : 11 ms
3 times for each direction of ±X/±Y/±Z

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

5. Electrical Specifications

5-1 Interface signals

Table 5-1 CN1(LCD)

Pin No	symbol	Description	Level
1	YD	Scan start-up signal	"H"
2	LP	Input data latch signal	"H"→"L"
3	VSS	Ground potential	
4	XCK	Data input clock signal	"H"→"L"
5	Vss	Ground potential	
6	DISP	Display control signal	H(ON),L(OFF)
?	VDD	Power supply for Logic	
8	VEE	Power supply for LCD drive	
9	Vs s	Ground potential	
10	DO	Display data signal	H(ON),L(OFF)
11	D1	Display data signal	H(ON),L(OFF)
12	D2	Display data signal	H(ON),L(OFF)
13	D3	Display data signal	H(ON),L(OFF)
14	Vss	Ground potential	
15	D4	Display data signal	H(ON),L(OFF)
16	D5	Display data signal	H(ON),L(OFF)
17	D6	Display data signal	H(ON),L(OFF)
18	D7	Display data signal	H(ON),L(OFF)
19	Vss	Ground potential	
20	NC	No connect	

Table 5-2 CN2(CCFT)

Pin No	symbol	Description	Note
L1	VL1 (GND)	Ground line (from Inverter)	for Backlight
L2	NC		
L3	VL2 (HV)	High voltage line (from Inverter)	

Table 5-3 CN3(CCFT)

Pin No	symbol	Description	Note
L4	VL3 (HV)	High voltage line (from Inverter)	for Backlight
L5	NC		
L6	VL4 (GND)	Ground line (from Inverter)	

Used connector CN1 : 006200207032 (ELCO)

CN2 ,3 : S3B-XH-A (JST)

Mating connector CN1 : 1 mmPitch FFC or FPC, Conductor width 0.7 mm

Conductor length 2.5 mm MIN

Contact portion thickness 0.3 mm

CN2,3 : XHP-3 (JST)

5-2 Electrical characteristics of LCD panel

Table 6

Parameter	symbol	Conditions	MIN.	TYP.	MAX.	Unit
Supply voltage (Logic)	VDD	Ta=0~60 'C	4.75	5	5.25	V
Supply voltage (LCD drive) Note 1)2)	VEE	Ta= 0 'C	-	**(26)	28.6	V
		Ta=25 'C	-	24.7	-	V
		Ta=60 'C	20.7	**(23)	-	V
Input signal voltage	VIN	"H" level	0.8VDD		VDD	V
		"L" level	0	-	0.2VDD	V
Input leakage current	IIL	"H"/Ta=25 "C	-	-	100	μA
		"L"/Ta=25 "C	-100	-	-	μA
Supply current (Logic)	IDD	Note 3)		3.5	5.5	mA
Supply current (LCD drive)	IEE			16	24	mA
Power consumption	Pd	Note 3)4)	-	420	620	mW

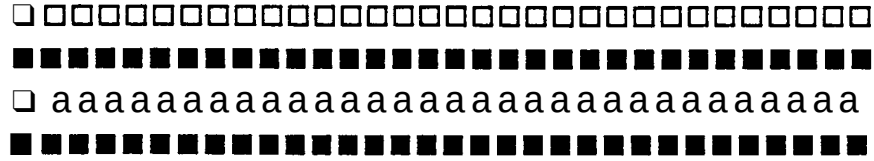
** ... Reference data

Note 1) The viewing angle θ at which the optimum contrast is obtained can be set by adjusting VEE-VSS. Refer to 7-Note 4 for the definition of θ.

Note 2) Frame frequency=180 Hz

Note 3) Under the following condition. ;
VDD-VSS=5.0 V, VEE-VSS=24.7 V
Frame frequency=180 Hz, Ta=25 "C
Display pattern=black/white stripe pattern.

Display pattern



Note 4) Excluded The backlight power consumption.

Note 5) Refer to Page.14 for Characteristics of CCFT.

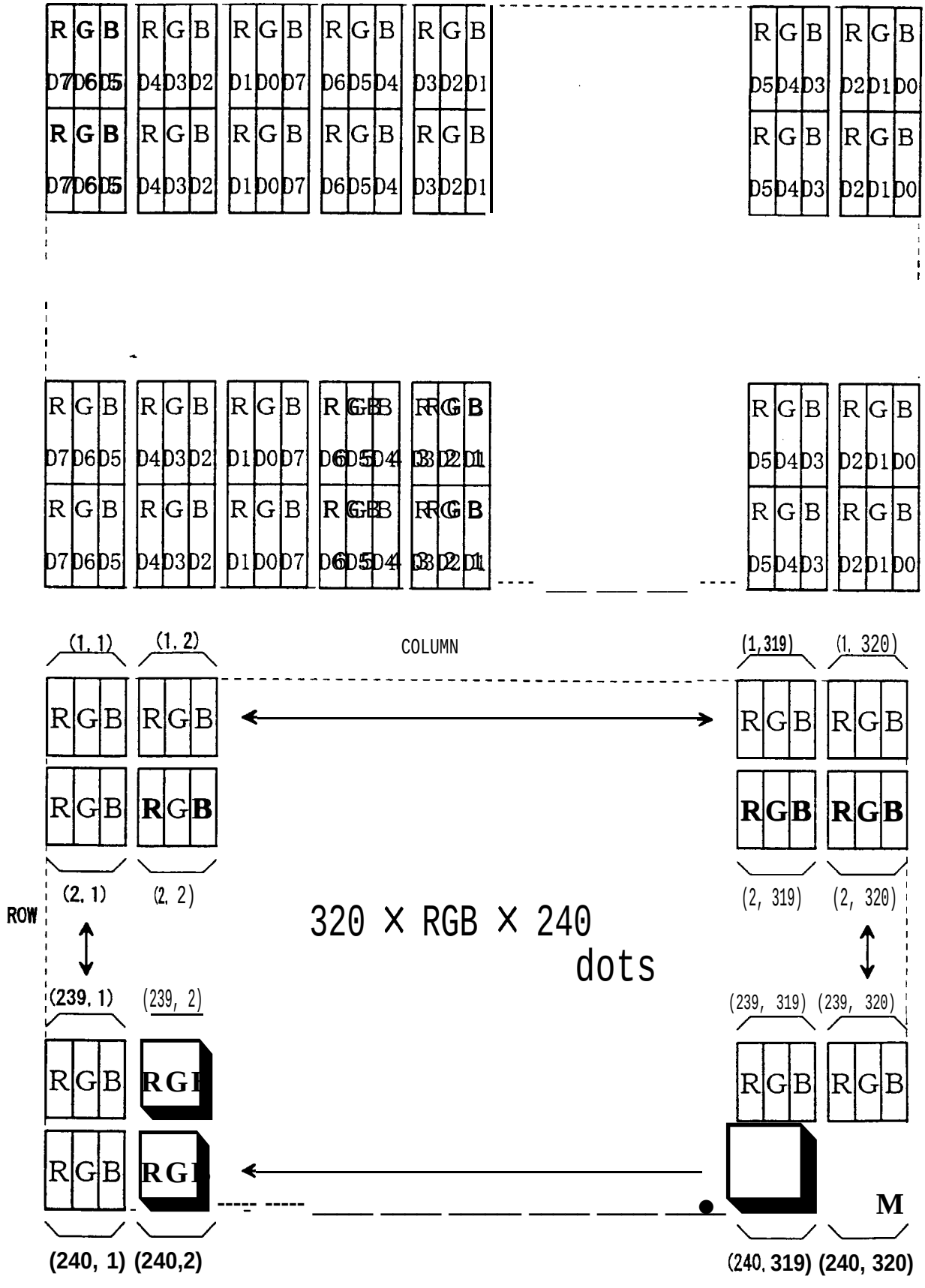


Fig.1 **Dot** chart of display area

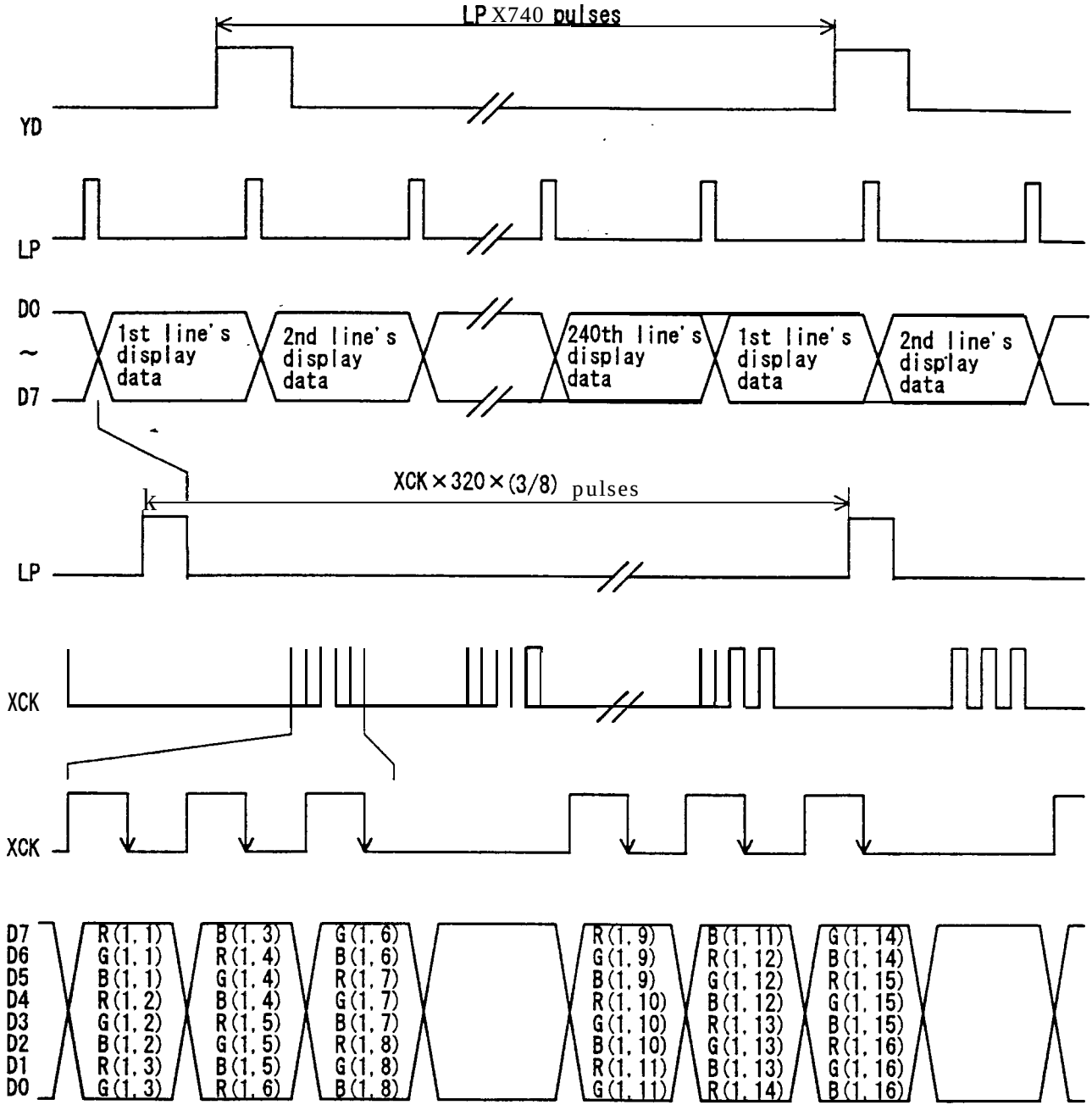


Fig.2 Data input timing chart

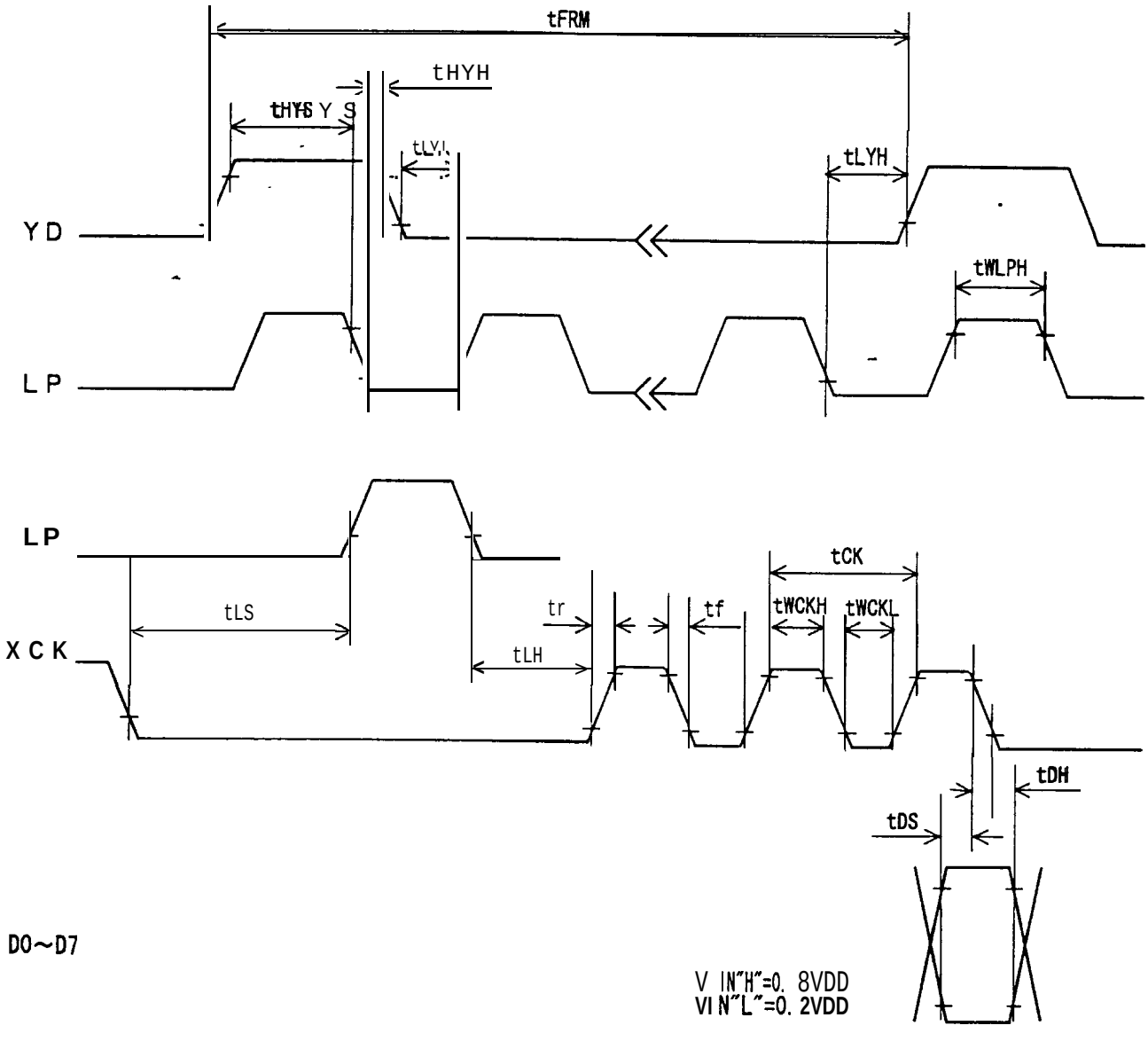


Fig.3 Interface timing chart

Table 7 Interface timing ratings

Item	symbol	Rating			Unit
		MIN.	TYP.	MAX.	
Frame cycle Note 1)	tFRM	4.8		6.6	ms
XCK clock cycle"	tCK	81			ns
XCK "H" level clock width	tWCKH	35			ns
XCK "L" level clock width	twCKL	35			ns
LP "H" level latch clock width	tWLPH	200			μs
Data set up time	tDS	35			μs
Data hold time	tDH	35			ns
YD "H" level set UP time	tHYs	100			ns
YD "H" level hold time	tHYH	100			ns
YD "L" level set UP time	tLYS	100			ns
YD "L" level hold time	tLYH	100			ns
LP↓ allowance time from XCK↑	tLS	200			ns
XCK↓ allowance time from LP↑	tLH	200			ns
Input signal rise/fall time	tr, tf			13	ns

Note 1) Owing to the characteristics of this LCD module, "shadowing" will become more eminent as frame frequency goes up, contrast ratio will be down and flicker will become more eminent as flame frequency goes down. So it is recommended that the module should be driven according to the specified limit.

Note 2) The intervals of one LP fall and the next must be always the same, and LPs must be input continuously. The interval must be 70μs Max.

5-3 Supply voltage sequence condition

The power ON/OFF sequence shown on Fig.4 shall be followed to avoid latch-up of drive LSIS and application of DC voltage to LCD panel.

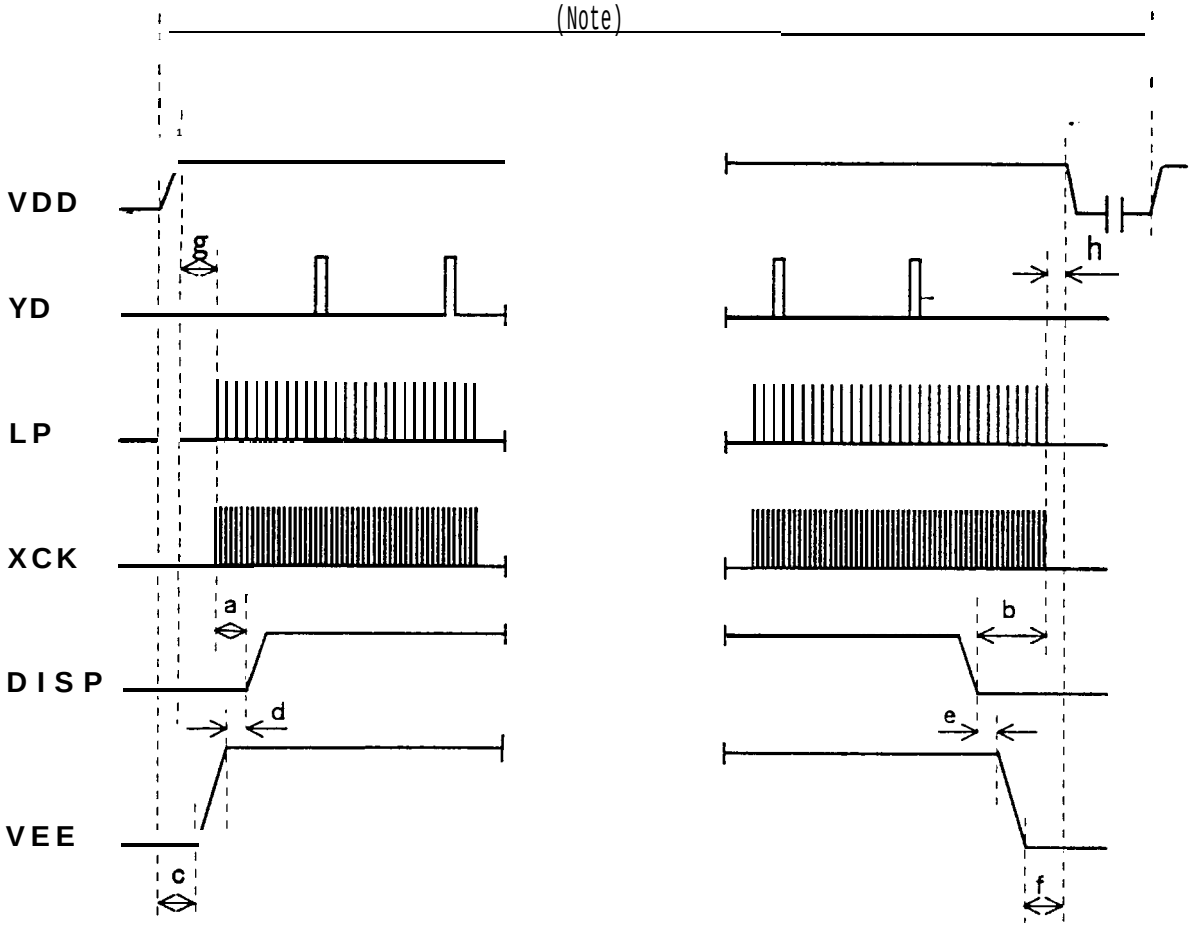


Fig .4 Sequence condition

Table 8 Sequence timing ratings

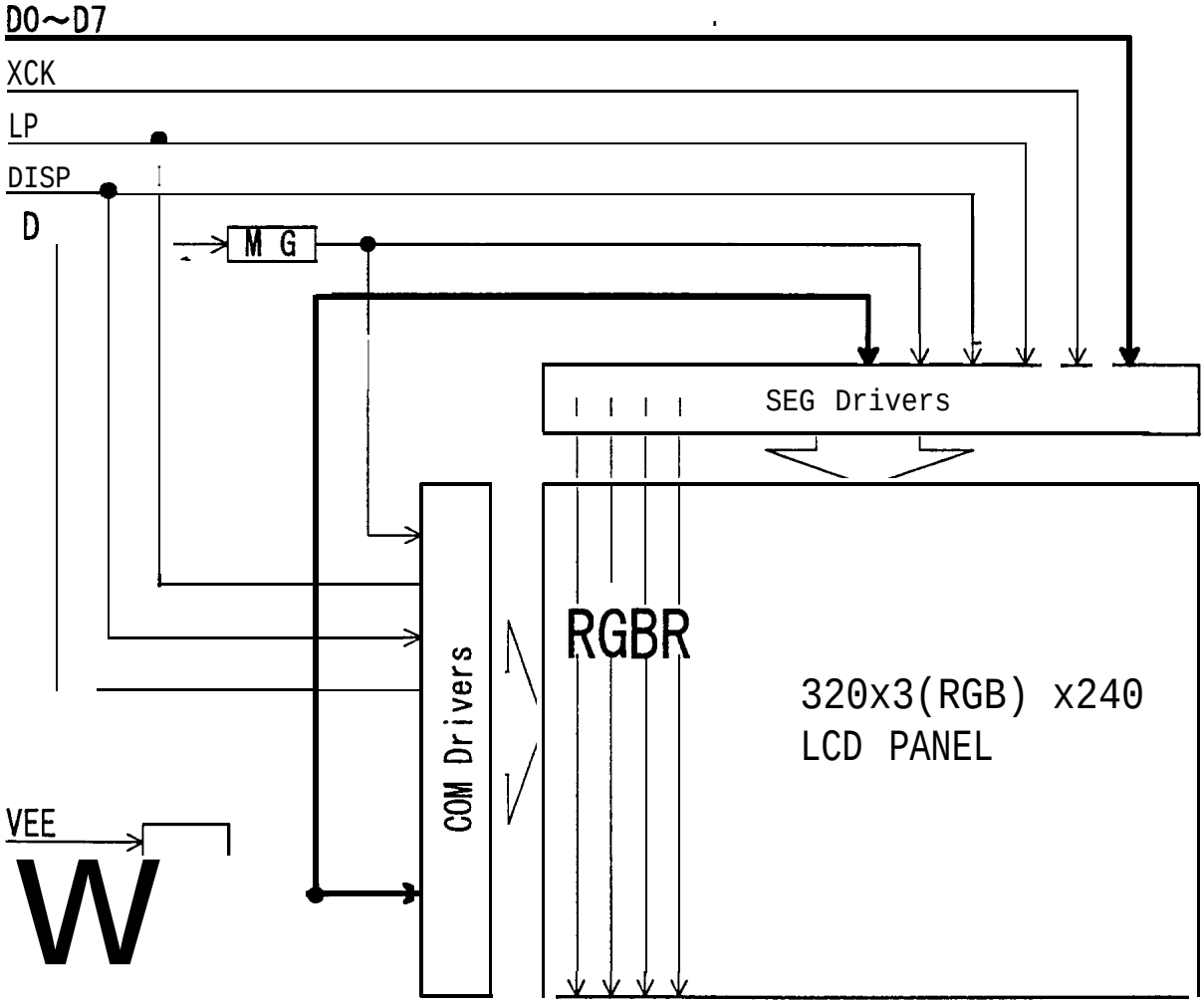
symbol	POWER ON	Symbol	POWER OFF
a	20 ms MIN.	b	20 ms MIN.
c	0 ms MIN.	e	20 ms MIN.
d	0 ms MIN.	f	0 ms MIN.
9	0 ms MIN.	h	0 ms MIN.

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

6. Module driving method

6-1 Circuit configuration

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



MG : M generator circuit
BG : Bias generator circuit

Fig.5 Circuit block diagram

6-2 Display face configuration

The display consists of 320x3 (R,G,B) x240 dots as shown in Fig.1. The interface is to be driven at 1/240 duty ratio.

6-3 Input Data and Control Signal

The LCD driver is 160 bits LSI, consisting of shift registers, latch circuits and LCD driver circuits. Input data for each row **(320x3**(R,G,B)) will be sequentially transferred in the form of 8 bit parallel data through shift registers from top left of the display together with clock signal (XCK) .

When input of one row (320 X 3(R,G,B) dots) is completed, the data will be latched in the form of parallel data corresponding to the signal electrodes by the falling edge of latch signal (LP) . Then, the corresponding drive signals will be transmitted to the 320 x 3 lines of column electrodes of the LCD panel by the LCD drive circuits.

At this time, scan start-up signal (YD) 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 row of the display face according to the combinations of voltages applied to the scan and signal electrodes of the LCD. While the data of 1st row are being displayed, the data of 2nd row are entered. When data for 320x3 dots have been transferred, they will be latched by the falling edge of LP, switching the display to the 2nd row.

Such data input will be repeated up to the 240th row of each display segment, from upper row to lower rows, to complete one frame of display by time sharing method.

YD generates scan signal to drive horizontal electrodes.

Since DC voltage, if applied to LCD panel, causes chemical reaction in LC materials, causing deterioration of the materials, drive wave-fore shall be inverted at every display frame to prevent the generation of such DC voltage. Control Signal M plays such a role.

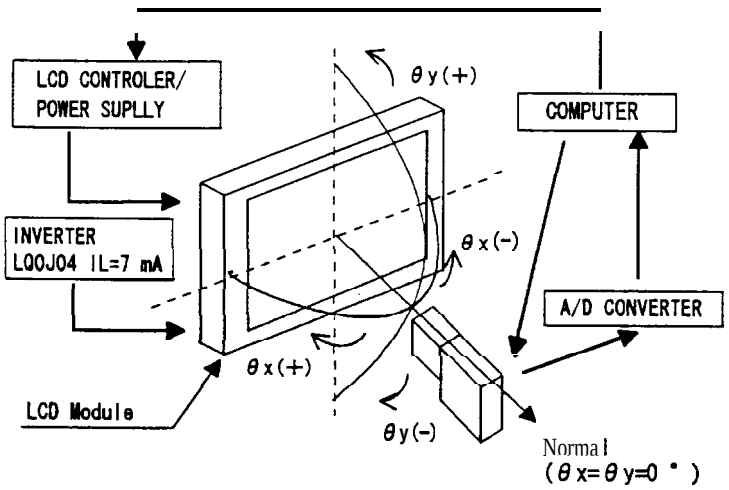
7.Optical characteristics

Table 9

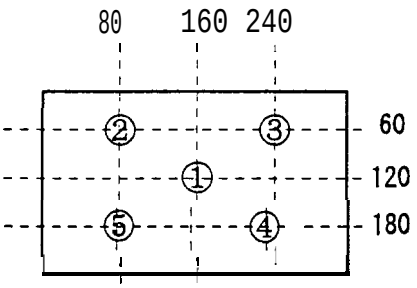
Ta=25 ℃, Frame frequency=180 Hz, 1/240 DUTY, VDD=5 V, VEE=Vcmax

Parameter		Symbol	Condition			MIN.	TYP.	MAX.	Unit	Remark
Viewing angle range		θy	Co>5	θx=0 "	θy≧0 .	25	.	.	°	Note 2
					θy<0 .	-	-	-15	"	
		θx		ey=0 °	θx≧0 .	35	-	-	"	
					θx<0 "	-	-	-35	° .	
Contrast ratio		co	θx=θy=0 °			10	20	-	-	Note 3
Brightness		B	IL=7 mA/ θx=θy=0 "			120	170	-	cd/m²	Note 4
Response time	Rise	τr	θx=θy=0 "				150	250	ms	Note 5
	Decay	τd	θx=θy=0 *				50	150	ms	
Module chromaticity	White	X	θx=θy=0 *				0.29	-	-	
		Y	θx=θy=0 "				0.3	-	-	

Note 1) Measurement method of
Contrast, Viewing angle, Brightness, Response time



Measuring points



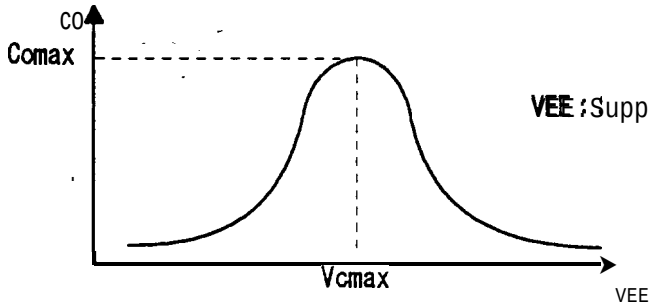
TOPCON BM-7 + quartz fiber
Measuring spot size : ϕ10 mm
Ta=25 "C
In dark room
Measurement shall be executed 30 min after turning on.

Note 2) The viewing angle range is defined as shown Note 1.

Note **3)** Contrast ratio is defined as follows:

$$\text{Contrast} = \frac{\text{Luminance(brightness) all pixels"White"at Vcmax}}{\text{Luminance (brightness) all pixels"dark" at Vcmax}}$$

Vcmax is defined as follows:



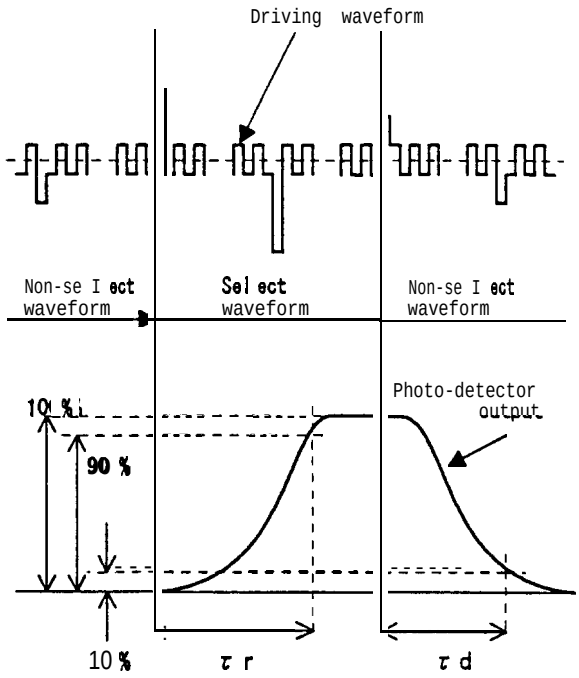
VEE: Supply voltage ofLCD drive "

Note 4) Brightness is defined as average luminance (brightness) of measuring points (①~⑤) at Vcmax.

-Measurement circuit : LQOJ04 at IL=7 mA

-All pixels of LCD is "White"

Note 5) Definition of Response time



8.Characteristics of CCFT(lamp)

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

8-1 Rating (2pcs)

Table 10

Parameter"	Symbo 1	MIN.	TYP .	MAX.	Unit	Remark
Lamp voltage (AC/rms)	VL	300	340	380	V	
Lamp current (AC/rms)	IL	6	7	8	mA	
Frequency	fL	20	-	60	kHz	
Kick-off voltage (AC/rms)	Vs	, -	750	1 100	V	(Ta=25 "C)
			1 120	1 400	v	(Ta= 0 'C)
power consumption	WL	-	4.8	6.1	w	Note 1

Note 1) Power consumption is calculated reference value. (IL×VL, excluded inverter loss.)
Note 2) Within no conductor closed. (CCFT only)
Note 3) It is recommended that IL be not more than 7 mA so that heat radiation of CCFT backlight may least affect the display quality.

8-2 Operating life

The operating life time is 5 000 h or more at 7 mA. (operating life with LQOJ04 or equivalent.)

The inverter should meet the following conditions to keep the specified life time of used lamp;
- Sine, symmetric waveform without spike in positive and negative.
- Output frequency range: 25 kHz~60 kHz.

Make sure the operating conditions by executing the burn-in enough time.

The operating life time is defined as having ended when any of the following conditions occur; 25±5 "C
- When the kick-off voltage has reached Maximum value.
- When the illuminance or quantity of light has decreased to 50 % of the initial value.

9. Precautions

1) The module 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. .**

Especially the power ON/OFF sequence shown on Page.9 shall be followed to avoid latch-up of drive LSIs and application of DC voltage to LCD panel.

2) Industrial (Mechanical) design of the product in which this LCD module will be incorporated must be made that the viewing angle characteristics of the LCD may be optimized. Please consider the optimum viewing conditions according to the purpose when installing the module. (For the optical characteristics refer to the table .)

3) This module is installed using mounting holes at the four corners of module. When installing the module, 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 module to protect the polarizer, LCD cells,etc.

4) Since the front polarizer is easily damaged. Please pay attention not to scratch on its face.

5) 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.

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

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

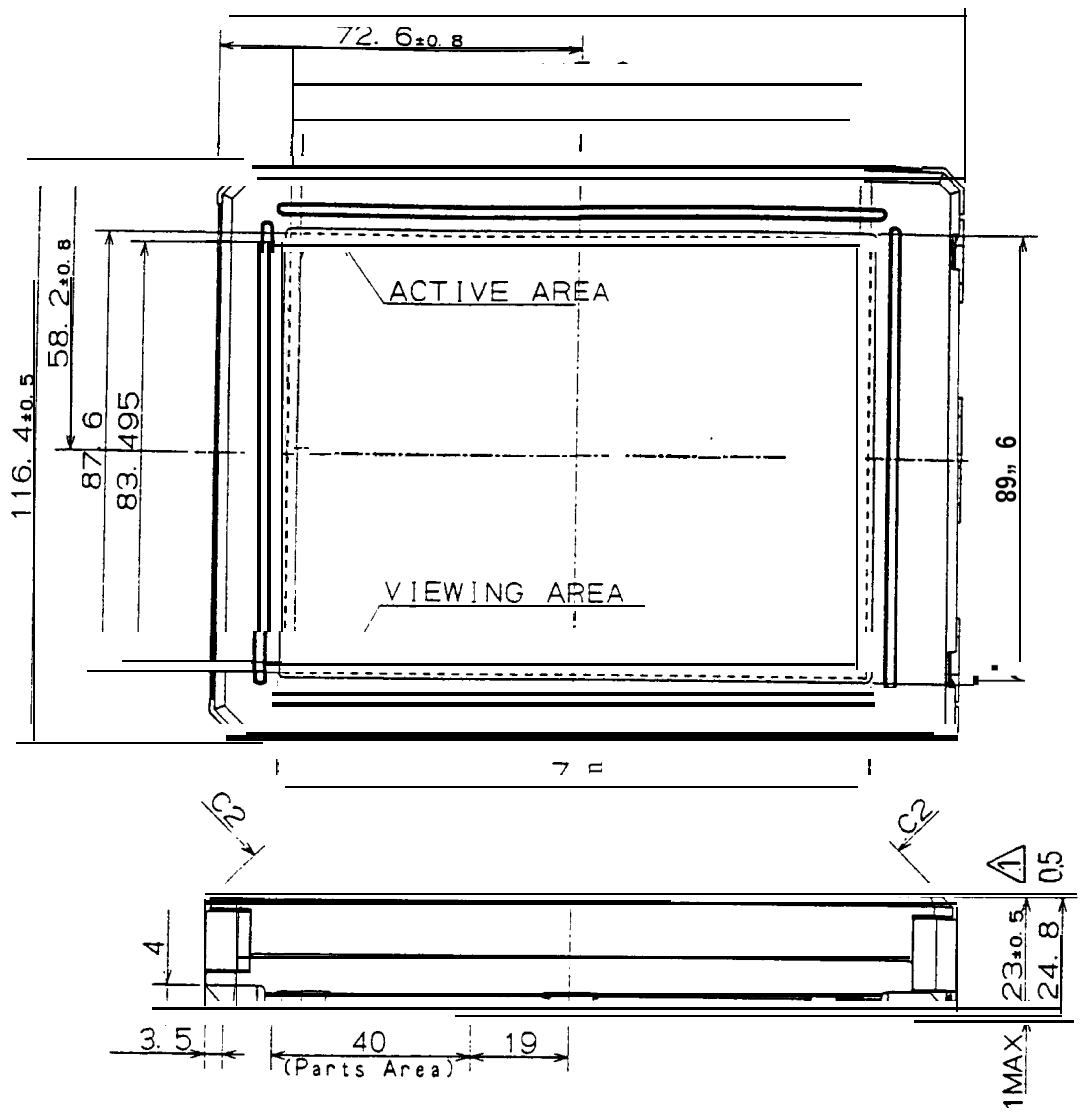
8) CMOS LSIS are equipped in this module, so care must be taken to avoid the electro static charge, by earthing human body, etc.

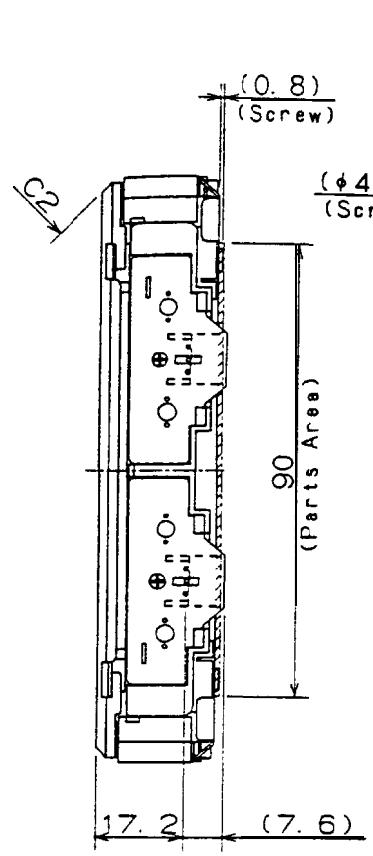
9) Avoid to expose the module to the direct sun-light, strong ultraviolet light, etc. for a long time.

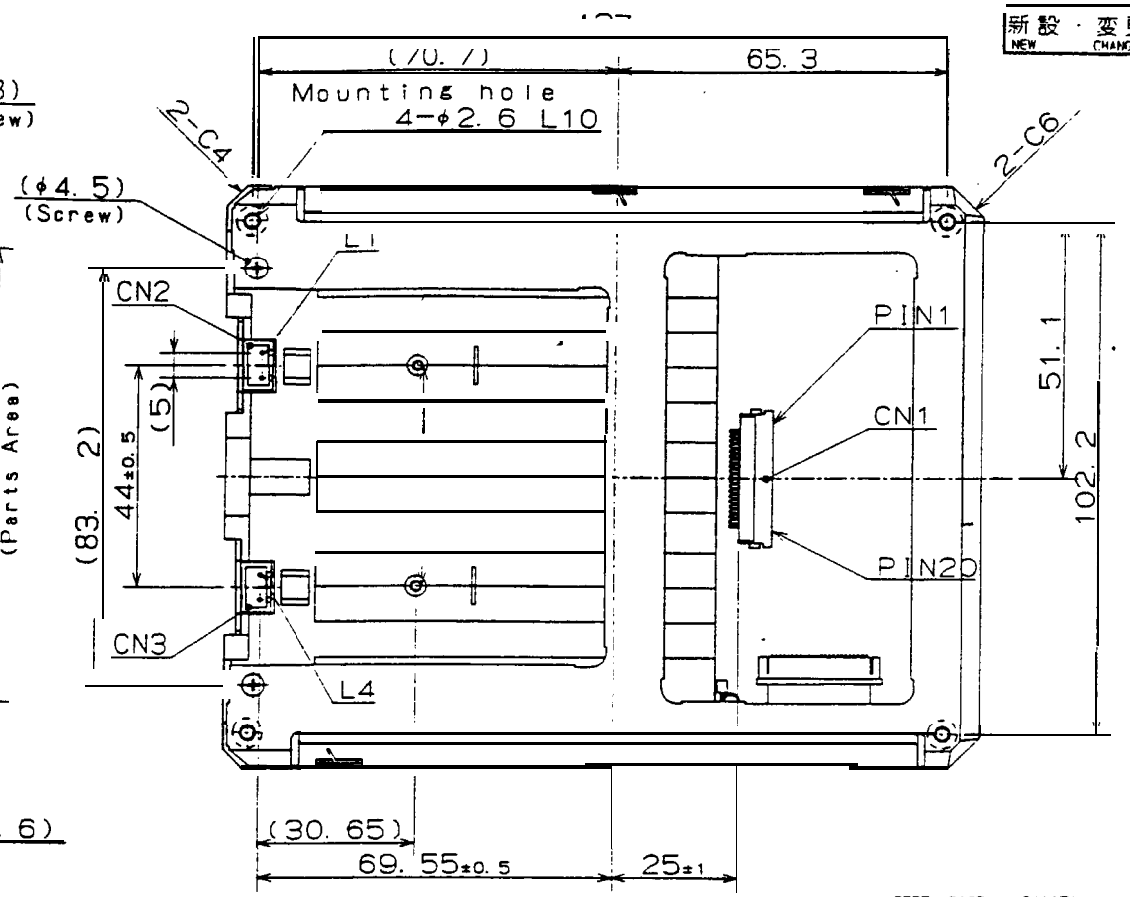
10) If stored at temperatures below specified storage temperature, the LC may freeze and be deteriorated. If storage temperatures exceed the specified rating, the molecular orientation of the LC may change to that of a liquid, and they may not revert to their original state.
11) Disassembling the LCD module can cause permanent damage and should be strictly avoided.
12) Don't use any materials that emit gas from epoxy resin (amines'herdener) and silicone adhesive agent (dealcohol or deoxym) to prevent change polarizer color owing to gas.

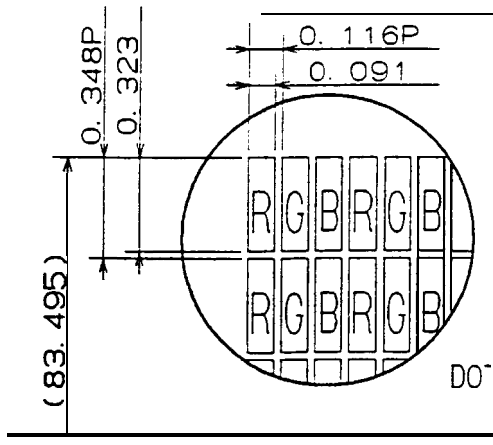
10. Applicable inspection standard
The LCD module shall meet the following inspection standard :S-U-014

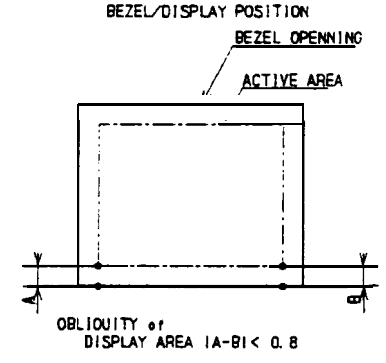
11. This specification describes display quality in case of no gray scale. Since display quality can be affected by gray scale methods, display quality shall be carefully evaluated for the usability of the LCD module in case gray scale is displayed on the LCD module.











INTERFACE PIN LAYOUT

Pin No	Symbol	Pin No	Symbol
1	YD	11	D1
2	LP	12	D2
3	Vss	13	D3
4	XCK	14	Vss
5	Vss	15	D4
6	DISP	16	D5
7	Vdd	17	D6
8	Vee	18	D7
9	Vss	19	Vss
10	D0	20	NC

BACKLIGHT PIN LAYOUT

CN2		CN3	
Pin No	Symbol	Pin No	Symbol
L1	GND	L4	HV
L2	NC	L5	NC
L3	HV	L6	GND

BACKLIGHT CONNECTOR
S3B-XH-A(JST)

Fig.7 Outline dimensions

出図 ISSUE
設計通報 DRAWING INFO. No.( )号による
連絡書 INFORMATION
新設・変更・書換 NEW CHANGE REPLACE 図面

年月日	改正記事	版番 No.	担当
		LM32C04P	

NAME: LCD MODULE OUTLINE DIMENSIONS

MATERIAL	THICKNESS	FINISH	SCALE
			0.7/1

記号 SYMBOL
部品コード PARTS CODE

DESIGN	TRACE	CHECK	CHECK	APPROVE
A. TAKAOKA				
	Y. TOMOMURA			

SHARP CORPORATION
シャープ株式会社 液晶奈良(事本)
NARA

作成日付 DATE: 1995 Jun 8
図番 DRAWING No.: 0D32C04P60021

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