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DEVICE SPECIFICATION for
Passive Matrix LCD Module
Model No.

LM3201921

CUSTOMER'S APPROVAL

DATE _____

BY _____

PRESENTED

BY



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Department General Manager
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○Precautions

- 1) Especially the power ON/OFF sequence shown on Page.16 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 and TOUCH SCREEN is made of glass plates, dropping the module or banging it against hard objects may cause cracking or fragmentation.
- 8) Since CMOS LSIs are equipped in this module, following countermeasures must be taken to avoid electrostatics charge.

1.Operator

Electrostatic shielding clothes shall be use for fear that the static electricity human body in case that operator have a insulating garment.

2.Equipment

There is a possibility that the static electricity is charged to equipment which have a function of peeling or mechanism of friction (EX:Conveyer,soldering iron, working table), so the countermeasure (electrostatic earth: $1 \times 10^8 \Omega$) should be made.

3.Humidity

Humidity of working room may lower electrostatics generating material's rasistance and have something to prevent electrifying. So,humidity should be kept over 50 % because humidity less than 50 % may increase material's electrostatic earth resistance and it become easy to electrify.

4.Transportation/storage

The measure should be made for storage materials because there is a possibility that the static electricity, which electrify human body or storage materials like cntainer by friction or peeling, cause the dielectric charge.

5.Other

The laminator is attached on the surface of LCD module to prevent from scratches, fouling and dust. It should be peeled off unhurriedly with using static eliminator.

- 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.
- 13) Since leakage current, which may be caused by routing of CCFT cables, etc., may affect the brightness of display, the inverter has to be designed taking the leakage current into consideration. Thorough evaluation of the LCD module/inverter built into its hosts equipment shall be conducted, therefore, to ensure the specified brightness.
- 14) 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 LCD module in case gray scale is displayed on the LCD module.

HANDLING INSTRUCTION FOR TOUCH PANEL

Following precaution should be taken on use of Touch Screen (ITO resistive analog detective type and matrix detective type).

1. PRECAUTION ON DESIGNING TOUCH PANEL

(please see Touch Panel plane drawing 1.)

1) ACTIVE AREA

Active area is described as inputted area by pen or finger, which assures quality clarified on the specifications related to input action such as functional property, optical property and durability.

- (1) For detection of coordinates and calibration, it should be always conducted within active area. If it is conducted outside of the active area, it may cause functional error.
- (2) Area which is actually inputted by pen or finger should be designed within active area. If it is designed outside of the active area, it may cause functional error.

2) NEUTRAL AREA

Neutral area is located in outside of the active area by 0.2~1.0mm (inside of non active area by 0.2 ~1.0mm), coordinates can be detected, but its location is in outside of the area which assures quality clarified on specifications related to input action such as functional property, optical property and durability.

- (1) Neutral area detects coordinates when inputted by pen or finger, but it may cause functional error when it is transacted as data detected.
- (2) Since a role of the neutral area is to protect non active area, hard pushing by tip of a pen, etc. may cause deterioration of its durability.

3) VISIBLE AREA

This is transparent area without printed silver electrode or flexible print circuit printed with opaque ink, it assures quality clarified on specifications related to appearance standard.

4) NON ACTIVE AREA

Upper electrode or lower electrode of the non active area is printed with transparent insulation ink, it is located in outside of the active area. Input by pen does not work in this area.

- (1) Non active area is printed with insulation ink, hard push may cause transformation of upper electrode film, active area located near may contact together, may generate conductive power.
- (2) Since a role of non active area is to hold flatness of the upper electrode film on its structure, hard pushing by pen or on housing may cause functional error.

2. PRECAUTION ON DESIGNING PRINT CIRCUIT OR TOUCH PANEL

- 1) There is contact resistance between upper and lower electrode of the Touch Panel. Setting impedance of receiving circuit high enough on the design is recommended. Lower impedance may cause functional error.

2) Conduction between upper and lower electrode generates contact resistance. Data input by pen or finger should be started after the contact resistance become stable enough. Otherwise it may cause functional error.

3) Touch Panel picks up noise easily, any measures such as earth, etc. is recommended. Otherwise it may cause functional error.

3. PRECAUTION ON DESIGNING HOUSING (please see drawing of housing assembly 2.)

1) TO RETAIN SPACE BETWEEN UPPER ELECTRODE FILM AND HOUSING TOP.

(1) Retain 0.2~0.8mm space above the non active area not to make pressure on upper electrode film. If there is any pressure on it, It may cause functional error due to transformation of the upper electrode film.

(2) Flexible material such as robber is recommended for cushion materials. It should be fixed outside of visible area. If it is placed over non active area, it may cause functional error due to transformation of the upper electrode film.

2) TO ASSEMBLE ON HOUSING

(1) To fix Touch Panel on Housing, supporting Touch Panel from back side (lower electrode glass) is recommended. If upper electrode film is fixed with both sides adhesive tape, it may lead to peeling-off of the upper electrode film due to repeated input pressure.

(2) TO PREVENT SWELLING OF UPPER ELECTRODE FILM OF TOUCH PANEL CAUSED BY ATMOSPHERIC PRESSURE DIFFERENCE BETWEEN INSIDE AND OUTSIDE OF THE DEVICE, ETC.

If upper electrode film swells caused by atmospheric pressure difference between inside and outside of the device, etc., it may cause deterioration of durability of Touch Panel and may cause functional error.

(3) TO PREVENT DEW CONDENSATION ON TOUCH PANEL AND TO PREVENT ANY LIQUID SUCH AS WATER, VAPOR FROM COMING INTO TOUCH SCREEN.

Upper electrode film and lower electrode glass of Touch Panel are fixed with adhesive, and there set up a vent hole between them. This shows liquid may penetrate into Touch Panel easily due to its structure, any measures on designing the Housing to prevent the penetration is required. Penetration of liquid may cause functional error.

4. PRECAUTION ON UNPACKING AND ASSEMBLING TOUCH PANEL.

1) STORAGE

Store the product without unpacking in a place where temperature and humidity is within the range clarified on specifications.

2) UNPACKING

(1) Check upper and lower side and be sure to unpack from upper side.

(2) Be careful not to hit the product when any tool such as sharp knife is to be used for unpacking.

- (3) Do not hold and pull out flexible tail, otherwise it may cause shut down of the flexible print circuit.
- (4) Any treatment is not made for glass edge. It may be sharp and may cause any injury when handled by bare hands. Wear a fingerstall or glove and handle with extra care.

3) HANDLING

- (1) Pick up outside of visible area for handling. Do not pick up center of the visible area and flexible tail.
- (2) Do not stack up the products and do not place anything on the product. It may cause scratch or transformation.
- (3) Wipe out any dirt on the product with dried flexible cloth. If it is heavy dirt, wipe it out with flexible cloth with some ethyl alcohol. Upper electrode film and lower electrode glass of Touch Panel are fixed with adhesive, and there set up a vent hole between them. Therefore ethyl alcohol may penetrate into Touch Panel easily from the edge, so extra care is required. It may cause functional error.

4) PRECAUTION ON ASSEMBLY

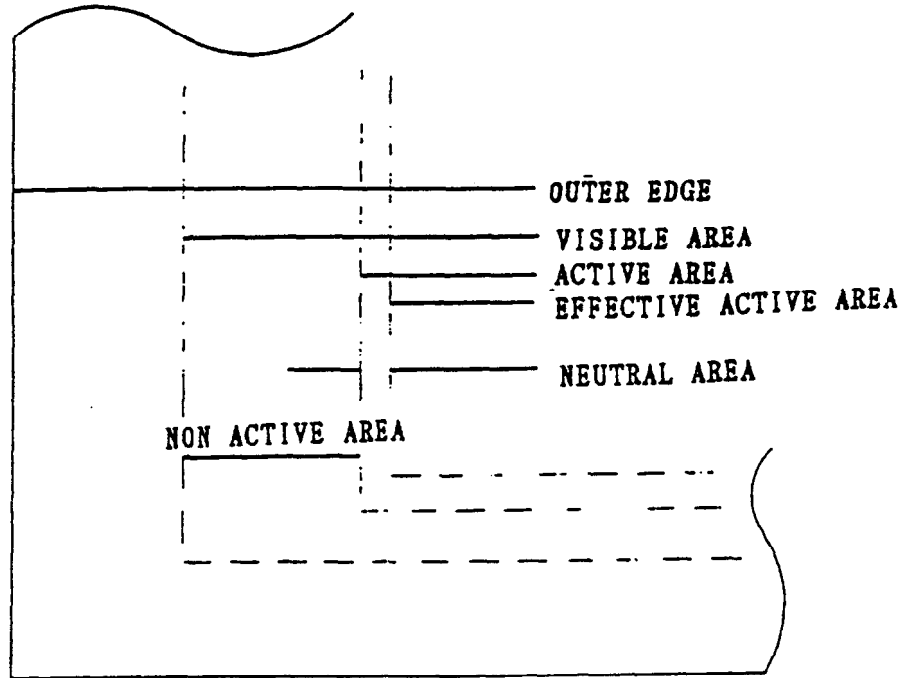
- (1) Be careful not to generate excess distortion on heat sealed area and flexible tail. It may cause functional error.
- (2) Be careful not to scratch the product on assembly.

5) PRECAUTION ON HANDLING

- (1) handle the product within the range of temperature and humidity clarified on specifications.
- (2) Use finger or polyacetal pen attached for input to Touch Panel. Surface of the Touch Panel is bar-code treated. film surface may be damaged if inputted by ball-point pen or metal piece.
- (3) Do not expose Touch Panel to direct sunlight for long period of time. Polyester film is used on Touch Panel, exposure to direct sunlight for long period of time may cause discoloration.
- (4) If Chemical stays on the Touch Panel for long period of time, upper electrode film may be swelled and may cause functional error. If it is to be used under severer circumstances, another measures for water protection is required.

5. If any other question may be arised, please feel free to contact us.

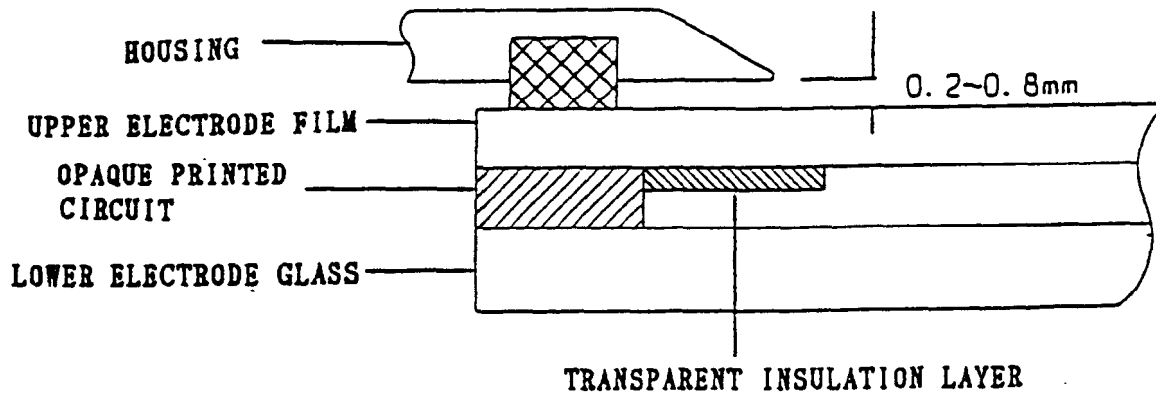
PLANE DRAWING OF TOUCH SCREEN



DRAWING 1

DRAWING OF HOUSING ASSEMBLY

CUSHION MATERIAL



DRAWING 2

○Contents

	Page
1.Application	8
2.Construction and Outline	8
3.Mechanical Specification	8
4.Absolute Maximum Ratings	
4-1.Electrical absolute maximum rating	9
4-2.Environment Conditions	9
5.Electrical Specification	
5-1.Interface signals	10
5-2.Electrical characteristics	11
5-3 Supply voltage sequence condition	16
6.Modules Driving Method	
6-1.Circuit configuration	17
6-2.Display face configuration	18
6-3.Input data and control signal	18
7.Optical Characteristic	19
8.Characteristics Backlight	21
9.Applicable inspection standard	22
10.Specification of Touch Panel	22
11.LCD module outline dimensions	24

1. Application

This data sheet is to introduce the specification of LM3201921, Passive Matrix type LCD module.

2. Construction and Outline

Construction: TOUCH PANEL and 320×240 dots 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.

Outline : See Fig. 7

Connection : See Fig. 7 and Table 5

3. Mechanical Specifications

Table 1

Parameter	Specifications	Unit
Outline dimensions Note 1)	166.0 (W) × 109.0 (H) × 9.2 (D) MAX	mm
Viewing area	121.0 (W) × 91.6 (H)	mm
Active area	115.17 (W) × 86.37 (H)	mm
Display format	320 × 240 Dots	
Dot size	0.33 (W) × 0.33 (H)	mm
Dot spacing	0.03	mm
Base color Note 2)	Dark blue Note 3)	-
Mass	approx 205	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)	VDD-V0	0	32	V	Ta=25 °C
Input signal voltage	VIN-VSS	0	VDD	V	Ta=25 °C
Supply voltage (CCFT)	VL	0	1.500	V _{rms}	Ta=25 °C
Supply current (CCFT)	IL	0	6.5	mA _{rms}	Ta=25 °C

4-2 Environmental Conditions

Table 3

Item	Tstg.		Topr.		Remark
	MIN.	MAX.	MIN.	MAX.	
Ambient temperature	-25 °C	+60 °C	0 °C	+45 °C	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 °C/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/11 min	

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

Note 3) Acceleration : 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 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	S	Scan start-up signal	"H"
2	CP1	Input data latch signal	"H"~"L"
3	CP2	Data input clock signal	"H"~"L"
4	NC	-	-
5	DISP OFF	Display Control signal	"H" -- Display ON
6	D0	Display data signal	"H" (ON), "L" (OFF)
7	D1		
8	D2		
9	D3		
10	VDD	Power supply for Logic	+5V
11	VSS	Ground potential	-
12	VEE	Power supply for LCD drive	(+16~22V)

Table 5-2 CN2 (CCFT)

Pin No	Symbol	Description	Note
1	VFT1	Power supply for CCFT back light (HOT)	for Backlight
2	NC	-	
3	VFT2	Power supply for CCFT back light (GND)	

* Used Cable : AWG26 UL STILE 3579

Used connector CN1 : 12 pin .1.25 mm pitch. FFC
 CN2 : BHR-03VS-1 (JST)

Mating connector CN1 : 5597-12APB, 5597-12CPB (MOLEX)
 CN2 : SM02 (8.0)-BHS-1-TB (JST)

5-2 Electrical characteristics of LCD panel

Table 6

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Supply voltage (Logic)	VDD-VSS	Ta=0~45 °C	4.75	5	5.25	V
Supply voltage (LCD drive) Note 1)2)	VEE-VSS	Ta= 0 °C	18.3	19.8	21.3	V
		Ta= 25 °C	17.6	19	20.4	V
		Ta= 45 °C	16.9	18.2	19.5	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	Note 3)	-	1.2	1.8	mA
Supply current (LCD drive)	IEE		-	3.5	5.3	mA
Power consumption	Pd	Note 3)4)	-	82	123	mW

Note 1) The viewing angle θ at which the optimum contrast is obtained can be set by adjusting VEE-VSS. Refer to 7-Note 2 for the definition of θ .

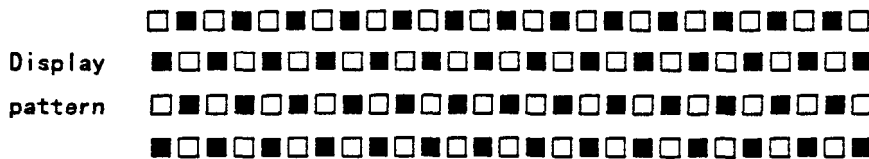
Note 2) The voltage at which the optimum contrast is obtained (VEE-VSS) is different in individual modules. And it changes because of temperature. Therefore need adjust the voltage at which the optimum contrast is obtained (VEE-VSS) in individual modules.

Note 3) Under the following condition.:

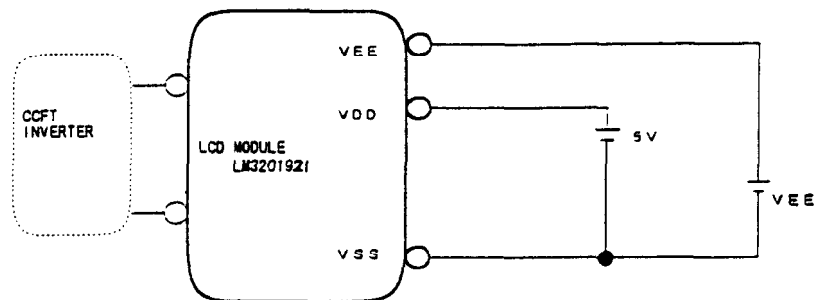
VDD-VSS=5.0 V, VEE-VSS=Vmax (Refer to P.16 about Vmax)

Frame frequency=80 Hz, Ta=25 °C

Display pattern=1 bit checker

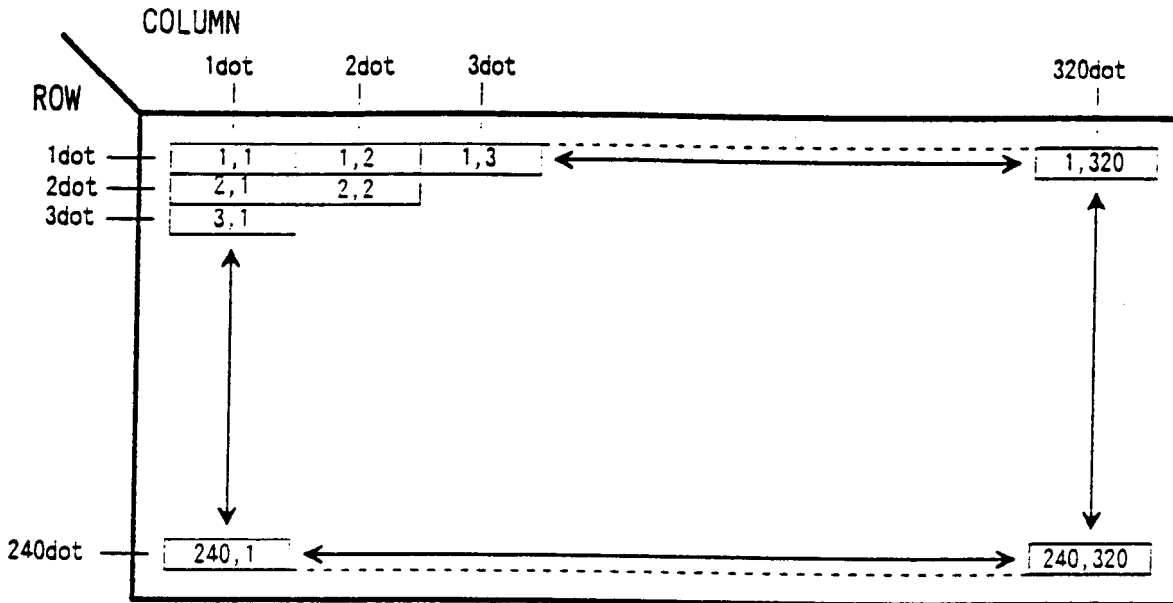


measuring circuit :



Note 4) Excluded The backlight power consumption.

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



Note) 1,2 means 1st row 2nd column dot.

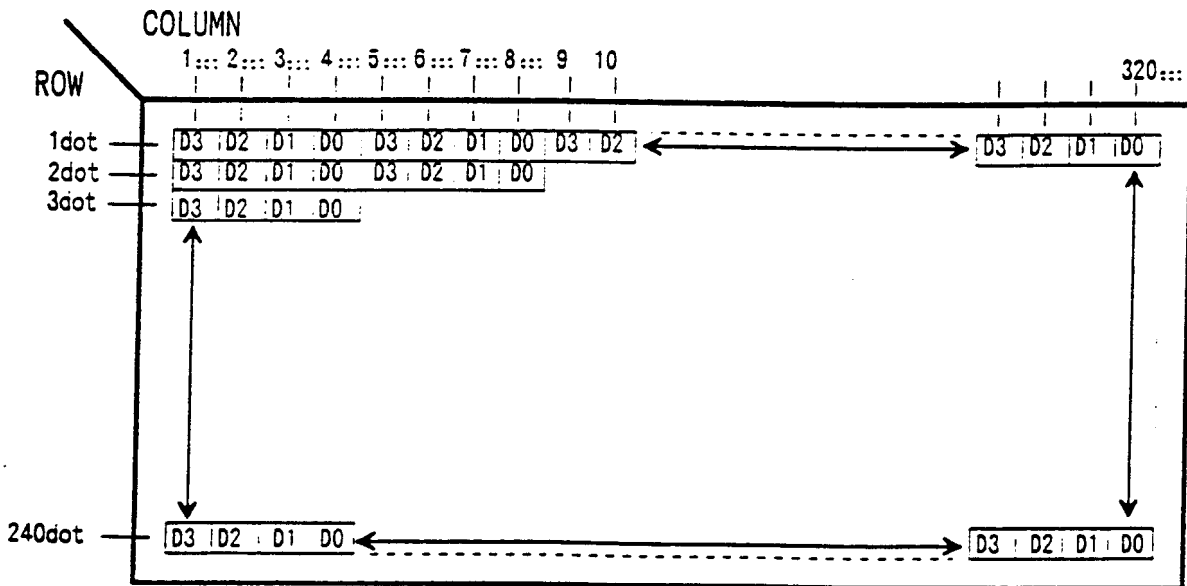


Fig.1 Dot chart of display area

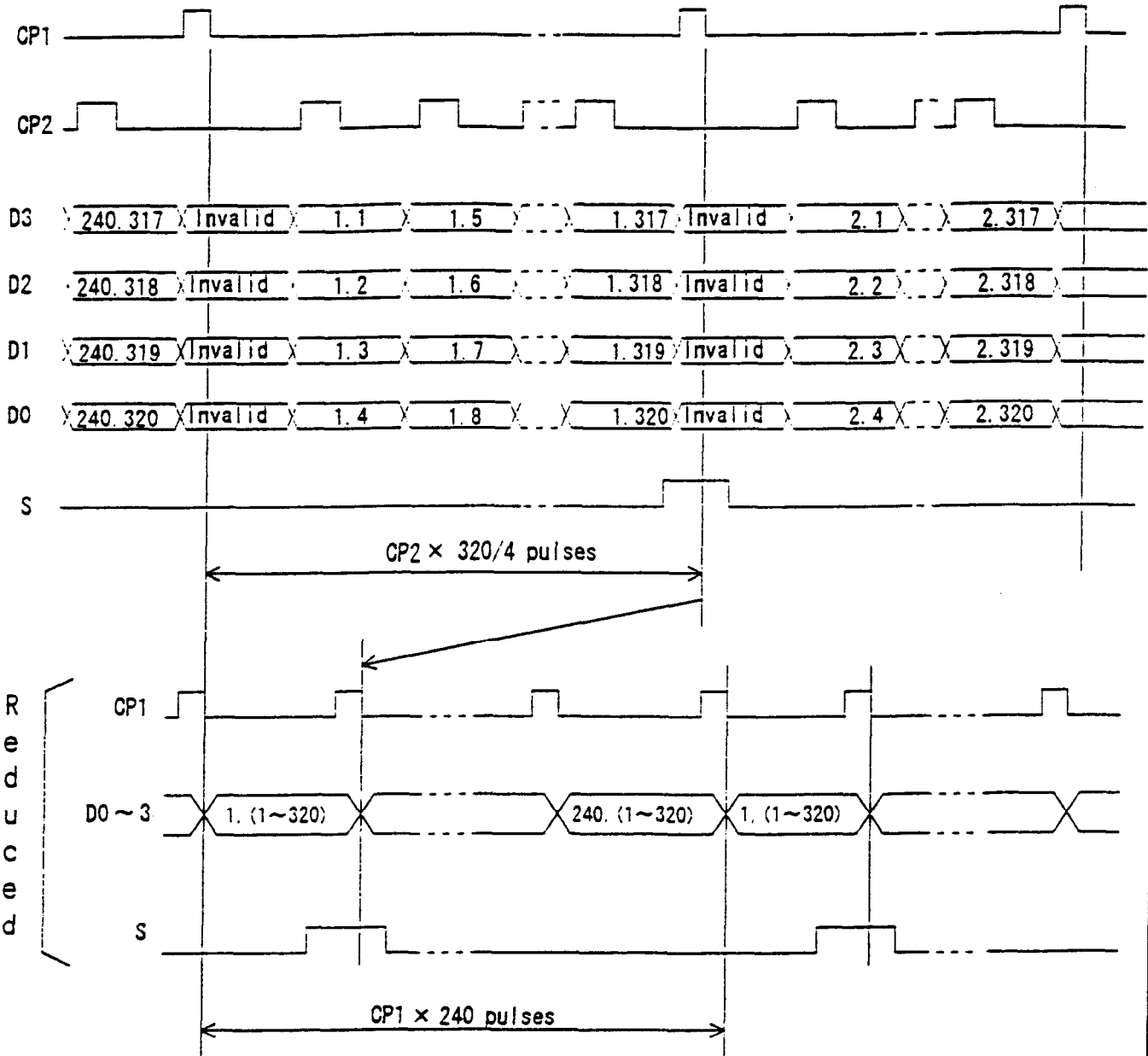
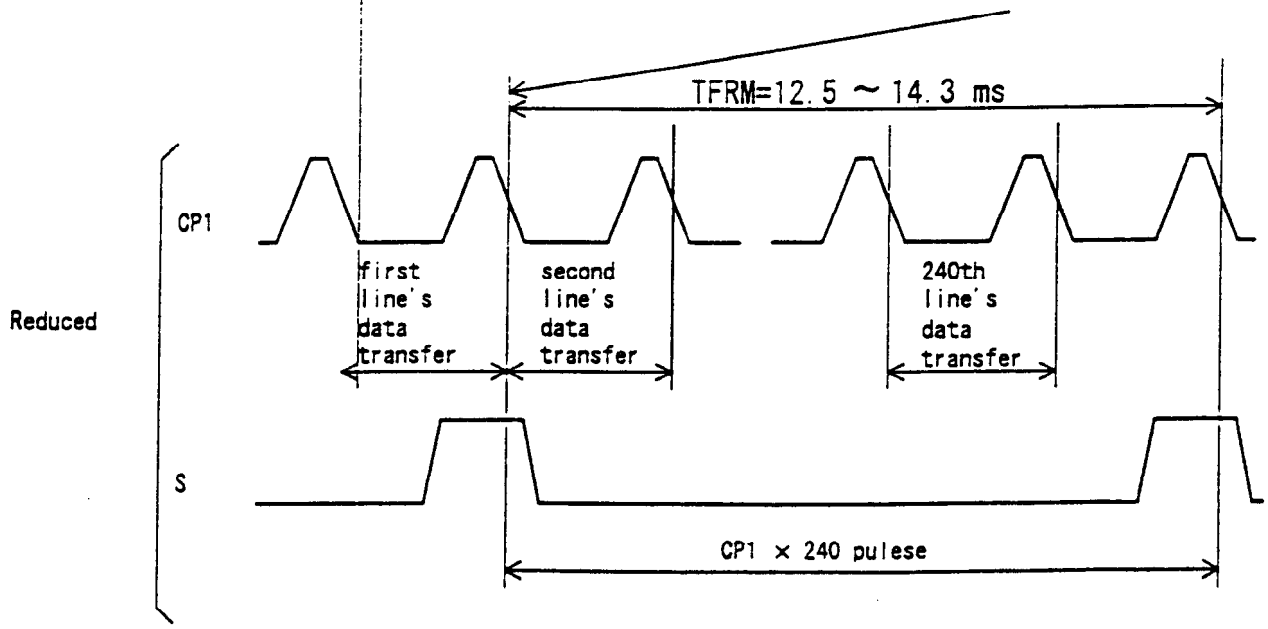
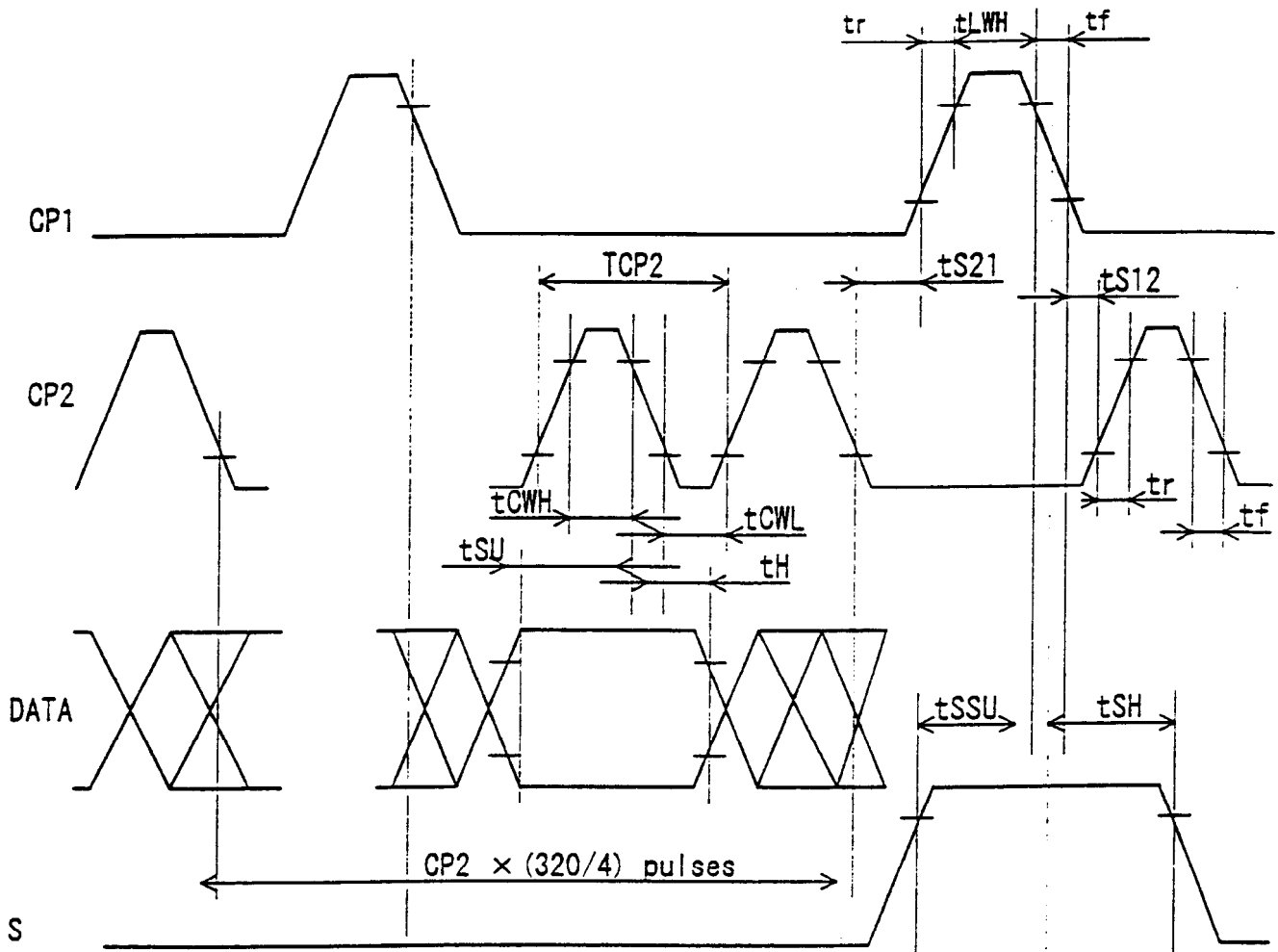


Fig. 2 Data input timing chart



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

Fig. 3 Interface timing chart

Table 7 Interface timing ratings

Item	Symbol	Rating			Unit
		MIN.	TYP.	MAX.	
Frame cycle	TFRM	12.5	-	14.3	ms
CP2 clock cycle	TCP2	130	-	-	ns
"H" level clock width	tCWH	60	-	-	ns
"L" level clock width	tCWL	60	-	-	ns
"H" level latch clock width	tLWH	60	-	-	ns
Data set up time	tSU	50	-	-	ns
Data hold time	tSH	40	-	-	ns
CP2 f clock allowance time from CP1 l	tS12	0	-	-	ns
CP1 f clock allowance time from CP2 l	tS21	0	-	-	ns
Input signal rise/fall time (Note 1)	tr, tf	-	-	trf	ns
S Signal Data set up time	tSSU	40	-	-	ns
S Signal Data hold time	tSH	60	-	-	ns

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

Note 2)

trf=50 in case $tCT = (TCP2 - tCWH - tCWL) / 2 \geq 50$

trf=tCT in case $tCT = (TCP2 - tCWH - tCWL) / 2 < 0$

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.

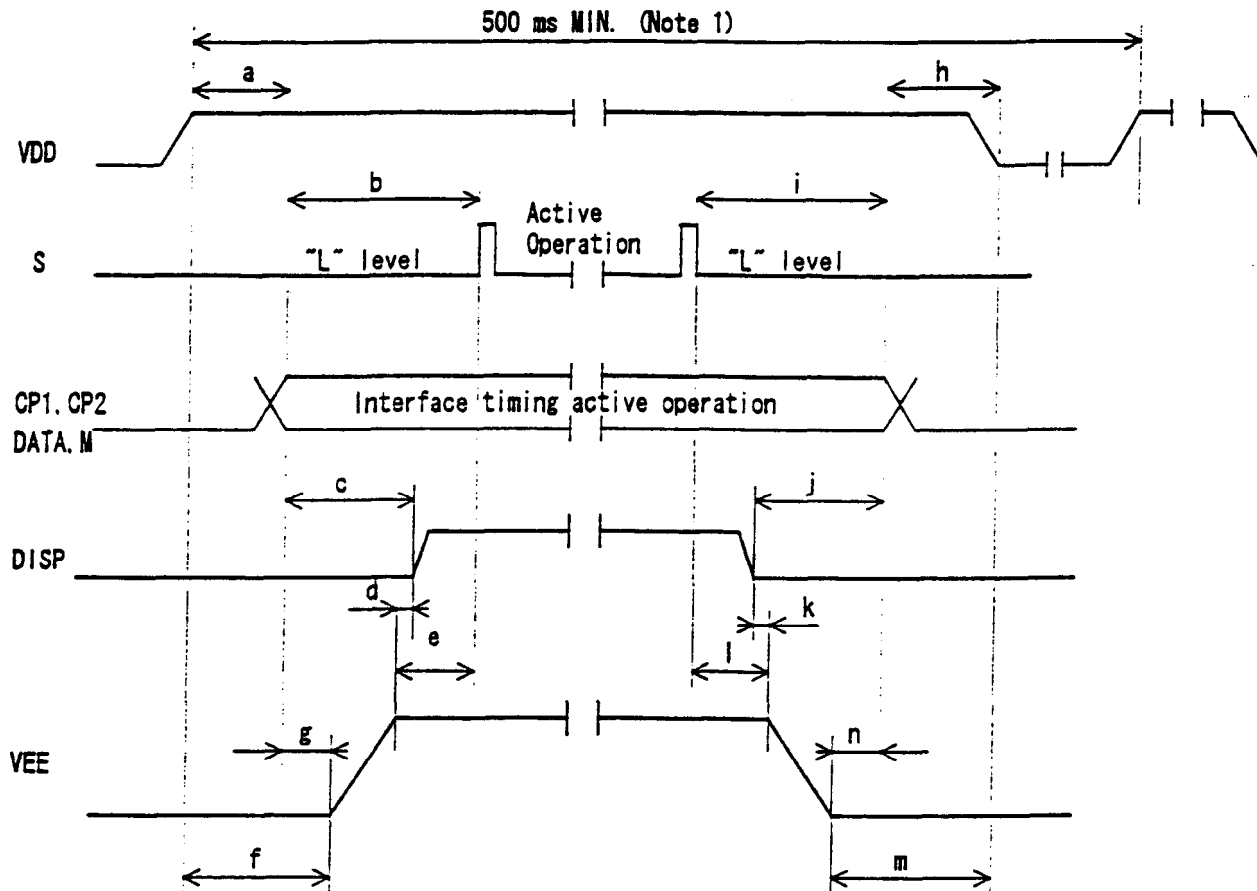


Fig.4 Power ON/OFF sequence

Table 8 Sequence timing ratings

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.	l	-	0 ms MIN.
f	0 ms MIN.	(Note 2)	m	0 ms MIN.	(Note 2)
g	-	20 ms MIN.	n	-	0 ms MIN.

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.

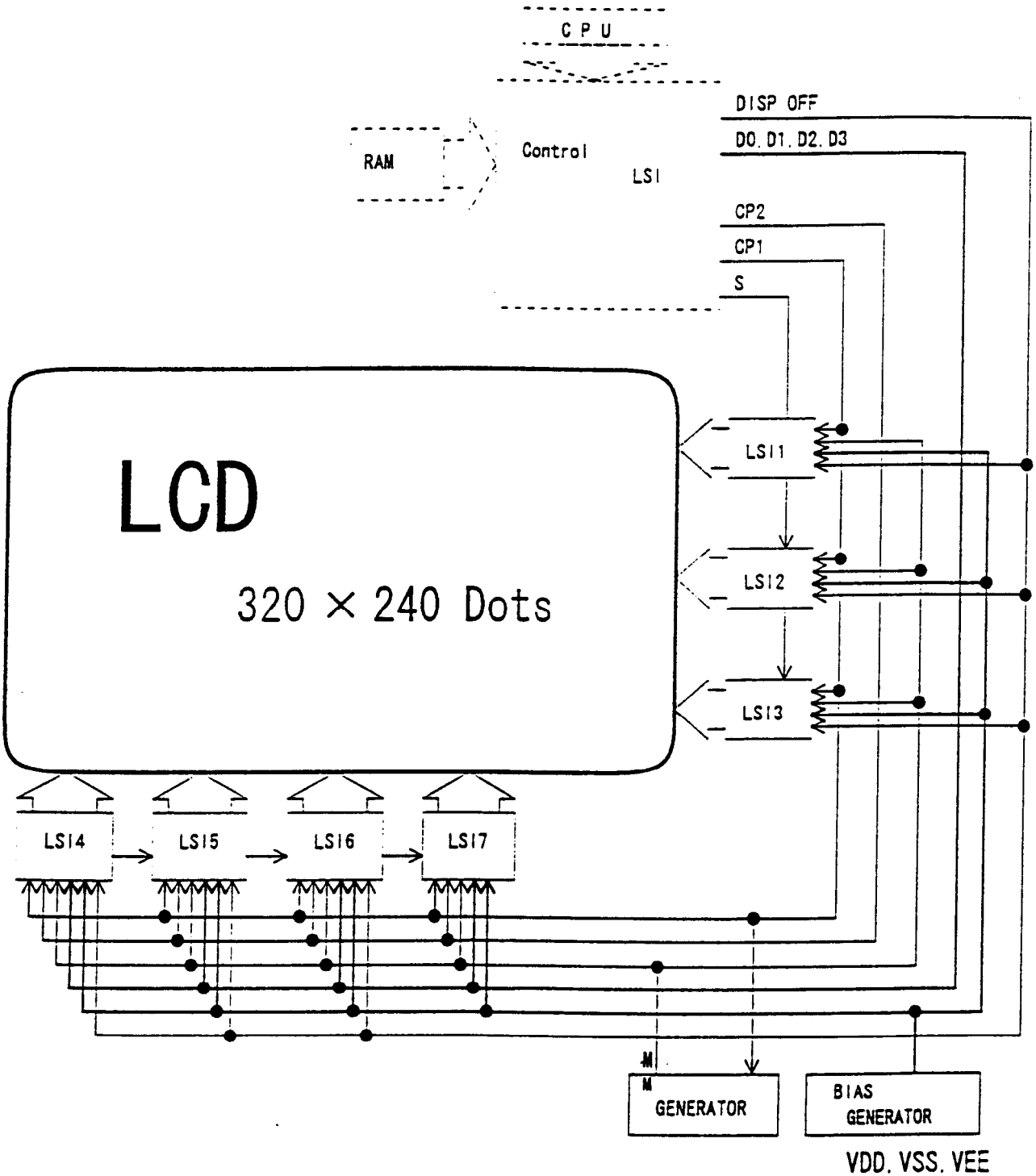
Note 2) VEE to be set at "VSS level"

6. Module driving method

6-1 Circuit configuration

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

Fig. 5 Circuit block diagram



6-2 Display face configuration

The display consists of 320×240 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 80 bits LSI, consisting of shift registers, latch circuits and LCD driver circuits. Input data for each row (320 dot) will be sequentially transferred in the form of 4 bit parallel data through shift registers from top left of the display together with clock signal (CP2).

When input of one row (320 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 (CP1). Then, the corresponding drive signals will be transmitted to the 320 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 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 320 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.

S 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-form shall be inverted at every display frame to prevent the generation of such DC voltage. Control Signal M plays such a role.

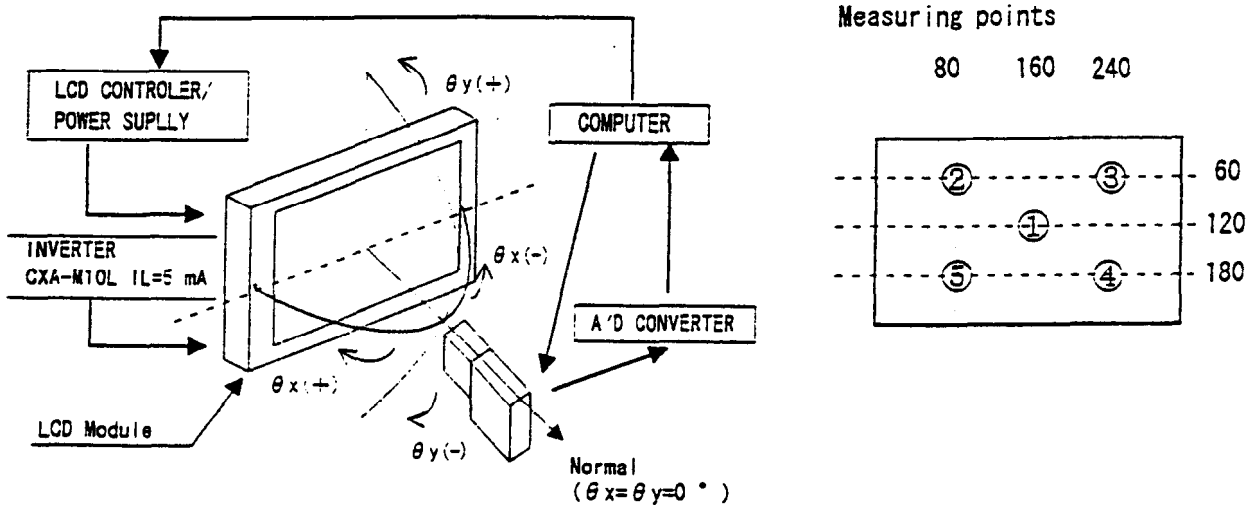
7. Optical characteristics

Table 9

Ta=25 °C. Frame frequency=80 Hz
1/240 DUTY. VDD=5 V. VEE-VSS=Vmax

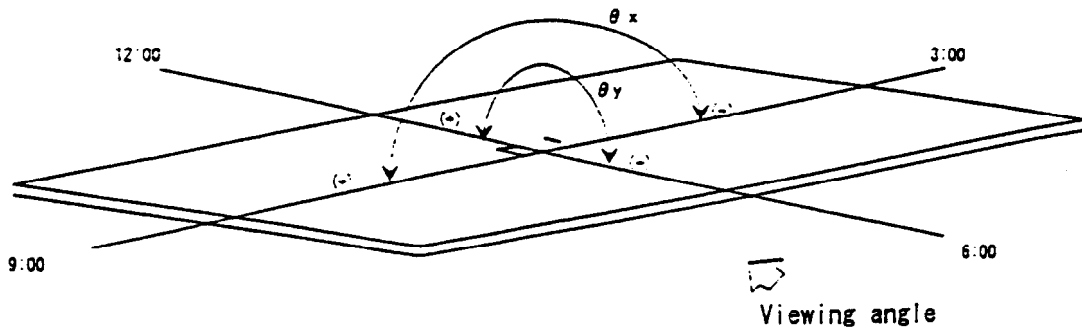
Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	Remark	
Viewing angle range	θ_x	$C_o \geq 4$ $\theta_y = 0^\circ$	$\theta_x \geq 0^\circ$	40	-	-	dgr.	Note 1 Note 2
			$\theta_x < 0^\circ$	-	-	-40	dgr.	
	θ_y	$\theta_x = 0^\circ$	$\theta_y \geq 0^\circ$	25	-	-	dgr.	
			$\theta_y < 0^\circ$	-	-	-40	dgr.	
Contrast ratio	C_o	$\theta_x = \theta_y = 0^\circ$	4	6	-	-	Note 3	
Contrast variation	C_{var}	$\theta_x = \theta_y = 0^\circ$	-	1.3	1.5	-	Note 1	
Response time	Rise	τ_r	-	220	330	ms	Note 4	
	Decay	τ_d	-	215	320	ms		

Note 1) Measurement method of
Contrast. Contrast variation. Viewing angle. Response time



TOPCON BM-7 + quartz fiber
Measuring spot size : $\phi 10$ mm
Ta=25 °C
In dark room
Measurement shall be executed 30 min after turning on.

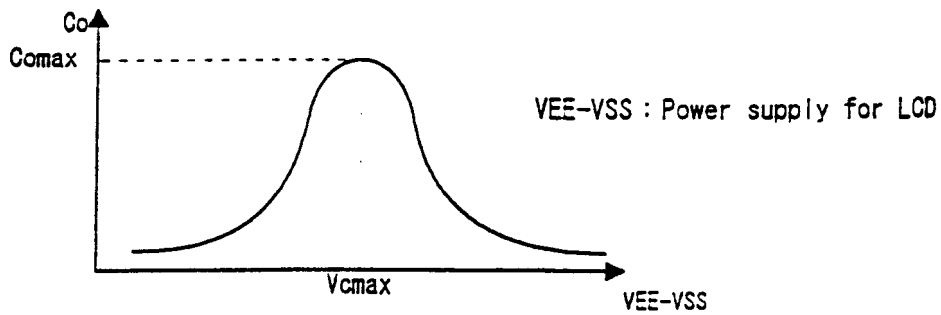
Note 2) The viewing angle range is defined as follows:



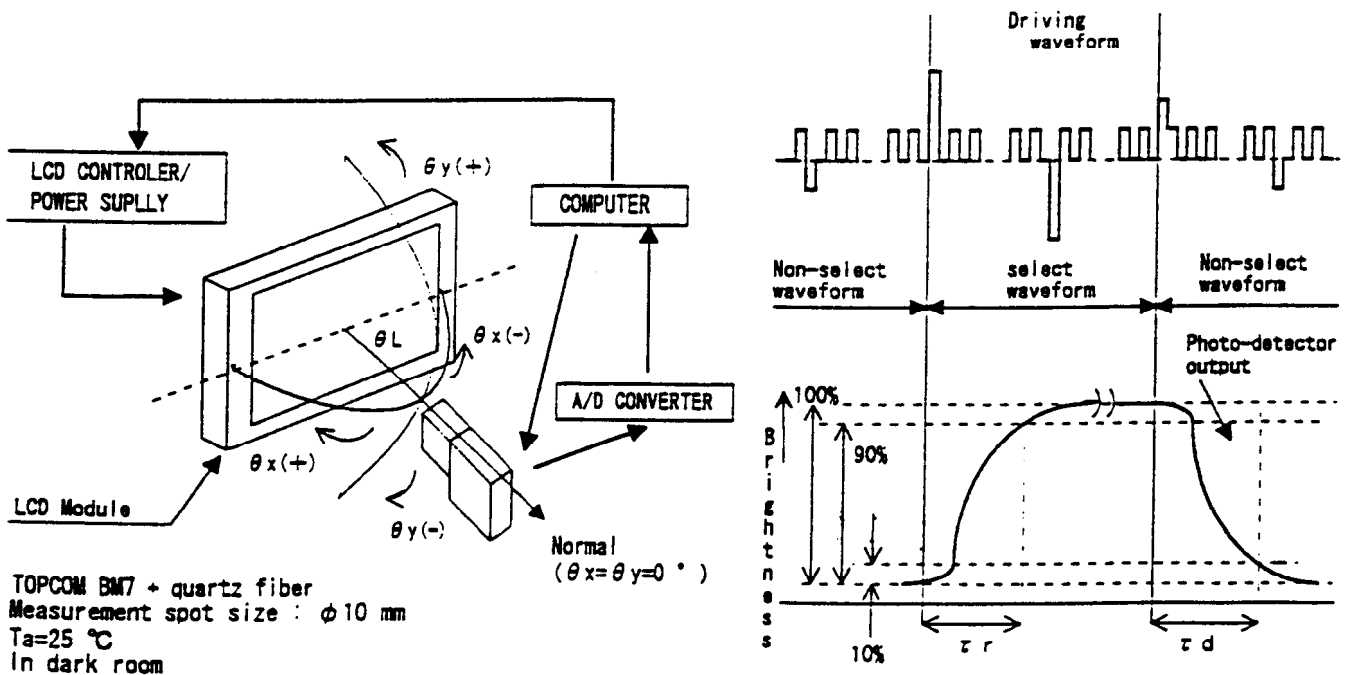
Note 3) Contrast ratio is defined as follows:

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

V_{cmax} is defined as follows:



Note 4) Definition of response time



8. Characteristics of CCFT back light

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

8-1 Rating

Table 10

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Remark
Supply voltage for CCFT	VL	280	290	310	V	
Supply current for LED	IL	3	4	5	mA	
Brightness	B	80	120	-	cd/m ²	Note 1, 2
Brightness variation	Bver	-	1.3	1.5		Note 1, 2
Lamp frequency	FL	20	-	60	kHz	
Start voltage	VS	-	-	750	V	Note 2
Power consumption	WL	-	1.3	-	W	Note 2
Life time	LL	-	15,000	-	h	

Note 1) Rating are defined as the average brightness inside the viewing area specified in Fig. 6.

Note 2) Measurement conditions

CCFT inverter : CXA-M10L-L (TDK)

Measurement circuit current : 4 mArms fix

(circuit voltage : approximation DC 9 V)

LCD pattern : All digits WHITE, VDD=5 V, VEE-VSS=Vmax

Ambient temperature : 25 °C

Measurement equipment: BM-7 (TOPCOM)

8-2 Operating life time

The operating life time is 15 000 hours more under the following conditions.

CCFT inverter : CXA-M10L-L

IFT=5 mArms

Ta=25±5°C

The operating life time is defined as having ended when any of the following conditions occur.

-When the illuminance or quantity of light has decreased to 50 % of the initial value.

-When the light of CCFT goes to flicker remarkable.

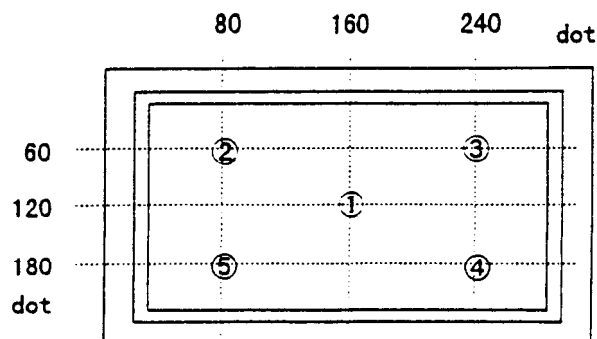


Fig. 6 Measuring point ①~⑤

9. Applicable inspection standard

The LCD module shall meet the following inspection standard
:(S-U-040)

10. SPECIFICATION of TOUCH PANEL

10-1. Structure and Size

1) Structure F/G

F (Upper Electrodes) Material: Polyester film Thickness: 175 μ m
Surface resistance: 500 Ω / \square
Surface Non-glare hard coating, Anti Newton Ring

G (Lower Electrodes) Material: Glass Thickness: 1.1mm
Surface resistance: 600 Ω / \square
Micro dot spacer: 0.05 Φ , 3.0mm pitch

2) Size (Details are shown in the drawing)

Outside Dimension	137.4 mm x 108.8 mm
Viewing Area	123.67mm x 93.87mm
Operating Area	118.57mm x 89.77mm
Non Operating Area	Inside of Viewing Area, Outside of Operating Area.
Effective Operating Area	116.57mm x 87.77mm

3) FPC Ag/C conductor (See detailed drawing)

Applicable connector
Manufactured by Japan FCI (SFW4R-5STEI)

4) Weight of Single Touch Panel 47g/pc.

10-2. Rating

Maximum Voltage: 7V Maximum Current: 25mA

10-2. Operating Temperature Range

0~45°C
(Humidity less than 90%RH. No dew condensation shall be acceptable.)

10-3. Storage Temperature Range

-25~60°C
(Humidity less than 90%RH. No dew condensation shall be acceptable.)

10-4. Quality Specification

NO.	Item	Unit	Spec.	Test Method
1)	Electrical Characteristics			
	Terminal Resistance			
	X(Long)direction upper	Ω	350~900	
	Y(Short)direction lower	Ω	200~650	
	Circuit Resistance Ratio			
	X(Long)direction upper	%	Max. 10	
	Y(Short)direction lower	%	Max. 20	
	Linearity	%	Max. 2.0	Measured at 10x10 point (X, Y direction)

NO.	Item	Unit	Spec.	Test Method
	Insulation Resistance	MΩ	Min. 5	DC 25V between upper and lower electrodes
	Insulation Pressure Resistance	min.	Min. 1	DC 25V between upper and lower electrodes
	Chattering	msec	Max. 20	
2)	Machine Characteristics ON Load Input with finger	g	5~100	7R silicone rubber with 50~60° hardness
	Surface Hardness	H	Min. 2	JIS K 5400
	FPC Tensile Strength	g/cm	Min. 150	Tensile angle 90°
3)	Optical Characteristics Newton Ring		Not Observed	Under 3 wave FL lamp
	Light Transmittance	%	Min. 80	Haze meter
	Haze	%	4~8	Haze meter
4)	Input Durability Writing Durability Input with finger		After each test, electrical, machine & optical characteristics shall meet specs.	7R silicone rubber with 50~60° hardness, 250g, 3HZ without load Min. one million Note) Exclusively for input with finger. Pen is also used on calibration.
6)	Chemical Resistance Salt solution(4%) Toluene Methyl alcohol Ethyl acetate Acetone		After each test, electrical, machine & optical characteristics shall meet specs.	Check the change of appearance on wiping out chemical agent at three minutes after dropping onto the surface of touch panel.

