CITIZEN
OEM DIVISION

Liquid Crystal Displays

G3242H-FF

features:

320 x 240 "¼ - VGA"

CCFT Backlight

Black and White mode

6 inch, 150mm diagonal screen

Fast Fluid - Quick Response

High contrast ratio

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Contents

RECORD OF REVISION

Date	Sheet NO.	Summary

1. Application

This specification shall be applied to Dot Matrix LCD MODULE G3242H-FF.

2. Composition

Display type	: B/W STN display	
Dot structure	: 320 ×240 Dots	Graphic display
Driving method	: 1/240 duty	Multiplex drive
Back light	: Cold Cathod Fluorescent Tube (CCFT)	
Surface texture	: Non-Glare	

Block Diagram

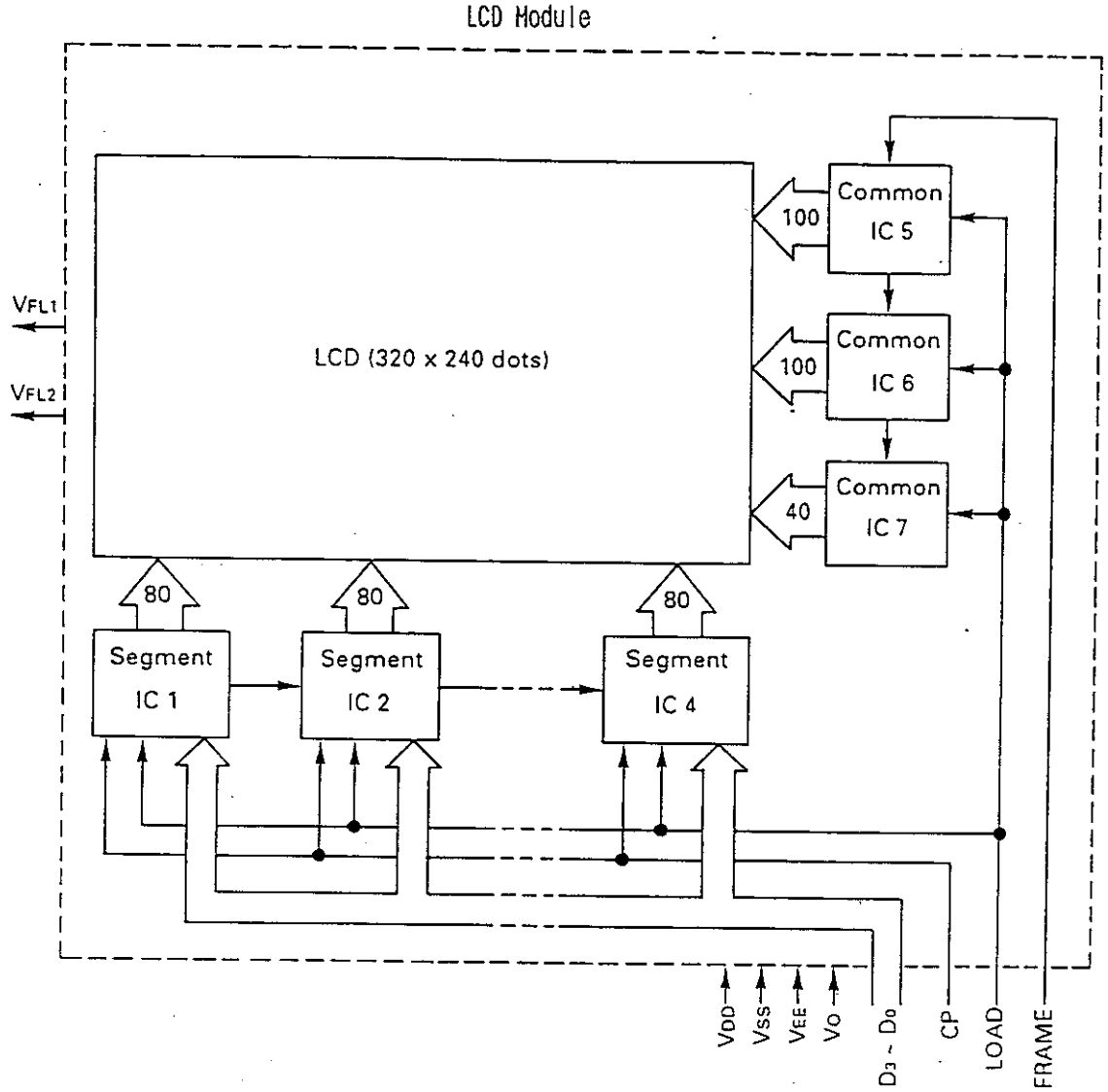


Fig 2-1

(Notes) · G3241H-FF does not incorporate any controller.

3. Mechanical Specifications

3-1 Dimentions and weights

Item	Dimensions	Unit
Module size	170(W) × 110(H) × 8(D) max	mm
Effective viewing area	121(W) × 91.6(H)	mm
Weight	Approx. 155	g

3-2 Dot Dimensional Drawing

(Unit mm)

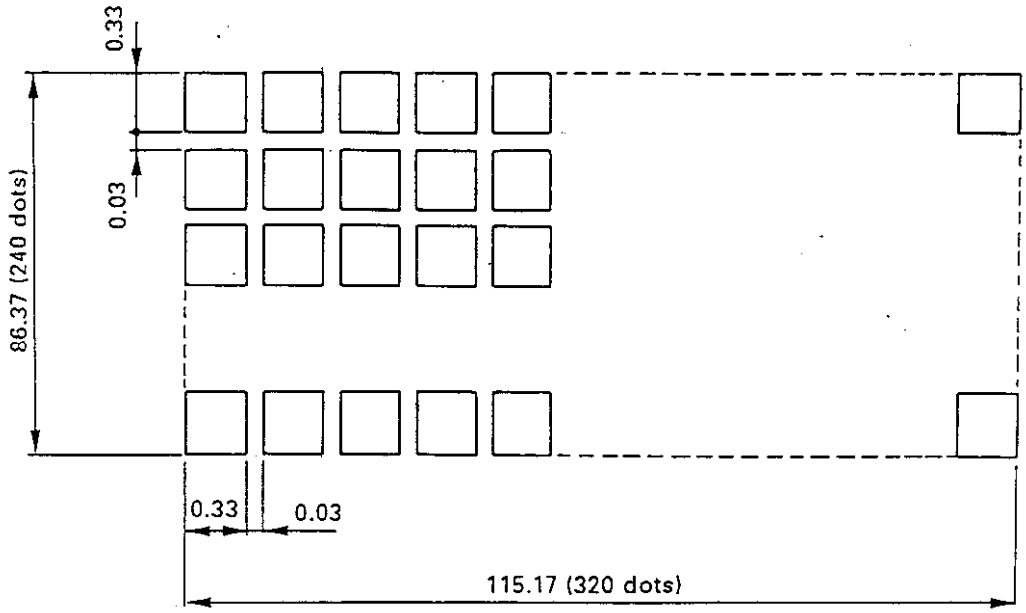


Fig 3-1

4. Absolute Maximum Ratings

4-1 Electrical absolute maximum ratings

(V_{SS}=0 V)

Item	Symbol	Min.	Max.	Unit	Remarks
Supply voltage for logic circuit	$V_{DD}-V_{SS}$	- 0.3	+ 6.0	V	
Supply voltage for LCD driving	$V_{DD}-V_{EE}$	0	+30.0	V	
Input voltage	V_{IN}	- 0.3	V_{DD}+0.3	V	Note 1

Note 1 : Shall be applied to FRAME, LOAD, CP, $D_0 \sim D_3$.

4-2 Environmental absolute maximum ratings

Item	Specification	Remarks
Storage temperature	Max. + 60℃ Min. - 20℃	Note 1 No condensation
Operating temperature	Max. + 45℃ Min. 0℃	Note 1 No condensation
Vibration	Frequency : 15 ~ 55Hz Acceletation : 1.5G Sweep : 2.5 octave/min.	X, Y, Z directions
Shock	Acceletation : 50G Acting time : 11 msec.	X, Y, Z directions

Note 1 : Ta ≦ + 40℃ ····· 95% RH Max.
Ta > + 40℃ ····· Absolute humidity must be lower than the humidity of 95% RH at + 40℃

5. Electrical Specifications

5-1 Electrical Characteristics

(V_{SS}=0V)

Item		Symbol	Test condition	Min	Typ	Max	Unit	Remarks
Supply voltage for logic circuit		$V_{DD}-V_{SS}$		4.5	5.0	5.5	V	
Supply voltage for LCD driving		$V_{DD}-V_{EE}$		–	–	28.0	V	
FRAME frequency		f_{FRAME}		–	80.0	–	Hz	
Input voltage	H level	VIH	$V_{DD}-V_{SS}$ =5.0V ±10%	0.8V_{DD}	–	V_{DD}	V	(Note)
	L level	VIL		V_{SS}	–	0.2V_{DD}	V	
Current consumption		Iss	Ta=25 ℃ $V_{DD}-V_{SS}$= 5.0V	–	0.4	1.5	mA	
		I_{EE}	$V_{DD}-V_{EE}$=24.2V f_{FRAME} = 70Hz	–	2.7	9.6	mA	

※ $V_{DD} > V_{SS} > V_O \geq V_{EE}$

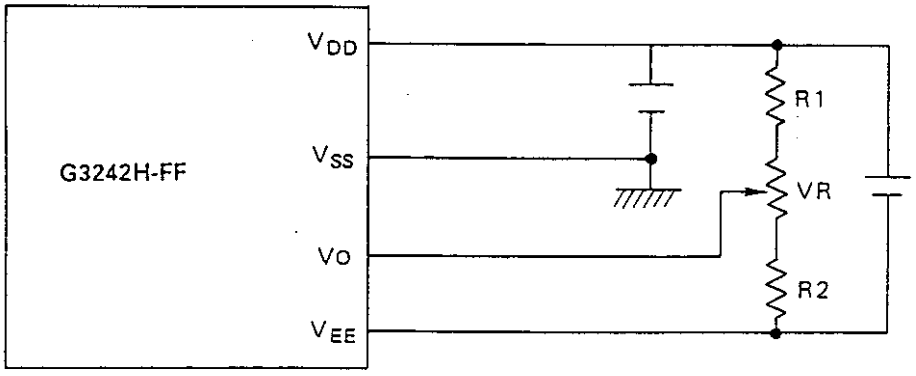
(Note) Shall be applied to FRAME, LOAD, CP, $D_0 \sim D_3$

5-2 Voltage for adjusting contrast ($V_{DD}-V_O$)

The contrast of the liquid crystal display depends on viewing angle, ambient temperature, and operating voltage, etc. Adjust the contrast by varying V_O as necessary.
The following values are recommended.

Ta= 0 ℃ ..... 26.5 Vtyp θ= 0 °, ϕ= 0 °
Ta=25 ℃ ..... 24.2 Vtyp f_{FRAME} = 70Hz
Ta=40 ℃ ..... 22.7 Vtyp Add about 0.5 V when f_{FRAME}=150Hz

5-3 V_O adjusting circuit



(Refer.) $R_1 + R_2 + VR$=10~20kΩ
$V_{DD}-V_O$ =28.0V~20.0V

Fig 5-1

6. Interface Specifications

6-1 Terminal Pin Assignment

Pin No.	Symbol	Function
1	V_O	Operating voltage for LCD driving
2	V_{EE}	Supply voltage for LCD driving
3	D_3	Display data
4	D_2	
5	D_1	
6	D_0	
7	NC	No connection
8	V_{SS}	GND
9	V_{DD}	+5V (Power source)
10	CP	Clock pulse for input of display data
11	LOAD	Latch pulse for output of display data cycle and clock pulse for scanning data shift
12	FRAM	Start signal of each display cycle

Others : 2 lead wires for FL back light (V_{FL}, VG (GND))

6-2 Relationships of DATA input signal and LCD Screen division

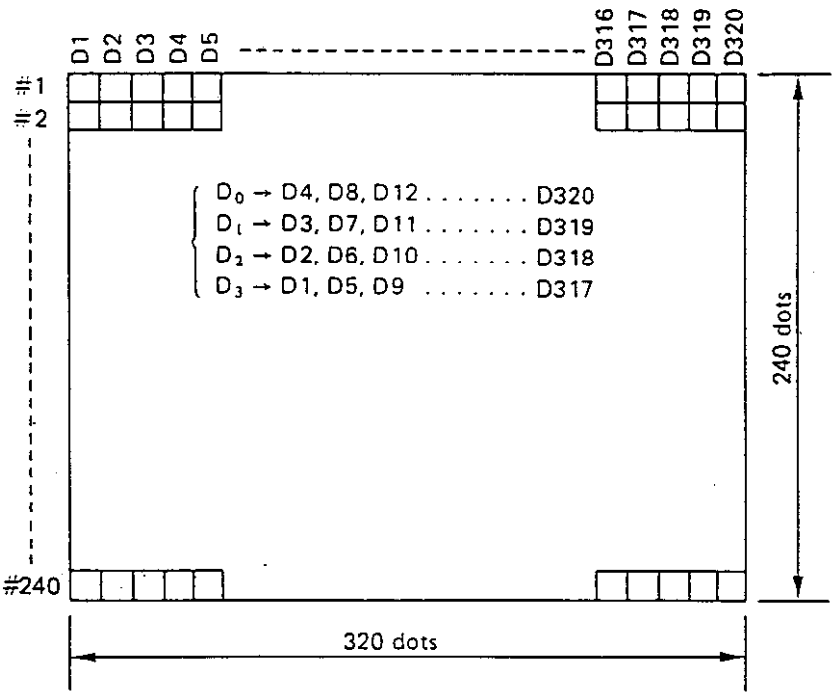


Fig 6-1 LCD screen

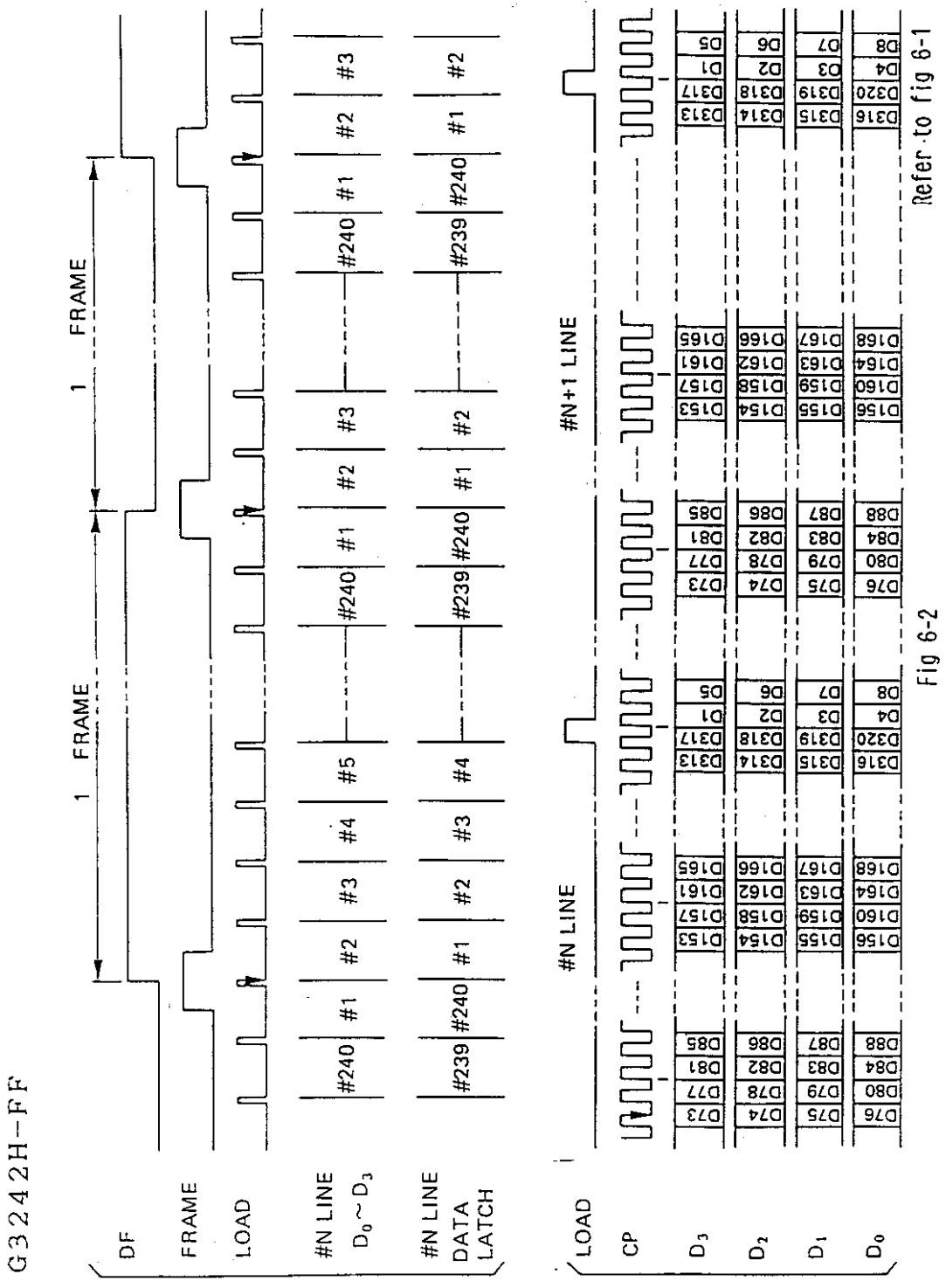

G3242H-FF
DF
FRAME
LOAD
#N LINE
$D_0 \sim D_3$
#N LINE
DATA
LATCH
1 FRAME
1 FRAME
#240 #1 #2 #3 #4 #5 #240 #1 #2 #3 #240 #1 #2 #3
#239 #240 #1 #2 #3 #4 #239 #240 #1 #2 #239 #240 #1 #2
LOAD
CP
D_3
D_2
D_1
D_0
#N LINE
#N+1 LINE
D73 D77 D81 D85 D153 D157 D161 D165 D313 D317 D1 D5
D74 D78 D82 D86 D154 D158 D162 D166 D314 D318 D2 D6
D75 D79 D83 D87 D155 D159 D163 D167 D315 D319 D3 D7
D76 D80 D84 D88 D156 D160 D164 D168 D316 D320 D4 D8
Refer to fig 6-1

Fig 6-2

6-4 Switching Characteristics

$V_{DD} - V_{SS} = 5V \pm 10\%$

Item	Symbol	Condition	Min	Typ	Max	Unit
CP cycle time	t_{CP}	$t_{R\ (CP)} \leqq 10nS$ $t_{F\ (CP)} \leqq 10nS$	100			nS
CP pulse width	$t_{W\ (CH)}$		40			nS
	$t_{W\ (CL)}$		40			nS
LOAD pulse width	$t_{W\ (LH)}$		40			nS
	$t_{W\ (LL)}$		600			nS
LOAD → CP time	t_{LC1}		20			nS
	t_{LC2}		40			nS
CP → LOAD time	t_{CL1}		0			nS
	t_{CL2}		15			nS
DATA set up time $UD_3 \sim UD_0$, $LD_3 \sim LD_0$ → CP	t_{DSU}		20			nS
DATA hold time CP → $UD_3 \sim UD_0$, $LD_3 \sim LD_0$	t_{DHD}		15			nS
LOAD → FRAME time	t_{LF}		100			nS
FRAME → LOAD time	t_{FL}		100			nS
FRAME set up time FRAME → LOAD	$t_{SU(FR)}$		50			nS
FRAME hold time LOAD → FRAME	$t_{HD(FR)}$		10			nS
CP rise & fall time	$t_{R\ (CP)}$				10	nS
	$t_{F\ (CP)}$				10	nS
LOAD rise & fall time	$t_{R\ (L)}$				30	nS
	$t_{F\ (L)}$				30	nS

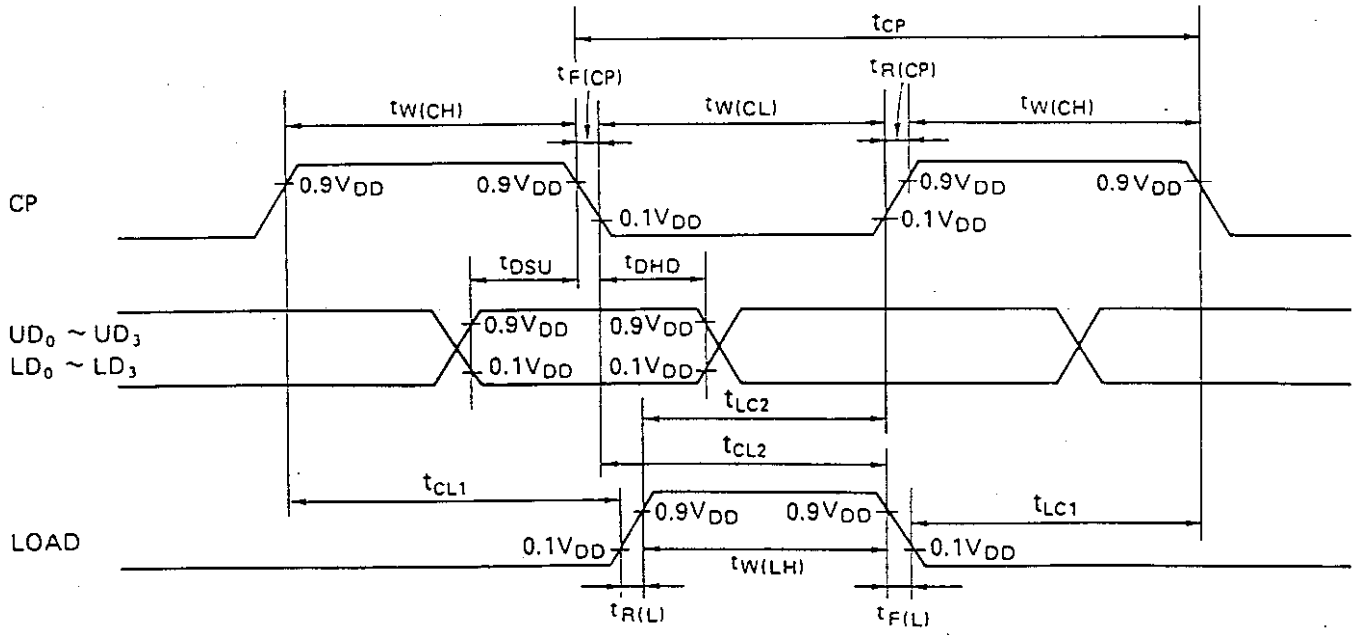

tCP
tF(CP)
tR(CP)
tW(CH)
tW(CL)
tW(CH)
CP
0.9VDD
0.1VDD
tDSU
tDHD
UD0 ~ UD3
LD0 ~ LD3
tLC2
tCL2
tCL1
tLC1
LOAD
tW(LH)
tR(L)
tF(L)

Fig 6-3

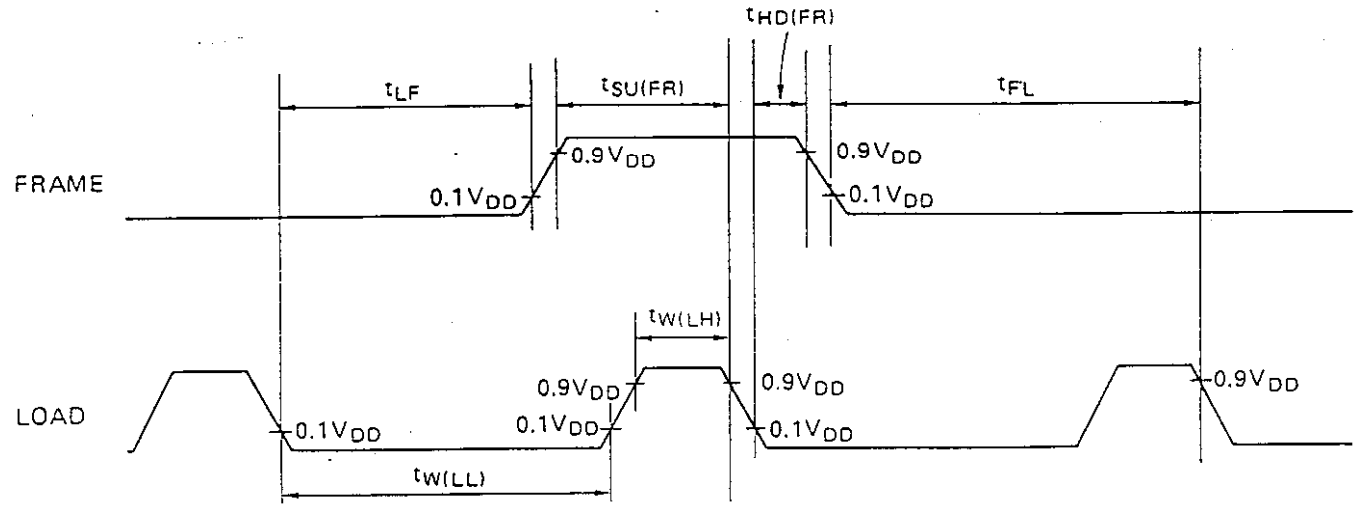

tHD(FR)
tLF
tSU(FR)
tFL
FRAME
0.9VDD
0.1VDD
tW(LH)
LOAD
tW(LL)

Fig 6-4

7. Optical Characteristics (Refer to Note 1~Note 4)

Ta=25 ℃

Item	Symbol	Min	Typ	Max	Unit	Condition
Turn on time	t_{ON}	—	210		ms	θ= 0°, ϕ= 0°
Turn off time	t_{OFF}	—	110		ms	
Contrast ratio	CR	8	18	—		θ= 0°, ϕ= 0°
Visual angle range	θ_1	$-20 \leqq \theta_1 \leqq 35$			deg.	ϕ= 0°, CR≧ 4
	θ_2	$-35 \leqq \theta_2 \leqq 35$			deg.	ϕ= 90°, CR≧ 4

(Note 1) Optical Characteristics measurement system

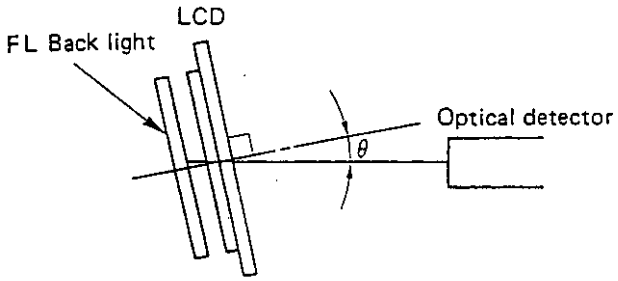


Fig 7-1

(Note 2) Definition of response time

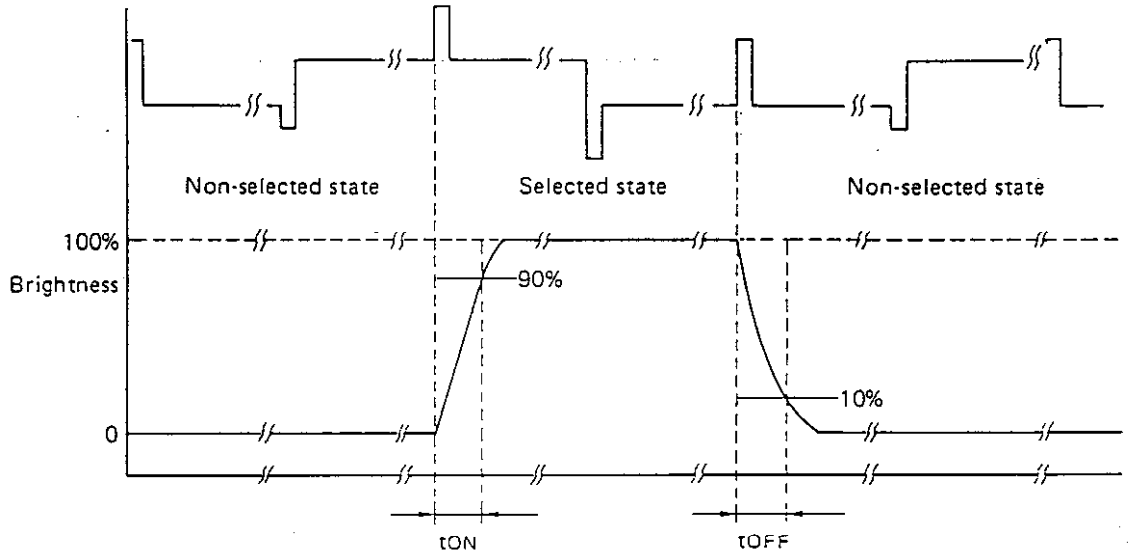


Fig 7-2

(Note 3) Definition of θ and ϕ

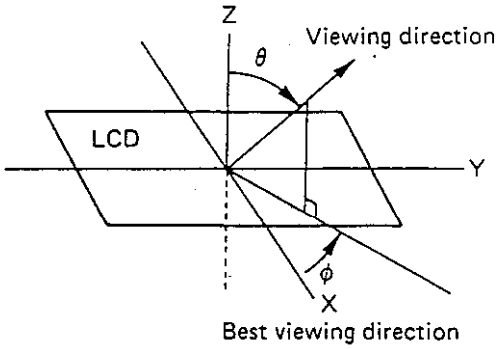


Fig 7-3

(Note 4) Definition of contrast ratio

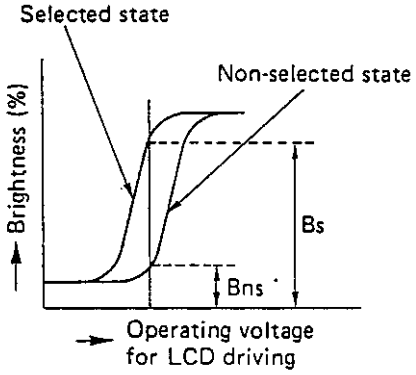


Fig 7-4

$$CR = \frac{\text{Brightness at selected state} \quad (Bs)}{\text{Brightness at non-selected state} \quad (Bns)}$$

8. Backlight Specifications

8-1 Electrical Characteristics

Item	Condition	Min.	Typ.	Max.	Unit
Lamp current	Ta = 25 ℃		5	5.5	mA rms
Lamp voltage	Ta = 25 ℃		260		V rms
Frequency			40		kHz
Starting discharge voltage	Ta = 0 ℃			900 *	V rms

* : At the last stage of the tube life, the discharge starting voltage becomes about 1.3 times as much as 530.

8-2 Optical Characteristics

Tube current = 5mA, Ta = 25 ℃

Item	Condition	Min.	Typ.	Max.	Unit
LCD surface brightness	FL invertor frequency = 40kHz Sin Wave		130		cd/㎡
Rise time	80% brightness		3	5	Minutes
Brightness uniformity				±20% *	

* : (Max. or Min. brightness - Ave. brightness) / Ave. brightness

8-3 Lifetime *

Item	Condition	Min.	Typ.	Unit
Continuous driving	Ta = 15 ℃ ~ 35℃ Lamp current = 5mA	10,000	15,000	hrs.
ON OFF cycle		200,000		Cycles **

* : The definition of lifetime is the period until the brightness becomes 1/2.
** : 1 cycle = 10sec. ON → 10sec. OFF

9. Precautions in use

9-1 Precautions for handling

(1) The polarizer is quite susceptible to scratches. Handle it very carefully. Do not handle it with metallic tweezers nor press nor rub it.
(2) Do not contact the display face by nor get it stained.
If the surface is dirty, wipe it off lightly with a cotton swab or a piece of soft cloth or chamois which is soaked with petroleum or benzine. Never use organic solvents including acetone, toluene, ethanol, and isopropyl alcohol: they would damage the surface.
(3) Do not allow saliva or water to remain on the surface for long; it might cause a local deformation or discoloration.
(4) When the LCD has broken and the liquid crystal has come out, never allow it in your mouth. If it sticks to the skin or clothes, wash it off immediately by using a soap.

9-2 Installation

(1) The ICs mounted on the PCB are very susceptible to static electricity. To protect them from static electricity which your body and clothing collect, connect your body to the ground via a resistor of some 1M ohms so that the electricity should discharge. Connect the resistor close to your body in the grounding line and protect yourself from electric shock hazard.
(2) Neither bend nor twist the module excessively when installing it. Otherwise the device might break or the circuits fail.
(3) Protect the LCD , particularly the surface of polarizer, with a transparent plate (such acrylic or glass plate) on the cabinet.

9-3 Storage

(1) Avoid high temperature and high humidity. The temperature should be 0-35 ℃ and humidity be under 60%.
(2) Store the module in a dark place, out of direct sunlight and fluorescent lamp, etc.
(3) Keep the polarizer from any external forces.
(4) Store the module, keeping it in the box as it is in delivery or in the same conditions.

9-4 Operational precautions

(1) The ICs would break down if the drive voltage exceeds the limit. Make sure of electrical specifications, particularly the supply voltage.
(2) The response of the display is slow when the ambient temperature is below the lower limit, and the display becomes unusual when the ambient temperature is above the upper limit. In any case, it does not mean failure. It operates properly in the normal operating temperature range.
(3) The contrast of the liquid crystal display varies with the viewing angle, ambient temperature, and drive voltage. Adjust the drive voltage for the best contrast by installing external variable switch.
(4) If you move the module from a cold storage into the room as during test, moisture would condense on the module and it might fail.
(5) In order to prevent IC Latch-up and DC voltage on the LCD panel, please power on by the following Fig. 9-1.
(6) Even when the module has worked normally, be sure to check if a noise level on each signal is within the specification (L level : less than $0.2V_{DD}$ and H level : more than $0.8V_{DD}$). If the noise level is beyond that specified figure, there is possibility to occure operational error statistically.
Moreover, be sure to measure the noise level with the module kept connected.
(7) As IC on the module, CMOS IC has been used and the input terminals do not incorporate a pull-up/pull-down function. So, avoid to keep the input terminals OPEN state during power ON condition.

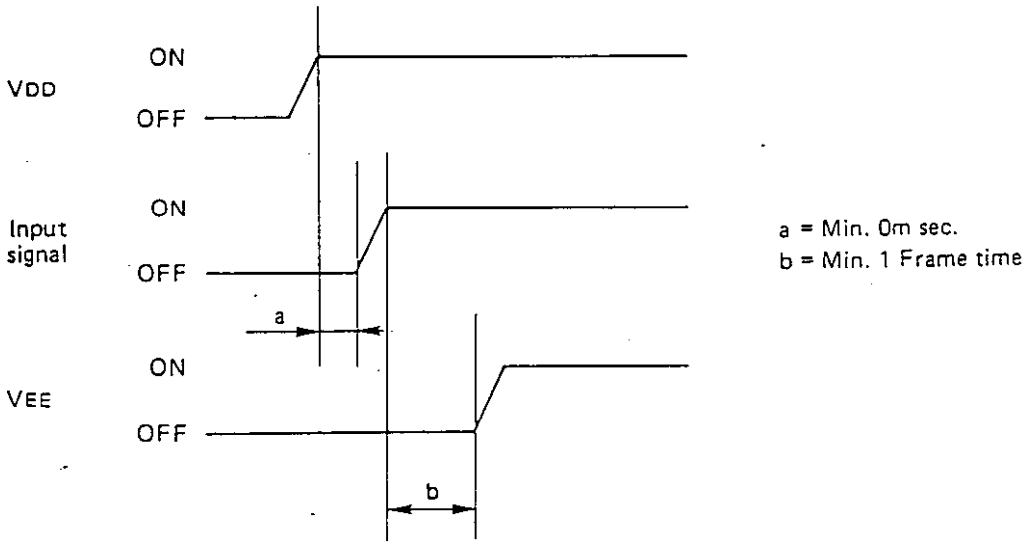


Fig 9-1

(8) Application of DC voltage to a liquid crystal results in debasement of the characteristics. Though the original characteristics can be recovered so long as the application time is short, e.g., up to 1 second maximum, a long-time application would bring a permanent deterioration in the characteristics.
If a control signal, especially LOAD signal is not applied correctly in a condition where the liquid crystal driving voltage V_{EE} being applied to the liquid crystal, DC voltage is applied to liquid crystal.
It is suggested before use to prevent such application of DC voltage by studying "Munual for use".

1 0. Reliability evaluation Standard of Dot Matrix LCD Module

10-1 Scope

This reliability evaluation standard applies to Dot Matrix LCD module G3242H-FF.

10-2 Reliability test items and criteria

Test items	Test conditions	Time	Criteria *1, 2
Operation at high temperature	+45 ± 2℃, RH ≦ 30% Operation with standard voltage	240 H	No noticeable change in operating performance
Operation at low temperature	0 ± 2℃, RH ≦ 60% Operation with standard voltage (non-condensing)	240 H	↑
Leaving in high temperature	+60 ± 2℃, RH ≦ 30%	240 H	↑
Leaving in low temperature	-20 ± 2℃, RH ≦ 60% (non-condensing)	240 H	↑
Leaving in high temperature	+40 ± 2℃, 90~95% RH (non-condensing)	240 H	↑
Temperature cycling	-20 ± 2℃, 30 min. ↓ 25 ± 2℃, 5 min. ↓ 60 ± 2℃, 30 min. ↓ 25 ± 2℃, 5 min. 1 cycle non-condensing	5 cycle	↑
Vibration	Vibration frequency : 15 ~55 Hz Acceleration : 1.5G Sweep : 2.5 octave/min X, Y and Z directions.	15 min. each in X, Y and Z directions	↑
Shock I	Gravity drop onto lauan board of 3cm thick from height of 70cm (in packaged condition) X, Y and Z directions.	One time each in X, Y and Z directions	↑
Shock II	Acceleration : 50G Acting times : 11msec X, Y and Z directions		—

* 1 The test measurement shall be made at ambient temperature of 20 ± 5℃ and humidity of 65 ± 5% RH.

* 2 The number of samples shall be : n = 5.

11. Outgoing inspection standard of Dot Matrix LCD Module

11-1 Scope

This inspection standard applies to dot matrix LCD Module G3242H-FF.

11-2 Delivery inspection

1) Inspection conditions

The inspection conditions shall be in accordance with the product specifications and inspection standard. Also as the environmental conditions, the inspection shall be made at ordinary temperature (20 to 25℃) and ordinary humidity (65 ± 5% RH) and the appearance shall be inspected visually at a distance of more than 30cm between product and eyes and besides from a vertical direction of the display unit under illumination of one fluorescent lamp of 20W. (However, excluded when there is the provision) Moreover, the display contrast obtained in the case of lighting shall be optimum.

2) Inspection lot

One lot shall comprise the quantity of products delivered at one time.

3) Inspection method

A sampling inspection shall be made according to the following provisions to judge the acceptability.

Applicable standard : MIL - STD - 105D

Normal one - time sampling method

Level Ⅱ

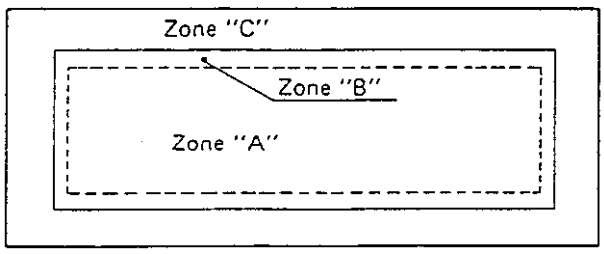
A Q L Major defect 1.0%

Minor defect 2.5% To be evaluated by overall items.

Major defect : Failure to discharge proper function as product

Minor defect : Depreciation in value as commodity though fulfilling function available as product.

4) Definition of applicable zone



Zone "A" : Effective display zone
Zone "B" : Viewing zone (Inside fo bezel window, not including zone "A")
Zone "C" : Bezel

11-3 Inspection standards

11-3-1 Visual defects classification

Section of defects	Inspection item	A Q L
Major defect	• Failure to discharge specified display function (All and specified dots) (Disconnection, short - circuit, etc.) • Maloperation	1.0%
Minor defect	Electrical characteristics • Current consumption Appearance • Overall size • Lighting appearance Pinholes, dot chipping, white spot, black spot, thickness, thinness, deformation, center line, uneven display, etc. • Display appearance (Scope having no effect on function and characteristics) Interference fringes, bubbles, flaws, stains, black spots and foreign matters • General appearance (Scope having no effect on function and characteristics) Flaws, stains, solder, identification marking and assembly	2.5%

11-3-2 Visual Inspection standard of display unit

<table>
<tr><th>Classification</th><th>Inspection items</th><th>Criteria</th><th colspan="2">Section of defects</th></tr>
<tr><td rowspan="4">Lighting appearance and operational inspection</td><td>(1) Display</td><td>(a) Failure to discharge specified display function
(b) Lighting by other display than that specified</td><td>Major defect

Major defect</td><td></td></tr>
<tr><td>(2) Dot chipping and pinholes</td><td>ϕ0.2 <d ≦ϕ0.4 : Within 5 pcs.
ϕ0.2 ≧d : Not counted as defect
d >0.4 : None
Size d = ϕmm
However, the area of pinhole and chipping holding in one dot shall be within 1/2 dot. A special shape shall be estimated with (Longer side + Shorter side)/2 = d.</td><td></td><td>Minor defect</td></tr>
<tr><td>(3) White spot I
Black spot I</td><td>A defect that size which can be seen does not vary even though voltage applied to LCD display element is changed.

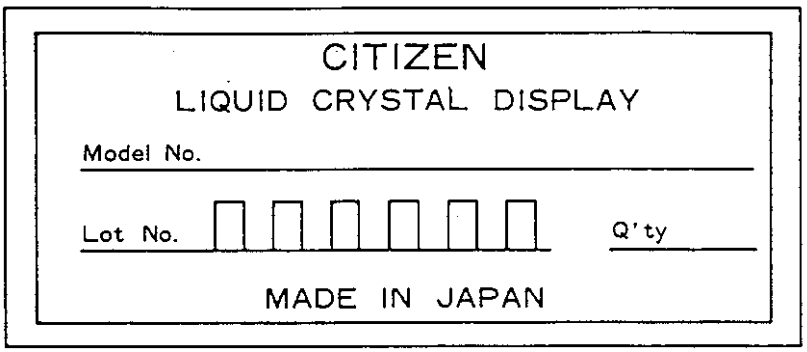
Circular spot and foreign matters
<table>
<tr><th rowspan="2">Size ϕ d (mm) \ Zone</th><th colspan="2">Allowable q'ty</th></tr>
<tr><th>Zone "A"</th><th>Zone "B"</th></tr>
<tr><td>d≦ 0.2</td><td>Ignore</td><td>Ignore</td></tr>
<tr><td>0.2< d≦ 0.4</td><td>3</td><td>5</td></tr>
<tr><td>0.4< d≦ 0.5</td><td>0</td><td>1</td></tr>
<tr><td>0.5< d</td><td>0</td><td>0</td></tr>
</table>
A special shape shall be estimated with (Longer side + Shorter side)/2 = d.
The number of defects must be within 5 pcs.</td><td></td><td>Minor defect</td></tr>
<tr><td>(4) White line I
Black line I</td><td>Linear spot and foreign matter
<table>
<tr><th rowspan="2">Length (mm) \ Thickness (mm) \ Zone</th><th colspan="2">Allowable q'ty</th></tr>
<tr><th>Zone "A"</th><th>Zone "B"</th></tr>
<tr><td>—</td><td>W<0.025</td><td>Ignore</td><td>Ignore</td></tr>
<tr><td>L<1.0</td><td>W<0.1</td><td>Ignore</td><td>Ignore</td></tr>
<tr><td>1.0≦L ≦5.0</td><td>0.05≦W ≦0.1</td><td>3</td><td>3</td></tr>
<tr><td>1.0≦L ≦3.0</td><td>0.1 ≦W ≦0.2</td><td>3</td><td>3</td></tr>
<tr><td>L≦1.0</td><td>0.2 ≦W</td><td colspan="2">IN accordance with inspection item(3)</td></tr>
</table>
The number of defects must be within 5 pcs.</td><td></td><td>Minor defect</td></tr>
</table>

Classification	Inspection items	Criteria	Section of defects	
Lighting appearance and operational inspection	(5) White spot Ⅱ Black spot Ⅱ	A defect that size which can be seen varies according to change in voltage applied to LCD display element. Size d = ϕmm ・A part seen thickly like a dot : within 1.5 picture element. (ϕ0.2 <d ≦ϕ0.45) A part of which size is ϕ0.2 ≧d is not counted as defect. ・A light-colored part in the vicinity of thick spot : within 9 picture elements. (ϕ0.6 <d ≦ϕ0.9) A part of which size is ϕ0.6 ≧d is not counted as defect. ・A light spot not accompanied by a thick spot must be judged by 9 picture elements or less. (ϕ0.6 <d ≦ϕ0.9)		Minor defect
	(6) White line Ⅱ Black line Ⅱ	A defect that line condition varies according to change in voltage applied to LCD display element. ・Defect mustn't be conspicuous at the display front (θ = 0° and ϕ = 0°) in the most suitable contrast voltage.		Minor defect
	(7) Thickness, Thinness and deformationn of dots	Less than ± 15% of dots width		Minor defect
	(8) Center line	Less than twice as much as specified dot space size		Minor defect
	(9) Uneven display	No conspicuous unevenness		Minor defect
Non-lighting appearance inspection	(10) White spot Ⅰ, Black spot Ⅰ	In accordance with lighting appearance inspection item (3).		Minor defect
	(11) White line Ⅰ, Black line Ⅰ	In accordance with lighting appearance inspection item (4).		Minor defect

<table>
<tr><th>Classification</th><th>Inspection items</th><th>Criteria</th><th>Section of defects</th><th></th></tr>
<tr><td rowspan="11">Non-lighting appearance inspection</td><td>(12) Bubbles (Originate to polarizer)</td><td><table><tr><th rowspan="2">Size \ Zone
ϕ d (mm)</th><th colspan="2">Allowable q'ty</th></tr><tr><th>Zone "A"</th><th>Zone "B"</th></tr><tr><td>d≦ 0.3</td><td>Ignore</td><td>Ignore</td></tr><tr><td>0.3< d≦ 0.5</td><td>2</td><td>3</td></tr><tr><td>0.5< d≦ 1.0</td><td>1</td><td>2</td></tr><tr><td>1.0< d< 1.5</td><td>0</td><td>1</td></tr></table>A special shape shall be estimated with (Longer side + Shorter side)/2 = d.
The number of defects must be within 5 pcs.</td><td></td><td>Minor defect</td></tr>
<tr><td>(13) Flaws and stains</td><td>・No effect having on characteristics and no considerable depreciation in value as commodity.
・A clear-cut flaw which is seen conspicuously from any direction when checked visually must be in accordance with white line I and black line I.
・A flaw shall be accepted which is too thin and light to be identified unless otherwise observed from other directions than a vertical one (θ = 0° and ϕ = 0°) when checked visually.</td><td></td><td>Minor defect</td></tr>
<tr><td>(14) Interference fringes</td><td>No conspicuous fringe</td><td></td><td>Minor defect</td></tr>
<tr><td>(15) Total number of defects</td><td>A total number of allowable defects must be within 5 pieces.</td><td></td><td>Minor defect</td></tr>
<tr><td>(16) Separation between defects</td><td>Adjoining defects must be separate more than 2cm from each other.</td><td></td><td>Minor defect</td></tr>
<tr><td>(17) Assembly</td><td>(a) Proper assembly of liquid crystal display element holder</td><td></td><td>Minor defect</td></tr>
<tr><td></td><td>(b) Proper assembly of each component part</td><td></td><td>Minor defect</td></tr>
<tr><td>(18) Overall size</td><td>Within specified limit</td><td></td><td>Minor defect</td></tr>
<tr><td>Electric characte-ristics</td><td>(19) Current consumption</td><td>Within specified limit</td><td></td><td>Minor defect</td></tr>
</table>

11-4 Lot marking

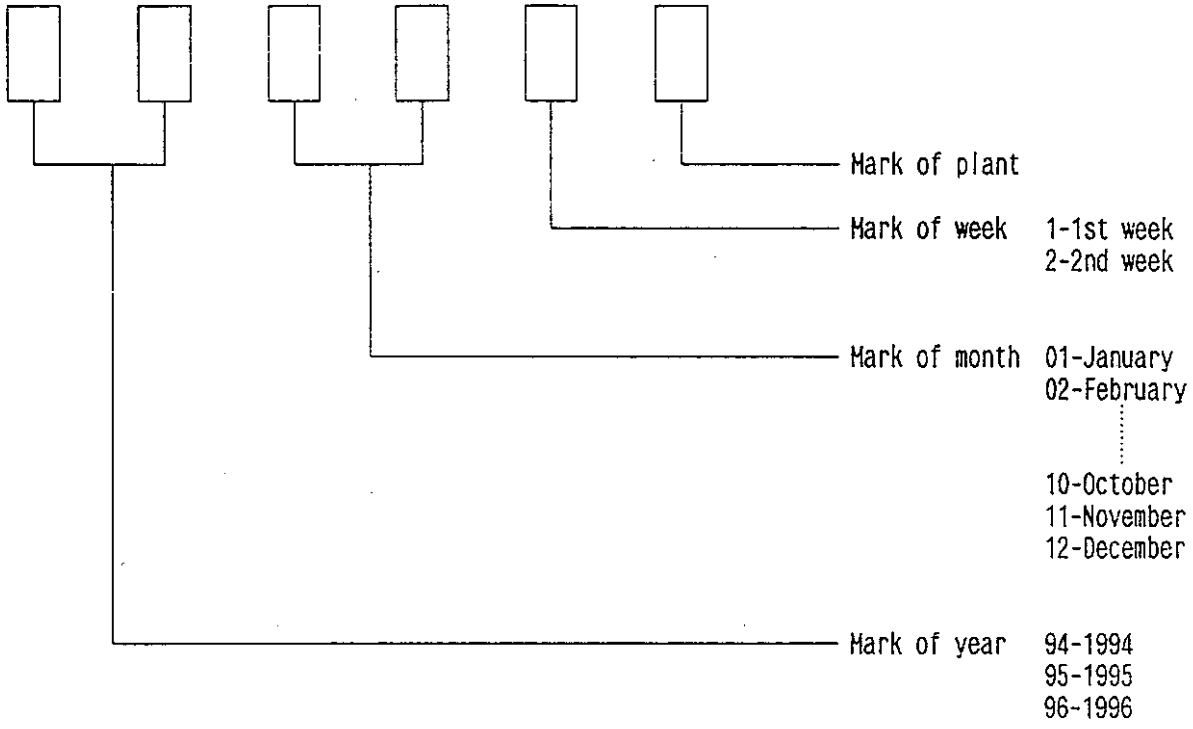
1) Form



Designation of product (Model)

Mfg. lot No.

2) Mfg. lot No.



3) When a special identification is required for the product, the marking shall be determined through discussion between personnel in charge.

11-5 Warranty

1) Each product shallbe warranted for one year after delivery.
2) Should any our product prove to be defective by reason of material or workmanship at our side obviously, it will be replaced at no charge to you or delivered again after eliminating any defecive part by reparing or correcting.

11-6 Others

1) If there is any doubt in the contents of this specification sheet or a new question not including the specified items should come up and further, if a special question should arise, proper ctions for these questions shall be taken to solve them through discussion held between both parties.

12. Manual for use

12-1 Protection of DC voltage from being applied to LCD module.

If DC voltage is applied to LCD panel, it brings about unfavorable effects, e.g., change to the worse condition of characteristics of liquid crystal substance, abnormal display in part of LCD panel and etc.

When LCD module is used in some system, there is possibility of DC voltage being applied to LCD panel in the time periods of T_1, T_2 and T_3 shown in Fig.12-1 below and T_4 shown in Fig.12-5 later.

T_1 : A time from turning on power to drive circuit in LCD module starts its normal operation. (See Fig.12-2 on the succeeding page.)
T_2 : A time from reset has been applied to system to drive circuit in LCD module starts its normal operation, in case where reset is applied to system and control signal to LCD module no longer makes its normal operation temporarily. (See Fig.12-3 latter.)
T_3 : A time from power has been turned OFF to liquid crystal driving voltage V_{EE} returns to V_{SS} level. (See Fig.12-4 later.)
T_4 : A time in which controller IC is controlling CRT +20msec. (See Fif.12-5 later.)

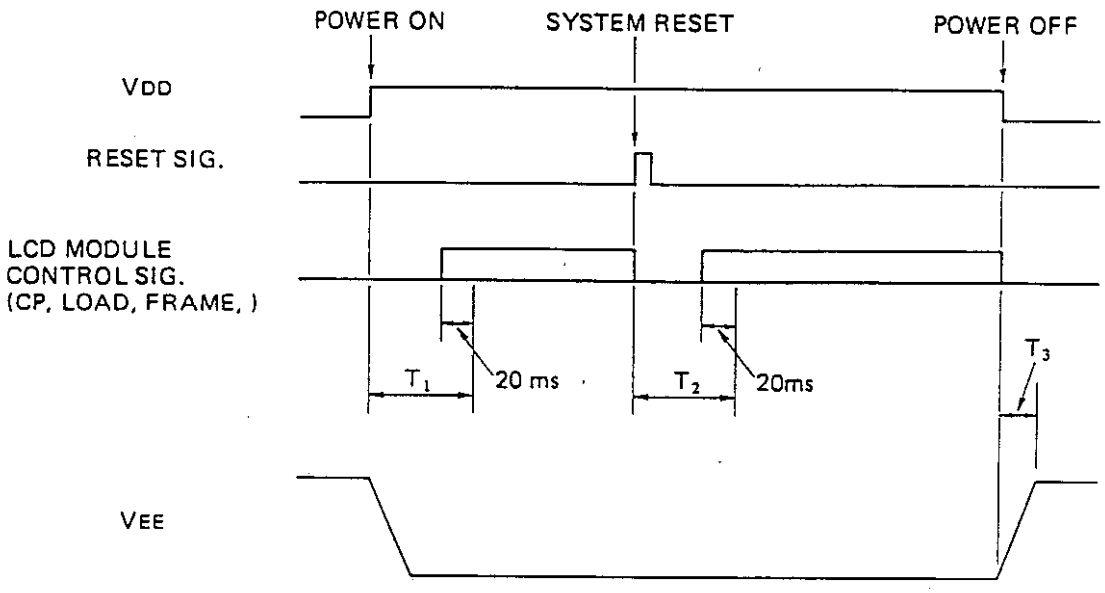


Fig.12-1

1. In case of POWER ON

Generally, the standard LCD controller IC requires initialization and before the initialization comes to an end, a normal control signal is not given out.

LCD module starts its normal operation about 20msec after a condition has been set up where the control signals (CP, LOAD, FRAME) are put out normally.

Therefore, there is possibility of DC voltage being applied to LCD panel in a period of T_1 shown in Fig.12-2 below.

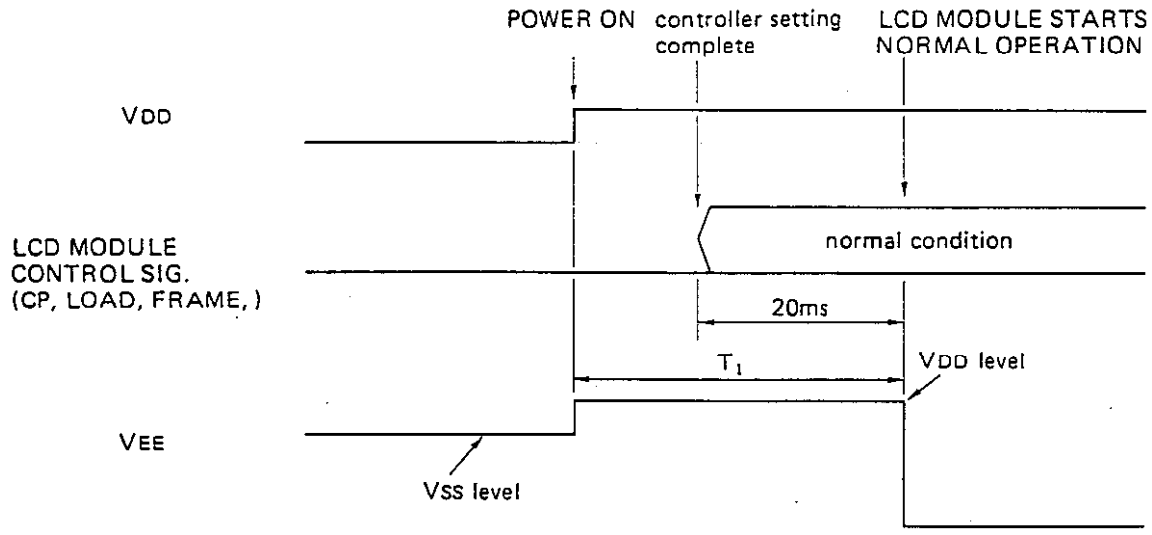


Fig.12-2

METHODS

In a period of T_1 , set the electric potential of V_{EE} at V_{DD} level.

If you use the above no DC voltage applied to LCD panel.

2. In case of SYSTEM RESET

In case where LCD controller IC is also reset together when the system has been reset, there is possibility of the control signal to LCD module being lost temporarily.

(It depends on the types of controller.) In such a case, no normal control signal can be obtained before LCD controller is initialized again.

As a result , there is possibility that DC voltage is applied to LCD panel in a period of T_2 shown in Fig.12-3 below.

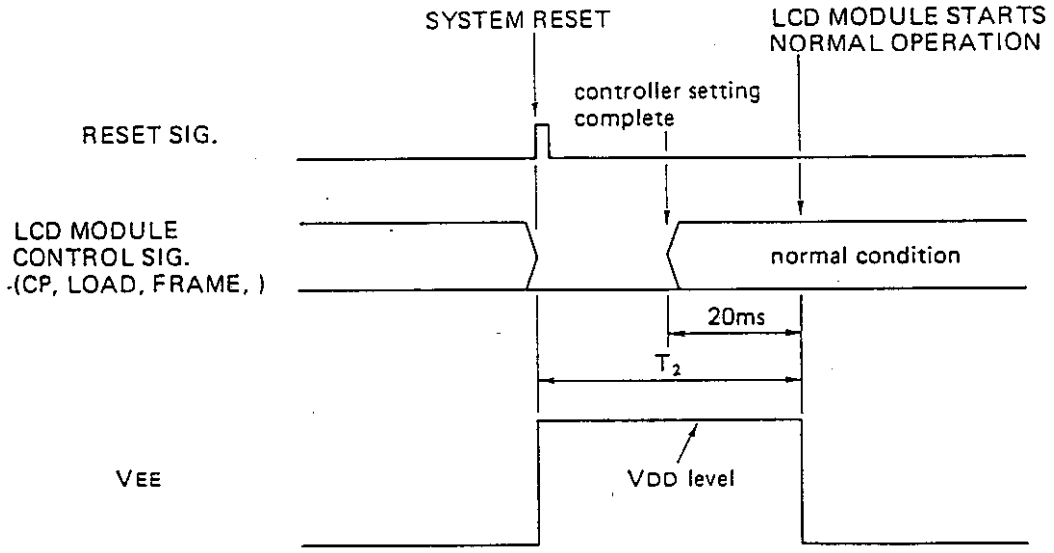


Fig.12-3

METHODS

In a period of T_2 , set the electric potential of V_{EE} at V_{DD} level.

If you use the above no DC voltage applied to LCD panel.

3. In case of POWER OFF

When V_{EE} return to V_{SS} level behind V_{DD} after the main power has been turned OFF, since the drive circuit of LCD module is stopping its logic operation at the point of time of power OFF, it might result in DC voltage being applied to LCD panel in a period of T_3 shown in Fig.12-4. below.

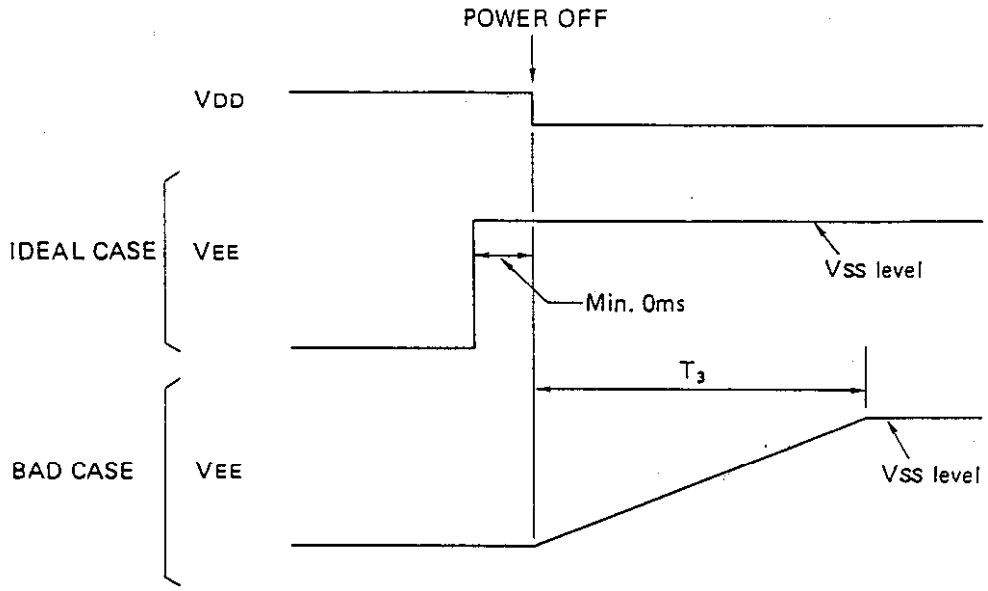


Fig.12-4

METHOD

It is the best possible way to set V_{EE} to V_{SS} level before the electric potential of V_{DD} terminal drops to V_{SS} level or simultaneouly with the drop.

If this is impossible, it should be designed so that V_{EE} level can reach V_{SS} level as quickly as possible after turning the power OFF.

NOTE :

It has already been verified experimentally that the damage of DC voltage applied to LCD panel is quite lesser in the case of power OFF than that in the case of power ON.

However, in such a case where DC voltage has been applied when the power is turned OFF, if the power is turned ON again in a short time thereafter, a bad effect may be brought about.

It is therefore necessary to take care about it.

4. Other case

A case where controller IC has been used which works to control both CRT and LCD.

There is an instance that normal control signal is not sent to LCD while the controller IC is working to control CRT. In such instance, the display of LCD panel goes out of order and DC voltage might be applied to LCD panel. It is as shown by T_4 in Fig.12-5 below that there is possibility of DC voltage being applied to LCD panel.

That is ;

From : Controller IC starts to control CRT.

TO : 20msec after the controller IC has begun to output LCD control signal again.

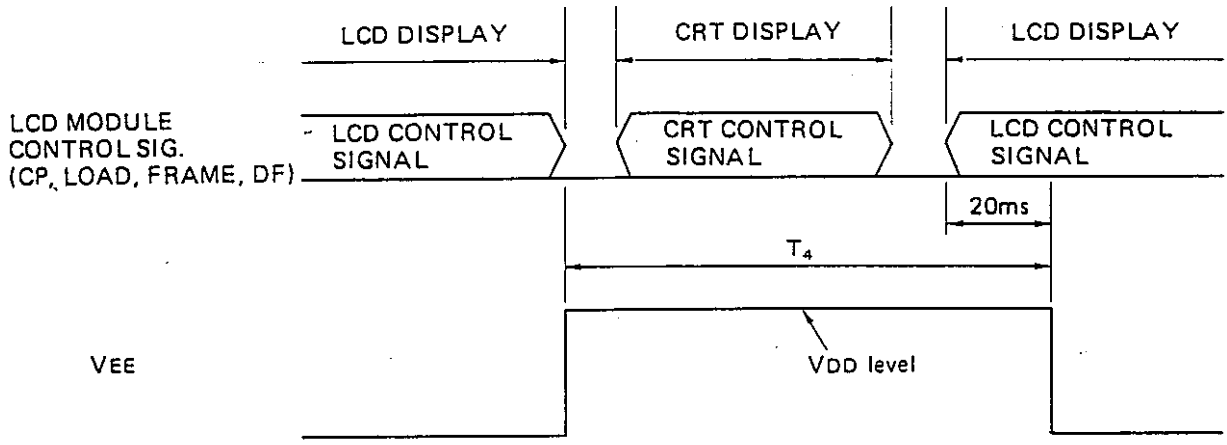


Fig.12-5

Methods

In a period of T_4 , set the electric potential of V_{EE} at V_{DD} level.

If you use the above LCD panel no longer gives its display while CRT is in use and no DC voltage applied to LCD panel.

12-2 Application of DC voltage to LCD module during system development.

A long-time application of DC voltage to LCD panel brings about an abnormal display in part of LCD panel and change to the worse condition of characteristics of liquid crystal as the case may be.

So far, there have been many examples that if only LCD module wherein an abnormal display has occurred is left as it is for a couple of days without applying voltage, it recovers from its abnormality.

It is however necessary to take care since LCD module may be damaged so seriously that it can no longer be recovered depending on the applied voltage value and time.

★It is also requested not to use LCD panel damaged by application of DC voltage for evaluation of the display quality since change to the worse condition in the display quality is often found.

It should be noted that DC voltage is left applied to LCD panel in the following conditions :

1. Where (LCD) controller IC is not working normally in a condition that negative voltage (V_{EE}) for the liquid crystal drive remains applied.
2. Where (LCD) controller IC is controlling CRT in a condition that negative voltage (V_{EE}) for the liquid crystal drive remains applied.

METHODS :

In order to avoid application of DC voltage over a long time, use either of the following methods when there is no need to take a look at LCD panel :

1. Keep the V_{EE} terminal of LCD module in OPEN state. (V_{EE} terminal shouldn't be kept maintained at GND level ; otherwise, it will result in DC 5V being applied.)
2. Keep V_{EE} terminal connected to V_{DD} as shown in Fig. 12-6.

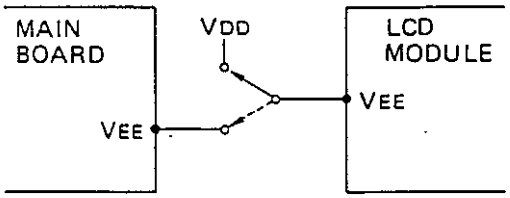


Fig. 12-6

12-3 Reason and solution way of abnormal operation of LCD module

1. Situation
   The whole display flickers heavily, unlike a mere, ordinary flickering.

2. Reason to cause the trouble
   · Noise is getting mixed in the control signal of LCD module, especially in LOAD signal and this noise level is in excess of a specified limit.

   Specified limits : V_{IL} : MAX 0.2 V_{DD}
   V_{IH} : MIN 0.8 V_{DD}.

   For the above reason, IC on the module is operating abnormally.

NOTE) The specified limits of V_{IL} and V_{IH} have been fixed in accordance with the specification of IC. Generally, since the specification of IC is to be provided with a fair allowance, IC does not always operate abnormally even if the noise level exceeds the specified limit. (Often, there is found an instance that only IC born with little allowance due to variations in manufacture operates abnormally.)
However, in case where the level is beyond the specified limit, it is unsafe since there is possibility of IC getting into an abnormal operation zone owing to change in power supply voltage, change in noise condition, change in temperature and so on. Therefore, even if only one LCD module among lots of samples operates abnormally, it is necessary to check if the level is over the specified limit, and if so, to take a proper action beforehand.

· Noize is generated by following reasons :
  A. A cable connected between the control signal generator and LCD module is too long.
  B. Noise generated in a device using LCD module is too loud.

3. Checking method of noise
   Connect an oscilloscope between No.8 pin (V_{SS}) and No.11 pin (LOAD) of the connector of LCD module to measure a peak value of noise.
   (If GND of the oscilloscope is connected to other point, correct measurement won't be accomplished.)
   (Sometimes, when the oscilloscope is connected, voltage change in V_{SS} becomes smaller according to the capacity of the oscilloscope and as a result, abnormal operation might no longer come about.)

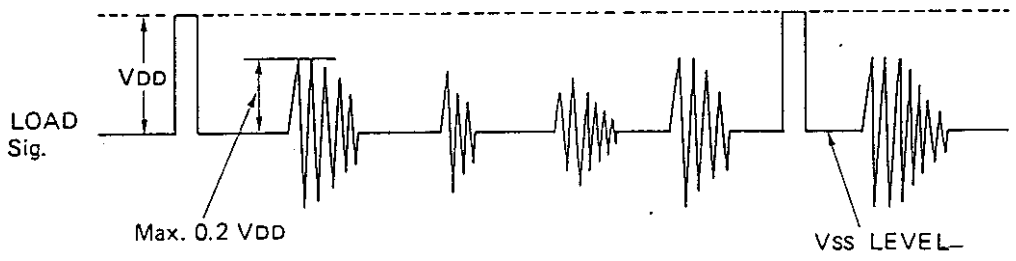
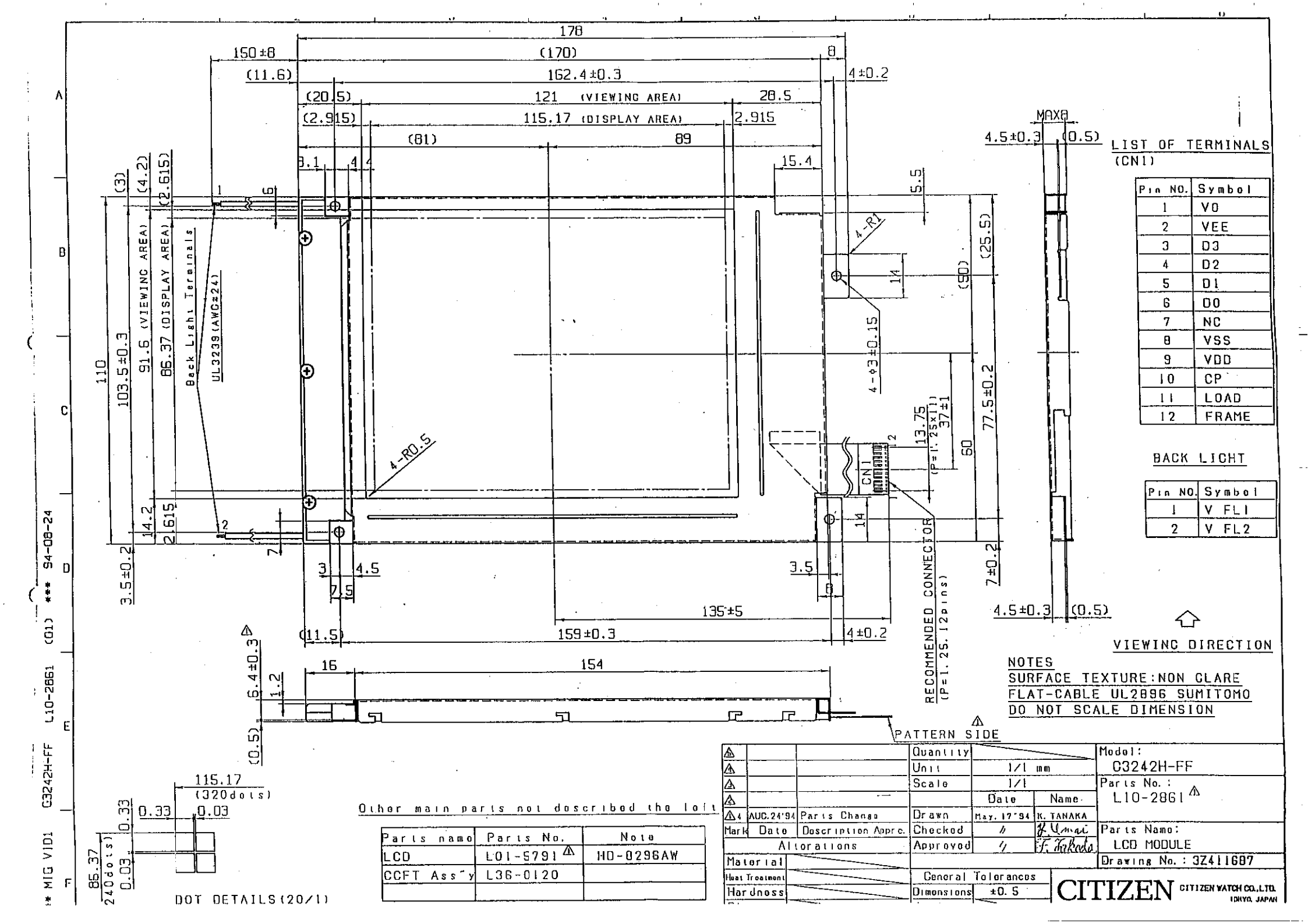


Fig. 12-7

4. Way for solution
   A. Reduce the cable length as much as possible.
   B. Make smaller an impedance between the metal frame of LCD module and V_{SS} (No.8 pin). (Connect with a direct conductor.)
   C. In case where the noise generated in a device using LCD module is loud, insulate the metal frame of the device from the metal frame of LCD module. (There are found many example that a noticeable effect can be gained.)
   D. Put a noise cut filter between a power supply for a load requiring large current and the power supply of LCD module.
   E. Shield the cable.



LIST OF TERMINALS
(CN1)

Pin NO.	Symbol
1	V0
2	VEE
3	D3
4	D2
5	D1
6	D0
7	NC
8	VSS
9	VDD
10	CP
11	LOAD
12	FRAME

BACK LICHT

Pin NO.	Symbol
1	V FL1
2	V FL2

VIEWING DIRECTION

NOTES
SURFACE TEXTURE:NON GLARE
FLAT-CABLE UL2896 SUMITOMO
DO NOT SCALE DIMENSION

Other main parts not described the left

Parts name	Parts No.	Note
LCD	L01-5791 ⚠	HD-0296AW
CCFT Ass'y	L36-0120	

Mark	Date	Description Appro.
⚠4	AUG.24'94	Parts Change
Alterations		

Material	
Heat Treatment	
Hardness	

Quantity	
Unit	1/1 mm
Scale	1/1
Drawn	May. 17'94 K. TANAKA
Checked	
Approved	

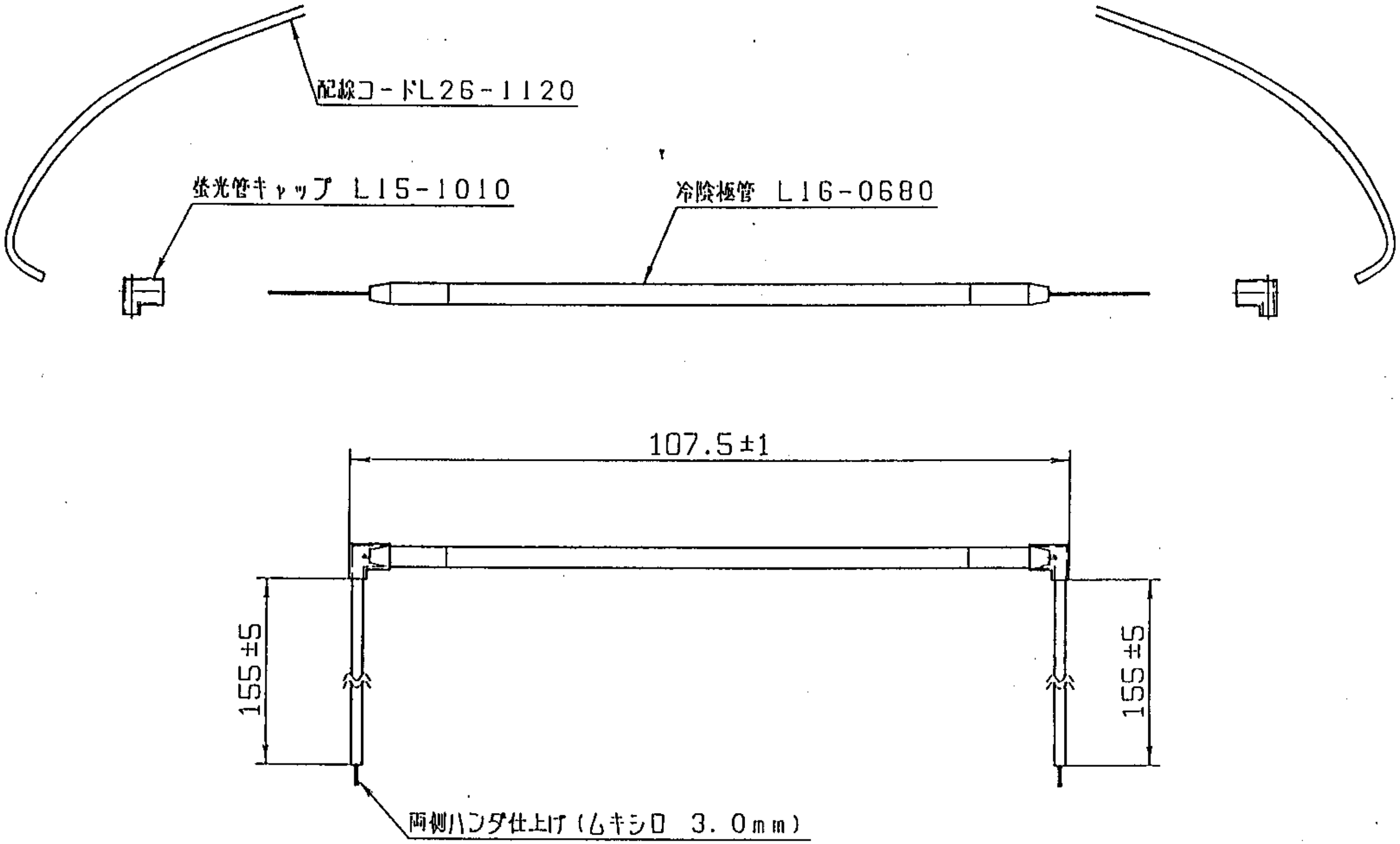
General Tolerances
Dimensions ±0.5

Model: C3242H-FF
Parts No.: L10-2861 ⚠
Parts Name: LCD MODULE
Drawing No. : 3Z411687

CITIZEN CITIZEN WATCH CO.,LTD. TOKYO, JAPAN

* MIG VID1 C3242H-FF L10-2861 (01) *** 94-08-24

SYSTEM=MIG　ファイル=VID1　ダ゛イヒョウコード゛=G3242H-FF　ガ゛メンNO=1
カンリ NO=29　モード゛=ブ゛ヒンズ゛　ブ゛　バ゛　ン =L36-0120　<DATE> 94-05-16



図番 4Z411710

一般公差	寸法 ±0.5	角度		熱処理		材質		G3242H-FF			
承認	担当	設計	製図	検図	カクリ		表面処理		機名	個数	機番号	個数
(高田)	(田中)	(田中)	(田中)	(今井)	単位	1/1 mm	部品完成図	名称	冷陰極管（完成体）		
日付	94.05.17				尺度	1/1	表示機器事業部	番号	L36-0120		

シチズン時計株式会社