

General Description

The G6485H-FF is a transmissive type display which uses an R.C.F. (Retardation Control Film) to give a high contrast true "Black-and-white" color to the display. The high-intensity backlight together with the efficient light guide gives bright, even illumination across the complete display.

The ultra-slim design as low as 4.5 mm, the remarkable weight as low as 79 grams and the low power consumption levels make these ideal for portable and battery powered applications as well as general 19" rack application. Due to its small vertical size, the fast -fluid liquid crystal and I.T.O. electrodes multiplex smear is reduced or eliminated even with the 1:480 multiplex drive.

G6485H-FF BabyVGA™

Made by Citizen Watch Co., Ltd. Tokyo, Japan

Features

- High contrast image
- True black-and -white color
- Fast response time
- Low power consumption
- Ultra Thin : 4.5 mm
- Lightweight : 79 g

Applications

- Portable Instruments
- PDA
- Ultra compact-size PCs
- Industrial Controls
- Lan/Cable Testers
- Handy Terminals



Actual Size Shown

Specifications

1. Application

This specification shall be applied to Dot Matrix LCD Module G6485H -FF.

2. Composition

- Display type : B/W STN display
- Dot structure : 640 x 3 (RGB) x 480 dot graphic display
- Driving method : 1/480 duty multiplex drive
- Backlight : Cold cathode fluorescent tube (CCFT)
- Surface texture : Non-Glare

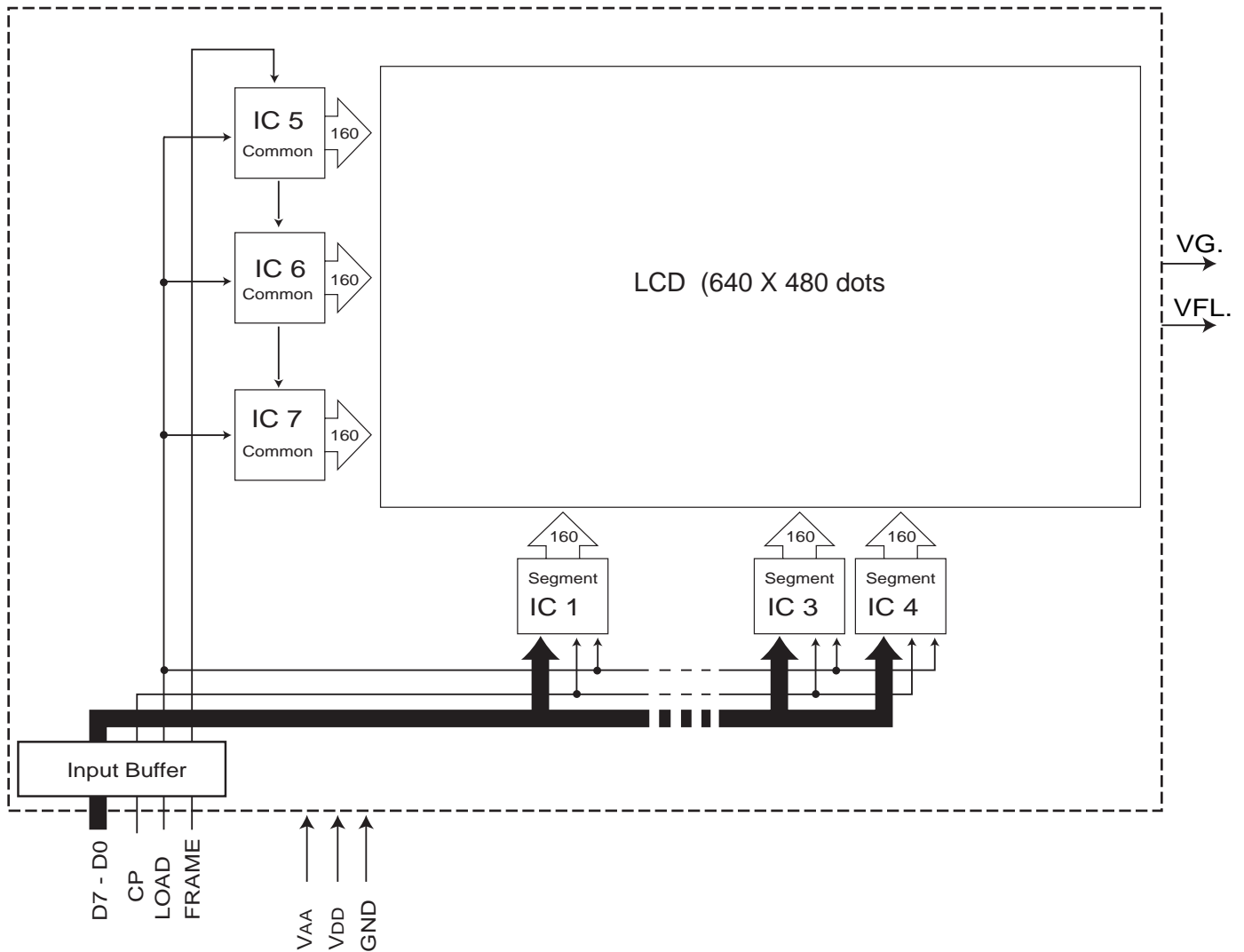


Fig 2-1 Block Diagram (G6485H-FF does not incorporate any controller)

3. Mechanical Specifications

3-1 Dimensions and weights

Module size : 162 (W) x 103 (H) x 5.3 (D) mm Typ.
 Effective viewing area : 107 (W) x 81 (H) mm
 Weight : Approx. 125 g

3-2 Dot dimensional drawing

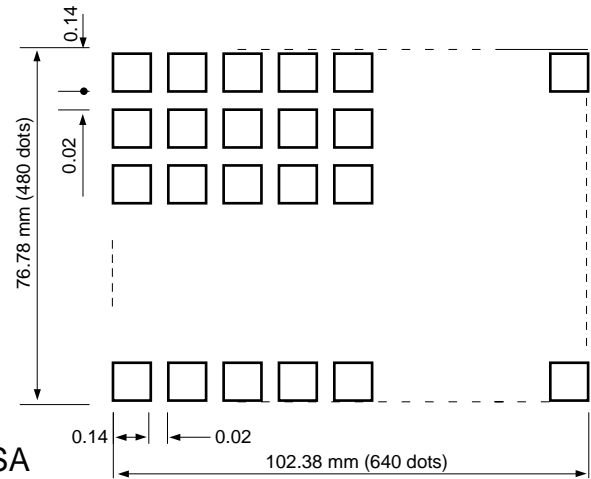


Fig 3-1

3-3 Input connector

Manufacturer : JAE
 Parts number : IL-402-20S-S1L-SA

3-4 Input FPC, FFC specification (Fig. 3-2)

3-5 Backlight connector

Manufacturer : JST
 Parts number : BHR-03VS-1
 Compatible PCB connector: SM02(8.0)B-BHS

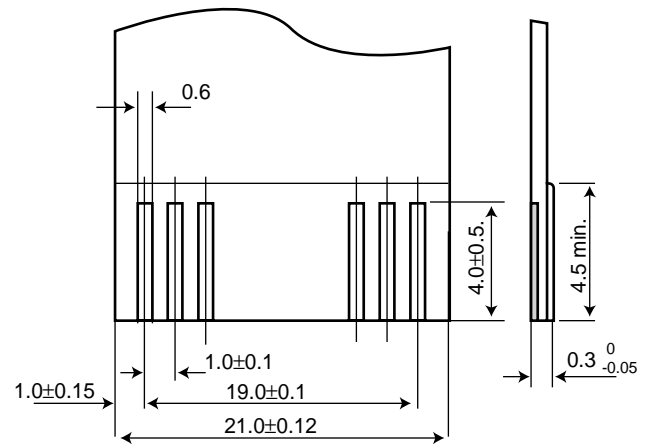


Fig 3-2

4. Absolute maximum ratings

4-1 Electrical absolute maximum ratings

Item	Symbol	Min.	Max.	Unit	Remarks
Supply voltage for logic circuit	VDD - GND	-0.3	+6.0	V	
Supply voltage for LCD driving	VAA - GND0	+3.0	+44.0	V	
Input voltage	VIN	-0.3	VDD+0.3	V	Note 1

Note 1 : Shall applied to Vs, DF, LOAD, CLK, DISP-OFF, D7~D0.

4-2 Environmental absolute maximum ratings

Item	Specification	Remarks
Storage temperature	Max. +60°C	Note 1
	Min. -20°C	No condensation
Operating temperature	Max. +45°C	Note1
	Min. 0°C	No condensation
Vibration	Frequency : 15~55Hz	X, Y, Z directions
	Acceleration : 1.5G	
	Sweep : 2.5 octave/min.	
Shock	Acceletation : 50G	X, Y, Z directions
	Acting time : 11msec.	

(Note) Ta ≤ +40°C85% RH Max.
 Ta > +40°CAbsolute humidity must be lower than the humidity of 85% RH at +40°C

5. Electrical specifications

5-1 Electrical characteristics

(GND = 0V)

Item		Symbol	Test Condition	Min	Typ	Max	Unit
Supply Voltage for Logic Circuit 1		VDD-GND		4.75	5.0	5.25	V
Supply voltage for LCD driving		VAA-GND		20.0	—	40.0	V
Frame Frequency		fFRAME		—	70	—	Hz
Input Voltage	H level	VIH	VDD-VSS = 3.0~5.25V	0.8VDD	—	VDD *	V
	L level	VIL		VSS	—	0.2VDD*	V
Current Consumption		IDD	DISPOFF=H		1.0	3.2	mA
			Ta = 25 °C VDD - GND= 5.0V	—	10.5	24.5	mA
		IAA	VAA - GND =33.3V f FRAME = 70HZ	—	1.0	3.2	mA
			DISPOFF=L	—	8.8	13.5	mA

* Shall be applied to DF, FRAME, LOAD, CP, DISPOFF, D7~D0 **V AA> VDD> GND

5-2 Supply voltage for LCD driving (VCON-VSS)

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

Ta = 0°C36.4 Vtyp θ = 0°, Ø = 0°
 Ta = 25°C33.3 Vtyp f FRAME = 70Hz
 Ta = 40°C31.5 Vtyp

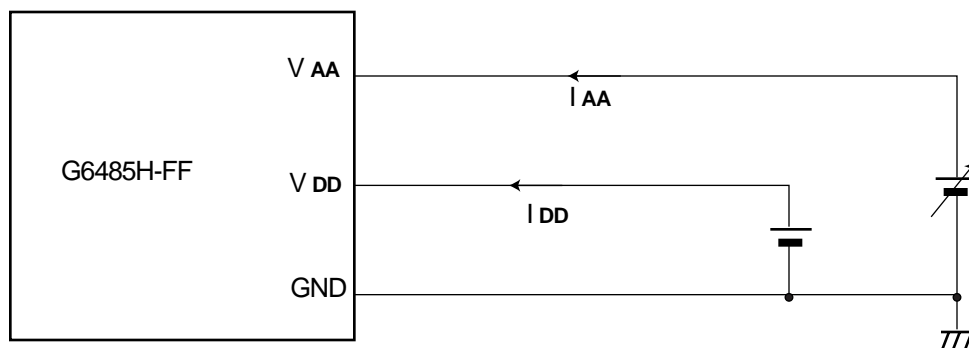
5-3 V_{CON} adjusting circuit

Fig 5-1

6. Interface specification

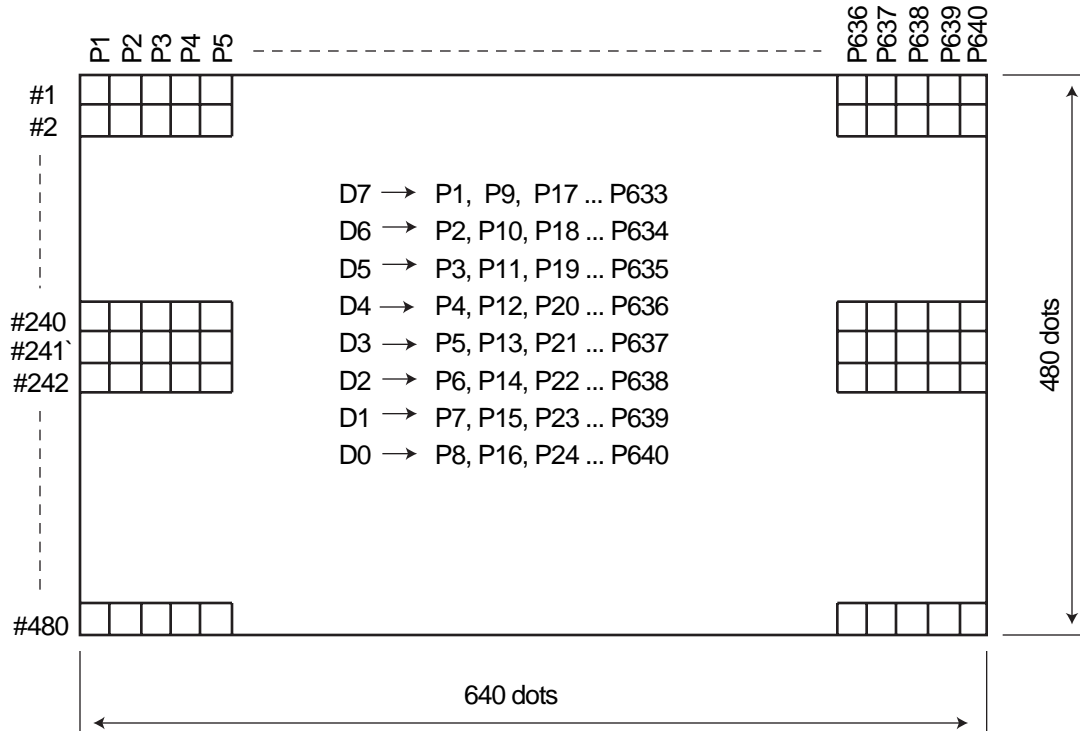
6-1 Terminal pin assignment

Pin No.	Symbol	Function
1	VAA	+V (Variable power supply for LCD drive circuit)
2	VDD	+5V (Supply voltage for logic circuit)
3	DISP-OFF	GND level : LCD becomes non-visual VDD level : LCD becomes normal operation
4	NC (DF)	No connection
5	Vss	GND
6	D7	Display data of screen (Fig. 6-2) (Note 1)
7	D6	
8	D5	
9	D4	
10	8/4	8-bit parallel processing at VDD level 4-bit parallel processing at Vss level
11	D3	Display data of screen (Fig. 6-2) (Note 1)
12	D2	
13	D1	
14	D0	
15	Vss	GND
16	FRAME	Scanning data (Start signal of each display cycle)
17	LOAD	Clock pulse for scanning data shift Latch pulse for output of display data
18	GND	GND
19	CP	Clock pulse for input of display data
20	GND	GND

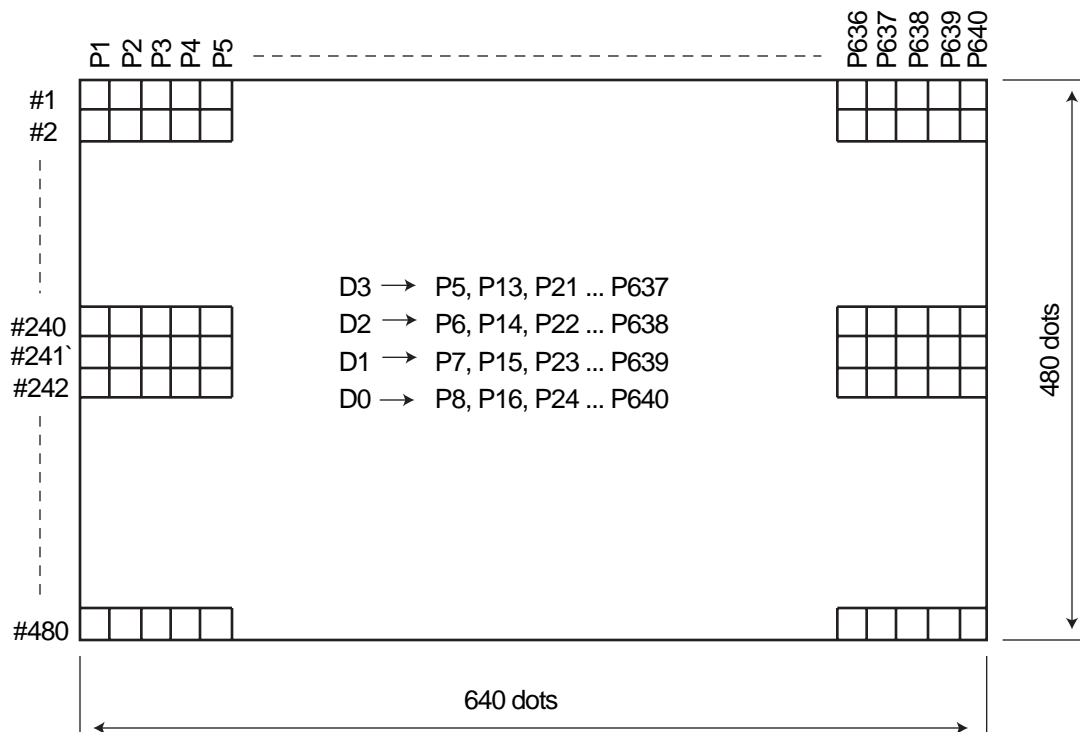
(Note 1) When 8/4 terminal is at Vss level (4-bit parallel setting), fix to VDD level.

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

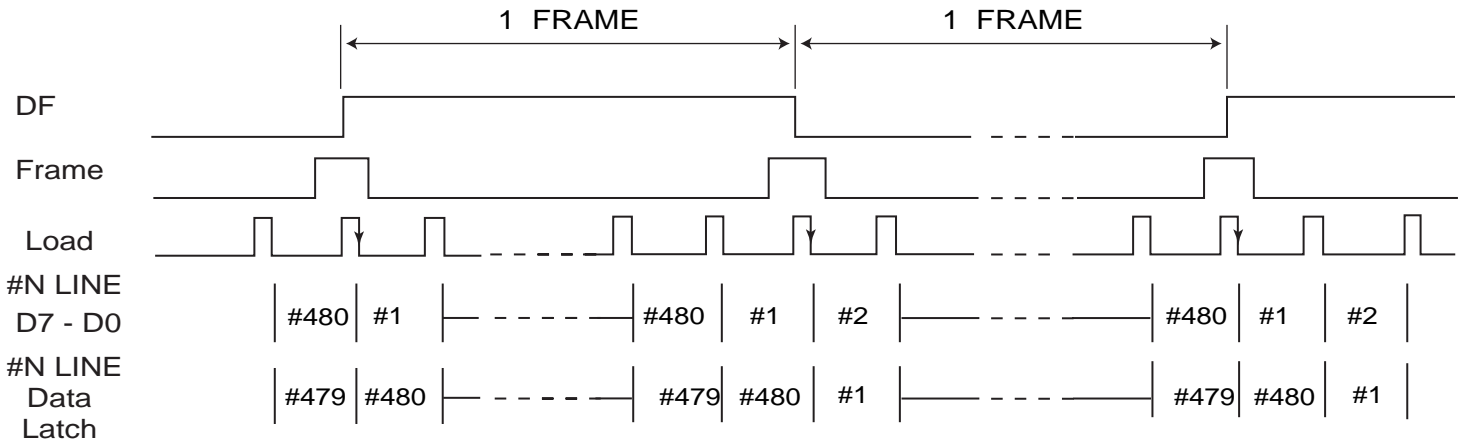
- When 8/4 terminal is at VDD level.



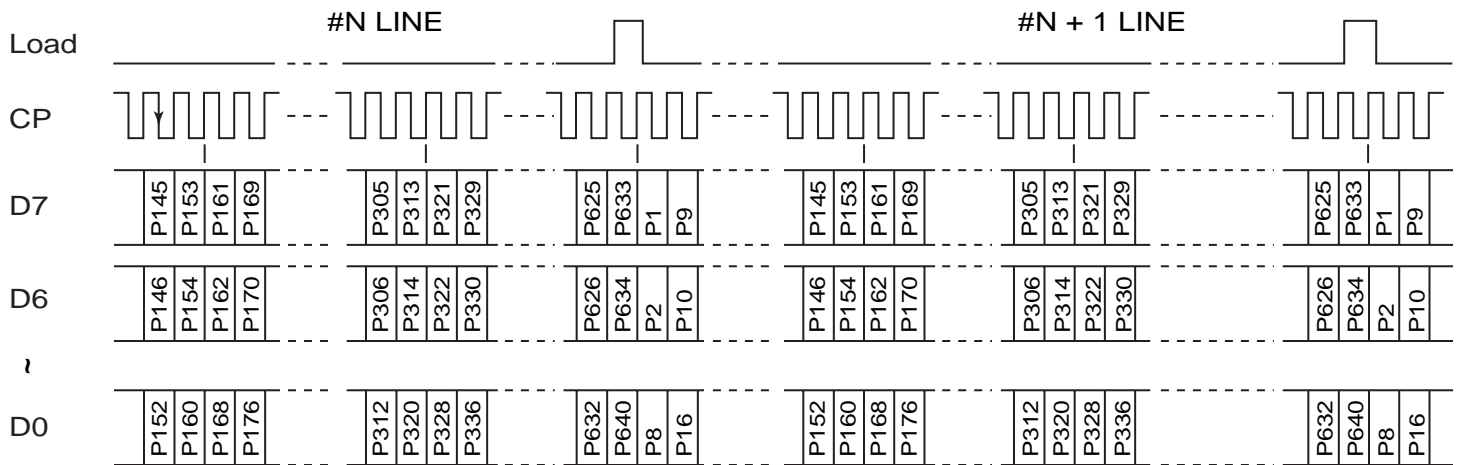
- When 8/4 terminal is at Vss level.



6-3 Timing chart



When 8/4 terminal is at V_{DD} level



When 8/4 terminal is at V_{SS} level

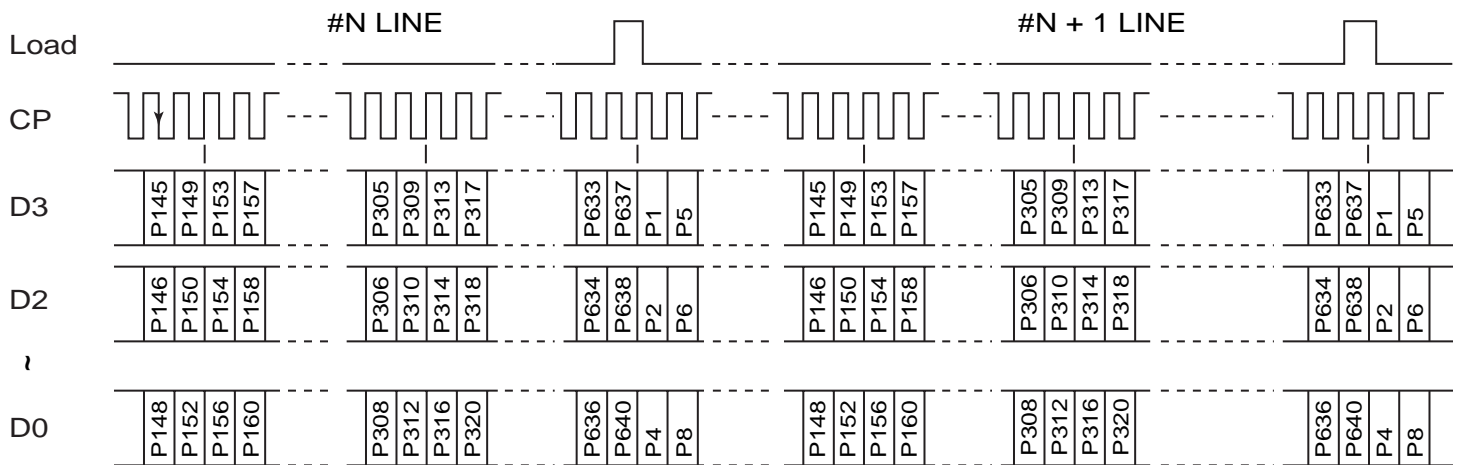


Fig 6-3 Timing chart

6-4 Switching characteristics

VDD - Vss = 5V ± 5%

Item	Symbol	Condition	Min	Typ	Max	Unit
Shift clock cycle	t WCK	t _r , t _f ≤ 10ns	78			ns
Shift clock high level pulse width	t WCKH	25			ns	
Shift clock Low level pulse width	t WCKL		25			ns
Data setup time	t DS		11			ns
Data hold time	t DH		22			ns
Latch pulse high level pulse width	t WLPH		25			ns
Shift clock rise Latch pulse rise time	t LD		0			ns
Shift clock fall Latch pulse fall time	t SL		28			ns
Latch pulse rise Shift clock rise time	t LS		28			ns
Latch pulse fall Shift clock fall time	t LH		28			ns
Input signal rise time	t r				45	ns
Input signal fall time	t f				45	ns
Shift clock cycle	t WLP	t _r , t _f ≤ 20ns	280			ns
Data setup time	t su		33			ns
Data hold time	t H		55			ns

6-5 Switching Timing Chart

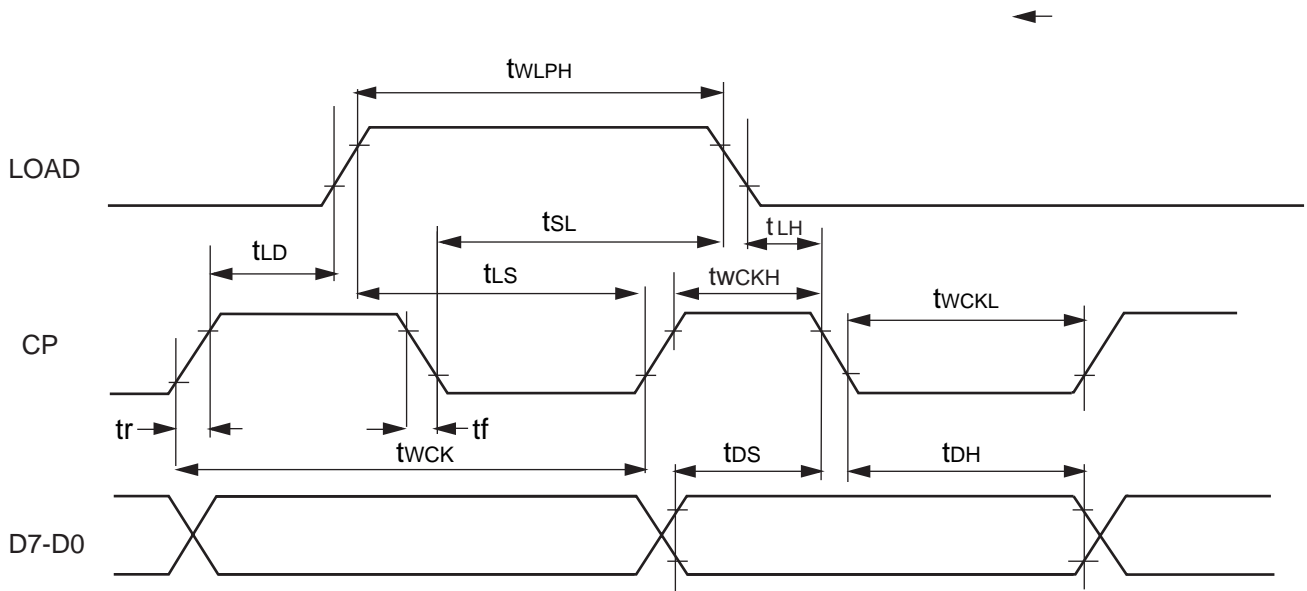


Fig 6-4

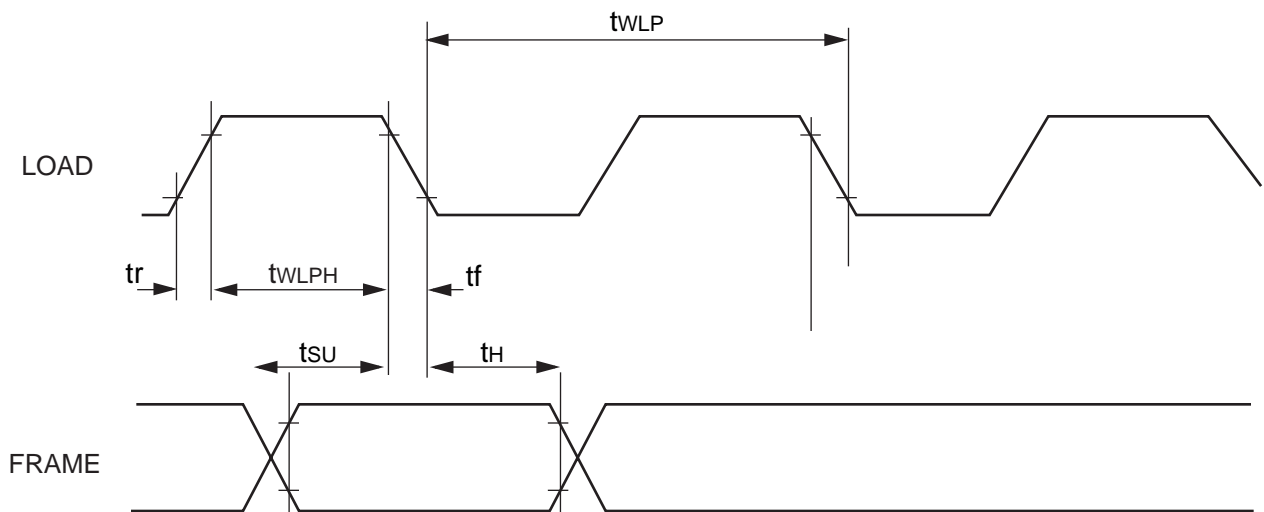


Fig 6-5

7. Optical characteristics

7-1 Optical characteristics (1) (Refer to Note 1 ~ Note 5)

Item	Symbol	Min	Typ	Max	Unit	Condition
Turn On Time	t _{ON}	-	200	-	ms	θ = 0°, φ = 0°
Turn Off Time	t _{OFF}	-	150	-	ms	
Contrast Ratio	CR	-	10	-		θ = 0°, φ = 0°
Visual Angle Range	θ ₁	-25 ≤ θ ₁ ≤ 15			deg.	φ = 0°, CR ≥ 3
	θ ₂	-30 ≤ θ ₂ ≤ 30			deg.	φ = 90°, CR ≥ 3
Viewing Direction	-	12:00				

(Note 1) Optical characteristics measurement system

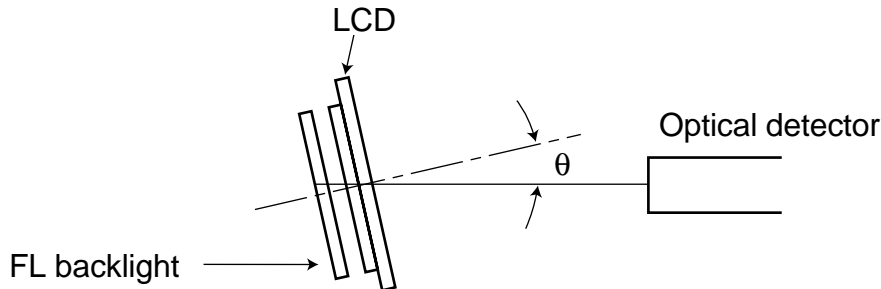


Fig 7-1

(Note 2) Definition of response time

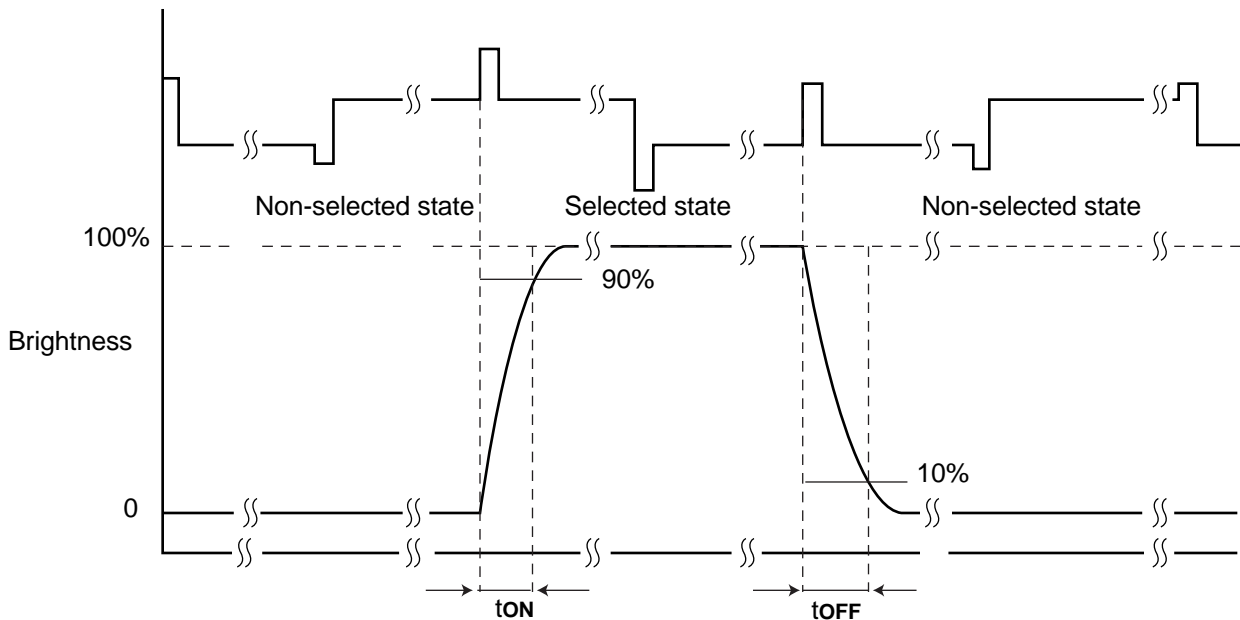


Fig 7-2

(Note 3) Definition of θ and \emptyset

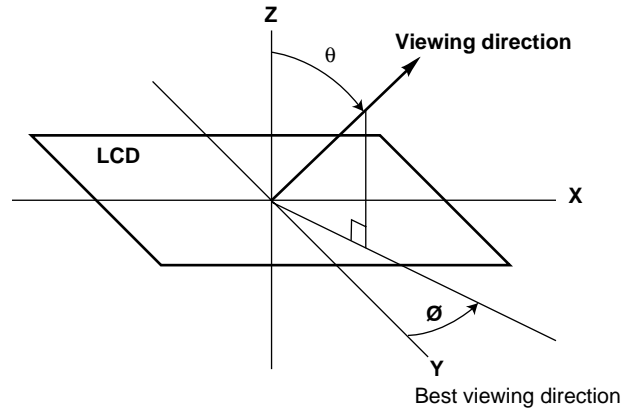


Fig 7-3

(Note 4) Definition of contrast ratio

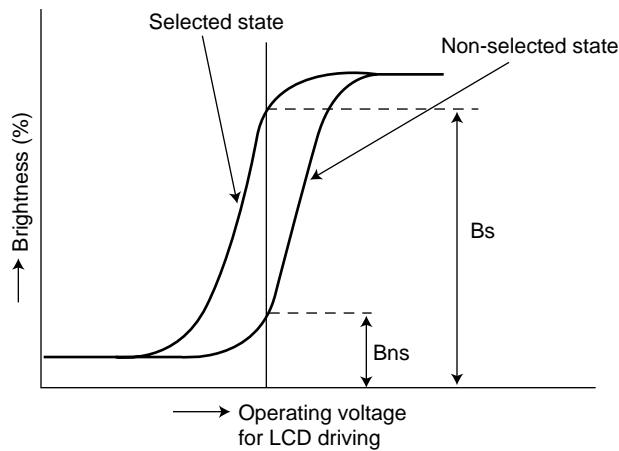


Fig 7-4

$$CR = \frac{\text{Brightness at selected state } (B_s)}{\text{Brightness at non-selected state } (B_{ns})}$$

(Note 5) Definition of visual field enlarging direction

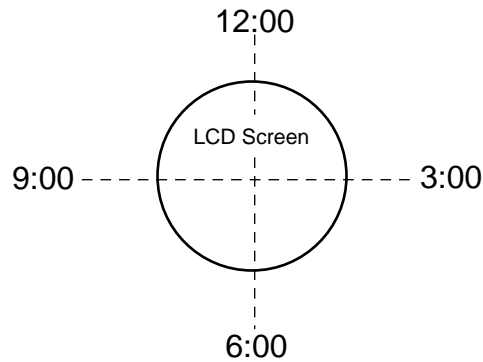


Fig 7-5

8. Backlight specifications

8-1 Electrical characteristics

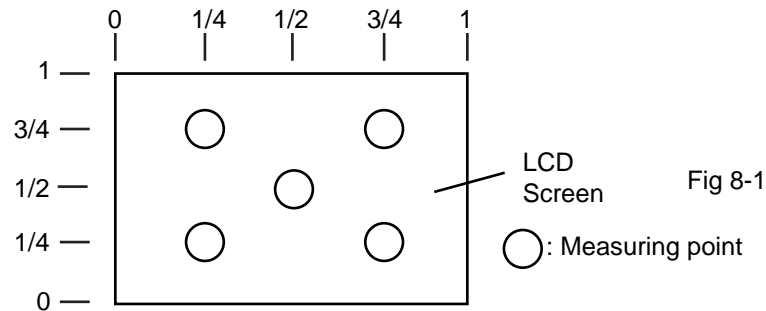
Item	Condition	Min.	Typ.	Max.	Unit
Lamp current	Ta = 25 °C		5.0		mArms
Lamp voltage	Ta = 25 °C		270		V rms
Frequency		—	40	—	kHz
Starting discharge voltage	Ta = 0°C	—	—	1000	V rms

8-1 Optical characteristics

Item	Condition	Min.	Typ.	Max.	Unit
Brightness	Frequency = 40kHz, Sin wave Lamp current = 5mA	—	120*	—	cd / m ²
Rise time	80% brightness	—	3	5	Minutes
Brightness uniformity		—	—	±20% **	

* : Windless condition at room temperature, average value of 5 points below.

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



8-3 Life time *

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

* : The definition of life time is the period until the brightness becomes 1/2.

** : 1 cycle = 10sec. ON → 10sec. OFF.

9. Precautions

9-1 Precautions for use

- (1) Before using the LCD module, peel off the protective plastic sheet, otherwise the displayed picture will be fuzzy or cloudy.
- (2) Before applying the supply voltage or video signal, make sure the power supply and the video signal are connected correctly. Improper connections may damage the unit.
- (3) Do not touch the semi-fix resistor mounted on PCB which was preadjusted in the factory for optimum display result, readjustment will need a special instrument.
- (4) Do not use this LCD module in a high humidity environment, otherwise the unit may be damaged.

9-2 Precautions in handling

- (1) Take great care to handle the LCD, since the surface of the LCD is covered by a layer of plastic, called polarizer which is very easy to be scratched.
- (2) Be careful not to touch the polarizer with the bare hand. Clean only with an absorbent cotton swab or a soft cloth by wiping gently with petroleum benzine. Do not use such chemicals as acetone, ethanol, toluene, isopropyl alcohol for cleaning, otherwise the polarizer may be deteriorated.
- (3) Also, saliva or water droplets should be removed right away or the LCD may become deformed or discolored if it was left on the polarizer surface for a long time.
- (4) If the LCD panel has been broken and the liquid crystal substance has leaked out, avoid inhaling or touching it. If the liquid crystal has contacted the skin or clothes, wash it immediately.

9-3 Installation

- (1) The circuit substrate with ICs mounted is a static sensitive element . Handle the substrate with utmost care.
- (2) Do not bend or twist the unit, LCD panel or circuit board may crack.
- (3) To protect LCD panel, especially the polarizer surface, put a transparent protective board (for example, acrylic or glass board) on the product case.

9-4 Storage

- (1) Avoid high humidity and temperature.
- (2) Do not expose the unit to direct sunlight.
- (3) Take precautions to avoid any unnecessary pressure on the unit.

9-5 Operational precautions

- (1) The ICs would break down if the drive voltage exceeds the limit. Make sure of electrical

specifications, particularly the supply voltage.

Moreover, if the input connector of LCD module is joined/disjoined with the power of LCD module kept ON, the internal circuit of LCD module might break down. So, be sure to join/disjoin the input connector with the power turned OFF.

- (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) To prevent IC latch-up and DC voltage on the LCD panel, power on by the following timing (Fig 9-1).

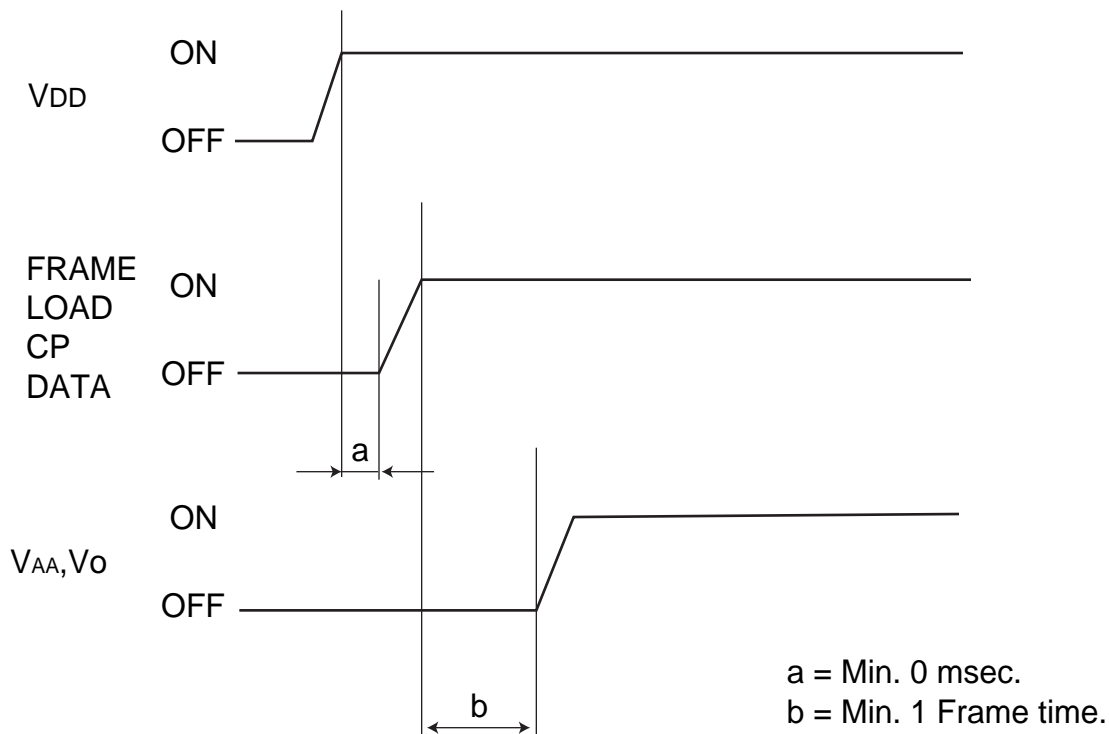


Fig 9-1

- (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 occur 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.
- (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 VAA, Vo 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 "Manual for use".
- (9) The metal frame is not connected to GND electrically. After the module has been built in your equipment, don't fail to connect the metal frame to GND. Otherwise, the internal IC is prone to latch up and could break down.
For lighting LCD module in a condition where it is not built in the equipment, be sure to connect the metal frame to GND and thereafter, turn the power ON.

9-5 Others

- (1) Don't disassemble nor dismantle LCD module. As to any LCD module which has ever been disassembled or dismantled at the user's side, WARRANTY provided by CITIZEN won't be applied.
- (2) In such a case where the same display pattern is left ON for a long time, there may be a slight residual image coming on. This residual image should disappear when any other display pattern is given or turn the power OFF and left the module as it is for a while. There is no problem in the reliability.
- (3) When a grey scale is displayed, a poor-looking displayed, e.g., a crosstalk or flicker may come on according to the type of controller outputting a grey scale signal. For displaying the grey scale, check beforehand if any poor-looking display comes on for every grey scales.

10. Reliability evaluation standard of Dot Matrix LCD Module

10-1 Scope

This reliability evaluation standard applies to Dot Matrix LCD module G6485H-FF.

10-2 Reliability test items and criteria[

Test items	Test conditions	Time	Criteria *1, 2
Operation at high temperature	+45 ± 2°C, RH ≤ 30% Operation with standard voltage	240 H	No noticeable change in operating performance
Operation at low temperature	0 ± 2°C, RH ≤ 60% Operation with standard voltage (non-condensing)	240 H	↑
Leaving in high temperature	+60 ± 2°C, RH ≤ 30%	240 H	↑
Leaving in low temperature	-20 ± 2°C, RH ≤ 60% (non-condensing)	240 H	↑
Leaving in high temperature	+40 ± 2°C, 90 ~ 95% RH (non-condensing)	240 H	↑
Temperature cycling	<div style="display: flex; align-items: center;"> <div style="margin-right: 20px;"> -20 ± 2°C, 30 min. ↓ 25 ± 2°C, 10 min. ↓ 60 ± 2°C, 30 min. ↓ 25 ± 2°C, 10 min. </div> <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 10px;"> 1 cycle non-condensing </div> </div>	10 cycle	↑
Vibration	Vibration frequency : 15 ~ 55Hz Acceleration : 1.5 G Sweep : 2.5 octave/min. X, Y and Z directions.	15 min/cycle in each direction 1 cycle	↑
Shock I	Gravity drop onto lauan board of 3 cm thick from height of 70 cm (in packaged condition) X, Y and Z directions.	One time each in X, Y and Z directions	↑
Shock II	Acceleration : 50 G Acting times : 11 msec X, Y and Z directions	↑	

* 1 The test measurement shall be made at ambient temperature of 25 ± 5°C and humidity of 65±5% RH.

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

11. Inspection standard of Dot Matrix LCD Module

11-1 Scope

this inspection standard applies to dot matrix LCD module G6485H-FF.

11-2 Delivery inspection

(1) Inspection conditions

The inspection conditions shall be in accordance with the conditions in this spec. sheet. Also as the environmental conditions, the inspection shall be made at ordinary temperature (20 to 25°C) and ordinary humidity (65 ± 5% RH) and the appearance shall be inspected visually at a distance of more than 30 cm 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) Defects shall be inspected at maximum contrast.

(2) Inspection lot

One lot shall comprise the quantity 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

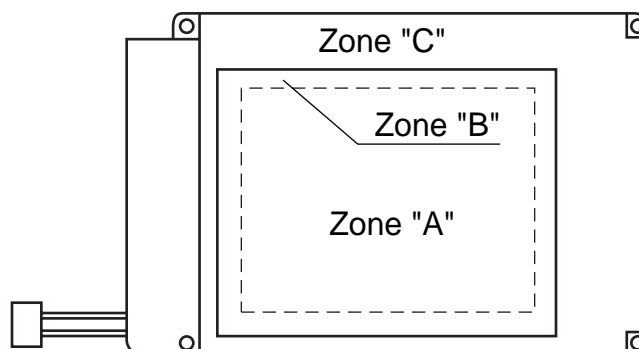
A Q L Major defect 1.0%

Minor defect 2.5% To be evaluated by overall items.

Major defect : Defect to miss proper function

Minor defect : Defect does not miss proper function but depreciates the value of the products.

(4) Definition of applicable zone



Zone "A" : Display area

Zone "B" : Viewing area
exclude Zone "A"

Zone "C" : Outside viewing
area

11-3 Inspection standard

11-3-1 Visual defects classification

Section of defects	Inspection item	A Q L
Major defect	<ul style="list-style-type: none"> • Defect to miss specified display function (For all and specified dots) (E.g. disconnection, short - circuit, etc.) • Malfunction <p>Electrical characteristics</p> <ul style="list-style-type: none"> • Current consumption 	1.0%
Minor defect	<p>Outward appearance</p> <ul style="list-style-type: none"> • Dimension • Display part appearance when LCD turn ON Pinholes, dot chipping, white spot, black spot, thick dot., thin dot, deformation, center line, uneven display, etc. • Display part appearance when LCD turn OFF (Scope having no effect on function) Bubbles, flaws, stains, and foreign article • Outward appearance excluding display part (Scope having no effect on function) Flaws, stains, solder, identification marking, assembly and deformation of metallic frame. 	2.5%

11-3-2 Visual inspection standard of display unit

Classification	Inspection items	Criteria	Section of defects																										
Lighting appearance and operational inspection	(1) Display	(a) Defect to miss specified display function (b) Turn ON area is different from specified area (c) Backlight doesn't light	Major defect Major defect Major defect																										
	(2) Dot chipping and pinholes	$\varnothing 0.15 < d \leq \varnothing 0.25$: Within 5 pcs. $\varnothing 0.15 \geq d$: Not count as defect $d > 0.25$: None Size $d = \varnothing$ mm 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.	Minor defect																										
	(3) White spot I, Black spot I	A defect that size which can be seen does not very even though voltage applied to LCD display element is changed. Circular spot and foreign matters <table border="1" data-bbox="561 890 1206 1115"> <thead> <tr> <th rowspan="2">Size $\varnothing d$ (mm)</th> <th colspan="2">Allowable q'ty</th> </tr> <tr> <th>Zone "A"</th> <th>Zone "B"</th> </tr> </thead> <tbody> <tr> <td>$d \leq 0.2$</td> <td>Ignore</td> <td>Ignore</td> </tr> <tr> <td>$0.2 < d \leq 0.4$</td> <td>3</td> <td>5</td> </tr> <tr> <td>$0.4 < d \leq 0.5$</td> <td>0</td> <td>1</td> </tr> <tr> <td>$0.5 < d$</td> <td>0</td> <td>0</td> </tr> </tbody> </table> a special shape shall be estimated with (Longer side + Shorter side) /2 = d . The number of defects must be within 5 pcs. * Zone "C" is not included in the object.	Size $\varnothing d$ (mm)	Allowable q'ty		Zone "A"	Zone "B"	$d \leq 0.2$	Ignore	Ignore	$0.2 < d \leq 0.4$	3	5	$0.4 < d \leq 0.5$	0	1	$0.5 < d$	0	0	Minor defect									
	Size $\varnothing d$ (mm)	Allowable q'ty																											
Zone "A"		Zone "B"																											
$d \leq 0.2$	Ignore	Ignore																											
$0.2 < d \leq 0.4$	3	5																											
$0.4 < d \leq 0.5$	0	1																											
$0.5 < d$	0	0																											
(4) White line I, Black line I	Linear spot and foreign article <table border="1" data-bbox="561 1398 1206 1776"> <thead> <tr> <th rowspan="2">Length (mm)</th> <th rowspan="2">Thickness (mm)</th> <th colspan="2">Allowed q'ty</th> </tr> <tr> <th>Zone "A"</th> <th>Zone "B"</th> </tr> </thead> <tbody> <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>$1.0 \leq L \leq 10.0$</td> <td>$0.025 \leq W \leq 0.05$</td> <td>3</td> <td>3</td> </tr> <tr> <td>$1.0 \leq L \leq 5.0$</td> <td>$0.05 \leq W \leq 0.1$</td> <td>1</td> <td>3</td> </tr> <tr> <td>$L \leq 1.0$</td> <td>$0.1 \leq W$</td> <td colspan="2">In accordance with inspection item (3)</td> </tr> </tbody> </table> The number of defects must be within 5 pcs. * Zone "C" is not included in the object.	Length (mm)	Thickness (mm)	Allowed q'ty		Zone "A"	Zone "B"		$W < 0.025$	Ignore	Ignore	$L < 1.0$	$W < 0.1$	Ignore	Ignore	$1.0 \leq L \leq 10.0$	$0.025 \leq W \leq 0.05$	3	3	$1.0 \leq L \leq 5.0$	$0.05 \leq W \leq 0.1$	1	3	$L \leq 1.0$	$0.1 \leq W$	In accordance with inspection item (3)		Minor defect	
Length (mm)	Thickness (mm)			Allowed q'ty																									
		Zone "A"	Zone "B"																										
	$W < 0.025$	Ignore	Ignore																										
$L < 1.0$	$W < 0.1$	Ignore	Ignore																										
$1.0 \leq L \leq 10.0$	$0.025 \leq W \leq 0.05$	3	3																										
$1.0 \leq L \leq 5.0$	$0.05 \leq W \leq 0.1$	1	3																										
$L \leq 1.0$	$0.1 \leq W$	In accordance with inspection item (3)																											

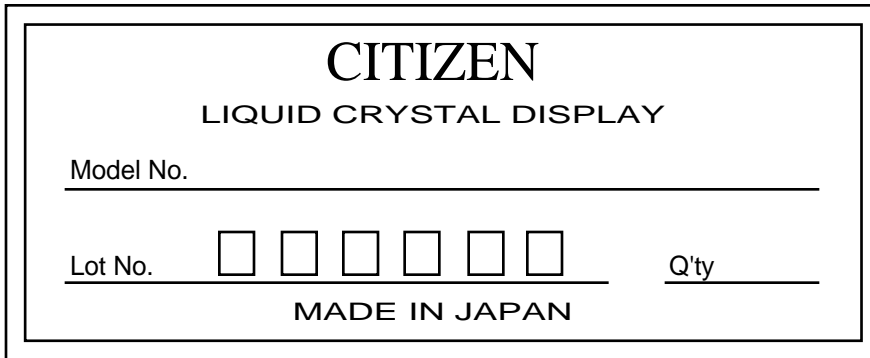
Classification	Inspection items	Criteria	Section of defects	
Lighting appearance and operational inspection	(5) White spot II, Black spot II	<p>A defect that size which can be seen varies according to change in voltage applied to LCD display element. Size $d = \varnothing$mm</p> <ul style="list-style-type: none"> • A part seen clearly : $\varnothing 0.2 < d \leq \varnothing 0.4$ A part of which size is $\varnothing 0.2 \geq d$ is not counted as defect. • A light colored part in the vicinity of thick spot : $\varnothing 0.6 < d \leq \varnothing 0.9$ A part of which size is $\varnothing 0.6 \geq d$ is not counted as defect. • A part seen unclearly not accompanied by a thick spot must be judged : $\varnothing 0.6 < d \leq \varnothing 0.9$ <p>The number of defects must be within 5 pcs.</p>		Minor defect
	(6) White line II, Black line II	<p>A defect that line condition varies according to change in voltage applied to LCD display element.</p> <ul style="list-style-type: none"> • Defect mustn't be conspicuous at the display front ($\theta = 0^\circ$ and $\varnothing = 0^\circ$) in the most suitable contrast voltage. 		Minor defect
	(7) Thickness, Thinness and deformation of dot	Less than $\pm 15\%$ 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

11-3-2 Visual inspection standard of display unit

Classification	Inspection items	Criteria	Section of defects																		
Non-lighting appearance inspection	(12) Bubbles (Originate to polarizer)	<table border="1"> <thead> <tr> <th data-bbox="571 365 764 480">Zone Size Ø d (mm)</th> <th colspan="2" data-bbox="769 365 1195 422">Allowable q'ty</th> </tr> <tr> <th data-bbox="571 428 764 480"></th> <th data-bbox="769 428 984 480">Zone "A"</th> <th data-bbox="989 428 1195 480">Zone "B"</th> </tr> </thead> <tbody> <tr> <td data-bbox="571 487 764 514">d ≤ 0.3</td> <td data-bbox="769 487 984 514">Ignore</td> <td data-bbox="989 487 1195 514">Ignore</td> </tr> <tr> <td data-bbox="571 520 764 548">0.3 < d ≤ 0.5</td> <td data-bbox="769 520 984 548">2</td> <td data-bbox="989 520 1195 548">3</td> </tr> <tr> <td data-bbox="571 554 764 581">0.5 < d ≤ 1.0</td> <td data-bbox="769 554 984 581">1</td> <td data-bbox="989 554 1195 581">2</td> </tr> <tr> <td data-bbox="571 588 764 615">1.0 < d < 1.5</td> <td data-bbox="769 588 984 615">0</td> <td data-bbox="989 588 1195 615">1</td> </tr> </tbody> </table>	Zone Size Ø d (mm)	Allowable q'ty			Zone "A"	Zone "B"	d ≤ 0.3	Ignore	Ignore	0.3 < d ≤ 0.5	2	3	0.5 < d ≤ 1.0	1	2	1.0 < d < 1.5	0	1	Minor defect
	Zone Size Ø d (mm)	Allowable q'ty																			
		Zone "A"	Zone "B"																		
	d ≤ 0.3	Ignore	Ignore																		
0.3 < d ≤ 0.5	2	3																			
0.5 < d ≤ 1.0	1	2																			
1.0 < d < 1.5	0	1																			
(13) Flaws and stains	<p>a special shape shall be estimated with (Longer side + Shorter side) /2 = d . The number of defects must be within 5 pcs.</p> <ul style="list-style-type: none"> • Don't miss proper function and don't depreciates the value of the product much. The object shall be within the viewing area • A scratch 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 Ø = 0°) when checked visually. <p>* Stains shall be accepted which are wiped up.</p>	Minor defect																			
(14) Interference fringes	No conspicuous unevenness	Minor defect																			
Common characteristics	(15) Total number of defects	A total number of allowable defects must be within 6 pieces.	Minor defect																		
	(16) Separation between defects	Adjoining defects must be separated more than 1 cm from each other	Minor defect																		
	(17) Assembly	(a) Proper assembly of liquid crystal display element holder (b) Proper assembly of each component part	Minor defect																		
	(18) Dimension	Within specified limit	Minor defect																		
	(19) Current consumption	Within specified limit	Minor defect																		

11-4 Lot marking

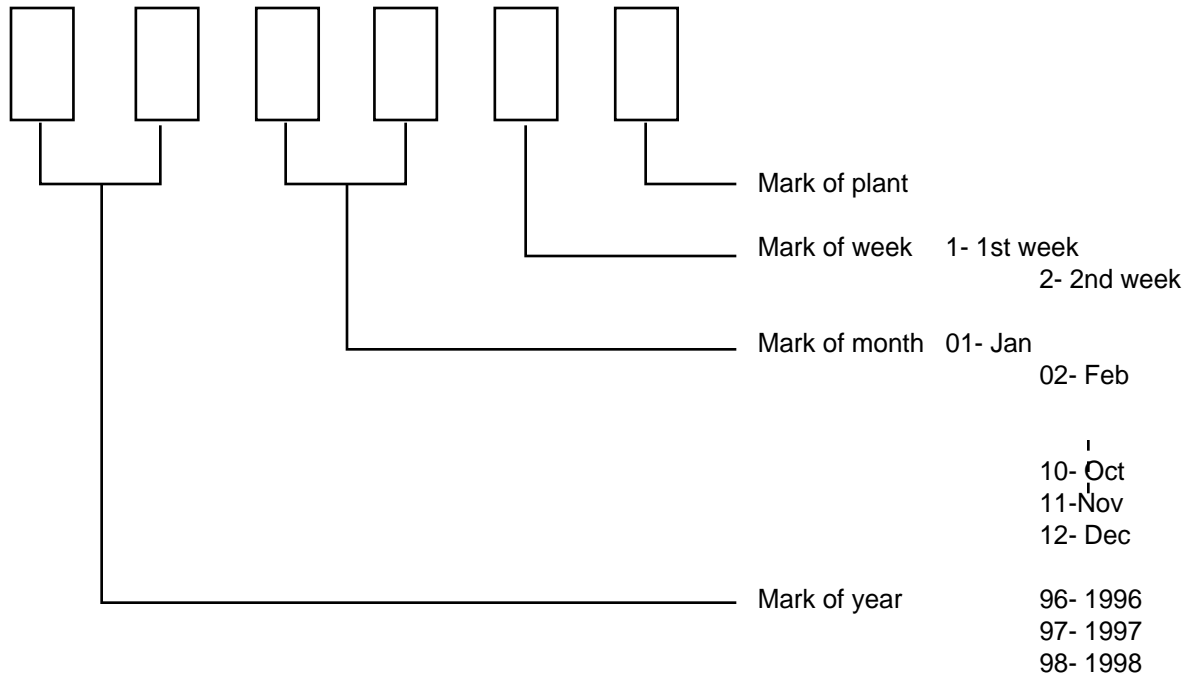
(1) Form : Indication of side of case



Designation of product (Model)

Mfg. Lot No.

(2) Composition of 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 shall be 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 defective part by repairing or correcting.

12. Manual for use (Vss = GND)

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 T1, T2 and T3 shown in Fig. 12-1 below and T4 shown in Fig. 12-5 later.

- T1 : A time from turning on power to drive circuit in LCD module starts its normal operation. (See Fig. 12-2 on the succeeding page.)
- T2 : 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 make its normal operation temporarily, (See Fig. 12-3 later.)
- T3 : A time from power has been turned OFF to liquid crystal driving voltage returns to Vss level. (See Fig. 12-4 later.)
- T4 : A time in which controller IC is controlling CRT +20msec. (See Fig. 12-5 later.)

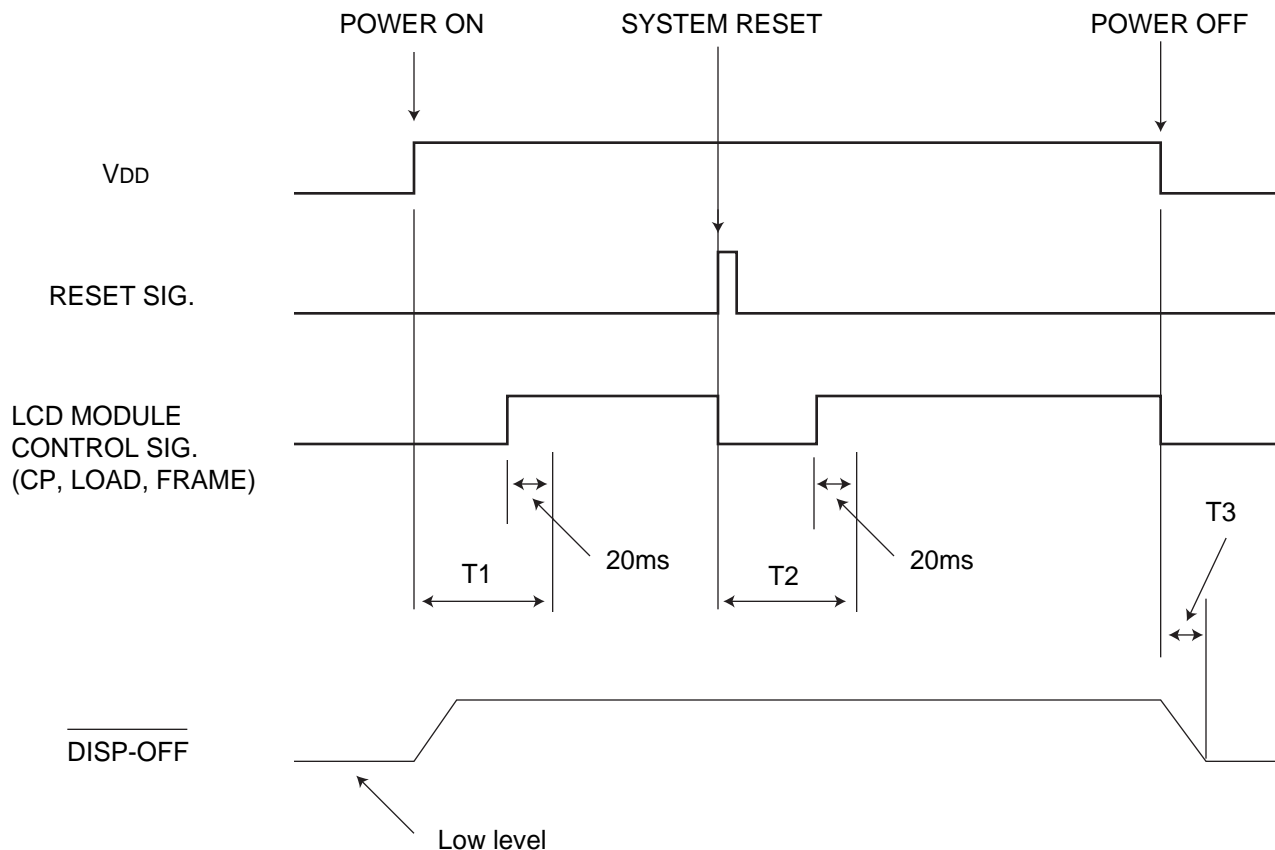


Fig. 12-1

- (1) In case of POWER ON ($V_{SS} = GND$)
 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 20ms after a condition has been set up where the control signals (CP, LOAD, FRAME & DF) are put out normally.
 Therefore, there is possibility of DC voltage being applied to LCD panel in a period of T1 shown in Fig. 12-2 below.

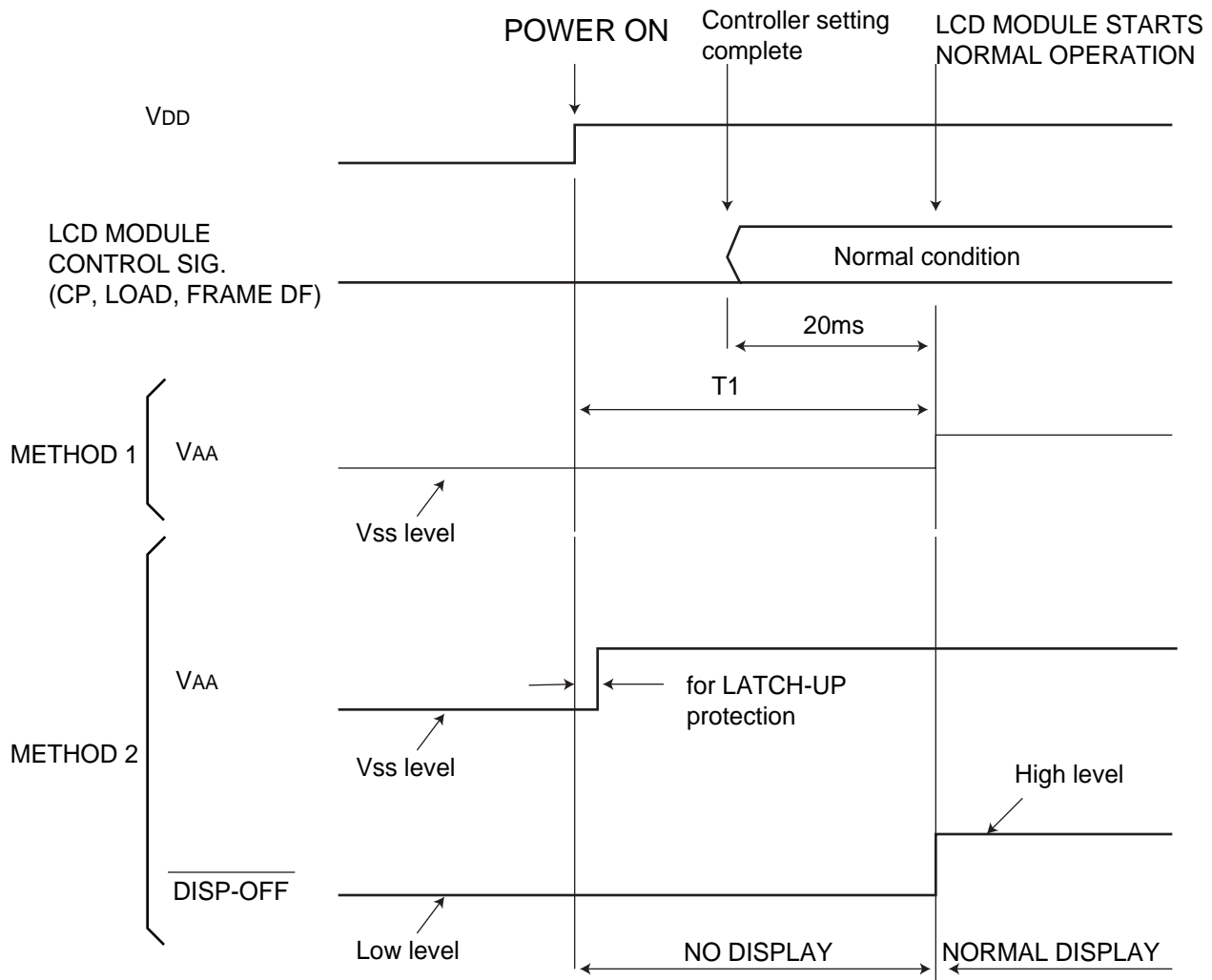


Fig. 12-2

METHODS

METHOD 1: In a period of T1, set the electric potential of V_{AA} at Vss level or set V_{AA} in OPEN

METHOD 2: In a period of T1, set the electric potential of $\overline{\text{DISP-OFF}}$ terminal at Vss level. (So long as the electric potential of $\overline{\text{DISP-OFF}}$ terminal is at Vss level, no voltage is applied to LCD panel.)

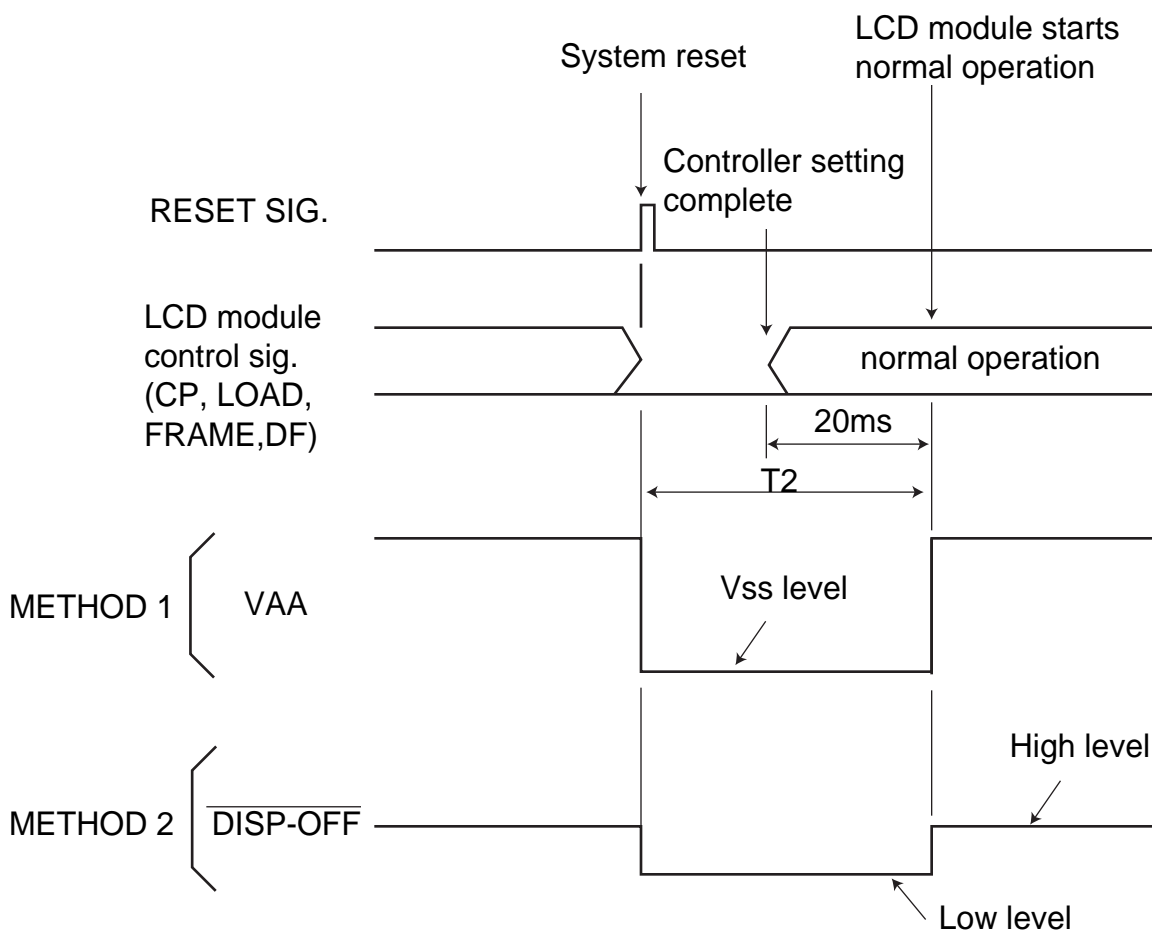
If you use the above METHOD 1 or 2, no DC voltage applied to LCD panel.

(2) In case of system reset (Vss = GND)

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 T2 shown in Fig. 12-3 below.



METHOD

1. Keep DISP-OFF terminal at low level or
 2. VAA terminal at Vss level or open during T2.
- If you use the above, no DC voltage applied to LCD panel.

(3) In case of POWER OFF ($V_{ss} = GND$)

When V_{AA} 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 Fig. 12-4. below.

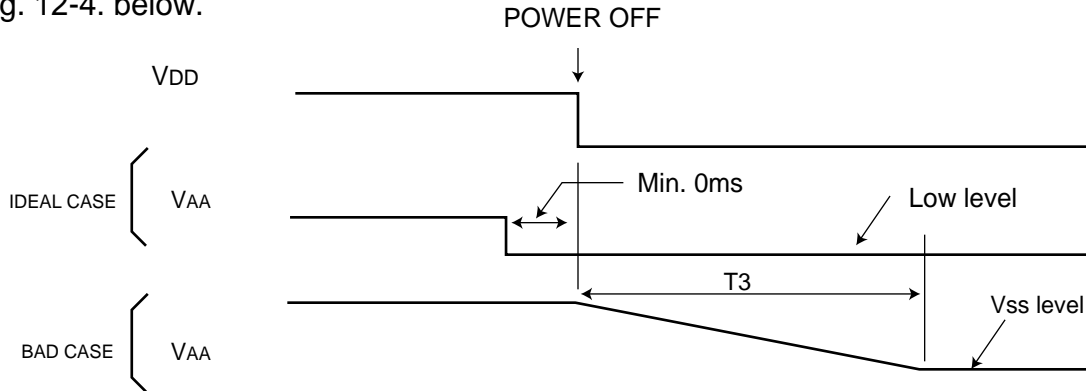


Fig. 12-4

METHOD

It is the best possible way to set V_{AA} to V_{ss} level before the electric potential of V_{DD} terminal drops to V_{ss} level or simultaneously with the drop.

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.

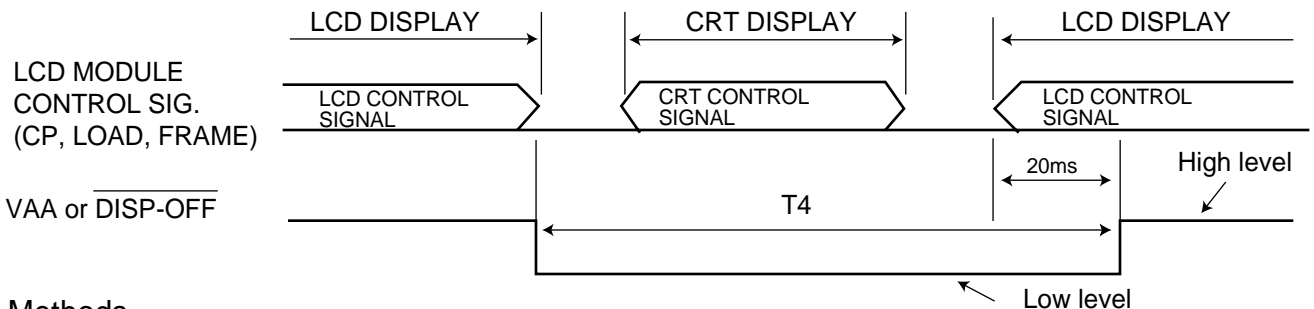
However, in such a case where DC voltage has been applied when the power is turned OFF, if the power is turned ON again in a short time thereafter, a bad effect may be brought about. it is therefore necessary to take care about it.

(4) Other case ($V_{ss} = GND$)

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 is: From : Controller IC starts to control CRT To : 20ms after the controller IC has begun to out put LCD control signal again.



Methods

keep V_{AA} or $\overline{DISP-OFF}$ terminal at Low level during T_4 .

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. ($V_{SS} = GND$)

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 condition :

- (1) Where (LCD) controller IC is not working normally in a condition that $\overline{\text{DISP-OFF}}$ terminal level is high.
- (2) Where (LCD) controller IC is controlling CRT in a condition that $\overline{\text{DISP-OFF}}$ terminal level is high.

Method ;

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_{AA} terminal of LCD module in OPEN state.
2. Keep $\overline{\text{DISP-OFF}}$ terminal connected to V_{SS} as shown in Fig. 12-6.
3. Keep V_{AA} terminal connected to V_{SS} as shown in Fig. 12-7

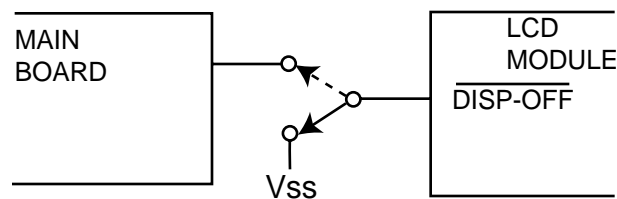


Fig. 12-6

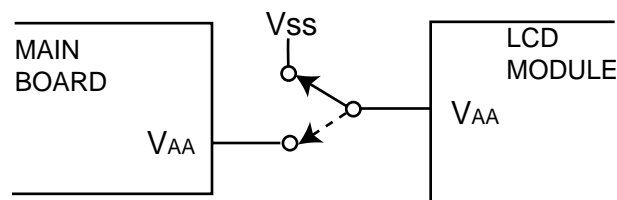


Fig. 12-7

12-3 Reason and solution way of abnormal operation of LCD module ($V_{SS} = GND$)

(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 0.2VDD

V_{IH} : MIN 0.8 VDD

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, and if so, to take proper action beforehand.

Noise is generated by following reasons :

A. A cable connected between the control signal generator and LCD module is too long.

B. The device using LCD module is too noisy.

(3) Checking method of noise

Connect an oscilloscope between V_{SS} and 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 of solution

- A. Use shorter cable , as short as possible.
- B. Connect the metal frame of the LCD module and Vss in low impedance way.
- C. Insulate the metal frame of the noisy device from the metal frame of LCD module.
- D. Insert a noise filter between the heavy load power supply and LCD module.
- E. Shield the cable.

12-4 Function of DISP-OFF terminal (Vss = GND)

as soon as L-level voltage is applied to DISP-OFF terminal, all data on display go out. (the LCD screen change to black)

DISP-OFF terminal provide the following functions:

(1) Erasing display

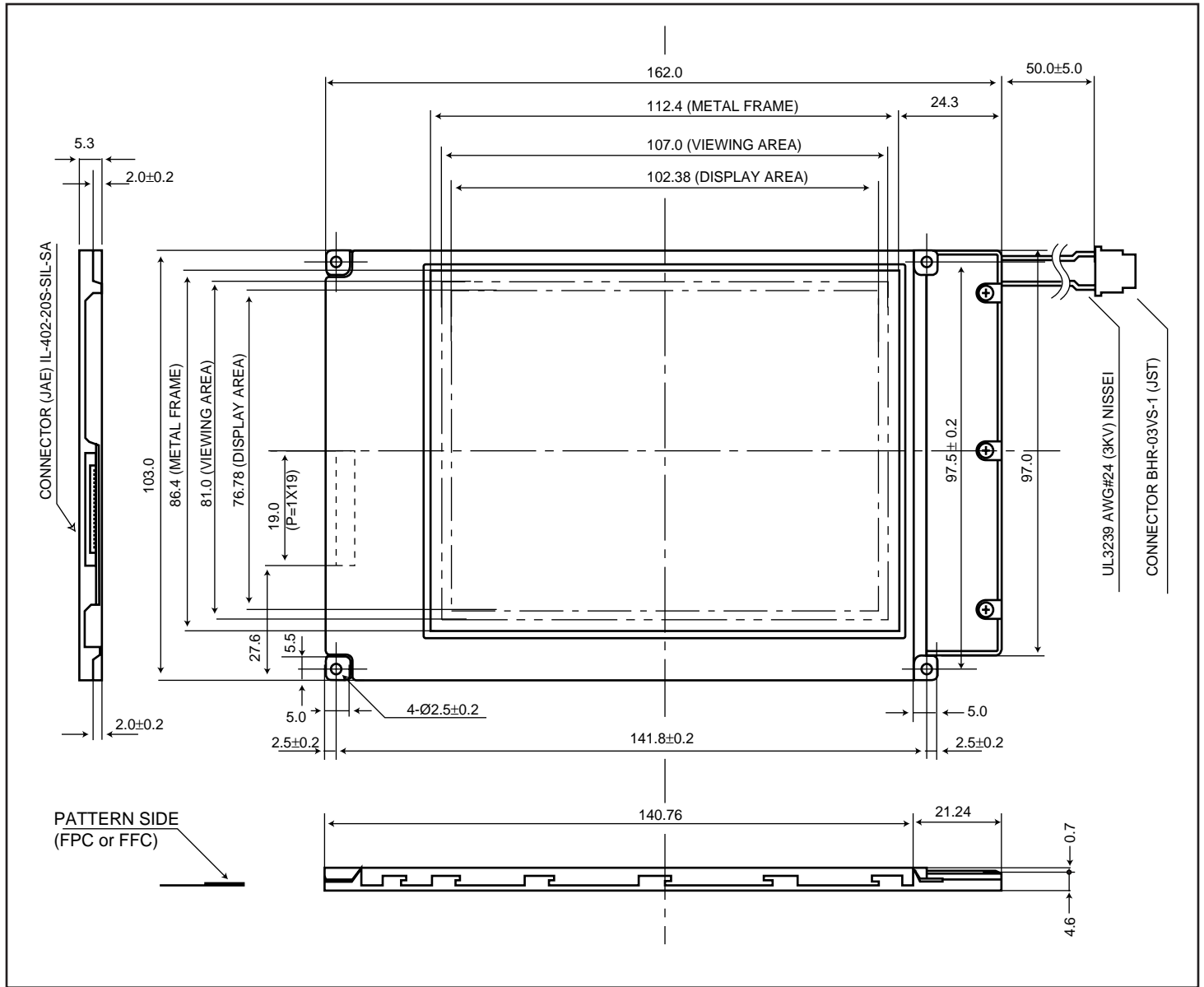
All data on display go out as in the case that all displayed data have been set to L-level. While L-level voltage is left applied to DISP-OFF terminal, nothing remains displayed as it is regardless of displayed data.

(2) Preventing DC voltage applied to LCD panel

While L-level voltage remains applied to DISP-OFF, voltage applied to LCD panel is zero. For the detail, refer to the following items in the " 12. Manual for use " :

- " 12-1 Protection of DC voltage from being applied to LCD module "
- " 12-2 Application of DC voltage to LCD module during system development "

Dimensional Drawing



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