



PACIFIC DISPLAY DEVICES

LCD Component Data Sheet

Model Number: 320240-17

**320 x 240 Dot
Graphic LCD Assembly
With Row and Column Drivers
Edge Lit LED / CCFL Backlight Options**

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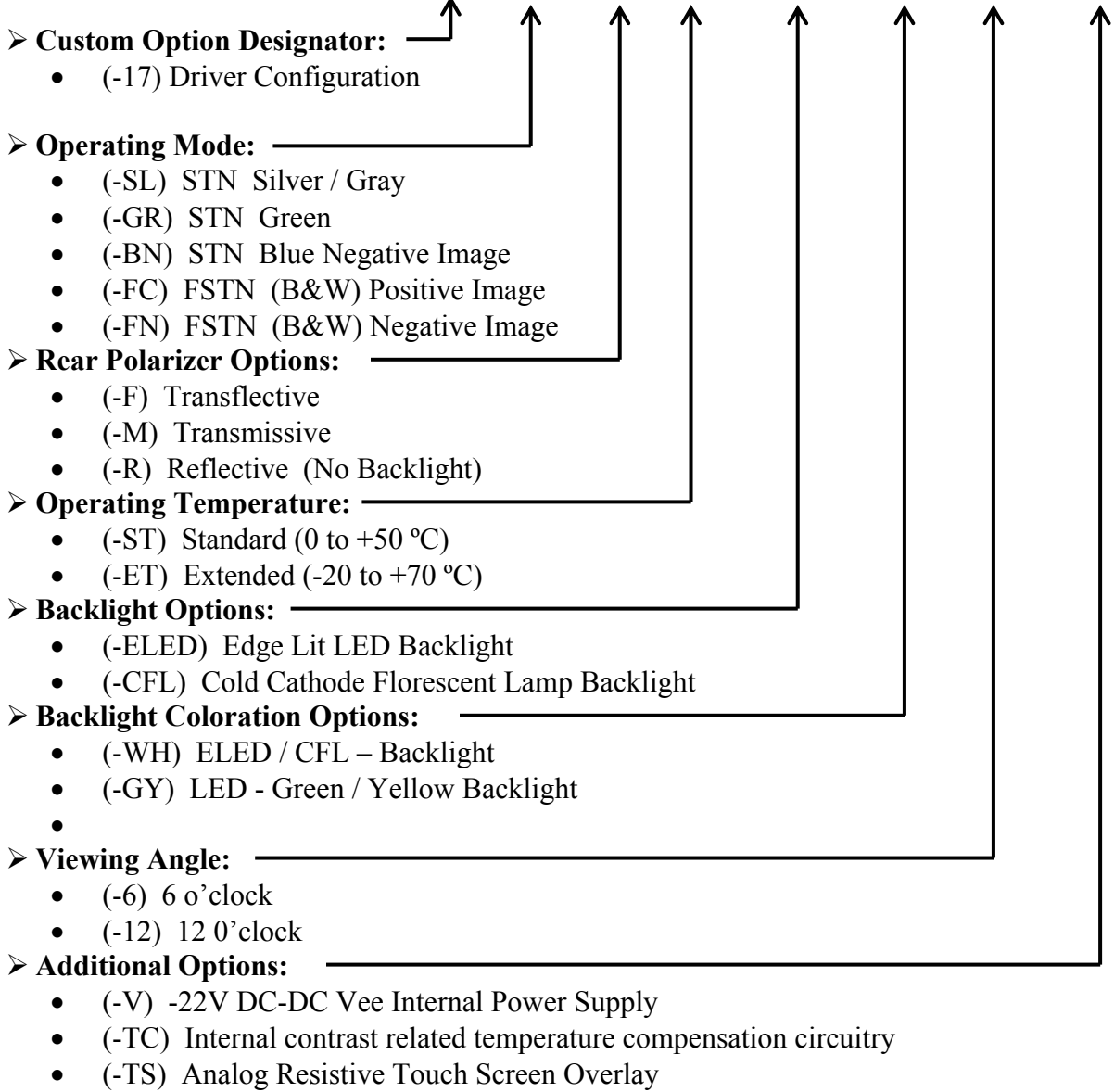
1. GENERAL INFORMATION

1.1 Product Overview

- 320 x 240 dot matrix LCD
- FSTN (Film compensated Super Twisted Nematic) & STN Technology
- HD66206 (or equivalent) Row and Column Driver ICs.
- Multiplex drive : 1/240 duty, 1/14 bias
- LCD Module Service Life: 100,000 hours minimum

1.2 Part Options and Numbering System

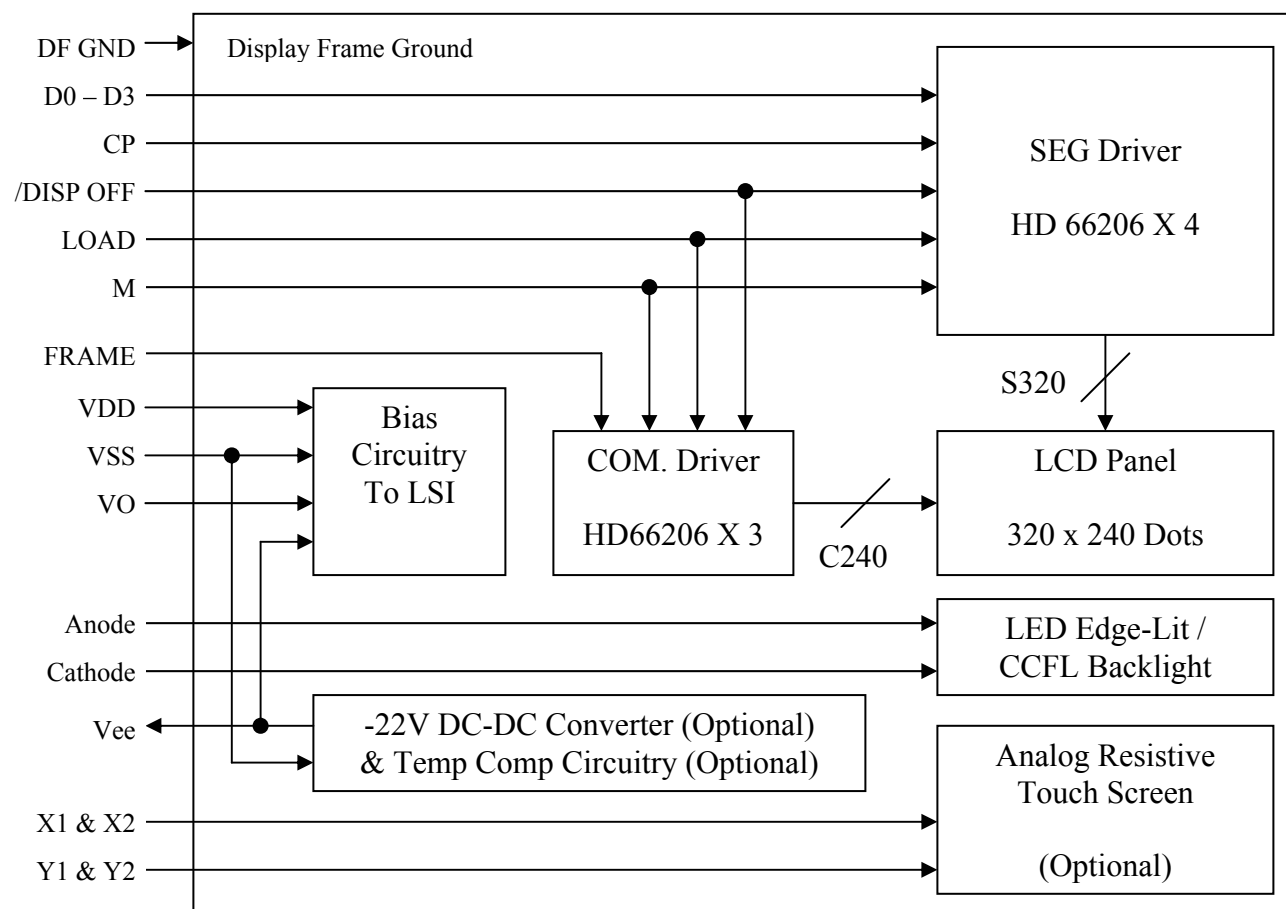
320240	-17	-FC	-F	-ST	-ELED	-WH	-6	-V-TC-TS
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1.3 Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Supply voltage for logic	V_{DD}	-0.3	7.0	V
Supply voltage for LCD	$V_{DD} - V_0$	-0.3	30.0	V
Input voltage	V_I	-0.3	$V_{DD} + 0.3$	V
Standard Operating temperature	TOP (-ST)	0	50	°C
Standard Storage temperature	TST (-ST)	-10	60	°C
Extended Operating temperature	TOP (-ET)	-20	70	°C
Extended Storage temperature	TST (-ET)	-30	80	°C
Soldering Temp	Tsolder	260		°C

1.4 Circuit Block Diagram



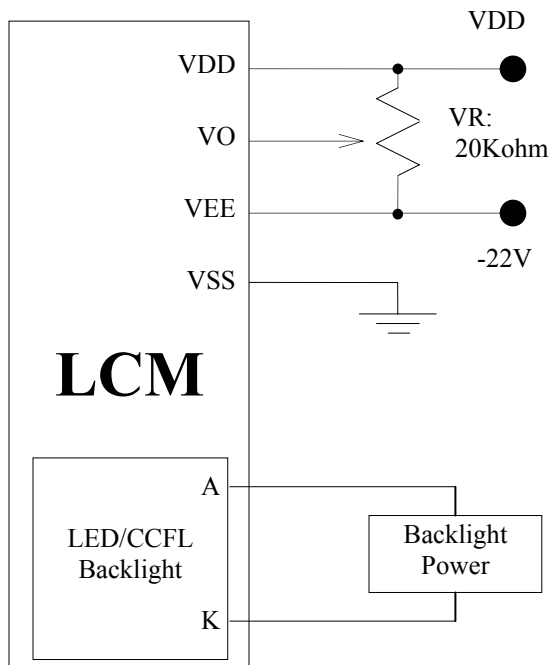
1.5 Mechanical Characteristics

Item	Contents	Unit
Module size (W×H×T)	160.0 x 108.0 x 11.0 Max	mm
Viewing area (W×H)	120.0 x 90.0	mm
Active area (W×H)	115.18 x 86.38	mm
Number of dots	320 x 240	dots
Dot size (W×H)	0.34 x 0.34	mm
Dot pitch (W×H)	0.36 x 0.36	mm

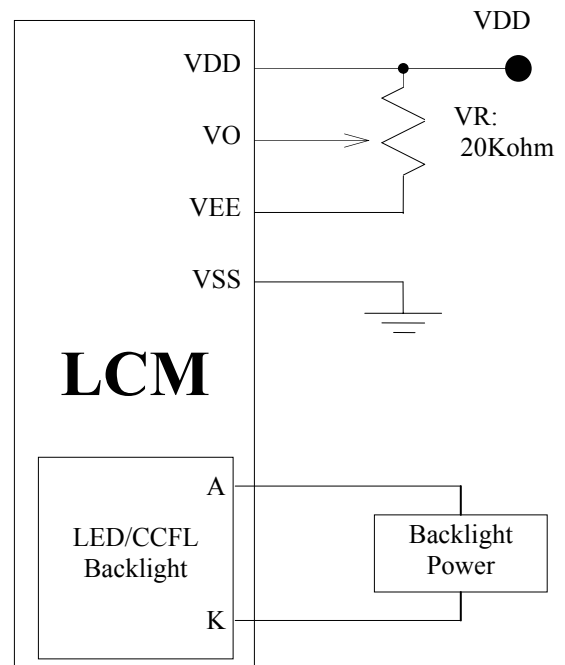
1.6 Input Signal Function

Pin No.	Symbol	Level	Description
1	D0	H/L	Data bit 0
2	D1	H/L	Data bit 1
3	D2	H/L	Data bit 2
4	D3	H/L	Data bit 3
5	/DISPOFF	H/L	H : display on, L : display off
6	FLM	H	First Line marker
7	M	H/L	Frame Reverse Signal
8	LOAD	H→L	Data latch signal
9	CP	H→L	Clock signal for shifting serial data
10	VDD	5.0V	Supply voltage for logic
11	VSS	0V	Ground
12	VEE	-22V	Supply voltage for LCD (*Internally or Externally supplied, Mfg Option)
13	VO	---	Variable voltage for LCD
14	FGND	---	Frame ground

1.7 LCM Power, Contrast Control and Bias



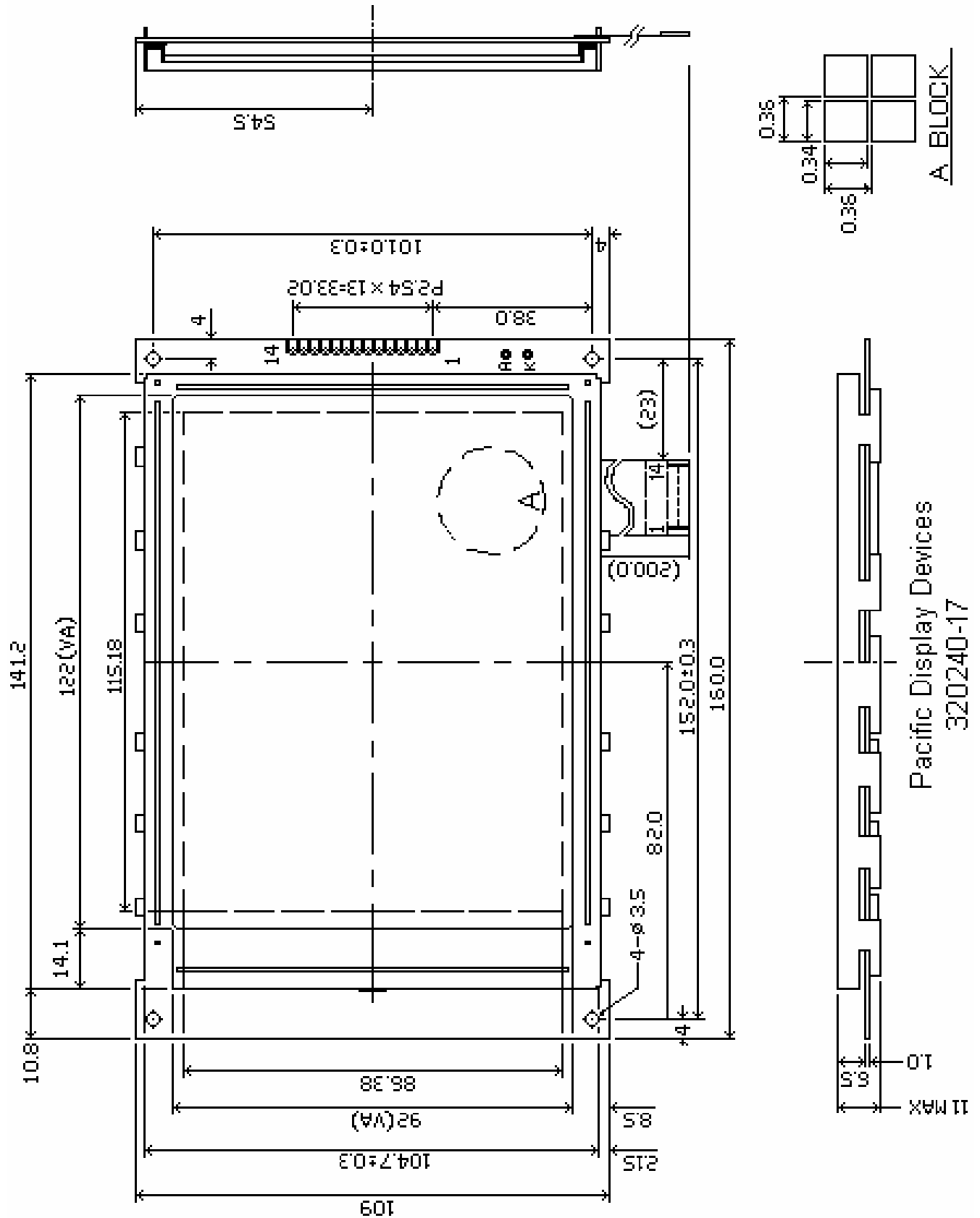
*Note : DC-to-DC Converter Not Built In



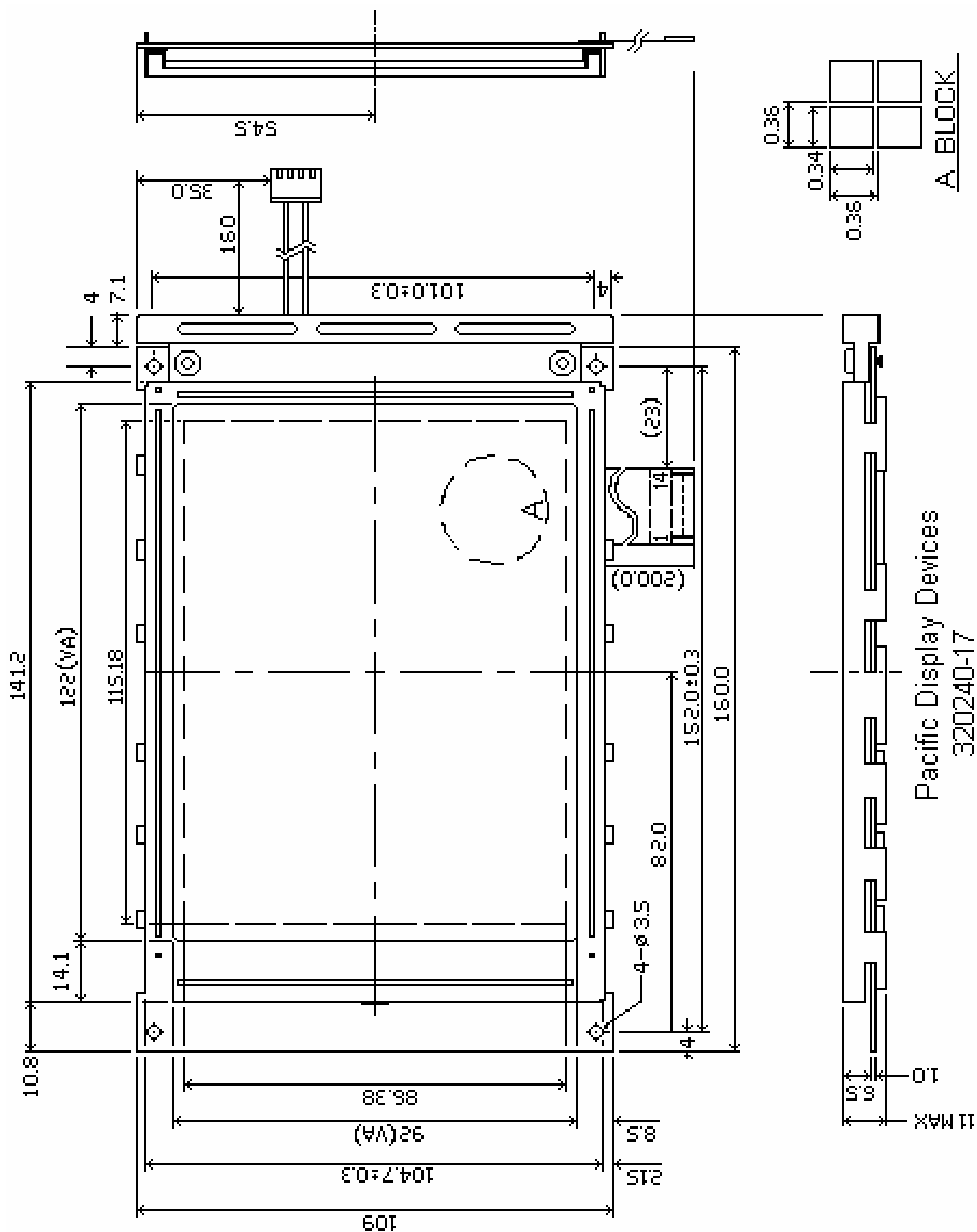
*Note : DC-to-DC Converter Built In (-V Option)

1.8 LCM Dimensions

■ Module Dimensions Without Touch-Screen, with LED Backlight

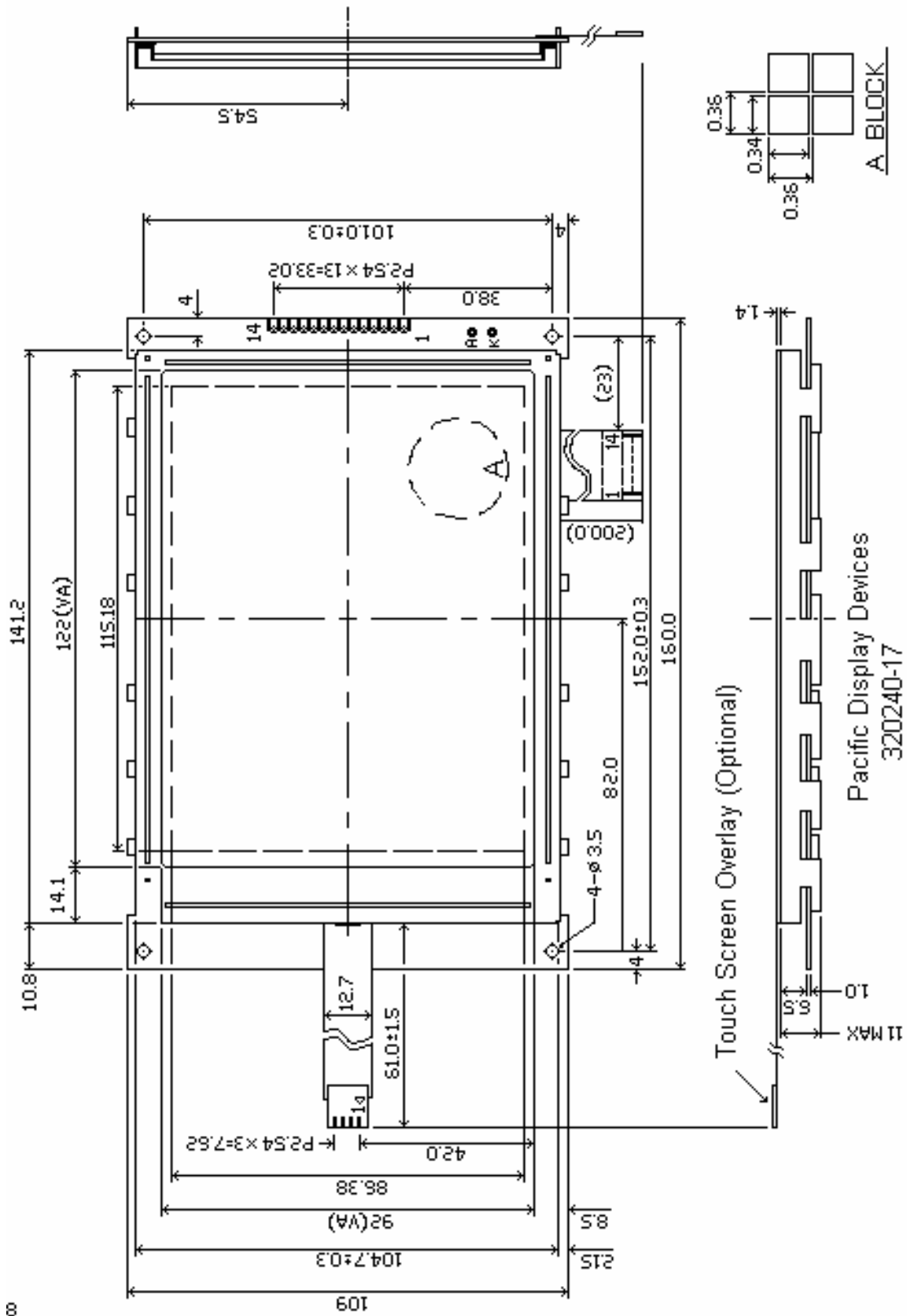


■ Module Dimensions Without Touch-Screen, CCFL Backlight



Pacific Display Devices
 320240-17

■ Module Dimensions With Touch-Screen (-TS Option, TS-9502 Shown)



2. ELECTRICAL / OPTICAL CHARACTERISTICS

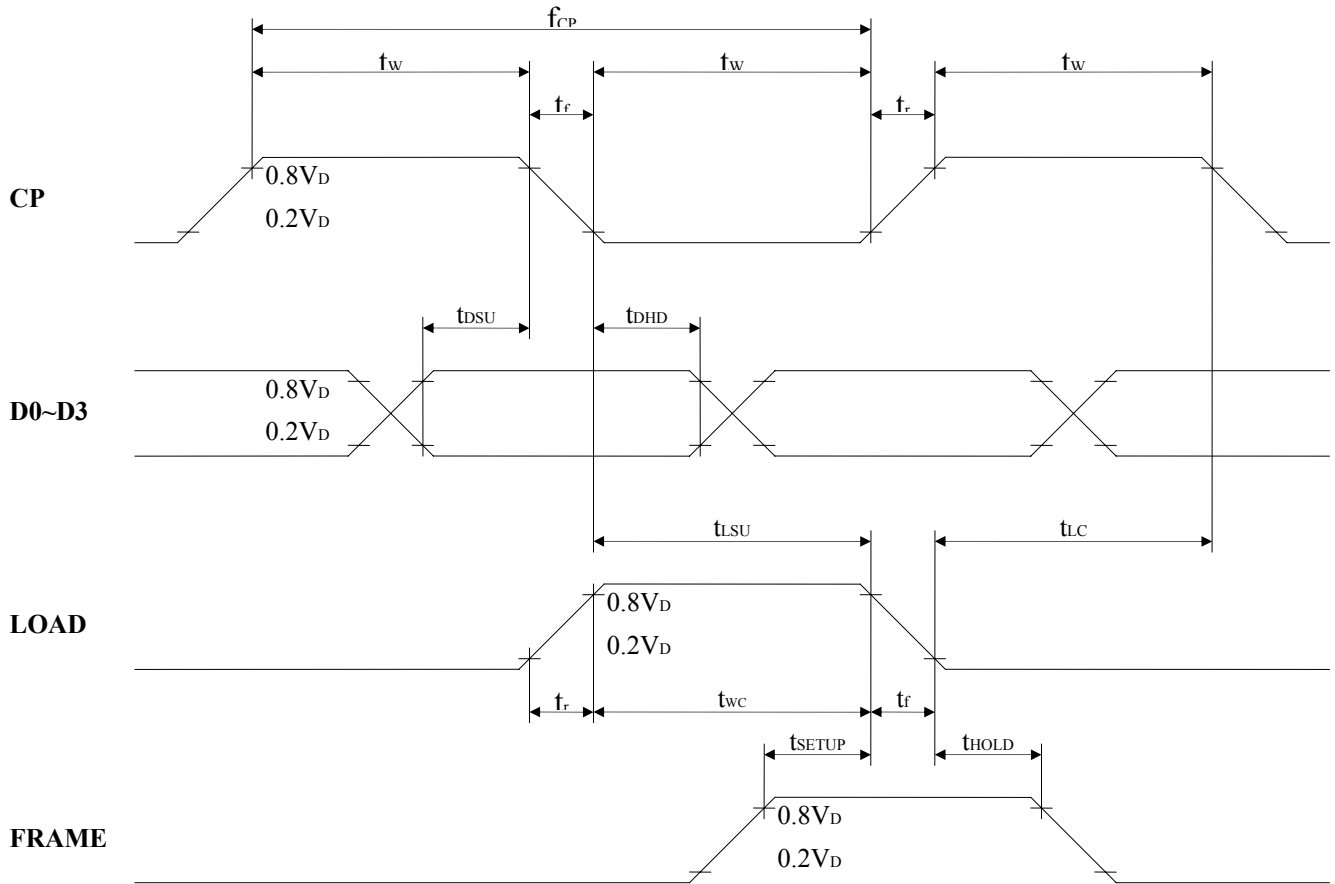
2.1 DC Electrical Characteristics ($V_{DD} = +5V \pm 10\%$, $V_{SS} = 0V$, $T_a = 25^\circ C$)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply voltage for logic	V_{DD}	---	4.5	5.0	5.5	V
Supply current for logic	I_{DD}	---	---	10	16	mA
Negative Supply Voltage*	Vee	$V_{SS}-V_{ee}$	---	-22	-25	V
Operating voltage for LCD	$V_{DD}-V_O$	0°C	23.6	24.3	25.0	V
		25°C	22.8	23.5	24.2	V
		50°C	21.9	22.6	23.3	V
Input voltage 'H' level	V_{IH}	---	$0.7 V_{DD}$	---	V_{DD}	V
Input voltage 'L' level	V_{IL}	---	0	---	$0.3 V_{DD}$	V

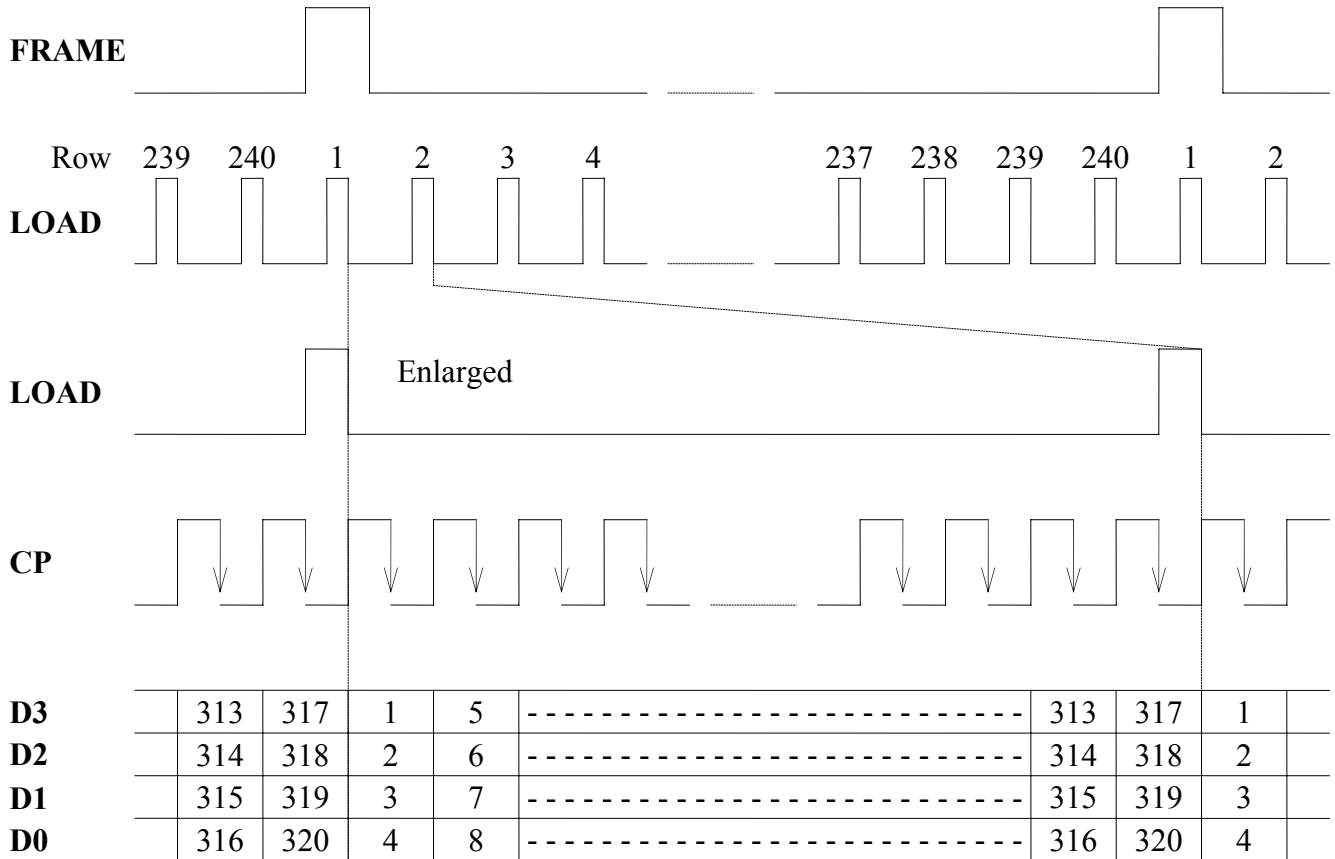
*Vee may be internally or externally supplied depending on module options

2.2 AC Electrical Characteristics

Item	Symbol	Min	Typ	Max	Unit
Clock frequency	f_{CP}	---	---	8	MHz
Clock pulse width	t_w	40	---	---	ns
Clock rise/fall time	t_r, t_f	---	---	1	ns
Data set up time	t_{DSU}	20	---	---	ns
Data hold time	t_{DHD}	20	---	---	ns
Load set up time	t_{LSU}	100	---	---	ns
Load → Clock time	t_{LC}	80	---	---	ns
'FRAME' set up time	t_{SETUP}	100	---	---	ns
'FRAME' hold time	t_{HOLD}	100	---	---	ns
'LOAD' pulse width	t_{WC}	80	---	---	ns



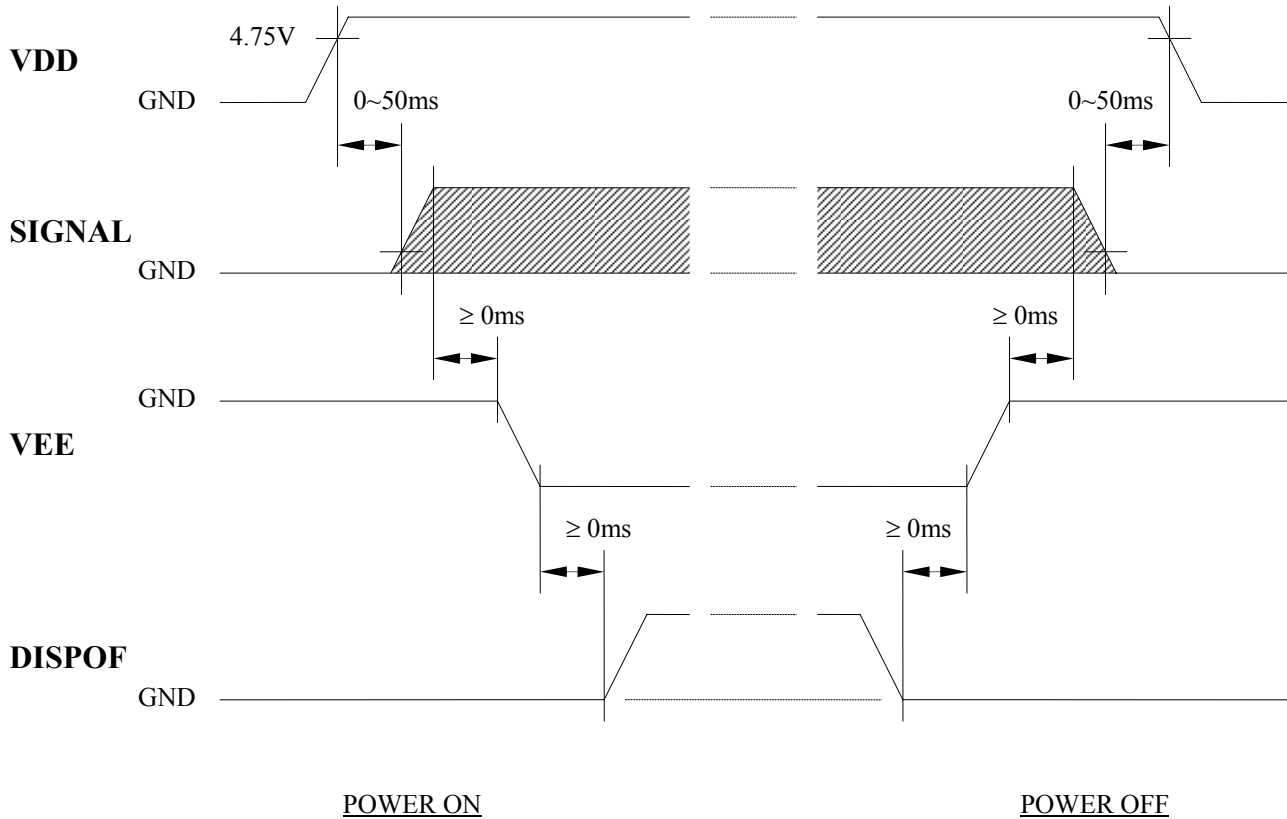
■ TIMING CHART OF INPUT SIGNALS



■ DISPLAY DATA PATTERN

	S1	S2	S3	S4	S5	• • • • •	S316	S317	S318	S319	S320	SEG															
C1	D3	D2	D1	D0	D3	• • • • •	D0	D3	D2	D1	D0																
C2	D3	D2	D1	D0	D3	• • • • •	D0	D3	D2	D1	D0																
• • • • • • •	<table border="1"> <thead> <tr> <th>Input data</th> <th colspan="2">Dots on display</th> </tr> </thead> <tbody> <tr> <td>D0</td> <td>Dot 4 Dot 8</td> <td>• • • Dot 316 Dot 320</td> </tr> <tr> <td>D1</td> <td>Dot 3 Dot 7</td> <td>• • • Dot 315 Dot 319</td> </tr> <tr> <td>D2</td> <td>Dot 2 Dot 6</td> <td>• • • Dot 314 Dot 318</td> </tr> <tr> <td>D3</td> <td>Dot 1 Dot 5</td> <td>• • • Dot 313 Dot 317</td> </tr> </tbody> </table>												Input data	Dots on display		D0	Dot 4 Dot 8	• • • Dot 316 Dot 320	D1	Dot 3 Dot 7	• • • Dot 315 Dot 319	D2	Dot 2 Dot 6	• • • Dot 314 Dot 318	D3	Dot 1 Dot 5	• • • Dot 313 Dot 317
Input data	Dots on display																										
D0	Dot 4 Dot 8	• • • Dot 316 Dot 320																									
D1	Dot 3 Dot 7	• • • Dot 315 Dot 319																									
D2	Dot 2 Dot 6	• • • Dot 314 Dot 318																									
D3	Dot 1 Dot 5	• • • Dot 313 Dot 317																									
C239	D3	D2	D1	D0	D3	• • • • •	D0	D3	D2	D1	D0																
C240	D3	D2	D1	D0	D3	• • • • •	D0	D3	D2	D1	D0																
COM																											

■ TIMING OF POWER SUPPLY

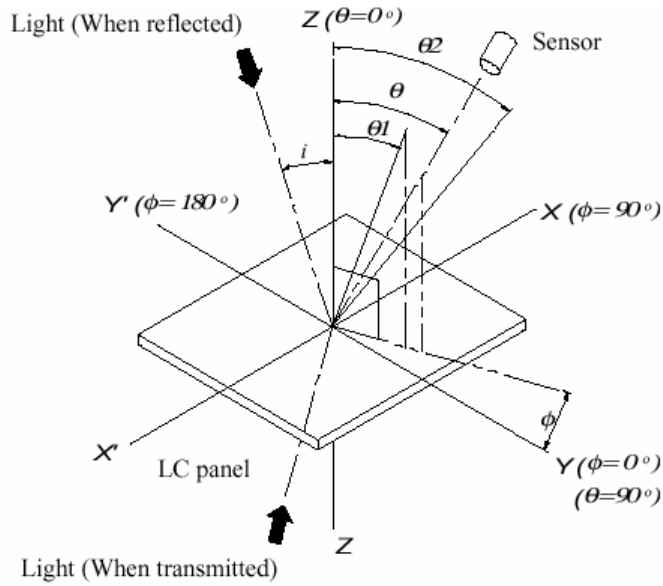


Note : The missing pixels may occur when the LCM is driven except above power supply timing sequence.

2.3 Optical Characteristics ($V_{OP} = 4.7V, T_a = 25^{\circ}C$)

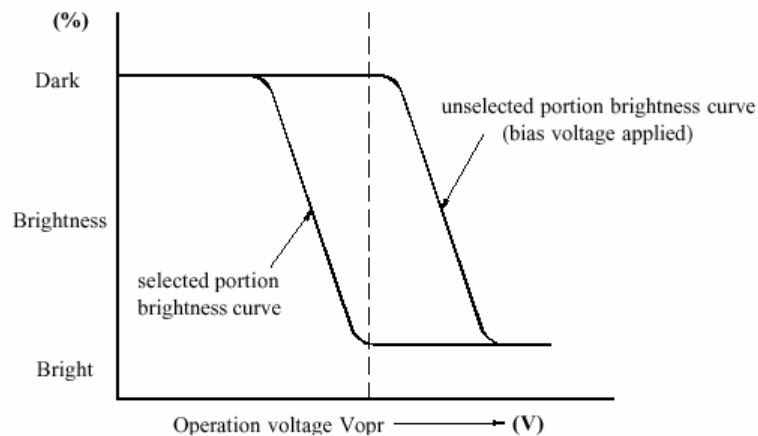
Item	Symbol	Condition	Min	Typ	Max	Unit
Contrast ratio	Cr	$\theta=0^{\circ}$ $\phi=0^{\circ}$	4.3	5.4	---	---
Frame Frequency	f_{FRM}	---	---	70	---	Hz
Viewing angle range	θ_1	25°C	---	43	---	deg
	θ_2		---	29	---	deg
Response time	T_{on}	25°C	---	157	---	ms
	T_{off}		---	255	---	ms

Definition of angles ϕ and θ :

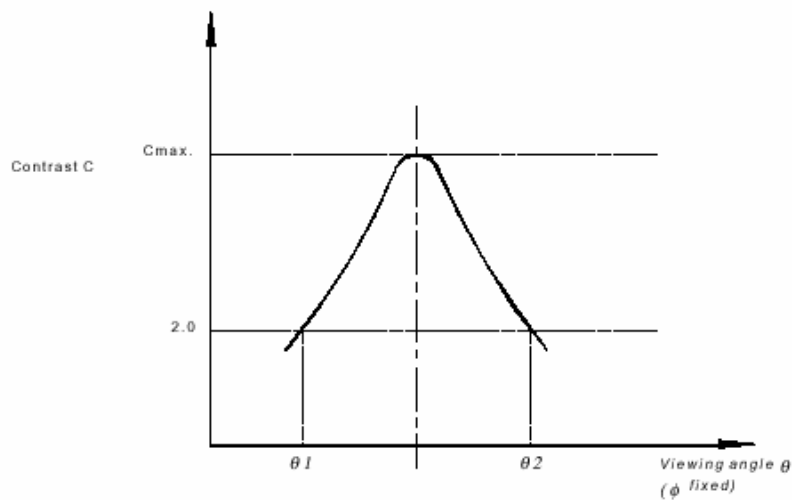


*Definition of contrast C

$$C = \frac{B1}{B2} = \frac{\text{Brightness of selected portion}}{\text{Brightness of unselected portion}}$$

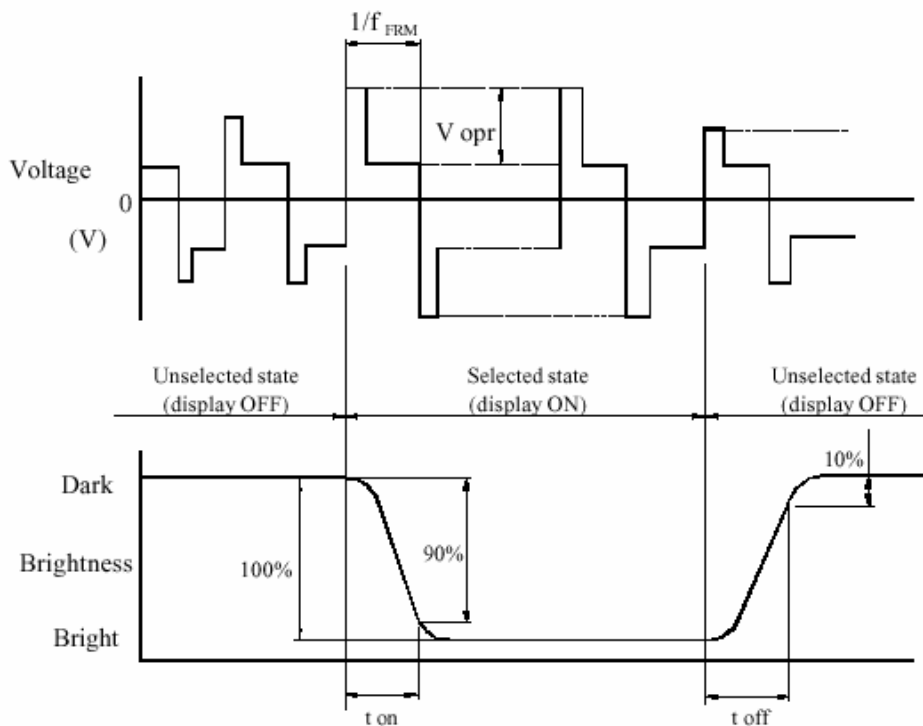


***Definition of viewing angles $\theta 1$ and $\theta 2$**



Note : Optimum vision with the naked eye and viewing angle θ at C_{max} above are not always the same.

***Definition of response time**



V_{opr} : Operating voltage (V) t_{on} : Response time (rise) (ms)
 f_{FRM} : Frame frequency (Hz) t_{off} : Response time (fall) (ms)

2.4 LED Backlight Characteristics

■ Standard White ELED (-WH) Operating Characteristics

Item	Symbol	Conditions	Standard			Unit
			Min.	Typ.	Max.	
Forward voltage	V_f	Ta= 25 °C		3.4	4.0	VDC
Forward Current	I_f	Ta= 25 °C		160	200	mA
Reverse Voltage	V_R	Ta= 25 °C	---	---	5	V

Item	Conditions	Standard		Unit
		Min.	Max.	
Life	Ta= 25 °C	20,000	---	hrs

■ Yellow-Green LED (-GY) Operating Characteristics

Item	Symbol	Conditions	Standard			Unit
			Min.	Typ.	Max.	
Forward voltage	V_f	Ta= 25 °C		2.2	2.4	VDC
Forward Current	I_f	Ta= 25 °C		280	560	mA
Reverse Voltage	V_R	Ta= 25 °C	---	---	8	VDC

Item	Conditions	Standard		Unit
		Min.	Max.	
Life	Ta= 25 °C	100,000	---	hrs

2.5 CCFL Backlight Characteristics (White)

■ Maximum Operating Condition (Ta=25°C, fL=55KHz)

The half-brightness life of the back light shall be kept as specified under the following absolute maximum conditions:

Power Consumption:	1.35W
Tube current:	5.0±1.0maArms

■ Electrical Characteristics (Ta=25°C)

Start Voltage:	450Vrms
Tube Voltage:	270Vrms typ.
Tube Current:	5.0mArms typ.
Drive frequency:	30-80KHz typ.

■ Initial Optical Characteristics (Ta: 25°C, 30%-85% relative humidity, no air flow)

Power Source:	TDK L10L inverter.
Brightness Uniformity:	75%
Average Brightness:	550cd/m ² min. (Measurement shall be continuous on for 30 minutes)
Chromaticity:	x=0.3475±0.015 y=0.3750±0.015

■ Life

Power Source:	TDK L10L inverter.
Tube Current:	5ma
Half-Brightness Life of Unit:	10,000 Hours min. The definition of half-brightness life is either average brightness reach to 50% of initial average brightness or lamp stopping light emission.

■ Temperature and Humidity Ratings:

Operating Temperature:	0 to 50°C
	Humidity 20 to 90%RH
Storage temperature:	-20 to 80°C
	Humidity 5 to 95%RH

■ CCFL Connector:

Manufacture:	JAE
Part Number:	IL-G-4S-S3C2
Pin Pitch:	2.5mm

2.6 Touch Panel Characteristics

■ Electrical Characteristics

Power ratings:

Maximum Voltage: 5V DC

Maximum Current: Less than 1ma at contact point of top layer with bottom layer

Insulation Resistance: >10MΩ at 25V DC

Terminal Resistance:

Between X1 and X2: 250 ~ 750Ω

Between Y1 and Y2: 250 ~ 850Ω

Static Electricity

Max Induced Energy: 15KV thru 150Ω 150pf

Linearity: 1.5% Max Linear Deviation

Maximum interlayer capacitance: 100nf max. (Application weight 3g/cm²)

■ Mechanical Characteristics

Actuation Force: 10g ~ 80g

Input Touch Radius = 0.8 stylus or finger

Transparency: 79% (Typical)

Heat Sealed Area Strength: 150g/cm with a 90 degree peeling test

Surface hardness: Pencil hardness >3H per JIS-K5400

■ Touch Screen Mechanical Configuration and Interconnect:

TS-9502 Option (shown in mechanical drawing, Interconnect tail exits left edge)

Pin No.	Symbol	Description
1	Top	Y Plane Electrode 1
2	Bottom	Y Plane Electrode 2
3	Left	X Plane Electrode 1
4	Right	X Plane Electrode 2

TS-9503 Option (not shown in mechanical drawing, Interconnect tail exits bottom edge)

Pin No.	Symbol	Description
1	Top	Y Plane Electrode 1
4	Right	X Plane Electrode 2
2	Bottom	Y Plane Electrode 2
3	Left	X Plane Electrode 1

TS-9504 Option (not shown in mechanical drawing, Interconnect tail exits left edge)

Pin No.	Symbol	Description
1	Top	Y Plane Electrode 1
2	Bottom	Y Plane Electrode 2
3	Left	X Plane Electrode 1
4	Right	X Plane Electrode 2

Note 1: Separate data sheets for touch screens are available.

Note 2: Specialized pin-outs and touch screens can be incorporated as needed by customer.

4. RELIABILITY

Environmental Test				
No	Test Item	Content of Test	Test Condition	Applicable Standard
1	High temperature storage	Endurance test applying the high storage temperature for a long time.	60 °C 200 hrs	-----
2	Low temperature storage	Endurance test applying the low storage temperature for a long time.	-10 °C 200 hrs	-----
3	High temperature operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	50 °C 200 hrs	-----
4	Low temperature operation	Endurance test applying the electric stress under low temperature for a long time.	0 °C 200 hrs	-----
5	High temperature / Humidity storage	Endurance test applying the high temperature and high humidity storage for a long time.	60 °C , 90 %RH 96 hrs	MIL-202E-103B JIS-C5023
6	High temperature / Humidity operation	Endurance test applying the electric stress (Voltage & Current) and temperature / humidity stress to the element for a long time.	40 °C , 90 %RH 96 hrs	MIL-202E-103B JIS-C5023
7	Temperature cycle	Endurance test applying the low and high temperature cycle. $\begin{array}{c} -20^{\circ}\text{C} \quad 25^{\circ}\text{C} \quad 70^{\circ}\text{C} \\ 30\text{min} \rightleftharpoons 5\text{min.} \rightleftharpoons 30\text{min} \\ \longleftarrow \hspace{10em} \longrightarrow \\ \hspace{10em} \text{1 cycle} \end{array}$	-10°C / 60°C 10 cycles	-----
Mechanical Test				
8	Vibration test	Endurance test applying the vibration during transportation and using.	10~22Hz → 1.5mmp-p 22~500Hz → 1.5G Total 0.5hrs	MIL-202E-201A JIS-C5025 JIS-C7022-A-10
9	Shock test	Constructional and mechanical endurance test applying the shock during transportation.	50G Half sign wave 11 msdc 3 times of each direction	MIL-202E-213B
10	Atmospheric pressure test	Endurance test applying the atmospheric pressure during transportation by air.	115 mbar 40 hrs	MIL-202E-105C
Others				
11	Static electricity test	Endurance test applying the electric stress to the terminal.	VS=800V , RS=1.5 kΩ CS=100 pF 1 time	MIL-883B-3015.1

*** Supply voltage for logic system = VDD. Supply voltage for LCD system = Operating voltage at 25°C

■ LCD Panel Service Life

Definition of panel service life

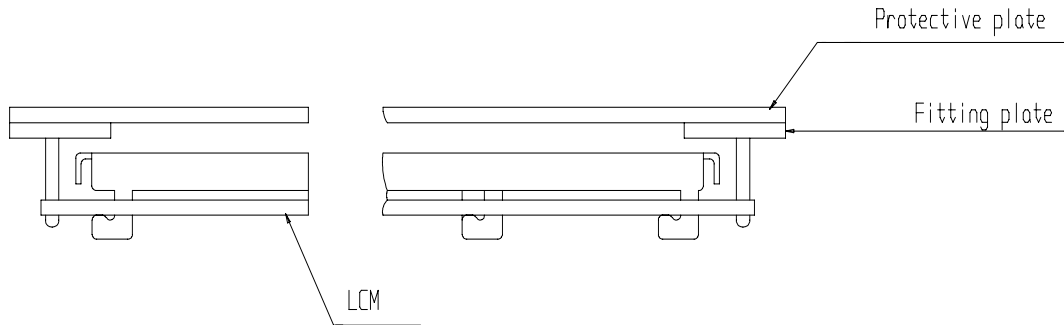
- 100,000 hours minimum at 25° C ±10%
- Contrast becomes 30% of initial value
- Current consumption becomes three times higher than initial value
- Remarkable alignment deterioration occurs in LCD cell layer
- Unusual operation occurs in display functions

5. PRECAUTIONS FOR USING LCD MODULES

Installing LCD Modules

The hole in the printed circuit board is used to fix LCM as shown in the picture below. Attend to the following items when installing the LCM.

- 1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



- 2) When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be ± 0.1 mm.

Precaution for Handling LCD Modules

Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

- 1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.
- 2) Do not alter, modify or change the shape of the tab on the metal frame.
- 3) Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
- 4) Do not damage or modify the pattern writing on the printed circuit board.
- 5) Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.
- 6) Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
- 7) Do not drop, bend or twist LCM.

Electro-Static Discharge Control

Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC.

- 1) Make certain that you are grounded when handling LCM.
- 2) Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential.
- 3) When soldering the terminal of LCM, make certain the AC power source for the soldering iron does not leak.
- 4) When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.
- 5) As far as possible make the electric potential of your work clothes and that of the work bench the ground potential.
- 6) To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%-60% is recommended.

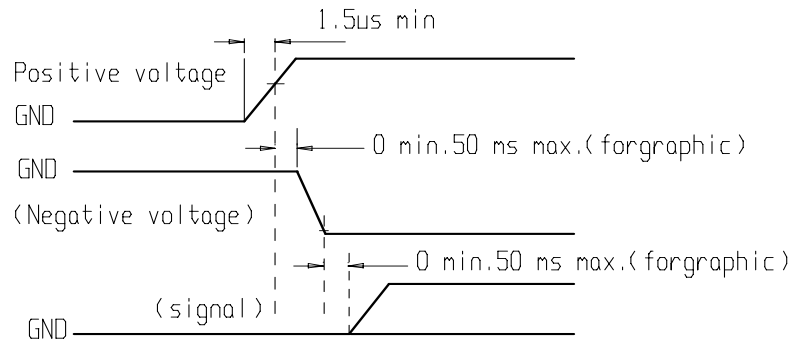
Precaution for soldering to the LCM

- 1) Observe the following when soldering lead wire, connector cable and etc. to the LCM.
 - a) Soldering iron temperature : $280^{\circ}\text{C} \pm 10^{\circ}\text{C}$.
 - b) Soldering time : 3-4 sec.
- 2) Solder : eutectic solder.

- 3) If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.
- 4) When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.
- 5) When remove the electroluminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PC board could be damaged.

Precautions for Operation

- 1) Viewing angle varies with the change of liquid crystal driving voltage (VO). Adjust VO to show the best contrast.
- 2) Driving the LCD in the voltage above the limit shortens its life.
- 3) Response time is greatly delayed at temperature below the operating temperature range. However, this does not mean the LCD will be out of the order. It will recover when it returns to the specified temperature range.
- 4) If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.
- 5) Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit. Therefore, it must be used under the relative condition of 40°C , 50% RH.
- 6) When turning the power on, input each signal after the positive/negative voltage becomes stable.



Safety

- If the LCD panel breaks, be careful not to get the liquid crystal in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

Handling

- The display panel is made of glass. Do not subject it to a mechanical shock by dropping it or impact.
- If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.
- Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents :
 - Isopropyl alcohol
 - Ethyl alcohol
- Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.
 - Water
 - Ketone
 - Aromatic solvents
- Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.
- Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.
- Do not attempt to disassemble or process the LCD module.
- NC terminal should be open. Do not connect anything.
- If the logic circuit power is off, do not apply the input signals.

- To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
 - Be sure to ground the body when handling the LCD modules.
 - Tools required for assembling, such as soldering irons, must be properly grounded.
 - To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.
 - The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

Storage

- When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps
- Store the module in a dark place where the temperature is $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$ and the humidity below 65% RH.
- Do not store the module near organic solvents or corrosive gases.
- Do not crush, shake, or jolt the module (including accessories).

Cleaning

- Do not wipe the polarizing plate with a dry cloth, as it may scratch the surface.
- Wipe the module gently with soft cloth soaked with a petroleum benzene.
- Do not use ketonic solvents (ketone and acetone) or aromatic solvents (toluene and xylene), as they may damage the polarizing plate.

Others:

- Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.
- If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.
- To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.
 - Exposed area of the printed circuit board.
 - Terminal electrode sections.