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1. SPECIFICATIONS

1.1 Features

- Dot-matrix structure with 16*2 characters
- STN LCD, 1/16 Duty, 1/4 bias
- Positive, Yellow Green, Transflective TYPE
- 6 o'clock viewing angle
- 8 bits parallel data input
- With LED backlight

1.2 Mechanical Specifications

- Outline dimension : 84.0 mm(L)* 44.0 mm(W)* 14.5mm max.(H)
- Viewing area : 61.0 mm * 15.8 mm
- Active area : 56.21mm * 11.5 mm
- Dot size : 0.56mm * 0.66mm
- Dot pitch : 0.6 mm * 0.7 mm
- Character Size : 2.96mm * 5.56mm

1.3 Absolute Maximum Ratings

Item	Symbol	Conditions	Min.	Max.	Unit
Power supply Voltage	VDD	-	0	6.5	V
LCD drive Supply voltage	VDD-VO	-	-	13	V
Input voltage	VIN	-	-0.3	VDD+0.3	V
Operating temperature	TOPR	-	-20	70	°C
Storage temperature	TSTG	-	-30	80	°C
Humidity*1	HD	-	-	90	%RH

1.4 DC Electrical Characteristics

VDD=+5V±10%, VSS=0V, TA=25°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Logic Supply voltage	VDD	-	4.5	5	5.5	V
“H” input voltage	VIH	-	0.8VDD	-	VDD	V
“L” input voltage	VIL	-	0	-	0.2VDD	V
“H” output voltage	VOH	-	VDD-0.3	-	-	V
“L” output voltage	VOL	-	-	-	0.3	V
Supply current	IDD	VDD=5V	-	1.55	-	mA
LCD driving voltage	VOP	VDD-VO	5.8	6.5	6.9	V



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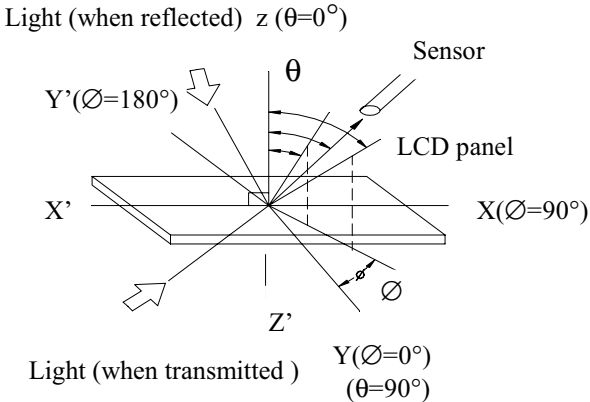
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1.5 Optical Characteristics

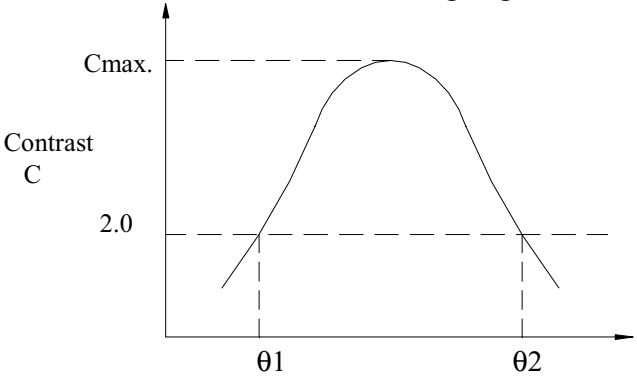
1/16 duty, 1/4 bias, $V_{opr}=6.5V$, $T_a=25^{\circ}C$

Item	Symbol	Conditions	Min.	Typ.	Max	Reference
Viewing angle	θ	$C \geq 2.0, \phi = 0^{\circ}C$	30°		-	Notes 1 & 2
Contrast	C	$\theta = 5^{\circ}, \phi = 0^{\circ}$	3	4.5	-	Note 3
Response time(rise)	t_r	$\theta = 5^{\circ}, \phi = 0^{\circ}$	-	120ms	180ms	Note 4
Response time(fall)	t_f	$\theta = 5^{\circ}, \phi = 0^{\circ}$	-	250ms	400ms	Note 4

Note 1: Definition of angles θ and ϕ



Note 2: Definition of viewing angles θ_1 and θ_2

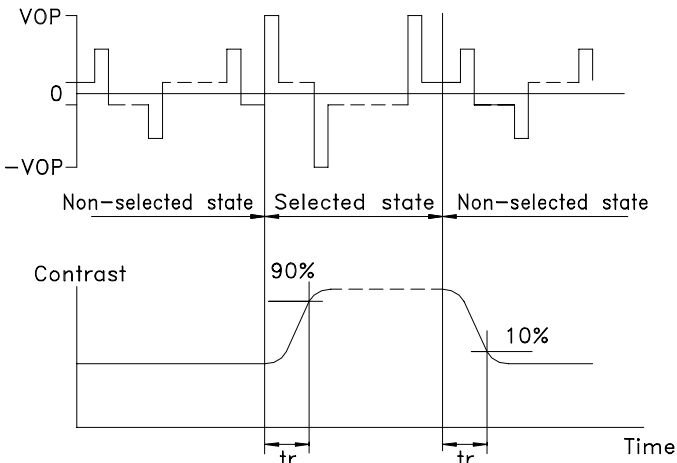
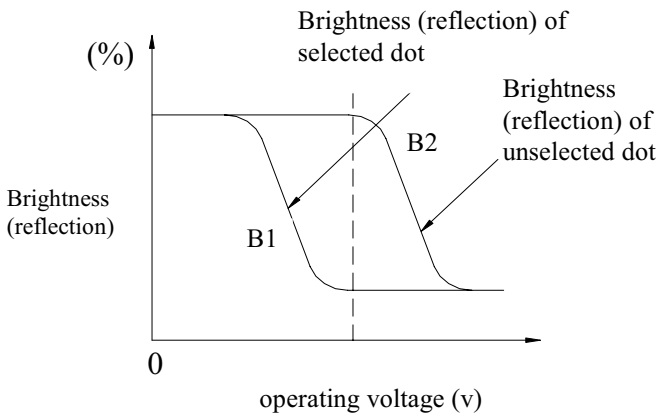


viewing angle θ (ϕ fixed)
 Note : Optimum viewing angle with the naked eye and viewing angle θ at C_{max} . Above are not always the same

Note 3: Definition of contrast C

$$C = \frac{\text{Brightness (reflection) of unselected dot (B2)}}{\text{Brightness (reflection) of selected dot (B1)}}$$

Note 4: Definition of response time



Note: Measured with a transmissive LCD panel which is displayed 1 cm^2

V_{opr} : Operating voltage f_{FRM} : Frame frequency
 t_r : Response time (rise) t_f : Response time (fall)

1.6 Backlight Characteristic

The LCD Module is backlight using a LED panel

- Maximum Ratings

Item	Symbol	Conditions	Min.	Max.	Unit
Forward current	IF	TA=25°C	-	300	mA
Reverse voltage	VR	TA=25°C	-	8	V
Power dissipation	PO	TA=25°C	-	1.38	W
Operating Temperature	TOPR	-	-20	70	°C
Storage temperature	TSTG	-	-40	80	°C

- Electrical Ratings

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward voltage	VF	IF=120mA	-	4.2	4.6	V
Reverse current	IR	VR=8V	-	-	0.2	mA
Luminous intensity	IV	IF=120mA	144	180	-	cd/m ²
Wavelength	λ_p	IF=120mA	571	-	576	nm
Color	Yellow Green					



2. MODULE STRUCTURE

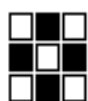
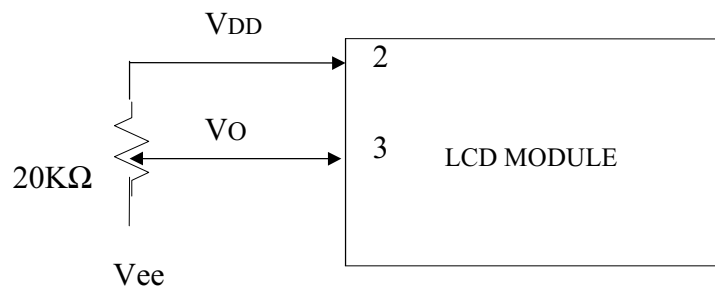
2.1 Counter Drawing

*See Appendix

2.2 Interface Pin Description

Pin No.	Symbol	Signal Description
1	VSS	Signal ground (GND)
2	VDD	Power Supply (5 V)
3	VO	Operating voltage (LCD Driver)
4	RS	Register Selection input High = Data register Low = Instruction register (for write) Busy flag address counter (for read)
5	R/W	Read/Write signal input is used to select the read/write mode High = Read mode, Low = Write mode
6	E	Start enable signal to read or write the data
7~10	DB0 ~ DB3	Four low order bi-directional three-state data bus lines. Use for data transfer between the MPU and the LCD module. These four are not used during 4-bit operation.
11~14	DB4 ~ DB7	For high order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCD module. DB7 can be used as a busy flag.
15	A	Power supply LED backlight (+)
16	K	Power supply LED backlight (-)

Contrast Adjust

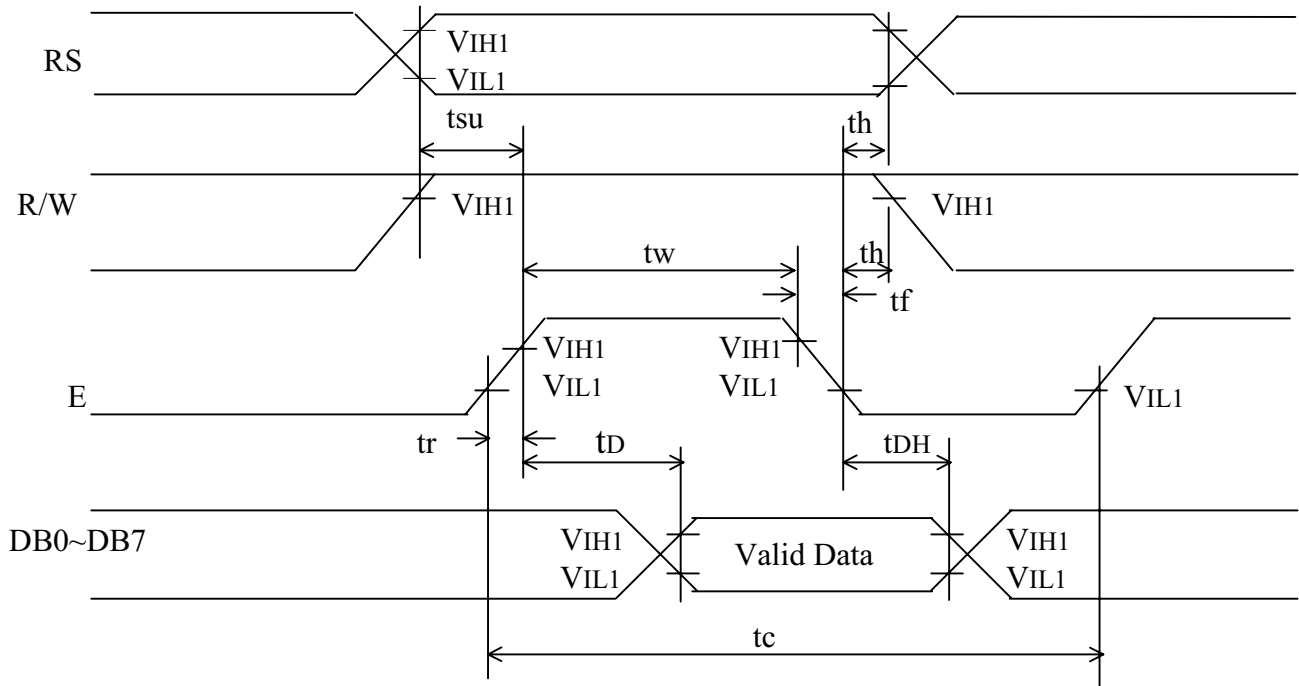


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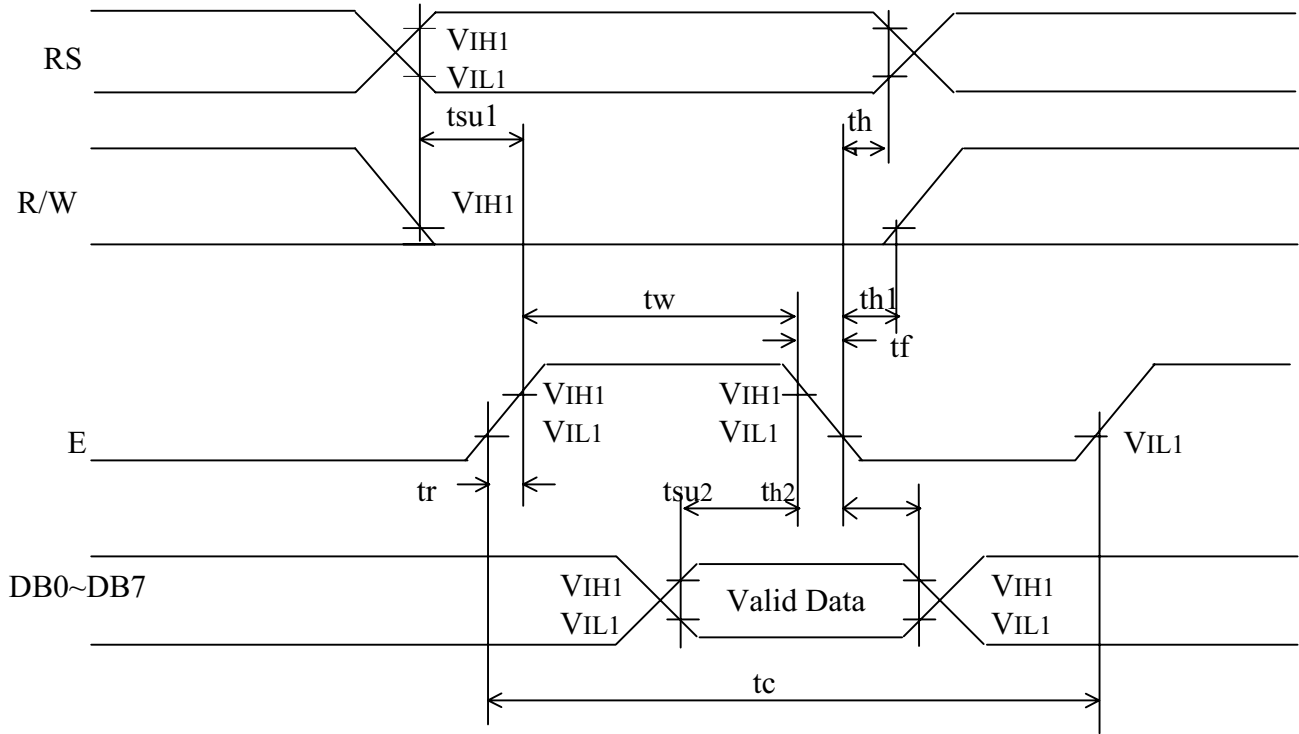
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2.3 Timing Characteristics

• Read cycle



• Write cycle



- Read cycle

 $V_{DD}=+5V\pm 10\%$, $V_{SS}=0V$, $T_a=25^{\circ}C$

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Pin
Enable cycle time	tc	500	-	-	ns	E
Enable "H" level pulse width	tw	230	-	-	ns	E
Enable rise /fall time	tr,tf	-	-	20	ns	E
RS,R/W setup time	tsu	40	-	-	ns	RS,R/W
RS,R/W address hold time	th	10	-	-	ns	RS,R/W
Read data output delay time	tD	-	-	120	ns	DB0~DB7
Read data hold time	tDH	5	-	-	ns	DB0~DB7

- Write cycle

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Pin
Enable cycle time	tc	500	-	-	ns	E
Enable "H" level pulse width	tw	230	-	-	ns	E
Enable rise /fall time	tr,tf	-	-	20	ns	E
RS,R/W setup time	tsu	40	-	-	ns	RS,R/W
RS,R/W address hold time	th	10	-	-	ns	RS,R/W
Read data output delay time	tD	80	-	-	ns	DB0~DB7
Read data hold time	tDH	10	-	-	ns	DB0~DB7



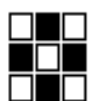
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2.4 Display Command

Instructions	Instruction Code										Description	Execution Time (fosc=270KHZ)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM. and set DDRAM address to "00H" from AC.	1.52ms
Return Home	0	0	0	0	0	0	0	0	1	×	Set DDRAM address to "00H" from AC and return cursor to it's original position if shifted. The contents of DDRAM are not changed.	1.52ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction and make shift of entire display enable.	37μs
Display ON/OFF Control	0	0	0	0	0	0	1	D	C	B	Sets display (D), cursor(C), and blinking of cursor(B) on/off control bit.	37μs
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	×	×	Set cursor moving and display shift control bit, and the direction, without changing of DDRAM data.	37μs
Function Set	0	0	0	0	1	DL	N	F	×	×	Set interface data length (DL:4-bit/8-bit), numbers of display line (N: 1-line/2-line), display font type(F:5*8 dots/5*11 dots)	37μs
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	37μs
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.	37μs
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0μs
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	43μs
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	43μs

※ "× ":don't care



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2.4 Character Pattern

		Higher 4-bit (D4 to D7) of Character Code (Hexadecimal)															
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Lower 4-bit (D0 to D3) of Character Code (Hexadecimal)	0	CG RAM (1)	±		0	0	P	'	P	5	é	á		r	R	B	t
	1	CG RAM (2)	≡	!	1	A	Q	a	g	Q	a	í		J	t	y	o
	2	CG RAM (3)	7	"	2	B	R	b	r	e	B	é	'	o	é	é	x
	3	CG RAM (4)	z	*	3	O	S	c	s	á	á	á		r	7	e	q
	4	CG RAM (5)	7	*	4	D	T	d	t	á	á	á		'	r	z	o
	5	CG RAM (6)	7	z	5	E	U	e	u	á	á	é	'	b	t	a	n
	6	CG RAM (7)	7	8	6	F	U	t	v	á	á	é	'	u	w	a	a
	7	CG RAM (8)	7	'	7	G	U	w	s	U	R	x	'	x	+	A	U
	8	CG RAM (1)	7	0	8	H	X	h	x	é	é	'	'	+	é	K	M
	9	CG RAM (2)	7	7	9	I	Y	i	y	é	é	'	'	z	7	M	X
	A	CG RAM (3)	8	*	8	J	Z	j	z	é	é	'	'	z	7	z	U
	B	CG RAM (4)	7	+	8	K	L	k	l	é	é	'	'	z	7	v	+
	C	CG RAM (5)	≡	'	<	L	\	l	l	é	é	'	'	z	7	z	U
	D	CG RAM (6)	8	-	=	M	I	m	i	é	é	'	'	z	7	z	U
	E	CG RAM (7)	8	.	>	N	^	n	^	é	é	'	'	z	7	z	U
	F	CG RAM (8)	8	/	?	O	_	o	_	é	é	'	'	z	7	z	U



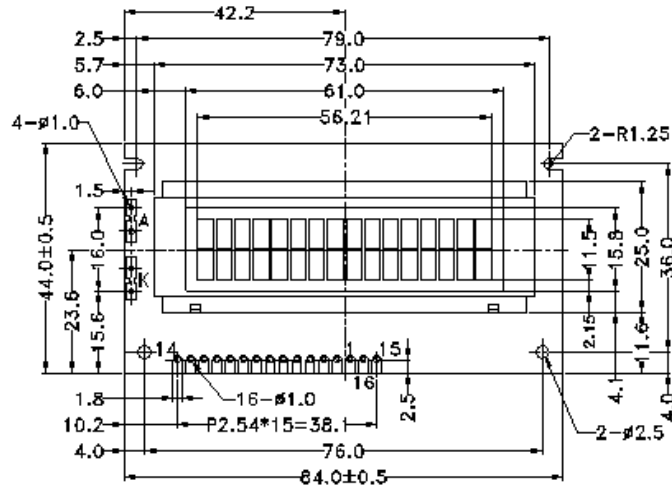
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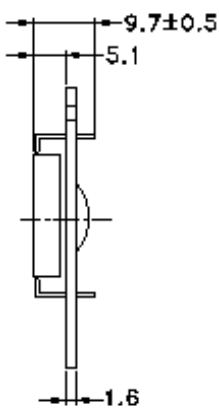
2.5 Dimensions (mm)

NOTE: all dimensions, unless otherwise stated have a tolerance of $\pm 0.3\text{mm}$

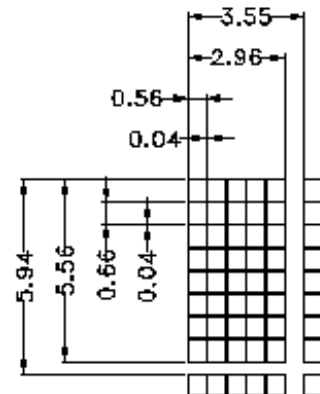
Front View



Side View



Character Dimensions



Handling Guidelines

Precautions for handling Static Safe Displays

- Do not subject to excessive shock by dropping the units.
- Do not modify or adjust the tab of the metal bezel.
- Do not modify the printed circuit board.
- Limit the soldering to the printed circuit board to only the I/O terminals.
- Do not touch the connective rubber (inter-connector), or modify its location.

Precautions regarding Static Electricity

- **Do not take LCM from its anti-static bag until it is time to assemble:**

LCM's are individually packaged in bags treated to resist static electricity. An LCM should not be removed from the bag until it is time to solder the terminals. When storing the LCM's keep them packaged in the anti-static bags, or a container that is resistant to static electricity, or in an electric conductive container.

- **Always use a body ground when handling an LCM:**

Always apply grounding to your body while you are working with an LCM from the time it is taken out of the anti-static bag until it is assembled. When it is necessary to handle the LCM, once it is taken out of the bag, always place it in an electric conductive container. Avoid wearing clothes of chemical fibre. Cotton or conductive treated fibre clothes are recommended.

- **Use a no-leak soldering iron:**

The soldering iron used for soldering the I/ O terminals of the LCM should be insulated at the iron tip or grounded on the iron tip.

- **An electrical apparatus is always required for assembly:**

When the LCM is to be assembled with an electrical apparatus, this assembly should be grounded to avoid transmitting spikes generated by the noise of the motor rotating.

- **Make the operation bench equal to the ground**

When the operation bench is grounded with an aluminium or steel plate, there is always the possibility of an electric shock being generated, when the impedance is too low. It is therefore recommended that an electric conductive (rubber) mat be used.

- **Peel off the LCM protective film slowly:**

Attached to the face of the LCM is a film to protect the display surface from contamination, flaw, adhesion of flux, etc. Peeling off this film too abruptly may cause static electricity to be generated. Thus peel the tape off slowly.

- **Attention should be paid to humidity:**

50~60%RH is acceptable.

Precautions for soldering the LCM

The following procedures should be followed when soldering the LCM:

- Solder is to be applied only to the I/O terminals.
- Use a soldering iron with no leakage.

In addition, further attention should be paid to the following.

(1) Conditions for soldering I/O terminals:

- Temperature at iron tip: 280°C + 10°C
- Soldering time: 3-4 sec. per terminal
- Type of solder: Eutectic solder (Rosin flux filled)
- Avoid using flux, since it may penetrate the LCM and could possibly cause contamination.
- When cleaning is required do not remove the protective film until after the soldering of the I/O terminals has been completed. This will eliminate contamination with by the dispersion of flux where soldering.

(2) Removing the wiring:

When a lead wire or a connector that has been soldered to the I/O terminals of the LCM is to be removed, do so only after the solder at the connection has sufficiently melted. If this wire or connector is forcefully removed, it may cause the terminal to break or peel. It is recommended that a suction-type soldering iron be used. Do not attempt to solder a lead wire or connector more than 3 times to a given LCM.

Long term Storage

When long-term storage of an LCM is necessary, the following procedures should be complied with. If not stored properly, it could cause deterioration of the polarizer and oxidation of the I/O terminals, which would make soldering more difficult.

- Store in original packaging if possible.
- For individual LCM's, place them in anti-static bags, sealing the opening and storing it where it is not subject to direct sunlight or the light from a fluorescent light.
- Store in a temperature range of 0oC ~35oC with low humidity. Note, refer to the specific module specification for requirements regarding storage temperature and humidity.

Excess Current Protection

An over current protection circuit is not provided with the LCM. Therefore, it is recommended to use an electrical source that will provide for this current protection.

Precautions for using LCD's

- Prevent external shock.
- Do not wipe the surface of the LCD with hard materials.
- Do not apply excessive force on the surface of the LCD.
- Do not apply DC voltage.
- Do not expose to direct sunlight or fluorescent light for extended periods.
- Avoid storage in high temperature and humidity. (When storage for an extended period at 40oC or higher, R/H should be less than 60%)
- The fluid within the LCD is hazardous. Do not permit this liquid to come into contact with the eyes or mouth area.