

TIANMA Microelectronics (U.S.A.) Inc.

SPECIFICATION FOR LCD MODULE

Model No. TM162AAC6

To:

Customer's Approval

Date: _____

By: _____

Presented

By: _____

Tianma Microelectronics (U.S.A.) Inc.

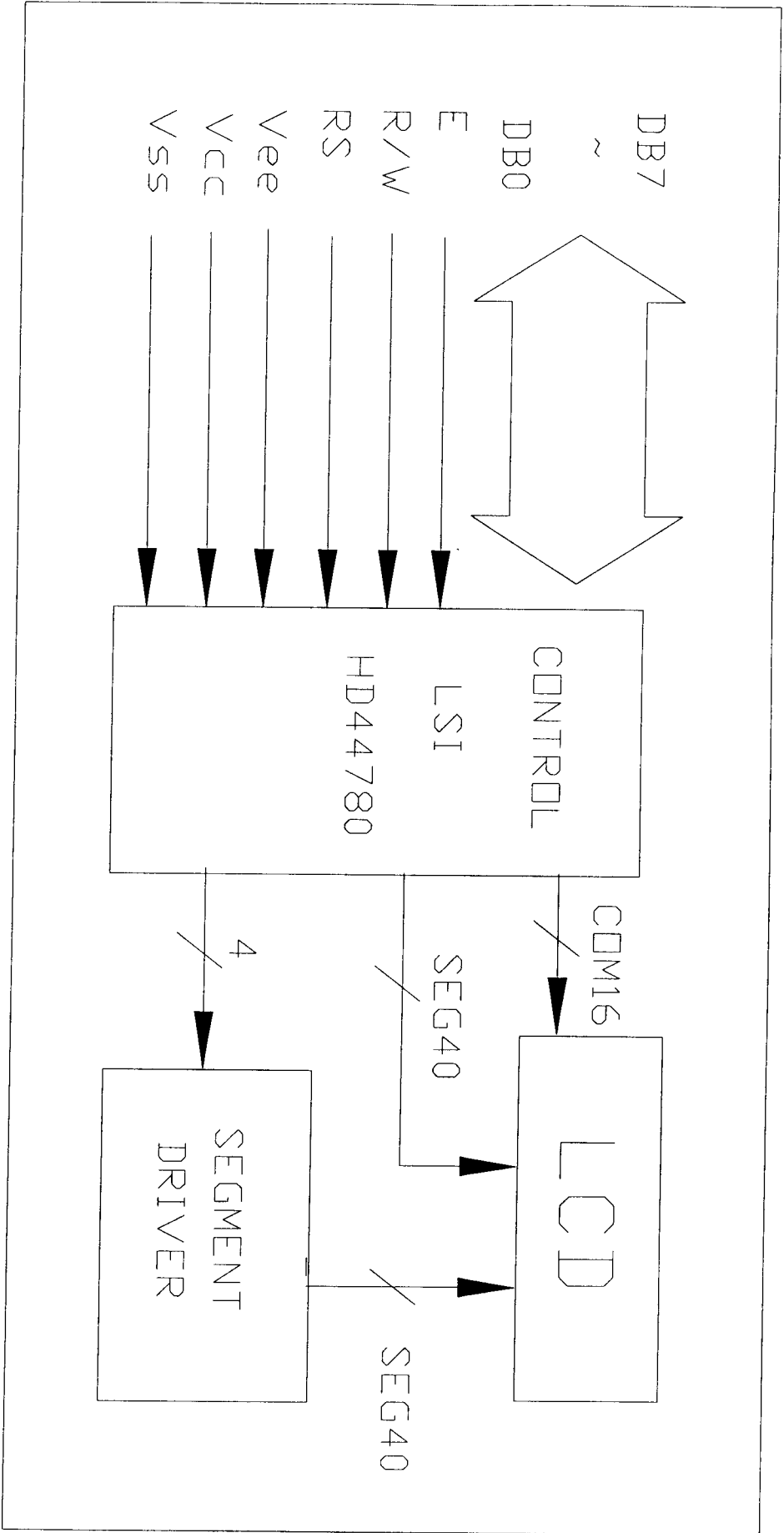
1, Display Specifications

- 1.1 Display Type: TN
- 1.2 Display Color: Blue-Black
- 1.3 Polarizer mode: Transflective
- 1.4 Viewing Angle: 6:00
- 1.5 Driving Duty: 1/16
- 1.6 Back light: LED

- Color tone is slightly changed by temperature and driving voltage.

2, Mechanical Specifications

- 2.1 Outline Dimensions: Refer to outline drawing on page 2
- 2.2 Dot Matrix: Refer to outline drawing on page 2
- 2.3 Dot Size; Refer to outline drawing on page 2
- 2.4 Dot Pitch: Refer to outline drawing on page 2



4 Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage	$V_{DD}-V_{SS}$	-0.3	7.0	V	
LCD Driving Voltage	$V_{DD}-V_{EE}$	-0.3	13.0		
Operating Temperature Range	T_{OP}	0	50	°C	No Condensation
Storage Temperature Range	T_{ST}	-20	70		

5 Electrical Specifications and Instruction Code

5.1 Electrical characteristics

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Supply Voltage (Logic)	$V_{DD}-V_{SS}$	4.5	5.0	5.5	V	
Supply Voltage (LCD Drive)	$V_{DD}-V_{EE}$	-	4.7	-	V	
Input Signal Voltage	'H'Level	V_{IH}	$0.7V_{DD}$	-	$V_{DD}+0.3$	V
	'L'Level	V_{IL}	-0.3	-	$0.2 V_{DD}$	V
Supply current (Logic)	I_{DD}	-	-	1.1	mA	
Supply current (LCD Drive)	I_{EE}	-	-	0.37	mA	
Supply Current (LED)	I_{LED}	-	-		mA	

5.2 Interface Signals

Pin No.	Symbol	Level	Description
1	V _{SS}	0V	Ground
2	V _{CC}	5.0V	Power supply voltage for logic and LCD(+)
3	V _{EE}	0.3V	Power supply voltage for LCD(-)
4	RS	H/L	Selects registers
5	R/W	H/L	Selects read or write
6	E	H/L	Starts data read/write
7	DB0	H/L	Data bit0
8	DB1	H/L	Data bit1
9	DB2	H/L	Data bit2
10	DB3	H/L	Data bit3
11	DB4	H/L	Data bit4
12	DB5	H/L	Data bit5
13	DB6	H/L	Data bit6
14	DB7	H/L	Data bit7
15	LED+	4.2V	The positive electrode of LED backlight
16	LED-	0V	The negative electrode of LED backlight

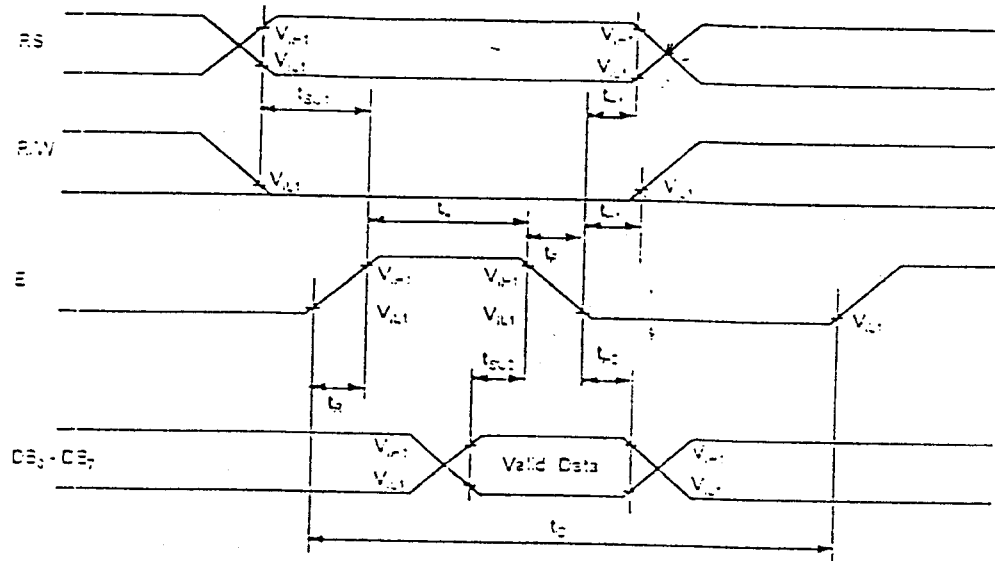
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5.3 Interface Timing Chart:

AC Characteristics ($V_{CC}=5V \pm 10\%$, $V_{EE}=0V$, $T_a=-20 - +75^\circ C$)

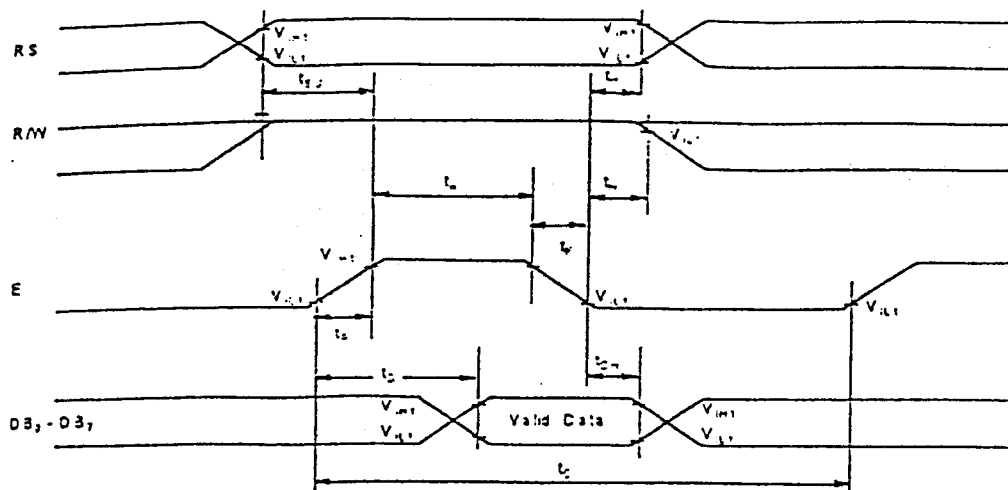
(1) Write mode (Writing data from Micom to K5C066)

Characteristic	Symbol	Min	Typ	Max	Unit	Test pin
E Cycle Time	t_c	500	-	-	ns	E
E Rise Time	t_r	-	-	25	ns	E
E Fall Time	t_f	-	-	25	ns	E
E Pulse Width (High, Low)	t_w	220	-	-	ns	E
RW and RS Set-up Time	t_{su}	40	-	-	ns	RW, RS
Rw and RS Hold Time	t_h	10	-	-	ns	RW, RS
Data Set-up Time	t_{sc}	60	-	-	ns	DB ₇ -DB ₀
Data Hold Time	t_{sh}	10	-	-	ns	DB ₇ -DB ₀



(2) Read mode (Reading data from K5C066 to Micom)

Characteristic	Symbol	Min	Typ	Max	Unit	Test pin
E Cycle Time	t_c	500	-	-	ns	E
E Rise Time	t_r	-	-	25	ns	E
E Fall Time	t_f	-	-	25	ns	E
E Pulse Width (High, Low)	t_w	220	-	-	ns	E
RW and RS Set-up Time	t_{su}	40	-	-	ns	RW, RS
Rw and RS Hold Time	t_h	10	-	-	ns	RW, RS
Data Output Delay Time	t_{od}	-	-	100	ns	DB ₇ -DB ₀
Data Hold Time	t_{oh}	20	-	-	ns	DB ₇ -DB ₀



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5.4 Instruction Code

CONTROL and DISPLAY COMMAND

Command	RS	RW	DB ₇	DB ₆	DB ₅	DB ₄	DB ₃	DB ₂	DB ₁	DB ₀	Execution time (fosc=250KHz)	Remark																		
DISPLAY CLEAR	L	L	L	L	L	L	L	L	L	H	1.64ms																			
RETURN HOME	L	L	L	L	L	L	L	L	H	X	1.64ms	cursor move to first digit																		
ENTRY MODE SET	L	L	L	L	L	L	L	H	VD	SH	40 μ s	•VD: set cursor move direction <table border="1"> <tr><td>VD</td><td>H</td><td>Increase</td></tr> <tr><td>VD</td><td>L</td><td>Decrease</td></tr> </table> •SH: Specifies shift of display <table border="1"> <tr><td>SH</td><td>H</td><td>display is shifted</td></tr> <tr><td>SH</td><td>L</td><td>display is not shifted</td></tr> </table>	VD	H	Increase	VD	L	Decrease	SH	H	display is shifted	SH	L	display is not shifted						
VD	H	Increase																												
VD	L	Decrease																												
SH	H	display is shifted																												
SH	L	display is not shifted																												
DISPLAY ON/OFF	L	L	L	L	L	L	H	D	C	B	40 μ s	•Display <table border="1"> <tr><td>D</td><td>H</td><td>Display on</td></tr> <tr><td>D</td><td>L</td><td>Display off</td></tr> </table> •Cursor <table border="1"> <tr><td>C</td><td>H</td><td>Cursor on</td></tr> <tr><td>C</td><td>L</td><td>Cursor off</td></tr> </table> •Blinking <table border="1"> <tr><td>B</td><td>H</td><td>Blinking on</td></tr> <tr><td>B</td><td>L</td><td>Blinking off</td></tr> </table>	D	H	Display on	D	L	Display off	C	H	Cursor on	C	L	Cursor off	B	H	Blinking on	B	L	Blinking off
D	H	Display on																												
D	L	Display off																												
C	H	Cursor on																												
C	L	Cursor off																												
B	H	Blinking on																												
B	L	Blinking off																												
SHIFT	L	L	L	L	L	H	S/C	R/L	X	X	40 μ s	<table border="1"> <tr><td>SC</td><td>H</td><td>Display shift</td></tr> <tr><td>SC</td><td>L</td><td>Cursor move</td></tr> </table> <table border="1"> <tr><td>R/L</td><td>H</td><td>Right shift</td></tr> <tr><td>R/L</td><td>L</td><td>Left shift</td></tr> </table>	SC	H	Display shift	SC	L	Cursor move	R/L	H	Right shift	R/L	L	Left shift						
SC	H	Display shift																												
SC	L	Cursor move																												
R/L	H	Right shift																												
R/L	L	Left shift																												
SET FUNCTION	L	L	L	L	H	DL	N	F	X	X	40 μ s	<table border="1"> <tr><td>DL</td><td>H</td><td>8 bits interface</td></tr> <tr><td>DL</td><td>L</td><td>4 bits interface</td></tr> </table> <table border="1"> <tr><td>N</td><td>H</td><td>2 line display</td></tr> <tr><td>N</td><td>L</td><td>1 line display</td></tr> </table> <table border="1"> <tr><td>F</td><td>H</td><td>5 x 10 dots</td></tr> <tr><td>F</td><td>L</td><td>5 x 7 dots</td></tr> </table>	DL	H	8 bits interface	DL	L	4 bits interface	N	H	2 line display	N	L	1 line display	F	H	5 x 10 dots	F	L	5 x 7 dots
DL	H	8 bits interface																												
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F	H	5 x 10 dots																												
F	L	5 x 7 dots																												
Command	RS	RW	DB ₇	DB ₆	DB ₅	DB ₄	DB ₃	DB ₂	DB ₁	DB ₀	Execution time (fosc=250KHz)	Remark																		
SET CG RAM ADDRESS	L	L	L	H	CG RAM address (corresponds to cursor address)						40 μ s	CG RAM Data is sent and received after this setting																		
SET DD RAM ADDRESS	L	L	H	DD RAM address						40 μ s	DD RAM Data is sent and received after this setting																			
READ BUSY FLAG & ADDRESS	L	H	BF	Address Counter used for Both DD & CG RAM address						0 μ s	<table border="1"> <tr><td>BF</td><td>H</td><td>Busy</td></tr> <tr><td>BF</td><td>L</td><td>Ready</td></tr> </table> - Reads BF indication internal operating is being performed. - reads address counter contents	BF	H	Busy	BF	L	Ready													
BF	H	Busy																												
BF	L	Ready																												
WRITE DATA	H	L	Write Data						45 μ s	Write data into DD or CG RAM																				
READ DATA	H	H	Read Data						45 μ s	Read data from DD or CGRAM																				

X: Don't care

5.5 Character generator ROM(KS0066U-00)

Higher 4bit Lower 4bit	0000	0010	0011	0100	0101	0410	0111	1010	1011	1100	1101	1110	1111
xxx0000	CG RAM (1)		0	a	P	`	P		-	夕	三	α	ρ
xxx0001	(2)	!	1	A	Q	a	q	。	ア	チ	△	ä	q
xxx0010	(3)	"	2	B	R	b	r	「	イ	ツ	×	β	θ
xxx0011	(4)	#	3	C	S	c	s	」	ウ	テ	ε	ε	∞
xxx0100	(5)	\$	4	D	T	d	t	,	エ	ト	⊥	μ	Ω
xxx0101	(6)	%	5	E	U	e	u	.	オ	ナ	1	ε	ü
xxx0110	(7)	&	6	F	V	f	v	ヲ	カ	ニ	ヨ	ρ	Σ
xxx0111	(8)	'	7	G	W	g	w	ア	キ	ヌ	ラ	q	π
xxx1000	(9)	(	8	H	X	h	x	イ	ク	ネ	リ	γ	∞
xxx1001	(10)	)	9	I	Y	i	y	ウ	ケ	ル		'	υ
xxx1010	(11)	*	:	J	Z	j	z	エ	コ	ン	レ	i	≠
xxx1011	(12)	+	:	K	[	k	(	オ	サ	ヒ	ロ	°	π
xxx1100	(13)	,	<	L	¥	l		カ	シ	フ	ワ	φ	π
xxx1101	(14)	-	=	M]	m)	ユ	ス	ハ	ン	±	÷
xxx1110	(15)	.	>	N	^	n	÷	ヨ	セ	ホ	°	ñ	
xxx1111	(16)	/	?	O	_	o	←	ッ	ソ	マ	°	ö	■

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6. Optical Characteristics

6.1 Optical Characteristics

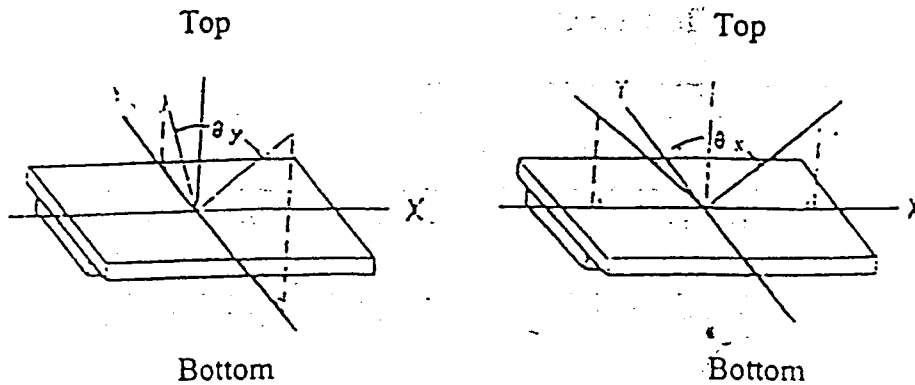
Top=25°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle	θ_x	Cr>2 $\theta_y=0^\circ$	-30	--	30	Deg	
	θ_y						
Contrast Ratio	Cr	$\theta_x=0^\circ$ $\theta_y=0^\circ$	4.0				
Response Time	Turn on	$\theta_x=0^\circ$ $\theta_y=0^\circ$			250	ms	
	Turn off						

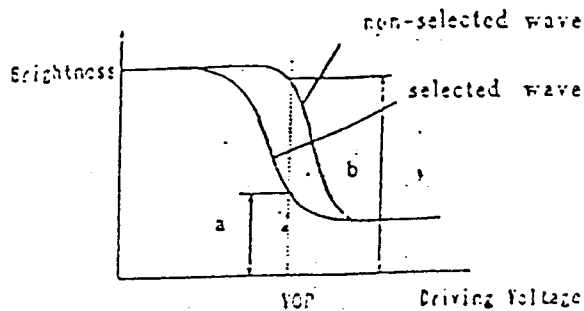
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6.2 Definition of optical characteristics

6.2.1 Definition of viewing Angle(see fig. as follow)



6.2.2 Definition of Contrast Ratio(see fig. as follow)

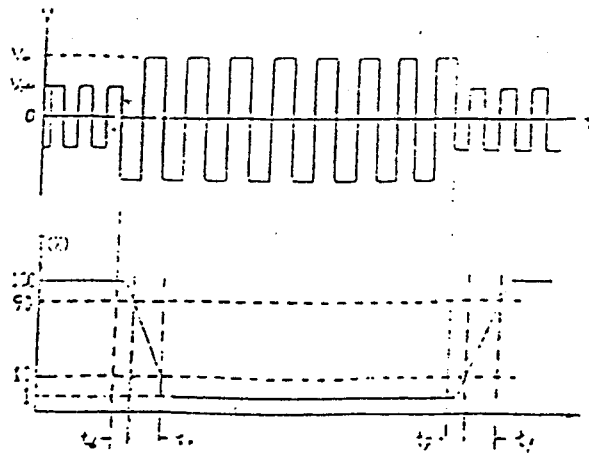


$$\text{Contrast Ratio} = b / a = \frac{\text{non-selected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

- 1) Ambient Temperature: 25 °C ; 2) Frame frequency: 64Hz

6.2.3 Definition of Response time(see fig. as follow)



Turn-on time: $t_{on} = t_d + t_r$

Turn-off time: $t_{off} = t_d + t_f$

Measuring Condition:

- 1) Operating Voltage: 4.7V ; 2) Frame frequency: 64Hz

7.2 Failure Judgment Criterion

Criterion Item	Test Item No.									Failure Judgement Criterion
	1	2	3	4	5	6	7	8	9	
Basic Specification	0	0	0	0	0	0	0	0	0	Out of the basic Specification
Electrical specification	0	0	0	0	0					Out of the electrical specification
Mechanical Specification							0	0		Out of the mechanical specification
Optical Characteristic	0	0	0	0	0	0			0	Out of the optical specification
Remark	Basic specification = Optical specification + Mechanical specification									

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8 Precautions for use of LCD Modules

8.1 Handling Precautions

- 8.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- 8.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.
- 8.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- 8.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- 8.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:
- Isopropyl alcohol
 - Ethyl alcohol
- Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:
- Water
 - Ketone
 - Aromatic solvents
- 8.1.6 Do not attempt to disassemble the LCD Module.
- 8.1.7 If the logic circuit power is off, do not apply the input signals.
- 8.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
- a. Be sure to ground the body when handling the LCD Modules.
 - b. Tools required for assembly, such as soldering irons, must be properly ground.
 - c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
 - d. The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.



8.2 Storage precautions

8.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

8.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

temperature : $0^{\circ}\text{C} \sim 40^{\circ}\text{C}$

relatively humidity: $\leq 80\%$

8.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

8.3 The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.

