

CUSTOMER :



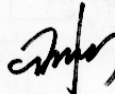
M O D E L : MOG-160GB03D-C-AE056

DESCRIPTION : LCD MODULE

◆ CUSTOMER APPROVAL

	CHECKED	CHECKED	APPROVAL
APPROVAL			
REMARK			

◆ SUPPLIER APPROVAL

PREPARED	CHECKED		APPROVAL
K.B.AHU			

MYTECH CORPORATION

180 Old Tappan Rd., Bldg. 6, Old Tappan, NJ 07675

Tel: (201) 784-8867 Fax: (201) 784-8932

Email: mysales@mytechcorp.com

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1. FEATURES

- Format : 128 x 160 Dots Graphic
- Display type : STN YELLOW, Transflective, 6 o'clock , Positive
- Driving method : 1/64 duty (Dual scan)
- Capable of interfacing to 8-bit or serial MPU.
- Built-in controller
 - a) Using controller T6963C
 - b) Display mode is defined by command
 - * Graphic * OR * XOR * AND * TEXT ATTRIBUTE
 - * Internal Character Generator * External Character Generator
 - c) Display capacity : Max. 80 Character × 32 Lines
 - d) Internal Character Generator ROM : 128 char. Max.
 - e) capable of interfacing directly connected TMPZ-80
 - f) Capacity built-in S-RAM : 8K byte
- Connector : FFC

2. MECHANICAL DATA

ITEM		WIDTH	HEIGHT	THICKNESS	UNIT
Module size		129.0	104.5	14.0	mm
Viewing area		101.0	82.0	-	mm
Graphic	Construction	128 x 160			dots
	Size	95.96	76.76	-	mm
Dot	Size	0.60	0.60	-	mm
	Pitch	0.64	0.64	-	mm
Weight		About 250			g

3. ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	CONDITION	STANDARD VALUE		UNIT
			MIN.	MAX.	
Power supply for logic	$V_{DD}-V_{SS}$	$T_a=25^{\circ}\text{C}$	0	7.0	V
Power supply for LCD	V_O	$T_a=25^{\circ}\text{C}$	-30	7.0	V
Input voltage	T_{IN}	$T_a=25^{\circ}\text{C}$	0	7.0	V
Operating temperature	T_{OP}	-	-20	70	$^{\circ}\text{C}$
Storage temperature	T_{STG}	-	-30	80	$^{\circ}\text{C}$

4. ELECTRICAL CHARACTERISTICS

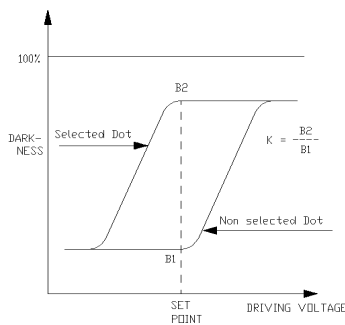
ITEM	SYMBOL	CONDITION	STANDARD VALUE			UNIT
			MIN.	TYP.	MAX.	
Power supply for logic	V_{DD}	$T_a = 25^{\circ}\text{C}$	4.5	5	5.5	V
Input high voltage	V_{IH}	-	$V_{DD}-2.2$	-	V_{DD}	V
Input low voltage	V_{IL}	-	V_{SS}	-	0.8	V
Output high voltage	V_{OH}	$I_{OH} = -0.5 \text{ mA}$	$V_{DD}-0.3$	-	V_{DD}	V
Output low voltage	V_{OL}	$I_{OL} = 0.5 \text{ mA}$	V_{SS}	-	0.4	V
Power supply current	I_{DD}	$V_{DD}=5.0\text{V}, V_L=13.0\text{V}$	-	10	18	mA
Frame Frequency	F_{FP}	-	-	50	-	Hz
Operating Frequency	F_{OSC}	-	0.4	-	5.5	MHz
LED Operating voltage	V_F	$I_F = 200\text{mA}$	-	5.2	5.5	V
Brightness	L	$I_F = 200\text{mA}$	3.0	4.2	-	nit
Power supply for LCD = V_L (Note 1)	$V_{DD}-V_{LCD}$	$T_a = -20^{\circ}\text{C}$	-	-	-	V
		$T_a = 25^{\circ}\text{C}$	-	13.0	-	V
		$T_a = 70^{\circ}\text{C}$	-	-	-	V

Note 1 : Power supply for LCD is available with R_L in accordance with contrast.

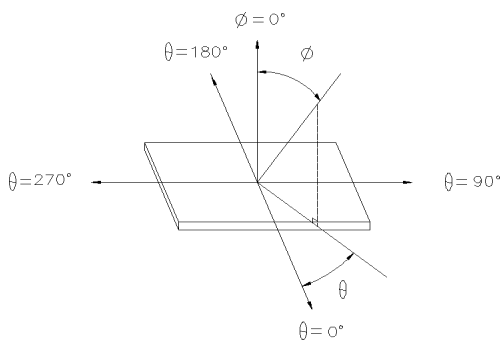
5. ELECTRO-OPTICAL CHARACTERISTICS (STN) (Ta = 25 °C)

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Contrast ratio	K	10	20	-	-	1
Response time (rise)	T_r	-	200	-	ms	2
Response time (fall)	T_f	-	200	-	ms	2
Viewing angle	ϕ	-10 ~ +40			deg.	3,4
	θ	-40 ~ +40				

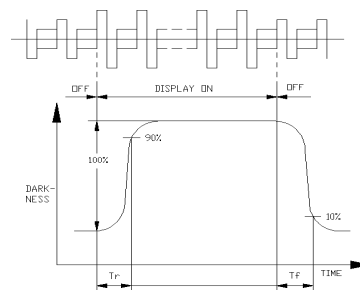
NOTE1. Definition of contrast K



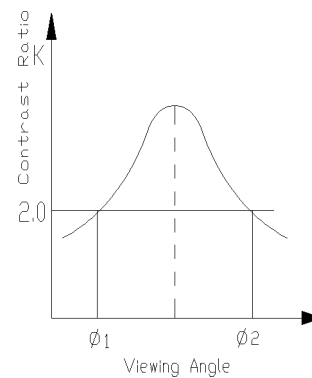
NOTE3. Definition of angle θ and ϕ



NOTE2. Definition of optical response



NOTE4. Definition viewing angle ϕ_1 and ϕ_2



6. QUALITY SPECIFICATION

6.1 Acceptable Quality Level

INSPECTION ITEM	SAMPLING PROCEDURES	A.Q.L
MAJOR	MIL-STD-105E Inspection Level II Normal Inspection Single sample inspection	1.0
MINOR	MIL-STD-105E Inspection Level II Normal Inspection Single sample inspection	2.5

Major defect :

A major defect is a defect that could result in failure or materially reduce that the usability of the unit of product for its intended purpose.

Minor defect :

A minor defect is one that does not materially reduce the usability of the product for its intended purpose or is a departure from established standards giving no significant bearing on the effective use or operation of the unit.

6.2 Inspection Conditions

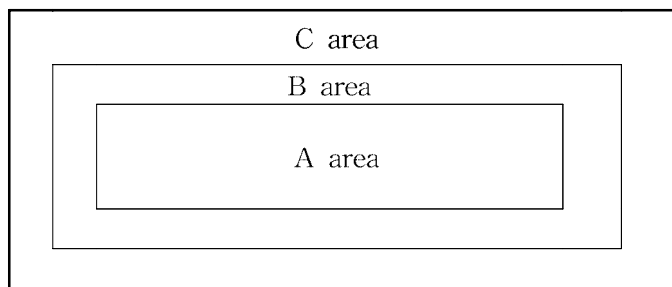
6.2.1 The environmental conditions for inspection shall be as follows

- Room Temperature : $25 \pm 3^{\circ}\text{C}$
- Humidity Temperature : $65 \pm 20\% \text{RH}$

6.2.2 The external visual inspection

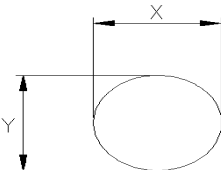
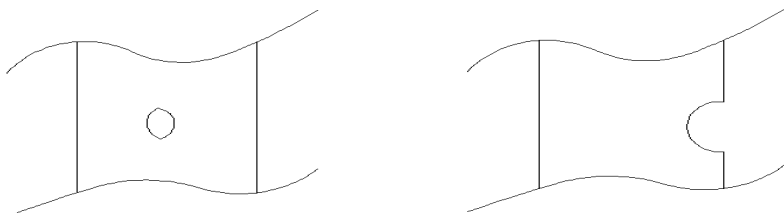
- The inspection shall be performed by using 40Watts fluorescent lamp for illumination and the distance between LCD and eyes of the inspector shall be 30cm or more.

6.3 Definition of the Area



A area: Active Area
 B area: Viewing Area
 C area: Out of Viewing Area

6.4 Inspection Standards

Class of defects	Inspection Item	Criteria of defects	Remarks	
MAJOR	Display on inspection	1) No Display 2) Abnormal Operation 3) Short Circuit 4) Pattern Open 5) Off Viewing angle		
	Missing	Component missing		
MINOR	Spot/Dent	Size	Defect size	Acceptable Number
		A Size	$\phi \leq 0.3$ mm	Ignore
			$0.3 < \phi \leq 0.4$ mm	2
			$\phi > 0.4$ mm	0
		B Size	$\phi \leq 0.3$ mm	Ignore
			$0.3 < \phi \leq 0.4$ mm	2
			$\phi > 0.4$ mm	0
	Cell Size (Viewing Area Criteria)		Spot size= (X+Y)/2	
	* A size < 2500mm ²		B size \geq 2500mm ²	
				
Scratch	POSITIVE		NEGATIVE	
	Width X Length	Acceptable Number	Width X Length	Acceptable Number
	0.1 X 1.5 mm	3	0.1 X 1.5 mm	3
	0.08 X 3.0 mm	2	0.08 X 3.0 mm	2
	0.05 X 5.0 mm	1	0.05 X 5.0 mm	1
* Scratches should be separated more than 10mm each other				
Bubble	1) Round bubble should be treated as spot(positive) 2) Line bubble should be treated as scratch(positive)			
Class of defects	Inspection Item	Criteria of defects	Remarks	
MINOR	Pattern Misalignment	Voids in segment 		
	Stain	Stains which cannot be removed even when wiped slightly with a soft cloth.		
	Rainbow	More than 2 colors are noticeable in the viewing direction.		

Class of defects	Inspection Item	Criteria of defects	Remarks
MINOR	PCB damage	Damage on gold or copper foil	
	Parts alignment	1) IC lead width is more than 50% beyond land pattern 2) Chip component is off center and more than 50% of the leads is off the pad out line.	
	Conductive foreignmatter (solderball, soldersplash)	Conductive foreign matter is not allowed	
	Bezel claw	Bezel claw missing or not bent	

7. RELIABILITY

- Operating life time : Longer than 50,000 hours
(at room temperature without direct irradiation of sunlight)
- Reliability characteristics shall meet following requirements.

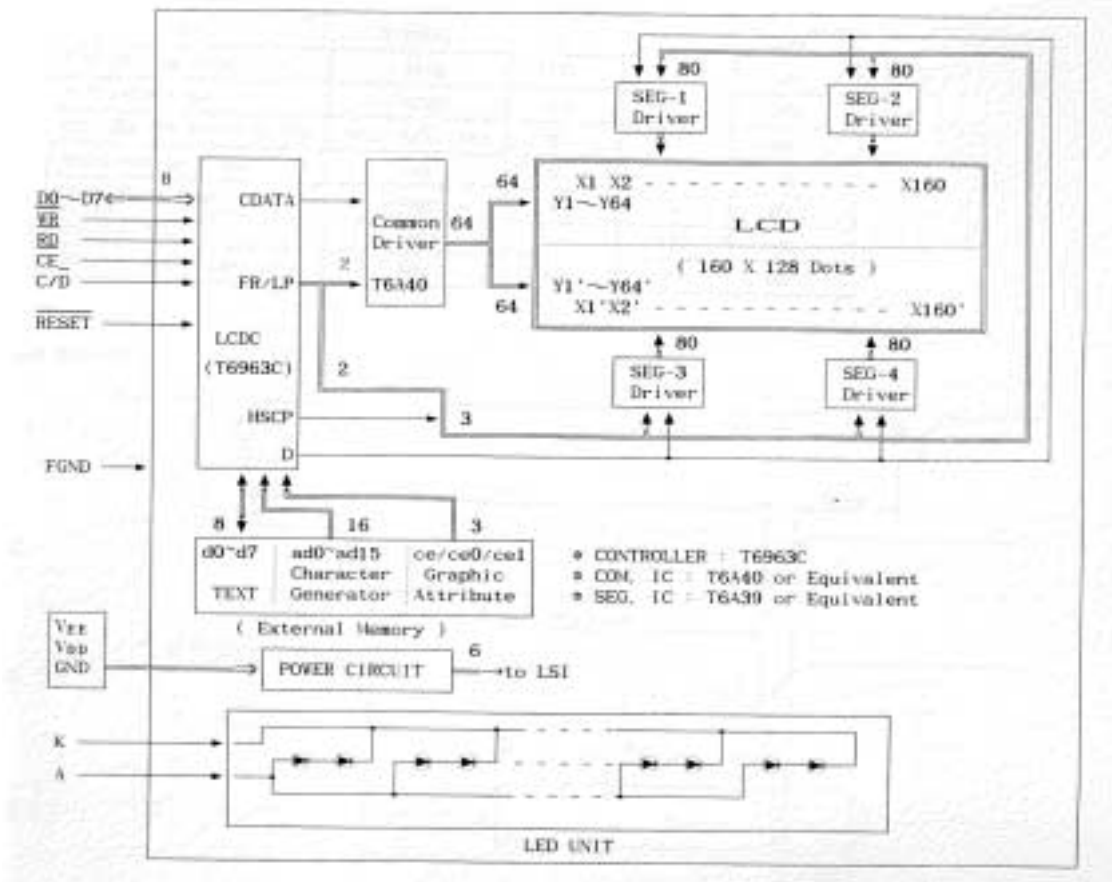
ITEM	TEST	CRITERION
High temp.	70°C / 240 Hrs	* Total current consumption should be below double of initial value
Low temp.	-20°C / 240 Hrs	
High humidity	40°C X 90%RH / 240 Hrs	
Thermal shock	-20°C → 25°C → 70°C → 25°C / 5 Cycles (30min) (5min) (30min) (5min)	* Contrast ratio should be within initial value ±50%
Vibration	1.Operating time : Thirty minutes exposure in each direction(x,y,z) 2.Sweep frequency (1min) : 10Hz →55Hz →10Hz 3.Amplitude : 0.75mm double amplitude	* No defect in cosmetic and operational function is allowable

* Remarks : Samples subjected to the tests shall be “ Not operating ” condition .

8. PIN CONNECTIONS

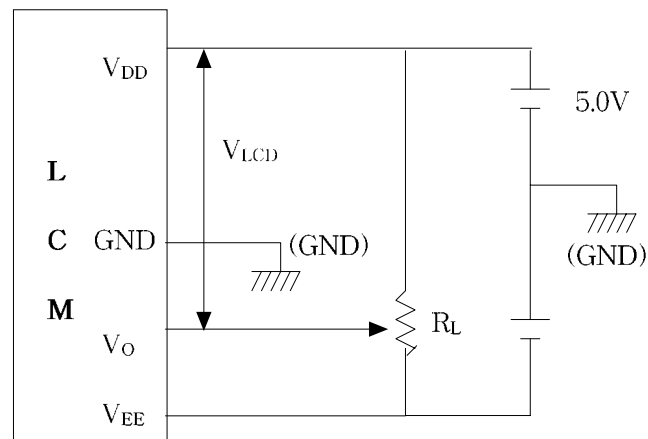
PIN NO.	SYMBOL	FUNCTION	
1.	FG	Frame Ground	
2.	V _{SS}	-	Ground
3.	V _{DD}	+ 5 V	Power supply for logic
4.	V _{LCD}	- 8.0 V	Operating voltage for LC driving
5.	V _{EE}		Operating voltage for LC driving
6.	/WR	Data write (Write data into T6963C at "L")	
7.	/RD	Data read (Read data from T6963C at "L")	
8.	/CE	Chip enable for T6963C. /CE must be "L" when CPU communicates with T6963C.	
9.	C/D	/WR = "L" → "H" : Command write "L" : data write /RD = "L" → "H" : State read "L" : data read	
10.	/HALT	"H" : Normal "L" : Stop the oscillation clock	
11.	/RESET	"H" : Normal (T6963C has internal pull up resistance) "L" : initialize	
12.	DB0	Data bus line	
:	:		
19.	DB7		
20.	NC		
21.	Λ	Operation volatage (+) for LED Backlight.	
22.	K	Operation volatage (-) for LED Backlight.	

9. BLOCK DIAGRAM



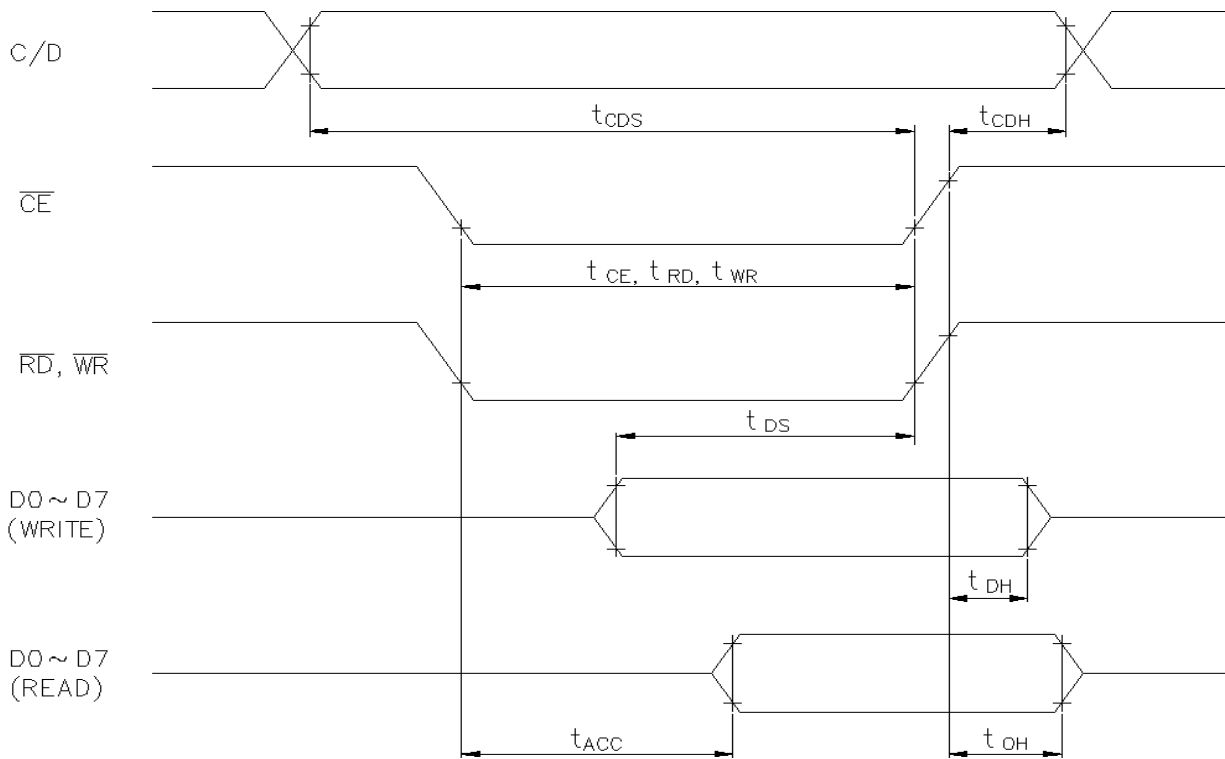
10. POWER SUPPLY

(DOUBLE POWER)



($R_L = 10 \sim 20 \text{ Kohm}$)

11. System Bus Read/Write Timing Characteristics



$V_{DD}=+5.0 \pm 10\%$, $V_{SS}=0V$, $T_a=0 \sim 50^\circ C$

ITEM	SYMBOL	MIN.	MAX.	UNIT
C/D Set up time	t_{CDS}	100	-	ns
C/D Hold time	t_{CDH}	10	-	ns
/CE, /RD, /WR Pulse Width	t_{CE}, t_{RD}, t_{WR}	80	-	ns
Data Set up time	t_{DS}	80	-	ns
Data hold time	t_{DH}	40	-	ns
Access time	t_{ACC}	-	150	ns
Output hold time	t_{OH}	10	50	ns

12. INSTRUCTION SET (COMMAND LIST)

COMMAND	CODE	D1	D2	FUNCTION
REGISTER SET	00100001	X-address	Y-address	Cursor point set
	00100010	Data	00H	Offer register set
	00100100	Low address	High address	Address point set
CONTROL WORD SET	01000000	-	-	Text home address set
	01000001	-	-	Text area
	01000010	-	-	Graphic home address set
	01000011	-	-	graphic area set
MODE SET	1000X000	-	-	"OR" mode
	1000X001	-	-	"EXOR" mode
	1000X011	-	-	"AND" mode
	1000X100	-	-	"TEXT attribute" mode
	10000XXX	-	-	Internal CG ROM mode
	10000XXX	-	-	External CG ROM mode
DISPLAY MODE	10010000	-	-	Display off
	1001XX10	-	-	Cursor on, Blink off
	1001XX11	-	-	Cursor off, Blink on
	100101XX	-	-	Text on, Graphic off
	100110XX	-	-	Text off, Graphic on
	100111XX	-	-	Text on, Graphic on
CURSOR PATTERN SELECT	10100000	-	-	1 line cursor
	10100001	-	-	2 line cursor
	10100010	-	-	3 line cursor
	10100011	-	-	4 line cursor
	10100100	-	-	5 line cursor
	10100101	-	-	6 line cursor
	10100110	-	-	7 line cursor
	10100111	-	-	8 line cursor
DATA AUTO READ/WRITE	10110000	-	-	Data auto write set
	10110001	-	-	Data auto read set
	10100111	-	-	Auto reset
DATA READ WRITE	11000000	Data	-	Data write and APD increment
	11000001	-	-	Data read and APD increment
	11000010	Data	-	Data write and APD decrement
	11000011	-	-	Data read and APD decrement
	11000100	Data	-	Data write and APD nonvariable
	11000101	-	-	Data read and APD nonvariable
SCREEN PEEK	11100000	-	-	Screen peek
SCREEN COPY	11101000	-	-	Screen copy
BIT SET/RESET	11110XXX	-	-	bit reset
	11111XXX	-	-	bit set
	1111X000	-	-	bit0 (LSB)
	1111X001	-	-	bit1
	1111X010	-	-	bit2
	1111X011	-	-	bit3
	1111X100	-	-	bit4
	1111X101	-	-	bit5
	1111X110	-	-	bit6
	1111X111	-	-	bit7 (MSB)

13. CHARACTER FONT TABLE (ROM Code 0101 : T6963C)

MSB LSB	0000	0001	0010	0011	0100	0101	0110	0111
xxxx0000		0	1	2	3	4	5	6
xxxx0001	7	8	9	A	B	C	D	E
xxxx0010	F	G	H	I	J	K	L	M
xxxx0011	N	O	P	Q	R	S	T	U
xxxx0100	V	W	X	Y	Z	[\]
xxxx0101	^	_	0	1	2	3	4	5
xxxx0110	6	7	8	9	A	B	C	D
xxxx0111	E	F	G	H	I	J	K	L
xxxx1000	M	N	O	P	Q	R	S	T
xxxx1001	U	V	W	X	Y	Z	[\
xxxx1010]	^	_	0	1	2	3	4
xxxx1011	5	6	7	8	9	A	B	C
xxxx1100	D	E	F	G	H	I	J	K
xxxx1101	L	M	N	O	P	Q	R	S
xxxx1110	T	U	V	W	X	Y	Z	[
xxxx1111	\]	^	_	0	1	2	3

14. PRECAUTION FOR USING

- HANDLING

- * Refrain from storing mechanical shock and from applying any force to LCD MODULE. It may cause mis_operation or damage of LCD.
- * Do not touch, press or rub the display panel with a hard, stiff tool or object as the polarizers in the panel are easily scratched.
- * If LCD is broken and liquid crystal material flow out, ingestion, inhalation, or contact with skin should be avoided. If liquid crystal material contact with skin, wash immediately with alcohol and rinse thoroughly with water.
- * Never use organic solvents to clear the display panel as these solvent may adversely affect the polarizer. To clean the display panel dampen a bit of absorbent cotton with petroleum benzene and gently wipe the panel, or contaminations by using a scotch tape.
- * Refrain from discharge of high electro-static voltage, it will damage C-MOS LSI in the MODULE.
- * Do not leave the MODULE in high temperature, especially in high humidity for a long time. It is recommended to store the MODULE where the temperature is in the range of 0°C to 35°C and the humidity is lower than 70%.
- * Store the MODULE without exposure to direct sunlight or fluorescent lamp.
- * Ultra violet cut filter is necessary for outdoor operation.
- * Avoid condensation of water, it may cause misoperation or disconnection of electrode.

- OPERATION

- * Never connect or disconnect the LCD MODULE from the main system while power is being supplied.
- * When supplying the M signal from the external unit to a GRAPHIC MODULE, set the duty to $50\% \pm 1\%$.
If the duty deviates too greatly from the value, a DC voltage will be applied to the liquid crystal, which could induce an electrochemical reaction and reduce the life of the MODULE.
- * Do not exceed the maximum rating values under the worst conditions taking account of the supply voltage variation, input voltage variation, and environmental temperature, etc. Otherwise LCD module may be damaged.

15. EXTERNAL DIMENSION

