ODT

SPEC. NO	
ISSUED DATE	

CUSTOMER :

M O D E L : OCM-16416B-00000

DESCRIPTION : LCD MODULE

THIS SPECIFICATION IS APPLIED FOR LCD MODULE DELIVERED TO YOUR COMPANY BY ORION DISPLAY TECHNOLOGY CO., LTD

◆ CUSTOMER APPROVAL

APPROVAL	CHECKED	CHECKED	APPROVAL
REMARK			

◆ SUPPLIER APPROVAL

PREPARED	CHECKED		APPROVAL

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ORION DISPLAY TECHNOLOGY CO.,LTD.

* REVISION RECORD

REV. NO.	REV.DATE	DESCRIPTION OF REVISION	PAGE	REMARK
0		INITIAL RELEASE	ALL	

*. REVISION INDEX

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1. FEATURES

1) Display construction ---------- 16 Characters x 4 Lines

2) Display mode ---------- TN

3) Display type ---------- Positive, Reflective

4) Viewing direction ---------- 6 o'clock

5) Operating temperature ---------- Indoor

6) Drving voltage ---------- Single power

7) Driving method ---------- 1/16 duty, 1/4 bias

8) Type ---------- COB (Chip On Board)

9) Number of data line ---------- 8-bit parallel

10) Apllicated IC ---------- KS0066U-00PCC & KS0065BPCC

○ Instruction functions

* Display clear , Cursor home , Display ON/OFF , Cursor ON/OFF
* Display character blink , Display shift , Cursor shift

2. MECHANICAL DATA

ITEM		WIDTH	HEIGHT	THICKNESS	UNIT
Module size		87.0	60.0	12.5	mm
Viewing area		61.8	25.2	-	mm
Character	Construction	5 x 7			dots
	Size	2.95	4.15	-	mm
	Pitch	3.55	5.35	-	mm
Dot	Size	0.55	0.55	-	mm
	Pitch	0.60	0.60	-	mm
Diameter of mounting hole		2.5			mm
Weight		About 60			g

3. ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	CONDITION	STANDARD VALUE		UNIT
			MIN.	MAX.	
Power supply for logic	V_{DD}-V_{SS}	Ta=25℃	0	7.0	V
Power supply for LCD	V_{DD}-V_L	Ta=25℃	0	13.5	V
Input voltage	V_{IN}	Ta=25℃	V_{SS}	V_{DD}	V
Operating temperature	Top	-	0	50	℃
Storage temperature	T_{STG}	-	-20	70	℃

4. ELECTRICAL CHARACTERISTICS

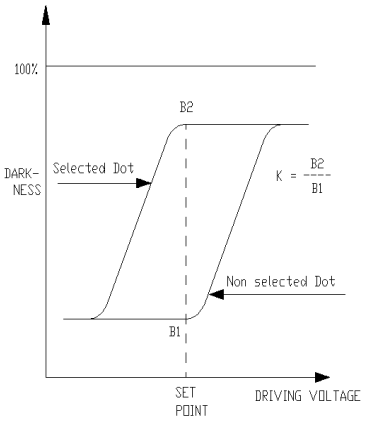
ITEM	SYMBOL	CONDITION	STANDARD VALUE			UNIT
			MIN.	TYP.	MAX.	
Power supply for logic	V_{DD}	Ta = 25℃	4.5	5	5.5	V
Input high voltage	V_{IH}	-	2.2	-	V_{DD}	V
Input low voltage	V_{IL}	-	V_{SS}	-	0.8	V
Output high voltage	V_{OH}	I_{OH} = -0.205 mA	2.4	-	V_{DD}	V
Output low voltage	V_{OL}	I_{OL} = 1.2 mA	V_{SS}	-	0.4	V
Power supply current	I_{DD}	V_{DD}=5.0V,V_{LCD}=7.8V	-	2.0	3.0	mA
Power supply for LCD (Note 1) = V_{LCD}	V_{DD}-V_L	T_a = 0 ℃	-	-	-	V
		T_a = 25℃	-	4.4	-	V
		T_a = 50℃	-	-	-	V

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

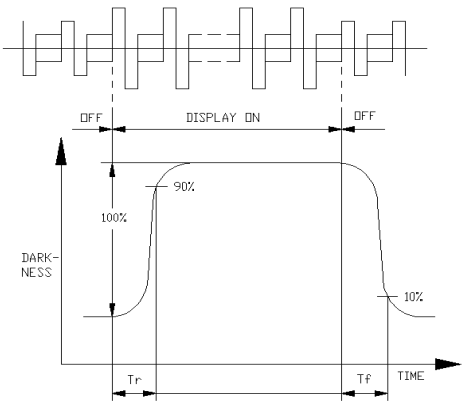
5. ELECTRO-OPTICAL CHARACTERISTICS (TN) (Ta = 25 ℃)

ITEM	SYMBOL	CONDITION		MIN.	TYP.	MAX.	UNIT	NOTE
Contrast ratio	K	Φ=20°		1.4	3	-	-	1
Response time (rise)	T_r	Φ=20°		-	100	-	ms	2
Response time (fall)	Tf	Φ=20°		-	100	-	ms	2
Viewing angle	Φ	k≥1.4	Vertical	+10 ~ +30			deg.	3,4
	θ	k≥1.4	Horizontal	-30 ~ +30				

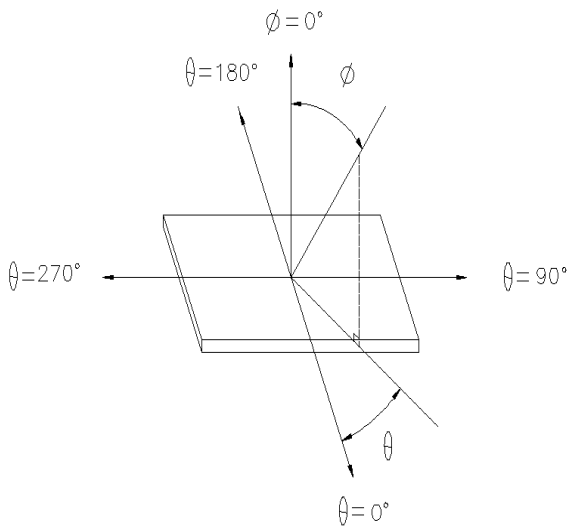
NOTE1. Definition of contrast K



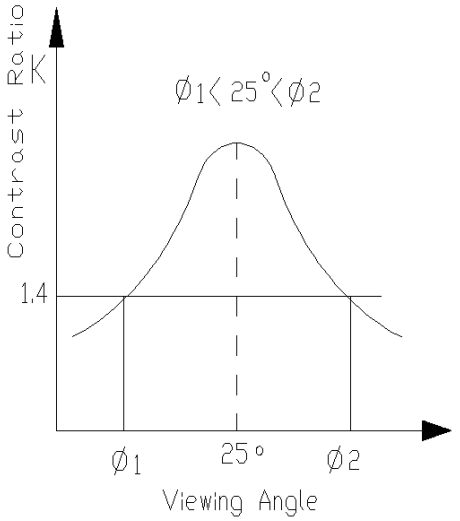
NOTE2. Definition of optical response



NOTE3. Definition of angle θ and Φ



NOTE4. Definition viewing angle Φ1 and Φ2



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 maternally 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

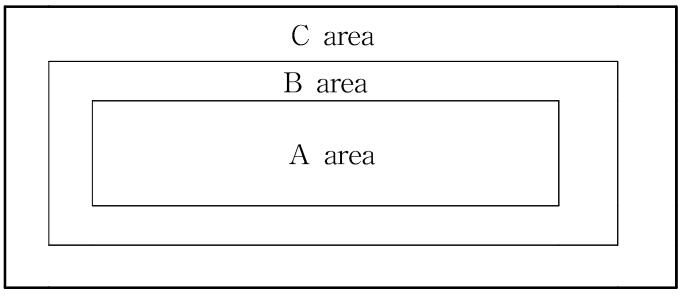
-Room Temperature : 25±3℃

-Humidity Temperature : 65±20%RH

6.2.2 The external visual inspection

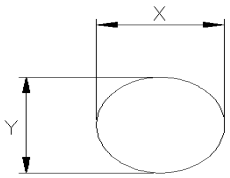
-The inspection shall be performed by using 40Watts fluorescent lamp for illumination and the distance between LCD and eyes of the inspector shall be 30cm or more.

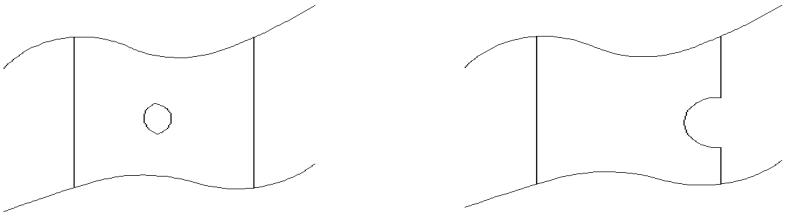
6.3 Definition of the Area



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

6.4 Inspection Standards

<table>
<tr><th>Class of defects</th><th>Inspection Item</th><th colspan="4">Criteria of defects</th><th>Remarks</th></tr>
<tr><td rowspan="3">MAJOR</td><td>Display on inspection</td><td colspan="4">1) No Display
2) Abnormal Operation
3) Short Circuit
4) Pattern Open
5) Off Viewing angle</td><td></td></tr>
<tr><td>Missing</td><td colspan="4">Component missing</td><td></td></tr>
<tr><td rowspan="15">MINOR</td><td rowspan="11">Spot/Dent</td><td>Size</td><td colspan="2">Defect size</td><td>Acceptable Number</td><td rowspan="11"></td></tr>
<tr><td rowspan="3">A Size</td><td colspan="2">$\phi \leq 0.2$ mm</td><td>Ignore</td></tr>
<tr><td colspan="2">$0.2 < \phi \leq 0.3$ mm</td><td>1</td></tr>
<tr><td colspan="2">$\phi > 0.3$ mm</td><td>0</td></tr>
<tr><td rowspan="3">B Size</td><td colspan="2">$\phi \leq 0.2$ mm</td><td>Ignore</td></tr>
<tr><td colspan="2">$0.2 < \phi \leq 0.3$ mm</td><td>2</td></tr>
<tr><td colspan="2">$\phi > 0.3$ mm</td><td>0</td></tr>
<tr><td colspan="4">Cell Size (Viewing Area Criteria)
※ A size < 2500mm^2 Spot size= (X+Y)/2
B size ≥ 2500mm^2
</td></tr>
<tr><td rowspan="5">Scratch</td><td colspan="2">POSITIVE</td><td colspan="2">NEGATIVE</td><td rowspan="5"></td></tr>
<tr><td>Width X Length</td><td>Acceptable Number</td><td>Width X Length</td><td>Acceptable Number</td></tr>
<tr><td>0.1 X 1.5 mm</td><td>3</td><td>0.1 X 1.5 mm</td><td>3</td></tr>
<tr><td>0.08 X 3.0 mm</td><td>2</td><td>0.08 X 3.0 mm</td><td>2</td></tr>
<tr><td>0.05 X 5.0 mm</td><td>1</td><td>0.05 X 5.0 mm</td><td>1</td></tr>
<tr><td colspan="4">※ Scratches should be separated more than 10mm each other</td></tr>
<tr><td>Bubble</td><td colspan="4">1) Round bubble should be treated as spot(positive)
2) Line bubble should be treated as scratch(positive)</td><td></td></tr>
</table>

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.	
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

ITEM	TEST	CRITERION
High temp.	70℃ / 200 Hrs	* Total current consumption should be below double of initial value * Contrast ratio should be within initial value ±50% * No defect in cosmetic and operational function is allowable
Low temp.	-20℃ / 200 Hrs	
High humidity	40℃ X 90%RH / 200 Hrs	
Thermal shock	-20℃ → 25℃ → 70℃ → 25℃ / 5 Cycles (20min) (5min) (30min) (5min)	
Vibration	1.Operating time : Thirty minutes exposure for each direction(x,y,z) 2.Sweep frequency (1min) : 10Hz →55Hz →10Hz 3.Amplitude : 0.75mm	

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

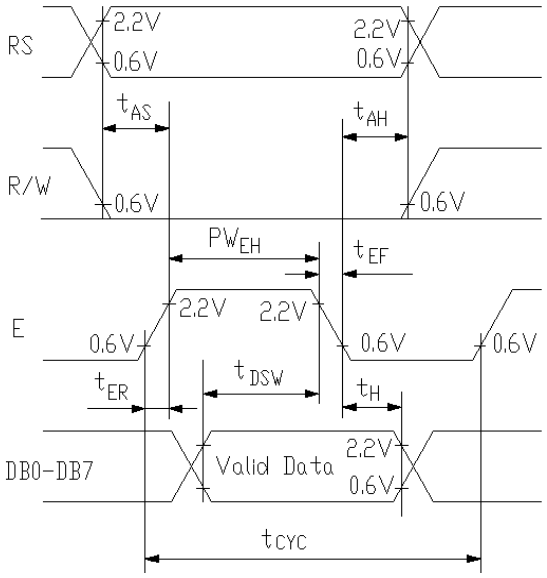
8. PIN CONNECTIONS

PIN NO.	SYMBOL	LEVEL	FUNCTION		
1.	V_{SS}	-	GND	Ground	POWER SUPPLY
2.	V_{DD}	-	5 V	Power supply for logic	
3.	V_L	-	-	Operating voltage for LCD driving	
4.	RS	H / L	H : Data input L : Instruction data input		
5.	R/W	H / L	H : Data read (CPU ← LCM) L : Data write (CPU → LCM)		
6.	E	H.H→L	Enable (Operating start signal for data read / write)		
7.	D0	H / L	Data bus line		
8.	D1	H / L			
9.	D2	H / L			
10.	D3	H / L			
11.	D4	H / L			
12.	D5	H / L			
13.	D6	H / L			
14.	D7	H / L			

* In case of 4 bits instruction, data is transferred by twice using only 4 buses of D4 to D7, and D0 to D3 are not used, first operation is higher order 4 bits and second is lower 4bits of 8 bits, but in case of 8 bits instruction data is transferred by data bus of D0 to D7.

9. TIMING DIAGRAM

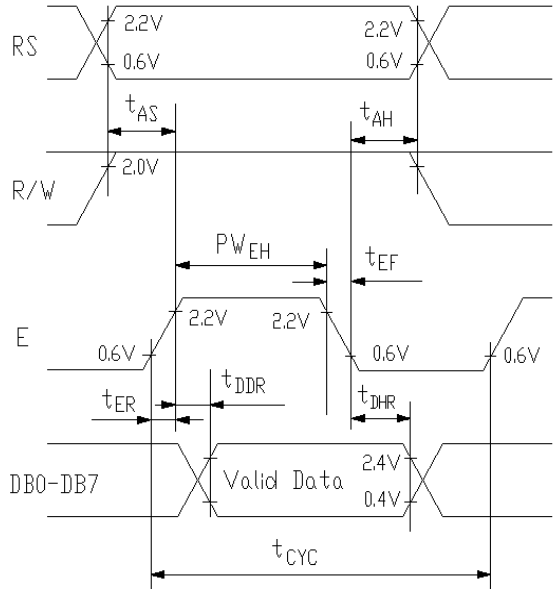
11.1 WRITE OPERATION



11.2 TIMING OF DATA WRITE

ITEM	SYMBOL	VALUE
Enable cycle time	t_{CYC}	500 nS min.
Enable Pulse width	PW_{EH}	220 nS min.
Enable rise/fall time	t_{Er}, t_{Ef}	25 nS max.
Address set up time	t_{AS}	60 nS min.
Address hold time	t_{AH}	10 nS min.
Data set up time	t_{DSW}	60 nS min.
Data hold time	t_H	10 nS min.

11.3 READ OPERATION



11.4 TIMING OF DATA READ

ITEM	SYMBOL	VALUE
Enable cycle time	t_{CYC}	500 nS min.
Enable Pulse width	PW_{EH}	220 nS min.
Enable rise/fall time	t_{Er}, t_{Ef}	25 nS max.
Address set up time	t_{AS}	60 nS min.
Address hold time	t_{AH}	10 nS min.
Data set up time	t_{DSW}	60 nS max.
Data hold time	t_H	20 nS min.

10. INSTRUCTION SET (Rosc = 200 kΩ)

INSTRUCTION	CODE										DESCRIPTION	f_{osc}= 125KHz
	RS	R/W	D7	D6	D5	D4	D3	D2	D1	D0		
Clear display	0	0	0	0	0	0	0	0	0	1	Clears entire display	3.28 mS
Return home	0	0	0	0	0	0	0	0	1	*	Returns display being shifted to original position	3.28 mS
Entry mode set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction and specifies shift of display	80 μS
Display on/off control	0	0	0	0	0	0	1	D	C	B	D : Display ON/OFF C : Cursor ON/OFF B : Cursor blink/not	80 μS
Cursor or display shift	0	0	0	0	0	1	S/C	R/L	*	*	Moves cursor and shifts display	80 μS
Function set	0	0	0	0	1	DL	N	F	*	*	DL : Interface data length N : Number of display lines F : Character font	80 μS
Set CG RAM address	0	0	0	1	CG RAM address						Sets CG RAM address	80 μS
Set DD RAM address	0	0	1	DD RAM address:corresponds to cursor address							Sets DD RAM address	80 μS
Read busy flag and address	0	1	BF	Address counter used for both DD and CG RAM address							BF : Busy flag Reads address counter contents	1 μS
Write data to CG or DD RAM	1	0	Write data								Writes data into DD RAM or CG RAM.	80 μS
Read data from CG or DD RAM	1	1	Read data								Reads data from DD RAM or CG RAM.	80 μS

**** REMARK ****

I/D = 1 : Increment
S = 1 : Accompanies display shift
S/C = 1 : Display shift
R/L = 1 : Shift to the right
DL = 1 : 8 bits
N = 1 : 2 lines
F = 1 : 5 x 10 dots
BF = 1 : Internally operating
DD RAM : Display data RAM

* : No effect (Don't care)

I/D = 0 : Decrement
S/C = 0 : Cursor move
R/L = 0 : Shift to the left
DL = 0 : 4 bits
N = 0 : 1 line
F = 0 : 5 x 7 dots
BF = 0 : Can accept instruction

CG RAM : Character generator RAM

11. INITIALIZATION SEQUENCE

POWER ON

(8-Bit interface)

↓

Wait more than 15 mS after V_{DD} rises to 4.5 V

** In case of 4-bits interface, refer to PIN CONNECTIONS and INSTRUCTION SET.

↓

RS	R/W	D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	1	1	1	0	*	*

BF cannot be checked before this instruction.

Function set (Interface is 8 bits long.)

↓

Wait more than 4.1 mS

↓

RS	R/W	D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	1	1	1	0	*	*

BF cannot be checked before this instruction.

↓

Wait more than 100 μS

↓

RS	R/W	D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	1	1	1	0	*	*

BF cannot be checked before this instruction.

Function set (Interface is 8 bits long.)

↓

BF can be checked after the following instruction.
When BF is not checked, the waiting time between instructions is longer than the execution instruction time.

RS	R/W	D7	D6	D5	D4	D3	D2	D1	D0	
0	0	0	0	1	1	1	0	*	*	Function Set(Interface is 8 bits long. Specify the number of display lines and character font.) The number of display lines and character font cannot be changed afterwards.
0	0	0	0	0	0	1	0	0	0	--- Display off
0	0	0	0	0	0	0	0	0	1	--- Display clear
0	0	0	0	0	0	0	1	I/D	S	--- Entry mode set ⟶ Initialization ends.
0	0	1	ADDR:DD RAM Address(1)							
1	0	DATA (2)								

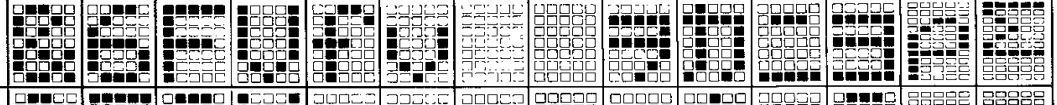
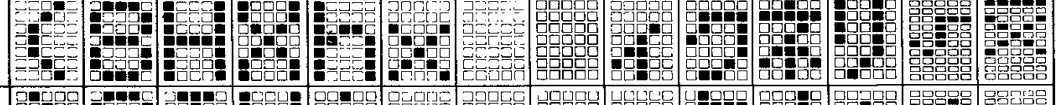
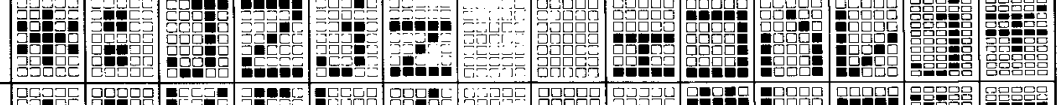
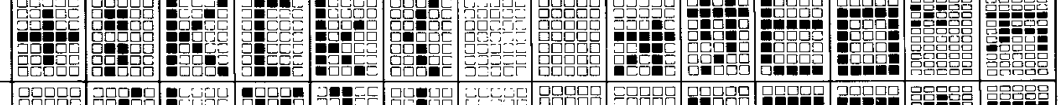
* : No effect

(1) ADDR is the setting data of cursor position to debug.
In data, MSB(D7) should be '1' and other 7 bits (D0 to D6) are cursor position.
(2) DATA means the ASCII CODES.

12. DD RAM ADDRESS

DIGIT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	DISPLAY POSITION
1 LINE	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	DD RAM ADDRESS
2 LINE	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	
3 LINE	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F	
4 LINE	50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F	

13. FONT TABLE

Upper 4bit / lower 4bit	LLLL	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL	CG RAM (1)														
LLLH	(2)														
LLHL	(3)														
LLHH	(4)														
LHLL	(5)														
LHLH	(6)														
LHHL	(7)														
LHHH	(8)														
HLLL	(1)														
HLLH	(2)														
HLHL	(3)														
HLHH	(4)														
HHLL	(5)														
HHLH	(6)														
HHHL	(7)														
HHHH	(8)														

14. PRECAUTION FOR USING

16.1 HANDLING

1) Refrain from storing mechanical shock and from applying any force to LCD MODULE. It may cause mis_operation or damage of LCD.

2) 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.

3) 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.

4) 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.

5) Refrain from discharge of high electro-static voltage, it will damage C-MOS LSI in the MODULE.

6) 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℃ to 35℃ and the humidity is lower than 70%.

7) Store the MODULE without exposure to direct sunlight or fluorescent lamp.

8) Ultra violet cut filter is necessary for outdoor operation.

9) Avoid condensation of water, it may cause mis-operation or disconnection of electrode.

16.2 OPERATION

1) Never connect or disconnect the LCD MODULE from the main system while power is being supplied.

2) When supplying the M signal from the external unit to a GRAPHIC MODULE, set the duty to 50%±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.

3) 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

