

# SPECIFICATION



## YMSC-G12864RDBSWSD

September 27 2007  
Version 1.01





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## 1. GENERAL SPECIFICATIONS :

### 1-1 SCOPE:

This specification covers the delivery requirements for the liquid crystal display delivered by YAOYU TECHNOLOGY to Customer .

### 1-2 PRODUCTS:

Liquid Crystal Display Module (LCM)

### 1-3 MODULE NAME:

**YMSP-G12864RDBSWSD**

## 2. FEATURES :

Item	Standard Value
Display Type	128*64dots
LCD Type	■STN, BLUE
Drive Pattern	1/32Duty, 1/6Bias
Viewing Direction	6 O'clock
Backlight Type	■WHITE EDGE LED BL
Weight	TBD
Interface	8-bit/4-bit MPU and serial interface
Driver IC	ST7920

## 3. MACHANICAL SPECIFICATIONS :

ITEM	STANDARD VALUE	UNIT
DISPLAY FORMAT	128X 64 DOTS	
MODULE DIMENSION	93.0(W) X 70.0(H) X14.0(T)	mm
EFFECTTVE DISPLAY AREA	66.52 (W) X33.24(H)	mm
DOT SIZE	0.48(W) X 0.48(H)	mm
DOT PITCH	0.04(W) X 0.04(H)	mm
LCD TYPE	Blue, STN	
DUTY AND BIAS	1/32 DUTY; 1/6 BIAS	
VIEWING DIRECTION	6:00	
BACK LIGHT	White SIDE LED	



#### 4. ABSOLUTE MAXIMUM RATING

ITEM	SYMBOL	CONDITION	STANDARD VALUE			UNIT
			MIN	TYP	MAX	
POWER SUPPLY FOR LOGIC	VDD	Ta=25°C	-0.3	—	5.5	V
INPUT VOLTAGE	VIN	Ta=25°C	-0.3	—	VDD+0.3	V
Module OPERATION TEMPERATURE	TOPR	---	-20	—	+70	°C
Module STORAGE TEMPERATURE	TSTG	---	-30	—	+80	°C
Storage Humidity	H <sub>D</sub>	Ta < 40 °C	-		90	%RH

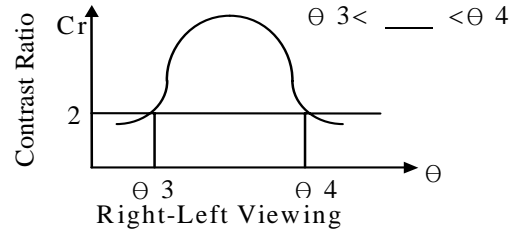
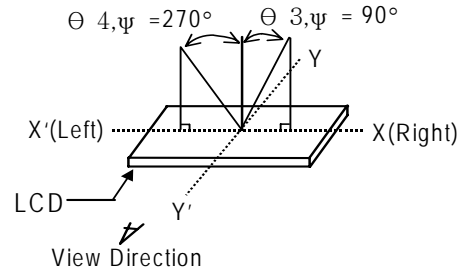
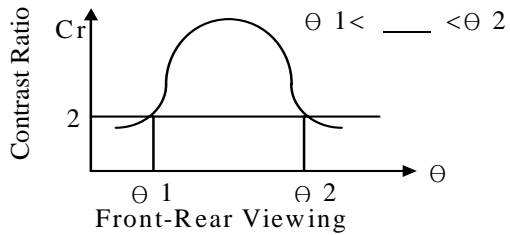
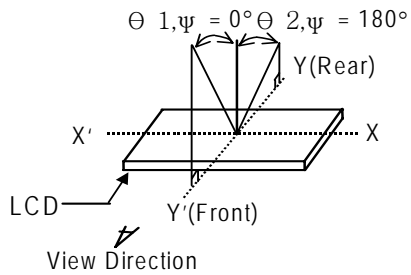
#### 5. ELECTRICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Supply Voltage (logic)	Vdd-Vss	-	4.8	5	5.5	V
Supply Voltage (LCD)	Vlcd	Vdd=5V (25°C)	5		6.5	V
Input signal voltage	V-ih	“H” level	0.7Vdd	-	Vdd	V
	V-il	“L” level	-0.3	-	0.6	V
Output signal voltage	V-oh	“H” level	0.8Vdd	-	Vdd	V
	V-ol	“H” level	-	-	0.1VDD	V
Supply Current (logic)	Icc	-	-	0.45	0.75	mA
Supply Current (LCD)	Io	-	-	-	-	mA
Supply Voltage (LED)	V-bl	See note 1	-	3.1		V
Supply Current (LED)	I-bl	See note 1	-	100		mA

Note 1: We have set some resistors between the backlight and the backlight power supply “A”.

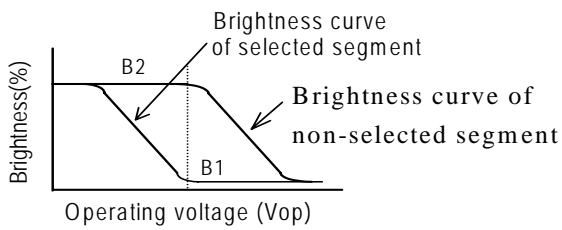
#### 6. OPTICAL CHARACTERISTICS

(1) DEFINITION OF VIEWING ANGLE

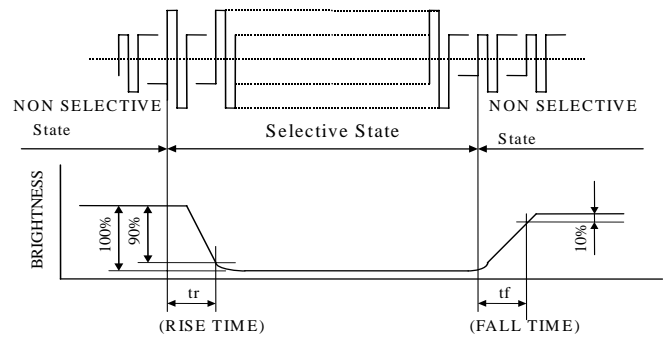


(2) DEFINITION OF CONTRAST

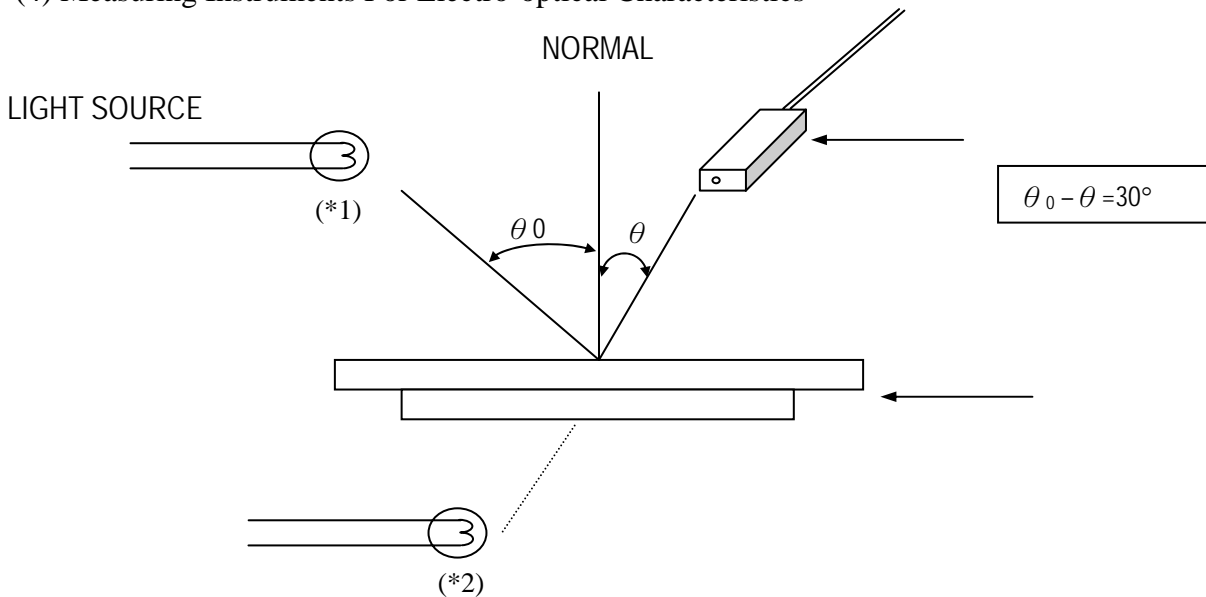
$$C.R = \frac{\text{Brightness of non-selected segment (B2)}}{\text{Brightness of selected segment (B1)}}$$



(3) DEFINITION OF RESPONSE



(4) Measuring Instruments For Electro-optical Characteristics





## 7.0 .TIMING CHARACTERISTICS

$T_A=25^{\circ}\text{C}$ ,  $V_{DD}=4.5\text{V}$  (PARALLEL MODE INTERFACE)

Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
<i>Internal Clock Operation</i>						
$f_{OSC}$	OSC Frequency	$R = 33\text{K}\Omega$	480	540	600	KHz
<i>External Clock Operation</i>						
$f_{EX}$	External Frequency	-	480	540	600	KHz
	Duty Cycle	-	45	50	55	%
$T_R, T_F$	Rise/Fall Time	-	-	-	0.2	$\mu\text{s}$
<i>Write Mode (Writing data from MPU to ST7920)</i>						
$T_C$	Enable Cycle Time	Pin E	1200	-	-	ns
$T_{PW}$	Enable Pulse Width	Pin E	140	-	-	ns
$T_R, T_F$	Enable Rise/Fall Time	Pin E	-	-	25	ns
$T_{AS}$	Address Setup Time	Pins: RS,RW,E	10	-	-	ns
$T_{AH}$	Address Hold Time	Pins: RS,RW,E	20	-	-	ns
$T_{DSW}$	Data Setup Time	Pins: DB0 - DB7	40	-	-	ns
$T_H$	Data Hold Time	Pins: DB0 - DB7	20	-	-	ns
<i>Read Mode (Reading Data from ST7920 to MPU)</i>						
$T_C$	Enable Cycle Time	Pin E	1200	-	-	ns
$T_{PW}$	Enable Pulse Width	Pin E	140	-	-	ns
$T_R, T_F$	Enable Rise/Fall Time	Pin E	-	-	25	ns
$T_{AS}$	Address Setup Time	Pins: RS,RW,E	10	-	-	ns
$T_{AH}$	Address Hold Time	Pins: RS,RW,E	20	-	-	ns
$T_{DDR}$	Data Delay Time	Pins: DB0 - DB7	-	-	100	ns
$T_H$	Data Hold Time	Pins: DB0 - DB7	20	-	-	ns
<i>Interface Mode with LCD Driver(ST7921)</i>						
$T_{CWH}$	Clock Pulse with High	Pins: CL1, CL2	800	-	-	ns
$T_{CWL}$	Clock Pulse with Low	Pins: CL1, CL2	800	-	-	ns
$T_{CST}$	Clock Setup Time	Pins: CL1, CL2	500	-	-	ns
$T_{SU}$	Data Setup Time	Pin: D	300	-	-	ns
$T_{DH}$	Data Hold Time	Pin: D	300	-	-	ns
$T_{DM}$	M Delay Time	Pin: M	-1000	-	1000	ns



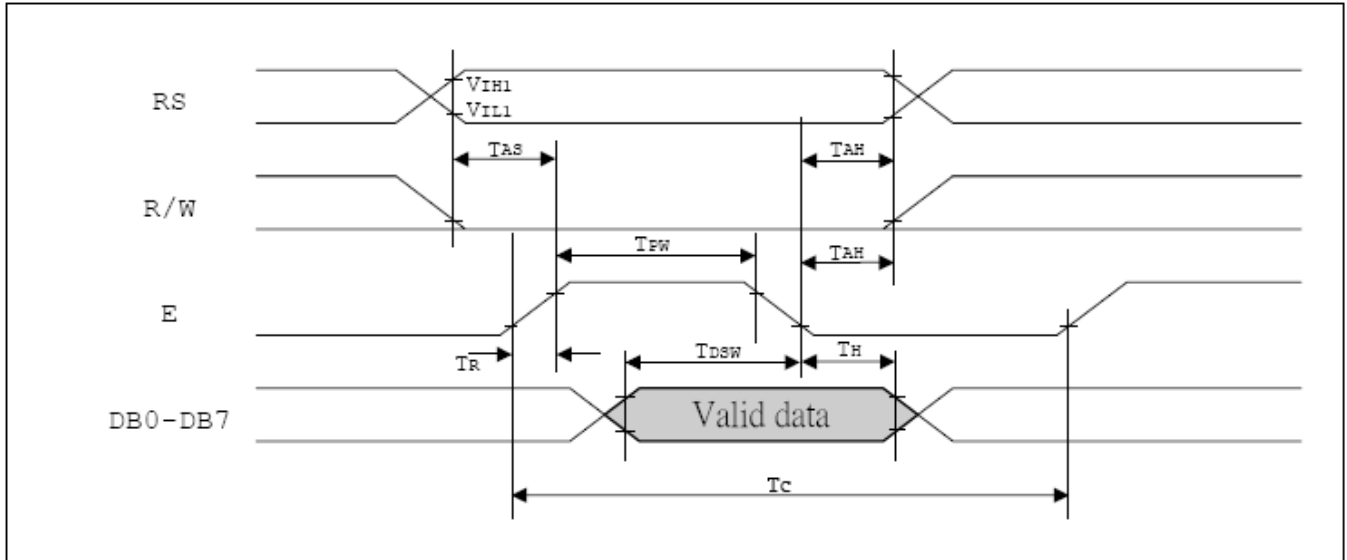
$T_A=25^{\circ}\text{C}$ ,  $V_{DD}=2.7\text{V}$ (PARALLEL MODE INTERFACE)

Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
<i>Internal Clock Operation</i>						
$f_{\text{OSC}}$	OSC Frequency	R = 18K $\Omega$	470	530	590	KHz
<i>External Clock Operation</i>						
$f_{\text{EX}}$	External Frequency	-	470	530	590	KHz
	Duty Cycle	-	45	50	55	%
$T_{\text{R}}, T_{\text{F}}$	Rise/Fall Time	-	-	-	0.2	$\mu\text{s}$
<i>Write Mode (Writing data from MPU to ST7920)</i>						
$T_{\text{C}}$	Enable Cycle Time	Pin E	1800	-	-	ns
$T_{\text{PW}}$	Enable Pulse Width	Pin E	160	-	-	ns
$T_{\text{R}}, T_{\text{F}}$	Enable Rise/Fall Time	Pin E	-	-	25	ns
$T_{\text{AS}}$	Address Setup Time	Pins: RS,RW,E	10	-	-	ns
$T_{\text{AH}}$	Address Hold Time	Pins: RS,RW,E	20	-	-	ns
$T_{\text{DSW}}$	Data Setup Time	Pins: DB0 - DB7	40	-	-	ns
$T_{\text{H}}$	Data Hold Time	Pins: DB0 - DB7	20	-	-	ns
<i>Read Mode (Reading Data from ST7920 to MPU)</i>						
$T_{\text{C}}$	Enable Cycle Time	Pin E	1800	-	-	ns
$T_{\text{PW}}$	Enable Pulse Width	Pin E	320	-	-	ns
$T_{\text{R}}, T_{\text{F}}$	Enable Rise/Fall Time	Pin E	-	-	25	ns
$T_{\text{AS}}$	Address Setup Time	Pins: RS,RW,E	10	-	-	ns
$T_{\text{AH}}$	Address Hold Time	Pins: RS,RW,E	20	-	-	ns
$T_{\text{DDR}}$	Data Delay Time	Pins: DB0 - DB7	-	-	260	ns
$T_{\text{H}}$	Data Hold Time	Pins: DB0 - DB7	20	-	-	ns
<i>Interface Mode with LCD Driver(ST7921)</i>						
$T_{\text{CWH}}$	Clock Pulse with High	Pins: CL1, CL2	800	-	-	ns
$T_{\text{CWL}}$	Clock Pulse with Low	Pins: CL1, CL2	800	-	-	ns
$T_{\text{CST}}$	Clock Setup Time	Pins: CL1, CL2	500	-	-	ns
$T_{\text{SU}}$	Data Setup Time	Pin: D	300	-	-	ns
$T_{\text{DH}}$	Data Hold Time	Pin: D	300	-	-	ns
$T_{\text{DM}}$	M Delay Time	Pin: M	-1000	-	1000	ns

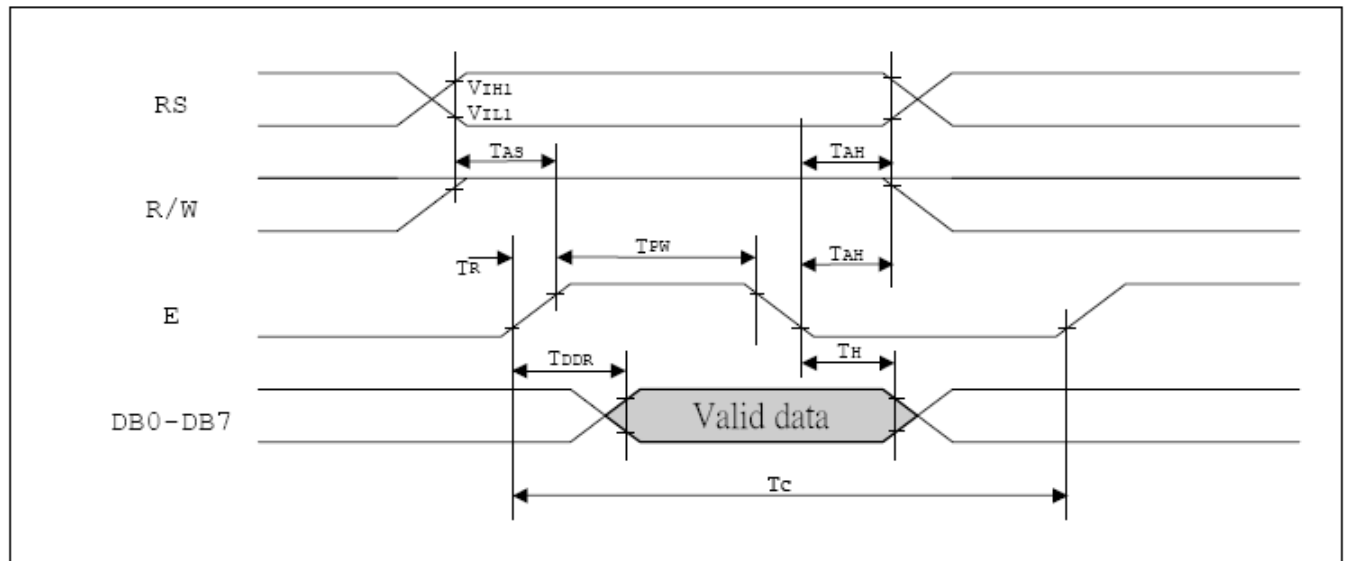


### 8-bit MPU INTERFACE TIMING

#### MPU WRITE(PARALLEL MODE)



#### MPU READ(PARALLEL MODE)





$T_A=25^{\circ}\text{C}$ ,  $V_{DD}=4.5\text{V}$ (SERIAL MODE INTERFACE)

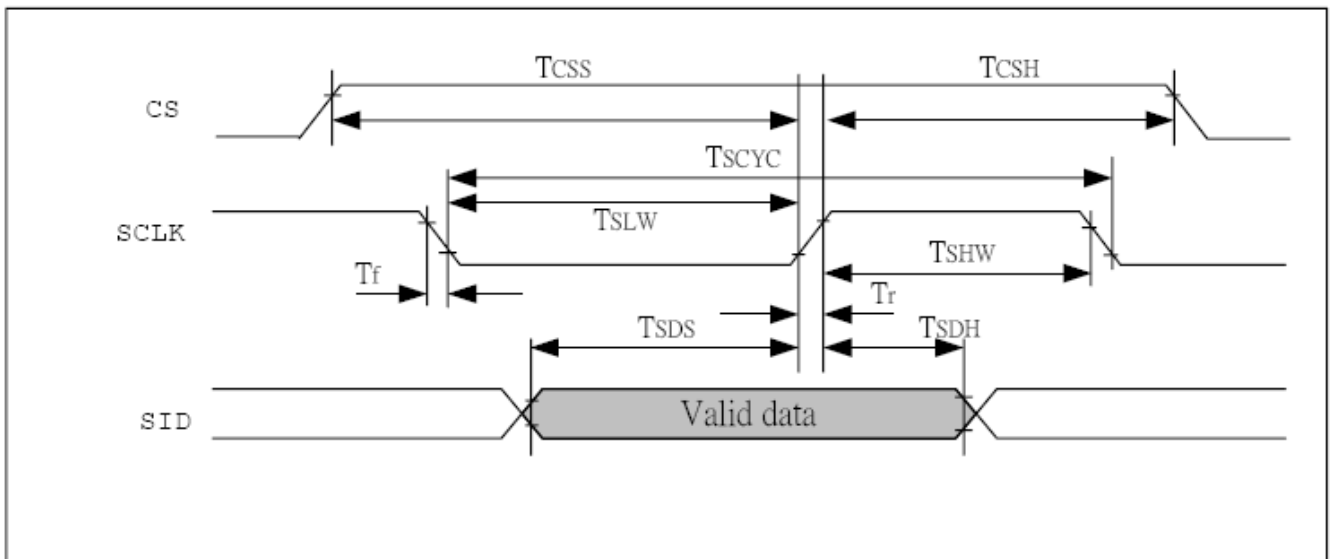
Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
<i>Internal Clock Operation</i>						
$f_{\text{OSC}}$	OSC Frequency	R = 33K $\Omega$	470	530	590	KHz
<i>External Clock Operation</i>						
$f_{\text{EX}}$	External Frequency	-	470	530	590	KHz
	Duty Cycle	-	45	50	55	%
$T_{\text{R}}, T_{\text{F}}$	Rise/Fall Time	-	-	-	0.2	$\mu\text{s}$
TSCYC	Serial clock cycle	Pin E	400	-	-	ns
TSHW	SCLK high pulse width	Pin E	200	-	-	ns
TSLW	SCLK low pulse width	Pin E	200	-	-	ns
TSDS	SID data setup time	Pins RW	40	-	-	ns
TSDH	SID data hold time	Pins RW	40	-	-	ns
TCSS	CS setup time	Pins RS	60	-	-	ns
TCSH	CS hold time	Pins RS	60	-	-	ns

$T_A=25^{\circ}\text{C}$ ,  $V_{DD}=2.7\text{V}$ (SERIAL MODE INTERFACE)

Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
<i>Internal Clock Operation</i>						
$f_{\text{OSC}}$	OSC Frequency	R = 18K $\Omega$	470	530	590	KHz
<i>External Clock Operation</i>						
$f_{\text{EX}}$	External Frequency	-	470	530	590	KHz
	Duty Cycle	-	45	50	55	%
$T_{\text{R}}, T_{\text{F}}$	Rise/Fall Time	-	-	-	0.2	$\mu\text{s}$
TSCYC	Serial clock cycle	Pin E	600	-	-	ns
TSHW	SCLK high pulse width	Pin E	300	-	-	ns
TSLW	SCLK low pulse width	Pin E	300	-	-	ns
TSDS	SID data setup time	Pins RW	40	-	-	ns
TSDH	SID data hold time	Pins RW	40	-	-	ns
TCSS	CS setup time	Pins RS	60	-	-	ns
TCSH	CS hold time	Pins RS	60	-	-	ns



MPU READ(SERIAL MODE)



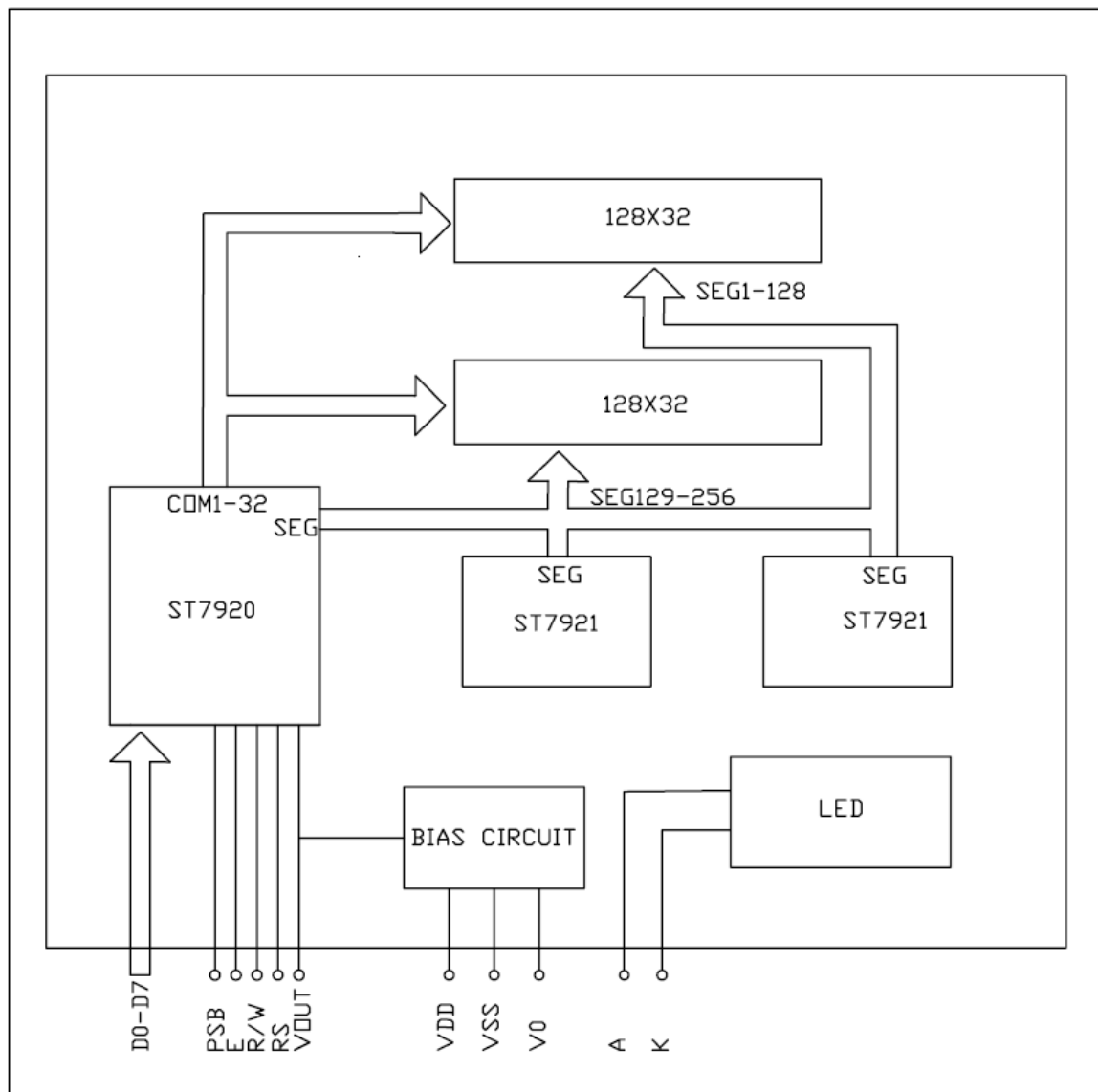
8. PIN ASSIGNMENT

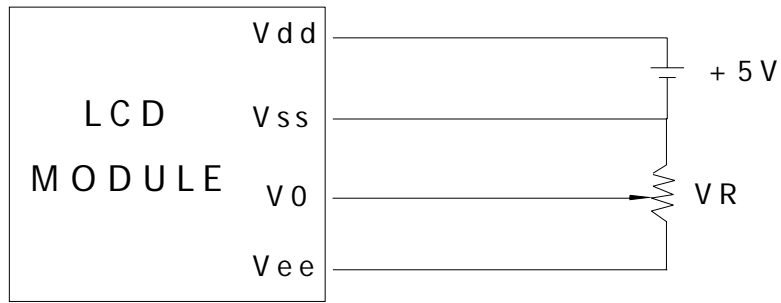
PIN	SYMBOL	FUNCTION
1	VSS	GND
2	VDD	POWER SUPPLY
3	V0	OPERRATION VOLTAGE FOR LCD
4	RS	SELECT REGISTER(PARALLEL MODE) 0: COMMAND 1:DATA CHIP SELECTION(SERIAL MODE) 1: CHIP ENABLE 0: CHIP DISABLE
5	R/W	READ/WRITE SIGNAL(0:WRITE;1:READ) (PARALLEL MODE) INPUT SERIAL DATA(SERIAL MODE)
6	E	READ/WRITE ENABLE(PARALLEL MODE) SERIAL PULSE(SERIAL MODE)
7-10	D0-D3	HIGH 4-BIT IN PARALLEL MODE; IN ORDER TO INTERFACE DATA OF TRANSMIT AND RECEIVE BETWEEN MPU AND ST7920 D0-D3 PINS ARE USELESS IN SERIAL MODE;
11-14	D4-D7	HIGH 4-BIT IN PARALLEL MODE; IN ORDER TO INTERFACE DATA OF TRANSMIT AND RECEIVE BETWEEN MPU AND ST7920;



		THE TERMINALS ARE USELESS IN 4-BIT CONTROL MODE AND SERIAL MODE;
15	PSB(VSS)	MPU CONTROL INTERFACE SELECTION 0: SERIAL MODE 1: PARALLEL MODE
16	NC	NO CONNECTION
17	/RET	RESET SIGNAL
18	VEE	MULTIPLE VOLTAGE OUTPUT
19	LEDA	LED ANODE
20	LEDK	LED CATHODE

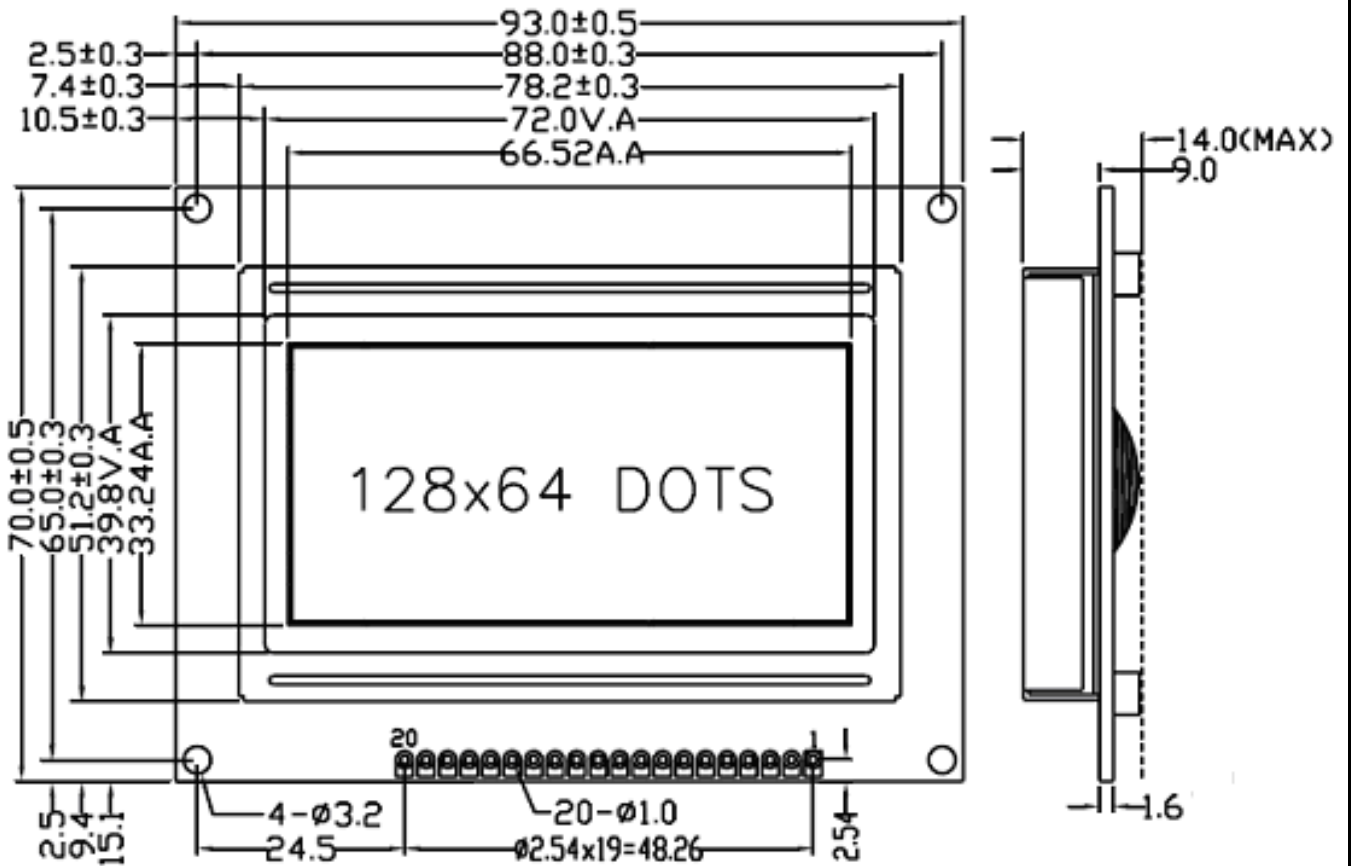
### 9. BLOCK DIAGRAM

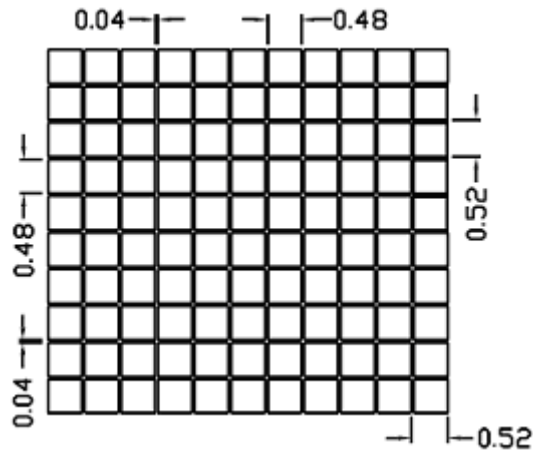




Vdd-V0: LCD Driving Voltage  
VR: 10K - 20K

### 10. OUTLINE DIMENSIONS





## 11. RELIABILITY

### Content of Reliability Test

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.	80 °C 200 hrs	
2	Low temperature storage	Endurance test applying the low storage temperature for a long time.	-30 °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.	70 °C 200 hrs	
4	Low temperature operation	Endurance test applying the electric stress under low temperature for a long time.	-20 °C 200 hrs	
5	High temperature Humidity storage	Endurance test applying the high temperature and high humidity storage for a long time.	50 °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.	50 °C , 90% RH 96 hrs	MIL-202E-103B JIS-C5023
7	Temperature cycle	Endurance test applying the low and high temperature cycle. <div style="text-align: center;"> <math display="block">-20^{\circ}\text{C} \quad 25^{\circ}\text{C} \quad 70^{\circ}\text{C}</math> <math display="block">\begin{array}{c} \leftarrow 30\text{min.} \rightleftharpoons 5\text{min.} \rightleftharpoons 30\text{min.} \rightarrow \\ \text{1 cycle} \end{array}</math> </div>	-20°C - 70°C 10 cycles	



<b>Mechanical Test</b>				
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 msecd 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
<b>Others</b>				
11	Static electricity test	Endurance test applying the electric stress to the terminal.	VS=800V, RS=1.5 k CS=100 pF 1 time	MIL-883B-3015.1

Supply voltage for logic system = 3V. Supply voltage for LCD system = Operating voltage at 25°C.

## 12. QUALITY GUARANTEE

### Acceptable Quality Level

Each lot should satisfy the quality level defined as follows.

- Inspection method : MIL-STD-105E LEVEL II Normal one time sampling
- AQL

Partition	AQL	Definition
A: Major	0.4%	Functional defective as product
B: Minor	1.5%	Satisfy all functions as product but not satisfy cosmetic standard

### Definition of 'LOT'

One lot means the delivery quantity to customer at one time.

### Conditions of Cosmetic Inspection

#### Environmental condition

The inspection should be performed at the 1cm of height from the LCD module under 2 pieces of



40W white fluorescent lamps (Normal temperature 20~25°C and normal humidity 60±15%RH).

**Inspection method**

The visual check should be performed vertically at more than 30cm distance from the LCD panel.

**Driving voltage**

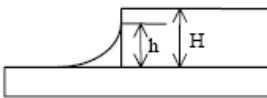
The VO value which the most optimal contrast can be obtained near the specified VO in the specification. (Within ±0.5V of typical value at 25°C.).

**13. INSPECTION CRITERIA**

**13.1 Module Cosmetic Criteria**

No.	Item	Judgement Criterion	Partition
1	Difference in Spec.	None allowed	Major
2	Pattern peeling	No substrate pattern peeling and floating	Major
3	Soldering defects	No soldering missing No soldering bridge No cold soldering	Major Major Major
4	Resist flaw on substrate	Invisible copper foil ('0.5mm or more) on substrate pattern	Minor
5	Accretion of metallic Foreign matter	No soldering dust No accretion of metallic foreign matters (Not exceed '0.2mm)	Minor Minor
6	Stain	No stain to spoil cosmetic badly	Minor
7	Plate discoloring	No plate fading, rusting and discoloring	Minor
8	Solder amount	a. Soldering side of PCB Solder to form a 'Filet' all around the lead. Solder should not hide the form perfectly. (too much)	Minor
	1. Lead parts	b. Components side ( In case of 'Through Hole PCB' )  Solder to reach the Components side of PCB.	
	2. Flat packages	Either 'Toe' (A) or 'Seal' the lead to be covered by 'Filet'.  Lead form to be assume over solder. A B	Minor



	3. Chips	$(3/2) H \geq h \geq (1/2) H$		Minor
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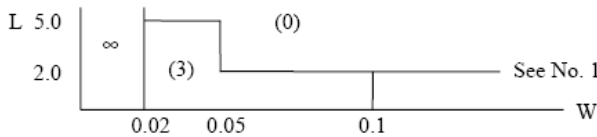
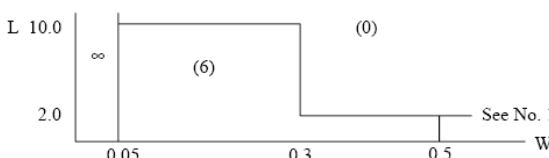
**13.2 Screen Cosmetic Criteria (Non-Operating)**

No.	Defect	Judgement Criterion	Partition										
1	Spots	In accordance with <i>Screen Cosmetic Criteria (Operating) No.1.</i>	Minor										
2	Lines	In accordance with <i>Screen Cosmetic Criteria (Operating) No.2.</i>	Minor										
3	Bubbles in polarizer	<table border="1" data-bbox="448 680 1106 831"> <thead> <tr> <th>Size : d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td><math>d \leq 0.3</math></td> <td>Disregard</td> </tr> <tr> <td><math>0.3 &lt; d \leq 1.0</math></td> <td>3</td> </tr> <tr> <td><math>1.0 &lt; d \leq 1.5</math></td> <td>1</td> </tr> <tr> <td><math>1.5 &lt; d</math></td> <td>0</td> </tr> </tbody> </table>	Size : d mm	Acceptable Qty in active area	$d \leq 0.3$	Disregard	$0.3 < d \leq 1.0$	3	$1.0 < d \leq 1.5$	1	$1.5 < d$	0	Minor
Size : d mm	Acceptable Qty in active area												
$d \leq 0.3$	Disregard												
$0.3 < d \leq 1.0$	3												
$1.0 < d \leq 1.5$	1												
$1.5 < d$	0												
4	Scratch	In accordance with spots and lines operating cosmetic criteria. When the light reflects on the panel surface, the scratches are not to be remarkable.	Minor										
5	Allowable density	Above defects should be separated more than 30mm each other.	Minor										
6	Coloration	Not to be noticeable coloration in the viewing area of the LCD panels. Back-lit type should be judged with back-lit on state only.	Minor										
7	Contamination	Not to be noticeable.	Minor										

**13.3. Screen Cosmetic Criteria (Operating)**

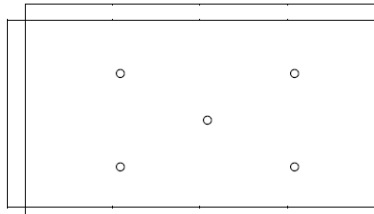
No.	Defect	Judgement Criterion	Partition																				
1	Spots	<p data-bbox="485 1352 687 1384">A) Clear Note :</p> <table border="1" data-bbox="493 1413 1214 1574"> <thead> <tr> <th>Size : d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td><math>d \leq 0.1</math></td> <td>Disregard</td> </tr> <tr> <td><math>0.1 &lt; d \leq 0.2</math></td> <td>3</td> </tr> <tr> <td><math>0.2 &lt; d \leq 0.3</math></td> <td>2</td> </tr> <tr> <td><math>0.3 &lt; d</math></td> <td>0</td> </tr> </tbody> </table> <p data-bbox="485 1603 1334 1675">Including pin holes and defective dots which must be within one pixel size.</p> <p data-bbox="485 1686 711 1718">B) Unclear Size :</p> <table border="1" data-bbox="493 1742 1206 1904"> <thead> <tr> <th>Size : d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td><math>d \leq 0.2</math></td> <td>Disregard</td> </tr> <tr> <td><math>0.2 &lt; d \leq 0.5</math></td> <td>6</td> </tr> <tr> <td><math>0.5 &lt; d \leq 0.7</math></td> <td>2</td> </tr> <tr> <td><math>0.7 &lt; d</math></td> <td>0</td> </tr> </tbody> </table>	Size : d mm	Acceptable Qty in active area	$d \leq 0.1$	Disregard	$0.1 < d \leq 0.2$	3	$0.2 < d \leq 0.3$	2	$0.3 < d$	0	Size : d mm	Acceptable Qty in active area	$d \leq 0.2$	Disregard	$0.2 < d \leq 0.5$	6	$0.5 < d \leq 0.7$	2	$0.7 < d$	0	Minor
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$0.7 < d$	0																						



2	Lines	<p>A) Clear</p>  <p>Note : ( ) - Acceptable Qty in active area L - Length (mm) W - Width (mm) ∞ - Disregard</p> <p>B) Unclear</p> 	Minor
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'Clear' = The shade and size are not changed by VO.  
'Unclear' = The shade and size are changed by VO.

**13.4. Screen Cosmetic Criteria (Operating) (Continued)**

No.	Defect	Judgement Criterion	Partition
3	Rubbing line	Not to be noticeable.	
4	Allowable density	Above defects should be separated more than 10mm each other.	Minor
5	Rainbow	Not to be noticeable.	Minor
6	Dot size	To be 95% ~ 105% of the dot size (Typ.) in drawing. Partial defects of each dot (ex. pin-hole) should be treated as 'Spot'. (see <i>Screen Cosmetic Criteria (Operating) No.1</i> )	Minor
7	Uneven brightness (only back-lit type module)	<p>Uneven brightness must be <math>B_{MAX} / B_{MIN} \leq 2</math></p> <ul style="list-style-type: none"> <li>- BMAX : Max. value by measure in 5 points</li> <li>- BMIN : Min. value by measure in 5 points</li> </ul> <p>Divide active area into 4 vertically and horizontally. Measure 5 points shown in the following figure.</p>  <p style="text-align: center;">○ : Measuring points</p>	Minor

Note :



- (1) Size :  $d = (\text{long length} + \text{short length}) / 2$
- (2) The limit samples for each item have priority.
- (3) Complexed defects are defined item by item, but if the number of defects are defined in above table, the total number should not exceed 10.
- (4) In case of 'concentration', even the spots or the lines of 'disregarded' size should be not allowed. Following three situations should be treated as 'concentration'.
  - 7 or over defects in circle of '5mm.
  - 10 or over defects in circle of '10mm.
  - 20 or over defects in circle of '20mm.

## 14. PRECAUTIONS FOR USING LCD MODULES

### Handing Precautions

- (1) The display panel is made of glass. Do not subject it to a mechanical shock by dropping it or impact.
- (2) 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.
- (3) Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- (4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- (5) 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
- (6) Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.
  - Water
  - Ketone
  - Aromatic solvents
- (7) 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.
- (8) 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.
- (9) Do not attempt to disassemble or process the LCD module.
- (10) NC terminal should be open. Do not connect anything.
- (11) If the logic circuit power is off, do not apply the input signals.
- (12) 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 Precautions**

When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps. Keep the modules in bags (avoid high temperature high humidity and low temperatures below 0 °C). Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

#### **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.

## **15. USING LCD MODULES**

#### **Liquid Crystal Display Modules**

LCD is composed of glass and polarizer. Pay attention to the following items when handling.

(1) Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.

(2) Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.).

(3) N-hexane is recommended for cleaning the adhesives used to attach front/rear polarizers and reflectors made of organic substances which will be damaged by chemicals such as acetone, toluene, ethanol and isopropylalcohol.

(4) When the display surface becomes dusty, wipe gently with absorbent cotton or other soft material like chamois soaked in petroleum benzine. Do not scrub hard to avoid damaging the display surface.

(5) Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading.

(6) Avoid contacting oil and fats.

(7) Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizers. After products are tested at low temperature they must be warmed up in a container before coming



is contacting with room temperature air.

(8) Do not put or attach anything on the display area to avoid leaving marks on.

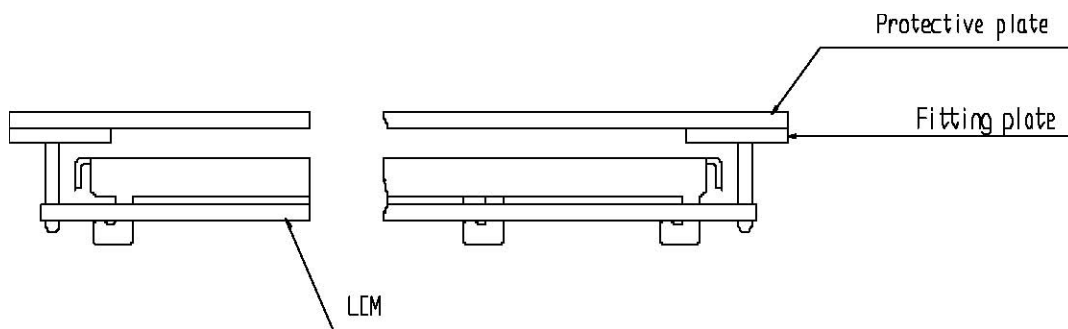
(9) Do not touch the display with bare hands. This will stain the display area and degrade insulation between terminals (some cosmetics are determined to the polarizers).

(10) As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring.

### 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 0.1mm.

### 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) Do not alter, modify or change the the shape of the tab on the metal frame.

(2) Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.

(3) Do not damage or modify the pattern writing on the printed circuit board.

(4) Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.

(5) Except for soldering the interface, do not make any alterations or modifications with a soldering iron.

(6) 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 potential 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.

- Soldering iron temperature : 280 C ± 10 C.
- Soldering time : 3-4 sec.
- Solder : eutectic solder.

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.

(2) 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.

(3) 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.

