Shenzhen Yaoxingyang Electronics Company Limited

SPECIFICATION FOR LCD MODULE

CUSTOMER	
MODEL	12864
REVISION	1.1

PREPARED	CHECKED	APPROVALED

CONTENTS

1、Record of Revision

The following table tracks the history of the changes made to this document.

Date	Rev.	Summary	Design	Check

2、Scope

This specification is applied to the liquid crystal display module 12864B V2.0. It's a STN, NEGATIVE, LCD module and display 128*64dots with chinese fonts.
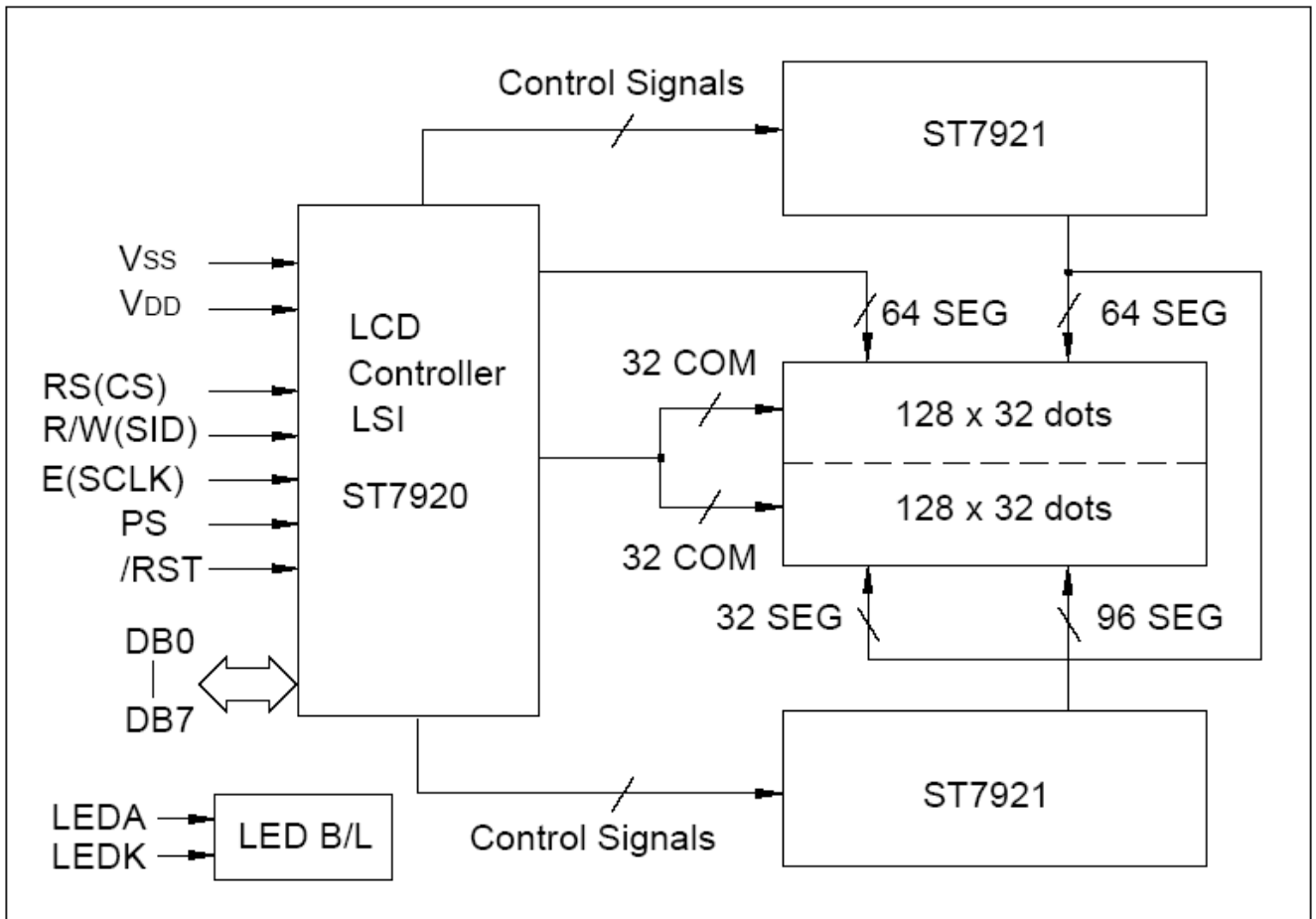
3、Technology Specifications
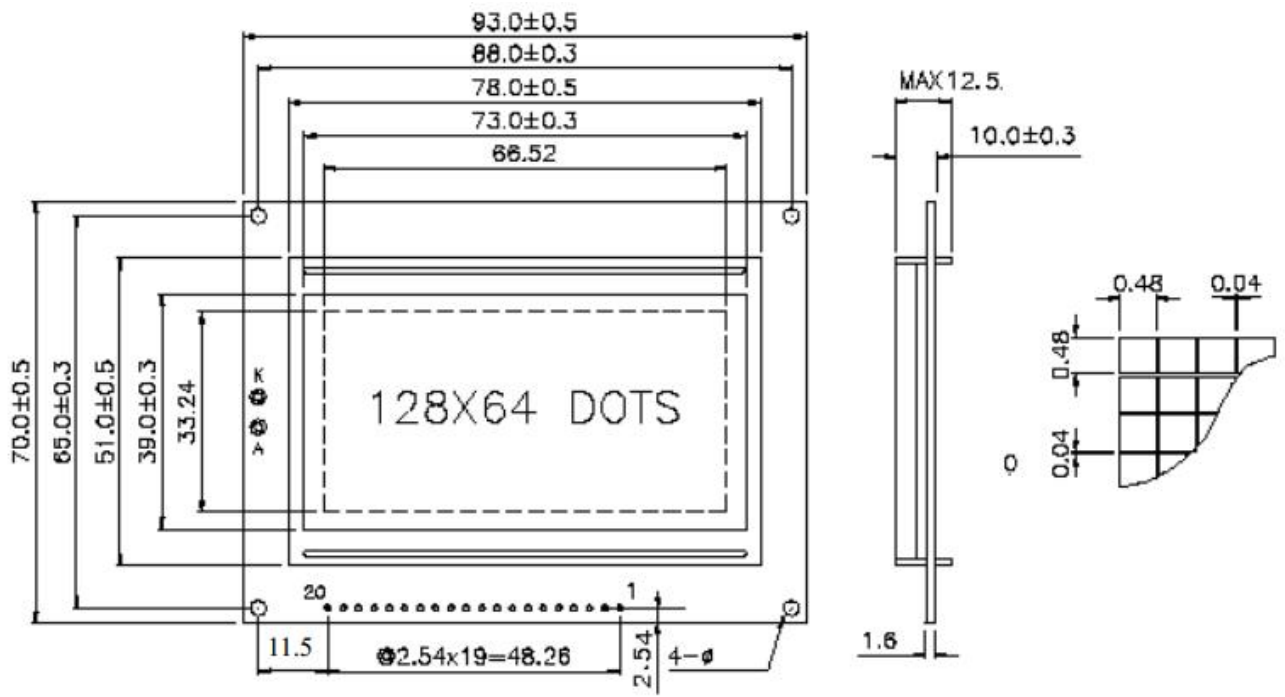
3.1 Features

- Display Format　　　　:　128×64 Dots
- Display Mode　　　　　:　STN,NEGATIVE,BLUE
- Polarizer Mode　　　　:　TransMISSIVE
- Driving Method　　　　:　1/32Duty, 1/6 Bias
- Viewing Direction　　　:　6 O'clock
- Backlight　　　　　　　:　LED, WHITE
- Weight　　　　　　　　:　——
- Controller　　　　　　:　ST7920 with chinese fonts
- Interface　　　　　　　:　8-Bit Parallel Interface or Serial Interface

3.2 Mechanical Specifications

Item	Description	Unit
Module Dimension	93.0(W) × 70.0(H) × 13.0(Max)(T)	mm
Viewing Area	72(W) × 39(H)	mm
Active Area	66.52(W) × 33.24(H)	mm
Dot Size	0.48(W) × 0.48(H)	mm
Dot Pitch	0.52(W) × 0.52(H)	mm
Character Matrix	——	dots
Character Size	——	mm

3.3 System Block Diagram

128X64 DOTS

93.0±0.5
88.0±0.3
78.0±0.5
73.0±0.3
66.52

70.0±0.5
65.0±0.3
51.0±0.5
39.0±0.3
33.24

K
A

20
1

11.5
⌀2.54x19=48.26
2.54
4-⌀

MAX12.5
10.0±0.3
1.6

0.48
0.04
0.48
0.04
0

3.4 Terminal Functions

PIN No.	Symbol	Level	Function
1	V$_{SS}$	——	Power Ground
2	V$_{DD}$	——	Power supply for logic(+3.3V)
3	V0	——	ower supply for
4	RS	H/L	Register selection 　　H: Display data L: Instruction code
5	R/W(SID)	H/L	Read/Write selection 　　H: Read operation　　L: Write operation
6	E(SCLK)	H,H→L	Enable signal
7	D0	H/L	Data Bit0
8	D1	H/L	Data Bit1
9	D2	H/L	Data Bit2
10	D3	H/L	Data Bit3
11	D4	H/L	Data Bit4
12	D5	H/L	Data Bit5
13	D6	H/L	Data Bit6
14	D7	H/L	Data Bit7
15	PSB	-	Interface selection: J7=vss Ssrial mode J7=vdd 8/4-bits parallel bus mode
16	NC		nc
17	RST		When rst is set　to "L",the settings are initialized
18	VOUT		LCD Voltage double output
19	LEDA	——	Power supply for LED backlight（+3.3V）
20	LEDK	——	Power supply for LED backlight（0V）

4、Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit
Supply Voltage (Logic)	V_{DD}-V_{SS}	-0.3	3.3	V
Supply Voltage (LCD)	VLCD	-0.3	7.0	V
Input Voltage	VI	-0.3	VDD+0.3	V
Operating Temperature	Topr	-20	70	℃
Storage Temperature	Tstg	-30	80	℃

5、Electrical Characteristics

5.1 DC Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage (Logic)	VDD		3.3	3.5	3.8	V
Supply Voltage (LCD Drive)	VDD-VO	Ta = 25℃	——	3.5	——	V
Input High Voltage	VIH		0.7VDD	——	VDD	V
Input Low Voltage	VIL		-0.3	——	0.6	V
Output High Voltage	VOH	IOH=-0.1mA	0.8VDD	——	VDD	V
Output Low Voltage	VOL	IOL=0.1mA	0	——	0.1VDD	V

5.2 AC Characteristics

Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
Internal Clock Operation						
f_{OSC}	OSC Frequency	R = 33KΩ	480	540	600	KHz
External Clock Operation						
f_{EX}	External Frequency	-	480	540	600	KHz
	Duty Cycle	-	45	50	55	%
T_R, T_F	Rise/Fall Time	-	-	-	0.2	μs
Write Mode (Writing data from MPU to ST7920)						
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
Read Mode (Reading Data from ST7920 to MPU)						
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
Interface Mode with LCD Driver(ST7921)						
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
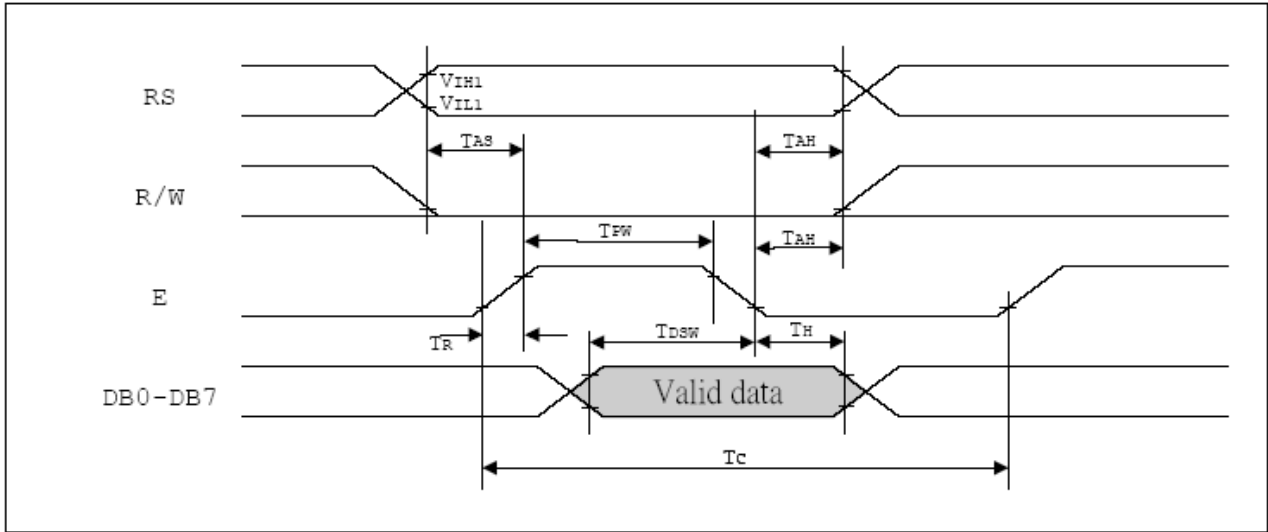
MPU WRITE TIMING
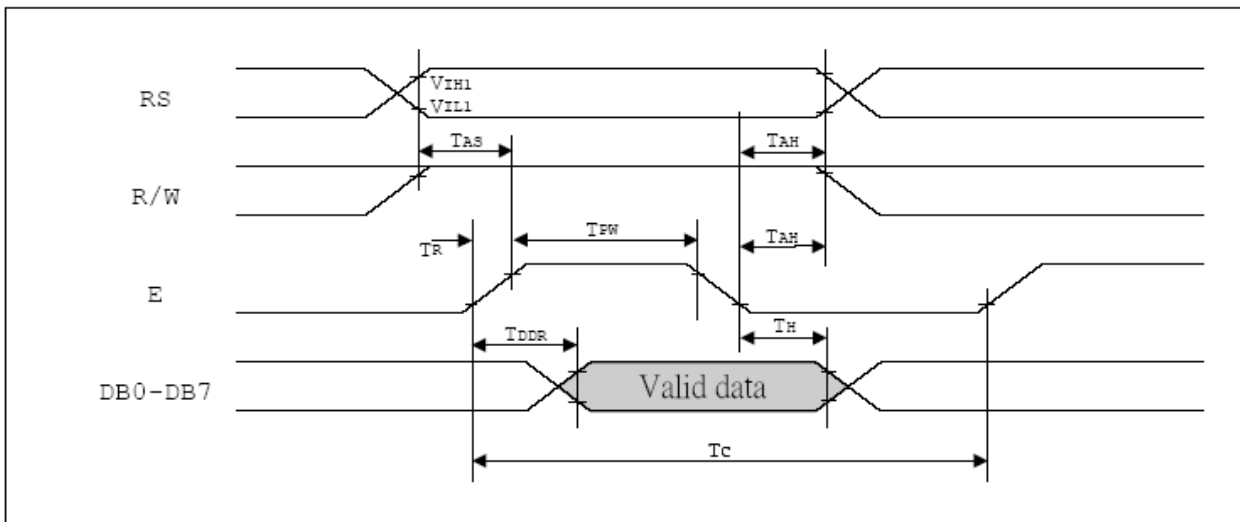
MPU READ TIMING

6、LED Backlight Characteristics(Ta = 25℃)

Item	Symbol	Min.	Typ.	Max.	Condition	Unit
Forward Voltage	Vf	2.9	3.1	3.3	If =60mA	V
Reverse Current	Ir		--			uA
Peak Wave Length	λp					nm
Spectral Line Half Width	Δλ					nm
Luminance	Lv				If = 60mA	cd/m^2
ElectroStatic Discharge	ESD					V

7、 DISPLAY CONTROL INSTRUCTION

Instruction set 1: (RE=0: basic instruction)

Ins	code										Description	Exec time (540KHZ)
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
CLEAR	0	0	0	0	0	0	0	0	0	1	Fill DDRAM with "20H", and set DDRAM address counter (AC) to "00H"	1.6 ms
HOME	0	0	0	0	0	0	0	0	1	X	Set DDRAM address counter (AC) to "00H", and put cursor to origin ; the content of DDRAM are not changed	72us
ENTRY MODE	0	0	0	0	0	0	0	1	I/D	S	Set cursor position and display shift when doing write or read operation	72us
DISPLAY ON/OFF	0	0	0	0	0	0	1	D	C	B	D=1: display ON C=1: cursor ON B=1: blink ON	72 us
CURSOR DISPLAY CONTROL	0	0	0	0	0	1	S/C	R/L	X	X	Cursor position and display shift control ; the content of DDRAM are not changed	72 us
FUNCTION SET	0	0	0	0	1	DL	X	0 RE	X	X	DL=1 8-BIT interface DL=0 4-BIT interface **RE=1: extended instruction** **RE=0: basic instruction**	72 us
SET CGRAM ADDR.	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address to address counter (AC) **Make sure that in extended instruction SR=0 (scroll or RAM address select)**	72 us
SET DDRAM ADDR.	0	0	1	0 AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address to address counter (AC) AC6 is fixed to 0	72 us
READ BUSY FLAG (BF) & ADDR.	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Read busy flag (BF) for completion of internal operation, also Read out the value of address counter (AC)	0 us
WRITE RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data to internal RAM (DDRAM/CGRAM/IRAM/GDRAM)	72 us
READ RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM/IRAM/GDRAM)	72 us

Instruction set 2: (RE=1: extended instruction)

Inst.	code										description	Exec. time (540KHZ)
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
STAND BY	0	0	0	0	0	0	0	0	0	1	Enter stand by mode, any other instruction can terminate (Com1..32 halted, only Com33 ICON can display)	72 us
SCROLL or RAM ADDR. SELECT	0	0	0	0	0	0	0	0	1	SR	SR=1: enable vertical scroll position SR=0: enable IRAM address (extended instruction) SR=0: enable CGRAM address(basic instruction)	72 us
REVERSE	0	0	0	0	0	0	0	1	R1	R0	Select 1 out of 4 line (in DDRAM) and decide whether to reverse the display by toggling this instruction **R1,R0 initial value is 00**	72 us
SLEEP	0	0	0	0	0	0	1	SL	X	X	SL=1: leave sleep mode SL=0: enter sleep mode	72 us
EXTENDED FUNCTION SET	0	0	0	0	1	DL	X	1 RE	G	0	DL=1 8-BIT interface DL=0 4-BIT interface RE=1: extended instruction set RE=0: basic instruction set G=1 :graphic display ON G=0 :graphic display OFF	72 us
SET IRAM or SCROLL ADDR	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	SR=1: AC5~AC0 the address of vertical scroll SR=0: AC3~AC0 the address of ICON RAM	72 us
SET GRAPHIC RAM ADDR.	0	0	1	0 AC6	0 AC5	0 AC4	AC3 AC3	AC2 AC2	AC1 AC1	AC0 AC0	Set GDRAM address to address counter（AC） First set vertical address and the horizontal address by consecutive writing Vertical address range AC6...AC0 Horizontal address range AC3…AC0	72 us

Note：

1. Make sure that ST7920 is not in busy state by reading the busy flag before sending instruction or data. If use delay loop instead please make sure the delay time is enough. Please refer to the instruction execution time.

2. "RE" is the selection bit of basic and extended instruction set. Each time when altering the value of RE it will remain. There is no need to set RE every time when using the same group of instruction set.

Initial setting(Register flag) (RE=0: basic instruction)

Inst.	code										Description
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
ENTRY MODE SET	0	0	0	0	0	0	0	1	I/D	S	Cursor move to right ,DDRAM address counter（AC）plus 1
									1	0	
DISPLAY STATUS	0	0	0	0	0	0	1	D	C	B	Display, cursor and blink　ALL OFF
								0	0	0	
CURSOR DISPLAY SHIFT	0	0	0	0	0	1	S/C	R/L	X	X	No cursor or display shift operation
							X	X			
FUNCTION SET	0	0	0	0	1	DL	X	0 RE	X	X	8 BIT MPU interface , basic instruction set
						1		0			

Initial setting(Register flag) (RE=1: extended instruction set)

Inst.	code										description
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
SCROLL OR RAM ADDR. SELECT	0	0	0	0	0	0	0	0	1	SR	Allow IRAMaddress or set CGRAM address
										0	
REVERSE	0	0	0	0	0	0	0	1	R1	R0	Begin with normal and toggle to reverse
									0	0	
SLEEP	0	0	0	0	0	0	1	SL	X	X	Not in sleep mode
								1			
EXTENDED FUNCTION SET	0	0	0	0	1	DL	X	1 RE	G	0	Graphic display OFF
								0			

8、 Precautions For use of LCD Module

8.1 Handling Precautions

LCD modules are assembled and adjusted with a high degree of precision, do not applying excessive shocks to it or making any alterations or modifications to it, the following precautions should be taken when handing.

— The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

— 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.

— Do not apply excessive force on the surface of display or the adjoining areas of LCD module since this may cause the color tone to vary.

— If the display surface of LCD module becomes contaminated, blow 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

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

> • Water
> • Ketone
> • Aromatic Solvents

— The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

— To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity, etc., exercise care to avoid touching the following sections when handling the module:

> • Terminal electrode sections.
> • Part of pattern wiring on TAB, etc.

8.2 Electro-Static Discharge Control

— The IC mounted on the LCD is very susceptible to static electricity. To protect them from static electricity which your body and clothing collect, connect your body to the ground via a resistor of some 1M Ω so that electricity should discharge connect the resistor close to your body in the grounding line and protect yourself from electric shock hazard.

— Module should be store in antistatic bag or other containers resistant to static after remove from its original package.

— The LCD modules use CMOS LSI drivers, so customers are recommend that any unused input terminal would be connected to VDD or VSS, do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

— In order to reduce the generation of static electricity, a relative humidity of 50-60% is recommended.
— The LCD module is coated with a film to protect the display surface. Take care when peeling off this protective film since static electricity may be charged.
— Tools required for assembly, such as soldering irons, must be properly grounded.

8.3 Design Precautions

— The absolute maximum ratings represent the rated value beyond which LCD module can not exceed. When the LCD modules are used in excess of this rated value, their operating characteristics may be adversely affected.
— To prevent the occurrence of erroneous operation caused by noise, attention must be paid to satisfy VIL, VIH specification values, including taking the precaution of using signal cables that are short.
— The liquid crystal display exhibits temperature dependency characteristics. Since recognition of the display becomes difficult when the LCD is used outside its designated operating temperature range, be sure to use the LCD within this range. Also, keep in mind that the LCD driving voltage levels necessary for clear displays will vary according to temperature.
— Sufficiently notice the mutual noise interference occurred by peripheral devices.
— To cope with EMI, take measures basically on outputting side.
— If DC is impressed on the liquid crystal display panel, display definition is rapidly deteriorated by the electrochemical reaction that occurs inside the liquid crystal display panel. To eliminate the opportunity of DC impressing, be sure to maintain the AC characteristics of the input signals sent to the LCD Module.

8.4 Soldering Precautions

Soldering should apply to I/O terminals only.
— Soldering temperature is 280℃+(-)10℃.
— Soldering time 3-4 seconds.
— Eutectic solder (rosin flux filled) should be used.
— Only properly grounded soldering iron should be used.
— If soldering flux is used, be sure to remove any remaining flux after finishing the soldering operation and LCD surface should be covered during soldering to prevent any damage to flux spatters.
— When remove the lead wires from the I/O terminals, use proper de-soldering methods, e.g. suction type de-soldering irons. Do not repeat wiring by soldering more than three times at the pads and plated though holes may be damaged.

8.5 Operational Precautions

— Do not remove the panel or frame from the liquid crystal display module.
— Power supplies should always be turned on before the independent input signal sources turned on, and input signals should be turned off before power supplies turned off.
— The IC would break down if the driving voltage exceeds the limit. Make sure of electrical

specifications, particularly the supply voltage.

— It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage than the limit causes the shorter LCD life. The use of direct current drive should be avoided because an electrochemical reaction due to direct current causes LCD's undesirable deterioration.

— Some font will be abnormally displayed when the display area is pushed hard during operation. But It resumes normal condition after turning off once.

— The response of the display is slow when the ambient temperature is below the lower limit, and the display surface appears dark everywhere when the ambient temperature is above the upper limit, in any case, id does not mean failure. It operates properly in the normal operating temperature range.

— The contrast of the liquid crystal display varies with the viewing angle, ambient temperature, and driving voltage. Adjust the driving voltage for the best contrast by installing external variable switch.

— 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.

— Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions. Therefore it must be used under the relative condition of 50% RH.

8.6 Storage Precautions

— Take care to minimize corrosion of the electrodes. Water droplets or a current flow in a high humidity environment accelerates corrosion of the electrodes.

— When storing the LCD module, avoid exposure to direct sunlight or to the light of fluorescent lamps. Keep the LCD module in sealed polyethylene bags designed to prevent static electricity charging under low temperature / normal humidity conditions (avoid high temperature / high humidity and low temperature below 0). The temperature range of $0℃\sim$ $-30℃$ and at low humidity is recommended.

Whenever possible, the LCD module should be stored in the same conditions in which they were shipped from our company.