SPECIFICATIONS FOR LCD MODULE

CUSTOMER	
MODEL	**SC12864028-V01**
CUSTOMER APPROVED	

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Specification Revision History

Version	Content	Date
A0	First Issue	31-Aug-2012
A1	Change Backlight Outline	20-Dec-2012

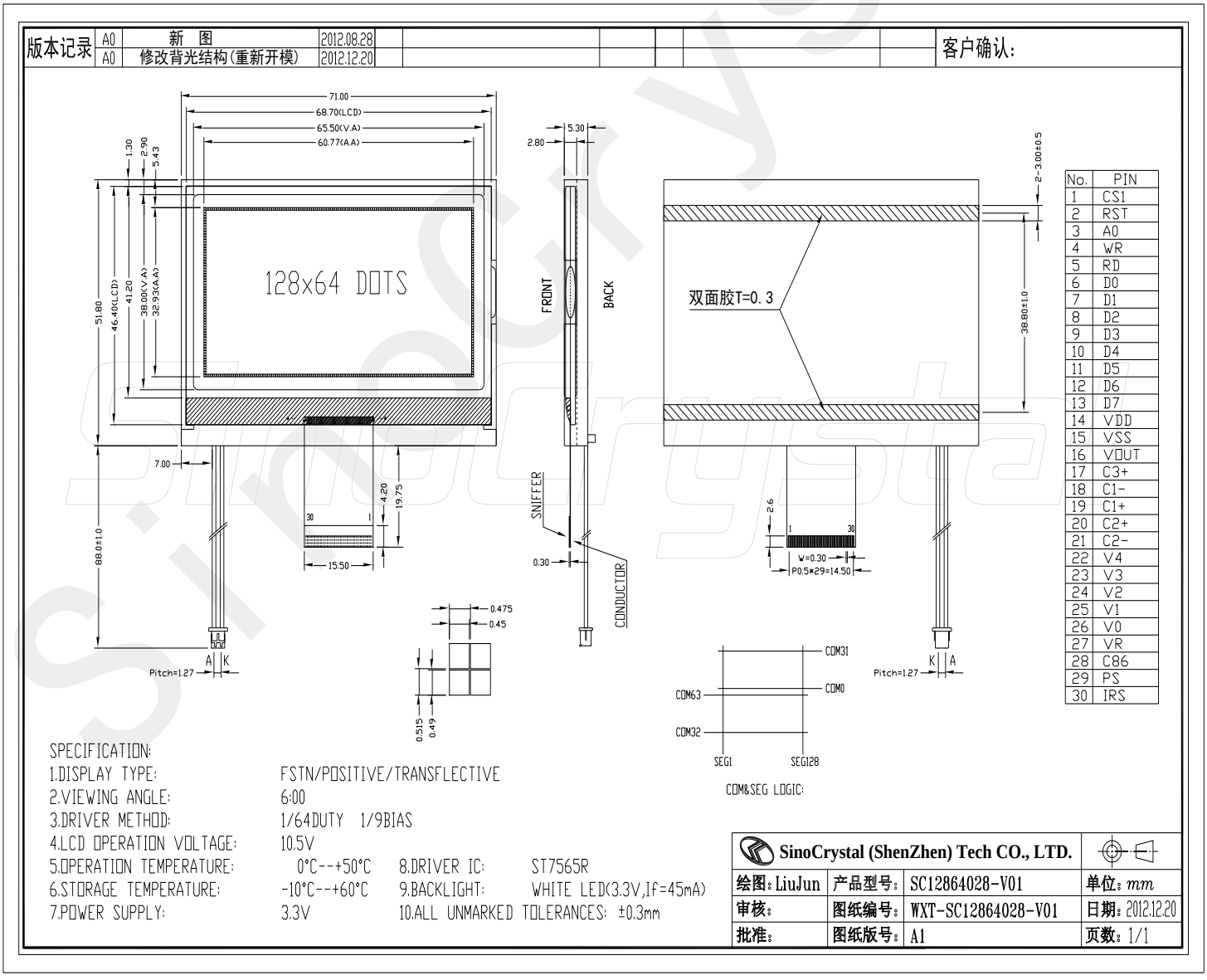
CONTENTS

■ MODULE CLASSIFICATION INFORMATION

■ PHYSICAL DATA

ITEM	STANDARD VALUE	UNIT
NUMBER OF GRAPHIC	128×64	Mm
MODULE DIMENSION	71.8×52.6×6.8(MAX)	Mm
EFFECTIVE DISPLAY AREA	60.77×32.93	Mm
DOT SIZE	0.45×0.49	Mm
DOT PITCH	0.476×0.515	Mm
LCD TYPE	FSTN/POSITIVE/TRANSMISSIVE	
DUTY	1/64	
VIEWING DIRECTION	6	o'clock
BACK LIGHT TYPE	SIDE LIT LED	
BACK LIGHT COLOR	WHITE	
APPROX. WEIGHT	85	G

■ MECHANICAL DIMENSIONS

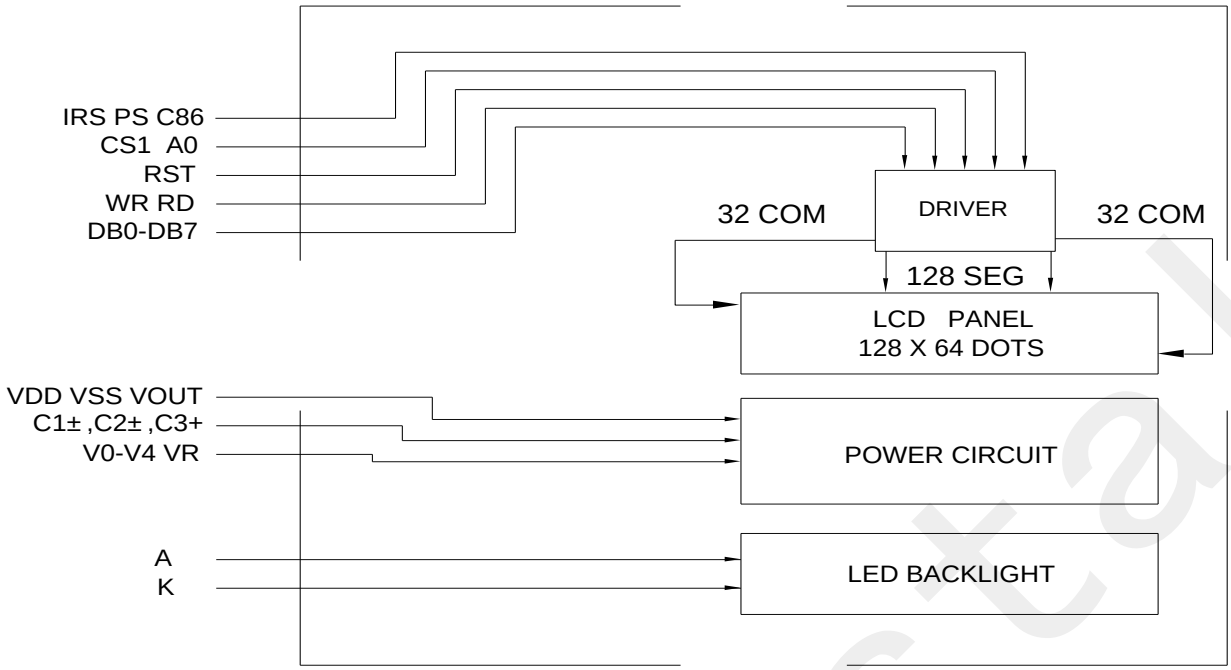


SPECIFICATION:

1.DISPLAY TYPE:	FSTN/POSITIVE/TRANSFLECTIVE		
2.VIEWING ANGLE:	6:00		
3.DRIVER METHOD:	1/64DUTY 1/9BIAS		
4.LCD OPERATION VOLTAGE:	10.5V		
5.OPERATION TEMPERATURE:	0°C--+50°C	8.DRIVER IC:	ST7565R
6.STORAGE TEMPERATURE:	-10°C--+60°C	9.BACKLIGHT:	WHITE LED(3.3V,If=45mA)
7.POWER SUPPLY:	3.3V	10.ALL UNMARKED TOLERANCES:	±0.3mm

SinoCrystal (ShenZhen) Tech CO., LTD.			
绘图:LiuJun	产品型号:	SC12864028-V01	单位: mm
审核:	图纸编号:	WXT-SC12864028-V01	日期: 2012.12.20
批准:	图纸版号:	A1	页数: 1/1

■DIAGRAM



■ INTERFACE PIN CONNECTIONS

NO	SYMBOL	LEVEL	FUNCTION
1	CS1	H/L	Chip select signal
2	RST	H/L	Chip reset signal
3	A0	H/L	Register selection input H : Indicate that D0 to D7 are display data. L:Indicate that D0 to D7 are control data
4	WR(R/W)	H/L	8080 series: Write signal 6800 series: Read or Write signal
5	RD(E)	H/L	8080 series: Read signal 6800 series: Enable signal
6-13	D0-D5 D6(SCL) D7(SI)	H/L	This is an 8-bit bi-directional data bus that connects to an 8-bit or 16-bit standard MPU data bus. When the serial interface (SPI-4) is selected (P/S = "L") : D7 : serial data input (SI) ; D6 : the serial clock input (SCL). D0 to D5 should be connected to VDD or floating.
14	VDD	--	Supply voltage for logic
15	VSS	--	Ground
16	VOUT	--	Power for LCD
17	C3+	--	DC/DC voltage converter. Connect a capacitor between this terminal and the CAP1N terminal.
18	C1-	--	DC/DC voltage converter. Connect a capacitor between this terminal and the CAP1P terminal.
19	C1+	--	DC/DC voltage converter. Connect a capacitor between this terminal and the CAP1N terminal. Reset signal.
20	C2+	--	DC/DC voltage converter. Connect a capacitor between this terminal and the CAP2N terminal.
21	C2-	--	DC/DC voltage converter. Connect a capacitor between this terminal and the CAP2P terminal. Chip select.
22-26	V4-V0	--	This is a multi-level power supply for the liquid crystal drive.
27	VR	--	Contrast adjustment input.
28	C86	H/L	C86 = "H": 6800 Series MPU interface. C86 = "L": 8080 Series MPU interface.
29	PS	H/L	P/S = "H": Parallel interface P/S = "L": Serial interface
30	IRS	H/L	RS = "H": Use the internal resistors IRS = "L": Do not use the internal resistors.

■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	MIN	MAX	UNIT
Supply voltage for logic	VDD	3.1	3.6	V
Supply voltage for LCD	V0	VDD-19.0	VDD+0.3	V
Input voltage	VI	-0.3	VDD+0.3	V
Operating temperature	TOP	-20	+70	℃
Storage temperature	TST	-30	+80	℃

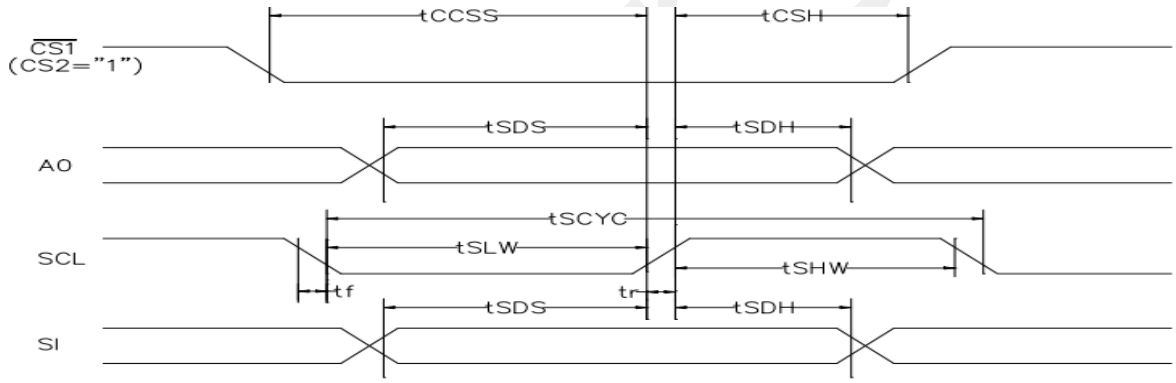
■ ELECTRICAL CHARACTERISTICS

▼ DC Characteristics

Condition: VDD=+5.0V±10%, VSS=0V, VDD-V0=8 to 17V, Ta=-30 to +85℃

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Supply voltage for logic	VDD	----	2.8	3.3	3.6	V
Supply current for logic	IDD	----	2.0	2.4	2.8	Ma
Operating voltage for LCD	V0-VSS	----	9.0	10.5	12.5	V
Input voltage ' H ' level	VIH	----	2.0	----	VDD	V
Input voltage ' L ' level	VIL	----	0	----	0.8	V
output voltage ' H ' level	VOH	IOH=-200μA	2.4	----	----	V
output voltage ' L ' level	VOL	IOL=1.6mA	----	----	0.4	V

▼ AC Characteristics



VDD=3.3 V Ta=25℃

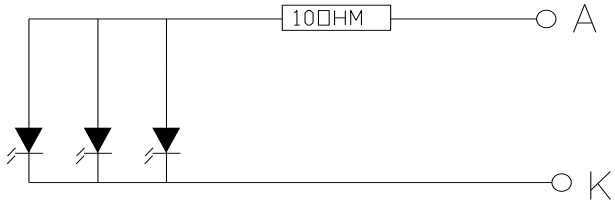
Item	Signal	Symbol	Condition	Rating		Units
				Min	Max	
Serial Clock Period	SCL	Tscyc		200		ns
SCL "H" pulse width		Tshw		75		
SCL "L" pulse width		Tslw		75		
Address setup time	A0	Tsas		50		
Address hold time		Tsah		100		
Data setup time	SI	Tsds		50		
Data hold time		Tsdh		50		
CS-SCL time	CS	Tcss		100		
CS-SCL time		Tcsh		100		

■ BACKLIGHT

Backlight Type

Backlight Type: LED

Power Supply For Backlight



Absolute Maximum Rating

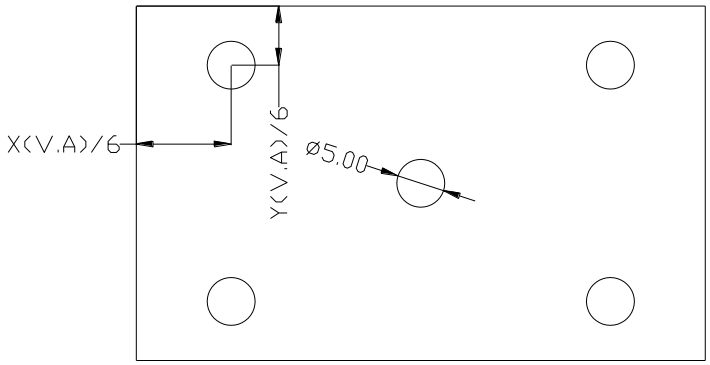
PARAMETER	SYMBOL	CONDITION	MAX	UNIT
Absolute maximum forward current	Ifm		60	Ma
Peak forward current	Ifp	1 MSEC plus 10% Duty Cycle	30	mA
Reverse voltage	V_R		5.0	V
Life	Hour	If(forward current) =45mA	20000	H

Note: For operation above 25℃, Then Ifm Ifp must be decreased, the Current decreased is -1.08mA/℃ for DC drive and -2.58mA/℃ Pulse drive, the power dissipation is -4.5mW/℃. The product working current must not more than the 70% of the Ifm or Ifp according to the working temperature.

Electrical-Optical Characteristics

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Forward voltage	Vf (LED(+)-LED(-))		2.8	3.3	3.5	V
Forward current	If		----	15	----	mA
Reverse current	Ir	VR=5.0V	----	----	160	μA
Wavelength (Chromaticity)	λp	If(forward current) = 15mA	x=0.275 y=0.285	x=0.295 y=0.300	x=0.305 y=0.315	
Luminance	Lv	If(forward current) = 15mA	200	260		cd/㎡

Note:The Master Screen's luminance is the average value of 5 points,and The Lvmin./Lvmax. is not less than 70%. The measurement instrument is BM-7 luminance Colorimeter. The aperture is Φ5 mm.



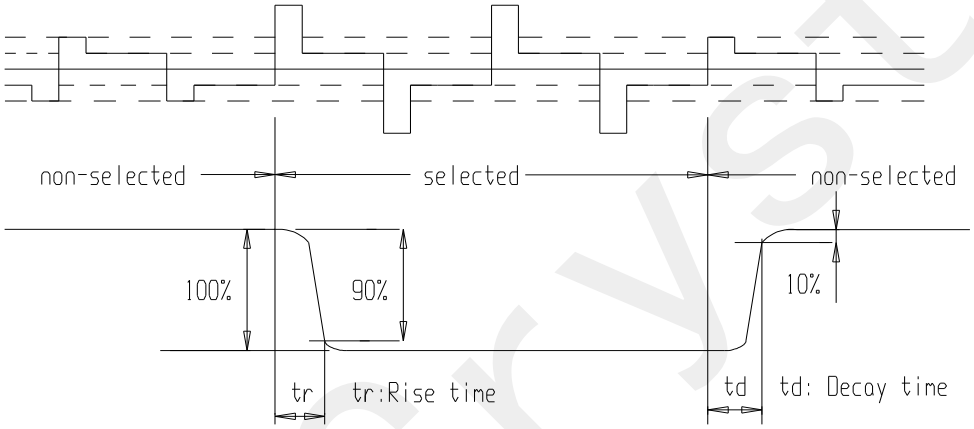
■ OPTICAL CHARACTERISTICS

Test instrument is LCD-5000,made in Japan

Item	Symbol	Condition	Min	Typ	Max	Unit	Remarks	Note
Operating voltage	Vop	25℃	9.6	9.8	10.0	V	---	---
Response time	Tr	----	----	128	400	Ms	---	1
	Td	----	----	143	400	Ms	---	1
Contrast ratio	Cr	----	----	24	----	---	---	2
Viewing angle range	θ	Cr≥6	----	60	----	Deg	Ø=0°	3
			----	28	----	Deg	Ø=180°	3

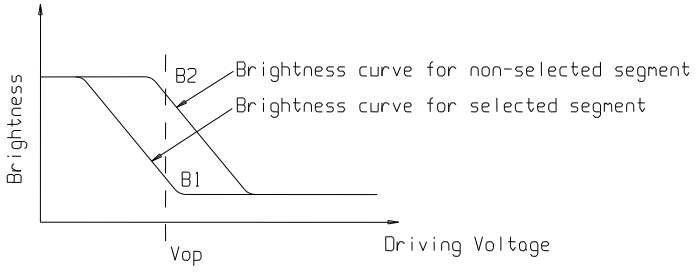
▼ Definition Of Viewing Angle

Note1: Definition of response time

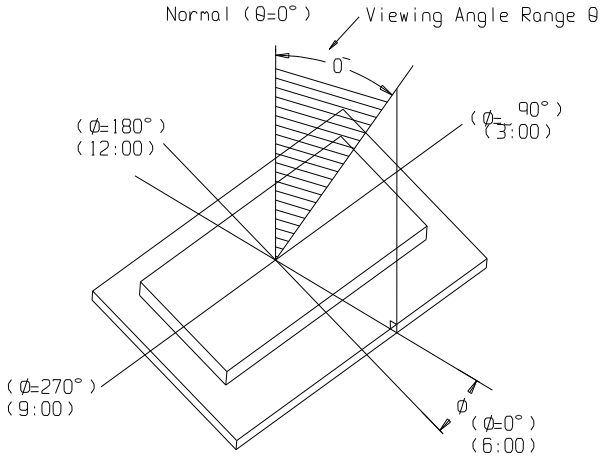


Note2: Definition of contrast ratio 'Cr'

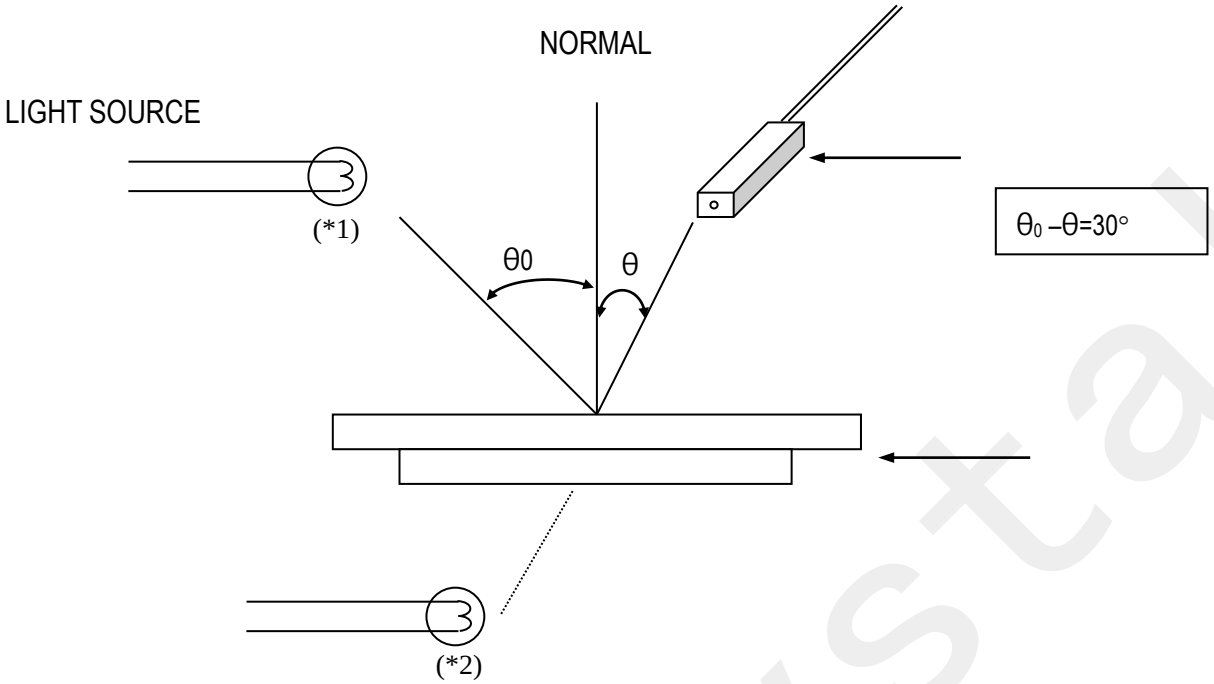
$$Cr = \frac{\text{Brightness of non-selected segment(B2)}}{\text{Brightness of selected segment(B1)}}$$



Note3: Definition of viewing angle range 'θ'



Note4:Measuring Instruments For Electro-optical Characteristics



*1.Light source position for measuring the reflective type of LCD panel
*2.Light source position for measuring the transflective / transmissive types of LCD panel

■ OPERATING PRINCIPLES & METHODS

▼ Control And Display Command

Command	Command code(note:*:disabled data) RS	\RD	\WR	D7	D6	D5	D4	D3	D2	D1	D0	Function
(1)Display ON/OFF	0	1	0	1	0	1	0	1	1	1	D	LCD display ON/OFF; 0:OFF,1:ON
(2)Display start line set	0	1	0	0	1	Display start address						Sets the display RAM display start line address
(3)Page address set	0	1	0	1	0	1	1	Page address				Sets the display RAM page address
(4)Column address set upper bit	0	1	0	0	0	0	1	Most significant column address				Sets the most significant 4bits of the display RAM column address.
(5)Status read	0	0	1	Status				0	0	0	0	Reads ths status data
(6)Display data write	1	1	0	Write data								Writes to the display RAM
(7)Display data read	1	0	1	Read data								Reads from the display RAM
(8)ADC select	0	1	0	1	0	1	0	0	0	0	D	Sets the display RAM address SEG output correspondence. 0: normal; 1: reverse.
(9)Display normal/ reverse	0	1	0	1	0	1	0	0	1	1	D	Sets the lcd display norma/reverse 0: normal; 1: reverse.
(10)Display all points ON/OFF	0	1	0	1	0	1	0	0	1	0	D	Display all points 0: normal; 1: reverse.
(11)LCD bias set	0	1	0	1	0	1	0	0	0	1	D	Sets the LCDdriver voltage bias ratio Set D=1.
(12)Read/modify/write	0	1	0	1	1	1	0	0	0	0	0	Column address increment at write:+1 at read:0
(13)End	0	1	0	1	1	1	0	1	1	1	0	Clear read/modify/write
(14)Reset	0	1	0	1	1	1	0	0	0	1	0	Internal reset
(15)Common output mode select	0	1	0	1	1	0	0	D	*	*	*	Select COM output scan direction 0:normal direction , 1:reverse direction
(16)Power control set	0	1	0	0	0	1	0	1	Operating mode			Select internal power supply operating mode
(17)V0 voltage regulator internal resistor ratio set	0	1	0	0	0	1	0	0	Resistor ratio			Select internal resistor ratio)Ra/Rb) mode
(18)Electronic volume mode set Electronic volume register set	0	1	0	1	0	0	0	0	0	0	1	Set the V0 output voltage electronic volume register
(19)Static indicator ON/OFF Stagic indicator register set	0	1	0	1	0	1	0	1	1	0	0	Set the flashing mode. 0:OFF,1:ON
(20)NOP	0	1	0	1	1	1	0	0	0	1	1	Command for non-operation

Display ON/OFF

This command turns the display ON and OFF.

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0	Setting
0	1	0	1	0	1	0	1	1	1	1	Display ON
										0	Display OFF

When the display OFF command is executed when in the display all points ON mode, sleep mode is entered. See the section on the Sleep Mode Set for details.

Display Start Line Set

This command is used to specify the display start line address of the display data RAM shown in Figure 4. For further details see the explanation of this function in "The Line Address Circuit".

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0	Line address
0	1	0	0	1	0	0	0	0	0	0	0
					0	0	0	0	0	1	1
					0	0	0	0	1	0	2
						↓					↓
					1	1	1	1	1	0	62
					1	1	1	1	1	1	63

Page Address Set

This command specifies the page address corresponding to the low address when the MPU accesses the display data RAM (see Figure 4). Specifying the page address and column address enables to access a desired bit of the display data RAM. Changing the page address does not accompany a change in the status display.

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0	Page address
0	1	0	1	0	1	1	0	0	0	0	0
							0	0	0	1	1
							0	0	1	0	2

Column Address Set

This command specifies the column address of the display data RAM shown in Figure 4. The column address is split into two sections (the higher 4 bits and the lower 4 bits) when it is set (fundamentally, set continuously). Each time the display data RAM is accessed, the column address automatically increments (+1), making it possible for the MPU to continuously read from/write to the display data. The column address increment is topped at 83H. This does not change the page address continuously. See the function explanation in "The Column Address Circuit," for details.

	A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0	A7	A6	A5	A4	A3	A2	A1	A0	Column address
High bits →	0	1	0	0	0	0	1	A7	A6	A5	A4	0	0	0	0	0	0	0	0	0
Low bits →							0	A3	A2	A1	A0	0	0	0	0	0	0	0	1	1
												0	0	0	0	0	0	1	0	2
															↓					↓
												1	0	0	0	0	0	1	0	130
												1	0	0	0	0	0	1	1	131

Status Read

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	BUSY	ADC	ON/OFF	RESET	0	0	0	0

BUSY	BUSY = 1: it indicates that either processing is occurring internally or a reset condition is in process. BUSY = 0: A new command can be accepted . if the cycle time can be satisfied, there is no need to check for BUSY conditions.
ADC	This shows the relationship between the column address and the segment driver. 0: Normal (column address n ↔ SEG n) 1: Reverse (column address 131-n ↔ SEG n) (The ADC command switches the polarity.)
ON/OFF	ON/OFF: indicates the display ON/OFF state. 0: Display ON 1: Display OFF
RESET	This indicates that the chip is in the process of initialization either because of a /RES signal or because of a reset command. 0: Operating state 1: Reset in progress

Display Data Write

This command writes 8-bit data to the specified display data RAM address. Since the column address is automatically incremented by "1" after the write, the MPU can write the display data.

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0
1	1	0	Write data							

Display Data Read

This command reads 8-bit data from the specified display data RAM address. Since the column address is automatically incremented by "1" after the read, the CPU can continuously read multiple-word data. One dummy read is required immediately after the column address has been set. See the function explanation in "Display Data RAM" for the explanation of accessing the internal registers. When the 4-line SPI interface is used, reading of the display data becomes unavailable.

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0
1	0	1	Read data							

ADC Select (Segment Driver Direction Select)

This command can reverse the correspondence between the display RAM data column address and the segment driver output. Thus, sequence of the segment driver output pins may be reversed by the command. See the column address circuit for the detail. Increment of the column address (by "1") accompanying the reading or writing the display data is done according to the column address indicated in Figure 4.

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0	Setting
0	1	0	1	0	1	0	0	0	0	0	Normal
										1	Reverse

Display Normal/Reverse

This command can reverse the lit and unlit display without overwriting the contents of the display data RAM. When this is done the display data RAM contents are maintained.

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0	Setting
0	1	0	1	0	1	0	0	1	1	0	RAM Data "H" LCD ON voltage (normal)
										1	RAM Data "L" LCD ON voltage (reverse)

Display All Points ON/OFF

This command makes it possible to force all display points ON regardless of the content of the display data RAM. The contents of the display data RAM are maintained when this is done. This command takes priority over the display normal/reverse command.

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0	Setting
0	1	0	1	0	1	0	0	1	0	0	Normal display mode
										1	Display all points ON

When the display is in an OFF mode, executing the display all points ON command will place the display in sleep mode. For details, see the Sleep Mode Set section.

LCD Bias Set

This command selects the voltage bias ratio required for the liquid crystal display.

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0	Select Status 1/65duty	1/49duty	1/33duty	1/55duty	1/53duty
0	1	0	1	0	1	0	0	0	1	0	1/9 bias	1/8 bias	1/6 bias	1/8 bias	1/8 bias
										1	1/7 bias	1/6 bias	1/5 bias	1/6 bias	1/6 bias

Read-Modify-Write

This command is used paired with the "END" command. Once this command has been input, the display data read command does not change the column address, but only the display data write command increments (+1) the column address. This mode is maintained until the END command is input. When the END command is input, the column address returns to the address it was at when the Read-Modify-Write command was entered. This function makes it possible to reduce the load on the MPU when there are repeating data changes in a specified display region, such as when there is a blanking cursor.

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	0	0	0	0

* Even in read/modify/write mode, other commands aside from display data read/write commands can also be used.

End

This command releases the read/modify/write mode, and returns the column address to the address it was at when the mode was entered.

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	1	1	1	0

Reset

This command initializes the display start line, the column address, the page address, the common output mode, the V_0 voltage regulator internal resistor ratio, and the electronic volume are reset, and the read/modify/write mode and test mode are released. There is no impact on the display data RAM. See the function explanation in "Reset" for details. The reset operation is performed after the reset command is entered.

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	0	0	1	0

The initialization when the power supply is applied must be done through applying a reset signal to the /RES terminal. The reset command must not be used instead.

Common Output Mode Select

This command can select the scan direction of the COM output terminal. For details, see the function explanation in "Common Output Mode Select Circuit."

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0	Selected Mode					
												1/65duty	1/49duty	1/33duty	1/55duty	1/53duty
0	1	0	1	1	0	0	0	*	*	*	Normal	COM0→COM63	COM0→COM47	COM0→COM31	COM0→COM53	COM0→COM51
							1				Reverse	COM63→COM0	COM47→COM0	COM31→COM0	COM53→COM0	COM51→COM0

* Disabled bit

Power Controller Set

This command sets the power supply circuit functions. See the function explanation in "The Power Supply Circuit," for details

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0	Selected Mode
0	1	0	0	0	1	0	1	0			Booster circuit: OFF
								1			Booster circuit: ON
									0		Voltage regulator circuit: OFF
									1		Voltage regulator circuit: ON
										0	Voltage follower circuit: OFF
										1	Voltage follower circuit: ON

V_0 Voltage Regulator Internal Resistor Ratio Set

This command sets the V_0 voltage regulator internal resistor ratio. For details, see the function explanation is "The Voltage Regulator circuit " and table 11

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0	Rb/Ra Ratio
0	1	0	0	0	1	0	0	0	0	0	Small
								0	0	1	
								0	1	0	
						↓					↓
								1	1	1	
								1	1	1	Large

The Electronic Volume (Double Byte Command)

This command makes it possible to adjust the brightness of the liquid crystal display by controlling the LCD drive voltage V_0 through the output from the voltage regulator circuits of the internal liquid crystal power supply. This command is a two byte command used as a pair with the electronic volume mode set command and the electronic volume register set command, and both commands must be issued one after the other.

The Electronic Volume Mode Set

When this command is input, the electronic volume register set command becomes enabled. Once the electronic volume mode has been set, no other command except for the electronic volume register command can be used. Once the electronic volume register set command has been used to set data into the register, then the electronic volume mode is released.

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	0	0	0	0	0	0	1

Electronic Volume Register Set

By using this command to set six bits of data to the electronic volume register, the liquid crystal drive voltage V_0 assumes one of the 64 voltage levels.
When this command is input, the electronic volume mode is released after the electronic volume register has been set.

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0	| V0 |
0	1	0	*	*	0	0	0	0	0	1	Small
			*	*	0	0	0	0	1	0	
			*	*	0	0	0	0	1	1	
									↓		↓
			*	*	1	1	1	1	1	0	
			*	*	1	1	1	1	1	1	Large

* Inactive bit (set "0")
When the electronic volume function is not used, set this to (1, 0, 0, 0, 0, 0)

Sleep Mode Set (Double Byte Command)

This command is a two byte command used as a pair with preceding command and following command, and both commands must issued one after the other.
This command stops all operations in the LCD display system, and as long as there are no accesses from the MPU, the consumption current is reduced to a value near the static current. The internal modes during sleep mode are as follows:
1. The oscillator circuit and the LCD power supply circuit are halted.
2. All liquid crystal drive circuits are halted, and the segment in common drive outputs output a Vss level.

	A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0	Status
Preceding Command	0	1	0	1	0	1	0	1	1	0	0	Sleep Mode
											1	Normal Mode
Following Command				*	*	*	*	*	*	0	0	

*Disable bit (set "0")

The Booster Ratio (Double Byte Command)

This command makes it possible to select step-up ratio. It is used when the power control set have turn on the internal booster circuit. This command is a two byte command used as a pair with the booster ratio select mode set command and the booster ratio register set command, and both commands must be issued one after the other.

Booster Ratio Select Mode Set

When this command is input, the Booster ratio register set command becomes enabled. Once the booster ratio select mode has been set, no other command except for the booster ratio register command can be used. Once the booster ratio register set command has been used to set data into the register, then the booster ratio select mode is released.

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	1	1	0	0	0

Booster Ratio Register Set

By using this command to set two bits of data to the booster ratio register, it can be select what kind of the booster ratio can be used.
When this command is input, the booster ratio select mode is released after the booster ratio register has been set.

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0	Booster ratio select
0	1	0	*	*	*	*	*	*	0	0	2x,3x,4x
			*	*	*	*	*	*	0	1	5x
			*	*	*	*	*	*	1	1	6x

* Inactive bit (set "0")
When the booster ratio select function is not used, set this to (0, 0) 2x,3x,4x step-up mode

NOP

Non-Operation Command

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	0	0	1	1

Test

This is a command for IC chip testing. Please do not use it. If the test command is used by accident, it can be cleared by applying a "L" signal to the /RES input by the reset command or by using an NOP.

A0	E /RD	R/W /WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	1	1	1	*	*

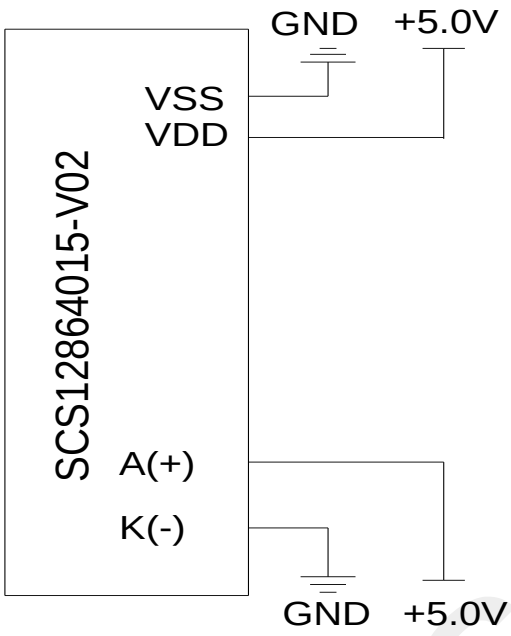
* Inactive bit

Note: The ST7565R maintain their operating modes until something happens to change them. Consequently, excessive external noise, etc., can change the internal modes of the ST7565R . Thus in the packaging and system design it is necessary to suppress the noise or take measure to prevent the noise from influencing the chip. Moreover, it is recommended that the operating modes be refreshed periodically to prevent the effects of unanticipated

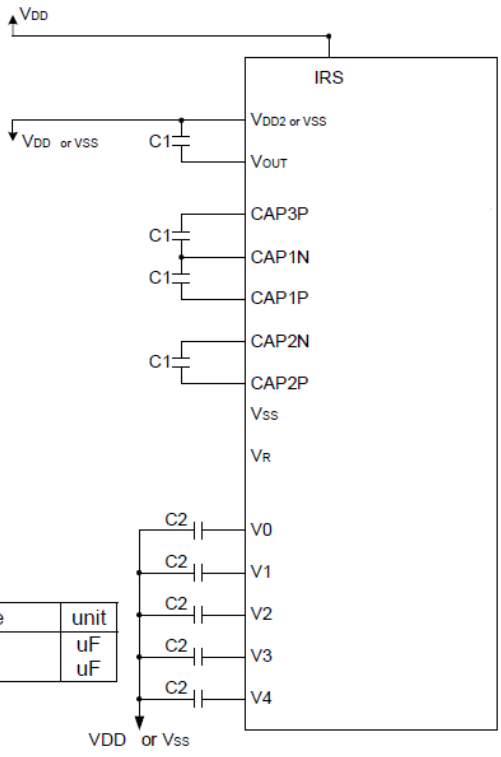
■ DISPLAY DATA RAM ADDRESS MAP

PAGE ADDRESS	DISPLAY DATA	CS1=H	CS2=H	LINE ADDRESS	COM MON
B8	D0			C0	0
	D1			C1	1
	D2			C2	2
	D3			C3	3
	D4			C4	4
	D5			C5	5
	D6			C6	6
	D7			C7	7
B9	D0			C8	8
	D1			C9	9
	D2			CA	10
	D3			CB	11
	D4			CC	12
	D5			CD	13
	D6			CE	14
	D7			CF	15
. . . . . .	. . . . . .			. . . . . .	. . . . . .
BE	D0			F0	48
	D1			F1	49
	D2			F2	50
	D3			F3	51
	D4			F4	52
	D5			F5	53
	D6			F6	54
	D7			F7	55
BF	D0			F8	56
	D1			F9	57
	D2			FA	58
	D3			FB	59
	D4			FC	60
	D5			FD	61
	D6			FE	62
	D7			FF	63
	COLUMN ADDRESS	40 41 42 43 44 45 46 …… 7F	40 …… 7F		
	SEGMENT	SEG0 SEG1 SEG2 SEG3 SEG4 SEG5 SEG6 …… SEG63	SEG64 SEG127		

■ POWER SUPPLY FOR LCM MODULE

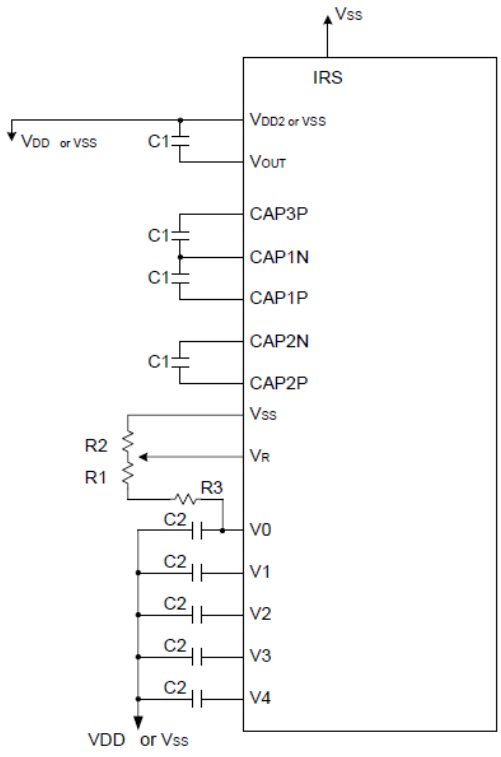


(1) When the voltage regulator internal resistor is used.



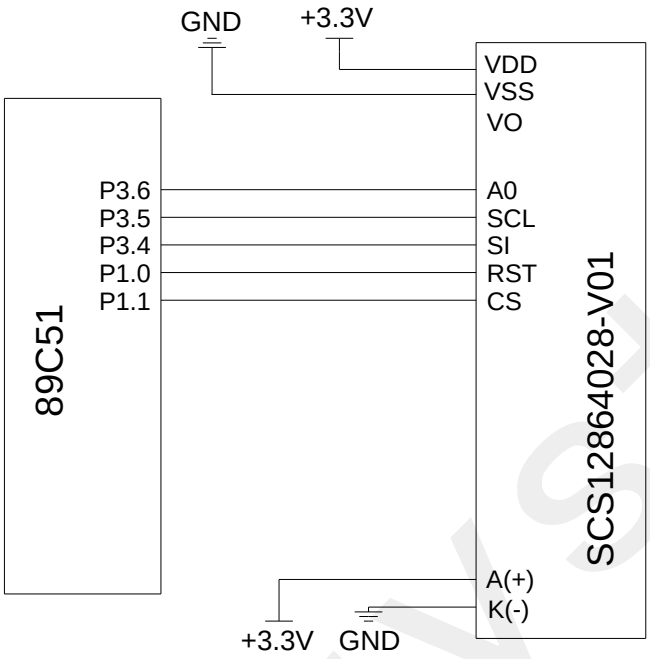
Item	Set value	unit
C1	1 ~ 2.2	uF
C2	0.1 ~ 1	uF

(2) When the voltage regulator internal resistor is not used.



■ EXAMPLE

▼ Application Circuit (Serial interface)



■ 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.	40 °C 90 %RH 96 hrs	MIL-202E-103B JIS-C5023
7	Temperature cycle	Endurance test applying the low and high temperature cycle. -20°C 30min. ⇌ 25°C 5min. ⇌ 70°C 30min. 1 cycle	-20°C / 70°C 10 cycles	-----
Mechanical Test				
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 1l msedc 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
Others				
11	Static electricity test	Endurance test applying the electric stress to the terminal.	VS=800V , RS=1.5 kΩ CS=100 pF 1 time	MIL-883B-3015.1

*** Supply voltage for logic system = 5V. Supply voltage for LCD system = Operating voltage at 25°C.

▼ Failure Judgement Criterion

Criterion Item	Test Item No.											Failure Judgment Criterion
	1	2	3	4	5	6	7	8	9	10	11	
Basic specification												Out of the Basic Specification
Electrical characteristic												Out of the DC and AC Characteristic
Mechanical characteristic												Out of the Mechanical Specification Color change : Out of Limit Apperance Specification
Optical characteristic												Out of the Apperance Standard

■ INSPECTION CRITERIA

see :Q/SC0002-05

■ 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.

■ 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 benzin. 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.

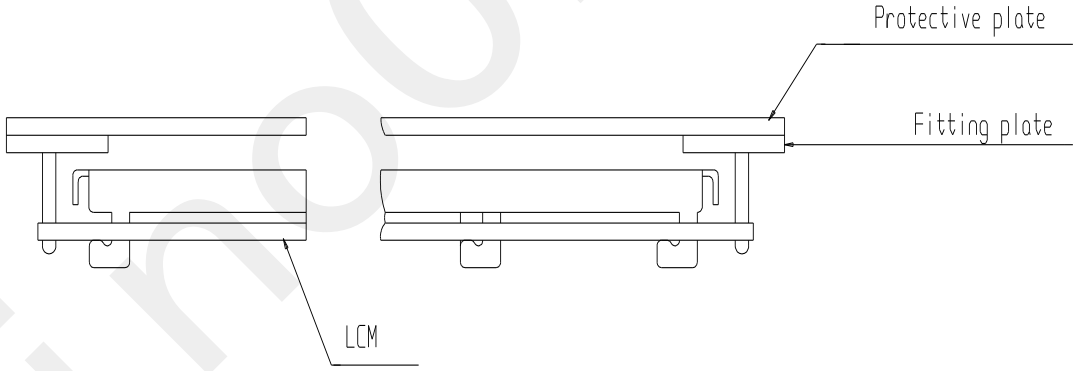
(9) Do not touch the display with bare hands. This will stain the display area and degradate insulation between terminals (some cosmetics are determinated to the polarizers).

(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 Handing 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 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 handing 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 potentiality 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

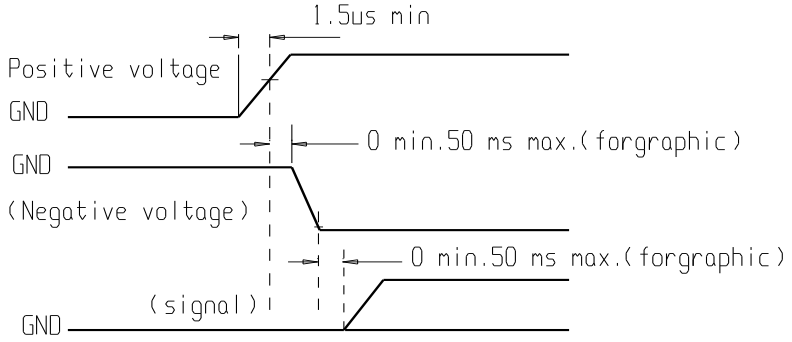
(1) Observe the following when soldering lead wire, connector cable and etc. to the LCM.
- Soldering iron temperature : 280°C ± 10°C.
- Soldering time : 3-4 sec.
- Solder : eutectic solder.

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 dur 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.



Storage

When storing LCD's as spares for some years, the following precaution are necessary.

(1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for dessicant.

(2) Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C.

(3) The polarizer surface should not come in contact with any other objects. (We advise you to store them in the container in which they were shipped.)

(4) Environmental conditions :

- Do not leave them for more than 168hrs. at 80°C.
- Should not be left for more than 48hrs. at -30°C.

Safety

(1) It is recommended to crush damaged or unnecessary LCD's into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.

(2) If any liquid out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

Limited Warranty

Unless agreed between SINO and customer, SINO will replace or repair any of its LCD modules which are found to be functionally defective when inspected in accordance with SINO LCD acceptance standards (copies available upon request) for a period of one year from date of shipments. Cosmetic/visual defects must be returned to SINO within 90 days of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of SINO limited to repair and/or replacement on the terms set forth above. SINO will not be responsible for any subsequent or consequential events.

Return LCM under warranty

No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are :

- Broken LCD glass.
- PCB eyelet's damaged or modified.
- PCB conductors damaged.
- Circuit modified in any way, including addition of components.
- PCB tampered with by grinding, engraving or painting varnish.
- soldering to or modifying the bezel in any manner.

Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB eyelet's, conductors and terminals.