深圳市华远显示器件有限公司

SHENZHEN HUAYUAN DISPLAY CO.,LTD.

液晶显示模块规格书

Specification for Liquid Crystal Display Module

HYG1286493G-FF62L-VA

Prepared By	Reviewed By	Approved By
Date:	Date:	Date:

REVISION HISTORY

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

SN	Rev.	Content	Date	Design
1	R00	Origin Released	2011-02-18	

CONTENTS

1. 0 GENERAL DESCRIPTION

The HYG1286493G-FF62L-VA is a 128x64 dots dot-matrix LCD module. It has a FSTN panel composed of 128 segments and 64 commons. The LCM can be easily accessed by microcontroller via 6800 series interface.

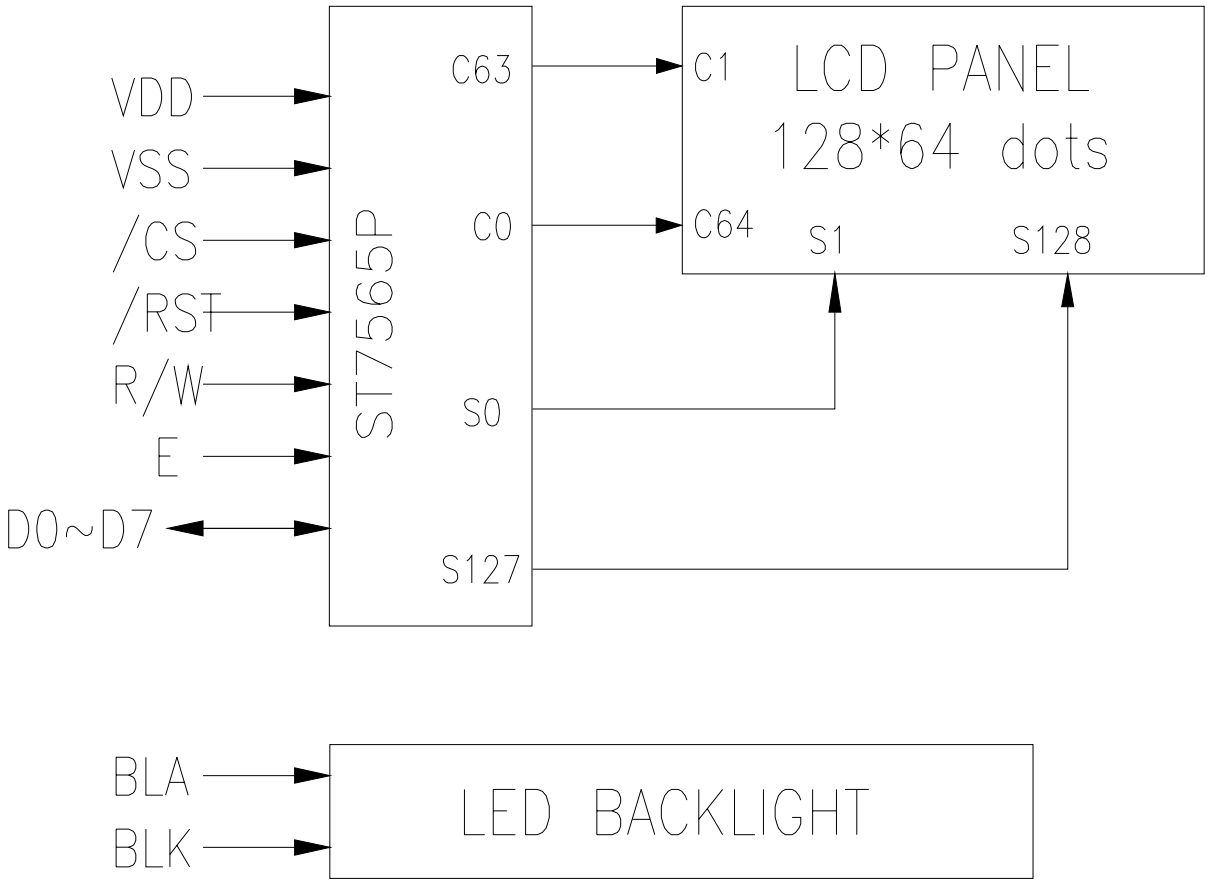
2. 0 FEATURES

Display Format	128x 64 dots
LCD Type	FSTN-POSITIVE
Polarizer Mode	TRANSFLECTIVE
Drive Method	1/65 Duty, 1/9 Bias
Viewing Direction	6 O'clock
Controller	ST7565P
Interface	6800 Series 8-Bit Parallel Interface
Backlight	White Side-Light Type LED Backlight

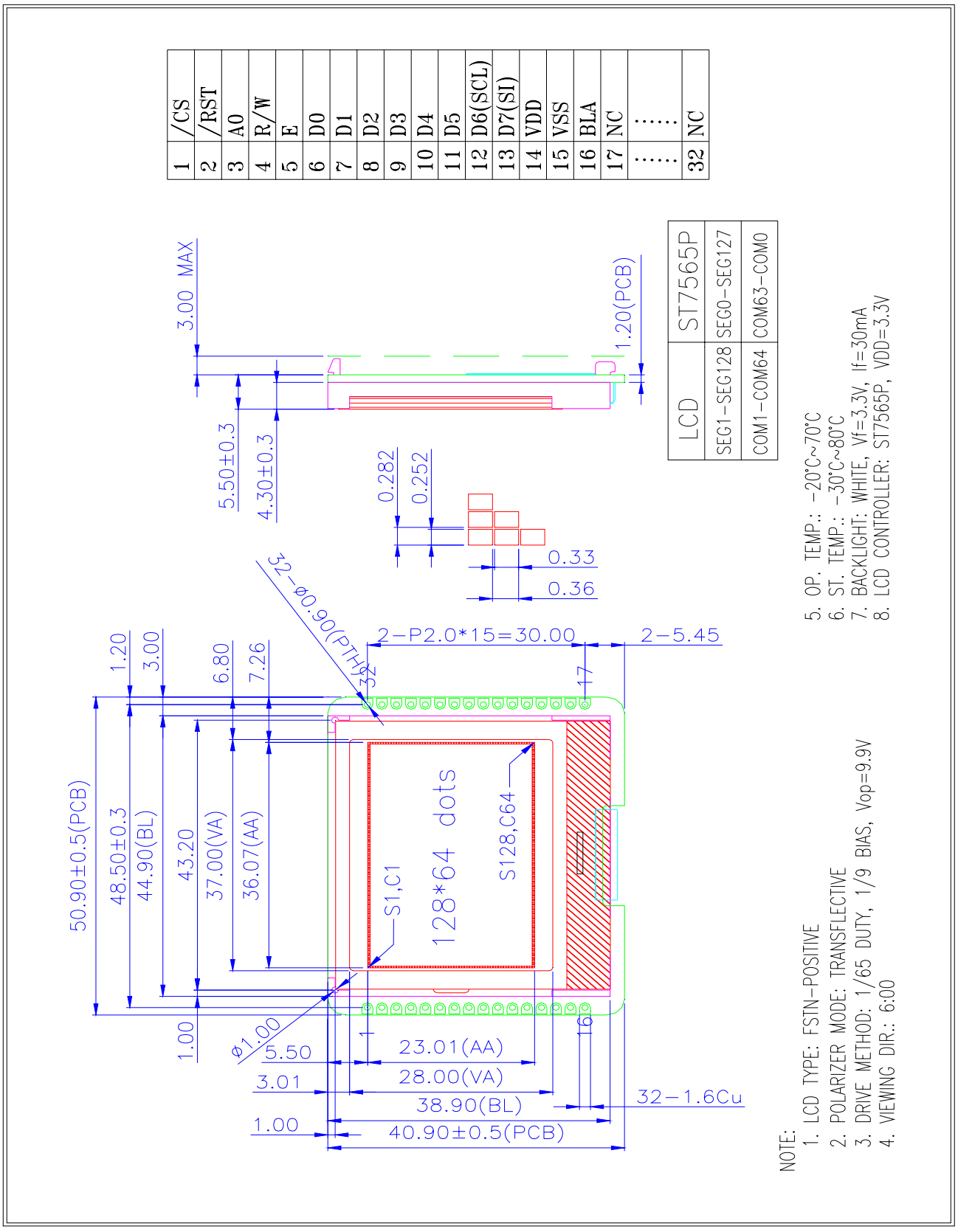
3. 0 MECHANICAL SPECIFICATION

Item	Description	Unit
Module Dimension	50.9(W) × 40.9(H) × 8.5(Max)(T)	mm
Viewing Area	37.0(W) × 28.0(H)	mm
Active Area	36.07(W) × 23.01(H)	mm
Dot Size	0.252(W) × 0.330(H)	mm
Dot Pitch	0.282(W) × 0.360 (H)	mm
Character Size	——	mm

4. 0 BLOCK DIAGRAM



5. 0 EXTERNAL DIMENSIONS



6. 0 INTERFACE PIN DESCRIPTIONS

PIN No.	Symbol	Level	Description
1	/CS	H/L	The chip select signal. When /CS = "L", then the chip select becomes active, and data/command I/O is enabled.
2	/RST	H/L	When / RST is set to "L", the register settings are initialized (cleared).
3	A0	H/L	It determines whether the data bits are data or command. A0 = "H": Indicates that D0 to D7 are display data. A0 = "L": Indicates that D0 to D7 are control data.
4	R/W	H/L	Read or Write. R/W=H: Data appears at D0 to D7 and can be read by the CPU R/W=L: Data of D0 to D7 can be written at falling of E
5	E	H,H→L	Enable signal. Write mode: data of D0 to D7 is latched at the falling edge of E Read mode: D0 to D7 appears the reading data while E is at high level.
6	D0	H/L	Data Bit0
7	D1	H/L	Data Bit1
8	D2	H/L	Data Bit2
9	D3	H/L	Data Bit3
10	D4	H/L	Data Bit4
11	D5	H/L	Data Bit5
12	D6(SCL)	H/L	Data Bit6 When the serial interface (SPI-4) is selected : D6: The serial clock input (SCL).
13	D7(SI)	H/L	Data Bit7 When the serial interface (SPI-4) is selected : D7: The serial data input (SI)
14	V_{DD}	P	Power supply for logic(+3.3V)
15	V_{SS}	P	Ground
16	BLA	P	Power supply for LED Backlight (+3.3V)
17~32	NC	--	No Connection

7. 0 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min.	Max.	Unit
Supply Voltage (Logic)	V_{DD}	0.3	3.6	V
Supply Voltage (LCD)	V_0	0.3	14.5	V
Input Voltage	VI	0.3	3.6	V
Operating Temperature	Topr	-20	70	℃
Storage Temperature	Tstg	-30	80	℃

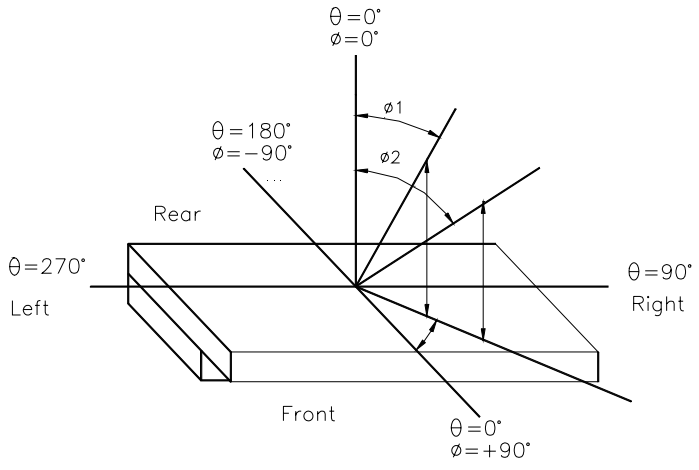
8. 0 ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply voltage for Logic	V_{DD}	--	3.0	3.3	3.5	V
LCD Operating Voltage	V0	-20℃				V
		+25℃	9.6	9.9	10.2	V
		+70℃				V
Input voltage H level	V_{IH}	For all inputs	$0.8V_{DD}$	---	V_{DD}	V
Input voltage L level	V_{IL}	For all inputs	V_{SS}	---	$0.2V_{DD}$	V
Output High Voltage	V_{OH}	I_{OH} = –0.5 mA	$0.8V_{DD}$	---	V_{DD}	V
Output Low Voltage	V_{OL}	I_{OL} = 0.5 mA	V_{SS}	---	$0.2V_{DD}$	V
Internal Oscillator	f_{OSC}	1/65 duty 1/33 duty	17	20	24	KHz

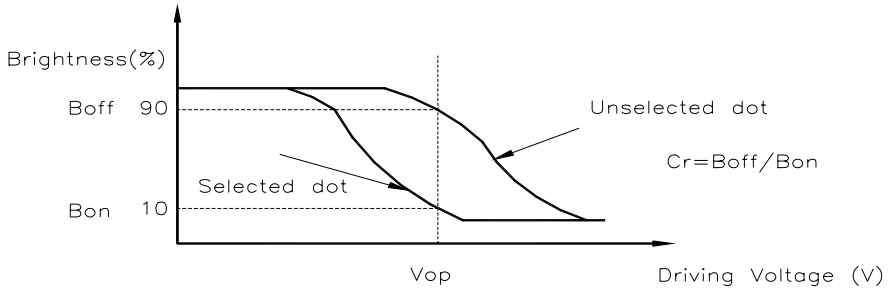
9. 0 OPTICAL CHARACTERISTICS

Item	Symbol	Condition		Min	Typ	Max	Unit
Response time	Ton	θ=0 ° and Ta=-20℃			--		ms
		θ=0 ° and Ta=+25℃			--		ms
		θ=0 ° and Ta=+70℃			--		ms
	Toff	θ=0 ° and Ta=-20℃			--		ms
		θ=0 ° and Ta=+25℃			--		ms
		θ=0 ° and Ta=+70℃			--		ms
Contrast ration	CR(MAX)	Ta=25℃		5	10		---
Viewing Angle	Ø	Deg θ=0 °	CR≥2.0 Ta=25℃		50		Deg
		Deg θ=90 °			35		
		Deg θ=180 °			30		
		Deg θ=270 °			35		
Crosstalk		Ta=25℃			1.2		---

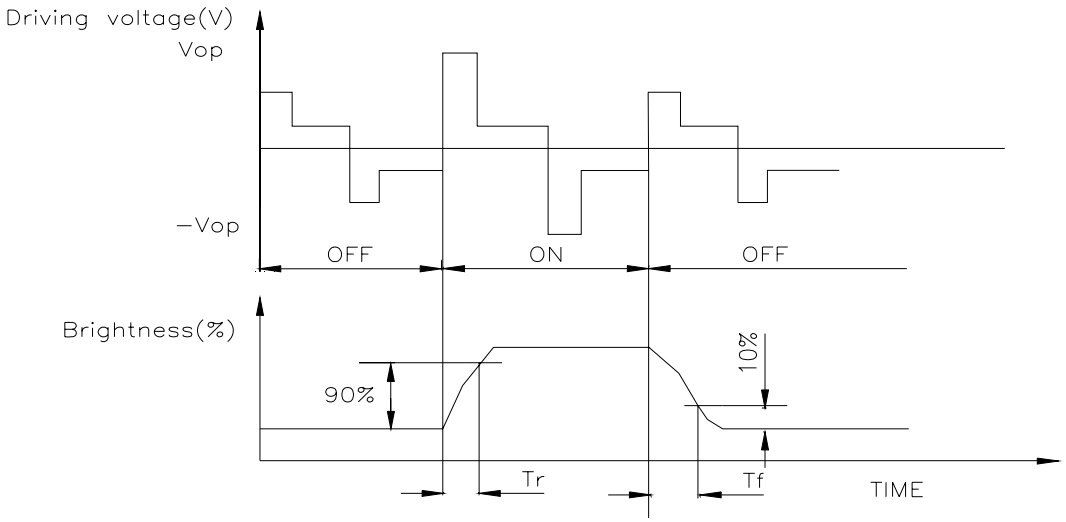
9.1 Viewing Angle θ , Ø and Viewing Angle Range: Δ Ø =|Ø2-Ø1|



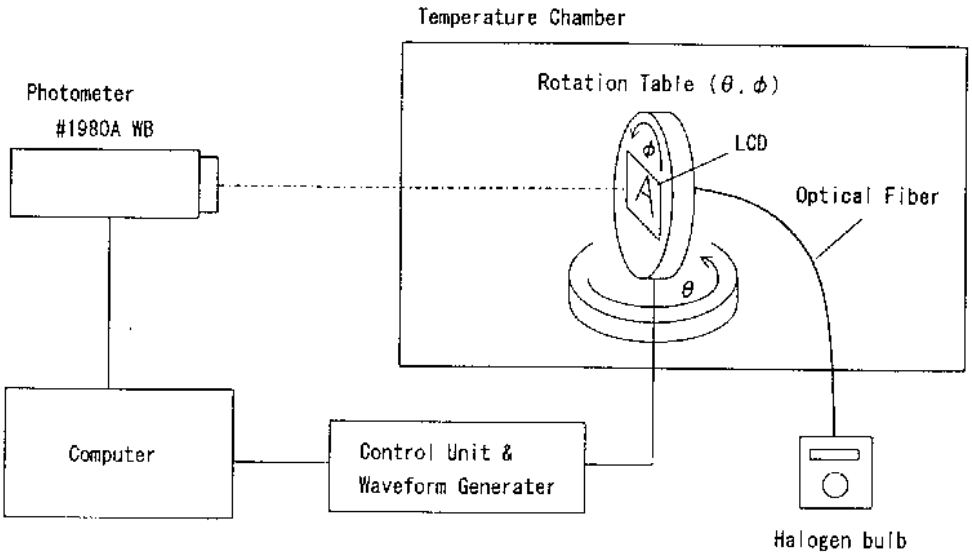
9.2 Contrast ratio(CR)



9.3 Response Time

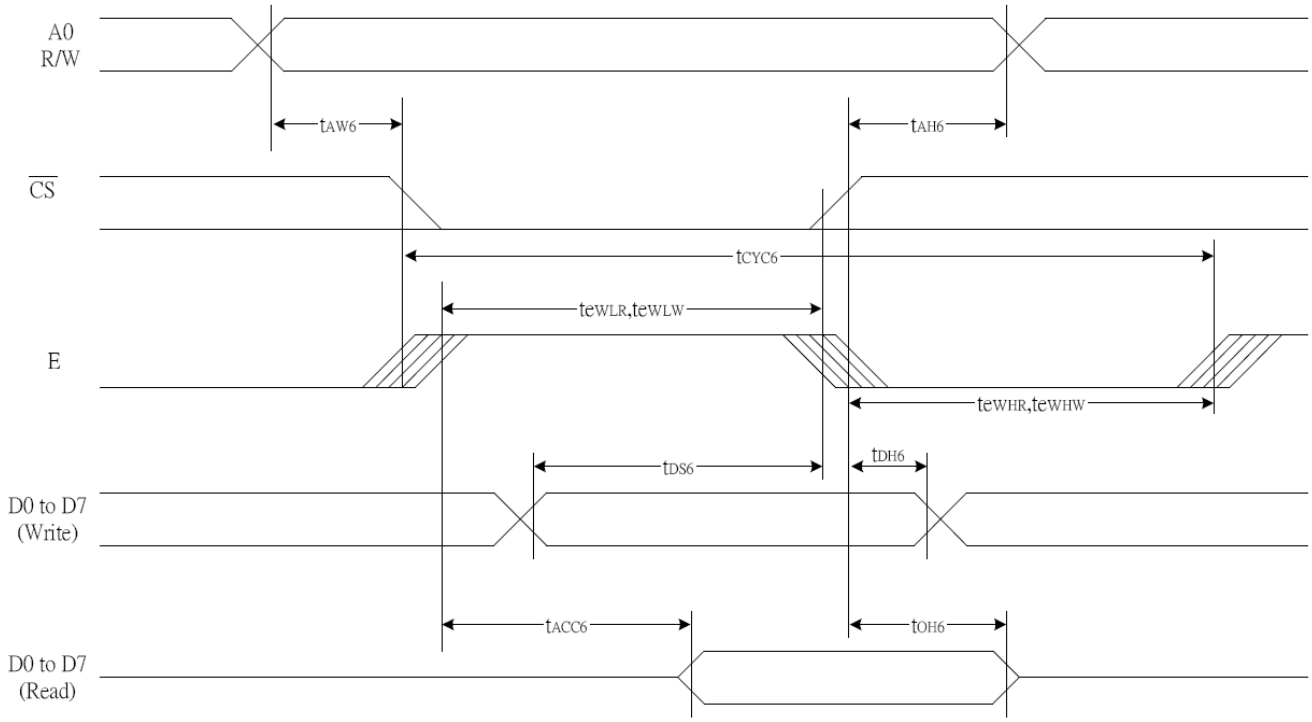


9.4 Optical Measurement System



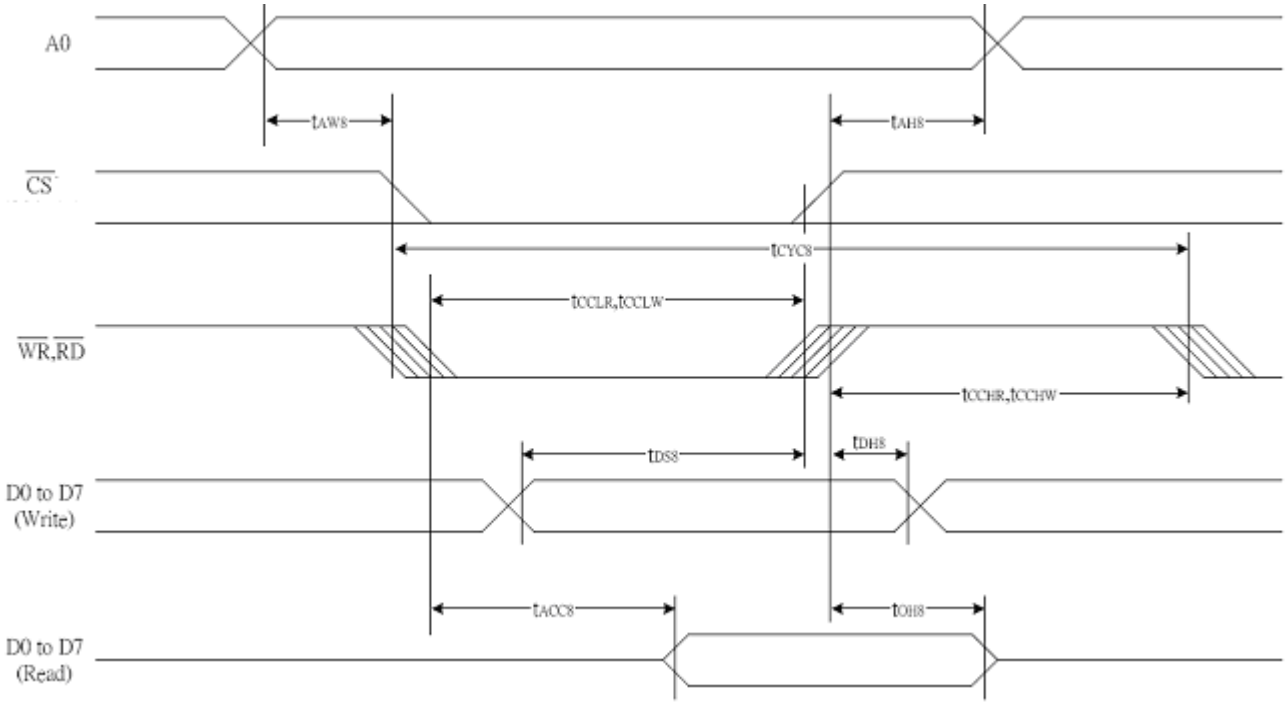
10. 0 TIMING CHARACTERICS

10.1 System Bus Read/Write Characteristics (For the 6800 Series MPU)



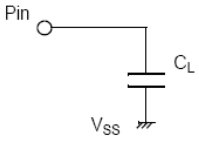
Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max	
Address hold time	A0	tAH6		0	—	ns
Address setup time		tAW6		0	—	
System cycle time		tCYC6		240	—	
Enable L pulse width (WRITE)	WR	tEWLW		80	—	
Enable H pulse width (WRITE)		tEWHW		80	—	
Enable L pulse width (READ)	RD	tEWLR		80	—	
Enable H pulse width (READ)		tEWHR		140		
WRITE Data setup time	D0 to D7	tDS6		40	—	
WRITE Address hold time		tDH6		0	—	
READ access time		tACC6	CL = 100 pF	—	70	
READ Output disable time		tOH6	CL = 100 pF	5	50	

10.2 System Bus Read/Write Characteristics (For the 8080 Series MPU)

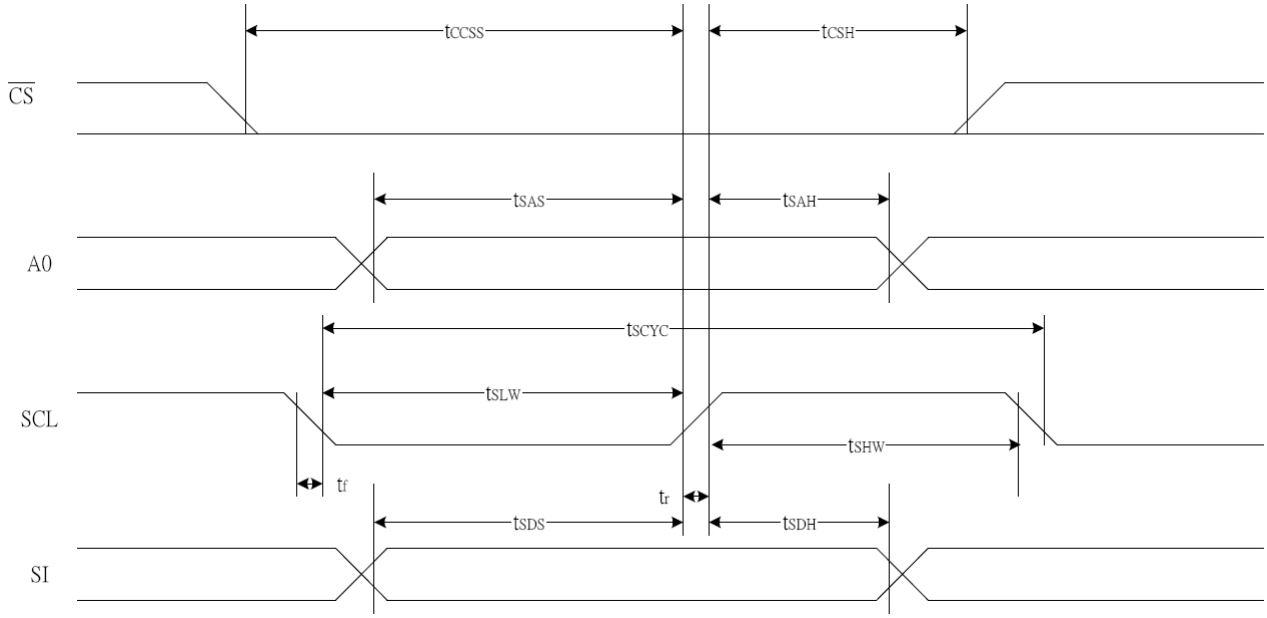


Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max	
Address hold time	A0	tAH8		0	—	ns
Address setup time		tAW8		0	—	
System cycle time		tCYC8		240	—	
Enable L pulse width (WRITE)	WR	tCCLW		80	—	
Enable H pulse width (WRITE)		tCCHW		80	—	
Enable L pulse width (READ)	RD	tCCLR		140	—	
Enable H pulse width (READ)		tCCHR		80		
WRITE Data setup time	D0 to D7	tDS8		40	—	
WRITE Address hold time		tDH8		0	—	
READ access time		tACC8	CL = 100 pF	—	70	
READ Output disable time		tOH8	CL = 100 pF	5	50	

Definition of CL:

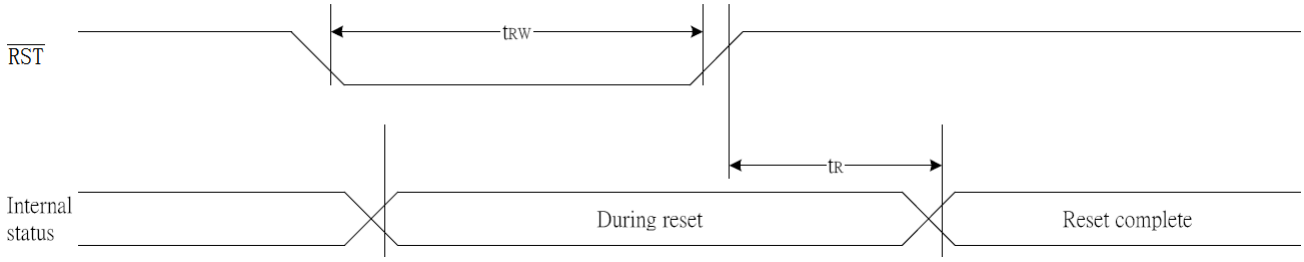


10.3 Serial Interface Characteristics



Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max	
Serial Clock Period	SCL	Tscyc		50	—	ns
SCL “H” pulse width		Tshw		25	—	
SCL “L” pulse width		Tslw		25	—	
Address setup time	A0	Tsas		20	—	
Address hold time		Tsah		10	—	
Data setup time	SI	Tsds		20	—	
Data hold time		Tsdh		10	—	
CS-SCL time	CS	Tcss		20	—	
CS-SCL time		Tcsh		40	—	

10.4 Reset Timing



Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max	
Reset “L” pulse width	/RST	tRW		—	1	us
Reset time		tR		1	—	

11. 0 BACKLIGHT CHARACTERISTICS

11.1 ABSOLUTE MAXIMUM RATINGS

(Ta=25℃)

Item	Symbol	Condition	Rating	Unit
Reverse Voltage	Vr		5.0	V
Absolute maximum forward current	Ifm		40	mA
Forward current	If	Vf=3.3V	30	mA
Power Description	Pd		90	mW
Operating temperature range	Topr		-20~+70	^{0}C
Storage temperature range	Tst		-30~+80	^{0}C

11.2 ELECTRICAL/OPTLCAL CHARACTERISTICS

(Ta=25℃)

Item	Symbol	Min	Typ	Max	Unit	Condition
Forward Voltage	Vf	3.2	3.3	3.4	V	If=30 mA
Reverse Current	Ir		20		uA	Vr=5.0 V
Dominant wave length	λp	--	--	--	nm	If=30 mA
Spectral Line Half width	Δ λ		--			If=30 mA
Luminance	Lv				cd/㎡	If=30 mA
Color Coordinate	X		WHITE			If=30 mA
	Y					

12. 0 OPERATING PRINCIPLES & METHODS

12.1 The Serial Interface

When the serial interface has been selected (P/S = “L”) then when the chip is in active state (/CS = “L”) the serial data input (SI) and the serial clock input (SCL) can be received. The serial data is read from the serial data input pin in the rising edge of the serial clocks D7, D6 through D0, in this order. This data is converted to 8 bits parallel data in the rising edge of the eighth serial clock for the processing.

The A0 input is used to determine whether or the serial data input is display data or command data; when A0 = “H”, the data is display data, and when A0 = “L” then the data is command data. The A0 input is read and used for detection every 8th rising edge of the serial clock after the chip becomes active. Figure 12-1 is a serial interface signal chart.

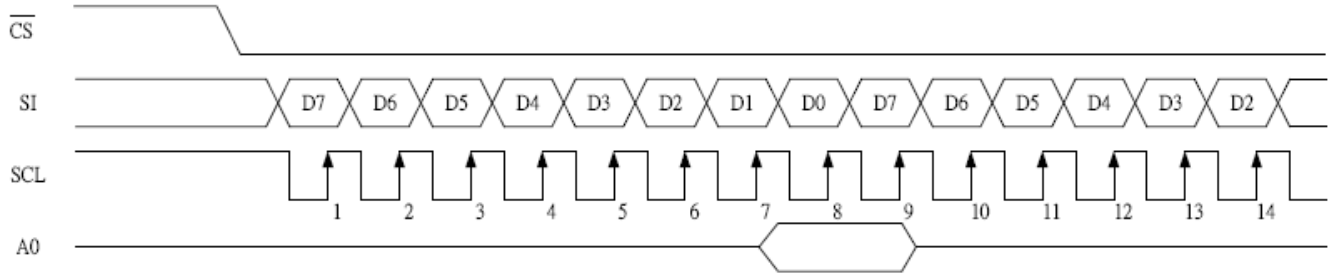


Figure 12-1

12.2 Display Data RAM

The display data RAM stores the dot data for the LCD. It has a 65 (8 page x 8 bit +1) x 132 bit structure.

As is shown in Figure 12-2, the D7 to D0 display data from the MPU corresponds to the LCD display common direction; there are few constraints at the time of display data transfer when multiple ST7565P are used, thus and display structures can be created easily and with a high degree of freedom.

Moreover, reading from and writing to the display RAM from the MPU side is performed through the I/O buffer, which is an independent operation from signal reading for the liquid crystal driver. Consequently, even if the display data RAM is accessed asynchronously during liquid crystal display, it will not cause adverse effects on the display (such as flickering).

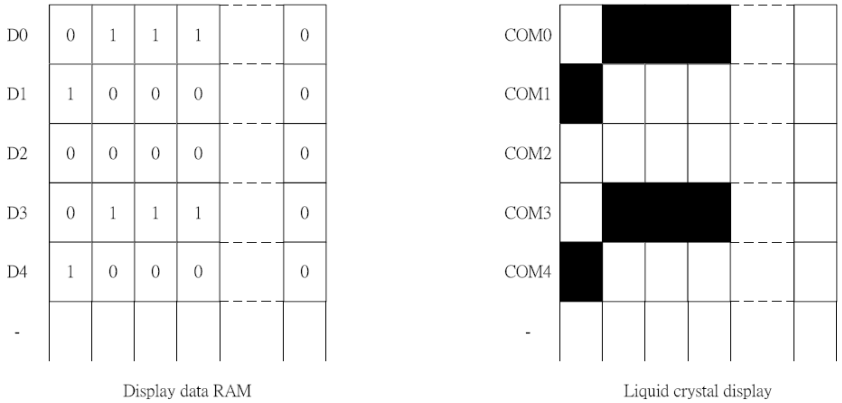


Figure 12-2

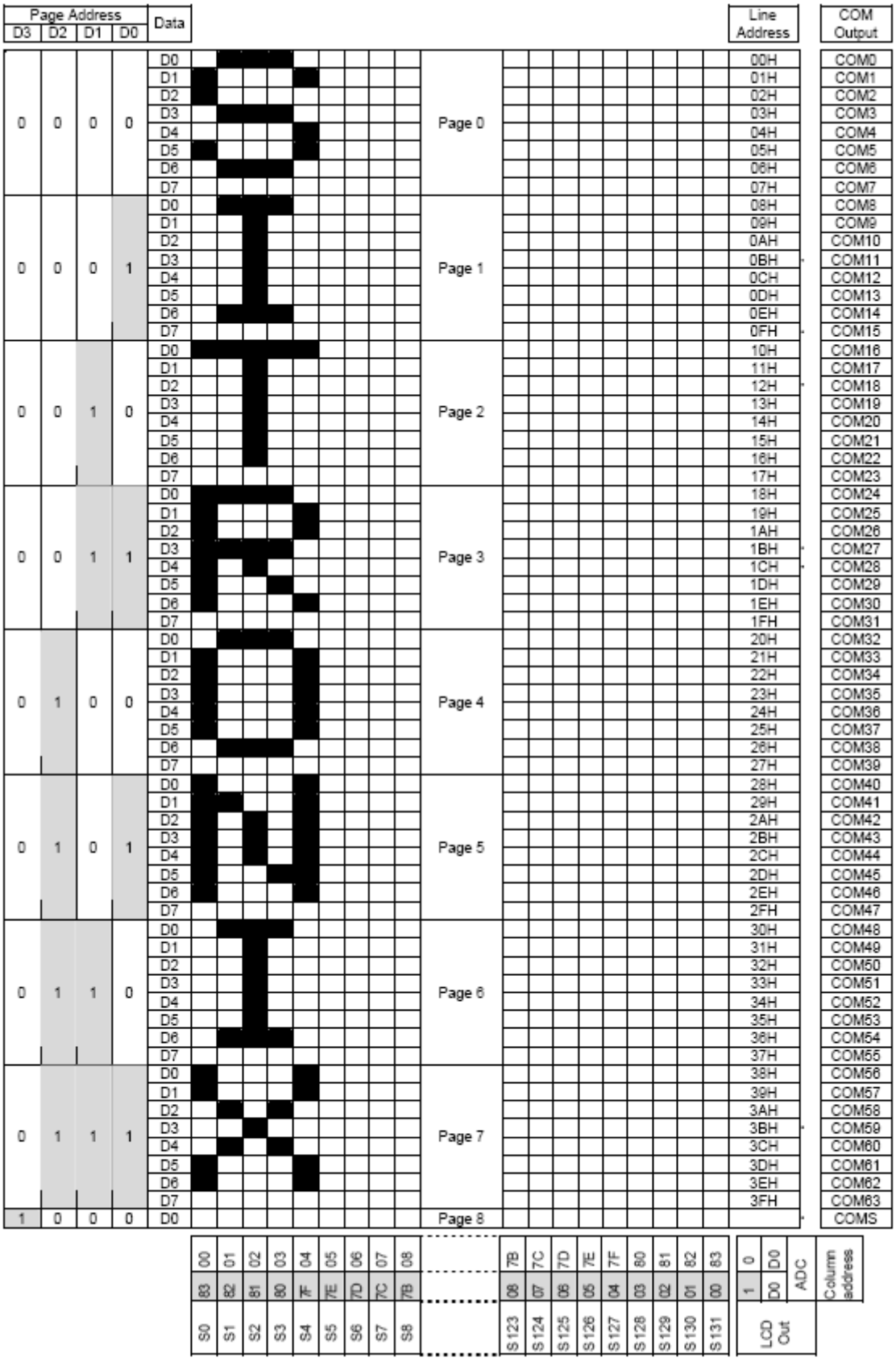

Page Address
D3 D2 D1 D0
Data
Line Address
COM Output
Page 0
Page 1
Page 2
Page 3
Page 4
Page 5
Page 6
Page 7
Page 8
COM0 COM1 COM2 COM3 COM4 COM5 COM6 COM7
COM8 COM9 COM10 COM11 COM12 COM13 COM14 COM15
COM16 COM17 COM18 COM19 COM20 COM21 COM22 COM23
COM24 COM25 COM26 COM27 COM28 COM29 COM30 COM31
COM32 COM33 COM34 COM35 COM36 COM37 COM38 COM39
COM40 COM41 COM42 COM43 COM44 COM45 COM46 COM47
COM48 COM49 COM50 COM51 COM52 COM53 COM54 COM55
COM56 COM57 COM58 COM59 COM60 COM61 COM62 COM63
COMS
00 01 02 03 04 05 06 07 08 ... 7B 7C 7D 7E 7F 80 81 82 83
83 82 81 80 7F 7E 7D 7C 7B ... 08 07 06 05 04 03 02 01 00
S0 S1 S2 S3 S4 S5 S6 S7 S8 ... S123 S124 S125 S126 S127 S128 S129 S130 S131
LCD Out
1 D0 ADC
0 D0
Column address

Figure 12-3

12.3 The Reset Circuit

When the /RES input comes to the “L” level, these LSIs return to the default state. Their default states are as follows:

1. Display OFF
2. Normal display
3. ADC select: Normal (ADC command D0 = “L”)
4. Power control register: (D2, D1, D0) = (0, 0, 0)
5. Serial interface internal register data clear
6. LCD power supply bias rate:

1/65 DUTY = 1/9 bias

1/49,1/55,1/53 DUTY = 1/8 bias

1/33 DUTY = 1/6 bias

7. All-indicator lamps-on OFF (All-indicator lamps ON/OFF command D0 = “L”)
8. Power saving clear
9. V0 voltage regulator internal resistors Ra and Rb separation
10. Output conditions of SEG and COM terminals SEG=VSS , COM=VSS
11. Read modify write OFF
12. Static indicator OFF Static indicator register : (D1, D2) = (0, 0)
13. Display start line set to first line
14. Column address set to Address 0
15. Page address set to Page 0
16. Common output status normal
17. V0 voltage regulator internal resistor ratio set mode clear 18. Electronic volume register set mode clear Electronic volume register : (D5, D4, D3, D2, D1, D0) = (1, 0. 0, 0, 0,0)
19. Test mode clear

12.4 The Voltage Regulator Circuit

The step-up voltage generated at VOUT outputs the LCD driver voltage V0 through the voltage regulator circuit. Because the ST7565P chips have an internal high-accuracy fixed voltage power supply with a 64-level electronic volume function and internal resistors for the V0 voltage regulator, systems can be constructed without having to include high-accuracy voltage regulator circuit components. (VREG thermal gradients approximate -0.05%/° C)

12.4.1 When the V0 Voltage Regulator Internal Resistors Are Used

Through the use of the V0 voltage regulator internal resistors and the electronic volume function the liquid crystal power supply voltage V0 can be controlled by commands alone (without adding any external resistors), making it possible to adjust the liquid crystal display brightness. The V0 voltage can be calculated using equation A-1 over the range where | V0 | < | VOUT |.

$$V_0 = \left(1 + \frac{Rb}{Ra}\right) \bullet V_{EV}$$

$$= \left(1 + \frac{Rb}{Ra}\right) \bullet \left(1 - \frac{\alpha}{162}\right) \bullet V_{REG}$$

$$\left[\because V_{EV} = \left(1 - \frac{\alpha}{162}\right) \bullet V_{REG}\right]$$

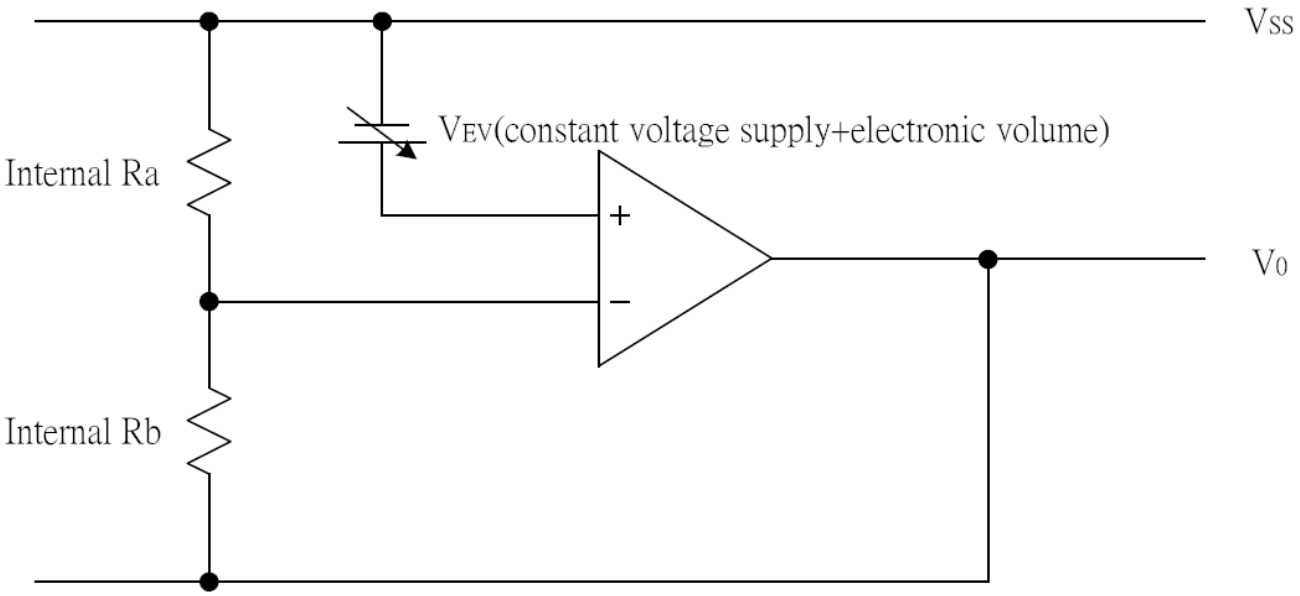


Figure 12-4

VREG is the IC-internal fixed voltage supply, and its voltage at Ta = 25° C is as shown in Table 12-1.

Part no.	Equipment Type	Thermal Gradient	VREG
ST7565P	Internal Power Supply	–0.05 %/°C	2.1V

Table 12-1

α is set to 1 level of 64 possible levels by the electronic volume function depending on the data set in the 6-bit electronic volume registers. Table 12-2 shows the value for α depending on the electronic volume register settings.

Rb/Ra is the V0 voltage regulator internal resistor ratio, and can be set to 8 different levels through the V0 voltage regulator internal resistor ratio set command. The (1 + Rb/Ra) ratio assumes the values shown in Table 12-3 depending on the 3-bit data settings in the V0 voltage regulator internal resistor ratio register.

D5	D4	D3	D2	D1	D0	α
0	0	0	0	0	0	63
0	0	0	0	0	1	62
0	0	0	0	1	0	61
			↓			↓
1	1	1	1	0	1	2
1	1	1	1	1	0	1
1	1	1	1	1	1	0

Table 12-2

V0 voltage regulator internal resistance ratio register value and (1 + Rb/Ra) ratio (Reference value)

Register			ST7565P
D2	D1	D0	(1) –0.05 %/°C
0	0	0	3.0
0	0	1	3.5
0	1	0	4.0
0	1	1	4.5
1	0	0	5.0
1	0	1	5.5
1	1	0	6.0
1	1	1	6.5

Table 12-3

Figures 12-1 show V0 voltage measured by values of the internal resistance ratio resistor for V0 voltage adjustment and electric volume resister for each temperature grade model.

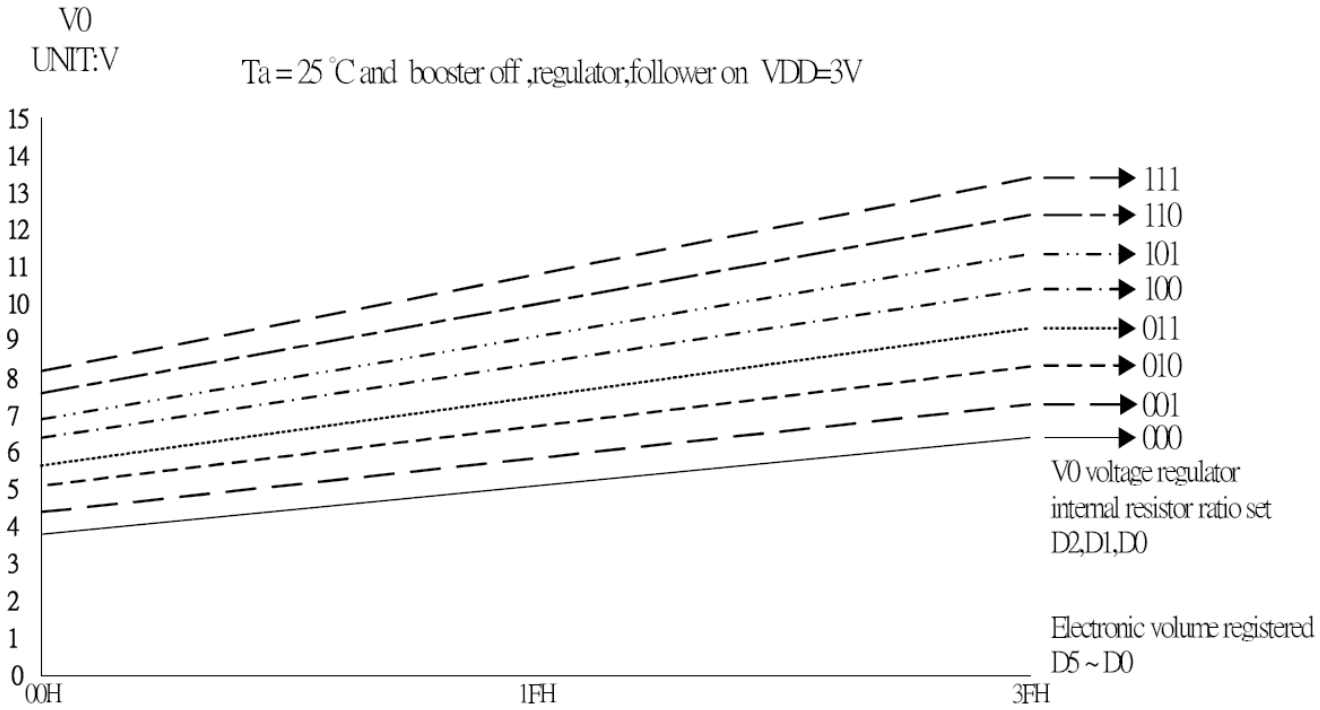


Figure 12-5 : (1) For ST7565P the Thermal Gradient = -0.05%/° C

The V0 voltage as a function of the V0 voltage regulator internal resistor ratio register and the electronic volume register.

13. 0 INSTRUCTION DESCRIPTION

13.1 INSTRUCTION TABLE

Command	Command Code											Function
	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	
(1) Display ON/OFF	0	1	0	1	0	1	0	1	1	1	0 1	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 Column address set lower bit	0 0	1 1	0 0	0 0	0 0	0 0	1 0	Most significant column address Least significant column address				Sets the most significant 4 bits of the display RAM column address. Sets the least significant 4 bits of the display RAM column address.
(5) Status read	0	0	1		Status			0	0	0	0	Reads the 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	0 1	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	0 1	Sets the LCD display normal/ reverse 0: normal, 1: reverse
(10) Display all points ON/OFF	0	1	0	1	0	1	0	0	1	0	0 1	Display all points 0: normal display 1: all points ON
(11) LCD bias set	0	1	0	1	0	1	0	0	0	1	0 1	Sets the LCD drive voltage bias ratio. 0: 1/9 bias, 1: 1/7 bias
(12) Read/modify/write	0	1	0	1	1	1	0	0	0	0	0	Column address increment At write: +1 At read: 0

续表：

Command	Command Code											Function
	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	
(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	0 1	*	*	*	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(Rb/Ra) 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
				0	0	Electronic volume value						
(19) Static indicator ON/OFF Static indicator register set	0	1	0	1	0	1	0	1	1	0	0 1	0: OFF, 1: ON Set the flashing mode
				0	0	0	0	0	0	Mode		
(20) Booster ratio set	0	1	0	1	1	1	1	1	0	0	0	select booster ratio 00: 2x,3x,4x 01: 5x 11: 6x
				0	0	0	0	0	0	step-up value		
(21) NOP	0	1	0	1	1	1	0	0	0	1	1	Command for non-operation
(22) Test	0	1	0	1	1	1	1	*	*	*	*	Command for IC test. Do not use this command

13.2 DESCRIPTION OF INSTRUCTION

1) Display ON/OFF

This command turns the display ON and OFF.

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

When the display OFF command is executed when in the display all points ON mode, power saver mode is entered.

2) Display Start Line Set

This command is used to specify the display start line address of the display data RAM.

A0	/RD	/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

3) Page Address Set

This command specifies the page address corresponding to the low address when the MPU accesses the display data RAM. 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	/RD	/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	1	1	1	7
							1	0	0	0	8

4) Column Address Set

This command specifies the column address of the display data RAM. 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.

A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Column address
0	1	0	0	0	0	1 0	A7 A3	A6 A2	A5 A1	A4 A0	--

A7	A6	A5	A4	A3	A2	A1	A0	Column address
0	0	0	0	0	0	0	0	0
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

5) Status Read

A0	/RD	/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 (This display ON/OFF command switches the polarity.)
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

6) 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	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0
1	1	0	Write data							

7) 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 them internal registers. When the serial interface is used, reading of the display data becomes unavailable.

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

8) 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.

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

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

10) 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	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Setting
0	1	0	1	0	1	0	0	1	0	0 1	Normal display mode Display all points ON

11) LCD Bias Set

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

A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Selected Status
0	1	0	1	0	1	0	0	0	0	0	1/9 bias
										1	1/7 bias

12) 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	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	0	0	0	0

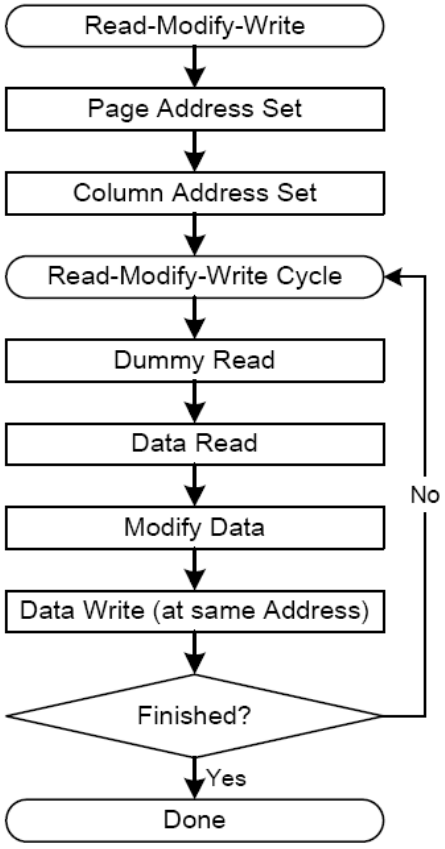


Figure 12-6

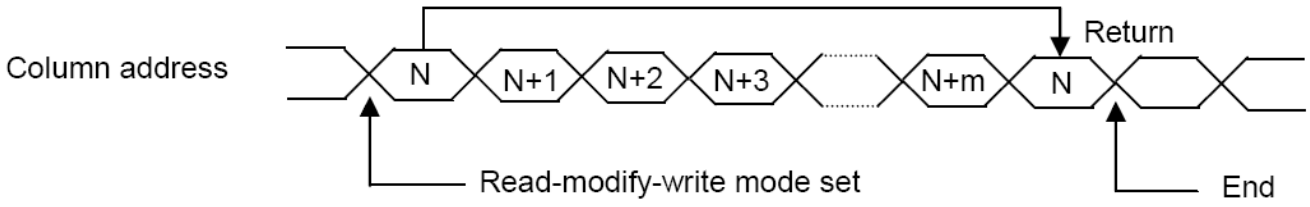


Figure 12-7

13) 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	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	1	1	1	0

14) Reset

This command initializes the display start line, the column address, the page address, the common output mode, the V0 voltage regulator internal resistor ratio, the electronic volume, and the static indicator 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	/RD	/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 /RST terminal. The reset command must not be used instead.

15) Common Output Mode Select

This command can select the scan direction of the COM output terminal.

A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Selected Mode
0	1	0	1	1	0	0	0 1	*	*	*	Normal (COM0→COM63) Reverse (COM63→COM0

16) Power Controller Set

This command sets the power supply circuit functions.

A0	/RD	/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

17) V0 Voltage Regulator Internal Resistor Ratio Set

This command sets the V0 voltage regulator internal resistor ratio.

A0	/RD	/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	0	
								1	1	1	Large

18) 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 V0 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.

(1) 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	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	0	0	0	0	0	0	1

(2) Electronic Volume Register Set

By using this command to set six bits of data to the electronic volume register, the liquid crystal drive voltage V0 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	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Rb/Ra Ratio
0	1	0	*	*	0	0	0	0	0	0	Small
					0	0	0	0	0	1	
					0	0	0	0	1	0	↓
								↓	↓		
					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)

The Electronic Volume Register Set Sequence

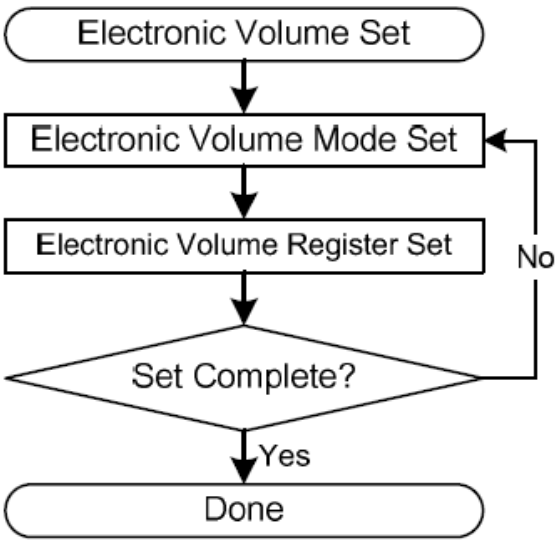


Figure 12-8

19) Static Indicator (Double Byte Command)

This command controls the static drive system indicator display. The static indicator display is controlled by this command only, and is independent of other display control commands.

This is used when one of the static indicator liquid crystal drive electrodes is connected to the FR terminal, and the other is connected to the FRS terminal. A different pattern is recommended for the static indicator electrodes than for the dynamic drive electrodes. If the pattern is too close, it can result in deterioration of the liquid crystal and of the electrodes.

The static indicator ON command is a double byte command paired with the static indicator register set command, and thus one must execute one after the other. (The static indicator OFF command is a single byte command.)

(1) Static Indicator ON/OFF

When the static indicator ON command is entered, the static indicator register set command is enabled. Once the static indicator ON command has been entered, no other command aside from the static indicator register set command can be used. This mode is cleared when data is set in the register by the static indicator register set command.

A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Static Indicator
0	1	0	1	0	1	0	1	1	0	0	OFF
										1	ON

(2) Static Indicator Register Set

This command sets two bits of data into the static indicator register, and is used to set the static indicator into a blinking mode.

A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Indicator Display State
0	1	0	*	*	*	*	*	*	0	0	OFF
									0	1	ON, See note
									1	0	ON, See note
									1	1	ON, See note

* Disabled bit (set “0”)

Note:

D[1:0]=01: blinking at approximately 1 second intervals

D[1:0]=10: blinking at approximately 0.5 second intervals

D[1:0]=11: constantly on

Static Indicator Register Set Sequence

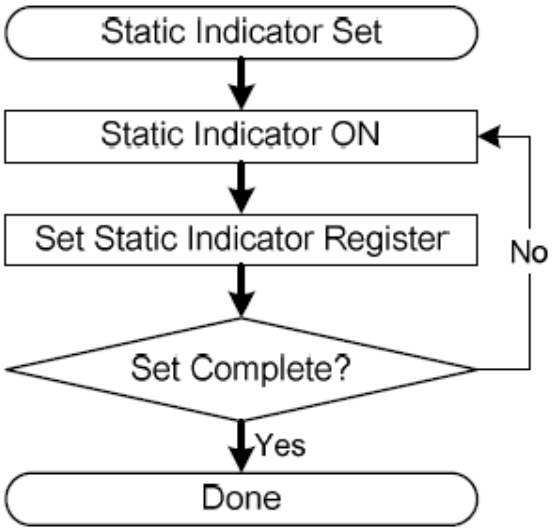


Figure 12-9

20) 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.

(1)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	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	1	1	0	0	0

(2)Booset 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	/RD	/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

The booster ratio Register Set Sequence

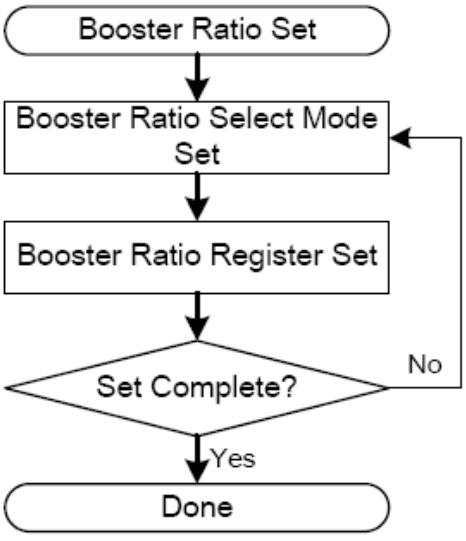


Figure 12-10

21) NOP

Non-Operation Command

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

22) 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	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	1	1	1	*	*

* Inactive bit

Note:

The ST7565P maintain their operating modes until something happens to change them. Consequently, excessive external noise, etc., can change the internal modes of the ST7565P . 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 noise.

23) Power Save (Compound Command)

When the display all points ON is performed while the display is in the OFF mode, the power saver mode is entered, thus greatly reducing power consumption.

The power saver mode has two different modes: the sleep mode and the standby mode. When the static indicator is OFF, it is the sleep mode that is entered. When the static indicator is ON, it is the standby mode that is entered.

In the sleep mode and in the standby mode, the display data is saved as is the operating mode that was in effect before them power saver mode was initiated, and the MPU is still able to access the display data RAM.

Power save off sequence

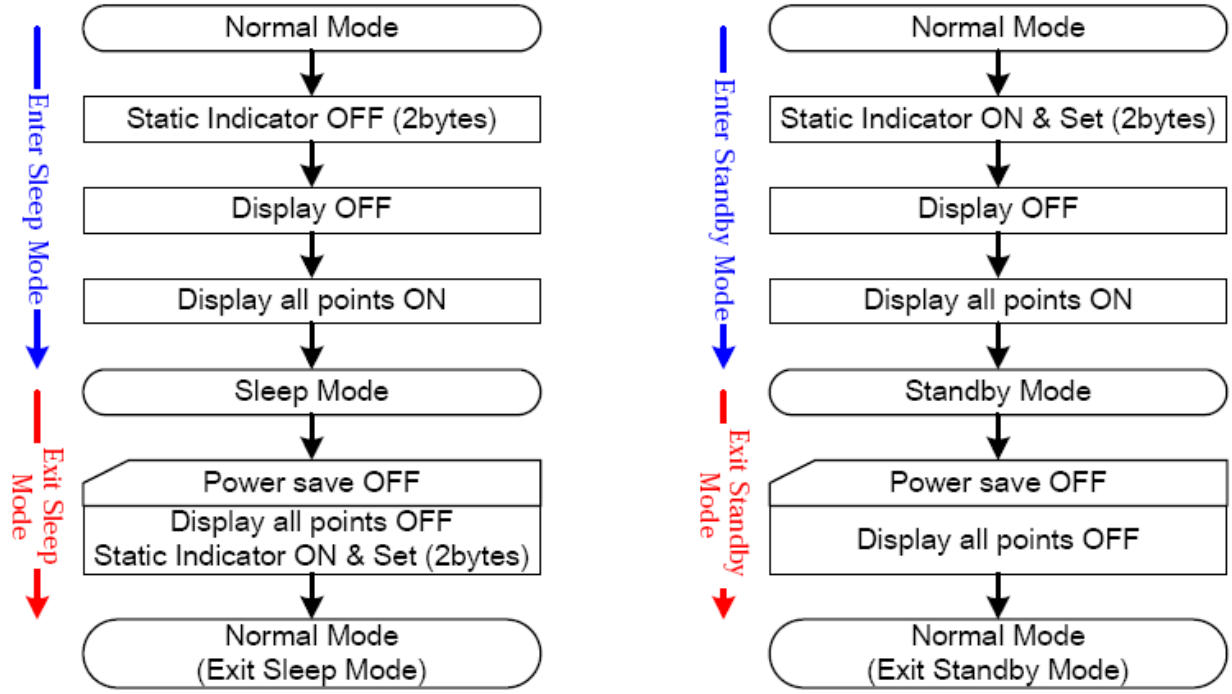


Figure 12-11

Sleep Mode

This 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.

Standby Mode

The duty LCD display system operations are halted and only the static drive system for the indicator continues to operate, providing the minimum required consumption current for the static drive. The internal modes are in the following states during standby mode.

1 The LCD power supply circuits are halted. The oscillator circuit continues to operate.

2 The duty drive system liquid crystal drive circuits are halted and the segment and common driver outputs output a VSS level.

The static drive system does not operate.

When a reset command is performed while in standby mode, the system enters sleep mode.

* When an external power supply is used, it is recommended that the functions of the external power supply circuit be stopped when the power saver mode is started. For example, when the various levels of liquid crystal drive voltage are provided by external resistive voltage dividers, it is recommended that a circuit be added in order to cut the electrical current flowing through the resistive voltage divider circuit when the power saver mode is in effect. The ST7565P series chips have a liquid crystal display blanking control terminal /DOF. This terminal enters an “L” state when the power saver mode is launched. Using the output of /DOF, it is possible to stop the function of an external power supply circuit.

* When the master is turned on, the oscillator circuit is operable immediately after the powering on.

14. 0 QUALITY GUARANTEE

14.1 ACCEPTABLE QUALITY LEVEL

Inspection items	Sampling procedures	AQL
Visual-operating (Electro-optical)	GB2828-81 Inspection level Ⅱ Normal inspection Single sample inspection	0.65
Visual-not operating	GB2828-81 Inspection level Ⅱ Normal inspection Single sample inspection	1.5
Dimension measurement	GB2828-81 Inspection level Ⅱ Normal inspection Single sample inspection	1.5

14.2 Conditions of Cosmetic Inspection

- Environmental condition

The inspection should be performed at the 1m of height from the LCD module under 2 pieces of 40W white fluorescent lamps (Normal temperature 20~25℃ 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

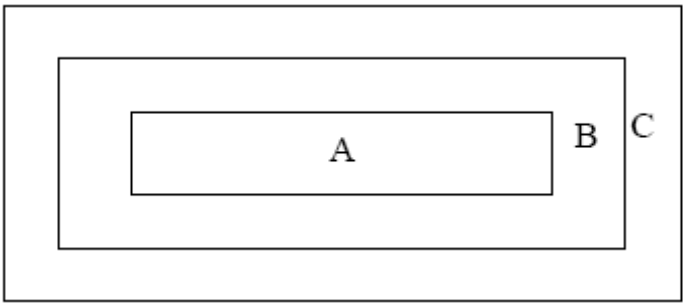
The V0 value which the most optimal contrast can be obtained near the specified V0 in the specification. (Within ±0.5V of the typical value at 25℃.).

14.3 Definition of inspection zone in LCD

Zone A: character/Digit area

Zone B: viewing area except Zone A (ZoneA+ZoneB=minimum Viewing area)

Zone C: Outside viewing area (invisible area after assembly in customer's product)



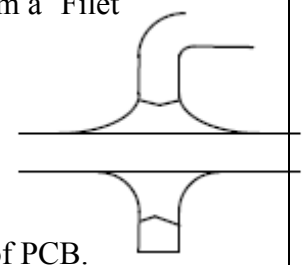
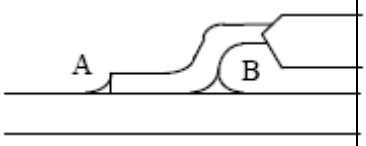
Note: As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer's product.

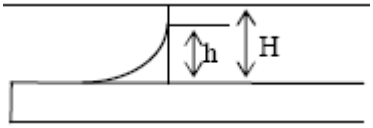
14.4 Inspection Standard

- **Major Defect**

Item No	Items to be inspected	Inspection Standard	Classification of defects
1	All functional defects	1) No display 2) Display abnormally 3) Missing vertical，horizontal segment 4) Short circuit 5) Back-light no lighting, flickering and abnormal lighting.	Major
2	Missing	Missing component	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed.	

- **Module Cosmetic Criteria**

No.	Item	Judgment 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 Minor
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 1. Lead parts	a. Soldering side of PCB Solder to form a ‘Filet’ all around the lead. Solder should not hide the lead form perfectly. (too much) b. Components side (In case of ‘Through Hole PCB’) Solder to reach the Components side of PCB. 	Minor
	2. Flat packages	Either ‘Toe’ (A) or ‘Seal’ (B) of the lead to be covered by ‘Filet’. Lead form to be assume over solder. 	Minor

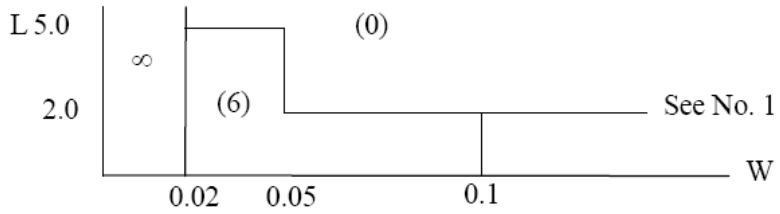
No.	Item	Judgment Criterion	Partition
8	3. Chips	(3/2) H ≥ h ≥ (1/2) H 	Minor

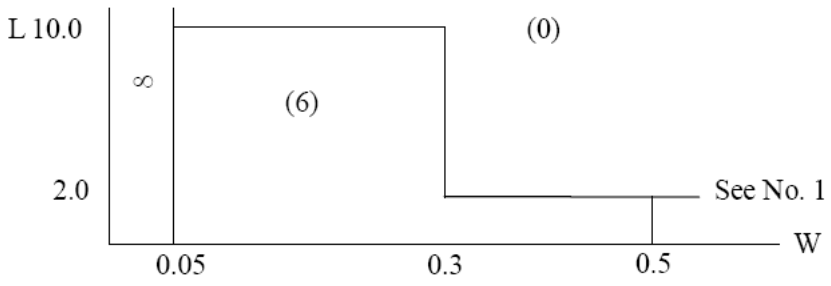
● Screen Cosmetic Criteria (Non-Operating)

No.	Defect	Judgement Criterion	Partition
1	Spots	In accordance with *Screen Cosmetic Criteria (Operating) No.1*.	Minor
2	Lines	In accordance with *Screen Cosmetic Criteria (Operating) No.2*.	Minor
3	Bubbles in polarizer	<table><tr><td>Size : d</td><td>mm</td><td>Acceptable Qty in active area</td></tr><tr><td>d</td><td>≤ 0.3</td><td>Disregard</td></tr><tr><td>0.3 < d</td><td>≤ 1.0</td><td>3</td></tr><tr><td>1.0 < d</td><td>≤ 1.5</td><td>1</td></tr><tr><td>1.5 < d</td><td></td><td>0</td></tr></table>	Minor
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

Note: Size : d = (long length + short length) / 2

● Screen Cosmetic Criteria (Operating)

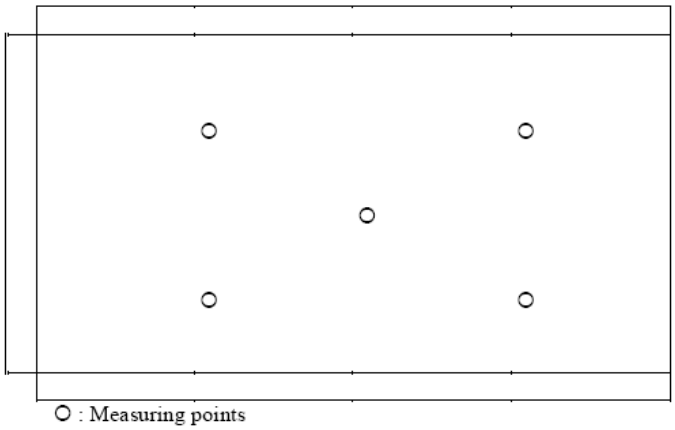
<table>
<tr><th>No.</th><th>Defect</th><th>Judgment Criterion</th><th>Partition</th></tr>
<tr><td>1</td><td>Spots</td><td>A) Clear
<table>
<tr><th>Size : d mm</th><th>Acceptable Qty in active area</th></tr>
<tr><td>d ≤ 0.1</td><td>Disregard</td></tr>
<tr><td>0.1 < d ≤ 0.2</td><td>6</td></tr>
<tr><td>0.2 < d ≤ 0.3</td><td>2</td></tr>
<tr><td>0.3 < d</td><td>0</td></tr>
</table>
Note : Including pin holes and defective dots which must be within one pixel size.
B) Unclear
<table>
<tr><th>Size : d mm</th><th>Acceptable Qty in active area</th></tr>
<tr><td>d ≤ 0.2</td><td>Disregard</td></tr>
<tr><td>0.2 < d ≤ 0.5</td><td>6</td></tr>
<tr><td>0.5 < d ≤ 0.7</td><td>2</td></tr>
<tr><td>0.7 < d</td><td>0</td></tr>
</table></td><td>Minor</td></tr>
<tr><td>2</td><td>Lines</td><td>A) Clear
 

Note :
( ) - Acceptable Qty in active area
L - Length (mm)
W - Width (mm)
∞ - Disregard
B) Unclear
 

‘Clear’ = The shade and size are not changed by Vop.
‘Unclear’ = The shade and size are changed by Vop.</td><td>Minor</td></tr>
</table>

Note: Size : d = (long length + short length) / 2

● Screen Cosmetic Criteria (Operating) (Continued)

No.	Defect	Judgment Criterion	Partition
3	Rubbing line	Not to be noticeable.	Minor
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 pot'. (see *Screen Cosmetic Criteria (Operating) No.1*)	Minor
7	Uneven brightness (only back-lit type module)	Uneven brightness must be BMAX / BMIN ≤ 2 - BMAX : Max. value by measure in 5 points - BMIN : Min. value by measure in 5 points Divide active area into 4 vertically and horizontally. Measure 5 points shown in the following figure.  	Minor

Note :

(1) The limit samples for each item have priority.

(2) Complex defects are defined item by item, but if the numbers of defects are defined in above table, the total number should not exceed 10.

(3) In case of 'concentration', even the spots or the lines of 'disregarded' size should not allowed. Following three situations should be treated as 'concentration'.

- 7 or over defects in circle of Æ5mm.
- 10 or over defects in circle of Æ10mm.
- 20 or over defects in circle of Æ20mm.

15. 0 RELIABILITY

15.1 Content of Reliability Test

No.	Test Item	Test Condition	Inspection after test
1	High Temperature Storage	80℃±2℃/200 hours	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 1.Air bubble in the LCD; 2.Sealleak; 3.Non-display; 4.missing segments; 5.Glass crack; 6.Current Idd is twice higher than initial value.
2	Low Temperature Storage	-30℃±2℃/200 hours	
3	High Temperature Operating	70℃±2℃/120 hours	
4	Low Temperature Operating	-20℃±2℃/120 hours	
5	Temperature Cycle	-20℃±2℃~25~70℃±2℃×10cycles (30min.) (5min.) (30min.)	
6	High Temperature / Humidity operation	50℃±5℃×90%RH/120 hours	
7	Vibration Test	Frequency：10Hz~55Hz~10Hz Amplitude：1.5mm, X，Y，Z direction for total 3hours (Packing condition)	
8	Drooping test	Drop to the ground from 1m height, one time, and every side of carton. (Packing condition)	
9	Static electricity test	Voltage:±8KV R: 330Ω C: 150pF Air discharge, 10time	

Remark:

1. The test samples should be applied to only one test item.
2. Sample size for each test item is 5~10pcs.
3. For Damp Proof Test, Pure water(Resistance＞10MΩ) should be used.
4. In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judge as a good part.
5. EL evaluation should be excepted from reliability test with humidity and temperature: Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence EL has.
6. Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

16. 0 PRECAUTIONS FOR USING LCD MODULES

16.1 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.

16.2 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.

16.3 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.

17. 0 USING LCD MODULES

17.1 About 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 polarizer 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 polarizer and reflectors made of organic substances which will be damaged by chemicals such as acetone, toluene, ethanol and isopropyl alcohol.

(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 polarizer. 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.

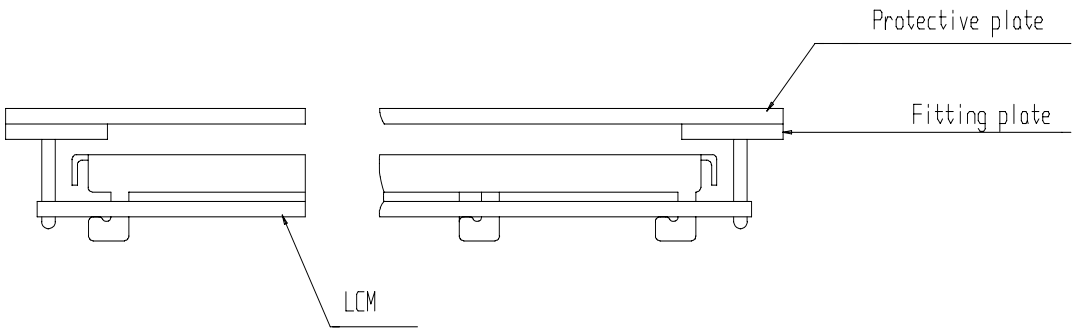
(9) Do not touch the display with bare hands. This will stain the display area and degradate insulation between terminals (some cosmetics are determinate to the polarizer).

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

17.2 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.

17.3 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 commutation 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.

17.4 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.

17.5 Operation

(1) Viewing angle varies with the change of liquid crystal driving voltage (VO). Adjust VO to show the best contrast.

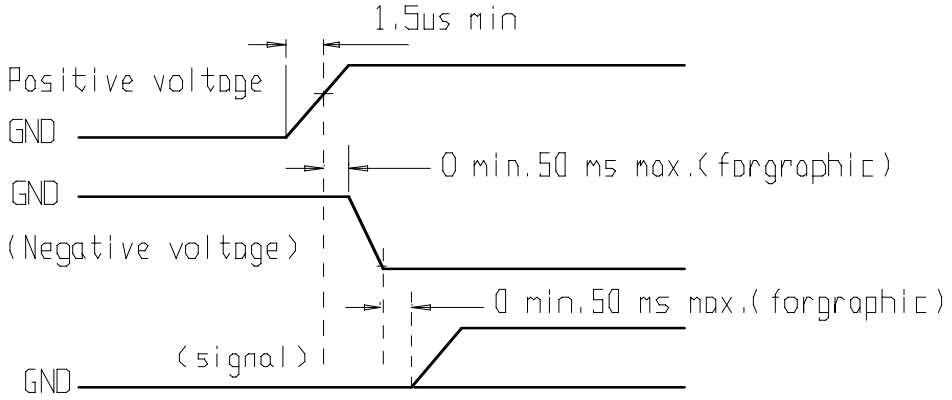
(2) Driving the LCD in the voltage above the limit shortens its life.

(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.



17.6 Storage

When storing LCDs 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 60°C.
- Should not be left for more than 48hrs. at -20°C.

17.7 Safety

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

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

17.8 Limited Warranty

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

17.9 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, conductors and terminals.

18. 0 APPENDIX

18.1 Initialization Code

```
void wr_cmd(uchar cmd)
{
    LCD_E       =0;
    LCD_RS      =0;
    LCD_RW      =0;
    LCD_CS      =0;
    LCD_E       =1;
    DATAPORT = cmd;
    LCD_E       =0;
    LCD_CS      =1;
}

//Write Display RAM Data
#pragma disable
void wr_dat(uchar dat)
{
    LCD_E       =0;
    LCD_RS      =1;
    LCD_RW      =0;
    LCD_CS      =0;
    LCD_E       =1;
    DATAPORT = dat;
    LCD_E       =0;
    LCD_CS      =1;
}

void Initial ()
{
    wr_cmd(0xE2);
    delay(250);
    delay(250);

    wr_cmd(0xAE); // Display OFF

    wr_cmd(0xA0); // Set The DDRAM Address SEG output Correspondence (ADC=0)SEG0--SEG127

    wr_cmd(0xC8); // Set COM Output scan direction (SHL=1)COM63-COM0

    wr_cmd(0x40); // The DDRAM Display Start Line Address (0)
```

```
    wr_cmd(0xA6); // Set The LCD Display(Normal

    wr_cmd(0xA4); // Sets Display all points 0: normal display

    wr_cmd(0xA2); // Set The LCD Display Driver Voltage Bias Ratio (1/9)

    wr_cmd(0x2F); // Booster Circuit ON,Voltage Regulator Circuit ON,Voltage Follower Circuit ON

    wr_cmd(0x25); // Select Internal Resistor Rate (Rb/Ra)

    wr_cmd(0x81); // Set Electronic volume Register (32)
    wr_cmd(0x27);

    wr_cmd(0xAF); // Display ON
}
```

18.2 Power Supply Circuit Diagram