中显液晶
技术资料

型号 :ZX0801A

2009年3月15日

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RECORDS OF REVISION

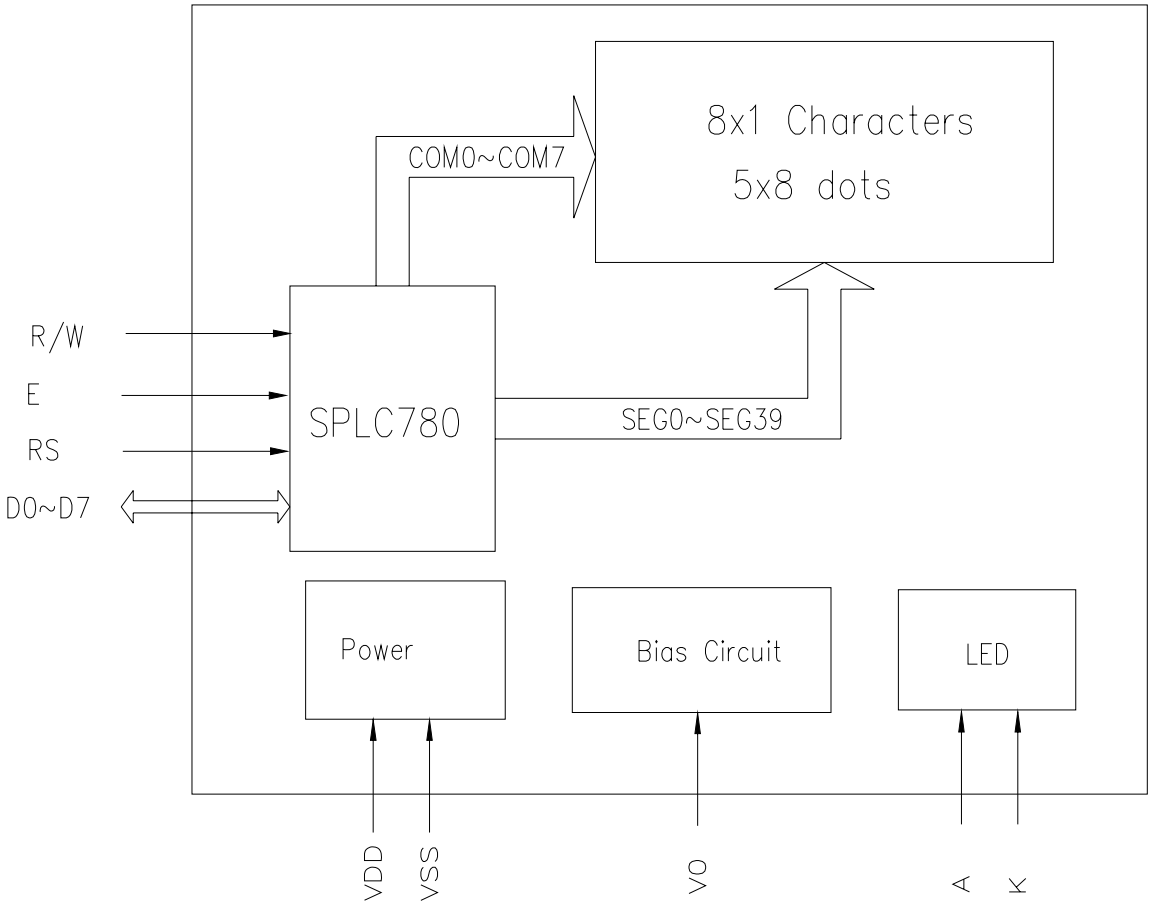
DATE	REVISED NO.	REVISED DESCRIPTIONS	PREPARED	CHECKED	APPROVED
June 25,2007	1.00	FIRST ISSUE	zdx		
May 27, 2008	1.01	Amend some contents	ynn		

CONTENTS

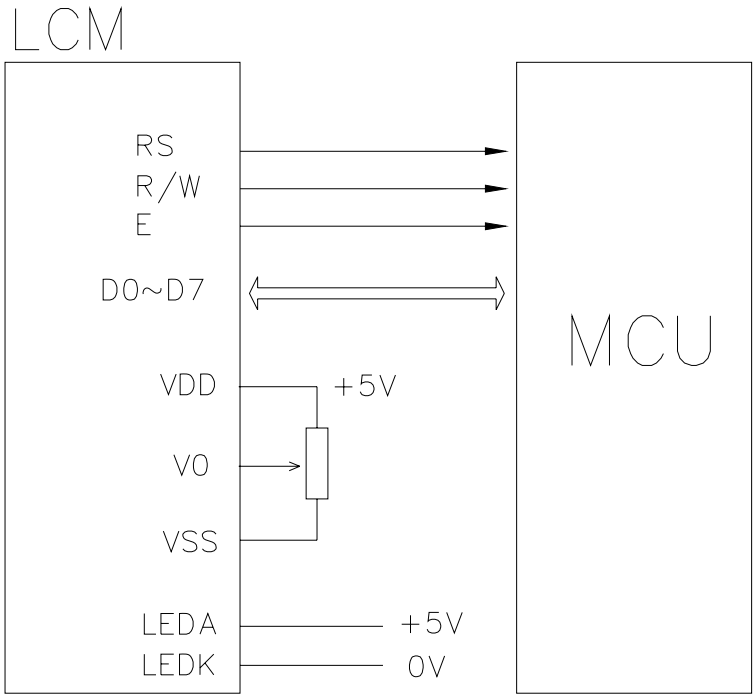
1. FEATURES：

ITEM	STANDARD VALUE	UNIT
Display Type	5×8(1 Cursor) dots, 8×1 Characters	-
LCD Type	■STN, YELLOW-GREEN, Transflective, Position ☐STN, BLUE , Transmissive, Negative ☐FSTN, Transflective, Position	-
LCD Duty	1/8	-
LCD Bias	1/4	-
Viewing Direction	6:00	-
Backlight Type	■LED(Yellow-Green) ☐LED(White)	-
Interface	6800 Series 8bit/4bit	-
Driver IC	SPLC780	-
Module Dimension	60.5 (W) X 33.0(H) X8.2(MAX)(T)	mm
Effective Display Area	40.83(W) X7.93(H)	mm
Character Size	4.43(W) X7.93(H)	mm
Character Pitch	5.2(W) X7.93(H)	mm

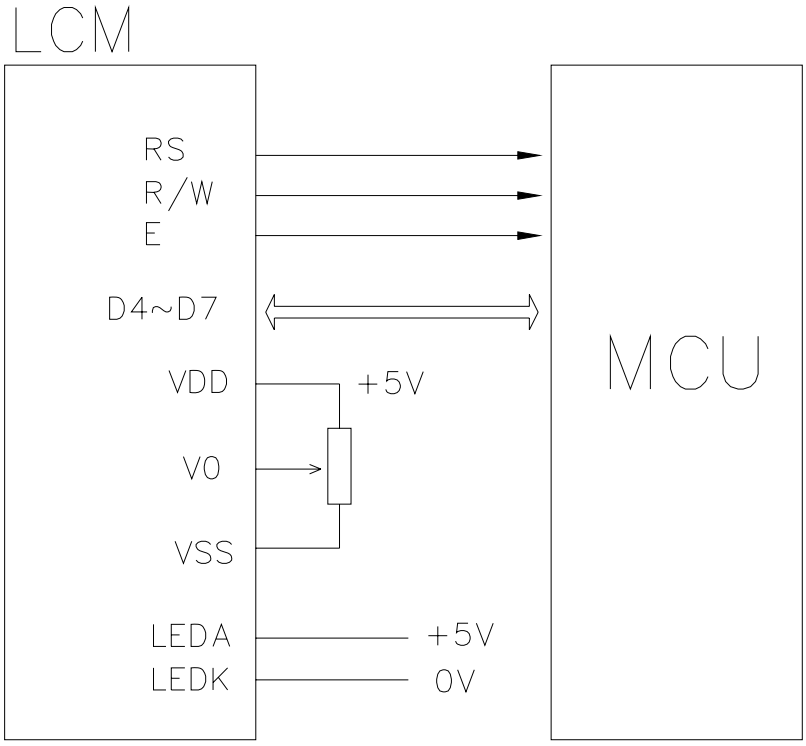
2. BLOCK DIAGRAM &APPLICATION CIRCUIT：



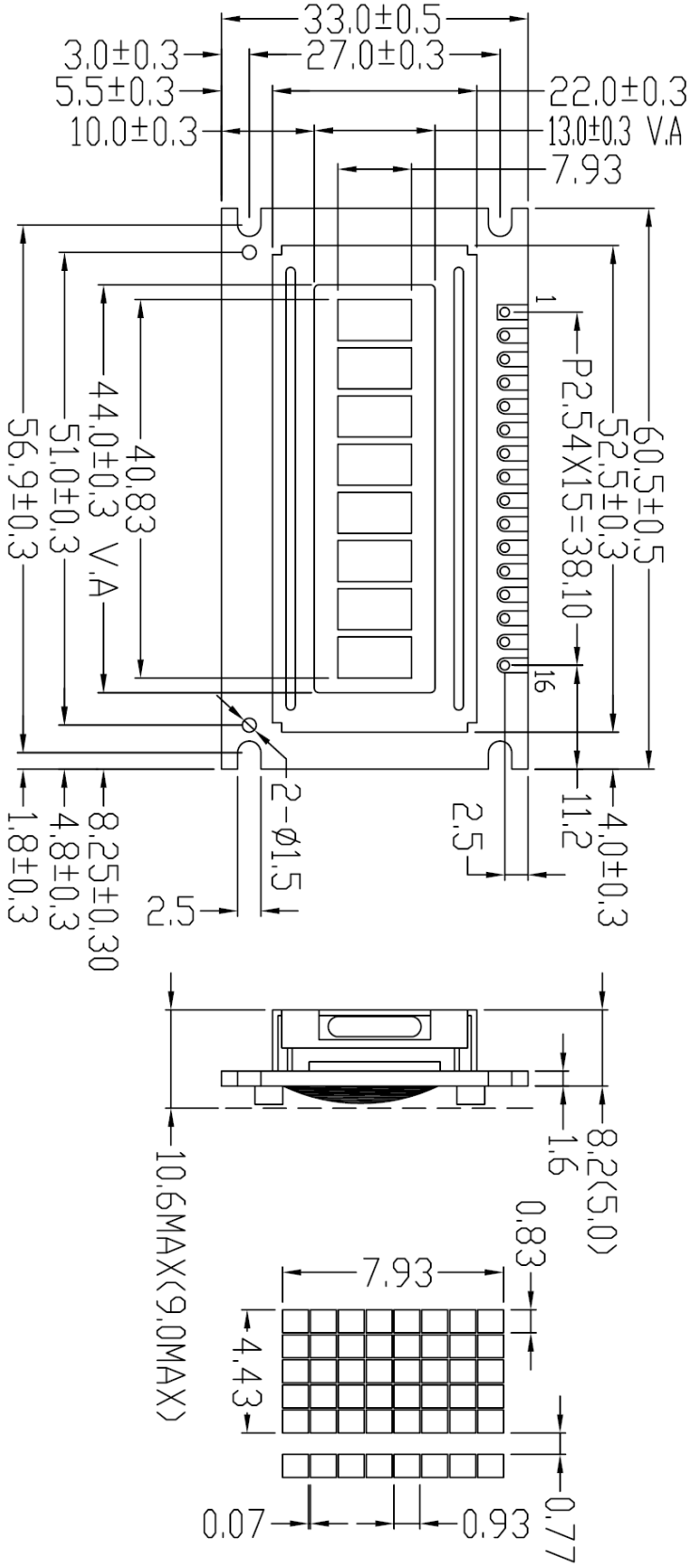
8 bit Application



4 bit Application



3. OUTLINE DIMENSIONS



4. ABSOLUTE MAXIMUM RATING

ITEM	SYMBOL	CONDITION	STANDARD VALUE			UNIT
			MIN	TYP	MAX	
POWER SUPPLY FOR LOGIC	VDD	Ta=25℃	-0.3	—	7.0	V
INPUT VOLTAGE	VIN	Ta=25℃	-0.3	—	VDD+0.3	V
MODULE OPERATION TEMP	TOPR	---	-20	—	+70	℃
MODULE STORAGE TEMP	TSTG	---	- 30	—	+80	℃
STORAGE HUMIDIT	H_D	Ta < 40 ℃	-		90	%RH

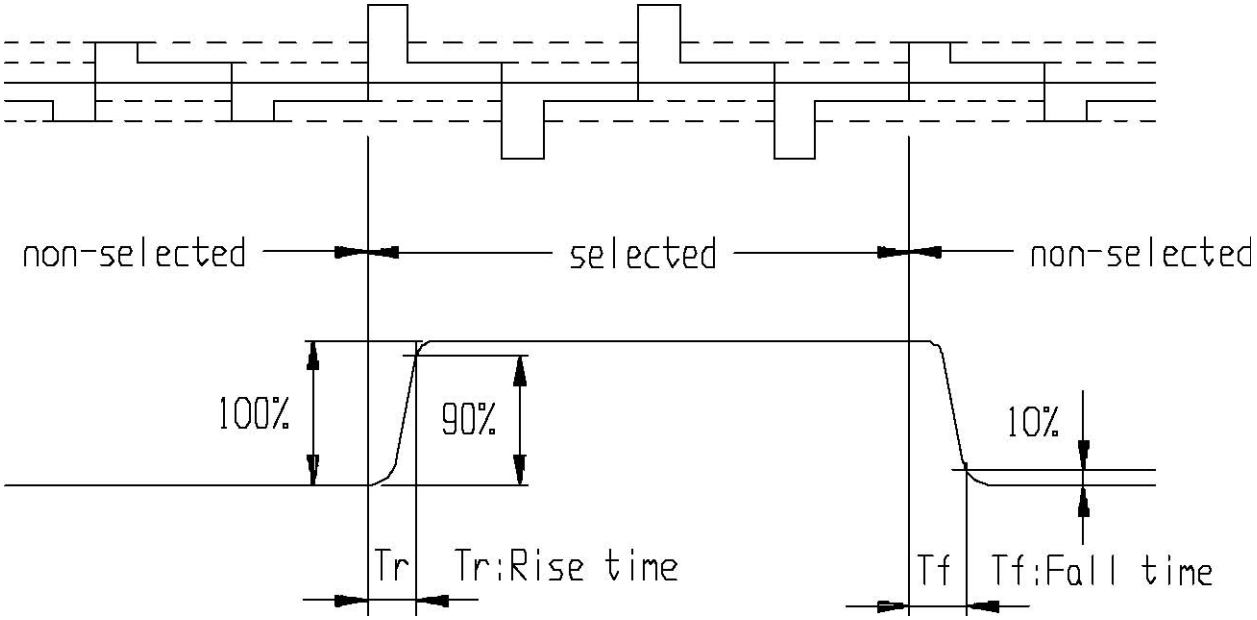
5. ELECTRICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Supply Voltage (logic)	VDD-VSS	-	4.5	5.0	5.5	V
Supply Voltage (LCD)	VDD-V0	STN, YELLOW-GREEN Ta= +25℃ STN, BLUE STN, GREY		4.8 4.5 4.5	-	V
Input signal voltage	V-IH	VDD=4.5~5.5V	2.2V	-	VDD	V
	V-IL	VDD=4.5~5.0V	-0.3	-	-0.6	V
Output signal voltage	V-OH	VDD=4.5~5.0V	0.9VDD	-	VDD	V
	VOL	VDD=4.5~5.0V	-	-	0.1VDD	V
Supply Current (logic)	IDD	VDD=5.0V	-	10	15	mA
Backlight Voltage	V-BL	LED(Yellow-Green) LED(White)	-	4.2V 3V	-	V
Backlight Current	I-BL	LED(Yellow-Green) LED(White)		80 15		mA
Backlight Driver Wave				-		kHz
Backlight Brightness						
Backlight Life Time						

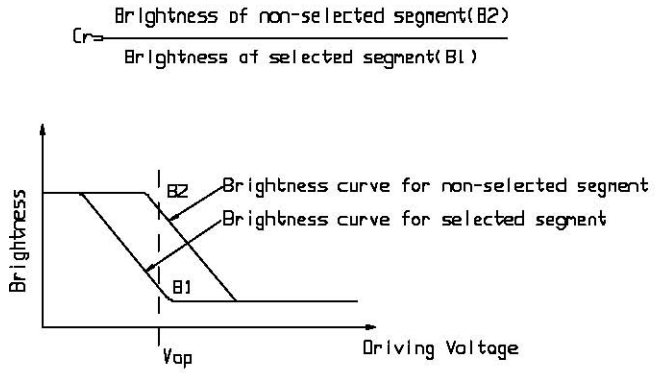
6. OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit	Remarks	Note
Response Time	Tr	25 ℃	-	150	200	ms	-	1
	Tf	25 ℃	-	200	250	ms	-	1
Contrast Ratio	Cr	25 ℃	2.0	5.0	-	-	-	2
Viewing Angle Range		Cr≥ 2	30	-	-	deg	Ø= 90	3
			30	-	-	deg	Ø = 270	3
			35	-	-	deg	Ø = 0	3
			35	-	-	deg	Ø = 180	3

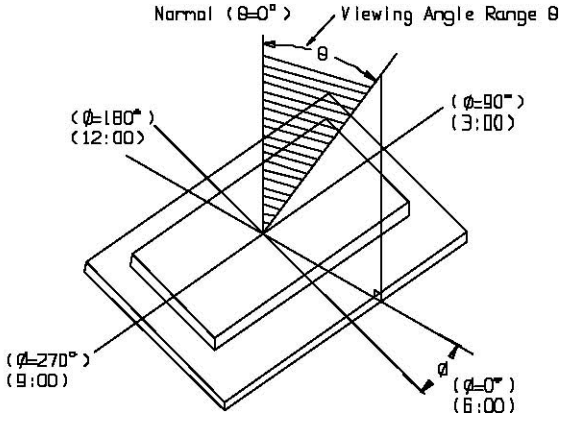
Note 1. Definition of response time



Note 2. Definition of Contrast Ratio 'Cr'



Note 3. Definition of Viewing Angle Range 'q'



7. TIMING CHARACTERISTICS

7.1 AC Characteristics (VDD=2.7V to 4.5V, T_A=25℃)

7.1.1. Internal clock operation

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
OSC Frequency	F_{OSC1}	190	270	350	KHz	VDD = 3.0V, Rf = 75KΩ±2%

7.1.2. External clock operation

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
External Frequency	F_{OSC2}	125	250	350	KHz	
Duty Cycle		45	50	55	%	
Rise/Fall Time	t r, t f	-	-	0.2	μs	

7.1.3. Write Mode (Writing data from MPU to SPLC780)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
E Cycle Time	t_C	1000	-	-	ns	Pin E
E Pulse Width	t_{PW}	450	-	-	ns	Pin E
E Rise/Fall Time	t_R, t_F	-	-	25	ns	Pin E
Address Setup Time	t_{SP1}	60	-	-	ns	Pins: RS, R/W, E
Address Hold Time	t_{HD1}	20	-	-	ns	Pins: RS, R/W, E
Data Setup Time	t_{SP2}	195	-	-	ns	Pins: DB0 - DB7
Data Hold Time	t_{HD2}	10	-	-	ns	Pins: DB0 - DB7

7.1.4. Read Mode (Writing data from SPLC780 to MPU)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
E Cycle Time	t_C	1000	-	-	ns	Pin E
E Pulse Width	t_W	450	-	-	ns	Pin E
E Rise/Fall Time	t_R, t_F	-	-	25	ns	Pin E
Address Setup Time	t_{SP1}	60	-	-	ns	Pins: RS, R/W, E
Address Hold Time	t_{HD1}	20	-	-	ns	Pins: RS, R/W, E
Data Output Delay Time	t_D	-	-	360	ns	Pins: DB0 - DB7
Data hold time	t_{HD2}	5.0	-	-	ns	Pin DB0 - DB7

7.2 SPLC780 Timing

7.2.1. Internal clock operation

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
OSC Frequency	F_{OSC1}	190	270	350	KHz	VDD = 5.0V, Rf = 91KΩ±2%

7.2.2. External clock operation

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
External Frequency	F_{OSC2}	125	250	350	KHz	
Duty Cycle		45	50	55	%	
Rise/Fall Time	t r, t f	-	-	0.2	μs	

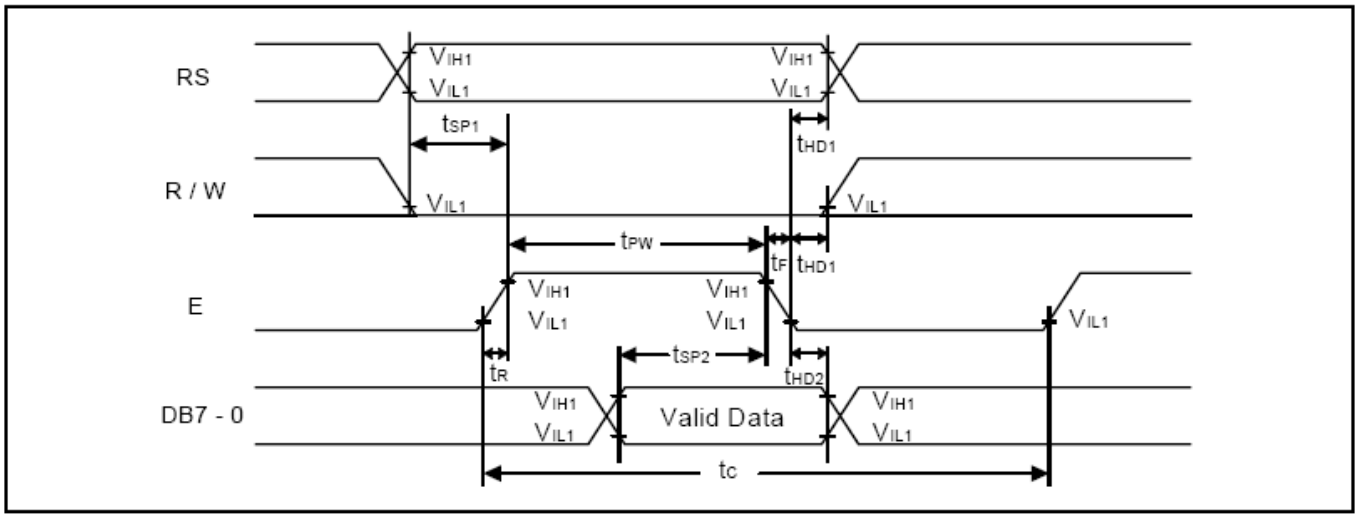
7.2.3. Write Mode (Writing data from MPU to SPLC780)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
E Cycle Time	t_C	500	-	-	ns	Pin E
E Pulse Width	t_{PW}	230	-	-	ns	Pin E
E Rise/Fall Time	t_R, t_F	-	-	20	ns	Pin E
Address Setup Time	t_{SP1}	40	-	-	ns	Pins: RS, R/W, E
Address Hold Time	t_{HD1}	10	-	-	ns	Pins: RS, R/W, E
Data Setup Time	t_{SP2}	80	-	-	ns	Pins: DB0 - DB7
Data Hold Time	t_{HD2}	10	-	-	ns	Pins: DB0 - DB7

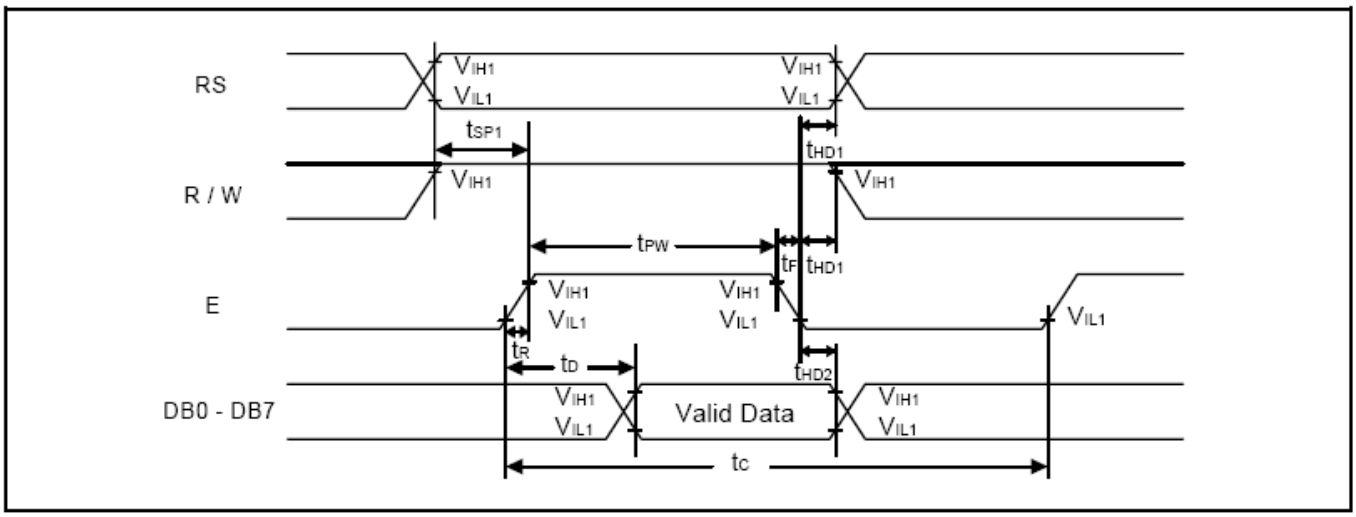
7.2.4. Read Mode (Writing data from SPLC780 to MPU)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
E Cycle Time	t_C	500	-	-	ns	Pin E
E Pulse Width	t_W	230	-	-	ns	Pin E
E Rise/Fall Time	t_R, t_F	-	-	20	ns	Pin E
Address Setup Time	t_{SP1}	40	-	-	ns	Pins: RS, R/W, E
Address Hold Time	t_{HD1}	10	-	-	ns	Pins: RS, R/W, E
Data Output Delay Time	t_D	-	-	120	ns	Pins: DB0 - DB7
Data hold time	t_{HD2}	5.0	-	-	ns	Pin DB0 - DB7

7.3 Write mode timing diagram (Writing Data from MPU to SPLC780)



7.3 Read mode timing diagram (Writing Data from SPLC780 to MPU)



8. FUNCTIONAL DESCRIPTIONS

8.1. Oscillator

SPLC780C oscillator supports not only the internal oscillator operation, but also the external clock operation.

8.2. Control and Display Instructions

Control and display instructions are described in details as follows:

8.2.1. Clear display

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	0	0	1

It clears the entire display and sets Display Data RAM Address 0 in Address Counter.

8.2.2. Return home

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	0	1	X

X: Do not care (0 or 1)

It sets Display Data RAM Address 0 in Address Counter and the display returns to its original position. The cursor or blink goes to the most-left side of the display (to the 1st line if 2 lines are displayed). The contents of the Display Data RAM do not change.

8.2.3. Entry mode set

During writing and reading data, it defines cursor moving direction and shifts the display.

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	1	I / D	S

I / D = 1: Increment, I / D = 0: Decrement.

S = 1: The display shift, S = 0: The display does not shift.

S = 1	I / D = 1	It shifts the display to the left
S = 1	I / D = 0	It shifts the display to the right

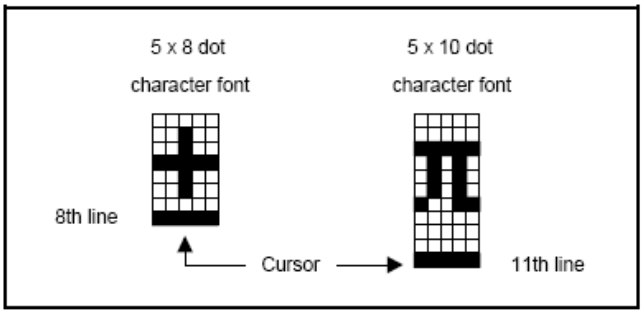
8.2.4. Display ON/OFF control

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	1	D	C	B

D = 1: Display on, D = 0: Display off

C = 1: Cursor on, C = 0: Cursor off

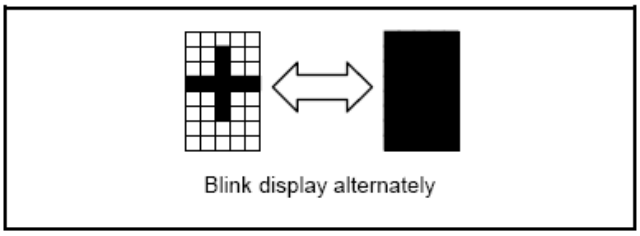
B = 1: Blinks on, B= 0: Blinks off



8.2.5. Cursor or display shift

Without changing DD RAM data, it moves cursor and shifts display.

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	1	S/C	R/L	X	X



S/C	R/L	Description	Address Counter
0	0	Shift cursor to the left	AC = AC - 1
0	1	Shift cursor to the right	AC = AC + 1
1	0	Shift display to the left. Cursor follows the display shift	AC = AC
1	1	Shift display to the right. Cursor follows the display shift	AC = AC

8.2.6. Function set

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	1	DL	N	F	X	X

X: Do not care (0 or 1)

DL: It sets interface data length.

DL = 1: Data transferred with 8-bit length (DB7 - 0).

DL = 0: Data transferred with 4-bit length (DB7 - 4).

It requires two times to accomplish data transferring.

N: It sets the number of the display line.

N = 0: One-line display.

N = 1: Two-line display.

F: It sets the character font.

F = 0: 5 x 8 dots character font.

F = 1: 5 x 10 dots character font.

N	F	No. of Display Lines	Character Font	Duty Factor
0	0	1	5 x 8 dots	1 / 8
0	1	1	5 x 10 dots	1 / 11
1	X	2	5 x 8 dots	1 / 16

It cannot display two lines with 5 x 10 dots character font.

8.2.7. Set character generator RAM address

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	1	a	a	a	a	a	a

It sets Character Generator RAM Address (aaaaaa)2 to the Address Counter.

Character Generator RAM data can be read or written after this setting.

8.2.8. Set display data RAM address

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	1	a	a	a	a	a	a	a

It sets Display Data RAM Address $(aaaaaaa)_2$ to the Address Counter.

Display data RAM can be read or written after this setting.

In one-line display (N = 0),

$(aaaaaaa)_2$: $(00)_{16}$ - $(4F)_{16}$.

In two-line display (N = 1),

$(aaaaaaa)_2$: $(00)_{16}$ - $(27)_{16}$ for the first line,

$(aaaaaaa)_2$: $(40)_{16}$ - $(67)_{16}$ for the second line.

8.2.9. Read busy flag and address

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	1	BF	a	a	a	a	a	a	a

When BF = 1, it indicates the system is busy now and it will not accept any instruction until not busy (BF = 0). At the same time, the content of Address Counter $(aaaaaaa)_2$ is read.

8.2.10. Write data to character generator RAM or display data RAM

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	1	0	d	d	d	d	d	d	d	d

It writes data $(dddddddd)_2$ to character generator RAM or display data RAM.

8.2.11. Read data from character generator RAM or display data RAM

	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	1	1	d	d	d	d	d	d	d	d

It reads data $(dddddddd)_2$ from character generator RAM or display data RAM.

To read data correctly, do the following:

1). The address of the Character Generator RAM or Display Data RAM or shift the cursor instruction.

2). The " Read " instruction.

8.3. Instruction Table

Instruction	Instruction Code										Description	Execution time (fosc=270KHz)
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM and set DDRAM address to "00H" from AC	1.52ms
Return Home	0	0	0	0	0	0	0	0	1	-	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.52ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Assign cursor moving direction and enable the shift of entire display	38μs
Display ON/ OFF Control	0	0	0	0	0	0	1	D	C	B	Set display(D), cursor(C), and blinking of cursor(B) on/off control bit.	38μs
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	-	-	Set cursor moving and display shift control bit, and the direction, without changing of DDRAM data.	38μs
Function Set	0	0	0	0	1	DL	N	F	-	-	Set interface data length (DL: 8-bit/4-bit), numbers of display line (N: 2-line/1-line) and, display font type (F:5x10 dots/5x8 dots)	38μs
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	38μs
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in counter	38μs
Read Busy Flag and Address Counter	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	38μs
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	38μs

Note: "-": don't care

8.4. 8-Bit Operation and 8-Digit 1-Line Display (Using Internal Reset)

No.	Instruction	Display	Operation
1	Power on. (SPLC780C starts initializing)		Power on reset. No display.
2	Function set RS R/W DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0 0 0 0 0 1 1 0 0 X X		Set to 8-bit operation and select 1-line display line and character font.
3	Display on / off control 0 0 0 0 0 0 1 1 1 0	_	Display on. Cursor appear.
4	Entry mode set 0 0 0 0 0 0 0 1 1 0	_	Increase address by one. It will shift the cursor to the right when writing to the DD RAM/CG RAM. Now the display has no shift.
5	Write data to CG RAM / DD RAM 1 0 0 1 0 1 0 1 1 1	W_	Write " W ". The cursor is incremented by one and shifted to the right.
6	Write data to CG RAM / DD RAM 1 0 0 1 0 0 0 1 0 1	WE_	Write " E ". The cursor is incremented by one and shifted to the right.
7	:	:	
8	Write data to CG RAM / DD RAM 1 0 0 1 0 0 0 1 0 1	WELCOME_	Write " E ". The cursor is incremented by one and shifted to the right.
9	Entry mode set 0 0 0 0 0 0 0 1 1 1	WELCOME_	Set mode for display shift when writing
10	Write data to CG RAM / DD RAM 1 0 0 0 1 0 0 0 0 0	ELCOME _	Write " "(space). The cursor is incremented by one and shifted to the right.
11	Write data to CG RAM / DD RAM 1 0 0 1 0 0 0 0 1 1	LCOME C_	Write " C ". The cursor is incremented by one and shifted to the right.
12	:	:	
13	Write data to CG RAM / DD RAM 1 0 0 1 0 1 1 0 0 1	COMPAMY_	Write " Y ". The cursor is incremented by one and shifted to the right.
14	Cursor or display shift 0 0 0 0 0 1 0 0 X X	COMPAMY_	Only shift the cursor's position to the left (Y).
15	Cursor or display shift 0 0 0 0 0 1 0 0 X X	COMPAMY_	Only shift the cursor's position to the left (M).
16	Write data to CG RAM / DD RAM 1 0 0 1 0 0 1 1 1 0	OMPANY_	Write " N ". The display moves to the left.
17	Cursor or display shift 0 0 0 0 0 1 1 1 X X	COMPAMY_	Shift the display and the cursor's position to the right.
18	Cursor or display shift 0 0 0 0 0 1 0 1 X X	OMPANY_	Shift the display and the cursor's position to the right.
19	Write data to CG RAM / DD RAM 1 0 0 1 0 0 0 0 0 0	COMPAMY_	Write " " (space). The cursor is incremented by one and shifted to the right.
20	:	:	:
21	Return home 0 0 0 0 0 0 0 0 1 0	WELCOME_	Both the display and the cursor return to the original position (address 0).

8.5. 4-Bit Operation and 8-Digit 1-Line Display (Using Internal Reset)

No.	Instruction	Display	Operation
1	Power on. (SPLC780C starts initializing)		Power on reset. No display.
2	Function set RS R/W DB7 DB6 DB5 DB4 0 0 0 0 1 0		Set to 4-bit operation.
3	0 0 0 0 1 0 0 0 0 0 X X		Set to 4-bit operation and select 1-line display line and character font.
4	0 0 0 0 0 0 0 0 1 1 1 0	_	Display on. Cursor appears.
5	0 0 0 0 0 0 0 0 0 1 1 0	_	Increase address by one. It will shift the cursor to the right when writing to the DD RAM / CG RAM. Now the display has no shift.
6	1 0 0 1 0 1 1 0 0 1 1 1	W_	Write " W ". The cursor is incremented by one and shifted to the right.

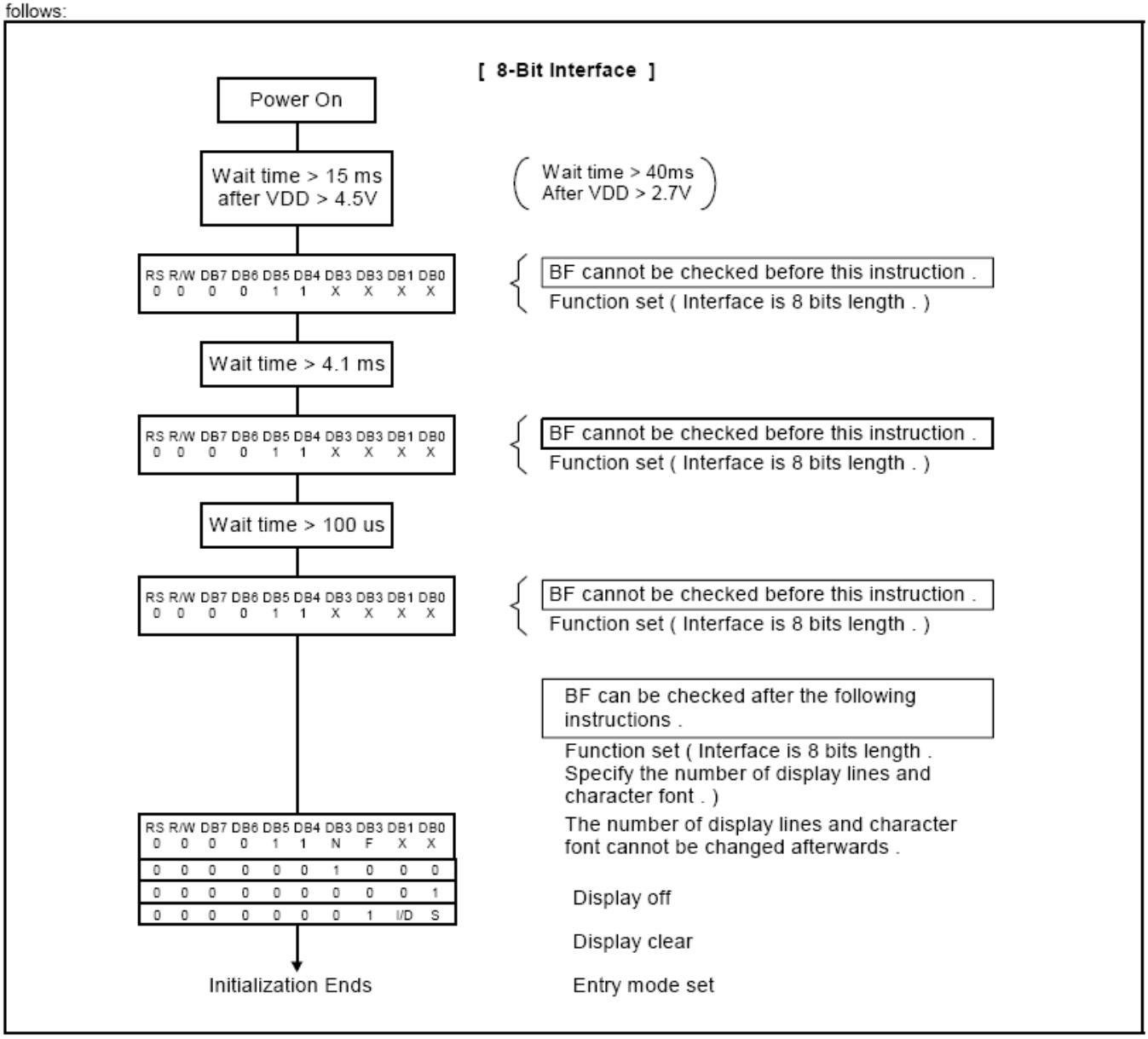
8.6. 8-Bit Operation and 8-Digit 2-Line Display (Using Internal Reset)

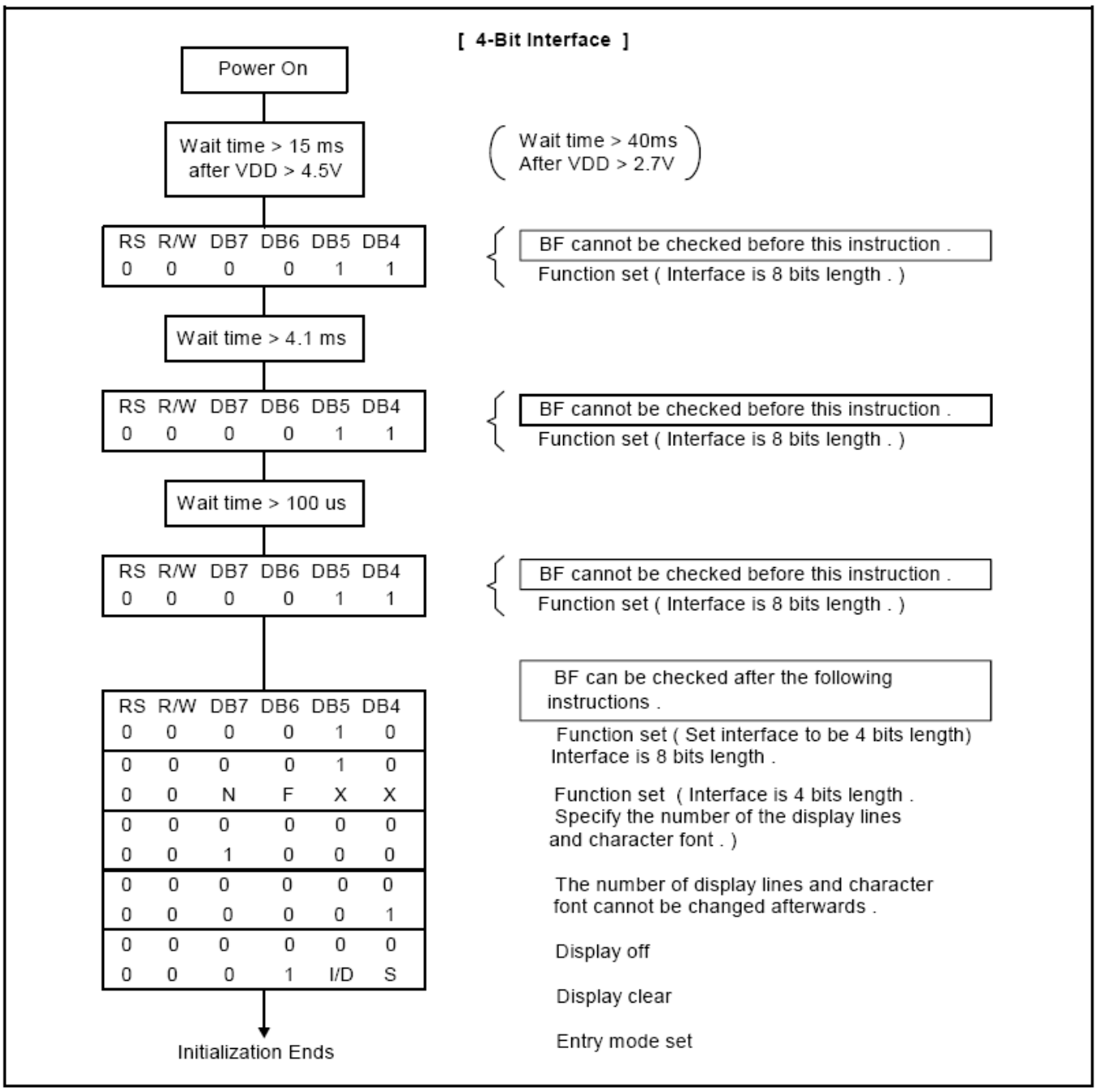
No.	Instruction	Display	Operation
1	Power on. (SPLC780C starts initializing)		Power on reset. No display.
2	Function set RS R/W DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0 0 0 0 0 1 1 1 0 X X		Set to 8-bit operation and select 2-line display line and 5 x 8 dot character font.
3	Display on / off control 0 0 0 0 0 0 1 1 1 0	_	Display on. Cursor appear.
4	Entry mode set 0 0 0 0 0 0 0 1 1 0	_	Increase address by one. It will shift the cursor to the right when writing to the DD RAM / CG RAM. Now the display has no shift.
5	Write data to CG RAM / DD RAM 1 0 0 1 0 1 0 1 1 1	W_	Write " W ". The cursor is incremented by one and shifted to the right.
6	:	:	:
7	Write data to CG RAM / DD RAM 1 0 0 1 0 0 0 1 0 1	WELCOME_	Write " E ". The cursor is incremented by one and shifted to the right.
8	Set DD RAM address 0 0 1 1 0 0 0 0 0 0	WELCOME _	It sets DD RAM's address. The cursor is moved to the beginning position of the 2nd line.
9	Write data to CG RAM / DD RAM 1 0 0 1 0 1 0 1 0 0	WELCOME T_	Write " T ". The cursor is incremented by one and shifted to the right.
10	:	:	:
11	Write data to CG RAM / DD RAM 1 0 0 1 0 1 0 1 0 0	WELCOME TO PART_	Write " T ". The cursor is incremented by one and shifted to the right.

No.	Instruction	Display	Operation
12	Entry mode set 0 0 0 0 0 0 0 1 1 1	WELCOME TO PART_	When writing, it sets mode for the display shift.
13	Write data to CG RAM / DD RAM 1 0 0 1 0 1 1 0 0 1	ELCOME O PARTY_	Write " Y ". The cursor is incremented by one and shifted to the right.
14	:	:	:
15	Return home 0 0 0 0 0 0 0 0 1 0	WELCOME TO PARTY	Both the display and the cursor return to the original position (address 0).

8.7. Reset Function

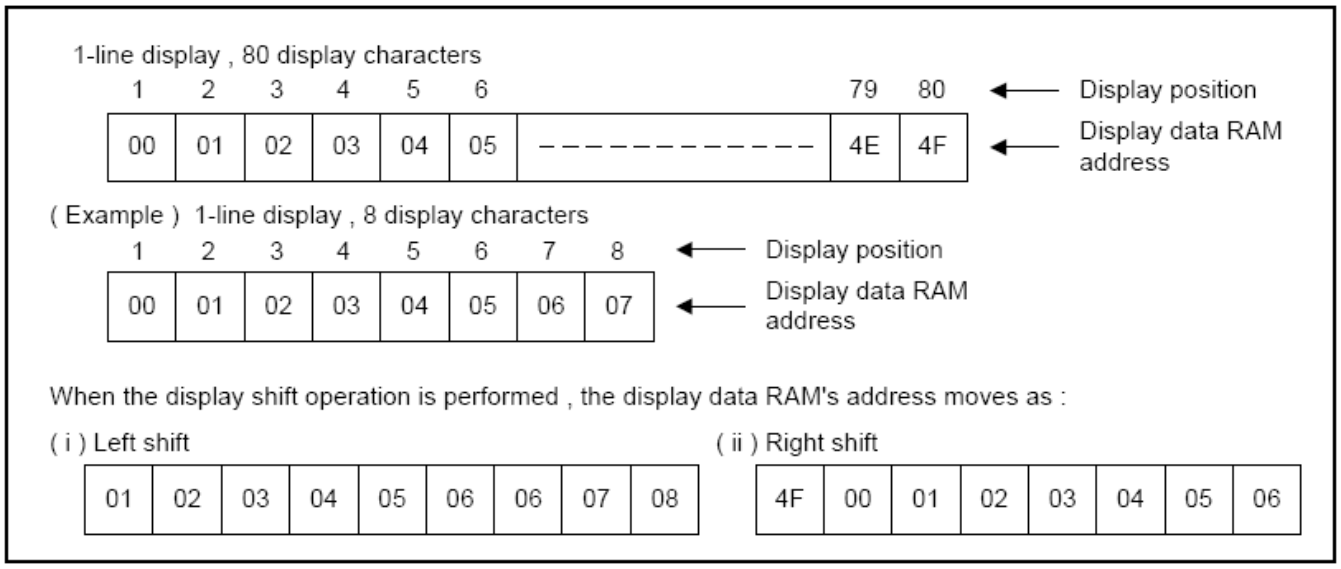
At power on, SPLC780C starts the internal auto-reset circuit and executes the initial instructions. The initial procedures are shown as follows:




[4-Bit Interface]
Power On
Wait time > 15 ms
after VDD > 4.5V
(Wait time > 40ms
After VDD > 2.7V)
RS R/W DB7 DB6 DB5 DB4
0 0 0 0 1 1
BF cannot be checked before this instruction .
Function set (Interface is 8 bits length .)
Wait time > 4.1 ms
RS R/W DB7 DB6 DB5 DB4
0 0 0 0 1 1
BF cannot be checked before this instruction .
Function set (Interface is 8 bits length .)
Wait time > 100 us
RS R/W DB7 DB6 DB5 DB4
0 0 0 0 1 1
BF cannot be checked before this instruction .
Function set (Interface is 8 bits length .)
BF can be checked after the following instructions .
RS R/W DB7 DB6 DB5 DB4
0 0 0 0 1 0
Function set (Set interface to be 4 bits length)
Interface is 8 bits length .
0 0 0 0 1 0
0 0 N F X X
Function set (Interface is 4 bits length .
Specify the number of the display lines
and character font .)
0 0 0 0 0 0
0 0 1 0 0 0
The number of display lines and character
font cannot be changed afterwards .
0 0 0 0 0 0
0 0 0 0 0 1
Display off
0 0 0 0 0 0
0 0 0 1 I/D S
Display clear
Entry mode set
Initialization Ends

8.8. Display Data RAM (DD RAM)

The 80-bit DD RAM is normally used for storing display data. Those DD RAM not used for display data can be used as general data RAM. Its address is configured in the Address Counter. The relationships between Display Data RAM Address and LCD's position are depicted as follows.



8.9. Timing Generation Circuit

The timing generating circuit is able to generate timing signals to the internal circuits. In order to prevent the internal timing interface, the MPU access timing and the RAM access timing are generated independently.

8.10. LCD Driver Circuit

Total of 16 commons and 40 segments signal drivers are valid in the LCD driver circuit. When a program specifies the character fonts and line numbers, the corresponding common signals output drive-waveforms and the others still output unselected waveforms.

8.11. Character Generator ROM (CG ROM)

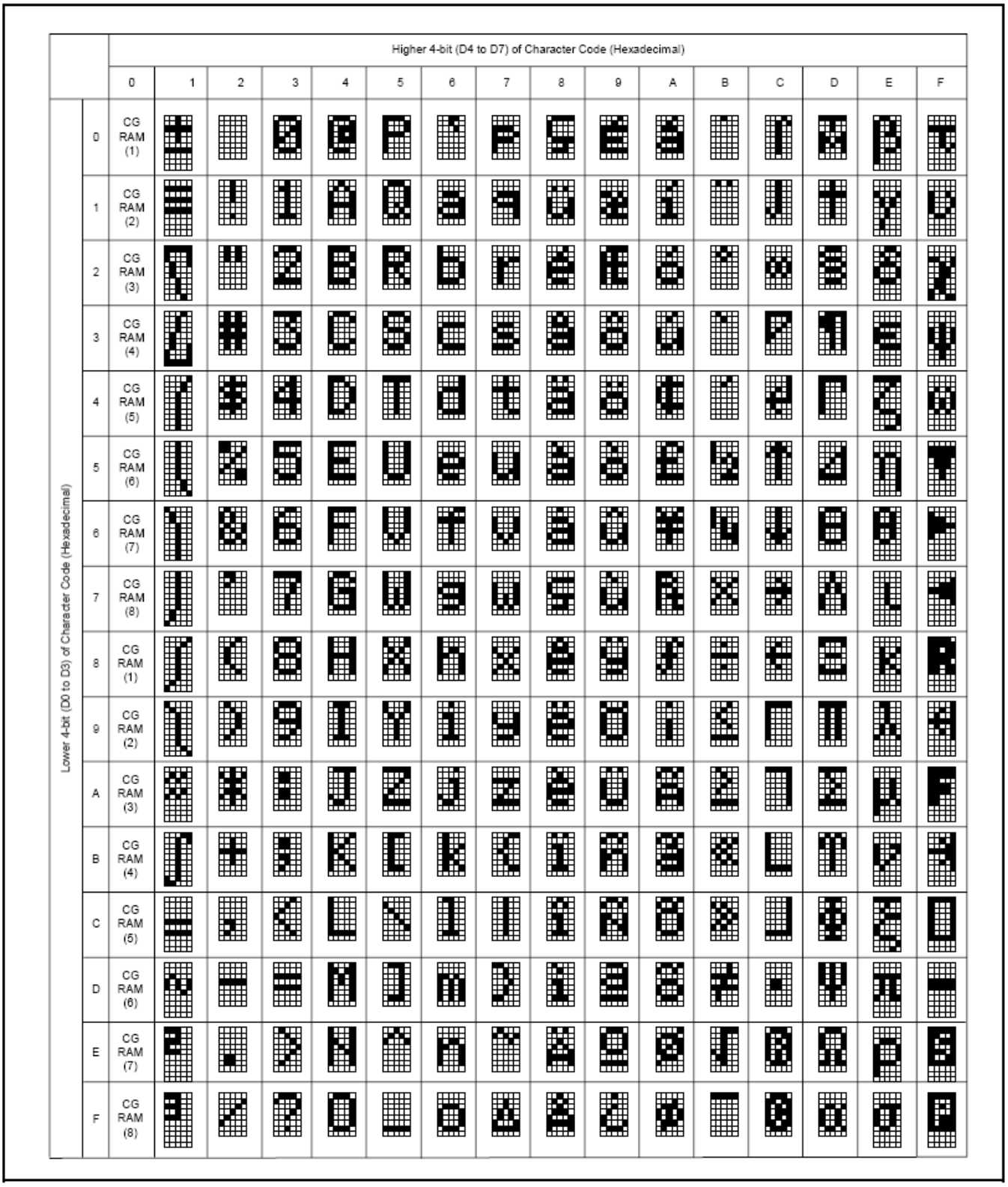
Using 8-bit character code, the character generator ROM generates 5 x 8 dots or 5 x 10 dots character patterns. It also can generate 192's 5 x 8 dots character patterns and 64's 5 x 10 dots character patterns.

8.12. Character Generator RAM (CG RAM)

Users can easily change the character patterns in the character generator RAM through program. It can be written to 5 x 8 dots, 8-character patterns or 5 x 10 dots for 4-character patterns.

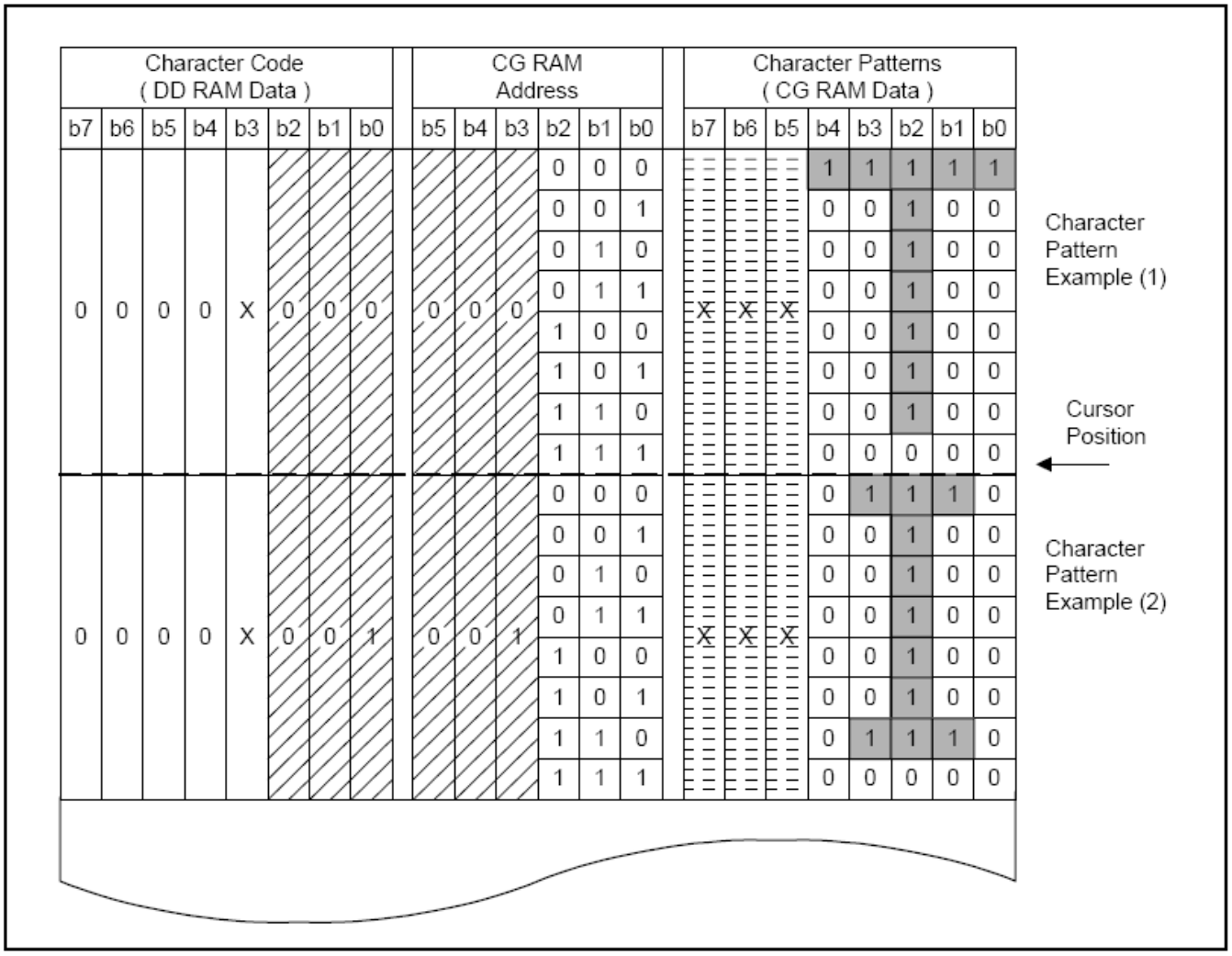
The following diagram shows the SPLC780C character patterns:

Correspondence between Character Codes and Character Patterns.



The relationships between Character Generator RAM Addresses, Character Generator RAM Data (character patterns), and Character Codes are depicted as follows:

8.12.1. 5 x 8 dot character patterns



Note1: ▨ It means that the bit0~2 of the character code correspond to the bit3~5 of the CG RAM address.

Note2: ▤ These areas are not used for display, but can be used for the general data RAM.

Note3: When all of the bit4-7 of the character code are 0, CG RAM character patterns are selected.

Note4: " 1 ": Selected, " 0 " : No selected , " X " : Do not care (0 or 1).

Note5: For example (1), set character code (b2 = b1 = b0 = 0, b3 = 0 or 1, b7-b4 = 0) to display " T ". That means character code (00) 16,and (08) 16 can display " T " character.

Note6: The bits 0-2 of the character code RAM is the character pattern line position. The 8th line is the cursor position and display is formed by logical OR with the cursor.

9. CHARACTER GENERATION ROM

10. INTERFACE PIN CONNECTIONS

(SPLC780 Controller)

PIN	SYMBOL	I/O	FUNCTION
1	VSS	-	Ground pin, connected to 0V
2	VDD	-	Power supply pin for logic .(+5V)
3	V0	-	Contrast control (VDD~VSS)
4	RS	I	A signal for selecting registers: 1: Data register (for read and write) 0: Instruction register (for write) Busy flag – Address Counter (for read).
5	R/W	I	A signal for selecting read and write actions: 1: Read 0: Write
6	E	I	A signal for selecting reading and writing data: 1: Start 0: Stop
7	D0	I	Tristate input/output pins. Connect these pins to an 8-bit microprocessor bus.
	D1	I	Tristate input/output pins. Connect these pins to an 8-bit microprocessor bus.
9	D2	I/O	Tristate input/output pins. Connect these pins to an 8-bit microprocessor bus.
10	D3	I/O	Tristate input/output pins. Connect these pins to an 8-bit microprocessor bus.
11	D4	I/O	Tristate input/output pins. Connect these pins to an 4-bit/8-bit microprocessor bus.
12	D5	I/O	Tristate input/output pins. Connect these pins to an 4-bit/8-bit microprocessor bus.
13	D6	I/O	Tristate input/output pins. Connect these pins to an 4-bit/8-bit microprocessor bus.
14	D7	I/O	Tristate input/output pins. Connect these pins to an 4-bit/8-bit microprocessor bus.
15	A	-	LED anode (+5V)
16	K	-	LED cathode (0V)

11. RELIABILITY

Content of Reliability Test

		Environmental Test		
No.	**Test Item**	**Content of Test**	**Test Condition**	**Applicable Standard**
1	High temperature storage	Endurance test applying the high storage temperature for a long time.	80 ℃ 200 hrs	
2	Low temperature storage	Endurance test applying the low storage temperature for a long time.	-30 ℃ 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 ℃ 200 hrs	
4	Low temperature operation	Endurance test applying the electric stress under low temperature for a long time.	-20 ℃ 200 hrs	
5	High temperature Humidity storage	Endurance test applying the high temperature and high humidity storage for a long time.	80 ℃ , 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.	70 ℃ , 90 RH 96 hrs	MIL-202E-103B JIS-C5023
7	Temperature cycle	Endurance test applying the low and high temperature cycle. -20℃ +25℃ +70℃ 30min. ⇌ 5min. ⇌ 30min. 1 cycle	-20℃ ~ +70℃ 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 k CS=100 pF 1 time	MIL-883B-3015.1

*** Supply voltage for logic system = 3V. Supply voltage for LCD system = Operating voltage at 25℃.

Failure Judgment 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

12. QUALITY GUARANTEE

Acceptable Quality Level

Each lot should satisfy the quality level defined as follows.

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

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

Definition of 'LOT'

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

Conditions of Cosmetic Inspection

Environmental condition

The inspection should be performed at the 1cm of height from the LCD module under 2 pieces of 40W white fluorescent lamps (Normal temperature 20~25℃and normal humidity 60 ± 15%RH).

Inspection method

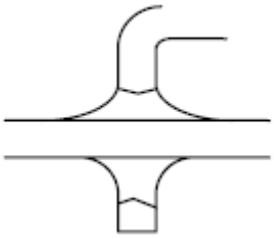
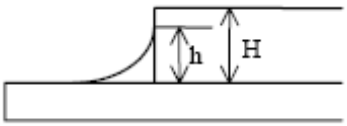
The visual check should be performed vertically at more than 30cm distance from the LCD panel.

Driving voltage

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

13. INSPECTION CRITERIA

13.1 Module Cosmetic Criteria

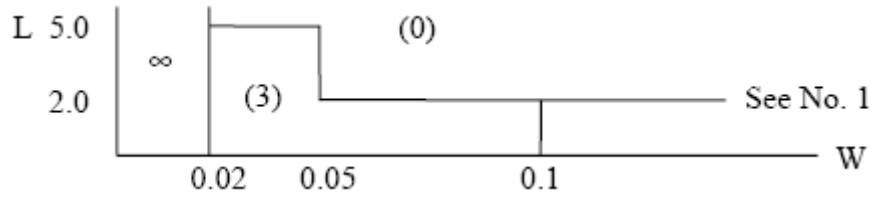
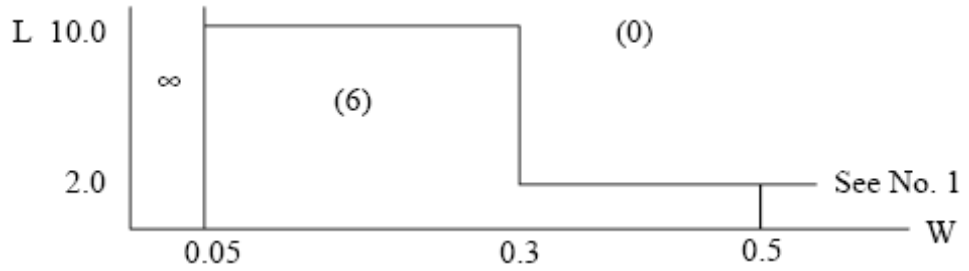
No.	Item	Judgment Criterion	Partition
1	Difference in Spec.	None allowed	Major
2	Pattern peeling	No substrate pattern peeling and floating	Major
3	Soldering defects	No soldering missing No soldering bridge No cold soldering	Major Major Major
4	Resist flaw on substrate	Invisible copper foil (′0.5mm or more) on substrate pattern	Minor
5	Accretion of metallic Foreign matter	No soldering dust No accretion of metallic foreign matters (Not exceed ′0.2mm)	Minor Minor
6	Stain	No stain to spoil cosmetic badly	Minor
7	Plate discoloring	No plate fading, rusting and discoloring	Minor
8	Solder amount 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. A B 	Minor
	3. Chips	(3/2) H ≥h ≥(1/2) H 	Minor

13.2 Screen Cosmetic Criteria (Non-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>In accordance with Screen Cosmetic Criteria (Operating) No.1.</td><td>Minor</td></tr>
<tr><td>2</td><td>Lines</td><td>In accordance with Screen Cosmetic Criteria (Operating) No.2.</td><td>Minor</td></tr>
<tr><td>3</td><td>Bubbles in polarizer</td><td><table><tr><th>Size : d mm</th><th>Acceptable Qty in active area</th></tr><tr><td>d ≤ 0.3</td><td>Disregard</td></tr><tr><td>0.3 < d ≤ 1.0</td><td>3</td></tr><tr><td>1.0 < d ≤ 1.5</td><td>1</td></tr><tr><td>1.5 < d</td><td>0</td></tr></table></td><td>Minor</td></tr>
<tr><td>4</td><td>Scratch</td><td>In accordance with spots and lines operating cosmetic criteria. When the light reflects on the panel surface, the scratches are not to be remarkable.</td><td>Minor</td></tr>
<tr><td>5</td><td>Allowable density</td><td>Above defects should be separated more than 30mm each other.</td><td>Minor</td></tr>
<tr><td>6</td><td>Coloration</td><td>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.</td><td>Minor</td></tr>
<tr><td>7</td><td>Contamination</td><td>Not to be noticeable.</td><td>Minor</td></tr>
</table>

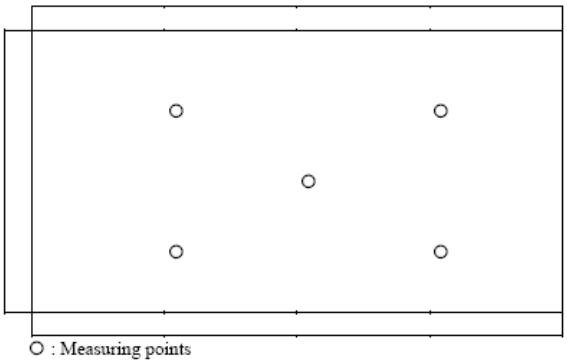
13.3. Screen Cosmetic Criteria (Operating)

<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 Note :<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>3</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>Including pin holes and defective dots which must be within one pixel size.
B) Unclear Size :<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>
</table>

2	Lines	A)Clear  Note : ( ) - Acceptable Qty in active area L -Length (mm) W - Width (mm) . - Disregard B) Unclear  	Minor

'Clear' = The shade and size are not changed by VO.
'Unclear' = The shade and size are changed by VO.

13.4. Screen Cosmetic Criteria (Operating) (Continued)

No.	Defect	Judgment Criterion	Partition
3	Rubbing line	Not to be noticeable.	
4	Allowable density	Above defects should be separated more than 10mm each other.	Minor
5	Rainbow	Not to be noticeable.	Minor
6	Dot size	To be 95̣ 105̣ of the dot size (Typ.) in drawing. Partial defects of each dot (ex. pin-hole) should be treated as 'Spot'. (see *Screen Cosmetic Criteria (Operating) No.1*)	Minor
7	Uneven brightness (only back-lit type module)	Uneven brightness must be BMAX̃ 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) Size : d = (long length+ short length)÷ 2

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

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

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

- 7 or over defects in circle of 5mm.
- 10 or over defects in circle of 10mm.
- 20 or over defects in circle of 20mm.

14. PRECAUTIONS FOR USING LCD MODULES

Handing Precautions

(1) The display panel is made of glass. Do not subject it to a mechanical shock by dropping it or impact.

(2) If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.

(3) Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

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

(5) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents :

- Isopropyl alcohol
- Ethyl alcohol

(6) Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.

- Water
- Ketone
- Aromatic solvents

(7) Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.

(8) Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.

(9) Do not attempt to disassemble or process the LCD module.

(10) NC terminal should be open. Do not connect anything.

(11) If the logic circuit power is off, do not apply the input signals.

(12) To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

- Be sure to ground the body when handling the LCD modules.

- Tools required for assembling, such as soldering irons, must be properly grounded.
- To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.
- The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

Storage Precautions

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

Others

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.

If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.

To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.
- Exposed area of the printed circuit board.
- Terminal electrode sections.

15. USING LCD MODULES

Liquid Crystal Display Modules

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

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

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

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

(4) When the display surface becomes dusty, wipe gently with absorbent cotton or other soft material like chamois soaked in petroleum 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 temp erature air.

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

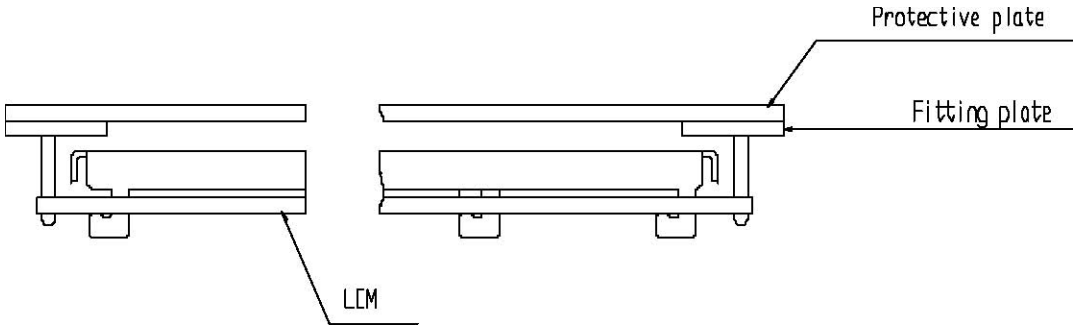
(9) Do not touch the display with bare hands. This will stain the display area and degradate insulation between terminals (some cosmetics are determinated to the polarizers).

(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 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 electoluminescent 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.

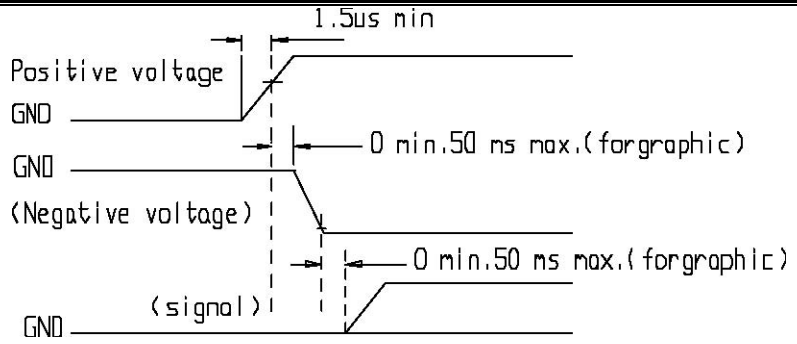
(2) Driving the LCD in the voltage above the limit shortens its life.

(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 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℃ and 35℃.

(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.)

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 leakes out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

Return LCM under warranty

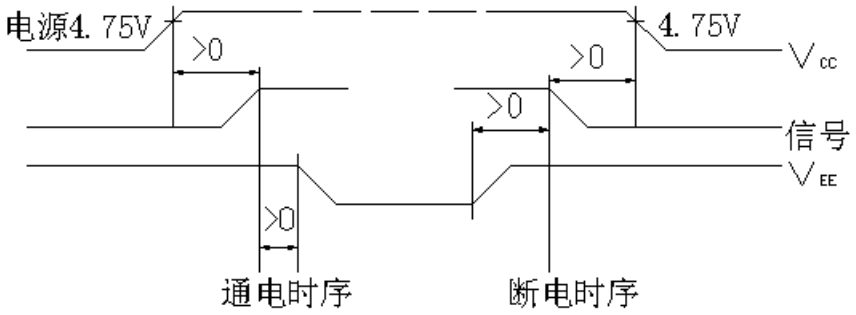
No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are :

- 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.

液晶显示模块使用注意事项

1. 请勿随意自行加工、整修、拆卸。
2. 避免对液晶屏表面施加压力。
3. 不要用手随意去摸外引线、电路板上的电路及金属框。
4. 如必须直接接触时，应使人体与模块保持同一电位，或将人体良好接地。
5. 焊接使用的烙铁、操作用的电动改锥等工具必须良好接地，没漏电。
6. 严防各种静电。
7. 模块使用接入电源及断开电源时，必须按图时序进行。即必须在正电源（ 5 ±0.25V）稳定接入后,才能输入信号电平。如在电源稳定接入前，或断开后就输入信号电平，将会损坏模块中的集成电路，使模块损坏。



8. 点阵模块在调节时，应调整 VEE 至最佳对比度、视角时为止。如果 VEE 调整过高,不仅会影响显示，还会缩短液晶的寿命。
9. 模块表面结雾时，不要通电工作，因为这将引起电极化学反应，产生断线。
10. 模块要存储在暗处（避阳光），温度在-10℃～+35℃，湿度在 RH60%以上的地方。如能装入聚乙烯口袋（最好有防静电涂层）并将口封住最好。

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