

TINSHARP

TC1602B-01 VER:00

Specification For Approval

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Description

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CONTENTS

1. SPECIFICATIONS

- 1.1 Features
- 1.2 Block Diagram
- 1.3 Mechanical Specifications
- 1.4 Absolute Maximum Ratings
- 1.5 DC Electrical Characteristics
- 1.6 AC Characteristics
- 1.7 Electro-Optical Characteristics
- 1.8 Backlight Characteristics

2. MODULE STRUCTURE

- 2.1 Interface Pin Description
- 2.2 Function Description
- 2.3 Rest Function
- 2.4 Display Data RAM

3. RELIABILITY

- 3.1 Reliability test condition:
- 3.2 Quality Guarantee
- 3.3 Inspection method
- 3.4 Inspection Standard for Solder
- 3.5 Screen Cosmetic Criteria (Appearance)
- 3.6 Precautions for using LCM Modules
- 3.7 Installing LCM Modules
- 3.8 Precaution for Handling LCM Modules
- 3.9 Electro-Static Discharge Control
- 3.10 Precaution for soldering to the LCM
- 3.11 Precautions for operation
- 3.12 Storage
- 3.13 Safety
- 3.14. Limited Warranty
- 3.15. Return LCM under warranty

4 . DATE CODE RULES

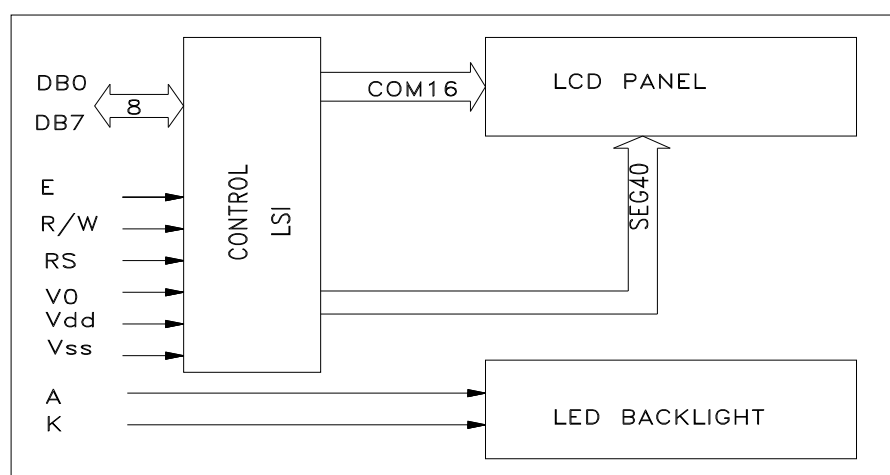
- 4.1 Date code for sample
- 4.2 Date code for production

1 . SPECIFICATIONS

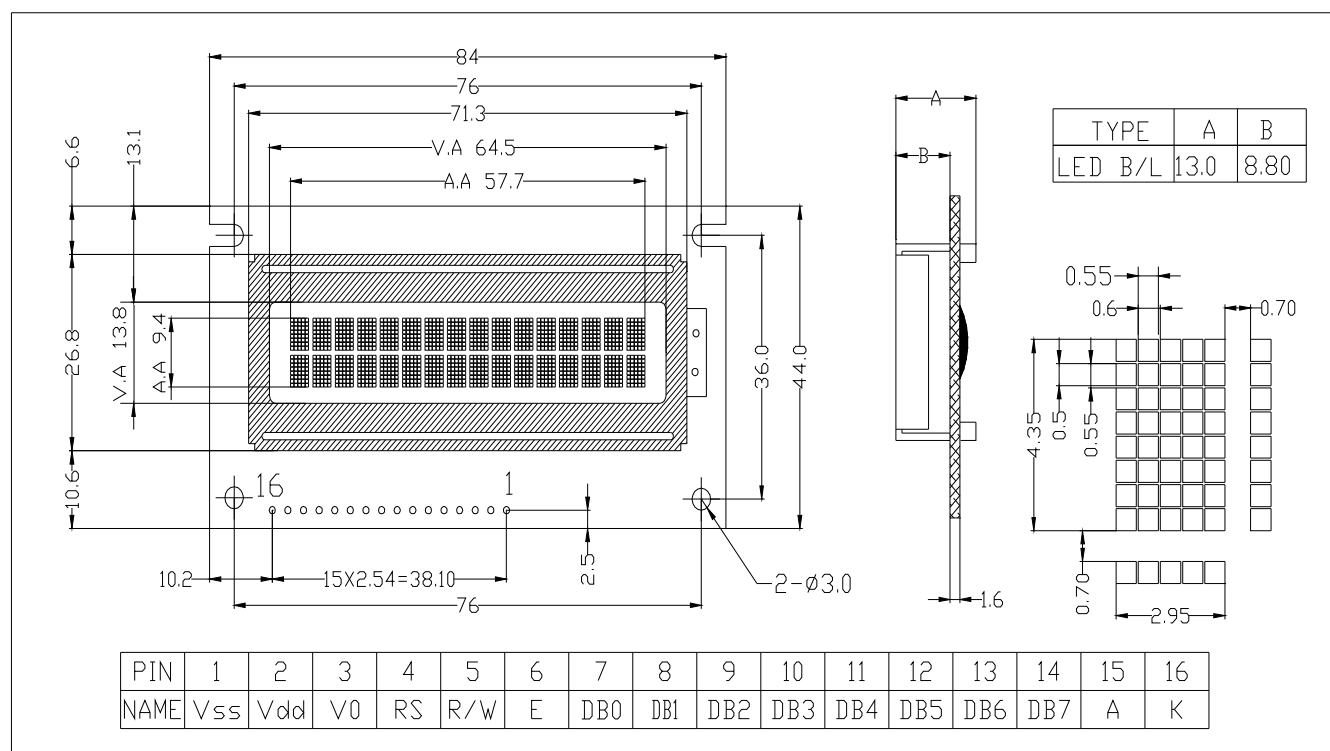
1.1 FEATURES

| Item | Contents | Unit |
|------------------------|------------------------|---------|
| LCD TYPE | STN/Transflective/Y-G | -- |
| LCD duty | 1/16 | -- |
| LCD bias | 1/5 | -- |
| Viewing direction | 6 | o'clock |
| Operating Temperature | 0°C--+55°C | |
| Storage Temperature | -10°C--+65°C | |
| Module size(W x H x T) | 122.0 X 33.0 X 13.6 | mm |
| Viewing area(W x H) | 99.0 X 13.0 | mm |
| Display Format | 16 Characters X 1 Line | dots |
| Character Size (W x H) | 4.84 X 9.66 | mm |
| Character pitch(W x H) | 6.0 X 9.66 | mm |

1.2. BLOCK DIAGRAM



1.3. MECHANICAL SPECIFICATION



1.4 ABSOLUTE MAXIMUM RATINGS (T_a = 25°C)

| Characteristics | Symbol | Ratings |
|-----------------------|------------------|-------------------------|
| Operating Voltage | VDD | -0.3V to +7.0V |
| Driver Supply Voltage | V _{LCD} | VDD - 12V to VDD + 0.3V |
| Input Voltage Range | V _{IN} | -0.3V to VDD + 0.3V |
| Operating Temperature | T _A | -30°C to +80°C |
| Storage Temperature | T _{STO} | -55°C to +125°C |

Note: Stresses beyond those given in the Absolute Maximum Rating table may cause operational errors or damage to the device. For normal operational conditions see AC/DC Electrical Characteristics.

1.5 DC CHARACTERISTICS(VDD = 3.5V to 5.0V, TA = 25°C)

| Characteristics | Symbol | Limit | | | Unit | Test Condition |
|----------------------------|------------------|---------|------|--------|------|---|
| | | Min. | Typ. | Max. | | |
| Operating Current | I _{DD} | - | 0.2 | 0.4 | mA | External clock (Note) |
| Input High Voltage | V _{IH1} | 0.7VDD | - | VDD | V | Pins:(E, RS, R/W, DB0 - DB7) |
| Input Low Voltage | V _{IL1} | -0.3 | - | 0.55 | V | |
| Input High Voltage | V _{IH2} | 0.7VDD | - | VDD | V | Pin OSC1 |
| Input Low Voltage | V _{IL2} | -0.2 | - | 0.2VDD | V | |
| Input High Current | I _{IH} | -1.0 | - | 1.0 | μA | Pins: (RS, R/W, DB0 - DB7) VDD = 3.0V |
| Input Low Current | I _{IL} | -5.0 | -15 | -30 | μA | |
| Output High Voltage (TTL) | V _{OH1} | 0.75VDD | - | - | V | I _{OH} = - 0.1mA Pins: DB0 - DB7 |
| Output Low Voltage (TTL) | V _{OL1} | - | - | 0.2VDD | V | I _{OL} = 0.1mA Pins: DB0 - DB7 |
| Output High Voltage (CMOS) | V _{OH2} | 0.8VDD | - | - | V | I _{OH} = - 40μA, Pins: CL1, CL2, M, D |
| Output Low Voltage (CMOS) | V _{OL2} | - | - | 0.2VDD | V | I _{OL} = 40μA, Pins: CL1, CL2, M, D |
| Driver ON Resistance (COM) | R _{COM} | - | - | 20 | KΩ | I _O = ±50μA, V _{LCD} = 4.0V Pins: COM1 - COM16 |
| Driver ON Resistance (SEG) | R _{SEG} | - | - | 30 | KΩ | I _O = ±50μA, V _{LCD} = 4.0V Pins: SEG1 - SEG40 |
| LCD Voltage | V _{LCD} | 3.0 | - | 9.0 | V | VDD-V5, 1/4 bias or 1/5 bias |

Note: FOSC = 250KHz, VDD = 3.0V, pin E = "L", RS, R/W, DB0 - DB7 are open, all outputs are no loads.

1.6 AC CHARACTERISTICS

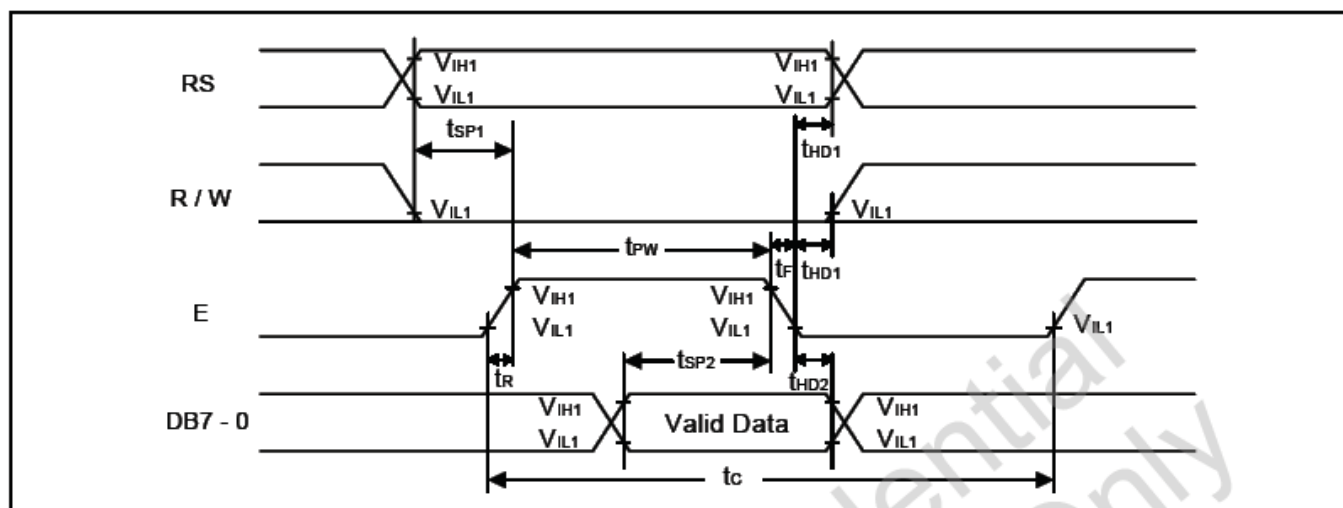
(1) Write Mode (Writing data from MPU to SPLC780D)

| 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 |

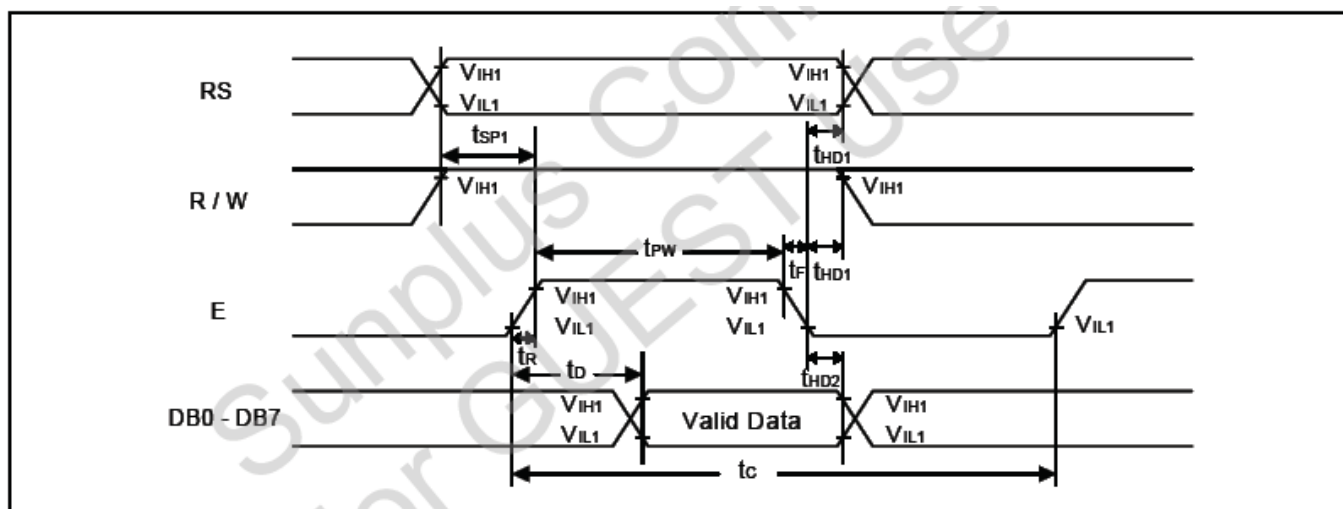
(2) Read Mode (Reading data from SPLC780D to MPU)

| 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 |

(3) Write Mode Timing Diagram (Writing data from MPU to SPLC780D)

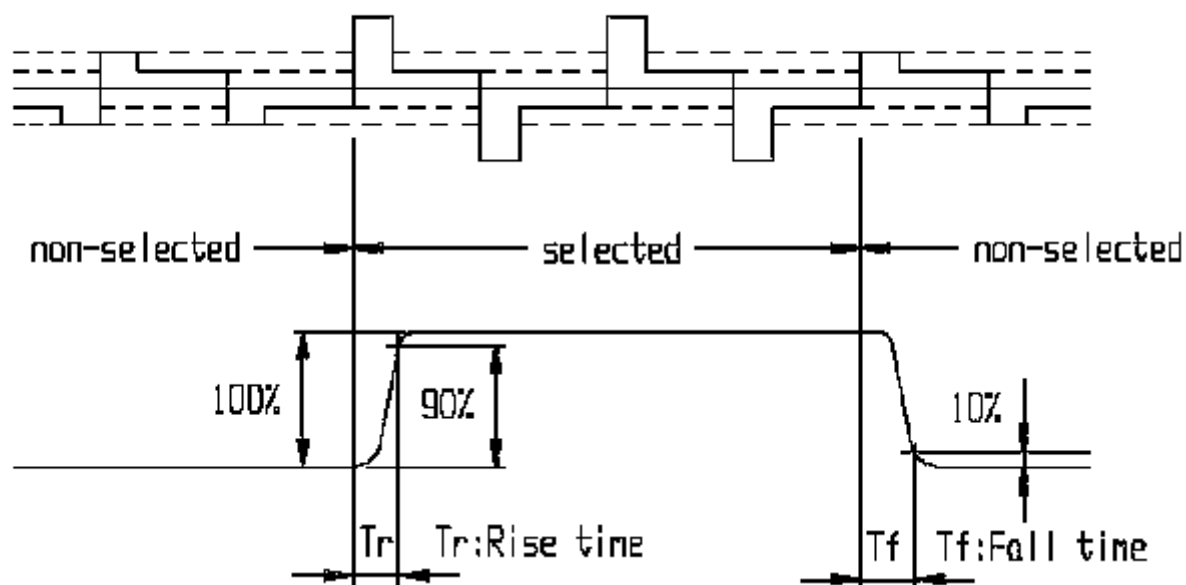


(4) Read Mode Timing Diagram (Reading data from SPLC780D to MPU)



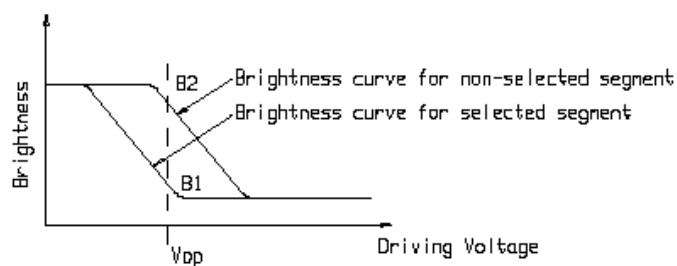
1.7 ELECTRO-OPTICAL CHARACTERISTICS

Note1: Definition of response time.

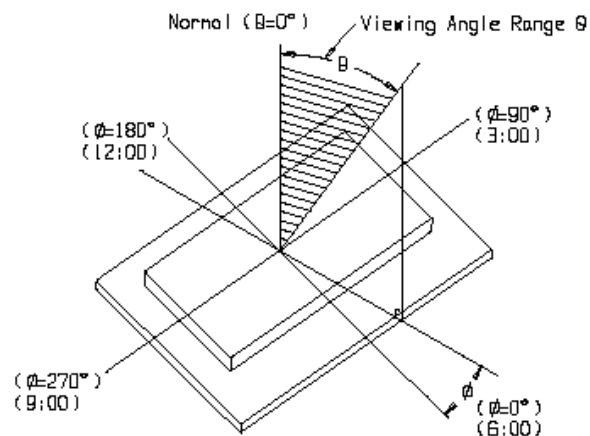


Note2: Definition of contrast ratio 'Cr'.

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



Note3: Definition of viewing angle range 'θ'.



1.8 BACKLIGHT CHARACTERISTICS

LCD Module with LED Backlight

ABSOLUTE MAXIMUM RATINGS($T_a=25^{\circ}\text{C}$)

| Item | Symbol | Conditions | Rating | Unit |
|----------------------------------|-----------|---|------------------------------|--------------------|
| Absolute maximum forward current | I_{fm} | | 150 | mA |
| Peak forward current | I_{fp} | I_{macc} 脉冲, 1/10 占空比 1 msec plus 10% Duty Cycle | 600 | mA |
| Reverse voltage | V_r | | 10 | V |
| Power dissipation | P_d | | 660 | mW |
| Operating Temperature Range | T_{OPr} | | $-30\sim+70^{\circ}\text{C}$ | $^{\circ}\text{C}$ |
| Storage Temperature Range | T_{stg} | | $-40\sim+80^{\circ}\text{C}$ | $^{\circ}\text{C}$ |

ELECTRICAL –OPTICAL CHARACTERISTICS($T_a=25^{\circ}\text{C}$)

| Item | Symbol | Min. | Typ. | Max. | Unit | Conditions |
|--------------------------|-----------------|------|------|------|-----------------|-----------------------|
| Forward Voltage | V_f | 4.0 | 4.2 | 4.4 | V | $I_f = 100\text{ mA}$ |
| Reverse Current | I_r | | | 100 | μA | $V_r = 10\text{ V}$ |
| Peak wave length | λ_p | | 570 | | nm | $I_f = 100\text{ mA}$ |
| Spectral line hair width | $\Delta\lambda$ | | 35 | | nm | $I_f = 100\text{ mA}$ |
| Luminance | L_v | | | | cd/m^2 | $I_f = 100\text{ mA}$ |

2. MODULE STRUCTURE

2.1 INTERFACE PIN DESCRIPTION

| Pin No. | Symbol | Level | Description |
|---------|--------|-------|---|
| 1 | VSS | 0V | Ground |
| 2 | VDD | 5.0V | Supply voltage for logic |
| 3 | V0 | -- | Input for adjusting the LCD contrast |
| 4 | RS | H/L | H : Data signal, L : Instruction signal |
| 5 | R/W | H/L | H : Read mode, L : Write mode |
| 6 | E | H/L | It is the clock latch signal input |
| 7 | DB0 | H/L | Data bit 0 |
| 8 | DB1 | H/L | Data bit 1 |
| 9 | DB2 | H/L | Data bit 2 |
| 10 | DB3 | H/L | Data bit 3 |
| 11 | DB4 | H/L | Data bit 4 |
| 12 | DB5 | H/L | Data bit 5 |
| 13 | DB6 | H/L | Data bit 6 |
| 14 | DB7 | H/L | Data bit 7 |
| 15 | A | +5V | LED Back light anode |
| 16 | K | 0V | LED Back light cathode |

2.2 FUNCTION DESCRIPTION

Oscillator

SPLC780D oscillator supports not only the internal oscillator operation, but also the external clock operation.

Control and Display Instructions

Control and display instructions are described in details as follows:

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.

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.

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 |

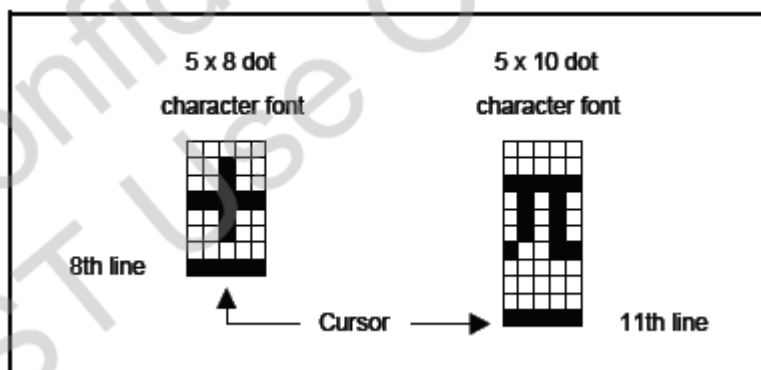
4. Display On/Off Control

| | 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

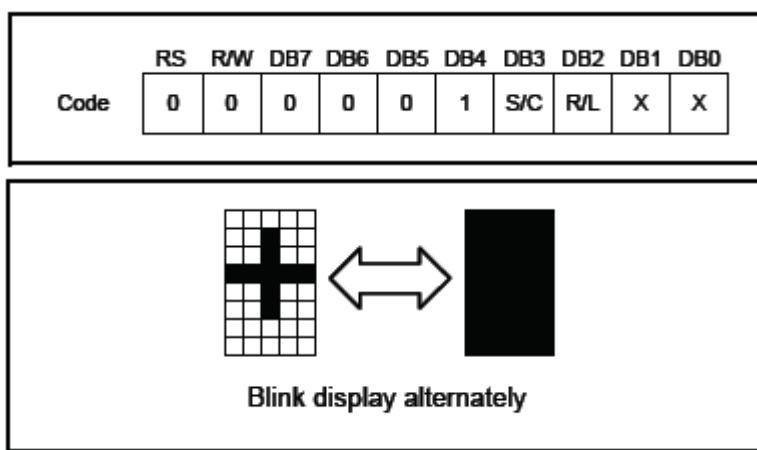
C = 1: Cursor on, C = 0: Cursor off

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



5. Cursor or Display Shift

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

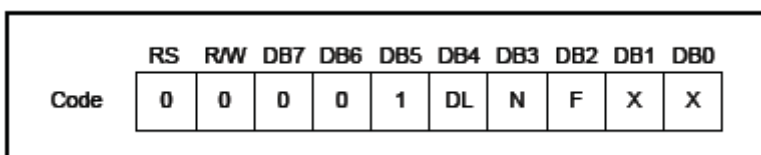


I / D = 1: Increment, I / D = 0: Decrement.

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

| 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 |

6. Function Set



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.

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. 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 (aaaaaa)2 to the Address Counter. Display data RAM can be read or written after this setting. In one-line display (N = 0), (aaaaaa)2: (00)16 - (4F)16. In two-line display (N = 1), (aaaaaa)2: (00)16 - (27)16 for the first line, (aaaaaa)2: (40)16 - (67)16 for the second line.

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 (aaaaaa)2 is read.

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 (ddddddd)2 to character generator RAM or display data RAM.

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 (ddddddd)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-Bit operation and 8-digit 1-line display (using internal reset)

| No. | Instruction | Display | Operation |
|-----|---|----------|---|
| 1 | Power on. (SPLC780D 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). |

4-Bit operation and 8-digit 1-line display (using internal reset)

| No. | Instruction | Display | Operation |
|-----|--|---------------|---|
| 1 | Power on. (SPLC780D starts initializing) | <div></div> | Power on reset. No display. |
| 2 | Function set RS R/W DB7 DB6 DB5 DB4 <div><div>000010</div></div> | <div></div> | Set to 4-bit operation. |
| 3 | <div><div>000010</div><div>0000XX</div></div> | <div></div> | Set to 4-bit operation and select 1-line display line and character font. |
| 4 | <div><div>000000</div><div>001110</div></div> | <div>-</div> | Display on. Cursor appears. |
| 5 | <div><div>000000</div><div>000110</div></div> | <div>-</div> | 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 | <div><div>100101</div><div>100111</div></div> | <div>w-</div> | Write " W ". The cursor is incremented by one and shifted to the right. |

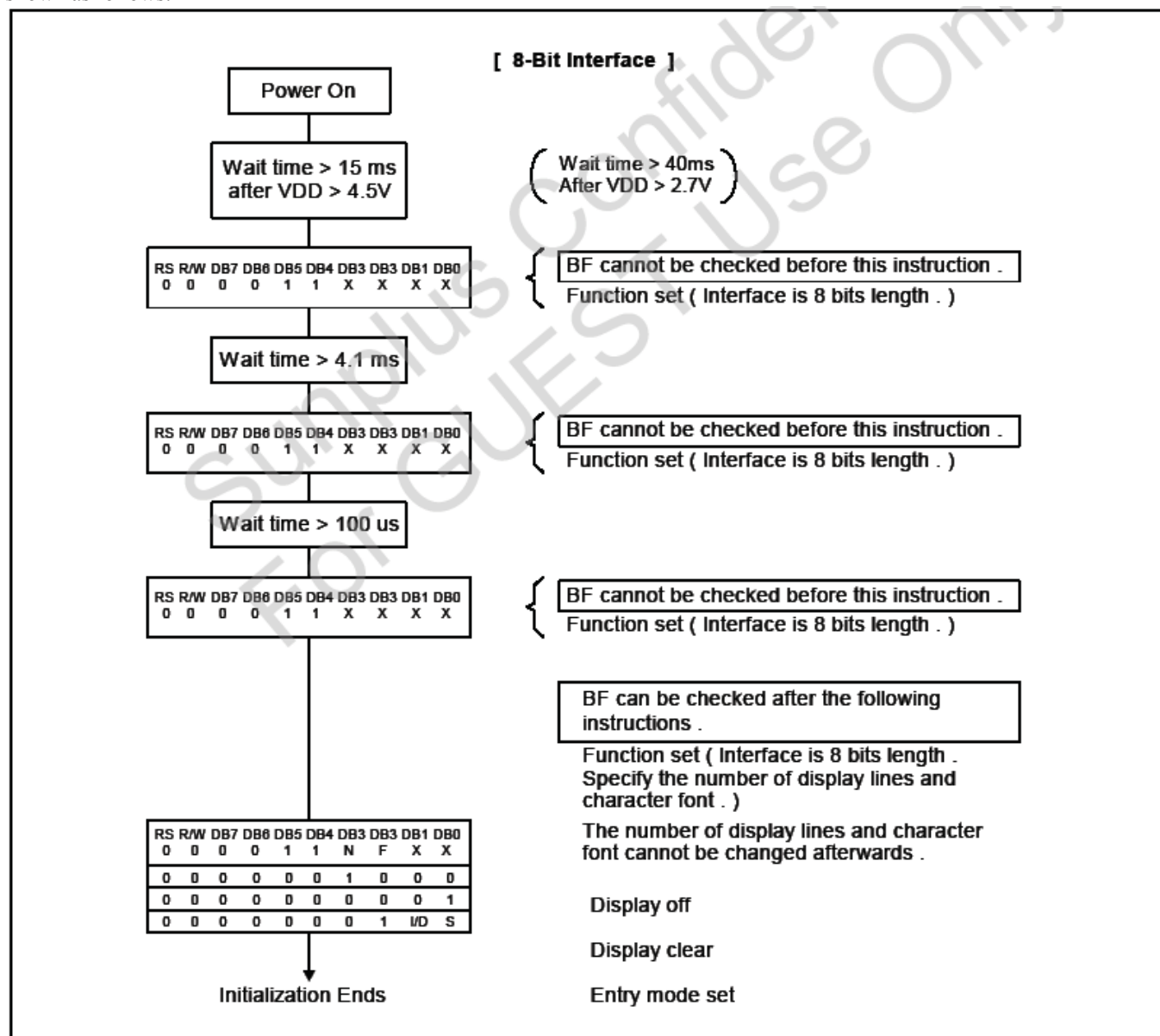
8-Bit Operation and 8-Digit 2-Line Display (Using Internal Reset)

| No. | Instruction | Display | Operation |
|-----|---|---------------------------------------|---|
| 1 | Power on. (SPLC780D starts initializing) | <div></div> | Power on reset. No display. |
| 2 | Function set RS R/W DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0 <div><div>0</div><div>0</div><div>0</div><div>0</div><div>1</div><div>1</div><div>1</div><div>0</div><div>X</div><div>X</div></div> | <div></div> | Set to 8-bit operation and select 2-line display line and 5 x 8 dot character font. |
| 3 | Display on / off control <div><div>0</div><div>0</div><div>0</div><div>0</div><div>0</div><div>0</div><div>1</div><div>1</div><div>1</div><div>0</div></div> | <div></div> | Display on. Cursor appear. |
| 4 | Entry mode set <div><div>0</div><div>0</div><div>0</div><div>0</div><div>0</div><div>0</div><div>1</div><div>1</div><div>0</div></div> | <div></div> | 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 <div><div>1</div><div>0</div><div>0</div><div>1</div><div>0</div><div>1</div><div>0</div><div>1</div><div>1</div><div>1</div></div> | <div>W</div> | Write " W ". The cursor is incremented by one and shifted to the right. |
| 6 | : | : | : |
| 7 | Write data to CG RAM / DD RAM <div><div>1</div><div>0</div><div>0</div><div>1</div><div>0</div><div>0</div><div>0</div><div>1</div><div>0</div><div>1</div></div> | <div>WELCOME</div> | Write " E ". The cursor is incremented by one and shifted to the right. |
| 8 | Set DD RAM address <div><div>0</div><div>0</div><div>1</div><div>1</div><div>0</div><div>0</div><div>0</div><div>0</div><div>0</div><div>0</div></div> | <div>WELCOME</div> | 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 <div><div>1</div><div>0</div><div>0</div><div>1</div><div>0</div><div>1</div><div>0</div><div>1</div><div>0</div><div>0</div></div> | <div>WELCOME</div> <div>T</div> | Write " T ". The cursor is incremented by one and shifted to the right. |
| 10 | : | : | : |
| 11 | Write data to CG RAM / DD RAM <div><div>1</div><div>0</div><div>0</div><div>1</div><div>0</div><div>1</div><div>0</div><div>1</div><div>0</div><div>0</div></div> | <div>WELCOME</div> <div>TO PART</div> | Write " T ". The cursor is incremented by one and shifted to the right. |

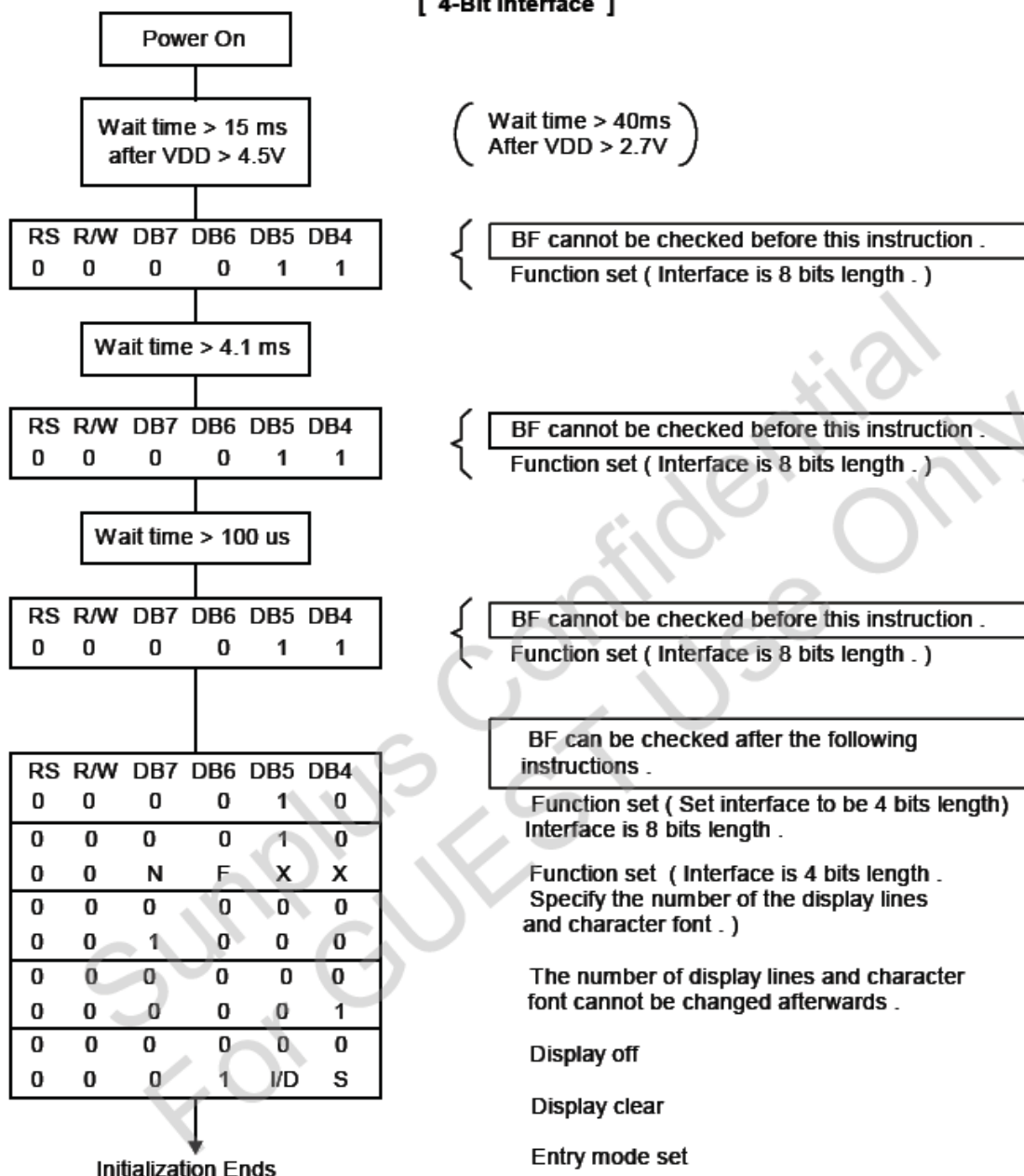
| No. | Instruction | Display | Operation |
|-----|--|---------------------|--|
| 12 | Entry mode set 0 0 0 0 0 0 0 1 1 1 | WELCOME TO PART_ | When writing, it sets mode for the display shift. |
| 13 | Write data to CG RAM / DD RAM 1 0 0 1 0 1 1 0 0 1 | ELCOME O PARTY_ | Write "Y". The cursor is incremented 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). |

2.3. RESET FUNCTION

At power on, SPLC780D starts the internal auto-reset circuit and executes the initial instructions. The initial procedures are shown as follows:

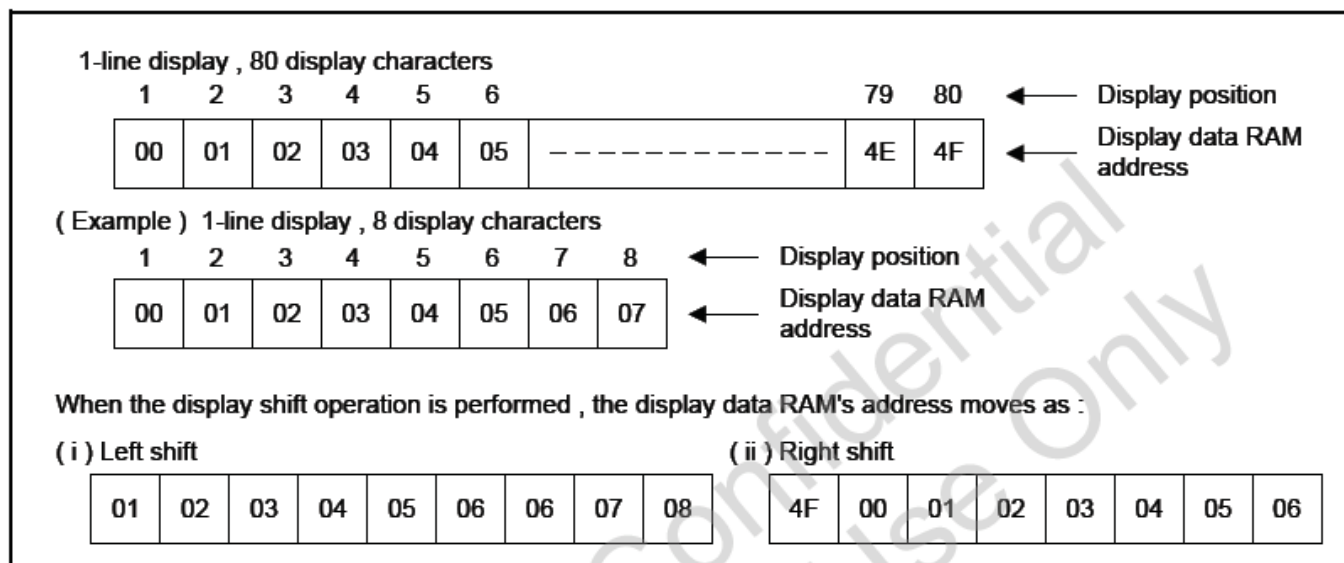


[4-Bit Interface]



2.4. 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.



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.

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. The relationships between Display Data RAM Address and LCD' s position are depicted as follows.

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.

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 SPLC780D character patterns:

Correspondence between Character Codes and Character Patterns.

| Upper 4 bit Lower 4 bit | LLLL | LLLH | LLHL | LLHH | LHLL | LHLH | LHHL | LHHH | HLLL | HLLH | HLHL | HLHH | HHLL | HHLH | HHHL | HHHH |
|----------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| LLLL | | | | | | | | | | | | | | | | |
| LLLH | | | | | | | | | | | | | | | | |
| LLHL | | | | | | | | | | | | | | | | |
| LLHH | | | | | | | | | | | | | | | | |
| LHLL | | | | | | | | | | | | | | | | |
| LHLH | | | | | | | | | | | | | | | | |
| LHHL | | | | | | | | | | | | | | | | |
| LHHH | | | | | | | | | | | | | | | | |
| HLLL | | | | | | | | | | | | | | | | |
| HLLH | | | | | | | | | | | | | | | | |
| HLHL | | | | | | | | | | | | | | | | |
| HLHH | | | | | | | | | | | | | | | | |
| HHLL | | | | | | | | | | | | | | | | |
| HHLH | | | | | | | | | | | | | | | | |
| HHHL | | | | | | | | | | | | | | | | |
| HHHH | | | | | | | | | | | | | | | | |

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

5 x 8 dot character patterns

| Character Code (DD RAM Data) | | | | | | | | CG RAM Address | | | | | | Character Patterns (CG RAM Data) | | | | | | | | | |
|-----------------------------------|----|----|----|----|----|----|----|-------------------|----|----|----|----|----|---------------------------------------|----|----|----|----|----|----|----|--|--|
| b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | b5 | b4 | b3 | b2 | b1 | b0 | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | | |
| 0 | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 1 | 1 | 1 | 1 | 1 | | |
| | | | | | | | | | | | | | | | | | 0 | 0 | 1 | 0 | 0 | | |
| | | | | | | | | | | | | | | | | | 0 | 0 | 1 | 0 | 0 | | |
| | | | | | | | | | | | | | | | | | 0 | 0 | 1 | 0 | 0 | | |
| | | | | | | | | | | | | | | | | | 0 | 0 | 1 | 0 | 0 | | |
| | | | | | | | | | | | | | | | | | 0 | 0 | 1 | 0 | 0 | | |
| | | | | | | | | | | | | | | | | | 0 | 0 | 1 | 0 | 0 | | |
| | | | | | | | | | | | | | | | | | 0 | 0 | 1 | 0 | 0 | | |
| 0 | 0 | 0 | 0 | X | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | X | X | X | 0 | 1 | 1 | 1 | 0 | | | |
| | | | | | | | | | | | | | | | | 0 | 0 | 1 | 0 | 0 | | | |
| | | | | | | | | | | | | | | | | 0 | 0 | 1 | 0 | 0 | | | |
| | | | | | | | | | | | | | | | | 0 | 0 | 1 | 0 | 0 | | | |
| | | | | | | | | | | | | | | | | 0 | 0 | 1 | 0 | 0 | | | |
| | | | | | | | | | | | | | | | | 0 | 0 | 1 | 0 | 0 | | | |
| | | | | | | | | | | | | | | | | 0 | 0 | 1 | 0 | 0 | | | |
| | | | | | | | | | | | | | | | | 0 | 0 | 1 | 0 | 0 | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |

Character Pattern Example (1)


Cursor Position

Character Pattern Example (2)

Character
Pattern
Example (1)

Cursor
Position
←

Character
Pattern
Example (2)

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.

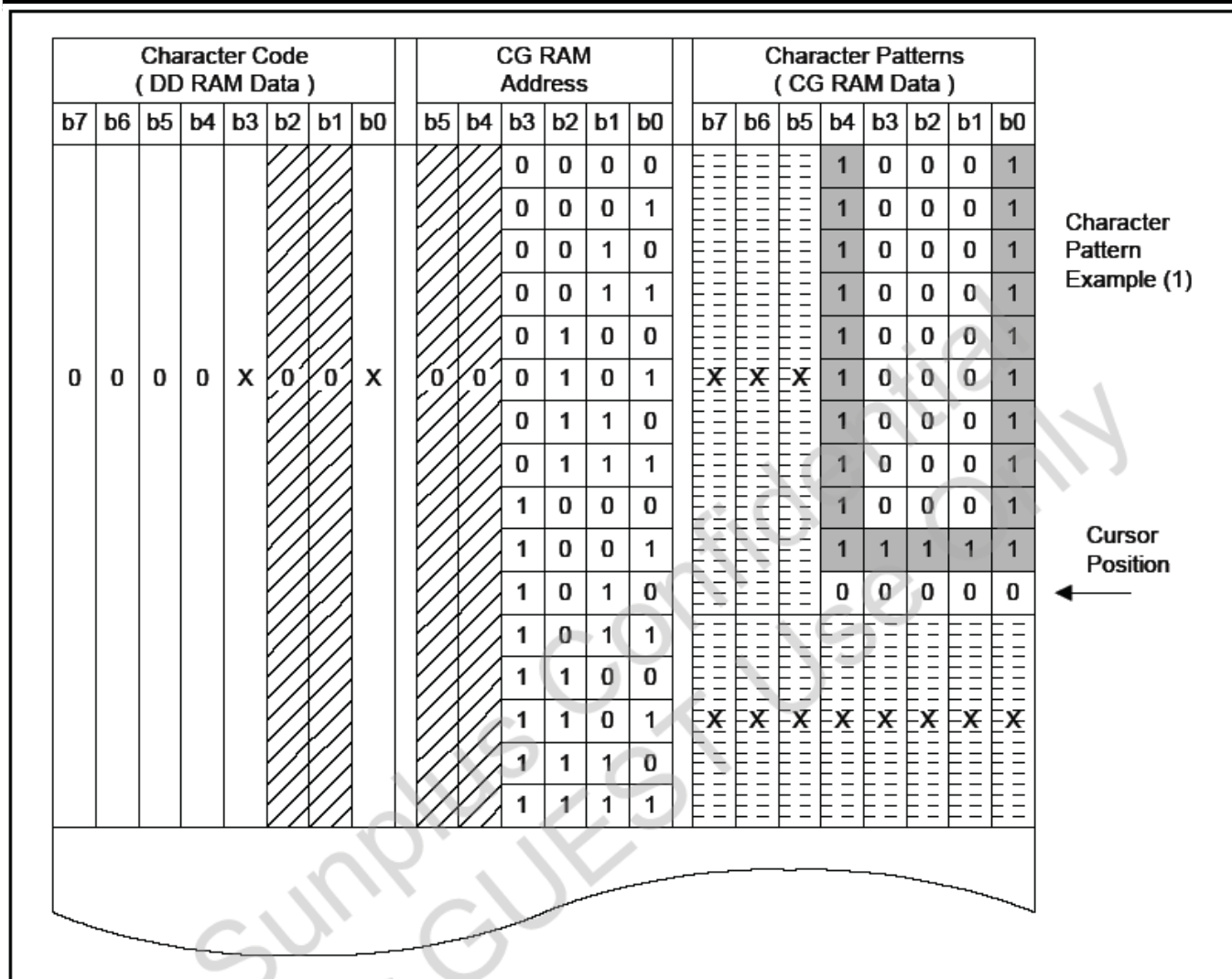
Note3: When all of the bit4-7 of the character code are 0, CG RAM character patterns are selected.


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.

5 X 10 dot character patterns



Note1:  It means that the bit1~2 of the character code correspond to the bit4~5 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.

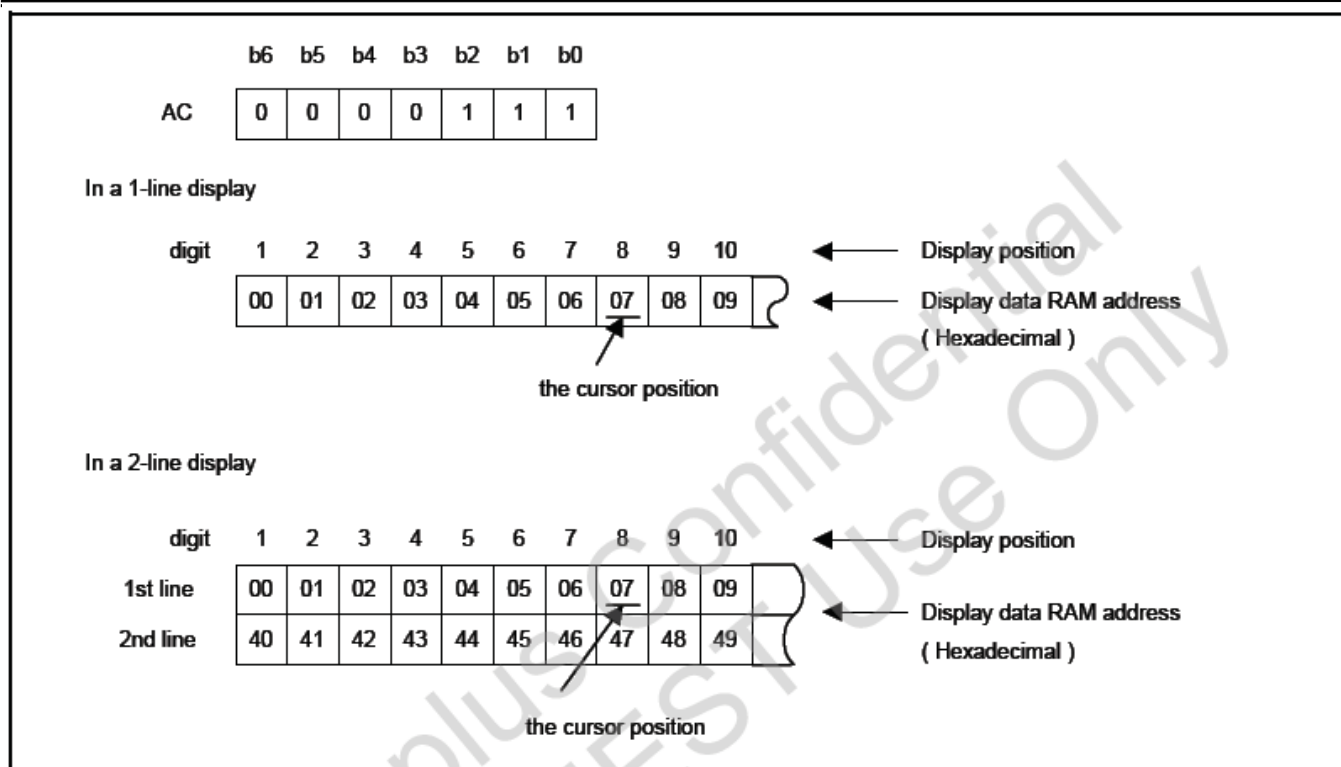
Note4: " 1 ": Selected, " 0 ": No selected, " X ": Do not care (0 or 1).

Note5: For example (1), set character code (b2 = b1 = 0, b3 = b0 = 0 or 1, b7-b4 = 0) to display " U ". That means all of the character codes (00) 16, (01) 16, (08) 16, and (09) 16 can display " U " character.

Note6: The bits 0-3 of the character code RAM is the character pattern line position. The 11th line is the cursor position and display is formed by logical OR with the cursor.

Cursor/Blink Control Circuit

This circuit generates the cursor or blink in the cursor / blink control circuit. The cursor or the blink appears in the digit at the Display Data RAM Address defined in the Address Counter.



Interfacing to MPU

There are two types of data operations: 4-bit and 8-bit operations. Using 4-bit MPU, the interfacing 4-bit data is transferred by 4-busline (DB4 to DB7). Thus, DB0 to DB3 bus lines are not used. Using 4-bit MPU to interface 8-bit data requires two times transferring. First, the higher 4-bit data is transferred by 4-busline (for 8-bit operation, DB7 to DB4). Secondly, the lower 4-bit data is transferred by 4-busline (for 8-bit operation, DB3 to DB0). For 8-bit MPU, the 8-bit data is transferred by 8-buslines (DB0 to DB7). When the Address Counter is (07) 16, the cursor position is shown as below:

REGISTER --- IR (Instruction Register) and DR(Data Register)

SPLC780D contains two 8-bit registers: Instruction Register (IR) and Data Register (DR). Using combinations of the RS pin and the R/W pin selects the IR and DR, see below:

| RS | R/W | Operation |
|----|-----|--|
| 0 | 0 | IR write (Display clear, etc.) |
| 0 | 1 | Read busy flag (DB7) and Address Counter (DB0 - DB6) |
| 1 | 0 | DR write (DR to Display data RAM or Character generator RAM) |
| 1 | 1 | DR read (Display data RAM or Character generator RAM to DR) |

The IR can be written by MPU, but it cannot be read by MPU.

Busy Flag (BF)

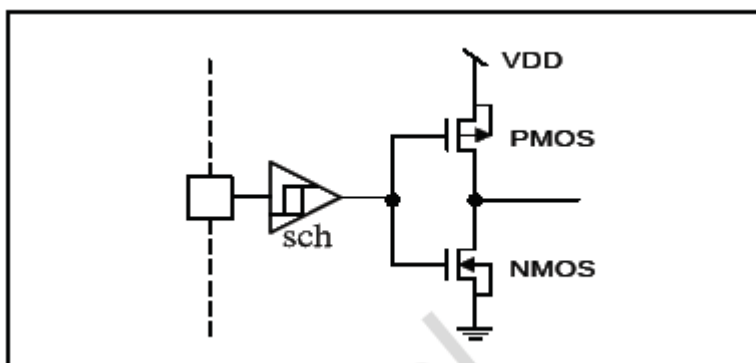
When RS = 0 and R/W = 1, the busy flag is output to DB7. As the busy flag =1, SPLC780D is in busy state and does not accept any instruction until the busy flag = 0.

Address Counter (AC)

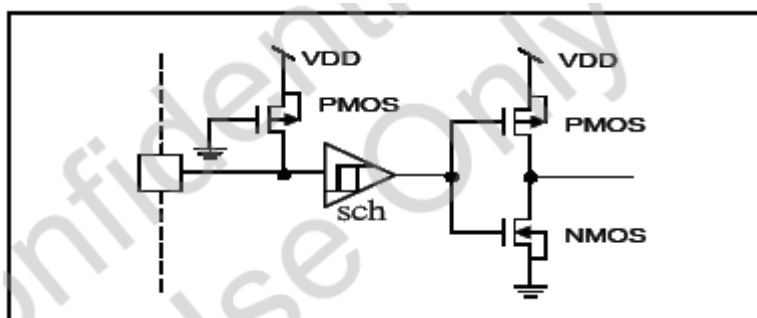
The Address Counter assigns addresses to Display Data RAM and Character Generator RAM. When an instruction for address is written in IR, the address information is sent from IR to AC. After writing to/reading from Display Data RAM or Character Generator RAM, AC is automatically incremented by one (or decremented by one). The contents of AC are output to DB0 - DB6 when RS = 0 and R/W=1.

I/O Port Configuration

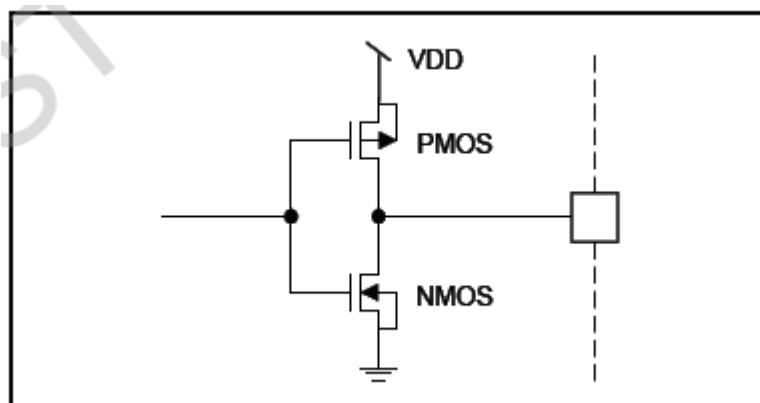
Input port: E



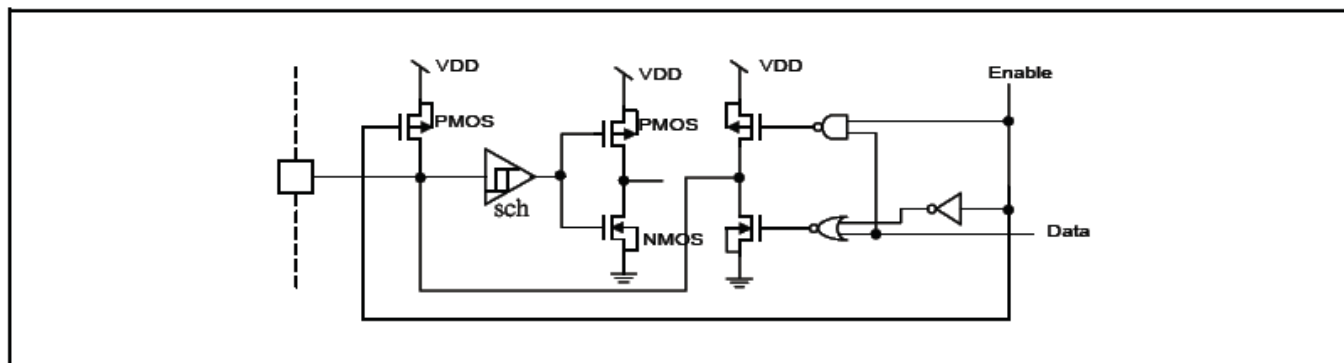
Input port: R/W, RS



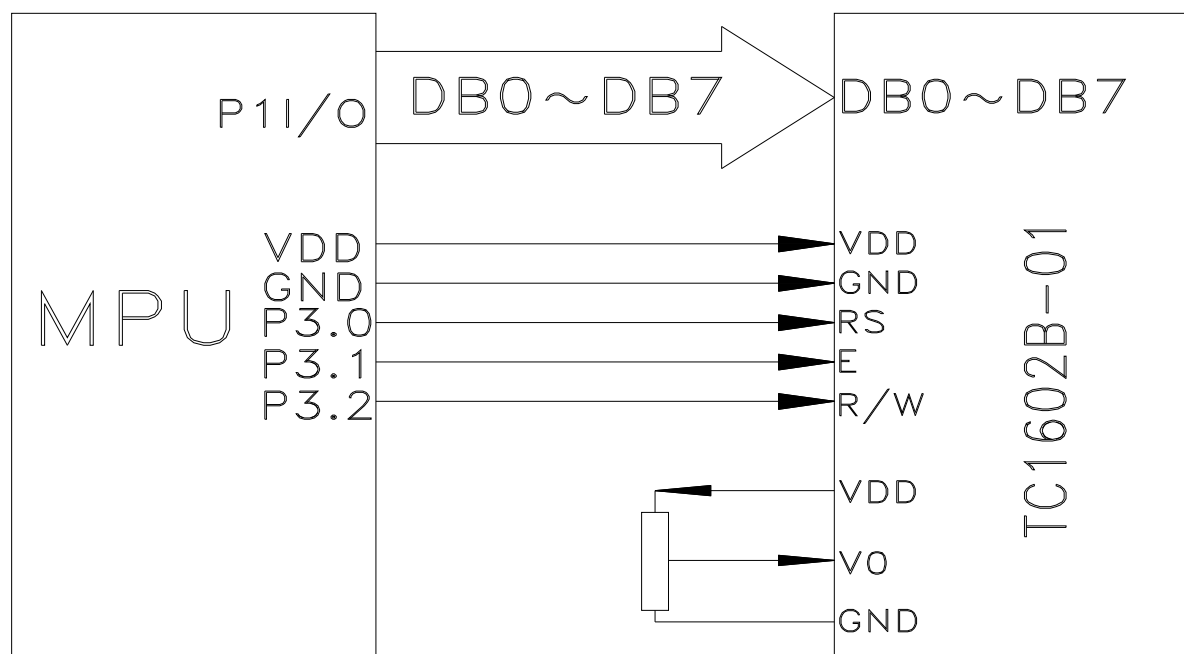
Output port: CL1, CL2, M, D



Input / Output port: DB7 - DB0



MPU and Module Connect:



3. RELIABILITY TEST AND QUALITY

3.1. RELIABILITY TEST CONDITION

| 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. | 60 °C 200 hrs | ----- |
| 2 | Low temperature storage | Endurance test applying the low storage temperature for a long time. | -10 °C 200 hrs | ----- |
| 3 | High temperature operation | Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time. | 50 °C 200 hrs | ----- |
| 4 | Low temperature operation | Endurance test applying the electric stress under low temperature for a long time. | 0 °C 200 hrs | ----- |
| 5 | High temperature / Humidity storage | Endurance test applying the high temperature and high humidity storage for a long time. | 60 °C , 90 %RH 96 hrs | MIL-202E-103B JIS-C5023 |
| 6 | High temperature / Humidity operation | Endurance test applying the electric stress (Voltage & Current) and temperature / humidity stress to the element for a long time. | 40 °C , 90 %RH 96 hrs | MIL-202E-103B JIS-C5023 |
| 7 | Temperature cycle | Endurance test applying the low and high temperature cycle. <div><div><div>-10°C</div><div>↔</div><div>25°C</div><div>↔</div><div>60°C</div></div><div>30min ← 5min. → 30min</div><div>← 1 cycle →</div></div> | -10°C / 60°C 10 cycles | ----- |

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

Mechanical Test

| | | | |
|---------------------------|--|--|--|
| Vibration test | Endurance test applying the vibration during transportation and using | 10~22Hz→1.5mmp-p 22~500Hz→1.5G Total 0.5hour | MIL-202E-201A JIS-C5025 JIS-C7022-A-10 |
| Shock test | Constructional and mechanical endurance test applying the shock during transportation. | 50G half sign wave 11 msede 3 times of each direction | MIL-202E-213B |
| Atmospheric pressure test | Endurance test applying the atmospheric pressure during transportation by air | 115mbar 40hrs | MIL-202E-105C |
| Static electricity test | Endurance test applying the electric stress to the terminal | VS=800V,RS-1.5K Ω CS=100pF, 1 time | MIL-883B-3015.1 |

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 Appearance Specification |
| Optical characteristic | | | | | | | | | | | | Out of the Appearance Standard |

3.2. QUALITY GURANTEEE

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 | Description |
|-----------|------|--|
| A: Major | 0.4% | Functional defective product |
| B: Minor | 1.5% | Satisfy all functions as product but not satisfy cosmetic standard |

Definition of 'LOT'

One lot means the delivery quality to customer at once time.

Conditions of Cosmetic Inspection

. Environmental condition

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

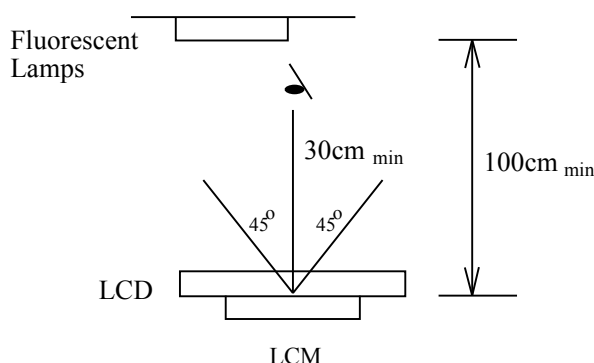
Driving voltage

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

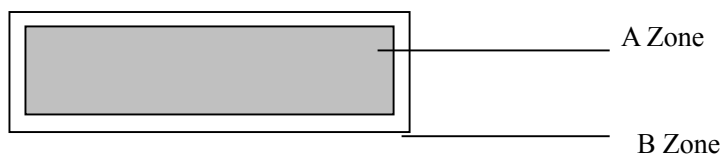
3.3. INSPECTION METHOD

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

Viewing direction for inspection is 45° from vertical against LCM.



Definition of zone:

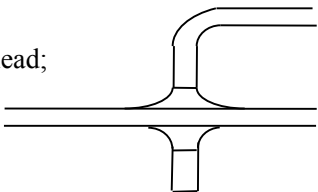
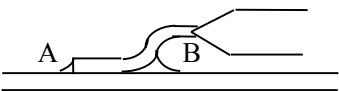
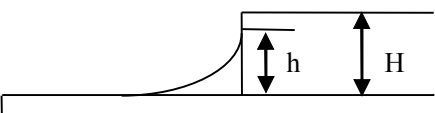


A Zone: Active display area (minimum viewing area).

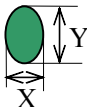
B Zone: Non-active display area (outside viewing area).

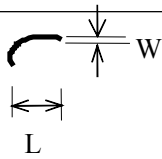
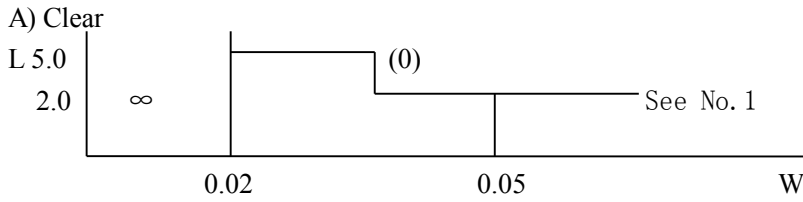
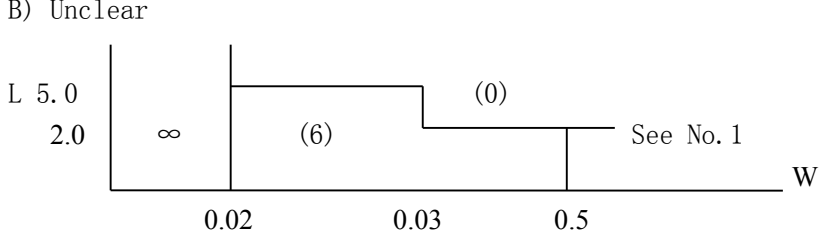
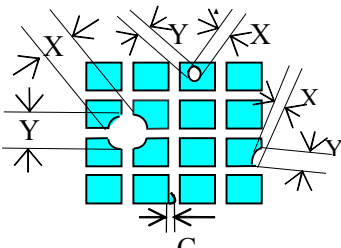
3.4. INSPECTION STANDARD FOR SOLDER

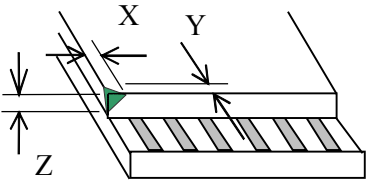
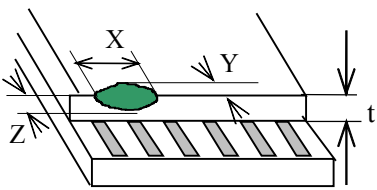
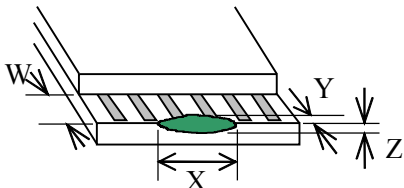
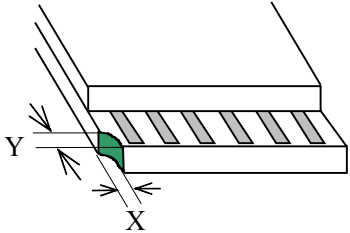
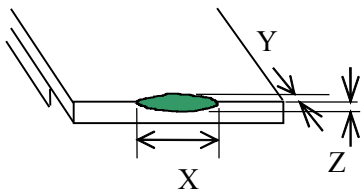
Module Cosmetic Criteria

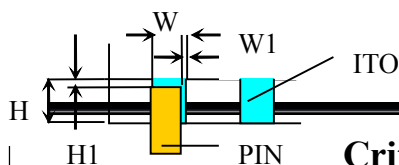
| No. | Item | Judgment Criterion | Partition |
|-----|---|---|-------------------------|
| 1 | Difference in Spec. | None allowed | Major |
| 2 | Pattern Peeling | No substrate pattern peeling and floating | Major |
| 3 | Soldering defects | No soldering missing No soldering bridge No cold soldering | Major Major Minor |
| 4 | Resist flaw on substrate | Invisible copper foil ($\Phi 0.5\text{mm}$ or more) on substrate pattern | Minor |
| 5 | Accretion of metallic Foreign matter | No soldering dust No accretion of metallic foreign matters (Not exceed $\Phi 0.2\text{mm}$) | Minor Minor |
| 6 | Stain | No stain to spoil cosmetic badly | Minor |
| 7 | Plate discoloring | No plate fading, rusting and discoloring | Minor |
| 8 | Plate discoloring | a. Soldering side of PCB | Minor |
| | 1. Lead parts | Solder to form a 'Filet' all around the lead; Solder should not hide the lead form perfectly too much  | |
| | 2. Flat packages | Either "toe"(A) or "heel" (B) of The lead to be covered by 'Filet' Lead form to be assume over Solder.  | Minor |
| | 3. Chips | $(3/2) H \geq h \geq (1/2) H$  | Minor |

3.5. SCREEN COSMETIC CRITERIA (APPEARANCE)

| No. | Item | Criterion | | | | | | | | | | |
|---------------------|---|---|------------|-----------------|----------------|-----------|---------------------|---|--------------------|---|-------------|---|
| 1 | Short or open circuit | No allow | | | | | | | | | | |
| | LC leakage | | | | | | | | | | | |
| | Flickering | | | | | | | | | | | |
| | No display | | | | | | | | | | | |
| | Wrong viewing direction | | | | | | | | | | | |
| | Wrong Back-light | | | | | | | | | | | |
| | Wrong or missing component | | | | | | | | | | | |
| 2 | Contrast defect (dim, ghost) | Refer to the approval sample | | | | | | | | | | |
| | Background color deviation | | | | | | | | | | | |
| 3 | Point defect, Black spot, dust (including Polarizer) $\Phi=(X+Y)/2$ | <div></div> <table><tr><th>Point Size</th><th>Acceptable Qty.</th></tr><tr><td>$\phi\leq0.10$</td><td>Disregard</td></tr><tr><td>$0.10<\phi\leq0.20$</td><td>6</td></tr><tr><td>$0.20<\phi\leq0.3$</td><td>2</td></tr><tr><td>$\phi>0.30$</td><td>0</td></tr></table> | Point Size | Acceptable Qty. | $\phi\leq0.10$ | Disregard | $0.10<\phi\leq0.20$ | 6 | $0.20<\phi\leq0.3$ | 2 | $\phi>0.30$ | 0 |
| Point Size | Acceptable Qty. | | | | | | | | | | | |
| $\phi\leq0.10$ | Disregard | | | | | | | | | | | |
| $0.10<\phi\leq0.20$ | 6 | | | | | | | | | | | |
| $0.20<\phi\leq0.3$ | 2 | | | | | | | | | | | |
| $\phi>0.30$ | 0 | | | | | | | | | | | |

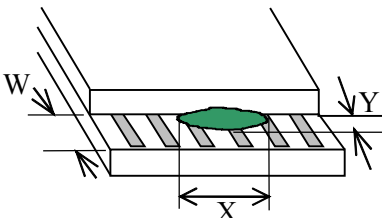
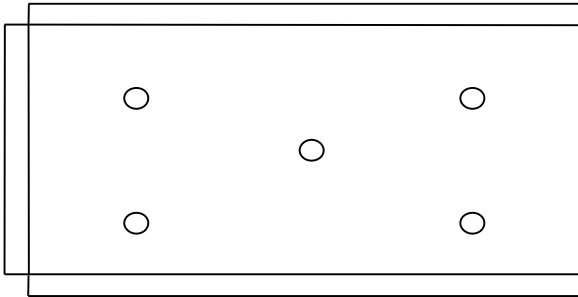
| No. | Item | Criterion | | | | | | | | | | | | | | | | | | | |
|----------------------------|---|---|------|-----------------|-----------------|-----------|----------------------------|-----|----------------|-----------|--------------|---------------|---|--------------|---------------|--------------|-----------|---|-----|------------|-------------------------|
| 4 | <p>Line defect,</p> <p>Scratch: In accordance with spots and lines operating cosmetic criteria. When the light reflective on the panel surface, the scratches are not to be remarkable.</p> | <div><div></div><table><thead><tr><th colspan="2">Line</th><th rowspan="2">Acceptable Qty.</th></tr><tr><th>L</th><th>W</th></tr></thead><tbody><tr><td>---</td><td>$0.015 \geq W$</td><td>Disregard</td></tr><tr><td>$3.0 \geq L$</td><td>$0.03 \geq W$</td><td rowspan="2">2</td></tr><tr><td>$2.0 \geq L$</td><td>$0.05 \geq W$</td></tr><tr><td>$1.0 \geq L$</td><td>$0.1 > W$</td><td>1</td></tr><tr><td>---</td><td>$0.05 < W$</td><td>Applied as point defect</td></tr></tbody></table></div> <p>Unit: mm</p> <p>A) Clear</p> <div></div> <p>Note: () –Acceptable Qty in active area L –Length (mm) W –Width (mm) ∞ –Disregard</p> <p>B) Unclear</p> <div></div> | Line | | Acceptable Qty. | L | W | --- | $0.015 \geq W$ | Disregard | $3.0 \geq L$ | $0.03 \geq W$ | 2 | $2.0 \geq L$ | $0.05 \geq W$ | $1.0 \geq L$ | $0.1 > W$ | 1 | --- | $0.05 < W$ | Applied as point defect |
| Line | | Acceptable Qty. | | | | | | | | | | | | | | | | | | | |
| L | W | | | | | | | | | | | | | | | | | | | | |
| --- | $0.015 \geq W$ | Disregard | | | | | | | | | | | | | | | | | | | |
| $3.0 \geq L$ | $0.03 \geq W$ | 2 | | | | | | | | | | | | | | | | | | | |
| $2.0 \geq L$ | $0.05 \geq W$ | | | | | | | | | | | | | | | | | | | | |
| $1.0 \geq L$ | $0.1 > W$ | 1 | | | | | | | | | | | | | | | | | | | |
| --- | $0.05 < W$ | Applied as point defect | | | | | | | | | | | | | | | | | | | |
| 5 | Rainbow | Not more than two colors change across the viewing area | | | | | | | | | | | | | | | | | | | |
| 6 | <p>Dot-matrix pattern</p> <p>$\phi = (X+Y)/2$</p> | <p>Pin hole:</p> <div><div></div><table><thead><tr><th>Size</th><th>Acceptable Qty.</th></tr></thead><tbody><tr><td>$\phi < 0.1$</td><td>Disregard</td></tr><tr><td>$0.10 \leq \phi \leq 0.20$</td><td>1</td></tr><tr><td>$\phi > 0.20$</td><td>0</td></tr></tbody></table><p>C: Shall not touch other dot(s).</p></div> | Size | Acceptable Qty. | $\phi < 0.1$ | Disregard | $0.10 \leq \phi \leq 0.20$ | 1 | $\phi > 0.20$ | 0 | | | | | | | | | | | |
| Size | Acceptable Qty. | | | | | | | | | | | | | | | | | | | | |
| $\phi < 0.1$ | Disregard | | | | | | | | | | | | | | | | | | | | |
| $0.10 \leq \phi \leq 0.20$ | 1 | | | | | | | | | | | | | | | | | | | | |
| $\phi > 0.20$ | 0 | | | | | | | | | | | | | | | | | | | | |

| No. | Item | Criterion | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------------------------|---|--|---|---|---|----------|-------|----------|---|---|---|----------|-------|------------|---|---|---|-----------|------------|----------|---|---|---|----------|----------|----------|------------------------|--|--|---|---|---|----------|----------|------------|
| 7 | Chip Remark: X: Length direction Y: Short direction Z: Thickness direction t: Glass thickness W: Terminal Width | <div>  <p>Acceptable criterion</p> <table border="1"> <tr> <th>X</th><th>Y</th><th>Z</th></tr> <tr> <td>≤ 2</td><td>0.5mm</td><td>$\leq t$</td></tr> </table> </div> <div>  <p>Acceptable criterion</p> <table border="1"> <tr> <th>X</th><th>Y</th><th>Z</th></tr> <tr> <td>≤ 2</td><td>0.5mm</td><td>$\leq t/2$</td></tr> </table> </div> <div>  <p>Acceptable criterion</p> <table border="1"> <tr> <th>X</th><th>Y</th><th>Z</th></tr> <tr> <td>Disregard</td><td>≤ 0.2</td><td>$\leq t$</td></tr> </table> </div> <div>  <p>Acceptable criterion</p> <table border="1"> <tr> <th>X</th><th>Y</th><th>Z</th></tr> <tr> <td>≤ 3</td><td>≤ 2</td><td>$\leq t$</td></tr> <tr> <td colspan="2">shall not reach to ITO</td><td></td></tr> </table> </div> <div>  <p>Acceptable criterion</p> <table border="1"> <tr> <th>X</th><th>Y</th><th>Z</th></tr> <tr> <td>≤ 5</td><td>≤ 2</td><td>$\leq t/3$</td></tr> </table> </div> | X | Y | Z | ≤ 2 | 0.5mm | $\leq t$ | X | Y | Z | ≤ 2 | 0.5mm | $\leq t/2$ | X | Y | Z | Disregard | ≤ 0.2 | $\leq t$ | X | Y | Z | ≤ 3 | ≤ 2 | $\leq t$ | shall not reach to ITO | | | X | Y | Z | ≤ 5 | ≤ 2 | $\leq t/3$ |
| X | Y | Z | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ≤ 2 | 0.5mm | $\leq t$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X | Y | Z | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ≤ 2 | 0.5mm | $\leq t/2$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X | Y | Z | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Disregard | ≤ 0.2 | $\leq t$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X | Y | Z | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ≤ 3 | ≤ 2 | $\leq t$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| shall not reach to ITO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X | Y | Z | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ≤ 5 | ≤ 2 | $\leq t/3$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



$$W1 \leq 1/3W$$

$$H1 \leq 1/3H$$

| No. | Item | Crite |
|-----|---|---|
| 8 | Total no. of acceptable Defect | <p>A. Zone</p> <p>Maximum 2 minor non-conformities per one unit. Defect distance: each point to be separated over 10mm</p> <p>B. Zone</p> <p>It is acceptable when it is no trouble for quality and assembly in customer's end product.</p> |
| 9 | Protruded W: Terminal Width |  <p>Acceptable criteria: $Y \leq 0.4$</p> |
| 10 | PIN | Position |
| 11 | Uneven brightness (only back-lit type module) | <p>Uneven brightness must be $B_{MAX}/B_{MIN} \leq 2$</p> <p>-BMAX : Max. value by measure in 5 points -BMIN : Min. value by measure in 5 points</p> <p>Divide active area into 4 vertically and horizontally. Measure 5 points shown in the following figure</p>  |
| 12 | Allowable density | Above defects should be separated more than 10mm each other. |
| 13 | Rubbing line | Not to be noticeable. |
| 14 | Dot size | <p>To be 95% ~ 105% of the dot size (typ.) in drawing,</p> <p>Partial defects of each dot (ex. Pin-hole) should be treated as 'spot'. (see Screen Cosmetic Criteria (operating) No.)</p> |

| No. | Item | Criterion | |
|-----|----------------------|--|-------------------------------|
| 15 | Bubbles in polarizer | Size : d mm | Acceptable Qty in active area |
| | | $d \leq 0.3$ | Disregard |
| | | $0.3 < d \leq 1.0$ | 3 |
| | | $1.0 < d \leq 1.5$ | 1 |
| | | $1.5 < d$ | 0 |
| 16 | Allowable density | Above defects should be seated more than 30mm each other | |
| 17 | Coloration | Not to be noticeable coloration in the viewing area of the LCD panels. Backlit type should be judged with back-lit on state only. | |
| 18 | Contamination | Not to be noticeable. | |

Note:

‘Clear’= the shade and size are not changed by Vo.

‘Unclear’= the shade and size are changed by V0.

Size: $d = (\text{long length} + \text{short length}) / 2$

The limit samples for each item have priority

Complete defects are defined item by item, but if the number of defects is defined in above table, the total number should not exceed 10.

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 $\Phi 2\text{mm}$

-10 or over defects in circle of $\Phi 10\text{mm}$

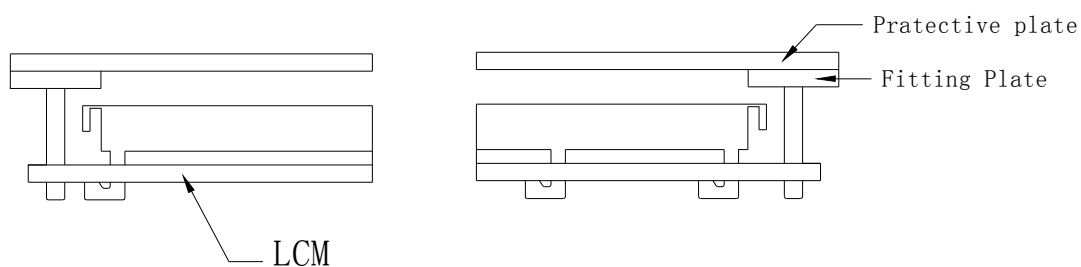
-20 or over defects in circle of $\Phi 20\text{mm}$

3.6. PRECAUTION FOR USING LCM MODULE

1. Liquid Crystal Display Modules

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

- (1) Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or Polarizer peel-off may occur with 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 polarizers 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 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 the must be warmed up in a container before coming is contacting temperature air.



(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 $\pm 0.1\text{mm}$

3.8. PRECAUTION FOR HANDING LCM MODULE

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 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

3.9. Electro-Static DISCHARGE CONTROL

Since this module uses a CMOS LSI, the same attention should be paid to electrostatic discharge as for an ordinary CMOS IC.

- (1) Make certain that you are grounded when handling LCM.
- (2) Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential.
- (3) When soldering the terminal of LCM, make certain the AC power source for the soldering iron does not leak.
- (4) When using an electric screwdriver to attach LCM, the screwdriver should be of ground 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 workbench 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.

3.10. PRECAUTION FOR SOLDERING TO THE LCM

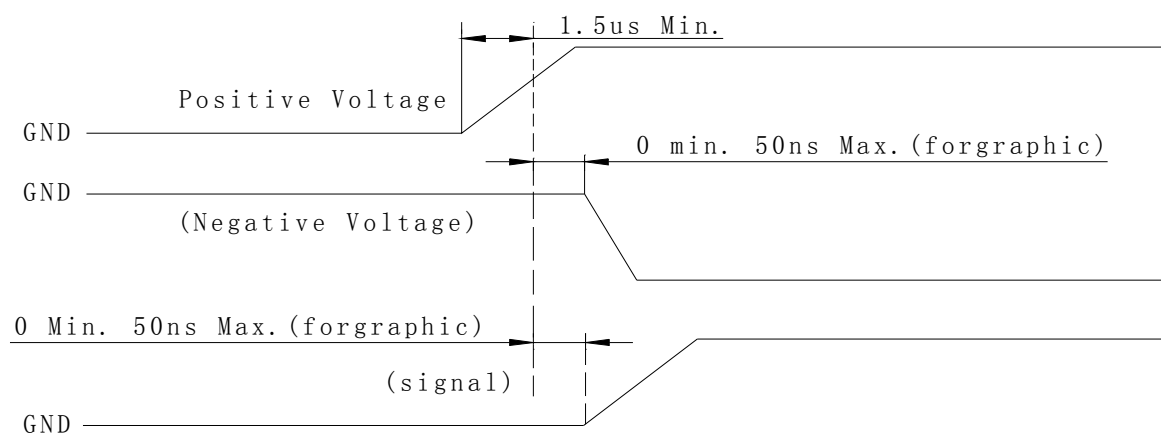
- (1) Observe the following when soldering lead wire , connector cable and etc. to the LCM
 - Soldering iron temperature: $280^{\circ}\text{C} \pm 10^{\circ}\text{C}$
 - Soldering time: 3-4 seconds
 - Solder: eutectic solder.

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 non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.

- (2) When soldering the electro-luminescent 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 electro-luminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PX board could be damaged.

3.11. PRECAUTIONS FOR OPERATION

- (1) Viewing angle varies with the change of liquid crystal driving voltage (V0). 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 cell 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. Used under the relative condition of 40°C , 50%RH.
- (5) When turning the power on input each signal after the positive/negative voltage becomes stable.



3.12. STORAGE

When storing LCD as spares for some years, the following precautions 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 object.(we advise you to store them in the container in which they were shipped.)
- (4) Environmental conditions:
 - Don not leave them for more than 168hrs. at 60°C
 - Should not be left for more than 48hrs. at -20°C .

3.13. SAFETY

- (1) It is recommended to crush damaged or unnecessary LCD 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.

3.14. LIMITED WARRANTY

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

3.15. RETURN LCM UNDER WARRANTY

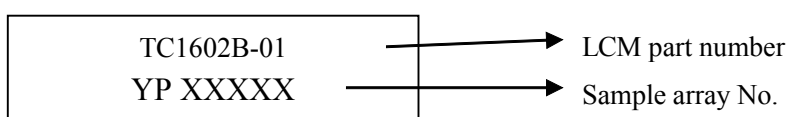
No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are:

- 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 lay 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 eyelets, conductors and terminals.

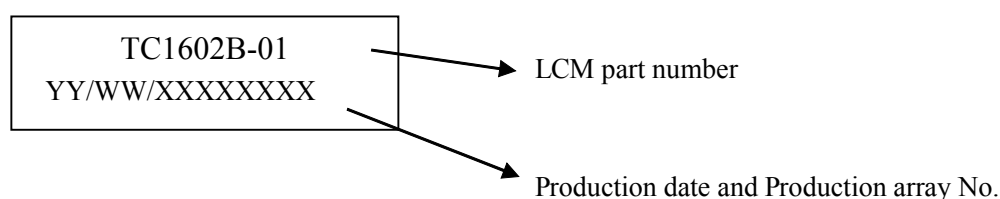
4. DATE CODE RULES

4-1. DATE CODE FOR SAMPLE



YP: meaning sample

4-2. DATE CODE FOR PRODUCTION



- A. TC1602B-01 represents LCM part number
C. YY/WW represents Year, Month, and Week

YY—Year WW—Week

XXXXXXXX—Production array No.

*****END*****