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1. General description

SC204A, a dot-matrix character LCD module, design for displaying 4 line 20 row characters. Character font is 5X7 dots with cursor. The SC204A provides two types of interfaces to MPU: 4-bit and 8-bit interfaces. SC204A can includes EL or LED backlight for custom design. The custom can design for color of EL or LED backlight, viewing angle and LCD type.

2. Maximum absolute limit

| Characteristics | Symbol | Ratings | Remark |
|-----------------------|--------|-------------------------|------------------------|
| Operating Voltage | VDD | -0.3V to +7.0V | |
| Driver Supply Voltage | VLCD | VDD - 12V to VDD + 0.3V | |
| Input Voltage Range | VIN | -0.3V to VDD + 0.3V | |
| Operating Temperature | TA1 | 0°C to+50°C | Normal temperature LCM |
| | Ta2 | -20°C to+60°C | Wide temperature LCM |
| Storage Temperature | TSTO | -25°C to+70°C | |

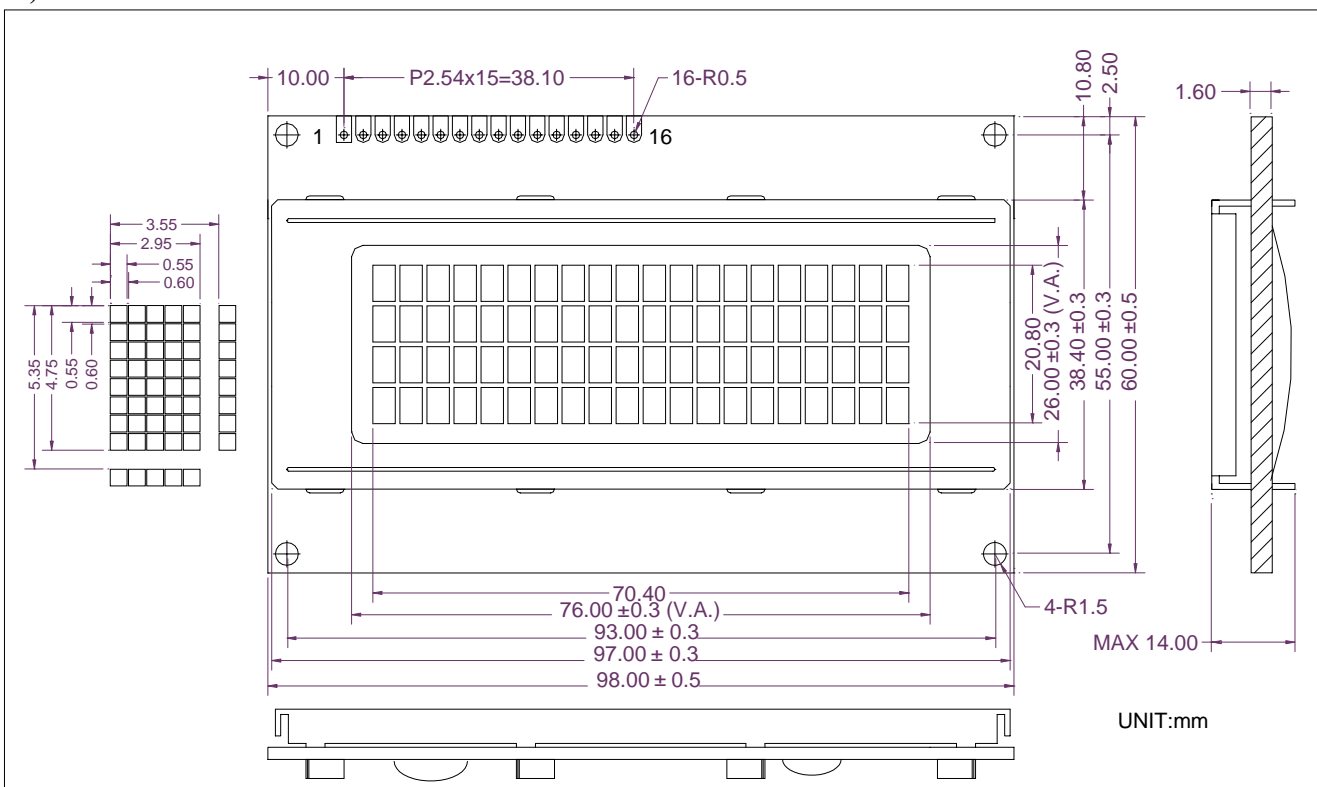
Note: Stresses beyond those given in the Absolute Maximum Rating table may cause operational errors or damage to the device.

3. Mechanical characteristics

a) Physical data

| ITEM | Standard value | Unit | Remark |
|----------------------|-------------------|------|--------|
| Number of characters | 20x4 | | |
| Module size | 98.0x60.0x14.0 | mm | |
| Viewing area | 76.0x26.0 | mm | |
| Active area | 70.4x20.80 | mm | |
| Character size | 4.75x2.95 | mm | |
| Character pith | 5.35x3.55 | mm | |
| Approx. weight | | g | |
| Drive method | 1/5bias 1/16 duty | | |

b) External dimensions





4. Electrical characteristics

a) DC CHARACTERISTICS ($T_A = 25^\circ\text{C}$, $V_{DD} = 4.5$ to 5.5V)

| Characteristics | Symbol | Limit | | | Unit | Test Condition |
|---------------------|-----------|-------|------|------|---------------|--------------------------------------|
| | | Min. | Typ. | Max. | | |
| Input High Voltage | V_{IH} | 2.2 | | VDD | V | VDD = 5.0V |
| Input Low Voltage | V_{IL} | -0.3 | | 0.6 | V | |
| Input High Current | I_{IH} | -2.0 | | 2.0 | μA | |
| Input Low Current | I_{IL} | -20 | -50 | -100 | μA | |
| Output High Voltage | V_{OH} | 2.4 | - | VDD | V | $I_{OH} = -0.1\text{mA}$ Pins: DB7-0 |
| Output Low Voltage | V_{OL} | - | - | 0.4 | V | $I_{OL} = 0.1\text{mA}$ Pins: DB7-0 |
| LCD Voltage | V_{LCD} | | 5 | | V | |
| Operating Current | I_{DD} | | 1.0 | | mA | |

Note: VDD = 5V

b) AC characteristics

b.1) AC CHARACTERISTICS ($T_A = 25^\circ\text{C}$, $V_{DD} = 4.5$ to 4.5V)

Write Mode (Writing data from MPU to LCD module)

| Characteristics | Symbol | Limit | | | Unit | Test Condition |
|--------------------|------------|-------|------|------|------|------------------|
| | | Min. | Typ. | Max. | | |
| E Cycle Time | t_c | 1000 | | | ns | PinE |
| E Pulse Width | t_{pw} | 450 | - | - | ns | PinE |
| E Rise/Fall Time | t_R, t_F | - | - | 25 | ns | PinE |
| Address Setup Time | t_{sp-i} | 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: DB7-0 |
| Data Hold Time | t_{HD2} | 10 | - | - | ns | Pins: DB7-0 |

Read Mode (Reading data from LCD module to MPU)

| Characteristics | Symbol | Limit | | | Unit | Test Condition |
|------------------------|------------|-------|------|------|------|------------------|
| | | Min. | Typ. | Max. | | |
| E Cycle Time | t_c | 1000 | | | ns | PinE |
| E Pulse Width | t_w | 450 | | | ns | PinE |
| E Rise/Fall Time | t_R, t_F | | | 25 | ns | PinE |
| Address Setup Time | t_{sp-i} | 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: DB7-0 |
| Data hold time | t_{HD2} | 5.0 | - | - | ns | Pin DB7-0 |



b.2) AC CHARACTERISTICS (ta = 25°C, VDD = 4.5 to 5.5V)

Write Mode (Writing Data from MPU to LCD module)

| Characteristics | Symbol | Limit | | | Unit | Test Condition |
|--------------------|--------|-------|------|------|------|------------------|
| | | Min. | Typ. | Max. | | |
| E Cycle Time | tc | 400 | | | ns | PinE |
| E Pulse Width | tpw | 150 | - | - | ns | PinE |
| E Rise/Fall Time | tR,tF | - | - | 25 | ns | PinE |
| Address Setup Time | tsp-i | 30 | | | ns | Pins: RS, R/W, E |
| Address Hold Time | tHD1 | 10 | | | ns | Pins: RS, R/W, E |
| Data Setup Time | tsP2 | 40 | | | ns | Pins: DB7-0 |
| Data Hold Time | tHD2 | 10 | - | - | ns | Pins: DB7-0 |

Read Mode (Reading Data from LCD module to MPU)

| Characteristics | Symbol | Limit | | | Unit | Test Condition |
|------------------------|--------|-------|------|------|------|-----------------|
| | | Min. | Typ. | Max. | | |
| E Cycle Time | tc | 400 | | | ns | Pin E |
| E Pulse Width | tw | 150 | | | ns | Pin E |
| E Rise/Fall Time | tR,tF | | | 25 | ns | Pin E |
| Address Setup Time | tsp-i | 30 | | | ns | Pins: RS, R/W,E |
| Address Hold Time | tHD1 | 10 | | | ns | Pins: RS, R/W,E |
| Data Output Delay Time | tD | | | 100 | ns | Pins: DB7-0 |
| Data hold time | tHD2 | 20 | - | - | ns | Pin DB7-0 |

c) EL backlight

EL ,Cold Cathode Fluorescent Lamp and LED etc, are available as backlight for LCD Module upon your choice ,your request.

1.EL

(1) Features

Max 1.3mm thickness (Max 1.5mm for lead portion).

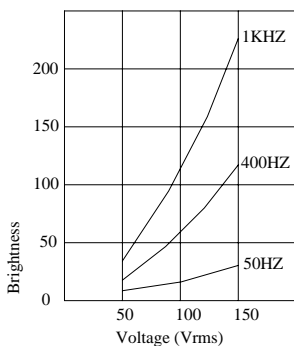
Wide driving condition of 60-1000Hz and 150V AC Max .with inverter , step-up voltage from 1.5V battery is available.

Emitted colors are blue-green and white .

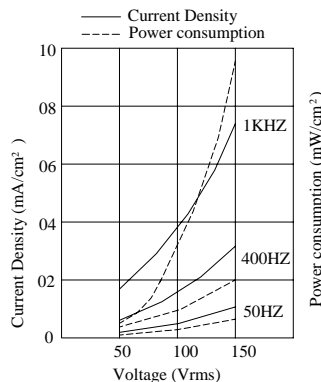
Operating characteristics

(2) Electrical Characteristics

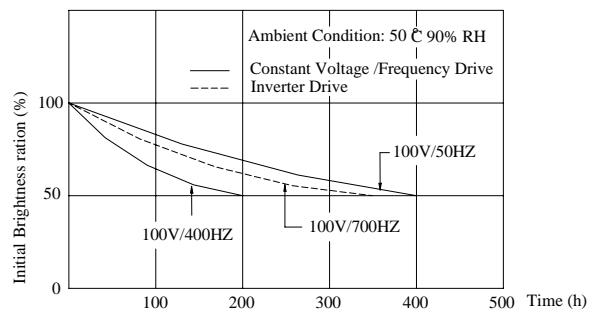
Voltage vs. Brightness



Voltage vs. Current Density



Life Characteristics



d) LED backlight

(1)Features

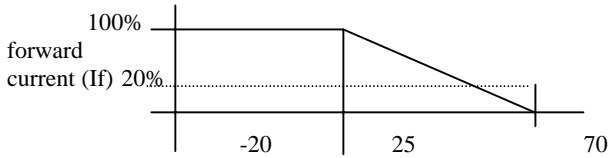
Low voltage driving (DC) is available without inverter.



Long life time 100000 hours (average).
No noise occurrence.
Various color of yellow-green and amber etc.
Operating characteristics

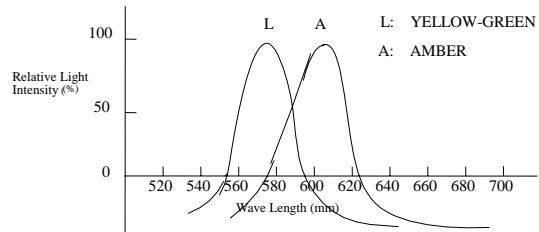
(2)Electrical Characteristics (Reference Data)

Forward Current Derating Curve

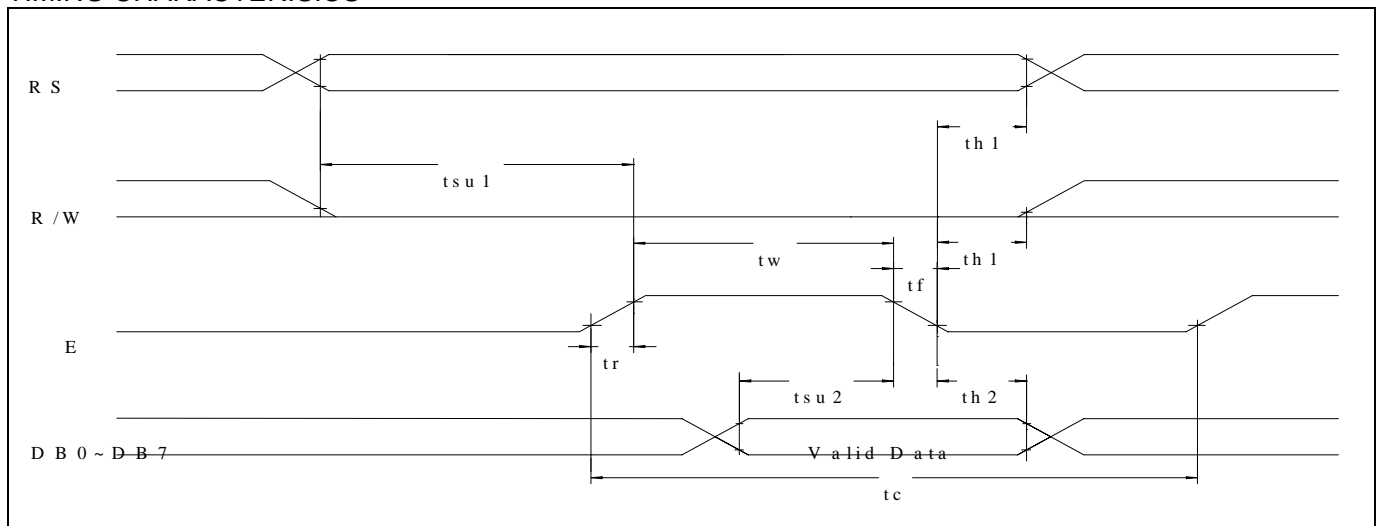


Note : The above spec . are only for reference

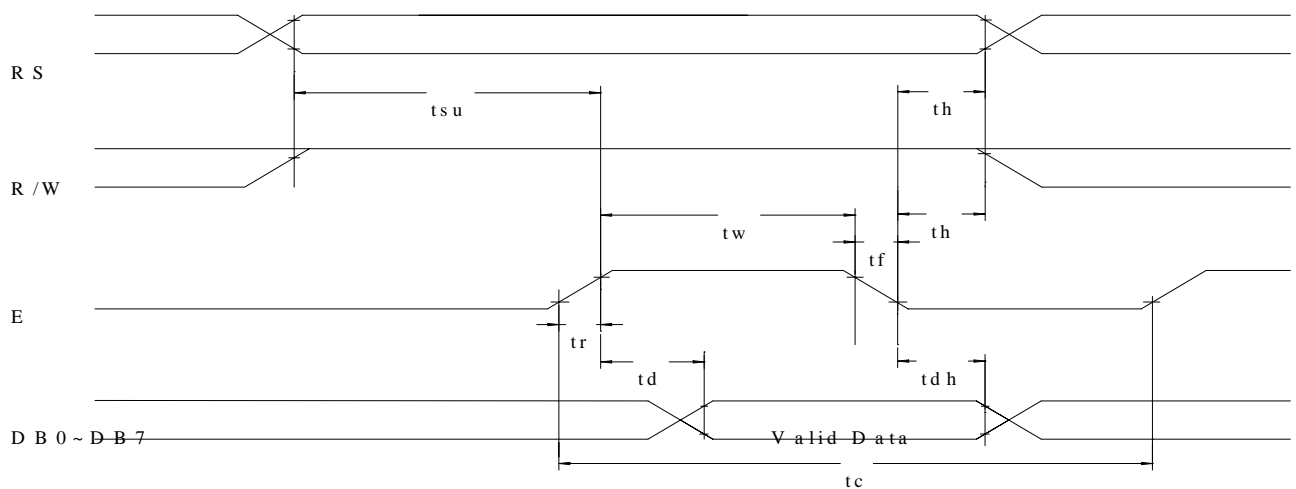
Wave Length vs. relative Light intensity



TIMING CHARACTERISTICS



Write Timing



Read Timing

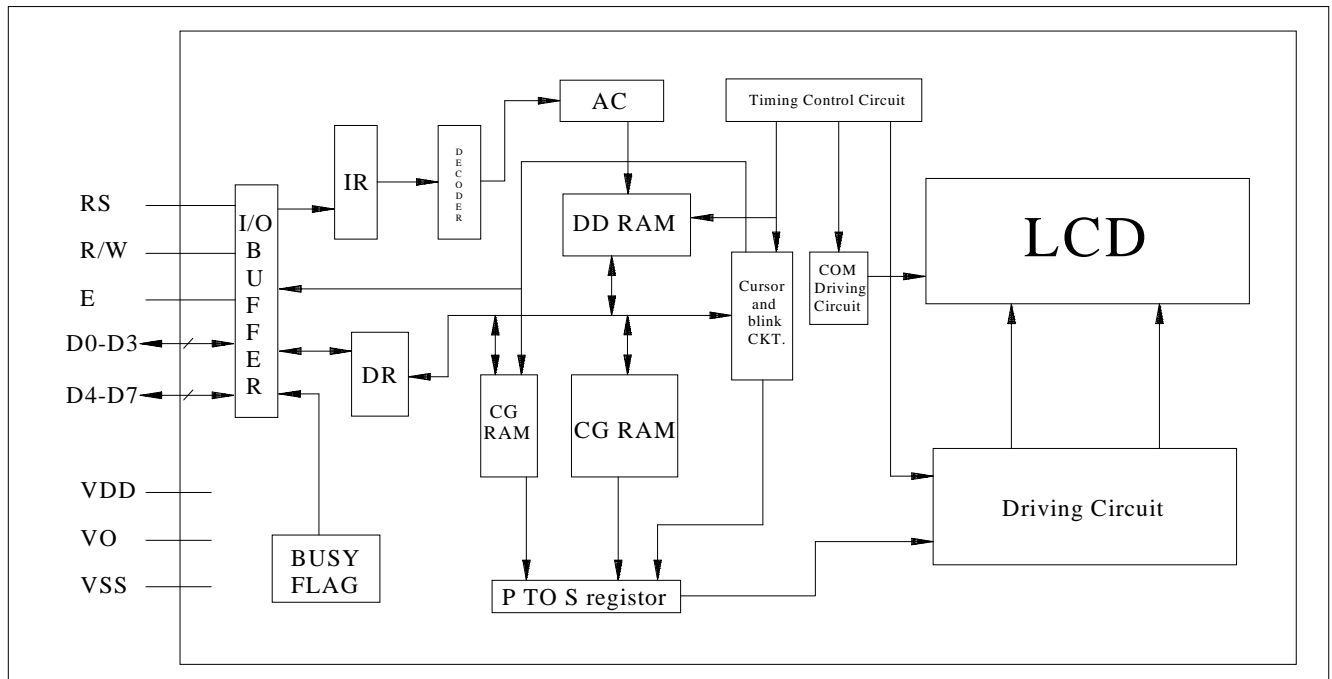


5. Operating Principles

a) Pin description

| Pin NO. | Symbol | Level | Function |
|---------|--------|-----------|---|
| 1 | VSS | 0V | Ground |
| 2 | VDD | 4.5V~5.5V | Supply voltage for logic |
| 3 | VO | | Variable voltage for LCD |
| 4 | RS | H/L | H: Instruction code L: Data |
| 5 | R/W | H/L | H: Read signal L: Write signal |
| 6 | E | H L | enable signal |
| 7 | DB0 | H/L | Data bits In case of 4 bits instruction, data is transferred by twice using only 4 buses of D4 – D7 ,and D0 – D3 are not used , first operation is higher order 4 bits and second is lower 4 bits of 8 bits , but in case of 8 bits instruction , data is transferred by data by data bus of D0 – D7 |
| 8 | DB1 | H/L | |
| 9 | DB2 | H/L | |
| 10 | DB3 | H/L | |
| 11 | DB4 | H/L | |
| 12 | DB5 | H/L | |
| 13 | DB6 | H/L | |
| 14 | DB7 | H/L | |
| 15 | BLA(+) | 4.2V | Supply voltage for LED-Backlight |
| 16 | BLK(-) | 0V | Supply voltage for LED-Backlight |

b) Block Diagram



- Data Register (DR): This is a register used for temporary storage of the data read/write from/into DD RAM and CG RAM.
- Instruction Register (IR): This is a register available for storing the instruction codes and address information of display data (DD) RAM and character generator (CG) RAM.
- BUSY FLAG (BF): When the Busy Flag is "1", it shows that LCM is in internal operation and it cannot accept the next instruction.
- Character Generator (CG) ROM: This ROM generates character patterns from 8-bit character codes and provides 192 character patterns.
- Character Generator (CG) RAM: This RAM allows the user to rewrite the character patterns freely according to the program.
- Address Counter (AC): This address counter is used to provide the address information of DD RAM and CG RAM.



- g. Display Data (DD) RAM: This display data RAM is used to store the display data expressed by 8-bit character code . The capacity is 80x 8bits and data for 80 characters can be storage.
- h. Cursor and Blink Control Circuit: This circuit generates the cursor and blink.

RAM's address and the LCD's position shown bellows.

Display Character address code:

| | | | | | | | | | | | | | | | | |
|------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Display position | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| DDRAM Address | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F |
| | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | 4F |

Relationship between Character Code (DDRAM) and character Pattern (CGRAM)

| Character code DD RAM Data | | | | | | | | CG RAM Address | | | | | | Character Pattern 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 | | |
| | | | | | | | | | | | 0 | 1 | 1 | | | | 0 | 0 | 0 | | |
| | | | | | | | | | | | 1 | 0 | 0 | | | | 0 | 0 | 0 | | |
| | | | | | | | | | | | 1 | 0 | 1 | | | | 0 | 0 | 0 | | |
| | | | | | | | | | | | 1 | 1 | 0 | | | | 0 | 0 | 0 | | |
| | | | | | | | | | | | 1 | 1 | 1 | | | | 0 | 0 | 0 | | |
| 0 | 0 | 0 | 0 | x | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | x | x | x | 0 | 1 | 1 | 1 | 0 |
| | | | | | | | | | | | 0 | 0 | 1 | | | | 0 | 0 | 0 | | |
| | | | | | | | | | | | 0 | 1 | 0 | | | | 0 | 0 | 0 | | |
| | | | | | | | | | | | 0 | 1 | 1 | | | | 0 | 0 | 0 | | |
| | | | | | | | | | | | 1 | 0 | 0 | | | | 0 | 0 | 0 | | |
| | | | | | | | | | | | 1 | 0 | 1 | | | | 0 | 0 | 0 | | |
| | | | | | | | | | | | 1 | 1 | 0 | | | | 0 | 0 | 0 | | |
| | | | | | | | | | | | 1 | 1 | 1 | | | | 0 | 0 | 0 | | |

1. ■ It means that the bit0~2 of the character code correspond to the bit3~5 of the CG RAM address.
2. ■ these areas are not used for display, but can be used for the general data RAM.
3. When all of the bit4-7 of the character code is 0, CG RAM character patterns are selected.
4. " 1 ": Selected, " 0 ": No selected, " X": Do not care (0 or 1).
5. for example (1), to set character code (b2 = b1 = b0 = 0, b3 = 0 or 1, b7-b4 = 0) is to display" T". That means character code (00)16, and (08)16 can display" T" character.
6. The bits 0-2 of the character code RAM is character pattern line position. The 8th line is the cursor position and display is formed by logical OR with the cursor



CGROM Character Code Table:

| Upper 4bit / Lower 4bit | LLLL | LLLH | LLHL | LLHH | LHLL | LHLH | LHHL | LHHH | HLLL | HLLH | HLHL | HLHH | HHLL | HHLH | HHHL | HHHH |
|-------------------------|------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| LLLL | CG RAM (1) | | | | | | | | | | | | | | | |
| LLLH | (2) | | | | | | | | | | | | | | | |
| LLHL | (3) | | | | | | | | | | | | | | | |
| LLHH | (4) | | | | | | | | | | | | | | | |
| LHLL | (5) | | | | | | | | | | | | | | | |
| LHLH | (6) | | | | | | | | | | | | | | | |
| LHHL | (7) | | | | | | | | | | | | | | | |
| LHHH | (8) | | | | | | | | | | | | | | | |
| HLLL | (1) | | | | | | | | | | | | | | | |
| HLLH | (2) | | | | | | | | | | | | | | | |
| HLHL | (3) | | | | | | | | | | | | | | | |
| HLHH | (4) | | | | | | | | | | | | | | | |
| HHLL | (5) | | | | | | | | | | | | | | | |
| HHLH | (6) | | | | | | | | | | | | | | | |
| HHHL | (7) | | | | | | | | | | | | | | | |
| HHHH | (8) | | | | | | | | | | | | | | | |



c) Instruction description

Control and display instructions will show in details as following:

c.1) Clear Display

| | | | | | | | | | |
|----|-----|----|----|----|----|----|----|----|----|
| RS | R/W | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

It clears the whole display and sets display data RAM's address 0 in address counter.

c.2) Return Home

| | | | | | | | | | |
|----|-----|----|----|----|----|----|----|----|----|
| RS | R/W | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | X |

X: Do not care (0 or 1)

It sets display data RAM's address 0 in address counter and display returns to its original position. The cursor or blink goes to the left edge of the display (to the 1st line if 2 lines are displayed). The contents of the Display Data RAM do not change.

c.3) Entry Mode Set

During writing and reading data, it sets cursor move direction and shifts the display.

| | | | | | | | | | |
|----|-----|----|----|----|----|----|----|-----|----|
| RS | R/W | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 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 |

c.4) Display On/Off Control

| | | | | | | | | | |
|----|-----|----|----|----|----|----|----|----|----|
| RS | R/W | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 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

c.5) Cursor or Display Shift

Without changing DD RAM's daters, it can move cursor and shift display

| | | | | | | | | | |
|----|-----|----|----|----|----|-----|-----|----|----|
| RS | R/W | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 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 |

c.6) Function Set

| | | | | | | | | | |
|----|-----|----|----|----|----|----|----|----|----|
| RS | R/W | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| 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: Datas are transferred with 8-bit lengths (DB7 - 0).DL = 0: Datas are transferred with 4-bit lengths (DB7 - 4).

(It needs two times to transfer datas) 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 7 dots character font.

F = 1: 5 x 10 dots character font.

| N | F | No. of Display Lines | Character Font | Duty Factor |
|---|---|----------------------|----------------|-------------|
| 0 | 0 | 1 | 5X7 dots | 1 /8 |
| 0 | 1 | 1 | 5x 10 dots | 1 /11 |
| 1 | X | 2 | 5x7 dots | 1 /16 |



c.7) Set Character Generator RAM Address

| RS | R/W | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|----|-----|----|----|----|----|----|----|----|----|
| 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 read or write after this setting.

c.8) Set Display Data RAM Address

| RS | R/W | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|----|-----|----|----|----|----|----|----|----|----|
| 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 read or write 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,gfor the first line,

(aaaaaaa)₂: (40)₁₆ - (67)₁₆,gfor the second line.

c.9) Read Busy Flag and Address

| RS | R/W | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|----|-----|----|----|----|----|----|----|----|----|
| 0 | 1 | BF | a | a | a | a | a | a | a |

When (BF = 1) indicates that the system is busy now, it will not accept any instruction until no busy (BF = 0). At the same time, the address counter content's (aaaaaaa)₂; is read out.

c.10) Write Data to Character Generator RAM or Display Data RAM

| RS | R/W | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|----|-----|----|----|----|----|----|----|----|----|
| 1 | 0 | d | d | d | d | d | d | d | d |

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

c.11) Read Data from Character Generator RAM or Display Data RAM

| RS | R/W | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|----|-----|----|----|----|----|----|----|----|----|
| 1 | 1 | d | d | d | d | d | d | d | d |

It reads data (ddddddd)₂ from character generator RAM or display data RAM. To get the correct data readout is shown below:

()Set the address of the character generator RAM or display data RAM or shift the cursor instruction.

(ii) Send the "Read "instruction.



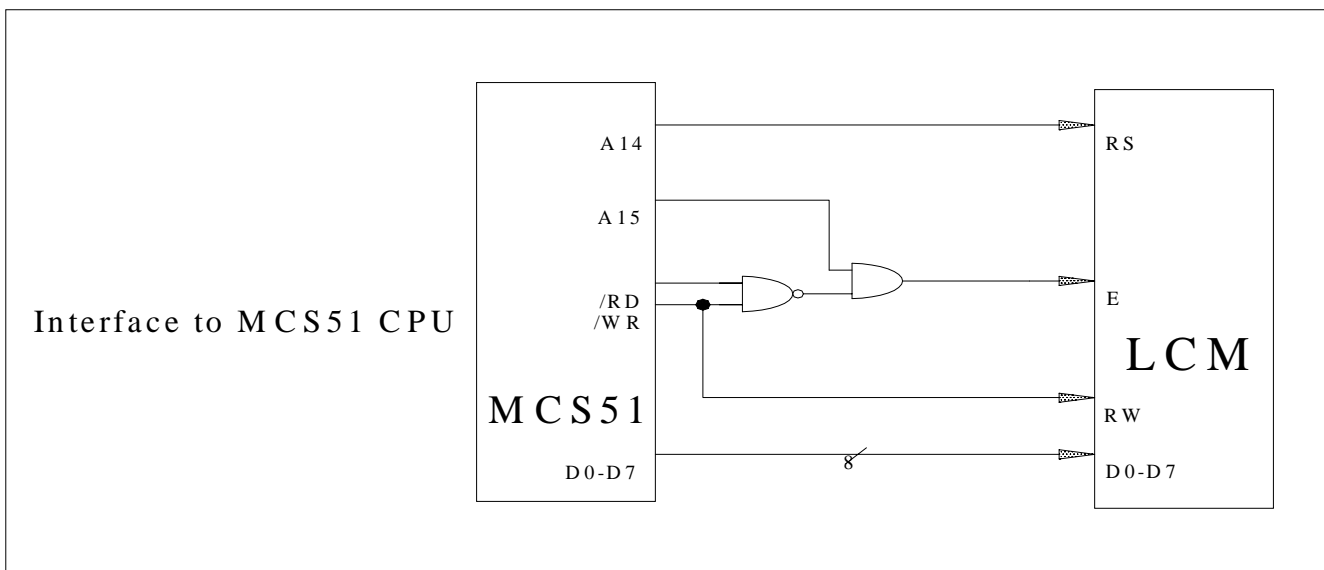
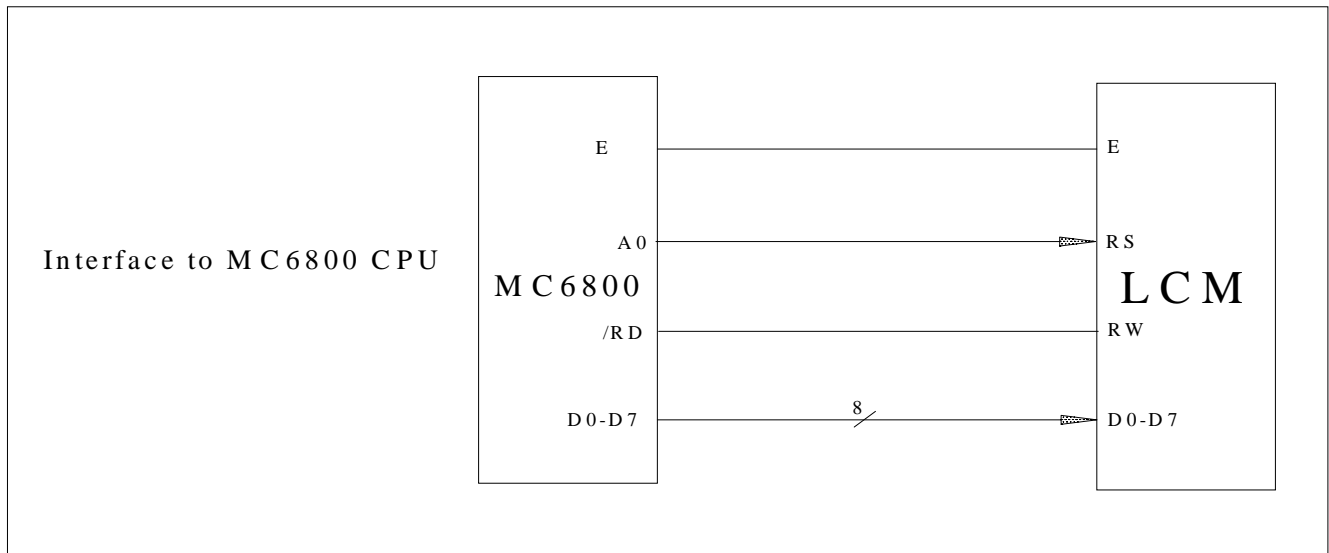
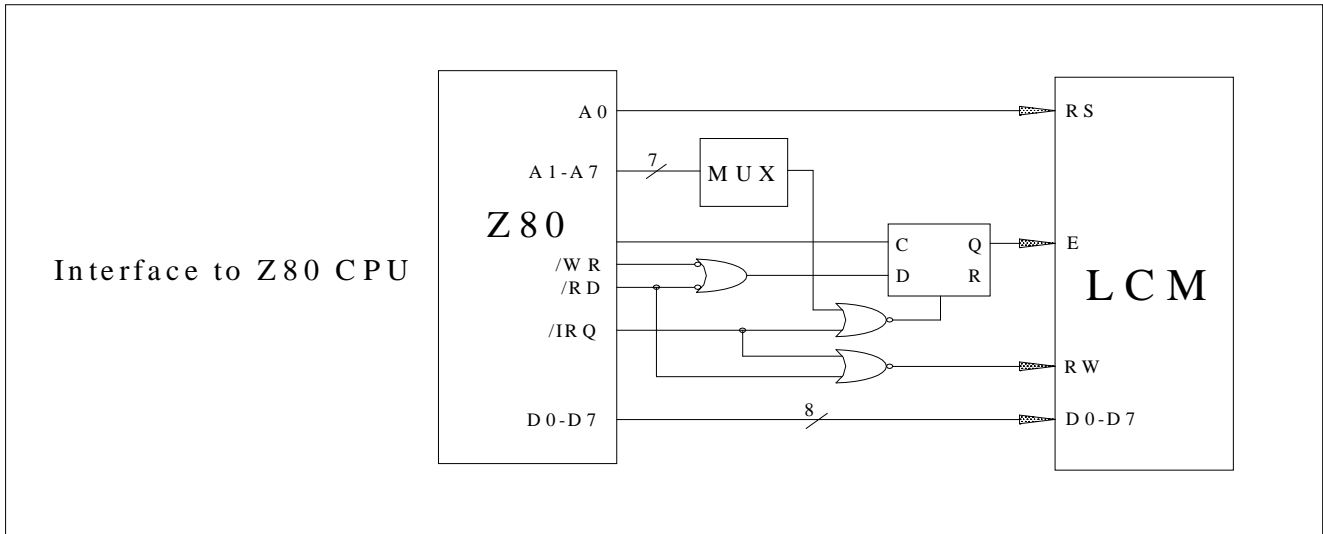
Instruction table

| Instruction | Instruction Code | | | | | | | | | | Description | Execution time (fosc=270KHz) |
|------------------------------------|------------------|----|----|-----|-----|-----|-----|-----|-----|-----|---|---------------------------------|
| | RS | RW | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | | |
| Clear Display | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Write "20H" to DDRAM and set DDRAM address to "OOH" from AC | 1.52ms |
| Return Home | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | - | Set DDRAM address to "OOH" 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 | 38us |
| Display ON/OFF | 0 | 0 | 0 | 0 | 0 | 0 | 1 | D | C | B | Set display(D), cursor(C), and blinking of cursor(B) on/off control bit. | 38us |
| 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. | 38us |
| 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:5x10dots/5x8dots) | 38us |
| Set CGRAM Address | 0 | 0 | 0 | 1 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set CGRAM address in address counter. | 38us |
| Set DDRAM Address | 0 | 0 | 1 | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set DDRAM address in counter | 38us |
| 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. | 38us |
| Write Data to RAM | 1 | 0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | DO | Write data into internal RAM (DDRAM/CGRAM). | 38us |
| Read Data from RAM | 1 | 1 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | DO | Read data from internal RAM (DDRAM/CGRAM). | 38us |



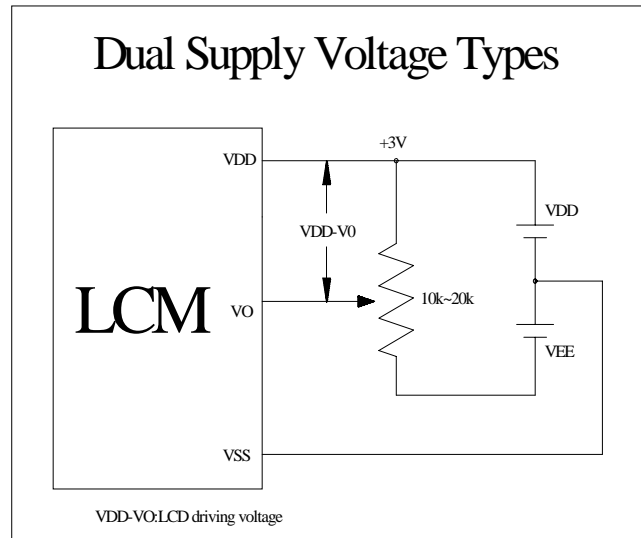
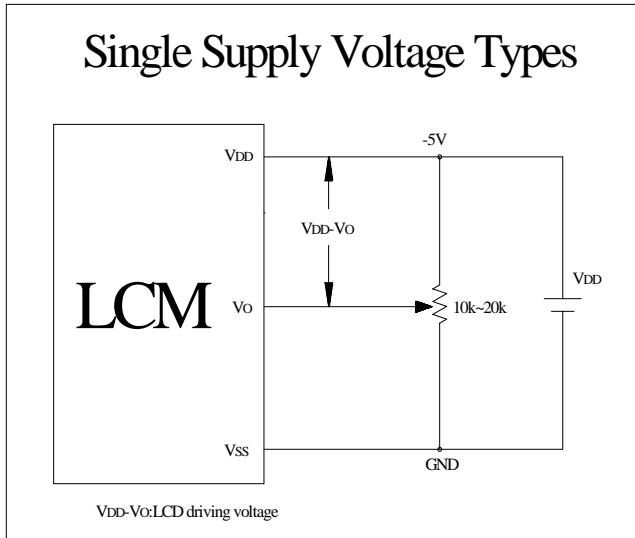
6. Operating Methods

a) Interface with MPU





b) Power supply



c) Operating example

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

| No | Instruction | Display | Operation |
|----|---|----------|---|
| 1 | Power on . (SPLC780A1 starts initializing) | | Power on reset. No display. |
| 2 | Function set RS R/W D7 D6 D5 D4 D3 D2 D1 D0 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 appears. |
| 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 incremented by one and shifted 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 | COMPANY | 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 | COMPANY | 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 | OMPANY | 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 . (SPLC780A1 starts initializing) | | Power on reset. No display. |
| 2 | Function set RS R/W D7 D6 D5 D4 0 0 0 0 1 0 | | Set to 4-bit operation |
| 3 | Function set 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 | Display on / off control 0 0 0 0 0 0 0 1 1 1 0 0 | - | Display on. Cursor appears. |
| 5 | Entry mode set 0 0 0 0 0 0 0 0 1 1 0 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 | Write data to CG RAM / DD RAM 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. |



Reset function

At power on, it starts the internal auto-reset circuit and executes the initial instructions .
There are the initial procedures shown as bellows:

