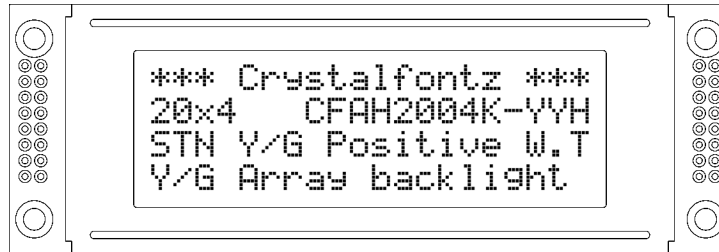


# Crystalfontz America, Incorporated

## CHARACTER LCD MODULE SPECIFICATIONS



|                           |  |
|---------------------------|--|
| Crystalfontz Model Number | <b>CFAH2004K-YYH-JP#</b>   |
| Hardware Version          | <b>v0.0 December 2005</b>  |
| Data Sheet Version        | <b>v0.0a January 2006</b>  |
| Product Pages             | <a href="http://www.crystalfontz.com/products/2004K">www.crystalfontz.com/products/2004K</a> |

|                      |  |
|----------------------|--|
| Customer Name        |  |
| Customer Part Number |  |

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## REVISION HISTORY

| HARDWARE   |  |
|------------|--|
| 2005/12/01 | Current hardware version: <b>v0.0</b><br>New module. |

| DATA SHEET |   |
|------------|---|
| 2005/12/01 | Data Sheet version: v0.0<br>New Data Sheet.   |
| 2006/01/01 | Current Data Sheet version: <b>v0.0a</b><br>Changes since last released version (v0.0):<br>Added " <a href="#">Luminous Intensity</a> " specification (Pg. 12).<br>Minor formatting and rewording changes to improve readability. |

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## FEATURES

- ❑ 20x4 LCD has a large display area in a compact 116 mm x 40 mm package (4.57" x 1.57"). CFAH2004K-YYH-JP# is only 2 millimeters higher than our 20x2 LCD [CFAH2002A](#).
- ❑ 8-bit or 4-bit parallel interface.
- ❑ Industry standard HD47780 compatible controller.
- ❑ RoHS compliant (indicated by “#” at the end of the part number).
- ❑ Yellow-green array LED backlit with STN yellow-green, positive transfective mode LCD (displays dark characters on yellow-green background).
- ❑ Wide temperature operation: -20 °C to +70°C.
- ❑ Sunlight readable.

## MODULE CLASSIFICATION INFORMATION

C
F
A
H
2
0
0
4
K
-
Y
Y
H
-
J
P
#

❶
❷
❸
❹
❺
❻
❼
❽
❾
❿

|   |  |                                 |
|---|--|---------------------------------|
| ❶ | Brand  | Crystalfontz America, Inc.      |
| ❷ | Display Type   | H – Character                   |
| ❸ | Number of Characters (horizontally)  | 20                              |
| ❹ | Number of Lines (vertically)   | 04                              |
| ❺ | Model Identifier   | K                               |
| ❻ | Backlight Type & Color   | Y – LED, yellow-green           |
| ❼ | Fluid Type, Image (positive or negative), & LCD Glass Color                      | Y – STN, positive, yellow-green |
| ❽ | Polarizer Film Type, Temperature Range (normal or wide), & View Angle (o ‘clock) | H – Transflective, WT, 6:00     |
| ❾ | CGROM Font   | JP – Japanese and English       |
| ❿ | RoHS Status  | # – RoHS Compliant              |

## ORDERING INFORMATION

| PART NUMBER       | FLUID | LCD GLASS COLOR | IMAGE    | POLARIZER FILM | BACKLIGHTS              |
|-------------------|-------|-----------------|----------|----------------|-------------------------|
| CFAH2004K-YYH-JP# | STN   | yellow-green    | positive | transflective  | yellow-green array LEDs |

Also see [Backlight Characteristics \(By Module Part Number\) \(Pg. 12\)](#).

# SYSTEM BLOCK DIAGRAM

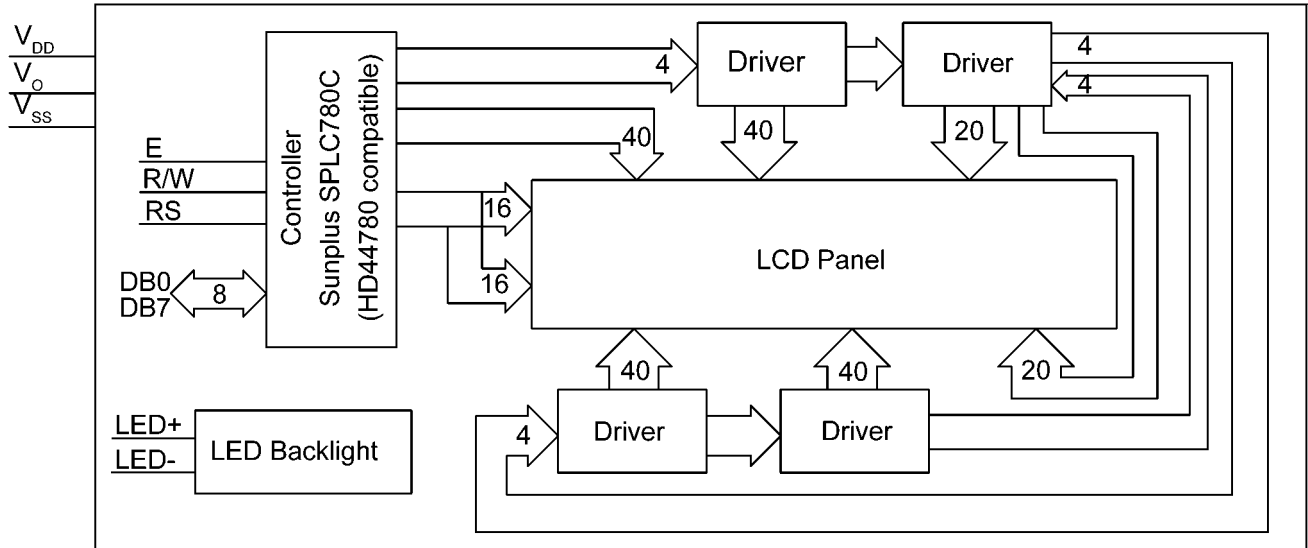


Figure 1. System Block Diagram

## PHYSICAL CHARACTERISTICS

| ITEM              | SIZE (mm)                   |
|-------------------|-----------------------------|
| Module Dimensions | 116 (W) x 40 (H) x 15.0 (D) |
| Viewing Area      | 76 (W) x 25.2 (H)           |
| Active Area       | 70.4 (W) x 20.8 (H)         |
| Character Size    | 2.95 (W) x 4.75 (H)         |
| Character Pitch   | 3.55 (W) x 5.35 (H)         |
| Dot Size          | .55 (W) x .55 (H)           |
| Dot Pitch         | .60 (W) x .60 (H)           |
| Depth             | 15.0                        |
| Weight            | 68 grams (typical)          |

## TEMPERATURE RANGE

| CRITERIA                    | SPECIFICATION                  |
|-----------------------------|--------------------------------|
| Operating Temperature Range | -20°C minimum to +70°C maximum |
| Storage Temperature Range   | -30°C minimum to +80°C maximum |

## OPTICAL CHARACTERISTICS

|                   |           |
|-------------------|-----------|
| Viewing Direction | 6 o'clock |
|-------------------|-----------|

| ITEM              | SYMBOL       | CONDITION | MINIMUM | TYPICAL | MAXIMUM |
|-------------------|--------------|-----------|---------|---------|---------|
| View Angle        | (V) $\theta$ | CR>2      | -20°    |         | 35°     |
| Contrast Ratio    | (H) $\rho$   | CR>2      | -30°    |         | 30°     |
| LCD Response Time | T rise       |           |         | 250 ms  |         |
|                   | T fall       |           |         | 250 ms  |         |

## CONDITIONS FOR DEFINITIONS IN FIGURES 2 AND 3

- Operating Voltage:  $V_{OP}$
- Viewing Angle ( $\theta, \varphi$ ):  $0^\circ, 0^\circ$
- Frame Frequency: 64 Hz
- Driving Waveform: 1/N Duty, 1/a Bias

## DEFINITION OF OPERATION VOLTAGE ( $V_{OP}$ )

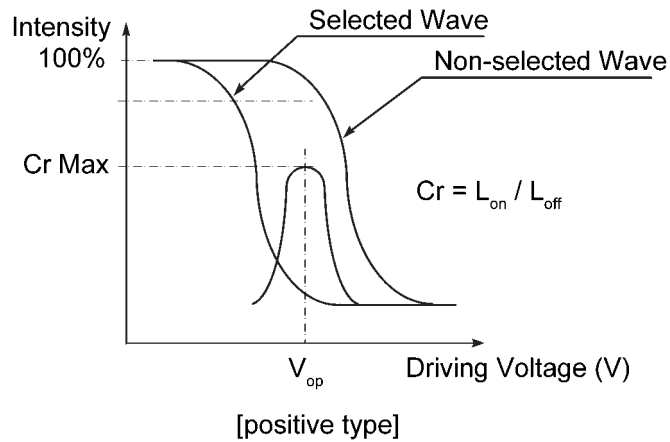


Figure 2. Definition of Operation Voltage ( $V_{OP}$ )

## DEFINITION OF RESPONSE TIME ( $T_R, T_F$ )

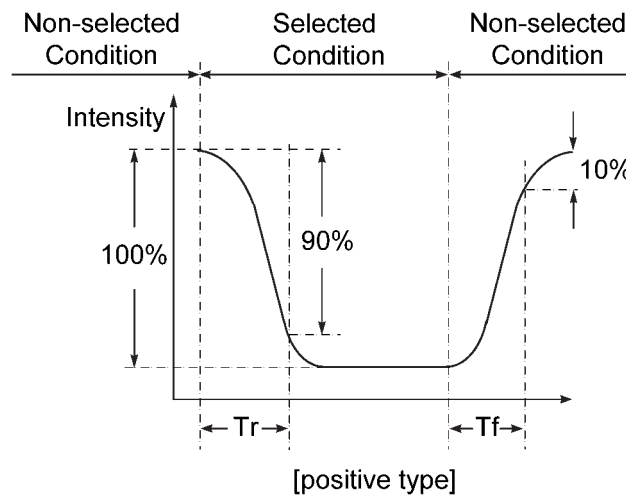


Figure 3. Definition of Response Time ( $T_r, T_f$ )

## DEFINITION OF VIEWING ANGLE (CR>2)

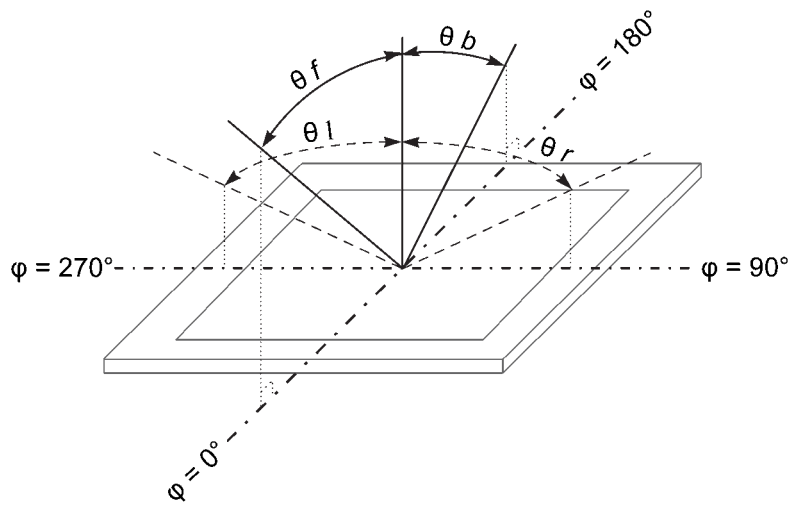


Figure 4. Definition of Viewing Angle



## ELECTRICAL SPECIFICATIONS

| DRIVING METHOD | SPECIFICATION |
|----------------|---------------|
| Duty           | 1/16          |
| Bias           | 1/5           |

| CHARACTERISTIC        | SYMBOL    | ABSOLUTE MAXIMUM RATINGS   |
|-----------------------|-----------|--|
| Operating Voltage     | $V_{DD}$  | -0.3v to +7.0v   |
| Driver Supply Voltage | $V_{LCD}$ | $V_{LCD} = V_{DD} - 12v$ to $V_{LCD} = V_{DD} + 0.3v$<br>or<br>$V_O = -7v$ to $V_O = +5.3v$<br>(for $V_{DD} = +5v$ ) |
| Input Voltage Range   | $V_{IN}$  | -0.3v to $V_{DD} + 0.3v$   |

| LCD SUPPLY VOLTAGE                                   |                     | MINIMUM | TYPICAL | MAXIMUM |
|--|---------------------|---------|---------|---------|
| Supply voltage for driving LCD<br>( $V_{DD} - V_O$ ) | $T_A = 0^\circ C$   |         |         | +4.8v   |
|  | $T_A = +25^\circ C$ |         | +4.5v   |         |
|  | $T_A = +50^\circ C$ | +4.2v   |         |         |

| CURRENT CONSUMPTION                           |  | MINIMUM | TYPICAL | MAXIMUM |
|---|--|---------|---------|---------|
| Supply current ( $I_{DD}$ )<br>$V_{DD} = +5v$ |  |         | +1.2 mA |         |

## DC CHARACTERISTICS

| CHARACTERISTICS     | SYMBOL    | MINIMUM      | TYPICAL     | MAXIMUM      | TEST CONDITION                                |
|---------------------|-----------|--------------|-------------|--------------|---|
| Input High Voltage  | $V_{IH1}$ | +2.2v        |             | $V_{DD}$     | Pins: E, RS, R/W, DB0 - DB7                   |
| Input Low Voltage   | $V_{IL1}$ | -0.3v        |             | -0.6v        |   |
| Input High Current  | $I_{IH}$  | -2.0 $\mu$ A |             | +2.0 $\mu$ A | Pins: RS, R/W, DB0 - DB7<br>$V_{DD} = +5.0$ v |
| Input Low Current   | $I_{IL}$  | -20 $\mu$ A  | -50 $\mu$ A | -100 $\mu$ A |   |
| Output High Voltage | $V_{OH1}$ | +2.4v        |             | $V_{DD}$     | $I_{OH} = -0.1$ mA<br>Pins: DB0 - DB7         |
| Output Low Voltage  | $V_{OL1}$ |              |             | +0.4v        | $I_{OL} = 0.1$ mA<br>Pins: DB0 - DB7          |

## ESD (ELECTRO-STATIC DISCHARGE)

The circuitry is industry standard CMOS logic and susceptible to ESD damage. Please use industry standard anti-static precautions as you would for any other PCB such as expansion cards or motherboards. For more information, read [CARE AND HANDLING PRECAUTIONS \(Pg. 18\)](#).

## TYPICAL $V_O$ CONNECTIONS

Adjust  $V_O$  to +1v ( $V_{LCD} = +4$ v) as an initial setting. When the module is operational, readjust  $V_O$  for optimal display appearance.

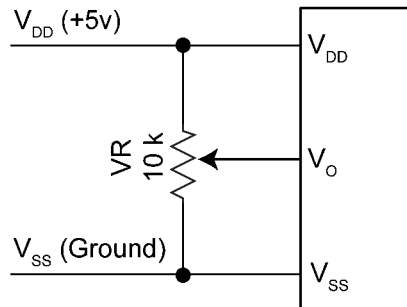


Figure 5.  $V_O$  Connections for Normal Temperature Operation

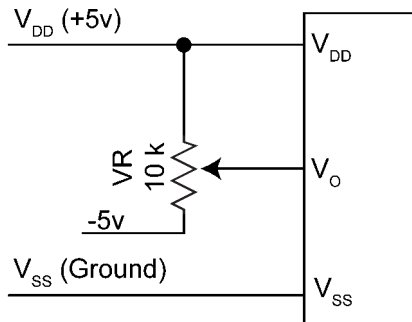


Figure 6.  $V_O$  Connections for Wide Temperature Operation

## BACKLIGHTS

The CFAH2004K-YYH-JP# uses LED backlights. LED backlights are easy to use properly but they are also easily damaged by abuse.

**NOTE**

Do not connect +5v to the backlight terminals. This will ruin the backlight.

LEDs are “current” devices. The important thing to an LED is the current flowing through it, not the voltage across it. Ideally, a current source would be used to drive the LEDs. In practice, a simple current limiting resistor will work well in most applications and is much less complex than a current source.

You need to know what the forward voltage of the LEDs will be so you can calculate a current limiting resistor ( $R_{LIMIT}$ ). The forward voltage will vary slightly from display to display.

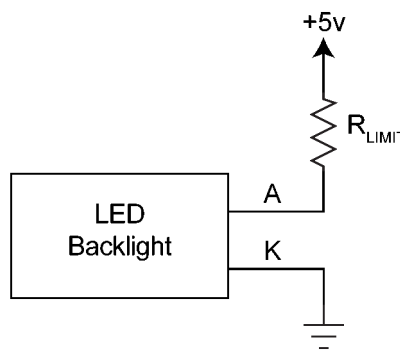


Figure 7. Typical LED Backlight Connections

The general equation to calculate  $R_{LIMIT}$  is:

$$R_{LIMIT} \text{ (minimum)} = \frac{V_{DD} \text{ (supply voltage)} - V_{LED} \text{ (LED forward voltage)}}{I_{LED} \text{ (maximum LED current)}}$$

The specific  $R_{LIMIT}$  calculation for the CFAH2004K-YYH-JP# at  $V_{DD} = +5v$  is:

$$R_{LIMIT} = \frac{5v - 4.2v}{0.180 \text{ A (maximum)}} = 5\Omega \text{ (minimum)}$$

The backlight may be dimmed by PWM (Pulse Width Modulation). The typical range for the PWM frequency is from 100 to 300 Hz.

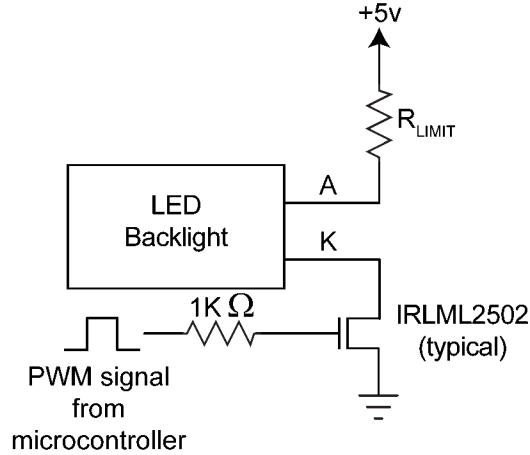


Figure 8. Typical LED Backlight Connections for PWM Dimming

## BACKLIGHT CHARACTERISTICS (BY MODULE PART NUMBER)

| <b>CFAH2004K-YYH-JP#</b>                                 |                |                    |                |
|--|----------------|--------------------|----------------|
| <i>Dark characters on yellow-green background</i>        |                |                    |                |
| <b>PARAMETER</b>   | <b>MINIMUM</b> | <b>TYPICAL</b>     | <b>MAXIMUM</b> |
| Current ( $I_{LED}$ )                                    |                | 180 mA             |                |
| Forward Voltage ( $V_{LED}$ )                            | +4.0v          | +4.2v              | +4.4v          |
| Reverse Voltage  |                |                    | +5v            |
| Luminous Intensity (IV)<br>$I_{LED} = 190 \text{ mA}$    |                | 34 $\text{cd/m}^2$ |                |
| Wavelength ( $\lambda_p$ )<br>$I_{LED} = 190 \text{ mA}$ |                | 568 nm             |                |

## RELIABILITY

---

| ITEM                              | SPECIFICATION                     |
|-----------------------------------|-----------------------------------|
| LCD portion (excluding Backlight) | 50,000 to 100,000 hours (typical) |
| Yellow-green LED Backlights       | 50,000 to 100,000 hours (typical) |

## INTERFACE PIN FUNCTIONS

| PIN | SIGNAL          | LEVEL    | DIRECTION | DESCRIPTION  |
|-----|-----------------|----------|-----------|--|
| 1   | V <sub>SS</sub> | +0v      | –         | Ground   |
| 2   | V <sub>DD</sub> | +5.0v    | –         | Supply voltage for logic   |
| 3   | V <sub>O</sub>  | variable | –         | Supply voltage for driving LCD<br>V <sub>O</sub> = +1v typical at V <sub>DD</sub> = +5v<br>which gives a<br>V <sub>LCD</sub> = (V <sub>DD</sub> - V <sub>O</sub> ) = +4v |
| 4   | RS              | H/L      | I         | Register selection input<br>H: data register (for read and write)<br>L: instruction code (for write)   |
| 5   | R/W             | H/L      | I         | Read/write selection input<br>H: read (MPU←module)<br>L: write (MPU→module)  |
| 6   | E               | H,H→L    | I         | Read/write enable signal<br>H: write data is latched on the falling edge<br>H→L: read data is enabled by a high level  |
| 7   | DB0             | H/L      | I/O       | Data bit 0   |
| 8   | DB1             | H/L      | I/O       | Data bit 1   |
| 9   | DB2             | H/L      | I/O       | Data bit 2   |
| 10  | DB3             | H/L      | I/O       | Data bit 3   |
| 11  | DB4             | H/L      | I/O       | Data bit 4   |
| 12  | DB5             | H/L      | I/O       | Data bit 5   |
| 13  | DB6             | H/L      | I/O       | Data bit 6   |
| 14  | DB7             | H/L      | I/O       | Data bit 7   |
| 15  | LED+ (A)        | –        | –         | Supply voltage for LED<br>“A” or “anode” or “+” of LED backlight   |
| 16  | LED- (K)        | –        | –         | Supply voltage for LED<br>“K” or “cathode” or “-” of LED backlight   |

## SPLC780C CONTROLLER INTERFACE INFORMATION

---

The CFAH2004K-YYH-JP# uses a Sunplus SPLC780C controller. The CFAH2004K-YYH-JP# is compatible with the industry standard Hitachi HD44780 controller. Software written for modules that use the HD44780 should work without modification for the CFAH2004K-YYH-JP#.

For your reference, we included the SPLC780C controller data sheet as an appendix to this CFAH2004K-YYH-JP# data sheet. Links to some of the most useful sections of the SPLC780C data sheet are:

- Instruction description (see [5. Functional Description in Appendix B, page 6](#)).
- Instruction table (see [5.3 Instruction Table in Appendix B, page 8](#).)
- Initializing the module (see [5.7 Reset Function in Appendix B, page 11](#)).
- Timing Characteristics (see [6. Electrical Specifications in Appendix B, page 21](#)).

## DISPLAY POSITION DDRAM ADDRESS

---

The following table shows the relationship between the controller's addresses and the corresponding character location on the CFAH2004K-YYH-JP#.

| ROW | COLUMN |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|-----|--------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|     | 0      | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13   | 14   | 15   | 16   | 17   | 18   | 19   |
| 0   | 0x00   | 0x01 | 0x02 | 0x03 | 0x04 | 0x05 | 0x06 | 0x07 | 0x08 | 0x09 | 0xA  | 0xB  | 0xC  | 0xD  | 0xE  | 0xF  | 0x10 | 0x11 | 0x12 | 0x13 |
| 1   | 0x40   | 0x41 | 0x42 | 0x43 | 0x44 | 0x45 | 0x46 | 0x47 | 0x48 | 0x49 | 0x4A | 0x4B | 0x4C | 0x4D | 0x4E | 0x4F | 0x50 | 0x51 | 0x52 | 0x53 |
| 2   | 0x14   | 0x15 | 0x16 | 0x17 | 0x18 | 0x19 | 0x1A | 0x1B | 0x1C | 0x1D | 0x1E | 0x1F | 0x20 | 0x21 | 0x22 | 0x23 | 0x24 | 0x25 | 0x26 | 0x27 |
| 3   | 0x54   | 0x55 | 0x56 | 0x57 | 0x58 | 0x58 | 0x5A | 0x5B | 0x5C | 0x5D | 0x5E | 0x5F | 0x60 | 0x61 | 0x62 | 0x63 | 0x64 | 0x65 | 0x66 | 0x67 |

## CHARACTER GENERATOR ROM (CGROM)

To find the code for a given character, add the two numbers that are shown in bold for its row and column. For example, the lowercase "h" is in the column labeled "96<sub>10</sub>" and in the row labeled "8<sub>10</sub>". So you would add 96 + 8 to get 104. When you send a byte with the value of 104 to the display, then a lowercase "h" will be shown. Additional character sets are available. Minimum order may be required. (See [APPENDIX B: SUNPLUS SPLC780C CONTROLLER DATA SHEET \(Pg. 26\).](#))

| upper<br>4 bits<br>lower<br>4 bits    | 0 <sub>10</sub><br>0000 <sub>2</sub> | 16 <sub>10</sub><br>0001 <sub>2</sub> | 32 <sub>10</sub><br>0010 <sub>2</sub> | 48 <sub>10</sub><br>0011 <sub>2</sub> | 64 <sub>10</sub><br>0100 <sub>2</sub> | 80 <sub>10</sub><br>0101 <sub>2</sub> | 96 <sub>10</sub><br>0110 <sub>2</sub> | 112 <sub>10</sub><br>0111 <sub>2</sub> | 128 <sub>10</sub><br>1000 <sub>2</sub> | 144 <sub>10</sub><br>1001 <sub>2</sub> | 160 <sub>10</sub><br>1010 <sub>2</sub> | 176 <sub>10</sub><br>1011 <sub>2</sub> | 192 <sub>10</sub><br>1100 <sub>2</sub> | 208 <sub>10</sub><br>1101 <sub>2</sub> | 224 <sub>10</sub><br>1110 <sub>2</sub> | 240 <sub>10</sub><br>1111 <sub>2</sub> |
|---------------------------------------|--------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|--|--|--|--|--|--|--|--|--|
| 0 <sub>10</sub><br>0000 <sub>2</sub>  | CGRAM<br>[0]                         |                                       |                                       | 0                                     | 1                                     | 2                                     | 3                                     | 4                                      |  |  |  | 5                                      | 6                                      | 7                                      | 8                                      | 9                                      |
| 1 <sub>10</sub><br>0001 <sub>2</sub>  | CGRAM<br>[1]                         |                                       | !                                     | 1                                     | 2                                     | 3                                     | 4                                     | 5                                      |  |  |  | 6                                      | 7                                      | 8                                      | 9                                      | 0                                      |
| 2 <sub>10</sub><br>0010 <sub>2</sub>  | CGRAM<br>[2]                         |                                       | "                                     | 2                                     | 3                                     | 4                                     | 5                                     | 6                                      |  |  |  | 7                                      | 8                                      | 9                                      | 0                                      | 1                                      |
| 3 <sub>10</sub><br>0011 <sub>2</sub>  | CGRAM<br>[3]                         |                                       | #                                     | 3                                     | 4                                     | 5                                     | 6                                     | 7                                      |  |  |  | 8                                      | 9                                      | 0                                      | 1                                      | 2                                      |
| 4 <sub>10</sub><br>0100 <sub>2</sub>  | CGRAM<br>[4]                         |                                       | \$                                    | 4                                     | 5                                     | 6                                     | 7                                     | 8                                      |  |  |  | 9                                      | 0                                      | 1                                      | 2                                      | 3                                      |
| 5 <sub>10</sub><br>0101 <sub>2</sub>  | CGRAM<br>[5]                         |                                       | %                                     | 5                                     | 6                                     | 7                                     | 8                                     | 9                                      |  |  |  | 0                                      | 1                                      | 2                                      | 3                                      | 4                                      |
| 6 <sub>10</sub><br>0110 <sub>2</sub>  | CGRAM<br>[6]                         |                                       | &                                     | 6                                     | 7                                     | 8                                     | 9                                     | 0                                      |  |  |  | 1                                      | 2                                      | 3                                      | 4                                      | 5                                      |
| 7 <sub>10</sub><br>0111 <sub>2</sub>  | CGRAM<br>[7]                         |                                       | '                                     | 7                                     | 8                                     | 9                                     | 0                                     | 1                                      |  |  |  | 2                                      | 3                                      | 4                                      | 5                                      | 6                                      |
| 8 <sub>10</sub><br>1000 <sub>2</sub>  |                                      |                                       | (                                     | 8                                     | 9                                     | 0                                     | 1                                     | 2                                      |  |  |  | 3                                      | 4                                      | 5                                      | 6                                      | 7                                      |
| 9 <sub>10</sub><br>1001 <sub>2</sub>  |                                      |                                       | )                                     | 9                                     | 0                                     | 1                                     | 2                                     | 3                                      |  |  |  | 4                                      | 5                                      | 6                                      | 7                                      | 8                                      |
| 10 <sub>10</sub><br>1010 <sub>2</sub> |                                      |                                       | *                                     | 0                                     | 1                                     | 2                                     | 3                                     | 4                                      |  |  |  | 5                                      | 6                                      | 7                                      | 8                                      | 9                                      |
| 11 <sub>10</sub><br>1011 <sub>2</sub> |                                      |                                       | +                                     | 1                                     | 2                                     | 3                                     | 4                                     | 5                                      |  |  |  | 6                                      | 7                                      | 8                                      | 9                                      | 0                                      |
| 12 <sub>10</sub><br>1100 <sub>2</sub> |                                      |                                       | ,                                     | 2                                     | 3                                     | 4                                     | 5                                     | 6                                      |  |  |  | 7                                      | 8                                      | 9                                      | 0                                      | 1                                      |
| 13 <sub>10</sub><br>1101 <sub>2</sub> |                                      |                                       | =                                     | 3                                     | 4                                     | 5                                     | 6                                     | 7                                      |  |  |  | 8                                      | 9                                      | 0                                      | 1                                      | 2                                      |
| 14 <sub>10</sub><br>1110 <sub>2</sub> |                                      |                                       | .                                     | 4                                     | 5                                     | 6                                     | 7                                     | 8                                      |  |  |  | 9                                      | 0                                      | 1                                      | 2                                      | 3                                      |
| 15 <sub>10</sub><br>1111 <sub>2</sub> |                                      |                                       | /                                     | 5                                     | 6                                     | 7                                     | 8                                     | 9                                      |  |  |  | 0                                      | 1                                      | 2                                      | 3                                      | 4                                      |

Figure 9. Character Generator ROM (CGROM)



# MODULE OUTLINE DRAWING

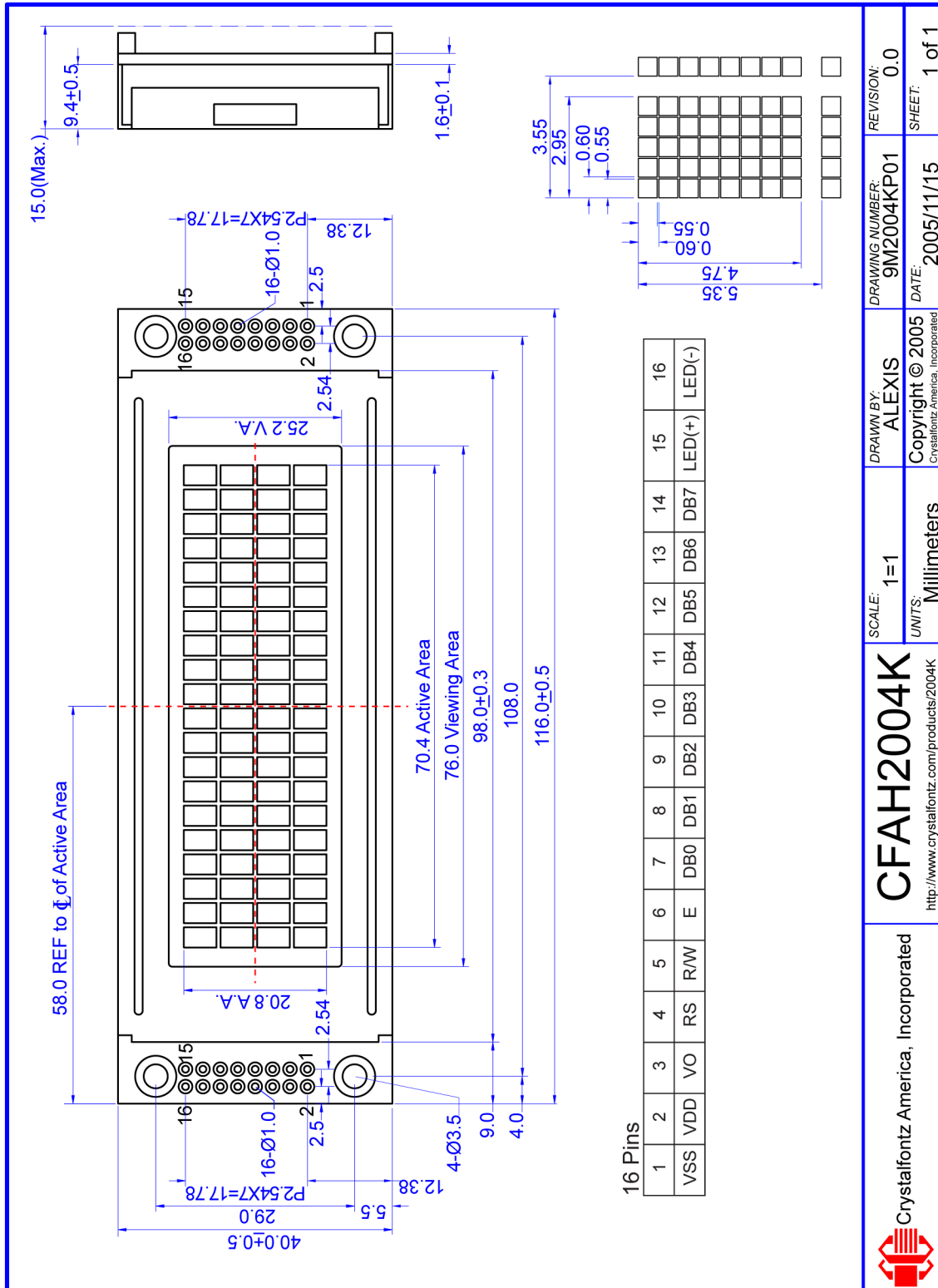


Figure 10. CFAH2004K Module Outline Drawing

## CARE AND HANDLING PRECAUTIONS

---

For optimum operation of the CFAH2004K-YYH-JP# and to prolong its life, please follow the precautions described below.

### ELECTROSTATIC DISCHARGE (ESD)

Please use industry standard antistatic precautions as you would for any other PCB such as expansion cards or motherboards. Ground your body, work surfaces, and equipment.

### DESIGN AND MOUNTING

- To protect the polarizer from damage, the CFAH2004K-YYH-JP# ships with a protective film over the LCD glass. Please peel off the protective film slowly. Peeling off the protective film abruptly may generate static electricity.
- Place a transparent plate (for example, acrylic, polycarbonate, or glass) in front of the CFAH2004K-YYH-JP#, leaving a small gap between the plate and the display surface. We use GE HP-92 Lexan, which is readily available and works well.
- Do not disassemble or modify the CFAH2004K-YYH-JP#.
- Do not modify the tab of the metal holder or make connections to it.
- Solder only to the I/O terminals. Use care when removing solder—it is possible to damage the PCB.
- Do not reverse polarity to the power supply connections. Reversing polarity will immediately ruin the module.

### AVOID SHOCK, IMPACT, TORQUE, AND TENSION

- Do not expose the CFAH2004K-YYH-JP# to strong mechanical shock, impact, torque, and tension.
- Do not drop, toss, bend, or twist the CFAH2004K-YYH-JP#.
- Do not place weight or pressure on the CFAH2004K-YYH-JP#.

### IF LCD PANEL BREAKS

- If the LCD panel breaks, be careful to not get the liquid crystal fluid in your mouth or eyes.
- If the liquid crystal fluid touches your skin, clothes, or work surface, wash it off immediately using soap and plenty of water.
- Do not eat the LCD panel.

### CLEANING

- To clean the front of the LCD, a standard household glass cleaner works well. Gently wipe with a nonabrasive soft cloth.
- The exposed surface of the LCD “glass” is actually the front polarizer laminated to the glass. The polarizer is made out of a fairly soft plastic and is easily scratched or damaged. The polarizer will eventually become hazy if you do not take great care when cleaning it. Long contact with moisture (from condensation or cleaning) may permanently spot or stain the polarizer.

## OPERATION

- Your circuit should be designed to protect the CFAH2004K-YYH-JP# from ESD and power supply transients.
- Observe the operating temperature limitations: a minimum of -20°C to +70°C maximum with minimal fluctuations. Operation outside of these limits may shorten the life and/or harm the display.
  - At lower temperatures of this range, response time is delayed.
  - At higher temperatures of this range, display becomes dark. (You may need to adjust the contrast.)
- Operate away from dust, moisture, and direct sunlight.

## STORAGE

- Store in an ESD-approved container away from dust, moisture, and direct sunlight.
- Observe the storage temperature limitations: a minimum of -30°C minimum to +80°C maximum with minimal fluctuations. Rapid temperature changes can cause moisture to form, resulting in permanent damage.
- Do not allow weight to be placed on the CFAH2004K-YYH-JP#s while they are in storage.

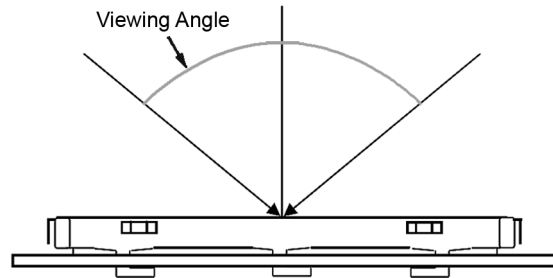


# APPENDIX A: QUALITY ASSURANCE STANDARDS

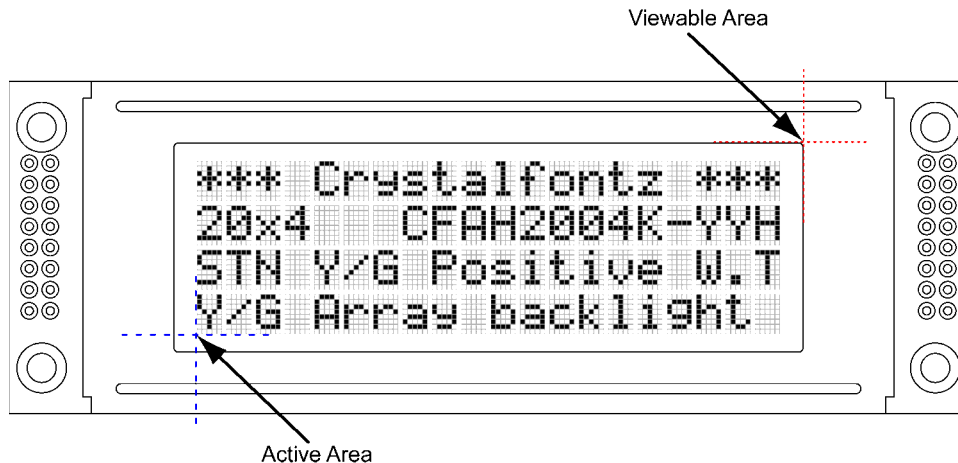
---

## INSPECTION CONDITIONS

- Environment
  - Temperature:  $25\pm 5^{\circ}\text{C}$
  - Humidity: 30~85% RH
- For visual inspection of active display area
  - Source lighting: two 20 Watt or one 40 Watt fluorescent light
  - Display adjusted for best contrast
  - Viewing distance:  $30\pm 5$  cm (about 12 inches)
  - Viewable angle: inspect at  $45^{\circ}$  angle of vertical line right and left, top and bottom



## DEFINITION OF ACTIVE AREA AND VIEWABLE AREA





## ACCEPTANCE SAMPLING


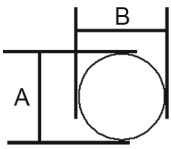
| DEFECT TYPE   | AQL*  |
|---|-------|
| Major   | ≤.65% |
| Minor   | <1.0% |
| * Acceptable Quality Level: maximum allowable error rate or variation from standard |       |

## DEFECTS CLASSIFICATION

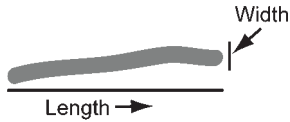
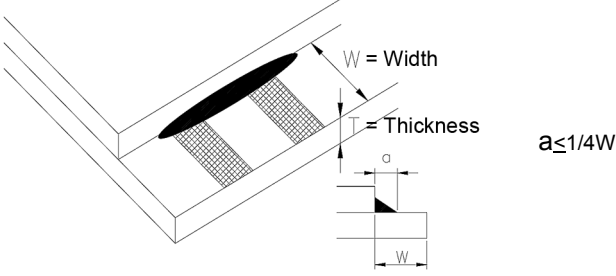
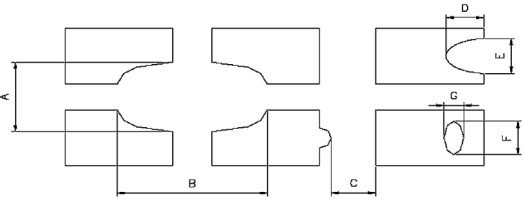
Defects are defined as:

- Major Defect: results in failure or substantially reduces usability of unit for its intended purpose
- Minor Defect: deviates from standards but is not likely to reduce usability for its intended purpose

## ACCEPTANCE STANDARDS

| # | DEFECT TYPE   | CRITERIA   |                                       | MAJOR / MINOR         |       |
|---|---|--|---------------------------------------|-----------------------|-------|
| 1 | Electrical defects  | 1. No display, display malfunctions, or shorted segments.<br>2. Current consumption exceeds specifications.    |                                       | Major                 |       |
| 2 | Viewing area defect   | Viewing area does not meet specifications. (See <a href="#">Inspection Conditions (Pg. 20)</a> ).              |                                       | Major                 |       |
| 3 | Contrast adjustment defect                                    | Contrast adjustment fails or malfunctions.   |                                       | Major                 |       |
| 4 | Blemishes or foreign matter on display segments               |                             | <i>Defect Size (mm)</i>               | <i>Acceptable Qty</i> | Minor |
|   |   |  | ≤0.3                                  | 3                     |       |
|   |   |  | ≤2 defects within 10 mm of each other |                       |       |
| 5 | Other blemishes or foreign matter outside of display segments | Defect size = (A + B)/2<br> | <i>Defect Size (mm)</i>               | <i>Acceptable Qty</i> | Minor |
|   |   |  | ≤0.15                                 | Ignore                |       |
|   |   |  | 0.15 to 0.20                          | 3                     |       |
|   |   |  | 0.20 to 0.25                          | 2                     |       |
|   |   |  | 0.25 to 0.30                          | 1                     |       |



| # | DEFECT TYPE  | CRITERIA   |   |                       | MAJOR / MINOR |
|---|--|--|---|-----------------------|---------------|
| 6 | Dark lines or scratches in display area<br><br> | <i>Defect Width (mm)</i>   | <i>Defect Length (mm)</i>                             | <i>Acceptable Qty</i> | Minor         |
|   |  | ≤0.03  | ≤3.0  | 3                     |               |
|   |  | 0.03 to 0.05   | ≤2.0  | 2                     |               |
|   |  | 0.05 to 0.08   | ≤2.0  | 1                     |               |
|   |  | 0.08 to 0.10   | ≤3.0  | 0                     |               |
|   |  | ≥0.10  | >3.0  | 0                     |               |
| 7 | Bubbles between polarizer film and glass   | <i>Defect Size (mm)</i>  | <i>Acceptable Qty</i>                                 | Minor                 |               |
|   |  | ≤0.20  | Ignore  |                       |               |
|   |  | 0.20 to 0.40   | 3   |                       |               |
|   |  | 0.40 to 0.60   | 2   |                       |               |
|   |  | ≥0.60  | 0   |                       |               |
| 8 | Glass rest defect  |   |   |                       | Minor         |
| 9 | Display pattern defect   |  |   |                       | Minor         |
|   |  | <i>Dot Size (mm)</i>   | <i>Acceptable Qty</i>                                 |                       |               |
|   |  | $((A+B)/2) \leq 0.2$   | $\leq 3$ total defects<br>$\leq 2$ pinholes per digit |                       |               |
|   |  | $C > 0$  |   |                       |               |
|   |  | $((D+E)/2) \leq 0.25$  |   |                       |               |
|   |  | $((F+G)/2) \leq 0.25$  |   |                       |               |



| #  | DEFECT TYPE                                       | CRITERIA | MAJOR / MINOR |          |          |          |                       |
|----|---|----------|---------------|----------|----------|----------|-----------------------|
| 10 | Chip in corner                                    |          | Minor         |          |          |          |                       |
|    |   |          |               | <i>a</i> | <i>b</i> | <i>c</i> | <i>Acceptable Qty</i> |
|    |   |          |               | ≤4 mm    | ≤W       | c≤T      | 3                     |
| 11 | Chip on "non-contact" edge of LCD                 |          | Minor         |          |          |          |                       |
|    |   |          |               | <i>a</i> | <i>b</i> | <i>c</i> | <i>Acceptable Qty</i> |
|    |   |          |               | ≤3 mm    | ≤1 mm    | ≤T       | Ignore                |
|    |   |          |               | ≤4 mm    | ≤1.5 mm  | ≤T       | 3                     |
| 12 | Chip on "contact" edge of LCD, on the active side |          | Minor         |          |          |          |                       |
|    |   |          |               | <i>a</i> | <i>b</i> | <i>c</i> | <i>Acceptable Qty</i> |
|    |   |          |               | ≤2 mm    | ≤W/4     | ≤T       | Ignore                |
|    |   |          |               | ≤3 mm    | ≤W/4     | ≤T       | 3                     |



| #   | DEFECT TYPE   | CRITERIA  | MAJOR / MINOR      |          |          |                |                |       |         |        |        |       |         |    |   |
|---|---|---|--------------------|----------|----------|----------------|----------------|-------|---------|--------|--------|-------|---------|----|---|
| 13  | Chip on "contact" edge of LCD, on the inactive side |   | Minor              |          |          |                |                |       |         |        |        |       |         |    |   |
|   |   | <table border="1"> <thead> <tr> <th><i>a</i></th> <th><i>b</i></th> <th><i>c</i></th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td>≤3 mm</td> <td>≤1 mm</td> <td>≤T</td> <td>Ignore</td> </tr> <tr> <td>≤4 mm</td> <td>≤1.5 mm</td> <td>≤T</td> <td>3</td> </tr> </tbody> </table>   |                    | <i>a</i> | <i>b</i> | <i>c</i>       | Acceptable Qty | ≤3 mm | ≤1 mm   | ≤T     | Ignore | ≤4 mm | ≤1.5 mm | ≤T | 3 |
|   |   | <i>a</i>  |                    | <i>b</i> | <i>c</i> | Acceptable Qty |                |       |         |        |        |       |         |    |   |
|   |   | ≤3 mm   |                    | ≤1 mm    | ≤T       | Ignore         |                |       |         |        |        |       |         |    |   |
| ≤4 mm   | ≤1.5 mm   | ≤T  | 3                  |          |          |                |                |       |         |        |        |       |         |    |   |
|   |   |   |                    |          |          |                |                |       |         |        |        |       |         |    |   |
|   |   |   |                    |          |          |                |                |       |         |        |        |       |         |    |   |
| 14  | Chip in seal area                                   |   | Minor<br><br>Major |          |          |                |                |       |         |        |        |       |         |    |   |
|   |   | <table border="1"> <thead> <tr> <th><i>a</i></th> <th><i>b</i></th> <th><i>c</i></th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td>&lt;3 mm</td> <td>≤1.5 mm</td> <td>≤1/2 T</td> <td>3</td> </tr> </tbody> </table>   |                    | <i>a</i> | <i>b</i> | <i>c</i>       | Acceptable Qty | <3 mm | ≤1.5 mm | ≤1/2 T | 3      |       |         |    |   |
|   |   | <i>a</i>  |                    | <i>b</i> | <i>c</i> | Acceptable Qty |                |       |         |        |        |       |         |    |   |
|   |   | <3 mm   |                    | ≤1.5 mm  | ≤1/2 T   | 3              |                |       |         |        |        |       |         |    |   |
| Unacceptable if $c > 50\%$ of glass thickness or if the seal area is damaged. |   |   |                    |          |          |                |                |       |         |        |        |       |         |    |   |
|   |   |   |                    |          |          |                |                |       |         |        |        |       |         |    |   |
| 15  | Backlight defects                                   | <ol style="list-style-type: none"> <li>1. Light fails or flickers. (Major)</li> <li>2. Color and luminance do not correspond to specifications. (Major)</li> <li>3. Exceeds standards for display's blemishes or foreign matter (<a href="#">see test 5, Pg. 21</a>), and dark lines or scratches (<a href="#">see test 6, Pg. 22</a>). (Minor)</li> </ol>  | See list           |          |          |                |                |       |         |        |        |       |         |    |   |
| 16  | COB defects   | <ol style="list-style-type: none"> <li>1. Pinholes &gt;0.2 mm.</li> <li>2. Seal surface has pinholes through to the IC.</li> <li>3. More than 3 locations of sealant beyond 2 mm of the sealed areas.</li> </ol>  | Minor              |          |          |                |                |       |         |        |        |       |         |    |   |
| 17  | PCB defects   | <ol style="list-style-type: none"> <li>1. Oxidation or contamination on connectors.*</li> <li>2. Wrong parts, missing parts, or parts not in specification.*</li> <li>3. Jumpers set incorrectly. (Minor)</li> <li>4. Solder (if any) on bezel, LED pad, zebra pad, or screw hole pad is not smooth. (Minor)</li> </ol> <p>*Minor if display functions correctly. Major if the display fails.</p> | See list           |          |          |                |                |       |         |        |        |       |         |    |   |





| #  | DEFECT TYPE       | CRITERIA   | MAJOR / MINOR |
|----|-------------------|--|---------------|
| 18 | Soldering defects | 1. Unmelted solder paste.<br>2. Cold solder joints, missing solder connections, or oxidation.*<br>3. Solder bridges causing short circuits.*<br>4. Residue or solder balls.<br>5. Solder flux is black or brown.<br>*Minor if display functions correctly. Major if the display fails. | Minor         |

## **APPENDIX B: SUNPLUS SPLC780C CONTROLLER DATA SHEET**

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The complete *Sunplus SPLC780C 16COM/40SEG Controller/Driver Data Sheet* (47 pages) follows.

# DATA SHEET



## **SPLC780C**

---

### **16COM/40SEG Controller/Driver**

JUL. 09, 2002

Version 1.1

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## 16COM/40SEG CONTROLLER/DRIVER

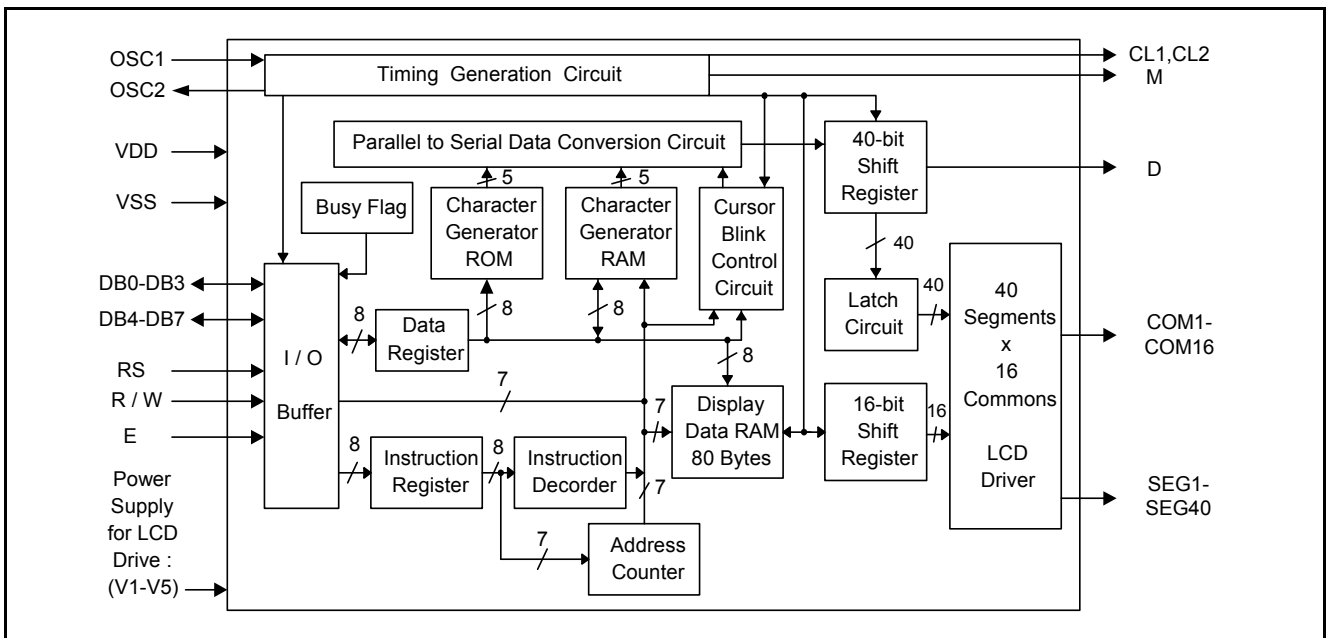
### 1. GENERAL DESCRIPTION

The SPLC780C, a dot-matrix LCD controller and driver from SUNPLUS, is a unique design for displaying alpha-numeric, Japanese-Kana characters and symbols. The SPLC780C provides two types of interfaces to MPU: 4-bit and 8-bit interfaces. The transferring speed of 8-bit is twice faster than 4-bit. A single SPLC780C is able to display up to two 8-character lines. By cascading with SPLC100 or SPLC063, the display capability can be extended. The CMOS technology ensures the power saves in the most efficient way and the performance keeps in the highest rank.

### 2. FEATURES

- Character generator ROM: 10880 bits
  - Character font 5 x 8 dots: 192 characters
  - Character font 5 x 10 dots: 64 characters
- Character generator RAM: 512 bits
  - Character font 5 x 8 dots: 8 characters
  - Character font 5 x 10 dots: 4 characters
- 4-bit or 8-bit MPU interfaces
- Direct driver for LCD: 16 COMs x 40 SEGs
- Duty factor (selected by program):
  - 1/8 duty: 1 line of 5 x 8 dots
  - 1/11 duty: 1 line of 5 x 10 dots
  - 1/16 duty: 2 lines of 5 x 8 dots / line
- Built-in power on automatic reset circuit
- Built-in oscillator circuit (with external resistor)
- Support external clock operation
- Low Power Consumption
- Package form: 80 QFP or bare chip available

### 3. BLOCK DIAGRAM



#### 4. SIGNAL DESCRIPTIONS

| Mnemonic                      | PIN No.           | Type | Description   |
|-------------------------------|-------------------|------|---|
| VDD                           | 33                | I    | Power input   |
| VSS                           | 23                | I    | Ground  |
| OSC1<br>OSC2                  | 24<br>25          | -    | Both OSC1 and OSC2 are connected to resistor for internal oscillator circuit. For external clock operation, the clock is input to OSC1.                       |
| V1 - V5                       | 26 - 30           | I    | Supply voltage for LCD driving.   |
| E                             | 38                | I    | A start signal for reading or writing data.   |
| RW                            | 37                | I    | A signal for selecting read or write actions.<br>1: Read, 0: Write.   |
| RS                            | 36                | I    | A signal for selecting registers.<br>1: Data Register (for read and write)<br>0: Instruction Register (for write),<br>Busy flag - Address Counter (for read). |
| DB0 - DB3                     | 39 - 42           | I/O  | Low 4-bit data  |
| DB4 - DB7                     | 43 - 46           | I/O  | High 4-bit data   |
| CL1                           | 31                | O    | Clock to latch serial data D.   |
| CL2                           | 32                | O    | Clock to shift serial data D.   |
| M                             | 34                | O    | Switch signal to convert LCD waveform to AC.  |
| D                             | 35                | O    | Sends character pattern data corresponding to each common signal serially.<br>1: Selection, 0: Non-selection.   |
| SEG1 - SEG22<br>SEG23 - SEG40 | 22 - 1<br>80 - 63 | O    | Segment signals for LCD.  |
| COM1 - COM16                  | 47 - 62           | O    | Common signals for LCD.   |

## 5. FUNCTIONAL DESCRIPTIONS

### 5.1. Oscillator

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

### 5.2. Control and Display Instructions

Control and display instructions are described in details as follows:

#### 5.2.1. 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.

#### 5.2.2. 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.

#### 5.2.3. 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 |

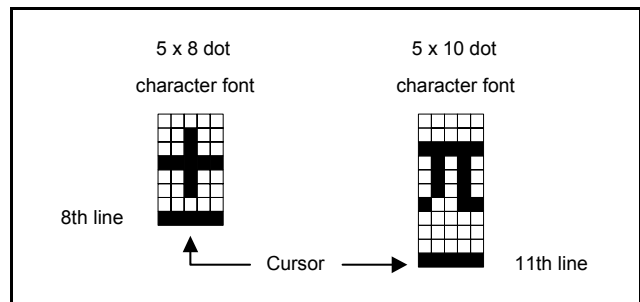
#### 5.2.4. Display ON/OFF control

|      |    |     |     |     |     |     |     |     |     |     |
|------|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|      | 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

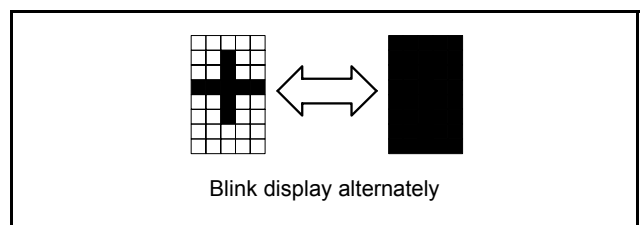
B = 1: Blinks on, B = 0: Blinks off



#### 5.2.5. 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         |



### 5.2.6. 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.

### 5.2.7. 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)<sub>2</sub> to the Address Counter.

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

### 5.2.8. 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 (aaaaaa)<sub>2</sub> 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),

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

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

### 5.2.9. 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)<sub>2</sub> is read.

### 5.2.10. 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 (ddddddd)<sub>2</sub> to character generator RAM or display data RAM.

### 5.2.11. 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 (ddddddd)<sub>2</sub> 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.

**5.3. Instruction Table**

| Instruction                        | Instruction Code |    |     |     |     |     |     |     |     |     | Description  | Execution time<br>(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   | 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   | 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   | 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   | 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   | 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

**5.4. 8-Bit Operation and 8-Digit 1-Line Display (Using Internal Reset)**

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

**5.5. 4-Bit Operation and 8-Digit 1-Line Display (Using Internal Reset)**

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

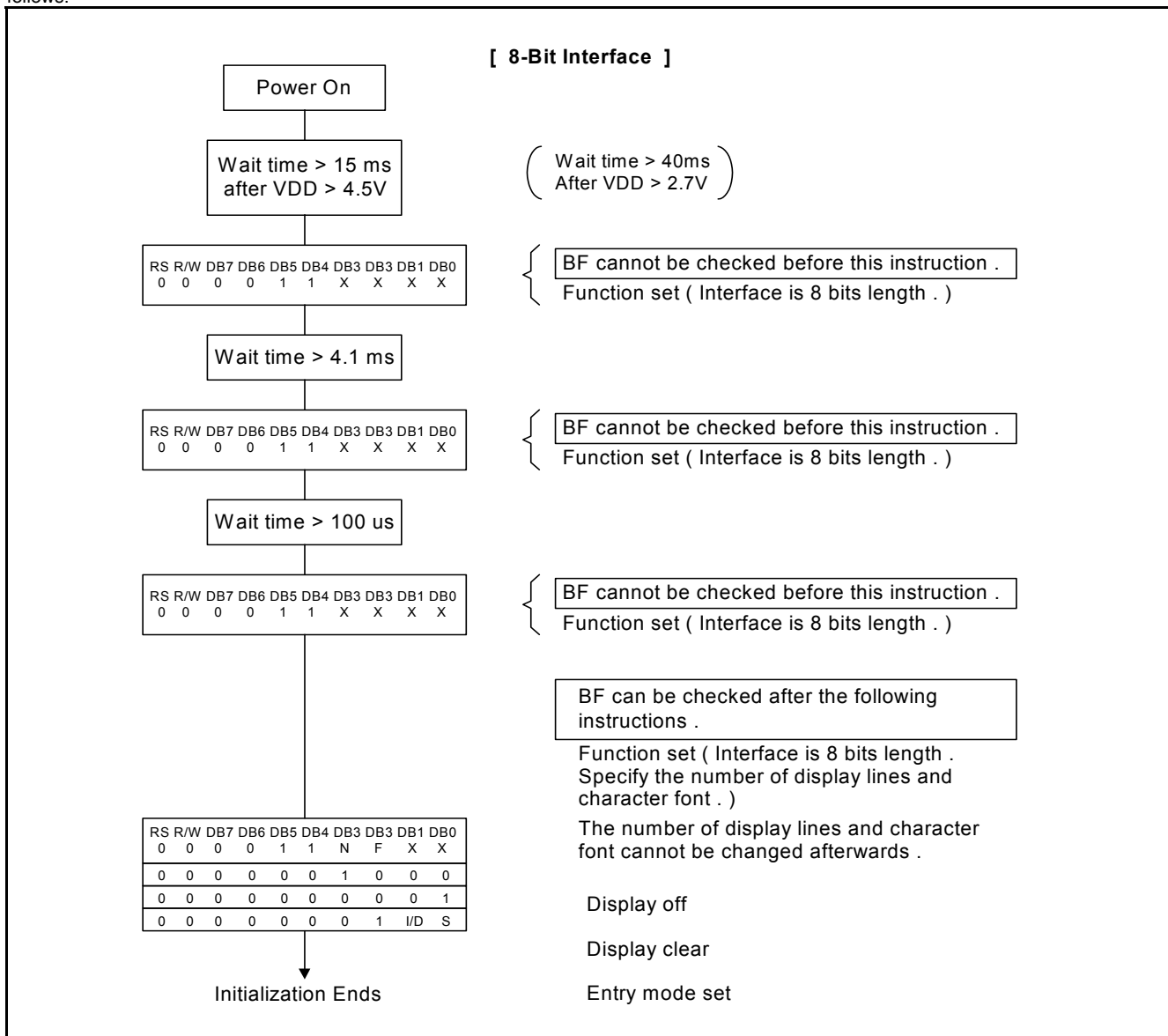
**5.6. 8-Bit Operation and 8-Digit 2-Line Display (Using Internal Reset)**

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

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

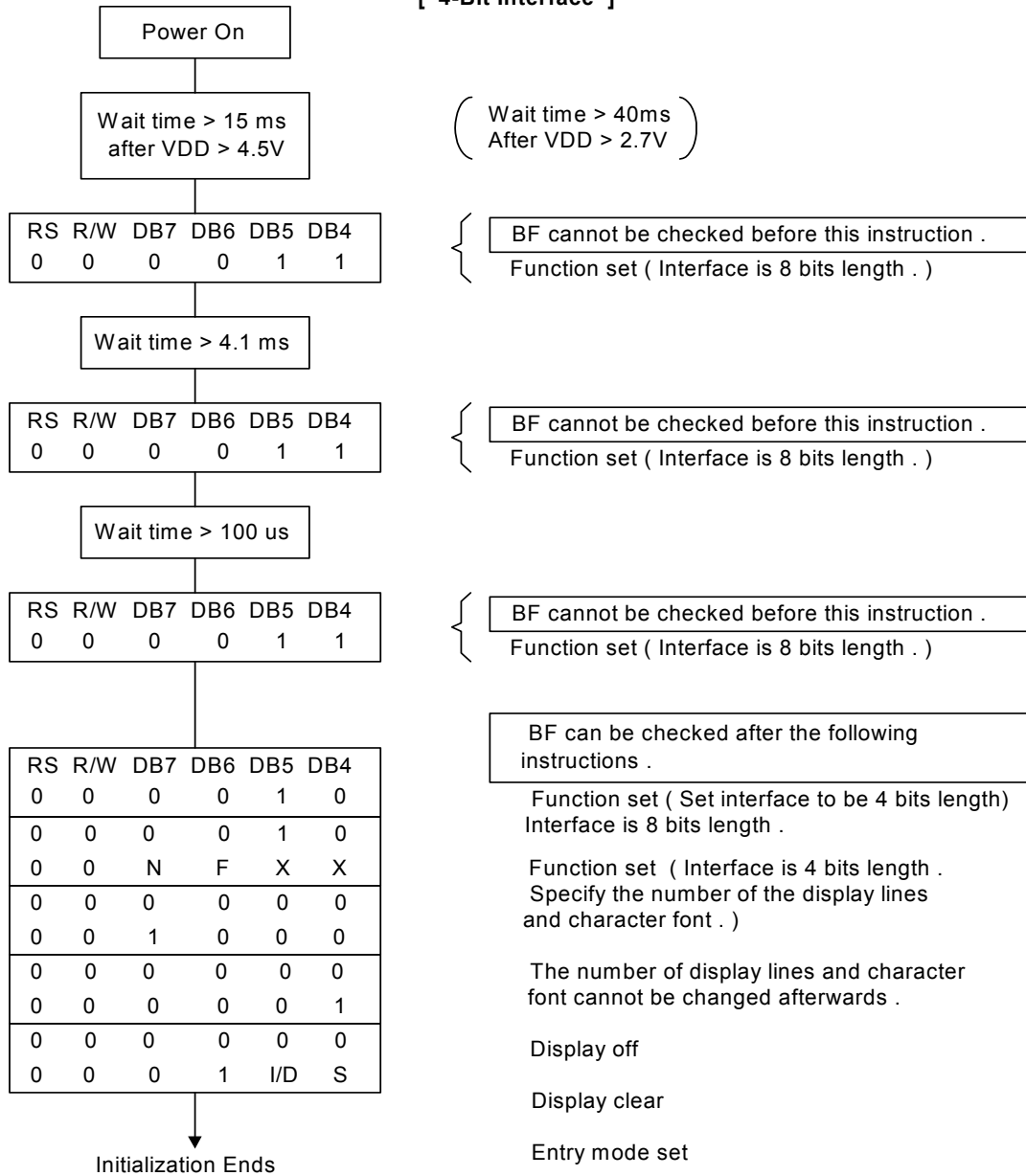
### 5.7. Reset Function

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





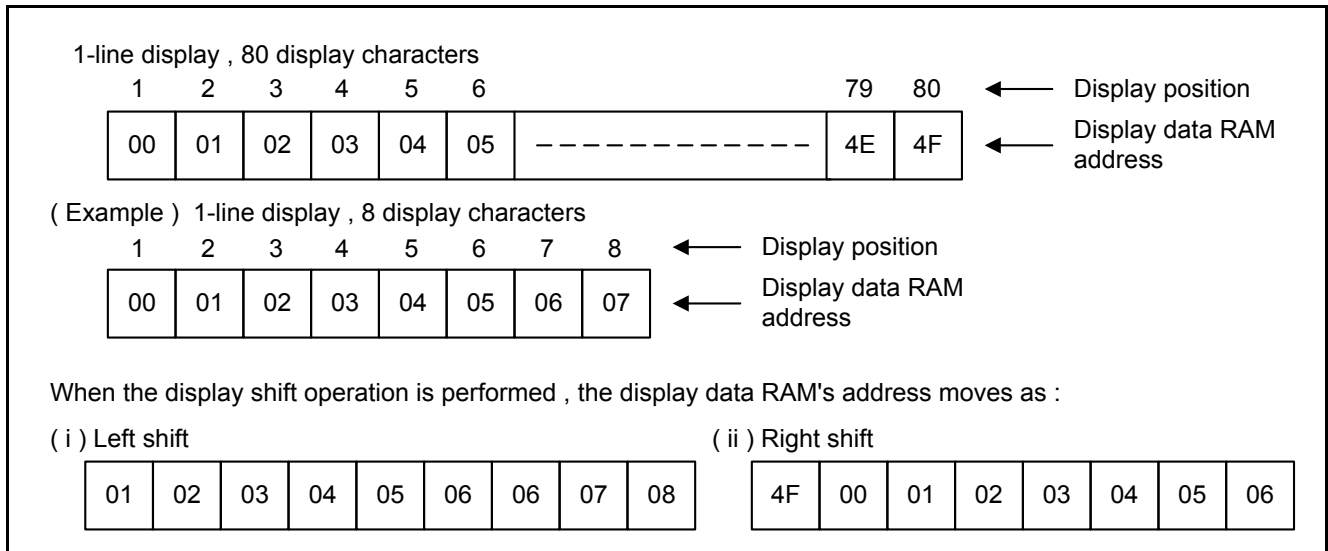
[ 4-Bit Interface ]



### 5.8. 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.



### 5.9. 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.

### 5.10. 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.

### 5.11. 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.

### 5.12. 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.

|  |   | Higher 4-bit (D4 to D7) of Character Code (Hexadecimal) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|--|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--|
|  |   | 0   | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |  |
| Lower 4-bit (D0 to D3) of Character Code (Hexadecimal) | 0 | CG RAM (1)  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|  | 1 | CG RAM (2)  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|  | 2 | CG RAM (3)  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|  | 3 | CG RAM (4)  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|  | 4 | CG RAM (5)  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|  | 5 | CG RAM (6)  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|  | 6 | CG RAM (7)  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|  | 7 | CG RAM (8)  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|  | 8 | CG RAM (1)  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|  | 9 | CG RAM (2)  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|  | A | CG RAM (3)  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|  | B | CG RAM (4)  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|  | C | CG RAM (5)  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|  | D | CG RAM (6)  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|  | E | CG RAM (7)  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
|  | F | CG RAM (8)  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |






**5.12.2. 5 X 10 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  |                                    |    |    |    | 1  | 0  | 0  | 0  | 1 |
|                                |    |    |    |    |    |    |    |                |    | 0  | 0  | 0  | 1  |                                    |    |    |    | 1  | 0  | 0  | 0  | 1 |
|                                |    |    |    |    |    |    |    |                |    | 0  | 0  | 1  | 0  |                                    |    |    |    | 1  | 0  | 0  | 0  | 1 |
|                                |    |    |    |    |    |    |    |                |    | 0  | 0  | 1  | 1  |                                    |    |    |    | 1  | 0  | 0  | 0  | 1 |
|                                |    |    |    |    |    |    |    |                |    | 0  | 1  | 0  | 0  |                                    |    |    |    | 1  | 0  | 0  | 0  | 1 |
| 0                              | 0  | 0  | 0  | X  | 0  | 0  | X  | 0              | 0  | 0  | 1  | 0  | 1  | X                                  | X  | X  | 1  | 0  | 0  | 0  | 1  |   |
|                                |    |    |    |    |    |    |    |                |    | 0  | 1  | 1  | 0  |                                    |    |    |    | 1  | 0  | 0  | 0  | 1 |
|                                |    |    |    |    |    |    |    |                |    | 0  | 1  | 1  | 1  |                                    |    |    |    | 1  | 0  | 0  | 0  | 1 |
|                                |    |    |    |    |    |    |    |                |    | 1  | 0  | 0  | 0  |                                    |    |    |    | 1  | 0  | 0  | 0  | 1 |
|                                |    |    |    |    |    |    |    |                |    | 1  | 0  | 0  | 1  |                                    |    |    |    | 1  | 1  | 1  | 1  | 1 |
|                                |    |    |    |    |    |    |    |                |    | 1  | 0  | 1  | 0  |                                    |    |    |    | 0  | 0  | 0  | 0  | 0 |
|                                |    |    |    |    |    |    |    |                |    | 1  | 0  | 1  | 1  |                                    |    |    |    |    |    |    |    |   |
|                                |    |    |    |    |    |    |    |                |    | 1  | 1  | 0  | 0  |                                    |    |    |    |    |    |    |    |   |
|                                |    |    |    |    |    |    |    |                |    | 1  | 1  | 0  | 1  | X                                  | X  | X  | X  | X  | X  | X  | X  | X |
|                                |    |    |    |    |    |    |    |                |    | 1  | 1  | 1  | 0  |                                    |    |    |    |    |    |    |    |   |
|                                |    |    |    |    |    |    |    |                |    | 1  | 1  | 1  | 1  |                                    |    |    |    |    |    |    |    |   |

Character Pattern Example (1)

Cursor Position ←

**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).

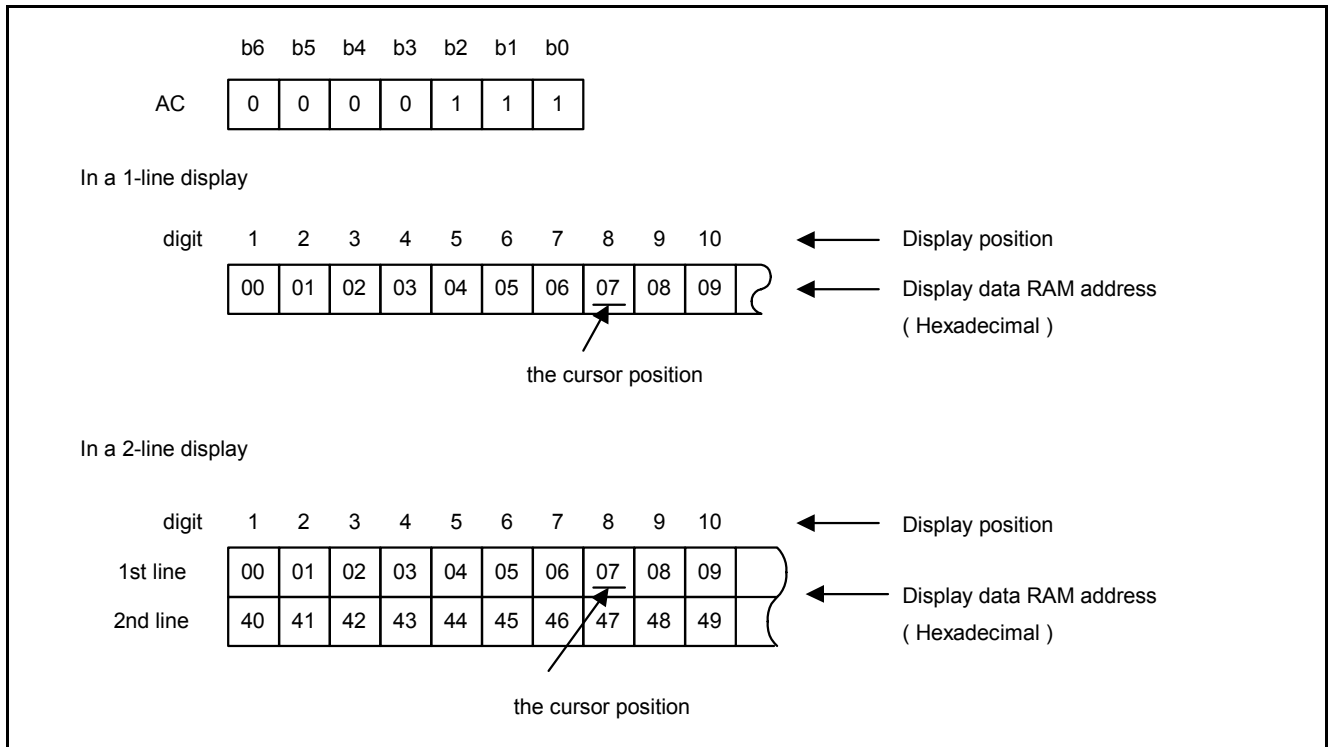
**Note5:** For example (1), set character code (b2 = b1 = 0, b3 = b0 = 0 or 1, b7-b4 = 0) to display " U ". That means all of the character codes (00) 16, (01) 16, (08) 16, and (09) 16 can display " U " character.

**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.

### 5.13. 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.

When the Address Counter is (07) 16, the cursor position is shown as belows:



### 5.14. Interfacing to MPU

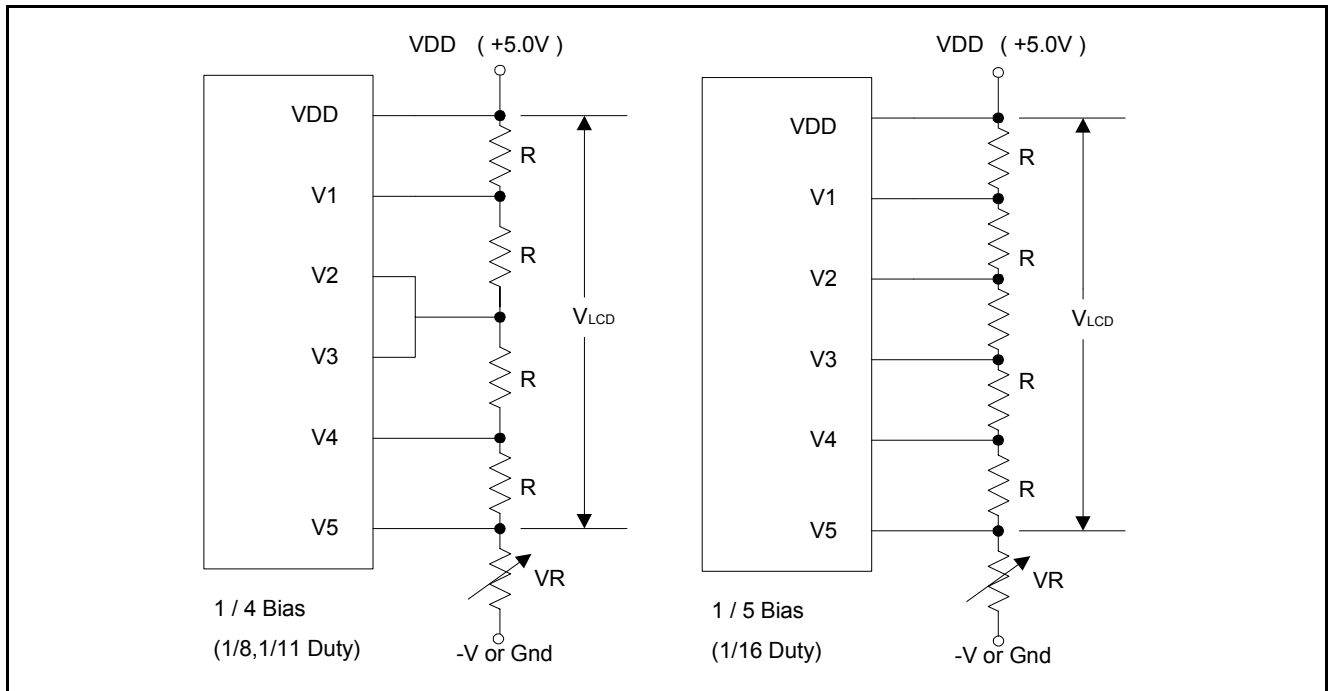
There are two types of data operations: 4-bit and 8-bit operations. Using 4-bit MPU, the interfacing 4-bit data is transferred by 4-busline (DB4 to DB7). Thus, DB0 to DB3 bus lines are not used. Using 4-bit MPU to interface 8-bit data requires two times transferring. First, the higher 4-bit data is transferred 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).

### 5.15. Supply Voltage for LCD Drive

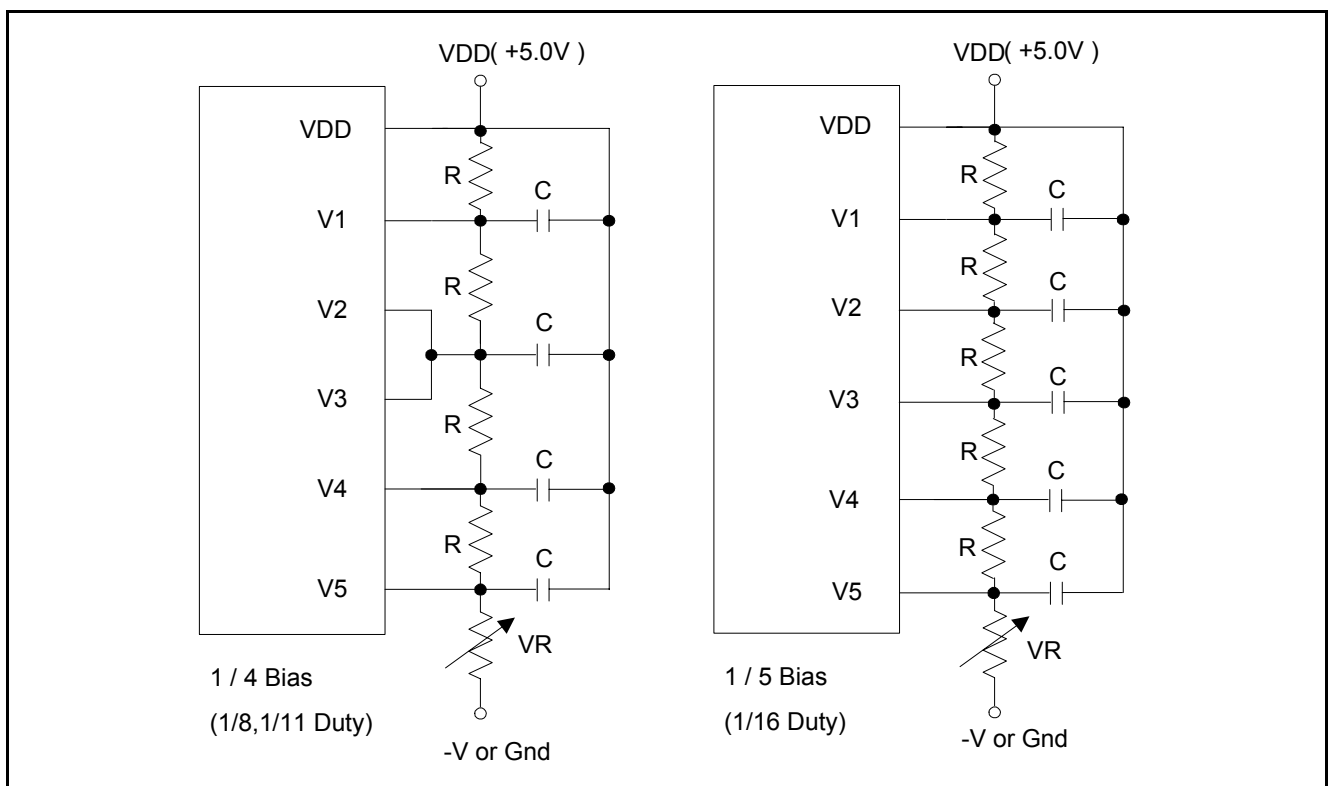
Different voltages can be supplied to SPLC780C's pins (V5 - 1) for obtaining LCD drive-waveform. The relationships between bias, duty factor and supply voltages are shown as belows:

| Supply Voltage | Duty Factor | 1/8, 1/11           | 1/16                |
|----------------|-------------|---------------------|---------------------|
|                |             | 1/4                 | 1/5                 |
| V1             |             | $VDD - 1/4 V_{LCD}$ | $VDD - 1/5 V_{LCD}$ |
| V2             |             | $VDD - 1/2 V_{LCD}$ | $VDD - 2/5 V_{LCD}$ |
| V3             |             | $VDD - 1/2 V_{LCD}$ | $VDD - 3/5 V_{LCD}$ |
| V4             |             | $VDD - 3/4 V_{LCD}$ | $VDD - 4/5 V_{LCD}$ |
| V5             |             | $VDD - V_{LCD}$     | $VDD - V_{LCD}$     |

5.15.1. The power connections for LCD (1/4 Bias, 1/5 Bias) are shown belows:



The bypass-capacitor improves the LCD display quality.



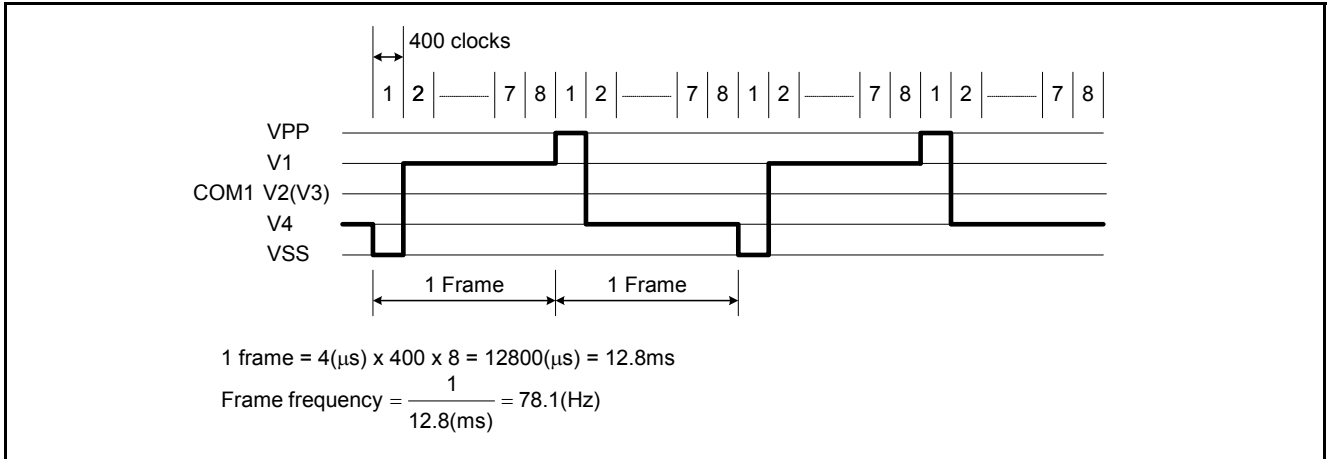
The bias voltage must have the following relations:

$$VDD > V1 > V2 \geq V3 > V4 > V5.$$

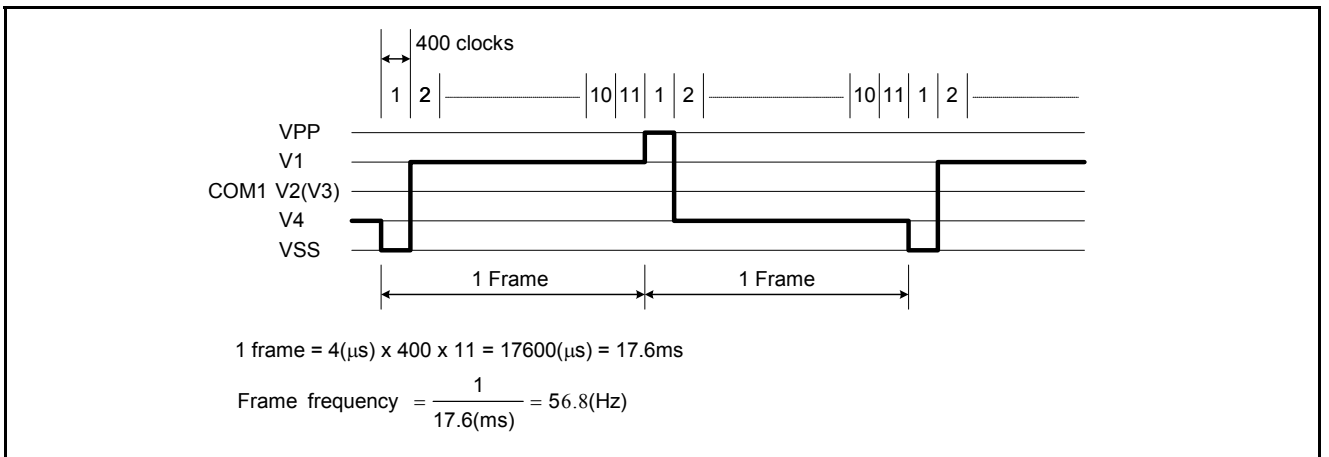
**5.15.2. The relationship between LCD frame's frequency and oscillator's frequency.**

(Assume the oscillation frequency is 250KHz, 1 clock cycle time = 4.0μs)

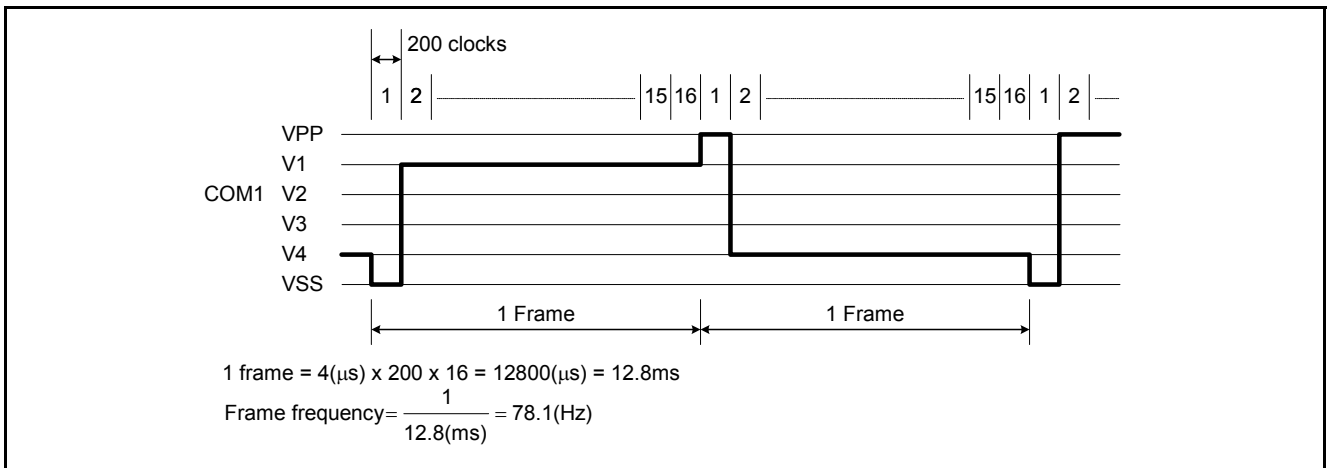
**5.15.2.1. 1/8 Duty, TYPE-B waveform**



**5.15.2.2. 1/11 Duty, TYPE-B waveform**



**5.15.2.3. 1/16 Duty, TYPE-B waveform**



### 5.16. REGISTER --- IR (Instruction Register) and DR (Data Register)

SPLC780C 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.

### 5.17. Busy Flag (BF)

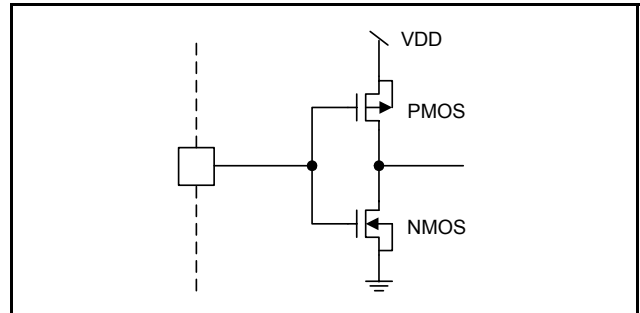
When RS = 0 and R/W = 1, the busy flag is output to DB7. As the busy flag =1, SPLC780C is in busy state and does not accept any instruction until the busy flag = 0.

### 5.18. Address Counter (AC)

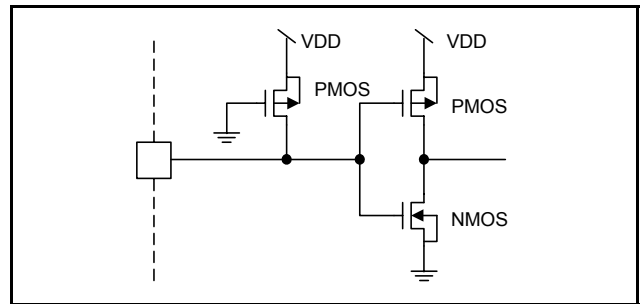
The Address Counter assigns addresses to Display Data RAM and Character Generator RAM. When an instruction for address is written in IR, the address information is sent from IR to AC. After writing to/reading from Display Data RAM or Character Generator RAM, AC is automatically incremented by one (or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

### 5.19. I/O Port Configuration

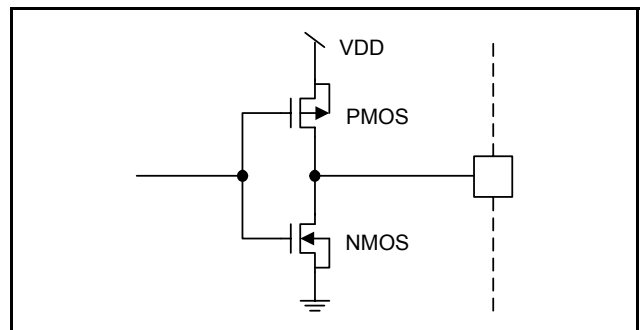
#### 5.19.1. Input port: E



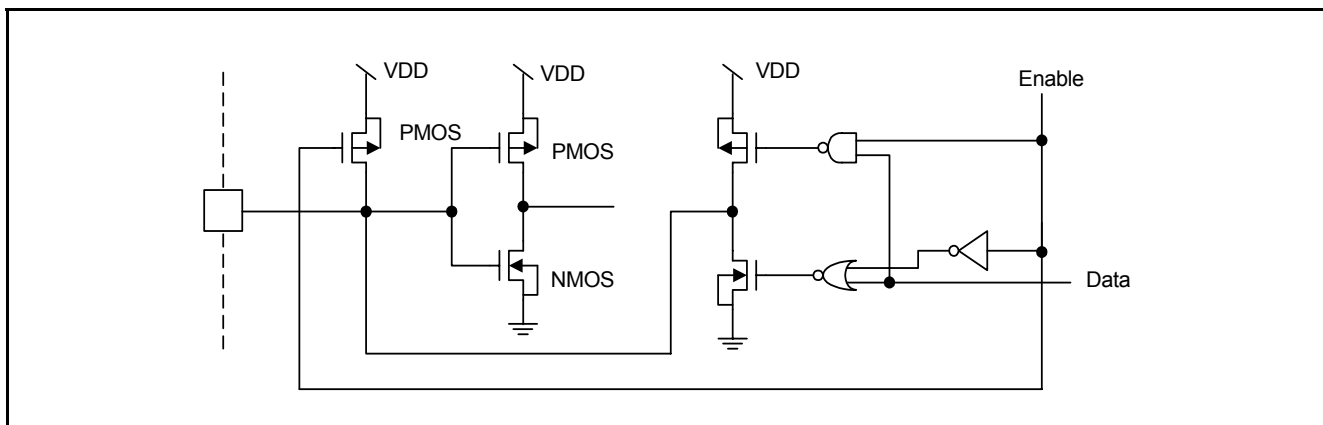
#### 5.19.2. Input port: R / W, RS



#### 5.19.3. Output port: CL1, CL2, M, D



#### 5.19.4. Input / Output port: DB7 - 0



**6. ELECTRICAL SPECIFICATIONS**
**6.1. Absolute Maximum Ratings**

| Characteristics       | Symbol           | Ratings                 |
|-----------------------|------------------|-------------------------|
| Operating Voltage     | VDD              | -0.3V to +7.0V          |
| Driver Supply Voltage | V <sub>LCD</sub> | VDD - 12V to VDD + 0.3V |
| Input Voltage Range   | V <sub>IN</sub>  | -0.3V to VDD + 0.3V     |
| Operating Temperature | T <sub>A</sub>   | -30°C to +80°C          |
| Storage Temperature   | T <sub>STO</sub> | -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.

**6.2. DC Characteristics (VDD = 2.7V to 4.5V, T<sub>A</sub> = 25°C)**

| Characteristics            | Symbol           | Limit   |      |        | Unit | Test Condition  |
|----------------------------|------------------|---------|------|--------|------|---|
|                            |                  | Min.    | Typ. | Max.   |      |   |
| Operating Current          | I <sub>DD</sub>  | -       | 0.2  | 0.4    | mA   | External clock (Note)   |
| Input High Voltage         | V <sub>IH1</sub> | 0.7VDD  | -    | VDD    | V    | Pins:(E, RS, R/W, DB0 - DB7)  |
| Input Low Voltage          | V <sub>IL1</sub> | -0.3    | -    | 0.55   | V    |   |
| Input High Voltage         | V <sub>IH2</sub> | 0.7VDD  | -    | VDD    | V    | Pin OSC1  |
| Input Low Voltage          | V <sub>IL2</sub> | -0.2    | -    | 0.2VDD | V    |   |
| Input High Current         | I <sub>IH</sub>  | -1.0    | -    | 1.0    | μA   | Pins: (RS, R/W, DB0 - DB7)<br>VDD = 3.0V                              |
| Input Low Current          | I <sub>IL</sub>  | -5.0    | -15  | -30    | μA   |   |
| Output High Voltage (TTL)  | V <sub>OH1</sub> | 0.75VDD | -    | -      | V    | I <sub>OH</sub> = - 0.1mA<br>Pins: DB0 - DB7                          |
| Output Low Voltage (TTL)   | V <sub>OL1</sub> | -       | -    | 0.2VDD | V    | I <sub>OL</sub> = 0.1mA<br>Pins: DB0 - DB7                            |
| Output High Voltage (CMOS) | V <sub>OH2</sub> | 0.8VDD  | -    | -      | V    | I <sub>OH</sub> = - 40μA,<br>Pins: CL1, CL2, M, D                     |
| Output Low Voltage (CMOS)  | V <sub>OL2</sub> | -       | -    | 0.2VDD | V    | I <sub>OL</sub> = 40μA, Pins:<br>CL1, CL2, M, D                       |
| Driver ON Resistance (COM) | R <sub>COM</sub> | -       | -    | 20     | KΩ   | I <sub>O</sub> = ±50μA, V <sub>LCD</sub> = 4.0V<br>Pins: COM1 - COM16 |
| Driver ON Resistance (SEG) | R <sub>SEG</sub> | -       | -    | 30     | KΩ   | I <sub>O</sub> = ±50μA, V <sub>LCD</sub> = 4.0V<br>Pins: SEG1 - SEG40 |
| LCD Voltage                | V <sub>LCD</sub> | 3.0     | -    | 11     | V    | VDD-V5, 1/4 bias or 1/5 bias  |

**Note:** F<sub>osc</sub> = 250KHz, VDD = 3.0V, pin E = "L", RS, R/W, DB0 - DB7 are open, all outputs are no loads.

**6.3. AC Characteristics (VDD = 2.7V to 4.5V, T<sub>A</sub> = 25°C)**
**6.3.1. Internal clock operation**

| Characteristics | Symbol            | Limit |      |      | Unit | Test Condition           |
|-----------------|-------------------|-------|------|------|------|--------------------------|
|                 |                   | Min.  | Typ. | Max. |      |                          |
| OSC Frequency   | F <sub>OSC1</sub> | 190   | 270  | 350  | KHz  | VDD = 3.0V, Rf = 75KΩ±2% |

**6.3.2. External clock operation**

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

**6.3.3. Write mode (Writing data from MPU to SPLC780C)**

| Characteristics    | Symbol                          | Limit |      |      | Unit | Test Condition   |
|--------------------|---------------------------------|-------|------|------|------|------------------|
|                    |                                 | Min.  | Typ. | Max. |      |                  |
| E Cycle Time       | t <sub>C</sub>                  | 1000  | -    | -    | ns   | Pin E            |
| E Pulse Width      | t <sub>PW</sub>                 | 450   | -    | -    | ns   | Pin E            |
| E Rise/Fall Time   | t <sub>R</sub> , t <sub>F</sub> | -     | -    | 25   | ns   | Pin E            |
| Address Setup Time | t <sub>SP1</sub>                | 60    | -    | -    | ns   | Pins: RS, R/W, E |
| Address Hold Time  | t <sub>HD1</sub>                | 20    | -    | -    | ns   | Pins: RS, R/W, E |
| Data Setup Time    | t <sub>SP2</sub>                | 195   | -    | -    | ns   | Pins: DB0 - DB7  |
| Data Hold Time     | t <sub>HD2</sub>                | 10    | -    | -    | ns   | Pins: DB0 - DB7  |

**6.3.4. Read mode (Reading data from SPLC780C to MPU)**

| Characteristics        | Symbol                          | Limit |      |      | Unit | Test Condition   |
|------------------------|---------------------------------|-------|------|------|------|------------------|
|                        |                                 | Min.  | Typ. | Max. |      |                  |
| E Cycle Time           | t <sub>C</sub>                  | 1000  | -    | -    | ns   | Pin E            |
| E Pulse Width          | t <sub>W</sub>                  | 450   | -    | -    | ns   | Pin E            |
| E Rise/Fall Time       | t <sub>R</sub> , t <sub>F</sub> | -     | -    | 25   | ns   | Pin E            |
| Address Setup Time     | t <sub>SP1</sub>                | 60    | -    | -    | ns   | Pins: RS, R/W, E |
| Address Hold Time      | t <sub>HD1</sub>                | 20    | -    | -    | ns   | Pins: RS, R/W, E |
| Data Output Delay Time | t <sub>D</sub>                  | -     | -    | 360  | ns   | Pins: DB0 - DB7  |
| Data hold time         | t <sub>HD2</sub>                | 5.0   | -    | -    | ns   | Pin DB0 - DB7    |



**6.4. DC Characteristics (VDD = 4.5V to 5.5V, T<sub>A</sub> = 25°C)**

| Characteristics            | Symbol           | Limit  |      |        | Unit | Test Condition  |
|----------------------------|------------------|--------|------|--------|------|---|
|                            |                  | Min.   | Typ. | Max.   |      |   |
| Operating Current          | I <sub>DD</sub>  | -      | 0.55 | 0.8    | mA   | External clock (Note)   |
| Input High Voltage         | V <sub>IH1</sub> | 2.2    | -    | VDD    | V    | Pins:(E, RS, R/W, DB0 - DB7)  |
| Input Low Voltage          | V <sub>IL1</sub> | -0.3   | -    | 0.6    | V    |   |
| Input High Voltage         | V <sub>IH2</sub> | VDD-1  | -    | VDD    | V    | Pin OSC1  |
| Input Low Voltage          | V <sub>IL2</sub> | -0.2   | -    | 1.0    | V    | Pin OSC1  |
| Input High Current         | I <sub>IH</sub>  | -2.0   | -    | 2.0    | μA   | Pins: (RS, R/W, DB0 - DB7)<br>VDD = 5.0V                              |
| Input Low Current          | I <sub>IL</sub>  | -20    | -50  | -100   | μA   |   |
| Output High Voltage (TTL)  | V <sub>OH1</sub> | 2.4    | -    | VDD    | V    | I <sub>OH</sub> = - 0.1mA<br>Pins: DB0 - DB7                          |
| Output Low Voltage (TTL)   | V <sub>OL1</sub> | -      | -    | 0.4    | V    | I <sub>OL</sub> = 0.1mA<br>Pins: DB0 - DB7                            |
| Output High Voltage (CMOS) | V <sub>OH2</sub> | 0.9VDD | -    | VDD    | V    | I <sub>OH</sub> = - 40μA,<br>Pins: CL1, CL2, M, D                     |
| Output Low Voltage (CMOS)  | V <sub>OL2</sub> | -      | -    | 0.1VDD | V    | I <sub>OL</sub> = 40μA, Pins:<br>CL1, CL2, M, D                       |
| Driver ON Resistance (COM) | R <sub>COM</sub> | -      | -    | 20     | KΩ   | I <sub>O</sub> = ±50μA, V <sub>LCD</sub> = 4.0V<br>Pins: COM1 - COM16 |
| Driver ON Resistance (SEG) | R <sub>SEG</sub> | -      | -    | 30     | KΩ   | I <sub>O</sub> = ±50μA, V <sub>LCD</sub> = 4.0V<br>Pins: SEG1 - SEG40 |
| LCD Voltage                | V <sub>LCD</sub> | 3.0    | -    | 11     | V    | VDD-V5, 1/4 bias or 1/5 bias  |

**Note:** F<sub>osc</sub> = 250KHz, VDD = 5.0V, pin E = "L", RS, R/W, DB0 - DB7 are open, all outputs are no loads.

**6.5. AC Characteristics (VDD = 4.5V to 5.5V, T<sub>A</sub> = 25°C)**
**6.5.1. Internal clock operation**

| Characteristics | Symbol            | Limit |      |      | Unit | Test Condition           |
|-----------------|-------------------|-------|------|------|------|--------------------------|
|                 |                   | Min.  | Typ. | Max. |      |                          |
| OSC Frequency   | F <sub>OSC1</sub> | 190   | 270  | 350  | KHz  | VDD = 5.0V, Rf = 91KΩ±2% |

**6.5.2. External clock operation**

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

**6.5.3. Write mode (Writing Data from MPU to SPLC780C)**

| 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  |

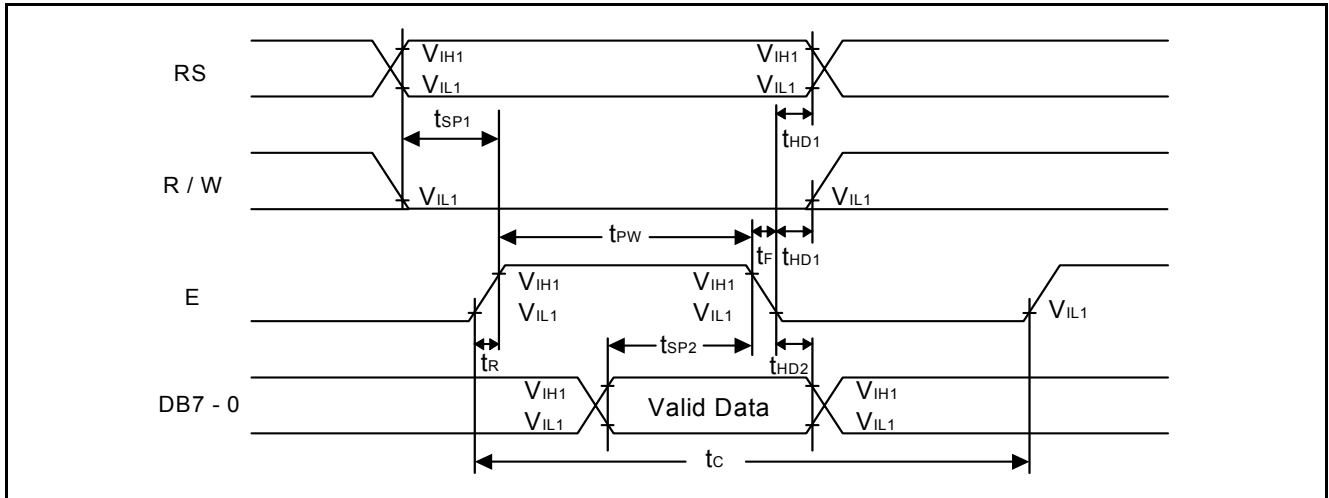
**6.5.4. Read mode (Reading Data from SPLC780C to MPU)**

| 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    |

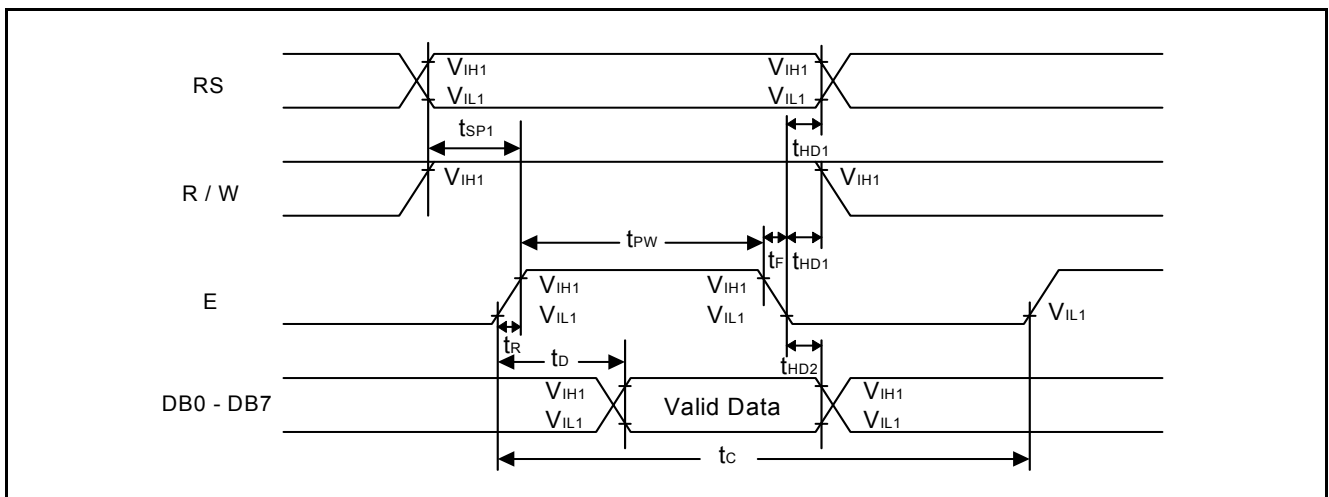
**6.5.5. Interface mode with LCD Driver (SPLC100A1)**

| Characteristics        | Symbol    | Limit |      |      | Unit | Test Condition |
|------------------------|-----------|-------|------|------|------|----------------|
|                        |           | Min.  | Typ. | Max. |      |                |
| Clock pulse width high | $t_{PWH}$ | 800   | -    | -    | ns   | Pins: CL1, CL2 |
| Clock pulse width low  | $t_{PWL}$ | 800   | -    | -    | ns   | Pins: CL1, CL2 |
| Clock setup time       | $t_{CSP}$ | 500   | -    | -    | ns   | Pins: CL1, CL2 |
| Data setup time        | $t_{DSP}$ | 300   | -    | -    | ns   | Pins: D        |
| Data hold time         | $t_{HD}$  | 300   | -    | -    | ns   | Pins: D        |
| M delay time           | $t_D$     | -1000 | -    | 1000 | ns   | Pins: M        |

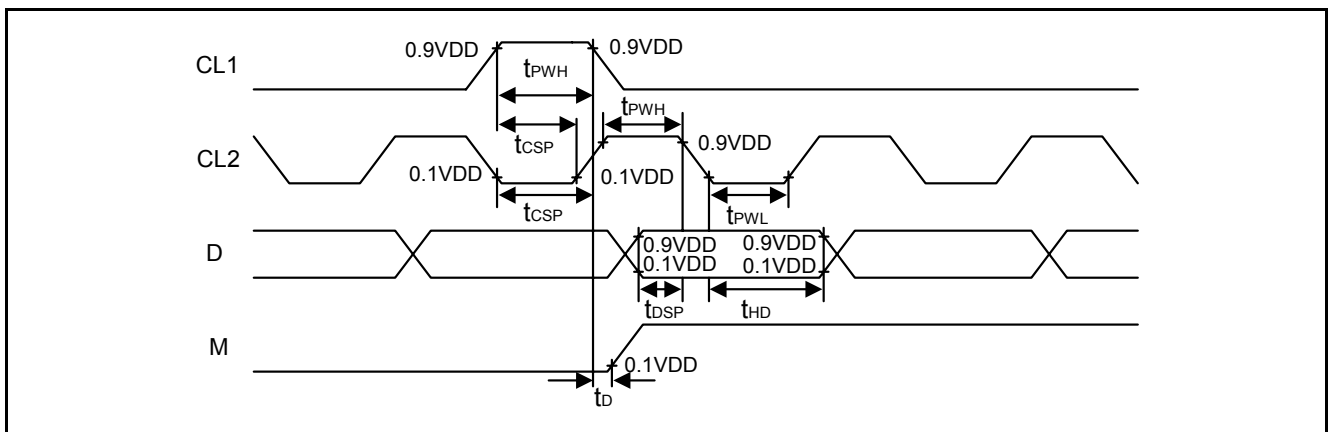
6.5.6. Write mode timing diagram (Writing Data from MPU to SPLC780C)



6.5.7. Read mode timing diagram (Reading Data from SPLC780C to MPU)



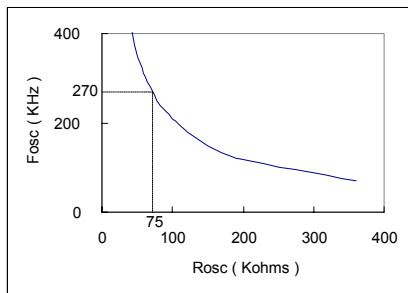
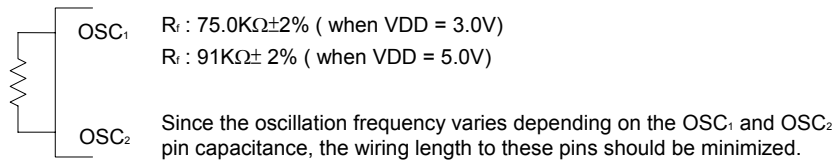
6.5.8. Interface mode with SPLC100A1 timing diagram



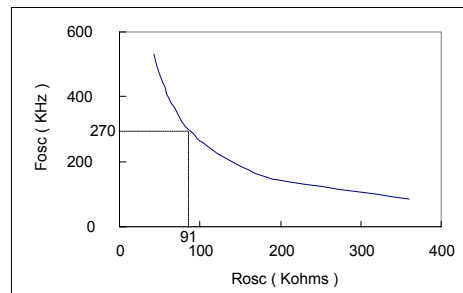
## 7. APPLICATION CIRCUITS

### 7.1. R-Oscillator

The oscillation resistor  $R_f$  is used only for the internal oscillator operation mode.



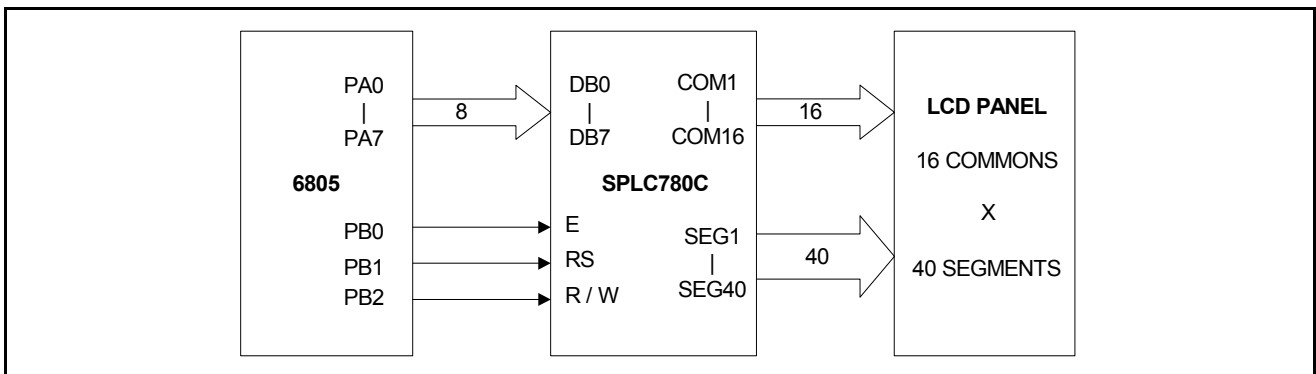
VDD = 3.0V



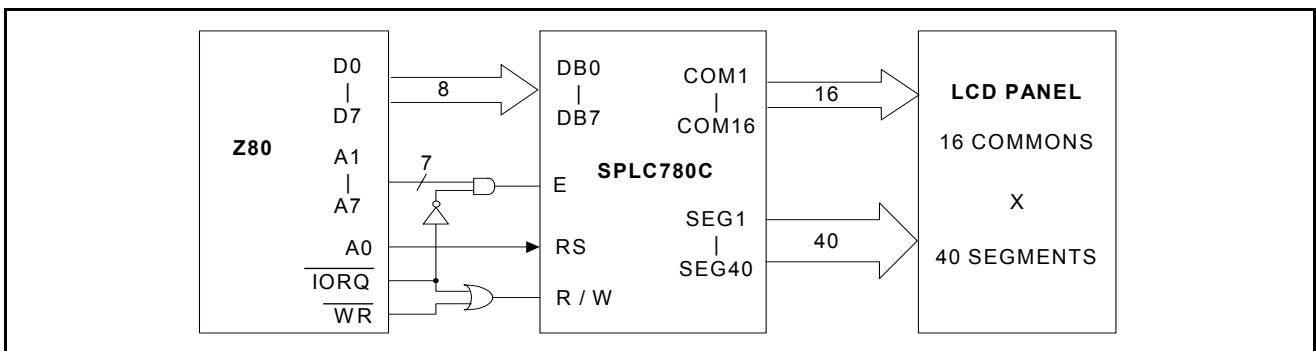
VDD = 5.0V

### 7.2. Interface to MPU

#### 7.2.1. Interface to 8-bit MPU (6805)

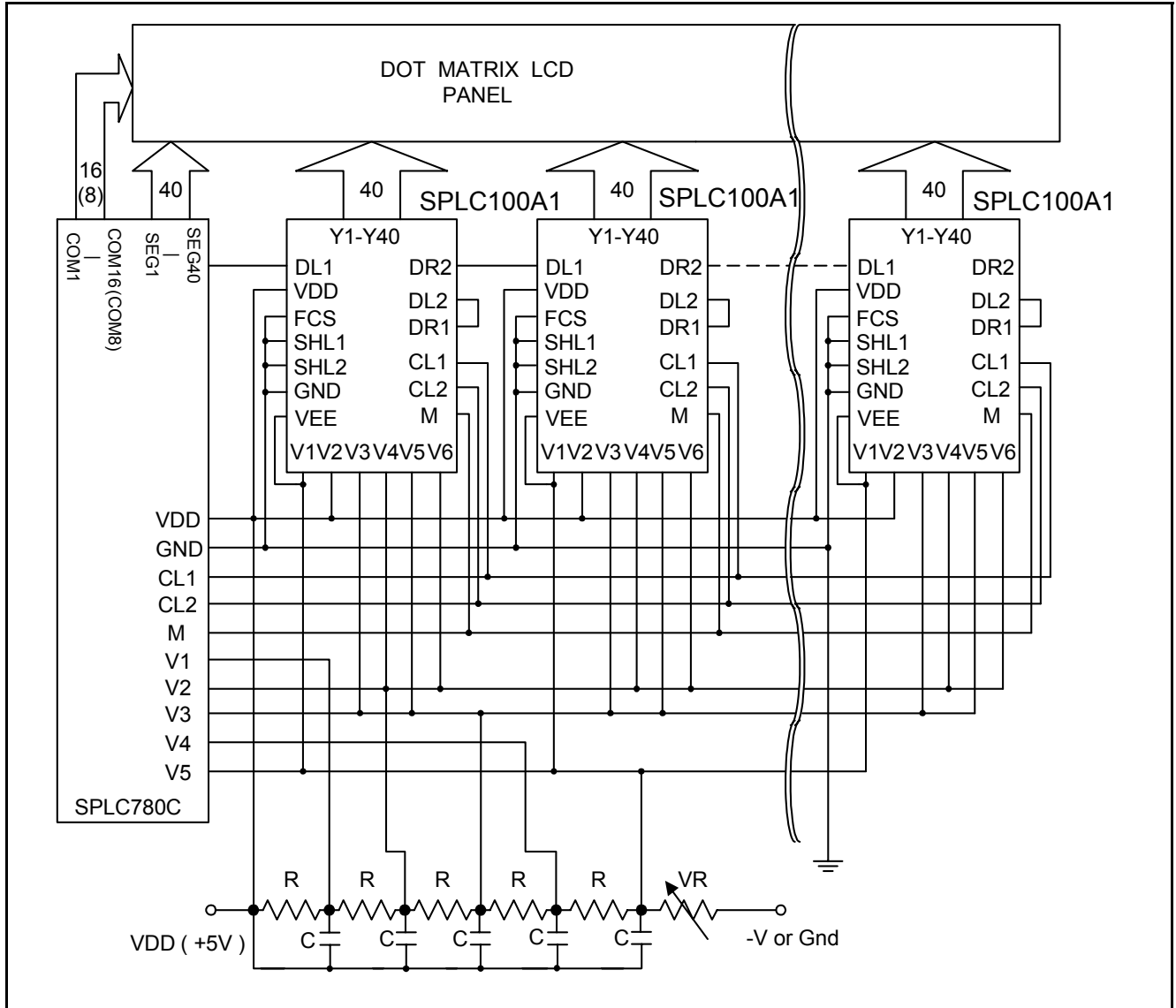


#### 7.2.2. Interface to 8-bit MPU (Z80)

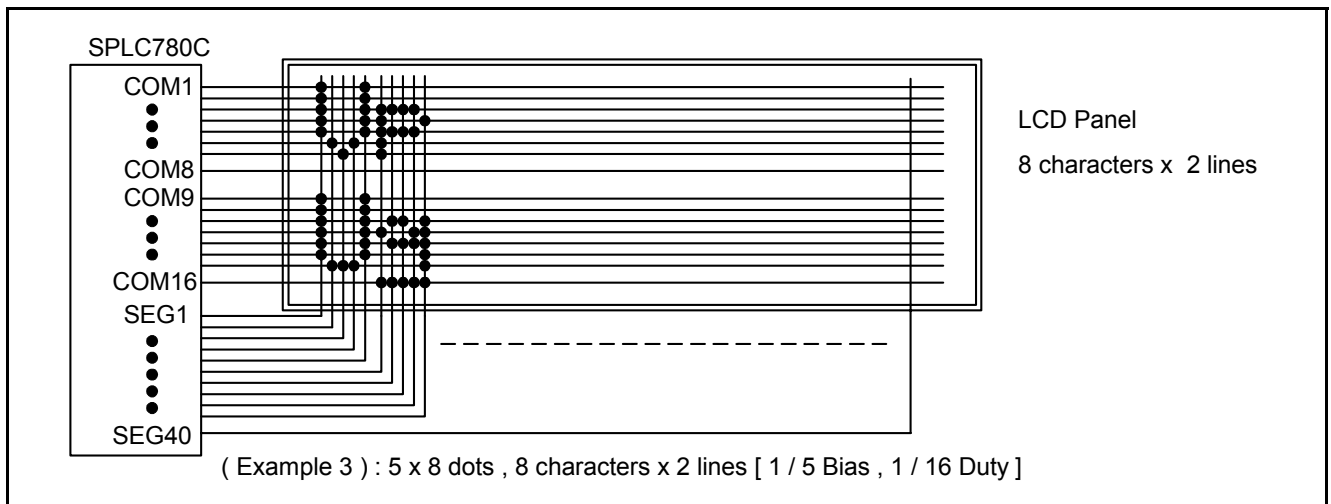
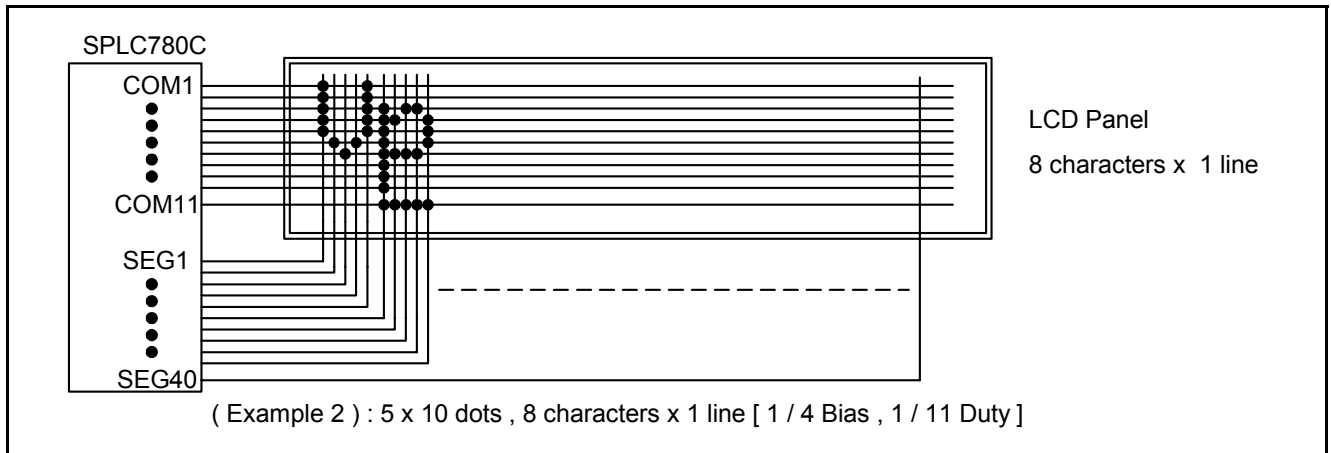
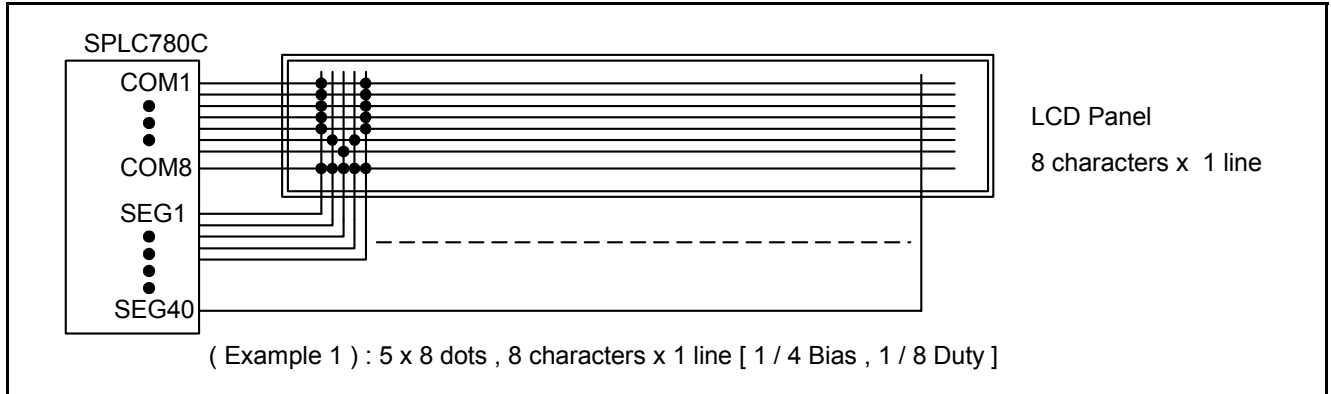


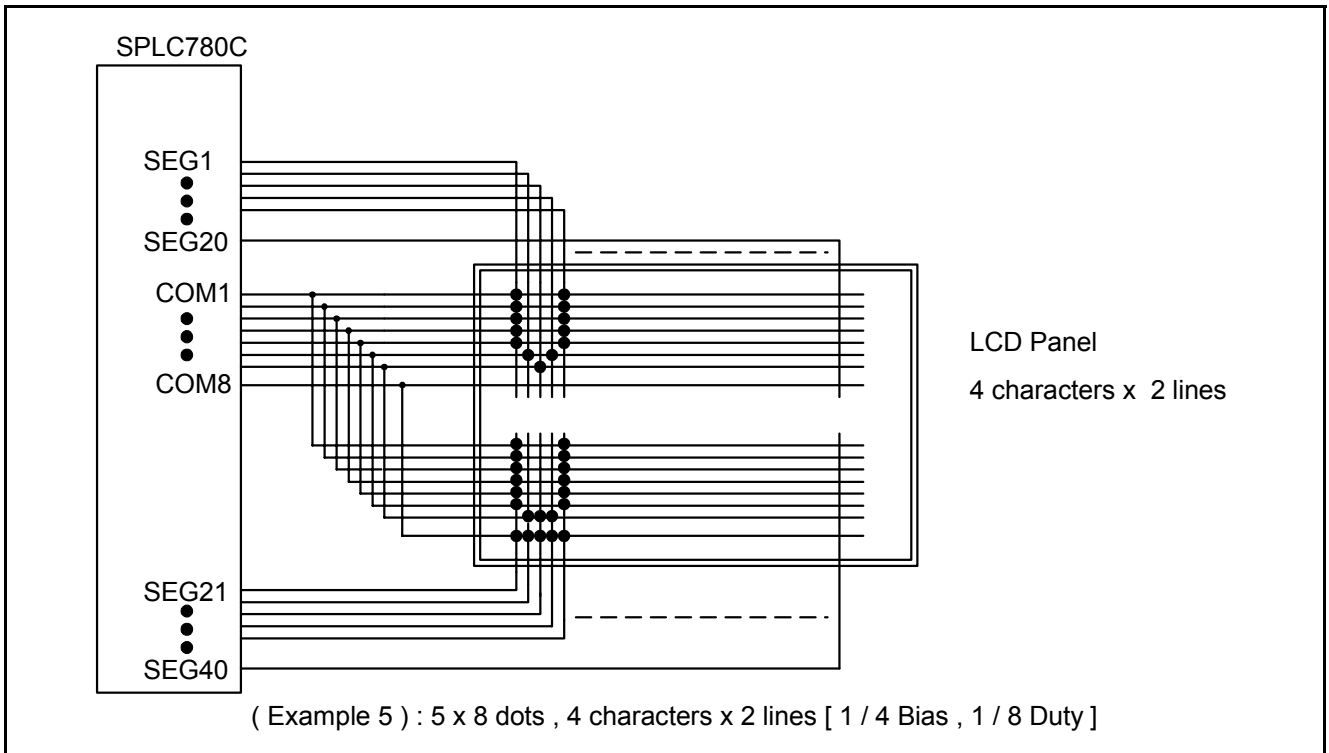
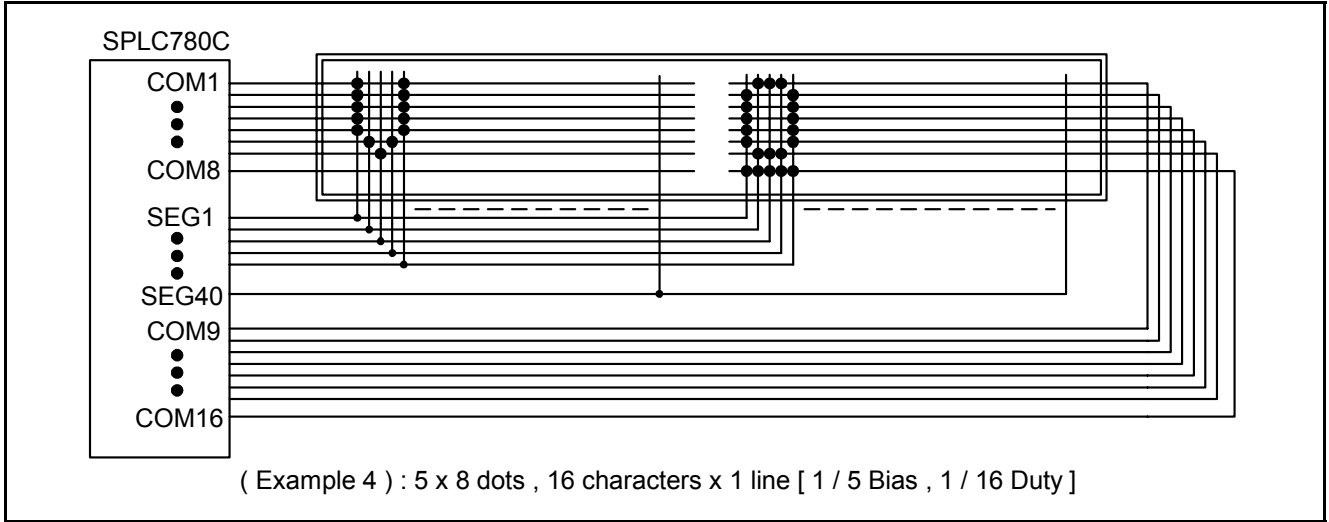


7.3. SPLC780C Application Circuit



7.4. Applications for LCD







8. CHARACTER GENERATOR ROM

8.1. SPLC780C - 01

| Upper<br>4 bit<br>Lower<br>4 bit | LLLL | LLLH | LLHL | LLHH | LHLL | LHLH | LHHL | LHHH | HLLL | HLLH | HLHL | HLHH | HHLL | HHLH | HHHL | HHHH |
|----------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| LLLL                             |      |      |      | 0    | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | A    | B    | C    |
| LLLH                             |      |      | !    | 0    | 1    | 2    | 3    | 4    |      |      | .    | ア    | チ    | ウ    | エ    | オ    |
| LLHL                             |      |      | "    | 2    | B    | R    | b    | r    |      |      | 「    | イ    | ウ    | ×    | 目    | 日    |
| LLHH                             |      |      | #    | 3    | C    | S    | c    | s    |      |      | 」    | ウ    | 子    | 毛    | 三    | ※    |
| LHLL                             |      |      | \$   | 4    | D    | T    | d    | t    |      |      | 、    | エ    | ト    | カ    | ワ    | ウ    |
| LHLH                             |      |      | %    | 5    | E    | U    | e    | u    |      |      | ・    | オ    | 大    | 工    | 区    | 口    |
| LHHL                             |      |      | &    | 6    | F    | V    | f    | v    |      |      | ヲ    | カ    | ニ    | ヨ    | 口    | 区    |
| LHHH                             |      |      | '    | 7    | G    | W    | g    | w    |      |      | ヲ    | キ    | 又    | ラ    | 目    | 区    |
| HLLL                             |      |      | (    | 8    | H    | X    | h    | x    |      |      | 、    | ウ    | 率    | リ    | 区    | 又    |
| HLLH                             |      |      | )    | 9    | I    | Y    | i    | y    |      |      | ウ    | ウ    | ル    | 区    | 目    | 区    |
| HLHL                             |      |      | *    | :    | J    | Z    | j    | z    |      |      | エ    | コ    | 口    | 区    | 目    | 区    |
| HLHH                             |      |      | +    | ;    | K    | C    | k    | c    |      |      | オ    | カ    | 区    | 口    | ※    | 区    |
| HHLL                             |      |      | ,    | <    | L    | 1    | l    | 1    |      |      | カ    | 目    | ウ    | ウ    | ※    | 区    |
| HHLH                             |      |      | =    | =    | M    | I    | m    | i    |      |      | ユ    | 又    | 区    | 区    | 目    | 区    |
| HHHL                             |      |      | .    | >    | N    | ^    | n    | ^    |      |      | ヨ    | セ    | 市    | 区    | 目    | 区    |
| HHHH                             |      |      | /    | ?    | O    | _    | o    | _    |      |      | ウ    | ウ    | ウ    | 区    | 目    | 区    |





8.2. SPLC780C - 02

| Upper<br>4 bit<br>Lower<br>4 bit | LLLL | LLLH | LLHL | LLHH | LHLL | LHLH | LHHL | LHHH | HLLL | HLLH | HLHL | HLHH | HHLL | HHLH | HHHL | HHHH |
|----------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| LLLL                             |      |      |      | 0    | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | .    | ,    |      |
| LLLH                             |      |      | !    | 1    | A    | Q    | a    | 9    |      |      | P    | R    | W    | U    | U    |      |
| LLHL                             |      |      | "    | 2    | B    | R    | b    | r    |      |      | E    | G    | E    | U    | U    |      |
| LLHH                             |      |      | #    | 3    | C    | S    | c    | s    |      |      | M    | B    | M    | U    | U    |      |
| LHLL                             |      |      | \$   | 4    | D    | T    | d    | t    |      |      | B    | P    | E    | S    | S    |      |
| LHLH                             |      |      | %    | 5    | E    | U    | e    | u    |      |      | N    | B    | B    | S    | U    |      |
| LHHL                             |      |      | &    | 6    | F    | V    | f    | v    |      |      | X    | M    | M    | S    | U    |      |
| LHHH                             |      |      | '    | 7    | G    | W    | g    | w    |      |      | J    | B    | B    | I    | '    |      |
| HLLL                             |      |      | (    | 8    | H    | X    | h    | x    |      |      | P    | M    | *    | I    | "    |      |
| HLLH                             |      |      | )    | 9    | I    | Y    | i    | y    |      |      | X    | X    | *    | T    | "    |      |
| HLHL                             |      |      | *    | :    | J    | Z    | j    | z    |      |      | Q    | K    | .    | T    | U    |      |
| HLHH                             |      |      | +    | ;    | K    | C    | k    | c    |      |      | Y    | M    | "    | K    | U    |      |
| HHLL                             |      |      | ,    | <    | L    | C    | l    | c    |      |      | W    | M    | M    | M    | U    |      |
| HHLH                             |      |      | -    | =    | M    | J    | m    | j    |      |      | B    | H    | S    | M    | *    |      |
| HHHL                             |      |      | .    | >    | N    | ^    | n    | ^    |      |      | M    | M    | T    | T    | U    |      |
| HHHH                             |      |      | /    | ?    | O    | _    | o    | _    |      |      | E    | T    | E    | .    | U    |      |



8.3. SPLC780C - 03

| Upper<br>4 bit<br>Lower<br>4 bit | LLLL | LLLH | LLHL | LLHH | LHLL | LHLH | LHHL | LHHH | HLLL | HLLH | HLHL | HLHH | HHLL | HHLH | HHHL | HHHH |
|----------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|                                  | LLLL | 士    | 士    | 士    | 士    | 士    | 士    | 士    | 士    | 士    | 士    | 士    | 士    | 士    | 士    | 士    |
| LLLH                             | 三    | !    | 1    | A    | Q    | 9    | 0    | 8    | 2    | J    | 十    | yo   |      |      |      |      |
| LLHL                             | ?    | "    | 2    | B    | R    | b    | r    | 6    | 用    | 6    | *    | ∞    | 8    | 8    | 8    | 8    |
| LLHH                             | 山    | #    | 3    | C    | S    | c    | s    | 3    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    |
| LHLL                             | 丫    | 4    | D    | T    | d    | t    | 5    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    |
| LHLH                             | U    | 5    | E    | U    | e    | u    | 6    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    |
| LHHL                             | Y    | &    | 6    | F    | U    | f    | u    | 7    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    |
| LHHH                             | J    | '    | 7    | G    | W    | w    | 8    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    |
| HLLL                             | J    | C    | 8    | H    | h    | 8    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    |
| HLLH                             | U    | 9    | I    | Y    | i    | y    | 9    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    |
| HLHL                             | *    | *    | J    | Z    | z    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    |
| HLHH                             | J    | +    | K    | K    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    |
| HHLL                             | =    | ,    | L    | L    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    |
| HHLH                             | ∞    | -    | M    | M    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    |
| HHHL                             | R    | .    | N    | n    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    |
| HHHH                             | 3    | /    | O    | O    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    | 各    |



8.4. SPLC780C - 08

| Upper<br>4 bit<br>Lower<br>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                             |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |



8.5. SPLC780C - 11

| Upper<br>4 bit<br>Lower<br>4 bit | LLLL | LLH | LLHL | LLHH | LHLL | LHLH | LHHL | LHHH | HLLL | HLLH | HLHL | HLHH | HHLL | HHLH | HHHL | HHHH |
|----------------------------------|------|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| LLLL                             |      |     |      | 0    | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | A    | B    | C    |
| LLLH                             |      |     | !    | 1    | A    | Q    | 3    | 4    | U    | E    | I    | ±    | L    | "    | 5    | 9    |
| LLHL                             |      |     | "    | 2    | R    | b    | r    | U    | E    | 1    | U    | 0    | "    | 5    | 8    |      |
| LLHH                             |      |     | #    | 3    | S    | s    | s    | U    | E    | 1    | ↑    | R    | "    | 5    | 8    |      |
| LHLL                             |      |     | \$   | 4    | T    | t    | t    | U    | E    | 1    | ↓    | R    | "    | 5    | 8    |      |
| LHLH                             |      |     | %    | 5    | U    | u    | u    | U    | E    | 1    | ↔    | R    | "    | 5    | 8    |      |
| LHHL                             |      |     | &    | 6    | V    | v    | v    | U    | E    | 1    | ↕    | R    | "    | 5    | 8    |      |
| LHHH                             |      |     | '    | 7    | W    | w    | w    | U    | E    | 1    | ↖    | R    | "    | 5    | 8    |      |
| HLLL                             |      |     | (    | 8    | H    | h    | h    | U    | E    | 1    | ↗    | R    | "    | 5    | 8    |      |
| HLLH                             |      |     | )    | 9    | I    | i    | i    | U    | E    | 1    | ↘    | R    | "    | 5    | 8    |      |
| HLHL                             |      |     | *    | +    | J    | j    | j    | U    | E    | 1    | ↙    | R    | "    | 5    | 8    |      |
| HLHH                             |      |     | +    | *    | K    | k    | k    | U    | E    | 1    | ↘    | R    | "    | 5    | 8    |      |
| HHLL                             |      |     | ,    | <    | L    | l    | l    | U    | E    | 1    | ↗    | R    | "    | 5    | 8    |      |
| HHLH                             |      |     | -    | =    | M    | m    | m    | U    | E    | 1    | ↖    | R    | "    | 5    | 8    |      |
| HHHL                             |      |     | .    | >    | N    | n    | n    | U    | E    | 1    | ↙    | R    | "    | 5    | 8    |      |
| HHHH                             |      |     | /    | ?    | 0    | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | A    | █    |



8.6. SPLC780C - 12

| Upper<br>4 bit<br>Lower<br>4 bit | LLLL | LLLH | LLHL | LLHH | LHLL | LHLH | LHHL | LHHH | HLLL | HLLH | HLHL | HLHH | HHLL | HHLH | HHHL | HHHH |
|----------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| LLLL                             |      |      |      | 0    | 1    | 2    | 3    | 4    |      |      |      | 5    | 6    | 7    | 8    | 9    |
| LLLH                             |      |      | !    | 0    | 1    | 2    | 3    | 4    |      |      | 5    | 6    | 7    | 8    | 9    |      |
| LLHL                             |      |      | "    | 2    | 3    | 4    | 5    | 6    |      |      | 7    | 8    | 9    | 0    | 1    | 2    |
| LLHH                             |      |      | #    | 3    | 4    | 5    | 6    | 7    |      |      | 8    | 9    | 0    | 1    | 2    | 3    |
| LHLL                             |      |      | \$   | 4    | 5    | 6    | 7    | 8    |      |      | 9    | 0    | 1    | 2    | 3    | 4    |
| LHLH                             |      |      | %    | 5    | 6    | 7    | 8    | 9    |      |      | 0    | 1    | 2    | 3    | 4    | 5    |
| LHHL                             |      |      | &    | 6    | 7    | 8    | 9    | 0    |      |      | 1    | 2    | 3    | 4    | 5    | 6    |
| LHHH                             |      |      | '    | 7    | 8    | 9    | 0    | 1    |      |      | 2    | 3    | 4    | 5    | 6    | 7    |
| HLLL                             |      |      | (    | 8    | 9    | 0    | 1    | 2    |      |      | 3    | 4    | 5    | 6    | 7    | 8    |
| HLLH                             |      |      | )    | 9    | 0    | 1    | 2    | 3    |      |      | 4    | 5    | 6    | 7    | 8    | 9    |
| HLHL                             |      |      | *    | 0    | 1    | 2    | 3    | 4    |      |      | 5    | 6    | 7    | 8    | 9    | 0    |
| HLHH                             |      |      | +    | 1    | 2    | 3    | 4    | 5    |      |      | 6    | 7    | 8    | 9    | 0    | 1    |
| HHLL                             |      |      | ,    | 2    | 3    | 4    | 5    | 6    |      |      | 7    | 8    | 9    | 0    | 1    | 2    |
| HHLH                             |      |      | =    | 3    | 4    | 5    | 6    | 7    |      |      | 8    | 9    | 0    | 1    | 2    | 3    |
| HHHL                             |      |      | .    | 4    | 5    | 6    | 7    | 8    |      |      | 9    | 0    | 1    | 2    | 3    | 4    |
| HHHH                             |      |      | /    | 5    | 6    | 7    | 8    | 9    |      |      | 0    | 1    | 2    | 3    | 4    | 5    |

8.7. SPLC780C - 13

| Upper<br>4 bit<br>Lower<br>4 bit | LLLL | LLH | LLHL | LLHH | LHLL | LHLH | LHHL | LHHH | HLLL | HLLH | HLHL | HLHH | HHLL | HHLH | HHHL | HHHH |
|----------------------------------|------|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| LLLL                             |      |     |      | 0    | 1    | 2    | 3    | 4    |      |      | 8    | 9    | A    | B    | C    | D    |
| LLLH                             |      |     | !    | 1    | A    | Q    | a    | 9    |      |      | 1    | 0    | 7    | 4    | 3    | 9    |
| LLHL                             |      |     | "    | 2    | B    | R    | b    | r    |      |      | A    | W    | U    | X    | P    | 0    |
| LLHH                             |      |     | #    | 3    | C    | S    | c    | s    |      |      | T    | 9    | 7    | E    | S    | 8    |
| LHLL                             |      |     | \$   | 4    | D    | T    | d    | t    |      |      | n    | 9    | t    | k    | u    | 0    |
| LHLH                             |      |     | %    | 5    | E    | U    | e    | u    |      |      | 1    | Y    | 大    | 1    | 5    | 0    |
| LHHL                             |      |     | &    | 6    | F    | V    | f    | v    |      |      | 2    | 8    | 二    | 3    | P    | 2    |
| LHHH                             |      |     | '    | 7    | G    | W    | g    | w    |      |      | n    | 2    | 8    | 7    | 9    | π    |
| HLLL                             |      |     | (    | 8    | H    | X    | h    | x    |      |      | 4    | 7    | 家    | 7    | J    | 2    |
| HLLH                             |      |     | )    | 9    | I    | Y    | i    | y    |      |      | '    | W    | 人    | 儿    | '    | Y    |
| HLHL                             |      |     | *    | 0    | J    | Z    | j    | z    |      |      | 7    | n    | n    | レ    | J    | 洋    |
| HLHH                             |      |     | +    | 1    | K    | [    | k    | [    |      |      | 3    | 8    | 日    | 0    | 8    | 5    |
| HHLL                             |      |     | ,    | <    | L    | 羊    | 1    | 1    |      |      | 7    | 5    | 7    | 7    | 5    | 4    |
| HHLH                             |      |     | =    | =    | M    | I    | m    | >    |      |      | 0    | 2    | 8    | 5    | 7    | 5    |
| HHHL                             |      |     | .    | >    | N    | ^    | n    | *    |      |      | 0    | 2    | 8    | 5    | 7    | 5    |
| HHHH                             |      |     | /    | ?    | 0    | 0    | 0    | *    |      |      | 1    | 9    | 2    | 8    | 0    | 0    |



8.8. SPLC780C - 14

| Upper<br>4 bit<br>Lower<br>4 bit | LLLL | LLLH | LLHL | LLHH | LHLL | LHLH | LHHL | LHHH | HLLL | HLLH | HLHL | HLHH | HHLL | HHLH | HHHL | HHHH |
|----------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| LLLL                             |      |      |      | 0    | 1    | 2    | 3    | 4    |      |      | 8    | 9    | A    | B    | C    | D    |
| LLLH                             |      |      | !    | 1    | A    | Q    | 9    |      |      |      | 0    | 0    | △    | 7    | △    | △    |
| LLHL                             |      |      | "    | 2    | R    | r    | r    |      |      |      | a    | v    | △    | △    | △    | △    |
| LLHH                             |      |      | #    | 3    | S    | s    | s    |      |      |      | T    | 9    | △    | △    | △    | △    |
| LHLL                             |      |      | Φ    | 4    | D    | T    | t    |      |      |      | 0    | 9    | △    | △    | △    | △    |
| LHLH                             |      |      | Σ    | 5    | E    | U    | u    |      |      |      | 1    | 7    | △    | △    | △    | △    |
| LHHL                             |      |      | Σ    | 6    | F    | V    | v    |      |      |      | Σ    | Σ    | 9    | △    | △    | △    |
| LHHH                             |      |      | '    | 7    | G    | g    | u    |      |      |      | 0    | P    | △    | △    | △    | △    |
| HLLL                             |      |      | 0    | 8    | H    | ×    | h    | ×    |      |      | 0    | 7    | △    | △    | △    | △    |
| HLLH                             |      |      | )    | 9    | I    | Y    | i    | y    |      |      | '    | u    | △    | △    | △    | △    |
| HLHL                             |      |      | *    | :    | J    | Z    | j    | z    |      |      | 7    | 0    | △    | △    | △    | △    |
| HLHH                             |      |      | +    | □    | K    | W    | k    | W    |      |      | 0    | 9    | △    | △    | △    | △    |
| HHLL                             |      |      | .    | <    | L    | □    | 1    | △    |      |      | 5    | △    | △    | △    | △    | △    |
| HHLH                             |      |      | -    | =    | M    | W    | m    | w    |      |      | 0    | △    | U    | △    | △    | △    |
| HHHL                             |      |      | .    | >    | N    | ^    | n    | *    |      |      | 0    | 9    | △    | U    | △    | △    |
| HHHH                             |      |      | /    | □    | 0    | 4    | 0    | ←    |      |      | 1    | △    | 7    | △    | △    | ■    |



8.9. SPLC780C - 15

| Upper<br>4 bit<br>Lower<br>4 bit | LLLL | LLLH | LLHL | LLHH | LHLL | LHLH | LHHL | LHHH | HLLL | HLLH | HLHL | HLHH | HHLL | HHLH | HHHL | HHHH |
|----------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| LLLL                             |      |      |      | 0    | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | A    | B    | C    |
| LLLH                             |      |      | !    | 1    | A    | Q    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | A    | B    | C    |
| LLHL                             |      |      | "    | 2    | B    | R    | b    | r    | 8    | 9    | A    | B    | C    | D    | E    | F    |
| LLHH                             |      |      | #    | 3    | C    | S    | c    | s    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | A    |
| LHLL                             |      |      | \$   | 4    | D    | T    | d    | t    | H    | 8    | 9    | A    | B    | C    | D    | E    |
| LHLH                             |      |      | %    | 5    | E    | U    | e    | u    | M    | 8    | 9    | A    | B    | C    | D    | E    |
| LHHL                             |      |      | &    | 6    | F    | V    | f    | v    | J    | 8    | 9    | A    | B    | C    | D    | E    |
| LHHH                             |      |      | '    | 7    | G    | W    | w    | w    | 0    | 8    | 9    | A    | B    | C    | D    | E    |
| HLLL                             |      |      | (    | 8    | H    | X    | h    | x    | 9    | 0    | 1    | 2    | 3    | 4    | 5    | 6    |
| HLLH                             |      |      | )    | 9    | I    | Y    | i    | y    | 0    | 1    | 2    | 3    | 4    | 5    | 6    | 7    |
| HLHL                             |      |      | *    | :    | J    | Z    | j    | z    | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    |
| HLHH                             |      |      | +    | ;    | K    | [    | k    | [    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    |
| HHLL                             |      |      | ,    | <    | L    | ]    | l    | ]    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 0    |
| HHLH                             |      |      | -    | =    | M    | ^    | m    | ^    | 4    | 5    | 6    | 7    | 8    | 9    | 0    | 1    |
| HHHL                             |      |      | .    | >    | N    | _    | n    | _    | 5    | 6    | 7    | 8    | 9    | 0    | 1    | 2    |
| HHHH                             |      |      | /    | ?    | O    | `    | o    | `    | 6    | 7    | 8    | 9    | 0    | 1    | 2    | 3    |





8.10. SPLC780C - 17

| Upper<br>4 bit<br>Lower<br>4 bit | LLLL | LLLH | LLHL | LLHH | LHLL | LHLH | LHHL | LHHH | HLLL | HLLH | HLHL | HLHH | HHLL | HHLH | HHHL | HHHH |
|----------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| LLLL                             |      | 月    |      | 00P  |      |      |      |      |      |      |      |      | 一    | 夕    | 三    | 00   |
| LLLH                             |      | 日    | !    | 1    | 0    | 3    | 4    | 0    |      |      |      |      | ア    | チ    | 4    | 00   |
| LLHL                             |      | 台    | "    | 2    | R    | b    | r    |      |      |      |      |      | イ    | ウ    | ×    | 00   |
| LLHH                             |      | 1    | #    | 3    | C    | S    | c    | s    |      |      |      |      | ウ    | テ    | 毛    | 00   |
| LHLL                             |      | 6    | *    | 4    | D    | T    | d    | t    |      |      |      |      | 工    | ト    | 木    | 00   |
| LHLH                             |      | 0    | %    | 5    | E    | U    | e    | u    |      |      |      |      | 才    | 大    | 工    | 00   |
| LHHL                             |      | 8    | &    | 6    | F    | V    | f    | v    |      |      |      |      | 力    | 二    | 日    | 00   |
| LHHH                             |      | 9    | '    | 7    | G    | W    | g    | w    |      |      |      |      | ア    | キ    | 又    | 00   |
| HLLL                             |      | 0    | (    | 8    | H    | X    | h    | x    |      |      |      |      | イ    | ウ    | 率    | 00   |
| HLLH                             |      | 0    | )    | 9    | I    | Y    | i    | y    |      |      |      |      | ウ    | ケ    | ル    | 00   |
| HLHL                             |      | 0    | *    | :    | J    | Z    | j    | z    |      |      |      |      | 0    | 正    | 日    | 00   |
| HLHH                             |      | 7    | +    | 8    | K    | K    | く    | キ    |      |      |      |      | 才    | 才    | 才    | 00   |
| HHLL                             |      | 7    | ,    | <    | L    | 羊    | l    | 羊    |      |      |      |      | カ    | ヨ    | ウ    | 00   |
| HHLH                             |      | 1    | -    | =    | M    | I    | m    | i    |      |      |      |      | 羊    | ユ    | 又    | 00   |
| HHHL                             |      | 0    | .    | >    | N    | n    | ナ    | 月    |      |      |      |      | 月    | 也    | 市    | 00   |
| HHHH                             |      | 0    | /    | ?    | 0    | 0    | ←    | 月    |      |      |      |      | ウ    | マ    | マ    | 00   |



8.11. SPLC780C - 18

| Upper<br>4 bit<br>Lower<br>4 bit | LLLL | LLLH | LLHL       | LLHH       | LHLL       | LHLH     | LHHL     | LHHH     | HLLL      | HLLH         | HLHL         | HLHH         | HHLL         | HHLH         | HHHL       | HHHH       |
|----------------------------------|------|------|------------|------------|------------|----------|----------|----------|-----------|--------------|--------------|--------------|--------------|--------------|------------|------------|
| LLLL                             |      |      |            | 0          | 1          | 2        | 3        | 4        | 5         | 6            | 7            | 8            | 9            | A            | B          | C          |
| LLLH                             |      |      | D          | E          | F          | G        | H        | I        | J         | K            | L            | M            | N            | O            | P          | Q          |
| LLHL                             |      |      | R          | S          | T          | U        | V        | W        | X         | Y            | Z            | [            | ]            | ^            | _          | grave      |
| LLHH                             |      |      | backslash  | pipe       | tilde      | space    | at       | asterisk | hash      | dollar       | percent      | ampersand    | single quote | double quote | underscore | backtick   |
| LHLL                             |      |      | circumflex | grave      | asciitilde | space    | at       | asterisk | hash      | dollar       | percent      | ampersand    | single quote | double quote | underscore | backtick   |
| LHLH                             |      |      | asciitilde | space      | at         | asterisk | hash     | dollar   | percent   | ampersand    | single quote | double quote | underscore   | backtick     | circumflex | grave      |
| LHHL                             |      |      | grave      | asciitilde | space      | at       | asterisk | hash     | dollar    | percent      | ampersand    | single quote | double quote | underscore   | backtick   | circumflex |
| LHHH                             |      |      | circumflex | grave      | asciitilde | space    | at       | asterisk | hash      | dollar       | percent      | ampersand    | single quote | double quote | underscore | backtick   |
| HLLL                             |      |      | space      | at         | asterisk   | hash     | dollar   | percent  | ampersand | single quote | double quote | underscore   | backtick     | circumflex   | grave      | asciitilde |
| HLLH                             |      |      | space      | at         | asterisk   | hash     | dollar   | percent  | ampersand | single quote | double quote | underscore   | backtick     | circumflex   | grave      | asciitilde |
| HLHL                             |      |      | space      | at         | asterisk   | hash     | dollar   | percent  | ampersand | single quote | double quote | underscore   | backtick     | circumflex   | grave      | asciitilde |
| HLHH                             |      |      | space      | at         | asterisk   | hash     | dollar   | percent  | ampersand | single quote | double quote | underscore   | backtick     | circumflex   | grave      | asciitilde |
| HHLL                             |      |      | space      | at         | asterisk   | hash     | dollar   | percent  | ampersand | single quote | double quote | underscore   | backtick     | circumflex   | grave      | asciitilde |
| HHLH                             |      |      | space      | at         | asterisk   | hash     | dollar   | percent  | ampersand | single quote | double quote | underscore   | backtick     | circumflex   | grave      | asciitilde |
| HHHL                             |      |      | space      | at         | asterisk   | hash     | dollar   | percent  | ampersand | single quote | double quote | underscore   | backtick     | circumflex   | grave      | asciitilde |
| HHHH                             |      |      | space      | at         | asterisk   | hash     | dollar   | percent  | ampersand | single quote | double quote | underscore   | backtick     | circumflex   | grave      | asciitilde |



8.12. SPLC780C - 19

| Upper<br>4 bit<br>Lower<br>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                             |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |



**9.3. PAD Locations**

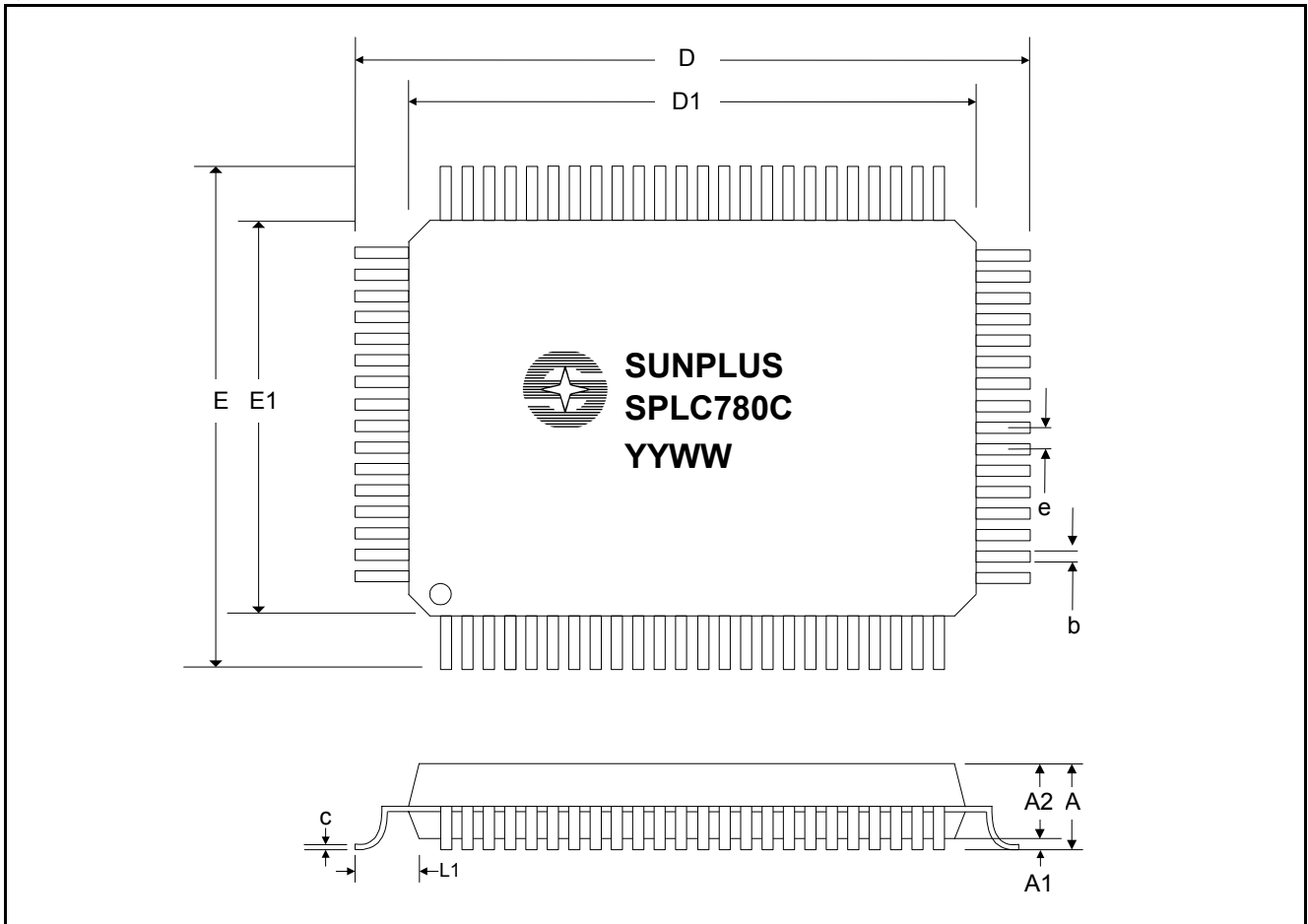
| PAD No. | PAD Name | X     | Y    | PAD No. | PAD Name | X     | Y     |
|---------|----------|-------|------|---------|----------|-------|-------|
| 1       | SEG22    | 1410  | 1164 | 41      | DB2      | -1410 | -1165 |
| 2       | SEG21    | 1270  | 1164 | 42      | DB3      | -1272 | -1165 |
| 3       | SEG20    | 1137  | 1164 | 43      | DB4      | -1140 | -1165 |
| 4       | SEG19    | 1017  | 1164 | 44      | DB5      | -1013 | -1165 |
| 5       | SEG18    | 897   | 1164 | 45      | DB6      | -890  | -1165 |
| 6       | SEG17    | 777   | 1164 | 46      | DB7      | -770  | -1165 |
| 7       | SEG16    | 657   | 1164 | 47      | COM1     | -637  | -1165 |
| 8       | SEG15    | 537   | 1164 | 48      | COM2     | -517  | -1165 |
| 9       | SEG14    | 417   | 1164 | 49      | COM3     | -397  | -1165 |
| 10      | SEG13    | 297   | 1164 | 50      | COM4     | -277  | -1165 |
| 11      | SEG12    | 177   | 1164 | 51      | COM5     | -157  | -1165 |
| 12      | SEG11    | 57    | 1164 | 52      | COM6     | -37   | -1165 |
| 13      | SEG10    | -63   | 1164 | 53      | COM7     | 83    | -1165 |
| 14      | SEG9     | -183  | 1164 | 54      | COM8     | 203   | -1165 |
| 15      | SEG8     | -303  | 1164 | 55      | COM9     | 323   | -1165 |
| 16      | SEG7     | -423  | 1164 | 56      | COM10    | 443   | -1165 |
| 17      | SEG6     | -543  | 1164 | 57      | COM11    | 563   | -1165 |
| 18      | SEG5     | -663  | 1164 | 58      | COM12    | 683   | -1165 |
| 19      | SEG4     | -783  | 1164 | 59      | COM13    | 803   | -1165 |
| 20      | SEG3     | -903  | 1164 | 60      | COM14    | 923   | -1165 |
| 21      | SEG2     | -1023 | 1164 | 61      | COM15    | 1043  | -1165 |
| 22      | SEG1     | -1143 | 1164 | 62      | COM16    | 1163  | -1165 |
| 23      | VSS      | -1271 | 1164 | 63      | SEG40    | 1283  | -1165 |
| 24      | OSC1     | -1411 | 1164 | 64      | SEG39    | 1410  | -1165 |
| 25      | OSC2     | -1391 | 932  | 65      | SEG38    | 1390  | -963  |
| 26      | V1       | -1391 | 784  | 66      | SEG37    | 1390  | -802  |
| 27      | V2       | -1391 | 624  | 67      | SEG36    | 1390  | -662  |
| 28      | V3       | -1391 | 504  | 68      | SEG35    | 1390  | -532  |
| 29      | V4       | -1391 | 384  | 69      | SEG34    | 1390  | -412  |
| 30      | V5       | -1391 | 264  | 70      | SEG33    | 1390  | -292  |
| 31      | CL1      | -1391 | 144  | 71      | SEG32    | 1390  | -172  |
| 32      | CL2      | -1391 | 24   | 72      | SEG31    | 1390  | -52   |
| 33      | VDD      | -1391 | -96  | 73      | SEG30    | 1390  | 68    |
| 34      | M        | -1391 | -216 | 74      | SEG29    | 1390  | 188   |
| 35      | D        | -1391 | -336 | 75      | SEG28    | 1390  | 308   |
| 36      | RS       | -1391 | -456 | 76      | SEG27    | 1390  | 428   |
| 37      | RW       | -1391 | -576 | 77      | SEG26    | 1390  | 548   |
| 38      | E        | -1391 | -696 | 78      | SEG25    | 1390  | 683   |
| 39      | DB0      | -1391 | -816 | 79      | SEG24    | 1390  | 818   |
| 40      | DB1      | -1391 | -955 | 80      | SEG23    | 1390  | 963   |



9.5. Package Information

QFP 80L Outline Dimensions

Unit: Millimeter



| Symbol | Min. | Nom.      | Max. | Unit       |
|--------|------|-----------|------|------------|
| D      |      | 23.20 REF |      | Millimeter |
| D1     |      | 20.00 REF |      | Millimeter |
| E      |      | 17.20 REF |      | Millimeter |
| E1     |      | 14.00 REF |      | Millimeter |
| e      |      | 0.80 REF  |      | Millimeter |
| b      | 0.30 | 0.35      | 0.45 | Millimeter |
| A      | -    | -         | 3.40 | Millimeter |
| A1     | 0.25 | -         | -    | Millimeter |
| A2     | 2.50 | 2.72      | 2.90 | Millimeter |
| c      | 0.11 | 0.15      | 0.23 | Millimeter |
| L1     |      | 1.60 REF  |      | Millimeter |

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**11. REVISION HISTORY**

| Date          | Revision # | Description  | Page         |
|---------------|------------|--|--------------|
| JUN. 04, 2001 | 0.1        | Original   |              |
| OCT. 02, 2001 | 1.0        | 1. Delete " <i>PRELIMINARY</i> "<br>2. Correct " <i>8.3 SPLC780C-03</i> "<br>3. Add " <i>8.4 SPLC780C-08</i> " and " <i>8.12 SPLC780C-19</i> " | 32<br>33, 41 |
| JUL. 09, 2002 | 1.1        | 1. Update " <i>9.2 Ordering Information</i> "<br>2. Update " <i>9.5 Package Information</i> "  | 42<br>45     |