



To : _____

SPECIFICATION

Rev. 3.0

Application: _____

VACUUM FLUORESCENT DISPLAY MODULE

Model No.: 160S321B1

Rev. No	Issued Date	Description	Note
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~~~~~ Index ~~~~~

|                                                                          |                |
|--------------------------------------------------------------------------|----------------|
| <b>1. SCOPE .....</b>                                                    | <b>Page 3</b>  |
| <b>2. FEATURES.....</b>                                                  | <b>Page 3</b>  |
| <b>3. PRECAUTIONS.....</b>                                               | <b>Page 3</b>  |
| <b>4. PRODUCT SPECIFICATIONS .....</b>                                   | <b>Page 4</b>  |
| 4.1 Type.....                                                            | Page 4         |
| 4.2 Outer Dimensions, Weight .....                                       | Page 4         |
| 4.3 Environment Conditions .....                                         | Page 4         |
| 4.4 Absolute Maximum Ratings.....                                        | Page 4         |
| 4.5 Recommend Operating Conditions .....                                 | Page 4         |
| 4.6 DC Characteristics.....                                              | Page 4         |
| 4.7 Timing Chart .....                                                   | Page 5         |
| 4.7.1 Parallel interface write-in timing .....                           | Page 5         |
| 4.7.2 Parallel interface read-out timing.....                            | Page 5         |
| 4.7.3 Asynchronous serial interface timing.....                          | Page 6         |
| 4.8 Interfacing Connectors .....                                         | Page 6         |
| 4.8.1 Asynchronous serial interface connector .....                      | Page 6         |
| 4.8.2 Parallel interface connector .....                                 | Page 6         |
| 4.9 System Block Diagram.....                                            | Page 7         |
| 4.10 Outer Dimensions.....                                               | Page 7         |
| <b>5. DISPLAY SPECIFICATION .....</b>                                    | <b>Page 8</b>  |
| 5.1 Character display.....                                               | Page 8         |
| 5.2 Display Area Map.....                                                | Page 8         |
| 5.3 Graphical Data Writes .....                                          | Page 8         |
| <b>6. FUNCTIONS .....</b>                                                | <b>Page 9</b>  |
| 6.1 Software Commands and Control Codes Description .....                | Page 9         |
| 6.1.1 Data Write (10H~FFH, RS=1).....                                    | Page 9         |
| 6.1.2 Display Clear (01H, RS=0).....                                     | Page 9         |
| 6.1.3 Display Position Home (02H, RS=0) .....                            | Page 9         |
| 6.1.4 Entry Mode (04H/06H, RS=0).....                                    | Page 9         |
| 6.1.5 Display ON/OFF Control (0CH/08H, RS=0) .....                       | Page 9         |
| 6.1.6 Display Shift Left (18H, RS=0).....                                | Page 9         |
| 6.1.7 Display Shift Right (1CH, RS=0).....                               | Page 9         |
| 6.1.8 Diming (30H, 31H, 32H, 33H, RS=0).....                             | Page 10        |
| 6.1.9 Set DD Address (80H~F3H, RS=0).....                                | Page 10        |
| 6.1.10 Set Area (F5H + X1 + Y1 + X2 + Y2 + 'H' or 'V', RS=0).....        | Page 10        |
| 6.1.11 Additional Serial Data Command: Set RS Low (0FH) .....            | Page 10        |
| 6.1.12 Select Font Mode (F6H + n, RW=0, RS=0).....                       | Page 10        |
| 6.2 Jumper Setting.....                                                  | Page 11        |
| 6.3 Display Examples.....                                                | Page 11        |
| 6.3.1 Serial Control.....                                                | Page 11        |
| 6.3.2 Extended Graphic Commands .....                                    | Page 11        |
| 6.3.3 Displaying Graphics .....                                          | Page 12        |
| <b>* Appendix 1: Characters Font Table1 (CG_ROM, 6x8dot font).....</b>   | <b>Page 13</b> |
| <b>* Appendix 2: Characters Font Table2 (CG_ROM, 11x16dot font).....</b> | <b>Page 14</b> |

## 1. SCOPE

This specification applies to VFD module (Model No. 160S321B1) manufactured by SSVD (Shanghai Samsung Vacuum Devices).

## 2. FEATURES

- \* 160×32 dot graphic.
- \* 8 bit parallel M68 LCD compatible & asynchronous serial interface (9600, 19200 bps).
- \* Since a DC/DC converter is used, only +5V<sub>DC</sub> power source is required to operate the module.
- \* CG-ROM which is mounted on module offers 6×8 dot and 11×16 dot font.
- \* 4 brightness levels can be selected by brightness control command.
- \* Chip in glass(CIG) driver VFD panel technology

## 3. PRECAUTIONS (OPERATING RECOMMENDATIONS)

- \* Avoid applying excessive shock or vibration beyond the specification for the VFD module.
- \* Since VFD is made of glass material, careful handling is required. i.e. Direct impact with hard material to the glass surface(especially exhaust tip) may crack the glass.
- \* When mounting the VFD module to your system, leave a slight gap between the VFD glass and your front panel. The module should be mounted without stress to avoid flexing of the PCB.
- \* Avoid plugging or unplugging the interface connection with the power on, otherwise it may cause the severe damage to input circuitry.
- \* Exceeding any of maximum ratings may cause the permanent damage.
- \* Since the VFD modules contain high voltage source, careful handling is required during powered on.
- \* When the power is turned off, the capacitor does not discharge immediately. The high voltage applied to the VFD must not contact to the ICs. In other words, the compulsory short-circuit of mounted components on PCB within 30 seconds after power-off may cause damage to the module.
- \* Sending any input signals to the VFD module during power-off condition may cause I/O port damage in VFD circuitry.
- \* The power supply must be capable of providing at least 5 times the rated current, because the inrush current maybe 5 times the specified current consumption when the power is turned on.
- \* Avoid using the module where excessive noise interference is expected. Noise may affects the interface signal and causes improper operation. And it is important to keep the length of the interface cable less than 15 meters (50 feet).
- \* Since all VFD modules contain C-MOS ICs, anti-static handling procedures are always required.

#### 4. PRODUCT SPECIFICATIONS

##### 4.1 Type

|              |                             |
|--------------|-----------------------------|
| Type         | 160S321B1                   |
| Digit Format | 160 * 32 graphic dot matrix |

##### 4.2 Outer Dimensions, Weight

| Parameters       | Symbols       | Specification                          | Unit |
|------------------|---------------|----------------------------------------|------|
| Outer Dimensions | W * H         | 154.0 * 45.0                           | mm   |
| Glass Size       | W * H         | 135.2 * 33.5                           | mm   |
| Display Area     | W * H         | 103.85 * 20.65                         | mm   |
| Dot Pitch        | DP(x) * DP(y) | 0.65 * 0.65                            | mm   |
| Dot Size         | DW * DH       | 0.5 * 0.5                              | mm   |
| Weight           |               | Approx. 90 (check the sample's weight) | g    |

##### 4.3 Environment Conditions

| Parameters               | Symbols          | Min. | Max. | Unit |
|--------------------------|------------------|------|------|------|
| Operating Temperature    | T <sub>OPR</sub> | 0    | +70  | °C   |
| Storage Temperature      | T <sub>STG</sub> | -40  | +85  | °C   |
| Humidity (Operating)     | H <sub>OPR</sub> | 30   | 85   | %    |
| Humidity (Non-operating) | H <sub>STG</sub> | 30   | 95   | %    |
| Vibration (10 ~ 55 Hz)   | -                | -    | 4    | G    |
| Shock                    | -                | -    | 40   | G    |

##### 4.4 Absolute Maximum Ratings

| Parameters                    | Symbols          | Min. | Max.                 | Unit            |
|-------------------------------|------------------|------|----------------------|-----------------|
| Supply Voltage                | V <sub>CC</sub>  | -0.3 | +6.0                 | V <sub>DC</sub> |
| Serial Input Signal Voltage   | V <sub>SIN</sub> | -0.3 | V <sub>CC</sub> +0.3 | V <sub>DC</sub> |
| Parallel Input Signal Voltage | V <sub>PIN</sub> | -0.3 | V <sub>CC</sub> +0.3 | V <sub>DC</sub> |

##### 4.5 Recommend Operating Conditions

| Parameters       | Symbols         | Min.               | Typ. | Max.               | Unit            |
|------------------|-----------------|--------------------|------|--------------------|-----------------|
| Supply Voltage   | V <sub>CC</sub> | 4.75               | 5.0  | 5.25               | V <sub>DC</sub> |
| Logic High Input | V <sub>IH</sub> | 0.8V <sub>CC</sub> | -    | V <sub>CC</sub>    | V <sub>DC</sub> |
| Logic Low Input  | V <sub>IL</sub> | 0                  | -    | 0.2V <sub>CC</sub> | V <sub>DC</sub> |

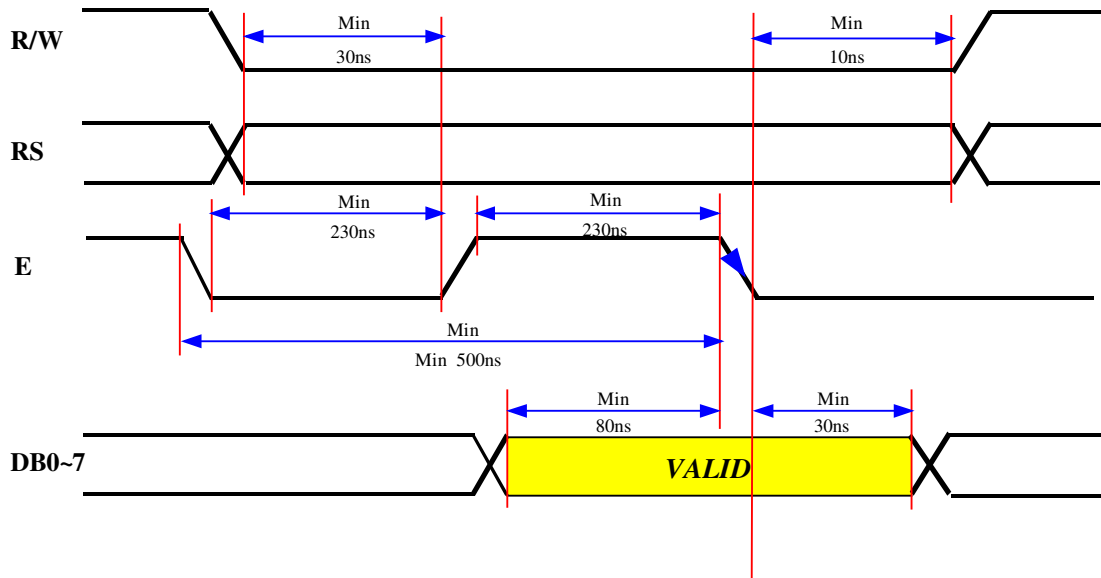
##### 4.6 DC Characteristics

| Parameters                                     | Test Conditions                        | Min.                     | Typ.         | Max.  | Unit                         |
|------------------------------------------------|----------------------------------------|--------------------------|--------------|-------|------------------------------|
| Supply Current (*)<br>(When all dots are lit.) | V <sub>CC</sub> = +5.0 V <sub>DC</sub> | -                        | 550          | 700   | mA                           |
| High Level Input Current                       |                                        | -                        | -            | 30    | uA                           |
| Low Level Input Current                        |                                        | -                        | -            | -0.36 | mA                           |
| Brightness                                     | V <sub>CC</sub> = +5.0 V <sub>DC</sub> | 102<br>(350)             | 204<br>(700) | -     | ft-L<br>(cd/m <sup>2</sup> ) |
| Display Color                                  |                                        | Green (x=0.250, y=0.439) |              |       | -                            |

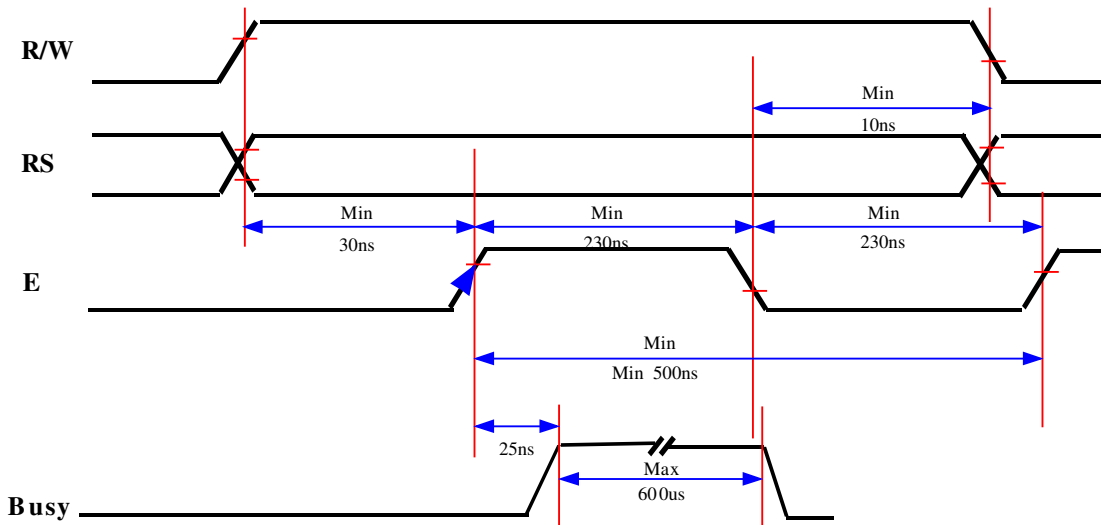
(\*): The inrush current can be 5 times the specified max. supply current at power on.

4.7 Timing Chart

4.7.1 Parallel interface write-in timing

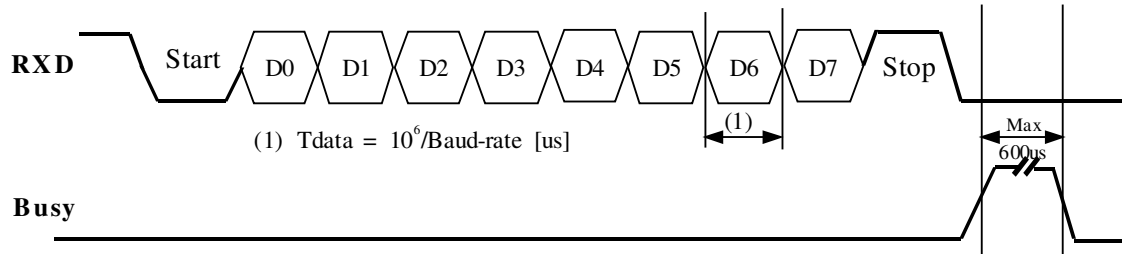


4.7.2 Parallel interface read-out timing



If the Busy signal is Low send data enable.

### 4.7.3 Asynchronous serial interface timing



## 4.8 Interfacing Connectors

### 4.8.1 Asynchronous serial interface connector

| Pin No. | Signal Name | Description             |
|---------|-------------|-------------------------|
| 1       | VCC         | Power Supply            |
| 2       | RXD         | Receive Data            |
| 3       | GND         | Power and Signal Ground |
| 4       | /RST        | Reset                   |
| 5       | SBUSY       | Display Busy            |

### 4.8.2 Parallel interface connector

| Pin No. | Signal Name | Description  |
|---------|-------------|--------------|
| 1       | GND         | Ground       |
| 2       | VCC         | Power Supply |
| 3       | PBUSY       | Display Busy |
| 4       | RS          | Select       |
| 5       | R/W         | Read/Write   |
| 6       | E           | Enable       |
| 7       | D0          | Data Bus     |

| Pin No. | Signal Name | Description     |
|---------|-------------|-----------------|
| 8       | D1          | Data Bus        |
| 9       | D2          | Data Bus        |
| 10      | D3          | Data Bus        |
| 11      | D4          | Data Bus        |
| 12      | D5          | Data Bus        |
| 13      | D6          | Data Bus        |
| 14      | D7(PBUSY)   | Data Bus(PBUSY) |

4.9 System Block Diagram

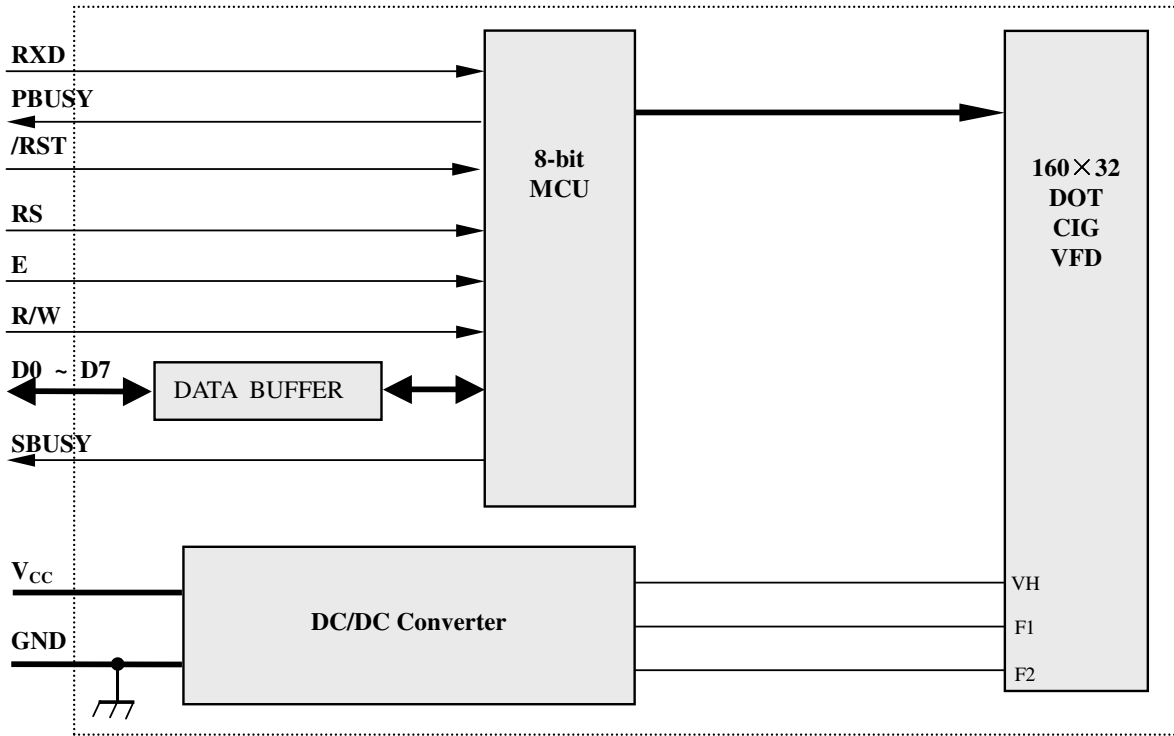


Fig.-2 System Block Diagram

4.10 Outer Dimensions

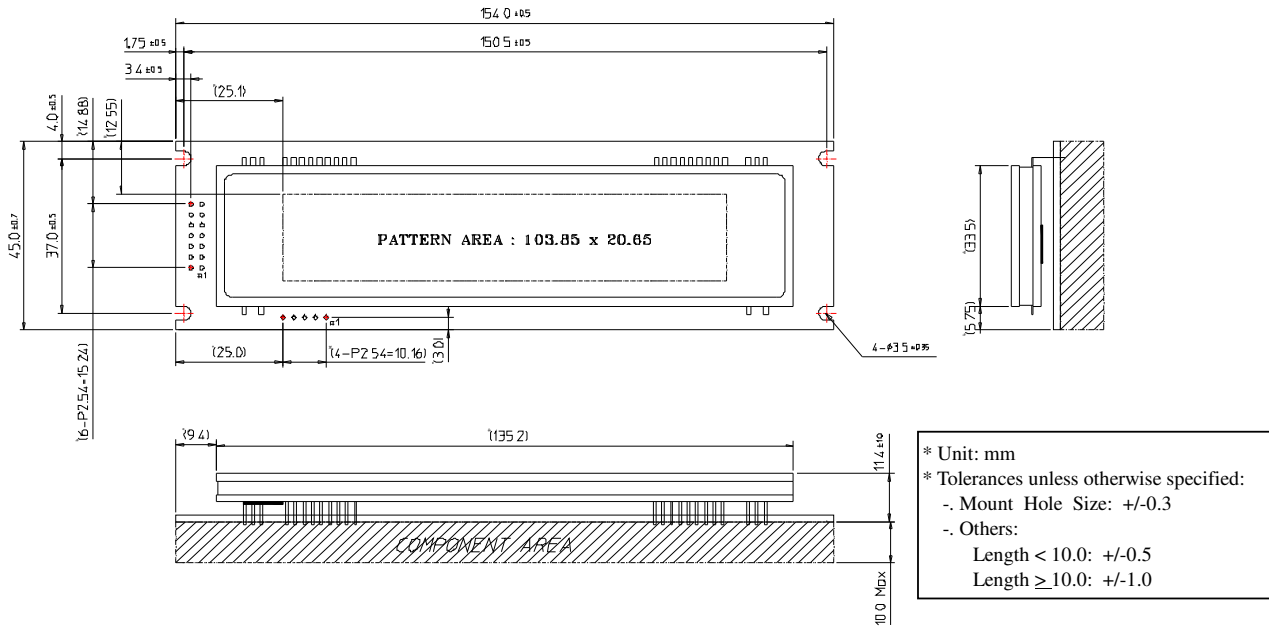


Fig.-3 Outer Dimensions

5. DISPLAY SPECIFICATION

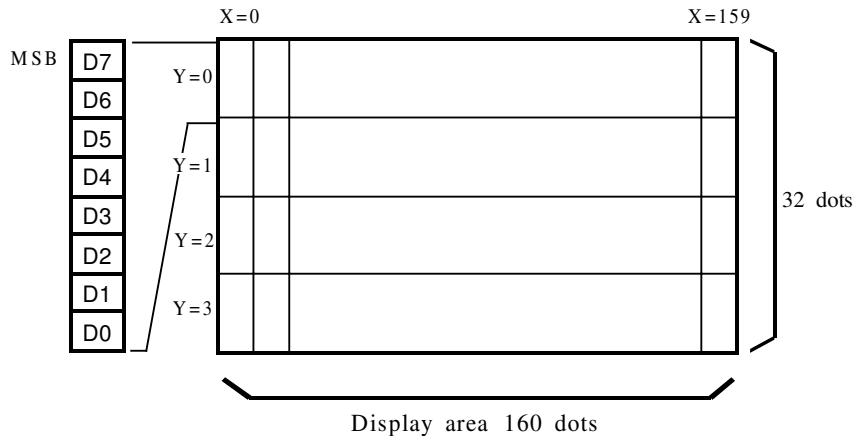
5.1 Character display

Character mode:            6×8 dot – Max. 26×4 characters  
                                  11×16 dot – Max. 14×2 characters  
 Character font type:      6×8 dot – Customer font  
                                  11×16 dot – Customer font

5.2 Display Area Map

This display is organized as 160×4 byte. All graphic data are written vertically with the most significant bit (MSB) uppermost.

5.3 Graphical Data Writes





## 6. FUNCTIONS

### 6.1 Software Commands and Control Codes Description

#### 6.1.1 Data Write (10H~FFH, RS=1)

Write data to the display. In normal (LCD compatible) mode of operation, data is written to the display data (DD RAM). When using the graphical data commands (F5H), data is written direct to the display and is not stored in DD RAM. Data write busy times will increase when using the graphic functions.

#### 6.1.2 Display Clear (01H, RS=0)

Fills all locations in the display data (DD) RAM with 00h.  
The address counter is set to 0 in the DD RAM.  
The address counter is set to increment on each data read/write.  
Any display offset (using the display shift command) is removed.

#### 6.1.3 Display Position Home (02H, RS=0)

The address counter is set to 0 in the DD RAM.  
Any display offset (using the display shift command) is removed.

#### 6.1.4 Entry Mode (04H/06H, RS=0)

Bit 1 (I/D) is used to select the direction of the address counter on each data read or write.  
If set to '1', the address counter is increased (06H).  
If set to '0', the address counter is decreased (04H).  
The display shift direction depends upon the address counter direction (bit1).  
If this is set to increment, the display is shifted left, if the address counter is set to decrement, the display is shifted right.

| RS | R/W | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|----|-----|------|------|------|------|------|------|------|------|
| 0  | 0   | 0    | 0    | 0    | 0    | 0    | 1    | I/D  | -    |

#### 6.1.5 Display ON/OFF Control (0CH/08H, RS=0)

Bit 2 (I/D) is used to enable or disable the display.  
If this bit is set to '0' the VFD's power supply is turned off to reduce power consumption.

| RS | R/W | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|----|-----|------|------|------|------|------|------|------|------|
| 0  | 0   | 0    | 0    | 0    | 0    | 1    | D    | -    | -    |

#### 6.1.6 Display Shift Left (18H, RS=0)

Shift the display left, one character position.

#### 6.1.7 Display Shift Right (1CH, RS=0)

Shift the display right, one character position.

### 6.1.8 Dimming (30H, 31H, 32H, 33H, RS=0)

The BR1, BR0 value sets the displays brightness.

| RS | R/W | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|----|-----|------|------|------|------|------|------|------|------|
| 0  | 0   | 0    | 0    | 1    | 1    | -    | -    | BR1  | BR0  |

BR1, BR0:      00 = full brightness,  
                   01 = 75%,  
                   10 = 50%,  
                   11 = 25%,

### 6.1.9 Set DD Address (80H~F3H, RS=0)

When  $6 \times 8$  dot, set the display data address (DD RAM).

80H~90H = 1st line, 9AH~B3H = 2nd line, C0H~D9H = 3rd line, DAH~F3H = 4th line.

|         | Left End | 2nd Column | 3rd Column | ..... | 25th Column | Right End |
|---------|----------|------------|------------|-------|-------------|-----------|
| 1st Row | 80 Hex   | 81 Hex     | 82 Hex     | ..... | 98 Hex      | 99 Hex    |
| 2nd Row | 9A Hex   | 9B Hex     | 9C Hex     | ..... | B2 Hex      | B3 Hex    |
| 3rd Row | C0 Hex   | C1 Hex     | C2 Hex     | ..... | D4 Hex      | D9 Hex    |
| 4th Row | DA Hex   | DB Hex     | DC Hex     | ..... | F2 Hex      | F3 Hex    |

When  $11 \times 16$  dot, set the display data address (DD RAM).

80H~8CH = 1st line, C0H~CDH = 2nd line.

|         | Left End | 2nd Column | 3rd Column | ..... | 13th Column | Right End |
|---------|----------|------------|------------|-------|-------------|-----------|
| 1st Row | 80 Hex   | 81 Hex     | 82 Hex     | ..... | 8C Hex      | 8D Hex    |
| 2nd Row | C0 Hex   | C1 Hex     | C2 Hex     | ..... | CC Hex      | CD Hex    |

### 6.1.10 Set Area (F5H + X1 + Y1 + X2 + Y2 + 'H' or 'V', RS=0)

X1 Y1 left top, X2 Y2 bottom right.  $X_{POS} = 0 \sim 159$ ,  $Y_{POS} = 0 \sim 3$ .

Co-ordinates and Graphical data should be written with RS line set high.

'H' or 'h': Graphic write is horizontal mode.

'V' or 'v': Graphic write is vertical mode (\*Refer to example).

### 6.1.11 Additional Serial Data Command: Set RS Low (0FH)

Set the RS line low for the following byte only. Used in serial communications only.

### 6.1.12 Select Font Mode (F6H + n, RW=0, RS=0)

n = 0:       $6 \times 8$  dot character (default).

n = 1:       $11 \times 16$  dot character.

## 6.2 Jumper Setting

The selection switches are located on the PCB right side. The switch settings are read only when the power is turned on. Therefore, changing the settings while the power is on has no effect.

\* Jumper Switches OPEN/SHORT Function Table

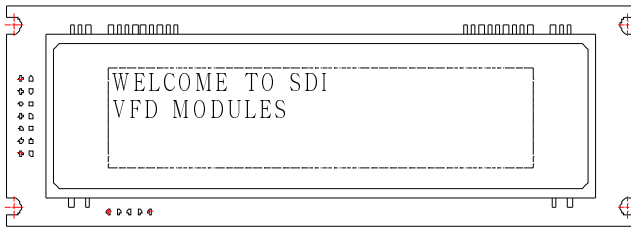
| J1    | J2    | J3    | Setting Value             | Description         |
|-------|-------|-------|---------------------------|---------------------|
| Open  | ×     | ×     | <b>9,600 bps</b>          | Baud-rate Selection |
| Short | ×     | ×     | 19,200 bps                |                     |
| ×     | Short | Open  | <b>Pin #14 PBUSY</b>      | PBUSY Select        |
| ×     | Open  | Short | Pin #3 PBUSY              |                     |
| Open  | Short | Open  | <b>Setting at Factory</b> |                     |

## 6.3 Display Examples

### 6.3.1 Serial Control (Select Font Mode “6×8dot Character”)

An additional command has been included to distinguish between command and data writes. When using serial communications. This command (0FH) will temporarily set RS line low for the subsequent written byte. The following example displays two text messages using the serial communications and the ‘Set RS Low’ command:

| Clear Display  | Set DDRAM      | Display Character |
|----------------|----------------|-------------------|
| <b>0FH 01H</b> | <b>0FH 80H</b> | WELCOME TO SDI    |
|                | <b>0FH 9AH</b> | VFD MODULES       |



### 6.3.2 Extended Graphic Commands

In addition to the standard LCD commands, this module includes additional commands to display graphical data and different font sizes. When any of these extended commands are executed, the module will change to the ‘graphics’ mode of operation. This graphics mode allows text to be written to any part of the display. There are many differences the user should be aware of when the display is in this graphics mode:

Written data may require additional busy times.

Text data is not written into the DD RAM and therefore can not be read back.

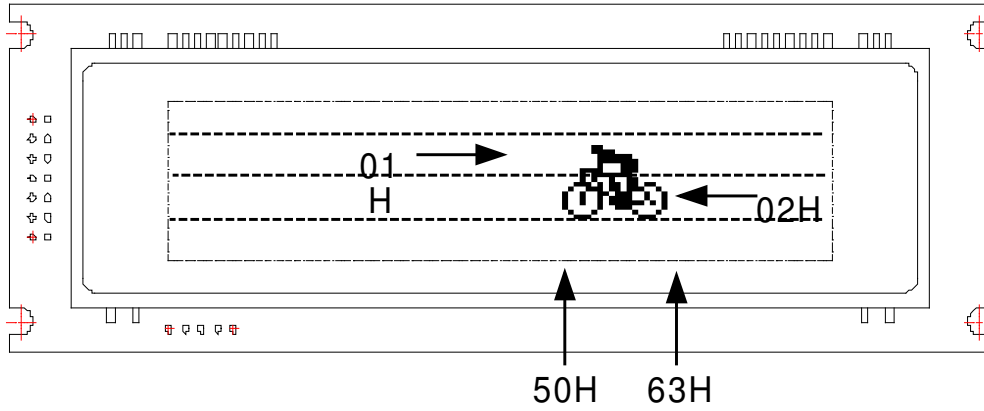
Graphical text can not be shifted onto the display.

The graphics mode is disabled as soon as any valid LCD command is received.

### 6.3.3 Displaying Graphics

Graphical images can be displayed on the VFD module. After each graphical data write, the display position is automatically advanced. All graphical data is contained within the defined area. Unused bits are masked where the screen area is not a byte multiple.

The following example displays a simple graphical image. Command bytes that are underlined should be sent with RS line low.



| Area Command | Area Co-ordinates |     |     |     | Display Mode | Graphic Data | Remark     |
|--------------|-------------------|-----|-----|-----|--------------|--------------|------------|
|              | X1                | Y1  | X2  | Y2  |              |              |            |
| F5H          | 50H               | 01H | 63H | 02H | 'H'          | Byte1~Byte40 | Horizontal |
| F5H          | 50H               | 01H | 63H | 02H | 'V'          | Byte1~Byte40 | Vertical   |

































































































































































































































































Graphic Data Map (Horizontal)

|        |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |       |     |     |       |     |     |        |     |        |     |     |     |     |     |     |     |     |     |  |  |  |  |  |  |  |  |  |  |  |  |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|-----|-------|-----|-----|-------|-----|-----|--------|-----|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|--|--|--|--|--|--|--|--|--|--|--|
| 00H    | 3CH | 42H | 81H | B9H | C1H | 42H | FCH | 20H | D8H | FCH | 3CH | FCH | CAH | 49H | B1H | 89H | 42H | 3CH | 00H | 00H   | 00H | 00H   | 00H | 07H | 04H   | C7H | FEH | 72H    | 73H | 32H    | 3EH | 3FH | 1DH | 00H | 00H | 00H | 00H | 00H | 00H |  |  |  |  |  |  |  |  |  |  |  |  |
| Byte21 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | Byte1 |     | Byte2 |     |     | Byte3 |     |     | Byte19 |     | Byte20 |     |     |     |     |     |     |     |     |     |  |  |  |  |  |  |  |  |  |  |  |  |

Graphic Data Map (Vertical)

|       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |     |       |     |     |       |     |     |        |     |        |     |     |     |     |     |     |     |     |     |  |  |  |  |  |  |  |  |  |  |  |  |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|-----|-------|-----|-----|-------|-----|-----|--------|-----|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|--|--|--|--|--|--|--|--|--|--|--|
| 00H   | 3CH | 42H | 81H | B9H | C1H | 42H | FCH | 20H | D8H | FCH | 3CH | FCH | CAH | 49H | B1H | 89H | 42H | 3CH | 00H | 00H   | 00H | 00H   | 00H | 07H | 04H   | C7H | FEH | 72H    | 73H | 32H    | 3EH | 3FH | 1DH | 00H | 00H | 00H | 00H | 00H | 00H |  |  |  |  |  |  |  |  |  |  |  |  |
| Byte2 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | Byte1 |     | Byte3 |     |     | Byte5 |     |     | Byte37 |     | Byte39 |     |     |     |     |     |     |     |     |     |  |  |  |  |  |  |  |  |  |  |  |  |

\* Appendix 1: Characters Font Table1 (CG\_ROM, 6×8dot font)

|   | 0                                                                                   | 1                                                                                   | 2                                                                                   | 3                                                                                   | 4                                                                                   | 5                                                                                   | 6                                                                                   | 7                                                                                   | 8                                                                                   | 9                                                                                   | A                                                                                   | B                                                                                    | C                                                                                     | D                                                                                     | E                                                                                     | F                                                                                     |
|---|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 0 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 1 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 2 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 3 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 4 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 5 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 6 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 7 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 9 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| A |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| B |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| C |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| D |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| E |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| F |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

\* Appendix 2: Characters Font Table2 (CG\_ROM, 11×16dot font)

|   | 0 | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8  | 9 | A | B | C | D | E | F |
|---|---|----|---|---|---|---|---|---|----|---|---|---|---|---|---|---|
| 0 |   | ▶  | 0 | @ | P | ' | p | v | °  |   | ° | À | Ð | à | ö |   |
| 1 | ◀ | 1  | A | Q | a | q | ■ | ★ | !  | ± | Á | Ñ | á | ñ |   |   |
| 2 | " | "  | 2 | B | R | b | r | d | B  | € | ² | Â | Ò | â | ò |   |
| 3 | ' | #  | 3 | C | S | c | s | o | k  | £ | ³ | Ã | Ó | ã | ó |   |
| 4 | ▲ | \$ | 4 | D | T | d | t | k | Hz | ¥ | ' | Ä | Ö | ä | ö |   |
| 5 | ▼ | %  | 5 | E | U | e | u | M | Hz | ¥ | µ | Å | Ö | å | ö |   |
| 6 | ● | &  | 6 | F | U | f | u | ◀ | ▶  |   | 9 | ƒ | Ö | ø | ö |   |
| 7 | ◀ | '  | 7 | G | w | g | w | ◀ | ▶  | ° | ° | ç | × | ç | ÷ |   |
| 8 | ↑ | <  | 8 | H | X | h | x | ◐ | ◑  | ° | ° | è | ø | è | ø |   |
| 9 | ↓ | >  | 9 | I | Y | i | y | ◐ | ◑  | ° | ° | é | ù | é | ù |   |
| A | → | *  | : | J | Z | j | z |   | °  | ° | ° | è | ù | é | ù |   |
| B | ← | +  | : | K | Γ | k | Γ |   |    |   |   | è | ù | é | ù |   |
| C | < | ,  | < | \ |   |   |   |   |    |   |   | ì | ü | ì | ü |   |
| D | > | -  | = | M | m | m | m |   |    |   |   | í | ý | í | ý |   |
| E | ▲ | .  | > | N | ^ | n | ~ |   |    |   |   | î | ÿ | î | ÿ |   |
| F | ▼ | /  | ? | O | o | o | o |   |    |   |   | ı | ı | ı | ı |   |