



To: _____

SPECIFICATION

Rev. 3.0

Application: _____

VACUUM FLUORESCENT DISPLAY MODULE

Model No.: 160S321A1

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## 1. SCOPE

This specification applies to VFD module (Model No. 160S321A1) manufactured by SSVD (Shanghai Samsung Vacuum Devices).

## 2. FEATURES

- \* Simple connection to the host system. Either parallel or RS-232 Serial interface can be selected. In case of RS-232 serial interface, it is possible to choose 9600, 19200, 28800 or 38400 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 PC437, PC850, KSC-5601 and GB-2312.
- \* High quality blue-green(505nm) vacuum fluorescent display provides an attractive and readable medium. Other colors can be achieved by simple wavelength filters.

## 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         | 160S321A1                       |
| Digit Format | 160 * 32 dots(Quadruple 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> | -25.0 | +25.0                | 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

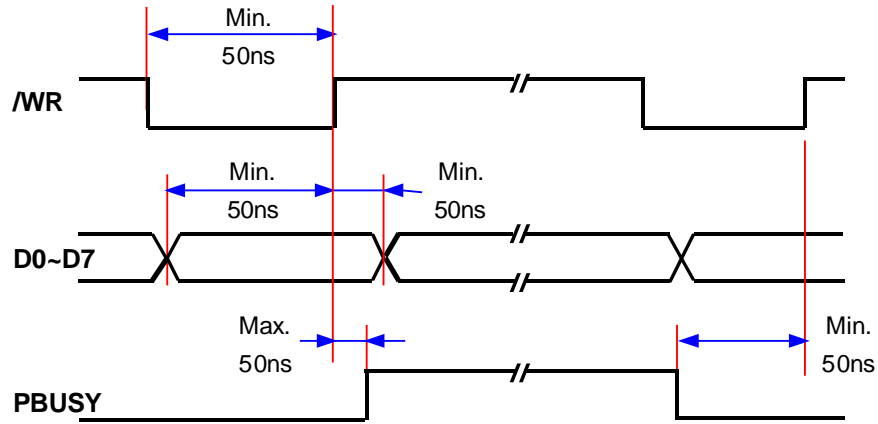
| Parameters                    | Symbols         | Min.               | Typ.  | Max.               | Unit            |
|-------------------------------|-----------------|--------------------|-------|--------------------|-----------------|
| Supply Voltage                | V <sub>CC</sub> | 4.75               | 5.0   | 5.25               | V <sub>DC</sub> |
| Serial Input Signal Voltage   | SPACE           | +3.0               | +12.0 | +15.0              | V <sub>DC</sub> |
|                               | MARK            | -15.0              | -12.0 | -3.0               | V <sub>DC</sub> |
| Parallel Input Signal Voltage | V <sub>IH</sub> | 0.8V <sub>CC</sub> | -     | V <sub>CC</sub>    | V <sub>DC</sub> |
|                               | V <sub>IL</sub> | 0                  | -     | 0.2V <sub>CC</sub> | V <sub>DC</sub> |

### 4.6 DC Characteristics

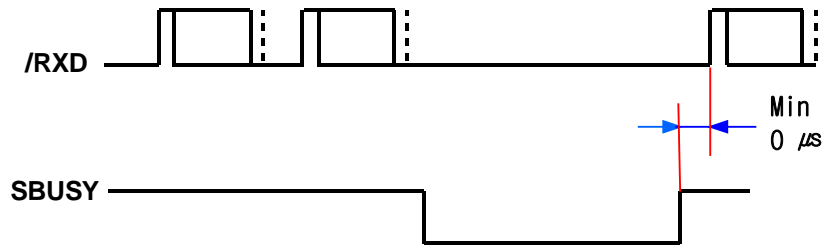
| Parameters                                     | Test Conditions                        | Min.                     | Typ. | Max.  | Unit |
|------------------------------------------------|----------------------------------------|--------------------------|------|-------|------|
| Supply Current (*)<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                      | 204  | -     | ft-L |
| Display Color                                  |                                        | Green (x=0.250, y=0.439) |      |       | -    |

4.7 Timing Chart

4.7.1 Parallel interface timing



4.7.2 Asynchronous serial interface timing



The RXD signal is RS-232 level. The logical value is inverted from above level.  
The SBUSY signal is TTL level.

Serial Interface Description:

|           |                                          |
|-----------|------------------------------------------|
| Baud rate | 9,600 ~ 38,400 bps(Jumper Setting)       |
| Format    | Start (1bit) + Data (8bit) + Stop (1bit) |
| Handshake | SBUSY                                    |

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       | SBUSY       | Display Busy            |
| 5       | NC          | Non Connection          |

4.8.2 Parallel interface connector

| Pin No. | Signal Name | Description    | Pin No. | Signal Name | Description |
|---------|-------------|----------------|---------|-------------|-------------|
| 1       | GND         | Ground         | 8       | D1          | Data Bus    |
| 2       | VCC         | Power Supply   | 9       | D2          | Data Bus    |
| 3       | PBUSY       | Display Busy   | 10      | D3          | Data Bus    |
| 4       | NC          | Non Connection | 11      | D4          | Data Bus    |
| 5       | /WR         | Data Write     | 12      | D5          | Data Bus    |
| 6       | NC          | Non Connection | 13      | D6          | Data Bus    |
| 7       | D0          | Data Bus       | 14      | D7          | Data Bus    |

4.9 System Block Diagram

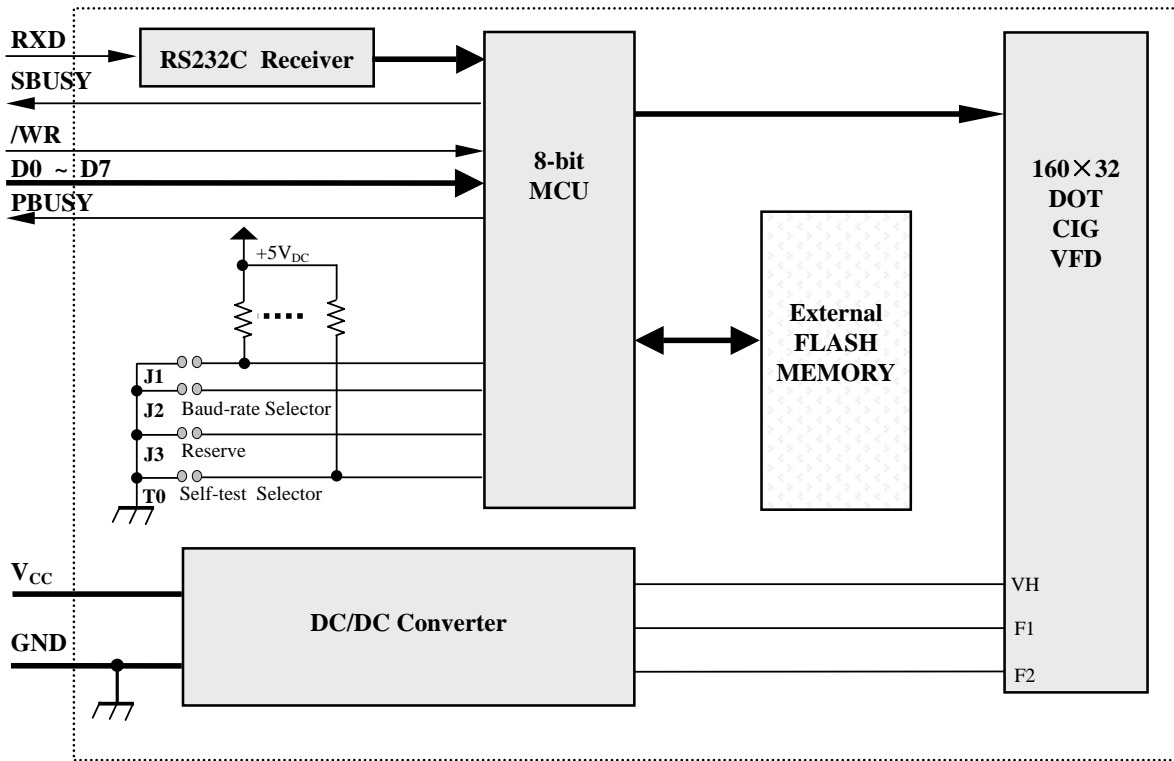


Fig.-2 System Block Diagram

4.10 Outer Dimensions

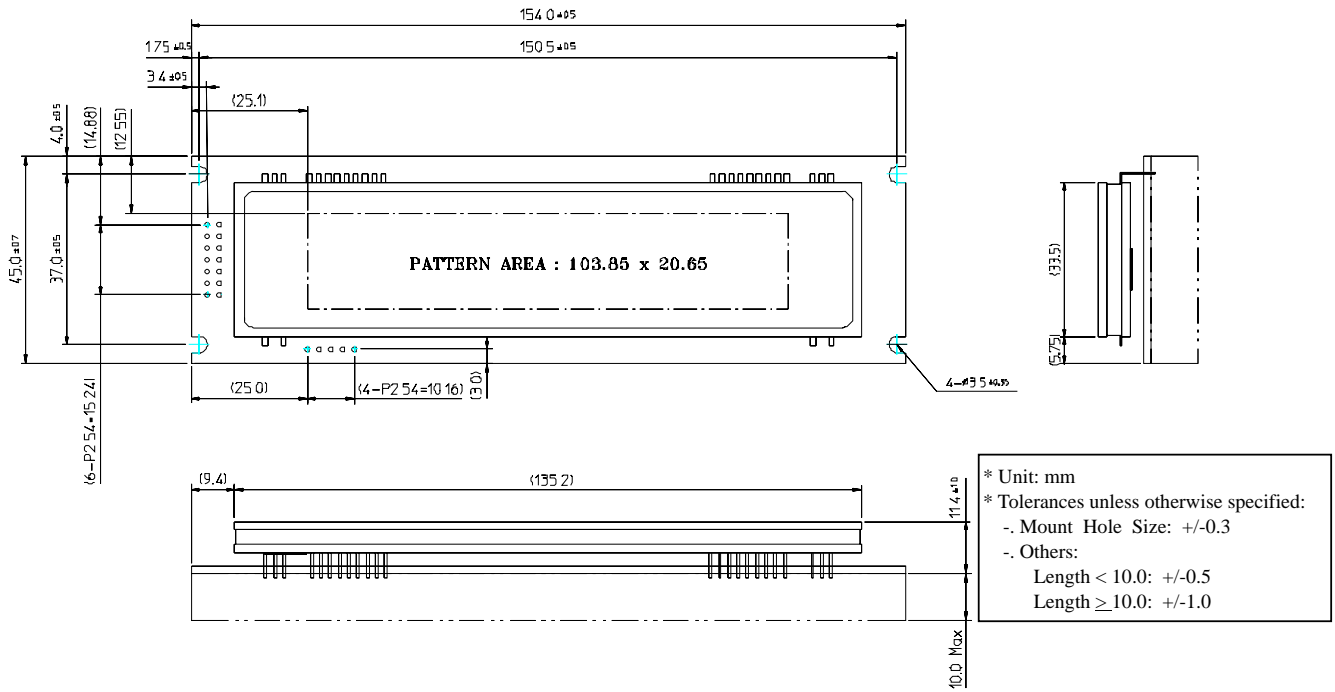


Fig.-3 Outer Dimensions

## 5. DISPLAY SPECIFICATION

### 5.1 Character display

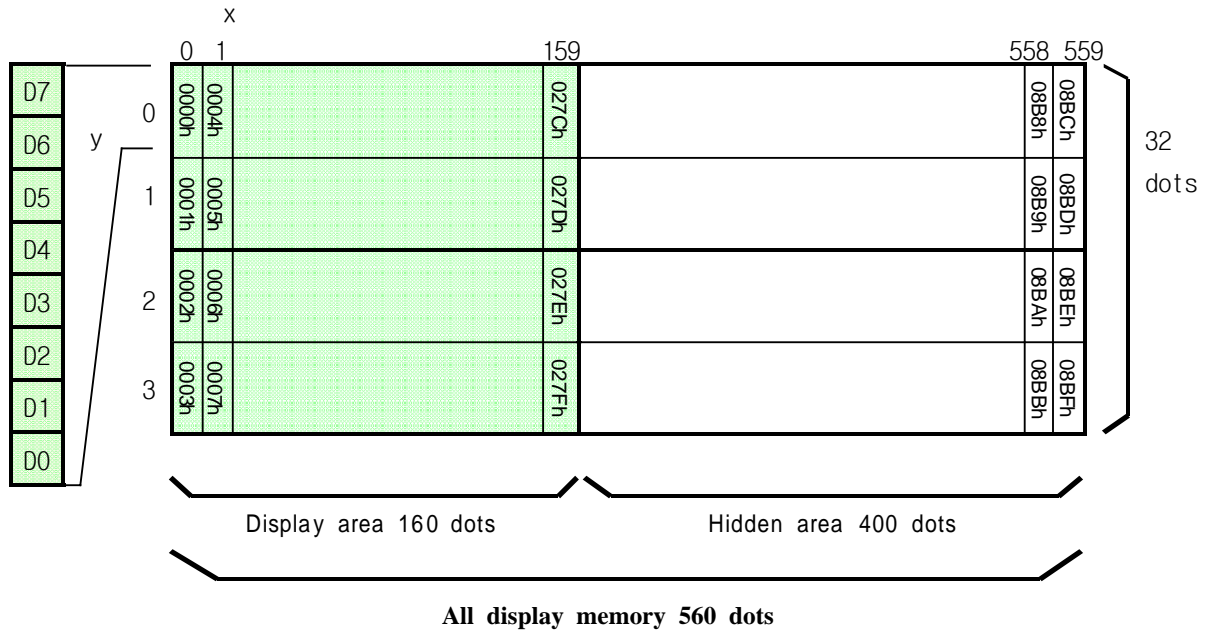
|                      |       |                                                      |                 |
|----------------------|-------|------------------------------------------------------|-----------------|
| Character mode:      | 7×8   | dot – Max.                                           | 22×4 characters |
|                      | 8×16  | dot – Max.                                           | 20×2 characters |
|                      | 16×16 | dot – Max.                                           | 10×2 characters |
| Character font type: | 7×8   | dot – International font                             |                 |
|                      | 8×16  | dot – International font                             |                 |
|                      | 16×16 | dot – Korean font(KS-5601) and Chinese font(GB-2312) |                 |

### 5.2 Display Area Map

Size: 560×32dot – separated as: Display area (160×32 dots)

Hidden area (160×32 dots)

Hidden area also can be displayed by using “Scroll display action” (Refer to Page 12, 6.5.13)



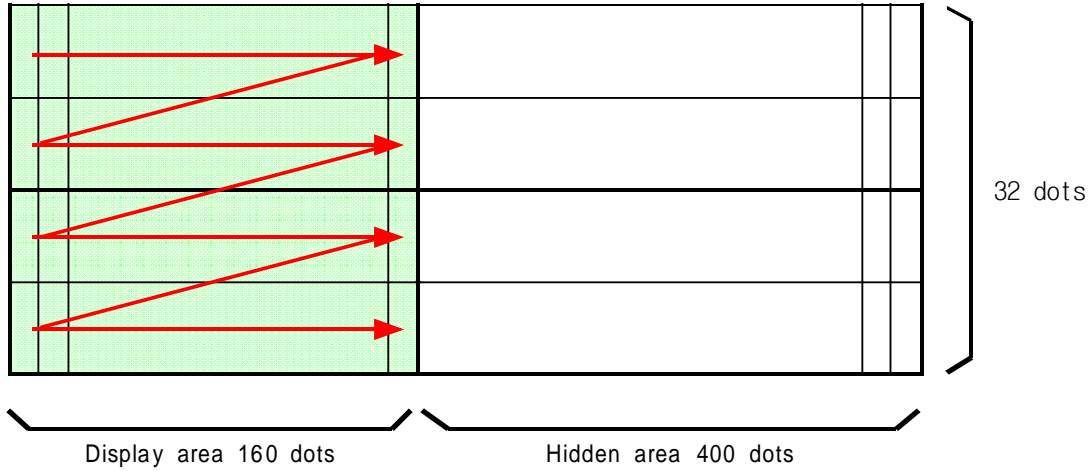
### 5.3 Write screen mode

There are two types of write screen mode, Display screen mode and all screen mode which can be changed by command. (Refer to Page 13, 6.5.16)



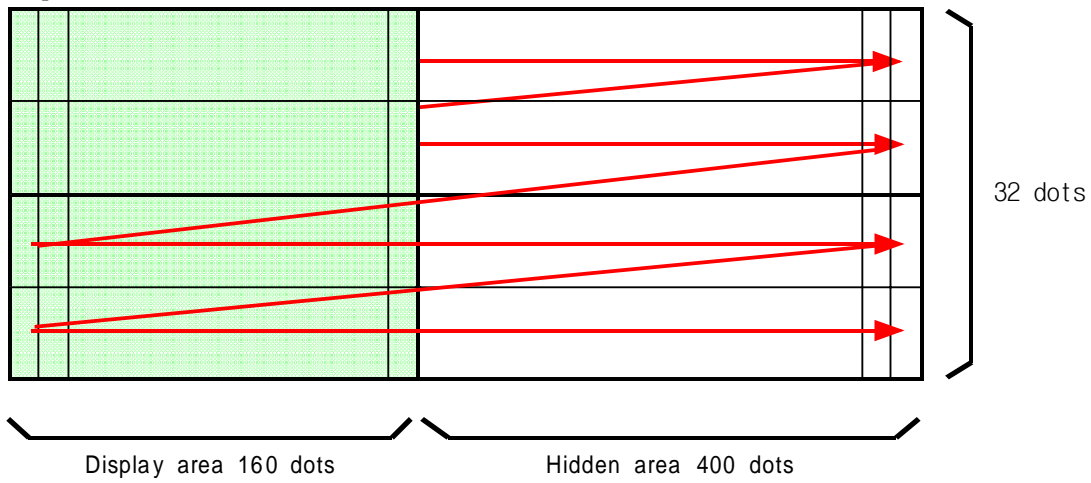
**5.4 Display screen mode (Scanning)**

When the cursor is located on the display area, all of operation will be done within display area, and when cursor is located on the hidden area, it will be done within hidden area.



**5.5 All screen mode (Scanning)**

All of operation will be done on all of area.



## 6. FUNCTIONS

### 6.1 Jumper Switches Setting

The selection switches are located on the PCB right side refer to Table. 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   | T0    | Setting Value      | Description         |
|---------------------|-------|------|-------|--------------------|---------------------|
| Open                | Open  | x    | x     | 9,600 bps          | Baud-rate Selection |
| Open                | Short | x    | x     | 19,200 bps         |                     |
| Short               | Open  | x    | x     | 28,200 bps         |                     |
| Short               | Short | x    | x     | 38,400 bps         |                     |
| x                   | x     | x    | Open  | Normal             | Self Test Selection |
| x                   | x     | x    | Short | Self-test          |                     |
| Open                | Open  | Open | Open  | Setting at Factory |                     |
| Note) x: Don't Care |       |      |       |                    |                     |

### 6.2 Power on Reset

When the module is turned on, the display and the memory(RAM) are cleared and the module is initialized. The displaying status is the same as the status of initialization.

### 6.3 Commands

The details of each command as follows:

(\*): the size of character (x×y dot) described in this section is depending on the command of "Font size select".

### 6.4 Character display

**Code: 20H – FFH or Korean font(KS-5601), Chinese font(GB-2312)**

Display the character on cursor position.

This command effects on the area selected by screen write mode.

To display 16×16 dot character, "Font size select" should be specified.

The character code (16×16 character) is depending on the type of character font equipped.

| Font type | Code type | First byte     | Second byte    |
|-----------|-----------|----------------|----------------|
| Korean    | KS-5601   | A1H ≤ c1 ≤ C8H | A0H ≤ c2 ≤ FFH |
| Chinese   | GB-2312   | A1H ≤ c1 ≤ F7H | A0H ≤ c2 ≤ FFH |

### 6.5 Control Code Write-in

The control commands are available as follows and details are will be explained.

Reference Table for Control Command

| No. | Symbol | Function                          | No. | Symbol | Function                       |
|-----|--------|-----------------------------------|-----|--------|--------------------------------|
| 1   | BS     | Move cursor left                  | 9   | ESC @  | Initialize display             |
| 2   | HT     | Move cursor right                 | 10  | ESC t  | Select character code table    |
| 3   | LF     | Move cursor down                  | 11  | US MD3 | Specify horizontal scroll mode |
| 4   | US LF  | Move cursor up                    | 12  | US X   | Brightness adjustment(Dimming) |
| 5   | HOM    | Move cursor to home position      | 13  | US e   | Scroll display action          |
| 6   | CR     | Move cursor to left-end position  | 14  | US f   | Real-time bit image display    |
| 7   | US \$  | Move cursor to specified position | 15  | US g   | Font size select               |
| 8   | CLR    | Clear display screen              | 16  | US h   | Write screen mode select       |

**6.5.1 BS (08 Hex, Back Space): Move cursor left**

Move the cursor one character position to the left and the display is not cleared.

**6.5.2 HT (09 Hex, Horizontal Tab): Move cursor right**

Move the cursor one character position to the right.

**6.5.3 LF (0A Hex): Move cursor down**

Moves the cursor to the same column of the lower line.

**6.5.4 US LF (1F Hex + 0A Hex): Move cursor up**

Moves the cursor up one line.

**6.5.5 HOM (0B Hex): Move cursor to home position**

Moves the cursor to the left-end position on the upper line (home position).

Home position indicates the first column of the upper line.

**6.5.6 CR (0D Hex): Move cursor to left-end position**

Moves the cursor to the left-end position on the current line.

**6.5.7 US \$ x y (1F Hex + 24 Hex + xL + xH +y): Move cursor to specified position**

[Range]  $0 \leq (xL + xH \times 256) \leq 559$

$0 \leq y \leq 3$

xL: Cursor position x size lower byte (by 1 dot)

xH: Cursor position x size upper byte (by 1 dot,  $0 \leq y \leq 2$ )

y: Cursor position y size (by 8 dot)

Moves the cursor to the xth column on the yth line. If a value exceeding the range is specified for x(column) and /or y(line), this command is ignored and the cursor does not move.

**6.5.8 CLR (0C Hex): Clear display screen**

Clear all the displayed characters.

After this command is executed, the cursor moves to the home position.

**6.5.9 ESC @ (1B Hex + 40 Hex): Initialize display**

Resets the various display settings to their initial values.

After initializing the display, the display screen is cleared and the cursor moves to the home position.

**6.5.10 ESC t n (1B Hex + 74 Hex + n): Select character code table**

[Range]  $0 \leq n \leq 1$

Select a character code table.

When  $n = 0$ , the PC437 is selected.

When  $n = 1$ , the PC850 is selected.

This command has no effect on data displayed before this command is received.

This command has no effect on the selected international character set.

**6.5.11 US MD3 (1F Hex + 03 Hex): Select horizontal scroll mode**

When the font is the  $8 \times 16$  dot and  $16 \times 16$  dot character, this function is execution.

Selects horizontal scroll mode as the display screen mode.

Under the horizontal scroll mode, entering a character code scrolls all displayed characters one character to the left, then displays the new character at the right end.

During execution time, if some code which is not a predefined is inputted then display is cleared, cursor moves to home position, and inputted code should be executed automatically at home.

**6.5.12 US X n (1F Hex + 58 Hex + n): Brightness adjustment**

[Range]  $0 \leq n \leq 10$  (0A Hex)

Sets the brightness of the vacuum fluorescent character display tube.

n selects the percentage of brightness as follows:

- n = 0, Brightness Level = 0%
- n = 1, Brightness Level = 10%
- n = 2, Brightness Level = 20%
- n = 3, Brightness Level = 30%
- n = 4, Brightness Level = 40%
- n = 5, Brightness Level = 50%
- n = 6, Brightness Level = 60%
- n = 7, Brightness Level = 70%
- n = 8, Brightness Level = 80%
- n = 9, Brightness Level = 90%
- n = 10(0A Hex), Brightness Level = 100%

Default: n = 10(0A Hex)

**6.5.13 US e (1F Hex + 65 Hex + x + cL + cH + s): Scroll display action**

[Range]  $0 \leq x \leq 255$

$0 \leq (cL + cH \times 256) \leq 65535$

$0 \leq s \leq 255$

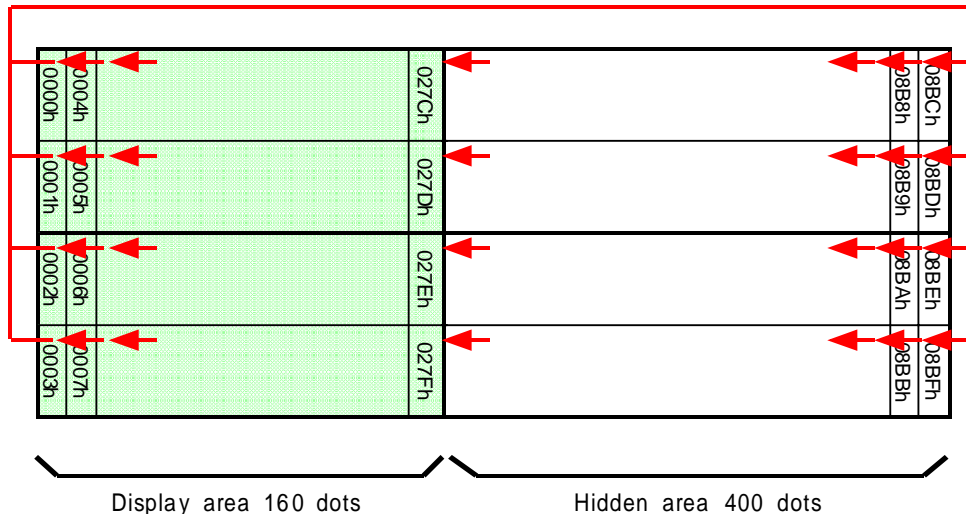
x: Display screen shift x size

cL: Number of repetition lower byte

cH: Number of repetition upper byte

s: Scroll action speed

Scroll speed is specified by "s". Scroll speed:  $s \times \text{approximate } 14\text{msec} / 1 \text{ shift}$ .



After repetition, if some code which is not scroll display code is inputted then display is cleared, cursor moves to home position, and inputted code should be executed automatically at home.

**6.5.14 US f (1F Hex + 66 Hex + xL + xH + y + d(1) ~ d(k)): Real-time bit image display**

[Range]  $0 \leq (xL + xH \times 256) \leq 560$

$1 \leq y \leq 4$

$0 \leq d \leq 255$

$k = x \times y$

xL: Bit image x size lower byte (by 1 dot)

xH: Bit image x size upper byte (by 1 dot)

y: Bit image y size byte (by 8 dot)

d(1) ~ d(k): Image data

Display the bit image data inputted on the cursor position real-time.

Cursor position will not change. "All screen mode" is select.

**6.5.15 US g n (1F Hex + 67 Hex + n): Font size select**

[Range]  $0 \leq n \leq 3$

n = 0, 7×8 dot character

n = 1, 8×16 dot character

n = 2, 16×16 dot character

n = 3, 16×16 dot character

Default: n = 0.

**6.5.16 US h n (1F Hex + 68 Hex + n): Write screen mode select**

[Range]  $0 \leq n \leq 1$

n = 0, Display screen mode

n = 1, All screen mode

Default: n = 0

Select "Display screen mode": Display action is valid within area of either display screen or non-display screen depending on cursor position.

Select "All screen mode": Display action is valid on all of the screen area.