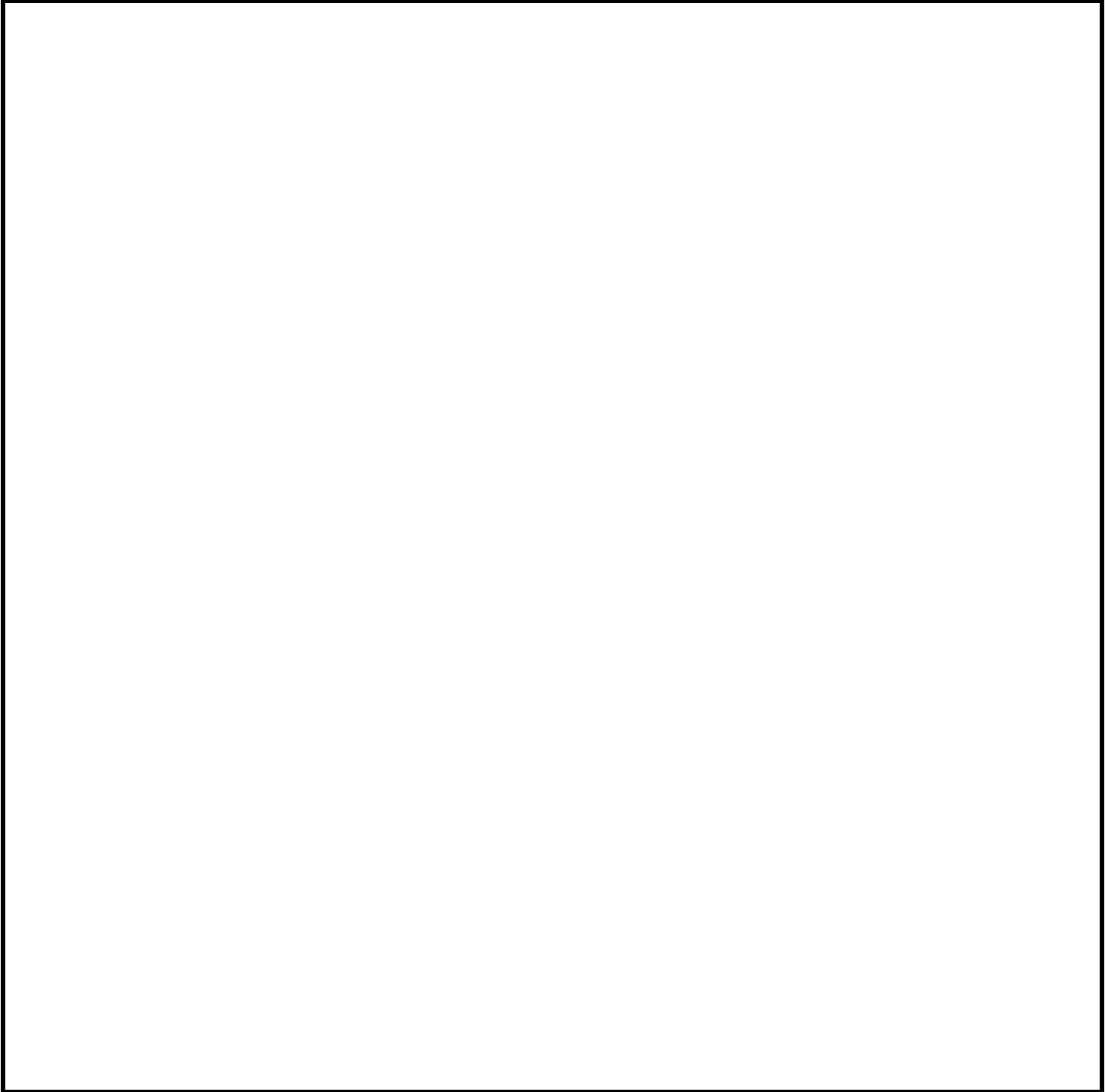



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		PART NUMBER: <b>NAGP1250AA1-0, -2, -3</b>	
DESIGNED BY: <b>Rick Page</b>	QUALITY ASSURANCE APPROVAL: <b>John Kowalewski</b>	CUSTOMER NAME / PART NUMBER: <b>STANDARD PRODUCT</b>	
CHECKED BY: <b>John Hohmeier</b>	SYSTEMS ENGINEERING APPROVAL: <b>Charlie Voegeli</b>	FILE NAME: <b>NAGP1250AA1_revPrelim_07Oct08</b>	
CUSTOMER APPROVAL: <b>N/A</b>	DIRECTOR OF ENGINEERING APPROVAL:	DATE PRINTED: <b>20Nov08</b>	SHEET: <b>1 OF 41</b>

## 1.0 GENERAL DESCRIPTION

This series of graphical 140 x 32 dot matrix Vacuum Fluorescent Display (VFD) modules is capable of displaying both graphics and text using built-in font tables. The modules contain VFD driver circuitry, one microcontroller, one DC-DC/AC converter and various host interfaces.

A six-pin connector supports the serial interface connections and a fourteen-pin connector supports the parallel interface. Both connections also require a 5VDC power supply to operate the module. See sections *System Block Diagram* and *Parallel Interface Connector* and *Serial Interface Connector* for more detail.

## 1.1 FEATURES

- 5VDC operation
- -40°C to +85°C operation
- displays both graphics and text simultaneously
- 140 x 32 dot matrix with fixed and proportional fonts for smoother character spacing
- 14 international font sets with up to 16 user defined characters
- font magnification up to 4X horizontally and 2X vertically
- 1000 cd/m<sup>2</sup> maximum luminance and wide viewing angles
- 8 levels of brightness control from 12.5% to 100%
- screen saver modes to reduce power consumption and to reduce image burn-in
- up to 4 screen windows with independent control
- variable speed scrolling
- legendary Futaba® quality and reliability
- choice of serial and parallel interfaces

NAGP1250AA-0: parallel and RS-232 asynchronous serial communication (9.6K – 115.2K baud)

NAGP1250AA-2: parallel, synchronous and asynchronous serial communication (9.6K – 115.2K baud)

NAGP1250AA-3: synchronous and asynchronous serial communication (9.6K – 115.2K baud)

## 2.0 APPLICABLE DOCUMENTS

- Futaba Vacuum Fluorescent Display Specification GP1250AI
- Futaba America Engineering Standard FAES 801, Printed Circuit Board Markings

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### 3.0 GENERAL SPECIFICATIONS

Item		Value
number of dots		140 columns X 32 rows
dot height (mm)		0.57
dot width (mm)		0.4
dot pitch vertical (mm)		0.67
dot pitch horizontal (mm)		0.5
pattern width (mm)		69.9
pattern height (mm)		21.34
peak wavelength of illumination		green x = 0.24, y = 0.41
Luminance (cd/m <sup>2</sup> )	min.	500 @ 100% luminance
	typ.	1000 @ 100% luminance

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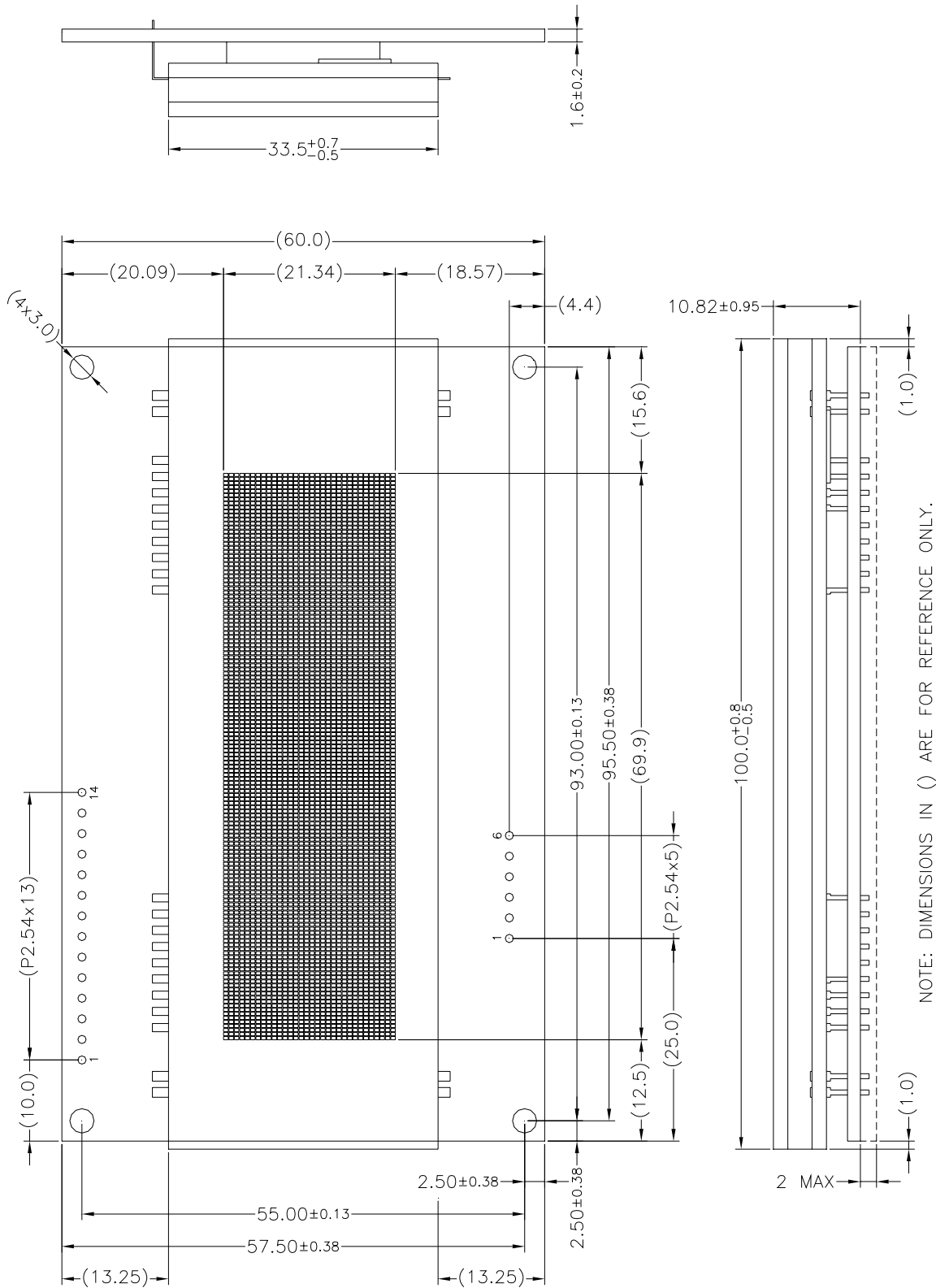
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### 3.1 MECHANICAL DRAWING



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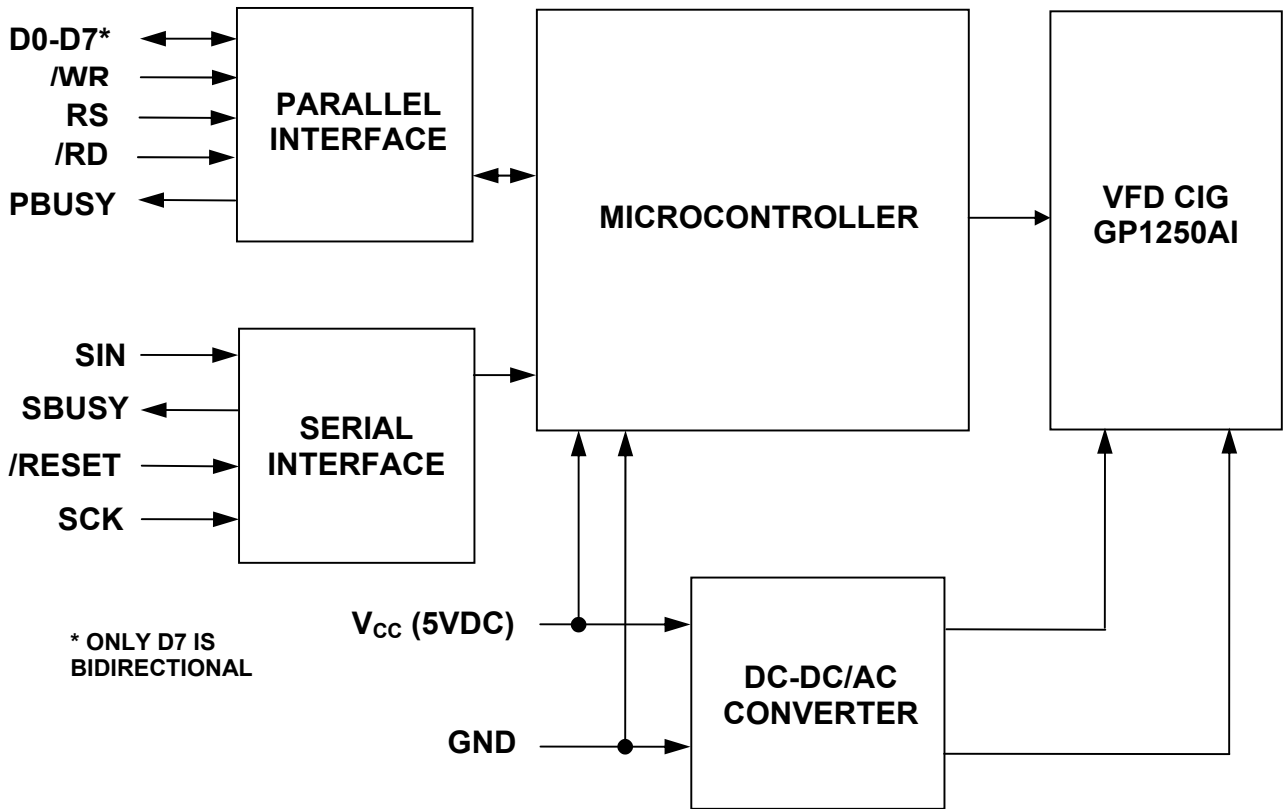
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### 3.2 SYSTEM BLOCK DIAGRAM



### 3.3 ENVIRONMENTAL SPECIFICATIONS

Item	Symbol	Min.	Max.	Unit	Comment
operating temperature	T <sub>opr</sub>	-40	+85	°C	
storage temperature	T <sub>stg</sub>	-40	+85	°C	
operating humidity	H <sub>opr</sub>	-	85	%RH	without condensation
storage humidity	H <sub>stg</sub>	-	90	%RH	without condensation
Vibration	-	-	4	G	total amplitude: 1.5mm freq: 10 ~ 55 Hz sine wave sweep time: 1 min / cycle duration: 2 hrs / axis (X, Y, Z)
Shock	-	-	40	G	duration: 11ms waveform: half sine wave 3 times / axis (X, Y, Z, -X, -Y, -Z)

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### 3.4 ABSOLUTE MAXIMUM SPECIFICATIONS

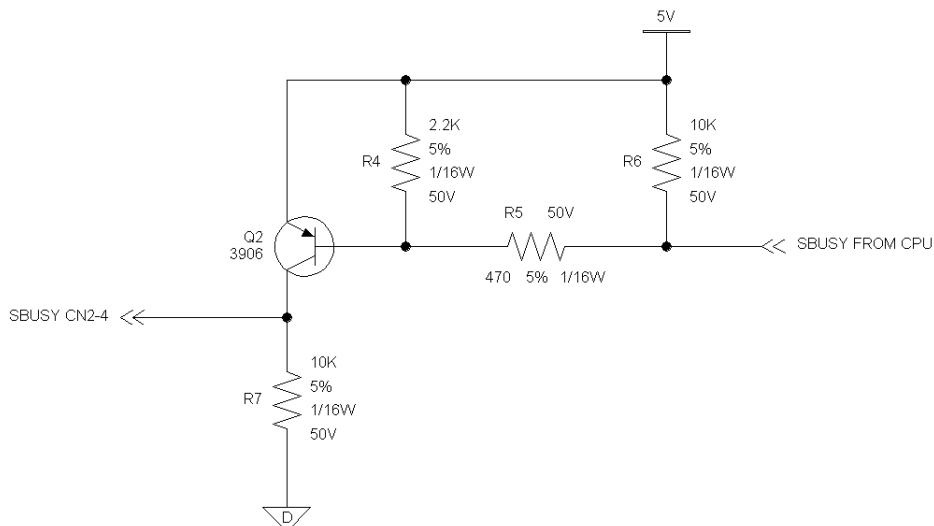
Item	Symbol	Min.	Max.	Unit
supply voltage	$V_{CC}$	-0.3	6.0	V
input signal voltage D0-D7, /MR,/RD/ RESET, SIN	$V_{IS}$	-0.3	$V_{CC}+0.3$	V
input signal voltage SIN RS-232 only	$V_{IRS232}$	-20.0	20.0	V

### 3.5 DC ELECTRICAL SPECIFICATIONS

Item	Symbol	Min.	Typ.	Max.	Unit
supply voltage	$V_{CC}$	4.75	5.0	5.25	V
supply current	$I_{CC}$	-	400	500	mA
high-level input signal voltage (except RS-232 SIN)	$V_{IH}$	$0.8 * V_{CC}$	-	$V_{CC}$	V
low-level input signal voltage (except RS-232 SIN)	$V_{IL}$	0.0	-	$0.2 * V_{CC}$	V
high-level input signal voltage (RS-232 SIN only)	$V_{IHRS232}$	3.0	-	15.0	V
low-level input signal voltage (RS-232 SIN only)	$V_{ILRS232}$	-15.0	-	0.5	V
high-level output signal voltage (see Notes 1 & 2)	$V_{OH}$	4.0	-	$V_{CC}$	V
low-level output signal voltage (see Note 1)	$V_{OL}$	0	-	0.5	V

Notes:

- $V_{CC} = 5.0V$ ,  $R_L = 3K\Omega$  to GND
- SBUSY is an open collector output.



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### 3.6 AC ELECTRICAL SPECIFICATIONS

#### 3.6.1 RESET TIMING

Refer to Figure 1 and the table below for reset timing details.

Item	Symbol	Min.	Max.	Unit
RESET/ pulse width	$t_{RST}$	1	-	ms
reset to not busy	$t_{RNB}$	-	100	ms
delay time after power-up reset	$t_{WAIT}$	-	1.5	$\mu$ s

Notes: All timing is specified using 20% and 80% of  $V_{CC}$  as the reference points.

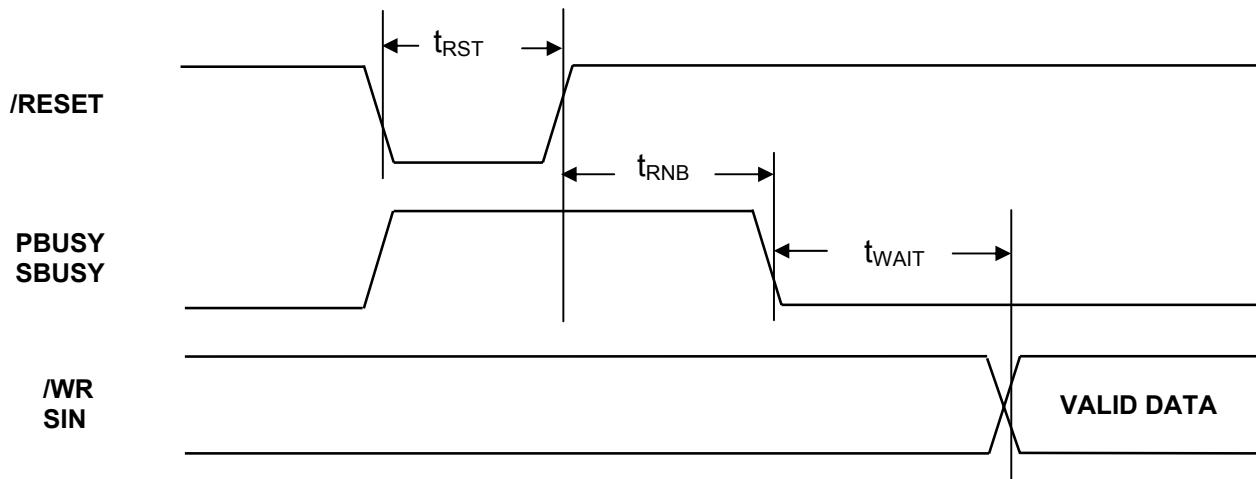


Figure 1: Reset Timing

The module sets PBUSY and SBUSY when /RESET is asserted. When ready to receive data, the module will clear PBUSY and SBUSY.

The module resets automatically upon power-up and may be reset at any time by pulling /RESET low. Further, if  $V_{CC}$  drops below 4.0V (4.0V typical, 3.68V min), the module resets.

### 3.6.2 PARALLEL INTERFACE OPERATION

The parallel interface accepts display data and commands in 8-bit bytes. Upon receipt of a byte, the module sets PBUSY and then holds PBUSY high until it can process the byte. PBUSY can be read either by reading data bit D7 or directly reading the PBUSY bit. RS is reserved for switching between data and command bytes but, it is not implemented in this series of modules.

Operation	/WR	/RD	RS	D0-D7
Data write	0→1	1	X	8-bit write data
Status read	1	0	X	D0-D6: undefined D7: PBUSY bit 1: busy 0: ready

Note: All timing is specified using 20% and 80% of  $V_{CC}$  as the reference points.

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### 3.6.2.1 PARALLEL INTERFACE WRITE TIMING

Item	Symbol	Min.	Max.	Unit
/WR pulse time	$t_{WR}$	100	–	ns
Data setup time	$t_{SETUP}$	50	–	ns
Data hold time	$t_{HOLD}$	10	–	ns
PBUSY lag time	$t_{LAG}$	–	100	ns
PBUSY wait time	$t_{WAIT}$	1.5	–	$\mu$ s

Note: All timing is specified using 20% and 80% of  $V_{CC}$  as the reference points.

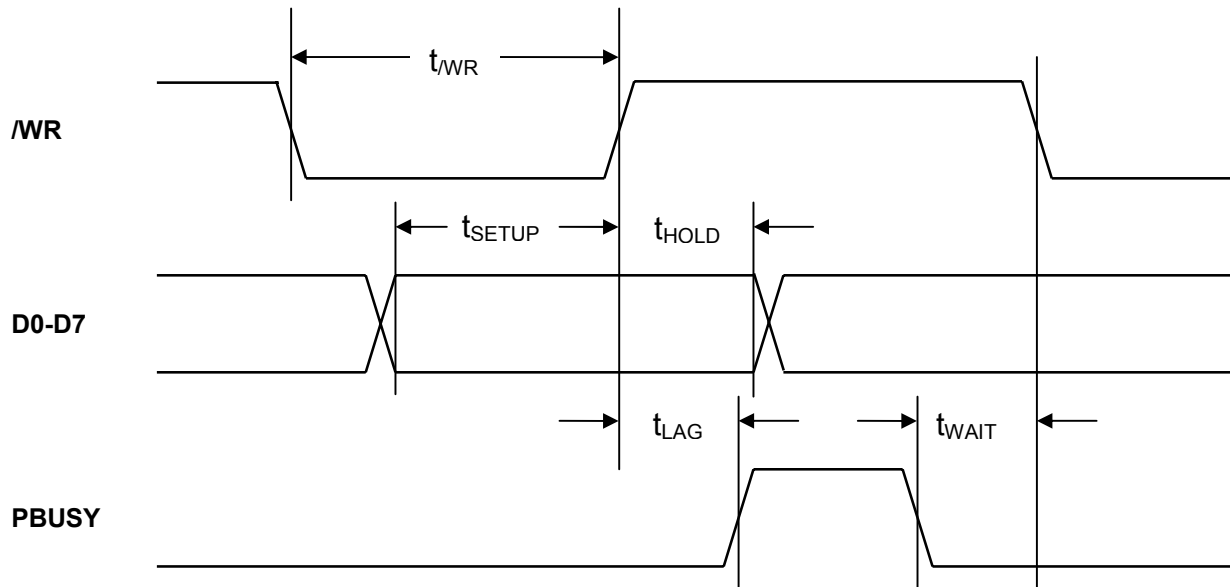


Figure 2: Parallel Interface Write Timing

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### 3.6.2.2 PARALLEL INTERFACE READ TIMING

Item	Symbol	Min.	Max.	Unit
/RD pulse time	$t_{RD}$	100	–	ns
Data access time	$t_{SETUP}$	50	–	ns
Data hold time	$t_{HOLD}$	10	–	ns

Note: All timing is specified using 20% and 80% of  $V_{CC}$  as the reference points.

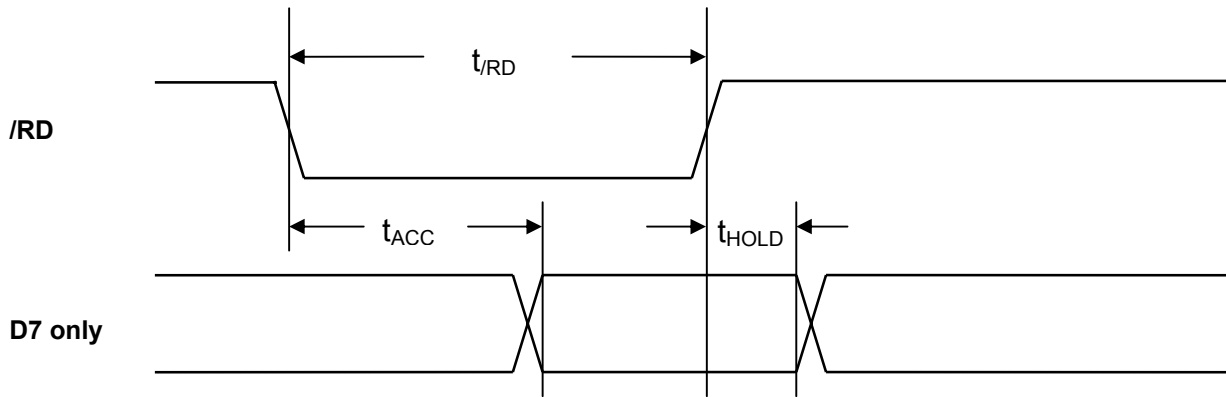



Figure 3: Parallel Interface Read Timing

### 3.6.3 SERIAL INTERFACE OPERATION

The NAGP1250AA series of VFD modules provides up to three serial interfaces depending on the exact model of the display: RS-232 level asynchronous, CMOS level asynchronous and CMOS level synchronous. Each of these modes is jumper selectable. Each mode uses the SBUSY line to control data flow.

When an 8-bit byte is sent to a module, SBUSY is asserted. One more byte may be sent after SBUSY is asserted. Although this is possible, it is not recommended. Then, the host must wait until the module clears SBUSY before sending any more data.

The table below shows the data format and rates for the RS-232 level and CMOS level of asynchronous communication. It is not possible to read SBUSY from the display using a serial interface.

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Parameter	Value
Baud rate	9600, 19200, 38400, 115200
Parity	no parity
Format	start (1 bit) + data (8 bits) + stop (1 bit)
Handshake	SBUSY

### 3.6.3.1 RS-232 LEVEL SERIAL INTERFACE OPERATION

Item	Symbol	Min.	Max.	Unit
SBUSY assert lag time	$t_{BAL}$	20	–	$\mu s$
SBUSY wait time	$t_{WAIT}$	0	–	$\mu s$

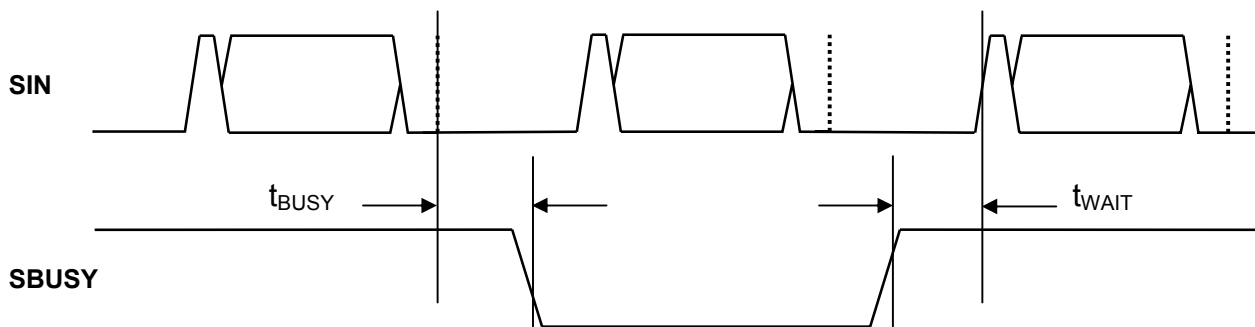


Figure 4: RS-232 Serial Interface Level Timing

### 3.6.3.2 CMOS LEVEL SERIAL INTERFACE OPERATION

The timing of the CMOS level asynchronous serial interface operation is exactly the same as that of the RS-232 level serial interface timing except the signal levels and polarity are not at RS-232 levels. All timing is specified using 20% and 80% of  $V_{CC}$  as the respective low and high logic levels.

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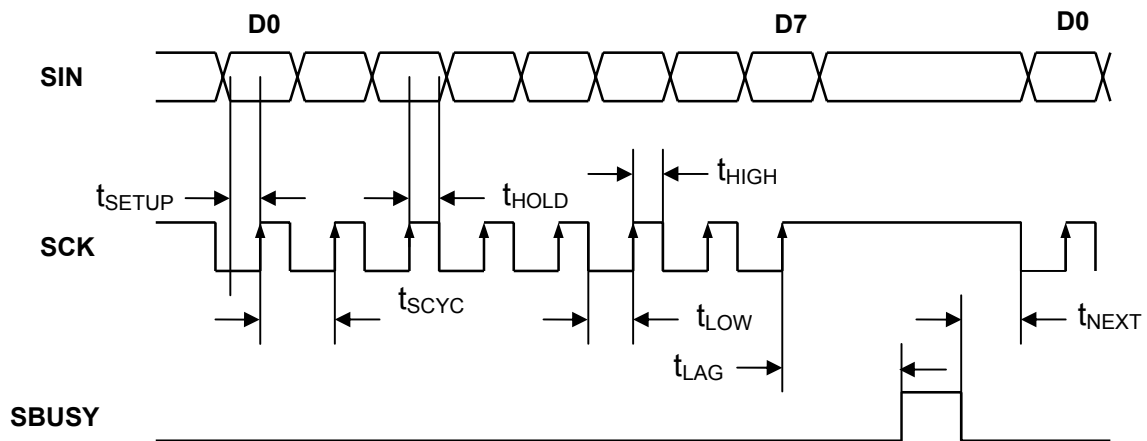
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### 3.6.3.3 SYNCHRONOUS SERIAL INTERFACE OPERATION

Item	Symbol	Min.	Max.	Unit
Data setup time	$t_{\text{SETUP}}$	200	–	ns
Data hold time	$t_{\text{HOLD}}$	200	–	ns
SCK cycle time	$t_{\text{SCYC}}$	500	–	ns
SCK high time	$t_{\text{HIGH}}$	200	–	ns
SCK low time	$t_{\text{LOW}}$	200	–	ns
SBUSY lag time	$t_{\text{LAG}}$	–	20	$\mu\text{s}$
SBUSY wait time	$t_{\text{NEXT}}$	0	–	$\mu\text{s}$

Note: All timing is specified using 20% and 80% of  $V_{\text{CC}}$  as the reference points.



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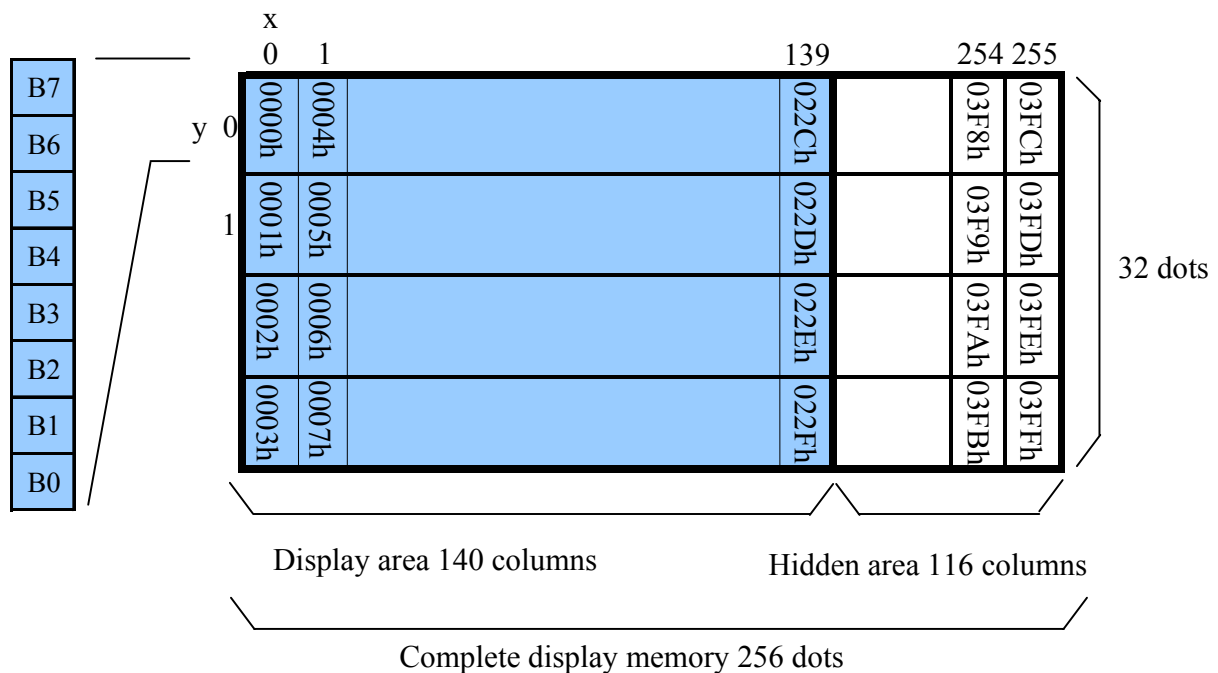
#### 4.0 DISPLAY SPECIFICATION

The NAGP1250AA module can display either graphics in a 140 column by 32 row dots format or 5 x 7 dots character fonts.

- Character mode: 5x7 dots
- Character font types: 5x7dots-character, ANK, international font
- Character display width: fixed character 1 & 2, proportional character format 1 & 2
- Attributes: Character magnify and reverse

#### 4.1 DISPLAY MEMORY ORGANIZATION

- Size : 256x32 dots total
- Display area: 140x32 dots
- Hidden area: 116x32 dots. The hidden area can be displayed by using commands from the Display Action Command Group
- With the User Window function, the display area can be divided and each window can be controlled independently.

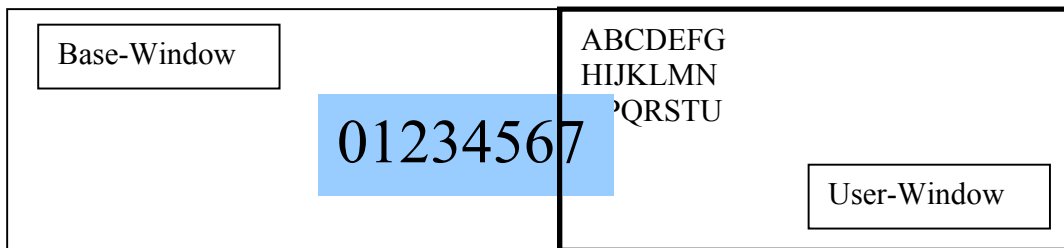


## 4.2 WINDOWS

The window functions divide the display area into individual windows; the Base-Window and User-Windows. Each window can be controlled and displayed independently. Refer to the Window Command Group. There is no independent display memory for each window.

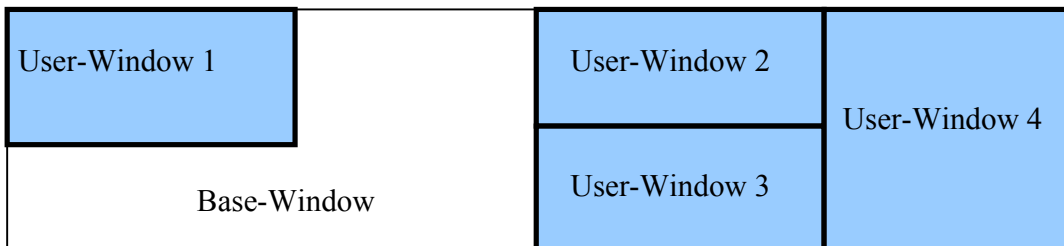
### 4.2.1 BASE-WINDOW

The Base-Window comprises the entire display area. If a User-Window is not defined, all display operations are processed within the Base-Window. When the Base-Window is selected, even if a User-Window is defined, all of the display operation is processed as the Base-Window. The current display pattern of the User-Window may be overwritten if its size exceeds the Base Window area.



### 4.2.2 USER-WINDOW

A User-Window is defined and selected by commands.



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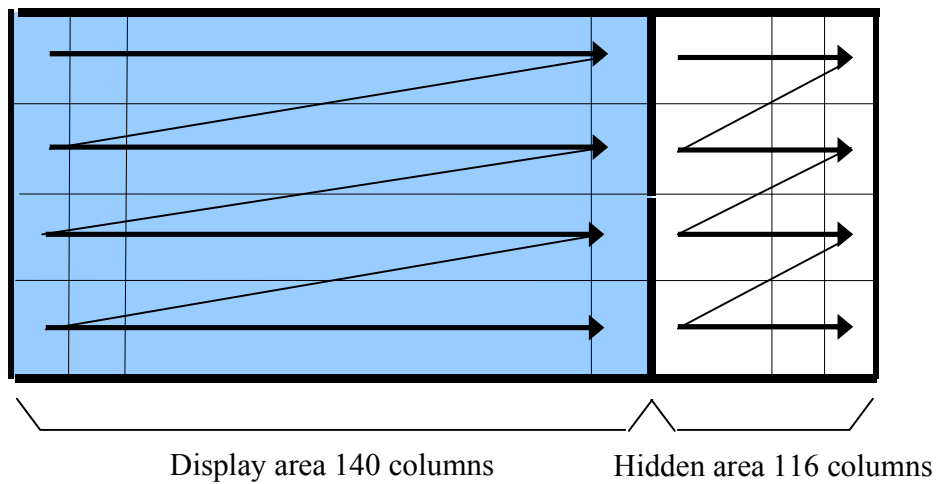
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### 4.3 BASE-WINDOW WRITE SCREEN MODES

There are two types of screen writing modes; Display Screen Mode and All Screen Mode that can be selected by command. (Refer to Window Command Group, “Write Screen Mode Select”).

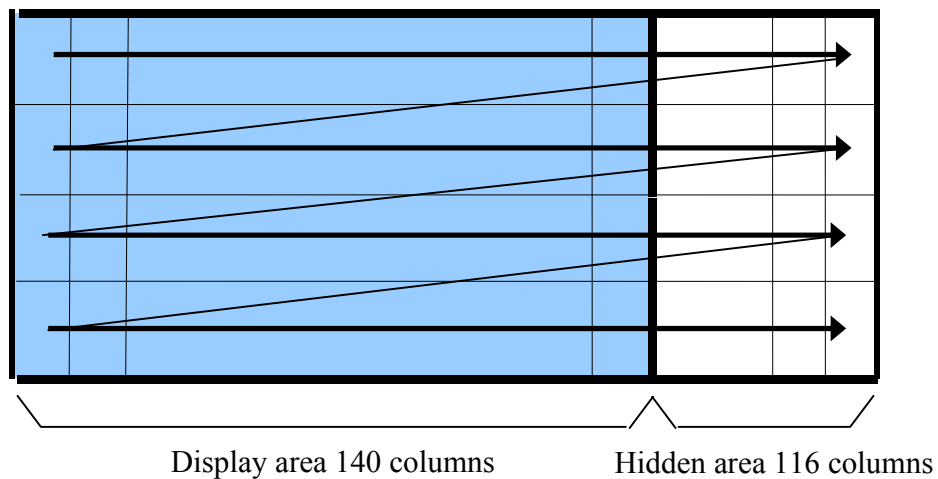
#### 4.3.1 DISPLAY SCREEN MODE (SCANNING)

When the cursor is located in the display area, all operations will be performed within the display area. When the cursor is located in the hidden area, all operations will be performed within the hidden area.



#### 4.3.2 ALL SCREEN MODE (SCANNING)

All operations are performed on the entire continuous display memory.



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#### 4.4 CHARACTER DISPLAY FORMATS

The following character display formats are selected by the Character Display Width command. When proportional character width is selected, the space character (20H) will be displayed as a 2-dot wide space character

Type of character	Display position	Format	Fixed character width 1	Fixed character width 2	Proportional character width 1	Proportional character width 2
Standard character And Download character 5x7	Y=0-3	Character size	5×7	5×7	n×7	n×7
		Upper space	0	0	0	0
		Lower space	1	1	1	1
		Left space	0	1	0	1
		Right space	1	1	1	1
Download Character 7×8 dot	Y=0-3	Character size	6×8 *	7×8	6×8 *	6×8
		Upper space	0	0	0	0
		Lower space	0	0	0	0
		Left space	0	0	0	0
		Right space	0	0	0	0

\*The left most part of 6×8 dots within 7×8 dots is displayed.

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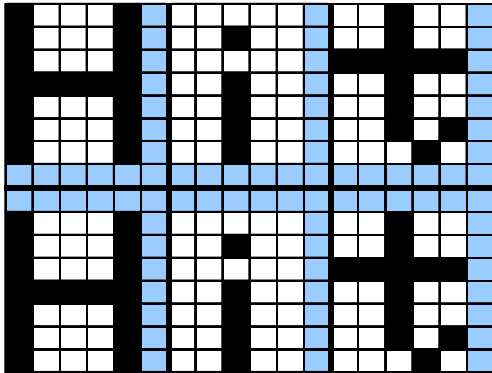
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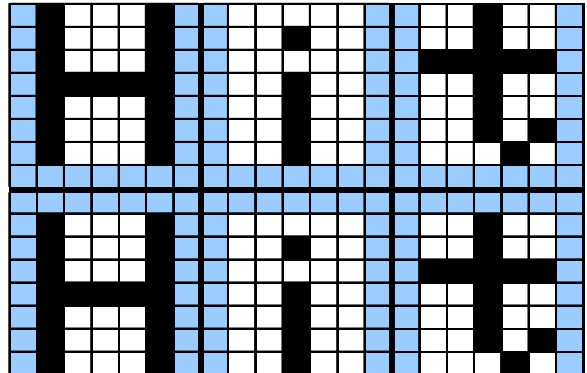
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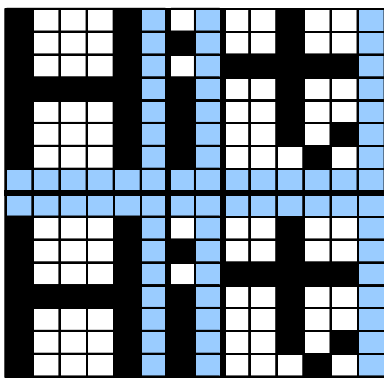
[Fixed character width 1]



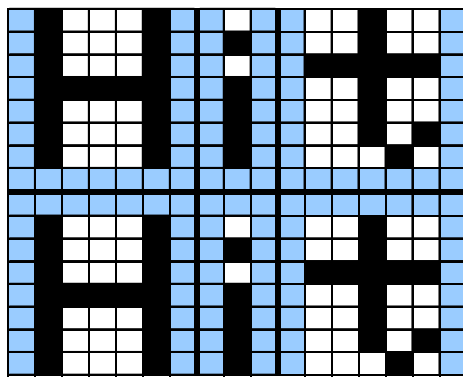
[Fixed character width 2]



[Proportional character width 1]



[Proportional character width 2]



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## 5.0 COMMANDS

The details of each command are as follows;

The size ( $X \times Y$  dot) of characters described in this section depends on the value selected using the Character Display Width or Font Magnified Display functions. The table below shows the character width sizes available.

Character type	Fixed character width 1	Fixed character width 2	Proportional character width 1	Proportional character width 2
Number of X dots	5+1	5+2	5+1	5+2
Number of Y dots	7+1	7+1	7+1	7+1

### 5.1.1 CHARACTER DISPLAY

Name: Character Display

Code: 20H – FFH

Function: Displays the selected character at the current cursor position in the selected window.  
HT denotes a Horizontal Tab.

#### MD1 mode selected

Cursor position		Operation
X direction	Y direction	
Space for characters to the right of the cursor	—	Display >> HT
Right end of display	Space for one line below is available	HT >> Display >> HT
	Space for one line below is NOT available.	HT >> Display >> HT

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**MD2 mode selected**

Cursor position		Operation
X direction	Y direction	
Space for characters to the right of the cursor	—	Display >> HT
Right end of display	Space for one line below is available	HT >> Display >> HT
	Space for one line below is NOT available.	HT >> Display >> HT

**MD3 mode selected**

Cursor position		Operation
X direction	Y direction	
Space for characters to the right of the cursor	—	Display >> HT
Right end of display	—	HT >> Display >> HT

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### 5.1.2 BACKSPACE (BS)

Name: Backspace

Code: 08h

Function: Moves the cursor to the left by one character position.

This command operates on the current window selected by Current Window Select.

#### MD1 and MD2 modes selected

Cursor position		Operation
X direction	Y direction	
Space for characters to the left of the cursor	—	The cursor moves to left by one character.
Left end of display	Space for one line above is Available	The cursor moves to the right end of one upper line.
	Space for one line above is NOT available.	The cursor does not move.

#### MD3 mode selected

Cursor position		Operation
X direction	Y direction	
Space for characters to the left of the cursor	—	The cursor moves to left by one character.
Left end of display	—	The cursor does not move.

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### 5.1.3 HORIZONTAL TAB (HT)

Name: Horizontal Tab

Code: 09h

Function: Moves the cursor to the right by one character position.

This command operates on the current window selected by Current Window Select.

#### MD1 mode selected

Cursor position		Operation
X direction	Y direction	
Space for characters to the right of the cursor	—	The cursor moves to right by one character.
Right end of display	Space for one line is in the lower side.	The cursor moves to the left end of one lower line.
	Space for one line is NOT in the lower side.	The cursor moves to the left end of top line.

#### MD2 mode selected

Cursor position		Operation
X direction	Y direction	
Space for characters to the right of the cursor	—	The cursor moves to right by one character.
Right end of display	Space for one line is in the lower side.	The cursor moves to the left end of one lower line.
	Space for one line is NOT in the lower side.	The displayed pattern is scrolled up to one line, displayed pattern of the lowest line is cleared. The cursor moves to left end of bottom line.

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**MD3 mode selected**

Cursor position		Operation
X direction	Y direction	
Space for characters to the right of the cursor	—	The cursor moves to right by one character.
Right end of display	—	The displayed pattern on cursor line is scrolled to left by one character, The right end character is cleared, and the cursor moves to the right end.

**5.1.4 LINE FEED (LF)**

Name: Line Feed

Code: 0AH

Function: Moves the cursor one line lower.

This command operates on the current window selected by Current Window Select.

**MD1 mode selected**

Cursor position		Operation
X direction	Y direction	
—	Space for one line is in the lower side.	The cursor moves to the same position of one lower line.
	Space for one line is NOT in the lower side.	The cursor moves to the left end of the top line.

**MD2 mode selected**

Cursor position		Operation
X direction	Y direction	
—	Space for one line is in the lower side.	The cursor moves to the same position of one line lower.
	Space for one line is NOT in the lower side.	The displayed pattern is scrolled one line up and the displayed pattern of the bottom line is cleared. The cursor does not move.

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## MD3 mode selected

Cursor position		Operation
X direction	Y direction	
—	—	The cursor does not move.

### 5.1.5 HOME (HOM)

Name: Home Position

Code: 0BH

Function: Moves the cursor to the home position.

This command operates on the current window selected by Current Window Select.

### 5.1.6 CARRIAGE RETURN (CR)

Name: Carriage Return

Code: 0DH

Function: Moves the cursor to the left end of the current line.

This command operates on the current window selected by Current Window Select.

### 5.1.7 US \$ xL xH yL yH

Name: Cursor Set

Code: 1FH 24H xL xH yL yH

xL: Cursor position x Lower byte (1 dot/unit)

xH: Cursor position x Upper byte (1 dot/unit)

yL: Cursor position y Lower byte (8 dot/unit)

yH: Cursor position y Upper byte (8 dot/unit)

Definable area:  $0 \leq (xL+xH \times 255) \leq 255$

$0 \leq (yL+yH \times 3) \leq 3$

Function: Moves the cursor to the specified X, Y position in display memory.

If the specified X, Y position (X, Y, either or both) is over range, the command is ignored and the cursor position remains unchanged.

This command operates on the current window selected by Current Window Select.

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### 5.1.8 CLEAR DISPLAY (CLR)

Name: Display Clear

Code: 0CH

Function: Clears the display screen and moves the cursor to the home position.

This command operates on the current window selected by Current Window Select.

### 5.1.9 CURSOR ON/OFF

Name: Cursor On/Off

Code: 1FH 43H n

Function: Turns the cursor on or off.

n=0: Turns off the cursor.

n=1: Turns on the cursor

### 5.1.10 ESC @

Name: Initialize Display

Code: 1BH 40H

Function: Returns the display to its default settings.

The contents of receive buffer remain in memory and are not cleared.

The jumper settings are not reloaded.

### 5.1.11 ESC % n

Name: Specify a Download Register

Code: 1BH 25H n

Definable area: n=0, 1

Default: n=0

Function: Enables or disables downloaded characters.

n=1: Enable (If a download character is not defined, the built-in character is displayed)

n=0: Disable (Characters already downloaded, defined and displayed are not affected)

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### 5.1.12 ESC & a c1 c2 [x1 d1...d(a×X1)]...[xk d1...d(a×xk)]

Name: Download a Character Definition

Code: 1BH 26H a c1 c2 [x1 d1...d(a×x1)]...[xk d1...d(a×xk)]

- a: Select character type
- c1: Start character code
- c2: End character code
- x: Number of dots for X direction
- d: Defined data

Definable area: a=1

- x=5: 5x7 dot font
- x=7: 7x8 dot font
- $32 \leq c1 \leq c2 \leq 255$
- $0 \leq d \leq 255$
- x=5: Upper 7 bit is valid
- x=7: All 8 bit is valid
- $k=c2-c1+1$

Function: Downloads character definitions into RAM.

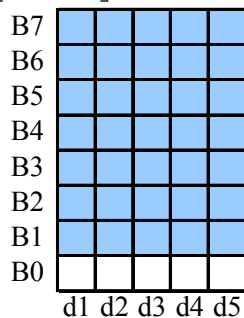
A maximum of 16 characters may be downloaded and defined.

x=5: Defined by 5x7 dot, and 5x7 dot character regulated upper and lower space is displayed as same as standard character display.

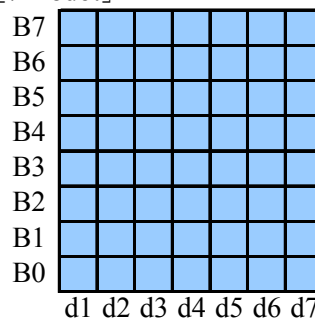
x=7: Defined by 7x8 dot and 6x8 or 7x8 dot character unrelated to space is displayed.

After the first 16 are defined, any additional characters required must replace one already defined. Downloaded characters are valid until they redefined, an initialize (ESC@) sequence is executed, or the power is turned off. To display the download character, execution of "Download Character Definition" and "Specify Download Character" is required.

[5×7dot]



[7×8dot]



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### 5.1.13 ESC ? a c

Name: Delete a Download Character

Code: 1BH 3FH a c

a: Select character

c: Character code for deletion

Definable area:  $c=1$

$32 \leq c \leq 255$

Function: Deletes a defined download character.

The built-in character is displayed after this command is executed although the already-displayed download character is not affected. This command is ignored if the character code for the download character has not been defined.

### 5.1.14 ESC R n

Name: Specify an International Font Set

Code: 1BH 52H n

Definable area:  $0 \leq n \leq 13$

Default:  $n=0$

Function: Selects an international font set.

n	Font set
0	America
1	France
2	Germany
3	England
4	Denmark 1
5	Sweden
6	Italy
7	Spain 1
8	Japan
9	Norway
10	Denmark 2
11	Spain 2
12	Latin America
13	Korea

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### 5.1.15 ESC t n

Name: Specify Character Code Type

Code: 1BH 74H n

Definable area: n=0, 1, 2, 3, 4, 5, 16, 17, 18, 19

Default: n=0

Function: Selects an international code set.

n	Font code type
0	PC437 (USA: Standard Europe)
1	Katakana - Japanese
2	PC850 (Multilingual)
3	PC860 (Portuguese)
4	PC863 (Canadian-French)
5	PC865 (Nordic)
16	WPC1252
17	PC866 (Cyrillic #2)
18	PC852 (Latin 2)
19	PC858

### 5.1.16 US MD1

Name: Overwrite Mode

Code: 1FH 01H

Function: Overwrites or replaces existing data.

This command operates on the current window selected by Current Window Select.

### 5.1.17 US MD2

Name: Vertical Scroll Mode

Code: 1Fh 02h

Function: Scrolls the cursor up 1 line.

This command operates on the current window selected by Current Window Select.

If a graphic image and character display are shown together on the same window and this mode is specified on that window, it may cause an irregular graphic image. Please do not apply this command to a window showing such a display.

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### 5.1.18 US MD3

Name: Horizontal Scroll Mode

Code: 1Fh 03h

Function: Scrolls the cursor horizontally 1 space.

This command operates on the current window selected by Current Window Select.

### 5.1.19 US s n

Name: Horizontal Scroll Speed

Code: 1FH 73H n

Definable area:  $0 \leq n \leq 31$

Default: n=0

Function: If n=0 is specified, scrolling is governed by character n.

n	Speed
0	by character
1	T msec/ 2 dots
2~31	(n-1)×T msec/dot

New commands will not execute until the scrolling action ends.

Scroll base speed “T” depends on the write screen mode and the character size selected.

### 5.1.20 US r n

Name: Specify or Cancel Reverse Display

Code: 1FH 72H n

n: Specify or cancel reverse character and graphic display

Definable area:  $0 \leq n \leq 1$

n=0: Cancel reverse mode

n=1: Specify reverse mode

Default: n=0

This command is valid only for new data sent to the display. It does not affect the current display image.

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### 5.1.21 US w n

Name: Specify Mixed Write Display Mode

Code: 1FH 77H n

n: Specify display mode

Definable area:  $0 \leq n \leq 3$

n=0: Normal display write

n=1: OR display write

n=2: AND display write

n=3: EX-OR display write

Default: n=0

Function: The new character or graphic image display is logically combined with the current display image in memory and overwrites the current display memory.

### 5.1.22 US X n

Name: Brightness Level Setting

Code: 1FH 58H n

n: level

Definable area:  $1 \leq n \leq 8$

Default: n=8

Function: Specifies the brightness level of the display screen.

n	Level
1	12.5%
2	25.0%
3	37.5%
4	50.0%
5	62.5%
6	75.0%
7	87.5%
8	100%

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### 5.1.23 US ( a n [PARAMETER]

Name: Display Action Command Group

Function: Executes processing of the display action command.

n	Function No.	Function
01h	Function 01h	Wait
10h	Function 10h	Scroll display action
11h	Function 11h	Blink display action
40h	Function 40h	Screen saver

n: specifies the function code.

The next command or data is not executed until the current display action processing ends.

#### 5.1.23.1 <FUNCTION 01h> US ( a n t

Name: Wait

Code: 1FH 28H 61H 01H t

n: Classify command

t: Wait time

Definable area: n=01H

$$0 \leq t \leq 255$$

Function: Defines the wait time. Commands and data processing are stopped during this command.

$$\text{Wait time} = t \times \text{approx.}0.5 \text{ sec}$$

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**5.1.23.2 <FUNCTION 10h> US ( a n wL wH cL cH s**

Name: Scroll Display Action

Code: 1Fh 28h 61h 10h wL wH cL cH s

n: Classify command

wL: Display screen shift, number of lower byte

wH: Display screen shift number of upper byte

cL: Number of repetitions lower byte

cH: Number of repetitions upper byte

s: Scroll action speed

Definable area: n=10h

$$0 \leq (wL+wH \times 256) \leq 1023$$

$$1 \leq (cL+cH \times 256) \leq 65535$$

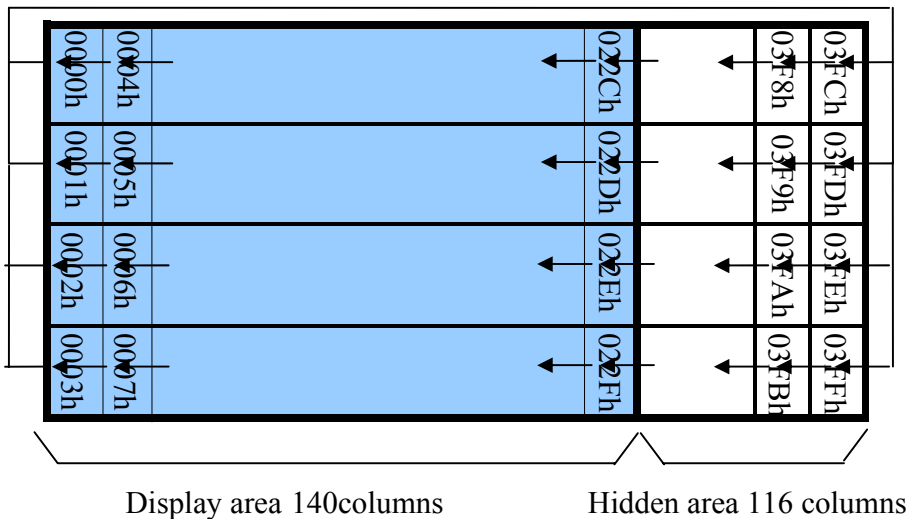
$$0 \leq s \leq 255$$

Function: Shift the display screen

Horizontal scrolling can be performed by specifying the shift byte to a multiple number of (Display screen “y” dot/8). Display switching can be performed by specifying the shift byte to (Display screen “x” dot×Display screen “y” dot/8). Scroll speed is specified by “s”.

Scroll speed :s×approx.14msec/1 shift.

For example: 1dot scroll to the left: wL=04h, wH=00h



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**5.1.23.3 <FUNCTION 11h> US ( a n p t1 t2 c**

Name: Display Blink

Code: 1FH 28H 61H 11H p t1 t2 c

n: Classify command

p: Blink pattern

t1: Normal display

t2: Blank or Reverse display time

c: Number of repetitions

Definable area: n=11h

$$0 \leq p \leq 2$$

p=0:Normal display

p=1:Repeat blink display with normal and Blank display

p=2:Repeat blink display with normal and Reverse display

$$1 \leq t1 \leq 255$$

$$1 \leq t2 \leq 255$$

$$0 \leq c \leq 255$$

Function: Blink display action.

Blink pattern specified by “p”.

Time specified by “t1”, “t2”, and repeat Blink display.

A:t1x approx.14msec Normal display

B:t2x approx.14msec Blank or Reverse display

This command does not affect the display memory. If c=0 is specified, blink display is repeated until c = 1-255 or the initialize command is specified. The command/data execution continues during display blinking. If c = 1-255 is specified, blink display is repeated 1-255 times, and the command/data execution stops.

After display blinking ends, normal display and command/data execution resumes.

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**5.1.23.4 <FUNCTION 12h> US ( a n p**

Name: Screen Saver

Code: 1FH 28H 61H 40H p

n: Classify command

p: Screen saver mode

Definable area: n=40h

$0 \leq p \leq 4$

p=0: Power OFF (all dots OFF, power save mode)

p=1: Power ON (all dots ON)

p=2: All dots OFF

p=3: All dots ON

p=4: Repeat blink display with normal and reverse display (normal: 2sec, reverse: 2sec)

Function: Control Power ON or OFF, and Start Screen saver mode.

p=0~1: Control Power ON or OFF.

p=2~4: Start Screen saver mode. This command is canceled if next data is input during screen saver mode. The display returns to the condition before the screen saver mode was specified.

**5.1.23.5 US ( f n [PARAMETER]**

Name: Bit Image Display Group

Function: Executes processing of bit image data.

n	Function No.	Function
11h	Function 11h	Real-time bit image display

n: Specifies function code.

**5.1.23.6 <FUNCTION 11h> US ( f n xL xH yL yH g d(1)...d(k)**

Name: Real-time Bit Image Display

Code: 1Fh 28h 66h 11h xL xH yL yH g d(1)...d(k)

n: Classify command

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

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

yL: Bit image Y size lower byte (by 8dots)

yH: Bit image Y size upper byte (by 8dots)

g: Image=1 (Fixed)

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d(1)–d(k):Image data (Refer to figure below)

Definable area: n=11h

$$1 \leq (xL+xH \times 256) \leq 256$$

$$1 \leq (yL+yH \times 4) \leq 4$$

$$g=1$$

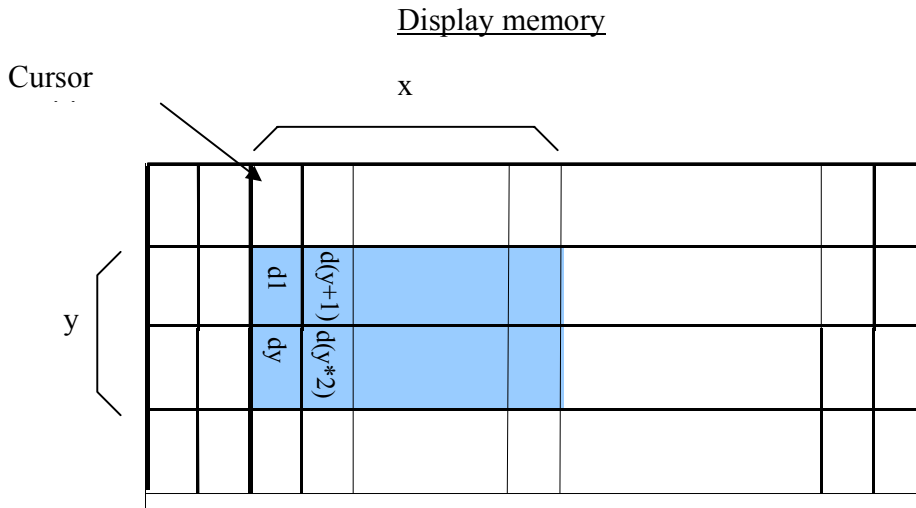
$$0 \leq d \leq 255$$

$$k=x \times y \times g$$

Function: Displays the bit image data input on the cursor position real-time

Cursor position will not change.

When the bit image is displayed at the cursor position, and if it overflows from the window, it is displayed only up to the edge of the area defined. Any remaining bit image overflow is not displayed. If the display position or image sizes are defined out of the definable area, the command is ignored and the data is valid as standard data.



### 5.1.23.7 US (g n [PARAMETER])

Name: Font Command Group

Function: Executes processing of the window command.

n	Function No.	Function
03h	Function 03h	Character display width
40h	Function 40h	Font magnified display

n: specify function code.

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### 5.1.23.8 <FUNCTION 03h> US ( g n w

Name: Character Display Width

Code: 1Fh 28h 67h 03h w

n: Classify command

w: Specify width

Definable area: n=03h

$$0 \leq w \leq 3$$

w=0: Fixed character width 1 (1 dot space in right side)

w=1 :Fixed character width 2 (1 dot space in each right and left side)

w=2: Proportional character width 1 (1 dot space in right side)

w=3: Proportional character width 2 (1 dot space in each right and left side)

Default: w=1

Function: Specifies the character display width.

Fixed character width 1&2: Character is written with fixed character width. (6 or 7dot)

Proportional character width: Character is written with proportioned character width.

### 5.1.23.9 <FUNCTION 40h> US ( g n x y

Name: Font Magnification

Code: 1Fh 28h 67h 40h x y

n: Classify command

x: Specify the size of magnification X

y: Specify the size of magnification Y

Definable area: n=40h

$$1 \leq x \leq 4$$

$$1 \leq y \leq 2$$

Default: x=1

y=1

Function: Specifies character magnification.

The character is magnified including the space specified by the Character Display Width command.

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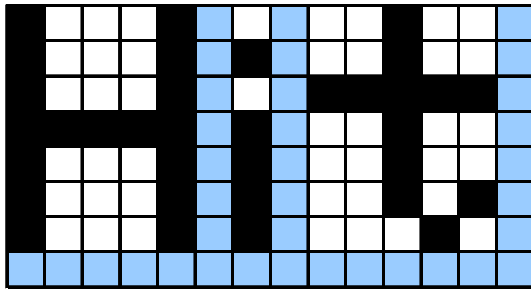
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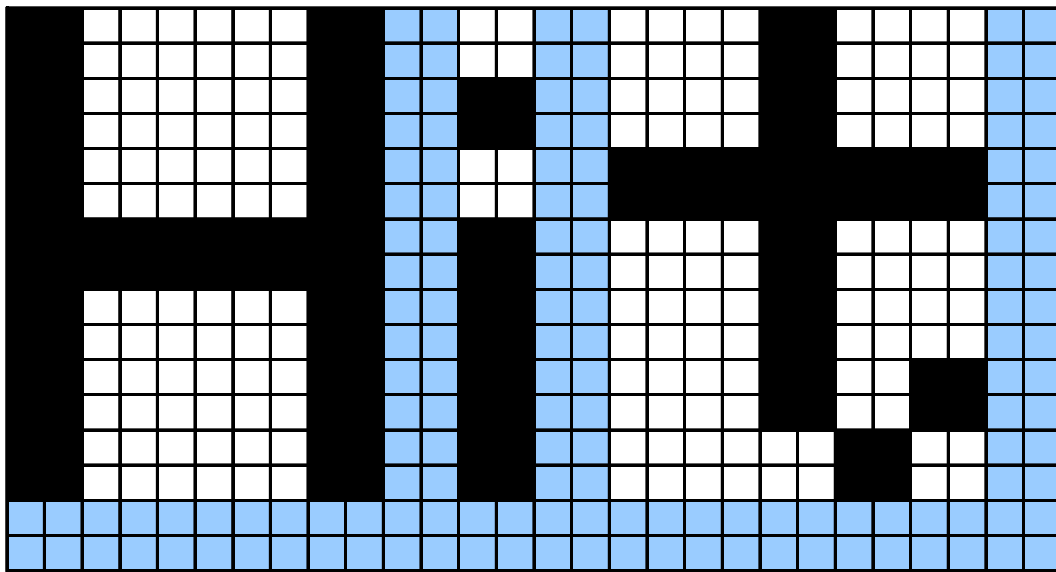
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[x=1, y=1]



[x=2, y=2]



### 5.1.23.10 US (w n [PARAMETER])

Name: Window Command Group

Function: Execute processing of the window / screen command.

n	Function No.	Function
01h	Function 01h	Current window select
02h	Function 02h	User-Window definition and cancel
10h	Function 10h	Write screen mode select

n: specify function code.

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**5.1.23.11 <FUNCTION 01h> US (w n a**

Name: Current Window Select

Code:1Fh 28h 77h 01h a

n: Classify command

a: Current window number.

a=0: Base-Window

a=1~4: User-Window

Definable area: n=01h

$0 \leq a \leq 4$

Function: Selects the current window

This command is ignored if the current window number is specified for a User-Window that is not defined.

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**5.1.23.12 <FUNCTION 02h> US ( w n a b ) [xPL xPH yPL yPH xSL xSH ySL ySH]**

Name: User Window Definition / Cancel

Code: 1Fh 28h 77h n a b [xPL xPH yPL yPH xSL xSH ySL ySH]

n: Classify command

a: Definable window No. : No.1~4

b: Definable or Cancel

b=0: Cancel, b=1: Define

xPL: Left position of window lower byte (by 1dot)

xPH: Left position of window upper byte (by 1dot)

yPL: Top position of window lower byte (by 8dots)

yPH: Top position of window upper byte (by 8dots)

xSL: X size of window lower byte (by 1dot)

xSH: X size of window upper byte (by 1dot)

ySL: Y size of window lower byte (by 8dots)

ySH: Y size of window upper byte (by 8dots)

Definable area: n=02h

$$1 \leq a \leq 4$$

$$0 \leq b \leq 1$$

$$0 \leq xP \leq 255$$

$$0 \leq yP \leq 3$$

$$1 \leq xS \leq 256$$

$$1 \leq yS \leq 4$$

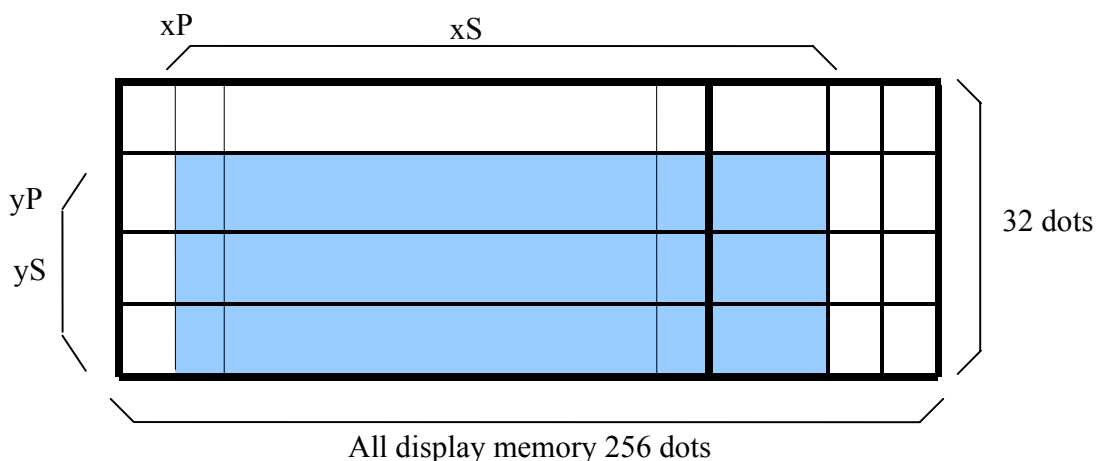
Function: Define or cancel User-Window

Display contents remain unchanged when this command is executed.

When User-Window is defined (b=1)

Specify Definable Window No., Window position and Window size, and Window position and Window size are specified by the block (Block/1 × 8dot)

After executing this command, the cursor position is located at (X=0, Y=0).



### 5.1.23.13 <FUNCTION 10h> US (w n a

Name: Write Screen Mode Select

Code:1Fh 28h 77h n a

n: Classify command

a: Write screen mode

a=0: Display screen mode

a=1: All screen mode

Definable area: n=10h

$0 \leq a \leq 1$

Default: a=0

Function: Selects the write screen mode. This affects only the Base Window.

Display action is valid within area of either the Display Area or the Hidden Area depending on the cursor position.

If "All Screen Mode" is selected then, the display action is valid for the entire screen area.

### 5.1.23.14 WINx (Shortcut Current Window Select)

Function: Shortcut for the current User Window selection

WINx	Function
WIN0 (10H)	Selects the base window
WIN1 (11H)	Selects user window 1
WIN2 (12H)	Selects user window 2
WIN3 (13H)	Selects user window 3
WIN4 (14H)	Selects user window 4

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## 6.0 JUMPER SETTINGS

Jumper	Function	Default
J0	Baud rate	OPEN
J1		OPEN
J2	Asynchronous / Synchronous serial select	OPEN
J3	Reserved	OPEN
JRB	Signal select for Pin 3 of CN1 (parallel I/F)	OPEN

J0	J1	Baud rate
OPEN	OPEN	38400 bps
SHORT	OPEN	19200 bps
OPEN	SHORT	9600 bps
SHORT	SHORT	115200 bps

J2	Mode
OPEN	Asynchronous serial mode
SHORT	Synchronous serial mode

### 6.1.1 JRB - SIGNAL SELECT FOR PIN 3 OF CN1 (PARALLEL I/F)

JRB	CN1 Pin #3 Signal
OPEN	NC
C-R SHORT	/RESET (Input)
C-B SHORT	PBUSY (Output)
R-C-B SHORT	Do not use

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## 7.0 CN1 - PARALLEL INTERFACE CONNECTOR (FOURTEEN THROUGH HOLES)

Pin	Signal	Function	Direction	Pin	Signal	Function	Direction
1	GND	Ground	Input	8	D1	Data input	Input/Output
2	Vcc	Power supply	Input	9	D2	Data input	Input/Output
3	NC *	No connect	—	10	D3	Data input	Input/Output
4	RS	Switch signal	Input	11	D4	Data input	Input/Output
5	/WR	Data write	Input	12	D5	Data input	Input/Output
6	/RD	Data read	Input	13	D6	Data input	Input/Output
7	D0	Data input	Input/Output	14	D7(PBUSY)	Data input	Input/Output

\*Pin 3 can be changed to /RESET or PBUSY with the JRB jumper.

## 8.0 CN2 - SERIAL INTERFACE CONNECTOR (SIX THROUGH HOLES)

Pin	Signal	Function	Direction
1	Vcc	Power supply	Input
2	SIN	Data receive	Input
3	GND	Ground	Input
4	SBUSY	Display busy	Output
5	SCK	Serial clock	Input
6	/RESET	Reset	Input

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### 1. Common Font Set (20H-7FH)

	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+A	+B	+C	+D	+E	+F
20	□	!	"	#	\$	%	&	'	(	)	*	+	,	-	.	/
30	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
40	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
50	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	□
60	▾	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
70	p	q	r	s	t	u	v	w	x	y	z	{		}	~	□

### 2. International Font Set

International Font Set is selected by ESC R n command.

	23H	24H	40H	5BH	5CH	5DH	5EH	60H	7BH	7CH	7DH	7EH
n=00H	#	\$	@	□	\	]	^	▾	□	H	I	J
n=01H	#	\$	▾	▾	▾	▾	▾	▾	▾	▾	▾	▾
n=02H	#	\$	▾	▾	▾	▾	▾	▾	▾	▾	▾	▾
n=03H	#	\$	@	□	\	]	^	▾	□	H	I	J
n=04H	#	\$	@	▾	▾	▾	▾	▾	▾	▾	▾	▾
n=05H	#	▾	▾	▾	▾	▾	▾	▾	▾	▾	▾	▾
n=06H	#	\$	@	▾	\	▾	▾	▾	▾	▾	▾	▾
n=07H	#	\$	@	▾	▾	▾	▾	▾	▾	▾	▾	▾
n=08H	#	\$	@	□	\	]	^	▾	□	H	I	J
n=09H	#	▾	▾	▾	▾	▾	▾	▾	▾	▾	▾	▾
n=0AH	#	\$	▾	▾	▾	▾	▾	▾	▾	▾	▾	▾
n=0BH	#	\$	▾	▾	▾	▾	▾	▾	▾	▾	▾	▾
n=0CH	#	\$	▾	▾	▾	▾	▾	▾	▾	▾	▾	▾
n=0DH	#	\$	@	□	\	]	^	▾	□	H	I	J

### 3.Character Code Type ( 80H-FFH )

Character Code Type is selected by ESC t n command.

n=0

	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+A	+B	+C	+D	+E	+F
80	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
90	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
B0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
C0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
D0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
E0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
F0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

n=1

	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+A	+B	+C	+D	+E	+F
80	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
90	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
B0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
C0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
D0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
E0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
F0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

n=2

	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+A	+B	+C	+D	+E	+F
80	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
90	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
A0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
B0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
C0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
D0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
E0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
F0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

n=3

	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+A	+B	+C	+D	+E	+F
80																
90																
A0																
B0																
C0																
D0																
E0																
F0																

n=4

	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+A	+B	+C	+D	+E	+F
80																
90																
A0																
B0																
C0																
D0																
E0																
F0																

n=5

	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+A	+B	+C	+D	+E	+F
80																
90																
A0																
B0																
C0																
D0																
E0																
F0																

n=16

	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+A	+B	+C	+D	+E	+F
80																
90																
A0																
B0																
C0																
D0																
E0																
F0																

n=17

	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+A	+B	+C	+D	+E	+F
80																
90																
A0																
B0																
C0																
D0																
E0																
F0																

n=18

	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+A	+B	+C	+D	+E	+F
80																
90																
A0																
B0																
C0																
D0																
E0																
F0																

n=19

	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+A	+B	+C	+D	+E	+F
80																
90																
A0																
B0																
C0																
D0																
E0																
F0																