

Vacuum Fluorescent Display Module Specification

Model: GU112X16G-7900D

Specification No: DS-2153-0001-00

Date of Issue: September 8, 2023

Revision:

Published by
NORITAKE ITRON CORP. / Japan
<https://www.noritake-itron.jp/>

This specification is subject to change without prior notice.

This product complies with RoHS Directive
Please contact our sales consultant for details and to confirm the current status.

Notice for the Cautious Handling of VFD Modules

Handling and Usage Precautions:

Please carefully follow the appropriate product application notes for proper usage, safety handling, and operation standards for maximum performance.

[VFD tubes are made of glass]

- Because the edges of the VFD glass-envelop are not smooth, it is necessary to handle carefully to avoid injuries to your hands
- Please avoid breaking the VFD glass-envelop to prevent injury from sharp glass particles.
- Please design the PCB for the VFD-module within 0.3 mm warping tolerance to avoid any forces that may damage the display due to PCB distortion causing a breakdown of the electrical circuit leading to VFD failure.

[High voltage]

- Avoid touching conductive electrical parts, because the VFD-module uses high voltage exceeding 30 – 80 volts.
- Even when electric power is turned off, it may take more than one minute for the electrical current to discharge.

[Cable connection]

- Do not unplug the power and/or data cables of VFD-modules during operating condition because unrecoverable damage may result.
- Sending input signals to the VFD-module during a power off condition sometimes causes I/O port damage.
- It is recommended to use a 30 cm or shorter signal cable to prevent functional failures.

[Electrostatic charge]

- VFD-modules needs electrostatic free packaging and protection from electrostatic charges during handling and usage.

[Structure]

- During operation, VFD and VFD-modules generate heat. Please consider sufficient heat radiation dissipation using heat sink solutions.
- We prefer to use UL grade materials or components in conjunction with VFD-modules.
- Wrap and twist motion causes stress and may break VFDs & VFD modules. Please adhere to allowances within 0.3mm at the point of attachment.

[Power]

- Apply regulated power to the VFD-module within specified voltages to protect from failures.
- Because some VFD-modules may consume in rush current more than twice the typical current at power-on timing, we recommend using a sufficient power capability and quick starting of the power regulator.
- VFD-module needs a specified voltage at the point of connection. Please use an adequate power cable to avoid a decrease in voltage. We also recommend inserting a power fuse for extra protection.

[Operating consideration]

- Illuminating phosphor will decrease in brightness during extended operation. If a fixed pattern illuminates for an extended period, (several hours), the phosphor efficiency will decrease compared to the non-operating phosphor causing a non-uniform brightness among pixels. Please consider programming the display patterns to use all phosphor segments evenly. Scrolling may be a consideration for a period of time to refresh the phosphor condition and improve even illumination to the pixels.
- We recommend using a signal cable 30cm or less to avoid some possible disturbances to the signal.

[Storage and operating environment]

- Please use VFD-modules under the recommended specified environmental conditions. Salty, sulfur and dusty environments may damage the VFD-module even during storage.

[Discard]

- When discarding VFDs or VFD-modules, please adhere to governmental related laws or regulations.

[Others]

- Although the VFD-module is designed to be protected from electrical noise, please plan your circuitry to exclude as much noise as possible.
- Do not reconstruct or repair the VFD-module without our authorization. We cannot assure the quality or reliability of unauthorized reconstructed VFD-modules.

Notice:

- We do not authorize the use of any patents that may be inherent in these specifications.
- Neither whole nor partial copying of these specifications are permitted without our approval. If necessary, please ask for assistance from our sales consultant.
- This product is not designed for military, aerospace, medical or other life-critical applications. If you choose to use this product for these applications, please ask us for prior consultation or we cannot take responsibility for problems that may occur.

Index.

Notice for the Cautious Handling of VFD Modules	2
1 General Description	5
1.1 Scope	5
1.2 Construction	5
1.3 Outline	5
1.4 Weight	5
1.5 Block Diagram	6
2 Electrical specification	6
2.1 Absolute Maximum Ratings	6
2.2 Electrical Ratings	6
2.3 Electrical Characteristics	7
3 Optical Specifications	7
4 Environmental Specifications	8
5 Interface	8
5.1 Type of interface	8
5.2 Parallel interface	8
5.2.1 Basic function	8
5.2.2 Parallel interface timing	9
5.3 Serial interface	10
5.3.1 Basic function	10
5.3.2 Asynchronous serial interface timing	10
5.4 Reset timing	10
6 Display specification	11
6.1 Displayable image types	11
6.1.1 Graphic display	11
6.1.2 Character display	11
6.2 Display Memory	11
6.3 Window	12
6.3.1 Base-Window	12
6.3.2 User-Window	12
6.4 Write screen mode for "Base Window"	13
6.4.1 Display screen mode	13
6.4.2 All screen mode	13
6.5 5 x 7 and 7 x 8 Character display format	14
7 Function	15
7.1 Commands	15
7.1.1 Character display	15
7.1.2 BS (Back Space)	16
7.1.3 HT (Horizontal Tab) - 1 character to right	16
7.1.4 LF (Line Feed)	17
7.1.5 HOM (Home Position)	18
7.1.6 CR (Carriage Return)	18
7.1.7 US \$ xL xH yL yH (Cursor Set)	18
7.1.8 CLR (Display Clear)	18
7.1.9 US C n (Cursor display ON/ OFF)	18
7.1.10 ESC@ (Initialize Display)	18
7.2 US (g 01h m (Font size select)	19
7.3 US (g 02h m (2-byte character)	19
7.4 US (g 0Fh m (2-byte character type)	19
7.4.1 ESC % n (Download Character ON/ OFF)	20
7.4.2 ESC & a c1 c2 [x1 d1...d(a×x1)]...[xk d1...d(a×xk)] (Download Character definition)	20
7.4.3 ESC ? a c (Download Character delete)	21
7.4.4 ESC R n (International font set)	21
7.4.5 ESC t n (Character table type)	22
7.4.6 US MD1 (Over-write mode)	22
7.4.7 US MD2 (Vertical scroll mode)	22

7.4.8	US MD3 (Horizontal scroll mode).....	22
7.4.9	US s n (Horizontal scroll speed).....	22
7.4.10	US r n (Reverse display)	23
7.4.11	US w n (Write mixture display mode)	23
7.4.12	US X n (Brightness level setting).....	23
7.4.13	US (a n [parameter] (Display action command group).....	23
7.4.14	<Function 01h> US (a n t (Wait).....	24
7.4.15	<Function 10h> US (a n wL wH cL cH s (Scroll display action)	24
7.4.16	<Function 11h> US (a n p t1 t2 c (Display blink)	25
7.4.17	<Function 40h> US (a n p (Screen Saver)	25
7.4.18	US (f n [parameter] (Bit image display group).....	26
7.4.19	<Function 11h> US (f n xL xH yL yH g d(1)...d(k) (Real-time bit image display).....	26
7.4.20	<Function 10h> US (f 10h m aL aH aE ySL ySH xL xH yL yH g (Downloaded bit image display)	27
7.4.21	US (d n [parameter] (Dot unit command group).....	29
7.4.22	<Function 20h> US (d 20h xPL xPH yPL yPH m aL aH aE ySL ySH xOL xOH yOL yOH xL xH yL yH g (Dot unit downloaded bit image display)	29
7.4.23	<Function 21h> US (d 21h xPL xPH yPL yPH xL xH yL yH g d(1)...d(k) (Dot unit real-time bit image display).....	32
7.4.24	<Function 30h> US (d 30h xPL xPH yPL yPH m bLen d(1)...d(bLen) (Dot unit character display)	34
7.4.25	US (g n [parameter] (Font command group)	35
7.4.26	<Function 03h> US (g n w (Font width)	35
7.4.27	<Function 40h> US (g n x y (Font magnification).....	36
7.4.28	US (w n [parameter] (Window command group).....	36
7.4.29	<Function 01h> US (w n a (Current window select).....	36
7.4.30	<Function 02h> US (w n a b[xPL xPH yPL yPH xSL xSH ySL ySH] (User Window define / cancel)	37
7.4.31	<Function 10h> US (w n a (Write screen mode select)	38
7.4.32	WINx (Window select shortcut)	38
7.4.33	FS M m d1...d6 (Memory re-write mode)	38
7.4.34	B k n d(1)...d(32768) (FROM bit image definition)	39
7.4.35	S k d1 d2 d3 d4 dm (FROM SUM compare)	39
7.4.36	E k (Memory re-write mode END)	39
7.5	Bit image data format	40
8	Setup.....	41
8.1	Jumper.....	41
8.1.1	Baud rate select (for serial interface)	41
8.1.2	Signal select of Pin#3 of 14 through-holes for Parallel I/F	41
9	Connector.....	42
9.1	Parallel interface connector (Through-holes) CN1	42
9.2	Serial interface connector (Through-holes) CN3, CN4	42
9.2.1	Asynchronous serial interface	42
10	Firmware Version Notation	42
11	Outline Drawing.....	43
12	Revision Note.....	44

1 General Description

1.1 Scope

This specification covers the operation and operating requirements of the vacuum fluorescent graphic display module GU112X16G-7900D.

1.2 Construction

The module consists of a 112 x 16 dot graphic VFD, refresh RAM, character generator, flash memory (FROM), DC/DC converter, display controller, and all necessary control logic. The module can simultaneously display graphic patterns and/or characters on the screen.

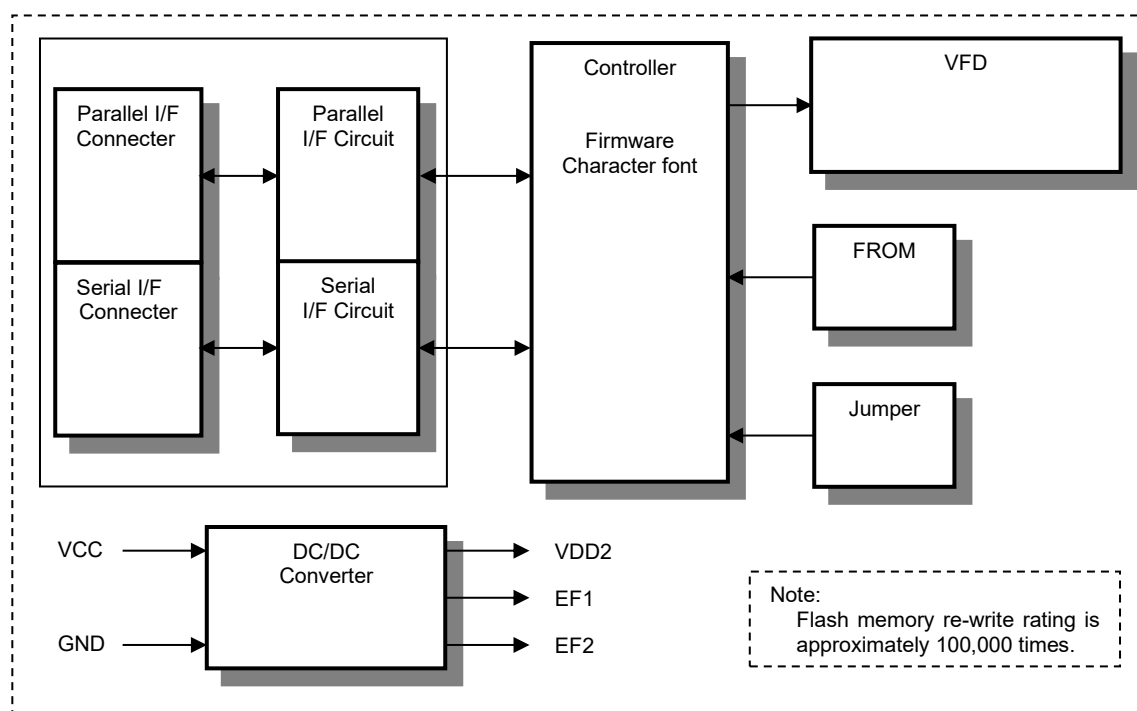
1.3 Outline

Power supply:	+5 VDC only
Interface:	Parallel interface (CMOS) Serial interface (Asynchronous, input only, RS-232 level)
Function:	Character display 5 x 7 dot, 8 x 16 dot and 16 x 16 dot, with display attributes 5 x 7 / 8 x 16 dot character font (specification DS-1162-0002-xx) 16 x 16 dot character font Japanese (specification DS-1162-0003-xx) Simplified Chinese (specification DS-1162-0005-xx) Traditional Chinese (specification DS-1162-0006-xx) Korean (specification DS-1162-0004-xx) Graphic display Control command Character download function Screen Saver function
Applicable reliability specification:	TT-99-3102x
Applicable module production specification:	TT-98-3413x
Applicable VFD quality specification:	TT-93-3336x
– The revision number is indicated by "x".	

1.4 Weight

Approximately 30g

1.5 Block Diagram



2 Electrical specification

2.1 Absolute Maximum Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power Supply Voltage	VCC	-0.3	-	+6.0	VDC
Logic Input Voltage D0-D7, /WR,/RD, /RESET	VIN1	-0.3	-	VCC+0.3	VDC
Logic Input Voltage SIN	VIN2	-20.0	-	+20.0	VDC

2.2 Electrical Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power Supply Voltage	VCC	4.75	5.00	5.25	VDC

All driving voltage for the VFD is converted from the DC/DC converter on board.

2.3 Electrical Characteristics

Measuring Conditions: Ambient temperature = 25degrees C, VCC =5.0VDC

Parameter		Symbol	Min.	Typ.	Max.	Unit	Condition	Note
“L” Level Logic Input Current	D0-D7, /WR, /RD	IIL1-1	-	-	-0.15	mA	VIN1=0V	-
	/RESET	IIL1-2	-	-	-0.6	mA	VIN1=0V	-
“H” level Logic Input Current D0-D7, /WR, /RD, /RESET		IIH1	-	-	1.0	μADC	VIN1=5V	-
Logic Input Voltage D0-D7, /WR, /RD, /RESET	"H"	VIH1	0.8VCC	-	VCC	VDC	-	-
	"L"	VIL1	0	-	0.2VCC	VDC	-	-
Logic Output Voltage D7(PBUSY flag), PBUSY	"H"	VOH1	3.8	-	VCC	VDC	IOH1=-1.5mA	-
	"L"	VOL1	0	-	0.6	VDC	IOL1=1.6mA	-
Logic input resistance SIN		RIN2	3	-	-	kOhm	-	-
Logic Input Voltage SIN	"H"	VIH2	3.0	-	+15.0	VDC	-	-
	"L"	VIL2	-15.0	-	0.5	VDC	-	-
Logic Output Voltage SBUSY	"H"	VOH2	4.0	-	VCC	VDC	RL=3kOhm	-
	"L"	VOL2	0	-	0.5	VDC	RL=3kOhm	-
Power Supply Current 1		ICC-1	-	175	220	mADC	-	(1)
Power Supply Current 2		ICC-2	-	115	150	mADC	-	(2)
Power Supply Current 3		ICC-3	-	14	19	mADC	-	(3)
Power Consumption		P1	-	0.9	1.1	W	-	(1)

(1) ICC-1 shows the current at all dots in the screen are lighted.

(2) ICC-2 shows the current at all dots off.

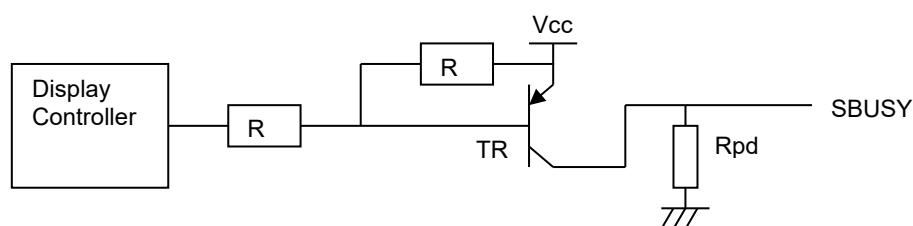
(3) ICC-3 shows the current at Display Power OFF (Power save mode). Refer to “7.4.17 Screen Saver”.

Note

Inrush current at power-on may exceed twice normal current. It is recommended to use a power supply with sufficient capacity.

The rise time of supply voltage should not exceed 100ms.

“SBUSY” is open collector terminal. (Rpd: Pull down by 10k ohm)



3 Optical Specifications

Number of dots:	1,792 (112 x 16)
Display area:	52.50mm x 11.45mm(X x Y)
Dot size:	0.330mm x 0.575mm(X x Y)
Dot pitch:	0.470mm x 0.725mm (X x Y)
Luminance:	350cd/m ² Min.
Color of illumination:	Green (Blue Green)

4 Environmental Specifications

Operating temperature:	-40 to +85 degrees C
Storage temperature:	-40 to +85 degrees C (-60 to -40 °C for less than 168 hours.)
Operating humidity:	20 to 80 % R.H (Non Condensing)
Storage humidity:	20 to 80 % R.H (Non Condensing)
Vibration:	10-55-10Hz, all amplitude 1mm, 30Min., X-Y-Z (Non-operating)
Shock:	392m/s ² (40G) 9mS X-Y-Z, 3 times each direction (Non-operating)

5 Interface

5.1 Type of interface

The following interfaces are available on this module;

Parallel interface (CMOS)

Serial interface (Asynchronous, input only, RS-232 level)

5.2 Parallel interface

5.2.1 Basic function

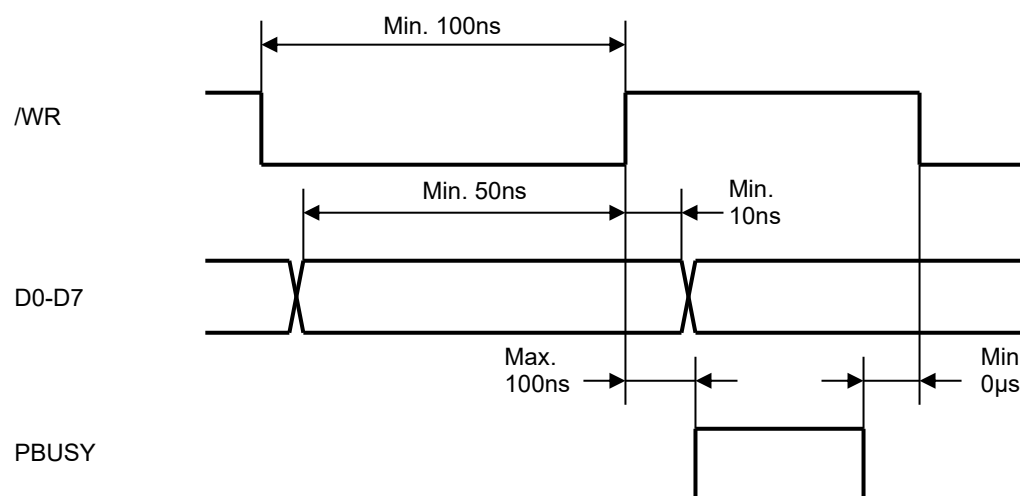
The module sets the PBUSY line upon receipt of data, and clears the line when ready to receive more data. PBUSY is readable by Status read of D7 bit or PBUSY signal directly.

RS terminal is reserved for switching of data and command. This is not available on this module. Please do not use this terminal.

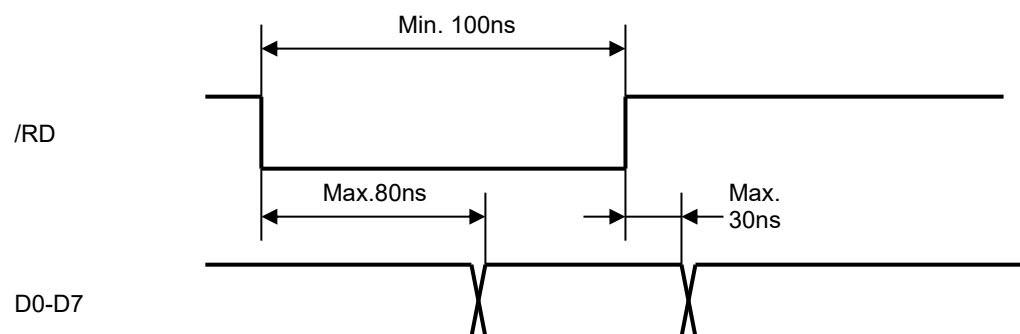
Operation	/WR	/RD	RS	D0 - D7
Data Write	0 → 1	1	X	D0 - D7: Data Write
Status Read (Data Read)	1	0	X	D0 - D6: Indefinite D7: PBUSY Flag 1:BUSY, 0:READY

5.2.2 Parallel interface timing

Data Write timing



Data Read timing

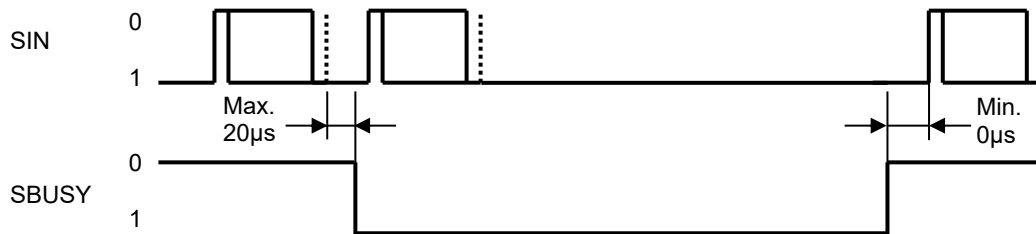


5.3 Serial interface

5.3.1 Basic function

There is an Asynchronous serial interface, supporting RS-232 level input only. The module sets the SBUSY line upon receipt of data, and clears the line when ready to receive more data.

5.3.2 Asynchronous serial interface timing



Interface:

Baud rate	9,600 – 115,200bps (Selectable by Jumper)
Parity	None Parity
Format	Start (1bit) + Data (8bit) + Stop (1bit)
Handshake	SBUSY

Receiving Buffer Capacity: 252 bytes

SBUSY change timing:

SBUSY	1(BUSY)	0(READY)
Condition	When there is data in buffer	When there is no data in buffer

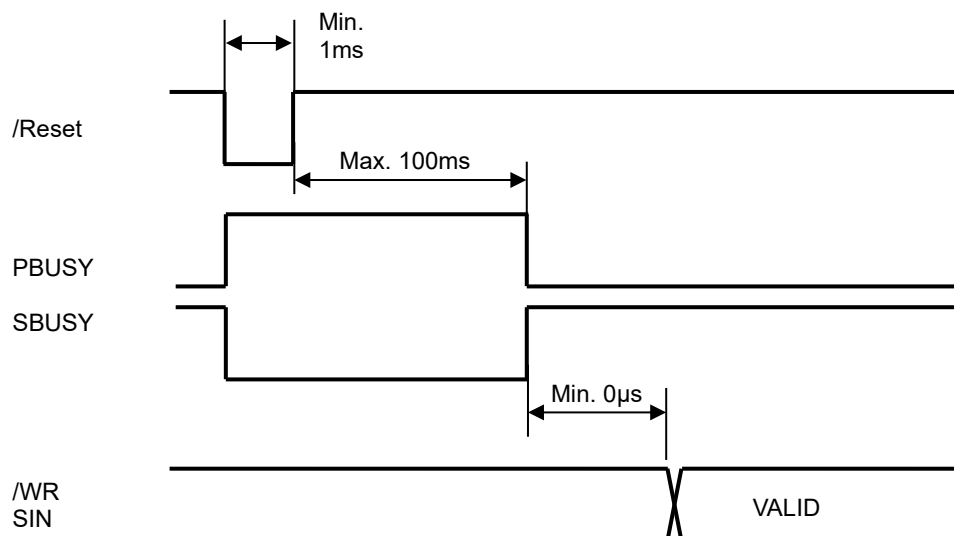
Data can be stored into receiving buffer.

However, it is recommended to not send data when SBUSY = 1.

5.4 Reset timing

Reset pulse (active low) should be longer than 1ms.

The module sets the SBUSY/ PBUSY line upon receipt of Reset signal and clears the line when ready to receive data.



6 Display specification

6.1 Displayable image types

6.1.1 Graphic display

Number of dot: 112 x 16 dots

6.1.2 Character display

Character mode: 5 x 7 dot mode

8 x 16 dot mode (8 x 16 dot: 1-byte, 16 x 16 dot: 2-byte)

Character font type:

1-byte character:

5 x 7 dot characters: ANK, international font

8 x 16 dot characters: ANK, international font

2-byte character:

16 x 16 dot characters: Japanese, Simplified Chinese, Traditional Chinese, Korean

Character display width: Fixed character format 1 & 2, Proportional character format 1 & 2. (5 x 7 dot mode only)

Attribution: Character magnify, Reverse

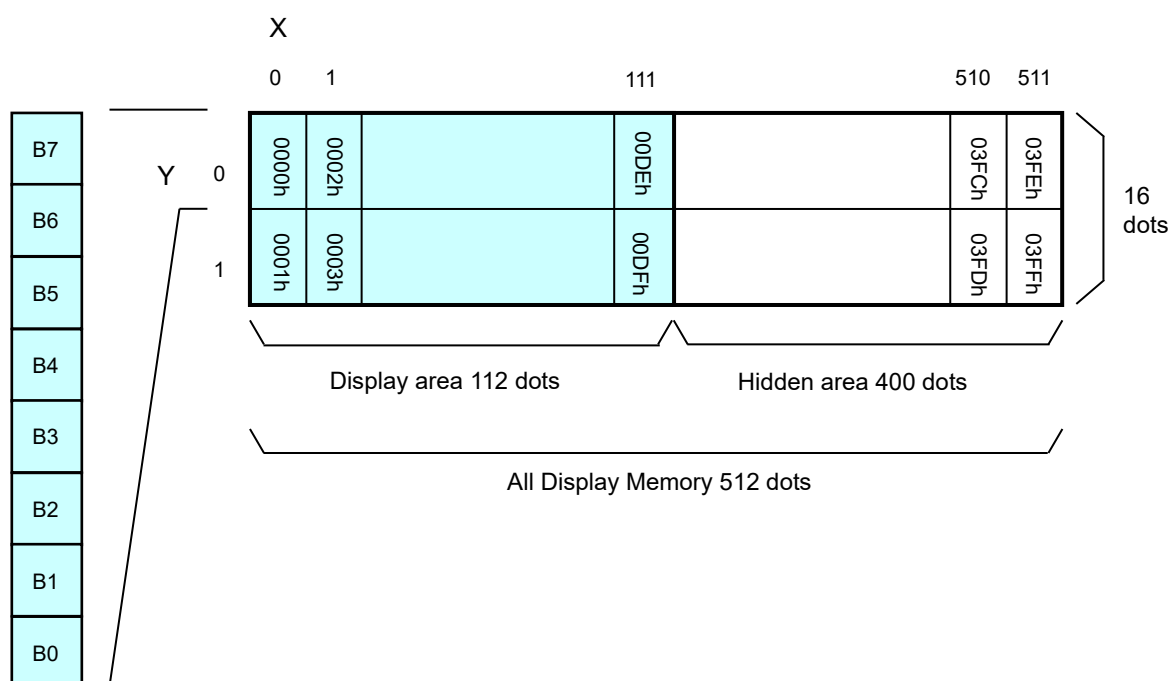
6.2 Display Memory

Size: 512 x 16 dots - separated as: Display area (112 x 16 dots) / Hidden area (400 x 16 dots).

Display Memory is comprised of Display area and Hidden area, as shown below.

By using "User Window" function, the memory area can be separated, and each separate window can be controlled independently (refer to "7.4.28 Window command group").

Hidden area can be displayed by using scroll or other action commands (refer to "7.4.13 Display action command group").

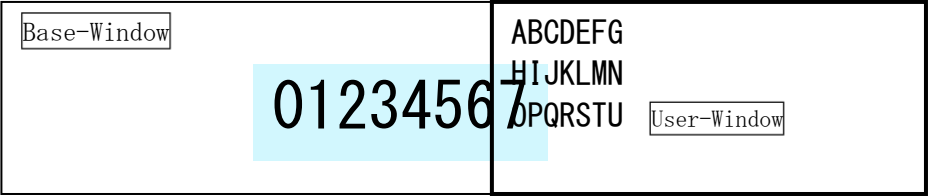


6.3 Window

Window function enables the display screen to be divided into “Windows”, each of which can be controlled and displayed independently.
Display Memory is shared by all windows; individual windows do not have their own display memory. There are 2 types of “window”: Base-Window and User-Window.
Refer to “7.4.28 Window command group”.

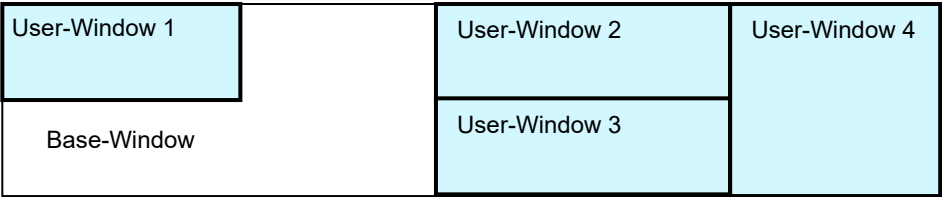
6.3.1 Base-Window

Base-Window covers the entire display screen. If no User-Windows are defined, all display operation is processed on this window. If one or more User-Windows are defined, display operation on any area not covered by a User-Window is done by selecting Base-Window.
When Base-Window is selected, even if User-Window(s) are defined, all display operation is processed under Base-Window. Therefore the current display contents of User-Window(s) is overwritten.



6.3.2 User-Window

User-Window is defined by “User Window define / cancel” command.
Display operation is processed on the window selected by Current Window select command.
A maximum of 4 User-Windows can be defined.
Refer to “7.4.29 Current window select” and “7.4.30 User Window define / cancel”.



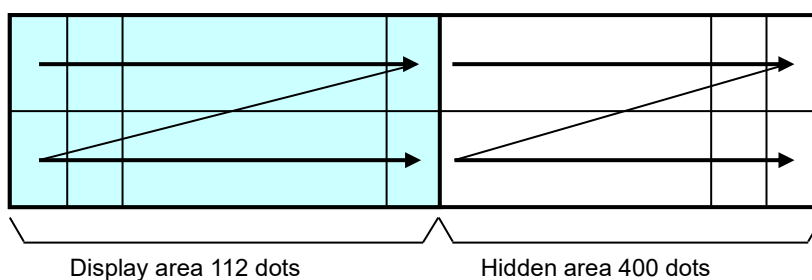
6.4 Write screen mode for “Base Window”

This setting is only applicable for Base-Window.

There are two Write screen modes, Display screen mode and All screen mode. The mode is set by command (Refer to the commands “7.4.28 Window command group” and “7.4.31 Write screen mode select”).

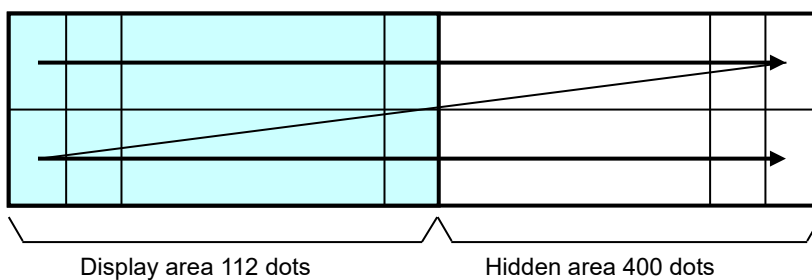
6.4.1 Display screen mode

When the cursor is located in the Display area, all operation will be done within the Display area, and when the cursor is located in the Hidden area, it will be done within the Hidden area.



6.4.2 All screen mode

Regardless of the cursor position, operation will be done over the entire area.



6.5 5 x 7 and 7 x 8 Character display format

5 x 7 and 7 x 8 Character display format is following selectable by "Font width" command.

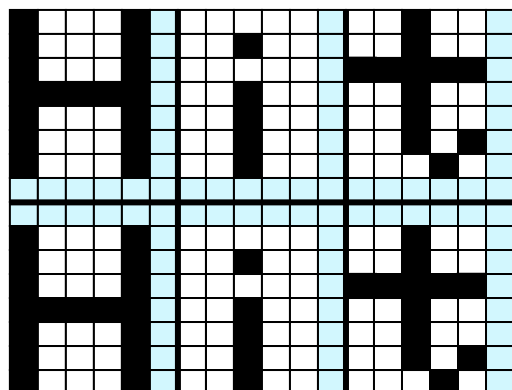
Refer to "7.4.26 Font width".

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 5 x 7dot	Y = 0 (Top line)	Character format	5 x 7	5 x 7	n x 7	n x 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
	Y = 1 (Bottom line)	Character format	5 x 7	5 x 7	n x 7	n x 7
		Upper space	1	1	1	1
		Lower space	0	0	0	0
		Left space	0	1	0	1
		Right space	1	1	1	1
Download Character 7 x 8dot	Y = 0 (Top line) Y = 1 (Bottom line)	Character format	6 x 8 *	7 x 8	6 x 8 *	7 x 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

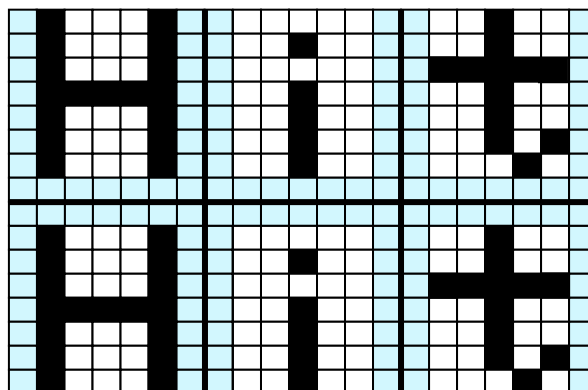
* The left-most 6 x 8 dot part of the 7 x 8 dot character is displayed.

Note: When proportional character width is specified, the blank character (20h) is treated as a 2-dot width character.

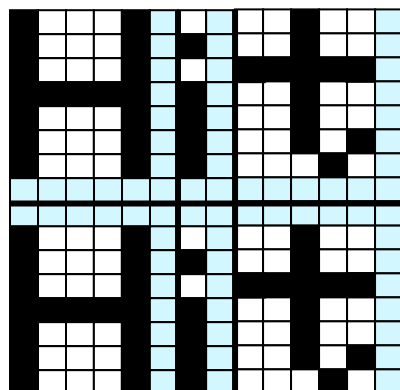
Fixed character width 1



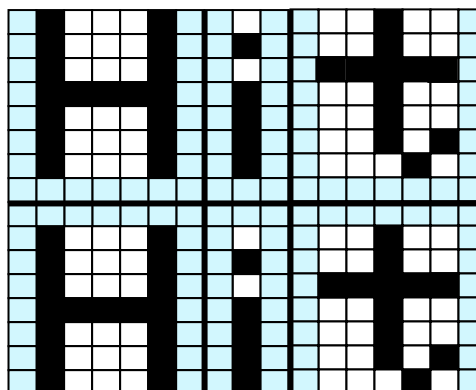
Fixed character width 2



Proportional character width 1



Proportional character width 2



7 Function

7.1 Commands

This section describes the operation of each command.

Note:

The character size (X x Y dot) referred to in this section depends on the “Font width” and “Font magnified display” command settings.

Number of X dot and Y dot for one character for commands other than “Character display” under the condition of each Font width are as follows:

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

MD1 mode, MD2 mode, and MD3 mode, described below, refer to Over-write mode, Vertical scroll mode, and Horizontal scroll mode respectively. (To select the mode, refer to the commands “**7.4.6 Over-write mode**”, “**7.4.7 Vertical scroll mode**”, and “**7.4.8 Horizontal scroll mode**”).

7.1.1 Character display

Code: 20h – FFh or 2 byte character code

Function: Display character at cursor position.

This command operates on the current window. (refer to “Current window Select”).

When MD1 mode (Over-write mode) is selected.

Cursor position		Operation
X direction	Y direction	
Space for one character on right side.	-	Display >> HT
Right end.	Space for one line below.	HT >> Display >> HT
	No space for one line below.	HT >> Display >> HT

When MD2 mode (Vertical scroll mode) is selected.

Cursor position		Operation
X direction	Y direction	
Space for one character on right side.	-	Display >> HT
Right end.	Space for one line below.	HT >> Display >> HT
	No space for one line below.	HT >> Display >> HT

When MD3 mode (Horizontal scroll mode) is selected.

Cursor position		Operation
X direction	Y direction	
Space for one character on right side.	-	Display >> HT
Right end.	-	HT >> Display >> HT

7.1.2 BS (Back Space)

Code: 08h

Function: Cursor moves to the left by one character.
This command has effect for the current window.

When MD1 (Over-write mode) and MD2 (Vertical scroll mode) modes is selected.

Cursor position		Operation
X direction	Y direction	
Space for one character on left side.	-	Cursor moves left by one character.
Left end.	Space for one line above.	Cursor moves to right end of next upper line.
	No space for one line above.	Cursor does not move.

When MD3 mode (Horizontal scroll mode) is selected.

Cursor position		Operation
X direction	Y direction	
Space for one character on left side.	-	Cursor moves left by one character.
Left end.	-	Cursor does not move.

7.1.3 HT (Horizontal Tab) - 1 character to right

Code: 09h

Function: Cursor moves to the right by one character.
This command has effect for the current window.

When MD1 mode (Over-write mode) is selected.

Cursor position		Operation
X direction	Y direction	
Space for one character on right side.	-	Cursor moves right by one character.
Right end.	Space for one line below.	Cursor moves to left end of next lower line.
	No space for one line below.	Cursor moves to left end of top line.

When MD2 mode (Vertical scroll mode) is selected.

Cursor position		Operation
X direction	Y direction	
Space for one character on right side.	-	Cursor moves right by one character.
Right end	Space for one line below.	Cursor moves to left end of next lower line.
	No space for one line below.	Display contents are scrolled up by one line and the bottom line is cleared. Cursor moves to left end of bottom line.

When MD3 (Horizontal scroll mode) mode is selected.

Cursor position		Operation
X direction	Y direction	
Space for one character on right side.	-	Cursor moves right by one character.
Right end	-	Contents of current line scroll left by one character, right end character is cleared, and cursor moves to the right end.

7.1.4 LF (Line Feed)

Code: 0Ah

Function: Cursor moves to next lower line.
This command has effect for the current window.

When MD1 mode (Over-write mode) is selected.

Cursor position		Operation
X direction	Y direction	
-	Space for one line below.	Cursor moves to the same position on next lower line.
	No space for one line below.	Cursor moves to the same position on top line.

When MD2 mode (Vertical scroll mode) is selected.

Cursor position		Operation
X direction	Y direction	
-	Space for one line below.	Cursor moves to the same position on next lower line.
	No space for one line below.	Display contents are scrolled up by one line and the bottom line is cleared. Cursor does not move.

When MD3 mode (Horizontal scroll mode) is selected.

Cursor position		Operation
X direction	Y direction	
-	-	Cursor does not move.

7.1.5 HOM (Home Position)

Code: 0Bh

Function: Cursor moves the home position (top left).
This command has effect for the current window.**7.1.6 CR (Carriage Return)**

Code: 0Dh

Function: Cursor moves to left end of current line.
This command has effect for the current window.**7.1.7 US \$ xL xH yL yH (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: $0000h \leq (xL + xH \times 100h) \leq 01FFh$ $0000h \leq (yL + yH \times 100h) \leq 0001h$ Function: The cursor moves to specified X, Y position on Display Memory.
If the specified X, Y position (X and/or Y) is outside the definable area, or outside the currently-selected window, the command is ignored and the cursor remains in the same position.
This command effects on the currently-selected window by "Current window select".**7.1.8 CLR (Display Clear)**

Code: 0Ch

Function: Display screen is cleared and cursor moves to home position.
This command has effect for the current window.**7.1.9 US C n (Cursor display ON/ OFF)**

Code: 1Fh 43h n

n: Cursor display setting

Definable area: $00h \leq n \leq 01h$

n = 00h: Cursor display OFF

n = 01h: Cursor display ON

Default: n = 00h

Function: Select cursor ON or OFF.

When cursor display is ON, cursor position appears as reverse blinking, 1 x 8 dots.

When cursor is in Hidden Area, it does not appear, even when cursor display is set ON.

This command has effect for the current window.

7.1.10 ESC@ (Initialize Display)

Code: 1Bh 40h

Function: Settings return to default values.
Jumper settings are not re-loaded.
The contents of receive buffer remain in memory.

7.2 US (g 01h m (Font size select)

Code: 1Fh 28h 67h 01h m

Definable area: 01h ≤ m ≤ 02h

Default: m = 01h

Function: Sets the font size for 1-byte characters.

m	Function
01h	5×7 dot character
02h	8×16 dot character

7.3 US (g 02h m (2-byte character)

Code: 1Fh 28h 67h 02h m

Definable area: 00h ≤ m ≤ 01h

Default: m = 00h

Function: Sets 2-byte character ON/OFF.

m	Function
00h	2-byte character mode OFF
01h	2-byte character mode ON

Example for displaying a 2-byte character:

Set the font size: 1Fh 28h 67h 01h 02h

Specify 2-byte character mode: 1Fh 28h 67h 02h 01h

Enter the 2-byte character code: Code B0h A2h (“阿” Example Simplified Chinese character)

7.4 US (g 0Fh m (2-byte character type)

Code: 1Fh 28h 67h 0Fh m

Definable area: 00h ≤ m ≤ 03h

Default: m = 01h

Function: Sets 2-byte character type.

The 2-byte character code depends on the type of built-in character fonts. This module has the following built-in 2-byte character fonts.

m	Font type	Code type	First byte	Second byte
00h	Japanese	JIS X0208 (SHIFT-JIS)	81h ≤ c1 ≤ 9Fh E0h ≤ c1 ≤ EFh	40h ≤ c2 ≤ 7Eh 80h ≤ c2 ≤ FCh
01h	Korean	KSC5601-87	A1h ≤ c1 ≤ FEh	A1h ≤ c2 ≤ FEh
02h	Simplified Chinese	GB2312-80	A1h ≤ c1 ≤ FEh	A1h ≤ c2 ≤ FEh
03h	Traditional Chinese	Big-5	A1h ≤ c1 ≤ FEh	40h ≤ c2 ≤ 7Eh, A1h ≤ c2 ≤ FEh

Example for displaying a 16×16, 2-byte character:

Set the font size: 1Fh 28h 67h 01h 02h

Specify 2-byte character mode: 1Fh 28h 67h 02h 01h

Specify 2-byte character type: 1Fh 28h 67h 0Fh 01h (Korean)
1Fh 28h 67h 0Fh 02h (Simplified Chinese)
1Fh 28h 67h 0Fh 03h (Traditional Chinese)

Enter the 2-byte character code: Code B0h A2h (“阿” Example Simplified Chinese character)

7.4.1 ESC % n (Download Character ON/ OFF)

Code:	1Bh 25h n	
	n:	Download Characters setting
Definable area:	00h ≤ n ≤ 01h	
	n = 00h:	Disable (Characters already downloaded, defined, and displayed are not affected.)
	n = 01h:	Enable (If Download Character is not defined, built-in character is displayed.)
Default:	n = 00h	
Function:	Specify enable or disable for Download Character.	

7.4.2 ESC & a c1 c2 [x1 d1...d(a×x1)]...[xk d1...d(a×xk)] (Download 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 dot for X-direction
	d:	Defined data
Definable area:	a = 01h	
	20h ≤ c1 ≤ c2 ≤ FFh	
	x = 05h: 5 x 7 dot font/ Upper 7 bit is valid.	
	x = 07h: 7 x 8 dot font/ All 8 bit is valid.	
	00h ≤ d ≤ FFh	
	k = c2 - c1 + 1	
Function:	Define Download Characters into RAM.	
	A maximum of 16 Download Characters can be defined.	
	x = 05h:	Defined by 5 x 7dot, and 5 x 7 dot character regulated upper and lower space is displayed as same as standard character display.
	x = 07h:	Defined by 7 x 8 dot, and 6 x 8 or 7 x 8 dot character unrelated to space is displayed. (Refer to “ 6.5 5 x 7 and 7 x 8 Character display format ”).

After the maximum number of Download Characters are defined, in order to define other character codes, space must first be obtained using the Download Character delete command.

Downloaded Characters are valid until redefined, an initialize (ESC @) sequence is executed, or the power is turned off.

To display Download Characters the commands “Download Character definition” and “Download Character ON/ OFF” (set to enable) are required.

If a currently-displayed Download Character is re-defined, there is no effect on the currently-displayed character. It is effective only for newly input characters.

(5 x 7 dot)

B7					
B6					
B5					
B4					
B3					
B2					
B1					
B0					
	d1	d2	d3	d4	d5

(7 x 8 dot)

B7							
B6							
B5							
B4							
B3							
B2							
B1							
B0							
	d1	d2	d3	d4	d5	d6	d7

7.4.3 ESC ? a c**(Download Character delete)**

Code: 1Bh 3Fh a c

a: Select character type
 c: Character code for delete

Definable area: a = 01h

20h ≤ c ≤ FFh

Function: Delete defined Download Character.

The built-in character is displayed after this command is executed.

It does not affect to the displaying Download Character.

This command is ignored if character code for Download Character is not defined.

7.4.4 ESC R n**(International font set)**

Code: 1Bh 52h n

n: International font set setting

Definable area: 00h ≤ n ≤ 0Dh

Default: n = 00h

Function: Select International font set.

Characters already displayed are not affected.

n	Font set
00h	America
01h	France
02h	Germany
03h	England
04h	Denmark 1
05h	Sweden
06h	Italy
07h	Spain1
08h	Japan
09h	Norway
0Ah	Denmark2
0Bh	Spain2
0Ch	Latin America
0Dh	Korea

7.4.5 ESC t n

Code:

(Character table type)

1Bh 74h n

n:

Character table type setting

Definable area:

n = 00h, 01h, 02h, 03h, 04h, 05h, 10h, 11h, 12h, 13h

Default:

n = 00h

Function:

Select character table type.

n	Font code type
00h	PC437(USA - Euro std)
01h	Katakana - Japanese
02h	PC850 (Multilingual)
03h	PC860 (Portuguese)
04h	PC863 (Canadian-French)
05h	PC865 (Nordic)
10h	WPC1252
11h	PC866 (Cyrillic #2)
12h	PC852 (Latin 2)
13h	PC858

7.4.6 US MD1

Code:

(Over-write mode)

1Fh 01h

Function:

Display mode set to Over-write mode.

Over-writes, or replaces existing data.

This command has effect for the current window.

7.4.7 US MD2

Code:

(Vertical scroll mode)

1Fh 02h

Function:

Display mode set to Vertical scroll mode.

Scrolls cursor up 1 line.

This command has effect for the current window.

7.4.8 US MD3

Code:

(Horizontal scroll mode)

1Fh 03h

Function:

Display mode set to Horizontal scroll mode.

Scrolls cursor horizontally 1 space.

This command has effect for the current window.

7.4.9 US s n

Code:

(Horizontal scroll speed)

1Fh 73h n

n:

Horizontal scroll speed setting

Definable area:

 $00h \leq n \leq 1Fh$

Default:

n = 00h

Function:

Set speed for Horizontal scroll mode.

Scroll speed is set by "n".

Subsequent commands are not processed until scroll is completed.

n	Speed
00h	Instantaneous (By Character)
01h	T ms / 2 dots
02h – 1Fh	$(n - 1) \times T$ ms / dot

Note

Scroll base time period "T" depends on screen mode and character size, etc.

7.4.10 US r n (Reverse display)

Code: 1Fh 72h n
 n: Reverse display ON/OFF

Definable area: $00h \leq n \leq 01h$
 n = 00h: Reverse OFF
 n = 01h: Reverse ON

Default: n = 00h

Function: Reverse display ON/OFF for character and image display.
 Changing this setting only affects subsequent data. Content already displayed is not affected.

7.4.11 US w n (Write mixture display mode)

Code: 1Fh 77h n
 n: Display write mode

Definable area: $00h \leq n \leq 03h$
 n = 00h: Normal display write (Not mixture display)
 n = 01h: OR display write
 n = 02h: AND display write
 n = 03h: EX-OR display write

Default: n = 00h

Function: Specifies write mixture mode.
 Newly-written characters and images are combined with current display contents in Display Memory.

7.4.12 US X n (Brightness level setting)

Code: 1Fh 58h n
 n: Brightness level setting

Definable area: $01h \leq n \leq 08h$

Default: n = 08h

Function: Set display brightness level.

n	Brightness level
01h	approximately 12.5%
02h	approximately 25.0%
03h	approximately 37.5%
04h	approximately 50.0%
05h	approximately 62.5%
06h	approximately 75.0%
07h	approximately 87.5%
08h	100%

7.4.13 US (a n [parameter] (Display action command group)

Code: 1Fh 28h 61h n p1 ... pn
 n: Function No.
 p1, ..., pn: Parameter

Function: Execute processing of display action command.
 The next command or data is not executed until display action processing is ended.

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

7.4.14 <Function 01h> US (a n t (Wait)

Code: 1Fh 28h 61h 01h t
 t: Wait time

Definable area: $00h \leq t \leq FFh$

Function: Waits for the specified time (command and data processing is stopped).
 Wait time = $t \times$ approximately 0.5s

7.4.15 <Function 10h> US (a n wL wH cL cH s (Scroll display action)

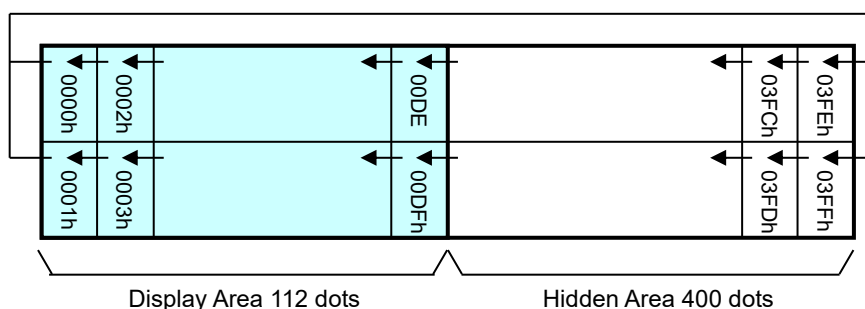
Code: 1Fh 28h 61h 10h wL wH cL cH s

wL: Display screen shift byte count, lower byte
 wH: Display screen shift byte count, upper byte
 cL: Number of cycles, lower byte
 cH: Number of cycles, upper byte
 s: Scroll action speed

Definable area: $0000h \leq (wL + wH \times 100h) \leq 03FFh$
 $0001h \leq (cL + cH \times 100h) \leq FFFFh$
 $00h \leq s \leq FFh$

Function: Shift the display screen.
 Horizontal scrolling is possible by specifying as the shift byte count a multiple of (display screen "y" dot / 8). Display switching is possible by specifying shift byte count as (display screen "x" dot \times display screen "y" dot / 8). Scroll speed is specified by "s".
 Scroll speed: $s \times$ approximately 14ms / one shift

For example: 1 dot scroll to the left: wL = 02h, wH = 00h



7.4.16 <Function 11h> US (a n p t1 t2 c (Display blink)

Code:	1Fh 28h 61h 11h p t1 t2 c
	p: Blink pattern
	t1: Normal display time
	t2: Blank or Reverse display time
	c: Number of repetition
Definable area:	00h ≤ p ≤ 02h
	p = 00h: Normal display.
	p = 01h: Blink display (alternately Normal and Blank display).
	p = 02h: Blink display (alternately Normal and Reverse display).
	01h ≤ t1 ≤ FFh
	01h ≤ t2 ≤ FFh
	01h ≤ c ≤ FFh
Function:	Blink display action Blink pattern specified by "p". Time specified by "t1", "t2", and repeat Blink display.
	A: t1 × approximately 14ms (Normal display)
	B: t2 × approximately 14ms (Blank or Reverse display)
	C: Repeated "c" times.
Note	
	c = 00h: Blink display is repeated until when c = 01h – FFh or Initialize command is specified, and the command/data execution is continued during display blinking.
	c = 01h – FFh: Blink display is repeated 1 – 255 times, and the command/data execution is stopped. After display blinking is ended, return to normal display and command/data execution is re-started.

This command does not affect to Display Memory.

7.4.17 <Function 40h> US (a n p (Screen Saver)

Code:	1Fh 28h 61h 40h p
	p: Screen Saver mode
Definable area:	00h ≤ p ≤ 04h
	p = 00h: Display Power OFF (Power save mode)
	p = 01h: Display Power ON
	p = 02h: All dot OFF
	p = 03h: All dot ON
	p = 04h: Repeat blink display with Normal and Reverse display (Normal: 2s, Reverse: 2s)
Function:	Control Power ON or OFF, and start Screen Saver mode.
	p=00h – 01h: Control Power ON or OFF. This setting is applied until this command is re-specified.
	p=02h – 04h: Start Screen Saver mode. This setting is canceled if next any data is inputted during Screen Saver mode, and return to the previous display condition before Screen Saver mode specified.

7.4.18 US (f n [parameter] (Bit image display group)

Code: 1Fh 28h 66h n p1 ... pn
 n: Function No.
 p1 ... pn: Parameter
 Function: Execute processing of bit image data.

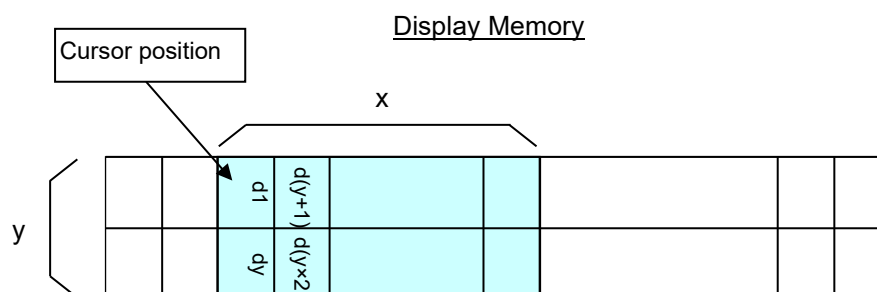
n	Function No.	Function
10h	Function 10h	Downloaded bit image display
11h	Function 11h	Real-time bit image display

7.4.19 <Function 11h> US (f n xL xH yL yH g d(1)...d(k) (Real-time bit image display)

Code: 1Fh 28h 66h 11h xL xH yL yH g d(1)...d(k)
 xL: Bit image X size, lower byte (by 1 dot)
 xH: Bit image X size, upper byte (by 1 dot)
 yL: Bit image Y size, lower byte (by 8 dots)
 yH: Bit image Y size, upper byte (by 8 dots)
 g: Image = 01h (Fixed)
 d(1) – d(k): Image data (see below)

Definable area: $0001h \leq (xL + xH \times 100h) \leq 0200h$
 $0001h \leq (yL + yH \times 100h) \leq 0002h$
 $g = 01h$
 $00h \leq d \leq FFh$

Function: $k = x \times y \times g$
 Display the bit image data inputted on the cursor position real-time.
 Cursor position will not change.
 If bit image exceeds the bounds of the current window, only the portion within the currently-selected window is displayed.
 If Display position or display size etc., are outside the definable area, the command is cancelled at the point where the error is detected, and the remaining data is treated as standard data.



7.4.20 <Function 10h> US (f 10h m aL aH aE ySL ySH xL xH yL yH g (Downloaded bit image display)

Code: 1Fh 28h 66h 10h m aL aH aE ySL ySH xL xH yL yH g

m: Select bit image data memory

aL: Bit image data definition address, lower byte

aH: Bit image data definition address, upper byte

aE: Bit image data definition address, extension byte

ySL: Bit image defined Y size, lower byte (by 8 dots)

ySH: Bit image defined Y size, upper byte (by 8 dots)

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

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

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

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

g: Image information = 1 (fixed)

Definable area: m = 01h

$$000000h \leq (aL + aH \times 100h + aE \times 10000h) \leq 07FFFFh$$

$$0000h \leq (ySL + ySH \times 100h) \leq FFFFh$$

$$0001h \leq (xL + xH \times 100h) \leq 0200h$$

$$0001h \leq (yL + yH \times 100h) \leq 0002h$$

g = 01h

Function: Display, at the cursor position, the bit image defined in FROM.
Cursor position does not change.

Select FROM bit image by select bit image data memory 'm'.

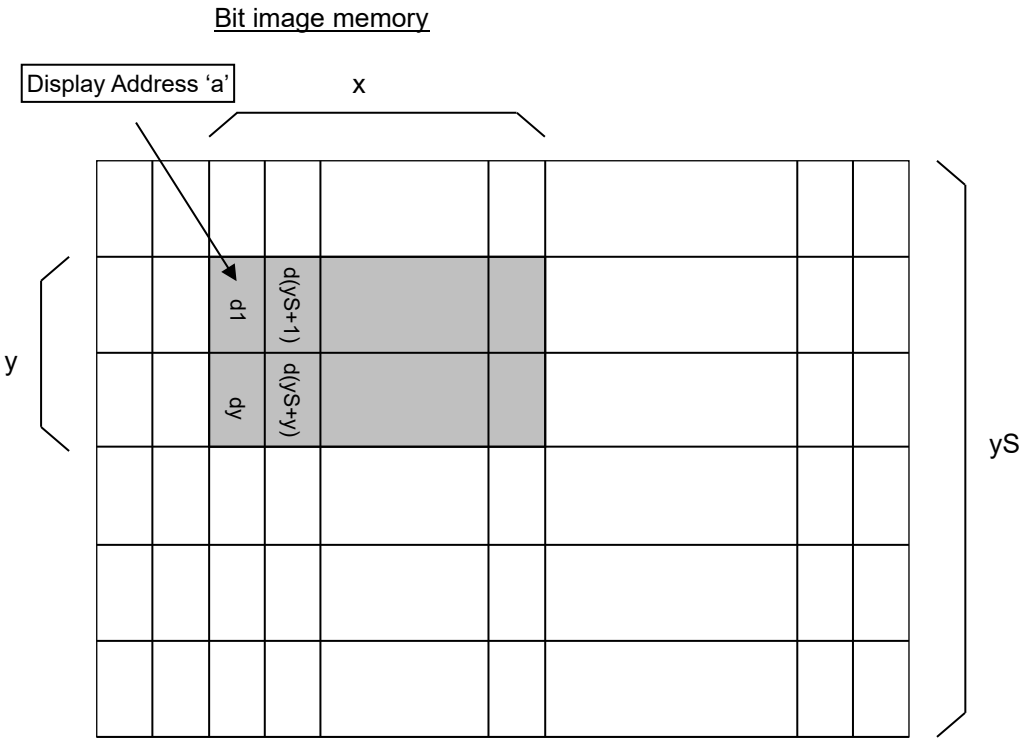
Set bit image defined Y size to the same Y size of the bit image defined in memory.

A portion of the defined bit image can be displayed by setting bit image display Y size less than defined bit image Y size, or by changing bit image display X size and/ or bit image data definition address.

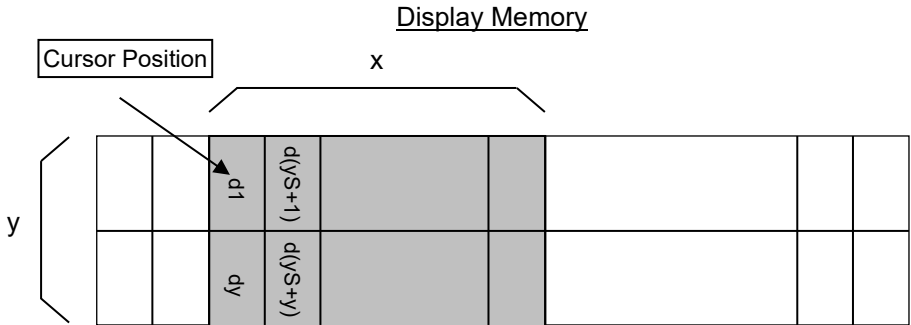
If the bit image extends beyond the currently-selected window, only the portion within the current window is displayed.

When the bit image is being written to the Display Memory, if the bit image memory area is exceeded, undefined data is displayed.

Refer to "7.4.34 FROM bit image definition" for definition method.



↓ Bit image data write



7.4.21 US (d n [parameter] (Dot unit command group)

Code: 1Fh 28h 64h n p1 ... pn
 n: Function No.
 p1, ..., pn: Parameter
 Function: Dot unit display bit image data or character.

n	Function No.	Function
20h	Function 20h	Dot unit downloaded bit image display
21h	Function 21h	Dot unit real-time bit image display
30h	Function 30h	Dot unit character display

7.4.22 <Function 20h> US (d 20h xPL xPH yPL yPH m aL aH aE ySL ySH xOL xOH yOL yOH xL xH yL yH g (Dot unit downloaded bit image display)

Code: 1Fh 28h 64h 20h xPL xPH yPL yPH m aL aH aE ySL ySH xOL xOH yOL yOH xL xH yL yH g

xPL: Display position x, lower byte (by 1 dot)
 xPH: Display position x, upper byte (by 1 dot)
 yPL: Display position y, lower byte (by 1 dot)
 yPH: Display position y, upper byte (by 1 dot)
 m: Image data Display Memory select
 aL: Bit image data definition address, lower byte
 aH: Bit image data definition address, upper byte
 aE: Bit image data definition address, extension byte
 ySL: Bit image defined, Y size, lower byte (by 8 dots)
 ySH: Bit image defined, Y size, upper byte (by 8 dots)
 xOL: Image data offset x, lower byte (by 1 dot)
 xOH: Image data offset x, upper byte (by 1 dot)
 yOL: Image data offset y, lower byte (by 1 dot)
 yOH: Image data offset y, upper byte (by 1 dot)
 xL: Bit image display X size, lower byte (by 1 dot)
 xH: Bit image display X size, upper byte (by 1 dot)
 yL: Bit image display Y size, lower byte (by 1 dot)
 yH: Bit image display Y size, upper byte (by 1 dot)
 g: Image information = 01h (fixed)

Definable area: $0000h \leq (xPL + xPH \times 100h) \leq 01FFh$
 $0000h \leq (yPL + yPH \times 100h) \leq 000Fh$
 $01h \leq m \leq 02h$
 m = 01h: FROM bit image
 m = 02h: Display Memory bit image

FROM bit image (m = 01h):

$000000h \leq (aL + aH \times 100h + aE \times 10000h) \leq 07FFFFh$
 $0000h \leq (ySL + ySH \times 100h) \leq FFFFh$
 $0000h \leq (xOL + xOH \times 100h) \leq FFFFh$
 $0000h \leq (yOL + yOH \times 100h) \leq FFFFh$
 $0001h \leq (xL + xH \times 100h) \leq 0200h$
 $0001h \leq (yL + yH \times 100h) \leq 0010h$

Display Memory bit image (m = 02h):

$(aL + aH \times 100h + aE \times 10000h) = 000000h$
 $(ySL + ySH \times 100h) = 0000h$
 $0000h \leq (xOL + xOH \times 100h) \leq 01FFh$
 $0000h \leq (yOL + yOH \times 100h) \leq 000Fh$
 $0001h \leq (xL + xH \times 100h) \leq 0200h$
 $0001h \leq (yL + yH \times 100h) \leq 0010h$

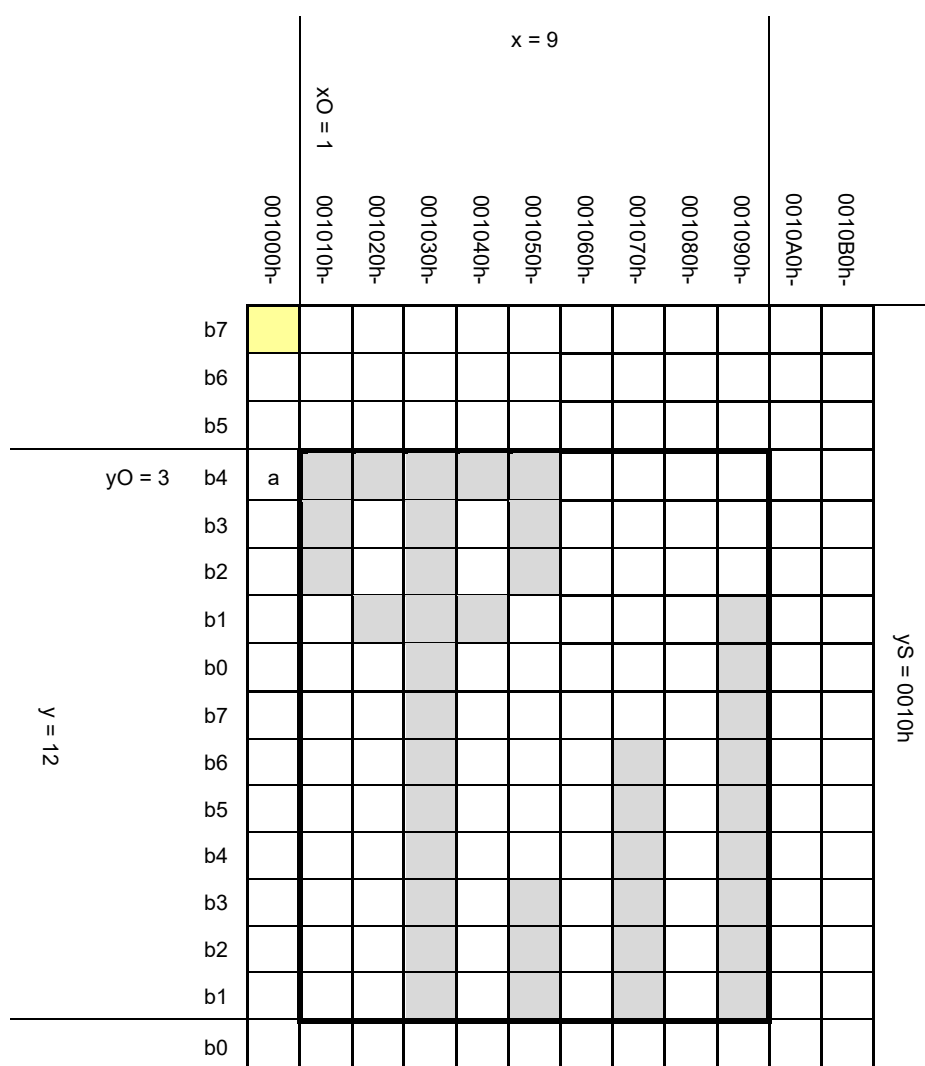
g = 01h

Function: Display the bit image defined in Display Memory at the specified (x, y) position. Display position, display size, and image data offset are specified in unit of 1 dot. If bit image exceeds the bounds of the current window, only the portion within the currently-selected window is displayed. If Display position or image size, etc. are outside the definable area, the command is cancelled at the point where the error is detected, and the remaining data is treated as standard data.

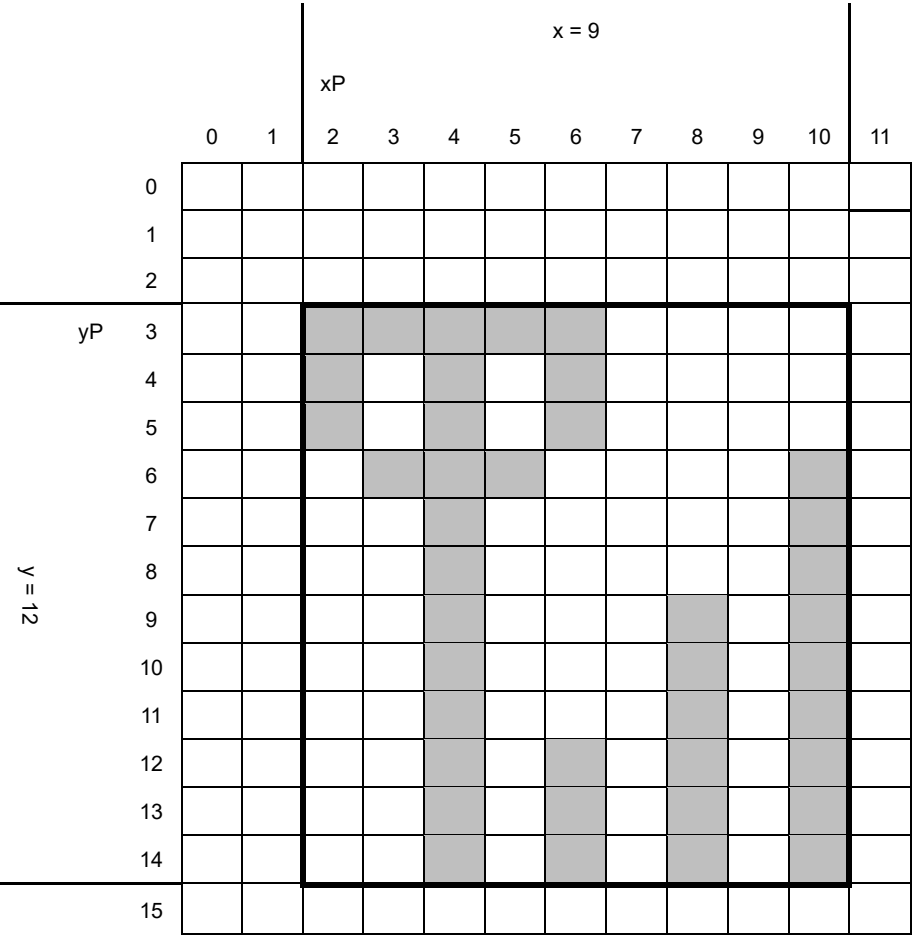
Example:

Display position xP = 2 (02h), yP = 3 (03h)
 Defined image data m = 01h, a = 001000h
 Defined image, Y size yS = 0010h
 Offset xO = 1 (01h), yO = 3 (03h)
 Display size x = 9 (09h), y = 12 (0Ch)

FROM Bit Image memory



Display Memory



7.4.23 <Function 21h> US (d 21h xPL xPH yPL yPH xL xH yL yH g d(1)...d(k)

(Dot unit real-time bit image display)

Code:	1Fh 28h 64h 21h xPL xPH yPL yPH xL xH yL yH g d(1)...d(k)
xPL:	Display position x, lower byte (by 1 dot)
xPH:	Display position x, upper byte (by 1 dot)
yPL:	Display position y, lower byte (by 1 dot)
yPH:	Display position y, upper byte (by 1 dot)
xL:	Bit image display X size, lower byte (by 1 dot)
xH:	Bit image display X size, upper byte (by 1 dot)
yL:	Bit image display Y size, lower byte (by 1 dot)
yH:	Bit image display Y size, upper byte (by 1 dot)
g:	Display information = 1 (fixed)
d(1) – d(k):	Bit image data (see below)
Definable area:	$0000h \leq (xPL + xPH \times 100h) \leq 01FFh$ $0000h \leq (yPL + yPH \times 100h) \leq 000Fh$ $0001h \leq (xL + xH \times 100h) \leq 0200h$ $0001h \leq (yL + yH \times 100h) \leq 0010h$ $g = 01h$ $00h \leq d \leq FFh$
Function:	Display the bit image data at the specified (x, y) position in real-time. Display position and display size are specified in units of 1 dot. If bit image exceeds the bounds of the current window, only the portion within the currently-selected window is displayed. If Display position or display size are outside the definable area, the command is cancelled at the point where the error is detected, and the remaining data is treated as standard data.
Example:	xP = 2 (02h), yP = 1 (01h), Display size x = 8 (08h), y = 14 (0Eh)

Image data:

b7	d1	d3	d5	d7	d9	d11	d13	d15
b6								
b5								
b4								
b3								
b2								
b1								
b0								
b7	d2	d4	d6	d8	d10	d12	d14	d16
b6								
b5								
b4								
b3								
b2								
b1								
b0								

Display Memory:

		x=8											
		xP											
		0	1	2	3	4	5	6	7	8	9	10	11
y=14	0												
	yP 1			d1	d3	d5	d7	d9	d11	d13	d15		
	2												
	3												
	4												
	5												
	6												
	7												
	8												
	9			d2	d4	d6	d8	d10	d12	d14	d16		
	10												
	11												
	12												
	13												
	14												
	15												

7.4.24 <Function 30h> US (d 30h xPL xPH yPL yPH m bLen d(1)...d(bLen) (Dot unit character display)

Code: 1Fh 28h 64h 30h xPL xPH yPL yPH m bLen d(1)...d(bLen)

xPL: Display position x, lower byte (by 1 dot)

xPH: Display position x, upper byte (by 1 dot)

yPL: Display position y, lower byte (by 1 dot)

yPH: Display position y, upper byte (by 1 dot)

m: -

bLen: Character data length

d(1) – d(bLen): Character data / reverse select

Definable area: $0000h \leq (xPL + xPH \times 100h) \leq 01FFh, FFFFh$

$0000h \leq (yPL + yPH \times 100h) \leq 000Fh$

m = 00h

$00h \leq bLen \leq FFh$

$00h \leq d \leq FFh$

d=10h: Reverse OFF

d=11h: Reverse ON

Function: Display the specified text characters at the specified (x, y) position.

Display position is specified in units of 1 dot.

For display position $(xPL + xPH \times 100h) = FFFFh$, write position continues from previous writes done using this command.

The current settings for character size and table type, etc. are used.

Font magnification setting is not used.

If character display exceeds the bounds of the current window, only the portion within the currently-selected window is displayed.

If Display position is outside the definable area, the command is cancelled at the point where the error is detected, and the remaining data is treated as standard data.

Example: Display position xP = 2 (02h), yP = 3 (03h), 6 × 8 dot character "AB"

Display Memory:

		xP													
		0	1	2	3	4	5	6	7	8	9	10	11	12	13
yP	0														
	1														
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														
	10														
	11														

7.4.25 US (g n [parameter] (Font command group)

Code: 1Fh 28h 67h n p1 p2
 n: Function No.
 p1, p2: Parameter
 Function: Font width and Font magnification settings.

n	Function No.	Function
03h	Function 03h	Font width
40h	Function 40h	Font magnification

7.4.26 <Function 03h> US (g n w (Font width)

Code: 1Fh 28h 67h 03h w
 w: Font width setting
 Definable area: $00h \leq w \leq 03h$
 w = 00h: Fixed character width 1 (1 dot space on right side)
 w = 01h: Fixed character width 2 (1 dot space on each right and left side)
 w = 02h: Proportional character width 1 (1 dot space in right side)
 w = 03h: Proportional character width 2 (1 dot space in each right and left side)

Default: w = 01h

Function: Sets the font (character) 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.

Note: When 8×16 or 16×16 font is selected, this command doesn't act.

7.4.27 <Function 40h> US (g n x y (Font magnification)

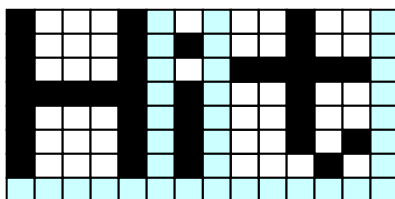
Code: 1Fh 28h 67h 40h x y
 x: X magnification factor
 y: Y magnification factor

Definable area: $01h \leq x \leq 04h$
 $01h \leq y \leq 02h$

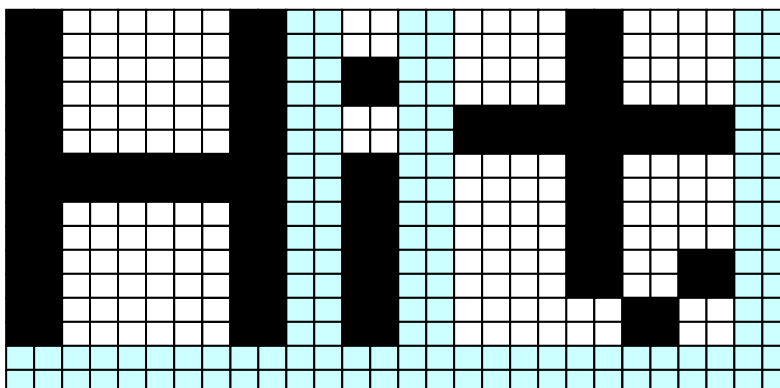
Default: x = 01h
 y = 01h

Function: Set character magnification “x” times to the right and “y” times downward.
 Character magnification includes the space specified by Font width command.

(x = 1, y = 1)



(x = 2, y = 2)

**7.4.28 US (w n [parameter] (Window command group)**

Code: 1Fh 28h 77h n p1 ... pn
 n: Function No.
 p1... pn: Parameter

Function: Window / screen commands

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

7.4.29 <Function 01h> US (w n a (Current window select)

Code: 1Fh 28h 77h 01h a
 a: Current window number

Definable area: $00h \leq a \leq 04h$
 a = 00h: Base-Window
 a = 01h – 04h: User-Window

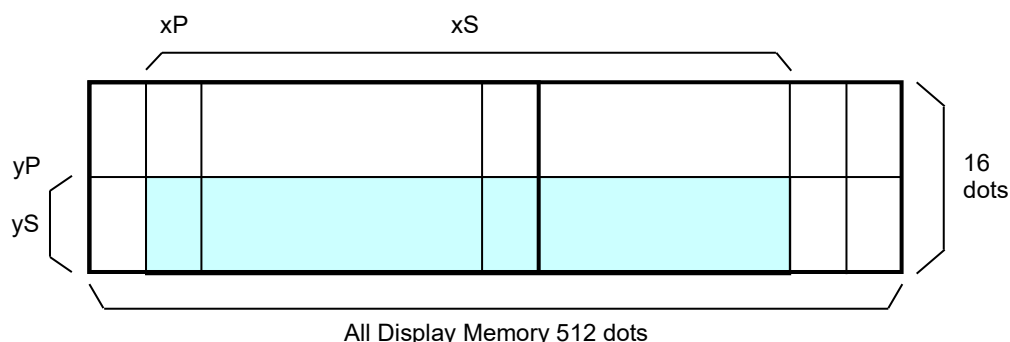
Function: Select current window.
 This command is ignored for User Windows with undefined window numbers.

7.4.30 <Function 02h> US (w n a b[xPL xPH yPL yPH xSL xSH ySL ySH] define / cancel)

(User Window

Code:	1Fh 28h 77h 02h a b [xPL xPH yPL yPH xSL xSH ySL ySH]
a:	Definable window No. (No.1 – 4)
b:	Define or Cancel
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 8dot)
yPH:	Top position of window upper byte (by 8dot)
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 8dot)
ySH:	Y size of window upper byte (by 8dot)
Definable area:	$01h \leq a \leq 04h$ $00h \leq b \leq 01h$ b = 00h: Cancel b = 01h: Define $0000h \leq (xPL + xPH \times 100h) \leq 01FFh$ $0000h \leq (yPL + yPH \times 100h) \leq 0001h$ $0001h \leq (xSL + xSH \times 100h) \leq (0200h - (xPL + xPH \times 100h))$ $0001h \leq (ySL + ySH \times 100h) \leq (0002h - (yPL + yPH \times 100h))$
Function:	Define or cancel User-Window Display contents are not changed by this command. – User-Window define (b = 01h): Specify User-Window number, window position, and window size. Window position and Window size are specified in units of one block (1 × 8 dot). Up to 4 User-Windows can be defined. The cursor position for the window is initialized to top left (X = 0, Y = 0). – User-Window cancel (b = 00h): For User-Window cancel, window range parameters [xPL - ySH] are not used. If the currently-selected window is cancelled, the Base-Window becomes the currently-selected window.

If any of “a”, “b”, “xP”, “yP”, “xS”, or “yS” are outside the definable area, the command is cancelled at that point and the following data is treated as standard data.



7.4.31 <Function 10h> US (w n a (Write screen mode select)

Code: 1Fh 28h 77h 10h a
 a: Write screen mode

Definable area: $00h \leq a \leq 01h$
 a = 00h: Display screen mode
 a = 01h: All screen mode

Default: a = 00h

Function: Select the Write screen mode. **This setting is only applicable for Base-Window.**

Display screen mode:
 Display action is valid within area of either Display area or Hidden area, depending on cursor position.

All screen mode:
 Display action is valid over the entire Display Memory.

For details, refer to “**6.4 Write screen mode**”.

7.4.32 WINx (Window select shortcut)

Code: n
 n: Window No. (WINx)

Definable area: $10h \leq n \leq 14h$

Function: Select current window (1-byte command).
 Refer to “**7.4.29 Current window select**” for more details.

WINx	Function
WIN0 (10h)	Select Base Window
WIN1 (11h)	Select User Window 1
WIN2 (12h)	Select User Window 2
WIN3 (13h)	Select User Window 3
WIN4 (14h)	Select User Window 4

7.4.33 FS | M m d1...d6 (Memory re-write mode)

Code: 1Ch 7Ch 4Dh m d1 ... d6

Definable area: m = D0h
 d1...d6 = “MODEIN”

Function: Shift to “Memory re-write mode” from “Normal mode”.
 Memory re-write mode is used for definition of bit image, and for changing the firmware and fonts, etc in FROM that cannot be changed in normal mode.
 Do not use this command unless necessary.

7.4.34 B k n d(1)...d(32768) (FROM bit image definition)

Code: 42h DBh n d(1)...d(32768)
 n: bank (32KB)
 d: bit image data

Definable area: $00h \leq n \leq 0Fh$
 $00h \leq d \leq FFh$

Function: Define user bit image to the FROM. Definition is performed in units of one bank.
 This command is only valid in Memory re-write mode.

n	Address
00h	00000h – 07FFFh
01h	08000h – 0FFFFh
02h	10000h – 17FFFh
03h	18000h – 1FFFFh
04h	20000h – 27FFFh
05h	28000h – 2FFFFh
06h	30000h – 37FFFh
07h	38000h – 3FFFFh
08h	40000h – 47FFFh
09h	48000h – 4FFFFh
0Ah	50000h – 57FFFh
0Bh	58000h – 5FFFFh
0Ch	60000h – 67FFFh
0Dh	68000h – 6FFFFh
0Eh	70000h – 77FFFh
0Fh	78000h – 7FFFFh

7.4.35 S k d1 d2 d3 d4 dm (FROM SUM compare)

Code: 53h ACh d1 d2 d3 d4 dm
 d1: value of comparison SUM $\times 01000000h$
 d2: value of comparison SUM $\times 010000h$
 d3: value of comparison SUM $\times 0100h$
 d4: value of comparison SUM $\times 01h$
 dm: Dummy data

Definition area: $00h \leq d1, d2, d3, d4, dm \leq FFh$

Function: Compare SUM of FROM re-write data (FROM bit image definition data) with d1 – d4.
 — If SUM is equal to d1 – d4, error message is not displayed, and BUSY signal at writing of dm data is normal length.
 — If not equal, error message is displayed, and BUSY signal at writing of dm data is longer.
 — Value of SUM is initialized to 0 when entering Memory re-write mode.
 This command is only valid in Memory re-write mode.

7.4.36 E k (Memory re-write mode END)

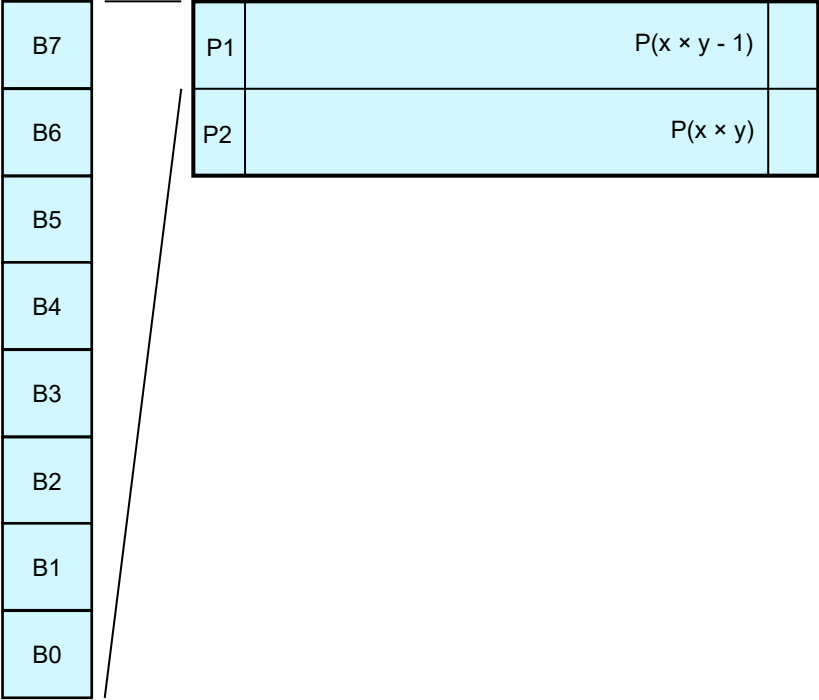
Code: 45h BAh

Function: End Memory re-write mode and return to normal mode.
 Settings return to default values, as per Initialize Display command.
 This command is only valid in Memory re-write mode.

7.5 Bit image data format

The Bit image consists of the data for image size (x × y) as follows;

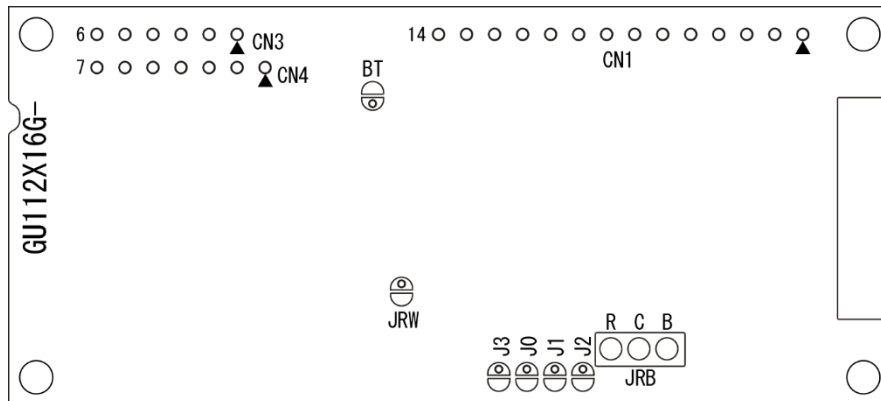
Data	Pattern position
d (1)	P1
d (2)	P2
.	.
.	.
.	.
d (x × y)	P(x × y)



8 Setup

8.1 Jumper

No.	Function	Default
J0	Baud Rate select	OPEN
J1		OPEN
J2	Reserved (Do not change)	OPEN
J3		OPEN
JRB	Signal select of Pin#3 of 14 through-holes for Parallel I/F	OPEN



Solder side (back of VFD) view.

J2, J3, BT, JRW: Factory use only.

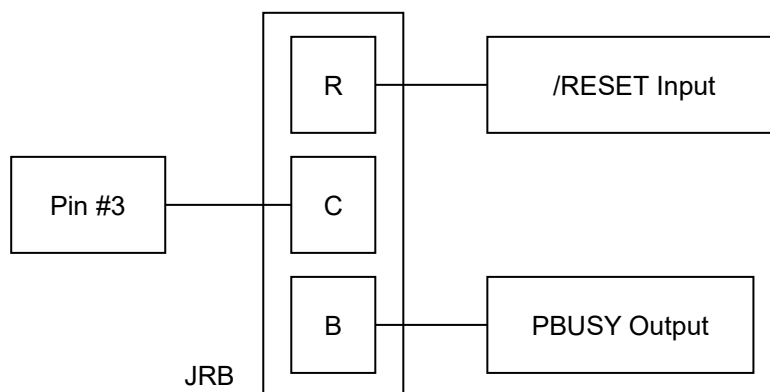
▲ : pin 1 mark.

8.1.1 Baud rate select (for serial interface)

J0	J1	Baud rate
OPEN	OPEN	38,400bps
SHORT	OPEN	19,200bps
OPEN	SHORT	9,600bps
SHORT	SHORT	115,200bps

8.1.2 Signal select of Pin#3 of 14 through-holes for Parallel I/F

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



9 Connector

9.1 Parallel interface connector (Through-holes) CN1

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

*1 Pin #3 can be set to /RESET or PBUSY terminal, selectable by Jumper. Refer to “8.1 Jumper”.

*2 Factory use only.

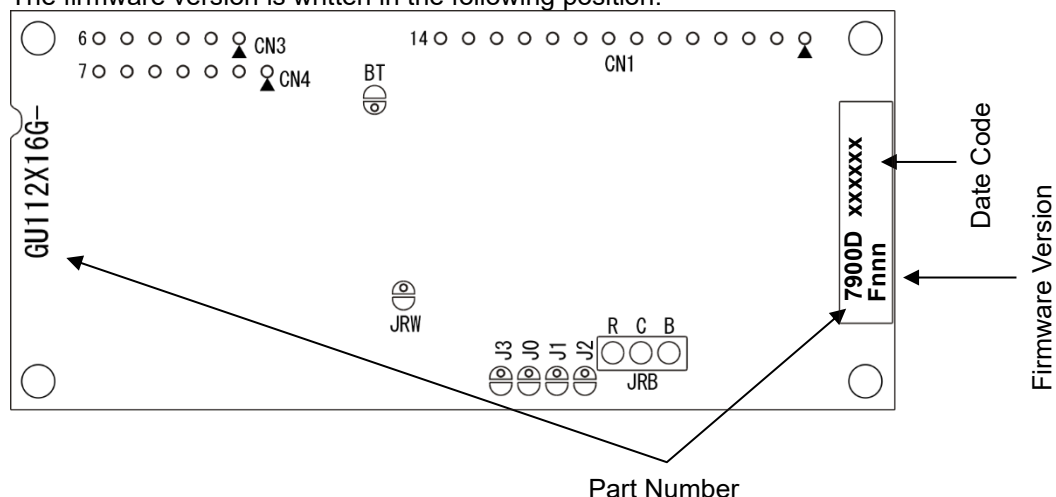
9.2 Serial interface connector (Through-holes) CN3, CN4

9.2.1 Asynchronous serial interface

Pin No.	Signal name		Function	Direction
	CN3	CN4		
1	VCC	VCC	Power supply	Input
2	SIN	SIN	Data receive	Input
3	GND	GND	Ground	Input
4	SBUSY	SBUSY	Display busy	Output
5	NC	NC	No Connection	-
6	/RESET	/RESET	Reset	Input
7	-	NC	No Connection	-

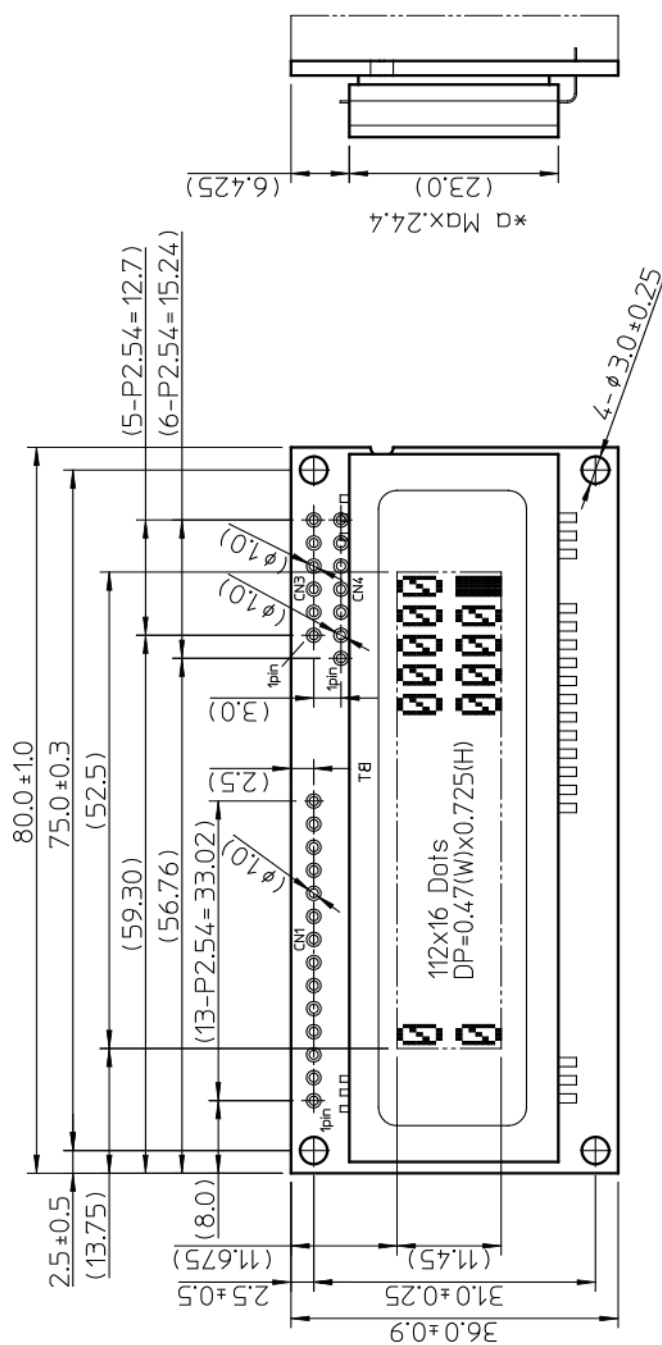
10 Firmware Version Notation

The firmware version is written in the following position.

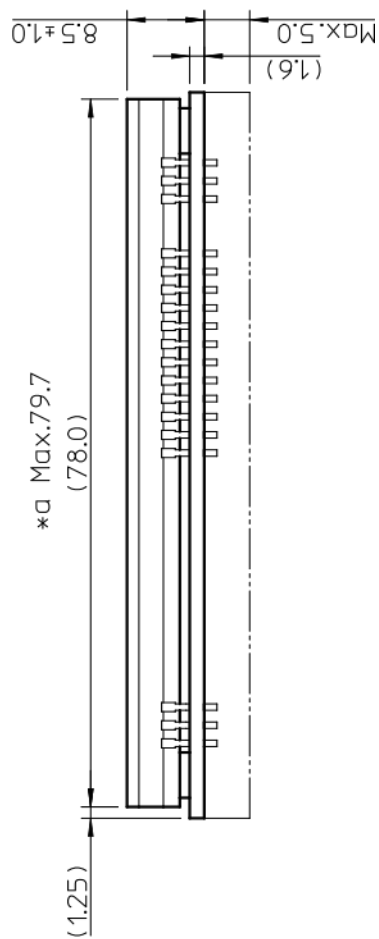


Solder side (back of VFD) view.

11 Outline Drawing



():Reference only
Unit:mm
*a Included extra frit glass



DS-2153-0100-00

