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**Vacuum Fluorescent Display  
Module  
Specification**

Model: CU24063-Y1A

Specification No:	DS-1552-0001-01
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# 1 General Description

## 1.1 Scope

This specification covers the operation and operating requirements of the Vacuum Fluorescent Display (VFD) module CU24063-Y1A.

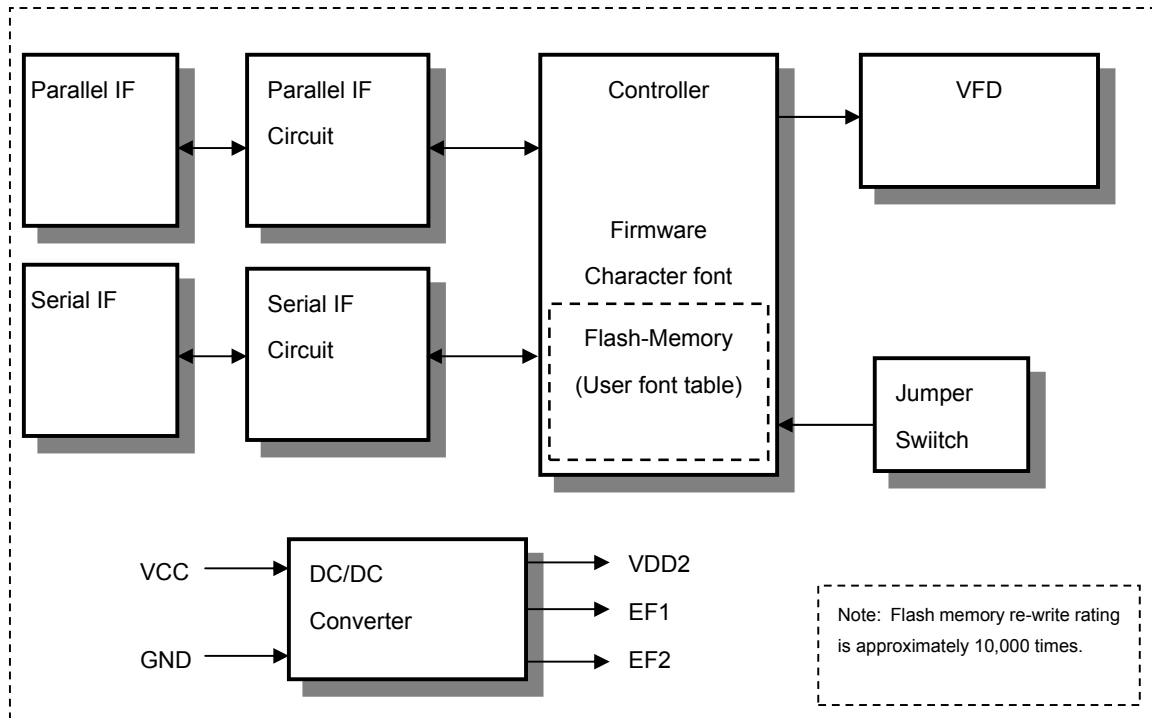
## 1.2 Features

- Functions
  - Character highlight
  - Easy to use ASCII commands and fonts.
  - Character Magnification
  - Screen Saver
  - Blink Action Command(Display or Character)
- Display
  - Vivid green indication
  - Wider viewing angle
  - High Brightness (Typ. 2000 cd/m<sup>2</sup>)
  - Brightness Levels: 8 levels of overall display brightness with 8 relative levels for each individual 5×8 Matrix
- Font
  - New 5×8 Matrix Character Font
  - Many International Font Sets
  - RAM User-Definable Characters (16 characters)
  - FROM User-Definable Characters (224 characters)
  - 144 (24×6) Characters on the compact display area
- Interface
  - C MOS Signal level
  - Parallel Interface: i80 type 8bit bus
  - Serial Interface: either Synchronous or Asynchronous is selected by jumper setting
- Operation
  - DC 5V input
  - Wide Operation Temperature Range (-40 ~ +85°C)

### 1.3 Hardware Configuration

The module consists of:  
 24 x 6 character Display (VFD)  
 Refresh RAM  
 Character generator  
 DC/DC converter (Supply all necessary power for VFD)  
 Display controller  
 All necessary control logic circuits

#### 1.3.1 Block Diagram



## 2 Electrical Specification

### 2.1 Absolute Maximum Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power Supply Voltage	$V_{CC}$	-0.3	-	+6.0	$V_{DC}$
Logic Supply Voltage D0-D7, /WR, SIN, SCK, /RESET	$V_{IN}$	-0.3	-	$V_{CC}+0.3$	$V_{DC}$

### 2.2 Electrical Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power Supply Voltage	$V_{CC}$	4.75	5.0	5.25	$V_{DC}$

### 2.3 Electrical Characteristics

Measuring Conditions: Ambient temperature = 25 °C,  $V_{CC} = 5.0 V_{DC}$

Parameter		Symbol	Min.	Typ.	Max.	Unit	Condition	Note
'L' Level Logic Input Current	D0-D7, /WR, /RESET	$I_{IL1}$	-	-	-0.15	mA	$V_{IN} = 0V$	-
	SIN, SCK	$I_{IL2}$	-	-	-0.55	mA	$V_{IN} = 0V$	-
'H' Level Logic Input Current	D0-D7, SIN, SCK	$I_{IH1}$	-	-	5.0	$\mu A$	$V_{IN} = 5V$	-
	/WR, /RESET	$I_{IH2}$	-	-	0.25	$\mu A$	$V_{IN} = 5V$	-
'L' Level Logic Input Voltage	D0-D7, /WR, SIN, SCK	$V_{IL1}$	0	-	$0.2 \times V_{CC}$	$V_{DC}$	-	-
	/RESET	$V_{IL2}$	0	-	0.8	$V_{DC}$	-	-
'H' Level Logic Input Voltage	D0-D7, /WR, /RESET, SIN, SCK	$V_{IH}$	$0.8 \times V_{CC}$	-	$V_{CC}$	$V_{DC}$	-	-
'L' Level Logic Output Voltage	PBUSY	$V_{OL1}$	-	-	0.1	$V_{DC}$	$I_{OL} = 50\mu A$	-
	SBUSY	$V_{OL2}$	-	-	0.45	$V_{DC}$	$I_{OL} = 200\mu A$	-
'H' Level Logic Output Voltage	PBUSY	$V_{OH1}$	$V_{CC}-0.1$	-	-	$V_{DC}$	$I_{OH} = -50\mu A$	-
	SBUSY	$V_{OH2}$	$V_{CC}-0.5$	-	$V_{CC}$	$V_{DC}$	$I_{OH} = -200\mu A$	-
Power Supply Current		$I_{CC1-1}$	-	320	400	$mA_{DC}$	Brightness 100%	(1)
		$I_{CC2-1}$	-	260	330	$mA_{DC}$	Brightness 100%	(2)
		$I_{CC1-2}$	-	420	530	$mA_{DC}$	Brightness 200%	(1)
		$I_{CC2-2}$	-	310	390	$mA_{DC}$	Brightness 200%	(2)
		$I_{CC3}$	-	25	35	$mA_{DC}$	Power Save Mode	(3)
Power Consumption			-	1.6	2.0	W	Brightness 100%	(1)
			-	2.1	2.65	W	Brightness 200%	(1)

(1)  $I_{CC1}$  shows the current when all dots in the display are on.

(2)  $I_{CC2}$  shows the current when all dots in the display are off.

(3)  $I_{CC3}$  shows the current with the Power Save Mode. Power save mode is one of the options of "Screen saver" command. Please refer to "Screen saver" command at Page 31.

**Note: A slow start power supply may cause erroneous operations.  $I_{CC}$  can be approximately twice the specified supply current at power on.**

### 3 Optical Specifications

Luminance: Minimum 350  $cd/m^2$ , typically 1000  $cd/m^2$  (100% brightness)  
Typically 2000  $cd/m^2$  (200% brightness)

Color of illumination: Green (Blue Green)

#### 4 Environmental Specifications

Operating temperature:	-40 to +85 °C
Storage temperature:	-40 to +85 °C
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, 30 minutes, X-Y-Z (non-operating)
Shock:	392m/s <sup>2</sup> (40G) 9ms X-Y-Z, 3 times each direction (non-operating)

#### 5 Physical Specifications

Number of characters:	144 (24 characters x 6 lines)
Matrix format:	5 x 8 dots
Display area:	70.38 x 22.69 mm (X x Y)
Character size:	2.07 x 3.34 mm (X x Y)
Character pitch:	2.97 mm
Line pitch:	3.87 mm
Dot size:	0.334 x 0.33 mm (X x Y)
Dot pitch:	0.434 x 0.43 mm (X x Y)
Weight:	Approximately 56 g

#### 6 Applicable Specifications

Applicable reliability spec:	TT-99-3102
Applicable production spec:	TT-98-3413

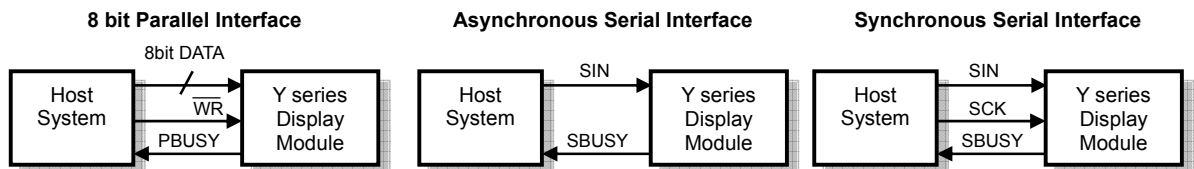
#### 7 Interface

C MOS Signal level

Parallel Interface: i80 type 8bit bus

Serial Interface: Either Synchronous or Asynchronous is selected by jumper setting.

**The module cannot receive both serial and parallel data at the same time.**



**Monitoring the busy line is strongly recommended, because it prevents data loss and minimizes a waiting time to write next data.**



## 7.1 Parallel Interface

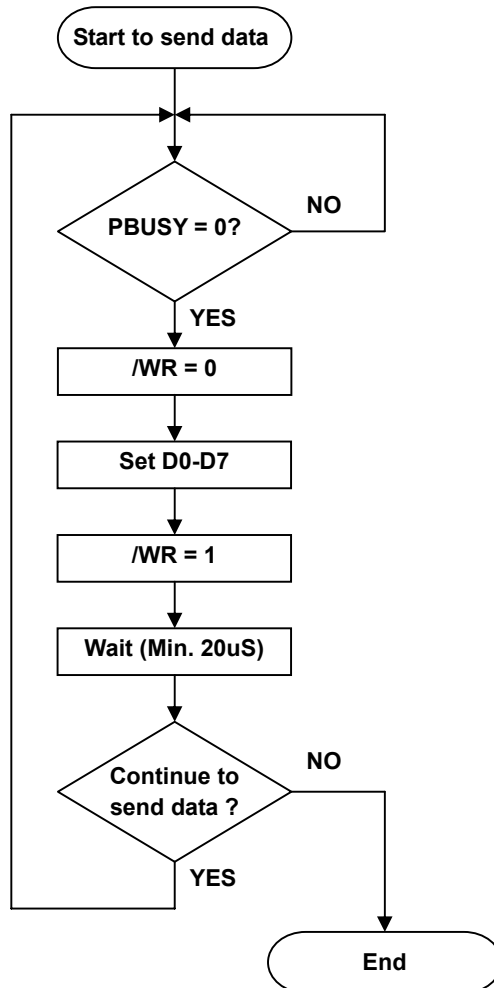
### 7.1.1 Basic Operation

Data (D0-D7) has to be set prior to a rising edge of /WR line, and the data is clocked in on the rising edge of /WR line.

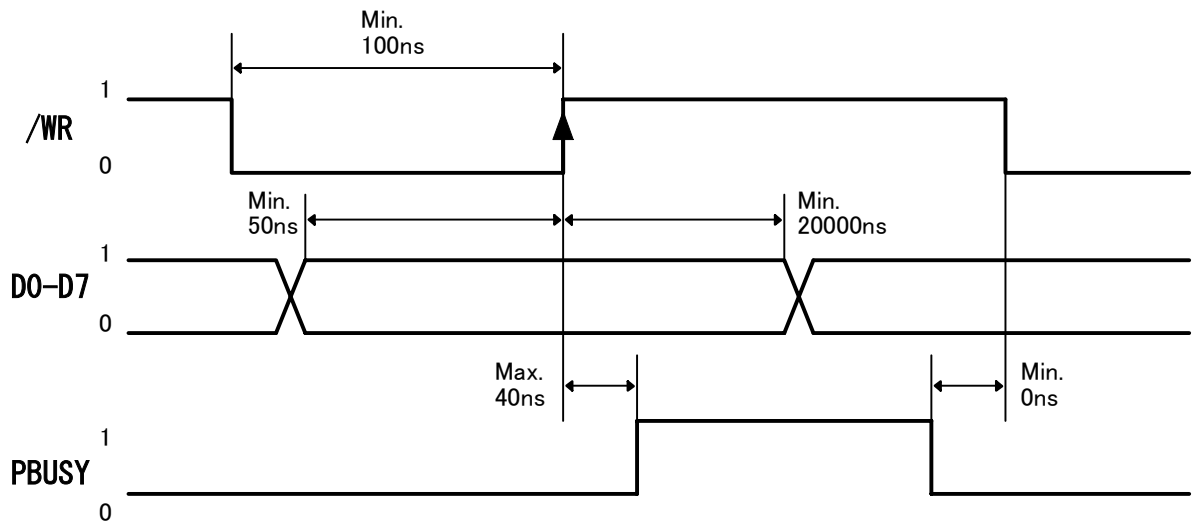
During data execution, the parallel busy line is high (PBUSY=1).

Writing data when PBUSY = 1 causes data loss, so please write data when PBUSY = 0.

### 7.1.2 Flowchart



### 7.1.3 Interface Timing



**Note:** Monitoring the parallel busy line (PBUSY) is strongly recommended, because it prevents data loss and minimizes a waiting time to write next data. Please write data when PBUSY = 0.

## 7.2 Serial Interface

### 7.2.1 Basic Operation

#### Default setting: Asynchronous Serial Interface (Baud rate = 38,400bps)

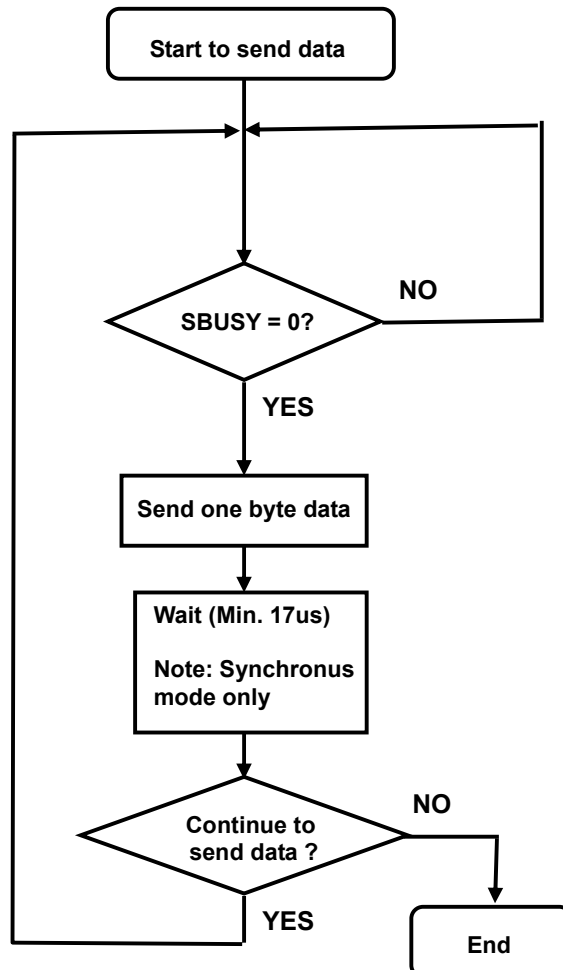
Either Synchronous or Asynchronous Serial Interface is selectable by jumper setting. Refer to "8 Jumper Setting" at page 12.

The capacity of the receiving buffer is 64 bytes. The relationship between SBUSY and the receiving buffer is as follows;

	Remaining space of receiving buffer
SBUSY 0 -> 1	16 byte or less
SBUSY 1 -> 0	24 byte or more

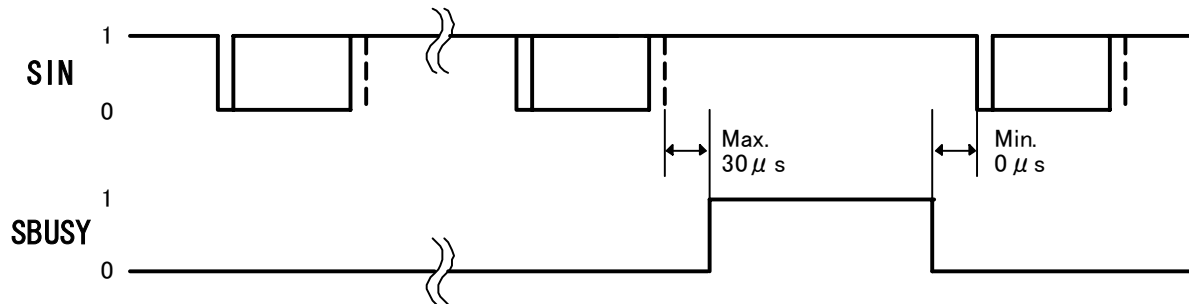
Writing data when SBUSY = 1 may cause data loss, so please write data when SBUSY = 0.

### 7.2.2 Flowchart



### 7.2.3 Asynchronous Serial Interface Timing

#### 7.2.3.1 Data write



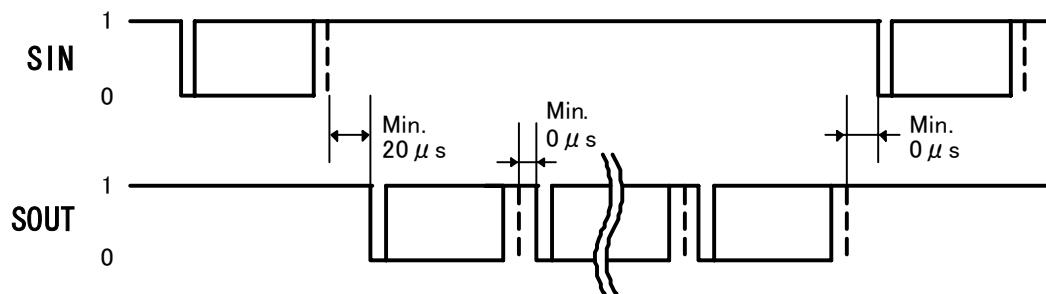
Protocol:

<b>Baud rate</b>	9,600 ~ 115,200bps (Selectable by Jumper) Default: 38,400bps
<b>Parity</b>	None
<b>Format</b>	Start (1bit) + Data (8bit) + Stop (1bit)
<b>Handshake</b>	SBUSY

**Note:** Monitoring the serial busy line (SBUSY) is strongly recommended, because it prevents data loss and minimizes a waiting time to write next data. Please write data when SBUSY = 0.

#### 7.2.3.2 Data read

This is used for Read states information command only.

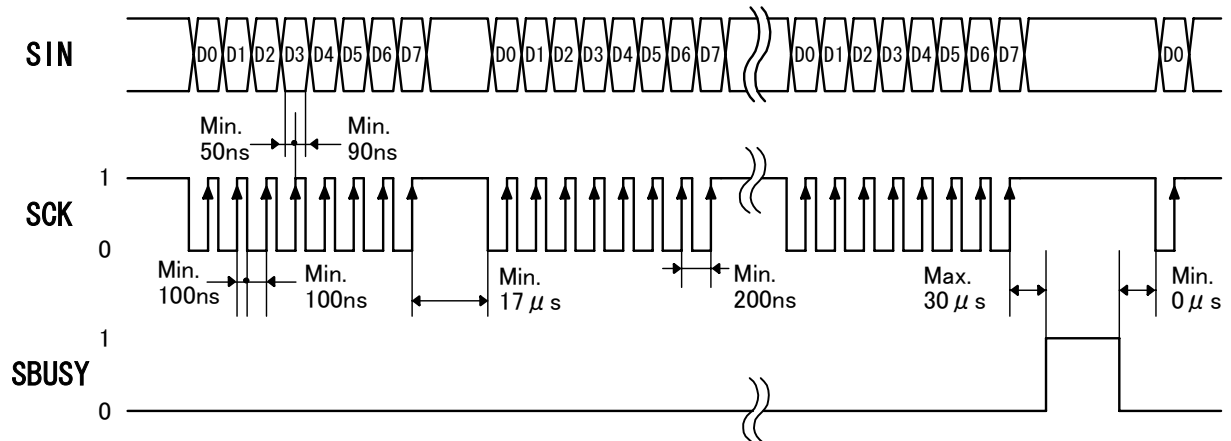


Protocol:

<b>Baud rate</b>	9,600 ~ 115,200bps (Selectable by Jumper) Default: 38,400bps
<b>Parity</b>	None
<b>Format</b>	Start (1bit) + Data (8bit) + Stop (1bit)
<b>Handshake</b>	None

**Note:** Output data is transferred collectively from a VFD module, so a receiving buffer may be required on a host system to prevent data loss.

### 7.2.4 Synchronous Serial Interface Timing

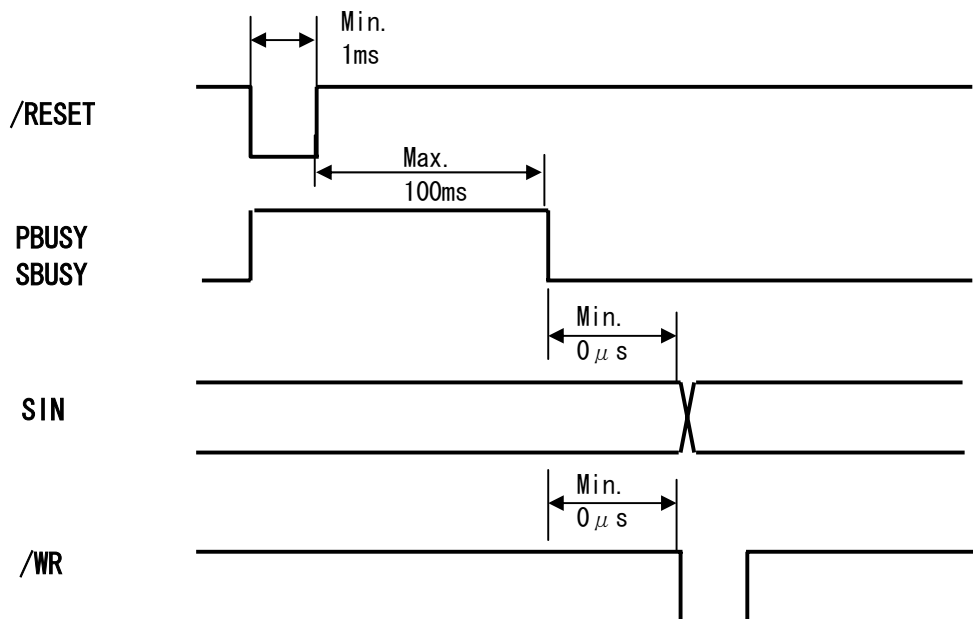


**Note:** Monitoring the serial busy line (SBUSY) is strongly recommended, because it prevents data loss and minimizes a waiting time to write next data. Please write data when SBUSY = 0.

### 7.3 Reset Timing

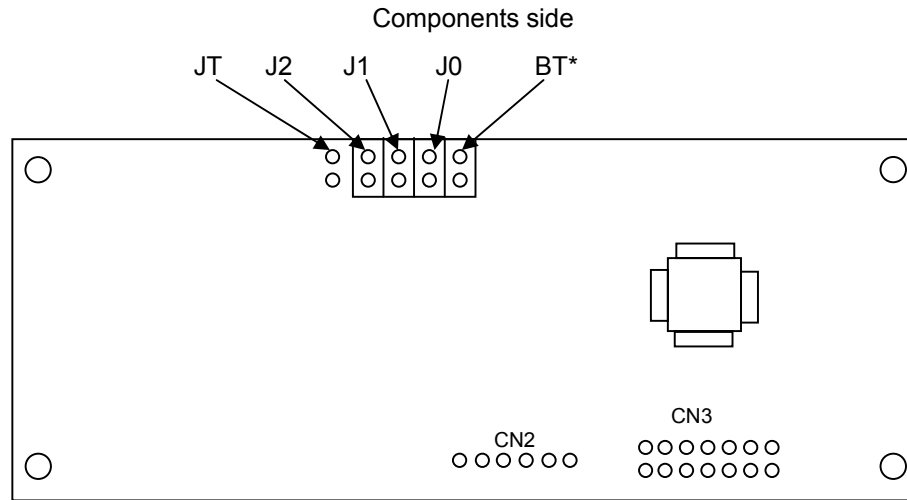
Reset pulse (active low) should be longer than 1ms.

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



## 8 Jumper Setting

### 8.1 Jumper location



Note: Jumper “BT” is for factory use only. **Please do not change.**

#### 8.1.1 Baud Rate Setting (for Asynchronous Serial Interface only)

Baud Rate	J0	J1
38,400bps (Default)	OPEN	OPEN
19,200bps	SHORT	OEPN
9,600bps	OPEN	SHORT
115,200bps	SHORT	SHORT

#### 8.1.2 Serial Synchronous / Asynchronous Interface Select

I/F	J2
Asynchronous serial I/F (Default)	OPEN
Synchronous serial I/F	SHORT

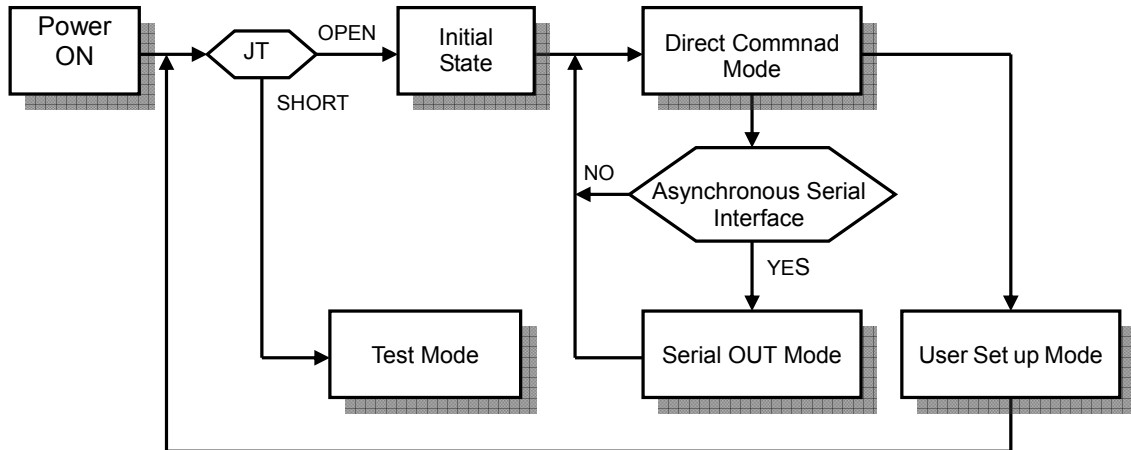
#### 8.1.3 Test Mode

Refer to “9.4 Test mode”.

Mode	JT
Direct Command Mode (Default)	OPEN
Test Mode	SHORT

## 9 Operating Mode

This module has the following operating modes which are selectable by commands or jumper setting.



### 9.1 Direct Command Mode

The module accepts data and all commands except “13.3.40 User setup mode end”, “13.3.41 Define FROM user font”, “13.3.42 Read status information”, “13.3.43 Display status information”, and “13.3.45 Serial OUT mode end”.

### 9.2 User Set up Mode

Under this mode, an on-board flash memory is accessible.

The module accepts only three commands: “13.3.40 User set up mode end”, “13.3.41 Define FROM user font” and “13.3.43 Display status information”.

### 9.3 Serial OUT Mode

Under this mode, status information is readable via Asynchronous Serial Interface.

The module accepts only two commands: “13.3.42 Read status information” and “13.3.45 Serial OUT mode end”.

### 9.4 Test mode

The module does not accept any commands but displays test-patterns. Test purpose only.

### 10 Font Table Configuration

This display's Font Table (20h-FFh) is configured as follows. The configuration can be changed by command.

The Font Table used in the default state is as follows.

	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
x0H		0	⓪	P	Ⓟ	p	9	é	á	á	L	á	á	≡	ⓧ
x1H	!	1	A	Q	a	q	Ü	æ	i	ⓧ	†	†	†	±	ⓧ
x2H	"	2	B	R	b	r	é	á	ó	ⓧ	†	†	†	±	ⓧ
x3H	ⓧ	3	C	S	c	s	á	ó	ú	†	†	†	†	±	ⓧ
x4H	ⓧ	4	D	T	d	t	á	ó	†	†	†	†	†	±	ⓧ
x5H	¿	5	E	U	e	u	á	ó	†	†	†	†	†	±	ⓧ
x6H	&	6	F	V	f	v	á	ó	†	†	†	†	†	±	ⓧ
x7H	'	7	G	U	g	w	á	ó	†	†	†	†	†	±	ⓧ
x8H	(	8	H	X	h	x	é	ó	†	†	†	†	†	±	ⓧ
x9H	)	9	I	Y	i	y	é	ó	†	†	†	†	†	±	ⓧ
xAH	*	:	J	Z	j	z	é	ó	†	†	†	†	†	±	ⓧ
xBH	+	:	K	⓪	k	Ⓟ	i	é	†	†	†	†	†	±	ⓧ
xCH	,	<	L	⓪	l	Ⓟ	i	é	†	†	†	†	†	±	ⓧ
xDH	-	=	M	⓪	m	Ⓟ	i	é	†	†	†	†	†	±	ⓧ
xEH	.	>	N	⓪	n	Ⓟ	á	á	†	†	†	†	†	±	ⓧ
xFH	/	?	O	⓪	o		á	á	†	†	†	†	†	±	ⓧ

13.3.20 Specify International font set 1Bh 52h n	13.3.30 Specify character code type 1Bh 74h n
---	--

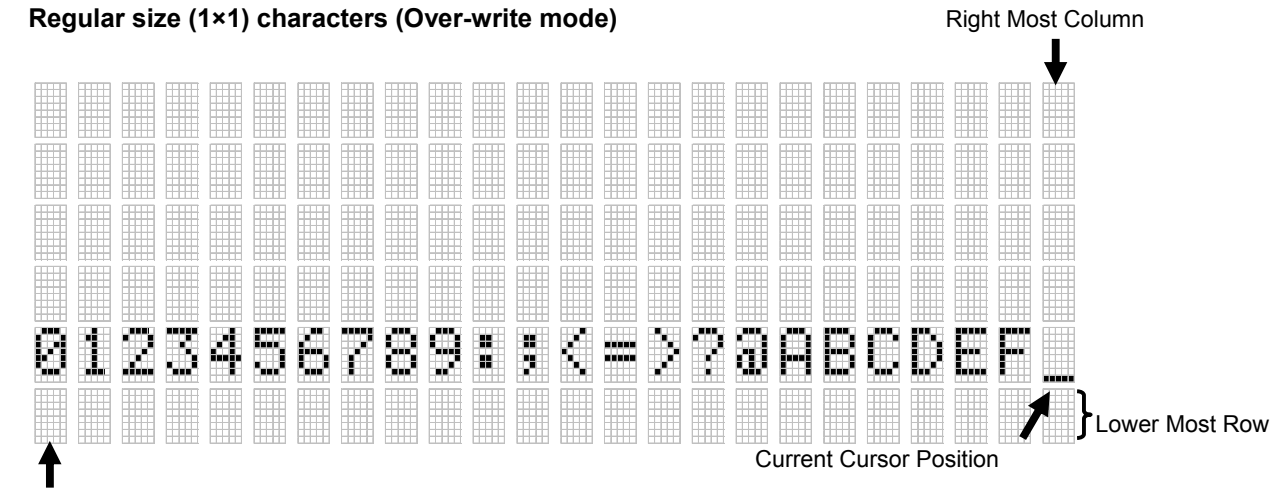
For font pattern details, refer to font spec. DS-1519-0002-xx.



### 11 Display Area-End of Line Behavior

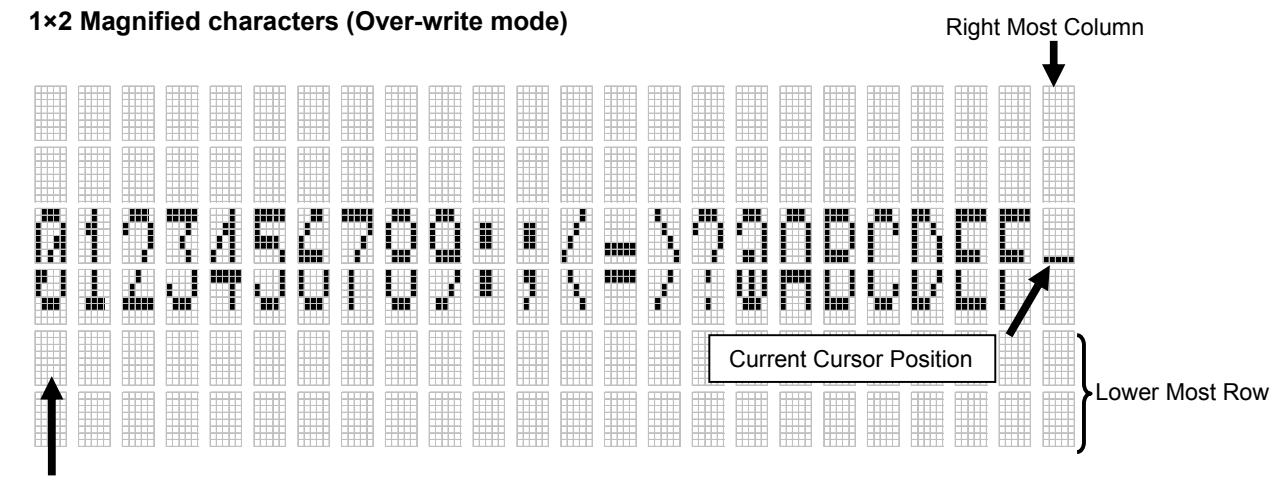
In most cases, a cursor moves to the next position after a character is displayed on the current cursor position, but some exceptional cases exist. At end of line, the next behavior of a display area depends on the current cursor position, character size and display mode. Display area behaviors for some magnified character sizes are as follows:

#### Regular size (1×1) characters (Over-write mode)



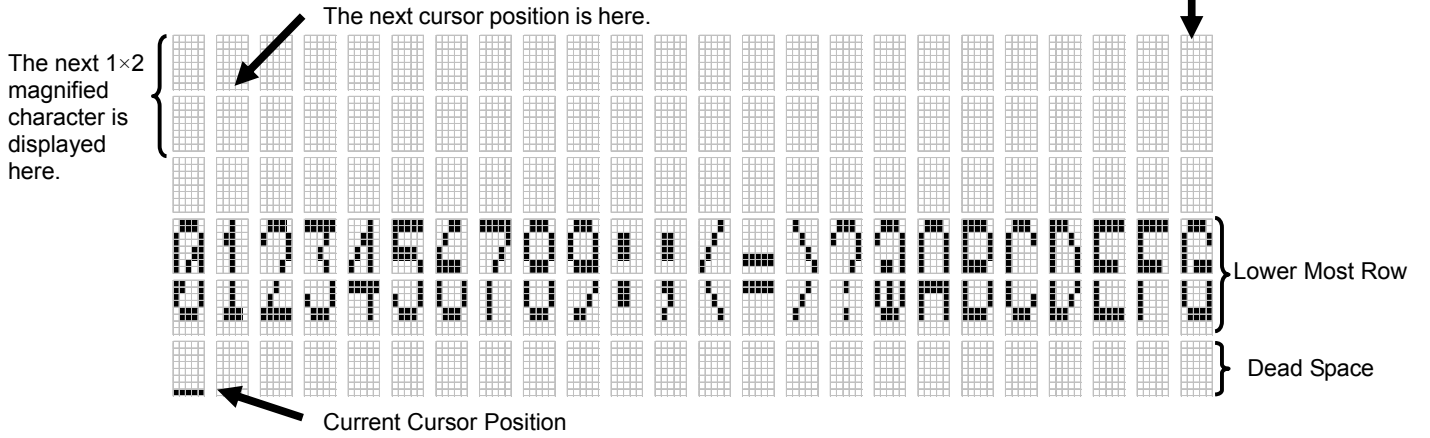
The next cursor position is here.

#### 1×2 Magnified characters (Over-write mode)



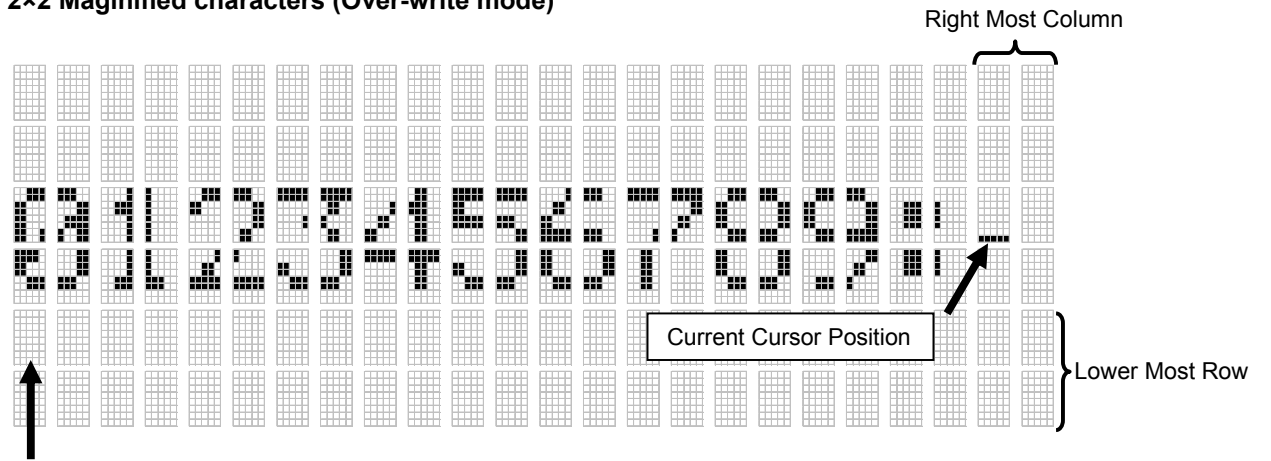
The next cursor position is here.

**1×2 Magnified characters (Over-write mode)**



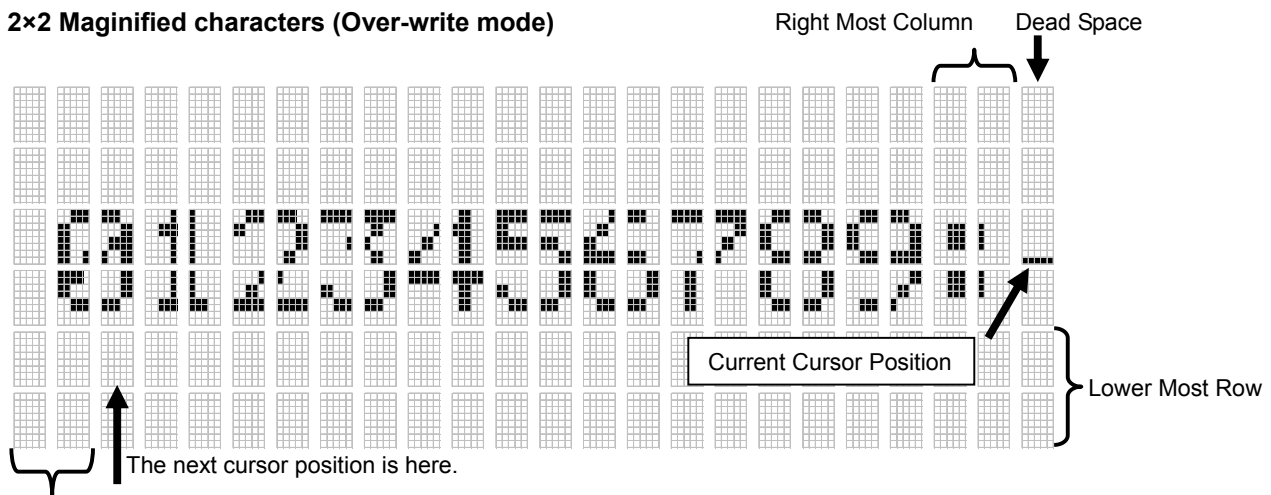
It is possible to display regular size (1×1) characters in the dead space.

**2×2 Magnified characters (Over-write mode)**



The next cursor position is here.

**2×2 Magnified characters (Over-write mode)**



The next 2×2 magnified character is displayed here.

It is possible to display a regular size (1×1) character in the dead space.

## 12 Initial setting

Initial states are set as follows.

	Power on	"Initialize display" command	External reset or "Reset" command	"User set up mode end" command
Cursor position	Home position			
RAM user font	Disable			
Cursor display	Underline cursor			
Display mode	Over-write mode			
Write mode	Quick write mode			
International font set	America			
Character code type	PC437(USA – Euro std)			
Character blink mode	Character blink mode OFF			
Underline display mode	Underline display mode OFF			
Individual Character Brightness Level Setting	Level 8 (100%)			
Brightness level	100%			
Blink speed	40h			
Horizontal scroll speed	Instantaneous (n=00h)			
RAM User font data	Cleared			
Blink display action (at c=00h)	–	Stopped		
Select/Deselect 5×8 Matrix font	5×8 Matrix font			
Select/Deselect Alternative Magnified Font	Normal font			
Font Magnification	x=1, y=1			
Baud rate (J0, J1)	Re-loaded	Not re-loaded	Re-loaded	Re-loaded
Serial interface (J2)	Re-loaded	Not re-loaded	Re-loaded	Re-loaded
Test mode (JT)	Re-loaded	Not re-loaded	Re-loaded	Re-loaded

## 13 Commands

This display's command is configured as following group.

### 13.1 Command Configuration

08H-16H	Control command
1BH ...	ESC command
1FH ...	User Setup command
– 1FH 28H 61H ...	– Action command
– 1FH 28H 65H ...	– Operation mode-related command
– 1FH 28H 67H ...	– Character-related command
20H-FFH	Character code

### 13.2 Command Set

Command Name	Hex Code				
	BYTE1	BYTE2	BYTE3	BYTE4	Parameter
Back Space	08h	—	—	—	—
Horizontal Tab	09h	—	—	—	—
Line Feed	0Ah	—	—	—	—
Home Position	0Bh	—	—	—	—
Display Clear	0Ch	—	—	—	—
Carriage Return	0Dh	—	—	—	—
Underline cursor mode	13h	—	—	—	—
Cursor off mode	14h	—	—	—	—
Block cursor mode	15h	—	—	—	—
Underline cursor blink mode	16h	—	—	—	—
RAM user font	1Bh	25h	—	—	n
Define RAM user font		26h	01h	—	c1 c2 [x1 d1...d(a X x1)]... [xk d1...d(a X xk)]
Delete RAM user font		3Fh	01h	—	c
Initialize display		40h	—	—	—
Character blink mode OFF		41h	—	—	—
Character blink mode ON		42h	—	—	—
Specify quick write mode		45h	—	—	—
Specify International font set		52h	—	—	n
Specify flickerless write mode		53h	—	—	—
Blink speed control		54h	—	—	s
Underline display mode ON		55h	—	—	—
Underline display mode OFF		57h	—	—	—
Insert character		58h	F3h	—	—
Delete character			F4h	—	—
Insert line			F5h	—	—
Delete line			F6h	—	—
Reset			FFh	—	—
Specify character code type		74h	—	—	n
Over-write mode		1Fh	01h	—	—
Vertical scroll mode			02h	—	—
Horizontal scroll mode	03h		—	—	—
Cursor set	24h		—	—	xL 00h yL 00h
Wait	28h		61h	01h	t
Display blink				11h	p t1 t2 c
Screen saver				40h	p
User set up mode start			65h	01h	d1 d2
User set up mode end				02h	d1 d2 d3
Define FROM user font				14h	P(20h-1) P(20h-2)...P(FFh-5)
Read Status information				40h	a [b c d e]
Display Status information			41h	a	
Serial OUT mode start			83h	d1 d2	
Serial OUT mode end			84h	d1 d2 d3	
Select / Deselect 5×8 Matrix font	67h		04h	d	
Select/Deselect Alternative Magnified Font			06h	s	
Font Magnification			40h	x y	
Individual Character Brightness Level Setting	50h		50h	d1 d2 d3	
Brightness level setting			58h	—	n
Horizontal scroll speed	73h		—	—	n
Character display	20-FFh	—	—	—	

### 13.3 Detail of Command Set

#### 13.3.1 Character display

Code: 20h – FFh

Please refer to “11 Display Area-End of Line Behavior” before reading.

Function: Display a character on the current cursor position. The details of operation are as follows:

When “Over-write mode” is selected.

Current cursor position		Operations
X position (Column)	Y position (Row)	
Excluding right most column	-	1. Display a character on the current cursor position. 2. Increment the cursor to the right by one column.
Right most column	Excluding lower most row	1. Display a character on the current cursor position. 2. Move the cursor to left most column of next lower row.
	Lower most row	1. Display a character on the current cursor position. 2. Move the cursor to the home position (left most column of upper most row).

When “Vertical scroll mode” is selected.

Current cursor position		Operations
X position (Column)	Y position (Row)	
Excluding right most column	-	1. Display a character on the current cursor position. 2. Increment the cursor to the right by one column.
Right most column	Excluding lower most row	1. Display a character on the current cursor position. 2. Move the cursor to left most column of next lower row.
	Lower most row	1. Display a character on the current cursor position. 2. Clear upper most row. 3. Shift all rows up by one to make lower most row clear. 4. Move the cursor to left most column of lower most row.

When “Horizontal scroll mode” is selected.

Cursor position		Operations
X direction	Y direction	
Excluding right most column	-	1. Display a character on the current cursor position. 2. Increment the cursor to the right by one column.
Right most column	-	1. Display a character on the current cursor position. 2. Move to Scroll ON mode. Note: The cursor does not move.

	Operations
Scroll ON mode	1. Shift only the current row left by one column to make a space for the next character. 2. Display a character on the space Note: The cursor does not move.

Note: Scroll ON mode is cancelled if any of the following commands are executed: “Back Space”, “Line Feed”, “Home Position”, “Display Clear”, “Carriage Return”, “Cursor Set”, “Over-write mode”, “Vertical scroll mode”, “Horizontal scroll mode”, “Insert character”, “Delete character”, “Insert line” and “Delete line”.

### 13.3.2 Back Space

**Code:** 08h

**Please refer to “11 Display Area-End of Line Behavior” before reading.**

Function: The cursor moves to the left by one character. The details of operation are as follows:

When “Over-write mode” or “Vertical scroll mode” is selected.

Current cursor position		Operations
X direction (Column)	Y direction (Row)	
Excluding left most column	-	1. Decrement the cursor to the left by one column.
Left most column	Excluding upper most row	1. Move the cursor to right most column of next upper row.
	Upper most row	No operation

When “Horizontal scroll mode” is selected.

Current cursor position		Operations
X direction (Column)	Y direction (Row)	
Excluding left most column	-	1. Decrement the cursor to the left by one column.
Left most column	-	No operation

### 13.3.3 Horizontal Tab

**Code:** 09h

**Please refer to “11 Display Area-End of Line Behavior” before reading.**

Function: The cursor moves to the right by one character. The details of operation are as follows:

When “Over-write mode” is selected.

Current cursor position		Operations
X direction (Column)	Y direction (Row)	
Excluding right most column	-	1. Increment the cursor to the right by one column.
Right most column	Excluding lower most row	1. Move the cursor to left most column of next lower row.
	Lower most row	1. Move the cursor to the home position (left most column of upper most row).

When “Vertical scroll mode” is selected.

Current cursor position		Operations
X direction (Column)	Y direction (Row)	
Excluding right most column	-	1. Increment the cursor to the right by one column.
Right most column	Excluding lower most row	1. Move the cursor to left most column of next lower row.
	Lower most row	1. Clear upper most row. 2. Shift all rows up by one to make lower most row clear. 3. Move the cursor to left most column of lower most row.

When "Horizontal scroll mode" is selected.

Current cursor position		Operations
X direction (Column)	Y direction (Row)	
Excluding right most column	-	1. Increment the cursor to the right by one column.
Right most column	-	1. Shift only the current row left by one column. 2. Keep executing this operation (Scroll ON mode). Note: The cursor does not move.

Note: Scroll ON mode is cancelled if any of the following commands are executed: "Back Space", "Line Feed", "Home Position", "Display Clear", "Carriage Return", "Cursor Set", "Over-write mode", "Vertical scroll mode", "Horizontal scroll mode", "Insert character", "Delete character", "Insert line" and "Delete line".

### 13.3.4 Line Feed

Code: 0Ah

Please refer to "11 Display Area-End of Line Behavior" before reading.

Function: The cursor moves to next lower line. The details of operation are as follows:

When "Over-write mode" is selected.

Current cursor position		Operations
X direction (Column)	Y direction (Row)	
-	Excluding lower most row	1. Move the cursor to the same column of next lower row.
-	Lower most row	1. Move the cursor to the home position (left most column of upper most row).

When "Vertical scroll mode" is selected.

Current cursor position		Operations
X direction (Column)	Y direction (Row)	
-	Excluding lower most row	1. Move the cursor to the same column of next lower row.
-	Lower most row	1. Clear upper most row. 2. Shift all rows up by one to make lower most row clear. Note: The cursor does not move.

When "Horizontal scroll mode" is selected.

Current cursor position		Operations
X direction (Column)	Y direction (Row)	
-	-	No operation

### 13.3.5 Home Position

Code: 0Bh

Function: Cursor moves to the home position. (the left end of top line).

**13.3.6 Display Clear****Code: 0Ch**

Function: Display is cleared and cursor moves to home position.

**13.3.7 Carriage Return****Code: 0Dh**

Function: Cursor moves to left end of same line.

**13.3.8 Underline cursor mode****Code: 13h**

Function: Cursor is displayed as underline.

**13.3.9 Cursor off mode****Code: 14h**

Function: Cursor display is OFF.

**13.3.10 Block cursor mode****Code: 15h**Function: Cursor is displayed as a block, blinking.  
Blinking speed can be varied by "Blink Speed Control" command.**13.3.11 Underline cursor blink mode****Code: 16h**Function: Cursor is displayed as underline, blinking.  
Blinking speed can be varied by "Blink Speed Control" command.**13.3.12 Cursor set****Code: 1Fh 24h xL 00h yL 00h**

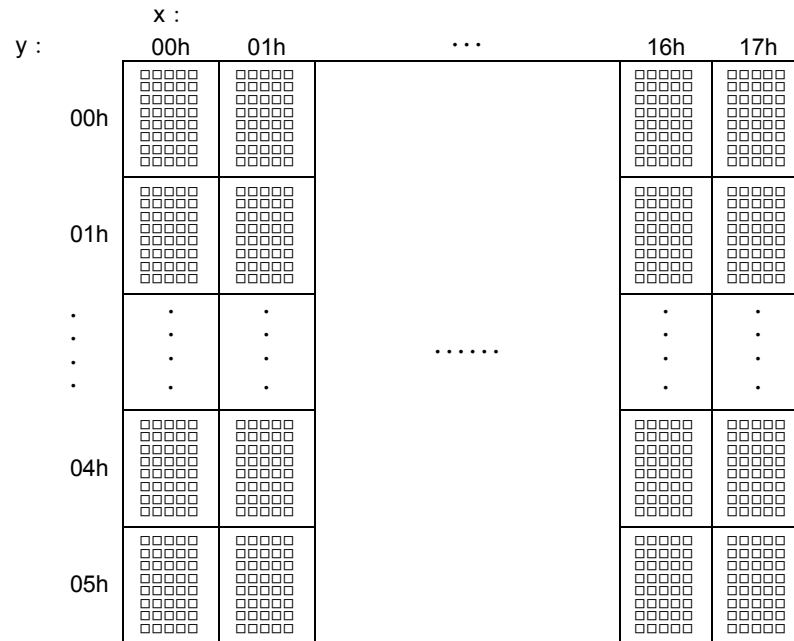
xL: Cursor position x Lower byte (1 char /unit)

yL: Cursor position y Lower byte (1 line /unit)

Definable area:  $0 (00h) \leq xL \leq 23 (17h)$   
 $0 (00h) \leq yL \leq 5 (05h)$ 

Function: The cursor moves to the specified X, Y position. If the specified X, Y position (X, Y, either or both) is outside the definable area, the command is ignored, and the cursor remains in the same position.





### 13.3.13 Initialize display

**Code:** 1Bh 40h

Function: Clear display and return settings to initial state.  
Software settings return to power-on state.  
Jumper settings are not re-loaded

### 13.3.14 RAM user font

**Code:** 1Bh 25h n

Function: Enable or disable for RAM user font.

n = 01h, 31h: Enable (If RAM user font is not defined for a character code, built-in character is displayed)

n = 00h, 30h: Disable (RAM user font already defined are not affected)

Initial value: n = 00h

Characters already displayed are not affected.

In case of user font enable (n=01h, 31h), RAM user font is used for character codes defined using "Define RAM user font" command regardless of the state of various other settings.

### 13.3.15 Define RAM user font

**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 = 1 (01h)  
 $32 (20h) \leq c1 \leq c2 \leq 255 (FFh)$   
 x = 5 (05h)  
 $0 (00h) \leq d \leq 255 (FFh)$   
 $k = c2 - c1 + 1$

Function: Define user font into RAM.

A maximum of 16 characters may be defined.

After the first 16 are defined, any additional user font characters required must replace one already defined.

To display RAM user font characters, execution of "Define RAM user font" and "RAM user font" command is required. If a RAM user font character that is currently being displayed is re-defined, the currently-displayed character also changes to the new RAM user font character.

< RAM User font data format> 5x8 dot assignment

P1	P2	P3	P4	P5
P6	P7	P8	P9	P10
P11	P12	P13	P14	P15
P16	P17	P18	P19	P20
P21	P22	P23	P24	P25
P26	P27	P28	P29	P30
P31	P32	P33	P34	P35
P36	P37	P38	P39	P40

	B7(MSB)	B6	B5	B4	B3	B2	B1	B0(LSB)
1st byte	P8	P7	P6	P5	P4	P3	P2	P1
2nd byte	P16	P15	P14	P13	P12	P11	P10	P9
3rd byte	P24	P23	P22	P21	P20	P19	P18	P17
4th byte	P32	P31	P30	P29	P28	P27	P26	P25
5th byte	P40	P39	P38	P37	P36	P35	P34	P33