SVC2004A Series

(20S401DA2)

VFD MODULE USER MANUAL

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Reference Controller Datasheet

Character VFD Selection Guide

~~~~~~~~~~~~~~~~~~ Index ~~~~~~~~~~~~~~~~~~

1. SCOPE

This specification applies to VFD module (Model No: 20S401DA2)

2. FEATURES

* Simple connection to the host system. Either parallel or serial input interface can be selected. In case of serial input, it is possible to choose 1200, 2400, 4800 or 9600 bps.

* Since a DC/DC converter is used, only +5V_{DC} power source is required to operate the module.

* One chip MCU offers ASCII (96 characters) + European (121 characters) or ASCII + Japanese Katakana.

* Four brightness levels can be selected by dimming function.

* High quality Green(505nm) vacuum fluorescent display provides an attractive and readable medium. Other colors can be achieved by simple wavelength filters.

* The module has up to 16 user definable characters.

3. PRECAUTIONS (OPERATING RECOMMENDATIONS)

* Avoid applying excessive shock or vibration beyond the specification for the VFD module.

* Since VFDs are made of glass material, careful handling is required. i.e. Direct impact with hard material to the glass surface(especially exhaust tip) may crack the glass.

* When mounting the VFD module to your system, leave a slight gap between the VFD glass and your front panel. The module should be mounted without stress to avoid flexing of the PCB.

* Avoid plugging or unplugging the interface connection with the power on, otherwise it may cause the severe damage to input circuitry.

* Slow starting power supply may cause non-operation because one-chip MCU won't be reset.

* Exceeding any of maximum ratings may cause the permanent damage.

* Since the VFD modules contain high voltage source, careful handling is required during powered on.

* When the power is turned off, the capacitor does not discharge immediately. The high voltage applied to the VFD must not contact to the ICs. And the short-circuitry of mounted components on PCB within 30 seconds after power-off may cause damage to those.

* The power supply must be capable of providing at least 10 times the rated current, because the surge current can be more than 5 times the specified current consumption when the power is turned on.

* Avoid using the module where excessive noise interference is expected. Noise may affects the interface signal and causes improper operation. And it is important to keep the length of the interface cable less than 50cm.

* Since all VFD modules contain C-MOS ICs, anti-static handling procedures are always required.

4. PRODUCT SPECIFICATIONS

4.1 Type

Type Number (Model)	20S401DA2
Character Format	5 * 7 Dot Matrix
Number of Digits	80 (4 lines * 20 characters)

4.2 Outer Dimensions, Weight

Parameters	Symbols	Specification	Unit
Outer Dimensions	W * H * t	135.0 * 70.0 * 31.0	mm
Glass Size	W * H	118.2 * 48.3	mm
Display Area	W * H	89.52 * 33.07	mm
Character Size	CW * CH	3.07 * 4.87	mm
Character Pitch	CP(x)*CP(y)	4.55 * 9.40	mm
Weight	-	Approx. 155	g

4.3 Environment Conditions

Parameters	Symbols	Min.	Max.	Unit
Operating Temperature	T_{OPR}	- 20	+ 70	^{o}C
Storage Temperature	T_{STG}	- 40	+ 85	^{o}C
Humidity (Operating)	H_{OPR}	0	85	%
Humidity (Non-operating)	H_{STG}	0	90	%
Vibration (10 ~ 55 Hz)	-	-	4	G
Shock	-	-	40	G

4.4 Absolute Maximum Ratings

Parameters	Symbols	Min.	Max.	Unit
Supply Voltage	VCC	-	+ 7.0	VDC
Input Signal Voltage	VIS	0.0	VCC+0.3	VDC

4.5 Recommended Operating Conditions

Parameters	Symbols	Min.	Typ.	Max.	Unit
Supply Voltage	VCC	4.5	5.0	5.5	VDC
H-Level Signal Input Voltage	VIH	0.7VCC	-	VCC+0.3	VDC
L-Level Signal Input Voltage	VIL	-	-	0.3VCC	VDC

4.6 DC Characteristics (when Ta = +25oC, VCC = +5.0VDC)

Parameters	Test Conditions	Min.	Typ.	Max.	Unit
Supply Current (*)	All dots are lit.	-	750	1000	mA
H-Level Input Current (**)	VIS = VCC	-	-	20	uA
L-Level Input Current	VIS = 0 VDC	-	-	-1.2	mA
Brightness	All dots are lit.	100 (340)	200 (680)	- -	ft-L (cd/m^2)
Display Color	-	Green (peak wave = 505nm)			-

(*) Note-1: The in-rush current can be approx. 3 times the specified supply current at power on. The peak in-rush current amplitude and duration are dependent on the characteristics of the host power supply.

(**) Note-2: 10Kohm resistors are pulled-up on all signals.

4.7 Timing Chart and AC Characteristics

4.7.1 Parallel Input Timing

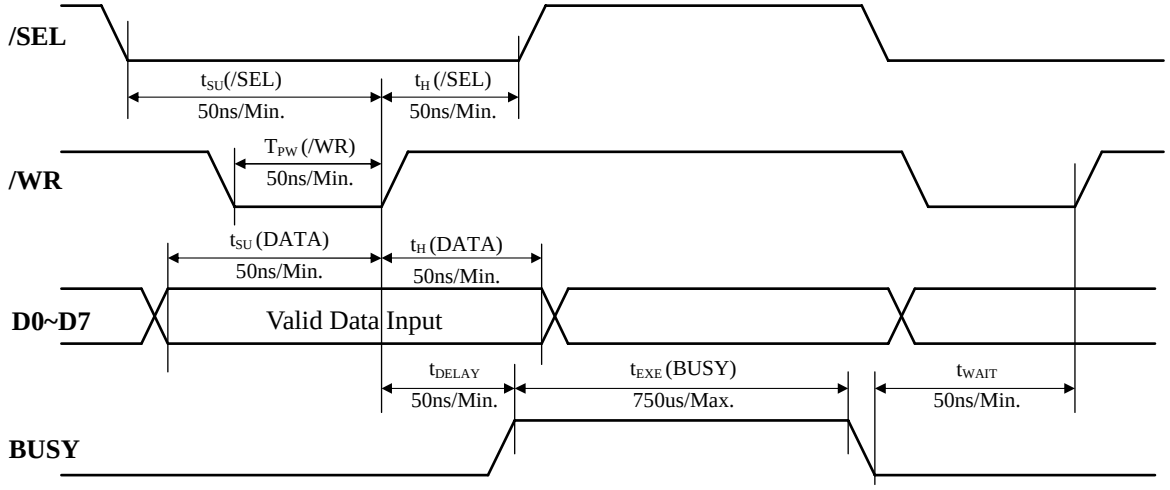

Fig.-1 Parallel Input Timing Diagram

4.7.2 Serial Input Timing

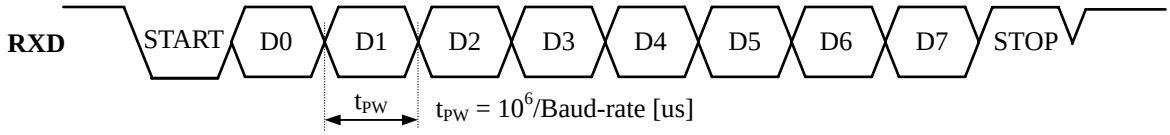

Fig.-2 Serial Input Timing Diagram

In case of serial input mode, it is not necessary to check the BUSY signal because the execution time of data (t_{EXE}) is shorter than the input time of 1 byte serial data. In this mode, BUSY signal always holds low state.

4.8 Signal Interfacing

* Connector (Male): PH-2S10-FG (aster) or equivalent(16-Pin Dual Box Header, Straight).
  → Mate Socket (Female): HIF3B-20D-2.54R (by Hirose) or equivalent.

Pin No.	Signal Name	Description
1	D7	Data Bus
3	D6	Data Bus
5	D5	Data Bus
7	D4	Data Bus
9	D3	Data Bus
11	D2	Data Bus
13	D1	Data Bus
15	D0	Data Bus
17	WR	Write Enable
19	RXD	Serial Data Receive

Pin No.	Signal Name	Description
2	V_{CC}	Power Supply
4	V_{CC}	Power Supply
6	V_{CC}	Power Supply
8	GND	Ground
10	GND	Ground
12	GND	Ground
14	GND	Ground
16	/TEST	System Test
18	/SEL	Module Select
20	BUSY	System Busy

4.9 System Block Diagram

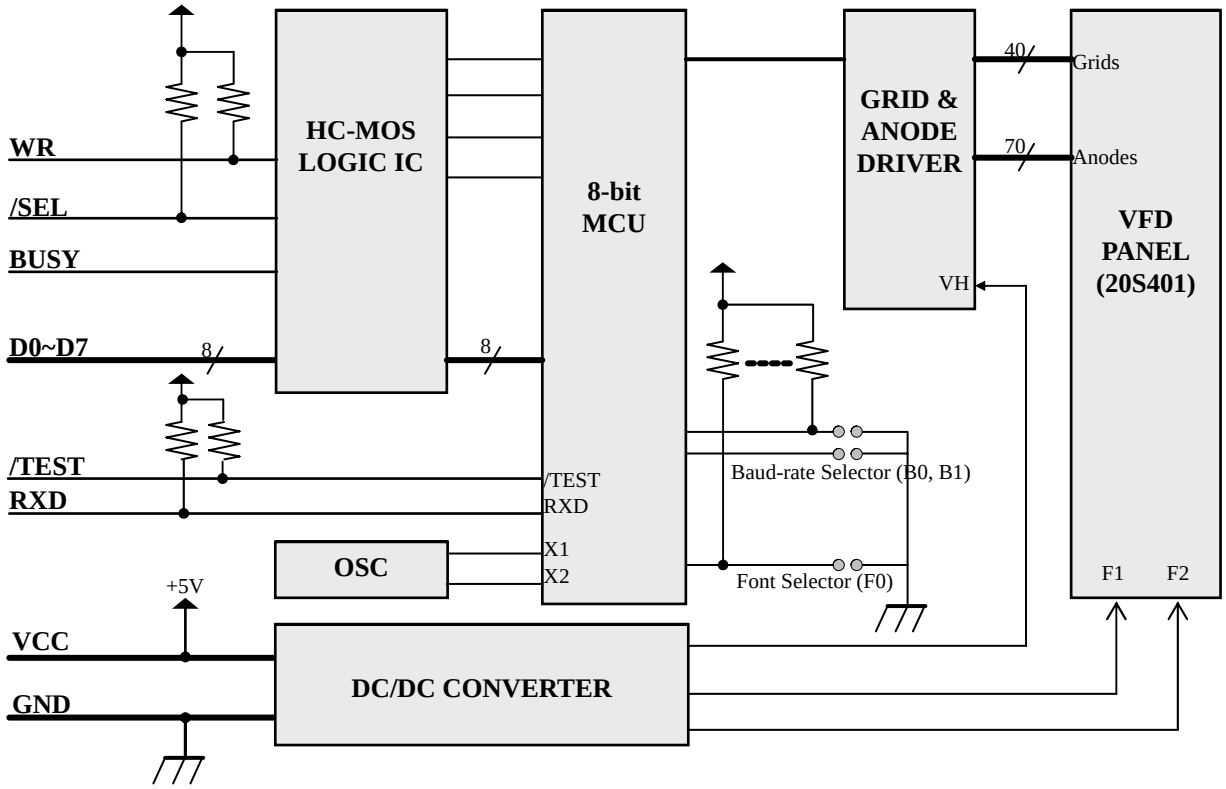

Fig.-3 VFD Module System Block Diagram

4.10 Outer Dimensions

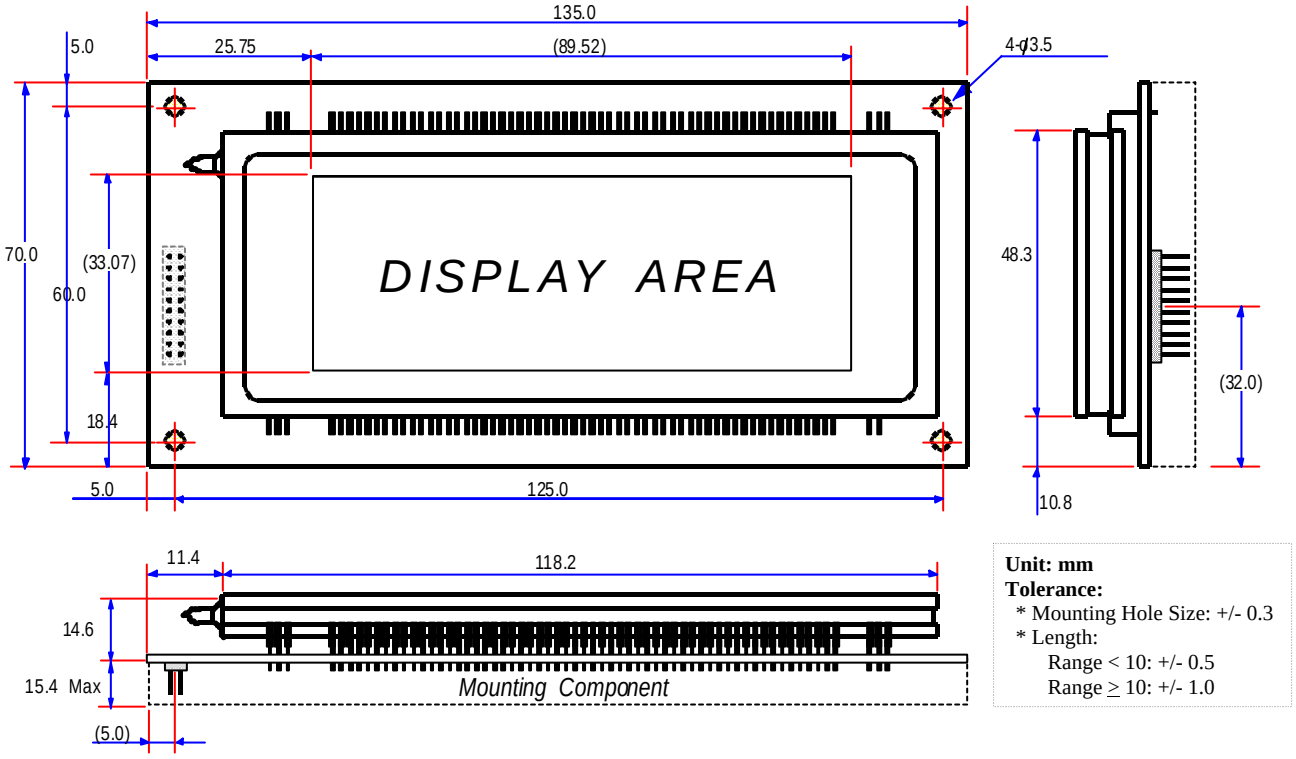

Fig.-4 Outer Dimensions

4.11 Pattern Details

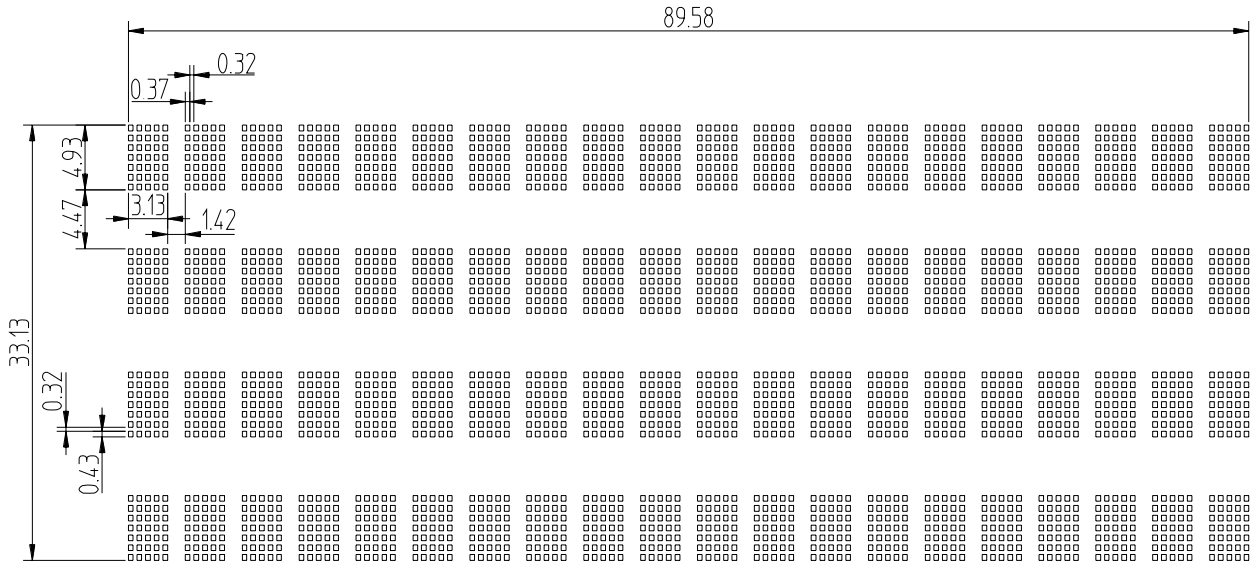

Fig.-5 Pattern Details

5. FUNCTIONS

The module has data and control code write-in, self-test and power on reset function. When the data is being written-in, the BUSY signal is active (High) which indicates that the module is processing the data.

* Data and Control Code Write-in Table

WR	/SEL	Function
0 → 1	0	Write-in Data and/or Control Code
*	1	No Operation

5.1 Character Data Write-in

When the character data code (20 Hex ~ FF Hex) is transferred to the module, the character font is displayed on the screen. At this time, the cursor will be shifted to the right one digit automatically.

5.2 Control Code Write-in

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

(1) UDF: Store an User-Definable Font.....03 Hex
(2) DIM: Dimming..... 04 Hex
(3) BS: Back Space..... 08 Hex
(4) HT: Horizontal Tab..... 09 Hex
(5) LF: Line Feed.....0A Hex
(6) CR: Carriage Return.....0D Hex
(7) DP: Display Position..... 10 Hex
(8) DC1: Normal Display Mode..... 11 Hex
(9) DC2: Vertical Scroll Mode.....12 Hex
(10) DC3: Cursor On Mode…..... 13 Hex
(11) DC4: Cursor Off Mode.....14 Hex
(12) DC5: Cursor Blinking Mode……..... 15 Hex
(13) FA: General European Font.....…..... 18 Hex
(14) FB: Japanese Katakana Font.....…..... 19 Hex
(15) RST: Reset (Initialization).....1B Hex

5.2.1 UDF (03 Hex): User Definable Font

The characters can be designed by using this command. These font data are memorized in the RAM of the module.

* Syntax: ESC (03 Hex) + CHR (00 ~ FF Hex) + PT1 + PT2 + PT3 + PT4 + PT5

Any 5x7 dots pattern consisted of data form PT1 through PT5 (3rd~7th byte) can be stored in the character code location specified by CHR (2nd byte). And the maximum kinds of UDFs (User Definable Font) are 16 characters at once. Storing more than 16 will kill the oldest font. However within 16 characters codes where already defined by UDF, the over-write-latest font replaces the former font.

* 1st byte: UDF (03 Hex).....Specify User-Definable-Font Command.
* 2nd byte: CHR (00 Hex ~ FF Hex).....Specify the character code location from 00hex to FF Hex by CHR. If CHR overlaps control codes such as BS, HT, LF etc., the control function will be lost. Therefore, overlaps to the UDF codes may not available further UDF function.
* 3rd ~ 7th byte (00 Hex ~ FF Hex)..... Specify ON/OFF of 35 (5x7 dot) dots' position. Below shows the relation between dots positions a data formation. The notation of "*x.y*" means the *y*th bit of *x*th byte. For example, "4.0" means LSB (Least Significant Bit) of 4th byte and "7.7" means MSB (Most Significant Bit) of 7th byte. ("1" = dot turn on, "0" = dot turn off)

5x7 Dot Matrix				
3.7	3.6	3.5	3.4	3.3
3.2	3.1	3.0	4.7	4.6
4.5	4.4	4.3	4.2	4.1
4.0	5.7	5.6	5.5	5.4
5.3	5.2	5.1	5.0	6.7
6.6	6.5	6.4	6.3	6.2
6.1	6.0	7.7	7.6	7.5
*) 7.4 ~ 7.0: Don't Care				

Design Example				
0	0	**1**	**1**	0
0	**1**	0	0	0
1	**1**	**1**	0	0
0	**1**	0	0	0
1	**1**	**1**	0	0
0	**1**	0	0	**1**
0	0	**1**	**1**	0
*	*	*	*	*

UDF Data Coding Example of Left Design
1st Byte: 43 Hex (Specify UDF Command)
2nd byte: nn Hex (Location Address)
3rd Byte: 00110010b = 32 Hex
4th Byte: 00111000b = 38 Hex
5th Byte: 10001110b = 8E Hex
6th Byte: 00100100b = 24 Hex
7th Byte: 11000000b = C0 Hex

5.2.2 DIM (04 Hex): Dimming

Brightness can be controlled into four levels by using this function. After writing 04 Hex, the successive Hex byte mentioned under is written to change the brightness level.

* Syntax: DIM Command (04 Hex) + Dimming Level Data

Dimming Level	Data
100%	80~FF Hex
60%	60~7F Hex
40%	40~5F Hex
20%	00~3F Hex

5.2.3 BS (08 Hex): Back Space

The write-in position is shifted to the left one digit and the character previously displayed on the digit will be cleared. When the write-in position is on the most significant digit (left-end digit) of the second to fourth row, the cursor moves to the least significant digit (right-end digit) of the over row. When the write-in position is on the most significant digit (left-end digit) of the first row, the cursor move to the least significant digit of the fourth row.

5.2.4 HT (09 Hex): Horizontal Tab

The write-in position is shifted to the right one digit.

When the write-in position is on the least significant digit (left-end digit), the cursor moves to the left-end of the lower line.

* DC1 Mode: When the write-in position is on the least significant digit of the fourth row, the cursor moves to the first row.
* DC2 Mode: When the write-in position is on the least significant digit of the fourth row, the cursor moves to the same row.

5.2.5 LF (0A Hex): Line Feed

When the write-in position is on the fourth row, the characters displayed in the second to fourth row are shifted up to the upper row, leaving the cursor at its present position, then the forth row is cleared.

5.2.6 CR (0D Hex): Carriage Return

The write-in position moves to the most significant digit of the same row.

5.2.7 DP (10 Hex): Display Position

Instead of writing the character from the first digit, the write-in starting position can be pointed out by using this command. After writing data 10 Hex, the successive Hex byte is written to specify the position desired.

* Syntax: DP (10 Hex) + Cursor Position Data

Left End	2nd Column	3rd Column	……	19th Column	Right End
00 Hex	01 Hex	02 Hex	……	12 Hex	13 Hex
14 Hex	15 Hex	16 Hex	……	26 Hex	27 Hex
28 Hex	29 Hex	30 Hex	……	3A Hex	3B Hex
3C Hex	3D Hex	3E Hex	……	4E Hex	4F Hex

DC1 and DC2 select the display mode. When the power is turned on, the DC1 mode is selected defaultly and will be held until the other mode (DC2) is selected.

5.2.8 DC1 (11 Hex): Normal Display Mode

After writing a character, the write-in position is shifted to the right one digit automatically.

When the write-in position is on the least significant digit of the first to third row, the cursor moves to the most significant digit of under line.

When the character is displayed on the least significant digit of the fourth row, the write-in position is on the same digit. And the character code is written in the module next, all the digits are cleared firstly, and then the character is displayed on the most significant digit of the first row. After that the write-in position moves to the next digit.

5.2.9 DC2 (12 Hex): Vertical Scroll Mode

After writing the characters up to the least significant digit of the fourth row, all the characters displayed in the second to fourth row are shifted up to the upper row, clearing the fourth row.

DC4~DC5 are the cursor control command. When the power is turned on, the DC4 mode is selected defaultly

5.2.10 DC3 (13 Hex): Cursor On Mode

The cursor is displayed. This module uses the bottom line (5 dots) of each digit for the cursor.

5.2.11 DC4 (14 Hex): Cursor Off Mode

The cursor won't be displayed.

5.2.12 DC5 (15 Hex): Cursor Blinking Mode

The cursor is blinked.

FA and FB select the character font table. When the power is turned on, the default table is depend on the font table select switch (F0).

5.2.13 FA (18 Hex): General European Font

The FA font table is selected.

5.2.14 FB (19 Hex): Japanese Katakana Font

The FB font table is selected.

5.2.15 RST (1F Hex): Reset

This command is used to initialize the module.
All the characters displayed are erased. The write-in position will be set on the most significant digit of the first row but the cursor isn't displayed, the dimming level is set to 100% and the display mode is set for DC1. Also, the baud-rate and character font table is defaultly set by the combination of following table.
But in this case, the user-defined fonts those were already defined remain effective.

F0	B1	B0	Function	Setting
*	Open	Open	Baud-rate Selection	1,200 bps
*	Open	Short		2,400 bps
*	Short	Open		4,800 bps
*	Short	Short		9,600 bps
Open	*	*	Font Selection	FA (European)
Short	*	*		FB (Japanese)
Open	Open	Open	Factory Setting	

5.3 Self-Test Mode

Self test starts when /TEST = "1" to "0" (Connecter pin #16 is connected to GND).
The display shows all characters, Alphabet, Numerics and symbols in that order. In using this mode, neither data nor control code write-in is allowed. To release this mode, /TEST must be set to "1".

5.4 Power on Reset

When the module is turned on, the display and memory are cleared and the module is initialized. The displaying status are the same as RST command.

* *Appendix-1. FA Character Code (General European Font Table)*

Upper / Lower	D7	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	D6	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
	D5	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
	D4	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
D3 D2 D1 D0		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0 0 0 0	0		DP														
0 0 0 1	1		DC1														
0 0 1 0	2		DC2														
0 0 1 1	3	UDF	DC3														
0 1 0 0	4	DIM	DC4														
0 1 0 1	5		DC5														
0 1 1 0	6																
0 1 1 1	7																
1 0 0 0	8	BS															
1 0 0 1	9	HT															
1 0 1 0	A	LF															
1 0 1 1	B																
1 1 0 0	C																
1 1 0 1	D	CR	FA														
1 1 1 0	E		FB														
1 1 1 1	F		RST														

** Appendix-2. FB Character Code (Japanese Katakana Font Table)*

Upper / Lower	D7	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	D6	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
	D5	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
	D4	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
D3 D2 D1 D0		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0 0 0 0	0		DP														
0 0 0 1	1		DC1														
0 0 1 0	2		DC2														
0 0 1 1	3	UDF	DC3														
0 1 0 0	4	DIM	DC4														
0 1 0 1	5		DC5														
0 1 1 0	6																
0 1 1 1	7																
1 0 0 0	8	BS															
1 0 0 1	9	HT															
1 0 1 0	A	LF															
1 0 1 1	B																
1 1 0 0	C																
1 1 0 1	D	CR	FA														
1 1 1 0	E		FB														
1 1 1 1	F		RST														