



To :  
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# SPECIFICATION

Rev 1.0

*Application :*  
\_\_\_\_\_

## VACUUM FLUORESCENT DISPLAY MODULE

*Model No. : 20S207DA4*  
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Rev No.	Issued Date	Description	Remark
Tentative	DEC. 01, 1999	First Edition (Version-up model of 20S206DA4) (Enlarge the Dot Size : 0.4x0.4mm → 0.5x0.5mm)	All Pages
1.0	MAR. 23, 2001	2nd Edition - Typing error correction of the 5.2.15 (UDF 03 → 1B) - Typing error correction of the "FA" font table (FA 1D → 18, FA 1E → 19) - Typing error correction of the "FB" font table (FA 1D → 18, FA 1E → 19)	9/13 12/13 13/13

Issued by

Checked by

Approved by

Customer Approval

4.3 Specifications of the Display Panel (See Fig-4 on Page 5/13 for details)

Table\_3

Parameter	Symbol	Specification	Unit
Display Size	WxH	102.3 x 17.5	mm
Number of Digit	-	20 Digits x 2 Rows	-
Character Size	WxH	3.5 x 5.0	mm
Character Pitch	-	5.2(x) / 11.1(y)	mm
Display Color	-	Blue-Green (505 nm)	-

4.4 Environment Conditions

Table\_4

Parameter	Symbol	Min.	Max.	Unit
Operating Temperature	TOPR	-20	+70	°C
Storage Temperature	TSTG	-40	+85	°C
Humidity (Operating)	TOPR	20	85	%
Humidity (Non-operating)	TSTG	20	90	%
Vibration (10 ~ 55 Hz)	-	-	4	G
Shock	-	-	40	G

4.5 Absolute Maximum Ratings

Table\_5

Parameter	Symbol	Min.	Max.	Unit
Supply Voltage	VCC	-	7.0	VDC
Input Signal Voltage	VIS	0	VCC	VDC

4.6 Recommend Operating Conditions

Table\_6

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	VCC	4.5	5.0	5.5	VDC
H-Level Input Voltage	VIH	2.4	-	VCC+0.3	VDC
L-Level Input Voltage	VIL	-	-	0.8	VDC

4.7 DC Characteristics (Ta=+25°C, Vcc=+5.0Vdc)

Table\_7

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply Current *)	ICC	-	350	500	mA
H-Level Input Current	IiH	-	-	20	uA
L-Level Input Current	IiL	-	-	-0.36	mA
H-Level Output Voltage @I <sub>OH</sub> =-0.5mA	VOH	3.6	-	-	VDC
L-Level Output Voltage @I <sub>OL</sub> =0.5mA	VOL	-	-	0.4	VDC
Luminance	L	100	200	-	ft-L

\* Note) The surge current can be approx. 10 times the specified supply current at power on. However, the exact peak surge current amplitude and duration are dependent on the characteristics of the host power supply.



## 1. SCOPE

This specification applies to VFD module(Model No.20S207DA4) manufactured by Samsung SDI.

## 2. FEATURES

- 2.1 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.
- 2.2 Since a DC/DC converter is used, only +5Vdc power source is required to operate the module.
- 2.3 One chip micom offers ASCII(96 characters)+European(121 characters) or ASCII+Japanese Katakana (128 characters) Font.
- 2.4 Four brightness levels can be selected by dimming function.
- 2.5 High quality blue-green(505 nm) vacuum fluorescent display provides an attractive and readable medium. Other colors can be achieved by simple wavelength filters.
- 2.6 Characters are provided with a 5x7 dot matrix.
- 2.7 The module has up to 16 user definable characters.

## 3. GENERAL DESCRIPTIONS

- 3.1 This specification becomes effective after being approved by the purchaser.
- 3.2 When any conflict is found in the specification, appropriate action shall be taken upon agreement of both parties.
- 3.3 The expected necessary service parts should be arranged by the customer before the completion of production.

## 4. PRODUCT SPECIFICATIONS

### 4.1 Type

Table\_1

Type	20S207DA4
Digit Format	5x7 Dot Matrix with Cursor

### 4.2 Outer Dimensions, Weight (See Fig-3 on Page 5/13 for details)

Table\_2

Parameter		Specification	Unit
Outer Dimensions	Width	155.0 +/-1.0	mm
	Height	43.0 +/-1.0	mm
	Thickness	22.5 Max	mm
Weight		Typical 100	g

4.8 AC Characteristics (Ta=+25 °C, Vcc=+5.0Vdc)

Table\_8

Parameter	Symbol	Min.	Max.	Unit
Pulse width of WR	Tpw (WR)	50	-	ns
Set up time of /SEL	Tsu(/SEL)	50	-	ns
Holding time of /SEL	Th(/SEL)	50	-	ns
Set up time of data bus	Tsu (data)	50	-	ns
Holding time of data bus	Th (data)	50	-	ns
Delay time of BUSY	Tdelay	-	50	ns
Execution time of data	Texe	-	500	us
Wait time of next WR	Twait	50	-	ns

4.9 Timing Chart

4.9.1 Parallel Input Timing

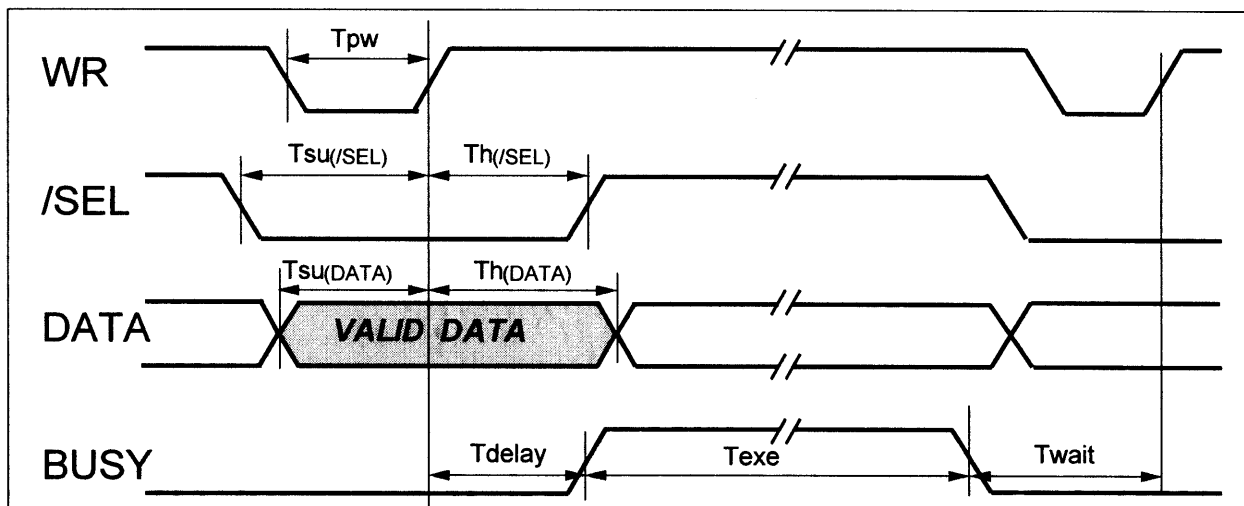


Fig-1. Parallel Input Timing Diagram

4.9.2 Serial Input Timing

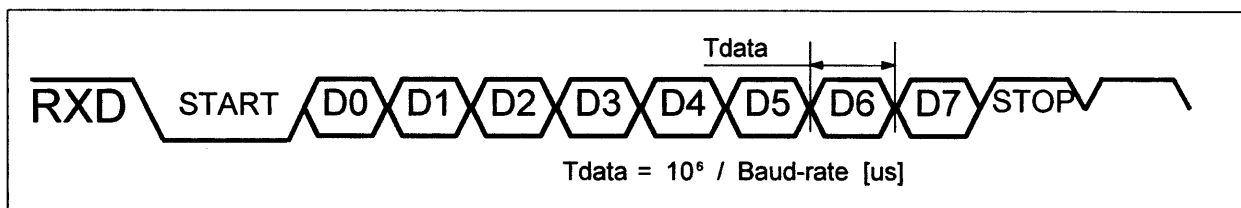


Fig-2 Serial Input Timing Diagram

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

4.10 Outer Dimensions

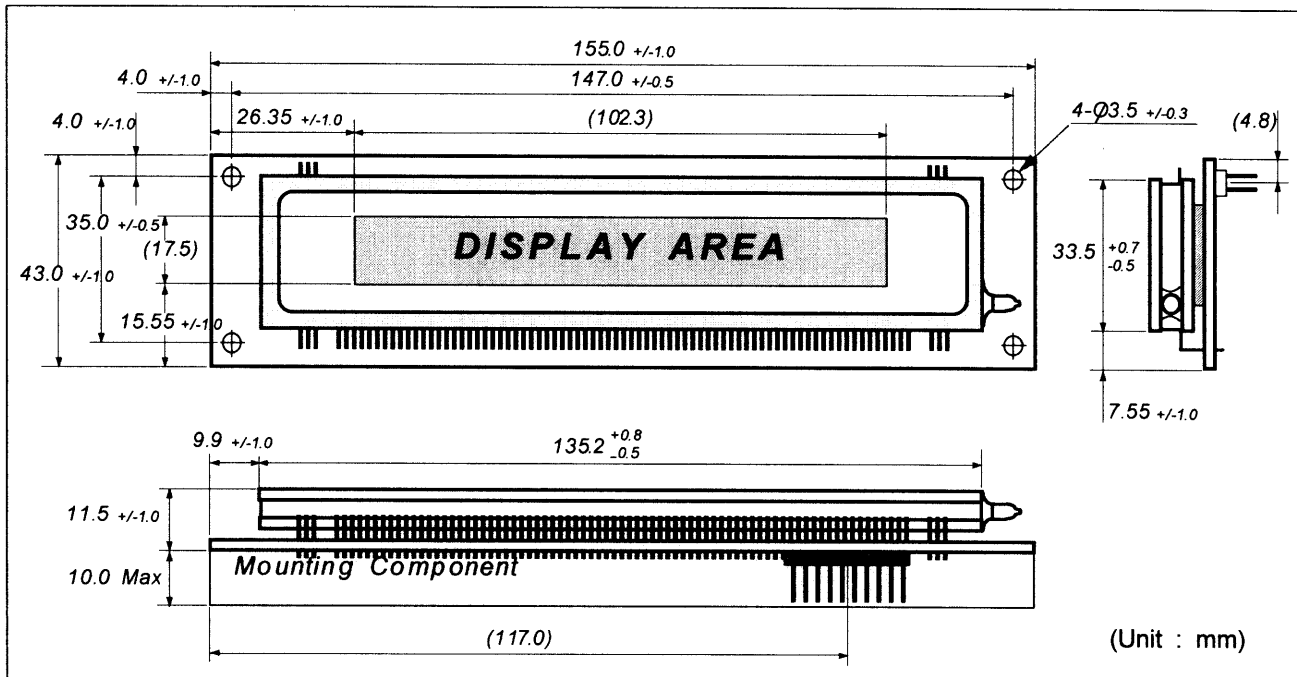


Fig-3. Outer Dimensions

4.11 Pattern Details

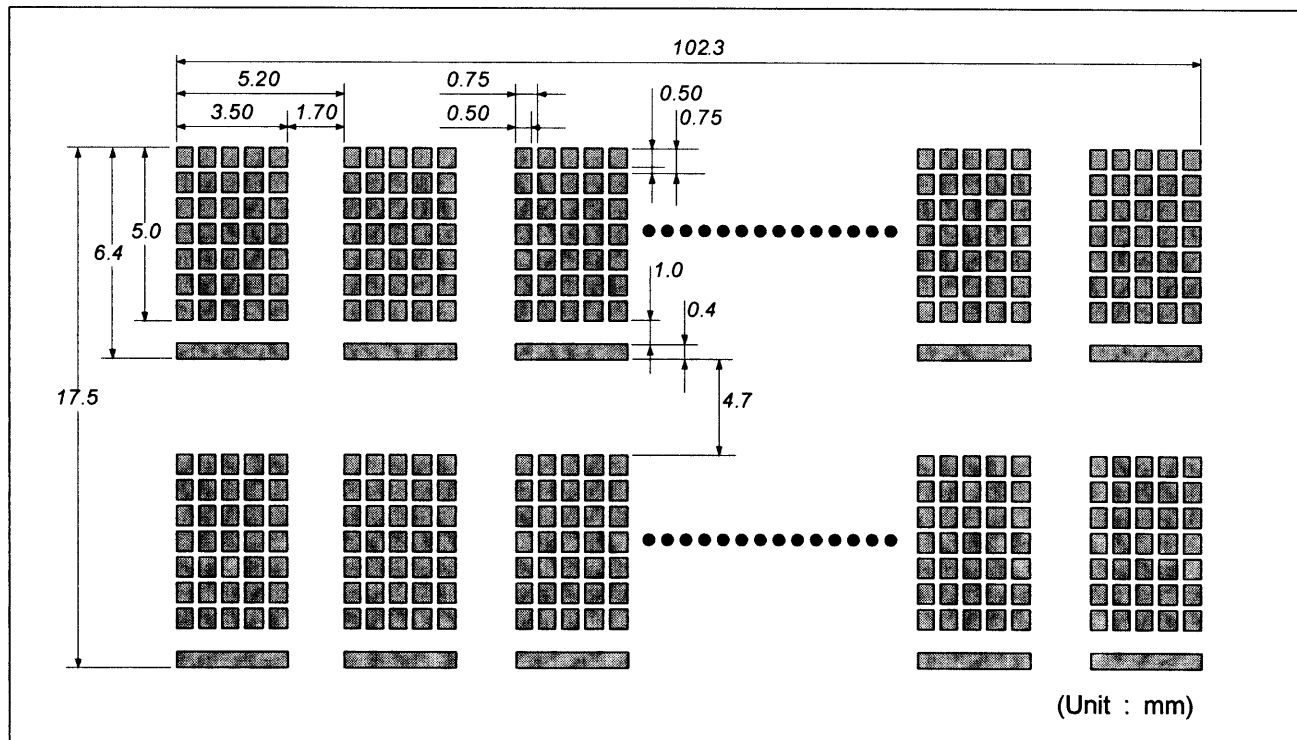


Fig-4. Pattern Details

4.12 System Block Diagram

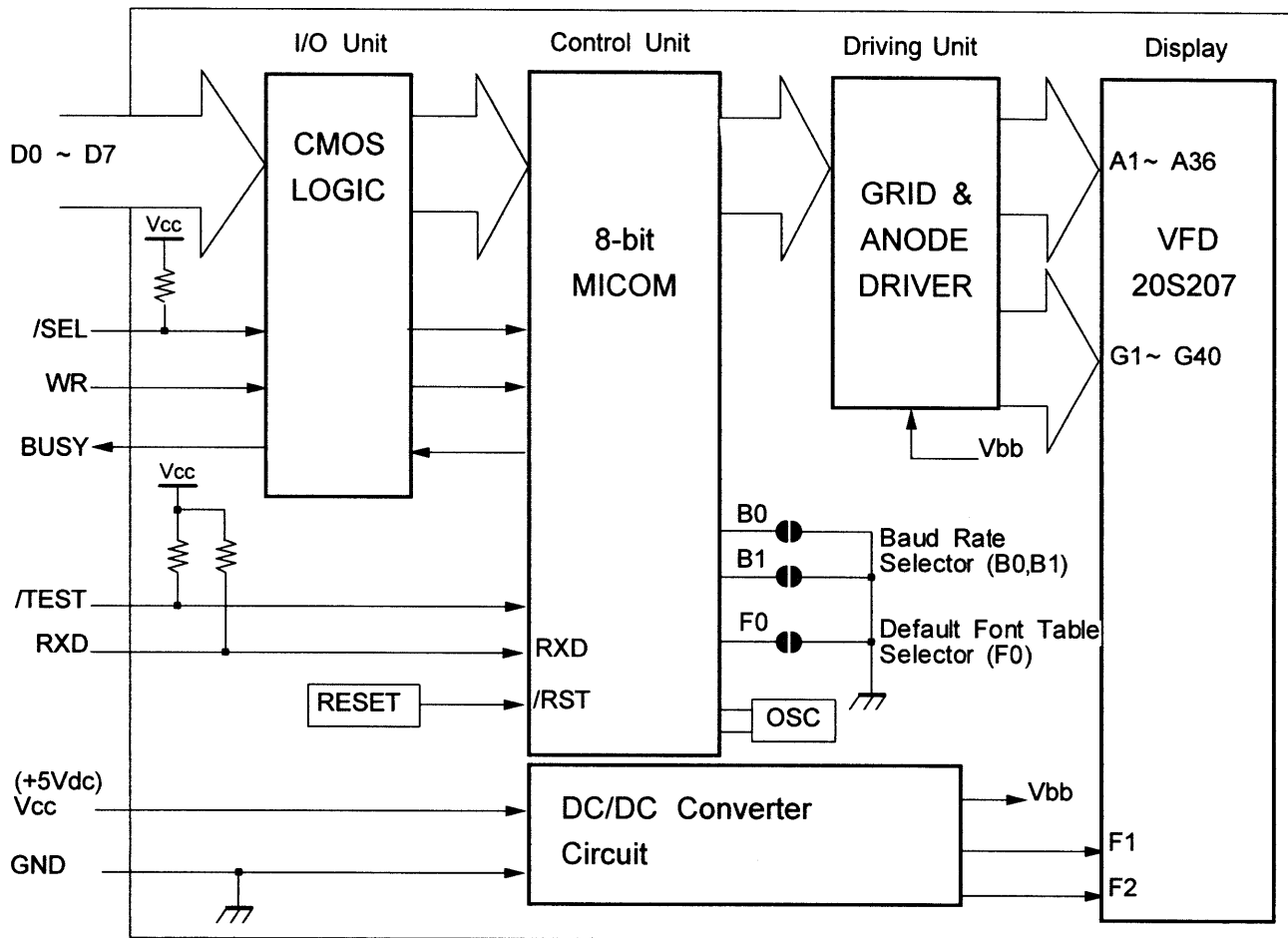


Fig-5. VFD Module System Block Diagram

4.13 Signal Interfacing

- Connector(Male) : PH-2S10-FG (Aster) or equivalent
- Mate Socket(Female) : HIF3B-20D-2.54R (by Hirose) or equivalent

Table\_9

Pin No	Signal	Parallel	Serial	Pin No	Signal	Parallel	Serial
1	D7	O	NC	2	Vcc	O	O
3	D6	O	NC	4	Vcc	O	O
5	D5	O	NC	6	Vcc	O	O
7	D4	O	NC	8	GND	O	O
9	D3	O	NC	10	GND	O	O
11	D2	O	NC	12	GND	O	O
13	D1	O	NC	14	GND	O	O
15	D0	O	NC	16	/TEST	O	O
17	WR	O	NC	18	/SEL	O	NC
19	RXD	NC	O	20	BUSY	O	NC

Note) O : Connection, NC : No Connection



## 5. FUNCTIONS

The module has data and control code write-in, self test and power on reset function.

Data and Control Code Write-in Table

Table\_10

/TEST	WR	/SEL	Function
1 or Open	0 → 1	0	Data and Control Code Write-in
1 → 0	X	X	Self-Test mode

X : Don't care.

When the data is being written-in, the BUSY signal is active (High) which indicates that the module is processing the data.

### 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) DIM : Dimming ~~~~~ 04 Hex
- (2) BS : Back Space ~~~~~ 08 Hex
- (3) HT : Horizontal Tab ~~~~~ 09 Hex
- (4) LF : Line Feed ~~~~~ 0A Hex
- (5) CR : Carriage Return ~~~~~ 0D Hex
- (6) DP : Display Position ~~~~~ 10 Hex
- (7) DC1 : Normal Display Mode ~~~~~ 11 Hex
- (8) DC2 : Vertical Scroll Mode ~~~~~ 12 Hex
- (9) DC3 : Cursor On Mode ~~~~~ 13 Hex
- (10) DC4 : Cursor Off Mode ~~~~~ 14 Hex
- (11) DC5 : Cursor Blinking Mode ~~~~~ 15 Hex
- (12) DC6 : Horizontal Scroll Mode ~~~~~ 16 Hex
- (13) FA : General European Font ~~~~~ 18 Hex
- (14) FB : Japanese Katakana Font ~~~~~ 19 Hex
- (15) UDF : Store an User-Definable Font ~~~~~ 1B Hex
- (16) RST : Reset (Initialization) ~~~~~ 1F Hex

#### 5.2.1 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 (See Table\_11)

Table\_11

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

**5.2.2 BS (08 Hex) : Back Space**

**DC1 Mode :** The write-in position is shifted to the left one digit and the character previously displayed on the digit will be cleared. (Beyond this point, the cursor position is identical with the write-in position of the display unless otherwise specified. Under DC4 mode, the cursor will not be shown up.) When the write-in position is on the most significant digit of the second row, the cursor moves to the least significant digit of the first row. When the write-in position is on the most significant digit of the first row, the cursor moves to the least significant digit of the second row.

**DC2 & DC6 Mode :** The same as DC1 mode operation.

**5.2.3 HT (09 Hex) : Horizontal Tab**

**DC1 Mode :** The write-in position is shifted to the right one digit. When the write-in position is on the least significant digit of the first row, the cursor moves to the most significant digit of the second row. When the write-in position is on the least significant digit of the second row, the cursor moves to the first row.

**DC2 Mode :** When the write-in position is on the least significant digit of the second row, the characters displayed in the second row are shifted up to the first row and the cursor moves to the most significant digit of the second row. Subsequently, the second row is cleared.

**DC6 Mode :** The same as DC1 mode operation

**5.2.4 LF (0A Hex) : Line Feed**

**DC1 Mode :** The write-in position moves up or down to the other row staying on the same column.

**DC2 Mode :** When the write-in position is on the second row, the characters displayed in the second row are shifted up to the first row, leaving the cursor at its present position, then the second row is cleared. When the write-in position is on the first row, the same as DC1 mode operation.

**DC6 Mode :** The same as DC1 mode operation

**5.2.5 CR (0D Hex): Carriage Return**

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

**5.2.6 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 (See Table\_12)*

Table\_12

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

**DC1, DC2 and DC6 modes are selection command of display mode.**

**5.2.7 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 row, the cursor moves to the most significant digit of the second row. When the character is displayed on the least significant digit of the second row, the cursor moves to the most significant digit of the first row.



**5.2.8 DC2 (12 Hex) : Vertical Scroll Mode**

After writing the characters up to the least significant digit of the second row, all the characters displayed in the second row are shifted up to the first row, clearing the second row. And the cursor moves to the most significant digit of the second row.

When the power is turned on, this DC2 mode is defaultly selected and will be held until another mode (DC1 or DC6 Mode) is selected.

**5.2.9 DC6 (16 Hex) : Horizontal Scroll Mode**

After writing the characters up to the least significant digit of each row, all the characters displayed in the same row of cursor position are shifted one digit to the left. At this time, the characters displayed on the most significant digit will be disappeared. But the characters displayed in the other row will not be changed.

**DC3-DC5 are the cursor control command.****5.2.10 DC3 (13 Hex) : Cursor On Mode**

The cursor is displayed. When the power is turned on, this mode is defaultly selected and will be held until another mode (DC4 or DC5 mode) is selected.

**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.

**5.2.13 FA (18 Hex) : General European Font**

The FA font table (See Table\_15.1 on Page 12/13) is selected.

**5.2.14 FB (19 Hex) : Japanese Katakana Font**

The FB font table (See Table\_15.2 on Page 13/13) is selected.

**5.2.15 UDF (1B 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 :** UDF(1B Hex) + CHR(00 ~ FF Hex) + PT1 + PT2 + PT3 + PT4 + PT5

Any 5x7 dots pattern consisted of data from 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 (1B Hex) ~~~~~~ Specify UDF command.
- \* 2nd byte : CHR (00~FF Hex) ~~~~~~ Specify the character code location from 00 Hex 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 code (1B Hex) may not avail further UDF function.
- \* 3rd~7th byte : (00 Hex ~ FF Hex) ~~~~~~ Specify ON or OFF of 35 dots position. Table\_11.1 shows the relation between dot position and data formation. The notation of "X.Y" means the Yth bit of Xth byte. For example, 3.7 means MSB(Most Significant Bit) of 3rd byte and 6.0 means LSB (Least Significant Bit) of 6th byte. ("1" = dot turn on, "0" = dot turn off at Table\_13.2)

Bit Map of 5x7 Dot Matrix					(Example) In Case of "S"					
Table_13.1					Table_13.2					
3.7	3.6	3.5	3.4	3.3	0	1	1	1	1	· 3rd byte : 7C Hex · 4th byte : 20 Hex · 5th byte : E0 Hex · 6th byte : 87 Hex · 7th byte : C0 Hex
3.2	3.1	3.0	4.7	4.6	1	0	0	0	0	
4.5	4.4	4.3	4.2	4.1	1	0	0	0	0	
4.0	5.7	5.6	5.5	5.4	0	1	1	1	0	
5.3	5.2	5.1	5.0	6.7	0	0	0	0	1	
6.6	6.5	6.4	6.3	6.2	0	0	0	0	1	
6.1	6.0	7.7	7.6	7.5	1	1	1	1	0	

\*) 7.4~7.0 are don't care.

**5.2.16 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 and display the cursor(set to DC3).

The display mode is set to DC2 (Vertical Scroll) mode, dimming level is set to FF Hex (100 %).

Also, the baud-rate and character font table is defaultly set by the combination of following Table\_15.

But in this case, the user-defined fonts that were already defined remain effective.

Soldering Switch OPEN/SHORT Combination Table

Table\_14

B0	B1	F0	FUNCTION	
Open	Open	X	Baud-rate Selection	1,200 bps
Short	Open	X		2,400 bps
Open	Short	X		4,800 bps
Short	Short	X		9,600 bps
X	X	Open	Character Font Selection	"FA" Font
X	X	Short		"FB" Font
Open	Open	Open	Setting at Factory	

X : Don't Care

\*) The switch symbols (B0, B1 and F0) are marked on PCB rear side.

**5.3 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.

**5.4 Self Test Mode**

Self test starts when /TEST = "1" to "0". (Connector 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".

## 6. OPERATING RECOMMENDATIONS

- 6.1 Avoid applying excessive shock or vibration beyond the specification for the VFD module.
- 6.2 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.
- 6.3 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.
- 6.4 Avoid plugging or unplugging the interface connection with the power on, otherwise it may cause the severe damage to input circuitry.
- 6.5 Slow starting power supply may cause non-operation because one chip micom won't be reset.
- 6.6 Exceeding any of maximum ratings may cause the permanent damage.
- 6.7 Since the VFD modules contain high voltage source, careful handling is required while power is on.
- 6.8 When the power is turned off, the capacitor does not discharge immediately.  
So the high voltage applied to the VFD must not get in contact with ICs. In other words, short-circuit of mounted components on PCB within 30 seconds after power-off may cause damage the module.
- 6.9 The power supply must be capable of providing at least 3 times the rated current, because the surge current may be 3 times the specified current consumption when the power is turned on.
- 6.10 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.
- 6.11 Since all VFD modules contain C-MOS ICs, anti-static handling procedures are always required.



"FA" (General European) Font Table

Table\_15.1

Upper		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		
Lower		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	a	P	`	P	Q	E	a	d	B	A	A	Z
0	0	0	1	1		DC1	!	1	A	0	a	q	u	x	i	P	E	E	A	z
0	0	1	0	2		DC2	"	2	B	R	b	r	e	R	o	r	R	O	N	s
0	0	1	1	3		DC3	#	3	C	S	c	s	a	s	u	d	/	E	H	L
0	1	0	0	4	DIM	DC4	\$	4	D	T	d	t	a	b	n	E	X	Y	Q	o
0	1	0	1	5		DC5	%	5	E	U	e	u	a	b	N	n	-	A	U	v
0	1	1	0	6		DC6	&	6	F	V	f	v	A	O	a	o	2	E	H	e
0	1	1	1	7			'	7	G	W	w	c	u	o	\	3	T	W	o	
1	0	0	0	8	BS	FA	(	8	H	X	h	x	a	y	z	P	*	O	W	e
1	0	0	1	9	HT	FB	)	9	I	Y	i	y	e	O	r	T	T	O	b	+
1	0	1	0	A	LF		*	A	J	Z	j	z	e	O	-	P	+	B	M	+
1	0	1	1	B		UDF	+	B	K	C	k	c	i	o	u	o	o	r	3	*
1	1	0	0	C			,	C	L	\	l	\	i	e	w	z	*	A	M	+
1	1	0	1	D	CR		-	D	M	I	m	)	z	y	i	o		X	R	
1	1	1	0	E			.	E	N	^	n	^	A	R	o	O		o		
1	1	1	1	F		RST	/	F	?	O	L	o	■	A	f	o	z	N	o	

"FB" (Japanese Katakana) Font Table

Table\_15.1

Upper		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				
Lower		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	P	'	P	A	E		—	9	E	↑	↘		
0	0	0	1	1		DC1		!	1	A	0	a	9	0	5	=	7	7	△	↓	↘	
0	0	1	0	2		DC2		"	2	B	R	b	r	E	r	/	w	x	+	+	+	
0	0	1	1	3		DC3		#	3	C	S	c	s	A	R	.	7	E	+	+	+	
0	1	0	0	4	DIM	DC4		\$	4	D	T	d	t	E	/	\	I	h	h	+		
0	1	0	1	5		DC5		%	5	E	U	e	u	n	x	.	*	+	1	h	!	
0	1	1	0	6		DC6		&	6	F	V	f	v	0	h	9	0	—	3	P	!	
0	1	1	1	7				'	7	G	W	g	w	λ	-	7	+	x	7	h	o	
1	0	0	0	8	BS	FA		(	8	H	X	h	x	P	2	4	0	*	U	K	o	
1	0	0	1	9	HT	FB		)	9	I	V	i	v	U	3	h	7	/	h	h	w	
1	0	1	0	A	LF			*	:	J	Z	j	z	P	*	+	3	h	v	h	w	
1	0	1	1	B		UDF		+	;	K	C	k	c	O	W	*	7	h	h	h	h	
1	1	0	0	C				,	<	L	*	l	l	7	/	h	3	7	7	o	7	
1	1	0	1	D	CR			—	=	M	I	m	i	)	0	r	u	x	\	U	0	h
1	1	1	0	E				h	>	N	^	n	^	0	+	3	E	h	h	h	h	o
1	1	1	1	F		RST		/	?	O	_	o	o	0	Σ	h	w	v	7	h	h	o

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