

To :

SPECIFICATION

Rev 2.0

Application :

VACUUM FLUORESCENT DISPLAY MODULE

Model No. : 20L203DA5

Rev No.	Issued Date	Description	Remark
Tentative	April. 20, 2000	First Edition	
1.0	April. 28, 2000	2nd Edition - Change of the description " ESC = n "	14/16
2.0	June. 10, 2000	3rd Edition - Change of the Self-Test routine. - Typing Error Correction of the PC850 font table. (90Hex ↔ A0Hex)	6/16 8/16

Issued by	<i>[Signature]</i>
Checked by	
Approved by	<i>[Signature]</i>

Customer Approval

1. SCOPE

This specification applies to VFD module(Model No:20L203DA5) manufactured by Samsung SDI.

2. FEATURES

- 2.1 Simple connection to the host system. With serial data transmission method, it is possible to choose 2400, 4800, 9600 or 19200 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 PC437(U.S.A., standard Europe), PC850(multilingual) and PC866(Russian).
- 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 5 x 7 dot matrix.

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	20L203DA5
Digit Format	5 x 7 Dot Matrix with Annunciator (▼)

4.2 Outer Dimensions, Weight (See Fig-3 for details) Table_2

Parameter		Specification	Unit
Outer Dimensions	Width	190.0 +/-1.0	mm
	Height	64.0 +/-1.0	mm
	Thickness	25.6 Max	mm
Weight		Typical 200	g

4.3 Specifications of the Display Panel (See Fig-4 for details)

Table_3

Parameter		Symbol	Specification	Unit
Display Size		W x H	146.1 x 29.0	mm
Number of Digit		-	20 Digits x 2 Rows	-
Character Size		W x H	5.5 x 10.5	mm
Character Pitch	Horizontal	CP(x)	7.4	mm
	Vertical	CP(y)	15.5	mm
Display Color		-	Blue-Green(505 nm)	-

4.4 Environment Conditions

Table_4

Parameter	Symbol	Min.	Max.	Unit
Operating Temperature	Topr	-0	+50	°C
Storage Temperature	Tstg	-20	+70	°C
Humidity (Operating)	Hopr	30	85	%
Humidity (Non-operating)	Hstg	30	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	-15.0	15.0	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 (Space Signal)	VIH	3.0	-	15.0	VDC
L-Level Input Voltage (Mark Signal)	VIL	-15.0	-	-3.0	VDC

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

Table_7

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply Current *)	Icc	-	800	1200	mA
H-Level Input Current	IiH	-	-	+8.3	mA
L-Level Input Current	IiL	-	-	-8.3	mA
Brightness	L	100	200	-	ft-L

* Note) The surge current can be approx. 3 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.

4.8 Timing Chart

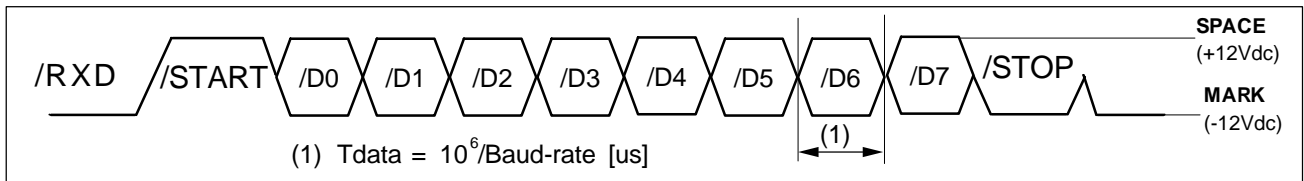
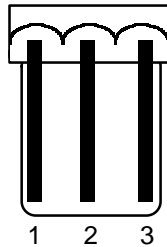


Fig-1. Serial Input Timing Diagram

4.9 Signal Interfacing

.Connector(Male) : 5046-03A (by MOLEX) - Single 3 Pins (Right Angled)

→ Mate socket(Female) : 5051-03 (by MOLEX) or equivalent



Table_8

Pin No.	Signal
1	Vcc
2	/RXD
3	GND

4.10 System Block Diagram

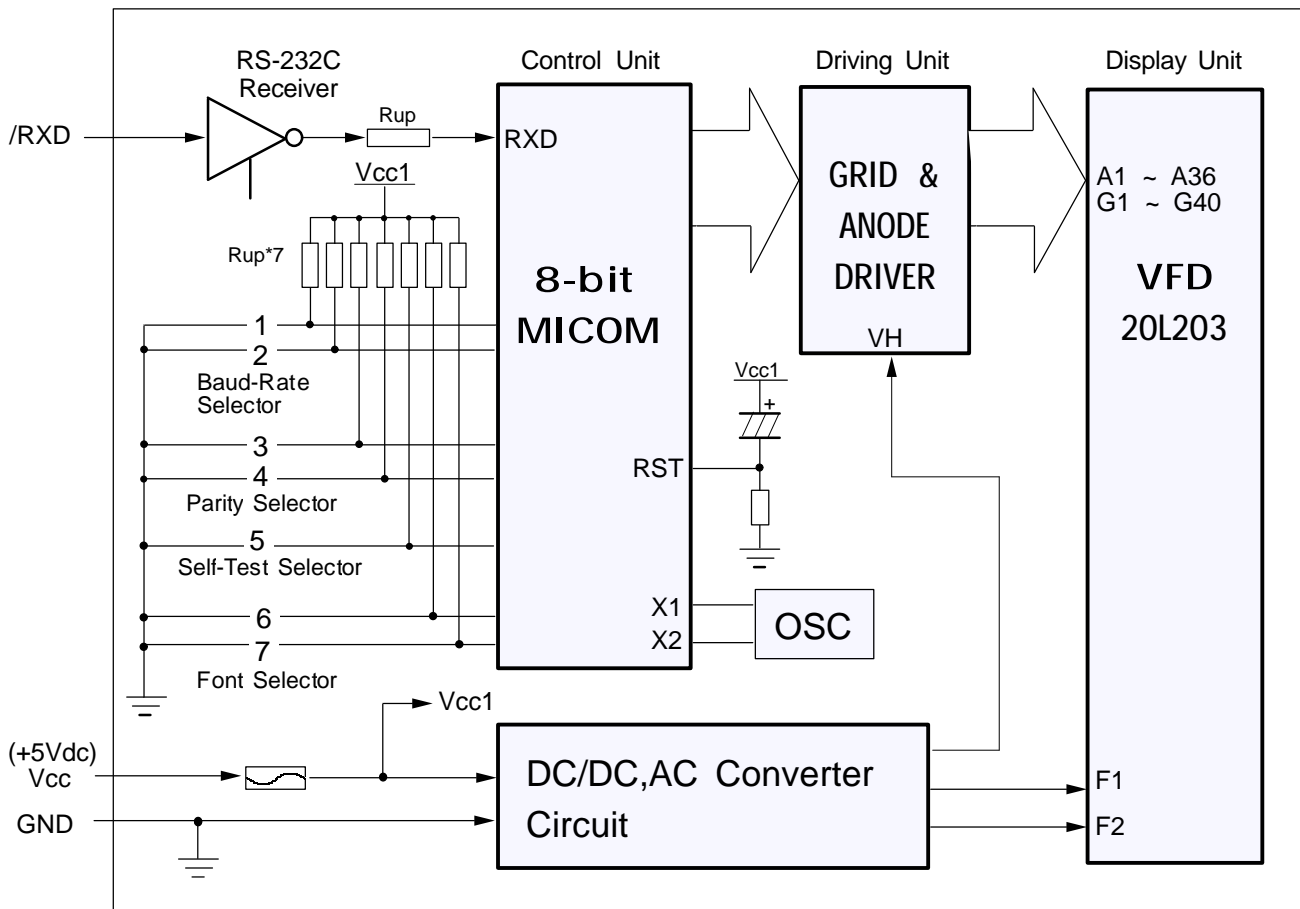


Fig-2. VFD Module System Block Diagram

4.11 Outer Dimensions

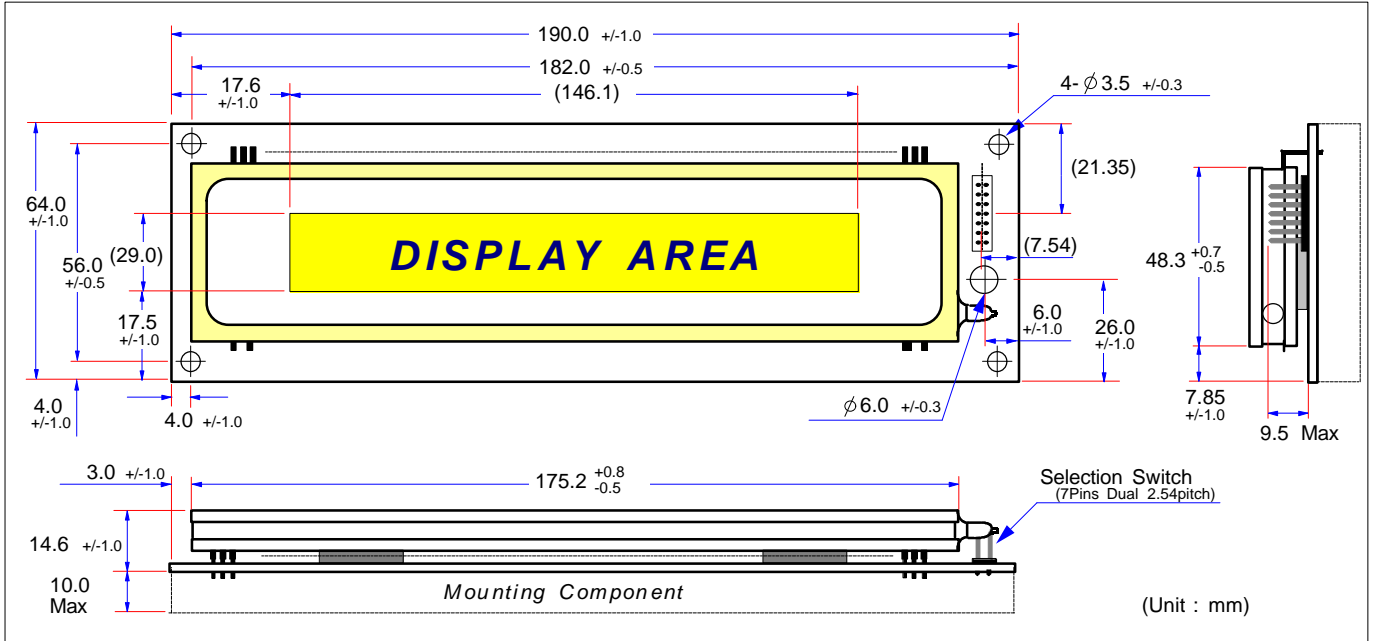


Fig-3. Outer Dimensions

4.12 Pattern Details

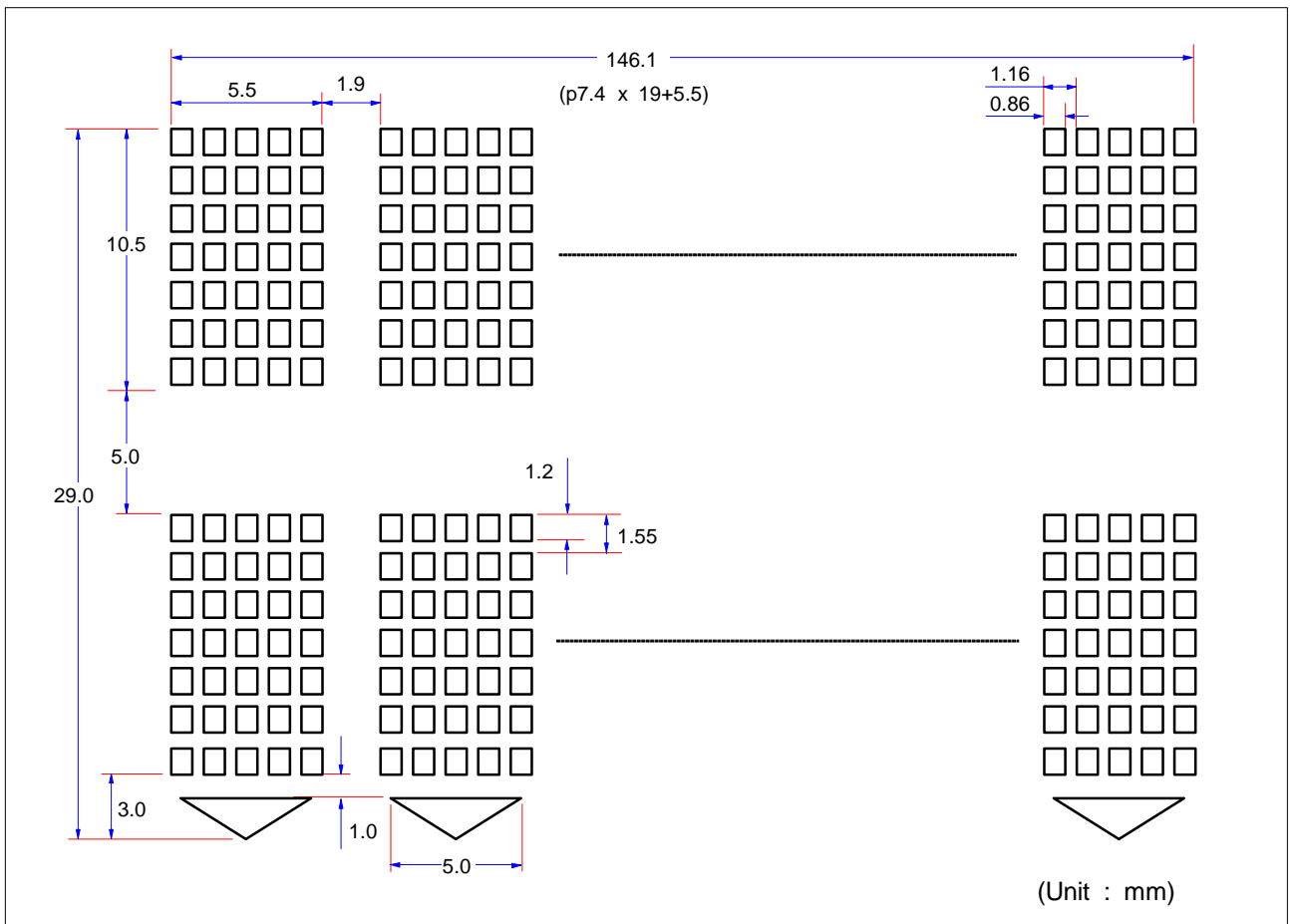


Fig-4. Pattern Details

5. FUNCTIONS

5.1 Switches

The Selection switches (Part No: PH-2S07-FG By Aster) are located on the PCB right side.

Refer to Table_9. The switch settings are read only when the power is turned on. Therefore, changing the settings while the power is on has no effect.

Selection Switches OPEN/SHORT Combination Table

Table_9

1	2	3	4	5	6	7	FUNCTION	
Open	Open	x	x	x	x	x	Baud-rate Selection	9,600 bps
Open	Short	x	x	x	x	x		4,800 bps
Short	Open	x	x	x	x	x		2,400 bps
Short	Short	x	x	x	x	x		19,200 bps
x	x	Open	x	x	x	x	Parity Selection	Non Parity
x	x	Short	Open	x	x	x		Odd Parity
x	x	Short	Short	x	x	x		Even Parity
x	x	x	x	Open	x	x	Self Test Selection	Do Not Perform
x	x	x	x	Short	x	x		Perform Self-Test
x	x	x	x	x	Open	Open	Font Selection	PC437
x	x	x	x	x	Short	Open		PC850
x	x	x	x	x	x	Short		PC866
Open	Open	Open	Open	Open	Open	Open	Setting at Factory	

5.2 Self-Test Function

5.2.1 Starting the Self-Test

There are two ways to start the self-test, as follows :

- 1) Use Control Commands (See Section 5.4.24)
- 2) /SELF_TEST="0". (Selection switch pin #5 is connected to GND.)

5.2.2 Ending the Self-Test

After a series of self-tests is executed, the screen is cleared, the cursor is moved to the home position, and the display goes into the standby state.

5.2.3 Contents of the Self-Test

The self-test shows the following :

- 1) Selection switches state
- 2) Display characters
- 3) Functions

Note 1) When a self-test is executed using command of "US @", the user-defined character definitions are retained.

Note 2) In using this mode, neither data nor control code write-in is allowed.

(A self-test operation will be executed for 20 seconds approximately. And when the self-test is being executed, receiving data is not processed. Therefore, host computer should transmit the data after 20 seconds from the beginning of a self-test)

Table-10-1 "PC437" Font Table (International Characters set : U.S.A.)

				DB7	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	
				DB6	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	1
				DB5	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	
				DB4	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
DB3	DB2	DB1	DB0		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
0	0	0	0	0	NUL			O	@	P	'	F	9	E	A	:	:	L	↑	α	≡
0	0	0	1	1	MD1			!	1	A	Q	a	9	Ü	æ	í	*	+	τ	B	±
0	0	1	0	2	MD2			"	2	B	R	b	r	é	Æ	ó	*	τ	τ	Γ	≥
0	0	1	1	3	MD3			#	3	C	S	c	s	À	à	Ó	í	†	†	π	≤
0	1	0	0	4				\$	4	D	T	d	t	ä	ö	Ä	†	-	†	Σ	Γ
0	1	0	1	5				%	5	E	U	e	u	à	ò	Ä	†	†	†	†	†
0	1	1	0	6				&	6	F	V	f	v	á	á	á	†	†	†	†	†
0	1	1	1	7				'	7	G	W	g	w	ú	ú	†	†	†	†	†	†
1	0	0	0	8	BS	CAN		(	8	H	X	h	x	é	ö	†	†	†	†	†	†
1	0	0	1	9	HT			)	9	I	Y	i	y	ë	ö	†	†	†	†	†	†
1	0	1	0	A	LF			*	:	J	Z	j	z	è	ü	†	†	†	†	†	†
1	0	1	1	B	HOM	ESC		+	:	K	[	k	[	ï	é	†	†	†	†	†	†
1	1	0	0	C	CLR			,	<	L	\	l	l	î	é	†	†	†	†	†	†
1	1	0	1	D	CR			-	=	M	]m	)	i	†	†	†	†	†	†	†	†
1	1	1	0	E				.	>	N	^	n	~	Ä	R	†	†	†	†	†	†
1	1	1	1	F		US		/	?	O	_	o		À	†	†	†	†	†	†	†

Table-10-2 "PC850" Font Table (International Characters set : U.S.A.)

				DB7	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	
				DB6	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1	1
				DB5	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	
				DB4	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
DB3	DB2	DB1	DB0		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
0	0	0	0	0	NUL			O	@	P	'	F	9	E	Á	B	U	á	ó	æ	
0	0	0	1	1	MD1			!	1	A	Q	a	9	ü	æ	í	Γ	4	Ð	B	±
0	0	1	0	2	MD2			"	2	B	R	b	r	é	Æ	ó	A	W	e	ó	š
0	0	1	1	3	MD3			#	3	C	S	c	s	á	ó	ú	X	W	è	ò	¼
0	1	0	0	4				\$	4	D	T	d	t	ä	ö	Å	3	b	è	ö	¶
0	1	0	1	5				%	5	E	U	e	u	à	ó	Ñ	A	M	N	ó	§
0	1	1	0	6				&	6	F	V	f	v	á	ó	á	A	á	i	µ	;
0	1	1	1	7				'	7	G	W	g	w	ú	ó	À	Å	i	P	Ò	
1	0	0	0	8	BS	CAN		(	8	H	X	h	x	é	ü	¿	M	3	i	P	°
1	0	0	1	9	HT			)	9	I	Y	i	y	ë	ö	ß	À	W	ó	z	
1	0	1	0	A	LF			*	:	J	Z	j	z	è	ü	Û	Œ	Z	O	€	
1	0	1	1	B	HOM	ESC		+	:	K	[	k	[	í	ø	£	Π	ó	■	Ò	1
1	1	0	0	C	CLR			,	<	L	\	l	\	î	É	MY	é	z	9	3	
1	1	0	1	D	CR			-	=	M	]	m	]	ï	ð	i	ç	é	¿	2	
1	1	1	0	E				.	>	N	^	n	^	Ä	×	«	¥	£	i	ç	°
1	1	1	1	F		US		/	?	O	_	o	_	Å	÷	»	Ø	×	R	È	

Table-10-3 "PC866" Font Table (Russian Characters)

		<i>MSB</i>																				
		DB7	DB6	DB5	DB4	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
<i>LSB</i>					0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F		
	DB3	DB2	DB1	DB0																		
0	0	0	0	0	NUL			0	@	P	'	Р	А	Р	а	:	Л	Л	Р	Е		
0	0	0	1	1	MD1		!	1	А	Q	а	а	Б	С	Б	*	+	Т	С	ё		
0	0	1	0	2	MD2		"	2	В	В	г	В	Т	В	*	т	т	Т	Е			
0	0	1	1	3	MD3		#	3	С	С	с	Г	Г	г	Г	Г	Г	Г	Г	Е		
0	1	0	0	4			\$	4	Д	Т	д	Т	А	Ф	А	+	-	+	о	И		
0	1	0	1	5			%	5	Е	U	e	U	Е	Х	e	+	+	Г	Х	и		
0	1	1	0	6			&	6	В	U	у	Х	Ц	Х	+	+	Г	У	9			
0	1	1	1	7			'	7	Г	W	g	w	3	4	з	г	Г	Г	У			
1	0	0	0	8	BS	CAN	(	8	Х	Х	х	Х	W	W	г	+	+	W	°		
1	0	0	1	9	HT		)	9	И	Y	i	y	А	W	А	+	Г	+	W	°
1	0	1	0	A	LF		*	:	Ж	З	ж	з	К	Б	К	+	+	Г	Б	.		
1	0	1	1	B	HOM	ESC	+	:	К	Г	к	Г	А	В	А	г	Г	Г	W	√		
1	1	0	0	C	CLR		,	<	Л	\	l	!	М	Б	М	+	+	Г	Б	М		
1	1	0	1	D	CR		-	=	М	Г	м	)	Н	З	Н	+	-	Г	З	Х	
1	1	1	0	E			.	>	Н	^	n	~	О	W	о	+	+	Г	W	Г		
1	1	1	1	F		US	/	?	О	_	o		П	Я	п	г	+	Г	Я			

5.3 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.

5.4 Control Code Write-in

The control commands are available as Table_11 and details are will be explained from section 5.1.1 to 5.4.24.

Reference Table for Control Command

Table_11

No	Symbol	Function	No	Symbol	Function
1	BS	Move cursor left	14	ESC &	Define user-definable font
2	HT	Move cursor right	15	ESC ?	Cancel user-defined font
3	LF	Move cursor down	16	ESC =	Select peripheral device
4	US LF	Move cursor up	17	ESC R	Select an internation character set
5	HOM	Move cursor to home position	18	ESC t	Select character code table
6	CR	Move cursor to left-end position	19	US MD1	Specify overwrite mode
7	US CR	Move cursor to right-end position	20	US MD2	Specify vertical scroll mode
8	US B	Move cursor to bottom position	21	US MD3	Specify horizontal scroll mode
9	US \$	Move cursor to specified position	22	US E	Select/Cancel display screen blinking
10	CLR	Clear display screen	23	US X	Brightness adjustment (Dimming)
11	CAN	Clear cursor line	24	US #	Turn annunciator on/off
12	ESC @	Initialize display	25	US @	Execute self-test
13	ESC %	Select/Cancel user-defined font			

5.4.1 BS (08 Hex, Back Space) : Move cursor left

Move the cursor one character position to the left.

When the cursor is at the left end of a line, the operation of this command depends on the display mode.

- 1) Overwrite mode : When the cursor is at the end of the lower line, it is moved to the right end of the upper line. When it is at the end of the upper line, it is moved to the right end of the lower line.
- 2) Vertical scroll mode : When the cursor is at the end of the lower line, it is moved to the right end of the upper line. When it is at the end of the upper line, the display on the upper line is scrolled to the lower line and the upper line is cleared. At this time the cursor is moved to the right end of the upper line.
- 3) Horizontal scroll mode : All characters on the current line are scrolled on character to the right. The cursor is not moved, but the character area at the left end is cleared.

5.4.2 HT (09 Hex, Horizontal Tab) : Move cursor right

Move the cursor one character position to the right.

When the cursor is at the right end of a line, the operation of this command depends on the display mode.

- 1) Overwrite mode : When the cursor is at the right end of the upper line, it is moved to the left end of the lower line. When it is at the right end of the lower line, it is moved to the left end of the upper line.
- 2) Vertical scroll mode : When the cursor is at the right end of the upper line, it is moved to the left end of the lower line. When it is at the right end of the lower line, the display on the lower line is scrolled to the upper line and the lower line is cleared.

At this time, the cursor is moved to the left end of the lower line.

- 3)Horizontal scroll line : All characters on the current line are scrolled one character to the left.
The cursor is not moved, but the character area at the right end is cleared.

5.4.3 LF (0A Hex) : Move cursor down

Moves the cursor down one line.

When the cursor is on the lower line, the operation of this command depends on the display mode, as follows:

- 1)Overwrite mode :
The cursor is moved to the same column on the upper line.
- 2)Vertical scroll mode :
The characters displayed in the lower line are scrolled to the upper line and the lower line is cleared. The cursor remains at the same position.
- 3)Horizontal scroll mode :
The cursor is not moved.

5.4.4 US LF (1F Hex + 0A Hex) : Move cursor up

Moves the cursor up one line.

When the cursor is on the upper line, the operation of this command depends on the display mode, as follows:

- 1)Overwrite mode :
The cursor is moved to the same column on the lower line.
- 2)Vertical scroll mode :
The characters displayed on the upper line are scrolled to the lower line and the upper line is cleared. The cursor remains at the same position.
- 3)Horizontal scroll mode :
The cursor is not moved.

5.4.5 HOM (0B Hex) : Move cursor to home position

Moves the cursor to the left-end position on the upper line (home position).
Home position indicates the first column of the upper line.

5.4.6 CR (0D Hex) : Move cursor to left-end position

Moves the cursor to the left-end position on the current line.

5.4.7 US CR (1F Hex + 0D Hex) : Move cursor to right-end position

Moves the cursor to the right-end position on the current line.

5.4.8 US B (1F Hex + 42 Hex) : Move cursor to bottom position

Moves the cursor to the 20th column of the lower line.

5.4.9 US \$ n m (1F Hex + 24 Hex + n + m) : Move cursor to specified position

[Range] 01 Hex ≤ n ≤ 14 Hex (20 Decimal), m = 1 or 2

Moves the cursor to the *n*th column on the *m*th line. If a value exceeding the range is specified for *n*(column) and/or *m*(line), this command is ignored and the cursor does not move.

5.4.10 CLR (0C Hex) : Clear display screen

Clear all the displayed characters.

After this command is executed, the cursor moves to the home position.

5.4.11 CAN (18 Hex) : Clear cursor line

Clears the line containing the cursor.

After this command is executed, the cursor moves to the left-end position on the current line.

5.4.12 ESC @ (1B Hex + 40 Hex) : Initialize display

Resets the various display settings to their initial values.

The software settings are reset to their power-on values. The soldering land switches are not checked again except font selector switches #6 and #7.

After initializing the display, the display screen is cleared and the cursor moves to the home position.

5.4.13 ESC % n (1B Hex + 25 Hex + n) : Select/cancel user-defined font set

[Range] n = 0 or 1

Selects or cancels the user-defined font set.

When n =1, the user-defined font set is selected. When the user-defined character set is not defined using the ESC & command, the international character set is displayed.

When n =0, the user-defined font set is canceled. (The international character set is selected.)

In this case, this command has no effect on the user-defined font that have already been defined using the ESC & command. This command has no effect on the characters already displayed.

5.4.14 ESC & s n m a p1 ... ps (1B Hex + 26 Hex + s + n + m + [a + p1+p2 ... ,psXa]^{m-n+1}) : Define user-definable font

[Range] s = 1

20 Hex ≤ n ≤ m ≤ 7E Hex

0 ≤ a ≤ 5

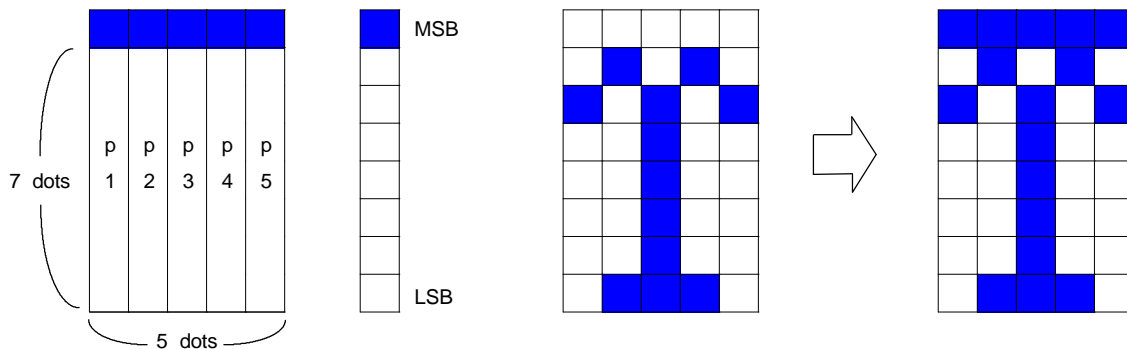
00 Hex ≤ p1, ..., psxa ≤ FF Hex

Define user-definable font.

- . 's' denotes the number of bytes in the vertical direction.
- . 'n' specifies the beginning character code for the direction, and 'm' the final character code. When only one character is defined, use n=m.
- . 4 characters can be defined between character codes 20Hex and 7EHex in the character code table.
- . 'a' denotes the number of dots in the horizontal direction. When 'a' < 5, the remaining dots on the right side of the user-defined characters are padded with spaces.
- . p1... ps is the dot data to be defined for the characters. The dot pattern is in the horizontal direction from the left side. The number of data items to be defined is specified for the communication word length, the most significant bit is ignored.
- . Once the user-defined characters are defined they remain effective until they are redefined, ESC @ is executed, or the power is turn off.
- . When only the user-defined character definition is set and user-defined character set is not selected using ESC % command, user-defined characters are not displayed.

[Example] To define the character "T" at character code 20H.

Table_12



When the communication word length is specified as seven bits, or when the word length is specified as eight bits and the most significant bit is processed as "0", the user-defined character definition is executed as shown blow.

1B Hex + 26 Hex + 01 Hex
 + 20 Hex + 20 Hex + 05 Hex
 + 20 Hex + 41 Hex + 3F Hex + 41 Hex + 20 Hex

When the word length is specified as eight bits and the most significant bit is processed as "0", the user-defined character definition is executed as shown blow.

1B Hex + 26 Hex + 01 Hex
 + 20 Hex + 20 Hex + 05 Hex
 + A0 Hex + C1 Hex + BF Hex + C1 Hex + A0 Hex

5.4.15 ESC ? n (1B Hex + 3F Hex + n) : Cancel user-defined fonts

[Range] 20 Hex ≤ n ≤ 7E Hex

Cancel user-defined fonts.

This command cancels the pattern defined for the character code specified by the 3rd byte(n). If the specified code is transmitted after the pattern is canceled by this command, the international character is displayed. If the specified character code is not defined, this command is ignored. This command has no effect on characters already displayed.

5.4.16 ESC R n (1B Hex + 52 Hex + n) : Select an international character set

[Range] 0 ≤ n ≤ 0A Hex (10 decimal)

When the power is turned on, the default value of n is 0(set to U.S.A.) Select an international character set n from the Table_13.

International Character Set

Table_13

		Hex	23	24	40	5B	5C	5D	5E	60	7B	7C	7D	7E
n	Country	Dec	35	36	64	91	92	93	94	96	123	124	125	126
0	U.S.A.		#	\$	@	[	\	\]	^	'	(	|	)	~
1	France		#	\$	à	°	ç	ç	^	'	é	ù	è	ˆ
2	Germany		#	\$	ß	Ä	Ö	Ü	^	'	ä	ö	ü	ß
3	U.K.		£	\$	@	[	\	\]	^	'	(	|	)	~
4	Denmark-#1		#	\$	@	Å	Ø	Å	^	'	æ	ø	å	ˆ
5	Sweden		#	å	£	Ä	Ö	Å	Ü	é	ä	ö	å	ù
6	Italy		#	\$	@	°	\	é	^	ù	à	ó	è	ì
7	Spain		Ñ	\$	@	ı	Ñ	¿	^	'	ˆ	Ñ	)	ˆ
8	Japan		#	\$	@	[	¥	]	^	'	(	|	)	ˆ
9	Norway		#	å	£	Å	Ø	Å	Ü	é	æ	ø	å	ù
10	Denmark-#2		#	\$	£	Å	Ø	Å	Ü	é	æ	ø	å	ù

5.4.15 ESC = n (1B Hex + 3D Hex + n) : Select / Cancel peripheral device

[Range] 1 ≤ n ≤ 3

Selects or cancels VFD device, in accordance with the value of n.

n = 1 : This VFD Module is canceled.

n = 2 : This VFD Module is selected. (Default)

n = 3 : This VFD Module and the other device are selected.

This Command is effectively applied that the data from the host is transmitted to the other device via the VFD module.

[Example : Data lines are used in common with the printer]

Table_14

n	Peripheral device	1	0
bit0	Printer	Selected	Canceled
bit1	VFD Module	Selected	Canceled
bit2 ~ bit7	Undefined		

.When the printer is selected by n=1, all the data from the host computer is transmitted to the printer via the VFD Module.

.When the VFD Module is selected by n=2, all the data from the host computer is processed internally in the VFD Module, and no data is transmitted to the printer.

.When both the printer and VFD Module are selected by n=3, all the data from the host computer is processed internally in the VFD Module and transmitted to the printer simultaneously.

5.4.17 ESC t n (1B Hex + 74 Hex + n) : Select character code table

[Range] 0 ≤ n ≤ 2

Select a character code table.

When n = 0, the PC437 is selected. (Refer to Table_10.1)

When n = 1, the PC850 is selected. (Refer to Table_10.2)

When n = 2, the PC866 is selected. (Refer to Table_10.3)

This command has no effect on data displayed before this command is received.

This command has no effect on the selected international character set.

When the power is turned on, the n depends on the header switches #6, #7 defaultly.

(See Table_9)

5.4.18 US MD1 (1F Hex + 01 Hex) : Select overwrite mode

Select overwrite mode as the screen display mode.

In overwriting mode, entering a character code moves to the left end of the lower line when the cursor is at the right end of the upper line, and to the left end of the upper line when the cursor is at the right end of the lower line. When the power is turned on, this mode is selected defaultly.

5.4.19 US MD2 (1F Hex + 02 Hex) : Select vertical scroll mode

Select vertical scroll mode as the screen display mode.

In vertical scroll mode, entering a character code moves the cursor to the left end of the lower line when the cursor is at the right end of the upper line, scrolls the characters displayed on the lower line, and clears the lower line when the cursor is at the right end of the lower line. At this time the cursor is moved to the left end of the lower line.

5.4.20 US MD3 (1F Hex + 03 Hex) : Select horizontal scroll mode.

Selects vertical scroll mode as the screen display mode.

In horizontal scroll mode, entering a character code scrolls all displayed characters one character to the left, then displays the new character at the right end.

(when the cursor is at the right end of either line).

5.4.21 US E n (1F Hex + 45 Hex + n) : Set display screen blink interval

[Range] 0 ≤ n ≤ FF Hex

Sets or cancels the blink interval of the display screen.

n specifies the blink interval. [(n x 13 msec.) ON + (n x 13 msec.) OFF] is repeated.

When n = 0, the display is kept on(cancels blinking).

When n = FF Hex (255 decimal), the display is turned off but the contents of the display are maintained. When the power is turned on, n = 0 is selected defaultly.

5.4.22 US X n (1F Hex + 58 Hex + n) : Brightness adjustment

[Range] 1 ≤ n ≤ 4

Sets the brightness of the vacuum fluorescent character display tube.

n selects the percentage of brightness as follows:

n = 1, Brightness Level = 40 %

n = 2, Brightness Level = 60 %

n = 3, Brightness Level = 80 %

n = 4, Brightness Level =100 %

When the power is turned on, n =4 is selected defaultly.

5.4.23 US # n m (1F Hex + 23 Hex + n + m) : Turn annunciator on/off

[Range] n = 0 or 1, 0 ≤ m ≤ 14 Hex (20 Decimal)

Turns the annunciator at column m on or off.

When n =0, the annunciator at column m is turned off.

When n =1, the annunciator at column m is turned on.

m specifies the column number (the left-end column is column 1) where the annunciator to be turned on or off is located. However, when m equals 0, all annunciators are either off or on, based on the corresponding value of n.

5.4.24 US @ (1F Hex + 40 Hex) : Execute self-test

Execute the self-test.

A series of self-tests is displayed. All set values except user-defined character definitions are initialized. After a series of self-tests is executed , the screen is cleared and the display position is moved to the home position.

5.5 Defaults (Initial States at Power-On)

The following Table_15 lists the default settings in effect at the time power is switched-on.

Table_15

No	Items	Default Settings
1	Display Device select	Selected
2	Display Mode	Overwrite Mode (US MD1)
3	Cursor position	Home Position (Left-end of Upper row)
4	Display condition	Clear screen
5	Character code table	Depend on the Selection switches #6, #7
6	International character set	U.S.A.
7	User-defined characters	Undefined
8	Screen Blinking	Turned off
9	Brightness	100%

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.