DOT MATRIX VFD MODULE M402SD07JJ

INSTRUCTION MANUAL

GENERAL DESCRIPTION

Futaba Vacuum Fluorescent Display Module M402SD07JJ, with Futaba VFD 402-SD-07GK display, produces 40 digits on 2 rows.

Each character is displayed in 5×7 dot matrix.

Consisting of a VFD, microcomputer, driver IC, the module can be connected directly to the system bus, thus simplifying interfacing.

The bright and aesthetic pleasing VFD makes the module desirable for application in office equipments, such as electronic typewriters, computer terminals, measuring equipment, etc.

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1. FEATURES

1-1. Microcomputer is equipped on the module and it realizes intelligent terminal.
The module can be connected to the system bus directly.

1-2. Two hundred and sixteen character fonts consisting of alphabets, numeral, and other symbols can be displayed.

1-3. By using dimming function, luminance can be controlled into four levels.

1-4. Additionally, original character fonts can be defined and displayed.
Twelve user definable characters are available.

1-5. Since a DC/DC converter is included, only 5Vdc power source is required to operate the module.

1-6. High quality and reliability, also long life can be achieved with FUTABA VFD.

1-7. Compact, light weight and thin design by using SMART (Surface Mount And Reflow Technology) provides excellent built-in capability.

1-8. Either parallel or serial input interface can be selected.
In case of serial input, it is possible to choose 1200, 2400, 4800 and 9600 bps.

2. GENERAL SPECIFICATIONS

2-1. DIMENSIONS, WEIGHT (Refer APPENDIX-1)

TABLE-1

Item	Specification	Unit
Outer Dimensions	(W)　240±1 (H)　38±1 (T)　21 MAX.	mm
Weight	APPROX. 150	g

2-2. SPECIFICATIONS OF THE DISPLAY PANEL

TABLE-2

Item	Specification	Unit
Display area	186.8×16.4	mm
Number of digits	40digits(5×7)×2rows	-
Digits size (H×W)	5.0×3.5	mm
Digits pitch (H×W)	10.0×4.7	mm
Color of illumination	Green (505nm)	-

2-3. ENVIRONMENT CONDITIONS

TABLE-3

Item	Symbol	Min.	Max.	Unit
Operating temperature	Topr	-20	+70	°C
Storage temperature	Tstg	-40	+85	°C
Operating humidity	Hopr	20	85	%
Storage humidity	Hstg	20	95	%
Vibration (10 to 55 Hz)	—	—	4	G
Shock	—	—	40	G

Note) Avoid operations and or storage in moist environmental conditions.

2-4. ABSOLUTE MAXIMUM RATINGS

TABLE-4

Item	Symbol	Min.	Max.	Unit
Supply voltage	V_{CC}	-0.3	6.5	Vdc
Input signal voltage	V_{IS}	-0.3	5.5	V

2-5. RECOMMENDED OPERATING CONDITIONS

TABLE-5

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}	—	4.5	5.0	5.5	Vdc
H-level input voltage	V_{IH}	$V_{CC}=5V$	2.6	—	—	V
L-level input voltage	V_{IL}	$V_{CC}=5V$	—	—	0.5	V

2-6. ELECTRICAL CHARACTERISTICS

TABLE-6

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply current	I_{CC}	$V_{CC}=5V$ All on	—	750	1000	mA
Power consumption	—		—	3.75	—	W
Luminance	L		350 (102)	700 (204)	—	cd/m^2 (fL)
H-level input current	I_{IH}	$V_{CC}=5V$	—	—	20	μA
L-level input current	I_{IL}	$V_{CC}=5V$	—	—	-0.6	mA
H-level output voltage	V_{OH}	$V_{CC}=5V$ $I_{OH}=-2mA$	3.5	—	—	V
L-level output voltage	V_{OL}	$V_{CC}=5V$ $I_{OL}=6mA$	—	—	0.5	V

3. FUNCTIONS

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

3-1. DATA AND CONTROL CODE WRITE IN

TABLE-7

TEST	$\overline{WR}$	$\overline{RXD}$	Functions
H or NC	L→H	L	Data and control code write in
L	-	-	Test mode

THE BASIC FUNCTIONS

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

(When the data is under processing, the BUSY signal is "H".)

The data or control command is to be written in at the rising edge of $\overline{WR}$ (L→H), when $\overline{SEL}$ = "L".

The display character form follows equivalent to ASCII (Alphabet, Numeral, and Symbol etc.).

After a character is written in, the cursor will be shifted to the right one digit automatically.

The above action can be executed, only when the BUSY signal is "L".

3-2. CONTROL CODE

The control codes are available as follows.

(1)	DEF	:	Define Characters	: (03HEX)
(2)	DIM	:	Dimming	: (04HEX)
(3)	BS	:	Back Space	: (08HEX)
(4)	HT	:	Horizontal Tab	: (09MEX)
(5)	LF	:	Line Feed	: (0AHEX)
(6)	CR	:	Carriage Return	: (0DHEX)
(7)	DP	:	Display Position	: (10HEX)
(8)	DC1	:	Normal Display Mode	: (11HEX)
(9)	DC2	:	Vertical Scroll Mode	: (12HEX)
(10)	DC3	:	Cursor On Mode	: (13HEX)
(11)	DC4	:	Cursor Off Mode	: (14HEX)
(12)	RST	:	Reset	: (1FHEX)

(1) DEF (Define Characters)

The DEF command defines user definable characters. The number of definable characters are twelve fonts. The fonts are stored in the module as follows.

1 byte	+	1 byte	+	5 bytes
DEF command code (03H)		Position code (20H ~ FFH)		The font data

TABLE-8

(a) Character font

1-1	2-1	3-1	4-1	5-1
1-2	2-2	3-2	4-2	5-2
1-3	2-3	3-3	4-3	5-3
1-4	2-4	3-4	4-4	5-4
1-5	2-5	3-5	4-5	5-5
1-6	2-6	3-6	4-6	5-6
1-7	2-7	3-7	4-7	5-7

(b) Font data

		bit							
		7	6	5	4	3	2	1	0
Byte	1st	1-1	2-1	3-1	4-1	5-1	1-2	2-2	3-2
	2nd	4-2	5-2	1-3	2-3	3-3	4-3	5-3	1-4
	3rd	2-4	3-4	4-4	5-4	1-5	2-5	3-5	4-5
	4th	5-5	1-6	2-6	3-6	4-6	5-6	1-7	2-7
	5th	3-7	4-7	5-7	"L"	"L"	"L"	"L"	"L"

Example of write in character "1" in 20H.

Control and data strings are 03H, 20H, 23H, 08H, 42H, 11H and C0H.

TABLE-9

		bit							
		7	6	5	4	3	2	1	0
Byte	1st	L	L	H	L	L	L	H	H
	2nd	L	L	L	L	H	L	L	L
	3rd	L	H	L	L	L	L	H	L
	4th	L	L	L	H	L	L	L	H
	5th	H	H	L	L	L	L	L	L

(a) Character font　　　　　　　　　(b) Font data　.　"H" : Turn on
　　　　　　　　　　　　　　　　　　　　　　　"L" : Turn off

All these data remain into the RAM and the client can display these original fonts on VFD module.

There are no back-up system of RAM, therefore, it is needed to restore these data when power on.

When a font of the character code is displayed in VFD and if you change the code using this command, the font in VFD is changed new one.

When you change a font using this code and if the change is thirteen times, the first changed font return to original font.

(2) DIM (Dimming)

Luminance can be controlled into four levels by using this function.

After written 04H, another Hex byte mentioned under is written to change the luminance out put.

1 byte　　　　　　+　　　　1 byte
DIM command code　　　　Dimming level
(04H)

TABLE-10

Dimming level	Data
100%	FFH
60%	60H
40%	40H
20%	20H

(3) BS (Back Space)

DC1 MODE : The cursor position (write in position) is shifted to the left one digit. (beyond this point, the position of cursor is identical with write in position of the display, unless otherwise specified. Under DC4 mode, the cursor will not show up.)

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

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

DC2 MODE: The same as above.

(4) HT (Horizontal Tab)

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

DC2 MODE: When the cursor 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.

(5) LF (Line Feed)

DC1 MODE: The cursor moves up or down to another row staying same line.

DC2 MODE: When the cursor is in the second row, the characters displayed there, is shifted up to the first row, leaving the cursor at its present position, then the second row is cleared. When the cursor is in the first row, the same as DC1 mode operation.

(6) CR (Carriage Return)

DC1 MODE: When the cursor moves to the most significant digit of the same row.

DC2 MODE: The same as DC1 mode operation.

(7) DP(Display Position)

Instead of writing the character from the first digit, the write in starting position can be pointed by using this function.

After writing 10 Hex to prepare module for this command, another Hex byte is written to specify the position desired.

A third byte representing data is then sent.

| 1 byte   +   1 byte |
| DP command code   Position code |
| (10H)   (00H ~ 4FH) | TABLE-11

	The most significant digit	The least significant digit
1st row	00 HEX	27 HEX
2nd row	28 HEX	4F HEX

DC1 ~ DC4 selects the display mode.

(8) DC1 (Normal Display Mode)

After writing a character, the cursor is shifted to the right one digit automatically.
When the cursor is on the least significant digit of the first row, the cursor moves to the most significant digit of the second row.
When the cursor is on the least significant digit of the second row, the cursor moves to the most significant digit of the first row.

(9) DC2 (Vertical Scroll Mode)

After writing a 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.
When the module is turned on, this DC2 mode is selected and will be held until another mode (DC1) is selected.

(10) DC3 (Cursor On Mode)

The cursor is displayed.
When the module is turned on, this DC3 mode is selected and will be held until another mode (DC4) is selected.

(11) DC4 (Cursor Off Mode)

The cursor will not be displayed.

(12) RST (Reset)

Resetting the module.
All the characters displayed are erased, then the writing position is set on the most significant digit of the first row.
The display status is the same as Power on Reset.
The display mode is set for DC2.
The cursor mode is set for DC3.

3-3. TEST MODE

$\overline{\text{TEST}}$ = "L" (connector pin #16 is connected to GND) starts the self test.
Then the display shows all characters, Alphabet, Numeral, and Symbol, in that order.
80 (2×40) characters are displayed at a time.
Using this mode, neither data write in nor control code write in is allowed.
To release this mode, $\overline{\text{TEST}}$ must be set to "H".

3-4. POWER ON RESET

When the module is turned on, the display and the memory are cleared and the module is initialized.
The display mode is set for DC2.
The cursor mode is set for DC3.

3-5. SELECTION OF THE INPUT MODE

TABLE-12 shows the combinations of the signal lines for the parallel or serial input. Users must choose one of the combinations.
Unused signal lines are to be opened (internal pulled up).

4. INTERFACE CONNECTION

4-1. CONNECTOR PIN CONNECTION

Connector (Header) : XG8B-2301 (OMRON) or equivalent

Connector (Socket) : 3421-6000SC (3M) or equivalent

TABLE-12

PIN NO	SIGNAL	SERIAL IN	PARALLEL IN	PIN NO	SIGNAL	SERIAL IN	PARALLEL IN
1	D7	NC	○	2	+5V	○	○
3	D6	NC	○	4	+5V	○	○
5	D5	NC	○	6	+5V	○	○
7	D4	NC	○	8	GND	○	○
9	D3	NC	○	10	GND	○	○
11	D2	NC	○	12	GND	○	○
13	D1	NC	○	14	GND	○	○
15	D0	NC	○	16	$\overline{\text{TEST}}$	○	○
17	$\overline{\text{WR}}$	NC	○	18	$\overline{\text{SEL}}$	NC	○
19	RXD	○	NC	20	BUSY	○	○

NC : No connection

4-2. WRITE-IN TIMMING

4-2-1. SERIAL INPUT

Baud rate is selected by J1 ~ J3 as follows.

TABLE-13

JAMPER		CONDITION			
J1		–	○	–	○
J2		–	–	○	○
J3	–	9600bps	4800bps	2400bps	1200bps
	○*	62500bps	31250bps	15625bps	7812.5bps

– : open
○ : short

When module is shipped, J1, J2 and J3 are set for 9,600bps.
(J1, J2 and J3 are opened.)

*NOTE) The baud rate which are made by J3 short needs additional oscillator and it can be equipped as the option.
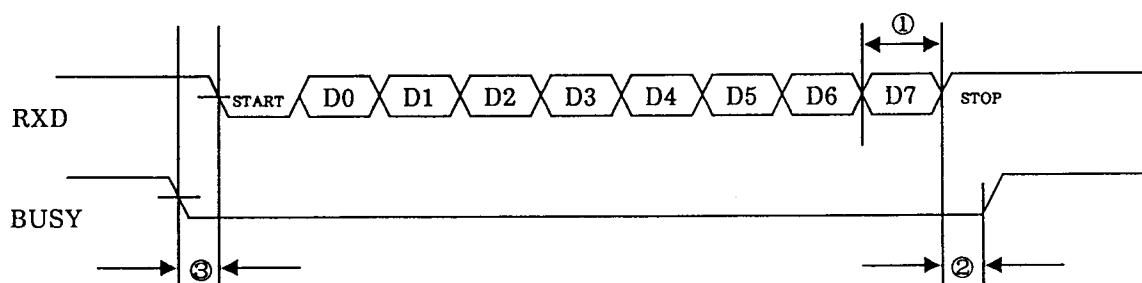

FIG-1.　TIMMING FOR WRITE IN SERIAL INPUT

① $t_{(DATA)} = 10^6 / \text{baud rate}$ [μs]
　　(This depends on the selection of the baud rate.)

② $t_{(DATA)} / 2$ [μs]
　　(BUSY becomes "H" at the center of stop bit.)

③ $t_{(WAIT)} = 0$ min. [μs]
　　(For min. 0μs, START should not be active ("L"), after BUSY is "L".)
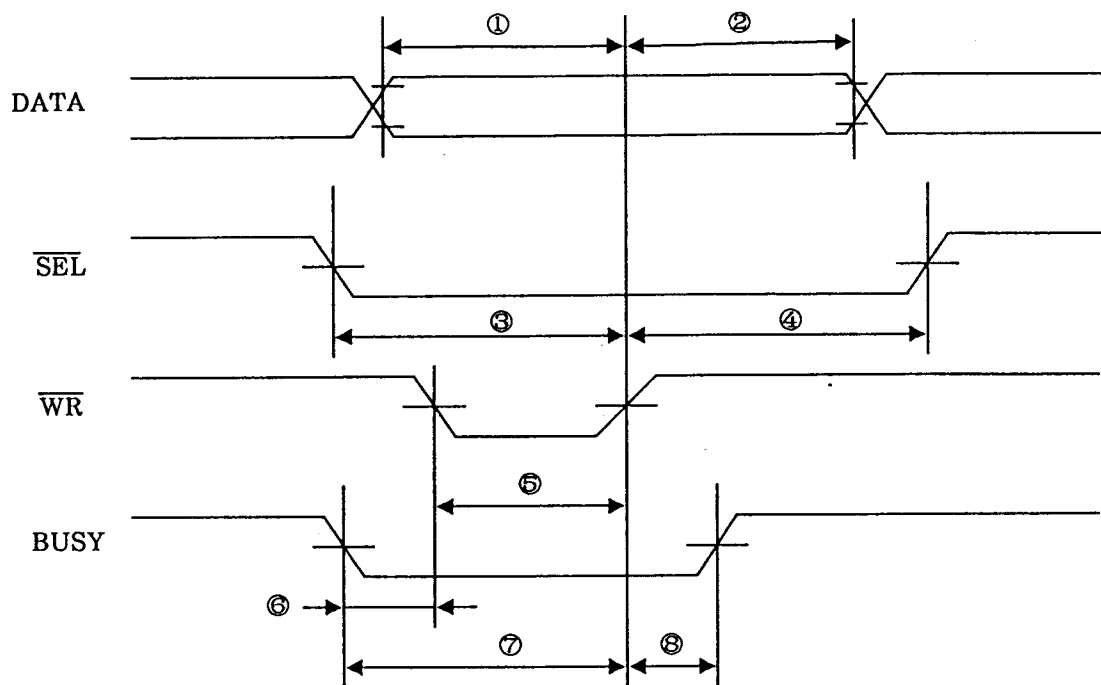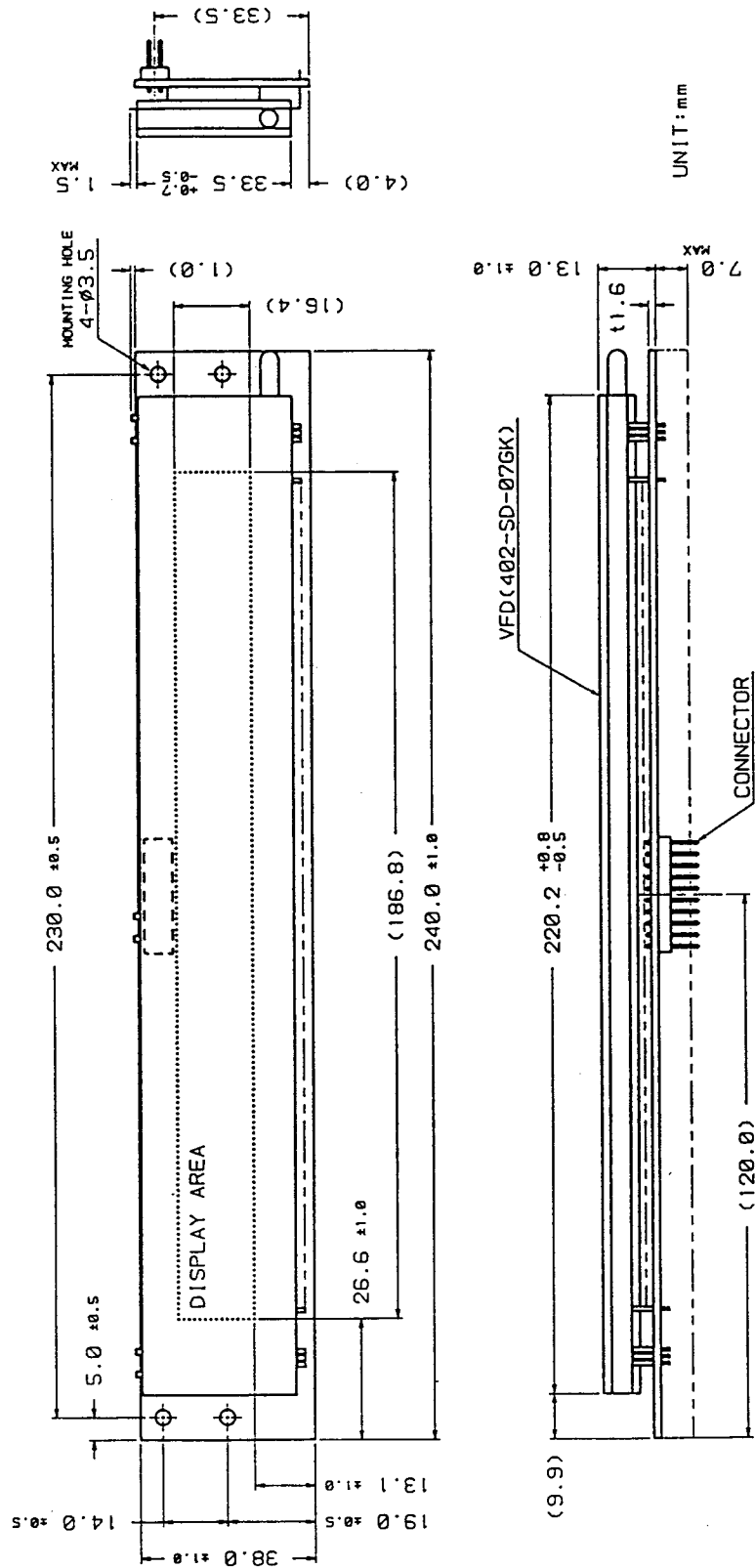
4-2-2. PARALLEL INPUT

FIG-2. TIMMING FOR WRITE IN OF PARALLEL INPUT

TABLE-14

ITEM	SYMBOL	MIN	MAX	Note
①	$t_{su(DATA)}$	50ns	—	
②	$t_{h(DATA)}$	50ns	—	
③	$t_{su(\overline{SEL})}$	50ns	—	
④	$t_{h(\overline{SEL})}$	50ns	—	
⑤	$t_{pw(\overline{WR})}$	50ns	—	
⑥	$t_{wait(1)}$	0ns	—	
⑦	$t_{wait(2)}$	500ns	—	For min. 500ns, $\overline{WR}$ should not be active, after BUSY is "L".
⑧	t_{delay}	—	50ns	

OUTER DIMENSIONS

UNIT:mm

DISPLAY AREA

MOUNTING HOLE
4-∅3.5

VFD(402-SD-07GK)

CONNECTOR

(33.5)

33.5 +0.2 -0.5

1.5 MAX

(4.0)

(1.0)

(16.4)

230.0 ±0.5

(186.8)

240.0 ±1.0

26.6 ±1.0

5.0 ±0.5

13.1 ±1.0

14.0 ±0.5

19.0 ±0.5

38.0 ±1.0

13.0 ±1.0

7.0 MAX

t1.6

220.2 +0.8 -0.5

(120.0)

(9.9)

CIRCUIT BLOCK DIAGRAM
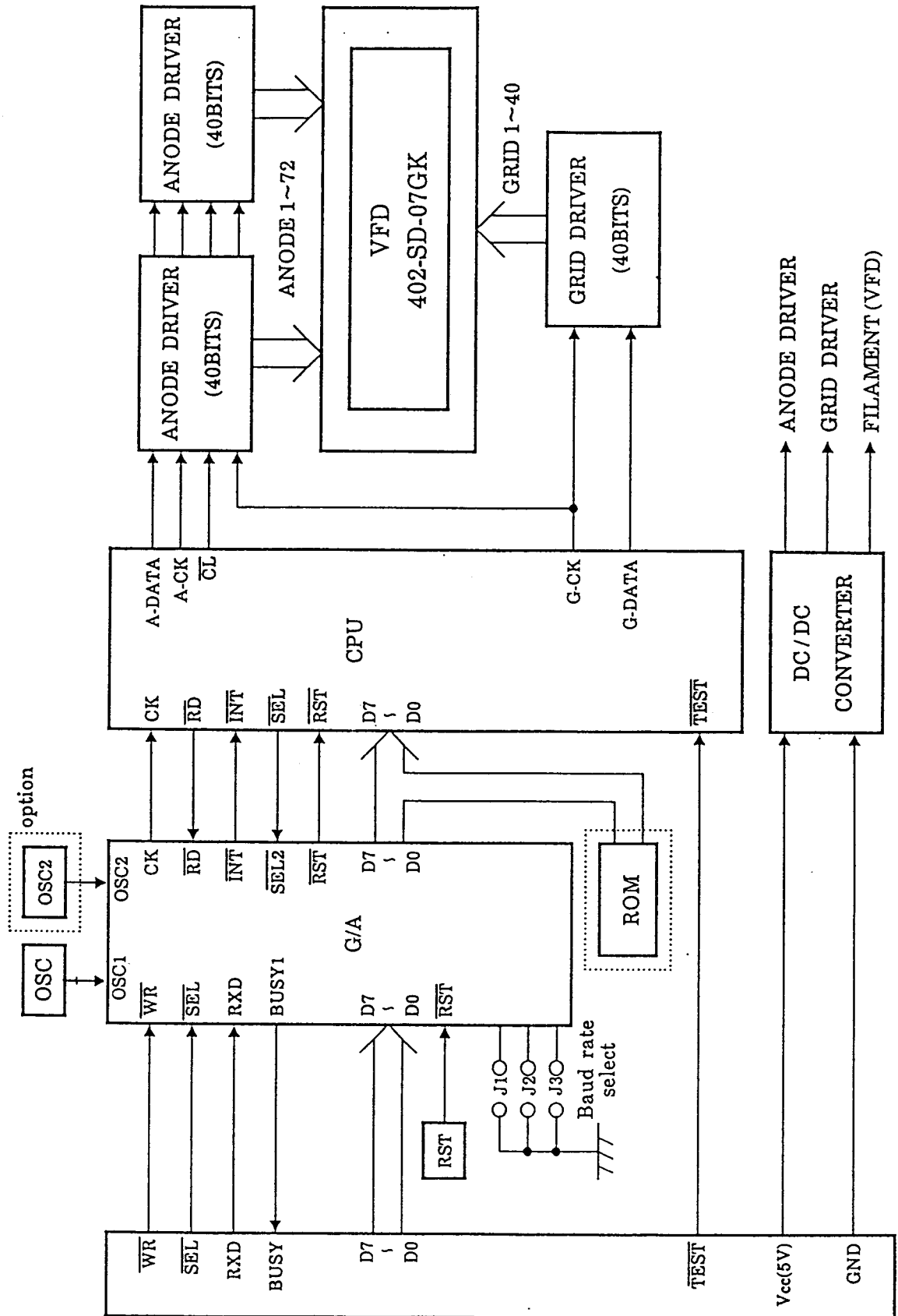
CHARACTER FONT CODE

D3 D2 D1 D0		D7 D6 D5 D4	0 0 0 0	0 0 0 1	0 0 1 0	0 0 1 1	0 0 1 1	0 1 0 0	0 1 0 1	0 1 1 0	0 1 1 1	1 0 0 0	1 0 0 1	1 0 1 0	1 0 1 1	1 1 0 0	1 1 0 1	1 1 1 0	1 1 1 1
			0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0 0 0 0	0			DP		0	@	P	`	p	Ç	É			S			
0 0 0 1	1			DC1	!	1	A	Q	a	q	ü	æ						
0 0 1 0	2			DC2	"	2	B	R	b	r	é				R			
0 0 1 1	3	DEF	DC3	#	3	C	S	c	s								
0 1 0 0	4	DIM	DC4	$	4	D	T	d	t					X			
0 1 0 1	5				%	5	E	U	e	u							
0 1 1 0	6				&	6	F	V	f	v							
0 1 1 1	7				'	7	G	W	g	w							
1 0 0 0	8	BS			(	8	H	X	h	x							
1 0 0 1	9	HT			)	9	I	Y	i	y							
1 0 1 0	A	LF			*	:	J	Z	j	z							
1 0 1 1	B				+	;	K	[	k	{							
1 1 0 0	C				,	<	L	\	l								
1 1 0 1	D	CR			-	=	M	]	m	}							
1 1 1 0	E				.	>	N	^	n								
1 1 1 1	F			RST	/	?	O	_	o								

5. WARRANTY

This display module is guaranteed for one year after the shipment from FUTABA.

6. CAUTIONS FOR OPERATION

6-1. Since VFD is are made of glass material.
Avoid applying excessive shock or vibration beyond the specification for the module.
Careful handing is essential.

6-2. Applying lower voltage than the specified may cause non activation for selected pixels.
Conversely, higher voltage may cause non-selected pixel to be activated.
If such a phenomenon is observed, check the voltage level of the power supply.

6-3. Avoid plugging or unplugging the interface connection with the power on.

6-4. Avoid using the module where excessive noise interference is expected.
Noise affects the interface signal and causes improper operation.
Keep the length of the interface cable less than 50cm.
(When the longer cable is required, please confirm there is no noise affection.)

6-5. When power is turned off, the capacitor will not discharge immediately.
Avoid touching IC and others.
The shorting of the mounted components within 30 sec., after power off, may cause damage.

6-6. The fuse is mounted on the module as circuit protection.

6-7. When fixed pattern is displayed for a long time, you may see uneven luminance.
It is recommended to change the display patterns sometimes in order to keep best display quality.

REMARKS:
This specification is subject to change without prior notice in order to improve the design and quality.
Your consultation with FUTABA sales office is recommended for the use of this module.