Futaba®

AN-E-2220

APPLICATION NOTE

VACUUM FLUORESCENT DISPLAY MODULE

CHARACTER DISPLAY MODULE

M202SD08HA

GENERAL DESCRIPTION

Futaba Vacuum Fluorescent Display Module M202SD08HA, with Futaba VFD 202-SD-08GYK display, produces on 2 rows.
Each character is displayed in 5×7 dot matrix with the cursor under it,.
Consisting of a VFD, one chip controller, driver IC, the module can be connected directly to the system bus, thus simplifying interfacing.
The luminance and aesthetic pleasing VFD makes the module desirable for application in office equipments, such as electronic typewriters, computer terminals, measuring equipment, etc.

⚠ Important Safety Notice

Please read this note carefully before using the product.

Warning

- The module should be disconnected from the power supply before handling.
- The power supply should be switched off before connecting or disconnecting the power or interface cables.
- The module contains electronic components that generate high voltages (approx. 50V) which may cause an electrical shock when touched.
- Do not touch the electronic components of the module with any metal objects.
- The VFD used on the module is made of glass and should be handled with care. When handling the VFD, it is recommended that cotton gloves be used.
- The module is equipped with a circuit protection fuse.
- Under no circumstances should the module be modified or repaired. Any unauthorized modifications or repairs will invalidate the product warranty.
- The module should be abolished as the factory waste.

CONTENTS PAGE

1. FEATURIS

1-1. One chip controller 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 twenty-three character fonts consisting of alphabets katakanas, numeral and other symbols can be displayed.

1-3. By using dimming function, luminance can be controlled into 6 levels.

1-4. Since a DC/DC converter is included, only 5V power source is required to the module.

1-5. High quality and reliability, also long life can be achieved with FUTABA VFD.

1-6. Compact, light weight and thin design by using SMART (Surface Mount And Reflow Technology) provides excellent built-in capability.

1-7. Either parallel or serial input interface can be selected.
IN case of serial input, it is possible to choose 1200, 2400, 4800, 7812.5, 9600, 15625, 31250 and 62500 bps .

2. GENERAL SPECIFICATIONS

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

Table-1

Item	Specification	Unit
Outer Dimensions	(W) 155.0 ± 1.0 (H) 39.0 ± 1.0 (T) 20.6 MAX.	mm
Weight	Approx. 100	g

2-2. SPECIFICATIONS OF THE DISPLAY PANEL

Table-2

Item	Specification	Unit
Display Area (W×H)	102.3×17.5	mm
Number of Digits	20 Digits(5×7)×2 Rows + Cursor	–
Dot Pitch (W×H)	0.75×0.75	mm
Dot Size (W×H)	0.5×0.5	mm
Character Size (W×H)	3.5×5.0	mm
Color of Illumination	Green (λp=505nm)	–

2-3. ENVIRONMENT CONDITIONS

Table-3

Item	Symbol	Min.	Max.	Unit
Operating Temperature	*T*opr	-20	+70	°C
Storage Temperature	*T*stg	-40	+85	°C
Operating Humidity	*H*opr	20	85	%
Storage Humidity	*H*stg	20	90	%
Vibration (10 to 55 Hz)	–	–	4	G
Shock	–	–	40	G

2-4. ABSOLUTE MAXIMUM RATINGS

Table-4

Item	Symbol	Min.	Max.	Unit
Supply Voltage	*V*cc	–	6.5	Vdc
Input Signal Voltage	V_{IS}	-0.3	5.5	Vdc

2-5. RECOMMENDED OPERATING CONDITIONS

Table-5

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	*V*cc	4.5	5.0	5.5	Vdc
H-Level Input Voltage	V_{IH}	0.7*V*cc	–	–	Vdc
L-Level Input Voltage	V_{IL}	–	–	0.3*V*cc	Vdc

2-6. ELECTRICAL CHARACTERISTICS

Table-6

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Current *	*I*cc	*V*cc=5.0V All on	–	350	500	mA
Power Consumption	–		–	1.75	–	W
H-Level Input Current	I_{IH}	*V*cc=5.5V	–	–	1	μA
L-Level Input Current	I_{IL}		-0.22	-0.11	-0.05	mA
H-Level Output Voltage	V_{OH}	*V*cc=4.5V I_{OH}=-0.5mA	3.6	–	–	μA
L-Level Output Voltage	V_{OL}	*V*cc=4.5V I_{OL}=0.5mA	–	–	-0.9	mA
Luminance	*L*	*V*cc=5.0V	340	690	–	cd/m^2

* Note) At power on the surge current may reach approx. 10 times the specified current.

3. FUNCTION

The module has the functions such as data and control code write-in, self-test, and power-on reset function. (See Table-7)

Table-7

	$\overline{TEST}$	$\overline{SEL}$	$\overline{WR}$	RXD	Functions
Parallel and Serial Interface	L	X	X	X	Self Test
Parallel Interface	NC	L	↑	NC	Data and control code write-in
Serial Interface	NC	NC	NC	*	Data and control code write-in

L :Low level
H :High level
X :Low or High
↑ :Low to high transition
* :Serial input

THE BASIC FUNCTION

3-1. DATA AND CONTROL CODE WRITE IN

When the data is being written in, the BUSY signal is active which indicates that the module is processing data.
(When data is under processing, the BUSY signal is high "H".)
The display character form follows equivalent to ASCII.(Alphabets, Numeral and Symbols etc.)
A character data is written in to the right end of 1st row, the write-in position will move to the left end of 2nd row. A character data is written in to the right end of 2nd row, the write-in position will move to the left end of 1st row. Then new character data is written-in to there, all displayed characters will be cleared except new one. After a character is written in, the write-in position will be shifted to the right one digit automatically.
The above action can be executed, only when the BUSY signal is low "L".
Control codes are shown in section 3-4.

3-2. SERIAL INPUT

When $\overline{TEST}$ is high "H", the module can receive serial input data.
Selection of baud rate is shown in section 3-7. and timing and protocol of input data are shown in section 4-2-1.

3-3. PARALLEL INPUT

When $\overline{TEST}$ is high "H" and $\overline{SEL}$ is low "L", parallel input data is to be written at the low-to-high transition of $\overline{WR}$.
Timing is shown in section 4-2-2.

3-4. CONTROL CODE

The control codes are available as follows.

(1)	DIM	: Dimming	:(04 HEX)
(2)	BS	: Back Space	:(08 HEX)
(3)	HT	: Horizontal Tab	:(09 HEX)
(4)	CLR	: Clear	:(0D HEX)
(5)	ALD	: All Display	:(0F HEX)
(6)	DP	: Display Position	:(10 HEX)
(7)	CU1	: Cursor Off	:(14 HEX)
(8)	CU2	: Cursor On	:(15 HEX)
(9)	CU3	: Cursor Blink	:(16 HEX)
(10)	DC	: Dot Cursor Mode	:(17 HEX)
(11)	RST	: Reset	:(1F HEX)

(1) DIM (Dimming)

The luminance can be controlled into 6 levels by using this function.
After writing 04H, the following dimming data is written to change the luminance out put.

04 HEX + 1 byte (Dimming level data)

Table-8

Dimming level	Data
100%	FFH
80%	80H
60%	60H
40%	40H
20%	20H
0%	00H

(2) BS (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 left end of the second row, the write-in position moves to the right end of the first row.
When the write-in position is on the left end of the first row, the write-in moves to the right end of the second row.

(3) HT (Horizontal Tab)

The write-in position is shifted to the right one digit.
When the write-in position is on the right end of the first row, the write-in position will move to the left end of the second row.
When the write-in position is on the right end of the second row, the write-in position will move to the left end of the first row.

(4) CLR (Clear)

All the characters displayed are erased, the write-in position moves to the left end of the first row. But the Dimming level and Cursor Mode are kept.

(5) ALD (All Display)

The full dots and cursor in all digits are displayed. The dimming level is set for 100%.
To release this mode, the module is turned off or the RST command shall be written.

(6) DP (Display Position)

Instead of writing a character from the first digit, the write-in starting position can be pointed by using this function.
After writing 10 HEX to prepare the module for this command, another HEX byte is written to specify the position desired.

10 HEX + 1 byte (Digit data)

	Left end of the row	Right end of the row
1st row	00 HEX	13 HEX
2nd row	14 HEX	27 HEX

(7) CU1 (Cursor Off)

The cursor is not displayed.

(8) CU2 (Cursor On)

The cursor is displayed.

(9) CU3 (Cursor Blink)

The cursor is blinking.
When the module is turned on, this CU3 mode is selected.

(10) DC (Dot Cursor Mode)

After writing 17 HEX, another HEX byte mentioned under is written to change the cursor mode.

17 HEX + 1 byte (Select Mode Data)

Table-9

Select Mode	Data
Lighting	FFH
Blinking	88H
No Lighting	00H

The dot cursor is always displayed at the write-in position.
The dot cursor is formed by the 5 dots located the bottom of 5×7 dot matrix character font.
The dot cursor will be displayed as an over writing mode and the behavior of the dot cursor under the lighting mode and blinking mode are explained below.

① Lighting mode

When the non displayed position is assigned as a write-in position, the dot cursor will be displayed there. But, the position that already one of the character located is assigned, this character will be eliminated and the cursor will be displayed.

② Blinking mode

The dot cursor will be repeated ON and OFF every 0.3 second when the non displayed position is selected for the write-in position. And the position of the character already located is selected (as a write-in position), the character and the cursor will be displayed alternately.

③ No lighting mode

The no lighting mode means that the cursor will not be displayed.

When the power is turned on, no lighting mode will be selected automatically. Therefore, if the cursor is required, DC command shall be sent to select the cursor lighting or blinking mode.

(11) RST (Reset)

Resetting the module.

All the characters displayed are erased, then the write-in position will be set on the left end of the first row.

The displaying status is the same as the power on reset.

Cursor mode is set for blinking mode, dot cursor mode is set for no lighting mode, and the dimming level is set for 100%.

3-5. SELF-TEST

When the $\overline{\text{TEST}}$ terminal is kept into low "L" (connector pin #16 to be connected to GND.) the self-test starts.

Then the display shows characters, Alphabets, and symbols, in that order.

Forty (2×20) 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 high "H".

3-6. POWER ON RESET

When the module is turned on, the display and the memory are cleared and the module is initialized.

The displaying status is the same as reset command.

Cursor mode is set for blinking mode, dot cursor mode is set for no lighting mode, and the dimming level is set for 100%.

When an external reset function is required, please contact Futaba sales office for further information.

3-7. SELECTION OF INPUT MODE

Table-10 shows the combinations of the signal lines for the parallel or signal input.

It is needed to choose one of the combinations before operation.

Unused signal lines are to be opened (internally pulled up.)

In case of serial input, it is possible to choose eight kinds of baud rate by J1~J3, as shown below.

Table-10

J1		Open	Short	Open	Short
J2		Open	Open	Short	Short
J3	Short	62500	31250	15625	7812.5
	Open	9600	4800	2400	1200

Note) J1,J2 and J3 are opened when a module is shipped.

BAUD RATE SELECTION

4. INTERFACE CONNECTION

4-1. CONNECTOR PIN CONNECTION

Connector : A1-20PA-2.54DSA (HIROSE) or equivalent
Socket : HIF3BA-20D-2.54DSA (HIROSE) or equivalent

Table-11

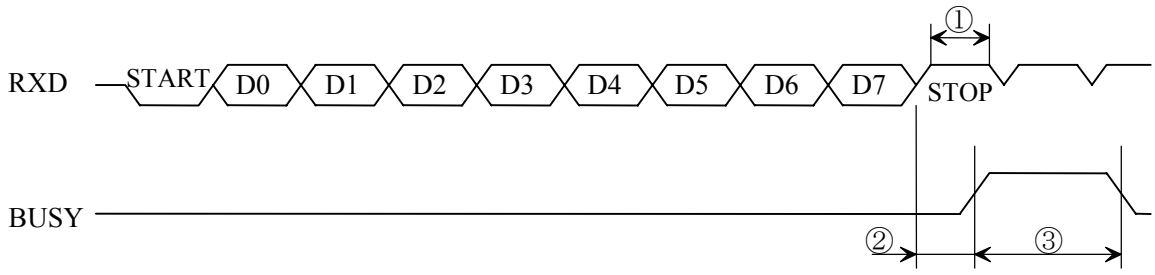
Pin No.	Signal	Parallel input	Serial input	Pin No.	Signal	Parallel input	Serial input
1	D7	○	NC	2	5V	○	○
3	D6	○	NC	4	5V	○	○
5	D5	○	NC	6	5V	○	○
7	D4	○	NC	8	GND	○	○
9	D3	○	NC	10	GND	○	○
11	D2	○	NC	12	GND	○	○
13	D1	○	NC	14	GND	○	○
15	D0	○	NC	16	$\overline{\text{TEST}}$	○	○
17	$\overline{\text{WR}}$	○	NC	18	$\overline{\text{SEL}}$	○	NC
19	RXD	NC	○	20	BUSY	○	○

NC : No Connection

○ : Connection

4-2. WRITE-IN TIMING

4-2-1. SERIAL INPUT



① *t* (DATA)=10^6/Baud rate [μs] (This depends on the selection of the baud rate)
② *t* (DATA)/2 [μs] (Busy becomes high "H" at the center of stop bit.)
③ *t* (WAIT) : 2~45 [μs]

Fig.1

4-2-2. PARALLEL INPUT

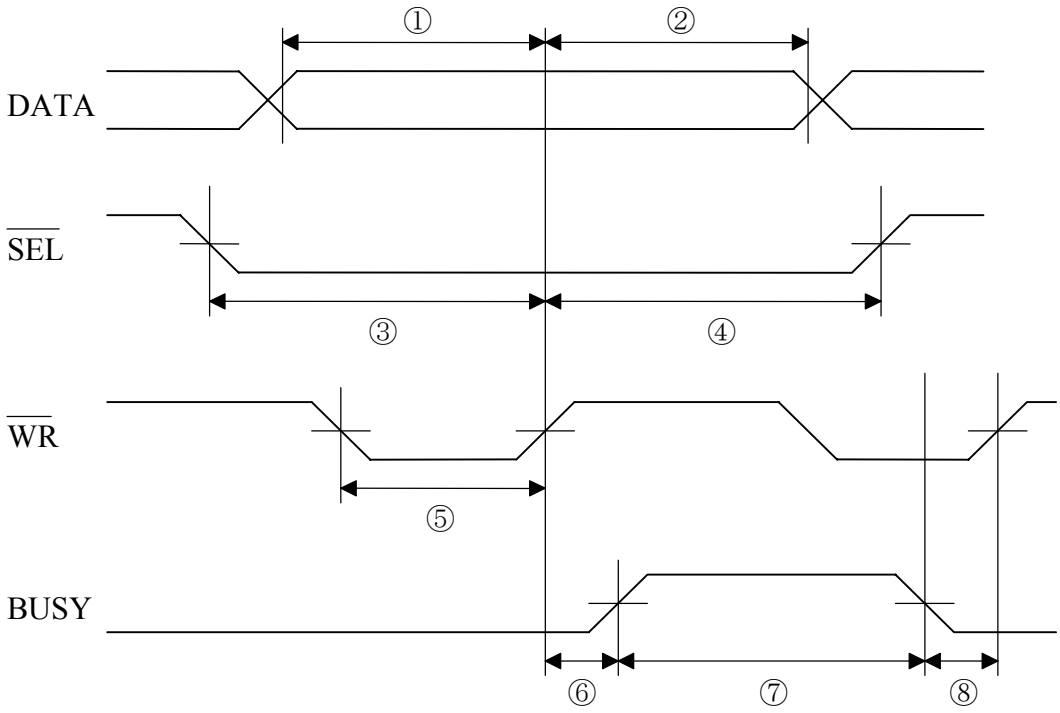


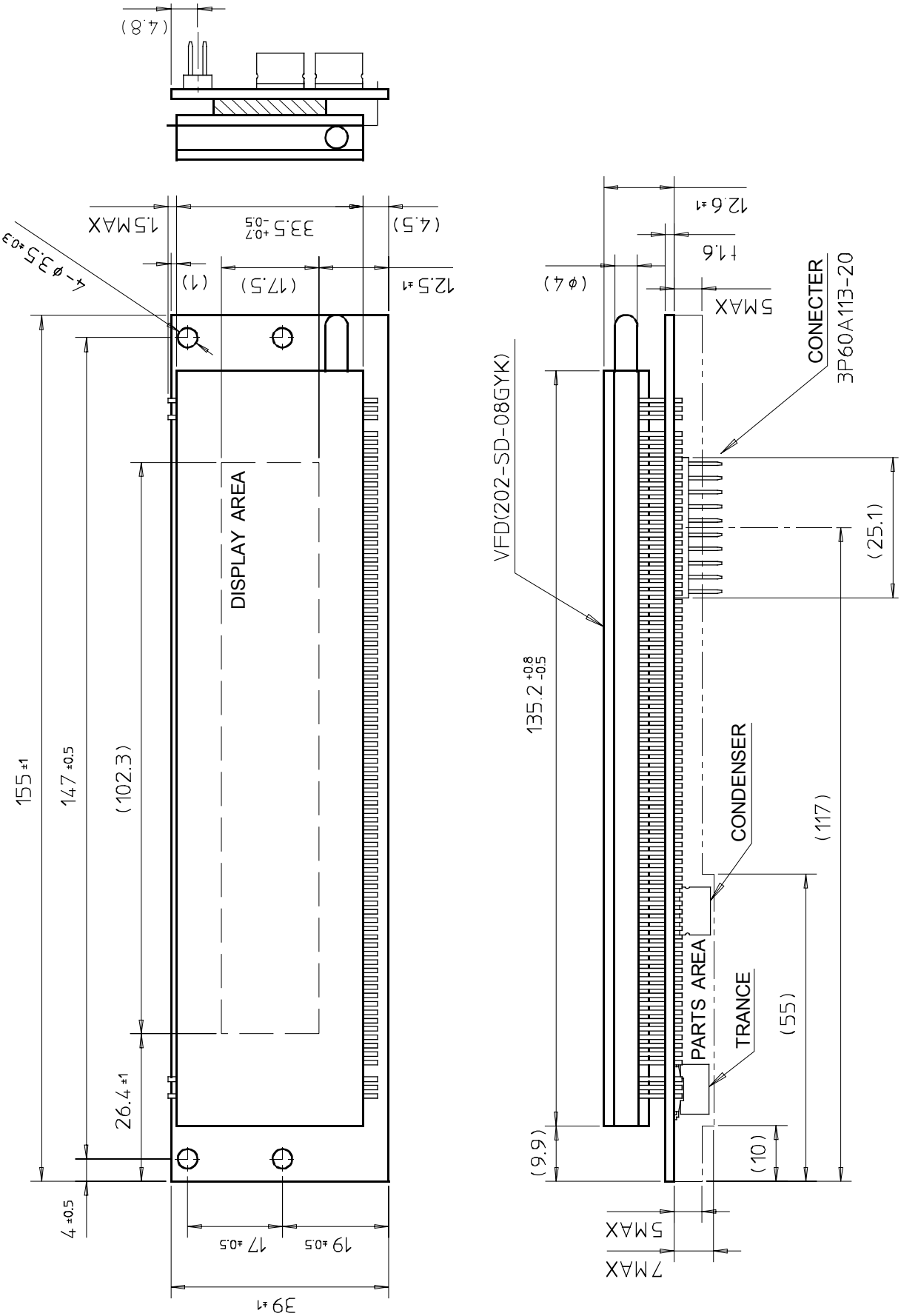
Fig. 2

Table-12

		Min.	Max.
①	*t* su(DATA)	50ns	–
②	*t* h(DATA)	100ns	–
③	*t* su($\overline{\text{SEL}}$)	50ns	–
④	*t* h($\overline{\text{SEL}}$)	50ns	–
⑤	*t* pw($\overline{\text{WR}}$)	50ns	–
⑥	*t* delay	–	150ns
⑦	*t* wait	–	45μs
⑧	*t* wait	1μs	–

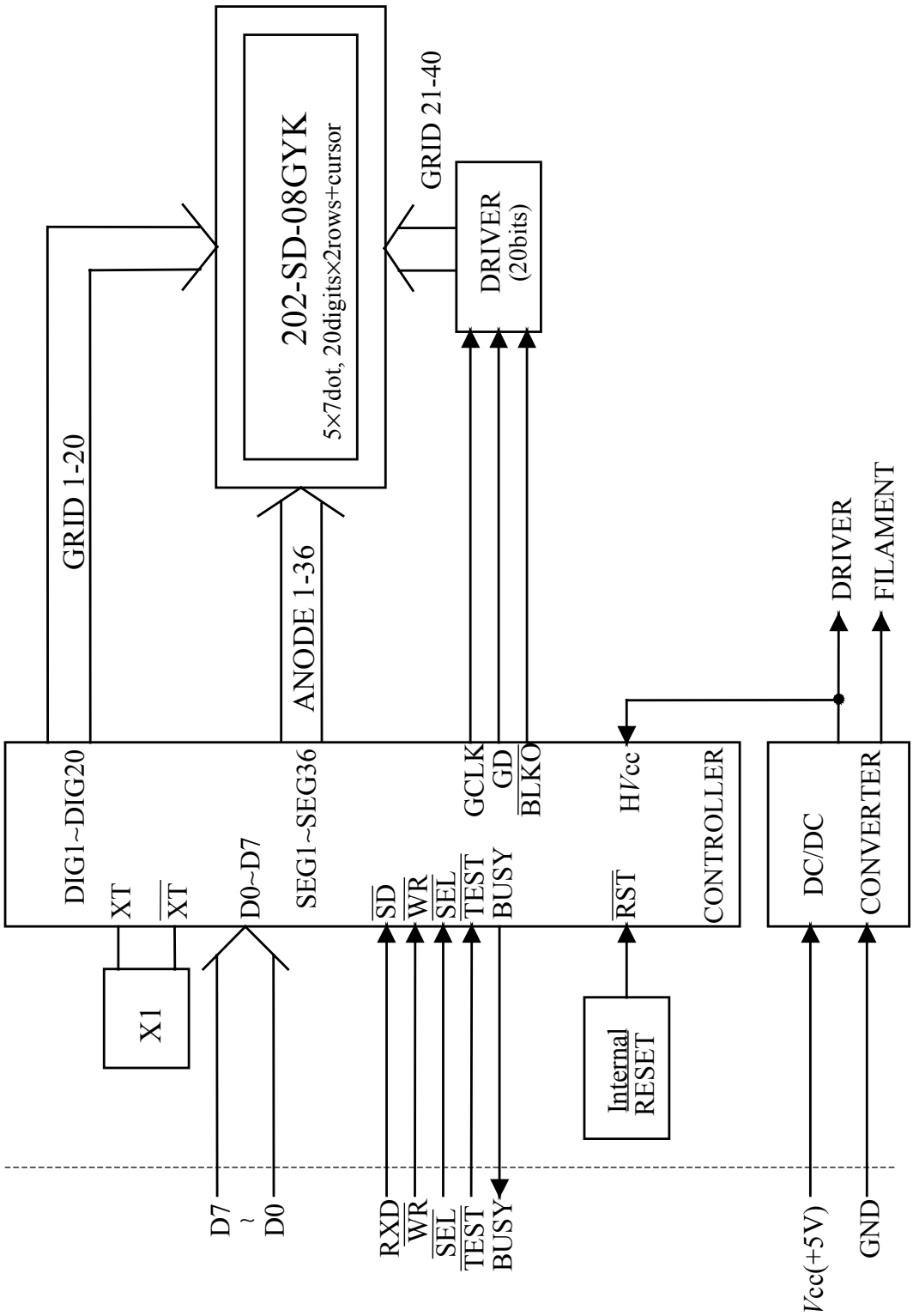
M202SD08HA　OUTER DIMENSIONS DRAWING

FIGURE-1



M202SD08HA　CIRCUIT BLOCK DIAGRAM

FIGURE-2



M202SD08HA DISPLAY CHARACTER CODE

FIGURE-3

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 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 0 0 0	0		DP	SP												
0 0 0 1	1															
0 0 1 0	2															
0 0 1 1	3	DEF														
0 1 0 0	4	DIM	CU1													
0 1 0 1	5		CU2													
0 1 1 0	6		CU3													
0 1 1 1	7		DC													
1 0 0 0	8	BS														
1 0 0 1	9	HT														
1 0 1 0	A															
1 0 1 1	B															
1 1 0 0	C															
1 1 0 1	D	CLR														
1 1 1 0	E															
1 1 1 1	F	ALD	RST													

SP : SPACE

5. WARRANTY

This display module is guaranteed for 1 year after the shipment from FUTABA.

6. OPERATING RECOMMENDATIONS

6-1. Avoid applying excessive shock or vibration beyond the specification for this module.

6-2. Since VFD is made of glass material, careful handling is important.

6-3. 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.

6-4. Avoid plugging or unplugging the interface connection with the power on.

6-5. If the start up time of the supply voltage is show, the controller may not be reset.
The supply voltage must be raised up to the specified voltage level within 30msec.

6-6. Avoid using the module where excessive noise interference is expected.
Noise affects the interface signal and cause improper operation.
Keep the length of the interface cable less than 50cm (When the longer cable is required, please contact FUTABA engineering.).

6-7. When power supply is turned off, the capacitor does not discharge immediately.
The high voltage applied to the VFD must not contact the controller IC.
(The shorting of the mounted components within 30 seconds after power off may cause damage.)

REMARKS:

This specification is subject to change without prior notice.
Your consultation with our engineer is recommended for the use of this module.