Futaba®

APPLICATION NOTE
VACUUM FLUORESCENT DISPLAY MODULE

CHARACTER DISPLAY MODULE

M202MD12BA

GENERAL DESCRIPTION

Futaba Vacuum Fluorescent Display M202MD12BA, with Futaba VFD
202-SD-12GK display, produces 20 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 aesthetically pleasing VFD makes the module desirable
for application in office equipment's, computer terminals, measuring
equipment, etc.

Futaba Corporation

⚠ <u>Important Safety Notice</u>

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 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

1. FEATURES

    1-1. Two hundred twenty-three different characters consisting of alphanumeric and other symbols can be displayed.

    1-2. By using dimming function, brightness can be controlled into six levels.

    1-3. Since a DC/DC converter is included, only a 5V power is required to operate the module.

    1-4. High quality reliability and long life can be achieved with FUTABA VFD.

    1-5. The module can be communicated by RS-232C interface.

    1-6. The module's small, light and thin mechanical sizing allows for maximum mounting flexibility.

2. GENERAL SPECIFICATIONS

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

Table-1

Item	Specification	Unit
Outer Dimensions	(W) 190 ± 1 (H) 64 ± 1 (T) 27 Max.	mm
Weight	Approx. 200	g

2-2. SPECIFICATIONS OF THE DISPLAY PANEL

Table-2

Item	Specification	Unit
Display Area	146.1×29.0	mm
Number of Digit	20 digits (5×7 Dots)×2 rows + Triangle Mark	–
Character Size	10.5(H)×5.5(W)	mm
Character Pitch	15.5(H)×7.4(W)	mm
Color of Illumination	Green(λp=505nm)	–

Note) By using a filter, uniform color ranging from blue to orange (including white) can be obtained.

2-3. ENVIRONMENT CONDITIONS

Table-3

Item	Symbol	Min.	Max.	Unit
Operating Temperature	Topr	-20	+70	°C
Storage Temperature	Tstg	-20	+70	°C
Operating Humidity (Note)	Hopr	20	85	%
Storage Humidity (Note)	Hstg	20	90	%
Vibration (10~55Hz)	–	–	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	Vcc	-0.3	6.5	V
Input Signal Voltage	V_{IS}	-20	+20	V

2-5. RECOMMENDED OPERATING CONDITIONS

Table-5

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage	Vcc	–	4.5	5.0	5.5	V
DATA "1"(MARK)	V_{MARK}	RS-232C	-15	–	-5	V
DATA "0"(SPACE)	V_{SPACE}		5	–	15	V

2-6. ELECTRICAL CHARACTERISTICS

Table-6

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Current (Note1)	Icc		–	1.0	1.5	A
Power Consumption	–	Vcc=5.0V All on	–	5.0	–	W
Luminance	L		350	700	–	cd/m^2

Note) The surge current can be approx.10 times the specified supply current at power on.

3. INTERFACE

Communication : Based on RS-232C
Asynchronous serial and bi-directional communication
Hand shaking : RTS control
Data length : 8 bits (LSB first)
Parity : Non
Stop bit : 1 bit
Baud rate : 9600bps
Signal level : MARK······ logic = "1"
SPACE······ logic = "0"

Basic Function

3-1. WRITE-IN CHARACTER CODE OR CONTROL CODE

A module keeps RTS signal disable (RTS = MARK "1") when processing a reception data, after receiving a character or control code. A data transfer can only be available when RTS signal is enable (RTS = SPACE "0").
The character set has alphabets/numeric/symbols according to JIS6220.

The write-in position is automatically shifted one digit to the right when a character code is received.
If the write-in position is at the right end of the first row, it is moved to the left end of the second row after writing a character.
If the write-in position is at the right end of the second row, it is moved to the left end of the first row after writing a character. Messages on the display will not be changed unless a next character code is received. After receiving the next character code, all of characters on the display are removed. And then the new character is shown at the left end of the first row, and the write-in position is shifted one digit to the right.

* The write-in position behaves as follows, in case the module is processing scroll function (SCR) and a character is written-in to a row where in not defined to the scroll mode.

If the write-in position is at the right end of the row, it is moved to the left end of the same row after writing a character. Messages on the same row is not be changed unless a next character code is received. After receiving the next character code, all of characters at the same row are cleared and the character is shown at the left end of the same row. The write-in position is shifted one digit to the right.

3-2. CONTROL CODE
   The control commands are available as follows.
   The details are explained on the following pages.

      (1) DIM : Dimming   : (04 hex)
      (2) BS   : Back Space   : (08 hex)
      (3) HT   : Horizontal Tab   : (09 hex)
      (4) CLR : Clear   : (0D hex)
      (5) DP   : Display Position   : (10 hex)
      (6) DC   : Cursor Mode   : (17 hex)
      (7) ALD : All Display   : (0F hex)
      (8) BLK : Blinking   : (0A hex)
      (9) SCR : Scroll   : (0B hex)
      (10)CAL : Calendar   : (0C hex)
      (11)TON : Triangle Mark On   : (18 hex)
      (12)TOF : Triangle Mark Off   : (19 hex)
      (13)TFF : Triangle Mark All Off : (1A hex)
      (14)TBK : Triangle Mark Blink : (1E hex)
      (15)RST : Reset   : (1F hex)
      (16)ID   : Display ID   : (1B + 5B + 63 hex)

   Note) Undefined control code or undefined property code is ignored as invalid data.

(1) DIM (Dimming)
     Brightness can be controlled into six levels by using this command
     After writing DIM code 04 hex, the second byte represents a level of the brightness
     corresponded below table.
     In case an other data which is not listed on the table below is transferred as the second byte,
     the data is ignored and also DIM command will be canceled then.

          1 byte   1 byte
          04 hex   +   (Dimming data)

Brightness	Data
0 %	00 hex
20 %	20 hex
40 %	40 hex
60 %	60 hex
80 %	80 hex
100 %	FF hex

(2) BS (Back Space)
     The write-in position is shifted one digit to the left, and the character previously displayed
     on the digit will be cleared.
     When the write-in position is at the left end of the second row, the write-in position is
     moved to the right end of the first row.
     When the write-in position is at the left end of the first row, the write-in position is moved
     to the right end of the second row.
   * While the scroll mode (SCR) is selected, the write-in position is moved to the right end of
     the same row where is not defined to the scroll mode after receiving BS command if the
     current write-in position is at the left end of the row.

(3) HT (Horizontal Tab)

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

When the write-in position is at the right end of the first row, the write-in position is moved to the left end of the second row.

When the write-in position is at the right end of the second row, the write-in position is moved to the left end of the first row. (But messages on the display will not be cleared.)

  * While the scroll mode (SCR) is selected, the write-in position is moved to the left end of the same row where is not defined to the scroll mode after receiving HT command if the current write-in position is at the right end of the row. (But messages on the row is not cleared.)

(4) CLR (Clear)

All the characters displayed are cleared, and the write-in position is moved to the left end of the first row. But the Dimming level and Cursor Mode will be kept.

  * After executing CLR command, the Blink command (BLK) and the scrolling command (SCR) are canceled.

(5) DP (Display Position)

The write-in position can be located at anywhere on the display by using this command. After writing DP code 10 hex, the second byte represents a new write-in position as following values.

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

In case an other data which is out of above position is transferred as the second byte, the data is ignored and also DP command will be canceled then.

  * While the scroll mode (SCR) is selected, in case transferred position data as the second byte is located on the row where is defined to the scroll mode, the second byte is ignored and also DP command will be canceled then.

(6) DC (Cursor Mode)

After writing DC mode17 hex, the second byte represents a selection of the cursor mode shown on the table below.

The cursor which is formed by the 5 dots located the bottom of 5×7 dot matrix character font is always displayed at the write-in position.

1 byte		1 byte
04 hex	+	(Select Mode Data)

Table-8

Select	Data
Lighting	FF hex
Blinking	88 hex
No Lighting	00 hex

(Note) In case an other data which is not listed on above table is transferred, the data is ignored and also DC command will be canceled then.

1) Lighting Mode
   The cursor appears at the write-in position. The character at the write-in position disappears instead. But it will appear again after the write-in position is moved to other position.

2) Blinking Mode
   The cursor repeats to blink with 0.3 second period. The character and the cursor at the write-in position is displayed alternately.

3) No Lighting Mode
   The cursor is not displayed.
   At the power on, "No Lighting" mode is selected.

(7) ALD (All Display)
   The full dots and triangle symbols in all digits are displayed. The dimming level is set at 100%.
   To release this mode, the module must be turned off or RST command must be written.

(8) BLK (Blinking)
   Blinking character can be realized by using this command.
   The command frame consists of following three bytes.

1 byte 0A hex	+	1 byte (Start digit)	+	1 byte (Number of digits)

- The second byte represents start digit address of the blinking ON/OFF characters. (The value of the digit address is specified as below.)

Start digit address (hex)

00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13
14	15	16	17	18	19	1A	1B	1C	1D	1E	1F	20	21	22	23	24	25	26	27

- In case 28 ~ FF hex is transferred as the second byte, its data is ignored and also BLK command will be canceled then.
- The third byte represents the number of digits which is specified as the blinking digits.
- In case the number of specified digits overflows the display area, the data is ignored and also BLK command will be canceled then.
- The maximum value of the third byte is the number of digits from the start digits specified by second byte to the right end digit of the second row.
- To make the digits blinking ON or OFF the most significant bit of the third byte must be set to "1" or "0".

D7	D6	D5	D4	D3	D2	D1	D0
	0	0					

1 : blinking ON
0 : blinking OFF

(Note) In case specified digits for blinking overlap an area where has been previously specified, latest command data is prior.
(Note) After executing CLR/ALD/RST, all of blinking digits are initialized as blinking OFF.

(9) SCR (Scrolling message):
SCR command can realize an automatic scrolling message.

Command frame

1 byte		1 byte		1 byte		60 byte max.
0B(HEX)	+	(Scroll mode)	+	(Timer)	+	(Message data)

- A Message starts scrolling after receiving all of data in a command frame. The end of data is identified by the code "END" (02 hex). In case there are some characters on the specified row, once the row is cleared and starts scrolling a message.
- After starting to scroll a message, write-in position moves to the left end of the row where is not defined to the scroll mode.
- The scroll mode can be canceled by CLR/ALD RST commands.

1) Scroll mode set
Selection of the row and direction are specified by the second byte (Scroll mode) as follows.

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	0	0		

1: Scrolling at the first row
0: Scrolling at the second row

1: Scrolling to the right side from the left.
0: Scrolling to the left side from the right.
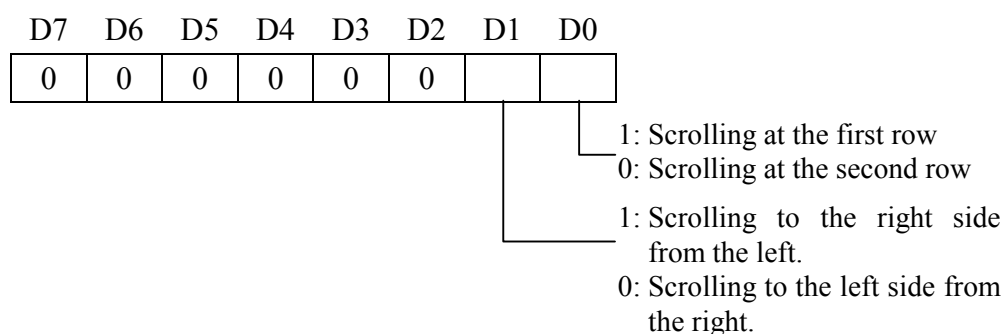
2) Timer
This third byte specifies an interval time of scrolling. Minimum interval time is 0.1 sec.

Table-9

Interval time	0.1 sec	0.2 sec	―――――	12.7 sec
Data	01 hex	02 hex	―――――	7F hex

* Initial value is 0.5 sec as 00 hex.

3) Message data
Maximum 60 bytes characters can be displayed with scrolling. These 60 bytes data include ID data which are described as follows and can realize some functions in the scrolling

*ID data
a) PAUSE (01 hex)+(Pause time, 1byte):
The scrolling pauses for a time specified the following one byte.

Table-10

Pause time	0.1 sec	0.2 sec	―――――	12.7 sec
Data	01 hex	02 hex	―――――	7F hex

* Initial value is 0.5sec as 00 hex.

b) CLEAR (03 hex):
Clear displaying message on the row. Afterwards it continues from the character after Clear ID code 03 hex.

c) END (02 hex):
   The END ID code 02 hex must be transferred following the message data.
   After receiving END, ID code, the messages restart from the top of the message data.

Note1) In case a message data is 60 bytes without END data, the scrolling message starts again from the top of the message data.

2) In case a message data is 60 bytes and last data is PAUSE, the PAUSE function is canceled.

3) When a scrolling message begins, cursor mode is set for non lighting mode, and all of blinking characters are canceled (no blinking), brightness level is set at 100%.

4) In case the module receives DC/BLK/DIM TBK/SCR/CAL commands while scrolling message, these command are ignored.

5) In case command frame data or message data includes improper data, all of data are ignored and also SCR command will be canceled then.

(10) CAL (Calendar):
   The data is displayed with calendar/time format.
   * Note that the module does not have real time counting function. This command is only to display data with specified format.

0C hex	Row	2 bytes	1 byte	1 byte	1 byte	1 byte	1 byte
		Year	Month	Day	Hour	Minute	Second

   Row : the first row (00 hex) / the second row (14 hex)

   ex.) 0C hex + 00 hex + 19 hex + 96 hex + 02 hex + 02 hex + 10 hex + 00 hex + 30 hex

1	9	9	6		2	/	2		1	0	:	0	0	.	3	0	

Note1) When the module receive improper data, the data is ignored and also CAL command will be canceled then.

Note2) 01 to 09 data as month/day/ hour/minute/second does not show "0" character.

Note3) After displaying a calendar on the first row, the write-in position moves to the left end of the second row.
       After displaying a calendar on the second row, the write-in position moves to the left end of the first row.

(11) TON (Triangle Mark On):
   Triangle Mark can be turned on.
   After writing TON code 18 hex, the second byte represents a position of the Triangle Mark which is turning on.

   1 byte   1 byte
   (18 hex)   +   (Position)

   Left end of the row   Right end of the row
   14 HEX   27 HEX

   Note) In case position data is out of the range, the data is ignored and also TON command will be canceled then.

(12) TOF (Triangle Mark Off):
   Triangle Mark can be turned off.
   After writing 19 hex, the second byte represents a position of the Triangle Mark which is turning off.

1 byte		1 byte
(19 hex)	+	(Position)

   Left end of the row   Right end of the row
   14 HEX   27 HEX

   Note) In case the position data is out of the range, the data is ignored and also TOF command will canceled then.

(13) TFF (Triangle Mark All Off):
   All of Triangle Mark are turned off.
   When this command is executed, other function mode, such as brightness level/write-in position/etc., will not be changed.

(14) TBK (Triangle Mark Blink):
   This command makes Triangle Mark blinking.
   After writing 1E hex, the second byte represents a position of the Triangle Mark which is blinking.

1 byte		1 byte
1E hex	+	(Position)

   Left end of the row   Right end of the row
   14 HEX   27 HEX

   Note) In case the position data is out of the range, the data is ignored and also TBK command will be canceled then.

(15) RST (Reset):
   The module is initialized.
   All characters displayed are cleared, then the write-in position is set at the left end of the first row. The state of the module becomes the same as power on.
   Cursor mode is set for no lighting mode, and the dimming level is set at 100%.

(16) ID (Display ID):
   After receiving this command from a host, the module send response data to the host.
   The command frame consists of three bytes as follows.

1 byte		1 byte		1 byte
1B hex	+	5B hex	+	63 hex

   Note) In case the second or third data is wrong, its data is ignored and also ID command will be canceled then.

   After receiving those three bytes, the module send the following response data.

   02 hex + 4D hex + 32 hex + 30hex + 32 hex + 4D hex + 44 hex + 31 hex + 32 hex + 42 hex + 41 hex + 03 hex
   ("M", "2", "0", "2", "M", "D", "1", "2", "B", "A"

   While sending the response data, the module can not receive any data from a host.
   The module will check a state of CTS level for each byte of response data. (CTS = SPACE "0")
   In case an interval time between response data is over one second, a time out error is occurred and the module stops sending the response data.

4. INTERFACE CONNECTION

4-1. CONNECTOR PIN CONNECTION

Connector : IL-8P-S3FP2 (JST) or equivalent
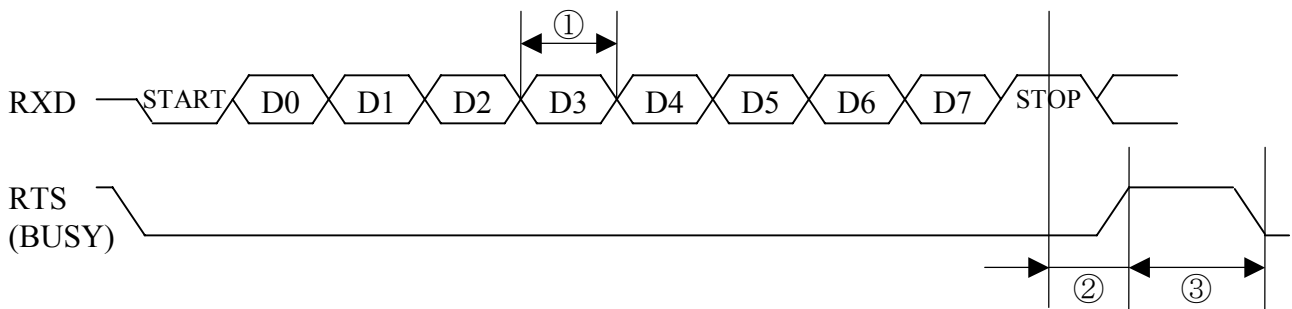
Socket : IL-8S-S3L-(N) (JST) or equivalent

PIN No.	Signal	Output/Input
1	RTS	Output
2	CTS	Input
3	GND	–
4	GND	–
5	RXD	Output
6	TXD	Input
7	+5V	–
8	+5V	–

Note) The module can received data regardless of the CTS level.

4-2. WRITE-IN TIMING

4-2-1. Serial Input

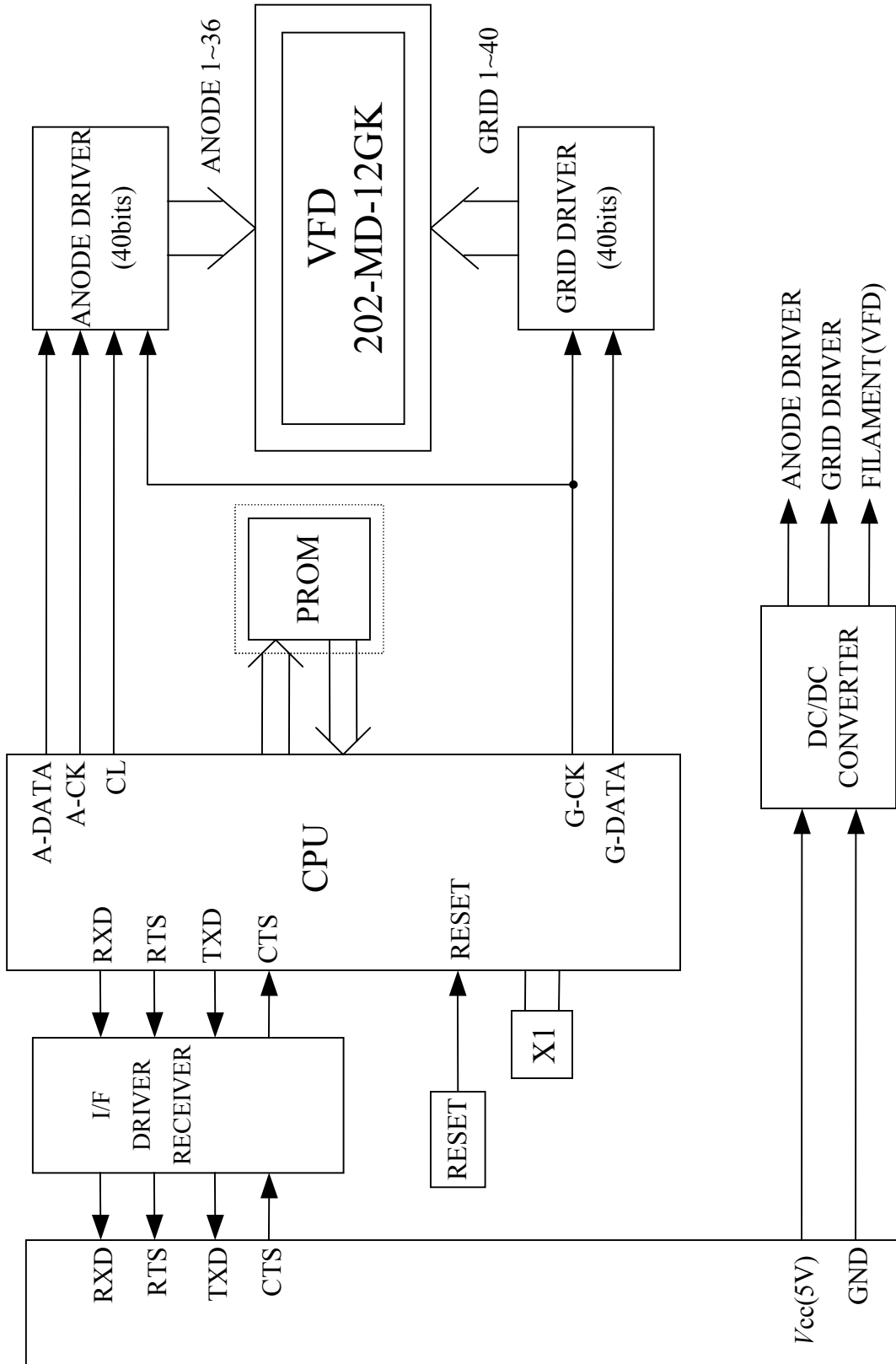* The signal level in the following timing chart is described by logic level. (Not RS232C level)

① $t\,(DATA) = 10^6/9600(bps)$ [µs]

② $t\,(WAIT) = 200$ [µs] MAX

③ $t\,(BUSY) = 1$ [ms] MAX

M202MD12BA   MECHANICAL DRAWING

FIGURE-1

UNIT : mm

MOUNTING HOLE

4-φ4.0

(4X)φ8

(4X)4

(4X)4

(32)

10 +0.7 -0.5

15MAX

48.3 +0.7 -0.5

(7.85)

190 ±1

(146.1)

182 ±0.5

17.55 ±1

DISPLAY AREA

8   1

4 ±0.5

(29)

17.5 ±1

56 ±0.5

4 ±0.5

64 ±1

NONE COMPONENTS AREA

VFD(202-MD-12GK)

175.2 +0.8 -0.5

15.0 ±1

11MAX

9MAX

1.6

10MAX

COMPONENTS AREA

(45)

(72.5)

(3)

(6.5)

(15)

(27.8)

CONNECTOR

M202MD12BA   CIRCUIT BLOCK DIAGRAM

FIGURE-2

M202MD12BA   CHARACTER DISPLAY CODE

FIGURE-3

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	SP	0	@	P	`	p								
0 0 0 1	1	ID PAUSE		!	1	A	Q	a	q								
0 0 1 0	2	ID END		"	2	B	R	b	r								
0 0 1 1	3	ID CLEAR		#	3	C	S	c	s								
0 1 0 0	4	DIM		$	4	D	T	d	t								
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		DC	'	7	G	W	g	w								
1 0 0 0	8	BS	TON	(	8	H	X	h	x								
1 0 0 1	9	HT	TOF	)	9	I	Y	i	y								
1 0 1 0	A	BLK	TFF	*	:	J	Z	j	z								
1 0 1 1	B	SCL		+	;	K	[	k	{								
1 1 0 0	C	CAL		,	<	L	¥	l										
1 1 0 1	D	CLR		-	=	M	]	m	}								
1 1 1 0	E		TBK	.	>	N	^	n										
1 1 1 1	F	ALD	RST	/	?	O	_	o									SP

(Top column binary values — D7 D6 D5 D4:)

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
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

SP：SPACE

6. WARRANTY

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

7. OPERATING RECOMMENDATIONS

7-1. Since VFDs are made of glass material.
Avoid applying excessive shock or vibration beyond the specifications for the module.
Careful handing is essential, especially the exhaust chip when mounting the module.

7-2. Applying lower voltage than the specified may cause non activation for selected pixels.
Conversely, higher voltage may cause may non-selected pixel to be activated.

7-3. If the start up time of the supply voltage is slow, the controller may not be reset.
The supply voltage must be risen up to specified voltage level within 30msec.

7-4. DC/DC converter is equipped on the module, the surge current may be approximately 10 times the specified supply current at the power on.

7-5. Avoid using the module where excessive noise interface 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.).

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

REMARKS :

The specification is subject to change without prior notice.
Your consultation with FUTABA sales office is recommended for the use of module.