Futaba®

APPLICATION NOTE

VACUUM FLUORESCENT DISPLAY MODULE

CHARACTER DISPLAY MODULE

M162SD17BA

Futaba Vacuum Fluorescent Display Module M162SD17BA, with Futaba VFD 162-SD-17INK display, produces 16 digits×2 rows with 5×7 dot matrix.
Consisting of a VFD, DC-DC converter, the module can be operated by a synchronous serial interface, and only 5 voltage power source is required to operate the module.

⚠ <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 (approx. 32V) 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

This vacuum fluorescent display (VFD) module consists of a 16 characters by 2 lines 5×7 dot matrix display, DC-DC converter, and controller/driver circuitry.

Setting eight bits in the function set instruction can vary the luminance level of the VFD.

Two hundred and forty eight character fonts consisting of alphabets, Cyrillic alphabets, numerals and other symbols can be displayed.

2. SPECIFICATIONS

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

Table-1

Item	Specification	Unit
Outer Dimensions	(L) 137.0 ±1 (W) 27.5 ±1 (T) 15.3 Max.	mm
Weight	Approx. 40	g

2-2. GENERAL SPECIFICATIONS

Table-2

Item	Value	
Number of characters	16 characters × 2 lines	
Character configuration	5×7 dot matrix	
Display Area	86.7 × 12.0 mm	
Character Size	3.45 × 5.45 mm	
Character Pitch	5.55 × 6.55 mm	
Dot Size	0.57 × 0.65 mm	
Dot Pitch	0.72 × 0.80 mm	
Peak Wavelength of Illumination	Green (λp=505nm)	
Luminance	Minimum 250 cd/m^2	Typical 500 cd/m^2

2-3. ENVIRONMENTAL SPECIFICATIONS

Table-3

Item	Symbol	Min.	Max.	Unit	Comment
Operating Temperature	Topr	-40	+85	°C	
Storage Temperature	Tstg	-40	+85	°C	
Operating Humidity	Hopr	20	85	%RH	Without condensation
Storage Humidity	Hstg	20	90	%RH	Without condensation
Vibration	–	–	4	G	Total amplitude: 1.5mm Freq: 10-55 Hz sine wave Sweep time: 1 min./cycle Duration: 2hrs./axis (X,Y,Z)
Shock	–	–	40	G	Duration: 11ms Wave form: half sine wave 3 times/axis (X,Y,Z,-X,-Y,-Z)

2-4. ABSOLUTE MAXIMUM SPECIFICATIONS

Table-4

Item	Symbol	Min.	Max.	Unit
Supply Voltage	Vcc	-0.3	6.5	V
Input signal Voltage	V_{IN}	-0.3	Vcc+0.3	V

2-5. DC ELECTRICAL SPECIFICATIONS

<div align="right">Table-5</div>

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	V_{cc}	4.5	5.0	5.5	V
Supply Current	I_{cc}	–	160	210	mA
Power Consumption	–	–	0.8	1.2	W
High - Level Input Voltage	V_{IH}	$0.8V_{cc}$	–	–	V
Low - Level Input Voltage	V_{IL}	–	–	$0.2V_{cc}$	V
High - Level Input Current	I_{IH}	–	–	5.0	μA
Low - Level Input Current	I_{IL}	–	–	-5.0	μA

3. FUNCTIONAL DESCRIPTION

The following are the list of commands.

Table-6 INSTRUCTIONS TABLE

INSTRUCTION	MSB			1st Byte				LSB	MSB			2nd Byte				LSB	
	B7	B6	B5	B4	B3	B2	B1	B0	B7	B6	B5	B4	B3	B2	B1	B0	
DCRAM_A DATA WRITE	0	0	0	X4	X3	X2	X1	X0	C7	C6	C5	C4	C3	C2	C1	C0	
DCRAM_B DATA WRITE	0	0	1	X4	X3	X2	X1	X0	C7	C6	C5	C4	C3	C2	C1	C0	
CGRAM DATA WRITE	0	1	0	*	*	Y2	Y1	Y0	*	D30	D25	D20	D15	D10	D5	D0	2nd Byte
									*	D31	D26	D21	D16	D11	D6	D1	3rd Byte
									*	D32	D27	D22	D17	D12	D7	D2	4th Byte
									*	D33	D28	D23	D18	D13	D8	D3	5th Byte
									*	D34	D29	D24	D19	D14	D9	D4	6th Byte
NUMBER OF DIGIT SET	1	1	1	0	0	0	*	*	0	*	*	*	F3	F2	F1	F0	
DIMMING SET	1	1	1	0	0	1	*	*	H7	H6	H5	H4	H3	H2	H1	H0	
GRAY−LEVEL SET	1	0	1	*	*	J2	J1	J0	I7	I6	I5	I4	I3	I2	I1	I0	
GRAY−LEVEL ON/OFF SET	1	1	0	X4	X3	X2	X1	X0	*	*	0	0	0	0	K1	K0	
DISPLAY LIGHT SET	1	1	1	0	1	0	LS	HS	*	*	*	*	*	*	*	*	

∗:   Not Relevant
Xn: Duty Timing (Digit) Address Set, n = 0 to 4
Cn: CGRAM/CGROM Character Code Bit, n = 0 to 7
Yn: CGRAM Address Bit, n = 0 to 2
Dn: CGRAM Character Code Setting, n = 0 to 34
Fn: Number of Digits Set, n = 0 to 3
Hn: Dimming Quantity Setting, n = 0 to 7
Jn: Gray−Level Register Setting, n = 0 to 2
In: Gray−Level Quantity Setting, n = 0 to 7
Kn: Each Gray−Level Enable/Disable Setting, n = 0 to 1
HS: "1": All Output (Anode, Segment) Data = "H"   "0": Normal Mode
LS: "1": All Output (Anode, Segment) Data = "L"   "0": Normal Mode

When data is written into the RAM (DCRAM,CGRAM or ADRAM) in a continuous manner,
the addresses are automatically incremented internally.
It is therefore not necessary to specify the first byte.

3-1. RESET FUNCTION

When initialized, the internal status after power supply has been reset as follows.

Table-7 RESET FUNCTION

Instruction	At Reset Condition
DCRAM_A	DCRAM_A Address=00H ALL DCRAM_A Data=20H
DCRAM_B	DCRAM_B Address=00H ALL DCRAM_B Data=20H
CGRAM	CGRAM Address=00H ALL CGRAM Data=00H
Number of Digit Set	F3 ～ F0="1111"F6 ～ F4="000"
Dimming Set	0/255
Gray Level Set	J2 ～ J0="000" 0/255
Gray Level On / Off Set	GLRAM Address=00H K5 ～ K0="000000"(Gray Level Disable)
Display Light Set	LS="1" HS="0" (Display all off)

3-2. COMMAND FUNCTION
3-2-1. DATA CONTROL RAM (DCRAM) DATA WRITE COMMAND

The DCRAM (Include: DCRAM_A and DCRAM_B) Data Write Command is used to specify the address
of the DCRAM and writes the character code of the CGROM and CGRAM (C0 to C7 bits). The DCRAM consists of 5 address bits which are used to store the CGRAM & CGROM character codes. The character codes specified by the DCRAM are converted to a 5 x 7 dot matrix character pattern via the CGROM and CGRAM. The DCRAM (Include: DCRAM_A, DCRAM_B) can each store up to 24 characters (DCRAM_A = 24 characters, DCRAM_B = 24 characters). The DCRAM Data Write Command Format is shown below.

1st Byte (1st)

	MSB							LSB
	B7	B6	B5	B4	B3	B2	B1	B0
	0	0	0	X4	X3	X2	X1	X0

DCRAM_A Data Write Mode is selected and the DCRAM_A Address is specified. (i.e. DCRAM_A Address = 0H)

or

1st Byte (1st)

	MSB							LSB
	B7	B6	B5	B4	B3	B2	B1	B0
	0	0	1	X4	X3	X2	X1	X0

DCRAM_B Data Write Mode is selected and the DCRAM_B Address is specified. (i.e. DCRAM_B Address = 0H)

2nd Byte (2nd)

	MSB							LSB
	B7	B6	B5	B4	B3	B2	B1	B0
	C7	C6	C5	C4	C3	C2	C1	C0

CGROM & CGRAM Character Codes are specified. (They are written into the DCRAM Address 0H)

3-2-2. CGRAM DATA WRITE COMMAND

The Character Generator RAM (CGRAM) Data Write Command is used to specify the CGRAM address (00H to 07H) and write the character pattern data. It consists of 3 address bits which is used to store the 5 x 7 dot matrix character patterns. The CGRAM can store up to 8 types of character patterns which may be displayed by specifying the Character Code (DCRAM Address). The CGRAM Data Write Command Format is given below.

1st Byte (1st)

MSB							LSB
B7	B6	B5	B4	B3	B2	B1	B0
0	1	0	*	*	Y2	Y1	Y0

CGRAM Data Write Mode is selected and the CGRAM Address is specified (i.e. CGRAM Address = 00H).

2nd Byte (2nd)

MSB							LSB
B7	B6	B5	B4	B3	B2	B1	B0
*	D30	D25	D20	D15	D10	D5	D0

1st Column Data is specified and rewritten into the CGRAM Address 00H.

3rd Byte (3rd)

MSB							LSB
B7	B6	B5	B4	B3	B2	B1	B0
*	D31	D26	D21	D16	D11	D6	D1

2nd Column Data is specified and rewritten into the CGRAM Address 00H.

4th Byte (4th)

MSB							LSB
B7	B6	B5	B4	B3	B2	B1	B0
*	D32	D27	D22	D17	D12	D7	D2

3rd Column Data is specified and rewritten into the CGRAM Address 00H.

5th Byte (5th)

MSB							LSB
B7	B6	B5	B4	B3	B2	B1	B0
*	D33	D28	D23	D18	D13	D8	D3

4th Column Data is specified and rewritten into the CGRAM Address 00H.

6th Byte (6th)

MSB							LSB
B7	B6	B5	B4	B3	B2	B1	B0
*	D34	D29	D24	D19	D14	D9	D4

5th Column Data is specified and rewritten into the CGRAM Address 00H.

During a continuous data write operation from one CGRAM Address to the next, it is not necessary to specify the CGRAM address since they are automatically incremented; however, the character pattern data must be specified. The 2nd to the 6th character pattern data byte are considered as one data item, **therefore 1µs is sufficient value for parameter tDOFF between bytes**. Please refer to the information below.

2nd Byte (7th)

MSB							LSB
B7	B6	B5	B4	B3	B2	B1	B0
*	D30	D25	D20	D15	D10	D5	D0

1st Column Data is specified and rewritten into the CGRAM Address 01H.

⋮

6th Byte (11th)

MSB							LSB
B7	B6	B5	B4	B3	B2	B1	B0
*	D34	D29	D24	D19	D14	D9	D4

5th Column Data is specified and rewritten into the CGRAM Address 01H.

where: Y2 (MSB) to Y0 (LSB): CGRAM Address Bits (8 Characters)
D34 (MSB) to D0 (LSB): Character Pattern Data Bits (35 outputs)

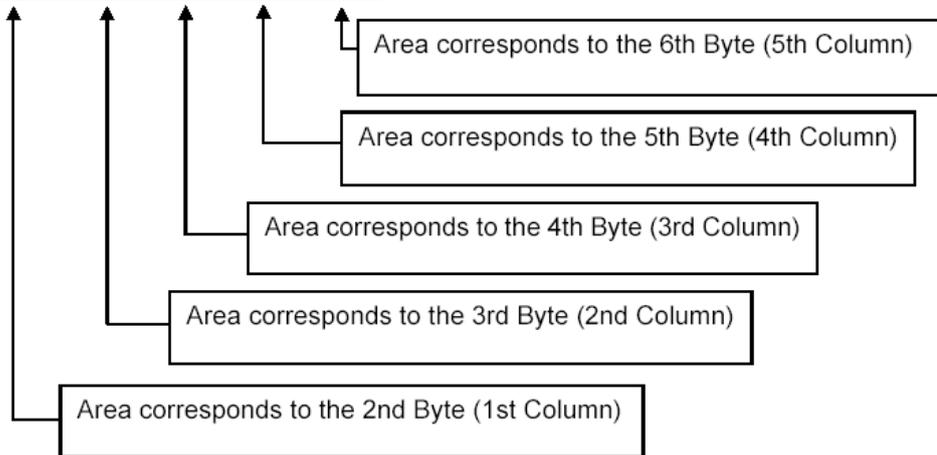Please refer below for the CGROM Address and CGRAM Address Setting relationship.

Table-8

Y2	Y1	Y0	CGROM Address
0	0	0	RAM00(01000000B)
0	0	1	RAM01(01000001B)
0	1	0	RAM02(01000010B)
0	1	1	RAM03(01000011B)
1	0	0	RAM04(01000100B)
1	0	1	RAM05(01000101B)
1	1	0	RAM06(01000110B)
1	1	1	RAM07(01000111B)

The CGROM and CGRAM output area placement is given in the table below.

Table-9

D0	D1	D2	D3	D4
D5	D6	D7	D8	D9
D10	D11	D12	D13	D14
D15	D16	D17	D18	D19
D20	D21	D22	D23	D24
D25	D26	D27	D28	D29
D30	D31	D32	D33	D34

Area corresponds to the 6th Byte (5th Column)

Area corresponds to the 5th Byte (4th Column)

Area corresponds to the 4th Byte (3rd Column)

Area corresponds to the 3rd Byte (2nd Column)

Area corresponds to the 2nd Byte (1st Column)

The Character Generator ROM (CGROM) consists of 8 CGROM Address bits generating 5 x 7 dot matrix character patterns. It can store up to a maximum of 248 types of character patterns.

3-2-3. NUMBER OF DIGITS SET COMMAND

	MSB							LSB
1st Byte (1st)	B7	B6	B5	B4	B3	B2	B1	B0
	0	1	1	X4	X3	X2	X1	X0

	MSB							LSB
2nd Byte	B7	B6	B5	B4	B3	B2	B1	B0
	0	*	*	*	F3	F2	F1	F0

The Number of Digits Set Mode is selected and the number of digit value is specified, Universal Function set to ON/OFF.

where: F3 (MSB) to F0 (LSB): Display Duty Data Bits (16 stages)

Table-10

F1	F2	F1	F0	Digits
0	0	0	0	T1(1G)
0	0	0	1	T1(1G)~T2(2G)
0	0	1	0	T1(1G)~T3(3G)
0	0	1	1	T1(1G)~T4(4G)
0	1	0	0	T1(1G)~T5(5G)
0	1	0	1	T1(1G)~T6(6G)
0	1	1	0	T1(1G)~T7(7G)
0	1	1	1	T1(1G)~T8(8G)
1	0	0	0	T1(1G)~T9(9G)
1	0	0	1	T1(1G)~T10(10G)
1	0	1	0	T1(1G)~T11(11G)
1	0	1	1	T1(1G)~T12(12G)
1	1	0	0	T1(1G)~T13(13G)
1	1	0	1	T1(1G)~T14(14G)
1	1	1	0	T1(1G)~T15(15G)
1	1	1	1	T1(1G)~T16(16G)

3-2-4. DIMMING SET COMMAND

The Dimming Set Command is used to write the display duty value to the duty cycle register. Using a 8-bit data, the display duty adjusts the contrast in 240 stages. When the power is turned ON or when the /RESET signal is inputted, the duty cycle register value is set to "0". It's advisable to always execute this command before turning on the display, after which the desired duty value may be set. The command format is given below.

	MSB							LSB	
2nd Byte	B7	B6	B5	B4	B3	B2	B1	B0	Display Duty Set Mode is selected and the duty
	H7	H6	H5	H4	H3	H2	H1	H0	value is specified.

The relationship between the Setup Data, Controlled Grid Duty and the Synchronous Signal Quantity are given in the table below.

Table-11

H7	H6	H5	H4	H3	H2	H1	H0	Dimming Quantity (Grid pin)	
0	0	0	0	0	0	0	0	0/255 x T	*default
0	0	0	0	0	0	0	1	1/255 x T	
0	0	0	0	0	0	1	0	2/255 x T	
0	0	0	0	0	0	1	1	3/255 x T	
0	0	0	0	0	1	0	0	4/255 x T	
:	:	:	:	:	:	:	:	:	
:	:	:	:	:	:	:	:	:	
1	1	1	0	1	1	1	1	239/255 x T	
1	1	1	1	0	0	0	0	240/255 x T	
1	1	1	1	0	0	0	1	240/255 x T	
:	:	:	:	:	:	:	:	:	
:	:	:	:	:	:	:	:	:	
1	1	1	1	1	1	1	0	240/255 x T	
1	1	1	1	1	1	1	1	240/255 x T	

3-2-5. GRAY-LEVEL SET COMMAND

The Gray-Level Set Command is used to write the register setting value and gray level duty value to the register. Using a 3-bit data 1st byte and 8-bit data 2nd byte, the set register adjusts the contrast in 240 stages. When the power is turned ON or when the /RESET signal is inputted, both the register are set to "0". At this time, it is necessary to set data. (Excluding "0")
The data sets the "1" (enable state) or "0" (disable state). The command format is given below.

1st Byte	MSB							LSB
	B7	B6	B5	B4	B3	B2	B1	B0
	1	0	1	*	*	J2	J1	J0

Table-12

J2	J1	J0	Register Setting
0	0	0	Anode(D0A～D34A)
0	0	1	Anode(D0B～D34B)
0	1	0	Don't Care
0	1	1	Don't Care
1	0	0	Don't Care
1	0	1	Don't Care
1	1	0	Don't Care
1	1	1	Don't Care

2nd Byte	MSB							LSB
	B7	B6	B5	B4	B3	B2	B1	B0
	I7	I6	I5	I4	I3	I2	I1	I0

Table-13

I7	I6	I5	I4	I3	I2	I1	I0	Dimming Data
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	1	1/255
0	0	0	0	0	0	1	0	2/255
0	0	0	0	0	0	1	1	3/255
:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:
1	1	1	0	1	1	1	1	239/255
1	1	1	1	0	0	0	0	240/255
1	1	1	1	0	0	0	1	240/255
:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:
1	1	1	1	1	1	1	1	240/255

*default (Please set it excluding "0".)

3-2-6. GRAY-LEVEL ON/OFF SET COMMAND

The Gray-Level ON/OFF Set consists of 2 address bits used to store the symbol data. The symbol data specified by the GLRAM is directly outputted. The command format is given below.

```
          MSB                                    LSB
2nd Byte   | * | * | 0 | 0 | 0 | 0 | K1 | K0 |
```

K1 = "0": Anode (D0B   D34B) are turned "OFF"
K1 = "1": Anode (D0B   D34B) are turned "ON"

K0 = "0": Anode (D0A   D34A) are turned "OFF"
K0 = "1": Anode (D0A   D34A) are turned "ON"
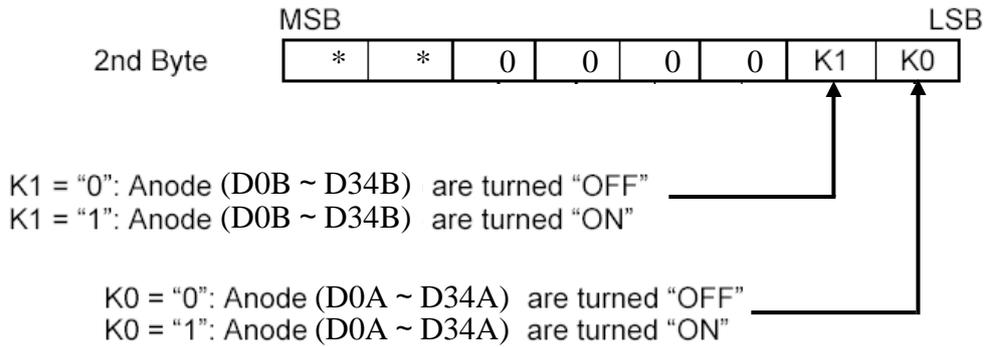
Please refer to the table below for Anode/Segment (K0~K2) position and GLRAM (X0~X4) Duty Timing (Digit) Address setting relationship.

Table-14

Duty Timing (Digit) Address	Anode (D0A D34A)	Anode (D0B D34B)
T1 (11000000B)	ON/OFF	ON/OFF
T2 (11000001B)	ON/OFF	ON/OFF
T3 (11000010B)	ON/OFF	ON/OFF
T4 (11000011B)	ON/OFF	ON/OFF
T5 (11000100B)	ON/OFF	ON/OFF
T6 (11000101B)	ON/OFF	ON/OFF
T7 (11000110B)	ON/OFF	ON/OFF
T8 (11000111B)	ON/OFF	ON/OFF
T9 (11001000B)	ON/OFF	ON/OFF
T10 (11001001B)	ON/OFF	ON/OFF
T11 (11001010B)	ON/OFF	ON/OFF
T12 (11001011B)	ON/OFF	ON/OFF
T13 (11001100B)	ON/OFF	ON/OFF
T14 (11001101B)	ON/OFF	ON/OFF
T15 (11001110B)	ON/OFF	ON/OFF
T16 (11001111B)	ON/OFF	ON/OFF

3-2-7. DISPLAY LIGHT SET COMMAND

The Display Light Set Command is used to turn all display lights ON or OFF. All Display Lights On Mode is primarily used for testing the display. The All Display Light OFF Mode is used for the blinking display and to prevent any malfunction when the power is turned on. The command format is given below.

	MSB							LSB
1st Byte	B7	B6	B5	B4	B3	B2	B1	B0
	1	1	1	0	1	0	LS	HS

where: HS: All Display Lights are turned ON
       LS: All Display Lights are turned OFF

The table below shows Segment and Anode Display Status in relation to the Display Light Set Command data.

Table-15

Bit Name	Segment and Anode Display Status
HS	"0": Normal Display Mode "1": All outputs (Anode, Segment) = "High" The duty of Grid will be follow Dimming Setting. The duty of Anode/Segment will be follow Gray-Level Setting.
LS	"0": Normal Display Mode "1": All outputs (Anode, Segment) = "Low"

4. CONNECTIOR PIN ASSIGNMENT

Table-16

Pin No.	Description
1	Vcc(5V)
2	$\overline{CS}$
3	CP
4	DA
5	$\overline{RESET}$
6	GND

Connector Pin Specifications

Table-17

| Function	Symbol	Input／Output	Description
Shift Clock Input	CP	Input	Serial data is shifted on the rising edge of CP
Serial Data Input	DA	Input	Input from LSB.
Chip Select Input	$\overline{CS}$	Input	Serial data transfer is disabled when CS pin is "H" level.
Reset Input	$\overline{RESET}$	Input	"Low" initializes all the functions. For an initial status, see Reset Function
GND Pin	GND	Input	GND

5. TIMING CHARACTERISTICS
5-1. WRITING WAVEFORM
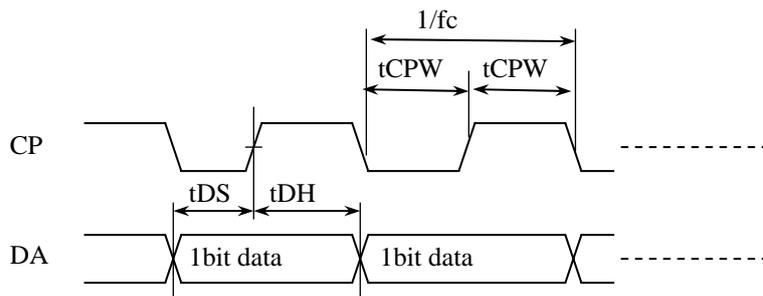
Table-18

Parameter	Symbol	Min	Typ	Max	Unit
CP Frequency	fc	–	–	0.5	MHz
CP Pulse Width	tCPW	700	–	–	ns
CP Hold Time	tCS–CP	1000	–	–	ns
CS Hold Time	tCP–CS	1000	–	–	ns
CS Pulse Width	tCSW	1000	–	–	ns
Data Processing Time	tDOFF	2000	–	–	ns
Data Setup Time	tDS	300	–	–	ns
Deta Hold Time	tDH	300	–	–	ns

5-2. GRID SCAN TIMING

Table-19

Grid Scan Timing	DCRAM Address Gray-Level ON/OFF Set Address	1G	2G	3G	4G	5G	6G	7G	8G	9G	10G	11G	12G	13G	14G	15G	16G	Selection of code DCRAM_A	DCRAM_B
T1	00H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	Note	Note
T2	01H	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	Note	Note
T3	02H	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	Note	Note
T4	03H	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	Note	Note
T5	04H	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	Note	Note
T6	05H	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	L	Note	Note
T7	06H	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L	L	Note	Note
T8	07H	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L	Note	Note
T9	08H	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	Note	Note
T10	09H	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	Note	Note
T11	0AH	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	Note	Note
T12	0BH	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	Note	Note
T13	0CH	L	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	Note	Note
T14	0DH	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L	L	Note	Note
T15	0EH	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L	Note	Note
T16	0FH	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	Note	Note
T17	10H									don't use									
T18	11H																		
T19	12H																		
T20	13H																		
T21	14H																		
T22	15H																		
T23	16H																		
T24	17H																		

Note) Please specify an arbitrary code from the CGROM code.

5-3. RESET CONTROL WAVE
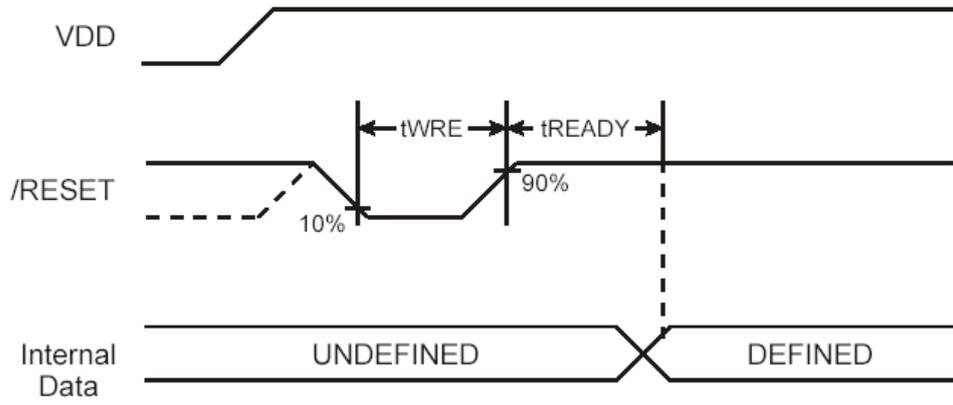
Table-20

Item	Symbol	Min	Typ	Max	Unit
Reset Pulse Width	tWRE	2	–	–	μ s
Ready Time after Reset	tREADY	3	–	–	ms
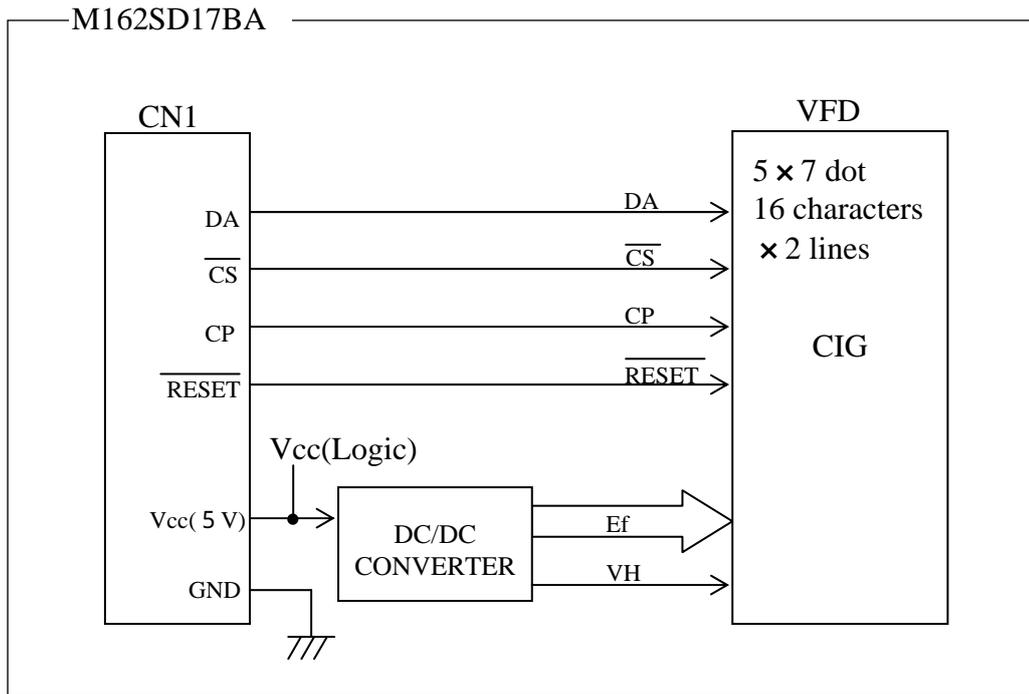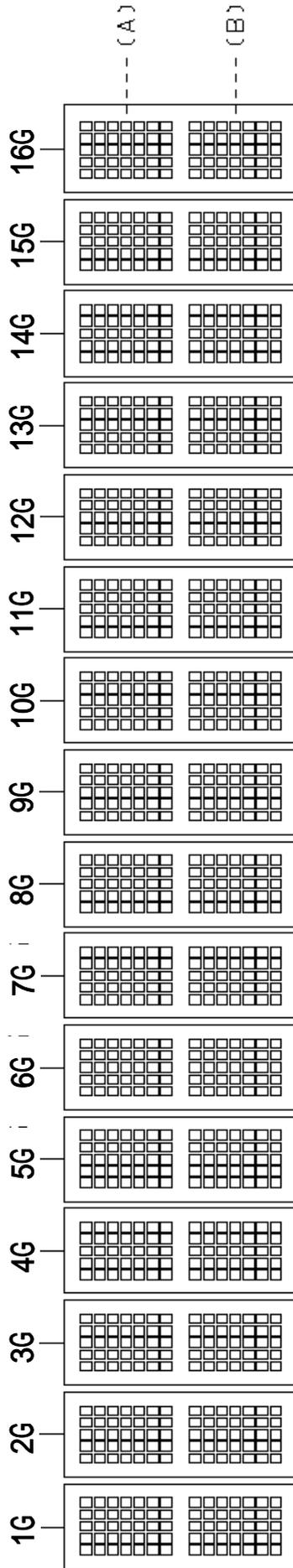
6. OUTER DIMENSION

FIGURE-1

Notes：
1. The connector is inserted from the VFD side, and soldered with the component side.
2. The customer selects the connector.

7. CIRCUIT BLOCK DIAGRAM

FIGURE-2

8. GRID ASSIGNMENT

FIGURE-3

9. CHARACTER FONT TABLES (Cyrillic alphabets Font)

Table-21

MSB / LSB	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	RAM0															
0001	RAM1															
0010	RAM2															
0011	RAM3															
0100	RAM4															
0101	RAM5															
0110	RAM6															
0111	RAM7															
1000																
1001																
1010																
1011																
1100																
1101																
1110																
1111																

10. WARRANTY

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

11. CAUTIONS FOR DETERMINING AND EXPORTING REGULATED GOODS OR SERVICES

This product does not correspond to the goods or services regulated by Japan's Foreign Exchange and Foreign Trade Law. If this product is combined with other products in order to make equipment, whether this product is regulated or not is judged by such newly made equipment. We ask you to determine by yourself whether the equipment corresponds to the regulated goods when this product is incorporated in the equipment.

We also ask you to confirm that this product will not be incorporated in any weapon or used for manufacturing any weapon.

If you export or re-export this product, we recommend you to adopt measures for appropriate export procedures, if any.

12. OPERATING RECOMMENDATION

12-1. Since VFDs are made of glass material.

Avoid applying excessive shock or vibration beyond the specification for the module.

Careful handing is essential.

12-2. 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.

If such a phenomenon is observed, check the voltage level of the power supply.

12-3. Avoid plugging or unplugging the interface connection with the power on.

12-4. If the start up time of the supply voltage is slow, the controller may not be reset.

The supply voltage must be raised up to the specified voltage level within 30msec.

12-5. 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 contact FUTABA engineering.).

12-6. 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.)

12-7. The fuse is mounted on the module as circuit protection.

If the fuse blown, the problem shall be solved first and change the fuse.

12-8. When fixed pattern is displayed for long time, you may see uneven luminance.

It is recommended to change the display patterns sometimes in order to keep best display quality.

13. The environmental specifications for this product

　13-1. With respect to EU RoHS Directive

　　　The contained amount of six prohibited substances in this product , which are cadmium, hexavalent chromium, lead, mercury, polybrominated biphenyl:PBB and polybrominated diphenyl ether :PBDE, is less than the permitted level stipulated in the EU RoHS Directive, or these substances are not included in the Directive.

　　　The substances excluded are based on Article 4 of the EU RoHS Directive.

　13-2. With respect to Chinese RoHS

　　　This product contains only "lead and its compound" from among six controlled substances, which are cadmium, hexavalent chromium, lead, mercury, polybrominated biphenyl:PBB and polybrominated diphenyl ether :PBDE.

　　　The contained amount of the controlled substances except lead and its compound in this product is less than the level stipulated in the Chinese RoHs.

　　　As for the display of information on containing EHS, please refer to the following.

　　　< Display of information on containing EHS >

　　　*Product and part the substances are contained : Vacuum Fluorescent Display(VFD)

　　　*Chemical materials contained : Lead and its compound

　　　*Time limit of use for environmental protection : 10 years

　　　*Reason for containing the substances: No materials are available except them under the current technology.

REMARKS

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