Futaba

AN-E-2416

APPLICATION NOTE

VACUUM FLUORESCENT DISPLAY MODULE

DISPLAY MODULE

M402SD64AB

Futaba Vacuum Fluorescent Display Module M402SD64AB, with Futaba VFD 402-SD-064GINK display, produces 40 digits×2rows with 5×7 dot matrix and cursor.
Consisting of a VFD, control circuit and power supply. The interface of the module can be selected as 8-bit parallel interface.

⚠ 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

1. FEATURE

The vacuum fluorescent display (VFD) module consists of a 40 characters by 2 lines with 5×7 dots matrix and cursor. The module is composed of VFD, control circuit and power supply. The interface of the module can be selected as 8-bit parallel interface.

2. SPECIFICATIONS

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

Table-1

Item	Specification	Unit
Outer Dimensions	(L) 240.0 ±1 (W) 43.0 ±1 (T) 20.6 Max. (except the connector)	mm
Weight	Approx. 140	g

2-2. GENERAL SPECIFICATIONS

Table-2

Item	Specification	Unit
Display Size	16.425(W) × 186.8(L)	mm
Number of Characters	40 characters(5×7 dot) × 2 lines	–
Character Pitch	10.0(W) × 4.7(L)	mm
Character Size	5.0(W) × 3.5(L)	mm
Color of Illumination	Green (λp=505nm)	–

Note) According to the filter, it is possible to choose the display color from green to orange and even to choose white.

2-3. ENVIRONMENTAL SPECIFICATIONS

Table-3

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

Note) Please avoid to storage and operate in the environment which causes condensation.

2-4. ABSOLUTE MAXIMUM SPECIFICATIONS

Table-4

Item	Symbol	Min.	Max.	Unit
Supply Voltage	*V*cc	–	6.0	V
Input signal Voltage	V_{IN}	-0.3	0.3	V

2-5. OPERATIN CONDITIONS

Table-5

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply Voltage	*V*cc	–	4.5	5.0	5.5	V
High Input Voltage	V_{IH}	*Vcc=5.0V*	*Vcc x 0.8*	–	*Vcc*	V
Low Input Voltage	V_{IL}		*0*	–	*Vcc x 0.2*	V

2-6. DC ELECTRICAL SPECIFICATIONS

Table-6

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply Current	I_{CC}	*Vcc=5.0V (ALL ON)*	–	0.75	1.0	A
Power Consumption	–		–	3.75	5.0	W
Luminance	*L*		350	700	-	cd/m^2 (fL)
High Level Input Current	I_{IH}	*Vcc=5.0V*	–	–	*5*	μA
Low Level Input Current	I_{IL}	*Vcc=0V (SI, CLK, LAT)*	–	–	-5	μA
		Vcc=0V (BK)	-35	-50	-400	
High Level Output Voltage	V_{OH}	*Vcc=5.0V* I_{OH}*=-2.6mA*	2.4	–	–	V
Low Level Output Voltage	V_{OL}	*Vcc=5.0V* I_{OL}*=12mA*	0.25	–	0.4	V

Note) The surge current can be approx.2~3 times the specified supply current at power on.

3. FUNCTION

The module is equipped with the function of data and control code write-in, test mode and power-on reset.

Table-7

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

L : Low Level (0V)
H : High Level(5V)
NC : No-Connection
↑ : Low to high Transition
* : RXD(Serial Input)
X : Low or High

Table-7 BASIC FUNCTION AND ACCESS METHOD

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

If $\overline{SEL}$ is "L" and $\overline{WR}$ changes from "L" to "H", it will execute control by data write-in or control code.

The display characters are shown on the FIGURE-3 which includes and European Font.

After display 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 low "L".

3-2. CONTROL CODE

The control codes are available as the following.
The details are explained below.

(1)	DIM	:	Dimming	(04 HEX)
(2)	BS	:	Back Space	(08 HEX)
(3)	HT	:	Horizontal Tab	(09 HEX)
(4)	LF	:	Line Feed	(0A HEX)
(5)	CR	:	Carriage Return	(0D HEX)
(6)	DP	:	Display Position	(10 HEX)
(7)	DC1	:	Normal Display Mode	(11 HEX)
(8)	DC2	:	Vertical Scroll Mode	(12 HEX)
(9)	DC3	:	Cursor ON Mode	(13 HEX)
(10)	DC4	:	Cursor OFF Mode	(14 HEX)
(11)	RST	:	Reset	(1F HEX)

(1) DIM (Dimming) :

Brightness can be controlled into four levels by using this function.
After writing 04 HEX, the next 1 byte data will be viewed as dimming level data.
It is possible to choose the dimming level from the four levels in the table below.

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

Table-8

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

(2) BS (Back Space) :

DC1 Mode …… The cursor position (the following is same as write-in position of non-lighting mode) is shifted to the left one digit.
At this time, the digit shifted is cleared.
When the cursor is on the most significant digit of the second row, the cursor will move to the least significant digit of the first row.
When the cursor is on the most significant digit of the first row, the cursor will move to the least significant digit of the second row.

DC2 Mode …… It is same as above.

(3) 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 will move to the most significant digit of the second row.
When the cursor is on the least significant digit of the second row, the cursor will move 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.

(4) LF (Line Feed) :

DC1 Mode …… The cursor moves up or down to another row staying on the same line.
When the cursor is in the second row, the cursor will move to the first row.

DC2 Mode …… When the cursor is in the second row, the character displayed there will be shifted up to the first row, but the cursor position will remain the same. At this time, the second row is cleared.
When the cursor is in the first row, the operation is same as DC1 Mode.

(5) CR (Carriage Return) :

DC1 Mode …… The cursor moves to the most significant digit of the same row.

DC2 Mode …… It is same as DC1 Mode operation.

(6) DP (Display Position) :

Instead of writing the character from the first digit, the write-in starting position can be assigned to any digit, then it will be possible to start the writing process from it.
After writing 10HEX to prepare module for the command, the next 1 byte data is viewed as the display position.

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

The next code can be used to select the display mode.

(7) 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, the cursor will move to the most significant digit of the next row.
When the cursor is on the least significant digit of the second row, the cursor will move to the most significant digit of the first row.

(8) DC2 (Vertical Scroll Mode) :

After writing the characters up to the least significant digit of the second row, all the characters displayed in the second row are shifted to the upper row (first row) and the second row is cleared.
When the power is turned on and the DC2 Mode is selected, DC2 mode will be held until another mode is selected.

(9) DC3 (Cursor ON Mode) :

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

(10) DC4 (Cursor OFF Mode) :

The cursor is not displayed.

(11) RST (Reset) :

Reset the module.
All the characters displayed are cleared, the display mode is set as DC2, and the cursor mode is set as DC3.
Then, the font table is not changed before and after resetting.

3-3. SELF-TEST

$\overline{TEST}$ ＝"L"(Connector pin №16 is connected to GND.), starts the Self-Test.
Then the display shows all characters, Alphabet, Numeric and symbols, in that order.
Eighty (2X40) characters are displayed at a time.
Using this mode, neither data write-in nor control code write-in is allowed.
To release this mode, $\overline{TEST}$ 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 as DC2, the cursor mode is set as DC3.

3-5. SELECTION OF INPUT MODE

Table-10 shows the combinations of the signal lines for the parallel or serial input. Users must choose from the combinations.
Unused signal lines remain to be open (internally pulled up).

・Serial Input

Baud rate is selected by J1～J2.

Table-9

J1	short	open	short	Open
J2	short	short	open	Open
Baud rate	1200bps	2400bps	4800bps	9600bps

Note) J1 and J2 are set to be open when the module is shipped.

Table-9　BAUD RATE SELECTION

4. INTERFACE CONNECTION

4-1. CONNECTOR PIN CONNECTION

Connector：2213S-20G-F1 (NAN TON) or equivalent

Table-10

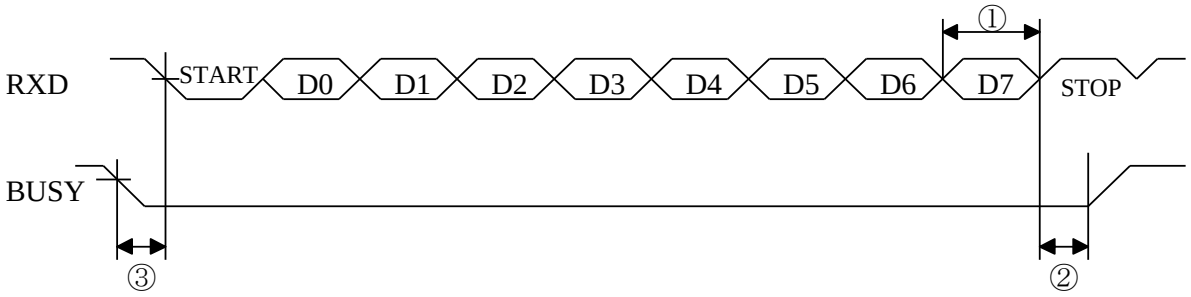
Pin №	Signal	Serial In	Parallel In	Pin №	Signal	Serial In	Parallel In
1	D7	NC	○	2	+5V	○	○
3	D6	NC	○	4	+5V	○	○
5	D5	NC	○	6	+5V	○	○
7	D4	NC	○	8	GND	○	○
9	D3	NC	○	10	GND	○	○
11	D2	NC	○	12	GND	○	○
13	D1	NC	○	14	GND	○	○
15	D0	NC	○	16	$\overline{\text{TEST}}$	○	○
17	$\overline{\text{WR}}$	NC	○	18	$\overline{\text{SEL}}$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

NC：No-Connection

4-2. WRITE-IN TIMING

4-2-1. SERIAL INPUT TIMING

Write the data only when the BUSY signal is “L”.
By the 10 BITs which consist of START BIT “L”, 8 BITs data and STOP BIT “H”, the serial input accept the data.



① t (DATA) $=10^6$/baud rate [μs]
(This depends on the selection of the baud rate.)

② t (DATA) /2 [μs] (BUSY signal becomes “H” at the center of STOP BIT.)

③ t (WAIT) : 0 min. [μs]

FIG.1. TIMING OF SERIAL INPUT

4-2-2. PARALLEL INPUT TIMING

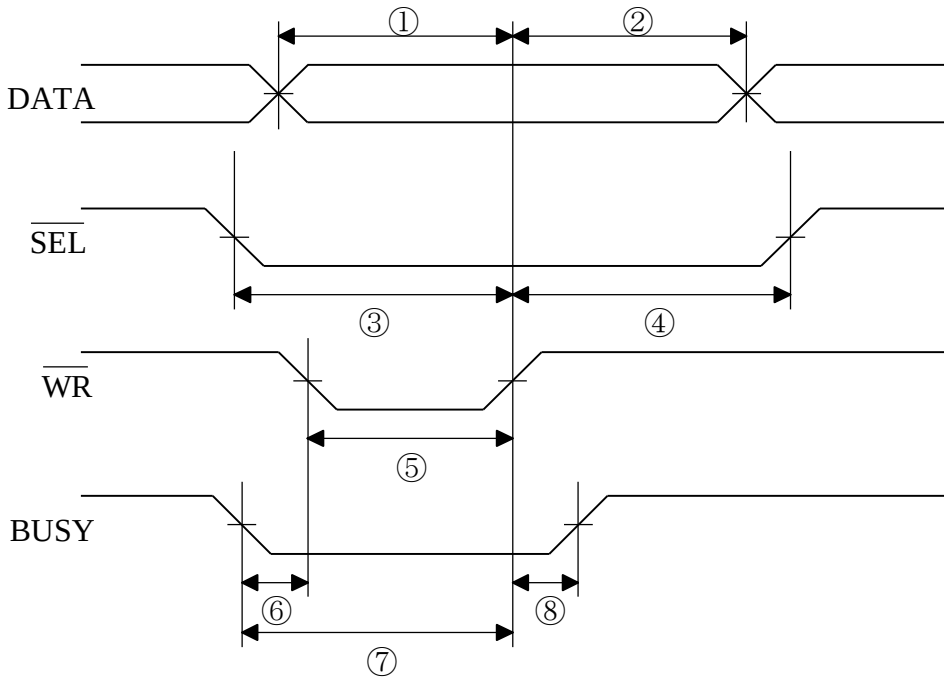


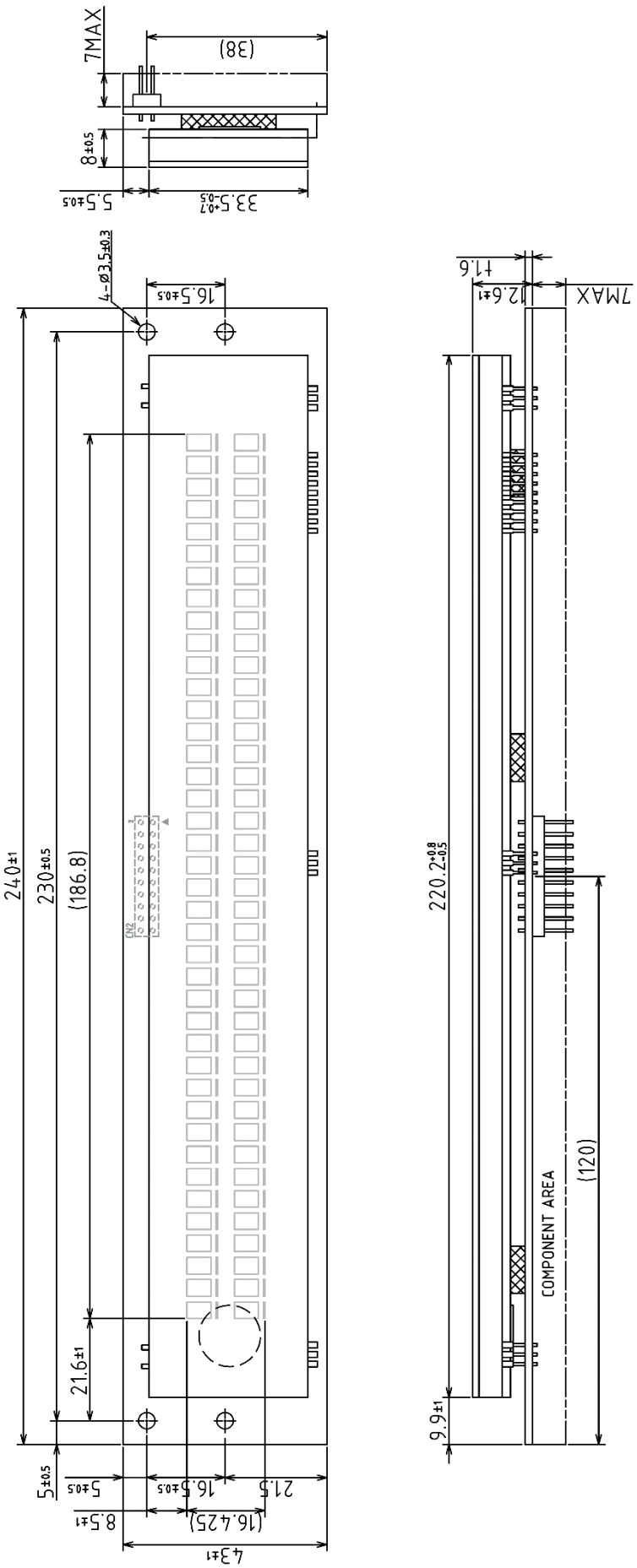
FIG.2. TIMING OF PARALLEL INPUT

Table-11

		Min.	Max.	Note
①	*t*	50ns	—	
②	*t* h(DATA)	50ns	—	
③	*t* su($\overline{\text{SEL}}$)	50ns	—	
④	*t* h($\overline{\text{SEL}}$)	50ns	—	
⑤	*t* pw($\overline{\text{WR}}$)	50ns	—	
⑥	*t* wait(1)	0ns	—	
⑦	*t* wait(2)	250ns	—	After the BUSY signal became to "L", $\overline{\text{WR}}$ should not be changed to "H" within 250ns.
⑧	*t* delay	—	50ns	

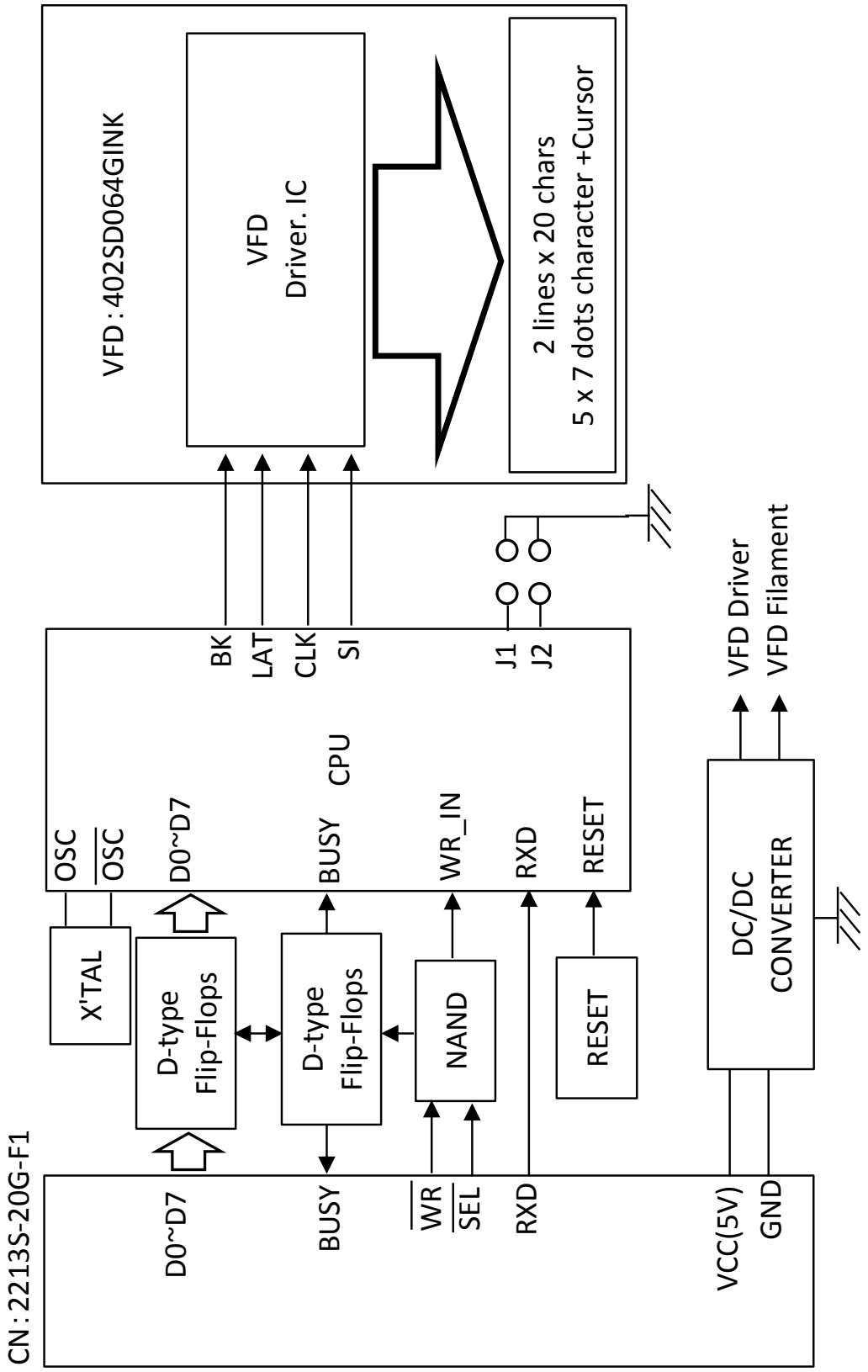
M402SD64AB　MECHANICAL DRAWING

FIGURE-1



M402SD64AB　CIRCUIT BLOCK DIAGRAM

FIGURE-2



M402SD64AB DISPLAY CHARACTER CODE (European Font)

FIGURE-3

D7 D6 D5 D4 / D3 D2 D1 D0	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	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0 0 0 0	0			SP												
0 0 0 1	1															
0 0 1 0	2															
0 0 1 1	3															
0 1 0 0	4															
0 1 0 1	5															
0 1 1 0	6															
0 1 1 1	7															
1 0 0 0	8															
1 0 0 1	9															
1 0 1 0	A															
1 0 1 1	B															
1 1 0 0	C															
1 1 0 1	D															
1 1 1 0	E															
1 1 1 1	F															

SP : SPACE

5. WARRANTY

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

6. 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.

7. CAUTIONS FOR OPERATION

7-1. 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.

7-2. The DC/DC converter generates approximately 64Vdc, avoid touching it with bare hands, or to other circuits.

7-3. Avoid using the module where excessive noise interface is expected.
Noise affects the interface signal and causes improper operation.
Keep the length of the interface cable less than 30cm.
(When the longer cable is required, please confirm there is no noise affection.)

7-4. 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.

7-5. 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.

7-6. DC/DC converter is equipped on the module, the surge current may be approximately 5 times the specified supply current at the power on.

8. The environmental specifications for this product

8-1. 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.

8-2. 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 :

The specification is subject to change without prior notice.

Your consultation with FUTABA sales office is recommended for the use of this module.