REV.－

# VACUUM FLUORESCENT DISPLAY MODULE

ENGINEERING PROPOSAL

## M202SD01LJ

EVALUATION
☐ ACCEPTED WITHOUT ANY CHANGE
☐ THE FOLLOWING CHANGE IS REQUIRED.

February 6, 1998

FUTABA CORPORATION

VFD MODULE GROUP

| | |
|---|---|
| ISSUED | BY |
| CHECKED | BY |
| CHECKED | BY |
| APPROVED | BY |

1. SCOPE

This specification applies to the VFD module manufactured by FUTABA Corp.

2. GENERAL DESCRIPTION

2-1. The specification becomes effective after being approved by the purchaser.

2-2. FUTABA reserves the right to make change at any time in order to improve design and to supply the best product possible.

3. GENERAL SPECIFICATIONS

3-1. DIMENSIONS, WEIGHT (Refer APPENDIX-1)

Table-1

| Item | Specification | Unit |
|---|---|---|
| Outer Dimension | (L) 100.0±1<br>(W) 35.0±1<br>(T) 26.3 Max. | mm |
| Weight | 80 | g |

3-2. SPECIFICATIONS OF THE DISPLAY PANEL

Table-2

| Item | Specification | Unit |
|---|---|---|
| Display Area (H×W) | 12.92×69.7 | mm |
| Number of Digits | 20digits(5×7dots)×2rows | － |
| Digits Size (H×W) | 4.16×2.25 | mm |
| Digits Pitch (H×W) | 8.76×3.55 | mm |
| Color of Illumination | Green(λp＝505nm) | － |

3-3. ENVIRONMENT CONDITIONS

Table-3

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

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

## 3-4. ABSOLUTE MAXIMUM RATINGS

Table-4

| Item | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| Supply Voltage | $V$cc | -0.3 | 7.0 | V |
| Input signal voltage | $V_{IS}$ | -0.3 | 7.0 | V |

## 3-5. RECOMMENDED OPERATING CONDITIONS

Table-5

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Supply Voltage | $V$cc | － | 4.5 | 5.0 | 5.5 | V |
| H-Level Input Voltage | $V_{IH}$ | $V$cc＝5V | 2.4 | － | － | V |
| L-Level Input Voltage | $V_{IL}$ | $V$cc＝5V | － | － | 0.8 | V |

## 3-6. ELECTRICAL CHARACTERISTICS

Table-6

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Supply Current | $I$cc | $V$cc＝5V All on | － | 320 | 400 | mA |
| Power Consumption | － | | － | 1.6 | － | W |
| Luminance | $L$ | | 340 | 690 | － | cd/m$^2$ |
| H-Level Output voltage | $V_{OH}$ | $V$cc＝5V $I_{OH}$＝-500μA | 4.5 | － | － | V |
| L-Level Output voltage | $V_{OL}$ | $V$cc＝5V $I_{OL}$＝2.0mA | － | － | 0.5 | V |

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

## 4. FUNCTION

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

Table-7

| | $\overline{TEST}$ | $\overline{SEL}$ | $\overline{WR}$ | RXD | Function |
|---|---|---|---|---|---|
| Parallel and Serial interface | L | H or L | H or L | H or L | 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
H : High level
NC : non connection
↑ : Low to high transition
* : RXD(Serial input)

## THE BASIC FUNCTION

### 4-1. 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".)
I case of parallel input, data or control command is to be written at the low-to-high transition of $\overline{WR}$ (L→H), when $\overline{SEL}$＝low "L", and $\overline{TEST}$＝high "H".
The display character from follows equivalent to JIS-6220 (Alphabets Katakanas and Symbols etc.).
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".

## 4-2. CONTROL CODE

The control codes are available as follows.
The details will be explained from the next page.

(1) DEF : Define Character : (03 HEX)

(2) DIM : Dimming : (04 HEX)

(3) BS : Back Space : (08 HEX)

(4) HT : Horizontal Tab : (09 HEX)

(5) CLR : Clear : (0D HEX)

(6) ALD : All Display : (0F HEX)

(7) DP : Display Position : (10 HEX)

(8) DC : Cursor Mode : (17 HEX)

(9) RST : Reset : (1F HEX)

DATA WRITE-IN

Write-in position will be shifted to the right after new character data is written-in.
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.
The new character data is written-in to the left end of 1st row, all displayed characters will be cleared except new one.

(1) DEF (Define UF0～3) :

The DEF command defines user definable characters, UF0～3.

These fonts are stored in the module according to the following command are data sequence.

| 1 byte | | 1 byte | | 5 bytes |
|---|---|---|---|---|
| DEF command code (03 H) | ＋ | Position code (1BH～1EH) | ＋ | font data |

| | | | | | |
|---|---|---|---|---|---|
| 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 |

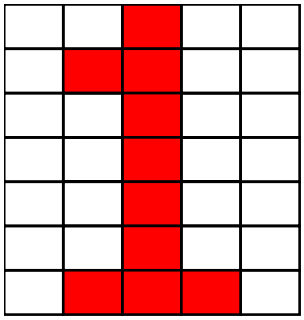
(a) Character Font

| | | 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" |

(b) Font Data

Example of write-in character "1" in UF0.

Control and data strings 03H, 1BH, 23H, 08H, 42H, 11H, C0H.



| | | 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 |

"H" : Turn On
"L" : Turn Off

Fig.1 Defining User's font

It is recommended to store these definable characters at the initializing of module.

All these data will remain into the RAM and the client can display them as the user's original font.

These is no backup system of this RAM, therefore, it is needed to restore these data every power on.

(2) DIM (Dimming):

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

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

Table-8

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

(3) 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 most significant digit of the second row, the write-in position moves to the least significant digit of the first row.
When the write-in position is on the most significant digit of the first row, the write-in position moves to the least significant digit of the second row.

(4) HT (Horizontal Tab):

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

(5) CLR (Clear):

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

(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.

| | The most significant digit | The least significant digit |
|---|---|---|
| 1st row | 00 HEX | 13 HEX |
| 2nd row | 14 HEX | 27 HEX |

(7) DC (Cursor Mode):

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

| 1 byte | | 1 byte |
|---|---|---|
| (DC command code) 17H | ＋ | (Select Mode Data) |

Table-9

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

The cursor is always displayed at the write-in position.

The cursor is formed by the 5dots located the bottom of 5×7 dot matrix character font.

The cursor will be displayed as an over writing mode and the behavior of the 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 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 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 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.

(8) ALD (All Display)

The full dots 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.

(9) RST (Reset) :

Resetting the module.
All the characters displayed are erased, then the write-in position will be set on the most significant digit of the first row.
The displaying status is the same as the power on reset, and cursor mode is set for lighting mode, the dimming level is set for 100%.

3-3. SELF-TEST

When the TEST terminal is kept into "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, TEST must be set to "H".

3-4. POWER ON RESET

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

3-5. SELECTION OF INPUT MODE

Table-11 shows the combination of the signal lines for the parallel or serial input.
It is needed to choose one of the combinations before operation.
Unused signal lines are to be open (internally pulled up).
In case of serial input, it is possible to select two baud rates by J1, as shown below.

Table-10

| J1 | OPEN | SHORT |
|---|---|---|
| baud rate | 9,600 | 1,200 |

BAUD RATE SELECTION

## 4. INTERFACE CONNECTION

### 4-1. CONNECTOR PIN CONNECTION

Connector : A1-20PA-2.54DSA (HIROSE) or equivalent
Socket : 3421-6000SL (3M) or equivalent

Table-11

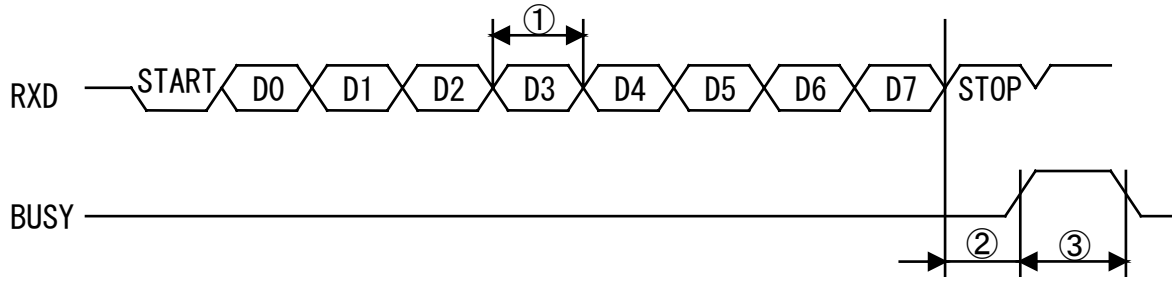
| PIN No. | Signal | SERIAL IN | PARALLEL IN | PIN No. | Signal | SERIAL IN | PARALLEL IN |
|---|---|---|---|---|---|---|---|
| 1 | D7 | NC | ○ | 2 | *V*cc | ○ | ○ |
| 3 | D6 | NC | ○ | 4 | *V*cc | ○ | ○ |
| 5 | D5 | NC | ○ | 6 | *V*cc | ○ | ○ |
| 7 | D4 | NC | ○ | 8 | GND | ○ | ○ |
| 9 | D3 | NC | ○ | 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 (See Fig.2)

Please be sure the BUSY signal is into "L", when the data will be written in.
In case of the serial input, the module accepts the 10 bits data string as a data, first "L" level data as a start bit, 2nd to 9th data as an input data and the last "H" level data as a stop bit.
When these data are not received exactly, they will be ignored and not displayed on the module.

#### 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 "H" at the center of stop bit.)
③ *t* (WAIT) : 3 [μs] Max

Fig.2 WRITE-IN TIMING

4-2-2. PARALLEL INPUT

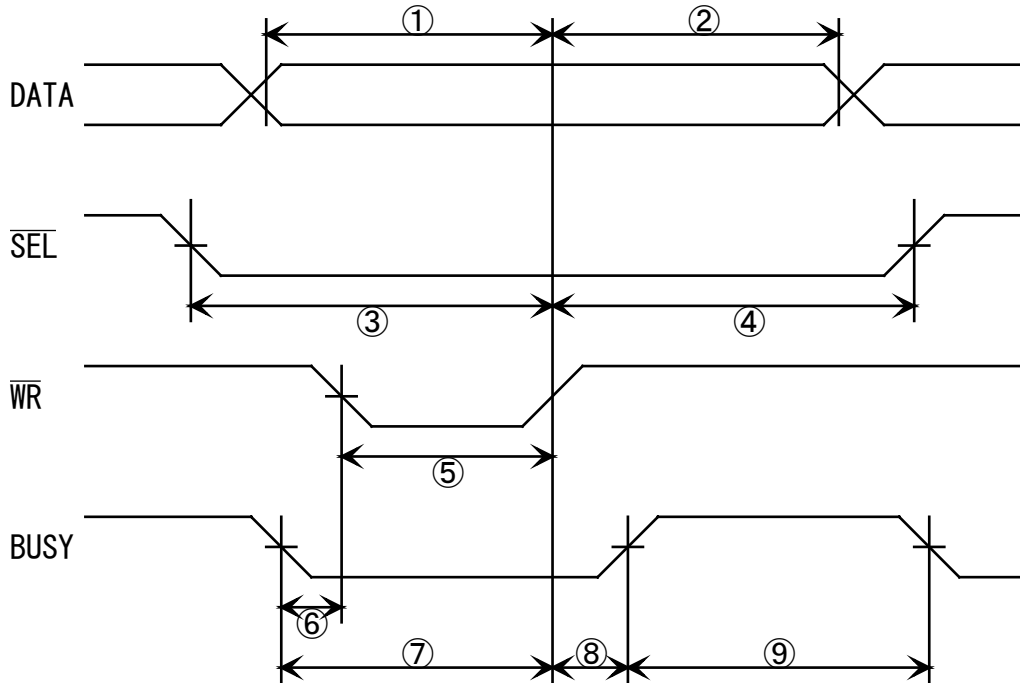


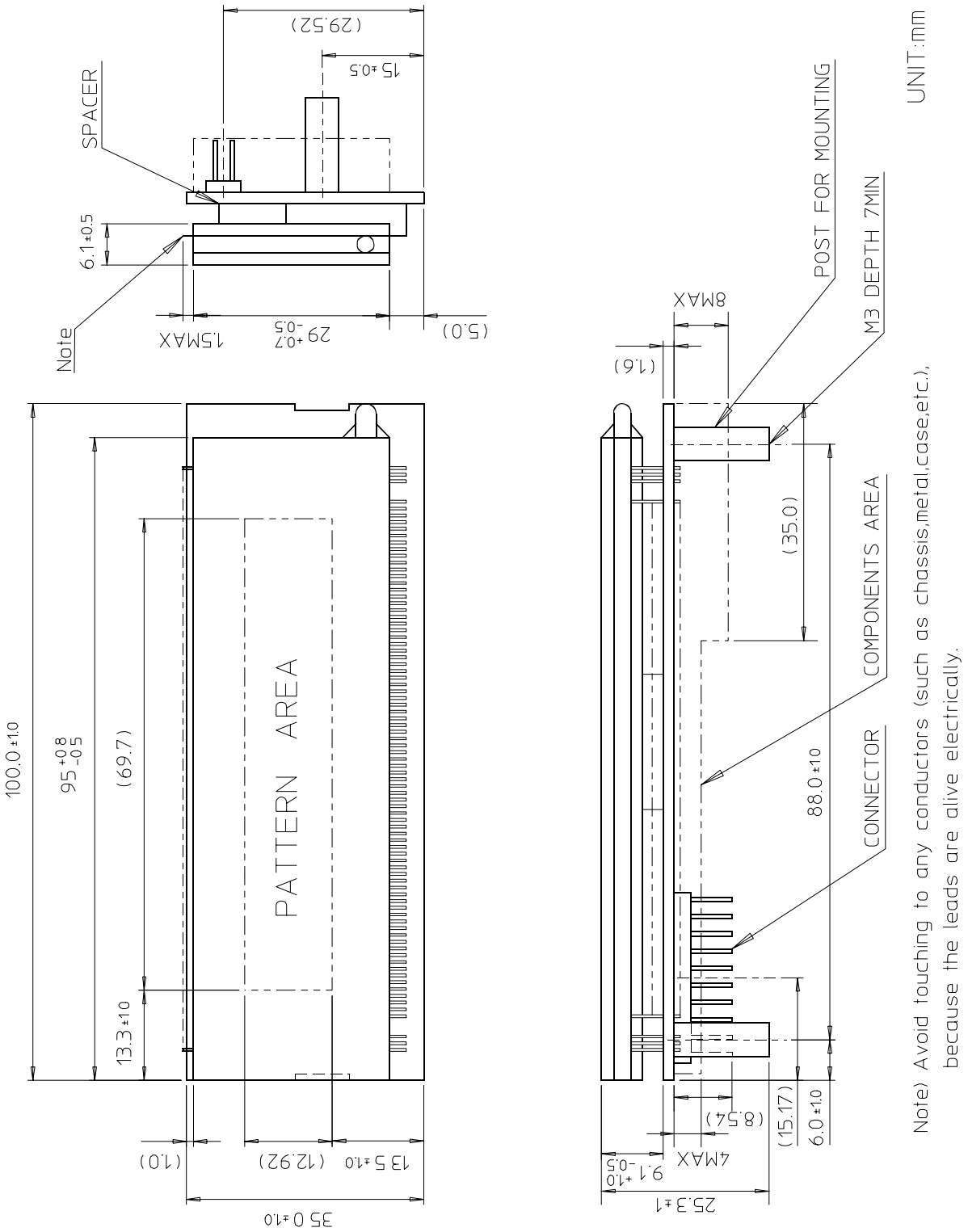

Fig.3 WRITE-IN TIMING

Table-12

| | | Min. | Max. | Note |
|---|---|---|---|---|
| ① | $t$ su(DATA) | 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) | 50ns | － | |
| ⑧ | $t$ delay | － | 150ns | |
| ⑨ | $t$ wait(3) | － | 3μs | |

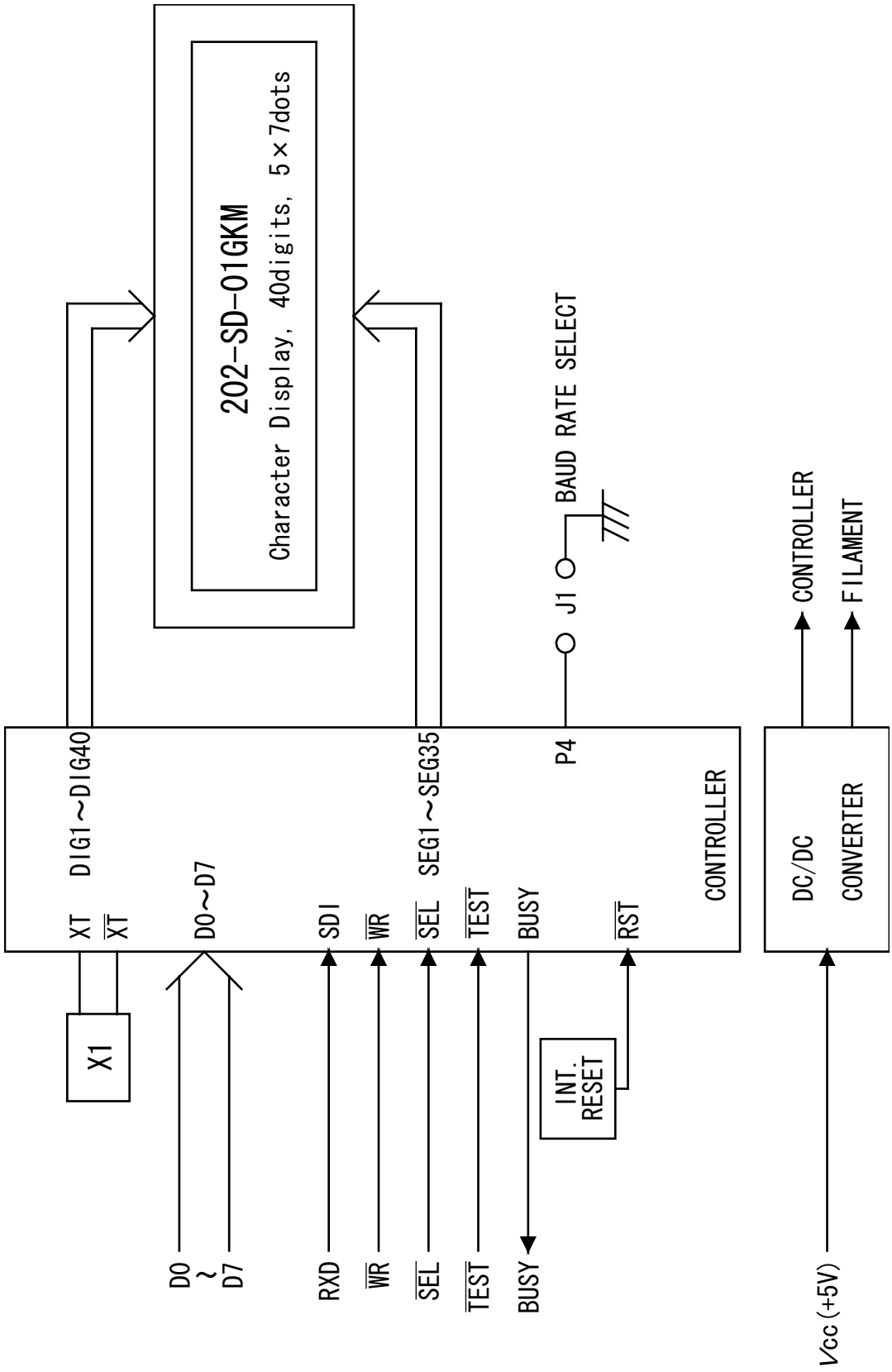
# M202SD01LJ MECHANICAL DRAWING

FIGURE-1



# M202SD01LJ CIRCUIT BLOCK DIAGRAM

FIGURE-2



# M202SD01LJ 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 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
| 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 | | | | | | | | | | | | | | |
| 0 1 0 1 | 5 | | | | | | | | | | | | | | | |
| 0 1 1 0 | 6 | | | | | | | | | | | | | | | |
| 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 | | UF0 | | | | | | | | | | | | | |
| 1 1 0 0 | C | | UF1 | | | | | | | | | | | | | |
| 1 1 0 1 | D | CLR | UF2 | | | | | | | | | | | | | |
| 1 1 1 0 | E | | UF3 | | | | | | | | | | | | | |
| 1 1 1 1 | F | ALD | RST | | | | | | | | | | | | | |

SP : SPACE