DOT MATRIX VFD MODULE M204SD01AA INSTRUCTION MANUAL

GENERAL DESCRIPTION

Futaba Vacuum Fluorescent display Module M204SD01AA,with
VFD 204-SD-01G display,produces 20 digits on 4 rows.
Each character is displayed in 5X7 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 desireable for an application in office equipments,
such as computer terminals,measuring equipment,etc.

CONTENTS

1)FEATURES:

1. Using an one chip micro computer,the module can be connected to the syatem bus directly.

2. Two hundred sixteen different characters consisting of alpha-numerin and other symbols can be displayed.

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

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

5. Either parallel or serial mode can be selected as the data input form.

6. The module is samaii,light and thin mechanical sizing allows for maximaum reliability.

7. The module's surface mount components allow for maximum reliability.

8. The module has up to three definable characters,they can be displyed as original fonts.

9. Four levels of brightness control is available.

2) GENERAL SPECIFICATIONS

The number of digits	20 digits,4 rows
Digit configuration	5X7 dot
Character configuration	Equivalent to ASCII code
Digit height	5.0 mm
Digit width	3.2 mm
Dot pitch	0.69X0.75 mm
Dot size	0.5X0.44 mm
Digit pitch	4.55X9.0 mm
Peak wave length of illumination	Green (505 nm)
Luminance	690 cd/m^2(200fL)
Weight	Approx. 145 grams

THE MODULE STRUCTURE

Mechanical dimension;Fig.1
Block diagram   ;Fig.2
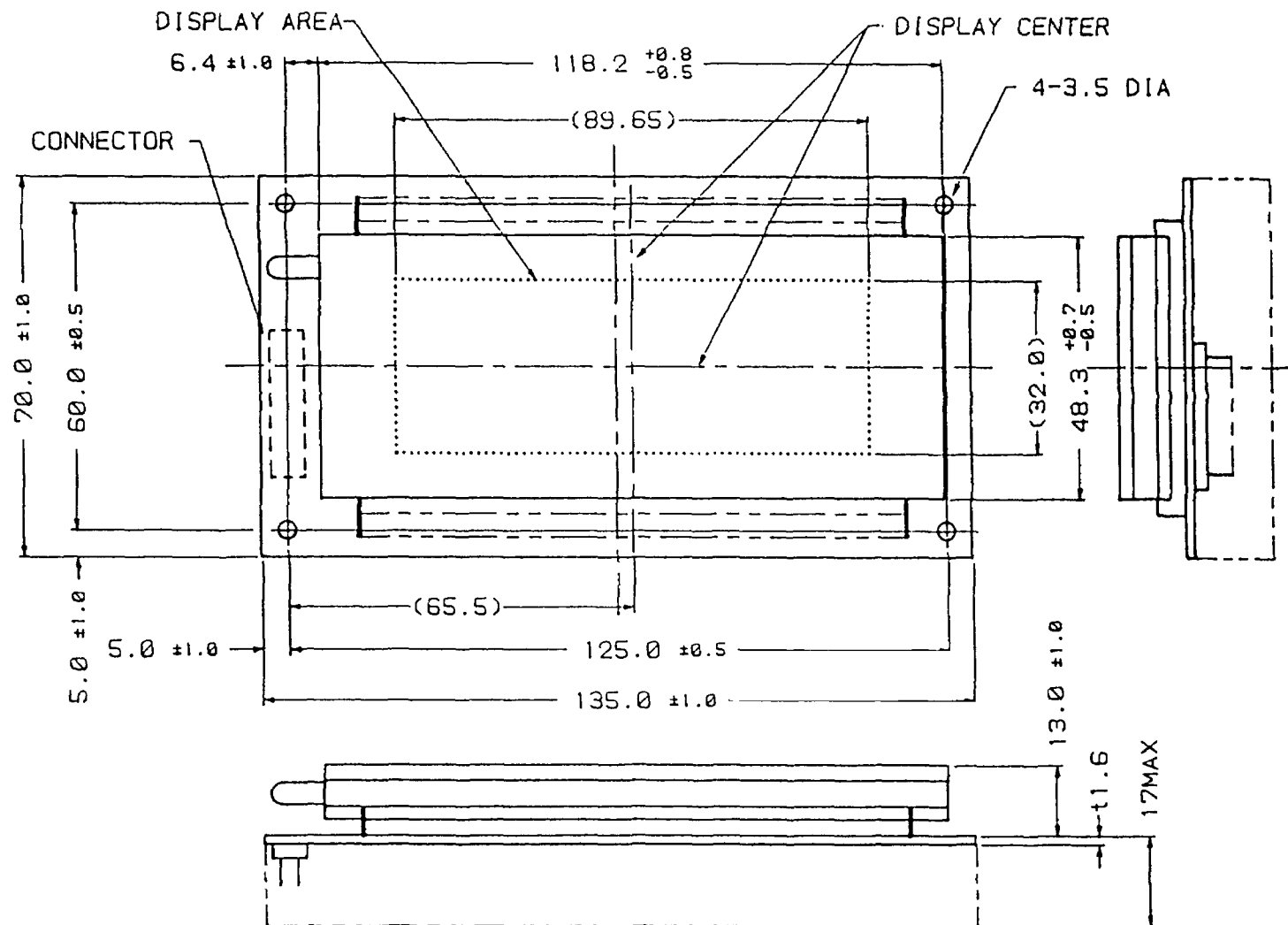
FIG.1 MECHANICAL DRAWING

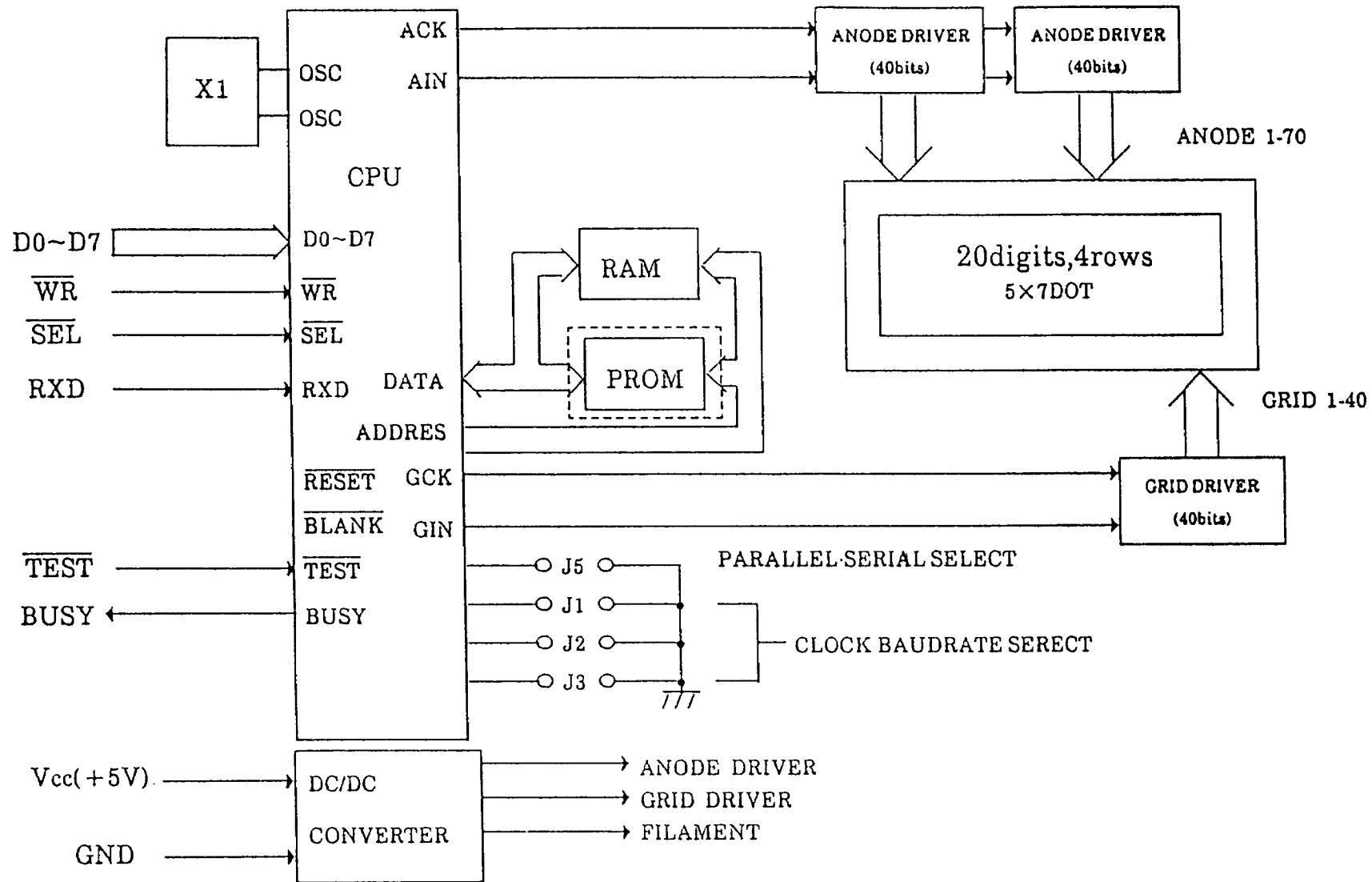UNIT : mm

FUTABA

DISPLAY AREA

DISPLAY CENTER

6.4 ±1.0

118.2 +0.8 -0.5

4-3.5 DIA

(89.65)

CONNECTOR

70.0 ±1.0

60.0 ±0.5

(32.0)

48.3 +0.7 -0.5

(65.5)

5.0 ±1.0

5.0 ±1.0

125.0 ±0.5

135.0 ±1.0

13.0 ±1.0

t1.6

17MAX

FIG.2 BROCK DIAGRAM

ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	MIN.	MAX.	UNIT
SUPPLY VOLTAGE	Vcc	-	7	Vdc
OPERATING TEMPERATURE	Topr	−20	+70	°C
STORAGE TEMPERATURE	Tstg	−20	+70	°C
OPERATING HUMIDITY	Hopr	20	85	%
STORAGE HUMIDITY	Hstg	20	90	%
VIBRATION(10 to 55 Hz)	-	-	4	G
SHOCK	-	-	40	G

TABLE-1

RECOMMENDED OPERATING CONDITIONS

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT
SUPPLY VOLTAGE	Vcc	4.5	5.0	5.5	Vdc
H-LEVEL INPUT VOLTAGE	V_{IH}	2.0	-	-	V
L-LEVEL INPUT VOLTAGE	V_{IL}	-	-	0.8	V

TABLE-2

ELECTRICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
SUPPLY CURRENT	Icc*	Vcc = 5Vdc	-	0.75	1	A
H-LEVEL INPUT CURRENT	I_{IH}	V_{IH} = 2.0V	-	-	20	µA
L-LEVEL INPUT CURRENT	I_{IL}	V_{IL} = 0.8V	-	-	-0.4	mA
LUMINANCE	L	-	340	-	-	cd/m²

TABLE-3

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

3) FUNCTIONS

The module has data and control code write, self test and power on reset functions.

3-1. DATA AND CONTROL CODE WRITE-IN

	$\overline{TEST}$	$\overline{SEL}$	$\overline{WR}$	Function
Parrallel or serial interface	0	—	—	Self Test Mode
Parrallel interface	1	0	0	Data and control code write
Serial interface	1	N C	N C	Data and control code write

NC : No connection
0 : Low level (0V)
1 : High level (5V)
– : Irrelevant induded no connection

TABLE-4 THE BASIC FUNCTIONS

When the data is being written in, the BUSY signal is active which indicates that the module is processing the data.

(When the data is under processing, the BUSY signal is high "1".)

The data or control command is to be written in at the rising edge of $\overline{WR}$(0→1), when $\overline{SEL}$= "0", and $\overline{TEST}$=high "1".

The display character form follows equivalent to ASCII (Alphabet, Numerics 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 "0".

TABLE-5   DISPLAY CHARACTER CODE

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		0	@	P	`	p								
0 0 0 1	1		DC1	!	1	A	Q	a	q								
0 0 1 0	2		DC2	"	2	B	R	b	r								
0 0 1 1	3		DEF	#	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			'	7	G	W	g	w								
1 0 0 0	8		BS	(	8	H	X	h	x								
1 0 0 1	9		HT	)	9	I	Y	i	y								
1 0 1 0	A		LF	*	:	J	Z	j	z								
1 0 1 1	B			+	;	K	[	k	{								
1 1 0 0	C			,	<	L	\	l	|								
1 1 0 1	D		CR	-	=	M	]	m	}						UF0		
1 1 1 0	E			.	>	N	^	n							UF1		
1 1 1 1	F		RST	/	?	O	_	o							UF2		

F U T A B A

CONTROL CODE

The control codes are available as follows.

The details will be explained on the next page.

(1) DEF : Define Characters UF0~2 : (03 HEX)

(2) DIM : Dimming : (04 HEX)

(3) BS : Back Space : (08 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) RST : Reset : (1F HEX)

4-3. INTERFACE TO CPUS

Since this module is designed to be directly connected to the bus line, the interface can be simplified.

Fig.8 and Fig.9 show examples for interfacing to typical CPUs.

4-4. CONNECTION TO I/O DEVICES

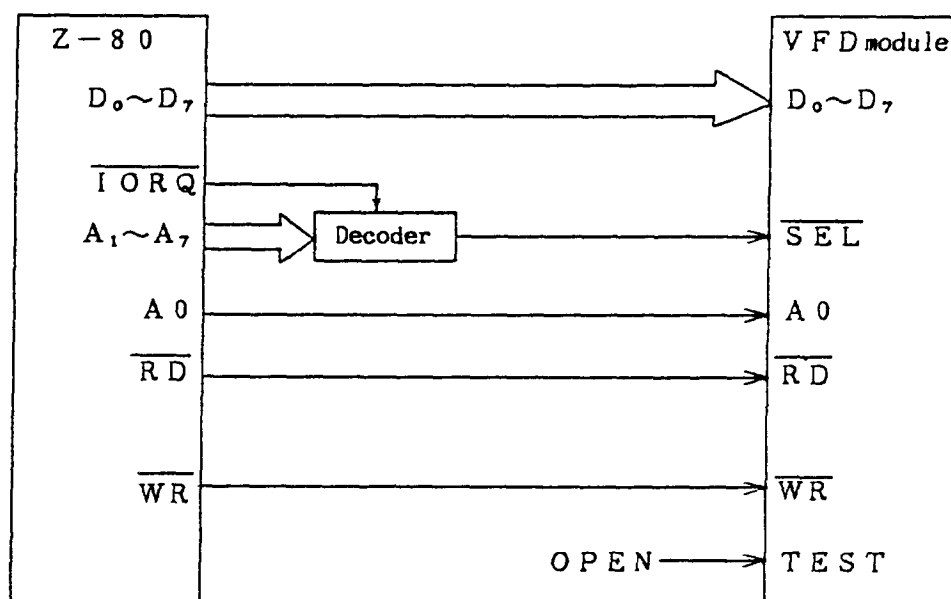Fig.10, Fig.11 and Fig.12 show examples for connecting to typical I/O devices.

FIG.8　CONNCTION TO Z-80
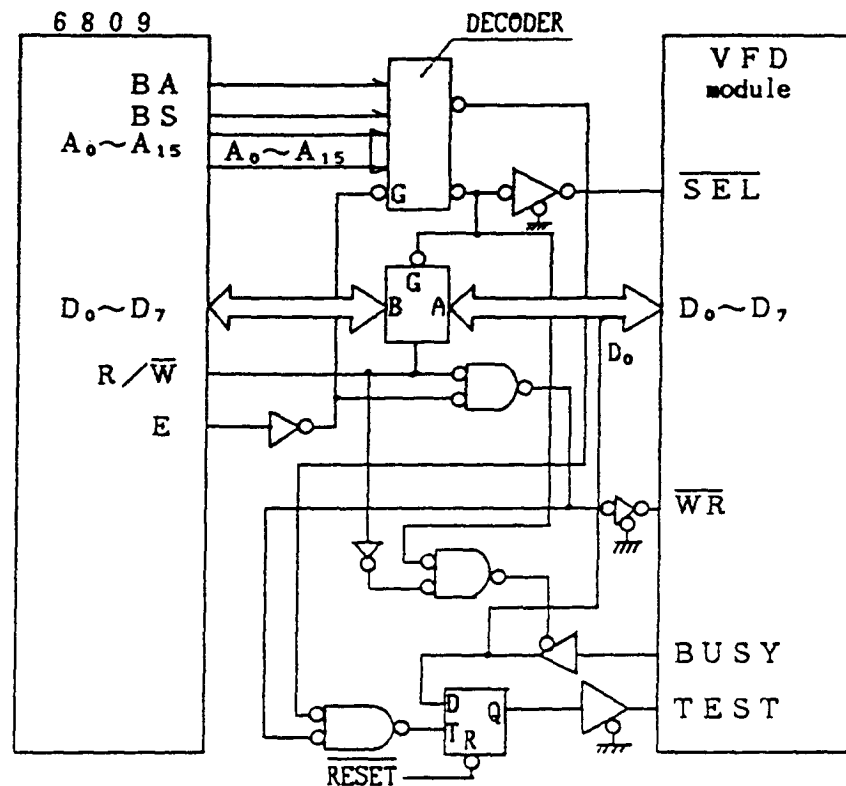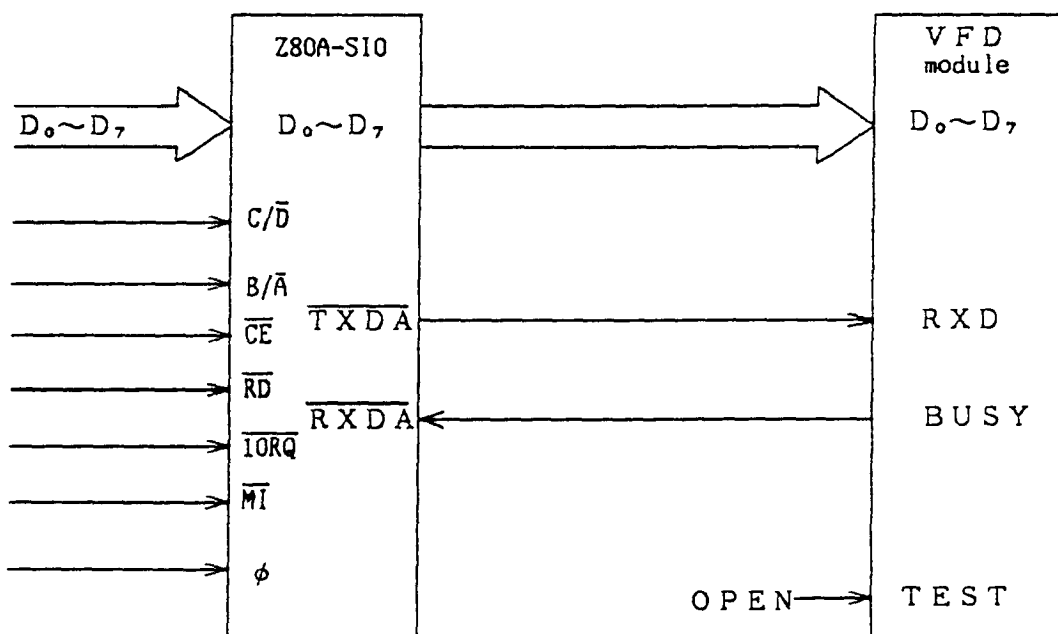
FIG.9 CONNECTION TO 6809

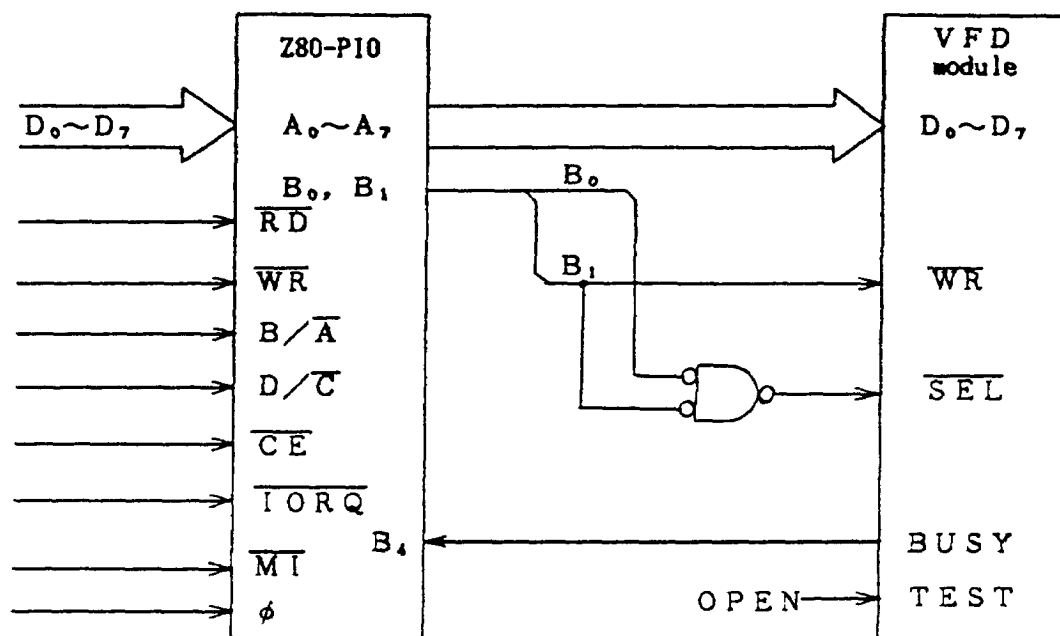
FIG.10   CONNECTION TO Z80A-SIO
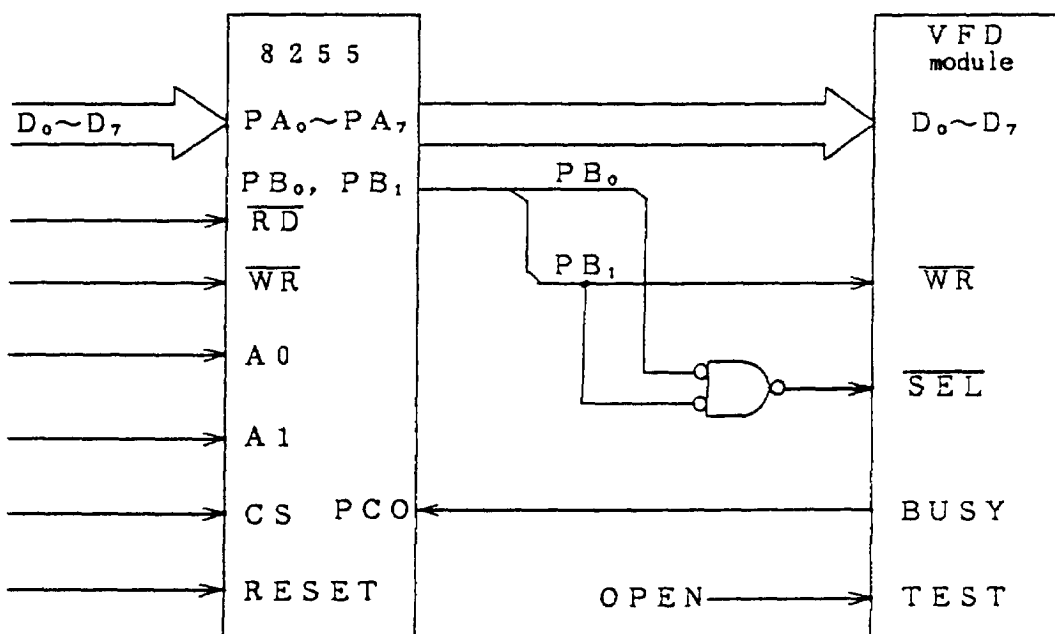
FIG.11   CONNECTION TO Z80-PIO

FIG.12   CONNECTION TO 8255

5) OPERATING RECOMMENDATIONS

1. Avoide applying excessive shock or vibration beyond the specification for this module.

2. Since VFDs are made of glass material, careful handling is important.

3. Applying lower voltage than specified may cause non activation for the selected pixels.
   Conversely, higher voltage may cause non-selected pixelsto be activiated
   If users observe the above phenomenon, check the voltage level of the power supply.

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

5. If the start up time of the supply voltage is slow, the CPU may not be reset. The supply voltage must be risen up to a specified voltage level within 30msec.

6. When power supply is turned on, such as 5A, 1msec of rush current may flow, because DC/DC converter is equipped on the module.

7. 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.).

8. When power supply is turned off, the capacitor isn't discharged immediately.
   The high voltage applied to the VFD must not contact the controller IC.
   (The shorting of the mounted components within 30sec. after power off may cause damage.)

R E M A R K S :

This specification is subject to change without prior notice in order to improve the design and quality.

Your consultation with our engineer is recommended for the use of this module.

4-2. THE LOCATION OF THE COMPONENTS
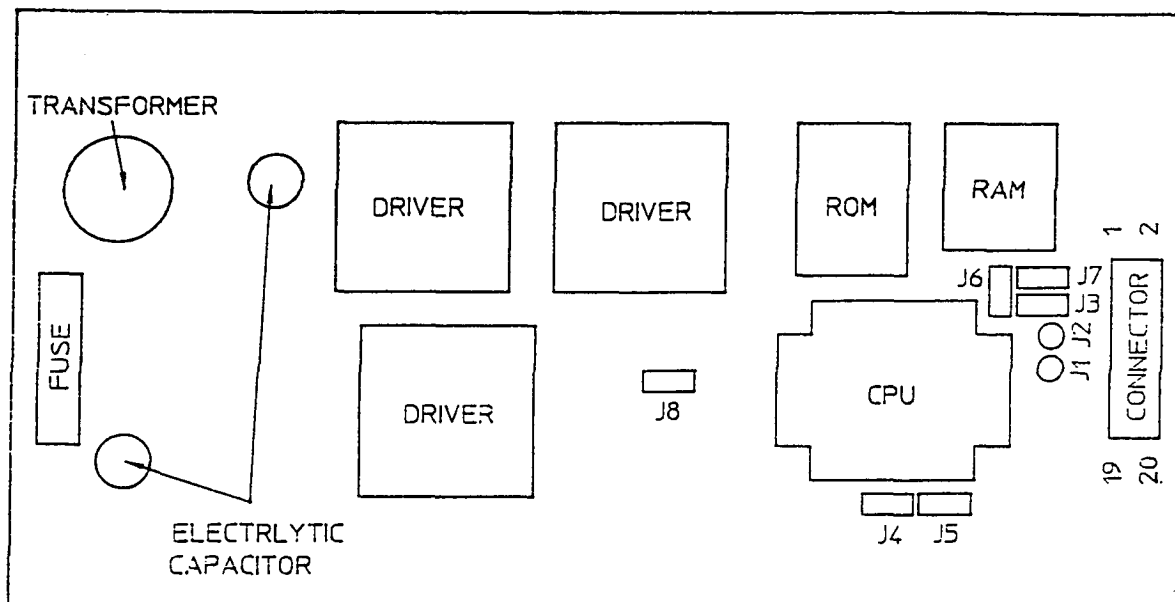
FIG.5 THE LOCATION OF THE COMPONENTS

4-3. WRITE-IN TIMING

See FIG.6, FIG.7.

PARALLEL INPUT
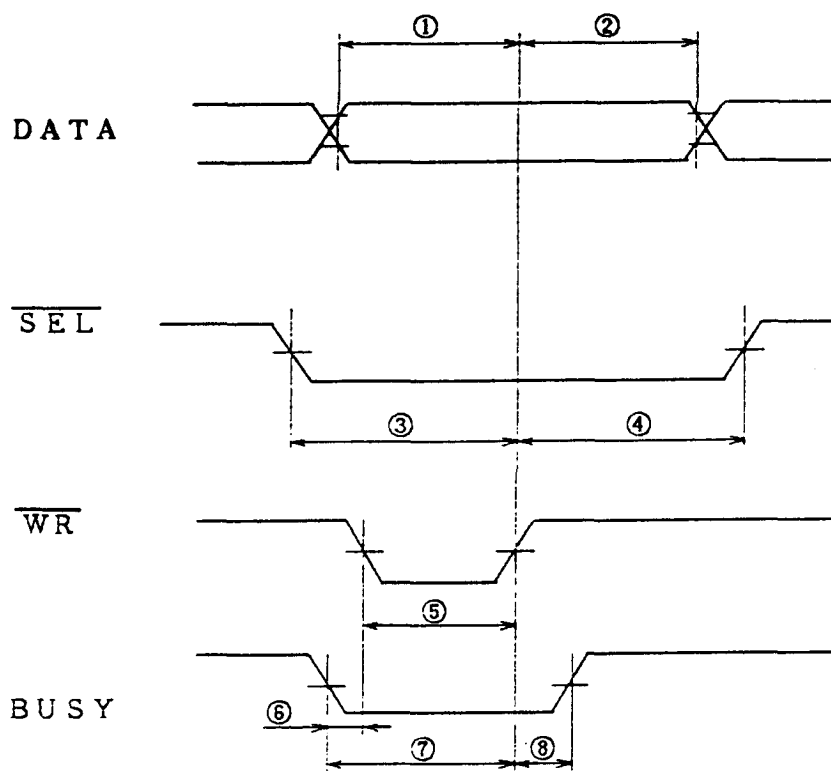
		M I N	M A X	N o t e
①	t s u (DATA)	65 ns	—	
②	t h (DATA)	55 ns	—	
③	t s u ($\overline{SEL}$)	75 ns	—	
④	t h ($\overline{SEL}$)	0 ns	—	
⑤	t p w ($\overline{WR}$)	75 ns	—	
⑥	t w a i t (1)	0 ns	—	
⑦	t w a i t (2)	200 ns	—	For Min 200ns, $\overline{WR}$ should not be active (positive H), after BUSY is "0".
⑧	t d e l a y	—	50 ns	

FIG.6   WRITE-IN TIMING

SERIAL INPUT
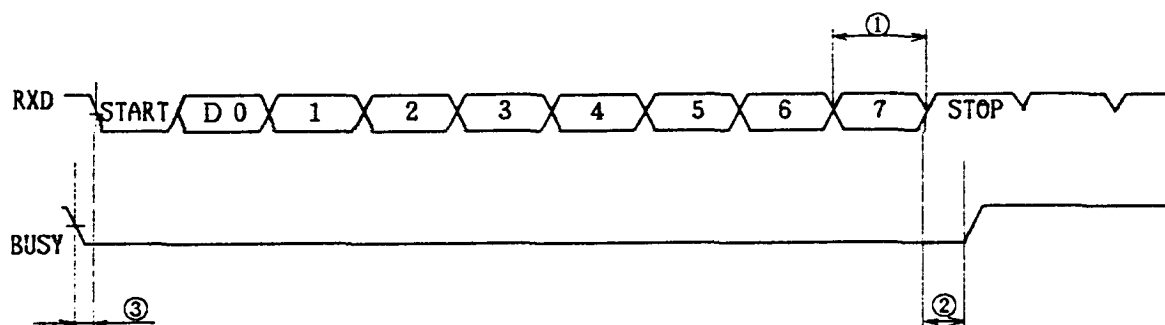
① t (DATA) = 10⁶／baud rate [μs]

(This depends on the selection of the baud rate.)

② t (DATA) ／2 [μs] (BUSY becomes "1" at the center of stop bit.)

③ t (WAIT) : 0 [μs] (START should be active ("0"), after BUSY is "0" .)

FIG.7 WRITE-IN TIMING

(1) D E F (Define UFO∼2) :

The DEF command defines user definable characters, UFO∼2. (up to 3 fonts)
These fonts are stored in the module as follows.

1 Byte	1 Byte	5 Byte
DEF command code,	Position code	the font data
(03 H)	(C9H to CFH)	

(a) Character font:

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

(b) Font data:

		bit							
		7	6	5	4	3	2	1	0
	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
Byte	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	"0"	"0"	"0"	"0"	"0"

(b) Font data

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

Control and data strings 03H, FCH, 23H, 08H, 42H, 15H, C0H.

(a) Character

	bit							
	7	6	5	4	3	2	1	0
1st	0	0	1	0	0	0	1	1
2nd	0	0	0	0	1	0	0	0
3rd	0	1	0	0	0	0	1	0
4th	0	0	0	1	0	0	0	1
5th	1	1	0	0	0	0	0	0

(b) Font data

"1" : Turn ON
"0" : Turn OFF

FIG.3   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 cliant can display user's original font on VFD module.

There is no back-up system of this RAM, therefore, it is needed to restore these data when power off.

(2) D I M (Dimming) :

Brightness can be controled into four level by using this function.
After writing 04H, another HEX byte mentioned under is written to change
the brightness out put.

<center>

1 byte   +   1 byte

(DIM command code),04H   Dimming level data

</center>

Dimming Level	Data
1 0 0 %	F F H
6 0 %	6 0 H
4 0 %	4 0 H
2 0 %	2 0 H

(3) B S (Back Space) :

The write-in position is shifted to the left one digit.
(beyond this point, the position of write-in position is identical with
write-in position of the display, unless otherwise specified. Under DC8 MODE,
the write-in position will not show up.)
When the write-in position is on the most significant digit of the third
row, the write-in position moves to the least significant digit of the
second row.
When the write-in position is on the most significant digit of the first
row, the utite-in position moves to the least significant digit of the
fourth row.

(4) L F (Line Feed) :

When the write-in position is in the fourth row, the character displayed
second to fourth row, is shifted up, leaving the write-in position at its
present position, then the fourth row is cleared.
When the write-in position is in first to third row, the write-in position
moves down to under row staying on the same line.

(5) C R (Carriage Return) :

The write-in position moves to the most significant digit of the same row.

(6) D P (Display Position) :

Instead of writing the character from the first digit, the write-in starting position can be pointed by using this function.

After writing 10HEX to prepare module for this command, another HEX byte is written to specify the position desired.

A third byte representing data is then sent.

	The most significant digit	The least significant digit
1st row	0 0 H E X	1 3 H E X
2nd row	1 4 H E X	2 7 H E X
3rd row	2 8 H E X	3 B H E X
4th row	3 C H E X	4 F H E X

(7) D C 1 (Normal Display Mode) :

After writing a character, the write-in position is shifted to the right one digit automatically.

When the write-in position is on the least significant digit of the first to therd row, the write-in position moves to the most significant digit of the under row.

When the character is displayed on the least significant digit of the fourth row, the write-in position is on the same digit.

And the character code is written in the module next, first, all digits are cleared, second, the character is displayed on the most significant digit of the first row and the write-in position moves to the next digit.

When the power is turn on, this DC1 MODE is selected, and will be held until another mode is selected.

(8) D C 2 (Vertical Scroll Mode) :

After writing the characters up to the least significant digit of the fourth row, all the characters displayed in the second to fourth row are shifted to the upper row, clearing the fourth row.

(9)   R S T (Reset) :

Resetting the module.

All the characters displayed are erased, then the write-in position
(cursor position) is set on the most significant digit of the first row.
The displaying status is the same as the hardware Reset, but the font
data of UF0~2 is kept.
The display mode is set for DC1.

3-2.   SELF-TEST

TEST=Low   "0" (connector pin #16 is connected to GND.) starts the self-test.
Then the display shows characters.

3-3.   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 for DC2.

3-4.   SELECTION OF INPUT MODE

TABLE-6 shows the combinations of the signal lines for the parallel or
serial input.
Users must choose one of the combinations.
Unused signal lines are to be open (internally pulled up).

F U T A B A

· Serial Input

Users must choose one of combinations.
When serial input is selected, J5 must be short.
Baud rate is selected by J1~J3.

J 1 ⎫
J 2 ⎬ baud rate select
J 3 ⎭

J 1	s h o r t	o p e n	s h o r t	o p e n
J 2	s h o r t	s h o r t	o p e n	o p e n
J 3 short	1200 (bps)	2400	4800	9600
J 3 open	7812.5	15625	31250	62500

F I G. 4 BAUD RATE SELECTION

NOTE) When the module is shipped, J1, J2, J3 and J5 are open.

4) INTERFACE CONNECTION

4-1. CONNECTOR PINCONNECTION

Connector : X G 8 B — 2 0 3 1 (O M R O N) or equivalent

Socket : 3 4 2 1 — 6 0 0 0 S C (3 M) or equivalent

PIN NO.	SIGNAL	SERIAL IN	PARALLEL IN	PIN NO.	SIGNAL	SERIAL IN	PARALLEL IN
1	D 7	N C	○	2	+ 5 V	○	○
3	D 6	N C	○	4	〃	○	○
5	D 5	N C	○	6	〃	○	○
7	D 4	N C	○	8	G N D	○	○
9	D 3	N C	○	10	〃	○	○
11	D 2	N C	○	12	〃	○	○
13	D 1	N C	○	14	〃	○	○
15	D 0	N C	○	16	$\overline{\text{TEST}}$	○	○
17	$\overline{\text{WR}}$	N C	○	18	$\overline{\text{SEL}}$	N C	○
19	R X D	○	N C	20	BUSY	○	○

NC : NO-CONNECTION

TABLE-6 CONNECTOR PINCONNECTION