

VACUUM FLUORESCENT DISPLAY MODULE
SPECIFICATION

Model : C U 1 6 5 E C P B - T 2 J

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1. General Description

1.1 Application : Readout of computer, micro-computer, communication-terminal and automatic instruments.

1.2 Construction : Single board display module consists of 16 character (1 x 16) VFD, VFD controller, DC /DC converter and all necessary control logics. Interface level is TTL compatible and the module can be connected to the host with synchronous serial input.

1.3 Drawing : See attached drawings.

2. Absolute Maximum Ratings

Parameter	Symbol	Min.	Tip.	Max.	Unit	Condition
Logic Inprt Voltage	VI	0	-	5.5	VDC	-
Power Supply Voltage	VCC	0	5.0	7.0	VDC	-

3. Electrical Characteristics

Parameter		Symbol	Min.	Typ.	Max.	Unit	Condition	
Logic Input Voltage	SDATA	High-level input voltage	V _{IH}	2.0	-	-	VDC	VCC=5.0V
		Low-level input voltage	V _{IL}	-	-	0.8	VDC	VCC=5.0V
	$\overline{\text{RESET}}$ $\overline{\text{CS}}$ $\overline{\text{SCK}}$	Positive-going threshold voltage	V _{T+}	1.75	2.8	3.5	VDC	VCC=5.0V
		Negative-going threshold voltage	V _{T-}	1.0	2.0	2.75	VDC	VCC=5.0V
Power Supply Voltage		VCC	4.75	5.00	5.25	VDC	-	
Power Supply Current		ICC	-	250	320	mADC	All dots "ON"	

Slow start power suply may cause erroneous operation.

ICC might be anticipated twice as usual at power on rush.

4. Optical Specifications

- Number of character : 16 (16 line x 1 chrs)
- Matrix format : 5x7 dot
- Display area : 61.8 × 5.1 mm (XxY)
- Character size : 2.55 × 5.1 mm (XxY)
- Character pitch : 3.95mm
- Dot size : 0.43 × 0.6 mm (XxY)
- Dot pitch : 0.53 × 0.75 mm (XxY)
- Luminance : 350cd/m² (100 fL) MIN.
- Color of illumination : Blue - green

5. Environmental Specifications

Operating temperature :	-10 to +65°C
Storage temperature :	-40 to +85°C
Operating humidity :	20 to 80% RH
Vibration :	10 to 55Hz, 10Gmax, 3 directions, 30 min. each
Shock :	100G, 9ms

6. Functional Descriptions

This module provides the functions of serial data write, and has 160 characters in Build-in character generator. The user definable fonts(UDF) can be programmable up to 16 characters.

6.1 Command Description

Function	Command Data								Contents
	D7	D6	D5	D4	D3	D2	D1	D0	
Set display length	0	0	0	0	0	*	*	*	Set the maximum number of digit to be displayed. (9 to 16 digits)
Set dimmer value	0	0	0	0	1	*	*	*	Adjust the brightness. (8 steps)
Set digit scan time	1	1	1	1	0	1	1	*	Either 160 μ s or 320 μ s is available.
Set digit pointer	1	1	1	0	*	*	*	*	This command is used to select a digit to display a character which is received as a character code data.
Automatic increment mode ON/OFF of digit pointer	1	1	1	1	0	1	0	*	When "ON", the digit pointer is advanced automatically after receiving a character code data. When "OFF", the digit pointer is fixed.
Display all ON/OFF	1	1	1	1	0	0	*	*	All dot outputs can be set "ON".
Storing data in UDF	1	1	1	1	1	1	X	X	This command is a declaration to define a UDF.

X : Don't care

* : Selection bits

"0" : Low - level

"1" : High - level

6.2 Command Format

6.2.1 Set display length

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

Maxium number of digit to be displayed
(See Table 1)

6.2.2 Set dimmer value

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	1			

Dimmer value (See Table 2)

6.2.3 Set digit scan time

D7	D6	D5	D4	D3	D2	D1	D0
1	1	1	1	0	1	1	

Digit scan time (T_{dsp})
 "0" : T_{dsp} = 160μs
 "1" : T_{dsp} = 320μs

Table1 Maximum number of digit

D2	D1	D0	Maximum number of digit
0	0	0	9
0	0	1	10
0	1	0	11
0	1	1	12
1	0	0	13
1	0	1	14
1	1	0	15
1	1	1	16

Table2 Dimmer value

D2	D1	D0	Dimmer value (T _{dig} /T _{dsp})
0	0	0	1/16
0	0	1	2/16
0	1	0	4/16
0	1	1	6/16
1	0	0	8/16
1	0	1	10/16
1	1	0	12/16
1	1	1	14/16

T_{dig} : Digit "ON" time

T_{dsp} : scan time

6.2.4 Set digit pointer

D7	D6	D5	D4	D3	D2	D1	D0
1	1	1	0				

Digit select (See Note 1)

(Note1) :

0,0,0,0(D3,D2,D1,D0) : digit pointer sets left most position

1,1,1,1(D3,D2,D1,D0) : digit pointer sets right most position

6.2.5 Auto increment mode ON/OFF

D7	D6	D5	D4	D3	D2	D1	D0
1	1	1	1	0	1	0	

"0" : Automatic Increment mode "OFF"
 "1" : Automatic increment mode "ON"

6.2.6 Display all ON/OFF

D7	D6	D5	D4	D3	D2	D1	D0
1	1	1	1	0	0		

See Table 3

Table3 Display mode selection

D1	D0	Function
X	0	All digits, all dots "OFF"
0	1	Normal display mode
1	1	All digits, all dots "ON"

X : Don't care

6.2.7 Storing data in UDF

The following 3steps define UDF to RA1~RA16

The 1st. is the declaration to define UDF. (1 byte command)

The 2nd. is the selection of a UDF character code number. (1 byte command)

And the 3rd. is the data set of the font. (5 bytes command)

Therefore, to design user font to UDF, continuous commands of 7 bytes are need.

The UDF character code of RA1 to RA16 are assigned to 90(Hex) to 9F(Hex).

1st. byte The Declaration

D7	D6	D5	D4	D3	D2	D1	D0
1	1	1	1	1	1	X	X

X : Don't care

2nd. byte UDF character code select

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

X : Don't care



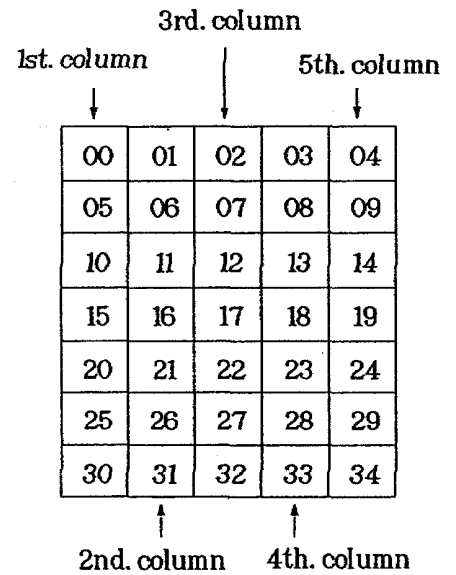
Lower 4-bit of UDF code to be defined.

Format data send

	D7	D6	D5	D4	D3	D2	D1	D0
3rd. byte	00	05	10	15	20	25	30	X
4th. byte	01	06	11	16	21	26	31	X
5th. byte	02	07	12	17	22	27	32	X
6th. byte	03	08	13	18	23	28	33	X
7th. byte	04	09	14	19	24	29	34	X

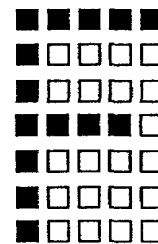
Data bit "0" : Segment "OFF"
 "1" : Segment "ON"

X : Don't care



(EX.) This is an example to define a font "F" in RM 1.

	Serial data	Remarks
1	FC	Decralation to define UDF.
2	00	Select RM 1.
3	FE	Data (1,1,1,1,1,1,0) send.
4	90	Data (1,0,0,1,0,0,0,0) send.
5	90	Data (1,0,0,1,0,0,0,0) send
6	90	Data (1,0,0,1,0,0,0,0) send.
7	80	Data (1,0,0,0,0,0,0,0) send.



The bits of don't care are assumed as "0".

7. Scan Timing Description

7.1 Set display length

This command sets the display length.

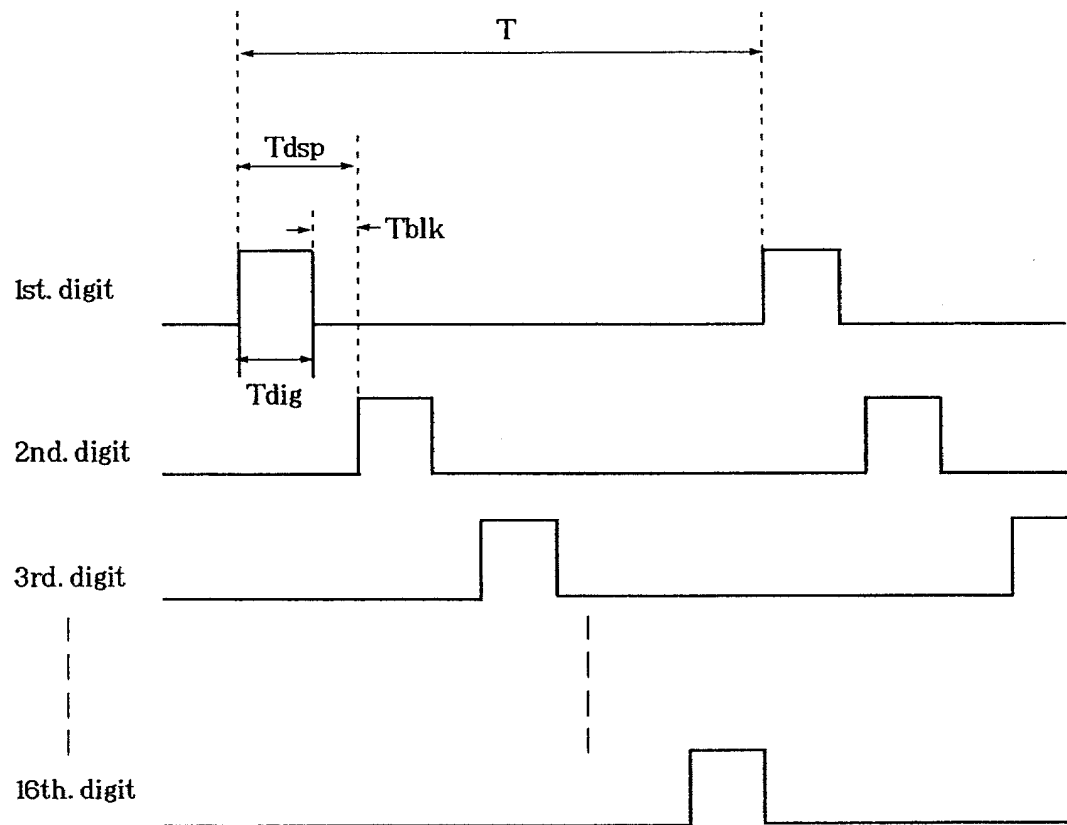
For example, if 12digit selected, 13~16dignita are always OFF.

7.2 Display scan timing

Either 160 μ sec or 320 μ sec can be selected on the digit scan time(T_{dsp}).

The frame cycle time(T) is 391Hz and 195Hz respectively.

(Scan timing chart)



T : Frame cycle time T_{dsp} : Digit scan time
 T_{dig} : Digit "ON" time T_{blk} : Blank time

7.3 Character Display Operation

There are two modes, one is automatic increment "ON" mode, the other is automatic increment "OFF" mode.

In automatic increment "ON" mode, the digit pointer, which indicates the digit to display a character from HOST, is advanced every time after displaying the character. After displaying on the upper most digit, the pointer returns to lowest digit.

In automatic increment "OFF", the digit pointer is fixed. Therefore, the received character is displayed on the same digit.

Sequence	serial data	Front view of VFD	Remarks
		1 2 3 4 5 6 7 8 9 10 11	
1	F4 (Hex)	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Set automatic increment "ON"
2	E0 (Hex)	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Set digit pointer to GRID#1
3	43 (Hex)	C <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	code of "C"
4	55 (Hex)	C U <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	"U"
5	31 (Hex)	C U 1 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	"1"
6	36 (Hex)	C U 1 6 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	"6"
7	35 (Hex)	C U 1 6 5 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	"5"
8	45 (Hex)	C U 1 6 5 E <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	"E"
9	43 (Hex)	C U 1 6 5 E C <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	"C"
10	50 (Hex)	C U 1 6 5 E C P <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	"P"
11	F4 (Hex)	C U 1 6 5 E C P <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Set automatic increment "OFF"
12	E5 (Hex)	C U 1 6 5 E C P <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Set digit pointer to GRID#6
13	53 (Hex)	C U 1 6 5 S C P <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	code of "S"
14	4D (Hex)	C U 1 6 5 M C P <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	"M"
15	45 (Hex)	C U 1 6 5 E C P <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	"E"

7.4 Display All ON/OFF Function

All digits and dots turn "ON" or "OFF" at a time by the command of display all ON/OFF command.

The written data in the module is not changed even in the state of display all "ON" or all "OFF", and any command and character code data from HOST are effective.

8. Initialization

Default mode at power-on is define at Table4

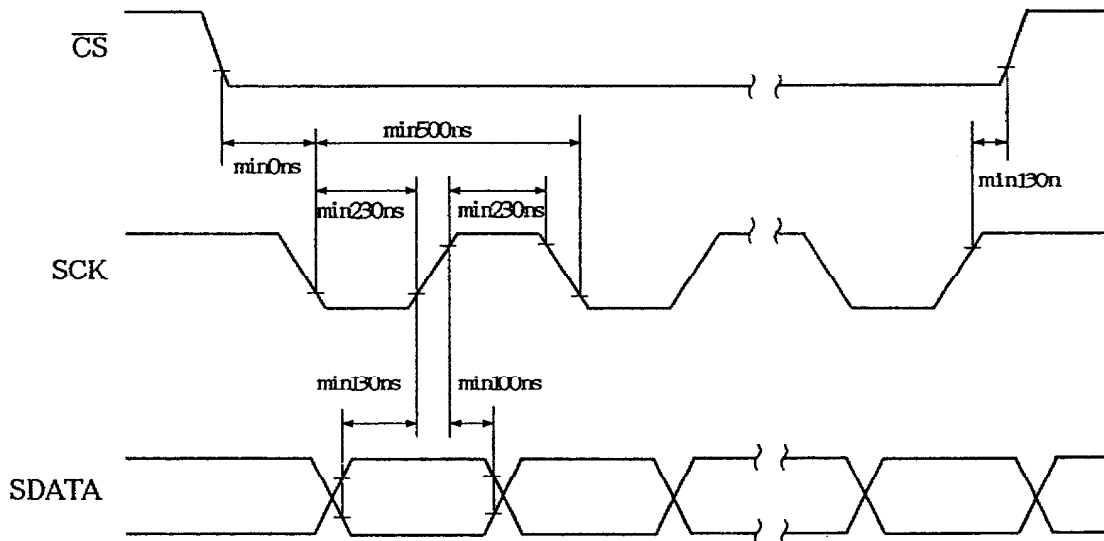
Command/Data Buffer	Default mode
Display all ON/OFF	all OFF
display length, dimmer value, digit pionter, digit scan time, UDF, auto-increment ON/OFF	not defined
serial data buffer	empty

Table 4 default mode

9. Timing Chart

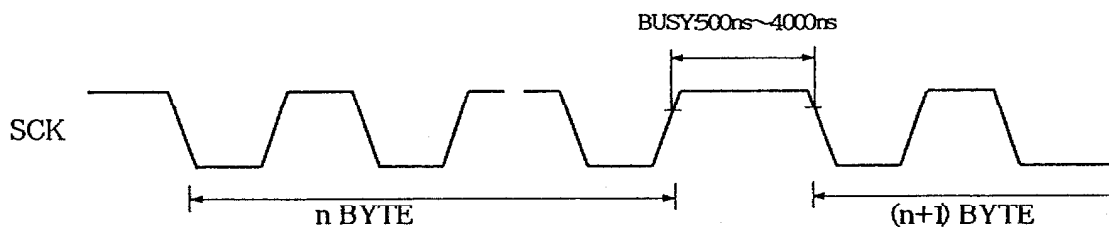
9.1 Data write timing

The data shall be written from D7(MSB) to D0(LSB). The data is fetched when the serial clock goes from Low to High.

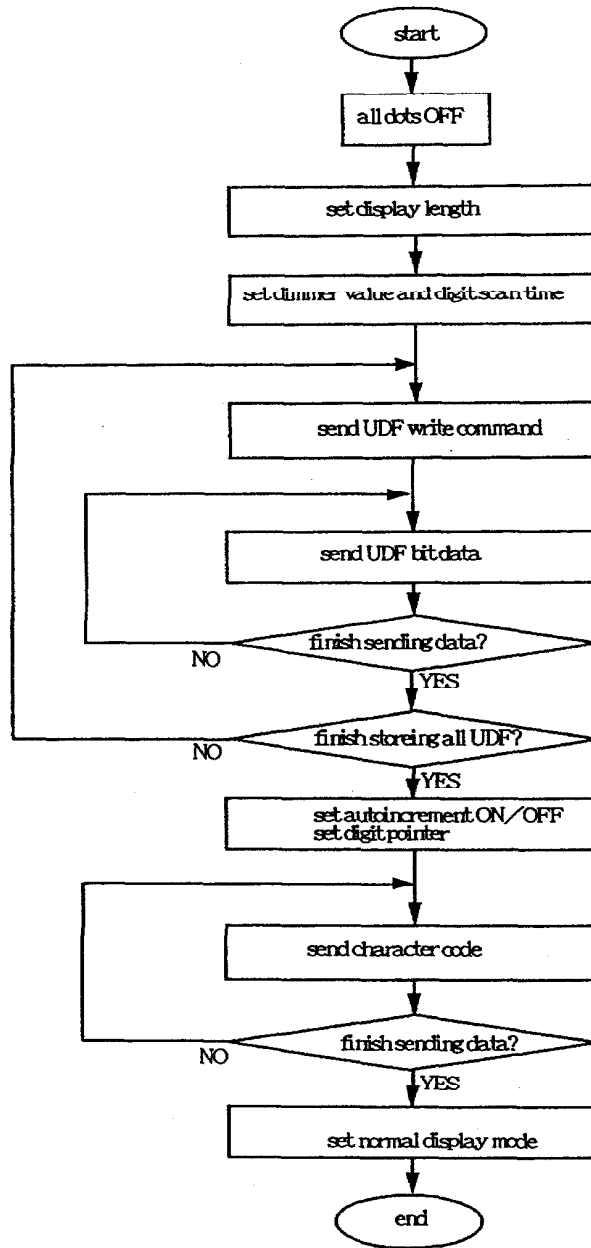


9.2 Busy timing

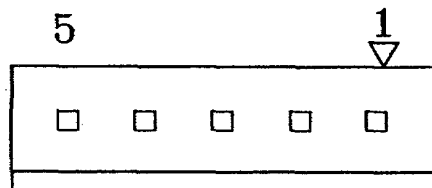
Busy time requires 500~4000ns.



10. Flow chart(initializing)



11. Pin assignment



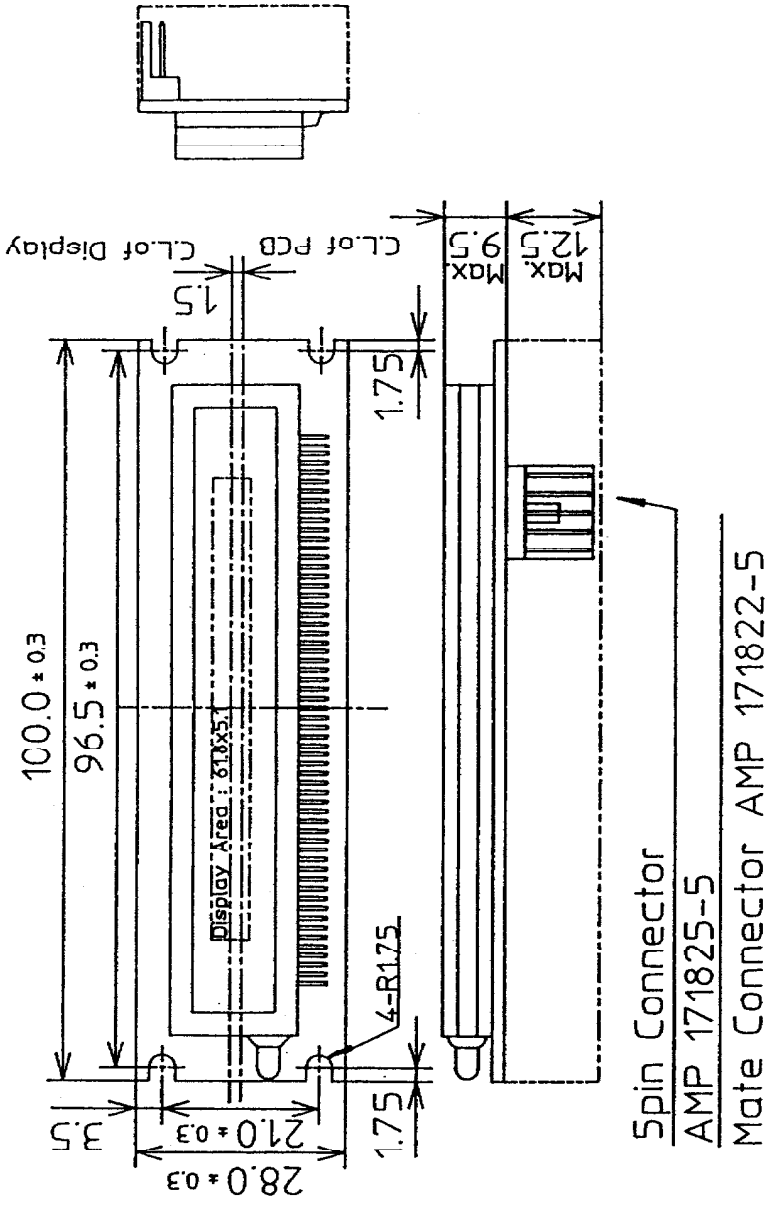
No.	Signal
1	Vcc
2	GND
3	\overline{CS}
4	CLK
5	DATA

12. Character font table

				D7	0	0	0	0	0	0	0	0	0	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
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			SP	0	0	P	^	#		RM1	SP	—	ヲ	三		
0	0	0	1	1			!	1	A	0	a	a		RM2	。	ア	チ	△		
0	0	1	0	2			"	2	B	R	b	r		RM3	「	イ	ツ	×		
0	0	1	1	3			#	3	O	S	c	e		RM4	」	ウ	テ	E		
0	1	0	0	4			*	4	D	T	d	t		RM5	、	エ	ト	ト		
0	1	0	1	5			z	5	E	U	e	u		RM6	=	オ	オ	ユ		
0	1	1	0	6			&	6	F	V	f	v		RM7	ラ	カ	ニ	ヨ		
0	1	1	1	7			'	7	G	W	g	w		RM8	フ	キ	ヌ	ウ		
1	0	0	0	8			<	8	N	X	n	x		RM9	イ	ウ	キ	リ		
1	0	0	1	9			>	9	I	Y	i	y		RM10	エ	ト	ル	ル		
1	0	1	0	A			*:	J	Z	j	z			RM11	エ	コ	ル	ル		
1	0	1	1	B			+:	K	E	k	e			RM12	*	サ	ヒ	ロ		
1	1	0	0	C			,<	L	*1	l				RM13	フ	シ	フ	フ		
1	1	0	1	D			-=	N	J	n	j			RM14	ユ	ズ	ソ	ソ		
1	1	1	0	E			,>	N	^n	^				RM15	ヨ	ロ	ホ	フ		
1	1	1	1	F			/?	O	_o	o	■			RM16	ウ	リ	マ	マ		

M66004

13. Outer dimension



I M P O R T A N T P R E C A U T I O N S

- * All VFD Modules contain MOS LSIs or ICs. Anti-Static handling procedures are always required.
- * VF Display consists of Soda-lime glass. Heavy shock more than 100 G, thermal shock greater than 10 °C/minute, direct hit with hard material to the glass surface — especially to the EXHAUST PIPE — may CRACK the glass.
- * Do not PUSH the display strongly. At mounting to the system frame, slight gap between display glass face and front panel is necessary to avoid a contact failure of lead pins of display. Twist or warp mounting will make a glass CRACK around the lead pin of display.
- * CONNECTOR should be connected or disconnected while power is applied. As is often the case with most subsystems, caution should be exercised in selectively disconnecting power within a computer based system. *The modules receive high logic on strobe lines as random signals on all data ports.*
Removal of primary power with logic signals applied may damage input circuitry.
- * Stress more than specification listed under the Absolute Maximum Ratings may cause PERMANENT DAMEGE of the modules.
- * +5 volts power line must be regulated completely since all control logics depend on this line.
Do not apply slow-start power. Provide sufficient output current power source to avoid trouble of RUSH CURRENT at power on. (At least output current of double figure of I_{cc} , listed on the specification of each module, is required.)
- * Data cable length between module and host system is recommended within 300 mm to be free from a mis-operation caused by noise.
- * Do not place the module on the conductive plate just after the power off. Due to big capacitors on the module, more than 1 min. of discharging time is required to avoide the failure caused by shorting of power line.