2SC-495

VACUUM FLUORESCENT DISPLAY MODULE SPECIFICATION

Model : CU40026SCPB-S26A

SPECIFICATION NO. : DS-356-0000-00
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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 80 character (2 x 40) VFD, refresh memory, character generator, control circuit and DC/DC converter.

1. 3 Display color : Blue-green.

1. 4 Outline dimension : See attached drawings.

2 . Absolute Maximum Ratings

Power Supply Voltage ··· V_{CC} : +7.0 Max. V DC

Logic Input Voltage ··· V_{IN} : V_{CC}+0.3 Max. V DC

3 . Electrical Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	V_{CC}	4.75	5.00	5.25	V DC

4 . Electrical Characteristics

V_{CC} = 5.0V Ta = 25°C

Parameter		Symbol	Min.	Typ.	Max.	Unit	Cond.
Input Voltage	H	V_{IH}	2.2	-	V_{CC}	V DC	V_{CC} = 5.0V
	L	V_{IL}	-	-	0.8	V DC	V_{CC} = 5.0V
Output Voltage	H	V_{OH}	2.4	-	-	V DC	I_{OH} = -400μA
	L	V_{OL}	0	-	0.45	V DC	I_{OL} = 1.6mA
Supply Current		I_{CC}	-	0.75	0.85	A	V_{CC} = 5.0V Operate all dots in all chr positions

Note :

Power-on delay of Vcc shall be within 30 ms.

Icc might be anticipated more than 2 times figure of above table at power on rush.

5 . Optical Specifications

Number of characters	: 80(2 lines x 20 chrs)
Matrix format	: 5 x 7 dot character with cursor
Display area	: 188.55 x 16.0 mm (X x Y)
Character size	: 3.3 x 5.05 mm (X x Y)
Character pitch	: 4.75 mm (center-to-center)
Dot size	: 0.5 x 0.55 mm (X x Y)
Dot pitch	: 0.7 x 0.7 mm (X x Y)
Luminance	: 700 cd/m^2 200 fL (Typ.)
Color of illumination	: Blue-green

6 . Environmental Specification

Operating temperature	: − 20 to +60 °C
Storage temperature	: −40 to +70 °C
Operating humidity	: 20 to 80 % R.H

7 . Environmental Specifications

Vibration Test	: Frequency	: 10–50–10 Hz
	Sweep time	: 1 minute
	Amplitude	: 2mm (Fixed 10G)
	Direction	: X, Y & Z (3 directions)
	Times	: 30 Min. for each direction
Shock Test	: Acceleration	: 100G
	Duration	: 9.0 msec
	Direction	: X, Y & Z (3 directions)
	Time	: Three (3) times for each direction

The test shall be done at no operating and no any mechanical and electrical failures should be found after the tests.

8 . Functional Descriptions

The CU40026SCPB-S26A VFD Module provide the functions of DATA WRITE , DATA READ , COMMAND WRITE , STATUS READ and DISPLAY RESET.

$\overline{WR}$	$\overline{RD}$	A0	$\overline{CS}$	Function	Direction Of Data Bus
0→1	1	0	0	Data Write	Host To Module
0→1	1	1	0	Command Write	Host To Module
1	0	0	0	Data Read	Module To Host
1	0	1	0	Status Read	Module To Host

8.1 Data write

Data write is executed at rising edge of $\overline{WR}$ pulse while $\overline{CS}$ = A0 ="0" and $\overline{RD}$ = "1".
This module accepts 159 ASCII characters and 19 control codes listed in Table 1. Two desired fonts may be alternated into character code of 00 Hex to FF Hex in Table 1 with ESC (1B Hex) code See (19) ESC.
Generally , the cursor automatically moves to right by one character position after execution of data write.

Control code are defined as follows :
(The term of "CURSOR" means the writing position.)

(1) BS : Back Space
DC1 Mode : The cursor position is shifted to the left by one character position.
When the cursor is located at the left end of the bottom line , the cursor is shifted to the right most position of the top-line after execution.
When the cursor is on the left most position of the top line , the cursor is to the right most position of the bottom line.
DC2 Mode : Same as DC1 Mode.

(2) HT Horizontal Tab
DC1 Mode : The cursor position is shifted to right by one character position.
When the cursor is located at the right end of the top line , the cursor is shifted to the left most position of the bottom lime.
When the cursor is on the right most position of bottom line , the cursor is shifted to the left most position of the top line.
DC2 Mode : When the cursor is on the right most position of the bottom line , all characters on the bottom line are shifted to one line up , and cursor is positioned to the left most position of the bottom line. At this time , all positions of the bottom line are cleared for a new line.

(3) LF : Line Feed
DC1 Mode : The cursor is shifted to the same column position of next line.
When the cursor is on the bottom line , the cursor is shifted to the same column position of the top line.
DC2 Mode : When the cursor is on the bottom line , all characters on the bottom line are shifted to the upper line , and the cursor maintains the same position of the bottom line. At this time , all positions of the bottom line are cleared for a new line. When the cursor is on the top line , same as DC1 Mode execution will be made.

(4) HM : Home
DC1 Mode : The cursor is positioned on the left most position of the top line.
DC2 Mode : Same as DC1 Mode.

(5) CLR : Clear
DC1 Mode : All writen characters are cleared. The cursor is positioned on the left most position of the top line.
DC2 Mode : Same as DC1 Mode.

(6) CR : Carriage Return

DC1 Mode : The cursor is positioned on the left most position of the same line.

DC2 Mode : Same as DC1 Mode.

(7) DC1 : Normal Mode (Default Mode)

After a character is written, the position of the cursor is automatically shifted to the right by one character position. When the cursor is on the right most position of the top line, the cursor is shifted to the left most position of the bottom line. When the cursor is on the right most position of the bottom line, the cursor is shifted to the left most position of the top line.

(8) DC2 : Scroll Mode

After all positions of the bottom line are written, the characters written on the bottom line are scrolled up to the top line, and the cursor is positioned at the left most position of the bottm line.

At this time, all characters on the bottom line are cleared for a new line.

The display module automatically selects the DC1 Mode above at initial power-on time. This selection will be maintained until another mode will be selected.

(9) DC3 : Cursor On Mode (Default Mode)

The cursor position is displayed as an under-line.

(10) DC4 : Block Cursor Mode

The character on cursor position is alternatively blinking with all dots.

(11) DC5 : Cursor Off Mode

The cursor position is invisible.

(12) DC6 : Cursor Blink Mode

The under-line on cursor position blink in this mode.

The following five control codes select the font as follows :

(13) SUB : English font (USA ASCII-7) (Default Code)

(14) FS : Danish font (ECMA-7)

(15) GS : General European font (ECMA-7)

(16) RS : Swedish font (ECMA-7)

(17) US : German font (ECMA-7)

Conversion table from ASCII to ECMA is shown as follws :

HEX CODE	CONVERSION CODES				
	1A	1C	1D	1E	1F
23	#	£	£	£	£
5B	[	Æ	[	Ä	Ä
5C	\	Ø	\	Ö	Ö
5D	]	Å	]	Å	]
5E	^	^	^	Ü	Ü
7B	{	æ	{	ä	ä
7C	|	ø	|	ö	ö
7D	}	å	}	å	ü
7E	~	~	~	ü	ß
	ASCII	DANISH	GEN EUROPE	SWEDISH	GERMAN

SUB (1A Hex), English font is automatically selected at the power-on or reset. The selected mode is maintained until other mode is seleted.

(18) SCN : Selection of Writing Mode

Flickerless mode can be selected by sending the code of 0E Hex.

Within Flickerless mode, although Busy might become longer, flickerless-high speed-continuous-data write can be achieved since refreshing of the screen has priority over the data acceptance.

Quick data write with minimum 'Busy time will be given by Quick Write Mode (Default mode) since the data acceptance has the priority over the refreshing of the screen.
Within this mode, continuous high speed data write may cause flicker display.

Note : Just after power on or reset, Quick Write Mode is selected until other mode is set. After selected Flickerless Mode, Quick Write Mode can't be selected unless otherwise reset.

(19) ESC : The following ESC code assigns two user desired fonts (UDF) into any character positions from 00 Hex to FF Hex of table 1. RAM of the module reserves two-character-size of memory for these new characters.

Six-byte data suceeding this ESC code alternates present character font to new font desired.

1st byte : 1B Hex

2nd byte : Definition character code

Definable character codes are available from 00 Hex to FF Hex of table 1. If the character code of control characters as BS, HT, CR, etc, is selected for new character, the module displays new character instead of control action.

Caution that definition of 1B Hex (ESC) character code kills ESC function thereafter.

3rd-7th byte : Formation of character font

Each dot data of 5x7 is defined with following Table.

Figures in the Table are correspond to each dot position of 5x7. The dots to be lighted shall be specified as "1" (active high).

Byte	D7	D6	D5	D4	D3	D2	D1	D0
3rd	23	15	22	16	21	17	20	18
4th	27	11	26	12	25	13	24	14
5th	31	9	30	*	29	*	28	10
6th	35	5	34	6	33	7	32	8
7th	*	3	*	2	19	1	UL	4

*="0" (low) UL : Under line

After execution of above sequence, new character defined will be displayed by defined character code.

DYSPLAY DOT

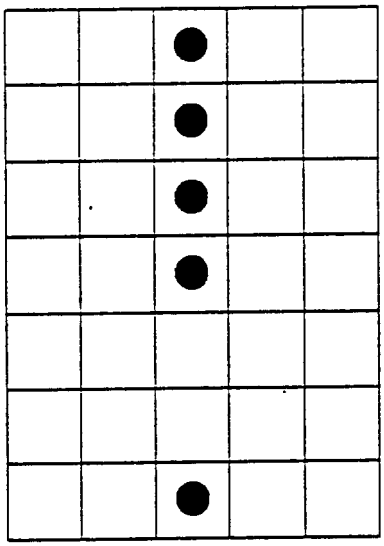
1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35

5X7 DOT

Example:

Definition of new character "!" to character code A0 Hex :

Desired Dot Pattern



5x7 Dot

Specify each dot

Byte/Bit	7	6	5	4	3	2	1	0	Hex
3th Byte	0	0	0	0	0	0	0	1	01
4th Byte	0	0	0	0	0	1	0	0	04
5th Byte	0	0	0	0	0	0	0	0	00
6th Byte	0	0	0	0	1	0	0	1	09
7th Byte	0	1	0	0	0	0	0	0	40

Then Syntax should be written : 1B + A0 + 01 + 04 + 00 + 09 + 40 (Hex)

8 .2 Command Write

Command write is executed at rising edge of $\overline{WR}$ pulse while $\overline{CS}$="0" and A0 = $\overline{RD}$ ="1".
This module provides followin commands :

00XX XXXX : Set the cursor on 00XX XXXX (Hex) position.
0000 0000 (00 Hex) : The left most of the top line
0000 0001 (01 Hex) : The 2nd column of the top line
0010 0111 (27 Hex) : The right most of the top line
0010 1000 (28 Hex) : The left most of the bottom line
0100 1111 (4F Hex) : The right most of the bottom line
When more than the number of characters (80) is specified , the cursor will not move.

0101 0000 : (50 Hex) Software reset
Same execution as hardware reset of 8 .5

0101 0001 : (51 Hex) Read the cursor position
Read data 00H means the left most cursor position.

8 .3 Data Read

After the data read command (51H) is written , data is executed when $\overline{CS}$ = A0 = $\overline{RD}$ = "0" and $\overline{WR}$ = "1" after confirming that bit 0 of status data is "1".
No confirming of status data , however , is needed , only when the data read is executed after 1.0 ms or more of command write.

8.4 Status Read

The module outputs the status on bit 1 of data bus , when $\overline{CS}$ = $\overline{RD}$ = "0" and A0 = $\overline{WR}$ = "1".
BIT 0 : Status of data read : data read is valid when BIT 0 = "1".
BIT 1 : Status of data write : data write and command write are valid only when BIT 1 = "0".
BIT 2 through 7 : Do not care.

No confirming of status bits , however , is needed , only when the period of write cycle is lnger than 1.0 ms.

8 .5 Hardware Reset

RESET = "1" Makes the module initialized as follows :
1. All character positions are filled with SP (20 Hex) characters.
2. The cursor position is set on the left most position of the top line.
3. DC1 and DC3 modes are selected.
4. Alternated characters specified by ESC code are cancelled , and standard characters in character generator are selected.

Reset signal is active high and shall be maintained 50 ms or longer. No input is executed within 100 ms after reset pulse or reset command. (SEE TIMING CHART)

8 .6 Test Mode

"0" more than 100msec to the TO line at the power on or reset may initiate the test mode. During the test mode , no any data/commands are acceptable.
The test mode can be canncelled only power off or reset at open of TO line.
All stored ROM character fonts are displayed automatically at this mode.

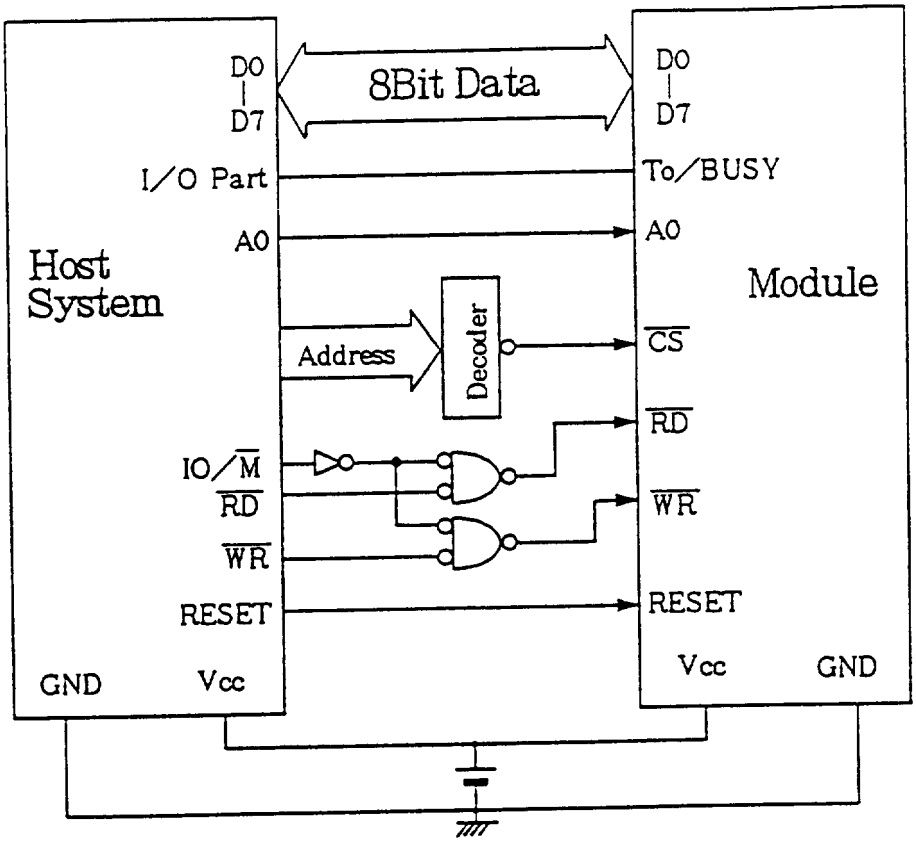
8.7 Character and control code table

CHARACTER FONTS

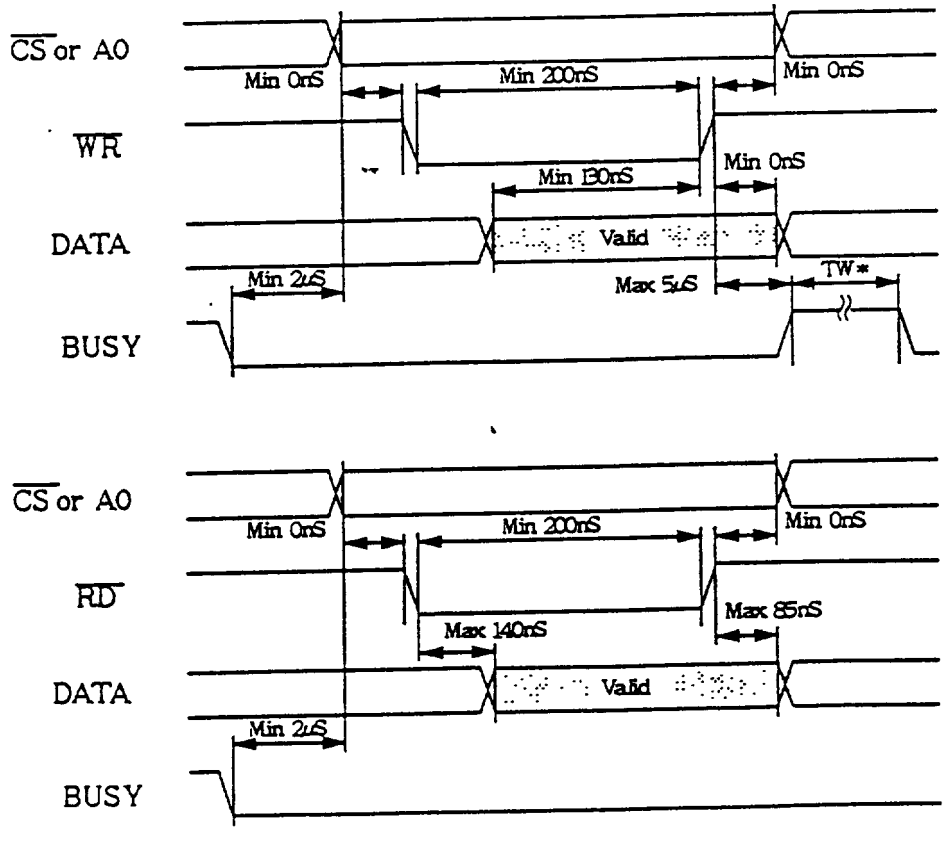
D7 D6 D5 D4		0 0 0 0	0 0 0 1	0 0 1 0	0 0 1 1	0 1 0 0	0 1 0 1	0 1 1 0	0 1 1 1	1 0 0 0	1 0 0 1	1 0 1 0	1 0 1 1	1 1 0 0	1 1 0 1	1 1 1 0	1 1 1 1
D3 D2 D1 D0	\	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0 0 0 0	0			SP	0	@	P	`	p				ー	タ	ミ		
0 0 0 1	1		DC1	!	1	A	Q	a	q			｡	ｱ	ﾁ	ﾑ		
0 0 1 0	2		DC2	"	2	B	R	b	r			｢	ｲ	ﾂ	ﾒ		
0 0 1 1	3		DC3	#	3	C	S	c	s			｣	ｳ	ﾃ	ﾓ		
0 1 0 0	4		DC4	$	4	D	T	d	t			､	ｴ	ﾄ	ﾔ		
0 1 0 1	5		DC5	%	5	E	U	e	u			･	ｵ	ﾅ	ﾕ		
0 1 1 0	6		DC6	&	6	F	V	f	v			ｦ	ｶ	ﾆ	ﾖ		
0 1 1 1	7			'	7	G	W	g	w			ｧ	ｷ	ﾇ	ﾗ		
1 0 0 0	8	BS		(	8	H	X	h	x			ｨ	ｸ	ﾈ	ﾘ		
1 0 0 1	9	HT		)	9	I	Y	i	y			ｩ	ｹ	ﾉ	ﾙ		
1 0 1 0	A	LF	SUB	*	:	J	Z	j	z			ｪ	ｺ	ﾊ	ﾚ		
1 0 1 1	B	HM	ESC	+	;	K	[	k	{			ｫ	ｻ	ﾋ	ﾛ		
1 1 0 0	C	CLR	FS	,	<	L	¥	l	|			ｬ	ｼ	ﾌ	ﾜ		
1 1 0 1	D	CR	GS	-	=	M	]	m	}			ｭ	ｽ	ﾍ	ﾝ		
1 1 1 0	E	SCN	RS	.	>	N	^	n	~			ｮ	ｾ	ﾎ	ﾞ		
1 1 1 1	F		US	/	?	O	_	o	■			ｯ	ｿ	ﾏ	ﾟ		

Ch570L

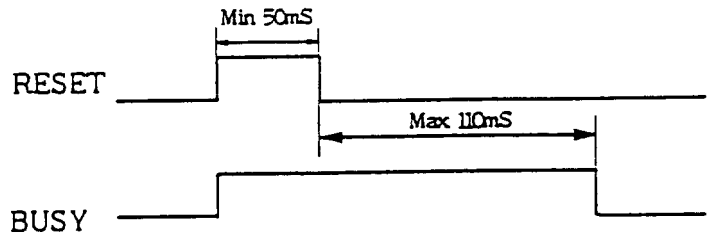
9 . Interface Example



10 . Data Write / Read Timing

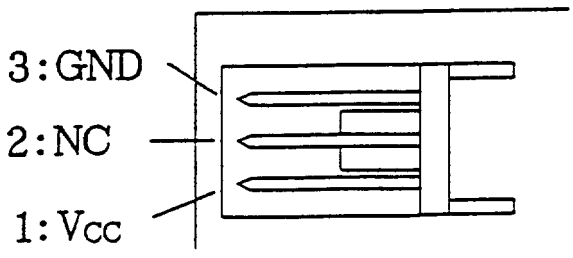


11 . Reset Timing



12. Pin Connection

PIN NO.	SIGNAL	PIN NO.	SIGNAL
1	D7	2	GND
3	D6	4	GND
5	D5	6	GND
7	D4	8	GND
9	D3	10	GND
11	D2	12	GND
13	D1	14	GND
15	D0	16	GND
17	$\overline{WR}$	18	GND
19	A0	20	RESET
21	$\overline{RD}$	22	GND
23	$\overline{CS}$	24	GND
25	TO/BUSY	26	GND



13 . BUSY Time

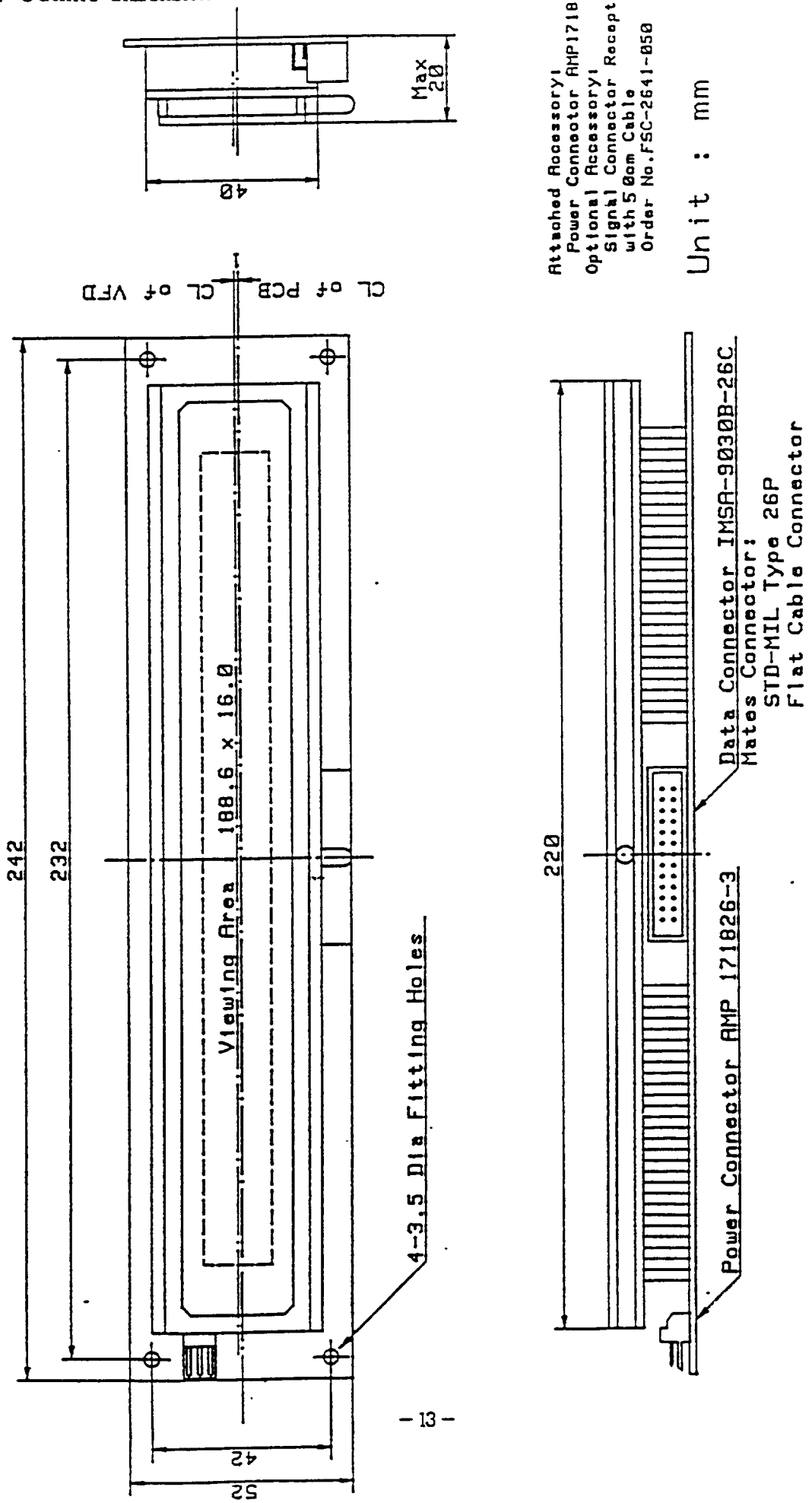
Input data or command execution times (TW) at "Quick write mode" are shown as follows.

Data Write		Execution time (TW)		Data Writing Mode
		DC1 Mode	DC2 Mode	
Character data write		250 μS	600 μS	Quick Write Mode
HT, LF		300 μS	600 μS	
HM, CR, SCN, BS		230 μS		
CLR		600 μS		
DC1~6		200 μS		
SUB, FS, GS, RS, US		180 μS		
ESC	1st byte	180 μS		
	2nd byte~	150 μS		

Data Write	Execution time (TW)		Data Writing Mode
	DC1 Mode	DC2 Mode	
00 Hex ~ 4F Hex	100 μS		Quick Write Mode
50 Hex	1.6 mS		
51 Hex	120 μS		

Within Flickerless Mode, Approximately 2 to 15 times of above table should be considered. Operating with Flickerless Mode , therefore , always watching of BUSY line is recommended.

14 . Outline dimension



IMPORTANT PRECAUTIONS

* 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.

* Neither DATA CONNECTOR or POWER 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 DAMAGE 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 Icc, 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.

* 2 hours pre-running with the test mode operation may help the stability of the brightness of the VFD when power was not applied more than 2 months.

* Steady repeating of a fixed (static) message displaying, longer than 5 hours in a day may cause the phosphor burn-out problem. An automatic shut down programming, scrolling message using DC2 mode or 2 hours test mode operation during the idling of the host is recommended.

* 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 avoid the failure caused by shorting of power line.