Specification

of

Vacuum Fluorescent Display Module

Model : CU406SCPB-S21A

Customer : AT&T

Revision

Ltr	Date	Description	CHK	APP
00	May.9.1988	Initial Issue		
01	June.2.1988	Outline Dimension is changed.		
02	Aug. 4.1988	Added Status Read		

		PRV	
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1.0 General Description

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

1.2 Construction : Single board display module consists of 40 character(1 x 40) VFD, refresh memory, character generator, control circuit, DC/DC converter and all necessary control logics. Interface level is TTL compatible and the module can be connected to the CPU bus of host directly.

1.3 Drawing : See attached drawings.

2.0 Absolute Maximum Ratings

Power Supply Voltage ------ V_{CC}: +7.0V_{DC}
Logic Input Voltage ------ V_{IN}: +5.5V_{DC}

3.0 Electrical Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit.
Power supply voltage	Vcc	4.75	5.0	5.25	V_{DC}

4.0 Electrical Characteristics

Parameter		Symbol	Min.	Typ.	Max.	Unit.	Cond.
Input voltage	"H"	V_{IH}	2.4	-	Vcc	V_{DC}	Vcc=5.0V
	"L"	V_{IL}	-	-	0.4		
Output voltage	"H"	V_{OH}	2.8	-	-	V_{DC}	I_{OH}=400μA
	"L"	V_{OL}	-	-	0.4		I_{OL}=1.6mA
Reset	"H"	V_{IH}(R)	3.0	-	-	V_{DC}	Vcc=5.0V
	"L"	V_{IL}(R)	-	-	0.5		
Supply current		Icc	-	350	400	mA_{DC}	Vcc=5.0V

Slow start power supply may cause erroneous operation.
I_{CC} might be anticipated twice as usual at power on rush.

5.0 Optical Specifications

Number of characters : 40(1 line x 40 chrs.)
Matrix format : 5 x 7 dot + Under line
Display area : 178.5 mm x 6.0 mm (X x Y)
Character size : 3.0 mm x 5.0 mm (X x Y)
Character pitch : 4.5 mm
Dot size : 0.4 mm x 0.5 mm (X x Y)
Dot pitch : 0.65 mm x 0.75 mm (X x Y)
Luminance : 350 cd/m^2 (100 fL) Min
Color of illumination : Blue-green

6.0 Environmental Specifications

Operating temperature	:	-20 to +60 ℃
Storage temperature	:	-40 to +70 ℃
Operating humidity	:	20 to 80 % RH
Vibration	:	10 to 55 Hz, 10 Gmax 3 directions, 30 min. each
Shock	:	100 G, 9 msec

7.0 Functional Descriptions

This module provides the functions of 8 bit parallel data write, data read, command write and status read.
Each control data and character fonts are shown in table 1.
Once character data is written, the writing position is incremented automatically.

$\overline{CS}$	$\overline{RD}$	$\overline{WR}$	A0	Function	BUS direction
0	1	↑	0	Character data write	Module ← Host
0	1	↑	1	Command data write	Module ← Host
0	0	1	0	Data read	Module → Host
0	0	1	1	Status read	Module → Host
1	×	×	×	No operation	Module × Host

↑ : rising edge of pulse × : don't care

7.1 Character and control code set

CHARACTER FONTS

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			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	NUL	DC2	"	2	B	R	b	r			「	イ	ツ	メ		
0 0 1 1	3	NUL	DC3	#	3	C	S	c	s			」	ウ	テ	モ		
0 1 0 0	4	NUL	DC4	$	4	D	T	d	t			、	エ	ト	ヤ		
0 1 0 1	5	UL	DC5	%	5	E	U	e	u			・	オ	ナ	ユ		
0 1 1 0	6	FON	DC6	&	6	F	V	f	v			ヲ	カ	ニ	ヨ		
0 1 1 1	7	FOF	DC7	'	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		ESC	+	;	K	[	k	{			ォ	サ	ヒ	ロ		
1 1 0 0	C		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	゛		
1 1 1 1	F		US	/	?	O	_	o				ッ	ソ	マ	゜		

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Table 1

7.2 Control Data Write

Detail of control data are shown in this clause. The term "Cursor" is the same meaning of "Writing Position".

7.2.1 BS : Back Space (08 Hex)

The cursor moves one character to the left.
No moves at the left end.

7.2.2 HT : Horizontal Tab (09 Hex)

The cursor moves one character to the right.
At the right end, the cursor motion is depended upon DC1, DC2, and DC3 mode.

DC1 : No moves at the right end.
DC2 : No moves at the right end.
DC3 : All displayed character is shifted to left by one, and right most position become blank.

7.2.3 LF : Line Feed (0A Hex)

All displayed character are cleared.

7.2.4 CR : Carriage Return (0D Hex)

The writing position moves to the left end.

7.2.5 DC1 : Automatic Carriage Return Mode

When the cursor reaches at the right end, additional data write makes automatic carriage return.

DC2 : Over-Write Mode
When the cursor reaches at the right end, additional data write makes over-write at the right most position.

DC3 : Holizontal Scroll Mode
When the cursor reaches at the right end, the next data write makes the cursor overflow, further data write shift all displayed characters to left by one, and those new characters are written at the right most position. Writing position moves to the left end when DC1 or DC2 mode selects in DC3 mode.

Alternative LINE ENDING MODE is specified by DC1, DC2 and DC3 when control data HT is written. Just after the power on, DC1 is selected (Default Mode).

7.2.6 DC4 : Device Control 4 (14 Hex) .... Make the cursor a non-flashing underline.

DC5 : Device Control 5 (15 Hex) .... Make the cursor a flashing block
DC6 : Device Control 6 (16 Hex) .... Make the cursor invisible.
DC7 : Device Control 7 (17 Hex) .... Make the cursor a flashing underline

Above four codes control the cursor rendition. DC4 is default mode. The mode is maintained until other mode is selected.

7.2.7 FON : Start a flashing field (06 Hex)

Start flashing field by sending the code of 06 Hex.
Send before characters which are desired to flashing.
Following characters are alternatively flashing with blank.

7.2.8 FOF : Stop a flashing field (07 Hex)

Stop falshing field by sending the code of 07 Hex.
Following characters will not flash.

FON(06 Hex) will mark the beginning of a string of flashing characters. FOF(07 Hex) will mark the end of the string of flashing characters and return to normal character presentation.
The display will be reset to non-flashing as the result of the Reset command(40 Hex), the Clear code(0A Hex) or the Stop flashing code (07 Hex).

7.2.9 The following five control codes select the font as follows;

SUB : English font (USA ASCII-7) (1A Hex) (Default code)
FS : Danish font (ECMA-7) (1C Hex)
GS : General European font (ECMA-7) (1D Hex)
RS : Swedish font (ECMA-7) (1E Hex)
US : German font (ECMA-7) (1F Hex)

Conversion table from ASCII to ECMA is shown as follows;

HEX CODE	CONVERSION CODES				
	1A	1C	1D	1E	1F
23					
5B					
5C					
5D					
5E					
7B					
7C					
7D					
7E					
	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 unless other mode is selected.

7.2.10 ESC : Escape (1B Hex)

User Definable Font (UDF)
User's desired fonts can be defined by software. The fonts will be memorized in RAM of the CPU.

Syntax : ESC(1B Hex) + chr + PT1 + PT2 + PT3 + PT4 + PT5

Any 5 X 7 dot patterns consisted of data form PT1 thru PT5 can be stored in the character code location specified by chr.
Maximum number of UDF are 5 characters at a once. Storing more than 5 will kill the oldest font. However, within the 5 character codes where already defined by UDF, the over-write-latest font replaces the former font.

1st byte : ESC (1B Hex)
2nd byte : chr (00 Hex to FF Hex)
Specify the character code location from 00 Hex to FF Hex by chr. If chr overlaps the control codes such as BS, HT, etc., the control function will be lost. And therefor, overlap to the ESC code may not avail further UDF.
3rd to 7th byte : PT1 thru PT5
Specify ON or OFF of 36 dot position (5x7 dot + 1 underline). Following table shows the relation of dot position and the data formation. ("1"= dot turn on, "0"= dot turn off)

	7(MSB)	6	5	4	3	2	1	0(LSB)
3rd byte	P5	P6	P17	P18	P7	P8	P19	P20
4th byte	P1	P2	P29	P30	P3	P4	P31	P32
5th byte	P13	P14	P25	P26	P15	P16	P27	P28
6th byte	P9	P10	P11	P12	UL	*	*	*
7th byte	P21	P22	P33	P34	P23	P24	P35	*

UL: Underline, * : don't care = "0"

Following is the dot assignment.

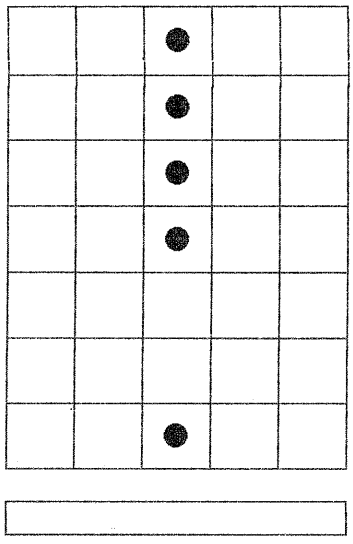
P1	P2	P3	P4	P5
P6	P7	P8	P9	P10
P11	P12	P13	P14	P15
P16	P17	P18	P19	P20
P21	P22	P23	P24	P25
P26	P27	P28	P29	P30
P31	P32	P33	P34	P35

UL

After execution of above sequence, a defined font will be stored in the character code location "chr"(Hex).

Following is an example of UDF sequence.
Example: "!" dot pattern should be stored in character code location A0 Hex.

Desired Dot Pattern



Turn on dot number

P3

P8

P13

P18

P33

Assign turn on dot number to the bit table as follows.

	7	6	5	4	3	2	1	0	Hex Data
3rd Byte	0	0	0	1	0	1	0	0	14 (PT1)
4th Byte	0	0	0	0	1	0	0	0	08 (PT2)
5th Byte	1	0	0	0	0	0	0	0	80 (PT3)
6th Byte	0	0	0	0	0	0	0	0	00 (PT4)
7th Byte	0	0	1	0	0	0	0	0	20 (PT5)

Then Syntax should be written; 1B + A0 + 14 + 08 + 80 + 00 + 20 (Hex)

7.2.11 SCN : Selection of Writing Mode (0E Hex)

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 achived 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 re-freshing of the screen. Within this mode, continuous high speed data write may cause flicker dispaly.

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.

7.2.12 UL : Attribution of underline (05 Hex)
Underlines attribute to the character code succeeding. Only underline code without character code may ignore (defined as a NUL).
Character code without above data shows character only.
Although character is flashing at FON mode(flashing field), underline is not flashing.

7.3 Control Commands
All input data are defind as the command when A_0 line is "High".
Following commands are provided.

7.3.1 Cursor Moving
Cursor can be moved any character position in the screen by giving of 1 byte data as follows.

00 Hex : The left most character position
:
:
27 Hex : The right most character position

7.3.2 Cursor Position Read
Cursor position can be read by sending the command of 41 Hex.
1 byte data of cursor position will be sent back to the host thru the data bus.

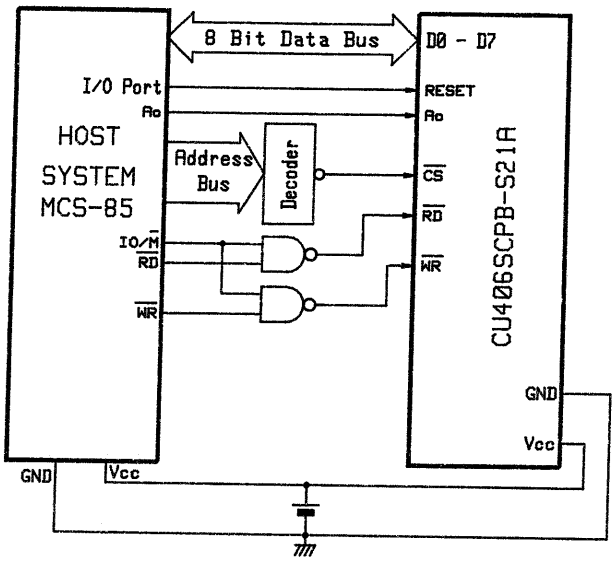
00 Hex : The left most character position
:
:
27 Hex : The right most character position
28 Hex : Character scroll position of DC3 mode

7.3.3 Reset
The module can be reset by sending the command of 40 Hex.
All displayed characters and all set factors are cleared. This is the same status just after the power on.

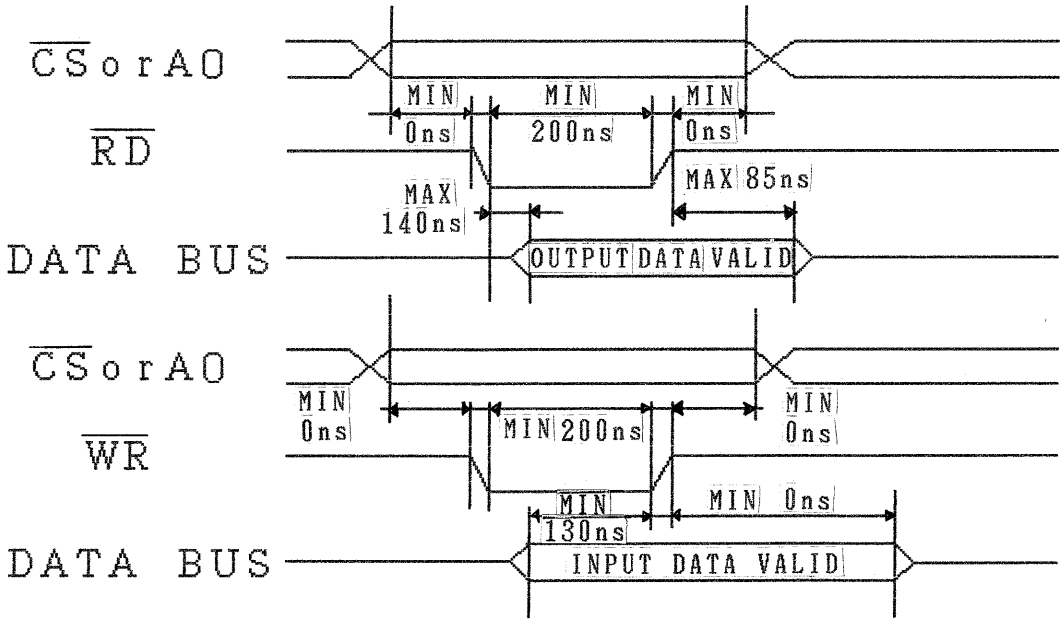
7.4 Status Read
The module outputs the status on both bit 0 & bit 1 of data bus, when $\overline{CS}=\overline{RD}$="0" and A0=$\overline{WR}$="1".

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.

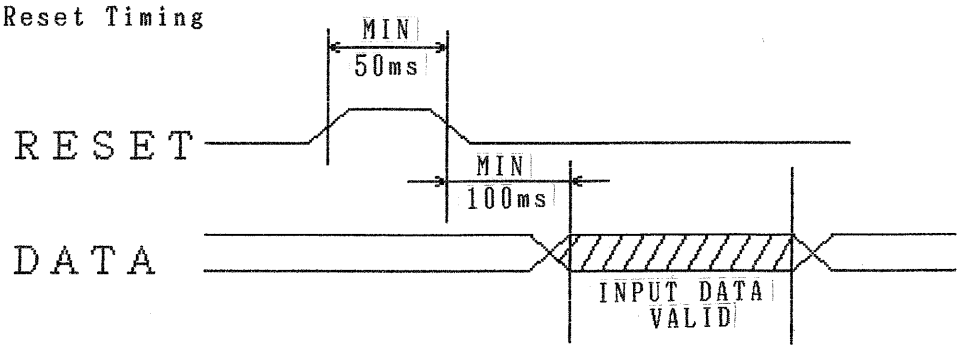
8.0 Interface Example



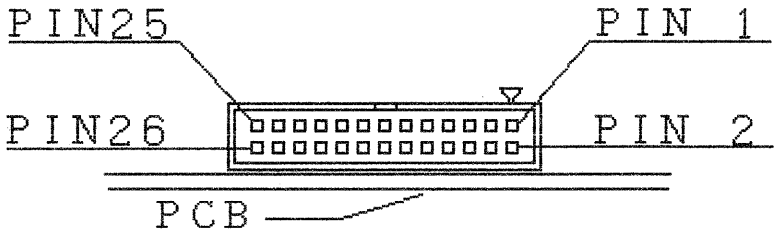
9.0 Data Write / Read Timing



10.0 Reset Timing



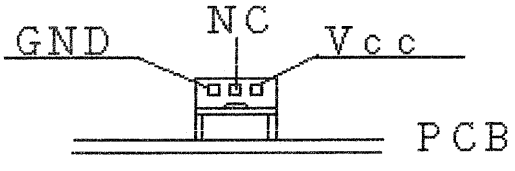
11.0 Connector Pin assignment
11.1 Data Connector



No.	Signal
1	D 7
3	D 6
5	D 5
7	D 4
9	D 3
11	D 2
13	D 1
15	D 0
17	$\overline{WR}$
19	A 0
21	$\overline{RD}$
23	$\overline{CS}$
25	T 0

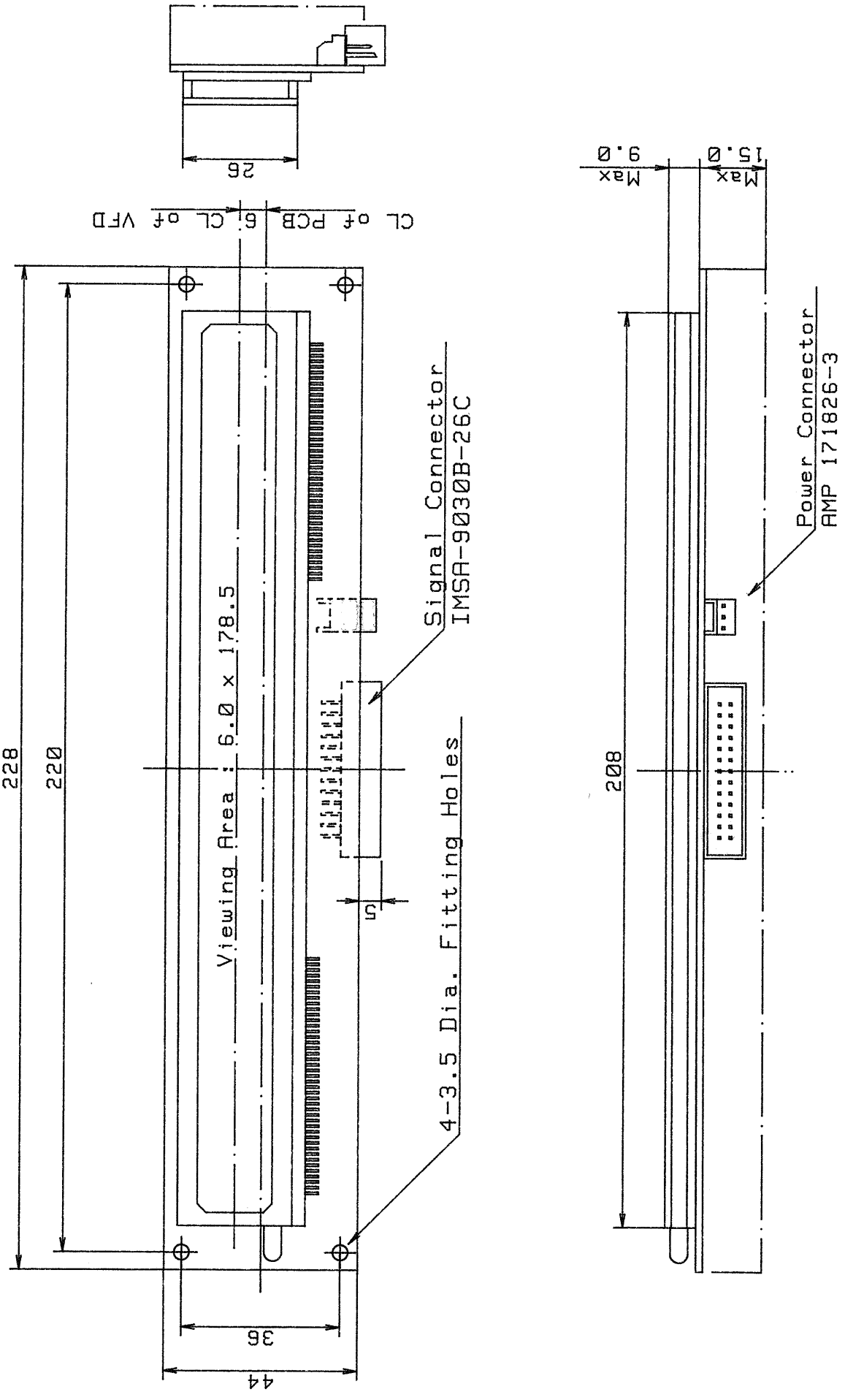
No.	Signal
2	GND
4	GND
6	GND
8	GND
10	GND
12	GND
14	GND
16	GND
18	GND
20	RESET
22	GND
24	GND
26	GND

11.2 Power connector



12.0 Outline dimension

CU406SCPB-T21A OUTLINE DIMENSION



IMPORTANT PRECAUTIONS

*All VFD Module 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 ℃/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 connect or disconnect 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.

*Stresses 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 are depended 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 modules, is required.)

*Data cable length between module and host system is recommended within 500mm to free from a mis-operation caused by noise.

*Do not place the module on the conductive plate just after 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.