

Noritake **itron**

VACUUM FLUORESCENT DISPLAY
MODULE
SPECIFICATION

MODEL : CU20045SCPB-T31A

SPECIFICATION NO.: DS-817-0000-02

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This specification is subject to change without prior notice.

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(4 x 20) VFD, refresh memory, character generator, control circuit, DC/DC converter and all necessary control logics. Interface level is CMOS compatible and the module can be connected to the CPU bus of host directly

1.3 Drawing · See attached drawings

2. Absolute Maximum Ratings

Parameter	Symbol	Min	Typ.	Max.	Unit	Condition
Logic Input Voltage	V_I	0	—	$V_{CC}+0.3$	VDC	$V_I < V_{CC}+0.2$
Power Supply Voltage	V_{CC}	0	—	6.5	VDC	—

3. Electrical Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Logic Input Voltage	"H"	$0.8V_{CC}$	-	V_{CC}	VDC	$V_{CC}=5.0V$ $T_A=25\text{degrees}$
	"L"	0	-	$0.3V_{CC}$		
Power Supply Voltage	V_{CC}	4.75	5.0	5.25	VDC	-

4. Electrical Characteristics

Measuring Conditions : T_A (Ambient temperature)=25degrees, $V_{CC}=5.0V$

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Logic Output Voltage	"H"	$V_{CC}-1.5$	-	-	VDC	$I_{OH}=-5mA$
	"L"	-	-	1.5	VDC	$I_{OL}=5mA$
Power Supply Current 1	I_{CC1}	-	310	380	mADC	Display ON
Power Supply Current 2	I_{CC2}	-	280	340	mADC	Display OFF

Note : I_{CC1} shows the current at all dots in the screen are lighted
 Slow start power supply may cause erroneous operation. The rise time of V_{CC} should not exceed 100 ms.
 I_{CC} might be anticipated twice as usual at power on rush

5. Optical Specifications

- Number of characters : 80(4 lines x 20 chars)
- Matrix format : 5 x 7 dot
- Display area : 90.4 x 26.0 mm (X x Y)
- Character size : 3.0 x 5.0 mm (X x Y)
- Character pitch : 4.6 x 7.0 mm (X x Y)
- Dot size : 0.4 x 0.5 mm (X x Y)
- Dot pitch : 0.65 x 0.75 mm (X x Y)
- Luminance : 350 cd/m² (102fL) Min.
- Color of illumination : Green(Blue-green)

6. Environmental Specifications

- Operating temperature : -10 to +65 degrees
- Storage temperature : -40 to +85 degrees
- Operating humidity : 20 to 80 % RH (No Condensation)
- Vibration(No operating) : 10 to 55 Hz, all amplitude 1mm, X,Y,Z 3direction
30 minutes
- Shock(No operating) : 100G, 9ms, X Y Z 3direction

7. Functional Descriptions

This module provides the functions of 8 bit parallel and serial data write
 Each control data and character fonts are shown in Character Table 0 and Character Table 1
 All data write should be done during BUSY line is low.

CS	WR	Function	Bus direction
0	↑	Data write	Module ← Host
1	X	No operation	Module X Host

↑: Rising edge of pulse X: Do not care

7.1 Character data write

Character font is displayed on the screen, and HT is executed (see para. 7.2.2 HT)

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.

At the top left end, the cursor doesn't move

At the left end on the other line, the cursor motion depends upon DC1, DC2 and DC3 mode

DC1 : The cursor moves to the right end of one upper line.

DC2 : The cursor moves to the right end of one upper line.

DC3 : The cursor doesn't move.

7.2.2 HT : Horizontal Tab (09 Hex)

The cursor moves one character to the right.

At the right end, the cursor motion depends upon DC1, DC2 and DC3 mode.

DC1 : The cursor moves to the lower left end.

DC2 : The cursor moves to the lower left end.

DC3 : The cursor overflow. Furthermore, if HT is inputted continuously, all displayed characters on the cursor line are scrolled to the left one character, and the blank is appeared at the right end of cursor line.

The other displayed characters on the other line are not changed.

At the bottom right end, the cursor motion depends upon DC1, DC2 and DC3 mode.

DC1 : The cursor moves to the top left end.

DC2 : All displayed characters are scrolled up one line.

The cursor moves to the bottom left end and all written characters in the top line is disappeared. The bottom line is cleared.

DC3 : The cursor overflow. Furthermore, if HT is inputted continuously, all displayed characters on the cursor line are scrolled to the left one character, and the blank is appeared at the right end of cursor line.

The other displayed characters on the other line are not changed.

7.2.3 LF : Line Feed (0A Hex)

The cursor moves to the same column on the lower line except DC3 mode.

At the DC3 mode, All displayed characters and cursor position are not changed in any line.

At the bottom line, it is depends upon DC1 or DC2 mode.

DC1 : The cursor moves to the same column on the top line.

DC2 : All displayed characters are scrolled up one line.

The cursor keeps the same column on the bottom line , and the bottom line is cleared.

7.2.4 FF : Form Feed (0C Hex)

The cursor moves to the top left end.

7.2.5 CR : Carriage Return (0D Hex)

The cursor moves to the left end on the same line.

7.2.6 CLR: Clear (0E Hex)

All displayed characters are cleared. The cursor doesn't move.

7.2.7 CAN: Cancel (0F Hex)

All displayed character on the cursor line are cleared. The other displayed characters on the other line are not changed. The cursor doesn't move.

7.2.8 DC1 : Device Control 1 (11 Hex) ... Character over write mode

DC2 : Device Control 2 (12 Hex) ... Scroll up mode

DC3 : Device Control 2 (13 Hex) ... Horizontal Scroll mode

*** Note : Do not use DC3 mode with Flicker less mode.**

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

7.2.9 DC4 : Device Control 4 (14 Hex) ... Cursor is turned to invisible

DC5 : Device Control 5 (15 Hex) ... Cursor is displayed as a blinking all dot character.

DC6 : Device Control 6 (16 Hex) ... Cursor is turned to invisible

DC7 : Device Control 7 (17 Hex) ... Cursor is turned to invisible.

Above four codes control the cursor rendition. DC4 is default mode. The mode is maintained until other mode is selected. The blinking speed can be varied by ESC sequence. (see para. 7.2.11 ESC)

7.2.10 CT0 : Character Table 0 (18 Hex) ... International character font

CT1 : Character Table 1 (19 Hex) ... KATAKANA character font

Above two codes select Character Table. Just after power on, CT0 is selected (Default Mode). Any characters from those 2 tables can be displayed on the screen by the bank selection.

EUR: Euro Currency mark (1AH) ... Euro Currency mark is stored instead of Blank in character code location AD Hex of CT0. This is replaced to Blank if CT0 is selected again, and it affects displayed character of AD Hex.

7.2.11 ESC : Escape (1B Hex)

The character or data strings succeeding of ESC code control the various functions such as user definable font, cursor addressing, screen luminance control, selection of data writing mode, blink speed control and initialize.

(1) User Definable Font (UDF)

Users desired fonts can be defined by software. The fonts will be memorized in RAM of the CPU.

Syntax : ESC (1B Hex) + "C" (43 Hex) + CHR + PT1 + PT2 + PT3 + PT4 + PT5

Any 5x7 dot patterns consisted of data from PT1 thru PT5 can be stored in character code location specified by CHR.

Maximum number of UDF are 16 characters at once. Storing more than 16 will kill the oldest font. However, within the 16 character codes where already defined by UDF, the over-write latest font replaces the former font.

1st byte : ESC(1B Hex)
 2nd byte : "C"(43 Hex)
 3rd 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 therefore, the overlap to the ESC code may not avail further UDF.

4th to 8th byte : PT 1 through PT5

Specify ON or OFF of 36 dot position (5x7 dot + 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)
4th byte	P8	P7	P6	P5	P4	P3	P2	P1
5th byte	P16	P15	P14	P13	P12	P11	P10	P9
6th byte	P24	P23	P22	P21	P20	P19	P18	P17
7th byte	P32	P31	P30	P29	P28	P27	P26	P25
8th byte	*	*	*	*	*	P35	P34	P33

* : don't care

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

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.

	b7	b6	b5	b4	b3	b2	b1	b0	Data (Hex)
4th byte	1	0	0	0	0	1	0	0	84
5th byte	0	0	0	1	0	0	0	0	10
6th byte	0	0	0	0	0	0	1	0	02
7th byte	0	0	0	0	0	0	0	0	00
8th byte	0	0	0	0	0	0	0	1	01

Then Syntax should be written · 1B + 43 + A0 + 84 + 10 + 02 + 00 + 01 (Hex)

(2) Cursor Moving

The cursor can be moved to any position of the screen by following ESC sequence.

Syntax · ESC (1B Hex) + "H" (48 Hex) + 1 Byte data

Column \ Line	Left end	2nd	3rd	-----	Right end
Top	00	01	02	-----	13
2nd	14	15	16	-----	27
3rd	28	29	2A	-----	3B
Bottom	3C	3D	3E	-----	4F

Data = 50 Hex to FF Hex : The cursor doesn't move.

(3) Luminance Control

The screen luminance can be varied by following ESC sequence
Just after power on, the screen luminance is set to 100%.

Syntax · ESC (1B Hex) + "L" (4C Hex) + 1 Byte data

Data = 00 Hex to 3F Hex : approx. 30%
 40 Hex to 7F Hex : approx. 50%
 80 Hex to BF Hex : approx. 75%
 C0 Hex to FF Hex : 100%

(4) Selection of Writing Mode

Flicker less Mode can be selected by following ESC sequence.

Syntax : ESC (1B Hex) + "S" (53 Hex) ... Flicker less Mode

Within Flicker less Mode, although BUSY might become longer, flicker less-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 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 ·

When serial data write with high speed baud rate at Flickerless Mode, it may have the read error of the data. Busy check within Flickerless Mode or setting to the Quick Write Mode is recommended for serial data write

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

(5) Blink Speed Control

Blinking speed of cursor can be varied by following ESC sequence.

Syntax · ESC (1B Hex) + "T" (54 Hex) + 1 Byte Data

Data = 00	Hex ...	256
FF	Hex ...	255
FE	Hex ...	254
:		
01	Hex ...	1

Period of Blinking = Data Value x Approx.30 mS

At power on default, 20 (14 Hex) is set to data.

(6) Initialize

All displayed characters and all setting factors are cleared by following ESC sequence.

Syntax : ESC (1B Hex) + "I" (49 Hex)

Execution of above sequence, module is reset as just after power on.

7.3 Test Mode

Test Mode is set by keeping SIN (T0) is low for more than 100mS at power on or initialize. During Test Mode, all character fonts are displayed automatically, and no any data are acceptable

7.4 Character and control code table

Following 2 character tables can be selected (see para. 7.2.10)

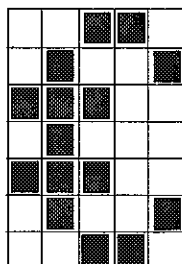
7.4.1 Inter national character font

	D7	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	D6	0	0	0	0	1	1	1	1	0	0	0	1	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
D D D D		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
3 2 1 0																	
0 0 0 0 0			SP	0	0	P	`	P	E	Z		"	À	Á	Â	Ã	ä
0 0 0 1 1	DC1	!	1	A	0	a	9	°	0	i	±	À	Á	Â	Ã	ä	å
0 0 1 0 2	DC2	"	2	E	R	b	r	ƒ	≡	€	2	À	Á	Â	Ã	ä	å
0 0 1 1 3	DC3	#	3	C	S	c	s	l	x	E	3	À	Á	Â	Ã	ä	å
0 1 0 0 4	DC4	\$	4	D	T	d	t	L	÷	0	'	À	Á	Â	Ã	ä	å
0 1 0 1 5	DC5	%	5	E	U	e	u	œ	0	¥	µ	À	Á	Â	Ã	ä	å
0 1 1 0 6	DC6	&	6	F	U	f	u	ŕ	?	!	Ŧ	E	0	æ	ö		
0 1 1 1 7	DC7	'	7	G	U	g	u	ó	E	S	-	Ç	×	ç	÷		
1 0 0 0 8	BS CT0	<	8	H	X	h	x	€	≤	"	,	È	É	Ê	Ë	è	é
1 0 0 1 9	HT CT1	)	9	I	Y	i	y	ñ	≥	0	1	É	0	é	0		
1 0 1 0 A	LF EUR	*	:	J	Z	j	z	0	#	3	€	È	0	è	0		
1 0 1 1 B	ESC	+	:	K	L	k	l	Ç	λ	Γ	€	3	È	0	è	0	
1 1 0 0 C	FF	:	<	L	\	l	!	π	0	Ŧ	Ŧ	Û	Û	Û	Û	Û	Û
1 1 0 1 D	CR	-	=	M	I	m	)	τ	J		Ŧ	Û	Û	Û	Û	Û	Û
1 1 1 0 E	CLR	.	>	N	^	n	˘	0	0	0	0	Û	Û	Û	Û	Û	Û
1 1 1 1 F	CAN	/	?	0	_	o	¥	0	0	0	0	Û	Û	Û	Û	Û	Û

CFX101

Character Table 0

Note: When EUR(1AH) is selected, Euro Currency mark is stored instead of Blank in character code location AD Hex of CT0 This is replaced to Blank if CT0 is selected again, and it affect displayed character of AD Hex.



7.4.2 KATAKANA character font

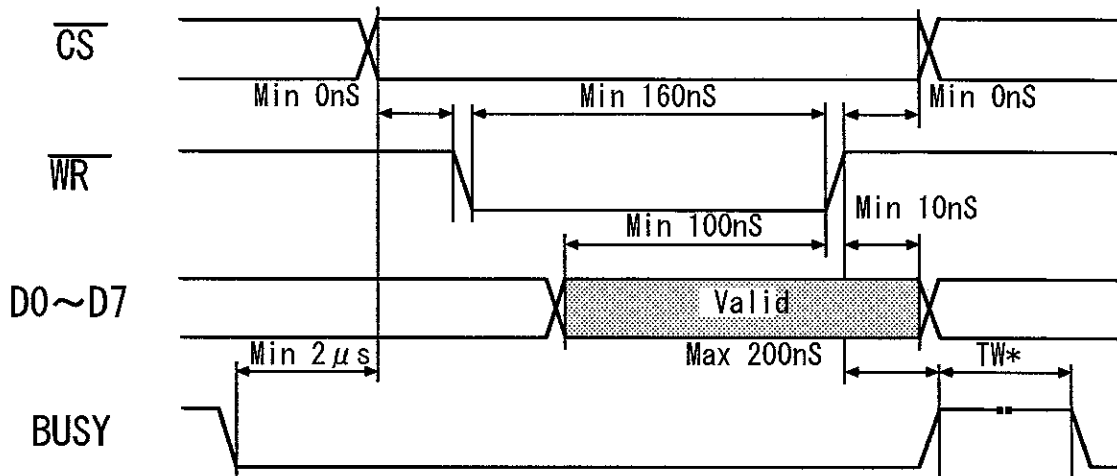
	D7	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	D6	0	0	0	0	1	1	1	1	0	0	0	1	1	1	1	1
	D5	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
	D4	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
D D D D																	
3 2 1 0																	
0 0 0 0 0																	
0 0 0 1 1	DC1	!	1	A	Q	a	q	Г	3	„	7	7	4	月			
0 0 1 0 2	DC2	"	2	B	R	b	r	Q	0	Г	4	ウ	×	火			
0 0 1 1 3	DC3	#	3	C	S	c	s	Ж	9	」	ウ	テ	モ	木			
0 1 0 0 4	DC4	\$	4	D	T	d	t	3	0	\	エ	ト	ホ	ホ			
0 1 0 1 5	DC5	%	5	E	U	e	u	M	0	.	オ	ヲ	ニ	金			
0 1 1 0 6	DC6	&	6	F	V	f	v	0	0	フ	カ	ニ	ヨ	上			
0 1 1 1 7	DC7	*	7	G	W	g	w	0	0	フ	キ	又	ウ	年			
1 0 0 0 8	BS CT0	<	8	H	X	h	x	П	7	4	ウ	ホ	リ	金			
1 0 0 1 9	HT CT1	)	9	I	Y	i	y	Б	ホ	ウ	リ	ル	年	テ			
1 0 1 0 A	LF EUR	* :	J	Z	j	z	0	*	エ	コ	ン	レ	セ	↓			
1 0 1 1 B	ESC	+ :	K	C	k	c	U	*	オ	ウ	ヒ	ロ	〜	÷			
1 1 0 0 C	FF	,	<	L	\	1	1	4	||	ホ	シ	フ	フ	#	↑		
1 1 0 1 D	CR	-	=	M	I	m	>	||	||	ユ	ズ	ハ	ン	0	←		
1 1 1 0 E	CLR	.	>	N	^	n	˘	||	キ	ヨ	セ	ホ	˘	←	⊗		
1 1 1 1 F	CAN	/	?	0	_	o	#	b	ス	ウ	リ	マ	˘	◊	♪		

CFX102

Character Table 1

8. Timing

8.1 Parallel interface Timing



TW* : see para 9. BUSY TIME

8.2 Serial Interface Timing

Serial data write, asynchronous-8bit CMOS level is also acceptable.

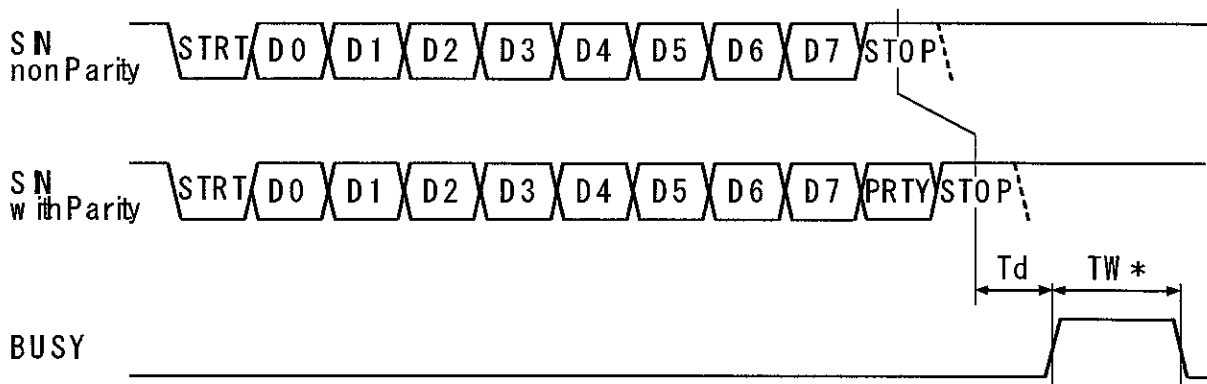
Following baud rates can be selected by combination of the Jumper wires.

(see para. 10 Jumper wires)

600, 1200, 2400, 4800, 9600, 19200 BPS

Besides, parity bit-even, odd and non parity can be selected by 2 jumper wires.

(see para 10 Jumper wires)



STRT : Start Bit

PRTY : Parity Bit

D0 : LSB

STOP : Stop Bit

:

D7 : MSB

Td : 10uS (Typ) at Quick Write Mode

0uS (Min) ~ 900uS (Max) at Flicker less Mode

TW* : see para. 9. BUSY Time

9. BUSY Time

Input data execution time (TW*) at Quick Write Mode are shown as follows.

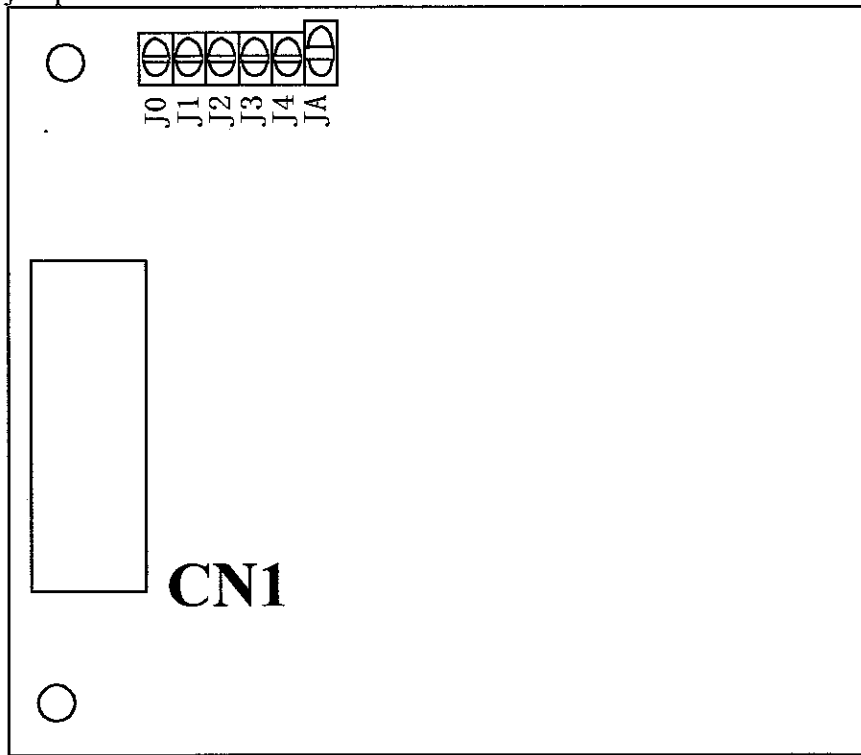
Data		Execution time (TW)			Data Writing Mode
		DC1 Mode	DC2 Mode	DC3 Mode	
Character Data, HT, LF		200 uS (MAX)	1000 uS (MAX.) at scrolling	300 uS (MAX.) at scrolling	Quick Write Mode
BS,FF,CR,CT0,CT1,EUR DC1,DC2,DC3,DC4,DC5,DC6,DC7		200 uS (MAX)			
CLR		900 uS (MAX.)			
CAN		300 uS (MAX.)			
ESC	1st byte	200 uS (MAX.)			
	2nd byte	"C"	200 uS (MAX.)		
		"I"	1400 uS (MAX.)		
		Expect"C", "I"	200 uS (MAX.)		
3rd byte ~		200 uS (MAX.)			

Above execution time are only talking about Quick Write Mode as mentioned.

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

10. Jumper wires

Position of jumper wire



PCB Parts Side

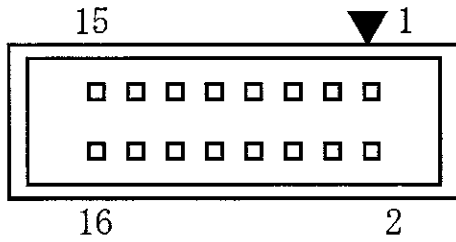
Jumper Function Table

JA	J4	J3	J2	J1	J0	Function	
X	X	X	1	1	1	Baud rate	19200 BPS
X	X	X	1	1	0		9600 BPS
X	X	X	1	0	1		4800 BPS
X	X	X	1	0	0		2400 BPS
X	X	X	0	1	1		1200 BPS
X	X	X	0	1	0		600 BPS
X	X	X	0	0	1		600BPS
X	X	X	0	0	0		600BPS
X	1	1	X	X	X	Parity selection	Even Parity
X	1	0	X	X	X		Odd Parity
X	0	X	X	X	X		Non Parity
0	X	X	X	X	X	Character fonts selection	International Font(CT0)
1	X	X	X	X	X		JIS Font(CT1)
0	1	1	1	1	1	Setting at Factory	

0 : short 1 : open X : Don't care

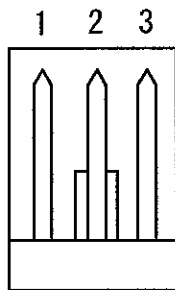
11. Connector Pin assignment

11.1 16pin Connector



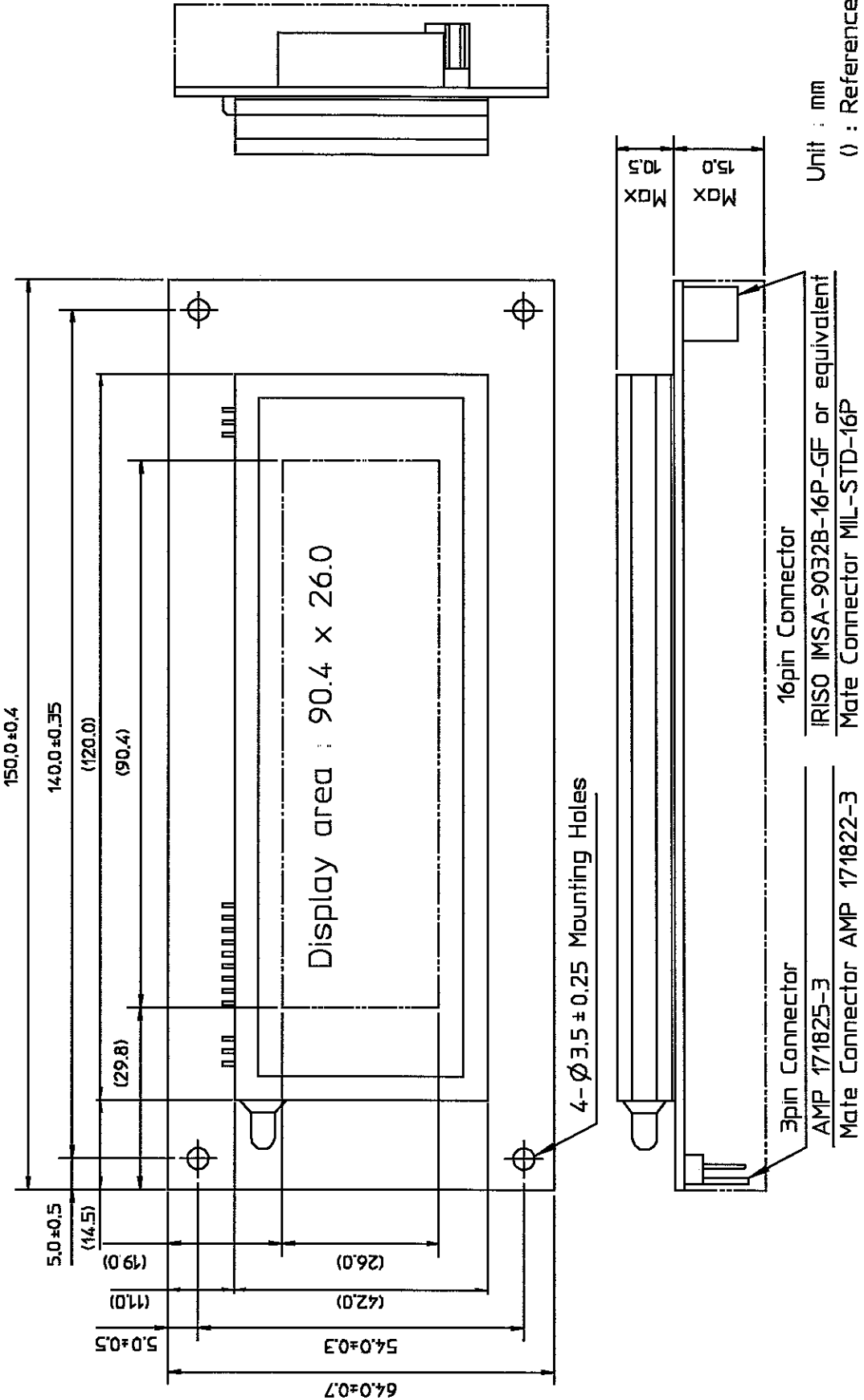
No.	Terminal	No.	Terminal
1	D7	2	D6
3	D5	4	D4
5	D3	6	D2
7	D1	8	D0
9	$\overline{\text{WR}}$	10	$\overline{\text{CS}}$
11	SIN/TO	12	BUSY
13	GND	14	GND
15	Vcc	16	Vcc

11.2 3pin Connector



No.	Terminal
1	Vcc
2	SIN/TO
3	GND

12. 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 100G, thermal shock greater than 10degrees /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 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 miss-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 avoid 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.