Noritake itron

VACUUM FLUORESCENT DISPLAY

MODULE

SPECIFICATION

MODEL : CU209SCPB-T22A

CUSTOMER : Baxter Healthcare

SPECIFICATION NO. : DS-507-0000-00

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REVISION :

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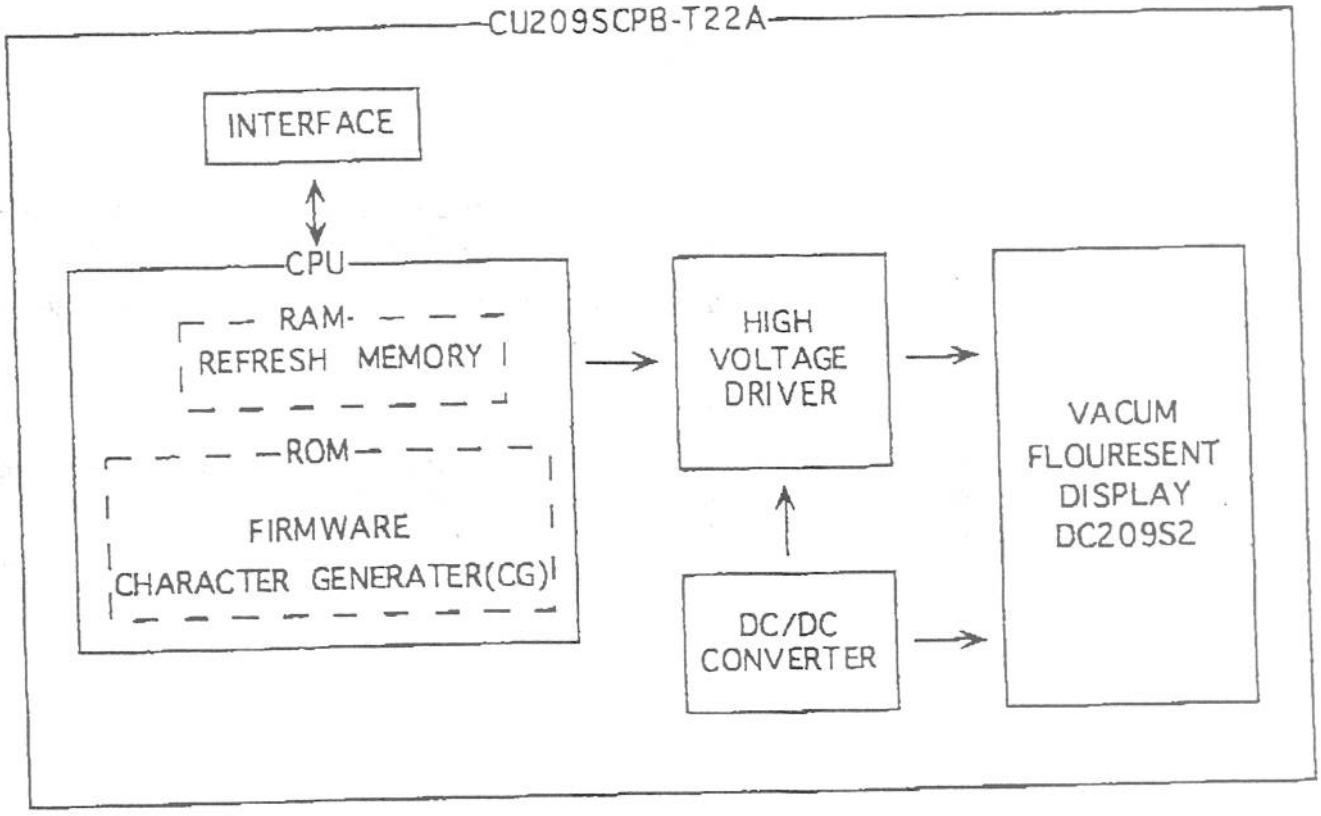
1.0 General Description

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

1.2 Construction : Single board display module consists of 20 character(1 x 20) 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 12.0 Outline Dimension.

2.0 Absolute Maximum Ratings.

Power Supply Voltage --------- Vcc : +7.0Vdc
Logic Input Voltage --------- Vin : Vcc+0.3

3.0 Electrical Ratings.

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	Vcc	4.75	5.0	5.25	Vdc

4.0 Electrical Characteristics.

Parameter		Symbol	Min.	Typ.	Max.	Unit	Condition
Input Voltage	"H"	V_{IH}	2.0	—	Vcc	V_{DC}	
	"L"	V_{IL}	0	—	0.8		
Output Voltage	"H"	V_{OH}	4.0	—	Vcc	V_{DC}	I_{OH}=1.0mA
	"L"	V_{OL}	0	—	1.0		I_{OL}=1.0mA
Reset	"H"	V_{IH}(R)	3.0	—	—	V_{DC}	Vcc=5.0V
	"L"	V_{IL}(R)	—	—	0.5		
Supply Current		Icc	—	500	650	mA_{DC}	Vcc=5.0V

Slow start power supply may cause erroneous operation.
Icc might be anticipated twice as usual at power on rush.

5.0 Optical Specifications.

Number of characters	:	20 (1 line x 20 chrs)
Matrix format	:	5 x 7 dot + Comma, Decimal point, Annunciator
Display area	:	155.2 mm x 12.0 mm (X x Y)
Character size	:	4.8 mm x 8.8 mm (X x Y)
Character pitch	:	7.85 mm
Dot size	:	0.72 mm x 1.0 mm (X x Y)
Dot pitch	:	1.02 mm x 1.3 mm (X x Y)
Luminance	:	350 cd/m² (100fL) MIN.
Color of illumination	:	Blue-green

6.0 Environmental Specifications.

Operating temperature	:	-20 to +70 °C
Storage temperature	:	-40 to +85 °C
Operating humidity	:	20 to 80 % RH
Vibration	:	10 to 55 Hz, 98 m/sec² Max 3 direction, 30 min., each
Shock	:	539 m/sec², 9 msec.

Vibration and shock tests shall be performed under the non-operating condition.

7.0 Functional Descriptions.

This module provides the functions of 8 bit parallel data write and read, command write and serial data write.
Each control data and character fonts are shown in table 1.
They can be written by parallel data write and serial data write.
Once character data is written, the writing position is incremented automatically.
All data and command write should be done during BUSY line is low.
All data read proceeded by ESC or commands should be done after BUSY line is low.
In the parallel data write, interfacing is met to the data bus of i80 series when jumper write JH is open (=as is from factory) and it can be changed to meet to M68 series by shorting of jumper wire JH.
Location of jumper wire JH shows in Para 10.

JH open (i80 series)

$\overline{CS}$	$\overline{RD}$	$\overline{WR}$	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
1	X	X	X	No operation	Module X Host

↑ : Rising edge of pulse X : don't care

JH short (M68 series)

$\overline{CS}$	$\overline{EN}$	R/$\overline{W}$	A0	Function	BUS direction
0	↓	0	0	Character data write	Module ← Host
0	↓	0	1	Command data write	Module ← Host
0	1	1	0	Data read	Module → Host
1	X	X	X	No operation	Module X Host

↓ : Falling edge of pulse X : don't care

Note :
The control lines $\overline{RD}$ and EN or $\overline{WR}$ and R/$\overline{W}$ are coincided in the data connector.

7.1 Character and control code set.

Following 3 character sets can be selected. (See Para. 7.2.9)

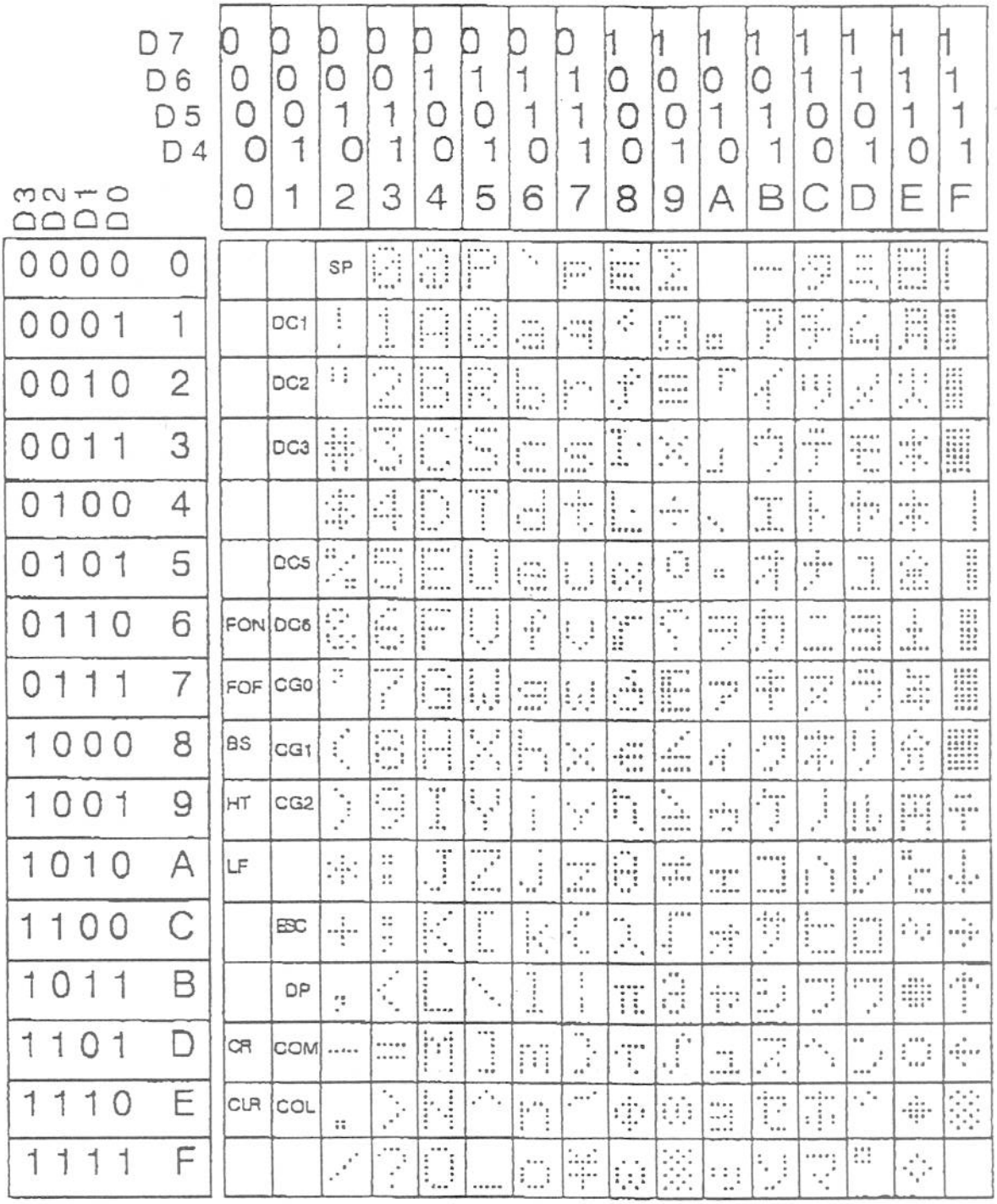
7.1.1 International Font

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	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
0000 0			SP	0	@	P	`	p	[illegible]	Σ		°	À	Ð	à	ð
0001 1		DC1	!	1	A	Q	a	q	[illegible]	Ω	¡	±	Á	Ñ	á	ñ
0010 2		DC2	"	2	B	R	b	r	ƒ	≡	¢	²	Â	Ò	â	ò
0011 3		DC3	#	3	C	S	c	s	ŀ	×	£	³	Ã	Ó	ã	ó
0100 4			$	4	D	T	d	t	Ŀ	÷	¤	´	Ä	Ô	ä	ô
0101 5		DC5	%	5	E	U	e	u	ŉ	°	¥	µ	Å	Õ	å	õ
0110 6	FON	DC6	&	6	F	V	f	v	[illegible]	[illegible]	¦	¶	Æ	Ö	æ	ö
0111 7	FOF	CG0	'	7	G	W	g	w	[illegible]	[illegible]	§	·	Ç	×	ç	÷
1000 8	BS	CG1	(	8	H	X	h	x	[illegible]	≤	¨	¸	È	Ø	è	ø
1001 9	HT	CG2	)	9	I	Y	i	y	ħ	≥	©	¹	É	Ù	é	ù
1010 A	LF		*	:	J	Z	j	z	[illegible]	[illegible]	ª	º	Ê	Ú	ê	ú
1100 C		ESC	+	;	K	[	k	{	[illegible]	[illegible]	«	»	Ë	Û	ë	û
1011 B		DP	,	<	L	\	l	|	[illegible]	[illegible]	¬	¼	Ì	Ü	ì	ü
1101 D	CR	COM	-	=	M	]	m	}	[illegible]	∫		½	Í	Ý	í	ý
1110 E	CLR	COL	.	>	N	^	n	~	[illegible]	[illegible]	®	[illegible]	Î	Þ	î	þ
1111 F			/	?	O	_	o	[illegible]	[illegible]	▒	¯	¿	Ï	ß	ï	ÿ

CFX001

Table 1

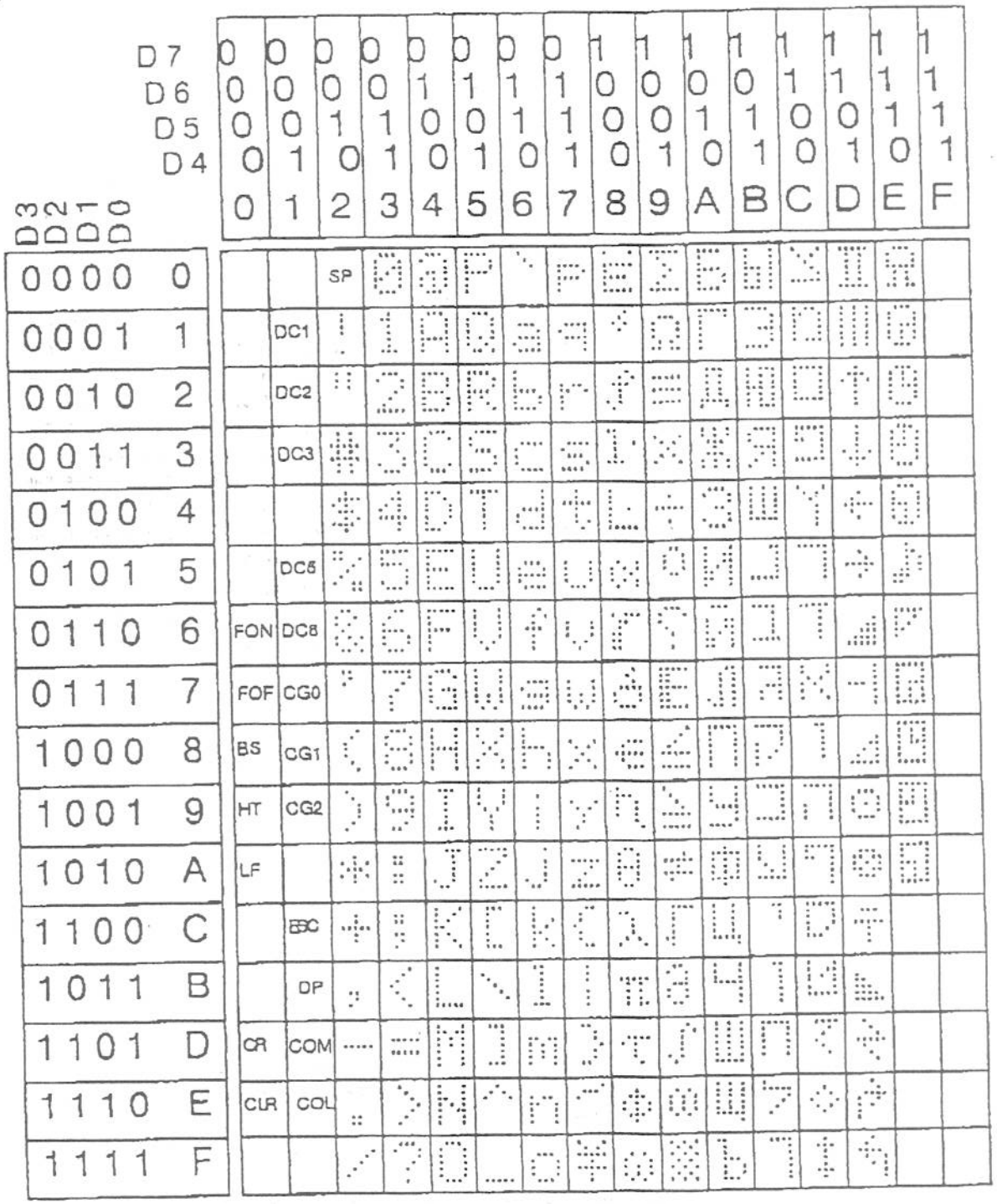
7.1.2 International character and KATAKANA character Font



CFX002

Table 2

7.1.3 International character and Russian character Font



CFX003

Table 3

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 top of left end.

7.2.2 HT : Horizontal Tab (09 Hex).

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

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

7.2.3 LF : Line Feed (0A Hex)

All displayed character is cleared.

7.2.4 CR : Carriage Return (0D Hex)

The writing position moves to the left end.

7.2.5 CLR: Clrear (0E Hex)

All written charactors are cleared.

7.2.6 DC1 : Automatic Carriage Return Mode (11 Hex)

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

DC2 : Over-Write Mode (12 Hex)
When the cursor reaches at the right end, additional data write makes over-write at the right most position.

DC3 : Holizontal Scroll Mode (13 Hex)
When the cursor reaches at the right end, the next data write makes the cursor overflowed, further data write shift all displayed characters to left by one, and those new characters are written at the right most position.

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).

7.2.7 Character Blinking

FON : Start a blinking field (06 Hex)
Start blinking field by sending the code of 06 Hex.
Following characters will blink, alternatively with blank.

FOF : Stop a blinking field (07 Hex)
Stop blinking field by sending the code of 07 Hex.
Following characters will not blink.

The blinking speed can be varied by ESC sequence. (See para. 7.2.11 ESC-6)

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

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

Above three codes control the cursor rendition. DC5 is default mode. The mode is maintained until other mode is selected. Within DC5, the blinking speed can be varied by ESC sequence. (See para. 7.2.11 ESC-6)

7.2.9 CG0 : Character bank 0 (17 Hex) ・・・ International charcter font

CG1 : Character bank 1 (18 Hex) ・・・ International character font and KATAKANA character font

CG2 : Character bank 3 (19 Hex) ・・・ International character font and Russian character font

These data select Character bank. Just after power on, CG0 is selected (Default Mode). The bank selection can be allowed by normal data write in the screen by the bank selection.

7.2.10 Attribution of DP, COM and COL

DP : Decimal Point	(1C Hex)
COM: Comma	(1D Hex)
COL : Semi-colon (DP + COM)	(1E Hex)

Above data attribute to the character code succeeding. Only above data without character code may ignore (defined as a NUL).
Character code without above data shows character only.

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, start and stop of self diagnostic mode, blink speed control, reset and annunciator control.

1.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) + "C"(43 Hex)+chr+PT1+PT2+PT3+PT4+PT5
Any 5 x 7 dot patterns consisted of data form PT1 through PT5 can be stored in the character code location specified by chr.
Maximum number of UDF are 4 characters at once. Storing more than 4 will kill the oldest font. However, within the 4 character codes where already defined by UDF, the over-write-latest font replaces the former font.

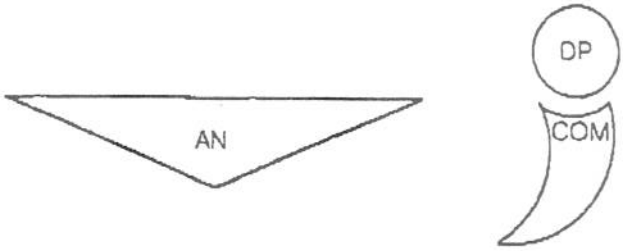
1st Byte : ESC (1B Hex)
2nd Byte : "C" (43 Hex)
3nd Byte : chr (00 Hex to FF Hex)
Specify the character code location from 00 Hex to FF Hex by chr. If chr overlaps the control codes such as BS, HT, etc., the control function will be lost, And therefore, overlap to the ESC code may not avail further UDF.
4th to 8th Byte
: PT1 thru PT5
Specify ON or OFF of 38 dot position (5 x 7 dot + announciator, comma, decimal point).
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	P1	P2	P3	P4	P5	P6	P7	P8
5th Byte	P9	P10	P11	P12	P13	P14	P15	P16
6th Byte	P17	P18	P19	P20	P21	P22	P23	P24
7th Byte	P25	P26	P27	P28	P29	P30	P31	P32
8th Byte	P33	P34	P35	AN	COM	DP	*	*

AN:Annunciator COM: Comma
DP: Decimal point *: do not care

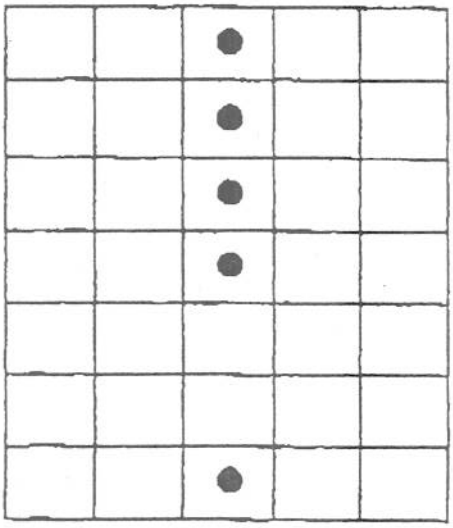
Following is the dot assignment.

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.



Turn on dot number

P 3

P 8

P13

P18

P33

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

	7	6	5	4	3	2	1	0	Hex Data
4th Byte	0	0	1	0	0	0	0	1	21 (PT1)
5th Byte	0	0	0	0	1	0	0	0	08 (PT2)
6th Byte	0	1	0	0	0	0	0	0	40 (PT3)
7th Byte	0	0	0	0	0	0	0	0	00 (PT4)
8th Byte	1	0	0	0	0	0	0	0	80 (PT5)

Then Syntax should be written; 1B + 43 + A0 +21 + 08 + 40 + 00 + 80 (Hex)

2.Cursor Moving

The cursor can be moved any position of the screen by following ESC sequence.
Syntax : ESC (1B HEX) + " H " (48 Hex) + 1 Byte data.

Data = 00 Hex : The left most column
01 Hex : The 2nd column
:
13 Hex : The right most column
14 Hex to FF Hex : NUL

3.Luminance Control

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

Syntax : ESC (1B Hex) + " L " (4C Hex) + 1 Byte Data

Data = 00 Hex to 1F Hex : approx. 21 %
20 Hex to 3F Hex : approx. 25 %
40 Hex to 5F Hex : approx. 31 %
60 Hex to 7F Hex : approx. 38 %
80 Hex to 9F Hex : approx. 47 %
A0 Hex to BF Hex : approx. 61 %
C0 Hex to DF Hex : approx. 77 %
E0 Hex to FF Hex : 100 %

4.Selection of Writing Mode.

Alternative Flickerless Mode and Quick Write Mode can be selected by following ESC sequence.

Syntax :

ESC (1B Hex) + " S " (53 Hex) ・ ・ ・ ・ Flickerless Mode
ESC (1B Hex) + " E " (45 Hex) ・ ・ ・ ・ Quick Write Mode (Default)

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 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 at reset, Quick Write Mode is selected until other mode is set.

5.Self Diagnostic Function

Start or stop of Test Mode and memory check of RAM and ROM can be done by following ESC sequence.

Syntax :

ESC (1B Hex) + " R " (52 Hex) ・ ・ ・ ・ Test Mode will be started.
ESC (1B Hex) + " N " (4E Hex) ・ ・ ・ ・ Test Mode will be stopped.
ESC (1B Hex) + " M " (4D Hex) ・ ・ ・ ・ Memory (RAM and ROM) will be checked and its result be sent to the host thru the data bus as following data format.

bit 2 to 7	:	not assigned, do not care.	
bit 1	:	1 = possess ROM error	0 = no ROM error
bit 0	:	1 = possess RAM error	0 = no RAM error

Within Test Mode, all stored ROM fonts are displayed in the screen one by one automatically. Font displaying speed can be varied by Speed control ESC sequence.
Test Mode also can be started by keeping "Low" signal of "Serial In" at the time of power on or reset.
Not possible to stop, however, by sending of ESC + " N " command.

6.Blink Speed Control

Blinking Speed of cursor and character font displaying speed at self test mode 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 3.5 msec.
At power on default, 128 (80 Hex) is set to the data.

7.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 of power on.

8. Annunciator Control

Annunciator blinking, turning on/off can be done by following ESC sequence.

Syntax :
ESC (1B Hex) + " A " (41 Hex) + 1 Byte Data ・・Annunciator turning on
ESC (1B Hex) + " B " (42 Hex) + 1 Byte Data ・・Annunciator blinking
ESC (1B Hex) + " D " (44 Hex) ・・All annunciator id turned off

Blinking speed is suitable to the cursor (ESC + " T ").

00 Hex ・・・The left most annunciator
01 Hex ・・・The 2nd annunciator
:
13 Hex ・・・ The right most annunciator
14 Hex to FF Hex : NUL

Note : Though the annunciator is not in the character area ordinary, it moves with the display character during DC3 scroll.

7.3 Command Data Write.

All input data is defined as the command when A0 line is " High ". Following commands are provided.

7.3.1 Cursor Moving (00 Hex ~ 13 Hex)

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
:
13 Hex : The right most character position

7.3.2 Positioning Data Read (80 Hex ~ 93 Hex)

The character data can be read by following 1 byte positioning data.

80 Hex : The left most character position
:
93 Hex : The right most character position

7.3.3 Cursor Position Read (F0 Hex)

Cursor Position can be read by sending the command of F0 Hex. 1 byte data of cursor position will be sent back to the host through the data bus.

7.3.4 Data Read at Cursor (F1 Hex)

Data at cursor position can be read by sending the command of F1 Hex. 1byte data of character code will be sent back to the host through the data bus.

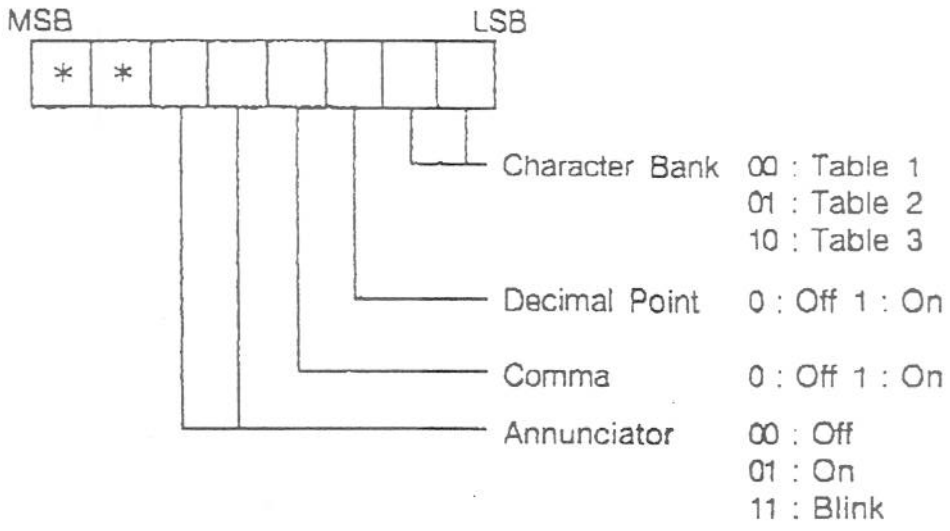
7.3.5 Data Read at Cursor and then Increment (F2 Hex)

Data at cursor position can be read and automatically next character position is addressed by sending the command of F2 Hex. 1 byte data of character code will be sent back to the host through the data bus.

7.3.6 Status Read at Cursor (F3 Hex)

Status of character at cursor position can be read by sending the command of F3 Hex.

Data



7.3.7 Reset (FF Hex)

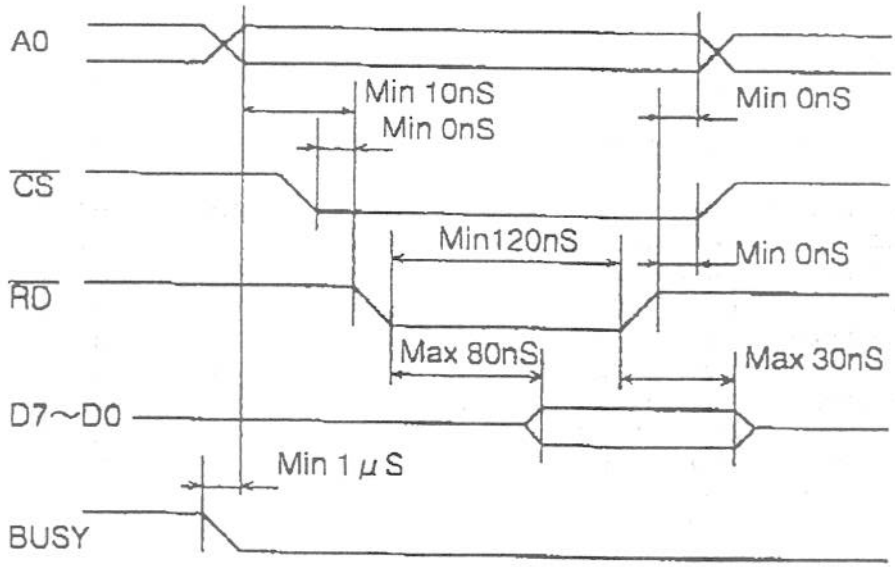
The module can be reset by sending the command of FF Hex. All displayed characters and all set factors are cleared. This is the same status just after the power on.

8.0 Timing

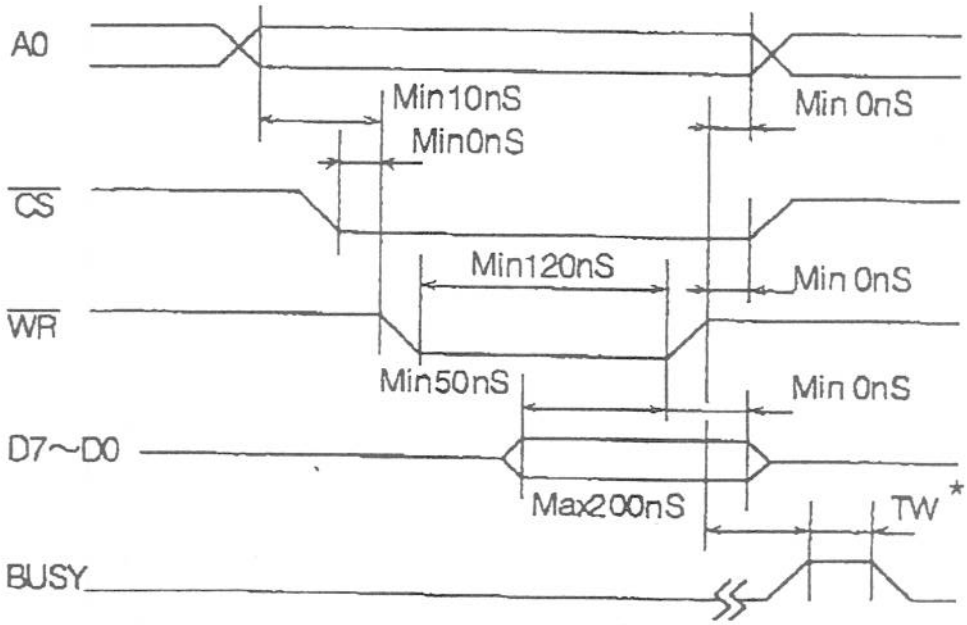
8.1 Parallel Interface Timing.

Following Timing Charts show Data Write and Data Read timing of CPU type i80 series and M68 series. Address and data bus can be directly connected to i80 series or M68 series which might be characterized by a jumper wire on a board.
(See Para 10.0 Jumper Wires)
i80 series is selected from factory.

i80 CPU Data read timing

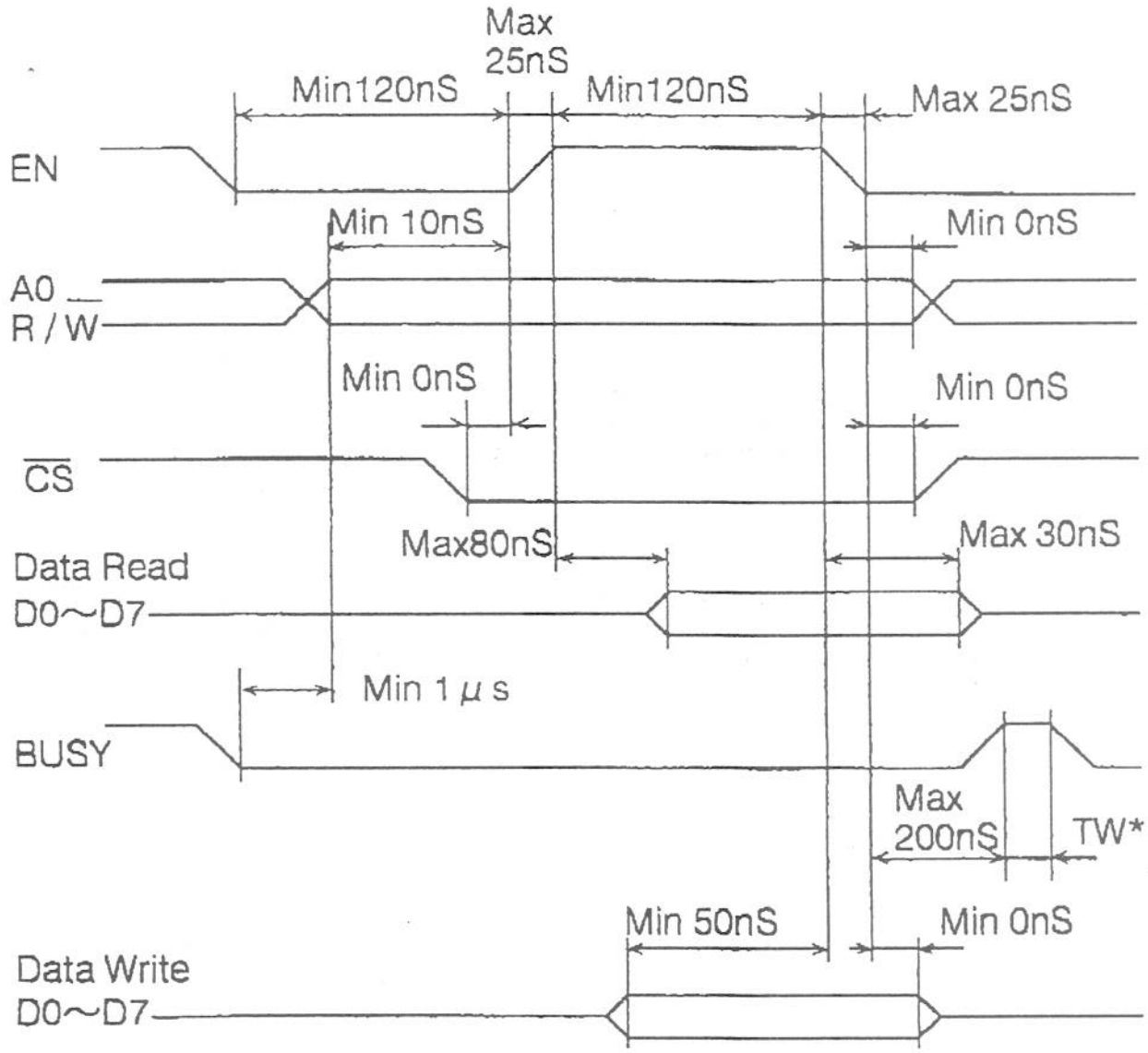


i80 CPU Data write timing



TW* : See Para 9.0 BUSY TIME

M68 CPU Data read / write timing



TW* : See Para 9.0 BUSY TIME

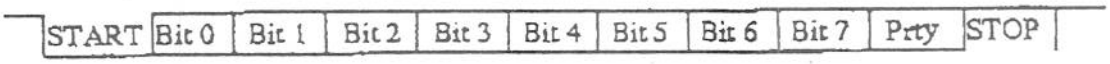
8.2 Serial Interface Timing.

Serial data write, asynchronous-8bit TTL level is also acceptable through a center pin of the power connector. Following baud rates can be selected by combination of the Jumper wires.

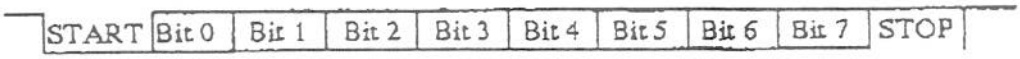
600, 1200, 2400, 4800, 9600, 19200 BPS

Besides, parity bit - even, odd and non parity - able to selected by 2 jumper wires.
(See Para 10.0 Jumper Wires)

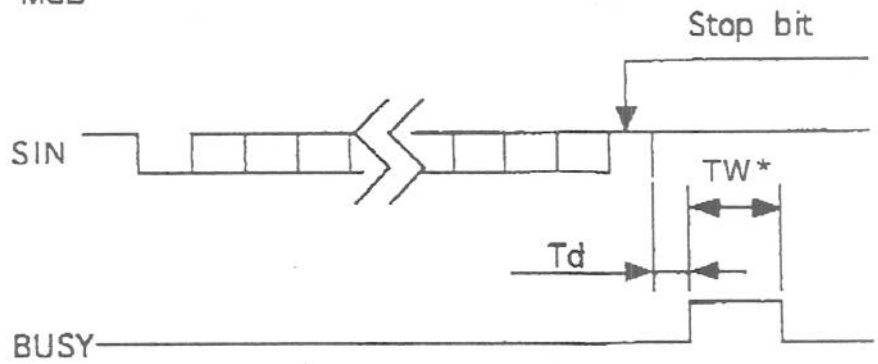
Serial data form with even or odd parity



Serial data form with non-parity

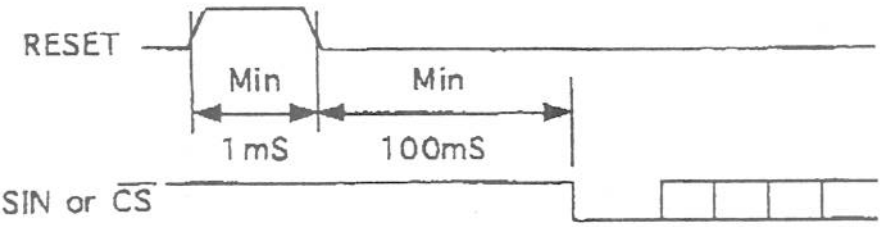


START : Start Bit Prty : Parity Bit
Bit 0 : LSB STOP : Stop Bit
:
:
Bit 7 : MSB



Td : 30 μS (Typ .) at Quick Write Mode
30 μS (Min .) ~ 500 μS (Max.) at Flickerless Mode
TW* : See Para 9.0 BUSY TIME

8.3 Reset Timing



Above chart shows the reset timing. Reset pulse (active high) should be longer than 1msec.. It is required at least 100 msec. to accept the data after reset pulse fall down.

9.0 BUSY TIME

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

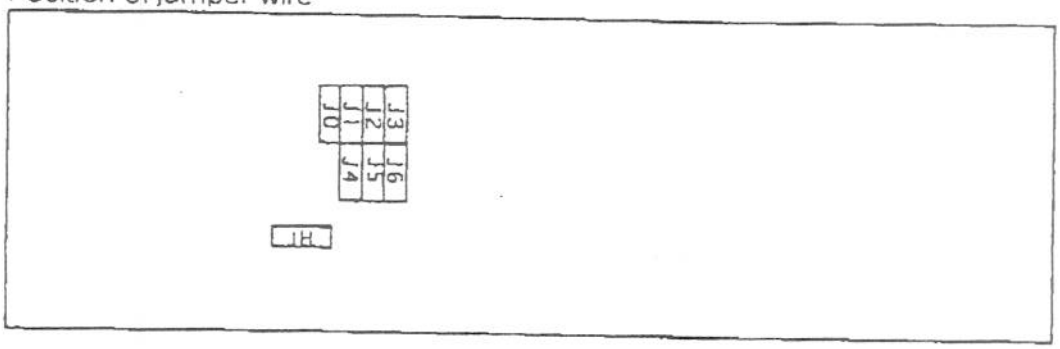
DATA WRITE			Execution time (TW*)	
			Quick write mode	Flickerless mode
Character data write HT			200 μ S(Max)	750 μ S(Max)
LF, CLR			300 μ S(Max)	
BS,CR, FON, FOF DC1, DC2, DC3, DC5, DC6 CG0, CG1, CG2 DP, COM, COL			300 μ S(Max)	
ESC	1st byte		180 μ S(Max)	
	2nd byte	" C "	180 μ S(Max)	
		" I "	1.2 mS(Max)	2 mS(Max)
		" M "	60 mS(Max)	61 mS(Max)
		Except " C ", " I " and " M "	180 μ S(Max)	750 μ S(Max)
	3rd byte ~		150 μ S(Max)	

COMMAND WRITE	Execution time (TW*)	
00 Hex ~ 27 Hex	150 μ S(Max)	750 μ S(Max)
80 Hex ~ A7 Hex		
F0 Hex ~ F3 Hex		
FF Hex	1.2 mS(Max)	2 mS(Max)

Above execution times are only talking about " Quick Data Write " as mentioned.
Within Flickerless Mode, Approximately 2 to 15 times of above table should be considered.
Operating with Flickerless mode, there fore, always watching of BUSY line is recommended.

10.0 Jumper wires

Position of jumper wire



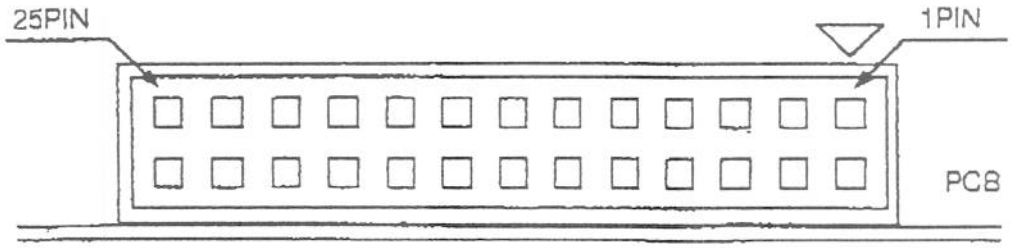
Jumper Function Table

Jumper	Function	Setting @ Factory
J6 J5 J4	BPS Select of serial data (J6, J5, J4) = (0, 0, 0) : 600 BPS (1, 0, 0) : 2400 BPS (0, 0, 1) : 600 BPS (1, 0, 1) : 4800 BPS (0, 1, 0) : 600 BPS (1, 1, 0) : 9600 BPS (0, 1, 1) : 1200 BPS (1, 1, 1) :19.2K BPS	All 1
J3 J2	Parity of serial data (J3, J2) = (0, X) : Non parity (1, 0) : Odd parity (1, 1) : Even parity	All 1
J1	Do not tocch.	
J0	Do not touch.	
JH	Select Parallel interface type 1: i80 type 0: M68 type	1

0 : Short 1 : Open X : Don't care

11.0 Connector Pin assignment

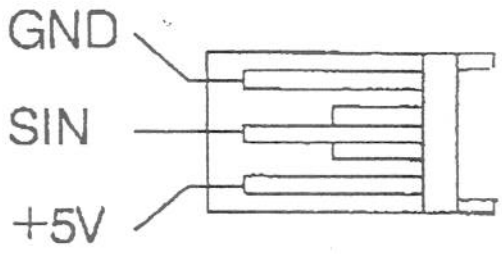
11.1 Data Connector



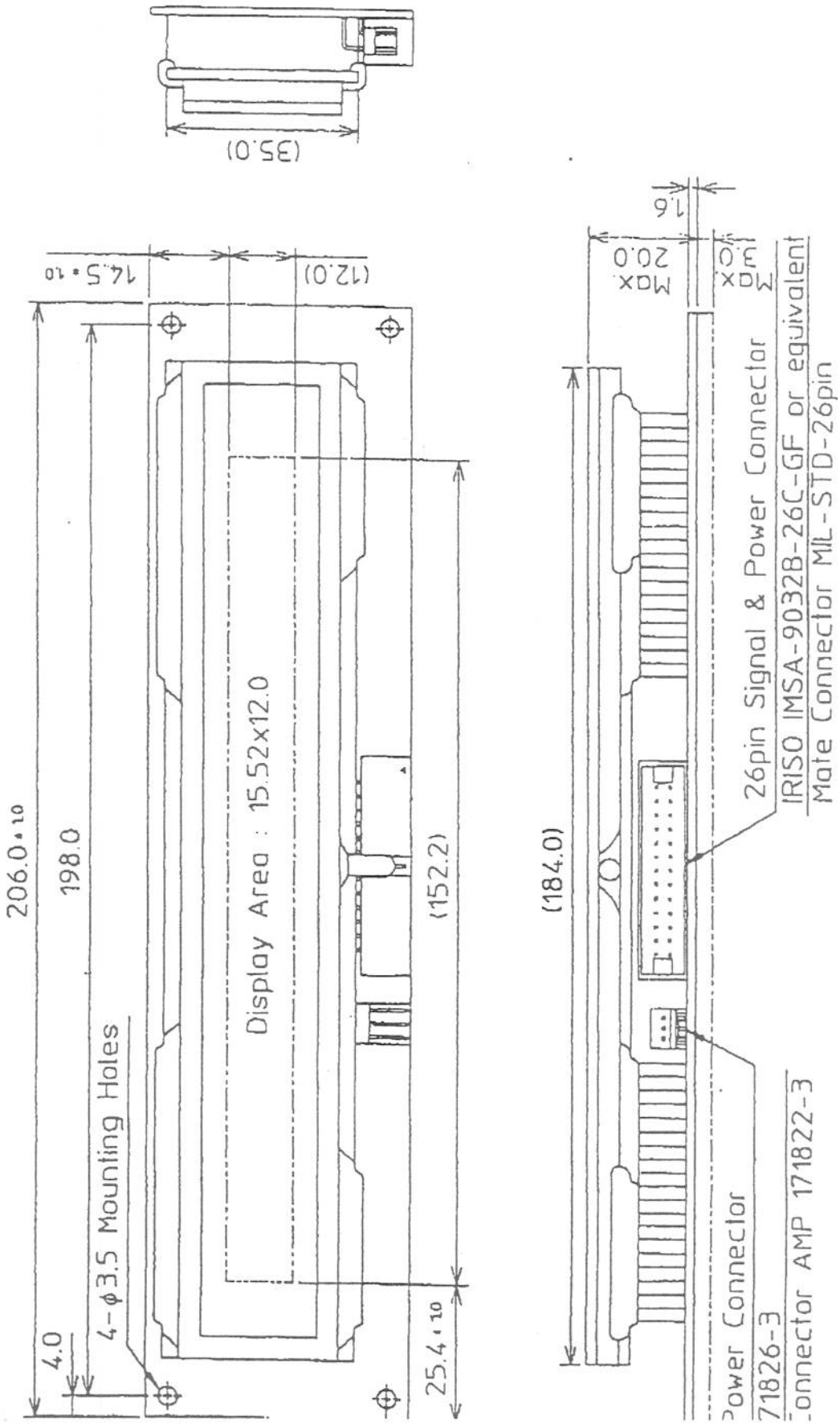
No.	Signal
1	D7
3	D6
5	D5
7	D4
9	D3
11	D2
13	D1
15	D0
17	$\overline{WR}$ (R/$\overline{W}$)
19	A0
21	$\overline{RD}$ (EN)
23	$\overline{CS}$
25	BUSY

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

11.2 Power Connector



12.0 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 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 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.