Noritake itron

VACUUM FLUORESCENT DISPLAY MODULE SPECIFICATION

MODEL : CU40046SCPB-T20A

SPECIFICATION NO. : DS-502-0000-01

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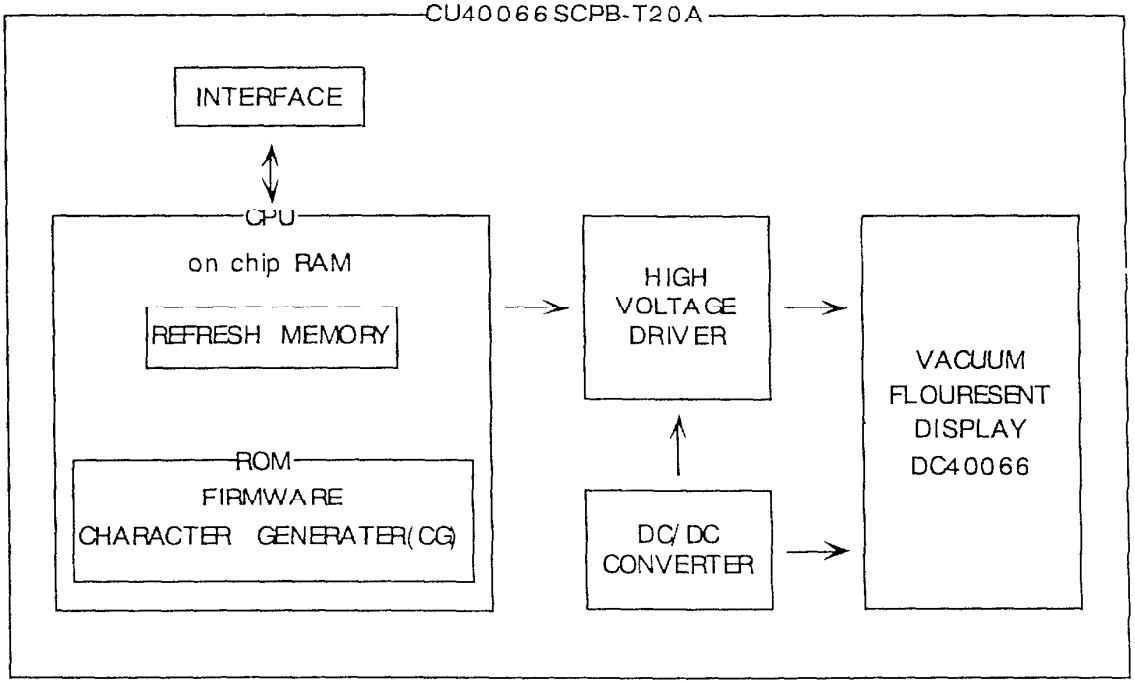
1.0 General Description

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

1.2 Construction : Single board display module consists of 160 character(4 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 12.0 Outline Dimension.

2.0 Absolute Maximum Ratings.

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

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 [D0-D7,A0 / WR,RD,CS / SIN	"H"	V_{IDH}	2.0	—	Vcc	V_{DC}	
	"L"	V_{IDL}	0	—	0.8	V_{DC}	
Input Voltage [RESET / BLK	"H"	V_{IRH}	2.0	—	Vcc	V_{DC}	
	"L"	V_{IRL}	0	—	0.8	V_{DC}	
Output Voltage DO-D7	"H"	V_{ODH}	Vcc-1.0	—	—	V_{DC}	I_{ODH}= -5mA
	"L"	V_{ODL}	—	—	0.45		I_{ODL}= 2mA
Output Voltage BUSY	"H"	V_{OBH}	4.13	—	—	V_{DC}	I_{OBH}= -4mA
	"L"	V_{OBH}	—	—	0.5		I_{OBL}= 4mA
Supply Current		Icc	—	1.3	1.5	A_{DC}	Vcc=5.0V Test Mode (at 25℃)
			—	1.4	1.6		Vcc=5.0V All Dots turn on (at 25℃)

Slow start power supply may cause erroneous operation.
Icc might be anticipated twice as usual at power on rush, and 1.3 time at -40℃.

5.0 Optical Specifications.

Number of characters	:	160 (4 line x 40 chrs)
Matrix format	:	5 x 7 dot Matrix + Under line
Display area	:	188.75 mm x 30.3 mm (X x Y)
Character size	:	3.5 mm x 5.0 mm (X x Y)
Character pitch	:	X 4.75mm, Y 8.0 mm
Dot size	:	0.45 mm x 0.5 mm (X x Y)
Dot pitch	:	X 0.75 mm, Y 0.75 mm
Luminance	:	350 cd/m² (100fL) MIN.
Color of illumination	:	Blue-green

6.0 Environmental Specifications.

Operating temperature	:	-40 to +85 ℃
Storage temperature	:	-50 to +85 ℃
Operating humidity	:	20 to 80 %
Vibration	:	10 to 55 Hz, 98m/sec^2 max 3 direction, 30 min., each
Shock	:	390m/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 font are shown in table 1 to table 3.
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)

$\overline{CS}$	$\overline{RD}$	$\overline{WR}$	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.

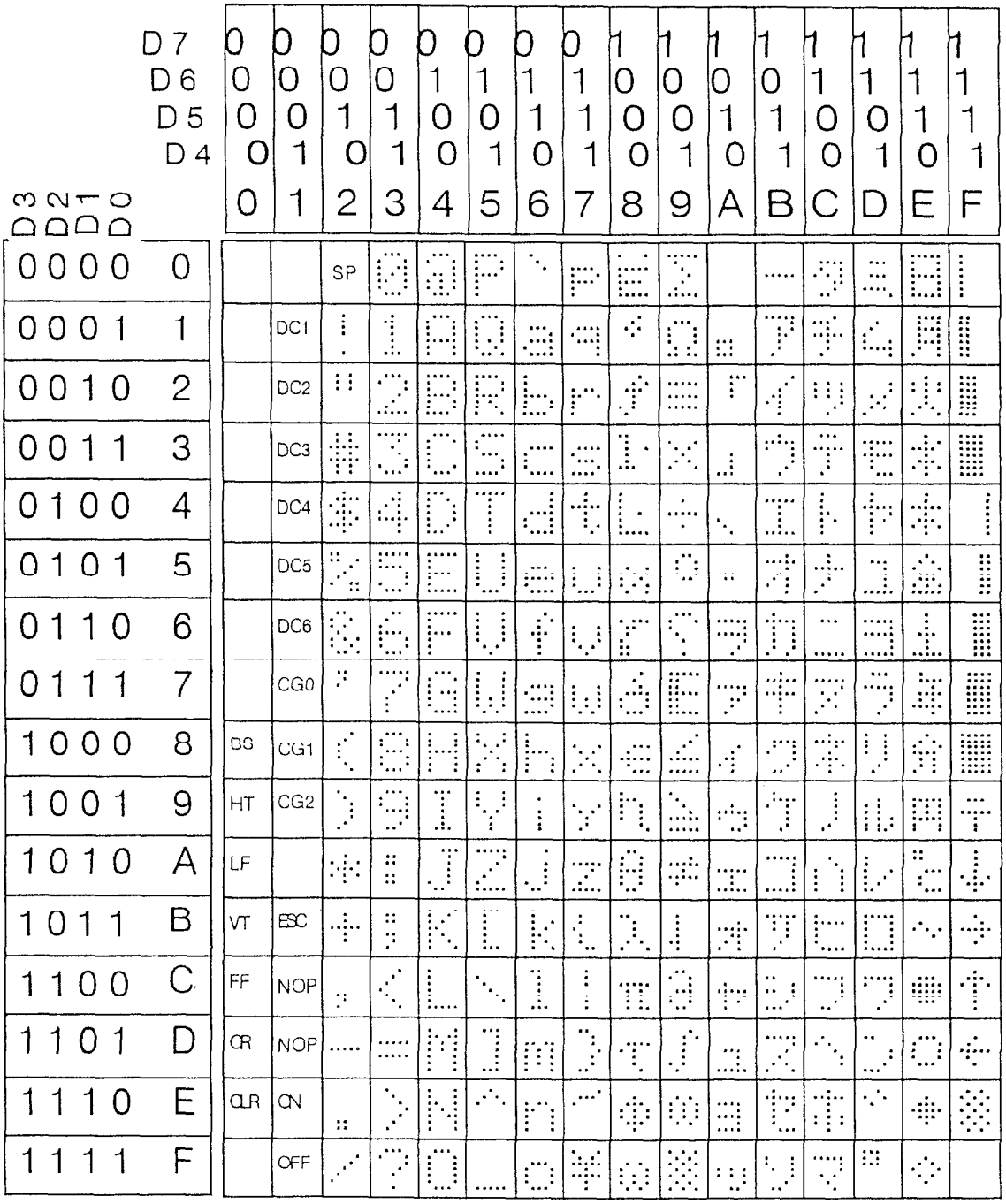
7.1 Character and control code set.
7.1.1 International Font.

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 0 0 1	1			DC1														
0 0 1 0	2			DC2														
0 0 1 1	3			DC3														
0 1 0 0	4			DC4														
0 1 0 1	5			DC5														
0 1 1 0	6			DC6														
0 1 1 1	7			CG0														
1 0 0 0	8	BS		CG1														
1 0 0 1	9	HT		CG2														
1 0 1 0	A	LF																
1 0 1 1	B	VT		ESC														
1 1 0 0	C	FF		NOP														
1 1 0 1	D	CR		NOP														
1 1 1 0	E	CLR		ON														
1 1 1 1	F			OFF														

CFX001

Table 1

7.1.2 International character and KATAKANA character Font



CFX002

Table 2

7.1.3 International Character and Russian Character Font

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 0 0 1	1		DC1														
0 0 1 0	2		DC2														
0 0 1 1	3		DC3														
0 1 0 0	4		DC4														
0 1 0 1	5		DC5														
0 1 1 0	6		DC6														
0 1 1 1	7		CG0														
1 0 0 0	8	BS	CG1														
1 0 0 1	9	HT	CG2														
1 0 1 0	A	LF															
1 0 1 1	B	VT	ESC														
1 1 0 0	C	FF	NOP														
1 1 0 1	D	CR	NOP														
1 1 1 0	E	CLR	ON														
1 1 1 1	F		OFF														

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. At the left end, the cursor moves to the above right end. 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 moves to the left end on next line. At the bottom of right end, it depends upon DC1 and DC2 mode.

DC1 : The cursor moves to the top of left end.
DC2 : Within this mode, all displayed characters are scrolled up one line. The cursor moves to the bottom of left end and all written characters on the top line are disappeared. The bottom line is cleared.

7.2.3 LF : Line Feed (0A Hex)

The cursor moves to the same position on the next line. At the bottom line, it depends upon DC1 and DC2 mode.

DC1 : The writing position moves to the same position on the top line.
DC2 : The displayed characters are scrolled up one line.The characters top line are disappeared. The cursor keeps the same column position and the bottom line is cleared.

7.2.4 VT : Vertical Tab (0B Hex)

The cursor moves to the same position on the above line. At the top line, it moves to the bottom.

7.2.5 CLR. Clear (0E Hex)

All written characters are cleared, The cursor doesn't move.

7.2.6 CR : Carriage Return (0D Hex)

The writing position moves to the left on the same line.

7.2.7 FF : Form Feed (0C Hex)

The writing position moves to the top of left end.

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

DC2 : Device Control 2 (12 Hex) --- Scroll up mode.
Alternative LINE ENDING MODE is specified by DC1 and DC2 when control data HT or LF or character data is written. Just after the power on.
DC1 is selected (Default Mode).

7.2.9 DC3 : Device Control 3 (13 Hex) --- Cursor is displayed on underline.

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 displayed as a blinking underline.
Above four codes control the cursor rendition. DC3 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-6)

7.2.10 CG0 : Character bank 0 (17 Hex) • • • International character font
CG1 : Character bank 1 (18 Hex) • • • International character font and KATAKANA character font
CG2 : Character bank 2 (19 Hex) • • • International character font and Russian character font

These data selected Character Bank. Just after power on, CG0 is selected (Default Mode). Any desired characters from those 3 tables can be displayed in the screen by the bank selection.

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, initialize, selection of underline display mode, selection of character blinking and command execution.

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 12 characters at once. Storing more than 12 will kill the oldest font. However, within the 12 character codes where already define 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 36 dot position (5 x 7 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	P22	P24	P26	P28	P30	P32	P34	UL
5th Byte	P6	P8	P10	P12	P14	P16	P18	P20
6th Byte	P29	P31	P33	P35	X	X	P2	P4
7th Byte	P13	P15	P17	P19	P21	P23	P25	P27
8th Byte	X	X	P1	P3	P5	P7	P9	P11

UL : Underline X : don't care

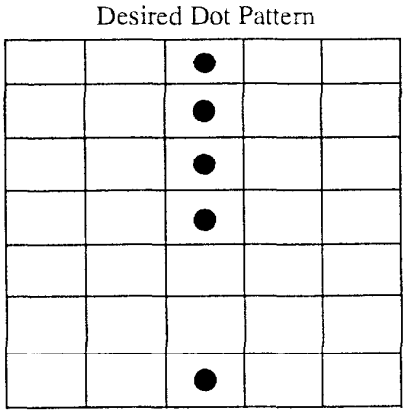
Following is the dot assignment.

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

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.



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	0	0	0	0	0	0	00 (PT1)
5th Byte	0	1	0	0	0	0	1	0	42 (PT2)
6th Byte	0	0	1	0	0	0	0	0	20 (PT3)
7th Byte	1	0	0	0	0	0	0	0	80 (PT4)
8th Byte	0	0	0	1	0	0	0	0	10 (PT5)

Then Syntax should be written; 1B + 43 + A0 + 00 + 42 + 20 + 80 + 10 (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.

	left most column	next column		right most column
top line	00	01	• • • • •	27
2nd line	28	29	• • • • •	4F
3rd line	50	51	• • • • •	77
bottom line	78	79	• • • • •	9F

(A0 ~ FF Hex = non-operation)

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 3F Hex : approx. 25 %
40 Hex to 7F Hex : approx. 50 %
80 Hex to BF Hex : approx. 75 %
C0 Hex to FF Hex : 100 % (default)

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 T0 = " 0 " 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 , FF Hex • • • • 128
FE , FD Hex • • • • 127
FC , FB Hex • • • • 126
:
:
02 , 01 Hex • • • • 1

Period of Blinking = Data Value x 30 msec.
At power on default, (40 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.Selection of underline mode.

Underline is displayed by following data write.
Syntax :
ESC (1B Hex) + " U " (55 Hex) • • • underline display mode select
ESC (1B Hex) + " W " (57 Hex) • • • underline display mode cancel

9.Selection of character blinking.

Characters are blinked by following data write.
ESC (1B Hex) + " B " (42 Hex) • • characters blinking mode select
ESC (1B Hex) + " A " (41 Hex) • • characters blinking mode cancel

10. Command execution.

Command write is executed. (see para 7.3)
ESC (1B Hex) + " X " (58 Hex) + 1 Byte data (Command Code)

7.2.12 ON : Screen ON (1B Hex)

All characters on the screen is on.
This mode is selected as Default Mode.

7.2.13 OFF : Screen OFF (1F Hex)

All characters on the screen is off.
The content in the RAM is not cleared.

7.2.14 NOP : Non Operation (1C Hex)

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 ~ 9F Hex)

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

	left most column	next column		right most column
top line	00	01	• • • • •	27
2nd line	28	29	• • • • •	4F
3rd line	50	51	• • • • •	77
bottom line	78	79	• • • • •	9F

(A0 ~ FF Hex = non-operation)

7.3.2 Cursor Position Read (F0 Hex)

Cursor Position can be read by following 1 byte positioning data.

	left most column	next column		right most column
top line	00	01	• • • • •	27
2nd line	28	29	• • • • •	4F
3rd line	50	51	• • • • •	77
bottom line	78	79	• • • • •	9F

7.3.3Data Read at Cursor (F1 Hex)

Data at cursor 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.

7.3.4 Data Read at Cursor + HT (F2 Hex)

Data at cursor can be read by sending the command of F2 Hex. And HT is executed. 1 byte data of character code will be sent back to the host through the data bus.

7.3.5 Character Insert (F3 Hex)

Character at cursor and following characters move one to right by sending the command of F3 Hex. The right most character will be overflowed. One Cursor doesn't move.

7.3.6 Character Delete (F4 Hex)

Character at cursor is deleted and following characters move one to left by sending the command of F4 Hex. One space is written at right most. Cursor doesn't move.

7.3.7 Line Insert (F5 Hex)

Line with cursor and following lines scroll one line down by sending the command of F5 Hex. On the line with cursor is cleared and settled at left most. The bottom line is overflowed.

7.3.8 Line Delete (F6 Hex)

Line with cursor is deleted and following lines scroll one line up by sending the command F6 Hex. On the bottom line is cleared. Cursor doesn't move.

7.3.9 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.

7.4 Data Read

After Data Read commands (F0, F1, F2 Hex)to the Display Module, the Data Read should be executed during the BUSY = " 0 ".

7.5 Test Mode

If T0 = " 0 " at power-on time, the Display Module selects Test Mode, and all stored ROM fonts are displayed in the screen one by one character. In this mode, Data Write and Command Write are not accepted.

7.6 Blanking

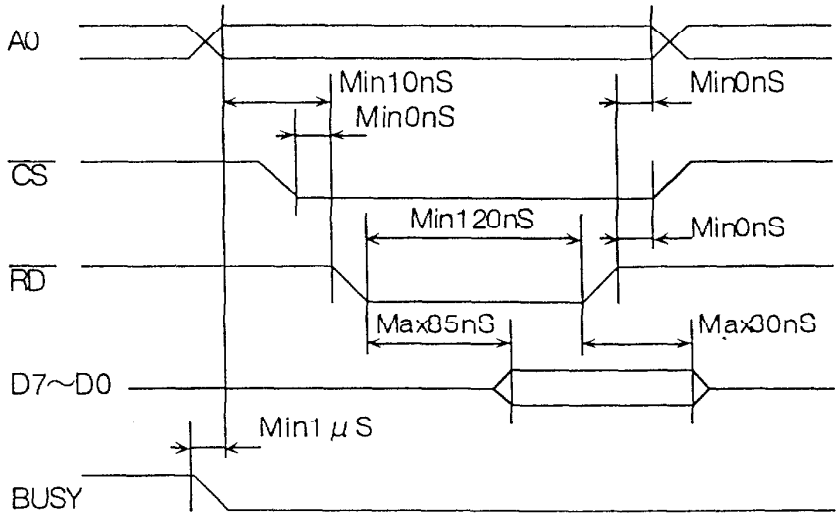
The display will be OFF at $\overline{BL}$ = " 0 ".
The Display Module's memory is maintained.

8.0 Timing

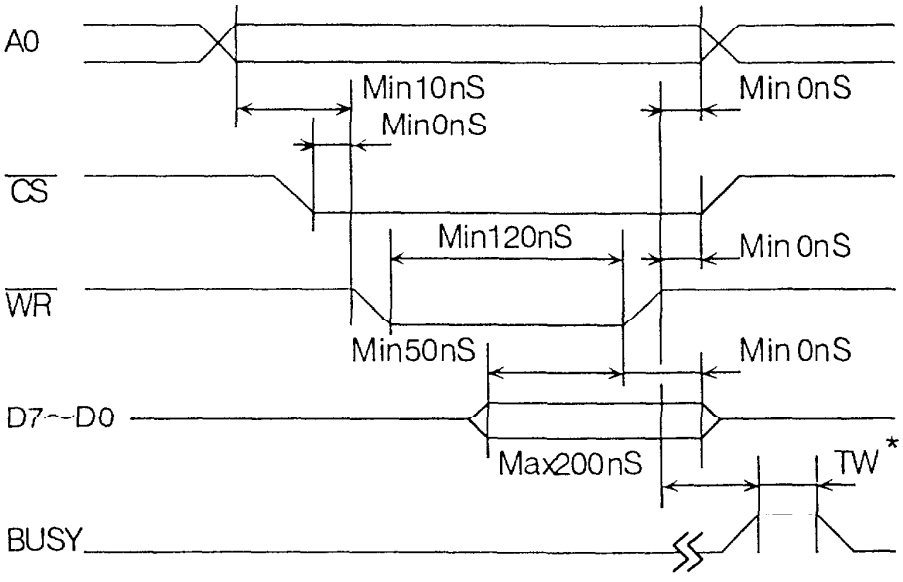
8.1 Parallel Interface Timing.

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

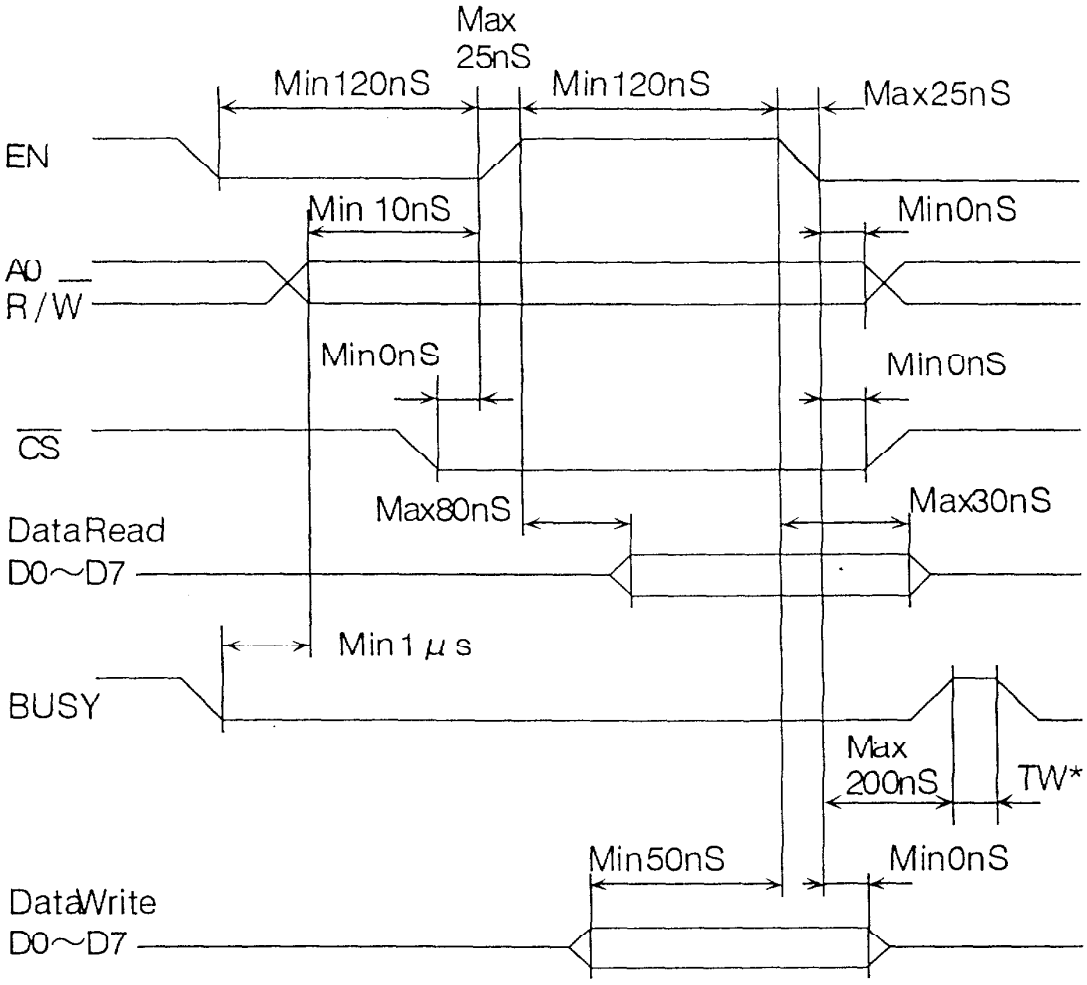


i80 CPU Data write timing



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 or " T0 " signal 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)

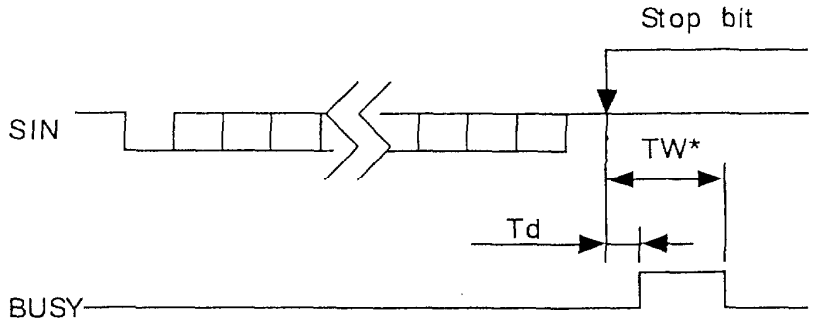
Serial data form with even or odd parity

START	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Prty	STOP

Serial data form with non-parity

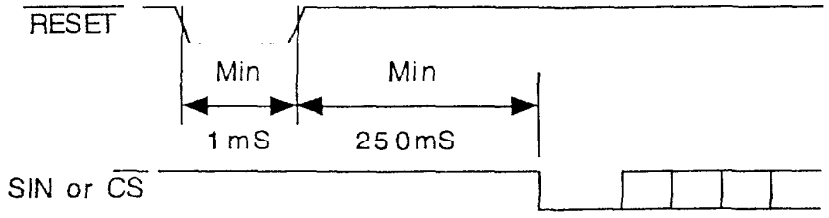
START	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	STOP

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 low) should be longer than 1msec.. It is required at least 250 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.

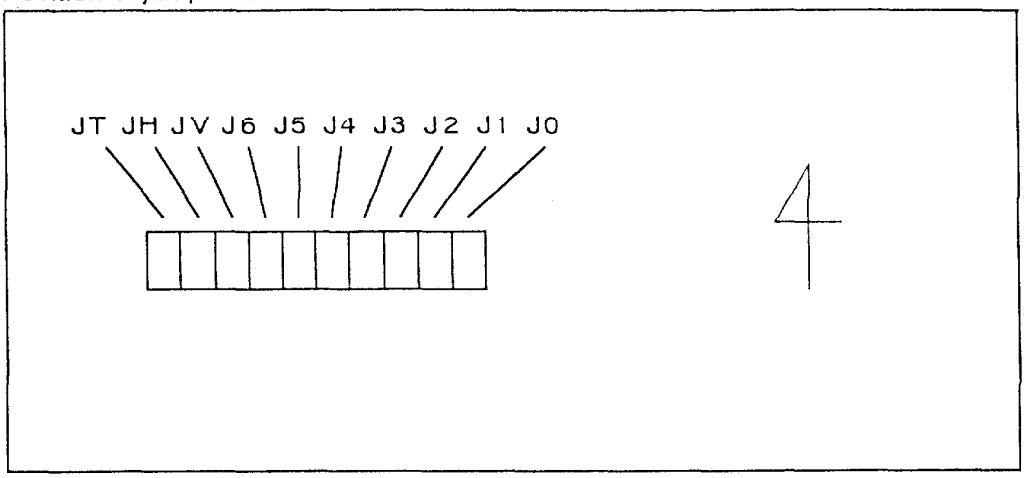
DATA WRITE			Execution time (TW*)		Data Writing Mode
			DC1 Mode	DC2 Mode	
Character data write HT, LF			240 μS	1.7 mS	Quick Write Mode
BS, VT, FF, CR DC1~6, CG0			240 μS		
CLR			1.3mS		
ESC	1st byte		240 μS		
	2nd byte	" C "	130 μS		
		" I "	2.1 mS		
		" M "	65 mS		
		Except " C ", " I " and " M "	190 μS		
	3rd byte ~		190 μS		

COMMAND WRITE	Execution time (TW*)		Data Writing Mode
	DC1 Mode	DC2 Mode	
00 Hex ~ EF Hex	130 μS		Quick write mode
F0 Hex F1 Hex			
F2 Hex	160 μS	1.7mS	
F3, F4 Hex	980 μS		
F5, F6 Hex	1.6 mS		
FF Hex	2.1 mS		

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



Parts Side of PCB

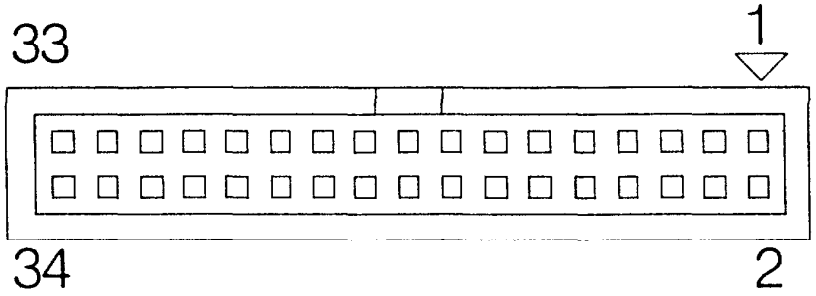
Jumper Function Table

Jumper	Function	Setting @ Factory
JT	Don't touch	
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	Don't touch	
J0	Select Default Mode of Character Fonts (0) = : JIS Fonts (CG1) (1) = : International Fonts (CG0)	1
JH	Select Parallel interface type 1 : i80 type 0 : M68 type	1
JV	Don't touch	

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

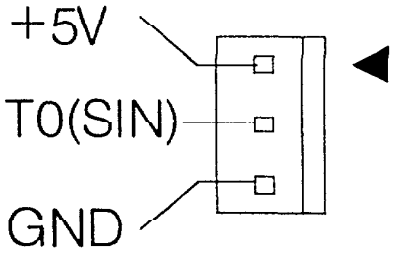
11.0 Connector Pin assignment

11.1 Data Connector : IMSA-9032B-34P-GF / Mate Connector : Flat Cable Connector



No	Signal	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	$\overline{WR}$ (R / $\overline{W}$)	18	GND
19	A0	20	GND
21	$\overline{RD}$ (EN)	22	GND
23	$\overline{CS}$	24	GND
25	T0 (SIN)	26	GND
27	BUSY	28	GND
29	$\overline{BL}$	30	GND
31	$\overline{RESET}$	32	GND
33	NC	34	GND

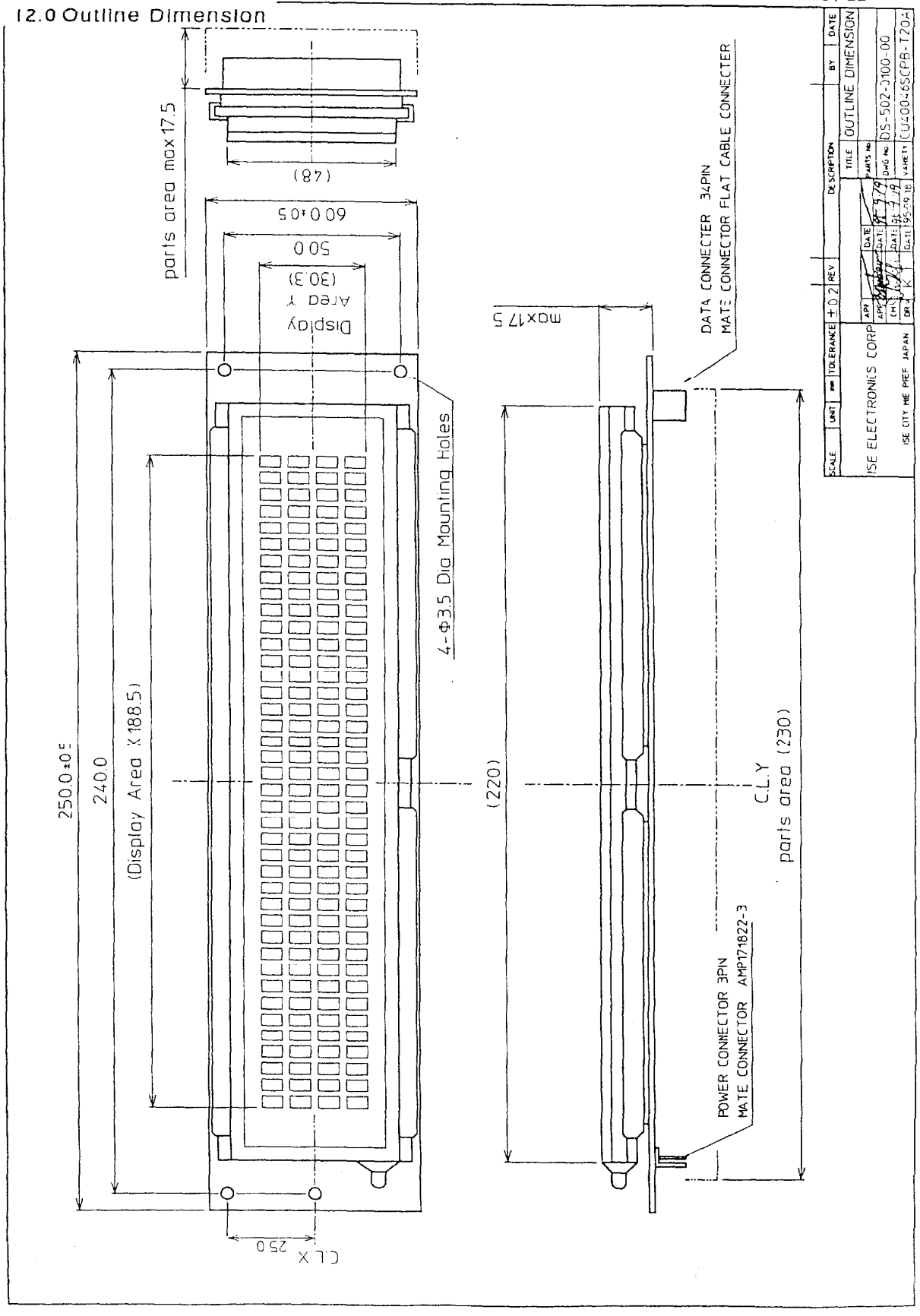
11.2 Power Connector : AMP 171825-3 / Mate Connector : AMP 171822-3



11.3 Optional Accessories

Signal Connector Receptacle with 50cm Cable	Order No. FSC-3431-050
Power Connector Receptacle with 50cm Cable	Order No. PCC-0301-050

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.