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Noritake

RoHS Compliant

# VACUUM FLUORESCENT DISPLAY

# MODULE

# SPECIFICATION

MODEL　　：CU40066-TW200A

| | | |
|---|---|---|
| SPECIFICATION NO. | : | DS-1448-0000-04 |
| DATE OF ISSUE | : | May 8, 2007(00) |
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This product complies with RoHS Directive

Please contact our sales consultant for details and to confirm the current status

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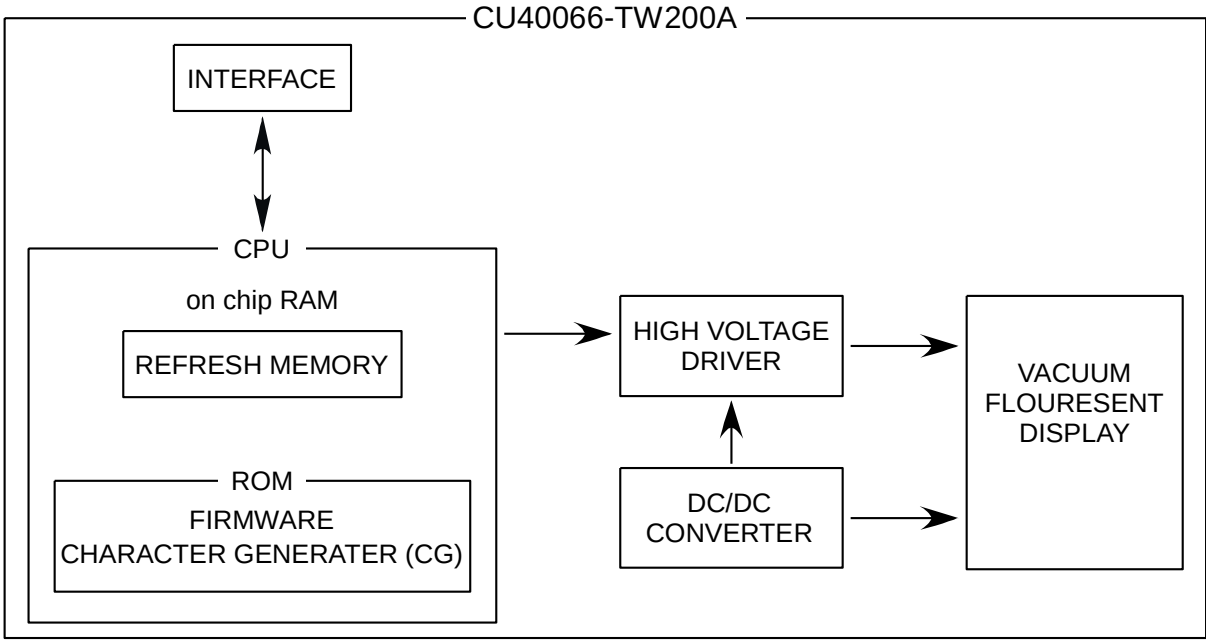
# 1. General Description

## 1.1 Application

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

## 1.2 Construction

Single board display module consists of 240 character (6 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. Outline Dimension”.

# 2. Absolute Maximum Ratings

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| Logic Input Voltage | VI | 0 | - | Vcc+0.3 | VDC | VI<Vcc+0.2 |
| Power Supply Voltage | Vcc | 0 | - | 6.0 | VDC | - |

# 3. Electrical Ratings

| Parameter | | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|---|
| Logic Input Voltage | "H" | VIH | 2.0 | - | VCC | VDC | Vcc=5.0V TA=25degrees |
| | "L" | VIL | 0 | - | 0.8 | | |
| Power Supply Voltage | | Vcc | 4.75 | 5.0 | 5.25 | VDC | - |

## 4. Electrical Characteristics

Measuring Conditions : TA (Ambient temperature)=25degrees, Vcc=5.0V

| Parameter | | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|---|
| Logic Output Voltage | "H" | VOH | 4.4 | - | - | VDC | IOH=-2mA |
| | "L" | VOL | - | - | 0.5 | VDC | IOL=2mA |
| Power Supply Current | | Icc | - | 0.9 | 1.1 | ADC | All dots turn off |
| | | | - | 1.1 | 1.4 | ADC | All dots turn on |

Note :Slow start power supply may cause erroneous operation. The rise time of Vcc should not exceed 100 ms.
Icc might be anticipated twice as usual at power on rush.

## 5. Optical Specifications

| | | |
|---|---|---|
| Number of characters | : | 240 (6 lines x 40 chars) |
| Matrix format | : | 5 x 7 dot Matrix + Underline |
| Display area | : | 188.75 x 46.0mm (X x Y) |
| Character size | : | 3.5 x 6.0 mm (X x Y, Including UL)<br>(3.5 x5.0 mm for 5x7dot) |
| Character pitch | : | 4.75 x 8.0 mm (X x Y) |
| Dot size | : | 0.5 x 0.5 mm (X x Y) |
| Dot pitch | : | 0.75 x 0.75 mm (X x Y) |
| Luminance | : | 350 cd/m2 (100fL) Min. |
| Color of illumination | : | Green |

## 6. Environmental Specifications

| | | |
|---|---|---|
| Operating temperature | : | -40 to +85 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<br>30 minutes |
| Shock(No operating) | : | 100G, 9ms, X Y Z 3direction |

## 7. 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 : Do not 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 : Do not 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

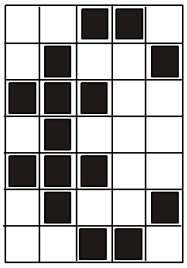
### 7.1.1 International font

| 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 | EUR | | | | | | | | | | | | | | |
| 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 | CAN | OFF | | | | | | | | | | | | | | |

CFX001

Table 1

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 affects displayed character of AD Hex.



### 7.1.2 International character and KATAKANA 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 | EUR | | | | | | | | | | | | | | |
| 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 | CAN | OFF | | | | | | | | | | | | | | |

CFX002

Table 2

### 7.1.3 International character and Russian character font

| 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 | | | SP | | | | | | | | | | | | | |
| 0 0 0 1 | | DC1 | | | | | | | | | | | | | | |
| 0 0 1 0 | | DC2 | | | | | | | | | | | | | | |
| 0 0 1 1 | | DC3 | | | | | | | | | | | | | | |
| 0 1 0 0 | | DC4 | | | | | | | | | | | | | | |
| 0 1 0 1 | | DC5 | | | | | | | | | | | | | | |
| 0 1 1 0 | | DC6 | | | | | | | | | | | | | | |
| 0 1 1 1 | | CG0 | | | | | | | | | | | | | | |
| 1 0 0 0 | BS | CG1 | | | | | | | | | | | | | | |
| 1 0 0 1 | HT | CG2 | | | | | | | | | | | | | | |
| 1 0 1 0 | LF | EUR | | | | | | | | | | | | | | |
| 1 0 1 1 | VT | ESC | | | | | | | | | | | | | | |
| 1 1 0 0 | FF | NOP | | | | | | | | | | | | | | |
| 1 1 0 1 | CR | NOP | | | | | | | | | | | | | | |
| 1 1 1 0 | CLR | ON | | | | | | | | | | | | | | |
| 1 1 1 1 | CAN | 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. At the top of left end, the cursor moves to the bottom of right 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 on the 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 FF : Form Feed (0C Hex)

The cursor moves to the top left end.

### 7.2.6 CR : Carriage Return (0D Hex)

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

### 7.2.7 CLR: Clear (0E Hex)

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

### 7.2.8 CAN: Cancel (0F Hex)

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

### 7.2.9 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 character data or HT or LF is written. Just after power on or initialize, DC1 is selected (Default Mode).

**7.2.10 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. 7.2.12 ESC)

**7.2.11 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 characters from those 3 tables can be displayed on the screen by bank selection.

**EUR : Euro Currency mark (1A Hex) ⋯ Euro Currency mark**

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.

**7.2.12 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 5x7 dot patterns consisted of data from PT1 through PT5 can be stored in 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 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 | P22 | P24 | P26 | P28 | P30 | P32 | P34 | UL |
| 5th byte | P6 | P8 | P10 | P12 | P14 | P16 | P18 | P20 |
| 6th byte | P29 | P31 | P33 | P35 | * | * | P2 | P4 |
| 7th byte | P13 | P15 | P17 | P19 | P21 | P23 | P25 | P27 |
| 8th byte | * | * | P1 | P3 | P5 | P7 | P9 | P11 |

* : don't care UL: Under line

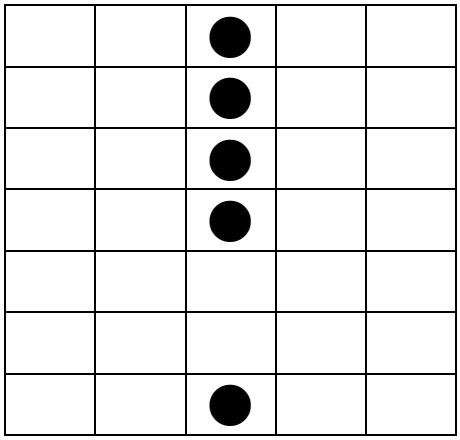
Following is the dot assignment.

| | | | | |
|---|---|---|---|---|
| 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.



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 | 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 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 line | 00 | 01 | 02 | ---------- | 27 |
| 2nd line | 28 | 29 | 2A | ---------- | 4F |
| 3rd line | 50 | 51 | 52 | ---------- | 77 |
| 4th line | 78 | 79 | 7A | ---------- | 9F |
| 5th line | A0 | A1 | A2 | ---------- | C7 |
| Bottom | C8 | C9 | CA | ---------- | EF |

Data = F0 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 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, 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 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 through the data bus as following data format.

Bit2 to 7 : not assigned, do not care
Bit1 : 1 = possess ROM error 0 = no ROM error
Bit0 : 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 Hex, FF Hex ⋯ 128
FE Hex, FD Hex ⋯ 127
FC Hex, FB Hex ⋯ 126
:
02 Hex, 01 Hex ⋯ 1

Period of Blinking = Data Value x Approx.30 mS
At power on default, 40 Hex is set to 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 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.

Syntax : 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).

Syntax : ESC (1B Hex) + " X " (58 Hex) + 1 Byte Data (Command Code)

### 7.2.13 ON : Screen ON (1E Hex)

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

### 7.2.14 OFF : Screen OFF (1F Hex)

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

### 7.2.15 NOP : Non Operation (1C, 1D 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 ~ EF Hex)

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

| Column / Line | Left end | 2nd | 3rd | ---------- | Right end |
|---|---|---|---|---|---|
| Top line | 00 | 01 | 02 | ---------- | 27 |
| 2nd line | 28 | 29 | 2A | ---------- | 4F |
| 3rd line | 50 | 51 | 52 | ---------- | 77 |
| 4th line | 78 | 79 | 7A | ---------- | 9F |
| 5th line | A0 | A1 | A2 | ---------- | C7 |
| Bottom | C8 | C9 | CA | ---------- | EF |

Data = F0 Hex to FF Hex : The cursor doesn't move.

#### 7.3.2 Cursor Position Read (F0 Hex)

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

| Column / Line | Left end | 2nd | 3rd | ---------- | Right end |
|---|---|---|---|---|---|
| Top line | 00 | 01 | 02 | ---------- | 27 |
| 2nd line | 28 | 29 | 2A | ---------- | 4F |
| 3rd line | 50 | 51 | 52 | ---------- | 77 |
| 4th line | 78 | 79 | 7A | ---------- | 9F |
| 5th line | A0 | A1 | A2 | ---------- | C7 |
| Bottom | C8 | C9 | CA | ---------- | EF |

#### 7.3.3 Data Read at Cursor (F1 Hex)

Data at cursor can be read by sending the command of F1 Hex. 1 byte 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. 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 cleaned. 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 SIN (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

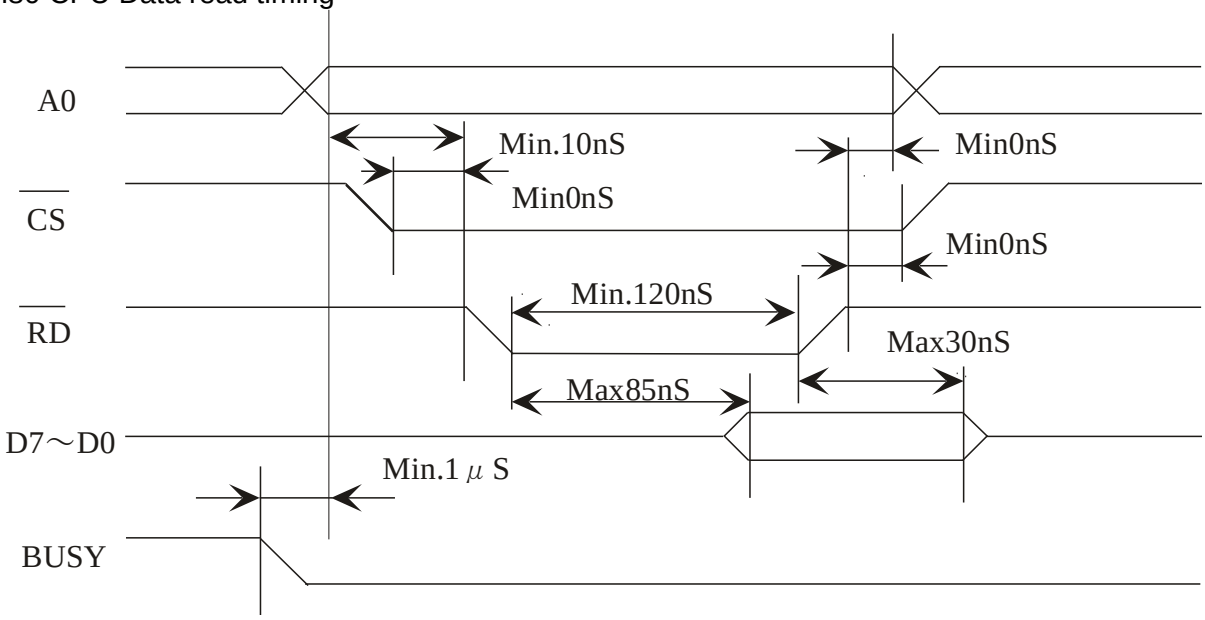
The display will be OFF at $\overline{BL}$ = " 0 ".
The display module's memory is maintained.

# 8. Timing

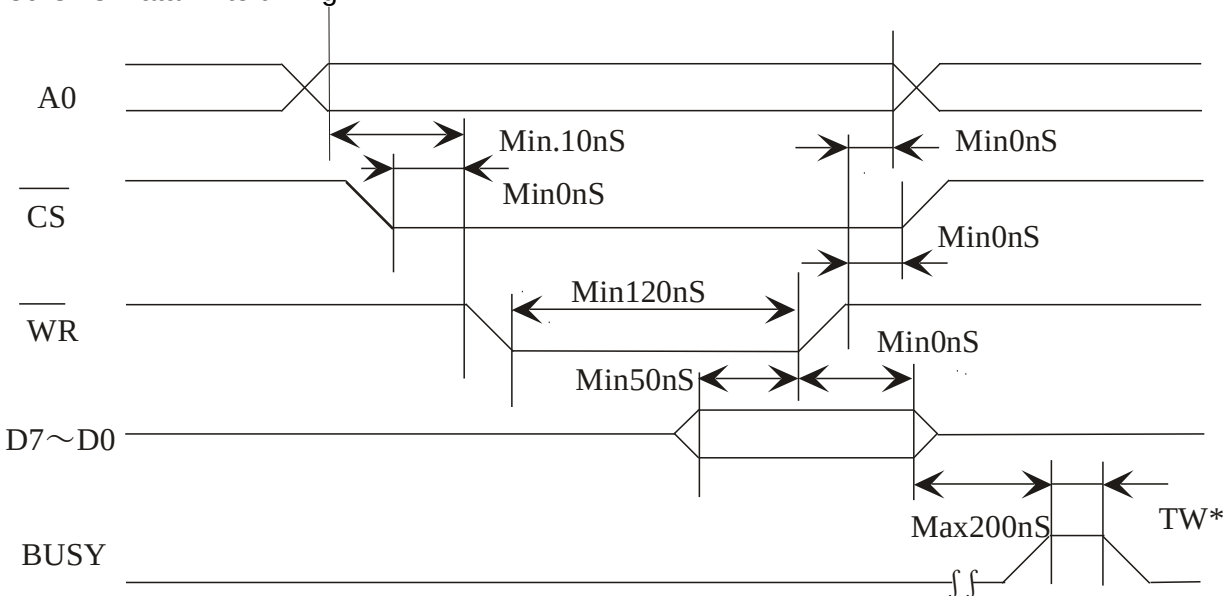
## 8.1 Parallel interface Timing

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. Jumper Wires”)
i80 series is selected from factory.

i80 CPU Data read timing

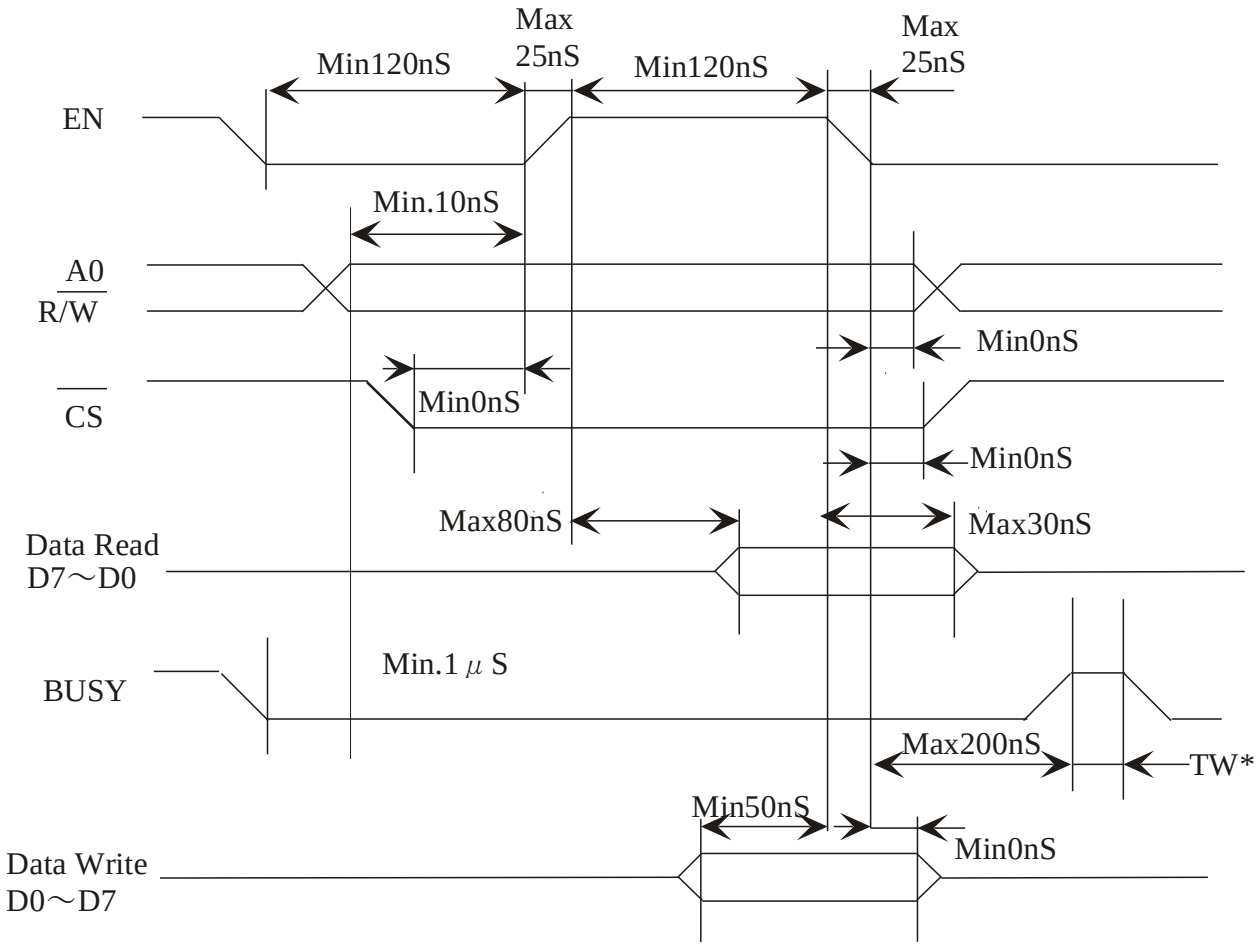



i80 CPU Data write timing




TW* : See Para 9.0 BUSY TIME.

M68 CPU Data read / write timing




TW* : See Para 9.0 BUSY TIME.

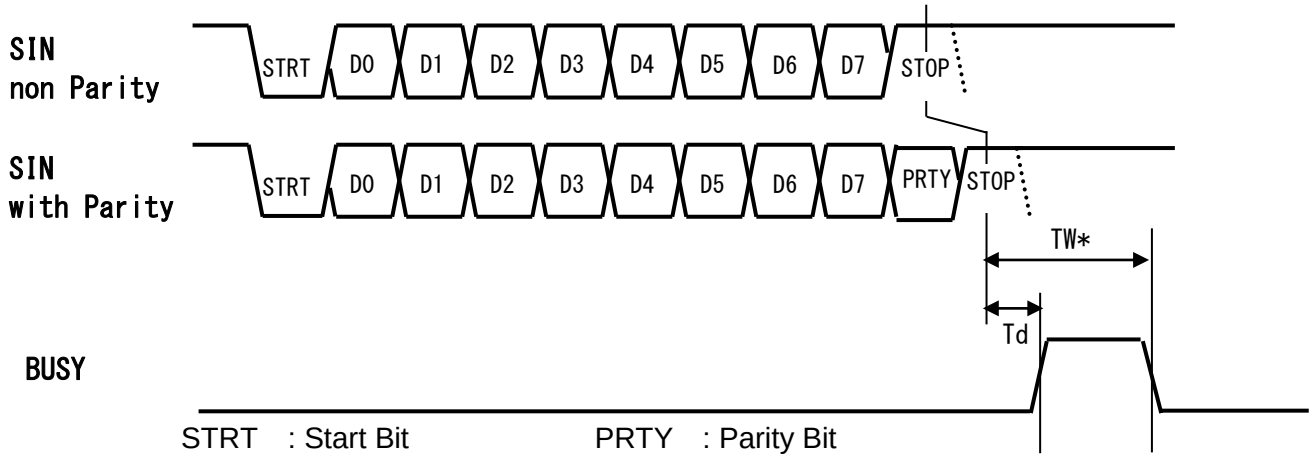
### 8.2 Serial Interface Timing

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.
(see para. “10. Jumper wires”)

600, 1200, 2400, 4800, 9600, 19200(Default*) BPS

Default* : Our warrantee covers only use in the above default condition.

Besides, parity bit-even, odd and non parity can be selected by 2 jumper wires.
( see para. “10. Jumper wires”)



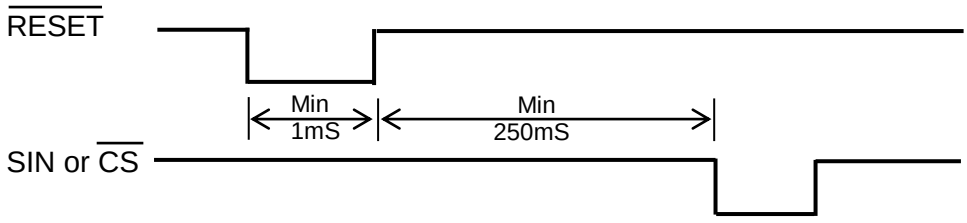

STRT : Start Bit
D0 : LSB
:
D7 : MSB
PRTY : Parity Bit
STOP : Stop Bit

Td : 30 µS ( Typ. ) at Quick Write Mode
30 µS ( Min. ) ~ 500 µS ( Max. ) at Flicker less Mode

TW* : see para. “9. BUSY Time”

### 8.3 Reset Timing

Following chart shows the reset timing.
Rest pulse (Active Low) should be longer than 1mS. It is required at least 250mS to accept the data after reset pulse rise up



## 9. BUSY Time

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

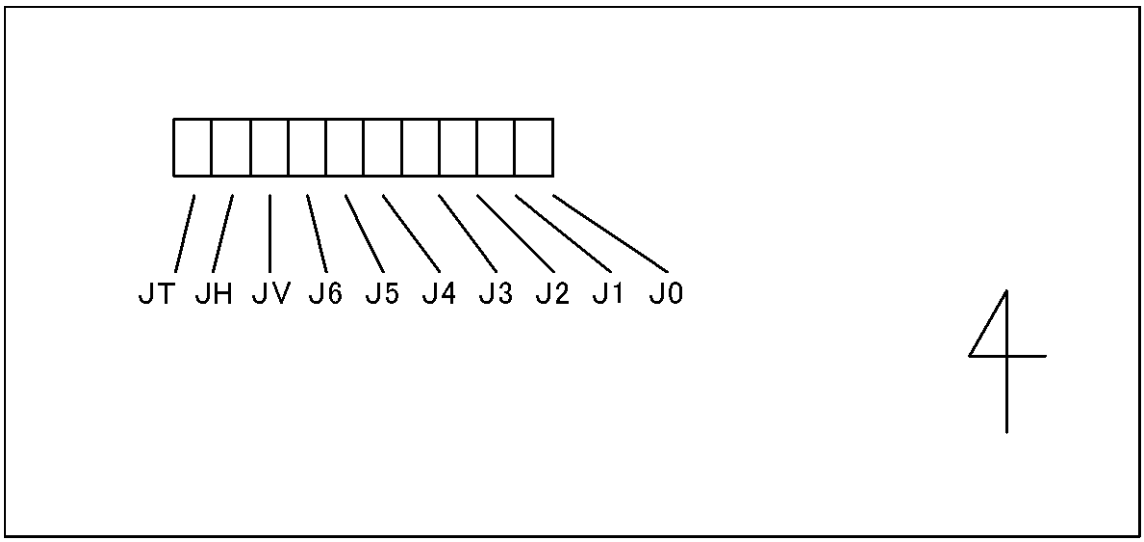
| Data Write | | | Excution time (TW) | | Data Writing Mode |
|---|---|---|---|---|---|
| | | | DC1 Mode | DC2 Mode | |
| Character Data Write, HT, LF | | | 240 µS | 1.7 mS | Quick Write Mode |
| BS, VT, FF, CR, CG0, EUR DC1,DC2,DC3,DC4,DC5,DC6 | | | 240 µS | | |
| CAN | | | 340 µS | | |
| CLR | | | 1.3 mS | | |
| ESC | 1st byte | | 240 µS | | |
| | 2nd byte | "C" | 130 µS | | |
| | | "I" | 2.1 mS | | |
| | | "M" | 65 mS | | |
| | | Expect"C", "I", "M" | 190 µS | | |
| | 3rd byte ～ | | 190 µS | | |

| Command Write | Excution time (TW) | | Data Writing Mode |
|---|---|---|---|
| | DC1 Mode | DC2 Mode | |
| 00 Hex ~ EF Hex | 130 µS | | Quick Write Mode |
| F0, F1 Hex | 130 µS | | |
| F2 Hex | 160 µS | 1.7 mS | |
| F3, F4 Hex | 980 µS | | |
| F5, F6 Hex | 1.6 mS | | |
| FF Hex | 2.1 mS | | |

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

## 10. Jumper wires

Position of jumper wire




PCB Parts Side

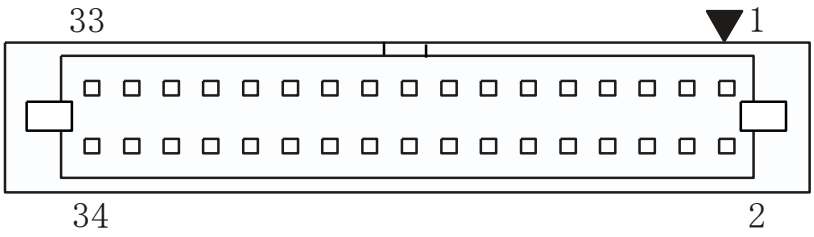
Jumper Function Table

| Jumper | Function | Setting @ Factory |
|---|---|---|
| JT | Don't touch | |
| J6<br>J5<br>J4 | BPS select of serial data<br>(J6, J5, J4) = (0, 0, 0) : 600 BPS (1, 0, 0) : 2400 BPS<br>(0, 0, 1) : 600 BPS (1, 0, 1) : 4800 BPS<br>(0, 1, 0) : 600 BPS (1, 1, 0) : 9600 BPS<br>(0, 1, 1) : 1200 BPS (1, 1, 1) : 19.2K BPS | All 1 |
| J3<br>J2 | Parity of serial data<br>(J3, J2,) = (0, X) : Non parity (1, 0) : Odd parity<br>(1, 1) : Even parity | All 1 |
| J1 | Don't touch | |
| J0 | Select default mode of character fonts<br>(0) = : JIS Fonts (CG1)<br>(1) = : International Fonts (CG0) | 1 |
| JH | Select parallel interface type<br>(0) = : M68 type<br>(1) = : i80 type | 1 |
| JV | Don't touch | |

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

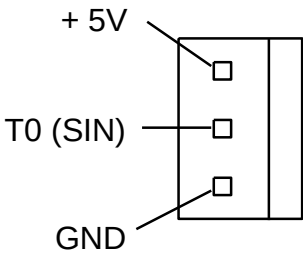
## 11. Connector Pin assignment

### 11.1 Data Connector : 3M 3431-6002SCFL / Mate Connector : Flat Cable Connector

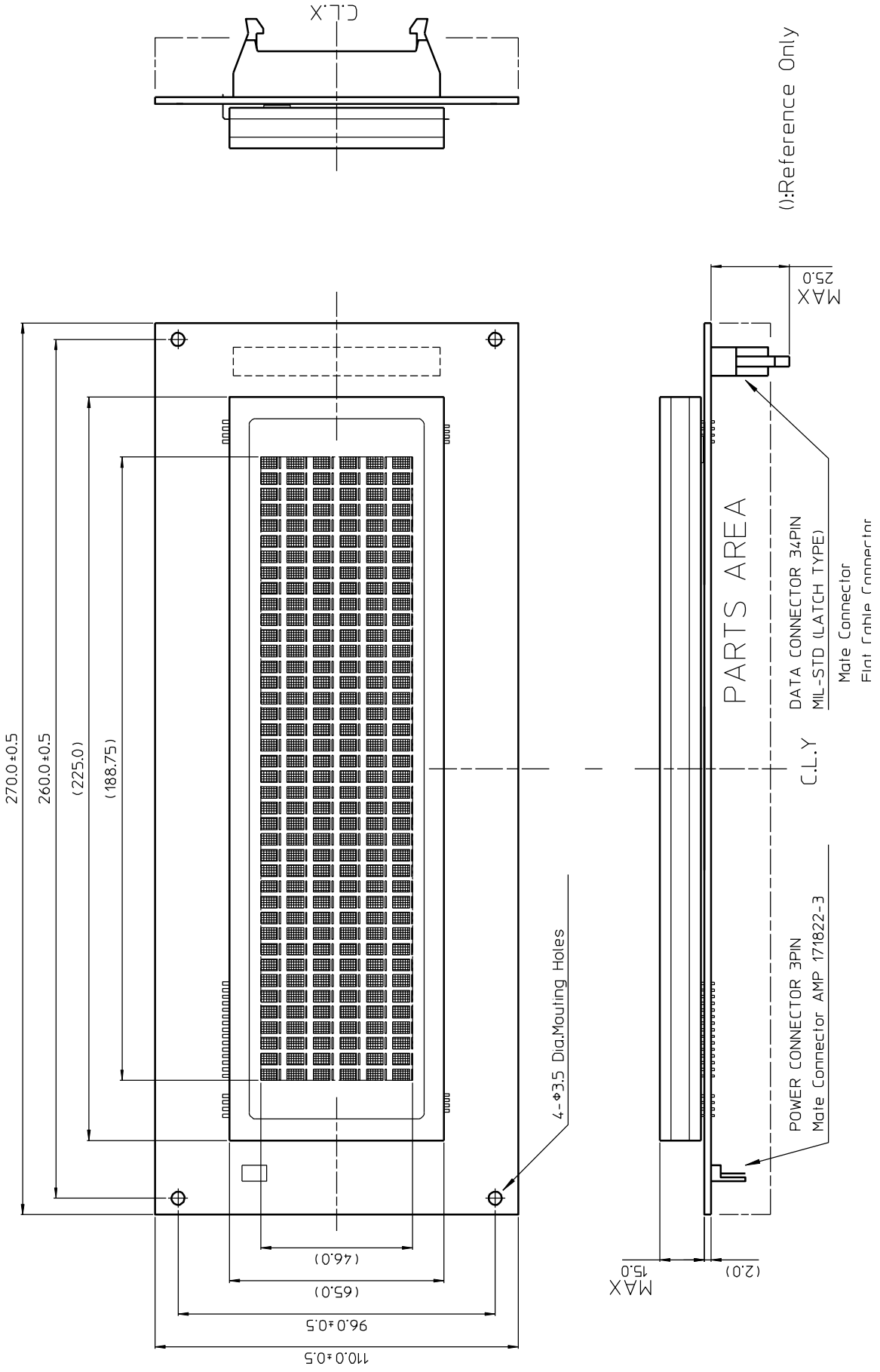



| No. | Signal | No. | Signal |
|---|---|---|---|
| 1 | D7 | 2 | GND |
| 3 | D6 | 4 | GND |
| 5 | D5 | 6 | GND |
| 7 | D4 | 8 | GND |
| 9 | D3 | 10 | GND |
| 11 | D2 | 12 | GND |
| 13 | D1 | 14 | GND |
| 15 | D0 | 16 | GND |
| 17 | $\overline{WR}$ (R/$\overline{W}$) | 18 | GND |
| 19 | A0 | 20 | GND |
| 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



## 12. Outline dimension



# Notice for the Cautious Handling VFD Modules

Handling and Usage Precautions:
Please carefully follow the appropriate product application notes for proper usage, safety handling, and operation standards for maximum performance.

[VFD tubes are made of glass]

- Because the edges of the VFD glass-envelop are not smooth, it is necessary to handle carefully to avoid injuries to your hands
- Please avoid breaking the VFD glass-envelop to prevent injury from sharp glass particles.
- The tip of the exhaust pipe is fragile so avoid shock from impact.
- It is recommended to allow sufficient open space surrounding the exhaust pipe to avoid possible damage.
- Please design the PCB for the VFD-module within 0.3 mm warping tolerance to avoid any forces that may damage the display due to PCB distortion causing a breakdown of the electrical circuit leading to VFD failure.

[High voltage]

- Avoid touching conductive electrical parts, because the VFD-module uses high voltage exceeding approx.35 volts.
- Even when electric power is turned off, it may take more than one minute for the electrical current to discharge.

[Electrostatic charge]

- VFD-modules needs electrostatic free packaging and protection from electrostatic charges during handling and usage.

[Structure]

- During operation, VFD and VFD-modules generate heat. Please consider sufficient heat radiation dissipation using heat sink solutions.
- We prefer to use UL grade materials or components in conjunction with VFD-modules.
- Wrap and twist motion causes stress and may break VFDs & VFD modules. Please adhere to allowances within 0.3mm at the point of attachment.

[Power]

- Apply regulated power to the VFD-module within specified voltages to protect from failures.
- Because some VFD-modules may consume in rush current equal to twice the typical current at power-on timing, we recommend using a sufficient power capability and quick starting of the power regulator.
- VFD-module needs a specified voltage at the point of connection. Please use an adequate power cable to avoid a decrease in voltage. We also recommend inserting a power fuse for extra protection.

[Operating consideration]

- Illuminating phosphor will decrease in brightness during extended operation. If a fixed pattern illuminates for an extended period,( several hours), the phosphor efficiency will decrease compared to the non operating phosphor causing a non uniform brightness among pixels. Please consider programming the display patterns to use all phosphor segments evenly. Scrolling may be a consideration for a period of time to refresh the phosphor condition and improve even illumination to the pixels.
- We recommend using a signal cable 30cm or less to avoid some possible disturbances to the signal.

[Storage and operating environment]

- Please use VFD-modules under the recommended specified environmental conditions. Salty, sulfur and dusty environments may damage the VFD-module even during storage.

[Discard]

- Some VFDs contain a small amount of cadmium in the phosphor and lead in the solder. When discarding VFDs or VFD-modules, please adhere to governmental related laws or regulations.

[Others]

- Although the VFD-module is designed to be protected from electrical noise, please plan your circuitry to exclude as much noise as possible.
- Do not reconstruct or repair the VFD-module without our authorization. We cannot assure the quality or reliability of unauthorized reconstructed VFD-modules.

Notice:

- We do not authorize the use of any patents that may be inherent in these specifications.
- Neither whole nor partial copying of these specifications are permitted without our approval.
  If necessary , please ask for assistance from our sales consultant.

- This product is not designed for military, aerospace, medical or other life-critical applications. If you choose to use this product for these applications, please ask us for prior consultation or we cannot take responsibility for problems that may occur.