

TO FEG

VACUUM FLUORESCENT DISPLAY MODULE

ENGINEERING PROPOSAL

MDM166AA

EVALUATION

- ACCEPTED WITHOUT ANY CHANGE
- THE FOLLOWING CHANGE IS REQUIRED

VFD MODULE FACTORY

Electronic Components Division

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## 1. GENERAL SPECIFICATIONS

## 1-1. DIMENSIONS, WEIGHT (Refer FIGURE-1)

Table-1

| Item            | Specification | Unit |
|-----------------|---------------|------|
| Outer Dimension | (L) 115.0±1   | mm   |
|                 | (W) 36.0±1    |      |
|                 | (T) 22.3Max.  |      |
| Weight          | 70            | g    |

## 1-2. SPECIFICATIONS OF THE DISPLAY PANEL

Table-2

| Item                  | Specification                                  | Unit |
|-----------------------|--|------|
| Display Area (W×H)    | 88.6×13.5                                      | mm   |
| Dot Size (W×H)        | 0.45×0.56                                      | mm   |
| Dot Pitch (W×H)       | 0.73×0.86                                      | mm   |
| Number of Dot (W×H)   | 96×16 + Segment                                | mm   |
| Color of Illumination | Green (x=0.24, y=0.41)<br>Red (x=0.67, y=0.33) | —    |

Note) By using a filter, uniform color ranging from blue to orange (including white) can be obtained.

## 1-3. ENVIRONMENT CONDITIONS

Table-3

| Item                      | Symbol                 | Min. | Max. | Unit |
|---------------------------|------------------------|------|------|------|
| Operating Temperature     | <i>T<sub>opr</sub></i> | 0    | +50  | °C   |
| Storage Temperature       | <i>T<sub>stg</sub></i> | -20  | +70  | °C   |
| Operating Humidity (note) | <i>H<sub>opr</sub></i> | 20   | 85   | %    |
| Storage Humidity (note)   | <i>H<sub>stg</sub></i> | 20   | 90   | %    |
| Vibration (10 to 55Hz)    | —                      | —    | 4    | G    |
| Shock                     | —                      | —    | 40   | G    |

Note) Avoid operations and or storage in moist environmental conditions.

## 1-4. ABSOLUTE MAXIMUM RATINGS

Table-4

| Item                 | Symbol                   | Min. | Max. | Unit |
|----------------------|--------------------------|------|------|------|
| Supply Voltage       | $V_{cc1}$ (USB Power)    | -0.3 | 5.5  | V    |
|                      | $V_{cc2}$ (Floppy Power) | -0.3 | 5.5  | V    |
| Input signal voltage | $V_{IS}$                 | -0.3 | 5.5  | V    |

## 1-5. RECOMMENDED OPERATING CONDITIONS

Table-5

| Item                  | Symbol                                      | Condition      | Min.        | Typ. | Max.        | Unit |
|-----------------------|---|----------------|-------------|------|-------------|------|
| Supply Voltage        | $V_{cc1}$ (USB Power) <small>note1)</small> | —              | 4.5         | 5.0  | 5.5         | V    |
|                       | $V_{cc2}$ (Floppy Power)                    | —              | 4.5         | 5.0  | 5.5         | V    |
| H-Level Input Voltage | $V_{IH}$                                    | $V_{cc1}=5.0V$ | $0.7V_{cc}$ | —    | —           | V    |
| L-Level Input Voltage | $V_{IL}$                                    | $V_{cc1}=5.0V$ | —           | —    | $0.3V_{cc}$ | V    |

Note1) According to USB standard

## 1-6. ELECTRICAL CHARACTERISTICS

Table-6

| Item                  | Symbol                          | Condition     | Min. | Typ. | Max. | Unit              |
|-----------------------|---------------------------------|---------------|------|------|------|-------------------|
| Supply Current (note) | $I_{cc1}$ <small>note2)</small> | $V_{cc}=5.0V$ | —    | 350  | 450  | mA                |
|                       | $I_{cc2}$ <small>note1)</small> | All on        | —    | 350  | 450  | mA                |
| Power Consumption     | —                               |               |      | 1.75 | 2.25 | W                 |
| Luminance             | $L(\text{Green})$               |               | 350  | 700  | —    | cd/m <sup>2</sup> |
|                       | $L(\text{red})$                 |               | 70   | 140  | —    |                   |
| H-Level Input Current | $I_{IH}$                        | $V_{IH}=5V$   | -1.0 | —    | 1.0  | μA                |
| L-Level Input Current | $I_{IL}$                        | $V_{IL}=0V$   | -0.6 | —    | 0.1  | mA                |

Note1) The surge current can be approx.5 times the specified supply current at power on.

Note2) According to USB standard

## 2. Interface

### 2-1. USB

This module can be communicated with the USB 2.0 interface (Full speed) if the USB cable is plugged. The communication with USB is based on HID class.

- USB Interface HID class (Standard) Conforming
- For Windows Xp multi language
- No additional driver for HID is needed

The module has interface of USB.

VFD Control Protocol uses HID report. HID report consists of the byte number of sending data and the sending data.

For HID, the report of data (IN or OUT) is fixed-length

The sum of data size and data is declared in HID Report Descriptor.

The data size means the size of sending or receiving data. Max is 63. So the report can send or receive 63bytes data max.

Following is type of report.

|               |                    |
|---------------|--------------------|
| Data Size (8) | Data Size (8) [63] |
|---------------|--------------------|

[Example]

Luminance adjustment (100%)

```
03 1B 40 02 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00
```

When the host needs the data (IN stage), more than 64bytes can be requested. If the length of response from VFD is over 63bytes, Data Size sets 64. If Data Size is 64, the host must read next data.

About interrupt in / Get report

The module replies 2 bytes "00H" to the request of the interrupt in / get report.

This data is not significant.

2-2. Descriptor Specifications  
Standard Device Descriptor

Table-7

| Offset | Field              | Description  | Size<br>[byt | Value | Comment |
|--------|--------------------|--|--------------|-------|---------|
| 0      | bLength            | Size of descriptor in bytes                                      | 1            | 12H   |         |
| 1      | bDescriptorType    | DEVICE Descriptor Type   | 1            | 01H   |         |
| 2      | bcdUSB             | USB Release Number in BCD  | 2            | 0200H | Rev.2.0 |
| 4      | bDeviceClass       | Class code   | 1            | 00H   |         |
| 5      | bDeviceSubClass    | Subclass code  | 1            | 00H   |         |
| 6      | bDeviceProtocol    | Protocol code  | 1            | 00H   |         |
| 7      | bMaxPacketSize     | Maximum packet size for endpoint zero                            | 1            | 40H   |         |
| 8      | idVendor           | Vendor ID  | 2            | 19C2H |         |
| 10     | idProduct          | Product ID   | 2            | 6A11H |         |
| 12     | bcdDevice          | Device release number in BCD                                     | 2            | 0100H | 1.00    |
| 14     | iManufacturer      | Index of string descriptor describing manufacturer               | 1            | 01H   |         |
| 15     | iProduct           | Index of string descriptor describing product                    | 1            | 02H   |         |
| 16     | iSerialNumber      | Index of string descriptor describing the device's serial number | 1            | 00H   |         |
| 17     | bNumConfigurations | Number of possible configurations                                | 1            | 01H   |         |

## Standard Configuration Descriptor

Table-8

| Offset | Field               | Description  | Size<br>[byte] | Value | Comment |
|--------|---------------------|--|----------------|-------|---------|
| 0      | bLength             | Size of this descriptor in bytes                         | 1              | 09H   |         |
| 1      | bDescriptorType     | CONFIGURATION Descriptor Type                            | 1              | 02H   |         |
| 2      | wTotalLength        | Total length of data returned for this configuration     | 2              | 0022H |         |
| 4      | bNumInterfaces      | Number of interfaces supported by this configuration     | 1              | 01H   |         |
| 5      | bConfigurationValue | Value to use as an argument                              | 1              | 01H   |         |
| 6      | iConfiguration      | Index of string descriptor describing this configuration | 1              | 00H   |         |
| 7      | bmAttributes        | Set self powered or Bus powered, and remote wakeup       | 1              | 80H   |         |
| 8      | MaxPower            | Maximum power consumption                                | 1              | FAH   | 500mA   |

Interface Descriptor (#1)

Table-9

| Offset | Field              | Description  | Size [byte] | Value | Comment |
|--------|--------------------|--|-------------|-------|---------|
| 0      | bLength            | Size of this descriptor in bytes                     | 1           | 09H   |         |
| 1      | bDescriptorType    | INTERFACE Descriptor Type                            | 1           | 04H   |         |
| 2      | bInterfaceNumber   | Number of this interface                             | 1           | 00H   |         |
| 3      | bAlternateSetting  | Value used to select this alternate setting          | 1           | 00H   |         |
| 4      | bNumEndpoints      | Number of endpoints used by this interface           | 1           | 01H   |         |
| 5      | bInterfaceClass    | Class code   | 1           | 03H   | HID     |
| 6      | bInterfaceSubClass | Subclass code  | 1           | 00H   |         |
| 7      | bInterfaceProtocol | Protocol code  | 1           | 00H   |         |
| 8      | iInterface         | Index of string descriptor describing this interface | 1           | 00H   |         |

HID Descriptor (#1)

Table-10

| Offset | Field           | Description                            | Size [byte] | Value | Comment              |
|--------|-----------------|--|-------------|-------|----------------------|
| 0      | bLength         | Size of HID descriptor                 | 1           | 09H   |                      |
| 1      | bDescriptorType | HID descriptor type                    | 1           | 21H   | HID Class descriptor |
| 2      | bcdHID          | HID class specification                | 2           | 0111H |                      |
| 4      | bCountry        | Country code of the localized hardware | 1           | 00H   | Not defined          |
| 5      | bNumDescriptors | Number of class descriptors            | 1           | 01H   | 1 report descriptor  |
| 6      | bReportType     | Type of class descriptor               | 1           | 22H   | REPORT descriptor    |
| 7      | wReportLength   | Descriptor length                      | 2           | 0027H | 39byte               |

Endpoint Descriptor (#1)

Table-11

| Offset | Description  | Size [byte] | Value | Comment            |
|--------|--|-------------|-------|--------------------|
| 0      | Size of this descriptor in bytes   | 1           | 07H   |                    |
| 1      | ENDPOINT Descriptor Type   | 1           | 05H   |                    |
| 2      | The address of the endpoint on the USB device described by this descriptor | 1           | 83H   | EP3 : IN           |
| 3      | The endpoint's attributes  | 1           | 03H   | Interrupt Transfer |
| 4      | Maximum packet size this endpoint  | 2           | 0040H |                    |
| 6      | Interval for polling endpoint for data transfers                           | 1           | FFH   | 255[ms]            |

HID Report Descriptor

Table-12

| Part                               | Value (HEX) |
|------------------------------------|-------------|
| Usage Page(Vendor-defined),        | 06 7F FF H  |
| Usage (VFD_CONTROL),               | 09 04 H     |
| Collection (Application),          | A1 01 H     |
| Usage (VFD_DATA_SIZE),             | 09 80 H     |
| Logical Minimum (0),               | 15 00 H     |
| Logical Maximum (255),             | 26 00 FF H  |
| Report Size (8),                   | 75 08 H     |
| Report Count (1),                  | 95 01 H     |
| Input (Data, Variable, Absolute),  | 81 02 H     |
| Usage (VFD_DATA_INPUT),            | 09 81 H     |
| Report Count (01),                 | 95 01 H     |
| Input (Data, Variable, Absolute),  | 81 02 H     |
| Usage (VFD_DATA_SIZE),             | 09 80 H     |
| Report Count (1),                  | 95 01 H     |
| Output (Data, Variable, Absolute), | 91 02 H     |
| Usage (VFD_DATA_OUTPUT),           | 09 82 H     |
| Report Count (63),                 | 95 3F H     |
| Output (Data, Variable, Absolute), | 91 02 H     |
| End Collection                     | C0 H        |

| Description     | Value(HEX) |
|-----------------|------------|
| VFD_CONTROL     | 04H        |
| VFD_DATA_SIZE   | 80H        |
| VFD_DATA_INPUT  | 81H        |
| VFD_DATA_OUTPUT | 82H        |

## String diskripter

| Part            | Description        | Value  |
|-----------------|--------------------|--|
| bLength         | Length             | 04H  |
| bDescriptorType | Type=STRING        | 03H  |
| bString         | LangID(English US) | 04 09 H                                      |
| bLength         | Length             | 34H  |
| bDescriptorType | Type=STRING        | 03H  |
| bString         | Manufacturer       | Targa GmbH                                   |
| bLength         | Length             | 5AH  |
| bDescriptorType | Type=STRING        | 03H  |
| bString         | Product            | Targa USB Graphic Vacuum Fluorescent Display |

3. Functions

The module has write-in mode and control codes as per section 3-1.

If power is supplied through CN1 (USB Power) only, the VFD power supply will not start-up and data cannot be received. Only if power is supplied through CN1 (USB Power) and CN2 (Floppy Power) too the VFD power supply will start-up, the clock with running time (6x8 format) at the top row, and "POWER ON" at the bottom row will be displayed centred on the VFD.

If the clock data was not set prior to CN1 (USB Power) on and CN2 (Floppy Power) on and was off meanwhile, only "POWER ON" will be displayed centred at the bottom row, no clock will be displayed at all.

Now the VFD can receive data.

When CN2 (Floppy Power) is switched off, the module enters stand-by mode. It will display the information sent before entering stand-by mode.

If clock was displayed before entering stand-by mode it will be displayed centred with running time until CN2 (Floppy Power) is switched on again and new data has been sent.

Clock mode (3-1-1, 3-1-2, 3-1-3) and Dimming level (3-1-4) will be kept.

In upper row Clock mode the last data sent before entering stand-by mode will be displayed too at the lower row.

In 1 row Clock mode (8x16 format) only the running clock will be displayed, the rest of the VFD is blanked.

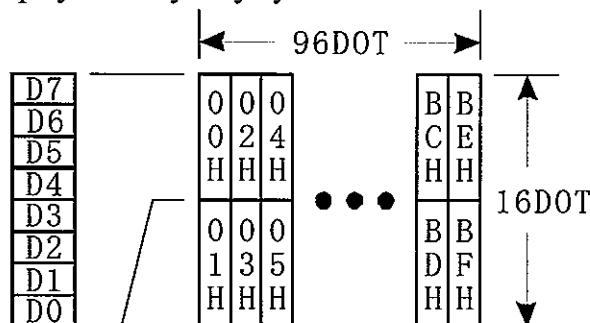
If CN2 (Floppy Power) is switched on again the clock with running time (6x8 format) at the top row and "POWER ON" at the bottom row will be displayed centred on the VFD until new data has been sent.

The module includes a power-on reset function.

| 5V<br>(USB<br>Power) | 5V<br>(Floppy<br>Power) | clock<br>data<br>valid | top row  | bottom row  |
|----------------------|-------------------------|------------------------|--|---|
| OFF                  | OFF                     | -                      | nothing  |   |
| OFF > ON             | OFF                     | no                     | nothing, because 5V Floppy missing for starting display                          |   |
| ON                   | OFF > ON                | no                     | nothing  | "POWER ON" is displayed (6x8)   |
| ON                   | OFF > ON                | yes                    | clock is displayed in 6x8 in the mode<br>which is set by the middleware acc. 3.1 | "POWER ON" is displayed (6x8)   |
| ON                   | ON                      | no / yes               | display content is defined by middleware   |   |
| ON                   | ON > OFF                | no                     | Keep previous data   | "POWER ON" is displayed (6x8)   |
| ON                   | ON > OFF                | yes                    | clock is displayed in 6x8 in the mode<br>which is set by the middleware acc. 3.1 | Character or Graphic that middleware wrote.<br>This text must be kept during Sleep state. |
|                      |                         |                        | clock is displayed in the mode which is set by the middleware acc. 3.1           |   |

\* Address map

\* This module has the display memory only by one screen.





3-1 . Control Commands

Table-13

| Code                         | Functions                                    |
|------------------------------|--|
| 1BH + 00H + 2bytes           | Set Clock Data                               |
| 1BH + 01H + 1byte            | Clock is displayed on upper row (6x8 format) |
| 1BH + 02H + 1byte            | Clock is displayed (8x16 format)             |
| 1BH + 30H + 2bytes           | Symbol Control                               |
| 1BH + 40H + 1bytes           | Dimming                                      |
| 1BH + 50H                    | Clear display RAM                            |
| 1BH + 55H                    | All segments "ON"                            |
| 1BH + 60H + 1byte            | Set AC value                                 |
| 1BH + 70H + 1byte + 1~48byte | Write graphic data                           |
| 1FH                          | RESET (Initialize the module)                |

3-1-1. Set Clock Data : 1BH + 00H + 2byte (clock data)

clock data : min(1byte) + hour (1byte)

\* The clock shifts at the rate during 1 minute/day.

3-1-2. Clock is displayed on upper row (6 x 8 format) :

1BH + 01H + 1byte(12h/24h)

12h:00H (default) 24h:01H

\* When clock data is not input, clock is not displayed.

\* This mode (clock is displayed on upper row) is default.

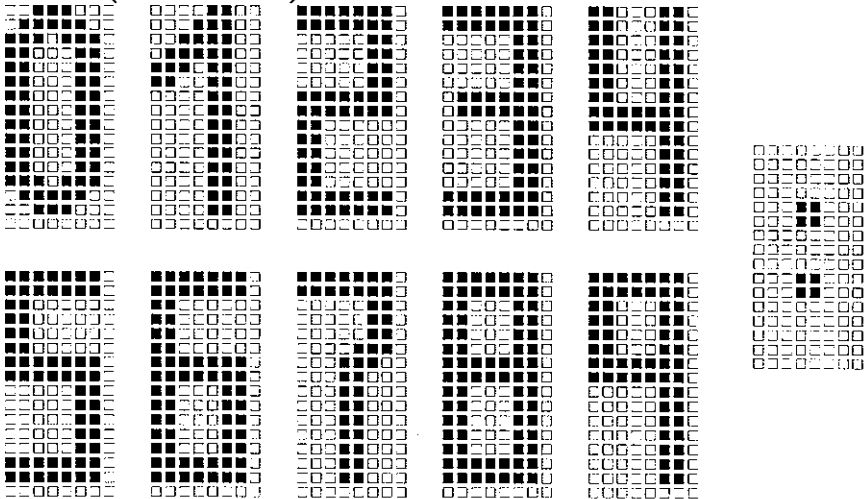
3-1-3. Clock is displayed on 1row (8 x 16 format)

1BH + 02H + 1byte(12h/24h)

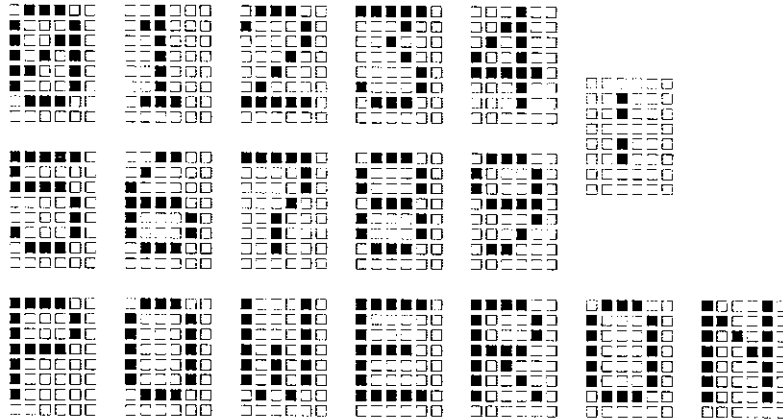
12h:00H 24h:01H

\* When clock data is not input, clock is not displayed.

\* Font of Numbers (8 x 16 format)



## \* Font of Numbers and alphabet (6 x 8 format)



## 3-1-4. Dimming : 1BH + 40H + 1 byte (Dimming level data)

The luminance can be controlled into 3 levels by using this function.

Dimming level data

|      |                  |
|------|------------------|
| 0%   | : 00 H           |
| 50 % | : 01 H (Default) |
| 100% | : 02 H           |

## 3-1-5. Clear display RAM : 1BH + 50H

Whole display RAM areas including invisible area are filled with 00H data.

(Include the symbol)

## 3-1-6. Set address Counter(AC) value : 1BH + 60H + xxH

xxH : 00 ~ BFH

AC value represents the start address for graphic data.

There are 192 bytes as display RAM. It can be set on anywhere even if AC value is not visible area. The default value is 00H.

\* Default : 00H

\* When clock is displayed, AC value is set 00H.

## 3-1-7. Write graphic data :

1BH + 70H + 1byte (Number of graphic data) + 1 ~ 48byte (Graphic data : xxH)

Number of graphic data : 01H ~ 30H

Graphic data : xxH : 00 ~ FFH

When a graphic data is written into the module, 8 bit pixel data would be displayed at AC position.

Graphic data can be sent at a time by 1 ~ 48 byte.

After this procedure, AC value will increment by one with the number of data sent before.

In case the AC value is over BFH, it becomes 00H as next.

## 3-1-8. Symbols control

Segment On/Off and Grayscale

1BH + 30H + 2 bytes (Symbol address + Grayscale level data)

Symbol address

Table-14

|      |     |     |     |      |      |      |      |
|------|-----|-----|-----|------|------|------|------|
| 00H  | 01H | 02H | 03H | 04H  | 05H  | 06H  | 07H  |
| A    | B   | C   | D-1 | D-2  | E    | F-1  | F-2  |
| 08H  | 09H | 0AH | 0BH | 0CH  | 0DH  | 0EH  | 0FH  |
| F-3  | F-4 | G   | H-1 | H-2  | H-3  | H-4  | H-5  |
| 10H  | 11H | 12H | 13H | 14H  | 15H  | 16H  | 17H  |
| H-6  | H-7 | H-8 | H-9 | H-10 | H-11 | H-12 | H-13 |
| 18H  |     |     |     |      |      |      |      |
| H-14 |     |     |     |      |      |      |      |

Grayscale level data

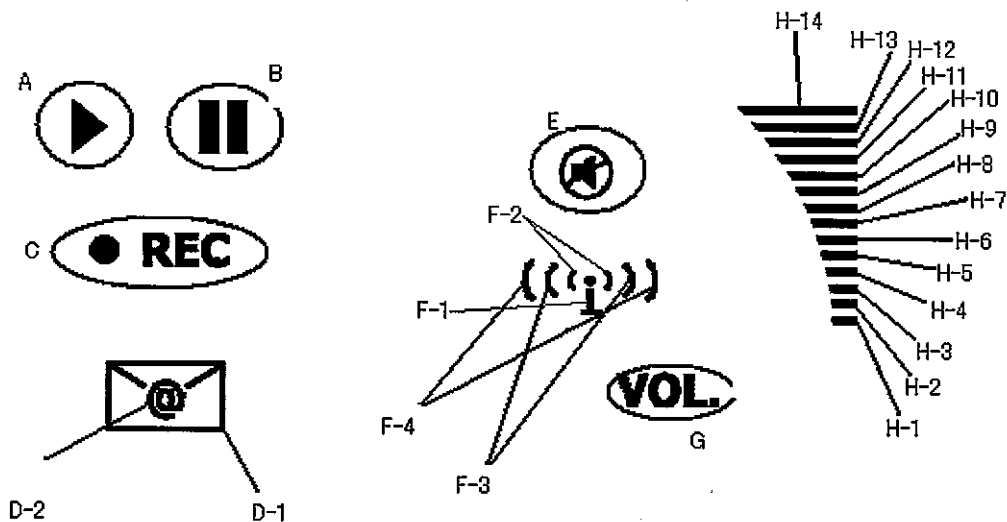
\*The symbol in a capable grayscale : 0B H ~ 18 H.

The grayscale data of other symbols is ignored, and set to 100% level automatically.

0% : 00 H

50% : 01 H

100% : 02 H



## 3-1-9. All segment "ON" : 1BH + 55H

All segments are "ON". (Exclude the symbols)

## 3-1-10. RESET(Initialize the module) : 1FH

The status of the module becomes as below. Only the status of DC/DC converter will not be changed.

Display RAM : Whole RAM area is filled by 00H.

AC : AC is set by 00H.

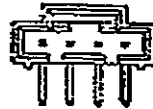
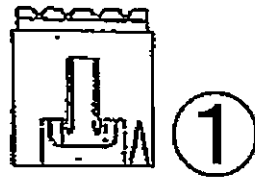
Dimming : 50% (01H)

## 4. CONNECTOR PIN CONNECTION

Connector CN1 : 9553-04-9-S1 (White) (ALEX)

Table-15

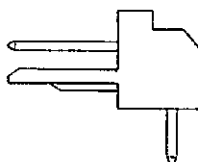
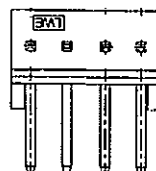
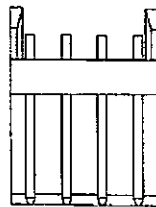
| Pin No. | Signal           |
|---------|------------------|
| 1       | Vcc1 (USB Power) |
| 2       | USB GND          |
| 3       | USB DATA +       |
| 4       | USB DATA -       |



Connector CN2 : 6203P040BT (White) (LANDWIN)

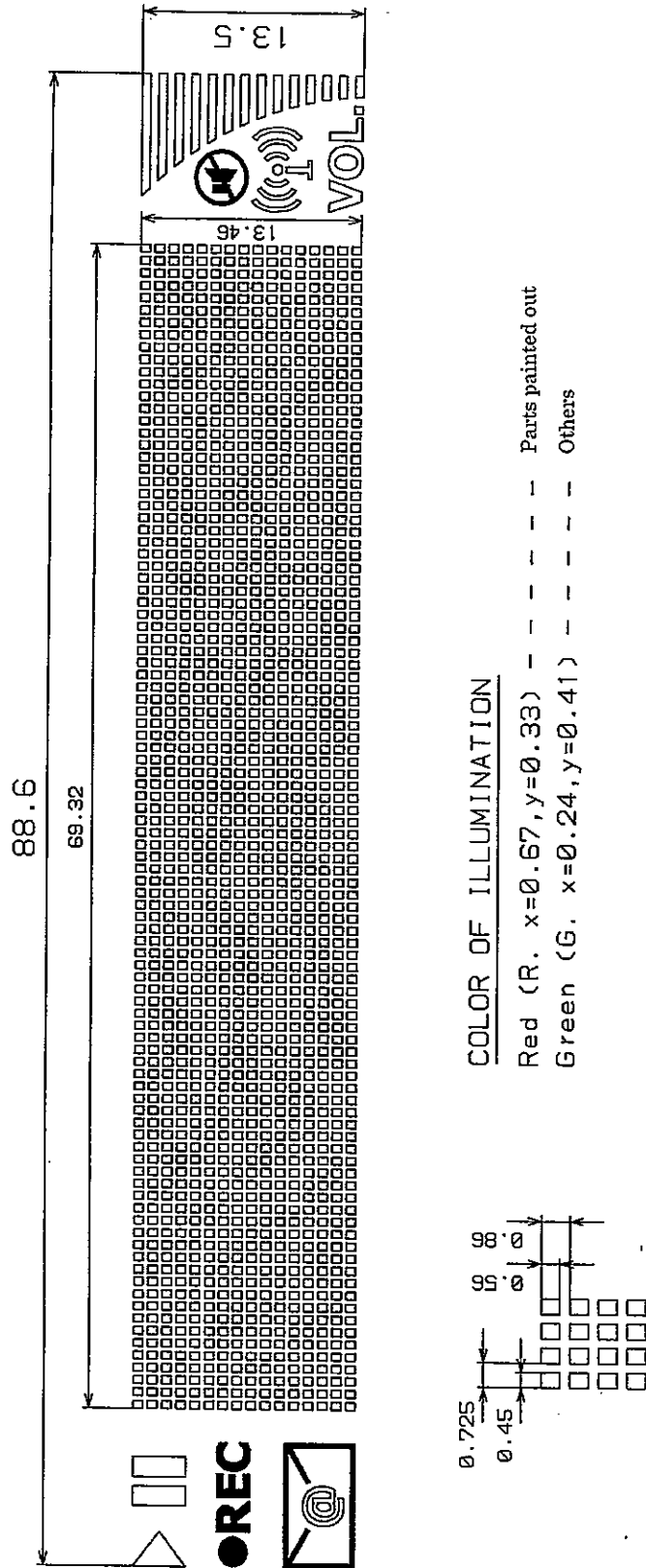
Table-16

| Pin No. | Signal      |
|---------|-------------|
| 1       | Vcc1        |
| 2       | GND         |
| 3       | GND         |
| 4       | NC (no pin) |



MDM166AA PATTERN DETAIL

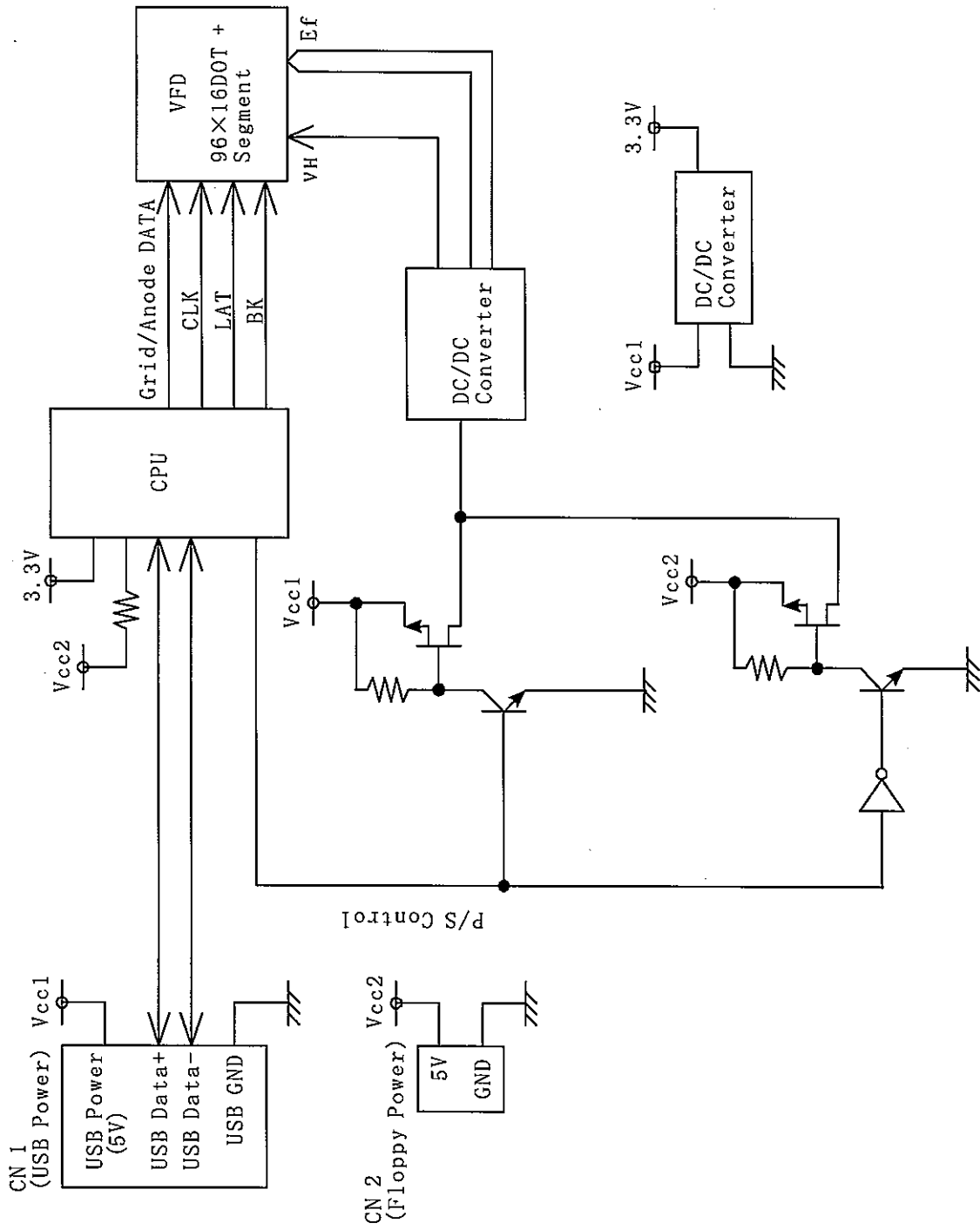
FIGURE-1





MDM166AA CIRCUIT BLOCK DIAGRAM

FIGURE-3



## 7. OPERATING RECOMMENDATION

- 7-1. Avoid applying excessive shock or vibration beyond the specification for this module.
- 7-2. Applying lower voltage than the specified may cause non activation for selected pixels.  
Conversely, higher voltage may cause non-selected pixel to be activated.  
If such a phenomenon is observed, check the voltage level of the power supply.
- 7-3. If the start up time of the supply voltage is slow, the controller may not be reset.  
The supply voltage must be risen up to the specified voltage level within 30msec.
- 7-4. Avoid using the module where excessive noise interference is expected. Noise affects the interface signal and causes improper operation.  
Keep the length of the interface cable less than 1.0m. (When the longer cable is required, please confirm there is no noise affection.)  
USB standard cable is recommended.
- 7-5. The expected lifetime half to the brightness is 30 k hours.