

# M0220MD-202MDAR1-3

## Dot-matrix Character Vacuum Fluorescent Display Module

|         |                                  |
|---------|----------------------------------|
| M-      | VFD Module                       |
| 0220-   | 2 lines x 20 characters          |
| M-      | Model                            |
| D-      | Dot-Matrix                       |
| 202MDA- | Character size = 3.68mm x 8.78mm |
| R-      | <b>RoHS Compliant</b>            |
| 1-3     | Parallel interface (M6800)       |

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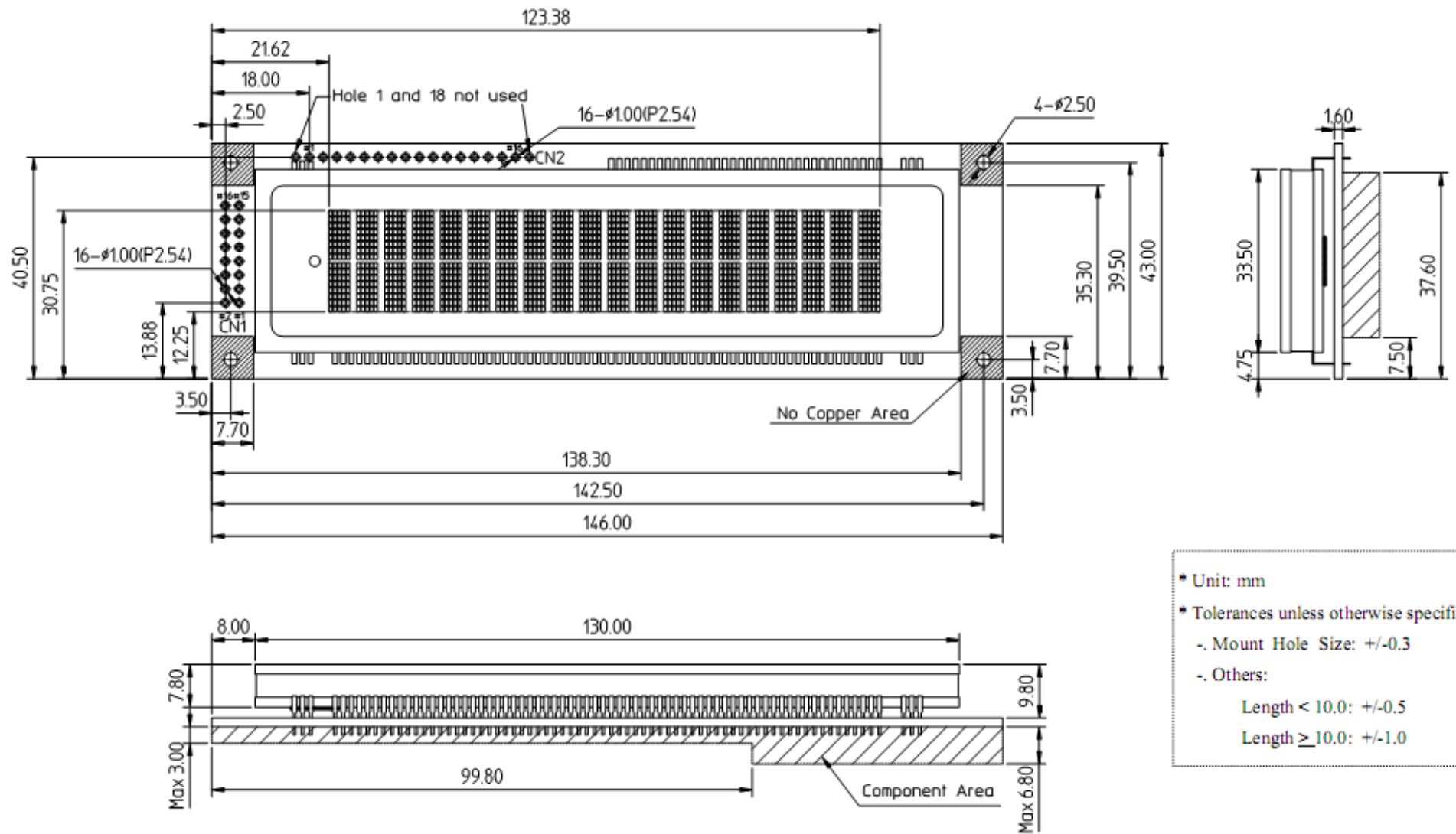
## Document Revision History

| Revision | Date      | Description                                           | Changed by |
|----------|-----------|-------------------------------------------------------|------------|
| 0        | 3/21/2005 | Initial Release                                       |            |
| 1        | 9/21/2009 | Updated Driver version, modified vf glass pins        | CL         |
| 2        | 12/4/2009 | Reduce pixel size to increase brightness and lifetime | CL         |
|          |           |                                                       |            |

## Functions and Features

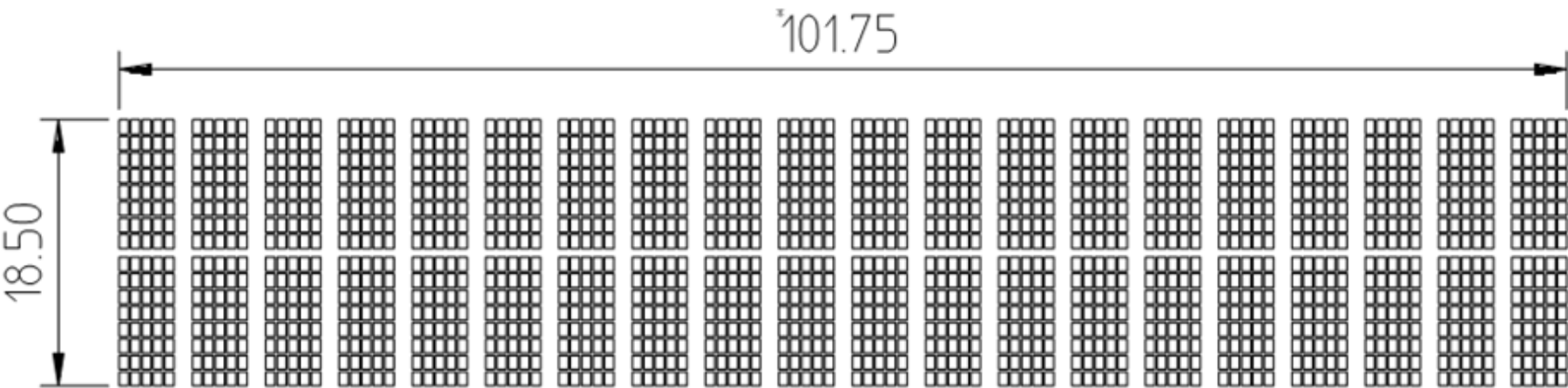
- 2 lines x 20 characters
- Built-in controller
- Built-in VF AC power supply
- 5.0V power supply
- 5x8 dots with cursor
- Parallel interface (Serial interface selectable by jumpers)

# Mechanical Drawing

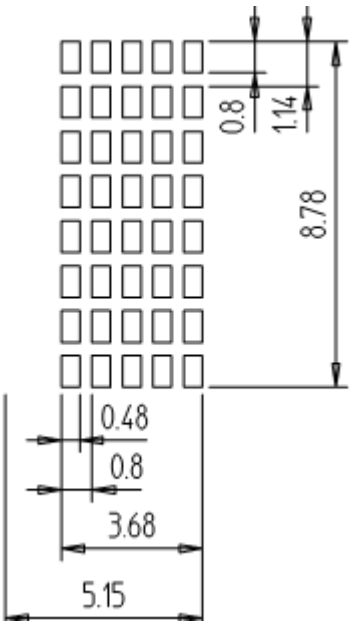


- Unit: mm
- Tolerances unless otherwise specified:
  - Mount Hole Size:  $\pm 0.3$
  - Others:
    - Length  $< 10.0$ :  $\pm 0.5$
    - Length  $\geq 10.0$ :  $\pm 1.0$

Pattern Detail



- ◎ Color of Illumination ◎
- Green (G. :x=0.250,y=0.439) ----- All Patterns.



## Pin Description (parallel interface)

| Pin No. | Symbol    | External Connection | Function Description                                                                                        |
|---------|-----------|---------------------|-------------------------------------------------------------------------------------------------------------|
| 1       | VSS       | Power Supply        | Ground                                                                                                      |
| 2       | VDD       | Power Supply        | Power supply for logic (+5.0V)                                                                              |
| 3       | NC (/RST) | - (MPU)             | No Connect (if JP2 is short, PIN3 = Active LOW reset signal)                                                |
| 4       | RS        | MPU                 | Register select signal RS=1: DATA RS=0: COMMAND                                                             |
| 5       | R/W       | MPU                 | Read/Write select signal RW=1: READ RW=0: WRITE                                                             |
| 6       | E         | MPU                 | Operation enable signal Falling Edge Triggered                                                              |
| 7-10    | DB0 – DB3 | MPU                 | Four low order bi-directional three-state data bus lines.<br>These four are not used during 4-bit operation |
| 11-14   | DB4 – DB7 | MPU                 | Four high order bi-directional three-state data bus lines.                                                  |

**Recommended LCD connector:** 2.54mm pitch pins

## Pin Description (optional serial interface)

| Pin No. | Symbol | External Connection | Function Description           |
|---------|--------|---------------------|--------------------------------|
| 1       | VSS    | Power Supply        | Ground                         |
| 2       | VDD    | Power Supply        | Power supply for logic (+5.0V) |
| 3       | SI/SO  | MPU                 | Serial Data In, data out       |
| 4       | STB    | MPU                 | Serial Strobe signal           |
| 5       | NC     | -                   | No Connect                     |
| 6       | SCK    | MPU                 | Serial Clock signal            |
| 7-14    | NC     | -                   | No Connect                     |

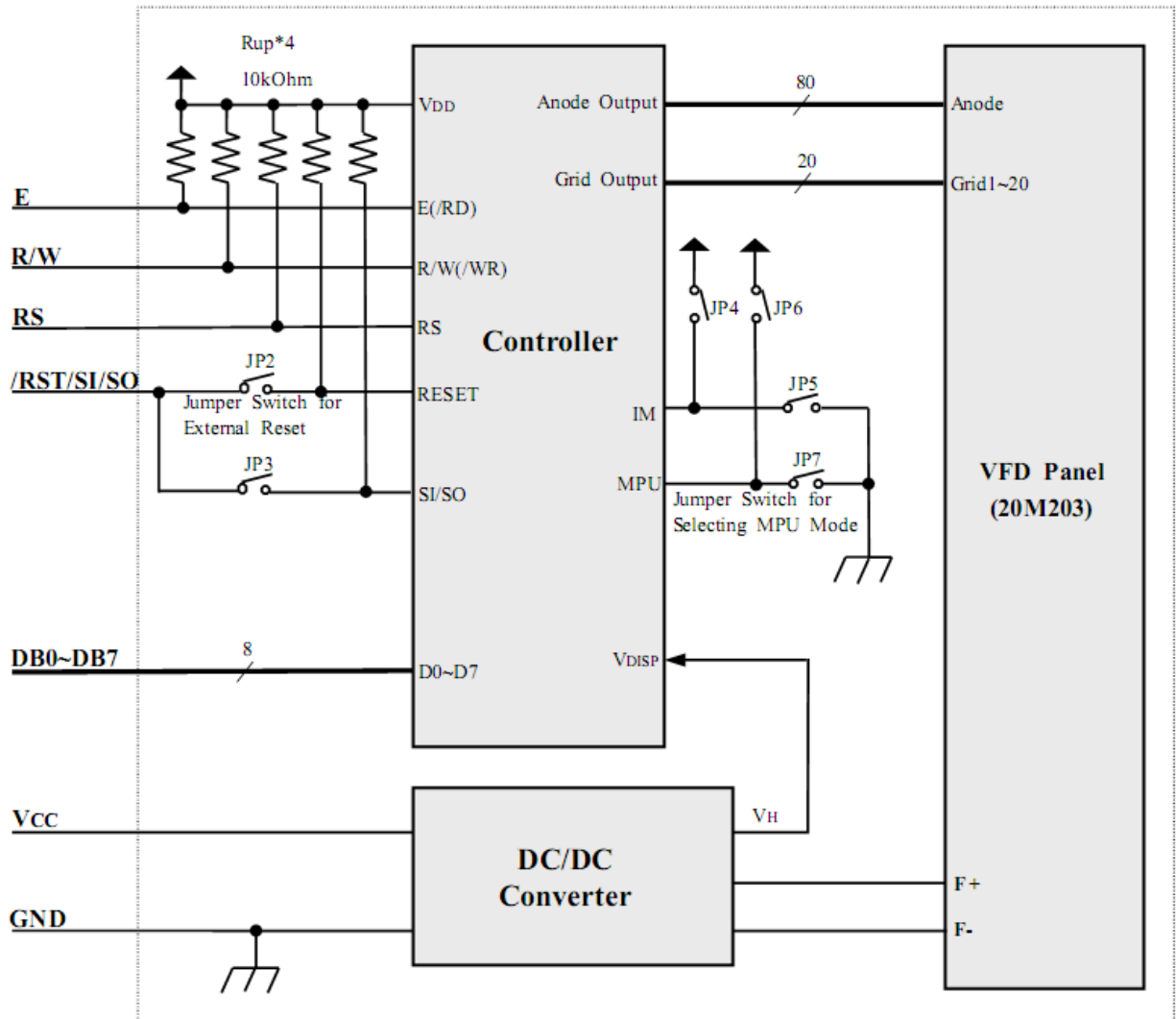
**Recommended LCD connector:** 2.54mm pitch pins

## Jumper Settings (Default Parallel M68 mode)

| Mode           | JP2  | JP3   | JP4   | JP5   | JP6   | JP7   |
|----------------|------|-------|-------|-------|-------|-------|
| Serial         | Open | Short | Open  | Short | Open  | Short |
| Parallel (I80) | *1   | Open  | Short | Open  | Open  | Short |
| Parallel (M68) | *1   | Open  | Short | Open  | Short | Open  |

\*1) JP2 short enables PIN3 as external reset. JP2 open disables reset.

## Block Diagram

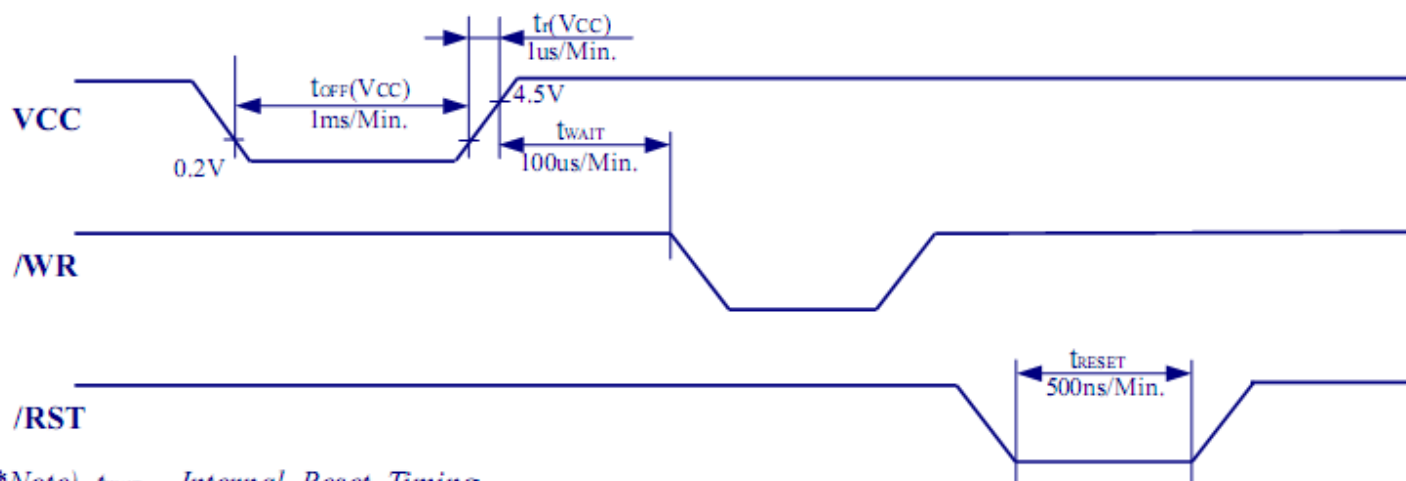


## Electrical Characteristics

| Item                        | Symbol | Condition           | Min. | Typ. | Max. | Unit              |
|-----------------------------|--------|---------------------|------|------|------|-------------------|
| Operating Temperature Range | Vop    |                     | -40  | -    | +85  | °C                |
| Storage Temperature Range   | Vst    |                     | -50  | -    | +95  | °C                |
| Operating Humidity          | Hop    |                     | 0    | -    | 85   | %                 |
| Storage Humidity            | Hst    |                     | 0    | -    | 90   | %                 |
| Vibration                   | -      | 10~55Hz             | -    | -    | 4    | G                 |
| Shock                       | -      |                     | -    | -    | 40   | G                 |
| Supply Voltage              | VDD    |                     | 4.5  | 5.0  | 5.5  | V                 |
| Supply Current (*Note)      | IDD    | Ta=25°C<br>VDD=5.0V | -    | 290  | 435  | mA                |
| Luminance                   | L      |                     | 350  | 500  | -    | cd/m <sup>2</sup> |
| "H" Level input             | Vih    |                     | 2.2  | -    | VDD  | V                 |
| "L" Level input             | Vil    |                     | 0    | -    | 0.6  | V                 |
| "H" Level output            | Voh    |                     | 2.4  | -    | -    | V                 |
| "L" Level output            | Vol    |                     | -    | -    | 0.4  | V                 |

**\*Note:** In-rush current can be approx 10 times the specified supply current at power up.

## Power-on Timing



*\*Note)  $t_{\text{WAIT}}$  – Internal Reset Timing*

## Controller Information

Built-in PT6314 controller. Download specification at [http://www.newhavendisplay.com/app\\_notes/PT6314.pdf](http://www.newhavendisplay.com/app_notes/PT6314.pdf)

## Table of Commands

| Instructions                          | Control                                                         |     | Instruction Code |                       |                      |    |    |     |     |                                                 | Descriptions                                                     |                                                                                                                                  |
|---------------------------------------|-----------------------------------------------------------------|-----|------------------|-----------------------|----------------------|----|----|-----|-----|-------------------------------------------------|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
|                                       | RS                                                              | R/W | D7               | D6                    | D5                   | D4 | D3 | D2  | D1  | D0                                              |                                                                  |                                                                                                                                  |
| Display Clear                         | 0                                                               | 0   | 0                | 0                     | 0                    | 0  | 0  | 0   | 0   | 1                                               | Clears all display and sets DD-RAM address 0 in address counter. |                                                                                                                                  |
| Cursor Home                           | 0                                                               | 0   | 0                | 0                     | 0                    | 0  | 0  | 0   | 0   | 1                                               | *                                                                | Sets DD-RAM address 0 in ACC. Also returns the display being shifted to the original position. DD-RAM contents remain unchanged. |
| Entry Mode Set                        | 0                                                               | 0   | 0                | 0                     | 0                    | 0  | 0  | 0   | 1   | I/D                                             | S                                                                | Sets the cursor direction and specifies display shift. These operations are performed during writing/reading data.               |
| Display ON/OFF Control                | 0                                                               | 0   | 0                | 0                     | 0                    | 0  | 0  | 1   | D   | C                                               | B                                                                | Sets all display ON/OFF (D), cursor ON/OFF (C), cursor blink of character position (B).                                          |
| Cursor or Display Shift               | 0                                                               | 0   | 0                | 0                     | 0                    | 0  | 1  | S/C | R/L | *                                               | *                                                                | Shifts display or cursor, keeping DD-RAM contents.                                                                               |
| Function Set                          | 0                                                               | 0   | 0                | 0                     | 1                    | IF | N  | *   | BR1 | BR0                                             |                                                                  | Sets data length (IF), number of display lines(N), Set brightness level(BR1,BR0)                                                 |
| CG-RAM Address Set                    | 0                                                               | 0   | 0                | 1                     | ACG (CG-RAM Address) |    |    |     |     |                                                 | Sets the CG-RAM address.                                         |                                                                                                                                  |
| DD-RAM Address Set                    | 0                                                               | 0   | 1                | ADD (DD-RAM Address)  |                      |    |    |     |     | Sets the DD-RAM address.                        |                                                                  |                                                                                                                                  |
| Busy Flag and Address Counter Reading | 0                                                               | 1   | BF               | ACC (Address Counter) |                      |    |    |     |     | Reads busy flag (BF) and address counter (ACC). |                                                                  |                                                                                                                                  |
| Data Writing to CG- or DD-RAM         | 1                                                               | 0   | Character Code   |                       |                      |    |    |     |     |                                                 | Writes data into CG-RAM or DD-RAM.                               |                                                                                                                                  |
| Data Reading from CG- or DD-RAM       | 1                                                               | 1   | Character Code   |                       |                      |    |    |     |     |                                                 | Reads data from CG-RAM or DD-RAM.                                |                                                                                                                                  |
| REMARKS:                              | * I/D = 1: Increment<br>* I/D = 0: Decrement                    |     |                  |                       |                      |    |    |     |     |                                                 |                                                                  | * IF = 1: 8-bit Operation<br>* IF = 0: 4-bit Operation                                                                           |
| * DD-RAM: Display Data RAM            | * S = 1: Display Shift Enabled<br>* S = 0: Cursor Shift Enabled |     |                  |                       |                      |    |    |     |     |                                                 |                                                                  | * N = 1: 2 Lines Display<br>* N = 0: 1 Line Display                                                                              |
| * CG-RAM: Character Generator RAM     |                                                                 |     |                  |                       |                      |    |    |     |     |                                                 |                                                                  |                                                                                                                                  |
| * ACG: CG-RAM Address                 | * S/C = 1: Display Shift<br>* S/C = 0: Cursor Move              |     |                  |                       |                      |    |    |     |     |                                                 |                                                                  | * BR1, BR0 =<br>00: 100%, 01: 75%, 10: 50%, 11: 25%                                                                              |
| * ADD: DD-RAM Address                 | * R/L = 1: Shift to the Right<br>* R/L = 0: Shift to the Left   |     |                  |                       |                      |    |    |     |     |                                                 |                                                                  | * BF = 1: Busy (Internally operating)<br>* BF = 0: Not busy (Instruction acceptable)                                             |
| * ACC: Address Counter                |                                                                 |     |                  |                       |                      |    |    |     |     |                                                 |                                                                  |                                                                                                                                  |

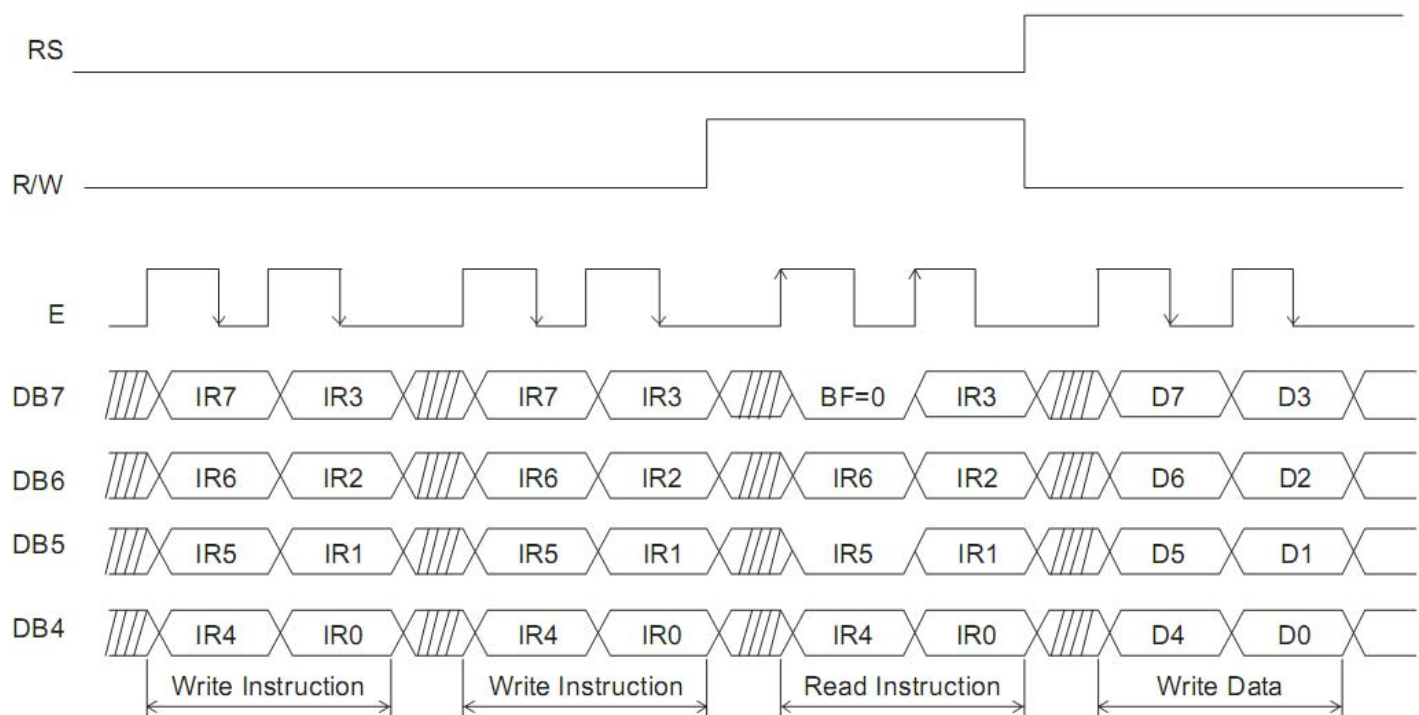
## Display character address code:

|         | 1st Column | 2nd Column | 3rd Column | ..... | 19th Column | 20th Column |
|---------|------------|------------|------------|-------|-------------|-------------|
| 1st ROW | 00 Hex     | 01 Hex     | 02 Hex     | ..... | 12 Hex      | 13 Hex      |
| 2nd ROW | 40 Hex     | 41Hex      | 42 Hex     | ..... | 52 Hex      | 53 Hex      |

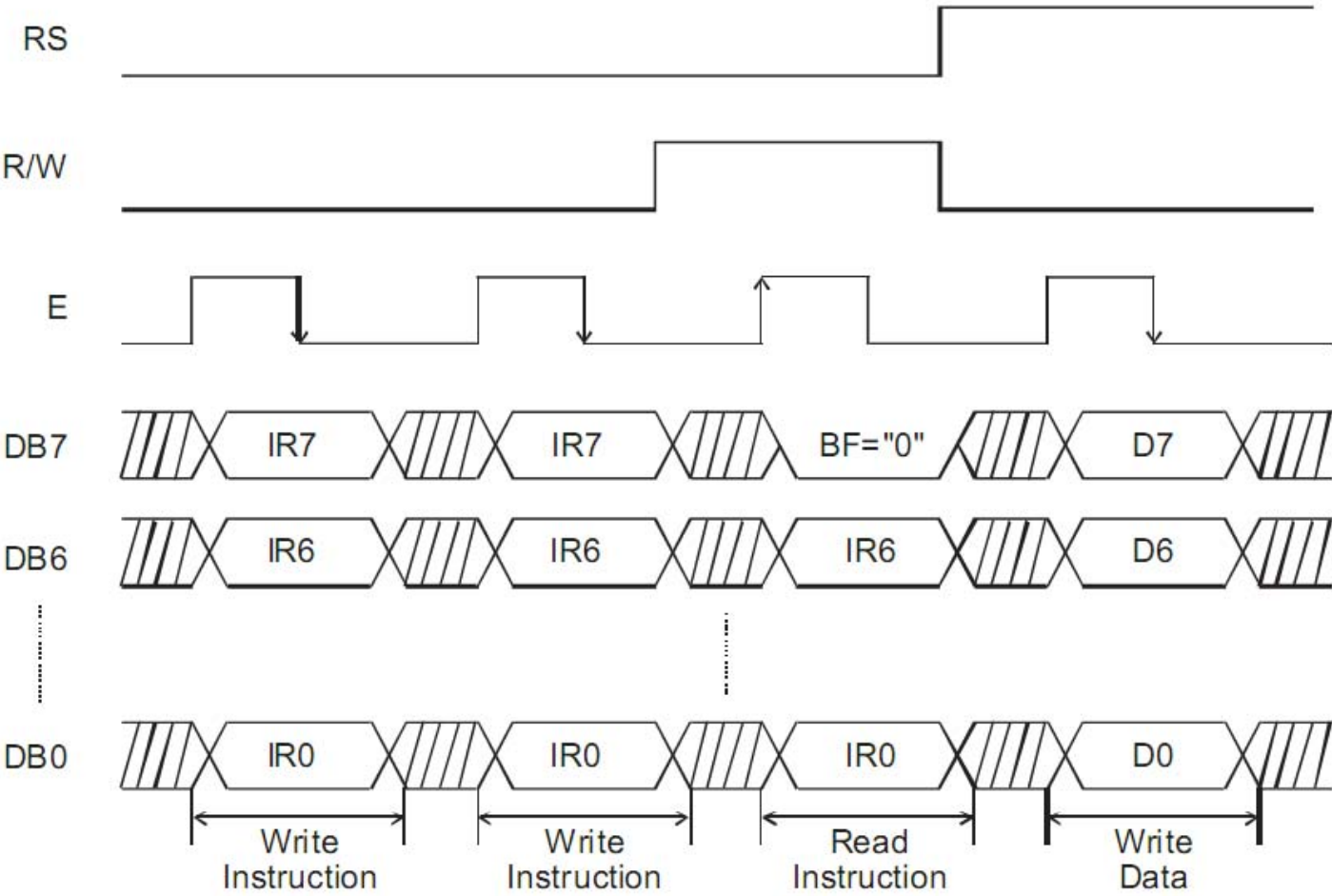
## M68 Parallel Interface:

The PT6314 can interface with the CPU in 4-bits or 8-bits. Note that the internal registers are composed of 8 bits. During data transfer in 4-bit mode, DB4-DB7 performs the data transfer operation two times, DB0-DB3 should be tied HIGH or LOW.

### 4-bit Data Transfer (M68):



8-bit Data Transfer (M68):



## Built-in Font Table

| Upper<br>Nibble<br>Lower<br>Nibble | 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 |  |
| 0 0 0 0                            | 0  | CG-RAM<br>(#1) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
| 0 0 0 1                            | 1  | CG-RAM<br>(#2) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
| 0 0 1 0                            | 2  | CG-RAM<br>(#3) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
| 0 0 1 1                            | 3  | CG-RAM<br>(#4) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
| 0 1 0 0                            | 4  | CG-RAM<br>(#5) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
| 0 1 0 1                            | 5  | CG-RAM<br>(#6) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
| 0 1 1 0                            | 6  | CG-RAM<br>(#7) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
| 0 1 1 1                            | 7  | CG-RAM<br>(#8) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
| 1 0 0 0                            | 8  | CG-RAM<br>(#1) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
| 1 0 0 1                            | 9  | CG-RAM<br>(#2) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
| 1 0 1 0                            | A  | CG-RAM<br>(#3) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
| 1 0 1 1                            | B  | CG-RAM<br>(#4) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
| 1 1 0 0                            | C  | CG-RAM<br>(#5) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
| 1 1 0 1                            | D  | CG-RAM<br>(#6) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
| 1 1 1 0                            | E  | CG-RAM<br>(#7) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |
| 1 1 1 1                            | F  | CG-RAM<br>(#8) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |

## Example Initialization after Power ON

| RS       | R/W | DB7   | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | Description                                                                                                                         |
|----------|-----|-------|-----|-----|-----|-----|-----|-----|-----|-------------------------------------------------------------------------------------------------------------------------------------|
| Power ON |     |       |     |     |     |     |     |     |     | Wait for 100 us                                                                                                                     |
| 0        | 0   | 0     | 0   | 1   | 1   | 1   | *   | 0   | 0   | Function set:<br>- Data length: 8 bits<br>- Display line No.: 2 lines<br>- Brightness: 100%                                         |
| 0        | 0   | 0     | 1   | 0   | 0   | 0   | 0   | 0   | 0   | CG-RAM address set to 00H                                                                                                           |
| 1        | 0   | *     | *   | *   | D   | D   | D   | D   | D   | Writes data into CG-RAM (the user-definable characters)<br>64 bytes in total (8 characters)                                         |
|          |     | *     | *   | *   | D   | D   | D   | D   | D   |                                                                                                                                     |
|          |     | ..... |     |     |     |     |     |     |     |                                                                                                                                     |
|          |     | *     | *   | *   | D   | D   | D   | D   | D   |                                                                                                                                     |
| 0        | 0   | 1     | 0   | 0   | 0   | 0   | 0   | 0   | 0   | DD-RAM address set to 00H (the first column of upper line)                                                                          |
| 1        | 0   | D     | D   | D   | D   | D   | D   | D   | D   | Writes data into DD-RAM (choose the character codes to display in upper line)<br>Totally 20 bytes in the upper line (20 characters) |
|          |     | D     | D   | D   | D   | D   | D   | D   | D   |                                                                                                                                     |
|          |     | ..... |     |     |     |     |     |     |     |                                                                                                                                     |
|          |     | D     | D   | D   | D   | D   | D   | D   | D   |                                                                                                                                     |
| 0        | 0   | 1     | 1   | 0   | 0   | 0   | 0   | 0   | 0   | DD-RAM address set to 40H (the first column of lower line)                                                                          |
| 1        | 0   | D     | D   | D   | D   | D   | D   | D   | D   | Writes data into DD-RAM (choose the character codes to display in lower line)<br>Totally 20 bytes in the lower line (20 characters) |
|          |     | D     | D   | D   | D   | D   | D   | D   | D   |                                                                                                                                     |
|          |     | ..... |     |     |     |     |     |     |     |                                                                                                                                     |
|          |     | D     | D   | D   | D   | D   | D   | D   | D   |                                                                                                                                     |
| 0        | 0   | 0     | 0   | 0   | 0   | 1   | 1   | 0   | 0   | Display ON, Cursor OFF, Cursor blink OFF                                                                                            |

\*Note): D is the binary data to be written-in.

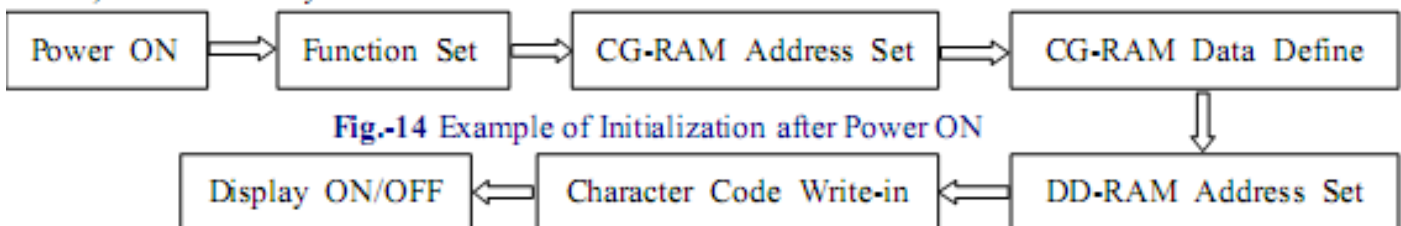


Fig.-14 Example of Initialization after Power ON

## Quality Information

| Test Item                             | Content of Test                                                                                                                 | Test Condition                                                                      | Note |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------|
| High Temperature storage              | Endurance test applying the high storage temperature for a long time.                                                           | +80°C , 48hrs                                                                       | 2    |
| Low Temperature storage               | Endurance test applying the low storage temperature for a long time.                                                            | -30°C , 48hrs                                                                       | 1,2  |
| High Temperature Operation            | Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.                    | +70°C 48hrs                                                                         | 2    |
| Low Temperature Operation             | Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.                     | -20°C , 48hrs                                                                       | 1,2  |
| High Temperature / Humidity Operation | Endurance test applying the electric stress (voltage & current) and the high thermal with high humidity stress for a long time. | +40°C , 90% RH , 48hrs                                                              | 1,2  |
| Thermal Shock resistance              | Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress.                  | 0°C,30min -> +25°C,5min -> +50°C,30min = 1 cycle<br>10 cycles                       |      |
| Vibration test                        | Endurance test applying vibration to simulate transportation and use.                                                           | 10-55Hz , 15mm amplitude.<br>60 sec in each of 3 directions X,Y,Z<br>For 15 minutes | 3    |
| Static electricity test               | Endurance test applying electric static discharge.                                                                              | VS=800V, RS=1.5kΩ, CS=100pF<br>One time                                             |      |

**Note 1:** No condensation to be observed.

**Note 2:** Conducted after 4 hours of storage at 25°C, 0%RH.

**Note 3:** Test performed on product itself, not inside a container.

## Precautions for using LCDs/LCMs

See Precautions at [www.newhavendisplay.com/specs/precautions.pdf](http://www.newhavendisplay.com/specs/precautions.pdf)

## Warranty Information and Terms & Conditions

[http://www.newhavendisplay.com/index.php?main\\_page=terms](http://www.newhavendisplay.com/index.php?main_page=terms)