

# OPTIONS & SELECTION GUIDES

## TN (Twisted Nematic)

### STN (Super Twisted Nematic)

- STN type offers high contrast and wide viewing angle.
- STN type is available with different background colors;
- Yellow-green w/black characters
- Silver-gray w/dark blue characters
- Dark blue w/white characters

### FSTN (Film STN)

- Black and white STN with very high contrast ratio for large graphic panels.

## BACK LIGHT

### EL (Electro- luminescent)

- Power efficient

### LED with a choice of colors

- Bright and even back lighting
- Long life expectancy, more than 100,000 hours
- Simple to drive. Needs +5 volts only
- Brightness can be easily adjusted

### CCFL (Cold Cathode Florescent Light)

- Paper white, best for large graphic displays
- Less power consumption than LED's

## TEMPERATURE RANGE

|          | OPERATION (°C) | STORAGE (°C) |
|----------|----------------|--------------|
| STANDARD | 0 ~ +50        | -20 ~ +70    |
| EXTENDED | -20 ~ +70      | -30 ~ +80    |

## DISPLAY TYPE

- Positive image (Dark dots on light background)
- Negative image (Light dots on dark background)

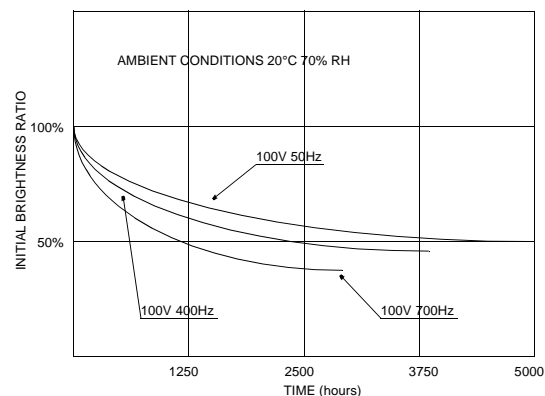
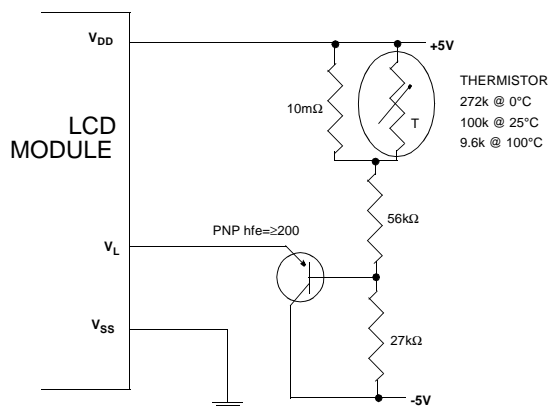
## VIEWING ANGLE

- 12:00 (Top) Display is below eye level
- 6:00 (Bottom) Display is above eye level

## SELECTION GUIDE

| DISPLAY/POLARIZER      | DISPLAY DESCRIPTION                                  | OUTDOORS  | OFFICE LIGHT | SUBDUED LIGHT | VERY LOW LIGHT | COMMENTS                       |
|------------------------|--|-----------|--------------|---------------|----------------|--------------------------------|
| REFLECTIVE POSITIVE    | DARK CHARACTERS ON A LIGHT GREY OR YELLOW BACKGROUND | EXCELLENT | VERY GOOD    | POOR          | UNUSABLE       | CAN'T BE BACK LIT              |
| TRANSFLECTIVE POSITIVE | DARK CHARACTERS ON A LIGHT GREY OR YELLOW BACKGROUND | EXCELLENT | VERY GOOD    | VERY GOOD     | EXCELLENT      | BEST CHOICE FOR GENERAL USE    |
| TRANSMISSIVE NEGATIVE  | LIGHT CHARACTERS ON A DARK BACKGROUND                | POOR      | GOOD         | VERY GOOD     | EXCELLENT      | MUST BE USED WITH A BACK-LIGHT |
| TRANSMISSIVE POSITIVE  | DARK CHARACTERS ON A LIGHT GRAY OR YELLOW BACKGROUND | GOOD      | VERY GOOD    | EXCELENT      | EXCELLENT      | HIGH CONTRAST DISPLAY          |

# TEMPERATURE COMPENSATION & EL LIFE TIME



# COMMANDS FOR CHARACTER MODULES

| Command                     | Code  |     |            |     |                 |                 |     |                                    |   |   | Description  | Execution Time  |             |
|-----------------------------|---|-----|------------|-----|-----------------|-----------------|-----|------------------------------------|---|---|--|---|-------------|
|                             | RS  | R/W | DB7        | DB6 | DB5             | DB4             | DB3 | DB2                                | DB1   | DB0   |  |   |             |
| Clear Display               | 0   | 0   | 0          | 0   | 0               | 0               | 0   | 0                                  | 0   | 0   | 1  | Clears the display and returns the cursor to the home position (address 0).   | 82µs~1.64ms |
| Return Home                 | 0   | 0   | 0          | 0   | 0               | 0               | 0   | 0                                  | 0   | 1   | *  | Returns the cursor to the home position (address 0). Also returns a shifted display to the home position. DD RAM contents remain unchanged. | 40µs~1.64ms |
| Entry Mode Set              | 0   | 0   | 0          | 0   | 0               | 0               | 0   | 0                                  | 1   | I/D   | S  | Sets the cursor move direction and enables/disables the display.  | 40µs        |
| Display ON/OFF Control      | 0   | 0   | 0          | 0   | 0               | 0               | 0   | 1                                  | D   | C   | B  | Turns the display ON/OFF (D), or the cursor ON/OFF (C), and blink of the character at the cursor position (B).                              | 40µs        |
| Cursor & Display Shift      | 0   | 0   | 0          | 0   | 0               | 0               | 1   | S/C                                | R/L   | *   | *  | Moves the cursor and shifts the display without changing the DD RAM contents.   | 40µs        |
| Function Set                | 0   | 0   | 0          | 0   | 0               | 1               | DL  | N\$                                | RE  | *   | #  | Sets the data width (DL), the number of lines in the display (L), and the character font (F).   | 40µs        |
| Set CG RAM Address          | 0   | 0   | 0          | 0   | 1               | A <sub>CG</sub> |     |                                    |   |   | Sets the CG RAM address. CG RAM data can be read or altered after making this setting.   | 40µs  |             |
| Set DD RAM Address          | 0   | 0   | 0          | 1   | A <sub>DD</sub> |                 |     |                                    |   | Sets the DD RAM address. Data may be written or read after making this setting. | 40µs   |   |             |
| Read Busy Flag & Address    | 0   | 1   | BF         | AC  |                 |                 |     |                                    | Reads the BUSY flag (BF) indicating that an internal operation is being performed and reads the address counter contents. | 1µs   |  |   |             |
| Write Data to CG or DD RAM  | 1   | 0   | Write Data |     |                 |                 |     | Writes data into DD RAM or CG RAM. | 46µs  |   |  |   |             |
| Read Data from CG or DD RAM | 1   | 1   | Read Data  |     |                 |                 |     | Reads data from DD RAM or CG RAM.  | 46µs  |   |  |   |             |
|                             | I/D = 1: Increment                      I/D = 0: Decrement<br>S = 1: Accompanies display shift.<br>S/C= 1: Display shift                  S/C = 0: cursor move<br>R/L= 1: Shift to the right.          R/L= 0: Shift to the left.<br>DL = 1: 8 bits                              DL = 0: 4 bits<br>N = 1: 2 lines                              N = 0: 1 line<br>RE = 1: Ext. Reg. Ena.                F = 0: 5 x 7 dots<br>BF = 1: Busy                                BF = 0: Can accept data<br># Set to 1 on 24x4 modules<br>\$ With KS0072 is Address Mode. |     |            |     |                 |                 |     |                                    |   |   | DD RAM: Display data RAM<br>CG RAM: Character generator RAM<br>A <sub>CG</sub> : CG RAM Address<br>A <sub>DD</sub> : DD RAM Address<br>Corresponds to cursor address.<br>AC: Address counter<br>Used for both DD and CG RAM address. | Execution times are typical. If transfers are timed by software and the busy flag is not used, add 10% to the above times.                  |             |

# CHARACTER MODULE INITIALIZATION

## Internal Reset Circuit

The module is automatically initialized when the power is applied. The following commands are executed during initialization. The busy flag is kept in the busy state until initialization is complete. The busy state lasts for 10 ms after  $V_{DD}$  reaches 4.5 volts.

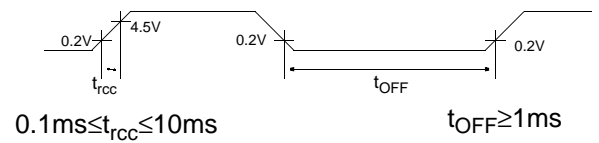
- 1) Clear Display
- 2) Function set
  - DL=1.....8-bit data length for interface
  - N=0.....Single-line display
  - F=0.....5x7 dot matrix character font
- 3) Display ON/OFF Control
  - D=0.....Display OFF
  - C=0.....Cursor OFF
  - B=0.....Blink function OFF
- 4) Entry Mode Set
  - I/D=1.....Increment Mode
  - S=0.....Display shift OFF

## NOTE:

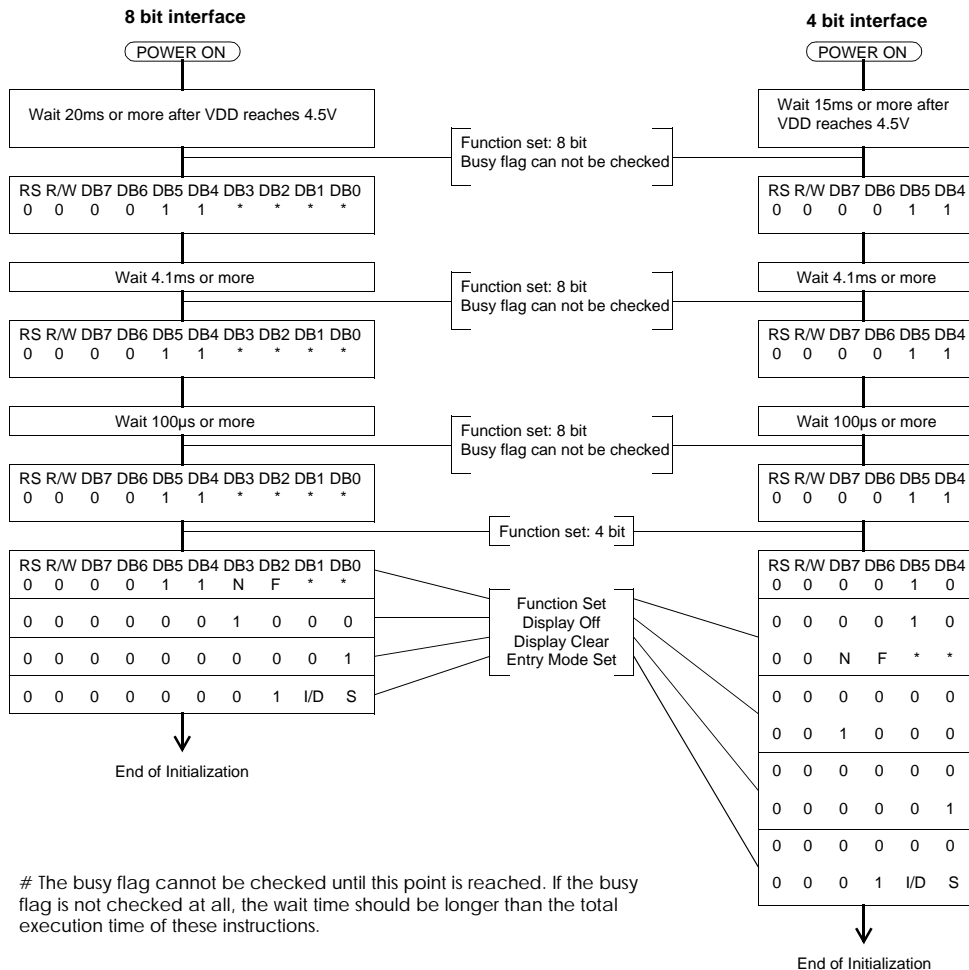
If the following power conditions are not satisfied, the internal reset circuit does not function properly. In this case, the initialization should be executed by the series of instructions from outside the MPU (Software Initialization).

## Power Conditions for Internal Reset

| ITEM                   | SYMBOL    | MIN | TYP | MAX | UNIT |
|------------------------|-----------|-----|-----|-----|------|
| Power Supply Rise Time | $t_{rcc}$ | 0.1 | -   | 10  | ms   |
| Power Supply Off Time  | $t_{OFF}$ | 1.0 | -   | -   | ms   |



## Software Initialization



# DISPLAY CHARACTER POSITION AND CHARACTER ADDRESS

1) 8 x 1: HDM08111H-1

|            | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | ← DISPLAY POSITION |
|------------|----|----|----|----|----|----|----|----|--------------------|
| FIRST LINE | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | ← DD RAM ADDRESS   |

2) 8 x 2: HDM08216H-1, HDM08216H-3, HDM08216L-3

|             | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | ← DISPLAY POSITION |
|-------------|----|----|----|----|----|----|----|----|--------------------|
| FIRST LINE  | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | ← DD RAM ADDRESS   |
| SECOND LINE | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |                    |

3) 12 x 2: HDM12216H, HDM12216L

|             | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | ← DISPLAY POSITION |
|-------------|----|----|----|----|----|----|----|----|----|----|----|----|--------------------|
| FIRST LINE  | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | ← DD RAM ADDRESS   |
| SECOND LINE | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B |                    |

4) 16 x 1: HDM16116H-L, HDM16116L-L

|            | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | ← DISPLAY POSITION |
|------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--------------------|
| FIRST LINE | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F | ← DD RAM ADDRESS   |

5) 16 x 1: HDM16116H-2, HDM16116L, HDM16116L-7

|            | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | ← DISPLAY POSITION |
|------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--------------------|
| FIRST LINE | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | ← DD RAM ADDRESS   |

6) 16 x 2: HDM16216H-2, HDM16216H-4, HDM16216H-5, HDM16216H-B, HDM16216H-S  
HDM16216L-2, HDM16216L-5, HDM16216L-6, HDM16216L-7, HDM16216L-B, HDM16216L-S

|             | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | ← DISPLAY POSITION |
|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--------------------|
| FIRST LINE  | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F | ← DD RAM ADDRESS   |
| SECOND LINE | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | 4F |                    |

7) 16 x 4: HDM16416H, HDM16416L

|             | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | ← DISPLAY POSITION |
|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--------------------|
| FIRST LINE  | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F | ← DD RAM ADDRESS   |
| SECOND LINE | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | 4F |                    |
| THIRD LINE  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 1A | 1B | 1C | 1D | 1E | 1F |                    |
| FORTH LINE  | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 5A | 5B | 5C | 5D | 5E | 5F |                    |

8) 20 x 2: HDM20216H-3, HDM20216H-L, HDM20216L, HDM20216L-L

|             | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| FIRST LINE  | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F | 10 | 11 | 12 | 13 |
| SECOND LINE | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | 4F | 50 | 51 | 52 | 53 |

← DISPLAY POSITION  
← DD RAM ADDRESS

9) 20 x 4: HDM20416H, HDM20416L

|             | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| FIRST LINE  | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F | 10 | 11 | 12 | 13 |
| SECOND LINE | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | 4F | 50 | 51 | 52 | 53 |
| THIRD LINE  | 14 | 15 | 16 | 17 | 18 | 19 | 1A | 1B | 1C | 1D | 1E | 1F | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| FORTH LINE  | 54 | 55 | 56 | 57 | 58 | 59 | 5A | 5B | 5C | 5D | 5E | 5F | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 |

← DISPLAY POSITION  
← DD RAM ADDRESS

10) 24 x 2: HDM24216H-2, HDM24216L-2

|             | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| FIRST LINE  | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | 0F | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| SECOND LINE | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | 4F | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 |

← DISPLAY POSITION  
← DD RAM ADDRESS

11) 24 x 4: HDM24416H, HDM24416L

|             | 1  | 2  | 3  | 4  | 5  | 6  | 7  |  |  |  |  |  |  |  | 21 | 22 | 23 | 24 |
|-------------|----|----|----|----|----|----|----|--|--|--|--|--|--|--|----|----|----|----|
| FIRST LINE  | 00 | 01 | 02 | 03 | 04 | 05 | 06 |  |  |  |  |  |  |  | 14 | 15 | 16 | 17 |
| SECOND LINE | 20 | 21 | 22 | 23 | 24 | 25 | 26 |  |  |  |  |  |  |  | 34 | 35 | 36 | 37 |
| THIRD LINE  | 40 | 41 | 42 | 43 | 44 | 45 | 46 |  |  |  |  |  |  |  | 54 | 55 | 56 | 57 |
| FORTH LINE  | 60 | 61 | 62 | 63 | 64 | 65 | 66 |  |  |  |  |  |  |  | 74 | 75 | 76 | 77 |

← DISPLAY POSITION  
← DD RAM ADDRESS

12) 40 x 1: HDM40108H-2

|            | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 |       |  |  |  | 37 | 38 | 39 | 40 |
|------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-------|--|--|--|----|----|----|----|
| FIRST LINE | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | ----- |  |  |  | 24 | 25 | 26 | 27 |

← DISPLAY POSITION  
← DD RAM ADDRESS

13) 40 x 2: HDM40216H-4, HDM40216L

|             | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 |       |  |  |  | 37 | 38 | 39 | 40 |
|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-------|--|--|--|----|----|----|----|
| FIRST LINE  | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 0A | 0B | 0C | 0D | 0E | ----- |  |  |  | 24 | 25 | 26 | 27 |
| SECOND LINE | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 4A | 4B | 4C | 4D | 4E | ----- |  |  |  | 64 | 65 | 66 | 67 |

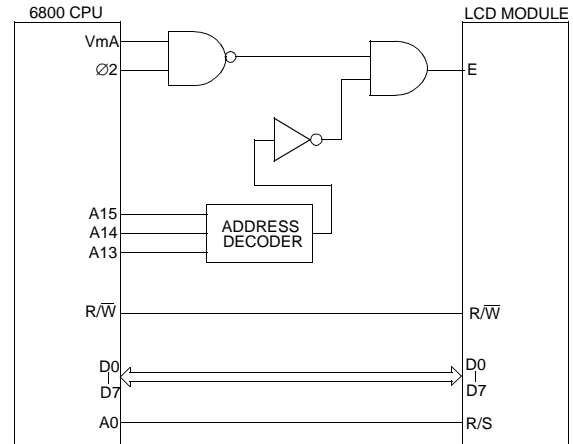
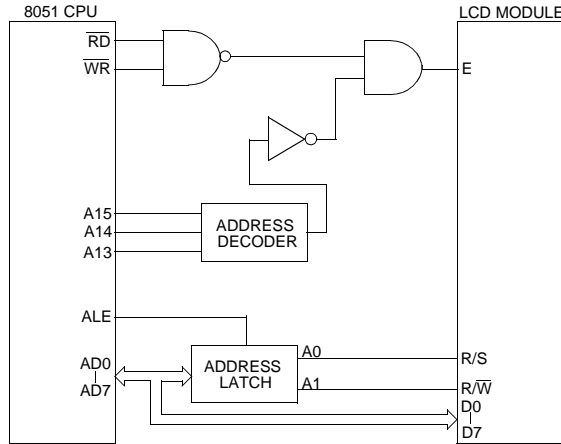
← DISPLAY POSITION  
← DD RAM ADDRESS

14) 40 x 4: HDM40416H-5, HDM40416L-4

|             | 1  | 2  | 3  | 4  | 5  | 6  | 7  |  |  |  |  |  |  |  | 37 | 38 | 39 | 40 |
|-------------|----|----|----|----|----|----|----|--|--|--|--|--|--|--|----|----|----|----|
| FIRST LINE  | 00 | 01 | 02 | 03 | 04 | 05 | 06 |  |  |  |  |  |  |  | 24 | 25 | 26 | 27 |
| SECOND LINE | 40 | 41 | 42 | 43 | 44 | 45 | 46 |  |  |  |  |  |  |  | 64 | 65 | 66 | 67 |
| THIRD LINE  | 00 | 01 | 02 | 03 | 04 | 05 | 06 |  |  |  |  |  |  |  | 24 | 25 | 26 | 27 |
| FORTH LINE  | 40 | 41 | 42 | 43 | 44 | 45 | 46 |  |  |  |  |  |  |  | 64 | 65 | 66 | 67 |

← DISPLAY POSITION  
← DD RAM ADDRESS

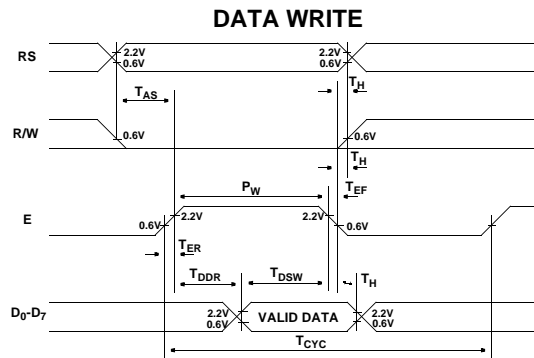
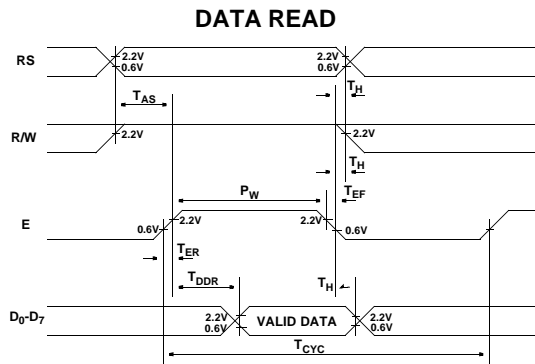
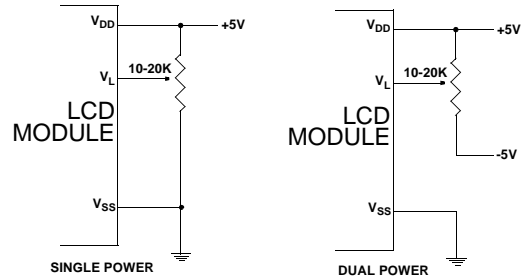
# PROCESSOR INTERFACING



## TIMING CHARACTERISTICS

| ITEM                  | SYMBOL           | MAX. | MIN. | UNIT |
|-----------------------|------------------|------|------|------|
| ENABLE CYCLE TIME     | $T_{CYC}$        |      | 500  | nS   |
| ENABLE PULSE WIDTH    | $P_W$            |      | 230  | nS   |
| ENABLE RISE/FALL TIME | $T_{ER}, T_{EF}$ | 20   |      | nS   |
| RS, R/W SET UP TIME   | $T_{AS}$         |      | 40   | nS   |
| DATA DELAY TIME       | $T_{DDR}$        | 360  |      | nS   |
| DATA SETUP TIME       | $T_{DSW}$        |      | 60   | nS   |
| HOLD TIME             | $T_H$            |      | 10   | nS   |

## POWER SUPPLY EXAMPLES



## HANDLING LCD'S & LCD MODULES

### CLEANING

- Wipe gently with cotton or soft material soaked in petroleum benzene.
- Do not use acetone, toluene, ethanol or isopropyl alcohol.
- Contact with water for a long period of time may damage the display.

### SAFETY

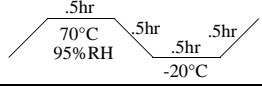
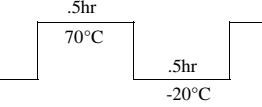
- The toxicity of liquid crystal fluid is very low, but wash it off immediately with soap and water if fluid touches the skin or clothing.

### HANDLING

- Do not touch display area with bare hands.
- Do not touch exposed polarizer with hard objects.
- Do not expose the CMOS IC's to static electricity.
- Avoid exposing the module to excessive shock or pressure.
- Do not allow the storage temperature to exceed the specified range.

# RELIABILITY DATA

## SUMMARY: LIFETIME AND ENVIRONMENTAL TESTS

| TEST ITEMS                          | TEST CONDITIONS   | TEST TIME                   | NUMBR OF UNITS TESTED | FAILURE RATE (%) |
|-------------------------------------|---|-----------------------------|-----------------------|------------------|
| TEMPERATURE LIFETIME                | 60°C, 5V, 32Hz<br>30°C, 5V, 32Hz  | 7,000hr<br>7,000hr          | 50<br>50              | 0<br>0           |
| HIGH TEMPERATURE                    | 70°C<br>95°C<br>60°C  | 1,000hr<br>100hr<br>5,000hr | 300<br>300<br>300     | 0<br>0<br>0      |
| LOW TEMPERATURE                     | -40°C<br>-30°C  | 100hr<br>1,000hr            | 300<br>300            | 0<br>0           |
| HIGH TEMPERATURE AND HUMIDITY       | 70°C, 95%RH<br>40°C, 95%RH  | 100hr<br>500hr              | 300<br>300            | 0<br>0           |
| TEMPERATURE AND HUMIDITY CYCLE      |  | 25 CYCLES                   | 50                    | 0                |
| POLARIZER AND REFLECTOR RELIABILITY | 70°C, DRY<br>90°C, DRY  | 1,000hr<br>100hr            | 300<br>300            | 0<br>0           |
| ULTRAVIOLET LIGHT                   | OUTDOOR EXPOSURE  | 5,000hr                     | 50                    | 0                |
| HEAT SHOCK                          |  | 25 CYCLES                   | 50                    | 0                |
| VIBRATION                           | 10 - 50Hz, 1g, X, Y, Z DIRECTIONS<br>51 - 300Hz, 0.5g, X, Y, Z DIRECTIONS         | 1hr                         | 50                    | 0                |
| MECHANICAL                          | 50g 15ms ± X, Y, Z  | 3 TIMES EACH                | 50                    | 0                |

## SUMMARY: LIFE EXPECTANCY

| COMPONENT                    | TYPICAL LIFETIME              |
|------------------------------|-------------------------------|
| LCD DISPLAY (GLASS ASSEMBLY) | 50,000hr (5.7yr)              |
| LCD ELECTRONICS              | 100,000hr (12yr) min          |
| EL BACK LIGHT                | 5,000hr (7mo) <sup>1, 2</sup> |
| CCFL BACK LIGHT              | 15,000hr (20mo) <sup>2</sup>  |
| LED BACKLIGHT                | 100,000hr (12yr) min          |

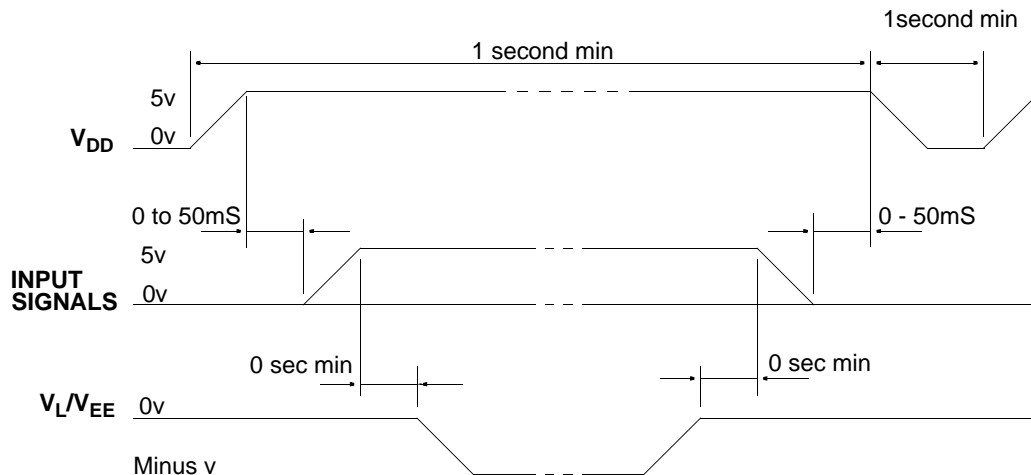
### NOTES:

1. It is recommended that the product be designed so that the EL back light is not left on continuously. This will greatly extend the life of the back light element.

2. Usable lifetime of the back light is reached when the light output reaches 50% of the original brightness.

## POWER SUPPLY SEQUENCING (Graphics Modules Only)

The power supply voltages should be sequenced according to the following timing diagram. This will insure that the internal electronics have time to begin operation before the negative voltage is applied. The sequence of events should be as follows: Apply  $V_{DD}$  first. When  $V_{DD}$  is stable at 5v, apply the input signals and then apply  $V_L/V_{EE}$ . The shut down sequence is exactly the opposite. **Failure to follow this procedure may result in permanent damage to the LCD fluid or to the CMOS electronics on the module.**



### NOTICE:

Specifications in this catalog are subject to change without notice. Some mechanical specifications may vary slightly from those listed in this catalog due to changes and improvements made to the product. The most current specifications are maintained on our Web site at: [www.hantronix.com](http://www.hantronix.com).

# CHARACTER MODULE FONT TABLE (Standard font)

Character modules with built in controllers and Character Generator (CG) ROM & RAM will display 96 ASCII and special characters in a dot matrix format. Then first 16 locations are occupied by the character generator RAM. These locations can be loaded with the user designed symbols and then displayed along with the characters stored in the CG ROM.

| CHARACTER FONT TABLE               |               |      |      |      |      |      |      |      |      |      |      |      |      |
|------------------------------------|---------------|------|------|------|------|------|------|------|------|------|------|------|------|
| UPPER<br>4 BITS<br>LOWER<br>4 BITS | 0000          | 0010 | 0011 | 0100 | 0101 | 0110 | 0111 | 1010 | 1011 | 1100 | 1101 | 1110 | 1111 |
| 0000                               | CG RAM<br>(1) |      | 0    | a    | P    | `    | P    |      | -    | 9    | E    | o    | p    |
| 0001                               | (2)           | !    | 1    | A    | Q    | a    | q    | .    | 7    | 7    | G    | ä    | q    |
| 0010                               | (3)           | "    | 2    | B    | R    | b    | r    | ´    | í    | W    | x    | ß    | e    |
| 0011                               | (4)           | #    | 3    | C    | S    | c    | s    | ¸    | ó    | 7    | E    | ε    | ∞    |
| 0100                               | (5)           | \$   | 4    | D    | T    | d    | t    | ˘    | ı    | ı    | ı    | μ    | Ω    |
| 0101                               | (6)           | %    | 5    | E    | U    | e    | u    | .    | o    | +    | ı    | ε    | ü    |
| 0110                               | (7)           | &    | 6    | F    | V    | f    | v    | ˆ    | o    | ı    | ı    | ρ    | Σ    |
| 0111                               | (8)           | '    | 7    | G    | W    | g    | w    | ˙    | ı    | ı    | ı    | g    | π    |
| 1000                               | (1)           | (    | 8    | H    | X    | h    | x    | ı    | ı    | ı    | ı    | ı    | ı    |
| 1001                               | (2)           | )    | 9    | I    | Y    | i    | y    | ı    | ı    | ı    | ı    | ı    | y    |
| 1010                               | (3)           | *    | :    | J    | Z    | j    | z    | ı    | ı    | ı    | ı    | j    | ı    |
| 1011                               | (4)           | +    | ;    | K    | L    | k    | l    | ı    | ı    | ı    | ı    | ı    | ı    |
| 1100                               | (5)           | ,    | <    | L    | *    | ı    | ı    | ı    | ı    | ı    | ı    | ı    | ı    |
| 1101                               | (6)           | -    | =    | M    | I    | m    | )    | ı    | ı    | ı    | ı    | ı    | ı    |
| 1110                               | (7)           | .    | >    | N    | ^    | n    | ı    | ı    | ı    | ı    | ı    | ı    | ı    |
| 1111                               | (8)           | /    | ?    | O    | _    | o    | ı    | ı    | ı    | ı    | ı    | ı    | ı    |