



**FOCUS LCDs**  
LCDs MADE SIMPLE®

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TFT | OLED | CHARACTER | GRAPHIC | UWVD | SEGMENT | CUSTOM

## Graphic Display Module

Part Number

*G12864A-FTW-DW63*

### Overview:

- 128x64 Graphic LCD
- FSTN Positive, Gray-White
- 89.70x49.80mm Module
- Parallel & Serial Interfaces
- White LED Backlight
- Transflective
- Wide Temp Range
- 3.0V
- LCD IC: NT7534
- RoHS Compliant

## Graphic LCD Features

Resolution: 128x64 Dots

Interface(s): Parallel & Serial

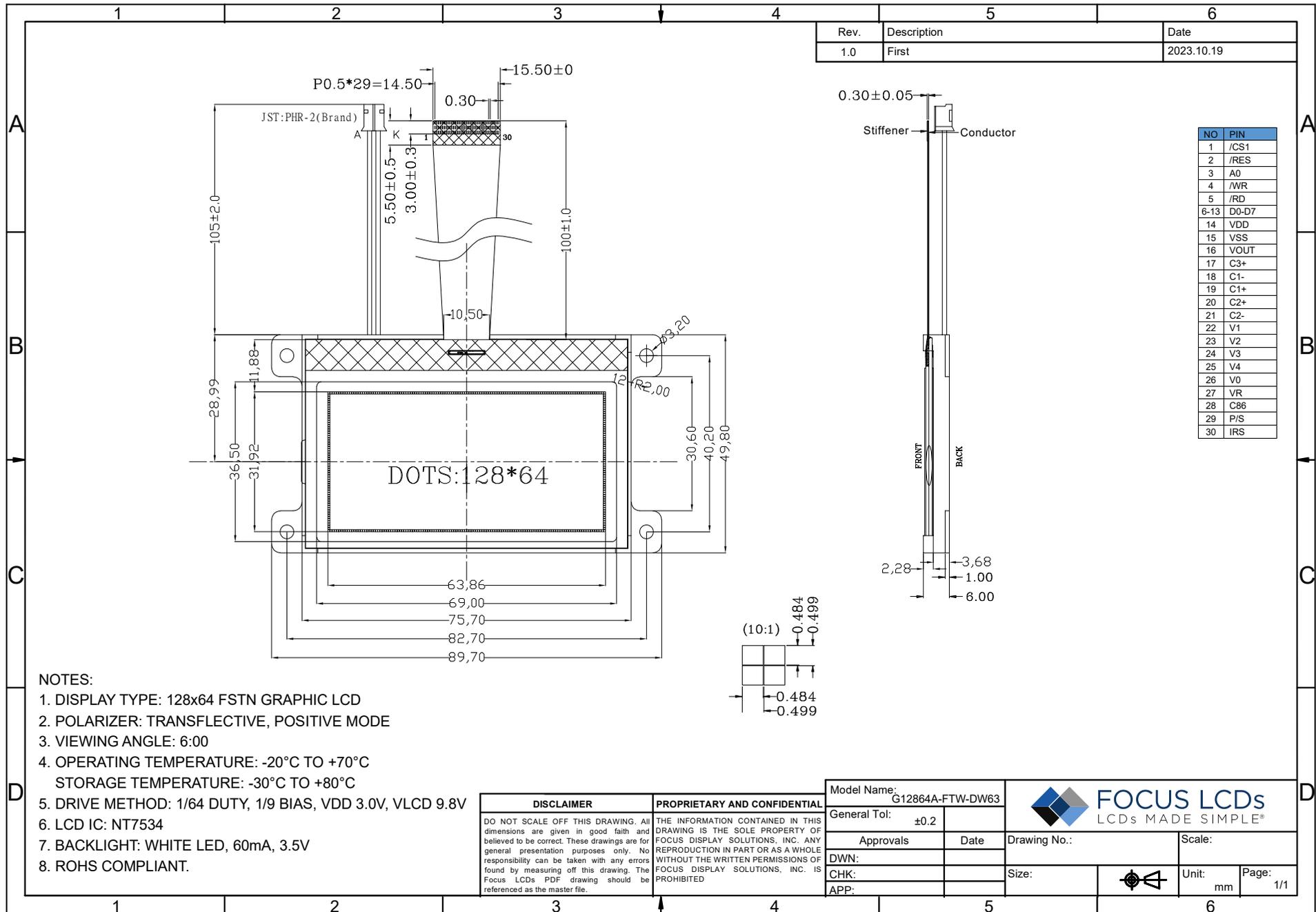
RoHS Compliant.

| General Information Items | Specification       | Unit    | Note |
|---------------------------|---------------------|---------|------|
|                           | Main Panel          |         |      |
| Viewing Area (VA)         | 69.0 (H) x 36.5 (V) | mm      | --   |
| LCD Type                  | FSTN Positive       | --      | --   |
| Viewing Angle             | 6:00                | O'Clock | --   |
| Polarizer                 | Transflective       | --      | --   |
| Backlight Type            | LED                 | --      | --   |
| Backlight Color           | White               | --      | --   |
| LCD IC                    | NT7534              | --      | --   |
| Drive Mode                | 1/64 Duty, 1/9 Bias | --      | --   |
| Operating Temperature     | -20 to +70          | °C      | --   |
| Storage Temperature       | -30 to +80          | °C      | --   |

## Mechanical Information

| Item        |                | Min. | Typ.  | Max. | Unit | Note        |
|-------------|----------------|------|-------|------|------|-------------|
| Module Size | Horizontal (H) | --   | 89.70 | --   | mm   | --          |
|             | Vertical (V)   | --   | 49.80 | --   | mm   | --          |
|             | Depth (D)      | --   | 6.00  | --   | mm   | --          |
| Weight      |                | --   | 33    | --   | g    | Approximate |

# 1. Outline Dimensions



## 2. Input Terminal Pin Assignment

| NO.      | Symbol                     | Description   | I/O      |       |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
|----------|----------------------------|---|----------|-------|----|----|----|----------|-------|-------|-------|-------|----------|-------|-------|-------|-------|----------|-------|-------|-------|-------|----------|-------|-------|-------|-------|----------|-------|-------|-------|-------|----------|-------|-------|-------|-------|-----|
| 1        | /CS1                       | Chip select signal. When /CS1="L" and CS2="H", then the chip select becomes active, and data/command I/O is enabled.  | I        |       |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 2        | /RES                       | External reset. When /RES is set to "L", the settings are initialized.  | I        |       |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 3        | A0                         | This is connected to the least significant bit of the normal MPU address bus, and it determines whether the data bits are data or a command.<br>A0 = "H": Indicate that D0 to D7 are display data.<br>A0 = "L": Indicates that D0 to D7 are control data.   | I        |       |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 4        | /WR                        | When connected to an 8080 MPU, this is active LOW.<br>This terminal connects to the 8080 MPU /WR signal.<br>The signals on the data bus are latched at the rising edge of the /WR signal.<br>When connected to a 6800 Series MPU, this is the read/write control signal input terminal.<br>When R/W = "H": Read.<br>When R/W = "L": Write.  | I        |       |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 5        | /RD                        | When connected to an 8080 MPU, this is active LOW.<br>This pad is connected to the /RD signal of the 8080MPU, and the NT7534 data bus is in an output status when this signal is "L".<br>When connected to a 6800 Series MPU, this is active HIGH.<br>This is used as an enable clock input of the 6800 series MPU.   | I        |       |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 6-13     | D0-D7                      | This is an 8-bit bi-directional data bus that connects to an 8-bit or 16-bit standard MPU data bus.<br>When the serial interface is selected (P/S="L"), then D7 serves as the serial data input terminal (SI) and D6 serves as the serial clock input terminal (SCL). At this time, D0 to D5 are set to high impedance.<br>When the chip select is inactive, D0 to D7 are set to high impedance.  | I/O      |       |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 14       | VDD                        | Power supply.   | P        |       |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 15       | VSS                        | Ground.   | P        |       |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 16       | VOUT                       | DC/DC voltage converter output.   | I/O      |       |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 17       | C3+                        | Capacitor 3+ pad for internal DC/DC voltage converter.  | O        |       |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 18       | C1-                        | Capacitor 1- pad for internal DC/DC voltage converter.  | O        |       |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 19       | C1+                        | Capacitor 1+ pad for internal DC/DC voltage converter.  | O        |       |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 20       | C2+                        | Capacitor 2+ pad for internal DC/DC voltage converter.  | O        |       |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 21       | C2-                        | Capacitor 2- pad for internal DC/DC voltage converter.  | O        |       |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 22-26    | V1<br>V2<br>V3<br>V4<br>V0 | LCD driver supplies voltages.<br>The voltage determined by the LCD cell is impedance-converted by a resistive driver or an operation amplifier for application.<br>Voltages should be according to the following relationship:<br>$V0 \geq V1 \geq V2 \geq V3 \geq V4 \geq VSS2$<br>When the on-chip operating power circuit is on, the following voltages are supplied to V1 to V4 by the on-chip power circuit.<br>Voltage selection is performed by the LCD Bias Set command.<br><table border="1" data-bbox="470 1787 1276 2020"> <thead> <tr> <th>LCD bias</th> <th>V1</th> <th>V2</th> <th>V3</th> <th>V4</th> </tr> </thead> <tbody> <tr> <td>1/4 bias</td> <td>3/4V0</td> <td>2/4V0</td> <td>2/4V0</td> <td>1/4V0</td> </tr> <tr> <td>1/5 bias</td> <td>4/5V0</td> <td>3/5V0</td> <td>2/5V0</td> <td>1/5V0</td> </tr> <tr> <td>1/6 bias</td> <td>5/6V0</td> <td>4/6V0</td> <td>2/6V0</td> <td>1/6V0</td> </tr> <tr> <td>1/7 bias</td> <td>6/7V0</td> <td>5/7V0</td> <td>2/7V0</td> <td>1/7V0</td> </tr> <tr> <td>1/8 bias</td> <td>7/8V0</td> <td>6/8V0</td> <td>2/8V0</td> <td>1/8V0</td> </tr> <tr> <td>1/9 bias</td> <td>8/9V0</td> <td>7/9V0</td> <td>2/9V0</td> <td>1/9V0</td> </tr> </tbody> </table> | LCD bias | V1    | V2 | V3 | V4 | 1/4 bias | 3/4V0 | 2/4V0 | 2/4V0 | 1/4V0 | 1/5 bias | 4/5V0 | 3/5V0 | 2/5V0 | 1/5V0 | 1/6 bias | 5/6V0 | 4/6V0 | 2/6V0 | 1/6V0 | 1/7 bias | 6/7V0 | 5/7V0 | 2/7V0 | 1/7V0 | 1/8 bias | 7/8V0 | 6/8V0 | 2/8V0 | 1/8V0 | 1/9 bias | 8/9V0 | 7/9V0 | 2/9V0 | 1/9V0 | I/O |
| LCD bias | V1                         | V2  | V3       | V4    |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 1/4 bias | 3/4V0                      | 2/4V0   | 2/4V0    | 1/4V0 |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 1/5 bias | 4/5V0                      | 3/5V0   | 2/5V0    | 1/5V0 |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 1/6 bias | 5/6V0                      | 4/6V0   | 2/6V0    | 1/6V0 |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 1/7 bias | 6/7V0                      | 5/7V0   | 2/7V0    | 1/7V0 |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 1/8 bias | 7/8V0                      | 6/8V0   | 2/8V0    | 1/8V0 |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 1/9 bias | 8/9V0                      | 7/9V0   | 2/9V0    | 1/9V0 |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |
| 27       | VR                         | Voltage adjustment pad. Applies voltage between V0 and VSS using a resistive divider.   | I        |       |    |    |    |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |          |       |       |       |       |     |

| 28  | C86          | <p>MPU interface switch terminal.<br/>         C86 = "H": 6800 Series MPU interface.<br/>         C86 = "L": 8080 Series MPU interface.</p>   | I          |              |      |            |              |     |    |          |          |    |     |    |         |            |          |   |
|-----|--------------|---|------------|--------------|------|------------|--------------|-----|----|----------|----------|----|-----|----|---------|------------|----------|---|
| 29  | P/S          | <p>Parallel data input/serial data input switch terminal.<br/>         P/S = "H": Parallel data input.<br/>         P/S = "L": Serial data input.<br/>         The following applies depending on the P/S status:</p> <table border="1" data-bbox="470 409 1337 537"> <thead> <tr> <th>P/S</th> <th>Data/Command</th> <th>Data</th> <th>Read/Write</th> <th>Serial Clock</th> </tr> </thead> <tbody> <tr> <td>"H"</td> <td>A0</td> <td>D0 to D7</td> <td>/RD, /WR</td> <td>--</td> </tr> <tr> <td>"L"</td> <td>A0</td> <td>SI (D7)</td> <td>Write only</td> <td>SCL (D6)</td> </tr> </tbody> </table> | P/S        | Data/Command | Data | Read/Write | Serial Clock | "H" | A0 | D0 to D7 | /RD, /WR | -- | "L" | A0 | SI (D7) | Write only | SCL (D6) | I |
| P/S | Data/Command | Data  | Read/Write | Serial Clock |      |            |              |     |    |          |          |    |     |    |         |            |          |   |
| "H" | A0           | D0 to D7  | /RD, /WR   | --           |      |            |              |     |    |          |          |    |     |    |         |            |          |   |
| "L" | A0           | SI (D7)   | Write only | SCL (D6)     |      |            |              |     |    |          |          |    |     |    |         |            |          |   |
| 30  | IRS          | <p>This terminal selects the resistors for the V0 voltage level adjustment.<br/>         IRS = "H", Use the internal resistors.<br/>         IRS = "L", Do not use the internal resistors.<br/>         The V0 voltage level is regulated by an external resistive voltage divider attached to the VR terminal.<br/>         This pad is enabled only when the master operation mode is selected.<br/>         It is fixed to either "H" or "L" when the slave operation mode is selected.</p>  | I          |              |      |            |              |     |    |          |          |    |     |    |         |            |          |   |

I: Input, O: Output, P: Power

### 3. LCD Optical Characteristics

| Item                                     |      | Symbol           | Condition   | Min | Typ. | Max | Unit   |
|--|------|------------------|-------------|-----|------|-----|--------|
| Contrast Ratio                           |      | CR               | --          | --  | 5    | --  | --     |
| Response Time                            | On   | T <sub>on</sub>  | --          | --  | 150  | 250 | ms     |
|  | Off  | T <sub>off</sub> |             | --  | 180  | 300 | ms     |
| Viewing Angle<br>C <sub>r</sub> ≥2, 25°C | Hor. | Θ <sub>L</sub>   | Φ=270°, 9H  | --  | 55   | --  | degree |
|  |      | Θ <sub>R</sub>   | Φ=90°, 3H   | --  | 55   | --  |        |
|  | Ver. | Θ <sub>T</sub>   | Φ=180°, 12H | --  | 40   | --  |        |
|  |      | Θ <sub>B</sub>   | Φ=0°, 6H    | --  | 70   | --  |        |

## 4. Electrical Characteristics

### 4.1 Absolute Maximum Rating

| Characteristics       | Symbol          | Min     | Max     | Unit |
|-----------------------|-----------------|---------|---------|------|
| Supply Voltage        | VDD             | 0.3     | 4.0     | V    |
|                       | Vout            | 0.3     | 15.0    | V    |
| Input Voltage         | V <sub>in</sub> | VSS-0.3 | VDD+0.3 | V    |
| Operating Temperature | T <sub>OP</sub> | -20     | +70     | °C   |
| Storage Temperature   | T <sub>ST</sub> | -30     | +80     | °C   |

*NOTE: If the absolute maximum rating of the above parameters is exceeded, even momentarily, the quality of the product may be degraded. Absolute maximum ratings specify the values which the product may be physically damaged if exceeded. Be sure to use the product within the range of the absolute maximum ratings.*

### 4.2 DC Electrical Characteristics

| Characteristics     | Symbol  | Condition       | Min | Typ.   | Max | Unit   |
|---------------------|---------|-----------------|-----|--------|-----|--------|
| LCD Driving Voltage | VLCD    | --              | --  | 9.8    | --  | V      |
| Supply Voltage      | VDD     | VDD-GND         | --  | 3.0    | --  | V      |
| Input Voltage       | H Level | V <sub>IH</sub> | --  | 0.8VDD | --  | VDD    |
|                     | L Level | V <sub>IL</sub> | --  | VSS    | --  | 0.2VDD |

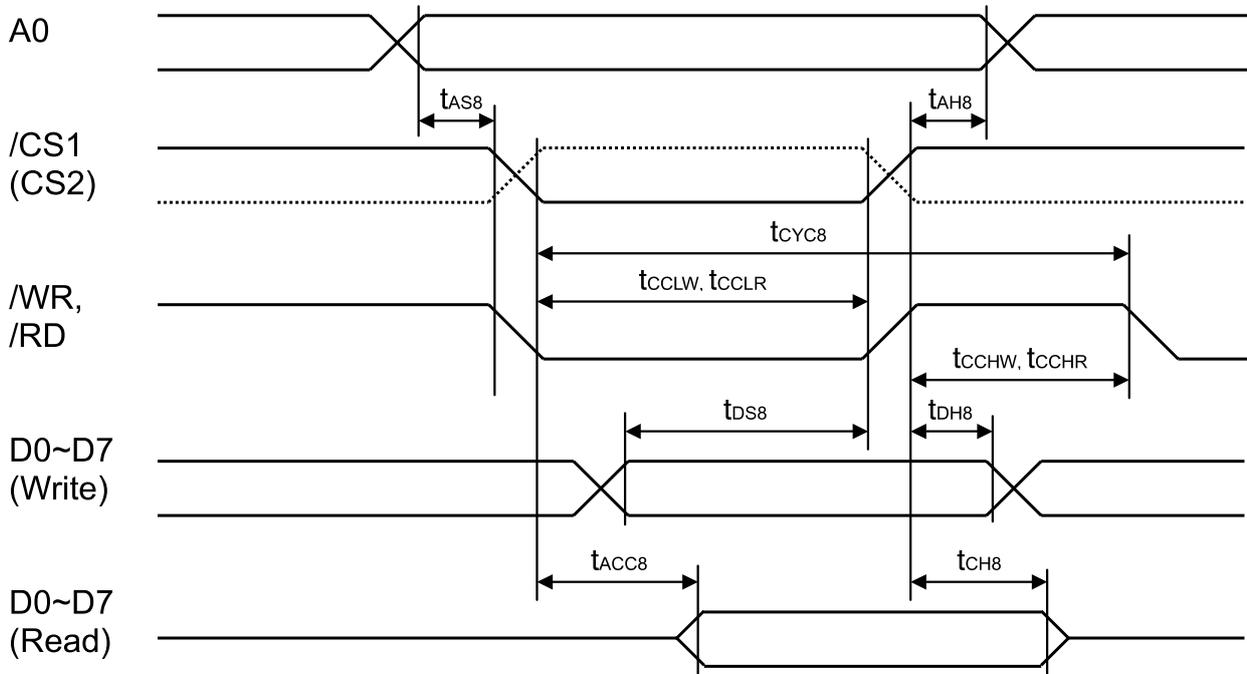
**Condition:**

1. VDD = 3.0V
2. 1/64 Duty, 1/9 Bias

## 5. Module Function

### 5.1 Timing Characteristics

System Bus Read/Write Characteristics 1 (for the 8080 Series MPU)



(VDD=2.7V ~ 3.6V, Ta=-40 ~ +85°C)

| Item                             | Signal | Symbol            | Condition | Rating |      | Units |
|----------------------------------|--------|-------------------|-----------|--------|------|-------|
|                                  |        |                   |           | Min.   | Max. |       |
| Address hold time                | A0     | t <sub>AH8</sub>  |           | 0      | -    | ns    |
| Address setup time               |        | t <sub>AS8</sub>  |           | 0      | -    |       |
| System cycle time                |        | t <sub>CYC8</sub> |           | 240    |      |       |
| Control low pulse width (write)  | /WR    | t <sub>CCLW</sub> |           | 120    | -    |       |
| Control high pulse width (write) |        | t <sub>CCHW</sub> |           | 100    | -    |       |
| Control low pulse width (read)   | /RD    | t <sub>CCLR</sub> |           | 120    | -    |       |
| Control high pulse width (read)  |        | t <sub>CCHR</sub> |           | 100    | -    |       |
| Write data setup time            | D0~D7  | t <sub>DS8</sub>  |           | 40     | -    |       |
| Write address hold time          |        | t <sub>DH8</sub>  |           | 10     | -    |       |
| Read access time                 |        | t <sub>ACC8</sub> | CL=100pF  | -      | 140  |       |
| Read output disable time         |        | t <sub>CH8</sub>  | CL=100pF  | 5      | 50   |       |

## System Bus Read/Write Characteristics 1 (for the 8080 Series MPU) – Continued

(VDD=1.8V ~ 2.7V, Ta=-40 ~ +85°C)

| Item                             | Signal | Symbol            | Condition | Rating |      | Units |
|----------------------------------|--------|-------------------|-----------|--------|------|-------|
|                                  |        |                   |           | Min.   | Max. |       |
| Address hold time                | A0     | t <sub>AH8</sub>  |           | 0      | -    | ns    |
| Address setup time               |        | t <sub>AS8</sub>  |           | 0      | -    |       |
| System cycle time                |        | t <sub>CYC8</sub> |           | 400    |      |       |
| Control low pulse width (write)  | /WR    | t <sub>CCLW</sub> |           | 150    | -    |       |
| Control high pulse width (write) |        | t <sub>CCHW</sub> |           | 120    | -    |       |
| Control low pulse width (read)   | /RD    | t <sub>CCLR</sub> |           | 150    | -    |       |
| Control high pulse width (read)  |        | t <sub>CCHR</sub> |           | 120    | -    |       |
| Write data setup time            | D0~D7  | t <sub>DS8</sub>  |           | 80     | -    |       |
| Write address hold time          |        | t <sub>DH8</sub>  |           | 30     | -    |       |
| Read access time                 |        | t <sub>ACC8</sub> | CL=100pF  | -      | 240  |       |
| Read output disable time         |        | t <sub>CH8</sub>  | CL=100pF  | 10     | 100  |       |

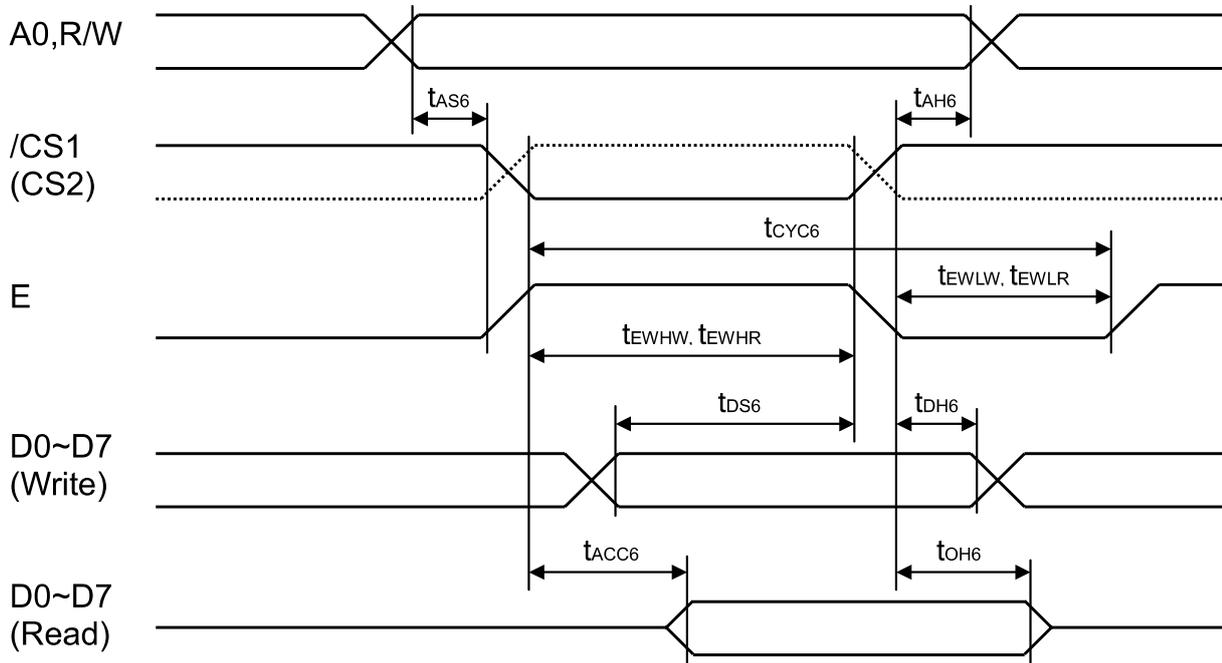
\*1. The input signal rise time and fall time (t<sub>r</sub>, t<sub>f</sub>) is specified at 15ns or less.

(t<sub>r</sub> + t<sub>f</sub>) < (t<sub>CYC8</sub> - t<sub>CCLW</sub> - t<sub>CCHW</sub>) for write, (t<sub>r</sub> + t<sub>f</sub>) < (t<sub>CYC8</sub> - t<sub>CCLR</sub> - t<sub>CCHR</sub>) for read.

\*2. All timing is specified using 20% and 80% of VDD as the reference.

\*3. t<sub>CCLW</sub> and t<sub>CCLR</sub> are specified as the overlap interval when /CS1 is low (CS2 is high) and /WR or /RD is low.

## System Bus Read/Write Characteristics 2 (for the 6800 Series MPU)



(VDD=2.7V ~ 3.6V, Ta=-40 ~ +85°C)

| Item                             | Signal  | Symbol            | Condition | Rating |      | Units |
|----------------------------------|---------|-------------------|-----------|--------|------|-------|
|                                  |         |                   |           | Min.   | Max. |       |
| Address hold time                | A0, R/W | t <sub>AH6</sub>  |           | 0      | -    | ns    |
| Address setup time               |         | t <sub>AS6</sub>  |           | 0      | -    |       |
| System cycle time                |         | t <sub>CYC6</sub> |           | 240    |      |       |
| Control low pulse width (write)  | E       | t <sub>EHLW</sub> |           | 100    | -    |       |
| Control high pulse width (write) |         | t <sub>EWHW</sub> |           | 120    | -    |       |
| Control low pulse width (read)   |         | t <sub>EHLR</sub> |           | 100    | -    |       |
| Control high pulse width (read)  |         | t <sub>EWHR</sub> |           | 120    | -    |       |
| Write data setup time            | D0~D7   | t <sub>DS6</sub>  |           | 40     | -    |       |
| Write address hold time          |         | t <sub>DH6</sub>  |           | 10     | -    |       |
| Read access time                 |         | t <sub>ACC6</sub> | CL=100pF  | -      | 140  |       |
| Read output disable time         |         | t <sub>OH6</sub>  | CL=100pF  | 5      | 50   |       |

## System Bus Read/Write Characteristics 2 (for the 6800 Series MPU) – Continued

(VDD=1.8V ~ 2.7V, Ta=-40 ~ +85°C)

| Item                             | Signal  | Symbol            | Condition | Rating |      | Units |
|----------------------------------|---------|-------------------|-----------|--------|------|-------|
|                                  |         |                   |           | Min.   | Max. |       |
| Address hold time                | A0, R/W | t <sub>AH6</sub>  |           | 0      | -    | ns    |
| Address setup time               |         | t <sub>AS6</sub>  |           | 0      | -    |       |
| System cycle time                |         | t <sub>CYC6</sub> |           | 400    |      |       |
| Control low pulse width (write)  | E       | t <sub>EWLW</sub> |           | 120    | -    |       |
| Control high pulse width (write) |         | t <sub>EWHW</sub> |           | 150    | -    |       |
| Control low pulse width (read)   |         | t <sub>EWLR</sub> |           | 120    | -    |       |
| Control high pulse width (read)  |         | t <sub>EWHR</sub> |           | 150    | -    |       |
| Write data setup time            | D0~D7   | t <sub>DS6</sub>  |           | 80     | -    |       |
| Write address hold time          |         | t <sub>DH6</sub>  |           | 30     | -    |       |
| Read access time                 |         | t <sub>ACC6</sub> | CL=100pF  | -      | 240  |       |
| Read output disable time         |         | t <sub>OH6</sub>  | CL=100pF  | 10     | 100  |       |

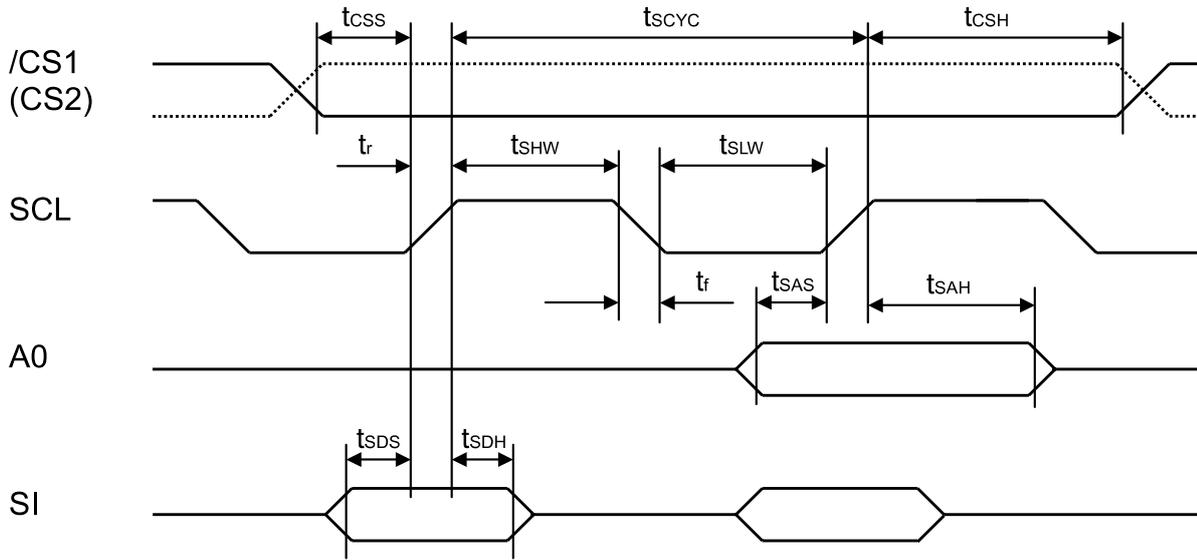
\*1. The input signal rise time and fall time (t<sub>r</sub>, t<sub>f</sub>) is specified at 15ns or less.

(t<sub>r</sub> + t<sub>f</sub>) < (t<sub>CYC6</sub> - t<sub>EWLW</sub> - t<sub>EWHW</sub>) for write, (t<sub>r</sub> + t<sub>f</sub>) < (t<sub>CYC6</sub> - t<sub>EWLR</sub> - t<sub>EWHR</sub>) for read.

\*2. All timing is specified using 20% and 80% of VDD as the reference.

\*3. t<sub>EWHW</sub> and t<sub>EWHR</sub> are specified as the overlap interval when /CS1 is low (CS2 is high) and E is high.

## Serial Interface Timing



(VDD=2.7V ~ 3.6V, Ta=-40 ~ +85°C)

| Item                       | Signal     | Symbol | Condition | Rating |      | Units |
|----------------------------|------------|--------|-----------|--------|------|-------|
|                            |            |        |           | Min.   | Max. |       |
| Serial clock cycle         | SCL        | tscyc  |           | 120    | -    | ns    |
| Serial clock H pulse width |            | tSHW   |           | 60     | -    |       |
| Serial clock L pulse width |            | tSLW   |           | 60     | -    |       |
| Address setup time         | A0         | tsAS   |           | 30     | -    |       |
| Address hold time          |            | tsAH   |           | 20     | -    |       |
| Data setup time            | SI         | tsDS   |           | 30     | -    |       |
| Data hold time             |            | tsDH   |           | 20     | -    |       |
| Chip select setup time     | /CS1 (CS2) | tcss   |           | 20     | -    |       |
| Chip select hold time      |            | tcsH   |           | 40     | -    |       |

(VDD=1.8V ~ 2.7V, Ta=-40 ~ +85°C)

| Item                       | Signal     | Symbol | Condition | Rating |      | Units |
|----------------------------|------------|--------|-----------|--------|------|-------|
|                            |            |        |           | Min.   | Max. |       |
| Serial clock cycle         | SCL        | tscyc  |           | 200    | -    | ns    |
| Serial clock H pulse width |            | tSHW   |           | 80     | -    |       |
| Serial clock L pulse width |            | tSLW   |           | 80     | -    |       |
| Address setup time         | A0         | tsAS   |           | 60     | -    |       |
| Address hold time          |            | tsAH   |           | 30     | -    |       |
| Data setup time            | SI         | tsDS   |           | 60     | -    |       |
| Data hold time             |            | tsDH   |           | 40     | -    |       |
| Chip select setup time     | /CS1 (CS2) | tcss   |           | 40     | -    |       |
| Chip select hold time      |            | tcsH   |           | 100    | -    |       |

\*1. The input signal rise time and fall time ( $t_r$ ,  $t_f$ ) is specified as 15ns or less.

\*2. All timing is specified using 20% and 80% of VDD as the standard.

## 5.2 LCM Application

Please see information on pages 21-25 of the data sheet for LCD controller NT7534. The data sheet can be found here: <https://focuslcds.com/wp-content/uploads/Drivers/NT7534.pdf>.

### 5.3 Command Table

| Command  | A0 | /RD | /WR | Code       |    |                          |                |                       |                  |      |                  | Hex   | Function   |  |
|--|----|-----|-----|------------|----|--------------------------|----------------|-----------------------|------------------|------|------------------|---|--|--|
|  |    |     |     | D7         | D6 | D5                       | D4             | D3                    | D2               | D1   | D0               |   |  |  |
| (1) Display OFF  | 0  | 1   | 0   | 1          | 0  | 1                        | 0              | 1                     | 1                | 1    | 0                | 1   | AEh<br>AFh   | Turn on LCD panel when high, and turn off when low         |
| (2) Display Start Line Set                                       | 0  | 1   | 0   | 0          | 1  | Display Start Address    |                |                       |                  |      | 40h<br>to<br>7Fh | Specifies RAM display line for COM0                   |  |  |
| (3) Page Address Set   | 0  | 1   | 0   | 1          | 0  | 1                        | 1              | Page Address          |                  |      |                  | B0h<br>to<br>B8h                                      | Set the display data RAM page in Page Address register                               |  |
| (4) Column Address Set   | 0  | 1   | 0   | 0          | 0  | 0                        | 1              | Higher Column Address |                  |      |                  | 00h<br>to<br>18h                                      | Set 4 higher bits and 4 lower bits of column address of display data RAM in register |  |
|  | 0  | 1   | 0   | 0          | 0  | 0                        | 0              | Lower Column Address  |                  |      |                  |   |  |  |
| (5) Read Status  | 0  | 0   | 1   | Status     |    |                          |                | 0                     | 0                | 0    | 0                | XX  | Reads the status information   |  |
| (6) Write Display Data   | 1  | 1   | 0   | Write Data |    |                          |                |                       |                  |      |                  | XX  | Write data in display data RAM   |  |
| (7) Read Display Data  | 1  | 0   | 1   | Read Data  |    |                          |                |                       |                  |      |                  | XX  | Read data from display data RAM  |  |
| (8) ADC Select   | 0  | 1   | 0   | 1          | 0  | 1                        | 0              | 0                     | 0                | 0    | 0                | 1   | A0h<br>A1h   | Set the display data RAM address SEG output correspondence |
| (9) Normal/Reverse Display                                       | 0  | 1   | 0   | 1          | 0  | 1                        | 0              | 0                     | 1                | 1    | 0                | 1   | A6h<br>A7h   | Normal indication when low, but full indication when high  |
| (10)Entire Display ON/OFF  | 0  | 1   | 0   | 1          | 0  | 1                        | 0              | 0                     | 1                | 0    | 0                | 1   | A4h<br>A5h   | Select normal display (0) or entire display on             |
| (11)LCD Bias Set   | 0  | 1   | 0   | 1          | 0  | 1                        | 0              | 0                     | 0                | 1    | 0                | 1   | A2h<br>A3h   | Sets LCD driving voltage bias ratio                        |
| (12)Read-Modify-Write  | 0  | 1   | 0   | 1          | 1  | 1                        | 0              | 0                     | 0                | 0    | 0                | 0   | E0h  | Increments column address counter during each write        |
| (13)End  | 0  | 1   | 0   | 1          | 1  | 1                        | 0              | 1                     | 1                | 1    | 0                | 0   | EEh  | Releases the Read-Modify-Write                             |
| (14)Reset  | 0  | 1   | 0   | 1          | 1  | 1                        | 0              | 0                     | 0                | 1    | 0                | 0   | E2h  | Resets internal functions                                  |
| (15)Common Output Mode Select                                    | 0  | 1   | 0   | 1          | 1  | 0                        | 0              | 0                     | 1                | *    | *                | *   | C0h<br>to<br>CFh   | Select COM output scan direction *: invalid data           |
| (16)Power Control Set  | 0  | 1   | 0   | 0          | 0  | 1                        | 0              | 1                     | Operation Status |      |                  | 28h<br>to<br>2Fh                                      | Select the power circuit operation mode  |  |
| (17)V0 Voltage Regulator Internal Resistor ratio Set             | 0  | 1   | 0   | 0          | 0  | 1                        | 0              | 0                     | Resistor Ratio   |      |                  | 20h<br>to<br>27h                                      | Select internal resistor ratio Rb/Ra mode  |  |
| (18)Electronic Volume mode Set<br>Electronic Volume Register Set | 0  | 1   | 0   | 1          | 0  | 0                        | 0              | 0                     | 0                | 0    | 0                | 1   | 81h  |  |
|  | 0  | 1   | 0   | *          | *  | Electronic Control Value |                |                       |                  |      | XX               | Sets the V0 output voltage electronic volume register |  |  |
| (19)Set Static indicator ON/OFF<br>Set Static Indicator Register | 0  | 1   | 0   | 1          | 0  | 1                        | 0              | 1                     | 1                | 0    | 0                | 1   | ACH<br>ADh   | Sets static indicator ON/OFF 0: OFF, 1: ON                 |
|  | 0  | 1   | 0   | *          | *  | *                        | *              | *                     | *                | Mode |                  |   | XX   | Sets the flash mode  |
| (20)Power Save   | 0  | 1   | 0   | -          | -  | -                        | -              | -                     | -                | -    | -                | -   | -  | Compound command of Display OFF and Entire Display ON      |
| (21)NOP  | 0  | 1   | 0   | 1          | 1  | 1                        | 0              | 0                     | 0                | 1    | 1                | 1   | E3h  | Command for non-operation                                  |
| (22)Oscillation Frequency Select                                 | 0  | 1   | 0   | 1          | 1  | 1                        | 0              | 0                     | 1                | 0    | 0                | 1   | E4h<br>E5h   | Select the oscillation frequency                           |
| (23)Partial Display mode Set                                     | 0  | 1   | 0   | 1          | 0  | 0                        | 0              | 0                     | 0                | 1    | 0                | 1   | 82h<br>83h   | Enter/Release the partial display mode                     |
| (24)Partial Display Duty Set                                     | 0  | 1   | 0   | 0          | 0  | 1                        | 1              | 0                     | Duty Ratio       |      |                  | 30h<br>37h  | Sets the LCD duty ratio for partial display mode                                     |  |
| (25)Partial Display Bias Set                                     | 0  | 1   | 0   | 0          | 0  | 1                        | 1              | 1                     | Bias Ratio       |      |                  | 38h<br>3Fh  | Sets the LCD bias ratio for partial display mode                                     |  |
| (26)Partial Start Line Set                                       | 0  | 1   | 0   | 1          | 1  | 0                        | 1              | 0                     | 0                | 1    | 1                | 1   | D3h  | Enter Partial Start Line Set                               |
| Partial Start Line Set   | 0  | 1   | 0   | 1          | 1  | Partial Start Line       |                |                       |                  |      | XX               | Sets the LCD Number of partial display start line     |  |  |
| (27)N-Line Inversion Set<br>Number of Line Set                   | 0  | 1   | 0   | 1          | 0  | 0                        | 0              | 0                     | 1                | 0    | 1                | 1   | 85h  | Enter N-Line inversion                                     |
|  | 0  | 1   | 0   | *          | *  | *                        | Number of Line |                       |                  |      |                  | XX  | Sets the number of line used for N-Line inversion                                    |  |

## Command Table (Continued)

| Command                      | A0 | /RD | /WR | Code |    |    |    |                |    |    |    |            | Hex                                       | Function              |
|------------------------------|----|-----|-----|------|----|----|----|----------------|----|----|----|------------|---|-----------------------|
|                              |    |     |     | D7   | D6 | D5 | D4 | D3             | D2 | D1 | D0 |            |   |                       |
| (28)N-Line Inversion Release | 0  | 1   | 0   | 1    | 0  | 0  | 0  | 0              | 0  | 1  | 0  | 0          | 84h                                       | Exit N-Line Inversion |
| (29)DC/DC Clock Set          | 0  | 1   | 0   | 1    | 1  | 1  | 0  | 0              | 1  | 1  | 0  | E6h        | Set DC/DC Clock Frequency                 |                       |
| DC/DC Clock Division Set     | 0  | 1   | 0   | 1    | 1  | 0  | 0  | Clock Division |    |    |    | XX         | Set the Division of DC/DC Clock Frequency |                       |
| (30)Test Command             | 0  | 1   | 0   | 1    | 1  | 1  | 1  | *              | *  | *  | *  | F1h to FFh | IC test command. Do not use!              |                       |
| (31)Test Mode Reset          | 0  | 1   | 0   | 1    | 1  | 1  | 1  | 0              | 0  | 0  | 0  | F0h        | Command of test mode reset                |                       |

## 5.4 Initialization Code

```

void lcd_init(void)
{
    RES=1;
    delays(10);
    RES=0;
    delays(10);
    RES=1;
    delays(50);
    writecommand(0xE2);
    delay(10);
    writecommand(0xA2); //0xA2=1/9bias ; 0xA3=1/7bias
    writecommand(0xA0); //0xA0=seg0->seg131 ; 0xA1=seg131->seg0
    writecommand(0xC0); //0xC0=com0->com63 ; 0xC8=com63->com0 ;
    writecommand(0x24); //vop
    writecommand(0x81); //vop
    writecommand(38); //vop
    writecommand(0x2c); //VB=0: Built-in Booster OFF ; VB=1: Built-in Booster
ON
    delays(100);
    writecommand(0x2e); //VR=0: Built-in Regulator OFF ; VR=1: Built-in
Regulator ON
    delays(100);
    writecommand(0x2f); //VF=0: Built-in Follower OFF ; VF=1: Built-in
Follower ON
    delays(100);
    writecommand(0xB0); //0xb0
    writecommand(0xA6); //0xA6=Normal display ; 0xA7=Inverse display
    writecommand(0xAF); //0xaf
}

```

## 6. Cautions and Handling Precautions

### 6.1 Handling and Operating the Module

1. When the module is assembled, it should be attached to the system firmly. Do not warp or twist the module during assembly work.
2. Protect the module from physical shock or any force. In addition to damage, this may cause improper operation or damage to the module and back-light unit.
3. Note that polarizer is very fragile and could be easily damaged. Do not press or scratch the surface.
4. Do not allow drops of water or chemicals to remain on the display surface. If you have the droplets for a long time, staining and discoloration may occur.
5. If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
6. The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane. Do not use ketene type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
7. If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs, or clothes, it must be washed away thoroughly with soap.
8. Protect the module from static; it may cause damage to the CMOS ICs.
9. Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
10. Do not disassemble the module.
11. Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
12. Pins of I/F connector shall not be touched directly with bare hands.
13. Do not connect, disconnect the module in the "Power ON" condition.
14. Power supply should always be turned on/off by the item Power On Sequence & Power Off Sequence.

### 6.2 Storage and Transportation

1. Do not leave the panel in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35 °C and relative humidity of less than 70%.
2. Do not store the TFT-LCD module in direct sunlight.
3. The module shall be stored in a dark place. When storing the modules for a long time, be sure to adopt effective measures for protecting the modules from strong ultraviolet radiation, sunlight, or fluorescent light.
4. It is recommended that the modules should be stored under a condition where no condensation is allowed. Formation of dewdrops may cause an abnormal operation or a failure of the module. In particular, the greatest possible care should be taken to prevent any module from being operated where condensation has occurred inside.
5. This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.