NHD-2.8-240320AF-CSXP-FCTP

IPS TFT Liquid Crystal Display Module

NHD- Newhaven Display
2.8- 2.8” Diagonal
240320- 240 x 320 Pixels (Portrait Mode)
AF- Model
C- Built-in Controller
S- High Brightness White LED Backlight
X- TFT
P- IPS, Wide Temperature
FCTP- FFC ZIF Connection Style, Capacitive Touch Panel with controller

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Functions and Features

- 240 x 320 pixels
- IPS type, full viewing angles
- High brightness LED backlight
- 3.0V power supply
- 8-bit or 16-bit Parallel MPU interface
- FFC ZIF I/O connection
- Built-in ST7789Vi controller
- 262K colors
- Capacitive touch panel with controller
  - 5-point multi-touch input
  - Gesture input
    - Zoom In/Out
    - Swipe Up/Down/Left/Right
1. Display Size: 2.8" TFT
2. Optimal View: Full View (IPS)
3. Display Mode: Transmissive / Normally Black / Anti-Glare
4. Driver IC: ST7789Vi: 8/16Bit Parallel Interface
5. Supply Voltage: 2.8V
6. Backlight: White LED / 100 mA (Typ) / 3.1V
7. Brightness: 500 cd/m² (Typ)
8. Film: 3M Brightness Enhancement
9. Touch Panel: PCAP
## Pin Description

### TFT:

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Symbol</th>
<th>External Connection</th>
<th>Function Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>Power Supply</td>
<td>Ground</td>
</tr>
<tr>
<td>2-6</td>
<td></td>
<td>-</td>
<td>No Connect</td>
</tr>
<tr>
<td>7</td>
<td>V\textsubscript{DD}</td>
<td>Power Supply</td>
<td>Supply Voltage for LCD (2.8V)</td>
</tr>
<tr>
<td>8</td>
<td>IOV\textsubscript{DD}</td>
<td>Power Supply</td>
<td>Supply Voltage for Logic (Tie to V\textsubscript{DD})</td>
</tr>
<tr>
<td>9</td>
<td>NC</td>
<td>-</td>
<td>No Connect</td>
</tr>
<tr>
<td>10</td>
<td>/CS</td>
<td>MPU</td>
<td>Active LOW Chip Select signal (can tie to GND)</td>
</tr>
<tr>
<td>11</td>
<td>D/C</td>
<td>MPU</td>
<td>Data / Command selection: ‘1’ = Data ; ‘0’ = Command</td>
</tr>
<tr>
<td>12</td>
<td>/WR</td>
<td>MPU</td>
<td>Active LOW Write signal</td>
</tr>
<tr>
<td>13</td>
<td>/RD</td>
<td>MPU</td>
<td>Active LOW Read signal</td>
</tr>
<tr>
<td>14-29</td>
<td>DB0 – DB15</td>
<td>MPU</td>
<td>Bi-directional data bus, 8-bit:DB8-DB15, 16-bit: DB0-DB15</td>
</tr>
<tr>
<td>30</td>
<td>/RES</td>
<td>MPU</td>
<td>Active LOW Reset signal</td>
</tr>
<tr>
<td>31</td>
<td>IM0</td>
<td>MPU</td>
<td>IM0=0: 16-bit i80 IM0=1: 8-bit i80</td>
</tr>
<tr>
<td>32</td>
<td>NC</td>
<td>-</td>
<td>No Connect</td>
</tr>
<tr>
<td>33</td>
<td>GND</td>
<td>Power Supply</td>
<td>Ground</td>
</tr>
<tr>
<td>34-37</td>
<td>LED-K1 – LED-K4</td>
<td>Power Supply</td>
<td>Backlight Cathode (Ground)</td>
</tr>
<tr>
<td>38</td>
<td>LED-A</td>
<td>Power Supply</td>
<td>Backlight Anode (100mA @ 3.1V)</td>
</tr>
<tr>
<td>39</td>
<td>GND</td>
<td>Power Supply</td>
<td>Ground</td>
</tr>
<tr>
<td>40</td>
<td>NC</td>
<td>-</td>
<td>No Connect</td>
</tr>
</tbody>
</table>

Recommended LCD connector: 40-pin, 0.5mm pitch FFC connector Molex P/N: 54132-4062 or similar

### Capacitive Touch Panel:

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Symbol</th>
<th>External Connection</th>
<th>Function Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>V\textsubscript{DD}</td>
<td>Power Supply</td>
<td>Supply voltage for Logic (3.3V)</td>
</tr>
<tr>
<td>2</td>
<td>V\textsubscript{SS}</td>
<td>Power Supply</td>
<td>Ground</td>
</tr>
<tr>
<td>3</td>
<td>SCL</td>
<td>MPU</td>
<td>Serial I2C Clock (Requires pull-up resistor)</td>
</tr>
<tr>
<td>4</td>
<td>SDA</td>
<td>MPU</td>
<td>Serial I2C Data (Requires pull-up resistor)</td>
</tr>
<tr>
<td>5</td>
<td>/INT</td>
<td>MPU</td>
<td>Interrupt signal from touch panel module to host</td>
</tr>
<tr>
<td>6</td>
<td>/RESET</td>
<td>MPU</td>
<td>Active LOW Reset signal</td>
</tr>
</tbody>
</table>

Recommended connector: 6pin, 1.0mm pitch, FFC connector. Molex P/N 52271-0679
### Electrical Characteristics

#### TFT:

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Temperature Range</td>
<td>T_{op}</td>
<td>Absolute Max</td>
<td>-20</td>
<td>-</td>
<td>+70</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>T_{st}</td>
<td>Absolute Max</td>
<td>-30</td>
<td>-</td>
<td>+80</td>
<td>°C</td>
</tr>
<tr>
<td>Supply Voltage for LCD</td>
<td>V_{dd}</td>
<td>-</td>
<td>2.6</td>
<td>2.8</td>
<td>3.3</td>
<td>V</td>
</tr>
<tr>
<td>Supply Voltage for Logic</td>
<td>IO{V_{dd}}</td>
<td>-</td>
<td>1.65</td>
<td>1.8</td>
<td>3.3</td>
<td>V</td>
</tr>
<tr>
<td>Supply Current</td>
<td>I_{dd}</td>
<td>V_{dd} = 2.8</td>
<td>3</td>
<td>9</td>
<td>15</td>
<td>mA</td>
</tr>
<tr>
<td>“H” Level input</td>
<td>V_{ih}</td>
<td>-</td>
<td>0.7 * V_{dd}</td>
<td>-</td>
<td>V_{dd}</td>
<td>V</td>
</tr>
<tr>
<td>“L” Level input</td>
<td>V_{il}</td>
<td>-</td>
<td>GND</td>
<td>-</td>
<td>0.3 * V_{dd}</td>
<td>V</td>
</tr>
<tr>
<td>“H” Level output</td>
<td>V_{oh}</td>
<td>-</td>
<td>0.8 * V_{dd}</td>
<td>-</td>
<td>V_{dd}</td>
<td>V</td>
</tr>
<tr>
<td>“L” Level output</td>
<td>V_{ol}</td>
<td>-</td>
<td>GND</td>
<td>-</td>
<td>0.2 * V_{dd}</td>
<td>V</td>
</tr>
</tbody>
</table>

#### Capacitive Touch Panel:

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Temperature Range</td>
<td>T_{op}</td>
<td>Absolute Max</td>
<td>-20</td>
<td>-</td>
<td>+70</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>T_{st}</td>
<td>Absolute Max</td>
<td>-30</td>
<td>-</td>
<td>+80</td>
<td>°C</td>
</tr>
<tr>
<td>Supply Voltage</td>
<td>V_{dd}</td>
<td>-</td>
<td>2.6</td>
<td>2.8</td>
<td>3.3</td>
<td>V</td>
</tr>
<tr>
<td>Supply Current – Operating</td>
<td>I_{dd}</td>
<td>V_{dd} = 3.3V</td>
<td>5.75</td>
<td>11.50</td>
<td>23</td>
<td>mA</td>
</tr>
<tr>
<td>Supply Current – Sleep</td>
<td>I_{dd}</td>
<td>V_{dd} = 3.3V</td>
<td>25</td>
<td>50</td>
<td>100</td>
<td>µA</td>
</tr>
<tr>
<td>“H” Level input</td>
<td>V_{ih}</td>
<td>-</td>
<td>0.7*V_{dd}</td>
<td>-</td>
<td>V_{dd}</td>
<td>V</td>
</tr>
<tr>
<td>“L” Level input</td>
<td>V_{il}</td>
<td>-</td>
<td>V_{ss}</td>
<td>-</td>
<td>0.3*V_{dd}</td>
<td>V</td>
</tr>
<tr>
<td>“H” Level output</td>
<td>V_{oh}</td>
<td>-</td>
<td>0.7*V_{dd}</td>
<td>-</td>
<td>V_{dd}</td>
<td>V</td>
</tr>
<tr>
<td>“L” Level output</td>
<td>V_{ol}</td>
<td>-</td>
<td>V_{ss}</td>
<td>-</td>
<td>0.3*V_{dd}</td>
<td>V</td>
</tr>
</tbody>
</table>

#### Backlight Supply Current

- I_{led} = - 80 – 100 – 125 mA

#### Backlight Supply Voltage

- V_{led} = 2.8 – 3.4 V

#### Backlight Lifetime*

- I_{led} = 100 mA
- T_{op} = 25°C
- 20,000 – 50,000 – Hrs.

*Backlight Lifetime is rated as Hours until half-brightness, under normal operating conditions. The LED of the backlight is driven by current drain; drive voltage is for reference only. Drive voltage must be selected to ensure backlight current drain is below MAX level stated.

#### Optical Characteristics

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimal Viewing Angles</td>
<td>θ{y}+</td>
<td>CR ≥ 10</td>
<td>-</td>
<td>80</td>
<td>-</td>
<td>°</td>
</tr>
<tr>
<td>Optimal Viewing Angles</td>
<td>θ{y}-</td>
<td>CR ≥ 10</td>
<td>-</td>
<td>80</td>
<td>-</td>
<td>°</td>
</tr>
<tr>
<td>Optimal Viewing Angles</td>
<td>θ{x}+</td>
<td>CR ≥ 10</td>
<td>-</td>
<td>80</td>
<td>-</td>
<td>°</td>
</tr>
<tr>
<td>Optimal Viewing Angles</td>
<td>θ{x}-</td>
<td>CR ≥ 10</td>
<td>-</td>
<td>80</td>
<td>-</td>
<td>°</td>
</tr>
<tr>
<td>Contrast Ratio</td>
<td>CR</td>
<td>600 – 800 – -</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luminance</td>
<td>L_{v}</td>
<td>I_{led} = 100 mA</td>
<td>410</td>
<td>500</td>
<td>-</td>
<td>cd/m^2</td>
</tr>
<tr>
<td>Response Time</td>
<td>T_{R} + T_{F}</td>
<td>T_{op} = 25°C</td>
<td>30</td>
<td>40</td>
<td>-</td>
<td>Ms</td>
</tr>
</tbody>
</table>

#### Chromaticity

| Red                              | X_{R}  | -    | 0.590 | 0.630 | 0.670 | -   |
| Green                            | X_{G}  | -    | 0.267 | 0.607 | 0.347 | -   |
| Blue                             | X_{B}  | -    | 0.107 | 0.147 | 0.187 | -   |
| White                            | X_{W}  | -    | 0.249 | 0.289 | 0.329 | -   |

[6]
Capacitive Touch Panel Material Characteristics:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC</td>
<td>FT5426</td>
<td></td>
</tr>
<tr>
<td>ITO Glass thickness</td>
<td>0.55</td>
<td>mm</td>
</tr>
<tr>
<td>Surface Hardness</td>
<td>≥6</td>
<td>H</td>
</tr>
<tr>
<td>Light transmission</td>
<td>85%</td>
<td></td>
</tr>
<tr>
<td>Operating Humidity</td>
<td>20~90</td>
<td>RH</td>
</tr>
<tr>
<td>Storage Humidity</td>
<td>20~90</td>
<td>RH</td>
</tr>
</tbody>
</table>

Controller Information

**TFT Display:**
Built-in ST7789V controller.

**Capacitive Touch Panel:**
Built-in FT5426 controller.
Please download app notes at [FT5x26 App Notes](#)

**TFT Table of Commands**

Capacitive Touch Panel Registers

<table>
<thead>
<tr>
<th>Register No.</th>
<th>Access</th>
<th>Register Name</th>
<th>Bits</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>01h</td>
<td>RO</td>
<td>Gesture ID</td>
<td>[7:0]</td>
<td>10</td>
<td>Swipe Up</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18h</td>
<td>Swipe Down</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1Ch</td>
<td>Swipe Left</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14h</td>
<td>Swipe Right</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>48h</td>
<td>Zoom Out</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>49h</td>
<td>Zoom In</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>00</td>
<td>No gesture</td>
</tr>
<tr>
<td>02h</td>
<td>RO</td>
<td>Touch Points</td>
<td>[7:0]</td>
<td>0-5h</td>
<td>0: No touch detected</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A: 5 touch points detected</td>
</tr>
<tr>
<td>03h</td>
<td>RO</td>
<td>TOUCH1_Event_Flag</td>
<td>[7:6]</td>
<td>0</td>
<td>Put Down</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Put Up</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>Contact</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>Reserved</td>
</tr>
<tr>
<td>03h</td>
<td>RO</td>
<td>TOUCH1_XH</td>
<td>[3:0]</td>
<td>0-1</td>
<td>Upper 4 bits of X touch coordinate</td>
</tr>
<tr>
<td>04h</td>
<td>RO</td>
<td>TOUCH1_XL</td>
<td>[7:0]</td>
<td>00 - FFh</td>
<td>Lower 8 bits of X touch coordinate</td>
</tr>
<tr>
<td>05h</td>
<td>RO</td>
<td>TOUCH1_YH</td>
<td>[3:0]</td>
<td>0-1</td>
<td>Upper 4 bits of Y touch coordinate</td>
</tr>
<tr>
<td>06h</td>
<td>RO</td>
<td>TOUCH1_YL</td>
<td>[7:0]</td>
<td>00 - FFh</td>
<td>Lower 8 bits of Y touch coordinate</td>
</tr>
<tr>
<td>07h</td>
<td>RO</td>
<td>TOUCH1_Weight</td>
<td>[7:0]</td>
<td></td>
<td>Touch Weight</td>
</tr>
<tr>
<td>08h</td>
<td>RO</td>
<td>TOUCH1_Misc</td>
<td>[3:0]</td>
<td>00-0Fh</td>
<td>Touch Area</td>
</tr>
<tr>
<td>09h</td>
<td>RO</td>
<td>TOUCH2_Event_Flag</td>
<td>[7:6]</td>
<td>0</td>
<td>Put Down</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Put Up</td>
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<td>Contact</td>
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<td>Reserved</td>
</tr>
<tr>
<td>Address</td>
<td>Mode</td>
<td>Register</td>
<td>Description</td>
<td></td>
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<td>---------</td>
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<td>----------</td>
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<td></td>
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<td>RO</td>
<td>TOUCH1_XH</td>
<td>Upper 4 bits of X touch coordinate</td>
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<td></td>
</tr>
<tr>
<td>0Ah</td>
<td>RO</td>
<td>TOUCH2_XL</td>
<td>Lower 8 bits of X touch coordinate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0Bh</td>
<td>RO</td>
<td>TOUCH2_YH</td>
<td>Upper 4 bits of Y touch coordinate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0Ch</td>
<td>RO</td>
<td>TOUCH2_YL</td>
<td>Lower 8 bits of Y touch coordinate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0Dh</td>
<td>RO</td>
<td>TOUCH2_Weight</td>
<td>Touch Weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0Eh</td>
<td>RO</td>
<td>TOUCH2_Misc</td>
<td>Touch Area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0Fh</td>
<td>RO</td>
<td>TOUCH3_Event_Flag</td>
<td>Put Down, Put Up, Contact, Reserved</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>RO</td>
<td>TOUCH3_XH</td>
<td>Upper 4 bits of X touch coordinate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11h</td>
<td>RO</td>
<td>TOUCH3_XL</td>
<td>Lower 8 bits of X touch coordinate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12h</td>
<td>RO</td>
<td>TOUCH3_YH</td>
<td>Upper 4 bits of Y touch coordinate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13h</td>
<td>RO</td>
<td>TOUCH3_YL</td>
<td>Lower 8 bits of Y touch coordinate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14h</td>
<td>RO</td>
<td>TOUCH3_Weight</td>
<td>Touch Weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15h</td>
<td>RO</td>
<td>TOUCH3_Misc</td>
<td>Touch Area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15h</td>
<td>RO</td>
<td>TOUCH4_Event_Flag</td>
<td>Put Down, Put Up, Contact, Reserved</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16h</td>
<td>RO</td>
<td>TOUCH4_XH</td>
<td>Upper 4 bits of X touch coordinate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17h</td>
<td>RO</td>
<td>TOUCH4_XL</td>
<td>Lower 8 bits of X touch coordinate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18h</td>
<td>RO</td>
<td>TOUCH4_YH</td>
<td>Upper 4 bits of Y touch coordinate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19h</td>
<td>RO</td>
<td>TOUCH4_YL</td>
<td>Lower 8 bits of Y touch coordinate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1Ah</td>
<td>RO</td>
<td>TOUCH4_Misc</td>
<td>Touch Area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1Ah</td>
<td>RO</td>
<td>TOUCH5_Event_Flag</td>
<td>Put Down, Put Up, Contact, Reserved</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18h</td>
<td>RO</td>
<td>TOUCH5_XH</td>
<td>Upper 4 bits of X touch coordinate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1Ch</td>
<td>RO</td>
<td>TOUCH5_XL</td>
<td>Lower 8 bits of X touch coordinate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1Dh</td>
<td>RO</td>
<td>TOUCH5_YH</td>
<td>Upper 4 bits of Y touch coordinate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1Eh</td>
<td>RO</td>
<td>TOUCH5_YL</td>
<td>Lower 8 bits of Y touch coordinate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1Fh</td>
<td>RO</td>
<td>TOUCH5_Weight</td>
<td>Touch Weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20h</td>
<td>RO</td>
<td>TOUCH5_Misc</td>
<td>Touch Area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80h</td>
<td>RW</td>
<td>ID_G_MC_THGROUP</td>
<td>Mutual-Capacitive touch Threshold / 4, Default: 4Bh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>81h</td>
<td>RW</td>
<td>ID_G_MC_THPEAK</td>
<td>Mutual-Capacitive Peak Threshold / 4, Default: 46h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>85h</td>
<td>RW</td>
<td>ID_G_THDIFF</td>
<td>Points Filtering Range Threshold / 16, Default: A0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>86h</td>
<td>RW</td>
<td>ID_G_CTRL</td>
<td>Allowed to switch to monitor mode or not (1: Allowed, 0: Not Allowed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>88h</td>
<td>RW</td>
<td>ID_G_PERIODACTIVE</td>
<td>Period of Active Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>89h</td>
<td>RW</td>
<td>ID_G_PERIODMONITOR</td>
<td>Timer to enter “idle” while in Monitor (ms)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1h</td>
<td>RO</td>
<td>ID_G_LIB_VERSION_H</td>
<td>App library version high-byte, Default: 0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A2h</td>
<td>RO</td>
<td>ID_G_LIB_VERSION_L</td>
<td>App library version low-byte, Default: 2h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A3h</td>
<td>RO</td>
<td>ID_G_CHIPER_HIGH</td>
<td>Chip Vendor ID, Default: 54h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A4h</td>
<td>RW</td>
<td>ID_G_MODE</td>
<td>INT Trigger Mode, INT Polling Mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Register No.</td>
<td>Access</td>
<td>Register Name</td>
<td>Bits</td>
<td>Value</td>
<td>Description</td>
</tr>
<tr>
<td>-------------</td>
<td>--------</td>
<td>------------------</td>
<td>--------</td>
<td>-------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>A5h</td>
<td>RW</td>
<td>ID_G_PMODE</td>
<td>[1:0]</td>
<td>0</td>
<td>Active</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Monitor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>Sleep</td>
</tr>
<tr>
<td>A6h</td>
<td>RO</td>
<td>ID_G_FIRMID</td>
<td>[7:0]</td>
<td>00-FfH</td>
<td>Firmware ID Number</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Default: 2</td>
</tr>
<tr>
<td>A8h</td>
<td>RO</td>
<td>ID_G_VENODRID</td>
<td>[7:0]</td>
<td>00-FfH</td>
<td>CTPM Vendor’s Chip ID</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Default: 79h</td>
</tr>
<tr>
<td>C0h</td>
<td>RW</td>
<td>ID_G_GLOVE_MODE_EN</td>
<td>[0]</td>
<td>0</td>
<td>Glove Mode Switch Disable</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Glove Mode Switch Enable</td>
</tr>
<tr>
<td>C1h</td>
<td>RW</td>
<td>ID_G_COVER_MODE_EN</td>
<td>[0]</td>
<td>0</td>
<td>Cover Mode Switch Disable</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Cover Mode Switch Enable</td>
</tr>
</tbody>
</table>
Timing Characteristics

Parallel 18/16/9/8-bit Interface Timing Characteristics (8080-II system)

<table>
<thead>
<tr>
<th>Signal</th>
<th>Symbol</th>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D/CX</td>
<td>T_{AST}</td>
<td>Address setup time</td>
<td>0</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T_{AHT}</td>
<td>Address hold time (Write/Read)</td>
<td>10</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T_{CSW}</td>
<td>Chip select “H” pulse width</td>
<td>0</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T_{CS}</td>
<td>Chip select setup time (Write)</td>
<td>15</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T_{RCS}</td>
<td>Chip select setup time (Read ID)</td>
<td>45</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T_{RCSFM}</td>
<td>Chip select setup time (Read FM)</td>
<td>355</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T_{CSF}</td>
<td>Chip select wait time (Write/Read)</td>
<td>10</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T_{CSH}</td>
<td>Chip select hold time</td>
<td>10</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>CSX</td>
<td>T_{WC}</td>
<td>Write cycle</td>
<td>66</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T_{WRL}</td>
<td>Control pulse “L” duration</td>
<td>15</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>WRX</td>
<td>T_{RDL}</td>
<td>Control pulse “L” duration</td>
<td>15</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>RDX (ID)</td>
<td>T_{RC}</td>
<td>Read cycle (ID)</td>
<td>160</td>
<td></td>
<td>ns</td>
<td>When read ID data</td>
</tr>
<tr>
<td></td>
<td>T_{RCH}</td>
<td>Control pulse “H” duration (ID)</td>
<td>90</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T_{RDL}</td>
<td>Control pulse “L” duration (ID)</td>
<td>45</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>RDX (FM)</td>
<td>T_{RDFM}</td>
<td>Read cycle (FM)</td>
<td>450</td>
<td></td>
<td>ns</td>
<td>When read from frame memory</td>
</tr>
<tr>
<td></td>
<td>T_{RDFHM}</td>
<td>Control pulse “H” duration (FM)</td>
<td>90</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T_{RDFLM}</td>
<td>Control pulse “L” duration (FM)</td>
<td>355</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>D[17:0]</td>
<td>T_{DIST}</td>
<td>Data setup time</td>
<td>10</td>
<td></td>
<td>ns</td>
<td>For CL=30pF</td>
</tr>
<tr>
<td></td>
<td>T_{DHT}</td>
<td>Data hold time</td>
<td>10</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T_{RAT}</td>
<td>Read access time (ID)</td>
<td>40</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T_{RATFM}</td>
<td>Read access time (FM)</td>
<td>340</td>
<td></td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T_{ODH}</td>
<td>Output disable time</td>
<td>20</td>
<td>80</td>
<td>ns</td>
<td></td>
</tr>
</tbody>
</table>
## Reset Timing

![Reset Timing Diagram](image)

### Table: Reset Timing Parameters

<table>
<thead>
<tr>
<th>Related Pins</th>
<th>Symbol</th>
<th>Parameter</th>
<th>MIN</th>
<th>MAX</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESX</td>
<td>TRW</td>
<td>Reset pulse duration</td>
<td>10</td>
<td>-</td>
<td>us</td>
</tr>
<tr>
<td>TRT</td>
<td></td>
<td>Reset cancel</td>
<td></td>
<td>5 (Note 1, 5)</td>
<td>ms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>120 (Note 1, 6, 7)</td>
<td>ms</td>
<td></td>
</tr>
</tbody>
</table>

## Power ON/OFF Sequence

![Power ON/OFF Sequence Diagram](image)

Timing when the latter signal rises up to 90% of its typical value, e.g., when VDD comes later, this timing is defined at the cross point of 90% of 2.75V, not 90% of 2.6V.

Timing when the latter signal falls up to 90% of its typical value, e.g., when VDD comes later, this timing is defined at the cross point of 90% of 2.75V, not 90% of 2.6V.

Tr_PW = +/- no limit

Tf_PW = +/- no limit

Tr_PW-CSX = +/- no limit

Tf_PW-CSX = +/- no limit

Tr_PW-RESX = +/- no limit

Tf_PW-RESX = +/- no limit

Tr_PW-RESX = +/ no limit

Tf_PW-RESX1 = min 120ms

Tr_PW-RESX2 = +/ no limit

Tf_PW-RESX2 = min 0ms

---

Tf_PW-RESX1 is applied to RESX falling in the Sleep Out Mode.

Tf_PW-RESX2 is applied to RESX falling in the Sleep In Mode.
Example Initialization Code

/** jokingly not recommended. **/

/* void TFT_28_7789_Write_Command(unsigned int command) */
void TFT_28_7789_Write_Command(unsigned int command)
{
    GPIO_ResetBits(GPIOC, CS1);
    GPIO_ResetBits(GPIOC, RS);
    GPIO_SetBits(GPIOC, nRD);
    GPIO_ResetBits(GPIOC, nWR);
    GPIO_Write(GPIOB, command);
    TFT_delay(10);
    GPIO_SetBits(GPIOC, nWR);
    TFT_delay(1);
}

/* void TFT_28_7789_Write_Data(unsigned int data1) */
void TFT_28_7789_Write_Data(unsigned int data1)
{
    GPIO_Write(GPIOB, data1);
    GPIO_SetBits(GPIOC, RS);
    GPIO_ResetBits(GPIOC, nWR);
    TFT_delay(1);
    GPIO_SetBits(GPIOC, nWR);
}

/* void TFT_28_7789_Init(void) */
void TFT_28_7789_Init(void)
{
    int n;
    GPIO_ResetBits(GPIOC, CS1);
    GPIO_SetBits(GPIOC, nRD);
    GPIO_ResetBits(GPIOC, nWR);
    GPIO_WriteBit(GPIOC, RES, Bit_RESET);
    TFT_delay(100);
    GPIO_WriteBit(GPIOC, RES, Bit_SET);
    TFT_delay(100);
    TFT_28_7789_Write_Command(0x0011);//exit SLEEP mode
    TFT_delay(100);
    TFT_28_7789_Write_Data(0x0000);
    TFT_28_7789_Write_Data(0x0080);//MADCTL: memory data access control
    TFT_28_7789_Write_Data(0x0036);
    TFT_28_7789_Write_Data(0x0066);//COLMOD: Interface Pixel format
    TFT_28_7789_Write_Command(0x0021);//INVON: Display Inversion ON (setting for IPS)
    TFT_28_7789_Write_Command(0x00B2);
    TFT_28_7789_Write_Data(0x000C);
    TFT_28_7789_Write_Data(0x0C);
    TFT_28_7789_Write_Data(0x00);
    TFT_28_7789_Write_Data(0x33);
    TFT_28_7789_Write_Data(0x33);//PORCTRK: Porch setting
    TFT_28_7789_Write_Command(0x0007);
    TFT_28_7789_Write_Data(0x0035);//GCTRL: Gate Control
    TFT_28_7789_Write_Data(0x00BB);
    TFT_28_7789_Write_Data(0x002B);//VCOMS: VCOM setting
    TFT_28_7789_Write_Command(0x00C0);
    TFT_28_7789_Write_Data(0x002C);//LCMCTRL: LCM Control
    TFT_28_7789_Write_Command(0x00C2);
    TFT_28_7789_Write_Data(0x0001);
    TFT_28_7789_Write_Data(0xFF);//VDVVRHEN: VDV and VRH Command Enable
    TFT_28_7789_Write_Command(0x00C3);
    TFT_28_7789_Write_Data(0x0011);//VRHS: VRH Set
}
TFT_28_7789_Write_Command(0x00C4);
TFT_28_7789_Write_Data(0x0020);//VDVS: VDV Set
TFT_28_7789_Write_Command(0x00C6);
TFT_28_7789_Write_Data(0x000F);//FRCTRL2: Frame Rate control in normal mode
TFT_28_7789_Write_Command(0x00D0);
TFT_28_7789_Write_Data(0xA4);
TFT_28_7789_Write_Data(0x00A4);//PWCTRL1: Power Control 1
TFT_28_7789_Write_Command(0x00E0);
TFT_28_7789_Write_Data(0x00D0);
TFT_28_7789_Write_Data(0x0000); //PVGAMCTRL: Positive Voltage Gamma control
TFT_28_7789_Write_Data(0x000D);
TFT_28_7789_Write_Data(0x000C);
TFT_28_7789_Write_Data(0x0006);
TFT_28_7789_Write_Data(0x002D);
TFT_28_7789_Write_Data(0x0044);
TFT_28_7789_Write_Data(0x0040);
TFT_28_7789_Write_Data(0x000E);
TFT_28_7789_Write_Data(0x001C);
TFT_28_7789_Write_Data(0x0018);
TFT_28_7789_Write_Data(0x0018);
TFT_28_7789_Write_Data(0x0016); //NVGAMCTRL: Negative Voltage Gamma control
TFT_28_7789_Write_Command(0x00E1);
TFT_28_7789_Write_Data(0x00D0);
TFT_28_7789_Write_Data(0x0000);
TFT_28_7789_Write_Data(0x0000);
TFT_28_7789_Write_Data(0x00EF);//X address set
TFT_28_7789_Write_Command(0x002B);
TFT_28_7789_Write_Data(0x0000);
TFT_28_7789_Write_Data(0x0000);
TFT_28_7789_Write_Data(0x0001); //Y address set
TFT_delay(10);
## Quality Information

<table>
<thead>
<tr>
<th>Test Item</th>
<th>Content of Test</th>
<th>Test Condition</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Temperature Storage</td>
<td>Endurance test applying the high storage temperature for a long time.</td>
<td>+80°C, 240hrs</td>
<td>2</td>
</tr>
<tr>
<td>Low Temperature Storage</td>
<td>Endurance test applying the low storage temperature for a long time.</td>
<td>-30°C, 240hrs</td>
<td>1,2</td>
</tr>
<tr>
<td>High Temperature Operation</td>
<td>Endurance test applying the electric stress (voltage &amp; current) and the high thermal stress for a long time.</td>
<td>+70°C, 120hrs</td>
<td>2</td>
</tr>
<tr>
<td>Low Temperature Operation</td>
<td>Endurance test applying the electric stress (voltage &amp; current) and the low thermal stress for a long time.</td>
<td>-20°C, 120hrs</td>
<td>1,2</td>
</tr>
<tr>
<td>High Temperature / Humidity Operation</td>
<td>Endurance test applying the electric stress (voltage &amp; current) and the high thermal with high humidity stress for a long time.</td>
<td>+50°C, 90-95% RH, 120hrs</td>
<td>1,2</td>
</tr>
<tr>
<td>Thermal Shock resistance</td>
<td>Endurance test applying the electric stress (voltage &amp; current) during a cycle of low and high thermal stress.</td>
<td>-20°C 30min -&gt; 25°C 5min -&gt; 70°C 30min -&gt; 25°C 5min = 1 cycle. For 10 cycles</td>
<td></td>
</tr>
<tr>
<td>Vibration test</td>
<td>Endurance test applying vibration to simulate transportation and use.</td>
<td>10Hz-55Hz, 1.5mm amplitude. 2hrs in each of 3 directions X,Y,Z</td>
<td>3</td>
</tr>
<tr>
<td>Static electricity test</td>
<td>Endurance test applying electric static discharge.</td>
<td>Air discharge: ±8KV 10 Times Contact discharge: ±4kv 10 Times</td>
<td></td>
</tr>
</tbody>
</table>

**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