

NHD-2.4-240320CF-CTXI#-FT

TFT (Thin-Film Transistor) Liquid Crystal Display Module

| | |
|---------|-------------------------------------|
| NHD- | Newhaven Display |
| 2.4- | 2.4" Diagonal |
| 240320- | 240 x 320 Pixels (Portrait Mode) |
| CF- | Model |
| C- | Built-in Controller |
| T- | White LED Backlight |
| X- | TFT |
| I- | 6:00 Optimal View, Wide Temperature |
| #- | RoHS Compliant |
| F- | FFC ZIF Connection Style |
| T- | 4-wire Resistive Touch Panel |

Newhaven Display International, Inc.

2661 Galvin Ct.

Elgin IL, 60124

Ph: 847-844-8795

Fax: 847-844-8796

www.newhavendisplay.com

nhtech@newhavendisplay.com

nhsales@newhavendisplay.com

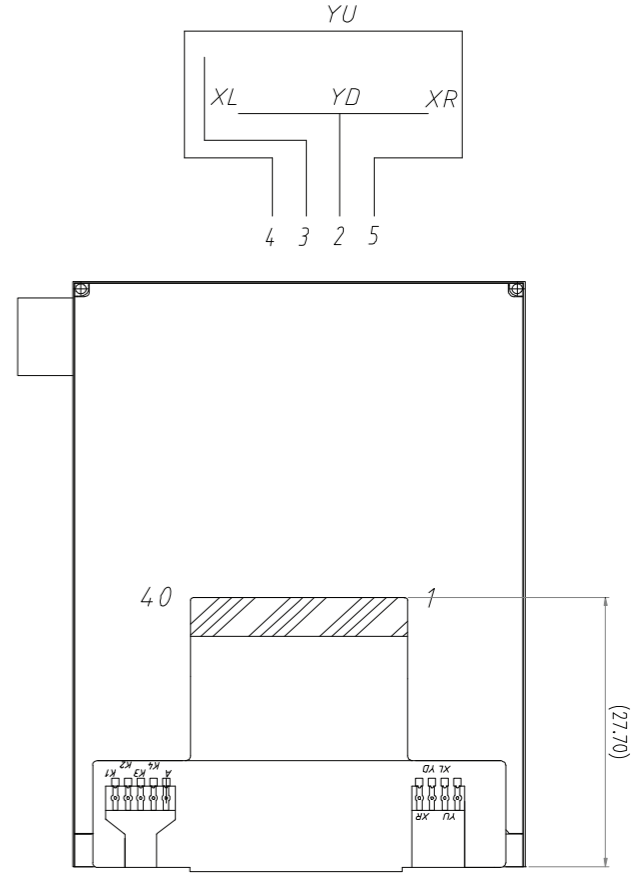
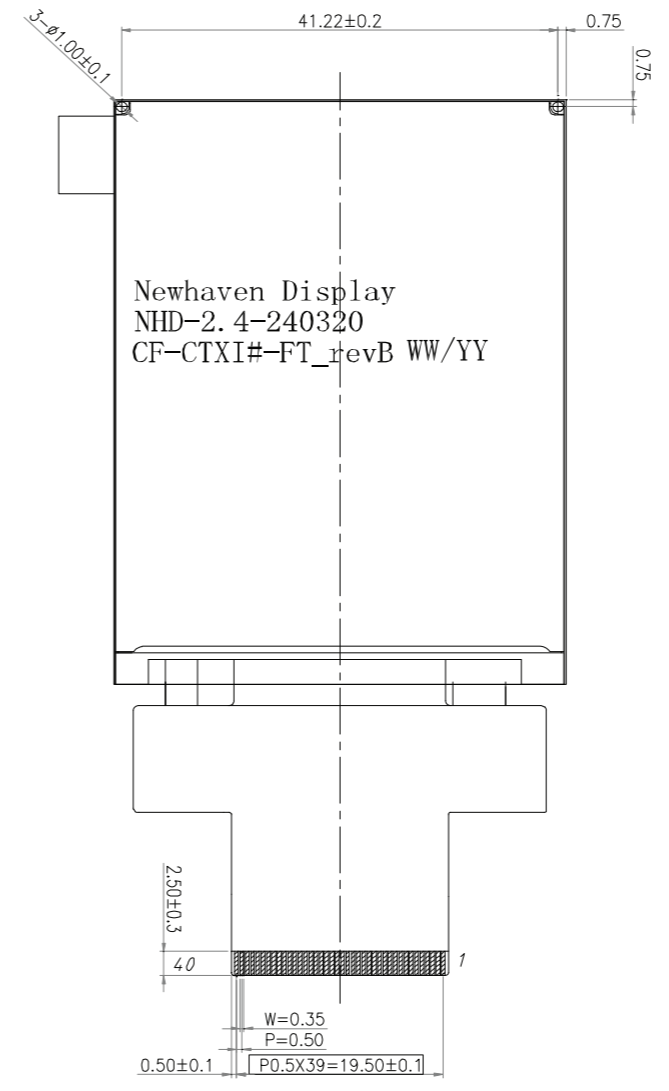
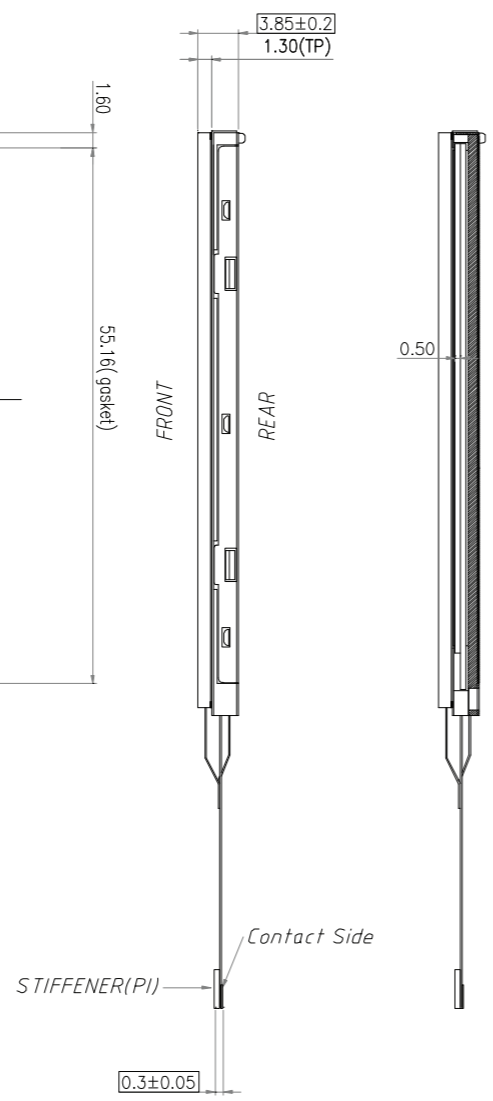
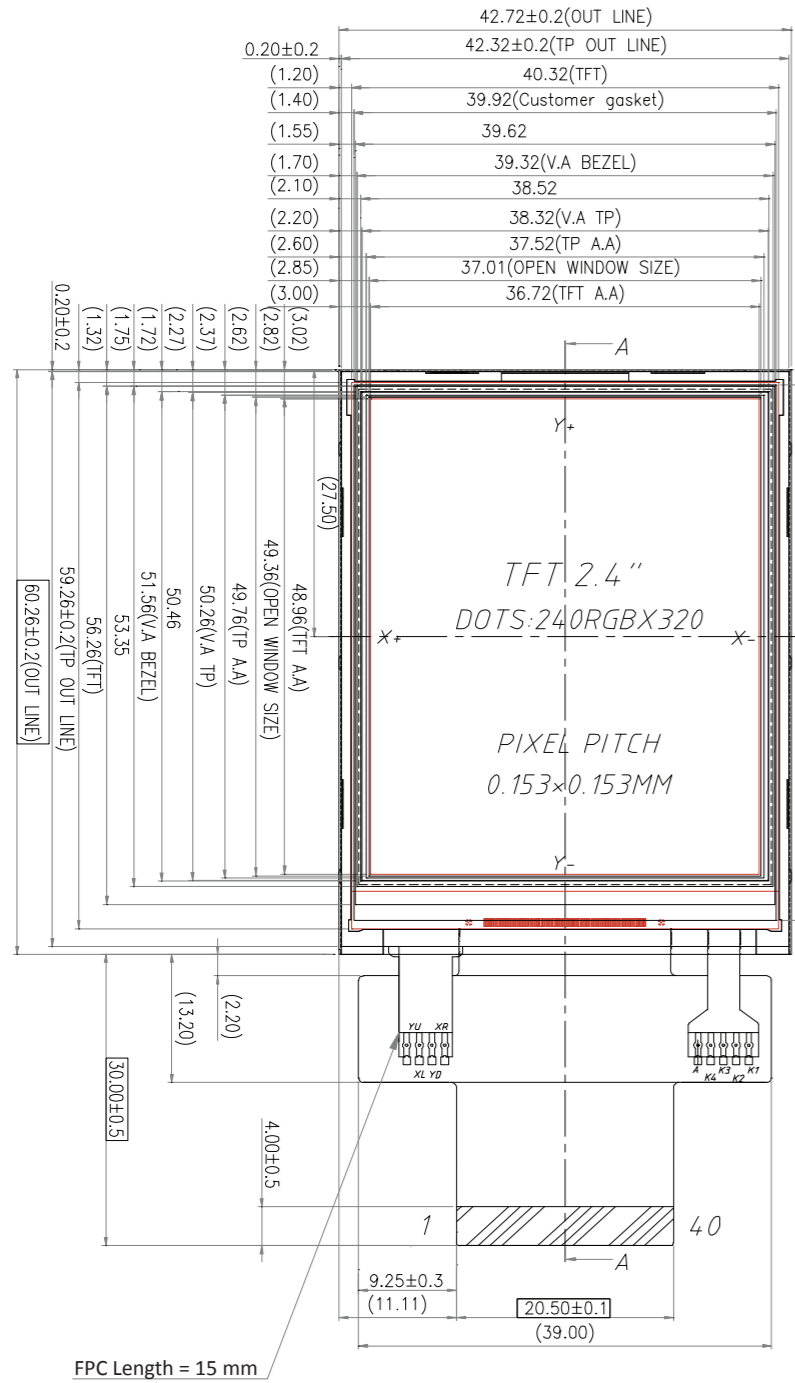
Document Revision History

| Revision | Date | Description | Changed by |
|----------|----------|--|------------|
| 0 | 11/21/14 | Initial Release | AK |
| 1 | 10/1/15 | Mechanical Drawing, Supply Voltage, Updated | SB |
| 2 | 11/6/15 | Mechanical Drawing Updated, Datasheet Reformat | SB |
| 3 | 4/7/16 | Viewing Angle Clarification | SB |
| 4 | 5/31/16 | Supply Voltage Updated | SB |
| 5 | 6/10/16 | Updated Brightness Rating | SB |
| 6 | 7/11/16 | Touch Panel FFC length increased to 15mm | SB |
| 7 | 2/7/17 | Bezel Redesign & Supply Current Updated | SB |
| 8 | 5/14/18 | Updated for new controller | TM |
| 9 | 6/18/18 | Backlight Characteristics Updated | SB |

Functions and Features

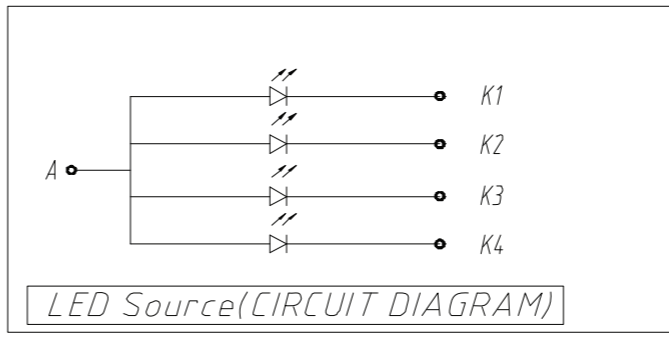
- 240 x 320 pixels
- LED backlight
- 3.3V power supply
- 8-bit or 16-bit Parallel MPU interface
- FFC ZIF I/O connection
- Built-in ST7789Vi controller
- 262K colors
- 4-wire Resistive Touch Panel

| SYMBOL | REVISION | DATE |
|--------|----------|------|
| | | |
| | | |



| No. | PIN NAME |
|-----|----------|
| 1 | GND |
| 2 | YD |
| 3 | XL |
| 4 | YU |
| 5 | XR |
| 6 | NC |
| 7 | VDD |
| 8 | IOVDD |
| 9 | NC |
| 10 | /CS |
| 11 | /D/C |
| 12 | /WR |
| 13 | /RD |
| 14 | DB0 |
| 15 | DB1 |
| 16 | DB2 |
| 17 | DB3 |
| 18 | DB4 |
| 19 | DB5 |
| 20 | DB6 |
| 21 | DB7 |
| 22 | DB8 |
| 23 | DB9 |
| 24 | DB10 |
| 25 | DB11 |
| 26 | DB12 |
| 27 | DB13 |
| 28 | DB14 |
| 29 | DB15 |
| 30 | /RES |
| 31 | IM0 |
| 32 | NC |
| 33 | GND |
| 34 | LED-K1 |
| 35 | LED-K2 |
| 36 | LED-K3 |
| 37 | LED-K4 |
| 38 | LED-A |
| 39 | GND |
| 40 | NC |

1. Display Size: 2.4" TFT
2. Optimal View: 6:00
3. Display Mode: Transmissive / Normally White / Anti-Glare
4. Driver IC: ST7789Vi: 8-16Bit Parallel Interface
5. Supply Voltage: 3.3V
6. Backlight: White LED/ 80 mA (Typ) / 3.1V
7. Brightness: 280 cd/m² (Typ)
8. Touch Panel: 4-Wire Resistive



| | | | | |
|---|----------------------------|------------------------------|----------------------------|----------------|
| STANDARD TOLERANCES (UNLESS OTHERWISE SPECIFIED) LINEAR: XX. ±0.3 mm XX.X ±0.3 mm XX.XX ±0.3 mm | | | | REVISION: B |
| | | | | SIZE: A3 |
| UNLESS OTHERWISE SPECIFIED - DIMENSIONS ARE IN MILLIMETERS - THIRD ANGLE PROJECTION | DRAWN BY: T. Mellenthin | CHECKED BY: T. Mellenthin | APPROVED BY: S. Baxi | SCALE: NS |
| | DRAWN DATE: 05/14/18 | CHECKED DATE: 05/14/18 | APPROVED DATE: 05/14/18 | SHEET 1 OF 1 |
| DO NOT SCALE DRAWING | | | | |
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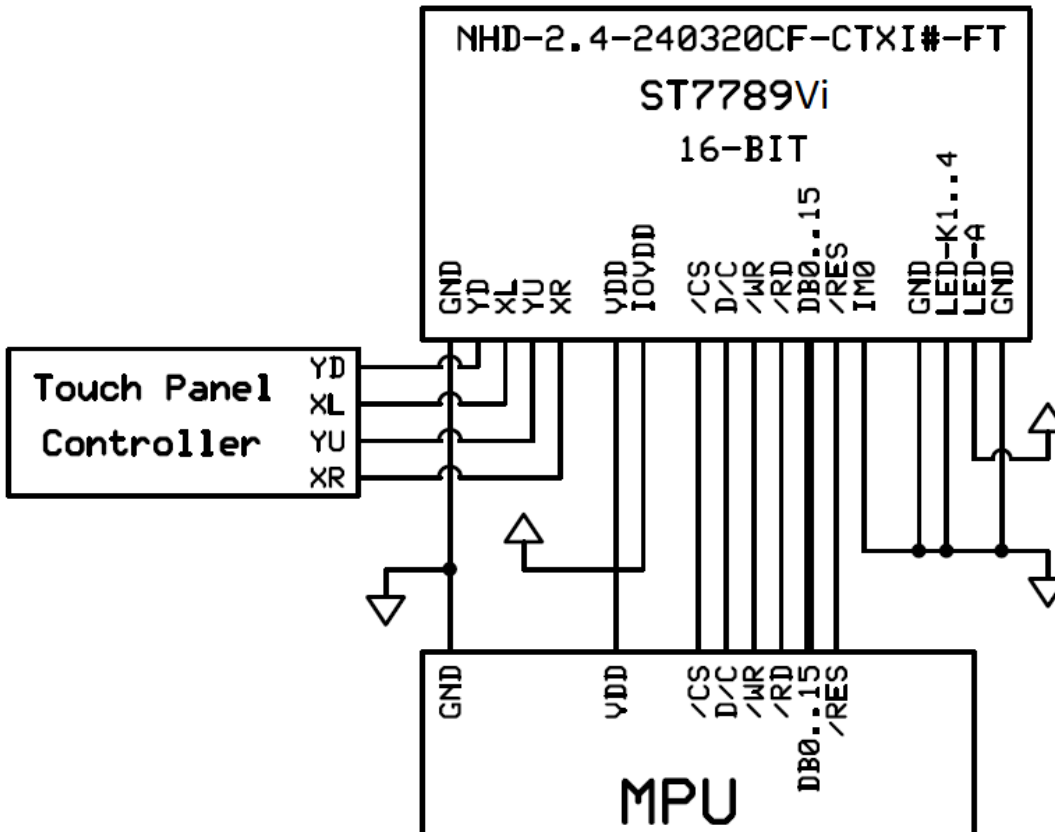
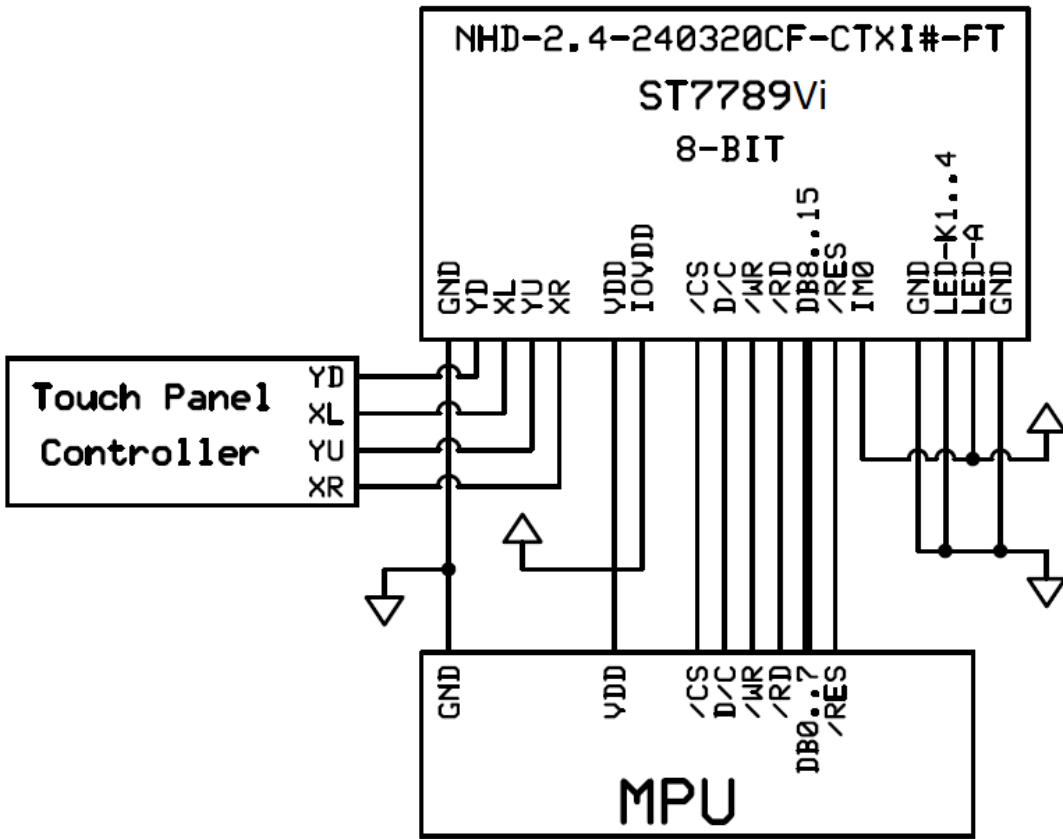
Pin Description

| Pin No. | Symbol | External Connection | Function Description |
|---------|-------------------|---------------------|--|
| 1 | GND | Power Supply | Ground |
| 2 | YD | Touch Controller | Touch Panel – Down |
| 3 | XL | Touch Controller | Touch Panel – Left |
| 4 | YU | Touch Controller | Touch Panel – Up |
| 5 | XR | Touch Controller | Touch Panel – Right |
| 6 | NC | - | No Connect |
| 7 | V _{DD} | Power Supply | Supply Voltage for LCD (3.3V) |
| 8 | IOV _{DD} | Power Supply | Supply Voltage for Logic (1.8V) |
| 9 | NC | - | No Connect |
| 10 | /CS | MPU | Active LOW Chip Select signal (can tie to GND) |
| 11 | D/C | MPU | Data / Command selection: '1' = Data ; '0' = Command |
| 12 | /WR | MPU | Active LOW Write signal |
| 13 | /RD | MPU | Active LOW Read signal |
| 14 | DB0 | MPU | Bi-directional data bus 8-bit: use DB8-DB15 16-bit: use DB0-DB15 |
| 15 | DB1 | MPU | |
| 16 | DB2 | MPU | |
| 17 | DB3 | MPU | |
| 18 | DB4 | MPU | |
| 19 | DB5 | MPU | |
| 20 | DB6 | MPU | |
| 21 | DB7 | MPU | |
| 22 | DB8 | MPU | |
| 23 | DB9 | MPU | |
| 24 | DB10 | MPU | |
| 25 | DB11 | MPU | |
| 26 | DB12 | MPU | |
| 27 | DB13 | MPU | |
| 28 | DB14 | MPU | |
| 29 | DB15 | MPU | |
| 30 | /RES | MPU | Active LOW Reset signal |
| 31 | IM0 | MPU | IM0=0: 16-bit i80 IM0=1: 8-bit i80 |
| 32 | NC | - | No Connect |
| 33 | GND | Power Supply | Ground |
| 34 | LED-K1 | Power Supply | Backlight Cathode (Ground) |
| 35 | LED-K2 | Power Supply | Backlight Cathode (Ground) |
| 36 | LED-K3 | Power Supply | Backlight Cathode (Ground) |
| 37 | LED-K4 | Power Supply | Backlight Cathode (Ground) |
| 38 | LED-A | Power Supply | Backlight Anode (3.1V) |
| 39 | GND | Power Supply | Ground |
| 40 | NC | - | No Connect |

Recommended LCD connector: 40-pin, 0.5mm pitch FFC connector

Molex P/N: 54132-4062 or similar

Wiring Diagram



Electrical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------------------------|-------------------|---|-----------------------|--------|-----------------------|------|
| Operating Temperature Range | T _{OP} | Absolute Max | -20 | - | +70 | °C |
| Storage Temperature Range | T _{ST} | Absolute Max | -30 | - | +80 | °C |
| Supply Voltage for LCD | V _{DD} | - | 2.4 | 3.3 | 3.5 | V |
| Supply Voltage for Logic | IOV _{DD} | - | 1.65 | 1.8 | 3.3 | V |
| Supply Current | I _{DD} | V _{DD} =3.3V | 2 | 6 | 12 | mA |
| "H" Level input | V _{IH} | - | 0.7 * V _{DD} | - | V _{DD} | V |
| "L" Level input | V _{IL} | - | V _{SS} | - | 0.3 * V _{DD} | V |
| "H" Level output | V _{OH} | - | 0.8 * V _{DD} | - | V _{DD} | V |
| "L" Level output | V _{OL} | - | V _{SS} | - | 0.2 * V _{DD} | V |
| Backlight Supply Current | I _{LED} | - | - | 80 | 100 | mA |
| Backlight Supply Voltage | V _{LED} | I _{LED} = 80mA | 2.8 | 3.1 | 3.5 | V |
| Backlight Lifetime | - | I _{LED} = 80 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

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------------------------|----------------|--------------------------|------|------|------|-------------------|
| Optimal Viewing Angles | Top | CR ≥ 10 | 50 | 50 | - | ° |
| | Bottom | | 55 | 55 | - | ° |
| | Left | | 55 | 55 | - | ° |
| | Right | | 55 | 55 | - | ° |
| Contrast Ratio | CR | - | 150 | 200 | - | - |
| Luminance | L _V | I _{LED} = 80 mA | 200 | 280 | 360 | cd/m ² |
| Response Time | Rise | T _{OP} = 25° C | - | 4 | 8 | ms |
| | Fall | | - | 12 | 24 | ms |

Touch Panel Characteristics

| Item | Min. | Typ. | Max. | Unit |
|-----------------------------|-----------|------|------|------------|
| Linearity | - | - | 1.5 | % |
| Circuit Resistance – X-Axis | 200 | - | 600 | Ω |
| Circuit Resistance – Y-Axis | 250 | - | 900 | Ω |
| Insulation Resistance | 20 | - | - | MΩ |
| Operating Voltage | - | - | 5 | V |
| Chattering | - | - | 15 | ms |
| Activation Force | 100 | - | - | g |
| Pen Writing Durability | 100,000 | - | - | Characters |
| Pitting Durability | 1,000,000 | - | - | Touches |
| Surface Hardness | 3 | - | - | H |

Controller Information

Built-in ST7789Vi controller.

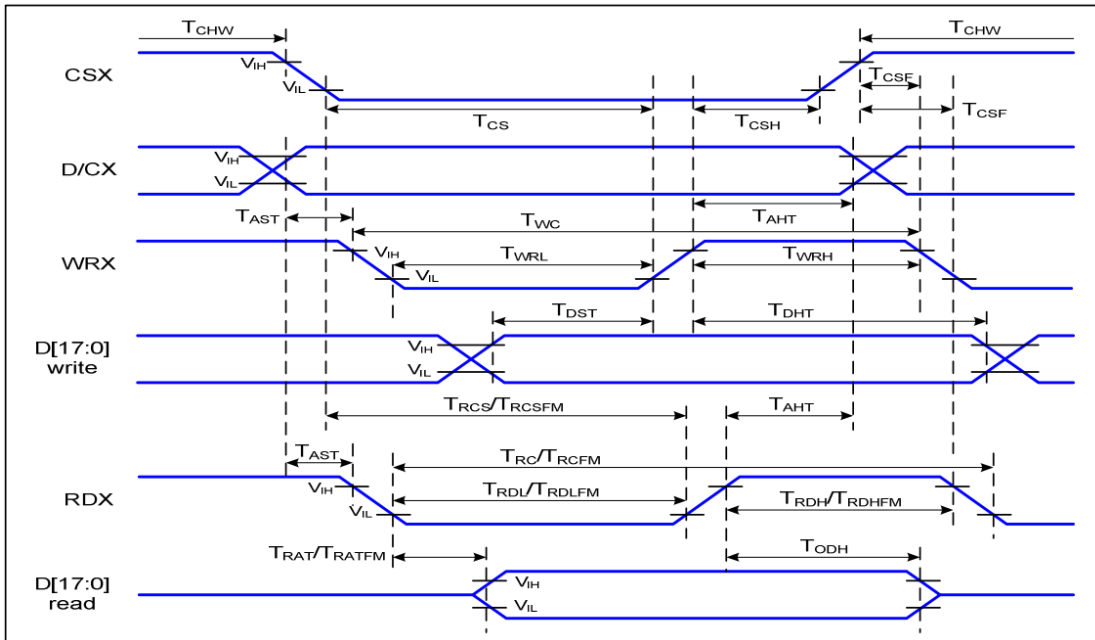
Please download specification at <http://www.newhavendisplay.com/appnotes/datasheets/LCDs/ST7789V.pdf>

Table of Commands

Please download specification at <http://www.newhavendisplay.com/appnotes/datasheets/LCDs/ST7789V.pdf>

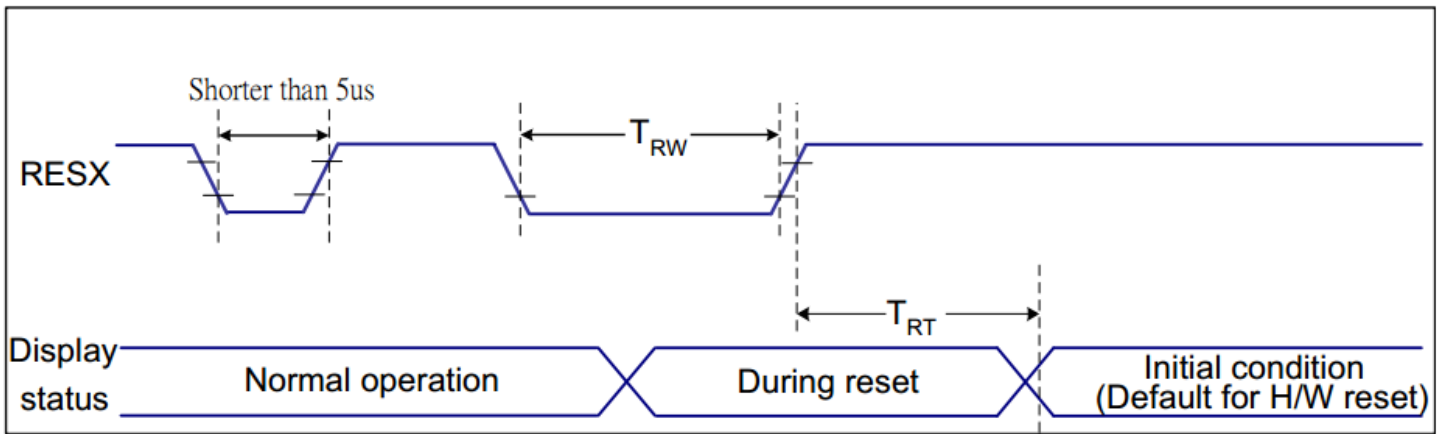
Timing Characteristics

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



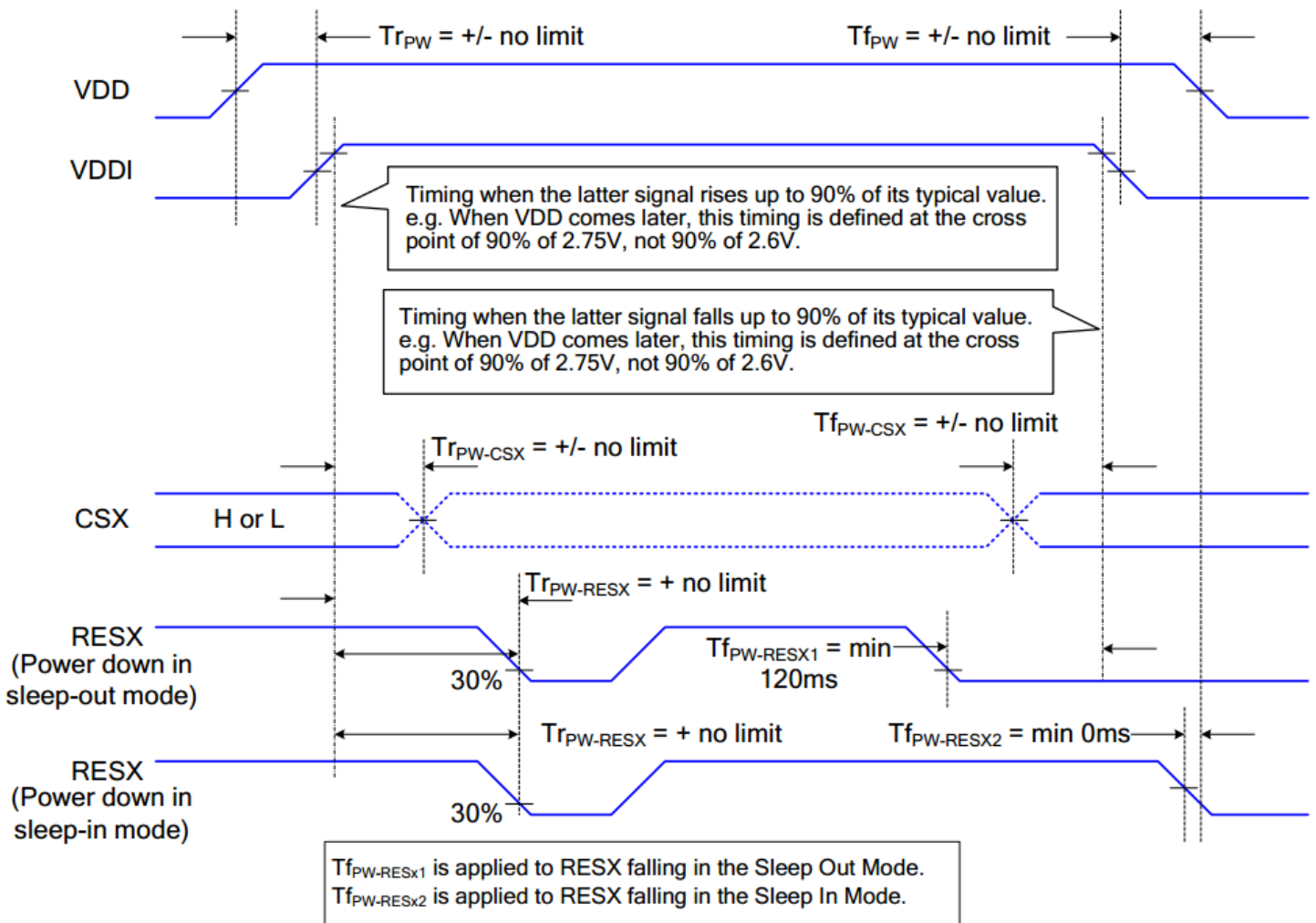
| Signal | Symbol | Parameter | Min | Max | Unit | Description |
|----------|-------------|------------------------------------|-----|-----|------|-----------------------------|
| D/CX | T_{AST} | Address setup time | 0 | | ns | - |
| | T_{AHT} | Address hold time (Write/Read) | 10 | | ns | |
| CSX | T_{CHW} | Chip select "H" pulse width | 0 | | ns | - |
| | T_{CS} | Chip select setup time (Write) | 15 | | ns | |
| | T_{RCS} | Chip select setup time (Read ID) | 45 | | ns | |
| | T_{RCSFM} | Chip select setup time (Read FM) | 355 | | ns | |
| | T_{CSF} | Chip select wait time (Write/Read) | 10 | | ns | |
| | T_{CSH} | Chip select hold time | 10 | | ns | |
| WRX | T_{WC} | Write cycle | 66 | | ns | |
| | T_{WRH} | Control pulse "H" duration | 15 | | ns | |
| | T_{WRL} | Control pulse "L" duration | 15 | | ns | |
| RDX (ID) | T_{RC} | Read cycle (ID) | 160 | | ns | When read ID data |
| | T_{RDH} | Control pulse "H" duration (ID) | 90 | | ns | |
| | T_{RDL} | Control pulse "L" duration (ID) | 45 | | ns | |
| RDX (FM) | T_{RCFM} | Read cycle (FM) | 450 | | ns | When read from frame memory |
| | T_{RDHFM} | Control pulse "H" duration (FM) | 90 | | ns | |
| | T_{RDLFM} | Control pulse "L" duration (FM) | 355 | | ns | |
| D[17:0] | T_{DST} | Data setup time | 10 | | ns | For CL=30pF |
| | T_{DHT} | Data hold time | 10 | | ns | |
| | T_{RAT} | Read access time (ID) | | 40 | ns | |
| | T_{RATFM} | Read access time (FM) | | 340 | ns | |
| | T_{ODH} | Output disable time | 20 | 80 | ns | |

Reset Timing



| Related Pins | Symbol | Parameter | MIN | MAX | Unit |
|--------------|--------|----------------------|-----|--------------------|------|
| RESX | TRW | Reset pulse duration | 10 | - | us |
| | TRT | Reset cancel | - | 5 (Note 1, 5) | ms |
| | | | | 120 (Note 1, 6, 7) | ms |

Power ON/OFF Sequence



Example Initialization Code

```
/******  
void TFT_24_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_24_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_24_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_24_7789_Write_Command(0x0011); //exit SLEEP mode  
    TFT_delay(100);  
  
    TFT_24_7789_Write_Command(0x0036);  
    TFT_24_7789_Write_Data(0x0080); //MADCTL: memory data access control  
    TFT_24_7789_Write_Command(0x003A);  
    TFT_24_7789_Write_Data(0x0066); //COLMOD: Interface Pixel format  
    TFT_24_7789_Write_Command(0x00B2);  
    TFT_24_7789_Write_Data(0x000C);  
    TFT_24_7789_Write_Data(0x0C);  
    TFT_24_7789_Write_Data(0x00);  
    TFT_24_7789_Write_Data(0x33);  
    TFT_24_7789_Write_Data(0x33); //PORCTRK: Porch setting  
    TFT_24_7789_Write_Command(0x00B7);  
    TFT_24_7789_Write_Data(0x0035); //GCTRL: Gate Control  
    TFT_24_7789_Write_Command(0x00BB);  
    TFT_24_7789_Write_Data(0x002B); //VCOMS: VCOM setting  
    TFT_24_7789_Write_Command(0x00C0);  
    TFT_24_7789_Write_Data(0x002C); //LCMCTRL: LCM Control  
    TFT_24_7789_Write_Command(0x00C2);  
    TFT_24_7789_Write_Data(0x0001);  
    TFT_24_7789_Write_Data(0xFF); //VDVVRHEN: VDV and VRH Command Enable  
    TFT_24_7789_Write_Command(0x00C3);  
    TFT_24_7789_Write_Data(0x0011); //VRHS: VRH Set  
    TFT_24_7789_Write_Command(0x00C4);  
    TFT_24_7789_Write_Data(0x0020); //VDVS: VDV Set
```

```

TFT_24_7789_Write_Command(0x00C6);
TFT_24_7789_Write_Data(0x000F); //FRCTRL2: Frame Rate control in normal mode
TFT_24_7789_Write_Command(0x00D0);
TFT_24_7789_Write_Data(0x00A4);
TFT_24_7789_Write_Data(0xA1); //PWCTRL1: Power Control 1
TFT_24_7789_Write_Command(0x00E0);
TFT_24_7789_Write_Data(0x00D0);
TFT_24_7789_Write_Data(0x0000);
TFT_24_7789_Write_Data(0x0005);
TFT_24_7789_Write_Data(0x000E);
TFT_24_7789_Write_Data(0x0015);
TFT_24_7789_Write_Data(0x000D);
TFT_24_7789_Write_Data(0x0037);
TFT_24_7789_Write_Data(0x0043);
TFT_24_7789_Write_Data(0x0047);
TFT_24_7789_Write_Data(0x0009);
TFT_24_7789_Write_Data(0x0015);
TFT_24_7789_Write_Data(0x0012);
TFT_24_7789_Write_Data(0x0016);
TFT_24_7789_Write_Data(0x0019); //PVGAMCTRL: Positive Voltage Gamma control
TFT_24_7789_Write_Command(0x00E1);
TFT_24_7789_Write_Data(0x00D0);
TFT_24_7789_Write_Data(0x0000);
TFT_24_7789_Write_Data(0x0005);
TFT_24_7789_Write_Data(0x000D);
TFT_24_7789_Write_Data(0x000C);
TFT_24_7789_Write_Data(0x0006);
TFT_24_7789_Write_Data(0x002D);
TFT_24_7789_Write_Data(0x0044);
TFT_24_7789_Write_Data(0x0040);
TFT_24_7789_Write_Data(0x000E);
TFT_24_7789_Write_Data(0x001C);
TFT_24_7789_Write_Data(0x0018);
TFT_24_7789_Write_Data(0x0016);
TFT_24_7789_Write_Data(0x0019); //NVGAMCTRL: Negative Voltage Gamma control
TFT_24_7789_Write_Command(0x002A);
TFT_24_7789_Write_Data(0x0000);
TFT_24_7789_Write_Data(0x0000);
TFT_24_7789_Write_Data(0x0000);
TFT_24_7789_Write_Data(0x00EF); //X address set
TFT_24_7789_Write_Command(0x002B);
TFT_24_7789_Write_Data(0x0000);
TFT_24_7789_Write_Data(0x0000);
TFT_24_7789_Write_Data(0x0001);
TFT_24_7789_Write_Data(0x003F); //Y address set

TFT_delay(10);
}
/*****/

```

Quality Information

| Test Item | Content of Test | Test Condition | Note |
|---------------------------------------|---|--|------|
| High Temperature Storage | Endurance test applying the high storage temperature for a long time. | +80°C, 96hrs | 2 |
| Low Temperature Storage | Endurance test applying the low storage temperature for a long time. | -30°C, 96hrs | 1,2 |
| High Temperature Operation | Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time. | +70°C, 96hrs | 2 |
| Low Temperature Operation | Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time. | -20°C, 96hrs | 1,2 |
| High Temperature / Humidity Operation | Endurance test applying the electric stress (voltage & current) and the high thermal with high humidity stress for a long time. | +40°C, 90-95% RH, 96hrs | 1,2 |
| Thermal Shock resistance | Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress. | -20°C,30min -> 25°C,5min -> 70°C,30min -> 25°C,5min = 1 cycle. 10 cycles | |
| Vibration test | Endurance test applying vibration to simulate transportation and use. | 10Hz-55Hz, 1.5mm amplitude. 2hrs in each of 3 directions X,Y,Z | 3 |
| Static electricity test | Endurance test applying electric static discharge. | VS=8KV, RS=330kΩ, CS=150pF Ten times | |

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

Warranty Information

See Terms & Conditions at http://www.newhavendisplay.com/index.php?main_page=terms