

NHD-2.4-240320SF-CTXI#-T1

TFT (Thin-Film Transistor) Liquid Crystal Display Module

| | |
|---------|-------------------------------------|
| NHD- | Newhaven Display |
| 2.4- | 2.4" Diagonal |
| 240320- | 240 x 320 Pixels (Portrait Mode) |
| SF- | Model |
| C- | Built-in Controller |
| T- | White LED Backlight |
| X- | TFT |
| I- | 6:00 Optimal View, Wide Temperature |
| #- | RoHS Compliant |
| T- | Touch Panel |
| 1- | ILI9341 Controller |

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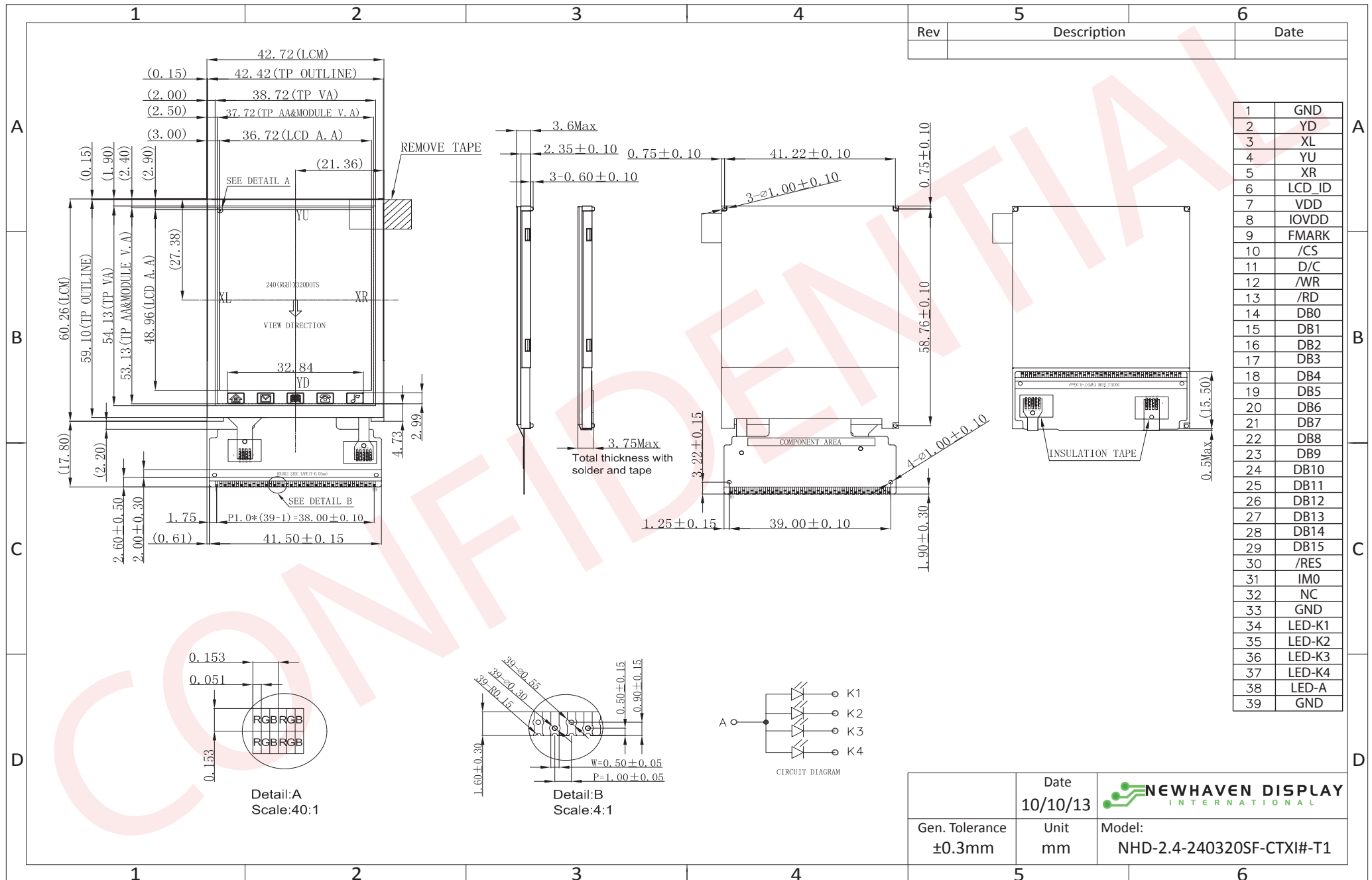
Document Revision History

| Revision | Date | Description | Changed by |
|----------|------------|--|------------|
| 0 | 9/17/2010 | Initial Release | MC |
| 1 | 5/9/2012 | Timing characteristics updated | AK |
| 2 | 6/25/12 | Electrical & Optical characteristics updated | TJ |
| 3 | 3/27/13 | Added wiring diagram. Updated mechanical drawing & electrical characteristics. | JN |
| 4 | 7/15/13 | Changed 12:00 view to 6:00 | ML |
| 5 | 10/10/2013 | Mechanical Drawing, Pin Description, Wiring Diagram, Electrical/Optical Characteristics, Example Code updated. Controller changed to ILI9341 | ML |

Functions and Features

- 240 x 320 pixels
- LED backlight
- 2.8V power supply
- 8-bit or 16-bit Parallel MPU interface
- Hot-Bar Solder I/O connection
- Built-in ILI9341 controller
- 262K colors
- 4-wire Resistive Touch Panel

Mechanical Drawing



| Rev | Description | Date |
|-----|-------------|------|
| | | |

| | |
|----|--------|
| 1 | GND |
| 2 | YD |
| 3 | XL |
| 4 | YU |
| 5 | XR |
| 6 | LCD_ID |
| 7 | VDD |
| 8 | IOVDD |
| 9 | FMARK |
| 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 |

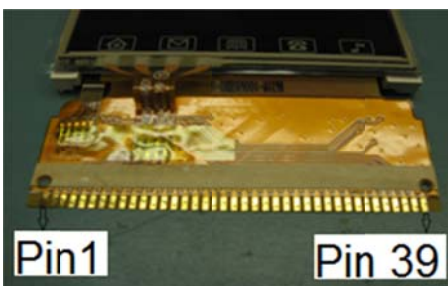
| | | | |
|----------------|--------|---------------------------|--|
| | Date | 10/10/13 | NEWHAVEN DISPLAY INTERNATIONAL |
| Gen. Tolerance | Unit | mm | |
| ±0.3mm | Model: | NHD-2.4-240320SF-CTXI#-T1 | |

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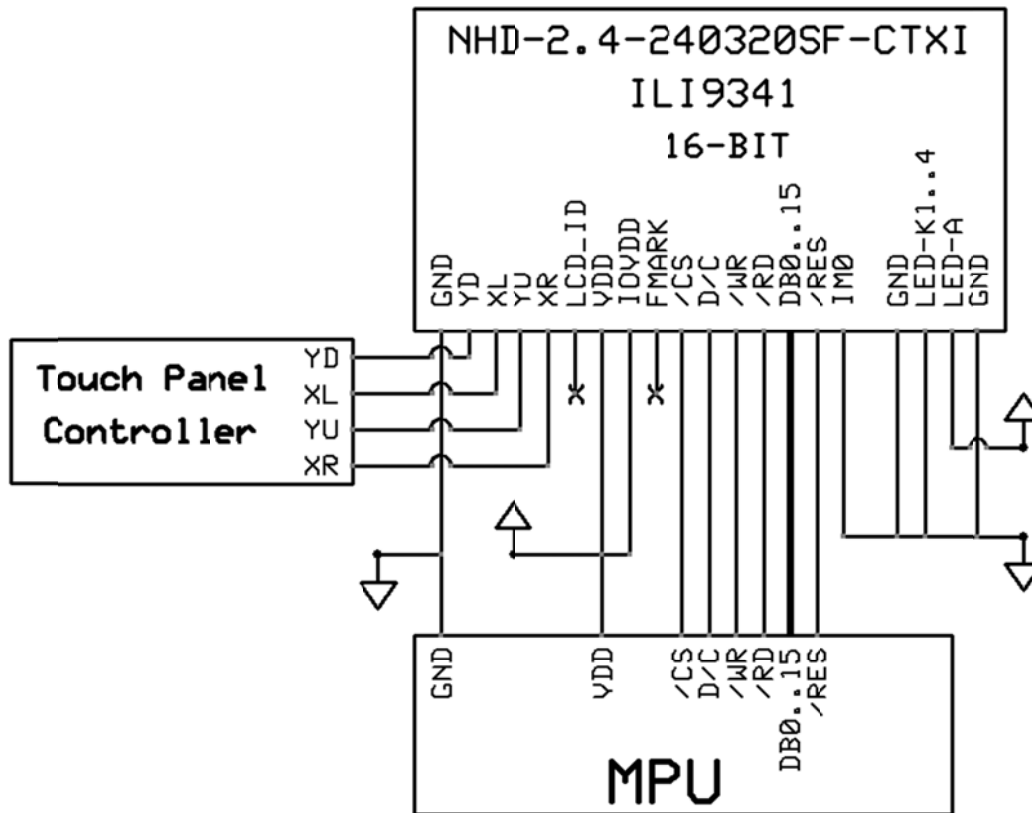
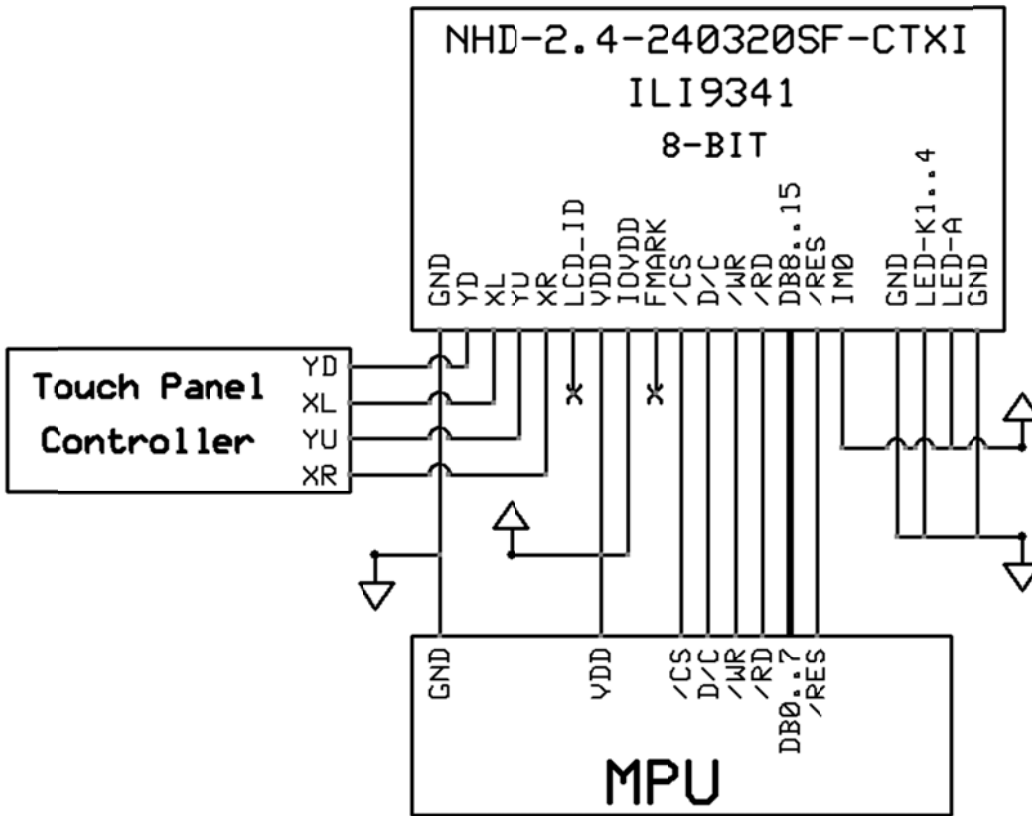
Pin Description

| 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 | LCD_ID | MPU/NC | LCD ID pin (No Connect) |
| 7 | VDD | Power Supply | Supply Voltage for LCD (2.8V) |
| 8 | IOVDD | Power Supply | Supply Voltage for Logic (2.8V) |
| 9 | FMARK | MPU/NC | Used when writing RAM data in sync with frame (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 (3.2V) |
| 39 | GND | Power Supply | Ground |

LCD connector: Hot-bar solder directly to PCB. 1mm pitch.



Wiring Diagram



Electrical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------------------------|--------|--------------|---------|------|---------|------|
| Operating Temperature Range | Top | Absolute Max | -20 | - | +70 | °C |
| Storage Temperature Range | Tst | Absolute Max | -30 | - | +80 | °C |
| Supply Voltage for LCD | VDD | - | 2.5 | 2.8 | 3.3 | V |
| Supply Voltage for Logic | IOVDD | - | 1.65 | 2.8 | 3.3 | V |
| Supply Current | IDD | VDD=2.8V | - | 7 | 9 | mA |
| "H" Level input | Vih | - | 0.8*VDD | - | VDD | V |
| "L" Level input | Vil | - | GND | - | 0.2*VDD | V |
| "H" Level output | Voh | - | 0.8*VDD | - | VDD | V |
| "L" Level output | Vol | - | GND | - | 0.2*VDD | V |
| | | | | | | |
| Backlight Supply Voltage | Vled | - | 2.9 | 3.2 | 3.4 | V |
| Backlight Supply Current | Iled | Vled=3.2V | - | 60 | - | mA |

Optical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------------------------|--------|-----------|------|------|------|-------------------|
| Viewing Angle – Top | - | Cr ≥ 10 | - | 60 | - | ° |
| Viewing Angle – Bottom | - | | - | 70 | - | ° |
| Viewing Angle – Left | - | | - | 70 | - | ° |
| Viewing Angle – Right | - | | - | 70 | - | ° |
| Contrast Ratio | Cr | - | 400 | 500 | - | - |
| Luminance | Lv | - | - | 250 | - | cd/m ² |
| Response Time (rise + fall) | Tr+Tf | - | - | 20 | 30 | ms |

Viewing angles based on 6:00 gray scale inversion

Touch Panel Characteristics

| Item | Min. | Typ. | Max. | Unit |
|------------------------|-----------|------|------|------------|
| Linearity | - | - | 1.5 | % |
| Insulation Resistance | 10 | - | - | MΩ |
| Operation Voltage | - | 5 | - | V |
| Response Time | - | - | 10 | ms |
| Transmittance | 80 | - | - | % |
| Operating Force | 50 | - | 200 | G |
| Touch Durability | 1,000,000 | - | - | Touches |
| Handwriting Durability | 100,000 | - | - | Characters |
| Hardness | 3 | - | - | H |

Controller Information

Built-in ILI9341 controller.

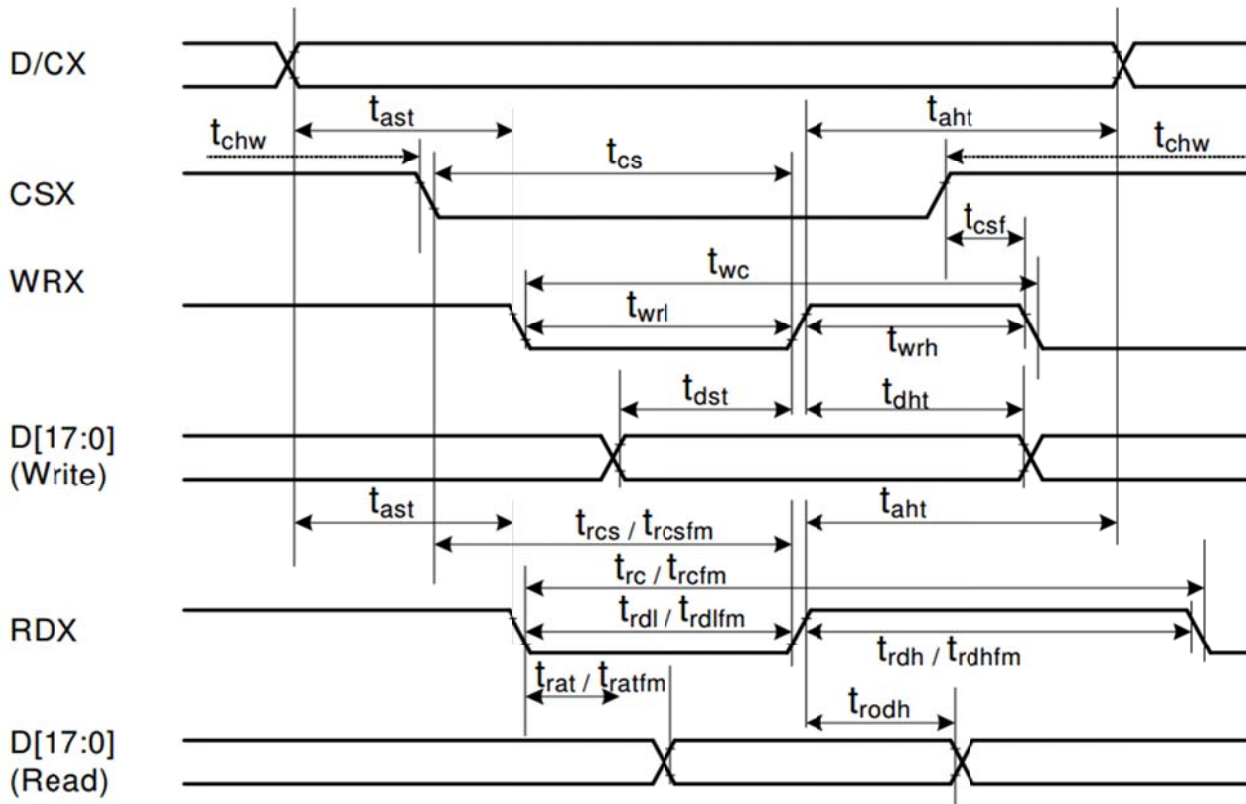
Please download specification at http://www.newhavendisplay.com/app_notes/ILI9341.pdf

Table of Commands

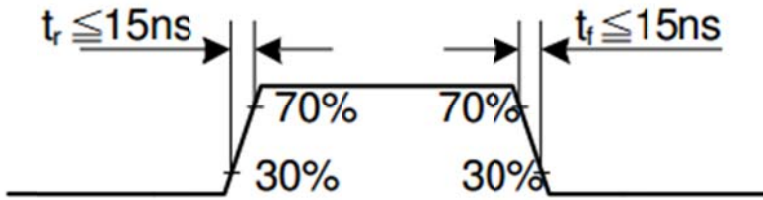
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Timing Characteristics

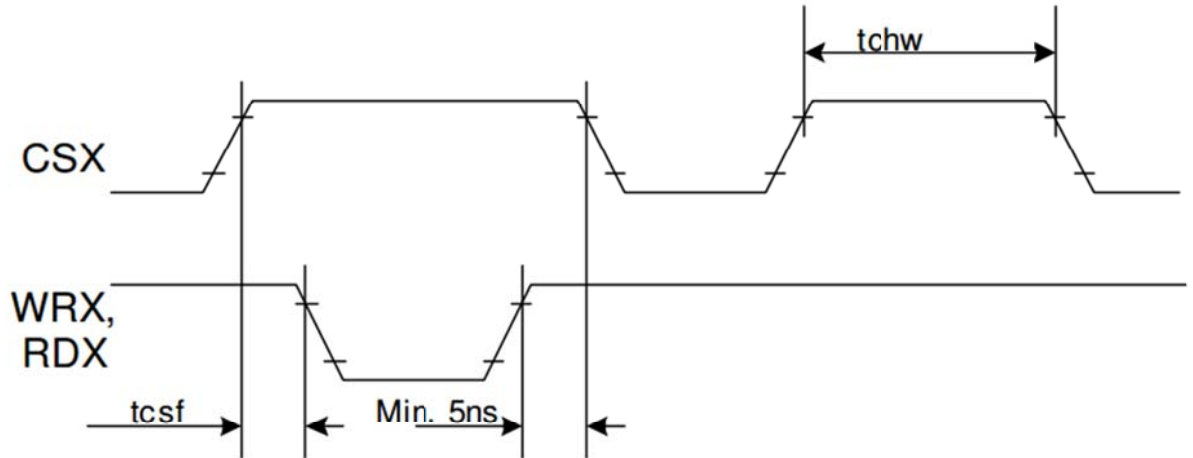
Parallel 18/16/9/8-bit Interface Timing Characteristics (8080-II system)



| Signal | Symbol | Parameter | min | max | Unit | Description |
|--|-------------------------------|------------------------------------|-----|-----|------|---|
| DCX | t _{ast} | Address setup time | 0 | - | ns | |
| | t _{ah} | Address hold time (Write/Read) | 0 | - | ns | |
| CSX | t _{chw} | CSX "H" pulse width | 0 | - | ns | |
| | t _{cs} | Chip Select setup time (Write) | 15 | - | ns | |
| | t _{r_{cs}} | Chip Select setup time (Read ID) | 45 | - | ns | |
| | t _{r_{csfm}} | Chip Select setup time (Read FM) | 355 | - | ns | |
| | t _{csf} | Chip Select Wait time (Write/Read) | 10 | - | ns | |
| WRX | t _{wc} | Write cycle | 66 | - | ns | |
| | t _{wrh} | Write Control pulse H duration | 15 | - | ns | |
| | t _{wrl} | Write Control pulse L duration | 15 | - | ns | |
| RDX (FM) | t _{r_{cfm}} | Read Cycle (FM) | 450 | - | ns | |
| | t _{r_{dhfm}} | Read Control H duration (FM) | 90 | - | ns | |
| | t _{r_{dlfm}} | Read Control L duration (FM) | 355 | - | ns | |
| RDX (ID) | t _{rc} | Read cycle (ID) | 160 | - | ns | |
| | t _{rdh} | Read Control pulse H duration | 90 | - | ns | |
| | t _{rdl} | Read Control pulse L duration | 45 | - | ns | |
| D[17:0], D[17:10]&D[8:1], D[17:10], D[17:9] | t _{dst} | Write data setup time | 10 | - | ns | For maximum CL=30pF For minimum CL=8pF |
| | t _{dht} | Write data hold time | 10 | - | ns | |
| | t _{rat} | Read access time | - | 40 | ns | |
| | t _{ratfm} | Read access time | - | 340 | ns | |
| | t _{rodh} | Read output disable time | 20 | 80 | ns | |

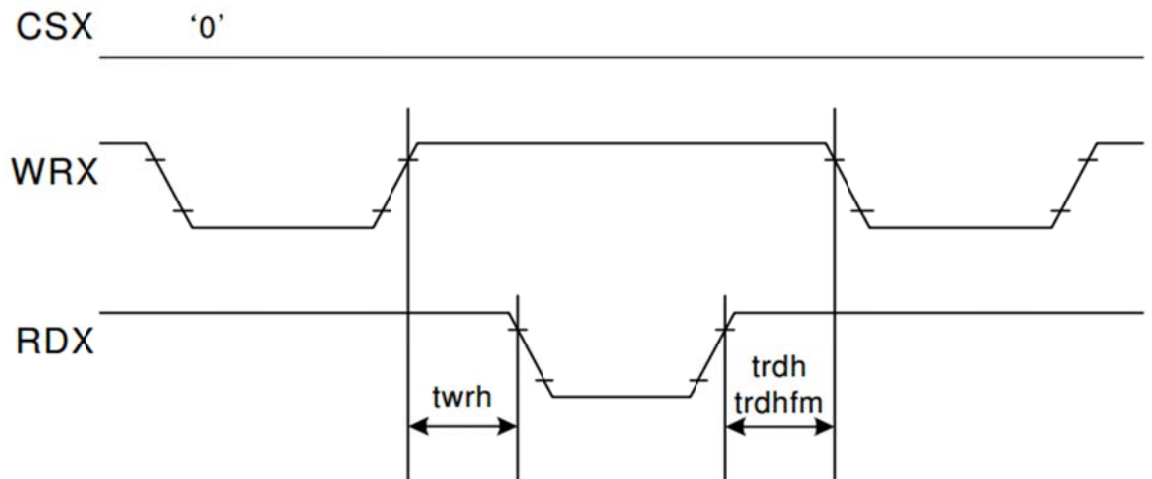


CSX timings :



Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

Write to read or read to write timings:



Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

Example Recommended Initialization Code

```
/******  
void TFT_24S_Write_Command(int command)  
{  
    GPIO_ResetBits(GPIOC, DC);  
    GPIO_Write(GPIOB, command);  
    GPIO_ResetBits(GPIOC, nWR);  
    GPIO_SetBits(GPIOC, nWR);  
}  
void TFT_24S_Write_Data(int data)  
{  
    GPIO_SetBits(GPIOC, DC);  
    GPIO_Write(GPIOB, data);  
    GPIO_ResetBits(GPIOC, nWR);  
    GPIO_SetBits(GPIOC, nWR);  
}  
/******  
void init()  
{  
    GPIO_ResetBits(GPIOC, CS);  
    GPIO_SetBits(GPIOC, nRD);  
    GPIO_ResetBits(GPIOC, nWR);  
    GPIO_WriteBit(GPIOC, RES, Bit_RESET);  
    delay(120);  
    GPIO_WriteBit(GPIOC, RES, Bit_SET);  
    delay(120);  
  
    TFT_24S_Write_Command(0x0028);        //display OFF  
  
    TFT_24S_Write_Command(0x0011);        //exit SLEEP mode  
    TFT_24S_Write_Data(0x0000);  
  
    TFT_24S_Write_Command(0x00CB);        //Power Control A  
    TFT_24S_Write_Data(0x0039);          //always 0x39  
    TFT_24S_Write_Data(0x002C);          //always 0x2C  
    TFT_24S_Write_Data(0x0000);          //always 0x00  
    TFT_24S_Write_Data(0x0034);          //Vcore = 1.6V  
    TFT_24S_Write_Data(0x0002);          //DDVDH = 5.6V  
  
    TFT_24S_Write_Command(0x00CF);        //Power Control B  
    TFT_24S_Write_Data(0x0000);          //always 0x00  
    TFT_24S_Write_Data(0x0081);          //PCEQ off  
    TFT_24S_Write_Data(0x0030);          //ESD protection  
  
    TFT_24S_Write_Command(0x00E8);        //Driver timing control A  
    TFT_24S_Write_Data(0x0085);          //non-overlap  
    TFT_24S_Write_Data(0x0001);          //EQ timing  
    TFT_24S_Write_Data(0x0079);          //Pre-charge timing  
  
    TFT_24S_Write_Command(0x00EA);        //Driver timing control B  
    TFT_24S_Write_Data(0x0000);          //Gate driver timing  
    TFT_24S_Write_Data(0x0000);          //always 0x00
```

```

TFT_24S_Write_Command(0x00ED); //Power-On sequence control
TFT_24S_Write_Data(0x0064); //soft start
TFT_24S_Write_Data(0x0003); //power on sequence
TFT_24S_Write_Data(0x0012); //power on sequence
TFT_24S_Write_Data(0x0081); //DDVDH enhance on

TFT_24S_Write_Command(0x00F7); //Pump ratio control
TFT_24S_Write_Data(0x0020); //DDVDH=2xVCI

TFT_24S_Write_Command(0x00C0); //power control 1
TFT_24S_Write_Data(0x0026);
TFT_24S_Write_Data(0x0004); //second parameter for ILI9340 (ignored by ILI9341)

TFT_24S_Write_Command(0x00C1); //power control 2
TFT_24S_Write_Data(0x0011);

TFT_24S_Write_Command(0x00C5); //VCOM control 1
TFT_24S_Write_Data(0x0035);
TFT_24S_Write_Data(0x003E);

TFT_24S_Write_Command(0x00C7); //VCOM control 2
TFT_24S_Write_Data(0x00BE);

TFT_24S_Write_Command(0x0036); //memory access control = BGR
TFT_24S_Write_Data(0x0088);

TFT_24S_Write_Command(0x00B1); //frame rate control
TFT_24S_Write_Data(0x0000);
TFT_24S_Write_Data(0x0010);

TFT_24S_Write_Command(0x00B6); //display function control
TFT_24S_Write_Data(0x000A);
TFT_24S_Write_Data(0x00A2);

TFT_24S_Write_Command(0x003A); //pixel format = 16 bit per pixel
TFT_24S_Write_Data(0x0055);

TFT_24S_Write_Command(0x00F2); //3G Gamma control
TFT_24S_Write_Data(0x0002); //off

TFT_24S_Write_Command(0x0026); //Gamma curve 3
TFT_24S_Write_Data(0x0001);

TFT_24S_Write_Command(0x002A); //column address set
TFT_24S_Write_Data(0x0000);
TFT_24S_Write_Data(0x0000); //start 0x0000
TFT_24S_Write_Data(0x0000);
TFT_24S_Write_Data(0x00EF); //end 0x00EF

TFT_24S_Write_Command(0x002B); //page address set
TFT_24S_Write_Data(0x0000);
TFT_24S_Write_Data(0x0000); //start 0x0000
TFT_24S_Write_Data(0x0001);
TFT_24S_Write_Data(0x003F); //end 0x013F
}

```

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. | +50°C, 90% RH, 96hrs | 1,2 |
| Thermal Shock resistance | Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress. | -10°C,30min -> 25°C,5min -> 60°C,30min = 1 cycle 100 cycles | |
| Vibration test | Endurance test applying vibration to simulate transportation and use. | 10Hz-55Hz-10Hz , 1.5mm amplitude. 60 mins 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