

# NHD-1.8-128160EF-CSXN#

## TFT (Thin-Film Transistor) Liquid Crystal Display Module

|         |   |
|---------|---|
| NHD-    | Newhaven Display                        |
| 1.8-    | 1.8" Diagonal                           |
| 128160- | 128 x 160 Pixels (Portrait Mode)        |
| EF-     | Model                                   |
| C-      | Built-in Controller                     |
| S-      | Sunlight Readable                       |
| X-      | TFT                                     |
| N-      | TN, 6:00 Optimal View, Wide Temperature |
| #-      | <b>RoHS Compliant</b>                   |

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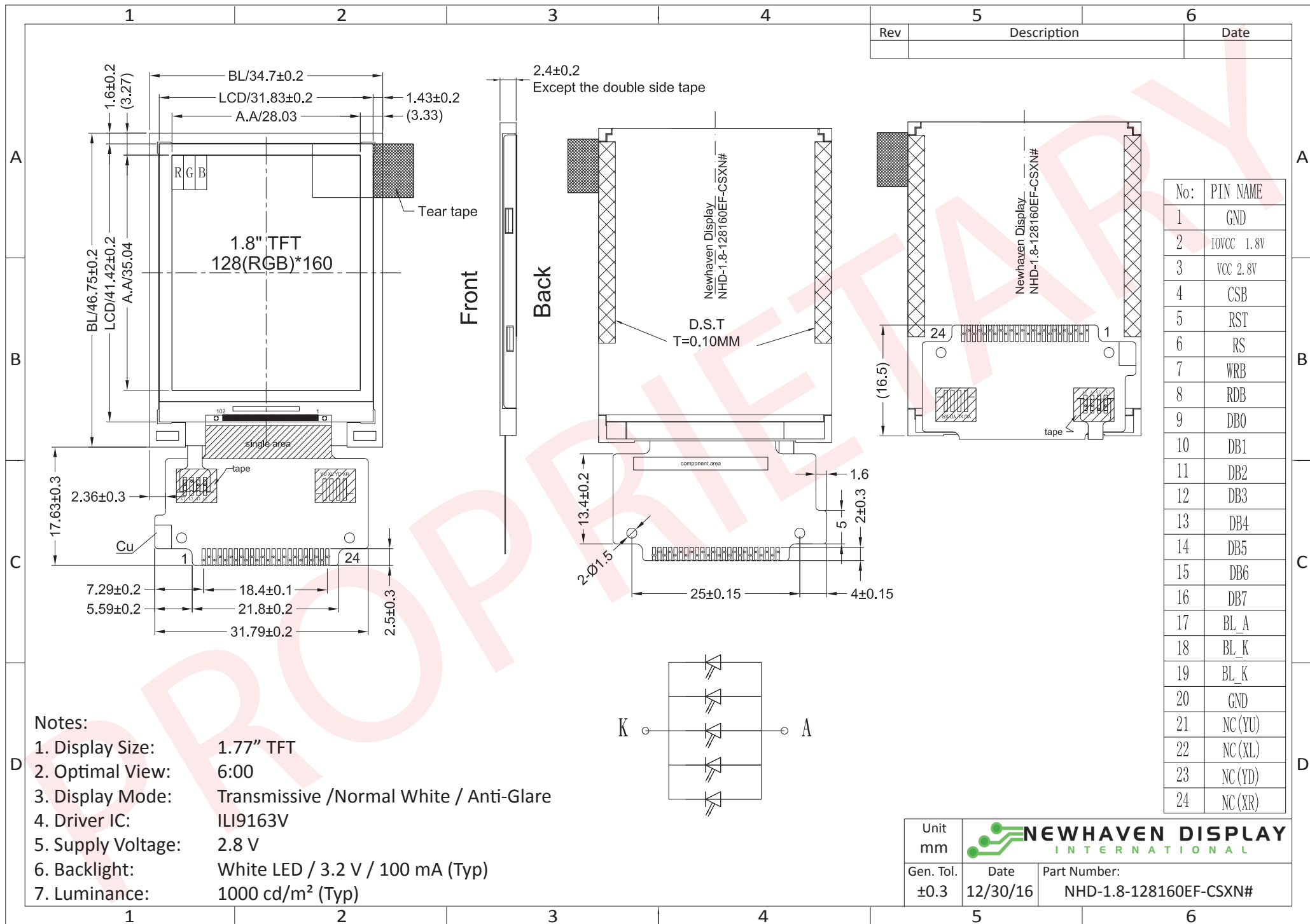
## Document Revision History

| Revision | Date     | Description   | Changed by |
|----------|----------|---|------------|
| 0        | 10/23/15 | Initial Release   | SB         |
| 1        | 2/26/16  | Supply Current and Brightness Updated, Added Backlight Lifetime | SB         |
| 2        | 3/23/16  | Modified Viewing Angles   | SB         |
| 3        | 12/30/16 | Modified Viewing Angles   | SB         |

## Functions and Features

- 128 x 160 pixels (portrait mode)
- High brightness LED backlight
- Sunlight readable
- 2.8V power supply
- 8-bit Parallel interface
- Built-in ILI9163V controller

# Mechanical Drawing

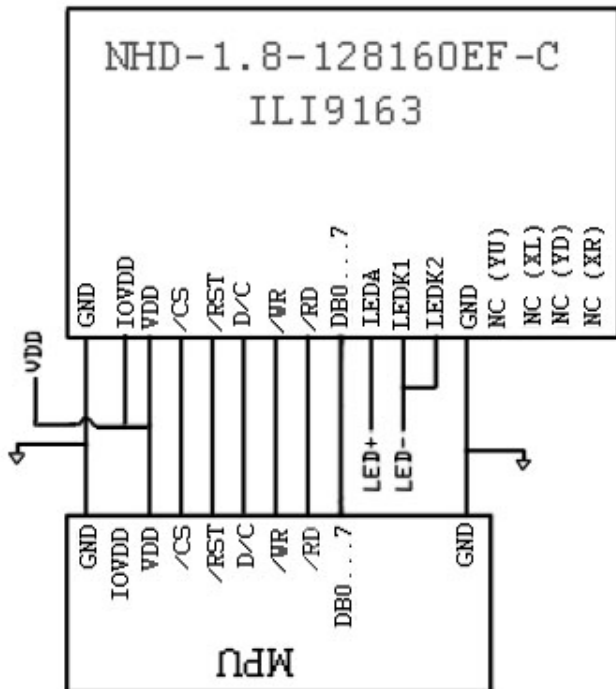


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## Pin Description and Wiring Diagram

| Pin No. | Symbol            | External Connection | Function Description                                 |
|---------|-------------------|---------------------|--|
| 1       | GND               | Power Supply        | Ground   |
| 2       | IOV <sub>DD</sub> | Power Supply        | Supply Voltage for Logic (2.8V) – Can be tied to VDD |
| 3       | V <sub>DD</sub>   | Power Supply        | Supply Voltage for LCD (2.8V)                        |
| 4       | /CS               | MPU                 | Active LOW Chip Select signal                        |
| 5       | /RST              | MPU                 | Active LOW Reset signal                              |
| 6       | D/C               | MPU                 | Data / Command selection: '1' = Data ; '0' = Command |
| 7       | /WR               | MPU                 | Active LOW Write signal                              |
| 8       | /RD               | MPU                 | Active LOW Read signal                               |
| 9       | DB0               | MPU                 | 8-bit bi-directional data bus                        |
| 10      | DB1               | MPU                 |  |
| 11      | DB2               | MPU                 |  |
| 12      | DB3               | MPU                 |  |
| 13      | DB4               | MPU                 |  |
| 14      | DB5               | MPU                 |  |
| 15      | DB6               | MPU                 |  |
| 16      | DB7               | MPU                 |  |
| 17      | LED-A             | Power Supply        | Backlight Anode (3.2V)                               |
| 18      | LED-K1            | Power Supply        | Backlight Cathode (GND)                              |
| 19      | LED-K2            | Power Supply        | Backlight Cathode (GND)                              |
| 20      | GND               | Power Supply        | Ground   |
| 21      | NC                | -                   | No Connect   |
| 22      | NC                | -                   | No Connect   |
| 23      | NC                | -                   | No Connect   |
| 24      | NC                | -                   | No Connect   |

**LCD connector:** Hot-bar solder directly to PCB



## Electrical Characteristics

| Item                        | Symbol            | Condition  | Min.                  | Typ.   | Max.                  | Unit |
|-----------------------------|-------------------|--|-----------------------|--------|-----------------------|------|
| Operating Temperature Range | T <sub>OP</sub>   | Absolute Max                                       | -20                   | -      | +70                   | °C   |
| Storage Temperature Range   | T <sub>ST</sub>   | Absolute Max                                       | -30                   | -      | +80                   | °C   |
| Supply Voltage for Logic    | IOV <sub>DD</sub> | -  | 1.65                  | 2.8    | 3.3                   | V    |
| Supply Voltage for LCD      | V <sub>DD</sub>   | -  | 2.5                   | 2.8    | 3.3                   | V    |
| Supply Current              | I <sub>DD</sub>   | V <sub>DD</sub> = 3.3V                             | 1                     | 3      | 5                     | mA   |
| "H" Level input             | V <sub>IH</sub>   | -  | 0.7*IOV <sub>DD</sub> | -      | IOV <sub>DD</sub>     | V    |
| "L" Level input             | V <sub>IL</sub>   | -  | GND                   | -      | 0.3*IOV <sub>DD</sub> | V    |
| "H" Level output            | V <sub>OH</sub>   | -  | 0.8*IOV <sub>DD</sub> | -      | IOV <sub>DD</sub>     | V    |
| "L" Level output            | V <sub>OL</sub>   | -  | GND                   | -      | 0.2*IOV <sub>DD</sub> | V    |
|                             |                   |  |                       |        |                       |      |
| Backlight Supply Voltage    | V <sub>LED</sub>  | -  | 3.0                   | 3.2    | 3.4                   | V    |
| Backlight Supply Current    | I <sub>LED</sub>  | V <sub>LED</sub> = 3.2V                            | 80                    | 100    | 110                   | mA   |
| Backlight Lifetime*         | -                 | I <sub>LED</sub> = 100mA<br>T <sub>OP</sub> = 25°C | 20,000                | 50,000 | -                     | Hrs. |

\*Backlight Lifetime is rated as Hours until **half-brightness**, under normal operating conditions.

## Optical Characteristics

| Item                   |             | Symbol                         | Condition               | Min. | Typ. | Max. | Unit              |
|------------------------|-------------|--------------------------------|-------------------------|------|------|------|-------------------|
| Optimal Viewing Angles | Top         | φY+                            | Cr ≥ 10                 | -    | 20   | -    | °                 |
|                        | Bottom      | φY-                            |                         | -    | 50   | -    | °                 |
|                        | Left        | θX-                            |                         | -    | 45   | -    | °                 |
|                        | Right       | θX+                            |                         | -    | 45   | -    | °                 |
| Contrast Ratio         |             | Cr                             | -                       | 400  | 500  | -    | -                 |
| Luminance              |             | L <sub>V</sub>                 | I <sub>LED</sub> =100mA | 800  | 1000 | -    | cd/m <sup>2</sup> |
| Response Time          | Rise + Fall | T <sub>R</sub> +T <sub>F</sub> | T <sub>OP</sub> = 25°C  | -    | 20   | 30   | ms                |

## Controller Information

Built-in ILI9163V controller.

Please download specification at [http://www.newhavendisplay.com/app\\_notes/ILI9163.pdf](http://www.newhavendisplay.com/app_notes/ILI9163.pdf)

## Table of Commands

| Hex Code | Command               | Description   | Number of Parameters | Display Architecture Implementation Requirement |        |        |
|----------|-----------------------|---|----------------------|---|--------|--------|
|          |                       |   |                      | Type 1  | Type 2 | Type 3 |
| 00h      | nop                   | No Operation  | 0                    | Yes   | Yes    | Yes    |
| 01h      | soft_reset            | Software Reset  | 0                    | Yes   | Yes    | Yes    |
| 06h      | get_red_channel       | Get the red component of the pixel at (0, 0).   | 1                    | No  | Yes    | Yes    |
| 07h      | get_green_channel     | Get the green component of the pixel at (0, 0).   | 1                    | No  | Yes    | Yes    |
| 08h      | get_blue_channel      | Get the blue component of the pixel at (0, 0).  | 1                    | No  | Yes    | Yes    |
| 0Ch      | get_pixel_format      | Get the current pixel format.   | 1                    | Yes   | Yes    | Yes    |
| 0Ah      | get_power_mode        | Get the current power mode.   | 1                    | Yes   | Yes    | Yes    |
| 0Bh      | get_address_mode      | Get the frame memory to the display panel read order.   | 1                    | Yes   | Yes    | Yes    |
| 0Dh      | get_display_mode      | Get the current display mode from the peripheral.   | 1                    | Yes   | Yes    | Yes    |
| 0Eh      | get_signal_mode       | Get display module signaling mode.  | 1                    | Yes   | Yes    | Yes    |
| 0Fh      | get_diagnostic_result | Get Peripheral Self-Diagnostic Result   | 1                    | Yes   | Yes    | Yes    |
| 10h      | enter_sleep_mode      | Power for the display panel is off.   | 0                    | Yes   | Yes    | Yes    |
| 11h      | exit_sleep_mode       | Power for the display panel is on.  | 0                    | Yes   | Yes    | Yes    |
| 12h      | enter_partial_mode    | Part of the display area is used for image display.   | 0                    | Yes   | Yes    | No     |
| 13h      | enter_normal_mode     | The whole display area is used for image display.   | 0                    | Yes   | Yes    | No     |
| 20h      | exit_invert_mode      | Displayed image colors are not inverted.  | 0                    | Yes   | Yes    | Yes    |
| 21h      | enter_invert_mode     | Displayed image colors are inverted.  | 0                    | Yes   | Yes    | Yes    |
| 26h      | set_gamma_curve       | Selects the gamma curve used by the display device.   | 1                    | Yes   | Yes    | Yes    |
| 28h      | set_display_off       | Blanks the display device.  | 0                    | Yes   | Yes    | Yes    |
| 29h      | set_display_on        | Show the image on the display device.   | 0                    | Yes   | Yes    | Yes    |
| 2Ah      | set_column_address    | Set the column extent.  | 4                    | Yes   | Yes    | No     |
| 2Bh      | set_page_address      | Set the page extent.  | 4                    | Yes   | Yes    | No     |
| 2Ch      | write_memory_start    | Transfer image data from the Host Processor to the peripheral starting at the location provided by set_column_address and set_page_address.           | Variable             | Yes   | Yes    | No     |
| 2Dh      | write_LUT             | Fills the peripheral look-up table with the provided data.  | Variable             | optional  | No     | No     |
| 2Eh      | read_memory_start     | Transfer image data from the peripheral to the Host Processor interface starting at the location provided by set_column_address and set_page_address. | Variable             | Yes   | Yes    | No     |
| 30h      | set_partial_area      | Defines the partial display area on the display device.   | 4                    | Yes   | Yes    | No     |
| 33h      | set_scroll_area       | Defines the vertical scrolling and fixed area on display device.  | 6                    | Yes   | No     | No     |
| 34h      | set_tear_off          | Synchronization information is not sent from the display module to the host processor.  | 0                    | Yes   | No     | No     |
| 35h      | set_tear_on           | Synchronization information is sent from the display module to the host processor at the start of VFP.  | 1                    | Yes   | No     | No     |

|     |                       |  |          |     |     |     |
|-----|-----------------------|--|----------|-----|-----|-----|
| 36h | set_address_mode      | Set the read order from frame memory to the display panel.   | 1        | Yes | Yes | Yes |
| 37h | set_scroll_start      | Defines the vertical scrolling starting point.   | 2        | Yes | No  | No  |
| 38h | exit_idle_mode        | Full color depth is used on the display panel.   | 0        | Yes | No  | No  |
| 39h | enter_idle_mode       | Reduced color depth is used on the display panel.  | 0        | Yes | No  | No  |
| 3Ah | set_pixel_format      | Defines how many bits per pixel are used in the interface.   | 1        | Yes | Yes | Yes |
| 3Ch | write_memory_continue | Transfer image information from the Host Processor interface to the peripheral from the last written location.                                   | Variable | Yes | Yes | No  |
| 3Eh | read_memory_continue  | Read image data from the peripheral continuing after the last read_memory_continue or read_memory_start.   | Variable | Yes | Yes | No  |
| 44h | set_tear_scanline     | Synchronization information is sent from the display module to the host processor when the display device refresh reaches the provided scanline. | 2        | Yes | No  | No  |
| 45h | get_scanline          | Get the current scanline.  | 2        | Yes | Yes | No  |
| Dah | Read ID1              |  |          |     |     |     |
| DBh | Read ID2              |  |          |     |     |     |
| DCh | Read ID3              |  |          |     |     |     |

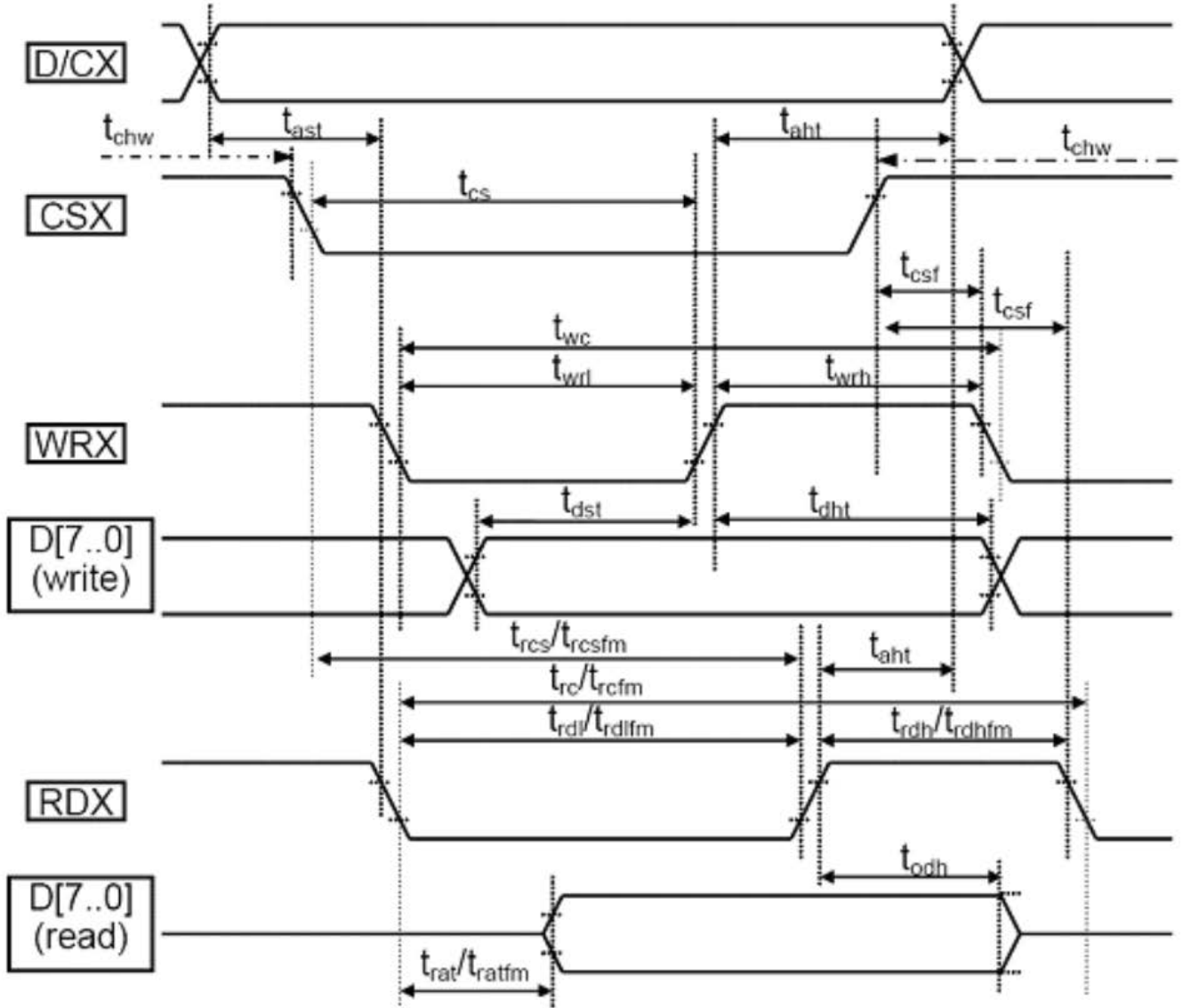
Notes:

1. There will be no abnormal visible effects on the display when S/W or H/W Reset are applied.
2. After Powered-On Reset finishes within 10 $\mu$ s after both VDD & VDDI are applied.
3. Mode 1 means Tearing Effect Output Line consists of V-Blanking Information only.

For Command Descriptions, please see: [http://www.newhavendisplay.com/app\\_notes/ILI9163.pdf](http://www.newhavendisplay.com/app_notes/ILI9163.pdf)

# Timing Characteristics

## Parallel 8-bit Bus



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



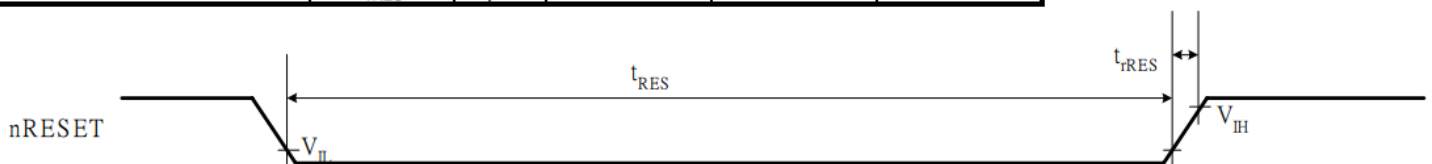
| Signal   | Symbol | Parameter                         | min | max | unit | description                 |
|----------|--------|-----------------------------------|-----|-----|------|-----------------------------|
| D/CX     | tast   | Address setup time                | 0   |     | ns   |                             |
|          | taht   | Address hold time(Write/Read)     | 10  |     | ns   |                             |
| CSX      | tchw   | "S""H" Pulse Width                | 0   |     | ns   |                             |
|          | tcs    | Chip Select setup time (Write)    | 10  |     | ns   |                             |
|          | trcs   | Chip Select setup time (Read ID)  | 45  |     | ns   |                             |
|          | trcsfm | Chip Select setup time (Read FM)  | 355 |     | ns   |                             |
|          | tcsf   | Chip Select Wait time(Write/read) | 10  |     | ns   |                             |
| WRX      | twc    | Write cycle                       | 66  |     | ns   |                             |
|          | twrh   | Controlpulse H duration           | 15  |     | ns   |                             |
|          | twrl   | Control pulse L duration          | 15  |     | ns   |                             |
| RDX      | trc    | Read cycle (ID)                   | 160 |     | ns   | When read ID data           |
|          | trdh   | Control pulse H duration(ID)      | 90  |     | ns   |                             |
|          | trdl   | Control pulse L duration(ID)      | 45  |     | ns   |                             |
| RDX      | trcfm  | Read cycle (FM)                   | 450 |     | ns   | When read from frame memory |
|          | trdhfm | Control pulse H duration (FM)     | 90  |     | ns   |                             |
|          | trdlfm | Control pulse L duration (FM)     | 355 |     | ns   |                             |
| D[17..0] | tdst   | Data setup time                   | 10  |     | ns   | For maximum CL = 30pF       |
|          | tdht   | Data hold time                    | 10  |     | ns   |                             |
|          | trat   | Read access time (ID)             |     | 40  | ns   | For minimum CL = 8pF        |
|          | tratfm | Read access time (FM)             |     | 340 | ns   |                             |
|          | todh   | Output disable time               | 20  | 80  | ns   |                             |

Note 1: VDDI 1.65 to 3.3V, VDD=2.6 to 3.3V, AGND=GND=0V, Ta=-30 to 70 °C (to +85°C no damage)

Note 2: This input signal rise time and fall time (tr, tf) is specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for input signals

### Reset Timing

| Item                  | Symbol     | Unit    | Min. | Typ. | Max. |
|-----------------------|------------|---------|------|------|------|
| Reset low-level width | $t_{RES}$  | ms      | 1    | -    | -    |
| Reset rise time       | $t_{rRES}$ | $\mu$ S | -    | -    | 10   |



## Example Program Code

```
void TFT_18E_Init(void)
{
    GPIO_ResetBits(GPIOC, CS1);
    GPIO_SetBits(GPIOC, nRD);
    GPIO_ResetBits(GPIOC, nWR);
    GPIO_WriteBit(GPIOC, RES, Bit_RESET);
    delay(5);
    TFT_delay(10);
    GPIO_WriteBit(GPIOC, RES, Bit_SET);
    delay(100);
    TFT_delay(10);
    TFT_18E_Write_Command(0x11);
    TFT_delay(100);
    TFT_18E_Write_Command(0x26);TFT_18E_Write_Data(0x04);
    TFT_18E_Write_Command(0xF2);TFT_18E_Write_Data(0x00);
    TFT_18E_Write_Command(0xB1);TFT_18E_Write_Data(0x0A);TFT_18E_Write_Data(0x14);
    TFT_18E_Write_Command(0xC0);TFT_18E_Write_Data(0x0A);TFT_18E_Write_Data(0x00);
    TFT_18E_Write_Command(0xC1);TFT_18E_Write_Data(0x02);
    TFT_18E_Write_Command(0xC5);TFT_18E_Write_Data(0x2F);TFT_18E_Write_Data(0x3E);
    TFT_18E_Write_Command(0xC7);TFT_18E_Write_Data(0x40);
    TFT_18E_Write_Command(0x2A);
    TFT_18E_Write_Data(0x00);
    TFT_18E_Write_Data(0x00);
    TFT_18E_Write_Data(0x00);
    TFT_18E_Write_Data(0x7F);
    TFT_18E_Write_Command(0x2B);
    TFT_18E_Write_Data(0x00);
    TFT_18E_Write_Data(0x00);
    TFT_18E_Write_Data(0x00);
    TFT_18E_Write_Data(0x9F);
    TFT_18E_Write_Command(0x36);TFT_18E_Write_Data(0x48);
    TFT_18E_Write_Command(0x3A);TFT_18E_Write_Data(0xC5);
    TFT_18E_Write_Command(0x29);
    TFT_18E_Write_Command(0x2C);
}
/*****/
void TFT_18E_Write_Command(unsigned char command)
{
    GPIO_ResetBits(GPIOC, RS);
    GPIO_Write(GPIOB, command);
    GPIO_ResetBits(GPIOC, nWR);
    GPIO_SetBits(GPIOC, nWR);
}
/*****/
void TFT_18E_Write_Data(unsigned char data1)
{
    GPIO_SetBits(GPIOC, RS);
    GPIO_Write(GPIOB, data1);
    GPIO_ResetBits(GPIOC, nWR);
    GPIO_SetBits(GPIOC, nWR);
}
/*****/
```

## 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 , 48hrs   | 2    |
| Low Temperature storage               | Endurance test applying the low storage temperature for a long time.  | -30°C , 48hrs   | 1,2  |
| High Temperature Operation            | Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.                    | +70°C , 48hrs   | 2    |
| Low Temperature Operation             | Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.                     | -20°C , 48hrs   | 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 , 48hrs  | 1,2  |
| Thermal Shock resistance              | Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress.                  | -20°C 30 min ~ +70°C 30 min, 10 cycles  |      |
| Vibration test                        | Endurance test applying vibration to simulate transportation and use.   | 10-55Hz , 1.5mm amplitude. 2 hours in each of 3 directions X,Y,Z. For 6 hours total | 3    |
| Static electricity test               | Endurance test applying electric static discharge.  | VS=4KV, RS=330Ω, CS=150pF<br>Five 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](http://www.newhavendisplay.com/specs/precautions.pdf)

## Warranty Information

See Terms & Conditions at [http://www.newhavendisplay.com/index.php?main\\_page=terms](http://www.newhavendisplay.com/index.php?main_page=terms)