

**Product Specification**

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# NHD-3.5-640480EF-MSXP-CTP

## TFT Liquid Crystal Display

|                |                                      |
|----------------|--------------------------------------|
| <b>NHD-</b>    | Newhaven Display                     |
| <b>3.5-</b>    | 3.5" Diagonal                        |
| <b>640480-</b> | 640 x 480 Pixels                     |
| <b>EF-</b>     | Model                                |
| <b>M-</b>      | MIPI Interface                       |
| <b>S-</b>      | High Brightness, White LED Backlight |
| <b>X-</b>      | TFT                                  |
| <b>P-</b>      | IPS, Wide Temperature                |
| <b>CTP-</b>    | Capacitive Touch Panel               |

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## Additional Resources

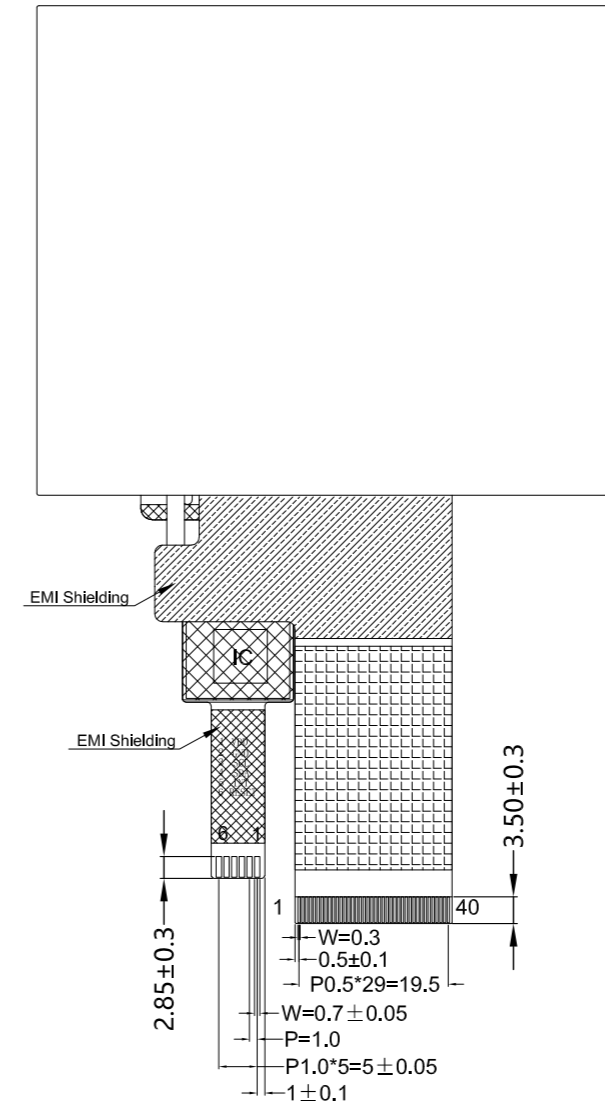
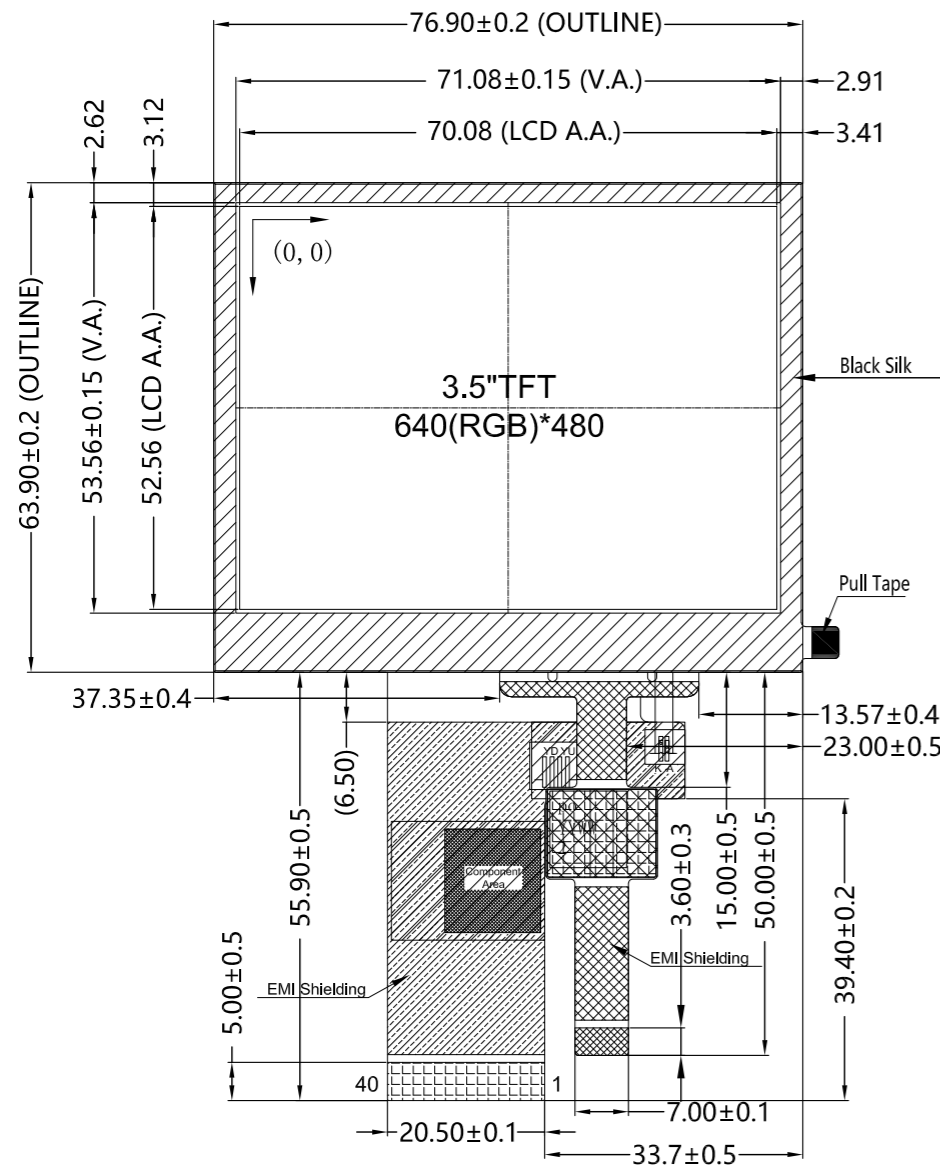
- **Support Forum:** <https://support.newhavendisplay.com/hc/en-us/community/topics>
- **GitHub:** <https://github.com/newhavendisplay>
- **Example Code:** <https://support.newhavendisplay.com/hc/en-us/categories/4409527834135-Example-Code/>
- **Knowledge Center:** [https://www.newhavendisplay.com/knowledge\\_center.html](https://www.newhavendisplay.com/knowledge_center.html)
- **Quality Center:** [https://www.newhavendisplay.com/quality\\_center.html](https://www.newhavendisplay.com/quality_center.html)
- **Precautions for using LCDs/LCMs:** <https://www.newhavendisplay.com/specs/precautions.pdf>
- **Warranty / Terms & Conditions:** <https://www.newhavendisplay.com/terms.html>



## Document Revision History

| Revision | Date       | Description                                       | Changed By |
|----------|------------|---|------------|
| 0        | 08/24/2023 | Initial Release                                   | KL         |
| 1        | 09/15/2023 | Pin Description and Interface Information Updated | KL         |

# Mechanical Drawing



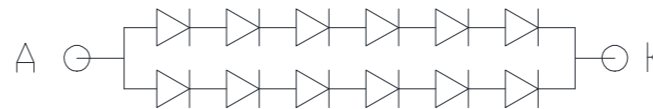
| Pin No. | Symbol  |
|---------|---------|
| 1       | LED_K   |
| 2       | LED_A   |
| 3       | NC      |
| 4       | VSS     |
| 5       | VDD     |
| 6       | NC      |
| 7       | CSX     |
| 8       | DCX     |
| 9       | SCL     |
| 10      | SDA     |
| 11      | NC      |
| 12      | VSS     |
| 13      | DSI_DOP |
| 14      | DSI_DON |
| 15      | VSS     |
| 16      | DSI_D1P |
| 17      | DSI_D1N |
| 18      | VSS     |
| 19      | DSI_CP  |
| 20      | DSI_CN  |
| 21      | VSS     |
| 22      | DSI_D2P |
| 23      | DSI_D2N |
| 24      | VSS     |
| 25      | DSI_D3P |
| 26      | DSI_D3N |
| 27      | VSS     |
| 28      | NC      |
| 29      | RESX    |
| 30      | VOUT    |
| 31      | HOUT    |
| 32      | T_IM    |
| 33      | IM1     |
| 34      | IMO     |
| 35      | LANSEL  |
| 36      | NC      |
| 37      | NC(XR)  |
| 38      | NC(YD)  |
| 39      | NC(XL)  |
| 40      | NC(YU)  |

CTP

| Pin No. | Symbol          |
|---------|-----------------|
| 1       | V <sub>DD</sub> |
| 2       | V <sub>SS</sub> |
| 3       | SCL             |
| 4       | SDA             |
| 5       | /INT            |
| 6       | /RESET          |

Product Description: 3.5" 640x480 IPS TFT w/ Capacitive Touch

1. Driver IC: FL7703NI TFT, FT5426-003 CTP
2. Interface: MIPI TFT, I<sup>2</sup>C CTP
3. Power Requirement: 3.0V TFT, 19.2V/40mA Backlight, 3.3V CTP
4. Optical Features: Normally Black, Transmissive, 808cd/m<sup>2</sup>
5. Recommended FFC Connector:
  - TFT: 40pin 0.5mm Pitch
  - CTP: 6pin 1.0mm Pitch; Molex 52271-0679
6. Key Features: EMI Shielded FPC, 10-point Multitouch



|   |  |                           |  |
|---|--|---------------------------|--|
| <b>Standard Tolerance:</b><br>(Unless otherwise specified)<br><br>Linear: $\pm 0.3\text{mm}$  |  |                           |  |
|   | Drawing/Part Number:<br><b>NHD-3.5-640480EF-MSXP-CTP</b> | Revision:<br>-            |  |
| <b>Unless otherwise specified:</b><br>• Dimensions are in Millimeters<br>• Third Angle Projection   | Drawn By: K. Lewis                                       | Approved By: K. Lewis     |  |
|   | Drawn Date: 08/24/2023                                   | Approved Date: 08/24/2023 |  |
| This drawing is solely the property of Newhaven Display International, Inc. The information it contains is not to be disclosed, reproduced or copied in whole or part without written approval from Newhaven Display. |  |                           |  |

## Pin Description

### TFT:

| Pin No. | Symbol  | External Connection | Function Description                                 |
|---------|---------|---------------------|--|
| 1       | LED_K   | Power Supply        | Backlight Cathode                                    |
| 2       | LED_A   | Power Supply        | Backlight Anode                                      |
| 3       | NC      | -                   | No Connect   |
| 4       | VSS     | Power Supply        | Ground   |
| 5       | VDD     | Power Supply        | Supply Voltage for LCD and logic                     |
| 6       | NC      | -                   | No Connect   |
| 7       | CSX     | MPU                 | Active LOW Chip Select signal                        |
| 8       | DCX     | MPU                 | Data/Command Selection. Command: 0/LOW; Data: 1/HIGH |
| 9       | SCL     | MPU                 | Serial Clock signal                                  |
| 10      | SDA     | MPU                 | Serial Data input/output signal                      |
| 11      | NC      | -                   | No Connect   |
| 12      | VSS     | Power Supply        | Ground   |
| 13      | DSI_D0P | MPU                 | High Speed Interface Data Differential signal        |
| 14      | DSI_D0N | MPU                 | High Speed Interface Data Differential signal        |
| 15      | VSS     | Power Supply        | Ground   |
| 16      | DSI_D1P | MPU                 | High Speed Interface Data Differential signal        |
| 17      | DSI_D1N | MPU                 | High Speed Interface Data Differential signal        |
| 18      | VSS     | Power Supply        | Ground   |
| 19      | DSI_CP  | MPU                 | High Speed Interface Clock Differential signal       |
| 20      | DSI_CN  | MPU                 | High Speed Interface Clock Differential signal       |
| 21      | VSS     | Power Supply        | Ground   |
| 22      | DSI_D2P | MPU                 | High Speed Interface Data Differential signal        |
| 23      | DSI_D2N | MPU                 | High Speed Interface Data Differential signal        |
| 24      | VSS     | Power Supply        | Ground   |
| 25      | DSI_D3P | MPU                 | High Speed Interface Data Differential signal        |
| 26      | DSI_D3N | MPU                 | High Speed Interface Data Differential signal        |
| 27      | VSS     | Power Supply        | Ground   |
| 28      | NC      | -                   | No Connect   |
| 29      | RESX    | MPU                 | Active LOW Reset signal                              |
| 30      | VOUT    | MPU                 | Vertical Frame Synchronization output signal         |
| 31      | HOUT    | MPU                 | Horizontal Frame Synchronization output signal       |
| 32      | T_IM    | MPU                 | Test Mode Enable signal                              |
| 33      | IM1     | MPU                 | Polarity and Data Lane swap signal                   |
| 34      | IM0     | MPU                 | Polarity and Data Lane swap signal                   |
| 35      | LANSEL  | MPU                 | Polarity and Data Lane swap signal                   |
| 36-40   | NC      | -                   | No Connect   |

**Recommended LCD connector:** 0.5mm pitch 40-Conductor FFC. **Backlight connector:** on LCD connector

### CTP:

| Pin No. | Symbol          | External Connection | Function Description                               |
|---------|-----------------|---------------------|--|
| 1       | V <sub>DD</sub> | Power Supply        | Supply voltage for Logic (3.3V)                    |
| 2       | V <sub>SS</sub> | Power Supply        | Ground   |
| 3       | SCL             | MPU                 | Serial I2C Clock (Requires 4.7KΩ pull-up resistor) |
| 4       | SDA             | MPU                 | Serial I2C Data (Requires 4.7kΩ pull-up resistor)  |
| 5       | /INT            | MPU                 | Interrupt signal from touch panel module to host   |
| 6       | /RESET          | MPU                 | Active LOW Reset signal                            |

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



T\_IM signal can be used to select between MIPI interface (normal mode) or serial interface (test mode).

| T_IM | Interface mode                      |
|------|-------------------------------------|
| 0    | MIPI Interface                      |
| 1    | DPI/DBI type-C Option 1 (9-bit SPI) |

The serial interface is used to communicate between the MPU and the LCD driver chip. It uses CSX (chip select), DCX (data/command select), SCL (serial clock), SDA (serial data input/output). Serial clock (SCL) can be stopped when no communication is necessary. CSX, DCX, SCL and SDA signals should be No Connect when test mode is disabled.

See FL7703NI datasheet using the link below for more details.

[https://support.newhavendisplay.com/hc/en-us/article\\_attachments/4688767550359](https://support.newhavendisplay.com/hc/en-us/article_attachments/4688767550359)

## Interface Selection

| IM1 | IM2 | LANSEL | D0P/N | D1P/N | CP/N | D2P/N | D3/PN |
|-----|-----|--------|-------|-------|------|-------|-------|
| 0   | 0   | 0      | D3P/N | D2P/N | CP/N | D1P/N | D0P/N |
| 0   | 1   | 0      | D3N/P | D2N/P | CN/P | D1N/P | D0N/P |
| 1   | 0   | 0      | D0P/N | D1P/N | CP/N | D2P/N | D3P/N |
| 1   | 1   | 0      | D0N/P | D1N/P | CN/P | D2N/P | D3N/P |
| 0   | 0   | 1      | D2P/N | D1P/N | CP/N | D0P/N | D3P/N |
| 0   | 1   | 1      | D2N/P | D1N/P | CN/P | D0N/P | D3N/P |
| 1   | 0   | 1      | D3P/N | D0P/N | CP/N | D1P/N | D2P/N |
| 1   | 1   | 1      | D3N/P | D0N/P | CN/P | D1N/P | D2N/P |

Command **SETMIPI (BAh)** is used to set MIPI related register.

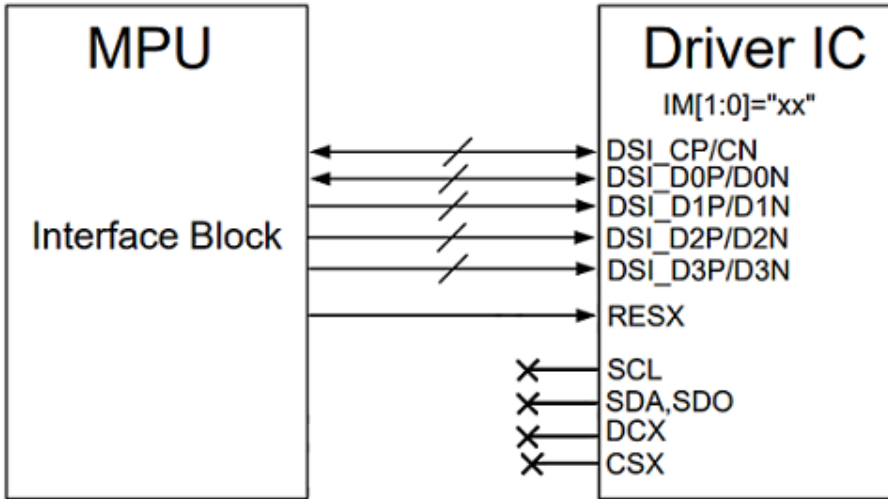
| BA H          | SETMIPI |                |                |                |              |                |                |                 |                 | HEX |
|---------------|---------|----------------|----------------|----------------|--------------|----------------|----------------|-----------------|-----------------|-----|
|               | R/W     | D7             | D6             | D5             | D4           | D3             | D2             | D1              | D0              |     |
| Command       | W       | 1              | 0              | 1              | 1            | 1              | 0              | 1               | 0               | BA  |
| Parameter 1st | R/W     | HOSTTY PE      | CD_DLY         | x              | CRC_En able  | VC_Main [1]    | VC_Main [0]    | Lane_Nu mber[1] | Lane_Nu mber[0] | 33  |
| Parameter 2nd | R/W     | DSI_LDO_SEL[2] | DSI_LDO_SEL[1] | DSI_LDO_SEL[0] | LPTX_D R[2]  | LPTX_D R[1]    | LPTX_D R[0]    | RTERM[ 1]       | RTERM[ 0]       | 61  |
| Parameter 3rd | R/W     | x              | x              | x              | X            | IHSRX[3]       | IHSRX[2]       | IHSRX[1]        | IHSRX[0]        | 06  |
| Parameter 4th | R/W     | DSI_HFP_OTP    | Txs_Wait [2]   | Txs_Wait [1]   | Txs_Wait [0] | Tx_clk_s el[1] | Tx_clk_s el[0] | VBP_OS C_EN     | VFP_OS C_EN     | F9  |
| Parameter 5th | R/W     | HFP_OS C[7]    | HFP_OS C[6]    | HFP_OS C[5]    | HFP_OS C[4]  | HFP_OS C[3]    | HFP_OS C[2]    | HFP_OS C[1]     | HFP_OS C[0]     | FF  |
| Parameter 6th | R/W     | HBP_OS C[7]    | HBP_OS C[6]    | HBP_OS C[5]    | HBP_OS C[4]  | HBP_OS C[3]    | HBP_OS C[2]    | HBP_OS C[1]     | HBP_OS C[0]     | 0A  |

**Lane [1:0]:** Specify the lane number selection.

| Lane [1:0] | MIPI Lane |
|------------|-----------|
| 0          | 1 lane    |
| 1          | 2 lanes   |
| 2          | 3 lanes   |
| 3          | 4 lanes   |



## Wiring Diagram



### Notes:

1. Connect DSI\_D3P/N to VSS in 3 data lanes application.
2. Connect DSI\_D3P/N and DSI\_D2P/N to VSS in 2 data lanes application.

## Electrical Characteristics

### TFT:

| 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              | V <sub>DD</sub>  | -   | 2.5                   | 3.0    | 3.3                   | V    |
| Supply Current              | I <sub>DD</sub>  | V <sub>DD</sub> = 3V                              | 38                    | 50     | 75                    | mA   |
| "H" Level input             | V <sub>IH</sub>  | -   | 0.7 * V <sub>DD</sub> | -      | V <sub>DD</sub>       | V    |
| "L" Level input             | V <sub>IL</sub>  | -   | GND                   | -      | 0.3 * V <sub>DD</sub> | V    |
| "H" Level output            | V <sub>OH</sub>  | -   | 0.8 * V <sub>DD</sub> | -      | V <sub>DD</sub>       | V    |
| "L" Level output            | V <sub>OL</sub>  | -   | GND                   | -      | 0.2 * V <sub>DD</sub> | V    |
| Backlight Supply Current    | I <sub>LED</sub> | -   | 30                    | 40     | 50                    | mA   |
| Backlight Supply Voltage    | V <sub>LED</sub> | I <sub>LED</sub> = 40mA<br>T <sub>OP</sub> = 25°C | 16.8                  | 19.2   | 20.4                  | V    |
| Backlight Lifetime*         | -                |   | -                     | 30,000 | -                     | 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.

### Capacitive Touch Panel:

| 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              | V <sub>DD</sub> | -            | 2.7                 | 3.3   | 3.6                 | V    |
| Supply Current – Operating  | I <sub>DD</sub> | -            | 12                  | 12.76 | 14.5                | mA   |
| "H" Level input             | V <sub>IH</sub> | -            | 0.7*V <sub>DD</sub> | -     | V <sub>DD</sub>     | V    |
| "L" Level input             | V <sub>IL</sub> | -            | V <sub>SS</sub>     | -     | 0.3*V <sub>DD</sub> | V    |
| "H" Level output            | V <sub>OH</sub> | -            | 0.7*V <sub>DD</sub> | -     | V <sub>DD</sub>     | V    |
| "L" Level output            | V <sub>OL</sub> | -            | V <sub>SS</sub>     | -     | 0.3*V <sub>DD</sub> | V    |

## Optical Characteristics:

| Item                        | Symbol                          | Condition                | Min. | Typ. | Max. | Unit              |
|-----------------------------|---------------------------------|--------------------------|------|------|------|-------------------|
| Optimal Viewing Angles      | Top                             | CR ≥ 10                  | 75   | 85   | -    | °                 |
|                             | Bottom                          |                          | 75   | 85   | -    | °                 |
|                             | Left                            |                          | 75   | 85   | -    | °                 |
|                             | Right                           |                          | 75   | 85   | -    | °                 |
| Contrast Ratio              | CR                              | -                        | 600  | 800  | -    | -                 |
| Luminance                   | L <sub>V</sub>                  | I <sub>LED</sub> = 40 mA | 646  | 808  | 1211 | cd/m <sup>2</sup> |
| Response Time (Rise + Fall) | T <sub>R</sub> + T <sub>F</sub> | T <sub>OP</sub> = 25°C   | -    | 25   | 50   | ms                |
| Chromaticity                | Red                             | X <sub>R</sub>           | .508 | .558 | .608 | -                 |
|                             |                                 | Y <sub>R</sub>           | .273 | .323 | .373 | -                 |
|                             | Green                           | X <sub>G</sub>           | .245 | .295 | .345 | -                 |
|                             |                                 | Y <sub>G</sub>           | .547 | .597 | .647 | -                 |
|                             | Blue                            | X <sub>B</sub>           | .100 | .150 | .200 | -                 |
|                             |                                 | Y <sub>B</sub>           | .027 | .077 | .127 | -                 |
|                             | White                           | X <sub>W</sub>           | .228 | .278 | .328 | -                 |
|                             |                                 | Y <sub>W</sub>           | .284 | .334 | .360 | -                 |

## Driver/Controller Information

Built-in FL7703NI Driver: <https://support.newhavendisplay.com/hc/en-us/articles/4688762082071-FL7703NI>

Built-in FT5426-003 Controller: <https://support.newhavendisplay.com/hc/en-us/articles/4414392845079-FT5x26>





## Capacitive Touch Panel Registers

| Register No. | Access | Register Name     | Bits  | Value    | Description   |
|--------------|--------|-------------------|-------|----------|---|
| 01h          | RO     | Gesture ID        | [7:0] | 1Ch      | Swipe Up  |
|              |        |                   |       | 14h      | Swipe Down  |
|              |        |                   |       | 10       | Swipe Left  |
|              |        |                   |       | 18       | Swipe Right   |
|              |        |                   |       | 48       | Zoom In   |
|              |        |                   |       | 49       | Zoom Out  |
|              |        |                   |       | 00       | No gesture  |
| 02h          | RO     | Touch Points      | [7:0] | 0-Ah     | 0: No touch detected<br>A: 10 touch points detected |
| 03h          | RO     | TOUCH1_Event_Flag | [7:6] | 0        | Put Down  |
|              |        |                   |       | 1        | Put Up  |
|              |        |                   |       | 2        | Contact   |
|              |        |                   |       | 3        | Reserved  |
| 03h          | RO     | TOUCH1_XH         | [3:0] | 0-1      | Upper 4 bits of X touch coordinate                  |
| 04h          | RO     | TOUCH1_XL         | [7:0] | 00 – FFh | Lower 8 bits of X touch coordinate                  |
| 05h          | RO     | TOUCH1_YH         | [3:0] | 0-1      | Upper 4 bits of Y touch coordinate                  |
| 06h          | RO     | TOUCH1_YL         | [7:0] | 00 – FFh | Lower 8 bits of Y touch coordinate                  |
| 07h          | RO     | TOUCH1_Weight     | [7:0] |          | Touch Weight  |
| 08h          | RO     | TOUCH1_Misc       | [3:0] | 00-0Fh   | Touch Area  |
| 09h          | RO     | TOUCH2_Event_Flag | [7:6] | 0        | Put Down  |
|              |        |                   |       | 1        | Put Up  |
|              |        |                   |       | 2        | Contact   |
|              |        |                   |       | 3        | Reserved  |
| 09h          | RO     | TOUCH1_XH         | [3:0] | 0-1      | Upper 4 bits of X touch coordinate                  |
| 0Ah          | RO     | TOUCH2_XL         | [7:0] | 00 – FFh | Lower 8 bits of X touch coordinate                  |
| 0Bh          | RO     | TOUCH2_YH         | [3:0] | 0-1      | Upper 4 bits of Y touch coordinate                  |
| 0Ch          | RO     | TOUCH2_YL         | [7:0] | 00 – FFh | Lower 8 bits of Y touch coordinate                  |
| 0Dh          | RO     | TOUCH2_Weight     | [7:0] |          | Touch Weight  |
| 0Eh          | RO     | TOUCH2_Misc       | [3:0] | 00-0Fh   | Touch Area  |
| 0Fh          | RO     | TOUCH3_Event_Flag | [7:6] | 0        | Put Down  |
|              |        |                   |       | 1        | Put Up  |
|              |        |                   |       | 2        | Contact   |
|              |        |                   |       | 3        | Reserved  |
| 0Fh          | RO     | TOUCH3_XH         | [3:0] | 0-1      | Upper 4 bits of X touch coordinate                  |
| 10           | RO     | TOUCH3_XL         | [7:0] | 00 – FFh | Lower 8 bits of X touch coordinate                  |
| 11h          | RO     | TOUCH3_YH         | [3:0] | 0-1      | Upper 4 bits of Y touch coordinate                  |
| 12h          | RO     | TOUCH3_YL         | [7:0] | 00 – FFh | Lower 8 bits of Y touch coordinate                  |
| 13h          | RO     | TOUCH3_Weight     | [7:0] |          | Touch Weight  |
| 14h          | RO     | TOUCH3_Misc       | [3:0] | 00-0Fh   | Touch Area  |
| 15h          | RO     | TOUCH4_Event_Flag | [7:6] | 0        | Put Down  |
|              |        |                   |       | 1        | Put Up  |
|              |        |                   |       | 2        | Contact   |
|              |        |                   |       | 3        | Reserved  |
| 15h          | RO     | TOUCH4_XH         | [3:0] | 0-1      | Upper 4 bits of X touch coordinate                  |
| 16h          | RO     | TOUCH4_XL         | [7:0] | 00 – FFh | Lower 8 bits of X touch coordinate                  |
| 17h          | RO     | TOUCH4_YH         | [3:0] | 0-1      | Upper 4 bits of Y touch coordinate                  |
| 18h          | RO     | TOUCH4_YL         | [7:0] | 00 – FFh | Lower 8 bits of Y touch coordinate                  |
| 1Ah          | RO     | TOUCH4_Misc       | [3:0] | 00-0Fh   | Touch Area  |
| 1Bh          | RO     | TOUCH5_Event_Flag | [7:6] | 0        | Put Down  |
|              |        |                   |       | 1        | Put Up  |
|              |        |                   |       | 2        | Contact   |
|              |        |                   |       | 3        | Reserved  |



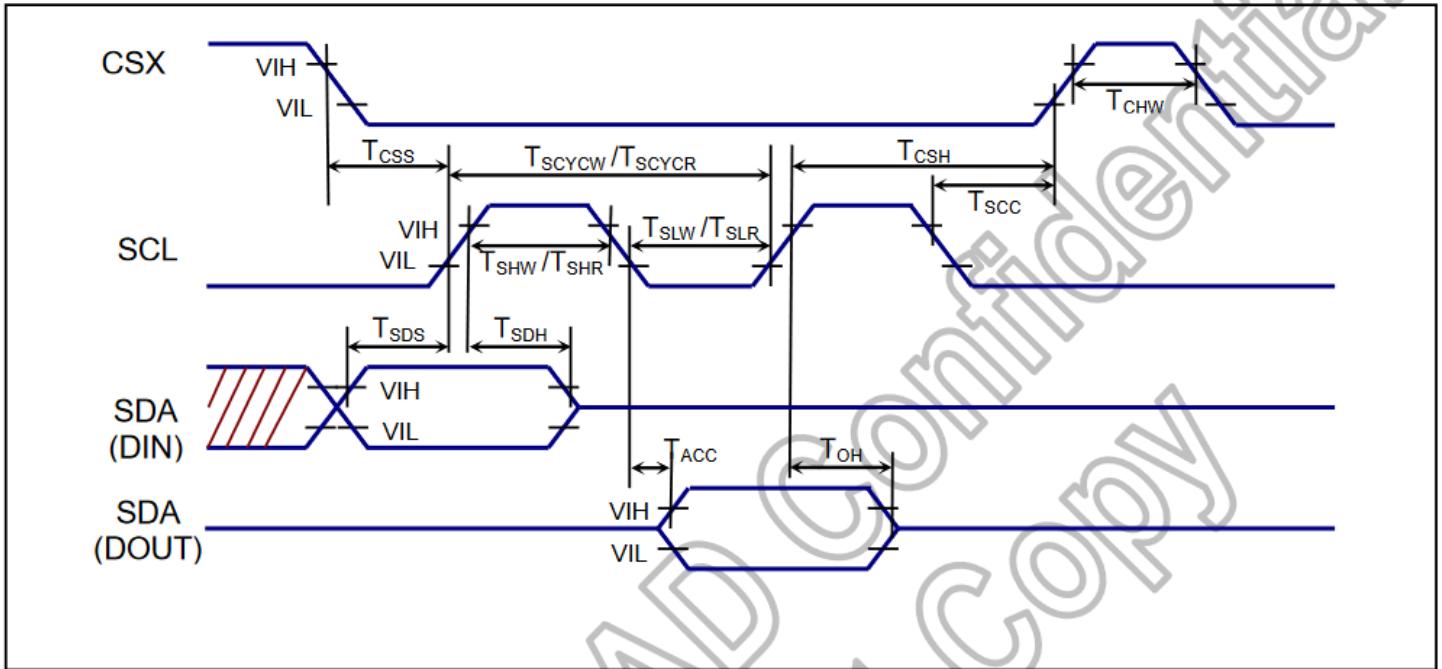
| Register No. | Access | Register Name      | Bits  | Value    | Description                        |
|--------------|--------|--------------------|-------|----------|------------------------------------|
| 1Bh          | RO     | TOUCH5_XH          | [3:0] | 0 -1     | Upper 4 bits of X touch coordinate |
| 1Ch          | RO     | TOUCH5_XL          | [7:0] | 00 – FFh | Lower 8 bits of X touch coordinate |
| 1Dh          | RO     | TOUCH5_YH          | [3:0] | 0 -1     | Upper 4 bits of Y touch coordinate |
| 1Eh          | RO     | TOUCH5_YL          | [7:0] | 00 – FFh | Lower 8 bits of Y touch coordinate |
| 1Fh          | RO     | TOUCH5_Weight      | [7:0] |          | Touch Weight                       |
| 20           | RO     | TOUCH5_Misc        | [3:0] | 00-0Fh   | Touch Area                         |
| 21h          | RO     | TOUCH6_Event_Flag  | [7:6] | 0        | Put Down                           |
|              |        |                    |       | 1        | Put Up                             |
|              |        |                    |       | 2        | Contact                            |
|              |        |                    |       | 3        | Reserved                           |
| 21h          | RO     | TOUCH6_XH          | [3:0] | 0 -1     | Upper 4 bits of X touch coordinate |
| 22h          | RO     | TOUCH6_XL          | [7:0] | 00 – FFh | Lower 8 bits of X touch coordinate |
| 23h          | RO     | TOUCH6_YH          | [3:0] | 0 -1     | Upper 4 bits of Y touch coordinate |
| 24h          | RO     | TOUCH6_YL          | [7:0] | 00 – FFh | Lower 8 bits of Y touch coordinate |
| 25h          | RO     | TOUCH6_Weight      | [7:0] |          | Touch Weight                       |
| 26h          | RO     | TOUCH6_Misc        | [3:0] | 00-0Fh   | Touch Area                         |
| 27h          | RO     | TOUCH7_Event_Flag  | [7:6] | 0        | Put Down                           |
|              |        |                    |       | 1        | Put Up                             |
|              |        |                    |       | 2        | Contact                            |
|              |        |                    |       | 3        | Reserved                           |
| 27h          | RO     | TOUCH7_XH          | [3:0] | 0 -1     | Upper 4 bits of X touch coordinate |
| 28h          | RO     | TOUCH7_XL          | [7:0] | 00 – FFh | Lower 8 bits of X touch coordinate |
| 29h          | RO     | TOUCH7_YH          | [3:0] | 0 – 1    | Upper 4 bits of Y touch coordinate |
| 2Ah          | RO     | TOUCH7_YL          | [7:0] | 00 – FFh | Lower 8 bits of Y touch coordinate |
| 2Bh          | RO     | TOUCH7_Weight      | [7:0] |          | Touch Weight                       |
| 2Ch          | RO     | TOUCH7_Misc        | [3:0] | 00-0Fh   | Touch Area                         |
| 2Dh          | RO     | TOUCH8_Event_Flag  | [7:6] | 0        | Put Down                           |
|              |        |                    |       | 1        | Put Up                             |
|              |        |                    |       | 2        | Contact                            |
|              |        |                    |       | 3        | Reserved                           |
| 2Dh          | RO     | TOUCH8_XH          | [3:0] | 0 – 1    | Upper 4 bits of X touch coordinate |
| 2Eh          | RO     | TOUCH8_XL          | [7:0] | 00 – FFh | Lower 8 bits of X touch coordinate |
| 2Fh          | RO     | TOUCH8_YH          | [3:0] | 0 – 1    | Upper 4 bits of Y touch coordinate |
| 30           | RO     | TOUCH8_YL          | [7:0] | 00 – FFh | Lower 8 bits of Y touch coordinate |
| 31h          | RO     | TOUCH8_Weight      | [7:0] |          | Touch Weight                       |
| 32h          | RO     | TOUCH8_Misc        | [3:0] | 00-0Fh   | Touch Area                         |
| 33h          | RO     | TOUCH9_Event_Flag  | [7:6] | 0        | Put Down                           |
|              |        |                    |       | 1        | Put Up                             |
|              |        |                    |       | 2        | Contact                            |
|              |        |                    |       | 3        | Reserved                           |
| 33h          | RO     | TOUCH9_XH          | [3:0] | 0 – 1    | Upper 4 bits of X touch coordinate |
| 34h          | RO     | TOUCH9_XL          | [7:0] | 00 – FFh | Lower 8 bits of X touch coordinate |
| 35h          | RO     | TOUCH9_YH          | [3:0] | 0 – 1    | Upper 4 bits of Y touch coordinate |
| 36h          | RO     | TOUCH9_YL          | [7:0] | 00 – FFh | Lower 8 bits of Y touch coordinate |
| 37h          | RO     | TOUCH9_Weight      | [7:0] |          | Touch Weight                       |
| 38h          | RO     | TOUCH9_Misc        | [3:0] | 00 – 0Fh | Touch Area                         |
| 39h          | RO     | TOUCH10_Event_Flag | [7:6] | 0        | Put Down                           |
|              |        |                    |       | 1        | Put Up                             |
|              |        |                    |       | 2        | Contact                            |
|              |        |                    |       | 3        | Reserved                           |
| 39h          | RO     | TOUCH10_XH         | [3:0] | 0 – 1    | Upper 4 bits of X touch coordinate |
| 3Ah          | RO     | TOUCH10_XL         | [7:0] | 00 – FFh | Lower 8 bits of X touch coordinate |
| 3Bh          | RO     | TOUCH10_YH         | [3:0] | 0 – 1    | Upper 4 bits of Y touch coordinate |
| 3Ch          | RO     | TOUCH10_YL         | [7:0] | 00 - FFh | Lower 8 bits of Y touch coordinate |



| Register No. | Access | Register Name      | Bits  | Value  | Description                                 |
|--------------|--------|--------------------|-------|--------|---|
| 3Dh          | RO     | TOUCH10_Weight     | [7:0] | 00-FFh | Touch Weight                                |
| 3Eh          | RO     | TOUCH10_Misc       | [3:0] | 00-0Fh | Touch Area                                  |
| A1h          | RO     | ID_G_LIB_VERSION_H | [7:0] | 00-FFh | App library version high-byte<br>Default: 0 |
| A2h          | RO     | ID_G_LIB_VERSION_L | [7:0] | 00-FFh | App library version low-byte<br>Default: 1h |
| A3h          | RO     | ID_G_CHIPER_HIGH   | [7:0] | 00-FFh | Chip Vendor ID<br>Default: 54               |
| A6h          | RO     | ID_G_FIRMID        | [7:0] | 00-FFh | Firmware ID Number<br>Default: 2            |
| A8h          | RO     | ID_G_VENODRID      | [7:0] | 00-FFh | CTPM Vendor's Chip ID<br>Default: 79h       |

# Timing Characteristics-TFT

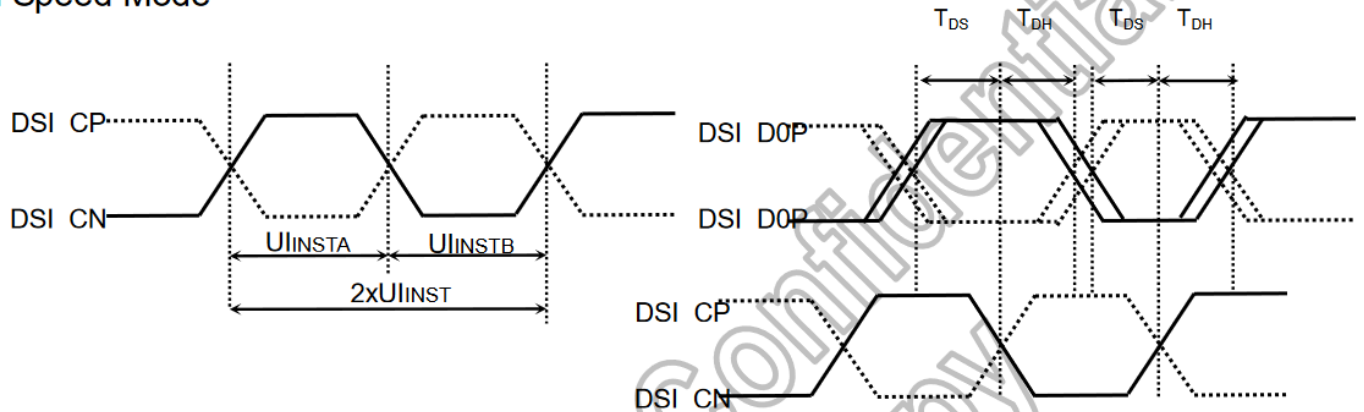
## Serial Interface



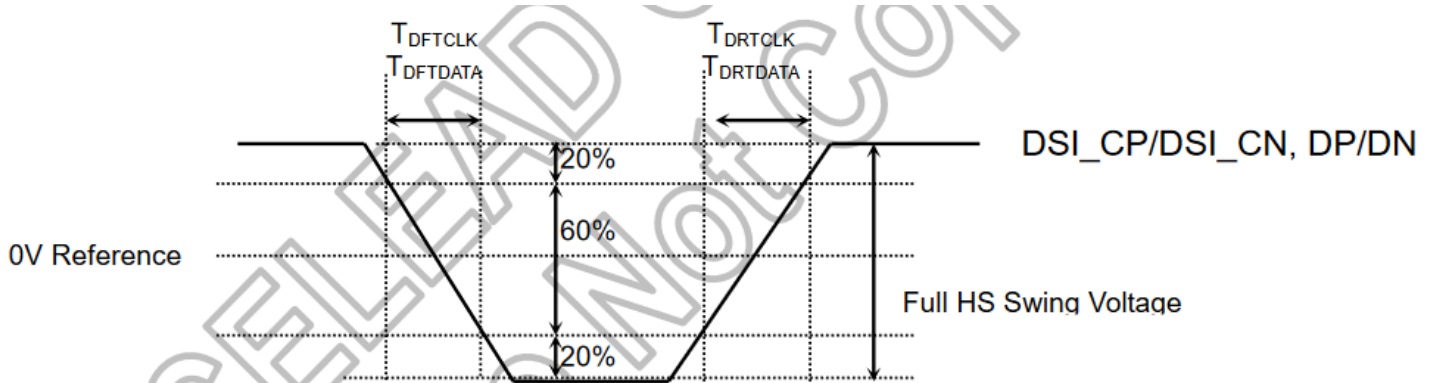
| Signal       | Symbol    | Parameter                      | Min. | Max. | Unit | Description                                     |
|--------------|-----------|--------------------------------|------|------|------|---|
| CSX          | $t_{CSS}$ | Chip select setup time (Write) | 15   | -    | ns   | -   |
|              | $t_{CSS}$ | Chip select setup time (Read)  | 60   | -    |      |   |
|              | $t_{CSH}$ | Chip select hold time (Write)  | 15   | -    |      |   |
|              | $t_{CSH}$ | Chip select hold time (Read)   | 65   | -    |      |   |
| DCX          | $t_{AST}$ | Address setup time             | 0    | -    | ns   | -   |
|              | $t_{AHT}$ | Address hold time (Write/Read) | 10   | -    |      |   |
| SCL (Write)  | $t_{WC}$  | Write cycle                    | 66   | -    | ns   | -   |
|              | $t_{WRH}$ | Control pulse "H" duration     | 15   | -    |      |   |
|              | $t_{WRL}$ | Control pulse "L" duration     | 15   | -    |      |   |
| SCL (Read)   | $t_{RC}$  | Read cycle                     | 150  | -    | ns   | -   |
|              | $t_{RDH}$ | Control pulse "H" duration     | 60   | -    |      |   |
|              | $t_{RDH}$ | Control pulse "L" duration     | 60   | -    |      |   |
| SDA (Input)  | $t_{DS}$  | Data setup time                | 10   | -    | ns   | For maximum $C_L=30pF$<br>For minimum $C_L=8pF$ |
|              | $t_{DH}$  | Data hold time                 | 10   | -    |      |   |
| SDA (Output) | $t_{ACC}$ | Read access time               | -    | 100  | ns   |   |
|              | $t_{OH}$  | Output disable time            | 10   | -    |      |   |

## DSI Interface

### High Speed Mode



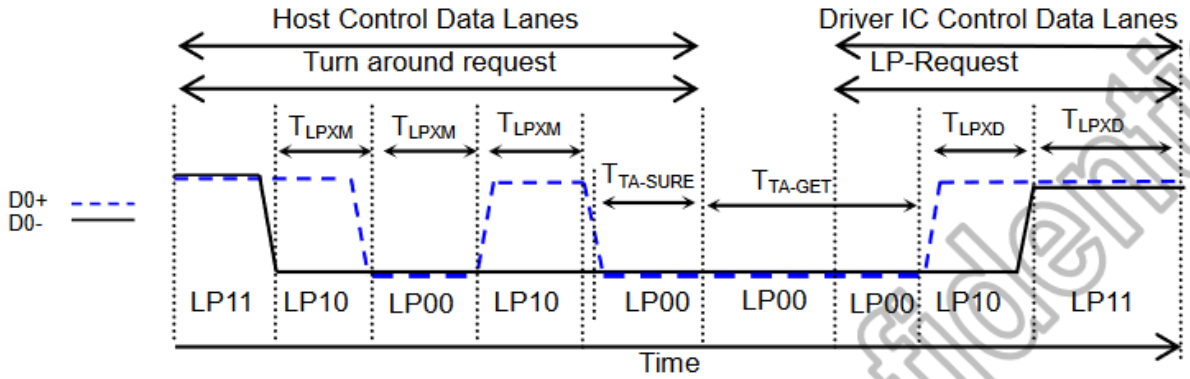
**Figure 7-4: DSI clock timing Characteristics**



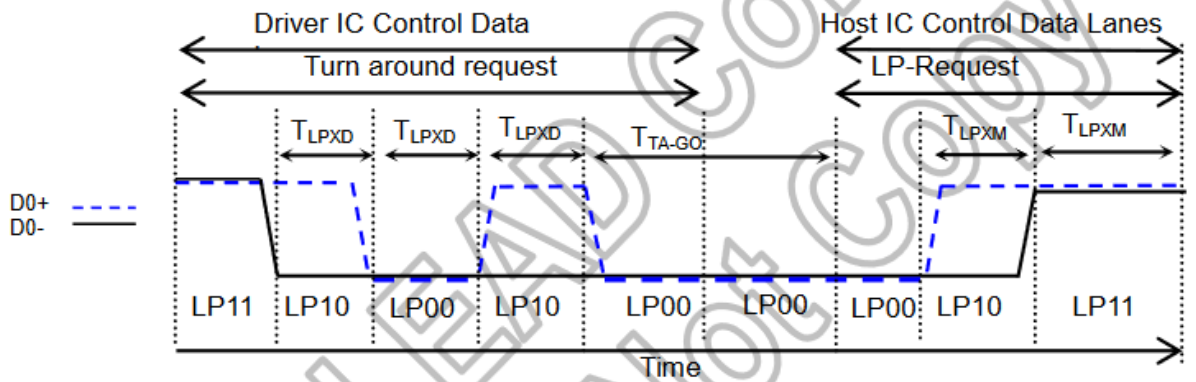
**Figure 7-5: Rising and falling time on clock and data channel**

| Signal            | Item                             | Symbol                     | Spec.                                     |      |         | Unit |
|-------------------|----------------------------------|----------------------------|---|------|---------|------|
|                   |                                  |                            | Min.                                      | Typ. | Max.    |      |
| DSI_CP/<br>DSI_CN | Double UI instantaneous          | $2xU_{INST}$               | 4LANE: 3.30<br>3LANE: 2.85<br>@ VDDD=1.8V | -    | 25      | ns   |
|                   | UI instantaneous                 | $U_{INSTA}$<br>$U_{INSTB}$ | 4LANE: 1.67<br>3LANE: 1.43<br>@ VDDD=1.8V | -    | 12.5    | ns   |
| DP/DN             | Data to clock setup time         | $T_{DS}$                   | $0.15xUI$                                 | -    | -       | ps   |
|                   | Data to clock hold time          | $T_{DH}$                   | $0.15xUI$                                 | -    | -       | ps   |
| DSI_CP/<br>DSI_CN | Differential rise time for clock | $T_{DRTCLK}$               | 150                                       | -    | $0.3UI$ | ps   |
|                   | Differential fall time for clock | $T_{DFTCLK}$               | 150                                       | -    | $0.3UI$ | ps   |
| DP/DN             | Differential rise time for data  | $T_{DRDATA}$               | 150                                       | -    | $0.3UI$ | ps   |
|                   | Differential fall time for data  | $T_{DFTDATA}$              | 150                                       | -    | $0.3UI$ | ps   |

## Low Power Mode



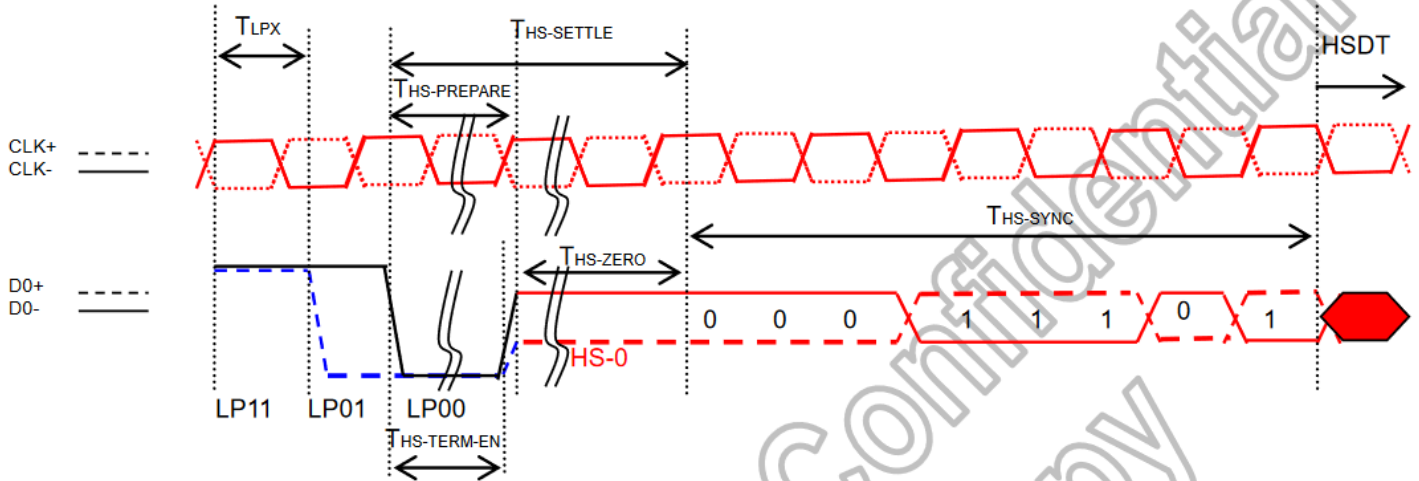
**Figure 7-6: BTA from HOST to Display Module Timing**



**Figure 7-7: BTA from Display Module Timing to HOST**

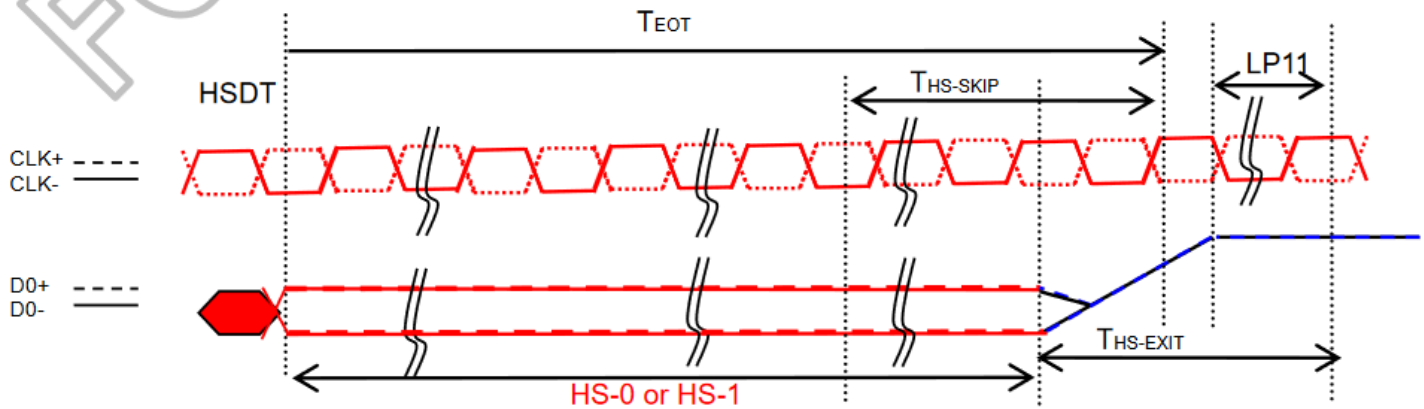
| Signal              | Item  | Symbol        | Spec.               |      |                     | Unit |
|---------------------|---|---------------|---------------------|------|---------------------|------|
|                     |   |               | Min.                | Typ. | Max.                |      |
| DSI_D0P/<br>DSI_D0P | Length of LP-00/LP01/LP10/LP11<br>Host → Display module | $T_{LPXM}$    | 50                  | -    | -                   | ns   |
|                     | Length of LP-00/LP01/LP10/LP11<br>Display module → Host | $T_{LPXD}$    | 50                  | -    | -                   | ns   |
|                     | Time-out before the MPU start driver                    | $T_{TA-SURE}$ | $T_{LPXD}$          | -    | $2 \times T_{LPXD}$ | ns   |
|                     | Time to drive LP-00 by display module                   | $T_{TA-GET}$  | $5 \times T_{LPXD}$ | -    | -                   | ns   |
|                     | Time to drive LP-00 after turnaround request<br>Host    | $T_{TAGO}$    | $4 \times T_{LPXD}$ | -    | -                   | ns   |

## DSI BURSTS



| Signal              | Item  | Symbol                  | Spec.               |      |         | Unit |
|---------------------|---|-------------------------|---------------------|------|---------|------|
|                     |   |                         | Min.                | Typ. | Max.    |      |
| DSI_D0P/<br>DSI_D0P | Length of LP-00/LP01/LP10/LP11                      | T <sub>LPX</sub>        | 50                  | -    | -       | ns   |
|                     | Time to Driver LP-00 to prepare for HS transmission | T <sub>HS-PREPARE</sub> | 40+4UI              | -    | 85+6UI  | ns   |
|                     | Time to enable data receiver line termination       | T <sub>HS-TERM-EN</sub> | -                   | -    | 35+4xUI | ns   |
|                     | Time to drive LP-00 by display module               | T <sub>TA-GET</sub>     | 5xT <sub>LPXD</sub> | -    | -       | ns   |
|                     | Time to drive LP-00 after turnaround request Host   | T <sub>TAGO</sub>       | 4xT <sub>LPXD</sub> | -    | -       | ns   |

**Table 7-5: DSI Low Power Mode to High Speed Mode Timing**

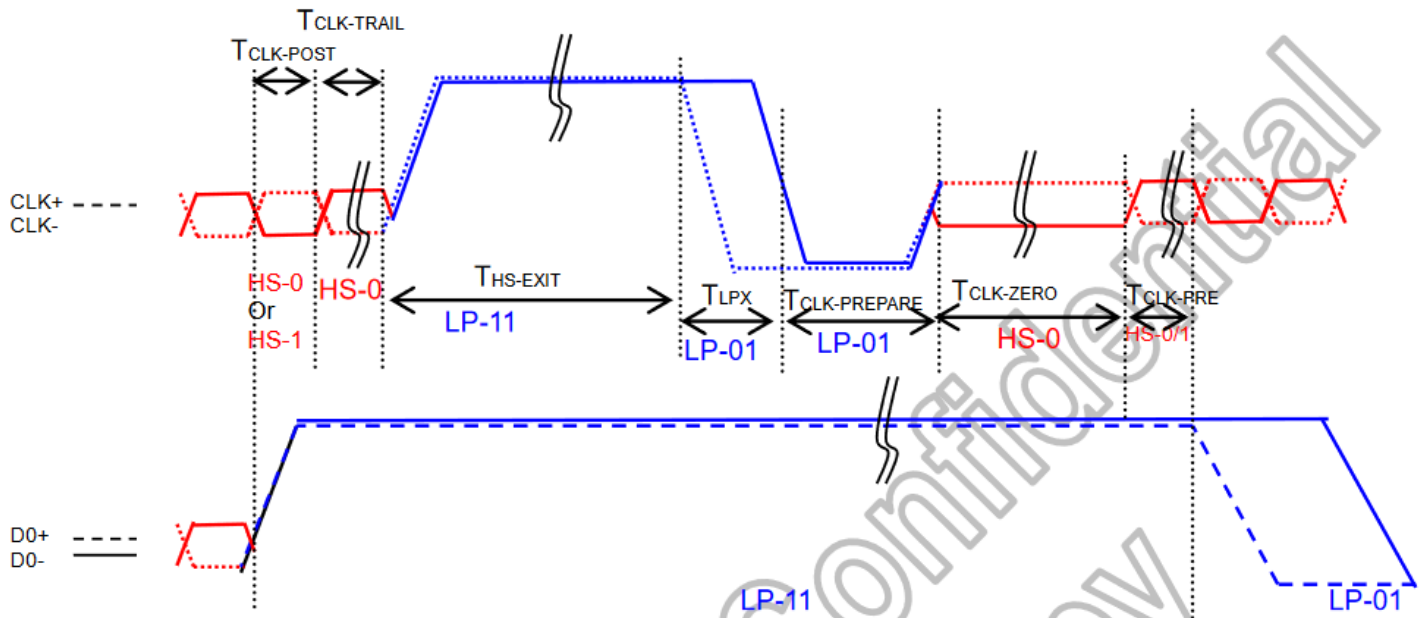


**NOTE:**

If the last bit is HS-0, the transmitter changes from HS-0 to HS-1  
 If the last bit is HS-1, the transmitter changes from HS-1 to HS-0

| Signal              | Item  | Symbol               | Spec. |      |         | Unit |
|---------------------|---|----------------------|-------|------|---------|------|
|                     |   |                      | Min.  | Typ. | Max.    |      |
| DSI_D0P/<br>DSI_D0P | Time-Out at Display Module to Ignore Transition Period of EoT | T <sub>HS-SKIP</sub> | 40    | -    | 55+4xUI | ns   |
|                     | Time to Driver LP-11 after HS Burst                           | T <sub>HS-EXIT</sub> | 100   | -    | -       | ns   |

**Table 7-6: DSI Low Power Mode to High Speed Mode Timing**

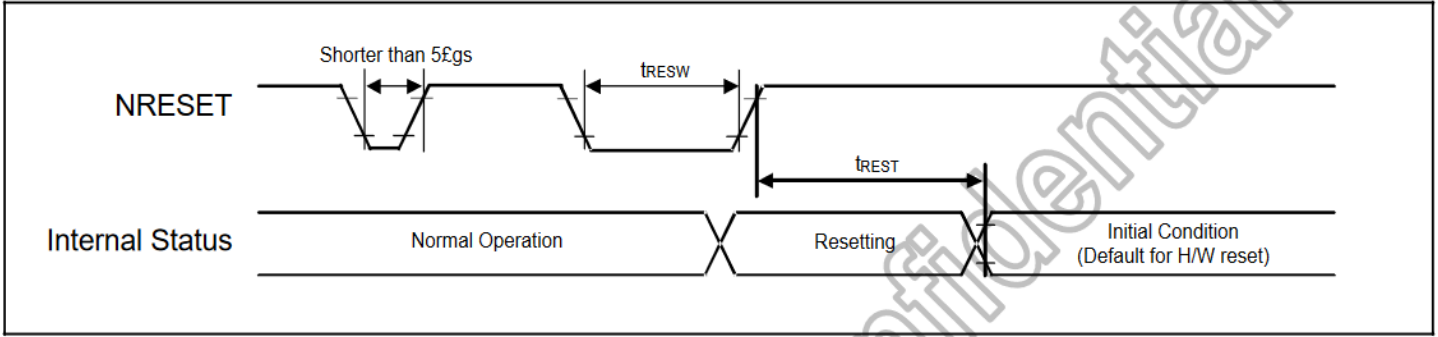


| Signal            | Item   | Symbol   | Spec.    |      |      | Unit |
|-------------------|--|--|----------|------|------|------|
|                   |  |  | Min.     | Typ. | Max. |      |
| DSI_CP/<br>DSI_CN | Time that the MCU shall continue sending HS clock after the last associated Data Lane has transitioned to LP mode    | T <sub>CLK-POST</sub>                            | 60+52xUI | -    | -    | ns   |
|                   | Time to drive HS differential state after last payload clock bit of a HS transmission burst                          | T <sub>CLK-TRAIL</sub>                           | 60       | -    | -    | ns   |
|                   | Time to drive LP-11 after HS burst   | T <sub>HS-EXIT</sub>                             | 100      | -    | -    | ns   |
|                   | Time to drive LP-00 to prepare for HS transmission   | T <sub>CLK-PREPARE</sub>                         | 38       | -    | 95   | ns   |
|                   | Time-out at Clock Lane Display Module to enable HS Termination   | T <sub>CLK-TERM-EN</sub>                         | -        | -    | 38   | ns   |
|                   | Minimum lead HS-0 drive period before starting Clock   | T <sub>CLK-PREPARE</sub> + T <sub>CLK-ZERO</sub> | 300      | -    | -    | ns   |
|                   | Time that the HS clock shall be driven prior to any associated data Lane beginning the transition from LP to HS mode | T <sub>CLK-PRE</sub>                             | 8xUI     |      |      |      |

**Table 7-7: Clock Lanes High Speed Mode to/from Low Power Mode Timing**



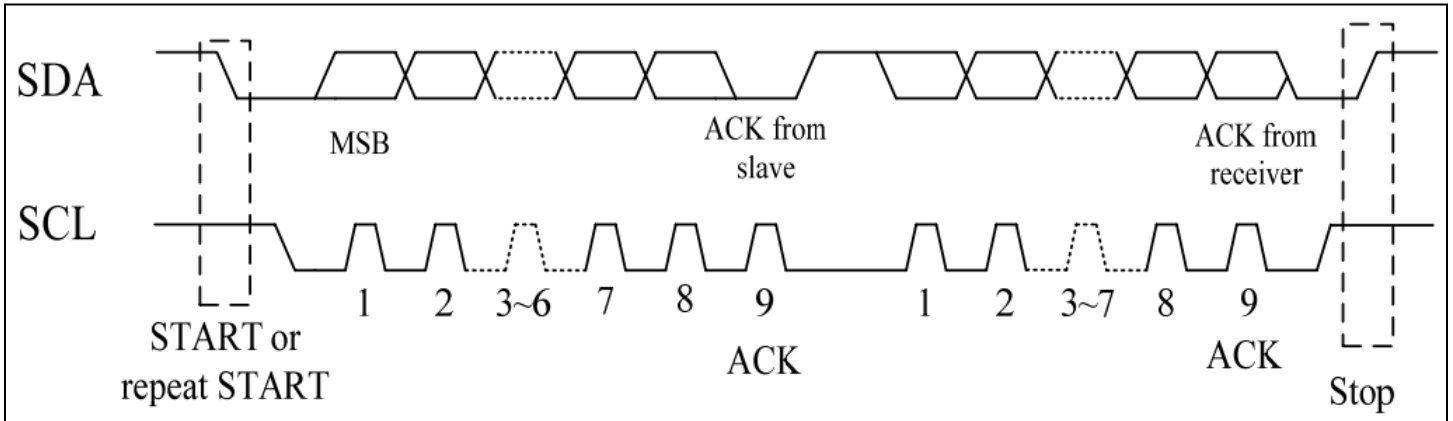
### Reset Input Timing



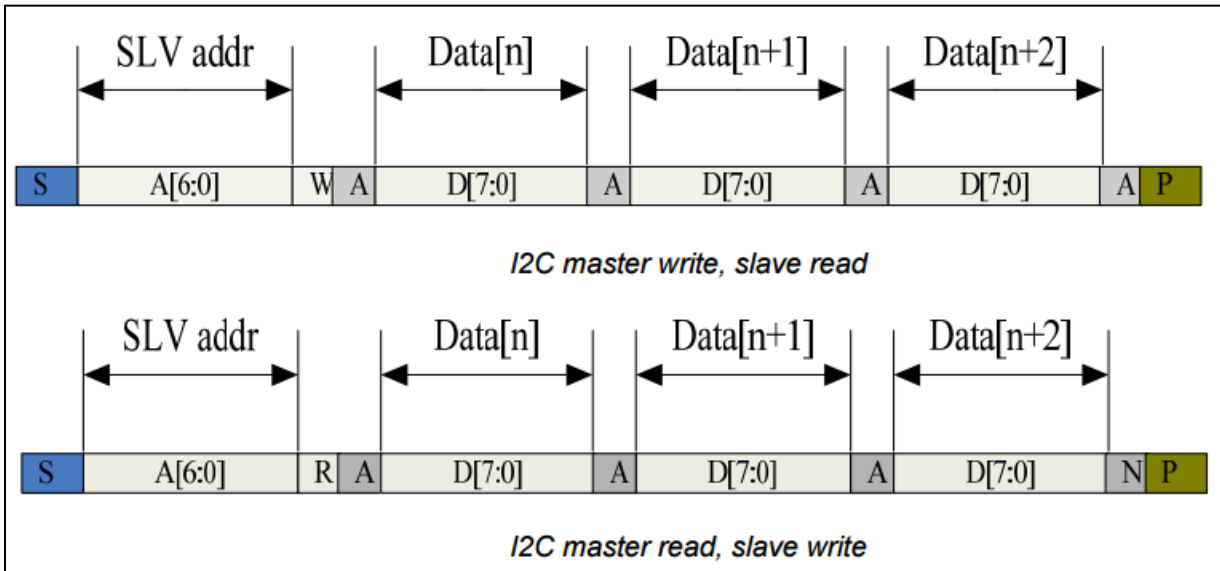
| Symbol | Parameter                            | Related Pins | Spec. |      |      | Note                                  | Unit |
|--------|--------------------------------------|--------------|-------|------|------|---------------------------------------|------|
|        |                                      |              | Min.  | Typ. | Max. |                                       |      |
| tRESW  | Reset low pulse width <sup>(1)</sup> | NRESET       | 10    | -    | -    | -                                     | µs   |
| tREST  | Reset complete time <sup>(2)</sup>   | -            | 15    | -    | -    | When reset applied during SLPIN mode  | ms   |
|        |                                      | -            | 120   | -    | -    | When reset applied during SLPOUT mode | ms   |

## Timing Characteristics – Capacitive Touch Panel

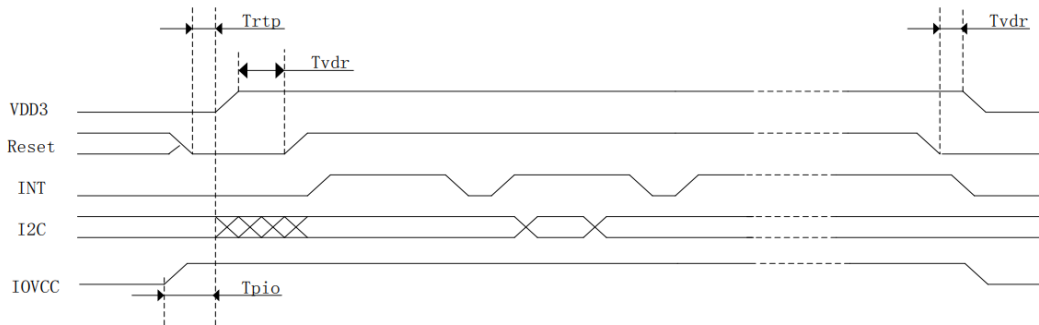
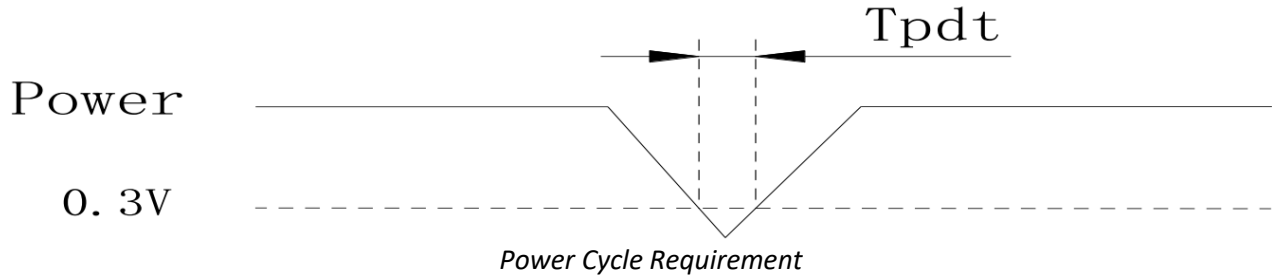
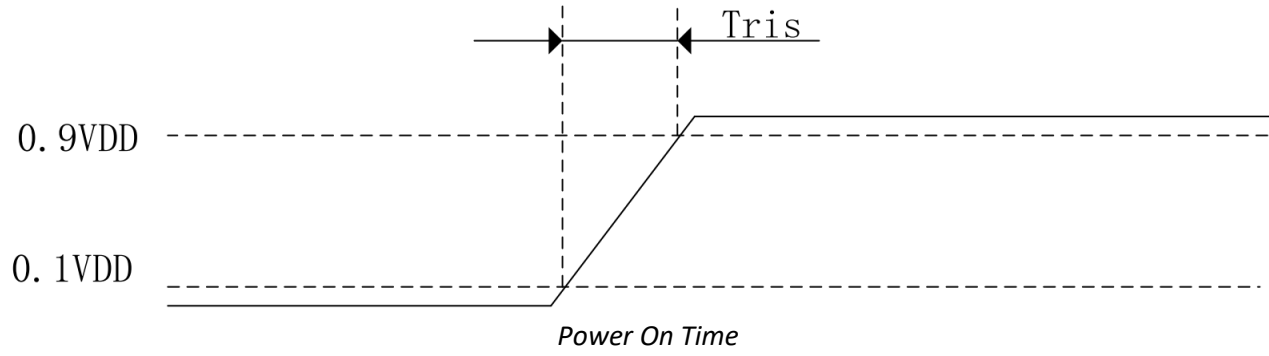
### Data Transfer Format



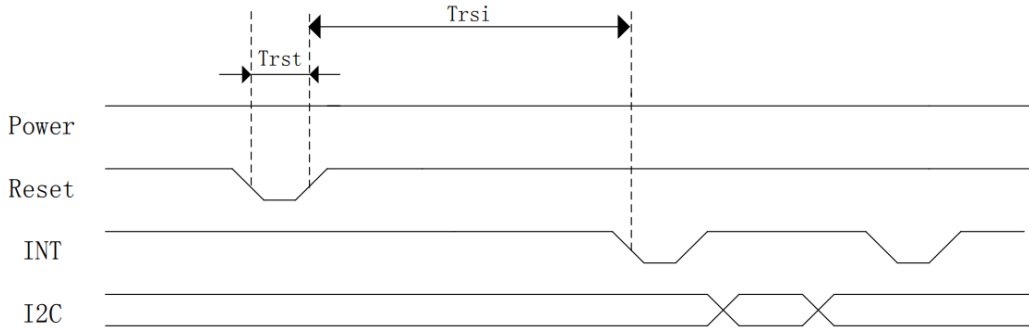
| Parameter                                      | Min | Max | Unit |
|--|-----|-----|------|
| SCL Frequency                                  | 0   | 400 | KHz  |
| Bus free time between a STOP & START condition | 1.3 | -   | μs   |
| Hold time Repeated START condition             | 0.6 | -   | μs   |
| Data Setup Time                                | 100 | -   | ns   |
| Setup time for a repeated START condition      | 0.6 | -   | μs   |
| Setup time for a STOP condition                | 0.6 | -   | μs   |



**Power ON/Reset Sequence**



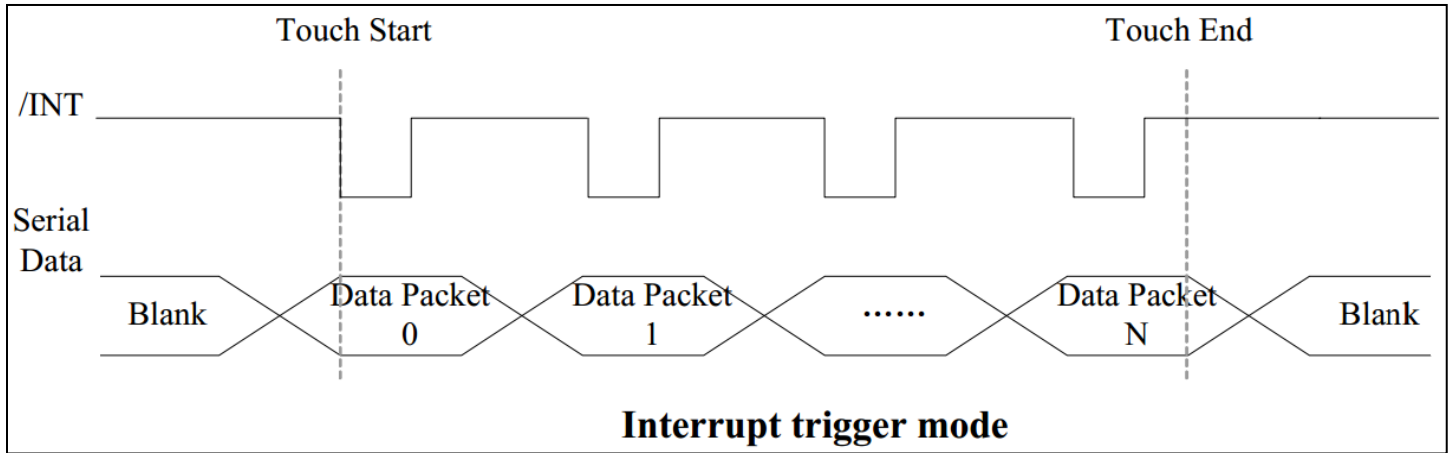
### Power ON Sequence



### Reset sequence

| Parameter | Description   | Min | Max | Unit |
|-----------|---|-----|-----|------|
| Tris      | Rise time from 0.1V <sub>DD</sub> to 0.9V <sub>DD</sub> | -   | 5   | ms   |
| Tpdt      | Time of the voltage of supply being below 0.3V          | 5   | -   | ms   |
| Trtp      | Time of resetting to be low before powering on          | 100 | -   | μs   |
| Tpon      | Time to start reporting after power on                  | -   | 200 | ms   |
| Tvdr*     | Reset time after applying V <sub>DD</sub>               | 1   | -   | ms   |
| Trsi      | Time to start reporting after reset                     | -   | 200 | ms   |
| Trst*     | Reset Time  | 1   | -   | ms   |

\*Note: If Reset is tied to V<sub>DD</sub> data corruption can occur



**Sample code to read touch data:**

```
i2c_start();
i2c_tx(0x70);           //Slave Address (Write)
i2c_tx(0x00);           //Start reading address
i2c_stop();

i2c_start();
i2c_tx(0x71);           //Slave Address (Read)
for(i=0x00;i<0x1F;i++)
{touchdata_buffer[i] = i2c_rx(1);}
i2c_stop();
```

**Sample code to overwrite default register values:**

```
i2c_start();
i2c_tx(0x70);           //Slave Address (Write)
i2c_tx(0xA4);           //ID_G_Mode
i2c_tx(0x01);           //Disable interrupt status to host
i2c_stop();
```

## 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 Storage | 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.                  | -20°C,60min -> 70°C,60min<br>= 1 cycle<br>20 cycles                                |      |
| Vibration test                      | Endurance test applying vibration to simulate transportation and use.   | 10-50Hz , 5G Acceleration<br>60 sec in each of 3 directions (X,Y,Z) For 30 minutes | 3    |
| Static electricity test             | Endurance test applying electric static discharge.  | Air: ±4kV 150pF/330Ω, 5 Times<br>Contact: ±2kV 150pF/330Ω, 5 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.

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