NEWHAVEN DISPLAY INTERNATIONAL

**Product Specification**

# NHD-3.5-640480EF-MSXP-CTP

## TFT Liquid Crystal Display

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

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REACH Compliant

RoHS Compliant

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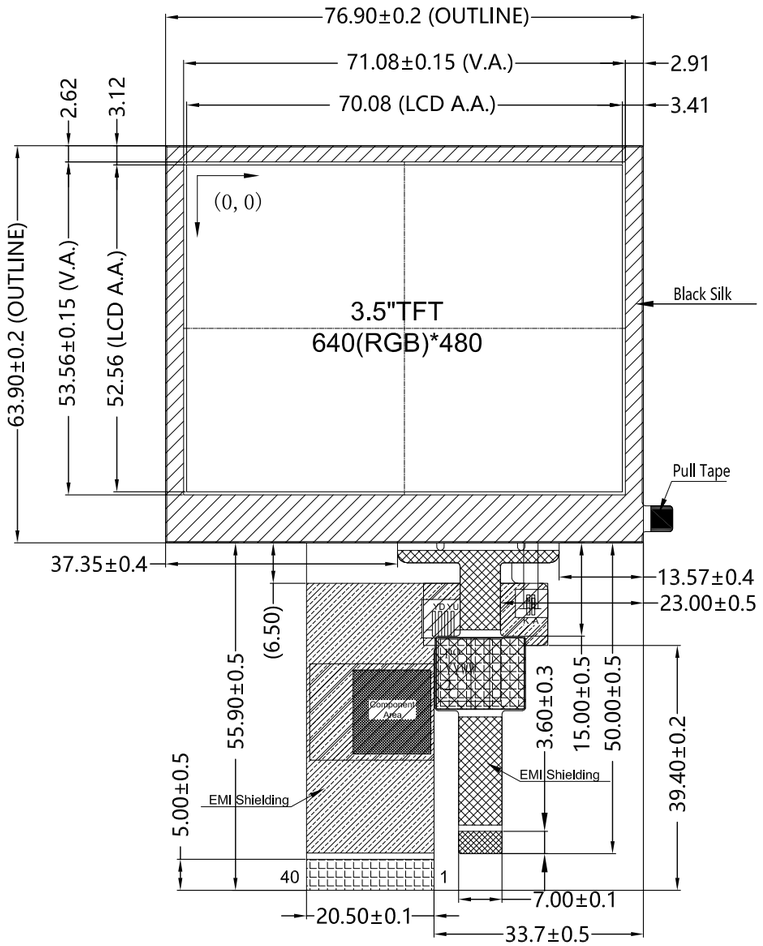
## Additional Resources

- **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
- **Quality Center:** 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

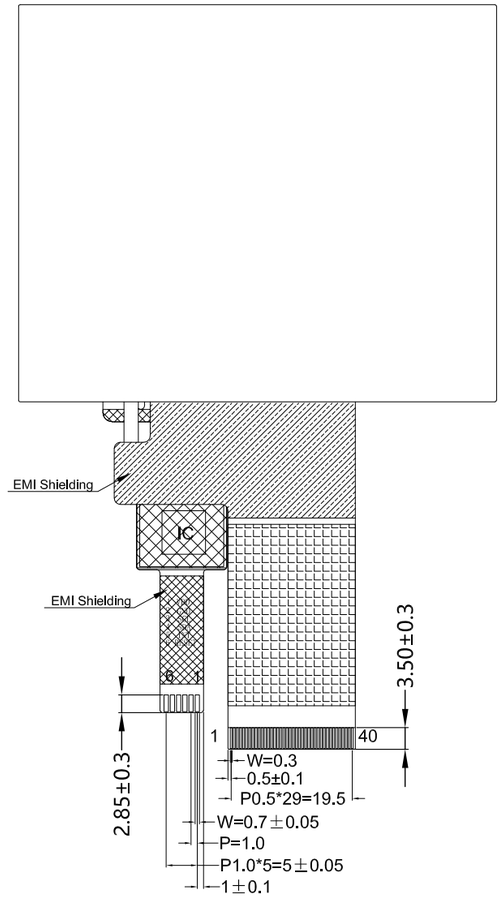
# Document Revision History

| Revision | Date | Description | Changed By |
|---|---|---|---|
| 0 | 08/24/2023 | Initial Release | KL |
| 1 | 09/15/2023 | Pin Description and Interface Information Updated | KL |
| 2 | 10/10/2023 | Luminance Values Updated | KL |
| 3 | 12/07/2024 | Input Data Timing Added | KL |

# Mechanical Drawing








TFT

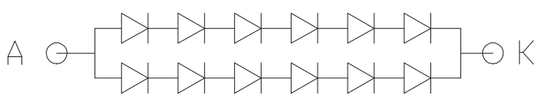
| Pin No. | Symbol |
|---|---|
| 1 | LED_K |
| 2 | LED_A |
| 3 | NC |
| 4 | VSS |
| 5 | VDD |
| 6 | NC |
| 7 | CSX |
| 8 | DCX |
| 9 | SCL |
| 10 | SDA |
| 11 | NC |
| 12 | VSS |
| 13 | DSI_D0P |
| 14 | DSI_D0N |
| 15 | VSS |
| 16 | DSI_D1P |
| 17 | DSI_D1N |
| 18 | VSS |
| 19 | DSI_CP |
| 20 | DSI_CN |
| 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 | IM0 |
| 35 | LANSEL |
| 36 | NC |
| 37 | NC(XR) |
| 38 | NC(YD) |
| 39 | NC(XL) |
| 40 | NC(YU) |

CTP

| Pin No. | Symbol |
|---|---|
| 1 | $V_{DD}$ |
| 2 | $V_{SS}$ |
| 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 DSI TFT, I²C CTP
3. Power Requirement: 3.0V TFT, 19.2V/40mA Backlight, 3.3V CTP
4. Optical Features: Normally Black, Transmissive, 810cd/m²
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




**Standard Tolerance:**
(Unless otherwise specified)
Linear: ±0.3mm

NEWHAVEN DISPLAY INTERNATIONAL

Drawing/Part Number: NHD-3.5-640480EF-MSXP-CTP
Revision: -

**Unless otherwise specified:**
- Dimensions are in Millimeters
- Third Angle Projection

Drawn By: K. Lewis
Approved By: K. Lewis
Drawn Date: 10/10/2023
Approved Date: 10/10/2023

# 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 | Command/Data Select. 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 | $V_{DD}$ | Power Supply | Supply voltage for Logic (3.3V) |
| 2 | $V_{SS}$ | 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

# Interface Selection

T_IM signal can be used to select between MIPI DSI interface (normal mode) or serial interface (test mode).

| T_IM | Interface mode |
|---|---|
| 0 | MIPI DSI 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.

**IM1**, I**M0** and **LANSEL** are used for the combination of polarity swap and data lane swap of MIPI DSI.

| IM1 | IM0 | LANSEL | D0P/N | D1P/N | CP/N | D2P/N | D3P/N |
|---|---|---|---|---|---|---|---|
| 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 |

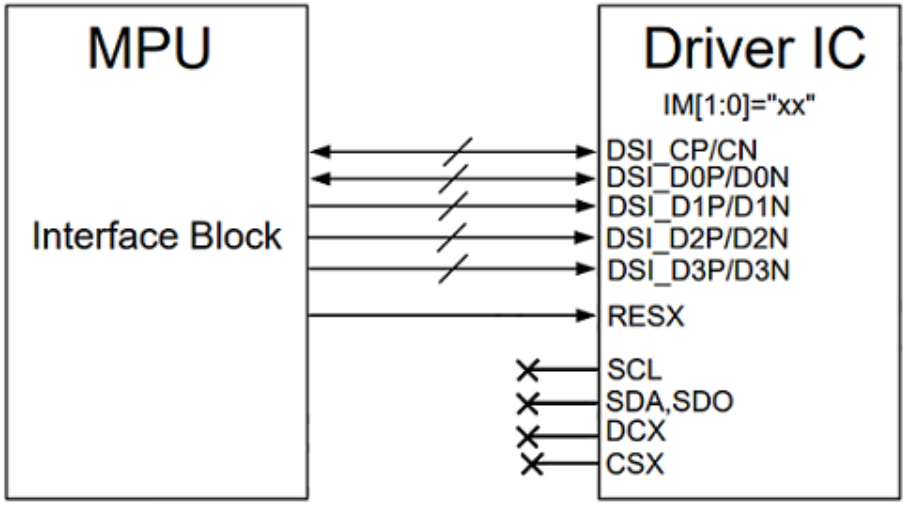
Command **SETMIPI (BAh)** is used to set MIPI DSI related register.

| BA H | SETMIPI | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | R/W | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX |
| Command | W | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | BA |
| Parameter 1st | R/W | HOSTTYPE | CD_DLY | x | CRC_Enable | VC_Main[1] | VC_Main[0] | Lane_Number[1] | Lane_Number[0] | 33 |
| Parameter 2nd | R/W | DSI_LDO_SEL[2] | DSI_LDO_SEL[1] | DSI_LDO_SEL[0] | LPTX_DR[2] | LPTX_DR[1] | LPTX_DR[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_sel[1] | Tx_clk_sel[0] | VBP_OSC_EN | VFP_OSC_EN | F9 |
| Parameter 5th | R/W | HFP_OSC[7] | HFP_OSC[6] | HFP_OSC[5] | HFP_OSC[4] | HFP_OSC[3] | HFP_OSC[2] | HFP_OSC[1] | HFP_OSC[0] | FF |
| Parameter 6th | R/W | HBP_OSC[7] | HBP_OSC[6] | HBP_OSC[5] | HBP_OSC[4] | HBP_OSC[3] | HBP_OSC[2] | HBP_OSC[1] | HBP_OSC[0] | 0A |

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

| Lane [1:0] | MIPI DSI 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 | $T_{OP}$ | Absolute Max | -20 | - | +70 | °C |
| Storage Temperature Range | $T_{ST}$ | Absolute Max | -30 | - | +80 | °C |
| Supply Voltage | $V_{DD}$ | - | 2.5 | 3.0 | 3.3 | V |
| Supply Current | $I_{DD}$ | $V_{DD}$ = 3V | 38 | 50 | 75 | mA |
| "H" Level input | $V_{IH}$ | - | 0.7 * $V_{DD}$ | - | $V_{DD}$ | V |
| "L" Level input | $V_{IL}$ | - | GND | - | 0.3 * $V_{DD}$ | V |
| "H" Level output | $V_{OH}$ | - | 0.8 * $V_{DD}$ | - | $V_{DD}$ | V |
| "L" Level output | $V_{OL}$ | - | GND | - | 0.2 * $V_{DD}$ | V |
| | | | | | | |
| Backlight Supply Current | $I_{LED}$ | - | 30 | 40 | 50 | mA |
| Backlight Supply Voltage | $V_{LED}$ | $I_{LED}$ = 40mA $T_{OP}$ = 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 | $T_{OP}$ | Absolute Max | -20 | - | +70 | °C |
| Storage Temperature Range | $T_{ST}$ | Absolute Max | -30 | - | +80 | °C |
| Supply Voltage | $V_{DD}$ | - | 2.7 | 3.3 | 3.6 | V |
| Supply Current – Operating | $I_{DD}$ | - | 12 | 12.76 | 14.5 | 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 | $V_{OH}$ | - | 0.7*$V_{DD}$ | - | $V_{DD}$ | V |
| "L" Level output | $V_{OL}$ | - | $V_{SS}$ | - | 0.3*$V_{DD}$ | V |

# Optical Characteristics

| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Optimal Viewing Angles | Top | φY+ | CR ≥ 10 | 75 | 85 | - | ° |
| | Bottom | φY- | | 75 | 85 | - | ° |
| | Left | θX- | | 75 | 85 | - | ° |
| | Right | θX+ | | 75 | 85 | - | ° |
| Contrast Ratio | | CR | - | 600 | 800 | - | - |
| Luminance | | $L_V$ | $I_{LED}$ = 40 mA | 650 | 810 | 1215 | cd/m² |
| Response Time (Rise + Fall) | | $T_R + T_F$ | $T_{OP}$ = 25°C | - | 25 | 50 | ms |
| Chromaticity | Red | $X_R$ | - | .508 | .558 | .608 | - |
| | | $Y_R$ | - | .273 | .323 | .373 | - |
| | Green | $X_G$ | - | .245 | .295 | .345 | - |
| | | $Y_G$ | - | .547 | .597 | .647 | - |
| | Blue | $X_B$ | - | .100 | .150 | .200 | - |
| | | $Y_B$ | - | .027 | .077 | .127 | - |
| | White | $X_W$ | - | .228 | .278 | .328 | - |
| | | $Y_W$ | - | .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<br>14h<br>10<br>18<br>48<br>49<br>00 | Swipe Up<br>Swipe Down<br>Swipe Left<br>Swipe Right<br>Zoom In<br>Zoom Out<br>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<br>1<br>2<br>3 | Put Down<br>Put Up<br>Contact<br>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<br>1<br>2<br>3 | Put Down<br>Put Up<br>Contact<br>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<br>1<br>2<br>3 | Put Down<br>Put Up<br>Contact<br>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<br>1<br>2<br>3 | Put Down<br>Put Up<br>Contact<br>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<br>1<br>2<br>3 | Put Down<br>Put Up<br>Contact<br>Reserved |

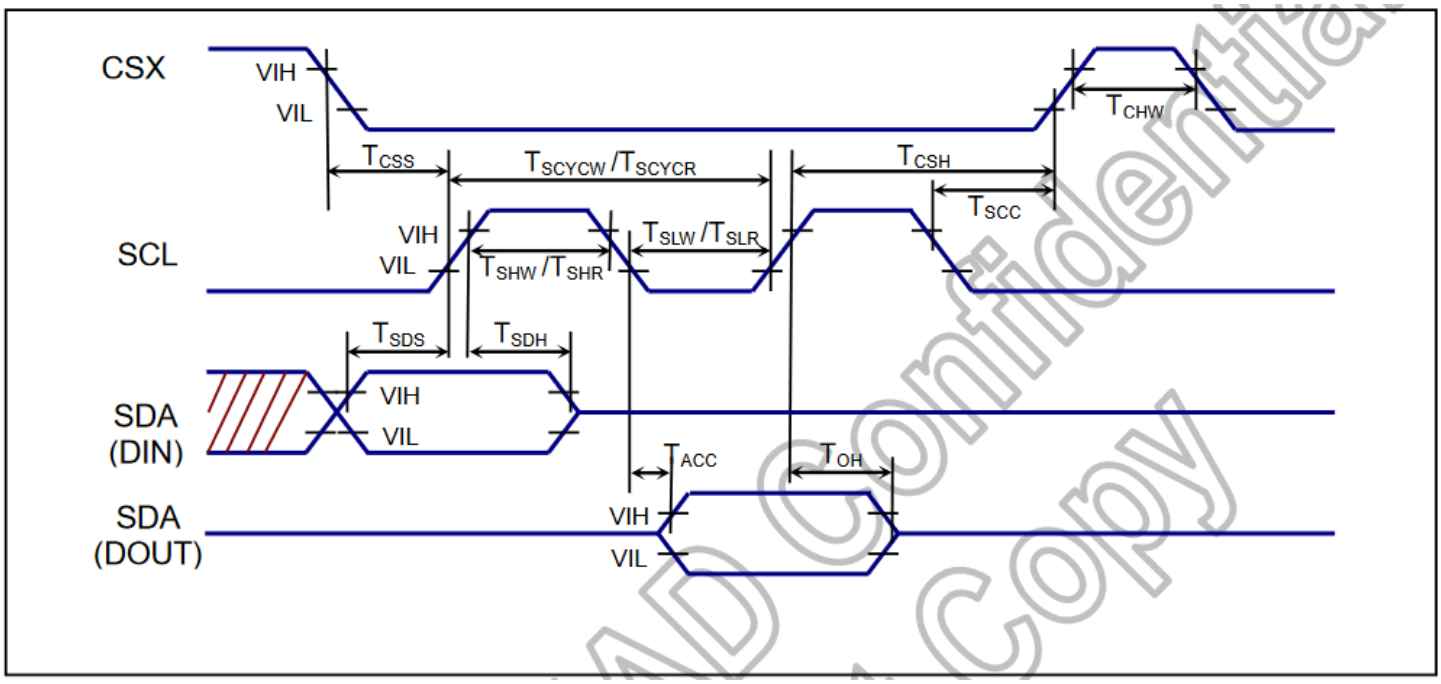
| Register No. | Access | Register Name | Bits | Value | Description |
|---|---|---|---|---|---|
| 1Bh | RO | TOUCH5_XH | [3:0] | 0 -1 | Upper 4 bits of X touch coordinate |
| 1Ch | RO | TOUCH5_XL | [7:0] | 00 – FFh | Lower 8 bits of X touch coordinate |
| 1Dh | RO | TOUCH5_YH | [3:0] | 0 -1 | Upper 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<br>1<br>2<br>3 | Put Down<br>Put Up<br>Contact<br>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<br>1<br>2<br>3 | Put Down<br>Put Up<br>Contact<br>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<br>1<br>2<br>3 | Put Down<br>Put Up<br>Contact<br>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<br>1<br>2<br>3 | Put Down<br>Put Up<br>Contact<br>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<br>1<br>2<br>3 | Put Down<br>Put Up<br>Contact<br>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

| Horizontal Sync Width | Horizontal Back Porch | Horizontal Active | Horizontal Front Porch | Vertical Sync Width | Vertical Back Porch | Vertical Active | Vertical Front Porch | Pixel Clock |
|---|---|---|---|---|---|---|---|---|
| 120 | 120 | 640 | 120 | 5 | 12 | 480 | 25 | 31.2MHz |

**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 | - | | |
| | $t_{RDL}$ | Control pulse "L" duration | 60 | - | | |
| SDA (Input) | $t_{DS}$ | Data setup time | 10 | - | ns | For maximum $C_L$=30pF 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 | - | | |

High Speed Mode

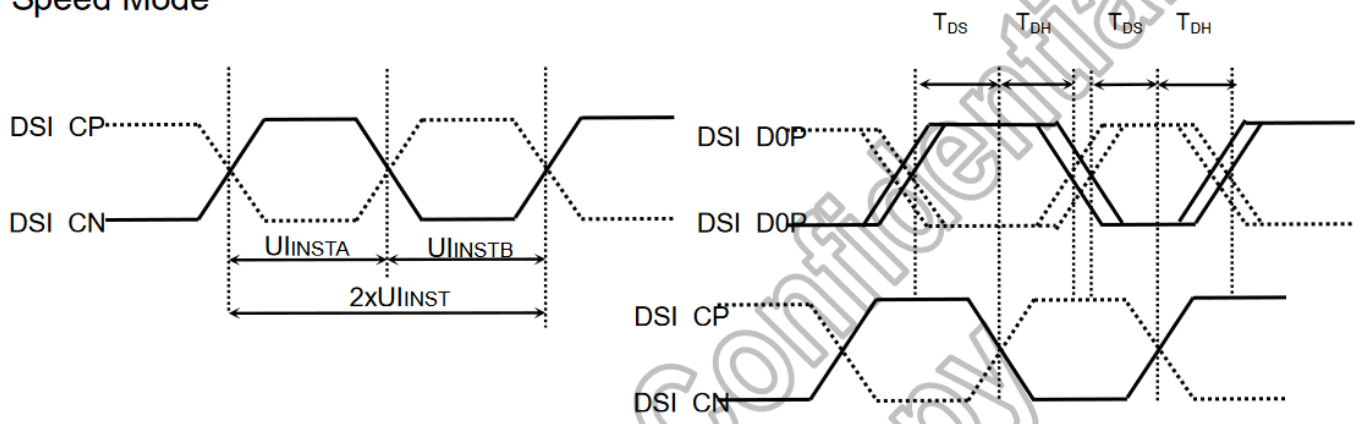



**Figure 7-4: DSI clock timing Characteristics**

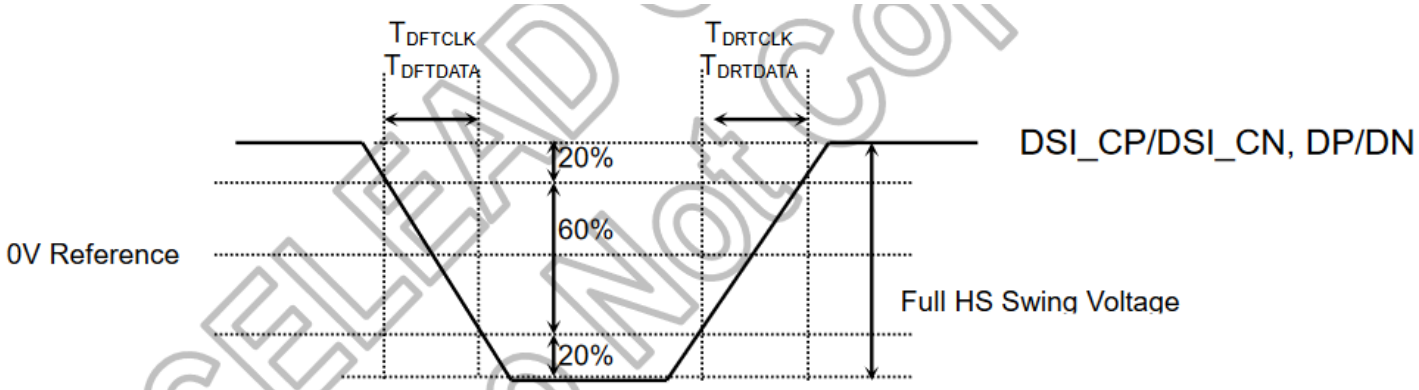



**Figure 7-5: Rising and falling time on clock and data channel**

| Signal | Item | Symbol | Spec. | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| DSI_CP/ DSI_CN | Double UI instantaneous | 2xUINST | 4LANE：3.30<br>3LANE：2.85<br>@ VDDD=1.8V | - | 25 | ns |
| | UI instantaneous | UINSTA<br>UINSTB | 4LANE：1.67<br>3LANE：1.43<br>@ VDDD=1.8V | - | 12.5 | ns |
| DP/DN | Data to clock setup time | TDS | 0.15xUI | - | - | ps |
| | Data to clock hold time | TDH | 0.15xUI | - | - | ps |
| DSI_CP/ DSI_CN | Differential rise time for clock | TDRTCLK | 150 | - | 0.3UI | ps |
| | Differential fall time for clock | TDFTCLK | 150 | - | 0.3UI | ps |
| DP/DN | Differential rise time for data | TDRTDATA | 150 | - | 0.3UI | ps |
| | Differential fall time for data | TDFTDATA | 150 | - | 0.3UI | ps |

## Low Power Mode

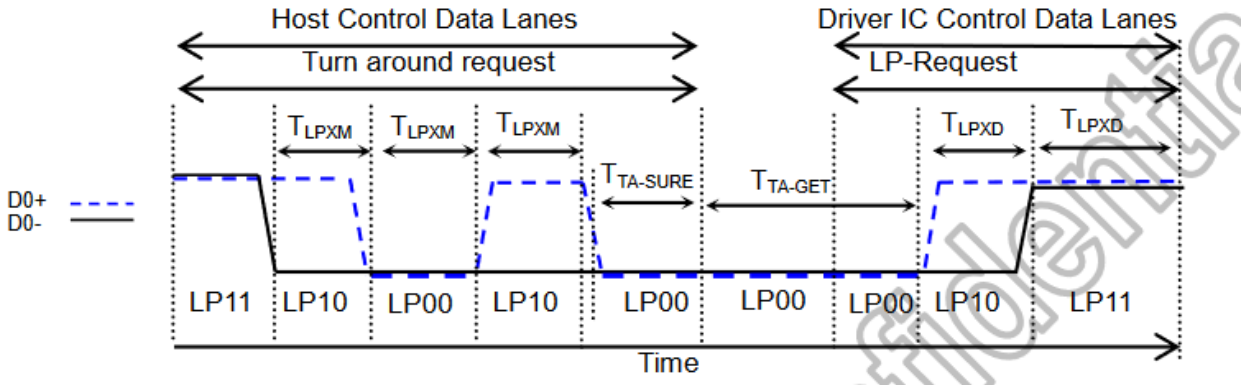



**Figure 7-6: BTA from HOST to Display Module Timing**

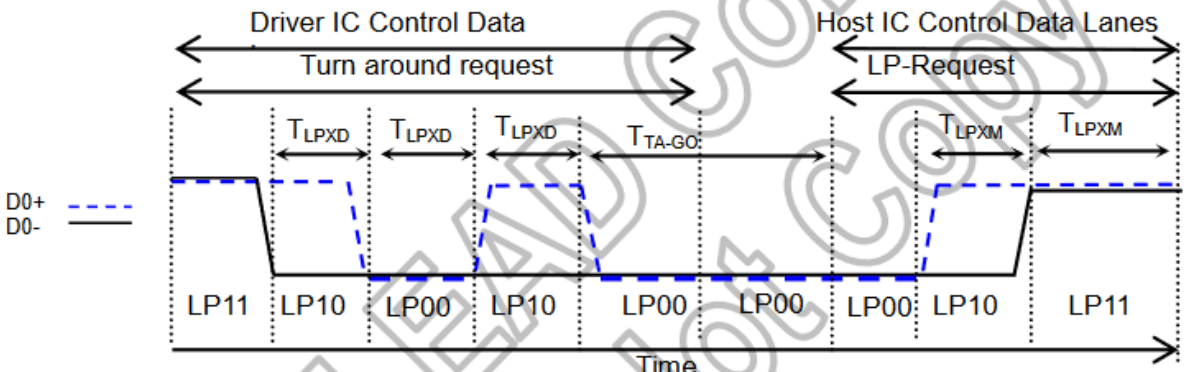
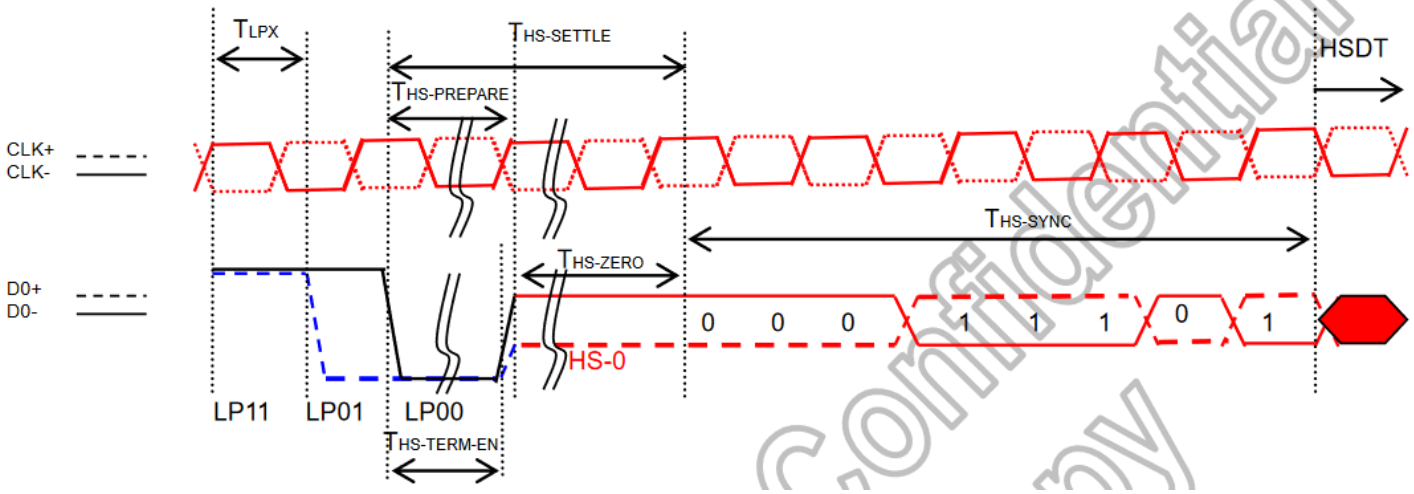



**Figure 7-7: BTA from Display Module Timing to HOST**

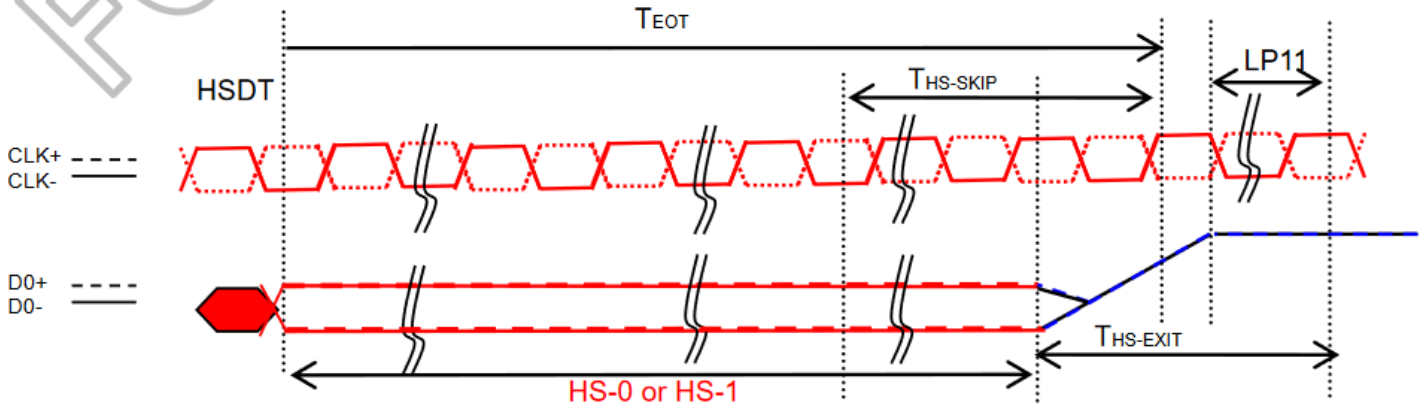
| Signal | Item | Symbol | Spec. | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| DSI_D0P/ DSI_D0P | Length of LP-00/LP01/LP10/LP11 Host→ Display module | $T_{LPXM}$ | 50 | - | - | ns |
| | Length of LP-00/LP01/LP10/LP11 Display module →Host | $T_{LPXD}$ | 50 | - | - | ns |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

## DSI BURSTS




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

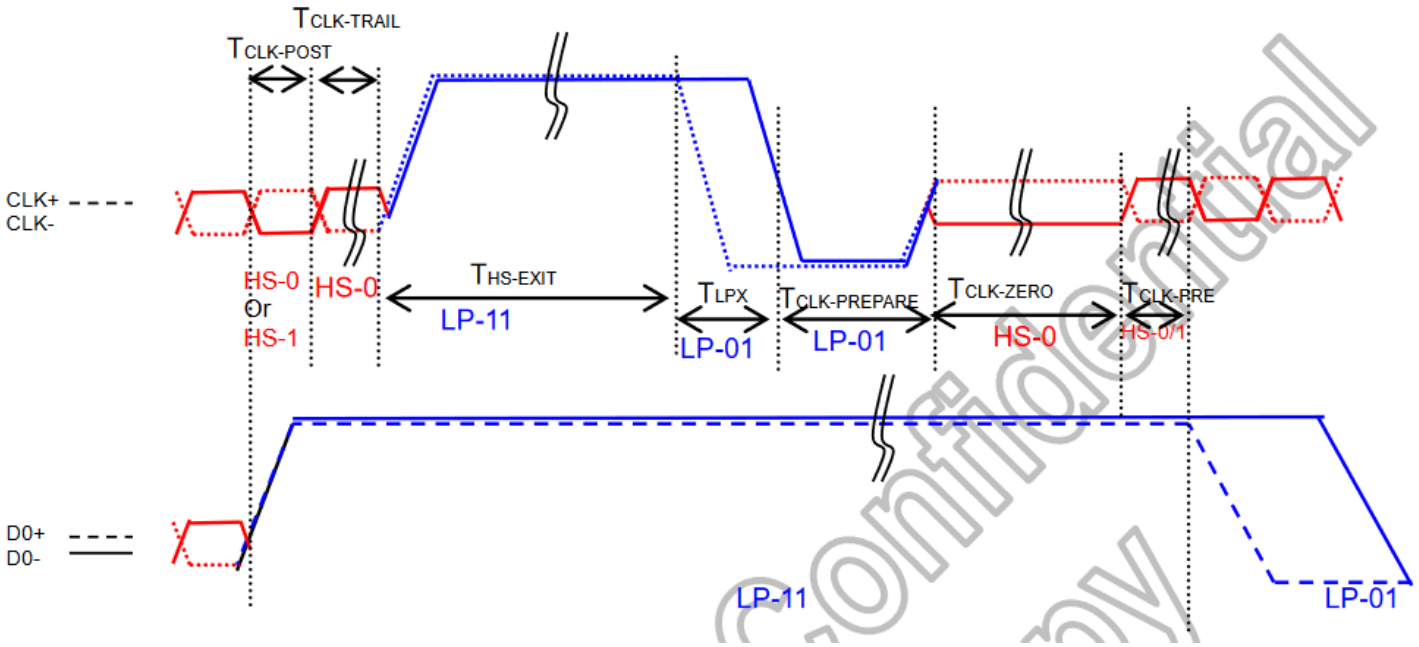
**Table 7-5: DSI Low Power Mode to High Speed Mode Timing**




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

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

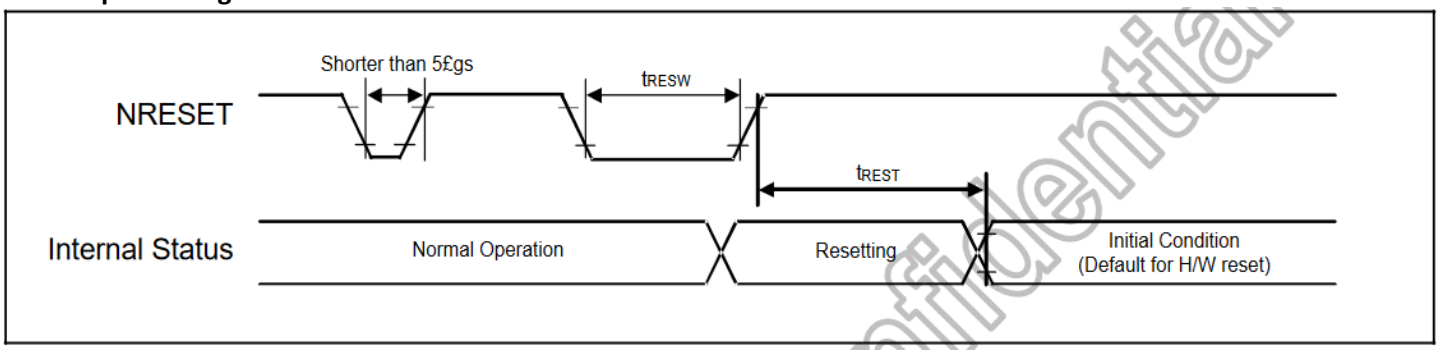
**Table 7-6: DSI Low Power Mode to High Speed Mode Timing**




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

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

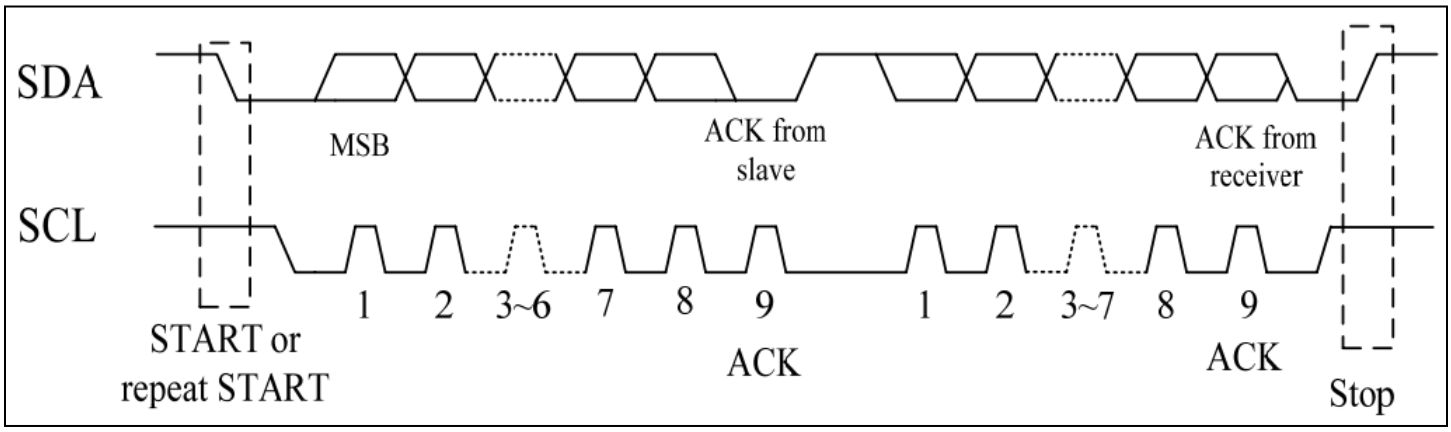
**Reset Input Timing**



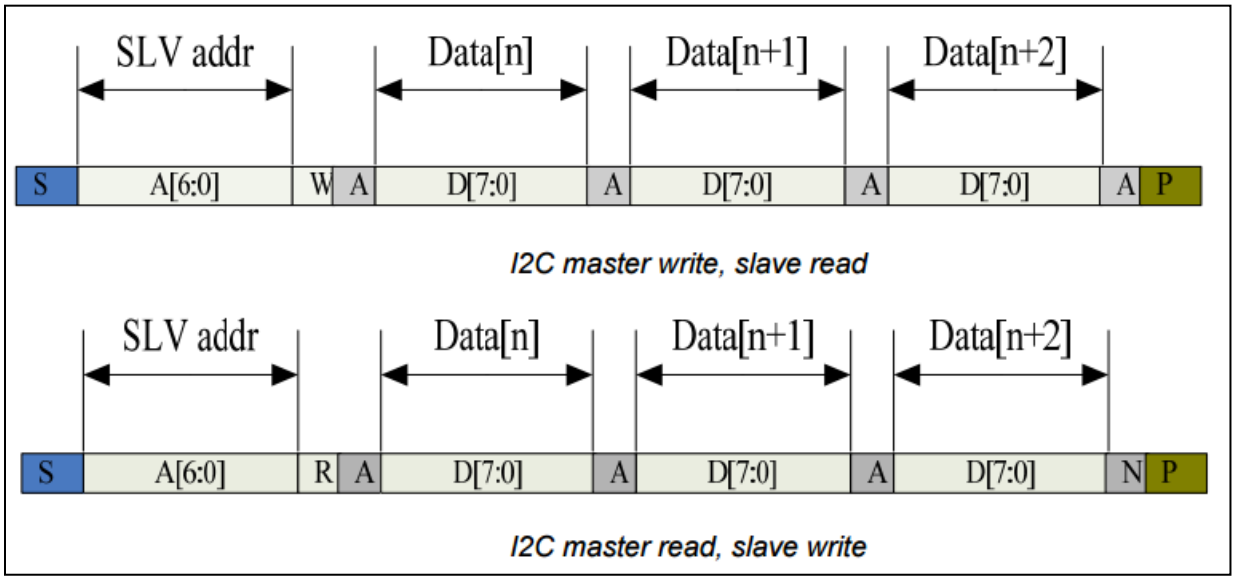

| Symbol | Parameter | Related Pins | Spec. | | | Note | Unit |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| tRESW | Reset low pulse width(1) | NRESET | 10 | - | - | - | µs |
| tREST | Reset complete time(2) | - | 15 | - | - | When reset applied during SLPIN mode | ms |
| | |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

# Timing Characteristics – Capacitive Touch Panel

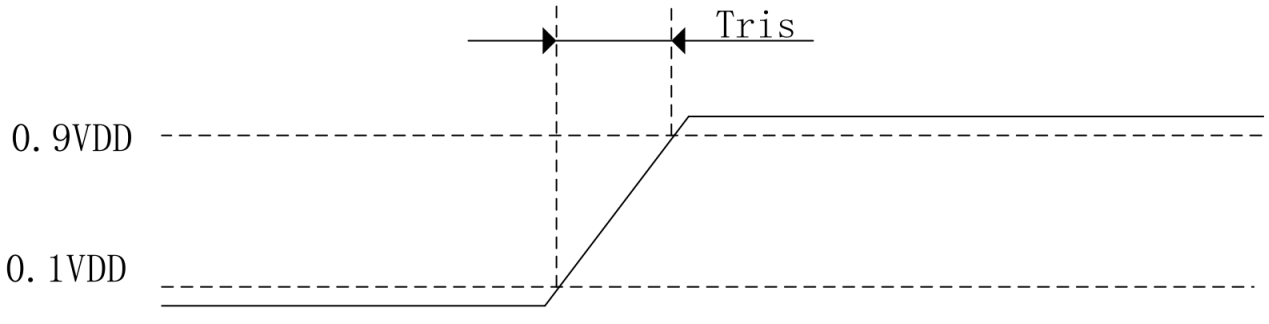
**Data Transfer Format**



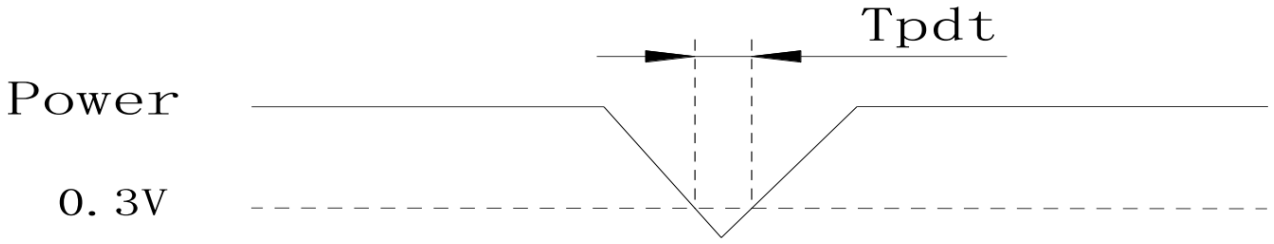

| Parameter | Min | Max | Unit |
|---|---|---|---|
| SCL Frequency | 0 | 400 | KHz |
| Bus free time between a STOP & START condition | 1.3 | - | µs |
| Hold time Repeated START condition | 0.6 | - | µs |
| Data Setup Time | 100 | - | ns |
| Setup time for a repeated START condition | 0.6 | - | µs |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



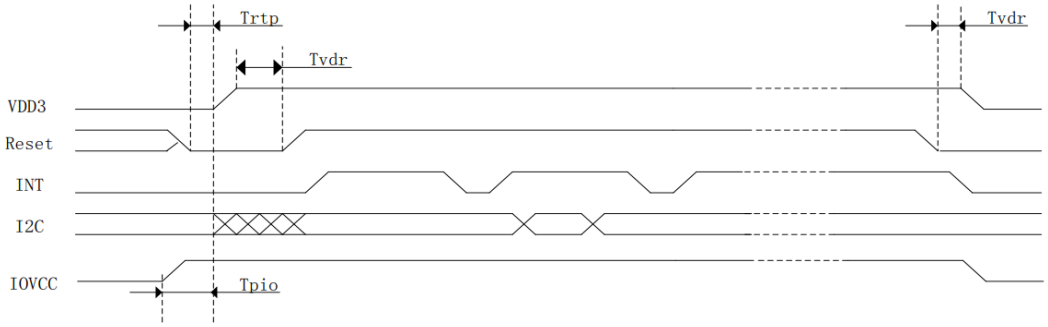
**Power ON/Reset Sequence**



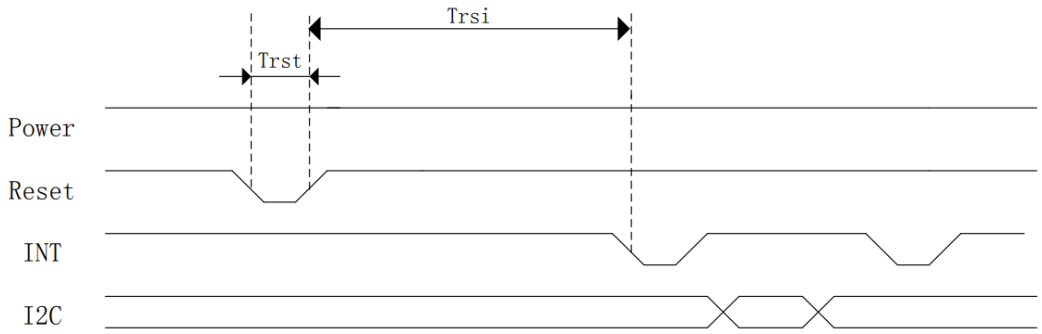

*Power On Time*




*Power Cycle Requirement*



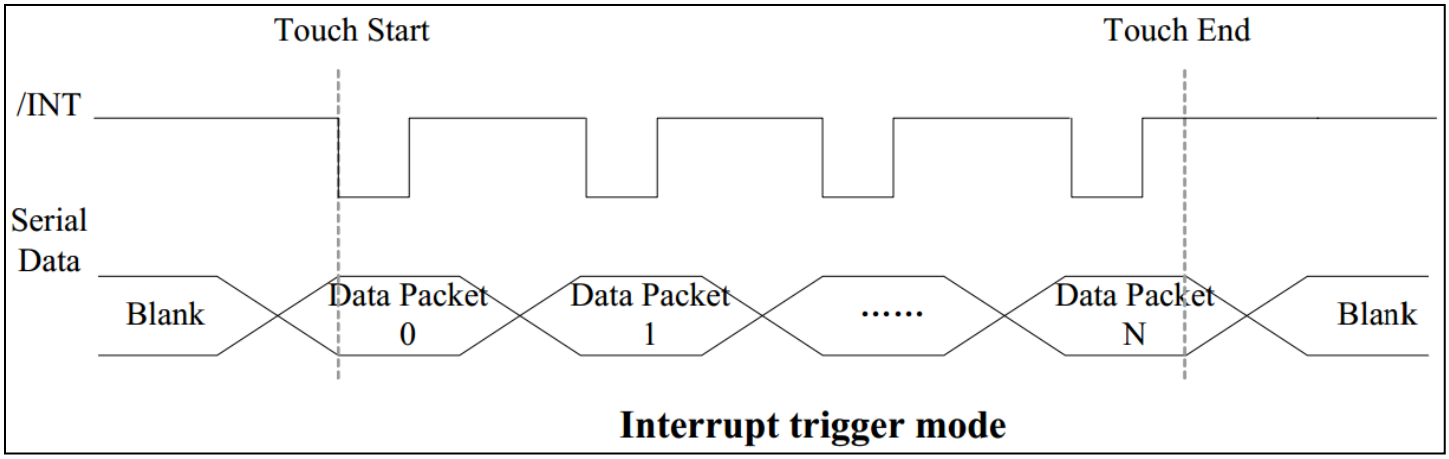
*Power ON Sequence*




*Reset sequence*

| Parameter | Description | Min | Max | Unit |
|---|---|---|---|---|
| Tris | Rise time from 0.1$V_{DD}$ to 0.9$V_{DD}$ | - | 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 $V_{DD}$ | 1 | - | ms |
| Trsi | Time to start reporting after reset | - | 200 | ms |
| Trst* | Reset Time | 1 | - | ms |

*Note: If Reset is tied to $V_{DD}$ 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<br>(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.