

## Product Specification

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# NHD-2.4-240320AF-CSXP-CTP

## TFT Liquid Crystal Display

|                |                                      |
|----------------|--------------------------------------|
| <b>NHD-</b>    | Newhaven Display                     |
| <b>2.4-</b>    | 2.4" Diagonal                        |
| <b>240320-</b> | 240xRGBx320 Pixels                   |
| <b>AF-</b>     | Model                                |
| <b>C-</b>      | Built-in Controller                  |
| <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 |
|----------|------------|------------------------|------------|
| -        | 03/20/2024 | Initial Release        | KL         |
| 1        | 07/01/2024 | Contrast Ratio Updated | KL         |

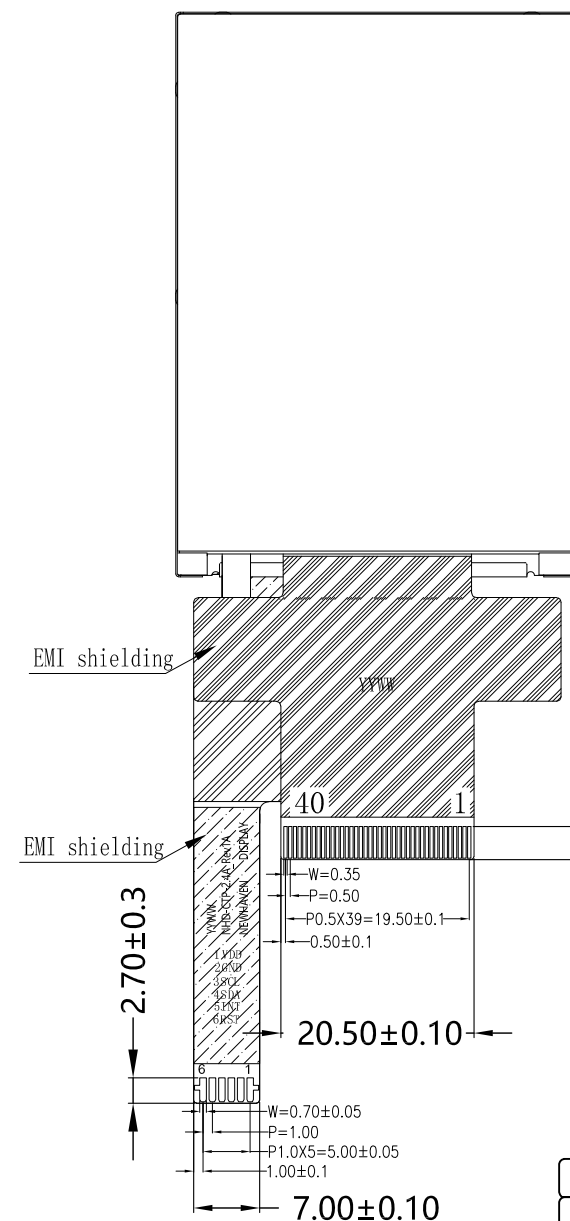
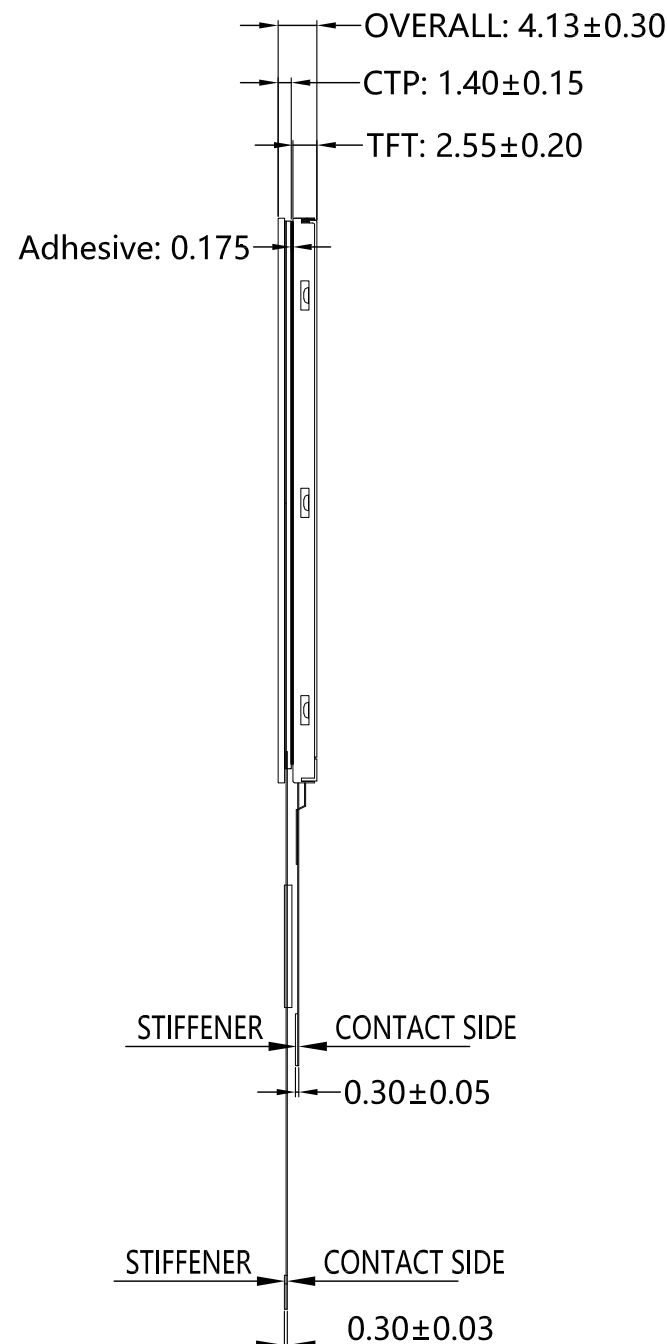
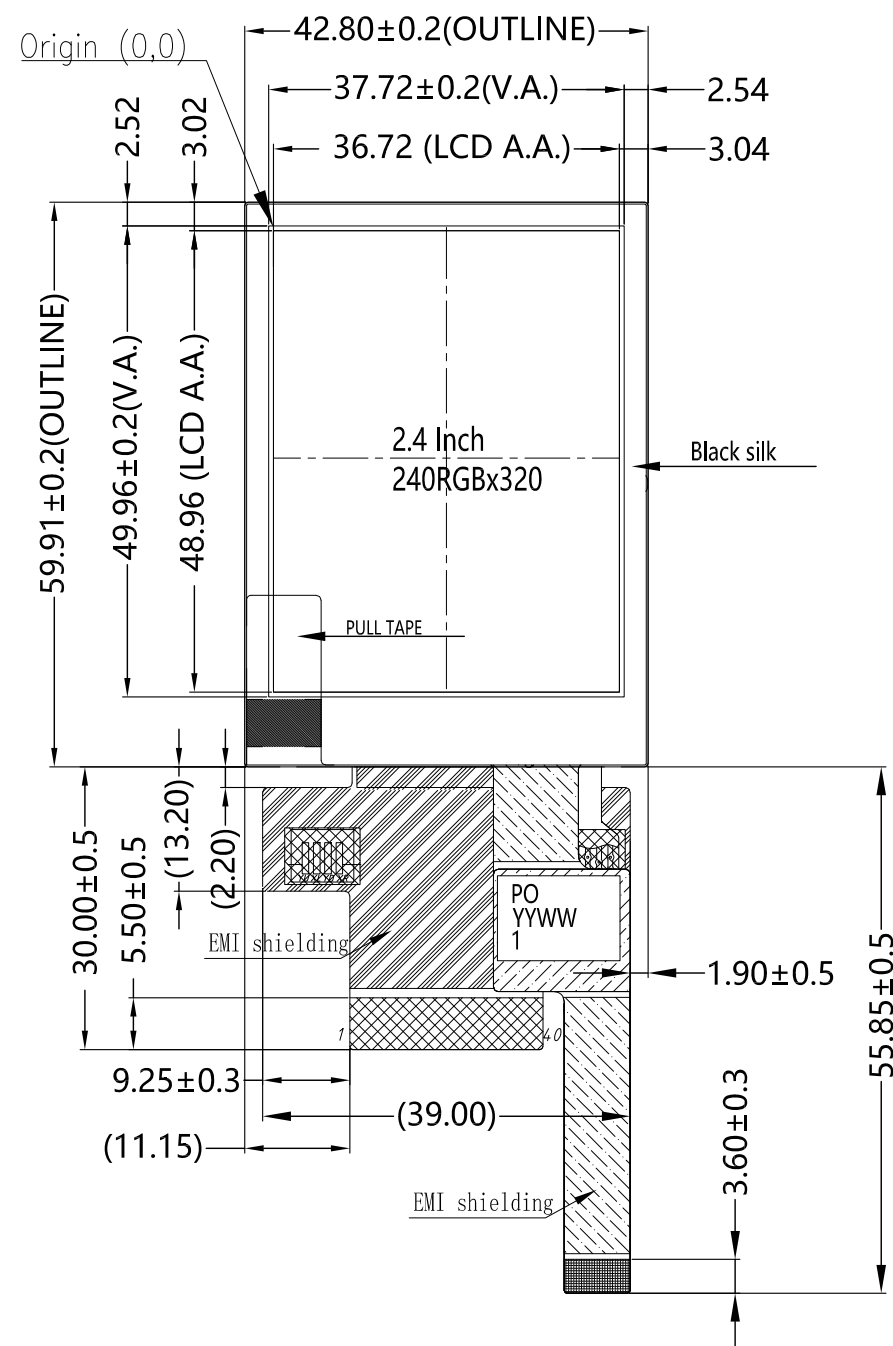
# Mechanical Drawing

Newhaven Display

NHD-2.4-240320AF-CSXP-CTP

Date Code

Part Label (type/format may vary)



TFT

| 1     | GND      |
|-------|----------|
| 2     | NC       |
| 3     | NC       |
| 4     | NC       |
| 5     | NC       |
| 6     | SDO      |
| 7     | VDD      |
| 8     | VDDI     |
| 9     | SDA      |
| 10    | CSX      |
| 11    | DCX      |
| 12    | WRX      |
| 13    | RDX      |
| 14-21 | DB0-DB7  |
| 22-29 | DB8-DB15 |
| 30    | RESX     |
| 31    | IMO      |
| 32    | IM2      |
| 33    | GND      |
| 34    | LED-K1   |
| 35    | LED-K2   |
| 36    | LED-K3   |
| 37    | LED-K4   |
| 38    | LED-A    |
| 39    | GND      |
| 40    | TE       |

CTP

| PIN | DEFINE     |
|-----|------------|
| 1   | VDD 3.3V   |
| 2   | GND        |
| 3   | SCL 3.3V   |
| 4   | SDA 3.3V   |
| 5   | INT 3.3V   |
| 6   | RESET 3.3V |

Product Description: 2.4" 240x320 IPS TFT w/ Capacitive Touch

1. Driver IC: ST7789VI TFT, FT5426-003 CTP

2. Interface: 8/16-bit Parallel, 3-wire SPI TFT, I<sup>2</sup>C CTP

3. Power Requirement: 3.3V TFT, 3.3V CTP

4. Optical Features: Normally Black, Transmissive, 1020cd/m<sup>2</sup>

5. Recommended FFC Connector:

TFT: 40 pin 0.5mm pitch; Ex. Molex 54132-4062

CTP: 6 pin 1.0mm pitch; Ex. Molex 52271-0679

6. Key Features: EMI Shielded FPC, 5-point Multitouch

Standard Tolerance:  
(Unless otherwise specified)

Linear: ±0.3mm

**NEWHAVEN DISPLAY**  
INTERNATIONAL

Drawing/Part Number:

NHD-2.4-240320AF-CSXP-CTP

Revision:

-

Unless otherwise specified:

• Dimensions are in Millimeters  
• Third Angle Projection

Drawn By: K. Lewis

Drawn Date: 12/15/2023

Approved By: K. Lewis

Approved Date: 12/15/2023

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## Pin Description

### TFT:

| Pin No. | Symbol   | External Connection | Function Description                                                   |
|---------|----------|---------------------|------------------------------------------------------------------------|
| 1       | GND      | Power Supply        | Ground                                                                 |
| 2       | NC       | -                   | No Connect                                                             |
| 3       | NC       | -                   | No Connect                                                             |
| 4       | NC       | -                   | No Connect                                                             |
| 5       | NC       | -                   | No Connect                                                             |
| 6       | SDO      | MPU                 | Serial Data Out                                                        |
| 7       | VDD      | Power Supply        | Supply Voltage for LCD (3.3V)                                          |
| 8       | VDDI     | Power Supply        | Supply Voltage for Logic                                               |
| 9       | SDA      | MPU                 | Serial Data In                                                         |
| 10      | CSX      | MPU                 | Active LOW Chip Select signal                                          |
| 11      | DCX      | MPU                 | Data / Command selection: '1' = Data; '0' = Command                    |
| 12      | WRX      | MPU                 | Active LOW Write signal                                                |
| 13      | RDX      | MPU                 | Active LOW Read signal                                                 |
| 14-21   | DB0-DB7  | MPU                 | Bi-directional data bus<br>8-bit: use DB8-DB15<br>16-bit: use DB0-DB15 |
| 22-29   | DB8-DB15 | MPU                 |                                                                        |
| 30      | RESX     | MPU                 | Active LOW Reset signal                                                |
| 31      | IM0      | MPU                 | Interface Mode Select                                                  |
| 32      | IM2      | MPU                 | Interface Mode Select                                                  |
| 33      | GND      | Power Supply        | Ground                                                                 |
| 34      | LED-K1   | Power Supply        | Backlight Cathode (Ground)                                             |
| 35      | LED-K2   | Power Supply        |                                                                        |
| 36      | LED-K3   | Power Supply        |                                                                        |
| 37      | LED-K4   | Power Supply        |                                                                        |
| 38      | LED-A    | Power Supply        | Backlight Anode (3.0V/160mA)                                           |
| 39      | GND      | Power Supply        | Ground                                                                 |
| 40      | TE       | MPU                 | Tearing Effect Output                                                  |

**Recommended LCD connector:** 40-pin, 0.5mm pitch FFC connector **Molex P/N:** 54132-4062 or similar

### 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 4.7K $\Omega$ pull-up resistor) |
| 4       | SDA             | MPU                 | Serial I2C Data (Requires 4.7k $\Omega$ pull-up resistor)  |
| 5       | /INT            | MPU                 | Interrupt signal from touch panel module to host           |
| 6       | /RESET          | MPU                 | Active LOW Reset signal                                    |

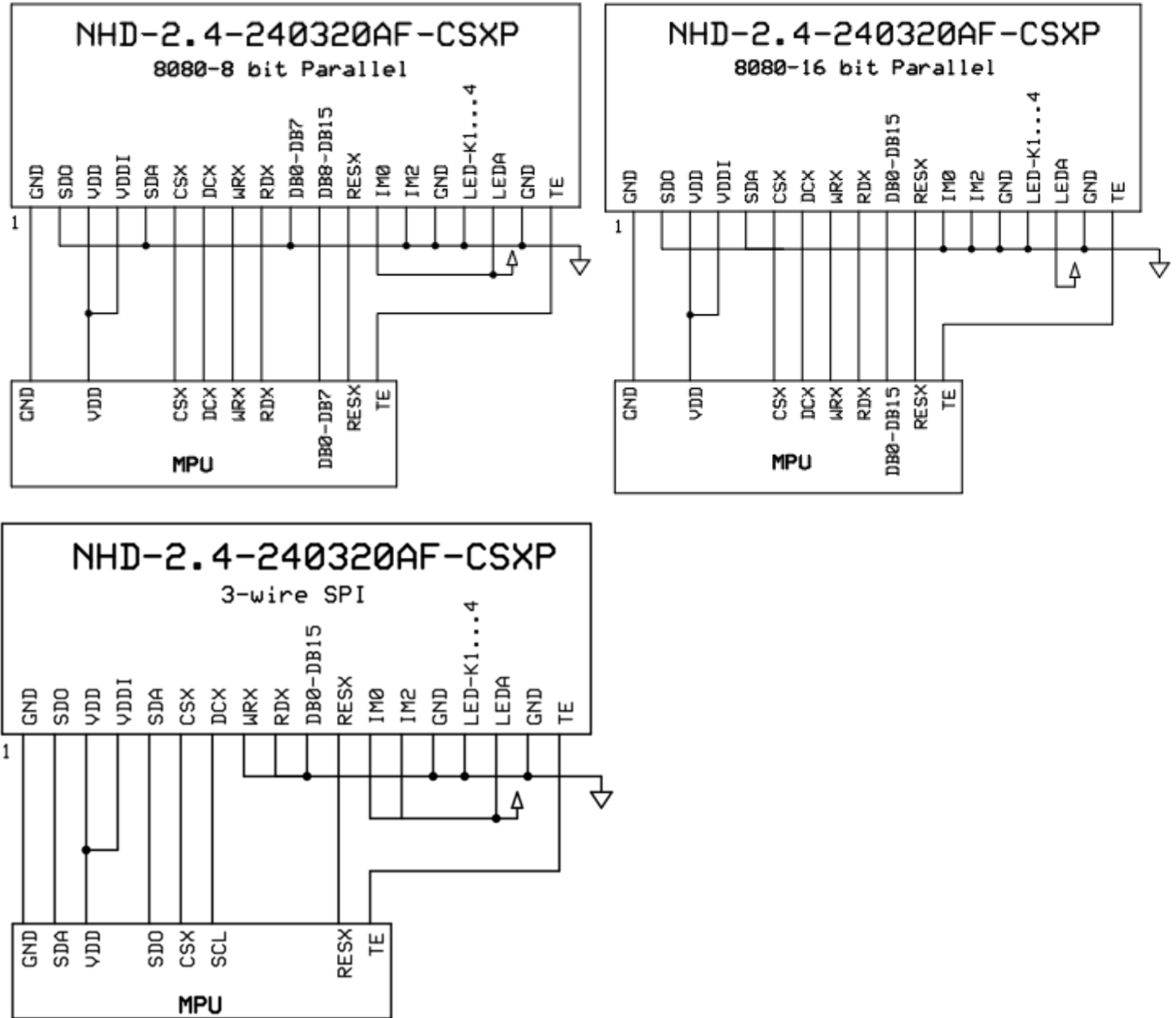
**Recommended connector:** 6pin, 1.0mm pitch, FFC connector. **Molex P/N** 52271-0679

## Interface Selection

| Pin Name | 8-bit 8080-II Parallel | 16-bit 8080-II Parallel | 3-wire SPI |
|----------|------------------------|-------------------------|------------|
| IM0      | 1                      | 0                       | 1          |
| IM2      | 0                      | 0                       | 1          |



## Wiring Diagram



## 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 LCD      | V <sub>DD</sub>   | -                                                  | 2.7                    | 3.3    | 3.6                    | V    |
| Supply Voltage for Logic    | IOV <sub>DD</sub> | -                                                  | 1.65                   | 1.8    | 3.6                    | V    |
| Supply Current              | I <sub>DD</sub>   | V <sub>DD</sub> = 3.3V                             | 5                      | 10     | 15                     | mA   |
| "H" Level input             | V <sub>IH</sub>   | -                                                  | 0.7 * V <sub>DDI</sub> | -      | V <sub>DDI</sub>       | V    |
| "L" Level input             | V <sub>IL</sub>   | -                                                  | GND                    | -      | 0.3 * V <sub>DDI</sub> | V    |
| "H" Level output            | V <sub>OH</sub>   | -                                                  | 0.8 * V <sub>DDI</sub> | -      | V <sub>DDI</sub>       | V    |
| "L" Level output            | V <sub>OL</sub>   | -                                                  | GND                    | -      | 0.2 * V <sub>DDI</sub> | V    |
|                             |                   |                                                    |                        |        |                        |      |
| Backlight Supply Current    | I <sub>LED</sub>  | -                                                  | 80                     | 160    | 200                    | mA   |
| Backlight Supply Voltage    | V <sub>LED</sub>  | I <sub>LED</sub> = 160mA                           | 2.7                    | 3.0    | 3.4                    | V    |
| Backlight Lifetime*         | -                 | I <sub>LED</sub> = 160mA<br>T <sub>OP</sub> = 25°C | 30,000                 | 50,000 | -                      | Hrs. |

\*Backlight Lifetime is rated as Hours until **half-brightness**, under normal operating conditions. The LED of the backlight is driven by current drain; drive voltage is for reference only. Drive voltage must be selected to ensure backlight current drain is below MAX level stated.

### 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> | -            | -                   | 15   | 23                  | 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    | $\phi Y+$   | $CR \geq 10$          | -     | 80    | -     | °        |
|                        | Bottom | $\phi Y-$   |                       | -     | 80    | -     | °        |
|                        | Left   | $\theta X-$ |                       | -     | 80    | -     | °        |
|                        | Right  | $\theta X+$ |                       | -     | 80    | -     | °        |
| Contrast Ratio         |        | CR          | -                     | 800   | 1500  | -     | -        |
| Luminance              |        | $L_V$       | $I_{LED} = 160mA$     | 850   | 1020  | -     | $cd/m^2$ |
| Response Time          |        | $T_R + T_F$ | $T_{OP} = 25^\circ C$ | -     | 35    | 45    | ms       |
| Chromaticity           | Red    | $X_R$       | -                     | 0.585 | 0.635 | 0.685 | -        |
|                        |        | $Y_R$       | -                     | 0.291 | 0.341 | 0.391 | -        |
|                        | Green  | $X_G$       | -                     | 0.276 | 0.326 | 0.376 | -        |
|                        |        | $Y_G$       | -                     | 0.569 | 0.619 | 0.669 | -        |
|                        | Blue   | $X_B$       | -                     | 0.105 | 0.155 | 0.205 | -        |
|                        |        | $Y_B$       | -                     | 0.026 | 0.076 | 0.126 | -        |
|                        | White  | $X_W$       | -                     | 0.283 | 0.313 | 0.343 | -        |
|                        |        | $Y_W$       | -                     | 0.299 | 0.329 | 0.359 | -        |

## Driver/Controller Information

Built-in ST7789VI Source Driver: <https://support.newhavendisplay.com/hc/en-us/articles/10814990300823-ST7789VI>

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                                         |
|              |        |                   |       | 10h      | Swipe Left                                         |
|              |        |                   |       | 18h      | Swipe Right                                        |
|              |        |                   |       | 48h      | Zoom In                                            |
|              |        |                   |       | 49h      | Zoom Out                                           |
|              |        |                   |       | 00       | No gesture                                         |
| 02h          | RO     | Touch Points      | [7:0] | 0-Ah     | 0: No touch detected<br>A: 5 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                                         |
| 18h          | RO     | TOUCH5_Event_Flag | [7:6] | 0        | Put Down                                           |
|              |        |                   |       | 1        | Put Up                                             |
|              |        |                   |       | 2        | Contact                                            |
|              |        |                   |       | 3        | Reserved                                           |

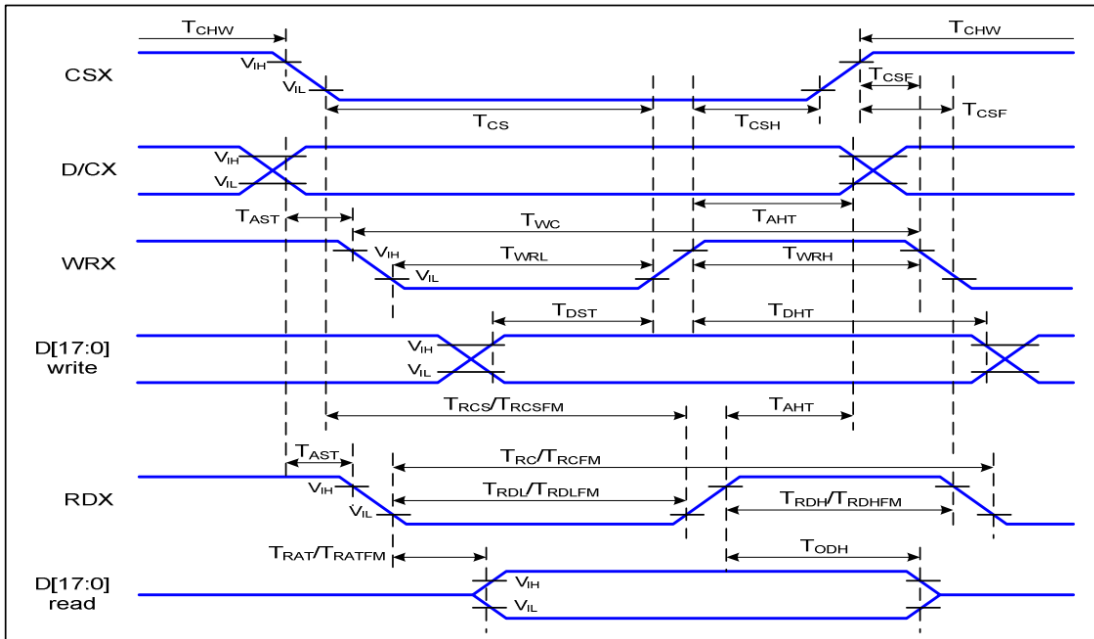
| Register No. | Access | Register Name      | Bits  | Value    | Description                        |
|--------------|--------|--------------------|-------|----------|------------------------------------|
| 1Bh          | RO     | TOUCH5_XH          | [3:0] | 0 -1     | Upper 4 bits of X touch coordinate |
| 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: 0x54             |
| A6h          | RO     | ID_G_FIRMID        | [7:0] | 00-FFh | Firmware ID Number<br>Default: 1            |
| A8h          | RO     | ID_G_VENODRID      | [7:0] | 00-FFh | CTPM Vendor's Chip ID<br>Default: 79h       |

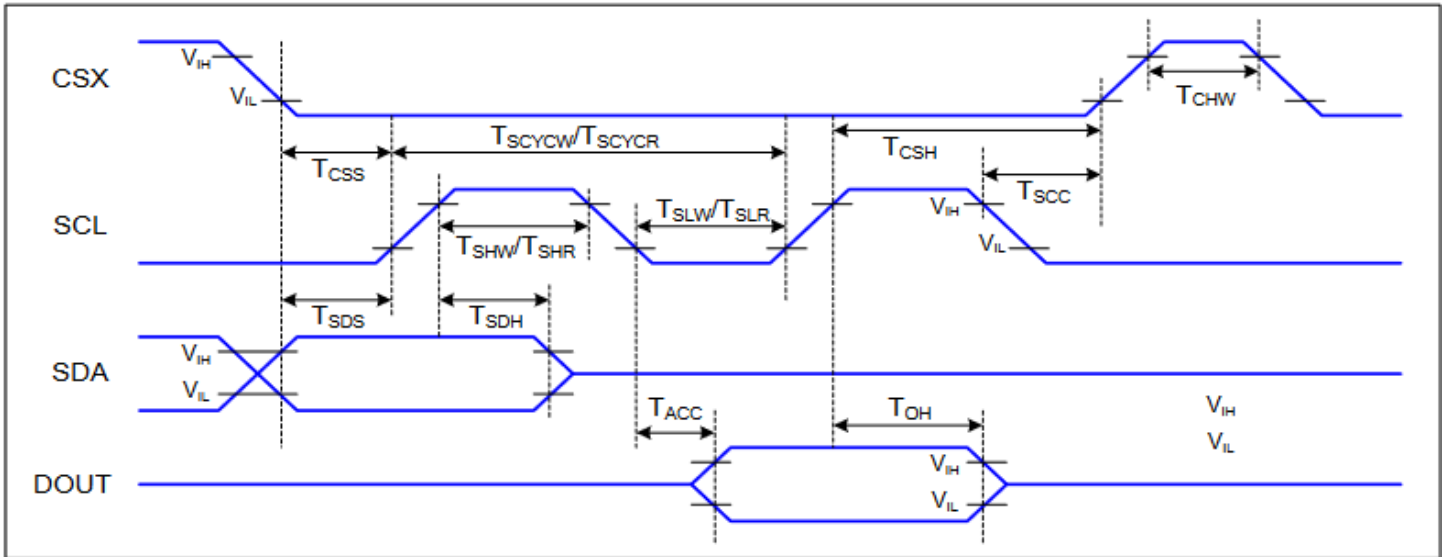
# Timing Characteristics for TFT

## Parallel 8/16-bit Interface Timing Characteristics



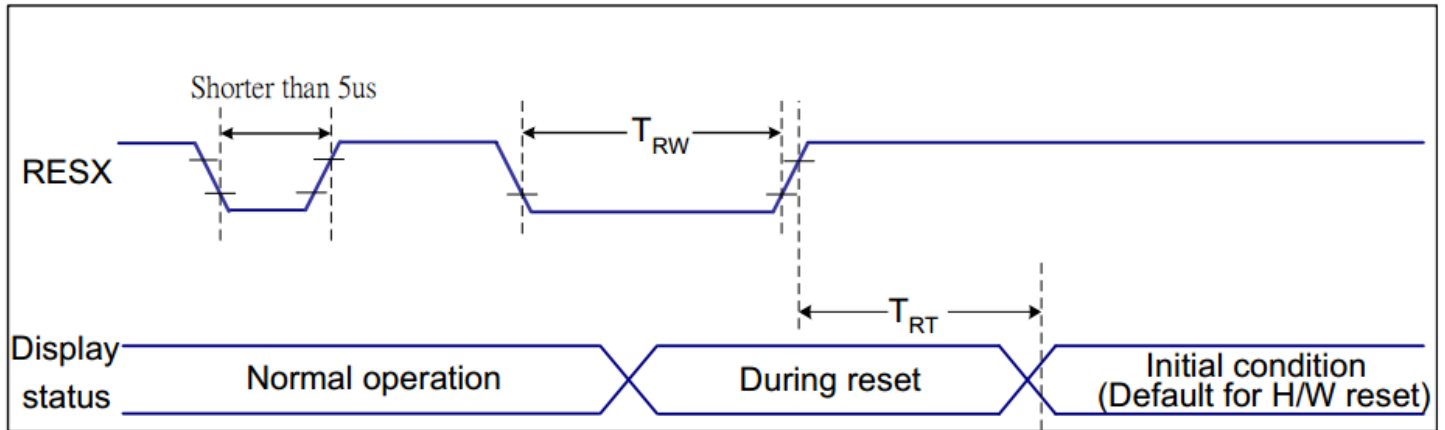
| Signal   | Symbol             | Parameter                          | Min | Max | Unit | Description                 |
|----------|--------------------|------------------------------------|-----|-----|------|-----------------------------|
| D/CX     | T <sub>AST</sub>   | Address setup time        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

### 3-wire Serial interface Timing Characteristics



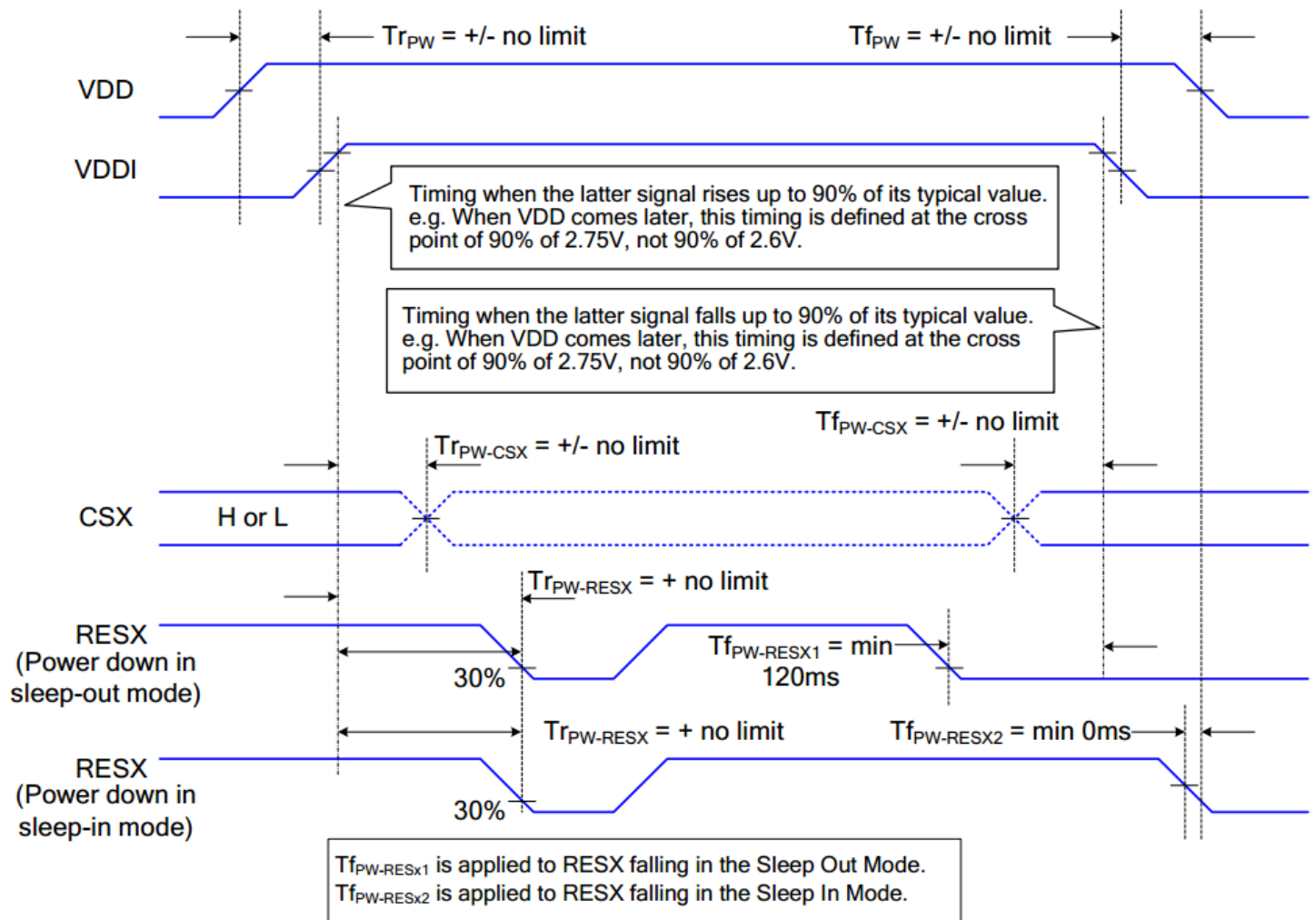
| Signal       | Symbol      | Parameter                      | Min | Max | Unit | Description         |
|--------------|-------------|--------------------------------|-----|-----|------|---------------------|
| CSX          | $T_{CSS}$   | Chip select setup time (write) | 15  |     | ns   |                     |
|              | $T_{CSH}$   | Chip select hold time (write)  | 15  |     | ns   |                     |
|              | $T_{CSS}$   | Chip select setup time (read)  | 60  |     | ns   |                     |
|              | $T_{SCC}$   | Chip select hold time (read)   | 65  |     | ns   |                     |
|              | $T_{CHW}$   | Chip select "H" pulse width    | 40  |     | ns   |                     |
| SCL          | $T_{SCYCW}$ | Serial clock cycle (Write)     | 16  |     | ns   |                     |
|              | $T_{SHW}$   | SCL "H" pulse width (Write)    | 7   |     | ns   |                     |
|              | $T_{SLW}$   | SCL "L" pulse width (Write)    | 7   |     | ns   |                     |
|              | $T_{SCYCR}$ | Serial clock cycle (Read)      | 150 |     | ns   |                     |
|              | $T_{SHR}$   | SCL "H" pulse width (Read)     | 60  |     | ns   |                     |
|              | $T_{SLR}$   | SCL "L" pulse width (Read)     | 60  |     | ns   |                     |
| SDA<br>(DIN) | $T_{SDS}$   | Data setup time                | 7   |     | ns   |                     |
|              | $T_{SDH}$   | Data hold time                 | 7   |     | ns   |                     |
| DOUT         | $T_{ACC}$   | Access time                    | 10  | 50  | ns   | For maximum CL=30pF |
|              | $T_{OH}$    | Output disable time            | 15  | 50  | ns   | For minimum CL=8pF  |

## Reset Timing



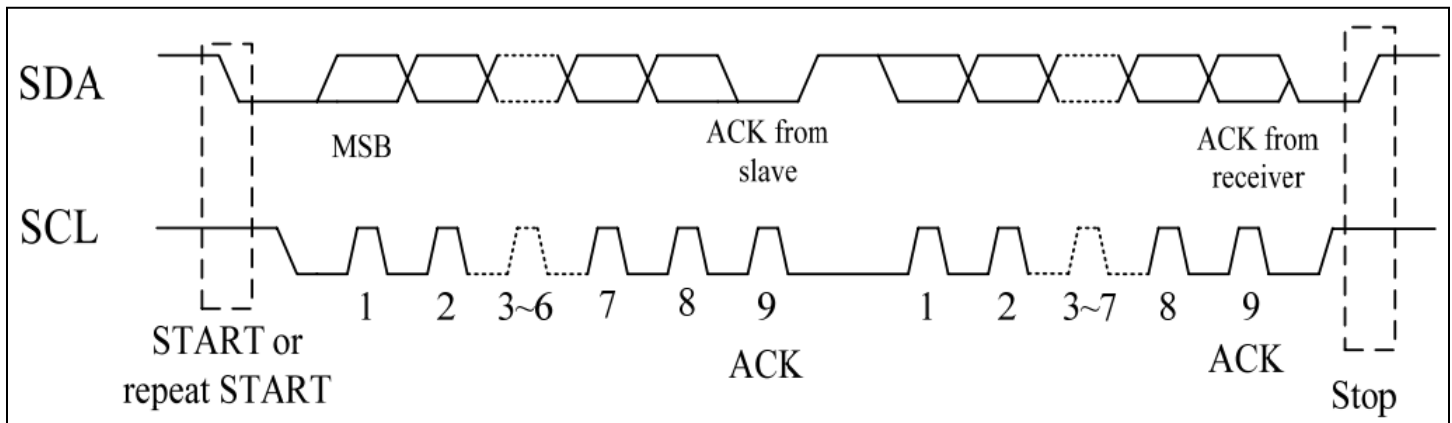
| Related Pins | Symbol | Parameter            | MIN | MAX                | Unit |
|--------------|--------|----------------------|-----|--------------------|------|
| RESX         | TRW    | Reset pulse duration | 10  | -                  | us   |
|              | TRT    | Reset cancel         | - 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

## Power ON/OFF Sequence

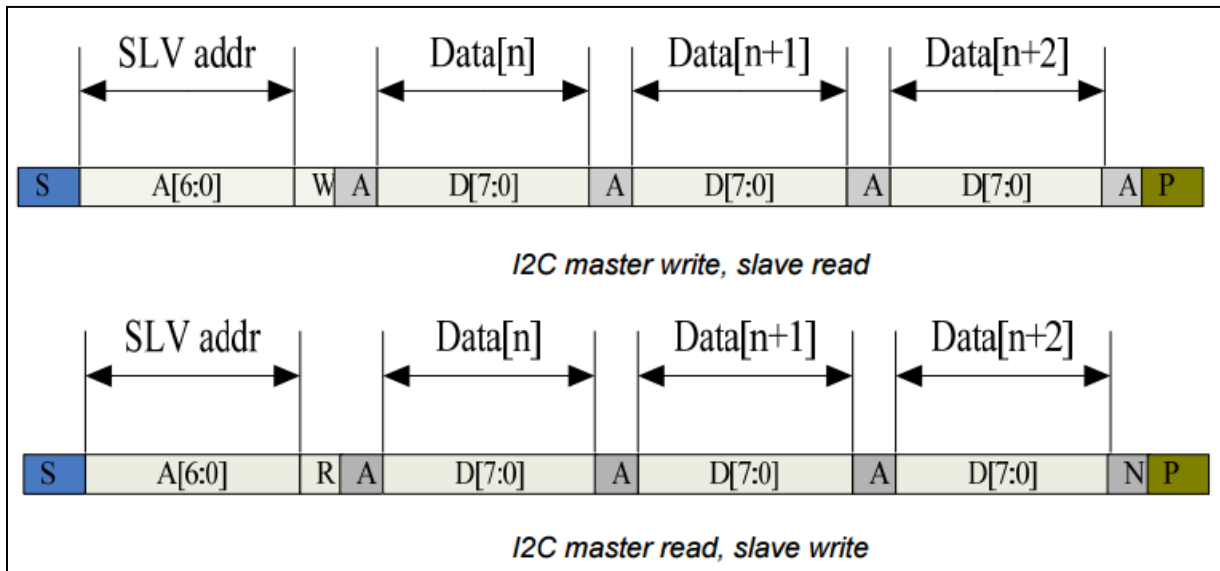


## Timing Characteristics – Capacitive Touch Panel

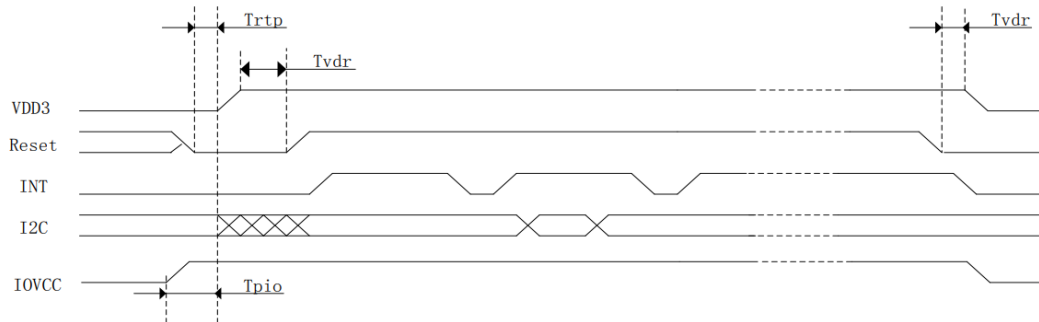
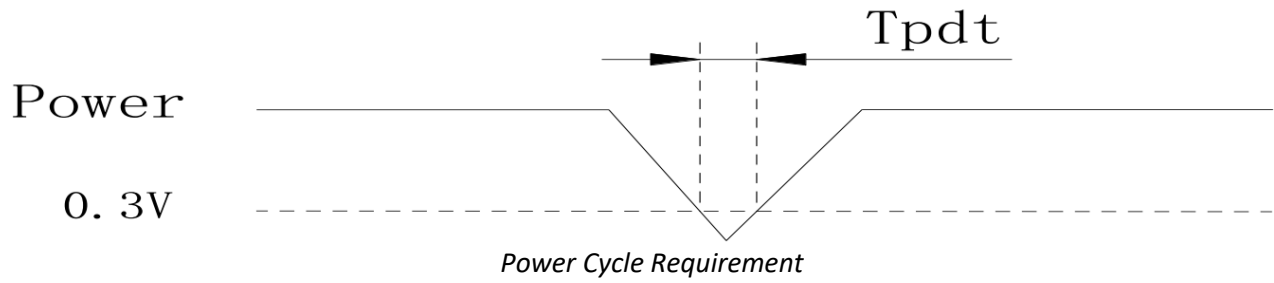
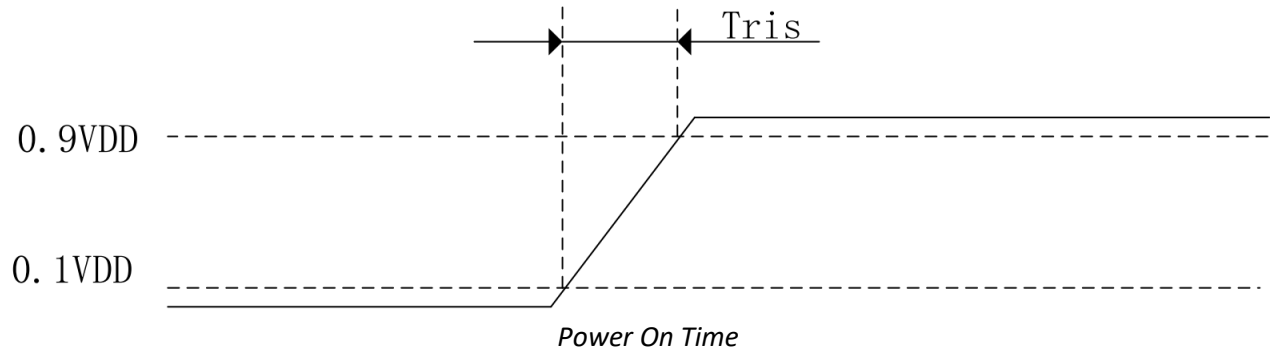
### Data Transfer Format



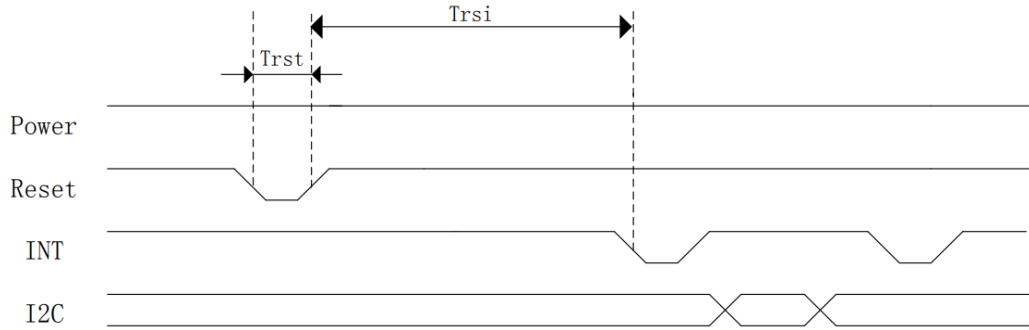
| Parameter                                      | Min | Max | Unit |
|------------------------------------------------|-----|-----|------|
| SCL Frequency                                  | 0   | 400 | KHz  |
| Bus free time between a STOP & START condition | 1.3 | -   | μs   |
| Hold time Repeated 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



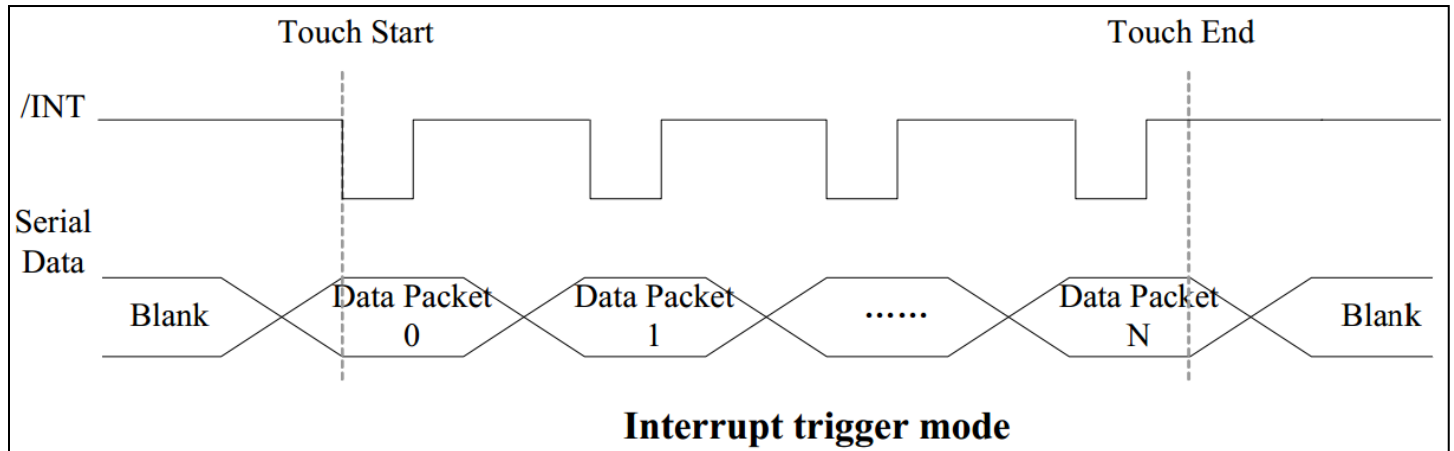
### Power ON Sequence



### 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();
```

## Example Initialization Code

```

/*****/
void Command_out(unsigned char c) //Function used for sending commands to TFT
{
    PORTA &= ~(1 << PORTA3); // Set DCX pin to LOW
    PORTL=c; // Assigning the Command Byte 'c' to PortL
    PORTA &= ~(1 << PORTA7); // Set WRX pin to LOW
    PORTA |= (1 << PORTA7); // Set WRX pin to HIGH
}

/*****/
void data_out(unsigned char d) //Function used for sending data to TFT
{
    PORTA |= (1 << PORTA3); // Set DCX pin to HIGH
    PORTL=d; // Assigning the Data Byte 'd' to PortL
    PORTA &= ~(1 << PORTA7); // Set WRX pin to LOW
    PORTA |= (1 << PORTA7); // Set WRX pin to HIGH
}

/*****/
void TFT_init(){

    digitalWrite(RESX, LOW);
    delay(250);
    digitalWrite(RESX, HIGH);
    delay(250);

    Command_out(0x28); //display off
    Command_out(0x11); //exit SLEEP mode
    delay(100);

    Command_out(0x36); //MADCTL: memory data access control
    data_out(0x88);

    Command_out(0x3A); //COLMOD: Interface Pixel format *** 65K-colors in 16bit/pixel (5-
6-5) format when using 16-bit interface to allow 1-byte per pixel
    data_out(0x55);

    Command_out(0xB2); //PORCTRK: Porch setting
    data_out(0x0C);
    data_out(0x0C);
    data_out(0x00);
    data_out(0x33);
    data_out(0x33);

    Command_out(0xB7); //GCTRL: Gate Control
    data_out(0x35);

    Command_out(0xBB); //VCOMS: VCOM setting
    data_out(0x2B);

    Command_out(0xC0); //LCMCTRL: LCM Control
    data_out(0x2C);

    Command_out(0xC2); //VDVVRHEN: VDV and VRH Command Enable
    data_out(0x01);
    data_out(0xFF);

```

```

Command_out(0xC3); //VRHS: VRH Set
data_out(0x11);

Command_out(0xC4); //VDVS: VDV Set
data_out(0x20);

Command_out(0xC6); //FRCTRL2: Frame Rate control in normal mode
data_out(0x0F);

Command_out(0xD0); //PWCTRL1: Power Control 1
data_out(0xA4);
data_out(0xA1);

Command_out(0xE0); //PVGAMCTRL: Positive Voltage Gamma control
data_out(0xD0);
data_out(0x00);
data_out(0x05);
data_out(0x0E);
data_out(0x15);
data_out(0x0D);
data_out(0x37);
data_out(0x43);
data_out(0x47);
data_out(0x09);
data_out(0x15);
data_out(0x12);
data_out(0x16);
data_out(0x19);

Command_out(0xE1); //NVGAMCTRL: Negative Voltage Gamma control
data_out(0xD0);
data_out(0x00);
data_out(0x05);
data_out(0x0D);
data_out(0x0C);
data_out(0x06);
data_out(0x2D);
data_out(0x44);
data_out(0x40);
data_out(0x0E);
data_out(0x1C);
data_out(0x18);
data_out(0x16);
data_out(0x19);

Command_out(0x2A); //X address set
data_out(0x00);
data_out(0x00);
data_out(0x00);
data_out(0xEF);

Command_out(0x2B); //Y address set
data_out(0x00);
data_out(0x00);
data_out(0x01);
data_out(0x3F);
delay(10);
Command_out(0x21); //Color inversion for IPS
Command_out(0x29); //display ON
delay(10);
}

```

## Quality Information

| Test Item                             | Content of Test                                                                                                                 | Test Condition                                                                     | Note |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------|
| High Temperature Storage              | Endurance test applying the high storage temperature for a long time.                                                           | +80°C, 240hrs                                                                      | 2    |
| Low Temperature Storage               | Endurance test applying the low storage temperature for a long time.                                                            | -30°C, 240hrs                                                                      | 1,2  |
| High Temperature Operation            | Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.                    | +70°C, 240hrs                                                                      | 2    |
| Low Temperature Operation             | Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.                     | -20°C, 240hrs                                                                      | 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. | +60°C, 90% RH, 240hrs                                                              | 1,2  |
| Thermal Shock resistance              | Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress.                  | -30°C 30min -> 25°C 3min -> 80°C 30min = 1 cycle.<br>For 100 cycles                |      |
| Vibration test                        | Endurance test applying vibration to simulate transportation and use.                                                           | 10Hz-55Hz (1 min.), 1.5mm amplitude.<br>30 min. exposure for each directions X,Y,Z | 3    |
| Static electricity test               | Endurance test applying electric static discharge.                                                                              | Air discharge: ±8kV 10 Times<br>Contact discharge: ±4kV 10 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.