

**Product Specification**

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# NHD-10.1-1024600BF-LSXP-CTP

## TFT Liquid Crystal Display

|                 |                                      |
|-----------------|--------------------------------------|
| <b>NHD-</b>     | Newhaven Display                     |
| <b>10.1-</b>    | 10.1" Diagonal                       |
| <b>1024600-</b> | 1024xRGBx600 Pixels                  |
| <b>BF-</b>      | Model                                |
| <b>L-</b>       | LVDS Interface                       |
| <b>S-</b>       | High Brightness, White LED Backlight |
| <b>X-</b>       | TFT                                  |
| <b>P-</b>       | IPS, Standard 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>

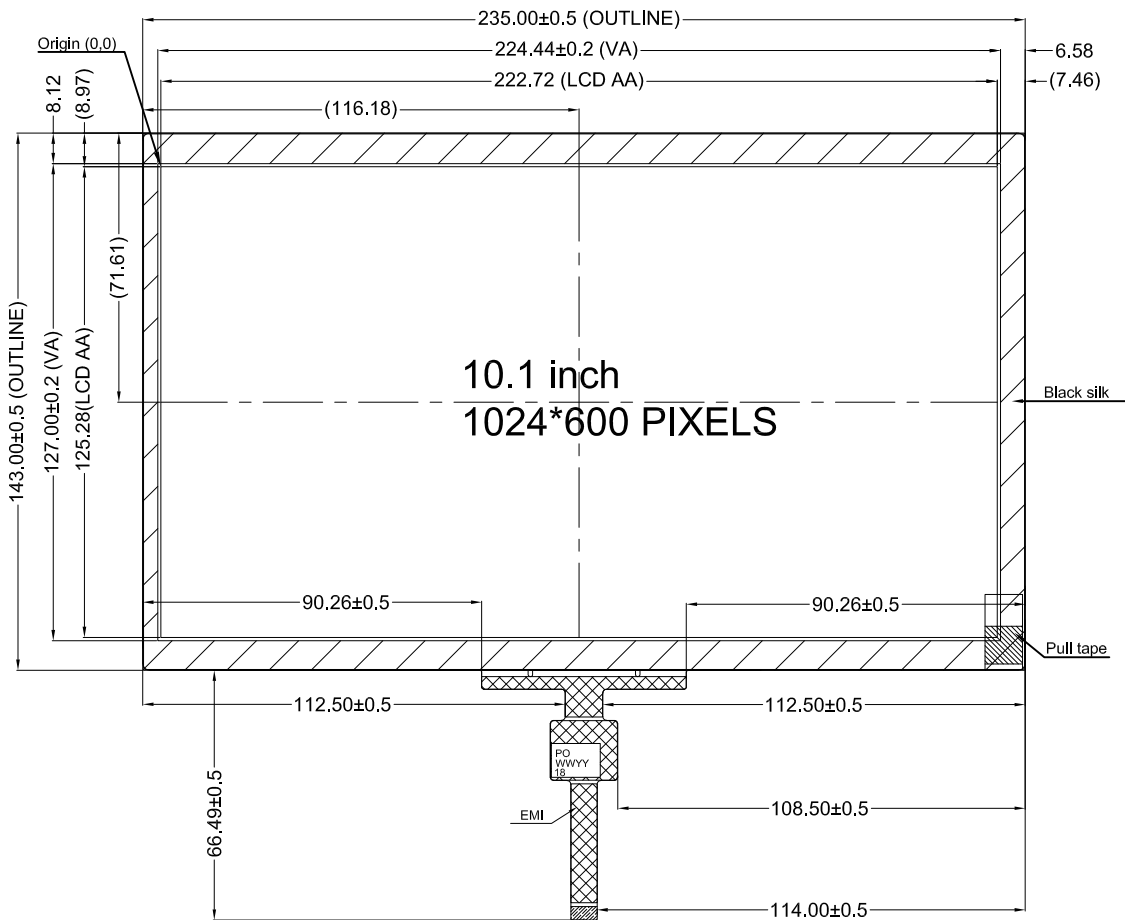


## Document Revision History

| Revision | Date       | Description                                                                                                                                           | Changed By |
|----------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 0        | 07/20/2022 | Preliminary Release                                                                                                                                   | CJ         |
| 1        | 09/08/2022 | Updated Operating and Storage Temperature Range, LCD Supply Current, Backlight Enable Voltage, Chromaticity Values, and Backlight PWM Frequency Range | JT         |

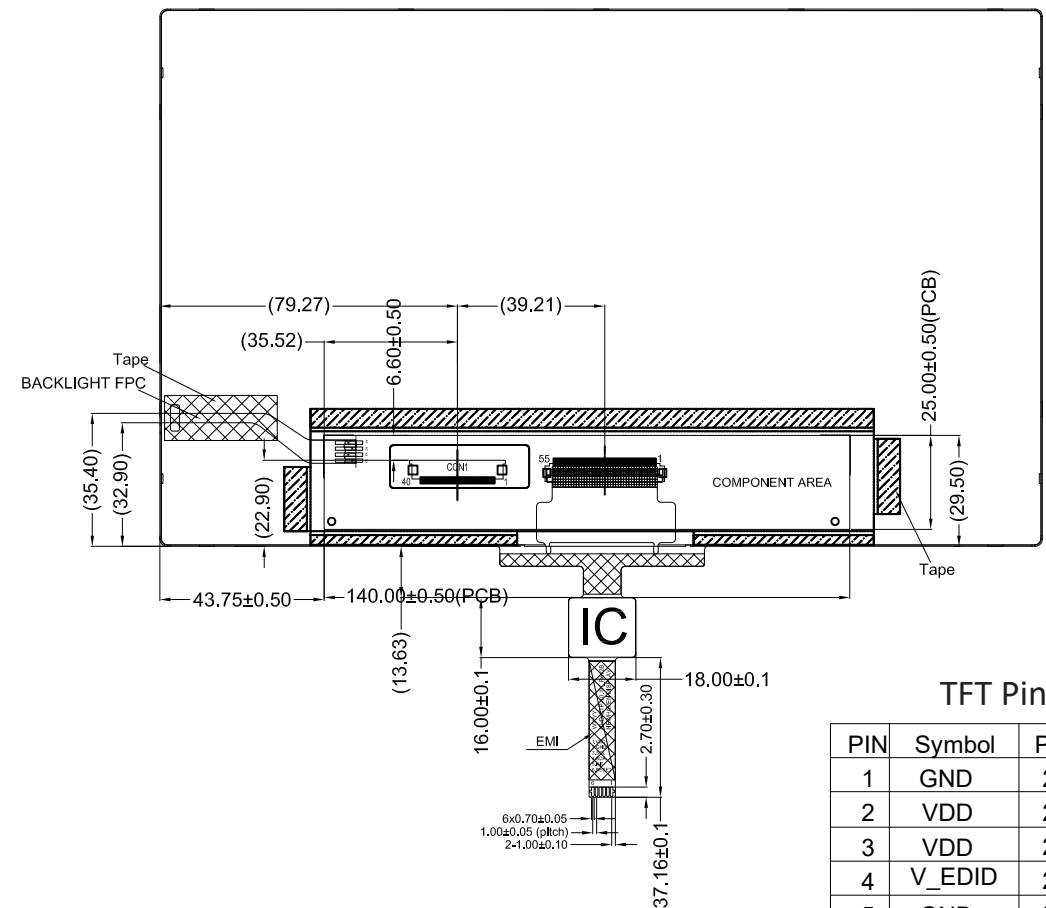
# Mechanical Drawing

| SYMBOL | REVISION | DATE |
|--------|----------|------|
|        |          |      |
|        |          |      |



Overall: 7.05±0.50  
CTP: 1.55±0.20  
TFT: 5.20±0.30  
Adhesive: 0.30

Steel Stiffener  
Components Area  
1.5 MAX  
Contact Side  
PI Stiffener  
0.3±0.05

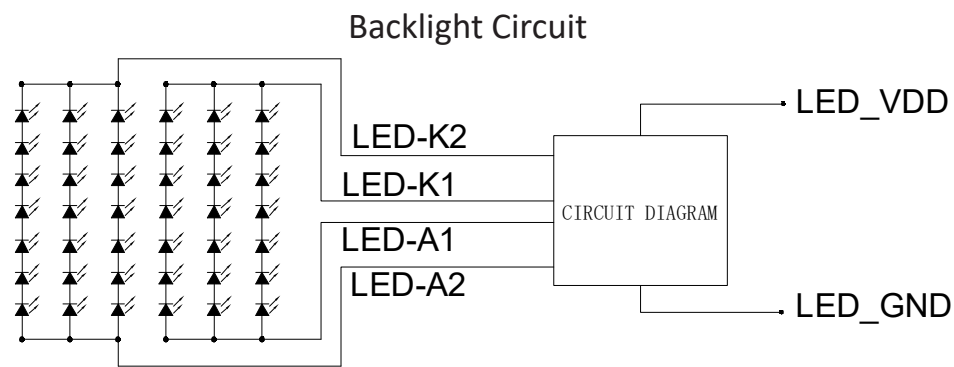


TFT Pinout

| PIN | Symbol | PIN | Symbol  |
|-----|--------|-----|---------|
| 1   | GND    | 21  | Rin3+   |
| 2   | VDD    | 22  | GND     |
| 3   | VDD    | 23  | INSEL   |
| 4   | V_EDID | 24  | GND     |
| 5   | GND    | 25  | GND     |
| 6   | SCL    | 26  | UPDN    |
| 7   | SDA    | 27  | SHLR    |
| 8   | Rin0-  | 28  | GND     |
| 9   | Rin0+  | 29  | RESET   |
| 10  | GND    | 30  | STBYB   |
| 11  | Rin1-  | 31  | LED-GND |
| 12  | Rin1+  | 32  | LED-GND |
| 13  | GND    | 33  | LED-GND |
| 14  | Rin2-  | 34  | GND     |
| 15  | Rin2+  | 35  | LED_PWM |
| 16  | GND    | 36  | LED_EN  |
| 17  | CLKIN- | 37  | BIST    |
| 18  | CLKIN+ | 38  | LED_VDD |
| 19  | GND    | 39  | LED_VDD |
| 20  | Rin3-  | 40  | LED_VDD |

CTP Pinout

| PIN | SYMBOL |
|-----|--------|
| 1   | VDD    |
| 2   | GND    |
| 3   | SCL    |
| 4   | SDA    |
| 5   | INT    |
| 6   | RESET  |



Product Description: 10.1" IPS TFT w/ Capacitive Touch

1. TFT Driver IC: HX8282-A11, CTP IC: FT5526EEZ-003
2. TFT Interface: LVDS, CTP Interface: I<sup>2</sup>C
3. TFT Power Requirement: 3.3V, 12.0V
4. Optical Features: Normally Black, Transmissive, 680 cd/m<sup>2</sup>
5. TFT Mating Connector: 40pin, 0.5mm pitch; Ex. Molex 54104-4031
6. CTP Mating Connector: 6pin, 1.0mm pitch; Ex. Molex 52271-067

|                                                                                                                                                                                                                       |                                                                                                                                |                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| <b>Standard Tolerance:</b><br>(Unless otherwise specified)                                                                                                                                                            |  <b>NEWHAVEN DISPLAY</b><br>INTERNATIONAL |                           |
|                                                                                                                                                                                                                       |                                                                                                                                |                           |
| Linear: ±0.3mm                                                                                                                                                                                                        | Drawing/Part Number:<br><b>NHD-10.1-1024600BF-LSXP-CTP</b>                                                                     |                           |
| <b>Unless otherwise specified:</b><br><br>• Dimensions are in Millimeters<br>• Third Angle Projection                            | Drawn By: C. Johnson                                                                                                           | Approved By: C. Johnson   |
|                                                                                                                                                                                                                       | Drawn Date: 07/20/2022                                                                                                         | Approved Date: 07/20/2022 |
|                                                                                                                                                                                                                       | <b>Do Not Scale Drawing</b>                                                                                                    |                           |
|                                                                                                                                                                                                                       | Sheet 1 of 1                                                                                                                   |                           |
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## Pin Description

### TFT:

| Pin No. | Symbol              | Connection   | Function Description                                                                              |
|---------|---------------------|--------------|---------------------------------------------------------------------------------------------------|
| 1       | GND                 | Power Supply | Ground                                                                                            |
| 2-3     | V <sub>DD</sub>     | Power Supply | Supply voltage for LCD (+3.3V)                                                                    |
| 4       | V <sub>EDID</sub>   | Power Supply | Supply voltage for EDID (+3.3V)                                                                   |
| 5       | GND                 | Power Supply | Ground                                                                                            |
| 6       | SCL                 | MPU          | Serial Clock for EDID                                                                             |
| 7       | SDA                 | MPU          | Serial Data for EDID                                                                              |
| 8       | Rin0-               | MPU          | -LVDS differential data input CH0                                                                 |
| 9       | Rin0+               | MPU          | +LVDS differential data input CH0                                                                 |
| 10      | GND                 | Power Supply | Ground                                                                                            |
| 11      | Rin1-               | MPU          | -LVDS differential data input CH1                                                                 |
| 12      | Rin1+               | MPU          | +LVDS differential data input CH1                                                                 |
| 13      | GND                 | Power Supply | Ground                                                                                            |
| 14      | Rin2-               | MPU          | -LVDS differential data input CH2                                                                 |
| 15      | Rin2+               | MPU          | +LVDS differential data input CH2                                                                 |
| 16      | GND                 | Power Supply | Ground                                                                                            |
| 17      | CLKIN-              | MPU          | -LVDS differential Clock                                                                          |
| 18      | CLKIN+              | MPU          | +LVDS differential Clock                                                                          |
| 19      | GND                 | Power Supply | Ground                                                                                            |
| 20      | Rin3-               | MPU          | -LVDS differential data input CH3                                                                 |
| 21      | Rin3+               | MPU          | +LVDS differential data input CH3                                                                 |
| 22      | GND                 | Power Supply | Ground                                                                                            |
| 23      | INSEL (HSD)         | MPU          | Data Input Format:<br>INSEL = L 8-Bit LVDS Input (Default)<br>INSEL = H 6-Bit LVDS Input          |
| 24-25   | GND                 | Power Supply | Ground                                                                                            |
| 26      | UPDN                | MPU          | Gate Driver Up/Down Scan Setting:<br>UPDN = H: Reverse Scan<br>UPDN = L: Normal Scan (Default)    |
| 27      | SHLR                | MPU          | Gate Driver Left/Right Scan Setting:<br>SHLR = H: Normal Scan (Default)<br>SHLR = L: Reverse Scan |
| 28      | GND                 | Power Supply | Ground                                                                                            |
| 29      | RESET               | MPU          | Active Low Reset Signal                                                                           |
| 30      | STBYB               | MPU          | Active Low Standby Signal                                                                         |
| 31-33   | LED_GND             | Power Supply | Ground for Backlight Driver                                                                       |
| 34      | GND                 | Power Supply | Ground                                                                                            |
| 35      | LED_PWM             | MPU          | Backlight PWM Signal Input (See Table Below)                                                      |
| 36      | LED_EN              | MPU          | Backlight Enable H: Backlight On; L: Backlight Off                                                |
| 37      | BIST                | MPU          | Built in Self-Test<br>BIST = H: Self-Test Enabled<br>BIST = L: Normal Operation (Default)         |
| 38-40   | LED_V <sub>DD</sub> | Power Supply | Supply Voltage for Backlight Driver                                                               |

**Recommended TFT connector:** 0.5mm pitch 40-Conductor FFC. **Molex P/N:** 15020-0435

### Capacitive Touch Panel:

| 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 CTP Connector:** 1.0mm pitch 6-Conductor FFC. **Molex P/N:** 52271-0679



## Driver Information

### TFT:

Source Driver HX8282-A11: <https://support.newhavendisplay.com/hc/en-us/articles/4414530594583-HX8282-A11>

Gate Driver HX8696-A01: <https://support.newhavendisplay.com/hc/en-us/articles/4414548297367-HX8696-A>

Backlight Driver IC: MP3398EGF

### Capacitive Touch Panel:

Built-in FocalTech FT5526EEZ-003 Capacitive Touch Controller.

Please download specification at <https://support.newhavendisplay.com/hc/en-us/articles/4414392845079-FT5x26>

## Electrical Characteristics

### TFT:

| Item                                             | Symbol            | Condition              | Min.   | Typ. | Max.    | Unit |
|--------------------------------------------------|-------------------|------------------------|--------|------|---------|------|
| Operating Temperature Range                      | T <sub>OP</sub>   | Absolute Max           | -0     | -    | +50     | °C   |
| Storage Temperature Range                        | T <sub>ST</sub>   | Absolute Max           | -20    | -    | +60     | °C   |
| Supply Voltage for LCD                           | V <sub>DD</sub>   | -                      | 3.0    | 3.3  | 3.6     | V    |
| Supply Voltage for EDID                          | V <sub>EDID</sub> | -                      | 3.0    | 3.3  | 3.6     | V    |
| Supply Current for LCD                           | I <sub>DD</sub>   | V <sub>DD</sub> = 3.3V | 84.5   | 169  | 210     | mA   |
| LVDS Differential input HIGH Voltage             | RxVTH             | -                      | -      | -    | +100    | mV   |
| LVDS Differential input LOW Voltage              | RxVTL             | -                      | -100   | -    | -       | mV   |
| LVDS Differential input Common Voltage           | RxVCM             | -                      | VID /2 | -    | VDD-1.2 | V    |
| LVDS Differential Voltage                        | VID               | -                      | 200    | -    | 600     | mV   |
|                                                  |                   |                        |        |      |         |      |
| Supply Voltage for Backlight Driver              | LED_VLED          | -                      | 5.0    | 12.0 | 22.4    | V    |
| Supply Current for Backlight Driver <sup>1</sup> | LED_ILED          | -                      | 160    | 360  | 1200    | mA   |
| Backlight Lifetime <sup>2</sup>                  | -                 | T <sub>OP</sub> = 25°C | 30,000 | -    | -       | Hrs. |
| Backlight Enable Voltage                         | LED_EN            | -                      | 1.5    | 3.3  | 5.5     | V    |
| Backlight PWM Voltage                            | LED_PWM           | -                      | 1.5    | 3.3  | 5.5     | V    |
| Backlight PWM Frequency                          | -                 | LED_PWM = 3.3V         | 200    | -    | 2000    | Hz   |

<sup>1</sup>Minimum supply current occurs when supply voltage is at max; maximum supply current when supply voltage is at minimum.

<sup>2</sup>Backlight lifetime is rated as Hours until **half-brightness**, under normal operating conditions.

### 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> | -            | 3.0                 | 3.3  | 3.6                 | V    |
| Supply Current – Operating  | I <sub>DD</sub> | -            | 8                   | 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          | -                     | 600  | 800  | -    | -                 |
| Luminance                   |        | $L_v$       | -                     | 510  | 680  | 850  | cd/m <sup>2</sup> |
| Response Time (Rise + Fall) |        | $T_R + T_F$ | $T_{OP} = 25^\circ C$ | -    | 25   | 35   | ms                |
| Chromaticity                | Red    | $X_R$       | -                     | 0.57 | 0.60 | 0.63 | -                 |
|                             |        | $Y_R$       | -                     | 0.33 | 0.36 | 0.39 | -                 |
|                             | Green  | $X_G$       | -                     | 0.30 | 0.33 | 0.36 | -                 |
|                             |        | $Y_G$       | -                     | 0.51 | 0.54 | 0.57 | -                 |
|                             | Blue   | $X_B$       | -                     | 0.10 | 0.13 | 0.16 | -                 |
|                             |        | $Y_B$       | -                     | 0.05 | 0.08 | 0.11 | -                 |
|                             | White  | $X_W$       | -                     | 0.28 | 0.31 | 0.34 | -                 |
|                             |        | $Y_W$       | -                     | 0.30 | 0.33 | 0.36 | -                 |

## Capacitive Touch Panel Material Characteristics

| Property            | Requirement   | Unit |
|---------------------|---------------|------|
| IC                  | FT5526EEZ-003 | -    |
| ITO Glass thickness | 0.7           | mm   |
| Surface Hardness    | $\geq 6$      | H    |
| Light transmission  | $> 85\%$      | -    |
| Operating Humidity  | 20~90         | RH   |
| Storage Humidity    | 20~90         | RH   |

## Capacitive Touch Panel Registers

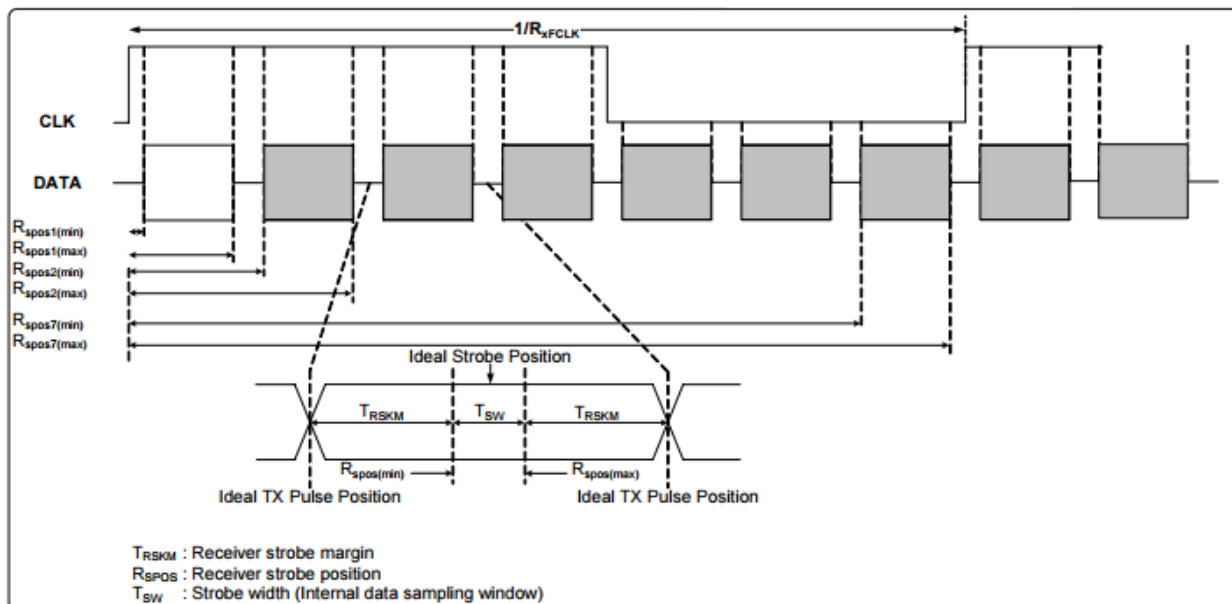
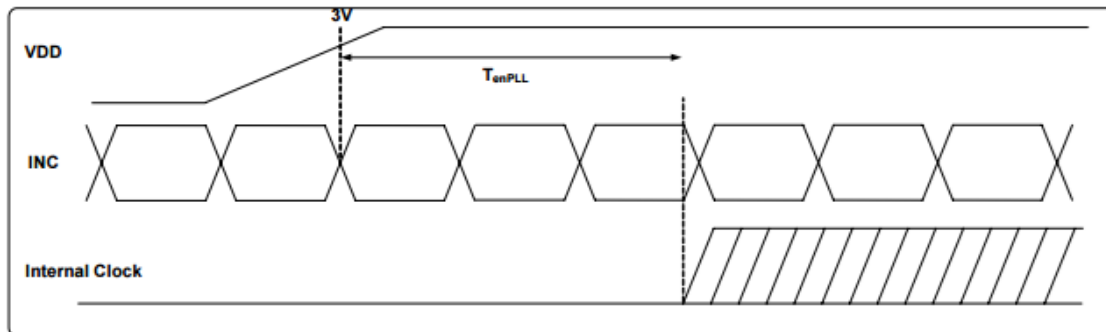
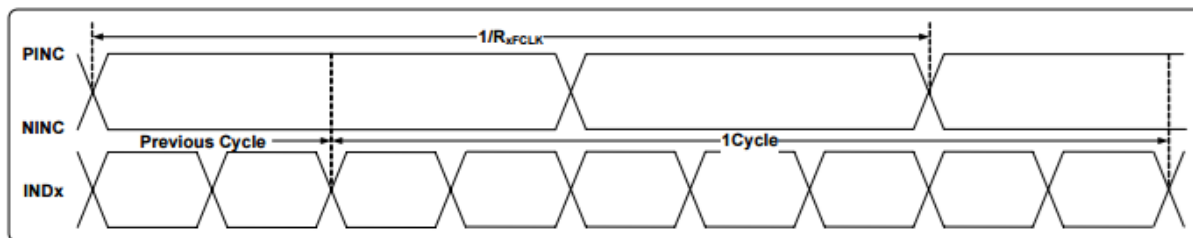
| Register No | Register Name      | Bits  | Value                                        | Description                                                                                                                                                   |
|-------------|--------------------|-------|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 00h         | Device Mode        | [2:0] | 000b<br>100b<br>001b                         | Normal Operating Mode<br>Test Mode - read raw data (reserved)<br>System Information Mode (reserved)                                                           |
| 01h         | Gesture ID         | [7:0] | 48h<br>49h<br>00h                            | Zoom In<br>Zoom Out<br>No Gesture                                                                                                                             |
| 02h         | Touch Points       | [3:0] | 000b<br>001b<br>010b<br>011b<br>100b<br>101b | 0 touch points detected<br>1 touch point detected<br>2 touch points detected<br>3 touch points detected<br>4 touch points detected<br>5 touch points detected |
| 03h         | Touch 1 Event Flag | [7:6] | 00b<br>01b<br>10b<br>11b                     | Put Down<br>Put Up<br>Contact<br>Reserved                                                                                                                     |
| 03h         | TOUCH1_XH          | [3:0] | 0h - 1h                                      | Upper 4 bits of X touch coordinate                                                                                                                            |
| 04h         | TOUCH1_XL          | [7:0] | 00h - FFh                                    | Lower 8 bits of X touch coordinate                                                                                                                            |
| 05h         | TOUCH1_YH          | [3:0] | 0h - 1h                                      | Upper 4 bits of Y touch coordinate                                                                                                                            |
| 06h         | TOUCH1_YL          | [7:0] | 00h - FFh                                    | Lower 8 bits of Y touch coordinate                                                                                                                            |
| 09h         | Touch 2 Event Flag | [7:6] | 00b<br>01b<br>10b<br>11b                     | Put Down<br>Put Up<br>Contact<br>Reserved                                                                                                                     |
| 09h         | TOUCH2_XH          | [3:0] | 0h - 1h                                      | Upper 4 bits of X touch coordinate                                                                                                                            |
| 0Ah         | TOUCH2_XL          | [7:0] | 00h - FFh                                    | Lower 8 bits of X touch coordinate                                                                                                                            |
| 0Bh         | TOUCH2_YH          | [3:0] | 0h - 1h                                      | Upper 4 bits of Y touch coordinate                                                                                                                            |
| 0Ch         | TOUCH2_YL          | [7:0] | 00h - FFh                                    | Lower 8 bits of Y touch coordinate                                                                                                                            |
| 0Fh         | Touch 3 Event Flag | [7:6] | 00b<br>01b<br>10b<br>11b                     | Put Down<br>Put Up<br>Contact<br>Reserved                                                                                                                     |
| 0Fh         | TOUCH3_XH          | [3:0] | 0h - 1h                                      | Upper 4 bits of X touch coordinate                                                                                                                            |
| 10h         | TOUCH3_XL          | [7:0] | 00h - FFh                                    | Lower 8 bits of X touch coordinate                                                                                                                            |
| 11h         | TOUCH3_YH          | [3:0] | 0h - 1h                                      | Upper 4 bits of Y touch coordinate                                                                                                                            |
| 12h         | TOUCH3_YL          | [7:0] | 00h - FFh                                    | Lower 8 bits of Y touch coordinate                                                                                                                            |
| 15h         | Touch 4 Event Flag | [7:6] | 00b<br>01b<br>10b<br>11b                     | Put Down<br>Put Up<br>Contact<br>Reserved                                                                                                                     |
| 15h         | TOUCH4_XH          | [3:0] | 0h - 1h                                      | Upper 4 bits of X touch coordinate                                                                                                                            |
| 16h         | TOUCH4_XL          | [7:0] | 00h - FFh                                    | Lower 8 bits of X touch coordinate                                                                                                                            |
| 17h         | TOUCH4_YH          | [3:0] | 0h - 1h                                      | Upper 4 bits of Y touch coordinate                                                                                                                            |
| 18h         | TOUCH4_YL          | [7:0] | 00h - FFh                                    | Lower 8 bits of Y touch coordinate                                                                                                                            |

| Register No | Register Name           | Bits  | Value                           | Description                                                                                                                                        |
|-------------|-------------------------|-------|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 18h         | Touch 5 Event Flag      | [7:6] | 00b<br>01b<br>10b<br>11b        | Put Down<br>Put Up<br>Contact<br>Reserved                                                                                                          |
| 18h         | TOUCH5_XH               | [3:0] | 0h - 1h                         | Upper 4 bits of X touch coordinate                                                                                                                 |
| 1Ch         | TOUCH5_XL               | [7:0] | 00h - FFh                       | Lower 8 bits of X touch coordinate                                                                                                                 |
| 1Dh         | TOUCH5_YH               | [3:0] | 0h - 1h                         | Upper 4 bits of Y touch coordinate                                                                                                                 |
| 1Eh         | TOUCH5_YL               | [7:0] | 00h - FFh                       | Lower 8 bits of Y touch coordinate                                                                                                                 |
| 80h         | ID_G_THGROUP            | [7:0] | 00h - FFh                       | Valid touching detect threshold<br>Actual value will be 4 times register's value                                                                   |
| 81h         | ID_G_THPEAK             | [7:0] | 00h - FFh                       | valid touching peak detect threshold                                                                                                               |
| 82h         | ID_G_THCAL              | [7:0] | 00h - FFh                       | Touch focus threshold                                                                                                                              |
| 83h         | ID_G_THWATER            | [7:0] | 00h - FFh                       | threshold when there is surface water                                                                                                              |
| 84h         | ID_G_THTEMP             | [7:0] | 00h- FFh                        | threshold of temperature compensation                                                                                                              |
| 85h         | ID_G_THDIFF             | [7:0] | 00h- FFh                        | Touch difference threshold<br>Actual value is 32 times the register's value                                                                        |
| 86h         | ID_G_CTRL               | [1:0] | 00h<br>01h                      | Power Control Mode: Not Auto Jump<br>Power Control Mode: Auto Jump                                                                                 |
| 87h         | ID_G_TIME_ENTER_MONITOR | [7:0] | 00h-FFh                         | Delay to enter 'Monitor' status (s)                                                                                                                |
| 88h         | ID_G_PERIODACTIVE       | [3:0] | 3h-Eh                           | Period of 'Active' status (ms)                                                                                                                     |
| 89h         | ID_G_PERIODMONITOR      | [7:0] | 1Eh-FFh                         | Timer to enter 'idle' when in 'Monitor' (ms)                                                                                                       |
| A0h         | ID_G_AUTO_CLB_MODE      | [7:0] | 00h<br>FFh                      | Auto calibration mode: Enable auto calibration<br>Auto calibration mode: Disable auto calibration                                                  |
| A1h         | ID_G_LIB_VERSION_H      | [7:0] | 30h                             | Firmware Library Version H byte                                                                                                                    |
| A2h         | ID_G_LIB_VERSION_L      | [7:0] | 01h                             | Firmware Library Version L byte                                                                                                                    |
| A3h         | ID_G_CIPHER             | [7:0] | 54h                             | Chip vendor ID                                                                                                                                     |
| A4h         | ID_G_MODE               | [0:0] | 00h<br>01h                      | Interrupt status: Enable interrupt to host<br>Interrupt status: Disable interrupt to host                                                          |
| A5h         | ID_G_PMODE              | [1:0] | 00h<br>01h<br>03h               | 'Active' Mode<br>'Monitor' Mode<br>'Hibernate' Mode                                                                                                |
| A6h         | ID_G_FIRMID             | [7:0] | 18h                             | Firmware ID                                                                                                                                        |
| A7h         | ID_G_STATE              | [7:0] | 00h<br>01h<br>02h<br>03h<br>04h | Running State: Configure<br>Running State: Work<br>Running State: Calibration<br>Running State: Factory<br>Running State: Auto-calibration         |
| A8h         | ID_G_FT5201ID           | [7:0] | 79h                             | CTPM Vendor's Chip ID                                                                                                                              |
| A9h         | ID_G_ERR                | [7:0] | 00h<br>03h<br>05h<br>1Ah        | Error Code: OK<br>Error Code: Chip register writing inconsistent with reading<br>Error Code: Chip start fail<br>Error Code: Calibration match fail |

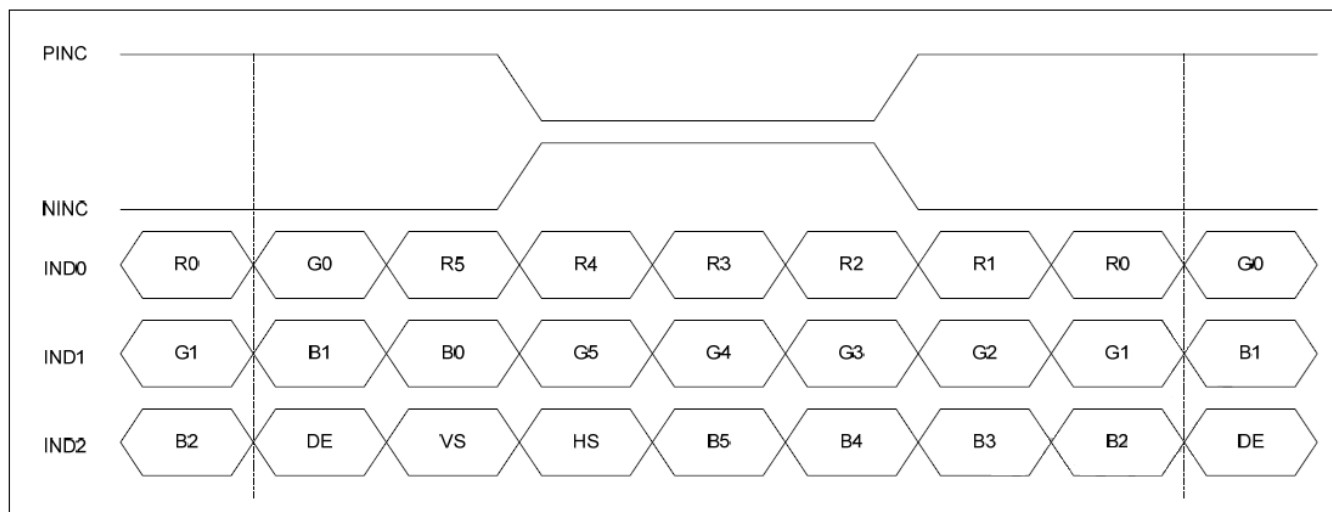
## Timing Characteristics: TFT Display

| Parameter              | Symbol             | Spec |                             |      | Unit | Condition                                                              |
|------------------------|--------------------|------|-----------------------------|------|------|------------------------------------------------------------------------|
|                        |                    | Min. | Typ.                        | Max. |      |                                                                        |
| Clock frequency        | R <sub>XFCLK</sub> | 20   | -                           | 71   | MHz  | -                                                                      |
| Input data skew margin | T <sub>RSKM</sub>  | 500  | -                           | -    | pS   | VID  = 400mV<br>R <sub>XVCM</sub> = 1.2V<br>R <sub>XFCLK</sub> = 71MHz |
| Clock high time        | T <sub>LVCH</sub>  | -    | 4/(7 * R <sub>XFCLK</sub> ) | -    | nS   | -                                                                      |
| Clock low time         | T <sub>LVCL</sub>  | -    | 3/(7 * R <sub>XFCLK</sub> ) | -    | nS   | -                                                                      |
| PLL wake-up time       | T <sub>emPLL</sub> | -    | -                           | 150  | μS   | -                                                                      |

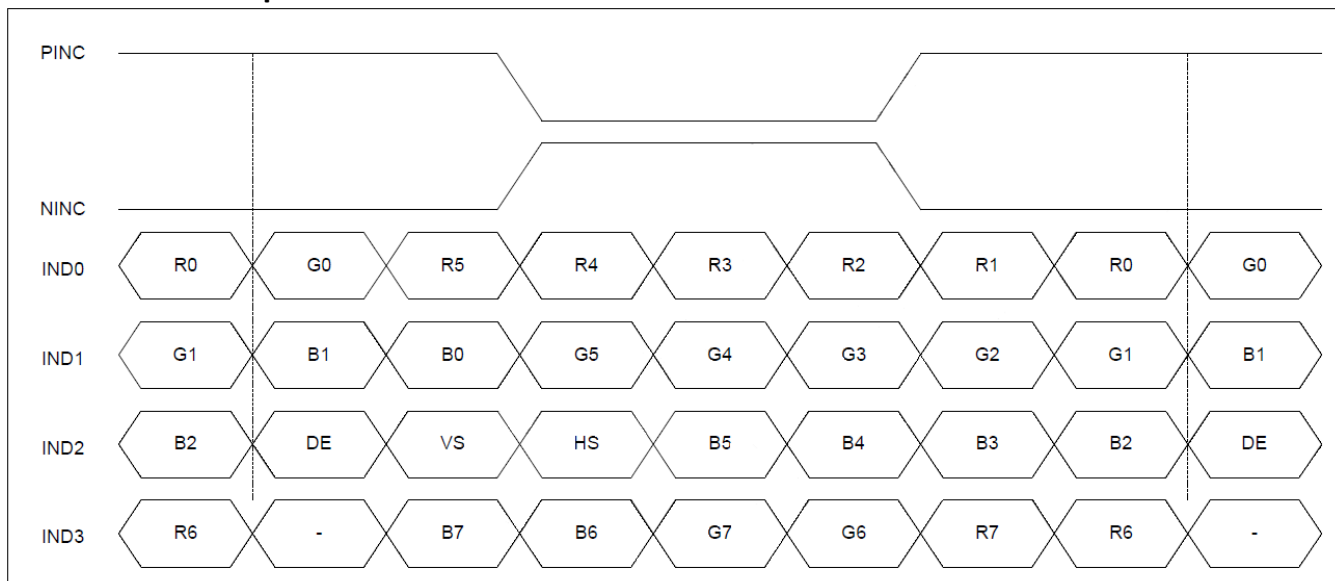
| Parameter            | Symbol            | Spec |      |      | Unit | Condition           |
|----------------------|-------------------|------|------|------|------|---------------------|
|                      |                   | Min. | Typ. | Max. |      |                     |
| Modulation Frequency | SSC <sub>MF</sub> | 23   | -    | 93   | KHz  | -                   |
| Modulation Rate      | SSC <sub>MR</sub> | -    | -    | ±3   | %    | LVDS Clock = 71 MHz |



## 6-Bit LVDS Data Input Format:



## 8-Bit LVDS Data Input Format:

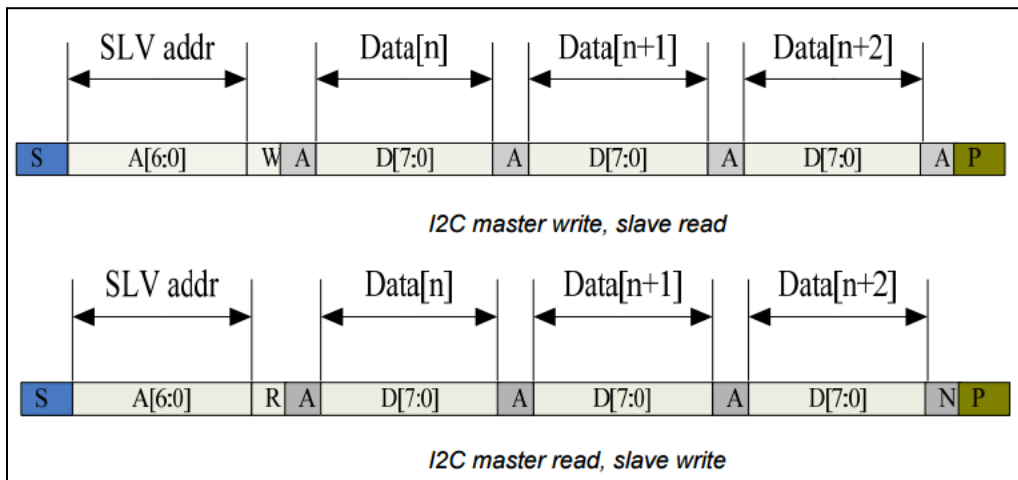
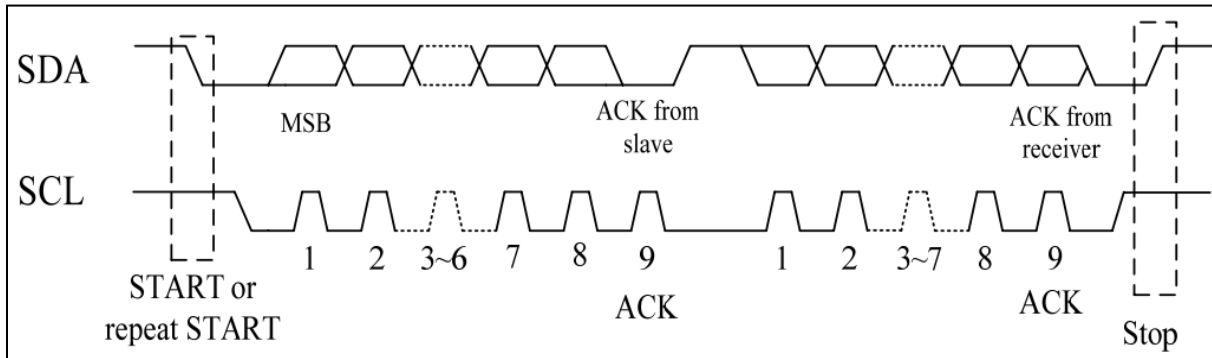


## Horizontal & Vertical Timing (1024x600)

| Item           | Symbol                  | Spec. |      |      | Unit           |
|----------------|-------------------------|-------|------|------|----------------|
|                |                         | Min.  | Typ. | Max. |                |
| DCLK Frequency | F <sub>CLK</sub>        | 44.9  | 51.2 | 63   | MHz            |
| HSYNC          | Horizontal Display Area | 1024  |      |      | DCLK           |
|                | HSD Period              | 1200  | 1344 | 1400 | DCLK           |
|                | HSD Pulse Width         | 1     | -    | 140  | DCLK           |
|                | HSD Back Porch          | 160   |      |      | DCLK           |
|                | HSD Front Porch         | 16    | 160  | 216  | DCLK           |
| VSYNC          | Vertical Display Area   | 600   |      |      | T <sub>H</sub> |
|                | VSD Period              | 624   | 635  | 750  | T <sub>H</sub> |
|                | VSD Pulse Width         | 1     | -    | 20   | T <sub>H</sub> |
|                | VSD Back Porch          | 23    |      |      | T <sub>H</sub> |
|                | VSD Front Porch         | 1     | 12   | 127  | T <sub>H</sub> |

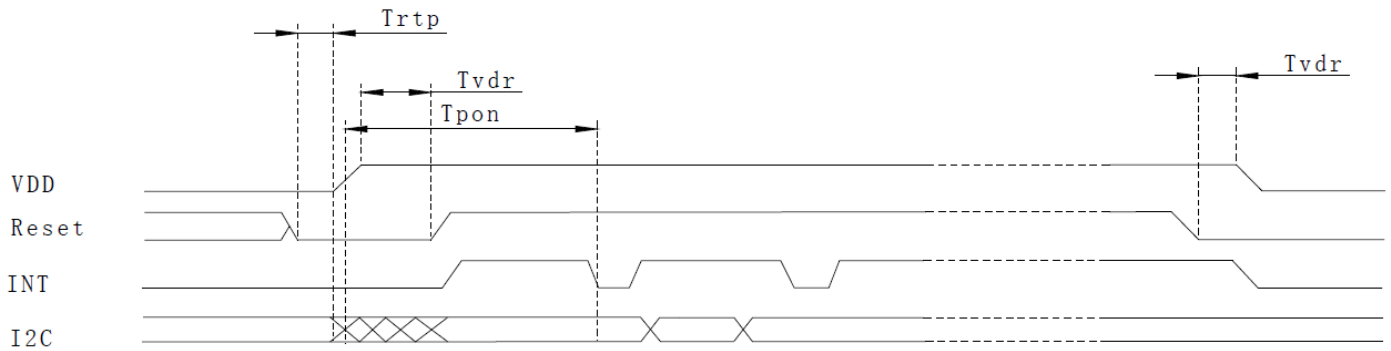
## Timing Characteristics: Capacitive Touch Panel

### Data Transfer Format

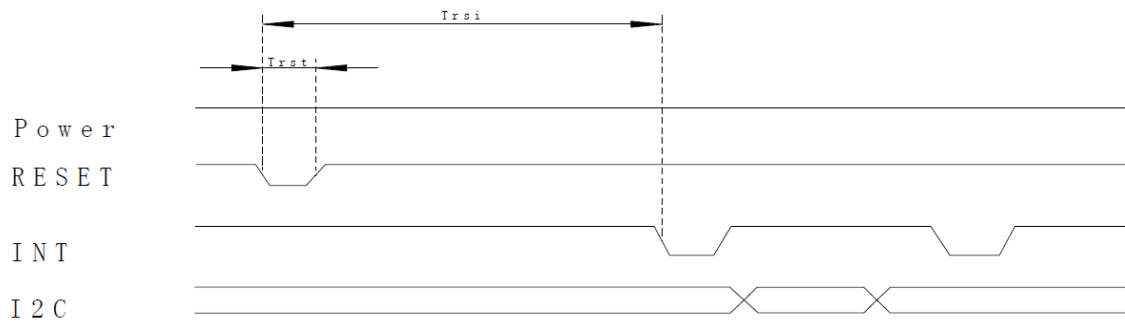


| Parameter                                        | Min | Max | Unit |
|--------------------------------------------------|-----|-----|------|
| SCL Frequency                                    | 0   | 400 | KHz  |
| Bus free time between a STOP and START Condition | 1.3 | -   | μs   |
| Hold Time (repeated)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

## Power ON Sequence



## Reset Sequence



| Parameter | Description                                             | Min | Max | Unit    |
|-----------|---------------------------------------------------------|-----|-----|---------|
| $T_{ris}$ | Rise time from $0.1 \cdot V_{DD}$ to $0.9 \cdot V_{DD}$ | -   | 5   | ms      |
| $T_{pdt}$ | Time for voltage supply below $0.3 \cdot V_{DD}$        | 5   | -   | ms      |
| $T_{rtp}$ | Time to hold reset low Before Applying Power            | 100 | -   | $\mu s$ |
| $T_{pon}$ | Time of starting to report point after powering on      | -   | 200 | ms      |
| $T_{vdr}$ | Reset time after $V_{DD}$ power on                      | 1   | -   | ms      |
| $T_{rsi}$ | Time of starting to report point after Reset            | -   | 200 | ms      |
| $T_{rst}$ | Reset Time                                              | 1   | -   | ms      |

### 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, 240 hrs.                                                    | 2    |
| Low Temperature storage             | Endurance test applying the low storage temperature for a long time.                                                            | -30°C, 240 hrs.                                                    | 1,2  |
| High Temperature Operation          | Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.                    | +70°C, 120 hrs.                                                    | 2    |
| Low Temperature Operation           | Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.                     | -20°C, 120 hrs.                                                    | 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, 120 hrs.                                            | 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, 10min -> 80°C, 30min<br>10 cycles              |      |
| Vibration test                      | Endurance test applying vibration to simulate transportation and use.                                                           | Frequency: 250r/min<br>Amplitude: 1 inch<br>Time: 45 min           | 3    |
| Static electricity test             | Endurance test applying electric static discharge.                                                                              | Air: V <sub>s</sub> =8KV, Contact: V <sub>s</sub> =4KV<br>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.