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# NHD-5.0-800480TF-ATXL#-CTP

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

NHD-	Newhaven Display
5.0-	5.0" Diagonal
800480-	800xRGBx480 Pixels
TF-	Model
A-	Built-in Driver / No Controller
T-	White LED Backlight
X-	TFT
L-	MVA, Enhanced Optical Characteristics, Wide Temperature
#	<b>RoHS Compliant</b>
CTP	Capacitive Touch Panel with Controller

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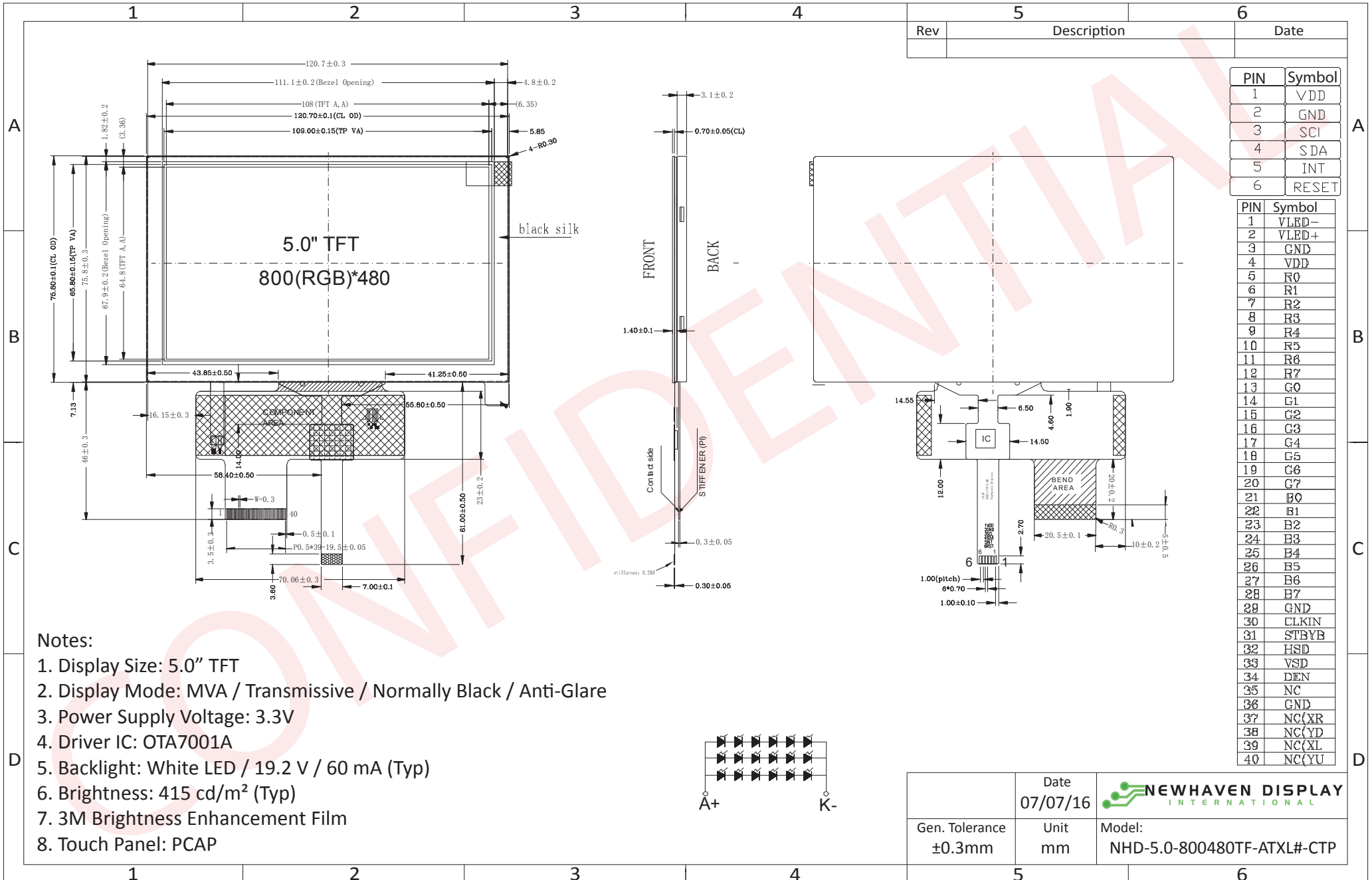
## Document Revision History

Revision	Date	Description	Changed by
0	3/20/13	Initial Release	AK
1	8/28/13	Electrical Characteristics updated	AK
2	9/16/14	Electrical Characteristics updated	ML
3	4/1/15	CTP mechanical dimensions updated	AK
4	9/2/15	Driver, Electrical, Optical characteristics updated	AK
5	10/27/15	Backlight lifetime rating added	AK
6	10/30/15	Datasheet Reformat	SB
7	1/18/16	CTP Controller Updated, Updated Brightness Rating	SB
6	2/23/16	Corrected Notes on Drawing, Updated CTP Supply Voltage	SB
7	4/5/16	Updated Brightness Rating	SB
8	7/7/16	Mechanical Drawing Updated	SB
9	7/22/16	Electrical Characteristics	TM
10	4/14/17	Supply Current Updated	SB

## Functions and Features

- 800xRGBx480 resolution, up to 16.7M colors
- 18-LED backlight
- 24 bit RGB interface
- Enhanced Optical Characteristics
- Wide Viewing Angles
- Capacitive touch panel with controller
  - 5 point multi-touch input
  - Gesture input
    - Zoom In/Out
    - Swipe Up/Down/Left/Right

# Mechanical Drawing



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## Pin Description

### TFT:

Pin No.	Symbol	External Connection	Function Description
1	LED-	LED Power Supply	Ground for Backlight
2	LED+	LED Power Supply	Backlight Power Supply (60mA @ ~19.2V)
3	GND	Power Supply	Ground
4	V <sub>DD</sub>	Power Supply	Power supply for LCD and logic (3.3V)
5-12	[R0-R7]	MPU	Red Data Signals
13-20	[G0-G7]	MPU	Green Data Signals
21-28	[B0-B7]	MPU	Blue Data Signals
29	GND	Power Supply	Ground
30	CLKIN	MPU	Clock for input data (Rising Edge)
31	STBYB	MPU	1: Normal Operation; 0: Standby Mode
32	HSD	MPU	Line synchronization signal
33	VSD	MPU	Frame synchronization signal
34	DEN	MPU	Data Enable signal
35	NC	-	No Connect
36	GND	Power Supply	Ground
37	XR	-	No Connect
38	YD	-	No Connect
39	XL	-	No Connect
40	YU	-	No Connect

**Recommended LCD connector:** 0.5mm pitch 40-Conductor FFC. Molex p/n: 54104-4031 (top contact)

**Backlight connector:** on LCD connector

**Mates with:** ---

### Capacitive Touch Panel:

Pin No.	Symbol	External Connection	Function Description
1	V <sub>CC</sub>	Power Supply	Power supply for logic (3.0V)
2	GND	Power Supply	Ground
3	SCL	MPU	Serial I2C Clock (Requires pull-up resistor)
4	SDA	MPU	Serial I2C Data (Requires pull-up resistor)
5	/INT	MPU	Interrupt signal from touch panel module to host
6	/RESET	MPU	Active LOW Reset signal

**Recommended connector:** 1.0mm pitch 6-Conductor FFC. Molex p/n: 52271-0679

## Driver/Controller Information

### TFT:

Built-in OTA7001A Source Driver: [http://www.newhavendisplay.com/app\\_notes/OTA7001A\\_V04.pdf](http://www.newhavendisplay.com/app_notes/OTA7001A_V04.pdf)

Built in OTD9960A Gate Driver: [http://www.newhavendisplay.com/app\\_notes/OTD9960A\\_V03.pdf](http://www.newhavendisplay.com/app_notes/OTD9960A_V03.pdf)

### Capacitive Touch Panel:

Built-in FocalTech FT5306 controller.

Please download specification at [http://www.newhavendisplay.com/app\\_notes/FT5x06.pdf](http://www.newhavendisplay.com/app_notes/FT5x06.pdf)

## Electrical Characteristics

**TFT:**

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T <sub>OP</sub>	Absolute Max	-20	-	+70	°C
Storage Temperature Range	T <sub>ST</sub>	Absolute Max	-30	-	+80	°C
Supply Voltage	V <sub>DD</sub>	-	3.0	3.3	3.6	V
Supply Current	I <sub>DD</sub>	V <sub>DD</sub> = 3.3V	50	100	170	mA
“H” Level input	V <sub>IH</sub>	-	0.7 * V <sub>DD</sub>	-	V <sub>DD</sub>	V
“L” Level input	V <sub>IL</sub>	-	GND	-	0.3 * V <sub>DD</sub>	V
“H” Level output	V <sub>OH</sub>	-	V <sub>DD</sub> - 0.4	-	V <sub>DD</sub>	V
“L” Level output	V <sub>OL</sub>	-	-	-	GND + 0.4	V
Backlight Supply Voltage	V <sub>LED</sub>	-	17.4	19.2	19.8	V
Backlight Supply Current	I <sub>LED</sub>	-	-	60	75	mA
Backlight Lifetime*	-	I <sub>LED</sub> = 60mA T <sub>OP</sub> = 25°C	20,000	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>	-	2.8	3.3	3.6	V
Supply Current – Operating	I <sub>DD</sub>	V <sub>DD</sub> = 3.3V	-	6.0	-	mA
Supply Current – Hibernate	I <sub>DD</sub>	T <sub>OP</sub> = 25°C	-	1.0	-	uA
“H” Level input	V <sub>IH</sub>	-	0.7 * V <sub>DD</sub>	-	V <sub>DD</sub>	V
“L” Level input	V <sub>IL</sub>	-	V <sub>SS</sub>	-	0.3 * V <sub>DD</sub>	V
“H” Level output	V <sub>OH</sub>	-	0.7 * V <sub>DD</sub>	-	V <sub>DD</sub>	V
“L” Level output	V <sub>OL</sub>	-	V <sub>SS</sub>	-	0.3*V <sub>DD</sub>	V

**Optical Characteristics:**

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top	CR ≥ 10	-	75	-	°
	Bottom		-	75	-	°
	Left		-	75	-	°
	Right		-	75	-	°
Contrast Ratio	CR	-	-	350	-	-
Luminance	L <sub>V</sub>	I <sub>LED</sub> = 60 mA	330	415	-	cd/m <sup>2</sup>
Response Time	T <sub>R</sub> + T <sub>F</sub>	T <sub>OP</sub> = 25°C	-	20	30	ms

**Capacitive Touch Panel Material Characteristics:**

Property	Requirement	Unit
IC	FT5306DE4	-
ITO Glass thickness	0.55	mm
Surface Hardness	≥6	H
Light transmission	83% ± 5%	-
Operating Humidity	20~90	RH
Storage Humidity	20~90	RH

# Capacitive Touch Panel Registers

Address	Name	B7	B6	B5	B4	B3	B2	B1	B0	Access	
00h	DEVICE_MODE	Device Mode [2..0]									R/W
01h	GEST_ID	Gesture ID [7..0]									R
02h	TD_STATUS						Touch Points [3..0]				R
03h	TOUCH1_XH	Event Flag			1st Touch X Position MSB [11..8]					R	
04h	TOUCH1_XL	1st Touch X Position LSB [7..0]									R
05h	TOUCH1_YH	Touch ID [3..0]			1st Touch Y Position MSB [11..8]					R	
06h	TOUCH1_YL	1st Touch Y Position LSB [7..0]									R
07h										R	
08h										R	
09h	TOUCH2_XH	Event Flag			2nd Touch X Position MSB [11..8]					R	
0Ah	TOUCH2_XL	2nd Touch X Position LSB [7..0]									R
0Bh	TOUCH2_YH	Touch ID [3..0]			2nd Touch Y Position MSB [11..8]					R	
0Ch	TOUCH2_YL	2nd Touch Y Position LSB [7..0]									R
0Dh										R	
0Eh										R	
0Fh	TOUCH3_XH	Event Flag			3rd Touch X Position MSB [11..8]					R	
10h	TOUCH3_XL	3rd Touch X Position LSB [7..0]									R
11h	TOUCH3_YH	Touch ID [3..0]			3rd Touch Y Position MSB [11..8]					R	
12h	TOUCH3_YL	3rd Touch Y Position LSB [7..0]									R
13h										R	
14h										R	
15h	TOUCH4_XH	Event Flag			4th Touch X Position MSB [11..8]					R	
16h	TOUCH4_XL	4th Touch X Position LSB [7..0]									R
17h	TOUCH4_YH	Touch ID [3..0]			4th Touch Y Position MSB [11..8]					R	
18h	TOUCH4_YL	4th Touch Y Position LSB [7..0]									R
19h										R	
1Ah										R	
1Bh	TOUCH5_XH	Event Flag			5th Touch X Position MSB [11..8]					R	
1Ch	TOUCH5_XL	5th Touch X Position LSB [7..0]									R
1Dh	TOUCH5_YH	Touch ID [3..0]			5th Touch Y Position MSB [11..8]					R	
1Eh	TOUCH5_YL	5th Touch Y Position LSB [7..0]									R
1Fh										R	

Address	Name	B7	B6	B5	B4	B3	B2	B1	B0	Access	
80h	ID_G_THGROUP	valid touching detect threshold								R/W	
81h	ID_G_THPEAK	valid touching peak detect threshold								R/W	
82h	ID_G_THCAL	the threshold when calculating the focus of touching								R/W	
83h	ID_G_THWATER	the threshold when there is surface water								R/W	
84h	ID_G_TEMP	the threshold of temperature compensation								R/W	
85h	ID_G_THDIFF	the threshold whether the coordinate is different from original								R/W	
86h	ID_G_CTRL						Power Control Mode [1..0]				R/W
87h	ID_G_TIME_ENTER_MONITOR	the timer for entering monitor status								R/W	
88h	ID_G_PERIODACTIVE						Period Active [3..0]				R/W
89h	ID_G_PERIODMONITOR	the timer of entering idle when in monitor status								R/W	
A0h	ID_G_AUTO_CLB_MODE	auto calibration mode								R/W	
A1h	ID_G_LIB_VERSION_H	Firmware Library Version H byte								R	
A2h	ID_G_LIB_VERSION_L	Firmware Library Version L byte								R	
A3h	ID_G_CIPHER	Chip vendor ID								R	
A4h	ID_G_MODE	the interrupt status to host								R	
A5h	ID_G_PMODE	Power Consume Mode									
A6h	ID_G_FIRMID	Firmware ID								R	
A7h	ID_G_STATE	Running State									
A8h	ID_G_FT5201ID	CTPM Vendor ID								R	
A9h	ID_G_ERR	Error Code								R	
AAh	ID_G_CLB	Configure TP module during calibration in Test Mode								R/W	
FEh	LOG_MSG_CNT	The log MSG count								R	
FFh	LOG_CUR_CHA	Current character of log message								R	

NOTE: Registers 80h – AFh have been configured for optimum settings and do not need to be modified.



Register No	Register Name	Bits	Value	Description
00h	Device Mode	[2:0]	000b 100b 001b	Normal Operating Mode Test Mode - read raw data (reserved) System Information Mode (reserved)
01h	Gesture ID	[7:0]	48h 49h 00h	Zoom In Zoom Out No Gesture
02h	Touch Points	[3:0]	000b 001b 010b 011b 100b 101b	0 touch points detected 1 touch point detected 2 touch points detected 3 touch points detected 4 touch points detected 5 touch points detected
03h	Touch 1 Event Flag	[7:6]	00b 01b 10b 11b	Put Down Put Up Contact 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 01b 10b 11b	Put Down Put Up Contact 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 01b 10b 11b	Put Down Put Up Contact 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 01b 10b 11b	Put Down Put Up Contact 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
1Bh	Touch 5 Event Flag	[7:6]	00b 01b 10b 11b	Put Down Put Up Contact Reserved
1Bh	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 Actual value will be 4 times register's value Recommended: 46h
81h	ID_G_THPEAK	[7:0]	00h - FFh	valid touching peak detect threshold Recommended: 3Ch
82h	ID_G_THCAL	[7:0]	00h - FFh	Touch focus threshold Recommended: 1Dh
83h	ID_G_THWATER	[7:0]	00h - FFh	threshold when there is surface water Recommended: D3h
84h	ID_G_THTEMP	[7:0]	00h - FFh	threshold of temperature compensation Recommended: EBh
85h	ID_G_THDIFF	[7:0]	00h - FFh	Touch difference threshold Actual value is 32 times the register's value Recommended: A0h
86h	ID_G_CTRL	[1:0]	00h 01h	Power Control Mode: Not Auto Jump Power Control Mode: Auto Jump
87h	ID_G_TIME_ENTER_MONITOR	[7:0]	00h-FFh	Delay to enter 'Monitor' status (s) Recommended: C8h
88h	ID_G_PERIODACTIVE	[3:0]	3h-Eh	Period of 'Active' status (ms) Recommended: 6h
89h	ID_G_PERIODMONITOR	[7:0]	1Eh-FFh	Timer to enter 'idle' when in 'Monitor' (ms) Recommended: 28h
A0h	ID_G_AUTO_CLB_MODE	[7:0]	00h FFh	Auto calibration mode: Enable auto calibration 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]	06h	Chip vendor ID
A4h	ID_G_MODE	[0:0]	00h 01h	Interrupt status: Enable interrupt to host Interrupt status: Disable interrupt to host
A5h	ID_G_PMODE	[1:0]	00h 01h 03h	'Active' Mode 'Monitor' Mode 'Hibernate' Mode
A6h	ID_G_FIRMID	[7:0]	30h	Firmware ID
A7h	ID_G_STATE	[7:0]	00h 01h 02h 03h 04h	Running State: Configure Running State: Work Running State: Calibration Running State: Factory Running State: Auto-calibration
A8h	ID_G_FT5201ID	[7:0]	98h	CTPM Vendor's Chip ID
A9h	ID_G_ERR	[7:0]	00h 03h 05h 1Ah	Error Code: OK Error Code: Chip register writing inconsistent with reading Error Code: Chip start fail Error Code: Calibration match fail

## Timing Characteristics – TFT display

### Horizontal input timing

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Horizontal display area	thd	800			DCLK
DCLK frequency	fclk	-	30	50	MHz
1 Horizontal Line	th	928			DCLK
HSD pulse width	thpw	Min.	1		
		Typ.	48		
		Max.	-		
HSD Back Porch (Blanking)	thb	-	88	-	
HSD Front Porch	thfp	-	40	-	

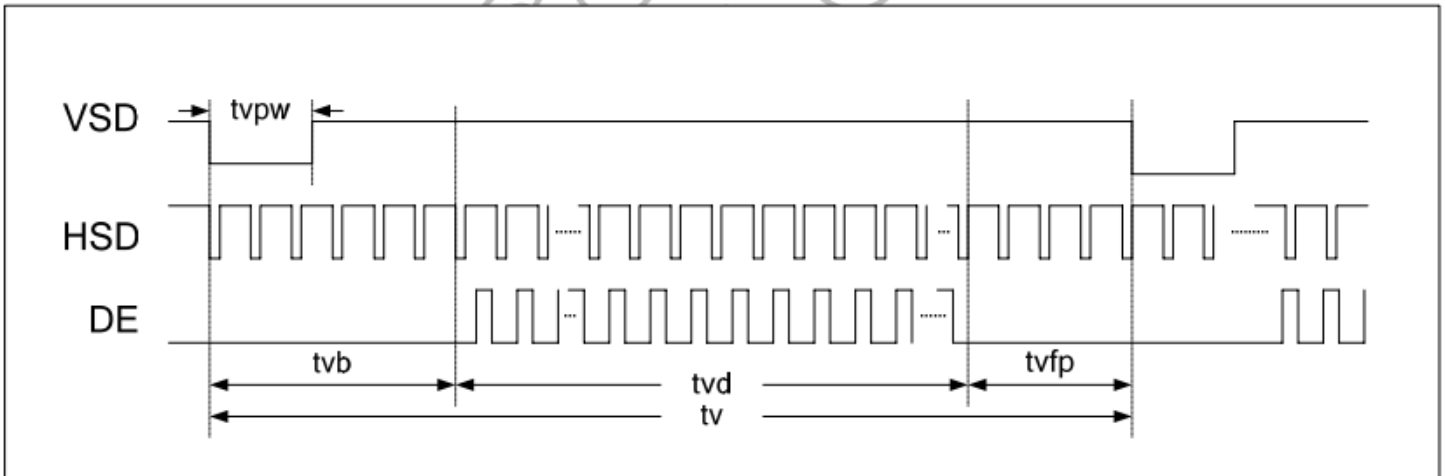
### Vertical input timing

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Vertical display area	tvd	480			H
VSD period time	tv	-	525	-	H
VSD pulse width	tvpw	-	3	-	H
VSD Back Porch (Blanking)	tvb	-	32	-	H
VSD Front Porch	tvfp	-	13	-	H

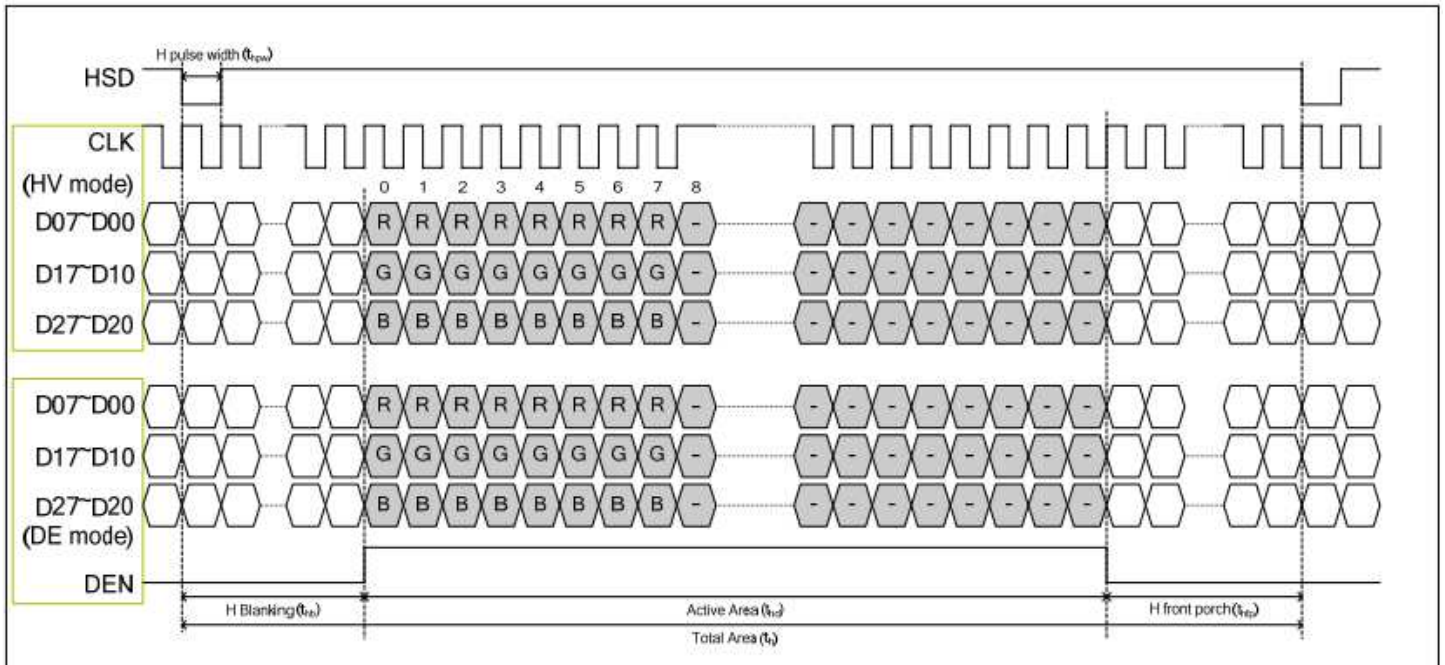
Parameter	Symbol	MIN.	Typ.	MAX.	UNIT	Conditions
VDD Power On Slew rate	T	-	-	20	ms	From 0V to 90% VDD
RSTB pulse width	T	10	-	-	us	CLKIN = 45MHz
CLKIN cycle time	Tcph	20	-	-	ns	
CLKIN pulse duty	Tcwh	40	50	60	%	
VSD setup time	Tvst	8	-	-	ns	
VSD hold time	Tvhd	8	-	-	ns	
HSD setup time	Thst	8	-	-	ns	
HSD hold time	Thhd	8	-	-	ns	
Data set-up time	Tdsu	8	-	-	ns	D0[7:0], D1[7:0], D2[7:0] to CLKIN
Data hold time	Tdhd	8	-	-	ns	D0[7:0], D1[7:0], D2[7:0] to CLKIN
DE set-up time	Tesu	8	-	-	ns	
DE hold time	Tehd	8	-	-	ns	
Output stable time	Tsst	-	-	6	us	10% to 90% target voltage. CL=120pF, R=10K ohm

Parameter	Symbol	MIN.	Typ.	MAX.	UNIT	Conditions
CLKIN Frequency	Fclk	-	33	50	MHz	VDDD = 2.3V ~ 3.6V
CLKIN Cycle Time	Tclk	20	30	-	ns	
CLKIN Pulse Duty	Tcwh	40	50	60	%	Tclk
Time from HSD to Source Output	Thso	-	Tld		CLKIN	
Time from HSD to LD	Thld	-	Tld		CLKIN	
Time from HSD to STV	Thstv	-	2		CLKIN	
Time from HSD to CKV	Thckv	-	20		CLKIN	
Time from HSD to OEV	Thoev	-	4		CLKIN	
LD Pulse	Twd	-	10		CLKIN	
CKV Pulse Width	Twckv	-	66		CLKIN	
OEV Pulse Width	Twoev	-	Tld+10		CLKIN	

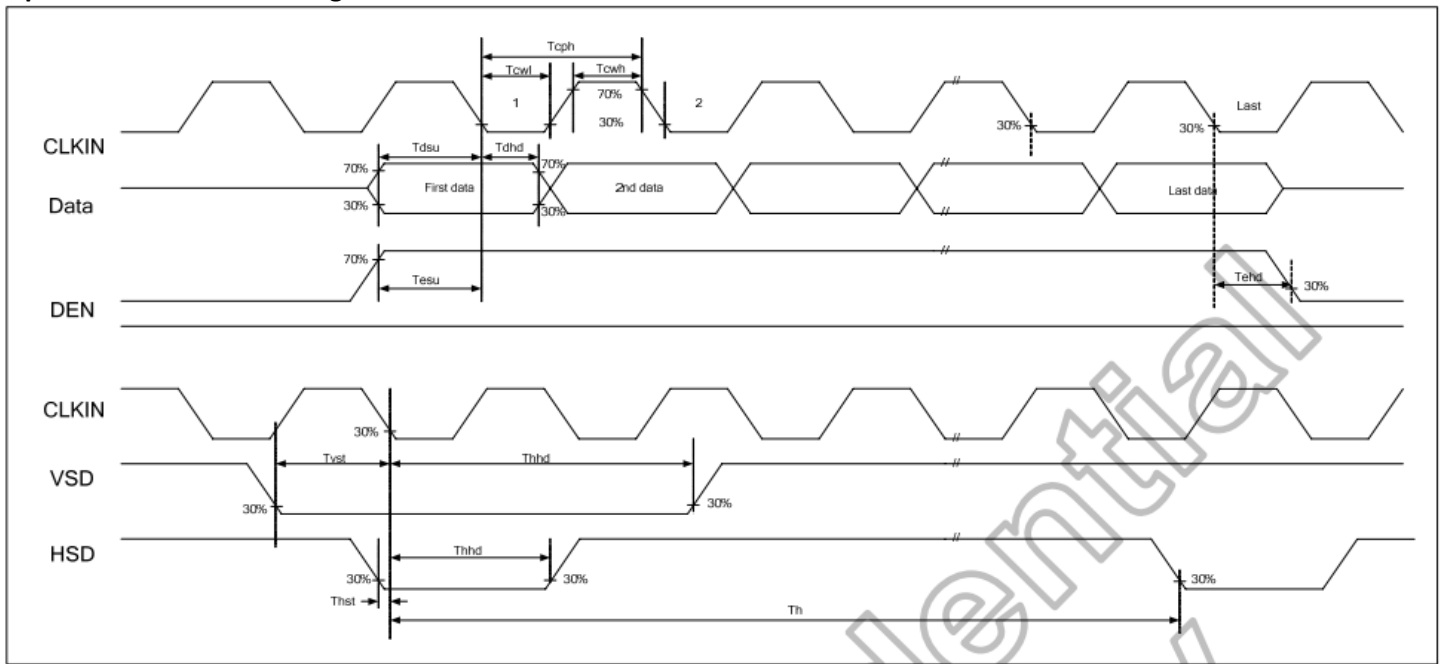
### Vertical Input Timing



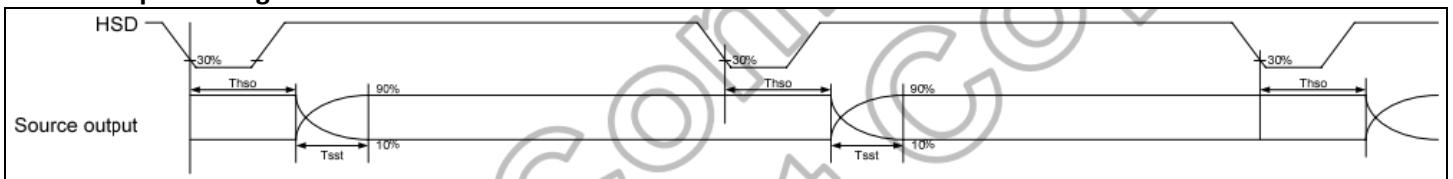
### Horizontal Input Timing



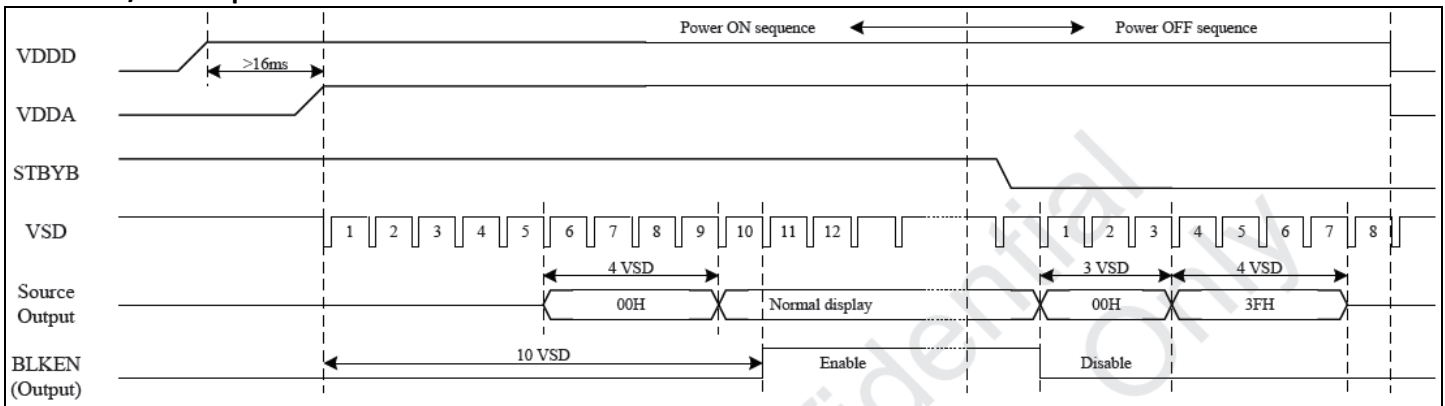
## Input Clock and Data Timing



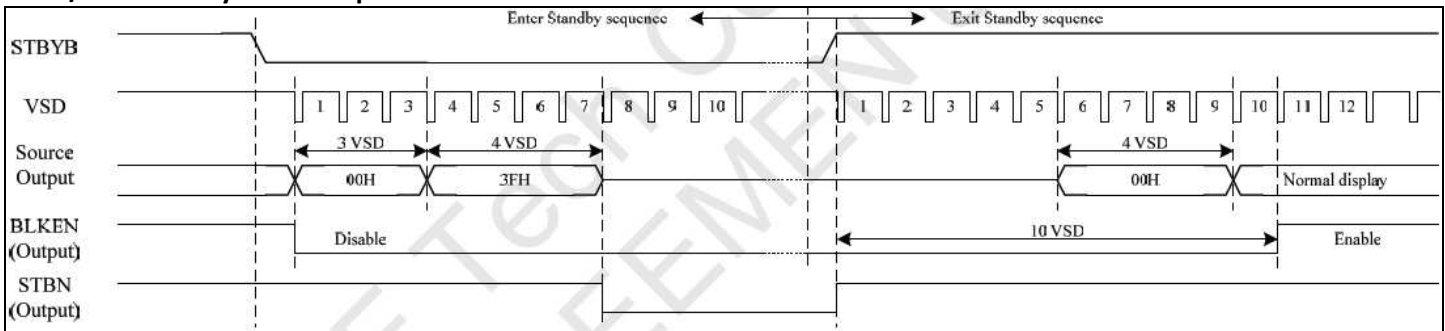
## Source Output Timing



## Power ON/OFF Sequence

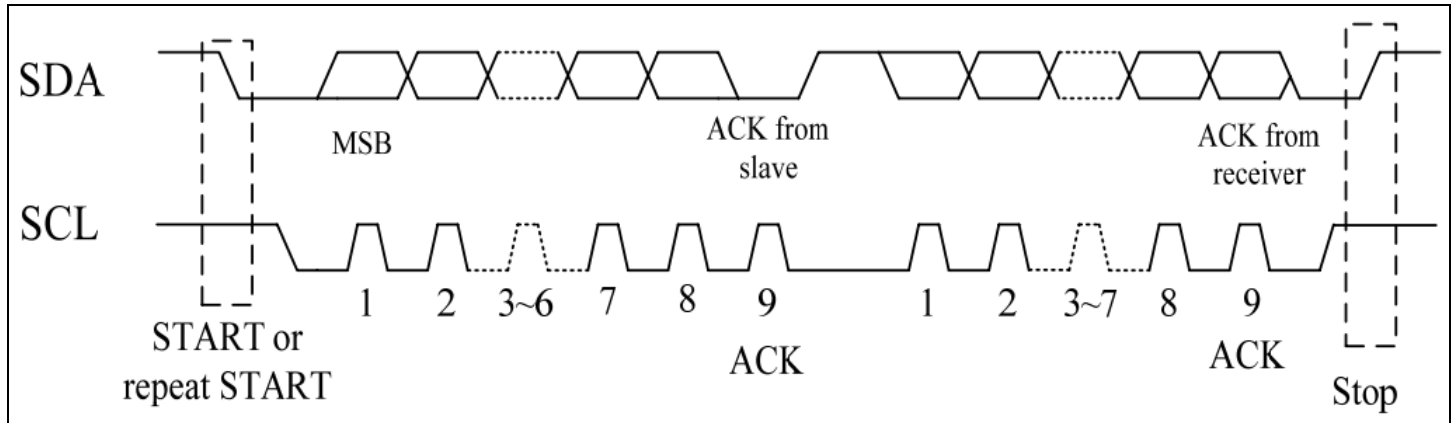


## Enter/Exit Standby Mode Sequence

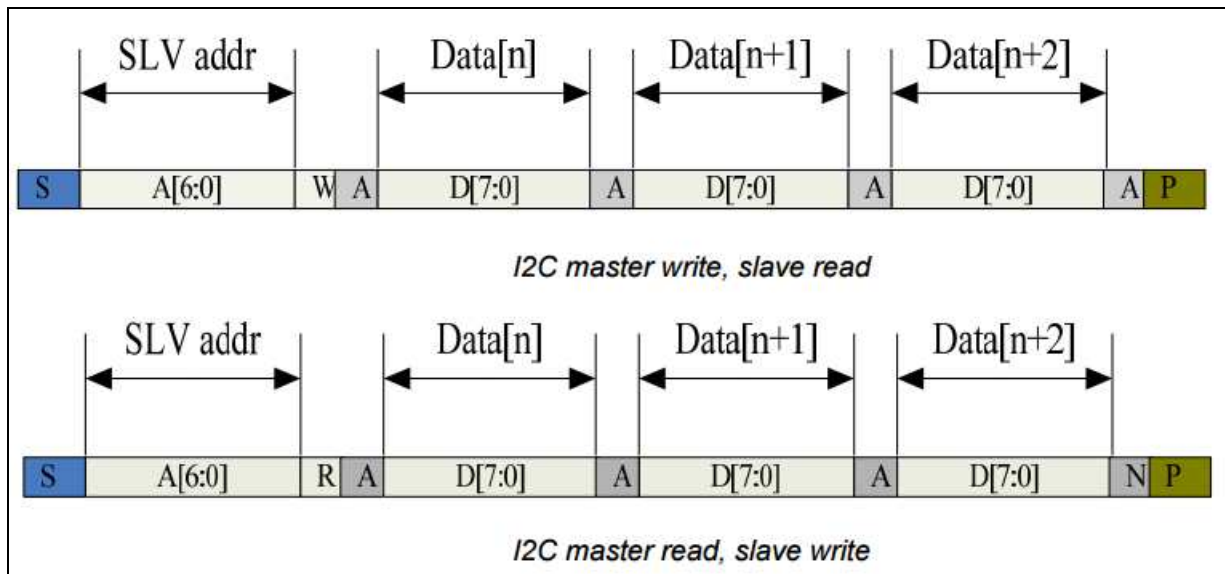


# Timing Characteristics – Capacitive Touch Panel

## Data Transfer Format

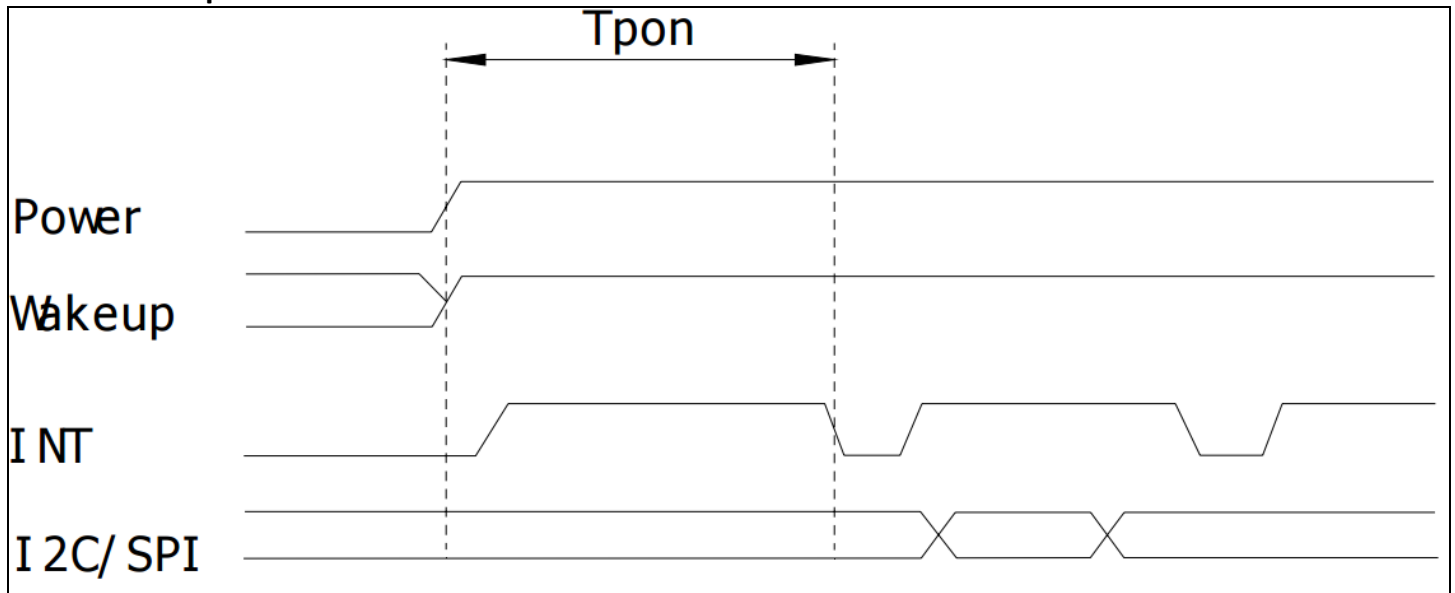


Parameter	Unit	Min	Max
SCL frequency	KHz	0	400
Bus free time between a STOP and START condition	us	4.7	\
Hold time (repeated) START condition	us	4.0	\
Data setup time	ns	250	\
Setup time for a repeated START condition	us	4.7	\
Setup Time for STOP condition	us	4.0	\

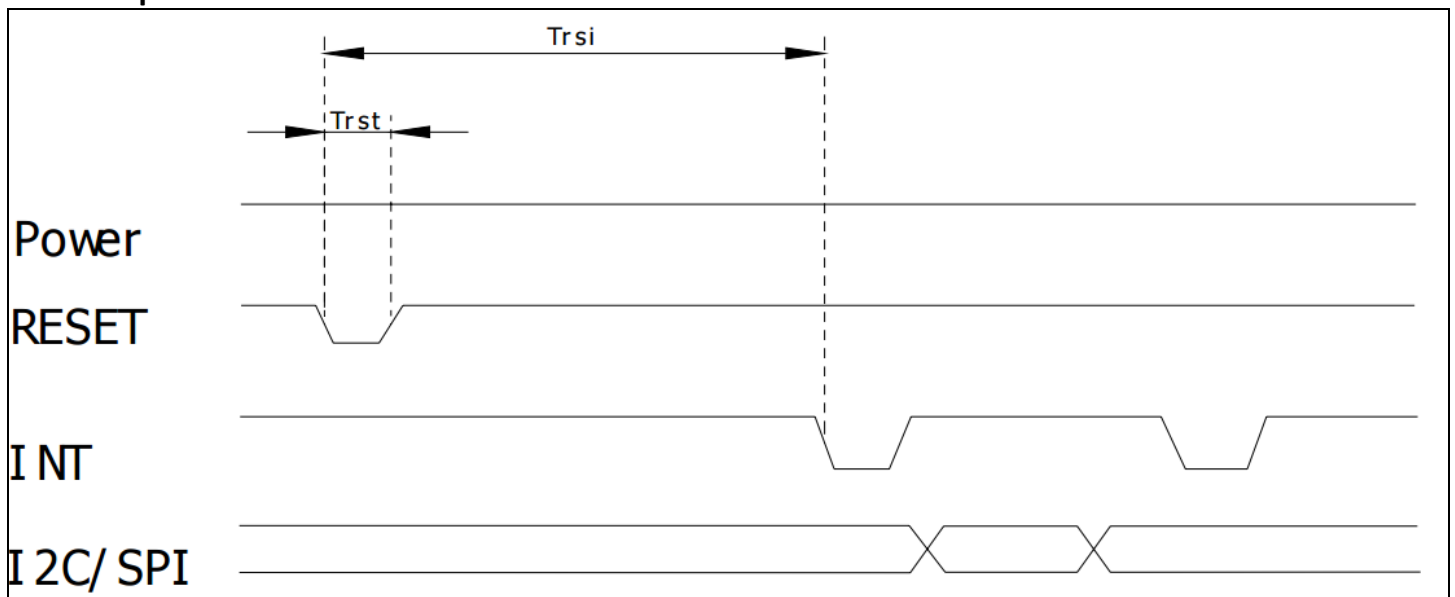




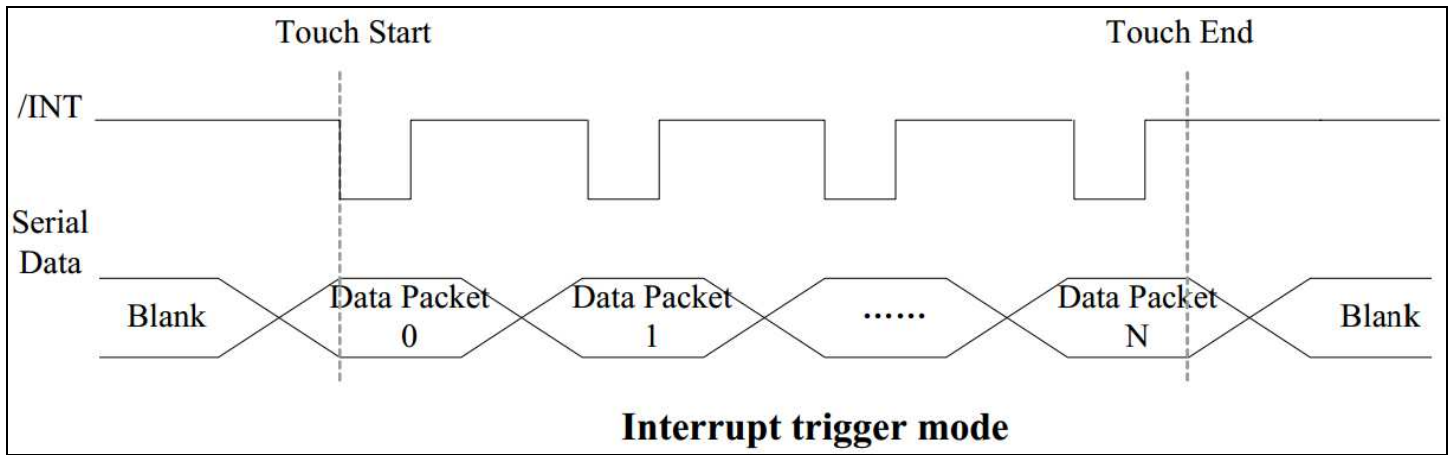
### Power ON Sequence



### Reset Sequence



Parameter	Description	Min	Max	Units
Tris	Rise time from 0.1VDD to 0.9VDD	--	10	ms
Tpon	Time of starting to report point after powering on	300	--	ms
Trsi	Time of starting to report point after resetting	300	--	ms
Trst	Reset time	5	--	ms
Twai	Time of starting to report point after waking	300	--	ms
Twak	Wake up time	5	--	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 , 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 Operation	Endurance test applying the electric stress (voltage & current) and the high thermal with high humidity stress for a long time.	+50°C , 90% RH , 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 = 1 cycle For 20 cycles	
Vibration test	Endurance test applying vibration to simulate transportation and use.	10-50Hz, 5G in each of 3 directions X,Y,Z For 30 minutes each direction	3
Static electricity test	Endurance test applying electric static discharge.	Air: 8kV, 150pF, 330Ω, 5 times Contact: 4kV, 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.

## Precautions for using LCDs/LCMs

See Precautions at [www.newhavendisplay.com/specs/precautions.pdf](http://www.newhavendisplay.com/specs/precautions.pdf)

## Warranty Information and Terms & Conditions

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