NEWHAVEN DISPLAY INTERNATIONAL

Product Specification

NHD-2.4C-CSXP-BREAKOUT

TFT Liquid Crystal Display Module

NHD-	Newhaven Display
2.4-	2.4" Diagonal
C-	Capacitive Touch Panel
C-	Built-in Controller
S-	High Brightness, White LED Backlight
X-	TFT
P-	IPS, Wide Temperature
BREAKOUT-	Breakout Board

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REACH Compliant

RoHS Compliant

NEWHAVEN DISPLAY INTERNATIONAL

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Additional Resources

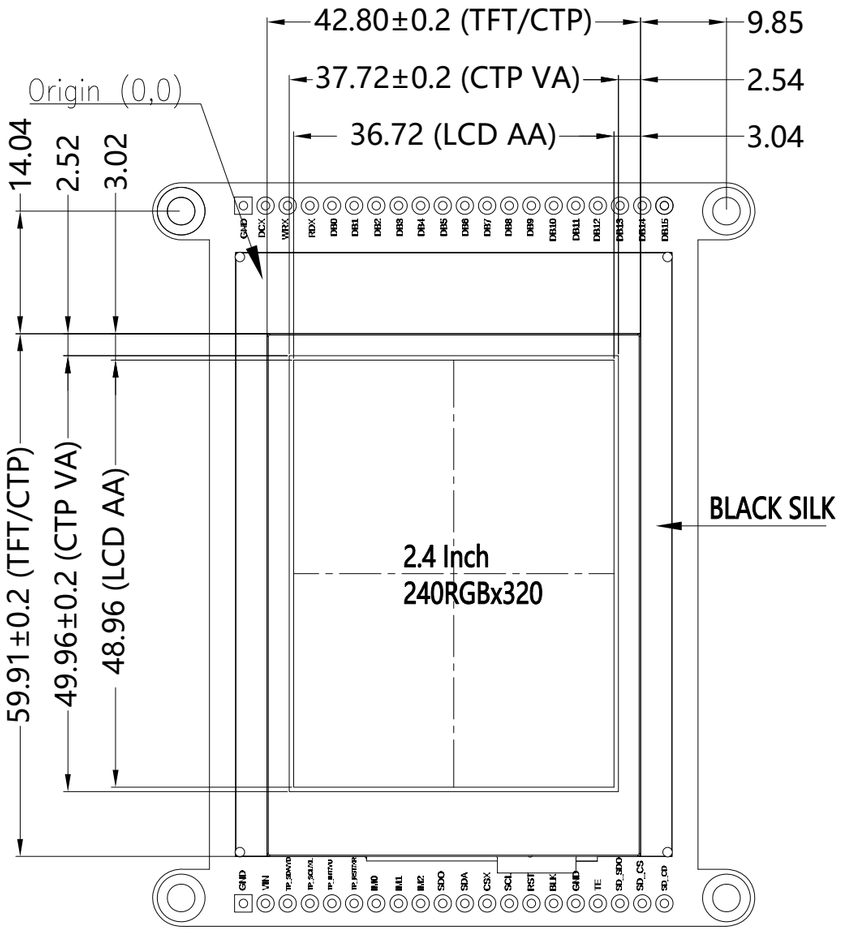
- **Support Forum:** https://support.newhavendisplay.com/hc/en-us/community/topics
- **GitHub:** https://github.com/newhavendisplay
- **Example Code:** https://support.newhavendisplay.com/hc/en-us/categories/4409527834135-Example-Code/
- **Knowledge Center:** https://www.newhavendisplay.com/knowledge_center.html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

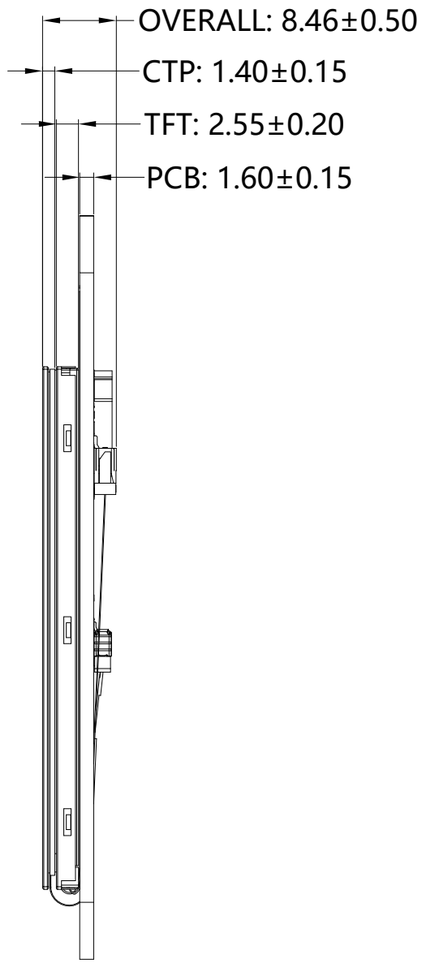
Document Revision History

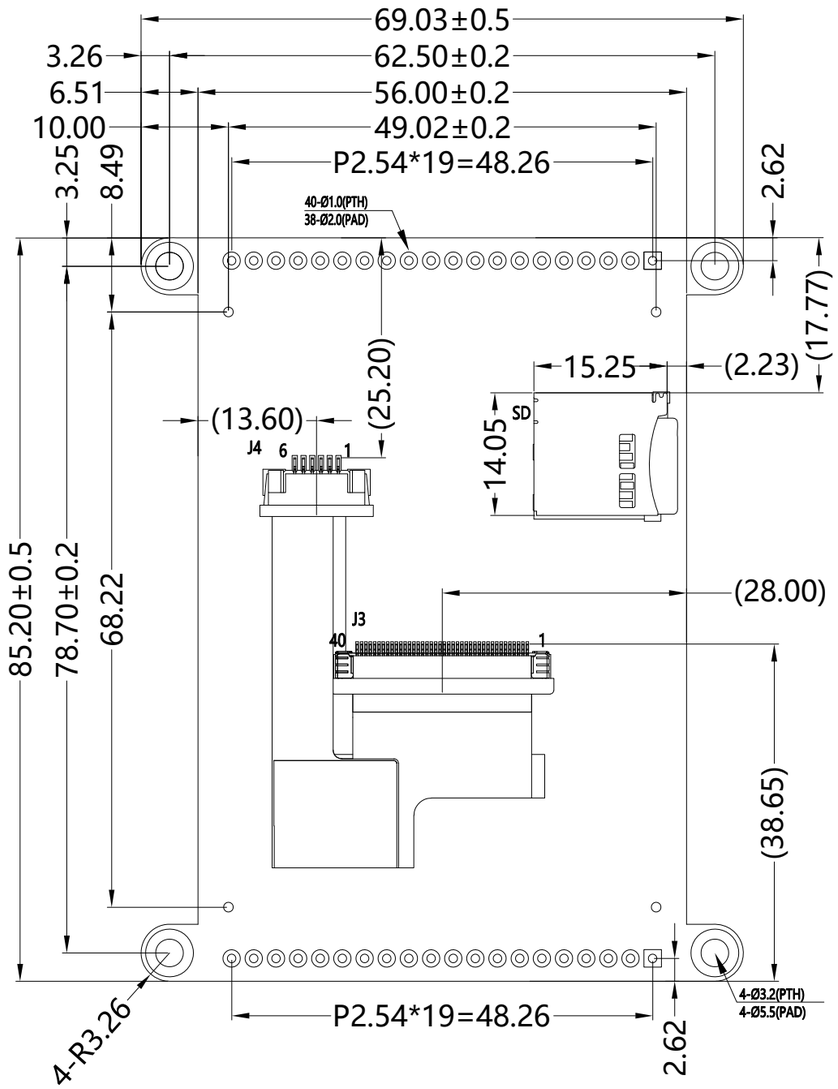
Revision	Date	Description	Changed By
-	12/01/2025	Initial Release	KL

Mechanical Drawing

Newhaven Display
NHD-2.4C-CSXP-BREAKOUT
Date Code
Part Label (type/format may vary)







Product Description: 2.4” 240x320 Capacitive Touch IPS TFT w/ Breakout PCB

1. Driver IC: ST7789VI
2. Interface: Parallel, SPI
3. Power Requirement: 3.3V
4. Optical Features: Normally Black, Transmissive, 1020cd/m²
5. Key Features: EMI Shielding, Backlight Driver, microSD Card Reader, Mounting Holes

Standard Tolerance: (Unless otherwise specified) Linear: ±0.3mm	NEWHAVEN DISPLAY INTERNATIONAL	
	Drawing/Part Number: NHD-2.4C-CSXP-BREAKOUT	Revision: -
Unless otherwise specified: • Dimensions are in Millimeters • Third Angle Projection	Drawn By: K. Lewis	Approved By: K. Lewis
	Drawn Date: 12/01/2025	Approved Date: 12/01/2025

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Pin Description

J1:

Pin No.	Symbol	External Connection	Function Description
1	GND	Power Supply	Ground
2	DCX	MPU	Data / Command selection: '1' = Data ; '0' = Command
3	WRX	MPU	Active LOW Write signal
4	RDX	MPU	Active LOW Read signal
5-20	DB0-DB15	MPU	Bi-directional data bus 8-bit: use DB8-DB15 16-bit: use DB0-DB15

Recommended Connector: 20pin, 1x20, 2.54mm pitch.

J2:

Pin No.	Symbol	External Connection	Function Description
1	GND	Power Supply	Ground
2	VIN	Power Supply	Supply Voltage (3.3V)
3	TP_SDA/YD	MPU	**Capacitive Touch Panel:**
4	TP_SCL/XL		
5	TP_INT/YU		
6	TP_RST/XR		
7	IM0	MPU	No Connect
8	IM1	MPU	No Connect
9	IM2	MPU	No Connect
10	SDO	MPU	Serial Data Output
11	SDA	MPU	Serial Data Input
12	CSX	MPU	Active LOW Chip Select signal
13	SCL	MPU	Serial Clock
14	RST	MPU	Active LOW Reset signal
15	BLK	MPU	No Connect
16	GND	Power Supply	Ground
17	TE	MPU	Tearing Effect Output
18	SD_SDO	MPU	SD card Serial Data Output
19	SD_CS	MPU	SD card Chip select Signal
20	SD_CD	MPU	SD Card Detect Pin

TP_SDA	Serial I2C Data
TP_SCL	Serial I2C Clock
TP_INT	Interrupt signal from touch panel module to host
TP_RST	Active LOW Reset signal

Recommended Connector: 20pin, 1x20, 2.54mm pitch.

Interface Selection

Interface	IM0		IM1		IM2	
	R1	R2	R3	R4	R5	R6
8-bit 8080-II Parallel (default)	Close	Open	Open	Close	Open	Close
16-bit 8080-II Parallel	Open	Close	Open	Close	Open	Close
3-wire SPI	Close	Open	Close	Open	Open	Close

Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T_{OP}	Absolute Max	-20	-	+70	°C
Storage Temperature Range	T_{ST}	Absolute Max	-30	-	+80	°C
Supply Voltage for LCD	V_{DD}	-	3.0	3.3	3.6	V
Supply Current	I_{DD}	V_{DD} = 3.3V	-	200	280	mA

Optical Characteristics

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top	φY+	CR ≥ 10	-	80	-	°
	Bottom	φY-		-	80	-	°
	Left	θX-		-	80	-	°
	Right	θX+		-	80	-	°
Contrast Ratio		CR	-	800	1100	-	-
Luminance		L_V	-	850	1020	-	cd/m²
Response Time		$T_R + T_F$	T_{OP} = 25°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	-

Controller Information

Built-in ST7789VI Controller: 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

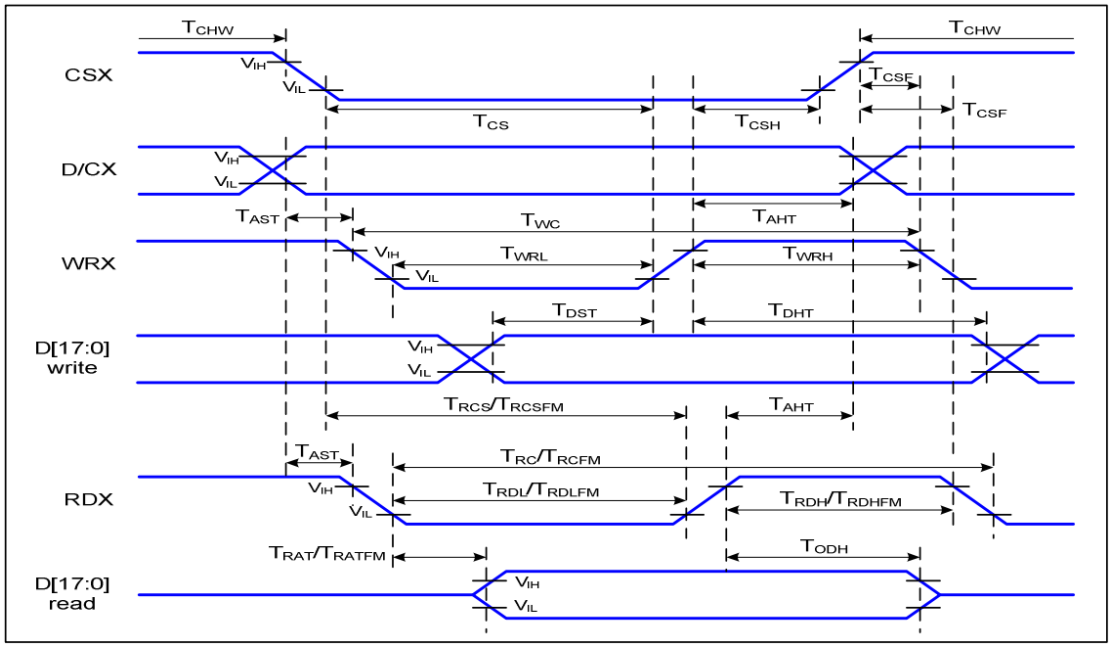
Register No.	Access	Register Name	Bits	Value	Description
01h	RO	Gesture ID	[7:0]	1Ch 14h 10h 18h 48h 49h 00	Swipe Up Swipe Down Swipe Left Swipe Right Zoom In Zoom Out No gesture
02h	RO	Touch Points	[7:0]	0-Ah	0: No touch detected A: 5 touch points detected
03h	RO	TOUCH1_Event_Flag	[7:6]	0 1 2 3	Put Down Put Up Contact 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 1 2 3	Put Down Put Up Contact 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 1 2 3	Put Down Put Up Contact 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 1 2 3	Put Down Put Up Contact Reserved
15h	RO	TOUCH4_XH	[3:0]	0 -1	Upper 4 bits of X touch coordinate
16h	RO	TOUCH4_XL	[7:0]	00 – FFh	Lower 8 bits of X touch coordinate
17h	RO	TOUCH4_YH	[3:0]	0 -1	Upper 4 bits of Y touch coordinate
18h	RO	TOUCH4_YL	[7:0]	00 – FFh	Lower 8 bits of Y touch coordinate
1Ah	RO	TOUCH4_Misc	[3:0]	00-0Fh	Touch Area
1Bh	RO	TOUCH5_Event_Flag	[7:6]	0 1 2 3	Put Down Put Up Contact 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 1 2 3	Put Down Put Up Contact 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 1 2 3	Put Down Put Up Contact 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 1 2 3	Put Down Put Up Contact 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 1 2 3	Put Down Put Up Contact 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 1 2 3	Put Down Put Up Contact 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 Default: 0
A2h	RO	ID_G_LIB_VERSION_L	[7:0]	00-FFh	App library version low-byte Default: 1h
A3h	RO	ID_G_CHIPER_HIGH	[7:0]	00-FFh	Chip Vendor ID Default: 0x54
A6h	RO	ID_G_FIRMID	[7:0]	00-FFh	Firmware ID Number Default: 1
A8h	RO	ID_G_VENODRID	[7:0]	00-FFh	CTPM Vendor's Chip ID Default: 79h

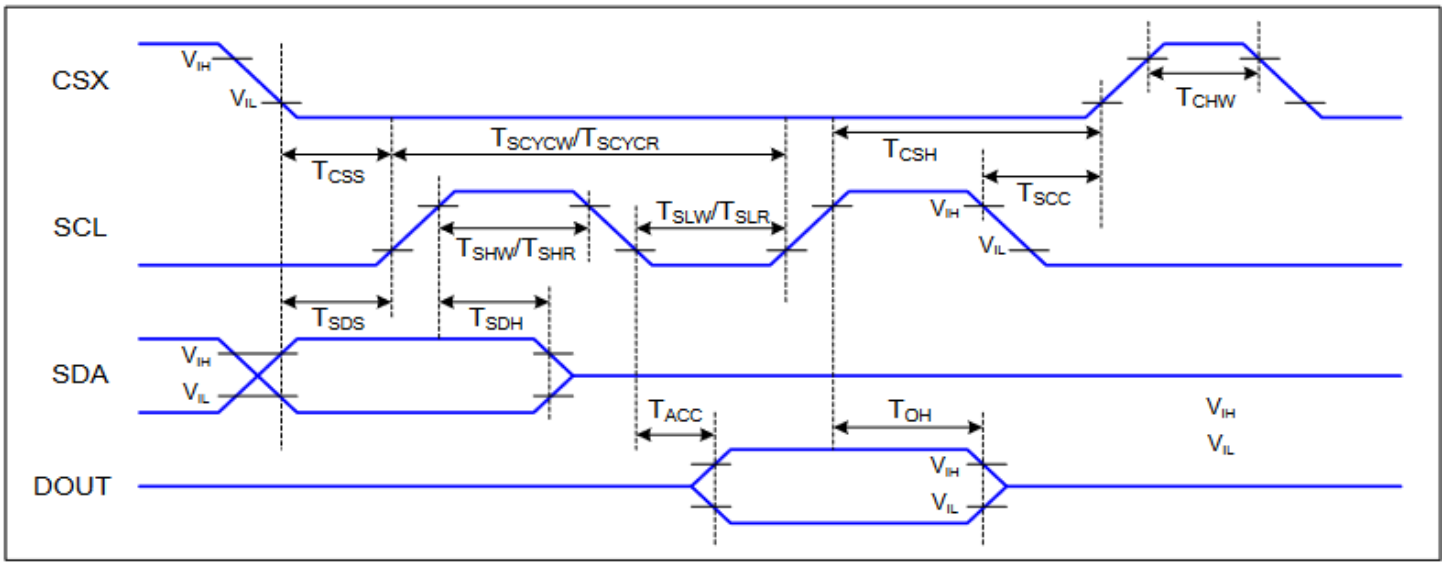
Timing Characteristics for TFT

Parallel 8/16-bit Interface Timing Characteristics



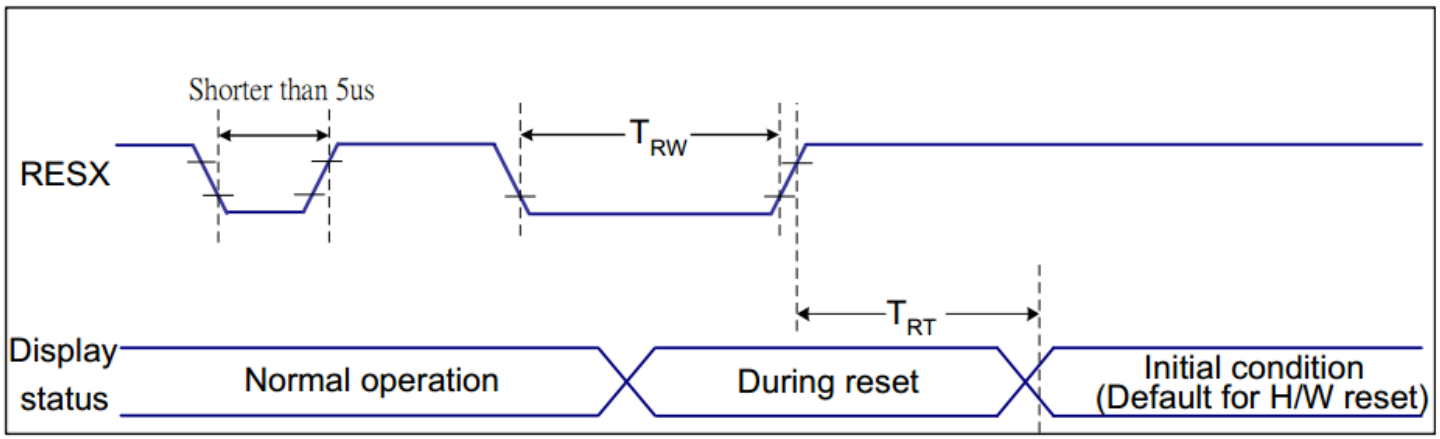
Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	T_{AST}	Address setup time	0		ns	-
	T_{AHT}	Address hold time (Write/Read)	10		ns	
CSX	T_{CHW}	Chip select "H" pulse width	0		ns	-
	T_{CS}	Chip select setup time (Write)	15		ns	
	T_{RCS}	Chip select setup time (Read ID)	45		ns	
	T_{RCSFM}	Chip select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

3-wire Serial interface Timing Characteristics



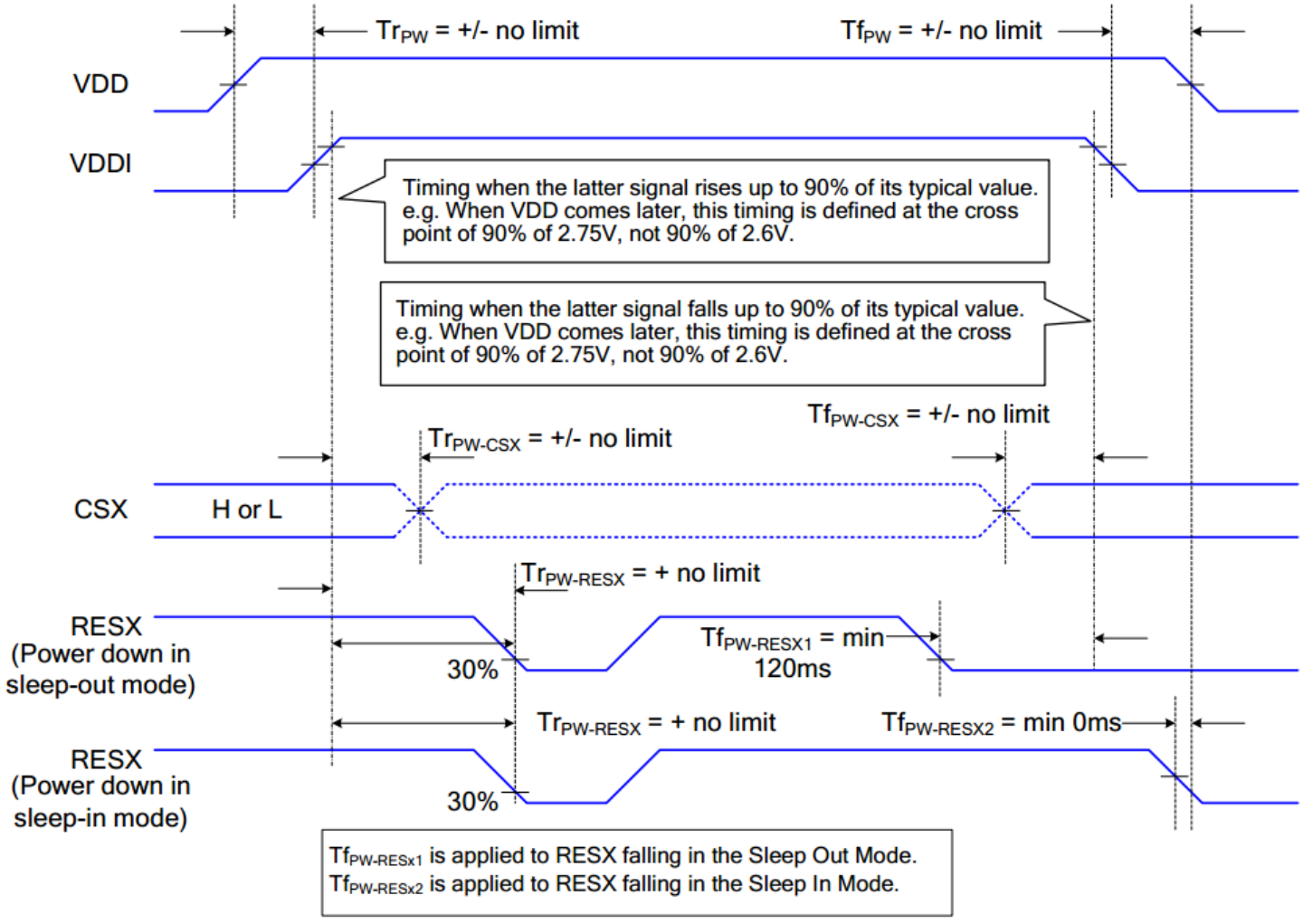
Signal	Symbol	Parameter	Min	Max	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (write)	15		ns	
	T_{CSS}	Chip select setup time (read)	60		ns	
	T_{SCC}	Chip select hold time (read)	65		ns	
	T_{CHW}	Chip select "H" pulse width	40		ns	
SCL	T_{SCYCW}	Serial 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 (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



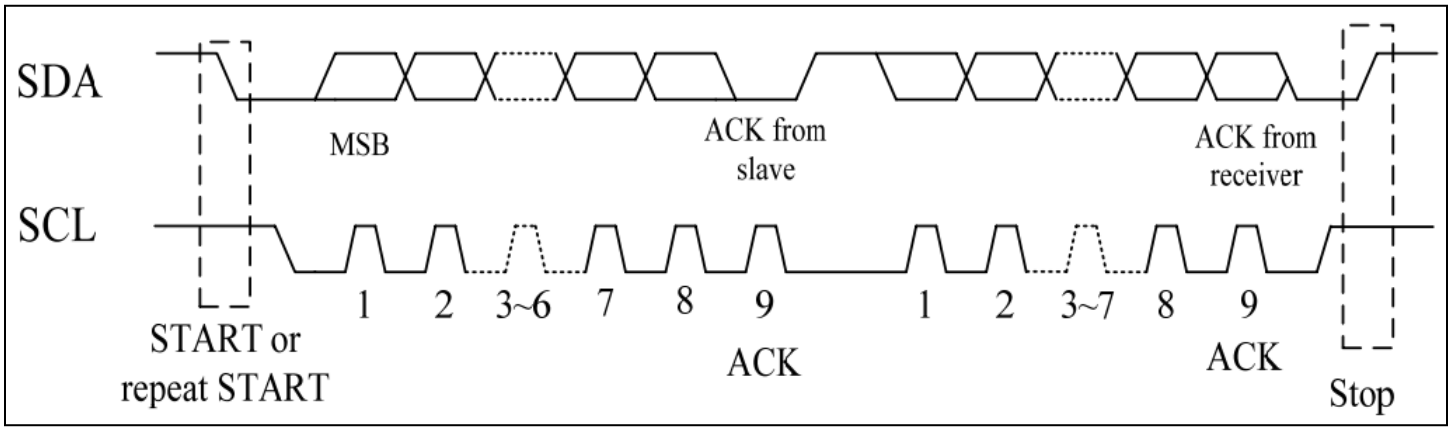
Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1, 5)	ms
				120 (Note 1, 6, 7)	ms

Power ON/OFF Sequence

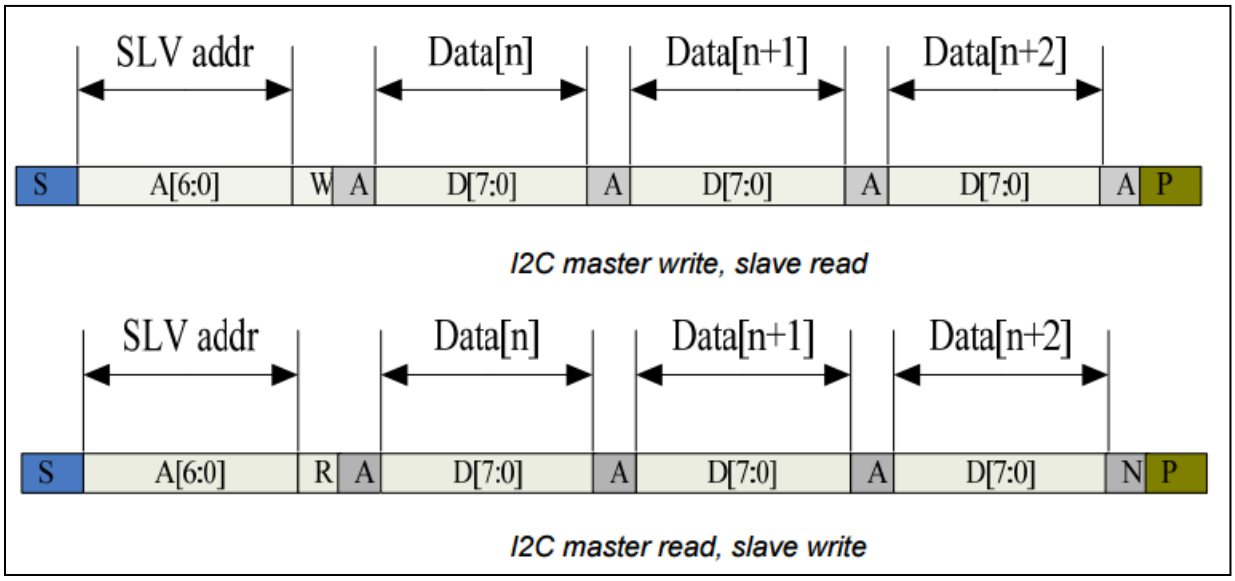


Timing Characteristics – Capacitive Touch Panel

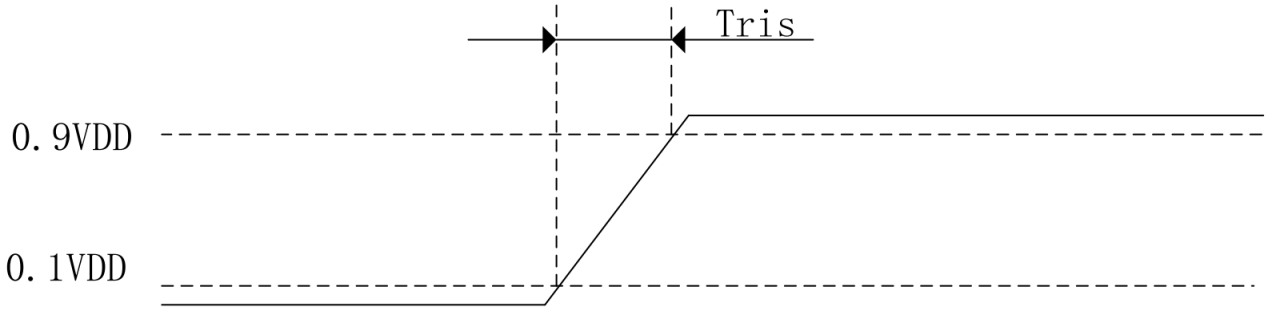
Data Transfer Format



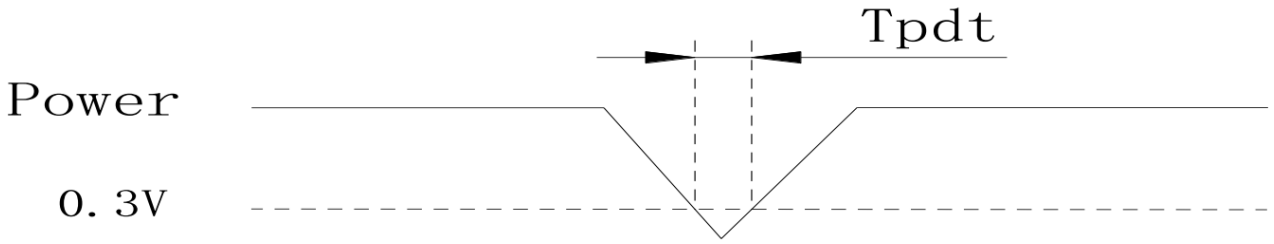
Parameter	Min	Max	Unit
SCL Frequency	0	400	KHz
Bus free time between a STOP & START condition	1.3	-	µs
Hold time Repeated START condition	0.6	-	µs
Data Setup Time	100	-	ns
Setup time for a repeated START condition	0.6	-	µs
Setup time for a STOP condition	0.6	-	µs



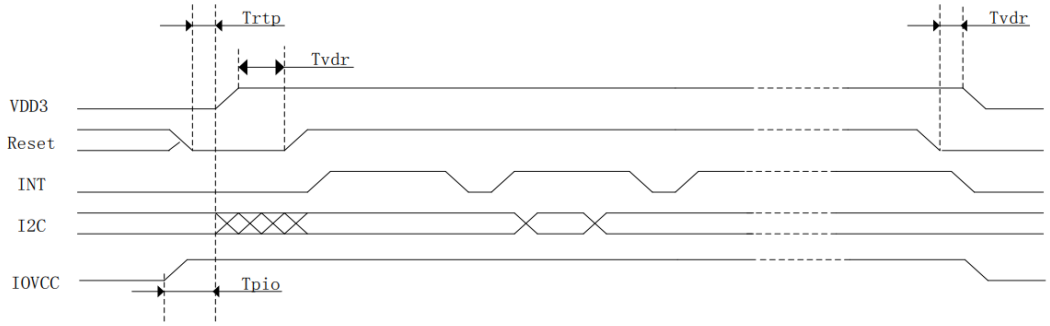
Power ON/Reset Sequence



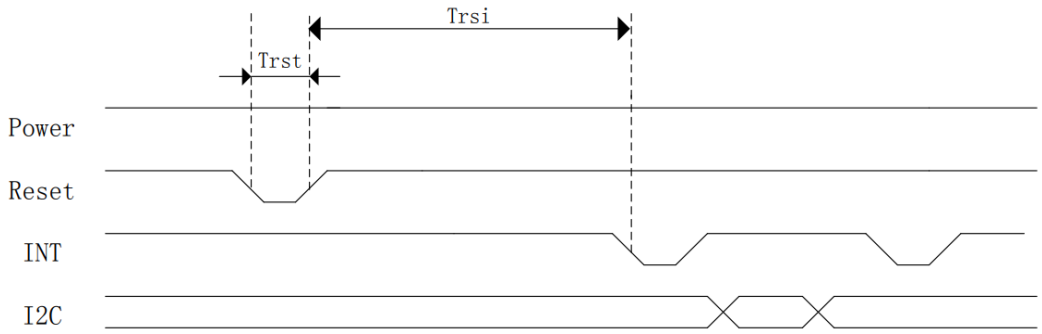
Power On Time



Power Cycle Requirement



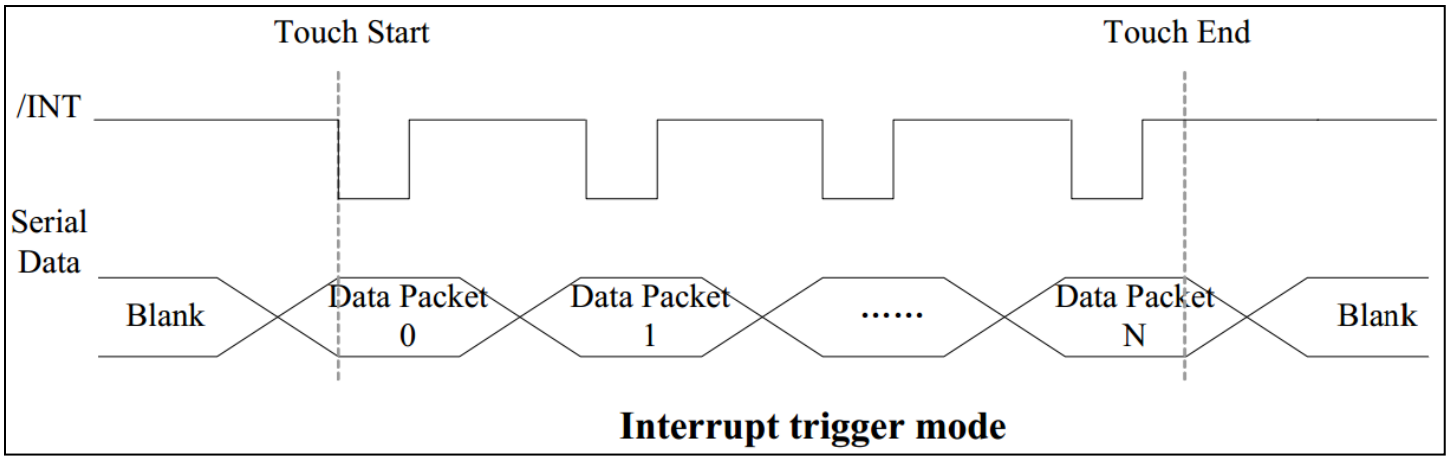
Power ON Sequence



Reset sequence

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

*Note: If Reset is tied to V_{DD} data corruption can occur



Sample code to read touch data:

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

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

Sample code to overwrite default register values:

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

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. For 100 cycles	
Vibration test	Endurance test applying vibration to simulate transportation and use.	10Hz-55Hz (1 min.), 1.5mm amplitude. 30 min. exposure for each directions X,Y,Z	3
Static electricity test	Endurance test applying electric static discharge.	Air discharge: ±8kV 10 Times 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.