ILITek TP IC
I²C Programming Guide

Application Note

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Document Revision History

Version	Data	Author	Description
1.00	2011/04/18	Jay	First Release Version
1/01	2011/5/23	Jay	Added Sleep mode support Added Idle Mode support

Table of Contents

List of Figures

1. Introduction

1.1. Overview

This document defines standard I²C interfacing protocols for use with ILItek TP IC products designing for capacitance touch panels.

1.2. Audience

It is intended for using by software engineers to port the I2C driver when using touch modules with ILItek TP IC products such as ILI2101, ILI2102, ILI2102s, and ILI2105.

2. Timing Specifications

2.1. Power Up Sequence and Reset timing Requirement

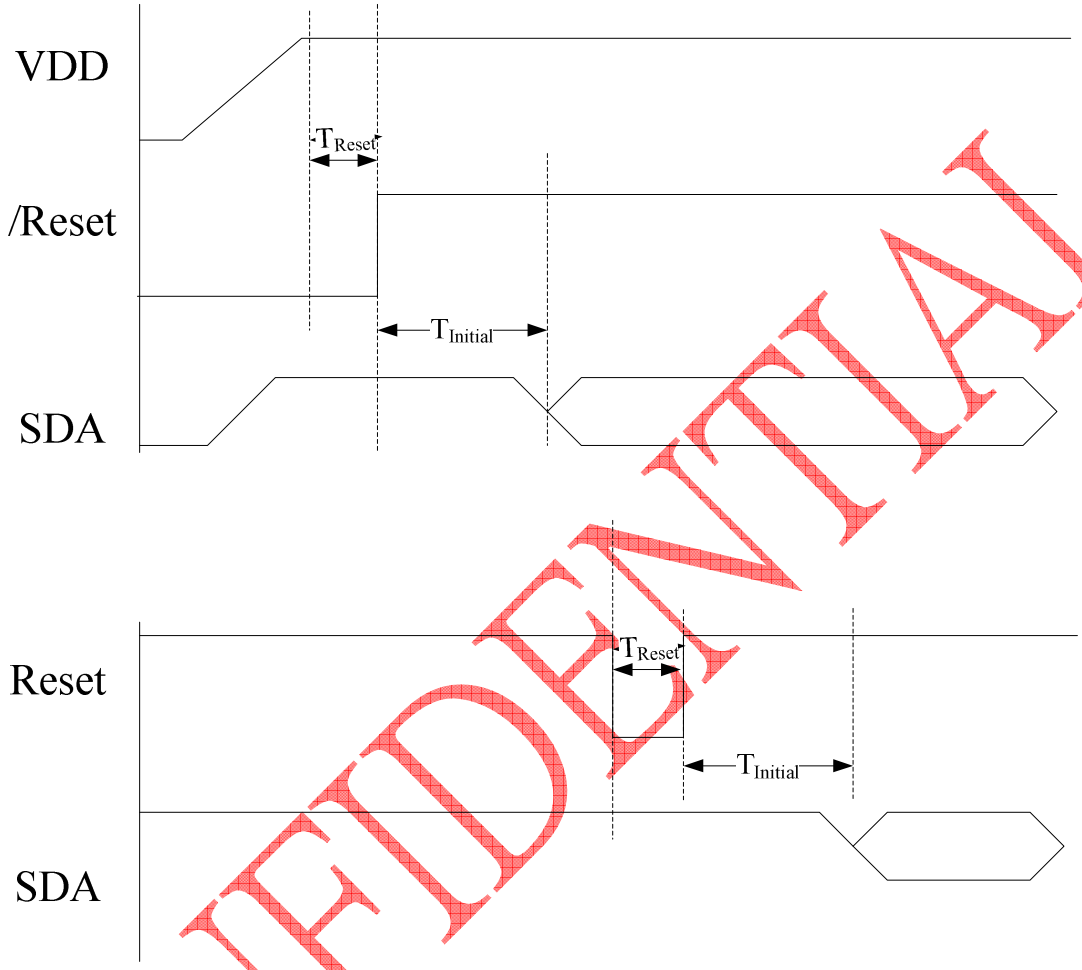


Fig 1: Power Up Sequence and Reset Diagram

Symbol	Parameter	MIN.	MAX.	Unit
$T_{Initial}$	After powering-on or resetting the device, the device needs $T_{Initial}$ time to config the system.	100	-	ms
T_{Reset}	/Reset pin low hold time	10	-	µs

2.2. I²C Timing

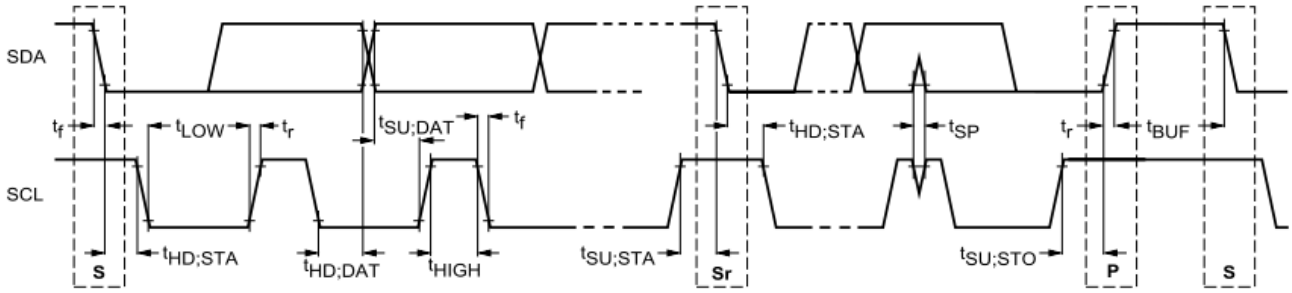


Fig 2: The timing of I²C Interface

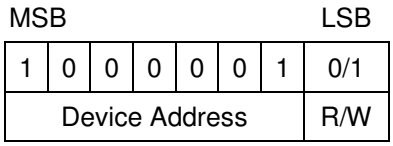
Characteristics of the SDA and SCL bus lines

Symbol	Parameter	Standard mode			Fast Mode		
		Min	Max	Unit	Min	Max	Unit
f_{SCL}	SCL clock frequency	0	100	kHz	0	400	kHz
$t_{HD;STA}$	Hold time (repeated) START condition. After this period, the first clock pulse is generated	4.0	–	µs	0.6	–	µs
t_{LOW}	LOW period of the SCL clock	4.7	–	µs	1.3	–	µs
t_{HIGH}	HIGH period of the SCL clock	4.0	–	µs	0.6	–	µs
$t_{SU;STA}$	Set-up time for a repeated START condition	4.7	–	µs	0.6	–	µs
$t_{HD;DAT}$	Data hold time	5.0	–	µs	0	0.9	µs
$t_{SU;DAT}$	Data set-up time	250	–	ns	100	–	ns
t_r	Rise time of both SDA and SCL signals	–	1000	ns	–	300	ns
t_f	Fall time of both SDA and SCL signals	–	300	ns	–	300	ns
$t_{SU;STO}$	Set-up time for STOP condition	4.0	–	µs	0.6	–	µs
t_{BUF}	Bus free time between a STOP and START condition	4.7	–	µs	1.3	–	µs

3. I2C Interface Data Structure

3.1. Device Address

The device addresses are 7 binary bits long and are conventionally expressed as 4 bits followed by 3 bits followed by the letter ‘b’, 1000 001b. These addresses occupy the high seven bits of an eight-bit field on the bus.



7-bit Device Address: 0x41

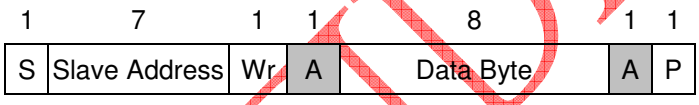
8-bit Device Read Address:0x83

8-bit Device Write Address:0x82

Fig 3: I²C Device Address

3.2. Data Transfer

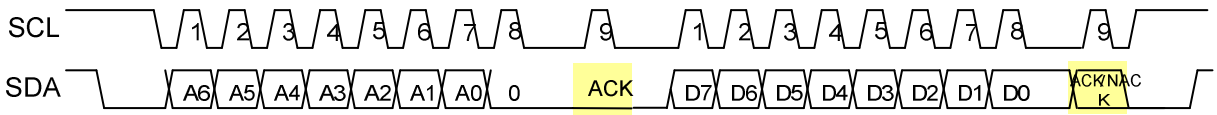
Data is transferred over the I²C bus with 8-bit address and 8-bit data. The related protocol and timing diagrams are shown as below.



S	Start Condition
Sr	Repeated Start Condition
Rd	Read (bit value of 1)
Wr	Write (bit value of 0)
A	Acknowledge (this bit position may be ‘0’ for an ACK or ‘1’ for a NACK)
P	Stop Condition
	Master-to-Slave
	Slave-to-Master
---	Continue

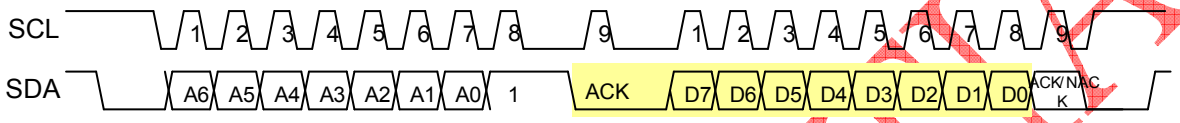
Fig 4: Generic Transaction Diagram

I2C Write timing



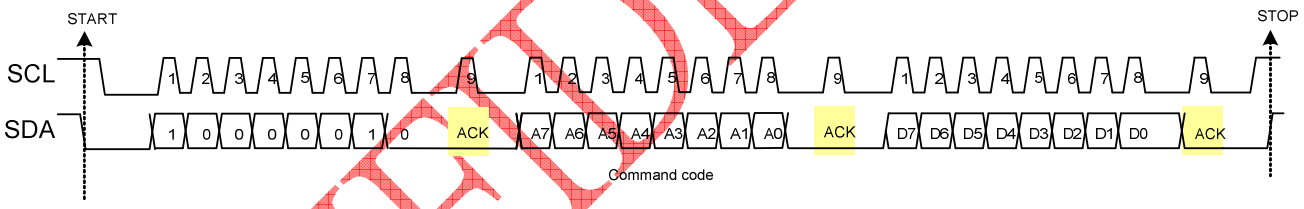
=> slave to master

I2C Read timing



=> slave to master

Byte Write



S	Slave Address	Wr	A	Command Code	A	Data Byte	A	P

Fig 5: Byte Write

Byte Read

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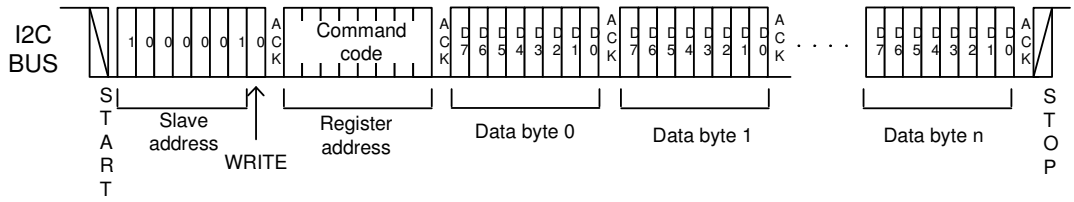
S	Slave Address	Wr	A	Command Code	A	Sr	Slave Address	Rd	A	Data Byte	A	P

Fig 6: Byte Read

Multi-Byte Write



S	Slave Address	Wr	A	Command Code	A	Data Byte 0	A	Data Byte 1	A

Data Byte 2	A	-----	A	Data Byte N	A	P

Fig 7: Multi-Byte Write

Multi-Byte Read

S	Slave Address	Wr	A	Command Code	A	Sr	Slave Address	Rd	A	Data Byte 0	A

Data Byte 1	A	-----	A	Data Byte N	A	P

Fig 8: Multi-Byte Read

4. Communication Protocol

4.1. Interrupt Pin (/INT) Control

ILI Touch device uses interrupt pin to signal the host when detecting touch events on the sensor. When a finger touches on the sensor surface, the /INT pin will be pull low. The /INT pin will continue to be low until the finger leaves the sensor surface.

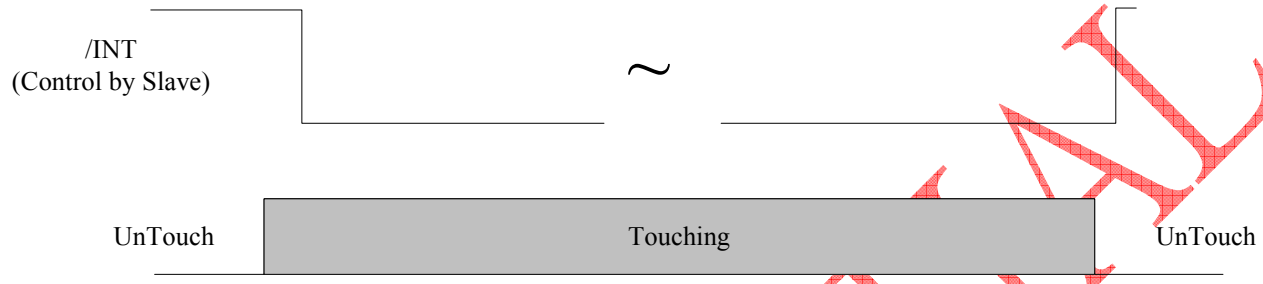


Fig 9: /INT Pin Control Diagram

4.2. General Command Description

4.2.1. Command List

CMD Code	Name	Set / Get (Write/Read)	Size (Bytes)	Description
0x10	Touch Information Report	Get	9	Touch Data report
0x20	Panel information	Get	6	The maximum report value and channel number.
0x30	Enter Sleep Mode	Set	1	The Chip enter the Sleep Mode
0x40	Firmware Version	Get	3	Firmware version V X.X.X
0xCC	Mass Production Calibration	Set	0	This command is used for calibration and modifying configuration data.

4.2.2. Data Format

Read Touch Information Report (0x10)

The Host sends I²C **"Multi-Byte Read"** format with command code **"0x10"** to read user touch information.

The touch device responds data with the following data format.

Touch Information Report Data Format										
Byte	**Name of Bytes**	**Description**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Status	Touching Status	0	0	0	0	0	0	2nd status	1st status
1	X1_Low	X direction coordinate of the 1st finger	X Position (bit 7:0) of the 1st finger							
2	X1_High		X Position (bit 15:8) of the 1st finger							
3	Y1_Low	Y direction coordinate of the 1st finger	Y Position (bit 7:0) of the 1st finger							
4	Y1_High		Y Position (bit 15:8) of the 1st finger							
5	X2_Low	X direction coordinate of the 2nd finger	X Position (bit 7:0) of the 2nd finger							
6	X2_High		X Position (bit 15:8) of the 2nd finger							
7	Y2_Low	Y direction coordinate of the 2nd finger	Y Position (bit 7:0) of the 2nd finger							
8	Y2_High		Y Position (bit 15:8) of the 2nd finger							

1st status:

1 = 1st finger touch

0 = 1st finger un-touch

2nd status:

1 = 2nd finger touch

0 = 2nd finger un-touch

Read Panel information (0x20)

The Host sends I²C **"Multi-Byte Read"** format with command code **"0x20"** to read touch panel information. The touch device responds data with the following data format.

Panel Information Data Format									
Byte	**Name of Bytes**	**Description**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Xmax_Low	The maximum report value	The maximum X coordinate (bit 7:0)							
1	Xmax_High		The maximum X coordinate (bit 15:8)							
2	Ymax_Low		The maximum Y coordinate (bit 7:0)							
3	Ymax_High		The maximum Y coordinate (bit 15:8)							
4	Xchannel_Num	Channel numbers	The channel numbers of X direction							
5	Ychannel_Num		The channel numbers of Y direction							

Enter Sleep Mode (0x30)

The Host sends I²C **"Byte Write"** format with command code **"0x30"** to touch device.
After the touch device receives this command, the touch panel will do MCU sleep for power saving.
More detail, PLZ reference 4.2.3 Sleep Mode: Mode Control.

Read Firmware Version (0x40)

The Host sends I²C **"Multi-Byte Read"** format with command code **"0x40"** to read touch device firmware version. The touch device responds data with following data format.

Firmware Version Data Format									
Byte	**Name of Bytes**	**Description**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	FW_Ver_0	Firmware Version V X.X.X	Firmware ID Code							
1	FW_Ver_1		Major firmware version							
2	FW_Ver_2		Minor firmware version							

Mass Production Calibration (0xCC)

The Host sends I²C **"Byte Write"** format with command code **"0xCC"** to touch device.

After the touch device receives this command, the touch panel is calibrated with the system environment.

Note 1: This command is only suggested to be used for mass production purpose.

Note 2: When using this command, it is very important to avoid any touch object surrounding the whole system during the calibrating period.

Note 3: This command need some time to execute. It takes about 5 seconds to be finished.

4.2.3. Sleep Mode: Mode Control

Entry Sleep mode

After the touch device receives this command (0x30), the touch device will enter the Sleep mode.

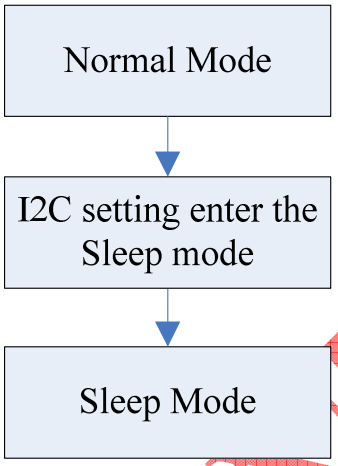


Fig 10: Entry Sleep mode Flowchart

Exit Sleep mode

After the touch device receives the /**Reset pin low and hold a period,** the touch device will exit the Sleep mode.

About the Reset timing Requirement reference Fig 1. Power Up Sequence and Reset Diagram

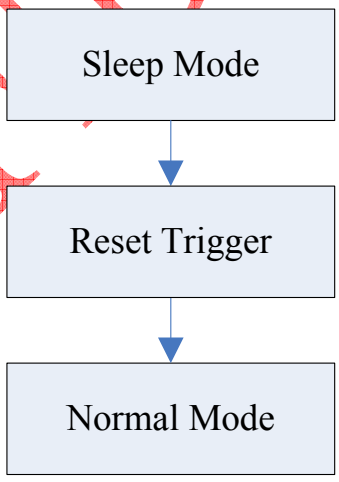


Fig 11: Exit Sleep mode Flowchart

4.2.4. Idle Mode: Mode Control

If no touch and the non-active time over the entry idle time, the chip enter Idle mode.

Entry Idle Mode

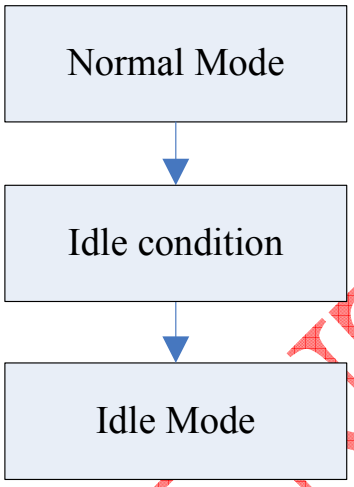


Fig 12: Entry Idle mode Flowchart

Exit Idle Mode

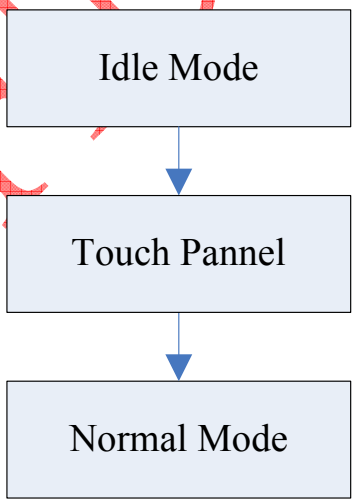


Fig 13: Exit Idle mode Flowchart