IT7259
Cap Sensor
User Programming Guide

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Version History

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Chris Wang	5/26/2016	0.0.0.1	Initial Version
Chris Wang	6/29/2016	0.0.0.2	1. Add Example for I2C Transfer Mode 2. Modify Command 0x15 3. Add Command 0x1A, Sub Command 0x02~0x04 4. Add Wakeup Report Data Format 5. Add Chapter for “Hardware Reset”
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Chris Wang	4/19/2017	0.0.0.8	1. Modify {0x1A, 0x02} Command 2. Add Device Version for Device Name Command 3. Modify Firmware & Configuration Upgrade Flow 4. Modify Hardware Reset Timing
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Chris Wang	6/5/2017	0.0.0.11	1. Add 0x10 Command 2. Add {0x14, 0x5A} Command 3. Add {0x1A, 0x0C} Command

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1. Introduction

1.1. Overview

IT7259 is designed for use with capacitance sensors implementing functions for mouse.

This document includes all the information about how to program and communicate with IT7259. This information includes the system diagram; I2C interface communication protocol, I2C timing charts, vendor commands, and data format.

1.2. Intended Audience

It is intended for using by software engineer sustaining and/or porting the driver and application of ITE cap sensor devices.

In this document, all data value format is **Little Endian**.

1.3. Glossary

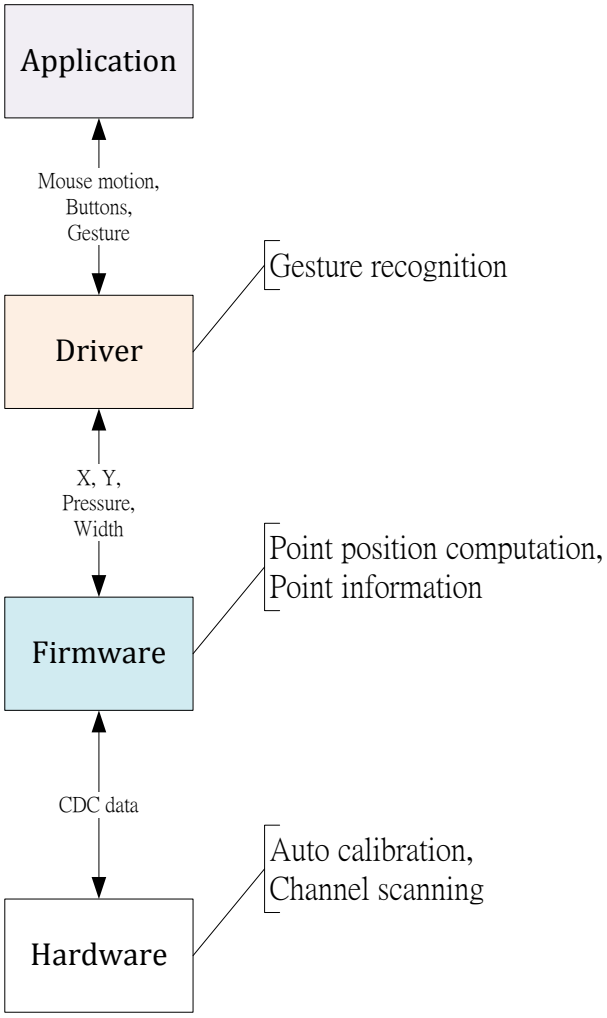
This section summarizes of many of the terms and notations used in the *IT7259 User Programming Guide*.

Gesture A finger action which the host interprets as a special command instead of as a simple cursor motion.

I^2C Shorthand for a standard Inter-IC (integrated circuit) bus.

2. System Diagram

This diagram shows the layers and their main functions of IT7259.



3. Communication Interfaces

3.1. I²C Interface

The IT7259 is available with an I²C –compatible interface. The serial interface supports four transfer types, single write, burst write, single read, and burst read.

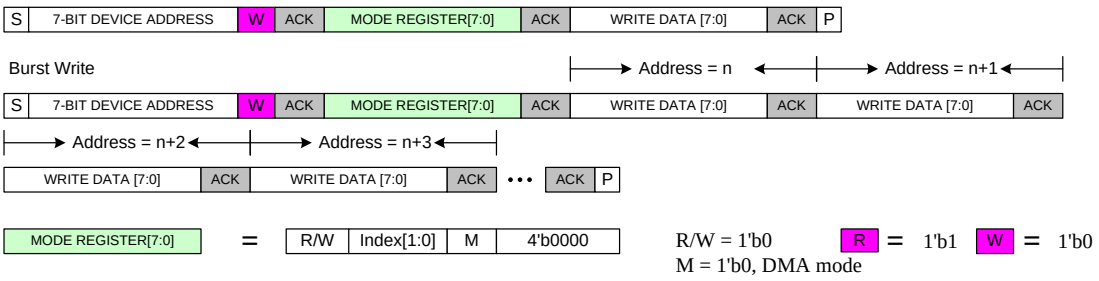
3.1.1. Device Address

I2C Address
1000 110

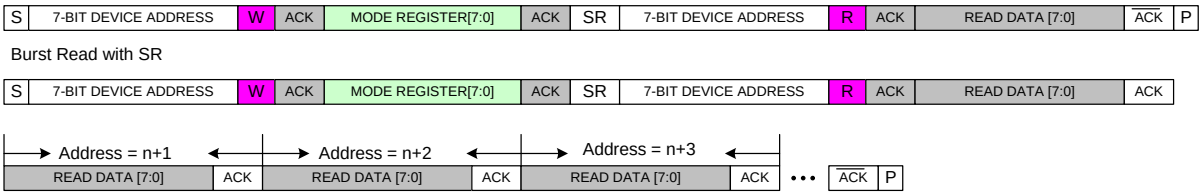
3.1.2. Data Transfer (DMA Mode)

Data is transferred over the I²C bus in 8-bits mode register and 8-bits data. The IT7259 supports the following four types of transfer. The related protocol and timing diagrams are shown below.

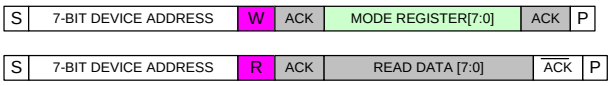
Single Write



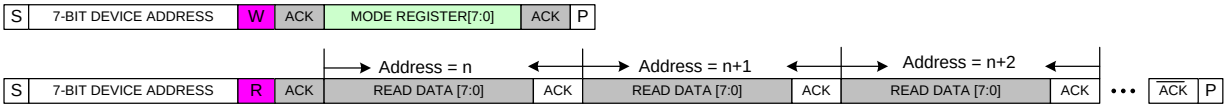
Single Read with SR

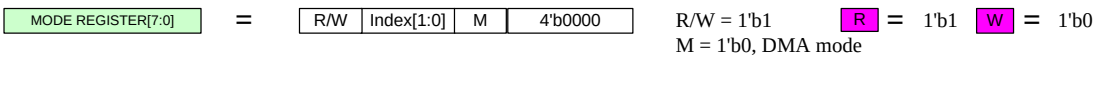


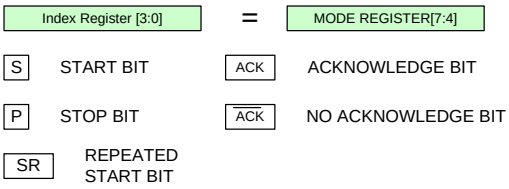
Single Read with STOP



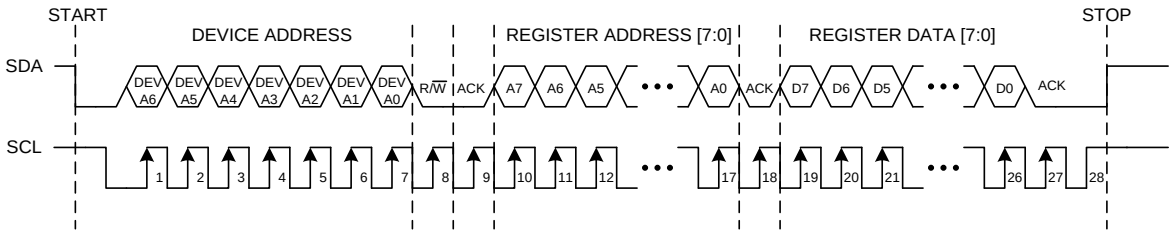
Burst Read with STOP



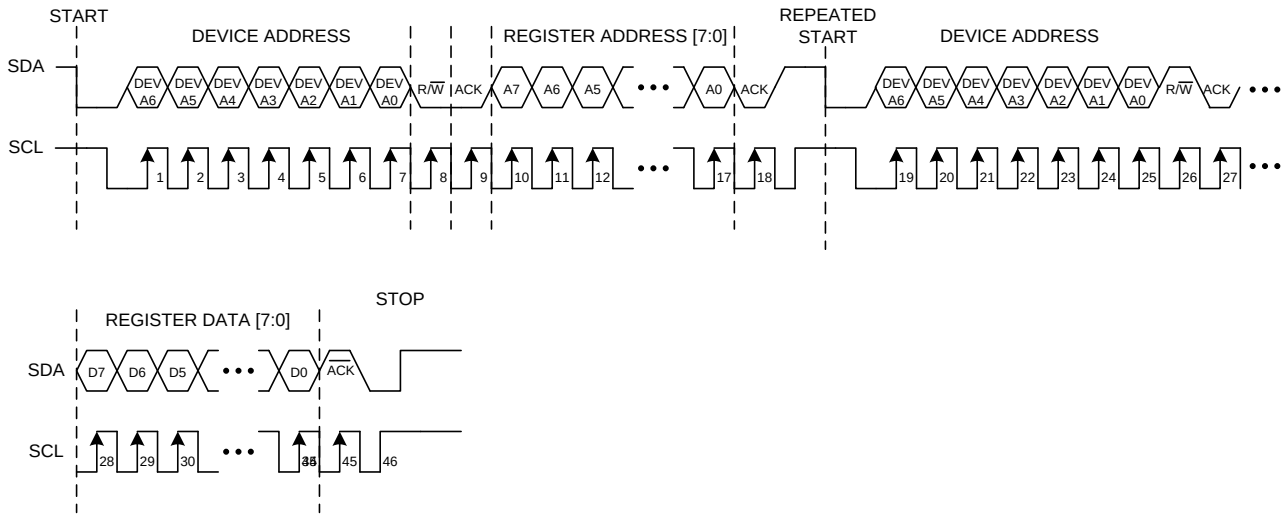




I²C Timing for Single Data Write Operation



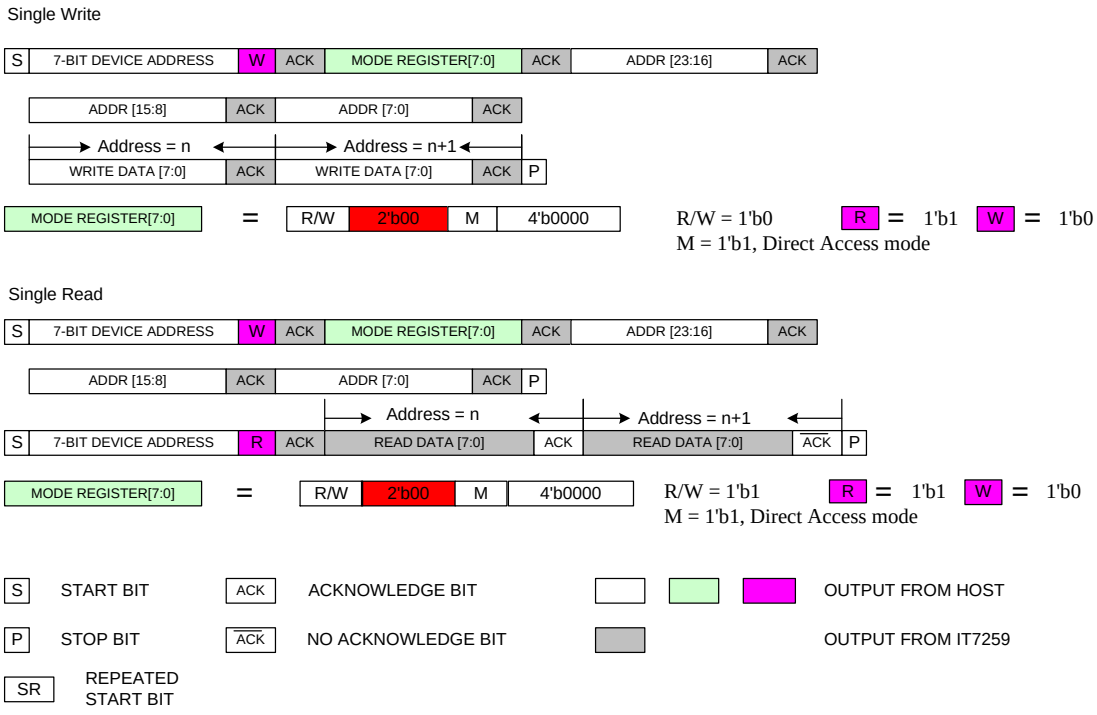
I²C Timing for Single Data Read Operation



3.1.3. Data Transfer (Direct Access Mode)

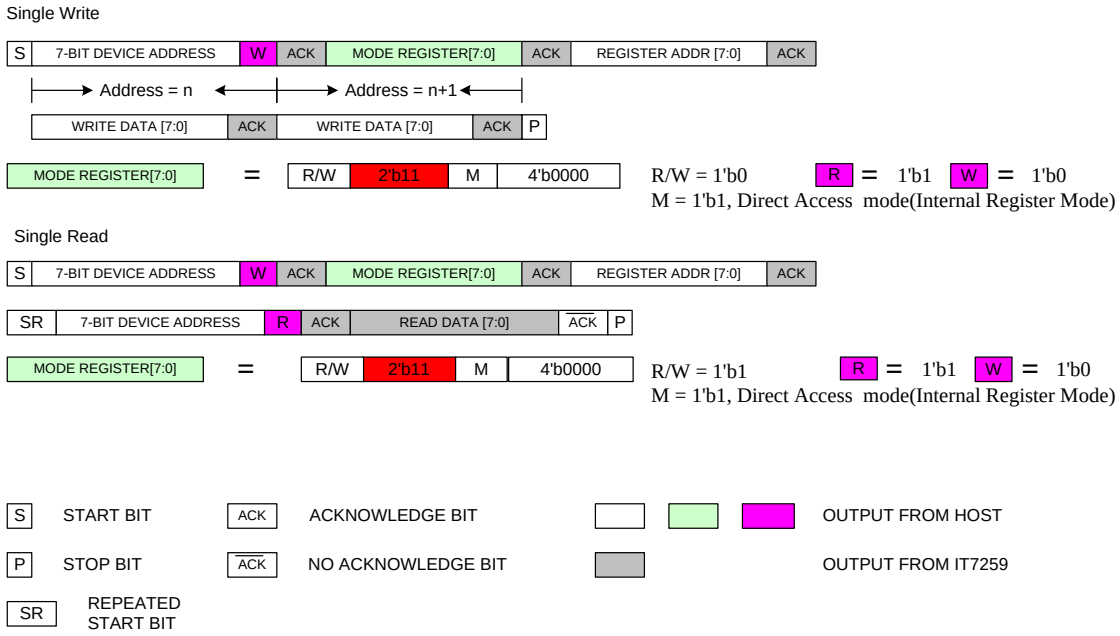
Data is transferred over the I²C bus in 8-bits mode register and 24-bits register address and 16-bits data. The IT7259 supports the following two types of transfer. The related protocol and timing diagrams are shown below.

Note: 24-bits register address MUST be WORD-alignment.



3.1.4. Data Transfer (Internal Register Mode)

Data is transferred over the I²C bus in 8-bits mode register and 8-bits register address and 8-bits data. The IT7259 supports the following two types of transfer. The related protocol and timing diagrams are shown below.



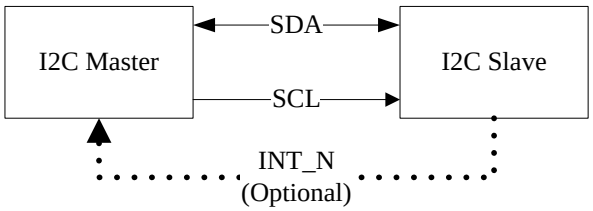
Internal CPU Control Register (ICCR) — Address : 0x23h

Bit	R/W	Default	Description
7	RW	0	**I2C Clock Stretch Control** 0 : I2C Clock Stretch Enable 1 : I2C Clock Stretch Disable
6-3	RW	0	**Reserved**
2	RW	1	**Dynamic Cache Control** 0 : Cache Disable 1 : Cache Enable
1	RW	0	**Internal System Clock Control** 0 : System Clock Enable 1 : System Clock Disable
0	RW	1	**Internal CPU Clock Control** 0 : CPU Clock Enable 1 : CPU Clock Disable

3.1.5. I²C Block Diagram

IT7259 I²C interface is compatible with I²C bus specification. The interrupt signal(INT_N) is used for IT7259 device

to notify host that point event happened in IT7259, and it is optional for customer. The difference is that IT7260 device can notify the host actively when there is information the host needs to know. Otherwise, the host needs to poll IT7259 continually.



3.1.6. Example for I²C Transfer Mode

3.1.6.1. DMA Mode

Burst Write		
Write 0x01 0x00 to Command Buffer	S 0x8C(W) 0x20 0x01 0x00 P	MODE REGISTER[7:0] = 0x20
Burst Read		
Read 9 Bytes from Response Buffer	S 0x8C(W) 0xA0 SR 0x8D(R) 0x09 0x01 0x00 0x00 0x01 0x01 0x05 0x00 0x00 P	MODE REGISTER[7:0] = 0xA0
Read 1 Byte from Query Buffer	S 0x8C(W) 0x80 SR 0x8D(R) 0x00 P	MODE REGISTER[7:0] = 0x80

3.1.6.2. Direct Access Mode

Write		
Write 0x000B(2Bytes) to Register(0xF418)	S 0x8C(W) 0x10 0x00 0xF4 0x18 0x0B 0x00 P	MODE REGISTER[7:0] = 0x10
Read		
Read 2 Bytes from Register(0xF400)	S 0x8C(W) 0x90 0x00 0xF4 0x00 SR 0x8D(R) 0x00 0x00 P	MODE REGISTER[7:0] = 0x90

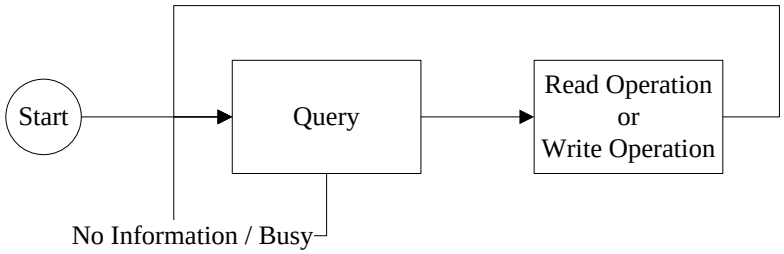
3.1.6.3. Internal Register Mode

Write		
Write 0x04(1Byte) to Internal Register(0x23)	S 0x8C(W) 0x70 0x23 0x04 P	MODE REGISTER[7:0] = 0x70
Read		
Read 1 Byte from Internal Register(0x23)	S 0x8C(W) 0x70 0x23 SR 0x8D(R) 0x04 P	MODE REGISTER[7:0] = 0x70

4. Communication Protocol

4.1. Communication Model

No matter if the host got the notification of interrupt signal or in polling mode, it always get Query status from "**Query Buffer**" first to know what information would get from IT7259 device. The information includes packet information, system status, or the executing result of previous command. After get Query status from "**Query Buffer**", the host can decide which information it wants to get with read operation, or which command it need to send with write operation.



4.2. Data Transfer Format

Below diagram shows the data transfer format in I^2C bus of IT7259.

Device Address (7-bit)	R W	Buffer Index (3-bit)	Reserved (5-bit)	Data 0 (8-bit)	...	Data N-1 (8-bit)

- Device Address (7-bit)

  Specify the address of device that the host wants to communicate. Every device should have a unique device address in the I^2C bus.

- RW (1-bit)

  Specify the data transfer direction.

- Buffer Index (3-bit)

  Specify the buffer by the index. Please reference Chapter 4.3 "Buffer Type and Format" for more information about the buffer.

- Reserved (5-bit)
- Data 0 --- Data N-1

These fields contain the transferred data. When the data transfer direction is Read, that means the data is transferred from IT7259 I^2C slave to the I^2C master, vice versa.

4.3. Buffer Type and Format

IT7259 hardware provides 4 buffers for read operations and 4 buffers for write operations of I^2C interface. The buffer address is set by "Slave Index 0-7 Destination Low/High Register". All buffers can be indicated by 3-bit buffer index.

The buffer mapping is listed below.

Buffer Index	Buffer Name
000b	Reserved
001b	Command Buffer
010b	Reserved
011b	Reserved
100b	Query Buffer
101b	Command Response Buffer
110b	Reserved
111b	Point Information Buffer

4.3.1. Query Buffer

Buffer index: 100b

Property: Read only for host.

The information stored in Query Buffer is used to indicate if any information available for host, and the command execution status. When host cannot get information in Query Buffer, in other words, I^2C gets NAK signal, that means the system is still busy, please retry until get correct response.

Below is the query data format:

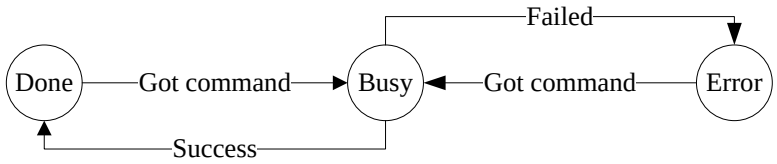
Query Data Format							
7	6	5	4	3	2	1	0
Packet Information Status		Reserved				Command Status	

- Point Information Status

Packet Information Status	
00b	No finger / pen touched. No packet information.
1xb	New packet information available.
01b	No Packet Information, but finger / pen is still touched.

- Command Status

Below is the state machine diagram of command execution.



Below is the definition of 2-bit command status.

Command Status	
00b	Done
01b	Busy
10b	Error
11b	Reserved

4.3.2. Point Information Buffer

Buffer index: 111b

Property: Read only for host.

The information stored in Point Information Buffer is used to indicate the point information that user touched.

Please reference Chapter 6 “Data Report Format” for the point information format.

4.3.3. Command Buffer

Buffer index: 001b

Property: Write only for host.

Command Buffer is used to store the command and data from the host. Host can send commands to Command Buffer though I^2C

In order to save memory, Command Buffer can be the same as Command Response Buffer.

For the different commands, there are different command format and parameters that would send to IT7259 device. So please reference Chapter 5.3 “Command Description” for the command format.

4.3.4. Command Response Buffer

Buffer index: 101b

Property: Read only for host.

The information stored in Command Response Buffer is used to indicate the result of command execution.

In order to save memory, Command Response Buffer can be the same as Command Buffer.

For the different commands, there is different command response data that would be replied for the host. So please reference Chapter 5.3 “Command Description” for the command response data format.

5. Command Set

The host driver can send a command to IT7259 Cap Sensor at any time. When the command status of Query Buffer is done (00b), the host can read the response data from Command Response Buffer, or send next command. When the command status of Query Buffer is error (10b), the host can read the error code from Command Response Buffer, or send next command.

5.1. Command Format

Command	Sub command or Length / Count	Parameter 0	…	Parameter N

- The format of all fields in the command is little endian.

5.2. Command Table

Command	Description
0x00	Device Name
0x01	Get Cap Sensor Information
0x02	Set Cap Sensor Information
0x04	Set Power Mode
0x05	Get Variable Value
0x06	Set Variable Value
0x07	Reset Queue
0x08	Enter/Exit Pure Command Mode
0x09	Set Start Offset of Flash
0x0B	Read Flash
0x0C	Reinitialize Firmware
0x0D	Write Memory/Register
0x0E	Read Memory/Register

0x0F	Enter/Exit Charge Mode
0x10	Enter/Exit GSM Mode
0x14	Get Algorithm Parameter
0x15	Set Algorithm Parameter
0x16	Write Start
0x17	Write Continue
0x18	Read Start
0x19	Read Continue
0x1A	Function Test
0x1C	Auto Tune CDC

5.3. Command Description

Each command has its own command format and return data format. If the host sends correct command, then it can get correct return data in "Command Response Buffer". Otherwise, if the sending command is error, the query status would be in error state, and the host can get error code (Please reference Chapter 10 “Error Code Table”) from "Command Response Buffer".

5.3.1. Command 0x00: Device Name

Description

The command is used for driver to check whether an ITE Cap Sensor device is connected with I^2C interface.

Command Format

Command Format	
Command	0x00
Sub command	None
Parameter	None

Data Format

Data Format	
Data Length	0x0A

Vendor ID	ASCII "ITE"
Device ID	ASCII "7259"
Device Version	0x30, 0x30 for AX IC 0x31, 0x30 for TC IC

5.3.2. Command 0x01: Get Cap Sensor Information

Description

The command is used for driver or application to get the necessary information of ITE Cap Sensor device.

Sub Command Table

Sub Command	Description
0x00	Firmware Information
0x02	2D Resolutions
0x03	Flash Size
0x04	Interrupt Notification Status
0x05	Gesture Information
0x06	Configuration Version

5.3.2.1. Sub Command 0x00: Firmware Information

Description

Get firmware information.

Command Format

Command Format	
Command	0x01
Sub command	0x00
Parameter	None

Data Format

Data Format	
Data Length	0x09/0x0A(Option)
ROM Version	A.B.C.D
Flash FW Version	A.B.C.D

Vendor FW Version(Option)	A

5.3.2.2. Sub Command 0x02: 2D Resolutions

Description

Get panel resolution.

Command Format

Command Format	
Command	0x01
Sub command	0x02
Parameter	None

Data Format

Data Format	
Data Length	0x0C
Reserved	0x00
X Resolution	0x????
Y Resolution	0x????
Scale	0x??
Connection Type	0x??
Stage A	0x?? (Channel of X-axis)
Stage B	0x?? (Channel of Y-axis)
Stage C	0x?? (Additional Channel)
Stage D	0x?? (Button Number)

5.3.2.3. Sub Command 0x03: Flash Size

Description

Get flash code total size in byte.

Command Format

Command Format	
Command	0x01
Sub command	0x03
Parameter	None

Data Format

Data Format	
Data Length	0x03
Flash Code Size	0x????

5.3.2.4. Sub Command 0x04: Interrupt Notification Status

Description

Get interrupt notification status. If interrupt notification is enabled, the response data is 0x01. If interrupt notification is disabled, the response data is 0x00. In default, the interrupt notification is disabled. Application or driver can enable it with command 0x02 and sub command 0x04.

Command Format

Command Format	
Command	0x01
Sub command	0x04
Parameter	None

Data Format

Data Format	
Interrupt Notification Status	0x00: Disable 0x01: Enable
Interrupt Type	0x00: Low level trigger 0x01: High level trigger 0x10: Falling edge trigger 0x11: Rising edge trigger

5.3.2.5. Sub Command 0x05: Gesture Information

Description

The command is used for the application/driver of the host to get the gesture mode of ITE Cap Sensor device.

Command Format

Command Format	
Command	0x01
Sub command	0x05
Parameter	None

Data Format

Data Format	
Data Length	0x0E
Gestures Support	0x00: Unsupported 0x01: Support
1-Finger Gesture	DWORD Each bit presents a gesture ID.
2-Finger Gesture	DWORD Each bit presents a gesture ID.
3 Finger Gesture	DWORD Each bit presents a gesture ID.

5.3.2.6. Sub Command 0x06: Configuration Version

Description

The command is used for the application/driver of the host to get the configuration version of ITE Cap Sensor device.

Command Format

Command Format

Command	0x01
Sub command	0x06
Parameter	None

Data Format

Data Format	
Data Length	0x07
Config Version	A.B.C.D
Reserved	0x0000

5.3.3. Command 0x02: Set Cap Sensor Information

Description

The command is used for driver or application to set the necessary information of ITE Cap Sensor device.

Sub Command Table

Sub Command	Description
0x04	Interrupt Notification Status

5.3.3.1. Sub Command 0x04: Interrupt Notification Status

Description

Set interrupt notification status. To enable interrupt notification the response data is 0x01. If interrupt notification is disabled, the response data is 0x00. In default, the interrupt notification is disabled. Application or driver can enable it with command 0x02 and sub command 0x04.

Command Format

Command Format	
Command	0x02
Sub command	0x04
Parameter	0x00: Disable. 0x01: Enable.
Interrupt Type	0x00: Low level trigger 0x01:

	High level trigger 0x10: Falling edge trigger 0x11: Rising edge trigger

Data Format

Data Format	
Command Status	0x0000: Success

5.3.4. Command 0x04: Set Power Mode

Description

The command is used to set power mode. From active mode to idle mode, the power consumption is different. In active mode, the power consumption is 1.5mA, in idle mode, the power consumption is 25μA. This command is used for user to control the system from active mode to idle mode. At active mode, IT7259 reports packets of points and gestures. At idle mode, IT7259 is in the power saving state, which means there is no packets can be reported, and it doesn't accept any command until the user touch it.

Command Format

Command Format	
Command	0x04
Sub command	0x00
Parameter	0x01: Idle mode

Data Format

Data Format	
Command Status	N/A

5.3.5. Command 0x05: Get Variable Value

Description

The command is used to get variable value.

Command Format

Command Format	
Command	0x05
Sub command	Index
Data Type	0x01: BYTE 0x02: WORD 0x04: DWORD

Data Format

Data Format	
Data Buffer	Data

Index

Index	BYTE	WORD	DWORD
0	Queue Size	1ms Timer	Idle Time
1	Packet Rate Control	Reserved	Idle Mode Power Down Timeout
2	OSC Clock	Reserved	Watch Dog Timer
3	Power Control	Reserved	Untouch Mode Power Down Timeout

5.3.6. Command 0x06: Set Variable Value

Description

The command is used to set variable value.

Command Format

Command Format	
Command	0x06
Sub command	Index
Data Type	0x01: BYTE 0x02: WORD 0x04: DWORD
Data Buffer	Data value depends on the data type

Data Format

Data Format	
Command Status	0x0000: Success

Index

Please reference command 0x05: Get Variable Value.

5.3.7. Command 0x07: Reset Queue

Description

The command is used for the application/driver of the host to reset the queue which is stored with point/gesture/event information of ITE Cap Sensor device.

Command Format

Command Format	
Command	0x07
Sub command	None
Parameter	None

Data Format

Data Format	
Command Status	0x0000: Success

5.3.8. Command 0x08: Enter/Exit Pure Command Mode

Description

The command is used for driver or application to enter pure command mode.

Command Format

Command Format	
Command	0x08
Sub command	0x00: Enter 0x80: Exit
Parameter	None

Data Format

Data Format	
Command Status	0x0000: Success

5.3.9. Command 0x09: Set Start Offset of Flash

Description

The command is used for set start offset for read flash. The offset is increased after flash Read/Write operation.

Command Format

Command Format	
Command	0x09
Sub command	0x00
Offset	0x????

Data Format

Data Format	
Command Status	0x0000: Success

5.3.10. Command 0x0B: Read Flash

Description

The command is used for read flash start with flash base address plus offset which is set by command 0x0B. If the command is a flash read operation, there is no page alignment limitation, and when the command status is done, user should read response data from System Information Buffer.

Command Format

Command Format	
Command	0x0B
Sub command (Length)	Data Length

Data Format

Data Format

Data Buffer	Flash Data

5.3.11. Command 0x0C: Reinitialize Firmware (Reset)

Description

The command is used for reset IT7259.

Note: The command will reinitialize IT7259 system. After sending this command, the host can idle about 100ms to wait IT7259 in ready state.

Command Format

Command Format	
Command	0x0C
Sub command	None
Parameter	None

Data Format

Data Format	
Command Status	0x0000: Success

5.3.12. Command 0x0D: Write Memory / Register

Description

The command is used for write memory and register.

Command Format

Command Format	
Command	0x0D
Sub command (Count)	Data Count
Data Type	0x01: BYTE 0x02: WORD 0x04: DWORD
Offset	0x???? (WORD)
Data Buffer	Data

Data Format

Data Format	
Command Status	0x0000: Success

5.3.13. Command 0x0E: Read Memory / Register

Description

The command is used for read memory and register.

Command Format

Command Format	
Command	0x0E
Sub command (Count)	Data Count
Data Type	0x01: BYTE 0x02: WORD 0x04: DWORD
Offset	0x???? (WORD)
Interval(Optional)	0x???? (WORD) Interval in bytes

Data Format

Data Format	
Data Buffer	Data

5.3.14. Command 0x0F: Enter/Exit Charge Mode

Description

The command is used for driver or application to enter charge mode.

Command Format

Command Format	
Command	0x0F
Sub command	0x00: Normal mode 0x01: Charge mode

Parameter	None

Data Format

Data Format	
Command Status	0x0000: Success

5.3.15. Command 0x10: Enter/Exit GSM Mode

Description

The command is used for driver or application to enter GSM mode.

Command Format

Command Format	
Command	0x10
Sub command	0x01: Enter GSM mode 0x00: Exit GSM mode
Parameter	Reserved(1-BYTE)

Data Format

Data Format	
Command Status	0x0000: Success

5.3.16. Command 0x14: Get Algorithm Parameter

Description

The command is used for driver or application to get the algorithm parameters of ITE Cap Sensor device.

Sub Command Table

Sub Command	Description
0x5A	CDC Tune Level

5.3.16.1. Sub Command 0x5A: CDC Tune Level

Description

The command is used for driver or application to get the variable “CDC Tune Level”.

Command Format

Command Format	
Command	0x14
Sub command	0x5A

Data Format

Data Format	
Data Length	0x03
Value of Sub Command	0x5A
CDC Tune Level	0x????

5.3.17. Command 0x15: Set Algorithm Parameter

Description

The command is used for driver or application to set the algorithm parameters of ITE Cap Sensor device.

Sub Command Table

Sub Command	Description
0x06	Report the Last Point
0x07	Gain Setting
0x18	Engine Scan Period
0x1D	Point Threshold
0x87	Idle Gesture Setting
0x88	Smooth Algorithm Factor

5.3.17.1. Sub Command 0x06: Report the Last Point

Description

The command is used for driver or application to set the variable “Report the Last Point”. Report the last point if there is a point movement over skip range.

Command Format

Command Format

Command	0x15
Sub command	0x06
Report the Last Point (1-BYTE)	Bit 1-7: Last point skip range Bit 0: Choose to output the last point or not 0: not output the last point 1: output the last point

Data Format

Data Format	
Command Status	0x0000: Success

5.3.17.2. Sub Command 0x07: Gain Setting

Description

The command is used for driver or application to set the variable “Gain Setting”. Firmware CDC compensation and AFE Gain.

Command Format

Command Format	
Command	0x15
Sub command	0x07
Gain Setting (1-BYTE)	Bit 7-4: FW CDC Compensation Bit 3-2: AFE Gain @AC Shielding Mode Bit 1-0: AFE Gain @Ground Mode

Data Format

Data Format	
Command Status	0x0000: Success

5.3.17.3. Sub Command 0x18: Engine Scan Period

Description

The command is used for driver or application to set the variable “Engine Scan Period”. Scan time would be large than Engine Scan Period.

Command Format

Command Format	
Command	0x15
Sub command	0x18
Engine Scan Period (1-BYTE)	Unit: ms

Data Format

Data Format	
Command Status	0x0000: Success

5.3.17.4. Sub Command 0x1D: Point Threshold

Description

The command is used for driver or application to set the variable “Point Threshold”. If moving distance is greater than threshold * resolution / 1000, we should report this point.

Command Format

Command Format	
Command	0x15
Sub command	0x1D
Point Threshold (1-BYTE)	Unit: resolution Max value: 255

Data Format

Data Format	
Command Status	0x0000: Success

5.3.17.5. Sub Command 0x87: Idle Gesture Setting

Description

The command is used for driver or application to set the variable “Idle Gesture Setting”. Report point after smooth algorithm by smooth factor.

Command Format

Command Format	
Command	0x15
Sub command	0x87
Idle Gesture Setting (1-DWORD)	Byte 0: Reserved (0x00) Byte 1: Reserved (0x00) Byte 2: Idle Gesture Type 0x00: Point 0x20: 1-Finger, Tap 0x23: 1-Finger, Double-Tap 0x80: Palm Byte 3: Idle Gesture Enable 0x00: Disable 0x80: Enable

Data Format

Data Format	
Command Status	0x0000: Success

5.3.17.6. Sub Command 0x88: Smooth Algorithm Factor

Description

The command is used for driver or application to set the variable “Smooth Algorithm Factor”. Report point after smooth algorithm by smooth factor.

Command Format

Command Format	
Command	0x15
Sub command	0x88
Smooth Algorithm Factor (1-DWORD)	Byte 0: Smooth Distance Strong Byte 1: Smooth Distance Weak Byte 2: Smooth Alpha Strong Byte 3: Smooth Alpha Weak

Data Format

Data Format

Command Status	0x0000: Success

5.3.18. Command 0x16: Write Start

Description

The command is used for the application/driver of the host to start N-BYTE write command sequence of ITE Cap Sensor device.

Command Format

Command Format		
Command	0x16	
Sub command	0x00	Reserved
	0x01	Command Buffer
	0x02	Reserved
	0x03	Reserved
Parameter	None	

Data Format

Data Format	
Command Status	0x0000: Success

5.3.19. Command 0x17: Write Continue

Description

The command is used for the application/driver of the host to continue N-BYTE write command sequence of ITE Cap Sensor device.

Command Format

Command Format	
Command	0x17
Sub command	Final write command 0x00: Not final write command 0x01: Final write command
Data Buffer	Data

Data Format

Data Format	
Command Status	0x0000: Success

5.3.20. Command 0x18: Read Start

Description

The command is used for the application/driver of the host to start N-BYTE read command sequence of ITE Cap Sensor device.

Command Format

Command Format		
Command	0x18	
Sub command	0x04	Reserved
	0x05	Command Response Buffer
	0x06	Reserved
	0x07	Point Buffer
Parameter	None	

Data Format

Data Format	
Command Status	0x0000: Success

5.3.21. Command 0x19: Read Continue

Description

The command is used for the application/driver of the host to continue N-BYTE read command sequence of ITE Cap Sensor device.

Command Format

Command Format	
Command	0x19
Sub command	Final read command 0x00: Not final read command

	0x01: Final read command
Parameter	Size (Unit: Byte)

Data Format

Data Format	
Data Buffer	Data

5.3.22. Command 0x1A: Function Test

Description

The command is used for driver or application to verify the functions of ITE Cap Sensor device.

Sub Command Table

Sub Command	Description
0x00	Read Stage CDC
0x01	Spectrum Mode Test
0x02	Analog Filter Test
0x03	Analog DDFS Test
0x04	Engine Control Test
0x05	Get CSEL/Compensated Value
0x06	Enable/Disable Firmware Calibration
0x07	Enable/Disable Water Detect Mode
0x08	Enable/Disable Check Engine Function
0x09	Set CSEL/Compensated Value
0x0A	Get CDC Frames
0x0B	Get All CDC Frames
0x0C	Switch HV Mode

5.3.22.1. Sub Command 0x00: Read Stage CDC

Description

The command is used for driver or application to read current untouched CDC, touched CDC or compensated single end CDC. The output CDC data begins from stage 0.

Command Format

Command Format	
Command	0x1A
Sub command	0x00
CDC Type	0x00: Untouched CDC 0x01: Touched CDC 0x02: Compensated Single End CDC
Number of Stage (1-BYTE)	0x??

Data Format

Data Format	
Data Buffer	CDC data for stages

5.3.22.2. Sub Command 0x01: Spectrum Mode Test

Description

The command is used for driver or application to execute spectrum mode test.

Command Format

Command Format	
Command	0x1A
Sub command	0x01
TX Mode	0x00: TX Off, by channel 0x01: TX On, by channel 0x02: TX Off, by stage 0x03: TX On, by stage
Channel/Stage Number (1-BYTE)	0x??

Data Format

Data Format	
Data Buffer	Memory address of spectrum data

5.3.22.3. Sub Command 0x02: Analog Filter Test

Description

The command is used for driver or application to modify analog filter coefficient.

Command Format

Command Format	
Command	0x1A
Sub command	0x02
Filter Coefficient (1-BYTE)	0x00: Default 0x03: 96pt 0x05: 160pt 0x06: 192pt 0x08: 256pt 0x0A: 320pt

Data Format

Data Format	
Command Status	0x0000: Success

5.3.22.4. Sub Command 0x03: Analog DDFS Test

Description

The command is used for driver or application to modify DDFS Tx Frequency and AFE Filter.

Note: Tx Frequency Control(TX_FC)

Tx Frequency = (6MHz/14)/(5040/TX_FC)

Command Format

Command Format	
Command	0x1A
Sub command	0x03
Tx Frequency Control (1-WORD)	0x????
AFE Filter (1-BYTE)	Bit 7 : AFE Filter Enable 0: Keep current setting

	1: Modify AFE Filter Bit 6-4: Reserved Bit 3-2: High Pass Filter 00: 70KHz 01: 45KHz 10: 25KHz 11: 5KHz Bit 1-0: Low Pass Filter 00: 150KHz 01: 100KHz 10: 50KHz 11: 10KHz

Data Format

Data Format	
Command Status	0x0000: Success

5.3.22.5. Sub Command 0x04: Engine Control Test

Description

The command is used for driver or application to control engine.

Command Format

Command Format		
Command	0x1A	
Sub command	0x04	
Parameter	0x00	Stop Engine
	0x01	Start Engine
	0x02	Send scan one round and stop engine
	0x03	Switch to ground mode
	0x04	Switch to shielding mode

Data Format

Data Format	
Command Status	0x0000: Success

5.3.22.6. Sub Command 0x05: Get CSEL/Compensated Value

Description

The command is used for driver or application to get CSEL or Compensated Value.

Command Format

Command Format		
Command	0x1A	
Sub command	0x05	
Parameter	0x00	Get Current Mode CSEL
	0x01	Get Ground Mode CSEL
	0x02	Get Shielding Mode CSEL
	0x03	Get Compensated Value

Data Format

Data Format	
Command Status	Get CSEL: 28-WORDS High-Byte : CIN Number Low-Byte : CSEL
	Get Compensated Value: 28-WORDS Compensated Value

5.3.22.7. Sub Command 0x06: Enable/Disable Firmware Calibration

Description

The command is used for driver or application to enable or disable Firmware Calibration.

Command Format

Command Format	
Command	0x1A
Sub command	0x06
Parameter	0x00: Disable. 0x01: Enable.

Data Format

Data Format	
Command Status	0x0000: Success

5.3.22.8. Sub Command 0x07: Enable/Disable Water Detect Mode

Description

The command is used for driver or application to enable or disable Water Detect Mode.

Command Format

Command Format	
Command	0x1A
Sub command	0x07
Parameter	0x00: Disable. 0x01: Enable.

Data Format

Data Format	
Command Status	0x0000: Success

5.3.22.9. Sub Command 0x08: Enable/Disable Check Engine Function

Description

The command is used for driver or application to enable or disable function for check calibration engine.

Command Format

Command Format	
Command	0x1A
Sub command	0x08
Parameter	0x00: Disable. 0x01: Enable.

Data Format

Data Format

Command Status	0x0000: Success

5.3.22.10. Sub Command 0x09: Set CSEL/Compensated Value

Description

The command is used for driver or application to set CSEL or Compensated Value.

Command Format

Command Format		
Command	0x1A	
Sub command	0x09	
Set Type	0x00	Set Current Mode CSEL
	0x01	Set Ground Mode CSEL
	0x02	Set Shielding Mode CSEL
	0x03	Set Compensated Value
Count	Stage Count	
Data	Set CSEL: High-Byte : CIN Number Low-Byte : CSEL	
	Set Compensated Value: Compensated Value	

Data Format

Data Format	
Command Status	0x0000: Success

5.3.22.11. Sub Command 0x0A: Get CDC Frames

Description

The command is used for driver or application to get CDC frames for specific stage. This command would be executed for long time.

Command Format

Command Format	
Command	0x1A

Sub command	0x0A
Stage Number (1-BYTE)	0x??
Frame Count (1-BYTE)	0x??

Data Format

Data Format	
Data Buffer	Memory address of CDC frame

5.3.22.12. Sub Command 0x0B: Get All CDC Frames

Description

The command is used for driver or application to get CDC frames for all stages. This command would be executed for long time.

Command Format

Command Format	
Command	0x1A
Sub command	0x0B
Frame Count (1-BYTE)	0x??

Data Format

Data Format	
Data Buffer	Memory address of CDC frame

5.3.22.13. Sub Command 0x0C: Switch HV Mode

Description

The command is used for driver or application to switch HV mode.

Note: The command is only useful for IT7259E IC series

Command Format

Command Format

Command	0x1A
Sub command	0x0C
HV Mode (1-BYTE)	0x??

Data Format

Data Format	
Command Status	0x0000: Success

5.3.23. Command 0x1C: Auto Tune CDC

Description

The command is used to auto tune CDC value.

Command Format

Command Format	
Command	0x1C
Sub Command	None
Parameter	None

Data Format

Data Format	
Command Status	0x0000: Success

6. Data Report Format

Data report format is used to define the format for different data packet, such as point data, gestures.

To identify different data packet is by the format tag (MSB 4-bit) in the first byte of data report.

Byte	*Bit 7*	*Bit 6*	*Bit 5*	*Bit 4*	*Bit 3*	*Bit 2*	*Bit 1*	*Bit 0*
0	Format Tag				Packet Information			
1	Packet Information							
…								
13								

6.1. Point Data Report Format

IT7259 Cap Sensor chip reports the information about finger or pen position and state when it detects user's input.

The format tag of point data report is 0000b.

Byte	*Bit 7*	*Bit 6*	*Bit 5*	*Bit 4*	*Bit 3*	*Bit 2*	*Bit 1*	*Bit 0*
0	Format Tag (0000b)				Finger	Point Information		
1	Reserved							Palm
2	X Position [7..0] of Point 0							
3	Y Position [11..8] of Point 0				X Position [11..8] of Point 0			
4	Y Position [7..0] of Point 0							
5	Reserved				Pressure of Point 0			
6	X Position [7..0] of Point 1							
7	Y Position [11..8] of Point 1				X Position [11..8] of Point 1			
8	Y Position [7..0] of Point 1							
9	Reserved				Pressure of Point 1			
10	X Position [7..0] of Point 2							
11	Y Position [11..8] of Point 2				X Position [11..8] of Point 2			
12	Y Position [7..0] of Point 2							
13	Reserved				Pressure of Point 2			

Description:

Format Tag	Indicate the format type. For position information, the format tag is 0000b.
Point Information	Indicate which point information (Point 0 ---3) is available.
	xx1b = Point 0 information is available.
	x1xb = Point 1 information is available.
	1xxb = Point 2 information is available.
	000b = All fingers are removed.
Finger	0b = A pen is touched the screen.
	1b = The finger is touched the screen. (Maybe 1/2/3 fingers)
Palm	0b = No palm detection.
	1b = Palm detection.
X Position	The point location in X-axis of the screen.
	(Range: 000h-FFFh)
Y Position	The point location in Y-axis of the screen.
	(Range: 000h-FFFh)
Pressure	The capacitance of the point.
	0h = No finger contact.
	1h = Finger hovering near the screen.
	2h = Light finger contact.
	4h = Normal finger contact.
	8h = High finger contact.
	Fh = Heavy finger contact.

6.2. Gesture Report Data Format

Byte	*Bit 7*	*Bit 6*	*Bit 5*	*Bit 4*	*Bit 3*	*Bit 2*	*Bit 1*	*Bit 0*
0	Format Tag (1000b)				Reserved			
1	Gesture Identification (GID)							
2	Gesture Information							
…								
13								

6.3. Touch Event Report Format

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Format Tag (0100b)				Touch Type			
1	Touch Event Identification (TID)							
2	Touch Event Information							
…								
13								

6.3.1. Button

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Format Tag (0100b)				Touch Type (0001b)			
1	Touch Event Identification (TID : ID of button)							
2	Button Status 0x00 : Button up 0x01: Button down							
3	Reserved							
…								
13								

6.4. Wakeup Report Format

IT7259 Cap Sensor chip reports the information when wakeup from idle mode.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Format Tag (0001b)				Reserved			
1	Reserved							
…								
13								

7. Gesture

In this chapter, it defines the properties of all gestures that IT7259 firmware supports. All gestures have unique gesture identifications (GID).

Each gesture can contains information about direction, scale, and rotation parameters. So following description defines these parameters.

I. The using coordinate system of gestures is the origin at the upper left of screen.
II. The vector (1, 0) refers to toward right and vector (0, 1) refers to toward down.
III. The scale value of 2D-Gesture with positive value means zoom-in and negative value means zoom-out.
IV. The rotate value of 2D-Gesture with positive value means rotate clockwise and negative value means rotate anti-clockwise.
V. The count value of the gesture “Clockwise” is always greater than 1.

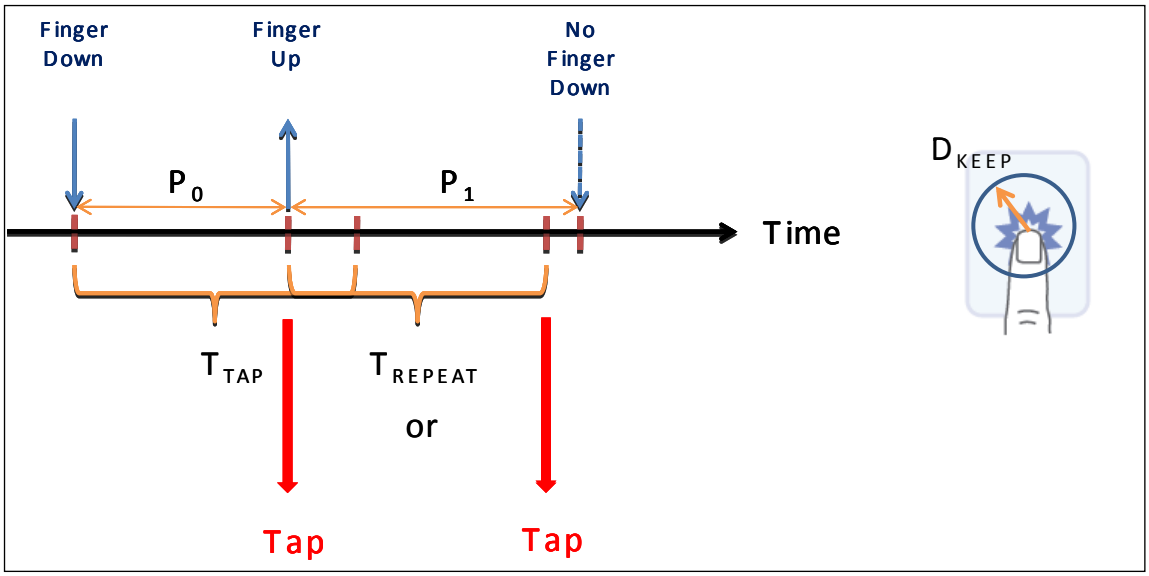
7.1. 1-Finger Gestures

Below table lists the 1-finger gestures.

GID	Gesture
0x20	Tap
0x21	Press
0x22	Flick
0x23	Double-Tap
0x24	Tap-and-Slide
0x25	Drag
0x26	Direction
0x27	Turn
0x28	Clockwise
0x29	Dir_4Way

7.2. Tap

- GID: 0x20
- Timing Diagram



- Properties

$P_0 \leqq T_{TAP}$

Moving distance $\leqq R_0$

P1 > T_{REPEAT} (Optional)

- Report Data Format

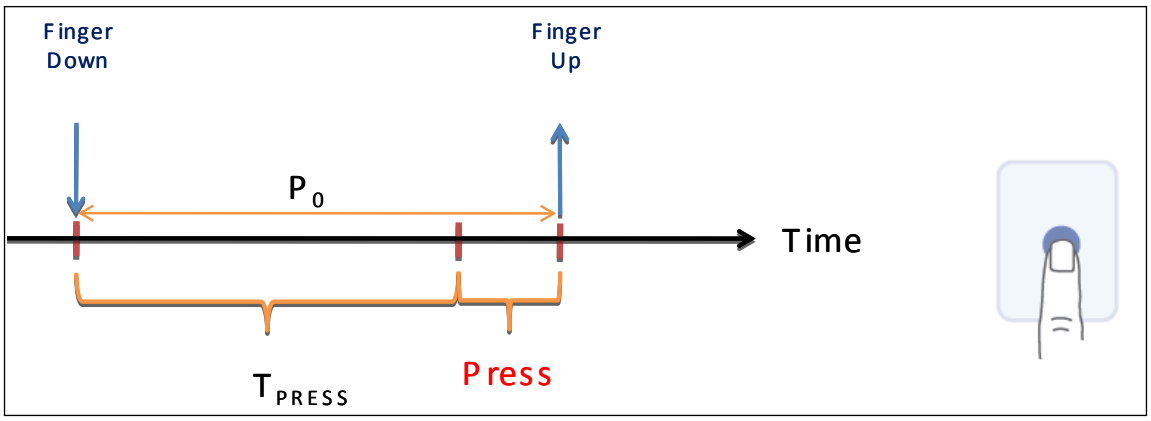
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Format Tag (1000b)				Reserved			
1	Gesture Identification (0x20)							
2	X Position of Point							
3								
4	Y Position of Point							
5								
6	Reserved							
…								
13								

- Description

None

7.3. Press

- GID: 0x21
- Timing Diagram



- Properties

$P_0 > T_{PRESS}$

Move distance $\leqq D_{KEEP}$

- Report Data Format

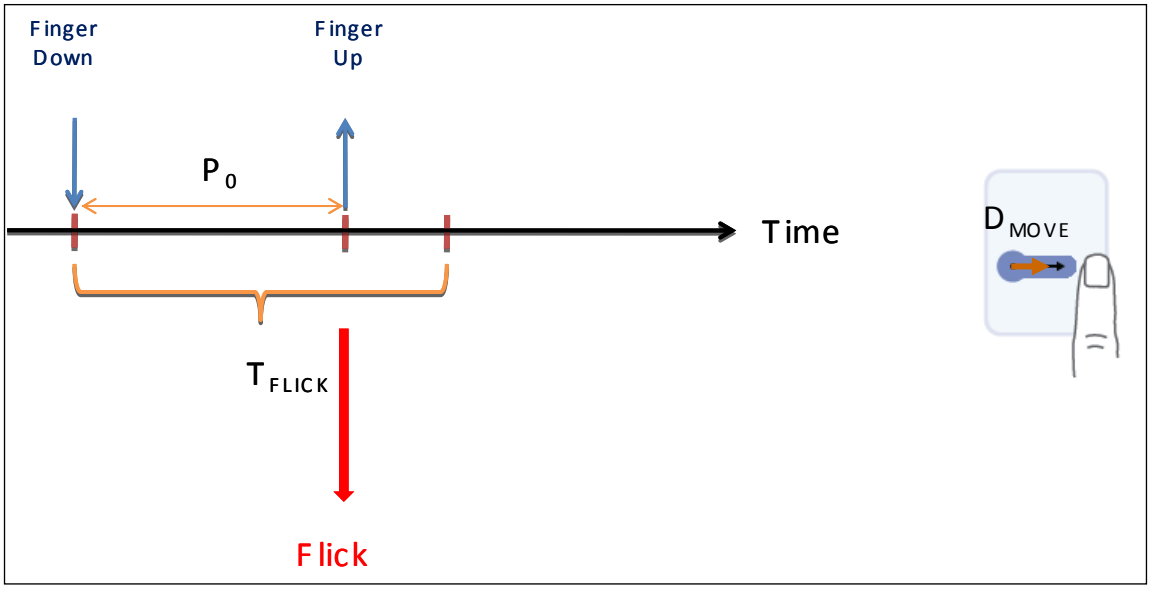
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Format Tag (1000b)				Reserved			
1	Gesture Identification (0x21)							
2	X Position of Point							
3								
4	Y Position of Point							
5								
6	Reserved							
...								
13								

- Description

None

7.4. Flick

- GID: 0x22
- Timing Diagram



- Properties

$P_0 \leqq T_{FLICK}$

Move distance > D_{MOVE}

- Report Data Format

Byte	*Bit 7*	*Bit 6*	*Bit 5*	*Bit 4*	*Bit 3*	*Bit 2*	*Bit 1*	*Bit 0*
0	Format Tag (1000b)				Reserved			
1	Gesture Identification (0x22)							
2	X Position of Start Point							
3								
4	Y Position of Start Point							

5	
6 7	X Position of End Point
8 9	Y Position of End Point
10	Flick Direction
11 … 13	Reserved

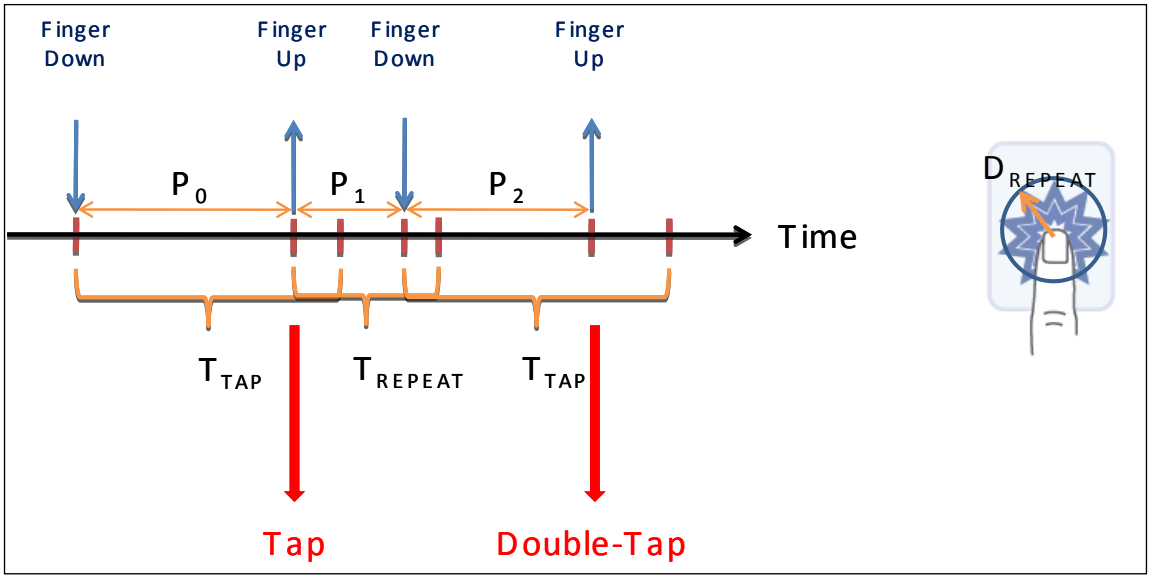
■ Description

Flick Direction		
High Nibble	**Low Nibble**	**Description**
0000b	0000b	Unmatched value or disabled now
0000b	1000b	Direction : Up
0000b	1001b	Direction : Upper right
0000b	1010b	Direction : Right
0000b	1011b	Direction : Lower right
0000b	1100b	Direction : Down
0000b	1101b	Direction : Lower left
0000b	1110b	Direction : Left
0000b	1111b	Direction : Upper left
1010b	1000b	Up and right
1100b	1000b	Up and down
1110b	1000b	Up and left
1000b	1010b	Right and up
1100b	1010b	Right and down
1110b	1010b	Right and left
1000b	1100b	Down and up
1010b	1100b	Down and right
1110b	1100b	Down and left
1000b	1110b	Left and up
1010b	1110b	Left and right
1100b	1110b	Left and down
1xxxb	0000b	N = xxxb, not all 0

		Clockwise N*45°
0xxxb	0000b	N = xxxb, not all 0 Anti-clockwise N*45°

7.5. Double-Tap

- GID: 0x23
- Timing Diagram



- Properties

$P_0 \leqq T_{TAP}, P_1 \leqq T_{REPEAT}, P_2 \leqq T_{TAP}$

Move distance $\leqq D_{REPEAT}$

- Report Data Format

Byte	*Bit 7*	*Bit 6*	*Bit 5*	*Bit 4*	*Bit 3*	*Bit 2*	*Bit 1*	*Bit 0*
0	Format Tag (1000b)				Reserved			
1	Gesture Identification (0x23)							
2	X Position of Point							
3								
4	Y Position of Point							
5								

6 *…* *13*	Reserved

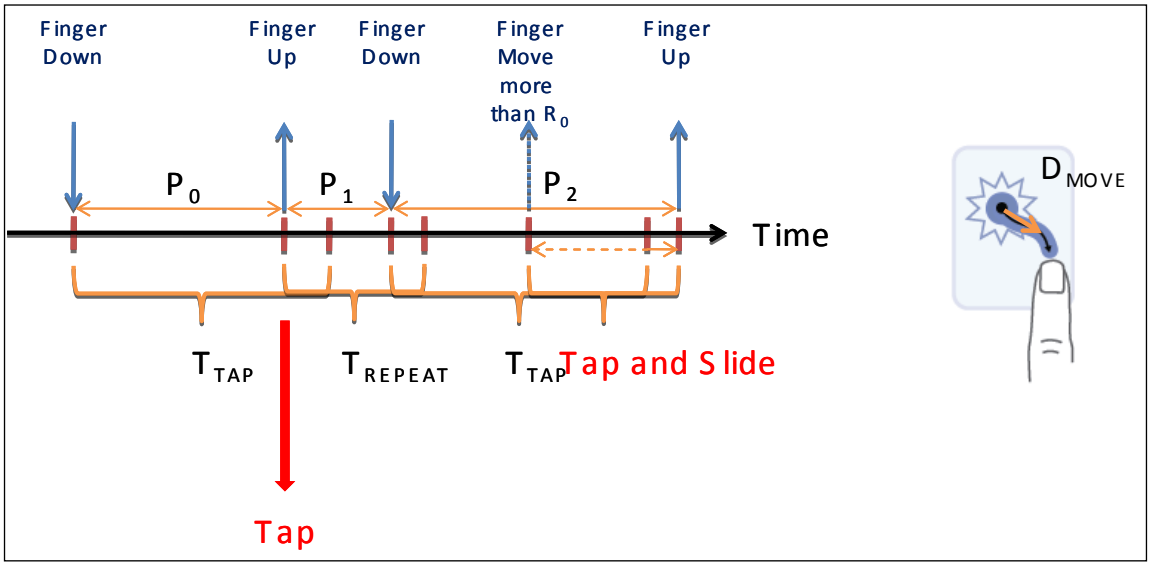
■ Description

None

7.6. Tap-and-Slide

■ GID: 0x24

■ Timing Diagram



■ Properties

$P_0 \leqq T_{TAP}, P_1 \leqq T_{REPEAT}$

Move distance > D_{MOVE} or $P_2 > T_{TAP}$

■ Report Data Format

Byte	*Bit 7*	*Bit 6*	*Bit 5*	*Bit 4*	*Bit 3*	*Bit 2*	*Bit 1*	*Bit 0*
0	Format Tag (1000b)				Reserved			
1	Gesture Identification (0x24)							
2	X Position of Point							

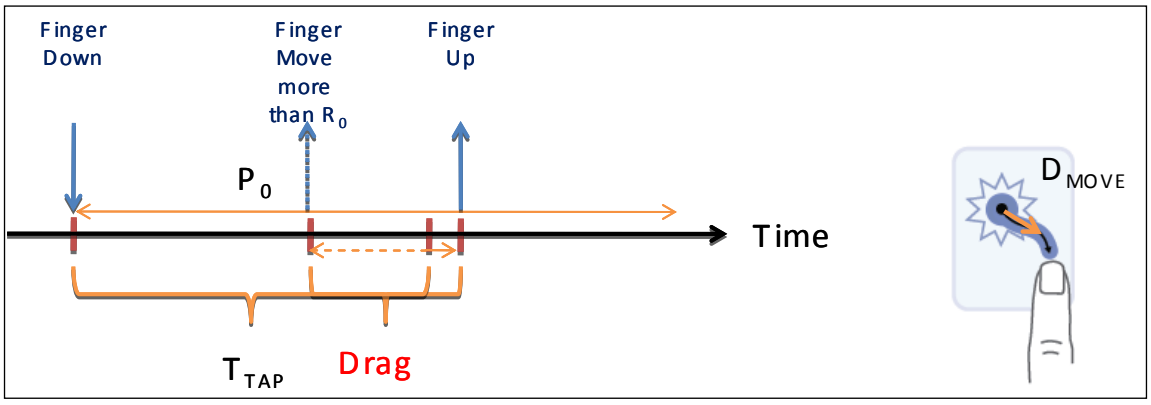
3	
4	Y Position of Point
5	
6	Reserved
…	
13	

- Description

None

7.7. Drag

- GID: 0x25
- Timing Diagram



- Properties

Move distance > D_{MOVE} or P_0 > T_{TAP}

- Report Data Format

Byte	*Bit 7*	*Bit 6*	*Bit 5*	*Bit 4*	*Bit 3*	*Bit 2*	*Bit 1*	*Bit 0*
0	Format Tag (1000b)				Reserved			
1	Gesture Identification (0x25)							
2	X Position of Point							
3								

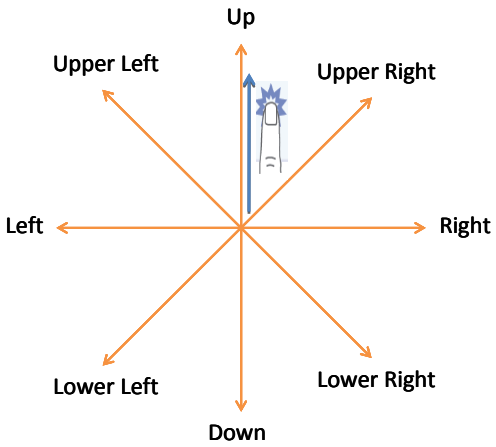
4 *5*	Y Position of Point
6 *…* *13*	Reserved

- Description

None

7.8. Direction

- GID: 0x26
- Timing Diagram



- Properties

Move distance > D_{MOVE} or P_0 > T_{TAP}

- Report Data Format

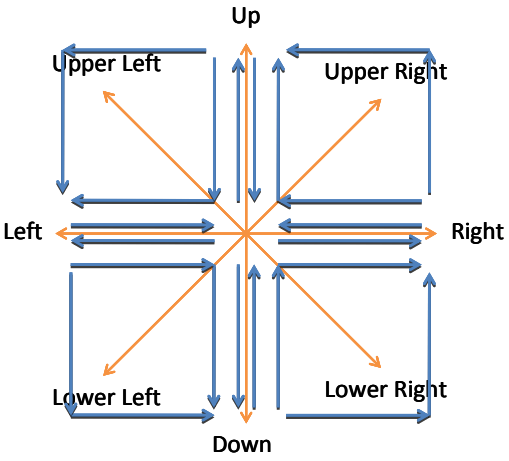
Byte	*Bit 7*	*Bit 6*	*Bit 5*	*Bit 4*	*Bit 3*	*Bit 2*	*Bit 1*	*Bit 0*
0	Format Tag (1000b)				Reserved			
1	Gesture Identification (0x26)							
2	Reserved				1	Direction		
3	Reserved							

- Description

Direction	
000b	Up
001b	Upper right
010b	Right
011b	Lower right
100b	Down
101b	Lower left
110b	Left
111b	Upper left

7.9. Turn

- GID: 0x27
- Timing Diagram



- Properties

Move distance > D_{MOVE} or P_0 > T_{TAP}

- Report Data Format

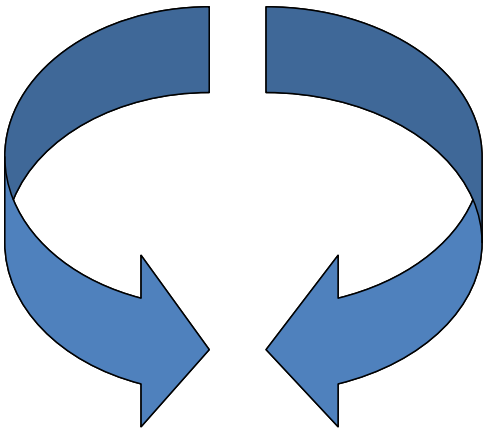
Byte	*Bit 7*	*Bit 6*	*Bit 5*	*Bit 4*	*Bit 3*	*Bit 2*	*Bit 1*	*Bit 0*
0	Format Tag (1000b)				Reserved			
1	Gesture Identification (0x27)							
2	1	End direction			1	Start direction		
3	Reserved							
…								
13								

- Description

Start/End Direction	
000b	Up
010b	Right
100b	Down
110b	Left

7.10. Clockwise

- GID: 0x28
- Timing Diagram



- Properties

Move distance > D_{MOVE} or P_0 > T_{TAP}

- Report Data Format

Byte	*Bit 7*	*Bit 6*	*Bit 5*	*Bit 4*	*Bit 3*	*Bit 2*	*Bit 1*	*Bit 0*
0	Format Tag (1000b)				Reserved			
1	Gesture Identification (0x28)							
2	CW	Count			Reserved			
3	Reserved							
…								
13								

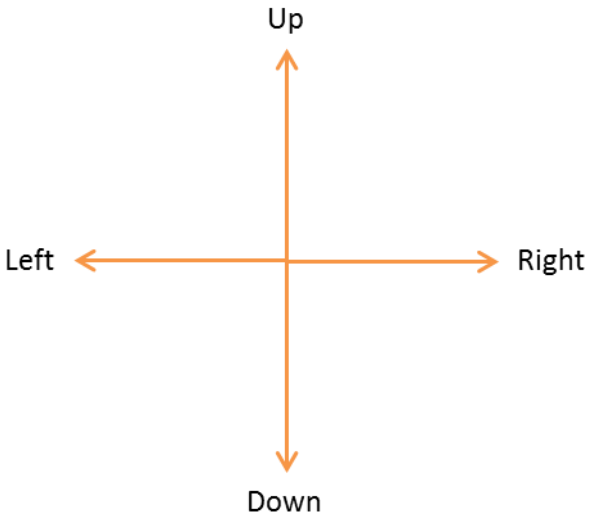
- Description

Degree = 45° * Count

CW(Clockwise value)	
1b	Clockwise
0b	Anti-clockwise

7.11. Dir_4Way

- GID: 0x29
- Timing Diagram



- Properties

Report only 4 way(Up, Right, Down, Left) when enable Dir_4Way

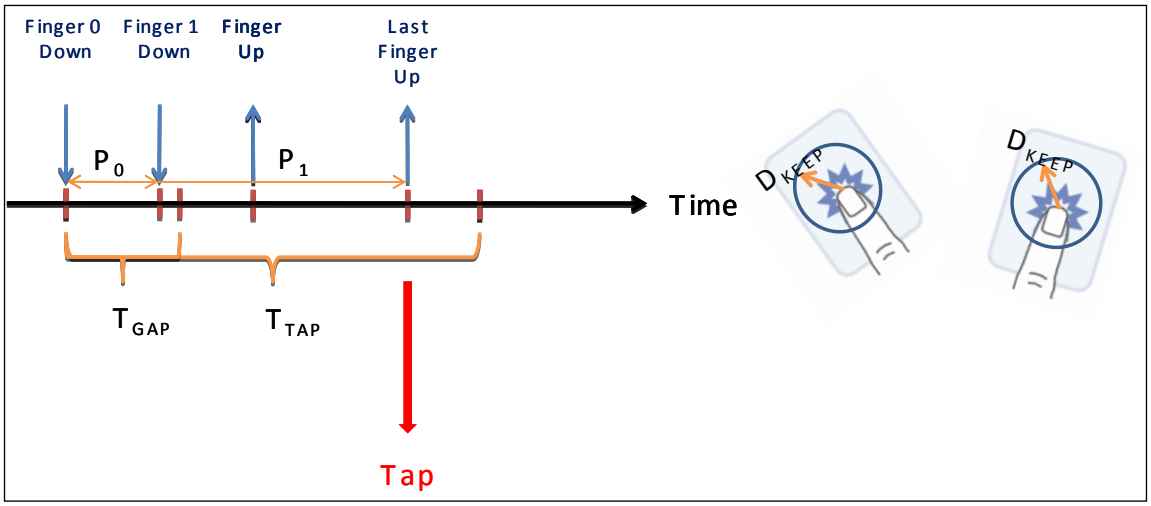
7.12. 2-Finger Gestures

Below table lists the 2-finger gestures.

GID	Gesture
0x40	Tap
0x41	Double-Tap
0x42	2D Gesture

7.13. Tap

- GID: 0x40
- Timing Diagram



- Properties

$P_0 \leqq T_{TAP}$

$P_1 \leqq T_{TAP}$

- Report Data Format

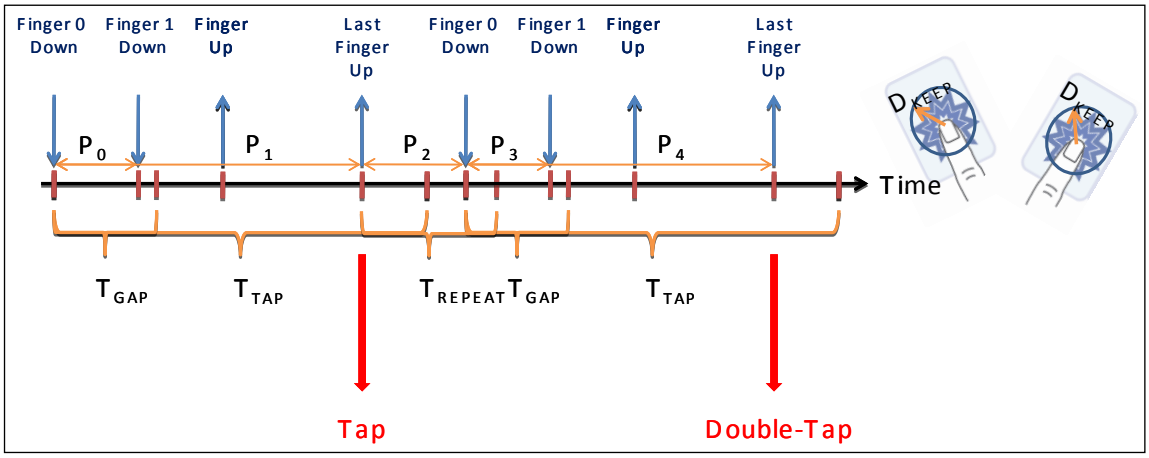
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Format Tag (1000b)				Reserved			
1	Gesture Identification (0x40)							
2	X Position of Point 0							
3								
4	Y Position of Point 0							
5								
6	X Position of Point 1							
7								
8	Y Position of Point 1							
9								
10	Reserved							
…								
13								

- Description

None

7.14. Double-Tap

- GID: 0x41
- Timing Diagram



- Properties

$P_0 \leqq T_{GAP,} P_1 \leqq T_{TAP,} P_2 \leqq T_{REPEAT,} P_3 \leqq T_{GAP,} P_4 \leqq T_{TAP}$

Move distance $\leqq D_{KEEP}$ for each finger

- Report Data Format

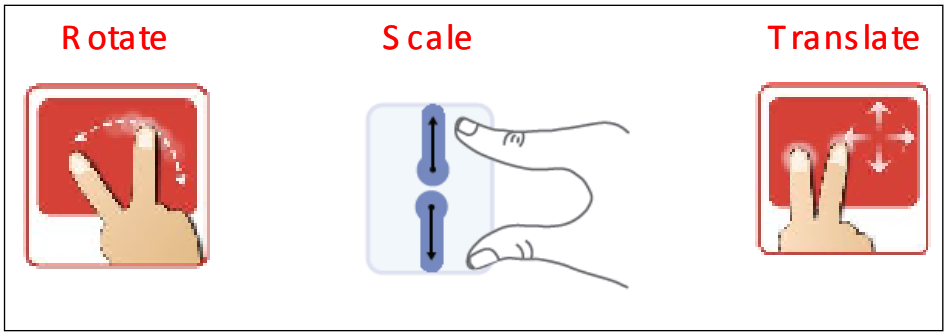
Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Format Tag (1000b)				Reserved			
1	Gesture Identification (0x41)							
2 3	X Position of Point 0							
4 5	Y Position of Point 0							
6 7	X Position of Point 1							
8 9	Y Position of Point 1							
10 … 13	Reserved							

- Description

None

7.15. 2D Gesture (Rotate + Scale + Translate)

- GID: 0x42
- Timing Diagram



■ Report Data Format

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Format Tag (1000b)				Reserved			
1	Gesture Identification (0x42)							
2 3	X Quantity of Translate Vector							
4 5	Y Quantity of Translate Vector							
6 7	Scale = new length – old length							
8 9	Rotate Degree (Unit: 0.01 degree, Signed)							
10 … 13	Reserved							

■ Description

The return value of rotate is a vector which has the same degree

The return value of scale is the difference of distance of two fingers.

The return value of translate is a vector.

8. Firmware Flow Charts

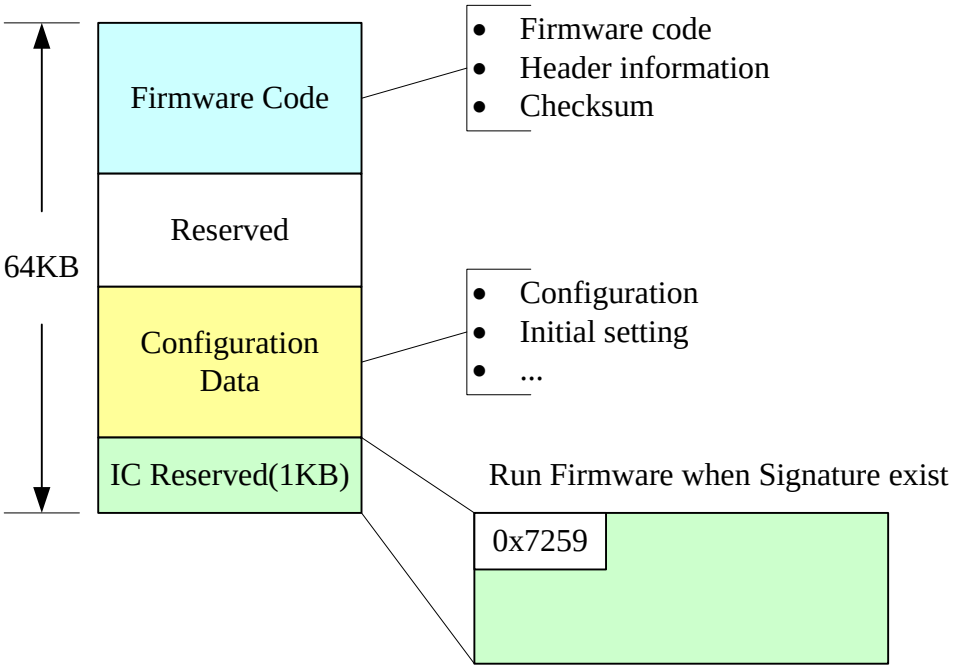
8.1. Flash Property

IT7259 fetch code from SPI-Flash. The properties of SPI-Flash are as below.

1. The size of SPI-Flash is 64KB.
2. The last page(1KB) is reserved for IT7259 IC used, so that size of f/w and configuration is up to 63KB.
3. The SPI-Flash memory space is 0x3000~0x33FF(1KB), according to assigned sector.
4. Before program operation, SPI-Flash must be erased. The unit of erase operation is 1 sector, the size of 1 sector is 1KB, and it must be aligned with 1KB boundary.

8.2. Flash Layout

IT7259 has 64KB flash which is used to store firmware and configuration data.



8.3. Firmware Header Information

The **Header Information** is located at offset address **0x80**, and length is 16bytes. The header information consists of signature, version and size.

F/W Header Information (16 Bytes)			
Signature “IT7259FW” (8 Bytes)	Version (4 Bytes)	Size (2 Bytes)	Reserved (2 Bytes)

The size of signature and version information is 16 bytes. The format of the signature is 8-byte ASCII code “IT7259FW”. The version information is 4-byte hexadecimal value “ABCD”. The size information is 2-byte value which represents the size in byte. For example, if the 16 bytes is “IT7259FW” 0x01 0x02 0x00 0x00 0x00 0x10 0x00 0x00, that means the firmware version is 1.2.0.0, the firmware size is 4KB.

8.4. Firmware Checksum

The **Checksum** is 2-byte length and is located at the end of the firmware data. The checksum is calculated from firmware data except itself.

8.5. Configuration Information

Configuration data has a 16-byte configuration information in the end of the file which is used to identify it is used for IT7259 configuration setting. Below is the format of configuration signature, version, and size information.

Extended Information (16 Bytes) [Optional]				
Configuration Information (16 Bytes)				
Signature “CFG-59” (6 Bytes)	Size (2 Bytes)	Version (4 Bytes)	Setting (2 Bytes)	Checksum (2 Bytes)

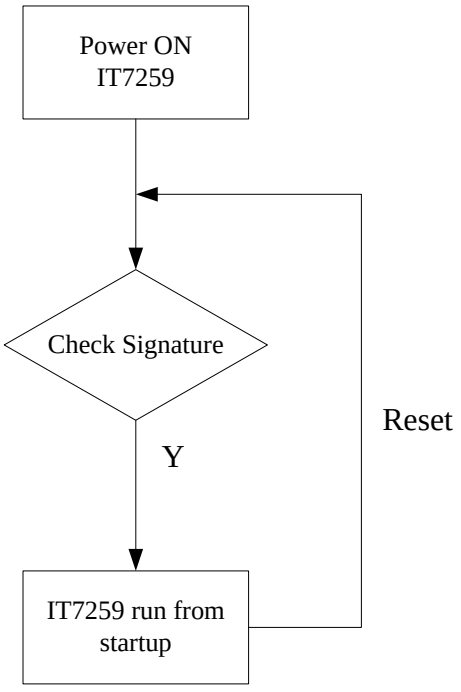
The size of configuration information is 16 bytes. The format of the signature is 6-byte ASCII code “CFG-59”. The size information is 2-byte value which represents the size in byte. The version information is 4-byte value which represents the version of configuration. For example, if the 16 bytes is “CFG-59” 0x00 0x04 0x01 0x00 0x00 0x02 0xA0 0x46 0x12 0x34, which means this is configuration data of IT7259, the size is 1KB, configuration version is

1.0.0.2, I2C slave address is 0x46, and the checksum value is 0x3412. When bit 11 of Setting is set to 1, Extended Information is enable and user defined data is stored here.

Below is the definition for field "Setting". Its default value is 0x0000.

Bit	Description
15 ←→ 12	0xA : Enable I2C Slave Address Setting Others : Disable I2C Slave Address Setting
11	1 : Enable Extended Information 0 : Disable Extended Information
10 ←→ 8	Reserved
7 ←→ 0	I2C Slave Address (7-bit)

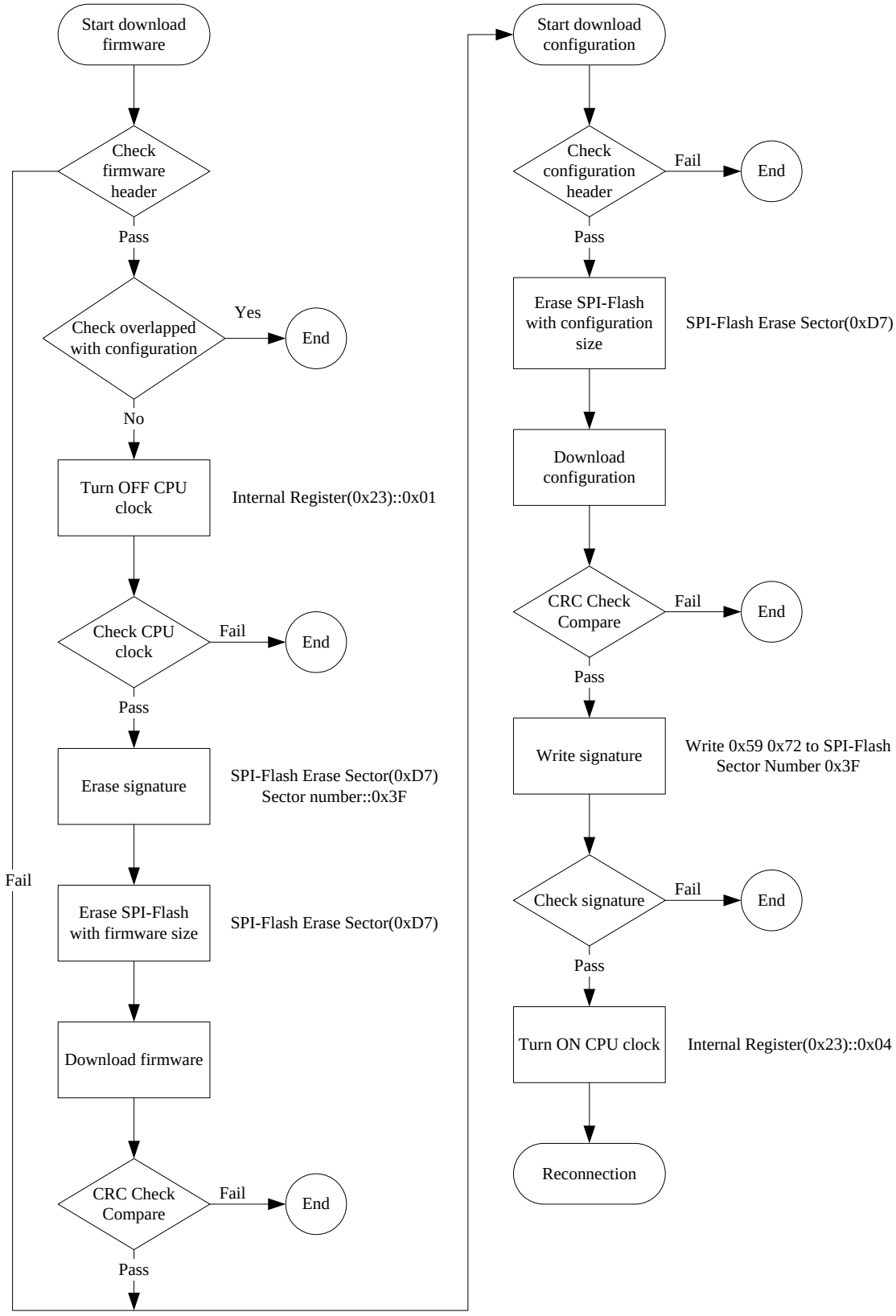
8.6. System Flow Chart



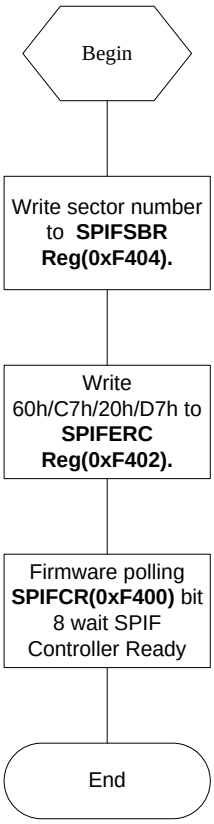
Signature

Sector63 in the SPI-Flash	
Byte 0	Byte 1
0x59	0x72

8.7. Firmware & Configuration Upgrade Flow

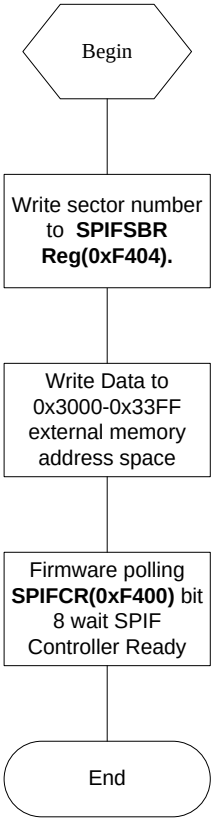


8.8. SPI-Flash Chip/Sector Erase Operation Flow Chart

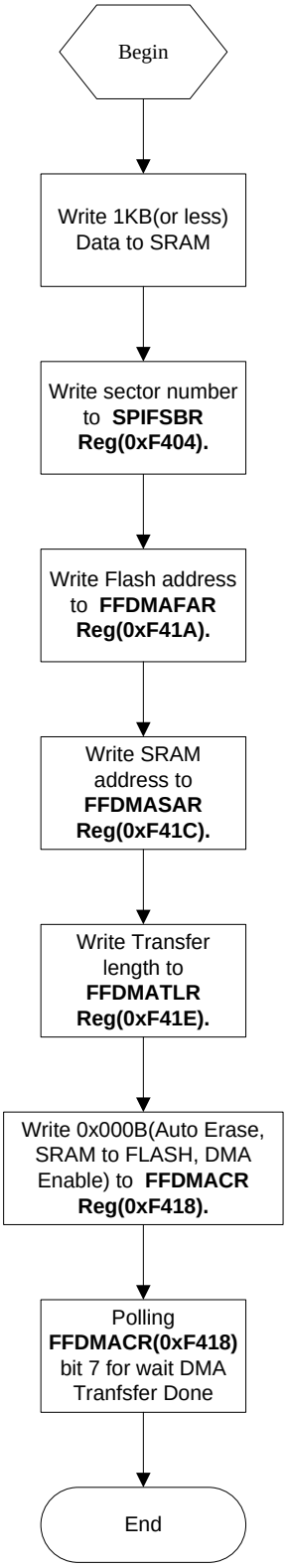


8.9. SPI-Flash Program Operation Flow Chart

This page program operation is the preference SPI-Flash writing operation at this chip, it must need erase operation before the write action. A program operation can alter “1”s into “0”s, but an erase operation is required to change “0”s back to “1”s. A byte cannot be reprogrammed without first erasing the whole sector or block.



8.10. SPI-Flash Program DMA Operation Flow Chart



9. Hardware Reset

IT7259 supports hardware reset de-glitch function. The reset pulse will be ignored when the pulse width is less than 1us. In addition, IT7259 will enter the sleep mode when the pulse width is larger than 1ms.

Figure 9-1. Definition of Timing for Hardware Reset

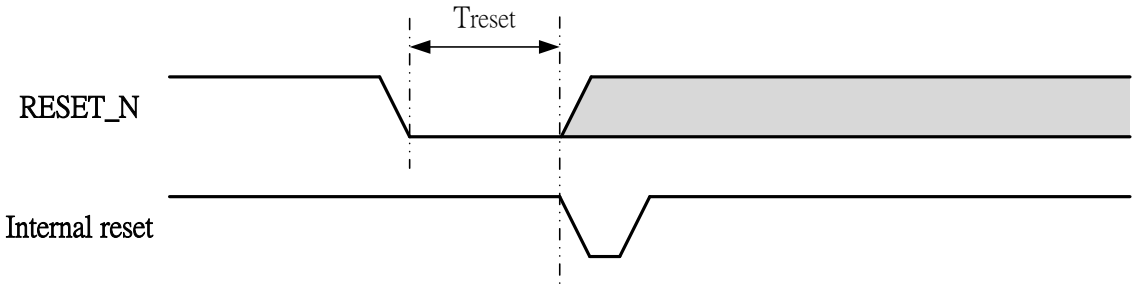


Figure 9-2. Definition of Timing for Sleep Mode

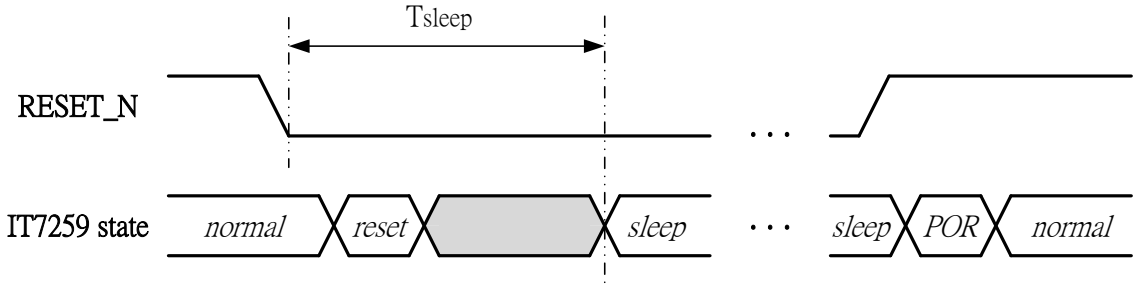


Table 9-1. Hardware Reset Timing

Symbol	Parameter	Min.	Typ.	Max.	Unit
Treset	Hardware Reset Timing	1	2	10	us
Tsleep	Sleep Mode Timing	1	2	-	ms

10. Error Code Table

Below is the error code table. The error code is used to indicate which problem occurred when the host sent command to IT7259, and it can be gets from the Command Response Buffer when the Query status indicates some error is happened.

Name	Error Code	Description
ERR_SUCCESS	0x0000	No error. Or firmware is already in death loop, so it cannot set error code.
ERR_BAD_CMD	0x0001	Unknown command.
ERR _BAD_SUBCMD	0x0002	Unknown sub command.
ERR _SIZE	0x0003	Incorrect data length or count.
ERR _BAD_DATATYPE	0x0004	When Read/Write memory, data type is not valid
ERR _BOUNDARY	0x0005	In Memory or Flash, offset + size > boundary.
ERR _BAD_PARAMETER	0x0006	Incorrect parameter value.
…	…	…
ERR _INVALID_KEY	0x0010	Invalid firmware upgrade key.
ERR _BAD_MODE	0x0011	Write flash operation is failed since it is not in firmware upgrade mode.
ERR _BAD_OFFSET	0x0012	Write flash operation is failed since the offset is not in page boundary.
ERR _FLASHSIZE	0x0013	Read / Write flash data length is incorrect.
ERR _BAD_ID	0x0014	Incorrect configuration ID.
ERR _BOOTLOADER	0x0015	Information is not available since program is running in bootloader.
ERR_FLASH	0x0016	Information is not available since program is running in flash.
ERR_SUPPORT	0x0017	Operation is not supported.
…	…	…
ERR _UNKNOWN	0xFFFF	Unknown error.