eKT8150

Capacitive Touch Pad Controller

Product Specification

DOC. VERSION 1.0

ELAN MICROELECTRONICS CORP.

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Contents

Specification Revision History

Doc. Version	Revision Description	Date
1.0	Preliminary version	2007/07/01

1 Introduction

The eKT8150 is a low-cost single chip solution for capacitive touch pad. It is an 8-bit RISC microcontroller with Serial Peripheral Interface (SPI-Master/Slave), Universal Asynchronous Receiver / Transmitter (UART 9600), and I2C-Slave (Normal/Fast Mode).

In function application, the eKT8150 supports slider information (absolute position) and key information (On/Off) for customers.

The capacitive touch pad sensor is covered with a plastic case. It can also auto calibrate the parameters for a wide range of capacitance on the touch pad sensor (5pF~25pF). The system controller converts finger position data to either scrolling data or button presses, depending on finger location and human interface context.

2 Features

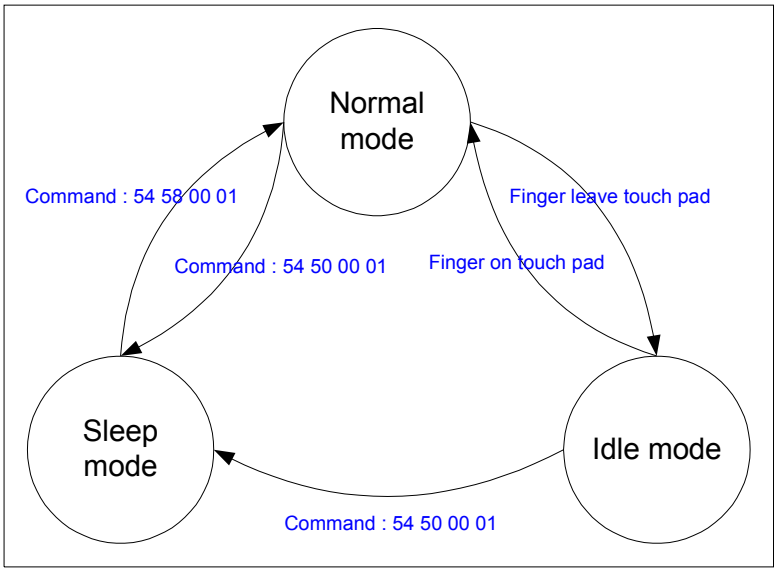
- Operating voltage: 2.6V ~ 5.5V, Ripple < 100mVpp
- Power-on reset time: Stable time for operating < 150ms, the touch pad will send "Packet Hello" after initialization
- Interface features: Serial Peripheral Interface (SPI-Master/Slave) / Universal Asynchronous Receiver Transmitter (UART) / I2C-Slave.
- Operating mode:

Mode	Description	Current
Normal	1. Finger on touch pad 2. Higher scan rate	<1.5 mA
Idle	1. Finger leaves touch pad 2. Lower scan rate 3. Scan rate in idle mode can be adjusted by changing the external RC value.	<200 µA
Sleep	No scan	<20 µA

- Application mode:
  - 1 Slider (0 ~ 79) + 6 Keys (ON/OFF). Default setting.
  - 1 Long Slider (0 ~ 207).
- Useful Information

  Slider information and Buttons information can be acquired through protocol decode.
- Sensitivity: Sensitivity can be adjusted from 0 to 10 for different thickness of the plastic cover. The default label is "4".
- Package type: QFN40

3 Three-Mode State Transition



4 Interface Description

4.1 UART Interface

The UART interface parameter is 9600 baud rate with no parity check and 8 bits in length. The following diagram shows the system functional blocks including UART interface. The controller detects an object on the touch pad sensor and sends the information to host.

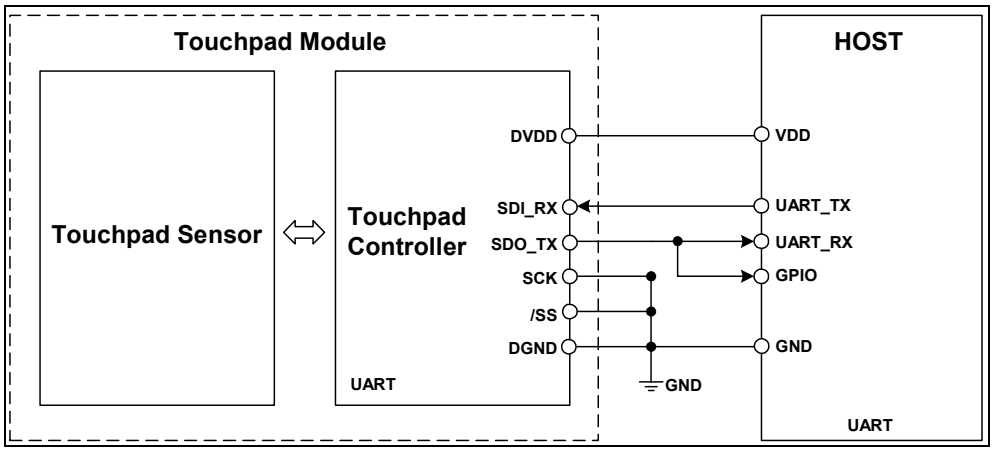


Fig. 4-1 System Block Diagram and UART Interface

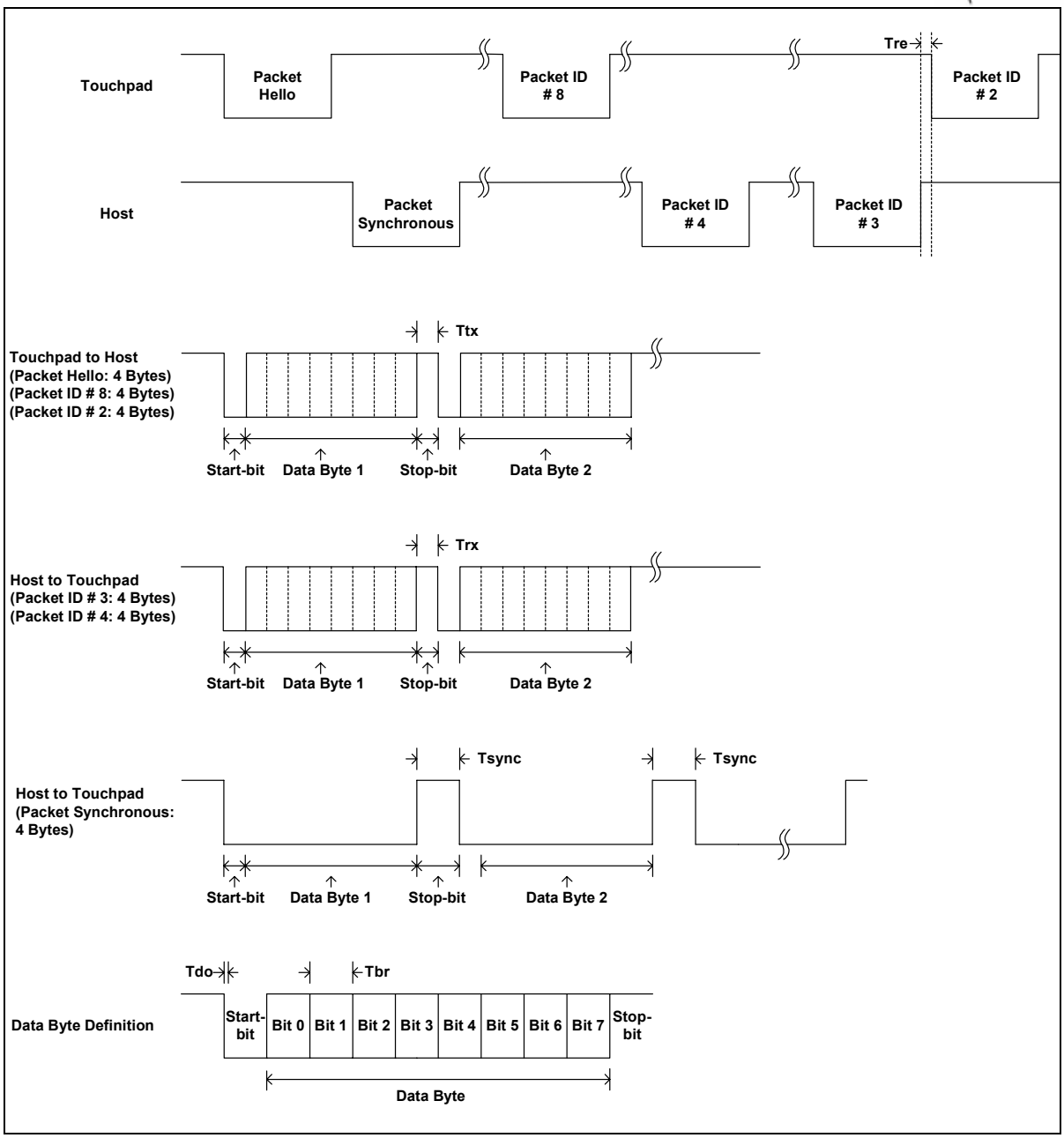


Fig. 4-1A Timing diagram for UART interface mode

The timing conditions are as follows:

Tre: 56 µs (typical), Touchpad response time after the host send command inquiring information from eKT8150

Ttx: 56 µs (typical), Stop-bit timing for touchpad to host communication

Trx: 104 µs (Minimum), Stop-bit timing for host to touchpad communication

Tsync: 250 µs (Minimum), Stop-bit timing after Packet Synchronous

Tdo: 100 ns (Maximum), Start-bit falling edge timing from high to low

Tbr: 104 µs (Typical), Timing of one bit (include of Start-bit)

4.2 SPI Master Interface

The Serial Peripheral Interface (SPI) is a 4-wire serial communications interface used by many microprocessor peripheral chips. It consists of two data pins, a device-select pin, and a clock pin and always transfers data in 8-bit blocks. The SPI provides communication with external devices in master or slave mode.

If the eKT8150 is configured as master controller, it controls the data flow by generating the SPI serial clock. If the touch pad controller is configured for slave mode the eKT8150 acts as slave and accepts new data from the master (host controller) into its shift register, while it transmits requested data out of the shift register through its SPI transmit data pin, based on both the clock rate and the selected edge.

The detection if eKT8150 is master or slave takes place during the power-on phase. When the touch pad controller is ready for operation, it will send “Packet Hello” to host.

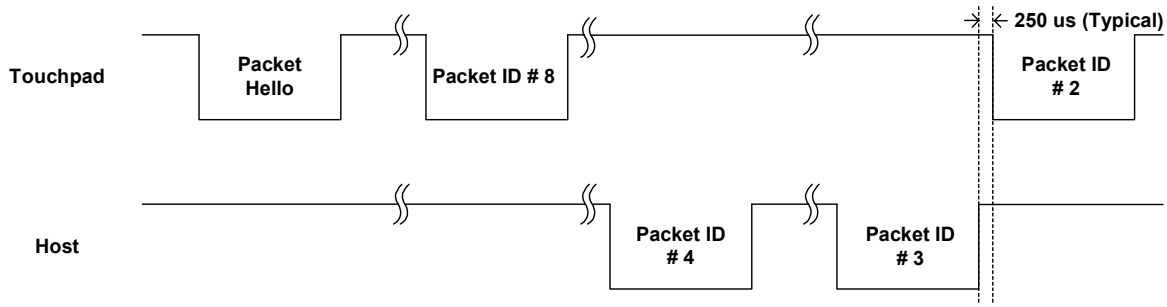


Fig. 4.2A Example for SPI communication

The SPI protocol defines four combinations of SCK phase and polarity with respect to the data. If a chip has control bits to set these four states, they are generally referred to as CPOL (clock polarity) and NCPHA (clock phase). CPOL is used to determine the inactive state value of the serial clock (SCK). NCPHA determines which edge of SCK causes data to change and which edge causes data to be captured. CPOL and NCPHA are used to produce a desired clock/data relationship between master and slave devices.

For the eKT8150, the SPI communication clock timing is shown in Fig 4-2B, whereas CPOL and NCPHA are defined as: CPOL = 1; NCPHA = 0

The settings mean the inactive state value of SCK is logic level one and data is latched at the rising edge of SCK. The data is shifted out and in start from MSB to LSB.

MOSI is the relation between SDO to SCK while the touch pad controller is defined as SPI master. MISO is the relation between SDO to SCK while the touch pad controller is defined as SPI slave.

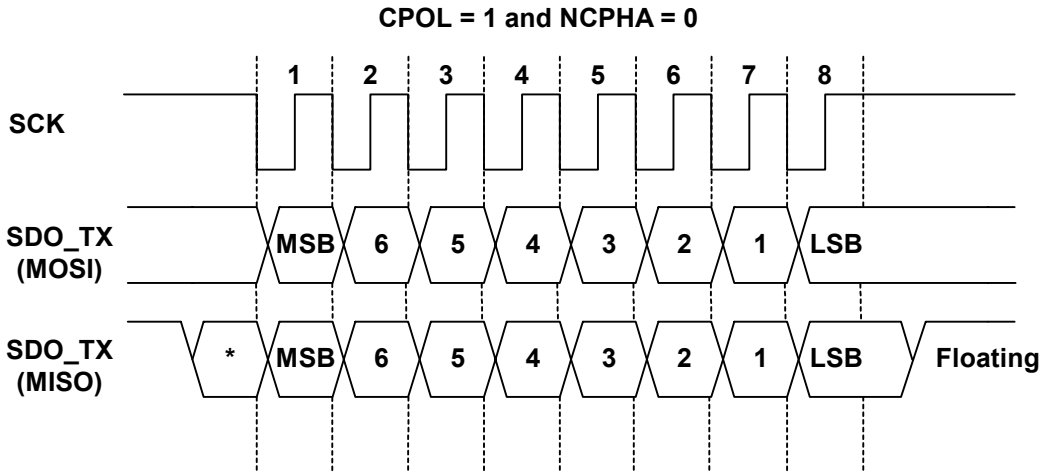


Fig. 4-2B CPOL and NCPHA timing of SPI

A typical packet transfer is shown below (Fig. 4-2C). The Packets are Packet Hello, Packet ID#2, Packet ID#3, Packet ID#4 and Packet ID #8, and are designed with the MSB always equal to "0" and the LSB always equal to "1".

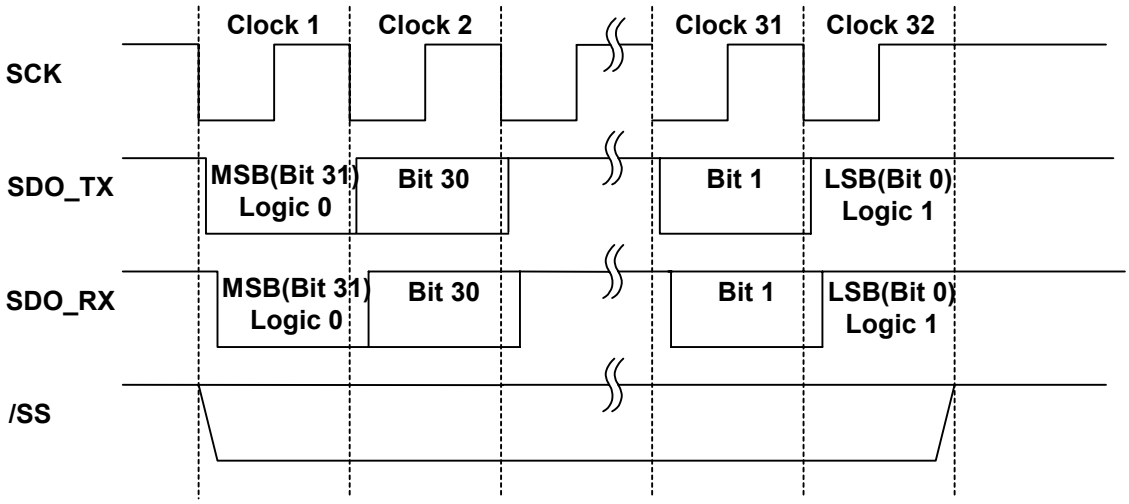


Fig. 4-2C SPI Packet Transmission (32 bits)

The SPI master interface parameter is 23 kHz, 8 bits in length, MSB first. The following diagram shows the system functional blocks through SPI master interface. The controller detects an object on the touch pad sensor and sends the information to host.

Although this controller is a master device, but the host can send commands to the touch pad by driving the /SS pin low.

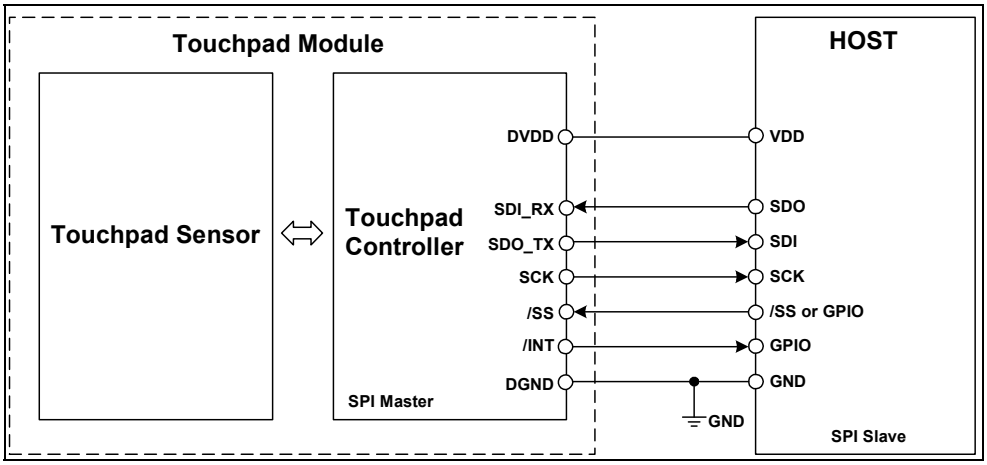


Fig. 4-2D System Block Diagram and SPI Master Interface

The timing of SPI master mode is defined below:

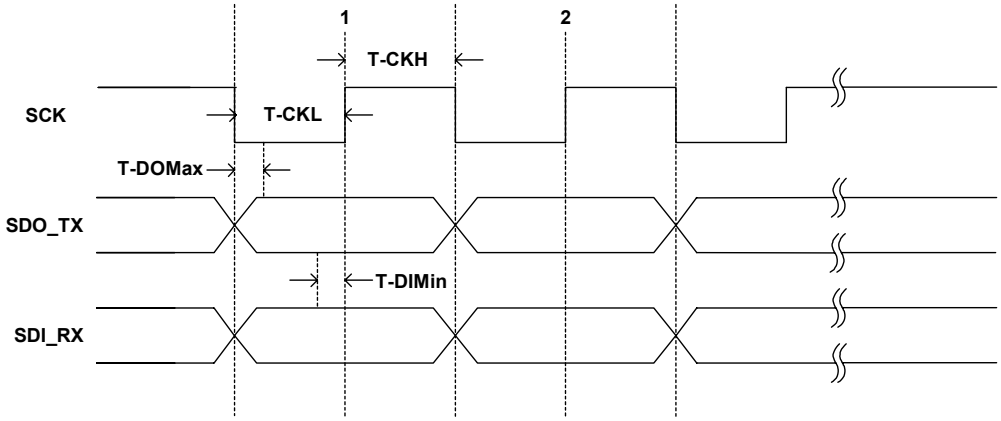


Fig. 4-2E Timing diagram for SPI master mode

The timing conditions are as follows:
- T- CKH: 20.3 µs (± 10%), Time of Clock High
- T- CKL: 20.3 µs (± 10%), Time of Clock Low
- T- DOMax: 250 ns, Maximum prepare time to send Data out
- T- DIMin:250 ns, Minimum prepare time to latch Data in

When the eKT8150 wants to send reports to the host, it will pull-low the /INT signal. The touch pad controller will start to send the first clock and data to the host after the time of "TTr_Start_0" (~ 100 µs). The interval time between each clock byte is "TByte_Interval" (~ 50 µs). After the report transmission, the touch pad controller will pull-high again the /INT signal (see Fig. 4-2F).

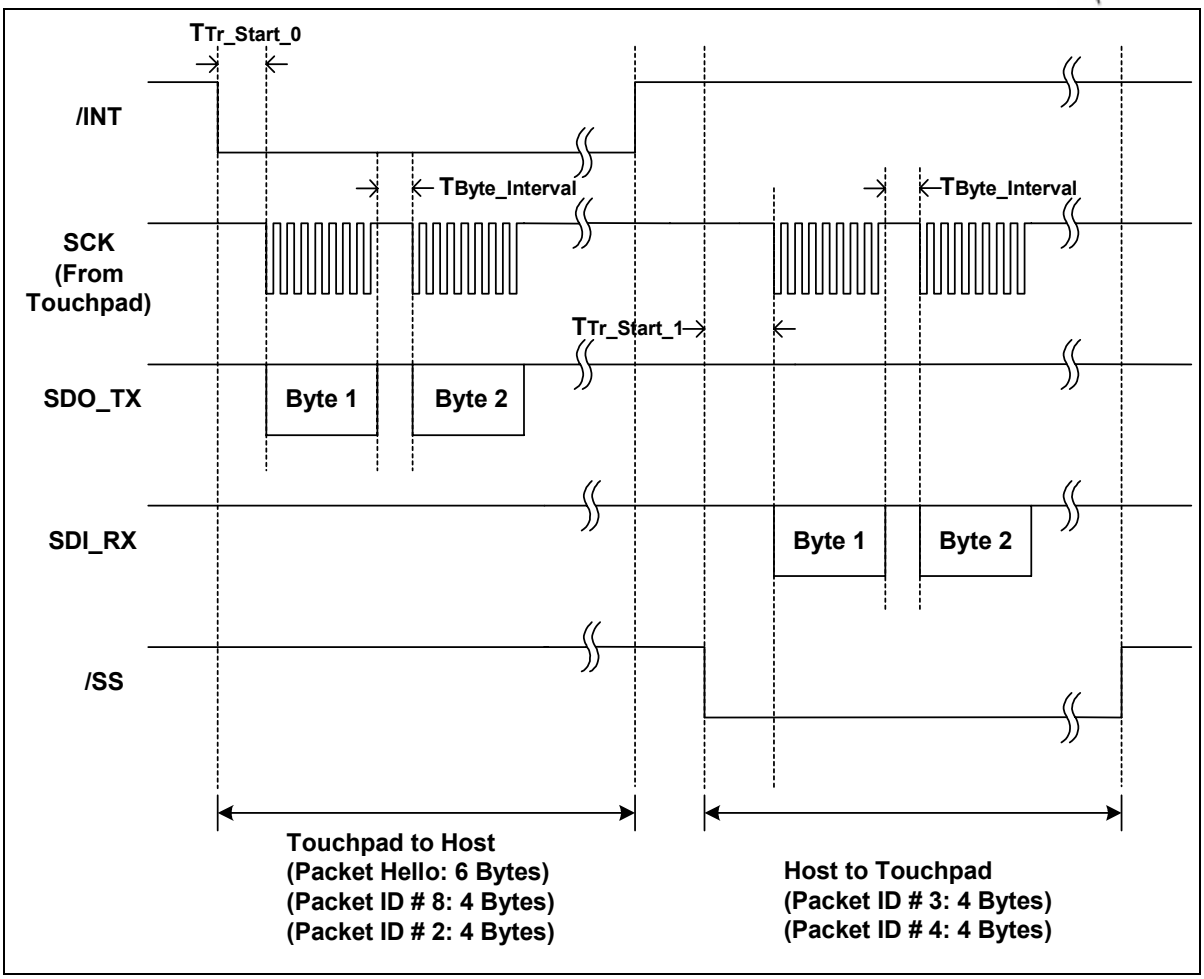


Fig. 4-2F Data transmission and Receiving in SPI master mode

Although the eKT8150 is the SPI master, the host can send commands to the touch pad controller by driving /SS pin to low. When the touch pad controller detects the low state of the /SS pin, it will start to send the first clock to the host after “TTr_Start_1” (~ 250 µs). The interval time between each clock byte is “TByte_Interval” (~ 50 µs) (see Fig. 4-2F).

4.3 SPI Slave Interface

For SPI slave mode selection, the /SS pin has to be tied to GND (see Fig. 4-3).

In SPI Slave mode, the host processor has to provide the SPI clock signal (SCK).

To inform the host that new data is available, the eKT8150 will pull low the /INT signal, so the host can start data transmission. After data transmission, the eKT8150 will pull high the /INT signal again.

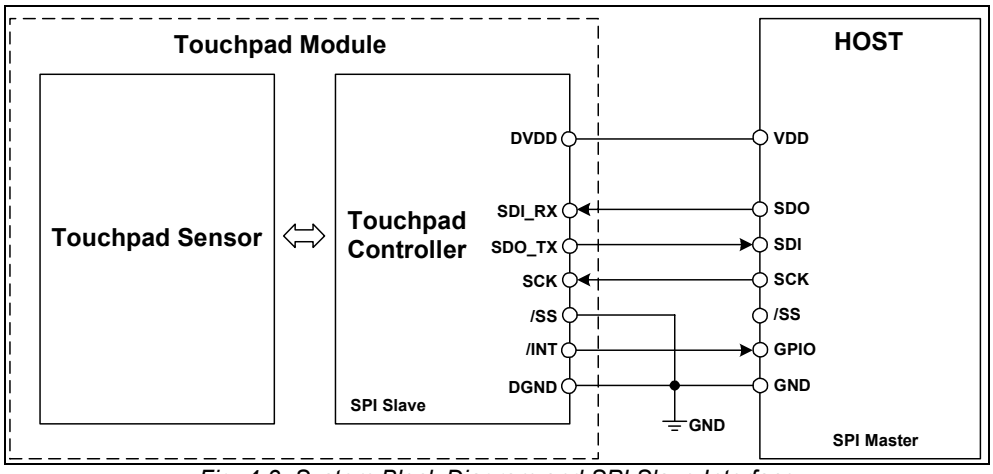


Fig. 4-3 System Block Diagram and SPI Slave Interface

If the eKT8150 is configured for slave mode the touch pad controller acts as slave and accepts new data from the master (host controller) into its shift register, while it transmits requested data out of the shift register through its SPI transmit data pin - based on both, the clock rate and the selected edge.

In SPI slave mode, the touch pad controller supports a maximum SPI bit rate of 1.2 Mbps. It detects each change of slider and button state. To inform the host that new data is available, the eKT8150 will pull-low the /INT signal. After the data transmission, the touch pad controller will pull-high the /INT signal again (see Fig. 4-3A).

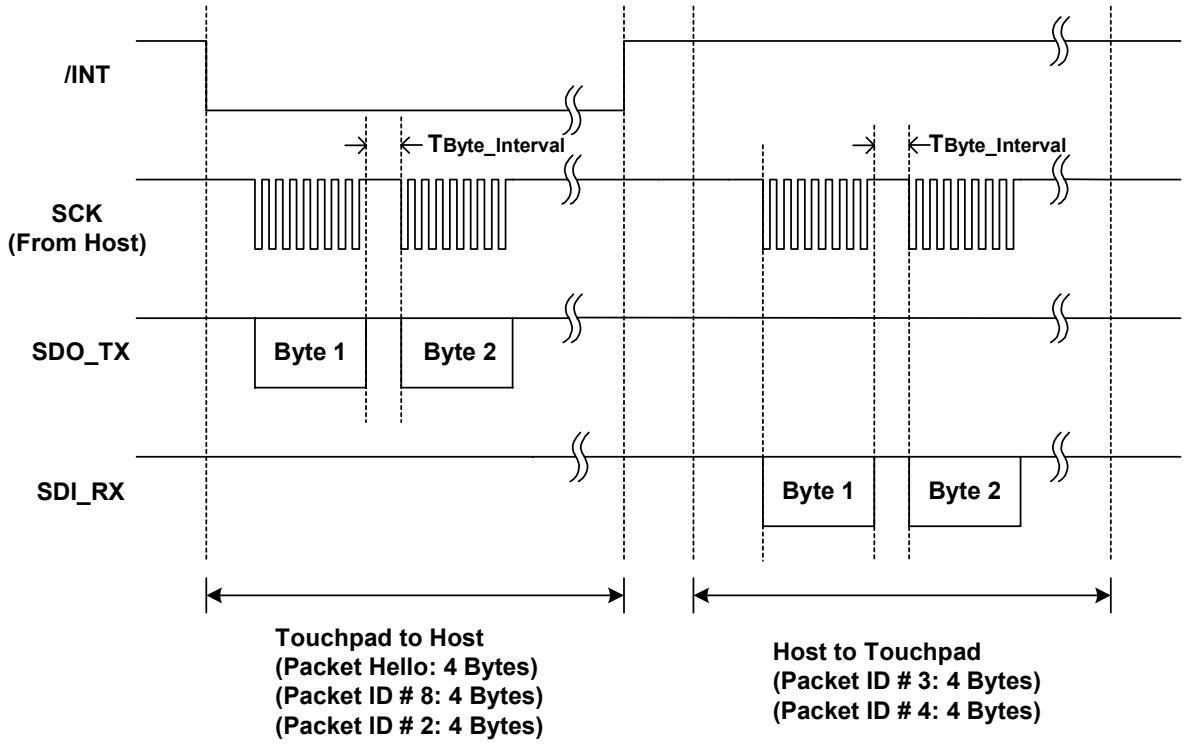


Fig. 4-3A Data transmission and Receiving in SPI slave mode

In SPI slave mode, the eKT8150 will pull-low the /INT signal, when the host sends a command where the touch pad controller has to reply to (Packet ID # 3). The interval time between each clock byte, generated by the host, has to be longer than "$T_{Byte\_Interval}$" (50 µs) (see Fig. 4-3A).

The commands receiving from host always have priority. In case the touch pad controller is sending a Packet ID, while the host is sending a command, the touch pad controller will stop sending its Packet ID, start receiving the command from host and respond accordingly.

4.4 I2C Slave Interface

For I2C slave mode selection, the SDI_RX、/SS pin has to be tied to GND. Further, the serial data signal SCK_SCL and SDO_SDA_TX have to be pulled-high with a 1kΩ resistor (see Fig. 4-4). In I2C slave mode, the host processor has to provide the I2C serial clock signal (SCL).
To inform the host, that new data is available, the touch pad controller will pull-low the /INT signal, so the host can start the data transmission. After data transmission, the touch pad controller will pull-high the /INT signal again.

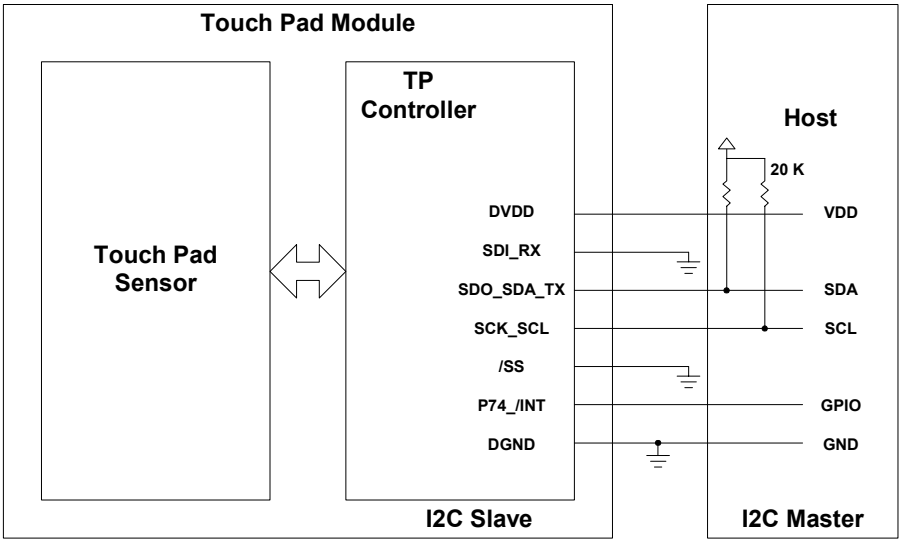


Fig. 4-4 System block diagram in I2C slave mode

If the touch pad controller is configured for slave mode the touch pad controller acts as slave and accepts new data from the master (host controller) into its buffer register, while it transmits requested data out of the buffer register through its I2C transmit data pin - based on the clock rate.

In I2C slave mode, the touch pad controller supports a maximum SCL clock frequency of 400 kHz. It detects each change of button state. To inform the host that new data is available, the touch pad controller will pull-low the /INT signal. After the data transmission, the touch pad controller will pull-high the /INT signal again (see Fig. 4-5).

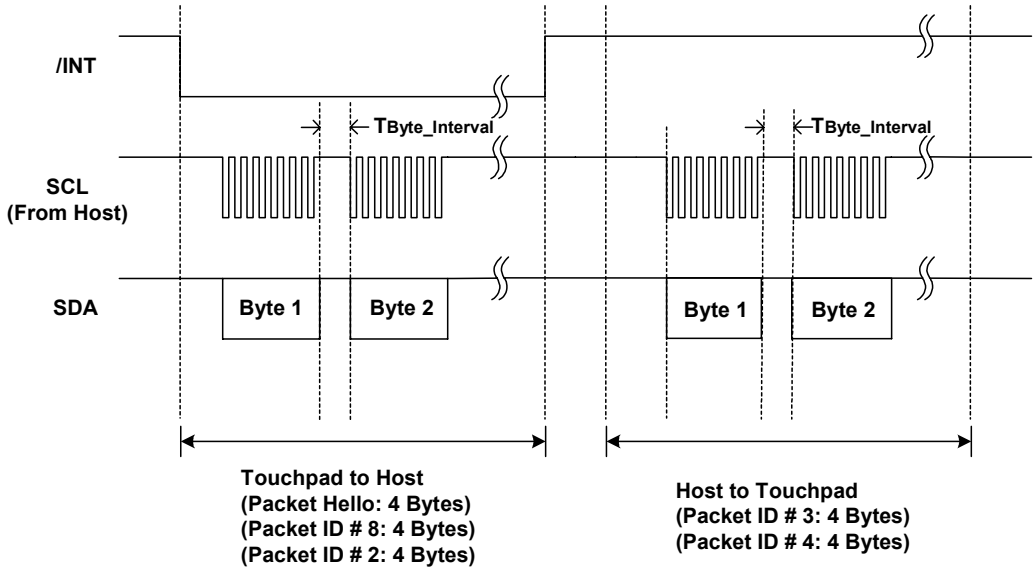


Fig. 4-5 Data transmission and Receiving in I2C slave mode

Fig. 4-6 shows the timing condition of the I2C interface. The characteristics of I2C interface are given in Table 1. The touch pad adopts the bit rate up to 400 kbit/s in the Fast-mode. The touch pad is defined as a slave I2C interface, Host (master) generates the clock signal through the serial clock (SCL) pin and data are transferred and received through the serial data (SDA) pin.

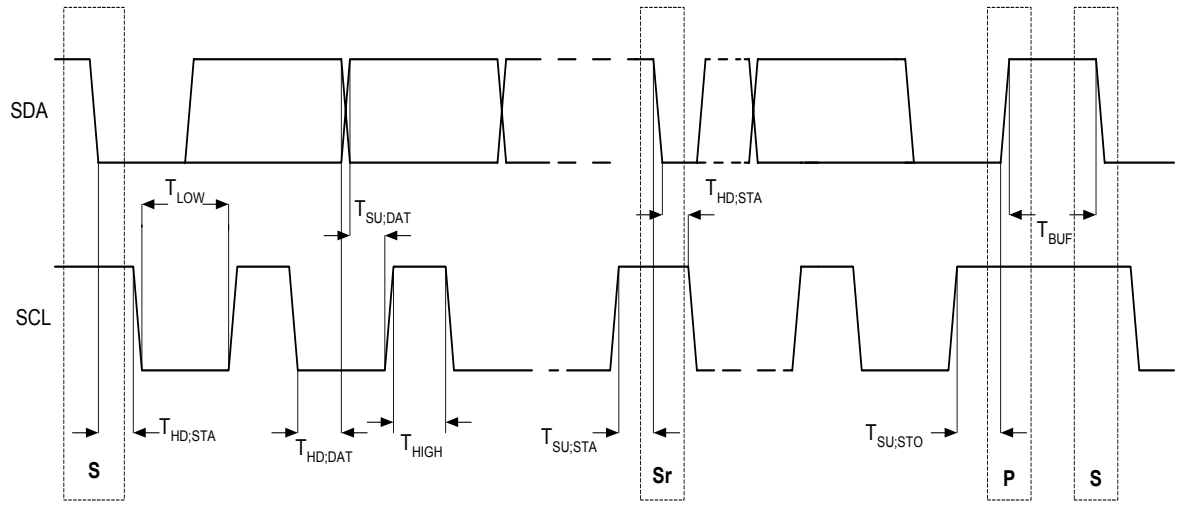


Fig. 2-3 The timing in I2C interface

Symbol	Parameter	Standard Mode		Fast Mode		Unit
		Min	Max	Min	Max	
F_{SCL}	SCL clock frequency	0	100	0	400	kHz
$T_{HD;STA}$	Hold time (repeated) START condition. After this period, the first clock pulse is generated.	4.0	-	0.6	-	µs
T_{LOW}	LOW period of the SCL clock	4.7	-	1.3	-	µs
T_{HIGH}	HIGH period of the SCL clock	4.0	-	0.6	-	µs
$T_{SU;STA}$	Set-up time for a repeated START condition	4.7	-	0.6	-	µs
$T_{HD;DAT}$	Data hold time	0	-	0	-	µs
$T_{SU;DAT}$	Data set-up time	250	-	100	-	ns
$T_{SU;STO}$	Set-up time for STOP condition	4.0	-	0.6	-	µs
T_{BUF}	Bus free time between a STOP and START condition	4.7	-	1.3	-	µs

Table 1 Characteristics of the SDA and SCL pins for I2C interface

The touch pad controller is defined as a slave device of I2C and host is defined as a master. The device address of touch pad controller is designed as 7-bits address format. The touch pad controller address is defined as 0x10 as Table 2.

Slave address	0	0	0	1	0	0	0	0

Table 2 Device address

5 Pin Assignment

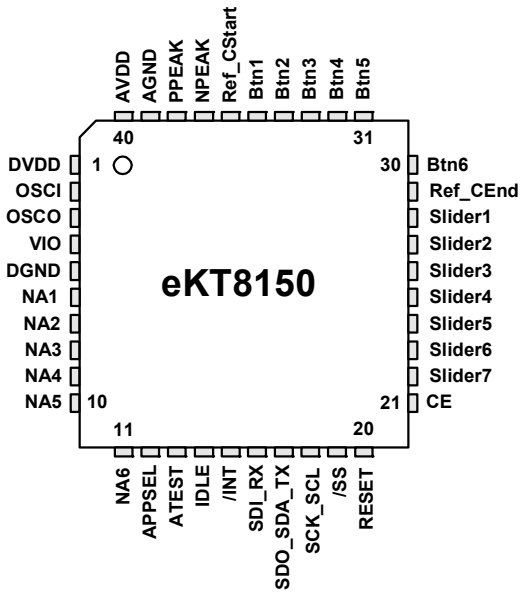
- QFN40

Dimension: 6mm × 6mm

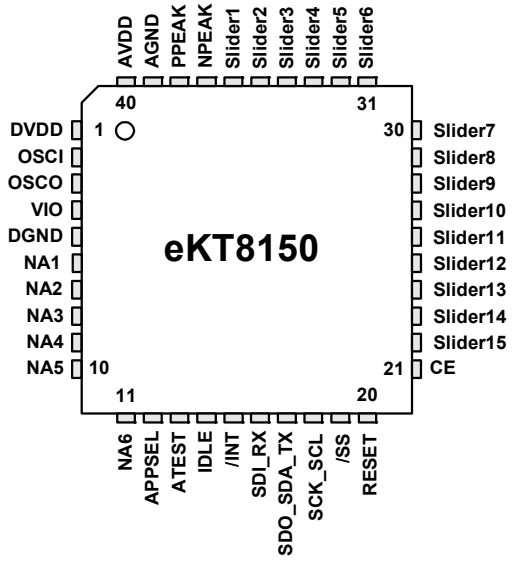
Thickness: 0.8mm

Green Package

For 1 Slider + 6 Keys:



For 1 Long Slider:



6 Pin Description

■ QFN40

Pin No.	Symbol	Function Description
1	DVDD	Power supply input. A decoupling capacitor (4.7uF) is needed between DVDD and DGND.
2	OSCI	6MHz ± 10% RC oscillator input with external resistor 47KΩ ± 1% tied to DVDD.
3	OSCO	6MHz±10% RC oscillator clock output pin.
4	VIO	I/O power supply select pin. - If power supply = 3V and I/O level = 3V -> connect to DVDD. - If power supply = 3V , but I/O level = 1.8V -> connect to 1.8V.
5	DGND	Digital block's ground.
6	NA1	Not connected.
7	NA2	Not connected.
8	NA3	Not connected.
9	NA4	Not connected.
10	NA5	Not connected.
11	NA6	Not connected.
12	APPSEL	Application Select - Defines Oscillator type mode: - Tied to DVDD = Internal RC Oscillator (6 MHz). - Tied to DGND = Crystal mode (6 MHz crystal required).
13	ATEST	Factory test pin: Internally tied to DVDD.
14	IDLE	Idle Mode control. Scan rate in idle mode can be adjusted by changing the RC value.
15	/INT	This pin is a interrupt signal. 1. If "/INT"=0, eKT8150 has data packet to transmit 2. If "/INT"=1, eKT8150 has no data packet to transmit
16	SDI_RX	1. Protocol select pin. 2. SDI pin in SPI mode and connect to host SDO pin. 3. RX pin in UART mode and connect to host TX pin.
17	SDO_SDA_TX	1. SDO pin in SPI mode and connect to host SDI pin. 2. SDA pin in I2C mode and connect to host SDA pin. 3. TX pin in UART mode and connect to host RX pin.
18	SCK_SCL	1. Protocol select pin. 2. SCK pin in SPI mode and connect to host SCK pin. 3. SCL pin in I2C mode and connect to host SCL pin.
19	/SS	1. Protocol select pin. 2. /SS pin in SPI master mode and connect to host GPIO.
20	RESET	Reset pin (External reset)
21	CE	Chip enable pin. - CE = 0 : Chip disable. - CE = 1 : Chip enable.
22	1. Slider7 2. Slider15	Analog signal input of 1. Slider7 (1 Slider + 6 Keys mode) 2. Slider15 (1 long slider mode)
23	1. Slider6	Analog signal input of

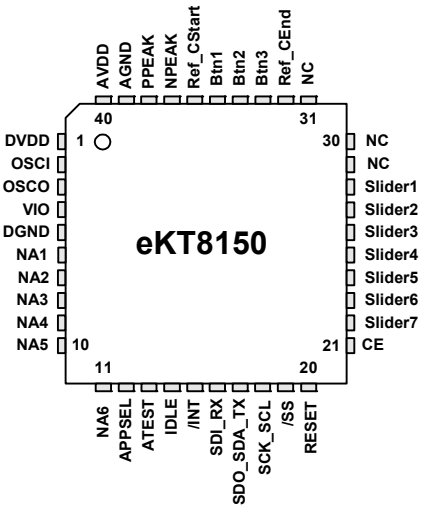
Pin No.	Symbol	Function Description
	2. Slider14	1. Slider6 (1 Slider + 6 Keys mode) 2. Slider14 (1 long slider mode)
24	1. Slider5 2. Slider13	Analog signal input of 1. Slider5 (1 Slider + 6 Keys mode) 2. Slider13 (1 long slider mode)
25	1. Slider4 2. Slider12	Analog signal input of 1. Slider4 (1 Slider + 6 Keys mode) 2. Slider12 (1 long slider mode)
26	1. Slider3 2. Slider11	Analog signal input of 1. Slider3 (1 Slider + 6 Keys mode) 2. Slider11 (1 long slider mode)
27	1. Slider2 2. Slider10	Analog signal input of 1. Slider2 (1 Slider + 6 Keys mode) 2. Slider10 (1 long slider mode)
28	1. Slider1 2. Slider9	Analog signal input of 1. Slider1 (1 Slider + 6 Keys mode) 2. Slider9 (1 long slider mode)
29	1. Ref_CEnd 2. Slider8	Analog signal input of 1. Ref_CEnd (1 Slider + 6 Keys mode), Reference capacitance of scan button end. <<See Note1>> 2. Slider8 (1 long slider mode)
30	1. Btn6 2. Slider7	Analog signal input of 1. Btn6 (1 Slider + 6 Keys mode) 2. Slider7 (1 long slider mode)
31	1. Btn5 2. Slider6	Analog signal input of 1. Btn5 (1 Slider + 6 Keys mode) 2. Slider6 (1 long slider mode)
32	1. Btn4 2. Slider5	Analog signal input of 1. Btn4 (1 Slider + 6 Keys mode) 2. Slider5 (1 long slider mode)
33	1. Btn3 2. Slider4	Analog signal input of 1. Btn3 (1 Slider + 6 Keys mode) 2. Slider4 (1 long slider mode)
34	1. Btn2 2. Slider3	Analog signal input of 1. Btn2 (1 Slider + 6 Keys mode) 2. Slider3 (1 long slider mode)
35	1. Btn1 2. Slider2	Analog signal input of 1. Btn1 (1 Slider + 6 Keys mode) 2. Slider2 (1 long slider mode)
36	1. Ref_CStart 2. Slider1	Analog signal input of 1. Ref_CStart (1 Slider + 6 Keys mode) , Reference capacitance of scan button start. <<See Note1>> 2. Slider1 (1 long slider mode)
37	NPEAK	Analog Test Pin
38	PPEAK	Analog Test Pin
39	AGND	Analog block's ground.
40	AVDD	2.4V / 3.3V regulator output. A decoupling capacitor (4.7uF) is needed between AVDD and AGND.

<<Note1>>

Ref_CStart: Connected to the start scan button's reference capacitor.

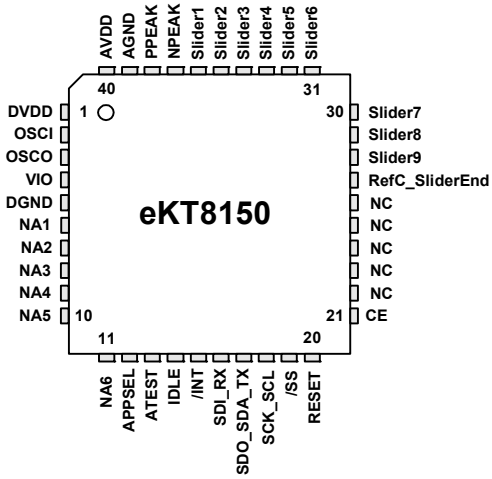
Ref_CEnd: Connected to the end scan button's reference capacitor.

Example: If customer designed 3 buttons, the Ref_CStart is Pin36 and connected to a reference capacitor (10pf ~ 20pf) and the Ref_CEnd is Pin32 and connected to a reference capacitor (10pf ~ 20pf).



<<Note2>>

If user design slider and only need analog input slider1 ~ slider9, in the end of scan slider analog input, it should add a reference capacitor RefC_SliderEnd(10pf ~ 20pf) to avoid calibration fail.



7 Timing Description

A. Power-on reset: After the touch pad is powered up, this controller will do initialization. The initialization includes MCU and analog parameter initialization. After the initial process, it will send Packet Hello to let the host know that the touch pad is ready to work. Fig. 7-1 shows the process after power up. TPowerUp is between 20ms and 100ms.

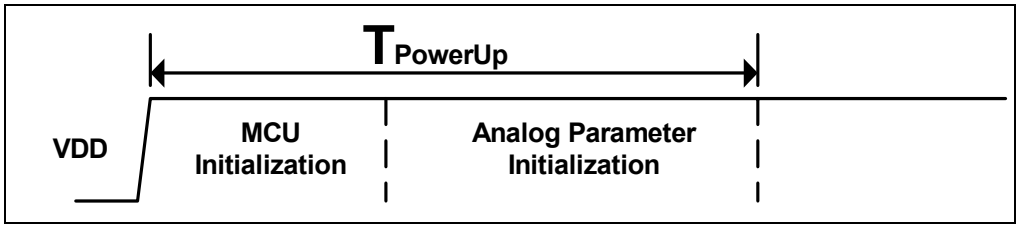


Fig. 7-1 Power-on Reset Timing Diagram

B. Wake-up: Fig 7-2 below shows eKT8150 wake-up time from deep sleep mode.

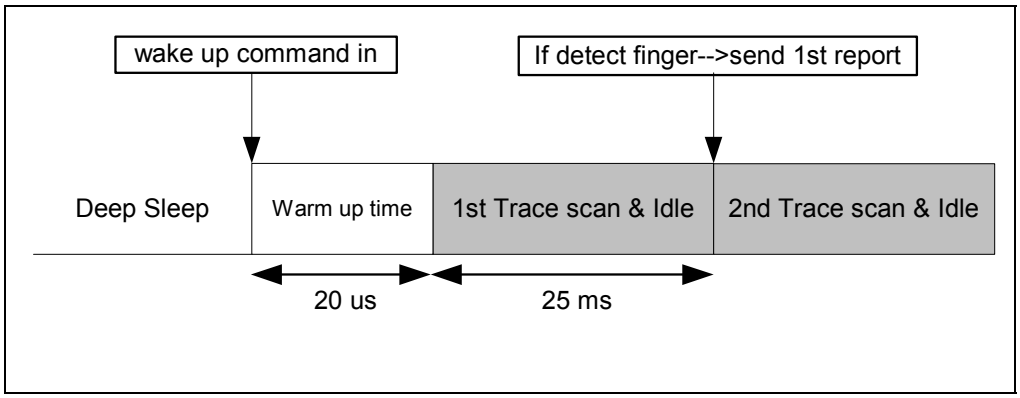


Fig. 7-2 Wake-up Timing from Deep Sleep Mode

C. RESET: Fig 7-3 below shows eKT8150 reset timing from normal operating to reset happened.

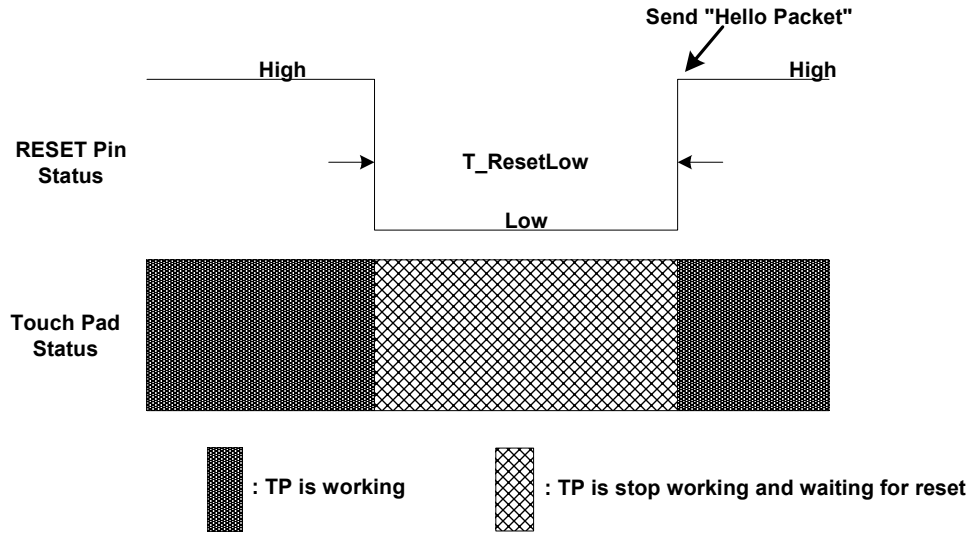


Fig. 7-3 Reset Timing from normal operating to reset happened

8 Special Pin Description

8.1 Interface Selection Pin

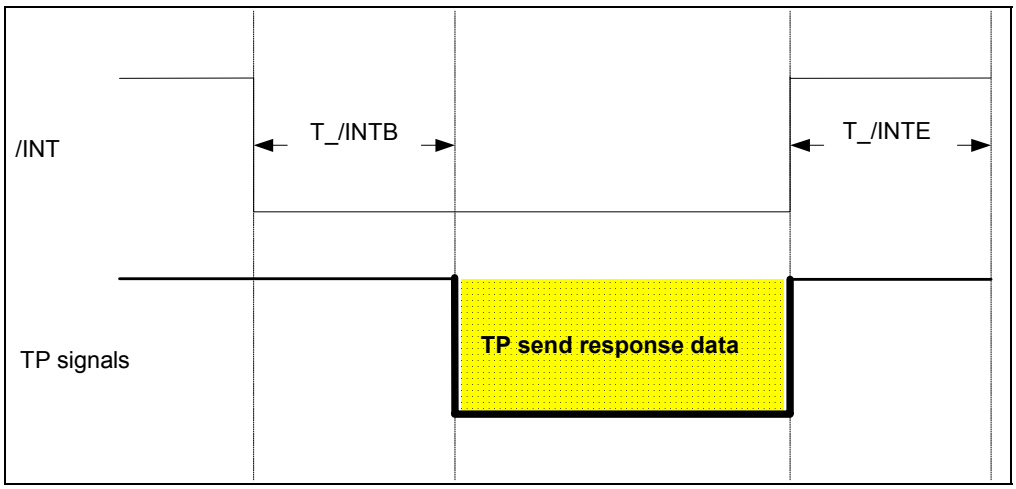
Interface	SPI Master Mode	SPI Slave Mode	UART Mode	I2C Slave
SDI_RX	High	High	High	Low
SCK_SCL	High	High	Low	High
/SS	High	Low	Low	Low

For each interface, the valid pins are:

1. SPI master mode: /SS, SCK_SCL, SDO_SDA_TX, and SDI_RX
2. SPI slave mode: SCK_SCL, SDO_SDA_TX, SDI_RX
3. UART mode: SDO_SDA_TX, SDI_RX
4. I2C slave mode: SCK_SCL, SDO_SDA_TX

8.2 /INT Pin

The /INT state is always high. In SPI master mode, If the eKT8150 detects a scroll position or the button state has changed, it will pull the /INT signal low first. After 100 µs (min), the eKT8150 will send a response data, and after 100 µs (max), the eKT8150 will pull the /INT signal high.



/INT Signal	Condition		Description
T_/INTB	100 µs (min)	130 µs (Typ.)	Minimum preparation time from pulling the /INT low and begin sending response data
T_/INTE	100 µs (max)	50 µs (Typ.)	Maximum preparation time to end sending response data and pulling the /INT high

Fig 8-1 /INT Pin Timing Diagram in SPI master mode

The /INT state is always high. In SPI slave or I2C slave mode, if the eKT8150 detects a scroll position or the button state has changed, it will pull the /INT signal low first. After host send clock signal to touch pad, the eKT8150 will send a response data, and after the data transmission, the touch pad controller will pull-high the /INT signal again (See Fig. 4-3A).

9 Electrical Characteristic

9.1 Absolute Maximum Ratings

Item	Min.	Max.	Unit
Temperature under bias	0	85	°C
Storage temperature	- 65	150	°C
Operating humidity (test 8h)	5	95	%
Voltage from VDD to VSS	- 0.5	7.0	V
Voltage from any pin to VSS	- 0.5	7.0	V
Chip level ESD (HBM test)	2	–	KV

9.2 DC Electrical Characteristic

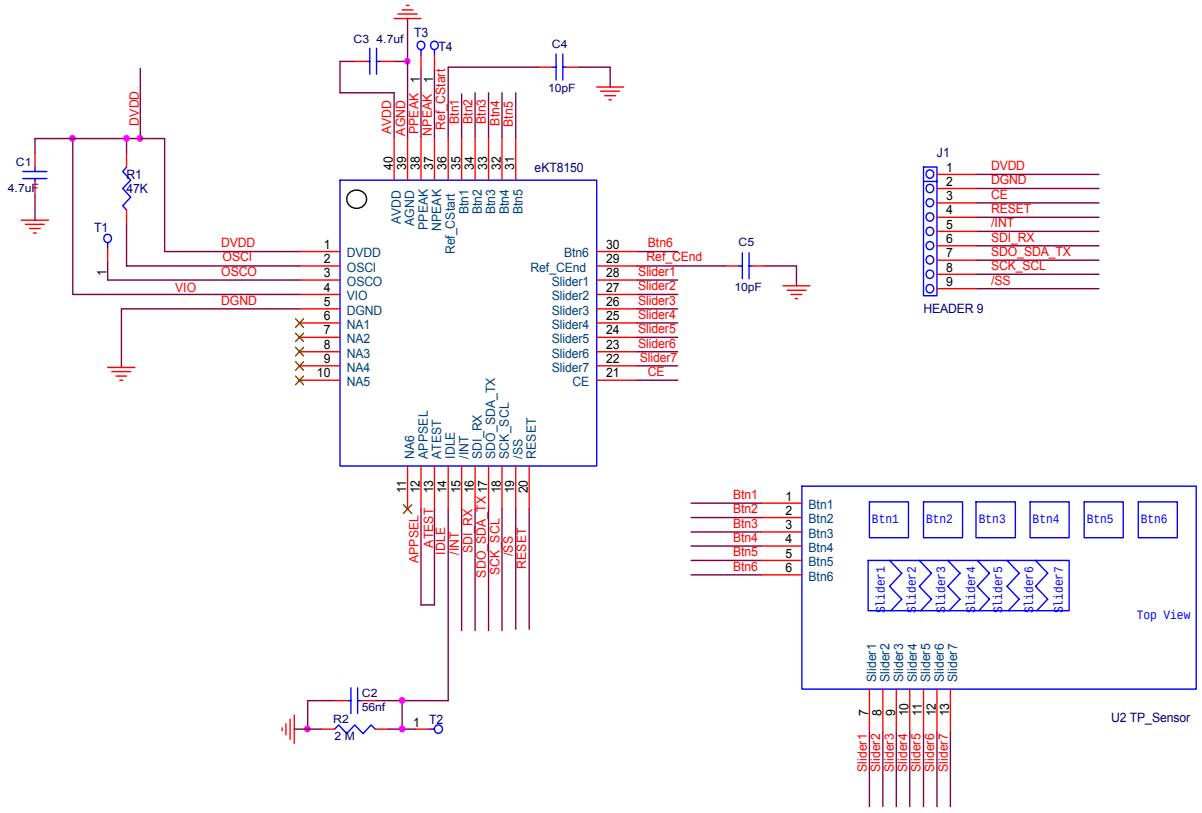
Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
DVDD	Power supply voltage request	General purpose	2.6	–	5.5	V
I_Normal	Normal operating current	2.8V power supply 6MHz RC oscillator	–	0.9	1.5	mA
I_Idle	Idle operating current	2.8V power supply	–	170	200	µA
I_Sleep	Sleep operating current	2.8V power supply	–	5	20	µA
MCU Operation						
V_OH	Output high level	5V power supply I_DRIVER = 8mA	2.4	–	–	V
V_OL	Output low level	5V power supply I_SINK = 8mA	–	–	0.4	V
V_IH	Input high voltage level	5V power supply	2.0	–	–	V
V_IL	Input low voltage level	5V power supply	–	–	1.2	V
I_IL	Input leakage current for input pins	VIN = VDD, VSS	–	–	1	µA

9.3 AC Electrical Characteristic

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
F_OSC1	External R internal C oscillator	2.8V power supply	–	6	–	MHz
F_OSC3	Internal RC oscillator	2.8V power supply	–	512	–	kHz

10 Application Circuit

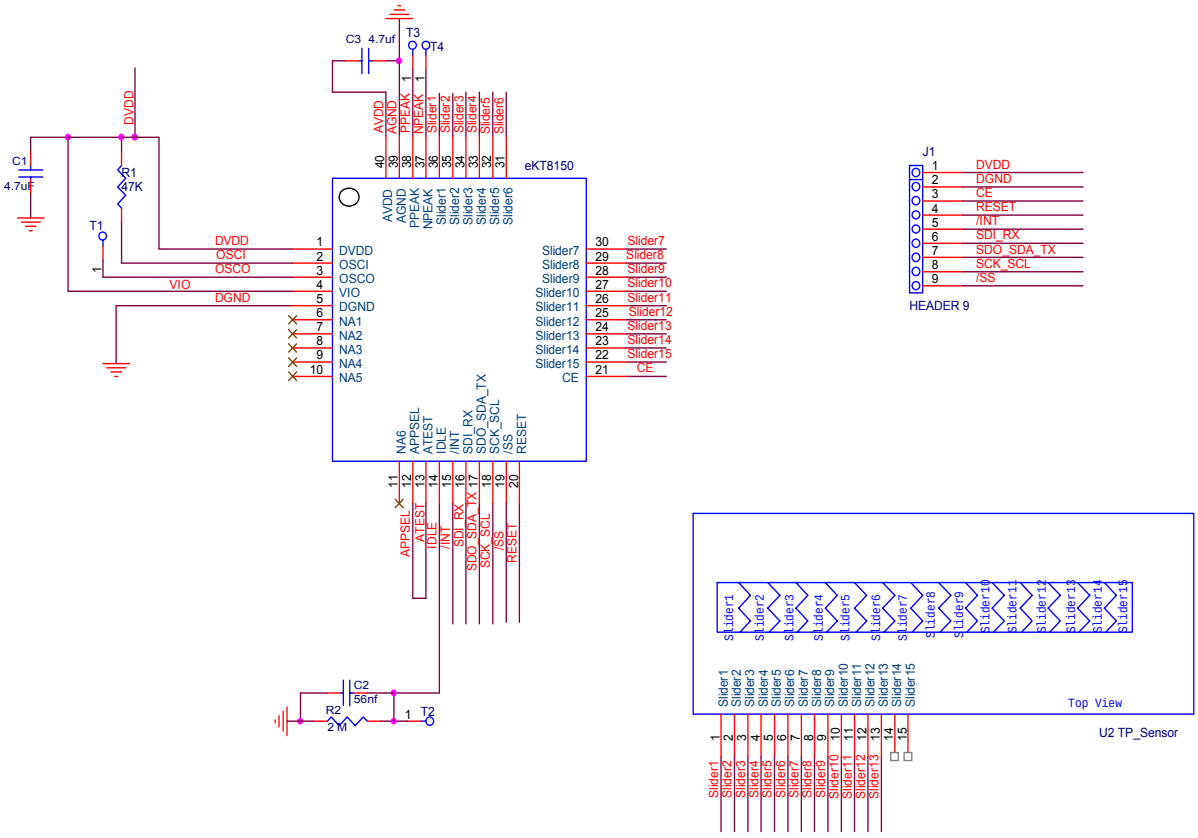
10.1 Slider + 6 Keys; SPI Master Mode



■ BOM Table

Component	Component P/N	Pin Location	Package	Qty.
MCU	eKT8150	U1	QFN40	1
Resistor	47kΩ	R1	SMD	1
Resistor	2MΩ	R2	SMD	1
Capacitor	4.7μF	C1, C3	SMD	2
Capacitor	56nF	C2	SMD	1
Capacitor	10pF	C4,C5	SMD	2

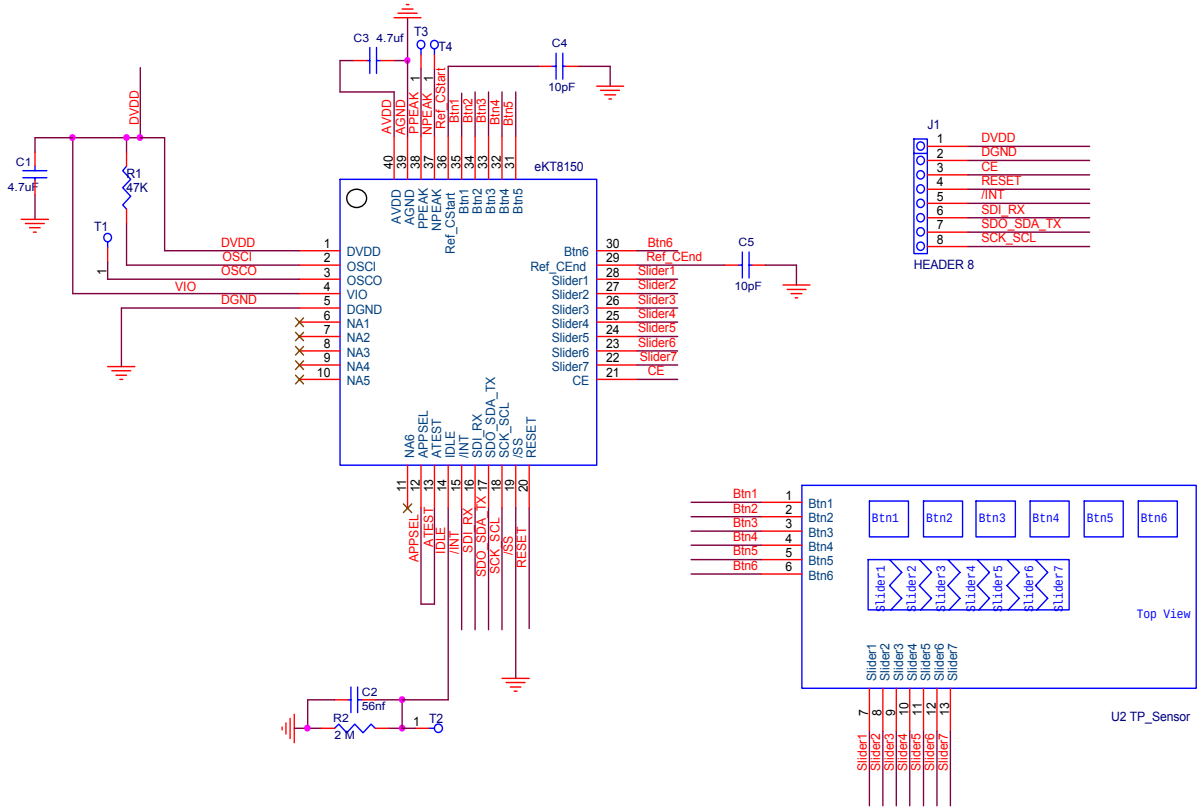
10.2 Long Slider; SPI Master Mode



■ BOM Table

Component	Component P/N	Pin Location	Package	Qty.
MCU	eKT8150	U1	QFN40	1
Resistor	47kΩ	R1	SMD	1
Resistor	2MΩ	R2	SMD	1
Capacitor	4.7μF	C1, C3	SMD	2
Capacitor	56nF	C2	SMD	1

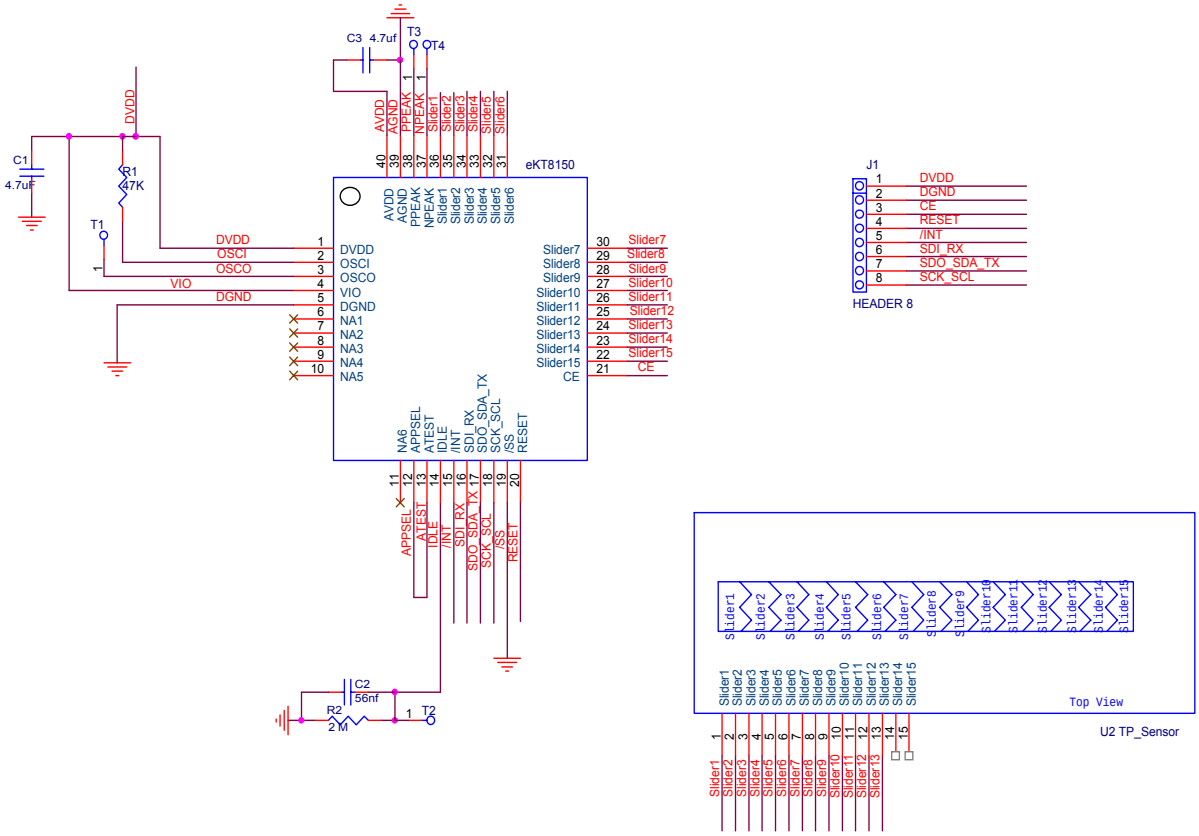
10.3 Slider + 6 Keys; SPI Slave Mode



■ BOM Table

Component	Component P/N	Pin Location	Package	Qty.
MCU	eKT8150	U1	QFN40	1
Resistor	47kΩ	R1	SMD	1
Resistor	2MΩ	R2	SMD	1
Capacitor	4.7μF	C1, C3	SMD	2
Capacitor	56nF	C2	SMD	1
Capacitor	10pF	C4,C5	SMD	2

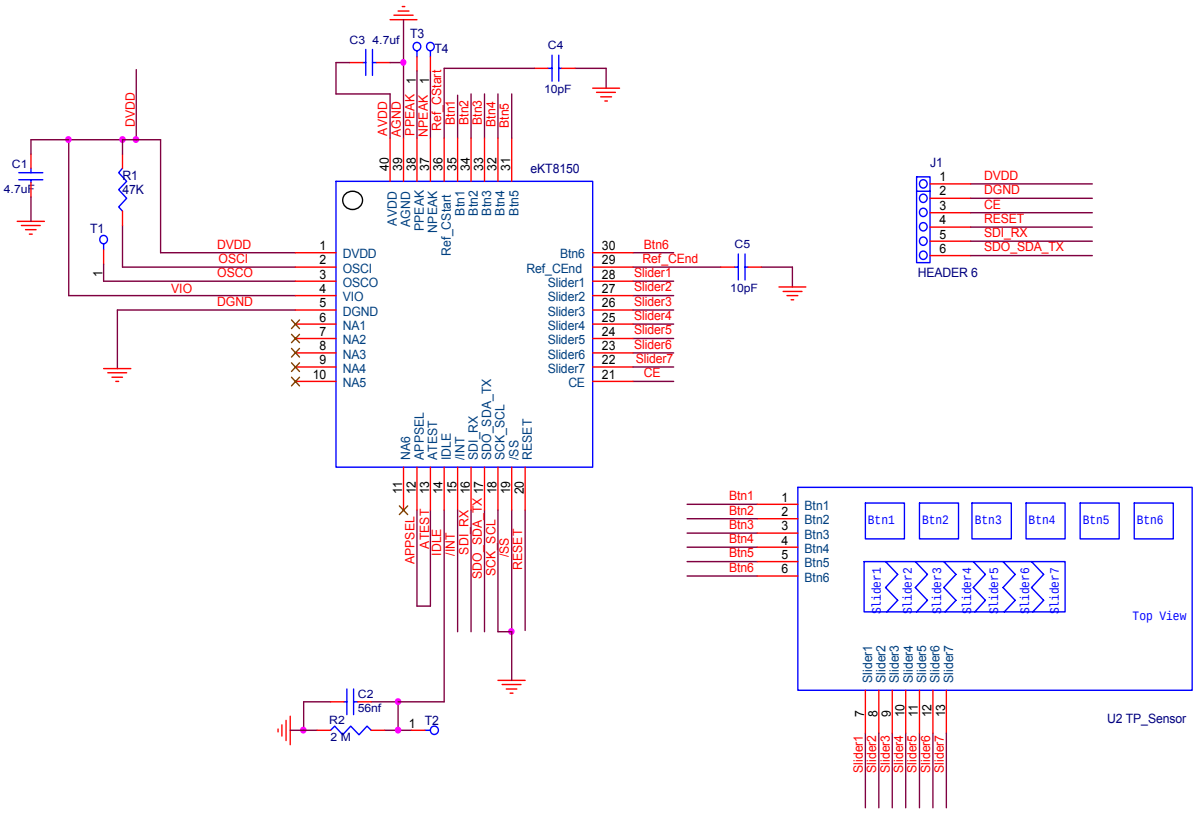
10.4 Long Slider; SPI Slave Mode



■ BOM Table

Component	Component P/N	Pin Location	Package	Qty.
MCU	eKT8150	U1	QFN40	1
Resistor	47kΩ	R1	SMD	1
Resistor	2MΩ	R2	SMD	1
Capacitor	4.7μF	C1, C3	SMD	2
Capacitor	56nF	C2	SMD	1

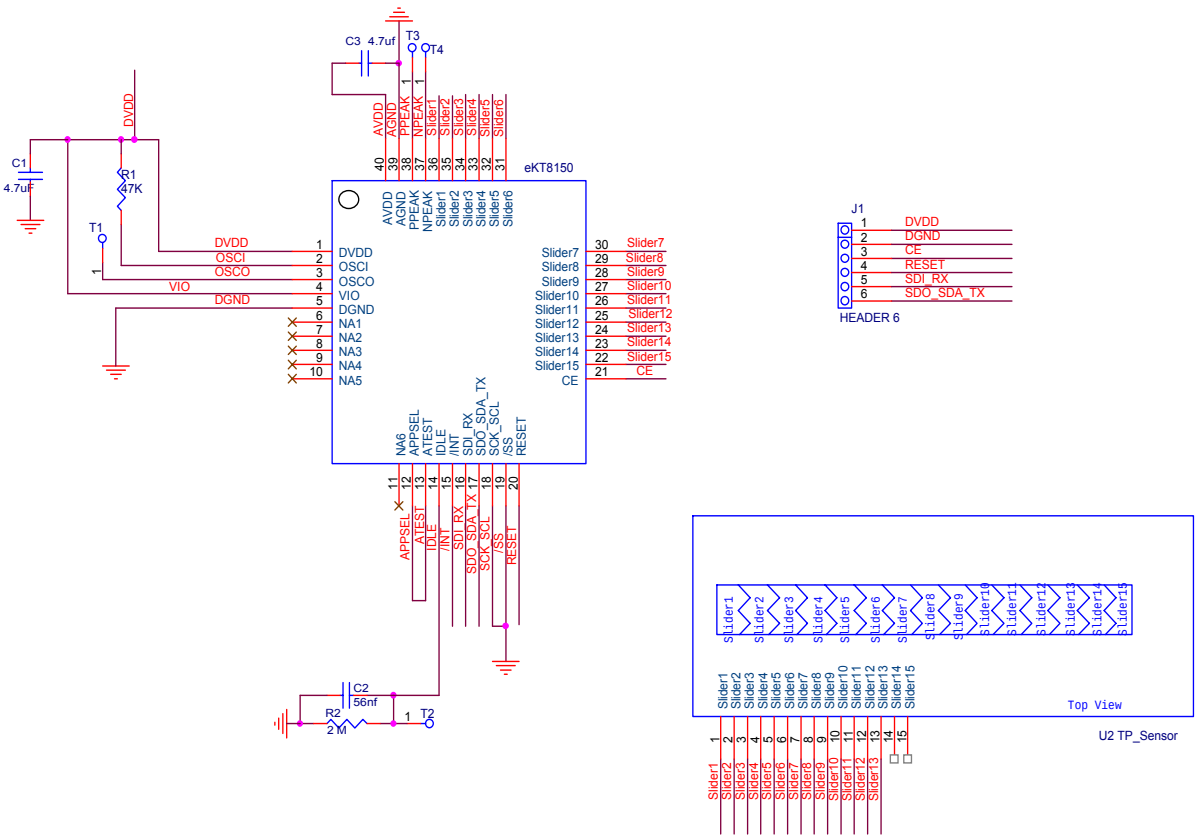
10.5 Slider + 6 Keys; UART Mode



■ BOM Table

Component	Component P/N	Pin Location	Package	Qty.
MCU	eKT8150	U1	QFN40	1
Resistor	47kΩ	R1	SMD	1
Resistor	2MΩ	R2	SMD	1
Capacitor	4.7μF	C1, C3	SMD	2
Capacitor	56nF	C2	SMD	1
Capacitor	10pF	C4,C5	SMD	2

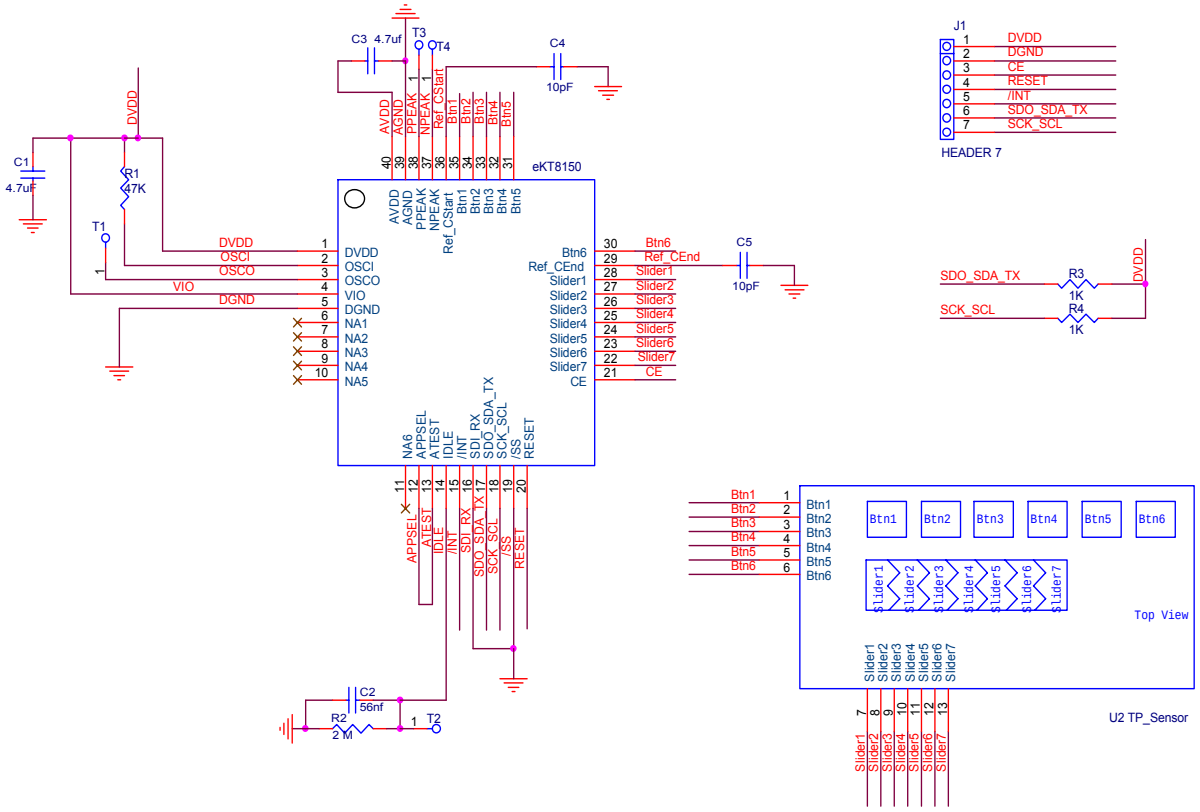
10.6 Long Slider; UART Mode



■ BOM Table

Component	Component P/N	Pin Location	Package	Qty.
MCU	eKT8150	U1	QFN40	1
Resistor	47kΩ	R1	SMD	1
Resistor	2MΩ	R2	SMD	1
Capacitor	4.7μF	C1, C3	SMD	2
Capacitor	56nF	C2	SMD	1

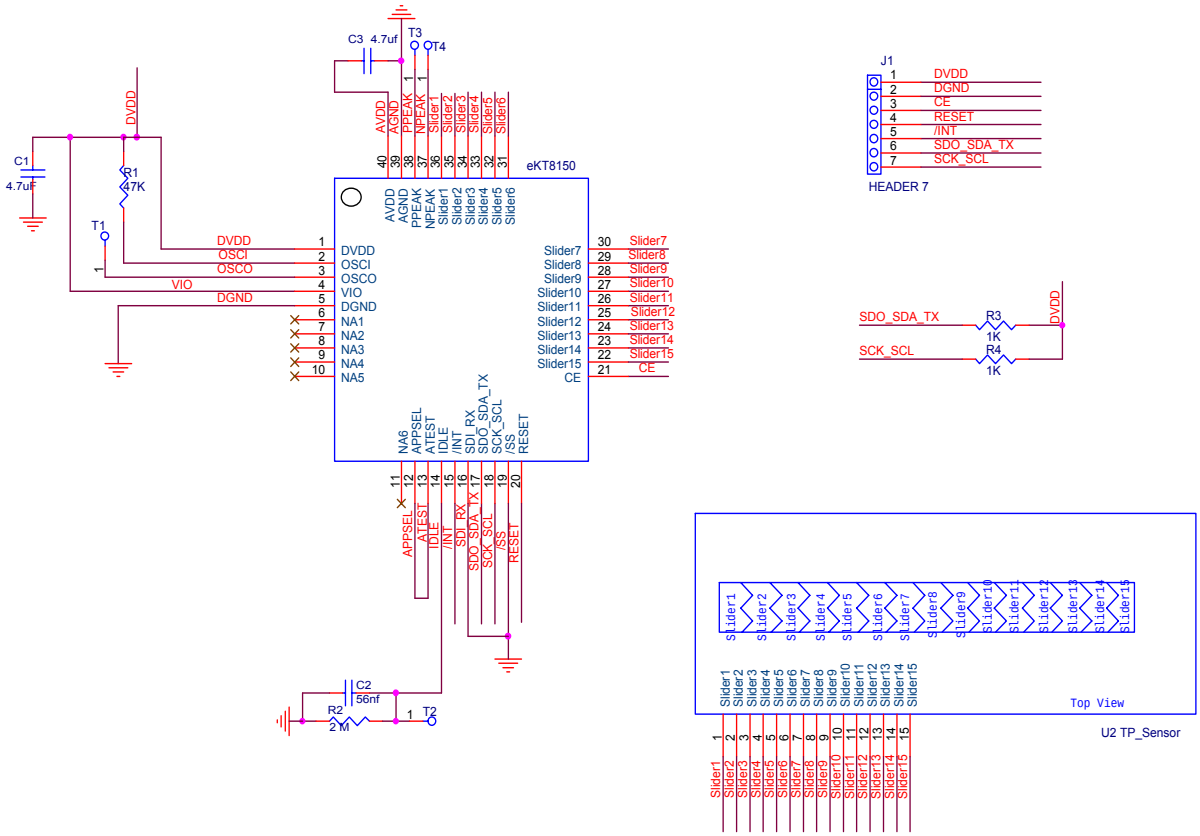
10.7 Slider + 6 Keys; I2C Slave Mode



■ BOM Table

Component	Component P/N	Pin Location	Package	Qty.
MCU	eKT8150	U1	QFN40	1
Resistor	47kΩ	R1	SMD	1
Resistor	2MΩ	R2	SMD	1
Capacitor	4.7μF	C1, C3	SMD	2
Capacitor	56nF	C2	SMD	1
Capacitor	10pF	C4,C5	SMD	2

10.8 Long Slider; I2C Slave Mode



■ BOM Table

Component	Component P/N	Pin Location	Package	Qty.
MCU	eKT8150	U1	QFN40	1
Resistor	47kΩ	R1	SMD	1
Resistor	2MΩ	R2	SMD	1
Capacitor	4.7μF	C1, C3	SMD	2
Capacitor	56nF	C2	SMD	1

11 Protocol Description

After power on, the touch pad (TP) will send “Packet Hello” to let the host know that TP is ready for operation. When TP detects slider or button status change, it then sends the new information to host.

In UART mode, Host should send “Packet Synchronous” to TP after receiving the “Packet Hello” from TP for synchronization interface. If host receives an unknown Packet ID, host can receive the correct packet after sending the “Packet Synchronous”.

The TP always sends Packet ID #8 unless specifically asked by the host to send another type. In the case of sending another Packet ID, the TP will only send once for each request by the host and then revert to the type of Packet ID #8. The touch pad will send Packet ID #8 packet whenever it detects a change of sensing status.

Host can change the Touch pad’s power status or sensitivity by sending Packet ID #4 with the correct register number. It can also read information immediately by sending Packet ID #3 with the correct register number; then TP will send Packet ID #2 in response to this command.

No matter which interfaces are used, the definition of the report packet is the same.

11.1 Command Description

11.1.1 Packet Synchronous (Host to Device, UART Mode Only)

31	30~24	23~16	15~8	7~1	0
0	0000000	00000000	00000000	0000000	0

Comment: This packet is used for interface synchronization in UART mode. After the host turns on the touch pad power, and received undefined packet ID, host should send this packet to do interface synchronization.

11.1.2 Packet Hello (Device to Host)

31	30~24	23~16	15~8	7~1	0
0	1010101	01010101	01010101	0101010	1

Comment: After the touch pad is powered on, TP will send “Packet Hello” to host

11.1.3 Packet ID #8 (Device to Host)

	Type	PID	Slider Position	Btn1 ~ Btn6	Reserve	Slider Finger	
31	30~28	27~24	23~16	15~10	9~4	3~2	1~0
0	101	0110	Absolute Position	1 : ON 0 : OFF	000000	Finger Numbers	01

Comment: The eKT8150 segregates the slider absolute position and 6 keys information. For the key information, the eKT8150 kernel will calculate the weight of every pressed key and output the highest sensing key. The slider and key timing diagram is shown in Fig.10.

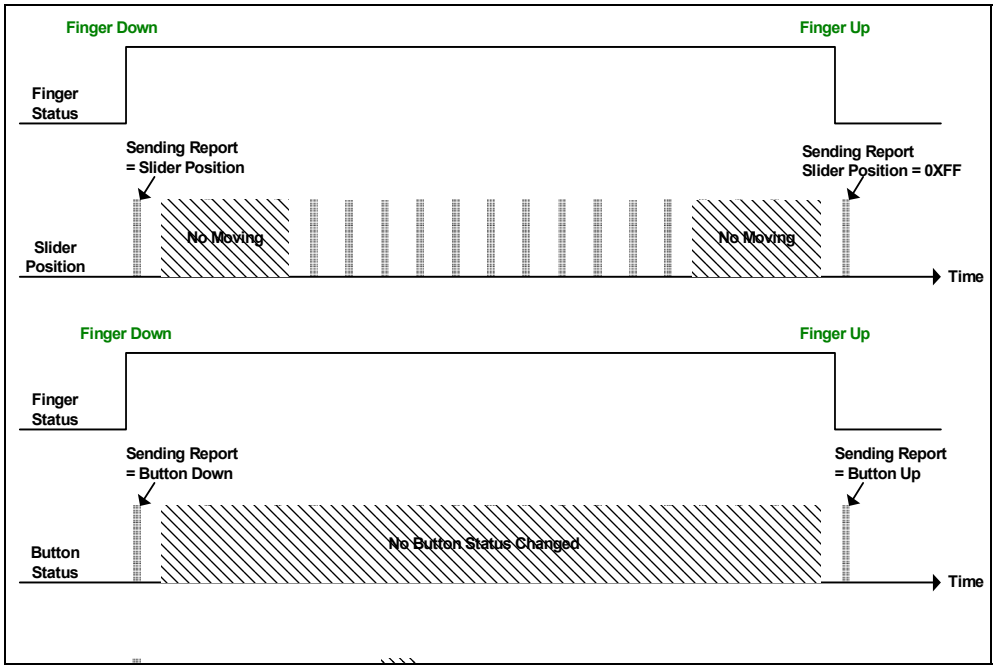


Fig. 10-1 Slider and Key Timing Diagram

Bit 23 ~ Bit 16: Slider absolute position

- 1 slider + 6 Keys mode: slider position range 0 ~ 79

- 1 long slider mode: slider position range 0 ~ 207

- If no finger on slider: slider position is 0xFF

<<How to design the analog trace and absolute position>>

The eKT8150 has 16 interpolation points of each ADC value and two analog traces have one ADC value.

Example1:

If user design slider analog trace is connect form slider1 ~ slider7,

The slider total interpolation points is (7-1-1)*16 = 80 and position range is 0 ~ 79.

Example2:

If user design slider analog trace is connect form slider1 ~ slider15,

The slider total interpolation points is (15-1-1)*16 = 208 and position range is 0 ~ 207.

Example3:

If user design slider analog trace is connect form slider1 ~ slider10,

The slider total interpolation points is (10-1-1)*16 = 128 and position range is 0 ~ 127.

Bit 15：Btn1；1 = Button pressed, 0 = Button released

Bit 14：Btn2；1 = Button pressed, 0 = Button released

Bit 13：Btn3；1 = Button pressed, 0 = Button released

Bit 12：Btn4；1 = Button pressed, 0 = Button released

Bit 11：Btn5；1 = Button pressed, 0 = Button released

Bit 10：Btn6；1 = Button pressed, 0 = Button released

EX: If Btn1 is pressed and Slider position is 45 (one finger), the packet is 0B01011000 00101101 10000000 00000101.

EX: If Btn6 is pressed and Slider position is 30 (two fingers), the packet is 0B01011000 00011110 00000100 00001001.

EX: If in long slider mode and Slider position is 168 (one fingers), the packet is 0B01011000 10101000 00000000 00000101.

EX: If in long slider mode and Slider position is 100 (two fingers), the packet is 0B01011000 01100100 00000000 00001001.

EX: If there is no finger on slider, and the position is 0xFF.

11.1.4 Packet ID #2 (Device to Host)

	Type	PID	Register No.	Read Register Response Data	
31	30~28	27~24	23~20	19~1	0
0	101	0010	–	–	1

Comment: The Touch pad will send this packet in response to Packet ID #3. The response data is determined by the register number in Packet ID #3. Refer to register number description.

EX: Host send command to read TP's button status, if Btn1 is pressed, the packet is 0B01010010 00011000 00000000 00000001.

EX: Host send command to read TP's button status, if Btn6 is pressed, the packet is 0B01010010 00010000 01000000 00000001.

EX: Host send command to read TP's slider position, if position = 45, the packet is 0B01010010 00110000 00101101 00000001.

11.1.5 Packet ID #3 (Host to Device)

	Type	PID	Register No.	Reserve	
31	30~28	27~24	23~20	19~1	0
0	101	0011	-	-	1

Comment: This is a read command packet. The Host can read the information in different register number. Refer to register number description.

EX: If Host want to read TP's button status, it should send command to TP and the packet is 0B01010011 00010000 00000000 00000001.

EX: If Host want to read TP's slider position, it should send command to TP and the packet is 0B01010011 00110000 00000000 00000001.

11.1.6 Packet ID #4 (Host to Device)

	Type	PID	Register No.	Register Data	
31	30~28	27~24	23~20	19~1	0
0	101	0100	-	-	1

Comment: This is a write command packet. Host can change the TP's status, like Sensitivity or the Power State via sending this packet. Refer to register number description.

EX: If host wants to change the sensitivity to 5, the packet is 0B01010100 01000101 00000000 00000001.

EX: If host wants to set the Power Status as 1, the packet is

0B01010100 01011000 00000000 00000001.

11.2 Register Description

The register numbers in Packet ID #2, Packet ID #3 and Packet ID #4 are defined as follows:

11.2.1 Register Number = 0, Read F/W Version (Read Only)

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0011	0000	00000000 00000000	000	1

Comment: If the host wants to read the firmware version of the touch pad, it should send Packet ID #3 with register number 0000.

	Type	PID	Register No.	Read Register Response Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0010	0000	00000001 00000000	000	1

Comment: The touch pad will then return the firmware version by sending Packet ID #2 to host.

Bit 19 ~ Bit 12: Major Version

Bit 11 ~ Bit 4: Minor Version

11.2.2 Register Number = 1, Read Button Status (Read Only)

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0011	0001	00000000 00000000	000	1

Comment: If the host wants to read the button status of the touch pad, it should send Packet ID #3 with register number 0001.

	Type	PID	Register No.	Read Register Response Data	Reserve	
31	30~28	27~24	23~20	19~14	13~1	0
0	101	0010	0001	Btn1~Btn6 status	0	1

Comment: The touch pad will then return the button status by sending Packet ID #2 to host.

Bit 19：Btn1；1 = Button pressed, 0 = Button released

Bit 18：Btn2；1 = Button pressed, 0 = Button released

Bit 17：Btn3；1 = Button pressed, 0 = Button released

Bit 16：Btn4；1 = Button pressed, 0 = Button released

Bit 15：Btn5；1 = Button pressed, 0 = Button released

Bit 14：Btn6；1 = Button pressed, 0 = Button released

In long slider mode, the packet always return

0B 01010010 00010000 00000000 00000001

11.2.3 Register Number = 2, NA

11.2.4 Register Number = 3, TP slider position (Read Only)

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0011	0011	00000000 00000000	000	1

Comment: If host wants to read the slider position of touch pad, it should send Packet ID #3 with register number 0011.

	Type	PID	Register No.	Reserve	Response Data	Reserve	
31	30~28	27~24	23~20	19~16	15~8	7~1	0
0	101	0010	0011	0000	Slider Position	0000000	1

Comment: The touch pad will then return the slider position of touch pad by sending Packet ID #2 to host.

Bit 15 ~ Bit 8: Slider absolute position.

If in “slider + 6Keys mode”, the slider position range is 0 ~ 79 and 255 means no finger is on this slider.

If in “long slider mode”, the slider position range is 0 ~ 207 and 255 means no finger is on this slider.

11.2.5 Register Number = 4, TP Sensitivity Setting(R/W)

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0011	0100	00000000 00000000	000	1

Comment: If host wants to read the sensitivity of touch pad, it should send Packet ID #3 with register number 0100.

	Type	PID	Register No.	Read Register Response Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0010	0100	00000000 00000000	000	1

Comment: The touch pad will then return the sensitivity by sending Packet ID #2 to host.

Bit 19 ~ Bit 16: Sensitivity, the sensitivity range is 0 ~ 10.

EX: If host send read sensitivity command to TP and TP’s sensitivity is 3. Touch pad will return 0B 01010010 01000011 00000000 00000001

	Type	PID	Register No.	Write Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0100	0100	00000000 00000000	000	1

Comment：If the host wants to write the sensitivity of the touch pad, it should send Packet ID #4 with register number 0100. Then the touch pad will keep the value.

Bit 19 ~ Bit 16: Sensitivity, the sensitivity range is 0 ~ 10. The default value is 4

11.2.6 Register Number = 5, TP Power State Setting(R/W)

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0

0	101	0011	0101	00000000 00000000	000	1

Comment: If host wants to read the power state of the touch pad, it should send Packet ID #3 with register number 0101.

	Type	PID	Register No.	Read Register Response Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0010	0101	00000000 00000000	000	1

Comment: The touch pad will then return the power state by sending Packet ID #2 to host.

Bit 19: Power State；1 = Normal Operation, 0 = Deep Sleep

EX: If host send read power state command to TP and TP's power state is 1. Touch pad will return 0B01010010 01011000 00000000 00000001

	Type	PID	Register No.	Write Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0100	0101	00000000 00000000	000	1

Comment：If host wants to write the power state of the touch pad, it should send Packet ID #4 with register number 0101. Then the touch pad will keep the value.

Bit 19：Power State；1 = Normal Operation, 0 = Deep Sleep

11.2.7 Register Number = 6, TP Calibration Setting (Write Only)

	Type	PID	Register No.	Write Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0100	0100	00000000 00000000	000	1

Comment：If the host wants to do Re_ Calibration to the touch pad, it should send Packet ID #4 with register number 0100. Then the touch pad will do calibration again.

Bit 19: Do Re-Calibration or not, 1 = Re-Calibration, 0 = Nothing

EX: If host want to do Re-Calibration, it should send the packet is

0B 01010100 01001000 00000000 00000001, then touch pad will do Re-Calibration. If touch pad calibration ok, the touch pad will send "calibration ok packet (A5 A5 A5 A5)" to let the host know that TP is calibration ok and ready for operation.

11.2.8 Register Number = 7, NA

11.2.9 Register Number = 8, NA

11.2.10 Register Number = 9, TP analog regulator voltage and operating frequency (R/W)

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0011	1001	00000000 00000000	000	1

Comment: If host wants to read the analog regulator voltage and operating frequency of touch pad, it should send Packet ID #3 with register number 1001.

	Type	PID	Register No.	Read Register Response Data	Reserve	

31	30~28	27~24	23~20	19~4	3~1	0
0	101	0010	1001	00000000 00000000	000	1

Comment: The touch pad will then return the analog regulator voltage and operating frequency by sending Packet ID #2 to host.

Bit 19: Analog regulator voltage, 1 = 3.3V, 0 = 2.4V (Default).

Bit 18 ~ Bit 16: Operating frequency,

000: 6MHz/4 = 1.5MHz

001: 6MHz/8 = 750KHz (Default)

010: 6MHz/16 = 375KHz

011: 6MHz/32 = 187.5KHz

	Type	PID	Register No.	Write Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0100	1001	00000000 00000000	000	1

Comment：If the host wants to write the analog regulator voltage and operating frequency of the touch pad, it should send Packet ID #4 with register number 1001. Then the touch pad will keep the value.

EX: If host want to set analog regulator voltage = 3.3V (Power supply need >3.3V) and operating frequency is 750KHz, the packet is

0B 01010100 10011001 0000000 00000001

EX: If host want to set analog regulator voltage = 2.4V and operating frequency is 375KHz, the packet is

0B 01010100 10010010 0000000 00000001

11.2.11 Register Number = 10, TP finger on - constant (R/W)

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0011	1010	00000000 00000000	000	1

Comment: If host wants to read the “finger on – constant” that add to finger’s threshold of touch pad, it should send Packet ID #3 with register number 1010.

	Type	PID	Register No.	Read Register Response Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0010	1010	00000000 00000000	000	1

Comment: The touch pad will then return the “finger on – constant” that add to finger’s threshold of touch pad by sending Packet ID #2 to host.

Bit 15 ~ Bit8: finger on – constant. Default value is 10.

EX: If “finger on – constant” = 10, the packet is

0B 01010010 10100000 00001010 00000001

	Type	PID	Register No.	Write Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0100	1010	00000000 00000000	000	1

Comment：If the host wants to write “finger on – constant” that add to finger’s threshold of touch pad, it should send Packet ID #4 with register number 1010. Then the touch pad will keep the value.

EX: If host want to set the “finger on – constant” = 20, the packet is

0B 01010100 10100000 00010100 00000001

11.2.12 Register Number = 11, TP Idle state control (R/W)

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0011	1011	00000000 00000000	000	1

Comment: If host wants to read the idle state of touch pad, it should send Packet ID #3 with register number 1011.

	Type	PID	Register No.	Read Register Response Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0010	1011	00000000 00000000	000	1

Comment: The touch pad will then return the idle state of touch pad by sending Packet ID #2 to host.

Bit 19 ~ Bit18: Idle state control.

11: Normal Idle (Default). Finger down=> Normal, Finger Up=> waiting 2 sec into Idle.

10: No Idle. Finger down=> Normal, Finger Up=> Normal.

01: Test Idle. Finger down=> Normal, Finger Up=> Immediately into Idle.

	Type	PID	Register No.	Write Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0100	1011	00000000 00000000	000	1

Comment：If the host wants to write *the idle state of touch pad*, it should send Packet ID #4 with register number 1011. Then the touch pad will keep the value.

11.2.13 Register Number = 12, TP slider operation mode (R/W)

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0011	1100	00000000 00000000	000	1

Comment: If host wants to read the slider operation mode of touch pad, it should send Packet ID #3 with register number 1100.

	Type	PID	Register No.	Read Register Response Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0010	1100	00000000 00000000	000	1

Comment: The touch pad will then return the slider operation mode of touch pad by sending Packet ID #2 to host.

Bit 19: slider operation mode.

0: slider + 6 Keys (Default). Position range is 0 ~ 79.

1: long slider. Position range is 0 ~ 207.

	Type	PID	Register No.	Write Register Data	Reserve	

31	30~28	27~24	23~20	19~4	3~1	0
0	101	0100	1100	00000000 00000000	000	1

Comment：If the host wants to write slider operation mode of touch pad, it should send Packet ID #4 with register number 1100. Then the touch pad will keep the value.

11.2.14 Register Number = 13, TP SPI Bit-Rate (R/W)

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0011	1101	00000000 00000000	000	1

Comment: If host wants to read the SPI Bit-Rate of touch pad, it should send Packet ID #3 with register number 1101. It is only used in SPI Master mode.

	Type	PID	Register No.	Read Register Response Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0010	1101	00000000 00000000	000	1

Comment: The touch pad will then return the SPI Bit-Rate of touch pad by sending Packet ID #2 to host. It is only used in SPI Master mode.

Bit 18 ~ Bit16: SPI Bit-Rate (Only used in SPI Master mode).

110: 23K bits (Default)

101: 46.8K bits

100: 93.75K bits

011: 187.5K bits

010: 375K bits

001: 750K bits

000: 1.5M bits

	Type	PID	Register No.	Write Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0100	1101	00000000 00000000	000	1

Comment：If the host wants to write the SPI Bit-Rate of touch pad, it should send Packet ID #4 with register number 1101. Then the touch pad will keep the value.

11.2.15 Register Number = 14, TP Report Rate Setting(R/W)

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0011	1110	00000000 00000000	000	1

Comment: If host wants to read the report rate of the touch pad, it should send Packet ID #3 with register number 1110.

	Type	PID	Register No.	Read Register Response Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0010	1110	00000000 00000000	000	1

Comment: The touch pad will then return the report rate by sending Packet ID #2 to host.

	Type	PID	Register No.	Write Register Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0100	1110	00000000 00000000	000	1

Comment：If host wants to write the report rate of the touch pad, it should send Packet ID #4 with register number 1110. The touch pad will then keep the value.

Bit 19 ~ Bit18: Report rate.

11 = Normal report rate (default)

10 = Slow report rate.

01 = Fast report rate.

The normal report rate is 20 ~ 25ms.

The slow report rate is 36 ~ 41ms.

The fast report rate is 12 ~ 17ms.

11.2.16 Register Number = 15, Read Firmware ID (Read Only)

	Type	PID	Register No.	Reserve	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0011	1111	00000000 00000000	000	1

Comment：If host wants to read the firmware ID of the touch pad, it should send Packet ID #3 with register number 1111.

	Type	PID	Register No.	Read Register Response Data	Reserve	
31	30~28	27~24	23~20	19~4	3~1	0
0	101	0010	1111	10000001 01010000	000	1

Comment：The touch pad will then return the firmware ID by sending Packet ID #2 to host.

Bit 19 ~ Bit 12: firmware ID high byte

Bit 11 ~ Bit 4: firmware ID low byte

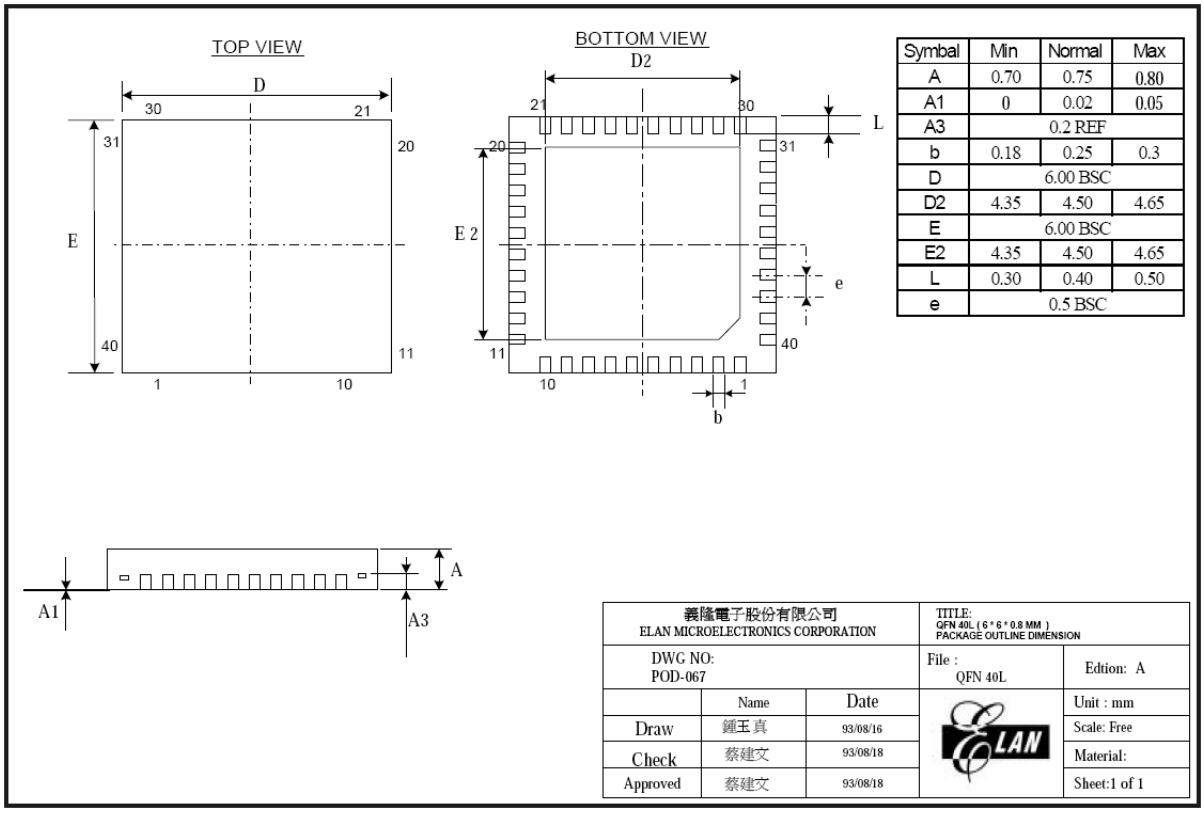
For this controller, the firmware ID is 8150:

Firmware ID high byte = 0x81

Firmware ID low byte = 0x50

12 Package Specification

QFN40



Symbal	Min	Normal	Max
A	0.70	0.75	0.80
A1	0	0.02	0.05
A3		0.2 REF	
b	0.18	0.25	0.3
D		6.00 BSC	
D2	4.35	4.50	4.65
E		6.00 BSC	
E2	4.35	4.50	4.65
L	0.30	0.40	0.50
e		0.5 BSC	

義隆電子股份有限公司 ELAN MICROELECTRONICS CORPORATION			TITLE: QFN 40L (6 * 6 * 0.8 MM) PACKAGE OUTLINE DIMENSION	
DWG NO: POD-067			File : QFN 40L	Edtion: A
	Name	Date		Unit : mm
Draw	鍾玉真	93/08/16		Scale: Free
Check	蔡建文	93/08/18		Material:
Approved	蔡建文	93/08/18		Sheet:1 of 1