

## **CONTENTS**

|                                                        |           |
|--------------------------------------------------------|-----------|
| <b>1 GENERAL DISCRIPTION .....</b>                     | <b>2</b>  |
| <b>2 FEATURES &amp; STRENGTH .....</b>                 | <b>2</b>  |
| 2.1 Features .....                                     | 2         |
| 2.2 Strength.....                                      | 2         |
| <b>3 PIN DESCRIPTION .....</b>                         | <b>2</b>  |
| 3.1 Pin Assignment.....                                | 2         |
| 3.2 Pin Description.....                               | 3         |
| <b>4 ELECTRICAL CHARACTERISTICS .....</b>              | <b>3</b>  |
| 4.1 Absolute Maximum Ratings.....                      | 3         |
| 4.2 DC Electrical Characteristics.....                 | 3         |
| <b>5 PACKAGE INFORMATION.....</b>                      | <b>4</b>  |
| <b>6 APPLICATION DESIGN GUIDE.....</b>                 | <b>5</b>  |
| 6.1 Unused Channel Processing .....                    | 5         |
| 6.2 Keys Spacing .....                                 | 5         |
| 6.3 Communication Interface Selection.....             | 5         |
| 6.3.1 Communication Interface Selection.....           | 5         |
| 6.3.2 Sensitivity Setting & Key Value Data Format..... | 5         |
| <b>7 APPLICATION NOTES .....</b>                       | <b>9</b>  |
| 7.1 Application Circuits .....                         | 9         |
| 7.2 Check List.....                                    | 9         |
| 7.3 Power Requirements .....                           | 9         |
| 7.4 PCB Layout .....                                   | 9         |
| 7.5 PCB Layout .....                                   | 10        |
| 7.6 PCB Reference Layout.....                          | 10        |
| 7.7 The Material Selection Of Overlay.....             | 11        |
| <b>8 SPECIFICATION CHANGE RECORD .....</b>             | <b>12</b> |

## 1 General Discription

The SCT80S16B is a touch key ASIC with eight touch key channels and UART/IIC interface. Users can set the sensitivity through UART/IIC. This IC with its industrial grade specifications and 4KV EFT and 6KV ESD performance can easily pass 3V dynamic and 10V static of the Conducted Susceptibility Tests. It is the first option for high-performance touch key solution. It is also suitable for the home appliances, security and industrial control.

## 2 Features & Strength

### 2.1 Features

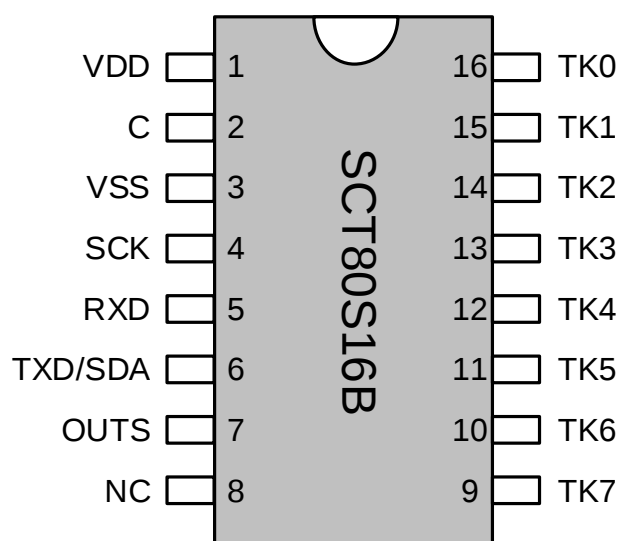
- Operating voltage: 3.3V ~ 5.5V
- Ambient temperature: -40 ~ 85 C
- Touch key channel: 8 channels, support up to two keys pressed down at the same time
- Communication interface: UART/IIC
- Sensitivity adjustment: UART/IIC communication
- Sensitivity level of touch channel can be set up in 2s by UART/IIC
- Thickness of covering: 0 ~ 10mm
- Touch key response time: less than 100ms
- Maximum press time of a key: 10s
- Package: SOP16

### 2.2 Strength

- Patented technology
- Perfect touch key operation experience
- Sensitivity adjustable
- Strong EMC capability, 4KV EFT, 6KV ESD, 10V CS

## 3 Pin Description

### 3.1 Pin Assignment



SCT80S16B Pin Assignment

### 3.2 Pin Description

| Pin Number | Pin Name | Pin Type | Function Discription                                                                               |
|------------|----------|----------|----------------------------------------------------------------------------------------------------|
| 1          | VDD      | Power    | Power Supply                                                                                       |
| 2          | C        | Cadj     | Connect a 10nf capacitor to Ground.                                                                |
| 3          | VSS      | Power    | Ground                                                                                             |
| 4          | SCK      | I        | IIC communication clock pin;<br>Recommend to cascade resistance of tens of ohms.                   |
| 5          | RXD      | I        | UART receiving data pin;<br>Recommend to cascade a resistor of tens of ohms.                       |
| 6          | TXD/SDA  | I/O      | UART transmission /IIC communication data pin;<br>Recommend to cascade a resistor of tens of ohms. |
| 7          | OUTS     | I        | Selection of communication mode:<br>Ground: IIC;<br>VDD or NC: UART.                               |
| 8          | NC       | O        | NC                                                                                                 |
| 9          | TK7      | I        | Touch key channel 7, connect to ground when not in use                                             |
| 10         | TK6      | I        | Touch key channel 6, connect to ground when not in use                                             |
| 11         | TK5      | I        | Touch key channel 5, connect to ground when not in use                                             |
| 12         | TK4      | I        | Touch key channel 4, connect to ground when not in use                                             |
| 13         | TK3      | I        | Touch key channel 3, connect to ground when not in use                                             |
| 14         | TK2      | I        | Touch key channel 2, connect to ground when not in use                                             |
| 15         | TK1      | I        | Touch key channel 1, connect to ground when not in use                                             |
| 16         | TK0      | I        | Touch key channel 0, connect to ground when not in use                                             |

## 4 Electrical Characteristics

### 4.1 Absolute Maximum Ratings

| Symbol           | Parameter           | Minimum | Maximum | UNIT |
|------------------|---------------------|---------|---------|------|
| V <sub>DD</sub>  | Operation voltage   | 3.3     | 5.5     | V    |
| T <sub>A</sub>   | Ambient temperature | -40     | 85      | °C   |
| T <sub>STG</sub> | Storage temperature | -55     | 125     | °C   |

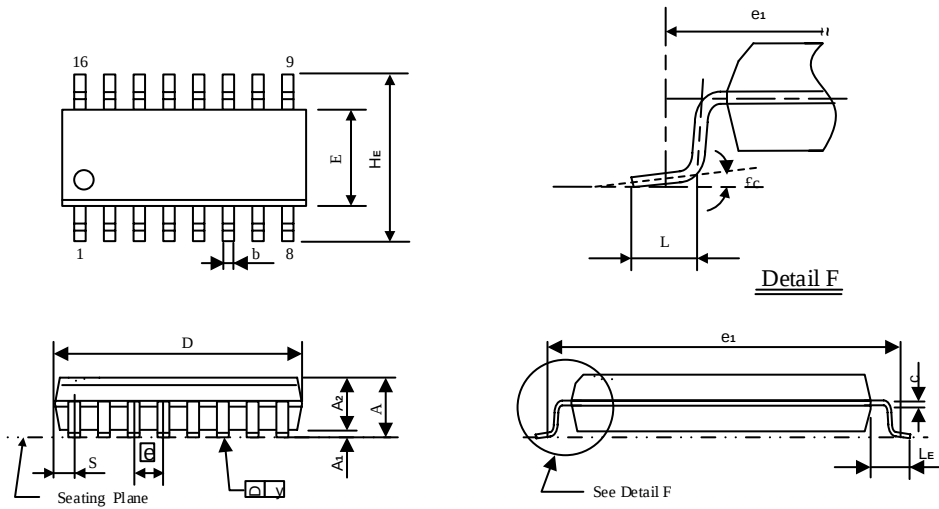
### 4.2 DC Electrical Characteristics

V<sub>DD</sub> = 5V, T<sub>A</sub> = +25°C, Unless otherwise noted

| Symbol          | Parameter           | Minimum            | Typical | Maximum              | Unit | Conditions             |
|-----------------|---------------------|--------------------|---------|----------------------|------|------------------------|
| I <sub>OP</sub> | Operating Current   | -                  | 8.0     | -                    | mA   | V <sub>DD</sub> =5V    |
| V <sub>IH</sub> | Input High Voltage  | 0.7V <sub>DD</sub> | -       | V <sub>DD</sub> +0.5 | V    |                        |
| V <sub>IL</sub> | Input Low Voltage   | -0.5               | -       | 0.3V <sub>DD</sub>   | V    |                        |
| I <sub>OL</sub> | Output Low Current  | -                  | 43      | -                    | mA   | V <sub>Pin</sub> =0.8V |
| I <sub>OH</sub> | Output High Current | -                  | 5.5     | -                    | mA   | V <sub>Pin</sub> =4.7V |

## 5 Package Information

SOP 16L(150mil) outline dimension Unit: mm



| Symbol | Unit(mm)  |        |         |
|--------|-----------|--------|---------|
|        | Minimum   | Normal | Maximum |
| A      | -         | -      | 1.75    |
| A1     | 0.05      | -      | 0.225   |
| A2     | 1.30      | 1.40   | 1.50    |
| b      | 0.39      | -      | 0.48    |
| C      | 0.21      | -      | 0.26    |
| D      | 9.70      | 9.90   | 10.10   |
| E      | 3.70      | 3.90   | 4.10    |
| HE     | 5.80      | 6.00   | 6.20    |
| e      | 1.27(BSC) |        |         |
| L      | 0.50      | -      | 0.80    |
| LE     | 1.05(BSC) |        |         |
| θ      | 0°        | -      | 8°      |

## 6 Application Design Guide

### 6.1 Unused Channel Processing

If user only uses some of the channels, then all the remaining channels must be connected to ground.

### 6.2 Keys Spacing

To minimize the interference between channels at high sensitivity mode, please ensure that the spacing between two keys is greater than the spring diameter.

### 6.3 Communication Interface Selection

#### 6.3.1 Communication Interface Selection

1. 0: IIC;
2. 1: UART。

#### 6.3.2 Sensitivity Setting & Key Value Data Format

1. IIC mode:
  - ① SCT80S16B is in Slave Mode;
  - ② The baud rate is less than 10Kbps.
  - ③ The MSB is transmitted/received first. (Bit7 to Bit0).
  - ④ The controller set the touch sensitivity level through communication.

Within 2 seconds after the IC power on, user can set the sensitivity level of each touch channel by IIC. The user only needs to set the sensitivity once. Then, the IC will keep the last-setting sensitivity level. Change the sensitivity again is available, user can do the setting procedure again within 2 seconds after the IC power on.

The following is the set flow of touch key sensitivity level through IIC:

Host → touch IC: fixed 11 Byte, independent of the number of TK channels selected by users.

| Command | Byte0    | Byte1        | Byte2        | ... | Byte8        | Byte9    | Byte10  |
|---------|----------|--------------|--------------|-----|--------------|----------|---------|
| Meaning | IICWrite | Sensitivity0 | Sensitivity1 | ... | Sensitivity7 | Checksum | IICRead |

Set flow

IICWrite: The host sends commands to the slave module and is fixed to 0x70.

Sensitivity0: The sensitivity level of the TK0 channel (the range of 01-0F is 15-level); The larger the value is, the lower the sensitivity.

Sensitivity1: The sensitivity level of the TK1 channel (the range of 01-0F is 15-level);

Sensitivity7: The sensitivity level of the TK7 channel (the range of 01-0F is 15-level);

Checksum: Sensitivity level setting checksum (checksum of Byte1-Byte8), touch IC checks the data and returns a 1-byte check information after receiving the sensitivity level setting information

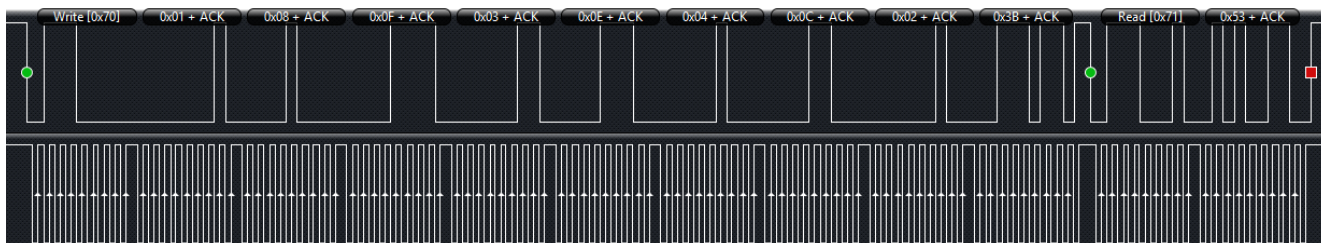
IICRead: The host sends the read data command to the slave module and is fixed to 0x71.

Touch IC → Host: 1 Byte

| Data    | Byte0  |
|---------|--------|
| Meaning | Status |

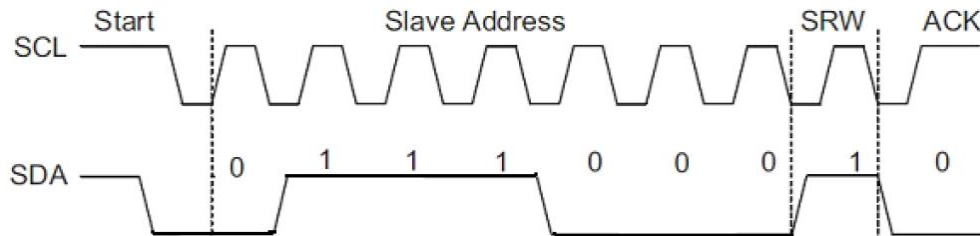
Status: The touch IC will send a 1-byte check message to the host after receiving the sensitivity setting information and reading data command from the host, and returns 0x53 to indicate that the sensitivity setting is done. Therefore, the user can stop setting the sensitivity; if the touch IC returns 0x49, or returns any other data, indicating that the IC receives the wrong sensitivity setting information, then the user needs to reset the sensitivity setting information again until the touch IC returns 0x53.

The following figure is the sensitivity setting waveform, in which 0x70 is the host-to-slave data command. 0x01 is the sensitivity level of TK0. 0x08 is the sensitivity level of TK1. 0x0F is the sensitivity level of TK2. 0x03 is the sensitivity level of TK3. 0x0E is the sensitivity level of TK4. 0x04 is the sensitivity level of TK5. 0x0C is the sensitivity level of TK6. 0x02 is the sensitivity level of TK7. 0x3B is the checksum of the sensitivity level. 0x71 is the host-to-slave data-reading command. 0x53 is the response information of the touch IC; the response of 0x53 indicates that the touch IC has received the correct settings, and the user can stop setting the sensitivity.



**Note:** The touch IC will be set according to the current command after the check succeeds. If the touch IC does not receive the correct setting information within 2s after power-on, the IC will maintain the previous sensitivity setting value. If the user has never set the sensitivity, the IC defaults to level 8. If the user sends the sensitivity setting information again after IC power-on for 2s, it will not reply to any information at this time. The length of sensitivity level setting information has nothing to do with the number of TK channels used by users. It is fixed to 8 Bytes. When the number of TK channels used by users is less than 8, users should write the sensitivity level of TK0-TK7 in turn. Unused channels can be set at any value, but it is recommended to set it to 0x0F.

- ⑤ Data format of the key:
- the host sends Start signal;
  - The host generates 7-bits of address bit and a read-write select bit (0x71), and determines whether the slave receives a valid address request by judging whether the SCT80S16B's response ACK signal is normal.



- c) The host reads a 2-byte keystroke information from SCT80S16B:

| Data bits                                  | Bit7                            | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|--------------------------------------------|---------------------------------|------|------|------|------|------|------|------|
| Meaning                                    | TK7                             | TK6  | TK5  | TK4  | TK3  | TK2  | TK1  | TK0  |
| Touch key status code 1: keyed; 0: no key. |                                 |      |      |      |      |      |      |      |
| Data bits                                  | Bit7                            | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
| Meaning                                    | Check code: negative code check |      |      |      |      |      |      |      |

Note: The host must respond to the ACK signal every time it reads a 1-byte data, and then read the next byte data. After reading the data of two bytes, the host should send out ACK signal and STOP signal. As shown in the figure below, it is the waveform of information transmission of a key. The host sends 0x71 to read the slave data and recover 2 Byte data from the slave.

It is suggested that the host reads the value of a key in a period of 30-50ms. After checking the correct value of the key, it can be confirmed that a key is pressed or released.

## 2. UART mode:

- Baud rate: 9600bps, 10-bit full duplex asynchronous communication, 1 bit start bits, 8 bit data bits and 1 bit stop bits.
- Sensitivity level setting of touch channels.

Within 2s after the IC is powered on, the user can set the sensitivity level of each touch channel by UART

communication. The user only needs to set the sensitivity once through communication. After power on again, the IC will keep the last sensitivity level setting. If the user wants to modify the sensitivity, he/she can reset it within 2s after power on the IC

The following is the command format for setting touch sensitivity level through UART communication:

Host → touch IC: fixed to 10 Byte, independent of the number of TK channels selected by users.

| Command word | Byte0   | Byte1        | Byte2        | ... | Byte8        | Byte9    |
|--------------|---------|--------------|--------------|-----|--------------|----------|
| Meaning      | Command | Sensitivity0 | Sensitivity1 | ... | Sensitivity7 | Checksum |

Command: Sensitivity setting command, fixed to 0x70.

Sensitivity0: The sensitivity level of the TK0 channel (the range of 01-0F is 15-level); the larger the value is, the lower the sensitivity.

Sensitivity1: The sensitivity level of the TK1 channel (the range of 01-0F is 15-level);

Sensitivity7: The sensitivity level of the TK7 channel (the range of 01-0F is 15-level);

Checksum: Sensitivity level setting checksum (checksum of Byte1-Byte8), touch IC checks the data and returns a 1-byte check information after receiving the sensitivity level setting information

IICRead: The host sends the read data command to the slave module and is fixed to 0x71.

Touch IC → Host: 1 Byte

| Data    | Byte0  |
|---------|--------|
| Meaning | Status |

Status: If the touch IC returns 0x53 after the verification succeed, indicating that the sensitivity setting completes, the user can stop setting the sensitivity; if the touch IC returns 0x49 after the verification fail, the user needs to re-send the sensitivity setting information until the touch IC returns 0x53.

As shown below, the sensitivity setting waveform, where 0x43 is the sensitivity setting command. 0x01 is the sensitivity level of TK0. 0x08 is the sensitivity level of TK1. 0x0F is the sensitivity level of TK2. 0x03 is the sensitivity level of TK3. 0x0E is the sensitivity level of TK4. 0x04 is the sensitivity level of TK5. 0x0C is the sensitivity level of TK6. 0x02 is the sensitivity level of TK7. 0x3B is the checksum of the sensitivity level. 0x53 is the check information returned from the touch IC, and the response 0x53 indicates that the touch IC has received the correct setting information, at which point the user can stop setting the sensitivity.



**Note:** The touch IC will be set according to the current command after the check succeeds. If the touch IC does not receive the correct setting information within 2s after power-on, the IC will maintain the previous sensitivity setting value. If the user has never set the sensitivity, the IC defaults to level 8 sensitivity. If the user sends the sensitivity setting information again after IC power-on for 2s, it will not reply to any information at this time. The length of sensitivity level setting information has nothing to do with the number of TK channels used by users. It is fixed to 8 Bytes. When the number of TK channels used by users is less than 8, users should write the sensitivity level of TK0-TK7 in turn. Unused channels can be set at any value, but it is recommended to set it to 0x0F.

### ③ reading process of the touch key:

The first step is to read the key value 1 Byte.

| Data bits                    | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|------------------------------|------|------|------|------|------|------|------|------|
| Meaning                      | 0    | 0    | 0    | 1    | 0    | 0    | 0    | 1    |
| Read key value command: 0X11 |      |      |      |      |      |      |      |      |

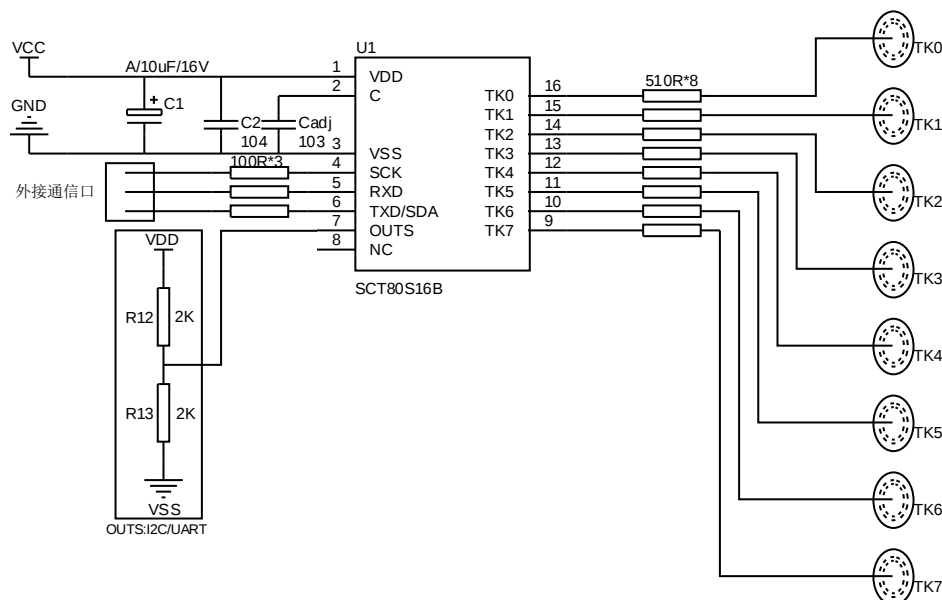
The second step, SCT80S16B returns the key value 2 Byte:

| Data bits | Bit7                                       | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|-----------|--------------------------------------------|------|------|------|------|------|------|------|
| Meaning   | TK7                                        | TK6  | TK5  | TK4  | TK3  | TK2  | TK1  | TK0  |
|           | Touch key status code 1: keyed; 0: no key. |      |      |      |      |      |      |      |
| Data bits | Bit7                                       | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
| Meaning   | Check code: negative code check            |      |      |      |      |      |      |      |

It is suggested that the host reads the key value in a period of 30-50ms. After checking the correct key value, it can be confirmed that a key is pressed or released.

## 7 Application Notes

### 7.1 Application Circuits



### 7.2 Check List

| NO. | Category                               | Suggestion / remarks                                                                                                                                                                                                                                                                                           |
|-----|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Decoupling capacitor C2 on the VDD pin | Connect 10 $\mu$ F and 0.1 $\mu$ F capacitor in parallel                                                                                                                                                                                                                                                       |
| 2   | Reference capacitance Cadj             | Connect 103 capacitor to VSS, X7R or NPO capacitor                                                                                                                                                                                                                                                             |
| 3   | Communication interface selection OUTS | R12/R13 Either-or:<br>1. If R12 is selected, then R13 should be disconnected, and vice versa. When R13 is selected, 0 $\Omega$ can replace 2K resistor in the circuit, that is, connect to ground directly.<br>2. OUTS is L, communication interface is IIC.<br>3. OUTS is H, communication interface is UART. |
| 4   | CS test                                | 150KHz~80MHz 3V dynamic, 10V static                                                                                                                                                                                                                                                                            |
| 5   | Unused touch channel pins              | Connect to ground                                                                                                                                                                                                                                                                                              |

### 7.3 Power Requirements

Consider the stability of the system, power should use voltage regulated IC, RC filter, LC filter and other circuits to prevent AC moire interference.

### 7.4 PCB Layout Guidelines

#### 1. Position of chip and build-out resistance

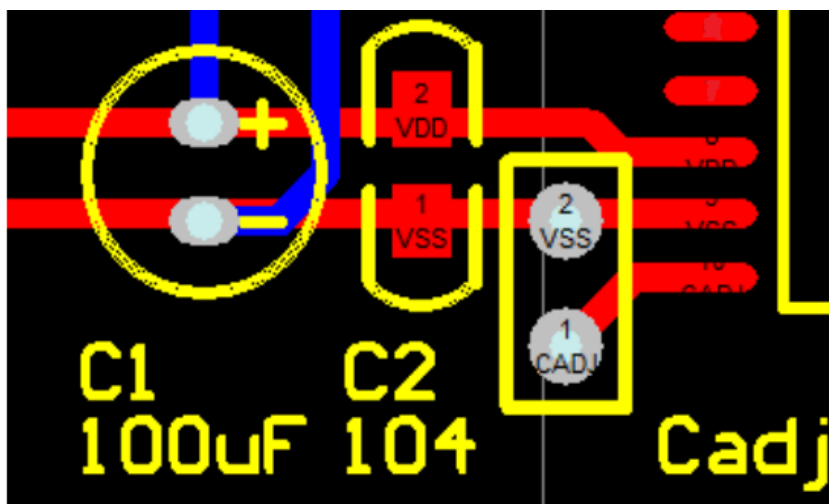
If the space of PCB allow, the touch chip should be placed in the middle of the touch panel in order to minimize the distance difference between the pin of each induction channel of IC and the touch key; the build-out resistance (recommended 510 Ohm) should be placed as close as possible to the touch chip.

#### 2. Power supply circuit and reference capacitor Cadj

- ① The input power should first connect capacitor filter (electrolytic capacitor + 104 ceramic capacitor) and then connect to the VDD pin of IC. The capacitor can also be replaced with tantalum capacitor.

The capacitance value should not be less than 10uF. 104 ceramic capacitor should be put close to the VDD and VSS pin of IC when it is laid out.

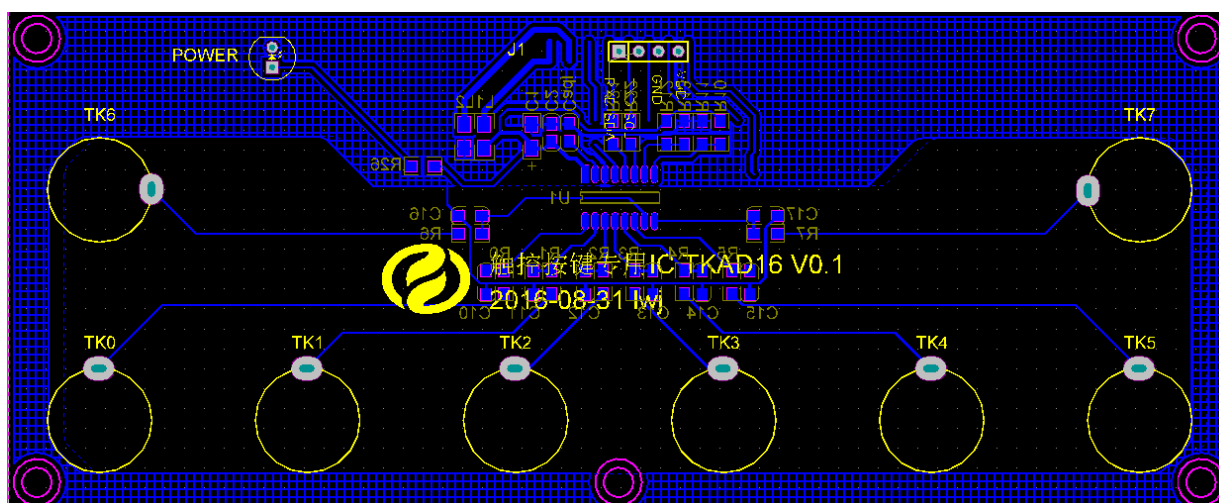
- ② Reference capacitor Cadj should be close to the C pin and VSS pin of the IC. Pay attention that the ground pin of Cadj connects behind to 104 capacitor, that is, the reference capacitor Cadj is closer to IC. As follows:



## 7.5 PCB Layout

1. The trace of the touch key should be as short as possible (suggested 7-15mil). A trace should not use both via and jumper, if used, no more than two is recommended;
2. For the traces of multi-KEY situation, the difference of the traces length should be as small as possible (IC should be placed in the center of the Keys).
3. The distance between the traces should be as large as possible, more than two times of the trace width is a preference.
4. Traces should avoid other components, high-current and high-frequency signal traces (IIC, SPI, RF and other high-frequency signal traces) as far as possible. If unavoidable, the two traces should be perpendicular, must not be parallel, or add ground plane between the two to isolate them.
5. The projection plane of the key button is strongly suggested to set no components or other signal traces. The touch sensor pad should be coated with overlay, and make no copper exposure.

## 7.6 PCB Reference Layout



## **7.7 The Material Selection Of Overlay**

1. The material of the overlay must be insulated or non-conductive. Avoid using conductive materials such as metals or metal containing carbon.
2. Under the same touch sensitivity level, the thicker the overlay is, the lower the touch sensitivity is, and the lower the signal-to-noise ratio is. When using acrylic material, the thickness of material is suggested to be 3-6 mm.
3. If the dielectric constant of the touch panel material is too small, the sensitivity of the touch button will fail. To solve this problem, one possible solution is to reduce the sensitivity level to increase the touch sensitivity; on the contrary, if the dielectric constant is too large, the touch button may fall to work, then the sensitivity level should be increased to reduce the touch sensitivity.

## 8 Specification Change Record

| Version | Record                             | Date    |
|---------|------------------------------------|---------|
| V1.1    | Modify header and CS specification | 07/2018 |
| V1.0    | The first version                  | 03/2018 |