



## WTC6401RSI Inductive touch Switch Chip of Six-channel Electric Capacitance Fast Browsing

Number of keys	2-4 keys
Number of slide bar / roller	1
Technical principle	Capacitive to digital conversion technology
Key response mode	Multi-key combination (SHIFT) mode can be selected
Dimension of key sense element	Minimum 3mm ×3mm, maximum 30mm ×30mm, to be determined according to actual demand and panel thickness
Spacing of key sense element	Minimum spacing 0.5mm, to be determined according to actual demand
Shape of key sense element	Arbitrary polygon, rotundity or ellipse, either panel with hole in the middle or hollow panel (optional)
Material of key sense element	PCB copper coil, sheet metal, flat-top cylinder spring, conductive rubber, conductive ink, ITO layer of conductive glass, etc.
Requirements for PCB	Single-sided PCB and double-sided PCB
Panel material	Insulating materials, such as organic glass, ordinary glass, tempered glass, plastic, wood timber, paper, ceramics and stone
Panel thickness	0 – 20 mm
Adjustment method of key sensitivity	Key sensitivity can be adjusted by changing value of base capacitance CSEL.
Effective touch response time	Less than 100 ms
Water resistance	Watering or spraying water on the panel will not cause malfunction of keys; when flooded or with water accumulation, no abnormal response occurs by touching the panel.
RFI resistance	Effectively suppress RFI (radio frequency interference) caused when GSM cell phone is used to make a call or answer a call next to the panel or a talk proceeds next to the panel over high-power walkie-talkie.
Operating voltage range	3.3V-5.5V
Operating temperature range	—40°C—+85°C
Data transmission interface	The output of the key is one-to-one
Storage temperature range	—50°C—+125C
Chip sealing mode	SSOP24(150MIL)
Typical application	Various home appliances, security equipment, communication equipment, industrial control equipment & instruments, entertainment equipment, medical equipment, sport facilities, toy,etc.



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## WTC6401RSI Inductive touch Switch Chip of Six-channel Electric Capacitance Specification (V1.5)

### 1. Product Introduction

WTC6401RSI series touch sensing IC is an integrated circuit designed to achieve human touch interface. It can replace mechanical light touch and mechanical rotary encoder, to realize waterproof and dustproof, seal isolation, solid and beautiful operation interface. A WTC6401RSI can achieve 2-4 independent touch keys and a touch roller encoder. It can provide user with a low-cost human-computer interaction interface. Touch roller, slide bar can be very sensitive to detect the finger on the sliding direction and sliding distance of the roller or slide bar, respectively and continuously output multi-pulse signals from the UP output foot or DOWN output foot. The longer the fingers sliding distance, the more the number of pulses output from UP and Down. The main controller can follow on the basis of the pulse signal to control the increase or decrease of physical quantity, make the operation roller and slide bar reaching the effect of the operating multi-turn potentiometer and sliding potentiometer

#### 1.1. High production efficiency.

It is only needed to adjust one capacitor Csel that can change the sensitivity of all channels, with less peripheral component, and high production efficiency.

#### 1.2. Adapt to different thickness panels

Through selecting the appropriate Csel capacitance value, appropriately adjusting the sense element can make WTC6401RSI to adapt the insulation panel of the different thickness of 0-5mm.

#### 1.3. Chip Package Type

WTC6401RSI is packaged with standard 24PIN SSOP.

### 2. Technical Features and Parameters

#### 2.1. Technical Features

##### 2.1.1. Simple Peripheral Circuits, and A Few Peripheral Components

With independently designed special test circuit, self-calibration circuit and RISC processor integrated inside the IC, there are a few peripheral components.

##### 2.1.2. Debugging-free Production and Excellent Long-time Working Stability



Calibration is not necessary for the system after the set value for capacitor Csel of sensitivity is determined. The system can automatically overcome the interference caused by electrostatic discharge, electromagnetic interference, temperature variation and accumulation of moisture and pollutants on the surface, and provide good precision and operation consistency in various environments, so the product can suffer long-distance transportation and be used in various environments. The unique compensation algorithm and high-strength anti-interference design can guarantee no occurrence of malfunction during long-time work of the product.

### **2.1.3. The user can use the compact keyboard of smaller spacing**

The adjacent key suppression function can prevent the adjacent keys from the faulty action. That is when the same finger touches two or more than two keys, only the finger occupies the key which the area is largest that can make the response, and the key which the relatively small area is occupied by finger is suppressed and not making the response. If the finger occupies two or more than two keys at the same area, these keys do not make the response. The minimum clearance of the key can reach 0.5mm

### **2.1.4. Excellent Water Resistance**

The special waterproof design is used for it. The keyboard not only can be splash proof, flood water proof, but also can be normal use after completely flooded, is different from the general induction at present which when the splashing water, flood water of key panel, it is easily getting false action and is unresponsive after waterlogging, or is occurring false action after pressing it by finger.

### **2.1.5. Excellent Electromagnetic Immunity**

When applying to home apparatuses and ordinary application products, the user may get good immunity to radio frequency signals by using single-sided PCB, and easily resist the interference of most of radio frequency sources including GSM cell phone to the sensitive keys.

When applying to military and other special situations, it is suggested that double-sided PCB should be designed according to the layout requirements provided by us.

### **2.1.6. Unique Line Length Self-correction Function**

It is common for the current similar products on the market that, the sensitivity largely differs according to the length of line from sensing key to IC pin. Our original line length self-correction technology can automatically correct such difference. The user can obtain almost uniform sensitivity for all keys of the whole sense element without complex adjustment.

### **2.1.7. Meet the specification requirements of the industrial application**

It can provide users with more reliable performance and wider range of applications.

### 2.1.8 Technical Parameters

Operating voltage:  $3.3V < V_{cc} < 5.5V$   
 Output voltage range:  $GND < V_{out} < V_{cc}$   
 Sensing thickness (insulating medium): 0-20mm  
 Response time of effective touch: Less than 100ms  
 Operating temperature:  $-40^{\circ}C \text{---} +85^{\circ}C$   
 Storage temperature:  $-50^{\circ}C \text{---} +125^{\circ}C$

### 3. Typical Application

Be applicable to various kitchen apparatuses, audio and video devices, air conditioners, sanitary electrical apparatuses, lights and switches, security equipment, instruments, portable player, mobile phones, electronic toys and learning machines.

### 4. Definitions of Product Pins

#### 4.1 Pin arrangement

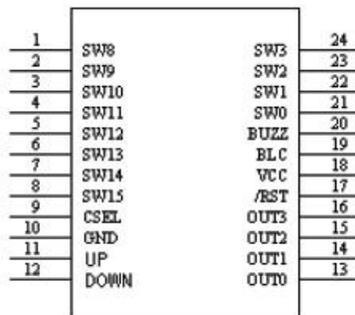


Figure 1

#### 4.2 Definitions of Pins

The definitions of WTC6401RSI pins

Pin No.	Pin Name	Usage	Function Description
1	SW8	I	Roller sense element unit interface
2	SW9	I	Roller sense element unit interface
3	SW10	I	Roller sense element unit interface
4	SW11	I	Roller sense element unit interface
5	SW12	I	Roller sense element unit interface
6	SW13	I	Roller sense element unit interface
7	SW14	I	Roller sense element unit interface
8	SW15	I	Roller sense element unit interface
9	CSEL	I	Capacitor interface for adjusting the sensitivity

10	GND	I	Power ground
11	UP	O	Roller, slide bar UP pulse output foot
12	DOWN	O	Roller, slide bar DOWN pulse output foot
13	OUT0	O	Touch key SW0 output
14	OUT1	O	Touch key SW1 output
15	OUT2	O	Touch key SW2 output
16	OUT3	O/I	Touch key SW3 output
17	/RST	I	Chip reset pin
18	VCC	I	Positive power supply output
19	BLC	O	Backlight LED control pin
20	BUZZ	O	Buzzer control pin
21	SW0	I	Touch key (sense element) interface 0
22	SW1	I	Touch key (sense element) interface 1
23	SW2	I	Touch key (sense element) interface 2
24	SW3	I	Touch key (sense element) interface 3

## 5. Output Display

### 5.1. The output of the touch key

When there is no any key pressed in WTC6401RSI, the four key output end OUT0-OUT3 are all high impedance state. When the valid touch on the keys sense element occurred is detected, WTC6401RSI responds within 100 ms, the corresponding key output port outputs the low level, until the finger leaves the sense element, and the output port can restore to the high impedance state. Taking SW0 channel as an example, the sequence diagram of the output signal is as follows:

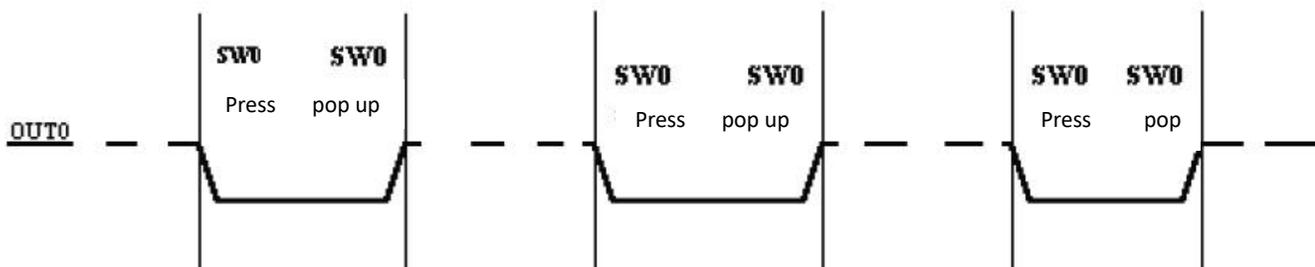


Figure 2: Sequence diagram of the output of the key

The signal output does not have the output jitter of mechanical key. The user does not need to make shaking process of mechanical key.

### 5.2. Touch slide bar roller output

WTC6401RSI

Touch roller, slide bar can very sensitively to detect the sliding direction and sliding distance of the finger on the roller or slide bar, continually outputs the pulse signal respectively from the UP output foot or DOWN output foot. The longer the fingers sliding distance is, the more number of the pulse output by UP or DOWN is.

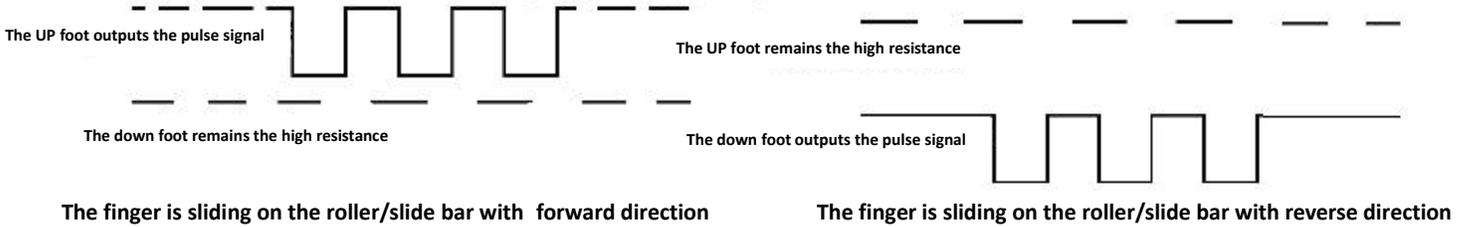


Figure 3: The output sequence diagram of the touch roller

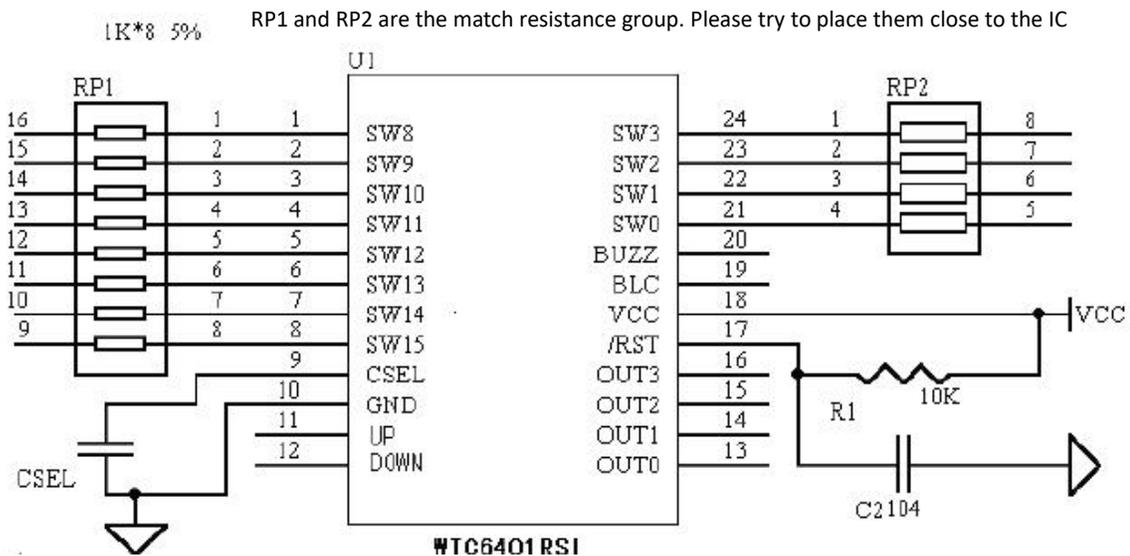
When the roller and slide bar are forward sliding, the UP foot can output 18 pulses in the whole journey  
 When the roller and slide bar are reverse sliding, the DOWN foot can output 18 pulses in the whole journey

## 6. Application circuit and sensitivity setting

### 6.1 The peripheral circuit and the matters needing attention

The peripheral circuit of WTC6401RSI is very simple, and only needs a few resistors and capacitors. The key component is capacitor CSEL for adjusting the sensitivity and 1K resistance group for measuring the matched impedance of circuit. CSEL should use 10%-precision polyester capacitor, capacitor **made of NOP material paster** or capacitor **made of X7R material paster**. 1K resistance group can provide you with the best and most stable measurement effect, and **CSEL and matched resistance shall be placed as close as possible to IC at PCB layout.**

Figure 5 is the application peripheral circuit diagram



10 % polyester capacitance 0.0047UF-0.022UF  
 Or 10% precision X7R texture chip capacitor

Figure 4: Application schematic diagram

## 6.2. Sensitivity Setting

The sensitivity setting of WTC6401RSI enables the user to use isolated media of various thicknesses to implement reliable and flexible touch function. The sensitivity setting of WTC6401RSI is achieved by selecting the appropriate capacitance Csel and adjusting the matching resistance value of the tandem connection in the induction channel.

The user can select the appropriate capacitance Csel according to the own use case. The larger the separation medium is, the larger the Csel capacity is. It is generally recommended to choose the appropriate capacitance between 0.0047 UF and 0.022 UF from large to small. It is recommended that it is best to use the A 5 % precision polyester capacitor with a small temperature coefficient for Csel. 10 percent accuracy of polyester capacitance can also be used. If needing use of patch capacitors, 10% or higher precision NPO material or X7R capacitance needs to be used.

It is recommended that the user places more than two solder plates on the Csel to exquisitely adjust the Csel. Increasing the area of the sense element can improve the sensitivity of the corresponding induction channel.

If the sensitivity of the sensor key and the induction pulley is not consistent, it can be adjusted through the matched resistance value of the tandem connection on the interaction channel. The greater the matched resistance value is, the larger the sensitivity of the corresponding induction channel is. But the value of the matching resistance is not less than 1K. The matched resistance value of the tandem connection on the pulley induction channel must be consistent.

## 7. Backlight Control

The 19th leg BLC of WTC6401RSI's can be used as the backlight control signal output of the touchpad.

When the finger is close to any sensor disc, the BLC outputs the electrical level. After the finger has left the touchpad or 8 seconds, BLC recovers low electrical level. BLC output level can normally provide 4mA source current drive. If the required electric current of LED backlight is more than 4mA, the drive circuit needed to be added to prevent the IC from damage.

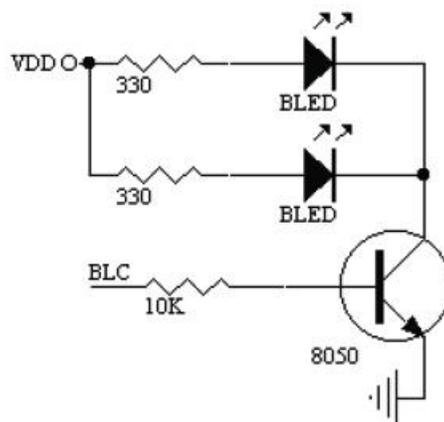


Figure 5: Backlight LED drive circuit

### 8. Buzzer Control Signal

The 20th leg BUZZ of WTC6401RSI can be used as the control signal output for the touchpad. After the finger is effectively touching key sense element, BUZZ outputs 50MS low level pulse, which can be used as the control signal for the built-in buzzer of the oscillating circuit, which generates the prompt tone under the key. The finger is effectively touching the touch pulley sense element roller to output 1 pulse pair, and the BUZZ will output a low level pulse

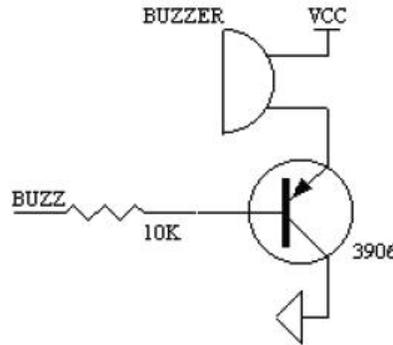
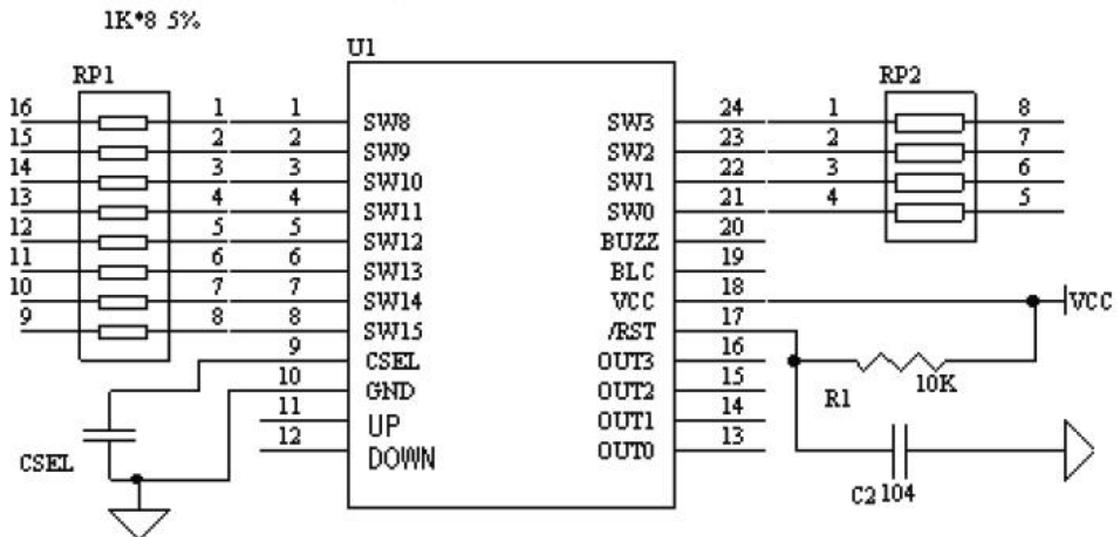


Figure 6: Buzzer drive electrical appliances

### 9. WTC6401RSI Power Supply

WTC6401RSI measures small change in capacitance, so it is required that the power ripple and noise should be small and the external strong interference involved from power supply shall be avoided. Particularly when it is applied to induction cooker and microwave oven, the external interference and voltage leap must be effectively isolated, and the power supply must have high stability. It is suggested that the voltage stabilizing circuit constituted by 78L05 as shown in the figure should be adopted.

RP1 and RP2 are the match resistance group. Please try to place them close to the IC



10 % polyester capacitance 0.0047UF-0.022UF  
Or 10% precision X7R texture chip capacitor

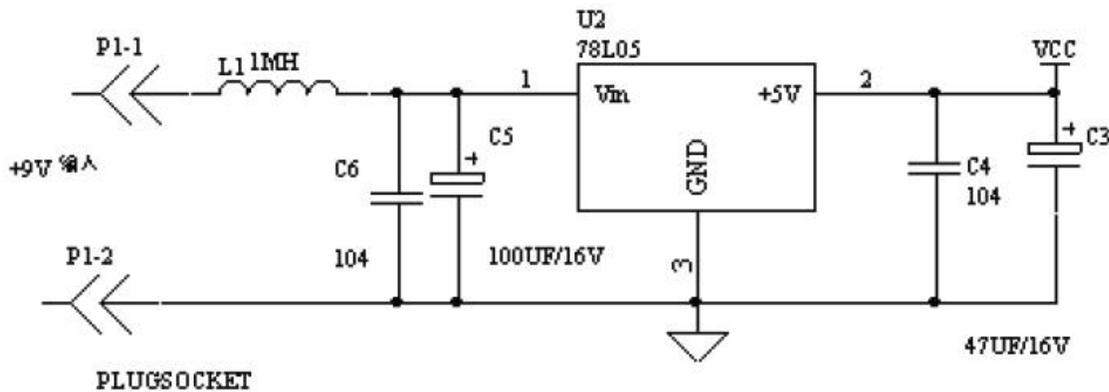


Figure 7: Power supply voltage regulator circuit

### 9.1. DC Voltage Stabilizer

At PCB LAYOUT, such 78L05 power component must be close to WTC6401RSI Vcc pin. 78L05, peripheral components and WTC6401RSI must be placed on the same circuit board centrally, to put an end to the noises caused by overlong power connection line. The common ground of the components as shown in the figure shall be separately connected into an independent group and then it shall be connected to the common ground of the whole machine from one point of it. (Use one point of star shape to connect the ground) The capacity of C2 capacity will affect the discharge time after power failure, and the too large capacity requires a longer reset time. It is the recommended values in the circle. The different applications can be flexibly adjusted

### 9.2. Precautions for High Noise Condition

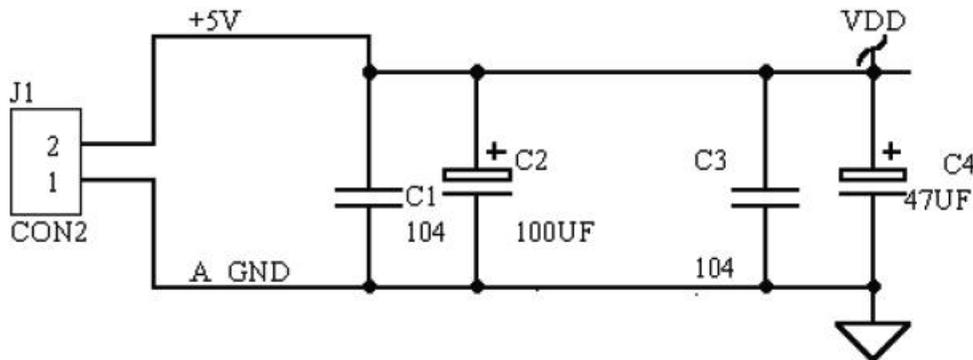
In case of application in a high-noise environment, up and down overlapped placement shall be avoided between high-voltage (220V), high-current, and high-frequency-operation main board and the touch circuit board. If such overlapped placement is unavoidable, try to keep far a channel from high-voltage, high-current components area or add shield on the main board.

When typesetting in PCB, it is recommended to reserve the inductor L1 (1MH) welding disc, but the general and the non-special applications do not need this inductance. The users can also cancel it.

When inputting 78L05 power supply, it needs to pay attention to ripple size. Please don't make the trough of ripple wave lower than DC 8V.

### 9.3. Use of +5V Power Supply of the Host

If the user directly uses 5V power supply of the main engine, it needs adding the power supply filter circuit in the front of the power supply of the modules or sensing power chips as shown in the figure. The requirement for PCB layout is the same as the above circuit



The analog and digital powers of circuit shall be connected separately to the ground in Y-connection method.

The capacitors shall be arranged in the sequence indicated in the schematic diagram and shall not be arranged arbitrarily.

Figure 8: Power Filter Circuit

**Precautions:**

This circuit is good for suppressing the power noise, but the larger load is easy to generate self - excitation. It is recommended that the user should not receive any other load except the touch module or touch chipset. LED lights, relays and other IC loads need to be connected to the front of the circuit and other filter stabilized circuit shall be added

**10. WTC6401RSI used capacitive sensors and layout recommendations**

**10.1. Induction key**

**10.1.1. The material and shape of the Sensors**

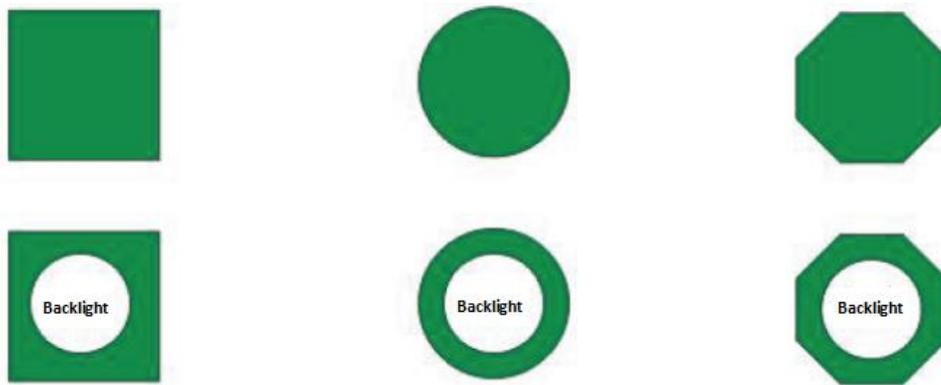
The capacitive sensors can be any type of conductor, but certain flat surface should be ensured. It is recommended to use a round metal sheet or other conductor with a diameter greater than 10mm. The commonly used sense elements are copper foil, spring, thin film line and ITO glass, etc. on the PCB plate etc. The area of each sense element should be kept as same as possible to ensure the same sensitivity.

**10.1.2. The bonding between the key sense element and the Insulating panel**

The capacitive sensor should be glued to glass and other insulating panels, or the elastic bonding is used for it. The common elastic connection methods are:  
 Use the sense element with spring  
 Use cylindrical conductive rubber to conduct elastic connection  
 Paste the sense element onto the panel with imported super double-sided glue, and the double-sided glue layer cannot be too thick.



Figure 10: Spring sense element



The key sense element can be solid or hollow rectangle, circle or polygon.

Figure 9: PCB Copper Foil sense element

The surface of the induction plate must be levelled off, and is no clearance between the panels. If the contact surface cannot be achieved closeness, please use the thermally conductive silicone grease to seal it, to ensure the air gap between the junction surfaces of the panel.

The connection between the capacitance sensor and the pins should be short and thin as far as possible (5-8 mil). It is best that WTC6401RSI can be placed on the keypad and that the back and around 0.5 mm of the connection is not placed other circuit, to ensure that the sensor has good sensitivity and to avoid false triggering.

## 10.2. Touch slide bar、pulley

The shape and size of the touch sensitive slide bar are shown in Figure 10. The size of the slide bar sensor unit can be appropriately scaled in proportion according to the panel design requirements.

The slide bar - The arrangement order of the interaction unit of the slide bar in sequence from left to right is: SW13,SW10.SW15,SW12,SW9,SW14,SW11,SW8,SW15.SW14,SW13,SW12,SW11,SW10, SW9,SW8

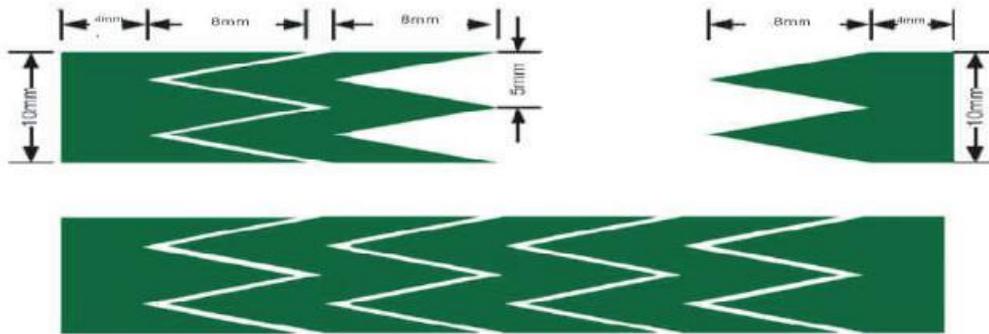


Figure 11: Geometry and dimension of touch slide bar

The shape of the induction unit of the touch-sensitive roller is as shown in figure 11. The clearance between the induction units is 0.2-0.5 mm, and the inside and outside diameter of the roller is 18mm and 36mm respectively. The size of the roller can be appropriately scaled in proportion according to the panel design requirements.

The arrangement order of the touch induction roller induction unit clockwise starting from left is: SW13,SW10.SW15,SW12,SW9,SW14,SW11,SW8,SW15.SW14,SW13,SW12,SW11,SW10, SW9,SW8 (For the specific details, please refer to the application schematic diagram and the PCB diagram of the DEMO board provided by us)

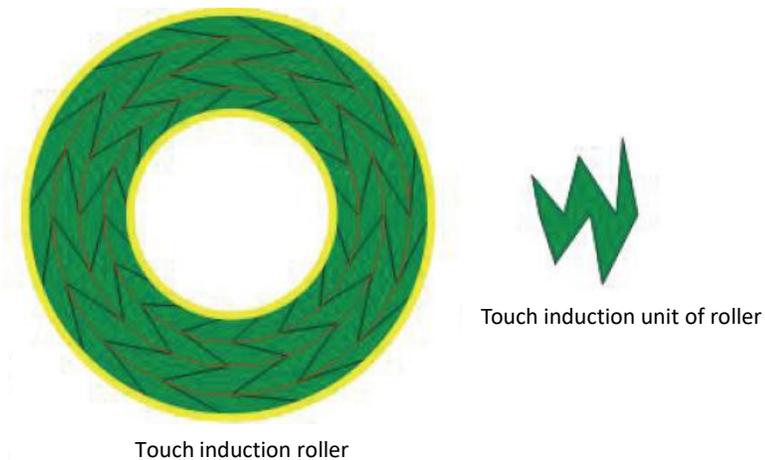


Figure 12: Geometry and dimensions of the Touch roller

## 11. Processing of Vacant Sensor Channel

WTC6401RSI requires that at least three touch keys must be used; otherwise the chip will not work properly.

WTC6401RSI

When using it in the case of less than 4 keys, SW3 ~ SW0 will have empty and unused sensor input channel. The empty input channel cannot be suspended, and the empty input channel must be connected to the power supply of WTC6401RSI with a 20K pull-up resistor and WTC6401RSI.

If the user must use three or less sensitive keys, please be sure to contact us for the corresponding technical support.

**12. Package Dimension Drawing of WTC6401RSI**

Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	228	—	244
B	150	—	157
C	8	—	12
C'	335	—	346
D	54	—	60
E	—	25	—
F	4	—	10
G	22	—	28
H	7	—	10
$\alpha$	0°	—	8°

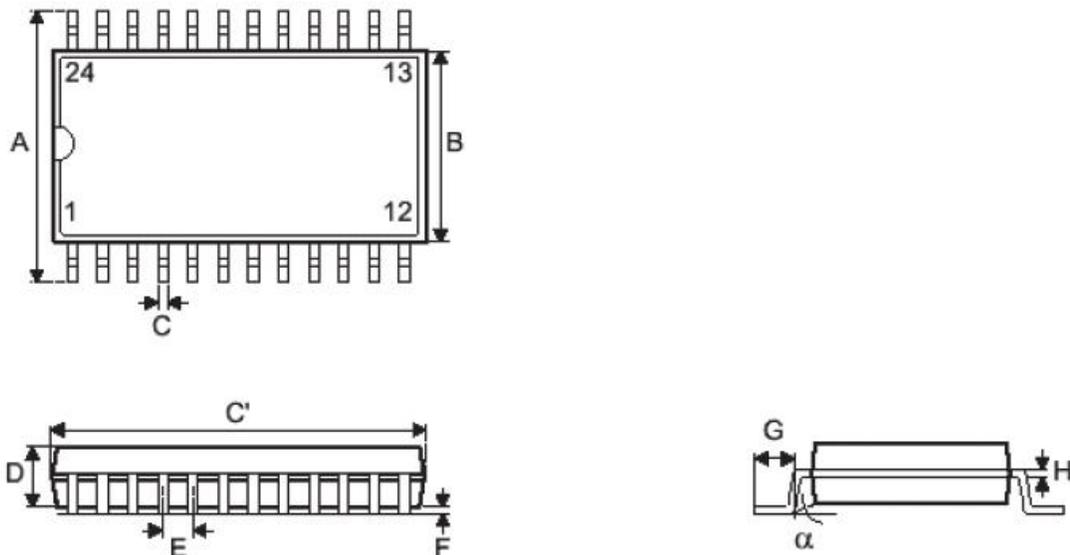


Figure 13: Package Dimension Drawing of WTC6401RSI