WTC6104BSI 4-Channel Capacitive-Sensing Touch Button Chip

Fast Browsing (V1. 5)

Model number	WTC6104BSI: Standard version; WTC6104BSI-L, a low power consumption version with sleep mode.
Number of keys	2-4 Keys
Technical principle	Capacitive to digital conversion technology
Key response mode	Multi-key (SHIFT) mode
Dimension of key sensor pad	Minimum 3mm ×3mm, maximum 30mm ×30mm, to be determined according to actual demand and panel thickness
Spacing of key sensor pad	Minimum spacing 0.5mm, to be determined according to actual demand
Shape of key sensor pad	Arbitrary polygon, rotundity or ellipse, either panel with hole in the middle or hollow panel (optional)
Material of key sensor pad	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	3.3 V – 5.5 V
Operating temperature range	－40℃－+85℃
Data transmission interface	One-for-one I/O interfaces, high/low level output, self-locking/non-self-locking function (optional), initial level (high or low, optional), buzzer prompt and backlight control.
Storage temperature range	－50℃－+125℃
Chip sealing mode	NSOP16 (150MIL)
Typical application	Various home appliances, security equipment, communication equipment, industrial control equipment & instruments, entertainment equipment, medical equipment, sport facilities, toys, etc.

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WTC6104BSI 4-Channel Capacitive-Sensing Touch Button Chip

Specification (V1. 5)

1 Product Introduction

1.1 Product Overview

As an integrated circuit designed for the purpose of implementing a human touch interface, WTC6104BSI series touch-sensing IC can take the place of the mechanical soft-touch keys and realize a water-proof, dust-proof, sealed, isolated, solid and beautiful operation interface. One WTC6104BSI can realize two to four independent keys, and the users may flexibly use them as required.

1.2 Technical Principle

WTC6104BSI identifies the touch action of people's fingers by using 16bit high-precision CDC (capacitive to digital converter) IC to detect the change in capacitance on the sensor pad (capacitive sensor), and the data output by CDC will be processed by the internal RISC processor in an efficient and reliable algorithm. The high/low level directly output toward the outside indicates the key action.

1.3 High Productivity

The sensitivity of all channels can be changed only by adjusting one capacitor Csel. There are a few peripheral components, so the productivity is high.

1.4 Adapted to Panels of Different Thickness

WTC6104BSI can be adapted to 0-20mm-thick insulated panels by selecting the capacitance value of suitable Csel and appropriately adjusting the area of sensor pad.

1.5 Chip Package Type

WTC6104BSI is packaged with standard 16PIN NSOP.

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 Usability in Intensive Keyboard with a Small Spacing

The adjacent key suppression function can prevent malfunction of adjacent key. Namely, when one finger touches two or more keys at one time, only the key with the maximum area occupied by the finger will respond, and the key with a smaller area occupied by the finger will be suppressed and not respond. If the two or more keys have the same area occupied by the finger, neither will respond. The minimum spacing between keys can be up to 0.5mm.

2.1.4 Excellent Water Resistance

The special water-proof design applies. The keyboard can be resistant to splashing water and overflowing water, and can also be normally used after it is totally flooded by water, which is different from current ordinary sensitive keyboard that is easy to malfunction in case of splashing water or overflowing water and will respond slow in case of water accumulation, or respond wrongly after it is pressed 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 sensor pad without complex adjustment.

2.1.7 Compliance with Industrial Application Specifications & Requirements

More reliable performance and wider application range is available for users.

3 Technical Parameters

Operating voltage:
WTC6104BSI: 3.3v<Vcc<5.5V
WTC6104BSI-L: 2.2v<Vcc<5.5V
Output voltage range: GND<Vout<Vcc
Sensing thickness (insulating medium): 0-20mm, maximum 500mm
Response time of effective touch: Less than 100ms
Operating temperature: -40℃－+85℃
Storage temperature: -50℃－+125℃

4 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.

5 Definitions of Product Pins

5.1 Pin Configuration

WTC6104BSI pin configuration diagram is shown below:

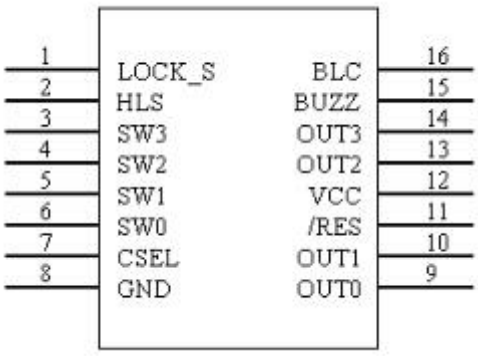


Figure 1: WTC6104BSI Pin Diagram

5.2 Definitions of Pins

The definitions of WTC6104BSI pins are as shown in the table below:

Pin No.	Pin Name	Usage	Function Description
1	LOCK_S	I	Selection of output mode Connecting VCC will enable ordinary soft-touch key mode Connecting GND will enable self-locking key output mode
2	HLS	I	Selection of initial level of output pin Connect VCC, and the initial level of output pin is high. Connect GND, and the initial level of output pin is low.
3	SW3	I	Interface of touch key 3 (sensor pad 3)
4	SW2	I	Interface of touch key 2 (sensor pad 2)
5	SW1	I	Interface of touch key 1 (sensor pad 1)
6	SW0	I	Interface of touch key 0 (sensor pad 0)
7	CSEL	I	Capacitor interface for adjusting the sensitivity
8	GND	I	Power ground
9	OUT0	O	SW0 status output
10	OUT1	O	SW1 status output
11	/RES	I	IC reset pin
12	VCC	I	Power input
13	OUT2	O	SW2 status output
14	OUT3	O	SW3 status output
15	BUZZ	O	Buzzer control pin
16	BLC	O	Backlight LED control pin

6 Output Display

When the occurrence of effective touch on the sensor pad is detected, WTC6104BSI will output the status of corresponding sensor pad channel within 100ms, so that it can be processed by user MCU, or directly drive the execution circuit to work. WTC6104BSI has two output modes, selected by IC LOCK_S pin connecting to VCC or GND. The initial level of output port can be selected in either output mode, by connecting HLS pin of chip to VCC or GND. If HLS is connected to VCC, the initial level is high, and if HLS is connected to GND, the initial level is low.

6.1 Output in Non-self-locking Mode

When LOCK_S is connected to VCC, WTC6104BSI will adopt the output mode of ordinary soft-touch switch.

When the occurrence of effective touch on sensor pad is detected, the corresponding indicative pin will output reversal, and when the finger leaves, the indicative pin will be recovered to output the initial level. Take SW0 channel as an example, the relationship between output signal and sensor input channel is as shown in Figure 3, and other channels are the same.

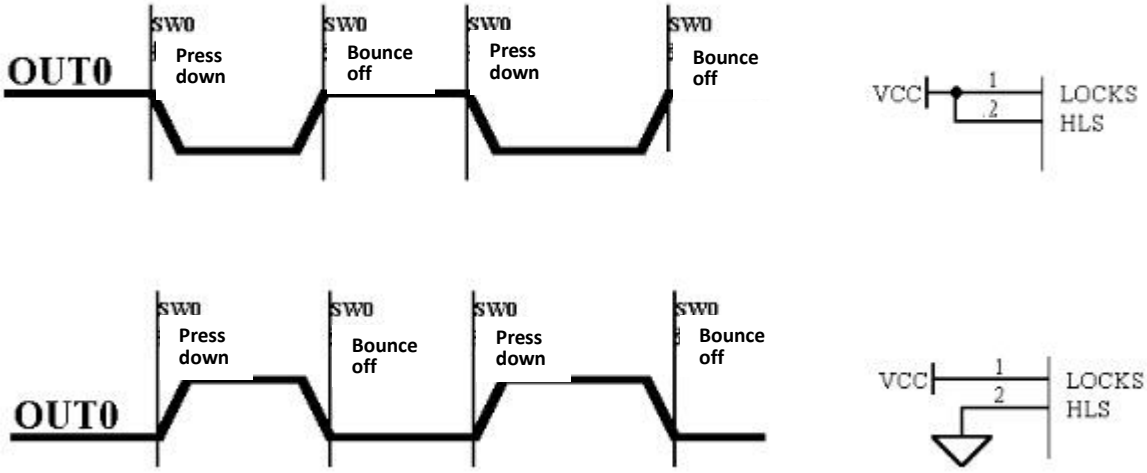


Figure 2: Output Sequence Diagram of Keys when WTC6104BSI is in Non-self-locking Mode

6.2 Output in Self-locking Mode

When LOCK_S is connected to GND, WTC6104BSI will adopt the output mode of self-locking switch. When the occurrence of effective touch on sensor pad is detected, the corresponding indicative pin of sensor pad will output reversal of level, and when the finger leaves, the output level of indicative pin will remain the same. Take SW0 channel as an example, the relationship between output signal and sensor input channel is as shown in Figure 4. Other channels are the same.

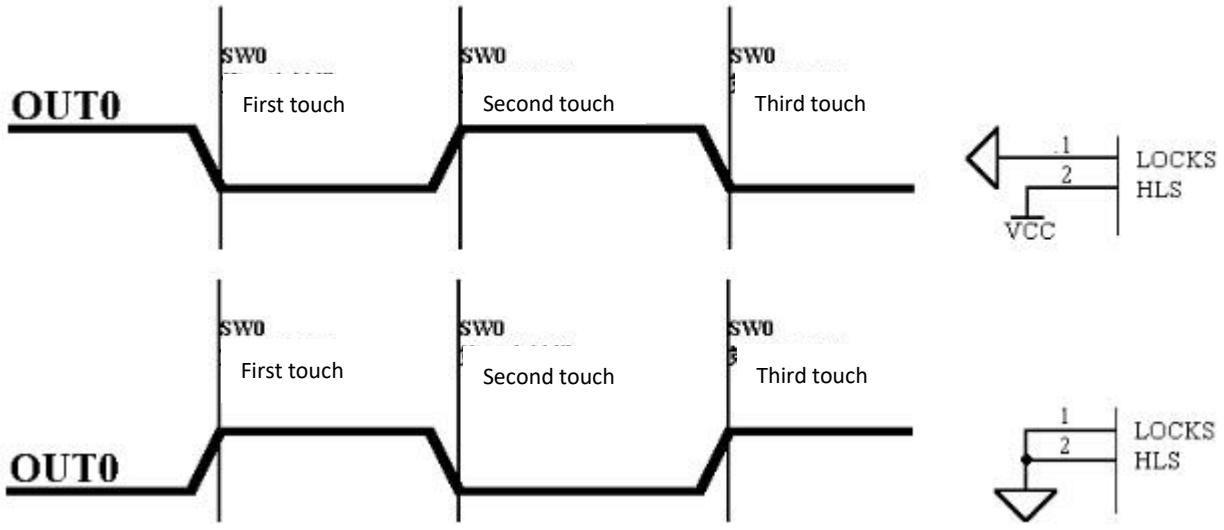


Figure 3: Output Sequence Diagram of Keys when WTC6104BSI is in Self-locking Mode

6.3 Multi-key (SHIFT) Working Mode

If the user presses multiple keys one after another and holds them, these keys can respond in sequence. The system designer can design several kinds of key combination operation function.

7 Typical Application Circuit and Sensitivity Setting

7.1 Peripheral Circuit and Precautions

The peripheral circuit of WTC6104BSI is very simple, and only needs a few resistors and capacitors. The key component is capacitor CSEL for adjusting the sensitivity and IK resistance group for measuring the matched impedance of circuit. CSEL should use 10%-precision polyester capacitor, capacitor made of NOP material or capacitor made of X7R material. 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 4 is operating circuit diagram of WTC6104BSI in 4-key non-self-locking mode:

The channel matched resistance R0-03 should be placed into IC as much as possible.

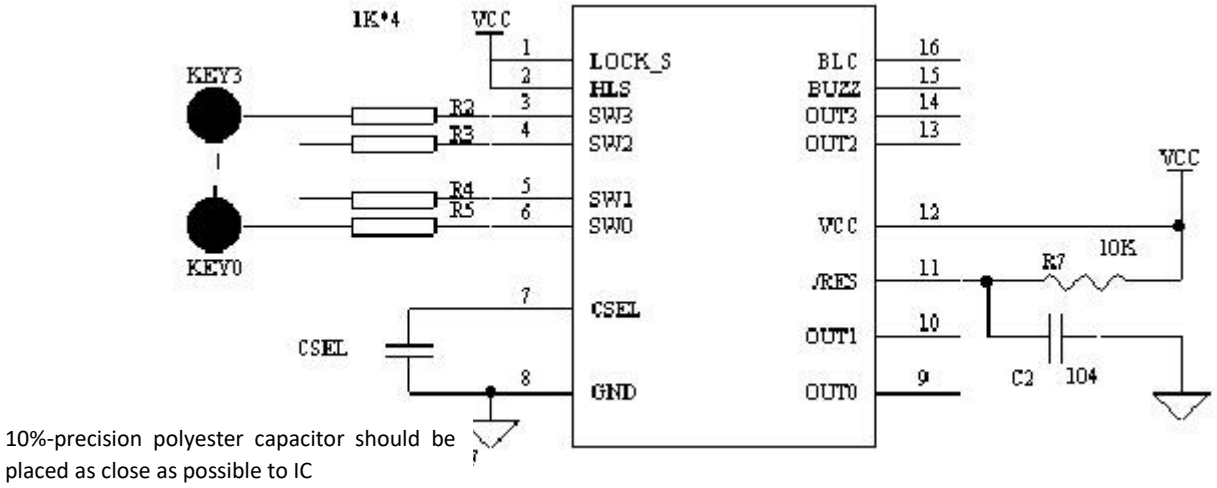


Figure 4: WTC6104BSI Application Schematic Diagram

7.2 Sensitivity Setting

The sensitivity setting of WTC6104BSI enables the user to use isolated media of various thicknesses to implement reliable and flexible touch function.

7.3 Selection of Suitable Capacitor Csel

The sensitivity setting of WTC6104BSI is realized by selecting a suitable capacitor Csel.
The user may select a suitable capacitor Csel as the case may be. **The thicker the isolated medium is, the bigger the Csel capacitance will be**, and it is usually suggested that the suitable capacitor should be selected from small to big within 0.0047UF and 0.022UF. **It is suggested that Csel** should use **5%-precision polyester capacitor** with **a small temperature coefficient**. 10%-precision **polyester capacitor** may also be used. If it is necessary to use the chip capacitor, it must be capacitor made of X7R material or capacitor made of NPO material, with 10% or higher precision.
It is suggested that the user should place two or more bonding pads on Csel side by side, so as to finely adjust Csel.

7.4 Area of Sensor Pad

Increasing the area of sensor pad is favorable to improve the penetrating power of touch sensor.

8 Backlight Control

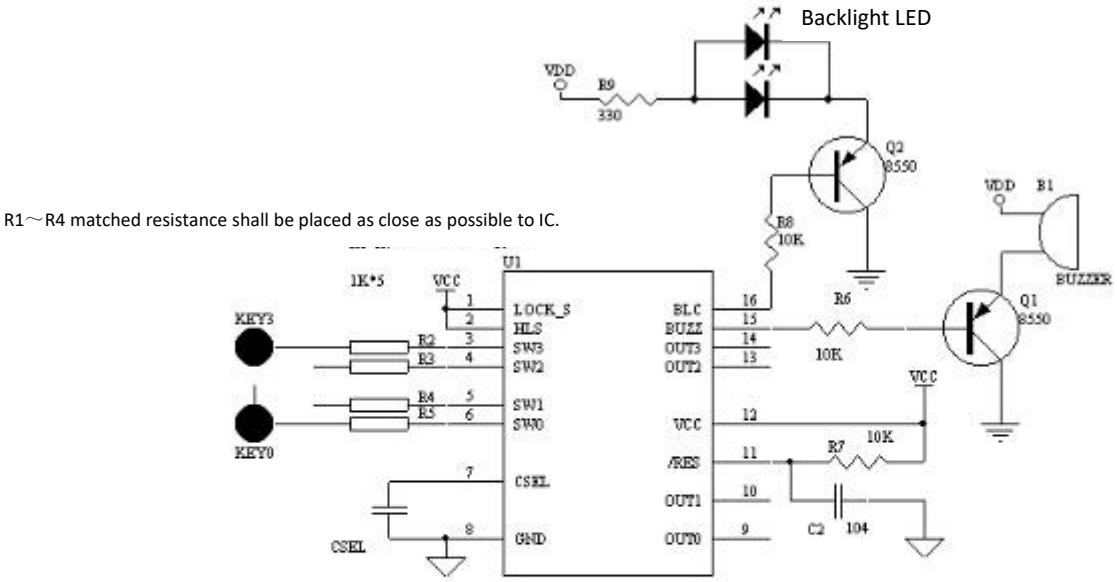
BLC of No. 16 Pin of WTC6104BSI can be output as backlight control signal of touchpad. When it is detected that finger approaches the sensor pad, BLC will output low level. 5 seconds later after the finger leaves the touchpad, BLC will be recovered to output high level. When BLC outputs low level, it can provide 10mA sink current to drive. If the current required by LED backlight exceeds 10mA, additional driving circuit is needed so as to avoid damaging IC.

9 Buzzer Control Signal

BUZZ of No. 15 Pin of WTC6104BSI can be output as buzzer control signal of touchpad. When it is detected that the finger effectively touches the sensor pad, BUZZ will output 50mS low-level impulse to serve as DC buzzer control signal, and generate the prompt tone that the key is pressed down.

10 WTC6104BSI Power Supply

WTC6104BSI 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.



10%-precision polyester capacitor or chip capacitor made of X7R material

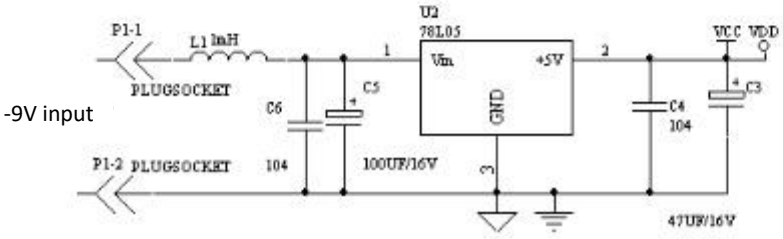


Figure 5: Full Function Circuit with Power Voltage Stabilizing Circuit

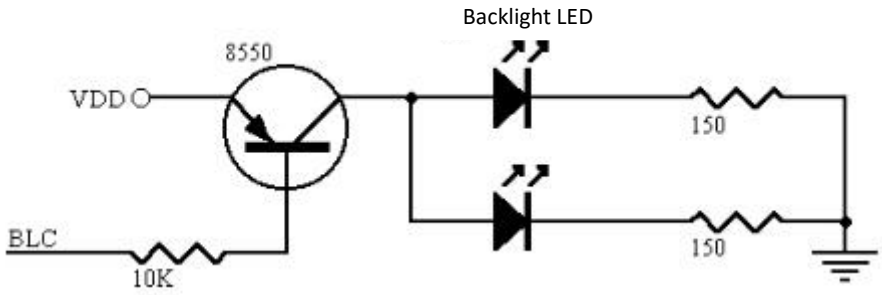


Figure 6: Additionally Driven Backlight Control Circuit

10.1 DC Voltage Stabilizer

At PCB LAYOUT, such 78L05 power component must be close to WTC6104BSI Vcc pin.

10.2 Placement of Voltage Stabilizer Component

78L05, peripheral components and WTC6104BSI must be placed on the same circuit board centrally, to put an end to the noises caused by overlong power connection line.

10.3 Grounding

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)

10.4 Precautions for High Noise Condition

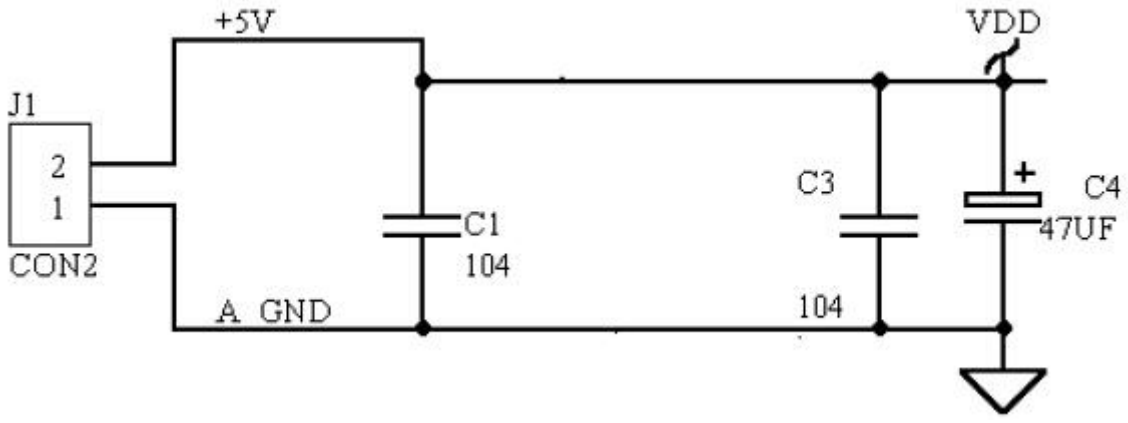
In case of application in a high-noise environment, up and down overlapped placement shall be avoided between high-voltage (220V), high-current, and high-frequency-operation main board and the touch circuit board. If such overlapped placement is unavoidable, try to keep far away from high-voltage, high-current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

10.5 Power Filter

At PCB layout, it is suggested that inductor L1 (1MH) bonding pad should be reserved, but such inductor is not needed in general and non-special application, and the user may cancel it.
For the power supply of input 78L05, pay attention to the ripple size and the ripple valley shall not be lower than DC 9V.

10.6 Use of +5V Power Supply of the Host

If the user directly uses 5V power supply of the host, add the power filter circuit as shown in the figure below before the power supply of sensing chipset. The requirements for PCB layout are the same as those for the previous 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 7: Power Filter Circuit

Precautions:

For the circuits as shown in the above figure, please connect capacitor 104 and electrolytic capacitor of filter circuit in the sequence as shown in the figure. Only when the capacitor 104 is connected in front of electrolytic capacitor, can the high-frequency noises be suppressed.

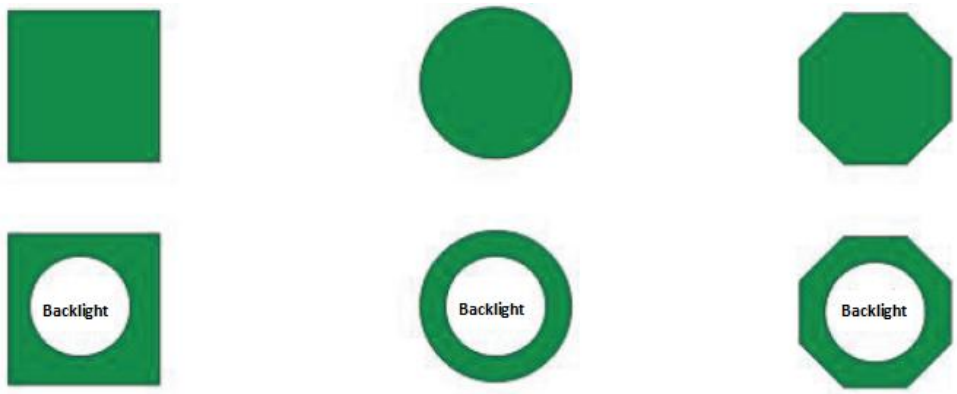
11 WTC6104BSI-L of Low Power Consumption Version

If the touch key is not touched within five seconds, WTC6104BSI-L will go to sleep mode automatically.
During sleep period, the chip will continue to detect the input channel of each key, and once any key is operated, the chip will be woken up and enter normal working mode.
During sleep period, the current is lower than 18μA, and such chip WTC6104BSI-L of low power consumption version can satisfy the design use need of using the touch-sensing keys on electronic products with the power supplied by batteries.

12 Capacitive Sensor Used by WTC6104BSI

12.1 Material and Shape of Capacitive Sensor

The capacitive sensor may be conductor of any shape, but certain area of plane must be guaranteed. It is suggested that round sheet metal or other conductor with the diameter greater than 10mm should be used. The commonly used sensor pad has PCB copper coil, spring, membrane circuit and ITO glass, etc.



The key sensor pad can be solid or hollow rectangle, circle or polygon.
Figure 8: PCB Copper Foil Sensor Pad

12.2 Area of Capacitive Sensor

The area of each sensor pad shall be the same as much as possible, so as to guarantee the same sensitivity.

12.3 Spacing of Key Sensor pad

WTC6104BSI is multi-key combination (SHIFT) mode, and it's required that the spacing between adjacent keys should be sufficient, so as to ensure that one finger will not touch two or more keys at the same time and prevent false operation. It is suggested that the edge spacing between adjacent key sensor pads should be greater than 5mm.

12.4 Connection between Capacitive Sensor and Panel

The capacitive sensor shall cling to glass and other insulated panel, and elastic connection shall apply between them.

12.5 Common Elastic Connection Methods

The common elastic connection methods are:
A. Use the sensor pad with spring.
B. Use cylindrical conductive rubber to conduct elastic connection.
C. Paste the sensor pad onto the panel with imported super double-sided glue, and the double-sided glue layer cannot be too thick.

Figure 9: Spring Sensor Pad

12.6 Requirements for Sensor Pad and Panel Contact Surface

The sensor pad surface shall be flat, and be close to the panel, without spacing.

12.7 Connection between Sensor Pad and IC Sensor Pad Input Pin

The connection line between capacitive sensor and WTC6104BSI pin shall be **as thin and short as possible** (0.1-0.2mm in width), and it would be better if WTC6104BSI was placed on the keyboard. On the back of and within 0.5mm area of the connection line, no copper shall be laid and other circuit cannot be placed,

so as to ensure good sensitivity of sensor and avoid false triggering.

13 Processing of Vacant Sensor Channel

WTC6104BSI **must at least use two touch keys, so as to guarantee stable work of chip**. When the keys are less than four, SW3～SW0 will have vacant sensor input channel. **The vacant input channel shall simply hang in the air and cannot be added with any pull-up or pull-down resistor**.
If only one touch key is used, any one of the rest three vacant channels shall be pulled up to VCC with a 20K resistor and the rest two vacant channels hang in the air.

14 Package Dimension Drawing of WTC6104BSI

Package Dimension Drawing of WTC6104BSI

Symbol	Dimensions in mm		
	Min.	Nom.	Min.
A	1.35	1.60	1.75
A1	0.10	—	0.25
A2	—	1.45	—
B	0.33	—	0.51
C	0.19	—	0.25
D	9.80	—	10.00
E	3.80	—	4.00
c	—	1.27	—
H	5.80	—	6.20
L	0.40	—	1.27
θ	0.00	—	8.00

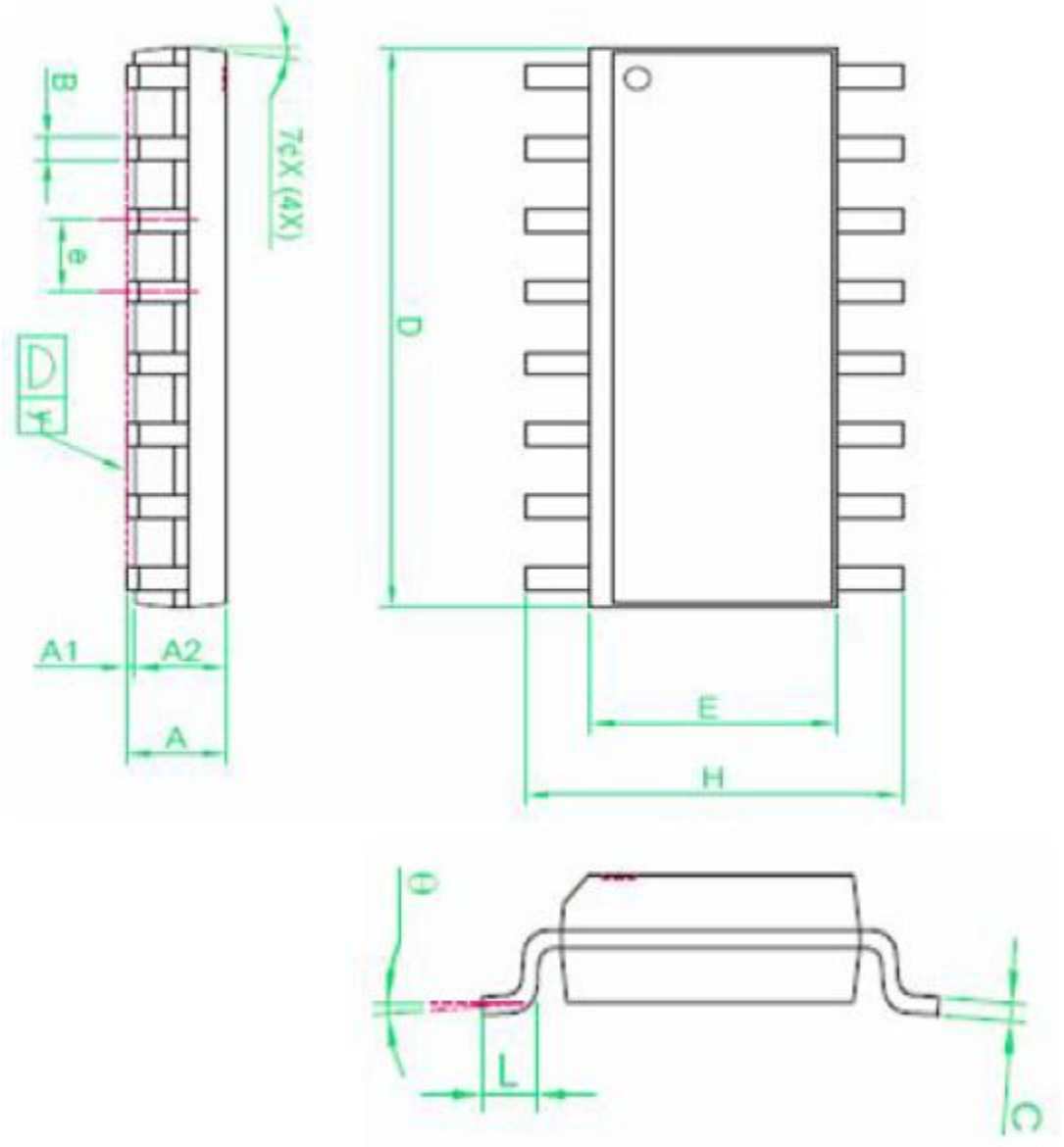


Figure 10: Package Dimension Drawing of WTC6104BSI