2021.8

ANY01

Single-Key, Small Package, High-Performance Capacitive Touch Sensing Chip

(Touch, Smart Toilet Human Body Sensing, Liquid Level Detection)

1. OVERVIEW

1.1 Summarize

The ANY01 is a single-key capacitive touch sensor that detects changes in capacitance through non-conductive materials such as glass and plastic. With customizable settings, the ANY01 can be applied in various scenarios, including:

Standard touch button switches
Human body sensing for smart toilets
Liquid level detection
This flexibility makes it suitable for a wide range of touch and sensing applications.

1.2 Key Features

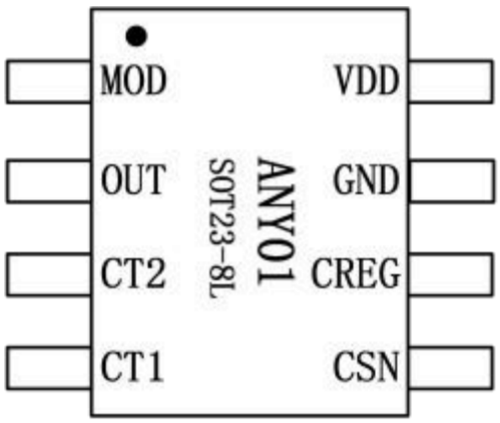
◇ Standard button application.
◇ Smart toilet human body sensing application.
◇ Liquid level detection application.
◇ Maintains automatic calibration, no external intervention required.
◇ Fully debounced key output.
◇ One-to-one parallel output.
◇ Operating voltage: 2.5V~6.0V.
◇ RoHS-compliant, eco-friendly SOT23-8L package.

1.3 Application

◇ Replacement for mechanical switches, access control buttons, and light control switches
◇ Human-machine interface for toys and interactive games
◇ Sealed keyboard panels
◇ Metal touch buttons
◇ Toilet seat occupancy sensors
◇ Liquid detection in floor scrubber clean water tanks
◇ Liquid level detection in various container water tanks
◇ Liquid detection in water purification equipment

1.4 Package

The ANY01 is packaged in SOT23-8L.



1-1：Package

1.5 Pin

1-1：

Pin No.	Pin	Type	Function
1	MOD	I/O	Mode Setting Pin
2	OUT	I/O	Sensing Key Output
3	CT2	I/O	Touch Detection Pin
4	CT1	I/O	Touch Detection Pin
5	CSN	I/O	Connect Sensitivity Capacitor
6	CREG	I/O	Connect Charge Collection Capacitor
7	GND	Pwr	Power Ground
8	VDD	Pwr	Power Supply

Pin Type

I CMOS INPUT I/O CMOS INPUT/OUTPUT Pwr Power

1.6 Pin Description

VDD, GND

Positive and Negative Power Input Terminals.

CREG

Charge Collector: Connects to the internal comparator input terminal, connected to a fixed-value capacitor, independent of sensitivity.

CSN

Sensitivity Capacitor: Ranges from 5pF to 100pF; the smaller the capacitor, the higher the sensitivity.

CT1

Input Detection Port for Sensing Capacitor: When used for smart toilet human body sensing and liquid level detection applications, connect a fixed capacitor as a comparison reference capacitor; when used for standard button latching output applications, connect to the touch button input.

CT2

Input Detection Port for Sensing Capacitor: When used for smart toilet human body sensing and liquid level detection applications, connect to the touch button input; when used for standard button detection functionality, the pin should be left floating.

OUT

Touch Output Port: The internal structure of the port features an NMOS open-drain output with a pull-up resistor. It outputs a weak high or strong low level, with the effective level being a strong low. The output port has a built-in pull-up resistor with a resistance value of approximately 10kΩ.

MOD

Working Mode Setting Port:

1: When MOD is connected to GND, the chip enters standard button latching output mode. Each time a finger touch is detected, the output level toggles, and the state is latched.

2: When MOD is left floating, the chip enters smart toilet human body detection mode. When a human presence is detected, the output changes from weak high level to low level; after the person leaves, the output changes from low level to weak high level.

3: When MOD is connected to VDD, the chip enters liquid level detection mode. When a liquid is detected or the liquid level reaches the specified threshold, the output changes from weak high level to low level. When no liquid is detected or the liquid level is below the threshold, the output changes from low level to weak high level.

2. CHIP FUNCTION

2.1 Initialization Time

After power-on reset, the chip requires 120 ms for initialization to calculate the environmental capacitance of the sensing pins before it can operate normally.

2.2 Sensitivity Setting

Sensitivity is determined by the capacitance value connected to the CSN port. **The capacitance range is from a minimum of 5pF to a maximum of 100pF; the smaller the value, the higher the sensitivity.**

To ensure consistent sensitivity, the CSN capacitor should ideally be a polyester capacitor, NPO material capacitor, or COG material capacitor with a tolerance of 10% or better. It is crucial to place the CSN capacitor as close to the IC as possible during PCB layout.

2.3 Standard Button Latching Output Mode

In the Standard Button Latching Output Mode, the CT1 channel is connected to the button sensor, while the CT2 channel is left floating. The chip will automatically adjust and calibrate the reference capacitance value of the button sensor to account for drift caused by external environmental factors such as temperature and humidity. This ensures consistent sensitivity of the touch button across different environmental conditions.

2.4 Smart Toilet Human Body Sensing Mode

In the Smart Toilet Human Body Sensing Mode, the chip operates in two stages: the power-on comparison stage and the self-calibration stage.

During the first 200 ms after power-on, the chip enters the power-on comparison stage. The CT1 port is connected to a fixed reference capacitor, which is used to adjust the difference between CT1 and CT2. The CT2 terminal is connected to the human presence sensor. The chip automatically collects the capacitance values of the touch channel CT1 and CT2 upon power-up to determine if the difference between CT2 and CT1 exceeds the internally set human presence threshold.

If the difference exceeds the threshold, the corresponding output port is pulled low until the difference falls below the internally set human absence threshold, at which point the chip transitions to the self-calibration stage. If the difference does not exceed the threshold, the corresponding output port remains in a weak high state, and the chip will automatically transition to the self-calibration stage after 200 ms.

2.5 Liquid Detection Mode

In the Liquid Detection Mode, the primary function is to monitor the presence of liquid or whether the liquid has reached the specified height.

The CT1 port is connected to a fixed reference capacitor to adjust the difference between CT1 and CT2. The CT2 terminal is connected to the liquid detection sensor. After the chip is powered on, it automatically collects the capacitance values of the touch channels CT1 and CT2 to determine if the difference between CT1 and CT2 exceeds the internally set liquid detection threshold.

If the difference exceeds the threshold, it indicates that liquid is present or that the liquid has reached the specified height, causing the corresponding output port to be pulled low. This state is maintained until the difference between CT2 and CT1 falls below the internally set liquid absence threshold, at which point the corresponding output port returns to a weak high state.

2.6 Touch Response Time

The chip samples each external channel approximately every 3 ms. After debouncing processing, the response time for detecting a button press is approximately 24 milliseconds, while the response time for detecting a button release is about 18 milliseconds. Therefore, the maximum detection frequency for the button is roughly 25 times per second.

2.7 Output Logic

The touch output has two states: weak high or strong low.

When MD is connected to GND, the chip is set to the standard button latching output mode, where each touch will trigger an output toggle, and the state is latched.

Table 2-1 MD Connected to GND: Button Latching Output Mode

Period	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
Action	Chip Reset	No Touch	Touch	No Touch	Touch	No Touch
Touch Output	Weak High	Weak High	Low Level	Low Level	Weak High	Weak High

When MD is left floating, the chip is set to the smart toilet human body sensing mode. When touch is detected, the output is strong low; when no touch is detected, the output is weak high.

Table 2-2 MD Floating: Smart Toilet Human Body Sensing Direct Output Mode

Period	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
Action	Chip Reset	No Human Presence	Human Presence	No Human Presence	Human Presence	No Human Presence
Touch Output	Weak High	Weak High	Low Level	Weak High	Low Level	Weak High

When MD is connected to VDD, the chip is set to the liquid level detection mode. When touch is detected, the output is strong low; when no touch is detected, the output is weak high.

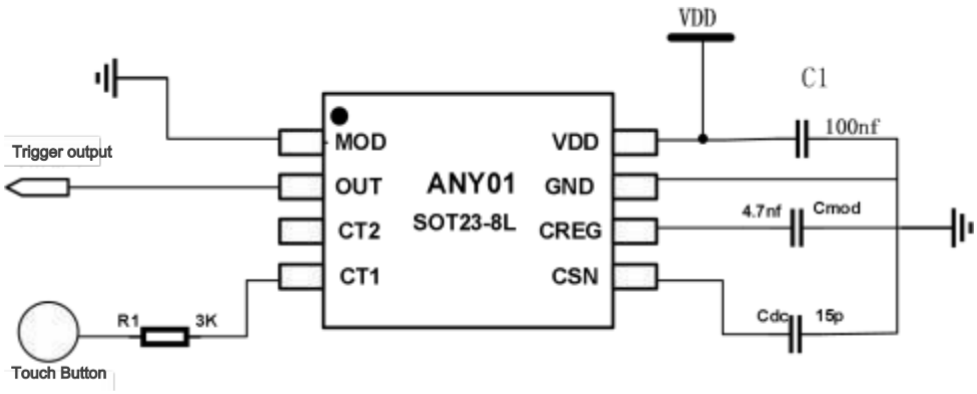
Table 2-3 MD Floating: Liquid Level Detection Direct Output Mode

Period	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
Action	Chip Reset	No Liquid	Liquid	No Liquid	Liquid	No Liquid
Touch Output	Weak High	Weak High	Low Level	Weak High	Low Level	Weak High

3. APPLICAGTION

3.1 Application Circuit

1 Standard Button Latching Output Mode



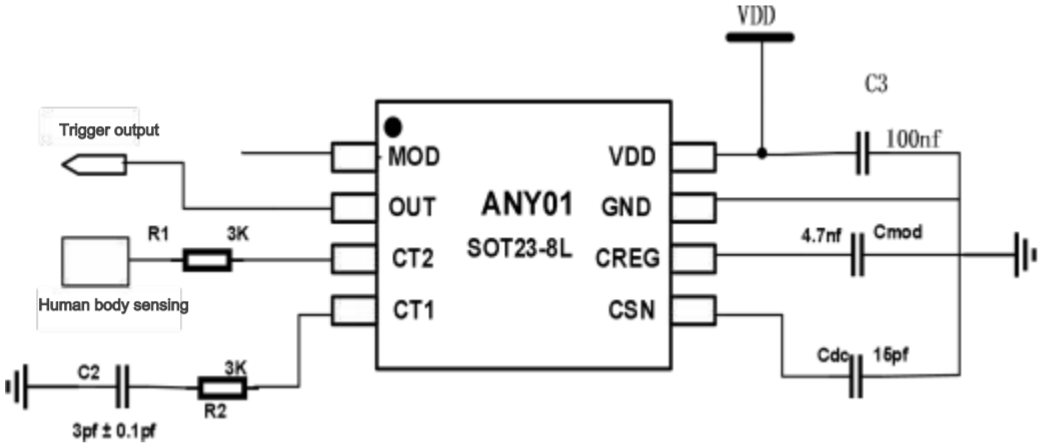
3-1 ：Standard Button Latching Output Application Circuit

Note:

1,CREG is the charge collection capacitor, typically ranging from 1nF to 10nF, with a typical value of 4.7nF.

2,CSN is the sensitivity capacitor, with a minimum value of 5pF and a maximum of 100pF; the smaller the capacitor value, the higher the sensitivity.

2：Smart Toilet Human Body Sensing Mode



3-2 Smart Toilet Human Body Sensing Mode Application Circuit

Note:

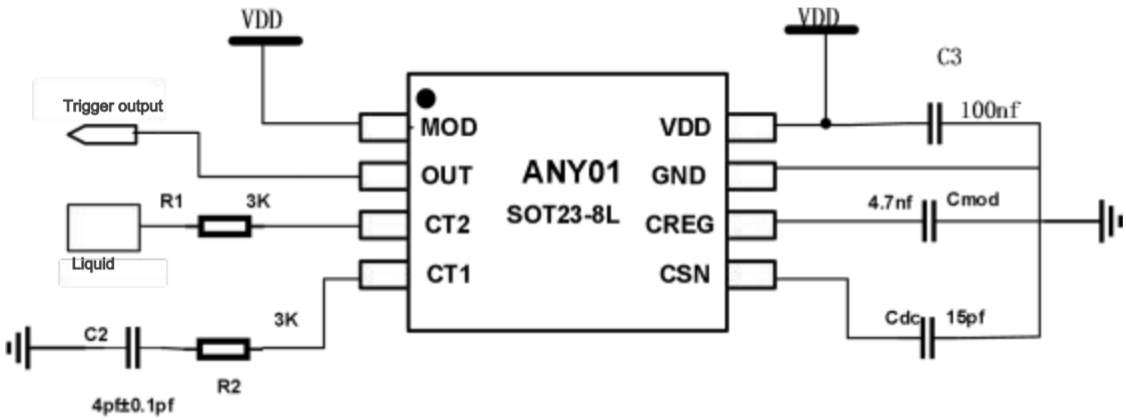
1. CREG is the charge collection capacitor, typically ranging from 1nF to 10nF, with a typical value of 4.7nF.

2. CSN is the sensitivity capacitor, primarily functioning during the self-calibration stage of the smart toilet human body sensing mode. Its role is relatively smaller during the power-on comparison stage, with a minimum value of 5pF and a maximum of 100pF; the smaller the capacitor value, the higher the sensitivity.

3. The C1 capacitor mainly acts on the power-on comparison stage. The larger the capacitance, the worse the sensitivity of the power-on comparison stage. The value range depends on the size of the human body sensor and the layout of the PCB layout. The general value range is between 0 and 15PF. This capacitor generally needs to be made of NPO material and has a higher level of precision. For low-capacitance capacitors, the precision is generally ±0.1PF or higher. If the precision is not enough, or there is no suitable capacitor in the adjustment range, two capacitors can be used in series to form a C1 capacitor.

4. Sensitivity debugging instructions: Assuming that the sensitivity of supporting a 5mm PP cover thickness needs to be adjusted, the CSN capacitor is generally set first, and the CSN capacitor is adjusted in the self-calibration stage when powered on, so that the CSN capacitor can support a 5mm PP cover thickness and fix the CSN capacitor. Next, set C1. The C1 capacitor size should be slightly larger than the parasitic capacitance on the CT2 pin. Estimate a C1 capacitance value of 4PF, for example, apply human body to the sensor, power on the system, if the presence of human body can be detected, it means the sensitivity is too high or appropriate, you can continue to detect upwards, continue to increase the C1 capacitance, and see if the human body can be detected again, until it is difficult to detect the human body when the power is increased, then select the previous capacitance option value. Apply human body to the sensor, power on the system, if the presence of human body cannot be detected, it means the capacitance is too large and the sensitivity is too low, then you need to appropriately reduce the C1 capacitance value, and repeatedly reduce the test until the selected C1 capacitance value can normally detect the human body when the power is turned on.

3：Liquid level detection mode



3-3 Liquid level detection mode application circuit

Note:

1.CREG is a charge collection capacitor, usually ranging from 1nf to 10nf, with a typical value of 4.7nf.

2.CSN is a sensitivity capacitor, mainly used to accurately adjust the liquid level point. The general value range is 5pf at the minimum and 50pf at the maximum. The smaller the capacitance value, the higher the sensitivity.

3.C1 capacitor is used to adjust the presence or absence of liquid or whether the liquid level reaches the corresponding height. This capacitor has a greater impact on the liquid level sensitivity adjustment. The value range depends on the size of the liquid level sensor and the layout of the PCB layout. The general value range is between 0 and 15PF. This capacitor generally needs to be made of NPO material and has a higher level of precision. For low-capacitance capacitors, generally choose ±0.1PF or higher precision. If the accuracy is not enough, or there is no suitable capacitor in the adjustment range, two capacitors can be used in series to form a C1 capacitor.

4. Liquid level debugging instructions: Generally, CSN = 20PF is fixed first, and a C1 capacitance value of 4PF is estimated. If the output port is low after power-on and no water is present, it means that C1 is too small and the capacitance of C1 should be increased; if the liquid level overflows the detection point after power-on and the output port is still high, it means that C1 is too large and the capacitance of C1 should be reduced. Under normal working conditions, the smaller the difference between the parasitic capacitance on the C1 and CT2 pins, the higher the sensitivity. After repeated adjustments, the best capacitance value is obtained, and then the C1 value is fixed. If the adjusted value of the C1 capacitance value is still deviated from the ideal liquid point, the CSN capacitance can be adjusted to make the liquid point reach a more ideal value.

4. DETAILED PARAMETERS

4.1 Rating *

Operating temperature ..... -40 ~ +85°C
Storage temperature ..... -50 ~ +150°C
Maximum Vdd voltage ..... -0.3 ~ +6.0V
Maximum DC output current of the pin..... ±10mA
Pin tolerance voltage..... -0.3V ~ (Vdd + 0.3) Volts

* **Note:** It may cause permanent damage to the chip if the above values are exceeded.

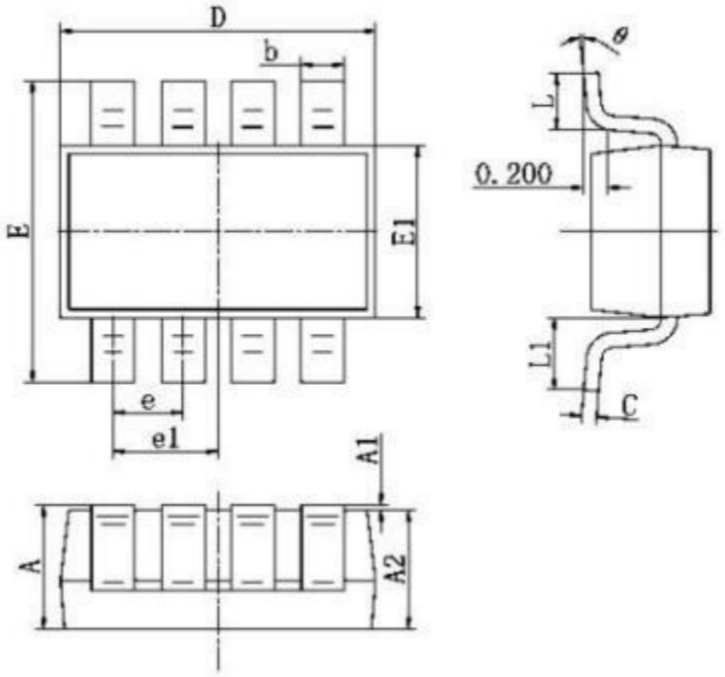
4.2 Electrical Characteristics

4-1： Electrical Characteristics TA = 25℃

Characteristics	Symbol	Conditions	Minimum	Typical	Maximum	Unit
Operating voltage	Vdd		2.5		6.0	V
Current consumption	Idd	VDD=5.0V		0.66		mA
		VDD=3.3V		0.47		mA
Power-on initialization time	Tini			120		ms
Sensor pin capacitance range	Cin				2.5*CSN[1]	
OUT output resistance (NMOS open drain)	Zo	delta Cin > 0.2pF		50		Ohm
		delta Cin < 0.2pF		10K		
OUT output current sink	Isk	VDD=5V			10.0	mA
Minimum detection capacitance	delta_Cin	CSN=5pf		0.2		pF

Note: If the parasitic capacitance of the sense pin exceeds 2.5 times the CSN capacitance, the chip will not work properly (in most cases, this limitation does not need to be considered)

4.3 Package Dimensions (SOT23-8L)



4-1：Packaging Example SOT23-8L

4-2：Package size parameters

Symbol	Unit: mm			Unit: inch		
	Minimum	Typical	Maximum	Minimum	Typical	Maximum
A	1.05	1.11	1.250	0.041	0.045	0.049
A1	0.00	0.050	0.100	0.000	0.002	0.004
A2	1.050	1.100	1.150	0.041	0.043	0.045
b	0.300	0.400	0.500	0.012	0.016	0.020
c	0.100	0.150	0.200	0.004	0.006	0.008
D	2.820	2.900	3.020	0.111	0.115	0.119
E1	1.500	1.600	1.700	0.059	0.063	0.067
E	2.650	2.800	2.950	0.104	0.110	0.116
e	0.650BSC			0.026BSC		
e1	0.975BSC			0.038BSC		
L	0.300	0.450	0.600	0.224	0.236	0.248
L1	0.600REF			0.038BSC		
θ	0°		8°	0°	--	8°