High-precision Two-wire Switch Microphone Chip

General Description

The ET602 and ET604 series products are new type of switch microphone chip designed for electronic vaping devices. The most distinctive feature is their PowerFree™ power-free operation mode, which eliminates the need for power connection cables of traditional switch microphones and reduces costs. ET602 supports AnyPa™ sensitivity setting function and can support the required air pressure sensitivity for high-precision production line settings. ET604 is a traditional preset sensitivity product, with a unified air pressure sensitivity threshold built-in. When the air pressure changes reach the preset threshold, an output signal is triggered. This series of products can be selected with either positive suction or reverse suction triggering direction, adapting to different structure microphones, and supporting two-level suction force determination. Two different frequency square waves are output to distinguish light suction from heavy suction, with the device current being less than 5 μA.

This series of products are packaged in SOT23-5, which is small in size and requires few external components.

Features

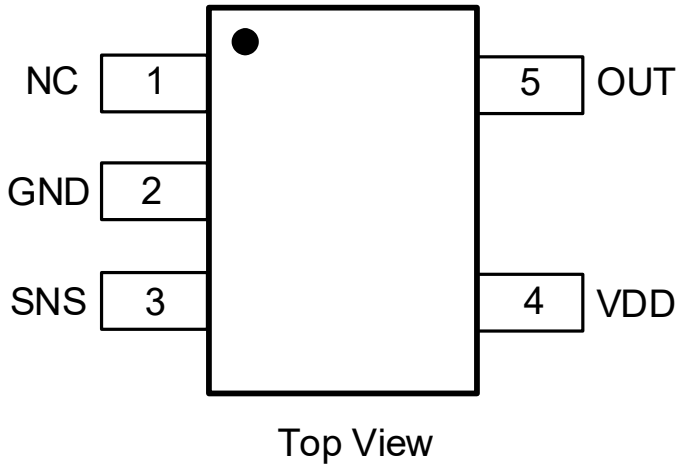
- Support for AnyPa™ sensitivity settings(ET602)
- Support the PowerFree™ power-free operation mode
- There are two trigger modes for smoking available: positive suction and reverse suction
- Support two-level suction force determination to distinguish between light suction and heavy suction
- The standby current is less than 5 μA
- High-Grade ESD protection:
  - Human Body Model: 2kV
  - Charged Device Model: 1kV
- Package Information:

Part No.	Trigger Polarity	Negative pressure sensitivity	Package
ET602	Positive Trigger	Settable	SOT23-5
ET604	Positive Trigger	Settable	SOT23-5

Application

- Various Electronic Vaping Devices

Pin Configuration

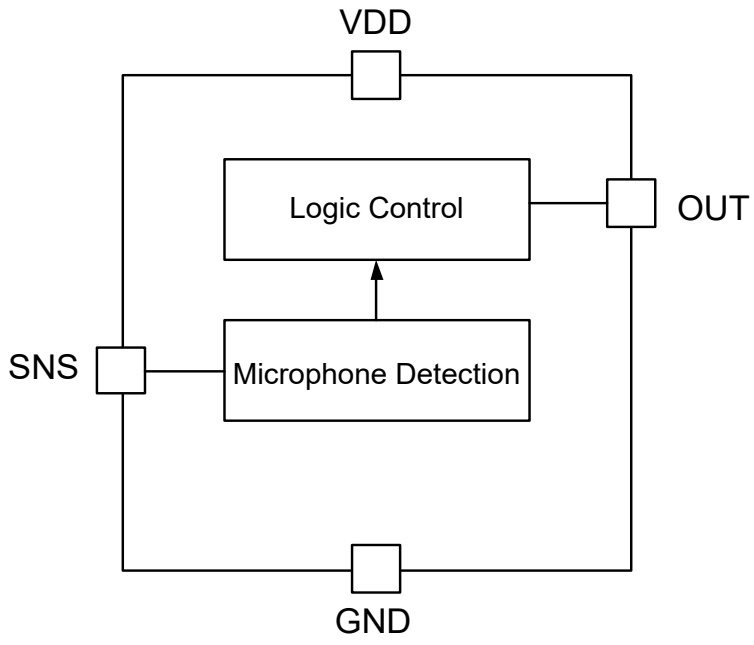


Top View

Pin Function

Pin No.	Name	Description
1	NC	Not Connected
2	GND	Ground, connect to the negative terminal of the battery
3	SNS	Sensor detection pin, detecting changes in the capacitance parameters
4	VDD	Power supply, connect to the positive terminal of the battery
5	OUT	Output, connect the IO of the microcontroller

Block Diagram



Functional Description

ET602 and ET604 are new two-wire powerless microphone sensor chips specifically designed for capacitive microphone sensors in electronic vaping devices. These chips integrate a low-power microphone detection circuit (with a typical static current of only 3μA in standby mode) and a circuit that supports two-wire switched microphone operation. When in standby mode, the OUT pin is at a high level. When the air pressure changes and reaches the preset threshold, a square wave signal is output to wake up the microcontroller. They have built-in microphone dynamic adjustment function, which adaptively compensates for the capacitance drift of the microphone caused by environmental changes, thereby enhancing the long-term stability of microphone sensitivity and reducing the risk of false activation. They support two levels of suction force determination. ET602 supports the AnyPa™ negative pressure sensitivity setting function, while ET604 supports the traditional fixed sensitivity trigger.

Microphone Detection

This series of chips are equipped with a microphone detection circuit. When the system is in standby mode, the chip continuously monitors the sensor status. An internal smoking detection circuit is included. When the sensor status changes in response to changes in air pressure, the preset smoking detection program is triggered. If the smoking conditions are met, it is determined that a smoking action has occurred. Due to environmental changes, the capacitance of the sensor in the standby mode may change even without smoking. The chip has an internal sensor baseline self-adjustment function. When the capacitance change is not caused by smoking, the baseline capacitance is automatically adjusted to adapt to the smoking sensitivity not being affected by environmental changes.

The ET602 supports the AnyPa™ negative pressure sensitivity setting function, allowing the trigger sensitivity to be freely set in the production line testing equipment. The ET604 supports the traditional fixed sensitivity trigger, with the trigger threshold being 3.125% of the baseline capacitance value.

PowerFree™ Model

The PowerFree™ mode is a unique working mode of this chip series. It enables the switch microphone to operate without a power connection cable, and is optimized into a two-wire structure. As shown in Figure 1, for ET602/ET604, the switch microphone and the microcontroller only have ground wire and IO wire between them, and there is no power wire. The PowerFree™ mode requires the IO line of the microcontroller to be configured as an input line with an upper pull-up resistor. The OUT pin of ET602/ET604 outputs a high level when it is in standby mode. When the air pressure changes reach the preset threshold, it outputs a square wave signal, as shown in Figure 2. The low pulse width of the square wave signal is a fixed 20 μs. The preset threshold is set on the production line (ET602) or a fixed value of 3.125% (ET604).

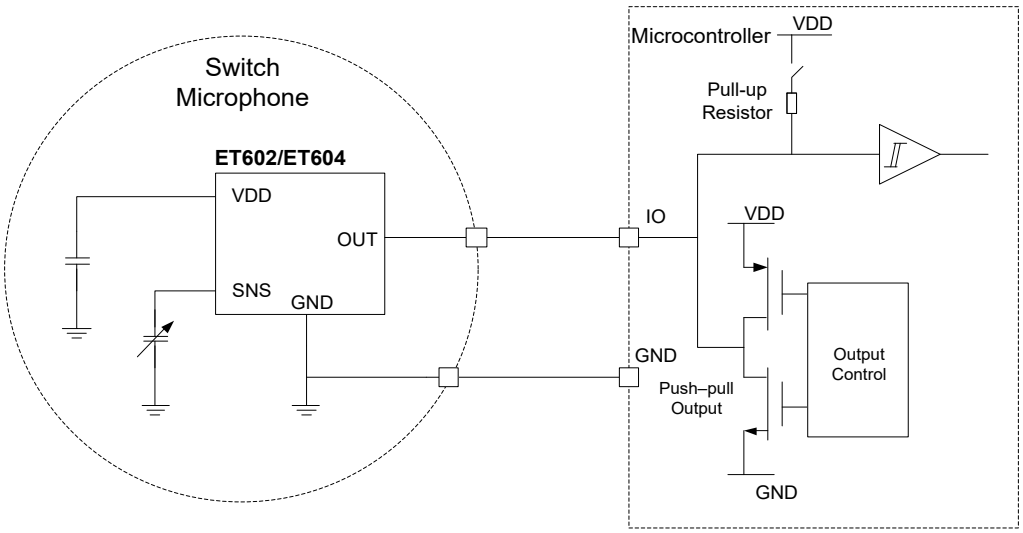


Figure 1. Connection Diagram for I/O Ports of the Single-chip Microcontroller

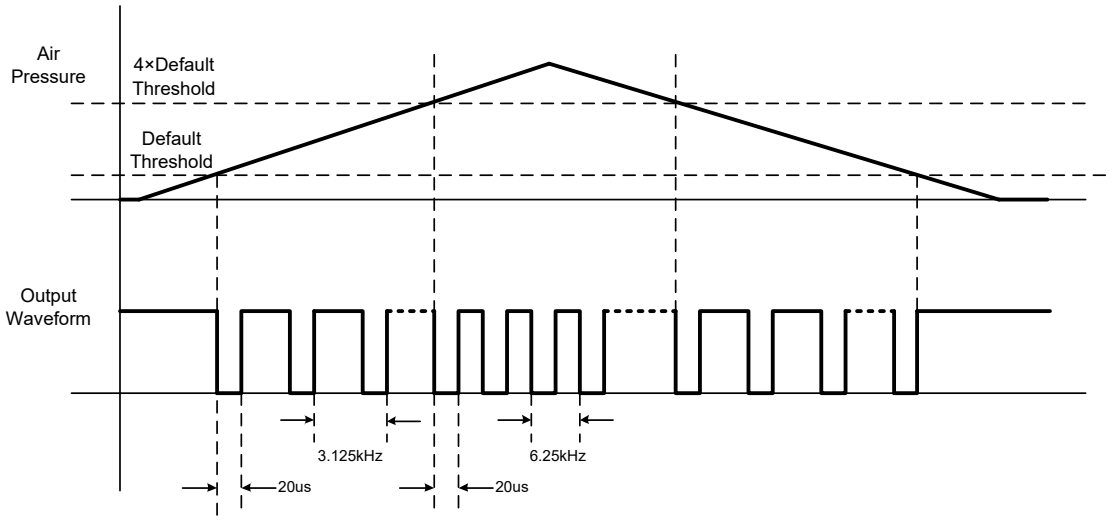


Figure 2. Negative Pressure Variation and OUT Pin Output Waveform

Initialization of the PowerFree™ function

When using the ET602/ET604 chips, initialization is required before power-on, followed by configuration into the standby mode.

Power-on Initialization

When the power is turned on, the OUT pins of ET602/ET604 are connected to the IO pins of the single-chip microcomputer as shown in Figure 1. In the power-on initialization program of the single-chip microcomputer, the IO pins in Figure 1 need to be configured as "push-pull output" in a high-level state. The output current capacity of the IO pins should be greater than 5mA, with an output voltage of more than 2.3V, and maintained for at least 250ms to complete the power-on initialization.

Standby Mode

After the above power-on initialization is completed, the power-on initialization program of the single-chip microcomputer needs to continue to configure the IO as the "input pull-up" mode, and at the same time configure it as the falling edge trigger interrupt mode, and then enter the low-power standby mode. At this time, the OUT pin of ET602/ET604 is in the open-drain state, and both the OUT pin and the IO pin are in the high-level state.

In standby mode, when smoking occurs, the OUT pin outputs a square wave signal of 3.125 kHz or 6.25 kHz. The first falling edge of the square wave signal triggers an interrupt of the single-chip microcomputer. When smoking stops, the OUT pin returns to the open-drain state and outputs a high level. When the single-chip microcomputer detects that the high level lasts for more than 360 μs (maximum value), it can be determined that smoking has stopped.

Two-level suction force determination

ET602/ET604 support two levels of suction force determination. When the pressure change reaches the preset threshold but does not exceed four times the threshold, the output frequency is 3.125 kHz (typical value). When the pressure change exceeds four times the threshold, the output frequency is 6.25 kHz (typical value). The low-level pulse width of the square wave signal is a fixed 20 μs, and the frequency of the square wave signal varies to distinguish between light suction and heavy suction actions. Figure 2 shows the reference waveforms for the two levels of suction force determination.

Over-absorption timeout protection

This series of chips are equipped with an over-voltage protection circuit. If the single smoking duration exceeds 15 seconds, it is regarded as an abnormal situation and the output signal will be stopped.

Absolute Maximum Ratings

Symbol	Parameters	Min	Max	Unit
V_{PIN}	Port Voltage	GND-0.3	GND+6.5	V
T_{STG}	Storage Temperature Range	-55	150	°C
ESD	HBM Model		2000	V
	CDM Model		1000	V

Note. Exceeding the rated maximum value may cause irreversible damage to the chip's internal components. Working continuously under conditions close to this limit may lead to a decrease in the chip's reliability.

Recommended Operating Conditions

Symbol	Parameters	Min	Max	Unit
V_{DD}	Input Voltage	2.8	4.4	V
C_{SNS}	Microphone Capacitor	0.5	5	pF
C_{VDD}	Input Decoupling Capacitor	100	1000	nF
T_A	Operating Temperature Range	-40	+85	°C

Electrical Characteristics

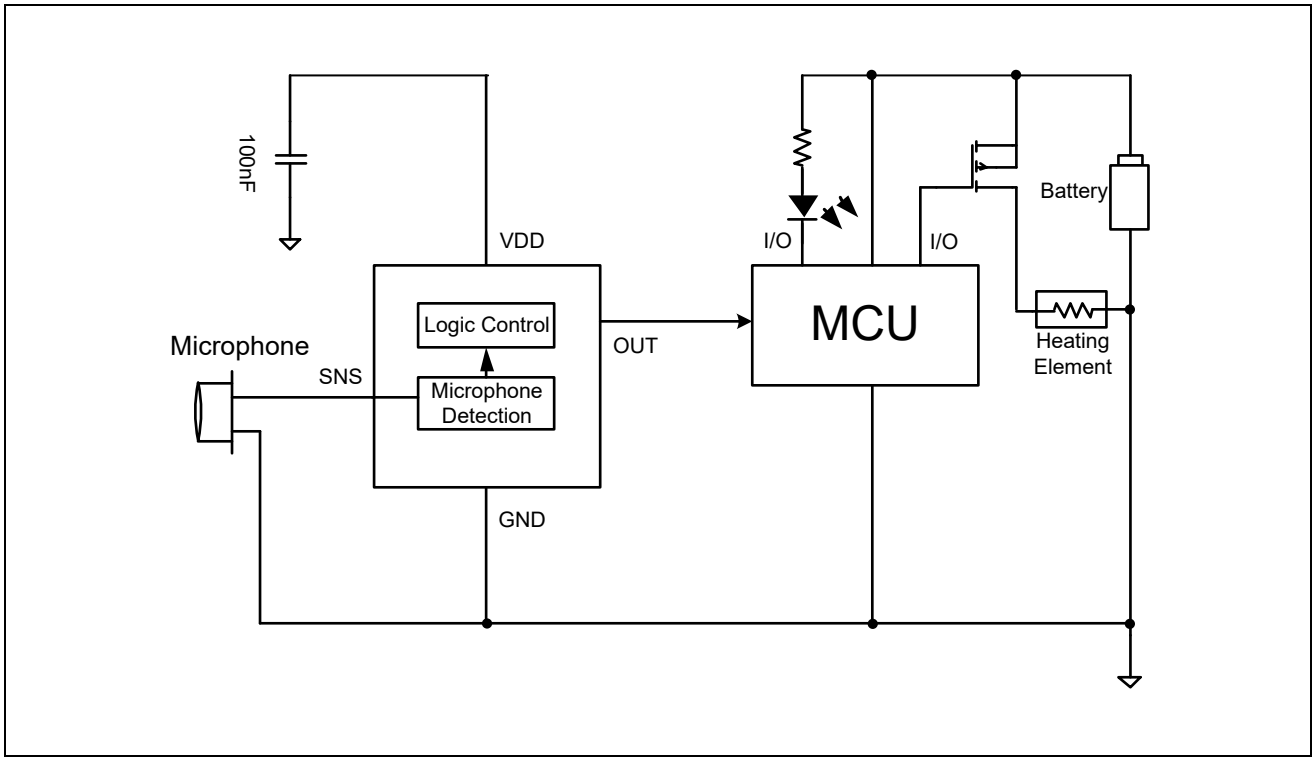
V_{DD} = 2.8V to 4.4V, C_{VDD} = 0.1μF, typical values are at T_A = +25°C, unless otherwise noted.

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
I_Q	Standby Static Current	V_{DD} = 4.2V, C_{SNS} = 10pF(1)		2.9	4.5	μA
f_{OUT}	Output Frequency	Light Inhalation Output	2.8	3.125	3.4	kHz
		Heavy Inhalation Output	5.6	6.25	6.8	kHz
K_{HVY}	Heavy Inhalation Times	V_{DD} = 2.5V to 4.2V,T_A = 25°C		4		
t_{LOW}	Low-level Pulse Width	V_{DD} =2.5V to 4.2V,T_A = 25°C	18	20	22	μs
t_{OUT}	Output Response Time	V_{DD} = 4.2V(2)		50	70	ms
t_{TO}	Smoke Timeout Threshold	V_{DD} = 4.2V(2)	13	15	17	s
V_{OL}	Output Low Voltage Level	V_{DD} = 2.8V to 4.2V, R_{LOAD} = 10kΩ(2)			0.3	V
V_{OH}	Output High Voltage Level	V_{DD} = 2.8V to 4.2V, R_{LOAD} = 10kΩ(2)	V_{DD}-0.3			V

Note1. This parameter is based on the application of a 10pF SNS capacitor.

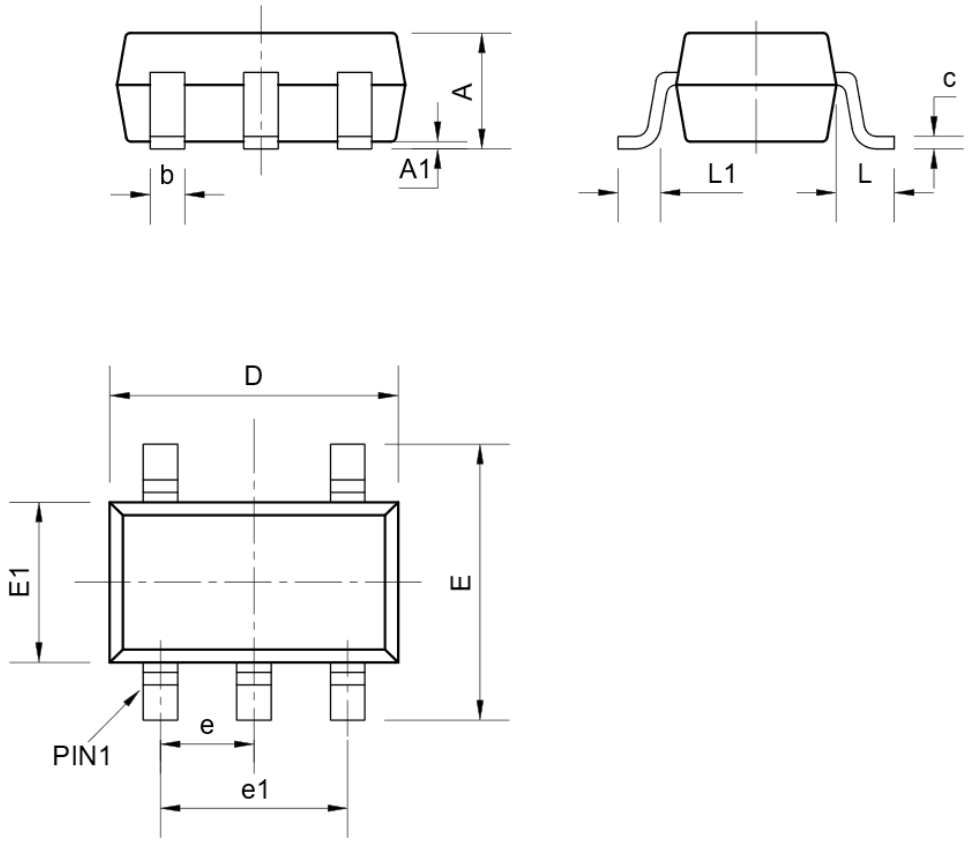
Note2. This parameter has been verified by design and laboratory tests and will not be subject to further testing during mass production.

Application Circuit



Package Dimension

SOT23-5



Dimensions Table (Units:mm)

Symbol	Min	Typ	Max
A	1.050	1.100	1.150
A1	0.030	0.080	0.130
b	0.350	0.400	0.450
c	0.120	0.128	0.135
D	2.820	2.920	3.020
E	2.800	2.900	3.000
E1	1.520	1.620	1.720
e	0.900	0.950	1.000
e1	1.800	1.900	2.000
L	0.600	0.650	0.700
L1	0.400	0.450	0.500

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2025-09-23	Official Version	Licx	Wanggp	Liujy