

4 keys Touch Pad Detector IC

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Outline

TTP119 is a touch pad detector IC which offers 4 touch keys. Stable sensing method can cover diversity conditions, which can widely meet the needs of different applications and can realize the touch function under the condition of medium isolation protection. It has high security (such as Glass, acrylic and other materials). The touching detection IC is designed for replacing traditional direct button key with diverse pad size. Low power consumption and wide operating voltage are the contact key features for DC or AC application.

Characteristic

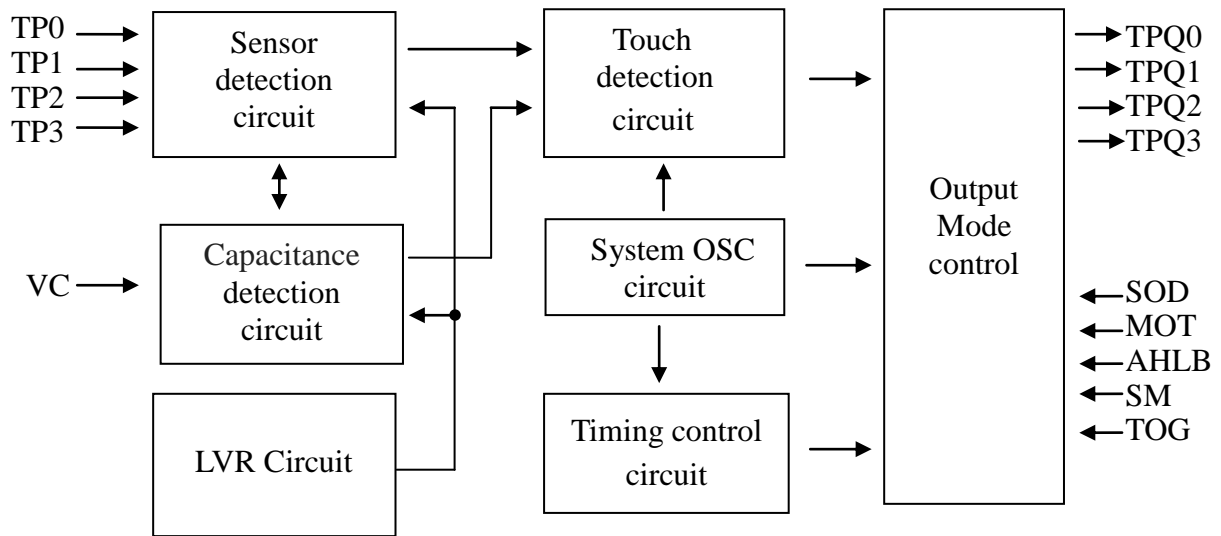
- Operating voltage 2.4~5.5V
- Standby mode Current (no load)
 - @VDD=3.3V, typical 7uA, maximum 14uA.
 - @VDD=5.0V, typical 14uA, maximum 28uA.
- Built-in power on initial(POR) and low voltage reset (LVR) function
- Output Response Time (minimum) @VDD=5.0V
 - @ Detective mode 48ms.
 - @ Standby mode 160ms.
- There are two ways to adjust channel sensitivity
 - (1) Can be adjusted uniformly by an external capacitor (C_{S0}) (C_{S0} :1~47nF).
 - (2) Each channel has an independent external capacitor (C_{TX}) for adjustment (C_{TX} :1~50pF).
- Provide direct mode or toggle mode 、CMOS output or open drain output 、active high or active low by TOG/SOD/AHLB pad option
- Provide multi-key or single-key effective output mode by SM pad option
- Provide the maximum on time infinite or 16 seconds by MOT pad option
- Auto calibration for life

The re-calibration period is about 62.5 milliseconds within 4 seconds after power-on. Power on after 4 seconds then it returns to standby mode, then the re-calibration period change to about 1 second.

Applications

- Wide consumer products
- Button key replacement

Block diagram



Pin Description

Pin no	Pin name	Type	腳位定義
1	TP0	I/O	TP0 touch input sensor port
2	TP1	I/O	TP1 touch input sensor port
3	TP2	I/O	TP2 touch input sensor port
4	TP3	I/O	TP3 touch input sensor port
5	VC	I/O	Capacitance detection
6	SOD	I-ZL	Output mode selection: open => CMOS output ; VSS=>open darin output
7	VSS	P	Negative power supply, ground
8	MOT	I-ZL	Maximum on time selection: open =>infinite ; VSS=>16 sec
9	AHLB	I-ZH	Active high or low selection: open=> Active high ; VDD=> Active low
10	VDD	P	Positive power supply
11	SM	I-ZH	Single/multi key selection: open=> single key ; VDD=> multi key
12	TOG	I-ZH	Output mode selection: open => direct mode ; VDD => toggle mode
13	TPQ3	O(OD)	Q3 output port, correspond TP3 touch input sensor port
14	TPQ2	O(OD)	Q2 output port, correspond TP2 touch input sensor port
15	TPQ1	O(OD)	Q1 output port, correspond TP1 touch input sensor port
16	TPQ0	O(OD)	Q0 output port, correspond TP0 touch input sensor port

Note:

1. I_ZH: A pull-down resistor when powering up, turn to built-in pull-up resistor after reading the status. (Leakage will be generated when connect to VSS)
2. I_ZL: A pull-up resistor when powering up, turn to built-in pull-down resistor after reading the status. (Leakage will be generated when connect to VDD)

Pin Type

- I CMOS input only
- O CMOS out
- I/O CMOS input/output
- P Power/Ground
- I-ZH CMOS input and pull-high resistor
- I-ZL CMOS input and pull-low resistor
- OD Open drain output, have diode protective circuit

Electrical Characteristics

- Absolute maximum ratings**

Parameter	Symbol	Conditions	Rating	Unit
Operating Temperature	TOP	—	-40~+85	°C
Storage Temperature	TSTG	—	-50~+125	°C
Supply Voltage	VDD	Ta=25°C	VSS-0.3~VSS+5.5	V
Input Voltage	VIN	Ta=25°C	VSS-0.3~VDD+0.3	V
Human Body Mode	ESD	—	≥4	KV

Note : VSS symbolizes for system ground

- DC / AC characteristics : (Test condition at room temperature = 25 °C)**

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Operating Voltage	VDD		2.4	3.3	5.5	V
Standby mode current (no load)	I _{st}	VDD=3.3V, VC=10nF	-	7.0	14	uA
		VDD=5.0V, VC=10nF	-	14	28	uA
Detective mode current (no load)	I _{OP}	VDD=3.3V, VC=10nF	-	20	40	uA
		VDD=5.0V, VC=10nF	-	30	60	uA
System oscillator	F _{OSC}	VDD = 3.3V	-	17K	-	Hz
		VDD = 5.0V	-	16K	-	Hz
Input ports	V _{IL}	Input low voltage	-	-	0.2	VDD
	V _{IH}	Input high voltage	0.8	-	1.0	VDD
TPQ0~3 Output port Sink Current	I _{OL}	VDD=3.3V, VOL=0.5V	-	10	-	mA
		VDD=5.0V, VOL=0.5V	-	14	-	mA
TPQ0~3 Output port Source Current	I _{OH}	VDD=3.3V, VOH=2.8V	-	-6.0	-	mA
		VDD=5.0V, VOH=4.5V	-	-9.0	-	mA
TPQ0~3 Output response time	T _R	VDD=3.3V, standby mode	-	150	-	ms
		VDD=3.3V, detective mode	-	45	-	ms
		VDD=5.0V, standby mode	-	160	-	ms
		VDD=5.0V, detective mode	-	48	-	ms

Function Description

I . Power-On and Reset instruction

The reference value is refreshed every 62.5 milliseconds within 4.0 seconds after power-on. If the touch button is not touched after 4.0 seconds of power-on, the recalibration cycle switching time is about 1.0 second. The output port returns to its initial state when rest.

II . Sensitivity adjustment

The total loading of electrode size and capacitance of connecting line on PCB can affect the sensitivity. The sensitivity adjustment must according to the practical application on PCB. The TTP119 offers some methods for adjusting the sensitivity outside.

1. By the electrode size

Under other conditions are fixed. Using a larger electrode size can increase sensitivity. Otherwise it can decrease sensitivity. But the electrode size must use in the effective scope.

2. By the panel thickness

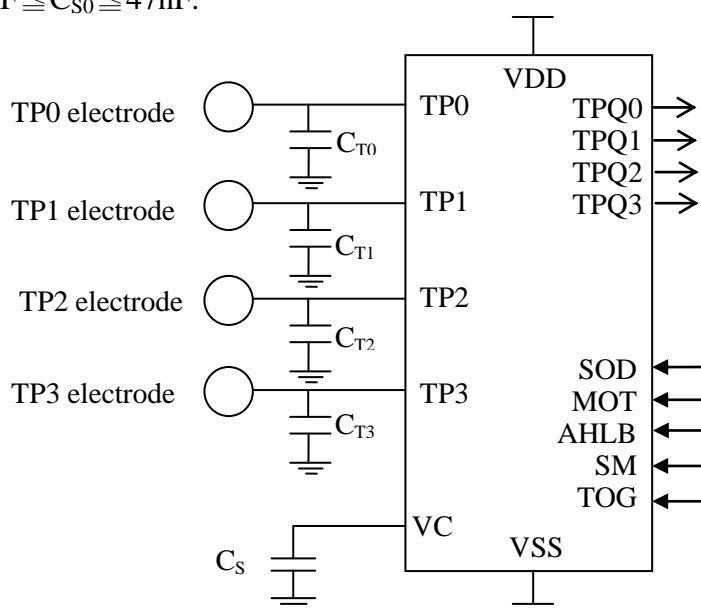
Under other conditions are fixed. Using a thinner panel can increase sensitivity. Otherwise it can decrease sensitivity. But the panel thickness must be below the maximum value.

3. By the value of $C_{T0} \sim C_{T3}$ capacitor (please see the down figure)

Under other conditions are fixed. Add the capacitor $C_{T0} \sim C_{T3}$, can fine tune the sensitivity for single key, that lets all key's sensitivity identical. When do not use any capacitor to VSS, the sensitivity is most sensitive. When adding the values of $C_{T0} \sim C_{T3}$ will reduce sensitivity in the useful range ($1 \leq C_{T0} \sim C_{T3} \leq 50\text{pF}$).

4. By the value of C_{S0} capacitor (please see the down figure)

Under other conditions are fixed. PAD VC to VSS capacitor C_{S0} can adjust sensitivity, when adding the value of C_{S0} will increase sensitivity in the useful range $1\text{nF} \leq C_{S0} \leq 47\text{nF}$.



III. Output mode (TOG , SOD , AHLB pin option)

TTP119 output (TPQ0~TPQ3) has active high or active low by AHLB pad option, has direct mode or toggle mode by TOG pad option and has CMOS out or open drain (have diode protective circuit) by SOD pad option.

TOG	SOD	AHLB	TPQ0 ~ TPQ3 option features
open	open	open	Direct mode, CMOS active high output
open	open	VDD	Direct mode, CMOS active low output
open	VSS	open	Toggle mode, open drain active high output
open	VSS	VDD	Toggle mode, open drain active low output
VDD	open	open	Toggle mode, COMS output, power on state=0
VDD	open	VDD	Toggle mode, COMS output, power on state=1
VDD	VSS	open	Toggle mode, power on state high-Z, active high output
VDD	VSS	VDD	Toggle mode, power on state high-Z, active low output

- Note: 1. Open drain output, have diode protective circuit.
 2. VDD: connect to VDD. VSS: connect to VSS. open: floating

IV. Key operating mode (By SM pad option)

The Multi key or Single key functions by SM pad option ◦

SM	Option features
open	Multi key mode
VDD	Single key mode

- Note: VDD: connect to VDD. open: floating
- Multi key mode : The TP0-TP3 can be detected 2 keys or above 2 keys at the same time.
 - Single key mode : The TP0-TP3 can be detected 1 key only at the same time, when any key be detected, the other 3 keys can't be detected.

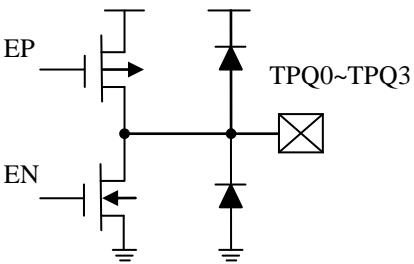
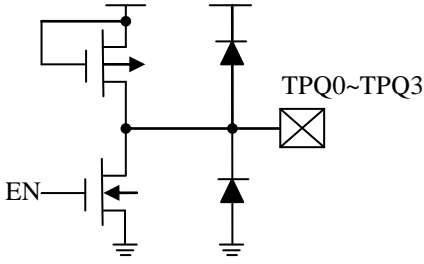
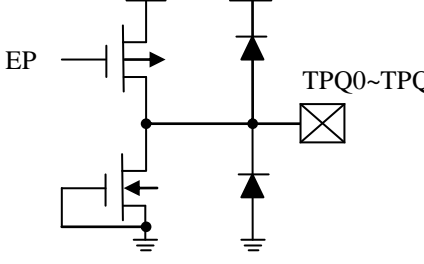
V. Maximum key on duration time (By MOT pad option)

If some objects cover in the sense pad, and causing the change quantity enough to be detected. To prevent this, the TTP119 IC sets a timer to monitor the detection. The timer is the maximum on duration time. When the detection is over the timer, the system will return to the power-on initial state, and the output becomes inactive until the next detection.

MOT	Option features
open	Infinite (Disable maximum on time)
VSS	Maximum on time 16 seconds

Note: VSS: connect to VSS. open: floating

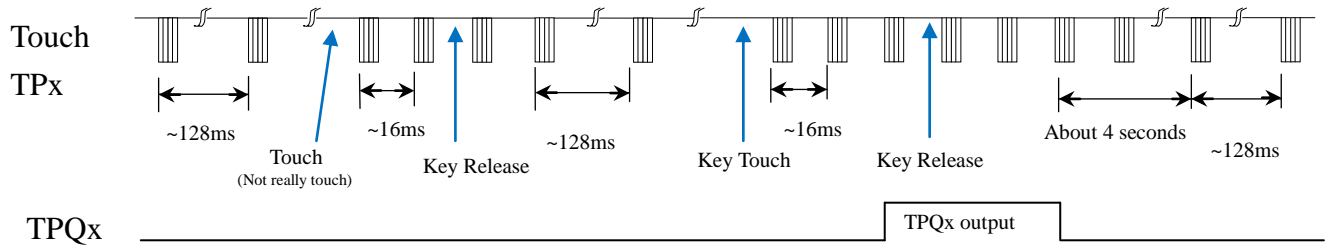
VI. CMOS and open drain (SOD) output description

CMOS output (SOD pad : open)	Open drain output (SOD pad : VSS)
	<p>AHLB pad : VDD</p> 
	<p>AHLB pad : open</p> 

Note: Open drain output, have diode protective circuit.

VII. Standby Mode Touch and TPQx output

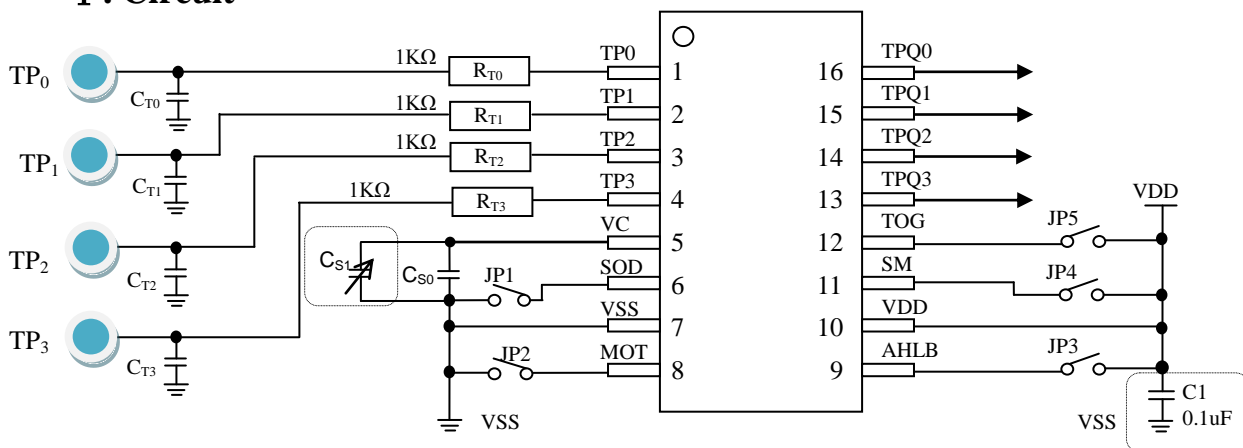
IC will save power in standby mode. When detecting key touch, it will switch to detective mode. Until the key touch is released and will keep a time about 4 sec. Then it returns to standby mode. At VDD=5V, the standby mode TPQx output response time about 160ms, the detective mode TPQx output response time about 48 milliseconds. (x=0,1,2,3)



Application circuit

Reference only

I . Circuit



- 註 : 1. C1, CS1 depending on the application.
 2. Please float the unused input sensor port (for example, if TP3 is not used, please float TP3).

II . Function table

1. Output mode selection

TOG	SOD	AHLB	TPQ0 ~ TPQ3 option features
open	open	open	Direct mode, CMOS active high output
open	open	VDD	Direct mode, CMOS active low output
open	VSS	open	Toggle mode, open drain active high output
open	VSS	VDD	Toggle mode, open drain active low output
VDD	open	open	Toggle mode, COMS output, power on state=0
VDD	open	VDD	Toggle mode, COMS output, power on state=1
VDD	VSS	open	Toggle mode, power on state high-Z, active high output
VDD	VSS	VDD	Toggle mode, power on state high-Z, active low output

Note: open drain output, have diode protective circuit.

2. Key operating

SM	Option features
open	Multi key mode
VDD	Single key mode

3. Maximum key on duration time

MOT	Option features
open	Infinite (Disable maximum on time)
VSS	Maximum on time 16 seconds

III. PCB layout note

1. On PCB, the length of lines from touch pad to IC pin shorter is better. And the lines do not parallel and cross with other lines.
2. The power supply must be stable. If the supply voltage drift or shift quickly, maybe causing sensitivity anomalies or false detections.
3. The material of panel covering on the PCB can not include the metal or the electric element. The paints on the surfaces are the same.
4. The C1 capacitor must be used between VDD and VSS; and should be routed with very short tracks to the device's VDD and VSS pins.
5. The capacitance $C_{T0}\sim C_{T3}$ can be used to adjust the sensitivity. The value of $C_{T0}\sim C_{T3}$ use smaller, then the sensitivity will be better. The sensitivity adjustment must according to the practical application on PCB. The range of $C_{T0}\sim C_{T3}$ value are 1~50pF.
6. The capacitance C_{S0} can be used to adjust the sensitivity. The value of C_{S0} use larger, then the sensitivity will be better. The sensitivity adjustment must according to the practical application on PCB. The range of C_{S0} value are 1nF~47nF.
7. The sensitivity adjustment capacitors ($C_{T0}\sim C_{T3}$, C_{S0}) must use smaller temperature coefficient and more stable capacitors. Such are X7R, NPO for example. So for touch application, recommend to use NPO capacitor, for reducing that the temperature varies to affect sensitivity.
8. Medium type for adjustment capacitors (C_{S0})

IV. C_{S0} value table

Medium Types	C_{S0} Capacitance (Reference)
Acrylic sheet ≤ 3 mm	6.8nF/25V
3mm \leq Acrylic sheet ≤ 6 mm	10nF/25V
Acrylic sheet ≤ 6 -10mm	22nF/25V

V. BOM table

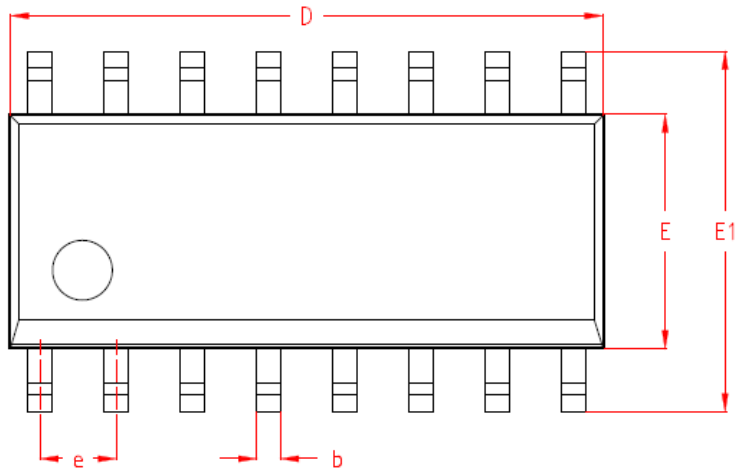
Symbol	Type	Element parameter
C_{S0}	capacitor	Reference C_{S0} value Table
C_{S1}	capacitor	0pF*
C1	Electrolytic capacitor	104*
$C_{T0}\sim C_{T3}$	capacitor	1pF~ 50pF
$R_{T0}\sim R_{T3}$	Carbon film resister	1K Ω *

Note: * Resistance and Capacitance value depends on the application.

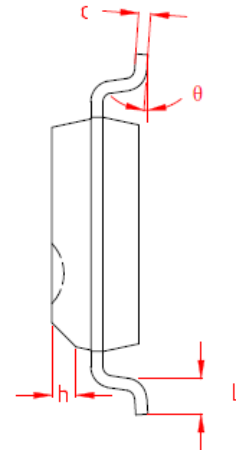
Package outline

Package Type: SOP-16

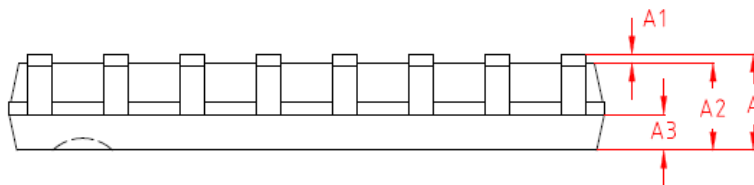
TOP VIEW



SIDE VIEW



SIDE VIEW



Symbol Parameter (Unit : mm)														
A			A1			A2			A3			b		
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
		1.75	0.10		0.25	1.35	1.45	1.55	0.60	0.65	0.70	0.35		0.50

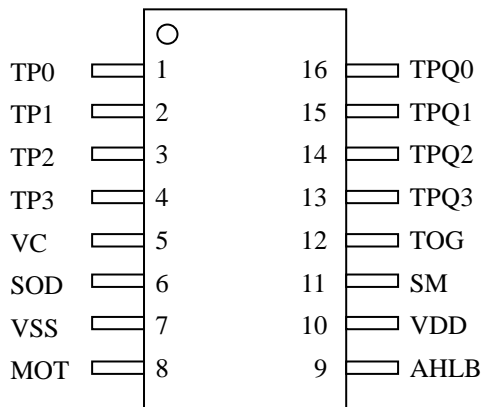
Symbol Parameter (Unit : mm)														
c			D			E			E1			e		
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Typ		
0.19		0.25	9.80	10.00	10.20	3.80	3.90	4.00	5.80	6.00	6.20	1.27 BSC		

Symbol Parameter (Unit : mm)									
h			L			theta			
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	
0.30		0.50	0.40		0.80	0		8°	

Package configuration

TTP119-AOB

Package type: SOP-16



Ordering Information

TTP119

Package Item	Package Type	Chip Type	Wafer Type
TTP119-AOB	SOP-16	No support	No support

Revision History:

- 2021/01/25 : Version: 1.0
Initial version.