A Low Power One-key Capacitor Touch Sensor

Features

- Sensitivity adjusted by the capacitance (0~50 pF) outside
- Maximum key-on duration time: 16s
- Maximum response time
  - Slow scan mode: 160ms (AW93001CDNR/DDNR)
  - Slow scan mode: 64ms (AW93001EDNR/FDNR)
  - Fast scan mode: 48ms
- Push-pull output, active high (AW93001CDNR/EDNR)
- Open-drain output, active low (AW93001DDNR/FDNR)
- Low power consumption
  - Slow scan mode: 1.0μA (AW93001CDNR/DDNR)
  - Slow scan mode: 2.2μA (AW93001EDNR/FDNR)
  - Fast scan mode: 3.2μA
- 2.4V~5.5V power supply
- Operation temperature range: -40°C~85°C
- DFN 1.0mmx1.0mmx0.37mm-4L package

General Description

AW93001X is a single channel capacitive touch controller with low power consumption and wide operation voltage range.

With the help of signal processing algorithms, the device is able to track slow environmental variations, and maintain high performance operation.

AW93001X is designed for replacing traditional mechanical button. It can be applied in many fields, such as consumer electronics, white goods and appliances, etc.

Applications

Wearable device, White goods and appliances

Replacing traditional mechanical button

Typical Application Circuit

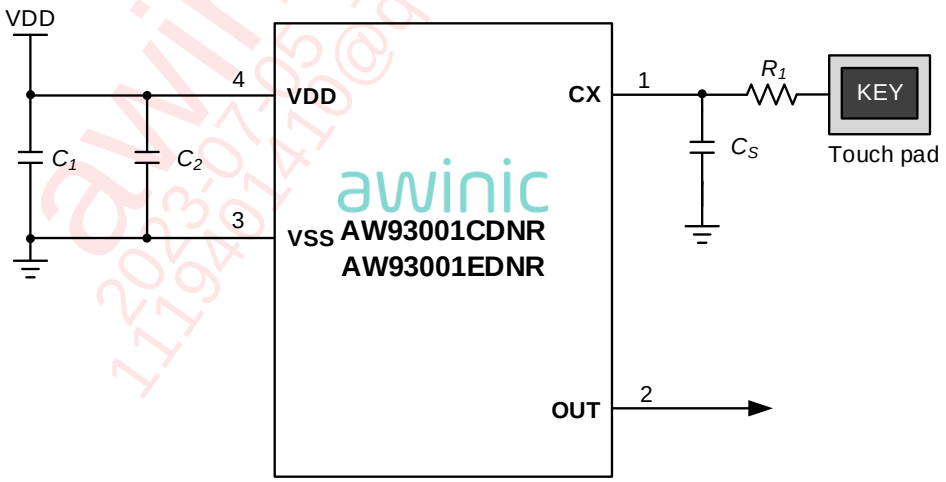


Figure 1 AW93001CDNR/EDNR Typical Application Circuit (push-pull output)

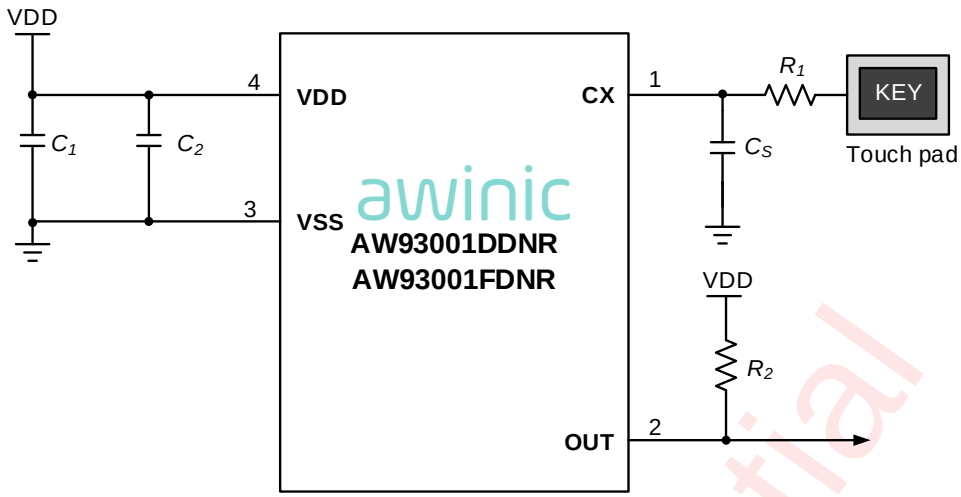
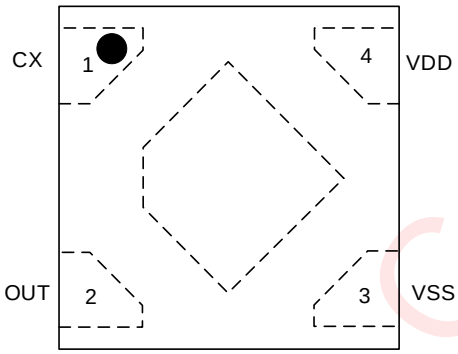


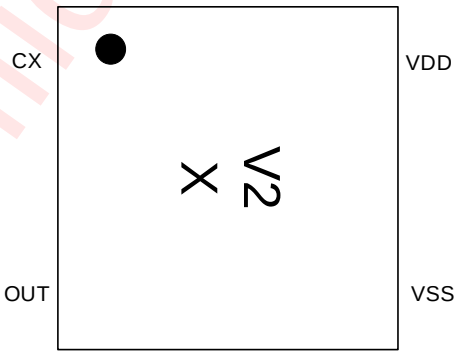
Figure 2 AW93001DDNR/FDNR Typical Application Circuit (open-drain output)

Pin Configuration And Top Mark

AW93001CDNR
(Top View)

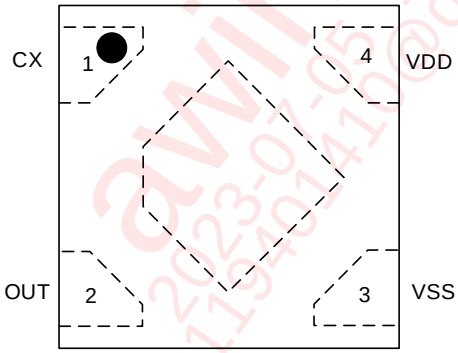


AW93001CDNR Marking
(Top View)

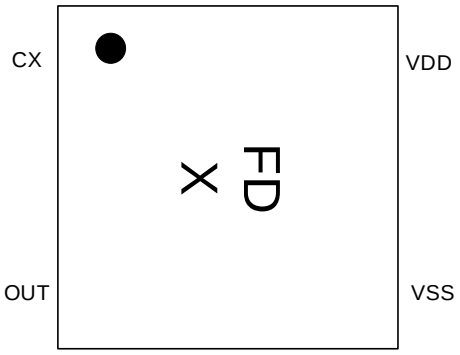


V2 - AW93001CDNR
X - Production Tracing Code

AW93001DDNR
(Top View)

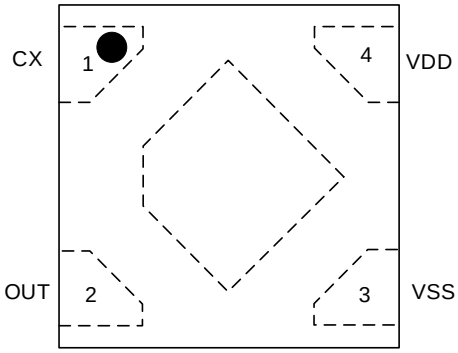


AW93001DDNR Marking
(Top View)

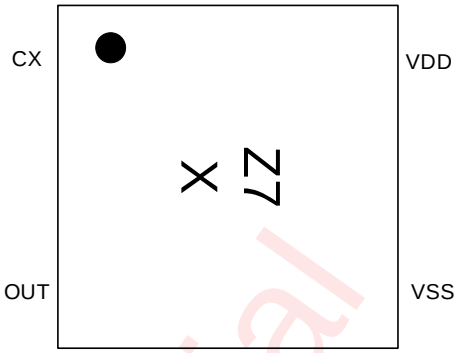


FD - AW93001DDNR
X - Production Tracing Code

AW93001EDNR
(Top View)

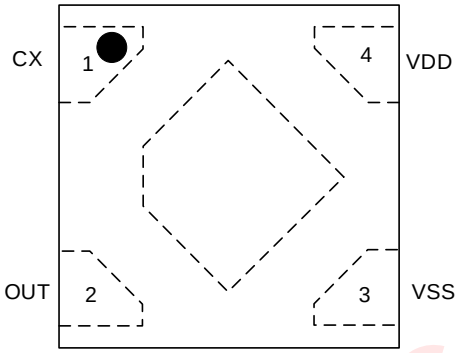


AW93001EDNR Marking
(Top View)

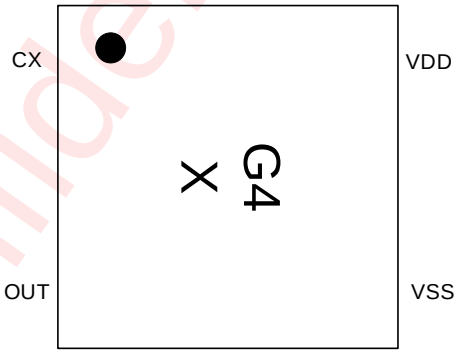


Z7 - AW93001EDNR
X - Production Tracing Code

AW93001FDNR
(Top View)



AW93001FDNR Marking
(Top View)



G4 - AW93001FDNR
X - Production Tracing Code

Note: The exposed pad in the middle is floating, it can be connected to VSS.

Pin Definition

No.	NAME	DESCRIPTION
1	CX	Capacitive detector input
2	OUT	Push-pull output (AW93001CDNR/EDNR) Open-drain output (AW93001DDNR/FDNR), require pull-up resistor
3	VSS	Ground
4	VDD	Power supply (2.4V~5.5V), requires decoupling capacitor

Device Comparison

Table 1 Device Comparison

Device	Package	Scan Period		MOT	Output Mode
		Fast scan	Slow scan		
AW93001CDNR	DFN1x1-4L	16ms	128ms	16s	Push-pull
AW93001DDNR	DFN1x1-4L	16ms	128ms		Open-drain
AW93001EDNR	DFN1x1-4L	16ms	32ms		Push-pull
AW93001FDNR	DFN1x1-4L	16ms	32ms		Open-drain

Functional Block Diagram

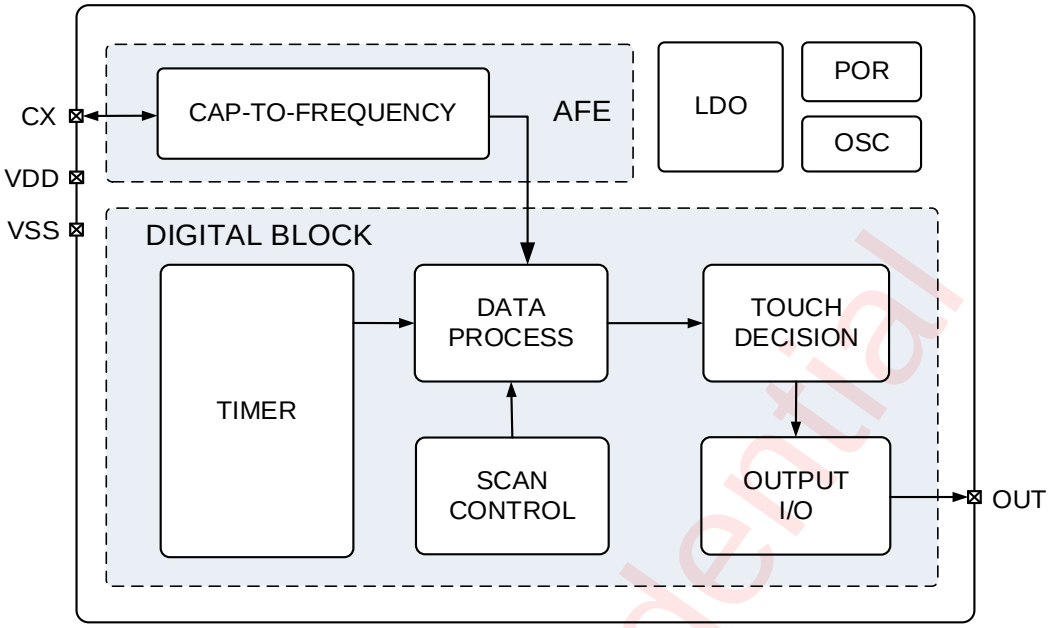


Figure 3 Functional Block Diagram

Ordering Information

Part Number	Temperature	Package	Marking	Moisture Sensitivity Level	Environmental Information	Delivery Form
AW93001CDNR	-40°C~85°C	DFN 1.0mmx1.0mm-4L	V2	MSL1	ROHS+HF	4500 units/ Tape and Reel
AW93001DDNR	-40°C~85°C	DFN 1.0mmx1.0mm-4L	FD	MSL1	ROHS+HF	4500 units/ Tape and Reel
AW93001EDNR	-40°C~85°C	DFN 1.0mmx1.0mm-4L	Z7	MSL1	ROHS+HF	4500 units/ Tape and Reel
AW93001FDNR	-40°C~85°C	DFN 1.0mmx1.0mm-4L	G4	MSL1	ROHS+HF	4500 units/ Tape and Reel

Absolute Maximum Ratings(NOTE1)

PARAMETERS		RANGE
Supply voltage range VDD		-0.3V to 6.0V
Input voltage range	CX	-0.3V to 6.0V
Output voltage range	OUT	-0.3V to 6.0V
Operating free-air temperature range		-40°C to 85°C
Maximum operating junction temperature T_{JMAX}		150°C
Storage temperature T_{STG}		-65°C to 150°C
Lead temperature (soldering 10 seconds)		260°C
ESD(Including CDM HBM)(NOTE 2)		
HBM		±6kV
CDM		±1.5kV

PARAMETERS	RANGE
Latch-Up	
Test condition: JESD78E	+IT: 200mA , -IT: -200mA

NOTE1: Conditions out of those ranges listed in "absolute maximum ratings" may cause permanent damages to the device. Exposure to absolute-maximum-rated conditions for prolonged periods may affect device reliability.

NOTE2: The human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin. Test method: ANSI/ESDA/JEDEC JS-001-2017(HBM), ANSI/ESDA/JEDEC JS-002-2018(CDM).

Electrical Characteristics

Note: Typical values are given for T_A = +25°C, VDD=3.0V unless otherwise specified.

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
VDD	Operation voltage	-	2.4	3.0	5.5	V
I_{SL}	Current in slow scan mode	C_S=20pF, scan period=128ms	-	1.0	-	μA
		C_S=20pF, scan period=32ms	-	2.2	-	μA
I_{FS}	Current in fast scan mode	C_S=20pF, scan period=16ms	-	3.2	-	μA
I_{OH}	Output high current	V_{OH} ≥ VDD-0.4V (for AW93001CDNR/EDNR)	-	-	-4	mA
I_{OL}	Output low current	V_{OL} ≤ 0.4V	8	-	-	mA
T_{RESP}	Response time	Fast scan mode, scan period=16ms	-	-	48	ms
		Slow scan mode, scan period=32ms	-	-	64	ms
		Slow scan mode, scan period=128ms	-	-	160	ms

Detailed Functional Description

Initialization

After power-on, the chip executes initialization process automatically, it lasts for about 500ms. During initialization, touch decision does not work, and no touch status can be reported.

Scan Mode

For power saving, the devices automatically switches scan mode between fast and slow mode according to touch detection status. After power-on, the devices enters fast scan mode directly. In fast scan mode, if there is no touch detected for 8s continuously, the devices switches to slow scan mode. In slow scan mode, if touch is detected, the devices returns to fast scan mode at once.

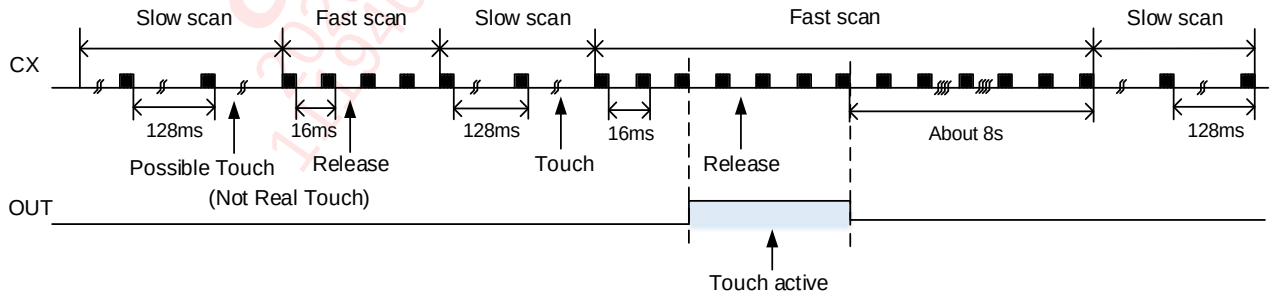


Figure 4 AW93001CDNR Scan Mode

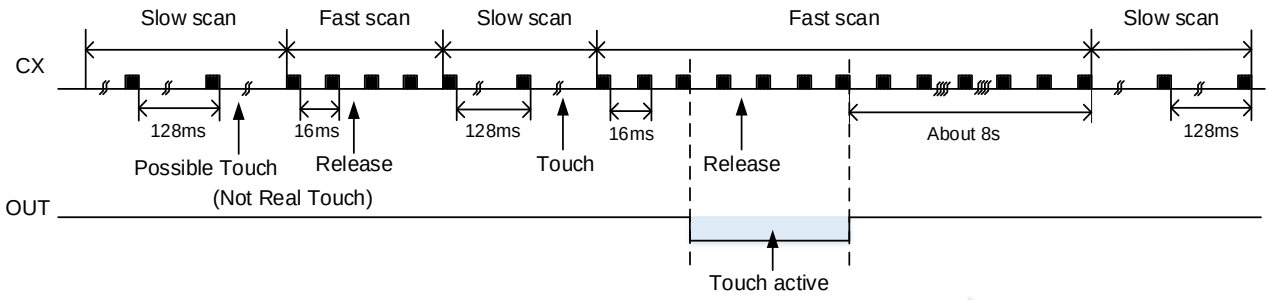


Figure 5 AW93001DDNR Scan Mode

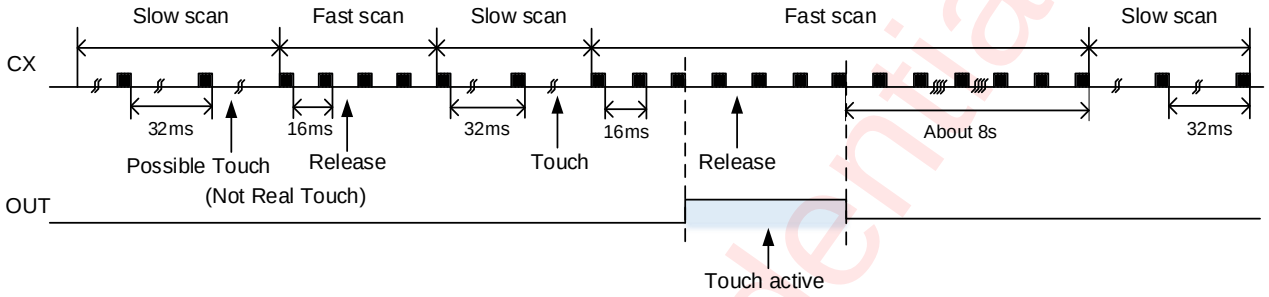


Figure 6 AW93001EDNR Scan Mode

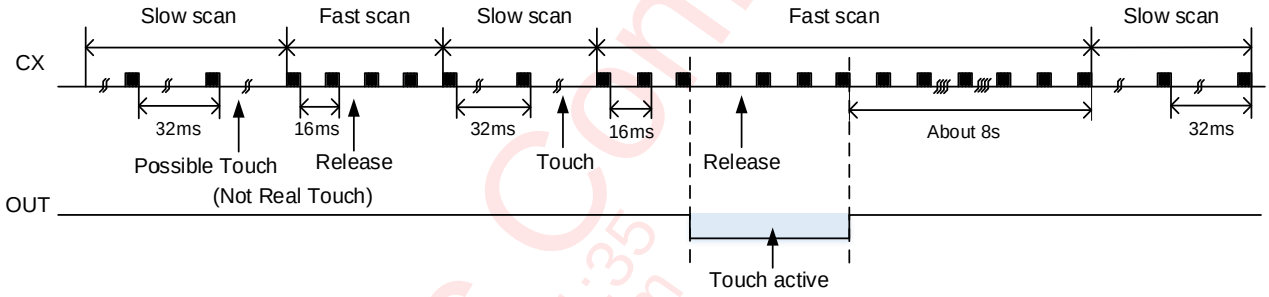


Figure 7 AW93001FDNR Scan Mode

Maximum Key-on Duration Time

In order to prevent the false touch detection caused by objects covering the touch pad, the chip sets maximum key-on duration time. If the AW93001CDNR/DDNR/EDNR/FDNR's touch status last over 16s, it will be released until a new touch action.

Application Information

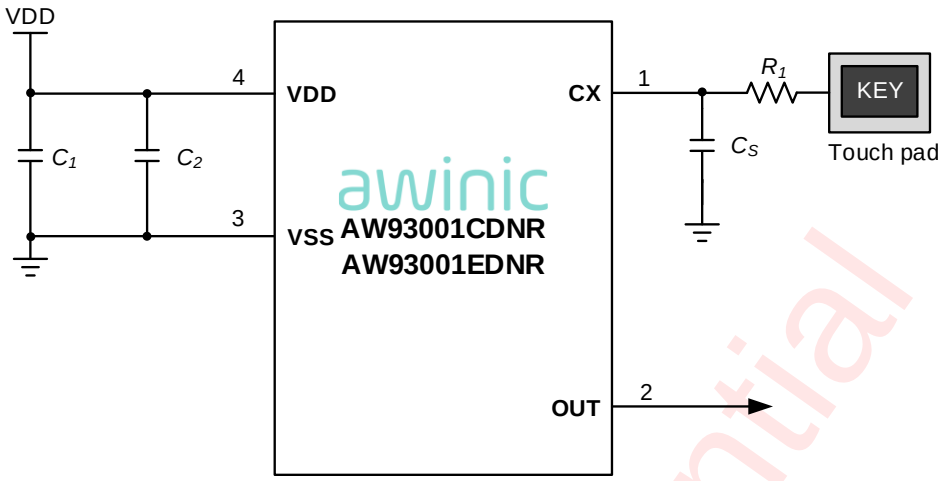


Figure 8 AW93001CDNR/EDNR Typical Application Circuit(push-pull output)

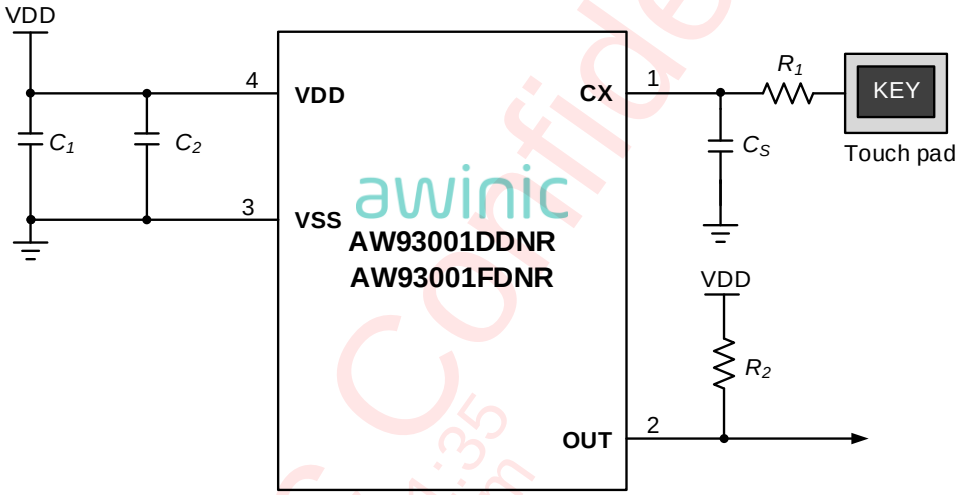


Figure 9 AW93001DDNR/FDNR Typical Application Circuit(open-drain output)

To obtain the optimal performance, the capacitive touch controller's application circuit should be considered carefully. Here are some guidelines:

1. The chip should be supplied by stable power, otherwise it may cause abnormal sensitivity or false detection.
2. Add a resistor R_1 between C_S and Touch pad to improve ESD protection and reduce EMI.
3. Sensitivity can be adjusted by C_S. The smaller the C_S, the higher the sensitivity, the higher the power consumption. The range of C_S is 0~50pF. It is suggested to use temperature insensitive capacitors to adjust the sensitivity, such as NP0 capacitors.
4. Sensitivity can be adjusted by the electrode size. Using a larger electrode size can increase sensitivity, but the electrode size must be used in the effective scope.
5. Sensitivity can be adjusted by the panel thickness. Using a thinner panel can increase sensitivity, but the panel thickness must be used in the effective scope.

Recommended Components List

Component	Name	DESCRIPTION	TYP.	UNIT
C	C_1	-	1	μF
	C_2	-	0.1	μF
	C_S	5% resolution Low temperature coefficient	-	pF
R	R_1	5% resolution	4.7	kΩ
	R_2	5% resolution	100	kΩ

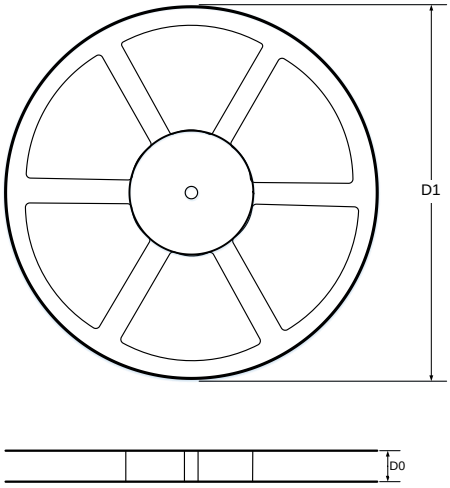
PCB Layout Consideration

To obtain the optimal performance, PCB layout should be considered carefully. Here are some guidelines:

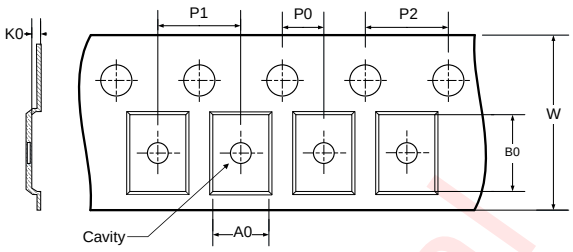
1. The connections between the capacitors (C_1, C_2) and the IC as short as possible, to reduce noise and EMI.
2. The distance from the touch pad to the pin CX as short as possible, and the signal trace as thin as possible.
3. The IC and sensor traces surrounded by ground, both top and bottom layers filled with ground plane.
4. The sensor and traces away from mic, earphone line, because capacitive sensor will disturb audio line.
5. The sensor and traces away from interferences, such as communication lines.
6. The material of panel covering the PCB cannot contain metal or electric element, and the surface coating is the same.

Tape And Reel Information

REEL DIMENSIONS

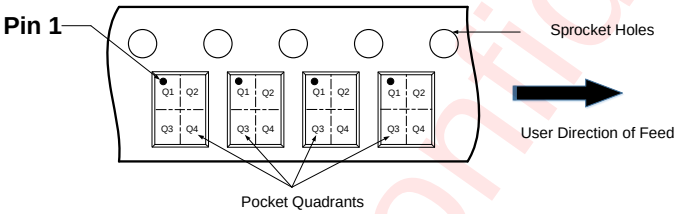


TAPE DIMENSIONS



A0：Dimension designed to accommodate the component width
B0：Dimension designed to accommodate the component length
K0：Dimension designed to accommodate the component thickness
W：Overall width of the carrier tape
P0：Pitch between successive cavity centers and sprocket hole
P1：Pitch between successive cavity centers
P2：Pitch between sprocket hole
D1：Reel Diameter
D0：Reel Width

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



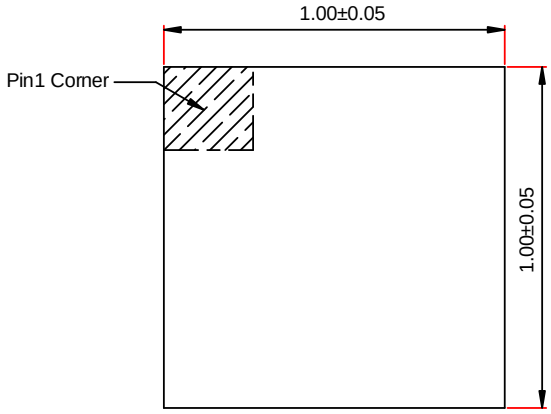
Note：The above picture is for reference only. Please refer to the value in the table below for the actual size

DIMENSIONS AND PIN1 ORIENTATION

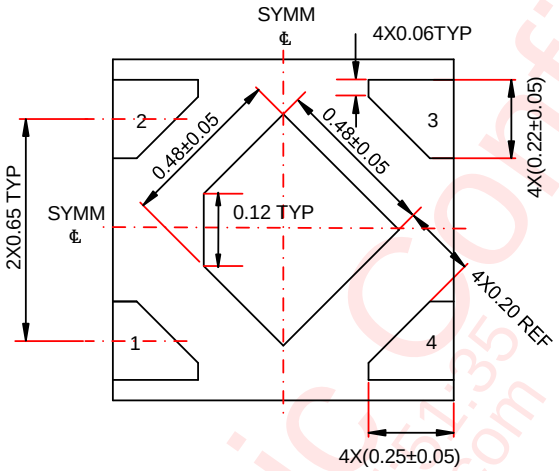
D1 (mm)	D0 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
178	8.4	1.15	1.15	0.5	2	4	4	8	Q1

All dimensions are nominal

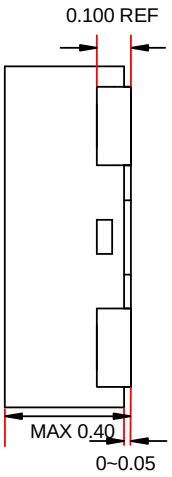
Package Description



Top View



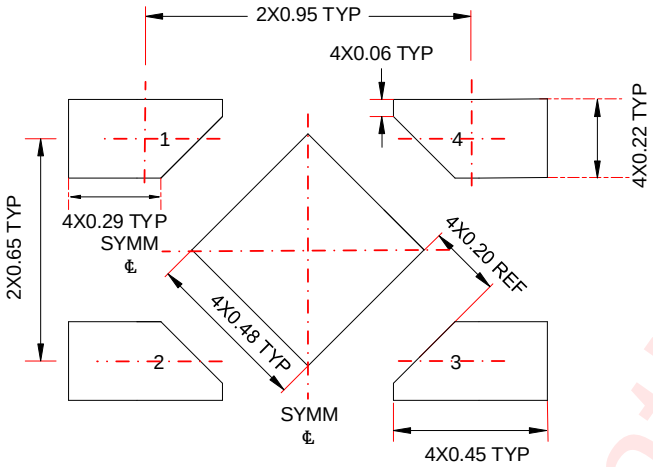
Bottom View

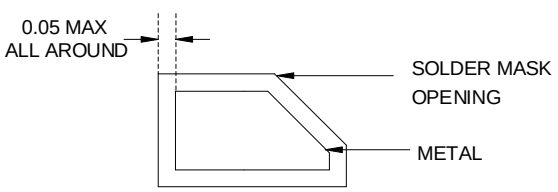


Side View

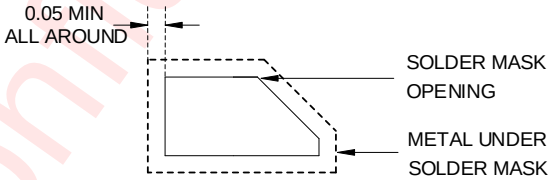
Unit:mm

Land Pattern Data





NON SOLDER MASK DEFINED



SOLDER MASK DEFINED

UNIT : mm

Revision History

Version	Date	Change Record
V1.0	Aug.2022	Officially released
V1.1	Sep.2022	Update the Absolute Maximum Ratings, correct the maximum voltage range. (P4)
V1.2	Jan.2023	Add the note of the exposed pad. (P3)
V1.3	Jun.2023	Update the current in fast scan mode (P1 and P5). Add the I_{OH} and I_{OL} in the table of Electrical Characteristics (P5).

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