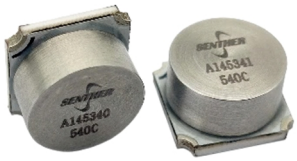
Embedded Piezoelectric Accelerometer (EPA)



Patent pending

Features

- High resolution
- Annular shear structure
- Excellent long-term stability
- Wide frequency response
  0.5Hz to 28kHz (±3dB)
- Ultra-Low noise: 4μg/√Hz @1kHz
- Linearity ±1% up to 2000g range
- Low power consumption: <1mA
- −40°C to +125°C temperature range
- Sensitive orientation vertical
  (To mounting surface)
- Wide acceleration range: 50~2000g
- Small package 10 mm × 10 mm × 5.5 mm
- Reflow solderable

Application

- Condition monitoring
- Shock/impact data logger
- Bear/Gearbox embedded
- Machine vibration monitoring
- General test and measurement

Functional Block Diagram

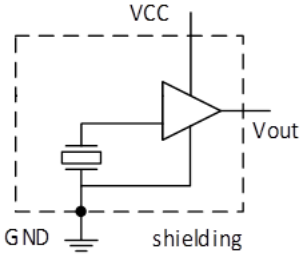


Figure 1

Description

The 540C is a miniature, high performance vibration sensor especially designed for embedded condition monitoring. With the lasted piezo-electrical (PE) technology incorporated in the sensor, 540C vibration sensors provide superior signal-to-noise ratio and frequency response than the other technology devices. The annular shear PE structure delivers the super stable output, ultra-low noise density over an extended frequency range, which is optimized for industrial machine monitoring. 540C have typical noise densities of 4 μg/√Hz with 0.9mA current consumption. All series products have stable and repeatable sensitivity output which is immune to external shocks up to 5000g. 540C offer diversity mounting configuration for embedded applications. With wide range of voltage excitation from 3 to 5.5 Vdc, 540C also enable wireless sensing and plug-in product design. 540C are available in a 10mm × 10mm × 5.5mm SMD package, and are rated for operation over −40°C to +125°C temperature range.

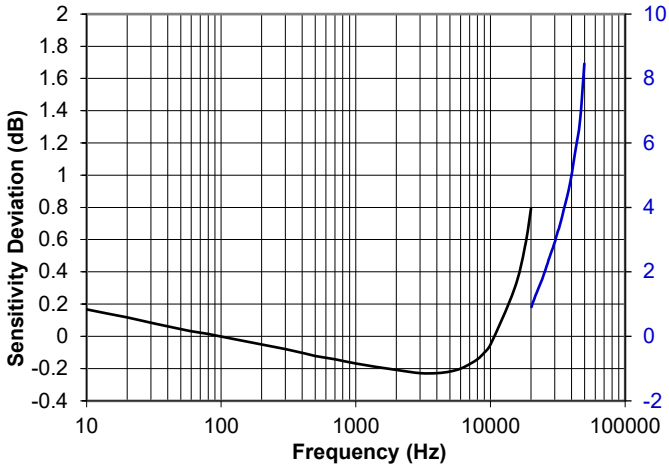


Figure 2 Typical Frequency Response

Table 1.

540 serials Accelerometer	
540C	Easy configuration, noise density 4μg/√Hz
540B	low power, supply current 60μA
540A	low noise, noise density 4μg/√Hz

Specifications

All values are typical at +24°C (+75°F), 5Vdc and 100 Hz unless otherwise stated.

Table 2.

Measurement Range	±50	±100	±200	±500	±1000	±2000	g
Sensitivity ±10%	40	20	10	4	2	1	mV/g
Frequency Range, ±10%	1-14000	1-14000	1-14000	1-14000	1-14000	1-14000	Hz
Frequency Range, ±3dB	0.5-28000	0.5-28000	0.5-28000	0.5-28000	0.5-28000	0.5-28000	Hz
Resonant Frequency	>50	>50	>50	>50	>50	>50	kHz
Transverse Sensitivity	<5	<5	<5	<5	<5	<5	%
Temperature Response -40 to +125°C	±10	±10	±10	±10	±10	±10	%
Broadband Resolution	0.0008	0.0009	0.001	0.002	0.003	0.004	Equiv. g RMS
Non-Linearity	±1	±1	±1	±1	±1	±1	%
Warm-up Time (Within 5% of final bias)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	Second
Shock Limit	±5000	±5000	±5000	±5000	±5000	±5000	g pk

Environmental

Operation Temperature	-40-125	°C

Electrical

Supply Voltage	3-5.5	Vdc
Bias Voltage (ZMO)	VCC/2	Vdc
Full Scale Output Voltage	±2.0	V
Output Impedance	<100	Ω
Total Supply Current	<1	mA
Insulation Resistance (@50Vdc)	>100	MΩ
Electrical Connection	SMD	

Physical

Weight	1.9	gm
Sensing Element	Ceramic/Shear	
Housing Material	Stainless Steel	
Sealing	Epoxy Sealed	

Remark:

All sensors would be serialized and calibrated. Look up the calibration data by S/N from our web site. Or Senther can print the data for >500units demand. Please contact your local sales representative for support.

Absolute Maximum Ratings

Table 3.

Parameter	Rating
Acceleration (Any Axials)	5,000 *g*
Drop Test (Concrete Surface)	2 m
V_{CC}	−0.3 V to +5.5 V
Output Short-Circuit Duration (Any Pin to Common)	<3S
Temperature Range (Storage and operation)	−40°C to +125°C

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

Thermal Resistance

Thermal performance is directly linked to printed circuit board (PCB) design and operating environment. Careful attention to PCB thermal design is required. θ_{JA} is the natural convection junction to ambient thermal resistance measured in a one cubic foot sealed enclosure. θ_{JC} is the junction to case thermal resistance.

Table 4. Package Characteristics

Package Type	θ_{JC}	θ_{JA}	Device Weight
SMD	25°C/W	15°C/W	1.4g

ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

Recommended Soldering Profile

Figure 3 and **Table 5** provide details about the recommended soldering profile.

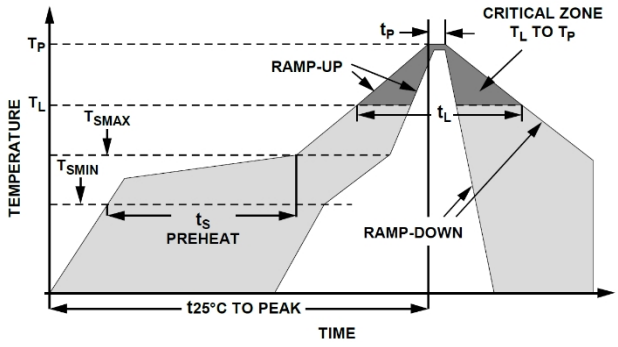


Figure 3 Recommended Soldering Profile

Table 5. Recommended Soldering Profile

Profile Feature	Condition	
	Sn63/Pb37	Pb-Free
Average Ramp Rate (T_L to T_P)	3°C/sec maximum	3°C/sec maximum
Preheat		
Minimum Temperature (T_{SMIN})	100°C	150°C
Maximum Temperature (T_{SMAX})	150°C	200°C
Time, T_{SMIN} to T_{SMAX} (t_S)	60 sec to 120 sec	60 sec to 180 sec
T_{SMAX} to T_L		
Ramp-Up Rate	3°C/sec maximum	3°C/sec maximum
Time Maintained Above		
Liquidous (T_L)		
Liquidous Temperature (T_L)	183°C	217°C
Time (t_L)	60 sec to 150 sec	60 sec to 150 sec
Peak Temperature (T_P)	240°C + 0°C/−5°C	260°C + 0°C/−5°C
Time Within 5°C of Actual Peak Temperature (t_P)	10 sec to 30 sec	20 sec to 40 sec
Ramp-Down Rate	6°C/sec maximum	6°C/sec maximum
Time 25°C to Peak Temperature (t25°C)	6 min maximum	8 min maximum

Pin Configuration and Function Descriptions

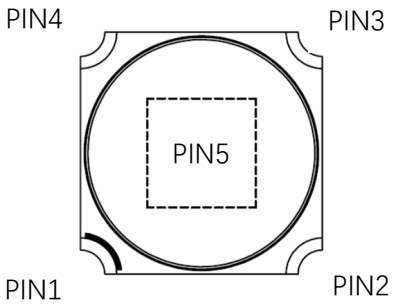


Figure 4 Pin Configuration

Table 6. Pin Function Descriptions

Pin No.	Mnemonic	Description
1	GND	Power Ground
2	Vout	Voltage Output
3	VCC	3V to 5.5V Supply Voltage
4	N/C	No Connection
5	GND	Bottom Pad for solder reinforce
/	Cover	Cover be connected to Power Ground

Typical Noise and Temperature Characteristics

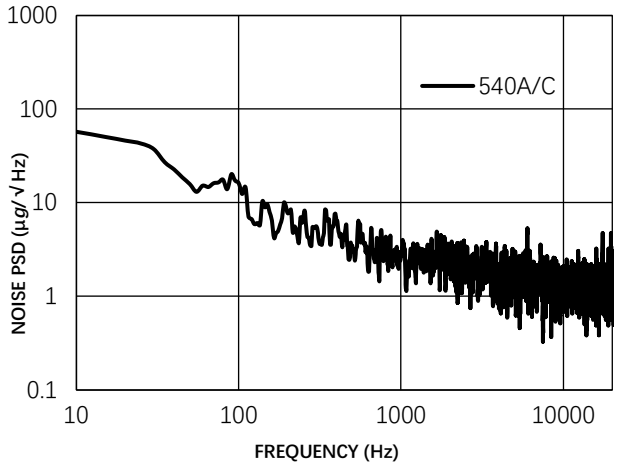


Figure 5 Noise Power Spectral Density (Noise PSD)

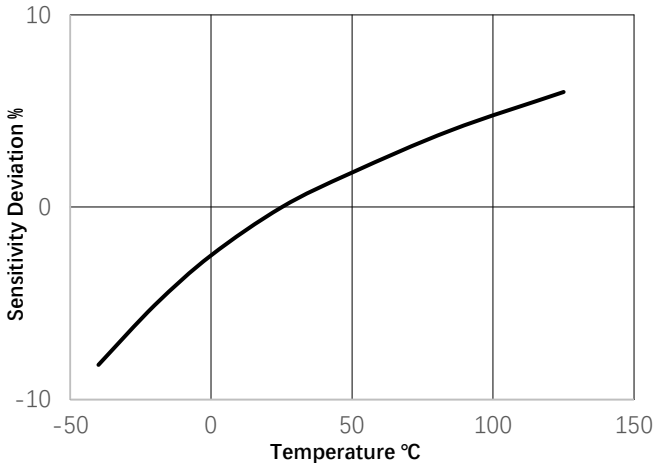


Figure 6 Typical Sensitivity temperature change

Application Note:

Power supply

The 540C can be powered from 3 to 5.5Vdc. For the most applications, a single 0.1~1 μF capacitor adequately decouples the accelerometer from noise on the power supply. Since the sensor's sensitivity was fixed, higher supply voltage will provide a wider output swing, then workable for higher acceleration range.

Application circuit

Figure 7 is the typical application circuit.

Bias output=Vcc /2. To get the widest output signal swing.

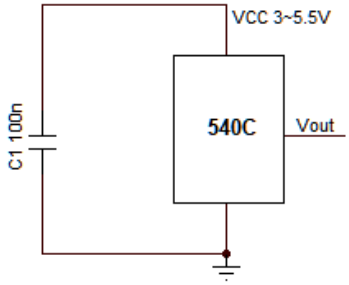


Figure 7 Typical circuit1

Mounting Note:

The 540C can be populated on PCB directly by SMT procedure. The central solder between sensor and PCB will help to achieve better performance on frequency response. See **figure 8.**

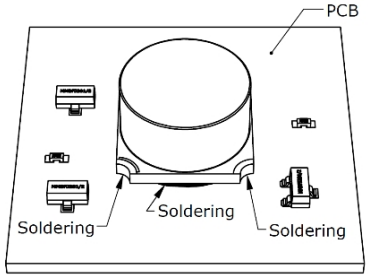


Figure 8

To achieve the best frequency response, attach the sensor on mounting surface by the lid is proposed. Solder light wire from sensor to the circuit and keep it short or anchor wire close to sensor will decrease micro resonance. When mounting sensor on lid upside-down, the phase response will be inverted. See **figure 9.**

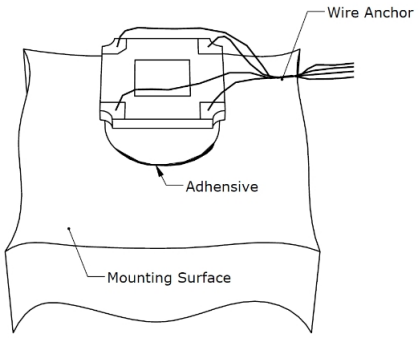


Figure 9

In case to attach sensor on a conductive surface, an insulating washer is proposed to be added between sensor and mounting surface, which avoid the grounding loop and keep signal clean. See **figure 10.**

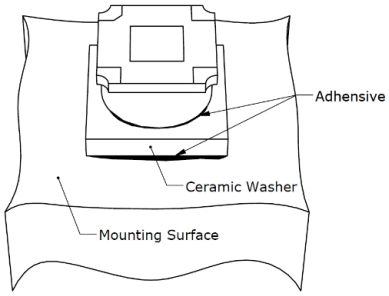


Figure 10

In case to embed sensor on an equipment, machine a mounting pit on the shell while avoid damaging the structural strength. Adhesive sensor with hard epoxy and potting for antifouling. See **figure 11.**

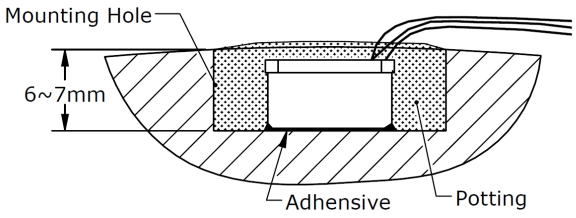


Figure 11

In case to encapsulate the sensor into a system, the frequency response is mainly decided by the method of mounting. Make sure robust mounting for high frequency application. See **figure 12** for frequency response by different mounting.

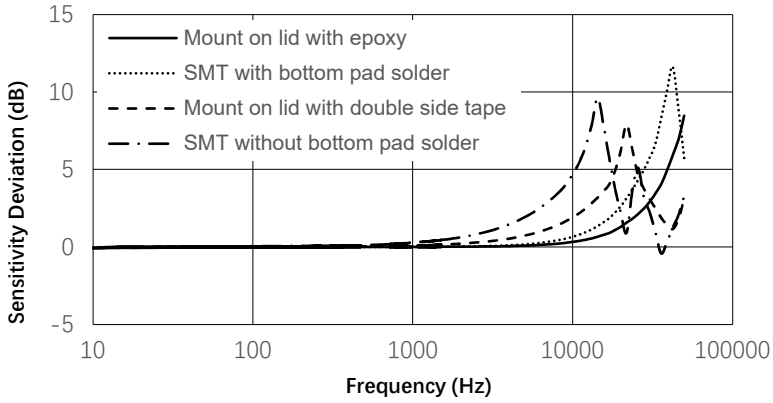


Figure 12

Outline Dimensions

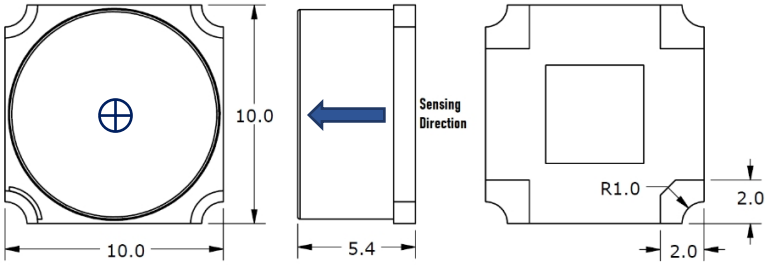


Figure 13 Outline Dimensions shown in millimeters

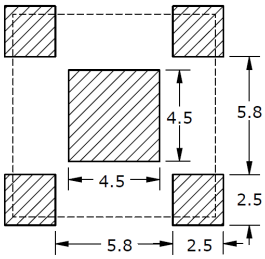


Figure 14 Recommended Printed Wiring Board Land Pattern

Ordering Guide

540	**C**	**-**	**500**
Model	Optional output feature	-	Range
540	C=Integrated convertor	-	50=50g 100=100g 200=200g 500=500g 1000=1000g 2000=2000g