

Model AC64

High-Resolution Accelerometer

A cost effective, sensitive, low-noise, piezo-ceramic accelerometer for low-power small-signal applications

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General Description

Applications

- Small-signal vibration measurements
- Integrity of structures, like pipelines
- Instrumentation with an embedded vibration sensor
- Machine health
- Seismic activity

Features

- Sensitivity of 3 V/g, noise spectral density of $< 0.1 \mu\text{g}/\sqrt{\text{Hz}}$ at 100 Hz
- One-axis acceleration measurement
- Operation at $V_{\text{IN}} = 6.3\text{--}36 \text{ V}$, @2.5 mA, no constant current diode needed
- Simple 3-wire interface with a DC-coupled low-impedance output and bias voltage of half V_{IN}
- Sealed stainless steel 316 housing, IP67
- Flexible design customization with low minimum quantity requirements

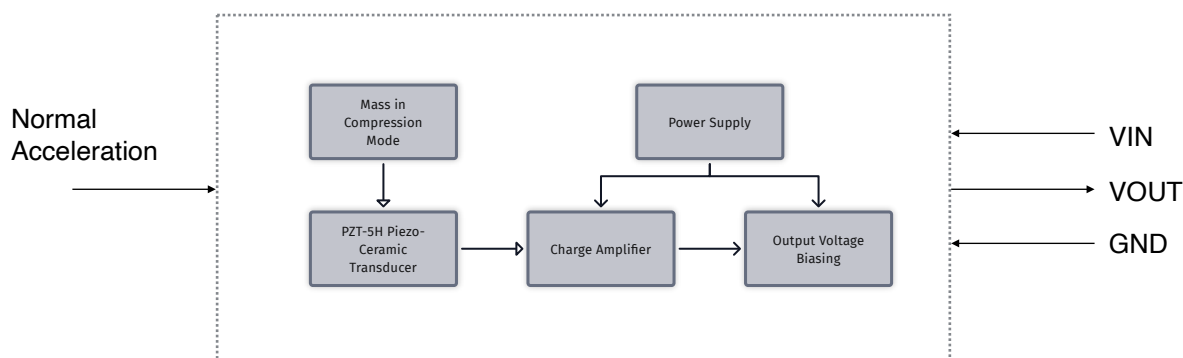


Overview

Model AC64 is a high-resolution accelerometer, with sensitivity of 3 V/g and a noise spectral density of less than $0.1 \mu\text{g}/\sqrt{\text{Hz}}$ at 100 Hz. It is sealed in a compact stainless steel 316 housing with a rating of IP67. Acceleration is measured along one axis normal to the base. The unit is mounted to a planar measurement surface using either a set screw (1/4-28 UNF) or via a screw-in black, nickel-plated steel and neodymium magnet base, which is available separately.

A 3-wire electrical interface accepts a low-power voltage input from 6.3 to 36 V @2.5 mA. A piezo-ceramic transducer stack, made of PZT-5H material sensing in compression mode, is connected to a charge amplifier. A low-impedance DC-coupled output voltage signal is biased at half the input voltage, V_{IN} . The internal electronic circuitry has high levels of power supply noise rejection. The electrically grounded housing shields the unit from electromagnetic interference.

Block Diagram



Functional Description

Principle of Operation

PZT-5H is a lead zirconate titanate ceramic material that generates an electric charge when subjected to a mechanical stress or strain. Performance characteristics of PZT-5H, like all piezo materials, specifically involve trade-offs.

Advantages of PZT-5H:

- High sensitivity over a wide range of frequencies
- Fast response and settling times to changes in input acceleration
- Mechanically strong and able to withstand significant shocks without damage
- Can operate at high temperature without loss of piezoelectric effect

Limitations of PZT-5H:

- The output charge is non-linear; it exponentially grows and drops when the temperature rises above and drops below 25°C, respectively
- The transducer is primarily sensitive to the acceleration vector normal to the face of the disk, but it will respond to other vibration vectors, with significant transverse sensitivity

Like all piezo ceramics, the stack's two electrical terminals have a very high impedance and so are very sensitive to electromagnetic interference (EMI) and high frequency noise. High impedance points are protected from EMI by the steel housing, which acts as a Faraday cage, and by a high-quality, FR4, ENIG-plated internal PCB. The PCB design shields and guards planes and traces that are susceptible to interference and/or noise.

Model AC64 Design

Model AC64 has a piezo-ceramic transducer composed of a stack of PZT-5H disks, electrically connected via silver-coated electrodes and brass contacts. The disks act as a bank of parallel capacitors that develop a charge proportional to an incident acceleration. The incident force is defined by an internal mass that compresses the stack. Sensitivity is proportional to the mass, but a higher mass would exhibit more inertia and reduce both the high frequency response and the resonant frequency of the sensing structure.

An instrumentation charge amplifier is powered by an input power voltage, VIN. The charge amplifier converts the high-impedance charge signal to a low-impedance voltage signal, VOUT, which is biased at approximately half VIN ($\pm 1\%$). The low frequency limit is 0 Hz, that is, VOUT is DC coupled. The nominal high frequency limit is set by an internal low-pass electronic filter, the mechanical response of the transducer, and the rigidity of mounting to a measurement surface. Generally, it's advantageous for the external application circuitry to shape the frequency response by electronic filtering.

Conventionally, PZT-based accelerometers are powered from a supply voltage of 12 - 18 V and require a constant current diode to drive internal JFET circuitry. Their output voltage signal appears as a variation on the supply voltage and is externally decoupled via a DC-blocking capacitor and an external reference voltage. Model AC64 can be used in this application.

Electrical Interface

Model AC64 has an electrical interface comprising three 28-AWG stranded wires.

Signal	Position	Color	Description
VIN	1	Blue	• Length is 125 mm (+5 / -0 mm) • PVC jacket • Termination is either snub cut or Hirose DF3 gold-contact crimp sockets, part no. DF3-2428SCFC
VOUT	2	Green	
GND	3	Brown	

Customization

We can flexibly design, document and produce variations of Model AC64 with low minimum quantity requirements:

- Dynamic performance: sensitivity and bandwidth
- Wire: length, color and type
- PZT material: 5A, 5H or 5J types (lead times apply)
- Customer-designed labels are available in two or multiple colors

Please do not hesitate to [contact us to discuss customization](#) of Model AC64.

Company Information

64seconds designs, manufactures and sells vibration sensing equipment, typically for pipeline leak detection. Model AC64 is used in our applications, which require high sensitivity, high resolution (very low intrinsic mechanical and electronic noise) and rugged, shock-proof performance. We manufacture, service and support all products from our factory in Framingham, Massachusetts. We maintain current ISO 9001-2015 and Apple MFi developer and manufacturing certifications.

Accessories

Magnet Base

A matching magnet base is available for Model AC64:

- Black nickel-plated martensitic steel
- Neodymium magnet, NdFeB, Grade N52, nickel plated, pull force of 70 lbf (flat steel-to-steel surfaces)
- Diameter: 34.0 mm (1.34 inches, matches Model AC64)
- Height: 12.43 mm (0.49 inches)
- Threaded for 1/4-28 UNF (a stainless steel set screw of length 3/8 inches is included)



Specifications

Dynamic Performance

Sensitivity	3 V/g	Other sensitivity values are available †
Sensitivity Range	±20%	Reduced sensitivity range and/or calibration measurement are custom options †
Noise	0.1 $\mu\text{g}/\sqrt{\text{Hz}}$ at 100 Hz	Total noise is application-dependent, depending on input voltage noise, parasitic vibrations from mounting, mechanical PZT noise and intrinsic electronic noise
Low Frequency Limit	0 Hz	The output signal voltage is DC coupled
Nominal High Frequency 6 dB Limit	11,500 Hz	High frequency response, roll-off and amplitude vs frequency pattern depend primarily on the measurement structure and rigidity of mounting
Nominal Resonant Frequency	7,500 Hz	Resonant frequency in any particular application depends significantly on mounting method
Acceleration Range	0 - 15 g	Upper limit proportional to input voltage, VIN
Operating Temperature Range	-20 to 80°C	Sensitivity rises exponentially above 25°C to +75% at 80°C and drops to -25% at -20°C; significant improvement in sensitivity vs temperature is available with PZT-5A material †
Shock Limit	2,000 g	Shock limit increases when the unit is unpowered

Electrical Characteristics

Input Voltage, VIN	6.3 to 36 V	Dynamic performance is maintained within these limits although the device will function at an input voltage above 4.5 V
Input Current Draw	2.5 mA	Current reduces slightly with higher input voltage
Output Bias Voltage	VIN / 2	Accuracy is ±1%
Output Impedance	10 Ω	May vary slightly with other sensitivity options †
Input Voltage Noise Rejection Ratio	110 dB	Range: 110 to 135 dB
Housing Potential	0 V	Steel housing is internally connected to GND of the electrical interface
Settling time	1 second	Time for output DC bias to reach 90% of VIN / 2

Mechanical Characteristics

Mounting Threaded Hole	1/4-28 UNF	Hole is tapped: 1/4-28 UNF x 5 mm
Piezo-Ceramic Material	PZT-5H	PZT material is machined to our design specification, with silver-coated / brass electrodes
Sealing / Protection	IP67	Steel housing, wires are potted with epoxy
Housing Material	316 stainless steel	
Weight	180 grams	Approximately 6.35 ounces
Diameter	34.0 mm	Approximately 1.34 inches
Height	48.02 mm	Approximately 1.89 inches, steel parts, not including rubber strain relief, wires or magnet base
Electrical Wires	AWG 24	Length is 120 mm (+10 / -0 mm), stranded wires, PVC jacket

† Please contact 64seconds for customization options.

Magnet Base

Mounting Threaded Hole	1/4-28 UNF	Hole is tapped: 1/4-28 UNF x 5 mm
Base Material	Black nickel-plated martensitic steel	Plain (magnetized) carbon steel coated for corrosion protection
Magnet Material	Neodymium NdFeB N52 grade	Nickel-plated, 70 lbf pull force between two flat steel surfaces
Weight	95 grams	Approximately 3.35 ounces
Diameter	34.0 mm	Approximately 1.34 inches
Height	12.43 mm	Approximately 0.49 inches

Drawings

PDF drawings of the accelerometer and magnet base are available. Please submit a request at www.sixtyfourseconds.com or send an email to support@sixtyfourseconds.com.

Ordering Information

Part numbers for Model AC64 accelerometer with standard options and the matching magnet base are shown below.

Model AC64 Part No.	Sensitivity	Input Voltage	Wire Termination
AC64-02	3 V/g	6 - 18 V	Hirose DF3 gold-contact crimp sockets, part no. DF3-2428SCFC †

† A 3-position DF3 receptacle, part no. DF3-3S-2C, is fitted to, and ships with, Model AC64. It connects to a variety of Hirose DF3 PCB-mounted pin headers, part nos. DF3-3P-*.

Magnet Base Part No.	Description
AC64-MB	Black nickel-plated martensitic steel / neodymium N52 grade magnet base

Revision History

Version	Date	Description
1.0	April 15, 2023	Initial product release.
1.1	July 31, 2023	Minor corrections and clarifications.
1.2	August 12, 2023	Changed wiring colors, lengths and tolerances, specified stainless steel 316 and tapped depths.