Monad Electronics

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Introduction

Winner of National Award for year 2009-2010 in R&D

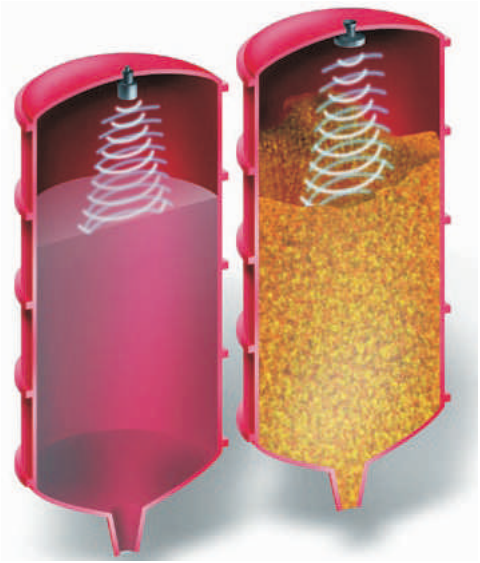
Monad Electronics is An ISO 9001:2015 certified company, which has been involved for over 20 year in the business of designing, manufacturing and export of Electronic Industrial products, Testing equipments , sensors and related indicating and controlling devices and allied products related to Data logging & Acquisition.

Monad is specialized in providing high end and high accuracy customized Force Transducers, Multi-Axial Force Transducers and Torque Sensors. Monad is an expert in providing import substitutes of high end Load Cells, Safe Load Indicators, etc

We are supplying to leading industries and government institutions and are also exporting our products to USA, Germany, Belgium, Turkey, Australia, U.A.E., Singapore, Spain, Brazil, New Zealand, Philippines, UK, Croatia and to the African countries.

Monad have quite a wide range in Acceleration sensors

* Strain gauge type
* Piezo-resistive type
* Piezo-electric type

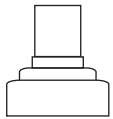


Our range starts from general purpose to most sophisticates high end sensor for Testing and development purpose

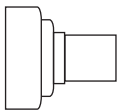
Common Types of Accelerometers Sensor

Category	Key Technologies
•Capacitive	-Metal beam or micro-machined feature produces capacitance; change in capacitance related to acceleration
•Piezoelectric	-Piezoelectric crystal mounted to mass –voltage output converted to acceleration
•Piezo resistive	-Beam or micro-machined feature whose resistance changes with acceleration
•Hall Effect	-Motion converted to electrical signal by sensing of changing magnetic fields
•Magneto resistive	-Material resistivity changes in presence of magnetic field
•Heat Transfer	-Location of heated mass tracked during acceleration by sensing temperature

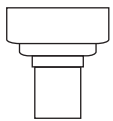
Acceleration Sensor Terminology



•+1g:Output of the sensor with the base connector pointed up



•0g:Output of the sensor with the base connector horizontal



•-1g:Output of the sensor with the base connector pointed down

•Linearity: The maximum deviation of the calibration curve from a straight line.

$$\textit{Linearity} = V_{out,}0g - \frac{1}{2}\left(V_{out,}+1g + V_{out,}-1g\right)$$

Acceleration Sensor Terminology

Sensitivity: A measure of how much the output of a sensor changes as the input acceleration changes. Measured in Volts/g

$$Sensitivity = \frac{\Delta V_{out}}{\Delta g} = \frac{V_{out,+1g} - V_{out,-1g}}{2g}$$

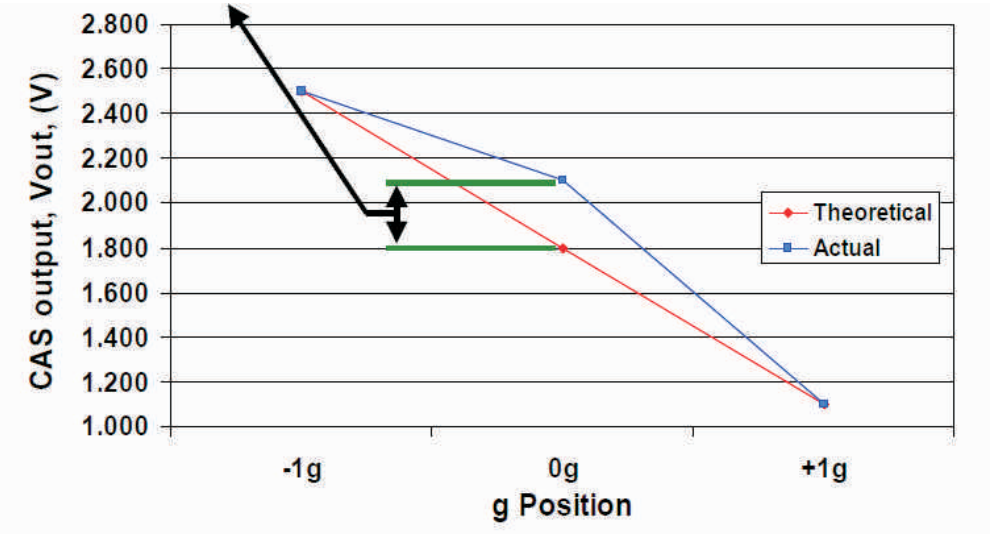
•Vcc: The voltage supplied to the input of the sensor

•%Vcc: Readings are often represented as a % of the supply voltage. This allows for correction due to supply voltage variances between readings.

Sensitivity & Linearity

$$\textit{Sensitivity} = \frac{\Delta V_{out}}{\Delta g} = \frac{V_{out,+1g} - V_{out,-1g}}{2g} = \frac{1.1V - 2.5V}{2g} = -0.7\frac{V}{g}$$

$$\textit{Linearity} = V_{out,0g} - \frac{1}{2}\left(V_{out,+1g} + V_{out,-1g}\right) = 2.1 - \frac{1}{2}\left(1.1 + 2.5\right) = 0.3 \text{ Volts}$$



Acceleration Sensor Terminology

- Ratiometric: The output of the sensor changes with a change in the input voltage.
- Example

  At Vcc = 5.000V, Vout at 0g = 1.800V
  In terms of %Vcc, this is 1.800Vout/5.000Vcc *100% = 36%Vcc

  Now suppose the input voltage changes: Vcc = 5.010V.
  At 0g, the ratiometric device output is still 36% Vcc.

  In terms of the output voltage, 36%Vcc * 5.010Vcc = 1.804Vout

- So a 0.010V change in Vcc will cause a 0.004V error in the 0g output if you do note valuate the output as %Vcc

Important Handling/Installation Requirements for Acceleration Sensor

- **Rigid Mounting**
  - –Bees Wax
  - –Double Sided tape
  - –Bolt(s)

- **No Loose Wires**
  - –Loose wires can create false signals
  - –Secure wires firmly to mounting body

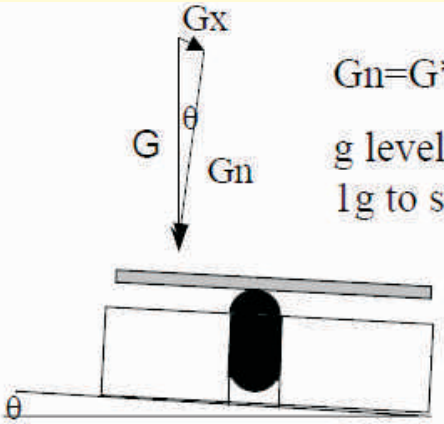
- **Weight of Sensor**
  - –Should be approximately an order of magnitude less than object being measured

- **Don't drop the sensor!**
  - –Extreme jarring accelerations can cause permanent errors in device output

Effect of Tilt

- DC response sensors measure tilt. Mounting errors are therefore significant.
- a 1° tilt in the 0g position creates an output error equivalent to a 10° tilt in the +1g or -1g positions.
- 0g is the most sensitive to mounting errors.

Why is device sensitive to tilt in the 0g orientation?



Gn=G*Cos(θ)

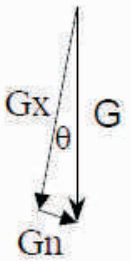
g level going from 1g to some % of 1g

+1g Position

(-1g Position uses same equation)

θ = 1° ⟶

Gn = 0.9998*G



Gn = G*Sin(θ)

g level going from 0g to some value

0g Orientation

θ = 1° ⟶

Gn = 1.7×10^{-2}*G

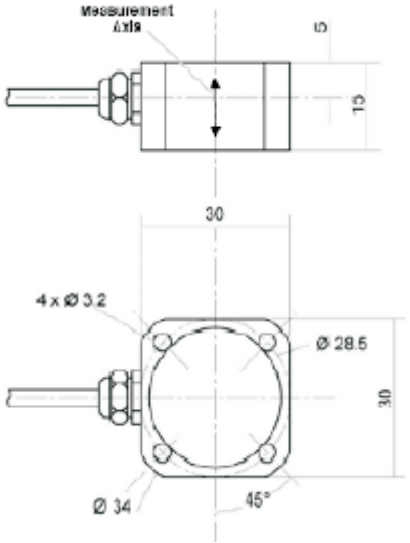
Conclusion: at 0g orientation, change in 1 tilt causes 57x bigger change in sensor output versus 1g or +1g orientation 1° -

Strain Gauge Accelerometers

The ***MAS 501*** is a general purpose accelerometer that is especially useful for measuring very low Frequencies. Compared with oil damped Accelerometers, the air-damped ***MAS 501*** is less Sensitive to temperature variations, thus Providing more accurate measurements.
The sensing element is fitted with a fully Temperature-compensated Wheatstone bridge comprised of high stability, micro-machined silicon strain gauges. Packaged in a rugged Aluminum alloy case, the ***MAS 501*** Accelerometers are designed to be easy to mount.

Full Scale Ranges ± 2 g to ± 500 g
DC Response
Solid State Reliability
High Over-Range Capability
Integrated Over-Range Stops
Built-In Critical Air Damping (~ 0.7)
Lightweight Aluminum Alloy Construction
Operating Temperature Range -20° to +80°C
High Level Output 2m V/V, excitation of 10v dc.
Impendance : 350 ohm, 4 wire circuit.

Strain Gauge Accelerometers



Dimension Drawing

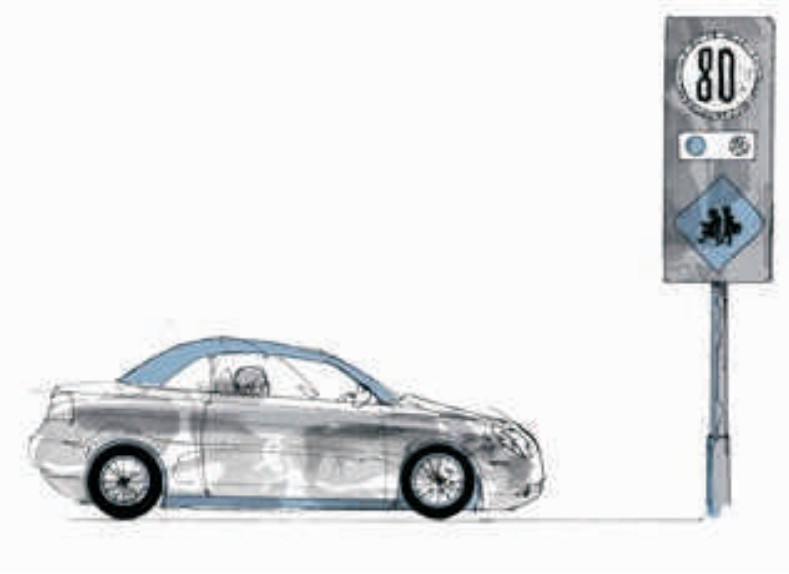
Strain Gauge Accelerometers

Technical Specifications

Linearity	:	± 2% FS
Transverse Sensitivity	:	≥3% FS standard (optional ±1%)
Operating Temperature Range (OTR)	:	-20 to +80°C
Compensated Temperature Range (CTR)	:	0 to 60°C
Zero Shift in OTR	:	≤2% FS / 60°C
Sensitivity Shift in OTR	:	≤2% Of Reading / 60°C
Weight	:	≤25 grams
Construction Material	:	Aluminum

Full Scale Range (g)	±2	±5	±10	±20	±50	±100	±200	±500
Over-Range	400	400	400	400	1000	2000	2000	2000
FS Output(mv) @ 10VDC excitation	±20	±40	±40	±40	±40	±40	±40	±40

Piezoresistive Accelerometer



Piezoresistive Accelerometer

The **Monad`s** Piezo-resistive Accelerometer consists of a Piezo-resistive MEMS sensor, a semiconductor temperature sensor, and all of the necessary front-end signal conditioning which includes data acquisition, data processing and the IntelliBus-compliant digital bus. It is packaged in a small, low profile metal case with two pig-tail connectors which are used for daisy chaining the IntelliBus-based network. Its low-noise front end signal conditioning . and programmable gain allows for measurement of a wide range of vibration levels. Temperature readings from its built in sensor may be used for on- or off board temperature correction.

There are two software selectable 3-pole anti-aliasing filters. One with a cut-off frequency at 2 kHz and the other at 360 Hz. The 16-bit A/D converter samples data at a programmable rate up to 250 ksps. A powerful processor performs digital signal processing algorithms such as digital filter, etc.

The Transducer Electronic Data Sheet stored in non-volatile memory provides the information needed to set up the highly versatile signal conditioner and data acquisition parameters.

Piezoresistive Accelerometer

Features:-

- Digital Output
- Programmable Full Scale: ± 12.5 g to ± 1000 g
- Noise Floor: 12 mg rms
- Freq Response: DC to 5 kHz
- Programmable Digital Filter: 64 Order FIR Type

* Filter Corners: 10Hz to 12 kHz

- A/D Converter: 16-bit, Programmable Sample Rate up to 250 Ksps

Piezoresistive Accelerometer

SPECIFICATIONS:-

The following performance specifications are typical values, referenced at +24°C and 100 Hz, unless otherwise noted.

PERFORMANCE	UNITS	
DYNAMIC CHARACTERISTICS		
Sensitivity	mV/g	2 to 40
Frequency Range(±5%)	kHz	0 to 1 kHz
Frequency Range(±10%)	kHz	0 to 2.5 kHz
Resonant Frequency	kHz	≥ 2 to 25
Phase Response(100Hz)	°	≤ 5 to 15
Non Linearity	%	≤ 0.1 to 1
Full Scale Input Range	g pk	± 1 to ±1000
Accuracy	%	± 0.2 Electronic signal conditioner and Data Acquisition ±1.5 Sensor Calibration Uncertainty at 100 Hz
Noise	%	0.2 of full scale max
Shock	%	1000 to 2500
Vibration	g rms	2000 (20-2000 Hz random)
Thermal Sensitivity shift	%/°F	0.002

Transverse Sensitivity	%	< 3 typical
Amplitude Linearity	%	< 0.5 to 2
Bandwidth (F-5%)	Hz	1 to 5,000 No filter, accelerometer and signal conditioner only

ANALOG/DIGITAL CONVERSION

Sample Rate	Ksps	Programmable up to 25
Resolution	bps	16
Transducer Bus/ ICP		1/2 Duplex IntelliBus compatible
Data Rate	Mbps	15Mbps. See sample rate Vs Number of IBIMs plot

ELECTRICAL

Excitation Voltage	VDC	3.3 to 30
Current Consumption	mA	≤5 to 100
Output Impendence	ohm	100 to 35
Offset Voltage(0g)	mVDC	≤± 20
Spectral Noise(1 to 100 Hz)	µg/√Hz	≤ 480
Supply Voltage	V	12 to 28 VDC 2.4 Watts Maximum
Warm-Up Time		3 seconds to within 10% of final basis
Case Isolation		Output and signal ground, 100 MΩ minimum @100 Vdc

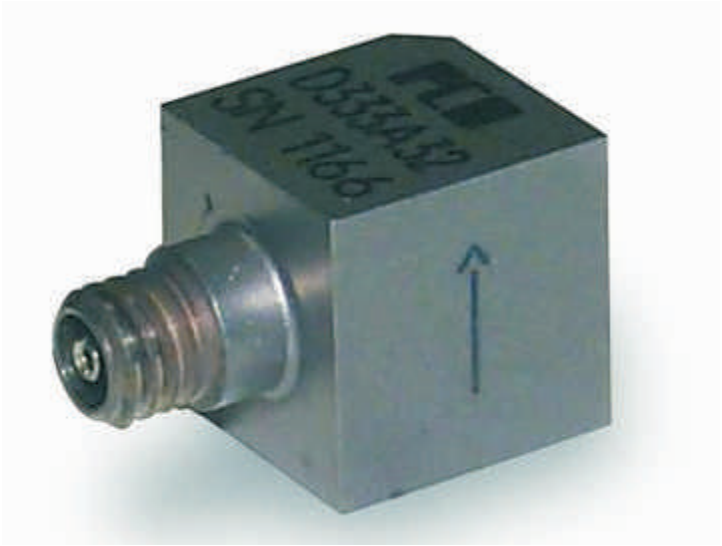
ENVIRONMENTAL

Operating Temperature	°C	-40 to +125
Storage Temperature	°C	-40 to +125

PHYSICAL

Weight	gm	10 to 50
Sealing		Hermetic
Electrical Connector		Circular 4-9 Pin
Electrical Connection Position		Side
Mounting		Through Hole
Housing Material		Aluminum alloy/Titenium/ Stainless steel

Piezoresistive Accelerometer



Piezoelectric Accelerometer

Piezoelectric Accelerometer General purpose

The model MNPZE-55 is a general purpose Piezoelectric accelerometer
The unit features a top connector mounting convenience in limited space.
The accelerometer is a self-generating device that requires no external power source for operation.

The model MNPZE-55 have crystal/Quartz/Ceramic element operating in annular shear mode. This sensor exhibits low base strain sensitivity, high resonance frequency, and excellent output stability over time.
Signal ground is connected to the outer case of the unit and, when used with an isolated mounting stud, the accelerometer case is electrically isolated from ground .
A low-noise coaxial cable is supplied for error-free operation.

Piezoelectric Accelerometer General purpose

Specifications:-

The following specifications are typical values, referenced at 24°C and 100Hz.

DYNAMIC CHARACTERISTICS	UNITS	
CHARGE SENSITIVITY		
TYPICAL	pC/g	12.0
MINIMUM	pC/g	8.5
RESONANCE FREQUENCY	kHz	10 to 200kHz
AMPLITUDE RESPONSE (a)		
± 5%	Hz	1 TO 10000
TRANSVERSE SENSITIVITY	%	≤ 3 (≤ 1on special order)
AMPLITUDE LINEARITY (b) per 250 g, (0 to 1000 g)	%	1

Piezoelectric Accelerometer General purpose

ELECTRICAL CHARACTERISTICS

OUTPUT POLARITY		Acceleration in to the base produces positive output
RESISTANCE	GΩ	≥ 10
GROUNDING		Signal ground common to transducer case

ENVIRONMENTAL CHARACTERISTICS

TEMPERATURE RANGE		-55°C to +177°C
SEALING		Sealed, Hermetic
SINUSOIDAL VIBRATION LIMIT	g pk	1000
SHOCK LIMIT	g pk	2000
BASE STRAIN SENSITIVITY	equiv. g pk/ strain	0.002
THERMAL TRANSIENT SENSITIVITY	equiv. g pk/ °C	0.002
ELECTROMAGNETIC SENSITIVITY	equiv. g rms/gauss	0.0001

Piezoelectric Accelerometer General purpose

PHYSICAL CHARACTERISTICS

DIMENSIONS		As per Drawing
CASE MATERIAL		303 stainless steel/Titanium
CONNECTOR		Coaxial, 10-32 thread
MOUNTING TORQUE	Nm	2

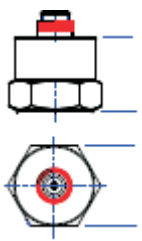
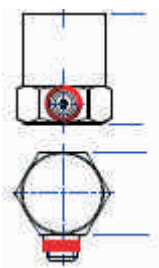
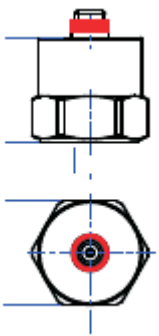
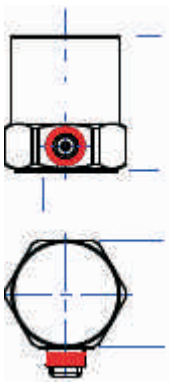
NOTES:-

a. Low - end response of the transducer is a function of its associated electronics.
b. Short duration shock pulses, such as those generated by metal to metal impacts, may excite transducer resonance and cause linearity errors.

Piezoelectric accelerometers High temperature

PARAMETER	UNIT	MPA- 601	MPA- 602	MPA- 603	MPA- 604
Accelerometer Type	-	Piezoelectric	Piezoelectric	Piezoelectric	Piezoelectric
Output	-	charge/voltage	charge/voltage	charge/voltage	charge/voltage
Design	-	Ring Shear	Ring Shear	Ring Shear	Ring Shear
Charge Sensitivity	pC/ms^{-2}	1	1	3.16	3.16
Capacity	pF	400	400	400	400
Transverse sensivity (max.)	%	2	2	2	2
Resonance frequency	kHz	32	32	25	25
(mounted 180g) Max. shock acceleration	kms^{-2}	40	40	20	20
Min leak resistance (at room temp.)	G	10	10	10	10
Magnetic sensitivity	ms^{-2}/T	1,2	1,2	2	2
Temperature transient sensitivity	ms^{-2}/K	0.25	0.25	0.2	0.2
Temperature range	°C	-40 to 250	-40 to 250	-40 to 250	-40 to 250
Material	-	SS/Titanium	SS/Titanium	SS/Titanium	SS/Titanium
Sensing element	-	piezoelectric	piezoelectric	piezoelectric	piezoelectric
Outlet	-	axial	axial	axial	axial

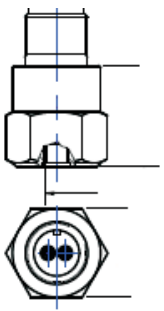
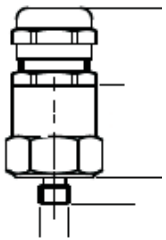
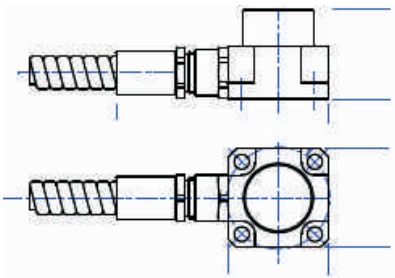
Piezoelectric accelerometers High temperature

PARAMETER	UNIT	MPA- 601	MPA- 602	MPA- 603	MPA- 604
Mounting thread	-	M5	M5	M5	M5
Dimensions (not in scale) 1.Typical parameters obtained in accordance with relevant parts of ISO 5347 & ISO 16063 standards. 2. LFF (low frequency filter)=3Hz 3. From mounting surface at central axis.					

Piezoelectric Industrial accelerometers

PARAMETER	UNIT	MPA- 611	MPA- 612	MPA- 613	MPA- 614
Acceleration Type	-	IEPE	IEPE	IEPE	piezoelectric
Output	-	voltage	voltage	voltage	charge/voltage
Design	-	Ring Shear	Ring Shear	Ring Shear	Ring Shear
Charge Sensitivity	pC/ms^{-2}	-	-	-	3.16
Voltage Sensitivity	mV/g	100	10	100	-
Capacity	pF	-	-	-	400
Transverse sensivity (max.)	%	2	2	2	2
Resonance frequency (mounted 180g)	kHz	22	32	-	-
Max. shock acceleration	kms^{-2}	40	40	20	20
Temperature transient sensitivity	ms^{-2}/K	0.25	0.25	0.2	0.2
Temperature range	°C	-40 to 125	-40 to 125	-25 to 100	-25 to 100
Material	-	SS/Titanium	SS/Titanium	SS/Titanium	SS/Titanium
Sensing element	-	piezoelectric	piezoelectric	piezoelectric	piezoelectric
Outlet	-	axial	axial	Radial	Radial
Mounting thread	-	M6	M8	4XM4	4XM4

Piezoelectric Industrial accelerometers

PARAMETER	UNIT	MPA- 611	MPA- 612	MPA- 613 MPA- 614
Dimensions (not in scale) 1 Piezoelectric sensor with integrated electronics				

Piezoelectric accelerometers

Measuring Range	± 100,000 g pK
Overload Limit (Shock)	± 200,000 g pK
Sensitivity (± 30%)	0.05 mV/g
Frequency range (± 1 dB)	1 to 10,000 Hz
Frequency range (± 3 dB)	0.5 to 35,000 Hz
Resonant Frequency	≥ 200 kHz
Resolution (1 to 10,000Hz)	0.3 g rms
Non-Linearity	± 0.5 %
Transverse Sensitivity	≥ 5%
Temperature Range(Operating)	-50°C to +100°C
Excitation Voltage	12 to 30 VDC
Constant Current Excitation	4mA to 20mA
Output Impedance	≤ 100 ohm
Weight	5 gm
Electrical Connector	Integral cable (3m) with 10-32 Coaxial Jack
Electrical Isolation (Case)	$\geq 10^{9}\Omega$
Mounting Provision	Integral stud with 1/4-28 thread

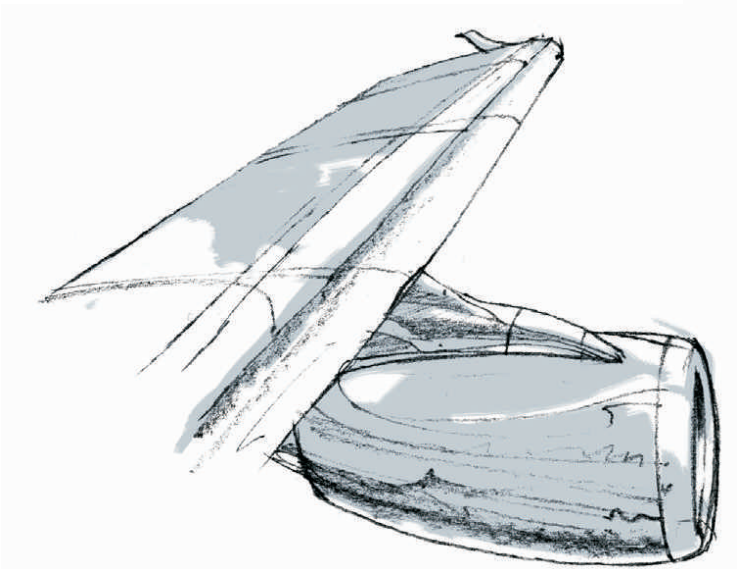
Piezoelectric accelerometers

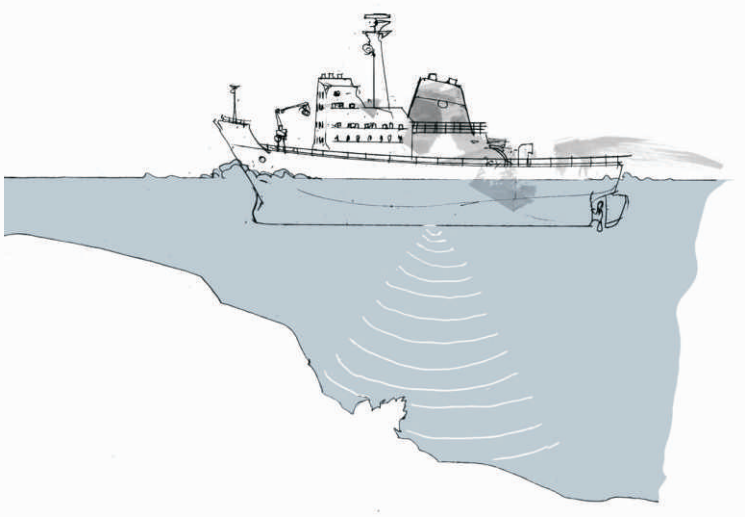
Measuring Range	± 50,000 g pK
Overload Limit (Shock)	± 100,000 g pK
Sensitivity (± 10%)	0.1 mV/g
Frequency Range (±10%)	0.35 to 10,000 Hz
Natural Frequency	≥ 90 kHz
Electrical Noise	maximum 0.7 g
Linearity	± 1% F.S.
Non-Linearity	± 0.5 %
Transverse Sensitivity	Maximum 3%
Temperature Range(Operating)	-50°C to +100°C
Excitation Voltage	12 to 30 VDC
Constant Current Excitation	4mA to 20mA
Sensing Element	Quartz
Output Impedance	≤ 100 ohm
Weight	≤ 6 gm
Electrical Connector	10-32 Micro Coaxial Jack
Electrical Isolation (Case)	Minimum 10 Ω
Mounting Provision	Integral stud with 1/4-28 thread

Piezoelectric accelerometers

Measuring Range	± 5,000 g pK
Overload Limit (Shock)	± 50,000 g pK
Sensitivity (± 10%)	1.0 mV/g
Frequency Range (±10%)	0.35 to 10,000 Hz
Natural Frequency	≥ 90 kHz
Electrical Noise	maximum 0.07 g
Linearity	± 1% F.S.
Transverse Sensitivity	Maximum 3%
Temperature Range(Operating)	-50°C to +100°C
Excitation Voltage	12 to 24 VDC
Constant Current Excitation	4mA to 20mA
Sensing Element	Quartz
Output Impedance	≤ 100 ohm
Weight	≤ 6 gm
Electrical Connector	10-32 Micro Coaxial Jack
Electrical Isolation (Case)	Minimum $10^9\Omega$
Mounting Provision	Integral stud with 1/4-28 thread

Piezoelectric Shock and special purpose accelerometer

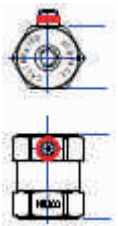
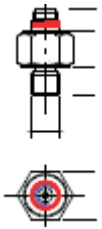
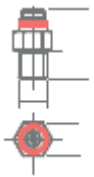
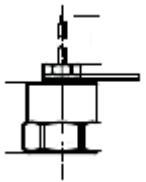




Piezoelectric Industrial accelerometers

PARAMETER	UNIT	MPA-621	MPA-622		MPA-623
Acceleration Type	-	piezoelectric	piezoelectric		piezoelectric
Output	-	charge/voltage	charge/voltage		charge/voltage
Design	-	Ring Shear	Ring Shear		Ring Shear
Charge Sensitivity	pC/ms^{-2}	1	0.1		3.16
Capacity	pF	400	260		400
Transverse sensivity (max.)	%	2	2		-
Resonance frequency (mounted 180g)	kHz	32	60		25
Max. shock acceleration	kms^{-2}	40	100		20
Min leak resistance (at room temp.)	G	10	10		10
Magnetic sensitivity	ms^{-2}/T	1,2	-		2
Temperature transient sensitivity	ms^{-2}/K	0.25	-		0.2
Temperature range	°C	-5 to 45	-40 to 150		-40 to 180
Material	-	SS/Titanium	SS/Titanium		SS/Titanium
Sensing element	-	piezoelectric	piezoelectric		piezoelectric
Outlet	-	Radial	Radial		Radial

Piezoelectric Industrial accelerometers

PARAMETER	UNIT	MPA-621	MPA-622		MPA-623
Mounting thread	-	2XM5	M6		M5
Dimensions (not in scale) 1.Typical parameters obtained in accordance with relevant parts of ISO 5347 & ISO 16063 standards. 2. LFF (low frequency filter)=3Hz				 preliminary	

Piezoelectric Electronic purpose accelerometers

PARAMETER	UNIT	MPA-631	MPA-632	MPA-633	MPA-634
Acceleration Type	-	IEPE	IEPE	IEPE	IEPE
Output	-	voltage	voltage	voltage	voltage
Design	-	Ring Shear	Ring Shear	Ring Shear	Ring Shear
Sensitivity	mV/ms^{-2}	1	1	10	10
Transverse sensivity (max.)	%	2	2	2	2
Resonance frequency (mounted 180g)	kHz	32	32	25	25
Max. shock acceleration	kms^{-2}	40	40	20	20
Temperature transient Sensitivity	ms^2/K	-	-	-	-
Temperature range	°C	-40 to 125	-40 to 125	-40 to 125	-40 to 125
Material	-	SS/Titanium	SS/Titanium	SS/Titanium	SS/Titanium
Sensing element	-	piezoelectric	piezoelectric	piezoelectric	piezoelectric
Outlet	-	axial	Radial	Axial	Radial
Mounting thread	-	M5	M5	M5	M5

Piezoelectric Electronic purpose accelerometers

PARAMETER	UNIT	MPA-631	MPA-632	MPA-633	MPA-634
Dimensions (not in scale) 1.Typical parameters obtained in accordance with relevant parts of ISO 5347 & ISO 16063 standards. 2. LFF (low frequency filter)=3Hz