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Helicopter

Helicopter Sensors

A helicopter is a rotary winged aircraft. Unlike fixed-wing aircraft, the rotor provides lift and forward propulsion to the helicopter. The fuselage of the helicopter is essentially balanced underneath the rotor. The helicopter presents a unique vibration scenario for the rotor. It must not only have proper blade balance to minimize unbalance vibration from the blades, but they also provide the lift to the vehicle. The blades themselves are very complex as they must pitch and tilt as well as providing flight attitude control. Any vibration of the rotor assembly will translate itself into vibration of the helicopter fuselage suspended below. The fuselage will also be affected by the pressure waves produced by the passage of the blades and set up vibration simply due to wave effects.

Wilcoxon has been manufacturing vibration accelerometers for many years that are being used in helicopter Health and Usage Monitoring System (HUMS) applications. Wilcoxon vibration sensors are at work in the CH-53/MH-53. These sensors are used in the rotor track and bearing monitoring. Specially designed sensors are fitted to the swashplate for vibration monitoring at the rotor. Additional sensors are mounted throughout the drive path to the tail rotor for monitoring vibration at critical points. Other vibration sensors are used within the U.S. military in the Vibration Analysis and Diagnostic System (VADS).

Wilcoxon Helicopter Sensors:

Model	Style	Sensitivity	Low Freq	High Freq	Accel / Veloc Range
991D	shear	40 mV/g	0.5 Hz	12 kHz	40 g peak
991V	shear	20 mV/ips	2.5 Hz	7 kHz	400 in/sec peak
992-1	shear	10 mV/g	2.0 Hz @ 1.5dB	20 kHz @ 1.5dB	N/A

Note: Frequency @ $\pm 3dB$.

Model 991D

Internally Amplified, Helicopter Accelerometer



FEATURES:

- Low noise
- Safety wire hole on case
- Compatible with helicopter systems

DYNAMIC

Sensitivity ¹ , $\pm 5\%$, 25°C	40 mV/g
Acceleration Range	40 g peak
Amplitude Nonlinearity	1%
Frequency Response:	
$\pm 5\%$	2.0 - 4,000 Hz
$\pm 10\%$	1.0 - 6,000 Hz
± 3 dB	0.5 - 12,000 Hz
Resonance Frequency, mounted, nominal	20 kHz
Transverse Sensitivity, max.	7% of axial
Temperature Response	-35°C +2%
	+100°C -10%

ELECTRICAL

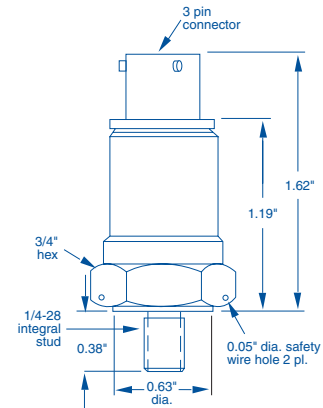
Power Requirement, voltage source	9 VDC
Electrical Noise, equiv. g, nominal:	
Broadband, 2.5 Hz to 25 kHz	75 μ g
Spectral 10 Hz	7.0 μ g/ $\sqrt{\text{Hz}}$
100 Hz	1.3 μ g/ $\sqrt{\text{Hz}}$
1000 Hz	0.9 μ g/ $\sqrt{\text{Hz}}$
Output Impedance, max.	2,400 Ω
Bias Output Voltage	3.5, ± 0.5 VDC
Grounding	base isolated

ENVIRONMENTAL

Temperature Range	-50 to 120°C
Vibration Limit	250 g peak
Shock Limit	1,000 g peak
Electromagnetic Sensitivity, equiv. g.	40 μ g/gauss
Base Strain Sensitivity	0.002 g/ μ strain

PHYSICAL

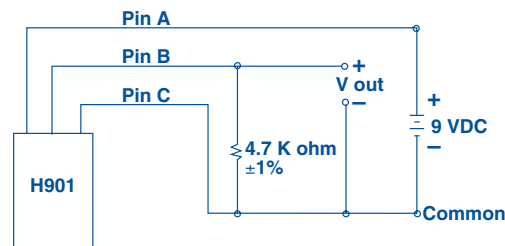
Weight	54 grams
Case Material	stainless steel
Mounting	1/4-28 x 0.38 integral stud
Output Connector	3 pin, MIL-C-26482 style
Pin A	9 VDC
Pin B	Signal out
Pin C	Common
Cabling:	
Mating Connector	Bendix PT06A-8-3S
Cable	2 conductor shielded



NOTES: ¹ As measured across a 4.7 k Ω load (see calibration powering diagram). Sensitivity is 60 mV/g as measured in operating system.



Calibration Powering Diagram

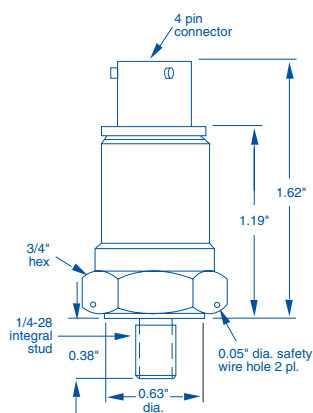


NOTE: This powering method is used for calibration purposes ONLY.



FEATURES:

- Internally integrated to velocity
- Compatible with helicopter monitoring systems
- Mechanical & thermal isolation
- Low noise



Model 991V

Internally Amplified, Velocity Helicopter Sensor

DYNAMIC

Sensitivity, $\pm 10\%$, 25°C	20 mV/in/sec
Velocity Range	400 in/sec peak
Amplitude Nonlinearity	1%
Frequency Response:	
$\pm 10\%$	5.0 - 4,000 Hz
$\pm 3\text{ dB}$	2.5 - 7,000 Hz
Resonance Frequency, mounted, nominal	20 kHz
Transverse Sensitivity, max.	5% of axial
Temperature Response	-50°C $+2\%$ $+120^{\circ}\text{C}$ -10%

ELECTRICAL

Power Requirement:	
current draw	see connections $<0.5\text{ mA}$
Electrical Noise, equiv. in/sec, nominal:	
Broadband 2.5 Hz to 25 kHz	1,500 $\mu\text{in/sec}$
Spectral 10 Hz	100 $\mu\text{in/sec}/\sqrt{\text{Hz}}$
100 Hz	9 $\mu\text{in/sec}/\sqrt{\text{Hz}}$
1000 Hz	3 $\mu\text{in/sec}/\sqrt{\text{Hz}}$
Output Impedance, max.	100 Ω
Grounding	base isolated

ENVIRONMENTAL

Temperature Range	-50 to 120°C
Vibration Limit	250 g peak
Shock Limit	1,000 g peak
Electromagnetic Sensitivity, equiv. in/sec.	300 $\mu\text{in/sec/gauss}$
Base Strain Sensitivity	0.004 in/sec/ μstrain

PHYSICAL

Weight	55 grams
Case Material	stainless steel
Mounting	1/4-28 x 0.38 integral stud
Output Connector	MIL-C-26482
Connections:	
Pin A	-9 VDC
Pin B	common
Pin C	$+9\text{ VDC}$
Pin D	signal
Cabling:	
Mating Connector	Wilcoxon R4V (Bendix SP06A-8-4S)
Recommended Cable	4 conductor shielded

ACCESSORIES AVAILABLE: Mating connector.



Model 992-1

Single Axis Accelerometer with Connector



DYNAMIC

Sensitivity, $\pm 10\%$ @ 100 Hz	10 mV/g
Amplitude Linearity:	
$\pm 1.0\%$	to 100 g
$\pm 1.5\%$	to 300 g
Frequency Range:	
± 1 dB	2 Hz - 15 kHz
± 1.5 dB	2 Hz - 20 kHz
Resonance Frequency, nominal	35 kHz
Transverse Sensitivity, max.	5%
Temperature Response	-35°C +2% +100°C -10%

ELECTRICAL

Power Requirement	2 mA $\pm 5\%$ at reference of 18-30VDC
Electrical Noise:	
Broadband	<0.002 g rms equivalent (2-25,000Hz)
Spectral Noise, nominal:	
2.5 Hz	160 $\mu\text{g}/\sqrt{\text{Hz}}$
10 Hz	40 $\mu\text{g}/\sqrt{\text{Hz}}$
100 Hz	20 $\mu\text{g}/\sqrt{\text{Hz}}$
1000 Hz	8 $\mu\text{g}/\sqrt{\text{Hz}}$
Output Impedance	600 Ω
Bias Output Voltage	8 VDC, ± 1.5 VDC
Phase Shift, absolute	<6° @ 2.5 Hz
Phase Shift, relative	$\pm 2^\circ$ max. @ 2.5 Hz

ENVIRONMENTAL

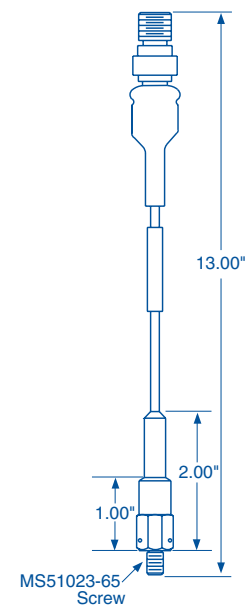
Temperature Range ¹	-35 °C to 100 °C
Vibration Limit	500 g peak
Shock Limit	10,000 g peak
Electromagnetic Sensitivity	<300 $\mu\text{g}/\text{gauss}$
Base Strain Sensitivity	<0.005 g/ μstrain
Acoustic Sensitivity	<0.004 g/100 dB SPL

PHYSICAL

Sensing Design Element	PZT ceramic / shear
Weight	45 grams
Case Material	stainless steel
Electrical Isolation	case isolated
Mounting	1/4 - 28 UNF
Cable	two conductors, with 100% overall shield
Connector Pinout:	
A	signal / power
B	no connection
C	no connection
D	common
Shell	shield
Connector	PC01A-8-4P

FEATURES:

- Low noise
- Safety wire hole on case
- Compatible with helicopter systems



NOTES:

¹ $\pm 15\%$ max change in sensitivity over temperature range.

ACCESSORIES SUPPLIED:

MS 51023-65 mounting screw epoxied in place.



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