# Micromachined Servo Accelerometer

**ENDEVCO MODEL MSA100**

## Model MSA100

- **3 mg Bias Composite Error**
- **Rugged, Low Vibration Rectification**
- **High Resolution**
- **Range Adjustable**
- **Self Test**




Actual size

### DESCRIPTION

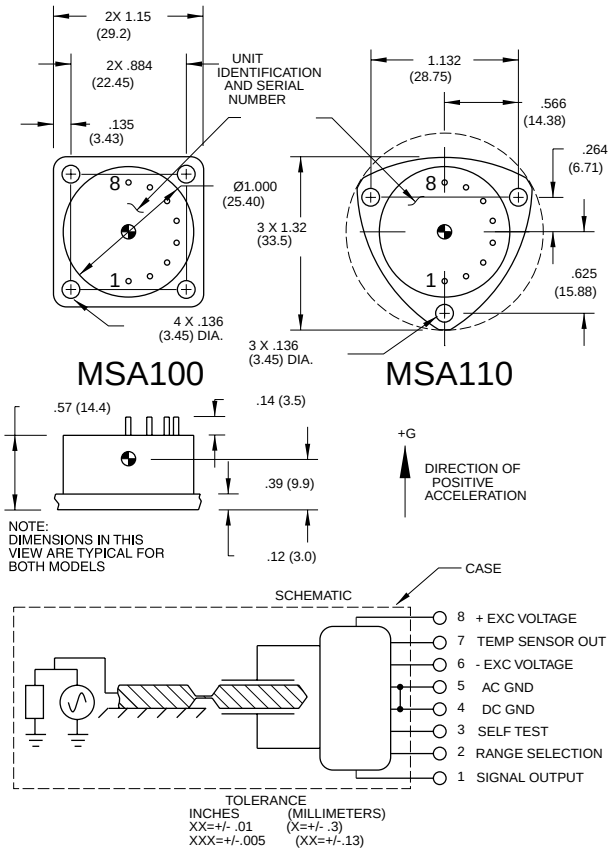
The ENDEVCO® Model MSA100 Servo Accelerometer utilizes a force rebalanced sensor that offers exceptional ruggedness, high resolution, and low vibration rectification. Temperature output and calibration coefficients are standard features allowing for modeling to 3 mg accuracies.

The Model MSA100 is designed for inertial motion studies in vehicles, tactical grade missile IMU's, flight tests, and tilt/angle measurements.

At the heart of the MSA100 is a three-layer micromachined silicon sensor. The middle layer includes the proof mass which, with applied acceleration, is electrostatically rebalanced to a null position between the upper and lower electrodes. This force rebalancing offers a wide bandwidth, minimal non-linearity and excellent performance in high shock and vibration environments. External resistors are used to adjust full scale range from the standard ±50 g's to lower g levels without affecting the accelerometer's electronics. The MSA100 also has self-test capability which moves the proof mass and outputs a proportional signal.

The micromachined silicon sensor and hybrid electronics are hermetically sealed for environmental protection in a stainless steel case with an industry standard mounting pattern. The Servo Accelerometer is also available with a triangular mounting plate as a Model MSA110.

U.S. Patent 5,205,171




### SPECIFICATIONS

PERFORMANCE CHARACTERISTICS: All values are typical at +75°F (+24°C) and ±15 Vdc excitation and with ±50 g range unless otherwise stated. Calibration data, traceable to the National Institute of Standards, (NIST), is supplied. Reference Note [6] for definitions.

| | Units | MSA100/MSA110 |
|---|---|---|
| RANGE[1] | g | ±50, Adjustable to ±0.5 [7] |
| BIAS | g Max | ±1.5 |
| BIAS COMPOSITE ERROR [2] | mg rms Typ | 3 |
| | mg rms Max | 5 |
| BIAS TEMPERATURE SENSITIVITY | µg/ °F Typ | 330 |
| | µg/ °C Typ | 600 |

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## SPECIFICATIONS—continued

**PERFORMANCE CHARACTERISTICS—continued**

| | Units | MSA100/MSA110 |
|---|---|---|
| SCALE FACTOR | mV/g | 200 ±40 |
| SCALE FACTOR COMPOSITE ERROR [2] | ppm Max | 1000 |
| SCALE FACTOR TEMPERATURE SENSITIVITY | ppm/°F Typ | -50 |
| | ppm/°C Typ | -90 |
| NON-LINEARITY | % FSO Typ | ±0.1 |
| FREQUENCY RESPONSE (±5% max, ref 100 Hz) | Hz | 0 to 500 |
| RESONANCE FREQUENCY | Hz Typ | 2000 |
| PHASE RESPONSE (0 to 500 Hz) | degree, Typ | -10 |
| | degree, Max | -15 |
| AXIS MISALIGNMENT | mrad Max | ±10 |
| VIBRATION RECTIFICATION COEFFICIENT [3] (0 to 2000 Hz) | $\mu g/g^2$ Max | 30 |
| VIBROPENDULOSITY | $\mu g/g^2$ Max | 10 |
| SELF-TEST | g/volt Typ | 2.5 |
| TEMPERATURE SENSOR OUTPUT@ +75°F (+24°C) [4] | V Typ | 0.630 |
| TEMPERATURE SENSOR SENSITIVITY | mV/°F Typ | 1.2 |
| | mV/°C Typ | 2.1 |
| ACTIVATION TIME | sec Max | 0.5 |

**ELECTRICAL**

| | | |
|---|---|---|
| EXCITATION | ±13 Vdc to ±18 Vdc | |
| Bias Voltage Sensitivity | < 1 µg/Vdc | |
| Scale Factor Voltage Sensitivity | <200 ppm/Vdc | |
| INPUT CURRENT | 25 mA max per supply | |
| OUTPUT RESISTANCE | 1000 ohms maximum | |
| INSULATION RESISTANCE | >20 Mohm at 50 Vdc | |
| OUTPUT NOISE [5] TYPICAL | 0.5 to 10 Hz | 0.4 µVrms/√Hz |
| | 0.5 to 500 Hz | 4 µVrms/√Hz |
| | 0.5 to 10 kHz | 40 µVrms/√Hz |

**PHYSICAL**

| | |
|---|---|
| CASE, MATERIAL | 304L Stainless Steel |
| ELECTRICAL CONNECTIONS | Eight solder pins |
| IDENTIFICATION | Manufacturer's logo, model number and serial number |
| MOUNTING TORQUE | Holes for 4-40 or M3 mounting screws/ 6 lbf-in (0.7 Nm) |
| WEIGHT | 40 grams maximum |

**ENVIRONMENTAL**

| | |
|---|---|
| TEMPERATURE RANGE, OPERATING | -65 to +221°F (-55 to +105°C) |
| VIBRATION | 30 grms, 20 to 2000 Hz |
| SHOCK (half-sine pulse) | 5000 g min, 200 µsecond or longer |
| HUMIDITY | Unaffected. Hermetically sealed |
| ALTITUDE | Unaffected |
| MAGNETIC SENSITIVITY ON BIAS | 30 µg/ Gauss at 15 Gauss field |

**CALIBRATION DATA SUPPLIED**

| | |
|---|---|
| BIAS | mV |
| SCALE FACTOR | mV/g |
| AXIS MISALIGNMENT | mrad |
| TEMPERATURE MODELING | Coefficients for third order fit of Bias and Scale Factor |
| FREQUENCY RESPONSE | 20 to 10 khz |

**ACCESSORIES**

| | |
|---|---|
| EHW265 | (4) Size 4, Flat Washers |
| EH409 | (4) 4-40 X 3/8 inch Cap Screws |
| EHM464 | (1) Hex Wrench |

**NOTES**

1. For best results unit should be calibrated to required lower acceleration ranges when rescaling.
2. RSS of temperature modeling residual and repeatability.
3. Optional 10 $\mu g/g^2$ available on special order.
4. Temperature modeling provides third order coefficients for bias and scale factor.
5. With 50 g full scale.
6. IEEE Std 337-1972. Standard Specification Format Guide and Test Procedure for linear, single axis, pendulous, analog and torque balance accelerometer.
7. Range selection external resistor ($R_s$) connected from pin 2 to pin 4.

$$R_s = \frac{10{,}000 \text{ ohms}}{\left(\frac{S_d}{S_u} - 1\right)}$$

$S_d$ = desired scale factor, V/g.
$S_u$ = unadjusted scale factor, V/g.

Continued product improvement necessitates that Endevco reserve the right to modify these specifications without notice. Endevco maintains a program of constant surveillance over all products to ensure a high level of reliability. This program includes attention to reliability factors during product design, the support of stringent Quality Control requirements, and compulsory corrective action procedures. These measures, together with conservative specifications have made the name Endevco synonymous with reliability.

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