

Established, Accurate and Robust
MEMS ACCELEROMETERS

Aerospace - Defense - Energy - Railway
Seismic - Test & Measurement

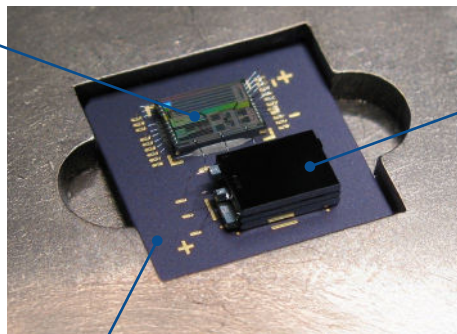


Single-Axis MEMS Analog Accelerometer Design

Safran Electronics & Defense provides high-end capacitive accelerometers. Designed for accuracy, these sensors offer high-performance and long-term reliability. More than a manufacturer of high-end sensors, Safran Electronics & Defense is a proven partner for those who demand a constant supply of high-tech marvels.

Bulk technology is among the key differentiators of Safran Electronics & Defense. It offers more stability and precision than any other capacitive technology.

Electronic IC



3D Bulk MEMS Die with proprietary attach process

Package LCC20 (9 x 9 mm) hermetically sealed and leadless ceramic package

Why us ?



FIELD PROVEN

Established

- **In-house Fabrication for more than 30 years**
- Free of export licence products
- Part of Safran Group
- ITAR FREE products

Accurate

- **Qualification based on MIL Standard**
- High Process Capability and Performances (CPk >2)
- Used with high-end gyroscopes (FOG, HRG)

Robust

- **Qualified for harsh environments in the oil and gas market**
- 100% of parts tested over full temperature and dynamic range
- Successfully integrated into Gun-hard applications (20'000g)
- Tested up to TID (Total Ionizing Dose) 50kRad for space app.
- Our technology is used in aeronautics DAL-A ("Design Assurance Level") applications for more than 20 years.



MEMS accelerometers

INERTIAL SENSORS & TILT

2g - 100g



MS1000
Tactical Grade
Performance
IMU, AHRS



MS1000L
Cost effective
IMU

HIGH TEMP. SENSORS

2g - 30g



TS1000T
High-temperature
MWD, LWD, RSS



MS1000T
Drilling, high performances
MWD, LWD, RSS

VIBRATION SENSORS

2g - 200g



VS1000
Low-noise
SHM, Bogie Monitoring, Instrumentation

SEISMIC SENSORS

3g - 5g



SI1000
Seismic sensor class B
SHM, Safety System

PRODUCT MATRIX

| Market | Domain | Applications | MS1000 | MS1000L | MS1000T | TS1000T | VS1000 | SI1000 |
|-----------------------|-----------------------|---|--------|---------|---------|---------|--------|--------|
| Aerospace and Defense | Air | AHRS (Attitude Heading Reference Systems) INS (Inertial Navigation System) Stand-by Instruments Aircraft Vibration Monitoring Flight Data Recorder | • | • | | | | |
| | Sea | Pointing Stabilization Towed Array | • | • | | | | |
| | Missiles | Precise Guidance Missiles Smart Missiles Anti-tank Guided bombs | • | • | | | | |
| | Land | Dead Reckoning navigation Autonomous North finding Weapon launch systems | • | • | | | | |
| | New Space | Small Sat Launchers | • | • | | | | |
| Mobile platforms | Air | UAV eVTOL Drones | • | • | | | | |
| | Sea | North Finding Heave measurements ROV | • | • | | | | |
| | Transportation | Bogie monitoring Train positioning Autonomous vehicles | • | • | | | • | |
| Industrial | Energy | MWD (Measurement while drilling) LWD (Logging while Drilling) RSS (Rotary Steerable System) Geothermal Drilling | • | • | • | • | | |
| | | Wind Turbines Instrumentation | • | | | | • | • |
| | Test and Measurements | SHM (Structural Health Monitoring) MHM (Machine Health Monitoring) Preventive maintenance Instrumentation Automotive testing Construction monitoring Seismic Monitoring | • | • | | | • | • |
| | Manufacturing | Tilt measurement Mining Autonomous agriculture | • | • | | | | |

Export Free*



MS1000 Premium

TACTICAL GRADE MEMS ACCELEROMETER

Key features (±2g) :

- **In-run bias stability** (@10s) : 3 µg
- **Long term bias repeatability**: 0.24mg
- **Low Noise**: 7 µg/√Hz
- **Non linearity**: ±0.3% (of full scale)
- **Reliable in harsh environments**
- **LCC20, hermetically sealed package**
- **SWaP¹** : 9x9x3,5mm³ - 1.5gr - 10mW
- **Temperature Range**: -55°C to 125°C

| Key Parameter, typical values | MS1002* | MS1005* | MS1010* | MS1016 | MS1030 | MS1050 | MS1100 | Units |
|-------------------------------|---------|---------|---------|--------|--------|--------|--------|--------|
| Full-Scale acceleration | ± 2 | ± 5 | ± 10 | ± 16 | ± 30 | ± 50 | ± 100 | g |
| In run bias stability (@10s) | 3 | 7.5 | 15 | 24 | 45 | 75 | 150 | µg |
| Noise in band | 7 | 17 | 34 | 54 | 102 | 170 | 340 | µg/√Hz |
| Long-term Bias Repeatability | 0.24 | 0.6 | 1.2 | 1.9 | 3.6 | 6 | 12.0 | mg |
| Residual Bias modeling error | 0.14 | 0.35 | 0.7 | 1.1 | 2.1 | 3.5 | 7.0 | mg |

* The MS1002, MS1005, MS1010 accelerometers are dual-use goods (category 7A101) and as such are subject to export control. Please contact us for additional information.
1: SWaP: Size Weight and Power

Featured Applications

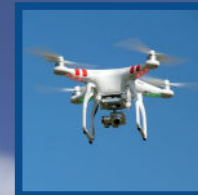
Aerospace & Defense :

- Inertial Measurement Units (IMUs)
- Attitude and Heading Reference System (AHRS)
- Short and mid-range guidance missiles systems

Naval & Land :

- Autonomous Vehicles, Robotics
- North finding, Antenna, Sonar orientation
- Train positioning (GPS dead reckoning)

Export Free



MS1000L

TACTICAL GRADE MEMS ACCELEROMETER

Key features (±2g) :

- **In-run bias stability** (@10s) : 3 µg
- **Long term bias repeatability**: 1.5mg
- **Low Noise**: 7 µg/√Hz
- **Non linearity**: ±0.3% (of full scale)
- **Reliable in harsh environments**
- **LCC20, hermetically sealed package**
- **SWaP¹** : 9x9x3,5mm³ - 1.5gr - 10mW
- **Temperature Range**: -55°C to 125°C

| Key Parameter, typical values | MS1002L | MS1005L | MS1010L | MS1030L | MS1050L | MS1100L | Units |
|-------------------------------|---------|---------|---------|---------|---------|---------|--------|
| Full-Scale acceleration | ± 2 | ± 5 | ± 10 | ± 30 | ± 50 | ± 100 | g |
| In run bias stability (@10s) | 3 | 7.5 | 15 | 45 | 75 | 150 | µg |
| Noise in band | 7 | 17 | 34 | 102 | 170 | 340 | µg/√Hz |
| Scale Factor Sensitivity | 1350 | 540 | 270 | 90 | 54 | 27 | mV/g |

1: SWaP: Size Weight and Power

Featured Applications

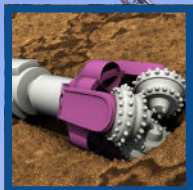
Aerospace & Defense :

- Inertial Measurement Units (IMUs)
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- Short and mid-range guidance missiles systems

Naval & Land :

- Autonomous Vehicles, Robotics
- North finding, Antenna, Sonar orientation
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Export Free



MS1000T



HIGH TEMPERATURE MEMS ACCELEROMETER

Key features (±2g):

- **High temperature range:** -40°C to 175°C
- **Excellent long term bias repeatability:** ±0.45mg
- **Non-linearity:** <0.3% of full scale
- **Residual bias model** <±0.3mg
- **SWaP¹:** 9x9x3.5mm³ - 1.5gr - 10mW
- **Robust to repetitive shocks**

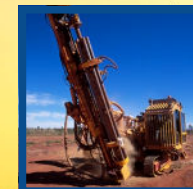
| Key Parameter, typical values | MS1002T | MS1005T | MS1010T | MS1030T | Units |
|---|---------|---------|---------|---------|-------|
| Full-Scale acceleration | ± 2 | ± 5 | ± 10 | ± 30 | g |
| Residual Bias modeling error ² | 0.3 | 0.75 | 1.5 | 4.5 | mg |
| Long-term Bias repeatability | 0.45 | 1.1 | 2.2 | 6.5 | mg |
| Non-Linearity (IEEE norm) | 0.3 | 0.3 | 0.3 | 0.3 | % FS |
| Endurance shocks (500 times) | 1000 | 1000 | 1000 | 1000 | g |

¹: SWaP: Size Weight and Power
²: Using 3rd order polynomial compensation from -40°C to +150°C.

Featured Applications

- Measurement While Drilling (MWD)
- Logging While Drilling (LWD)
- Rotary Steerable Systems (RSS)
- Geothermal drilling
- Borehole Survey
- Geological Exploration

Export Free



TS1000T



HIGH TEMPERATURE MEMS ACCELEROMETER

Key features (±2g):

- **High temperature range:** -40°C to 175°C
- **Excellent long term bias repeatability:** ±2mg
- **Non-linearity:** <0.3% of full scale
- **Residual bias model** <±0.6mg
- **SWaP¹:** 9x9x3.5mm³ - 1.5gr - 10mW
- **Robust to repetitive shocks**

| Key Parameter, typical values | TS1002T | TS1005T | TS1010T | Units |
|---|---------|---------|---------|-------|
| Full-scale acceleration | ± 2 | ± 5 | ± 10 | g |
| Residual Bias modeling error ² | 0.6 | 1.5 | 3.0 | mg |
| Long-term Bias repeatability | 2 | 5 | 10 | mg |
| Non-Linearity (IEEE norm) | 0.3 | 0.3 | 0.3 | % FS |
| Endurance shock (500 times) | 1500 | 1500 | 1500 | g |

¹: SWaP: Size Weight and Power
²: Using 3rd order polynomial compensation from -40°C to +150°C.

Featured Applications

- Measurement While Drilling (MWD)
- Logging While Drilling (LWD)
- Rotary Steerable Systems (RSS)
- Geothermal drilling
- Borehole Survey
- Geological Exploration

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VS1000



VIBRATION SENSOR

Key features (±2g):

- **Low Noise:** < 7 µg/√Hz
- **Analog differential output**
- **Repetitive high-shocks resistance**
- **Smart overload system**
- **SWaP¹:** 9x9x3.5mm³ - 1.5gr - 10mW

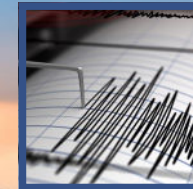
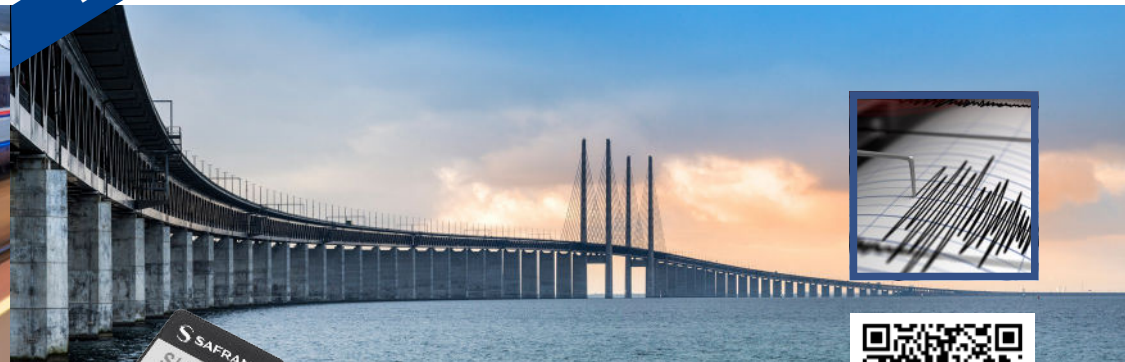
| Key Parameter, typical values | VS1002 | VS1005 | VS1010 | VS1030 | VS1050 | VS1100 | VS1200 | Units |
|------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Full-scale acceleration | ± 2 | ± 5 | ± 10 | ± 30 | ± 50 | ± 100 | ± 200 | g |
| Frequency response (±3dB) | 0-1150 | 0-1900 | 0-3200 | 0-4000 | 0-4500 | 0-5000 | 0-7000 | Hz |
| Noise (in band) | 7 | 17 | 34 | 102 | 170 | 339 | 678 | µg/√Hz |
| Scale factor (nominal) | 1'350 | 540 | 270 | 90 | 54 | 27 | 13.5 | mV/g |
| Bias temp. coefficient (min./max.) | ± 0.2 | ± 0.5 | ± 1 | ± 3 | ± 5 | ± 10 | ± 20 | mg/°C |
| Shock survivability | 6'000 | 6'000 | 6'000 | 6'000 | 6'000 | 6'000 | 6'000 | g |

¹: SWaP: Size Weight and Power

Featured Applications

- Bogie security monitoring
- Rolling stock fatigue analysis
- Test & Measurement
- Structural health monitoring (SHM)
- Automotive testing (ride quality)
- Track monitoring system
- Vibration monitoring instrumentation
- Preventive maintenance

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SI1000



HIGH-END MEMS ACCELEROMETER SEISMIC MEASUREMENTS

Key features (±3g):

- **Low Noise:** < 0.7 µg/√Hz
- **Analog differential output**
- **Operational Temperature:** -40°C to +85°C
- **SWaP¹:** 9x9x3.5mm³ - 1.5gr - 90mW
- **Measurement range:** ± 3 to ± 5g

| Key Parameter, typical values | SI1003 | SI1005 | Units |
|--|--------|--------|--------|
| Full-scale acceleration | ± 3 | ± 5 | g |
| Frequency response (± 3dB) | 550 | 700 | Hz |
| White Noise | 0.7 | 1.2 | µg/√Hz |
| Noise (Integrated over 0.1Hz to 100Hz) | 8 | 13 | µg |
| Dynamic range (0.1Hz to 100Hz) | 108.5 | 108.5 | dB |
| Scale Factor Sensitivity | 900 | 540 | mV/g |

¹: SWaP: Size Weight and Power

Featured Applications

- Structural health monitoring (SHM)
- Earth-related safety systems and alerts
- Strong motion detection
- Construction monitoring and site evaluation
- Low-noise industrial test&measurement
- Bridges, dams, power plants, high buildings rails, hospitals

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