

MEMS Capacitive Accelerometers

Application Notes

Accelerometer for Train Applications

30N.TR.A.01.09

Features

Full scale range from $\pm 2g$ to $\pm 200g$
Extended bandwidth (DC to $> 1\text{ kHz}$ @ 5%)
Excellent long term stability
Qualified for Safety Critical applications
Harsh Environment (shock, vibration, temperature)

Applications

Railway technology

- High-speed train tilt control
- Bogie monitoring and diagnostics
- Magnetic levitation train control system
- Track monitoring for safety and maintenance

Introduction

Accelerometers sensors detect various form of mechanical motion including inertial force, tilt, vibration or shock. There are various types of accelerometers using piezoelectric, piezoresistive or capacitive sensing element. However these different sensing technologies do not offer the same level of sensor performances.

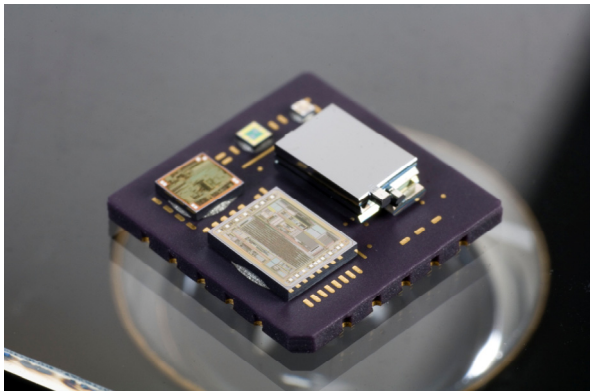


Fig. 1: MEMS Capacitive Accelerometer

Colibrys accelerometers are based on silicon MEMS capacitive sensors (Fig. 1). For low-frequency measurements (typ. up to 1 kHz @ 5%), the capacitive sensor offers higher performances than the other technologies in term of reliability, long term stability, signal to noise, robustness, size and power.

Motion sensors for railway

Motion sensors find a variety of applications in the areas of railway technologies. Typical examples are: bogie monitoring and diagnostics system for security and comfort, high-speed train tilt control system for improved passenger comfort, position monitoring of magnetic levitation train (Fig. 2), control system, Health and Usage Monitoring System (HUMS), shock monitoring during transportation, precise train positioning or railway track monitoring system for safety and maintenance.

Colibrys accelerometers for railway

There are many opportunities for motion sensors products in the railway technology market. Colibrys MEMS capacitive accelerometers are already well recognized for their high reliability in harsh environment and have already been successfully qualified for safety critical railway applications. One of the first important integration of MEMS capacitive accelerometers has been the tilt bogie control system for high-speed trains. Tilting trains are well established and in service since years in many countries (Fig. 3). Other opportunities include all applications related to rolling vibration measurements, e.g. to examine bogies instability (Fig. 4), derailment, axis bearing or wheel conditions.



Fig. 2: Maglev

Colibrys offers two types of accelerometers dedicated to the railway applications:

VS9000 Colibrys product is designed for vibration sensing which requires wide bandwidth, extended g range, small size and dedicated signal conditioning. Typically this product family covers the full range from $\pm 2g$ to $\pm 200g$ and offers a constant frequency response ($< 5\%$ variation) from DC up to 1 kHz . MS9000 product family is designed for inertial sensing which requires long term stability. Both product families are offered in a new small LCC20 package ($9\text{ mm} \times 9\text{ mm}$).

COLIBRYS accelerometers

MS9000
VS9000

Range

± 2g to 200g
± 2g to 200g

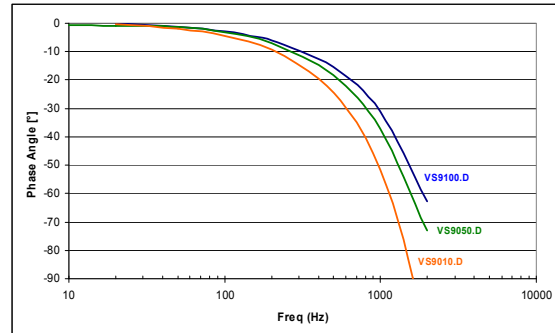
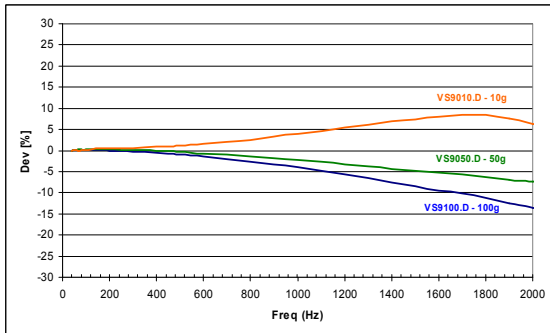
Key specifications

Long term stability
Bandwidth > 1 kHz@5%

Packaging

LCC20
LCC20

Main features of VS9000.D



Principle of operation

VS9000 and MS9000 sensors operate from a single power supply voltage (between 2.5V and 5.5V) with low current consumption (< 0.5mA at 5V). The output is a ratiometric analog voltage that varies between 0.5V and 4.5V for the full-scale acceleration range at a voltage supply of 5V. It is essential to have a stable power supply since any instability is directly transferred to the output.

The sensor is fully self-contained and packaged in a 20-pin LCC standard ceramic housing: LCC20; insuring full hermeticity. It operates over the temperature range of -55°C to +125°C and can withstand shocks up to 6'000g without performance degradation. For further technical information please refer to the related specification and product descriptions.

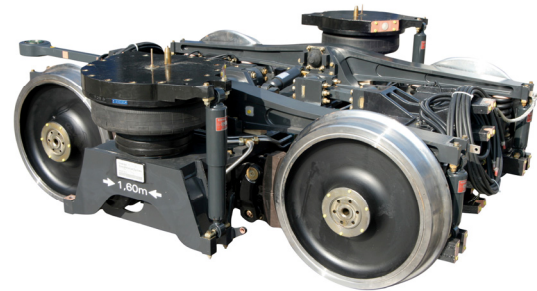


Fig. 4: Bogie (Siemens)



Fig. 3: Tilt train

Conclusion

MEMS capacitive accelerometers are the best candidates for the fast growing railway market of high speed-lines in most countries and the deployment of new generation of high-speed trains which will be more and more equipped with onboard safety control equipment requiring reliable and high specification accelerometers.

Colibrys is the right partner to provide the best and adequate accelerometers for your railway applications.

