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# APPLICATION NOTE

## Accelerometers for strong motion measurements

30N.S-MOTION.B.05.11

The SF2006 class B seismic sensor

### Features

- Extreme low noise
- Wide frequency response
- High reliability
- Harsh environment (shock, vibration, temperature)
- Small size

### Reliable performance

Strong motion recorders are used to map earthquakes and record how earthquakes affect structures. Earthquake data is used to create precise maps for earthquake hazard mitigation. The maps enable buildings to be constructed appropriately according to local earthquake risks. Once structures have been built, they are monitored during an earthquake so that engineers can validate building designs, document failures, and evaluate building codes. Strong motion applications require accelerometers with excellent stability, linearity, dynamic range and DC response. The Si-Flex accelerometer meets these demanding requirements and offers other advantages over conventional sensors.

#### Self testing and super sensitive

Once installed, strong motion recorders are typically left unattended and expected to work whenever an earthquake occurs. This means the entire system including the accelerometer must be reliable and consistent over extended periods of time. The MEMS technology behind the Si-Flex accelerometers produces results that are reliable and repeatable over time. This is evident from the low offset thermal coefficient of ±l00 µg/°C and low linearity error of ±0.l % of the Si-Flex accelerometers.

Accelerometers for strong motion recorders in buildings are often located in areas with limited access. They are mounted to key structural elements such as beams, foundations and walls. Because these areas are not readily accessible, self-testing capability of the accelerometer is important. The Si-Flex SF1500 or SF2006 accelerometers are designed with a self-test capability specifically for strong motion applications. A TTL signal can be remotely applied to the self-test pin of the sensor. The signal is injected into the feedback loop of the accelerometer, producing a pulse in the output channel of the accelerometer.

Fig. 2: SiFlex accelerometer

Seismic events vary greatly in magnitude, ranging from weak tremors that are imperceptible to catastrophic events that destroy structures. It is important for strong motion accelerometers to have enough dynamic range to measure local events with a good signal-to-noise ratio and on scale. The small events provide a source signal for structure health monitoring and characterization. This can help reveal flaws in construction or design and indicate warning signs of premature aging of structures. Structure response to large quakes can help identify failure modes and improve designs.

Maladière 83 | 2000 Neuchâtel | Switzerland
P +41 32 720 58 11 | F +41 32 720 57 84
www.colibrys.com



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Structures within buildings and large structures such as bridges often have low frequency modes. Since damaging seismic energy occurs at low frequencies, a DC coupled accelerometer with a flat frequency response is required in order to faithfully record these events. A stable DC coupled accelerometer used for strong motion applications can also measure static changes in tilt or displacement after a large event. Since the Si-Flex accelerometer has both excellent DC stability and a flat frequency response, it is particularly well suited for strong motion measurements.

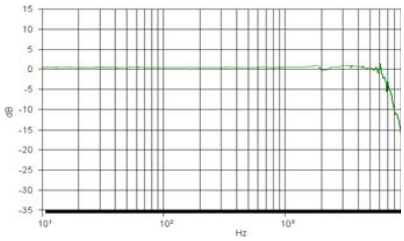


Fig. 3: Frequency response up to few kHz

**Protecting People and Property**

The Si-Flex accelerometer is uniquely well suited to the demanding performance requirements of strong motion applications. Strong motion recording systems play an important role in protecting life and property in earthquake prone areas. The performance and success of these systems is highly dependent on accelerometer technology and performance.

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# We are here for you. Addresses and Contacts

## Sales Switzerland

Postcode 3000 – 9999
Liechtenstein

Matthias Rüegg
Ruhbergstrasse 32
CH-9230 Flawil

Phone + 41 44 877 35 18
Mobile + 41 76 491 66 66
Fax + 41 44 877 35 19

matthias.rueegg@pewatron.com

Postcode 1000 – 2999

Raffael Favaretto
Route d'Oron 124
CH-1673 Promasens

Phone + 41 44 877 35 22
Mobile + 41 76 444 63 14
Fax + 41 44 877 35 23

raffael.favaretto@pewatron.com

## Sales Germany

Postcode 60000 – 79999

Dieter Hirthe
Mühlweg 23
D-71554 Weissach i.T.

Phone + 49 719 149 60 58
Mobile + 49 163 762 74 30
Fax + 49 719 193 31 88

dieter.hirthe@pewatron.com

Postcode 10000 – 59999
Postcode 80000 – 99999

Kurt Stritzelberger
Neumarkter Str. 86a
D-81673 Munich

Phone + 49 89 260 38 47
Mobile + 49 171 803 41 35
Fax + 49 89 43 10 91 91

kurt.stritzelberger@pewatron.com

Key Accounts
Aerospace and Defence

Claus Wübbena
Vogelkamp 26
D-26655 Westerstede

Phone + 49 4488 5204 614
Mobile + 49 173 9700 691
Fax + 49 4488 5204 616

claus.wuebbena@pewatron.com

## Sales Austria

Kurt Stritzelberger
Neumarkter Str. 86a
D-81673 Munich

Phone + 49 89 260 38 47
Mobile + 49 17 18 03 41 35
Fax + 49 89 43 10 91 91

kurt.stritzelberger@pewatron.com

## Sales Other Countries / Product Management

### Sensors

Physical Sensors
Data Acquisition

Peter Felder
Phone + 41 44 877 35 05
peter.felder@pewatron.com

Geometrical Sensors

Eric Letsch
Phone + 41 44 877 35 14
eric.letsch@pewatron.com

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Sebastiano Leggio
Phone + 41 44 877 35 06
sebastiano.leggio@pewatron.com

### E-Components

Current Sensors
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Sebastiano Leggio
Phone + 41 44 877 35 06
sebastiano.leggio@pewatron.com

PEWATRON AG
Thurgauerstrasse 66
CH-8052 Zurich

Phone + 41 44 877 35 00
Fax + 41 44 877 35 25

www.pewatron.com
info@pewatron.com