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Operator's Manual
Capacitive Accelerometer CB31 and Supply Unit 037

Application

Compared to other capacitive accelerometers, the CB31 provides excellent resolution at high bandwidth. These characteristics open a large number of applications as for instance in the field of seismic measurement, in building industry and in vehicle and aircraft engineering. The advantage of capacitive transducers is the possibility to measure acceleration with very low frequencies and static acceleration. That means, besides dynamic motions you may also detect the constant gravitation acceleration. From this follows an additional application in tilt measurement.
The extremely small current requirement makes the CB31 a good choice for battery operated equipment.
The Supply Unit for Capacitive Transducers Model 037 provides the necessary operating voltage for the transducer and decouples the output signal.

Function

Main component of the CB31 is a capacitive sensing element. It is manufactured on micro-machined base in multilayer silicon technology. Figure 1 shows the principle of the accelerometer. The measuring element consists of a seismic mass / spring system. It is positioned flexible between two fixed plates. At an exciting acceleration this differential capacitor changes its capacitance. This very small change of capacitance (10^{-14} .... 10^{-11} pC) is converted by an electronic circuit into a voltage proportional to the exciting acceleration. The enclosed gas inside the mechanical system causes damping of the resonant frequency of the spring / mass system.

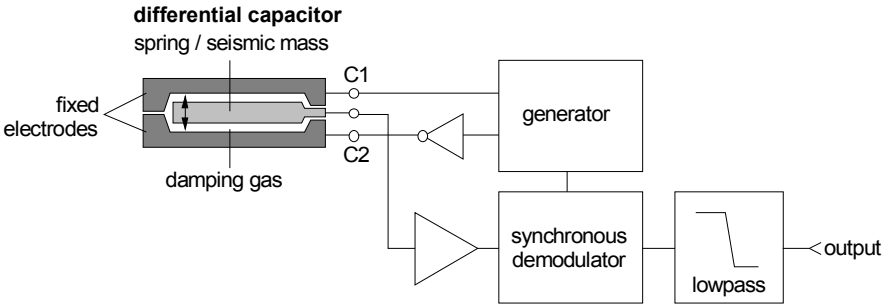
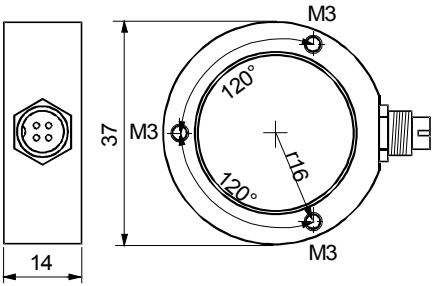


Figure 1: Block diagram

Mounting and Connection

The CB31 has 3 tapped holes with M 3 female metric threads for mounting. Screws with M 2.5 metric thread can also be stuck through these holes.
Alternatively the accelerometer may be mounted adhesively. Fig. 2 shows the measures of the fixing points and the contact pin functions of the connector.



male socket Binder 711 series
view at pins

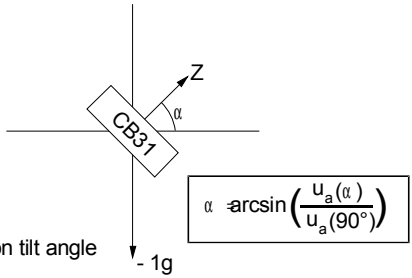
1 0 V, ground of supply voltage
2 output
3 supply voltage + 5 .. 30 V
4 internally generated offset voltage +1,5V

Figure 2: Dimensions and socket pin configuration

Because of its internal stabilization the supply voltage at pin 3 may vary over a wide range. However, the supply voltage should have low ripple and noise components. When measuring the output voltage between pin 2 and pin 1, it has added an offset voltage of 1.5 V and is, therefore, positive in any case. Pin 4 provides a stabilized reference voltage of 1.5 V. It is useful as reference voltage for the output, if you need a bipolar output signal from the transducer.
The easiest way to connect the CB31 to measuring equipment is the use of the Supply Unit Model 037, described below.
For a simple function control of the accelerometer you may measure the constant gravitational acceleration (1 g = 9.81 ms^{-2}). Positioned with the top upwards on a horizontal surface the accelerometer delivers an output voltage for 1 g, as given in the data sheet. Positioned with the top downwards, the output voltage is proportional to –1 g. Turning the accelerometer on its side, you measure 0 g.
Warning: One of the outstanding characteristics of the CB31 is its high resistance against mechanical shocks. Nevertheless, it is recommended to handle the accelerometer carefully. Especially at transport and mounting it is important to avoid impacts of the accelerometer to hard surfaces. In such case an acceleration of several 1000 g may occur, which may be able to damage the micro-machined spring-mass system.
Important: The electronic circuit of the accelerometer carries out automatically some test and adjustment processes after connection of the supply voltage. To start the measuring operation it is necessary, that the supply voltage reaches its nominal value within 2 ms. Some DC power supply units don't ensure this. In case the CB 31 does not deliver an output voltage after connecting the power supply, it is recommended to switch off the Supply Unit Model 037 or to disconnect the cable of the accelerometer at the supply unit for a short time.

Tilt Measurement Using the CB31

The possibility to measure static acceleration allows the use of the CB31 as sensor for tilt angles. Fig. 3 explains the principle function.



Z: positive sensor axis
g: gravitation acceleration
α : tilt angle
$u_a(\alpha)$: sensor output depending on tilt angle
$u_a(90°)$: sensor output at 90° or 1g

Figure 3: Tilt measurement using the CB31

The accuracy of the tilt angle measurement depends on the following parameters:

- Noise: The inherent random noise of the sensor decides on the resolution of tilt angle measurement. Filtering the measuring signal by means of an external lowpass filter will reduce the noise and so improve the resolution of tilt angle measurement. With a lowpass filter of 10 Hz the tilt angle resolution amounts to 0.005° (Model CB31-2) and 0.02° (Model CB31-10).
- Transverse sensitivity: It causes a deviation of the tilt angle of maximum ± 3°. This can be compensated mechanically.
- Offset error of the output signal: It amounts to maximum 1% and can be adjusted electrically.
- Nonlinearity: < 0.4% from the measured tilt angle.

Supply Unit Model 037

The Supply Unit 037 has been developed especially for the Metra´s capacitive accelerometers. It supplies the operating voltage for the sensor circuit. This voltage comes from an internal 9V block battery Type IEC 6F22 (about 300 h operational life) or from an external DC power supply, for instance the included mains plug adapter. Figure 4 shows the connectors and controls of the instrument.
Using an external supply voltage, the internal battery will be disconnected from the accelerometer automatically. The center contact of the circular power supply socket (according to DIN 45323) is connected with the plus pole. The 037 is protected against false polarization.
To increase battery life it is recommended to move the slide switch into "OFF" position as long as the connected accelerometer is not in use. If no accelerometer is connected the battery will not be discharged, independent of the position of the switch.
The slide switch gives you the choice of two modes of operation:

- In position "0 V" the output signal is bipolar, that means, it can be modulated by ± 1 V around zero. In this mode the supply voltage has to be insulated from the output. This is guaranteed at battery operation or operation with the included mains plug adapter. The connection of the output ground with the minus pole of the operating voltage may cause the damage of the electronic circuit inside the accelerometer.
- In position "1.5 V" the output signal oscillates with a maximum modulation of ± 1 V around the offset voltage of 1.5 V, that means, the output voltage changes from 0.5 V to 2.5 V. In this mode the minus pole of the operating voltage is connected inside with the screen of the output socket.

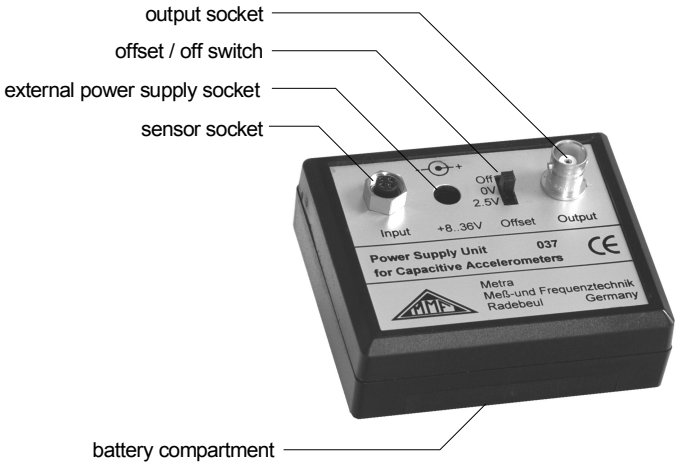


Figure 4: Supply Unit 037

Technical Data

	CB31-2	CB31-10
Sensitivity	500 mV/g ± 2 %	100 mV/g ± 2 %
Range	± 2 g	± 10 g
Offset voltage	+1.5 V ± 2 %	+1.5 V ± 2 %
Linear frequency range (+ 3dB)	0 .. 800 Hz	0 .. 600 Hz
Transverse sensitivity	< 5%	< 5%
Nonlinearity	0.4 % of FSO	0.4 % of FSO
Noise density	10 µV/√Hz	10 µV/√Hz
Temperature coefficient of sensitivity	0.02 %/K	0.02 %/K
Temperature coefficient of offset voltage	100 µV/K	100 µV/K
Operating temperature range	-20 .. 100 °C	-20 .. 100 °C
Maximum shock (half sine 0.5 ms)	6000 g	6000 g
Maximum continuous acceleration	20 g rms	20 g rms
Supply voltage	+5 .. 30 V	+5 .. 30 V
Current consumption	0.5 .. 5 mA	0.5 .. 5 mA
Weight	40 gr.	40 gr.
Accessories	1.5 m cable	1.5 m cable
	Extension cables on demand.	

CE

Declaration of Conformity

Products: Capacitive Accelerometer and Supply Unit
Type: CB31 and 037

Hereby is certified that the above mentioned products

comply with the demands of the following standards:

- EN 50081-1
- EN 50082-1

Responsible for this declaration is the producer:

Metra Mess- und Frequenztechnik

Meissner Str. 58

D-01445 Radebeul

declared by

Manfred Weber

Radebeul, 13th October, 1999

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