MEMS Capacitive Accelerometer – Digital Interface

ASC DiSens ECO-3321 (CAN)



Triaxial
MEMS Capacitive
Measurement Range: ±2 to ±40 g
Frequency Range (±5 %): DC to 630 Hz
Scale Factor: 12800 LSB/g to 256000 LSB/g
Aluminum Housing
Made in Germany

MEMS Capacitive Accelerometer

The key components in capacitive accelerometers are high-quality micro-electro-mechanical systems (MEMS). This technology enables the measurement of static (DC) and constant accelerations, which can be used to calculate the velocity and displacement of moving objects. Depending on the design of the spring-mass-damping system, however, it is also possible to detect dynamic (AC) accelerations with amplitudes up to ±40 g and within a frequency response range of up to 630 Hz (±5 %) or 2.4 kHz (±3 dB).

Description

The digital accelerometers of type ASC DiSens® ECO featuring an extremely robust design which leads to a shock resistance up to 10,000 g. The integrated electronic circuitry enables the digital interfaces CAN as well as a flexible power supply voltage from 5 to 30 VDC. The sensors of the ASC DiSens® ECO series provide already implemented filter settings enabling a sampling rate of up to 4 kHz at a 3dB-corner frequency of 1 kHz.

The sensors feature a lightweight, reliable aluminum housing with protection class IP67 and a 5-pin circular metric M12 connector.

The triaxial accelerometers allow quick and easy mounting. Due to several options for digital interfaces and filter settings the ASC DiSens® ECO series is ideally suited for condition monitoring and industrial applications.

Features

- Configuration of Filter Settings and Measurement Ranges
- Digital Interface CAN
- Use in Applications with Electromagnetic Interference and long Cables

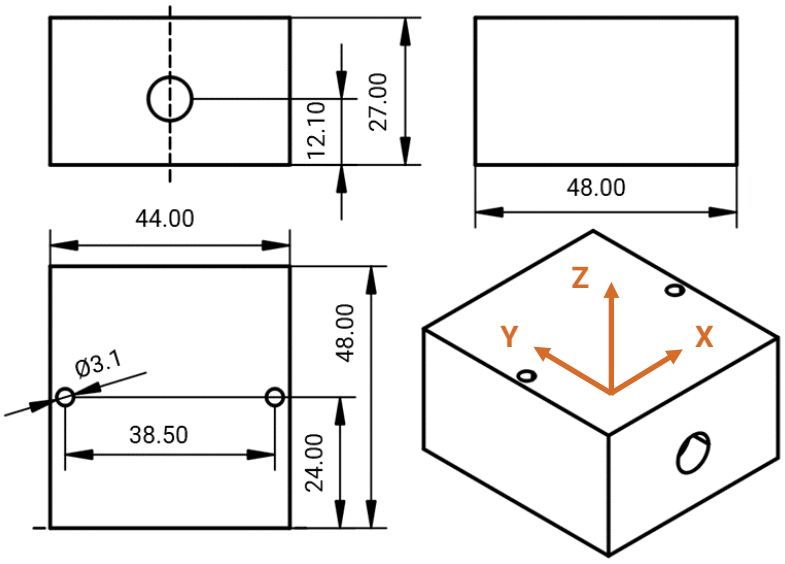
Options

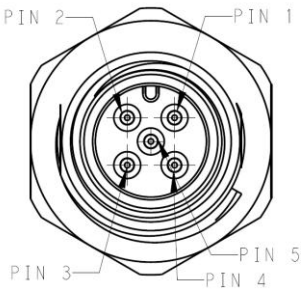
- Customized Cable Length
- Customized Connector

Applications

- General Industrial Test&Measurement
- Robotics and Automation
- Condition Monitoring

More applications in several markets are figured out on our web page **www.asc-sensors.de**





ASC DiSens® ECO-3321 (CAN)

MEMS Capacitive Accelerometer – Digital Interface

Typical Specification

Dynamic

Measurement Range	g	±2	±4	±8	±10	±20	±40
Scale Factor (sensitivity, ±8 % max)	LSB/g	256000	128000	64000	51200	25600	12800
Offset (bias)	LSB	±6400	±3200	±1600	±6400	±3200	±1600
Noise Density	µg/√Hz	22.5	25.0	30.0	75.0	80.0	90.0
Sample Rate (configurable)	Hz	3.90625 | 7.8125 | 15.625 | 31.25 | 62.5 | 125 | 250 | 500 | 1000 | 2000 | 4000					
3dB-Corner Frequency (configurable to corresponding sample rate)	Hz	0.977 to 1000 (¼ of sample rate)					
Frequency Response Range (±5 %)	Hz	DC to 630					
Frequency Response Range (±3 dB)	Hz	DC to 1500			DC to 2400		
Amplitude Non-Linearity	%	0.1	0.8	1.6	0.1	0.5	1.3
Resolution (1 LSB)	µg	4	8	16	20	40	80
Transverse Sensitivity	%	<1 (typ)					

Electrical

Power Supply Voltage	V	5 to 30	
Operating Power and Current Consumption	W | mA	1.5 W (max, regardless power supply voltage) | 62.5 mA @ 24 V	
Isolation		Case Isolated	

Environmental

Temperature Coefficient of the Scale Factor (typ)	ppm/K	±100	
Temperature Coefficient of the Offset	mg/K	±0.1 (typ) | ±0.15 (max)	±0.2 (typ) | ±0.75 (max)
Operating Temperature Range	°C	-40 to +85	
Storage Temperature Range	°C	-40 to +85	
Shock Limit	g	5000 (0.5 ms, unpowered)	10000 (0.1 ms, unpowered and powered)
Protection Class		IP67	

Physical

Sensing Element		MEMS Capacitive
Case Material		Anodized Aluminum
Connector at Sensor Housing (5-pin circular metric M12 connector, male)	CAN	Pin 1: Shielding Pin 2: Power Supply + Pin 3: Power Supply - (GND) Pin 4: CAN-High Pin 5: CAN-Low
Mounting		Adhesive | Screw Holes
Weight (without cable)	gram	80

Protocol Description

In table 1 and 2 all available CAN messages for ASC DiSens® ECO are listed. After all the required configurations are made and saved to the flash, a complete power reset of the sensor is recommended. If the measurement ranges are changed, the default values will overwrite the offset and scale factor calibration data. Therefore, the calibration data should be resent to the sensor if the measurement range is changed.

Message IDs and message structure received by the sensor

Message Type (4 Bit)	Node ID (7 Bit)	1. Cmd Byte	2. Cmd Byte	Parameter / Values (max. 6 Byte)		Description
0x0F	1 - 127	0x10	0x01	none		Start Measurement immediately (default)
		0x10	0xFF	none		Stop Measurement
		0x20	0x01	uint8_t: 1 - 127 (default 1)		Set Node ID / Sensor ID Applies after Save / Restart
		0x20	0x02	0x01	uint8_t	Set Baudrate: 20 kbit/s Applies after Save / Restart
		0x20	0x02	0x02		Set Baudrate: 50 kbit/s
		0x20	0x02	0x03		Set Baudrate: 100 kbit/s
		0x20	0x02	0x04		Set Baudrate: 125 kbit/s
		0x20	0x02	0x05		Set Baudrate: 250 kbit/s
		0x20	0x02	0x06		Set Baudrate: 500 kbit/s (default)
		0x20	0x02	0x07		Set Baudrate: 1000 kbit/s
		0x20	0x03	0x00	uint8_t	Set CAN Termination: OFF Applies after Save / Restart
		0x20	0x03	0x01		Set CAN Termination: ON (default) Applies after Save / Restart
		0x20	0x22	0x01	uint8_t	Set Sample rate / LPF: 3.906 / 0.977 Hz
		0x20	0x22	0x02		Set Sample rate / LPF: 7.813 / 1.953 Hz
		0x20	0x22	0x03		Set Sample rate / LPF: 15.625 / 3.906 Hz
		0x20	0x22	0x04		Set Sample rate / LPF: 31.25 / 7.813 Hz
		0x20	0x22	0x05		Set Sample rate / LPF: 62.5 / 15.625 Hz
		0x20	0x22	0x06		Set Sample rate / LPF: 125 / 31.25 Hz
		0x20	0x22	0x07		Set Sample rate / LPF: 250 / 62.5 Hz
		0x20	0x22	0x08		Set Sample rate / LPF: 500 / 125 Hz
		0x20	0x22	0x09		Set Sample rate / LPF: 1000 / 250 Hz (default)
		0x20	0x22	0x0A		Set Sample rate / LPF: 2000 / 500 Hz
		0x20	0x22	0x0B		Set Sample rate / LPF: 4000 / 1000 Hz
		0x20	0xE0	0x00	uint8_t	Separate X/Y/Z frames (default)
		0x20	0xE0	0x01		Combined XYZ binary frame
		0x20	0xE1	0x01	uint8_t	Set Data Format ACC: Raw (without scaling)
		0x20	0xE1	0x02		Set Data Format ACC: m/s² [SI-Unit] (default)
		0x20	0xE1	0x03		Set Data Format ACC: g
		0x20	0xE3	0x01	uint8_t	Set Measurement Range: 2 g | 10 g
		0x20	0xE3	0x02		Set Measurement Range: 4 g | 20 g
		0x20	0xE3	0x03		Set Measurement Range: 8 g | 40 g (default)
		0x20	0xE4	float (32-bit, little-endian)		Set g-Value (default 9.80665 m/s²)
		0x30	0x01	none		Get Sensor ID / Node ID
		0x30	0x02	none		Get Baudrate
		0x30	0x22	none		Get Sample Frequency
		0x30	0xE3	none		Get Measurement Range ACC
		0x30	0xE1	none		Get Data Format ACC
		0x30	0xE4	none		Get g-Value
		0x30	0xF0	none		Get Firmware Revision
		0x40	0x01	int16_t (default 0)		X-offset (raw counts); little-endian
		0x40	0x02	uint32_t (default 64000 | 12800)		X-scale factor (counts/g); nonzero, little-endian
		0x40	0x03	int16_t (default 0)		Y-offset (raw counts); little-endian
		0x40	0x04	uint32_t (default 64000 | 12800)		Y-scale factor (counts/g); nonzero, little-endian
		0x40	0x05	int16_t (default 0)		Z-offset (raw counts); little-endian
		0x40	0x06	uint32_t (default 64000 | 12800)		Z-scale factor (counts/g); nonzero, little-endian
		0x50	0x01	none		Save Settings to Flash and Restart
		0x50	0x02	none		Reset Settings to Factory Settings and Restart

The CAN message ID (11 bits) is built in combining the command (4 bits) and the node ID (7 bits). The data field contains maximum 8 bytes of data (standard CAN). Some messages need more information than only the message ID, so the first, second or even third byte of the data field is used to specify a command in more detail or to transmit parameters etc.

The message IDs are parted in two sections. First, messages, which are sent by the sensor and second messages, which are received by the sensor. Each message, which is sent to the sensor has the command 0x0F (upper 4 bit) combined with the node ID (lower 7bit). As the length of the node ID is 7 bits, up to 127 different nodes can be addressed on the CAN bus.

Message IDs and message structure sent by the sensor

Message Type (4 Bit)	Node ID (7 Bit)	1. Cmd Byte		Parameter / Values (max. 8 Byte)		Description
0x01	1 - 127	float				Measurement Data (x-axis: Acc)
0x02		float				Measurement Data (y-axis: Acc)
0x03		float				Measurement Data (z-axis: Acc)
0x04		0x11	uint8_t	default:	1 (0x01)	Get Sensor ID / active Node ID
0x04		0x12	uint8_t	default:	0x06 (500 kbit/s)	Get Baudrate (configured selector code)
0x04		0x14	uint8_t	default:	0x09 (1000 Hz)	Get Sample Frequency (selector code)
0x04		0x16	uint8_t	default:	0x02 (m/s²)	Get Data Format ACC (selector code)
0x04		0x17	uint8_t	default:	0x03 (8 g | 40 g)	Get Measurement Range ACC (selector code)
0x04		0x19	float	default:	9.80665 m/s²	Get value used for 1 g in m/s²
0x04		0x1A	float			Get Firmware Revision (32-bit, little-endian)
0x09		3 × signed 20-bit (X, Y, Z) | unsigned 4-bit sequence Bits: X 0-19 | Y 20-39 | Z 40-59 | sequence 60-63				Combined XYZ: uncalibrated raw counts; 8 bytes, little-endian. Replaces separate axes
0x0D		Node ID	State			Heartbeat every 1 s: Node ID and State 0x01 = started; 0xFF = stopped
0x0E		0xFF 0xFF 0xFF 0xFF				Invalid Command / processing error

Please note: details and further information are available by a separate user guide.

Safety Precaution for Installing and Operating

This data sheet is a part of the product. Read the data sheet carefully before using the product and keep it available for future operation. Handling, electrical connections, mounting or any other work performed at the sensor must be carried out by authorized experts only. Appropriate safety precautions must be taken to exclude any risk of personal injury and damage to operating equipment as a result of a sensor malfunction.

Handling

The sensor is packaged in a reliable housing to protect the sensing elements and integrated electronic components from the ambient environment. However, poor handling of the product can lead to damages that may not be visible and cause electrical failure or reliability issues. Handle the component with caution:

- Avoid shocks and impacts on the housing, such as dropping the sensor on hard surface
- Never move the sensor by pulling the cable
- Make sure that the sensor is used within the specified environmental conditions
- Transport and store the sensor in its original or similar packaging
- The sensor should be mounted on a stable flat surface with all screws tightened or other mounting options
- When adhesives are used to mount the sensors, please select the corresponding products according to permanent or removable mounting, ambient temperature range as well as quality of the mounting surface
- Avoid any deformation during mounting the sensor
- Mounting tolerances may have an influence on the measured result

Electrical

ASC's inertial sensors are working with many established data acquisition systems. However, make sure that a proper DAQ is used, for the corresponding operation principle of the sensor. Furthermore, suitable precautions shall be employed during all phases of shipment, handling and operating:

- Active sensor pins are susceptible to damage due to electrostatic discharge (ESD)
- Make sure that the sensor is used within the specified electrical conditions
- Check all electrical connections prior to initial setup of the sensor
- Completely shield the sensor and connecting cable
- Do not perform any electrical modifications at the sensor
- Do not perform any adaptions on the wiring or connectors while the device under power
- Never plug or unplug the electrical connection while the sensor is under power
- When a certain pin is not used during operation, make sure that the pin is insulated

Quality

- We have a quality management system according to ISO 9001:2015.
- The Deutsche Akkreditierungsstelle GmbH (DAkkS) has awarded to our calibration laboratory the DIN EN ISO/IEC 17025:2018 accreditation for calibrations and has confirmed our competence to perform calibrations in the field of mechanical acceleration measurements. The registration number of the certificate is **D-K-18110-01-00**.

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