Smart Sensor Systems ASC AiSys

ASC AiSys ECO-3321 (CAN)

Efficient and smart sensor system
Internal processing for extracting feature vectors
Adaptable by modular concept
Measurement range: configurable ±2 to 8 g or ±10 g to ±40 g
Frequency range (±5 %): DC to 630 Hz
Aluminum Housing
Made in Germany



CE

Smart Sensor Systems ASC AiSys®

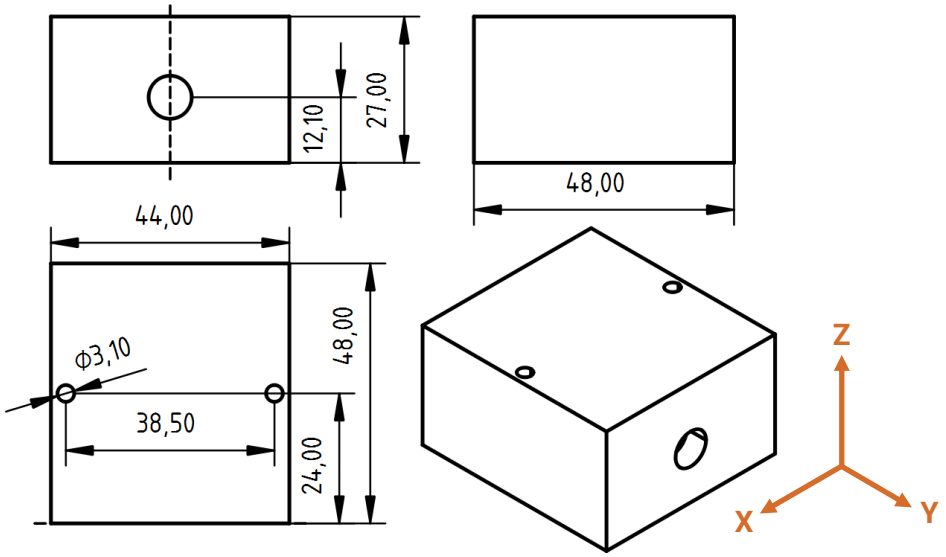
Smart sensor systems play a central part in digitization and networking: They enable the basis for numerous monitoring solutions and innovative applications. Based on a modular concept, which contains the complete measuring task from the acquisition of physical input values, through the implementation of complex decision algorithms, to the analysis of the extracted, application-specific feature vectors in one compact sensor system.

Description

The smart sensor systems ASC AiSys® ECO-3321 are based on proven MEMS technology and capacitive operating principle. Furthermore, the integrated electronic circuitry enables acquisition and real-time analysis of accelerations. The acquired data are internally processed while FIR and IIR filters as well as algorithms for extracting feature vectors are already preconfigured. Digitalized g-values and results of frequency analyses are accessible by a CAN bus interface which also provides an alarming option based on threshold detection. Further functionalities could be easily implemented due to a modular concept of hardware and firmware components.

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

The smart sensor systems ASC AiSys® ECO-3321 monitor the properties and behavior of components, vehicles, machines or infrastructures and are used for condition monitoring in real time. Furthermore, those systems are ideally suited to merge historical and current data and using this to determine the future development of the critical parameters. Especially, these analyzes enable predictive maintenance solutions but are also used in digital twins which help to automate process flows and thus make them more efficient.



Features

- User friendly configuration of filter settings and measurement ranges
- Calculating of velocity and displacement based on the acceleration data
- Frequency analysis due to internal Fast Fourier Transformation (FFT)
- Mathematical operations to calculate average and standard deviation

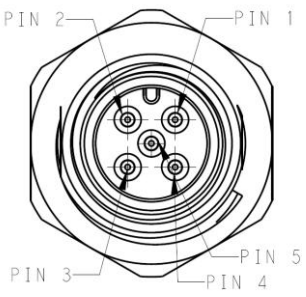
Options

- Implementation of further Functionalities and APIs
- Adaption of Components
- Configurable Filter Coefficients

Applications

- Industry 4.0 Applications
- Predictive Maintenance and Condition Monitoring
- Structural Health Monitoring

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



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Typical Specification for Acquiring the Physical Input

Dynamic

Measurement Range	g	±2	±4	±8	±10	±20	±40
Broadband Noise (frequency range ±5 %)	mg	0.70	0.80	0.95	2.35	2.55	2.85
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
Transverse Sensitivity	%	<1 (typ)					

Electrical

Power Supply Voltage	V	5 to 30
Operating Current Consumption	mA	20 to 80 mA (depending on application)
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 Elements		MEMS Capacitive
Case Material		Anodized Aluminum
Connector at Sensor Housing (5-pin circular metric M12 connector, male)		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	gram	80

Ordering Information

Do you need a smart monitoring solution? No problem, we have the right sensor system for you! The modular concept allows to adapt all smart sensor systems ASC AiSys® to the exact demands of the application. Please don't hesitate to contact us for further information and detailed discussion of your requirements.

ASC AiSys ECO-3321 (CAN)

Smart Sensor Systems ASC AiSys

The revolution in sensor technology

What makes a sensor system smart? – Analog measurement technology and experience from many applications are the basis for the implementation of the ASC AiSys® smart sensor systems. The functional modular system is based on proven hardware components – for example reliable sensor elements for the determination of acceleration and/or angular velocity as well as the housing and cable assembly adapted to the harsh environmental conditions. Furthermore, additional electronics for analog-to-digital conversion and standardized interfaces are integrated.

The main feature of the sensor systems, however, is their ability to evaluate the acquired data and extract predefined feature vectors. The ASC AiSys® smart sensor systems provide information and the user takes care of which information is visualized and required for the corresponding users. Data security is always up to the user and APIs (programming interfaces) enable the integrating of customer-specific algorithms.

ASC also develops algorithms that allow speed and displacement to be calculated on the ASC AiSys® smart sensor system. This has already been successfully implemented in a project to develop a sensor-based intelligent monitoring system for wind turbines. The aim was to calculate the tower deflection from the measured accelerations in order to determine wear types and aging processes. In addition to the numerical integrations, it is necessary to compensate static offset components and drift-dependent components by means of frequency analyses. All calculation steps were carried out completely on the smart sensor system and can be adapted to specific applications.

Adjustments

Flexibility in configuration of filter settings and measurement ranges to fulfill application specific requirements

Pre-Processing

Mathematical operations to calculate average and standard deviation over configurable time

Analyzing

Frequency analysis due to internal Fast Fourier Transformation (FFT) and alarming functionality due to threshold detection

Algorithms

Calculating and output of velocity and displacement based on the acceleration data and internal algorithms for offset and drift compensation

Data Processing

Customized implementation of algorithms due to APIs allows data and trend analysis as well as anomaly recognition based on domain specific know-how

ASC AiSys® CAN Protocol | Commands

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

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		0x13	uint32_t	default:	1000 µs	Get Sample Period (µs, little-endian)
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:	0x01 (2 g | 10 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)
0x05		float				Vector length (m/s²)
0x06		float | float				FFT: frequency (Hz), unnormalized magnitude; 512 frames/block
0x07		float | float				Displacement (mm), velocity (mm/s); 1024 pairs/block
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

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 (default)
		0x20	0xE3	0x02		Set Measurement Range: 4 g | 20 g
		0x20	0xE3	0x03		Set Measurement Range: 8 g | 40 g
		0x20	0xE4	float (32-bit, little-endian)		Set g-Value (default 9.80665 m/s²)
		0x20	0xE5	0x01	0x01 | 0x02 | 0x03	FFT without windowing; 1024 samples. Byte 4: 0x01=X, 0x02=Y, 0x03=Z (default)
		0x20	0xE5	0x02	0x01 | 0x02 | 0x03	FFT with Parzen window
		0x20	0xE5	0x03	0x01 | 0x02 | 0x03	FFT with Welch window
		0x20	0xE5	0x04	0x01 | 0x02 | 0x03	FFT with Hanning window (default window)
		0x20	0xE5	0x05	0x01 | 0x02 | 0x03	FFT with Hamming window
		0x20	0xE5	0x06	0x01 | 0x02 | 0x03	FFT with Blackman window
		0x20	0xE6	0x01		Vector length (all sensitive directions)
		0x20	0xE6	0x02	0x01 | 0x02 | 0x03	Velocity and displacement; bandwidth from 10 Hz. Byte 4: 0x01=X, 0x02=Y, 0x03=Z (default)
		0x30	0x01	none		Get Sensor ID / Node ID
		0x30	0x02	none		Get Baudrate
		0x30	0x21	none		Get Sample Period
		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 256000 | 51200)		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 256000 | 51200)		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 256000 | 51200)		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

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 system 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

The smart sensor systems ASC AiSys® are working with many established data acquisition systems or communication protocols. However, make sure that a proper interface is used for the corresponding operation principle of the sensor system. 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 system is used within the specified electrical conditions
- Check all electrical connections prior to initial setup of the sensor system
- Completely shield the sensor system and connecting cable
- Do not perform any electrical modifications at the sensor system
- 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 system 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**.
- All ASC products are CE-compliant.

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