ASC IMU 7
Industrial Grade Inertial Measurement Unit

SPECIFICATIONS

- 6 DOF System
- Modular Concept – Measurement Range Selection
- MEMS Capacitive and Vibrating Ring Technology
- Measurement Range Accelerometers: ±2 to ±50 g
- Measurement Range Gyroscopes: ±75 to ±900 °/s
- Aluminum Housing
- Made in Germany

ANALOG INERTIAL MEASUREMENT UNITS

ASC's analog inertial measurement units are based on three accelerometers and three gyroscopes that are integrated in a single housing. The modular concept allows to adapt all IMUs to the exact requirements of the application. Two different types of accelerometer series (Low Noise and Medium Frequency) are available and ideal measurement ranges for the accelerometers and gyroscopes are selectable and combinable. The ASC IMU 7 features high bias stability and low angular random walk leading to industrial grade performance. The design of the micro-mechanical silicon structures makes the IMU extremely insensitive to external impacts and vibrations. They are therefore ideal suited for use in harsh environmental conditions.

DESCRIPTION

The inertial measurement unit (IMU) is based on proven MEMS accelerometers and gyroscopes for detecting the smallest linear accelerations and angular rates. The LN (Low Noise) accelerometers provide an outstanding noise performance from 7 to 50 µg/√Hz while the MF (Medium Frequency) accelerometers provide a wide frequency response range from 0 Hz to 4.5 kHz (±3 dB). The integrated electronic circuitry enables separate analog voltage outputs for all 6 degrees of freedom and flexible power supply voltage from 5 (LN) or 6 (MF) to 40 VDC. In addition, the gyroscopes providing a bias stability of 12 °/hr and an angular random walk of 0.2 °/√hr

The IMU feature a lightweight, reliable aluminum housing with protection class IP65 and a detachable connector cable with configurable length and connectors.

The compact design of the ASC IMU 7 allows its use in applications for evaluating the driving dynamics of ships, trains or motor vehicles. IMUs are also used in automated guided vehicles (AGV), where they help to optimize curve speed and to control driving performance.

FEATURES

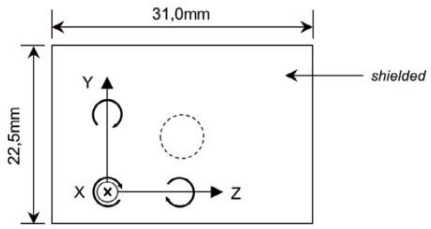
- Industrial Grade IMU
- Low Noise Analog Voltage Output Signal
- High Bias Stability
- Low Angular Random Walk
- Excellent Shock and Vibration Resistance

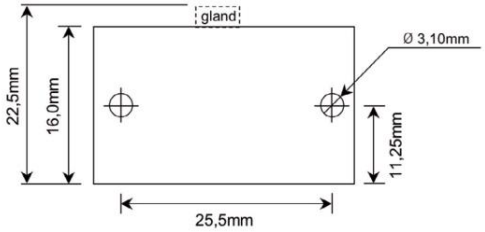
OPTIONS

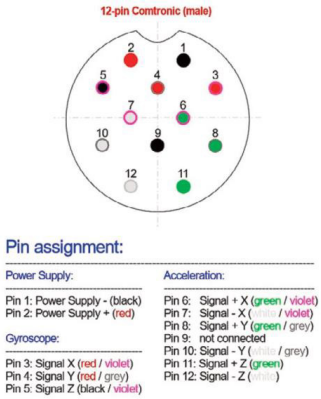
- Customized Cable Length
- Customized Connector
- Integrated Cable

APPLICATIONS

- Vehicle and Running Dynamics
- Driving and Ride Comfort Tests
- Short-term Bridging Navigation







TYPICAL SPECIFICATION OF THE IMU

An inertial measurement unit (IMU) is a 6-DOF system that measures linear and angular motion using a combination of accelerometers and gyroscopes. The MEMS based IMUs feature a range of precision inertial sensors, including:

- 3 LN (Low Noise) accelerometers (see detailed specification on page 3)
- **or** 3 MF (Medium Frequency) accelerometers (see detailed specifications on page 4)
- **and** 3 industrial grade gyroscopes (see detailed specifications on page 5)

The IMU thus outputs acceleration and angular rate signals in the form of an analog voltage signal. Due to the very good long-term stability and the low noise of the sensors used, it is possible to reliably obtain position changes in all 6 DOFs with high accuracy and repeatability.

Dynamic

Measurement Range (accelerometers)	g	±2 to ±50	
Measurement Range (gyroscopes)	°/s	±75 to ±900	

Electrical

Power Supply Voltage	V	LN: 6 to 40	MF: 5 to 40
Operating Current Consumption	mA	LN: < 40	MF : <35
Isolation		Case Isolated	

Environmental

Operating Temperature Range	°C	- 40 to +85
Storage Temperature Range	°C	- 40 to +100
Shock Limit (operating)	g	1000
Shock Limit (unpowered)	g	2000
Protection Class		IP65

Physical

Case Material		Anodized Aluminum
Connector Sensor Housing		12-pin Comtronic (male)
Connector at Cable End		Optional
Mounting		M3 Screws
Weight (without cable)	gram	26
Cable		30 gram per meter | AWG 30 | Polyurethane (PUR) | Diameter 4.5 mm

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DETAILED TYPICAL SPECIFICATION OF THE LN ACCELEROMETERS

The key components of the capacitive accelerometers are high-quality micro-electro-mechanical systems (MEMS) that feature excellent long-term stability and reliability. 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 ±50 g within a frequency response range up to 2.1 kHz (±3 dB) and a noise performance <50 µg/√Hz. Other advantages of capacitive accelerometers are their outstanding temperature stability, excellent response behavior and achievable resolution.

Dynamic

Measurement Range	g	±2	±5	±10	±25	±50
Scale Factor (sensitivity)	mV/g	2000	800	400	160	80
Noise Density	µg/√Hz	7	12	18	25	50
Frequency Response Range (±5 %)	Hz	0 to 250	0 to 400	0 to 700	0 to 1300	0 to 1600
Frequency Response Range (±3 dB)	Hz	0 to 525	0 to 800	0 to 1100	0 to 1750	0 to 2100
Amplitude Non-Linearity	% FSO	<0.15 (typ) | <0.5 (max)				
Transverse Sensitivity	%	<2 (typ) | <3 (max)				

Electrical

Full Scale Output (differential mode)	V	±4.0				
Positive (signal +), Analog Output Voltage Signal Range	V	0.5 to 4.5				
Negative (signal -), Analog Output Voltage Signal Range	V	0.5 to 4.5				
Offset (bias)	mV	±80	±80	±40	±40	±40
Broadband Noise (over specified frequency range ±5 %)	µV	225	195	190	145	160
Output Impedance	Ω	90				

Environmental

Temperature Coefficient of the Scale Factor (max)	ppm/K	±200				
Temperature Coefficient of the Offset (max)	mg/K	±0.8	±2	±4	±10	±20

Physical

Sensing Element	MEMS Capacitive

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DETAILED TYPICAL SPECIFICATION OF THE MF ACCELEROMETERS

The key components of the capacitive accelerometers are high-quality micro-electro-mechanical systems (MEMS) that feature excellent long-term stability and reliability. 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 ±50 g within a frequency response range up to 4.5 kHz (±3 dB) and a noise performance <170 µg/√Hz. Other advantages of capacitive accelerometers are their outstanding temperature stability, excellent response behavior and achievable resolution.

Dynamic

Measurement Range	g	±2	±5	±10	±30	±50
Scale Factor (sensitivity)	mV/g	1350	540	270	90	54
Noise Density	µg/√Hz	10	20	35	100	170
Frequency Response Range (±5 %)	Hz	0 to 700	0 to 1150	0 to 2000	0 to 2300	0 to 2700
Frequency Response Range (±3 dB)	Hz	0 to 1150	0 to 1900	0 to 3200	0 to 4000	0 to 4500
Amplitude Non-Linearity	% FSO	<0.1 (typ) | <0.3 (max)				
Transverse Sensitivity	%	<1				

Electrical

Full Scale Output (differential mode)	V	±2.7				
Positive (signal +), Analog Output Voltage Signal Range	V	0.3 to 3.0				
Negative (signal -), Analog Output Voltage Signal Range	V	0.3 to 3.0				
Offset (bias)	mV	±10				
Broadband Noise (over specified frequency range ±5 %)	µV	250	310	410	440	475
Resistive Load	kΩ	1000				

Environmental

Temperature Coefficient of the Scale Factor (typ)	ppm/K	120				
Temperature Coefficient of the Scale Factor (max)	ppm/K	20 to 220				
Temperature Coefficient Of the Offset (max)	mg/K	±0.2	±0.5	±1	±3	±5

Physical

Sensing Element	MEMS Capacitive

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DETAILED TYPICAL SPECIFICATION OF THE GYROSCOPES

The key components of the tactical grade gyroscopes are high-quality micro-electro-mechanical systems (MEMS) that feature excellent long-term stability and reliability. The design of the micro-mechanical silicon structures makes the gyroscopes extremely insensitive to external impacts and vibrations. They are therefore ideal suited for use in harsh environmental conditions. Due to their very high performance, the gyroscopes fulfill the requirements of tactical grade applications with respect to the maximum achievable precision, which otherwise can be achieved only with fiber optic gyroscopes (FOG).

Dynamic

Measurement Range	°/s	±75	±150	±300	±900
Scale Factor (sensitivity)	mV/°/s	13.2	6.6	3.3	1.1
Rate Noise Density	°/s/√Hz	0.018 (typ) | 0.025 (max)			
Bandwidth	Hz	150			
Amplitude Non-Linearity	% FSO	0.06 (typ) | 0.15 (max)			
Bias Stability	°/hr	12			
Angular Random Walk	°/√hr	0.2			

Electrical

Full Scale Output (quasi -differential mode)	V	±0.99
Analog Output Voltage Signal Range	V	0.66 to 2.64
Offset (bias) referred to Reference Output Voltage	V	1.65 ± 0.08

Environmental

Scale Factor Error over Temperature Range (typ)	%	±0.5
Scale Factor Error over Temperature Range (max)	%	±1.5
Offset (bias) Error over Temperature Range (typ)	°/s	±1
Offset (bias) Error over Temperature Range (max)	°/s	±3
Vibration induced Noise	°/s/g^2	0.060 (typ) | 0.072 (max)
Vibration Rectification Error	°/s/g^2	0.001 (typ) | 0.003 (max)
g-Sensitivity	°/s/g	0.080 (typ) | 0.200 (max)

Physical

Sensing Element	MEMS Vibrating Ring

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SENSOR CALIBRATION OF THE LN ACCELEROMETERS

Factory Calibration (supplied with the sensor)

Part Number						
Measurement Range (sensor)	g	±2	±5	±10	±25	±50
Applied Frequency (min)	Hz	1	10	10	10	10
Applied Frequency (max)	Hz	100	400	700	1300	1600
Input Amplitude	m/s^2	5	5	50	100	200
Reference Frequency for Determination of Scale Factor	Hz	16	80	80	80	80

Calibration according DIN ISO 17025 (order separately)

Part Number						
Measurement Range (sensor)	g	±2	±5	±10	±25	±50
Applied Frequency (min)	Hz	0.5	10	10	10	10
Applied Frequency (max)	Hz	150	800	1100	1750	2100
Input Amplitude	m/s^2	5	5	50	100	200
Reference Frequency for Determination of Scale Factor	Hz	16	80	80	80	80

The c onversion factor 1g corresponds to 9.80665 m/s^2. If any other calibration procedure is required, don't hesitate to contact us. Furthermore, sensors have to be calibrated regularly to ensure accurate and precise results. Our services include both factory calibration and calibration in accordance with DAkkS guidelines. On request we will be glad to remind you of the next scheduled calibration of your sensors.

SENSOR CALIBRATION OF THE MF ACCELEROMETERS

Factory Calibration (supplied with the sensor)

Part Number						
Measurement Range (sensor)	g	±2	±5	±10	±30	±50
Applied Frequency (min)	Hz	1	10	10	10	10
Applied Frequency (max)	Hz	100	1150	2000	2300	2700
Input Amplitude	m/s^2	5	5	50	100	200
Reference Frequency for Determination of Scale Factor	Hz	16	80	80	80	80

Calibration according DIN ISO 17025 (order separately)

Part Number						
Measurement Range (sensor)	g	±2	±5	±10	±30	±50
Applied Frequency (min)	Hz	0.5	10	10	10	10
Applied Frequency (max)	Hz	150	1900	3200	4000	4500
Input Amplitude	m/s^2	5	5	50	100	200
Reference Frequency for Determination of Scale Factor	Hz	16	80	80	80	80

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SENSOR CALIBRATION – GYROSCOPES

Factory Calibration (supplied with the sensor)

Part Number		#16148	#16149	#16150	#16151
Measurement Range (sensor)	°/s	75	150	300	900
Applied Frequency (min)	Hz	1	1	1	1
Applied Frequency (max)	Hz	100	100	100	100
Input Amplitude	°/s	35	75	150	450
Reference Frequency for Determination of Scale Factor	Hz	16	16	16	16

Calibration according DIN ISO 17025 (order separately)

Part Number					
Measurement Range (sensor)	°/s	75	150	300	900
Applied Frequency (min)	Hz	1	1	1	1
Applied Frequency (max)	Hz	100	100	100	100
Input Amplitude	°/s	35	75	150	450
Reference Frequency for Determination of Scale Factor	Hz	16	16	16	16

CABLE CODE / PIN CONFIGURATION (12 WIRE SYSTEM) INCLUDING COMMON POWER SUPPLY FOR ALL AXES

12-Pin Sensor Connector (male)		Color Code ASC AK - IMU 7	Description	
1	Supply +	Red	Power:	supply voltage LN: +6 to +40 VDC supply voltage MF: +5 to +40 VDC
2	Supply -	Black	Power:	GND
3	Gyro Signal	Red/Violet	X- Axis:	single -ended analog output voltage signal
4	Gyro Signal	Red/Grey	Y- Axis:	single -ended analog output voltage signal
5	Gyro Signal	Black/Violet	Z- Axis:	single -ended analog output voltage signal
6	Acc Signal +	Green/Violet	X- Axis:	positive, analog output voltage signal for differential mode
7	Acc Signal -	White/Violet	X- Axis:	negative, analog output voltage signal for differential mode
8	Acc Signal +	Green/Grey	Y- Axis:	positive, analog output voltage signal for differential mode
9	nc	---	---	Not connected
10	Acc Signal -	White/Grey	Y- Axis:	negative, analog output voltage signal for differential mode
11	Acc Signal +	Green	Z- Axis:	positive, analog output voltage signal for differential mode
12	Acc Signal -	White	Z- Axis:	negative, analog output voltage signal for differential mode

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ORDERING INFORMATION

Series	.	Range Accelerometer [g]	Type Accelerometer	.	Range Gyroscope [°/s]
ASC IMU 7		002	LN (Low Noise)		075
		005	MF (Medium Frequency)		150
		010			300
		025 (LN accelerometer only)			900
		030 (MF accelerometer only)			
		050			

Example:

ASC IMU 7.002LN.075

Ordering information are based on standard configurations. All customized versions will lead to a change or extension of the corresponding product match code.

All types of ASC IMU 7 are fabricated for operating with a detachable connector cable which is part of the product but needs to be ordered separately. For connecting the sensor housing , a 12-pin Comtronic connector (female) is used and already assembled. Furthermore, the cable features different options like configurable length, integrating a cable switch or connectors at the cable end including customized pin configuration. Please contact us for further information.

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
- 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 pictured DAkkS -ILAC logo refers exclusively to the accredited service.
- All ASC products are CE - compliant.

DAkkS Deutsche Akkreditierungsstelle D-K-18110-01-00