GEMAC Motus®
Product overview

GEMAC Motus® GREENLINE	GEMAC Motus® BLACKLINE	GEMAC Motus®

		accuracy [1]	GEMAC Motus® GREENLINE	GEMAC Motus® BLACKLINE	GEMAC Motus®
Performance Class	E economic	static	±0.1° to ±0.5°	-	-
		dynamic	±0.8°	-	-
	B basic	static	-	±0.3°	±0.3°
		dynamic	-	±0.5°	±0.5°
	C classic	static	-	±0.1°	±0.1°
		dynamic	-	±0.5°	±0.25°

Product variants of GEMAC Motus®														
X Inertial measurement unit (IMU)									XE	XB	XB	XC	XC	IB
N Inclination sensor dynamic				NE	NB	NB	NC	NC						
S Inclination sensor static	SE	SB	SC											
Inclination, Accelerometer, Gyroscope														
Measurement range Inclination [2]	±90°/ ±180° (360°)													-
Measurement range Accelerometer	-	-	-	-	-	-	-	-	±2 g	±8 g	±8 g	±8 g	±8 g	±8 g
Measurement range Gyroscope	-	-	-	-	-	-	-	-	±250 °/s	±250 °/s	±250 °/s	±250 °/s	±250 °/s	±250 °/s
Static accuracy [1]	±0.1° to 0.5°	±0.3°	±0.1°	±0.1° to 0.5°	±0.3°	±0.3°	±0.1°	±0.1°	±0.5°	±0.3°	±0.3°	±0.1°	±0.1°	-
Dynamic accuracy [1]	-	-	-	±0.8°	±0.5°	±0.5°	±0.5°	±0.25°	±0.8°	±0.5°	±0.5°	±0.5°	±0.25°	-
In run bias stability	-	-	-	-	-	-	-	-	10°/h	5 °/h	2.5 °/h	5 °/h	2.5 °/h	2.5 °/h
Angle Random Walk (ARW)	-	-	-	-	-	-	-	-	0.4 °/√h	0.2 °/√h	0.1 °/√h	0.2 °/√h	0.1 °/√h	0.1 °/√h
Interface	CAN, CANopen, SAE J1939, Current 4...20 mA, Voltage 0...10 V								CAN, CANopen, SAE J1939					

[1] incl. compensated cross sensitivity [2] up to 2 measuring axes with configurable orientation

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GEMAC Motus®
Order overview

		Performance Class - E economic			
S Inclination sensor static	Stat. accuracy	±0.1° to ±0.5°			
	Dyn. accuracy	-			
	Product line	**GREENLINE**			
	Specification	4-hole variant		2-hole variant	
	Meas. range	+/- 90°	±180° (360°)	+/- 90°	±180° (360°)
	Axis	2D	1D	2D	1D
	CAN	PR-28038-00-00		PR-28028-00-00	
	CANopen	PR-28138-00-00		PR-28128-00-00	
	SAE J1939	PR-28738-00-00		PR-28728-00-00	
	Current	PR-28438-00-00	PR-28437-00-00	PR-28428-00-00	PR-28427-00-00
	Voltage	PR-28538-00-00	PR-28537-00-00	PR-28528-00-00	PR-28527-00-00
N Inclination sensor dynamic	Stat. accuracy	±0.1° to ±0.5°			
	Dyn. accuracy	±0.8°			
	Product line	**GREENLINE**			
	Specification	4-hole variant		2-hole variant	
	Meas. range	+/- 90°	±180° (360°)	+/- 90°	±180° (360°)
	Axis	2D	1D	2D	1D
	CAN	PR-28034-00-00		PR-28024-00-00	
	CANopen	PR-28134-00-00		PR-28124-00-00	
	SAE J1939	PR-28734-00-00		PR-28724-00-00	
	Current	PR-28434-00-00	PR-28430-00-00	PR-28424-00-00	PR-28420-00-00
	Voltage	PR-28534-00-00	PR-28530-00-00	PR-28524-00-00	PR-28520-00-00
X/I Inertial measurement unit / IMU	Stat. accuracy	±0.5°			
	Dyn. accuracy	±0.8°			
	Product line	**GREENLINE**			
	Specification	4-hole variant		2-hole variant	
	Meas. range	+/- 90°	±180° (360°)	+/- 90°	±180° (360°)
	CAN	PR-28036-00-00		PR-28026-00-00	
	CANopen	PR-28136-00-00		PR-28126-00-00	
	SAE J1939	PR-28736-00-00		PR-28726-00-00	

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GEMAC Motus®
Order overview

		Performance Class - B basic			Performance Class - C classic		
S Inclination sensor static	Stat. accuracy	±0.3°			±0.1°		
	Dyn. accuracy	-			-		
	Product line	**BLACKLINE**			**BLACKLINE**		
	Specification						
	Meas. range	to ±180° (360°)			to ±180° (360°)		
	Axis	1D/2D			1D/2D		
	CAN	PR-26048-30-00			PR-27048-30-00		
	CANopen	PR-26148-30-00			PR-27148-30-00		
	SAE J1939	PR-26748-30-00			PR-27748-30-00		
	Current	PR-26448-00-00			PR-27448-00-00		
	Voltage	PR-26548-00-00			PR-27548-00-00		
N Inclination sensor dynamic	Stat. accuracy	±0.3°	±0.3°	±0.3°	±0.1°	±0.1°	±0.1°
	Dyn. accuracy	±0.5°	±0.5°	±0.5°	±0.5°	±0.25°	±0.25°
	Product line	**BLACKLINE**	**GEMAC Motus®**	**GEMAC Motus®**	**BLACKLINE**	**GEMAC Motus®**	**GEMAC Motus®**
	Specification						
	Meas. range	to ±180° (360°)	+/- 90°	±180° (360°)	to ±180° (360°)	+/- 90°	±180° (360°)
	Axis	1D/2D	2D	1D	1D/2D	2D	1D
	CAN	PR-26044-30-00	PR-26014-30	PR-26010-30	PR-27044-30-00	PR-27014-30	PR-27010-30
	CANopen	PR-26144-30-00	PR-26114-30	PR-26110-30	PR-27144-30-00	PR-27114-30	PR-27110-30
	SAE J1939	PR-26744-30-00	PR-26714-30	PR-26710-30	PR-27744-30-00	PR-27714-30	PR-27710-30
	Current	PR-26444-00-00	PR-26414-00	PR-26410-00	PR-27444-00-00	PR-27414-00	PR-27410-00
	Voltage	PR-26544-00-00	PR-26514-00	PR-26510-00	PR-27544-00-00	PR-27514-00	PR-27510-00
X/I Inertial measurement unit / IMU	Stat. accuracy	±0.3°	-	±0.3°	±0.1°	±0.1°	
	Dyn. accuracy	±0.5°	-	±0.5°	±0.5°	±0.25°	
	Product line	**BLACKLINE**	**GEMAC Motus®**	**GEMAC Motus®**	**BLACKLINE**	**GEMAC Motus®**	
	Specification		without inclination	with inclination			
	Meas. range	to ±180° (360°)	to ±180° (360°)	to ±180° (360°)	to ±180° (360°)	to ±180° (360°)	
	CAN	PR-26046-30-00	PR-26015-30	PR-26016-30	PR-27046-30-00	PR-27016-30	
	CANopen	PR-26146-30-00	PR-26115-30	PR-26116-30	PR-27146-30-00	PR-27116-30	
	SAE J1939	PR-26746-30-00	PR-26715-30	PR-26716-30	PR-27746-30-00	PR-27716-30	

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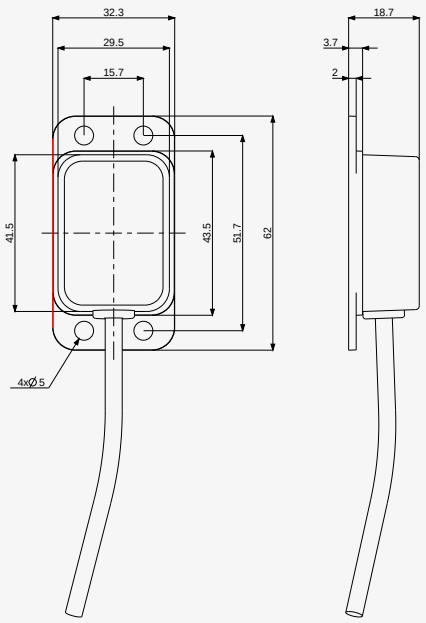
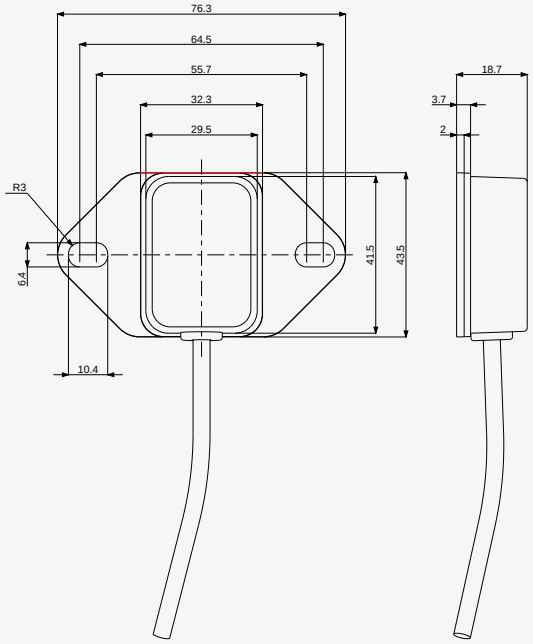
GEMAC Motus®
Product overview

GEMAC Motus® GREENLINE

Product line	GEMAC Motus® GREENLINE 4-hole variant	GEMAC Motus® GREENLINE 2-hole variant
Dimensions	62 x 32.3 x 18.7 mm (without cable)	43.5 x 76.3 x 18.7 mm (without cable)
Weight	approx. 30 g (without cable)	approx. 30 g (without cable)
Housing material	plastic (PA)	plastic (PA)
		

Dimensions of all housing variants

Product line	GEMAC Motus® GREENLINE 2-hole variant	GEMAC Motus® GREENLINE 4-hole variant	GEMAC Motus® BLACKLINE	GEMAC Motus®
Dimensions	43.5 x 76.3 x 18.7 mm (without cable)	62 x 32.3 x 18.7 mm (without cable)	121 mm x 66 mm x 30 mm	114 mm x 66 mm x 30 mm
Weight	approx. 30 g (without cable)	approx. 30 g (without cable)	approx. 200 g	approx. 330 g
Housing material	plastic (PA)	plastic (PA)	plastic (PA)	zinc die casting, nickel plated

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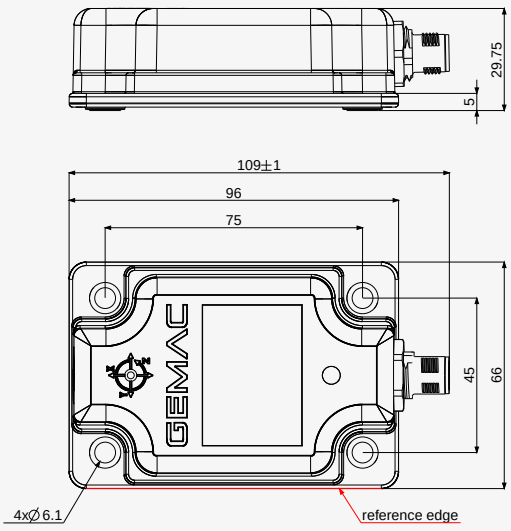
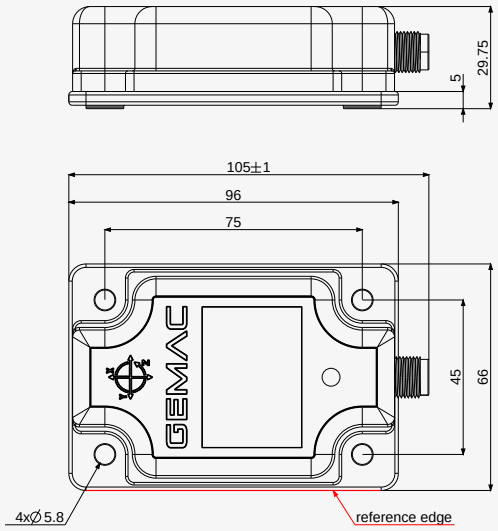
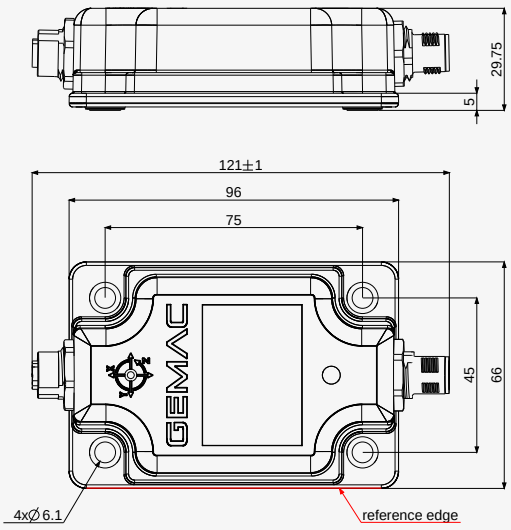
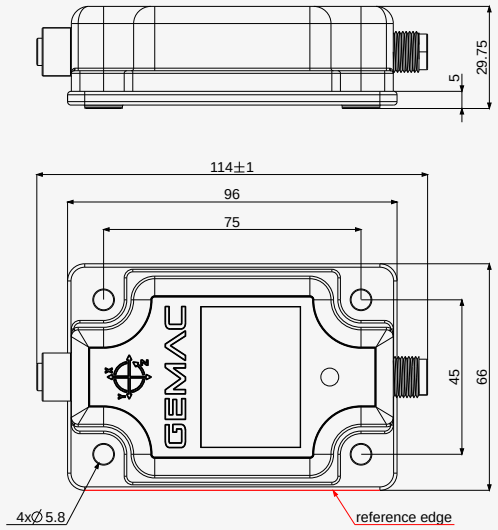
GEMAC Motus®
Product overview

GEMAC Motus® BLACKLINE

GEMAC Motus®

Product line	GEMAC Motus® BLACKLINE	GEMAC Motus®
Dimensions	121 mm x 66 mm x 30 mm	114 mm x 66 mm x 30 mm
Weight	approx. 200 g	approx. 330 g
Housing material	plastic (PA)	zinc die casting, nickel plated
analog		
digital		

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GEMAC Motus® GREENLINE

The FIRST POWER-IMU for Mobile POWER-Machines

GEMAC Motus® ***GREENLINE*** with its slim design puts the focus above all on flexibility and price. With the two standard housing variants available for 2- or 4-point mounting, the user gains more independence from the existing hole patterns on the mobile machine. Customerspecific mounting variants are possible on request.

With a static accuracy of ±0.5° the **GEMAC Motus®** ***GREENLINE*** offers a wide range of applications, e.g. in **agriculture and forestry, crane and lifting technology, industrial trucks** and **industrial automation**.

Other variants of the **GEMAC Motus®** ***GREENLINE*** are also capable of measuring inclination in dynamic processes via a sensor fusion algorithm developed in-house by GEMAC.

The **GEMAC Motus®** ***GREENLINE*** portfolio is rounded off by IMU cost effective solutions, which, in addition to inclination, also measure acceleration and rotation rate in all 3 axes via the digital interface.

The sensor measuring units can be parameterized very conveniently via a programming kit and enable the user to optimally match his applications with the sensors to the existing technical requirements.

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GEMAC Motus® GREENLINE variants

- Recording of static inclination:
  GEMAC Motus® *GREENLINE* SE
- Recording of static and dynamic inclination:
  GEMAC Motus® *GREENLINE* NE
- Recording of inclination (static and dynamic), acceleration and rotation rate:
  GEMAC Motus® *GREENLINE* XE

Variants	SE	NE
General parameters	Inclination static	Inclination static and dynamic
Measurement range digital	±90°/ ±180° (360°) [2]	±90°/ ±180° (360°) [2]
Measurement range analog	±5° to ±180° (360°) [2]	±5° to ±180° (360°) [2]
Resolution digital	0.01°	0.01°
Resolution analog	0.01° to 0.1°	0.01° to 0.1°
Temperature coefficient	±0.02 °/K	±0.02 °/K
Static accuracy [1]	±0.1° to ±0.5°	±0.1° to ±0.5°
Dynamic accuracy [1]		±0.8°
Interface	CAN, CANopen, SAE J1939, Current 4...20 mA, Voltage 0...10 V	

Note:
Resolution and accuracy depend on the measuring range of the sensor. With a lower measuring range, a higher resolution and accuracy are achieved (with default settings, see minimum values in table). The number of measuring axes (max. 2), their axis assignment, measuring range and range of the analog output are preconfigured in the factory or can be parameterized by the customer.

Variants	XE		
General parameters	Inclination	Accelerometer	Gyroscope
Measurement range	±90°/ ±180° (360°) [2]	±2 g	±250 °/s
Resolution	0.01°	0.488 mg	0.035 °/s
Temperature coefficient	±0.02 °/K	0.4 mg/K	0.02 °/s/K
Static accuracy [1]	±0.5°		
Dynamic accuracy [1]	±0.8°		
In run bias stability			10°/h
Angle Random Walk (ARW)			0.4 °/√h
Interface	CAN, CANopen, SAE J1939		

[1] incl. compensated cross sensitivity [2] up to 2 measuring axes with configurable orientation

Available interfaces:

- CAN 2.0 A and B (11- and 29-Bit-ID) according ISO 11898-2
- CANopen according CiA DS-301, profile according CiA DSP-410
- SAE J1939, configurable process data
- Starter kit (including programming adapter, cables and PC software)
- Analog: Current (4...20 mA), Voltage (0...10 V), customized values on request
- Output linearized or non-linearized (configurable)

Mechanical parameters:

Connector: cable (0.2 m) with sensor connector M12 5-pole, A-coded (customer-specific connection variants on request)
Degree of protection: IP6K7/IP6K9K, Operating temperature: -40 °C to +80 °C
Dimensions and weight: 4-hole variant 62 x 32.3 x 18.7 mm (without cable), 2-hole variant 43.5 x 76.3 x 18.7 mm (without cable), approx. 30 g without cable
Housing material: plastic (PA)

Electrical parameters:

Supply Voltage: 11 V to 30 V (in some cases from 7.5 V)
Current consumption at 24 V: approx. 12 mA (digital), max. 70 mA (analog)

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GEMAC Motus® BLACKLINE

The FIRST POWER-IMU for Mobile POWER-Machines

GEMAC Motus® ***BLACKLINE*** expands the portfolio of the GEMAC Motus® sensor generation with additional high-precision sensor variants.

The configurable sensor measuring unit GEMAC Motus® enables 6-axis motion detection on Mobile POWER-Machines, such as **construction machinery, agricultural and forestry machinery, cranes and lifting technology**, as well as **ships**.

GEMAC Motus® ***BLACKLINE*** also offers cost-effective variants in plastic housing and different accuracy types.

Our in-house developed sensor fusion algorithm with the **„Enhanced Kalman Filter“** specially optimized for motion detection takes over the highly accurate orientation calculation and is even more robust. It enables the correction of nonlinear disturbances and thus even better damping of external accelerations or vibrations.

The accuracy of the inclination measurement includes a compensated cross-sensitivity and is independent of the local gravity field due to the 3D measurement.

- Automatic adaptation of the filter parameters according to the motion state of the sensor
- Improved offset correction of the gyroscope
- Increased user-friendliness through simplification of sensor configuration

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GEMAC Motus® BLACKLINE variants

- Recording of static inclination:
  GEMAC Motus® *BLACKLINE* SB and SC
- Recording of static and dynamic inclination:
  GEMAC Motus® *BLACKLINE* NB and NC
- Recording of inclination (static and dynamic), acceleration and rotation rate:
  GEMAC Motus® *BLACKLINE* XB and XC

Variants	SB	SC	NB	NC
General parameters	Inclination static		Inclination static and dynamic	
Measurement range	±90°/ ±180° (360°) [2]		±90°/ ±180° (360°) [2]	
Resolution	0.01°		0.01°	
Temperature coefficient	±0.01 °/K	±0.0016 °/K	±0.01 °/K	±0.0016 °/K
Static accuracy [1]	±0.3°	±0.1°	±0.3°	±0.1°
Dynamic accuracy [1]	-	-	±0.5°	±0.5°
Interface	CAN, CANopen, SAE J1939, Current 4...20 mA, Voltage 0...10 V			

Variants	XB			XC		
General parameters	Inclination	Accelerometer	Gyroscope	Inclination	Accelerometer	Gyroscope
Measurement range	±90°/ ±180° (360°) [2]	±8 g	±250 °/s	±90°/ ±180° (360°) [2]	±8 g	±250 °/s
Resolution	0.01°	0.244 mg	0.00875 °/s	0.01°	0.244 mg	0.00875 °/s
Temperature coefficient	±0.01 °/K	0.2 mg/K	0.01 °/s/K	±0.0016 °/K	0.02 mg/K	0.01 °/s/K
Static accuracy [1]	±0.3°			±0.1°		
Dynamic accuracy [1]	±0.5°			±0.5°		
In run bias stability			5 °/h			5 °/h
Angle Random Walk (ARW)			0.2 °/√h			0.2 °/√h
Interface	CAN, CANopen, SAE J1939					

[1] incl. compensated cross sensitivity [2] up to 2 measuring axes with configurable orientation

Range of functions:

- Automatic adaptation of the filter parameters according to the motion state of the sensor
- Improved offset correction of the gyroscope
- More user-friendliness through simplification of sensor configuration
- Automatic configuration of the mounting position
- Flexible zero point adjustment
- Expert mode with advanced setting options
- Individual configuration of the sensor fusion

Available interfaces:

- CAN 2.0 A and B (11- and 29-Bit-ID) according ISO 11898-2
- CANopen according CiA DS-301, profile according CiA DSP-410
- SAE J1939, configurable process data
- Analog: Current (4...20 mA), Voltage (0...10 V)

- Starter kit (including programming adapter, cables and PC software)

Mechanical parameters:

Connector: 1 or 2 sensor connectors M12 5-pole, A-coded
Degree of protection: IP6K7/IP6K9K,
Operating temperature: -40 °C to +85 °C
Dimensions and weight: 121 mm x 66 mm x 30 mm, approx. 200 g
Housing material: plastic (PA)

Electrical parameters:

Supply Voltage: 10 V to 36 V (in some cases from 7.5 V)
Current consumption at 24 V: approx. 12 mA (digital), max. 70 mA (analog)

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GEMAC Motus®

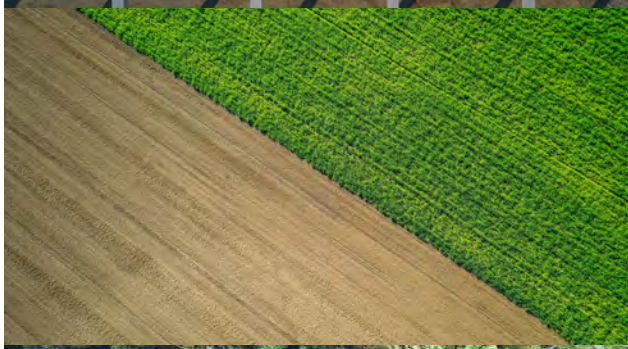
The *FIRST* POWER-*IMU* for Mobile POWER-Machines

NEW! With an extended range of functions

Our configurable sensor measuring unit GEMAC Motus® enables 6-axis motion detection on Mobile POWER-Machines, such as **construction machinery, agricultural and forestry machinery, cranes and lifting technology**, as well as **ships**. Our proprietary **sensor fusion algorithm** performs high-precision orientation calculation, supported by sensor fusion filters that suppress external accelerations. The combination and calculation of the six measured values mean that only one measuring system needs to be integrated for a wide range of requirements.

The accuracy of the inclination measurement includes a compensated cross-sensitivity and is independent of the local gravity field due to the 3D measurement.

GEMAC Motus® stands for the highest performance in the high-precision recording and digitization of movements with the aim of guaranteeing the greatest possible safety when using Mobile POWER-Machines. The design and functionality also ensure maximum durability and economy.



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GEMAC Motus® variants

- Recording of inclination:
  GEMAC Motus® NB and NC
- Recording of acceleration and rotation rate:
  GEMAC Motus® IB
- Recording of inclination, acceleration and rotation rate:
  GEMAC Motus® XB und XC

Variants	NB	NC	IB	
General parameters	Inclination		Accelerometer	Gyroscope
Measurement range	±90°/ ±180° (360°) [2]		±8 g	±250 °/s
Resolution	0.01°		0.244 mg	0.00875 °/s
Temperature coefficient	±0.01 °/K	±0.0016 °/K	0.2 mg/K	0.005 °/s/K
Static accuracy [1]	±0.3°	±0.1°		
Dynamic accuracy [1]	±0.5°	±0.25°		
In run bias stability				2.5 °/h
Angle Random Walk (ARW)				0.1 °/√h
Interface	CAN, CANopen, SAE J1939, Current, Voltage		CAN, CANopen, SAE J1939	

Variants	XB			XC		
General parameters	Inclination	Accelerometer	Gyroscope	Inclination	Accelerometer	Gyroscope
Measurement range	±90°/ ±180° (360°) [2]	±8 g	±250 °/s	±90°/ ±180° (360°) [2]	±8 g	±250 °/s
Resolution	0.01°	0.244 mg	0.00875 °/s	0.01°	0.244 mg	0.00875 °/s
Temperature coefficient	±0.005 °/K	0.2 mg/K	0.005 °/s/K	±0.0016 °/K	0.02 mg/K	0.005 °/s/K
Static accuracy [1]	±0.3°			±0.1°		
Dynamic accuracy [1]	±0.5°			±0.25°		
In run bias stability			2.5 °/h			2.5 °/h
Angle Random Walk (ARW)			0.1 °/√h			0.1 °/√h
Interface	CAN, CANopen, SAE J1939			CAN, CANopen, SAE J1939		

[1] incl. compensated cross sensitivity
[2] up to 2 measuring axes with configurable orientation

NEW! With an extended range of functions

- Automatic configuration of the mounting position
- Flexible zero point adjustment
- Expert mode with extended setting options
- Configuration of the sensor fusion
- Configuration of the output data with SAE J1939
- CANopen autostart

Available interfaces:

- CAN 2.0 A and B (11- and 29-Bit-ID) according ISO 11898-2
- CANopen according CiA DS-301, profile according CiA DSP-410
- SAE J1939, configurable process data
- Starter kit (including programming adapter, cables and PC software)
- Analog: Current (4 ... 20 mA), Voltage (0 ... 10 V)

Mechanical parameters:

Connector: 1 or 2 sensor connectors M12 5-pole, A-coded
Degree of protection: IP6K7/IP6K9K, Operating temperature: -40 °C to +85 °C
Dimensions and weight: 114 mm x 66 mm x 30 mm, approx. 330 g
Housing material: zinc die casting, nickel plated

Electrical parameters:

Supply Voltage: 10 V to 36 V (in some cases from 7.5 V)
Current consumption at 24 V: approx. 12 mA (digital), max. 70 mA (analog)

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