



1 / 2 Axis Tilt Measuring System NM1 / NM2-4L



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■ 1 General Information

To ensure reliable and safe operation, the measuring amplifier must be operated in compliance with the specifications according to this technical description only. These regulations must also be observed if using accessories, that have been ordered from Althen Mess- & Sensortechnik GmbH together with the measuring amplifier.

Notice: Every person who is in charge for the start-up or service of this measuring amplifier must have read this technical manual and must have understood the safety instructions in particular.

■ 1.1 Safety Instructions

When using the amplifier, the legal- and safety regulations for each case of application must be observed. To avoid risks for the system or the operator the following points are to be considered.

- If any visual damage or malfunctions are noticed, the measuring system must be switched off and marked appropriately.
- Disconnect the supply voltage before opening the device.
- The complete measuring unit must be protected against contact and influence of unauthorized persons.
- In the case of a safety-relevant application, where a potential malfunction could cause damage to property or persons, it is imperative that an additional, independent monitor is provided.
- In combination with sensors, the maximum loads / pressures etc. must never be exceeded.

If you have reasons to assume that safe operation is no longer possible, immediately take the device out of operation and secure it against unintentional operation.

■ 1.2 Qualified Personnel

This measuring system must be operated by qualified personnel and in compliance with the relevant technical specifications only. Qualified personnel include such persons who are conversant with the setting up, mounting and starting up of the measuring system and who have qualifications that are appropriate for the tasks they're about to perform.

■ 1.3 Intended Use

Amplifiers from Althen Mess- & Sensortechnik GmbH serve to measure the intended measurand and the evaluation thereof in combination with one or more sensors. Any other use over and above that is regarded as non-intended use.

■ 2 Instructions for use of the measuring amplifier

Notice: The parameterizations, closer information concerning the scaling as well as the customized analogue output can be found on the additional sheet "Device-Configuration".

Since this amplifier is a highly sensitive measurement technology product, it must be used for its intended use as well as the described operating conditions only. Initial start-up and changes in setup and settings must be done by qualified personnel only. To prevent interventions / modifications made by unauthorized personnel, suitable measures must be taken. Both function and calibration must be checked regularly.

The amplifier must be operated with a separate power source used for measurement devices only. Shielded cables, preferably twisted in pairs should be used only. The EMC-installation instructions must be complied with.

The amplifier is contained in an aluminum housing which is equipped with an EMC- cover gasket as well as EMC-cable glands. After initial start-up the lid is to be closed properly.

The tilt measuring system must be connected to clean earth-potential. Please refer to the EMC-Mounting-Instructions in order to connect the sensor-shields correctly. To avoid possible potential equalization currents over the shield of the cable to the following evaluation unit, this shield should be connected over a suitable capacitor (10 nF / 200 V).

Overall the shield connections must be done properly to EMC-standards (as short as possible with large wire cross-section) and connected to a central point (star grounding). In order to not increase the disturbance sensitivity of the amplifier, all cables should be kept as short as possible and should not be extended. Possible cable-bound disturbances (i.e. noise) must be blocked very near the cable ends (evaluation unit) by suitable measures.

If it is to be expected that the amplifier is, as example, cleaned with a high-pressure cleaner/ steam jet an additional protection shall be provided.

Notice: Changes of the measuring system of any kind demand for the explicit approval of Althen Mess- & Sensortechnik GmbH. Changes of any kind done without that approval exclude all possible warranty and/or liability of Althen Mess- & Sensortechnik GmbH.

Please note that the tilt measuring system responds not to inclination changes only, but as well to vibrations and to acceleration forces. If necessary and been ordered, a low pass filter can be installed.

The one axis tilt measuring system is intended for sidewall montage.

The dual axis tilt measuring system is intended for base montage.

■ 3 Technical Description

The described tilt measuring system is either a single-, or dual axis version. Each measuring channel is in 4-wire technology. Which means there's 2 wires for supply and 2 galvanically isolated ones for the signal.

The input stage of the system is a precision difference amplifier with an input resistance of more than 3 Megaohms.

The on-board tilt sensor, type AccuStar, is supplied with an internal voltage of 10 V. The output signal has a ground reference. With a tilt of 0 degrees the output signal of the sensor is 2,5 V. The signal, which is 33 mV per degree tilt, is amplified to an analogue output of either 0 ... 10 Volt, ± 10 Volt, 0 ... 20 mA or 4 ... 20 mA.

The system supply voltage is galvanically isolated from the internal supply for the sensor and the analogue output.

A deviation of the zero-point of max. ± 1.5 degrees may be corrected with the N-potentiometer.

■ 4 Terminal Assignment

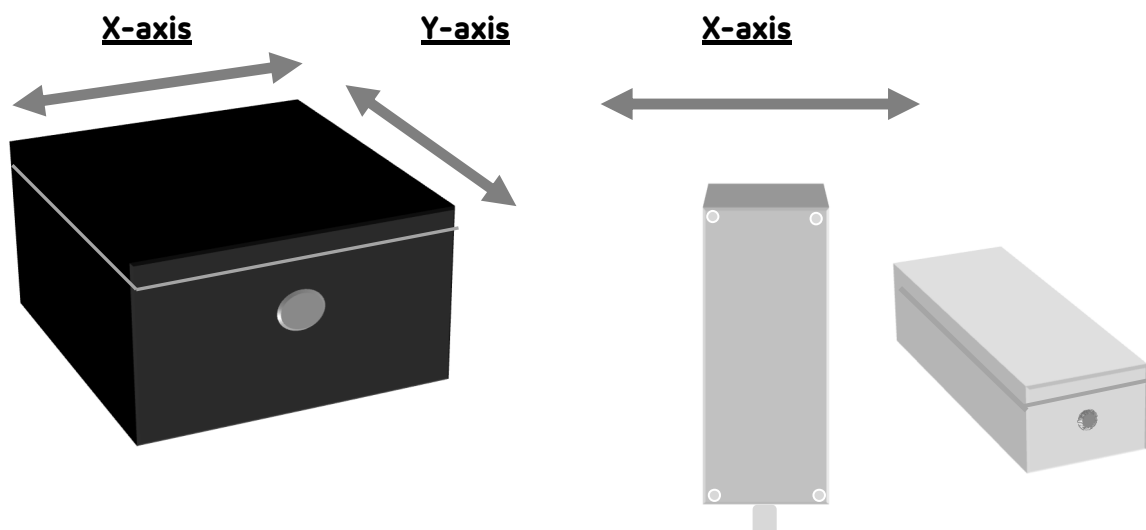
The electrical connections of the tilt measuring system are made via EMC cable glands to terminal blocks inside. The terminal numbering can be found on the blocks itself. The maximum cable cross section is 2.5 mm². The EMC-installation instruction is to be complied with.

NM1-IP-4L-12E/24E:

Clamp	Description
1	Supply voltage +Ub
2	GND operating voltage
Galvanic isolation	
3	Analogue output
4	GND analogue output

NM2-IP-4L-12E/24E

	Description
1	Operating voltage +Ub
2	GND operating voltage
Galvanic Isolation	
3	Analogue output y-axis
4	GND analogue output
5	Analogue output x-axis
6	GND analogue output



■ 4.1 Supply voltage

The supply voltage is with version -24E in the range of 18 to 30 VDC and with version –E12 within 10 to 18 VDC. The presence of the supply/ internal operating voltage is indicated by the 2 green LEDs on the pcb.

To protect the electronics an (to the supply voltage version corresponding) internal self-healing “polyswitch-resettable®” fuse is built in. Whether an external additional fuse is necessary is to be considered. However, an additional external fuse of

S_{extern} 0,4 A slow is recommended.

■ 4.2 Galvanic isolation

The supply voltage of the amplifier is galvanically isolated from analogue output, sensor supply and sensor signal. To unset this isolation, just bridge clamp 2 and 4 (resp. 6).

■ 4.3 Analogue Outputs

According to your order the following analogue outputs are available:

...-010-...	Analogue output: 0...10 V	Zero-point at 5 V
...-B10-...	Analogue output: ± 10 V	Zero-point at 0 V
...-020-...	Analogue output: 0...20 mA	Zero-point at 10 mA
...-420-...	Analogue output: 4...20 mA	Zero-point at 12 mA

■ 5 Starting up

NM1-IP-4L-12E/24E:

1. The measuring system is to be leveled vertically with the cable gland pointing down.
2. The tilt measuring system is to be mounted to a vertical surface on the object. The mounting holes are visible after remove of the lid.
3. Connect the tilt measuring system according to the terminal assignment. Mind the EMC-instructions.
4. Switch on supply voltage.
5. Allow the measuring system approx. 15 minutes to warm up.
6. The possibly necessary zero-point adjustment is to be performed.
7. The function and calibration of the tilt measuring system is to be checked
8. In order to accomplish the EMC and IP 65 protection, the lid is to be closed carefully right after the initial start-up.

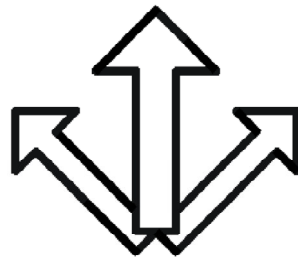
NM2-IP-4L-12E/24E:

1. The measuring system is to be leveled horizontally
2. The tilt measuring system is to be mounted to a horizontal surface on the object. The mounting holes are visible after remove of the lid.
3. Connect the tilt measuring system according to the terminal assignment. Mind the EMC-instructions.
4. Switch on supply voltage.
5. Allow the measuring system approx. 15 minutes to warm up
6. The possibly necessary zero-point adjustment is to be performed.
7. The function and calibration of the tilt measuring system is to be checked
8. In order to accomplish the EMC and IP 65 protection the lid is to be closed carefully right after the initial start-up.

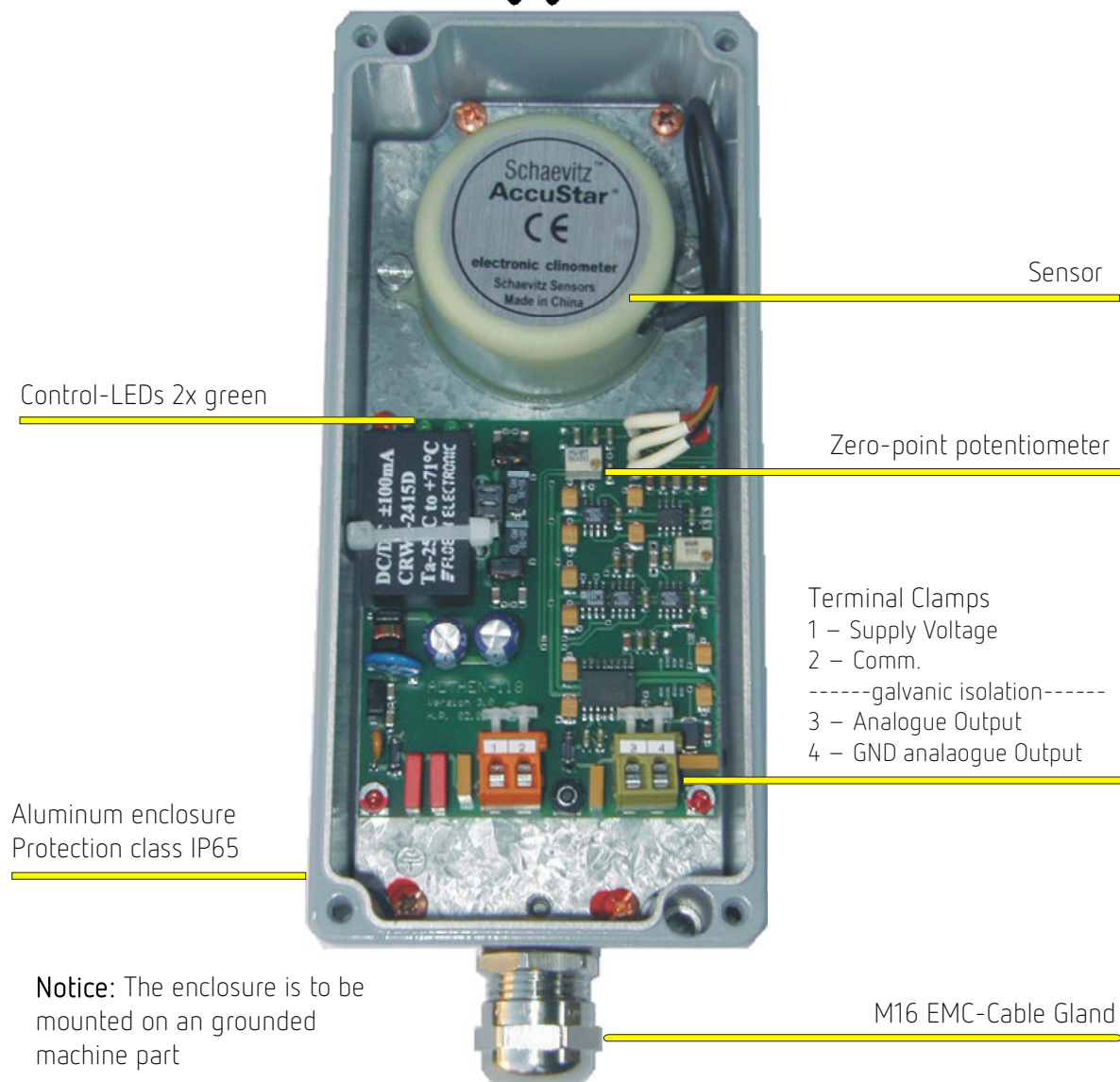
■ 5.1 Description / measuring axis

NM1-IP-4L-12E/24E:

Version ..010..	0 Volt ... +5 Volt ... +10 Volt	Scaling of analogue output
Version..B10..	-10 Volt ... 0 Volt ... +10 Volt	
Version..420..	4 mA ... 12 mA ... 20 mA	
Version..020..	0 mA ... 10 mA ... 20 mA	



Axis



Notice: The enclosure is to be mounted on an grounded machine part

NM2-IP-4L-12E/24E:

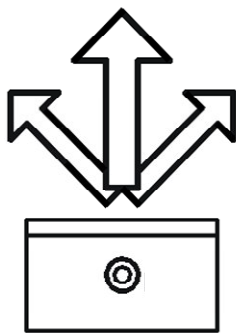
Scaling analogue output
X-AXIS

0 Volt ... +5 Volt ... +10 Volt
-10 Volt ... 0 Volt ... +10 Volt
4 mA ... 12 mA ... 20 mA
0 mA ... 10 mA ... 20 mA

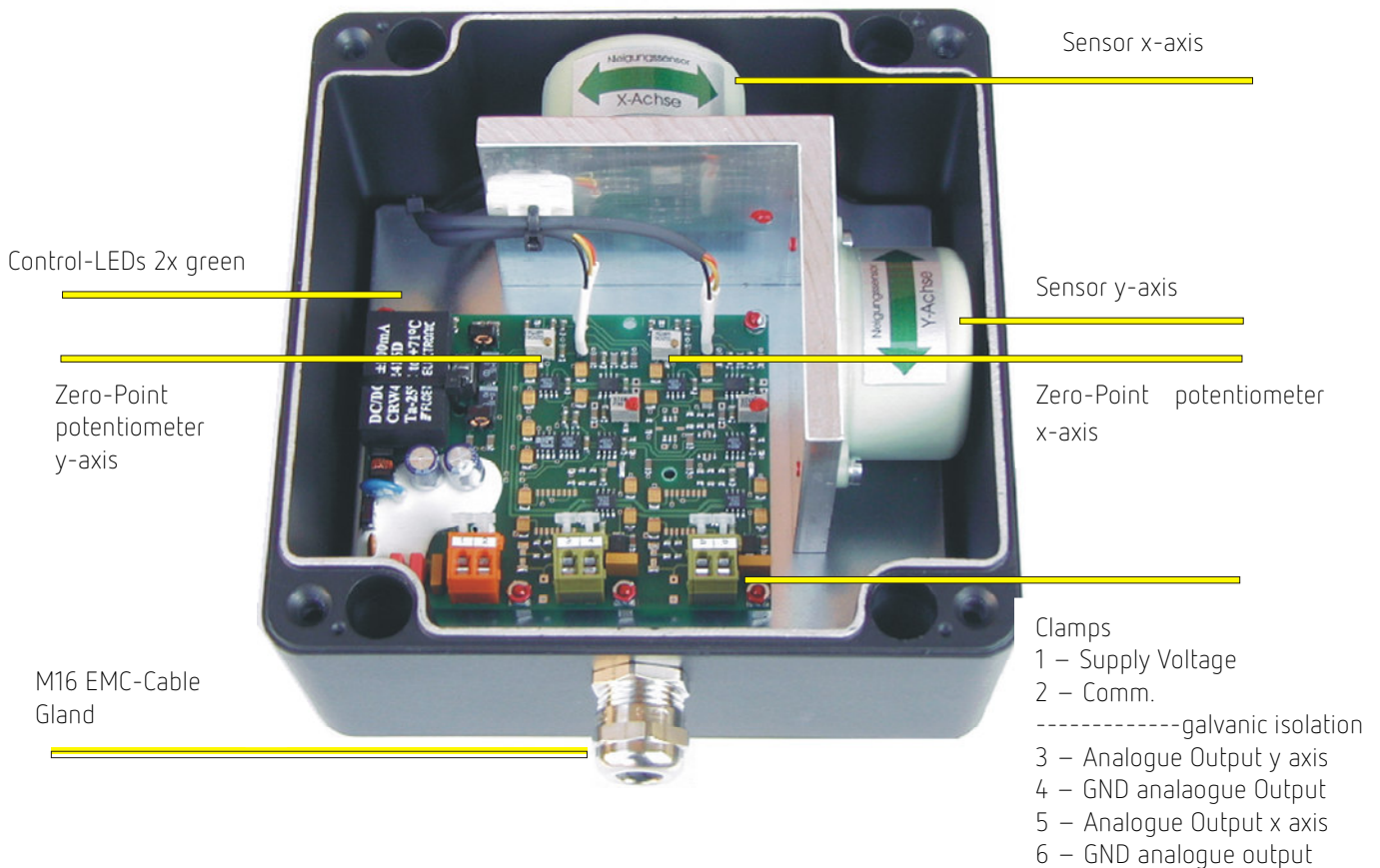
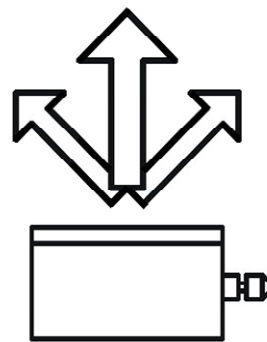
Version -010-
Version -B10-
Version -420-
Version -020-

Scaling analogue output
Y-AXIS

0 Volt ... +5 Volt ... +10 Volt
-10 Volt ... 0 Volt ... +10 Volt
4 mA ... 12 mA ... 20 mA
0 mA ... 10 mA ... 20 mA



Measuringaxis



■ 5.2 Calibration of the tilt measuring system

Notice: The measuring system has been conscientiously calibrated and tested, therefore no change of amplification/end value should be necessary.

Due to slight inaccuracies while and after montage, or not too straight walls, an adjustment of the zero-point might be reasonable. The calibration of gain/ end value has to be checked. This setting should not be changed. However, if an adjustment of gain/ end value is inevitable please refer to chapter

■ 5.3 Zero-point adjustment

1. Connect a multimeter to the according analogue output, please refer to chapter 4: Terminal assignment
2. Level the measuring system with the help of e.g. precision spirit level.
3. Now adjust the zero-point according to the table below.

Version	Analogue Output	Zero-point
NM1/NM2-IP-4L...010	0 ... 10 Volts	+ 5 V
NM1/NM2-IP-4L...B10	± 10 Volts	0 V
NM1/NM2-IP-4L...020	0 ... 20 mA	10 mA
NM1/NM2-IP-4L...420	4 ... 20 mA	12 mA

Notice: If the maximum zero-point adjustment range of ± 1.5 degrees should not be sufficient, a remounting is to be considered.

■ 5.4 Adjustment / calibration of the amplifier

The gain/ end value potentiometer has been marked with Tamper Evident Seal.

1. Connect a multimeter to the according analogue output, please refer to chapter 4: Terminal assignment
2. Level the measuring system with the help of e.g. precision spirit level.
3. Now adjust the zero-point.
4. Now tilt the measuring system about 80 ... 100% of its maximum range.
5. Now use the gain /end value potentiometer to set the analogue output to the desired value.

■ 5.5 Calculation tilt angle

Version -010-

$$\text{Analogue Output} = 5 \text{ V} + \frac{\text{defined angle}}{\text{full range}} \times 5 \text{ V}$$

Version -B10-

$$\text{Analogue Output} = \frac{\text{defined angle}}{\text{full range}} \times 10 \text{ V}$$

Version -420-

$$\text{Analogue Output} = 12 \text{ mA} + \frac{\text{defined angle}}{\text{full range}} \times 8 \text{ mA}$$

Version -020-

$$\text{Analogue Output} = 10 \text{ mA} + \frac{\text{defined angle}}{\text{full range}} \times 10 \text{ mA}$$

■ 6 Maintenance

The flawless function and calibration of the whole measuring system is to be checked regularly. This inspection is also necessary after every repair or change of any component of the measurement system.

■ 7 Old appliances disposal



According to European and German law, it is prohibited to dispose of old electronic devices into household waste, but must be collected and disposed of separately.

Amplifiers and measurement units manufactured and sold by Althen Mess- & Sensortechnik GmbH serve B2B purposes only. Therefore, those old appliances must not be given to the communal disposer, but must be given back to the seller or disposed of properly. If you need any further information, please contact your local authorities.

These measures serve to protect the environment and allow recycling and recovery of valuable materials. Furthermore, do electronic devices contain substances that may cause damage to the environment if burned or dumped with normal household waste.

■ Appendix

■ Datasheet

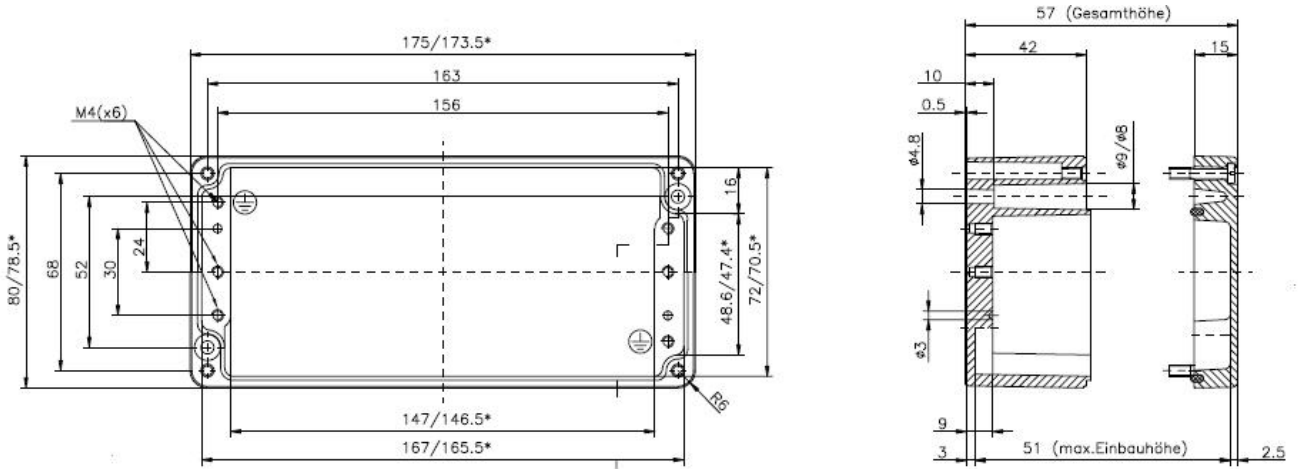
Number of measuring axis:	1 (Version NM1) 2 (Version NM2)	
Operating voltage:	10 ... 18 VDC 18 ... 30 VDC	
Power consumption:	Max. 3 W (Version NM1) Max. 4 W (Version NM2)	
Analogue Output/Test Signal:	0 ... 10 V / ± 10 V 4 ... 20 mA	max 1 mA max 500 Ohms
Preferred measuring ranges:	$\pm 3^\circ$, $\pm 5^\circ$, $\pm 10^\circ$, $\pm 15^\circ$, $\pm 20^\circ$, $\pm 30^\circ$, $\pm 45^\circ$	
Accuracy at 23°:	Up to $\pm 15^\circ$: Up to $\pm 60^\circ$: Up to $\pm 65^\circ$:	$\pm 0,1^\circ$ 0,5% full scale on request
Electrical Connections:	M16x1,5 EMC-Cable screw connection on internal extension spring	
Enclosure:	EMC aluminum-pressure enclosure (IP66)	
Dimensions (W x H x D)	NM1: 175x80x57 NM2: 160x160x91	
Weight:	NM1: ca. 1000g NM2: ca. 2300g	
Storage temperature range:	-20°C ... +60°C	
Operating temperature range:	-20°C ... +60°C	

■ Order Designation

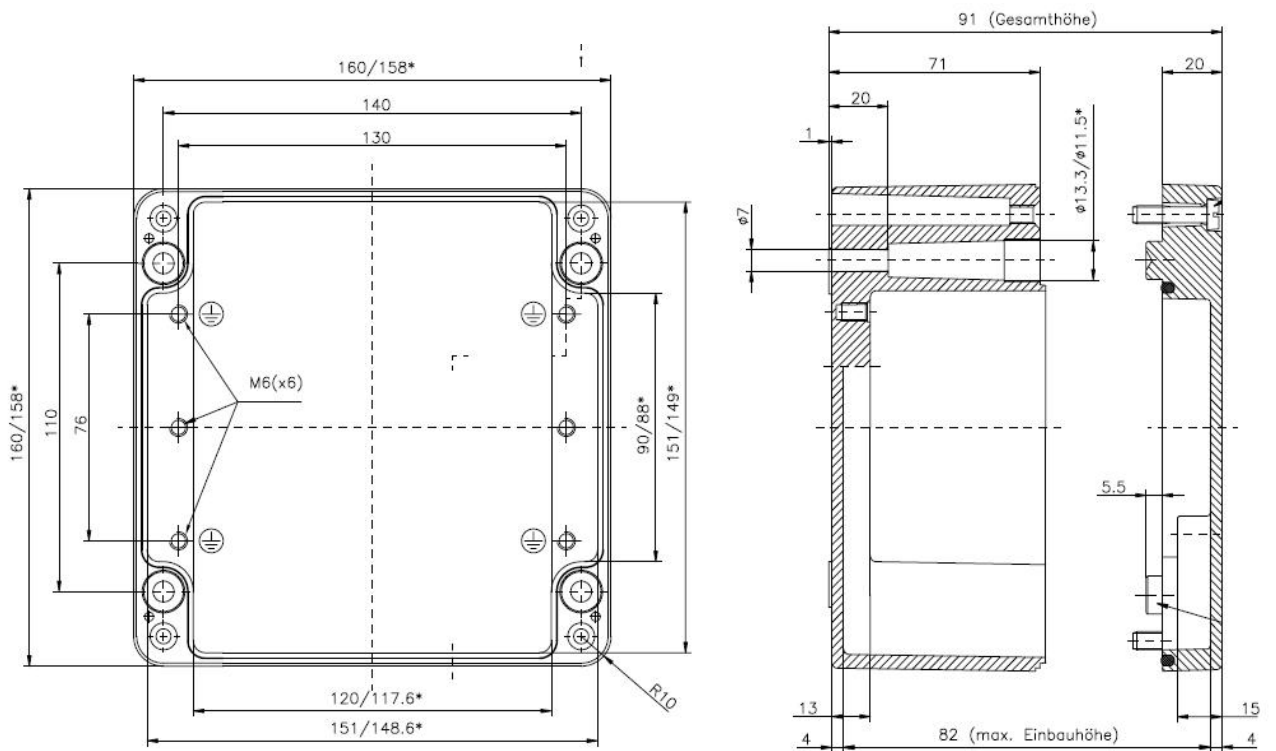
NM1-IP-4L...	1-axis tilt measuring system
NM2-IP-4L...	2-axis tilt measuring system
...-12E-...	Operating voltage: 10 ... 18 VDC
...-24E-...	Operating voltage: 18 ... 30 VDC
...-010-...	Analogue output: 0 ... 10 V; Zero-point at 5 V
...-B10-...	Analogue output: ± 10 V; Zero-point at 0 V
...-020-...	Analogue output: 0...20 mA; Zero-point at 10 mA
...-420-...	Analogue output 4...20 mA; Zero-point at 12 mA
...-V	Encapsulated Electronics and Sensor

■ Housing Dimensions

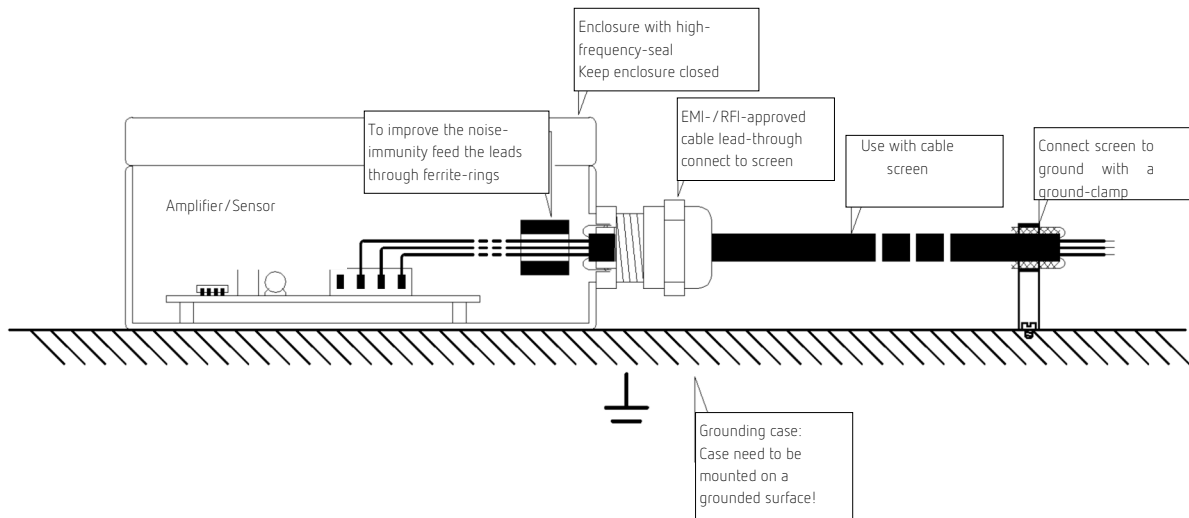
NM1



NM2



■ EMC-mounting

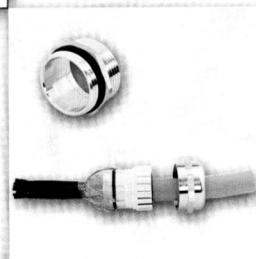


1st Step

- ✓ + Skin cable
- + Lay open the braid

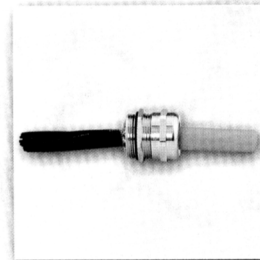
2nd Step

- ✓ + Lead cable through cap nut
- + Establish cable in clamping
- + put braid over clamping
- + Braid have to overlap the o-ring approx. 2mm



3rd Step

- ✓ + Put clamping application in Cable gland
- + Tighten cap nut
- + FINISHED!



■ Datasheet Accustar

AccuStar®-EA Electronic Clinometer



±60° linear sensing range
 Single-Ended and Bipolar DC models
 High accuracy / low cost
 Lightweight and compact
 Rugged plastic housing

DESCRIPTION

The AccuStar®-EA Electronic Clinometer is the next generation in the highly acclaimed AccuStar® family. Building on the success of the original AccuStar®, the AccuStar®-EA takes low cost tilt sensing to the next level by combining 100% solid state technology with digital calibration and proprietary filtering techniques. The result is an extremely accurate tilt sensor with improved linearity, expanded linear sensing range (±60°), generous operating temperature range (-40° to +80°C), and a 70% reduction in temperature induced errors.

Like its predecessor, the AccuStar®-EA measures just 2 inches in diameter, making this compact and affordable sensor the ideal choice where high accuracy tilt measurements are required in space restrictive applications.

The AccuStar®-EA mounts easily onto any vertical surface using just two #6 or M3.5 screws. The slot at the base allows for fine adjustment of the zero angle position after installation. With a choice of either Single-Ended or Bipolar DC output models, the AccuStar®-EA is designed for easy installation and integration.

Also see our other models, AccuStar® IP-66 (2-wire current loop or voltage output, IP-66 rating) and the AngleStar® Protractor System (AngleStar® Electronic Clinometer with digital readout).

Measurement Specialties, Inc. offers many other types of sensors. Data sheets can be downloaded from our web site at: <http://www.meas-spec.com/datasheets.aspx>

FEATURES

- ±65° total sensing range
- Single-Ended or Bipolar DC operation
- Rugged plastic housing
- 18" flying lead termination

APPLICATIONS

- Wheel alignment
- Construction equipment
- Antenna position
- Robotics

AccuStar®-EA Electronic Clinometer

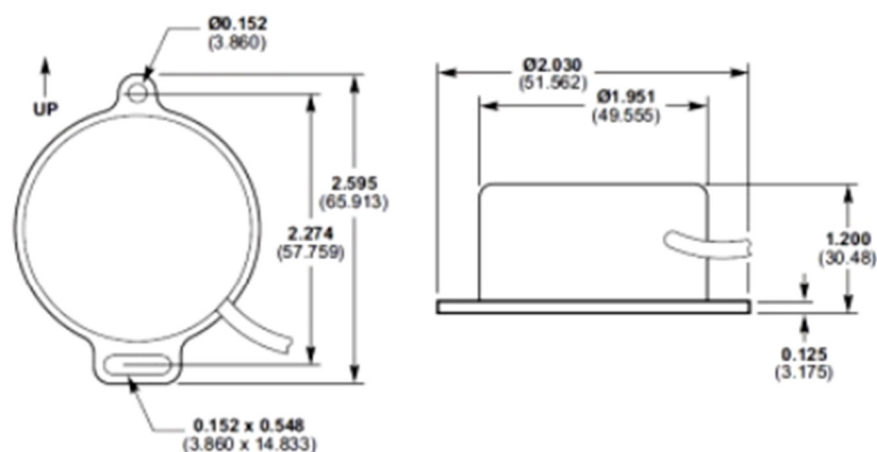
PERFORMANCE SPECIFICATIONS (COMMON)

ELECTRICAL	
Total range	±65°
Linear range	±60°
Linearity	
Null to ±15°	0.075°
±15° to 60°	±0.5% of reading
±60° to 65°	Monotonic
Resolution	0.05°
Null repeatability	0.05°
Cross axis error	<1% up to 90°
Frequency response	2.0Hz @ -3db
ENVIRONMENTAL/MECHANICAL	
Operating temperature range	-40° to +80°C
Storage temperature range	-55° to +80°C
Temp. coefficient of null	0.010° / °C
Temp. coefficient of scale factor	0.01% / °C
Cable	18" flying leads, PTFE insulation
EMC	
Emissions and Immunity	EN 61326-1

Notes:

All values are nominal unless otherwise noted!

DIMENSIONS (COMMON)

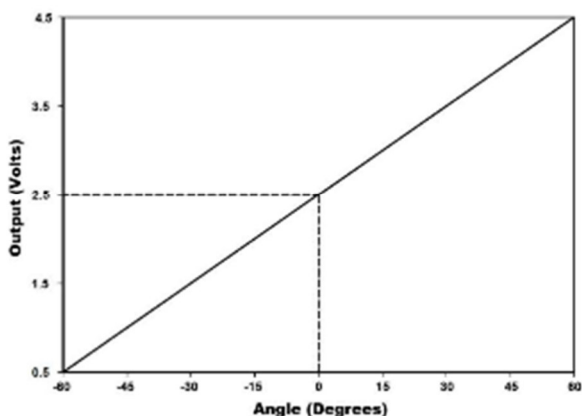


Dimensions are in inches (mm)

AccuStar®-EA Electronic Clinometer

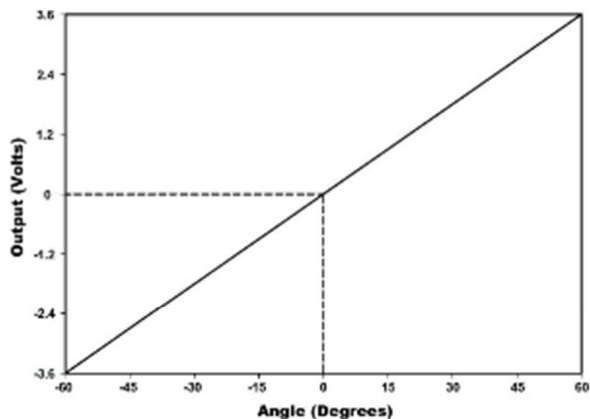
SINGLE-ENDED OUTPUT MODEL

SPECIFICATIONS	
Input voltage	+5 to +30VDC (unregulated)
Input current (max)	5mA
Load resistance (min)	10k Ω
Output	+0.5 to +4.5VDC, $\pm 0.5\%$
Level output (0°)	+2.5Vdc
ELECTRICAL CONNECTIONS	
Red	+ 5 to +30VDC (unregulated)
Black	Power ground
Yellow	Signal output (referenced to power ground)



ANALOG OUTPUT MODEL

SPECIFICATIONS	
Input voltage range	± 8 to ± 15 VDC
Input current (max)	5mA / supply
Scale factor	60mV / degree, $\pm 0.5\%$
Load resistance (min)	10k Ω
Level output (0°)	0 VDC
ELECTRICAL CONNECTIONS	
Red	+8 to +15VDC
Black	Power ground
Gray	-8 to -15VDC
Blue	Signal output (referenced to power ground)



Subject to modifications.

All information describe our products in general form.