



Picture: Inclinometers *sns/inc/dfa*, *sns/inc/d*, *sns/inc/da*

With the inclinometer range *sns/inc/d.*, marco provides various sensors for measuring inclination in harsh environments. The properties of the sensors are described in the tables below.

The *sns/inc/d...* inclinometers consist of accelerometers for two axes and a powerful 32 bit controller. Pre-amplifiers and analysis software for vibration sensors as well as an analogue output are available as optional extras.

Data is usually exchanged digitally via marco's own SSB protocol. *sns/inc/d.* comes with a slave interface and a master interface so that chains can be formed.

The analogue interface, however, also enables calculated data to be output as voltage.

Software can be modified during operation, the sensors have a large flash memory.

The inclinometers have two possible evaluation methods:

1. x/y angle: the angles are calculated from the trigonometric relationships.
2. 360° mode: the values of sin/cos are converted to a full circle.

Features <i>sns/inc/</i>	<i>d</i>	<i>da</i>	<i>df</i>	<i>dfa</i>	<i>dfsa</i>	<i>dk</i>	<i>dm</i>	<i>ds</i>	<i>dsa</i>	<i>dfai</i>	<i>dfsai</i>
Housing type	A	D	E	F	F	B	C	A	D	F	F
SSB	x	x	x	x	x	x	x	x	x	x	x
Inclinometer for 2 axes	x	x	x	x	x	x	x	x	x	x	x
Vibration pre-amplifier					x			x	x		x
Wireless transmission			x	x	x					x	x
Display		x		x	x				x	x	x
Infrared										x	x
MMC card		x	x	x	x				x	x	x



Housing	Description
A	Brass with 2x conm connector
B	Plastic with 2x M12 connector
C	Brass with 1x conm connector, magnet mount
D	Brass with local display
E	Brass with aerial
F	Brass with aerial and local display

See drawings below.

The inclinometer with a plastic housing (type *sns/inc/dk*) must be mounted in a protected area. If necessary, additional protective measures must be implemented to ensure that the housing is not damaged by falling rocks e.g.

Pin assignment

PM32 <- CON1	CON2 -> extension
1 +UB	1 +UB
2 out1	2 in2
3 in1	3 out2
4 0V	4 0V

Power supply (version sns/inc/d)	7 V - 27 mA, 12 V - 17 mA, 15 V - 14.5 mA
Accuracy	0.5 gon
Resolution	0.1 gon
Temperature range	-20 - 60 ° C
Level of protection	IP54
ATEX approval	EX I M2 Ex ib I, IBE XU07ATEX1044 $U_i = 15.1 \text{ V}$, $I_i = 2.5 \text{ A}$ $L_i = 100 \mu\text{H}$ in series with 90Ω , $C_i = 15\mu\text{F}$ in series with 90Ω

Applications

<i>sns/inc</i>	Application
<i>d, dk, dm</i>	General measurement tasks, connection to control unit <i>pm32/sg/</i> via SSB.
<i>ds</i>	Like <i>d</i> with additional vibration sensor connection. Canopy with sensor, tail shield with sensor.
<i>dsa</i>	Like <i>ds</i> with additional local display and MMC card.
<i>da</i>	Hand-held inclinometer with local display and MMC card.
<i>df</i>	General measurement tasks, additional wireless transmission and MMC card. Wireless connection to shearer and across the shield.
<i>dfa</i>	Like <i>df</i> , with additional local display. The inclinometer is mounted on the shearer to provide directly visible information.
<i>dfai</i>	Like <i>dfa</i> with additional infrared interface.
<i>dfsa</i>	Like <i>dfa</i> with additional inputs for vibration sensor. Enables independent shearer control via vibration analysis.
<i>dfsai</i>	Like <i>dfsa</i> plus infrared interface.



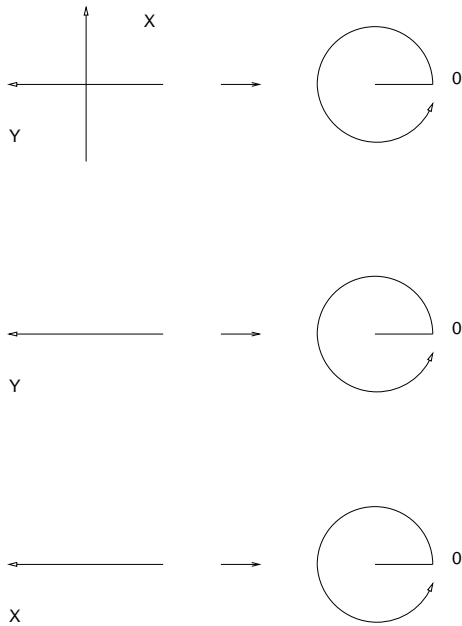
Examples:

■ Hand-held inclinometer

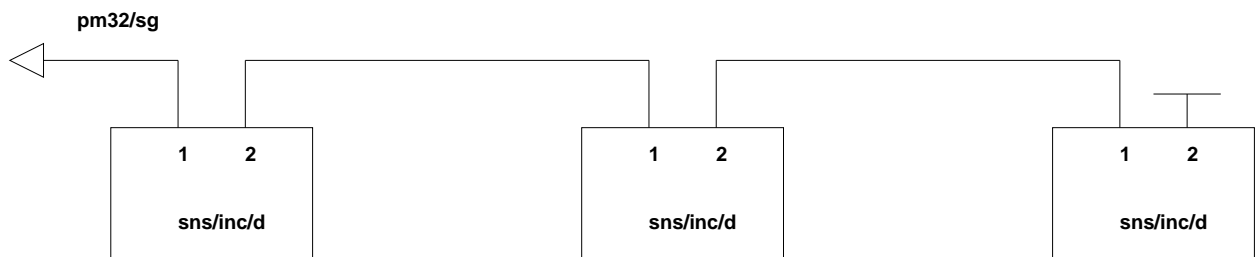
By shorting pin 2-3 at CON2 a special application is started which allows the device to be used as a hand-held inclinometer. The output on the display turns so that it is always shown the right way round. If the gradient of the inclinometer is less than 45 ° the display shows evaluation method 1. (x/y angle) and evaluation method 2. (360 ° mode) when the gradient is greater. The changeover happens automatically. Measuring accuracy is particularly high with this application.

For further information please refer to doc:P/sns/inc/doc/001.

■ Shield height measurement



The SSB inclinometer for two axes measures the angle to gravity (and/or the gradient) of mining machines (e.g. canopy, shearer main frame, conveyor pan). Two accelerometers are evaluated and the angle is calculated trigonometrically over 360° (400 gon). The sensor can measure one or two angles depending upon how it is mounted. If it is mounted vertically, as shown in the first photograph, then one angle is calculated. If it is mounted horizontally as shown in the other two photographs then in each case one angle per axis to gravity is measured.



A series of *sns/inc/d.* can be connected together to form a face height measuring system.

An example of this system can be found in the document *streb/shs doc:P/streb/shs/doc/001.*



■ Canopy control/steering cylinder protection

During automatic advance of supports, the gradient of the canopy should be controlled so that the canopy stays aligned in its group (e.g. during re-lowering or setting where there are cavities). A secondary effect of this type of control is that the steering cylinders cannot be over-retracted during setting in a cavity.

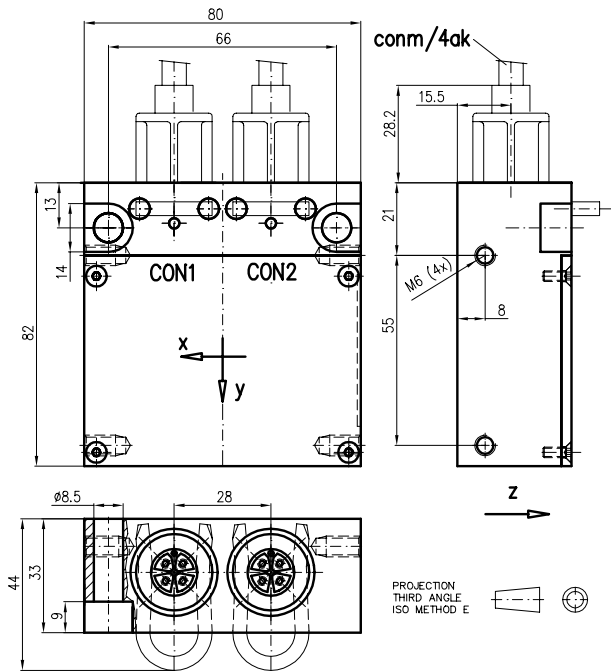
To avoid damage to the steering cylinder fittings, the leg has to be stopped as soon as the canopy has reached the gradient of the roof. For this purpose, the inclinometer is mounted on the canopy and the controller can stop the setting movement of the leg with the aid of the measurement taken.

For further information on this type of application, please refer to *doc:D/streb/verfahren/eck-zylinderschutz*.

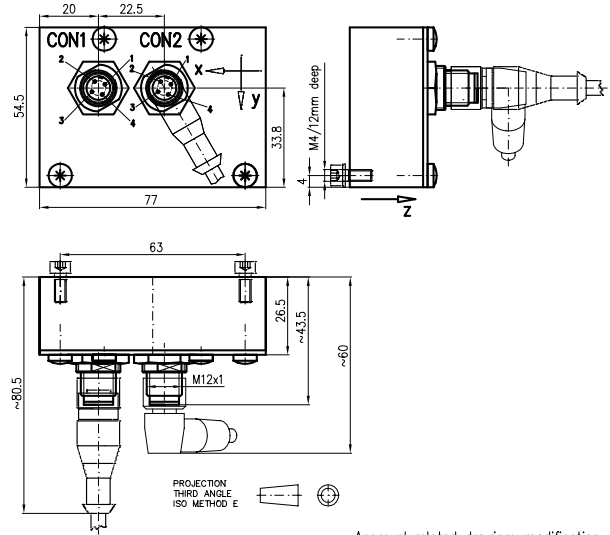
The inclinometer should only be mounted on machine parts subjected to low vibration.



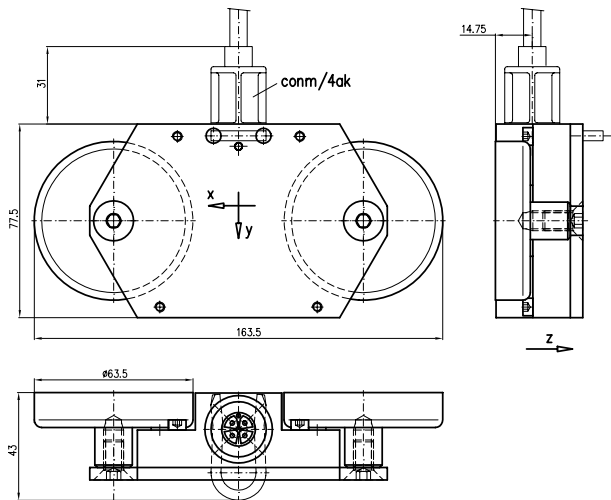
Housing drawings



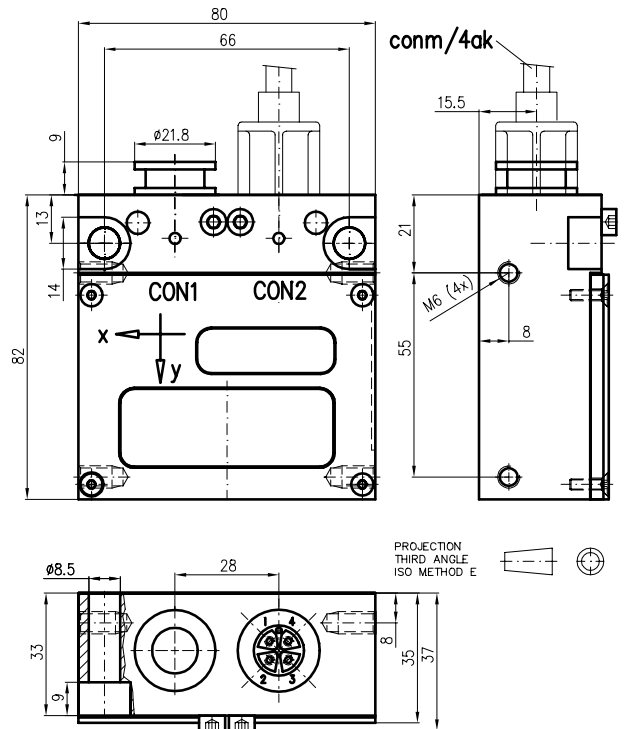
Picture: Housing A



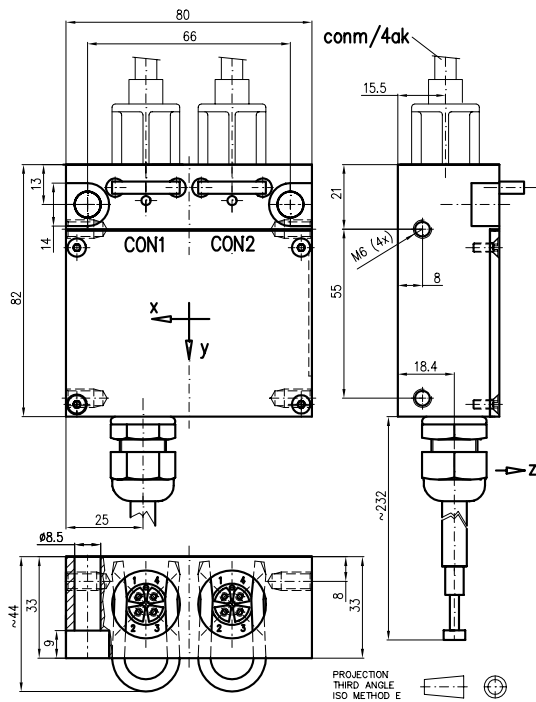
Picture: Housing B



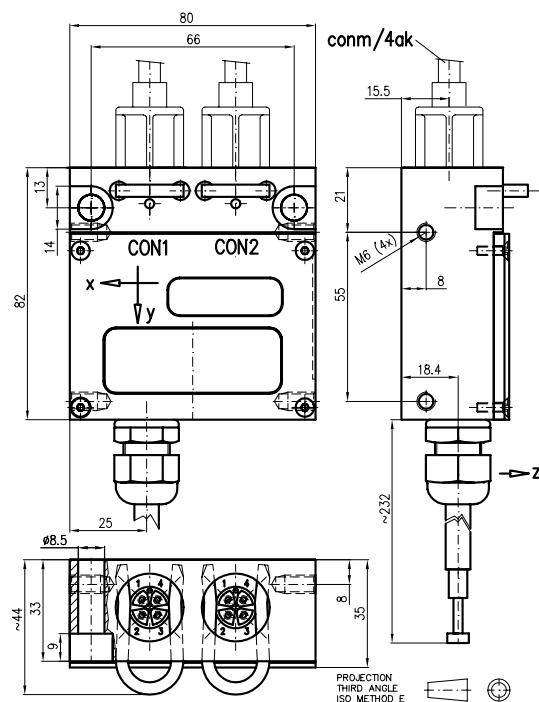
Picture: Housing C



Picture: Housing D



Picture: Housing E



Picture: Housing F

Order Number	Release	Description
sns/inc/d	2.0	SSB inclinometer for two axes
sns/inc/da	2.0	SSB hand-held inclinometer for two axes with display and MMC card
sns/inc/df	2.0	SSB inclinometer for two axes with wireless transmission and MMC card
sns/inc/dfa	2.0	SSB inclinometer for two axes with wireless transmission, display and MMC card
sns/inc/dfai	2.0	SSB inclinometer for two axes with wireless transmission, display, MMC card and infrared
sns/inc/dfsai	2.0	SSB inclinometer for two axes with wireless transmission, display, MMC card and sensor input
sns/inc/dk	2.0	SSB inclinometer for two axes with plastic housing
sns/inc/dm	2.0	SSB inclinometer for two axes with magnet mount
sns/inc/ds	2.0	SSB inclinometer for two axes with sensor input
sns/inc/dsa	2.0	SSB inclinometer for two axes with sensor input, display and MMC card
conm/4ske		Staple, 42 mm