
E-Series Inclinometer

Instruction Manual
E-Series Inclinometer Module

NS-5/E and NS-15/E



Version 1.2

E-Series Inclinometer

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1 Introduction

The E-series Inclinometers are inclination sensors which incorporate modern microsystems technology. Consisting of a sensing element and signal conditioning circuitry, the E-series is a ready to install package. External pinning allows adjustment to both the zero (null) and sensitivity (scale factor) using common passive components.

2 Sample Switching Circuit

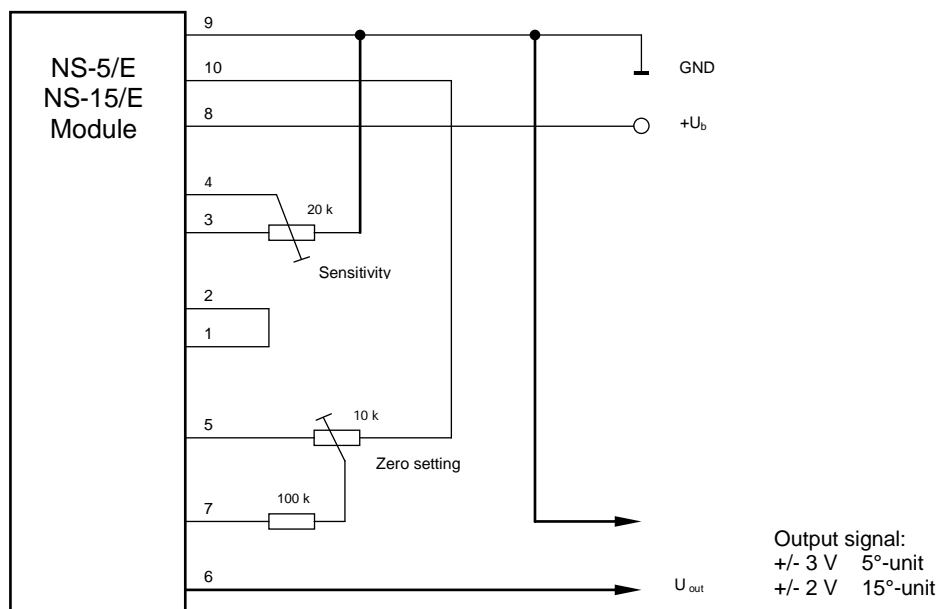
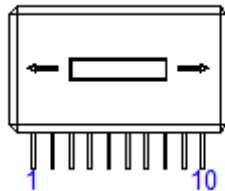


Fig. 2.0.1 Sample switching circuit

External zero point- and sensitivity adjustment, voltage supply + 6.5 to + 24 VDC

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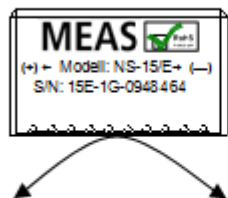
2.1 Pinning



Top view

Pin	Condition	Description
1	f_{in}	External frequency input possible
2	f_{out}	Frequency output 1KHz square wave
3	$U_{ref out}$	Reference voltage output +1.22 VDC
4	$U_{ref in}$	External reference voltage input possible 0...+2.5 VDC
5	$-U_H$	Output voltage $-5V_{out}$, maximal 10mA
6	U_{out}	Output signal, $R_L > 10 K\Omega$, NS-5/E: +/-3V, NS-15/E: +/-2V
7	U_{off}	Offset voltage input
8	$+U_b$	Power supply voltage +6.5...+24 VDC
9	GND	GND
10	$+U_H$	Output voltage, +5 VDC, maximal 50mA

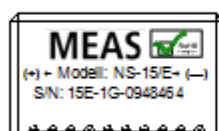
2.2 Measurement Direction



Front view

Positive voltage output Negative voltage output

2.3 Mounting

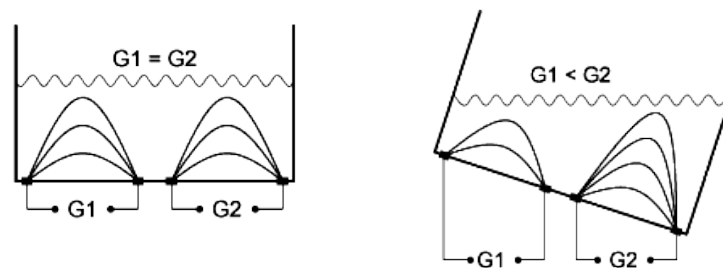


Reference surface for mounting

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3 Circuit Description

The sensing element works according to a conductivity measurement principle. Platinum electrodes are deposited in pairs on the base of the sensors cell parallel to the sensitive axis. The chamber is partially filled with an electrolytic liquid. When an alternating voltage is passed between two electrodes, the electric current will create a dispersed field. By tilting the sensor and thereby reducing the level of liquid, it is possible to confine this stray field. Because of the constant, specific conductivity of the electrolytes a variance of resistance is formed in relation to the liquid level.



The differential principle offers an angle of inclination from the polarity signs.

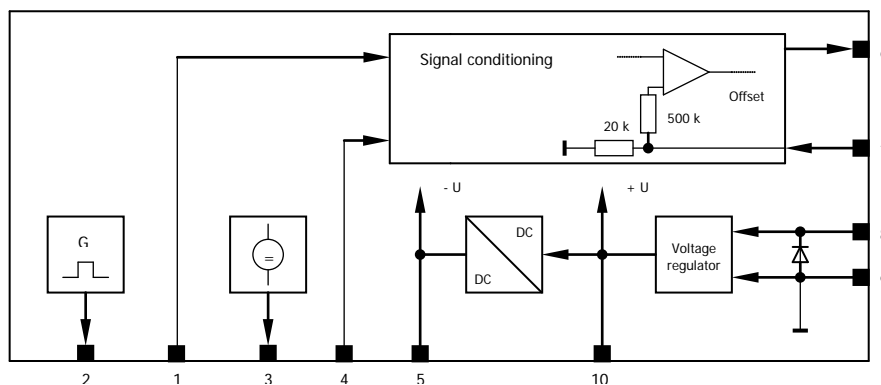


Fig. 3.1 Block diagram of the E-series inclinometer module.

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3.1 Timing Generator

The timing generator supplies a square wave voltage with an amplitude of $U_G \cong \pm 4.5V$ and a frequency of $f_G \cong 1KHz$. The square wave signal is available at pin 2. For proper operation of the sensor pin 2 must be connected to pin 1. The accuracy of the sensor can be increased by supplying a precision, stable external square wave signal, 50% duty cycle.

3.2 Reference Voltage Generator

A reference voltage is internally generated, and is available at pin 3 with $U_{ref\ out} \cong 1,220 V (\pm 3\%)$. Minimum load resistance should be $R_L > 50 K\Omega$. For the operation of the sensor, pin 4 has to be connected to pin 3. The sensitivity of the sensor can be set by applying a reference voltage at pin 4 where is $U_{ref\ in} = 0...+ 2.5 VDC$.

Alternative to adjust the sensitivity, use a potentiometer in connection with pin 3 (internal reference voltage output), pin 4 (internal reference voltage input) and pin 9 (GND) .Fig. 2.0.1.

If the voltage signal will be decrease at pin 4, the sensitivity of the sensor goes down.

3.3 Signal Conditioning

The internal signal conditioning generates a voltage output proportional to the angle of inclination. The zero (null) output can be adjusted up to $\pm 1^\circ$ by supplying a current of $\pm 5 \mu A$ to pin 7. This is useful in helping to correct for physical mounting errors.

3.4 Power Supply

This power supply consists of a low-drop voltage regulator with small reverse polarity protection. The voltage regulator requires a supply voltage of $+U_b = +6.5$ to $+24 VDC$. The internal regulator supplies pin 10 ($+U_H$) with $+5 VDC$. The maximum current draw should not exceed $I_H \sim 50mA$.

3.5 Auxiliary Voltage Generation

The internal regulator supplies a negative auxiliary voltage with a value of $-U_H = -5VDC (\pm 8\%)$. This auxiliary voltage is available at pin 5. The maximum current draw should not exceed 10 mA.

NOTE: The voltages at pin 5 and 10 are not stabilized. For high accuracy measurements, a stable external voltage source for zero setting is recommended!

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3.6 Typical Output signal E-series

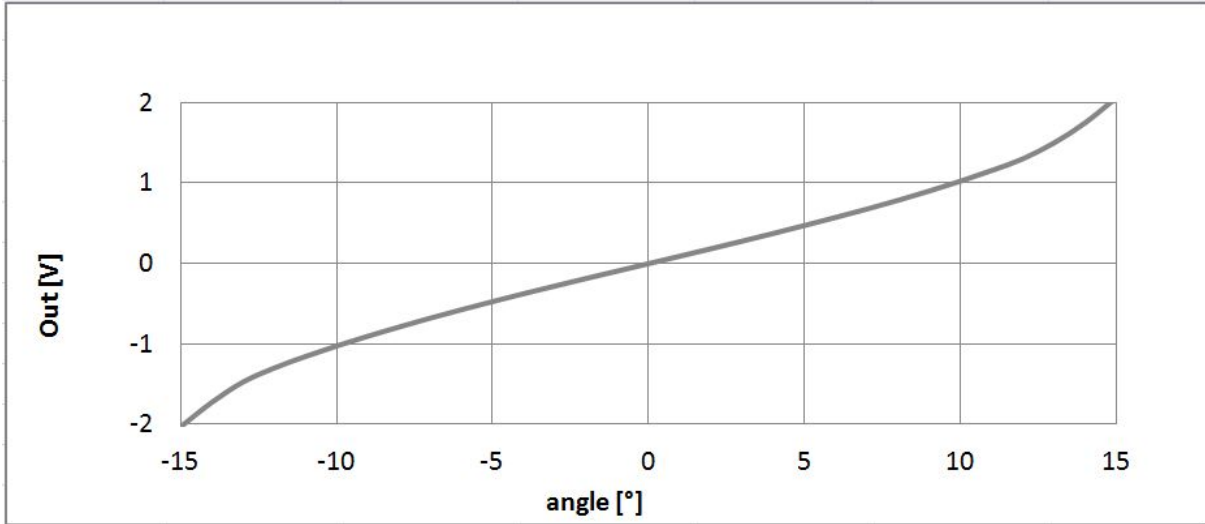


Fig. 3.6.1 Typical output signal [V] vs. angle[°] , 15° version

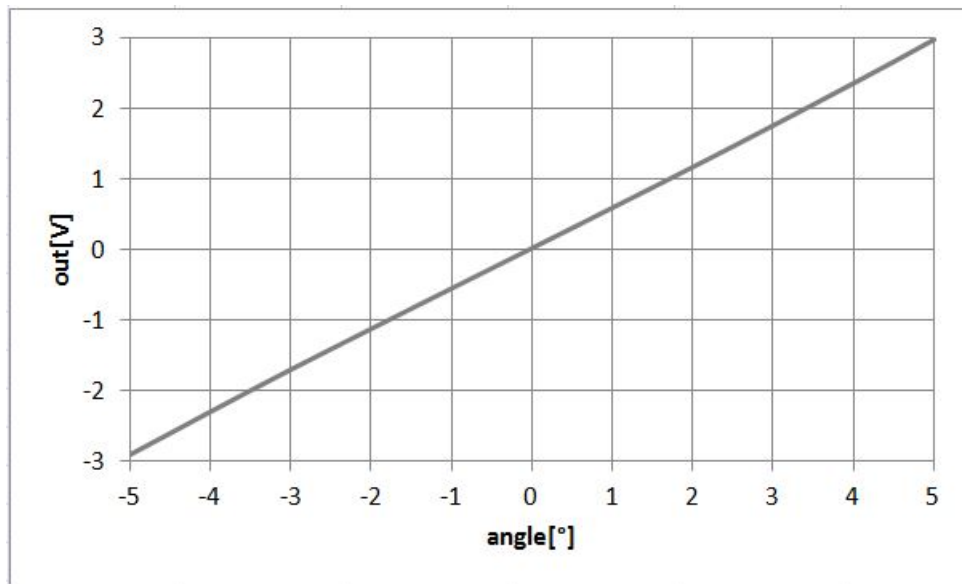


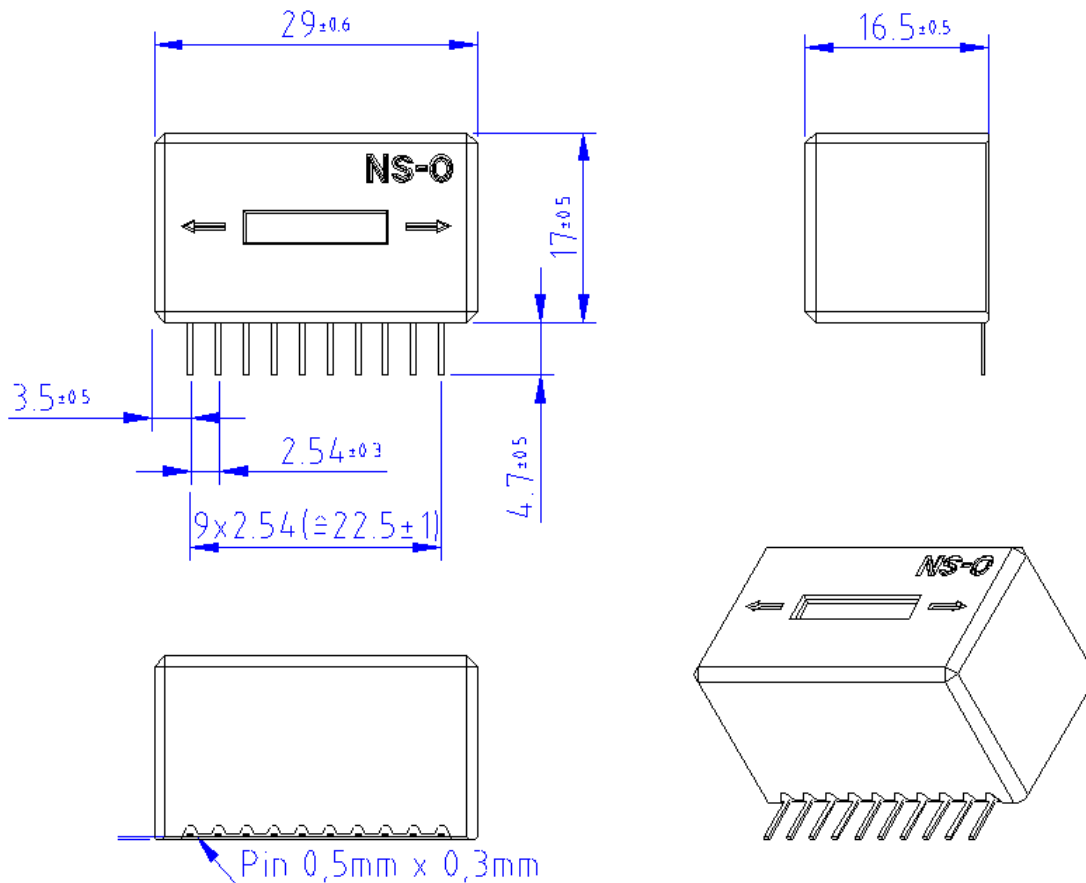
Fig. 3.6.2 Typical output signal [V] vs. angle[°] , 5° version

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3.7 Additional Information

All E-series sensors have manufacturing tolerances, both mechanically and electrically. The zero (null) point has a tolerance of $\pm 0.7^\circ$, and the sensitivity (scale factor) has a tolerance of $\pm 10\%$. Corrections to both zero and sensitivity can be made by use of precision external passive components.

4 Dimension [mm]



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5 EMC

As the E-series sensors are used in OEM applications, no CE declaration is available.

There is also no special protection circuit against overload, bust, surge, etc. implemented.

The module will be designed using capacitors for blocking and ground plane areas in order to prevent wireless coupled disturbances as good as possible.

6 Additional Information

ORDERING INFORMATION

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