



**Inclinometers with integrated 0...5 Volt signal conditioner for inclination measurement in the ranges of  $\pm 5$ ,  $\pm 10$ ,  $\pm 30$ ,  $\pm 45$ ,  $\pm 70$  degrees**

## Features

- small size light weight
- linear output response
- high measurement accuracy
- small zero drift
- small cross sensitivity
- high long term stability - virtually infinite lifespan
- hysteresis-free output signal
- integrated sensor electronics including signal conditioner and low-pass filter
- no data memory with memory loss
- temperature compensated, conditioned 0...5V output signal
- highly stable internal voltage regulation
- optional 5 Volt reference voltage output
- unconditioned operating voltage between 9V and 30V
- low power consumption
- protection against reverse supply voltage polarity
- EMC certified CE certified
- no interference by surrounding electromagnetic fields
- shockproof as without moving mechanical parts
- hermetically sealed
- sensor electrically isolated from point of measurement by high quality plastic housing – no ground connection
- zero point adjustable through 360° using clamping ring

## Description

The capacitive, dielectric liquid based inclinometers NA2-05, NA2-10, NA3-30, NA4-45 and NA4-70 contain new sensor electronics. These are made up of a highly stable, laser-trimmed signal conditioner with electronic compensation for temperature drift, highly stable supply voltage regulation circuitry and low-pass filtering of the measurement signal to eliminate unwanted noise.

The capacitive measurement principle guarantees a very stable, linear relationship between the inclination being measured and the normalised output signal.

The sensor electronics require minimal power and, together with the capacitive primary transformer, are characterised by low errors, high signal-to-noise ratio and high long-term stability.

Contrary to measuring inclinations using accelerometers, this measurement principle enables a linear relationship between the inclination to be measured and the output signal, independent of the constant of gravity at the place of measurement, i.e. Independently of where the measurement is taking place, whether in Europe, Australia, on Mount Everest or the Moon.

## Application

The NA2, NA3 and NA4 can be used for measurements requiring small and light devices, replacability, measurement of relatively large inclinations and a normalised, analogue voltage output signal.

Measurements of inclinations in measuring instruments and inspection equipment, in water, land and air vehicles, in automation and safety technology, on cranes and lifting equipment, on robots, in the manufacture of scientific equipment, in medicine and telecommunication as well as navigation systems are typical examples.

## Shared Technical Specifications

|                              |               |            |                       |
|------------------------------|---------------|------------|-----------------------|
| Supply voltage <sup>1)</sup> | 9V ... 30V DC | Dimensions | see dimension drawing |
|------------------------------|---------------|------------|-----------------------|

|  |  |   |                 |
|--|--|---|-----------------|
| Current drawn                                      | approx. 2mA  | Reference voltage output <sup>3)</sup>            | 5.00 Volt       |
| Externally regulated supply voltage <sup>2)</sup>  | 5 Volt   | Temperature drift of the reference voltage        | < 25 ppm/K      |
| Current drawn with external supply voltage 5V      | approx. 1mA  | Maximum current of the reference voltage output   | 5mA             |
| Maximum Operating Temperature                      | +85°C  | Output resistance                                 | Ca. 100 Ohm     |
| Minimum Operating Temperature                      | -40°C  | Protection  | IP 65           |
| Maximum Storage Temperature                        | +90°C  | Weight (Sensor excluding mounting ring and cable) | 18.5 g          |
| Minimum Storage Temperature                        | -55°C  | Environment Humidity                              | 0...100% r.F.   |
| Signal-to-noise ratio at signal output (0...10kHz) | <150µVss   | Electrical signal-to-noise ratio                  | >85dB           |
| Transverse sensitivity at 45° tilt                 | <1% of measurement value   | Voltage Offset (at Zero degree tilt)              | 2.5V            |
| Settling time (to 98% of the actual value)         | <0.3 s   | Maximum output voltage range                      | 0.05V ... 4.95V |
| Terminals  | 3 (4) highly flexible cables, Øca.1mm, length 18cm optionally: shielded cable Ø2.1mm |   |                 |

Notes:

1) Standard supply voltage

2) optional externally regulated supply voltage

3) reference voltage output (5.00 V) only optionally connected (for wire terminals only)

Each sensor will be delivered with individual calibration dates (offset, sensitivity) and calibration record.

### Technical Specifications of types NA2-05 and NA2-10

| Typ  | NA2-05               | NA2-10               |
|--|----------------------|----------------------|
| Measuring range  | ±5degrees            | ±10degrees           |
| Resolution   | <0.001degrees        | <0.002degrees        |
| Nominal sensitivity  | 400 mV/degree        | 200 mV/degree        |
| Output voltage range                                       | 2.5V±2V at ±5°       | 2.5V±2V at ±10°      |
| Linearity deviation over whole measurement range           | <±0.02degrees        | <±0.03degrees        |
| sensitivity shift over a temperature range -25°C ... +85°C | <2%                  | <2%                  |
| Temperature drift of zero point                            | ±0.002degrees/Kelvin | ±0.002degrees/Kelvin |

### Technical Specifications of types NA3-30, NA4-45 and NA4-70

| Typ             | NA3-30        | NA4-45       | NA4-70       |
|-----------------|---------------|--------------|--------------|
| Measuring range | ±30degrees    | ±45degrees   | ±70degrees   |
| Resolution      | <0.005degrees | <0.01degrees | <0.01degrees |

|  |                  |                  |                  |
|--|------------------|------------------|------------------|
| Nominal sensitivity  | 66.6.. mV/degree | 44.4.. mV/degree | 28.57 mV/degree  |
| Output voltage range                                       | 2.5V±2V at ±30°  | 2.5V±2V at ±45°  | 2.5V±2V at ±70°  |
| Linearity deviation over whole measurement range           | <±0.06 degrees   | <±0.14 degrees   | <±0.28 degrees   |
| sensitivity shift over a temperature range -25°C ... +85°C | <2%              | <2%              | <2%              |
| Temperature drift of zero point                            | ±0.002deg/Kelvin | ±0.003deg/Kelvin | ±0.003deg/Kelvin |

**Dimensions and Connections**

