

# INCLINATION SENSOR OF HORIZONTAL AND VERTICAL INSTALLATION

Designed to measure and control the angular positions of static and dynamic objects relative to the vector of a known reference.

Can measure the dimensional angular positioning and subsequent position control of:

- ▶ building and constructions
- ▶ roofing
- ▶ piping
- ▶ bridges and pillars
- ▶ arm of cranes and excavators
- ▶ rotation shafts of different types
- ▶ underground excavations, including mine entries
- ▶ premises for production and non-production type
- ▶ motor and railway transport
- ▶ rotations levers with complete and incomplete revolution
- ▶ other stable or dynamic objects

The Inclination Sensor (IS) can be used in any industry where its technical and functional parameters and external factor protection levels meet the technical specifications and requirements of pertinent regulatory documents.



## Description of IS

Sensor type is described in Table 1;

Angle measurement range and resolution are shown in Tables 2 and 3

angle measure range according to table 2

angle measure resolution according to table 3

Table 1 **Sensor type**

| Description | Sensor type      |
|-------------|------------------|
| 1           | Vertical         |
| 2           | Horizontal       |
| P           | Rotation measure |

Vertical and horizontal installation sensors have two axes to measure angle parameters. Rotation measurement sensors have one axis to measure rotation angle.

Table 2 **Angle measure range**

| Description | Measure range                  |
|-------------|--------------------------------|
| 1           | From minus 30° till plus 30°   |
| 2           | From minus 45° till plus 45°   |
| 3           | From minus 60° till plus 60°   |
| 4           | From minus 80° till plus 80°   |
| 5           | From minus 179° till plus 179° |
| 6           | From 0° till plus 360°         |

Note - Measurement ranges 5 and 6, mentioned in Table 2, apply only to rotation measurement sensors (marked "R" in Table 1).

Table 3 **Angle Measure Resolution**

| Description | Resolution |
|-------------|------------|
| 1           | 0,001°     |
| 2           | 0,002°     |
| 3           | 0,005°     |
| 4           | 0,01°      |
| 5           | 0,02°      |
| 6           | 0,05°      |
| 7           | 0,1°       |
| 8           | 0,2°       |
| 9           | 0,5°       |
| 10          | 1°         |

Table 4

## Accepted Value of parameter combination

| Range description for angular range according to Table 2 | Angular measure resolution description according to Table 3 |   |   |   |   |   |   |   |   |    |
|----------------------------------------------------------|-------------------------------------------------------------|---|---|---|---|---|---|---|---|----|
|                                                          | 1                                                           | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1                                                        | +                                                           | + | + | + | + | + | + | + | + | +  |
| 2                                                        | -                                                           | + | + | + | + | + | + | + | + | +  |
| 3                                                        | -                                                           | - | + | + | + | + | + | + | + | +  |
| 4                                                        | -                                                           | - | - | + | + | + | + | + | + | +  |
| 5                                                        | -                                                           | - | - | + | + | + | + | + | + | +  |
| 6                                                        | -                                                           | - | - | + | + | + | + | + | + | +  |

Note: «+» - parameter combination is accepted;  
«-» - parameter combination is not accepted.

## TECHNICAL CHARACTERISTICS FOR ANGULAR PARAMETERS

| Sensor measure resolution                         | 0,001°         | 0,002°         | 0,005°         | 0,01°          | 0,02°          | 0,05°          | 0,1°          | 0,2°          | 0,5°          | 1°           |
|---------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|---------------|---------------|---------------|--------------|
| Absolute accuracy                                 | ±0,01° ± 1 EMP | ±0,01° ± 1 EMP | ±0,01° ± 1 EMP | ±0,01° ± 1 EMP | ±0,02° ± 1 EMP | ±0,05° ± 1 EMP | ±0,1° ± 1 EMP | ±0,2° ± 1 EMP | ±0,5° ± 1 EMP | ±1° ± 1 EMP  |
| Absolute accuracy for 0 value correction          | ±0,005°        | ±0,005°        | ±0,005°        | ±0,005°        | ±0,008°        | ±0,01°         | ±0,01°        | ±0,05°        | ±0,05°        | ±0,05°       |
| Cross impact on perpendicular, not more than      | ±0,1 % MB3     | ±0,1 % MB3     | ±0,1 % MB3     | ±0,1 % MB3     | ±0,1 % MB3     | ±0,1 % MB3     | ±0,1 % MB3    | ±0,1 % MB3    | ±0,1 % MB3    | ±0,1 % MB3   |
| Temperature index, not more than                  | ±0,01 % MB3    | ±0,005 % MB3   | ±0,005 % MB3   | ±0,005 % MB3   | ±0,005 % MB3   | ±0,005 % MB3   | ±0,005 % MB3  | ±0,005 % MB3  | ±0,005 % MB3  | ±0,005 % MB3 |
| Temperature index for 0 correction, not more than | ±0,005 % MB3   | ±0,005 % MB3   | ±0,005 % MB3   | ±0,005 % MB3   | ±0,005 % MB3   | ±0,005 % MB3   | ±0,005 % MB3  | ±0,005 % MB3  | ±0,005 % MB3  | ±0,005 % MB3 |

**Note:** EMP – low order position unit

MB3 – upper value module in measurement range

For sensors with the measurement range of minus 80° to plus 80°, the absolute accuracy is not less than ±0,01° ± 1 EMP. In the angular measurement range of minus 60° to plus 60°, the absolute accuracy is not less than ±0,02° ± 1 EMP.

## Technical Characteristics for Additional Measurement Parameters

|                                                          |                 |
|----------------------------------------------------------|-----------------|
| Temperature measurement for the sensor body              |                 |
| Range                                                    | - 40... + 80° C |
| Resolution                                               | 0,1° C          |
| Voltage measurement at power supply input terminal range | 10...35 V       |
| measure resolution                                       | 0,1 V           |

## General Technical Characteristics

|                                           |                       |
|-------------------------------------------|-----------------------|
| Communication interface type              | RS485                 |
| Rate of exchange range                    | 1200...460800 bit/sec |
| Communication protocol                    | MODBUS RTU            |
| Power supply voltage                      | DC 10...35 V          |
| Current consumption at 24B, not more than | 0,04 A                |
| Working temperature range                 | - 40... + 80° C       |
| Level of protection                       | IP67                  |
| Weight, not more than                     | 0,5 kg                |
| Dimensions, not more than                 | 140x65x35 mm          |

## Design Solutions of Physical Process Analysis Design Bureau

Physical Process Analysis Design Bureau of RPC Radiy is set up for development of seismic protection systems, calibration equipment and qualification of product data at NPP. The bureau designs and implements the Seismic Sensor that is the source of seismic data for the seismic protection equipment. Other successfully designed and implemented product is the vibration measuring system for periodic calibration of seismic sensors in semi-automatic mode. Besides nuclear products the design bureau has developed the Information Acquisition and Display Unit that is the basic item in any monitoring system design including the Automatic System for Early Diagnostics of Emergencies. Additionally, the design bureau develops the angel precision gages for the wide scope of measurement.