



## FRX502 - Small angle rotary sensor

### Intrinsically safe for hazardous gas/vapour atmosphere

- Intrinsically safe for Gas to: Ex II 1G
- Non contacting inductive technology to eliminate wear
- Angle set to customer's requirement
- Compact, durable and reliable
- High accuracy and stability
- Sealing to IP65/IP67 as required



As a leading supplier of linear, rotary, tilt and intrinsically safe position sensors, Altheris has the expertise to supply a sensor to suit a wide variety of applications.

Our intrinsically safe FRX502 RIPS (Rotary Inductive Position Sensor) incorporates electronics system EX04 which is ATEX approved for use in potentially explosive gas/vapour atmospheres.

The FRX502 is designed for industrial and scientific feedback applications, like the FDX500 but with better resolution at smaller angles of deflection, and is ideal for OEMs seeking good sensor performance for arduous applications in hazardous areas.

The FRX502 provides a linear output proportional with angle of rotation. Each unit is supplied with the output calibrated to the angle required by the customer, between 5 and 20 degrees and with full EMC protection built in.

There is a machined registration mark to identify the calibrated mid point. Overall performance, repeatability and stability are outstanding over a wide temperature range.

The FRX502 has long service life and environmental resistance with a rugged stainless steel body and shaft. The flange or servo mounting options make the sensor easy to install, it also offers a range of mechanical options. Environmental sealing is to IP65 or IP67 depending on selected cable or connector options.

### ■ Specification

#### DIMENSIONS

Body diameter	35 mm
Body Length (to seal face)	44 mm
Shaft	15mm Ø 6mm

*For full mechanical details see drawing FRX502-11*

#### Power Supply

+5V dc nom. ± 0.5V, 10mA typ 20mA max

#### Output Signal

0.5-4.5V dc ratiometric, Load: 2kΩ min.

#### Independent linearity

< ± 1% FSO @ 20°C

#### Temperature coefficients

< ± 0.01%/°C Gain &  
< ± 0.01%FS/°C Offset

#### Frequency response

> 10 kHz (-3dB)

#### Resolution

Infinite

#### Noise

< 0.02% FSO

#### Torque

<20 mNm Static

#### Intrinsic Safety

Ex II 1G  
EEx ia IIC T4 (Ta = -40°C to +80°C)

Sensor Input parameters  
(connector option/s)  
(cable option/s)

Ui: 11.4V, li: 0.20A, Pi: 0.51W.  
Ci: 1.16µF, Li: 50µH  
Ci: 1.36µF, Li: 710µH with 1km max. cable

#### Environmental Temperature Limits

Operating	-40 to +80°C
Storage	-40 to +125°C

#### Sealing

IP65/IP67 depending on connector / cable option

#### EMC Performance

EN 61000-6-2, EN 61000-6-3

#### Vibration

IEC 68-2-6: 10g

#### Shock

IEC 68-2-29: 40 g

#### MTBF

350,000 hrs 40°C Gf

#### Drawing List

FRX502-11	Sensor Outline
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*Drawings, in AutoCAD® dwg or dxf format, available on request.*

**Do you need a position sensor made to order to suit a particular installation requirement or specification? We'll be happy to modify any of our designs to suit your needs - please contact us with your requirements.**

Intrinsically safe equipment is defined as “equipment which is incapable of releasing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of a specific hazardous atmosphere mixture in its most easily ignited concentration.”

ATEX approved to; Ex II 1G  
EEx ia IIC T4 (Ta = -40°C to +80°C)

Designates the sensor as belonging to; Group II: suitable for all areas **except mining**, Category 1 G: can be used in areas with continuous, long or frequent periods of exposure to hazardous gas (Zone 0).

Protection class ia, denotes intrinsically safe for all zones  
Apparatus group IIC: suitable for IIA to IIC explosive gas.  
Temperature class T4: maximum surface temperature under fault conditions 135°C.

Ambient temperature range extended to -40°C to +80°C.

It is imperative intrinsically safe sensors be used in conjunction with a galvanic barrier to meet the requirements of the product certification. The FRX005 Galvanic Isolation Amplifier is purpose made for Altheris IS sensors making it the perfect choice. Refer to the FRX005 datasheet for product specification and output configuration options.

**Safety Parameters:-**

Ui: 11.4V, Ii: 0.20A, Pi: 0.51W  
Ci = 1.36µF\*      Li = 710µH\* (cable option/s)  
Ci = 1.16µF      Li = 50µH (connector option/s)

\*Figures for 1km cable where: Ci = 200pF/m & Li = 660nH/m

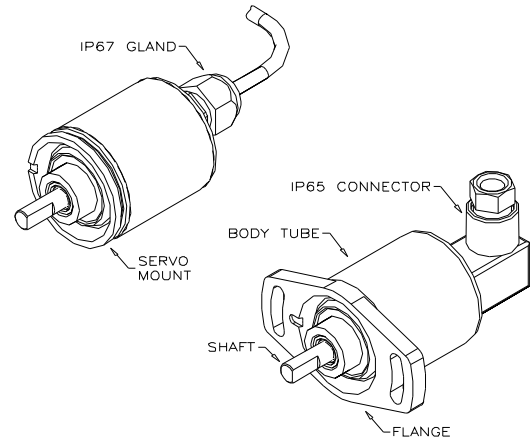
Sensors can be installed with a maximum of 1000m of cable.

Cable characteristics must not exceed:-

Capacitance: ≤ 200 pF/m for max. total of: 200 nF.  
Inductance: ≤ 660 nH/m for max. total of: 660 µH

For cable lengths exceeding 10 metres a five wire connection is recommended to eliminate errors introduced by cable resistance and associated temperature coefficients.

ATEX approved sensors suitable for dust (E series) and mining (M series) applications, are also available from Altheris.



**Table of options**

**MEASUREMENT RANGE:** Factory-set to any angle from ±2.5° to ±10° in increments of 1 degree.  
Full 360° Mechanical rotation.

**ELECTRICAL INTERFACE OPTIONS**

Option for output 'zero' and 'span' adjustment available.

The FRX005 Galvanic Isolation Amplifier is available with 0.5-9.5V or 4-20mA transmission output options.

**CONNECTOR/CABLE OPTIONS**

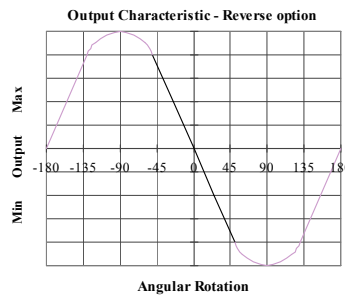
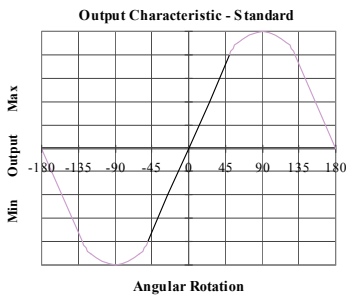
Connector - Hirschmann GD series IP65  
Cable with M12 gland or short gland IP67

Cable length >50cm – please specify length in cm up to 15000cm maximum.

We recommend all customers refer to the 3 or 5-Wire Mode Connection page.

**MOUNTING OPTIONS**

Flange 2 off 4.5 mm x 30 degree wide slots, 48 mm PCD.  
Servo 2 mm wide groove, internal diameter 31.8 mm.



The following discussion about three and five wire mode connections, between the FRX005 Galvanic Isolation Amplifier and sensor, is intended as an aid for end-users who are not familiar with the topic. Whether opting for a pre-wired Intrinsically Safe sensor or one with a connector, choosing the right mode of connection and cable to suit the application requires careful consideration. Conductor resistance, a function of conductor cross-section, cable length and temperature, causes volts drop across a cable.

As the term implies cables do not transmit the voltage perfectly, depending on material resistivity, conductor cross section and the current drawn from the power supply the voltage at the end of the cable will be less that at the power supply. This can significantly alter the perceived accuracy of the sensor which is ratiometric i.e. the output signal is directly affected by the supply voltage at the sensor.

It should be noted that volts drop calculations consider the current flow return path so the cable length is multiplied by two. Three wire mode connections are common and are suitable in most cases with short or moderate cable runs. Applications that do not require a high degree of accuracy but have cable runs, say in excess of 50m, volts drop can be reduced by introducing a terminal box close to the sensor and using a larger cross-section cable with for a majority of the intended cable run. Another factor to consider is conductor temperature. Fluctuations in temperature cause minor changes in resistance, the effects of which will be seen as gain variation in the sensor output.

Sensors supplied with cable are calibrated with the cable fitted which negates errors due to conductor resistance at room temperature; however, small gain errors due to temperature fluctuations in the cable should be expected. There are instances where large cross-section cables are not practical; for example most standard industrial connectors of the type used for sensors have a maximum conductor capacity of 0.75mm<sup>2</sup>, copper prices and ease of installation are other considerations.

Five wire mode connections have significant benefits over three wire mode as losses in the power and ground conductors are compensated for, thus smaller cables can be used. The Galvanic Isolation Amplifier senses and dynamically adjusts the output voltage so that the voltage at the sensor is correct, the effects of cable resistance and associated temperature coefficients are eliminated. The FRX005 amplifier can compensate for up to 15Ω per conductor with a current flow of 15mA, which is more than adequate for 150m of 0.25mm<sup>2</sup> cable. For this reason Altheris recommends five wire connections for cable lengths exceeding 10 metres in 0.25 mm<sup>2</sup> cable to preserve the full accuracy of the sensor. See illustrations below for examples of connecting a sensor to the Galvanic Isolation Amplifier.



The barrier will compensate for up to 12 ohms resistance in each conductor so this imposes the following minimum cable sizes:-

Cross Section (mm <sup>2</sup> )	Cable Length (metres)
0.25	Up to 150
0.5	150 to 300
0.75	300 to 450
1.0	450 to 600
1.5	600 to 900
2.0	900 to 1000

It should be noted that the maximum cable length as specified in the sensors certification takes precedence and must not be exceeded. The above lengths and conductor sizes used in a three wire connection will introduce a gain reduction of 5% and a ±1% temperature dependence of gain over the range -40°C to +80°C for the cable temperature. (i.e. about -150 ppm/°C for the maximum lengths shown and less pro rata for shorter lengths.)

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