

Field Calibration IncOder

REV 230330

INTRODUCTION: ERRORS ASSOCIATED WITH ENCODER ACCURACY

This application note outlines factors that affect encoder accuracy and introduces Field Calibration IncOder® for applications that require a high accuracy, robust solution.

While there will always be some position measurement error from encoders, if there is a high level of repeatability with the encoder and the installation is mechanically stable, it is possible to reliably compensate for these errors and increase accuracy.

In the case of high-accuracy encoders, the end user can take all the steps possible to mitigate position errors and still experience reduced system accuracy – due to high shock and vibration or the presence of contaminants. In this instance, a solution with superior accuracy, that is also environmentally robust is preferred.

With IncOder, errors associated with installation are repeatable and therefore deterministic in nature, allowing them to be compensated for via calibration.

WHAT IS FIELD CALIBRATION INCODER

Field Calibration IncOder is an encoder that enables calibration *in-situ*, offering the highest possible accuracy across the IncOder product line.

Via a *transfer calibration* from a high-accuracy reference measurement sensor, the user can program calibration table(s) directly into IncOder to compensate for non-linearities in position output, minimising accuracy error that arises from the installation process. Generating and populating calibration tables is made possible by sending and receiving commands to the IncOder via a serial interface.

APPLICABLE CONFIGURATION OPTIONS

Field Calibration IncOder is available in Mini and Midi IncOder sizes (37-300mm). It is selected by specifying the letter C within the Mechanical Format part number element.

Example: INC-3**C**-175-221001-SSI1-AC1-12-S

The following IncOder configurations are supported:

- Single turn & Multi turn.
- Protocols: ABZ, SSI, BiSS-C, SPI, ASI.
- Resolution (High resolution only)

IncOder Size	Field Cal Acceptable Resolution
37mm	16 - 17 bits
58mm	17 - 20 bits
75mm	18 - 21 bits
90mm	18 - 21 bits
100mm	18 - 21 bits
125mm	19 - 22 bits
150mm	19 - 22 bits
175mm	19 - 22 bits
200mm	19 - 22 bits
225mm	19 - 22 bits
250mm	19 - 22 bits
300mm	19 - 22 bits

REQUIREMENTS

To make use of the Field Calibration IncOder, the user will need the following:

- IncOder with Field Calibration enabled, and max resolution output selected.
- A Third-Party High Accuracy Reference Encoder.
- Power supply.
- RS-485 - USB A cable that connects the IncOder to a PC.
- PC to read data and write commands to the IncOder.
- Ability to read position measurement data from IncOder and Reference measurement device and store in PC memory.

WHY SHOULD YOU CHOOSE FIELD CALIBRATION INCODER

High accuracy encoders are typically sensitive in environments that have high levels of dust, dirt, and moisture. They also suffer in systems where there is high levels shock and vibration.

Field Calibration IncOder was designed to optimise the performance of the inductive sensing method, enabling maximum accuracy performance (up to 10 arcseconds) with high environmental integrity - while maintaining the classic robustness of IncOder.

This solution is best suited for applications where ultra-high accuracy is required, and extended accuracy performance is required of smaller sensor sizes.

Below is an example of a 125mm Field Calibration IncOder showing the reduction in position error over 360 degrees (Pre vs Post calibration):

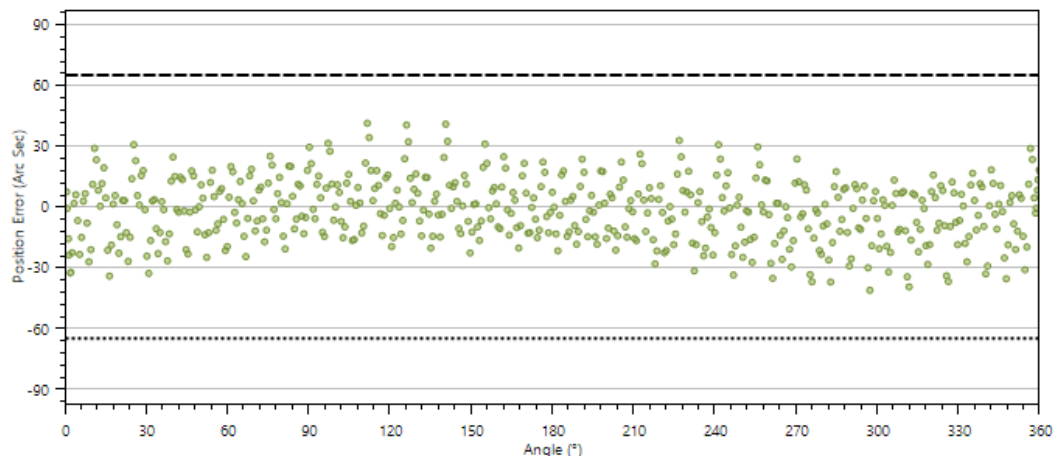


Figure 1: Pre-calibrated 125mm IncOder - Max Position Error ± 41.27 arcseconds.

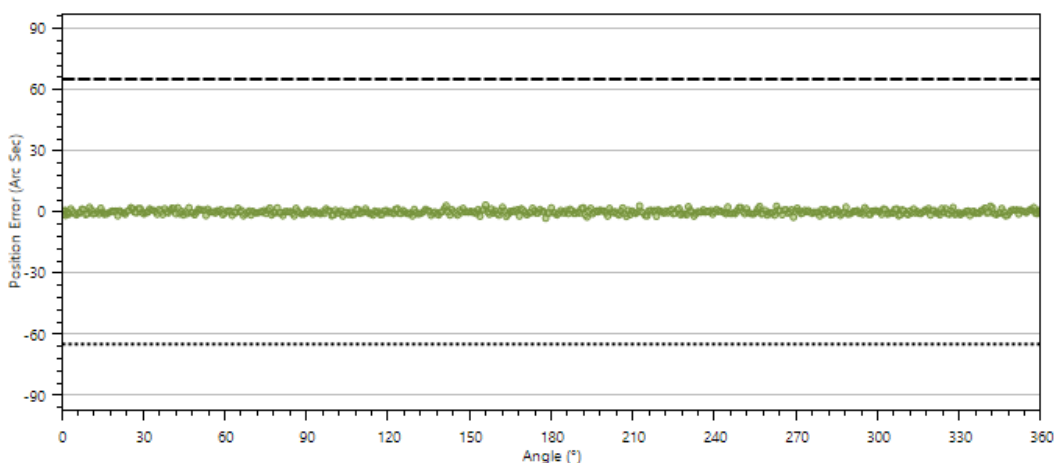


Figure 2: Post-calibrated 125mm Field Calibration IncOder - Max Position Error ± 3.27 arcseconds.

HOW IT COMPARES: ULTRA INCODER VS FIELD CALIBRATION INCODER

Novanta has developed two ways to extend the accuracy of IncOder beyond the standard IncOder Series.

Ultra IncOder – Pre-calibrated for twice the accuracy compared it’s IncOder series counterpart. This increase in accuracy performance is enabled through a precision calibration process, applied during manufacture of the device.

Field Cal. IncOder – In-situ calibrated for superior accuracy performance up to 10 arcseconds. The user employs a high accuracy reference sensor to perform a transfer calibration, done locally after installation. The following accuracy performance stated for Field Calibration is dependent on a broad range of external factors, the following table provides an expectation of what accuracy performance can be achieved in arcseconds.

Size	Standard IncOder	Ultra IncOder	Field Calibration IncOder
37mm	353 arcseconds	150 arcseconds	50 arcseconds
58mm	150 arcseconds	75 arcseconds	20 arcseconds
75mm	125 arcseconds	62.5 arcseconds	20 arcseconds
90 – 300mm	98 – 38 arcseconds	49 – 19 arcseconds	10 arcseconds

FURTHER CONSIDERATIONS FOR OPTIMISING ACCURACY

While calibrating in-situ provides distinct benefits, this method requires a minimum technical background knowledge. Directions for using this product can be found in the Field Calibration IncOder User Manual.

Most errors will be mitigated through calibration, a range of factors will impact final accuracy. These include:

- Pre-calibration installation – how well centred the IncOder rotor and stator are aligned.
- Mechanical stability - a well installed system is needed, with considered use of high-quality bearings and installation mechanics to minimise drift in alignment over performance life.
- Environment – Temperature, mechanical shock and vibration may also contribute to installation drift.
- Accuracy and quality of installation of the reference encoder.
- Size of the IncOder – Larger encoder sizes typically enable higher accuracies.
- Resolution of IncOder – A higher output resolution will afford a higher measurement precision.
- Number of calibration points – The higher the amount of measurement points, the higher the final accuracy. Calibration tables can store up to 2048 measurement points, with 1024 points recommended.