

# Machinery Health™ Sensor

EZ 1000, Converter for Eddy Current Sensors



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## Patents

The product(s) described in this manual are covered under existing and pending patents.

|                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <p>Vermerk zur Installation der Messketten in explosionsgefährdeter Umgebung.</p> <p>Soll die Messkette in explosionsgefährdeter Umgebung installiert werden, so ist auf die Einhaltung der in der Gebrauchsanweisung enthaltenen Installationshinweise zu achten. Sollten dabei sprachliche Schwierigkeiten auftreten, wenden Sie sich bitte an die Herstellerfirma, sie wird Ihnen eine Übersetzung der relevanten Artikel in der Landessprache des Verwendungslandes zukommen lassen.</p> |
|  | <p>Nota fuq l-installazzjoni tal-ktajjen tal-kejl f'ambjent esploziv</p> <p>Jekk il-katina tal-kejl support li tigi installata f'ambjent esploziv, hu importanti li ssegwi l-istruzzjonijiet pertinenti tal-manwal. Jekk issib xi diffikultà bil-lingwa, jekk joghgbok ikkuntattja lill-manifattur biex tikseb traduzzjoni tal-paragrafi rilevanti fil-lingwa mehtiega.</p>                                                                                                                  |
|  | <p>Anmärkning beträffande installation av mätkedjorna i explosionsfarlig miljö.</p> <p>Ska mätkedjan installeras i explosionsfarlig miljö, måste de anvisningar följas som ges i instruktionsboken beträffande installationen. Skulle därvid språkproblem uppstå, ber vi dig kontakta det tillverkande företaget som då kommer att sända dig en översättning av de relevanta artiklarna på användningslandets språk.</p>                                                                     |
|  | <p>Opomba za namestitve merilne verige v eksplozivno ogroženem okolju</p> <p>Če se merilna veriga namešča v eksplozivno ogroženem okolju, je potrebno upoštevati namestitvena opozorila, ki so v Navodilih za uporabo. Če se pri tem pojavijo jezikovne težave, se posvetujte z izdelovalcem; poslali vam bodo prevod ustreznih člankov v jeziku države, kjer se naprava uporablja.</p>                                                                                                      |
|  | <p>Záznam k inštalácii meracích reťazcov vo výbušnom prostredí</p> <p>Ak má byť merací reťazec inštalovaný vo výbušnom prostredí, treba dbať na dodržiavanie pokynov k inštalácii, uvedených v návode na použitie. V prípade, že by sa pritom vyskytli jazykové problémy, obráťte sa prosím na výrobcu, ktorý Vám zašle preklad relevantných článkov v jazyku Vašej krajiny.</p>                                                                                                             |

|                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <p>Nota referente à instalação de cadeias de agrimensor em ambientes potencialmente explosivos</p> <p>Caso a cadeia de agrimensor deva ser instalada em um ambiente potencialmente explosivo, é imprescindível observar e cumprir as indicações de instalação das instruções de serviço. Caso tenha dificuldades idiomáticas, queira entrar em contato com a firma produtora, esta poderá enviar-lhe uma tradução dos capítulos mais importantes no idioma do país onde o produto deverá ser empregado.</p> |
|    | <p>Wskazówka dotycząca instalacji łańcuchów mierniczych w otoczeniach zagrożonych eksplozją</p> <p>Jeżeli łańcuch mierniczy ma być zainstalowany w otoczeniu zagrożonym eksplozją, należy uwzględnić wskazówki dotyczące instalacji zawarte w instrukcji obsługi. Jeżeli w trakcie lektury wstąpią jakiegokolwiek problemy związane ze zrozumieniem tekstu, prosimy zwrócić się do producenta, który chętnie prześle tłumaczenie konkretnego artykułu w języku danego kraju.</p>                            |
|    | <p>Opmerking m.b.t. installatie van elektrische meet circuits in explosiegevaarlijke omgeving</p> <p>Dient de installatie van elektrische meet circuits in een explosiegevaarlijke omgeving te geschieden, moet men toezien dat de in de gebruikshandleiding opgenomen installatieinstructies worden nageleefd. Bij taalkundige problemen gelieve contact op te nemen met de fabrikant, deze zal u vervolgens een vertaling in de taal van het gebruiksland doen toekomen.</p>                              |
|  | <p>Pastaba dėl matavimo grandinės įrengimo sprogimo atžvilgiu pavojingoje aplinkoje</p> <p>Jei matavimo grandinė turi būti įrengta sprogimo atžvilgiu pavojingoje aplinkoje, privaloma laikytis vartotojo instrukcijoje pateiktų įrengimo nurodymų. Jei kiltų sunkumų dėl kalbos, prašome kreiptis į gamintojo įmonę, kuri pateiks Jums reikiamo skyriaus vertimą į vartotojo valstybės kalbą.</p>                                                                                                          |
|  | <p>Nota sull'installazione delle catene per misurazione in ambienti a rischio di esplosioni</p> <p>Nel caso in cui si debbano installare le catene per misurazione in ambienti a rischio di esplosioni, è necessario attenersi alle avvertenze per l'installazione contenute nelle istruzioni d'uso. Per difficoltà di carattere linguistico, rivolgetevi alla ditta produttrice. Quest'ultima Vi farà pervenire una traduzione degli articoli rilevanti nella lingua del paese d'impiego.</p>              |
|  | <p>Megjegyzés a mérőláncok robbanásveszélyes környezetben történő szereléséhez.</p> <p>Ha a mérőláncot robbanásveszélyes környezetben kell felszerelni, akkor ügyeljen a Használati útmutatóban közölt szerelési utasítások betartására. Amennyiben nyelvi nehézségek merülnek fel, szíveskedjen a gyártó céghez fordulni, amely elküldni Önnek a felhasználó ország nyelvére lefordított, erre vonatkozó cikket.</p>                                                                                       |

|                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <p>Remarque concernant l'installation des chaînes de mesure dans un environnement présentant un risque d'explosion</p> <p>Si la chaîne de mesure doit être installée dans un environnement présentant un risque d'explosion, il est impératif de veiller à respecter les consignes d'installation contenues dans les instructions de service. S'il devait ce faisant surgir des problèmes linguistiques, veuillez vous adresser à la société fabricante: elle vous fera parvenir une traduction des articles significatifs dans la langue du pays de mise en oeuvre.</p> |
|    | <p>Huomautus mittausketjun asentamisesta räjähdysalttiissa ympäristössä</p> <p>Jos mittausketju tulee asentaa räjähdysalttiissa ympäristössä, on käyttöohjeessa annettu asennusohjeita noudatettava. Jos käyttöohjeessa käytetty kieli aiheuttaa ongelmia, kääntykää valmistajayrityksen puoleen. Se toimittaa käyttöönnne tarvittavat artikkelit käyttömaan viralliselle kielelle käännettynä.</p>                                                                                                                                                                      |
|    | <p>Juhend mõõdukettide ülespanemiseks plahvatusohtlikus piirkonnas.</p> <p>Kui panna üles mõõdukettid plahvatusohtlikkus piirkonnas, nii tuleb jälgida kasutusjuhendis sisaldatud instalationimärkeid. Juhul kui tekkivad raskused keelega, siis pöörduge palun tootja poole. Tootja saadab emakeelse tõlge vastavalt artiklile ning maale.</p>                                                                                                                                                                                                                          |
|  | <p>Notas sobre la instalación de cadenas de medición en un entorno potencialmente explosivo.</p> <p>Si ha de instalar la cadena de medición en un entorno potencialmente explosivo, deberá respetar las indicaciones sobre la instalación, contenidas en el manual de uso. Si surgieran dificultades lingüísticas, póngase en contacto con la empresa fabricante, que le facilitará una traducción del artículo en la lengua del país donde se emplee.</p>                                                                                                               |
|  | <p>Note on the installation of the measuring chains in an explosive environment</p> <p>If the measuring chain is supposed to be installed in an explosive environment, it is important to follow the pertinent installation instructions in the manual. Should you encounter difficulties with the language, please contact the manufacturer to obtain a translation of the relevant paragraphs into the language required.</p>                                                                                                                                          |
|  | <p>Σημείωση για την εγκατάσταση αλυσίδων μέτρησης σε περιβάλλον, στο οποίο υπάρχει κίνδυνος έκρηξης</p> <p>Εάν η αλυσίδα μέτρησης πρόκειται να εγκατασταθεί σε περιβάλλον, στο οποίο υπάρχει κίνδυνος έκρηξης, πρέπει να τηρηθούν οπωσδήποτε οι οδηγίες εγκατάστασης που περιλαμβάνονται στις οδηγίες χρήσης. Εάν υπάρξουν γλωσσικές δυσκολίες κατανόησης, παρακαλούμε να απευθυνθείτε στην κατασκευάστρια εταιρεία, η οποία θα φρουτίσει για την αποστολή μιας μετάφρασης των σχετικών άρθρων στη γλώσσα της Χώρας Χρήσης.</p>                                          |
|  | <p>Info vedrørende installation af målekæderne i eksplosionstruede omgivelser</p> <p>Hvis målekæden skal installeres i eksplosionstruede omgivelser, skal installationsanvisningerne i brugsanvisningen følges. Hvis der i denne forbindelse opstår sproglige problemer, bedes De henvende Dem til produktionsfirmaet, som så vil sørge for, at De modtager en oversættelse af den relevante artikel på Deres sprog.</p>                                                                                                                                                 |



Poznámka k instalaci měřících řetězců v prostředí s nebezpečím výbuchu.

Když má být měřicí řetězec (sestavující z čidla a konvertoru) instalován v prostředí s nebezpečím výbuchu, tak je třeba respektovat instalační pokyny, které jsou součástí návodu k upotřebení. Kdyby při tom došlo k jazykovým potížím, tak prosíme kontaktujte výrobní firmu, která Vám relevantní článek zašle v jazyku krajiny použití.



Piezīme par mērīšanas ķēžu instalēšanu sprādziena bīstamās zonās.

Ja mērīšanas ķēde jāuzstāda sprādzienbīstamā zonā, ir jāievēro lietošanas instrukcijā dotie instalēšanas norādījumi. Ja rodas kādas valodas grūtības, lūdzu griezties pie izgatavotāja firmas, kas Jums nosūtīs nozīmīgāko nodaļu tulkojumus lietotāja valsts valodā.

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# 1 General

Topics covered in this chapter:

- *Using this manual*
- *Symbols*
- *Liability and guarantee*
- *Incoming goods inspection*
- *Technical support*
- *Storage and transport*
- *Disposal of the device*
- *China RoHS Compliance*
- *Installation awareness*

## 1.1 Using this manual

This manual contains information concerning the use of the device.

Read the operating manual completely prior to starting installation and operating the device. Comply with all safety instructions.

This operating manual applies for EZ 1000 Converters with serial numbers 0000690 to 0001029 and P181900XXX. See type plate for serial number.

Include the operating manual when transferring the device to third parties.

---

### Note

When requesting technical support, please indicate type and serial number from the type plate.

---

*Table 1-1* shows a list of documents that are referred to in this operating manual.

**Table 1-1: Referenced documents**

|           |                                                     |
|-----------|-----------------------------------------------------|
| MHM-97879 | Operating Manual Machine Studio - General Functions |
| MHM-97883 | Installation Guide EZ 10xx, Eddy Current Sensors    |

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### Note

*Chapter 6* and *Chapter 7* are only valid for EZ 1000 Converters labeled as an Ex ia or Ex nA device.

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## 1.2 Symbols

### Note

This symbol marks passages that contain important information.

### ⚠ CAUTION!

This symbol marks operations that can lead to malfunctions or faulty measurements, but will not damage the device.

### ⚠ DANGER!

A danger indicates actions that can lead to property damage or personal injury.



According to IEC 61010, this symbol means that the documentation of the device must be completely read and understood before installing and commissioning of the device. Observe all safety related instructions in this document.



According to IEC 61010, this symbol means that this device must be operated with DC voltage.

## 1.3 Liability and guarantee

WayCon is not liable for damages that occur due to improper use. Proper use also includes the knowledge of, and compliance with, this document.

Customer changes to the device that have not been approved expressly by WayCon will result in the loss of guarantee.

Due to continuous research and further development, WayCon reserves the right to change technical specifications without notice.

## 1.4 Incoming goods inspection

Check the content of the shipment to ensure that it is complete; visibly inspect the goods to determine if the device has been damaged during transport. The following parts are included in the scope of delivery and must be contained in the shipment.

- EZ 1000 Converter
- Sensor Documentation CD with Operating Manual

If the contents is incomplete, or if you observe any defects, file a complaint with the carrier immediately. Inform the responsible WayCon sales organization so your device can be replaced. In this case, attach a tag with customer name and the observed defect.

## 1.5 Technical support

You may need to ship this product for return, replacement, or repair to an WayCon Product Service Center. Before shipping this product, contact WayCon Product Support to obtain a Return Materials Authorization (RMA) number and receive additional instructions.

### Product Support

WayCon provides a variety of ways to reach your Product Support team to get the answers you need when you need them:

|       |                                                      |
|-------|------------------------------------------------------|
| Phone | +49 89 976713 - 0                                    |
| Email | <a href="mailto:sales@waycon.de">sales@waycon.de</a> |
| Web   | <a href="http://www.waycon.biz">www.waycon.biz</a>   |

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### Note

If the equipment has been exposed to a hazardous substance, a Material Safety Data Sheet (MSDS) must be included with the returned materials. A MSDS is required by law to be available to people exposed to specific hazardous substances.

---

## 1.6 Storage and transport

Store and transport the device only in its original packaging. Technical data specifies the environmental conditions for storage and support.

### Related information

*Technical data*

## 1.7 Disposal of the device

Provided that no repurchase or disposal agreement exists, recycle the following components at appropriate facilities:

- Recyclable metal
- Plastic elements

Sort the remaining components for disposal, based on their condition. National laws or provisions on waste disposal and protection of the environment apply.

**Note**

Environmental hazards! Electrical waste and electronic components are subject to treatment as special waste and may only be disposed by approved specialized companies.

## 1.8 China RoHS Compliance

Our products manufactured later than June 30, 2016 and those which are sold in the People's Republic of China are marked with one of the following two logos to indicate the Environmental Friendly Use Period in which it can be used safely under normal operating conditions.

Products without below mentioned marking are either manufactured before June 30 or are non-electrical equipment products (EEP).



Circling arrow symbol with "e": The product contains no hazardous substances over the Maximum Concentration Value and it has an indefinite Environmental Friendly Use Period.



Circling arrow symbol with a number: This product contains certain hazardous substances over the Maximum Concentration Value and it can be used safely under normal operating conditions for the number of years indicated in the symbol. The names and contents of hazardous substances can be found in folder "China RoHS Compliance Certificates" on the documentation CD or DVD enclosed with the product.

## 1.9 Installation awareness

**Note**

When planning a measurement, observe the following items:

- Consider environmental conditions which might have an influence on the measurement such as temperature, humidity, substances aggressive to the sensor, and pollution.
- Always use a stiff and vibration-free sensor holder.
- Define a suitable measuring range, not larger than necessary, in consultation with the operator of the plant.
- Define the trip limit in consultation with the operator of the plant.
- Take measurement deviations into account when defining the trip limit.
- Use a sensor that meets the requirements of the defined measuring range.
- Ensure an EMC-compatible installation including the use of proper cables.
- Ensure proper function of the measurement before activating the measurement for regular operation.

## 2 Safety instructions

Topics covered in this chapter:

- *Using the device*
- *Owner's responsibility*
- *Radio interference*
- *ESD safety*

To ensure safe operation, carefully observe all instructions in this manual.

The correct and safe use of this device requires that operating and service personnel both understand and comply with general safety guidelines and observe the special safety comments listed in this manual. Where necessary, safety-sensitive points on the device are marked.

### DANGER!

Because the device is electrical equipment, commissioning and service may be performed only by trained and authorized personnel. Maintenance may be carried out only by trained, specialized, and experienced personnel.

### 2.1 Using the device

Install and use the device as specified in this manual.

If the device is used in a manner not specified by the manufacturer, the protection provided by the device may be impaired.

### 2.2 Owner's responsibility

If there is a reason to suspect that hazard-free operation, and thus, adequate machine protection is no longer possible, take the device out of operation and safeguard it from unintentional operation. This is the case:

- if the device shows visible damage.
- if the device no longer works.
- after any kind of overload that has exceeded the permissible limits (such as those detailed in chapter "Technical data," section "Environmental conditions").

**DANGER!**

If device tests have to be completed during operation or if the device has to be replaced or decommissioned, it will impair the machine protection and may cause the machine to shut down. Make sure to deactivate machine protection before starting such work, and reactivate it after work has been completed.

---

**Related information***Technical data*

## 2.3 Radio interference

The device is carefully shielded and tested to be technically immune to radio interference and complies with current standards. However, if you operate this device together with other peripheral devices that are not properly shielded against radio interference, disturbances and radio interferences may occur.

## 2.4 ESD safety

**DANGER!**

Internal components can be damaged or destroyed due to electrostatic discharge (ESD) during handling of the device.

Take suitable precautions before handling the device to prevent electrostatic discharges through the sensor electronics. Such measures might include, for example, wearing an ESD bracelet. Transport and storage of electronic components may only be made in ESD-safe packaging.

Handle the device with particular care during dry meteorological conditions with relative humidity below 30% as electrostatic discharges can appear more frequently.

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## 3 Application and design

Topics covered in this chapter:

- *Application*
- *Design*

### 3.1 Application

The EZ 1000 is a signal converter for different types of eddy current sensors. The converter is designed for the connection of eddy current sensors of the EZ 10xx series and a selection from third party sensors:

- EZ 105x and EZ 108x
- Bently Nevada 3300 XL 8 mm Proximity Probes 33010x

The sensor adapter EZ1900-003-ADAP-2 is required for the connection of 33010x probes.

The EZ 1000, in combination with eddy current sensors listed above, can be used for static and dynamic distance measurements at a variety of different rotating machinery. This means that slow axial displacements and fast radial vibrations of rotating machines can be measured. By using pulse wheels or key marks stuck on the shaft, the speed of the machine can be measured and key pulses generated.

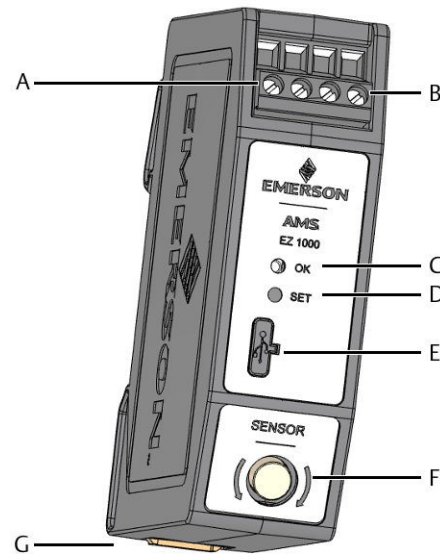
The EZ 1000 is integrated into Machine Studio which allows an easy on-site calibration of the converter to the sensor. Machine Studio also provides the opportunity of detuning the converter if sensors are fitted closely together or to extend the standard measuring range of several sensors.

Supply circuits for the eddy current sensor and the measuring electronic are contained in the converter. The nominal supply voltage for the converter is -24 V DC, the nominal range of the output signal, proportional to the nominal measuring range of the sensor, is -2 to -18 V.

### 3.2 Design

The EZ 1000 is designed for DIN rail mounting within a field housing or cabinet. The connection of converter supply and sensor signal is made by screw terminals. The converter is equipped with a LEMO connector for connection of an eddy current sensor. The USB 2.0 Micro-B socket is the interface for the configuration. *Figure 3-1* explains the connections and operating elements.

Figure 3-1: EZ 1000



- A. Two screw terminals for -24 V DC supply voltage.
- B. Two screw terminals for sensor output signal (range: -2 V to -18 V)
- C. Green Channel OK LED (see [Table 3-1](#))
- D. Button for offline calibration (Easy calibration) without Machine Studio and for Firmware update
- E. Configuration interface (USB 2.0 Micro-B socket with cover)
- F. Sensor socket with external thread for sensor connection
- G. Build-in spring DIN rail clip

Table 3-1: LED blinking pattern

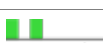
| Event                                         | Blinking pattern                                                                                                    | Sequence <sup>(1)</sup>                                                                        |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Normal operation                              | Steady green light                                                                                                  |           |
| Offline (Easy) calibration                    | Slow flashing (1 Hz) for approximately 5 seconds; request of calibration – before measurement                       |  1 Second |
|                                               | Double flashing (1 Hz) for approximately 5 seconds during measurement (see <a href="#">Section 8.7</a> for details) |  1 Second |
| Offline (Easy) calibration – failure detected | Unlimited fast flashing (5 Hz) – until power off/ on the EZ 1000                                                    |  1 Second |
| Automatic calibration with Machine Studio     | Slow flashing (1 Hz) for approximately 5 seconds; request of calibration – before measurement                       |  1 Second |
|                                               | Double flashing (1 Hz) for approximately 5 seconds during measurement                                               |  1 Second |

Table 3-1: LED blinking pattern (continued)

| Event                                                        | Blinking pattern                                                            | Sequence <sup>(1)</sup>                                                             |
|--------------------------------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Automatic calibration with Machine Studio – failure detected | Unlimited fast flashing (5 Hz) – until power off/ on the EZ 1000            |  |
| Firmware update                                              | Slow flashing (1 Hz) while waiting for button press                         |  |
|                                                              | Steady light while erasing and writing the firmware                         |  |
| Sensor error                                                 | LED off                                                                     |  |
| Sensor is too close to the measuring object                  |                                                                             |                                                                                     |
| Converter error                                              |                                                                             |                                                                                     |
| No power supply                                              |                                                                             |                                                                                     |
| Factory default                                              | Continuously triple flashing                                                |  |
| Factory calibrated                                           | Slow flashing (1 Hz) for approximately 3 seconds after power on the EZ 1000 |  |

(1)  = on /  = off

## 4 Function principle

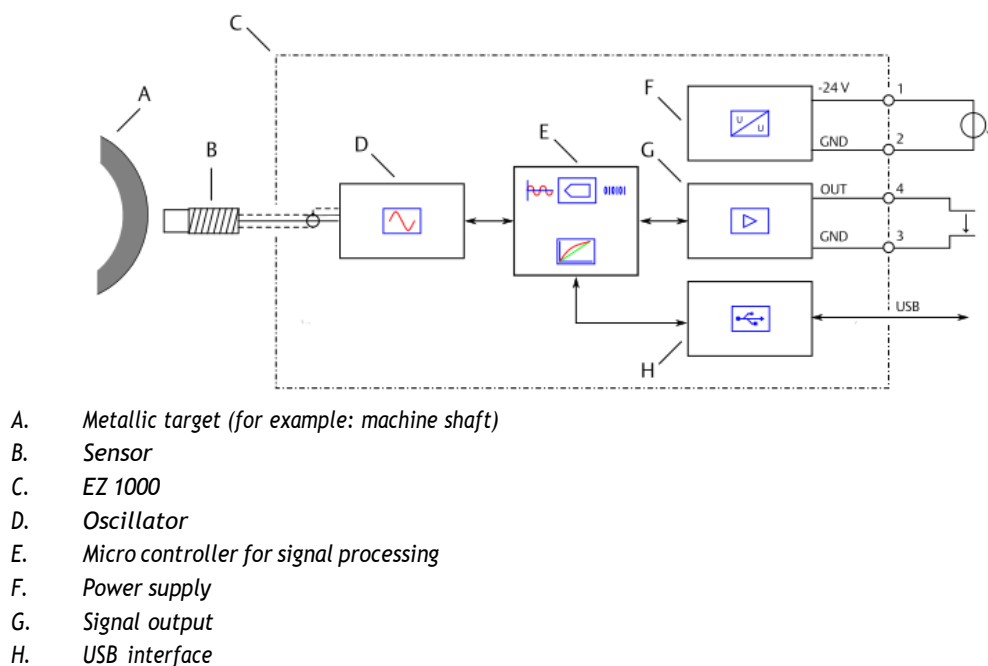
The measuring coil of the eddy current sensor (for example EZ 1050 or EZ 1080) is connected to an oscillator circuit in the converter through a shielded connection cable.

The oscillator circuit generates a high-frequency signal resulting in a high-frequency magnetic field around the tip of the eddy current probe. If this magnetic field meets a metallic target, it induces high-frequency currents and another magnetic field which is inversely induced to the original one. According to the rule of Lenz, the induced current damps the oscillator signal.

The damping factor depends on the distance between sensor head and target material. The smaller the distance to the sensor, the smaller the amplitude of the oscillator.

The demodulator at the output of the oscillator generates a distance proportional signal from the amplitude modulated HF-signal. The following units serve the purpose of linearization and amplification of the signal. The output connectors OUT and GND provide a signal proportional to the actual distance between sensor head and target material (measurement object).

Figure 4-1: Block diagram



The target material, the sensor, and the sensor cable length have an influence on the oscillator circuit and consequently on the output signal. The EZ 1000 converter must be calibrated on the connected sensor, the sensor cable length, and the material of the target to reduce this influence. Sensor, sensor cable, and calibrated EZ 1000 converter form the measuring chain.

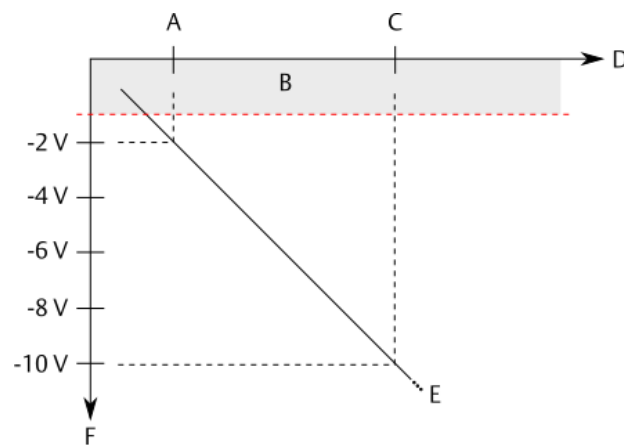
**Note**

If installing a calibrated measuring chain at a different measuring point, ensure that the target material of this point is the same as of the previous point. Otherwise, recalibrate the converter on the new target material.

## 4.1 Sensor supervision

The EZ 1000 checks the connected sensor by supervising the signal voltage. A sensor not OK indication is displayed when the sensor OK limit of -1.5 V has been violated.

Figure 4-2: Diagram sensor supervision



- A. Beginning of the measuring range (smallest distance to measuring object)
- B. Sensor not OK area. Limit: -1.5 V
- C. Mid of measuring range
- D. Distance between sensor and measuring object
- E. Voltage output curve (-2 to -18 V)
- F. Output voltage

Sensor not OK indication:

- Green LED on the converter front is switched off (see [Table 3-1](#)).  
The green LED is used for sensor, voltage, and converter fault indication.
- Sensor state in the online view of Machine Studio indicates a fault (see [Section 9.1](#)).

[Table 4-1](#) lists causes for a sensor not OK indication.

Table 4-1: Causes for sensor not OK indication

| Cause                                        | Possible reasons                   | Solution                                                          |
|----------------------------------------------|------------------------------------|-------------------------------------------------------------------|
| Sensor is too close to the measuring object. | Machine behavior has been changed. | Check the distance and readjust the sensor position if necessary. |
|                                              | Loosened sensor holder.            |                                                                   |

Table 4-1: Causes for sensor not OK indication (*continued*)

| Cause              | Possible reasons                                                      | Solution                                                                                                       |
|--------------------|-----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| Sensor cable break | Open connector.                                                       | Check the sensor cable and connections. Replace a defective sensor. Check cable path to avoid further damages. |
|                    | Damaged sensor cable.                                                 |                                                                                                                |
| Sensor head damage | Permissible environmental temperature has been considerably exceeded. | Replace the defective sensor. Check sensor adjustment and environmental condition to avoid further damages.    |
|                    | Sensor head has touched the measuring object.                         |                                                                                                                |

The sensor not OK indication is reset as soon as the voltage is below the limit again.

# 5 Installation and commissioning

Topics covered in this chapter:

- *CSA - General safety*
- *Mounting*
- *Hints for installation and connection*
- *Adjustment of measuring chains at the machine*
- *Mutual influences of two measuring chains*

## 5.1 CSA - General safety

Equipment to be installed within another enclosure which provides the safety aspects and protects the operator from hazards and is suitable for outdoor environment conditions.

## 5.2 Mounting

Mount the EZ 1000 converter into a suitable housing that contains a mounting rail of type NS 35/7.5. The minimum space on the DIN rail is equal to the converter width of 26 mm. The minimum mounting space for the EZ 1000 within a housing is shown in *Figure 5-1*.

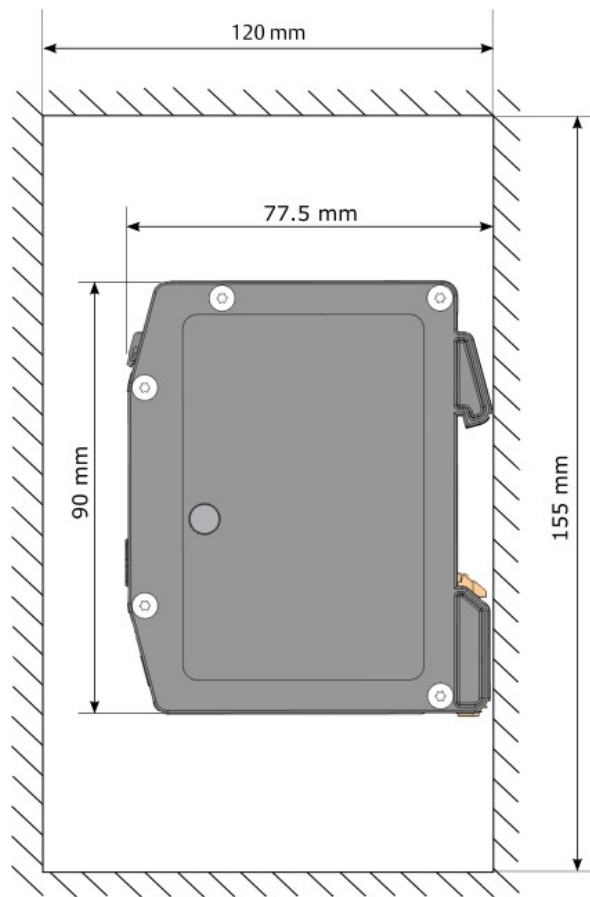
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### Note

Ensure that there is no heated surface beneath the EZ 1000.

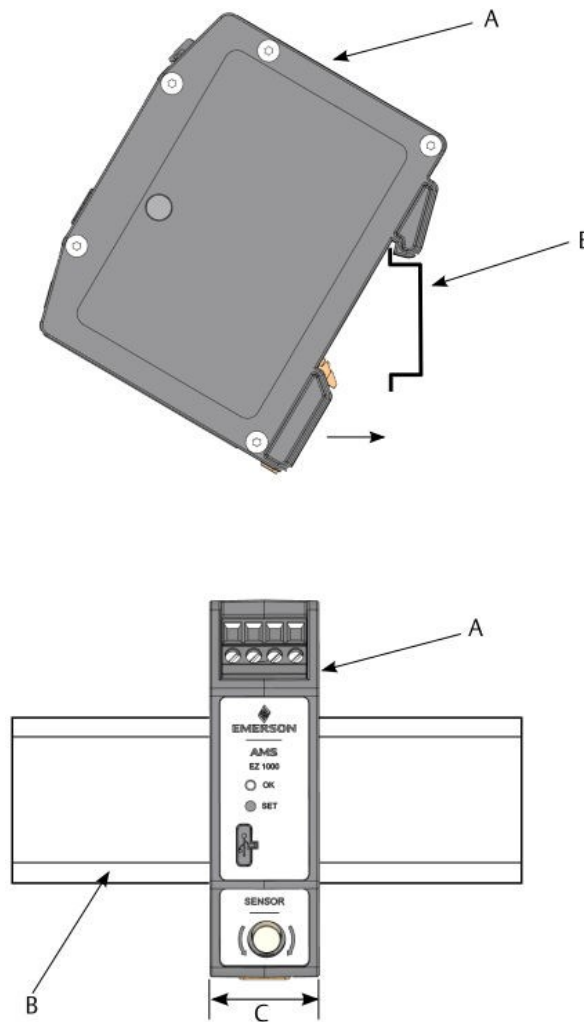
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Figure 5-1: Minimum required mounting space



Snap the EZ 1000 onto the DIN rail as shown in [Figure 5-2](#).

Figure 5-2: DIN rail mounting



- A. EZ 1000
- B. DIN rail type NS 35/7.5
- C. Minimum required space on DIN rail: 26 mm

## 5.3 Hints for installation and connection

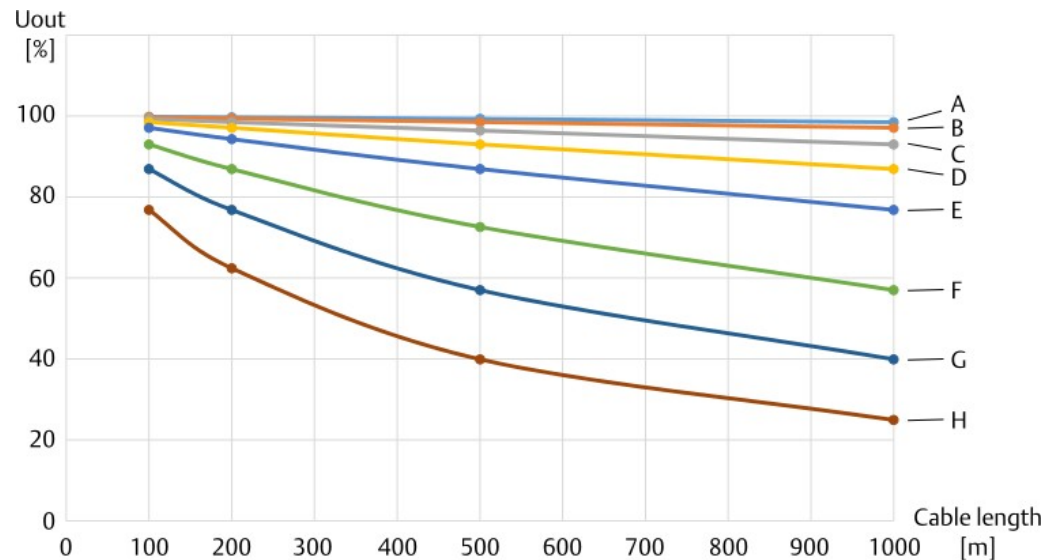
To ensure the electromagnetic compatibility of the eddy current measuring chain, WayCon recommends using a double shielded twisted pair cable for connecting the EZ 1000 converter to the measuring amplifier, for example to an A6500-UM Universal Measurement Card of the AMS 6500 ATG system. For direct connections to the converter, LiYCY-CY 2x2x0.25 mm<sup>2</sup> or equivalent cables are preferred. Master connection cable may be any multicore cable with a corresponding cable structure. WayCon recommends connecting the outer cable shield to protective earth/measuring ground close to the

measuring amplifier directly at the cable inlet of the control cubicle. Moreover, connect the outer cable shield to protective earth as often as possible, for example, at every intermediate distribution frame or cable gland.

A higher electromagnetic compatibility can be achieved by connecting the cable shield to protective ground at either end of the cable – provided that no ground loop current (equalizing current) occurs.

The maximum cable length, for installation in non-hazardous locations, between an EZ 1000 and a measuring amplifier, such as an A6500-UM card, depends on the electrical properties of the used cable. *Figure 5-3* explains the influence of the used cable on the output signal of the EZ 1000. The signal frequency has the most significant influence on the maximum cable length. The higher the signal frequency and the longer the cable, the higher the signal damping.

Figure 5-3: Cable influence on the converter output signal



Cable capacity 120 nF/km (wire/wire); signal frequency:

- A. 100 Hz
- B. 200 Hz
- C. 500 Hz
- D. 1000 Hz
- E. 2000 Hz
- F. 5000 Hz
- G. 10000 Hz
- H. 20000 Hz

Example: At a signal frequency of 1000 Hz and a cable length of 1000 m, the converter output voltage is reduced by approximately 13%.

The accuracy of the calculated  $U_{out}$  values is  $\pm 10\%$ .

- Install measuring cables according to general standards for measuring and control cables.
- If possible, install cables in metallic cable channels or tubes.
- Observe that the measuring cables are arranged orthogonally.

### 5.3.1 Connections and wiring

The EZ 1000 is equipped with four screw terminals for power supply connection and output signal connection, and a LEMO socket for the connection of one eddy current sensor. See [Table 5-1](#) for the minimum and maximum permissible wire cross-section of the screw terminals.

Table 5-1: Permissible wire cross-section

| Wire description                                                                  | Wire cross-section   |                     |
|-----------------------------------------------------------------------------------|----------------------|---------------------|
|                                                                                   | Minimum              | Maximum             |
| Conductor cross section solid                                                     | 0.34 mm <sup>2</sup> | 2.5 mm <sup>2</sup> |
| Conductor cross section flexible                                                  | 0.2 mm <sup>2</sup>  | 2.5 mm <sup>2</sup> |
| Conductor cross section flexible, with ferrule without plastic sleeve             | 0.25 mm <sup>2</sup> | 2.5 mm <sup>2</sup> |
| Conductor cross section flexible, with ferrule with plastic sleeve                | 0.25 mm <sup>2</sup> | 2.5 mm <sup>2</sup> |
| Conductor cross section AWG                                                       | 24                   | 12                  |
| 2 conductors with same cross section, solid                                       | 0.2 mm <sup>2</sup>  | 1 mm <sup>2</sup>   |
| 2 conductors with same cross section, stranded                                    | 0.2 mm <sup>2</sup>  | 1.5 mm <sup>2</sup> |
| 2 conductors with same cross section, stranded, ferrules without plastic sleeve   | 0.25 mm              | 1 mm <sup>2</sup>   |
| 2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve | 0.5 mm <sup>2</sup>  | 1.5 mm <sup>2</sup> |
| AWG according to UL/CUL                                                           | 30                   | 12                  |

The required wire stripping length is 10 mm.

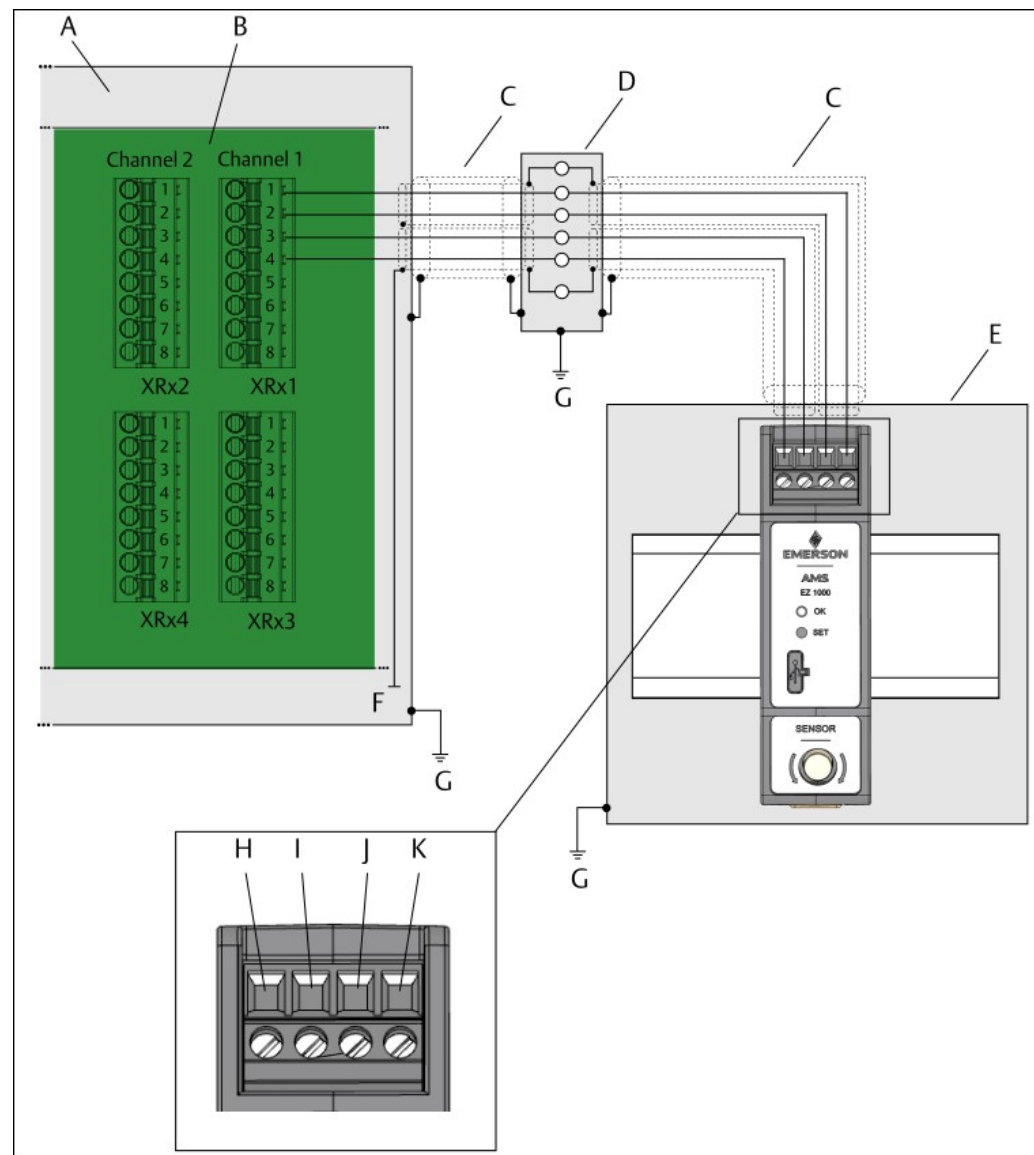
### Power supply and output signal connection

The EZ 1000 converter requires a -24 V DC power supply and is typically supplied by the used measuring amplifiers such as an A6500-UM Universal Measurement Card. Usage of a suitable external power supply is also possible.

If using an external power supply, ensure that it is a Class 2 power supply or a Limited Energy source in accordance to CSA 61010-1-12.

*Figure 5-4* exemplifies the connection of an EZ 1000. The shown grounding concept is one possibility. Adapt the grounding concept to the on-site requirements.

Figure 5-4: Connection example



- A. Cabinet
- B. Rear view of a slot of an AMS 6500 ATG backplane (x = slot number).
- C. Double shielded and twisted pair cable, for example LiYCY-CY 2x2x0.25mm<sup>2</sup>
- D. Junction box
- E. Field housing with EZ 1000
- F. Shield earth
- G. Protection earth
- H. Screw terminal for power supply: -24 V
- I. Screw terminal for power supply: ⊥ (GND)
- J. Screw terminal for output signal: ⊥ (GND)
- K. Screw terminal for output signal: Out

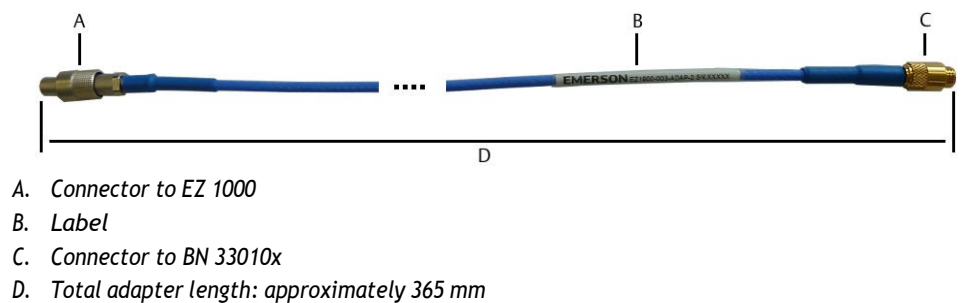
## Sensor connection

The following sensor types can be connected.

- EZ 105x and EZ 108x
- Bently Nevada 3300 XL 8 mm Proximity Probes 33010x.

The sensor adapter EZ1900-003-ADAP-2 is required for the connection of 33010x probes.

Figure 5-5: Sensor adapter EZ 1900-003-ADAP-2



The sensor socket of the EZ 1000 is a mini LEMO socket with an external thread to secure the sensor against unintentional removing.

### Connect

1. Plug the sensor connector into the sensor socket. See [Figure 3-1](#) for the location of the sensor socket.
2. Gently turn the cap nut of the sensor connector clockwise to secure the sensor.

### Disconnect

1. Turn the cap nut of the sensor connector counter clockwise to unfasten the sensor.
2. Unplug the sensor.

### Isolate the adapter connection

If using the EZ1900-003-ADAP-2 adapter to connect third party sensors to the EZ 1000 converter, isolate the connection between the sensor cable and the adapter with the included black shrink sleeve. For installation in a hazardous environment, also use the included blue shrink sleeve.

### Procedure

1. At the open connection, push the shrink sleeve over the connector of the sensor cable so that the sleeve completely covers the sensor cable.

- First the blue shrink sleeve<sup>(1)</sup> and then the black shrink sleeve.
2. Close the connection.
  3. Move the black shrink sleeve over the closed connection. Plug and socket must be completely covered by the shrink sleeve.
- Ensure that the shrink sleeve evenly overlaps plug and socket.
4. Use a hot air gun to evenly shrink the sleeve. The required shrinking temperature is approximately 200°C.
  5. Ensure that the shrunken sleeve touches sensor cable, plug, and socket. It is important that the shrink sleeve cannot slip from the connection.
  6. Move the blue shrink sleeve evenly over the closed connection already isolated with the black shrink sleeve.<sup>(1)</sup>
  7. Use a hot air gun to evenly shrink the blue sleeve. The required shrinking temperature is approximately 200°C.<sup>(1)</sup>

## 5.4 Adjustment of measuring chains at the machine

### 5.4.1 General connection

#### Prerequisites

- -24 V DC power supply, if the converter is not supplied by a measuring amplifier such as an A6500-UM.
- Voltmeter with an accuracy of 1%.

#### Procedure

1. Connect the converter supply -24 V DC (+24 V to  $\perp$  (GND)). See *Power supply and output signal connection*.
2. Connect the sensor to the sensor socket. See *Sensor connection*.
3. Measure the output level at pins OUT and  $\perp$  (GND). See *Power supply and output signal connection*.

### 5.4.2 Sensors EZ 105x and EZ 108x

1. Loosen the lock nut of the sensor.
- See installation guide of the used sensor for further installation details.
2. Turn the sensor in the holder until the nominal distance between sensor head and measuring target is reached, and the connected voltmeter indicates the desired point on the characteristic curve.

(1) Only necessary for installation in a hazardous environmental.

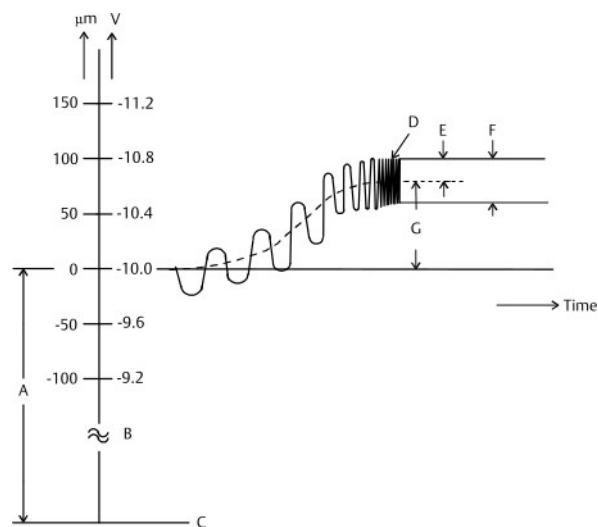
For sensors with an extension cable, WayCon recommends removing the extension cable to avoid twisting the cable during mounting and turning the sensor. Reconnect the extension cable before measuring the output voltage for the fine adjustment.

- For measuring shaft vibrations, it is sufficient to adjust the sensor to an output value of  $-10\text{ V} \pm 1\text{ V}$ . See [Figure 5-6](#).
- For static measurements, a precise adjustment to one output value is required, the sensor is preferably set to one of the three output levels of the converter:
  - For symmetrical displacements around the center point (see [Figure 5-7, F](#)) to  $-10\text{ V} \pm 0.05\text{ V}$  (recommended procedure).
  - For the measuring range minimum (= minimum distance) to  $-2\text{ V} \pm 0.05\text{ V}$  for single-sided movements to greater distances ([Figure 5-7, E](#)).
  - For the measuring range maximum (= maximum distance) to  $-18\text{ V} \pm 0.05\text{ V}$  for single-sided movements to smaller distances. ([Figure 5-7, G](#)).
  - Or to any other value within the measuring range when different distances in both directions must be measured.

#### Note

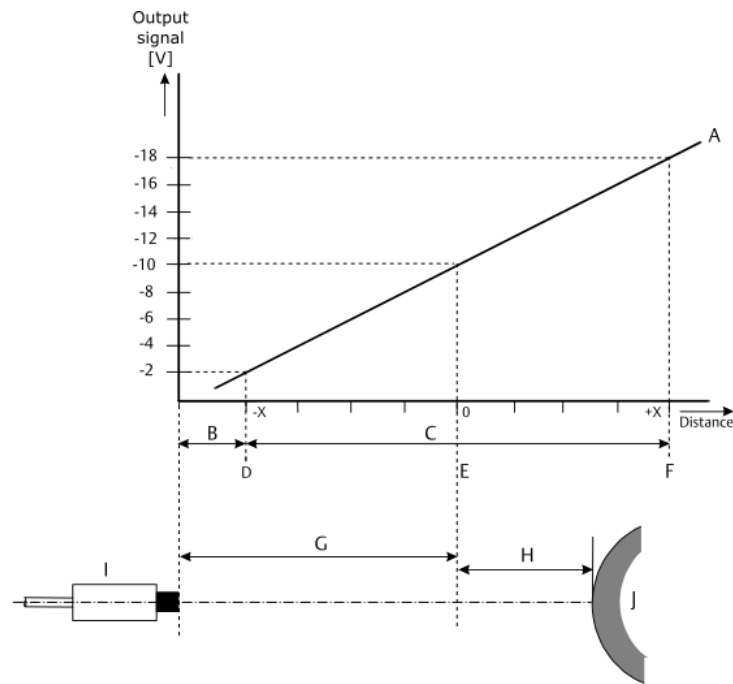
The position of the machine shaft must be known when adjusting the sensor for static measurement.

Figure 5-6: Characteristic curve - dynamic



- A. Nominal distance<sup>(3)</sup>
- B. Voltage range:  $-2\text{ V}$  to  $-18\text{ V}$
- C. Sensor tip
- D. Shaft vibration signal
- E. 0-to-Peak
- F. Peak-to-Peak
- G. Quasi static displacement

Figure 5-7: Characteristic curve - static



- A. Characteristic curve -2 V to -18 V
- B. Initial air gap<sup>(2)</sup>
- C. Working range (-x to +x)
- D. Minimum distance
- E. Center point (zero point)
- F. Maximum distance
- G. Nominal distance<sup>(3)</sup>
- H. Instantaneous distance<sup>(4)</sup>
- I. Sensor
- J. Shaft (measuring target)

3. Fix the sensor using the lock nut.

For the maximum tightening torque, see sensor installation guide.

## 5.5 Mutual influences of two measuring chains

Two eddy current measuring chains mounted too closely together influence each other and generate invalid measuring results (cross talking effects). Measurements with the risk of mutual influences are:

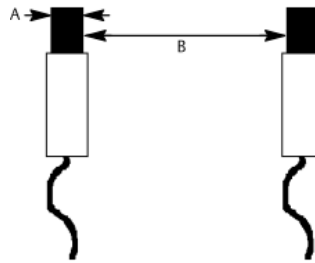
- (2) Non-linear range at the beginning of the total measuring range of the sensor, before the beginning of the linear measuring range.
- (3) Distance between sensor and zero point of the measuring range including initial air gap.
- (4) Current distance between zero position of the measuring range and measuring target.

- Shaft vibration measurement with two sensors in X-Y arrangement (for example: two EZ 108x sensors, mounted in a 90° angle at a shaft with ≤100 mm diameter).
- Shaft displacement measurement with Tandem application.
- Shaft displacement measurement with Cone or Double Cone application.

In this case, the oscillator frequency of one of the converters must be slightly shifted. See [Section 8.5.4](#) how to change the oscillator frequency.

Calculate the minimum distance D between two sensors based on the sensor head diameter and a factor x.

**Figure 5-8: Minimum distance between two sensors**



- A. Sensor head diameter  
 B. Minimum distance between two sensors:  $D = x \cdot \text{Sensor head diameter}$ .

[Table 5-2](#) shows the necessary factor x for calculating the minimum distance D between sensors at de-tuned (different oscillator frequency) and tuned (identical oscillator frequency) measuring chains depending on the sensor type.

**Table 5-2: Factor for distance calculation**

| Sensor type | Factor x de-tuned | Factor x tuned |
|-------------|-------------------|----------------|
| EZ 105x     | 3                 | 4              |
| EZ 108x     | 2.5               | 3              |

Example for EZ 108x with sensor head diameter of 8 mm:

Minimum Distance<sub>de-tuned</sub> = 8 mm \* 2.5 = 20 mm

Minimum Distance<sub>tuned</sub> = 8 mm \* 3 = 24 mm

## 6 Hazardous location installation

Topics covered in this chapter:

- *General installation requirements*
- *Installation requirements - intrinsic safe*
- *Installation requirements - non-sparking*
- *Installation of the sensors*
- *CSA - Special conditions of safe use*
- *Technical data, explosion protection*
- *Control drawings*
- *Revision history*

Version 1.3

### 6.1 General installation requirements

The EZ 1000 converter is designed for the type of protection Ex ia as an intrinsically safe equipment (according to EN 60079-11) and for the type of protection Ex nA as a non-sparking equipment (according to EN 60079-15).

The conditions of use are different, depending on the respective application. Observe the points, listed in this section, for both types of protection.

Sensor and converter are allowed to be mounted within potentially explosive atmospheres. The sensor is connected through a connector to the converter. The converter must be mounted into a field housing.

Third party sensors can be connected, provided that it is permitted by the safety related data of these sensors, and the safety related data of the EZ 1000 converter.

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#### Note

When operating the EZ 1000 converter in hazardous areas, observe the following points for installation for type of protection i and nA:

- Operation is only permitted if the EZ 1000 is mounted in appropriate field housings that ensure that the converter and housing are not exposed to strokes or shocks and that friction at the housing is avoided.
- The transition resistance of the field housing to the protective earth must not exceed 1 MOhm.
- If using a non-metallic field housing, the surface resistance of that housing must be in accordance to EN 60079-0 7.4.
- Configuration of the converter through the USB interface is only permitted if no potentially explosive atmosphere is present, and the environmental temperature is below 60°C.
- A battery powered device with  $U_m < 30$  V is required for connection to the USB interface.

- For the maximum environmental temperature of the EZ 10xx and PR 642x sensors approved for temperature classes T2, T4, and T6 see [Table 6-5](#).
- Install the EZ 1000 according to the control drawing CDG 5800-00182.
- For the maximum environmental temperature of the EZ 1000 approved for temperature classes T2, T4, and T6 see [Table 6-1](#) to [Table 6-3](#).
- The converter is intended for use with safety barriers as an Ex ia device or without safety barriers as an Ex nA device. Once used without an safety barrier, it is not permitted to use the device as an Ex ia device.

## 6.2 Installation requirements - intrinsic safe

In the following conditions, sensors EZ 105x, EZ 108x, and PR 642x in combination with the EZ 1000 converter can be used for applications in hazardous areas for Zone 0, protection class Intrinsic safety – Ex ia IIC T6:

- Connect the EZ 1000 converter by using safety barriers according to [Section 6.7](#).
- All barriers with Zener diodes and safety data within the permitted limits are approved.
- The characteristic of the safety barriers must be linear.
- Install the safety barriers outside of the explosive area, in cabinets or control cubicles with protection classes of at least IP 20, according to IEC 60529.
- With appropriate approval, the safety barriers can be installed in Zone 2. In this case, observe the specifications of the manufacturer.
- To achieve compensation of electric potentials, connect the connectors for the protective earth to the corresponding protective earth connectors by a compensation cable within the explosive area.
- Isolate the mounting rail for the safety barriers.
- Within the ATEX-field of application, dimension the compensation cable according to EN 60079-14 12.2.4 with a minimum copper wire cross section of  $2 \times 1.5 \text{ mm}^2$  or  $1 \times 4 \text{ mm}^2$ . Outside of the ATEX-field of application, observe the respectively valid installation instructions.
- Observe the heating within the field housing. Expect a maximum heat dissipation of 840 mW for each EZ 1000 converter.
- Neither  $P_{O1}$  nor  $P_{O2}$  may exceed 630 mW.

## 6.3 Installation requirements - non-sparking

The sensors EZ 105x, EZ 108x, and PR 642x are connected to the EZ 1000 converter with intrinsically protection class in Zone 2/Division 2 by internal protection of the EZ 1000.

In the following conditions, the sensors EZ 105x, EZ 108x, and PR 642x in combination with the EZ 1000 converter can be used for applications in hazardous areas for Zone 2/Division 2, protection class Non-sparking – Ex nA:

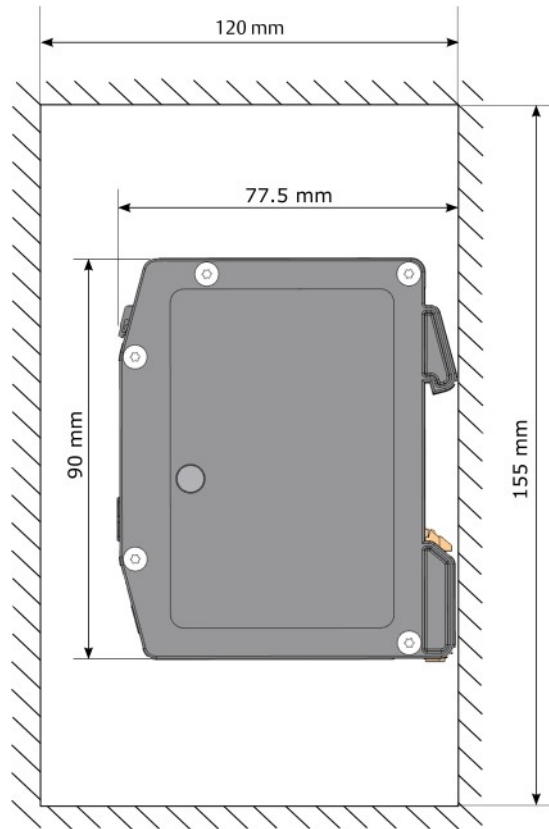
- Solely connect the EZ 1000 converter to SELV/PELV electrical circuits to meet the requirements of  $U_m = 60 \text{ V}$  for the explosion protection. This is valid for both, the supply ( $-24 \text{ V}/\perp$ ) and the signal ( $\perp/\text{OUT}$ ) terminals.
- Install the converter completely inside an additional enclosure according to EN 60079-0, providing a degree of protection of not less than IP 54.
- The field housing must be labeled with the following warning:

WARNING – EXPLOSION HAZARD – DO NOT OPEN ENCLOSURE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS.

AVERTISSEMENT – RISQUE D'EXPLOSION. – NE PAS OUVRIR L'ENCEINTE, A MOINS QU'IL NE S'AGISSE D'UN EMPLACEMENT NON DANGEREUX.

- The field housing is only accessible by tools.
- The field housing and the cable glands must have an approval for the required temperature range.
- At temperatures higher than  $70^\circ\text{C}$  at the cable inlet of the field housing, ensure that proper glands and cables are used.
- The connection terminal block of the EZ 1000 converter must be plugged-in when the wires are energized (EN 60079-0 - 20.4).
- Dimension the connection compartment so that cables can be connected without any complications. The minimum dimension of the field housing cross section is  $120 \text{ mm} \times 155 \text{ mm}$  (see *Figure 6-1*).

Figure 6-1: Minimum dimension of the field housing cross section



- Ensure that the cable glands match the diameter of the used cables.
  - Diameter EZ 105x, EZ 108x, and PR 642x sensor cable: 2.65 to 2.90 mm
  - Diameter of the supply and signal cables are variable and must be observed.
- The wire cross section of the cables used for supply and signal must be within the range of  $0.34 < F < 2.5 \text{ mm}^2$ . At stranded conductors, use ferrules.
- Observe the heating within the field housing. Expect a maximum heat dissipation of 1.12 W for each EZ 1000 converter.

## 6.4 Installation of the sensors

If an EZ 105x, EZ 108x, or PR 642x sensor is used with interconnector, the grounding of the connector housing has to be considered. Isolate the connector:

1. Shrink the black shrink sleeve on the interconnector.
2. Additionally, shrink the blue shrink sleeve on the interconnector already isolated with the black shrink sleeve.

Both shrink sleeves have to be positioned and shrunk over the housing of the connector.

Third party sensors must comply to the Ex i requirements.

During the sensor mounting, give particular attention to the grounding of its metal housing. The transition resistance of the sensor housing to the protective earth must not exceed 1 MOhm.

## 6.5 CSA - Special conditions of safe use

### Note

Installation in protection class Ex i (intrinsically safe) or Ex nA (non-sparking):

- Install the EZ 1000 converter in accordance to the control drawing CDG 5800-00182.
- Install the converter completely inside an additional enclosure according to CSA/UL 60079-0, providing a degree of protection of not less than IP 54.
- Final acceptance of the equipment when installed is subject to the jurisdiction of the local inspection authority.

## 6.6 Technical data, explosion protection

For connection to intrinsically safe electric circuits and for use in hazardous areas, the EZ 1000 converter is tested and certified for:

Explosion protection class

Table 6-1: cCSAus

| Intrinsically safe (Ex ia)             |                                 |
|----------------------------------------|---------------------------------|
| Identification                         | Class I, Division 1             |
|                                        | Group A, B, C, D T6, T4, T2     |
|                                        | (Class 1, Zone 0/1)             |
|                                        | Ex/AEx ia IIC T6, T4, T2 Ga     |
|                                        | T6 -35°C ≤ Ta ≤ 50°C            |
|                                        | T4 -35°C ≤ Ta ≤ 80°C            |
|                                        | T2 -35°C ≤ Ta ≤ 80°C            |
| Standards EC – Design test certificate | CSA 60079-0                     |
|                                        | CSA 60079-11                    |
|                                        | CSA 60079-26                    |
| CSA approval number                    | CSA 18.70093801                 |
| Non- incentive (Ex nA)                 |                                 |
| Identification                         | Class I, Division 2             |
|                                        | Group A, B, C, D T6, T4, T2     |
|                                        | (Class 1, Zone 2)               |
|                                        | Ex/ AEx nA [ic] IIC T6 T4 T2 Gc |

Table 6-1: cCSAus (continued)

|                     |                                    |
|---------------------|------------------------------------|
|                     | T6 -35°C ≤ Ta ≤ 50°C               |
|                     | T4 -35°C ≤ Ta ≤ 80°C               |
|                     | T2 -35°C ≤ Ta ≤ 80°C               |
| Standards           | CSA E60079-15 (Zone 2, Type n)     |
|                     | UL 60079-15-02 2002 (Protection n) |
| CSA approval number | CSA 18.70093801                    |

Table 6-2: ATEX/IECEx

|                            |                                                             |
|----------------------------|-------------------------------------------------------------|
| Intrinsically safe (Ex ia) |                                                             |
| Identification             | ⊕ II 1G - Ex ia IIC T6, T4, T2 Ga                           |
|                            | T6 -35°C ≤ Ta ≤ 50°C                                        |
|                            | T4 -35°C ≤ Ta ≤ 80°C                                        |
|                            | T2 -35°C ≤ Ta ≤ 80°C                                        |
| Standards                  | According to EU standard 94/9/EG                            |
|                            | EN 60079-0:2012 +A11:2013, Equipment - general requirements |
|                            | EN 60079-11:2012, Intrinsically safe "i"                    |
|                            | IEC 60079-0:2011, Edition 6                                 |
|                            | IEC 60079-11:2011, Edition 6                                |
| ATEX approval number       | BVS 18 ATEX E 011 X                                         |
| IECEx approval number      | IECEx BVS 18.0009X                                          |
| Non-incentive (Ex nA)      |                                                             |
| Identification             | ⊕ II 3G -Ex nA [ic] IIC T6, T4, T2 Gc                       |
|                            | T6 -35°C ≤ Ta ≤ 50°C                                        |
|                            | T4 -35°C ≤ Ta ≤ 80°C                                        |
|                            | T2 -35°C ≤ Ta ≤ 80°C                                        |
| Standards                  | According to EU standard 94/9/EG                            |
|                            | EN 60079-0:2012 +A11:2013, Equipment - general requirements |
|                            | EN 60079-15:2010, Non-sparking n                            |
|                            | IEC 60079-0:2011, Edition 6                                 |
|                            | IEC 60079-15:2010, Edition 4                                |
| ATEX approval number       | BVS 18 ATEX E 011 X                                         |
| IECEx approval number      | IECEx BVS 18.0009X                                          |

Table 6-3: General

|                                                                              |                                                                                                                                                                                                                                            |
|------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Electrical data                                                              |                                                                                                                                                                                                                                            |
| Output and supply circuit                                                    | With explosion protection class Intrinsically safe, only for connection to certified intrinsically safe circuits with the following maximum values.                                                                                        |
| -24 V / $\perp$ / $\perp$ / Out terminals                                    |                                                                                                                                                                                                                                            |
| Open-circuit voltage                                                         | $U_i = -28 \text{ V}$                                                                                                                                                                                                                      |
| Sum of short-circuit currents                                                | $\Sigma I_i = -140 \text{ mA}$                                                                                                                                                                                                             |
| Total power                                                                  | $\Sigma P_i = 840 \text{ mW}$                                                                                                                                                                                                              |
| Within output- and supply circuit effective internal capacity and inductance | $C_i = 5 \text{ nF}$                                                                                                                                                                                                                       |
|                                                                              | $L_i = 0 \text{ mH}$ (negligible)                                                                                                                                                                                                          |
| Sensor circuit                                                               | With explosion protection class Intrinsically safe, only for connection of sensors which are, together with their connection cable and where applicable their extension cable, do not exceed the total maximum capacities and inductances. |
| Sensor terminal                                                              |                                                                                                                                                                                                                                            |
| Open-circuit voltage                                                         | $U_0 = 7.14 \text{ V}$                                                                                                                                                                                                                     |
| Short-circuit current                                                        | $I_0 = 140 \text{ mA}$                                                                                                                                                                                                                     |
| Total power                                                                  | $P_0 = 250 \text{ mW}$                                                                                                                                                                                                                     |
|                                                                              | $C_0 = 600 \text{ nF}$                                                                                                                                                                                                                     |
|                                                                              | $L_0 = 790 \text{ }\mu\text{H}$                                                                                                                                                                                                            |
| USB connector                                                                | With explosion protection class Intrinsically safe and Non-sparking, only for connection to circuits with the following values.                                                                                                            |
|                                                                              | $U_m < 30 \text{ V}$                                                                                                                                                                                                                       |
| -24 V / $\perp$ / $\perp$ / Out terminals                                    | With explosion protection class Non-sparking, only for connection to circuits with the following maximum values.                                                                                                                           |
|                                                                              | $U_m < 60 \text{ V}$                                                                                                                                                                                                                       |

Table 6-4: Capacities and inductances of sensors including connection cable and extension cable

| Sensor                                                                   | Capacity ( $C_{\text{Sensor}}$ ) | Inductance ( $L_{\text{Sensor}}$ ) |
|--------------------------------------------------------------------------|----------------------------------|------------------------------------|
| EZ 105x, EZ 108x, and PR 642x with 4 m cable                             | $\leq 450 \text{ pF}$            | $\leq 100 \text{ }\mu\text{H}$     |
| For each additional meter cable (maximum total cable length = 10m + 10%) | +110 pF                          | negligible                         |

Table 6-4: Capacities and inductances of sensors including connection cable and extension cable (continued)

| Sensor                                                              | Capacity ( $C_{\text{Sensor}}$ ) | Inductance ( $L_{\text{Sensor}}$ ) |
|---------------------------------------------------------------------|----------------------------------|------------------------------------|
| EZ1900-003-ADAP-1 Adapter cable for connection of PR 642x sensors   | +39 pF                           | negligible                         |
| EZ1900-003-ADAP-2 Adapter cable for connection of BN 33010x sensors | +39 pF                           | negligible                         |

Table 6-5: Temperature classification of sensors

|                                |                                                                                 |
|--------------------------------|---------------------------------------------------------------------------------|
| EZ 105x and EZ 108x            | T6 -35°C ≤ $T_a$ ≤ 55°C<br>T4 -35°C ≤ $T_a$ ≤ 130°C<br>T2 -35°C ≤ $T_a$ ≤ 200°C |
| PR 6422                        | T6 -35°C ≤ $T_a$ ≤ 60°C<br>T4 -35°C ≤ $T_a$ ≤ 130°C<br>T2 -35°C ≤ $T_a$ ≤ 150°C |
| PR 6423                        | T6 -35°C ≤ $T_a$ ≤ 65°C<br>T4 -35°C ≤ $T_a$ ≤ 130°C<br>T2 -35°C ≤ $T_a$ ≤ 200°C |
| PR 6424                        | T6 -35°C ≤ $T_a$ ≤ 65°C<br>T4 -35°C ≤ $T_a$ ≤ 130°C<br>T2 -35°C ≤ $T_a$ ≤ 155°C |
| PR 6425                        | T6 -35°C ≤ $T_a$ ≤ 65°C<br>T4 -35°C ≤ $T_a$ ≤ 130°C<br>T2 -35°C ≤ $T_a$ ≤ 275°C |
| PR 6426                        | T6 -35°C ≤ $T_a$ ≤ 65°C<br>T4 -35°C ≤ $T_a$ ≤ 130°C<br>T2 -35°C ≤ $T_a$ ≤ 155°C |
| PR 642x high temperature types | T6 -35°C ≤ $T_a$ ≤ 65°C<br>T4 -35°C ≤ $T_a$ ≤ 130°C<br>T2 -35°C ≤ $T_a$ ≤ 200°C |

## 6.7 Control drawings

### Control - Drawing : eddy - current - measuring chain (CSA), intrinsically safe

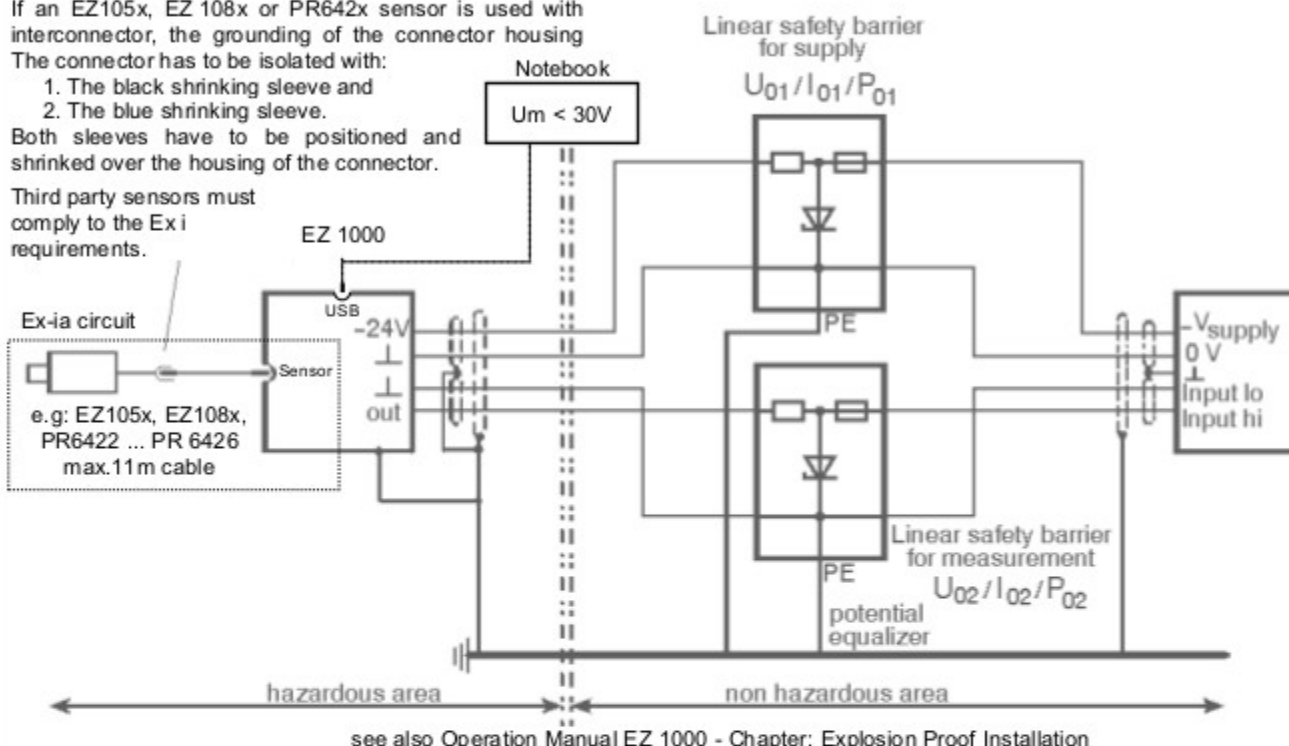
|                                                       |                                                                                                                                                                      |
|-------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Class I<br>Division 1 (Zone 0/1)<br>Groups A, B, C, D | Do not configure via USB unless area is known to be non hazardous.<br>Connect only USB equipment with $U_m < 30V$ .<br>Max. Tamb = 60°C while configuration via USB. |
|-------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|

If an EZ105x, EZ 108x or PR642x sensor is used with interconnector, the grounding of the connector housing  
The connector has to be isolated with:

1. The black shrinking sleeve and
2. The blue shrinking sleeve.

Both sleeves have to be positioned and shrunk over the housing of the connector.

Third party sensors must comply to the Ex i requirements.



see also Operation Manual EZ 1000 - Chapter: Explosion Proof Installation

| Eddy current measuring chain<br>(-24V / $\perp$ / $\perp$ / OUT): | Maximum Barrier parameters with linear characteristics: | Output circuit in type of protection Ex ia<br>(plug connector sensor) | Sensor<br>EZ105x, EZ108x,<br>PR6422 ... PR 6426<br>Internal capacity / inductance<br>with max. 11m sensor cable |
|-------------------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| $U_i (V_{max}) = -28 V$                                           | $U_{01} \text{ and } U_{02} \leq U_i$                   | $U_o (V_{max}) = 7,14 V$                                              | $C_i \text{ SENSOR} = 1,21nF$                                                                                   |
| $I_i (I_{max}) = -140 mA$                                         | $I_{01} + I_{02} \leq I_i$                              | $I_o (I_{max}) = 140 mA$                                              | $L_i \text{ SENSOR} = 100\mu H$                                                                                 |
| $P_i = 840 mW$                                                    | $P_{01} + P_{02} \leq P_i$                              | $P_o = 250 mW$                                                        |                                                                                                                 |
| $C_i = 5 nF$                                                      | $P_{01} / P_{02} \leq 630 mW$                           | $C_o = 600nF$                                                         |                                                                                                                 |
| $L_i = \text{negligible}$                                         |                                                         | $L_o = 790\mu H$                                                      |                                                                                                                 |

#### Maximum ambient temperatures

| Sensor     | T6   | T4    | T2    |
|------------|------|-------|-------|
| EZ 105x    | 55°C | 130°C | 200°C |
| EZ 108x    | 55°C | 130°C | 200°C |
| PR 6422    | 60°C | 130°C | 150°C |
| PR 6423    | 65°C | 130°C | 200°C |
| PR 6424    | 65°C | 130°C | 155°C |
| PR 6425    | 65°C | 130°C | 275°C |
| PR 6426    | 65°C | 115°C | 155°C |
| PR 642x HT | 65°C | 130°C | 200°C |

| Converter | T6          |
|-----------|-------------|
| EZ 1000   | -35...+50°C |

| T4, T2      |
|-------------|
| -35...+80°C |

| USB configure |
|---------------|
| -35...+60°C   |

#### External capacities/inductivities

| Groups | $C_o (C_a)$ | $L_o (L_a)$ |
|--------|-------------|-------------|
| A, B   | 78nF        | 1,8mH       |
| C      | 645nF       | 7,2mH       |
| D      | 2,145μF     | 14,5mH      |

# Control - Drawing : eddy - current - measuring chain (CSA), non sparking apparatus / intrinsically safe

Class I  
Division 2 (Zone 2)  
Groups A, B, C, D

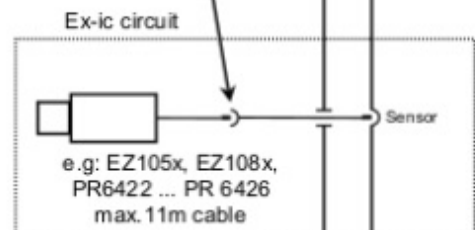
The wire diameter of the supply line and the signal line must be 0,34 to 2,5 mm<sup>2</sup>.

If an EZ105x, EZ 108x or PR642x sensor is used with interconnector, the grounding of the connector housing has to be considered. The connector has to be isolated with:

1. The black shrinking sleeve and
2. The blue shrinking sleeve.

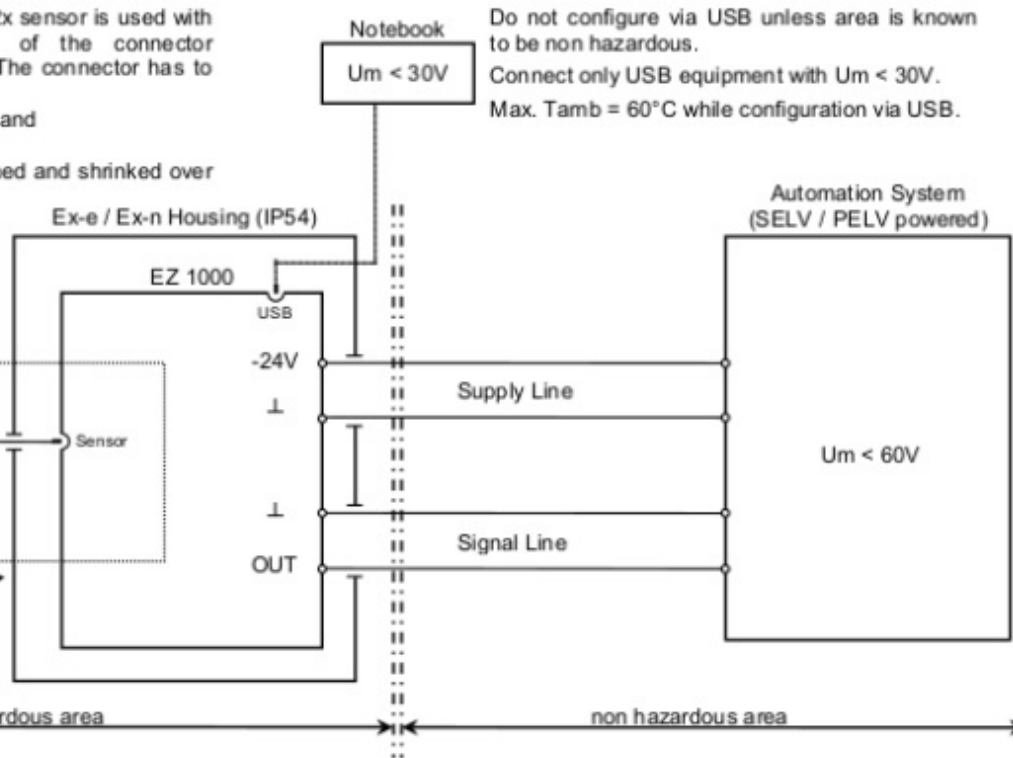
Both sleeves have to be positioned and shrunk over the housing of the connector.

Third party sensors must comply to the Ex i requirements



APPLY WARNING ON HOUSING

WARNING - EXPLOSION HAZARD -  
DO NOT OPEN ENCLOSURE  
UNLESS AREA IS KNOWN TO BE  
NON-HAZARDOUS.



Do not configure via USB unless area is known to be non hazardous.  
Connect only USB equipment with Um < 30V.  
Max. Tamb = 60°C while configuration via USB.

see also Operation Manual EZ 1000 - Chapter: Explosion Proof Installation

## Output circuit in type of protection Ex ic (plug connector sensor)

$U_o (V_{max}) = 7,14 \text{ V}$  /  $C_o = 600 \text{ nF}$   
 $I_o (I_{max}) = 140 \text{ mA}$  /  $L_o = 790 \mu\text{H}$   
 $P_o = 250 \text{ mW}$

## Sensor EZ105x, EZ108x, PR6422 ... PR 6426

Internal capacity / inductance with max. 11m sensor cable

$C_i \text{ SENSOR} = 1,21 \text{ nF}$   
 $L_i \text{ SENSOR} = 100 \mu\text{H}$

## Maximum ambient temperatures

| Sensor     | T6   | T4    | T2    |
|------------|------|-------|-------|
| EZ 105x    | 55°C | 130°C | 200°C |
| EZ 108x    | 55°C | 130°C | 200°C |
| PR 6422    | 60°C | 130°C | 150°C |
| PR 6423    | 65°C | 130°C | 200°C |
| PR 6424    | 65°C | 130°C | 155°C |
| PR 6425    | 65°C | 130°C | 275°C |
| PR 6426    | 65°C | 115°C | 155°C |
| PR 642x HT | 65°C | 130°C | 200°C |

| Converter | T6          |
|-----------|-------------|
| EZ 1000   | -35...+50°C |

| T4, T2      |
|-------------|
| -35...+80°C |

| USB configure |
|---------------|
| -35...+60°C   |

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**SPECIAL CONDITION OF SAFE USE:**

- THE INFLUENCE OF POWER DISSIPATION OF OTHER DEVICES PLACED BESIDE THE CONVERTER HAS TO BE TAKEN INTO ACCOUNT WITH REGARD TO TEMPERATURE RISE OF THE CONVERTER'S AMBIENT TEMPERATURE.
- THE APPARATUS HAS TO BE INSTALLED AND USED IN SUCH A WAY THAT ELECTROSTATIC CHARGING FROM OPERATION, MAINTENANCE OR CLEANING IS EXCLUDED.
- THE INTRINSICALLY SAFE CIRCUITS ARE CONNECTED TO EARTH; ALONG THE INTRINSICALLY SAFE CIRCUITS POTENTIAL EQUALIZATION MUST EXIST.
- FINAL ACCEPTANCE OF THIS EQUIPMENT WHEN INSTALLED IS SUBJECT TO THE JURISDICTION OF THE LOCAL INSPECTION AUTHORITY.

**FOR USE AS AN INTRINSICALLY SAFE APPARATUS (Ex ia IIC T6,T4,T2 Ga):**

- NEITHER PO1 NOR PO2 MAY EXCEED 630 mW.
- THE SIGNAL CONVERTER EZ1000 SHALL BE MOUNTED COMPLETELY INSIDE IN AN ADDITIONAL ENCLOSURE FULFILLING AT LEAST IP 20 IN ACCORDANCE WITH CSA/UL 60079-0 AND IEC 60079-0 AND IEC 60079-11.
- DURING THE INSTALLATION INTERNAL WIRING, CLEARANCES, CREEPAGE DISTANCES AND SEPARATIONS HAVE TO BE CONSIDERED ACCORDING TO IEC 60079-11.

**FOR USE AS AN ASSOCIATED APPARATUS (Ex nA [ic] IIC T6,T4,T2 Ge):**

- THE SIGNAL CONVERTER EZ 1000 SHALL BE MOUNTED COMPLETELY INSIDE IN AN ADDITIONAL ENCLOSURE IN ACCORDANCE WITH CSA/UL 60079-0, IEC 60079-0 AND IEC 60079-15, PROVIDING A DEGREE OF PROTECTION OF NOT LESS THAN IP 54.
- DURING THE INSTALLATION CLEARANCES CREEPAGE DISTANCES AND SEPARATIONS HAVE TO BE CONSIDERED ACCORDING TO IEC 60079-15.
- THE APPARATUS SHALL ONLY BE USED IN AN AREA OF AT LEAST POLLUTION DEGREE 2, AS DEFINED IN IEC 60664-1.
- MAXIMUM OVERVOLTAGE CATEGORY II ACCORDING TO IEC 60664-1 IS PERMITTED FOR THE CIRCUITS.

**WARNINGS:**

- WARNING - EXPLOSION HAZARD - DO NOT OPEN ENCLOSURE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS.
- AVERTISSEMENT - RISQUE D'EXPLOSION. - NE PAS OUVRIR L'ENCEINTE, À MOINS QU'IL NE S'AGISSE D'UN EMPLACEMENT NON DANGEREUX.

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## 6.8 Revision history

| Version | Date             | Remarks/Changes                                    |
|---------|------------------|----------------------------------------------------|
| 1.0     | 26. January 2018 | Initial version                                    |
| 1.1     | 3. April 2018    | Control Drawing update                             |
| 1.2     | 10. July 2018    | Grammar corrections                                |
| 1.3     | 1. August 2018   | Control Drawing update and addition to chapter 6.2 |

# 7 Hazardous location installation – application notes

Topics covered in this chapter:

- *Mark the converter as "once used without safety barrier"*
- *EZ 1000 with AMS 6500*

This chapter contains additional information about the installation of the EZ 1000 converter within hazardous areas. Before installing the EZ 1000 within hazardous areas observe the information of *Chapter 6*.

## 7.1 Mark the converter as "once used without safety barrier"

The converter is intended for use with safety barriers as an Ex ia device or without safety barriers as an Ex nA device. Once used without a safety barrier, it is not permitted to use the device as an Ex ia device. The EZ 1000 converter has a removable sticker to mark the EZ 1000 converter as "once used without safety barrier".

Remove the sticker with the inscription "remove at non intrinsically safe usage" shown in *Figure 7-1* to mark the EZ 1000 converter as "once used without safety barrier".

Figure 7-1: Removable sticker



A. Removable sticker

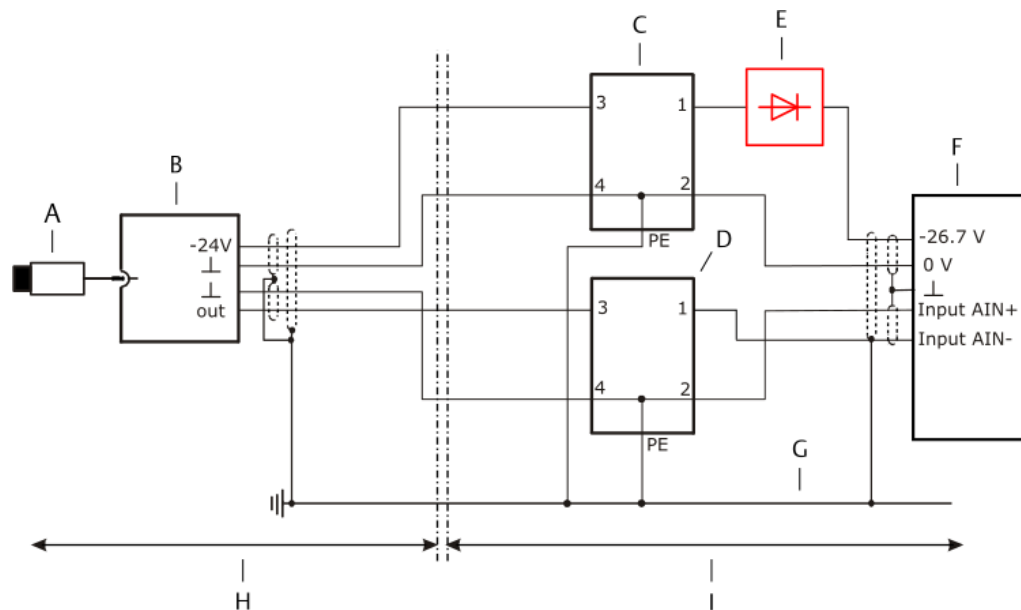
The inscription below the sticker reads: Only non intrinsically safe use.

## 7.2 EZ 1000 with AMS 6500

Use an additional diode when connecting an EZ 1000 converter through safety barriers to cards for eddy current sensors of the AMS 6500 system.

The nominal voltage of the safety barriers with  $U_0 = -28\text{ V}$  is slightly lower than the nominal supply voltage of the AMS 6500 cards for eddy current measuring chains. To reduce unintentional and disturbing effects, it is necessary to integrate a diode module into the converter supply circuit. Install the diode module between the safety barrier for the supply circuit and the AMS 6500 card. Diode module and safety barrier for the supply circuit are delivered together in a package (order code: MPT9001/00-280/085/101)

Figure 7-2: Connection diagram - additional diode



- A. Sensor, such as EZ 105x or EZ 108x.
- B. EZ 1000 Converter
- C. Safety barrier, supply circuit (Stahl 9001/00-280/085/101)
- D. Safety barrier, measuring circuit (Stahl 9001/00-280/020/101)
- E. Two level terminal with diode. The diode is only necessary at supply voltages higher than -26 V.
- F. AMS 6500 card for eddy current sensors, such as A6110, A6210, or A6312.
- G. Potential equalizer
- H. Hazardous area
- I. Non-hazardous area

## 8 Configuration

Topics covered in this chapter:

- *General configuration procedure*
- *Start of an offline configuration*
- *Start of an online configuration*
- *Configuration of an already existing converter*
- *Configuration editor and parameters*
- *Send and Reload a configuration*
- *Offline (Easy) calibration*
- *Components database - add a new target material*

### 8.1 General configuration procedure

The configuration can be performed offline without connection to the EZ 1000 converter or online with a connection to the converter. In any case, the configuration must be loaded to the converter to become active.

#### Prerequisites

- USB cable with Type-A and micro-USB B plug

---

#### Note

The USB interface is designed for configuration, maintenance, and trouble-shooting purposes. Do not leave the USB Interface permanently connected.

---

- Latest version of Machine Studio (configuration software)

---

#### Note

For general description of the configuration software, see operating manual "Machine Studio – General Functions" (MHM-97879).

---

- PC or laptop with Microsoft Windows 7 or higher

For intrinsically safe operations, use a battery powered device with a battery voltage of less than 30 V (see [Section 6.1](#)).

#### 8.1.1 Offline configuration overview

1. Start Machine Studio.
2. Enter configuration parameter according to the used eddy current sensor and the measuring task (see [Section 8.5](#)).

The calibration procedure requires an online connection to the converter.

3. Save the configuration (Configuration editor > File > Save as).

When you connect to the EZ 1000, load the saved configuration file to the converter, and complete the calibration process (see *Send a saved configuration file to the EZ 1000*).

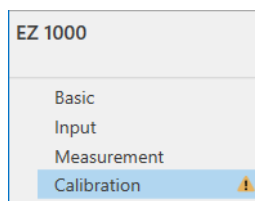
## Send a saved configuration file to the EZ 1000

1. Switch on the power supply of the converter, if not already done.
2. Connect the converter to the configuration computer by using the USB connection (see *Figure 8-2*).
3. Start Machine Studio.

The EZ 1000 is automatically detected by Machine Studio.

4. Select the converter to be configured, and click Configure.
5. Open the saved configuration file (window File, menu item Open).
6. Check the configuration – does the configuration meet the requirements of the measurement?
7. The calibration data is not always included in the saved configuration file. If the Calibration tab is marked with the yellow warning triangle, start the calibration process, and select a calibration method (see *Section 8.5.5*).

Figure 8-1: Calibration required



The configuration is sent to the converter during the calibration process.

The configuration is automatically saved to the current project.

8. If a single file is needed, save the configuration (Configuration editor > File > Save as).

The data of the calibration is saved with the configuration file. The data of the Automatic calibration and the Offline calibration (Easy calibration – calibration process without Machine Studio) is saved as Manual calibration data.

### Note

Before saving the configuration, reload the configuration including the calibration data from the EZ 1000 converter. See *Reload*.

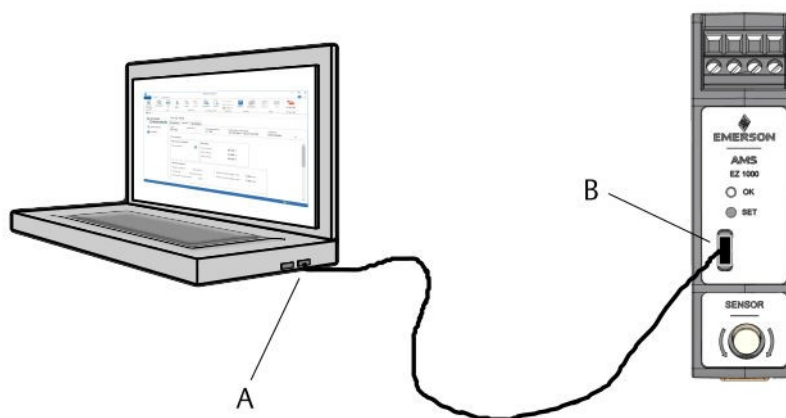
9. Close Machine Studio, and disconnect from the converter.

After these steps, the converter is ready for operation.

## 8.1.2 Online configuration overview

1. Switch on the power supply of the converter, if not already done.
2. Connect the converter to the configuration computer by using the USB connection.

Figure 8-2: Connection - computer to USB interface



- A. USB socket at the computer with Machine Studio installed.  
 B. USB interface at the converter front.

3. Start Machine Studio.  
 The EZ 1000 is automatically detected by Machine Studio.
4. Select the converter to be configured, and click Configure.
5. Enter the configuration parameters according to the used eddy current sensor and the measuring task (see [Section 8.5](#)).
6. Start the calibration process, and select a calibration method (see [Section 8.5.5](#)).  
 The configuration is sent to the converter during the calibration process.  
 The configuration is automatically saved to the current project.
7. If a single file is needed, save the configuration (Configuration editor > File > Save as).

The data of the calibration is saved with the configuration file. The data of the Automatic calibration and the Offline calibration (Easy calibration – calibration process without Machine Studio) is saved as Manual calibration data.

### Note

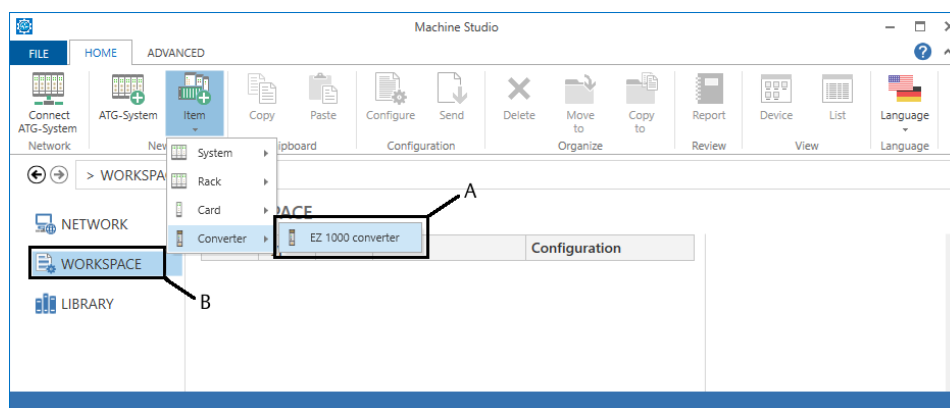
Before saving the configuration, reload the configuration including the calibration data from the EZ 1000 converter. See [Reload](#).

8. Close Machine Studio, and disconnect from the converter.  
 After these steps, the converter is ready for operation.

## 8.2 Start of an offline configuration

1. Select Workspace in the left part of the main view, then click Item > Converter > EZ 1000 converter.

Figure 8-3: Start new device configuration



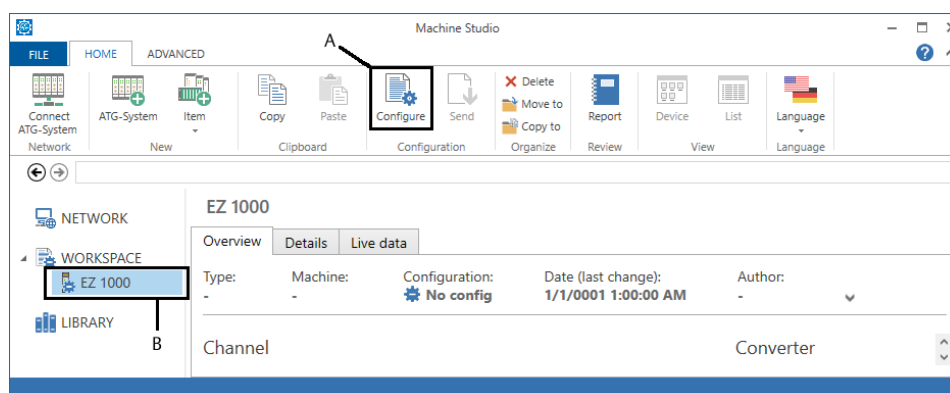
A. Item EZ 1000 converter

B. Workspace

The EZ 1000 converter is added to the list below Workspace.

2. Select an EZ 1000 from the Workspace list, and click Configure.

Figure 8-4: Select an EZ 1000 for offline configuration

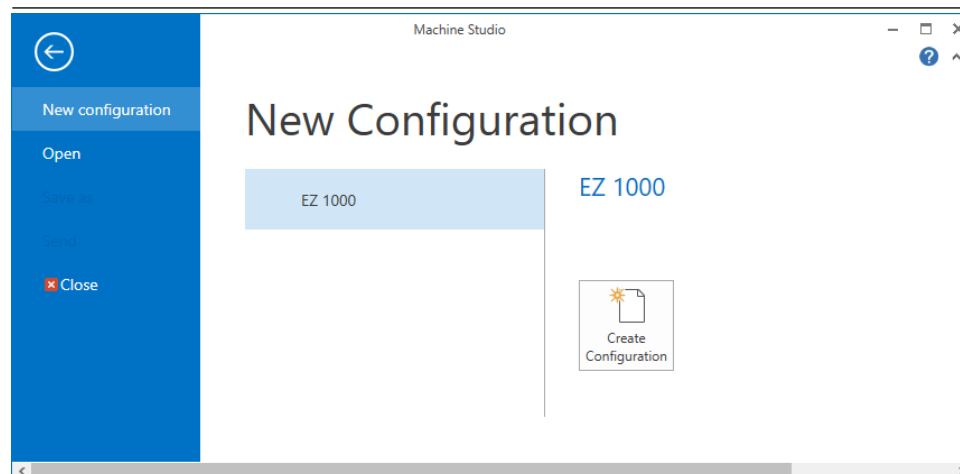


A. Button Configure to open the configuration editor.

B. New EZ 1000 converter.

The New Configuration dialog opens.

Figure 8-5: New Configuration dialog



3. Select EZ 1000, and click Create Configuration to open the configuration editor.

See [Section 8.5](#) for parameter description and settings.

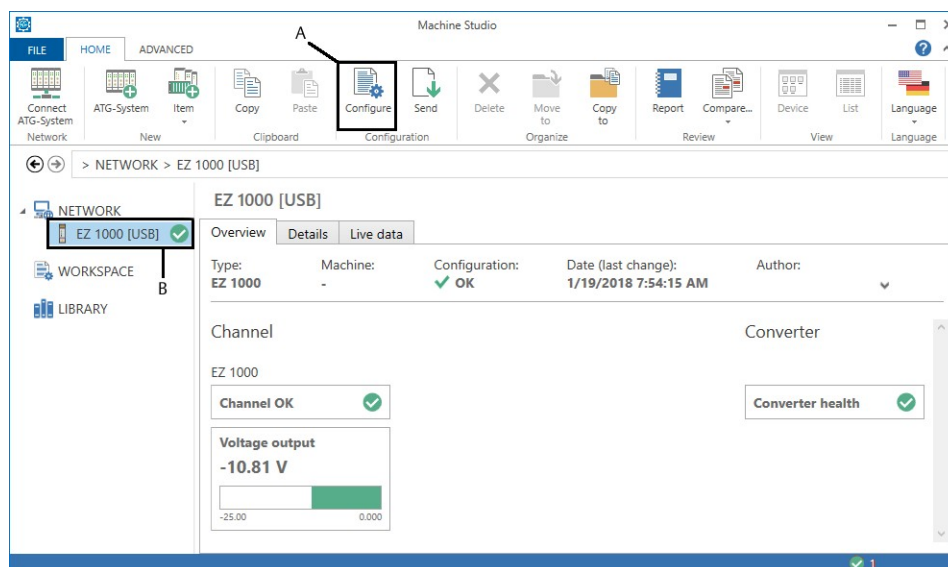
#### Note

The calibration requires an online connection to the EZ 1000 converter. Move the converter configuration from Workspace by drag and drop to an already connected converter below Network. Complete the configuration.

## 8.3 Start of an online configuration

1. Select the EZ 1000 converter from the Network list in the left part of the main view, then click Configure.

Figure 8-6: Select an EZ 1000 for online configuration



A. Button Configure for opening the configuration editor.

B. Selected EZ 1000 converter.

If the selected EZ 1000 is not configured, the New Configuration dialog opens (see [Section 8.2](#)). Otherwise, the configuration editor opens directly.

See [Section 8.5](#) for parameter description and settings.

2. Check the configuration, and modify it in accordance to the requirements.

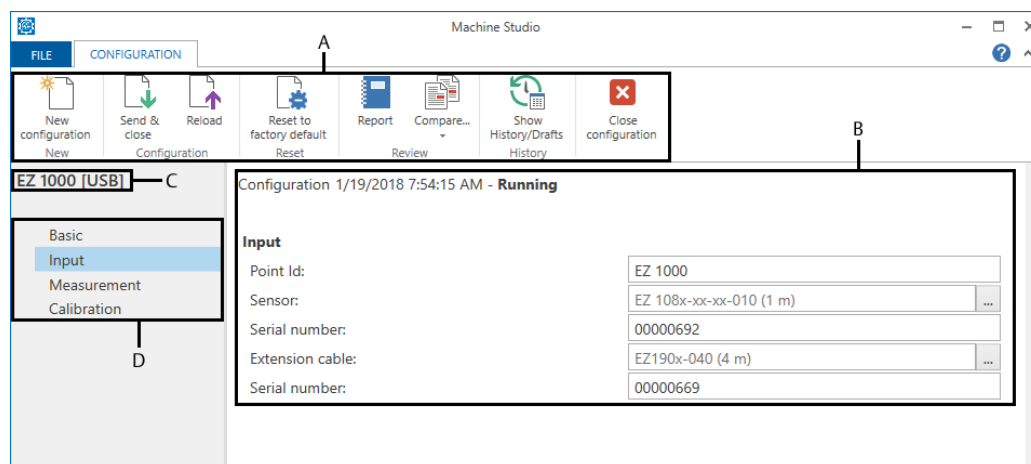
## 8.4 Configuration of an already existing converter

1. Select the converter to be reconfigured from the Network list.
2. Click Configure to open the configuration editor.
3. Make the changes to the configuration.
4. Run the calibration process. The configuration is sent to the converter during this process (see [Section 8.5.5](#)).
5. Click Close configuration to close the editor. Do not click Send & close.

## 8.5 Configuration editor and parameters

[Figure 8-7](#) shows an overview about the configuration editor Configuration.

Figure 8-7: Configuration



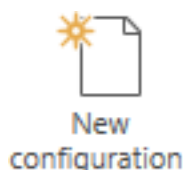
- A. Ribbon command bar
- B. Configuration dialog
- C. Converter name with type of used interface in brackets
- D. List of configuration pages

## 8.5.1 Ribbon command bar

### New configuration

Click New configuration to start a new configuration with default parameters.

Figure 8-8: Button New configuration



### Send & close

Click Send & close to send the configuration to the converter. The configuration editor automatically closes after the sending process. This command requires an online connection to the converter.

Minor changes to the configuration can be sent without recalibration of the converter. Major changes require a recalibration. In this case, the configuration is sent by the calibration process.

Minor changes are:

1. All parameters on the Basic tab.

2. The parameters Point Id, Serial number of the sensor, and Serial number of the cable on tab Input.
3. The parameter Output sensitivity on tab Measurement.

Major changes are:

1. The parameters Sensor and Extension cable on the Input tab.
2. All parameters on the Measurement tab except parameter Output sensitivity.

Figure 8-9: Button Send & close



#### Note

Send & close is disabled after major changes, which require a calibration of the converter, or if the calibration state of the converter is not OK (see [Calibration state](#)).

#### Reload

Click Reload to reload the configuration including the calibration data from the converter to the configuration editor. The data of the Automatic calibration and the Offline calibration (calibration process without Machine Studio) is loaded as Manual calibration data. Use the report function to display the calibration data. Any configuration changes you made in Machine Studio will be overwritten by the configuration loaded from the converter.

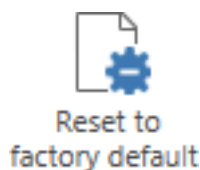
Figure 8-10: Button Reload



#### Reset to factory default

Click Reset to factory default to reset the connected converter to the default parameter settings.

Figure 8-11: Button Reset to factory default



This command requires an online connection to the converter.

### ⚠ CAUTION!

The preset configuration on the converter including the calibration data will be deleted and replaced by the default configuration.

### Compare

Click Compare to show differences between the configuration on the converter and in the memory of the used Laptop or PC.

Figure 8-12: Button Compare



### Report

Click Report to open the report viewer. This report shows all configured parameters and some additional information, such as serial number and user information. This report can be exported to different formats, such as PDF, XPS, and Microsoft Excel, or it can be printed.

Figure 8-13: Button Report

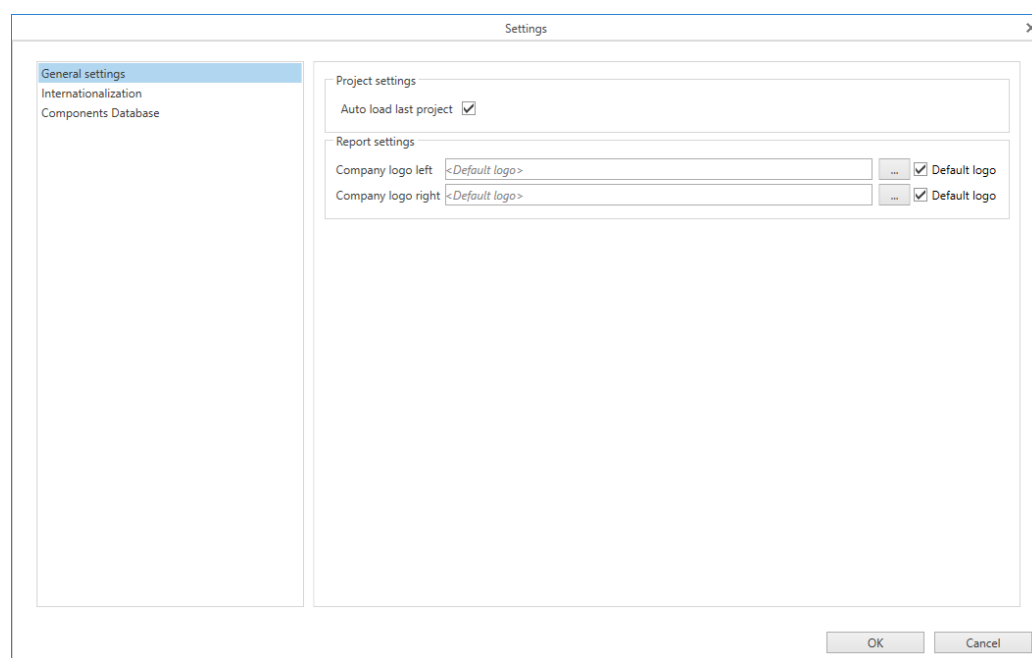


Where required, change the logos in the header of the report:

1. Close the configuration editor. The configuration is automatically saved as a draft configuration.
2. Click File and then Settings.

- The Settings window opens.
3. Click the buttons with the dotted line within the Report settings area to browse for logos.
- Logos with file format png or jpg can be selected.
4. Click OK to confirm your settings.
- The window closes.
5. Open the configuration editor, and go back to the report.
- Now the report contains the selected logos.

Figure 8-14: General settings



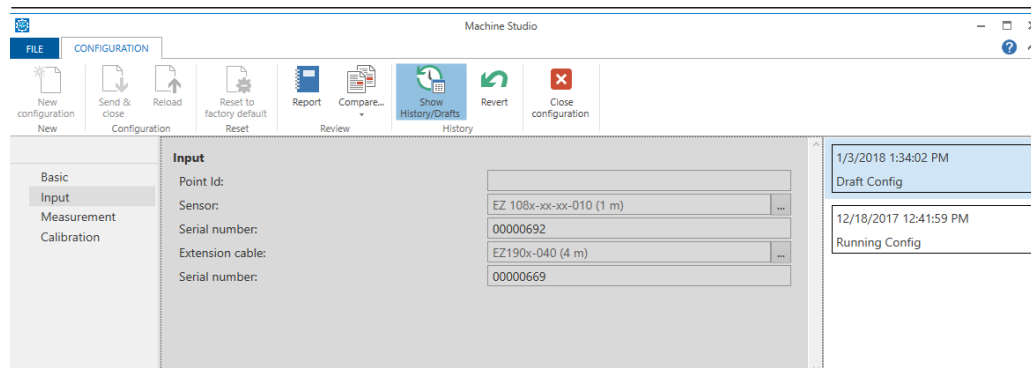
### Show History/Drafts

Click Show History/Drafts to open the History.

Figure 8-15: Button Show History/Drafts



Figure 8-16: History



The right part of [Figure 8-16](#) shows the configuration history. The individual files are marked with date, time, and type:

- **Draft Config**  
A saved preliminary configuration file which has not yet been sent to the converter.
- **Running Config**  
This configuration file is running on the connected converter.
- **Running Config (historic)**  
An old configuration file which was running in the past.

The editor area is grayed out. You can see the parameters of the historic files, but you can not change them. Parameters can only be changed in the editor. To copy a historic configuration to the editor:

1. Select a draft or historic file from the list.  
The parameters of the selected file are displayed in the grayed out editor area.
2. Click **Revert**. The selected file is copied to the editor, and the history window is closed. Click **Show History/Drafts** again, if you want to leave the history without any file copying.

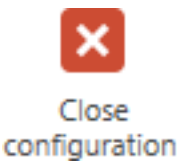
Figure 8-17: Button Revert



### Close configuration

Click **Close configuration** to leave the editor. Changes are automatically saved as a draft configuration. Use the history view to open saved draft configurations.

Figure 8-18: Button Close configuration



### 8.5.2 Basic

Enter general machine and plant information.

Figure 8-19: Basic

|                                              |                     |                                                   |  |
|----------------------------------------------|---------------------|---------------------------------------------------|--|
| EZ 1000 [USB]                                |                     | Configuration 1/19/2018 7:54:15 AM - Running      |  |
| Basic<br>Input<br>Measurement<br>Calibration | <b>Basic</b>        |                                                   |  |
|                                              | Name:               | <input type="text" value="EZ 1000"/>              |  |
|                                              | Machine:            | <input type="text"/>                              |  |
|                                              | Area:               | <input type="text"/>                              |  |
|                                              | Plant:              | <input type="text"/>                              |  |
|                                              | User (last change): | <input type="text"/>                              |  |
|                                              | Date (last change): | <input type="text" value="1/19/2018 7:54:15 AM"/> |  |

|                    |                                                                                                                                                                                                                           |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Name               | Enter the converter name or a short description of the measurement.                                                                                                                                                       |
| Machine            | Enter the machine designation.                                                                                                                                                                                            |
| Area               | Enter a name or a short description of the area where the machine is located.                                                                                                                                             |
| Plant              | Enter the plant/factory name.                                                                                                                                                                                             |
| User (last change) | The name of the user who made the last configuration is displayed here. The user name of the login data of the operation system is used for this automatic entry. It is not possible to change the content of this field. |
| Date (last change) | The date and time of the last converter configuration is displayed here. Time and date of the configuration PC is used. It is not possible to change the content of this field.                                           |

### 8.5.3 Input

Define the eddy current sensor to be connected.

Figure 8-20: Input

| EZ 1000 [USB]    |                                                     |
|------------------|-----------------------------------------------------|
| Basic            | Configuration 1/19/2018 7:54:15 AM - <b>Running</b> |
| <b>Input</b>     |                                                     |
| Measurement      |                                                     |
| Calibration      |                                                     |
| <b>Input</b>     |                                                     |
| Point Id:        | EZ 1000                                             |
| Sensor:          | EZ 108x-xx-xx-010 (1 m) ...                         |
| Serial number:   | 00000692                                            |
| Extension cable: | EZ190x-040 (4 m) ...                                |
| Serial number:   | 00000669                                            |

**Point Id** Enter the point ID of the measuring point where the sensor is installed.

**Sensor** Click the button  behind the display field to open the selection dialog for the sensor. The dialog lists all eddy current sensors compatible with EZ 1000. Select the appropriate sensor, and click OK.

**Serial number** Enter the serial number of the used sensor. See sensor or sensor cable for the serial number.

**Extension cable** If an extension cable is used, click the button  behind the display field to open the selection dialog for the extension cable. The dialog lists all extension cables compatible with the EZ 1000 and the sensor already selected. Select the appropriate extension cable or select No extension cable, and click OK.

**Serial number** Enter the serial number of the used extension cable. See label of the extension cable for the serial number.

#### Note

The sensor adapter EZ1900-003-ADAP-2 is automatically considered during the calibration process, if Sensor > 3301x is selected.

## 8.5.4 Measurement

Enter the measurement details.

Figure 8-21: Measurement

| EZ 1000 [USB]          |                                                     |
|------------------------|-----------------------------------------------------|
| Basic                  | Configuration 1/19/2018 7:54:15 AM - <b>Running</b> |
| Input                  |                                                     |
| <b>Measurement</b>     |                                                     |
| Calibration            |                                                     |
| <b>Measurement</b>     |                                                     |
| Extended range factor: | 1.0                                                 |
| Target material:       | 42CrMo4 ...                                         |
| Detune frequency:      | No detuning                                         |
| Output sensitivity:    | ISO                                                 |

**Extended range factor** The standard measuring range of several eddy current sensors can be extended. Use this list field to select a factor for the range extension. The available factors depend on the selected sensor (see Input > Sensor). The standard measuring range is multiplied with the selected factor. Example with EZ 108x with standard range of 2.0 mm (absolute) and selected factor of 2.0:  
 Extended range = Standard Range \* Factor  
 Extended range = 2.0 mm \* 2.0 = 4.0 mm

**Target material** Click the button  behind the display field to open the selection dialog for the material of the measuring object. The measuring object is the machine part the sensor is facing, such as machine shaft, measuring collar, or trigger wheel. The dialog lists all materials contained in the components database. Select the appropriate material, and click OK. See [Section 8.8](#) how to add a missing target material to the component database. The target material can not be changed if 33010x is selected for Input > Sensor.

### CAUTION!

This parameter is important for the linearity of the measurement. Ensure that the selected material matches to the material of the measuring object.

**Detune frequency** Eddy current sensors mounted too closely together influence each other. [Section 5.5](#) explains this mounting situation. In some cases, it is necessary to detune – changing of the oscillator frequency – one EZ 1000 converter. Use the list field to select a detune level. The available detune levels depend on the selected sensor (see Input > Sensor). If detuning is activated, use the calibration method Multipoint calibration. Detuning can not be activated if 33010x is selected for Input > Sensor.

- No detuning  
No detuning.
- Detune frequency low  
Use this level to detune, for example, one converter if two sensors are mounted close together.
- Detune frequency high  
Use this level if three sensors are mounted close together. Example for a three sensor setup:  
 Converter 1: No detuning  
 Converter 2: Detune frequency low  
 Converter 3: Detune frequency high

**Output sensitivity** Select the output sensitivity.

- ISO  
Example sensitivity EZ 108x with standard measuring range: 8.0 V/mm
- API  
Example sensitivity EZ 108x with standard measuring range: 7.87 V/mm

## 8.5.5 Calibration

Enter the calibration parameters or start the automatic calibration. A wizard guides you through the calibration process. The calibration dialog depends on the selected calibration method.

### Note

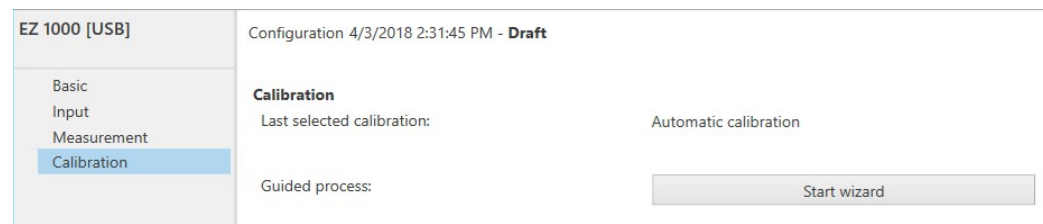
The sensor data is sent to the EZ 1000 at the beginning of the calibration methods Automatic calibration or Multipoint calibration. Before starting the calibration process, ensure that the dialogs Input and Measurement have been completed in accordance to the requirements of the measurement and the used sensor.

### ⚠ CAUTION!

Connections to external devices may be interrupted when sending configurations.

The output voltage of the EZ 1000 is set to  $> -1.5$  V during this process.

Figure 8-22: Calibration



**Last selected calibration** The calibration method used before is displayed here.

**Guided process**

1. Click Start wizard to start the guided calibration process. The dialog for selecting the calibration method opens.

### Note

The guided process requires an online connection to the EZ 1000 converter (see [Section 8.1.2](#)).

2. Select the calibration method.
  - **Manual calibration**  
Use this method if the calibration data is known. Sensor types EZ 105x and EZ 108x have this data attached to the sensor cable. The extension cables are labeled with cable calibration data.
  - **Automatic calibration**  
Use this method for sensor types EZ 105x and EZ 108x.
  - **Multipoint calibration**

Use this method for third party sensors, for a configuration with activated detuning (Measurement > Detune frequency), or to recalibrate an already calibrated measuring chain.

Depending on the selected sensor (Input > Sensor), a calibration method is recommended. The recommended method is marked with (Recommended).

The calibration method is fixed to Multipoint calibration if 33010x is selected for Input > Sensor or the detuning is activated (Measurement > Detune frequency).

3. Click Next to continue with the process.  
See [Manual calibration - guided process](#), [Automatic calibration - guided process](#), or [Multipoint calibration - guided process](#) for details.

## Manual calibration - guided process

The process steps after the selection of the calibration method are described below.

### Procedure

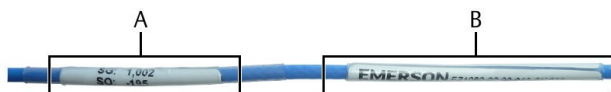
1. Enter the calibration data.

Figure 8-23: Manual calibration

The screenshot shows a 'Manual calibration' dialog box. It has a title bar with 'Calibration' and standard window controls. The main title is 'Manual calibration'. Below it, there are five input fields arranged in two groups. The first group contains 'Sensor gain' (value 1), 'Sensor offset' (value 0), and 'Sensor frequency offset [Hz]' (value 0). The second group contains 'Cable gain' (value 1) and 'Cable frequency offset [Hz]' (value 0). At the bottom right, there are four buttons: 'Back', 'Next' (highlighted with a blue border), 'Finish', and 'Cancel'.

**Sensor gain** Enter the sensor gain. See [Figure 8-24](#) where to find the data if using an EZ 105x or an EZ 108x sensor. The abbreviation for the sensor gain on the label is SG.

**Figure 8-24: Location sensor data**



- A. Label with sensor calibration data  
B. Label with sensor type and serial number.

**Sensor offset** Enter the sensor offset. See [Figure 8-24](#) where to find the data if using an EZ 105x or an EZ 108x sensor. The abbreviation for the sensor offset on the label is SO.

**Sensor frequency offset [Hz]** Enter the frequency offset. See [Figure 8-24](#) where to find the data if using an EZ 105x or an EZ 108x sensor. The abbreviation for the sensor frequency offset on the label is SFO.

**Cable gain** Enter the gain of the extension cable. See [Figure 8-25](#) where to find the data on the cable. The abbreviation for the cable gain on the label is CG.

**Figure 8-25: Location extension cable data**



- A. Label with extension calibration data  
B. Label with extension cable type and serial number.

**Cable frequency offset** Enter the frequency offset of the extension cable. See [Figure 8-25](#) where to find the data on the cable. The abbreviation for the cable frequency offset on the label is CFO.

2. Click Next.

The dialog for sending the configuration opens.

3. Click Next to send the configuration to the EZ 1000.

### ⚠ CAUTION!

Connections to external devices may be interrupted when sending configurations.

The output voltage of the EZ 1000 is set to > -1.5 V during this process.

The sending progress is displayed.

4. Click Next.
5. Click Finish to exit the wizard.
6. Click Close configuration to exit the configuration editor. Do not click Send & close.

## Automatic calibration - guided process

The process steps after the selection of the calibration method are described below.

### Note

Wait 60 seconds after powering up the EZ 1000 converter or after a firmware update before starting the automatic calibration.

### Prerequisites

The sensor is not installed in the machine.

### Procedure

1. Click Next to send the already entered configuration data to the EZ 1000.

### ⚠ CAUTION!

Connections to external devices may be interrupted when sending configurations.

The output voltage of the EZ 1000 is set to  $> -1.5\text{ V}$  during this process.

The sending progress is displayed.

2. Click Next.
3. Follow the instructions of the wizard.

The program calculates the necessary calibration data. The progress is displayed.

4. Click Finish to exit the wizard.
5. Click Close configuration to exit the configuration editor. Do not click Send & close.

## Multipoint calibration - guided process

The process steps after the selection of the calibration method are described below.

### Prerequisites

- Calibration gauge (for example CAL 064) with micrometer screw gauge and material sample that matches the material of the measuring object (machine shaft).
- -24 V DC power supply, if the converter is not supplied by a measuring amplifiers such as an A6500-UM.

- USB cable
- Sensor is not installed in the machine.

The start point for the calibration – maximum gap between measuring target and sensor including the initial air gap <sup>(1)</sup> – depends on the selected sensor type. **Table 8-1** lists the start points depending on the sensor and the configured extended range factor (Measurement > Extended range factor). The initial air gap<sup>(1)</sup> for EZ 105x and 33010x sensors is 0.25 mm and for EZ 1080 sensors 0.5 mm.

**Table 8-1: Start point**

| Sensor  | Start point (maximum distance between measuring target and sensor) |                           |                           |
|---------|--------------------------------------------------------------------|---------------------------|---------------------------|
|         | Extended range factor 1.0                                          | Extended range factor 1.5 | Extended range factor 2.0 |
| EZ 105x | 1.25 mm                                                            | 1.75 mm                   | 2.25 mm                   |
| EZ 108x | 2.5 mm                                                             | 3.5 mm                    | 4.5 mm                    |
| 33010x  | 2.25 mm                                                            | ---                       | ---                       |

### Procedure

1. Click Next to send the already entered configuration data to the EZ 1000.

#### CAUTION!

Connections to external devices may be interrupted when sending configurations.

The output voltage of the EZ 1000 is set to > -1.5 V during this process.

The sending progress is displayed.

2. Click Next.

**Step 1** and **Step 2** are skipped if an already configured converter is connected and the parameters of the dialogs Basic, Input, and Measurement are unchanged.

3. Enter the expected temperature at the sensor mounting location as exact as possible. If sensor and converter have the same temperature, use the button  in the dialog to measure the internal temperature of the converter. This step is only necessary if an EZ 105x or an EZ 108x sensor is connected to the EZ 1000 converter.

(1) Non-linear range at the beginning of the total measuring range of the sensor, before the beginning of the linear measuring range.

Figure 8-26: Dialog - sensor temperature

Calibration

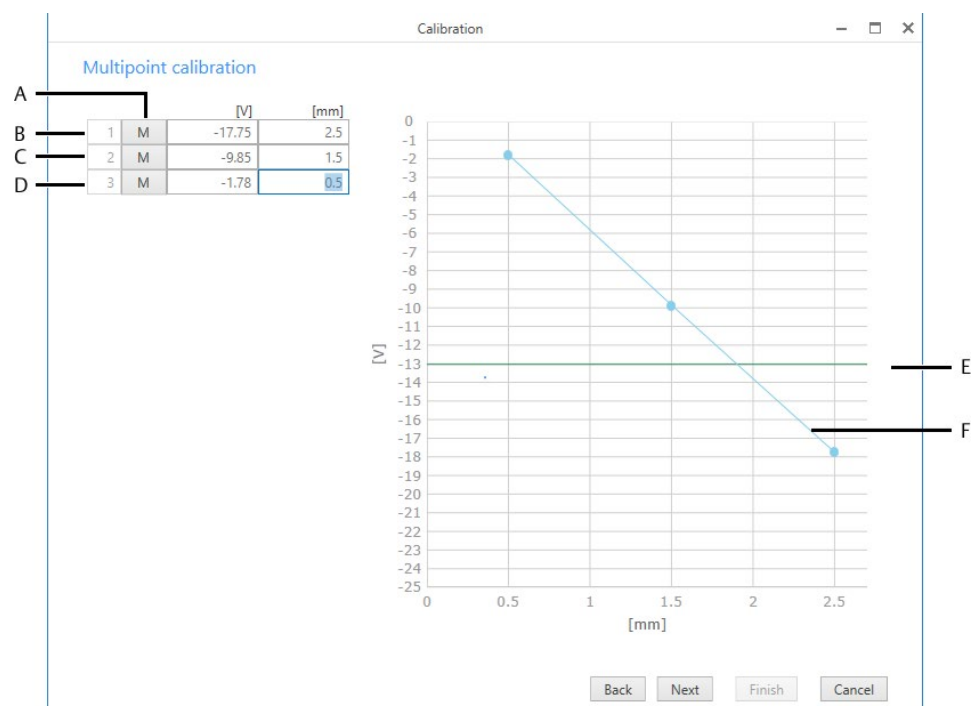
Enter Sensor temperature

Sensor temperature [°C]:

**i** Enter the current sensor temperature (°C) or click 'M' to take the current converter temperature instead.

4. Mount the sensor into the calibration gauge.
5. With the micrometer screw, adjust the distance between measuring object and sensor head to the maximum gap stated in row B of [Figure 8-27](#). The distances in column [mm] can not be changed here and depend on the selected sensor and the extended range factor (see [Table 8-1](#)).

Figure 8-27: Multipoint calibration



- A. Buttons for measurement of converter output voltage.
- B. Calibration point for the end of the measuring range (greatest distance between sensor and measuring object).
- C. Calibration point for the center of the measuring range.
- D. Calibration point for the beginning of the measuring range (smallest distance between sensor and measuring object).
- E. Indication of the current output voltage of the connected converter.
- F. Calibration curve as a result of the calibration points.

Rows C and D are disabled until the measurement for the start point has been made (row B).

6. Click the measuring button  in row B to measure the output voltage of the converter.

This process can take several minutes.

The measured voltage (approximately -18 V) is entered into the related field of column [V].

7. With the micrometer screw, adjust the distance between measuring object and sensor head to the center of the measuring range stated in row C of [Figure 8-27](#).
8. Click the measuring button  in row C to measure the output voltage of the converter.

This process can take several minutes.

The measured voltage (approximately -10 V) is entered into the related field of column [V].

9. With the micrometer screw, adjust the distance between measuring object and sensor head to the minimum gap stated in row D of *Figure 8-27*.
10. Click the measuring button  in row D to measure the output voltage of the converter.

This process can take several minutes.

The measured voltage (approximately -2 V) is entered into the related field of column [V].

11. Click Next.
12. Click Next to send the calibration table to the EZ 1000.

### CAUTION!

Connections to external devices may be interrupted when sending configurations.

The output voltage of the EZ 1000 is set to > -1.5 V during this process.

The calibration and sending progress is displayed.

13. Click Next.
14. Click Finish to exit the wizard.
15. Click Close configuration to exit the configuration editor. Do not click Send & close.

## 8.6 Send and Reload a configuration

### 8.6.1 Send a configuration

#### CAUTION!

Connections to external devices may be interrupted when sending configurations.

The output voltage of the EZ 1000 is set to > -1.5 V during this process.

The configuration is generally sent during the calibration process. Use Send & close to send minor changes to the configuration or configuration files loaded into Machine Studio to the converter.

#### Procedure

1. Ensure that there is an online connection between the EZ 1000 converter and Machine Studio.

Machine Studio will automatically establish an online connection to the EZ 1000 as soon as there is a physical connection through the USB port.

2. Click Send & close in the ribbon command bar to send the configuration to the EZ 1000. The configuration editor automatically closes after the sending process.

A successfully sent configuration will be indicated by a message in the upper right corner of the software window. This message window will automatically disappear. Otherwise close it by clicking on the cross.

The converter is ready to use when the sensor is connected, the converter output voltage is within the OK range, and the green Ok LED on the converter front shows a steady light.

---

#### Note

After sending a configuration the configuration becomes active immediately – this is indicated by Machine Studio and a steady green LED on the converter front. The output of the EZ 1000 is activated 25 seconds after the sending process.

---

## 8.6.2 Reload a configuration

Once an online connection has been established, the configuration of the EZ 1000 is automatically loaded to Machine Studio. Click Reload in the ribbon command bar if the configuration and the calibration data must be loaded again.

## 8.7 Offline (Easy) calibration

### ⚠ CAUTION!

Any work on the system may impair machine protection.

---

The EZ 1000 converter can be calibrated on EZ 108x sensors with 5 m or 10 m sensor cable without using Machine Studio, provided that the material of the measuring object is 42CrMo4.

---

#### Note

The offline calibration requires an EZ 1000 with factory default settings (delivery state). If uncertain about the calibration state, use the online view of Machine Studio (see [Section 9.2](#)) to check the current calibration type of the converter – Auto, Easy, or Manual. Factory default settings are also indicated by a continuously triple flashing of the LED (see [Table 3-1](#)).

Reset an already configured EZ 1000 converter to the factory default settings by using Machine Studio (see [Reset to factory default](#)) before starting the offline calibration procedure.

An already offline (easy) calibrated EZ 1000 can be offline calibrated again without resetting the converter to factory default.

---

### Prerequisites

- -24 V DC power supply, if the converter is not supplied by a measuring amplifiers such as an A6500-UM Universal Measuring Card.
- EZ 1000 with factory default settings.
- EZ 108x sensor with 5 m or 10 m sensor cable.
- Suitable tool for pressing the calibration button such as a 2 mm screw driver or a pen.
- Material of the measuring object: 42CrMo4
- Sensor is not installed in the machine.

### Procedure

1. Connect the sensor to the EZ 1000 (see *Sensor connection*).
2. Connect the power supply if not already done (see *Power supply and output signal connection*).
3. Switch on the power supply.

---

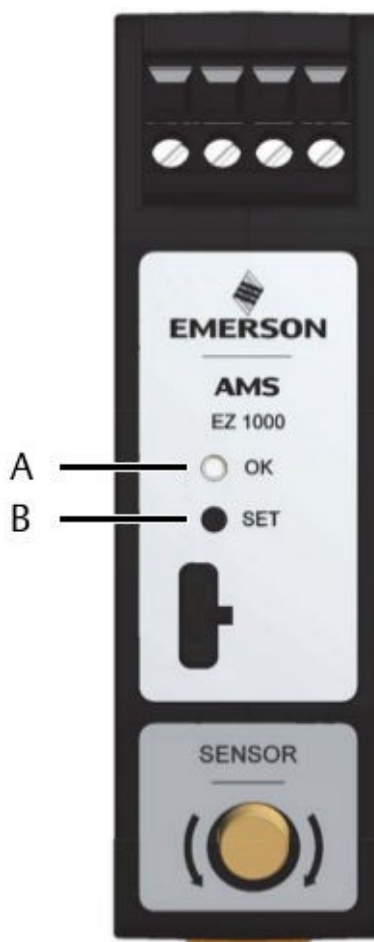
#### Note

Wait 60 seconds after powering up the EZ 1000 converter or after a firmware update before starting the calibration process.

---

4. Take the sensor and hold it straight up into the air – away from ferro magnetic materials.
5. With a suitable tool, press and hold the button on the front of the EZ 1000 to start the calibration process. The green LED starts flashing. See *Figure 8-28* for location of the button and the LED. Hold the button until the LED changes the flashing pattern to double flashing.

Figure 8-28: LED and button location



- A. Green LED (OK)  
 B. Calibration button (SET)

6. To complete the calibration, release the button. The calibration process starts and the double flashing of the LED continues for five seconds.

The calibration is finished when the LED stops double flashing, and the light is constantly green.

#### Note

If a fault has been detected during the process or if the converter has been already calibrated with Machine Studio, the calibration is stopped, and the LED flashes fast (5 Hz) until the EZ 1000 is powered off and on again. The existing calibration of the converter remains unchanged.

7. Mount the sensor (see [Section 5.2](#)).

## 8.8 Components database - add a new target material

The target materials, available in the components database, are listed in the component selection dialog of the configuration editor. If the required target material is not listed in the selection dialog, follow the steps to add it to the components database.

### ⚠ CAUTION!

Before adding a new target material to the components database, ensure that the required material data is known, as the material has an influence on the accuracy of the measurement.

For additional target material data, go to the Emerson download portal. If the required material data is not available on the portal, contact Product Support. If required, Product Support will ask you to send in a sample of the target material to determine the material data. The thickness of the sample should be not less than 5 mm and the diameter not less than 50 mm.

### Procedure

1. Get the target material data from the download portal.
  - a. Enter <http://reliabilitymobile.com/apps/registration/Account/Login.aspx> into the address bar of your internet browser.
  - b. Log in to the download portal.  
Click Register if you do not already have an account. Follow the instructions.
  - c. Go to AMS EZ 1000 and download the target material data list to your computer.  
If the required material is not on the list, contact Product Support.
2. Start Machine Studio, and go to File > Settings.
3. Select Components Database, and click Add.  
The dialog for the selection of the components type opens.
4. Select Material, and click Next.  
The dialog for entering the material data opens.
5. Enter a name for the material and the data from the already downloaded material data list. Click Next.  
The confirmation dialog opens.
6. Check your entries, and place a checkmark in the box Data is correct to confirm the correctness of the entries. Click Finish.

### Note

Once entered into the database, the material data cannot be changed, only deleted.

The new target material is added to the components database and available for the converter configuration.

[Related information](#)

[Technical support](#)

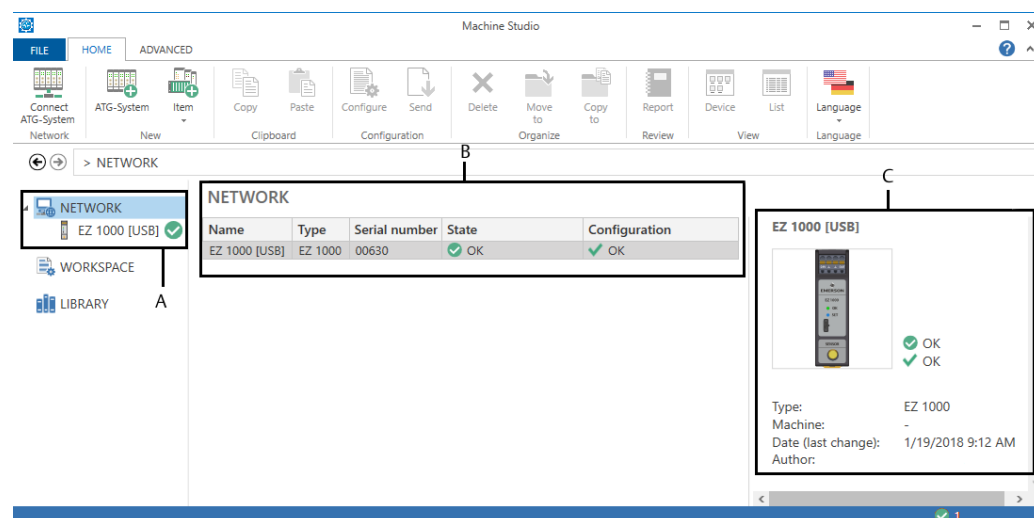
## 9 Online View

Topics covered in this chapter:

- *Overview*
- *Details*
- *Live data*

After connecting Machine Studio with an EZ 1000 converter, the Online View of the converter appears.

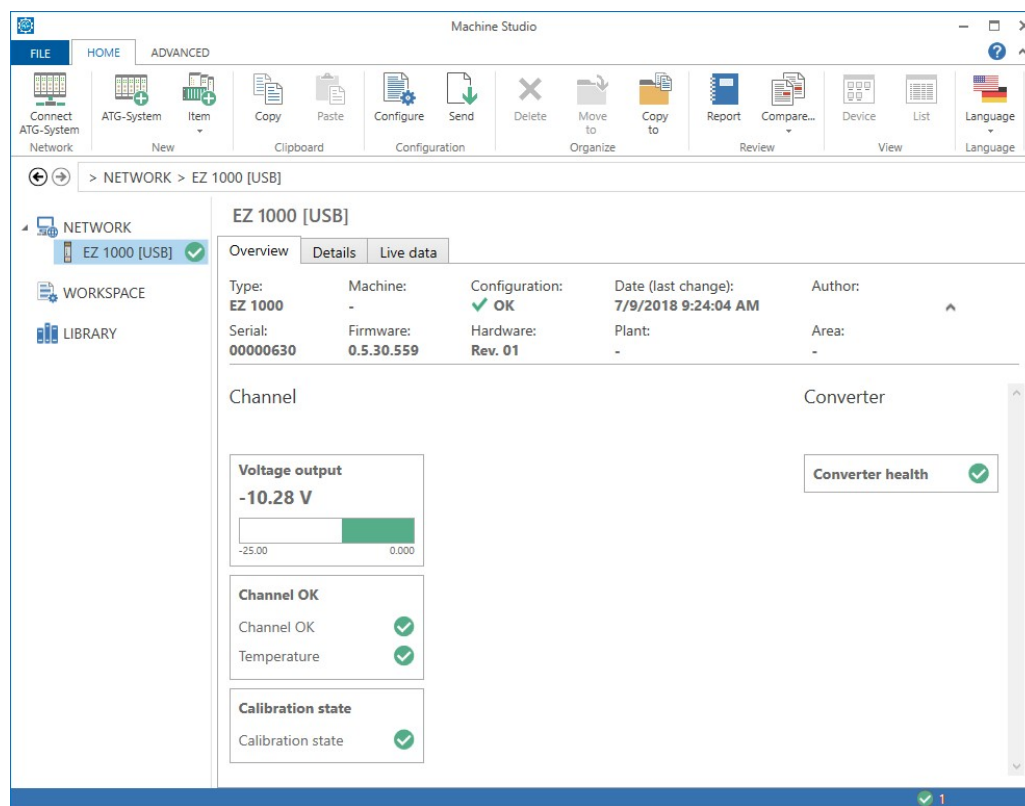
Figure 9-1: Online View - overview



- Connected devices in the device tree
- List of connected EZ 1000 converters
- A few details of the converter selected from the list.

To open the Online View of a specific EZ 1000, double-click it in the list, or click it in the device tree. The Online View of the selected EZ 1000 opens. This view contains three tabs: Overview, Details, and Live data. Machine name, plant name, area, serial number, converter type, firmware version, date of last change to the configuration, and the author of the last configuration are shown at the top of each Online View page.

Figure 9-2: Online View



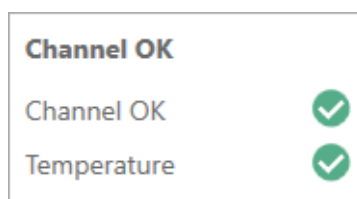
## 9.1 Overview

Overview contains several graphic objects to provide an overview about the converter status.

### Channel OK

This graphic object displays the converter state.

Figure 9-3: Channel OK - expanded object



- A fault-free converter is indicated with a checkmark within a green solid circle ✓.
- A faulty converter is indicated with a yellow warning triangle ⚠.

Click on Channel OK to expand the object, and get more information about the converter state.

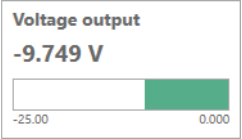
Table 9-1: Flags Channel OK

| Flag        | Meaning |                                                                                                       | Action                                                                                                            |
|-------------|---------|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| Channel OK  | ✓       | No fault detected.                                                                                    | ---                                                                                                               |
|             | ⚠       | Sensor or converter fault detected.                                                                   | Check sensor and converter including wiring and connections                                                       |
|             |         | Sensor is too close to the measuring target.                                                          | Check the distance between sensor and measuring target and readjust the sensor. See <a href="#">Section 4.1</a> . |
| Temperature | ✓       | The temperature, measured by the internal sensor is within the OK range of -35°C to 85°C.             | ---                                                                                                               |
|             | ⚠       | The temperature, measured by the internal temperature sensor, is out of the OK range of -35°C to 85°C | Take appropriate measures to reduce the environmental temperature.                                                |

Voltage output

This graphic object displays the DC part of converter output voltage. This voltage is proportional to the distance between sensor and measuring object.

Figure 9-4: Voltage output



Calibration state

This graphic object displays the state of the calibration.

Figure 9-5: Calibration state - expanded object



- A fault- free calibration is indicated with a checkmark within a green solid circle ✓.

- A faulty calibration is indicated with a yellow warning triangle ⚠.

Click on Calibration state to expand the object.

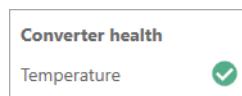
Table 9-2: Calibration state flags

| Flag              | Meaning |                                                         | Action                                                                                                                                                                                                                                     |
|-------------------|---------|---------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Calibration state | ✓       | Calibration is OK.                                      | ---                                                                                                                                                                                                                                        |
|                   | ⚠       | No calibration.                                         | Calibrate the converter.                                                                                                                                                                                                                   |
|                   | ⚠       | The Easy calibration or Automatic calibration is not OK | Repeat the Easy or Automatic calibration. If this is not successful, calibrate the converter with the Manual<br><i>Manual calibration - guided process</i> or<br>Multipoint<br><i>Multipoint calibration - guided process</i> calibration. |

### Converter health

This graphic object displays the converter health.

Figure 9-6: Converter health - expanded object



- A fault-free converter is indicated with a checkmark within a green solid circle ✓.
- A faulty converter is indicated with a yellow warning triangle ⚠.

Click on Converter health to expand the object, and get more information about the converter health.

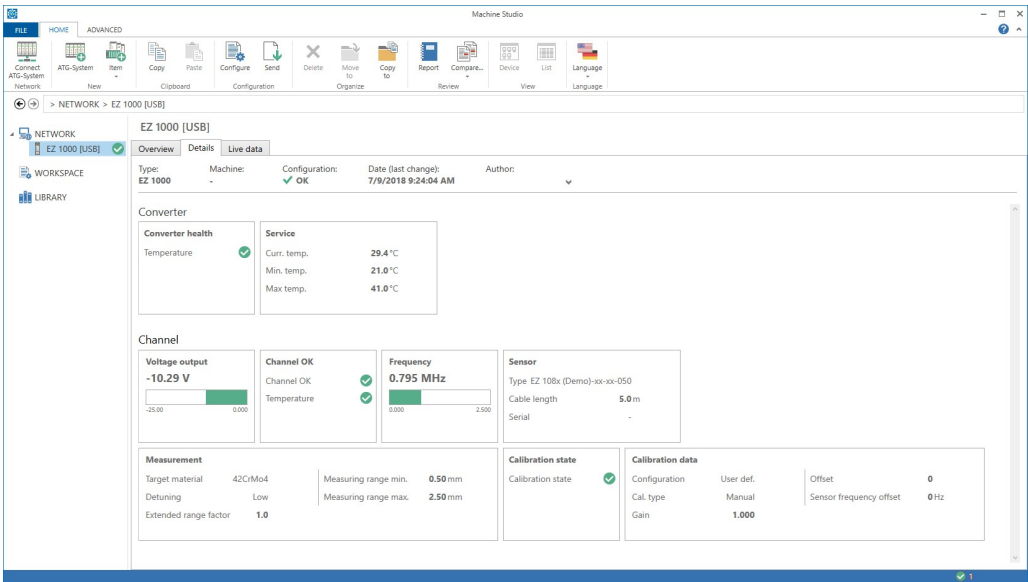
Table 9-3: Converter health flags

| Flag        | Meaning |                                                                                                       | Action                                                             |
|-------------|---------|-------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| Temperature | ✓       | The temperature, measured by the internal sensor is within the OK range of -35°C to 85°C.             | ---                                                                |
|             | ⚠       | The temperature, measured by the internal temperature sensor, is out of the OK range of -35°C to 85°C | Take appropriate measures to reduce the environmental temperature. |

## 9.2 Details

Details provides more detailed status information of the converter. The graphic objects Converter health, Channel OK, Voltage output, and Calibration state are described in [Section 9.1](#).

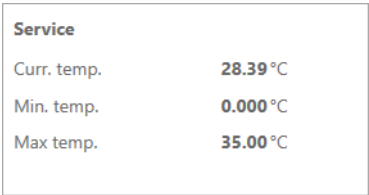
Figure 9-7: Details



### Service

This graphic object displays temperatures measured by the internal temperature sensor.

Figure 9-8: Service



|             |                                       |
|-------------|---------------------------------------|
| Curr. temp. | Current temperature of the converter. |
| Min. temp.  | Minimum temperature of the converter. |
| Max. temp.  | Maximum temperature of the converter. |

### Measurement

This graphic object displays measurement related data.

Figure 9-9: Measurement

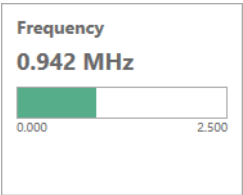
| Measurement           |             |                      |         |
|-----------------------|-------------|----------------------|---------|
| Target material       | 42CrMo4     | Measuring range min. | 0.50 mm |
| Detuning              | No detuning | Measuring range max. | 2.50 mm |
| Extended range factor | 1.0         |                      |         |

|                       |                                                                                                                                                                            |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Target material       | Material of the measuring object entered in the configuration (see <a href="#">Section 8.5.4</a> ).                                                                        |
| Detuning              | Displays the selected detuning level (see <a href="#">Section 8.5.4</a> ).                                                                                                 |
| Extended range factor | Configured factor for the measuring range extension (see <a href="#">Section 8.5.4</a> ).                                                                                  |
| Measuring range min.  | The beginning of the configured measuring range depends on the selected sensor type and the factor for the measuring range extension (see <a href="#">Section 8.5.4</a> ). |
| Measuring range max.  | The end of the configured measuring range depends on the selected sensor type and the factor for the measuring range extension (see <a href="#">Section 8.5.4</a> ).       |

Frequency

This graphic object displays the frequency of the oscillator circuit of the converter. The frequency depends on the connected sensor type, the cable length of the sensor, and the selected detune frequency (Measurement > Detune frequency).

Figure 9-10: Frequency



Sensor

This graphic object displays general sensor data.

Figure 9-11: Sensor

| Sensor       |                   |
|--------------|-------------------|
| Type         | EZ 108x-xx-xx-010 |
| Cable length | <b>1.0 m</b>      |
| Serial       | 00000692          |

Type Configured sensor type.  
Cable length Cable length of the configured sensor type.  
Serial Serial number of the sensor entered in the configuration (see [Section 8.5.3](#)).

Extension cable

This graphic object displays general extension cable data.

Figure 9-12: Extension cable

| Extension cable |              |
|-----------------|--------------|
| Type            | EZ190x-040   |
| Cable length    | <b>4.0 m</b> |
| Serial          | 00000669     |

Type Configured extension cable type.  
Cable length Length of the configured extension cable.  
Serial Serial number of the extension cable entered in the configuration (see [Section 8.5.3](#)).

Calibration data

This graphic object displays configured and determined calibration data.

Figure 9-13: Calibration data

| Calibration data |              |                         |               |
|------------------|--------------|-------------------------|---------------|
| Configuration    | User def.    | Offset                  | <b>-4 127</b> |
| Cal. type        | Auto         | Sensor frequency offset | <b>0 Hz</b>   |
| Gain             | <b>1.112</b> |                         |               |

Configuration Indicates the configuration state.

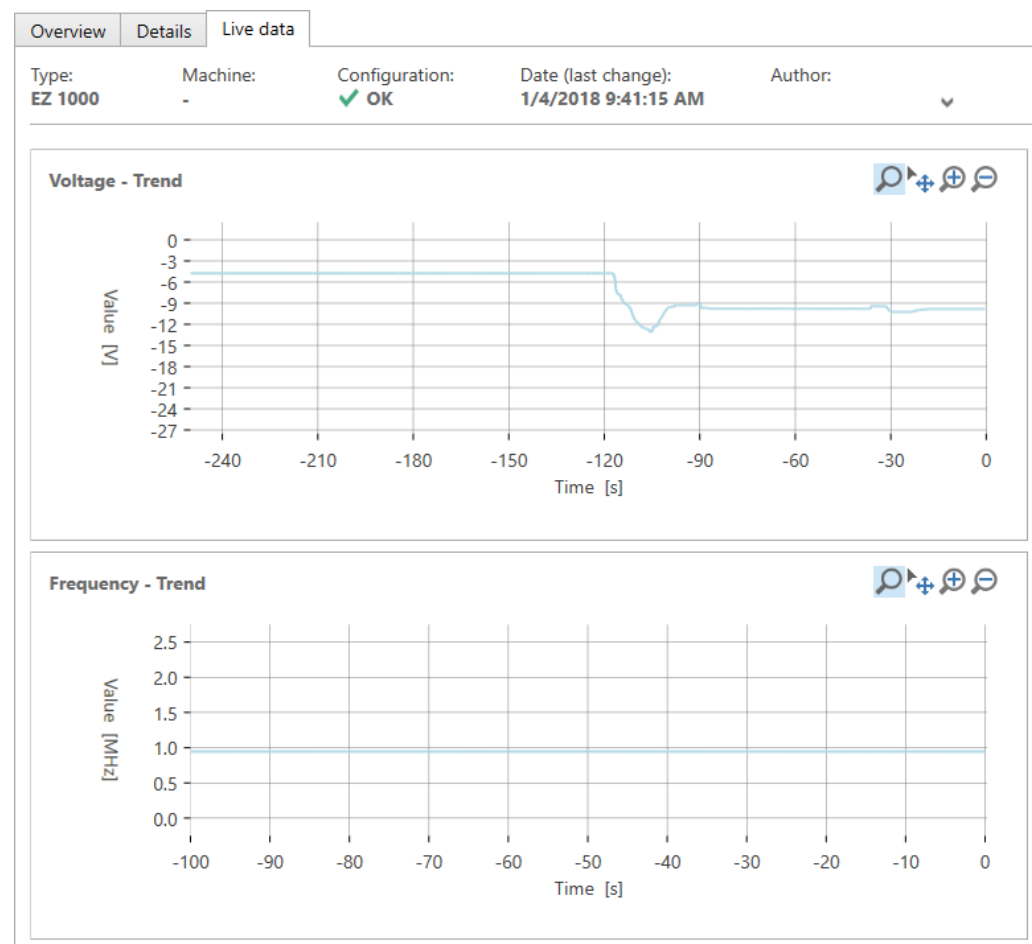
- Not available: State is not available.

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | <ul style="list-style-type: none"> <li>• Factory def.: Converter has the factory default configuration (delivery state).</li> <li>• User def.: Converter has a user defined configuration.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Cal. type               | <p>Indicates the calibration type.</p> <ul style="list-style-type: none"> <li>• Not available: Calibration state is not available.</li> <li>• Auto: The converter has been calibrated with the Automatic calibration function.</li> <li>• Easy: The converter has been calibrated with the Offline calibration function.</li> <li>• Manual: The converter has been calibrated with the Manual calibration function.</li> <li>• Multipoint: The converter has been calibrated with the Multipoint calibration function.</li> </ul> <p>See <a href="#">Section 8.5.5</a> and <a href="#">Section 8.7</a> for details.</p> |
| Gain                    | Value which has been determined for the gain during the calibration process.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Offset                  | Value which has been determined for the offset during the calibration process.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Sensor frequency offset | Value which has been determined for the sensor frequency offset during the calibration process.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

## 9.3 Live data

Live data displays continues online data. The trend diagram shows the last five minutes. The trend Voltage displays the DC voltage part of the converter output signal. The trend Frequency displays the oscillator frequency of the converter.

Figure 9-14: Live data



Each diagram has several controlling elements:

**Region  
zoom**

Use this function to enlarge an interesting part of the diagram.

1. Click the icon to activate the function. The button is colored light blue if the function is activated.
2. Place the mouse cursor close to the area of interest.
3. Left-click and hold.
4. Move the mouse to frame the area of interest.
5. Release the mouse button to enlarge the selected area.

Right-click somewhere on the diagram to reset the view change.

**Move**

Use this function to move the entire diagram view.

1. Click the icon to activate the function. The button is colored light blue if the function is activated.
2. Left-click an arbitrary point in the diagram and hold.

3. Move the view to the desired position.

4. Release the mouse button to place the view at that point.

Right-click somewhere on the diagram to reset the view change.

**Zoom in** Use this function to stepwise enlarge the diagram view at mouse position.



1. Click the icon to activate the function. The button is colored light blue if the function is activated.

2. Left-click an arbitrary point in the diagram. At every click, the view is enlarged.

Right-click somewhere on the diagram to reset the view change.

**Zoom out** Use this function to stepwise reduce the diagram view at mouse position.



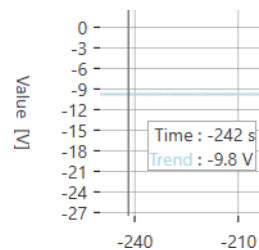
1. Click the icon to activate the function. The button is colored light blue if the function is activated.

2. Left-click an arbitrary point in the diagram. At every click, the view is reduced.

Right-click somewhere on the diagram to reset the view change.

**Cursor** Use the cursor within the diagram to display single values of the trend line. The cursor function is activated as soon as the mouse is within the diagram view.

Figure 9-15: Cursor



# 10 Maintenance, fault finding, and repair

Topics covered in this chapter:

- *Maintenance*
- *Hints for fault finding*
- *Replace an EZ 1000*
- *Replace a sensor*
- *Linearity check*
- *Firmware update*

## 10.1 Maintenance

During operation, the EZ 1000 converter does not require any maintenance.

## 10.2 Hints for fault finding

### CAUTION!

Any work on the system may impair machine protection.

For quick fault finding, WayCon recommends connecting an identical sensor to the converter temporarily. If the head of the sensor is moved to a metallic target, the output voltage of the converter must change from approximately -18 V to -2 V.

The converter output voltage is a useful indicator for the cause of a faulty measuring chain. Measure the output voltage with a DC voltmeter at the output terminals OUT and  $\perp$ . *Table 10-1* shows converter output voltages and their possible cause or meaning.

**Table 10-1: Meaning of converter output voltages**

| Converter output voltage | Meaning / Error                                                                      |
|--------------------------|--------------------------------------------------------------------------------------|
| -18 V to -22 V           | Distance between sensor and measuring object (shaft, measuring collar) is too large. |
| -2 V to -18 V            | Output voltage range. Measuring chain is OK.                                         |
| -10 V                    | Center of the output voltage range. Measuring chain is OK.                           |
| -1 V to -2 V             | Distance between sensor and measuring object (shaft) is too small.                   |
|                          | Sensor damaged, cable break, or open connection.                                     |
| -1.5 V                   | Sensor OK limit. See <i>Section 4.1</i> for details.                                 |
| 0 to -1 V                | Converter is defective.                                                              |

Table 10-1: Meaning of converter output voltages (*continued*)

| Converter output voltage                                                                    | Meaning / Error                                      |
|---------------------------------------------------------------------------------------------|------------------------------------------------------|
|                                                                                             | No supply voltage.                                   |
| Output voltage range is not properly scaled on the measuring range of the connected sensor. | Converter is not calibrated on the connected sensor. |

Eddy current sensors consist of a low impedance coil, so use a resistance measurement to detect a break in the sensor cable.

The sensor cable shield must be isolated from the converter housing, from the metal protection tube, and from the housing of the LEMO connector. A possible error source could be a missing or incorrectly shrunk shrink sleeve at the adapter between sensor and extension cable.

Also, use Machine Studio to get an overview of the converter state. See [Chapter 9](#) for details.

## 10.3 Replace an EZ 1000

It is not possible to repair a defective EZ 1000 converter. In case of defects, the converters must be replaced. Follow the steps listed below if an EZ 1000 needs to be replaced.

### CAUTION!

Any work on the system may impair machine protection.

#### Procedure

1. Save the EZ 1000 configuration, if possible.
  - a. Connect the configuration device (PC/Laptop) through the USB connection to the EZ 1000.
  - b. Switch on the power supply of the converter to be replaced – if not already done.
  - c. Start Machine Studio. The software automatically connects to the EZ 1000 and opens the online view of the converter.
  - d. Click Configure to open the configuration of the EZ 1000.
  - e. Click Reload to load the configuration and the calibration data from the converter.
  - f. Save the configuration file including the calibration data. Go to File, and select Save as.

#### Note

The data of the Automatic calibration and the Easy calibration (calibration process without Machine Studio) is saved as Manual calibration data.

g. Go back to the editor and close it.

Do not close Machine Studio.

h. Switch off the power supply.

2. Disconnect all wires from the EZ 1000 including sensor and USB cable.
3. Remove the EZ 1000 from the mounting rail.
4. Install the new EZ 1000.
5. Reconnect all wires including sensor and USB cable.
6. Switch on the power supply.

The converter will automatically be detected by Machine Studio.

7. Load the configuration file including the calibration data from the memory of the configuration device to the EZ 1000. If a defect prevents reading the configuration from the EZ 1000 to be replaced, use a back-up configuration file or create a new configuration.
  - a. Click the new EZ 1000 to open the online view.
  - b. Click Configure to open the configuration of the EZ 1000.
  - c. Open the saved configuration file. Go to File, and select Open.
  - d. Click Send & close to send the configuration to the new converter.

#### Note

To ensure proper work of the replaced converter, check the linearity of the measuring chain. See [Section 10.5](#) for details. WayCon recommends calibrating the measuring chain – no matter whether the sensor or the converter has been replaced.

Now, the new EZ 1000 is ready for operation.

## 10.4 Replace a sensor

Follow the steps below to replace a defective sensor.

### ⚠ CAUTION!

Any work on the system may impair machine protection.

#### Procedure

1. Remove the sensor to be replaced from the machine and unfasten all sensor cable fastenings.
2. Disconnect the sensor to be replaced from the EZ 1000 converter.

The sensor can be disconnected and connected while the EZ 1000 converter is powered.

3. Connect the new sensor to the EZ 1000.
4. Check the EZ 1000 configuration.  
Does the current configuration meets the requirements of the new sensor?
5. Calibrate the EZ 1000 and the new sensor.  
See [Section 8.5.5](#) and [Section 8.7](#) for details.
6. To ensure proper work of the replaced sensor, check the linearity of the measuring chain.  
See [Section 10.5](#) for details.
7. Install the new sensor.  
See sensor manual for installation details.

## 10.5 Linearity check

WayCon recommends checking the linearity of the EZ 1000 after sensor or converter replacement and after changes to the configuration of the converter.

The configured measuring range of the sensor is checked from the measuring range center to the end of the measuring range (0 to +x) and then from the center to the beginning of the measuring range (0 to -x).

### Prerequisites

- Calibration gauge (for example CAL 064) with micrometer screw gauge and material sample that matches the material of the measuring object (machine shaft).
- -24 V DC power supply, if the converter is not supplied by a measuring amplifier such as an A6500-UM.
- Voltmeter with an accuracy of 1%.
- EZ 1000 with sensor connected, configured, and calibrated on the connected sensor.

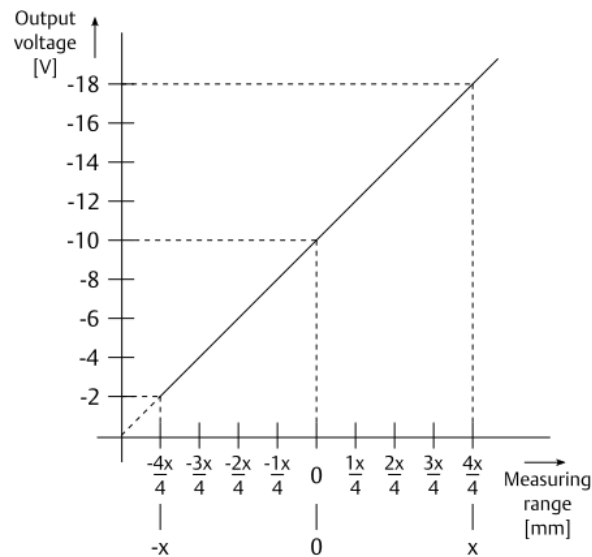
### Procedure

1. Connect the power supply – if not already done.
2. Connect the voltmeter to the signal output of the converter.
3. Switch on the power supply.
4. Measure the output voltage of the converter.
5. Mount the sensor into the calibration gauge at the center of the measuring range – the voltmeter reads -10 V.
6. Set the micrometer screw of the calibration gauge to 0.

This defines the center of the measuring range [ -10 V / 0 mm] and is the starting point for the linearity check.

7. Adjust the voltage steps -12 V, -14 V, -16 V, and -18 V as shown in [Figure 10-1](#) with the calibration gauge, and check the distance with the micrometer screw of the gauge. Continue the check with the voltage steps -8 V, -6 V, -4 V, and -2 V, and check the distance.

Figure 10-1: Linearity check



$x$ : Measuring range beginning and end value ( $-x$  to  $0$  to  $x$ )

Example:  $x = 1$  mm if an EZ 1080 sensor with a standard measuring range of  $-1$  mm to  $+1$  mm is used.

The deviation between the ideal distance, described by the [Figure 10-1](#), and the measured distance must be lower than 1%.

## 10.6 Firmware update

### ⚠ CAUTION!

Any work on the system may impair machine protection.

The firmware of the EZ 1000 can be updated by using Machine Studio.

#### Note

WayCon recommends saving the configuration of the EZ 1000 converter before starting the update process. See operating manual Machine Studio - General Functions (MHM-97879) for details.

### Prerequisites

Ensure that the EZ 1000 to be updated is powered and the following items are available:

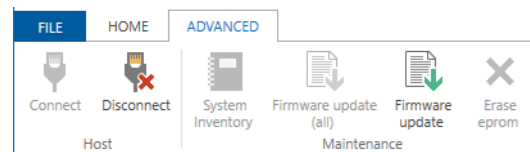
- PC or Laptop with the latest version of Machine Studio installed.
- USB cable with Type-A and micro-USB B plug
- Latest firmware file
- Suitable tool for pressing the calibration button, such as a 2 mm screw driver or a pen.

### Procedure

1. Start Machine Studio.
2. Connect the EZ 1000 converter through the USB interface to the PC.
3. Switch on the power supply of the EZ 1000, if not already done.  
Machine Studio automatically establishes a connection to the EZ 1000.
4. In Machine Studio, go to the Advanced tab, and press Ctrl+Alt+M to enable the maintenance mode.

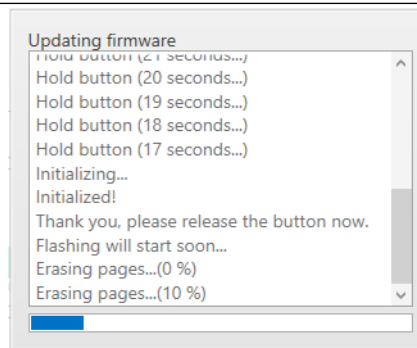
The button for the firmware update appears.

Figure 10-2: Advanced



5. Select the EZ 1000 to be updated from the device tree.  
The button for the firmware update is activated (colored).
6. Click Firmware update to open a file browser to browse to the storage location of the firmware file.
7. Select the firmware file, and click Open.  
The update process starts. The update dialog opens.

Figure 10-3: Update dialog



8. Follow the instructions on the screen.

Do not remove the USB cable during the update process.

After the successful firmware update, the EZ 1000 restarts and the LED switches to a steady light – provided that a sensor is connected and within the OK range.

The firmware version, currently installed on the EZ 1000, can be verified by the Online View of Machine Studio (see [Chapter 9](#)).

9. Check the configuration of the EZ 1000. If necessary load the configuration saved beforehand to the converter (see [Send a saved configuration file to the EZ 1000](#)).
10. Disconnect the USB cable.
11. Finally, check the calibration of the EZ 1000 (see [Section 10.5](#)).

# 11 Technical data

Topics covered in this chapter:

- *Input*
- *Supply*
- *Output*
- *Errors and tolerances*

Only specifications with indicated tolerances or limit values are required. Data without tolerances or without error limits are informative data and not guaranteed. Technology is under constant development, and specifications are subject to change without notice. If not otherwise specified, all data refer to a nominal supply voltage of -24 V and an environmental temperature of +23°C.

## 11.1 Input

|                                           |                                                                                                     |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------|
| Sensor connector for eddy current sensors | EZ 105x and EZ 108x                                                                                 |
|                                           | Third party sensors which meet the technical requirements of the sensor input such as:<br>BN 33010x |
| Connector                                 | For plugs with cap nut.                                                                             |
| Protection against short circuit          | Yes                                                                                                 |

## 11.2 Supply

|                            |                               |
|----------------------------|-------------------------------|
| Overvoltage protection     | Yes, maximal voltage -60 V DC |
| Reverse connect protection | Yes                           |
| Nominal supply voltage     | -24 V                         |
| Permissible voltage range  | -20 V to -32 V                |
| Nominal supply current     | 12 mA                         |
| Load resistor              | 100 kΩ                        |

## 11.3 Output

|                              |                                            |
|------------------------------|--------------------------------------------|
| Short-circuit prove          | Yes                                        |
| Nominal output voltage range | -2 V to -18 V                              |
| Limit range                  | -1.1 V to -21.6 V                          |
| Nominal frequency range      | 0 to 20 kHz (-3 dB) without cable capacity |

## 11.4 Errors and tolerances

### 11.4.1 EZ 1000 with EZ 105x

Typical accuracy of the standard measuring chain following API 670 consisting of EZ 105x-xx-xx-010, EZ 190x-040, and EZ 1000 with standard target material 42CrMo4 (AISI 4140) and calibration methods Manual, Automatic, or Multipoint:

Table 11-1: Accuracy according to API 670

| Temperature range                        | DSL                               | ISF                         |
|------------------------------------------|-----------------------------------|-----------------------------|
| 0°C to 45°C (Test range)                 | $\pm 1.25\%$ of MR <sup>(1)</sup> | $\pm 5\%$ of nominal value  |
| EZ 1000 -35°C to 65°C (Operating range)  | $\pm 3.75\%$ of MR <sup>(1)</sup> | $\pm 15\%$ of nominal value |
| EZ 190x -35°C to 65°C (Operating range)  |                                   |                             |
| EZ 105x -35°C to 120°C (Operating range) |                                   |                             |

(1) Measuring range

The deviation from straight line (DSL) error is the maximum error (in mm) in the sensor gap reading at a given voltage compared to a 16.0 mV per micrometer best fit straight line. DSL errors are associated with errors in axial position or sensor gap readings.

The incremental scale factor (ISF) error is the maximum amount the scale factor varies from 16.0 mV per micrometer when measured at specified increments throughout the linear range. Measurements are taken at 125  $\mu\text{m}$  increments. ISF error is associated with errors in radial vibration readings.

Basis of the data are measurements with:

- EZ 1000 and EZ 190x at temperature of EZ 1000.
- First meter of EZ 105x at temperature of EZ 105x.

- No ambient temperature change of EZ 1000 during 1 hour before measurement, power and sensor connected to EZ 1000 for at least 10 minutes before measurement and calibration.
- WayCon reference target material is 42CrMo4 (AISI 4140), unless otherwise stated.

#### Note

For measurements that require a higher measuring accuracy, factory calibrated measuring chains are available.

#### Accuracy of measuring chains different from the standard measuring chain

Add the measurement inaccuracies in [Table 11-2](#) to the values in [Table 11-1](#) to get the accuracy of measuring chains different from the standard measuring chain.

Table 11-2: Additional inaccuracies - DSL

| Parameter                                                     | Additional Measurement Inaccuracy (DSL), Test range | Additional Measurement Inaccuracy (DSL), Operating range | Remarks                                              |
|---------------------------------------------------------------|-----------------------------------------------------|----------------------------------------------------------|------------------------------------------------------|
| Cable length 1 m + 3 m                                        |                                                     |                                                          |                                                      |
| Manual calibration                                            | 8.25%                                               | 8.25%                                                    |                                                      |
| Automatic calibration                                         | 0.75%                                               | 0.75%                                                    |                                                      |
| Multipoint calibration                                        | 0.0%                                                | 0.75%                                                    |                                                      |
| Cable length 1 m + 7 m                                        |                                                     |                                                          |                                                      |
| Manual calibration                                            | 2.75%                                               | 2.75%                                                    |                                                      |
| Automatic calibration                                         | 0.75%                                               | 0.75%                                                    |                                                      |
| Multipoint calibration                                        | 0.0%                                                | 0.75%                                                    |                                                      |
| Other cable lengths                                           |                                                     |                                                          |                                                      |
| Manual calibration                                            | 0.75%                                               | 0.75%                                                    |                                                      |
| Automatic calibration                                         | 0.75%                                               | 0.75%                                                    |                                                      |
| Multipoint calibration                                        | 0.0%                                                | 0.75%                                                    |                                                      |
| Other target materials                                        | 2.25%                                               | 2.25%                                                    | Material selected from Machine Studio material table |
| Extended measuring range: 1.5 mm (Extended range factor: 1.5) |                                                     |                                                          |                                                      |
| Manual calibration                                            | 1.75%                                               | 2.0%                                                     |                                                      |
| Automatic calibration                                         | 1.75%                                               | 2.0%                                                     |                                                      |
| Multipoint calibration                                        | 0.25%                                               | 0.5%                                                     |                                                      |

Table 11-2: Additional inaccuracies - DSL (*continued*)

| Parameter                                                        | Additional Measurement Inaccuracy (DSL), Test range | Additional Measurement Inaccuracy (DSL), Operating range | Remarks                                   |
|------------------------------------------------------------------|-----------------------------------------------------|----------------------------------------------------------|-------------------------------------------|
| Extended measuring range: 2.0 mm<br>(Extended range factor: 2.0) |                                                     |                                                          |                                           |
| Manual calibration                                               | 3.75%                                               | 4.0%                                                     |                                           |
| Automatic calibration                                            | 3.75%                                               | 4.0%                                                     |                                           |
| Multipoint calibration                                           | 0.5%                                                | 1.0%                                                     | Only possible with multipoint calibration |
| Detune 1 / 2                                                     | 0.75%                                               | 1.25%                                                    |                                           |

## 11.4.2 EZ 1000 with EZ 108x

Accuracy of the standard measuring chain according to API 670 consisting of EZ 108x-xx-xx-010, EZ 190x-040, and EZ 1000 with standard target material 42CrMo4 (AISI 4140):

Table 11-3: Accuracy according to API 670

| Temperature range                        | DSL                               | ISF                         |
|------------------------------------------|-----------------------------------|-----------------------------|
| 0°C to 45°C (Test range)                 | $\pm 1.25\%$ of MR <sup>(1)</sup> | $\pm 5\%$ of nominal value  |
| EZ 1000 -35°C to 65°C (Operating range)  | $\pm 3.75\%$ of MR <sup>(1)</sup> | $\pm 10\%$ of nominal value |
| EZ 190x -35°C to 65°C (Operating range)  |                                   |                             |
| EZ 108x -35°C to 120°C (Operating range) |                                   |                             |

(1) *Measuring range*

The deviation from straight line (DSL) error is the maximum error (in mils) in the sensor gap reading at a given voltage compared to a 7.87 mV (8.0 mV) per micrometer best fit straight line. DSL errors are associated with errors in axial position or sensor gap readings.

The incremental scale factor (ISF) error is the maximum amount the scale factor varies from 7.87 mV (8.0 mV) per micrometer when measured at specified increments throughout the linear range. Measurements are taken at 250  $\mu\text{m}$  increments. ISF error is associated with errors in radial vibration readings.

Basis of the data are measurements with:

- EZ 1000 and EZ 190x at temperature of EZ 1000.

- First meter of EZ 108x at temperature of EZ 108x.
- No ambient temperature change of EZ 1000 during 1 hour before measurement, power and sensor connected to EZ 1000 for at least 10 minutes before measurement and calibration.
- WayCon reference target material is 42CrMo4 (AISI 4140), unless otherwise stated.

#### Note

For measurements that require a higher measuring accuracy, factory calibrated measuring chains are available.

#### Calibration methods Offline (Easy) and Automatic - typical values

The values of **Table 11-3** are typical values for measuring chains, calibrated with calibration method Offline (Easy) or Automatic.

#### Accuracy of non-API 670 conform measuring chains

Add the measurement inaccuracies in **Table 11-4** to the values in **Table 11-3** to get the accuracy of non-API 670 conform measuring chains.

**Table 11-4: Additional inaccuracies - DSL**

| Parameter                                                      | Additional Measurement Inaccuracy (DSL), Test range | Additional Measurement Inaccuracy (DSL), Operating range | Remarks                                              |
|----------------------------------------------------------------|-----------------------------------------------------|----------------------------------------------------------|------------------------------------------------------|
| Other cable lengths                                            | 0.25%                                               | 0.75%                                                    |                                                      |
| Other target materials                                         | 1.25%                                               | 1.25%                                                    | Material selected from Machine Studio material table |
| Extended measuring range: 3 mm<br>(Extended range factor: 1.5) |                                                     |                                                          |                                                      |
| Manual calibration                                             | 1.25%                                               | 1.5%                                                     |                                                      |
| Automatic calibration                                          | 1.25%                                               | 1.5%                                                     |                                                      |
| Multipoint calibration                                         | 0.25%                                               | 0.5%                                                     |                                                      |
| Extended measuring range: 4 mm<br>(Extended range factor: 2.0) |                                                     |                                                          |                                                      |
| Manual calibration                                             | 3.75%                                               | 4.0%                                                     |                                                      |
| Automatic calibration                                          | 3.75%                                               | 4.0%                                                     |                                                      |
| Multipoint calibration                                         | 0.5%                                                | 1.0%                                                     |                                                      |

Table 11-4: Additional inaccuracies - DSL (*continued*)

| Parameter    | Additional Measurement Inaccuracy (DSL), Test range | Additional Measurement Inaccuracy (DSL), Operating range | Remarks                                   |
|--------------|-----------------------------------------------------|----------------------------------------------------------|-------------------------------------------|
| Detune 1 / 2 | 0.75%                                               | 1.25%                                                    | Only possible with multipoint calibration |

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