CUTSFORTH

THE POWER OF INNOVATION™

Operations Manual EZDP-2046 Rev B

Remote Meter Point

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1. About Cutsforth

Cutsforth specializes in developing innovative new technologies and services to support the power generation industry. Cutsforth's patented EASYchange® brush holder design, online truing service, and patented shaft grounding and monitoring systems have been installed across the globe in generators of all sizes and in nearly every industry application, including nuclear, natural gas, coal, wind, and hydroelectric.

Cutsforth's knowledge and commitment to excellence drives our innovative solutions for the changing needs of the power industry. Whether it is a quick response to a critical situation or a new way of solving an old problem, our commitment to quality ensures that our customers receive the best-in-class products and services—Cutsforth is the Power of Innovation.

Cutsforth, Inc. started back in 1991 as a small company focused primarily on making replacement brush holders for generators and exciters. Today, after 25+ years in business, Cutsforth's experience and innovative designs have brought its best-in-class excitation brush holder and shaft grounding replacements and collector ring services to some of the world's largest power companies.

1.1. Cutsforth Products

- EASYchange® Removable Brush Holders
- EASYchange® Brush Condition Monitoring
- Cutsforth Shaft Grounding Systems
- Rotor Flux Monitoring
- Electro-Magnetic Interference Monitoring

1.2. Cutsforth Field Services

Cutsforth provides comprehensive product installations for all product offerings as well as on-site training after the installation. We work efficiently during your outage to ensure a smooth upgrade to our innovative solutions such as Product Installations, Online Collector Ring and Commutator Truing, Spiral Groove Restoration, and Consulting and Emergency Services.

1.3. Cutsforth Electrical Contractor Services

In addition to our Field Service installation services, Cutsforth offers turn-key services including the electrical contractor scope of work as an additional service in select regions within the US. With this service offering, Cutsforth can greatly simplify the process of monitoring product installation from beginning to end.

2. Legal Information

2.1. Limited Warranty

This document is provided 'as is' and is subject to being changed, without notice, in future editions. Cutsforth reviews this document carefully for technical accuracy; however, CUTSFORTH MAKES NO EXPRESS OR IMPLIED WARRANTIES AS TO THE ACCURACY OF THE INFORMATION CONTAINED HEREIN AND SHALL NOT BE LIABLE FOR ANY ERRORS. Cutsforth warrants that its hardware products will be free of defects in materials and workmanship that cause the product to fail to substantially conform to the applicable Cutsforth published specifications for one (1) year from the date of invoice.

For a period of ninety (90) days from the date of invoice, Cutsforth warrants that (i) its software products will perform substantially in accordance with the applicable documentation provided with the software, and (ii) the software media will be free from defects in materials and workmanship. If Cutsforth receives notice of a defect or non-conformance during the applicable warranty period, Cutsforth will, in its discretion: (i) repair or replace the affected product, or (ii) refund the fees paid for the affected product. Repaired or replaced Hardware will be warranted for the remainder of the original warranty period or ninety (90) days, whichever is longer. If Cutsforth elects to repair or replace the product, Cutsforth may use new or refurbished parts or products that are equivalent to new in performance and reliability and are at least functionally equivalent to the original part or product. You must obtain an RMA number from Cutsforth before returning any product to Cutsforth. Cutsforth reserves the right to charge a fee for examining and testing Hardware not covered by the Limited Warranty.

This Limited Warranty does not apply if the defect of the product resulted from improper or inadequate maintenance, installation, repair, or calibration performed by a party other than Cutsforth; unauthorized modification; improper environment; use of an improper hardware or software key; improper use or operation outside of the specification for the product; improper voltages; accident, abuse, or neglect; or a hazard such as lightning, flood, or other act of nature.

THE REMEDIES SET FORTH ABOVE ARE EXCLUSIVE AND THE CUSTOMER'S SOLE REMEDIES, AND SHALL APPLY EVEN IF SUCH REMEDIES FAIL OF THEIR ESSENTIAL PURPOSE.

WARNING REGARDING USE OF CUTSFORTH SHAFT MONITORING EQUIPMENT: CUSTOMER IS ULTIMATELY RESPONSIBLE FOR VERIFYING AND VALIDATING THE SUITABILITY AND RELIABILITY OF THE PRODUCTS WHENEVER THE PRODUCTS ARE INCORPORATED IN THEIR SYSTEM OR APPLICATION, INCLUDING THE APPROPRIATE DESIGN, PROCESS, AND SAFETY LEVEL OF SUCH SYSTEM OR APPLICATION. PRODUCTS ARE NOT DESIGNED, MANUFACTURED, OR TESTED FOR USE IN LIFE OR SAFETY CRITICAL SYSTEMS, OR ANY OTHER APPLICATION IN WHICH THE FAILURE OF THE PRODUCT OR SERVICE COULD LEAD TO DEATH, PERSONAL INJURY, SEVERE PROPERTY DAMAGE OR ENVIRONMENTAL HARM (COLLECTIVELY, "HIGH-RISK USES"). FURTHER, PRUDENT STEPS MUST BE TAKEN TO PROTECT AGAINST FAILURES, INCLUDING PROVIDING BACK-UP AND SHUT-DOWN MECHANISMS. CUTSFORTH EXPRESSLY DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY OF FITNESS OF THE PRODUCTS OR SERVICES FOR HIGH-RISK USES.

CUTSFORTH DOES NOT WARRANT, GUARANTEE, OR MAKE ANY REPRESENTATIONS REGARDING THE USE OF OR THE RESULTS OF THE USE OF THE PRODUCTS IN TERMS OF CORRECTNESS, ACCURACY, RELIABILITY, OR OTHERWISE. CUTSFORTH DOES NOT WARRANT THAT THE OPERATION OF THE PRODUCTS WILL BE UNINTERRUPTED OR ERROR FREE. INCIDENTAL AND CONSEQUENTIAL DAMAGES, INCLUDING LOSS OF USE, ARE SPECIFICALLY EXCLUDED FROM THIS WARRANTY; THE MAXIMUM VALUE OF A WARRANTY CLAIM CANNOT EXCEED THE ORIGINAL VALUE OF THE ASSEMBLY OR COMPONENT.

2.2. Copyright

2.3. Patents

Please send patent information requests to patents@cutsforth.com.

3. Safety Information

Following is important safety information. For safe installation and operation of this equipment, be sure to read and understand all cautions and warnings.

3.1. Safety Conventions

NOTE

Additional information.

ELECTRICAL DANGER

Indicates an action or specific equipment area that can result in personal injury or death from an electrical hazard if proper precautions are not taken.

CAUTION

Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury or equipment damage.

WARNING

Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

ROTATING PART CAUTION

Indicates possible injury from rotating parts.

DANGER

Indicates a hazardous situation that, if not avoided, will result in death or serious injury.

3.2. General Safety Instructions

ELECTRICAL DANGER

Only qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid injury should work with Cutsforth products. Among the many considerations are the following:

- Avoid contact with energized circuits.
- Avoid contact with rotating parts.
- Never install any component that appears not to be functioning in a normal manner.
- Always ensure proper installation of the holder assembly and shaft grounding rope.

ELECTRICAL DANGER

Before working on the generator, de-energize, lock out, and tag out all power sources to the generator, shaft, and accessory devices. Electric shock and death may result due to failure to heed this warning.

ROTATING PART CAUTION

High-voltage and rotating parts can cause serious or fatal injury. Installation, operation, and maintenance of this product must be performed only by qualified personnel, in accordance with all applicable safety regulations and guidelines.

4. The Cutsforth Remote Meter Point

This manual covers the installation and operation of the Cutsforth Remote Meter Point.

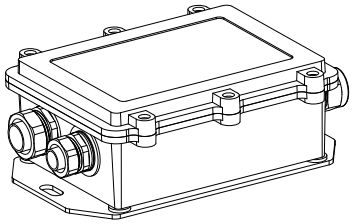
If this system is replacing an OEM system, see the documentation that came with the OEM system for instructions on how to remove it.

NOTE

This manual does not cover all details or variations in equipment, nor does it consider every possible contingency for installation, operation, or maintenance. If you have questions or concerns that are not addressed in this manual, contact Cutsforth Engineering Support.

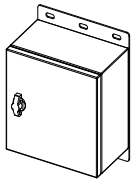
4.1. Components

The following parts are included in the Remote Meter Point installation package:



1 Junction box

Part number: EGMA-202



1 Remote Meter Point

Part number: EGMA-203

4.2. Required Tools

- 1/2 in hex wrench socket
- 9/16 in socket wrench
- 1/4 in hex key wrench
- 3/16 in hex key wrench
- Drill
- 5/16 in-18 tap
- Letter F drill bit
- Wire cutters
- Wire strippers
- Wire crimpers

4.3. Installation Prerequisites

- The shaft must be fully coupled.
- The generator and turbine bearing caps in the load compartment must be fully installed.
- The condition of the shaft at the Shaft Grounding Assembly installation location must be documented by photo or video. If the shaft is still rotating, use a strobe to capture a video of the shaft condition. To facilitate a robust electrical contact for the shaft grounding system, make sure that the shaft surface is free of grooving, pitting, oxidation, and contamination.

ELECTRICAL DANGER

Before working on the generator, de-energize, lock out, and tag out all power sources to the generator, shaft, and accessory devices. Electric shock and death may result due to failure to heed this warning.

5. Installation Strategies

Determine the best component locations for your installation by applying the following strategies.

5.1. Determining a Ground Conductor Termination Location

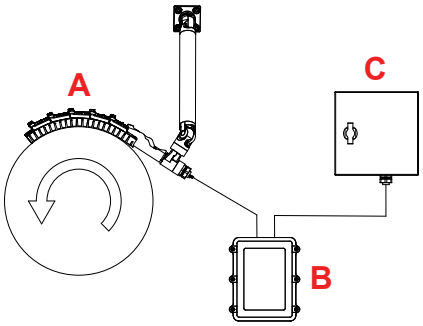
The goal when choosing a grounding location is to electrically bond the shaft to the unit case. Cutsforth suggests drilling and tapping into the lower half of the unit case to create a grounding location close to the Shaft Grounding Assembly. The location at which the ground wire will terminate should have all paint removed and should be free of all contaminants in order to create a smooth, conductive surface. Structural steel and station ground are examples of unacceptable grounding locations. It is important to note that it is not necessary for the ground conductor to be grounded to an existing generator grounding pad.

5.2. Identifying an Accessible and Safe Mounting Location

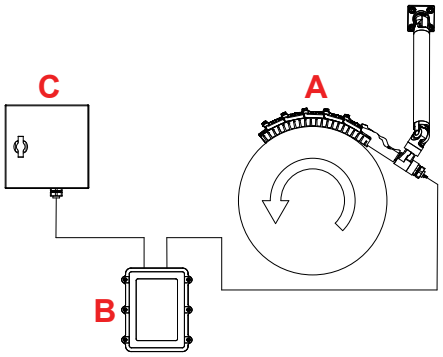
The enclosure and the junction box must be installed on the same side of the shaft as the Shaft Grounding Assembly. This helps shorten the overall length of the ground run considerably. Installing the enclosures on the opposite side of the shaft can be acceptable if it allows for a significantly safer, more ergonomic solution, provided that the total ground conductor run length can be kept within the distance requirements. Because the ground conductor must run through the junction box prior to routing to ground, the junction box should be installed between the Shaft Grounding Assembly and the ground location to accommodate a short ground run.

The Remote Meter Point should be placed in a location that is safe and accessible for plant personnel. The Remote Meter Point should be placed at an ergonomic height so that plant personnel can safely and comfortably access the test points.

The following illustration shows the correct arrangement on the left.



Correct



Incorrect

A - Shaft Grounding Assembly

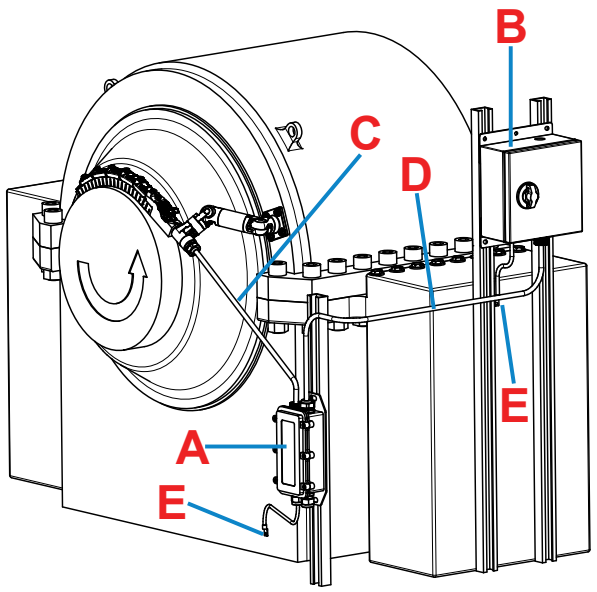
B - Junction box

C - Remote Meter Point

6. Installation

This section describes the installation of the Remote Meter Point and the junction box, and it describes the routing and termination of the signal cables and ground wires.

6.1. Installation Overview



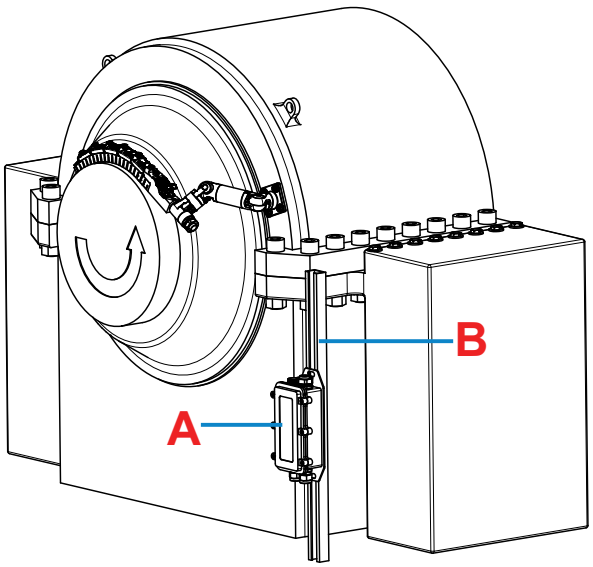
1. Mount the junction box **A** and the Remote Meter Point enclosure **B**.
2. Connect the signal cables to the junction box **C** and the Remote Meter Point **D**.
3. Connect the ground cables to unit case ground **E**.

6.2. Placement of Enclosures

The section covers the placement and mounting requirements for the junction box and the Remote Meter Point enclosure.

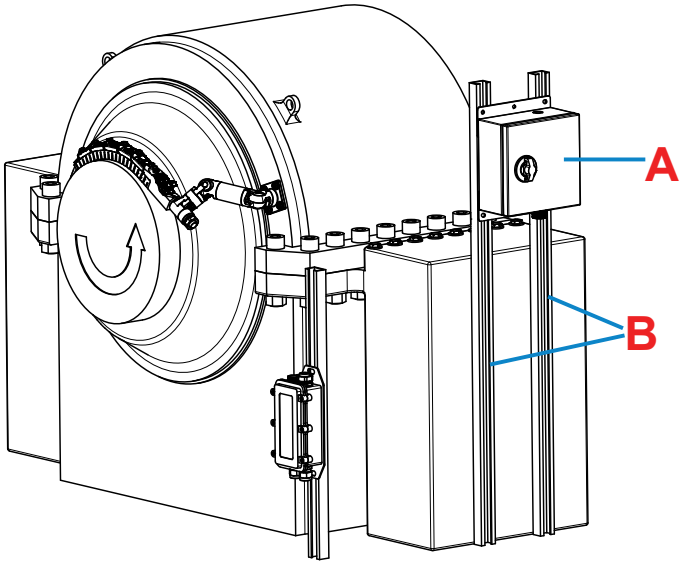
6.2.1. Junction Box (EGMA-202)

The junction box **A** requires one strut channel rail **B**. The junction box receives cable from the rope guide assembly.



6.2.2. Remote Meter Point (EGMA-203)

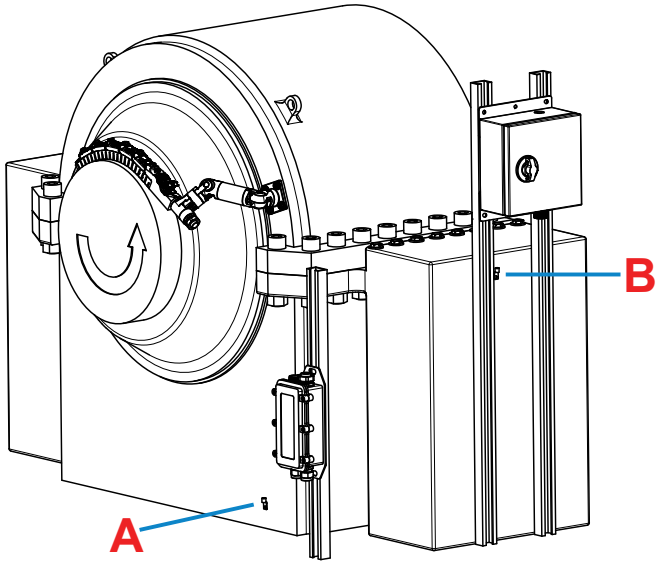
The Remote Meter Point **A** requires two strut channel rails **B**. The Remote Meter Point enclosure receives cable from the junction box.



6.3. Grounding and Signal Cables

This section describes the routing and termination of the signal cables and ground wires.

1. Drill and tap two 5/16 in - 18 holes 3/4 in deep in a suitable grounding location on the outside of the unit case to attach the grounding ring terminals (3/8 in diameter terminal). One hole is for the junction box ground **(A)**, and one is for the Remote Meter Point ground **(B)**.



2. Cut the supplied grounding and signal cable to the appropriate length to run from the Shaft Grounding Assembly to the junction box.
3. Cut the supplied 4-twisted-pair signal cable to the appropriate length to run from the junction box to the Remote Meter Point.
4. Run an 8 AWG conductor and an 18 AWG coaxial cable from the junction box and the Remote Meter Point, respectively, to the unit case grounding ring terminals.

6.3.1. Shaft Grounding Assembly Cabling Requirements

- Total ground conductor length from Shaft Grounding Assembly to unit case shall not exceed 47 ft (14.3 m).
- Signal cable length from Shaft Grounding Assembly to monitoring system shall not exceed 30 ft (9.1 m).
- Ground conductor shall not have any sharp bends or service loops anywhere in the run.

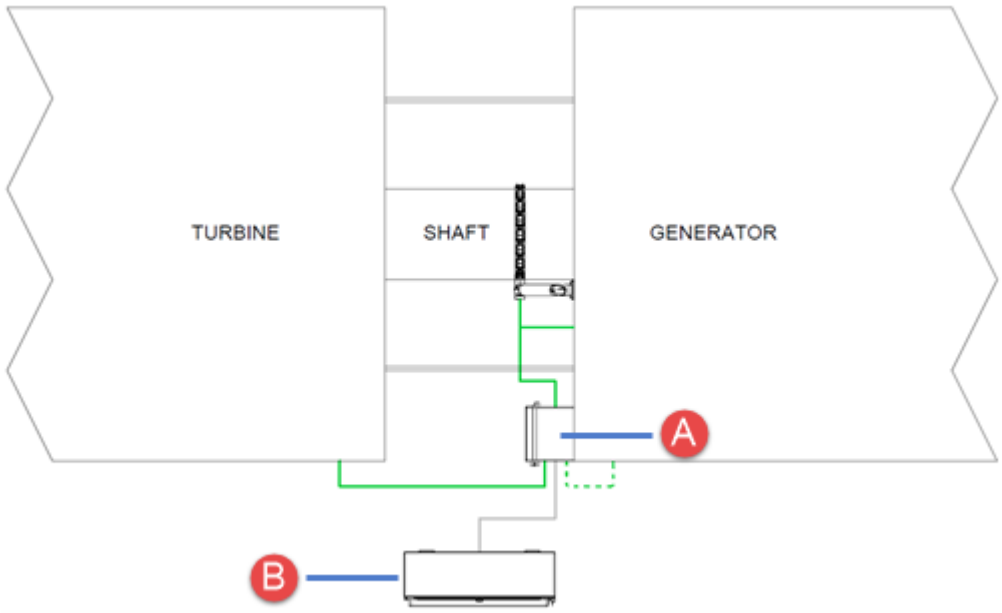
6.4. Additional Ground Wire Routing Information

The turbine case is the preferred grounding location. The ground conductor should run the shortest route possible, up to a maximum of 47 ft.

NOTE

Do not run the ground wire an excessive distance in an attempt to terminate to an existing grounding pad. A short run is the best run.

Grounding to the generator case is an alternate option that should be used if it facilitates a shorter overall ground run. However, it typically results in a much noisier ground reference and may introduce unwanted interference, especially when measuring with a handheld oscilloscope.



A Junction box

B Remote Meter Point

6.5. System Wiring

For system wiring, refer to *EGSK-201 Remote Meter Point Wiring Diagram*. This diagram represents the entire grounding system, including the Shaft Grounding Assembly, junction box, and Remote Meter Point.

6.6. Trimmer Potentiometer (Trimpot) Calibrations

You calibrate the Remote Meter Point using two trimmer potentiometers on the Remote Meter Point:

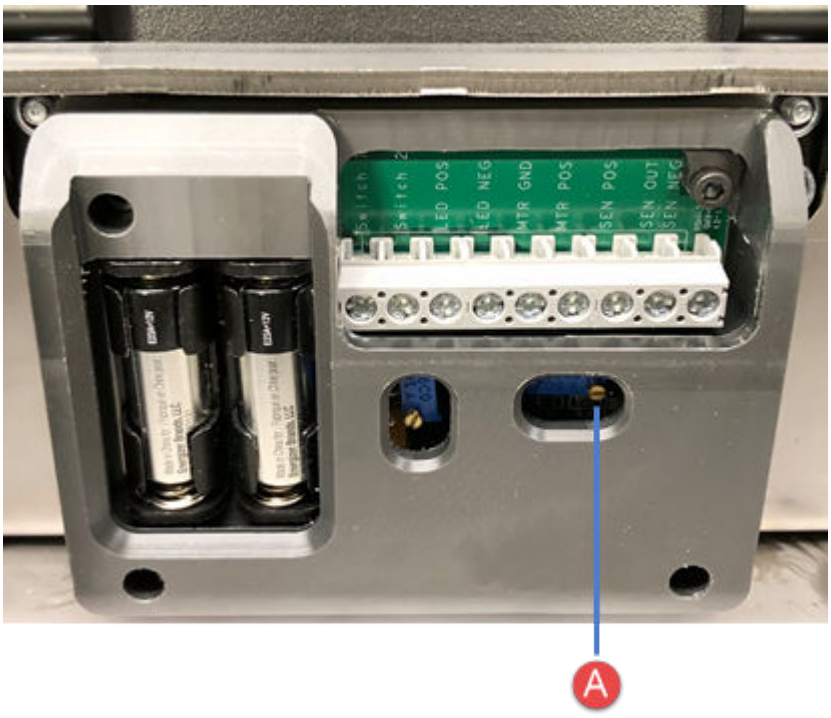
- Gain trimpot
- Calibration trimpot

6.6.1. Gain Trimpot

The gain trimpot is factory set. Do not adjust it unless specifically instructed to do so by Cutsforth Support.

To adjust the gain trimpot

1. Turn the trimpot A in any direction to the farthest extent until there is an audible click.
2. Turn the trimpot in the other direction for 15 turns and mark the position with a permanent marker or similar.



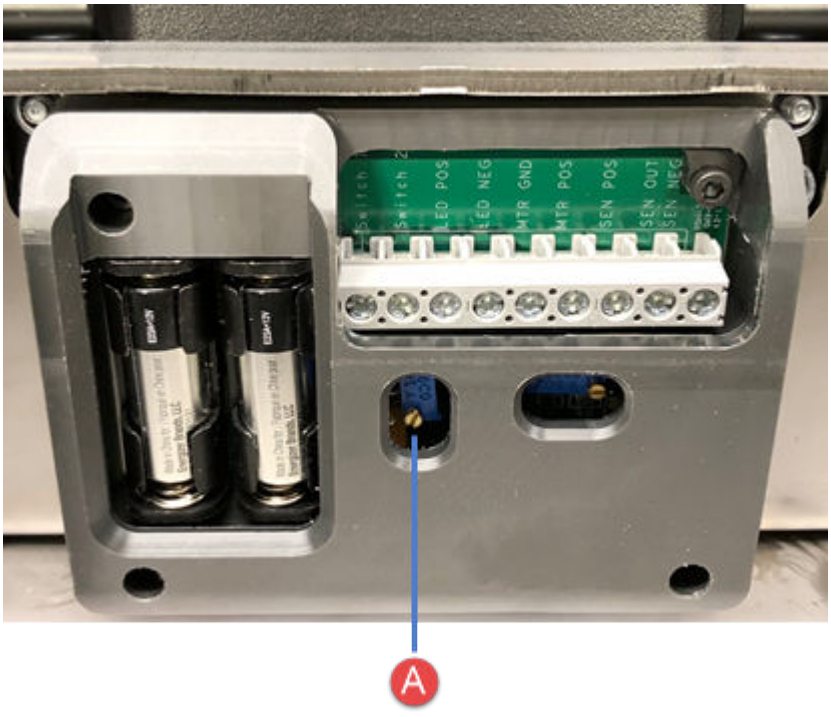
6.6.2. Calibration Trimpot

The calibration trimpot allows you to calibrate the Hall effect sensor (ground current sensor) so that it reads accurately.

To set the calibration trimpot

1. After hardware installation and all wiring is complete, remove the grounding and metering ropes from the Rope Guide Assembly so that no current is flowing through the ground conductor.
2. Activate the current sensor (push and hold the button on the Remote Meter Point faceplate) while measuring the voltage at the + CURRENT SENSOR and - CURRENT SENSOR test points.

3. Turn the trimpot (A) until the reading is as close to 0.000 V as possible.



On a meter that reads two decimal places, a reading of 0.00 V should be attainable, but on a meter that measures to three places (0.000) it may not be possible to adjust all the way to 0.000 V. +/- 0.009 V or less is acceptable.

6.7. Shaft Grounding Continuity Test

Perform this procedure to confirm the proper wiring of the junction box and Remote Meter Point.

1. Remove ropes from the Shaft Grounding Assembly. See *Removing a Rope* in the *EZDP-2035 Shaft Grounding Assembly Installation Manual*.
2. Check that continuity exists between the Remote Meter Point panel ground points and turbine ground.
3. Check that continuity exists between the Remote Meter Point panel shaft voltage test point and the metering rope.
4. Install ropes into the Shaft Grounding Assembly. See *Installing a Rope* in the *EZDP-2035 Shaft Grounding Assembly Installation Manual*.
5. Measure the resistance between the shaft and the case to which the ground connection is made and confirm it is less than 1 ohm.

7. Remote Meter Point Operation

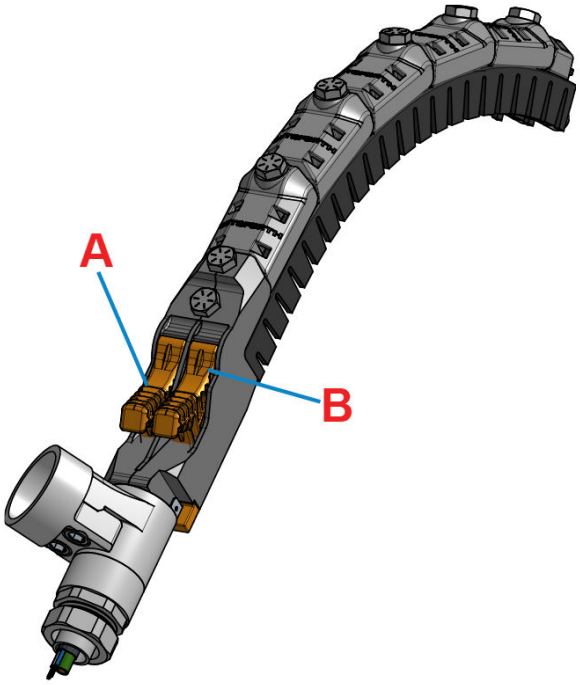
With the Remote Meter Point, you can easily measure shaft voltage and ground current. You can also test for a worn rope.

ELECTRICAL DANGER

Only qualified electrical personnel should take measurements at the remote test points. For any of the test points on the faceplate, use a hand-held voltmeter, oscilloscope, clamp-on ammeter, or other appropriate testing device. Always follow proper electrical safety procedures.

A - Ground rope

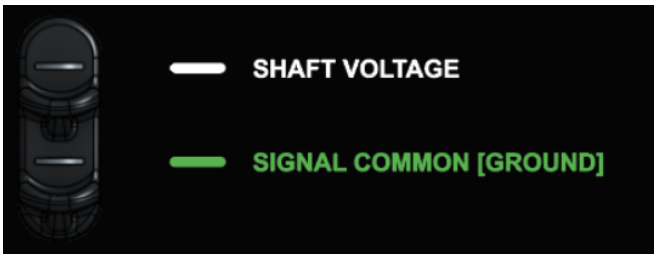
B - Meter rope (connected to High-Frequency Drain)



7.1. Shaft Voltage Test Point

To read the shaft voltage

Place the positive and negative probes of an oscilloscope or digital voltmeter on the SHAFT VOLTAGE and SIGNAL COMMON [GROUND] test points, respectively.

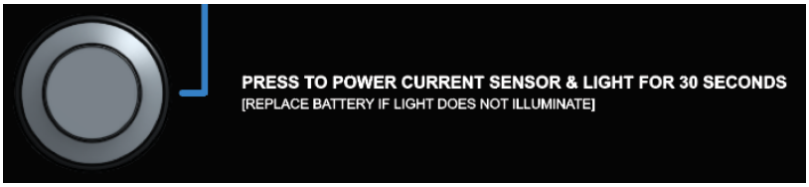


The resulting voltage or waveform read at this point represents the shaft voltage at the metering rope location.

7.2. Rope Wear Indicator LED

To test for a worn rope

Press the button at the bottom of the faceplate to illuminate the rope wear indicator LED at the center of the faceplate:



- If the LED illuminates green, the ropes are not yet in need of replacement.
- If the LED illuminates red, one or both of the ropes is worn to the point of needing replacement.

7.3. Ground Current Test Point

To measure current flowing to ground from the shaft

1. Set an oscilloscope or digital voltmeter to measure in the mV scale.
2. Press the button at the bottom of the faceplate to power the current sensor, then place the positive and negative probes on the CURRENT SENSOR + and - test points, respectively.

Use the conversion 100 mV = 1 Amp to convert the read voltage to current, or refer to the following table.

Meter Reading (V)	Associated Current (A)
0	0
2.5	25
5	50
7.5	75
10	100

8. Glossary

Assurance Monitoring System	A Cutsforth product that connects to Cutsforth's Shaft Grounding Assembly to provide shaft voltage and ground current readings on a touchscreen display. It can also be connected to plant DCS systems for real-time data in the control room.
attenuation	The reduction of the amplitude of a signal due to excessive cable length.
AWG	American Wire Gauge
DC	Direct Current
DCS	Distributed Control System
FEP	Fluorinated Ethylene Propylene (high-temperature cable jacket material)
ground conductor	An 8 AWG ground conductor that runs from the Shaft Grounding Assembly to the junction box, then to unit case ground.
ground current	The electrical current between the shaft and the unit case ground through the ground conductor.
ground rope	The left rope in the shaft grounding assembly, which provides the primary path to unit case ground through the 8 AWG ground conductor.
High-Frequency Drain (HFD)	A 12 AWG conductor that splits off from the meter rope, runs through a low-inductance resistor, and then connects to unit case ground in less than 4 ft 6 in (1 m 15 cm). The HFD ensures that high frequency voltage spikes are grounded properly.
impedance	The resistance to change in the current of a circuit.
junction box	An enclosure that contains the current-sensing equipment and is placed between the Shaft Grounding Assembly and the grounding location.
LOTO	Lock-out, tag-out
meter rope	The right rope in the shaft grounding assembly, which provides a shaft contact point at which shaft voltage readings are taken. It also

	provides a secondary path to unit case ground through the High-Frequency Drain.
RMS	
rope refresh kit	A rope assembly that can be used as a ground rope or a meter rope.
Shaft Grounding Assembly (SGA)	A Cutsforth product designed to provide a best-in-class ground connection, as well as a shaft contact point at which shaft voltage can be measured.
shaft voltage	The voltage potential between the shaft and the unit case ground as measured by the metering rope.
signal cable	A shielded, twisted-pair cable that carries voltage signals from the Shaft Grounding Assembly to the junction box and the Assurance Monitoring System.
TC/TC-ER	Ratings that describe the crush and impact requirements for cable types. For more information, see *Type TC vs. Type TC-ER Cable* at http://www.ecmweb.com/nec/type-tc-vs-type-tc-er-cable.
unit	The equipment being monitored by the Cutsforth monitoring system.
unit case ground	The lower half of the turbine case, generator case, or coupler case near the Shaft Grounding Assembly to which the shaft can be grounded.
zero-to-peak	A measurement of a signal determined by the maximum absolute value amplitude of the signal over a given time frame.

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nqa. ISO 9001 Registered Quality Management

ANAB ACCREDITED ISO/IEC 17021 MANAGEMENT SYSTEMS CERTIFICATION BODY

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General Sales Inquiries
Cutsforth.com/Sales
800.290.6458 x. 1
info@Cutsforth.com