INSTALLATION MANUAL

Premium Monitoring System

Document #: EZDP-2041

CUTSFORTH

THE POWER OF INNOVATION™

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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

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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.

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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 Assurance Monitoring System

This manual describes the installation and operation of the Cutsforth Assurance Monitoring System.

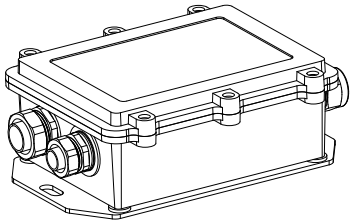
If this system is replacing an OEM system, see the documentation that came with the OEM system for instructions on how to remove it.

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.

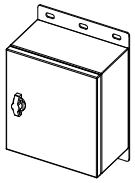
4.1. Components

The following parts are included in the Assurance Monitoring System installation package:



1 Junction box

Part number: EGMA-202



1 Assurance Monitoring System

Part number: EGMA-301

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

To most effectively ground your generator and minimize the effects of inductance on the 8 AWG ground conductor, it is imperative that the ground conductor take the shortest, most direct route from the Shaft Grounding Assembly to the unit case ground location.

When it comes to the ground conductor, shorter is always better. Cutsforth requires the total run length of the ground conductor (from the Shaft Grounding Assembly to the junction box, to unit case ground) to be as short as possible, with a maximum length of 47 ft. Cutsforth recommends the installation of a High-Frequency Drain on any installation with a ground run greater than 5 ft. The purpose of the High-Frequency Drain is to combat the effects of impedance on the ground wire. The High-Frequency Drain does this by dissipating the high-frequency transient voltage spikes through a short ground run with an inline 1-ohm resistor.

It is not necessary for the ground conductor to be grounded to an existing generator grounding pad. A generator grounding pad is often not the ideal ground location, as it requires a longer ground conductor run. The goal when choosing a grounding location is to electrically bond the shaft to the unit case ground. Cutsforth suggests drilling and tapping into the lower half of the unit case to create a grounding location closer to the Shaft Grounding Assembly. The location at which the ground wire will be terminated should have all paint removed and should be free of all contaminants in order to create a smooth, conductive surface.

After you determine the grounding location, you can install the junction box directly between the grounding location and the Shaft Grounding Assembly. Structural steel and station ground are examples of unacceptable grounding locations.

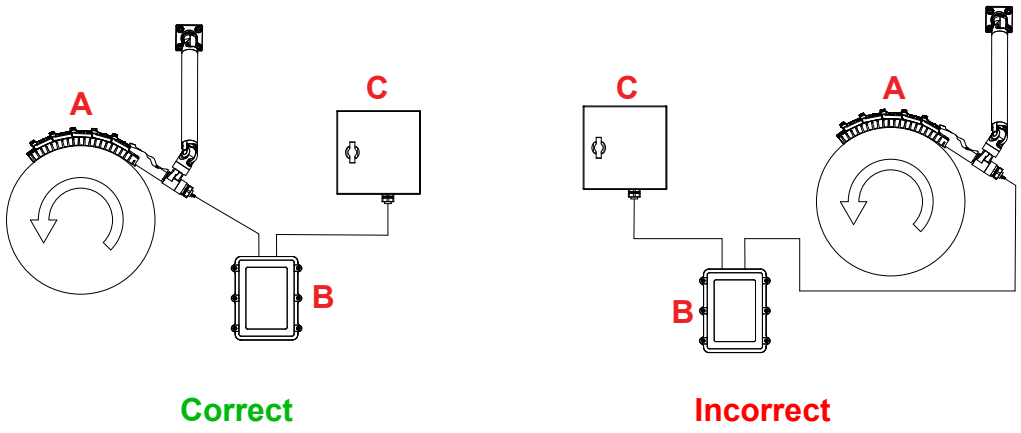
5.2. Identifying an Accessible and Safe Mounting Location

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 Assurance Monitoring System contains an interactive touchscreen display and should be placed in a location that is safe and accessible for plant personnel. The Assurance Monitoring System 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

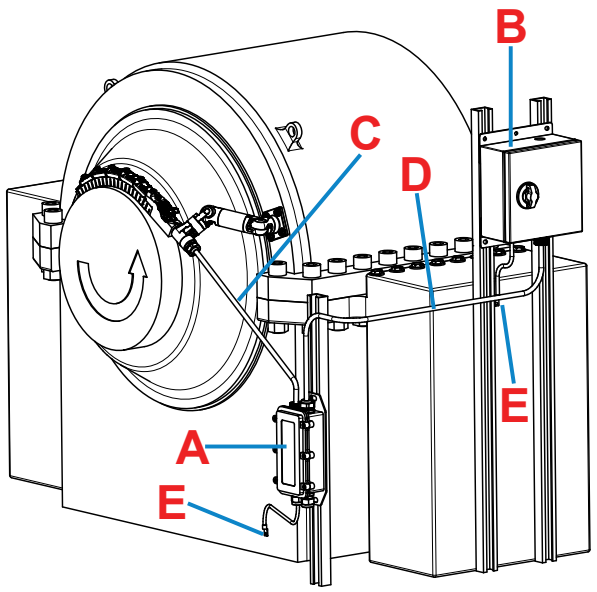
B - Junction box

C - Assurance Monitoring System

6. Installation

This section describes the installation of the Assurance Monitoring System and the junction box, and it describes the routing and termination of the signal cables and ground wires.

6.1. Installation Overview



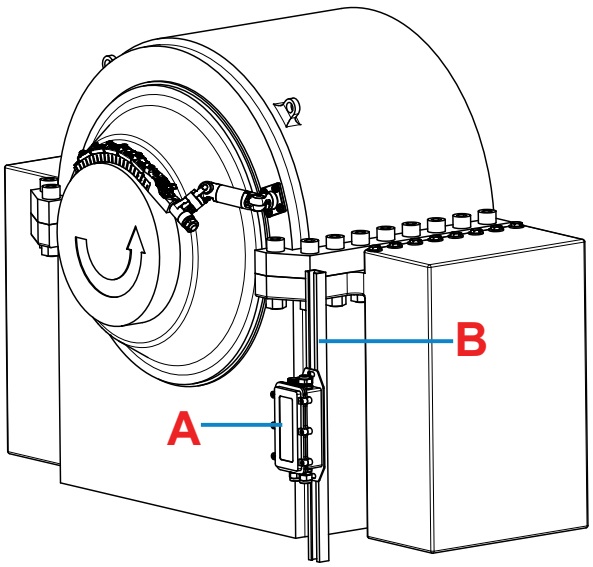
1. Mount the junction box **A** and the Assurance Monitoring System enclosure **B**.
2. Connect the signal cables to the junction box **C** and the Assurance Monitoring System **D**.
3. Connect the ground cables to unit case ground **E**.

6.2. Placement of Enclosures

The section covers the placement and mounting requirements for the junction box and the Assurance Monitoring System enclosure.

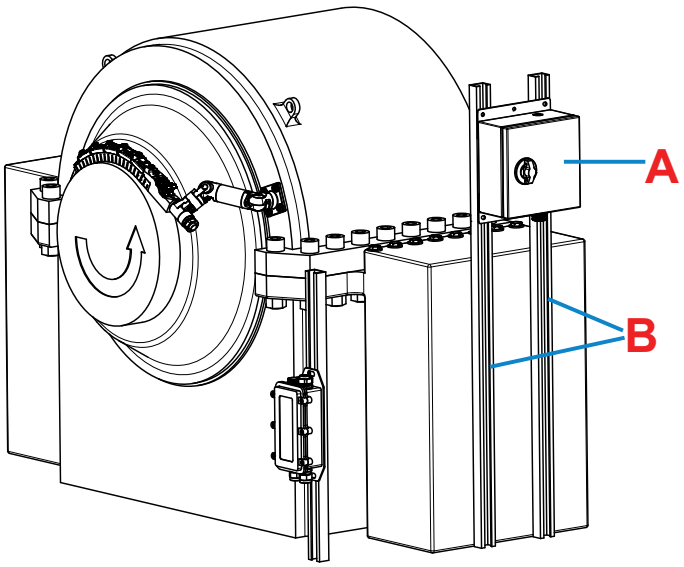
6.2.1. Junction Box (EGMA-202)

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



6.2.2. Assurance Monitoring System (EGMA-301)

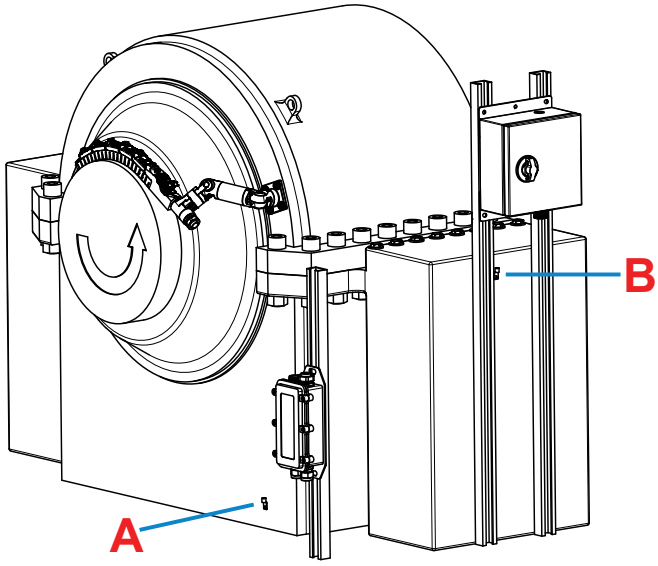
The Assurance Monitoring System **A** requires two strut channel rails **B**. The Assurance Monitoring System enclosure receives cable from the junction box.



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 Assurance Monitoring System 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 Assurance Monitoring System.
4. Run an 8 AWG conductor and an 18 AWG coaxial cable from the junction box and the Assurance Monitoring System, 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.

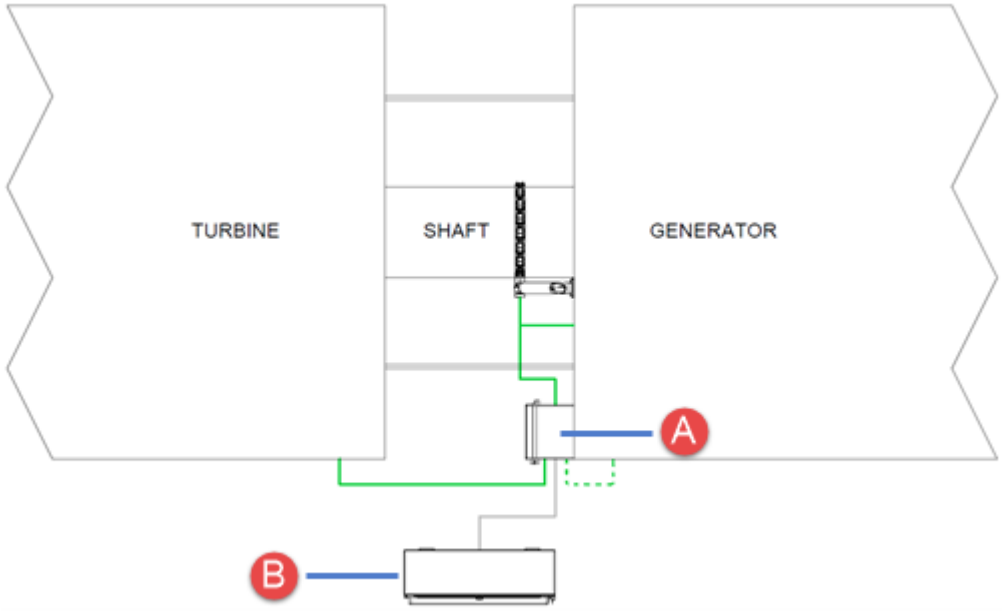
6.4. Additional Ground Wire Routing Information

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 Assurance Monitoring System

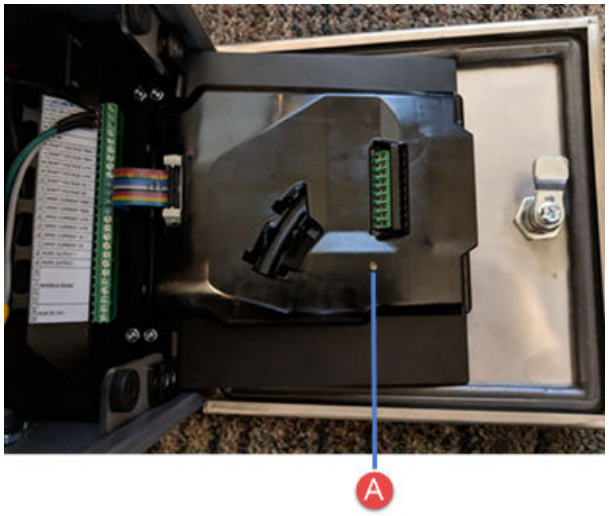
6.5. System Wiring

For system wiring, refer to *EGSK-301 Assurance Monitoring System Wiring Diagram*. This diagram represents the entire grounding system, including the Shaft Grounding Assembly, junction box, and Assurance Monitoring System.

6.6. Hall Effect Current Sensor (Trimpot) Calibration

After hardware installation and wiring is complete, perform this calibration procedure. Repeat it on a yearly basis during outage.

1. Remove the grounding and metering ropes from the Shaft Grounding Assembly so that no current is flowing through the ground conductor.
2. While looking at the ground current DC reading on the Assurance Monitoring System display, turn the trimpot **(A)** until the reading is as close to 0.00 amps as possible. +/- 0.1 amps or less is acceptable.



6.7. Shaft Grounding Continuity Test

Perform this procedure to confirm the proper wiring of the junction box and Assurance Monitoring System.

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 Assurance Monitoring System panel ground points and turbine ground.
3. Check that continuity exists between the Assurance Monitoring System 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. Assurance Monitoring System Operation

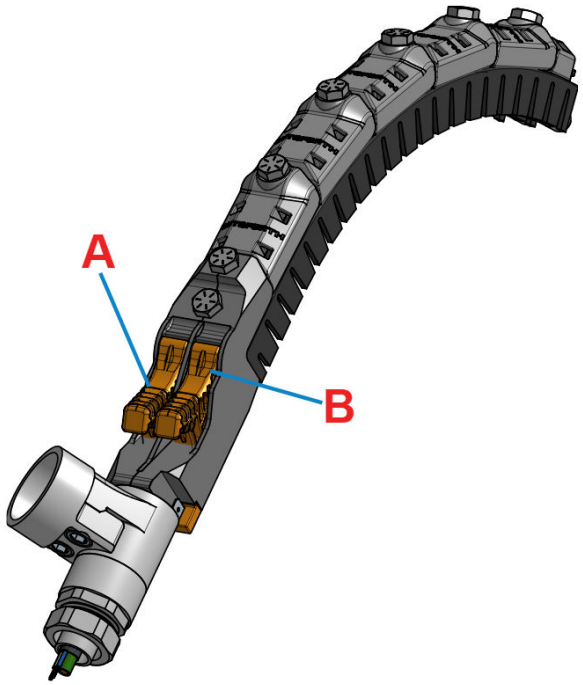
With the Assurance Monitoring System, you can view real-time shaft voltage and ground current readings and receive worn rope warnings. You can also access test points for shaft voltage, ground current, and rope wear.

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.

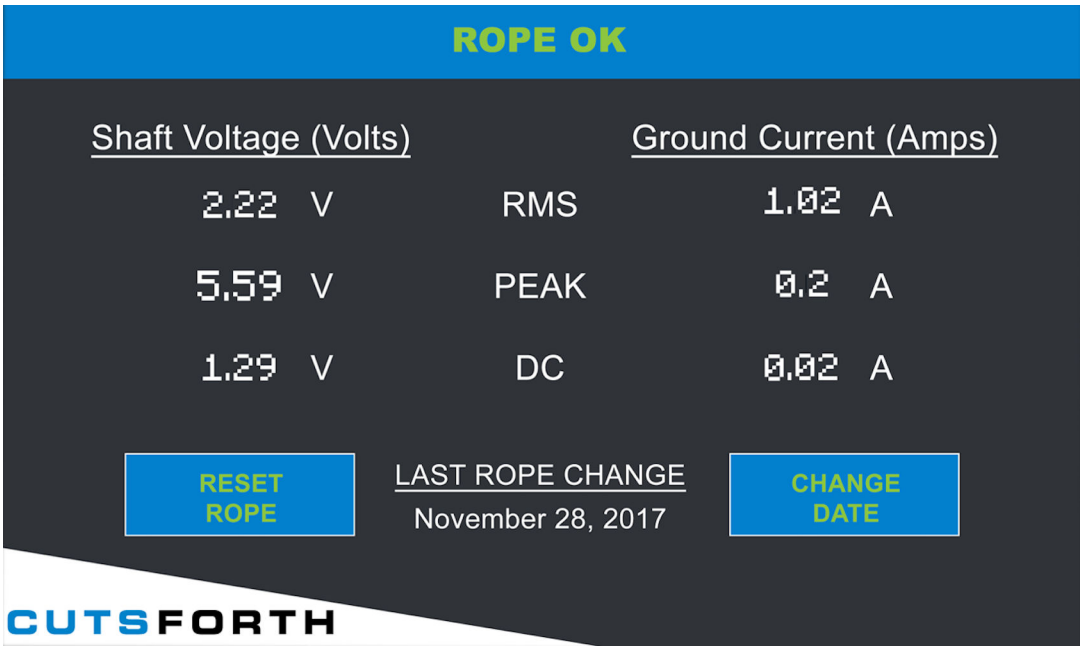
A - Ground rope

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

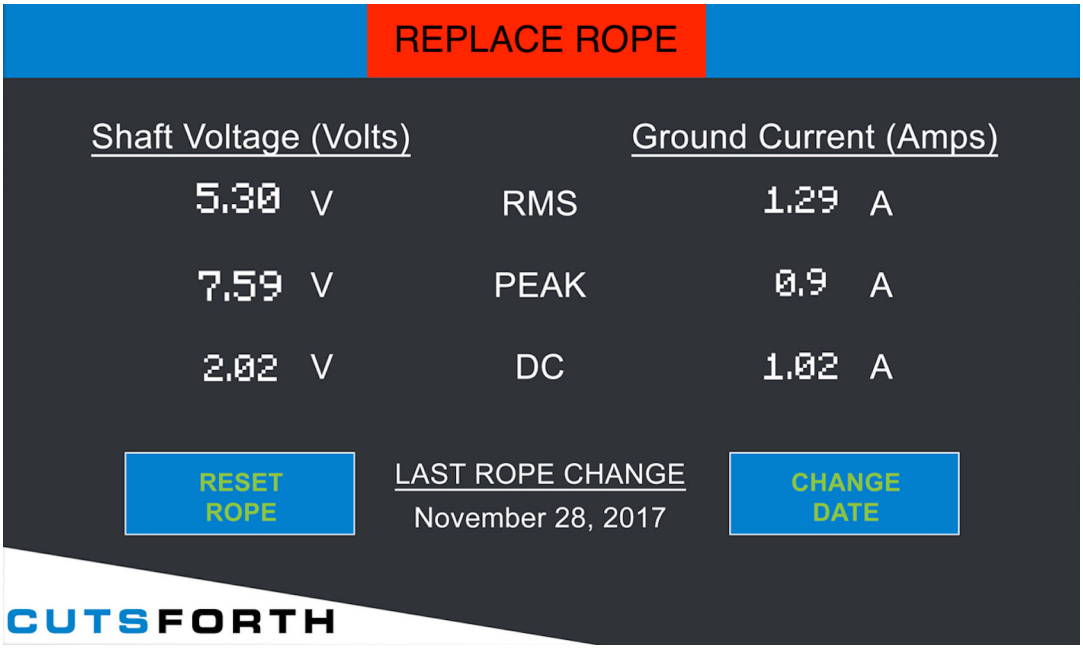


7.1. Display

The Assurance Monitoring System contains a 5 in touchscreen interface that displays real-time shaft voltage and ground current readings.



When the system senses a worn rope, it displays a red REPLACE ROPE alert indicating that it is time to replace the ropes.



After replacing ropes

1. Press RESET ROPE to clear the alert on the system.
2. Enter the date on which the ropes were replaced by pressing CHANGE DATE.

7.2. Shaft Voltage Test Point

The + and - shaft voltage test points connect directly to the following points:

- + is the isolated meter rope on the shaft.
- - is case ground.

To read the shaft voltage

Place the positive and negative probes on the Shaft Voltage "+" and "-" test points, respectively.

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

7.3. Rope Wear Indicator Test Point

The rope wear indicator test points are connected to the rope status circuitry.

To test for rope wear

1. Set an oscilloscope or digital voltmeter to read DC voltage.
2. Place the positive and negative probes on the Rope Wear Indicator "+" and "-" test points, respectively.
   - A reading between 4.8 V and 5.1V DC indicates that the ropes are in good condition and not in need of replacement.
   - A reading of 0 V DC or fluctuating DC voltages below 4.8 V DC indicate that the ropes should be inspected and the worn rope should be replaced.

After replacing ropes

1. Press RESET ROPE to clear the alert on the system.
2. Enter the date on which the ropes were replaced by pressing CHANGE DATE.

7.4. Ground Current Test Point

The ground current test points are connected to the Hall effect sensor drivers.

To measure current flowing to ground from the shaft

1. Set an oscilloscope or digital voltmeter to measure in the mV scale.
2. Place the positive and negative probes on the Ground Current + and - test points, respectively.
3. Refer to the following table to interpret that voltage reading as an associated current value.

Meter Reading (V)	Associated Current (A)
0	0

Meter Reading (V)	Associated Current (A)
0.03	1
0.06	2
0.15	5
0.30	10

8. 4–20 mA Lines

The 4–20 mA output connection points are located inside the Assurance Monitoring System enclosure. The terminal strips are labeled to indicate which signal pair is carried at each terminal connection point.

Shaft V RMS		Shaft V 0-Pk		Shaft V DC		Gnd I RMS		Gnd I 0-Pk		Gnd I DC		Rope Status	
BK	WT	BK	WT	BK	WT	BK	WT	BK	WT	BK	WT	BK	WT
+	-	+	-	+	-	+	-	+	-	+	-	+	-

8.1. DCS Programming: Interpreting Output Values

The 4–20 mA outputs are intended to be used with a plant DCS. Refer to the following seven tables when programming.

8.1.1. Channel 0: Shaft Voltage RMS

- Measurement Range: 0–50 V RMS
- 4–20 mA Scale: 1 mA = 3.125 V RMS

Shaft Voltage RMS (V)	4–20 mA Output
0	4
12.5	8
25	12
37.5	16
50	20

8.1.2. Channel 1: Shaft Voltage 0-Pk

- Measurement Range: 0–200 V 0-Pk
- 4–20 mA Scale: 1 mA = 12.5 V 0-Pk

Shaft Voltage 0-Pk (V)	4–20 mA Output
0	4
50	8
100	12
150	16
200	20

8.1.3. Channel 2: Shaft Voltage DC

- Measurement Range: -25–25 V DC
- 4–20 mA Scale: 1 mA = 3.125 V DC

Shaft Voltage DC (V)	4–20 mA Output
-25	4
-12.5	8
0	12
12.5	16
25	20

8.1.4. Channel 3: Ground Current RMS

- Measurement Range: 0–30 A RMS
- 4–20 mA Scale: 1 mA = 1.875 A RMS

Ground Current RMS (A)	4–20 mA Output
0	4
7.5	8
15	12
22.5	16
30	20

8.1.5. Channel 4: Ground Current 0-Pk

- Measurement Range: 0 –70 A 0-Pk
- 4–20 mA Scale: 1 mA = 4.375 A 0-Pk

Ground Current 0-Pk (A)	4–20 mA Output
0	4
17.5	8
35	12
52.5	16
70	20

8.1.6. Channel 5: Ground Current DC

- Measurement Range: -30–30 A DC
- 4–20 mA Scale: 1 mA = 3.75 A DC

Ground Current DC (A)	4–20 mA Output
-30	4
-15	8
0	12
15	16
30	20

8.1.7. Channel 6: Rope Status

Measurement Range: Pass/Fail

Rope Status	4–20 mA Output
Pass	4
Fail	20

9. Modbus Serial Communication API

The Assurance Monitoring System is equipped with RS232, which enables it to send and receive data via serial communication. To allow multiple device communication, RS232 is converted into RS485 in addition to using the Modbus RTU (Remote Terminal Unit) protocol. Each device operates as a slave only. These controllers will answer to a master query only if the query contains the same slave address as defined on the device's SD card. The permitted addresses range from 1 to 254 (0x01 – 0xFE), and there should be no controllers with the same address on the same line.

9.1. Modbus RTU Protocol Features

Feature	Description
Baud-rate	19200 bit/sec, Not selectable
Format	8-bit, No parity, 1 stop
Supported functions	Read Holding Register (0x03)
Cyclical Redundancy Check (CRC)	16-bit value calculated by both devices, Error message displayed when values are not equal

9.2. Address Declarations

Modbus Address	Description	Read/Write
1001	Shaft Voltage RMS	Read Only
1002	Shaft Voltage 0-Peak	Read Only
1003	Shaft Voltage DC	Read Only
1004	Ground Current RMS	Read Only
1005	Ground Current 0-Peak	Read Only
1006	Ground Current DC	Read Only
1007	0-bit, rope status, 1 = OK, 0 = NOT_OK	Read Only

The rope status will be determined by the bit field response. This means that although the response will be in terms of 2 bytes or 16 bits, the last bit contains the status as 0 or 1. The status is indicated as: 1 = OK; 0 = NOT_OK.

9.3. Example Query

In this example, the master device sends a request to read from the slave device at address 2. The function 03 enables the device to read from a holding register. The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits. In the table below, seven register addresses will be read beginning at address 03 E9 (1001). The assigned registers 1001-1007 above will be read.

Field Name	Example (Hex)
Slave Address	2
Function	03
Starting Address Hi	03
Starting Address Lo	E9
No. of Points Hi	00
No. of Points Lo	07
Error Check (CRC)	-

9.4. Example Response

In the table below, the response from the slave device at address 2 can be seen. Again, the function 03 was utilized to read from the holding registers for each address. Since there are 7 different addresses being read at 2 bytes per address, there is a total of 14 bytes used in this example.

Field Name	Example (Hex)
Slave Address	2
Function	03
Byte Count	14
Data Hi (Register 1001)	00
Data Lo (Register 1001)	32
Data Hi (Register 1002)	00
Data Lo (Register 1002)	18
Data Hi (Register 1003)	00
Data Lo (Register 1003)	64
Data Hi (Register 1004)	00
Data Lo (Register 1004)	58
Data Hi (Register 1005)	00
Data Lo (Register 1005)	22
Data Hi (Register 1006)	00
Data Lo (Register 1006)	31
Data Hi (Register 1007)	00
Data Lo (Register 1007)	01
Error Check (CRC)	--

The contents of register 1001 is displayed as two hex values, 00 and 32 representing the decimal number 50. This value would represent the Shaft Voltage RMS value received from the device. The rest of the values were received in the same way and represent the description assigned to one of the specific addresses 1001-1006. For address 1007, the result being read back from the slave indicates the rope status and is defined by the values 0 and 1 as described in the Address Declaration section. In this case, the values 00 01 were received resulting in an OK status.

10. Technical Specifications

Enclosure	NEMA 4X rated
Operating Temperature Range	-15 to 65°C (+5 to 149°F)
Input Power Options	AC: 85–264 V AC, 47–440 Hz, 10 W DC: 20–32 V DC, 10 W
Touch Screen Display	Real time shaft voltage, ground current and rope condition: ▪ Voltage Zero to Peak: Range 0 to 200 V ▪ Current Zero to Peak: Range 0 to 70 A ▪ Voltage RMS: 0 to 50 V RMS ▪ Current RMS: 0 to 30 A RMS ▪ Voltage DC: +/- 25 V ▪ Current DC: +/- 30 A ▪ Rope Status: Pass/Fail
Rope Change Tracking	Manual input tracks date of rope change and enables operator to reset rope fault after change or inspection.
Connectivity to Plant Systems	The values measured above are transmitted to the plant historian or other management software via seven 4–20 mA channels. RMS and peak measurements: ▪ 4 mA = zero ▪ 20 mA = a full-scale reading. DC measurements: ▪ 4 mA = full-scale minus reading ▪ 20 mA = full-scale positive reading.
Accuracy	RMS and DC readings within +/-2% of source.
Frequency Response	Down 10% between 10 Hz and 100 kHz
Pulse Response	Captures pulses 10 microseconds or wider. 100 kHz or slower (based on laboratory tests with flat-topped pulses).

11. 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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