VIBROSYSTM MD/®

MFM™-100

Magnetic Flux Measuring System
Installation Manual

P/N 9409-25I1A-101

Safety Information

The following manual contains information and warnings. They must be followed in order to keep the instrument in a working condition and ensure safe operation.

Safety Symbols

	**Warning - Danger** - Identifies conditions or practices that could cause physical harm or death.
	**Caution** - Identifies conditions or practices that could result in a permanent loss of data or damage the measuring chain and/or other equipment to which it is connected.
	**Important Information** - Identifies important information, hints, and tips that must be read and applied.

Safety Precautions

**  Warning - Danger  Caution**

- **To use the described product correctly and safely, read and follow all safety instructions or warnings that appear throughout this manual.**
- **This product in intended to be used by qualified operators and maintenance personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information before using this product.**
- **Use this product only as specified in this manual or the protection provided by this product might be impaired.**
- **When in doubt that safety protection has been impaired, make this product inoperative and secure it against any unintended operation.**
- **Use caution when working with voltage levels above 30 VAC RMS or 42 VDC. These voltage levels are potential shock hazards.**
- **Follow all generally accepted safety practices and procedures when working with or around electricity.**
- **Do not use this product in wet environments.**

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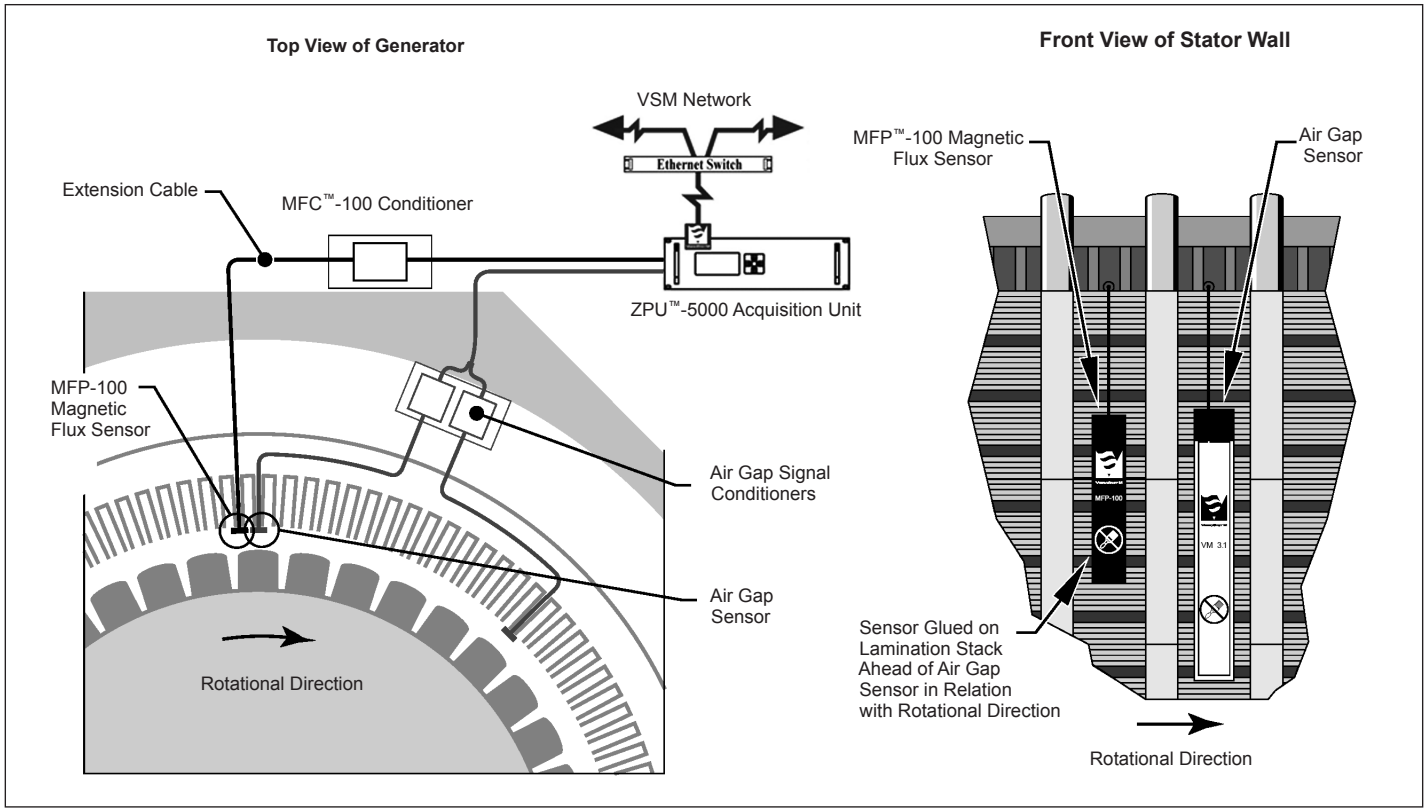
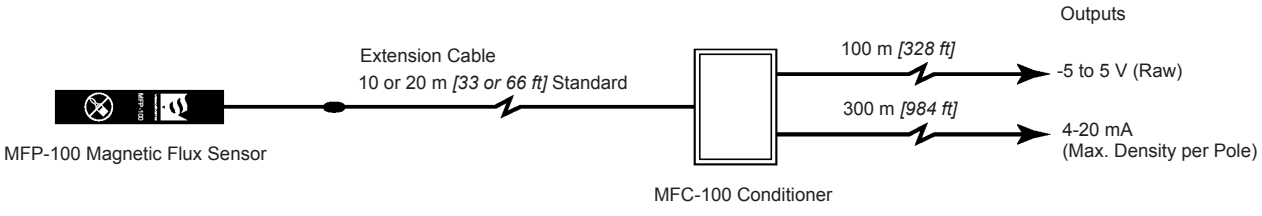
1. MFM-100 MAGNETIC FLUX MEASUREMENT SYSTEM OVERVIEW

Combined with Air Gap Measurement

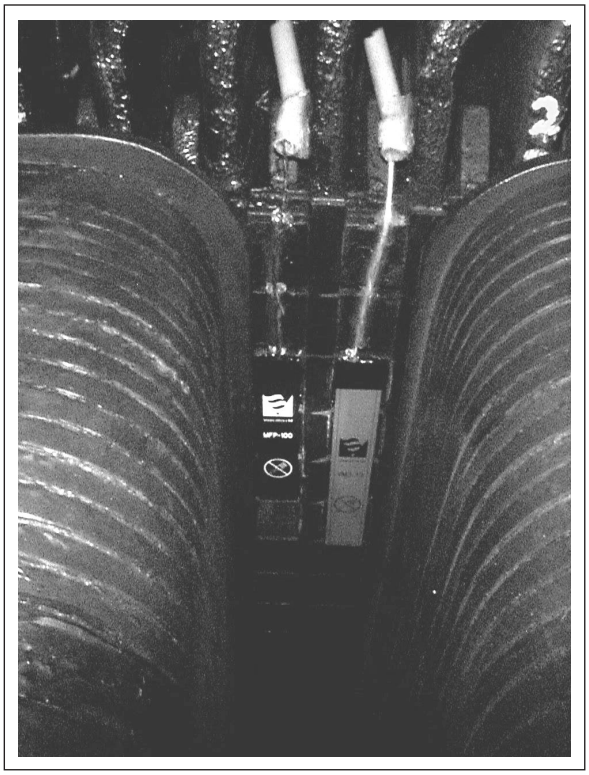


Standalone Installation



2. MFP-100 SENSOR INSTALLATION

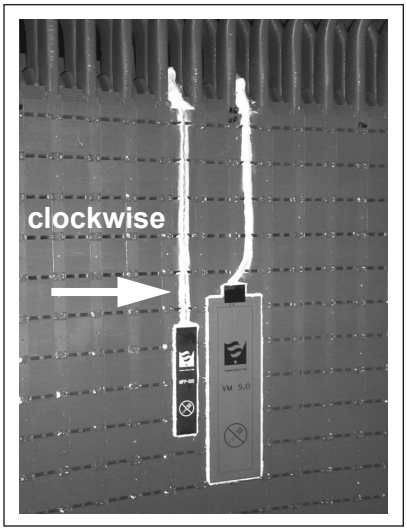
2.1 Preliminary Considerations

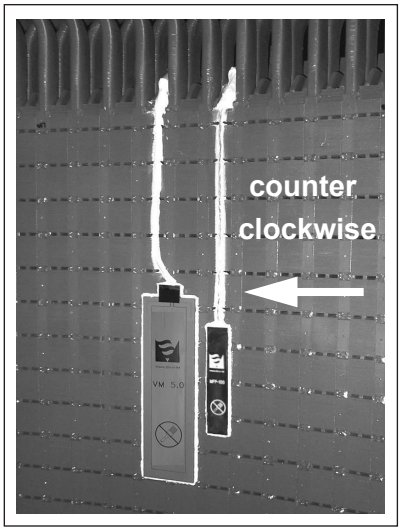


- The sensor must be glued onto the stator core laminations (stackings), beneath the second ventilation hole or lower. The MFP-100 sensor is equipped with a 50 cm *[19.7 in],* twisted-pair integral cable. This length limits the depth at which the sensor can be glued. The connector must remain outside of the air gap (on top of the stator) at all times.
- The integral cable must be secured against the stator wall.

> **⚠ Caution**
>
> Never install cables on high voltage components.

- Magnetic flux measurements are closely related to the air gap characteristics of each pole. Therefore, evaluation of a pole winding quality must also take into consideration the air gap value associated with that pole. To allow synchronization and correlation of MFP-100 and air gap sensor measurements, the MFP-100 sensor must be installed on the stator tooth immediately adjacent to the first air gap sensor, which usually is the one closest to the upstream position (0°).





Poles must always cross the magnetic flux sensor first, before the air gap sensor.

If a dual-mode (pumped storage) unit is equipped with an air gap sensor, magnetic flux measurements must take place with the unit in generating mode.

If the unit turns in a **clockwise (CW) direction**, the MFP-100 sensor will be installed to the left of the air gap sensor.

If the unit turns in a **counterclockwise (CCW) direction**, the MFP-100 sensor is installed to the right of the air gap sensor.

> **Important Information**
>
> - It is imperative that the stator surface be thoroughly cleaned prior to gluing the sensor. This step must not be neglected as sensor adherence depends on surface preparation.

Caution

- Handle the sensor with care. Never pull on the extension cable or connector.

2.1.1 Supplies Needed for Preparation and Installation

- Fine sandpaper (with non metallic particles).
- A clean, dry cloth.
- A sensor installation kit including: glue (Loctite 330) and its activator (Loctite 7387) or equivalent and silicone (RTV3145) or equivalent.

Important Information

Make sure to use a glue and activator kit that is well within its expiration date.

2.2 Stator Surface Preparation

1. After establishing sensor location, run a clean rag over the stator surface to remove oil and carbon deposits.
2. Run fine sandpaper on the stator surface, along the laminations. Make sure non-metallic paper is used.
3. After sanding, clean the stator surface again with a clean rag.

Important Information

- Since the sensor must be glued onto a flat surface, make sure none of the laminations protrudes.

2.3 MFP-100 Sensor Installation

1. If necessary, clean the rear of the sensor with a clean rag.
2. Apply glue on the sensor's rear surface and spread to a thin and even coat so it does not run down when the sensor is pressed against the stator.
3. Apply the catalyst over the glue.
4. Position the sensor on the clean surface of the stator. The top of the sensor should be placed below the second ventilation hole.
5. Slightly pivot the sensor in order to evenly spread the glue and then reposition vertically. Hold in a straight position for 60 seconds.
6. Temporarily fasten the sensor's integral cable with adhesive tape so it does not hang into the air gap or get pulled inadvertently.

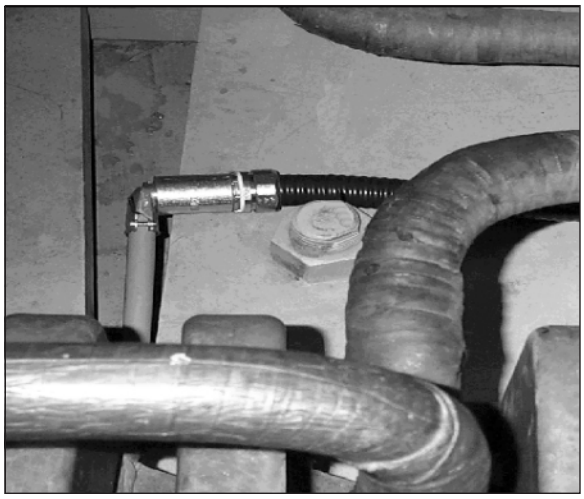
3. EXTENSION CABLE INSTALLATION

3.1 Preliminary Considerations

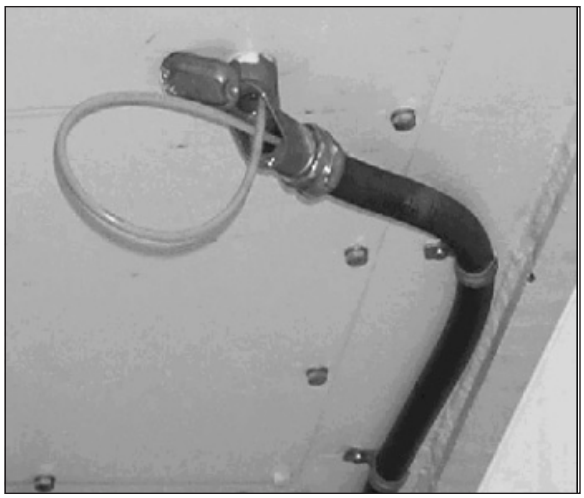
- The MFP-100 sensor connects to the MFC-100 conditioner through a twisted-pair extension cable. Installation of this cable usually follows that of the sensor.
- The extension cable is supplied in a standard length of 10 or 20 m *[33 or 66 ft]*.

Important Information

- The extension cable must be protected by a combination of a rigid or flexible conduit and heat-shrinkable tubing.



- The protective conduit runs from the protection box to the top of the stator wall near the sensor connections.
- From the stator wall to the edge of the air gap, a piece of protective tubing covers the extension cable and its connection to the sensor.
- A 90° - 3/8 elbow connects the rigid conduit to the protective tubing.



- Cable clamps must be used to secure protective tubing and conduits.

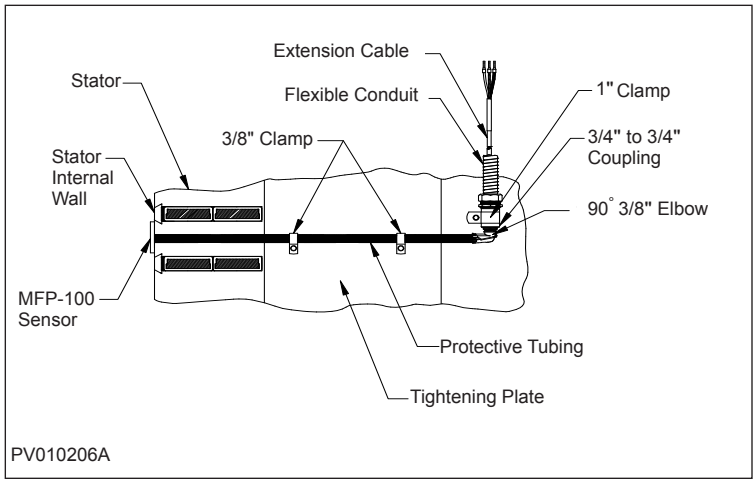
3.1.1 Supplies Required

- Extension cable
- Protective tubing
- 3/4" to 1/2" reducer
- 90° 3/8 elbow
- Watertight connector (not included)
- 3/4" to 3/4" coupling
- Heat-shrinkable tubing
- Rigid or flexible conduits (not included)
- Clamp kit

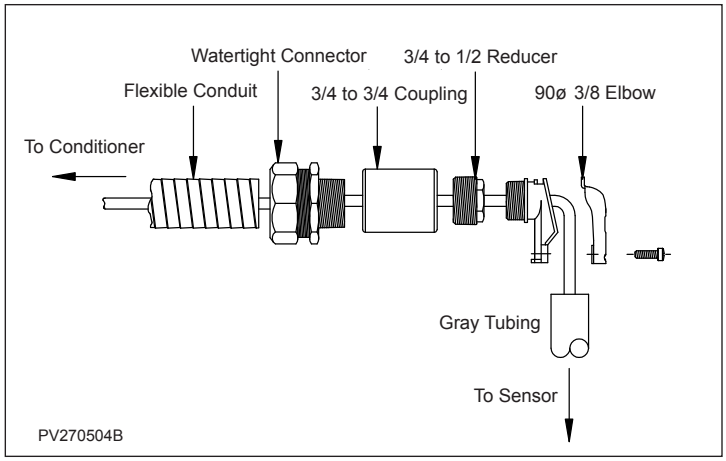
3.1.2 Tools Required

- Assorted drill bits and taps.
- Heat gun.
- Cutters or a saw for protective tubing.
- Fish tape.

3.2 Protective Conduit Installation



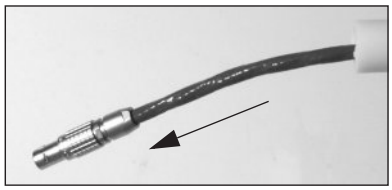
1. Determine the protective conduit's routing from the protection box to the elbow's location.
2. Install the conduit following the extension cable's planned routing. Cut the conduit to the desired length.
3. Cut a section of protective tubing to the desired length. Make sure the tubing does not stick out into the air gap. This tubing can be heated and lightly bent to adapt to the stator contour.
4. With a fish tape, carefully pull the extension cable into the conduit. Notice the cable's direction: the connector must be placed on the sensor side.



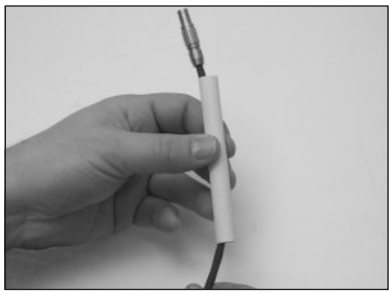
5. Assemble the elbow at the end of the flexible conduit. **Do not tighten the connection yet**.

   At the protection box side, the conduit will be terminated by a watertight connector.

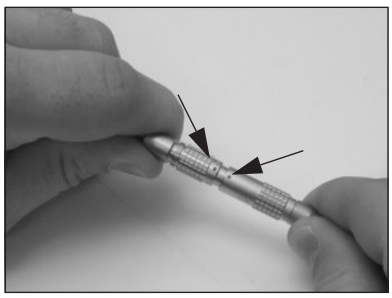
3.3 Extension Cable Connection



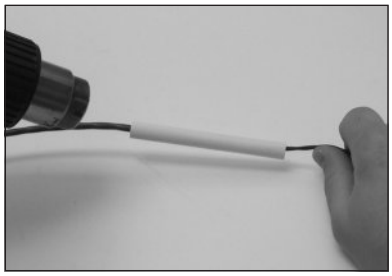
1. Insert the extension cable into the installed plastic tubing. Allow a sufficient length of cable protrude from the tubing to ease the connection.



2. Slide the heat-shrinkable tubing over the extension cable beyond the connector.

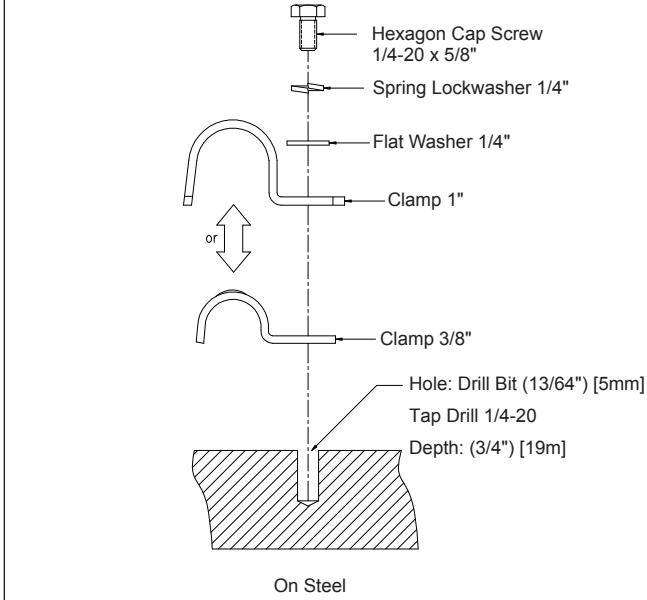


3. Attach the extension cable connector to the sensor connector. Align the red dots and push until the connectors clip together.



4. Slide the heat-shrinkable tubing over the connection and heat with a heat gun.

Important Information
The heat-shrinkable tubing must cover the entire connection to provide proper insulation and secure the connection.

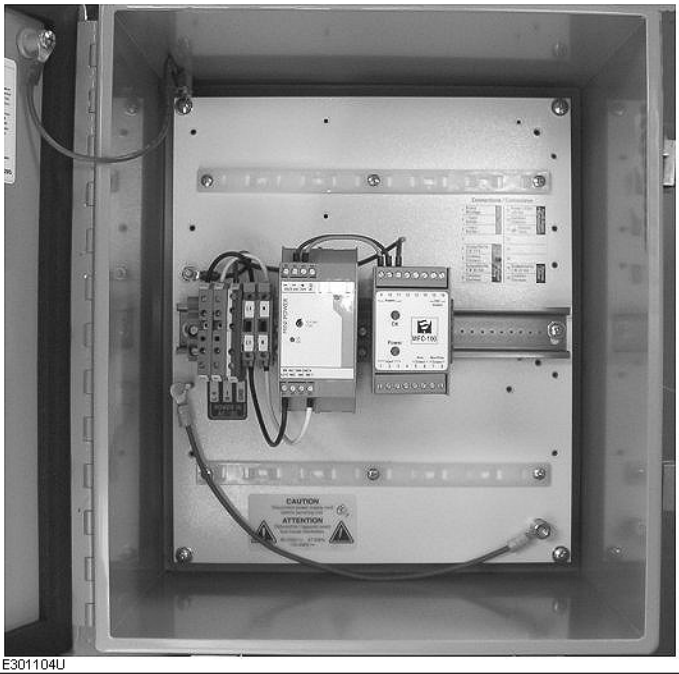


5. Pull gently on the cable to straighten it inside the protective tubing and conduit, and then tighten firmly the various parts of the elbow. In the final assembly, the protective tubing must be securely clamped inside the elbow. Clearly label the end of the extension cable connecting to the conditioner with the number and angular position of the sensor.
6. Use the clamp kit to secure the protective tubing and elbow assembly firmly against the installation surface. Drill holes and secure the protective tubing and coupling as shown in section **3.2 Protective Conduit Installation**.
7. The sensor's integral cable can now be glued and secured against the stator wall with silicone, from the top of the sensor to the edge of the protective tubing.
8. Any excess cable may be pulled back and stored inside the protection box.
9. To prevent cable deterioration and accumulation of dust and debris inside the protective tubing, apply silicone inside the tubing to form a plug.

   At this stage, sensor and extension cable installation is complete. Make sure all components are firmly secured with cable clamps.

4. MFC-100 CONDITIONER INSTALLATION

4.1 Preliminary Considerations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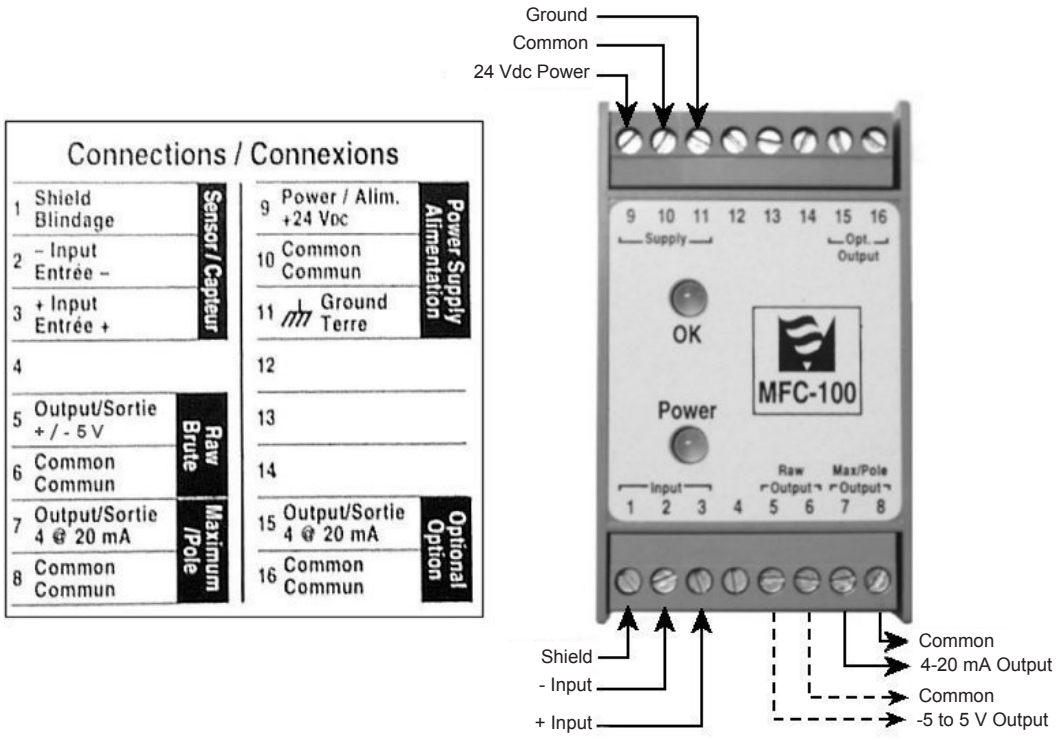
- The MFC-100 conditioner is usually pre-installed on a mounting plate along with a power supply and protected terminal blocks. Input and output signal cabling is done directly on the module, while the connection for the power supply is done through the protected terminal blocks.

- Protection box and extension cable installation for the MFP-100 sensor should be completed before proceeding with the connection of the MFC-100 conditioner.

When the module is installed separately, the power source should come from a 24VDC power supply.



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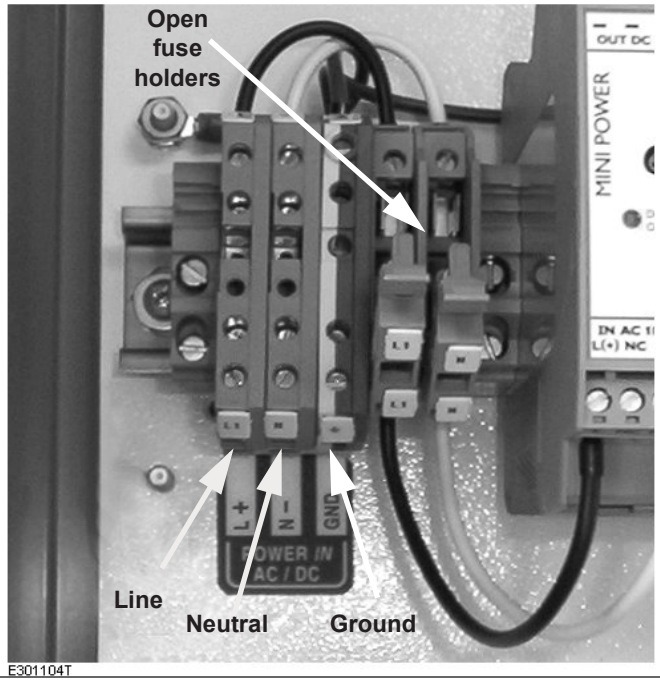
4.1.1 Tools Required

- Wire stripper
- Small flat screwdriver.

4.2 Connecting the Power Supply

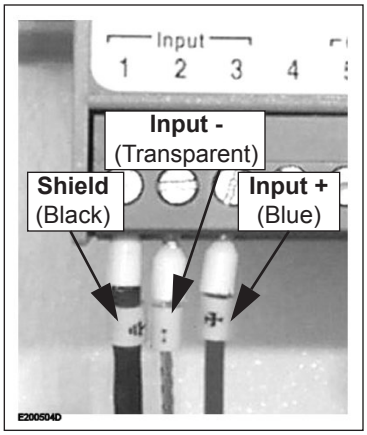
⚠ Warning-Danger

- Make sure the power is turned off at the source before connecting the power supply.



1. Open the two fuse holders.
2. Connect the power source wires to the connection terminals as shown in the illustration.

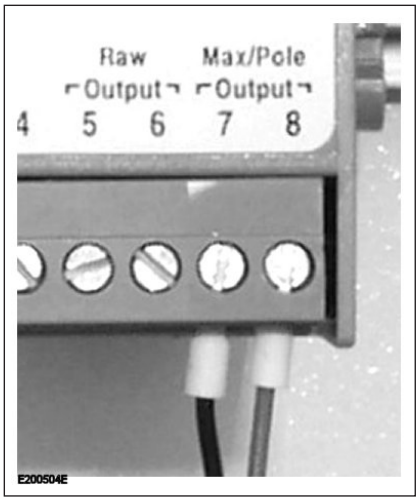
4.3 Connecting the Sensor's Extension Cable



1. Before connecting the extension cable to the conditioner, use an ohmmeter to test the resistance between the blue conductor (+) and the transparent conductor (-). If the extension cable is correctly installed, the value should read between 980 and 1030 ohms. If the value is outside this range, then check the connections on the whole length of the cable.

   Match the conductors on the extension cable with the corresponding terminals.

4.4 Connecting the Output Signal Cable

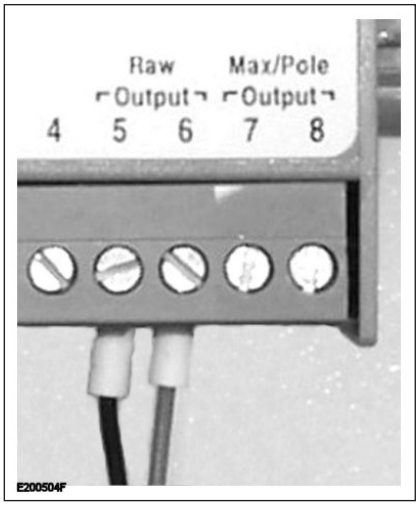


For connection of the Max/Pole output signal to an acquisition unit, use terminals 7 and 8.

Recommended cable: one shielded twisted pair 22 AWG.

Maximum length is 300 m *[984 ft]*.

The shield must be connected on the acquisition unit side only.



For connection of the raw +/- 5 V output to a meter or other instrument, use terminals 5 and 6.

Recommended cable: one shielded twisted pair 22 AWG.

Maximum length is 100 m *[328 ft]*.

The shield must be connected on the meter or other instrument side only.

5. MFM-100 MAGNETIC FLUX MEASUREMENT SYSTEM COMMISSIONING

5.1 Visual Inspection of the Measuring Chain

Sensor:

- Glued onto the stator core laminations (stackings) beneath the second ventilation hole or lower, and protected with silicone around the edges.
- When combined with air gap measurements, placed:
  - to the left of the 0° air gap sensor if the generator turns in a clockwise direction.
  - to the right of the 0° air gap sensor if the generator turns in a counter-clockwise direction.

Sensor's Integral Cable:

- Fixed to the stator with silicone.

Protective Tubing:

- Fixed with silicone on the sensor side and normally fixed to the stator plate with cable clamps on the other side.

Flexible or rigid conduit connections leading to the protection box:

- All mechanical connections are properly secured.

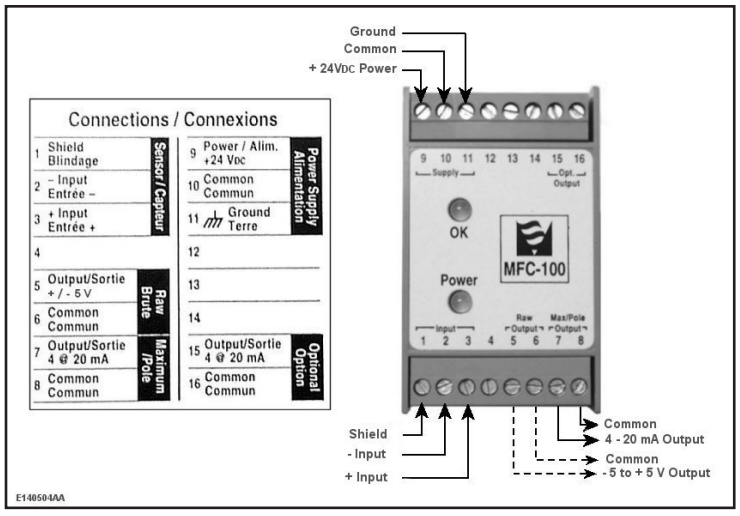
Protection Box Installation:

- The enclosure is well secured to the surface.
- The protection box is grounded to the stator frame.

Extension Cable Connected to the MFC-100 Conditioner:

- All mechanical connections are properly secured.

MFC-100 Conditioner Connections



Wiring is done according to the illustration with secure mechanical connections.

5.2 Output Signal Verification

Verify the output characteristics by applying the following transfer formulas:

Raw output (B(t)) (Tesla)

$$B(t) = V_{out}(t) / S_{RFD}$$

where $V_{out}(t)$: output voltage
t: real-time
S_{RFD}: sensitivity of raw flux density (V/Tesla)*

Max Output per pole (Bmax (x)) (Tesla)

$$B(x) = (I_{out}(x) - 4) / S_{MFD}$$

where $I_{out}(x)$: current output (in milliamperes)
x: pole number
S_{MFD}: sensitivity of maximum output per pole (mA/Tesla)*

** Refer to the MFM-100 data sheet for the applicable sensitivity value*

Important Information

- The MFC-100 conditioner adds a one-pole delay to the Max/Pole output signal. When pole X is in front of the sensor, the 4-20 mA signal transmitted by the MFC-100 conditioner is in fact the maximum value reading for the previous pole read, Pole X-1.
- VibroSystM acquisition units realign poles.