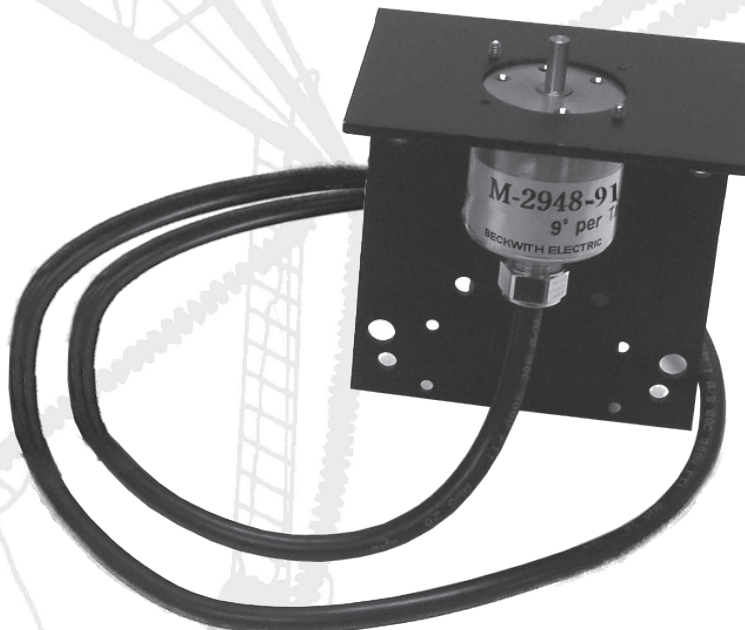


Tap Position Sensor M-2948



Shown with optional mounting bracket

- **M-2948 Tap Position Sensor directly mechanically replaces the Selsyn-Type Tap Position Sensor.**
- **Directly interfaces with a 4 to 20 mA output to the M-2025D Current Loop Interface which provides the tap position to the M-2001 Series Tapchanger Control.**
- **Rotation – 0 to 210°, 297°, 306°, 315°, 325°, 330°, 340° and 350° configurations**
- **Degrees per Tap – 9° or 10°**
- **Neutrals – 1, 2, 3, 5 or 6**
- **Rotation Direction – Tap Position Sensors are available with either a positive or negative rotation. With positive rotation, the shaft of the M-2948 rotates clockwise while raising taps. With negative rotation, the shaft of the M-2948 rotates counter-clockwise while raising taps.**

M-2948 Digital Tapchanger Control – Specification

Input

- +12 Vdc Power input supplied from the M-2025D
- M-2025D Transient protected to ANSI/IEEE C37.90.1-1989

Output

- 4 to 20 mA relative to tap position
- 2 digital outputs for mechanical calibration

Connections and Calibration

The M-2948 Tap Position Sensor is designed to operate exclusively with the M-2025D Current Loop Interface. For connections and calibration refer to the M-2025D Specification.

Options

Mounting Bracket - Part No. 441-41191

Tests and Standards

The M-2948 Tap Position Sensor complies with the following Electro Magnetic Compatibility (EMC) standards:

EN55022 (2001) Class B: Emissions Radiated 30-230 MHz: 30 Db/ μ V; 230-1000 MHz: 37 Db/ μ V

EN55024 (2003) Including:

EN61000-4-2: ESD: 8 kV Air; 4 kV Contact

EN61000-4-3: Radiated Immunity: 27 Mhz–1 Ghz, 10 V/m

EN61000-4-4: Fast Transient/Burst: 1 kV Supply, 0.5 kV Signal

EN61000-4-5: Surge Immunity: 1 kV Signal

EN61000-4-6: Conducted Immunity: 150 kHz–80 MHz 10 V emk or 16 V RMS

EN61000-4-8: Magnetic Field Immunity: 30 A/M @ 50 Hz

Atmospheric Environment

Temperature Range: -40° C to +80° C

Humidity: Operational to a maximum of 95% relative humidity

Physical

Size: Body 62.35 mm Long, 36.5 mm Wide

Shaft 12.7 mm Long, 4.76 mm Wide

Cable Length 12' (3.6 m)

Approximate Weight: 0.7 lbs

Warranty

The M-2948 Tap Position Sensor is covered by a five year warranty from date of shipment.

Specification subject to change without notice.

Application Notes

- The M-2948 Tap Position Sensor directly mounts in place of the Incon Tap Sensor Model 1292.
- The M-2948 Tap Position Sensor directly mechanically replaces the Selsyn-Type Position Sensor.
- The M-2948-91N Tap Position Sensor is for use with a Qualitrol Position Indicator, Model 081-002-01 or equivalent.

Sensor	Rotation	Degrees/ Tap	Taps	Neutrals
M-2948-91N	Negative	9°	±16	1
M-2948-91P	Positive	9°	±16	1
M-2948-92N	Negative	9°	±16	2
M-2948-92P	Positive	9°	±16	2
M-2948-93N	Negative	9°	±16	3
M-2948-93P	Positive	9°	±16	3
M-2948-95N	Negative	9°	±16	5
M-2948-95P	Positive	9°	±16	5
M-2948-11N	Negative	10°	±16	1
M-2948-11P	Positive	10°	±16	1
M-2948-12N	Negative	10°	±16	2
M-2948-12P	Positive	10°	±16	2
M-2948-13N	Negative	10°	±16	3
M-2948-13P	Positive	10°	±16	3
M-2948-16N	Negative	10°	±8	6
M-2948-16P	Positive	10°	±8	6

■ **NOTE:** Tap Position Sensors are available with either a positive "P" or negative "N" rotation. With **positive** rotation, the shaft of the M-2948 rotates **clockwise** while raising taps. With **negative** rotation, the shaft of the M-2948 rotates **counter-clockwise** while raising taps.

Table 1 Sensor Selection Information

Beckwith Electric Tap Position Sensors

Most LTC tapchangers have an output shaft on the tapchanger mechanism whose angular position is a mechanical analog of the tapchanger tap position. In many cases, the total range of tap positions is represented by less than one complete rotation of this position output shaft. The typical values of shaft movement on 33 and 35 tap mechanisms are 9° or 10° of mechanical rotation per tap position.

The tap position sensors are available in both clockwise and counter-clockwise rotation configurations for increasing tap position. They have Tap Min to Tap Max rotations of 210, 297, 306, 315, 325, 330, 340 and 350 degrees respectively for ± 8 or ± 16 taps and 1, 2, 3, 5 or 6 neutral positions. Other angular rotation values may be encountered, therefore, contact Beckwith Electric for information regarding sensor availability for specific requirements.

The tap position sensor is a rotary shaft encoder with built-in microprocessors that provide stepped output signals in 9 or 10 degree increments. The electrical output of these sensors is a 4-20 mA current loop which matches the input requirements of the Beckwith Electric M-2025D Current Loop Interface Module.

Determining the Number of Degrees Per Tap

To select a sensor with the proper output signal for the application, first determine the number of degrees of rotation between taps. On the existing mechanical tap position indicator, count the number of tap positions (including extra neutrals) that occur in 90° of the indicator dial after the center neutral. If there are 10 taps in 90°, there are 9° between taps. If there are 9 taps in 90°, there are 10° per tap. See [Figure 1](#) for example illustrations of tap position indicators. The Beckwith Electric M-2948 part number contains a "9" for 9° indicators or a "1" for 10° indicators.

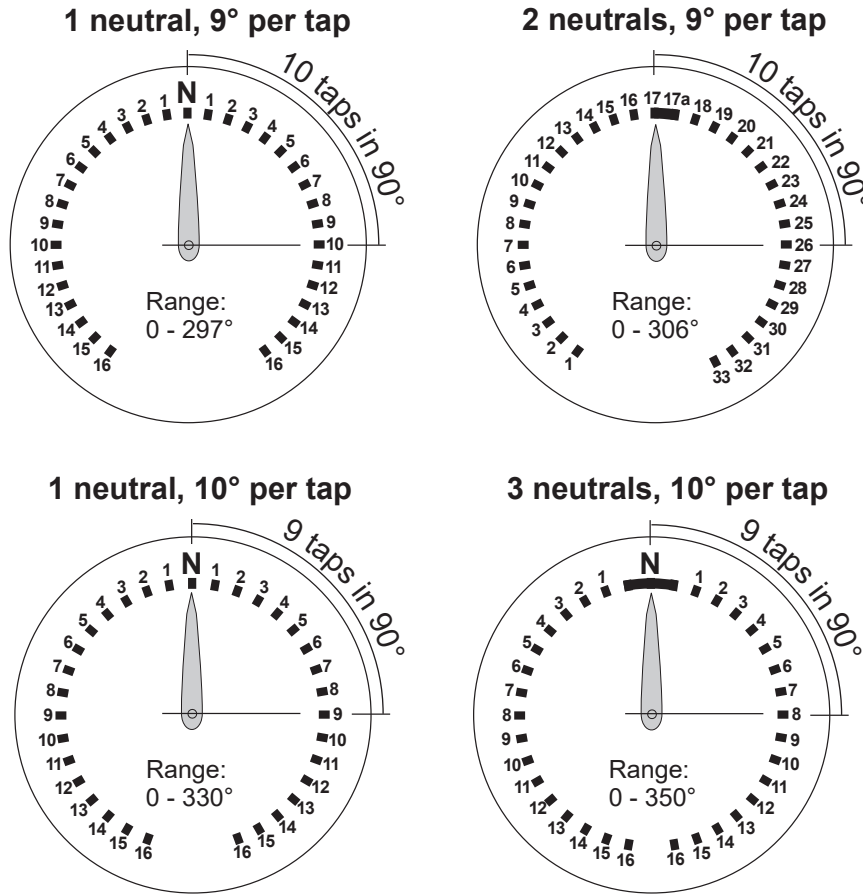


Figure 1 Examples of Determining the Number of Degrees Per Tap

Determining the Number of Neutrals

The angular range of the M-2948 input shaft also depends on the number of neutrals on the indicator because these positions add to the total number of degrees that the sensor must register. The second to the last character in the part number matches the number of neutrals as listed in the Sensor Selection Information table ([Table 1](#)).

Determining Positive and Negative Rotation

The rotation direction for the sensor input shaft is specified by the last character of the part number, either "P" for Positive or "N" for Negative. The appropriate direction for a particular installation depends on where and how the sensor will be attached to the mechanical tap position indicator.

If the sensor is not attached directly to a Geneva gear like the example in [Figure 2](#), most practical sensor input shaft attachments are either driven by a small gear or flex line driven. Some common examples are illustrated in [Figure 3](#). The rotation direction can only be selected after deciding how the sensor will be connected to the position indicator, and then determining which rotation direction will match the direction of the mechanical indicator as the tap is raised. Select "P" Positive Rotation if the sensor input shaft will rotate clockwise, select "N" Negative Rotation if the sensor input shaft will rotate counter-clockwise as the tap is raised.

Geneva Gear

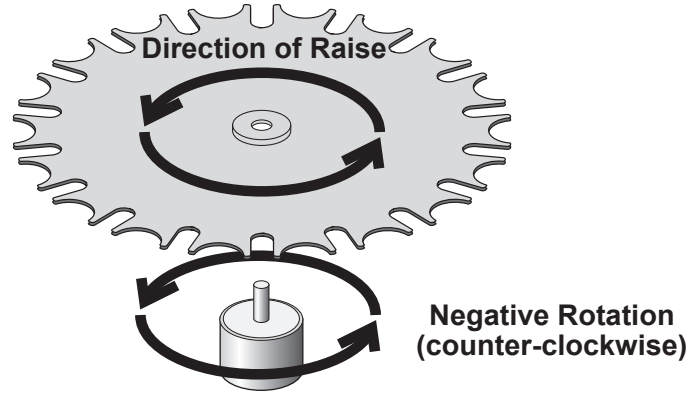
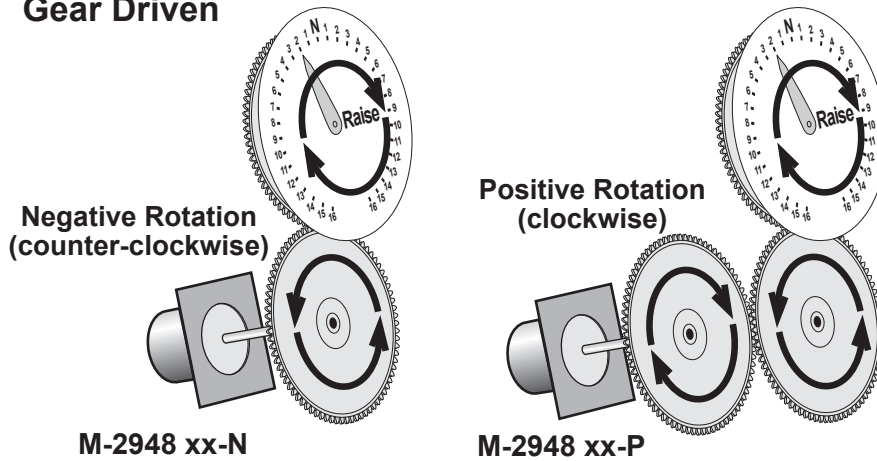


Figure 2 Geneva Gear Sensor Rotation Direction Example

Gear Driven



Sensors shown with optional mounting bracket

Flex Driven

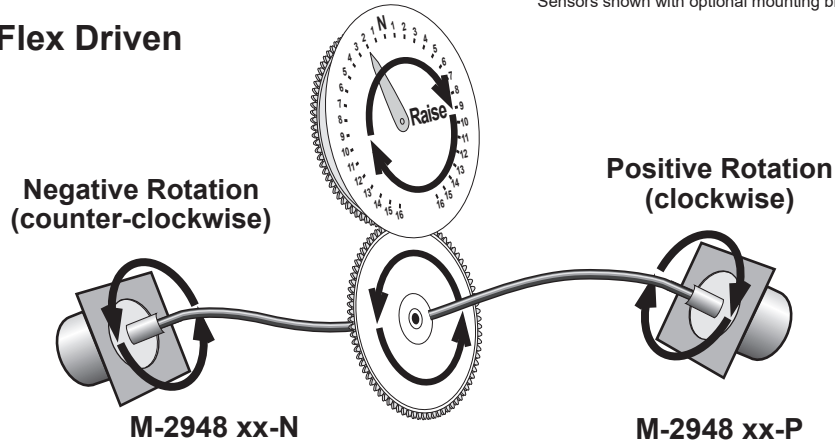


Figure 3 Tap Position Sensor Rotation (Positive or Negative) Examples

■ **NOTE:** In gear driven installations, the gear attached to the sensor input shaft must have the same number of teeth as the mechanical indicator gear so that the angular range of motion remains the same.

Connection With M-2025D Current Loop Interface Module

▲ **CAUTION:** Hardware and software must be configured correctly for the sensor functions to operate safely.

The input terminals of the M-2025D require a current loop resistor to match the signal range from the Tap Position Sensor. **Refer to the wiring diagrams and resistor selection table in the M-2025D Specification document.**

Calibration

■ **NOTE:** The M-2948 tap sensor is required to be mechanically calibrated at the neutral position. After the mechanical calibration is complete (steps 1-8 below) with the M-2025D, then perform the calibration of the M-2001 Digital Tapchanger Control's displayed tap position.

▲ **CAUTION:** Calibration of the tap position should be carefully checked, as incorrect tap positioning and limiting can result in improper voltage regulation. If the tap position knowledge function is not used, the M-2001 Tap Information screen should be set to DISABLE.

● **WARNING:** Do not rely on the Digital Tapchanger Control's display of tap position for bypassing a regulator — doing so may result in death, severe injury or damage to the regulator.

Mechanical Calibration of the Tap Position Sensor

The M-2948 tap sensor must be mechanically calibrated before attempting to read a valid tap position on the tapchanger control. To calibrate the sensor perform the following:

1. Mount the tap sensor in the mounting bracket, leaving the mounting screws loose so that the sensor body can be rotated.
2. Connect the shaft of the tap sensor to the Regulator/Transformer tap position measuring shaft.
3. Set the Regulator/Transformer to a tap position of Neutral (With 3 neutrals set the Regulator/Transformer to the middle neutral position).
4. Turn the M-2025D Calibration switch to the ON position (up).
5. Rotate the body of the tap sensor until the Yellow LED (labeled "NEAR NEUTRAL CAL") on the M-2025D illuminates.

■ **NOTE:** When the Yellow LED is illuminated, it may be necessary to rotate the sensor body as much as 30° to the left or right to cause the Green LED to also illuminate. The Green LED will only illuminate within a window of 2°.

6. Slowly rotate the body of the tap sensor until the yellow and green LEDs (labeled "NEAR NEUTRAL CAL" and "NEUTRAL CAL" respectively) on the M-2025D illuminate.
7. Tighten the Sensor Mounting Screws to lock the tap sensor in position with Green LED illuminated.
8. Turn the M-2025D Calibration switch to the OFF position (down). The mechanical calibration is complete.

Configuring M-2001 Series Digital Tapchanger Controls

The M-2001 configuration menu provides a selection screen to disable or to select whether the M-2001 uses the Contact KeepTrack, Shaft Coupled KeepTrack, Resistor Divider KeepTrack or Motor Direct Drive KeepTrack method for tap position knowledge. The correct options must be selected in the M-2001 configuration menu for the tap position sensor to operate properly. Refer to the Beckwith Electric M-2025D Specification for information.

M-2001 – Calibration of the Control Displayed Tap Position

1. Calibration should be performed at the highest position possible between neutral and the maximum tap position. The higher the tap position during calibration, the more accurate the tap position indication.
2. Determine the actual tap position from the mechanical tap position indicator on the LTC Transformer or Regulator.
3. Scroll through the M-2001 screens to the **TAP CALIBRATE** screen in the **Configuration** menu.
4. Press the **ENTER** pushbutton, a flashing "**C**" indicates that the control is ready to accept data.
5. Press the **UP** or **DOWN** pushbutton until the correct tap position is displayed.
6. Press the **ENTER** pushbutton, the tap position is now calibrated and the present tap position at which the tapchanger is operating is indicated in the status menu at the **TAP POSITION** screen.
7. Verify that the tap position displayed on the M-2001 and the actual tap position agree:
 - If the tap position displayed on the M-2001 and the actual tap position agree, then the calibration is complete.
 - If the tap position displayed on the M-2001 and the actual tap position do not agree, then continue to the Tap Position Troubleshooting section of the **M-2025D Specification** document for more information.

Tap Position Sensor Troubleshooting

Refer to the Beckwith Electric M-2025D Specification for procedures and voltage tables for troubleshooting sensor problems. This document also provides details for wiring and configuring the M-2948 sensor for use with the M-2025D Current Loop Interface Module.

●WARNING: Do not rely on the Digital Tapchanger Control's display of tap position for bypassing a regulator — doing so may result in death, severe injury or damage to the regulator. Always verify neutral using the tapchanger's mechanical position indicator.

Trademarks

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Specification subject to change without notice. Beckwith Electric Co., Inc. has approved only the English version of this document.



BECKWITH ELECTRIC

6190 118th Avenue North • Largo, Florida 33773-3724 U.S.A.

PHONE (727) 544-2326

beckwithelectricshupport@hubbell.com

www.beckwithelectric.com

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