

Using Viatran's Field Calibration Feature

An important feature of many Viatran pressure transmitters is the internal field calibration (cal) signal. This feature allows quick field set-up because the transmitter is not removed from service and a precise pressure source is not required. The field cal signal "simulates" a known pressure that allows for zero and span adjustment; and in turn, ensures accurate transmitter measurements. It can then be used for calibrating data acquisition equipment and safety limit alarms, and also for ranging units to read lower pressures at Full Scale Output. This Tech Note explains how the calibration feature works and how to use it.

The "Cal" Signal:

Figure 1 represents a block diagram of a pressure transmitter. The pressure sensor provides an electronic linear output proportional to the applied pressure. The slope of the input/output line is the sensor's sensitivity and is expressed as a ratio of signal to pressure, i.e., Volts/PSI.

The calibration signal is a fixed, stable electronic signal that is added to the sensor output when activated. Since the cal signal is constant, the electronic signal it provides is equivalent to a constant pressure. For example, let's assume the sensor generates 1 Volt for each PSI of pressure applied. If the cal circuit is designed to generate 1 Volt, activating the cal feature would be equivalent to applying exactly 1 PSI to the sensor. The function of the signal conditioner is to convert the sensor signal to the electronic format needed, such as 4-20 mA or 0-5 VDC. The signal conditioner can also perform error correction, radio frequency interference protection, temperature compensation, and allow for zero and span adjustments.

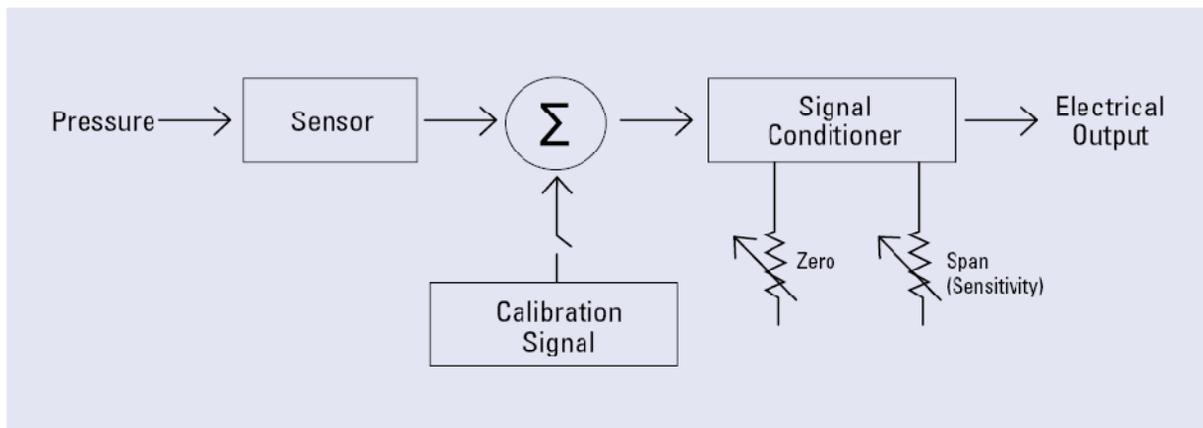


Figure 1 - Block diagram of a pressure transmitter.

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Activating Field Cal:

Activation of the cal signal depends on the specific Viatran product. Some of our pressure transmitters use a two pin calibration connection (see figure 2). Shorting these pins together activates the calibration circuit.

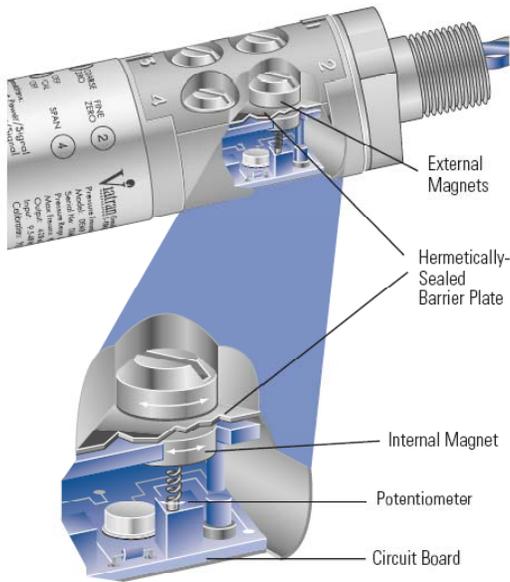


Figure 3 - Magnetic coupling safely drives controls

Other Viatran transmitters employ a special signal conditioner with all internal controls connected to magnets (see figure 3). By driving the external magnets with a screwdriver, the internal magnets follow and adjust the controls. Turning control magnet #3 on this “magnetic module” 1/4 turn (to approximately three o'clock) activates the cal feature.

The primary benefit of magnetic coupling is safety and reliability. The permanent hermetic seal protects the electronics from penetration of explosive gasses or fluids, prohibiting an explosion or failure. This feature allows the transmitter to be calibrated without operation shutdown.

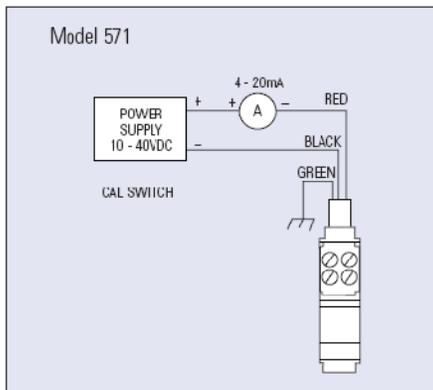


Figure 4 - Connection diagram for a typical magnetic module transmitter

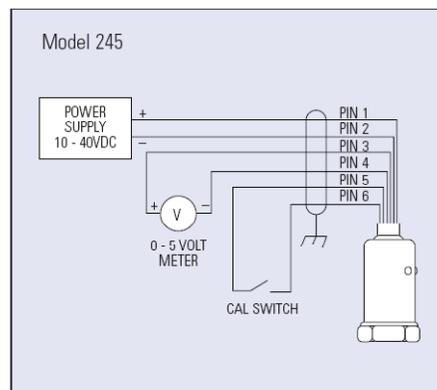


Figure 2 - Connection diagram for a typical pressure transmitter

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Using Field Cal

Tools Required:

The only materials needed are a meter that measures transmitter output, a screwdriver to activate the cal, and a calculator to help compute the calibration current.

The calibration pressure is laser etched onto the body of each transmitter. The accuracy of this value is within 0.1% of its stated value.

General Procedure:

- Remove pressure from the transmitter
- "Zero" the transmitter by adjusting the zero control
- Determine the calibration current (or voltage) by the ratio:

$$\frac{\text{Calibration Pressure}}{\text{Desired Span Pressure}} = \frac{\text{Calibration Current}}{\text{Desired Span Current}} +4$$

- Activate the cal signal
- Adjust the span control until the output of the transmitter is equal to the calibration current
- De-activate the cal signal

The original zero may change due to interaction of the zero and span controls. This is especially true in cases of high ranging or suppressed zeroes. Re-zero the transmitter and repeat the process until the zero does not appreciably change. As a rule, pressure transmitters can be span adjusted $\pm 10\%$ of the transmitter's standard pressure range.

Example 1: Simple Ranging of a Transmitter

Viatran transmitters can be ranged 3 to 5 times, depending on the specific model. This means a 10,000 PSI pressure transmitter can be adjusted to provide full output at 2,000 PSI. In this example, we'll adjust a 10,000 PSI transmitter to provide a 4-20 mA signal from 1 to 3,500 PSI. The cal pressure stated on this particular unit is 2,042.4 PSI.

Summarized, the desired output of the transmitter is:

<u>PSI Input</u>	<u>Signal Out</u>
0	= 4 mA
2,042.4	= Cal Current
3,500	= 20mA

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Using the above formula, the calibration current is determined by:

$$\frac{2,042.4}{3,500} = \frac{\text{Cal Current}}{16 \text{ mA}}$$

Cal current is therefore 9.3367 mA. This value must be added to the 4 mA zero current, making the cal current 13.3367 mA.

- Insert a current meter into the 4-20 mA loop as shown in Figure 4 on the previous page
- Remove pressure from the transmitter
- Adjust the Coarse and Fine Zero controls (#1 & #2 respectively) until the output is 4 mA
- Activate the cal signal by turning control #3 to 3 o'clock - output will increase
- Adjust the span control (#4) until output is 13.3367 mA
- De-activate the cal signal by turning control #3 to twelve o'clock
- Re-zero the transmitter if necessary and repeat until the zero pressure output and cal pressure output are as calculated

The transmitter is now calibrated to 0-3,500 PSI with a 4-20 mA output.

Example 2: Non standard Zero

In cases where pressure cannot be removed from the sensor, the cal signal still can adjust the sensitivity of the transmitter.

In this example, a 0-100"WC tank level transmitter needs to be ranged to 0-80", however the tank contains 12" of water. Although the tank cannot be emptied or the transmitter removed, the unit can still be calibrated. The calibration pressure stated on the transmitter is 34.1"WC.

In this example, consider the 12"WC pressure on the sensor a "fake zero" pressure. In order to accurately calibrate the unit, we need to determine the "fake zero" output. Add the FZ current to the "true zero" current (4 mA) and add this sum to the calculated cal current to obtain the correct calibration output. Summarized, the output of the transmitter is:

<u>Level in "WC</u>	<u>Output</u>
0	= 4 mA
12	= "Fake Zero"
34.1	= Cal Current
80	= 20 mA

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- Determine the “fake zero” output by the ratio:

$$\frac{12\text{''WC}}{80\text{''WC}} = \frac{\text{FZ mA}}{16 \text{ mA}}$$

- FZ = 2.4 + 4 mA
- Adjust the zero to 6.4 mA
- Calculate the cal current:
$$\frac{34.1\text{''WC}}{80\text{''WC}} = \frac{\text{Cal mA}}{16 \text{ mA}}$$

Cal = 6.82 mA. Activating the cal signal should shift the output by 6.82 mA. Since the transmitter is at a “fake zero” of 6.4 mA, activating the cal results in a 6.82 + 6.4 = 13.22 mA output.

- Activate the cal and adjust span for a 13.22 mA output
- De-activate cal and readjust zero for 6.4 mA
- Repeat if necessary - when the tank is empty, the output should be at 4 mA

Calibrating Data Acquisition Equipment:

Once the transmitter’s zero and span are calibrated to the desired range, the cal feature can then be used to confirm the operation of data acquisition equipment “down the line.” When the cal is activated, the display which should have been adjusted for special ranging, should read the calibration pressure. The panel meter can then be adjusted to read the calibration pressure stated on the body of the transmitter.

The cal feature can also be used to see if certain limit alarms are activated. If the limit alarm is set to the calibration pressure or below, then activating the cal should trip the alarm. Using the cal in this manner is a quick way to see if emergency shut down equipment is functional.

Caveats:

This cal feature provides many benefits however there are precautions to consider.

Use of the cal signal presumes that the sensor’s response to pressure does not change over time. Occasionally, environmental factors change the characteristics of the sensors, such as long term exposure to corrosive media, which may erode a sensing diaphragm until it is oversensitive.

The cal signal only simulates a pressure, and may differ from its stated value up to 0.1%. Applying a known pressure to the sensor, like that from a dead weight pressure generator, will more closely simulate actual operation.