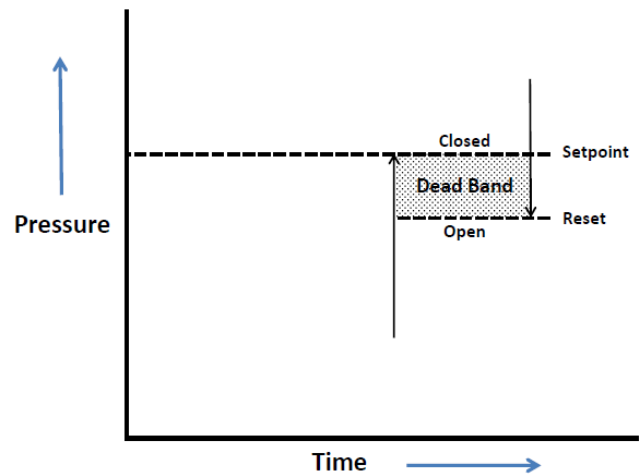# Application Note

## Calibrating a Pressure Switch

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Pressure switches are commonly used in the process industry for a wide range of applications. A pressure switch is a form of sensor that closes or opens an electrical contact when a certain pressure has been obtained either through a pressure rise or a pressure drop. Pressure switches are used to monitor, control, or provide a caution or warning for a pressure related process. The repeatability, accuracy, and functionality of a pressure switch often tie directly into the saftey or efficiency of a process and thus it becomes important that pressure switches are verified and calibrated to ensure their proper function in the process.

## Calibrating or Verifying a Pressure Switch

There are several terms that describe the function of a switch which need to be understood when testing a pressure switch:

- **Set point:** The pressure which the switch will change state.
- **Normal State:** The state of the switch when at barometric pressure (typically it would be either OPEN or CLOSED).
- **Reset:** The pressure at which the switch resets back to the normal state.
- **Tolerance:** The allowable variation from the set point pressure.
- **Repeatability:** The closeness of agreement between the results of consecutive measurements.
- **Dead Band:** The pressure difference between the change-of-states (i.e. OPEN-CLOSE or CLOSE-OPEN).
- **Trip Type:** This is the direction to which the change-of-state should happen. If the trip type is low, this means the change-of-state happens when the pressure is falling. If the trip type is high, this means the change-of-state happens when the pressure is rising.

The application of the switch will largely determine which functions need to be calibrated. For the purpose of this application note, we will assume the tolerance, repeatability, and dead band need to be calibrated for a single-point switch. To illustrate the calibration, we will use the following switch specifications:

| | |
|---|---|
| Full Scale of Switch: | 150 psi (10.34 bar) |
| State: | Normally open |
| Set point: | 110 psi (7.58 bar) |
| Reset point: | 100 psi (6.89 bar) |
| Dead band: | 10 psi (689 mbar) |
| Set point tolerance: | 2.5%FS |
| Repeatability: | 0.5%FS |

Because this is a normally open switch, we will need to test when the switch changes between open to close. Next, we'll test the reset pressure (from closed to open) and lastly, repeat the test at least once to determine repeatability. First, we must use a pressure calibrator or DMM to determine the current state of the switch. Second, we need to have a

pressure generation device (preferably a pump or controller). And lastly, we will need a way to measure the true pressure using a pressure calibrator or gauge.

First we connect the pressure standard and switch to the pressure generation device. Then we need to measure the electrical output of the switch with a pressure calibrator or DMM. With our connections complete, we are ready to perform the calibration. We do this by increasing pressure until we detect a change in the switch. If possible, our increase in pressure should mimic the same rate of change the switch would typically see in the process as we approach the set and reset points. When we see the switch change state from open to close, we record the result. Next, we decrease the pressure till we see the switch reset (change from close to open) and record the results. Lastly, we would repeat this test at least once to determine repeatability. The difference between set point and rest pressures is the dead band. And the deviation from the first test to prior tests gives us our repeatability results.

## Using the Additel 672 Pressure Calibrator for Switch Testing

The Additel 672 Digital Pressure Calibrator series makes the calibration process for pressure switches simple and easy to perform. The ADT672 has a built in a switch test routine which displays the switch state and the pressure for the change in state (open or close). A full test routine can be set up and results can be stored with date and time stamps in its non-volatile memory. Below are two example procedures for running a switch test with the ADT672 and a pressure pump. We assume the switch is normally open and we'll test the set point, reset, tolerance, dead band, and repeatability.

### *Example: Manual Documentation*

**Set up:**
1. Connect the pressure switch and ADT672 to the pressure pump as illustrated to the right. (Note: The pressure switch may not need to be connected to a hose but may be connected directly on the pump)
2. Ensure the test leads to the ADT672 are connected as illustrated (Figure 1).
3. Power on the ADT672, and press the electrical function ( ⊞ Fun HART ) button till the switch display is present as shown in figure 2 below. The switch icon ( ⌐∘⟋ – ) will also be shown in the right corner of the display.
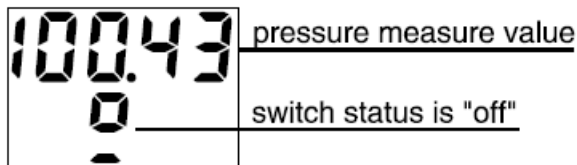


**Figure 2**: ADT672 switch function screen



**Figure 1**: ADT672 switch connection

4. Press MENU ( ▤ ) and scroll down till you reach Ƌ. SCH (this is the switch test menu) and press ENTER ( ↵ ). Scroll down till option Ⴏ. °o° and press ENTER and then MENU to return to the main screen.

**Performing the test:**

1. Pressurize the pump to the set point. When the switch changes from open to close, the ADT672 will beep and the pressure at which the change occurred will be displayed on the screen along with the following symbol **H⁰₀** (see example to the right). When the set point or reset point is detected, the ADT672 will freeze the results on the display.

2. Record the result and press ENTER to unfreeze the display and return to an active screen.



**Figure 3**: ADT672 set point results

3. Next, begin to decrease the pressure and the screen will freeze and beep when the reset point has occurred (see screen shot below).
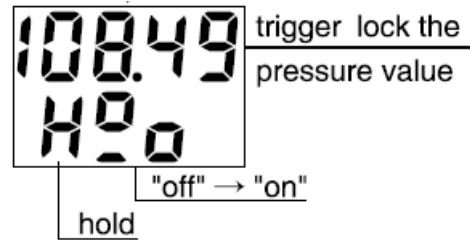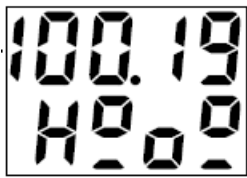


**Figure 4:** ADT672 screen with reset results

4. Record the result and press ENTER to return to an active screen.

5. Repeat steps 1 thru 4 for subsequent test so repeatability can be checked.

## Example: Automated Documentation

**Set up:**

1. Connect the pressure switch and ADT672 to the pressure pump as illustrated to the right.

2. Ensure the test leads to the ADT672 are connected as illustrated (Figure 1).

3. Power on the ADT672, and press the electrical function ( **E Fun HART** ) button till the switch display is present as shown in figure 5. The switch icon ( ◢ – ) will also be shown in the right corner of the display.
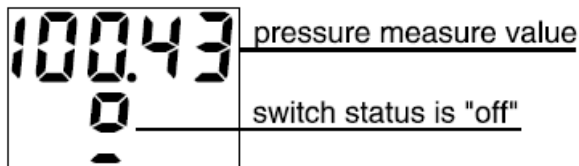


**Figure 1**: ADT672 switch connection



**Figure 5:** ADT672 screen with set point results

4. Press MENU ( ▤ ) and scroll down till you reach **3. SCH** (this is the switch test menu) and press ENTER ( ⏎ ). Scroll down till option **4. ⁰₀⁰** and press ENTER and then MENU to return to the main screen.

5. Press and hold SAVE ( ▣ ). Press ENTER, then go down to the last option **8. SEL** and press ENTER which takes you back to the main screen.

**Performing the test:**

1. Pressurize the pump to the set point. When the switch changes from open to close, the ADT672 will beep and the pressure at which the change occurred will be displayed on the screen along with the following symbol H⁰o (Figure 6).
   *(Note: The results are automatically recorded)*
2. Press ENTER to return to an active display.
3. Next, begin to decrease the pressure and the screen will freeze and beep when the reset point has occurred.
   **(Note: The results are automatically recorded)**
4. Press ENTER to return to an active display.
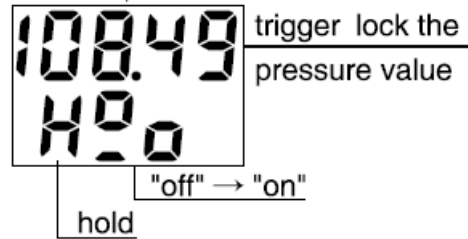5. Repeat steps 1 thru 4 for subsequent tests so that repeatability can be checked.

**Figure 6**: ADT672 set point results

**Viewing the test results:**

1. Press and hold SAVE. This takes you out of the active save mode.
2. Press and hold SAVE again (this takes you into the file menu). Select the file where data was stored and press ENTER.  ᵗ.SEE is now displayed on the screen, press ENTER one more time to view the data in the file. To scroll through the data, press ENTER and the next file will appear.

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## Application Video

Our application video will demonstrate the steps used in this application note on pressure switch testing.
**Click here to see the application video.**

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We hope you found this application note to be helpful. For more information please contact us (PH: 1-714-998-6899, E: sales@additel.com) or visit us on the web at www.additel.com