A digital multimeter (DMM) is the tool most commonly associated with diagnosing an electrical problem. After all, the word multimeter means the meter has many functions, such as measuring voltage, current and resistance. It may have additional functions and features, such as frequency or Min-Max.

Measuring current with a DMM usually involves having to open the circuit and connect the meter in series with the circuit. Essentially the meter has to become part of the circuit to measure the current directly.

This is where a current clamp can save you time and effort. Current clamps have several different names: current probe, inductive current clamp, etc. They all refer to a tool you can clamp around a wire to measure current without otherwise disturbing or opening the circuit.

A current clamp can be a real time-saver and is pretty straightforward to use, but if you don’t follow all the steps, you can wind up with some false test readings that can lead you to an incorrect diagnosis. In this article we’re going to go over how to use a current clamp and learn some tips on performing accurate measurements and getting consistent readings.

First, make sure you have the right tool for the job. There are current clamps designed to measure hundreds of amps, such as testing starting and charging system circuits. These current clamps won’t measure currents below 5 amps accurately. The type of current clamp you want to use when testing transmission solenoid circuits is a low current or milliamp current clamp. When working on automatic transmission circuits, you need to be able to measure current accurately below 1 amp, because most transmission solenoids will draw between 300 milliamps (0.300 amps) and 1.5 amps.

Because there are some differences between brands, I highly recommend that you first read the setup instructions provided by your current clamp’s manufacturer, as there may be some setup procedures that are specific to its design.

The Tools

We’re going to use a PDI CA-60 AC/DC current clamp with a PDI 920 Automotive DMM. The CA-60 is a low current clamp, designed to measure current up to 60 amps. Both of these tools are made by Precision Diagnostic Instruments, and are available from Shaffer Test Products (1-877-SH IFTER).
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Most current clamps don’t have a built-in display, and have to be connected to a DMM to measure the circuit. The current clamp converts the current (amperage) into a voltage, which you can measure with your DMM.

**Setting up the DMM**

- Plug the black (– or Negative) banana plug of the current clamp into your meter’s COM (– or Negative) jack (figure 1).
- Plug the red (+ or Positive) banana plug of the current clamp into the DMM’s V/Ω input (remember, the DMM has to display the voltage from the current clamp).
- Set your DMM to measure millivolts (mV).

Leaving the meter set on auto range will usually work; you just want to make sure you have a range of at least a couple hundred millivolts if you set it to a range manually.

**Select Range and Zero the Current Clamp**

The PDI CA-60 has two ranges:

- 1 mV = 10 mA
- 1 mV = 100 mA.

The CA-60 instructions recommend selecting the 1mV / 10 mA range to measure currents below 2 amps accurately (figure 1). This range gives us 1 millivolt for every 10 milliamps of current. It’s actually very simple to convert the voltage reading on your meter to current: we’ll cover this shortly.

After selecting the range, zero the current clamp by depressing the zero button, until the DMM displays a steady zero reading on display (figure 2).

**Taking a Measurement**

To measure a circuit’s current, simply open the jaws of the current clamp and clamp it around the wire. We’re going to connect our current clamp to the Pressure Control HI circuit (Red/Black wire) and measure the pressure control solenoid (PCS) current on a 4L60E in a 1995 Chevrolet pickup (figure 3). Then we’ll compare the actual current measurement to the PCM scan data.

We’ve had quite a few HelpLine calls on pre-OBD-II GM trucks and vans with high line pressure, and have found the measured PCS amperage may be much lower than the value displayed by scan data. This particular problem is usually caused by a faulty PCM, and we’ve seen a few fixed by replacing the EPROM. You can verify this problem by monitoring the actual circuit current and comparing it to scan tool data.

IMPORTANT: Always cover all your bases; check PCM power and grounds, charging voltage, etc before you condemn any computer.

The wiring diagram shows two wires that connect the pressure control solenoid to the PCM: one for the Pressure Control HI circuit and one for the Pressure Control LO circuit. We’ll call them PCS HI and PCS LO for short.

The PCM controls the duty cycle on the positive side (PCS HI) of the circuit. It monitors current on the negative side (PCS LO) by measuring the voltage drop across a 1 ohm “current sense” resistor in the ground path inside the PCM. This design makes it difficult to get accurate diagnostic information from measuring voltages on this circuit.
Using an Inductive Current Clamp: Checking a Circuit under Operating Conditions

The PCS LO circuit will typically be about 1 volt above powertrain ground (transmission case), with 1 amp of PCS current (remember the 1 ohm current sense resistor), so don’t be fooled into thinking you have a bad ground somewhere, based on voltage drop readings in the PCS LO circuit.

The thing to remember is that the current through the pressure control solenoid dictates how the solenoid controls line pressure, and the PCM is designed and programmed to monitor and control the pressure control solenoid current to control the transmission line pressure.

It doesn’t matter whether you hook the current clamp around the Pressure Control High circuit or the Pressure Control Low circuit, because there’s only one path for current: from the PCM, down the Pressure Control High circuit, through the solenoid, and up the Pressure Control Low circuit back to the PCM. Since current is equal throughout the circuit, the current will be the same anywhere in the circuit.

With the engine running and the transmission in park, we’re reading 103.1 millivolts on the DMM (figure 4). With the current clamp in the 1mV/10mA range, to convert the DMM voltage reading to amperage we simply move the decimal point two places to the left. This gives us a reading of 1.031 amps; 1.03 amps is close enough.

The scan data for the PCS DES (AMP) and PRESS CTRL AMP are both reading 1.08 amps (figure 5). So the amperage the PCM is trying to achieve and the PCM measured amperage are identical, and the amperage we measured with our current clamp is reasonably close.

Based on these results, we know the PCM and pressure control solenoid circuits are doing their jobs. If the transmission can’t achieve minimum line pressure, it has an internal problem. The pressure control solenoid may have failed mechanically or hydraulically, or there are other problems with the pressure regulator or torque signal hydraulic circuits.

Current Clamp Tips and Tricks

Make sure the jaws of the current clamp are completely closed around the wire you’re testing. If the wire is too large for the jaw opening, or there’s tape, dirt, or another wire trapped in the jaws, you won’t get an accurate reading.

Current clamps have polarity. The PDI CA-60 is designed to give a positive reading when the top side of the jaws (the side with the selector and zero switches) is facing the positive source in the circuit. Look at figure 2: I’ve drawn a “+” on the top of the jaws to help remember this. If you connect the current clamp backward, you’ll just get a negative reading on your meter; it won’t affect accuracy. It can be a little annoying or distracting to have the “–” symbol on the DMM display, so I like to mark the current clamp to remind myself which way to install it.

Diagnostic Tips: Using the Test Results for Accurate Diagnosis

A current clamp is a great tool for identifying problem circuits, or for verifying that a circuit doesn’t have a problem. In the example we covered, we were able to prove that the Pressure Control Solenoid and circuit were working properly, without having to disconnect the circuit or measure individual components within the circuit.

In a circuit that does have a problem, measuring current is only going to verify the problem. For example, suppose you have a shift solenoid circuit DTC. You use your current clamp to determine the circuit current draw is much lower than it should be (using system voltage and the solenoid resistance to calculate the amperage with Ohm’s Law).

Measuring the current verified there was a circuit problem; it didn’t identify exactly what that problem was. To pinpoint the problem, you’re back to checking solenoid resistance, supply voltage, grounds, voltage drop, etc., to pinpoint the problem. A current draw test is a simple go/no-go test to indicate whether the circuit is functioning correctly under actual operating conditions. It doesn’t show you specifically where the problem is located.

What a current draw test can do is help you verify the circuit is working correctly and is able to carry the current required for the circuit to operate properly. This can give you confidence that the circuit is good, so you can move on to other suspects, such as a faulty PCM or a mechanical problem. Just remember to check all the basics (powers, grounds, etc) before replacing the computer.
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