**Power-supply troubleshooting with a multimeter**

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It may seem unlikely, but over a quarter of all PC problems are in some way related to trouble with the power supply. It’s tempting to think that if something is wrong with the power supply, the PC simply won't power up at all, making the culprit easy to identify. But this isn’t always the case. Power-supply problems can also cause lockups, unexpected reboots, and intermittent boot problems. To help you ensure that you've covered all of the bases, I’ll explain how to test the PC’s power supply using a multimeter on your power connections and motherboard.

Before I begin  
Because of the many brands of multimeters that are available, I can’t provide you with specific instructions on how to use your particular brand. So before you begin, make sure you have a thorough understanding of how to use your multimeter. Using it incorrectly could result in your receiving a strong electric shock, or it could destroy your multimeter.

Background information on the power supply  
The power supply’s purpose is to convert the 115-volt alternating current (AC) supplied by an electrical outlet into direct current that the PC can use. Typically, the power supply converts the AC into a 12-volt, 5-volt, or 3.3-volt direct current. The 12-volt direct current is used to power devices with motors, such as hard drives and CD-ROM drives. The 5-volt and 3.3-volt outputs are used to power various electronics on the system board.  
  
Almost every PC power supply in use today is either an AT or an ATX power supply. The main difference between the two is the number of connectors attached to the wires. But regardless of which type of power supply you're working with, there are some basic components that apply to all power supplies. The first is the power connection, which is where the power supply connects to the electrical outlet. Next is the motherboard power, which is delivered via a set of cables running from the power supply. Power supplies also have a fan (which you can troubleshoot easily by just looking at it to see if it's working).  
  
Testing the power connection  
To begin the diagnostic process, verify that the PC is unplugged from the wall and is receiving no power. Next, check the voltage selector on the back of the PC near the fan to make sure that it is in the 115-volt position. You can see an example of this in **Figure A**.

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| Figure A |
| http://www.techrepublic.com/i/tr/cms/contentPics/t01620020319pos01_01.jpg |
| Make sure that the power supply is set to 115 volts. |

The next step is to check to see if the fan is spinning. If the fan is spinning, then the main power input is definitely working. If the fan isn’t spinning, then either the fan is bad or the main power connector isn’t getting any electricity. To find out if the connection is bad, set your multimeter to the next AC voltage level above 115 volts and test the power outlet, as shown in **Figure B**.

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| Figure B |
| http://www.techrepublic.com/i/tr/cms/contentPics/t01620020319pos01_02.jpg |
| Be careful! Your best bet to avoid electrocution is to attach the multimeter to an unplugged power strip and then plug the power strip into the wall outlet. |

If the outlet is producing adequate power, then use your multimeter to do a continuity test on your power cord, as shown in **Figure C**. If the electrical outlet has power and your power cord passes the continuity test, then the fan is dead and the power supply must be replaced.

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| Figure C |
| http://www.techrepublic.com/i/tr/cms/contentPics/t01620020319pos01_03.jpg |
| Perform a continuity test on the PC's power cord. |

Testing the motherboard power  
Depending on whether you have an AT or an ATX motherboard, you’ll either have one or two connectors that attach the power supply to the motherboard. Whichever type you have, you should unplug the system from the electrical outlet before testing the motherboard power.  
  
If you’re using an AT power supply, you’ll have two connectors, called P8 and P9, that connect the power supply to the system board. Detach the P8 and P9 connectors from the system board but make sure to note their positioning. Although both connectors are keyed to prevent you from putting them on backwards, it is possible to accidentally reverse the two connectors. Reversing the connectors will almost certainly destroy the motherboard and will likely destroy the power supply, too. When replacing the P8 and P9 connectors back on the motherboard, remember that the two black ground wires should be next to each other.  
  
The ATX motherboard power connector, shown in **Figure D**, uses a single P1 connector rather than a P8 and a P9 connector. This connector is keyed to prevent it from being inserted backwards.

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| Figure D |
| http://www.techrepublic.com/i/tr/cms/contentPics/t01620020319pos01_04.jpg |
| The ATX motherboard connector uses a single P1-type connector. |

Both the AT and ATX power supplies supply power to the system board at the 12-volt, 5-volt, and 3.3-volt levels. The reason for the different volt levels is that various system-board components require different amounts of electricity.

Note  
Because of a built-in logic circuit, the fan won’t spin in an ATX power supply unless the power supply is connected to the system board. Thus, the ATX power supply must be connected to the system board in order to function. The AT power supply, however, does not require such a connection.

In Figure D, you saw that the ATX P1 connector was basically a bunch of wires connected to a 20-pin connector. In **Figure E,** you can see a diagram of what each pin represents.

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| Figure E |
| http://www.techrepublic.com/i/tr/cms/contentPics/t01620020319pos01_05.gif |
| This is the layout of the P1 connector. |

Your first step is to figure out which pin is which, but the presence of a clip on the P1 connector will make this easier than you might think. The clip is located between pin 15 and pin 16. By using the clip to locate these pins, you may intuitively figure out what the other pins represent.  
  
Using your multimeter on an ATX power supply, pin 9 should have 5 VDC (Volts of DC power) flowing through it anytime the PC is plugged in. This should be the case whether the main power switch is turned on or off. You will notice pin 9 easily because it is typically a purple wire. Checking for a 5-volt DC on pin 9 using the multimeter is a good way to begin testing to see if the system board is receiving any power.  
  
Once you’ve tested pin 9, test the voltage on the various 12-VDC circuits. You might have noticed that there are several black and several yellow wires on the P1 connector. The yellow wires indicate 12-VDC circuits. To test these circuits, set your multimeter to the 15-VDC or 20-VDC range (depending on what your individual multimeter uses). Next, with the PC powered on, place the red probe onto a yellow wire on the P1 connector and then place the black probe onto a black wire. Because the PC must be powered on, the P1 connector must be connected to the system board. Therefore, you’ll have to use the probes in the manner demonstrated in **Figure F**.

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| Figure F |
| http://www.techrepublic.com/i/tr/cms/contentPics/t01620020319pos01_06.jpg |
| Connect the red probe to a yellow wire and the black probe to a black wire. |

Once the probes are connected, your multimeter should indicate a voltage between 11 and 13 VDC. If a power supply is slowly dying and causing the types of problems that I described earlier, the voltage will be a little below this level. If you read a power level between 10.5 and 11 VDC, then your PC needs a new power supply. If you read anything below 10.5 VDC, there’s a good chance that your PC won’t boot until you replace the power supply. You may also notice voltage drops on the 5-VDC and 3.3-VDC circuits, but these voltage drops are smaller because you’re dealing with less power to begin with. Therefore, I recommend performing the tests on the 12-VDC circuits.  
  
Conclusion  
A faulty power supply is not the easiest PC component to detect, and it is often overlooked when troubleshooting in favor of the more popular PC hardware problems most IT pros check first. However, armed with a multimeter, you can quickly check the connections for proper current flow. The heart of most power supply problems exist at the power input and motherboard, so by testing these areas as I've described above, you should now be able to rule out the power supply as the culprit.