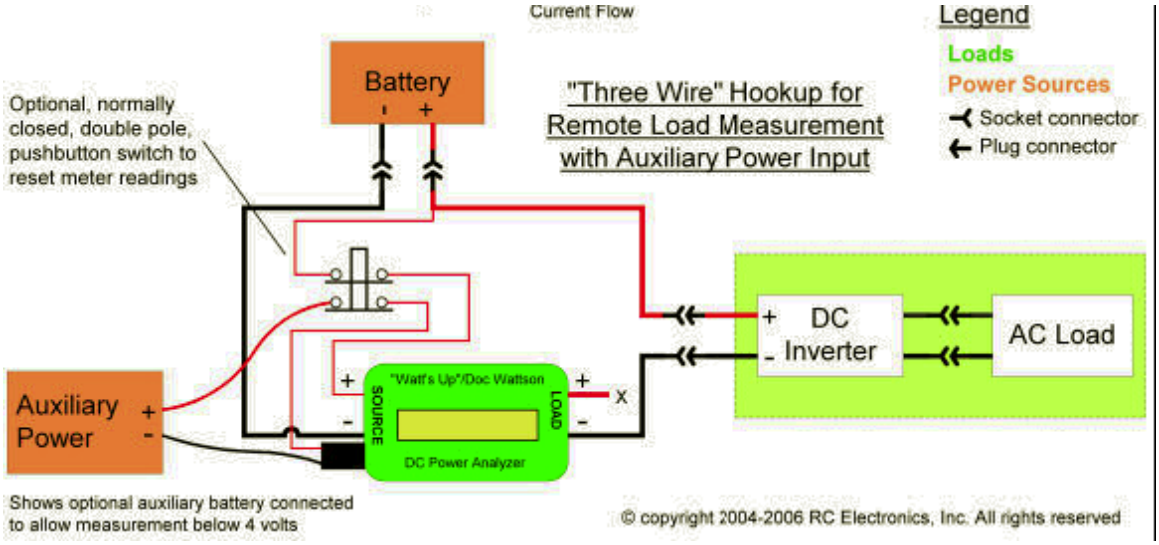
A Wind Generator DC kWh Meter

One of the ways to increase the return on investment of a renewable energy system is to earn Renewable Energy Credits (RECs). The owner is paid an open market valuation for the renewable energy produced. In my case, for the state of Nevada Public Utilities Commission (NPUC), I must have meters on each source of renewable energy, e.g., solar heating, wind generation, and photovoltaic (PV) generation. Since, for one system, I have both the wind generators and PV modules feeding the same battery bank and inverter system, I need separate kWh (kilowatt-hour) meters, to segregate the wind and PV contributions (note, wind and PV are valuated differently, so both must be precisely and independently measured).

Since one cannot determine the AC kWh contribution from each source, as wind and PV generation is combined at the DC battery level, a DC kWh meter is required. Unfortunately, I could not find a DC kWh meter compatible with the output of my windmill, e.g., a nominal 3 kW of 60 Amps or more at the nominal 48 VDC battery voltage (float voltage setting of 52.8 VDC).

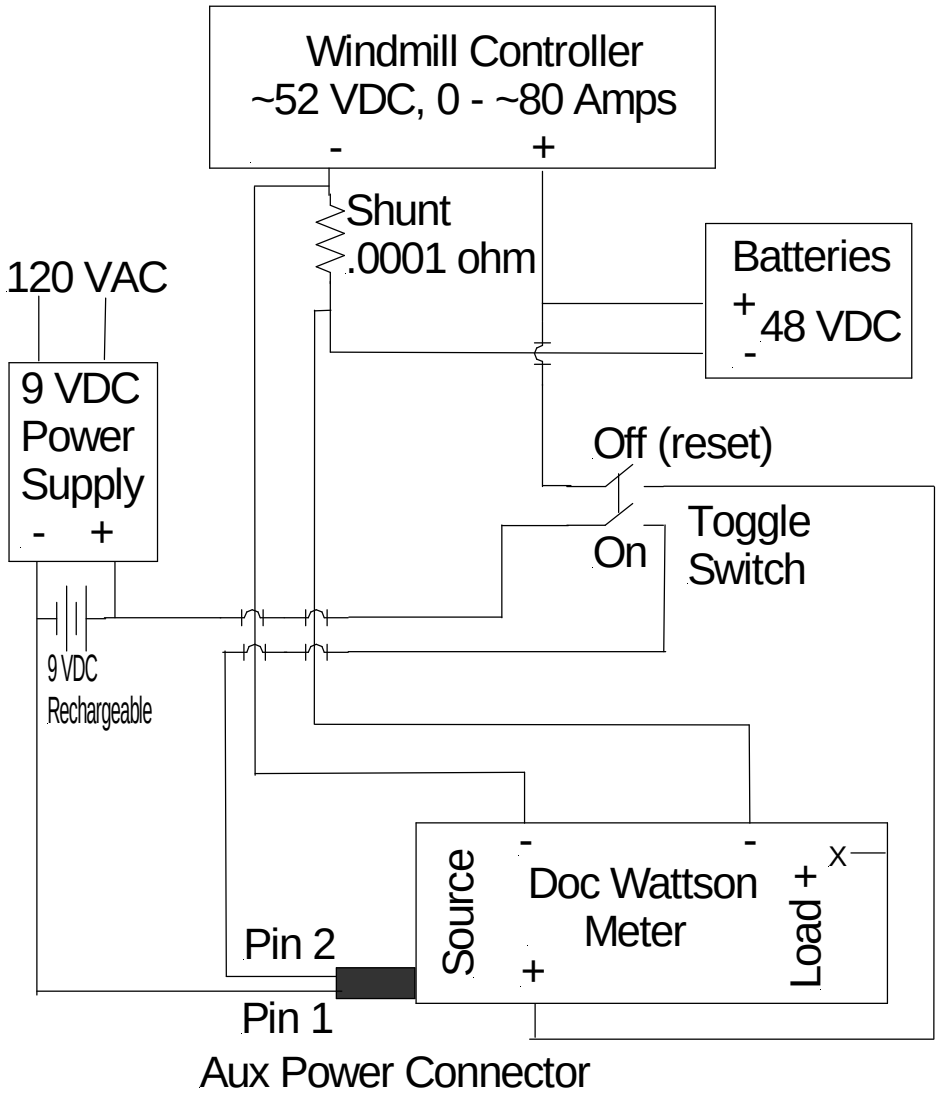
RC Electronics (www.re-electronics-usa.com) makes the "Doc Wattson" DC kWh meter that can be modified to accept a higher power input, suitable for use with a medium output wind generator, such as mine (Whisper 175). The following diagram (provided by RC Electronics) shows the standard configuration for measuring low power systems, using an auxiliary power supply. The auxiliary power supply is required because the Doc Wattson meter uses volatile memory to record readings; thus, with loss of power all readings to date are lost. My reporting to the NPUC on a quarterly basis must not have any interruption of the power supply; otherwise I would lose the readings (and value thereof).



Therefore, with verbal inputs from technical support at RC Electronics, I physically modified the Doc Wattson to meet my requirements. Modifications included:

1. Removing the existing internal shunt (0.001-ohm) and replacing with a 50 mV/500A external shunt (model CSB500-50 available from RC Electronics). The new shunt resistance is 0.0001-ohm, so one will have to multiply the kWh reading by a factor of 10 in order to get the correct value.
2. Remove diode D1; this allows the external power supply to operate independently of the voltage sense line, assuring no loss of readings should the external voltage sense line go to zero and to assure no conflict with the external auxiliary power supply.
3. Adding an external power supply using the auxiliary power connector cable (available from RC Electronics, part # conn100). In my case, I used a standard AC/DC converter, with a 9-volt rechargeable battery. The converter plugs into a standard 120 VAC wall outlet and provides 9 VDC, both to operate the unit and charge the battery (for use in case the 120 VAC is unavailable). A connector plug is needed for the converter to plug into the box and to connect the DC voltage to the other components.

The following schematic shows how the meter is now wired:



Modified Doc Wattson DC kWh Meter

Modifying the meter is not very difficult, the following methodology was used:

1. Open the meter case; this does void the warranty but is necessary to use the meter. I used a Dremel tool with a saw wheel to cut the plastic between the top and bottom molded cases. This was done at an "anti-static" work station to prevent inadvertent "electrostatic" damage to any components. I kept the top case to mount the modified meter into a larger box, this also allowed retention of the "source & load" locations.
2. Remove diode D1. A standard soldering station is adequate to remove the solder.
3. Remove the internal shunt. I used a soldering gun, as there is a lot of solder to be heated. I was able to heat one edge at a time and lift that edge sufficiently so that the shunt could be removed.
4. Make new connections, e.g., soldering wires together. I used 18-gauge wires for the shunt and voltage sense inputs. Mount the parts in the box.

5. To make the power supply, I just used a standard 9 VDC converter from 120 VAC. A standard plug and socket was used to plug the output of the power supply into the face of the new meter case. A standard 9 VDC rechargeable battery was inserted into a standard 9 VDC battery holder, whose terminals were appropriately connected.
6. I used a standard double-pole, single-throw switch. In the "on" position, the power supply (9 VDC) is connected to the auxiliary power connection input and the voltage sense line is connected to the positive (+) source lead. The "off" position also serves as a reset. I was not able to easily find a "normally closed" two pole pushbutton switch, as recommended in the RC Electronics drawing.
7. The unused load positive (+) lead was "taped off" to prevent inadvertent contact with any other conductive element.
8. The meter (with top case), switch, and power supply connector were all mounted in a standard electronics plastic case. I bought one slightly larger than necessary in order to have plenty of room for wires and ease of access. The battery holder is mounted inside the case. The wires from the top of the case go to the shunt, the wire from the bottom of the case goes to the voltage sense (+ supply from the windmill).

The below picture shows the meter and accessories ready for installation.

This modification is suitable for applications < 60 VDC and ~ 350 Amps. If a higher voltage is in use, then a voltage divider can be installed on the voltage sense line to reduce the voltage to the meter to less than 60 VDC. The output then will be multiplied by the corresponding voltage divider factor, e.g., if divide the voltage in half, then the output is multiplied by 20, 10X for the shunt and 2X for the voltage divider.

In operation with the windmill turning, the voltage and current readings on the Doc Wattson correlate with the TriMetric battery monitor on the common battery bank (one must multiply the Doc Wattson current reading by a factor of 10 to correlate with the TriMetric). The cumulative DC kWh value is displayed.

In summary, these relatively simple changes can allow the Doc Wattson meter to be used for applications outside of the existing specification limits, with no negative impact on the quality of the readings or the reliability of the meter, assuming standard electronic safety and assembly techniques are used.

The following table summarizes costs:

Item	Cost
Doc Wattson R102	$59.95
Auxiliary Power Cable (conn100)	$3.59
Shunt B-series (CSB500-50)	$21.95
Miscellaneous Parts (box, wire, switch, battery, battery holder, plug, converter)	~$35.00