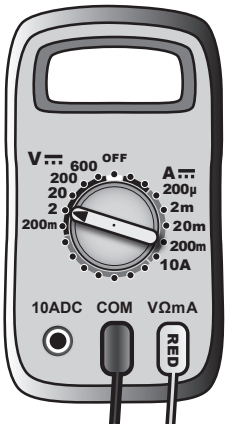
Using the Digital Multimeter & the Solar Cell Set

CAUTION: DO NOT use a multimeter to test AC or household electric systems without proper supervision and instruction. DO NOT test battery *amperage* with a multimeter.

Measuring the OPEN CIRCUIT VOLTAGE (Voc) of a single solar cell:
This is the *highest voltage* reading the solar can give, measured when it's not powering a load.
1. Put the black lead in the COM port, and the red lead in the VΩmA port. Set the dial to the number in the V ⎓ range that is *closest to and greater than* the expected voltage of the solar cell. Silicon solar cells produce ~ 0.5 volts open circuit; set the meter to 2 volts.
2. Connect the black multimeter lead to the black wire from the solar cell, and the red multimeter lead to the red wire from the solar cell. Aim the cell toward the sun. Record the reading.

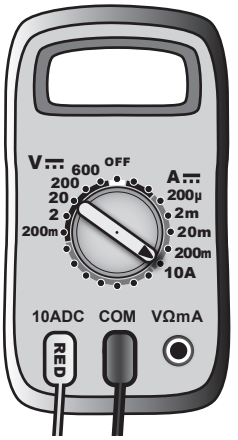
Measuring the SHORT CIRCUIT AMPERAGE (Isc) of a single solar cell:
This is the *highest amperage* reading the cell can give.
1. Move the red lead to the 10ADC port. Set the dial to 10A. The single cells produce ~ 0.4 amps.
2. Aim the cell toward the sun. Record the reading.



Meter set to test voltage less than 2 volts.

Measuring the OPEN CIRCUIT VOLTAGE (Voc) of two solar cells in SERIES:
1. Place the black lead in the COM port, and the red lead in the VΩmA port. Set the dial to the number in the V ⎓ range *closest to and greater than* the expected voltage of the solar cells. Series wiring ADDS the voltage of cells together. Set the meter to 2 volts.
2. Connect the red (+) wire from one solar cell to the black (-) wire of the next.
3. Connect the black multimeter lead to the remaining black wire from the two solar cells, and the red lead to the remaining red wire. Aim the cells toward the sun. Record the reading.

Measuring the SHORT CIRCUIT AMPERAGE (Isc) of two solar cells in SERIES:
1. Move the red lead to the 10ADC port. Set the dial to 10A.
2. Aim the cells toward the sun. Record the reading.

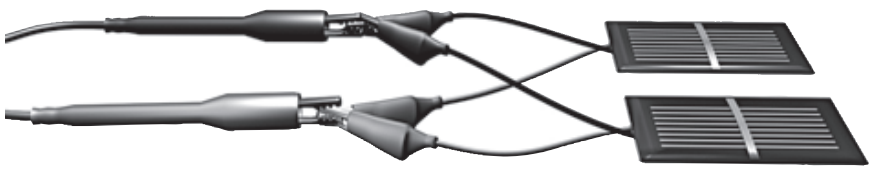


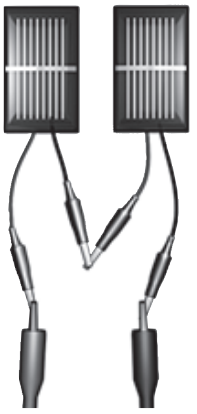
Meter set for current less than 10 amps.

Measuring the OPEN CIRCUIT VOLTAGE (Voc) of two solar cells in PARALLEL:
1. Place the black lead in the COM port, and the red lead in the VΩmA port. Set the dial to the number in the V ⎓ range *closest to and greater than* the expected voltage of the solar cells. Note: In parallel wiring the voltage stays the same as the voltage of a single solar cell.
2. Connect the red (+) wires from both cells together, and the black (-) wires from both cells together.
3. Connect the black multimeter lead to both black wires from the two solar cells, and the red multimeter lead to both red wires. Aim the cells toward the sun. Record the reading.

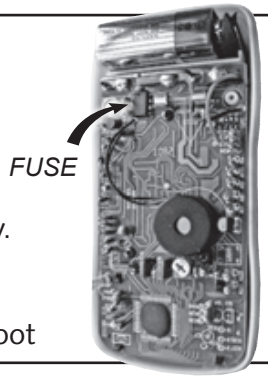
Measuring the SHORT CIRCUIT AMPERAGE (Isc) of two solar cells in PARALLEL:
1. Move the red lead to the 10ADC port. Set the dial to 10A.
2. Aim the cells toward the sun. Record the reading.

If a reading is negative, the polarity is reversed: Switch the connections to the PV cells. Turn the dial to OFF when the meter is not in use, and put the red lead in the **VΩmA** port.


Solar cells connected to multimeter probes in parallel: the positives (+) of each cell are clipped together, and the negatives (-) are clipped together.


Cells wired in series

TROUBLESHOOTING

Issue	Remedy
Digital Multimeter (DMM)	
DMM is on but there is no AMP reading	• Make sure the RED (+) lead is in the 10ADC port, & the BLACK (-) lead in the center (COM) port. • The Dial should point to 10A. • Connect the two DMM leads to the matching color solar cell leads. • Point the solar cell toward the sun (or light).
DMM is on but there is no VOLT reading	• Make sure the RED (+) lead is in the VΩmA port, & the BLACK (-) lead in the center (COM) port. • The Dial should point to 20V or 200V. • Connect the two DMM leads to the matching color solar cell leads. • Point the solar cell toward the sun or light.
The DMM doesn't work	Change the battery &/or the fuse: 1. Turn the DMM dial to OFF position 2. Remove Test Leads from ports. 3. Slip the protective boot off the DMM. 4. Remove 2 screws in back & remove cover. 5. Unsnap contacts, remove & replace 9V battery. 6. Check & replace the fuse if it's blown. (replacements are available @ Radio Shack) 7. Reattach contacts, replace the back cover & boot 
Solar Cells	
No Volt or Amp reading from the solar cell	Be sure to clip to metal parts of the connectors, not the outer insulator. Make sure your circuit is not creating a Short Circuit. This happens when the + and – clips on the solar cell touch each other, creating a path of least resistance back to the cell, and bypassing the load or DMM.
Solar Cell wires detach from the wires	Reattach the wires with a soldering iron. Add a dab of silicone on the wires for strain relief &/or tape the wires to the back of the cell.
2 solar cells wired in series produce no voltage	Instead of + to – series wiring, one cell may be wired from + to the + of the next solar cell. When a positive and negative voltage combine in this manner, they cancel each other out, producing zero voltage.
Series wiring doesn't power the radio	For radios & other electronics, polarity matters, meaning that the + and – wires must match correctly for it to work. Motors will simply spin the other way if the + & – wires are switched. For radios make sure that the last + wire (red) from the solar cells is connected to the + terminal on the radio, and the – (black) solar cell wire is connected to the – terminal on the radio. The connections between the solar cells should still be + to – for series wiring to increase the voltage.