**Solar Electric Technician (Level 2)**

**Module 3: Measurement of electrical and solar parameter**

**E6: Assignment-Series and parallel connections**

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| **E6: ASSIGNMENT MEMO** | |
| **Date** | …. |
| **To** | Participants |
| **From** | Trainers |
| **Subject** | Series and parallel connection |
| **What** | Learn how to connect solar panels in series and parallel. |
| **Why** | The objective of the assignment is to set up sample series and parallel circuits and measure the electrical parameters. You will gain an understanding how connecting solar panels in series affects voltage and current. |
| **How** | 1. Work in group of 2 or 4. 2. Gather the required tools and equipment. 3. Read and carefully follow the instructions for each task given. 4. Record the findings, measured values, and any observations during the test. 5. Some tasks include notes to assist participants for tallying the measured value or results. 6. After completing the assigned tasks, discuss your results within the class and answer any related questions. |
| **Time** | 90’ |

**Task 1: Connect two solar panels in series and measure electrical parameters.**

1. **Required tools/equipment**

* Two solar panels (with same voltage and current rating)
* Multimeter
* Wires for connection
* Insulation tapes, cable shoes
* Wire stripper and crimper

1. **Instructions**

* Identify the rating of each panel:  
  Voltage (Vmp) = \_\_\_\_\_\_ V  
  Current (Imp) = \_\_\_\_\_\_\_ A  
  Power (Pmax) = \_\_\_\_\_\_ W
* Connect panels in series:
* Connect the positive terminal of the first panel to the negative terminal of the second panel.
* The remaining positive terminal from the second panel and the negative terminal from the first panel will be the output of the series connection.
* Set multimeter to measure DC voltage across output terminals (positive and negative).
* Set multimeter to measure DC current across output terminals (positive and negative).
* Formula: Power (P) = Voltage (V) x Current (I)
* Note down the value.

1. **Measured value**

* Series voltage: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Volt
* Series current: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Amp
* Total power: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Watt

1. **Notes**

* The total voltage should be the sum of the voltages of both panels (Voltage adds up in series).
* The current should remain the same as for a single panel (Current stays the same in series).

**Task 2: Connect two solar panels in parallel and measure electrical parameters.**

1. **Required tools/equipment**

* Two solar panels (with same voltage and current rating)
* Multimeter
* Wires for connection
* Insulation tapes, cable shoes
* Wire stripper and crimper

1. **Instruction**

* Identify the rating of each panel:  
  Voltage (Vmp) = \_\_\_\_\_\_ V  
  Current (Imp) = \_\_\_\_\_\_\_ A  
  Power (Pmax) = \_\_\_\_\_\_ W
* Connect panels in parallel:
* Connect the positive terminal of both panels together.
* Connect the negative terminal of both panels together.
* The combined positive and negative terminals will be output of the parallel connection.
* Set multimeter to measure DC voltage across output terminals (positive and negative).
* Set multimeter to measure DC current across output terminals (positive and negative).
* Formula: Power (P) = Voltage (V) x Current (I)
* Note down the value.

1. **Measured value**

* Parallel voltage: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Volt
* Parallel current: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Amp
* Total power: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Watt

1. **Notes**

* The total voltage should be the same of the voltages of single panel (Voltage adds up in series).
* The current should remain the sum of the current of both panels (Current stays the same in series)

**Task 3: Connect solar panels in series-parallel combination and measure voltage and current.**

1. **Required tools/equipment**

* Four solar panels (with same voltage and current rating)
* Multimeter
* Wires for connection
* Insulation tapes, cable shoes
* Wire stripper and crimper

1. **Instructions**

* Identify the rating of each panel:  
  Voltage (Vmp) = \_\_\_\_\_\_ V  
  Current (Imp) = \_\_\_\_\_\_\_ A  
  Power (Pmax) = \_\_\_\_\_\_ W
* Connect two panels in series and repeat the connection with remaining two panels.
* Now, connect two-series connected sets in parallel.
* Set multimeter to measure DC voltage across output terminals (positive and negative).
* Set multimeter to measure DC current across output terminals (positive and negative).
* Formula: Power (P) = Voltage (V) x Current (I)
* Note down the value.

1. **Measured value**

* Parallel voltage: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Volt
* Parallel current: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Amp
* Total power: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Watt

1. **Notes**

* The voltage will be the same as that of one series string.
* The current will be the sum of the currents of the two parallel branches.

**Task 4: Testing voltage drop in series and parallel connection.**

1. **Required tools/equipment**

* Two solar panels (with same voltage and current rating)
* Multimeter
* Wires for connection
* Insulation tapes, cable shoes
* Wire stripper and crimper

1. **Instruction**

* Identify the rating of each panel:  
  Voltage (Vmp) = \_\_\_\_\_\_ V  
  Current (Imp) = \_\_\_\_\_\_\_ A  
  Power (Pmax) = \_\_\_\_\_\_ W
* Connect two panels in series.
* Measure voltage at output terminals close to panels and at the end of long wire connected to output.
* Formula:  
  Voltage drops in series = Initial voltage – Voltage at wire end
* Now, connect two panels in parallel.
* Measure voltage at output terminals close to panels and at the end of long wire connected to output.
* Formula:  
  Voltage drops in parallel = Initial voltage – Voltage at wire end
* Note down the value and compare results.

1. **Measured value**

* Voltage drops in series: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Volt
* Voltage drops in parallel: \_\_\_\_\_\_\_\_\_\_\_\_\_\_ Volt

1. **Notes**

* Voltage drop tends to be larger in series connections than in parallel due to higher overall voltage in series circuits.