**Solar Electric Technician (Level 2)**

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

**E3: Assignment-Measurement of voltage**

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| **E3: ASSIGNMENT MEMO** | |
| **Date** | …. |
| **To** | Participants |
| **From** | Trainers |
| **Subject** | Measurement of voltage. |
| **What** | Measure voltage at different points of solar PV system as mentioned in the sheet below and compare the findings. |
| **Why** | The objective of the assignment is to perform the voltage measurement including:   * AC and DC Voltage. * Solar panel open circuit voltage (Voc), Maximum Power Voltage(Vmpp) and solar array string voltage. * Solar inverter Input voltage (Vdc) and output voltage (Vac). * Battery voltage. * Solar charge controller input and output voltage. * Voltage drops. |
| **How** | 1. Individual or group work of 2 or 4. 2. Gather the required tools and equipment. 3. Read and carefully follow the instructions for each given task carefully and perform the task. 4. Some tasks are provided with notes to assist participants for tallying the measured value or results. 5. Record the findings, measured values, and any observations during the test. 6. After completing the assigned tasks, discuss your results with the class and answer any related questions. |
| **Time** | 60’ |

**Task 1: Measure the voltage of the given AC or DC load.**

1. **Instructions:**

* Set the meter for the highest range provided for AC volt or DC volt.
* Keep rotator switch on V ∿ for measuring AC voltage and V⎓ for measuring DC voltage.
* Insert the test probes.
* Locate the voltage scales.
* Test a common electrical outlet.
* Rotate the selector knob to the lowest range offered that is greater than the voltage indicated (120 or 240)
  + Reinsert the probes as previously.

1. **Measured value: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Volt**

**Task 2. Measure open-circuit voltage (Voc) of solar PV module.**

1. **Instructions:**

* Disconnect the solar panel from the system and ensure no load is connected to it.
* Set your multimeter to the DC voltage setting.
* Measure the voltage by placing the positive probe on the positive terminal and the negative probe on the negative terminal of the solar panel.
* Note down the value.

1. **Measured value: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Volt**
2. **Notes**:

* The open-circuit voltage should match the manufacturer’s specification (e.g., for a 250W panel, Voc could be around 35-40V). ). Refer to the panel specifications to tally the measured value to that of the standard value.
* Compare the measured value to the panel's datasheet specification.
* If the measured Voc is significantly lower, this could indicate panel degradation or damage.

**Task 3. Measure operating voltage (Vmpp) of solar PV module under load.**

1. **Instructions:**

* Ensure the solar panel is connected to the inverter or battery, and the system is operational.
* Set your multimeter to the DC voltage mode.
* Measure the voltage at the output terminals of the panel.
* Note down the value.

1. **Measured value: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Volt**
2. **Notes:**

* The voltage under load (Vmp) will be lower than Voc.   
  For a typical 250W panel, the maximum power voltage (Vmp) could be around 30-35V.
* If Vmp is significantly lower than expected, it could indicate excessive shading, poor system wiring, or faulty connections.

**Task 4. Measure voltage across solar array (string voltage).**

1. **Instructions**:

* Ensure the system is operational, and the string of solar panels is exposed to sunlight.
* Set your multimeter to the DC voltage mode.
* Measure the voltage at the positive and negative terminals of the entire string.
* Note down the value.

1. **Measured value: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Volt**
2. **Notes:**

* The total string voltage should be the sum of the individual panel voltages. For example, if each panel’s Vmp is 30V, and you have 10 panels connected in series, the string voltage should be around 300V.
* Compare the measured string voltage to the calculated value. If it’s much lower, there could be a problem with one or more panels in the string.

**Task 5. Measure input voltage (Vdc) of Inverter.**

1. **Instructions:**

* Ensure the solar array is connected to the inverter and is producing power.
* Set your multimeter to the DC voltage mode.
* Measure the voltage at the DC input terminals of the inverter.
* Note down the value.

1. **Measured value: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Volt**
2. **Notes:**

* The measured voltage should match the input voltage range of the inverter. For example, if the inverter accepts a voltage range of 200-500V, and the array is configured to produce 350V, you should see a value around 350V.
* If the input voltage is outside the acceptable range, there may be an issue with the array configuration or the inverter’s MPPT (Maximum Power Point Tracking) function.

**Task 6. Measure output voltage (Vac) of Inverter.**

1. **Instructions:**

* Ensure the inverter is connected to the grid and is operating.
* Set your multimeter to the AC voltage mode.
* Measure the voltage at the output terminals of the inverter.
* Note down the value.

1. **Measured value: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Volt**
2. **Notes:**

* The AC output voltage should match the grid voltage (e.g., 230V or 120V, depending on the system's configuration).
* If the output voltage is too low or too high, this could indicate issues with the inverter or the grid connection.

**Task 7. Measure battery voltage in off-grid solar system to monitor its state of charging.**

1. **Instructions:**

* Set your multimeter to the DC voltage mode.
* Measure the voltage across battery terminals.
* Note down the value.

1. **Measured value: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Volt**
2. **Notes:**

* The battery voltage will vary depending on its state of charge. For a 12V battery, a fully charged state might show around 12.6-13.8V, while a discharged battery could show less than 12V.
* If the voltage is too low, the battery may be undercharged, or there could be an issue with the charging system.

**Task 8. Measure voltage of solar charge controller to verify proper operation.**

1. **Instructions:**

* Set your multimeter to the DC voltage mode.
* Measure the voltage at the input terminals (connected to solar array).
* Measure the voltage at the out terminals (connected to battery or load).
* Note down the value.

1. **Measured value:**

* Input voltage: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Volt
* Output voltage: \_\_\_\_\_\_\_\_\_\_\_\_\_ Volt

1. **Notes:**

* The input voltage should be similar to the solar arrays voltage, and the output voltage should match the battery’s charging voltage (e.g., 13.8V for a 12V system).
* If the input voltage is correct, but the output voltage is too low, the charge controller may be malfunctioning.

**Task 9. Measure voltage drop in solar wires between solar array and inverter.**

1. **Instructions:**

* Set your multimeter to the DC voltage mode.
* Measure the voltage at output of solar array.
* Measure the voltage at input terminals of the inverter.
* Note down the value.

1. **Measured value:**

* Voltage at array: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Volt
* Voltage at inverter: \_\_\_\_\_\_\_\_\_\_\_\_\_ Volt
* Voltage drops: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Volt

1. **Notes:**

* If the voltage drop is excessive, this could indicate undersized cables or poor connections.