UNIVERSIDAD DE VALLADOLID

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The Environment and Renewable Energy

STAND ALONE PVSyst LABORATORY REPORT

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ABSTRACT

The main objective of this session is to build a real stand-alone PV system (‘’T’’ setup), to observe how it works and to measure the main magnitudes under different irradiation conditions and load ones.

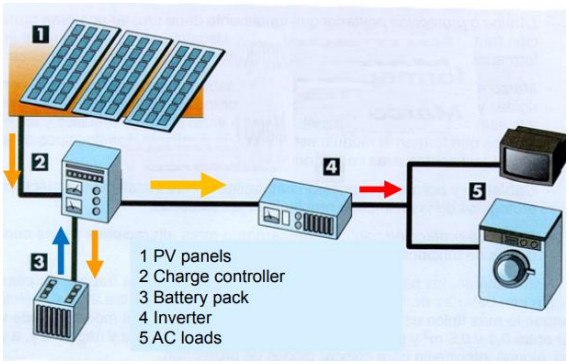
This report is divided, as follows, in three parts:

1. **Inputs**
2. **Procedure**
3. **Output**

Every part shown will explored in the following report.

INPUTS

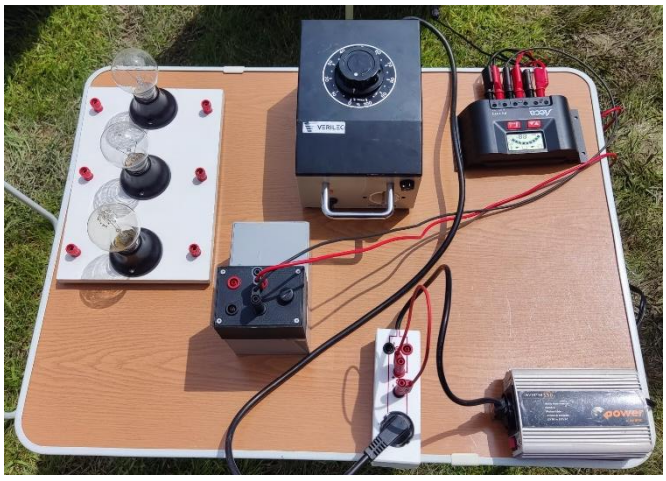
A stand-alone PV system ‘’T’’ setup without DC load is shown as follow with a scheme, the differences between the scheme and components used are the type of AC loads: variable transformer and AC bulbs in the real case.



The laboratory session required, as shown:

- PV panel
- Controller
- Battery pack
- Variable Transformer
- 220V AC bulbs
- Multimeter
- Power-meter tool

Following are shown all the components used not connected yet, below there is an overall of them:



	*PV panel*: a monocrystalline one with:
	Pmax=90W Vmp=19.54V Imp=19.54A Voc=23.44V Isc=4.98A
	*Controller*: in delivering energy it gives priority to the load, if the energy is not enough it takes energy from the battery until reaching the minimum of battery charge. It is used one with only one plug for one load and its specs are:
	I=10A V=12-24V
	*Battery pack*: in this case a small lead-acid battery that has the possibility to be charged and discharge with a fast rate, useful to study behavior of this configuration in low battery charge condition and its specs are:
	V=12V Capacity=12Ah
	*Variable Transformer*: the first load of this setup that allows us to change the energy demand to the source of energy and its specs are:
	Power= 625VA Outputs 0-250V and 2,5A
	*220V AC bulbs*: the second load after the variable transformer, they will be connected in parallel among them. With them it can be seen if the system is working in the right way.
	*Multimeter*: to measure: Voltage, Current and Power.
	*Power-meter tool*: to take measures before the loads and know the amount of energy they are asking to the system.

PROCEDURE

After setting up all the system, connecting:

- PV panel, battery and inverter to the controller;
- Power-meter tool between inverter and variable transformer;
- 3 AC bulbs in parallel connection to the variable transformer.

During the laboratory session were performed 7 measurements as the following images will show, measurements were taken caring before about the *best orientation* of the panel to the sun thanks to the voltage displayed on the charge controller:

<table>
<tr><td>Case 1</td><td>Case 2</td></tr>
<tr><td> 
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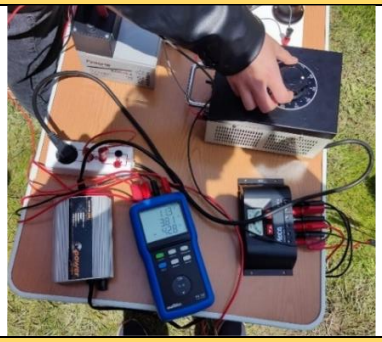
<tr><td>Case 3</td><td>Case 4</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Case 5</td><td>Case 6</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Case 7
  </td><td>In all the cases the firsts 5 cases the only multimeter present has current from the PV panel and voltage from the battery to display the power delivered to the loads.

In Case 6 and Case 7 there were two multimeters one connected before the load (power-meter tool) to know what is the loads' demand and the second connected before the battery (voltage from battery and current received by the battery from the controller) to know if it is in charge displayed with positive power convention or if it is discharging displayed with negative power convention.</td></tr>
</table>

OUTPUTS

Following a table with all the test's variables and comments about results.

Cases	Shadow	LOAD 1 Variable Transformer	LOAD 2 AC bulbs	Charging Battery	Discharging Battery	COMMENTS
Case 1	No	Off	Off	Yes (33.9W)	No	PV module is only charging the battery.
Case 2	Yes	Off	Off	Yes (4.2W)	No	PV module is only charging the battery. It is done with a lower rate due to the presence of shadows.
Case 3	No	On	On	No (1.2W)	No	High load, battery is charged and only PV module providing energy to the loads.
Case 4	No	On	On	No	Yes (-28.9W)	High load, also the battery providing energy in addition to the PV module. The battery discharging itself.
Case 5	No	Off	Off	No	Yes (-42.8W)	Sound appears then loads goes off, so the load is too high. The sum of the energy provided by PV module and the battery is not enough so, who has the minimum cutting values between controller and switcher, cuts the circuit.
Case 6	No	Yes (41.5W)	On	Yes (Positive) (+0.5W)	No	Energy provided by the PV module to the loads and to the battery because a little current is flowing inside the battery like shown by the second multimeter.
Case 7	No	Yes (66.0W)	On	No	Yes (Negative) (-29.3)	Battery and PV panel providing energy to the load. As shown by the second multimeter current is flowing from the battery to the loads.