SOLAR STAND ALONE SYSTEM

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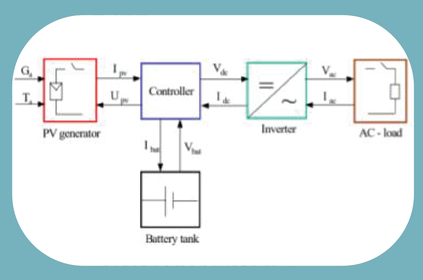
Sddec19-06 Class of 2019

PROJECT OVERVIEW

- As renewable energy sources become more developed, the power industry has begun to implement them into mainstream power generation.
- The goal of this project is to help students gain an understanding of the characteristics of a solar PV system.This is done by using a simulation in Simulink as well as experiments done with the physical solar PV system in the EE 452 lab

Solar Panels in Coover



Solar PV System

HOW DOES THE SYSTEM WORK?

- Two 135 watt solar panels in series along with two 24V batteries for power.
- A Maximum Power Point Tracking (MPPT) device
  - To adjust the duty ratio maximizing power for any given load
- Direct solar setting.
  - Clearly demonstrate the characteristics of MPPT.
- Experiments can be run to show how PV systems work when using: direct solar (DC), MPPT, AC, and 3 - phase.

MPPT

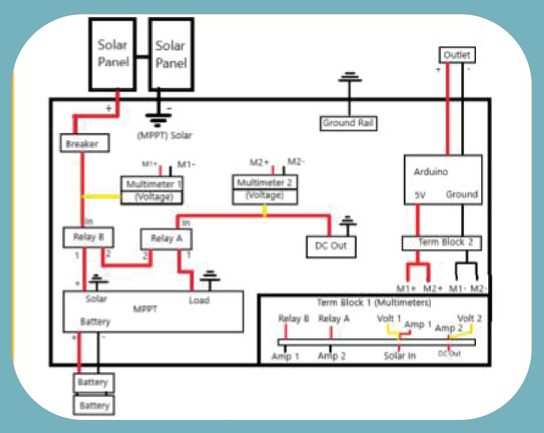
COMPONENTS

- Solar panels
- Batteries
- MPPT
- Termination blocks
- Inverter
- Three-phase converter
- Resistor box
- Matlab/Simulink

THE SOLUTION PROCESS

- Researched in order to gain a complete understanding of PV systems, to be able to help students grasp important concepts as they interact with it for the first time.
- Re-engineered the system.
  - Took it apart, redesigned it, and installed new multimeters.
  - Assured the system functioned correctly so that PV relationships can be easily understood by the EE 452 students.

THE SYSTEM



System Wiring

External View

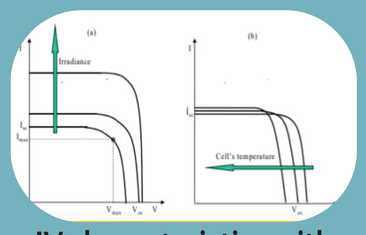
TESTING

- Record voltages, amperage, and power.
- Compare values under similar conditions (irradiance and temperature) between hardware and simulation.
- Run the experiments for EE 452 lab.

R	Irr	Vsim	Vhard	Psim	Phard	Temp = 25
OC	75	39.74	39.03	0	0	
200	73	38.51	35.66	7.4151005	6.358178	
143.2	69	38.24	32.37	10.2115754	7.31715712	
100	67	37.34	25.13	13.942756	6.315169	
25	65	13.45	6.804	7.2361	1.85177664	
16	64	8.523	4.364	4.54009556	1.190281	
5	63	2.682	1.397	1.4386248	0.3903218	

Comparison of simulation MPP and hardware MPP under similar conditions

IRR - TEMP RELATIONSHIP



IV characteristics with changing irradiance (a) and cell temprature (b)

COST

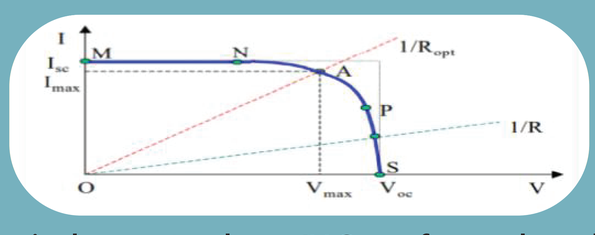
Three teams project costs include:

- Resistors Box: $248.65
- Solar Panels: $350.00 x 2
- Batteries: $45.98 x 3
- Enclosure: $53.70
- Circuit Breaker: $19.19 x 3
- Arduino Uno Rev3: $22.00 x 2
- Banana Pins: $.65 x 24
- Fan: $5.87 x 3
- Digital Multimeter: $19.99
- Terminal Blocks: $5.60 x 4
- Resistor Clips: $31.4
- Resistor Enclosure: $38.96
- Circuitry

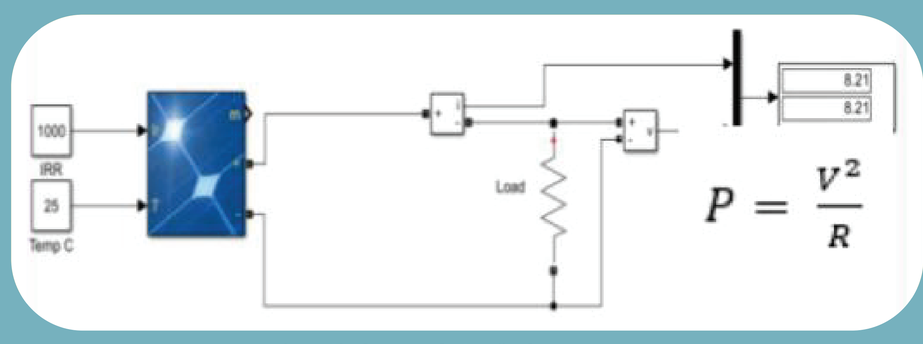
TOTAL COST ≈ $1406.83

UNDERSTAND THE SYSTEM

- Weather dependent
- Irradiance and Temperature
- Max Power Tracking



Typical current-voltage IV Curve for a solar cell



Simulink Model of The System