# *Solar Cell Power Tester*

# TEST PLAN

Version 2.0

VERSION HISTORY

| ID & Version # | Prepared By | Revision Date | Reason |
|---|---|---|---|
| 1.0 | Team 8 | 11/2/2018 | |
| 2.0 | Team 8 | 11/24/2018 | |

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# 1 INTRODUCTION

## 1.1 PURPOSE OF THE TEST PLAN DOCUMENT

The solar cell tester plugs into a USB compatible computer or smartphone and measures the voltage and current a solar cell provides under the current lighting conditions. The I-V curve is displayed along with the true maximum output power of the cell. This information can be use for a variety of purposes, including:

- Comparing the maximum output power with the advertised value
- Identifying cell types based on characteristic I-V curves
- Checking if cells are suitable for a particular project

# 2 TEST ITEM

## 2.1 PROJECT DESCRIPTION

Solar system design requires finding solar cells which meet the system output power requirements. Cells are specified by their theoretical output power, but actual output varies widely. Device chemistry, manufacturing quality, and the brightness of available light all influence the final output.

Output power is obtained by multiplying the current (I) and voltage(V) produced by cells as the electrical load changes. Commercial measurement tools are targeted at large solar systems and cost several thousand dollars. Our system provides a reasonably priced alternative for making such measurements in low power hobbyist systems.

**Requirements**

The following criteria define the featureset for the final product:

- Must vary load on solar cell
- Must measure voltage across cell
- Must measure current through cell
- Must produce an I-V curve
- Must provide the sample data
- Must be powered by USB
- Must be able to dissipate load heat

● Must prevent overheating of load
● May support averaging voltage/current measurements

**System Architecture**

The system consists of a microcontroller, a power sensor, and a variable load. The microcontroller adjusts the load, demanding different amounts of power from the solar cell. The power sensor records the voltage across the solar cell and current through the cell. Graphing the resulting data produces the cell I-V curve. The maximum power point occurs where voltage multiplied by current is maximum.

## 2.2 ITEMS TO BE TESTED

To enable rapid prototyping, our device is based on the circuit designs for the Arduino Micro and the Adafruit INA219 Current Sensor Breakout. A MOSFET with PWM switching provides the variable load, while the INA219 measures input voltage, and voltage drop across a shunt resistor. The INA219 communicates over I2C and supports computing current and power as well as multiple sample averaging.

| Item to Test | Test Description | Test Date |
|---|---|---|
| Processor ATmega32U4 | Test Microchip | 11/24 |
| Firmware | Flashing bootloader Arduino | 11/26 |
| Software | Develop Arduino environment And Python plotting | 11/31 |

## 2.3 TEST APPROACH(S)

**Test Microchip:** Processor ATmega32U4 has been soldered in to the printed circuit board . Connect the microchip through the USB serial port to computer.

**Flashing bootloader Arduino**: Firmware using AVR Dragon to flash chip memory with .hex file bootloader

**Develop Arduino environment And Python plotting** : Python send a character command through serial port to the chip to initiate the transmission..

## 2.4 TEST PASS / FAIL CRITERIA

**Test Microchip:** Processor ATmega32U4 has been soldered in to the printed circuit board . Connect the microchip through the USB serial port to computer.

**Flashing bootloader Arduino**: Firmware using AVR Dragon to flash chip memory with .hex file bootloader

**Develop Arduino environment And Python plotting** : Python send a character command through serial port to the chip to initiate the transmission.

## 2.5 TEST DELIVERABLES

Testing MOSFET on prototype: Getting the approximate result as expected.
**Input and Output** : Pass no issue occur.
**Test Current/Power Monitor on prototype:** Got the right Voltage and Current measurement on the chip
**Flashing bootloader Arduino**: Chip was able to boot through the bootloader. However, when upload the sketch the chip went to fault clock signal. we have to hit the hardware reset button in order for the chip to to boot again but this time it will load the sketch and set the right clock for the chip. After that result is as expected
**Develop Arduino environment And Python plotting** : Python send a character command through serial port to the chip to initiate the transmission.

## 2.6 TEST RISKS / ISSUES

**Testing MOSFET on prototype:** MOSFET can easily overheat
**Test Microchip:** when solder, the pins on the chip got solder overlay to each other. Set the right temperature for solder to melt
**Flashing bootloader Arduino**: Clocking issue. Solving it by hard reset button

# 3 ROLES AND RESPONSIBILITIES

## 3.1 ROLES AND ASSIGNED RESPONSIBILITIES

| Role | Responsibility |
|---|---|
| Jeff Fischer | Testing Hardware, Soldering |
| Phong Nguyen | Firmware and Soldering |
| Adel Alkharraz | Software and documents |
| Ali Bosherhri | 3d print case and software |