OUC All-in-One Photovoltaic Sensor

Final Demonstration Video

Group 5

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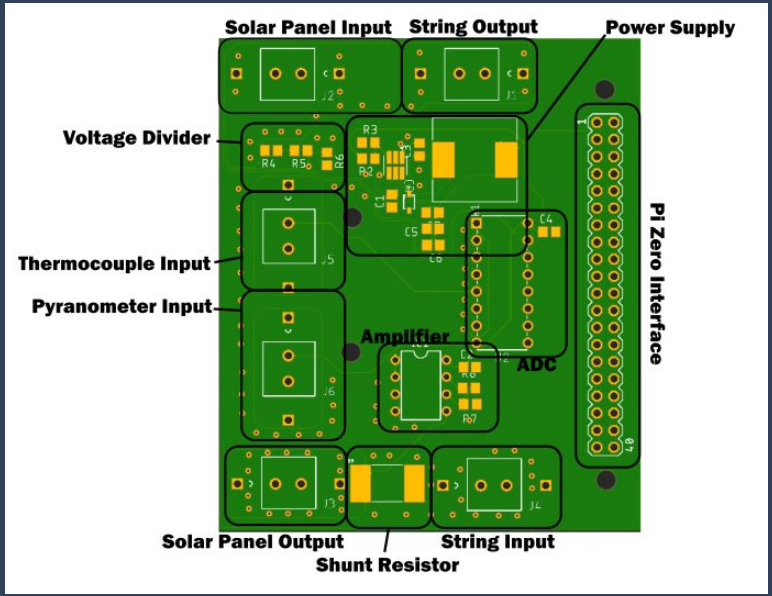
Demonstrable Specifications

Requirement:	Specification:
Voltage Measurement Accuracy	Measured within 5% of real value
Current Measurement Accuracy	Measured within 5% of real value
Data Transmission	Accessible on the local database within 10 seconds from time of measurement

PCB Layout

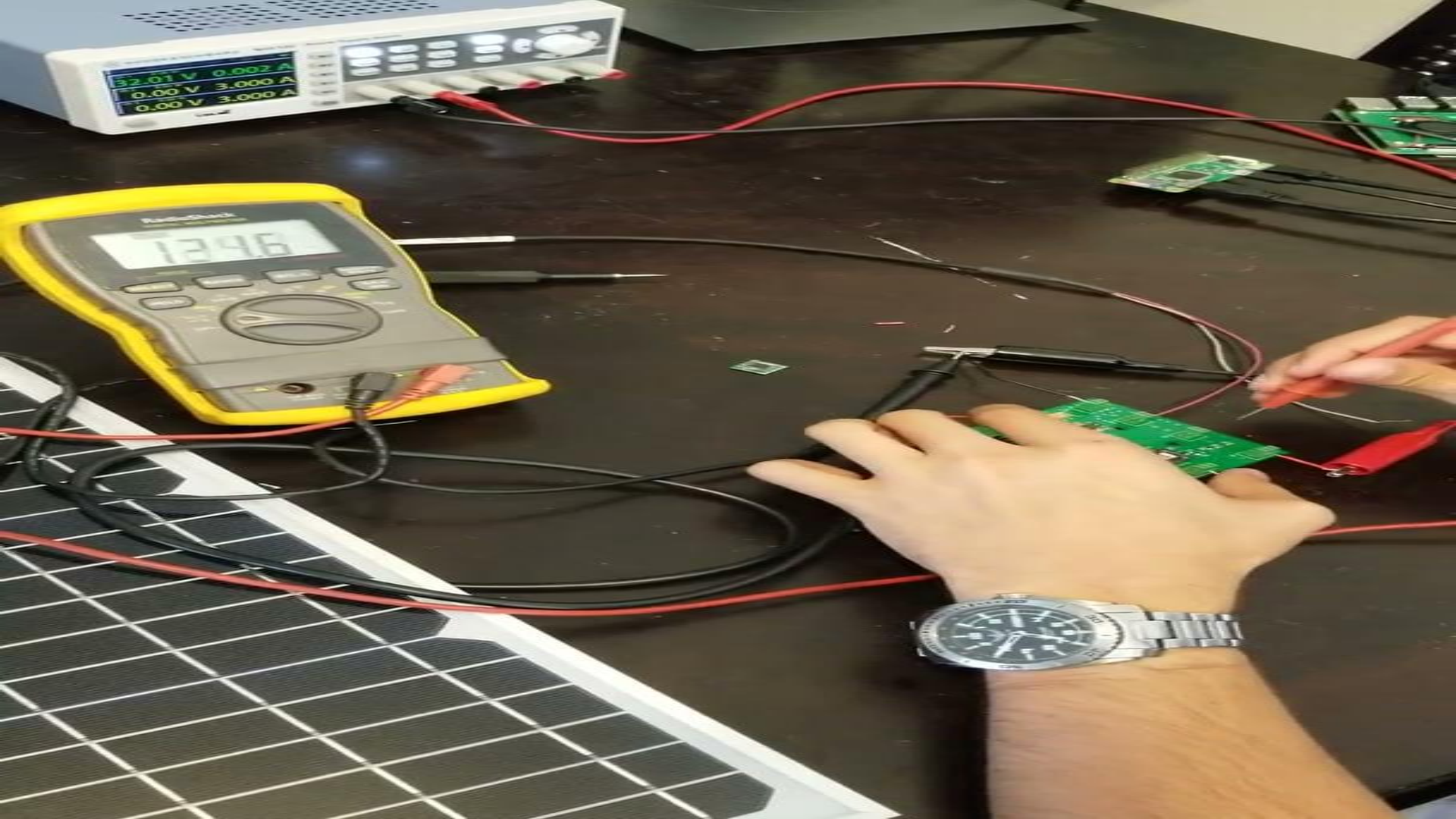
Our printed circuit board incorporates three major sections: an Analog to Digital Converter to send digital data to the Raspberry Pi, a dual operational amplifier to create the desired voltage and current levels for the ADC, and a DC to DC converter to provide an appropriate level of power to the rest of the system



Power Supply and Amplifier Circuits

The power supply takes an input voltage ranging from 8 to 32 volts and outputs a steady 5 volts that powers the other ICs in our design.

The amplifier is a dual operational amplifier which modifies the voltages that represent the voltage and current readings for use by the ADC. The voltage reading is pushed through a unity gain buffer while the current reading is multiplied by 85.


32.01 V 0.002 A
0.00 V 3.000 A
0.00 V 3.000 A
1296

The Current Amplifier

As seen in the demo videos, we show a low current reading (less than 200 mA). This is due to the low amount of DC load that was accessible to us.

We spent time with our sponsor at the OUC solar array hooking our device up, and to no avail. When hooked up to the array, we were showing incorrect current. When connected to the light DC load they provided, we had accurate measurements.

We expect amperage levels up to and including 10 A, so when we had a load only consuming 0.1 A, the measurement range was limited.

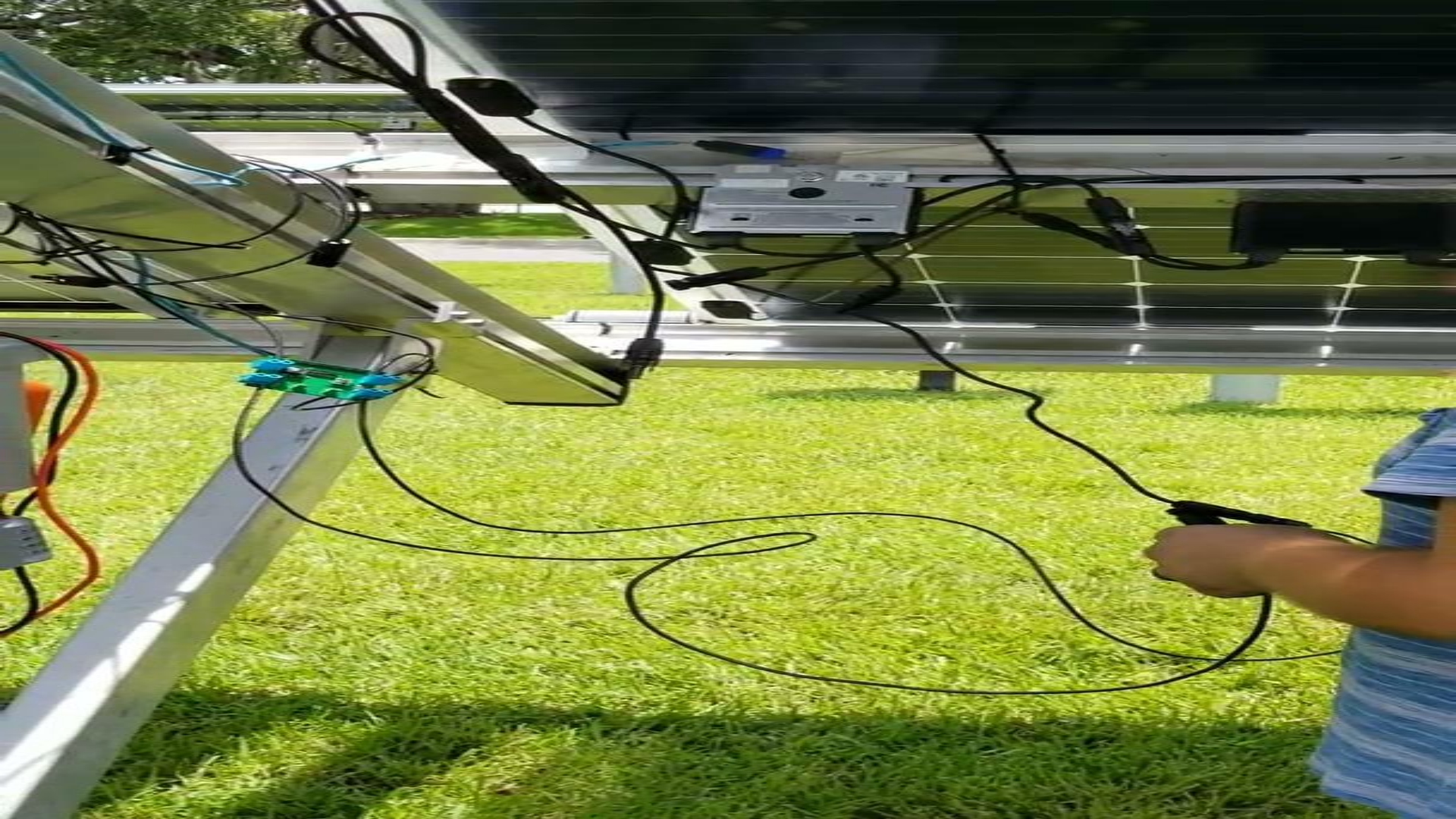
Data Transmission

Specification:
Data should be accessible on the local database within 10 seconds from time of measurement

Result:
Over 10,000+ insertions the average data transmission time was 50 milliseconds, with a maximum time of 672 milliseconds.


Sensor: B8:27:EB:01:44:7B
Timestamp: 2021-07-24 02:41:55
Inserted data from sensor 1 in 0.039 seconds.
Voltage: 31.641 V
Current: 0.057 A
Irradiance: 0.000 W/m²
Sensor: B8:27:EB:01:44:7B
Timestamp: 2021-07-24 02:41:56

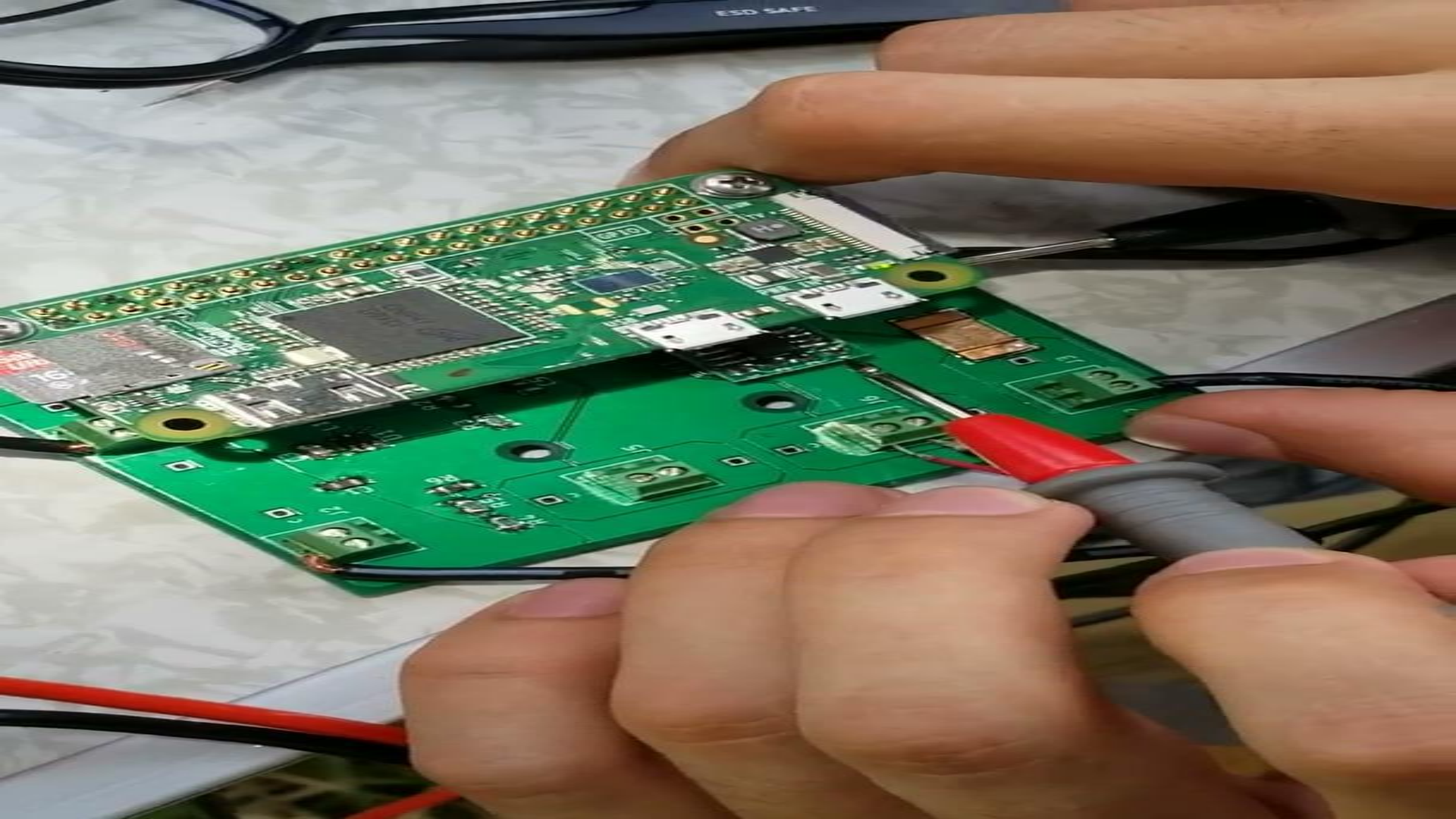
Sensor Connected to Solar Panel



Power Supply Circuit


EXTECH
INSTRUMENTS
AUTO
True RMS Industrial MultiMeter
REL
MAX
MIN
RANGE
Hz
%
EX520
Auto Power Off
MODE
OFF
VAC
Hz
10A
Hz
mA
µA

Amplifier and Analog-to-Digital Converter Circuits


ESD SAFE

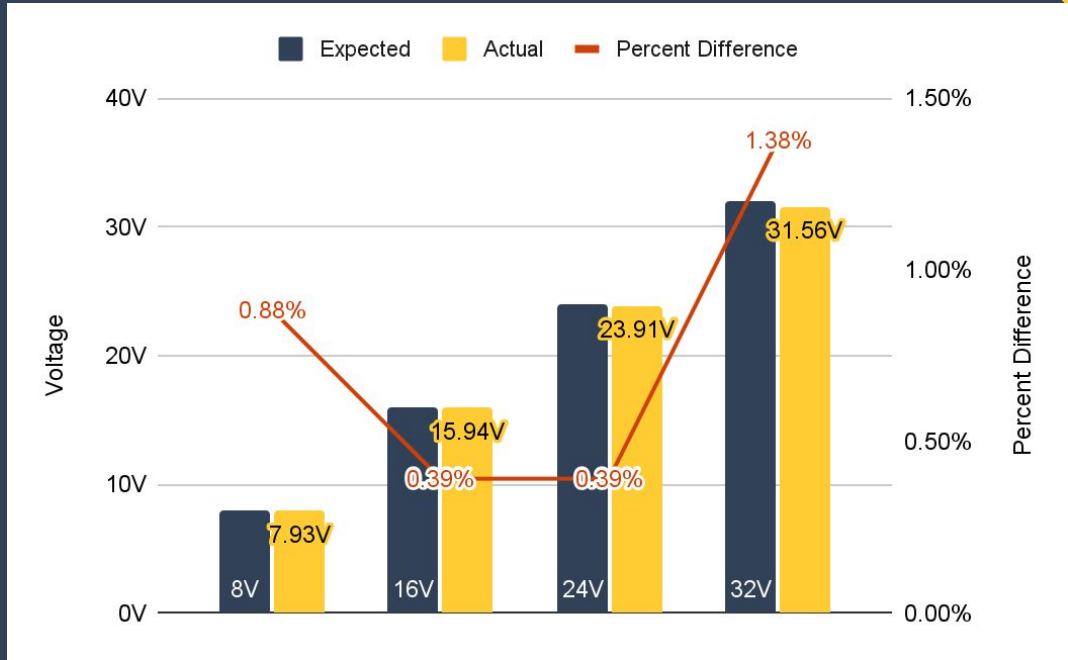
Data Transmission in the Field


+--------------------------------+
| Voltage: 18.086 V |
| Current: 0.071 A |
| Temperature: 1.561 °F |
| Irradiance: 48.828 W/m² |
| |
| Sensor: B8:27:EB:A6:5F:1C |
| Timestamp: 2021-07-21 23:09:13 |
+--------------------------------+
Dropped a sensor connection!
Trying to connect to a sensor...
DELL

Voltage Measurement Accuracy

Specification:
Voltage should be measured within 5% of real value.

Result:
Across four different voltage levels average percent difference between expected and actual voltage was 0.76%, with a peak of 1.38%.



Sensor Connected to DC Optimizer

When connected in parallel with the panel and in series with the DC optimizer, a strange issue occurred: only 1.6V was reaching the input of our sensor.

We tried using a different panel and DC optimizer, but to no avail.

However, connecting our sensor directly to the panel (without the optimizer) allowed the sensor to receive the full 34 V.