

# Electrical Panel Power Sensing System

Nathanael.Frisch@unh.edu  
 Matthew.Corso@unh.edu  
 Department of Electrical and Computer Engineering  
 University of New Hampshire, Durham NH

Nathanael J. Frisch, Matthew C. Corso

Dr. Richard A. Messner, Faculty Advisor



## Problem

- People want to save money on electricity.
- Finding where power is being used can be complicated in modern homes and businesses.

## Motivation

We wanted to analyze existing current sensing technologies and improve upon them by creating our own sensor from the ground up. We found that a modular design, along with a user display, allowed us to create a simple product that could be scaled to fit many applications.

## Goal

Minimum viable product to measure current using a modular system and display it using a master module.

## Master Module:

Talks with the Current Sensor modules via I2C.  
 Organizes the data it receives.  
 Communicates the real-time power usage information to the user.

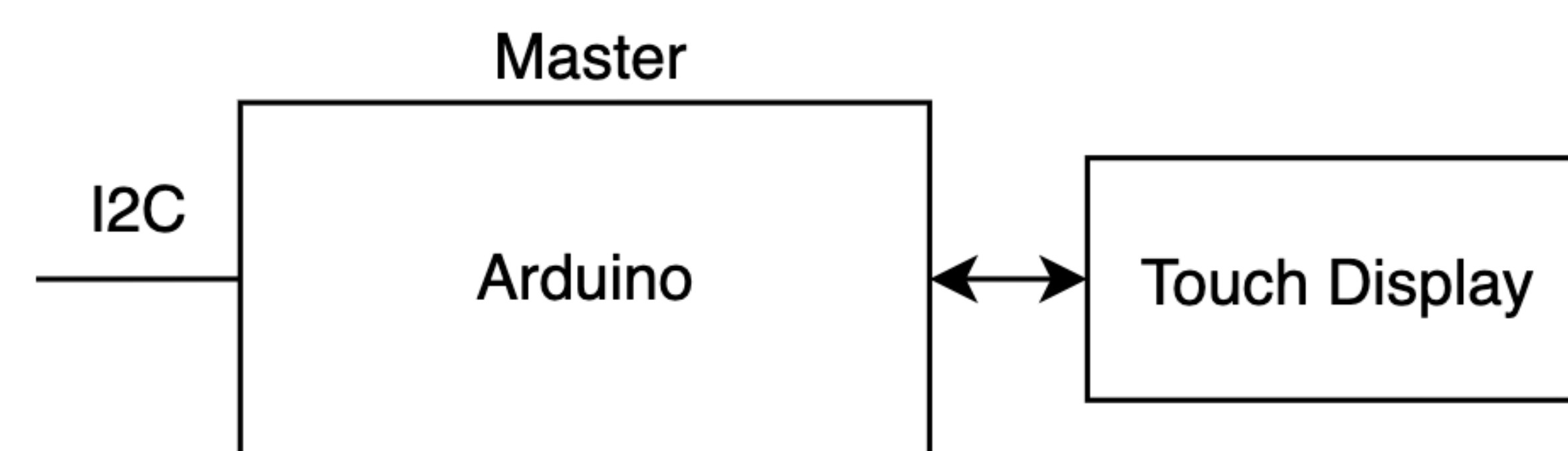


Fig. 2 Master Module with display in development

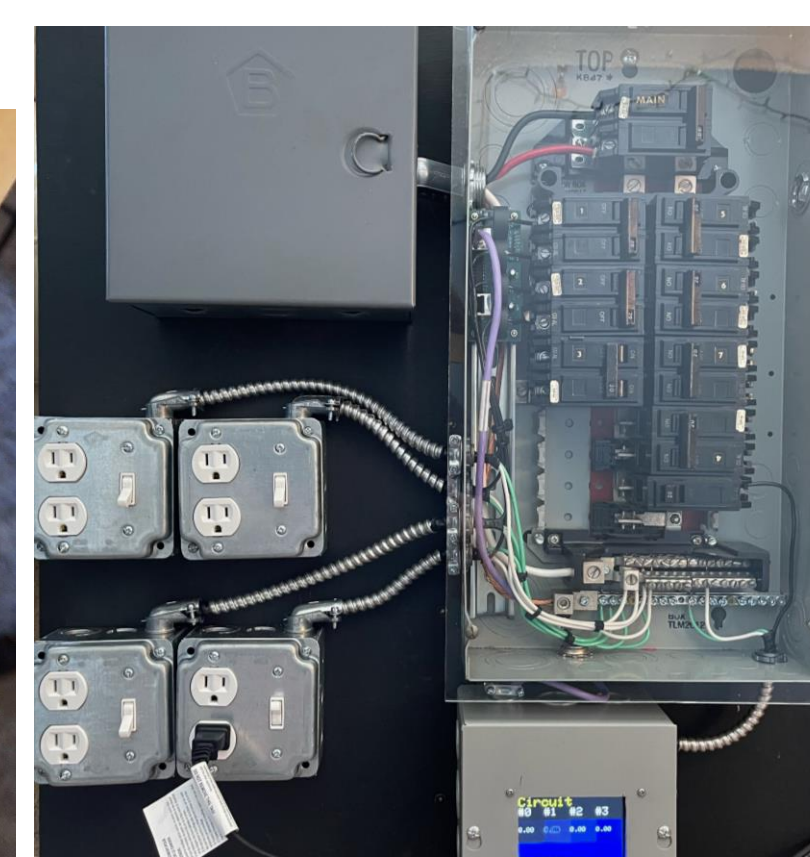


Fig. 3 Complete system installed in a panel

## Project Implementation

**Modular Design** to measure current in breaker panel.

### Single Module:

We designed a circuit board that can communicate with others to send information about current usage.

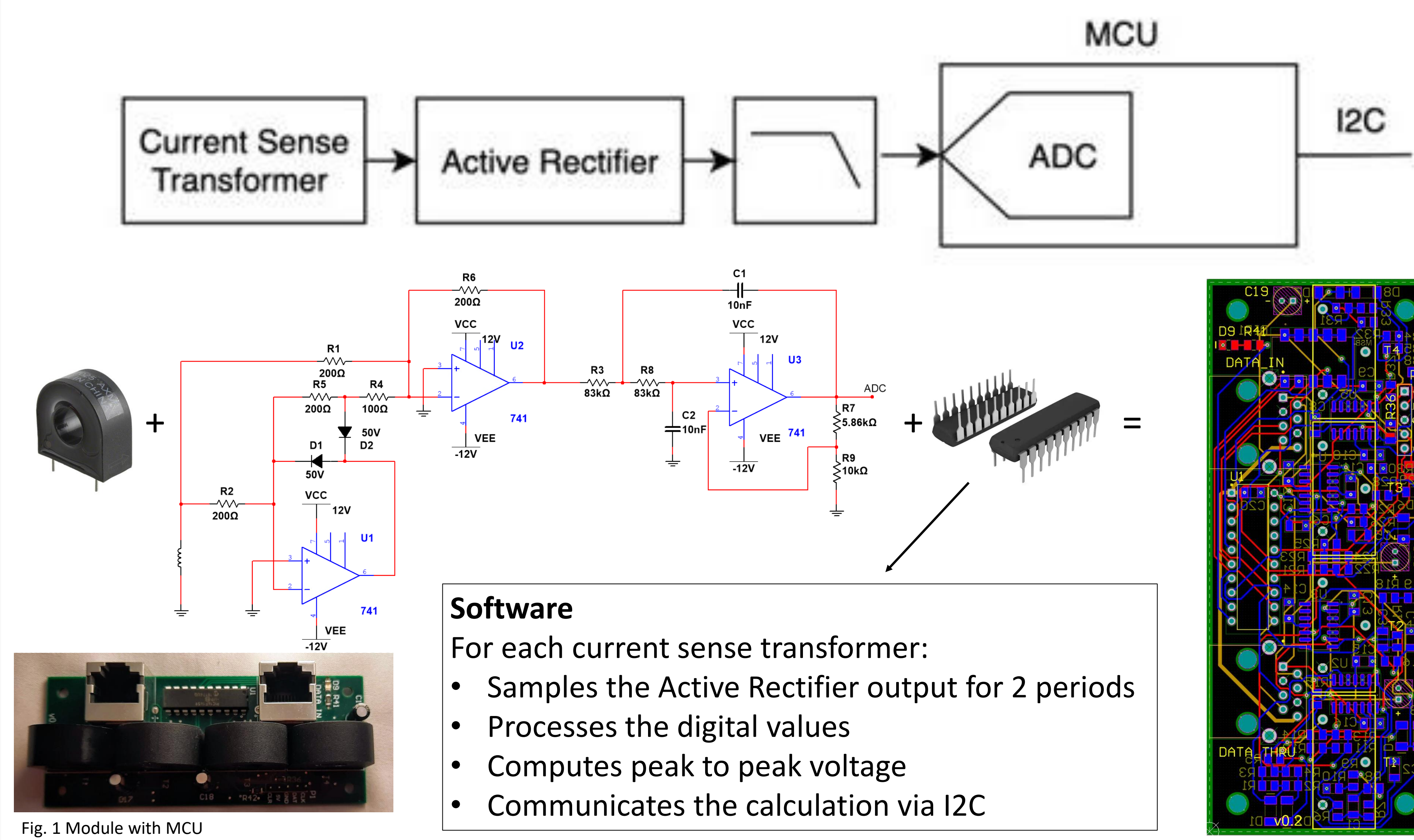
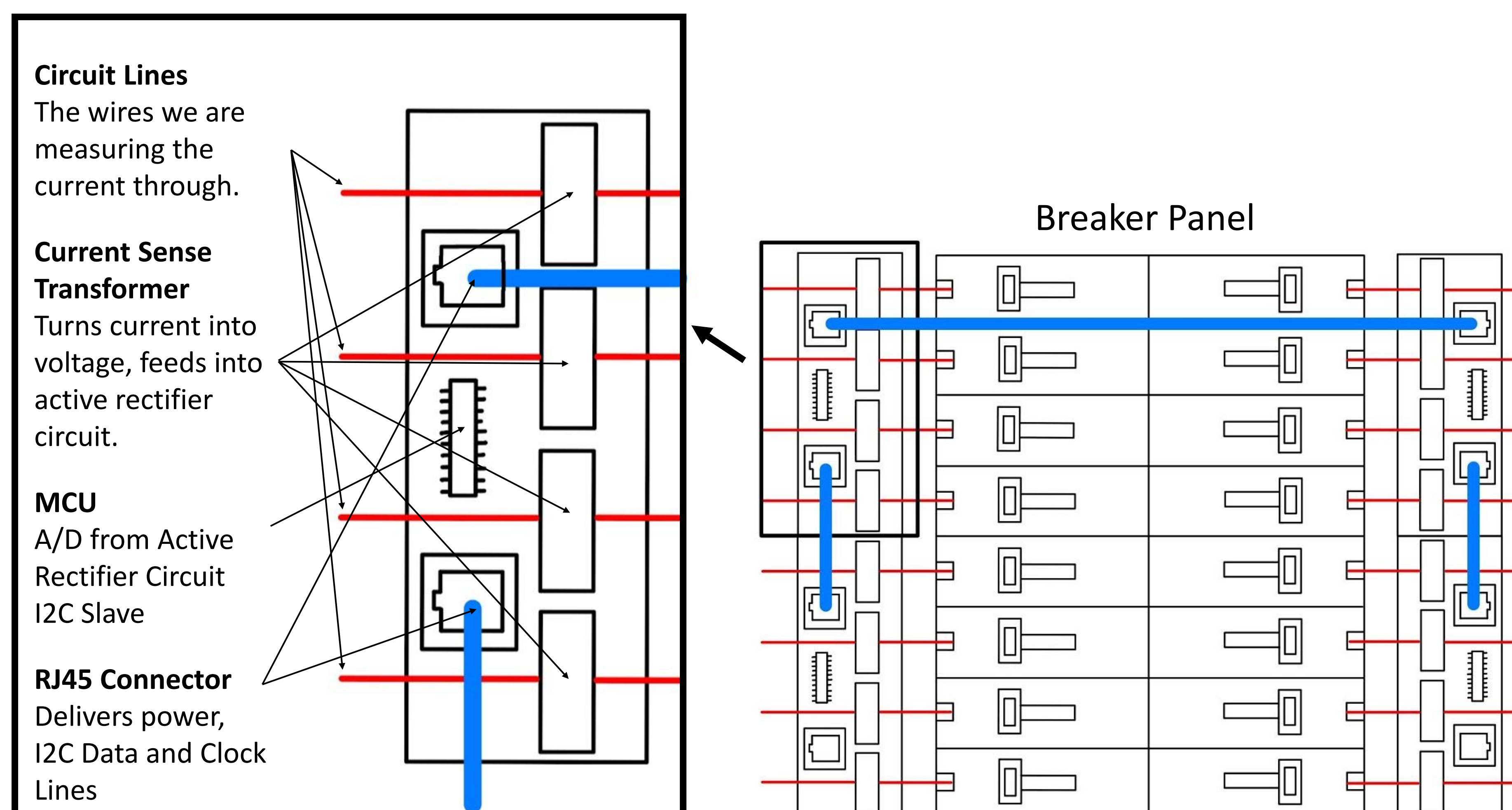


Fig. 1 Module with MCU

### Modules Connected Together:

Multiple modules are connected via Ethernet cable. This allows the device to fit all breaker panels by connecting multiple modules.



## Obstacles

- Picking an MCU with all the necessary capabilities (we went through two different components)
- The module PCB design has over 80 components and many connections (we went through two iterations)
- Choosing op amps that perform best in the active rectifier circuit (three components)

## Achievements

### Module

- Accurate active rectification
- Low pass filter with 200Hz cutoff to avoid aliasing in the digital domain
- MCU efficiently samples signal for 2 periods at 3kHz with A/D conversion

### Modular interaction

- I2C Bus Architecture
- Distributed data and power over single CAT5e cable

### Master module

- Touchscreen display
- Data logging

## Potential Applications

- Reactive vs. Resistive Power
- Panel Load Balancing
- Use the master module to provide data to relays that turn devices on and off
- Collect data from users to allow for device classification with machine learning
- Modify master module to connect to Wi-Fi and sync to mobile applications

## Acknowledgments

Mario Maimone for donating a breaker panel.  
 American West Surplus for donating a resistor.