Garmin Power Sensor Test Fixture

Amna Aftab, Brandon Floyd, Stephen Julich, Francis Wagner, Xi Zhu

Adviser: Dr. Degang Chen Client: Jeramie Vens

Introduction

During product development at Garmin, engineers want to be able to measure the power consumed by parts of circuits within their fitness electronics. Our power sensor fixture has one channel with two probes capable of measuring currents from 10 µA to 10 mA and voltages from 0 to 5.5 V. We use a microcontroller to calculate power consumption with the aforementioned measurements, and an SD card will be capable of storing the data. Garmin engineers hope to hook up our fixture to different circuit sections of a gadget and let it run overnight to obtain a comprehensive set of power consumption data points.

Overview

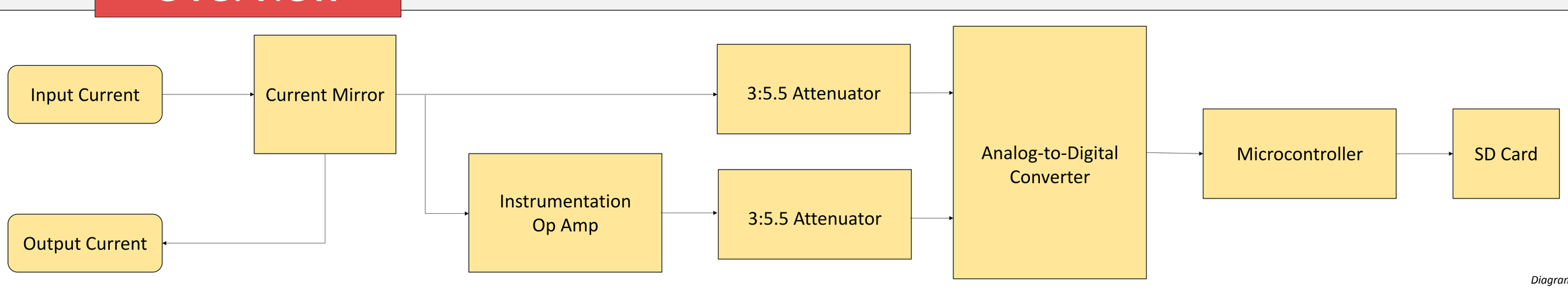
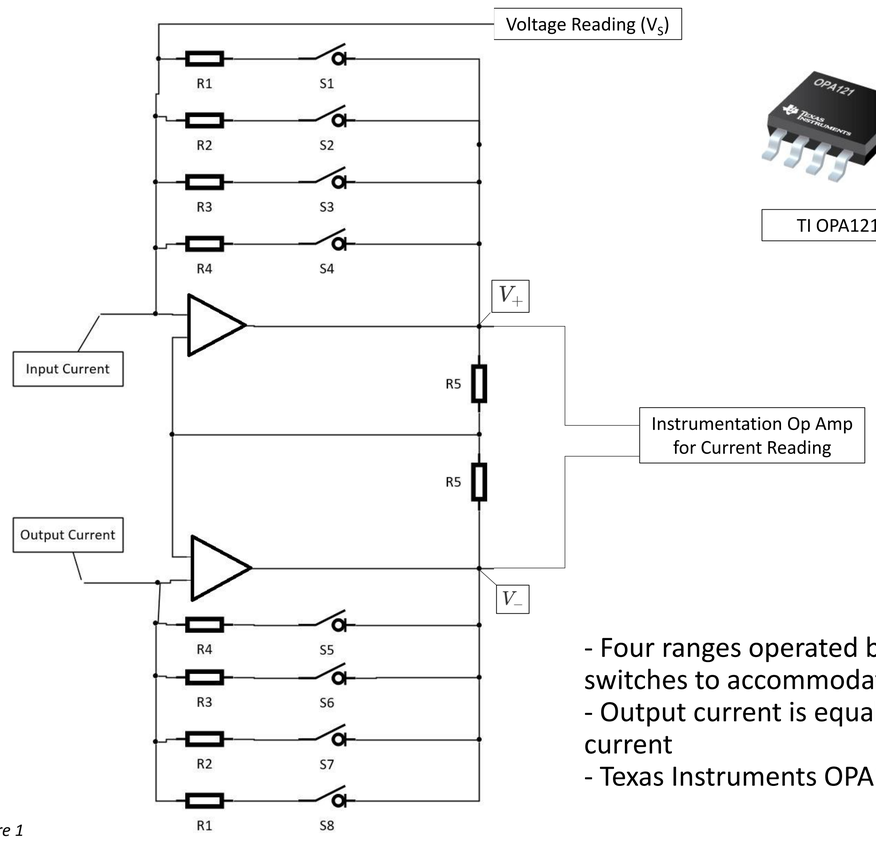


Diagram 1

Current Mirror Design



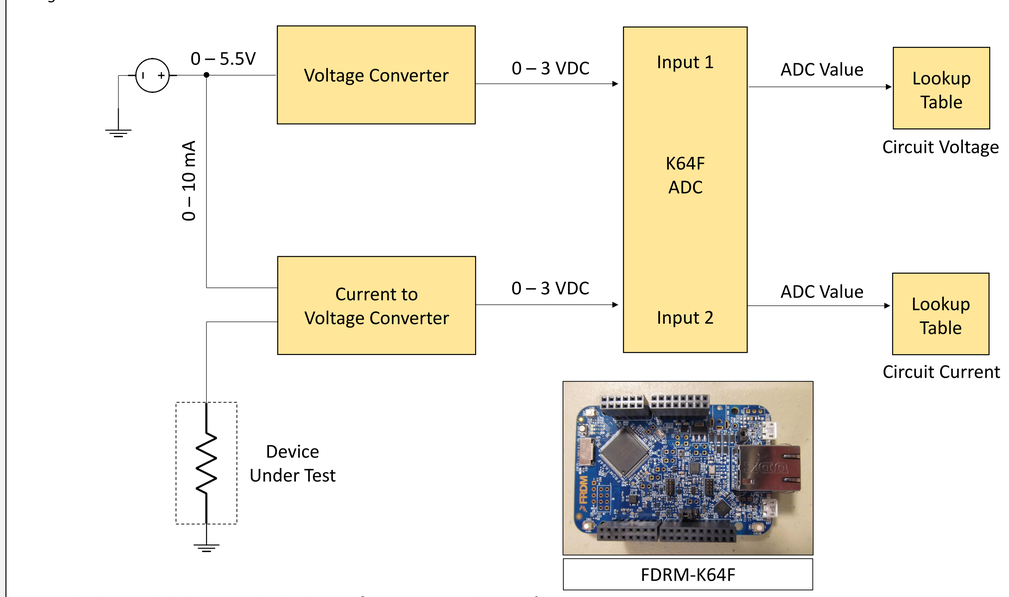
TI OPA121

- Four ranges operated by manual switches to accommodate currents
- Output current is equal to input current
- Texas Instruments OPA121

Figure 1

ADC Design

Diagram 2



FDRM-K64F

- ADC on FRDM-K64F Development Board
- Current measured at a min. rate of 10 ksamples/seconds
- Voltage measured at a min. rate of 1 sample/seconds
- Unattended data logging to an SD Card for up to 16 hours

Theoretical Results

$$V_{out} = V_{in} \cdot \frac{R_1}{R_1 + R_2}$$

- 3:5.5 Attenuator
- R_1 = 1.2 kΩ, R_2 = 1 k Ω

* See Figure 2 for Attenuator Design

$$V_+ = V_S - I_S \cdot R_F$$

$$V_- = V_S + I_S \cdot R_F$$

- Voltage readings to Instrumentation Op Amp
- Source voltage and current to obtain power measurements

* See Figure 1

$$V_{cm} = V_+ + V_- = 2V_S$$

$$V_{dm} = V_+ - V_- = 2I \cdot R_F$$

- Common and differential mode voltages
- Input to Instrumentation Op Amp

Numerical Results

Figure 2

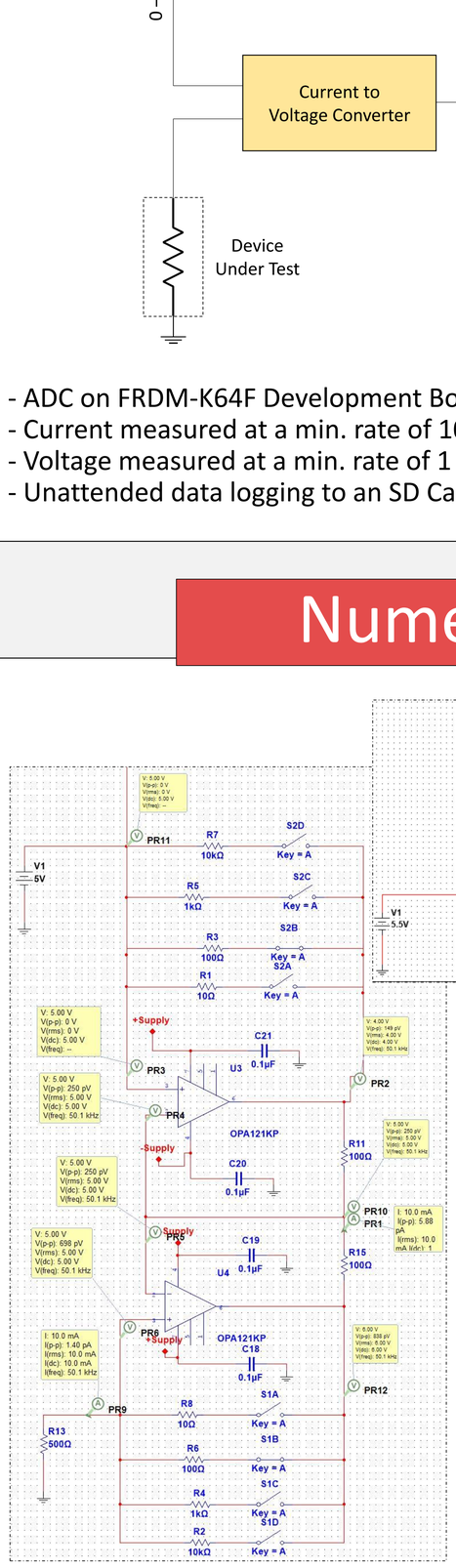


Figure 3

- Current Mirror Performance Test (Left)
- 3:5.5 Voltage Attenuator Test (Above)
- Multisim software used for testing