

ELECTENG209  
Team 02:  
Project Component Values

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13/08/2020

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# 1 Introduction

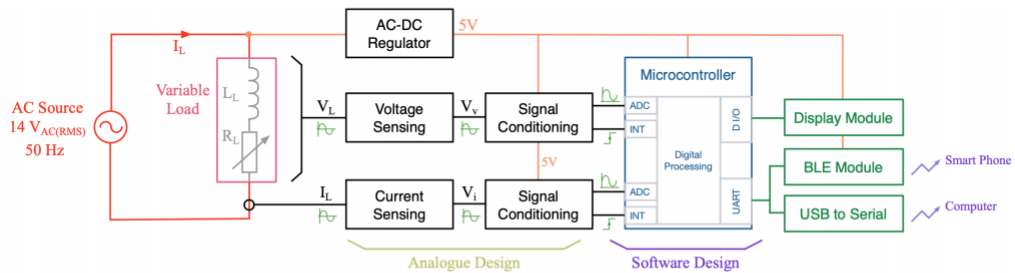
This document details the circuits and component values we will use to build our project. The structure and order of the component values and circuits described follow the order of the Labs.

The basic structure of components is as follows:

## System to Implement

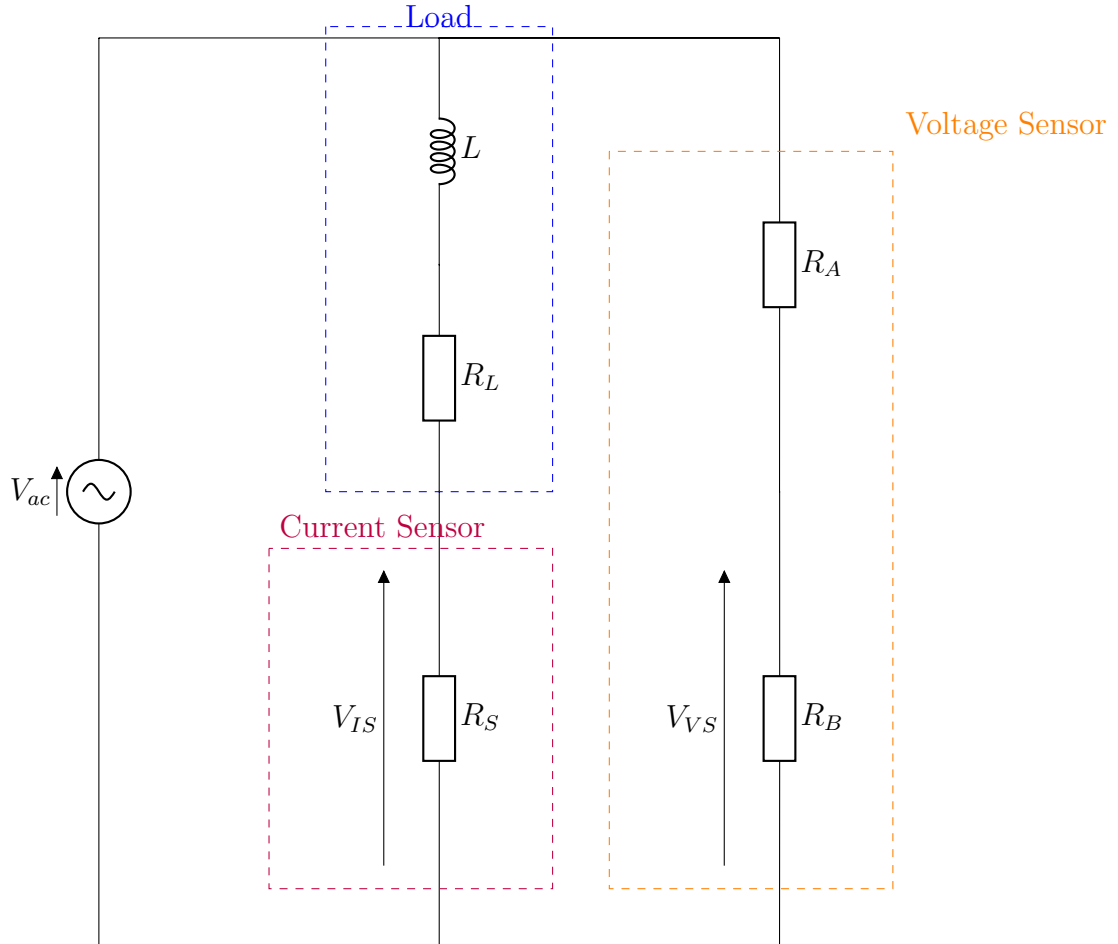


- To simplify the design, we will consider a scaled-down system, which uses a low-voltage AC source
  - An AC load, consisting of a variable resistor in series with a fixed inductor, is used to emulate an house-hold appliance



All (fixed) component values are based on the The E-12 Series

## 2 Voltage & Current Sensors



$R_S$  is the Shunt Resistor that we use to measure the current drawn through the load.

$V_{IS}$  is the voltage dropped across the shunt resistor ( $R_S$ ). This drop in voltage is proportional to the current through the shunt resistor (and therefore proportional to the current through the load).

**The nominated value of  $R_S$  is  $R_S = 0.56 \Omega$ .**

$R_A$  and  $R_B$  are the two Voltage Dividers that make up the voltage sensor. The Voltage sensors output is taken to be the voltage across  $R_B$  ( $V_{VS}$ ).

**The nominated values for  $R_A$  and  $R_B$  are:  $R_A = 82 \text{ k}\Omega$  and  $R_B = 3.8 \text{ k}\Omega$ .**

The following is a table of values to use for testing the limits of the sensors:

Source $V_{AC}$	$V_{AC(RMS)}$	$R_L$
7.5 VA	12.6 V	16.65 $\Omega$
7.5 VA	15.4 V	29.00 $\Omega$
2.5 VA	15.4 V	92.82 $\Omega$

### 3 Measurement Conditioning

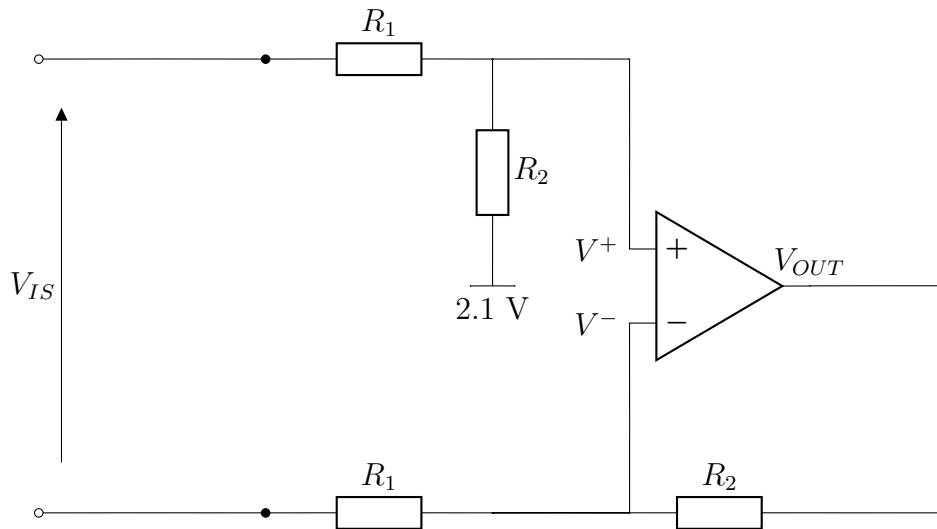


Figure 1: Current Signal Conditioning Circuit

The the four resistors of value  $R_1$  and  $R_2$  control the gain and offset applied by the Operational Amplifier to the input signal  $V_{IS}$ .

**The value of  $R_1$  and  $R_2$  is:  $R_1 = 39 \text{ k}\Omega$  and  $R_2 = 82 \text{ k}\Omega$ .**

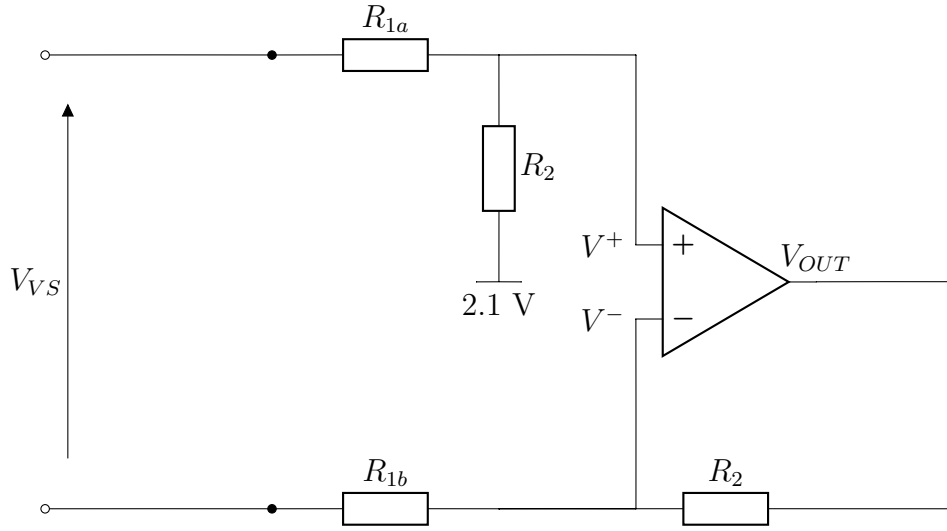


Figure 2: Voltage Signal Conditioning Circuit

The four resistors of value  $R_{1a}$ ,  $R_{1b}$  and  $R_2$  control the gain and offset applied by the Operational Amplifier to the input signal  $V_{VS}$ .

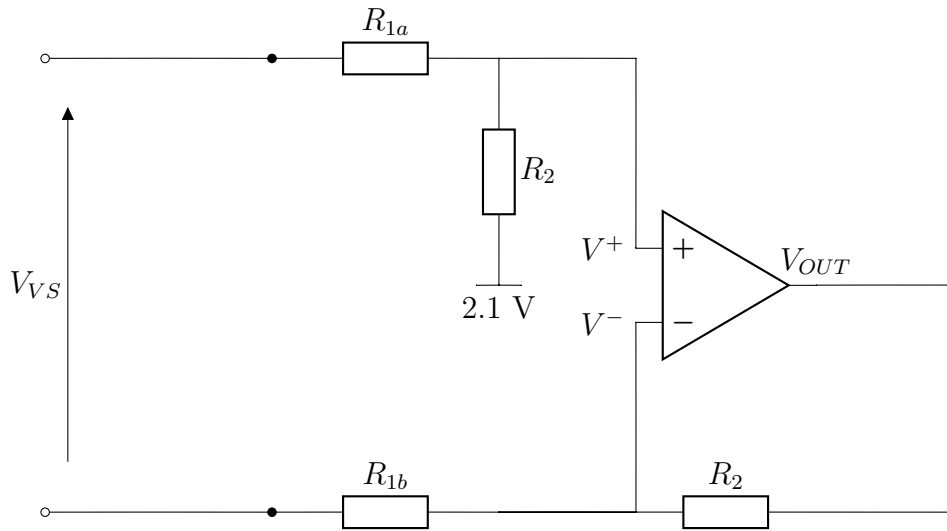
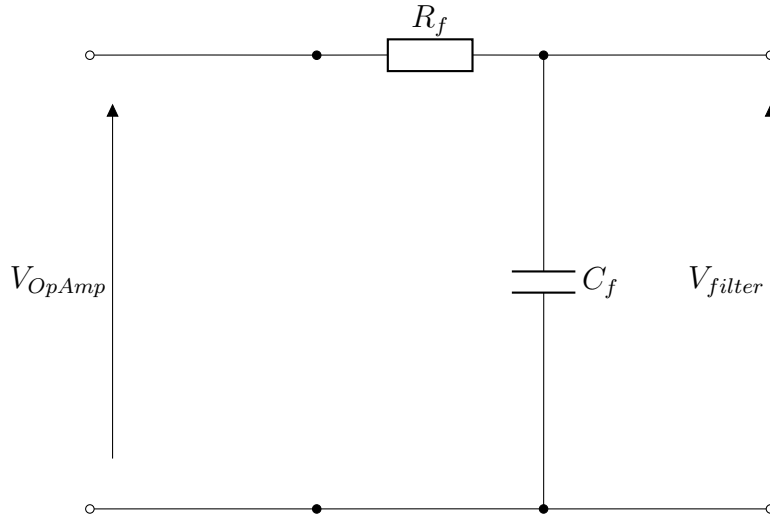


Figure 3: Voltage Signal Conditioning Circuit

**The value of  $R_{1a}$ ,  $R_{1b}$  and  $R_2$  is:  $R_{1a} = 10 \text{ k}\Omega$ ,  $R_{1b} = 47 \text{ k}\Omega$  and  $R_2 = 47 \text{ k}\Omega$ .**

## 4 Filters



The Resistor and Capacitor create a filter that has a breakpoint frequency of 100 kHz.

**The value of  $R_f$  and  $C_f$  is:  $R_f = 33\text{ k}\Omega$  and  $C_f = 4.8\text{ nF}$ .**

## 5 Zero Crossing Detection

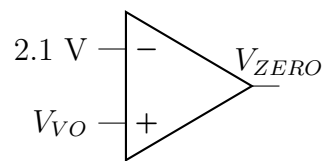


Figure 4: Voltage Signal Conditioning Circuit

2.1 V is a voltage source,  $V_{VO}$  is the conditioned voltage signal.



## 6 The E-12 Series:

1.0  $\Omega$  1.2  $\Omega$  1.5  $\Omega$  1.8  $\Omega$  2.2  $\Omega$  2.7  $\Omega$   
3.3  $\Omega$  3.9  $\Omega$  4.7  $\Omega$  5.6  $\Omega$  6.8  $\Omega$  8.2  $\Omega$  10.0  $\Omega$

(Multiplied by any power of ten).