Agilent Technologies

EL 351 - Linear Integrated Circuits Laboratory
Design of a Signal Conditioning Circuit

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Equipment:

- Agilent 54622A Deep-Memory Oscilloscope
- Agilent E3631A Triple-Output DC power supply
- Agilent 33120A Function Generator
- Agilent 34401A Digital Multimeter

Introduction:

The circuit designer's job is to create circuits that perform a certain function well, reliably, and cost-effectively. If two designers create different solutions to the same problem, both work equally well, and one is half as expensive as the other, the less expensive circuit is likely to be chosen by the supervisor. The designer of the more expensive circuit may well be reassigned to work on the shipping dock unloading boxes from trucks. This experiment is to acquaint you with a practical design problem, similar to what you may be challenged with in industry. There are **many** "correct" solutions to this design problem; you need to come up with only **one**.

Situation:

A temperature (or pressure or sound or strain gauge or accelerometer or magnetic field) sensor has an analog output voltage that ranges from 3 V to 4 V, and an output impedance of 1k Ω. This output voltage is to be conditioned so that it can be sent into an analog-to-digital converter (ADC). To complicate things a bit, two types of ADCs may be used, and the conditioned output voltage must be usable for either one as determined by a SPST selector switch, with positions A and B:

A) the type A ADC has an input voltage range of 0 V to +10 V; so 3 V in produces 0 V out, and 4 V in produces +10 V out.

B) the type B ADC has an input voltage range of -5 V to +5 V; so 3 V in produces -5 V out, and 4 V in produces +5 V out.
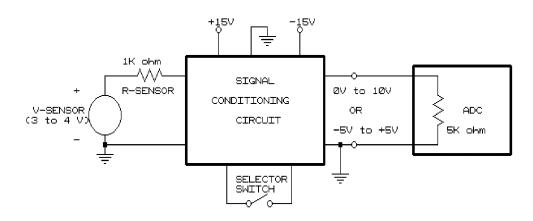
Either ADC has an input resistance of 5k Ω, and operates on ±15 VDC, which are the available supply voltages. See the block diagram below.

Task:

1. Design a signal conditioning circuit that will take the output of the sensor, and will convert the sensor output voltage (varying between 3 V and 4 V) to 0 V to 10 V **OR** to -5 V to +5 V, switch selectable. Give consideration to the loading effect of the signal conditioning circuit on the sensor, to the number of total op-amps, and number of parts in your circuit design. Any op-amp(s) you have used so far may be used, and 20k Ω potentiometers are available.

2. Draw a complete schematic diagram of your design.

3. Simulate the circuit you designed, using an appropriate simulation program (SNAP or PSPICE will work very well), to make sure it works. Have your instructor look at your design and the simulation results before proceeding to step 4.

4. Build the signal conditioning circuit, and test it with an input voltage source that ranges between 3 V and 4 V, with 1K Ω output resistance, which simulates the sensor (adjustable DC is fine, or a sinusoid with DC offset is fine).

N.B.　F　Steps 1, 2 and 3 can and should be done OUTSIDE of lab, prior to coming to lab to do step 4. If needed, you should consult with anyone who can assist you, including your course instructor (who has unloaded far too many trucks on shipping docks!).

Block Diagram of Signal Conditioning Circuit in the Measurement System