Analog Wheatstone bridge-based automatic interface for grounded wide-range resistive sensors

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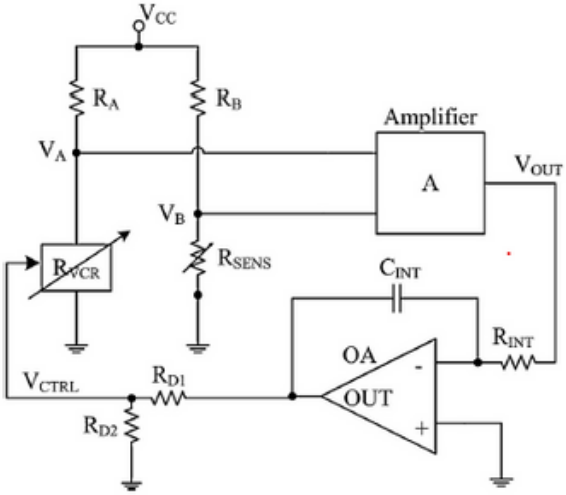
Abstract

Presenting an analog Wheatstone bridge-based architecture for a resistive sensor circuit. In this circuit, the change in external stimulus is measured with a highly sensitive change in resistance. The change in resistance is then converted into output voltage, which holds a direct relation with the reciprocal of the sensor resistance. The circuit operates in autonulling mode, meaning the bridge remains balanced automatically for a wide range of sensor resistance.

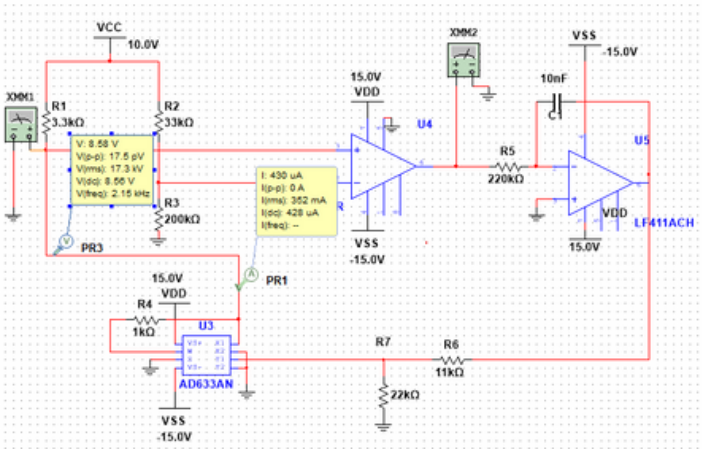
Circuit Design

The proposed circuit works properly for the range of resistive sensor 10kohm to 200kohm in the autonulling mode. In the auto nulling mode the change in the sensor resistance is automatically callibrated across the parallel arm of the bridge and the overall bridge remains balanced, outside the auto-nulling region the bridge is unbalanced as the integrator saturates and in this case output of the amplifier (Va-Vb) is the measure of sensor resistance. A voltage controlled resistance has been employed using a Analog Multiplier by which we can control the resistance value with the help of integrator output voltage.

In Simulating this circuit I have tried to improve the range of resistive sensor value that can be used in auto-nulling mode with least % error.



proposed uncalibrated Wheatstone bridge.



Circuit Simulated in Multisim
Note: Here R3 is the grounded sesnsor resistance.

Observation

By simulating the circuit in this paper i understood the auto-nulling process (automatic balancing of bridge using an integrator) and application of a voltage controlled resistance in balancing the bridge. Investigated the op-amp saturation problem.

Reference paper -

Analog Wheatstone bridge-based automatic interface for grounded and floating wide-range resistive sensors
https://doi.org/10.1016/j.snb.2012.12.044