Self-powered wireless air-flow sensor project – rectifier characterisation

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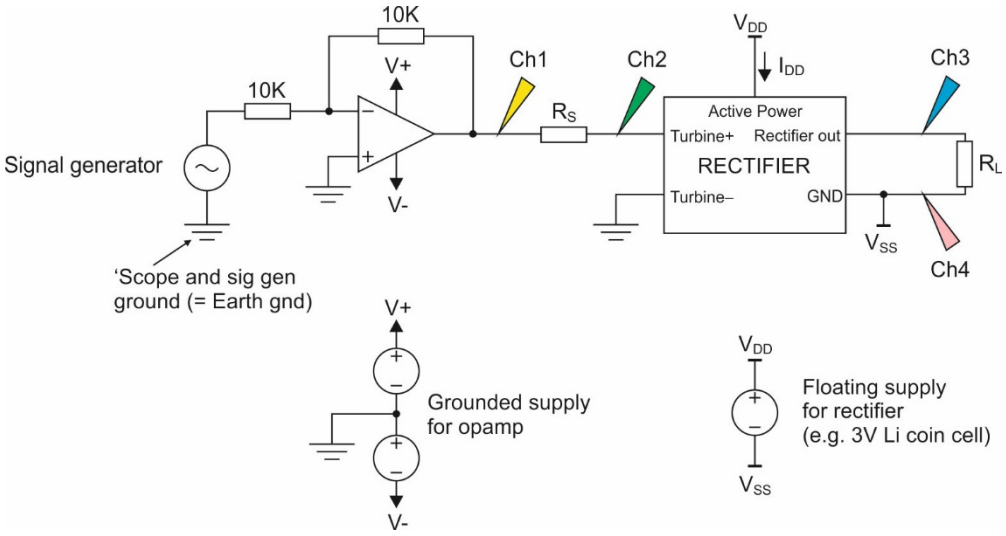
It will be necessary to make accurate measurements of the input power, output power and supply power for the active rectifier. This task is made more complicated by the fact that the rectifier input and output do not share a common ground. The suggested approach is as shown below, where Ch1 – Ch4 are the input channels of a 4-channel scope. (They could equally be channels on a DAQ module if you are planning to use LabVIEW to automate the measurements to any degree.)



The purpose of the Opamp is simply to buffer the output of the signal generator so that the source impedance can be set to a value below 50 Ω. To emulate the microturbine the source resistance should be set to R_S = 20 Ω.

With the 'scope probes attached, the following power values can be extracted (where ⟨ ⟩ denotes time average):

$P_{RECT\_IN} = \langle (Ch1 - Ch2)Ch2 \rangle / R_S$ Rectifier input power

$P_{GEN\_IN} = \langle (Ch1 - Ch2)Ch1 \rangle / R_S$ Generator input power (assuming only resistive losses in generator)

$P_{RECT\_OUT} = \langle (Ch3 - Ch4)^2 \rangle / R_L$ Rectifier output power

Note that the small differential voltage across R_S at low input current levels might be an issue; if so you might want to add a differential amplifier to boost the current sense voltage.

An alternative method for measuring P_{RECT_OUT} would be to use a digital multimeter (DMM). This will work fine provided the DMM has sufficient bandwidth and processes the output voltage ripple correctly.

The rectifier supply power can be obtained from separate measurements of V_{DD} (referred to V_{SS}) and I_{DD}:

$P_{RECT\_SUPPLY} = V_{DD}\langle I_{DD}\rangle$ Rectifier supply power

Note that if V_{DD} and I_{DD} are measured with a DMM there will be some (small) error even if bandwidth is not an issue because the current measurement will be RMS rather than mean.