Reference Circuit of Hall Effect Elements

1. Voltage and Current Sources

A hall-effect element can be driven by either a constant voltage source or a constant current source.

1.1 Constante Voltage Source

Figure 1 shows a basic circuitry for biasing a hall-effect element with a constant voltage source.

The amplifier is used as a voltage follower, hence, the voltege across the hall-effect element is equal to V_0, which is the voltage applied at the positive input terminal of the amplifier and it won't change unless the V_0 changes.

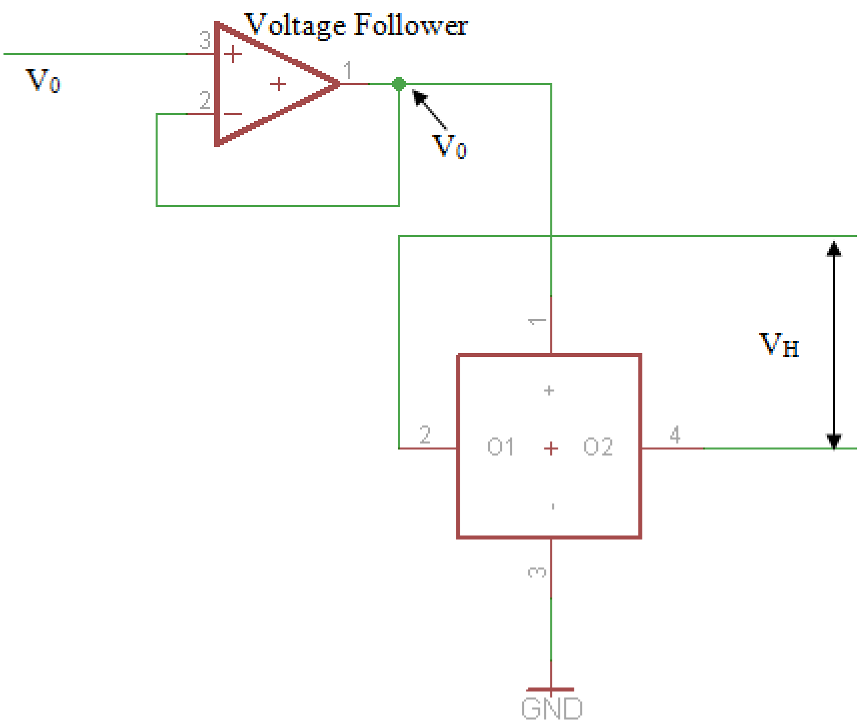

Figure1. Voltage-mode of Hall-effect element

1.2 Constante Current Source

Figure 2 shows a simple but workable bias current circuit. According to the principles of the amplifier, the voltage across the resistor (V_B) is equal to the voltage of the positive input terminal of the amplifier. Hence, the current passing through the resistor is V_0/R.

Actually, the current passing through the hall-effect element is the same as the current passing through the resistor, which is V_0/R. The current will keep stable no matter how the resistor between Point A and Point B changes, as long as the voltage of the output terminal is less than the maximum output of the amplifier due to the power supply.

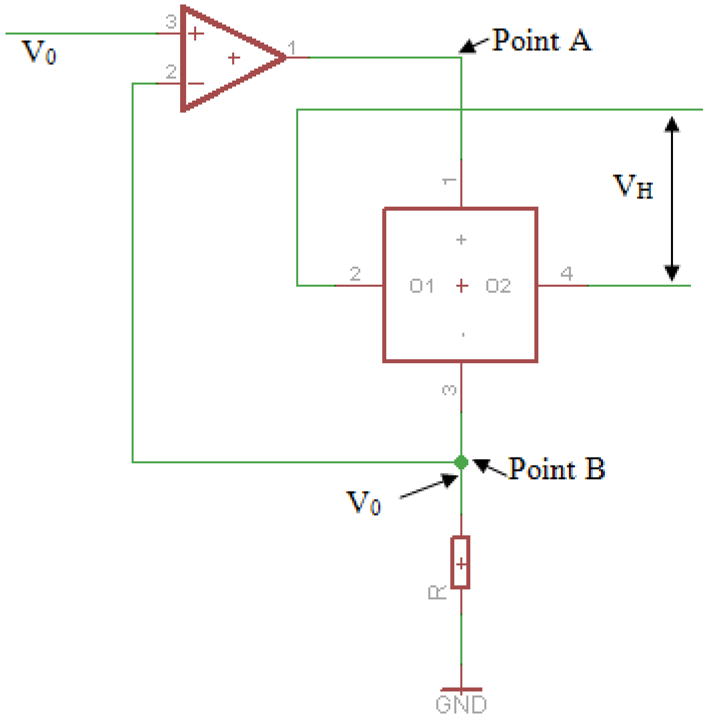

Figure 2. Current-mode Hall-effect element

2. Differential Amplifiers

One of the simplest technique for constructing differential amplifiers is to use an op-amp and a few discrete resistors as shown in Figure 3.

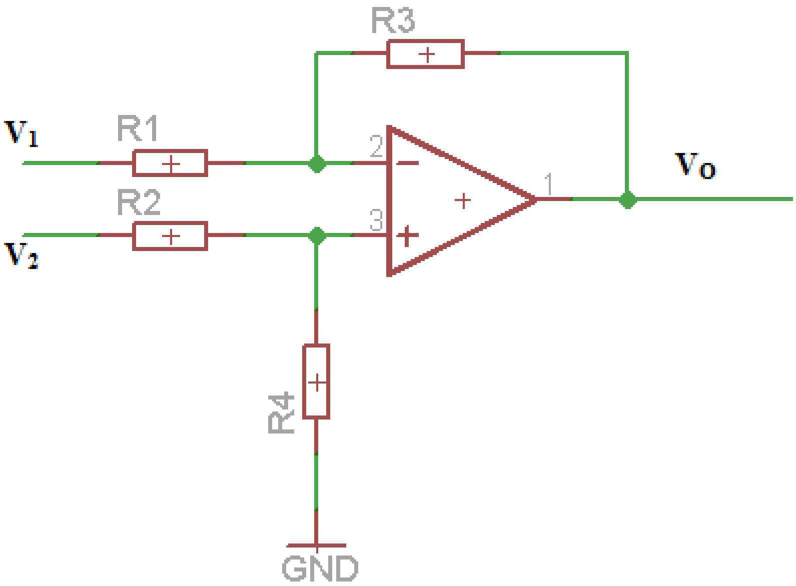

Figure 3. Differential amplifier

This circuit provides an output voltage (with respect to ground) that is proportional to the difference in the input voltages. The output voltage is given by:

$$V_O = \frac{R_4}{R_2 + R_4} \bullet \frac{R_1 + R_3}{R_1} \bullet V_2 - \frac{R_3}{R_1} V_1$$

Usually, if R_1=R_2, R_3=R_4, the output is simplified as:

$$V_O = \frac{R_3}{R_1}(V_2 - V_1)$$

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One can use an Instrumentation (or Instrumentational) Amplifier for processing the output signals of a Hall Effect element, see Figure 4.

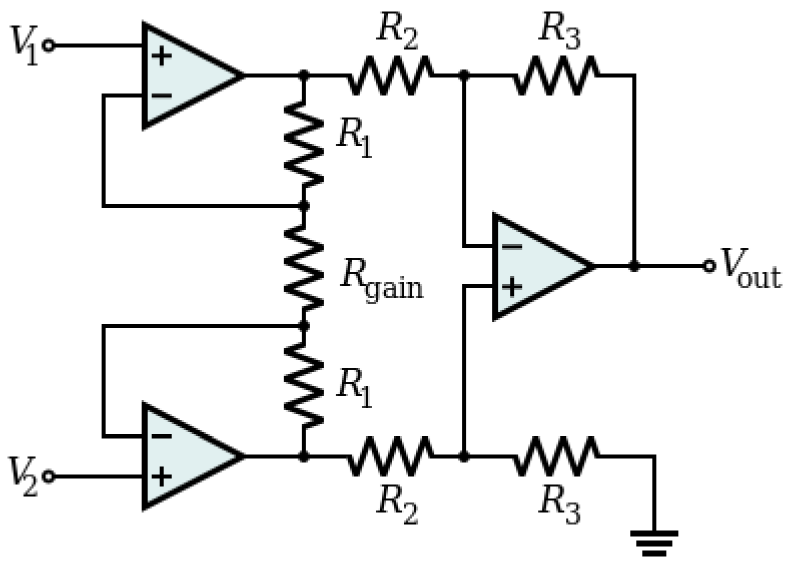

Figure 4. Typical instrumentation amplifier schematic
(https://en.wikipedia.org/wiki/Instrumentation_amplifier)

An instrumentation (or instrumentational) amplifier is a type of differential amplifier that has been outfitted with input buffer amplifiers, which eliminate the need for input impedance matching and thus make the amplifier particularly suitable for use in measurement and test equipment. Additional characteristics include very low DC offset, low drift, low noise, very high open-loop gain, very high common-mode rejection ratio, and very high input impedances. Instrumentation amplifiers are used where great accuracy and stability of the circuit both short and long-term are required.
Although the instrumentation amplifier is usually shown schematically identical to a standard operational amplifier (op-amp), the electronic instrumentation amp is almost always internally composed of 3 op-amps. These are arranged so that there is one op-amp to buffer each input (+,−), and one to produce the desired output with adequate impedance matching for the function.
The most commonly used instrumentation amplifier circuit is shown in the figure. The gain of the circuit is:

$$Gain = \frac{V_{out}}{V_2 - V_1} = \left(1 + \frac{2R_1}{R_{gain}}\right)\frac{R_3}{R_2}$$

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