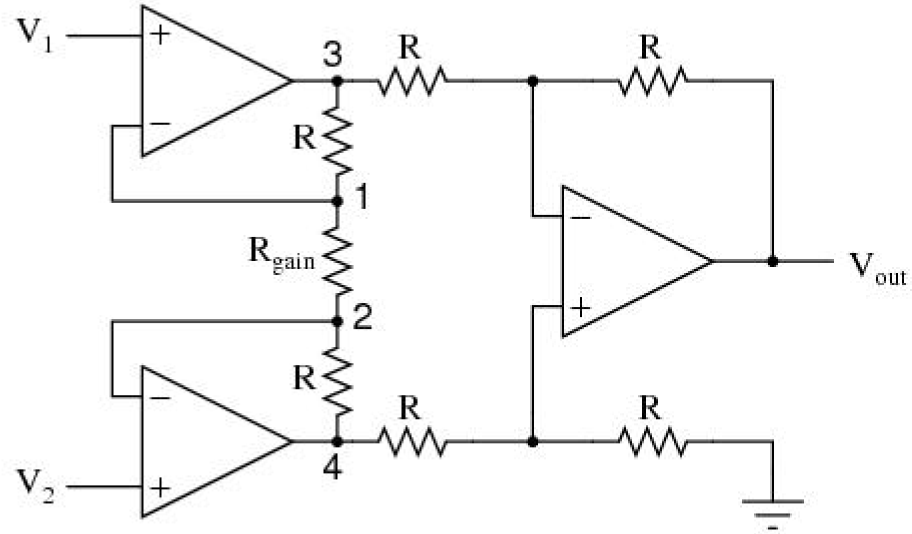
INSTRUMENTATION AMPLIFIER

INTRODUCTION:

An instrumentation amplifier is a differential op-amp circuit providing high input impedances with ease of gain adjustment through the variation of a single resistor.It 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.

CIRCUIT:



Consider all resistors to be of equal value except for Rgain. The negative feedback of the upper-left op-amp causes the voltage at point 1 (top of Rgain) to be equal to V1. Likewise, the voltage at point 2 (bottom of Rgain) is held to a value equal to V2. This establishes a voltage drop across Rgain equal to the voltage difference between V1 and V2. That voltage drop causes a current through Rgain, and since the feedback loops of the two input op-amps draw no current, that same amount of current through Rgain must be going through the two “R” resistors above and below it. This produces a voltage drop between points 3 and 4 equal to:

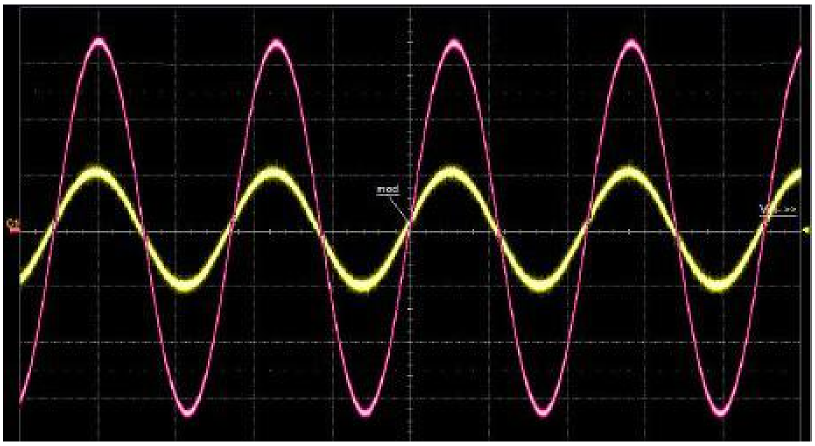
$$V_{3\text{-}4} = (V_2 - V_1)(1 + \frac{2R}{R_{gain}})$$

The regular differential amplifier on the right-hand side of the circuit then takes this voltage drop between points 3 and 4, and amplifies it by a gain of 1 (assuming again that all “R” resistors are of equal value). Though this looks like a cumbersome way to build a differential amplifier, it has the distinct advantages of possessing extremely high input impedances on the V1 and V2 inputs (because they connect straight into the noninverting inputs of their respective op-amps), and adjustable gain that can be set by a single resistor. Manipulating the above formula a bit, we have a general expression for overall voltage gain in the instrumentation amplifier:

$$A_V = (1 + \frac{2R}{R_{gain}})$$

Please note that the lowest gain possible with the above circuit is obtained with Rgain completely open (infinite resistance), and that gain value is 1.

EXPECTED WAVEFORM:



The input waveform which is the difference of the sine waves at the two inputs of V1 and V2 (representation,yellow sine wave of small magnitude).The output waveform which is the amplified version of the input is produced by the instrumentation amplifier (representation,purple sine wave).

CONCLUSION:

Always the input of an instrumentation amplifier is the output from the transducers and will a small signal. Instrumentation amplifiers don't need input impedance that makes this amplifier suits for measurement purposes. These are used where great accuracy and stability of the circuit are required for both short and long-term.The importance of an instrumentation amplifier is that it can reduce unwanted noise that is picked up by the circuit.

In industries, physical quantities are converted into electrical signals using transducers and the signal is amplified for signal processing. For this, an instrumentation amplifier is used instead of an Opamp.