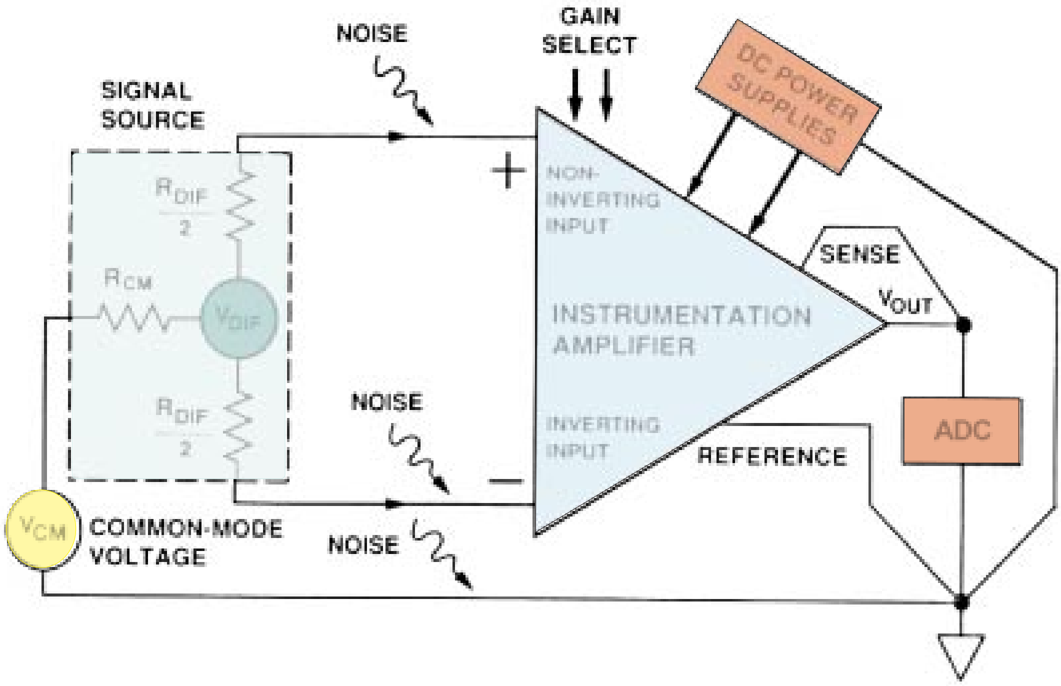
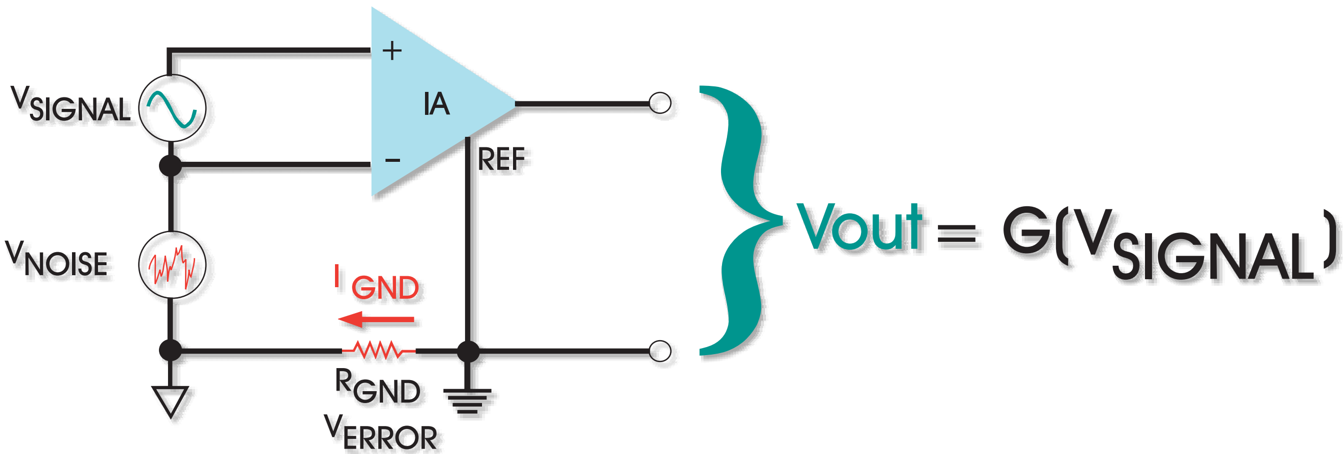


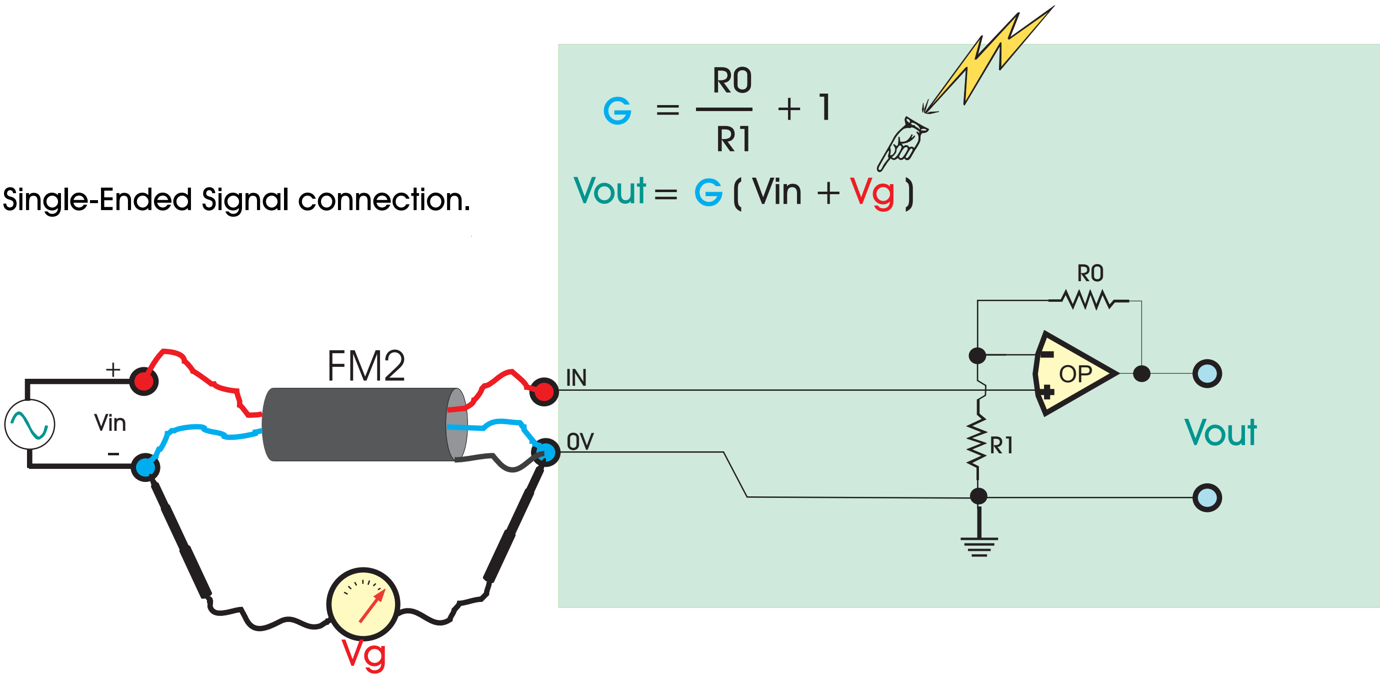
TRUE DIFFERENTIAL INPUTS HELP REJECT NOISE & ERRORS

Error rejection is accomplished by the Instrumentation Amplifier (**IA**) because its inputs can be connected directly to the input signal source differentially



The **IA** isolates (not galvanically) the inputs from the output ground. The **IA** senses a differential input voltage, amplifies it, and references it to an output ground (REF). You can think of it as a differential-to-single ended converter. In this way, the **IA** can amplify low level differential signals while rejecting signals common to both inputs (common-mode voltages).

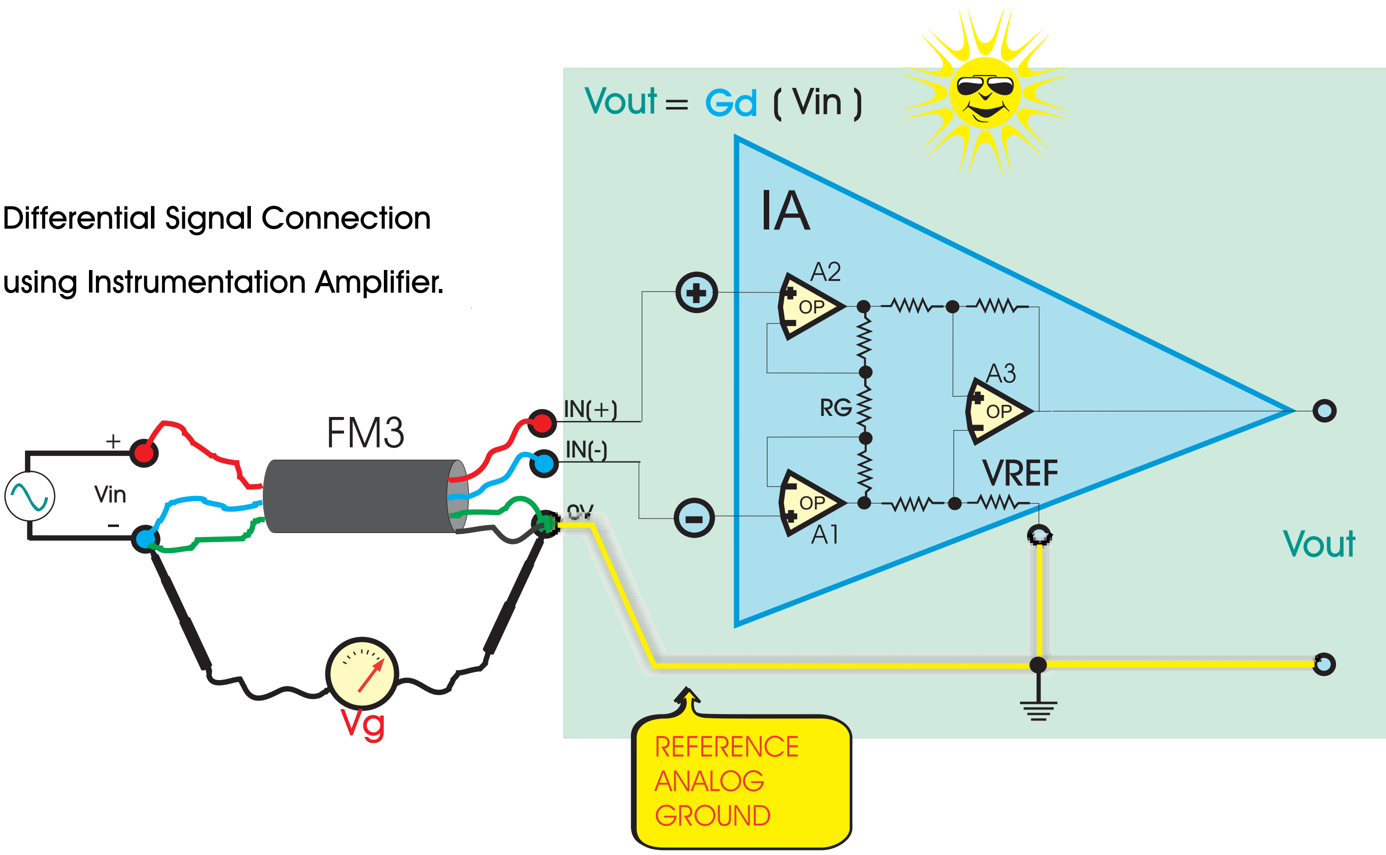
Single-Ended Signal connection.



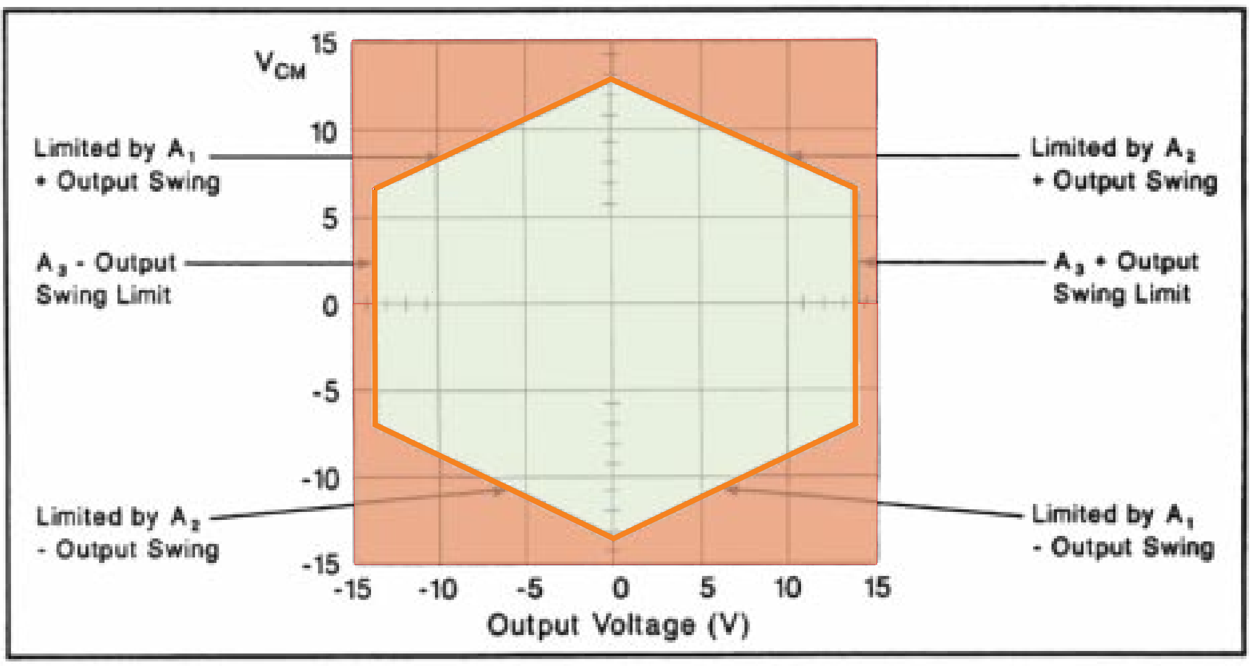
Vg = Voltage ground

Differential Signal Connection

using Instrumentation Amplifier.



The common-mode voltage input range of an instrumentation Amplifier is limited by both the input and output stages



There are several factors which contribute to the common-mode voltage input range of an **IA** : the linear common-mode input range of the input range of the input amplifiers, or the ability of the input stage to track the input signal; and the output voltage swing capability.

As the output voltage increases the common-mode input range is limited by the output voltage swing of the input amplifiers.

A combination of common-mode and differential input signals can cause the output of the input amplifiers to saturate. The outputs of the input amplifiers are Vcm (G . VD/2). With a unity gain difference amplifier, it takes a 10V input to the difference stage to get a 10V output.

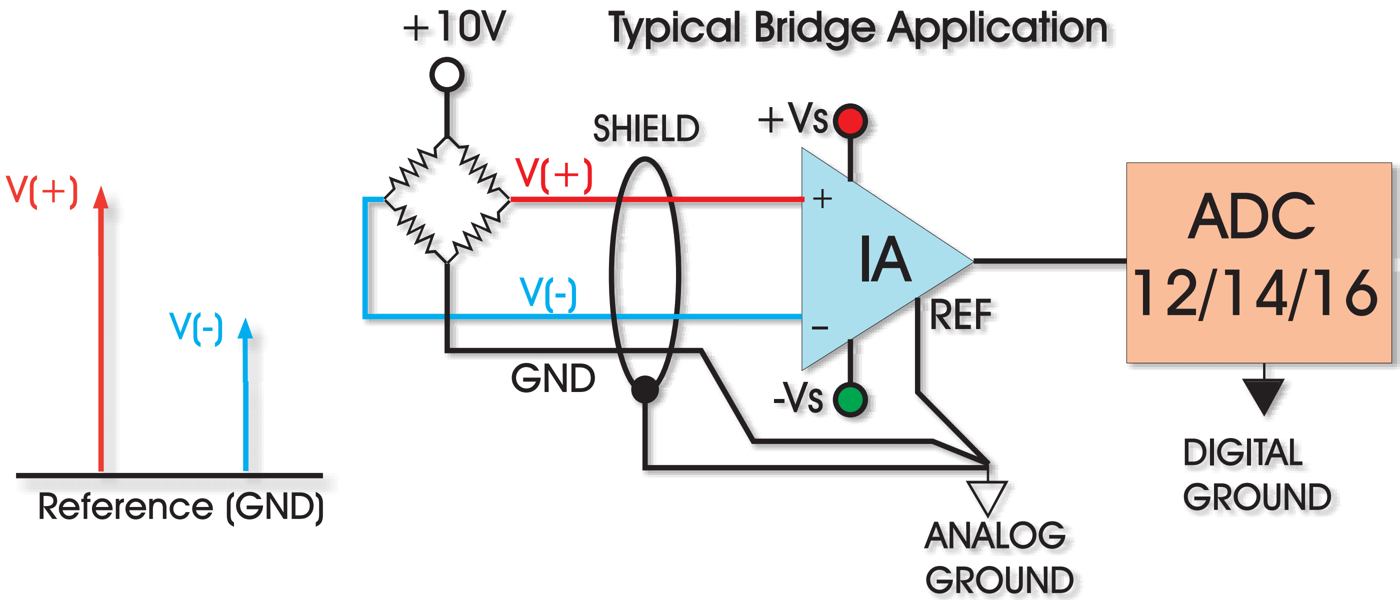
This signal comes from the input stage. With a 10V common-mode input, the output of one of the input gain stage amplifiers would need to be at 15V to drive 10V into a unity gain difference amplifier. This places a theoretical limit of 10V common-mode range for a 10V output with 15V power supplies. In practice, common-mode range is limited to less than 10V in **IA**s with unity gain difference amplifiers because of output voltage swings (headroom) of the input stages. With a difference amplifier gain of 5V/V, only a 2V input to the difference amplifier is needed to get a 10V output.

The **IA** has a 12.5V common-mode range with 10V out. For applications where input common-mode range must be maximized, limit the output voltage swing by connecting the IA in a lower gain if necessary, add a subsequent gain stage to increase the voltage swing.

This plot shows the common-mode range vs output voltage for an **IA** with a unity gain output stage (diff amp). To adapt it for other output stage gains (like G = 5 in the **IA**) the slope of the lines will change, and for other maximum amplifier output voltages (Vo SAT), the end points will change. The equation to determine the maximum amount of common-mode voltage vs output voltage is :

VCM MAX = VO SAT - VOUT /(2 . GAIN DIFF)

- A differential measurement thus gives 3 wires.



- *Only differential inputs can ensure proper measurements*
- *Make sure you dissociate the power supply wires from the measurement leads*
- *Beware of* AC coupling *and* EMC
- *Have a clear idea of potentials reference and make sure that no current flows in the measurement leads*
- *"Differential" does not mean galvanic insulation.*
  The Common Mode Voltage must stay low (the sum Vcm + Vmeas must not be above 10…11V)
- *Short the unused channels on the multiplexed input boards*
- What is true in the analog field is also with differential digital inputs

9, rue Georges Besse - 78330 FONTENAY LE FLEURY - FRANCE -
tél:(33) 1 30 58 90 09 fax:(33) 1 30 58 21 33 http://www.adas.fr