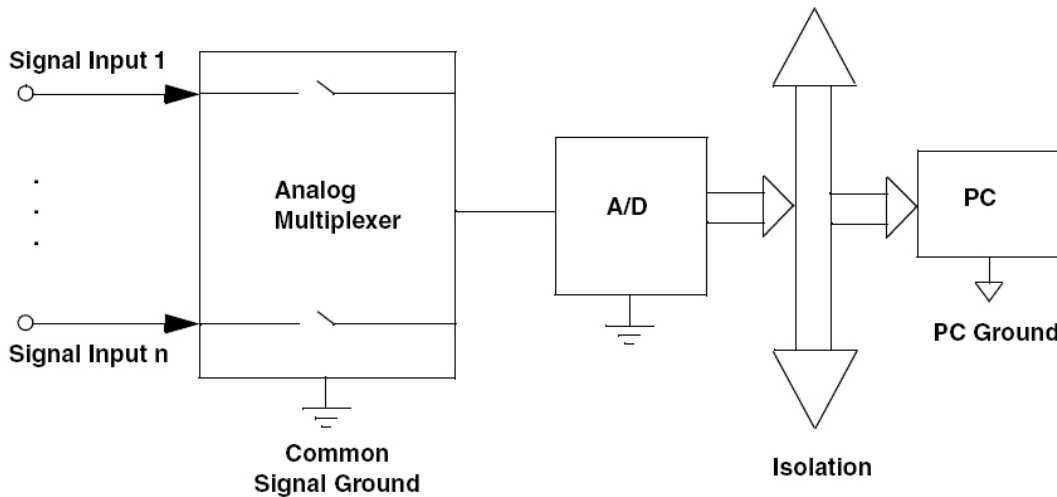


Isolated Inputs Offer New Application Advantages

Protection from noise and ground loops due to ISO-Channel architecture

Precision measurement systems are often limited in that all inputs are connected to a single ground. Typically, multiplexer input configurations are set up this way, since all signal inputs are connected to the same return. Even differential input configurations use the same ground reference. The result is that accuracy and flexibility for accurate measurements can be severely compromised when noise or common mode voltage is present.



(see Figure 1).

Figure 1. In multiplexed systems, all inputs are connected to a signal ground, which can cause errors when noise or common mode voltage is present.

Crosstalk from one input signal can easily be reflected onto another input. The design movement to an A/D per channel can help this problem. But that is not sufficient in many cases (see Figure 2).

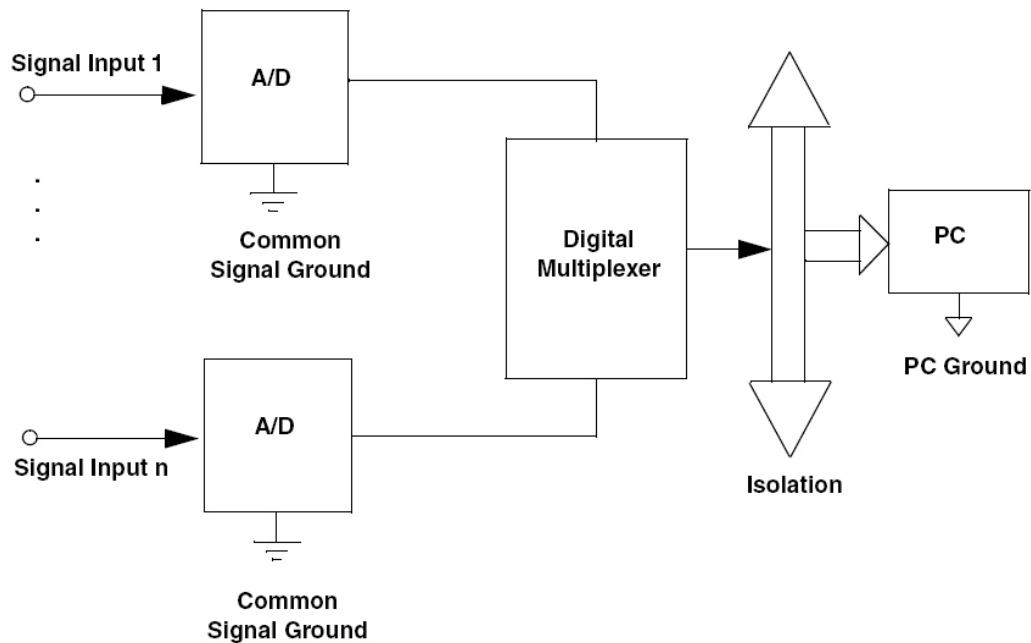


Figure 2. Even when using an A/D per channel, noise can contribute errors to your measurement results.

To minimize noise and ground loops, some newer systems offer isolation between the input signal ground reference and the computer ground. This effectively separates the computer ground from the measurement portion of the system. **But still, there is no isolation between input sensor channels, which is a common source of error and frustration for user applications.** Why?

The assumption is made that all signal sources have the same exact ground reference. After all...ground is ground...isn't it? Often this is not the case. For example, thermocouples for measuring temperature may be dispersed widely throughout an industrial setting, such as in the manufacture of air frames or in curing ovens. Grounds for these sensors may differ by several volts or even hundreds of volts. The resulting common mode voltage causes current to flow in the signal path, producing serious errors, which are very hard to diagnose and correct.

Isolating Each Input (ISO-Channel)

Oftentimes it is NOT apparent that ground references from various sensors such as thermocouples, RTDs, strain gages, etc., are at different voltage potentials. Factors that can contribute to these ground differences are extensive wiring from long runs, crosstalk from motors or generators, or high source impedance from the signal source. Without recognizing this extraneous voltage, the measurement system “sees” this noise or common mode voltage as the actual signal. These unwanted noise sources lead to measurement errors (see Figure 3).

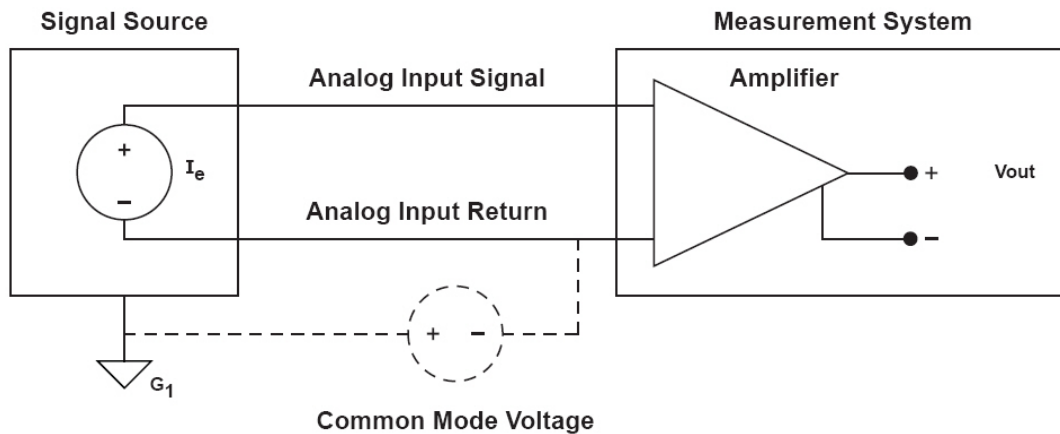


Figure 3. Common mode voltage is present when different ground potentials exist in your measurement system.

In many applications, noise is a fact and a common occurrence. To prevent this noise from entering the signal path, the signal must be isolated on a channel-to-channel basis as well as from the PC ground reference.

Technology breakthroughs now allow channel-to-channel isolation to be accomplished effectively. Using an A/D per channel with a DC-DC converter for each A/D allows each signal input channel to be isolated from one another (see Figure 4).

With this individual isolation per channel, each input channel can now “float” to its own ground reference. Separate channels are then effectively isolated from each other by the isolation barrier, up to +/-500V for each channel. Now any noise or common mode voltage to that level is eliminated from the system measurement, allowing pristine results from each sensor without any interaction from any other sensor.

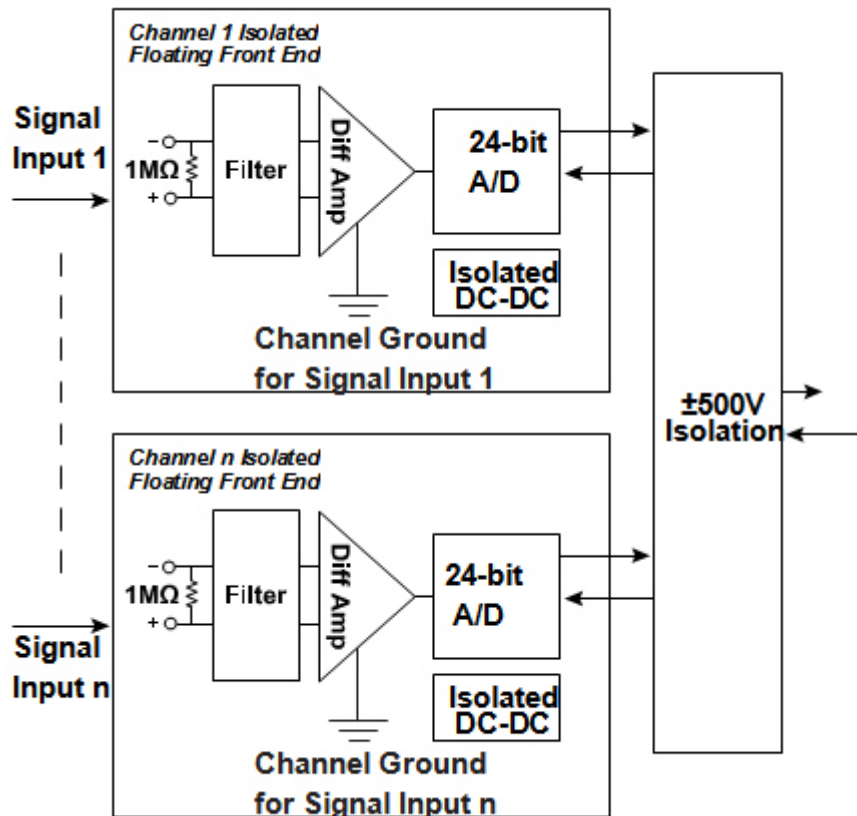


Figure 4. An A/D per channel and a DC-to-DC converter for each A/D provides channel-to-channel isolation, where each signal can float to its own ground reference.

Input channel return references are effectively separate instruments when the inputs are isolated. This individual isolation now allows the ground reference of each channel to measure at the level of this common mode voltage, up to +/-500V. This capability allows some new application ideas to flourish.

Measurement of two signals, as shown in Figure 5, can now have essentially 3 separate ground references: each signal input (signal 0 and signal 1) has a separate return reference; additionally, the PC has a third ground reference. This scheme can be extended for many signal inputs, such as 48 inputs in a single small measurement box, for a total of 49 different ground references.

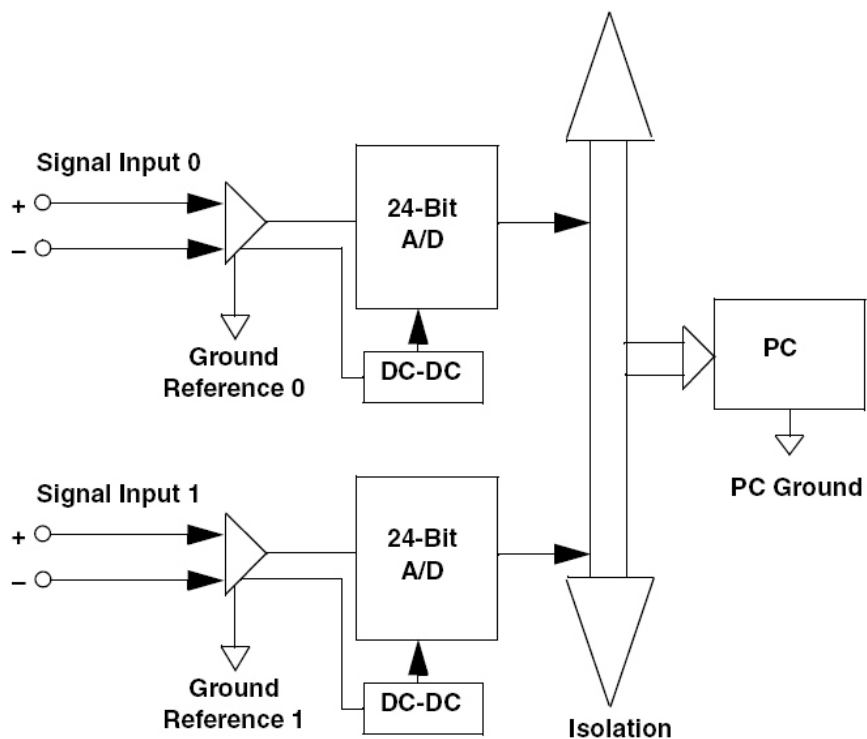


Figure 5. When measuring two input signals with channel-to-channel isolation, three ground references are provided (signal 0, signal 1, and PC ground).

New Application Derived from Isolated Channels

A typical application of measuring 48 channels of varying voltages from sensors, such as batteries, thermocouples, RTDs, pressure sensors, etc., often must use different instruments because of the various ranges needed. Standard ranges of +/-10V may handle some applications, but not others, to the required resolution and accuracy. With isolation per channel, combinations of channels can be used to measure higher voltage ranges. Figure 6 shows a configuration of 2 separate channels “ganged up” to measure a signal of up to 20V. Normally each input would measure +/-10V. But, by using two identical channels, a range of twice that level can be accommodated. The output readings of each A/D are then summed to give the very accurate result. This is possible because the isolation between channels allows the return of the first channel to “float up” to a level halfway between the input signal. This reflects the accurate impedance balance of each input, and the high common mode rejection of each stage.

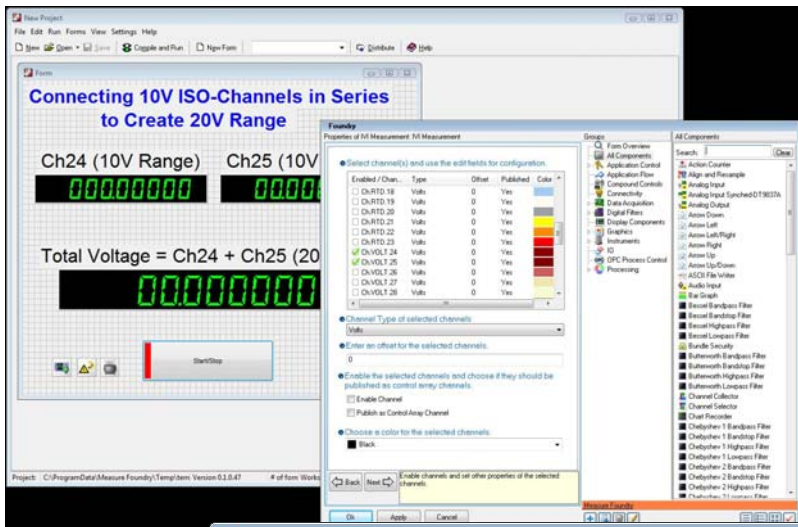
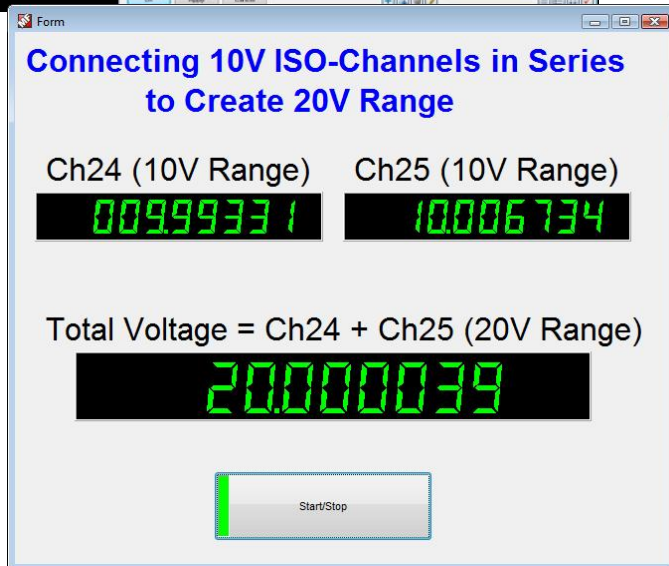


Figure 6. Because each floating signal input is isolated from each other, you can use two separate channels, normally each configured for +/-10V, to measure a +/-20V signal. Simply sum the result of each channel to get your result.



Summary

When you need the highest accuracy and the most flexibility from your measurement system, ensure that floating signal inputs are provided. This approach allows noise-free measurements in tough industrial settings. It also saves countless days of tracking down erroneous readings that inevitably result if these precautions are not taken from the project's beginning.