

## **Why ISO-Channel Technology is Your Best Return on Investment**

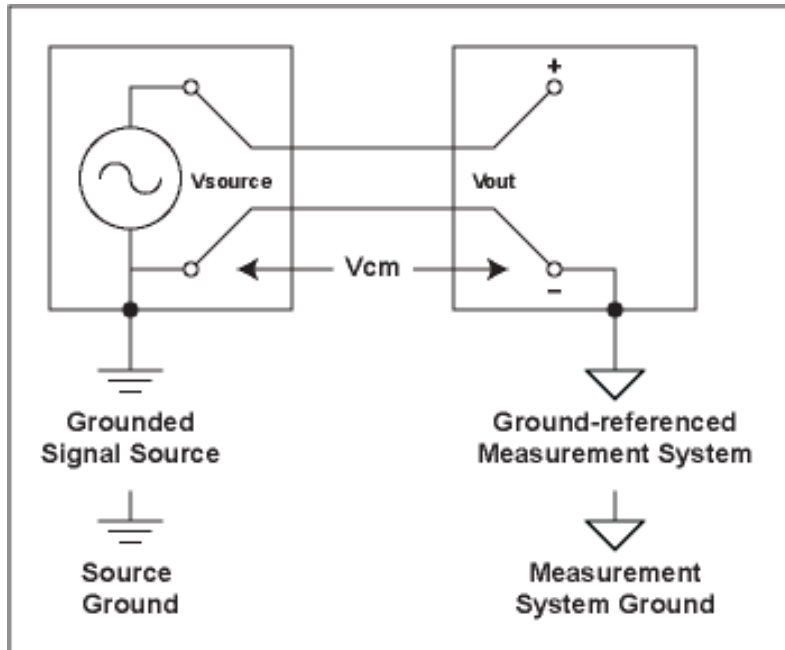
When connecting signal sources to an instrument, it is important to eliminate the sources of error that can contribute to inaccuracies in your measurements. In most measurement instruments, this burden is on the customer. Instruments that use ISO-Channel technology, however, solve this problem for you – saving you tremendous setup and debug time and reducing costly grounding problems when connecting signals.

In today's economy, we understand that every equipment decision needs to make good fiscal sense. This paper describes why instruments with ISO-Channel technology offer you the best return on investment.

### **Understanding Ground Loops**

When measuring signals, users often assume that the grounds of their signals and their measurement system are at the same ground potential. However, these ground potentials can be hundreds of millivolts or higher from each other!

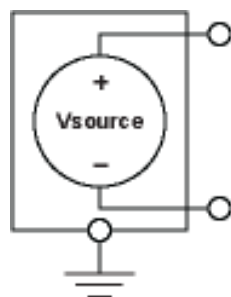
If the difference in ground potential is large enough, current flows between the signal and your measurement system; this is called a ground loop (see Figure 1). Ground loops contribute noise that can greatly affect the accuracy of your measurements, especially when you are trying to measure low level signals precisely. Ground loop problems are the most common source of error in all measurements! Eliminating these errors, therefore, is critical when taking high accuracy measurements.



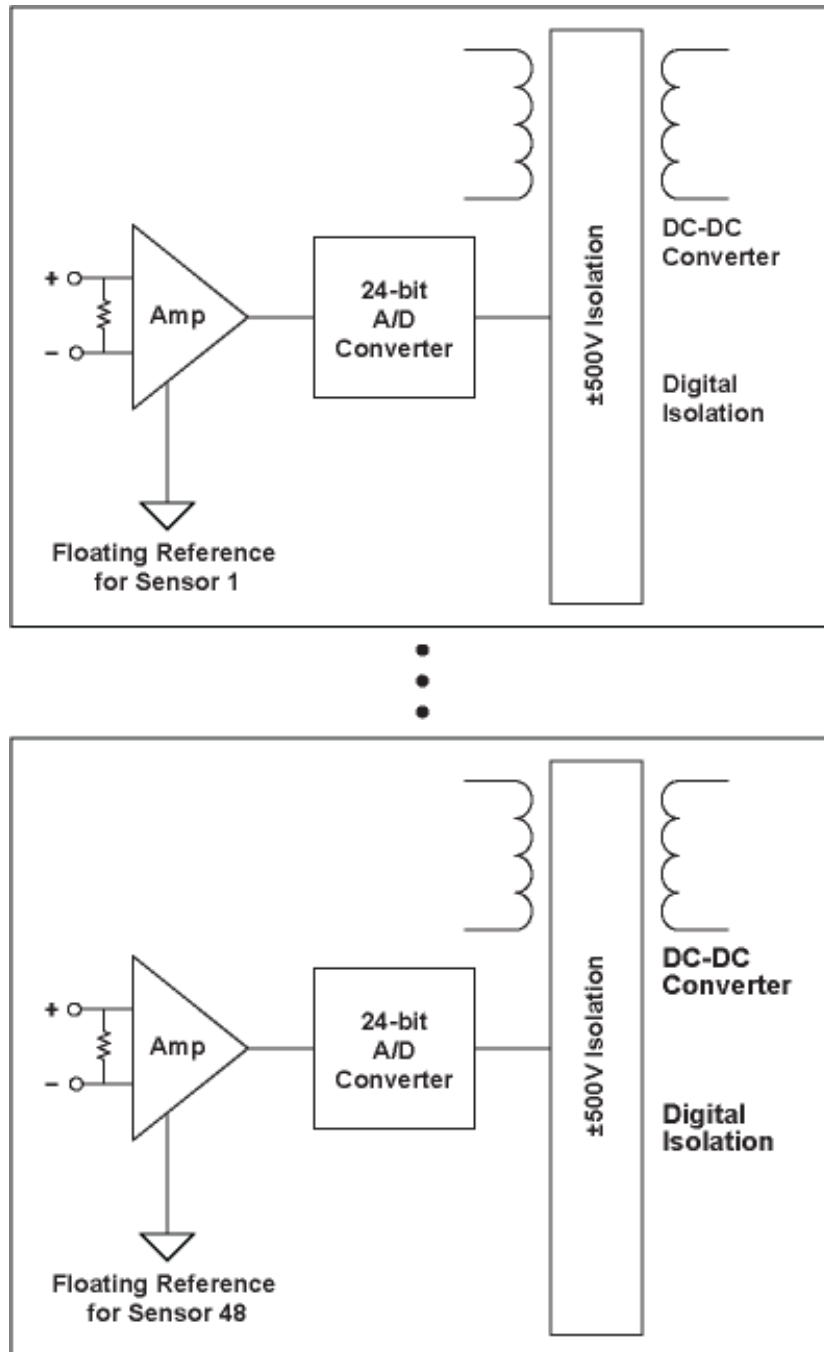
When a ground loop exists, the measured voltage,  $V_{out}$ , is the sum of the signal voltage,  $V_{source}$ , and the ground potential difference,  $V_{cm}$ , which exists between the signal source ground and the measurement system ground. These errors often appear as transients or periodic signals in the measurement. For example, if a ground loop is formed with 50 Hz or 60 Hz AC power lines, the unwanted AC signal appears as a periodic voltage error in the measurement.

### ISO-Channel Eliminates Ground Loops and Increases Common-Mode Rejection

ISO-Channel technology eliminates ground loop problems by using a **differential, isolated, floating front-end**. As you can see in Figure 2, a floating voltage signal is not referenced to system ground.



**Figure 2.**  
**Floating Signals**



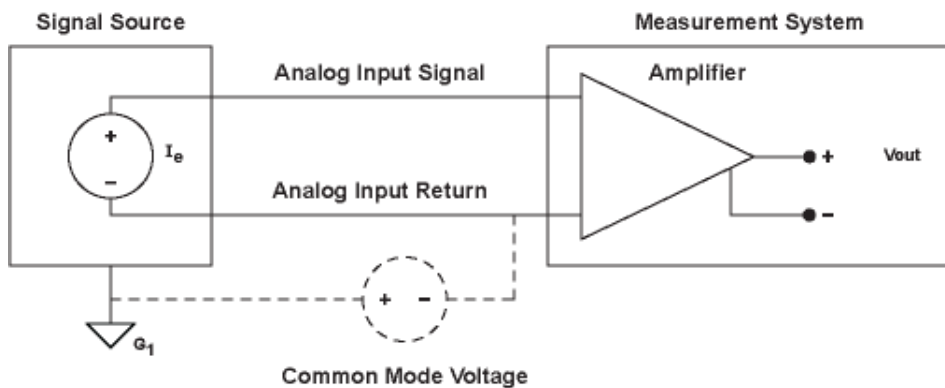
**Figure 3. ISO-Channel Technology**

*To measure floating signal sources, ISO-Channel technology uses differential analog input signals, a 24-bit Delta-Sigma A/D converter for each channel, and channel-to-channel isolation, as shown in Figure 3.*

## Floating, Differential Signals

ISO-Channel technology implements a virtually ideal differential measurement system that reads only the potential difference between the positive and negative terminals of the amplifier. Ground loop problems are eliminated by ensuring that there is a separate ground reference for each channel in the measurement system. Each signal source is isolated from each other and from the measurement instrument.

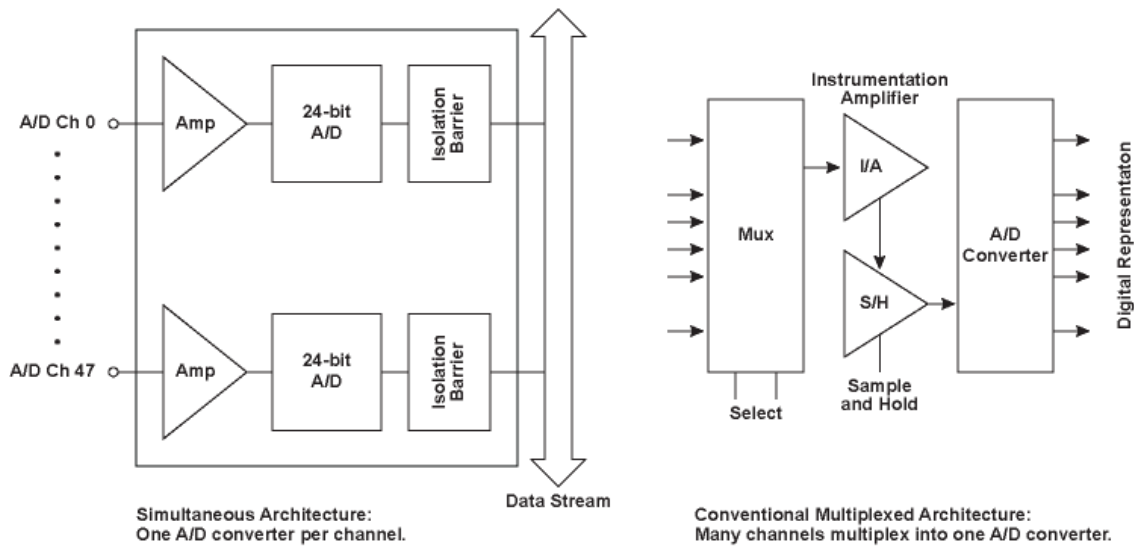
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**Figure 4. Differential Signals and Common-Mode**

*Common-mode voltage is any voltage present at the instrumentation amplifier input with respect to the amplifier ground. Shorting the inputs together allows you to measure the common-mode voltage, since any voltage measured at  $V_{out}$  is equal to the common-mode voltage at the input of the amplifier.*

*ISO-Channel technology provides common-mode rejection of 150 dB, which contributes an almost imperceptible error (33.5 million to 1) to  $V_{out}$ . Compare this to traditional data acquisition measurement instruments, which typically provide only 80 dB of common-mode rejection and therefore, contribute much more error on the order of 1 part per 10,000.*



**Figure 5. Simultaneous vs. multiplex architecture**

### Simultaneous Architecture

Many measurement instruments on the market today provide multiplexed architectures, where one A/D is used to measure multiple channels. In this kind of architecture, if one channel goes down, all channels go down.

ISO-Channel technology, on the other hand, uses a simultaneous architecture, where each channel has its own dedicated 24-bit Delta-Sigma A/D, as shown in Figure 5.

## Channel-to-Channel Isolation

Besides differential, floating channels and a simultaneous architecture, ISO-Channel technology provides channel-to-channel isolation, not just isolation from the analog front-end to the computer ground. With this kind of isolation, each channel is individually isolated from each other and from other non-isolated system components.

Typically, instrument manufacturers have used relays, isolation amplifiers, or optical isolation to provide channel-to-channel isolation. Each of these methods has the following advantages and limitations:

- Relays – This technology provides good galvanic separation and can provide good accuracy and thermal properties, but are slow as they operate on one channel at a time (10 cycles/s), wear out over time, and are sensitive to magnetic fields. If one channel goes down, the entire system fails!
- Isolation amplifiers – Isolation amplifiers are used in multiplexed architectures. While they are solid-state, they are expensive, not as accurate, require more power, and generate more noise and heat than other solutions.
- Optical isolation - Optical isolation is good in digital isolation systems but causes accuracy problems in analog isolation systems. It is also subject to long-term drift and requires considerably more power.

With ISO-Channel technology, the A/D is on the sensor side and optical or transformer isolation is used to transfer the sensor data **digitally**. Each channel has its own custom DC /DC converter so that data is converted even at low power levels. And, due to the simultaneous architecture of ISO-Channel technology, all data is transferred in parallel.

### Summary

ISO-Channel technology offers built in system redundancy to protect your investment - if one channel goes down, the remaining channels are completely unaffected! Instruments with ISO-Channel technology also adapt to the sensors that they are connected to, allowing a different ground reference for each signal without introducing errors! For these key reasons, ISO-Channel technology saves you time and reduces costs – what a great return on your investment.