

All DSO isolated channels are not the same

Application Note

The ability to display information from multiple information sources – “channels” – at once is critical to troubleshooting and maintaining today’s complex equipment. Virtually all modern power control systems have circuitry designs that require different reference measurements. Control circuits based on micro-controllers, for example, are likely to run at the 3 or 5 V levels of today’s logic systems, whereas the power electronics could well be driven by the 380 V three-phase mains supply. To complicate matters even more, such systems may be designed with one or more floating sections so even their grounds are not the same voltage.

In the past, technicians and engineers have juggled the need to track such divergent system components by using multiple test instruments at once. A more accurate and efficient method is to employ a handheld Fluke Corporation ScopeMeter® 190 Series. Unlike standard dual-input oscilloscopes in which the inputs are connected to a common ground, ScopeMeter 190’s three inputs are independently isolated, which means they can be connected to signals of widely differing voltage reference levels with complete accuracy and safety. And the standard probes cover a wide application range from mV to kV, making the ScopeMeter 190C ideal for micro electronics to electrical power applications.

Beware. A few other dual-input oscilloscopes say they have isolated channels, but the

isolation is limited, suitable for use only to about 30 V, which is severely inadequate for industrial environments. By contrast, the isolation on the Fluke ScopeMeter 190 Series is certified up to a 1000 V CAT II safety rating and 600 V CAT III. That level of isolation makes the 190 an extremely safe instrument for professional and industrial applications.

Those differences are critical, for both accuracy and safety.

The need to measure and capture waveforms from different test points in sources is such a common requirement that it is easy to forget that incorrectly attaching a dual-input oscilloscope without adequately isolated channels can be a safety hazard. It’s not uncommon for oscilloscopes without industrial-strength isolated channels to encounter unexpected or unknown divergent grounds, which can cause the instrument to short out or in extreme cases explode. Even if users encounter no system unknowns, the drive for speed and efficiency can encourage unsafe work habits. Too often, bench-top oscilloscopes are operated ungrounded to make their inputs floating, greatly increasing the danger of physical injury or even electrocution. The level of channel isolation engineered into the ScopeMeter 190 protects the unit, the equipment you’re troubleshooting, your test tool investment, and your eyeballs.

The heavy-duty strength of the 190 Series’ isolated channel capabilities are allowing technicians to easily, accurately and



safely troubleshoot and maintain systems from ac motor drives to switched-mode power supplies and all manner of high-energy industrial systems.

Fluke relied on the advice of its most valuable design team, its customers, as it developed the extended isolated channel capacity, said Hilton Hammond, Fluke’s ScopeMeter U.S. product manager.

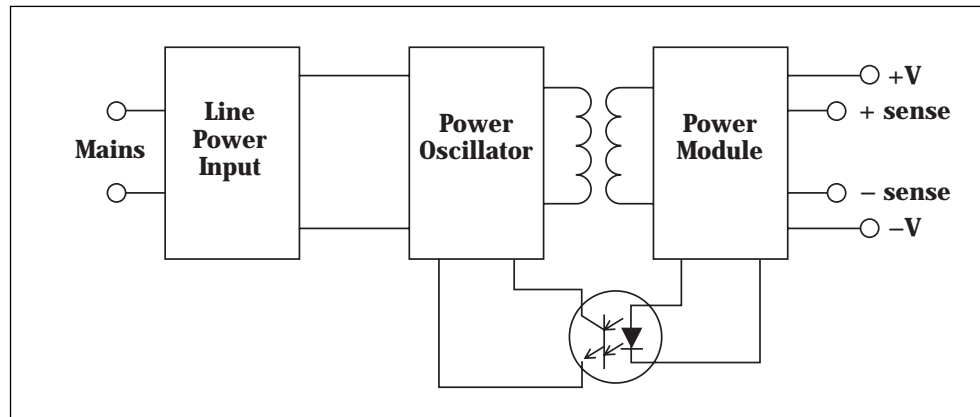
“Our customers were asking for it,” he said. “They need to be able to safely and accurately look at two different signals with two different ground potentials. The 190, with its isolated channel architecture, IEC safety rating of 1000 V CAT II and 600 V CAT III, does exactly that!”

Workshop: Use isolated channels to troubleshoot industrial ac motor drives

One of the most common forms of ac motor drive is the pulse width modulated inverter. In this drive, semiconductor switches such as isolated-gate bipolar transistors (IGBT), are triggered by a microprocessor-based control circuit to provide a constant voltage pulse width modulated (PWM) output for driving the motor.

The output voltage in a PWM inverter circuit is a series of constant-magnitude positive and negative pulses of varying width to provide varying levels of average voltage per pulse cycle. The wider the pulses, the higher the average voltage. Therefore, if the switches are triggered to produce narrow pulses at the start and end of an intended mains cycle and wider pulses toward the middle, the average value of the output voltage approximates a sine wave of the mains frequency. Although the output voltage looks very distorted, the large inductance of the motor smoothes the current enough to make it sine-shaped again so that the motor runs smoothly by changing the clock rate of the firing pulses, the output frequency – and therefore the motor speed – can be changed.

A fairly common cause of failure in three-phase induction motors is what's known as single phasing, in which one of the phase voltages applied to the motor is totally lost. When this happens, the other two-phase windings conduct more current, resulting in a rise in temperature and potentially premature motor failure. Single



phasing is not easy to detect since, except for an increase in heat generated and some loss of torque and smoothness, the motor appears to run almost normally. Detecting single phasing with measurements also is tricky if voltage measurements are made at the motor terminals, since the voltages will read close to normal, as the rotating windings act as a generator, inducing voltage into the open winding. The best way to detect this condition is by current measurements on all phases to detect the open phase through an absence of current flow.

If the condition is detected, the problem may be in the motor itself or in the drive circuitry. To check this, it is necessary to check the firing of the IGBTs and to compare these against the output microcontroller's output pulses.

Here's where the advantage of the ScopeMeter 190's isolated dual inputs comes in. A direct comparison between these two signals on the same display would be impossible with a standard dual input

oscilloscope because of the widely differing voltage levels. It's no problem at all, however, with the 190. Input A can be set to measure the output of the IGBTs in the power circuit at a voltage level of, say, 400 V while Input B is set to trigger on the 5 V output pulses from the control circuitry. The 190's graphical display clearly shows the correlation in the time domain between the two signals, including whether the IGBTs are firing correctly. Similar abilities can be used to debug switched-mode power supplies and troubleshoot virtually all high-energy industrial circuits.

For more information about the ScopeMeter 190 Series, including a virtual demonstration, visit www.fluke.com/scopemeter.

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