FLUKE®

The Case for Isolated Grounds

in a 199C ScopeMeter® Test Tool

Application Note

You probably know that a dual-channel oscilloscope has three input sections: Channel A, Channel B, and an external trigger. And you also probably know that each section has a signal input and a reference input, making six connections to the scope, and each of these interfaces to the instrument is tied to ground internally. And you may even know that isolated channels provide an extra measure of safety.

But are the grounds for the input sections tied together in a common ground plane internal to the instrument, or is each ground isolated from the others? (Check your scope specs for the term "isolated inputs" or "isolated channels.") And have you thought about grounding issues with the battery charger? How about between the data ports and your computer?

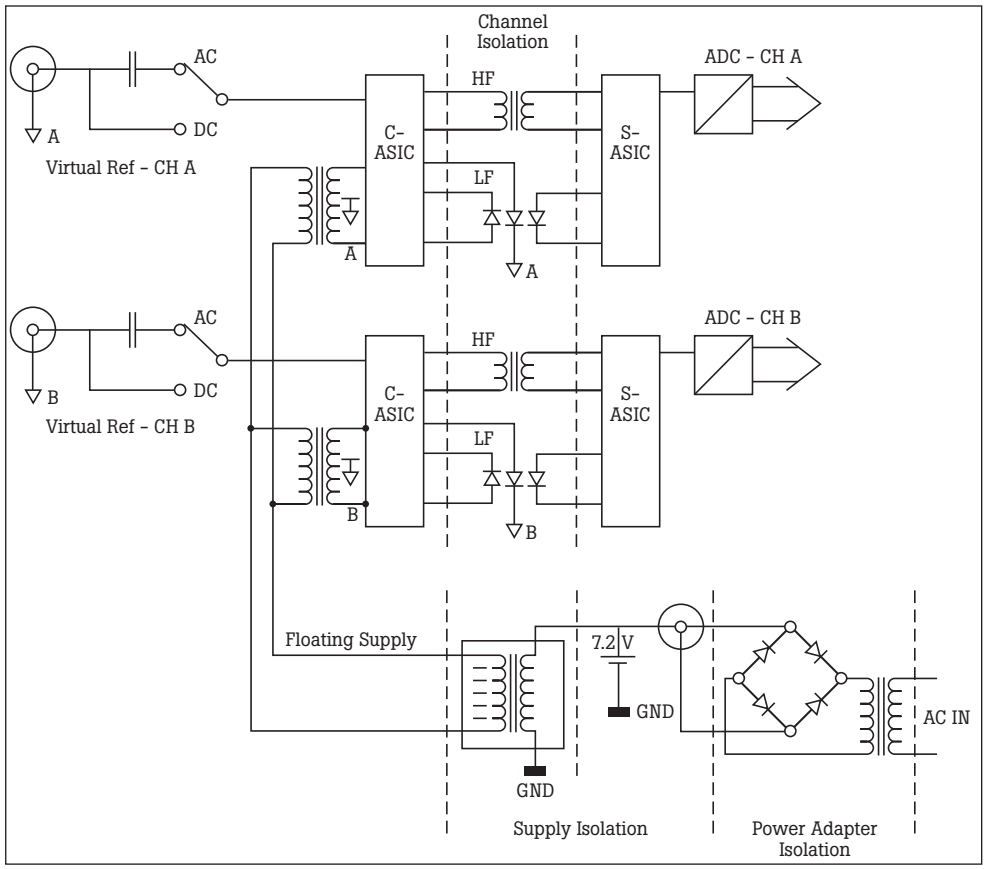

Figure 1: Fluke ScopeMeter 190 Series channel isolation achieved through HF coils and LF opto-isolator in signal conditioning circuits.

Isolation basics

Let's define "isolation" in the context of an oscilloscope. A scope has multiple connection points, with a hi and low for each point. These low reference points (ground connections) are usually tied together electrically. Building an isolation barrier between the two points prevents current from flowing between them (See Figure 1).

If current did connect between two reference points, it could potentially become much higher than the circuit voltage (See Figure 2). Because of this concern, oscilloscopes must be rated to withstand the maximum voltage of the working environment. In the ScopeMeter 199C test tool, that electrical barrier can withstand up to 1000 V in a CAT II or 600 V in a CAT III environment

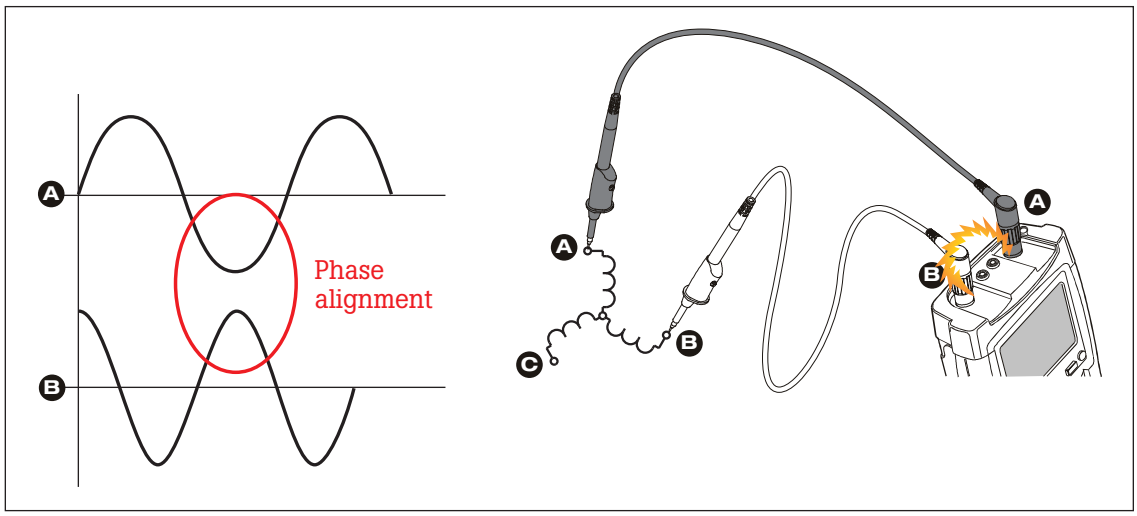

Figure 2: If out-of-sync phases become connected, the combined current can exceed the rating of the test instrument.

(per IEC 61010). Isolated grounding is an important requirement in the industrial environment, to help prevent shock hazard and arc blast.

Internal battery chargers

Complicating the picture, a handheld scope has an integral power port—either for powering the scope or for recharging the batteries—that also must be grounded and isolated from the reference points.

Let's look at a common test scenario: a test set-up for a 220 V circuit. Let's say you connect the reference lead to –220 V and the input to +220 V. Now you plug in a charger to recharge the scope. If the earth ground point on that charger is connected to the reference point on the scope input, or the charger is not properly isolated, that –220 V could be brought down to zero volts through the charger's earth ground point. This is a potentially hazardous condition.

That's why the adapter of the power supply should have its own isolated ground, ensuring electrical isolation between the earth ground of the wall outlet, the dc charging circuit, and the meter itself.

Data collection concerns

Now suppose the scope is connected to a personal computer—for example, if you are uploading captured data to signal analysis software on the PC. That makes up to five conducting circuits that could be active at any one time, and the data interface circuit is now tied to earth ground through the PC.

"You can't take that reference point on the scope input and tie it down to earth ground through the charging circuit," cautions Hilton Hammond, product marketing director for Fluke ScopeMeter. "And the PC interface similarly needs to be electrically isolated. Otherwise, you're going to bring that point down to zero volts, through the PC interface. And let's say you're connected to the three-phase power grid—you're going to have a lot of amps going through that circuit. In short, you have to maintain isolation at the charging circuit level and at the PC interface level so that you don't bring that reference point on the scope measurement input down to earth ground through any external means—through a PC, through a charging adapter, or through a dc supply circuit."

Take caution: A scope may have a USB connector with an integral metal shield to insulate it from the influence of external noise on the digital signal. That metal shield is typically earth-grounded to dissipate the influence of EMI, ensuring that it does not permeate into the data or signal control lines. But the shield is also a potential shock hazard unless it's also isolated from earth ground.

Again, check the user manual beforehand. That, along with your own safety practices, can help prevent your work from becoming a shocking experience.

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