

## Improving on a legend: The story behind the new 190 Series II ScopeMeter® test tool

### Application Note

Before 1991, if you mentioned the ScopeMeter® test tool, you would have gotten a quizzical look. “A what-Meter?” Technicians knew what an oscilloscope was; and they knew what a meter was; but those were two different measurement devices. When Fluke introduced the first ScopeMeter tool, it created a new category of test tool, one that combined an oscilloscope with a digital multimeter (DMM) and a frequency counter, in a handheld tool.

That first portable oscilloscope wasn't much by today's standards. One channel, 50 MHz, and a green screen. But for electronics engineers in the early nineties, it was revolutionary. Especially in the medical device arena, engineers desperately needed to troubleshoot electronic devices in the field, without lugging a bench scope into the hospital X-ray room.

The next change came as the manufacturing sector began implementing variable speed drives. The change from straight up relays and motors to electronic controls introduced the requirement for commissioning, maintaining, and troubleshooting those controls, and doing so as installed, not back at the bench. The difference was that this environment involved significantly higher voltage than the X-ray room. And so, the ScopeMeter test tool evolved to address higher CAT safety ratings.

Fast forward 20 years, mention “ScopeMeter” today, and heads will nod. It's now commonplace for field service technicians and engineers to use a portable oscilloscope



How much cold can a portable oscilloscope stand and still function? The Fluke team tasked with creating the new ScopeMeter® series set out to find out.

during the commissioning, maintenance and troubleshooting of an electronic device, be it in healthcare, manufacturing, telecommunications or a host of other environments. Electronics and electronic controls are everywhere, and troubleshooting them has become both increasingly complex and increasingly necessary.

Working from those early ScopeMeter models, Fluke added a steady stream of capabilities, increased performance and enhanced usability, going from that green screen to a full-color interface (Fluke no longer even sells a black-and-white screen scope!) and adding such niceties as automatic pwm (pulse width modulated) signal triggering.

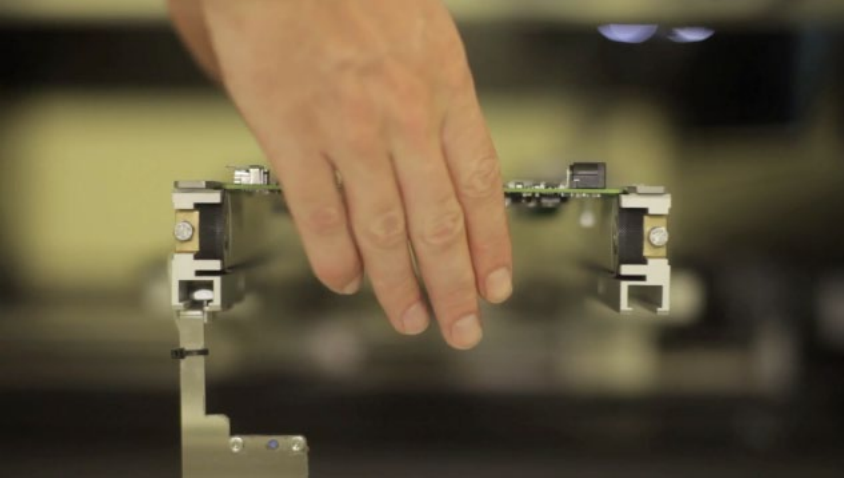
But part of the reason a Fluke tool is so nice to have is because it so precisely anticipates what the end user needs to do—and makes it possible. That means the more the end user's world changes, the more Fluke tools

have to change. There came a point where the existing line of portable oscilloscopes no longer met all of the challenges electronic technicians faced. Thus began development of the new 190 Series II ScopeMeter®.

#### Where to start: (Re) Designing the Fluke ScopeMeter

The possibilities for the new tool were endless. The challenge was narrowing down the possibilities to those most useful to technicians. “How are you going to improve something that is already very good? It's kind of like trying to improve a paper clip,” said Christian Suurmeijer, a member of the Fluke team tasked with creating the new ScopeMeter® series.

The design team had a lot of ideas for additions and enhancements, but they were more interested in finding out what the people who used the tool had in mind. They interviewed



Setting up tests of many kinds was the mandate of the development team.

800 people who had used the original 190 Series ScopeMeter®, asking them what improvements they would most like to see. Those interviews produced a wealth of ideas that the team boiled down to several basic goals. Based on customer input, the new portable scope series needed to include:

- Category III 1000V/Category IV 600 V safety rating
- Four channels
- A sealed case to protect the instrument against harsh conditions such as water and dust
- Easier battery swaps
- Increased communication speed
- Extended battery life
- USB capabilities to expand electronic storage capacity and mobility

Each of these goals had its own set of requirements—that in some cases introduced more challenges. For example, to qualify for a Category IV rating the new scopes would need larger clearances between conductors; yet the tool's footprint also had to be narrow enough to accommodate easy handheld operation. The battery compartment needed to be easier to access but also needed to maintain its dustproof and waterproof integrity. Sealing the ScopeMeter® tool against harsh environments was critical, but then how would they dissipate the heat buildup?

As the team worked on incorporating each goal into the design, they simultaneously overcame the obstacles.

### Designing more capabilities into less space

To achieve the CAT IV safety rating, designers had to allow for larger clearances between conductors in a smaller physical space. So the Fluke team had to rethink the components. Some of the new components were available as off-the-shelf products. Other components did not exist, and the team had to develop them. By reworking the components, the team achieved the necessary conductor clearances within a space compatible with four-channel vertical form factor requirements.

To make the tool even more compact, the team decided to eliminate parallel chips. They developed a single-chip acquisition system with four input sections that support mixing and matching the number of input channels and the need for high speed sampling. The four input channels are electrically isolated from each other to allow users to perform differential floating measurements without the need for external differential probes. This helps to prevent potentially dangerous user errors.

### Achieving IP-51 rating and avoiding heat buildup

In addition to keeping the size down, the innovative single-chip design also reduced power requirements, which helped extend battery life and reduced heat output. However, even low power can generate heat over time. The 190 Series II ScopeMeter® features a sealed

chassis that protects it from the dust and water drips of harsh industrial environments. But that raised the question of how to avoid heat buildup within the sealed chassis.

The solution was to use metal interior parts. The heat generated by the electronic parts is transferred through the metal into the plastic housing and then to the outside. The 190 Series II is IP-51-rated against dust and drips and is the first portable scope that is completely sealed—with no fans or vents.

Keeping with the sealed chassis requirements, the Fluke team also designed a battery compartment that provides quick and easy access to the batteries and still keeps out dust and moisture.

### Maximizing productivity

Beyond redesigning the battery compartment, the design team nearly doubled the battery life with a new lithium-ion (Li-ion) battery that gives technicians seven hours on a single charge. The extended battery life along with the battery conserving technology included in the ScopeMeter® test tool means you can typically work a full shift on a single battery charge.

While it's easier to record data with the new tool, it's also much easier to put all that recorded data to work. The 190 II Series ScopeMeter® includes two isolated USB ports—one to connect with a PC and one to store data on USB memory sticks.

### Putting the scope to the test

When the design challenges were resolved the Fluke team put the instrument's firmware through its paces. The automated firmware test ran 24 hours a day, 7 days a week as the testing machine pressed the ScopeMeter® keys in random sequences. Each key press entered a bit of code, and when all the conditions were met

the assertions were correctly passed. When an illegal condition occurred, the instrument stopped, noted the line where the collision caused the problem, and then started all over again. To pass the test the instrument had to execute an average of a few thousand key sequences without an illegal condition occurring. This far exceeds normal operating conditions where most technicians complete their tasks within 20 or 30 key sequences.

That commitment to far exceeding the demands of normal use guided every stage of the 190 Series II ScopeMeter® development. The result is the only portable scope that offers a handheld battery-operated instrument with 1000 volt CAT III/600 volt CAT IV safety rating and four channels in a sealed case. As Project Engineering Manager Henk ter Harmsel observed, "It's the only four-channel scope you can take into a Category IV environment...in fact it's the only scope you can take into a Category IV environment."

View a video about the creation of the 190 Series II ScopeMeter® at [www.fluke.com.designinsights](http://www.fluke.com.designinsights).



The development team simulated harsh environments to make certain the sealed case could protect the instrument.

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