Soil Resistivity Testing

Inside this Issue:

- Featured Product: Performing a Wenner Soil Resistivity Test with the AEMC® Ground Tester Model 6472

- True RMS, True*InRush*®, and True Megohmmeter®

- Setting Up a Recording Session in the DataView® PowerPad® III Control Panel

- Customer Support Tip: NEC 220.87 – Load study: Finding the maximum 15-minute demand for a 30-day period using AEMC® PEL 100 Series or PowerPad® III instruments

- Minimizing Noise Voltage in Cables

- AEMC® Interview: Timothy Cowgill (Western Regional Manager), Mark Gutekunst (Mid-Atlantic District Sales Engineer), and George Vlachos (Eastern US Sales Manager)

- New AEMC® Products: Power & Energy Logger Model PEL 105, Data Logger Model 452, IR Camera Model 1950

Featured Product:

Performing a Wenner Soil Resistivity Test with the AEMC® Model 6472

Soil resistivity is a key factor for determining what the resistance of a grounding electrode will be, to what depth it must be driven in order to obtain low earth resistance, and even the type of grounding system that should be designed for this location and facility.

The resistivity of the soil varies widely throughout the world and changes seasonally. Resistivity is strongly affected by the content of electrolytes in the soil, its moisture content, and even its temperature. Soil resistivity measurements are therefore critical for designing and constructing a grounding system appropriate for your site and requirements.

This article describes a simple way to measure soil resistivity known as the Wenner method. Our test instrument will be the AEMC® Ground Tester Model 6472. This instrument automatically calculates and displays soil resistivity, with no manual calculations necessary.

The Model 6472 also features advanced capabilities such as test currents up to 250 milliamps for testing soils with high resistivity, automatic test frequency selection for testing in high EMI environments, and the ability to connect to a computer via AEMC's DataView® data analysis software.

Soil Resistivity vs Resistance

In this article, we refer to both soil resistivity and soil resistance. To avoid possible confusion, it's important to have a basic understanding of what these terms mean and how they differ. Simply put, resistance (represented by the letter **R**) is a property of a specific physical item of a definite size and shape; while resistivity (represented by the Greek letter ρ), is a general property of a material irrespective of its shape or size.

For example, a 500-foot length of 10-gauge copper wire has a specific resistance, measureable in ohms (Ω); while copper as a material possesses a general resistivity, expressed in units such as ohm-centimeters (Ωcm) or ohm-meters (Ωm). Changing the length or gauge of the wire changes its resistance, while the resistivity of the copper from which it is made remains the same.

Wenner Test Setup

The Wenner test involves placing four equally spaced and in-line electrodes into the ground. The two outer electrodes (called the current electrodes) inject current into the soil. The two inner electrodes (called the potential electrodes) measure voltage, which is then used to calculate soil resistance.
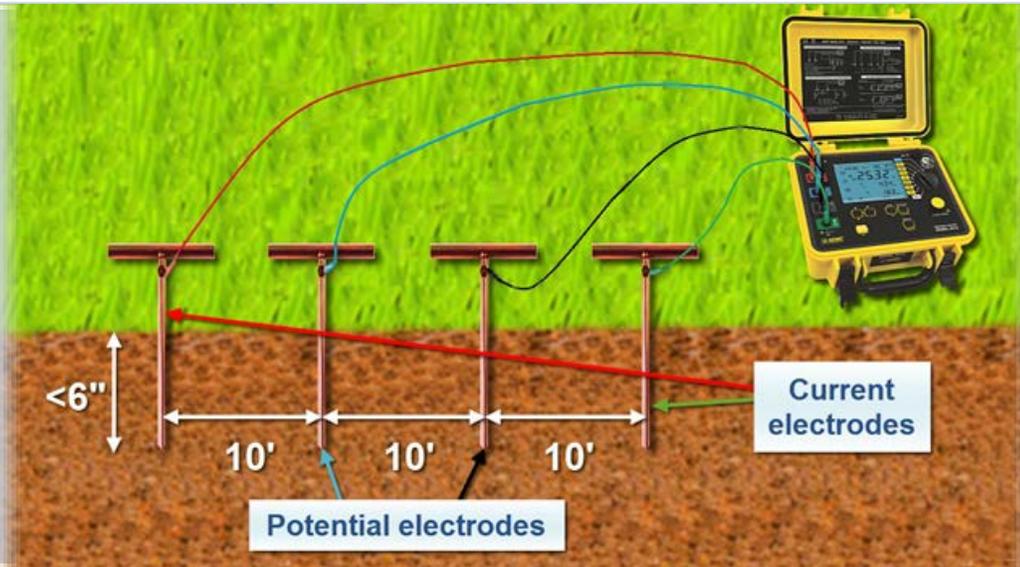
The Model 6472 automatically calculates soil resistivity using a formula that assumes the auxiliary electrodes are inserted into the ground to a depth that does not exceed 1/20th of the spacing distance between electrodes. So for our demonstration, we will place the electrodes 10 feet apart and no more than 6 inches deep. Other distances can be used, as long as depth does not exceed 1/20th of the spacing. Note that when calculating the spacing-to-depth ratio, the spacing distance is the primary value. Determine the electrode spacing first, and then adjust the depth accordingly.

The two outer electrodes are connected to the instrument's outer terminals, labeled H and E. The inner electrodes are connected the inner terminals, labeled S and ES.

To enable the instrument to accurately calculate soil resistivity, we must enter the electrode spacing distance. We start by ensuring the instrument is configured for the correct units of measure. Turn the instrument's dial to the set-up setting. Then press the DISPLAY button. The unit of measure, either meters (m) or feet (ft), appears blinking on the screen. Pressing the Up button toggles between these two options. In our example we're using feet, so if this is set to meters press the Up button to change this setting.
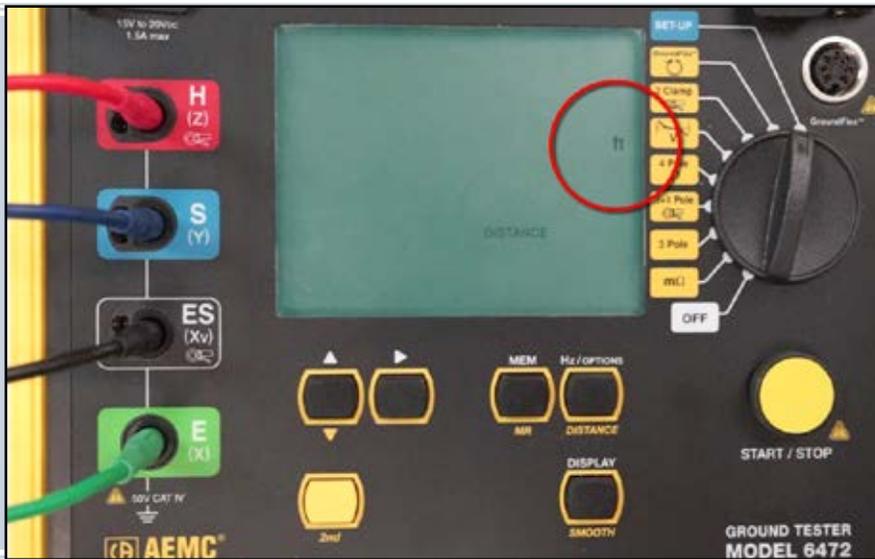
Next, turn the dial to the 4-pole ρ setting. To enter the spacing distance, press the yellow button labeled 2nd. The symbol 2nd appears on the screen, indicating buttons will now perform the actions labeled in yellow.

Press the DISTANCE button. The word DISTANCE appears on the screen, and the first digit in the distance field blinks, indicating it is in edit mode. Use the Up and Right buttons to navigate through this field and make selections. For example, to set the distance to 10 feet, press the Right button to navigate to the second digit and press the Up button to change this to 1. The field should now be set to 10 feet.

You can save the setting by pressing the yellow 2nd button to enter 2nd mode and then pressing the DISTANCE button.
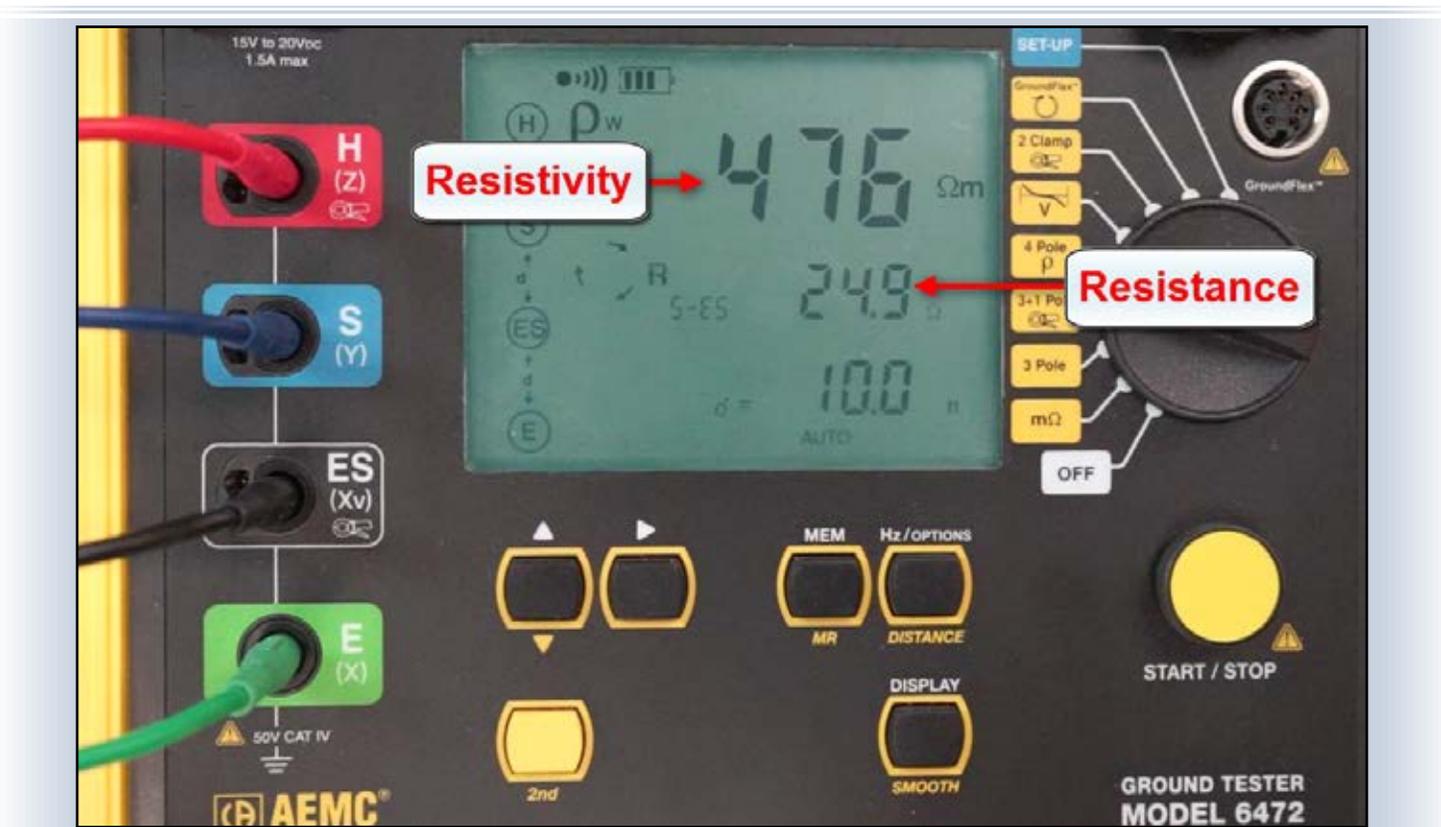
You are now ready to take a soil resistivity measurement. To do this, push the START/STOP button and hold it down for at least two seconds. After a few moments, the resistivity reading appears, displayed in ohm-meters. The resistance of the soil between the two potential electrodes is also displayed, in ohms.

To save the measurement in the instrument's memory, press the MEM button twice. This saves the reading, along with the date and time the reading was taken. This stored record can later be displayed on the instrument's screen, and downloaded to a computer using DataView® for further analysis.

This concludes our quick explanation of how to perform a Wenner soil resistivity measurement with the Model 6472. For more information about this instrument, please visit our Product Page*.*

True RMS, True*InRush*®, and True Megohmmeter®

If you're a user of AEMC® instruments, you may have come across the terms True RMS, True*InRush*®, and/or True Megohmmeter®. In this article, we'll briefly define what these terms mean and why they are important to you.

True RMS

The most well-known of these is True RMS, an industry term for a method for calculating Root Mean Square. Root Mean Square, or RMS, is a mathematical concept used to derive the average of a constantly varying value. In electronics, RMS provides a way to measure effective AC power that allows you to compare it to the equivalent heating value of a DC system.

Some low-end instruments employ a technique known as "average sensing," sometimes referred to as "average RMS." This entails multiplying the peak AC voltage or current by 0.707, which represents the decimal form of one over the square root of two.

For electrical systems where the AC cycle is sinusoidal and reasonably undistorted, this can produce accurate and reliable results. Unfortunately, for other AC waveforms, such as square waves, this calculation can introduce significant inaccuracies. The equation can also be problematic when the AC wave is non-linear, as would be found in systems where the original or fundamental wave is distorted by one or more harmonic waves.

In these cases, we need to apply a method known as "true" RMS. This involves a more generalized mathematical calculation that takes into consideration all irregularities and asymmetries that may be present in the AC waveform:

$$V_{RMS} = \sqrt{\frac{x1^2 + x2^2 + \cdots + xn^2}{n}}$$

In this equation, **n** equals the number of measurements made during one complete cycle of the waveform. The higher this number is, the more accurate the RMS calculation will be. This is because the higher the value of **n**, the higher the order of harmonics this formula can accommodate.

Less well-known are the terms True*InRush*® and True Megohmmeter®. These are unique to AEMC®, and represent advanced capabilities not found in competing products.
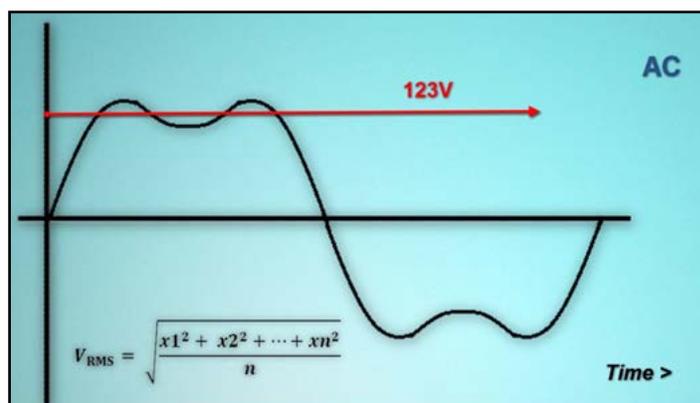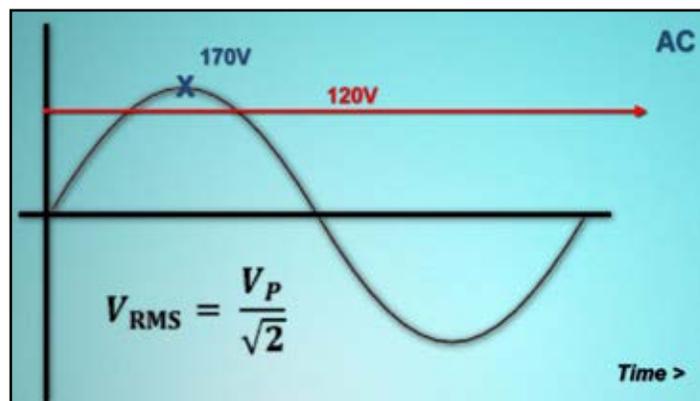
True*InRush*®

When an electrical system or device is turned on, voltage and current initially spike before settling down to steady-state operation. This phenomenon is known as "startup inrush," and it can be an important consideration when monitoring your electrical network for events that could affect the performance of your facility. Inrush is also a critical factor in determining the proper wiring size for your network.

Most instruments can only measure inrush in systems that are initially powered off. Basically, these instruments measure current and voltage starting with the initial powered-down state, through power-up and finally steady state operation. This usually occurs within the first few seconds after start-up. The instrument then compares the power-up peak to steady-state and depending on the threshold criteria used, displays the inrush reading.

AEMC's True*InRush*® function adds the unique ability to measure power-up events from devices added to a network that is already powered on.

In addition to the initial power-up event, True*InRush*® can also detect subsequent power-up inrush events that meet user-defined threshold criteria. True*InRush*® captures all overcurrents, making it simpler and easier to size complex installation correctly.
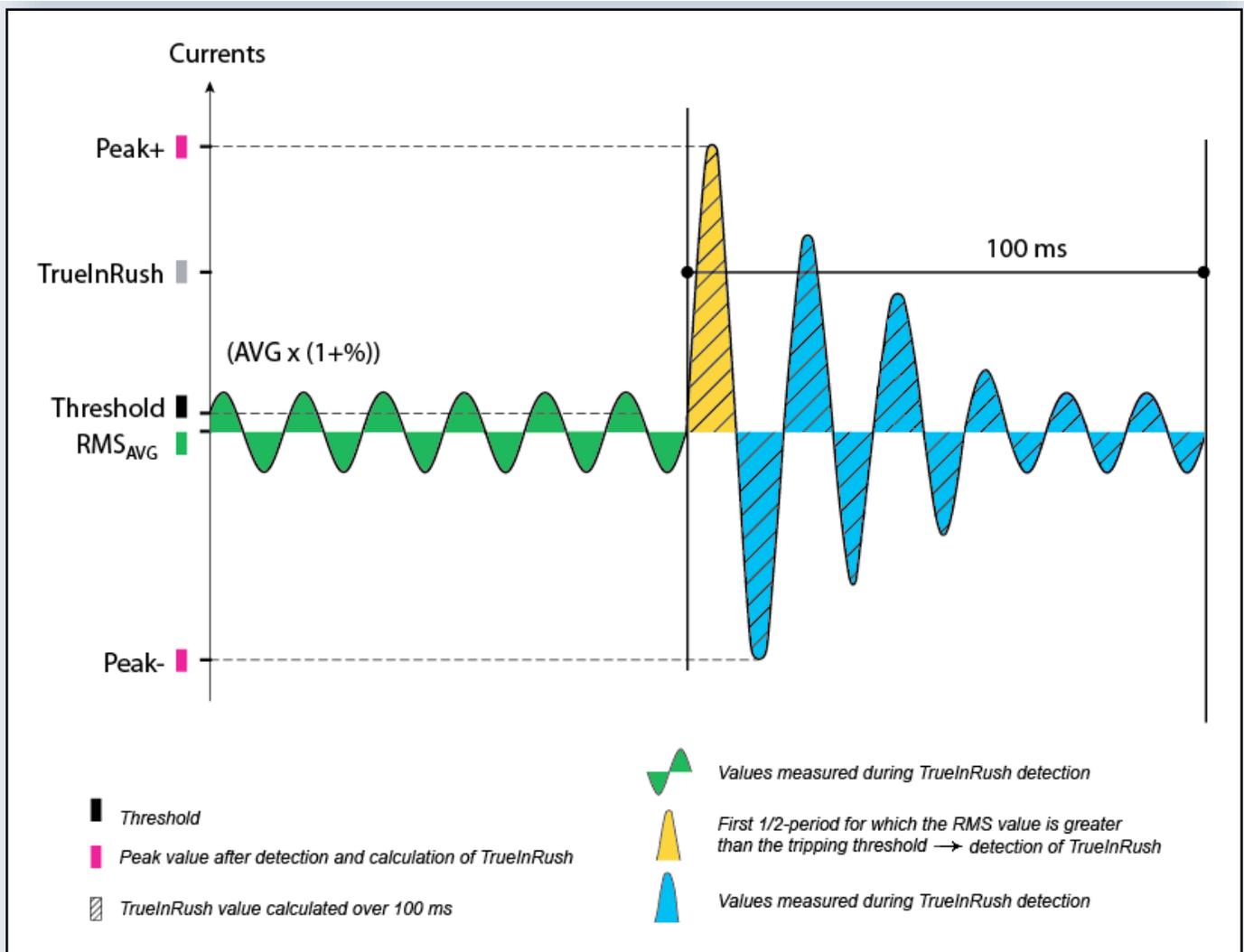
True Megohmmeter®

Another term unique to the AEMC® world is True Megohmmeter®. To understand its meaning, consider the general principle behind how megohmmeters operate. Basically, these instruments apply a constant voltage to the test conductor, measure current, and then calculate and display resistance in accordance with Ohm's Law.

AEMC® Megohmmeter Model 5070

Unfortunately, holding the voltage constant can be a challenge at lower resistances. To accommodate this, most megohmmeters adjust the voltage level in this situation and continue with the test. This may introduce a level of uncertainty into the data, since ideally all measurements within a test should be made at the same test voltage to ensure a true "apples-to-apples" comparison among the readings.

AEMC's True Megohmmeter® functionality ensures that the test voltage remains constant throughout the test, irrespective of how low the level of resistance. If for any reason the voltage cannot be held constant, True Megohmmeter® instruments will end the test. This ensures complete voltage consistency across all measurements in a test, enabling you to compare results with a high degree of confidence.

Conclusion

This concludes our quick explanation of True RMS, True*InRush*®, and True Megohmmeter®. All three terms speak to AEMC's commitment to providing you with the most reliable and accurate data.

Setting Up a Recording Session in the DataView® PowerPad® III Control Panel

By Mike Van Dunk

The DataView® PowerPad® III Control Panel is designed for working with AEMC® PowerPad® III Power Quality Analyzers, including the Models 8333, 8336, and 8435. An important feature of the Control Panel is its ability to set up, schedule, and run recording sessions on the instrument. The data recorded during these sessions can then be downloaded to the computer, viewed, and formatted into DataView® reports and/or Microsoft Excel-compatible spreadsheets.

In this article, we explain how to set up and run an example recording session with the PowerPad® III Control Panel. Our demonstration instrument is the Model 8336. We assume that the Control Panel is installed and running on your computer, and is actively connected to the instrument.

Step 1: General Setup

1. Open the Configure Instrument dialog box by doing one of the following:

    - Click *INSTRUMENT* in the menu bar and select *CONFIGURE*.
    - Click the Configure [icon] icon in the toolbar.
    - Click the Configure [button] button at the top of the data frame.

2. In the *SETUP* tab, select the electrical hook-up type. This needs to match the physical hook-up between the instrument and the system under test.

3. If you want reactive values to be calculated with harmonics, click the radio button *N. COMBINED (WITH HARMONICS)* in the *REACTIVE VALUES (VAR) CALCULATION* field.
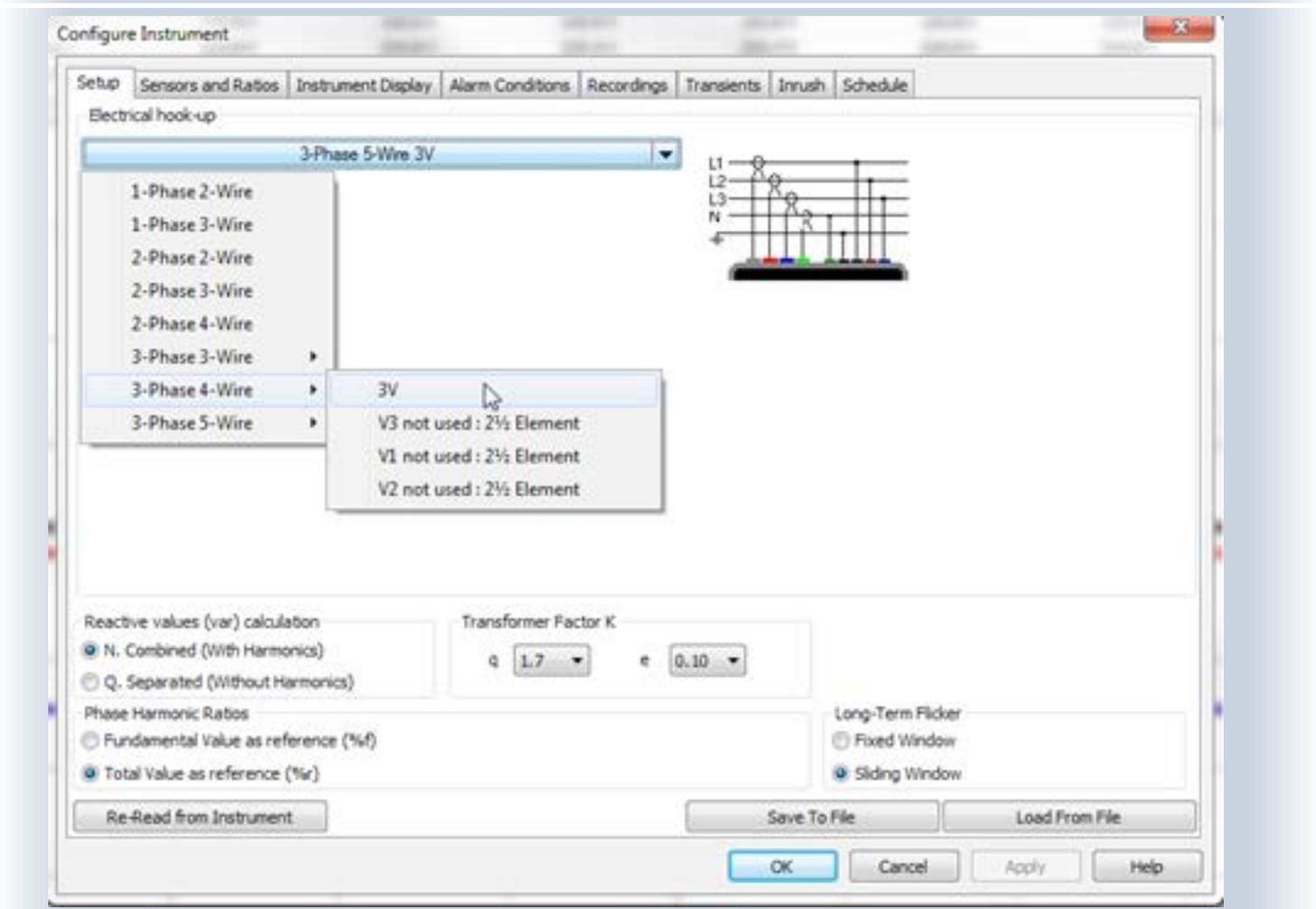
4. In the *PHASE HARMONIC RATIOS* field, select *TOTAL VALUE AS REFERENCE (%)* to calculate, display, and report harmonics as a ratio of the total value.

5. In the *TRANSFORMER FACTOR K* field, enter the appropriate values in the "*Q*" and "*E*" fields to define the variables for calculating the transformer Factor K. (In the preceding illustration, q = 1.7 and e = 0.10.)

6. Select *FIXED WINDOW* or *SLIDING WINDOW* in the *LONG-TERM FLICKER* field to specify which type of window of time is used for measuring long-term flicker.

Step 2: Selecting Voltage Ratios

1. Open the *SENSORS AND RATIOS* tab.

2. Click the *VOLTAGE RATIO* field. In our example, we will select *L1+L2+L3+N SEPARATE RATIOS* from the drop-down menu. The Primary and Secondary fields then appear for *L1*, *L2*, *L3*, and *N*.

3. Set the *PRIMARY* ratios for all lines and neutral.
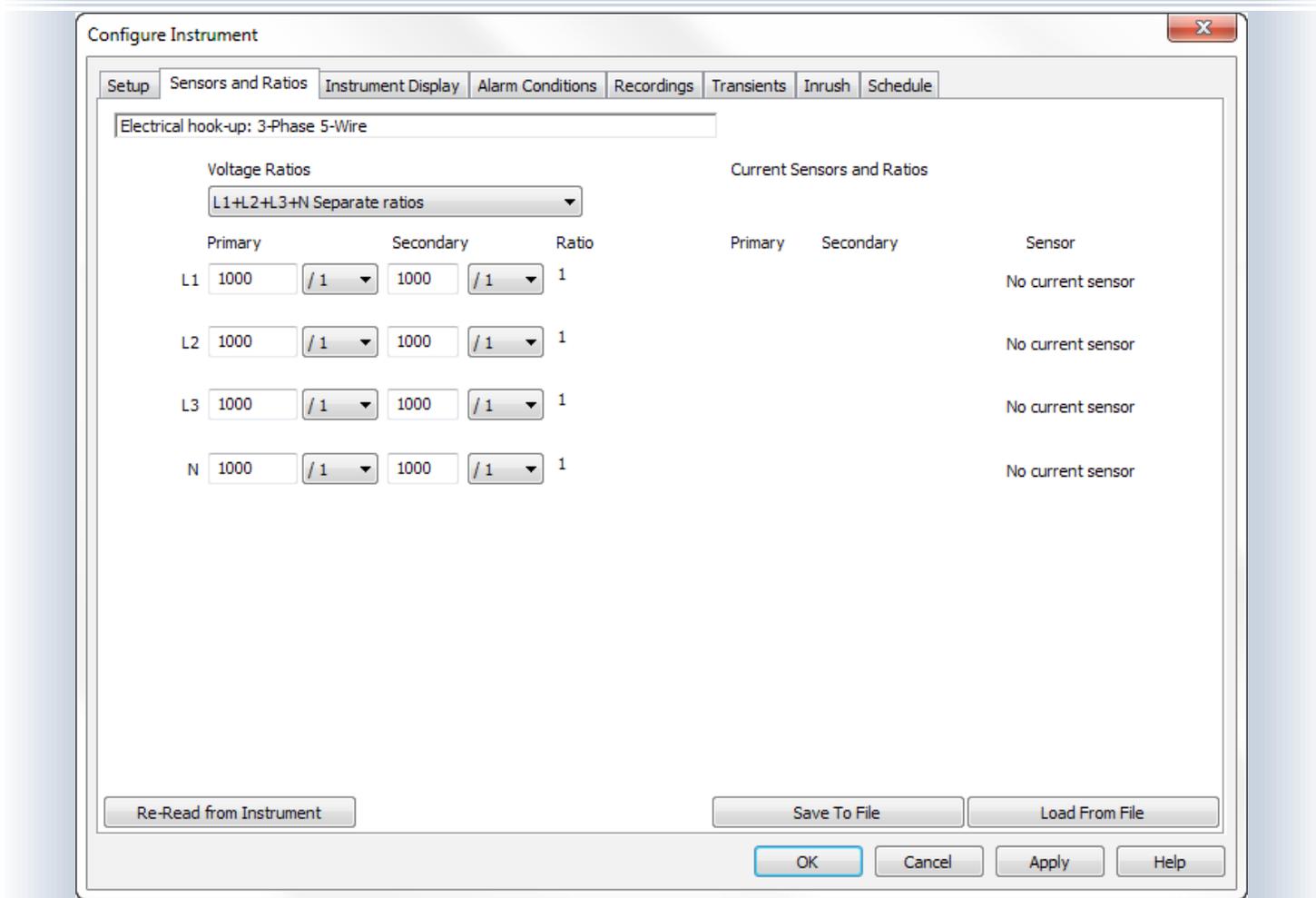
4. Set the *SECONDARY* ratios.

Unless you have current probes attached to the instrument, the *CURRENT SENSORS AND RATIOS* fields are inactive (as they are in our demonstration) so we can skip these. We will also leave the *INSTRUMENT DISPLAY* tab settings unchanged, and proceed with setting alarms.

Step 3: Defining Alarms

The *ALARM CONDITIONS* tab lists all the parameters (measured and calculated) for which alarms can be set. Since we are using the Model 8336 in our example, we are able to configure up to 40 alarms. For each alarm you can set the following (note that not all these fields apply to each type of alarm):

■ *DATA TO CAPTURE* is a drop-down list of all the choices of quantities (including None) for which an alarm can be set. After you select a quantity, a check box appears to the left of the measurement's name. Check or uncheck this box to enable or disable this alarm. This allows you to define an alarm but choose to include or exclude it depending on the recording.

■ *PHASES* specifies the phase to be monitored. Options are 3L, N, and 4L. Note that this field does not appear for some quantity types.

■ *< OR >* specifies whether the alarm activates when a quantity exceeds a defined threshold, or activates when it falls below that threshold. This field is inactive for some quantities.

■ *THRESHOLD* defines the limit that activates the alarm. Depending on the quantity being configured, the threshold may be expressed as a percentage, or in terms of units. In the latter case, some quantities offer a choice of units, which you can select from a drop-down list.

■ *DURATION* sets the time period the condition must persist before it is recorded as an alarm. This can be expressed in either seconds or minutes, as selected from the accompanying drop-down list.

■ *HYSTERESIS* selects the hysteresis percentage for the quantity. Options are 1%, 2%, 5% and 10%.

For instance, suppose we complete this tab as follows:

In the preceding example, we have set the first alarm for frequency (Hz). The checkmark to the left indicates this alarm is enabled. The setting in the *< OR >* field indicates the alarm will activate if the measured frequency falls below the threshold, which we have set to 50Hz. We have set *DURATION* to 5s; this specifies that the alarm will be included in the recording if it lasts 5 seconds or longer. Finally, we allow 5% of the measurement for hysteresis.

We suggest you spend a few minutes navigating through and experimenting with these parameters. When finished, open the Recordings tab and proceed as instructed on the next page.

Step 4: Selecting Data to Record

The *RECORDINGS* tab of the Configure Instrument dialog box defines what data should be captured during instrument recording sessions. You can create up to four different recording configurations that you can re-use for future recordings. To configure a recording:

1. In the *CONFIGURATION NUMBER* field, select the radio button labeled 1. This will save our configuration settings as "Configuration 1."

2. Click *NONE* to deselect all check boxes.

3. For demonstration purposes, select all the variables listed in the first column on the left.
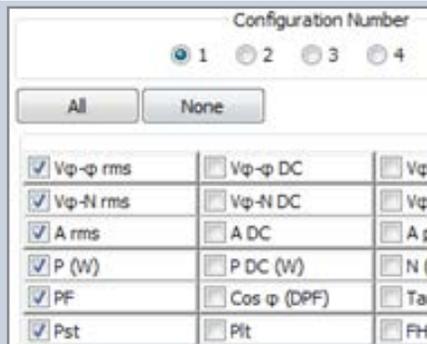
4. We will now create a second (blank) configuration. Start by selecting the button labeled 2 in the Configuration Number field. Then click None to de-select all variables.

5. Similarly, click 3 in the Configuration Number field and select all variables listed in the second and third columns from the left.
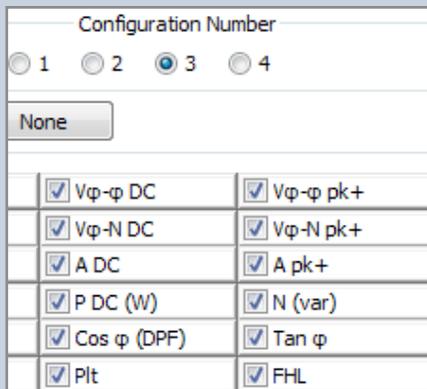
6. Finally, click 4 in the Configuration Number field and click the *ALL* button to select all variables.

7. If you click 1 again in the Configuration Number field, you will see that only the parameters in the far left column are checked. Selecting 2 shows no variables selected, 3 shows the second and third column parameters checked, and 4 has all selected.

Step 5: Scheduling the Recording

Now that we have defined what data to include in the recording, we can perform the final step of deciding when (and for how long) the recording session will run. To do this, open the *SCHEDULE* tab of the Configure Instrument dialog box, and proceed as follows:

1. Check the *INSTRUMENT CLOCK* setting to view the current time and date settings on the instrument. If this needs to be changed, click the *SET* button to display the *DATE/TIME* dialog box. To ensure the computer and instrument have the same time, click *SYNCHRONIZE WITH PC CLOCK*.

2. You can start a recording immediately, or schedule one for a future time and date. In this demonstration, we want to start immediately, so click *RECORD NOW*. This displays the *DURATION* field to define how long the recording the recording will run. In this example we select 30 minutes.
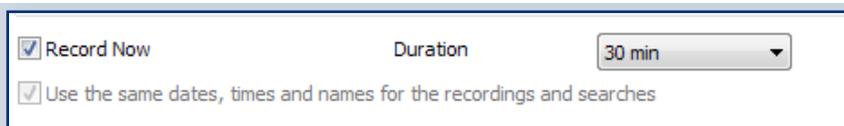
3. You can name a recording by filling out the *NAME* field on the right side of the tab. In this example we will give our recording the name Test1.
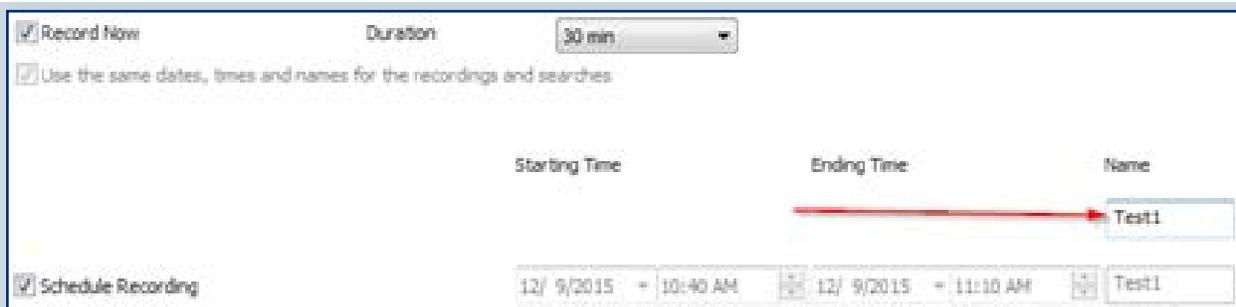
4. Click *OK* to save your configuration settings.

5. Highlight the connected instrument in the navigation frame. This displays the instrument's status information in the data frame. This should indicate that the new recording is underway or about to begin.

Note that you can cancel a scheduled or in-progress recording session by opening the Configure Instrument dialog box, opening the Schedule tab, and clicking *END TRENDS RECORDING*. A prompt appears asking you to confirm the cancellation, click *YES* to confirm.

The start and end times requested for the recording might be adjusted by the PowerPad® III to be in even multiples of the averaging period. For instance, if an integration period of 10 minutes was requested and the start time was 9:03, the recording might not actually begin until 9:10.

For more information about the PowerPad® III product family, consult the [AEMC®](Web Site)[Web Site](Web Site).

About the Author:

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Customer Support Tip:

NEC 220.87 – Load Study: Finding the Max 15-Minute Demand for a 30-Day Period Using AEMC® PEL 100 Series or PowerPad® III

By Guy Belliveau

The National Electrical Code NEC article 220.87 for determining existing loads states the following:

> The calculation of a feeder or service load for existing installations can be based on:
>
> The maximum demand data for one year.
>
> *Exception: If the maximum demand data for one year isn't available, <u>the maximum power demand over a 15-minute period continuously recorded over a minimum 30-day period using a recording ammeter or power meter connected to the highest loaded phase, based on the initial loading at the start of the recording is permitted.</u> The recording must be taken when the building or space is occupied based on the larger of the heating or cooling equipment load.*

AEMC® offers a variety of instruments that can record the system's load for the study. These include the PowerPad® III Power Quality Analyzers Models 8333, 8336 and 8435; and the Power and Energy Loggers Model PEL 100 Series.

This tip will show you how to quickly identify the peak 15-minute demand from a 30-day recording from these instruments.

The following steps assume you have already configured each instrument for a 30-day recording period with a 15-minute demand interval. This instructs each instrument to record for 30-days and write a data point every 15-minutes containing the RMS average of all selected channels. We will focus on the Current (I/A) channels in the following examples.

PEL 100 Series

For Models PEL 102, 103, and 105, download the 30-day recording using the DataView® PEL Control Panel. Once downloaded, the recording will appear in the My Open Sessions folder in the Navigation frame. Click on the 15-minute Summary sub-folder of the recording to show the Trend Graph. Then follow these steps (and refer to the illustration below) to find the maximum demand for each leg:

1. Display RMS values by clicking the RMS button.

2. Display Current (**I**) traces.

3. Turn off Min/Max traces. This will display only the RMS Averages.

4. The Window MAX column will show the Maximum RMS Average Current of all 15-minute samples. Use these numbers for your load calculations as these represent the highest 15-minute demand, per leg, during the entire 30-day recording period.

PowerPad® III

For Models 8333, 8336, and 8435, download the 30-day recording using the PowerPad® III Control Panel. Once downloaded, the recording will appear in My Campaigns. Click on the name of the recording to show the Trend Graph. Then follow these steps (and refer to the accompanying illustration) to find the maximum demand for each leg:

1. Display RMS values by clicking the RMS button.

2. Display Current (A) traces only.

3. Turn off Min/Max traces. This will display only the RMS Averages.

4. The Window MAX column will show the Maximum RMS Average Current of all 15-minute samples. Use these numbers for your load calculations as these represent the highest 15-minute demand, per leg, during the entire 30-day recording period.
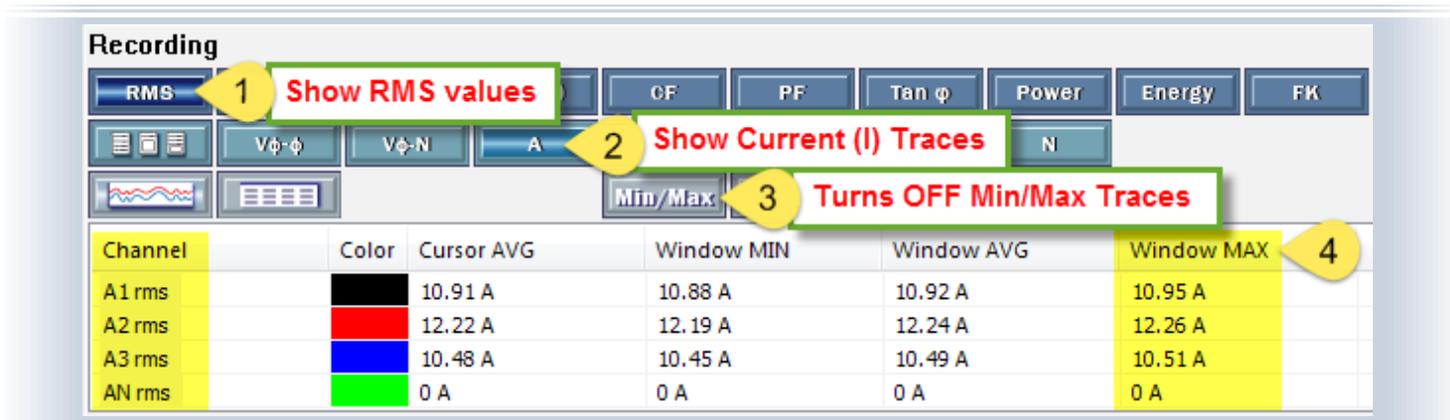
Using these simple and quick steps, the peak demand for a 15-minute period over a 30-day recording can be found fast and easy.

If you have any questions about this article or any AEMC® instrument, please contact our Technical Support staff at 1-800-343-1391 x351 or techsupport@aemc.com.

About the Author:

Guy Belliveau is Applications Engineer for AEMC® Instruments, Dover, NH.

Reducing Noise Voltage in Shielded Cable

In this short article, we demonstrate the importance of properly grounding the shielding in a cable. This helps minimize the presence of stray noise voltage being generated in the cable due to the proximity of live electrical lines.

For our demonstration, we have placed a length of shielded cable adjacent to an extension cord plugged into a common electrical outlet.
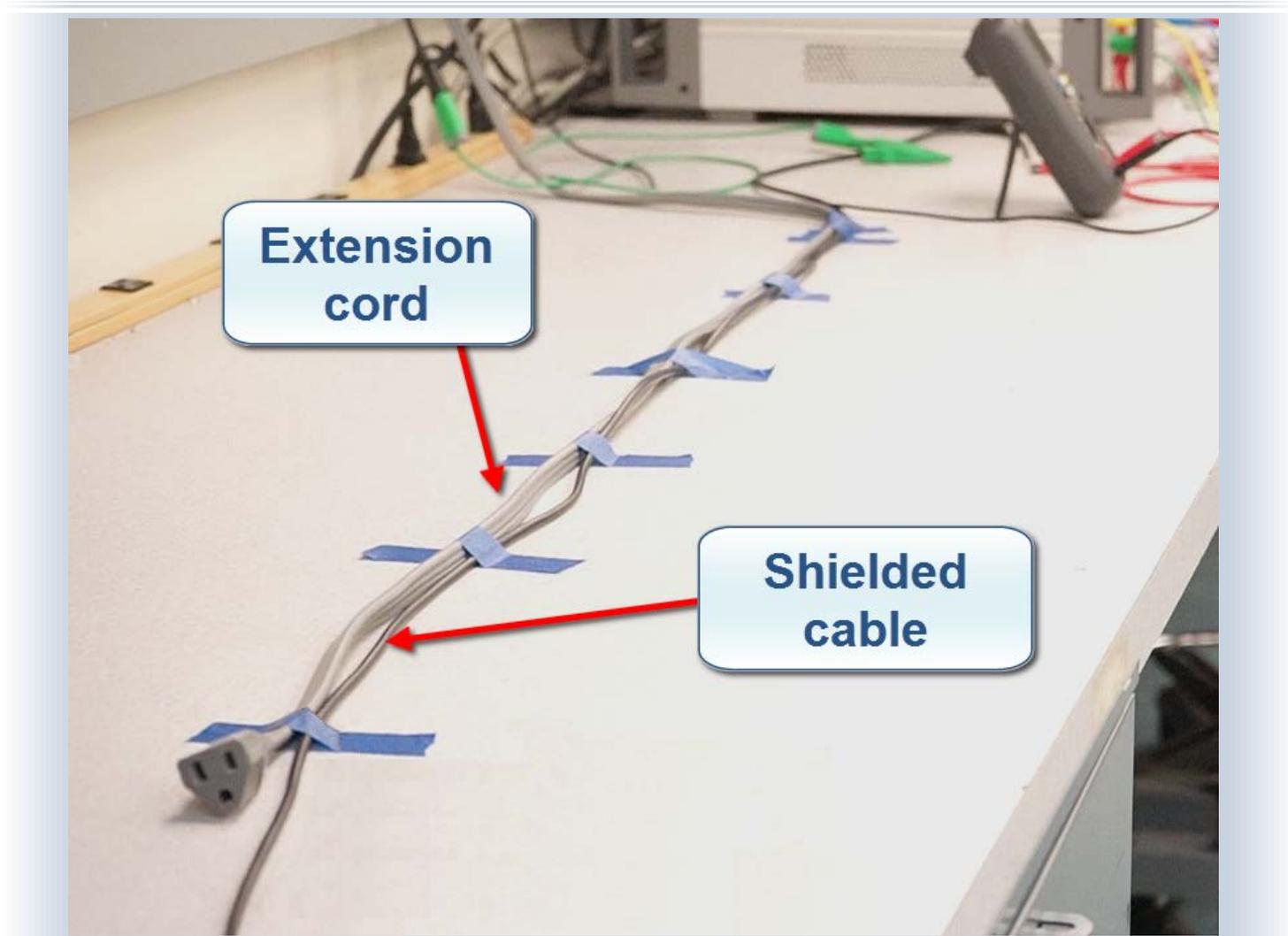
We have connected one end of the cable conductor to the Model 5217. For our first measurement, we will leave the cable shielding ungrounded:

As you can see, the noise voltage being generated within the cable is over 6V, a voltage that could potentially corrupt data sent through the cable.

Now we'll connect the cable shielding to ground:

Notice that the noise voltage has dropped to around 100mV, nearly two orders of magnitude lower than our previous reading. In other words, grounding the shielding has reduced noise voltage within the cable by around 98%!

Note that only one end of the shielding should be grounded. The addition of one or more other grounding points could result in a ground loop that could compromise the efficacy of the ground.

AEMC® Interview:

Timothy Cowgill, Western Regional Manager
Mark Gutekunst, Mid-Atlantic District Sales Engineer
George Vlachos, Eastern US Sales Manager

In this issue we depart from our usual format and present a group interview with three members of the AEMC® Sales force. Tim, Mark, and George share a few thoughts and experiences about selling AEMC® products in the U.S.A. and Canada.

Q. What are your primary responsibilities with AEMC?

Mark Gutekunst

MARK GUTEKUNST: My responsibilities include promoting sales growth, providing field technical support, and developing new business in the Mid-Atlantic region, which extends from New York City south through Virginia.

I also present the Understanding Ground Resistance Testing Training Seminar, and serve as the regional interface for our distributors to provide market information back to AEMC® sales management.

TIM COWGILL: I manage all sales for U.S. Region 2, which is everything west of Texas.

GEORGE VLACHOS: I am the Sales Manager for the Eastern U.S. and Canada region.

Q. Are there any unique aspects or challenges to selling for AEMC?

Tim Cowgill

TIM: One main challenge we all face in Field Sales is getting our products demoed to the customer. Some of our competitors have very high name recognition within the industry, and this can make it somewhat difficult at times to get the customer's attention.

But when we are able to present our products to end users, we normally win the order because of our superior product design. This includes our DataView® software.

GEORGE: I echo this sentiment. AEMC's biggest challenge is getting in front of enough customers. Lack of awareness of our products is the only thing preventing us from being #1 in all markets.

MARK: I'm in agreement with Tim and George.

Q. Can you share a particularly interesting customer experience?

GEORGE: While there are many, the most unique was when I was able to assist a customer in using a PEL 103 to find out how much electricity (and cost) was incurred to produce a washing machine.

George Vlachos

Another example involved the state of New Jersey. A state agency needed to reduce electric costs and used several PELs to determine whether or not the measures they had put into place were effective. As it turned out, the cost reductions were as promised.

MARK: A scenario I've seen repeated multiple times is when we educate a customer during a visit about our product diversity, and they had no idea AEMC® makes such a wide variety of products. So they try some of our products and typically buy thereafter!

This is in keeping with something George told me when I joined AEMC: our biggest competitor is customer lack of awareness about who we are and what we provide. I absolutely believe that statement today, since I experience it on a weekly basis.

Q. Any final "words of wisdom" you'd like to share?

TIM: We are perceived in the marketplace by our distributors and end users a responsive company that manufactures and ships quality products. Maintaining this reputation requires a lot of people working closely together. Our Customer Service is highly rated and our people do a great job. Our distributors and end users can get quick Tech Support answers. This saves time for our Field Sales force. AEMC® is represented very well in our distributor catalogs, mailers, and other marketing material due to the quality work done by our Graphics Department.

All of this makes the Field Sales effort easier and creates more AEMC® mindshare with our customers and distributors.

MARK: Sales continues to be a person-to-person business. When we are able to contact and visit our current and future customers, AEMC® typically wins new business. This is due to our product capability and features, stocking, and price commitments. This is also the benefit of our ongoing interest – which at this point is almost unique in the industry – in actually visiting customers and demonstrating products to them.

GEORGE: I'd just like to add this: The more people see our products the more we sell!

New Products:

Power and Energy Logger Model PEL 105

The AEMC® Model PEL 105 is a rugged, simple-to-use power and energy logger. This instrument provides all the necessary functions and features for power/energy data logging for most 50, 60, and 400Hz and DC distribution systems worldwide. The primary users for the PEL 105 include utilities and contractors performing power system evaluation and monitoring.

The PEL 105 measures phase-to-pase (U_1, U_2, U_3), phase-to-neutral (V_1, V_2, V_3) and neutral-to-earth (V_{NE}) voltage up to 1000V in measurement category IV, with pollution degree 4 (IEC 61010-1 Ed3). The instrument also measures phase (I_1, I_2, I_3) and neutral (I_N) current, using a variety of external current sensors.

A total of 17 types of electrical hook-ups are supported, including single-phase, split-phase, 3-phase 3-wire, 3-phase 4-wire, open leg, and DC 2-, 3- and 4-wire. This measurement data is then used to calculate numerous values, including active, reactive, and apparent power and energy; cos ϕ, tan Φ, and Power Factor (PF); crest factor, harmonics and total harmonic distortion (THD); and others. Quantities can be aggregated from 1 minute to 1 hour and stored in a SD-Card or SDHC-Card (up to 32 GB). The PEL 105 is designed for full outdoor use, resistant to both water (IP67) and sunlight (UL746C f1). The instrument complies with the following specifications: IEC 61000-4-30, IEC 62053-22, IEC 62053-22, IEC 61557-12, and IEEE 1459:2010. It can run on voltage input power supplied by 100 to 1000V 50/60Hz or 100 to 600V 400Hz without an adapter.

The PEL 105 can be connected to a computer running DataView® data analysis software via Wi-Fi, Bluetooth, USB, or Ethernet. Once the instrument is connected, DataView® can view its real-time data, start and stop a recording session, download previously recorded sessions stored on the instrument for further analysis and report generation, and set configuration variables. The PEL 105 can also communicate with an Android device through a free app available for downloading from the Google Play Store. This app enables users to view real-time data and modify the instrument's configuration.

The PEL 105 is the newest member of the AEMC® PEL 100 family of power and energy loggers. This instrument provides a number of features and advantages unavailable in previous PEL 100 instruments. These include physical enhancements (compact rugged case, additional terminals for earth-to-neutral voltage and neutral current measurements, larger LCD front-panel display screen, IP67 rating, and pole-mounting capability) as well as performance enhancements (Wi-Fi connectivity, auto-recognition of current sensors, aggregated harmonics, one-second min/max, aggregated min/max, and 200ms quantities). These features make the PEL 105 both the most physically rugged and functionally robust of the AEMC® power and energy loggers. They also extend the utility and reach of the PEL 100 family to outdoor environments and applications where equipment is exposed to the elements.

Data Logger Model L452

The AEMC® Data Logger Model L452 is an inexpensive and easy-to-use two-channel data logger. The instrument is Bluetooth-enabled and records DC voltage, DC current, pulses, and digital input. Typical applications for this instrument include process control and measurement, utility metering, and environmental monitoring.

Real-time measurement data can be viewed through the LCD screen, or through a computer connected to the instrument via a Bluetooth or USB connection. AEMC's DataView® data analysis software has been updated with a new Control Panel designed for Data Logger instruments. You can use this Control Panel to connect to and configure the L452, download recorded data, and format this data into a variety of standard and customizable reports.

The Model L452 combines the functionality of three previously released AEMC® Simple Logger II instruments:

- Model L322 (4 to 20mA logger)

- Model L432 (user-selectable 100mV, 1V, and 10V logger)

- Model L404 (event logger).

This combined functionality is further enhanced by usability features including a front-panel LCD display, buttons, large internal memory, and a user-friendly interface. This makes the Model L452 the first AEMC® Data Logger capable of being operated as a standalone instrument.

Thermal Imaging IR Camera Model 1950

The AEMC® Thermal Imaging IR Camera Model 1950 is a simple-to-use "focus free" instrument that features a 20° x 20° field of view. The camera can be used as a real-time viewer for detecting hot spots and other thermal anomalies. Thermal images (also known as *thermograms*) can be recorded and stored on the instrument. You can also add audio comments and measurement data (provided by a compatible clamp-on meter or multimeter) to the stored image files.

The instrument features Bluetooth for connecting to measurement instruments and a headphone for recording narration. You can download stored thermograms to a computer running CamReport software (provided with the instrument) for image processing, analysis, and report generation.

The Model 1950 can be a valuable tool in industry sectors as diverse as:

- metallurgy and steel-making

- electric power generation

- petroleum

- automation

- natural gas exploration

- transportation

- fire-fighting

- border surveillance

In these and other applications requiring just-in-time operating procedures, high-voltage production equipment, powerful electric currents, and/or high operating speeds; the Model 1950 provides a real-time non-contact inspection method.

The Model 1950 infrared thermal imaging detection can be used for:

- surveillance of electrical equipment and high-voltage transformers

- locating leaks from thermal equipment and heat exchangers; analysis of heat losses

- identifying thermal failures in rail transport

- inspecting circuits for systematic hot spots

- locating latent fire sources, aiding victims, and tactical command