Data Loggers –

A Useful Tool for Monitoring Power & Energy

Part 2 of a 2 part article

By John Olobri, Director of Sales and Marketing for AEMC® Instruments

Last month, we dealt with the features, benefits and attributes of using data loggers to monitor power and energy and the advantages and cost savings associated with reviewing and analyzing the data associated with them.

As we continue this article, we will examine what is needed to select the proper logging features, functions and specifications to properly collect the data you need.

Data loggers are available in a wide variety of formats and pricing levels. When you are planning for your requirements it is important to think beyond your immediate need. Planning for future usage will provide you with a solution that will give you many years of service from your investment.

Let's start with the basics, the first thing to consider is the number of inputs (also referred to as channels) you need. Looking at the networks you will be working with, will give you a quick indication of how many inputs you need for your data logger. If you are doing primarily single phase work you need a minimum of two inputs, one for voltage and one for current. If it is a split phase network then you need four inputs, two voltage and two current. Do your needs also require monitoring of both neutral current and voltage? Then you will need two more inputs. If you are doing industrial work you will need at least six inputs, three for voltage and three for current. Finally, if you plan to log neutral voltage and current on a three-phase network you will need a data logger with eight inputs. Several power and energy loggers available today can calculate neutral current rather than measure it. This will save on the number of inputs as well as the cost. If you are doing single phase residential work requiring four inputs, you would be better off in the long run looking at a three phase system with at least six inputs.

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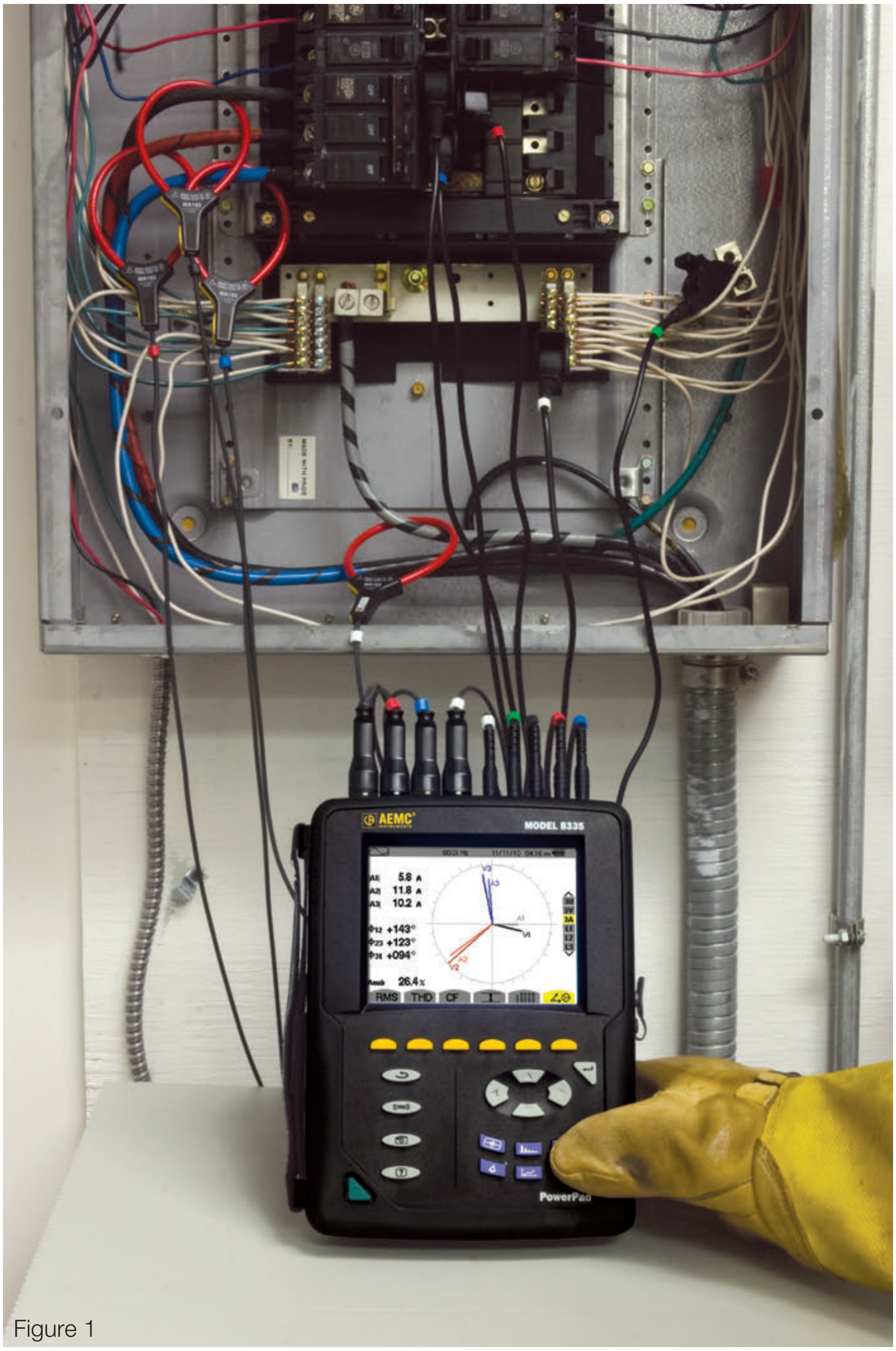

Figure 1

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Your investment will provide you with more utility down the road. Figure 1 shows a typical power and energy logger with eight inputs.

Now that we have determined the number of inputs, we need to look at what voltage and currents will be measured. Voltages are generally measured directly by the data logger while the current measurements are measured through the use of clamps, sensors or transducers. Ideally, the voltage inputs will handle at least twice the normal voltage you need to measure. Most commonly, current clamps and sensors are iron core ridged jaw types or air core flexible sensors. The choices and considerations are too vast to cover here. Here are a few points to consider. The iron core current probes offer good accuracy and phase shift specifications. Models are available that measure AC as well as DC currents. They tend to be large in size making it difficult to close the panel cover in many applications. Flexible probes on the other hand have good phase shift specifications, are slightly less accurate than their iron core cousins and can get into tight spaces. They will not saturate like iron core models when excess current is applied and will allow the panel cover to be closed in many applications.

Will the logger be used as an on-site diagnostic tool or as a remote data collector or both? If on-site diagnostics is important then a display will be required, if not then a blind (no display) logger will fit the bill. If a display is required you should consider whether a full graphic display is needed to look at waveforms or whether a multi-line text type display will do to show the measured values. Text type displays will be less costly and will be more than adequate for power quantity applications measuring volts, amps, power and energy usage. On the other hand, if power quality analysis is required you will be better off with a full graphics display capable of showing individual waveforms , harmonic spectrums and transients, as well as the power quantity measurements just mentioned. Figure 2 shows typical

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Figure 2

The industry has evolved to the use of some standard terms to represent power and energy.

The terms used today to display are:

P .... Active Power measured in Watts
S .... Apparent Power measured in VA
Q........ Reactive Power measured in var
EP .... Active Energy measured in Wh
ES........ Apparent Energy measured in VAh
EQ .... Reactive Energy measured in varh
EQ1 .... 1st quardrant Reactive Energy measured in varh
EQ3 .... 2nd quardrant Reactive Energy measured in varh
EQ3........ 3rd quardrant Reactive Energy measured in varh
EQ4 .... 4th quardrant Reactive Energy measured in varh

Quadrant energy indication provides the ability to determine both direction as well as its inductive or capacitive properties as shown here.

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graphic and text type displays.

Next, we need to look at the sample rate and storage rate. These two parameters are often wrongfully used interchangeably. The sample rate deals with how often the data logger looks at each input signal and takes a measurement whereas the storage rate deals with how often the results are stored to the loggers memory. Typical sample rates found on power and energy loggers are 64, 128 and 256 samples per cycle. The higher the sample rate, the more capability the logger will have in detecting and storing anomalies such as surges, sages spikes and motor inrush data. Storage rates are generally user programmable from rates as fast as every cycle, to as slow as once per day with a wide variety of choices in between. Some of the more common rates used are 1 per second, 1 every 10, 15 or 30 minutes and 1 per hour.

An often overlooked specification is what the data logger is doing with the input signals when not storing data. Lower cost loggers tend to only sample the inputs when they are about to store data thus missing all the data in between. Data loggers suited for power and energy measurement monitor every cycle (no missing data points) at their sample rate and will store the RMS average, as well as the min and max values since the last stored data point.

When considering the parameters to be recorded for power and energy work, the major recorded variables include Volts, Amps, Watts, VA, vars, power factor, displacement power factor, kWh, Vah, varh, THD, individual harmonics and phase angle. The ability to determine source and load characteristics are valuable as well typically referred to four quadrant measurement capability. See side bar article for this and the current standard terms used for power and energy.

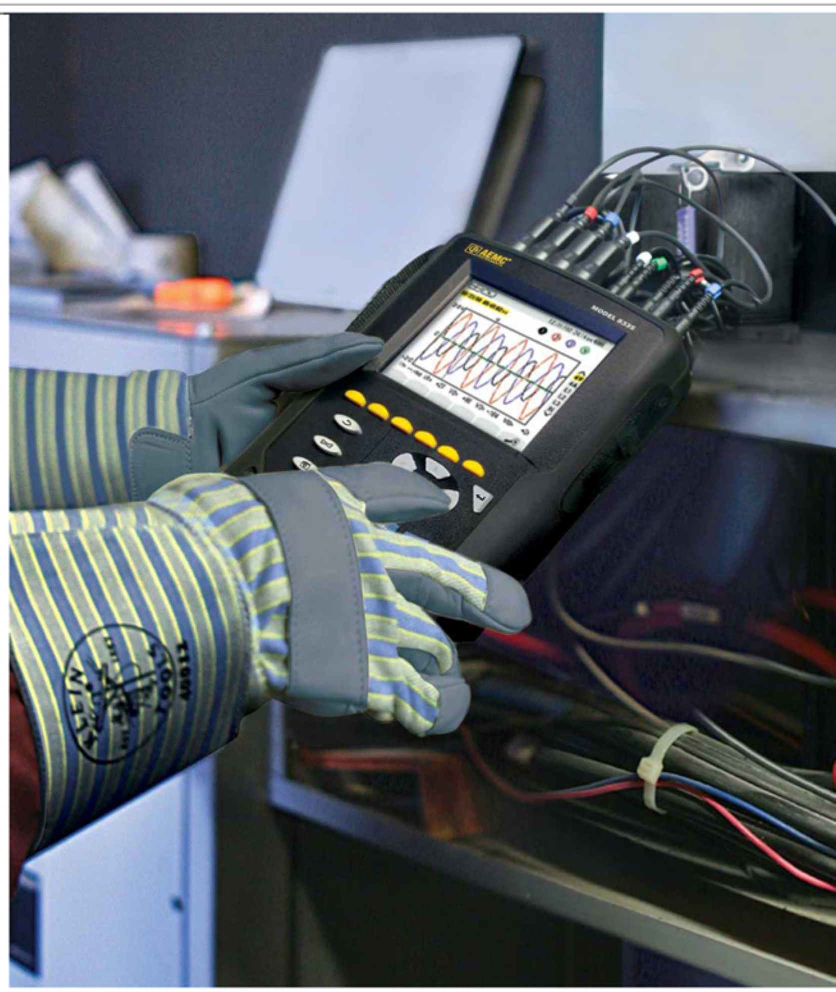
Next let's review the data storage and communications capability required for your application.

With the cost of memory relatively inexpensive today you can't go wrong with lots of it. The drawback is the amount of time it takes to download the data stored. It is not uncommon for example to take several hours to download data stored in 2 gigabytes of memory. Typical applications look to store data for a day, a week or a month. In most case 1 to 2 gigabytes of memory will be sufficient to handle a months' worth of recording at storage rates as fast as 1 per second.

The more common communication methods available today include direct connection using a USB cable, wirelessly via Bluetooth or WiFi or through a network through the use of an Ethernet connection.

When considering Bluetooth you have a choice of either a class 1 or class 2 for practical use in industrial applications. Class 1 devices typically have communication ranges up to 300 feet in open space where as class 2 devices have ranges up to 30 feet.

A distinct advantage Continued on page 14



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of Ethernet communication is the ability to look at the information in the data logger from remote locations within the facility or over the internet from anywhere. Good data logging instruments provide the ability to see the measured parameters both in real time, as well as downloading the stored data. This can be a major troubleshooting and time saving option. Adding WiFi to this capability provides another degree of flexibility in installing the logger for data collection.

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Let's take a brief look at software. Now that you have recorded your power and energy data, you need the ability to analyze it, store it on your computer and generate reports. Most, if not all, data logger manufactures provide software with their products for this purpose. The simplest form provides the ability to download the data, store it and tabular list it in a spreadsheet type program. Therefore, leaving the task to you to provide analysis tools using additional software. More comprehensive software packages provides the ability to configure the data logger's functions as you would from the instrument itself, as well as provide the analysis tools. Important tools to look for include the ability to zoom into sections of data for more accurate analysis, the ability to label data points with time date and value and to show the data in trend graph, as well as tabular listings.

Finally, report generation can be a tremendous help documenting the work and providing analysis for future reference. Look for the capability to generate reports from built-in templates, as well as the ability to create your own reports using tools provided within the software.

As you can see there are many variables, features and functions to consider when deciding on a data logger to measure power and energy. We have attempted to cover some of the more important ones here. The key is to give considerable thought beforehand on both what needs to be measured and how the data will be used after the fact. This will be time well spent when making a choice for a logging device. ❑