Going Green 1 MilliWatt at a Time

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New developments in several technologies challenge our neurons to come up with innovative ways to meet our daily life and customer needs.

Just last year, digital panel meters (DPMs), counters/timers and barmeters required external power in the Watts range to display data to the operator (HMI), interface with computers (MMI) and measure a process variable such as the current loop. These processes inherently have their own energy (approximately 100 mW), produced by the 4-20 mA or V/mA transmitter. Most of this signal energy is wasted because most digitals require external power. The industryôs first current-loop-powered digital meter (before ñgreenò existed) was designed around the concept of a barge going downstream using only the free energy of the flow of water. There is a lot of free energy all around us, such as the water flowing from your garden hose, wind, sea waves, solar. All of it is free. Later an ultra-efficient current transformer (CT) was designed to use the free energy of the signal to power a barmeter without the need of the external power. This new technology requires no power other than the signalôs.

As a result of other peopleôs development or other peopleôs inventions and after more than 40 years, the technology has been further developed and applied to many instruments now available. These instruments can be powered by the signal it measures just like Sir Edward Westonôs analog meters invented in 1893, display data in automatic tricolor LED bargraph (like analog meters) and have high digital accuracy (like a DPM). Units can communicate with other machines, control a process with analog or digital outputs (like a PLC) and detect (post-mortem) when the input signal has failed and give you isolated serial I/O powerlessly.

How is it possible? Patience and the development of ultra-efficient custom LEDs requiring around 1% of the current of standard LEDs, parasitic ASIC using around 1% of the current of a regular microcontroller, and engineers developing an ingenious software to efficiently share the 10-100 mW of power available from a 4-20 mA current loop ac signal or current transformers (CTs).

The result is process control instrumentation which utilizes existing (and often wasted) energy to measure/control any process variable without external power, as long as the signal can produce greater than 10 mW, about 1% of todayôs traditional technology. This is a 99% reduction in energy use. Imagine if we could all reduce our ñfootprintò by 99%.

Why is every milliWatt important? Why is powerless technology green? Analog meters are sensitive to wear and tear and to shock and vibration. The meters, although inexpensive, are also inaccurate and unreliable. They are also the cause of major disasters in airplanes, ships and nuclear power plants. When they read zero, operators cannot tell if the signal or the meter failed. Consequently operators ignore it when the needle doesnôt

move. Yet still, they are cheap and easy to connectð usually two wiresð so many still rely on them.

Why the CT? Typical 5-A CTs are used to measure ac current and/or power (W) along with Vac, but designing a highly linear and efficient miniature CT to extract the power of the ac line proved just as effective and less power-consuming. This CT was able to power the electronics for Volts, Amps, Watts, frequency and other high-voltage (HV) line data, instantaneously detect signal failure (open or short) and transmit wireless a substation problems, such as terrorist attacks or other problems essential to the HV grid system.

What inspired the new technology? The digital counterparts, DPMs, make up for most of the analog deficiencies. They are durable (no moving parts), accurate, reliable and easy to read by operators (HMI). Some units can communicate with supervisory (SCADA/DCS) computers via serial input/output (MMI). There are units that can even control the process they measure with analog or digital outputs (like a PLC but with display). Conversely, they require external power (on average 2-10 W), are not easy to install (do not conform to pre-existing installations) and are expensive. A typical nuclear power plant built between 1960 and 1980 has more than 300 individual meters (mostly analog) per reactor. Replacement would require rework of panels, wiring, engineering designs, agency approvals, inspection, operator training, additional normal and emergency power sources (battery banks) and more than two years of planning and implementing. If approximately 300 analog meters were to be replaced with traditional digitals, assuming they only require the average 5 W to operate, the new power source would have to produce and store continuously more than 1,500 W. The typical cost of the switchover would be $20 million.

Powerless technology includes the benefits of the two existing technologies and is plug-and-play. The meters needed to be signal-driven just like the analog meter and to imitate the needle of the analog meter. The design also had to be something that was easy to mount and connect by incorporating a mechanical design which was a drop in replacement for either analog or digital meters. The units would also need to be interference-free, Class 1E and computer-compatible, all while maintaining high accuracy, reliability and durability, as well as overcome the Fukushima syndrome (no signal, no data).

One night I was driving home, I was stopped by a traffic light and an epiphany hit me. Why not copy the world-accepted. red-yellow-green traffic-light standard? Red was known to imply danger, yellow inevitably stood for caution, and green represented safety. So this universal color system made sense in the meters. The meters were designed to have an automatic tricolor bargraph and were called barmeters.

When the signal, the meterôs power source, fails, how can the ñdeadò meter detect and record the occurrence? A battery would limit the practicality of the meter. And, in certain sections of the market, a battery would be hazardous. About 100 mW of energy was needed to last long enough to visually display a message while sending serial data to the central computer. An energy storage device (ESD) could store the excess energy from the

signal, detect when the signal went dead and enable the alarms, so, the post-mortem alarm was born.

The result is a new innovating technology that replaces fit, form and function of the 1893 analog meter and the 20th-century digital meter. A meter capable of so many things could help prevent additional disasters like Fukushima, Chernobyl, Three Mile Island and countless aircraft and shipboard accidents. The new technology harvests and uses the existing energy produced by the signal. This meter does not require re-wiring from the existing analog versions. It eliminates the need for expensive inspections, battery banks, additional emergency power generators and reworking of panels. There is no longer a need for a massive and costly switchover. Analogs and digitals can be replaced one at a time as necessary. Most important, the result is a meter that will ensure added safety with built-in input failure detection. Operators will no longer have to tap on stuck needles guess the status of their processes or the status of their meters.

OTEK Corporation designs and manufactures a comprehensive line of electronic instrumentation for digital process control and measurement using the latest LED technology. Our vast product offering includes digital panel meters, controllers, batch counters, process loggers and bargraph indicators. Our world-wide customer base includes nuclear and fossil power plants, water and waste water utilities, military contractors, aerospace, maritime, oil and gas, chemical, pulp and paper and the automotive industries. We work very closely with our clients to determine the course of action that best meets their instrumentation and control needs and then supply an end product that exceeds every prerequisite and requirement.

OTEK instruments offer everything you need to control and monitor your process in an accurate and safe manner. Many of our digital meters and displays utilize features to enhance Human to Machine Interfacing (HMI), such as input failure alarms with serial I/O, automatic tri-color LED bargraphs (standard red, yellow, green) and programmable set-points. The models within our NTM series share common hardware and software, which provides more production flexibility and facilitates the qualification and customization processes. All OTEK meters are available in industrial grade, with MIL-Standards on request. Safety-related instruments for the nuclear industry are supplied through an exclusive non-partnership with AZZ/NLI, Inc. Using the highest quality components and sophisticated firmware allows us to offer an industry-unique lifetime warranty. Learn more about our productsð digital panel meters, bargraph meters, loop power meters, signal conditioners, edgewise/switchboard and transmittersð at www.otekcorp.com.