

## The Basics of Substation and SCADA Metering for Communications to RTUs



**E-SINE**  
Engineering Solutions



## ***Improve Communication for Substation and SCADA Metering***

- ▶ Meet Utilities' Accurate Monitoring Requirements
- ▶ Provide Digital Data to SCADA to Improve Operating System Reliability
- ▶ Implement Newer IEC 61850 and DNP 3.0 over Ethernet Protocols
- ▶ Serial Protocols and Serial Communication
- ▶ Support Legacy 0-1 mA or 4-20 mA Analog Retransmits to RTUs
- ▶ Provide Migration Paths to Smart Substations

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## ► Communication Requirements for Utilities

Utilities have requirements, whether by law or by company policy, to monitor and be able to restore electrical power flow as quickly as possible. This has led power providers like investor owned utilities, cities, and municipals, to focus on collecting data on circuit breaker trips, status, and metering values. The industry has relied on various forms of IEDs (intelligent electronic devices) to communicate this data back to remote terminal units (RTUs) or communication gateways that then send the data back to a SCADA master. An RTU is a device that collects analog and digital data about a substation and transmits that data back to a SCADA master station. The SCADA master allows operators and engineers to view, control, and analyze power flow throughout a utility operating territory.

## ► Considerations in Choosing an IED

There are substantial considerations when choosing the type of IED to communicate this data. Initially, the IED should be “substation grade.” This means that the IED has to be designed with sufficient protection and reliability to protect it against dangerous electrical events that can occur in stations whenever there is a breaker operation. The IED should also be protected at all inputs, including sense inputs, power supply, and communication outputs. To accomplish this, the IED manufacturer has to look at internal isolation levels, surge suppression, and voltage clearances that are normally higher and more conservatively specified than traditional commercial/industrial equipment. Moreover, the manufacturer should be able to substantiate claims, with proper test equipment, to relevant industry standards, such as IEEE C37.90.1 and ANSI C62.41.

The next consideration for the substation IED is that it supports standard communication protocols that RTUs and communication gateways are able to understand. A communication protocol is the communication language that the equipment uses. While Modbus is considered to be an industry standard, today, in utility substations, DNP 3.0 and IEC 61850 are the standards that are supported and usually required by most modern RTUs and communication gateways. Meters that specify only Modbus or other industrial or commercial protocols are not sufficient, because while Modbus communication may be available for an RTU, it is generally not easily supported in the installation environment.

Serial (RS485 or RS232) DNP 3.0 protocol has been considered the industry gold standard for safe and reliable communication from an IED. However, there are newer requirements for the IEDs to support DNP 3.0 over Ethernet and IEC 61850 over Ethernet. For this reason, modern and capable IED devices, in addition to RS485, must support Ethernet communication that allows users to provide metering data over Ethernet channels using an IP addressable TCP/IP architecture.

When interfacing with older RTUs, there are limits as to the type of input that is acceptable. Many RTUs designed before the newer protocols were popular, utilized “analog” inputs or digital inputs. Analog inputs typically provide data from an analog transducer source. Digital inputs generally provide the status of a digital type of “on/off” source, like an alarm or a breaker position. Modern IEDs should also have the ability to replace these transducers by providing analog retransmits that will mimic the old transducer outputs. Also, because they are digital, they will be able to provide multiple outputs from one meter, instead of one transducer per meter. The newer meters also have the capability of sending digital signals for alarm or control purposes.

## ► Interesting, But What Should I Use?

E-Sine's' Nexus® 1500+ and Shark® 200 meters are designed to provide useful outputs for utility communication applications. In the first place, the design is rugged and hardened. It is generally specified for utility applications and is designed to provide a long life and reliable operation.

A base Shark® 200 meter (ideal for distribution stations) has a standard serial port capable of communicating to an RTU via DNP 3.0 over serial. It allows a user to gather “analog” data via a digital means and bring this data back to an RTU, so that the quantities can be viewed by a SCADA master and a control room operator. More advanced applications may call for Ethernet communication, such as DNP 3.0 over Ethernet or the more modern IEC 61850 Ethernet. The Shark® 200 meter also allows the user to choose serial, Ethernet, or both, so that the meter can be utilized with the new implementations, yet still support existing implementations until they are upgraded.

For legacy applications, where there isn't the budget or desire to upgrade the existing RTU, the Shark® 200 meter also has the ability to add up to 8 analog retransmit signals that are either 0-1 mA or 4-20 mA. This allows a user to upgrade analog transducers as they fail, replacing them with digital IEDs that can be upgraded to modern communication architecture at a later time. Status inputs and control outputs are also available, so that most of the traditional substation telemetry applications are fulfilled.

When looking at transmission substation applications, there may be a need for additional performance in an IED. The considerations can include security, fault-analysis, and time-sync options. The Nexus® 1500+ meter would be the suitable solution to improve transmission power distribution system reliability. Moreover, in sophisticated communication schemes, the Nexus® 1500+ meter offers considerable versatility when configuring complex telemetry, especially using its GOOSE messaging capability with IEC 61850 protocol architecture.

## ► Conclusion

When designing a newer infrastructure, substation IEDs provide a very cost effective and powerful way to enhance substation performance. Choosing the right IED allows a user to not only upgrade technology, but also to plan for future expansion and additional functionality.

# TYPICAL BILL OF MATERIALS:

## Transmission Stations

### For New Applications: Nexus® 1500+ Meter – High Performance IED

Nexus1500+-D2-60-20-V3-485P-NTRJ-6RO1-16DI1

A Nexus® 1500+ meter with (100-240)VAC @ 60 Hz or (100-240) V DC power supply; 60 Hz; Class 20; 4 MB memory, DNP 3.0, IEC 61850 protocol, 50 MHz transient recording; 2 RS485 ports and 2 pulse outputs; Second RJ45 Ethernet card; 6 relay outputs; 16 status inputs.



### For Retrofit Applications: Nexus® 1450 Meter – Cyber Secure Energy Panel Meter

Nexus1450-D2-60-V2

A Nexus® 1450 meter with universal (96-276) V @50/60 Hz or DC power supply; 60 Hz; 1200 MB memory, 1024 seconds per cycle waveform recording.



## Distribution

### Shark® 200 Meter – Mid-Range IED

Shark200-60-10-V6-D2-INP100S-1mAOS-DIN

A Shark® 200 meter with 60 Hz; 10 A Secondary; Data logging, Harmonics, Limits and Control, 512 samples/cycle waveform recording; (90-265)V AC/DC power supply; DNP 3.0 or IEC 61850 (INP300S Option), 100BaseT Ethernet; 4 channel 0-1 mA bi-directional analog outputs; DIN rail mounting brackets.



## At the Customer

### Shark® 270 Socket Form Meter – Provides Shark® 200 meter SCADA communication in an ANSI-Rated Socket Meter

Shark270-9S-60-20-V5-S-INP100S-20mAOS

A Shark® 270 meter with 9S form; 60 Hz; Class 20; Extended logging memory and 512 samples/cycle waveform recording; Blade powered; 100BaseT Ethernet; 4 channel 4-20 mA unidirectional analog outputs.



## Base Data Collection Software

### Communicator EXT™ 4.0 software for configuring meters, automatically collecting data, and studying power quality



# ENGINEERING ASSISTANCE:

Contact us for conformance specifications and engineering design assistance. E-Sine has on-staff dedicated application engineers to provide comprehensive support and make your project a success.

### **Contact E-Sine at:**

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