SCADA Signaling from Badger Flow Meters

**Badger Ultrasonic Flow Meters (pictured left)
include the E-Series G2. Badger Also Manufactures
Turbine, Positive Displacement, and Magnetic Flow Meters.**

James Mimlitz, SCADAmetrics – 'Slim' Mimlitz

Badger Meter (Milwaukee, Wisconsin, USA) manufactures a broad line of flow meters and AMI/AMR systems, serving the municipal water utility industry. Here at **SCADAmetrics (Wildwood, MO)**, we manufacture flow metering instrumentation in support of this industry, with the stated mission of helping users extend such meters for enhanced SCADA interoperability and functionality.

Like many manufacturers of AWWA-style flow meters, Badger's signaling options are focused upon their 3-wire, encoded protocol for interfacing with AMI/AMR endpoints. However, Badger also offers pulse and 4-20mA SCADA signaling options, as well. Badger's 3-wire encoded protocol implementation is capable of transmitting **9-digit, fine-resolution totalization** information — which SCADAmetrics instrumentation leverages to generate additional industrial signal and display options — thereby providing an extended ability to solve the unique challenges facing the **SCADA, Telemetry, and Building Automation spheres**.

The purpose of this document is to provide a summary of several of the main SCADAmetrics devices and methods that we offer to extend the broad line of Badger flow meters.

Badger Compatible Cable Types

Optimal performance is delivered when the most suitable meter signal cable type is provided. Cable types include 3-wire encoded, 2-wire pulse, and in instances where available — *both*.

When encoded cables are utilized, it is always recommended that the Badger meter be pre-programmed to provide the finest resolution available and the maximum number of digits or "wheels" (usually 9 or 8):

SCADAmetrics Recommendations:
Badger Encoded Resolution

Meter Diameter (in)	8-Wheels	9-Wheels
5/8" – 1"	0.1 USG 0.01 FT3 0.1 L	0.01 USG 0.001 FT3 0.01 L
1.5" – 4"	1 USG 0.1 FT3 1 L	0.1 USG 0.01 FT3 0.1 L
6" – 12"	10 USG 1 FT3 10 L	1 USG 0.1 FT3 1 L

When pulse cables are utilized, it is always recommended that the Badger meter be pre-programmed to provide the finest resolution pulse available:
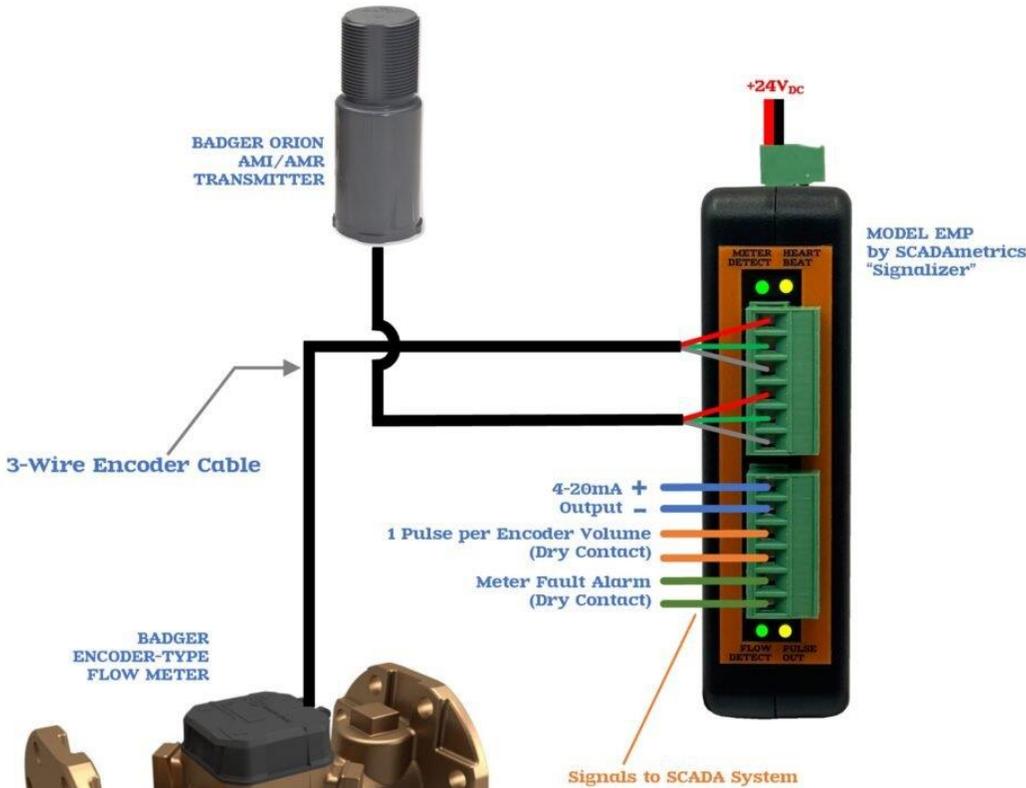
SCADAmetrics Recommendations:
Badger Pulse Option

Meter Diameter (in)	Pulse Weight
5/8" – 1"	0.1 USG 0.01 FT3 0.1 L
1.5" – 4"	1 USG 0.1 FT3 1 L
6" – 12"	10 USG 1 FT3 10 L

1. Concurrent Basic SCADA and AMI from Encoded-Only Flow Meter

The following illustrates how a model EMP Signalizer display can be paired with an encoded-only Badger flow meter to provide basic SCADA signaling, while preserving the existing AMI signaling to the water utility. The SCADA signaling is in the form of a 4-20 milliamp output, a pulse-per-volume output, and a meter fault alarm output. Please note that the 4-20 milliamp SCADA output requires a 8/9-digit encoded signal from the meter. Excellent for custody-transfer stations. Also excellent for utility-owned water meters at commercial and industrial buildings, where the building owner desires a meter reading into its BMS system, without requiring the installation of a new water meter, or without interfering with the utility's AMI system. Design Basis: SCADAmetrics **Model EMP Signalizer**:
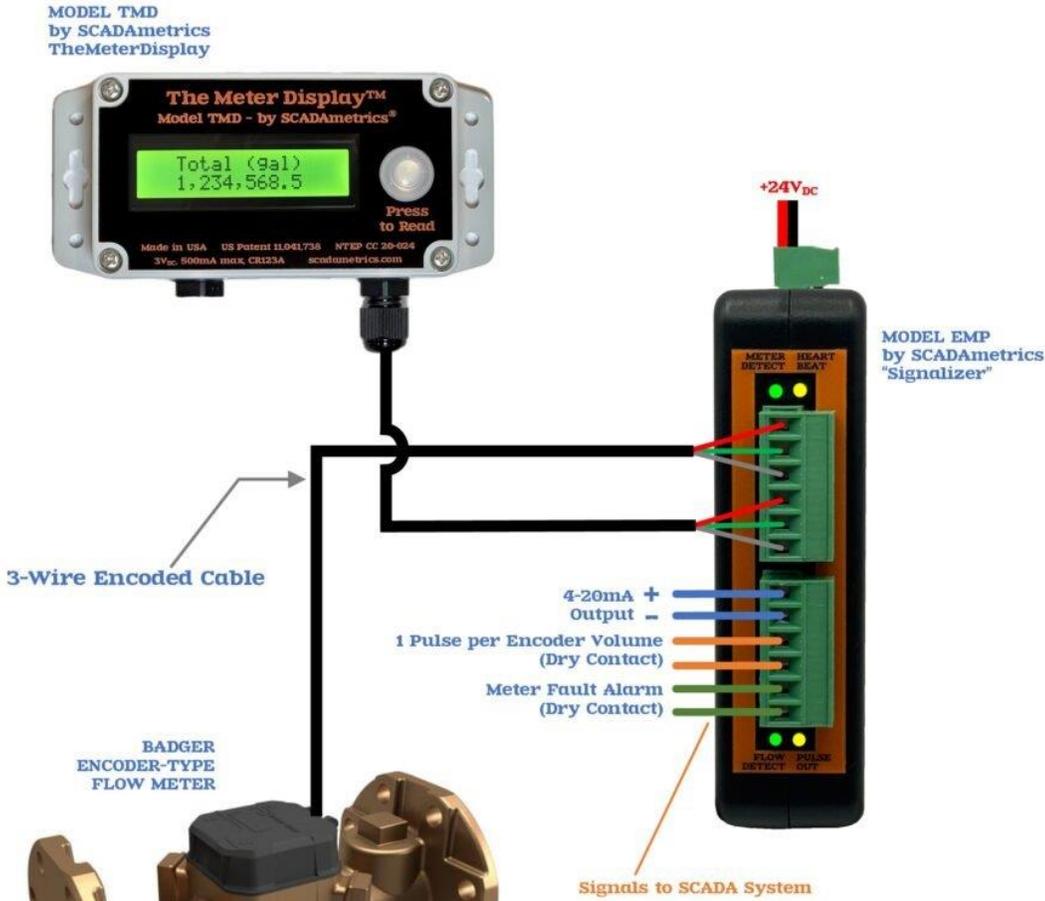

SCADAmetrics Recommendations: Badger Encoded Resolution

Meter Diameter (in)	8-Wheels	9-Wheels
5/8" – 1"	0.1 USG 0.01 FT3 0.1 L	0.01 USG 0.001 FT3 0.01 L
1.5" – 4"	1 USG 0.1 FT3 1 L	0.1 USG 0.01 FT3 0.1 L
6" – 12"	10 USG 1 FT3 10 L	1 USG 0.1 FT3 1 L

2. Concurrent Basic SCADA and Remote Display from Encoded-Only Flow Meter

The following illustrates how an encoded-only Badger flow meter can provide basic SCADA signaling (4-20 milliamp, pulse-per-volume, meter fault alarm), and a Remote Wall Display. Excellent for custody-transfer stations and commercial buildings. Design Basis: **Model EMP Signalizer** and **Model TMD TheMeterDisplay**. Coming soon! — TMD Support for Badger E-Series advanced alarm flags (Temperature & Pressure).
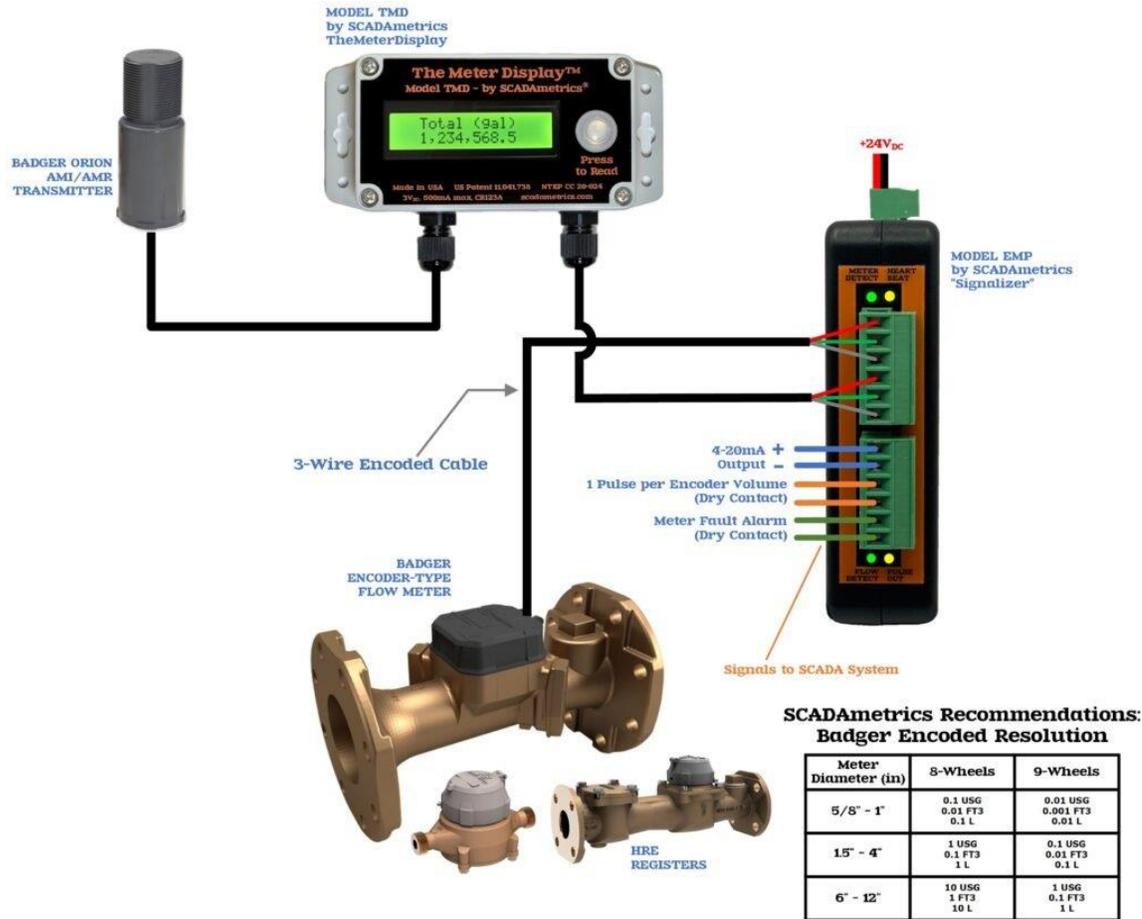

SCADAmetrics Recommendations: Badger Encoded Resolution

Meter Diameter (in)	8-Wheels	9-Wheels
5/8" - 1"	0.1 USG 0.01 FT3 0.1 L	0.01 USG 0.001 FT3 0.01 L
1.5" - 4"	1 USG 0.1 FT3 1 L	0.1 USG 0.01 FT3 0.1 L
6" - 12"	10 USG 1 FT3 10 L	1 USG 0.1 FT3 1 L

3. Concurrent Basic SCADA, AMI, and Remote Display from Encoded-Only Flow Meter

The following illustrates how an encoded-only Badger flow meter can provide basic SCADA signaling (4-20 milliamp, pulse-per-volume, meter fault alarm), AMI signaling (3-Wire Encoder Protocol), and a Remote Wall Display. Excellent for custody-transfer stations and commercial buildings. Design Basis: **Model EMP Signalizer** and **Model TMD TheMeterDisplay**. Coming soon! — TMD Support for Badger E-Series advanced alarm flags (Temperature & Pressure).

SCADAmetrics Recommendations: Badger Encoded Resolution

Meter Diameter (in)	8-Wheels	9-Wheels
5/8" - 1"	0.1 USG 0.01 FT3 0.1 L	0.01 USG 0.001 FT3 0.01 L
1.5" - 4"	1 USG 0.1 FT3 1 L	0.1 USG 0.01 FT3 0.1 L
6" - 12"	10 USG 1 FT3 10 L	1 USG 0.1 FT3 1 L

4. Advanced SCADA from Encoded Flow Meter

The gold standard of SCADA connectivity for a flow meter is transmission of the *"true"* meter reading into the SCADA system with zero error. We call that "revenue-grade accuracy". The following illustrates how a Badger flow meter can be enhanced to provide advanced SCADA signaling (Modbus, Allen-Bradley EtherNet/IP). Excellent for custody-transfer pumping and valve stations where revenue-grade accuracy is of paramount importance. Also excellent for military bases and educational facilities. Design Basis: **Model EM.100 EtherMeter**:

SCADAmetrics Recommendations:
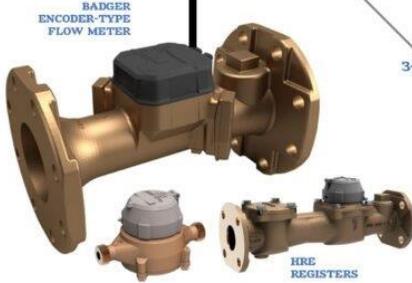**Badger Encoded Resolution**

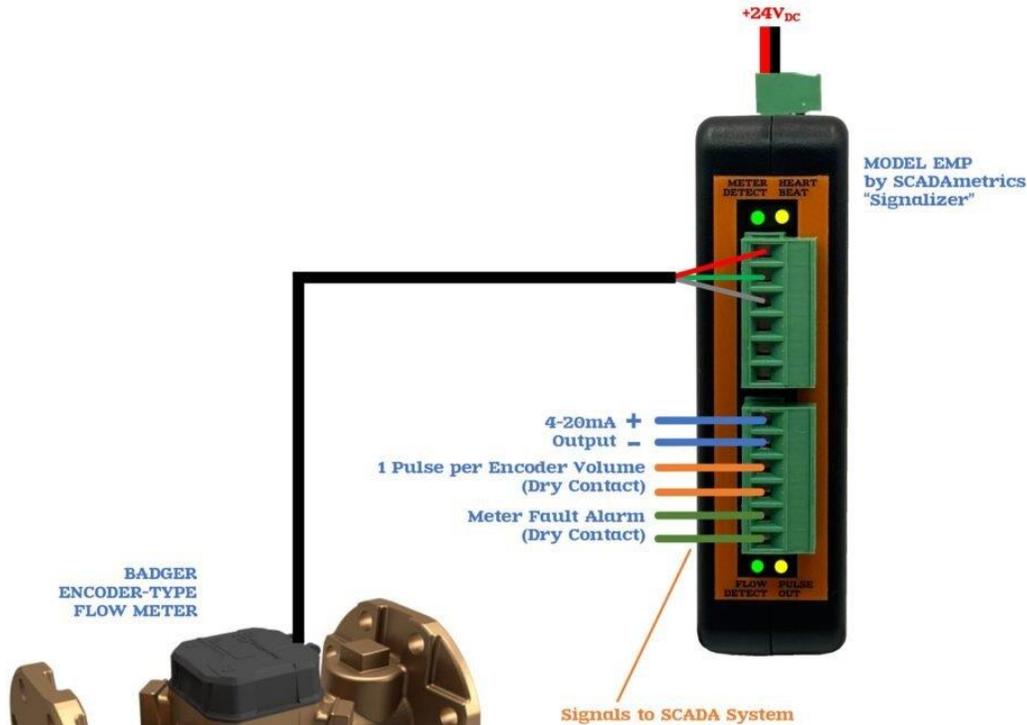| Meter Diameter (in)	8-Wheels	9-Wheels
5/8" – 1"	0.1 USG 0.01 FT3 0.1 L	0.01 USG 0.001 FT3 0.01 L
1.5" – 4"	1 USG 0.1 FT3 1 L	0.1 USG 0.01 FT3 0.1 L
6" – 12"	10 USG 1 FT3 10 L	1 USG 0.1 FT3 1 L

5. Concurrent Advanced SCADA and AMI from Encoded Flow Meter

The gold standard of SCADA connectivity for a flow meter is transmission of the *"true"* meter reading into the SCADA system with zero error. We call that "revenue-grade accuracy". The following illustrates how a Badger flow meter can be enhanced to provide advanced SCADA signaling (Modbus, Allen-Bradley EtherNet/IP), while at the *same time* provide signaling to a connected AMI System. Excellent for custody-transfer metering, pumping, and valve stations where revenue-grade accuracy is of paramount importance for both the SCADA system and AMI system. Also excellent for commercial and industrial facilities who wish to internally track the utility-owned water meter. The inclusion of a model SDA or SDAW Duplexer (illustrated below) ensures concurrent AMI connectivity. Design Basis: **Model EM.100 EtherMeter** and **Model SDA SCADA Duplexer for AMI**:

SCADAmetrics Recommendations:
Badger Encoded Resolution

Meter Diameter (in)	8-Wheels	9-Wheels
5/8" – 1"	0.1 USG 0.01 FT3 0.1 L	0.01 USG 0.001 FT3 0.01 L
1.5" – 4"	1 USG 0.1 FT3 1 L	0.1 USG 0.01 FT3 0.1 L
6" – 12"	10 USG 1 FT3 10 L	1 USG 0.1 FT3 1 L
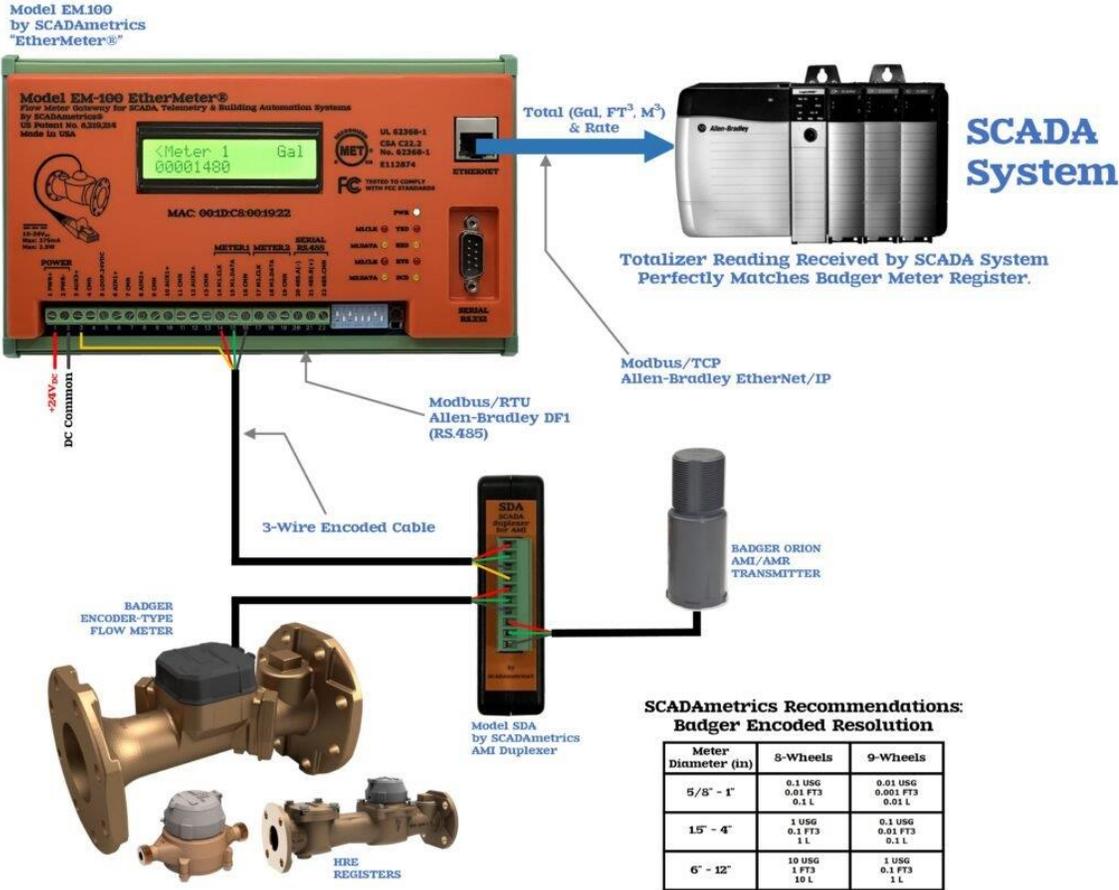
6. Basic SCADA from Encoded-Only Flow Meter

The following illustrates how an encoded-only Badger flow meter can provide basic SCADA signaling (4-20 milliamp, pulse-per-volume, meter fault alarm). Excellent for well and pumping stations, as well as commercial building submetering. Design Basis: **Model EMP Signalizer**:
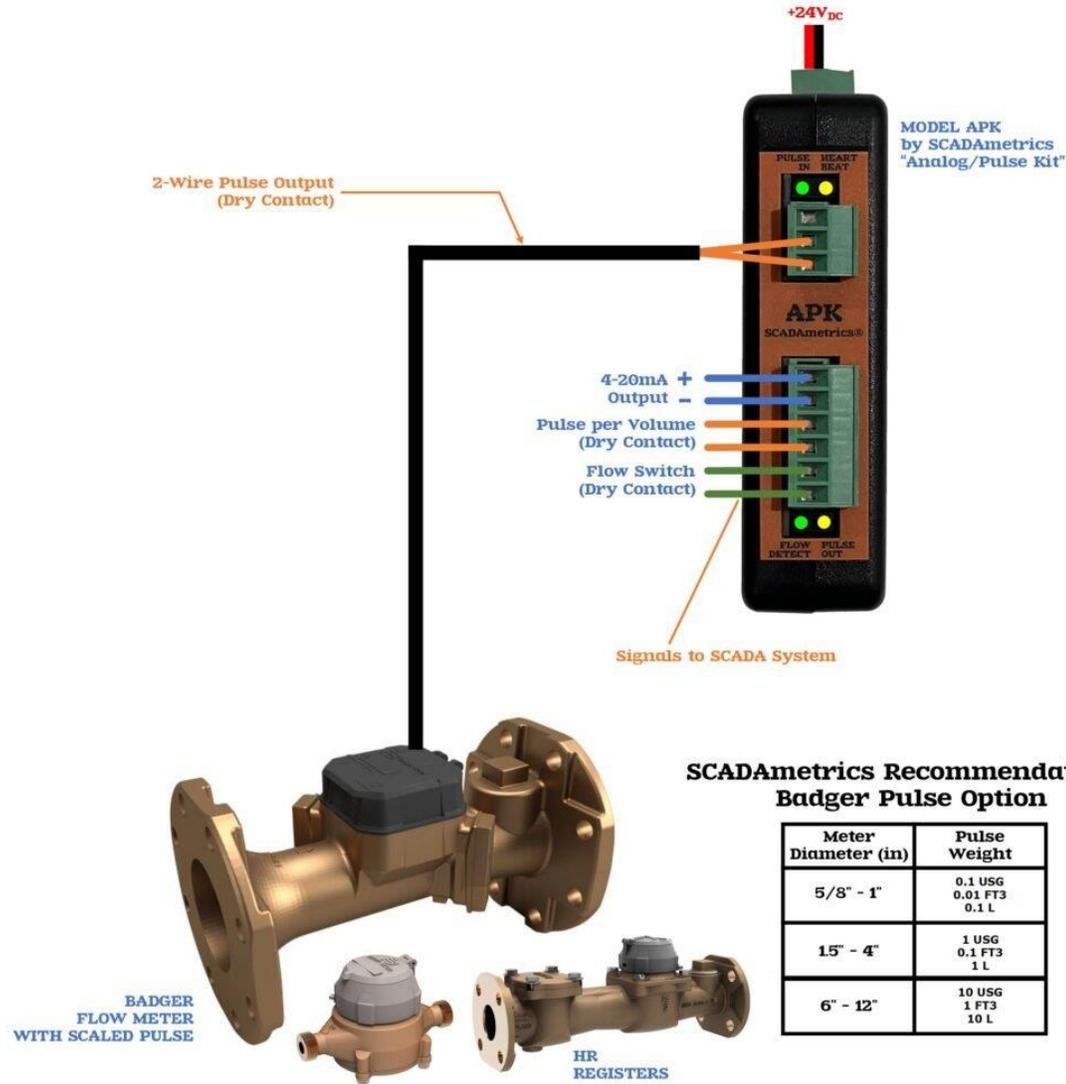

SCADAmetrics Recommendations: Badger Encoded Resolution

Meter Diameter (in)	8-Wheels	9-Wheels
5/8" – 1"	0.1 USG 0.01 FT3 0.1 L	0.01 USG 0.001 FT3 0.01 L
1.5" – 4"	1 USG 0.1 FT3 1 L	0.1 USG 0.01 FT3 0.1 L
6" – 12"	10 USG 1 FT3 10 L	1 USG 0.1 FT3 1 L

7. Basic SCADA Outputs from Pulse Flow Meter

The following illustrates how a Badger pulse-type flow meter can provide basic SCADA signaling (4-20 milliamp, pulse-per-volume, flow switch, meter fault alarm). Excellent for well and pumping stations and commercial submetering. Design Basis: SCADAmetrics Model APK Analog-Pulse Kit:

SCADAmetrics Recommendations: Badger Pulse Option

Meter Diameter (in)	Pulse Weight
5/8" - 1"	0.1 USG 0.01 FT3 0.1 L
1.5" - 4"	1 USG 0.1 FT3 1 L
6" - 12"	10 USG 1 FT3 10 L

8. Visual Batching, Visual Rate-of-Flow, plus SCADA Outputs from Pulse Flow Meter

The following illustrates how a Badger pulse-type flow meter can provide basic SCADA signaling (4-20 milliamp, pulse-per-volume, flow switch, meter fault alarm), along with an always-ON operator flow and batch display. Excellent for well and pumping stations. Design Basis: SCADAmetrics **Model APK.PLUS Analog-Pulse Kit, Plus**:
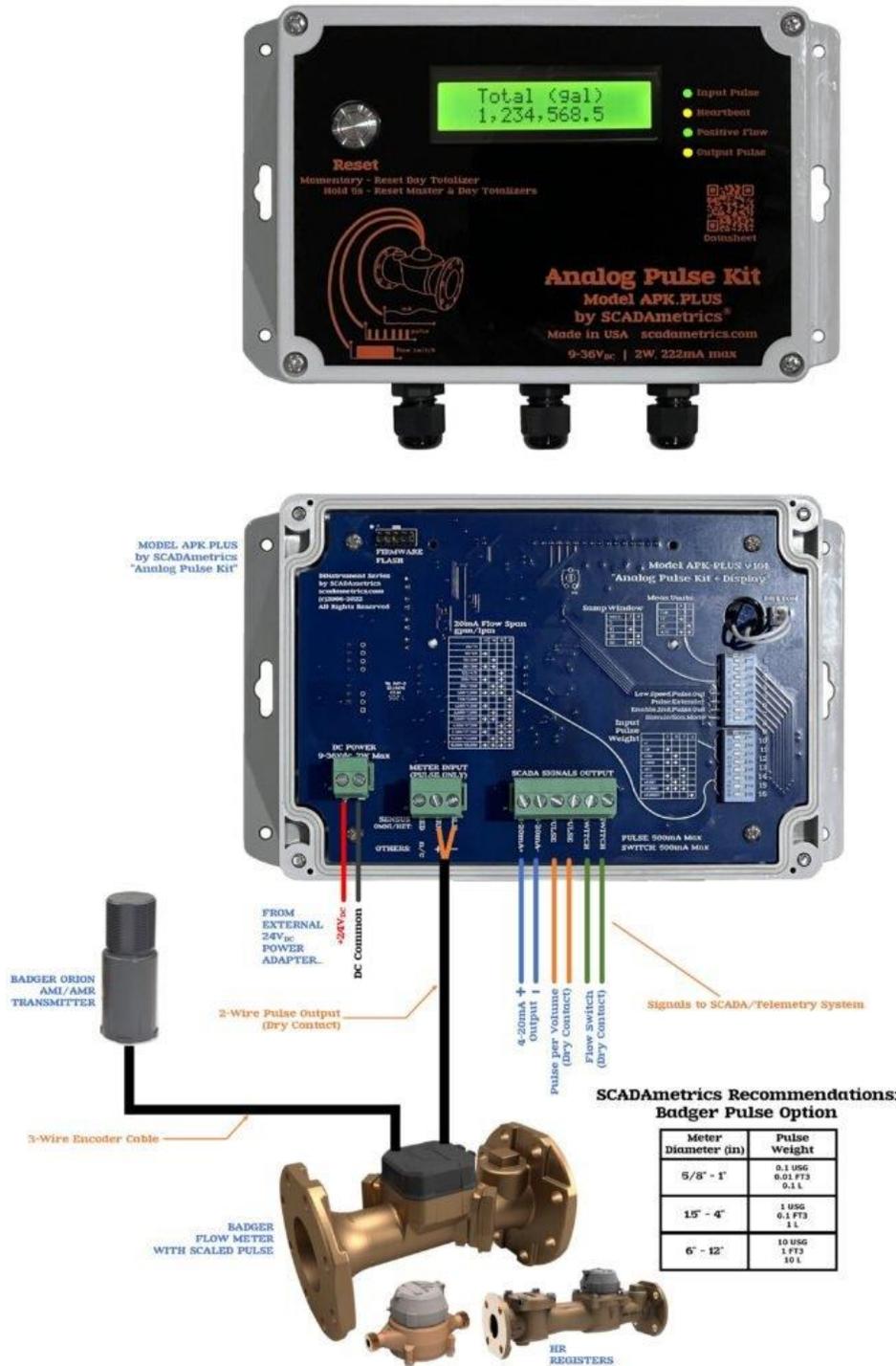
9. Basic SCADA plus AMI from a Dual-Output Flow Meter (Encoded+Pulse)

The following illustrates how a Badger dual-output flow meter (encoded+pulse) can provide basic SCADA signaling (4-20 milliamp, pulse-per-volume, flow switch, meter fault alarm) — and concurrent AMI capability. Excellent for well and pumping stations and custody-transfer stations. Design Basis: SCADAmetrics Model APK Analog-Pulse Kit:

SCADAmetrics Recommendations:
Badger Pulse Option

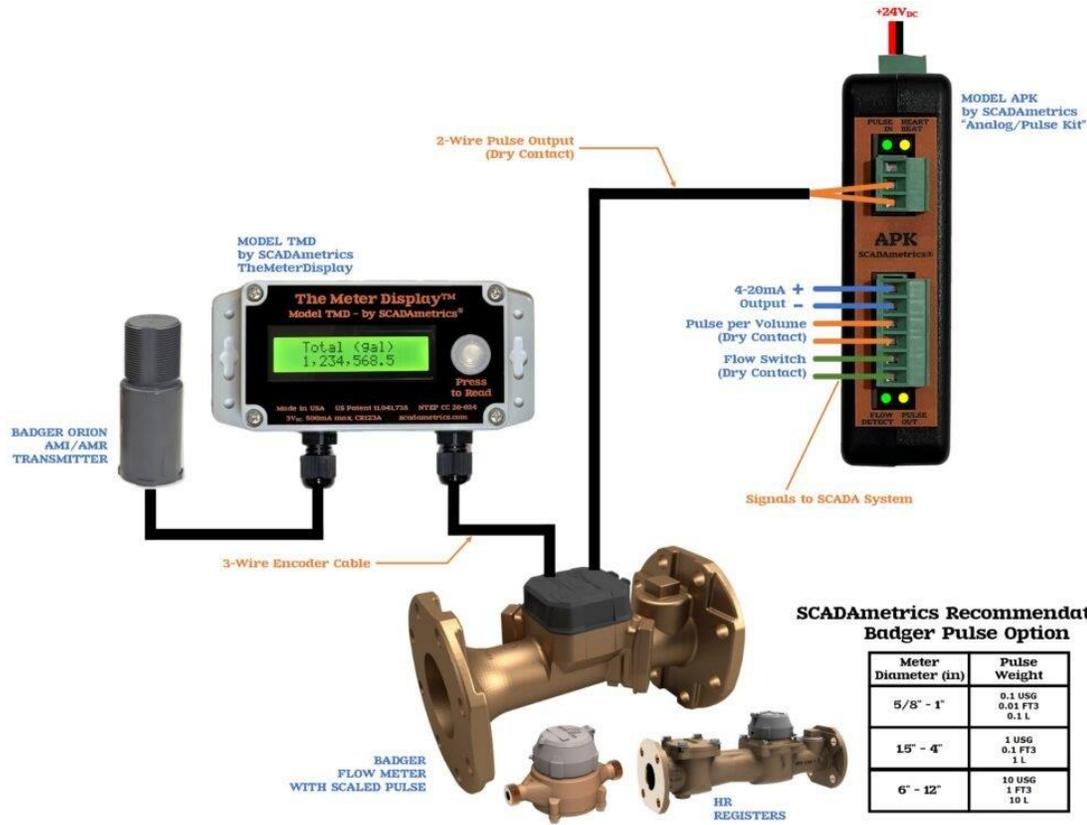| Meter Diameter (in)	Pulse Weight
5/8" – 1"	0.1 USG 0.01 FT3 0.1 L
1.5" – 4"	1 USG 0.1 FT3 1 L
6" – 12"	10 USG 1 FT3 10 L
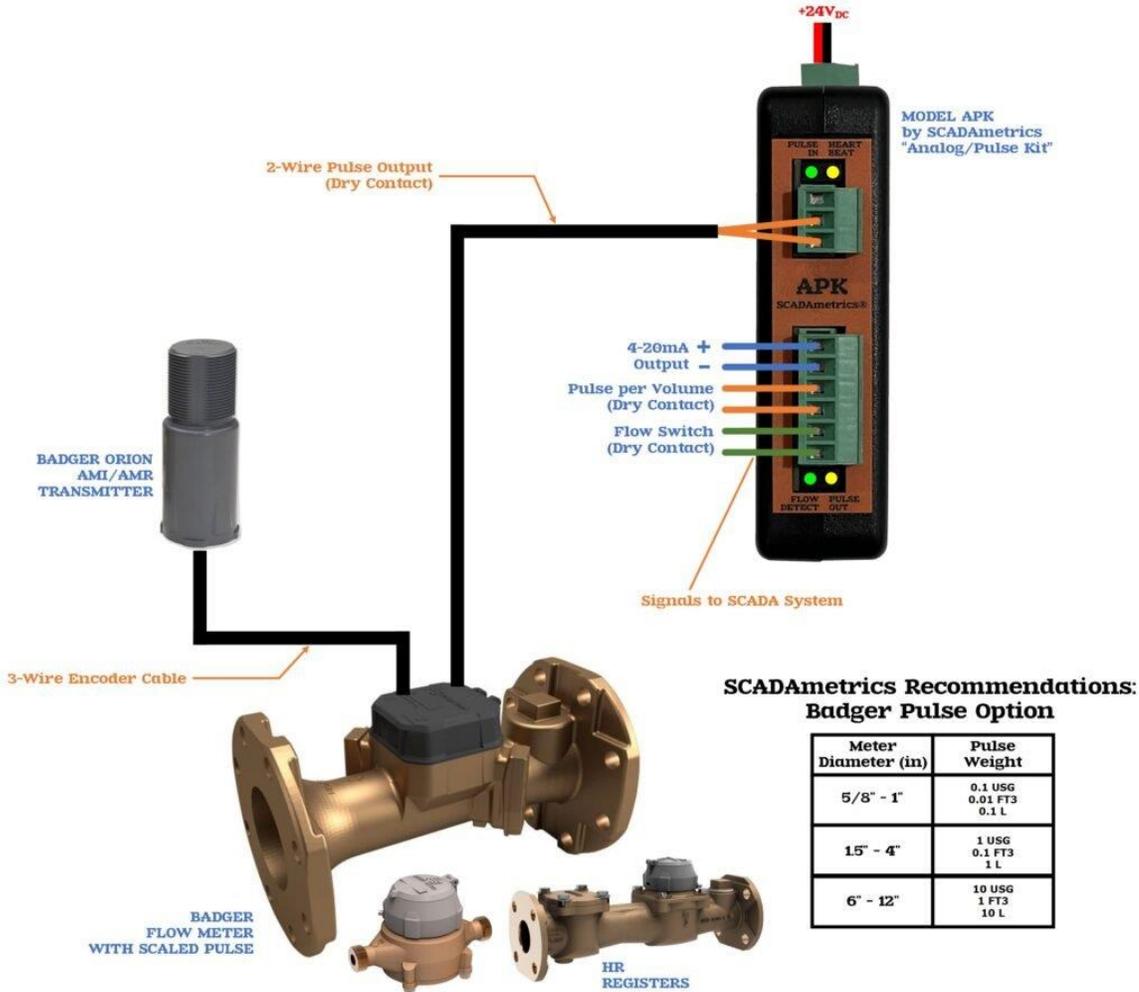
10. Visual Batching, Visual Rate-of-Flow, plus SCADA Outputs from Dual-Output (Encoded+Pulse) Meter

The following illustrates how a Badger dual-output (encoded+pulse) flow meter can provide basic SCADA signaling (4-20 milliamp, pulse-per-volume, flow switch, meter fault alarm), along with an always-ON operator flow and batch display — and concurrent AMI capability. Excellent for well and pumping stations and custody-transfer stations. Design Basis: SCADAmetrics **Model APK.PLUS Analog-Pulse Kit, Plus**:

11. Basic SCADA plus Remote Display plus AMI from a Dual-Output Flow Meter (Encoded+Pulse)

The following illustrates how a Badger dual-output flow meter (encoded+pulse) can provide basic SCADA signaling (4-20 milliamp, pulse-per-volume, flow switch, meter fault alarm) — and concurrent AMI capability. Excellent for well and pumping stations and custody-transfer stations. Design Basis: SCADAmetrics Model APK Analog-Pulse Kit:

SCADAmetrics Recommendations: Badger Pulse Option

Meter Diameter (in)	Pulse Weight
5/8" – 1"	0.1 USG 0.01 FT3 0.1 L
1.5" – 4"	1 USG 0.1 FT3 1 L
6" – 12"	10 USG 1 FT3 10 L

12. Dual-AMI Connectivity

The following illustrates how a Badger flow meter can provide AMI signaling to two separate systems. Excellent for custody-transfer stations, where both the water buyer and seller desire meter connectivity to their separate respective AMI systems. Design Basis: SCADAmetrics **Model UDA Universal Duplexer for AMI**:
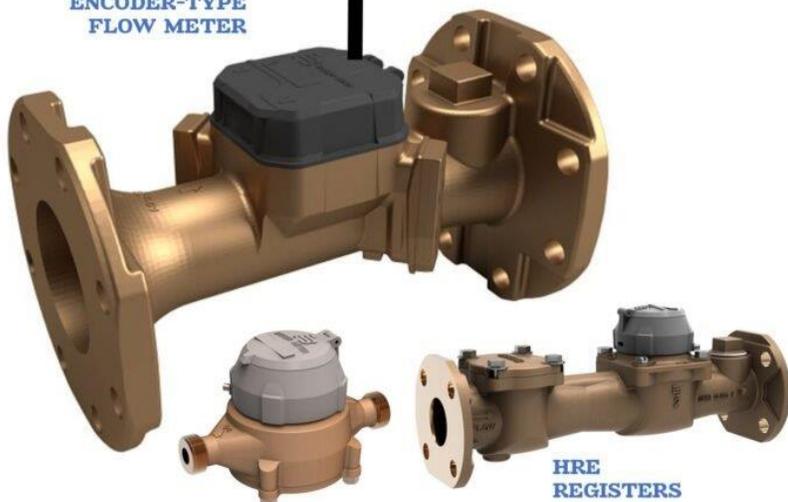
13. Concurrent AMI Connectivity and Remote Visual Display

The following illustrates how a model TMD display can work with a Badger flow meter to provide AMI signaling to the water utility, while concurrently providing a visual remote display whose reading is a perfect match to the Badger meter register total. Furthermore, if the Badger register is programmed for 8 or 9 digit resolution, then this fine resolution will enable the display of rate-of-flow (GPM, lpm), as well. Excellent for utility-owned water meters at commercial and industrial buildings, where the building owner desires a meter reading without requiring entry to a vault or confined-space. Design Basis: SCADAmetrics **Model TMD TheMeterDisplay**. Coming soon! — TMD Support for Badger E-Series advanced alarm flags (Temperature & Pressure).
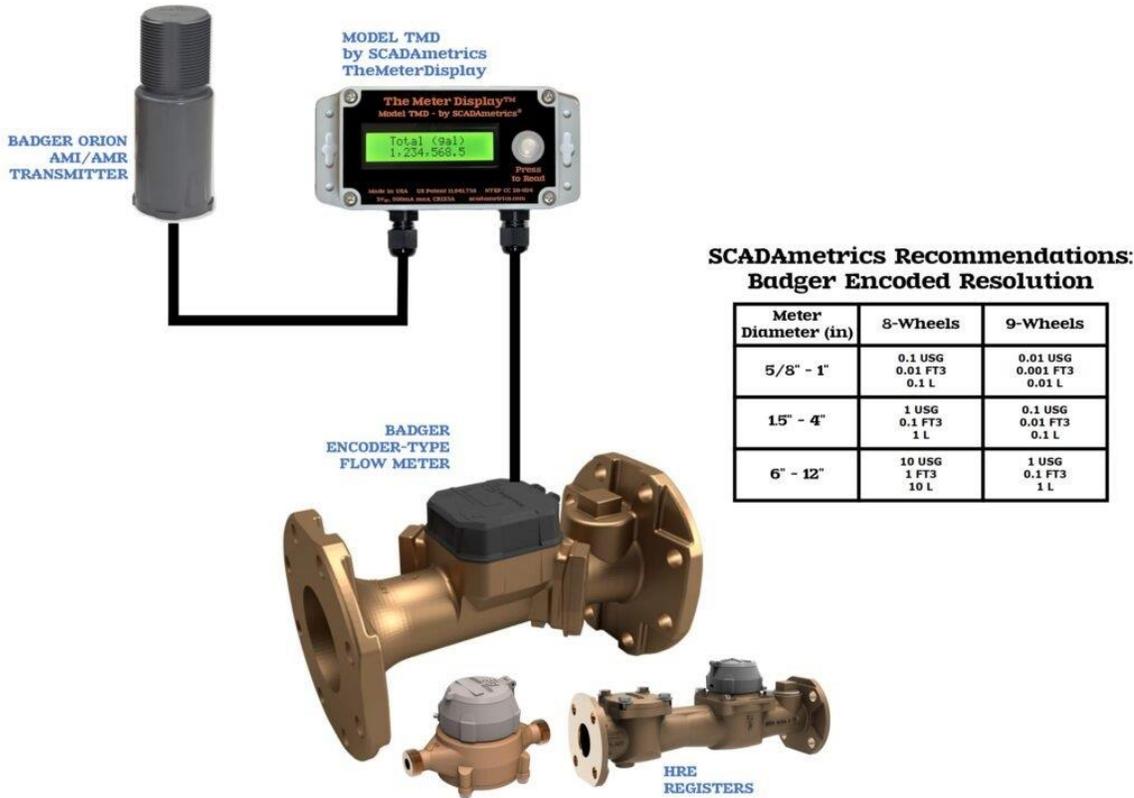
SCADAmetrics Recommendations: Badger Encoded Resolution

Meter Diameter (in)	8-Wheels	9-Wheels
5/8" – 1"	0.1 USG 0.01 FT3 0.1 L	0.01 USG 0.001 FT3 0.01 L
1.5" – 4"	1 USG 0.1 FT3 1 L	0.1 USG 0.01 FT3 0.1 L
6" – 12"	10 USG 1 FT3 10 L	1 USG 0.1 FT3 1 L

14. Remote Visual Display

The following illustrates how a model TMD display can work with a Badger flow meter to provide a remote visual display to an otherwise not-easily accessible water meter. The remote display provides a perfect match to the reading displayed on the Badger meter register. Furthermore, if the Badger meter register is programmed for 8 or 9 digit resolution, then this fine resolution will enable the display of rate-of-flow (GPM, lpm), as well. Excellent for customer-owned sub-meters at commercial and industrial buildings, where the building owner desires a meter reading without requiring entry to a vault or confined-space. Design Basis: SCADAmetrics **Model TMD TheMeterDisplay**. Coming soon! — TMD Support for Badger E-Series advanced alarm flags (Temperature & Pressure).

SCADAmetrics Recommendations:
Badger Encoded Resolution

Meter Diameter (in)	8-Wheels	9-Wheels
5/8" – 1"	0.1 USG 0.01 FT3 0.1 L	0.01 USG 0.001 FT3 0.01 L
1.5" – 4"	1 USG 0.1 FT3 1 L	0.1 USG 0.01 FT3 0.1 L
6" – 12"	10 USG 1 FT3 10 L	1 USG 0.1 FT3 1 L

15. Connect Pulse Flow Meters to Badger Orion AMI

The Pulse Encodalizer is a battery-powered signal converter with integral 9-digit display. It counts pulses from most 2-wire, pulse-type flow meters (magmeters, wastewater meters, gas meters, steam meters, reclaimed water meters, irrigation meters, etc…) — and converts to a 3-Wire Encoded protocol — thereby providing compatibility with Badger's Orion AMI system. Badger's lineup of magmeters already feature encoded outputs, so the Encodalizer is not needed for those. However, there are a large number of 3rd-party pulse type meters that can benefit from the Encodalizer, whose battery pack offers a life up to 10 years and is user-replaceable.

The following illustrates how a model PTE Pulse Encodalizer™ can transform a pulse-type flow meter into an Orion-compatible encoder-type flow meter. Excellent for wastewater lift stations, irrigation points-of-sale, sewer deduct meters, natural gas meters. Design Basis: SCADAmetrics **Model PTE Pulse Encodalizer**:

Want to Learn More?…

Are you interested in learning more about how SCADAmetrics flow instrumentation, when paired with Badger flow meters, can provide a wealth of value-added SCADA and visual display options? Give us a call!… We'll be glad to discuss the details!