QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) PLAN

FOR

ITHACA AREA WASTEWATER TREATMENT FACILITY

ANAEROBIC DIGESTER GAS (ADG) SYSTEM

Agreement # ADG 149N

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Submitted to:

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Introduction

The Ithaca Area Wastewater Treatment Facility (IAWWTF) is a 13.1 million gallons per day (MGD) monthly average design capacity treatment facility. The IAWWTF typically treats approximately 6.5 MGD average daily flow but has had recorded peak flows in excess of 30 MGD. The IAWWTF was designed to remove phosphorus, biological oxygen demand and solids. The IAWWTF treats waste from the City of Ithaca, the Town of Ithaca, the Town of Dryden, peak flows diverted from the Cayuga Heights Wastewater Treatment Plant, and trucked waste including: septage, landfill leachate, municipal sludge, alkaline hydrolysis liquid waste from the College of Veterinary Medicine, whey, and other dairy processing wastes.

This plan describes the approach to monitor and verify the performance of the anaerobic digester gas (ADG) system that is installed at the IAWWTF to produce biogas and electricity. Biogas is used to drive four (4) micro-turbine generators to produce power that is consumed on site. A monitoring system is installed to measure and collect the data necessary to quantify the electric power produced by the micro-turbine generators. The data will serve as a basis of payment for a capacity incentive to help with capital expenses associated with the procurement of new generation equipment and three (3) years of performance incentive payments, which IAWWTF has applied for under a Standard Performance Contract with NYSERDA based on a Total Contracted Capacity of 260 kW.

ADG System Description

The primary and secondary anaerobic digesters were designed by Stearns & Wheler and installed in 1987. Digester inputs currently include biosolids from on-site primary, secondary and tertiary treatment as well as trucked waste including: septage, grease traps, alkaline hydrolysate, acid whey, and other high strength organic waste. Biogas produced is stored in and Ovivo Biogas Dome with a storage capacity of 35,000 cubic feet, and is dewatered and compressed using a Unison Biogas conditioning skid. Biogas is used to power four (4) 65 kW Capstone CR-65 micro-turbines and boilers while excess gas is flared. The electrical system includes protective relay, a local disconnect, and a breaker for back feeding.

Table 1. Components of Biogas System at IAWWTF

Equipment	Description
Feedstock	Biosolids (from primary, secondary, and tertiary treatment) and trucked waste (septage, grease traps, alkaline hydrolysate, acid whey and other high strength organic waste)
Primary Digester	Mixed digester, mixed with Ovivo Linear Motion Mixer Working Volume: 1.4 million gallons Hydraulic Retention Time (days): 25
Secondary Digester	Plug-flow digester Working Volume: 1.2 million gallons Hydraulic Retention Time (days): 23
Micro-turbines	Four (4) 65 kW Capstone CR-65-ICHP
Biogas Conditioning	Gas Clean-Up Equipment Size: 125 CFM @ 90 PSI, 80°F Manufacturer/Model: Unison
Engine backup	None
Biogas Storage	35,000 cubic foot Biogas Dome manufactured by OVIVO and Ecomembrane.
Heat Recovery Use	digester heating and supplemental building heat One small boiler and one large boiler that can use biogas for heating when micro-turbines are down.
Excess	Waste gas burner

Gas Conditioning Skid

Gas Holder Control Panel

Gas Flow Monitors

Micro-Turbines

Figure 1a. Photos of System Components

Digesters and Biogas Storage

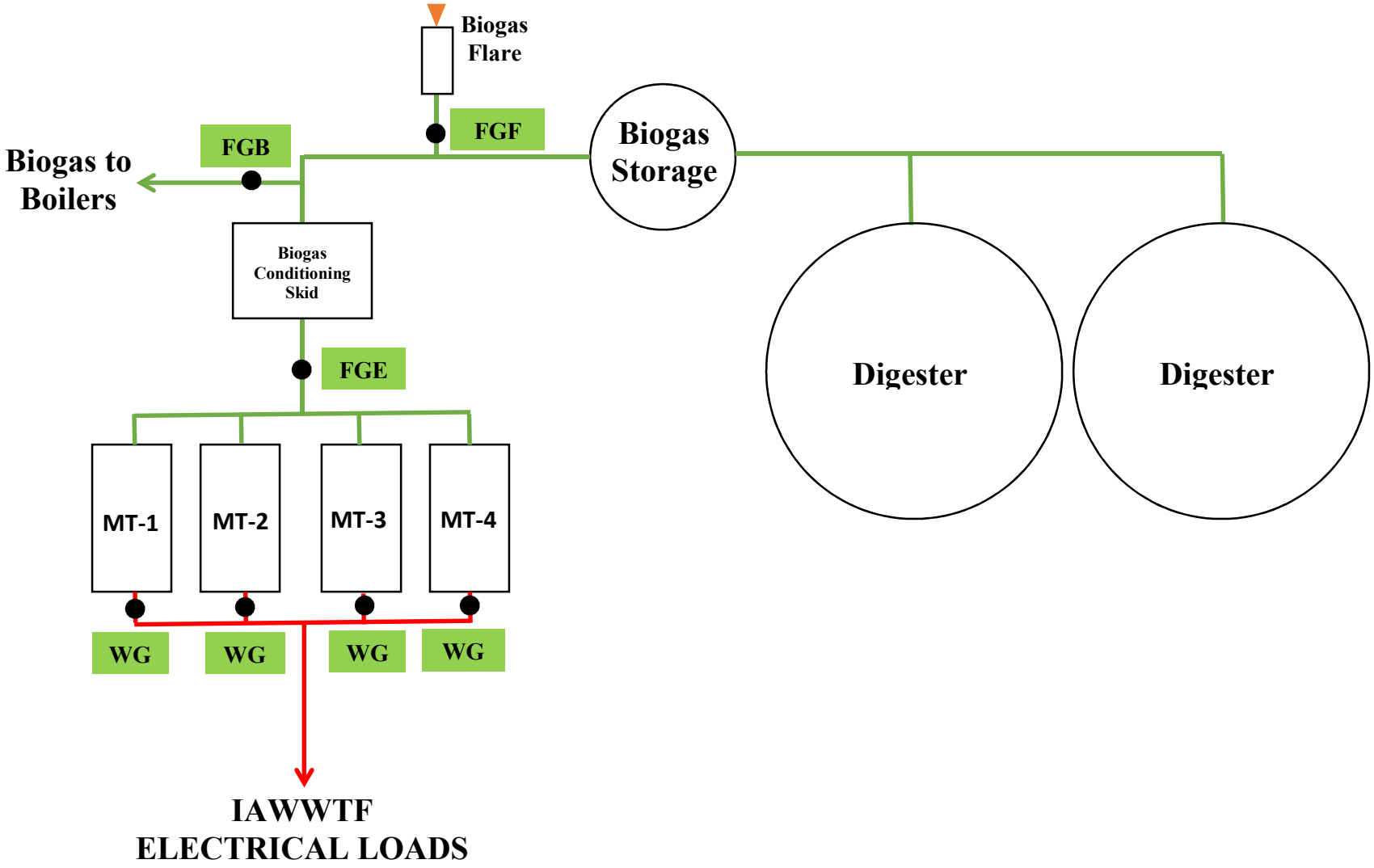
Boilers

Figure 1b. Photos of System Components

Power Meters (Measuring Power Output)

BTU Meters (Measuring Energy, Flow and Temperature)

Figure 1c. Photos of System Components



KEY:

● - **Sensor**

Figure 2. Schematic of System

Monitoring System Equipment, Installation, Operation, and Maintenance

Figure 2 shows the locations of the data monitoring points which will be used to measure system performance. There are three (3) gas meters, one measures fuel gas input to the engine/micro-turbines (**FGE**), one measures gas input to the boilers (**FGB**), and one measures gas wasted to the flare (**FGF**). There are four (4) power meters, one for each micro-turbine, which measures power output (**WG**). Information on these data points is shown in Table 2.

Table 1. Monitored Points for ADG System

Point Type	Point Name	Description	Instrument	Engineering Units	Expected Range
Pulse	WG	Micro-Turbine Power	Veris Instruments E50 Series	kW kWh	0-1.84437e19 0-3.4+E38
Pulse	FGE	Biogas Flow to Engine/Micro-turbine	Magnetrol	SCFH	0-12,000 SCFH
Pulse	FGB	Biogas to Boiler	Magnetrol	SCFH	0-7,000 SCFH
Pulse	FGF	Biogas to Flare	Magnetrol	SCFH	0-3,000 SCFH

The electrical output of the four (4) micro-turbines will be measured with four (4) Veris Instruments E50 series power meters (**WG**). The power meters each have an LCD display and are installed next to each of the micro-turbines. The Veris power meters record kW and totalize kWh. The power meters are connected to Metasys and the data is recoded and stored every 10 minutes. The power meters have been installed in accordance with the Installation and Operation Manual. The electrical system includes protective relays, a local disconnect, and a breaker for back feeding.

The biogas input into the micro-turbines is measured by a Magnetrol gas meter (**FGE**) that provides pulse output proportional to the volume that is compensated for temperature. The Magnetrol gas meter is installed in the biogas pipe feeding the micro-turbines. The biogas input into the boilers is also measured by a Magnetrol gas meter (**FGB**) and is installed in the biogas pipe feeding the boilers. The biogas wasted to the flare is also measured by a Magnetrol gas meter (**FGF**) and is installed in the biogas pipe feeding the flare. The Magnetrol gas meters are installed in accordance with the Installation and Operation Manual. A log of maintenance activities for the meter will be maintained at the site.

The lower heating value for the biogas is estimated to be approximately 600 Btu/ft^3, based on past measurements of the CO_2 content of the biogas. This value will be verified weekly based on measurements of carbon dioxide using a handheld Bacharach Combustion Test Kit 10-5032 CO_2 gas analyzer. The IAWWTF staff will perform the CO_2 tests and record the results in the project log.

There is an existing datalogger that logs the data from the four (4) monitoring points listed in Table 2. The datalogger is programmed to average or totalize data for each monitoring point for each 10-minute interval as appropriate. A record of all multipliers and datalogger settings will be

maintained. The datalogger will be connected to an uninterruptible power supply (UPS) to ensure the datalogger retains its settings and data in the event of a power outage. The UPS is capable of powering the data logger for at least one day. IAWWTF will provide a dedicated phone line (or an Ethernet connection with fixed IP address) that will be used to communicate with the data logger. The NYSERDA CHP Website Contractor (CDH Energy Corp.) will communicate with the data logger nightly to extract monitored data from the data logger and transfer the data to the NYSERDA CHP Website. If communications are lost, the data logger is capable of holding at least 15 days of 15-minute interval data.

Management of Monitoring System Data (Applicant Responsibilities)

The Applicant will perform the following quality assurance and quality control measures to ensure the data produced from the monitoring system accurately describes system performance.

On a daily basis, the equipment manager (or other specified employee) will perform inspections of the digester and engine-generator equipment and record findings into the project log.

On a weekly basis, the equipment manager will perform inspections of the QA/QC meter installations and complete the routine maintenance on the meters, noting any abnormalities or unexpected readings. The Applicant will also maintain a weekly log of the cumulative power generation (kWh) and gas flow (cf or ft^3) from the new engine in the event that data transfer to the NYSERDA CHP Website fails or other anomalies occur.

On a weekly basis, the IAWWTF staff will review the data available on the NYSERDA CHP Website (chp.nyserda.org) to ensure it is consistent with their observed performance of the ADG system and logged readings. The Applicant will review the data using the reporting features at the website, including:

- Monitored Data – Plots and Graphs and
- RPS: Customer-Sited Tier Anaerobic Digester Gas-to-Electricity Program NYSERDA Incentive Program Reports

In addition, the IAWWTF staff will also setup and use the email reports that are available at the CHP Website to help the track system performance, including:

- a periodic email report summarizing system performance and the estimated incentive,
- an email report sent out if data are not received at web site or do not pass the quality checks

The website will automatically take the data collected from the datalogger and evaluate the quality of the data for each interval using range and relational checks. The expected ranges for the sensors (see Table 2) will be used for the range checks. The relational check will compare the kWh production data and gas production data for each interval to ensure both meters always provide non-zero readings at the same time (e.g., to detect if a meter has failed). Only data that pass the range and relational quality checks are used in the incentive reports listed above. However, all hourly data are available from the NYSERDA CHP Website using the "Download (CSV file)" reporting option.

In the event of a communications or meter failure, IAWWTF will work with CDH to resolve the issue in a few days.

If unanticipated loss of data occurs when the engine-generator continues to produce electricity, IAWWTF will follow the procedures outlined in Exhibit D of their contract, i.e. using data from similar periods – either just before or after the outage – to replace the lost data. IAWWTF understands that they can use this approach for up to two 36 hour periods within each 12-month performance reporting period. If more than two such data outages occur, IAWWTF will provide information from other acceptable data sources (e.g., weekly recorded logs) to definitively determine the amount of power that was produced from biogas during the period in question.

Annual Performance Reports

IAWWTF will prepare the Annual Performance Report summarizing the monthly data over the 12-month performance period. The report will include a table showing the monthly kWh production, biogas used by the engine, and other data listed in Table 3. IAWWTF may use the NYSERDA Incentive Program Reports found on the CHP website. Alternatively, they may provide their own summary of the data (using hourly CSV data downloaded from the Website) along with a narrative justifying why their data and calculations are more appropriate. The methods for calculating these values are provided below.

Table 3. Summary of Monthly Data for Annual Performance Report

Start Date of Reporting Period	Monthly Periods	Number of Days in Reporting Period	Electricity Production, $kWh_{generator}$	Biogas Production, CF (cubic feet)	Biogas to Flare, CF	Biogas to Engine, CF	Biogas LHV, BTU/CF	Biogas Energy Content, Q_{biogas} BTU
TOTALS								

IAWWTF will calculate monthly values for lower heating value of the biogas (LHV_{biogas}), total energy content of the biogas (Q_{biogas}), total energy of the propane ($Q_{propane}$), and adjusted kWh production ($kWh_{adjusted}$) as follows.

Monthly Biogas Lower Heating Value

The readings of CO_2 concentration in the biogas gathered weekly to estimate the average monthly Biogas Lower Heating Value using the following equation:

$$LHV_{biogas} = LHV_{methane} \cdot (1 - F_{CO_2})$$

where:

$LHV_{methane}$ - lower heating value of methane (911 Btu/ft^3 at standard conditions, 60 °F and 1 atm)

F_{CO2} - fraction of biogas that is CO_2 (average of readings for each month)

Monthly Biogas Energy Content

Calculate the average monthly Biogas Energy Content using the following equation:

$$Q_{biogas} = CF \cdot LHV_{biogas}$$

where:

CF - volume (ft^3) of biogas in month

Monthly Propane Energy Content

It is not anticipated that any propane will be used, but if so the following average monthly Propane Energy Content equation would apply:

$$Q_{propane} = Gallons \cdot \left[83{,}500 \frac{Btu_{LHV}}{gal} \right]$$

where:

Gallons - propane consumption in the period (gallons)

Monthly Adjusted Electricity Production

It is not anticipated that any propane will be used, but if so the following monthly adjusted electricity production equation would apply:

$$kWh_{adjusted} = kWh_{generator} \left[\frac{Q_{biogas}}{Q_{biogas} + Q_{propane}} \right]$$

where:

$kWh_{generator}$ - actual electricity production

In some cases, propane data may not be available on a monthly basis. In this event, the calculations to determine the adjusted electric production using $Q_{propane}$ will be completed at the smallest possible interval (not greater than 12 months).

Reasonable Electrical Efficiency

The Annual Performance Report will also provide a comparison of power output and fuel input for the engine to confirm their reasonableness. For instance, the electrical efficiency – measured as power output ($kWh_{generator}$) divided by the energy content of the fuel input ($Q_{biogas} + Q_{propane}$) in similar units and based on lower heating value – should be in the 25% over any interval for the engine generator at IAWWTF.

APPENDIX A

Equipment Cut Sheets

Thermatel®
Enhanced Model TA2
Thermal Mass Flow Meter

DESCRIPTION

The Thermatel Enhanced Model TA2 Thermal Mass Flow Meter provides reliable mass measurement for air and gas flow applications. The powerful, yet easy to use, electronics are contained in a compact explosion proof enclosure. The TA2 is available with both insertion probes as well as flow body design for smaller pipe sizes. The TA2 offers excellent performance at an exceptional value.

TECHNOLOGY FEATURES

- Direct mass flow measurement of air and gases
- High turndown ratios
- Excellent low flow sensitivity
- Low pressure drop
- NIST traceable calibrations

ELECTRONICS FEATURES

- Compact explosion proof/NEMA 4X enclosure, mounted either integrally on the probe or at a remote location
- Accepts all input power—11.6 to 30 VDC and 100 to 264 VAC
- 4–20 mA flow signal can be set for either active or passive operation
- Optional pulse output plus second mA output which can be used for temperature or different flow range (mA output passive connection only)
- HART communications with AMS and DTMs available
- 2-line × 16-character backlit display with four push-buttons for ease of configuration
- Rotatable housing
- Calibration for two different gases
- Language selections of English, German, French, Spanish, and Russian

PROBE FEATURES

- All 316 welded stainless steel and Hastelloy® C-276 construction
- Selection of process connections, including threads, welded flange construction, and use with a compression fitting
- Process temperatures up to +400° F (+200° C)
- Pressure rating to 1500 psig (103 bar) dependent upon process connections
- Probe can be field-replaced
- Unique sensor design permits higher mass flow rates yet maintains equivalent thermal mass for varying temperature operation
- Optional hot tap retractable probe assembly

APPLICATIONS

- Combustion air
- Compressed air
- Natural gas
- Aeration air
- Digester/Bio-gas
- Vent lines/Flare headers
- Hydrogen lines

FLOW BODY FEATURES

- ½" to 4" pipe sizes
- NPT threads available up to 2" in size
- Stainless steel and carbon steel (with stainless steel sensor) construction
- Flange connections for all sizes
- Optional stainless steel flow conditioning plate for 1.5" and higher
- Flow conditioning for ½" to 1" based on upstream length and sensor design

ADDITIONAL FEATURES

TOTALIZER

Two 7-digit flow totalizers, one resettable and one non-resettable are provided. Flow units selectable in user's choice of engineering units. Totalizer data is electronically stored eliminating the need for backup batteries and provides maximum safeguard data in the event of a power interruption. The totalizer can be reset using the display module, HART or via PACT*ware*™.

TEMPERATURE COMPENSATION

Thermal flow technology measures the mass flow rate without the need for pressure and temperature correction as required with most gas flow instruments that measure the flow rate at actual conditions. However, changing temperature will change the properties of the gas which effect convective heat transfer. The Model TA2 measures the gas temperature and automatically adjusts the mass flow measurement for changes in gas properties over the entire temperature range of the instrument.

DIAGNOSTICS

Diagnostics is an important aspect of the TA2. The Enhanced TA2 has additional diagnostics to check the operation and performance of the unit. Diagnostics includes probe status, a test of RTD drift with automatic recalibration, and overall performance.

In order to verify that the calibration and configuration match the original calibration conditions, the user can select a specific signal and compare the TA2 display value against the original calibration certificate.

LOW VOLTAGE OPERATION

The TA2 will accept input power as low as 11.6 VDC on Explosion Proof units when used with Integral Electronics.

SELECTABLE STP CONDITIONS

The TA2 directly measures mass flow of the gas referenced to Standard Temperature and Pressure (STP) conditions. Software permits the user to change STP conditions for their own requirements.

AREA COMPENSATION FOR PIPE SIZE

The TA2 automatically compensates the flow measurement based on actual area of the pipe. The user simply enters the size or the area of the new pipe, and the instrument automatically calculates the flow including factors for the probe blockage.

HART COMMUNICATION

Using HART/AMS communication, the user can configure the instrument from a remote location. HART provides the same functionality as the display module interface including all configuration and diagnostic information.

AIR EQUIVALENCY

Using historic air-gas calibration data, an air equivalency calibration can be performed on select gases. Consult Magnetrol for details and flow ranges.

PROBE INSTALLATION

Probes can be provided with a variety of process connections, including threads, flanges, or installation through a compression fitting. The sensor will fit pipe sizes of 1½" diameter or larger (2" minimum size with thread connection).

The sensor is protected to prevent damage due to "bottoming-out" if inserted too far into a pipe.

PULSE OUTPUT

The optional pulse output provides a pulse output equivalent to user selected units and multiplier factor. Both active (power from the TA2) or passive (external power supply) connections are provided to match the user's interface. This output can optionally be used as an alarm to indicate that the flow rate is above or below the desired set point.

PORTABLE DISPLAY MODULE

A portable display module for configuration and diagnosis of multiple units is available (part number 089-5219-002). This portable module plugs into the electronics in the same manner as the normal display and uses the same software menu. This module permits the user to reduce installation cost by having one display module with keypad for multiple TA2 units.

Usage of the display module requires that the housing cover be removed during use and thus may not be useable in hazardous areas. In these cases, the HART option should be utilized.

Portable Display Module

NAMUR COMPLIANCE

Model TA2 output signal meets NAMUR NE43 recommendations for the 4–20 mA signal levels.

FACTORY CALIBRATION AND CONFIGURATION

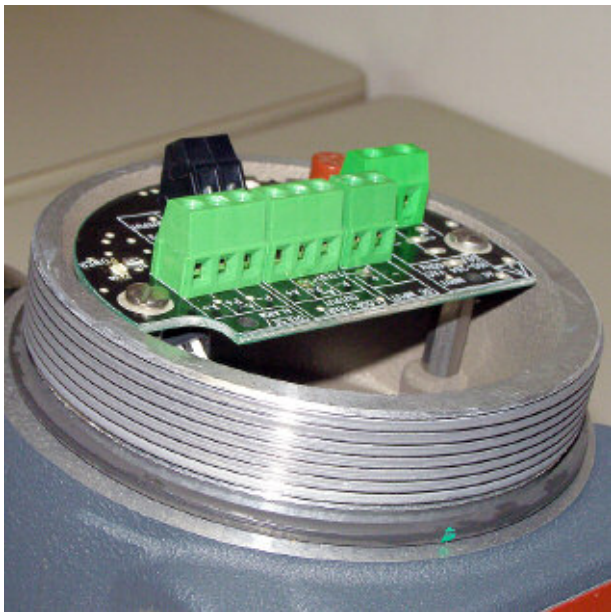
Each TA2 is calibrated at the factory for the type of gas and the specified flow rate. The instrument is configured for the specific application information. The result is an instrument which can be installed and immediately be placed into operation without field setup.

CALIBRATION VERIFICATION

Magnetrol has developed a procedure to verify the calibration of the TA2 in the field. Following this procedure, the user can verify that the heat transfer characteristics of the instrument have not changed from first received. While the calibration is a permanent calibration, the user can now check the calibration without having to return the instrument to the manufacturer. When using a HART handheld or PACT*ware*™, the user is guided through the procedure.

ELECTRICAL WIRING

Elevated terminal strips with very visible markings make wiring of the TA2 extremely easy.



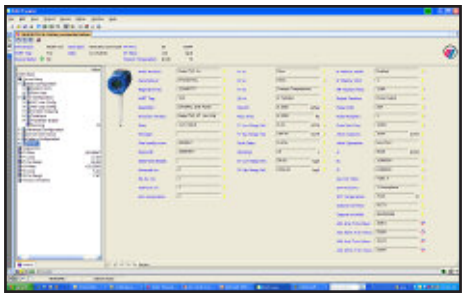
The Most Efficient PC Configuration Tool for TA2 Mass Flow Meters

PACT*ware* *is the modern, user-friendly adjustment software that enables quick configuration and diagnostics of your TA2 mass flow meters.*

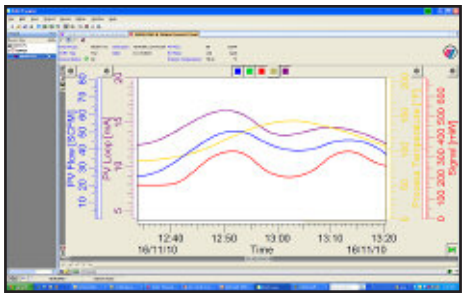
With your PC connected through a serial interface to the HART loop, all functionality can be managed remotely anywhere on the loop.

Parameters Screen Every Parameter in the TA2 can be reviewed and monitored remotely with a few clicks of the mouse. From units of measurement to pipe size, I/O Configuration or Calibration Factors, the parameters can be viewed or changed.

Trending Screen Trending is available of the flow rate, temperature, and signal providing useful information on the operation of the TA2. This is especially important for troubleshooting and diagnostics if required.



Parameters Screen



Process Trend Screen

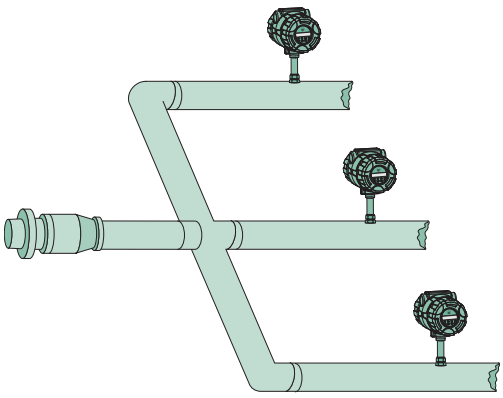
APPLICATIONS

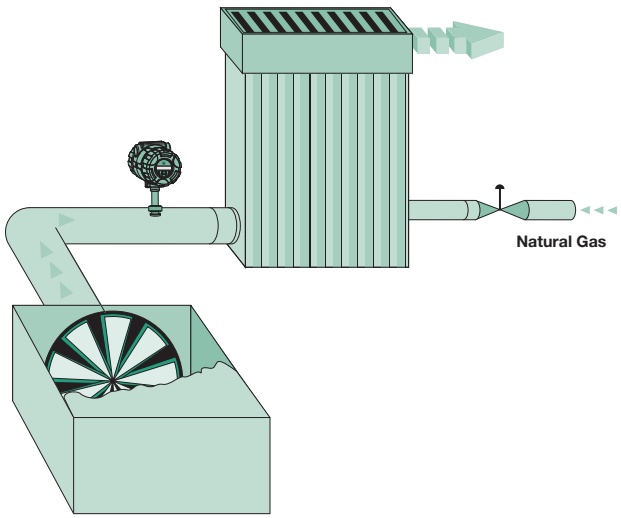
COMPRESSED AIR/GASES

Measurement of mass flow in different gas lines to determine compressor efficiency or in plant usage for internal allocation.

Advantages:

- direct mass flow
- high turndown rates
- flow totalization
- easy installation





BOILER COMBUSTION

The TA2 measures the inlet air flow to the boiler. This signal is sent to the DCS where it is used to trim the natural gas flow.

Advantages:

- mass flow measurement
- repeatable flow signal
- high rangeability

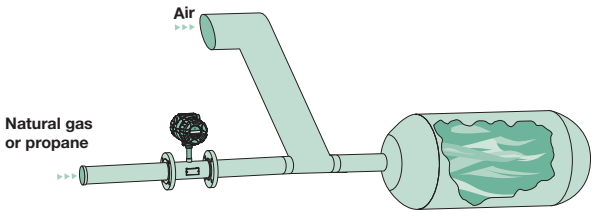
APPLICATIONS

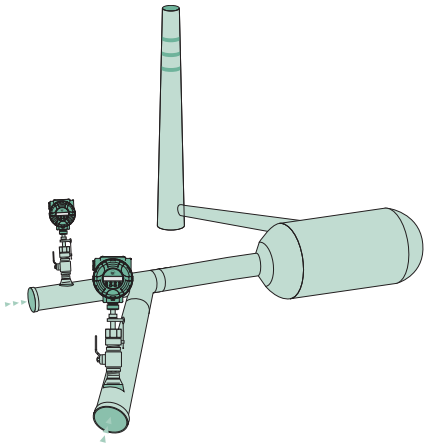
NATURAL GAS FLOW

The Model TA2 efficiently measures the flow and totalized flow of fuel to furnaces, heaters, or boilers. This data may be used for internal allocation or to report emission rates.

Advantages:

- direct mass flow in SCFM
- built-in totalizer
- ease in setup and operation



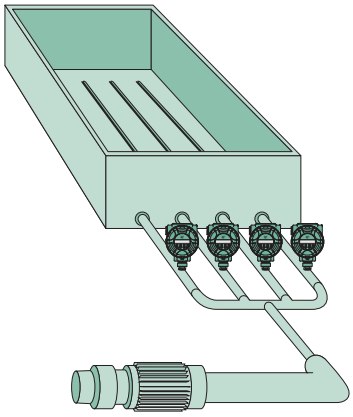


FLARE LINES

Measurement of flow in different sections of flare line.

Advantages:

- good low flow sensitivity
- high turndown
- easy removal if cleaning is required

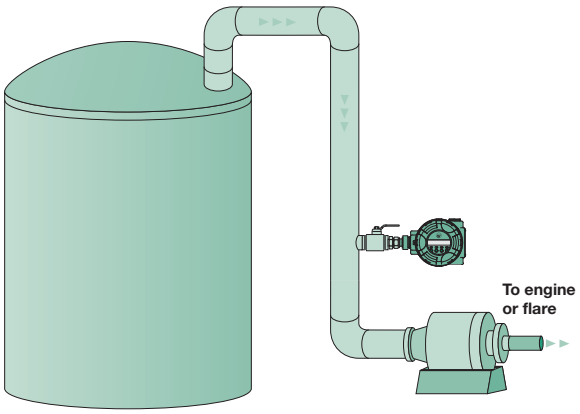


AERATION AIR FLOW

Measurement and balance of the flow to each section of the aeration basin in waste water treatment plants.

Advantages:

- low installation cost
- direct mass flow
- high reliability



DIGESTER GAS/BIO-GAS

The off gas from a digester contains a mixture of methane and carbon dioxide saturated with moisture. This is a difficult flow measurement due to low flow rate and low pressures.

Advantages:

- excellent low flow sensitivity
- high turndown rates
- provides measurement of flow and totalized flow

TECHNOLOGY

Thermatel Model TA2 flow transmitter measures mass flow by detecting heat dissipation from a heated surface. The sensor contains two mass balanced elements with precision matched RTDs. The reference sensor measures the process temperature (up to +400° F [+200° C]); the second RTD measures the temperature of the heated sensor. The power to the heater is varied to maintain a constant temperature difference above the reference temperature.

There is an inherent non-linear relationship between power and mass flow. The microprocessor in the TA2 compares the power against the calibration curve and converts the power requirements to the mass flow rate. Temperature is also measured to provide temperature compensation of the mass flow over the operating range of the instrument.

For further information on thermal mass flow measurement, request a copy of the Magnetrol "Thermal Dispersion Mass Flow Measurement Handbook," Bulletin 54-621.

AGENCY APPROVALS

AGENCY	APPROVED MODEL	PROTECTION METHOD	AREA CLASSIFICATION
UNITED STATES FM APPROVED	TA2-AXXX-X3X TA2-AXXX-X4X with TXR-XXXX-XXX (probe) TFT-XXXX-000 (flow body)	Explosion proof	Class I, Div 1, Groups B, C, & D Class II, Div 1, Groups E, F, & G Class III, T6 Ta = 160° F, T5 Ta = 175° F NEMA 4X, IP 66
		Non-Incendive	Class I, Div 2, Groups A, B, C, & D Class II, Div 2, Groups F & G Class III, T4 Ta = 160° F NEMA 4X, IP 66
CANADA C FM APPROVED	TA2-AXXX-X3X TA2-AXXX-X4X with TXR-XXXX-XXX (probe) TFT-XXXX-000 (flow body)	Explosion proof	Class I, Div 1, Groups B, C, & D Class II, Div 1, Groups E, F, & G Class III, T6 Ta = 160° F, T5 Ta = 175° F Type 4X
The TXR probe complies with Canadian Electric Code requirements of ANSI/ISA 12.27.01-2003 as a single seal device.		Non Incendive:	Class I, Div 2, Groups A, B, C, & D Class II, Div 2, Groups E, F, & G Class III, T4 Ta = 160° F, T5 Ta = 175° F Type 4X
ATEX Ex	TA2-AXXX-X3X TA2-AXXX-X4X with TXR-XXX0-XXX (probe) TFT-XXXX-000 (flow body)	Explosion proof EN60079-0: 2007 EN60079-1: 2007	Ex II 2 G Ex d IIC T6, IP66
	TA2-AXXX-XEX TA2-AXXX-XFX with TXR-XXXX-XXX (probe) TFT-XXXX-000 (flow body)	Ex d Explosion proof w/IS probe circuit EN60079-0: 2007 EN60079-1: 2007 EN60079-11: 2007 EN60079-26: 2006	Ex II 1/2 G Ex d+ib d{ib} IIC T5/T4 IP66 Approval Pending
ROS TECH/ GOST-R	TA2-AXXX-X3X TA2-AXXX-X4X	Russian Authorization Standards - Consult Magnetrol for Details	

Note: Maximum surface temperature of the probe is 4° C above process temperature.

CE These units have been tested to EN 61326 and are in compliance with the EMC Directive 2004/106/EC.

SPECIFICATIONS

PERFORMANCE

Flow range maximum	10–50,000 SFPM (0.05–250 Nm/s) air reference to standard conditions
	Contact Magnetrol for other gases
Accuracy flow	±1% of reading +0.5% of calibrated full scale
Accuracy temperature	±2° F (1° C)
Repeatability	±0.5% of reading
Linearity	Included in flow accuracy
Turn down	100:1 typical (depending on calibrated flow range)
Calibration	NIST traceable
Span	Minimum 0–100 SFPM
Response time	1 to 3 second time constant typical
Cable length	500 feet (150 m); (see page 11 for cable specifications)
SIL	Safe Failure Fraction (SFF) 88.4%

TRANSMITTER

Display	Two-line alphanumeric LCD, 16-characters per line
Keypad	Four push button
Menu Language	English, French, German, Spanish, Russian
Supply voltage	100–264 VAC, 50–60 Hz ~
	11.6–30 VDC ⎓ (11.6 VDC requires integral electronics)
Power consumption	DC = 6.8 watts, AC = 7 VA typical, 11.9 VA maximum
Signal Output	4–20 mA, HART available (3.8 to 20.5 mA useable—meets NAMUR NE 43)
Analog output signal Active	4–20 mA (isolated) maximum 1000 Ω loop resistance
Passive	4–20 mA (isolated) loop resistance dependent on power supply, 11–36 VDC
Diagnostic Alarm	3.6 mA, 22 mA, HOLD
HART	Optional
Pulse Output	Active Connection—24 VDC (±10%) Power, 150 mA
	Passive Connection—2.5 to 60 VDC Power, 1.5 AMP
Alarm Output	Active Connection—24 VDC (±10%) Power, 100 mA
	Passive Connection—2.5 to 60 VDC Power, 1 AMP
Ambient temperature	-40° to +176° F (-40° to +80° C); display not readable below -22° F (-30° C)
Temperature effect	Approximately ±0.04% of reading per ° C
Humidity	99% Non-condensing
Housing Material	Aluminum A356 (<0.2% copper)
Shock Vibration	ANSI/ISA-S71.03 table 2, level SA1 (Shock), ANSI/ISA-S71.03 table 1, level VC2 (Vibration)

PROBE

Materials	316/316L stainless steel all welded
	Hastelloy® C-276
Process connections	Refer to model number, hot tap optional
Process Pressure	1500 psig @ +70° F (103 bar @ +20° C), 1375 psig @ +400° F (95 bar @ +200° C)
Temperature rating	-50° to +400° F (-45° to +200° C)①

FLOW BODY

Materials	316/316L stainless steel all welded
	Carbon steel with stainless steel sensor
Process connections	NPT or 150 pound flange – Refer to model number
Pressure rating	1500 psig @ +70° F (103 bar @ +20° C), 1100 psig @ +400° F (76 bar @ +200° C)
Temperature rating	-50° to +400° F (-45° to +200° C)①

① For operating temperatures between +250° F and +400° F (+120° C and +200° C), either use remote electronics or a longer length insertion probe to provide an additional four inches (100 mm) between the electronics and the compression fitting.

MODEL NUMBER

Models available for quick shipment, usually within one week after factory receipt of a complete purchase order, through the Expedite Ship Plan (ESP)

SIGNAL OUTPUT

0	4-20 mA
1	4-20 mA with HART
4	4-20 mA with HART, Pulse/Alarm, second mA Output

DISPLAY

0	None
B	Plug-in display with keypad (with window)

CALIBRATION–INSERTION PROBE

Actual Gas Calibration	
0	Special
1	Air
2	Nitrogen
3	Hydrogen
4	Natural Gas
5	Methane
6	Digester Gas
7	Propane
8	Oxygen
Air Equivalency Calibration	
9	Air Equivalency

CALIBRATION – FLOW BODY

Actual Gas Calibration	
A	Special
B	Air
C	Nitrogen
D	Hydrogen
E	Natural Gas
F	Methane
G	Digester Gas
H	Propane
J	Oxygen
Air Equivalency Calibration	
K	Air Equivalency

HOUSING LOCATION / AGENCY APPROVAL

3	Integral, general purpose, non-incendive, & explosion proof FM/FMC (class B, C, & D), ATEX Exd
4	Remote, general purpose, non-incendive, & explosion proof FM/FMC (class B, C, & D), ATEX Exd
E	Integral, general purpose, ATEX, Ex d + ib
F	Remote, general purpose, ATEX, Ex d + ib

ENCLOSURE TYPE

0	Aluminum, ¾" NPT
1	Aluminum, M20

T	A	2	—	A			0	—			

MODEL NUMBER

INSERTION PROBE

THERMATEL PROBE

T E	Probe length in inches
T M	Probe length in centimeters

PROBE TYPE

R	¾" diameter probe

MATERIALS OF CONSTRUCTION

A	316/316L Stainless Steel
B	Hastelloy C

PROCESS CONNECTION SIZE

00	Compression Fitting Utilized (customer supplied)
03	¾" NPT SS compression fitting with Teflon Ferrules
04	¾" NPT SS compression fitting with Stainless Steel Ferrules
05	1" NPT SS compression fitting with Teflon Ferrules
06	1" NPT SS compression fitting with Stainless Steel Ferrules
11	¾" NPT
21	1" NPT
22	G1 (1" BSP)

ANSI FLANGES

23	1" 150# ANSI raised face flange
24	1" 300# ANSI raised face flange
33	1½" 150# ANSI raised face flange
34	1½" 300# ANSI raised face flange
43	2" 150# ANSI raised face flange
44	2" 300# ANSI raised face flange

DIN FLANGES

BB	DN 25 PN 16/25/40	EN 1092-1, Type A
CB	DN 40 PN 16/25/40	EN 1092-1, Type A
DA	DN 50 PN 16	EN 1092-1, Type A
DB	DN 50 PN 25/40	EN 1092-1, Type A

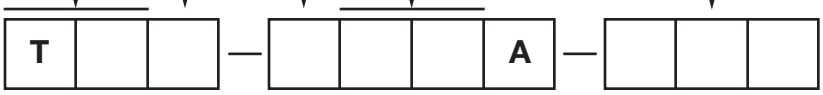
PROBE LENGTH

2.6 to 99.9 inches (example 8.5" = 085)
Minimum lengths: 2.6" (026) with threaded process connection
2.8" (028) with flanged process connection
4.5" (045) with compression fitting process connection

7 to 253 centimeters (example: 18 cm = 018)
Minimum lengths:
7 cm (007) with threaded or flanged process connection
11 cm (011) with compression fitting process connection

The following probes are available through the Expedite Ship Plan:

TER-A0XA-080 TMR-A0XA-020
TER-A0XA-180 TMR-A0XA-046



MODEL NUMBER

FLOW BODY

MATERIALS OF CONSTRUCTION

A	All stainless steel
1	Carbon steel body with stainless steel sensor

SIZE

0	½ inch
1	¾ inch
2	1 inch
3	1½ inch
4	2 inch
5	3 inch
6	4 inch

PROCESS CONNECTION TYPE

1	NPT Threads (only when Digit 5 = 0, 1, 2, 3, or 4
3	150# Flange

FLOW CONDITIONING PLATE (stainless steel)

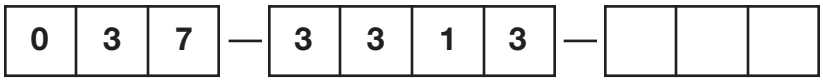
A	Not provided
B	Provided (only when Digit 5 = 3, 4, 5, or 6)

CONNECTING CABLE

FOR CABLE LENGTHS UP TO 200 FEET

037-3313-XXX (Cable length in feet)—10 feet minimum, 200 feet maximum length

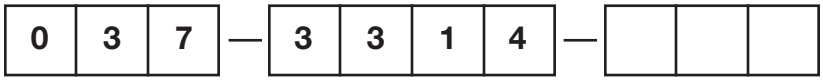
Example: 50 feet = 050



FOR CABLE LENGTHS UP TO 60 METERS

037-3314-XXX (Cable length in meters)—3 meters minimum, 60 meters maximum length

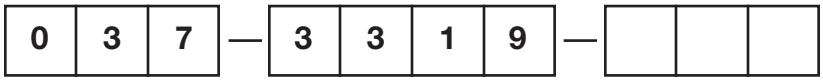
Example: 8 meters = 008



FOR CABLE LENGTHS BETWEEN 200 AND 500 FEET

037-3319-XXX (Cable length in feet)—10 feet minimum, 500 feet maximum length

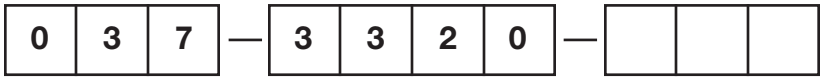
Example: 300 feet = 300



FOR CABLE LENGTHS BETWEEN 60 AND 150 METERS

037-3320-XXX (Cable length in meters)—3 meters minimum, 150 meters maximum length

Example: 80 meters = 080



RETRACTABLE PROBE ASSEMBLY

HOT TAP

Two methods are offered of removing the probe from the pipe without having to shut down the process. The Hot Tap Retractable Probe Assembly (RPA) is designed to meet API (American Petroleum Institute) standards. The less demanding valve and compression fitting (part number 089-5218-001) will have some minor leakage when the probe is removed or re-inserted and does not have the safety cable to prevent "blow out" of the probe when removed under pressure.

RPA requires a probe with ¾" NPT process connection (code 11).

The valve with compression fitting uses a 1" NPT connection while the RPA uses a 1½" NPT connection.

High Pressure **Low Pressure** **089-5218-001**

BASIC MODEL NUMBER

RPA	Retractable probe assembly

DESIGN TYPE

5	Low pressure (up to 80 psi, 5.5 bar), length in tenths of an inch
6	High pressure (up to 300# class service), length in tenths of an inch
E	Low pressure (up to 80 psi, 5.5 bar), length in centimeters
F	High pressure (up to 300# class service), length in centimeters

MATERIALS OF CONSTRUCTION

1	Carbon steel (available on flange and high pressure units). Seal gland is 316 stainless steel.
4	316 stainless steel

PROCESS CONNECTION

0	1½" NPT
1	1½" 150# flange
2	1½" 300# flange

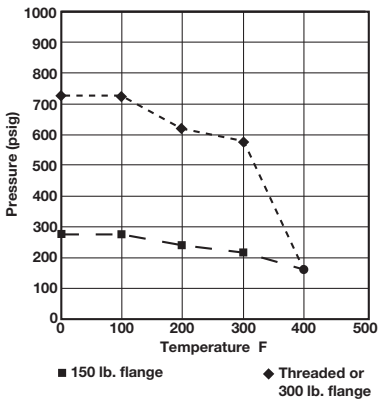
BALL VALVE

0	None
1	Carbon steel
2	Stainless steel

PROBE LENGTH

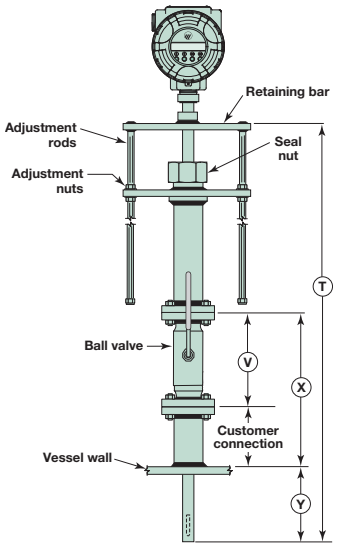
10 to 99.9 inches (example: 12" = 120)
25 to 253 centimeters (example: 30 cm = 030)

R	P	A	—					—			

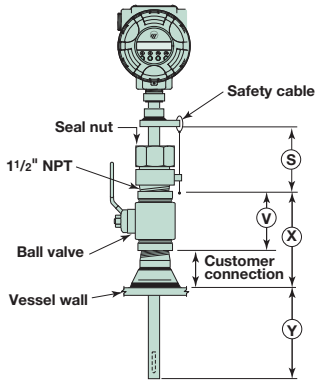


DIMENSIONAL SPECIFICATIONS

HOT TAP – inches (mm)



Hot Tap
Model RPA-6X12-XXX
Minimum Probe Length:
T = 2(X+Y)



Hot Tap
Model RPA-5402-XXX
Minimum Probe Length
= S+X+Y

S Dimension	
Threaded conn.	4.0 (102)
Flanged conn.	5.0 (127)

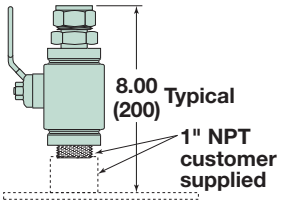
Ball Valve Dimensions*	
Size	**V**
1½" NPT	4.4 (112)
1½" 150# flange	6.5 (165)
1½" 300# flange	7.5 (191)

*Dimension of ball valve if supplied by Magnetrol.

Dimension V:
Ball valve dimension (see chart)

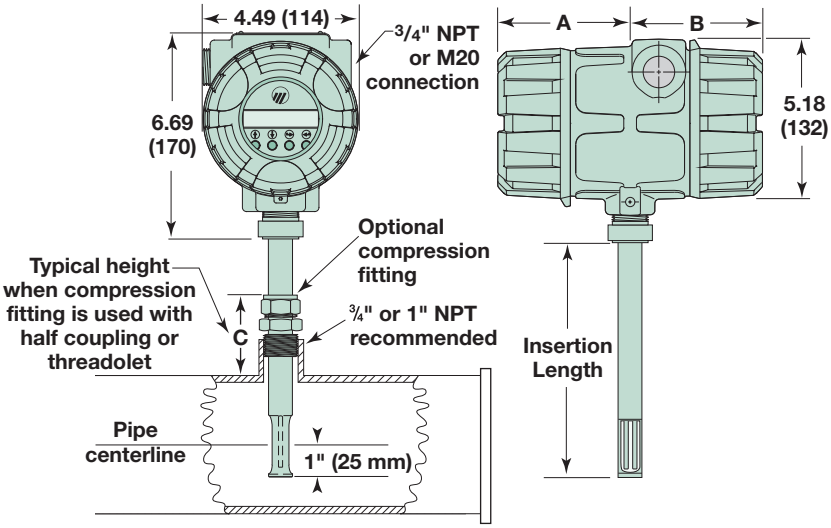
Dimension X:
Length from wall to top of ball valve

Dimension Y:
Insertion length into pipe

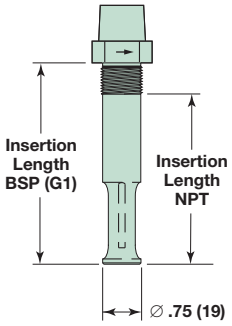


Valve with Compression Fitting (089-5218-001)

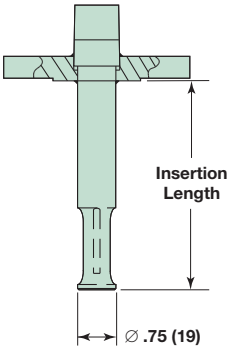
INTEGRAL MOUNT – inches (mm)



Integral Mount Model TA2
Front and Side Views



TXR with Threaded Connection



TXR with Flanged Connection

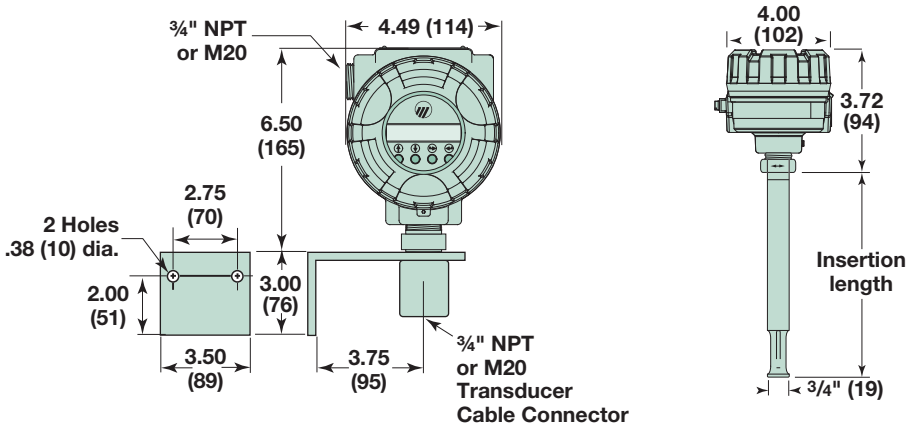
Process Conn. Size	Height C	Compression fitting	
		Teflon ferrules	Stainless steel ferrules
1" NPT	3.1 (79)	011-4719-009 (100 psi maximum)	011-4719-007 (1500 psi maximum)
¾" NPT	2.6 (66)	011-4719-008 (100 psi maximum)	011-4719-006 (1500 psi maximum)

Dimension A:
3.33 (85) without display
3.88 (99) with display

Dimension B:
3.88 (98)

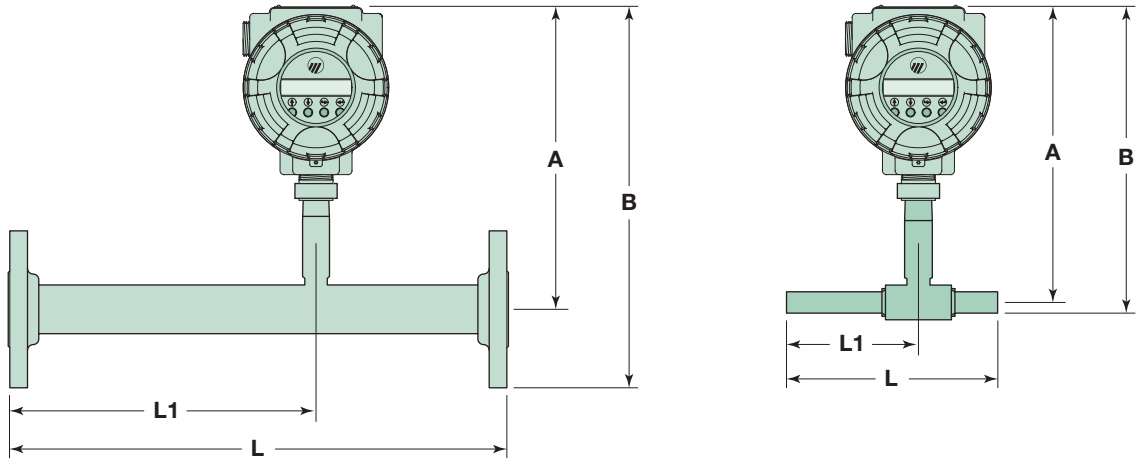
DIMENSIONAL SPECIFICATIONS

REMOTE MOUNT – inches (mm)

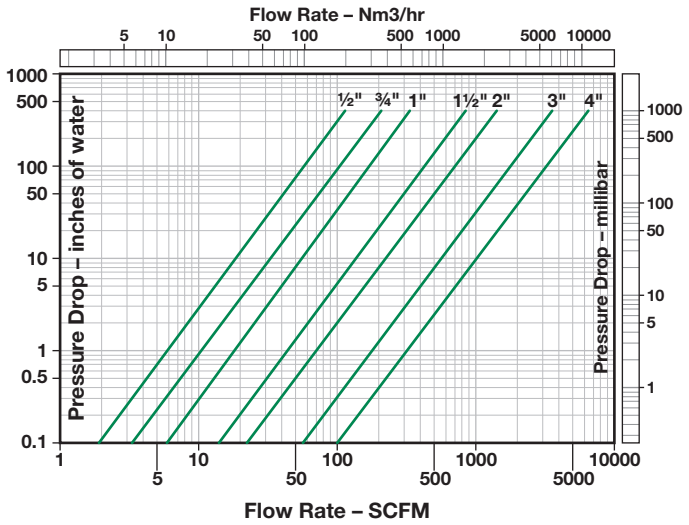


Remote Mount Model TA2

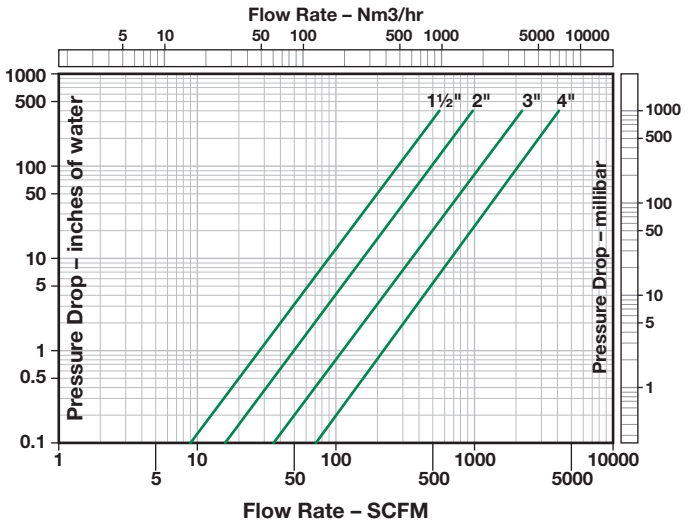
FLOW BODY – see chart at right



Pressure Drop



Pressure Drop with Flow Conditioning Plate



Pressure drop is based on air at +70° F and 1 atmosphere (density = 0.075 lb/ft³). For other gases, pressure or temperatures, estimate pressure drop by multiplying value from chart by actual density (at operating conditions) divided by 0.075.

FLOW BODY SIZING

The following table is a general guide on flow sizing. Contact factory or your local representative for specific application information.

Code	Size	Air, N_2, O_2	Natural Gas, Methane	Digester Gas	Propane	Hydrogen	CO_2, Argon
0	½"	85 SCFM 145 Nm³/h	60 SCFM 100 Nm³/h	60 SCFM 100 Nm³/h	30 SCFM 50 Nm³/h	20 SCFM 35 Nm³/h	80 SCFM 140 Nm³/h
1	¾"	162 SCFM 275 Nm³/h	115 SCFM 195 Nm³/h	115 SCFM 195 Nm³/h	55 SCFM 95 Nm³/h	40 SCFM 70 Nm³/h	150 SCFM 250 Nm³/h
2	1"	270 SCFM 459 Nm³/h	190 SCFM 320 Nm³/h	190 SCFM 320 Nm³/h	95 SCFM 160 Nm³/h	65 SCFM 115 Nm³/h	250 SCFM 435 Nm³/h
3	1½"	660 SCFM 1120 Nm³/h	460 SCFM 780 Nm³/h	460 SCFM 780 Nm³/h	230 SCFM 390 Nm³/h	160 SCFM 275 Nm³/h	625 SCFM 1060 Nm³/h
4	2"	965 SCFM 1640 Nm³/h	680 SCFM 1160 Nm³/h	680 SCFM 1160 Nm³/h	350 SCFM 600 Nm³/h	265 SCFM 450 Nm³/h	920 SCFM 1560 Nm³/h
5	3"	2700 SCFM 4580 Nm³/h	1890 SCFM 3210 Nm³/h	1890 SCFM 3210 Nm³/h	690 SCFM 1170 Nm³/h	730 SCFM 1230 Nm³/h	2560 SCFM 4360 Nm³/h
6	4"	4860 SCFM 8260 Nm³/h	3400 SCFM 5780 Nm³/h	3400 SCFM 5780 Nm³/h	1230 SCFM 2090 Nm³/h	1310 SCFM 2200 Nm³/h	4620 SCFM 7845 Nm³/h

FLOW BODY DIMENSIONS CHART

inches (mm)

Code	Size	Length (L)		L1		Height to Centerline (A)	Overall Height (B)	
		With Flow Conditioning	Without Flow Conditioning	With Flow Conditioning	Without Flow Conditioning		NPT	Flange
0	½"	8 (203)	—	5 (127)	—	8.0 (203)	8.4 (213)	9.7 (246)
1	¾"	11.25 (285)	—	7.5 (190)	—	8.0 (203)	8.5 (216)	9.9 (251)
2	1"	15 (381)	—	10 (254)	—	8.0 (203)	8.6 (218)	10.1 (257)
3	1½"	19.5 (495)	7.5 (191)	12 (305)	3.75 (95)	8.3 (210)	9.2 (234)	10.8 (274)
4	2"	26 (660)	7.5 (191)	16 (406)	3.75 (95)	9.5 (241)	10.7 (272)	12.5 (318)
5	3"	39 (991)	10 (254)	24 (610)	5 (127)	9.5 (241)	N/A	13.3 (338)
6	4"	52 (1321)	12 (305)	36 (914)	6 (152)	9.5 (241)	N/A	14.0 (356)

Flow conditioning on ½" to 1" is provided due to length of flow body and sensor design.
Optional flow conditioning plate is available on flow bodies 1½" and larger.

QUALITY

MAGNETROL
REGISTERED TO
ISO 9001
Your Assurance of
Quality and Service

The quality assurance system in place at Magnetrol guarantees the highest level of quality throughout the company. Magnetrol is committed to providing full customer satisfaction both in quality products and quality service.

The Magnetrol quality assurance system is registered to ISO 9001 affirming its commitment to known international quality standards providing the strongest assurance of product/service quality available.

ESP

Expedite
Ship
Plan

Several TA2 Models (see page 9) are available for quick shipment, usually within one week after factory receipt of a purchase order, through the Expedite Ship Plan (ESP).

ESP service may not apply to orders of ten units or more. Contact your local representative for lead times on larger volume orders, as well as other products and options.

WARRANTY

All Magnetrol electronic level and flow controls are warranted free of defects in materials or workmanship for one full year from the date of original factory shipment.

If returned within the warranty period; and, upon factory inspection of the control, the cause of the claim is determined to be covered under the warranty; then, Magnetrol will repair or replace the control at no cost to the purchaser (or owner) other than transportation.

Magnetrol shall not be liable for misapplication, labor claims, direct or consequential damage or expense arising from the installation or use of equipment. There are no other warranties expressed or implied, except special written warranties covering some Magnetrol products.

Additional information

The following additional Thermatel literature is available from your local representative:

54-631	Thermatel Model TA2 Mass Flow Transmitter Instruction Manual and Parts List
54-100	Thermatel Technology brochure
54-105	Thermatel TG1 Flow and Level Switch sales literature
54-110	Thermatel Model TD1/TD2 Thermal Dispersion Flow and Level Switch sales literature
54-131	Thermatel Model TA2 Probe location literature
54-210	Thermal Dispersion Mass Flow Meter Applications
54-621	Thermal Dispersion Mass Flow Measurement Handbook

Magnetrol®

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145 Jardin Drive, Units 1 & 2 • Concord, Ontario Canada L4K 1X7 • 905-738-9600 • Fax 905-738-1306
Heikensstraat 6 • B 9240 Zele, Belgium • 052 45.11.11 • Fax 052 45.09.93
Regent Business Ctr., Jubilee Rd. • Burgess Hill, Sussex RH15 9TL U.K. • 01444-871313 • Fax 01444-871317

BULLETIN: 54-140.0
EFFECTIVE: January 2011

Magnetrol®

MAGNETROL REGISTERED TO ISO 9001 Your Assurance of Quality and Service

Checklist for QA Documentation Required with Shipment

PRODUCTION NO.: T-012334

CUSTOMER: CITY OF ITHACA

P.O. NUMBER: DANRAMER

PREPARED BY:Mary Berland **DATE: 9/10/2012**

		MAGNETROL ORDER ITEM NUMBER											
TYPE OF DOCUMENTATION	FORM NO.	1	2	3									
10 Flow Points with Certificate		1	1	1									

NOTES: 1 Copies Documentation with Shipment

__ Copies Documentation to:

Partial:

Completed : KEH September 10, 2012

Magnetrol®

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info@magnetrol.com • www.magnetrol.com

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Downers Grove, Illinois 60515-4499
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Fax: 630-969-9489
info@magnetrol.com

CALIBRATION CERTIFICATE

Model TA2 Thermal Dispersion Mass Flow Transmitter

Customer	ITHACA AREA WASTE WATER FACILITY
Reference	T-012334
Model	TA2-A4B0-640
Probe	TER-A00A-080
Date	August 23, 2012
Serial Number	12334-01-001

Calibration Type	
Gas type	Digester Gas 65% CH4, 35% CO2

Advanced Configuration		
STP Conditions		
Temperature	70.0	F
Pressure	1 atm	

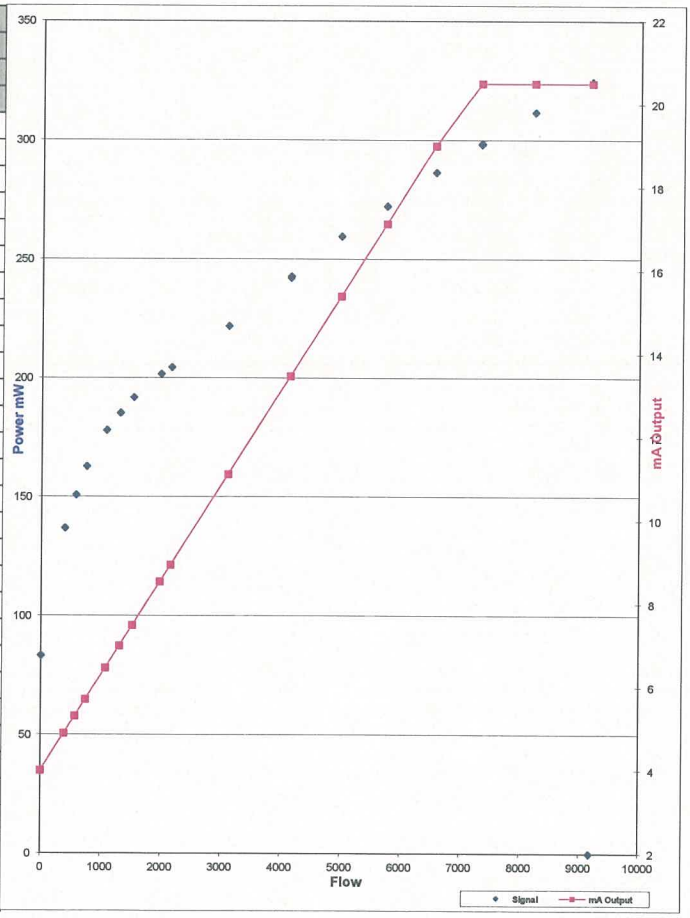
I/O Configuration		
Controlled by..	4mA	20mA
SCFH	0.00	7000.00

System Configuration		
	Units	Value
Volumetric Flow	SCFH	
Mass Flow	lbs/hr	
Temperature	F	
Density	lbs/ft3	
Line Size	6.0", Sch. 80	
Area	0.18102	sq ft

Factory Configuration					
Probe Parameters		Control Parameters		Gas Parameters	
T_0	46037072.0	Set Pt.	9	Density lbs/ft3	0.066785
F_0	16376.000	Lo Cal	24.48	TCC-A	0.939550
ZFS - Gas	83.251	Hi Cal	13.5	TCC-B	2.971500
ZFS - Air	82.120			TCC-C	0.000000
U-L	728.621			Gas Coeff Ag	0.000000
L-L	41.031			Gas Coeff Bg	1.000000
				Gas Coeff Cg	0.000000
				Gas Coeff Dg	0.000000
				Gas Coeff Eg	0.000000

Factory Configuration values are entered using password "126".

Instrument Setup				
	Customer Calibration Data		Table A Values	
Data Pt.	Units	4-20 mA	Signal	Velocity
	SCFH	output	mW	SFPM
1	0.00	4.00	83.25	0.00
2	390.11	4.89	136.87	41.03
3	572.68	5.31	150.77	60.23
4	748.81	5.71	162.76	78.76
5	1078.14	6.46	177.98	107.40
6	1309.61	6.99	185.19	122.35
7	1526.35	7.49	191.73	135.76
8	1985.07	8.54	201.57	163.37
9	2161.14	8.94	204.45	173.80
10	3115.50	11.12	221.82	229.71
11	4144.91	13.47	242.14	297.86
12	4146.81	13.48	242.77	298.02
13	4985.00	15.39	259.51	366.63
14	5745.40	17.13	272.19	430.18
15	6563.00	19.00	286.44	499.80
16	7326.44	20.50	298.13	565.84
17	7326.46	20.50	298.49	565.85
18	8214.34	20.50	311.67	643.70
19	9170.92	20.50	324.44	728.62
20	9170.92	20.50		
21	9170.92	20.50		
22	9170.92	20.50		
23	9170.92	20.50		
24	9170.92	20.50		
25	9170.92	20.50		
26	9170.92	20.50		
27	9170.92	20.50		
28	9170.92	20.50		
29	9170.92	20.50		
30	9170.92	20.50		



Calibrated By

Checked By

August 23, 2012
Date

If the calibration was done in the Actual Gas listed above the calibration is NIST Traceable using an uncertainty in flow measurement of ± 0.3% of Mass Flow reading or better. Contact Factory to determine if calibration was done in the Actual Gas.

MISC. INFO:	

5300 Belmont Road
Downers Grove, Illinois 60515-4499
Phone: 630-969-4000
Fax: 630-969-9489
info@magnetrol.com

CALIBRATION CERTIFICATE

Model TA2 Thermal Dispersion Mass Flow Transmitter

Customer	ITHACA WASTE WATER FACILITY
Reference	T-012334
Model	TA2-A4B0-640
Probe	TER-A00A-080
Date	August 23, 2012
Serial Number	12334-02-001

Calibration Type	
Gas type	Digester Gas 65% CH4, 35% CO2

Advanced Configuration		
STP Conditions		
Temperature	70.0	F
Pressure	1 atm	

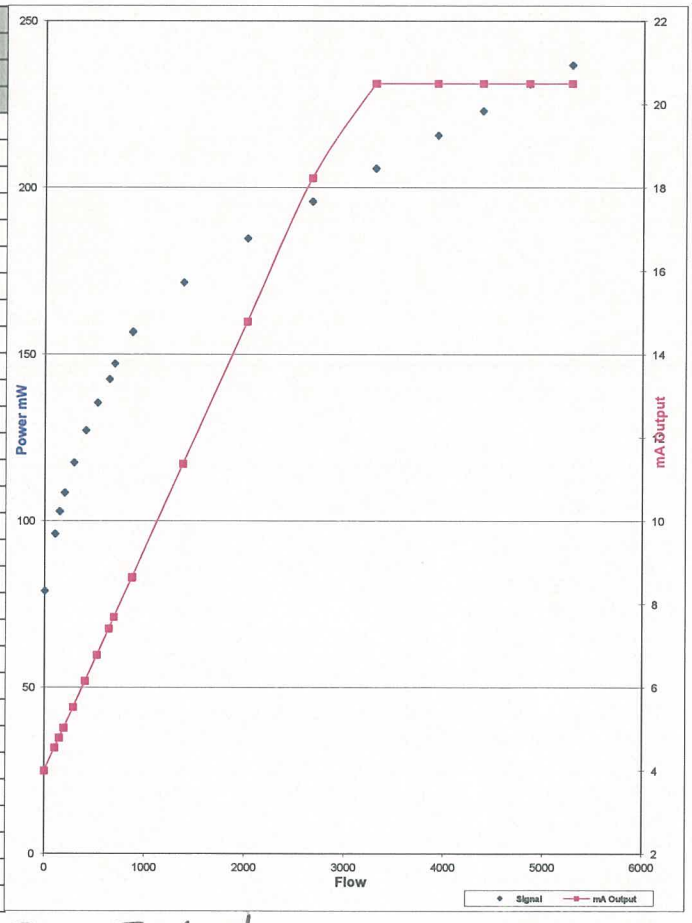
I/O Configuration		
Controlled by..	4mA	20mA
SCFH	0.00	3000.00

System Configuration		
	Units	Value
Volumetric Flow	SCFH	
Mass Flow	lbs/hr	
Temperature	F	
Density	lbs/ft3	
Line Size	6.0", Sch. 80	
Area	0.18102	sq ft

Factory Configuration					
Probe Parameters		Control Parameters		Gas Parameters	
T_0	46096584.0	Set Pt.	9	Density lbs/ft3	0.066785
F_0	-65522.000	Lo Cal	25.704	TCC-A	0.939550
ZFS - Gas	78.989	Hi Cal	16.83	TCC-B	2.971500
ZFS - Air	78.890			TCC-C	0.000000
U-L	390.875			Gas Coeff Ag	0.000000
L-L	10.863			Gas Coeff Bg	1.000000
				Gas Coeff Cg	0.000000
				Gas Coeff Dg	0.000000
				Gas Coeff Eg	0.000000

Factory Configuration values are entered using password "126".

Instrument Setup				
	Customer Calibration Data		Table A Values	
Data Pt.	Units	4-20 mA	Signal	Velocity
	SCFH	output	mW	SFPM
1	0.00	4.00	78.99	0.00
2	103.29	4.55	96.10	10.86
3	147.92	4.79	102.86	15.56
4	193.47	5.03	108.44	20.35
5	286.33	5.53	117.49	30.12
6	404.68	6.16	127.15	42.56
7	521.17	6.78	135.41	54.82
8	640.14	7.41	142.53	67.33
9	692.40	7.69	147.20	72.82
10	869.76	8.64	156.64	91.48
11	872.32	8.65	156.77	91.75
12	1382.26	11.37	171.56	126.89
13	2022.71	14.79	184.76	165.60
14	2668.74	18.23	195.84	203.59
15	3303.01	20.50	205.72	240.87
16	3307.15	20.50	205.75	241.12
17	3929.15	20.50	215.66	279.20
18	4383.47	20.50	222.98	317.21
19	4851.55	20.50	231.04	355.59
20	5276.69	20.50	236.73	390.87
21	5276.69	20.50	236.73	
22	5276.69	20.50	236.73	
23	5276.69	20.50	236.73	
24	5276.69	20.50	236.73	
25	5276.69	20.50	236.73	
26	5276.69	20.50	236.73	
27	5276.69	20.50	236.73	
28	5276.69	20.50	236.73	
29	5276.69	20.50	236.73	
30	5276.69	20.50	236.73	



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Checked By

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Date

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MISC. INFO:	

5300 Belmont Road
Downers Grove, Illinois 60515-4499
Phone: 630-969-4000
Fax: 630-969-9489
info@magnetrol.com

CALIBRATION CERTIFICATE

Model TA2 Thermal Dispersion Mass Flow Transmitter

Customer	ITHACA AREA WASTEWATER FACILITY
Reference	T-012334
Model	TA2-A4B0-640
Probe	TER-A00A-080
Date	July 24, 2012
Serial Number	12334-03-001

Calibration Type	
Gas type	Digester Gas 65% CH4, 35% CO2

Advanced Configuration		
STP Conditions		
Temperature	70.0	F
Pressure	1 atm	

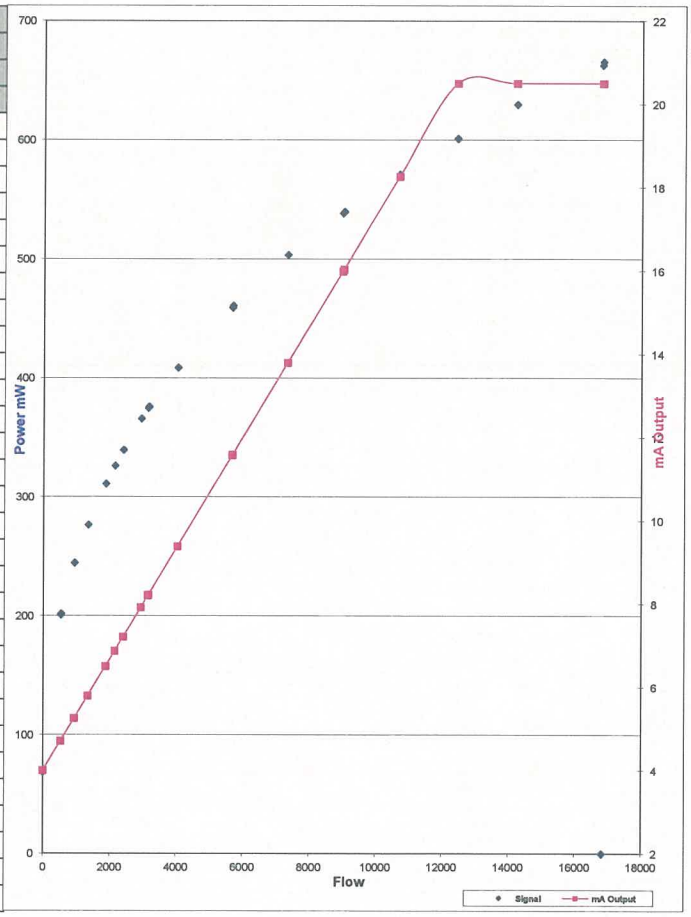
I/O Configuration		
Controlled by..	4mA	20mA
SCFH	0.00	12000.00

System Configuration		
	Units	Value
Volumetric Flow	SCFH	
Mass Flow	lbs/hr	
Temperature	F	
Density	lbs/ft3	
Line Size	2.0", Sch. 40	
Area	0.0233	sq ft

Factory Configuration					
Probe Parameters		Control Parameters		Gas Parameters	
T_0	46056472.0	Set Pt.	7	Density lbs/ft3	0.066785
F_0	14547.000	Lo Cal	24.156	TCC-A	0.939550
ZFS - Gas	68.598	Hi Cal	15.228	TCC-B	2.971500
ZFS - Air	67.150			TCC-C	0.000000
U-L	12041.514			Gas Coeff Ag	0.000000
L-L	342.892			Gas Coeff Bg	1.000000
				Gas Coeff Cg	0.000000
				Gas Coeff Dg	0.000000
				Gas Coeff Eg	0.000000

Factory Configuration values are entered using password "126".

Instrument Setup				
	Customer Calibration Data		Table A Values	
Data Pt.	Units	4-20 mA	Signal	Velocity
	SCFH	output	mW	SFPM
1	0.00	4.00	68.60	0.00
2	530.13	4.71	200.85	342.89
3	532.45	4.71	201.74	344.37
4	937.73	5.25	244.21	638.13
5	942.62	5.26	244.61	641.69
6	1347.25	5.80	276.48	934.49
7	1878.71	6.50	310.88	1317.18
8	2155.10	6.87	326.02	1515.88
9	2408.08	7.21	339.36	1697.65
10	2940.48	7.92	365.61	2080.03
11	3151.38	8.20	374.64	2231.45
12	3167.19	8.22	375.70	2242.80
13	4040.29	9.39	408.56	2869.51
14	5677.36	11.57	459.06	4044.27
15	5691.69	11.59	460.58	4054.55
16	7344.08	13.79	503.18	5240.12
17	8992.66	15.99	538.37	6422.87
18	9023.83	16.03	539.51	6445.24
19	10697.92	18.26	570.94	7646.25
20	12444.68	20.50	600.99	8899.37
21	14221.59	20.50	629.68	10174.10
22	16806.44	20.50	662.91	12028.42
23	16824.70	20.50	665.57	12041.51
24	16824.70	20.50		
25	16824.70	20.50		
26	16824.70	20.50		
27	16824.70	20.50		
28	16824.70	20.50		
29	16824.70	20.50		
30	16824.70	20.50		



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DE 2012 1
Checked By

July 24, 2012
Date

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54-355 Jun-10

MISC. INFO:	

Enhanced Power and Energy Meter

E50/E51

Versatile Energy Monitoring Solution

DESCRIPTION

The **E5x Series** DIN Rail Meter combines exceptional performance and easy installation to deliver a cost-effective solution for power monitoring applications. The E5x can be installed on standard DIN rail or surface mounted as needed. The Modbus, LON, and BACnet output models offer added flexibility for system integration. The data logging capability (E5xC3 and E5xx5) protects data in the event of a power failure. Combinations of serial communication, pulse output, and phase alarms are provided to suit a wide variety of applications.

Additional pulse inputs on E5xHx and E5xFx provide an easy way to incorporate simple flow sensors to track gas, water, steam, or other energy forms using a BACnet or LON system.

The E51 models add a bi-directional monitoring feature designed expressly for renewable energy applications, allowing measurement of power imported from the utility grid as well as power exported from the renewable energy source (e.g. solar panels). In this way, a facility administrator can track all energy data, ensuring accuracy in billing and crediting. They are also useful for monitoring loads that use regenerative braking.

APPLICATIONS

- Energy monitoring in building automation systems
- Renewable energy
- Energy management
- Commercial submetering
- Industrial monitoring
- Cost allocation

FEATURES

- Revenue Grade measurements
- DIN rail, panel, or wall mounting options...easy installation
- ANSI 12.20 0.5% accuracy, IEC 62053-22 Class 0.5S...great for cost allocation
- Real energy output and phase loss alarm output on E50Bx and E5xCx models... one device serves multiple applications
- 90-600VAC...application versatility with fewer models to stock
- Data logging capability (E5xC3 and E5xx5)... ensures long term data retrieval and safeguards during power failures
- Compatible with CTs from 5A to 32000A...wide range of service types
- User-enabled password protection...protect from tampering
- System integration via Modbus (E5xCx), BACnet MS/TP (E5xHx), or LON FT (E51Fx)...convenient compatibility with existing systems
- Native BACnet MS/TP support (no gateway) with serial rates up to 115.2 kbaud (E5xHx)
- E51 models: Bi-directional metering (4-quadrant), an essential solution for solar and other renewable energy applications, measures Import, Export and net energy transfer
- CSI approved...eases submission process for California Solar Initiative
- E51Cx includes SunSpec compliant common and meter register blocks

SPECIFICATIONS

5 Year Warranty

Inputs:

Control Power, AC	50/60 Hz; 5VA max.; 90V min.; UL Maximums: 600V$_{L-L}$ (347V$_{L-N}$); CE Maximums: 300V$_{L-N}$ (520V$_{L-L}$)
Control Power, DC	3W max.; UL and CE: 125 to 300VDC (external DC current limiting required)
Voltage Input	UL: 90V$_{L-N}$ to 600V$_{L-L}$; CE: 90V$_{L-N}$ to 300V$_{L-L}$
Current Input	
Scaling	5A to 32,000A
Input Range	0 to 0.333V or 0 to 1V (selectable)
Pulse Inputs (E5xHx and E51Fx only)	Contact inputs to pulse accumulators (one set with E5xH2 and E50F2; two sets with E5xH5 and E51F5)

Accuracy:

Real Power and Energy	0.5% (ANSI C12.20, IEC 62053-22 Class 0.5S)

Outputs:

All Models (except E5xHx and E51Fx)	Real Energy Pulse: N.O. static; Alarm contacts: N.C. static
E50Bx	Reactive energy pulse 30VAC/DC
E5xCx	RS-485 2-wire Modbus RTU (1200 baud to 38.4 kbaud)
E5xHx	RS-485 2-wire BACnet MS/TP (9600 baud to 115.2 kbaud)
E51Fx	2-wire LON FT

Mechanical:

Mounting	DIN Rail or 3-point screw mount

Environmental:

Operating Temperature Range	-30° to 70°C (-22° to 158°F)
Storage Temperature Range	-40° to 85°C (-40° to 185°F)
Humidity Range	<95% RH noncondensing
Safety	UL508, EN61010

California CSI Solar, ANSI C12.20

VERIS INDUSTRIES

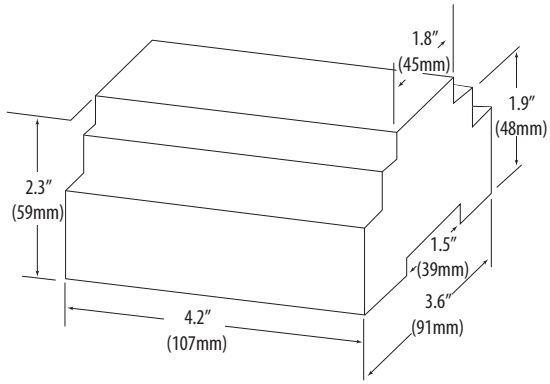
VERIS INDUSTRIES

ORDERING INFORMATION

SunSpec alliance — E51Cx only

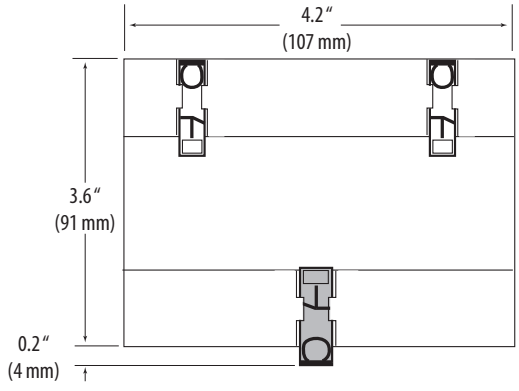
	E50B1	E50C2	E50C3	E50H2	E50H5	E51C2	E51C3	E51H2	E51H5	E51F2	E51F5
				COMING SOON!				COMING SOON!	COMING SOON!	COMING SOON!	COMING SOON!
MEASUREMENT CAPABILITY - FULL DATA SET											
Bi-directional Energy Measurements						●	●	●	●	●	●
Power (3-phase total and per phase): Real (kW) Reactive (kVAR), and Apparent (kVA)	●	●	●	●	●	●	●	●	●	●	●
Power Factor: 3-phase average and per phase	●	●	●	●	●	●	●	●	●	●	●
Present Power Demand: Real (kW), Reactive (kVAR), and Apparent (kVA)	●	●	●	●	●	●	●	●	●	●	●
Import and Export totals of Present Power Demand: Real (kW), Reactive (kVAR), and Apparent (kVA)						●	●	●	●	●	●
Peak Power Demand: Real (kW), Reactive (kVAR), and Apparent (kVA)	●	●	●	●	●	●	●	●	●	●	●
Current (3-phase average and per phase)	●	●	●	●	●	●	●	●	●	●	●
Voltage: Line-Line and Line-Neutral (3-phase average and per phase)	●	●	●	●	●	●	●	●	●	●	●
Frequency	●	●	●	●	●	●	●	●	●	●	●
Accumulated Net Energy: Real (kWh), Reactive (kVARh), and Apparent (kVAh)	●	●	●	●	●	●	●	●	●	●	●
Import and Export Accumulators of Real and Apparent Energy						●	●	●	●	●	●
Reactive Energy Accumulators by Quadrant (3-phase total and per phase)						●	●	●	●	●	●
Demand Interval Configuration: Fixed or Rolling Block	●	●	●	●	●	●	●	●	●	●	●
Demand Interval Configuration: External Sync to Comms		●	●	●	●	●	●	●	●	●	●
DATA LOGGING:											
Data Logging: 10 16-Bit Configurable (can include Date/Time) Data Buffers			●				●				
Data Logging: 3 Timestamped 32-Bit Configurable Data Buffers					●				●		●
Store up to 60 days of readings at 15-minute intervals			●		●		●		●		●
OUTPUTS:											
Alarm Output (N.C.)	●	●	●	●		●	●	●		●	
1 Pulse Output (N.O.)		●	●			●	●				
2 Pulse Outputs (N.O.)	●										
RS-485 Serial (Modbus RTU Protocol)		●	●			●	●				
RS-485 Serial (BACnet MS/TP Protocol)				●	●			●	●		
LON FT Serial (LonTalk Protocol)										●	●
INPUTS:											
2 Pulse Contact Accumulator Inputs					●				●		●
1 Pulse Contact Accumulator Input				●				●		●	

DIMENSIONAL DRAWING

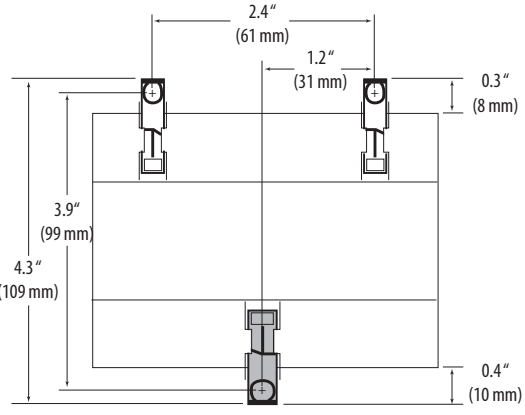


MOUNTING DIAGRAMS

DIN Mount Configuration



Wall Mount Configuration



ACCESSORIES

NEMA4 enclosure (AE010) and locking mechanism (AE011)
Fuse Kits with hi-interrupt capability AC Fuses (AH02, AH03, AH04)
Split-core and solid-core CTs (H681x, SCT)
Replacement mounting clips (AE004)
DIN Rail (AV01), DIN Rail Stop Clips (AV02)
Modbus TCP Gateway (U013-0012)
BACnet IP Router (U013-0013)


U013-0012


U013-0013


AE010


AH04


AV01/AV02
(clip styles may vary)

POWER/ENERGY MONITORING

Engineering Specifications
Veris E50H5
Compact Power and Energy Meter with BACnet Communication
And Data Logging Capability

1. The power meter shall be fully electronic with multi-line backlit LCD display showing measured parameters.

2. The power meter shall perform the following measurements:

    a) Accumulated Real Energy (kWh) for each phase and total of all phases
    b) Accumulated Reactive Energy (kVARh) and Apparent Energy (kVAh) totals for all phases
    c) Net Present Demand for Real (kW), Reactive (kVAR) and Apparent (kVA) Power over a user-specified interval (block or sliding window)
    d) Maximum (Peak) Real (kW), Reactive (kVAR) and Apparent (kVA) Demand Intervals
    e) Instantaneous Real (kW), Reactive (kVAR) and Apparent Power (kVA), by phase and in total
    f) Current (amps) for each phase and average of all phases
    g) Phase-to-phase voltage for each phase and average of all phase pairs
    h) Phase-to-neutral voltage for each phase pair and average of all phases
    i) Power factor for each phase and average of all phases
    j) AC frequency

3. The power meter shall communicate using the BACnet MS/TP protocol at speeds from 9600 to 115,200 baud (no parity). The meter shall provide a BACnet Device object, a set of writable Analog_Value objects for remote configuration, a set of Analog_Input objects to provide access to scaled 32-bit measurement values and their unit types, and a set of Binary_Input objects for indicating individual alarm conditions.

4. The meter shall be UL/CUL listed to the latest applicable safety standards.

5. Power meter models must be available to directly accept voltage input over the range of 90 to 600 VAC (50 or 60 Hz).

6. The power meter shall accept either 0 to 0.333 VAC or 0 to 1 VAC input from up to three current transducers to 32000 amps.

7. The measured energy consumption shall be retained in non-volatile memory for the life of the product warranty.

8. The power meter shall have demand measurement programmable for up to 6 sub-intervals of 10 seconds to 546 minutes duration.

9. Meter shall be optionally available in an outdoor NEMA 4X enclosure.

10. The power meter shall operate from -30C to +70C.

11. The power meter shall have dimensions not exceeding 4.2” x 3.6” x 2.3”.

12. The power meter shall be Veris E50H5 or equivalent.

13. The power meter shall meet both ANSI C12.20 0.5% and IEC 62053-22 Class 0.5S real power and energy accuracy specifications.

14. The power meter shall meet IEC 62053-22 Class 2 reactive power and energy accuracy specifications.

15. The power meter shall be configurable for operation on Single Phase (AN or AB), Split Phase (ABN), Delta (ABC), and Wye (ABCN) systems.

16. The power meter shall have automatic phase reversal compensation such that it is insensitive to the CT’s load orientation.

17. The power meter shall have separate control power inputs such that is may be powered from a different service than it measures.

18. The power meter shall have two user-configurable Pulse Contact inputs to support measurement of other related energy values (gas, water, steam, etc.) over BACnet using simple pulse-output transducers.

19. The power meter shall be configurable for use with potential transformers to 32000 volts.

20. The power meter shall calculate a maximum theoretical system power using the configuration parameters set by the user.

21. The power meter shall support warnings for low power factor (phase current or voltage miss-wired), current over range, voltage over range, and frequency out of range.

22. The power meter shall log and retain in non-volatile memory up to 5760 (up to 60 days at 15 minute intervals) measurement records at time intervals determined by the Demand Interval duration setting. These records shall contain any three 32-bit data values that the user selects from the list of supported Analog_Input objects. These logged data records shall be readable over BACnet via three Trend_Log objects.

23. The product shall have a 5-year warranty.

E50H2, E50H5

Compact Power and Energy Meters With BACnet MS/TP Support

E50H2 only

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Follow safe electrical work practices. See NFPA 70E in the USA, or applicable local codes.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Read, understand and follow the instructions before installing this product.
- Turn off all power supplying equipment before working on or inside the equipment.
- Product may use multiple voltage/power sources. Disconnect all sources of power before servicing.
- Use a properly rated voltage sensing device to confirm power is off. DO NOT DEPEND ON THIS PRODUCT FOR VOLTAGE INDICATION.
- Current transformer secondaries must be shorted or connected to a burden at all times.
- Products rated only for basic insulation must be installed on insulated conductors.
- Replace all doors, covers and protective devices before powering the equipment.

Failure to follow these instructions will result in death or serious injury.

A qualified person is one who has skills and knowledge related to the construction and operation of this electrical equipment and installations, and has received safety training to recognize and avoid the hazards involved. NEC2014 Article 100

No responsibility is assumed by Veris Industries for any consequences arising out of the use of this material.

Control system design must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to acheive a safe state during and after a path failure. Examples of critical control functions are emergency stop and over-travel stop.

WARNING

LOSS OF CONTROL

- Assure that the system will reach a safe state during and after a control path failure.
- Separate or redundant control paths must be provided for critical control functions.
- Test the effect of transmission delays or failures of communication links.[1]
- Each implementation of equipment using communication links must be individually and thoroughly tested for proper operation before placing it in service.

Failure to follow these instructions may cause injury, death or equipment damage.

[1]For additional information about anticipated transmission delays or failures of the link, refer to NEMA ICS 1.1 (latest edition). *Safety Guidelines for the Application, Installation, and Maintenance of Solid-State Control* or its equivalent in your specific country, language, and/or location.

NOTICE

- This product is not intended for life or safety applications.
- Do not install this product in hazardous or classified locations.
- The installer is responsible for conformance to all applicable codes.
- Mount this product inside a suitable fire and electrical enclosure.

FCC PART 15 INFORMATION

NOTE: This equipment has been tested by the manufacturer and found to comply with the limits for a class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

Modifications to this product without the express authorization of the manufacturer nullify this statement.

For use in a Pollution Degree 2 or better environment only. A Pollution Degree 2 environment must control conductive pollution and the possibility of condensation or high humidity. Consider the enclosure, the correct use of ventilation, thermal properties of the equipment, and the relationship with the environment. Installation category: CAT II or CAT III. Provide a disconnect device to disconnect the meter from the supply source. Place this device in close proximity to the equipment and within easy reach of the operator, and mark it as the disconnecting device. The disconnecting device shall meet the relevant requirements of IEC 60947-1 and IEC 60947-3 and shall be suitable for the application. In the US and Canada, disconnecting fuse holders can be used. Provide overcurrent protection and disconnecting device for supply conductors with approved current limiting devices suitable for protecting the wiring. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the device may be impaired.

Product Overview

The E50H2 and E50H5 DIN rail power meters provide a solution for measuring energy data with a single device. Inputs include control power, CT, and 3-phase voltage. Both models support BACnet MS/TP protocol. The E50H2 has one pulse contact input and a phase loss alarm output. The E50H5 has data logging capability and two pulse contact inputs. The LCD screen on the faceplate allows instant output viewing.

The meter is housed in a plastic enclosure suitable for installation on T35 DIN rail according to EN50022. It can be mounted with any orientation over the entire ambient temperature range, either on a DIN rail or in a panel. The E50Hx meters are not sensitive to CT orientation, reducing installation errors.

Product Identification

Model	BACnet MS/TP Protocol Output	Alarm Output	Full Data Set	Data Logging	Pulse Input
E50H2	●	●	●		●
E50H5	●		●	●	● (2 pulses)

Specifications

MEASUREMENT ACCURACY	
Real Power and Energy	IEC 62053-22 Class 0.2S, ANSI C12.20 0.2%
Reactive Power and Energy	IEC 62053-23 Class 2, 2%
Current	0.4% (+0.015% per °C deviation from 25°C) from 5% to 100% of range; 0.8% (+0.015% per °C deviation from 25°C) from 1% to 5% of range
Voltage	0.4% (+0.015% per °C deviation from 25°C) from 90V_{L-N} to 600VAC$_{L-L}$
Sample Rate	2520 samples per second
Data Update Rate	1 sec
Type of Measurement	True RMS up to the 21st harmonic 60 Hz; One to three phase AC system
INPUT VOLTAGE CHARACTERISTICS	
Measured AC Voltage	Minimum 90V_{L-N} (156V_{L-L}) for stated accuracy; UL Maximum: 600V_{L-L} (347V_{L-N}); CE Maximum: 300V_{L-N}
Metering Over-Range	+20%
Impedance	2.5 MΩ $_{L-N}$/5 MΩ $_{L-L}$
Frequency Range	45 to 65 Hz
INPUT CURRENT CHARACTERISTICS	
CT Scaling	Primary: Adjustable from 5 A to 32,000 A
Measurement Input Range	0 to 0.333 VAC or 0 to 1.0 VAC (+20% over-range), rated for use with Class 1 voltage inputs
Impedance	10.6 kΩ (1/3 V mode) or 32.1 kΩ (1 V mode)

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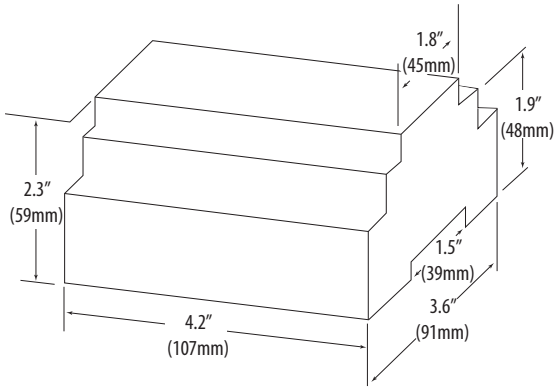
Specifications (cont.)

CONTROL POWER	
AC	5 VA max.; 90V min. UL Maximum: 600V_{L-L} (347V_{L-N}); CE Maximum: 300V_{L-N}
DC*	3 W max.; UL and CE: 125 to 300VDC
Ride Through Time	100 msec at 120VAC
INPUT	
Pulse	Solid-state or mechanical contacts (current less than 1 mA); E50H2: 1 pulse input; E50H5: 2 pulse inputs
Minimum Pulse Width	20 msec
OUTPUT	
Alarm Contacts (E50H2 only)	N.C., static output; (30VAC/DC, 100mA max.@25°C, derate 0.56mA per °C above 25°C)
RS-485 Port	2-wire, 9600 to 115.2 kbaud, BACnet MS/TP
MECHANICAL CHARACTERISTICS	
Weight	0.62 lb (0.28 kg)
IP Degree of Protection (IEC 60529)	IP40 front display; IP20 Meter
Display Characteristics	Back-lit blue LCD
Terminal Block Screw Torque	0.37 to 0.44 ft-lb (0.5 to 0.6 N·m)
Terminal Block Wire Size	24 to 14 AWG (0.2 to 2.1 mm^2)
Rail	T35 (35mm) DIN Rail per EN50022
OPERATING CONDITIONS	
Operating Temperature Range	-30° to 70°C (-22° to 158°F)
Storage Temperature Range	-40° to 85°C (-40° to 185°F)
Humidity Range	<95% RH noncondensing
Altitude of Operation	3000 m
COMPLIANCE INFORMATION	
US and Canada	CAT III, Pollution degree 2; for distribution systems up to 347V_{L-N} /600VAC_{L-L}
CE	CAT III, Pollution degree 2; for distribution systems up to 300V_{L-N}
Dielectric Withstand	Per UL 508, EN61010
Conducted and Radiated Emissions	FCC part 15 Class B, EN55011/EN61000 Class B (residential and light industrial)
Conducted and Radiated Immunity	EN61000 Class A (heavy industrial)
US and Canada (cULus)	UL508 (open type device)/CSA 22.2 No. 14-05
Europe (CE)	EN61010-1

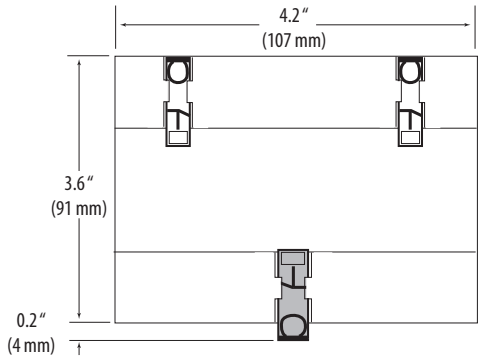
** External DC current limiting is required, see fuse recommendations.*

Table of Contents

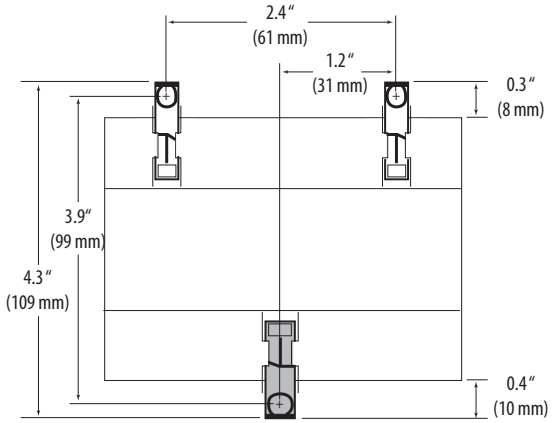
Dimensions



Bottom View (DIN Mount Option)



Bottom View (Screw Mount Option)



Data Outputs

Full Data Set (FDS):

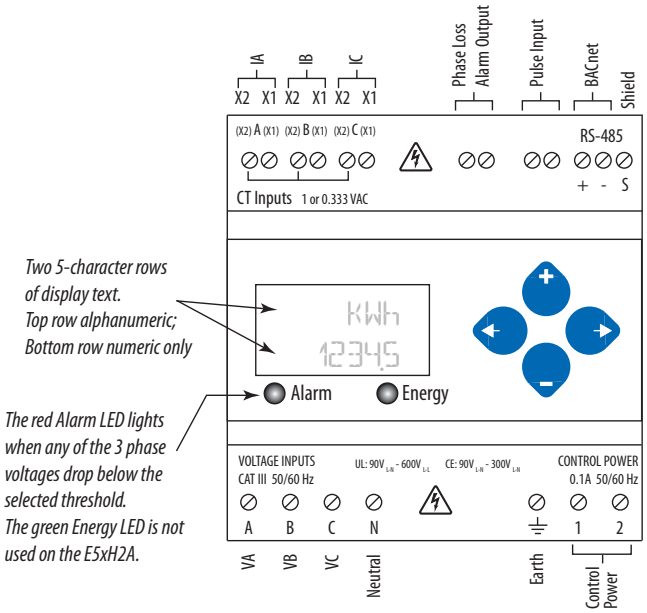
Power (kW)
Energy (kWh)
Configurable for CT & PT ratios, system type, and passwords
Diagnostic alerts
Current: 3-phase average
Volts: 3-phase average
Current: by phase
Volts: by phase Line-Line and Line-Neutral
Power: Real, Reactive, and Apparent 3-phase total and per phase
Power Factor: 3-phase average and per phase
Frequency
Power Demand: Most Recent and Peak
Demand Configuration: Fixed, Rolling Block, and External Sync
Real Time Clock: uses BACnet Time Synchronization services

Data Logging (E50H5 only; includes all FDS outputs, plus):

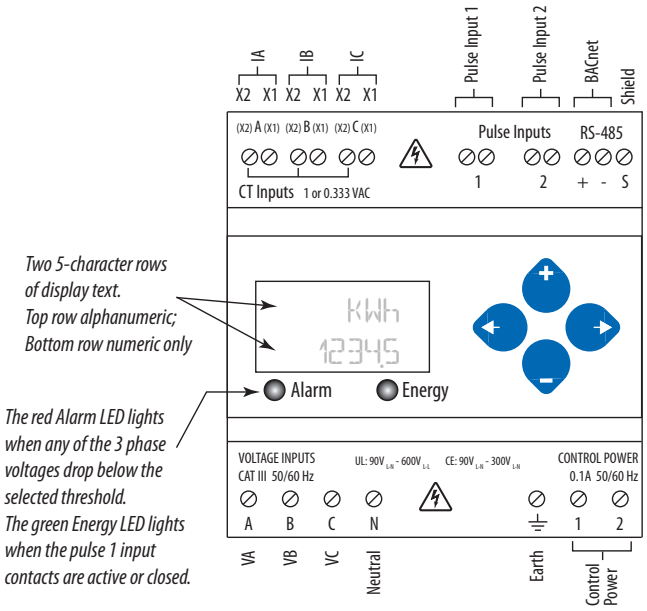
3 BACnet Log_Events: each buffer holds 5760 time-stamped 32-bit entries
(User configures which 3 data points are stored in these buffers)
User configurable logging interval
(When configured for a 15 minute interval, each buffer holds 60 days of data)
Continuous and Single Shot logging modes: user selectable

Product Diagrams

E50H2

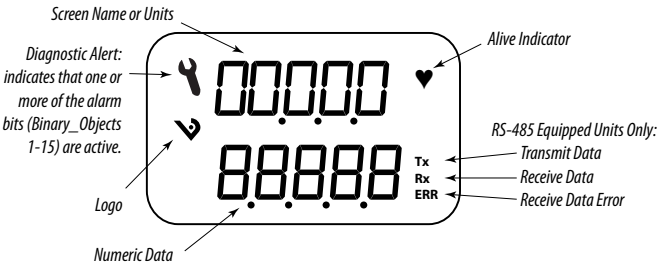


E50H5

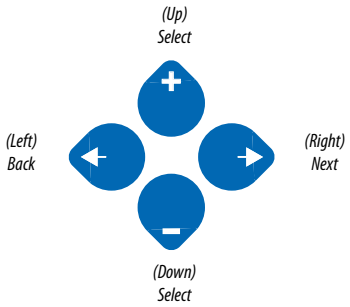


Display Screen Diagram

LCD Screen:



Buttons:



Installation

Disconnect power prior to installation.

Reinstall any covers that are displaced during the installation before powering the unit.

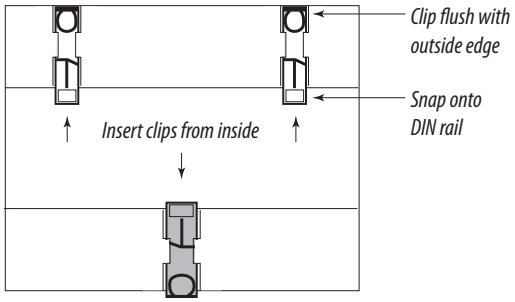
Mount the meter in an appropriate electrical enclosure near equipment to be monitored.

Do not install on the load side of a Variable Frequency Drive (VFD), aka Variable Speed Drive (VSD) or Adjustable Frequency Drive (AFD).

The meter can be mounted in two ways: on standard 35 mm DIN rail or screw-mounted to the interior surface of the enclosure.

A. DIN Rail Mounting

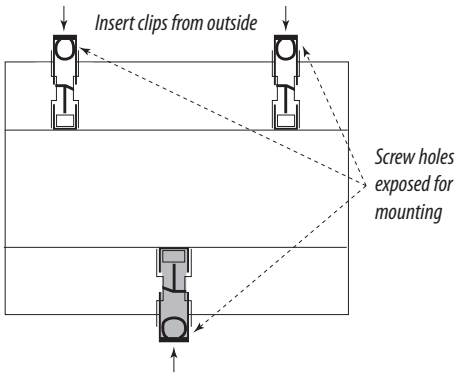
1. Attach the mounting clips to the underside of the housing by sliding them into the slots from the inside. The stopping pegs must face the housing, and the outside edge of the clip must be flush with the outside edge of the housing.
2. Snap the clips onto the DIN rail. See the diagram of the underside of the housing (below).



3. To reduce horizontal shifting across the DIN rail, use two Veris AV02 end stop clips.

B. Screw Mounting

1. Attach the mounting clips to the underside of the housing by sliding them into the slots from the outside. The stopping pegs must face the housing, and the screw hole must be exposed on the outside of the housing.
2. Use three #8 screws (not supplied) to mount the meter to the inside of the enclosure. See the diagram of the underside of the housing (below).



Supported System Types

The E50HxA power meters have a number of different possible system wiring configurations (see Wiring section). To configure the meter, set the System Type via the User Interface or by writing the Present_Value of AV2 with the System Type value in the table below. The System Type tells the meter which of its current and voltage inputs are valid, which are to be ignored, and if neutral is connected. Setting the correct System Type prevents unwanted energy accumulation on unused inputs, selects the formula to calculate the Theoretical Maximum System Power, and determines which phase loss algorithm is to be used. The phase loss algorithm is configured as a percent of the Line-to-Line System Voltage (except when in System Type 10) and also calculates the expected Line to Neutral voltages for system types that have Neutral (12 & 40).

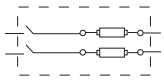
Values that are not valid in a particular System Type display as "----" on the User Interface or as QNAN in the BACnet objects.

	CTs		Voltage Connections			System Type		Phase Loss Measurements			Wiring Diagram
Number of wires	Qty	ID	Qty	ID	Type	BACnet object AV2	User Interface: SETUP>S SYS	VLL	VLN	Balance	Diagram number
Single-Phase Wiring											
2	1	A	2	A, N	L-N	10	1L + 1n		AN		1
2	1	A	2	A, B	L-L	11	2L	AB			2
3	2	A, B	3	A, B, N	L-L with N	12	2L + 1n	AB	AN, BN	AN-BN	3
Three-Phase Wiring											
3	3	A, B, C	3	A, B, C	Delta	31	3L	AB, BC, CA		AB-BC-CA	4
4	3	A, B, C	4	A, B, C, N	Grounded Wye	40	3L + 1n	AB, BC, CA	AN, BN, CN	AN-BN-CN & AB-BC-CA	5, 6

Wiring Symbols

To avoid distortion, use parallel wires for control power and voltage inputs.

The following symbols are used in the wiring diagrams on the following pages.

Symbol	Description
	Voltage Disconnect Switch
	Fuse (installer is responsible for ensuring compliance with local requirements. No fuses are included with the meter.)
	Earth ground
	Current Transducer
	Potential Transformer
	Protection containing a voltage disconnect switch with a fuse or disconnect circuit breaker. The protection device must be rated for the available short-circuit current at the connection point.

CAUTION

RISK OF EQUIPMENT DAMAGE

- **This product is designed only for use with 1V or 0.33V current transducers (CTs).**
- **DO NOT USE CURRENT OUTPUT (e.g. 5A) CTs ON THIS PRODUCT.**
- **Failure to follow these instructions can result in overheating and permanent equipment damage.**

Wiring

⚠ WARNING

RISK OF ELECTRIC SHOCK OR PERMANENT EQUIPMENT DAMAGE

CT negative terminals are referenced to the meter's neutral and may be at elevated voltages

- Do not contact meter terminals while the unit is connected
- Do not connect or short other circuits to the CT terminals

Failure to follow these instructions may cause injury, death or equipment damage.

Diagram 1: 1-Phase Line-to-Neutral 2- Wire System 1 CT

Use System Type 10 (1L + 1n)

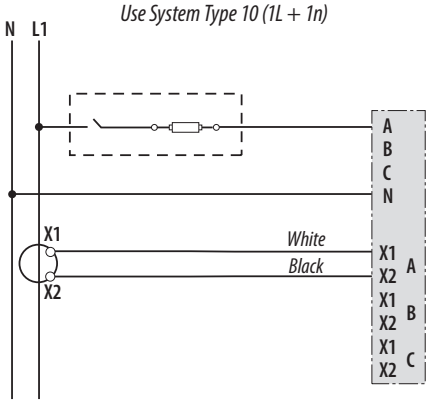


Diagram 2: 1-Phase Line-to-Line 2-Wire System 1 CT

Use System Type 11 (2L)

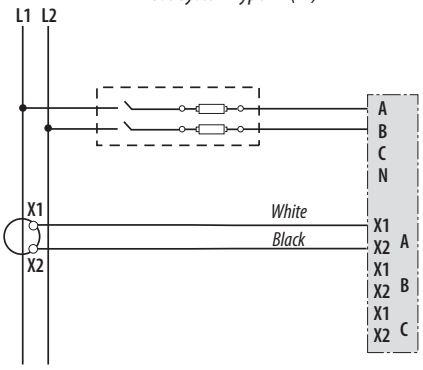


Diagram 3: 1-Phase Direct Voltage Connection 2 CT

Use System Type 12 (2L + 1n)

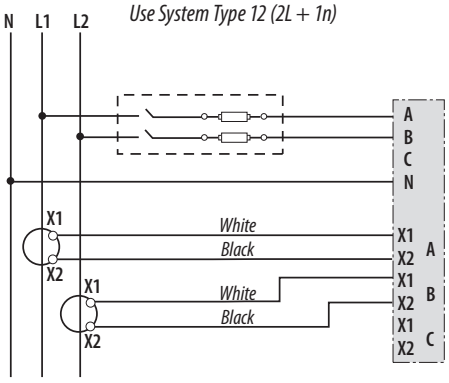


Diagram 4: 3-Phase 3-Wire 3 CT no PT

Use System Type 31 (3L)

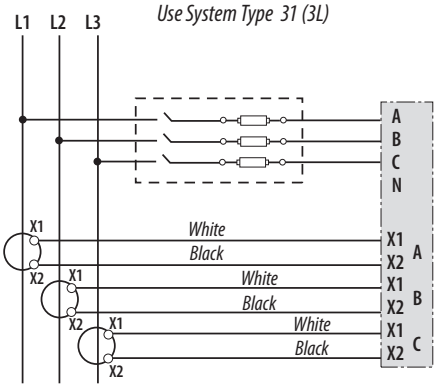


Diagram 5: 3-Phase 4-Wire Wye Direct Voltage Input Connection 3 CT

Use System Type 40 (3L + 1n)

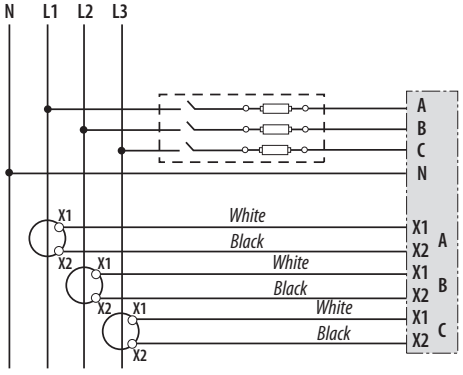
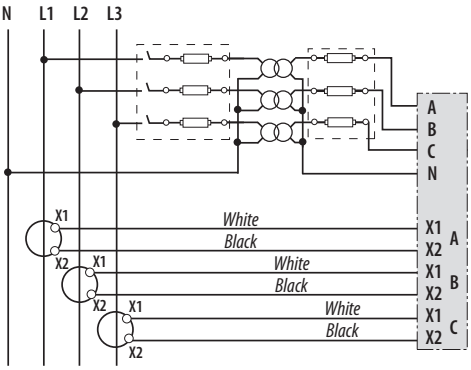


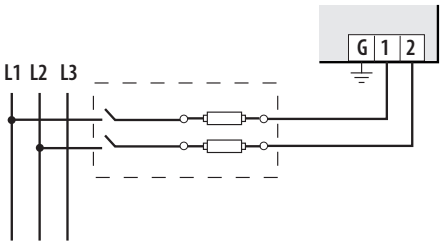
Diagram 6: 3-Phase 4-Wire Wye Connection 3 CT 3 PT

Use System Type 40 (3L + 1n)



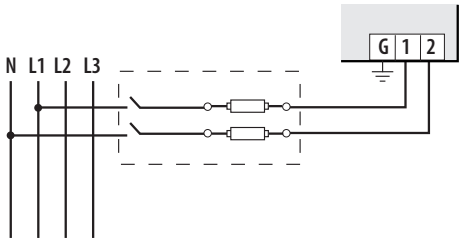
Control Power

Direct Connect Control Power (Line to Line)



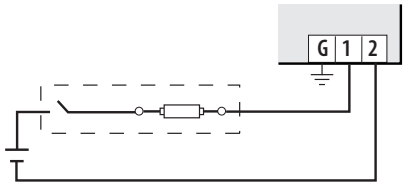
Line to Line from 90 VAC to 600 VAC (UL). In UL installations the lines may be floating (such as a delta). If any lines are tied to an earth (such as a corner grounded delta), see the Line to Neutral installation limits. In CE compliant installations, the lines must be neutral (earth) referenced at less than 300 VAC_{L-N}

Direct Connect Control Power (Line to Neutral)



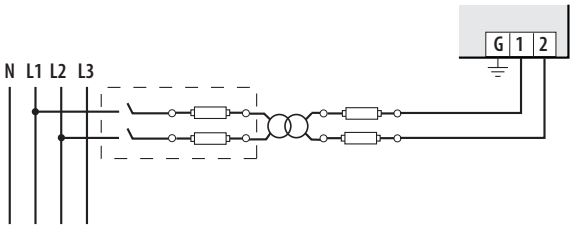
Line to Neutral from 90 VAC to 347 VAC (UL) or 300 VAC (CE)

Direct Connect Control Power (DC Control Power)



DC Control Power from 125 VDC to 300 VDC (UL and CE max.)

Control Power Transformer (CPT) Connection



The Control Power Transformer may be wired L-N or L-L. Output to meet meter input requirements

Fuse Recommendations

Keep the fuses close to the power source (obey local and national code requirements).

For selecting fuses and circuit breakers, use the following criteria:

- Select current interrupt capacity based on the installation category and fault current capability.
- Select over-current protection with a time delay.
- Select a voltage rating sufficient for the input voltage applied.
- Provide overcurrent protection and disconnecting means to protect the wiring. For AC installations, use Veris AH02, AH03, AH04, or equivalent. For DC installations, provide external circuit protection. Suggested: 0.5 A, time delay fuses.
- The earth connection (G) is required for electromagnetic compatibility (EMC) and is not a protective earth ground.

Quick Setup Instructions

Use this section to enter:

- BACnet communication parameters

- CT (Current Transducer) output voltage and input current ranges

- The service type to be monitored

These instructions assume the meter is set to factory defaults. If it has been previously configured, check all optional values.

A. To Navigate to the Setup screens:

1. Press ⊕ or ⊖ repeatedly until SETUP screen appears.
2. Press → to get to the PASWD screen.
3. Press → to move through the digits. Use the ⊕ or ⊖ buttons to enter your password (the default is 00000).
4. Press → to move to the first Setup screen (S BAC)
5. Use ⊕ or ⊖ to select the parameter screen you want to set.
6. After you set the parameters you want, use ⊕ or ⊖ to select the next Setup screen or ← to exit the Setup screens (return to SETUP).

B. To Enter BACnet communication parameters

1. Navigate to the S BAC (set BACnet) Setup screen (see section A above).
2. Press → to go to the MAC screen and through the address digits. Use ⊕ or ⊖ to select the BACnet MAC address (default is 001).
3. Press → to accept the value and go to the KBAUD screen. Use ⊕ or ⊖ to select the baud rate (default is 76.8K).
4. Press → to go to the ID1 screen and through the upper four digits of the Device Instance. Use ⊕ or ⊖ to select the ID digits. The setup screen splits the Device ID into two parts, the most significant four digits (ID1) and the least significant three digits (ID2). The E50Hx supports BACnet Device ID values from 1 to 4,193,999. Units are shipped with a factory default setting that is pseudo-randomly generated in the range from 1,000,000 to 3,097,151.
5. Press → to accept the value and go to the ID2 screen and through the lower three digits of the Device Instance. Use ⊕ or ⊖ to select the ID digits.
6. Press → to accept the value and go back to the S BAC screen.

C. To Enter the CT (Current Transducer) output voltage and input current ranges:

1. Navigate to the S CT (Set Current Transducer) Setup screen (see section A above).
2. Press → to go to the CT V screen. Use ⊕ or ⊖ to select the voltage mode Current Transducer output voltage (default is 1.00).
3. Press → to go to the CT SZ screen and through the digits. Use ⊕ or ⊖ to select the CT size in amps (default is 100). accept the value and
4. Press → to accept the value and go back to the S CT screen.

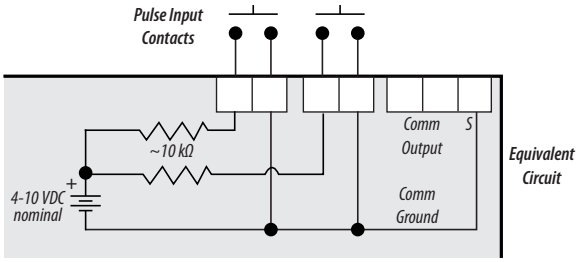
D. To Enter the service type to be monitored:

1. Navigate to the S SYS (Set System) Setup screen (see section A above).
2. Press → to go to the SYSTM screen. Use ⊕ or ⊖ to select the configuration (see wiring diagrams - default is 3LN-1N).
3. Press → to go back to the S SYS screen.

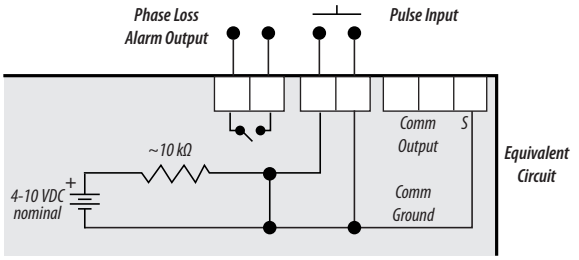
For full setup instructions, see the configuration instructions on the following pages.

Pulse Contact Input

The E50H5 has two inputs with pulse accumulators for solid state or mechanical contacts in other sensors, such as water or gas flow meters. These inputs are isolated from the measured circuits and referenced to the communication signal ground. Use with contacts that do not require current to remove oxidation.



The E50H2 has one input with pulse accumulator as described above, and one phase loss alarm output terminal.



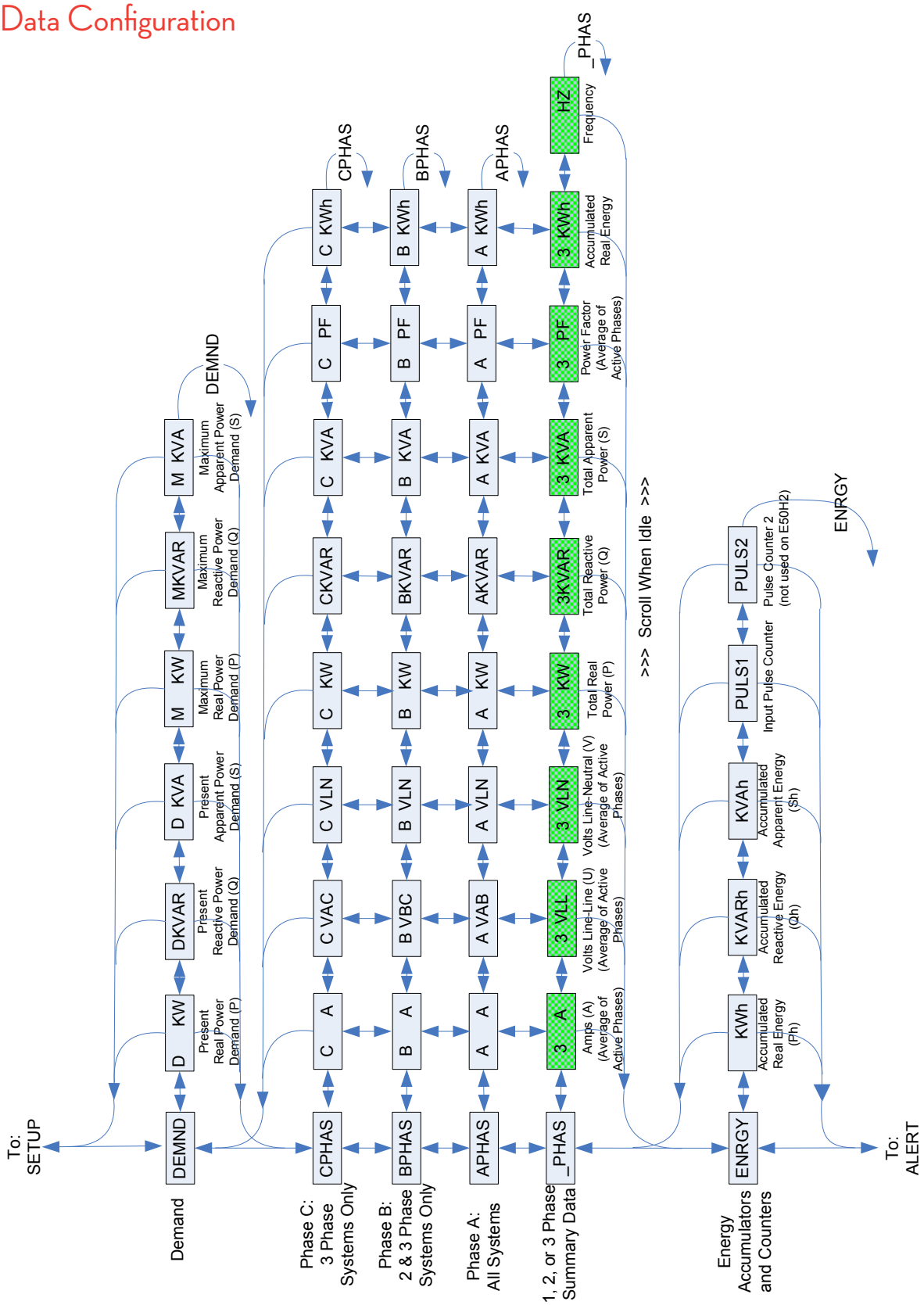
User Interface (UI) Menu Abbreviations Defined

The user can set the display mode to either IEC or IEEE notation in the SETUP menu.

Main Menu		
IEC	IEEE	Description
D	D	Demand
MAX	M	Maximum Demand
P	W	Present Real Power
Q	VAR	Present Reactive Power
S	VA	Present Apparent Power
A	A	Amps
UAB, UBC, UAC	VAB, VBC, VAC	Voltage Line to Line
V	VLN	Voltage Line to Neutral
PF	PF	Power Factor
U	VLL	Voltage Line to Line
HZ	HZ	Frequency
KSh	KVAh	Accumulated Apparent Energy
KQh	KVARh	Accumulated Reactive Energy
KPh	KWh	Accumulated Real Energy
PLOSS	PLOSS	Phase Loss
LOWPF	LOWPF	Low Power Factor Error

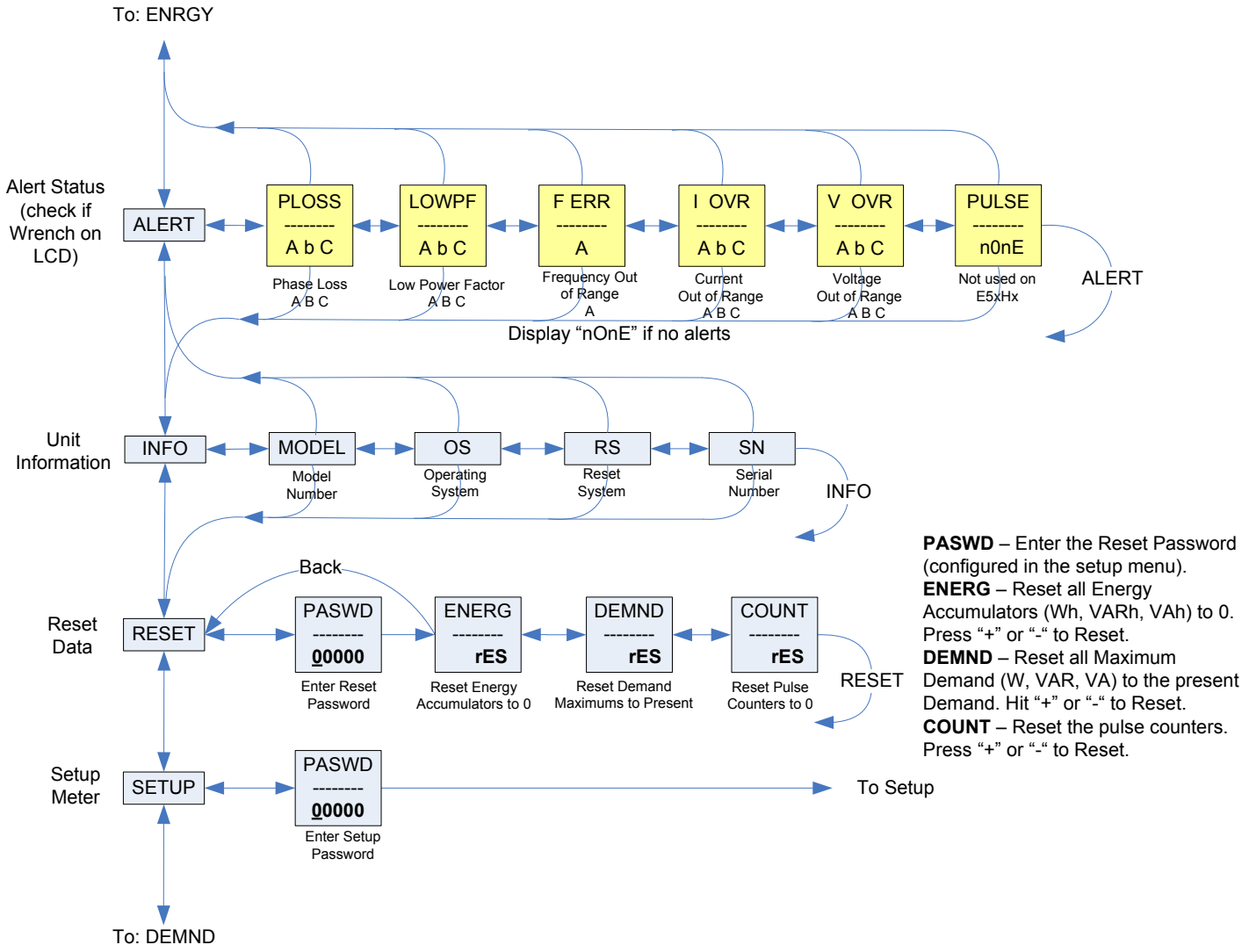
Main Menu		
IEC	IEEE	Description
F ERR	F ERR	Frequency Error
I OVR	I OVR	Over Current
V OVR	V OVR	Over Voltage
PULSE	PULSE	kWh Pulse Output Overrun (configuration error)
_PHASE	_PHASE	Summary Data for 1, 2, or 3 active phases
ALERT	ALERT	Diagnostic Alert Status
INFO	INFO	Unit Information
MODEL	MODEL	Model Number
OS	OS	Operating System
RS	RS	Reset System
SN	SN	Serial Number
RESET	RESET	Reset Data
PASWD	PASWD	Enter Reset or Setup Password
ENERG	ENERG	Reset Energy Accumulators
DEMND	DEMND	Reset Demand Maximums

User Interface for Data Configuration



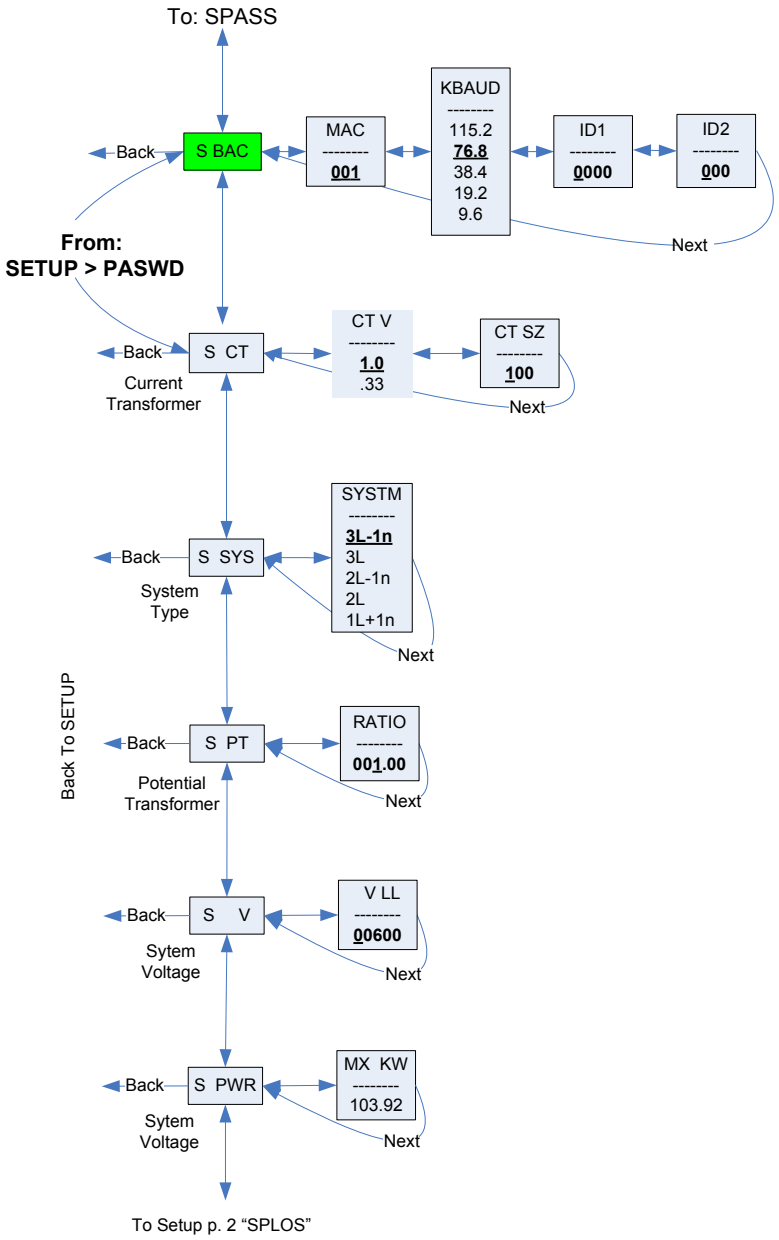
The units for all Power and Energy screens change to preserve resolution as the accumulated totals increase. For example, energy starts out as Wh, then switches to kWh, MWh, and eventually GWh as the accumulated value increases.

Alert/Reset Information



PASWD – Enter the Reset Password (configured in the setup menu).
ENERG – Reset all Energy Accumulators (Wh, VARh, VAh) to 0. Press "+" or "-" to Reset.
DEMND – Reset all Maximum Demand (W, VAR, VA) to the present Demand. Hit "+" or "-" to Reset.
COUNT – Reset the pulse counters. Press "+" or "-" to Reset.

UI for Setup



Set Communications Parameters:
ADDR – BACnet MS/TP MAC Address: 0 – 127.
+ increments the selected (blinking) digit.
– selects the digit to the left.
BAUD - Baud Rate: 9600 – 115200 Baud
BACnet ID: These two screens set the 7 digit BACnet device ID. Screen ID1 is the most significant 4 digits and ID2 the least significant three digits. This is in the range of 0 - 4,194,302.

Set Current Transducer:
CT V - CT Input Voltage: + or **–** to Select 1.0 or .33V.
CT SZ - CT Size: in Amps. Maximum is 32000 Amps.

Set System Configuration:
SYSTM: **+** or **–** to step through the following System Type options:

System	Reg 130	CTs	Description
3L-1n	40	3	Wye Three Phase: A, B, & C with Neutral (Default).
3L	31	3	Delta Three Phase: A, B & C; no Neutral
2L-1n	12	2	Single Split Phase: A & B with Neutral
2L	11	1	Single Phase: A & B; no Neutral
1L-1n	10	1	Single Phase: A to Neutral

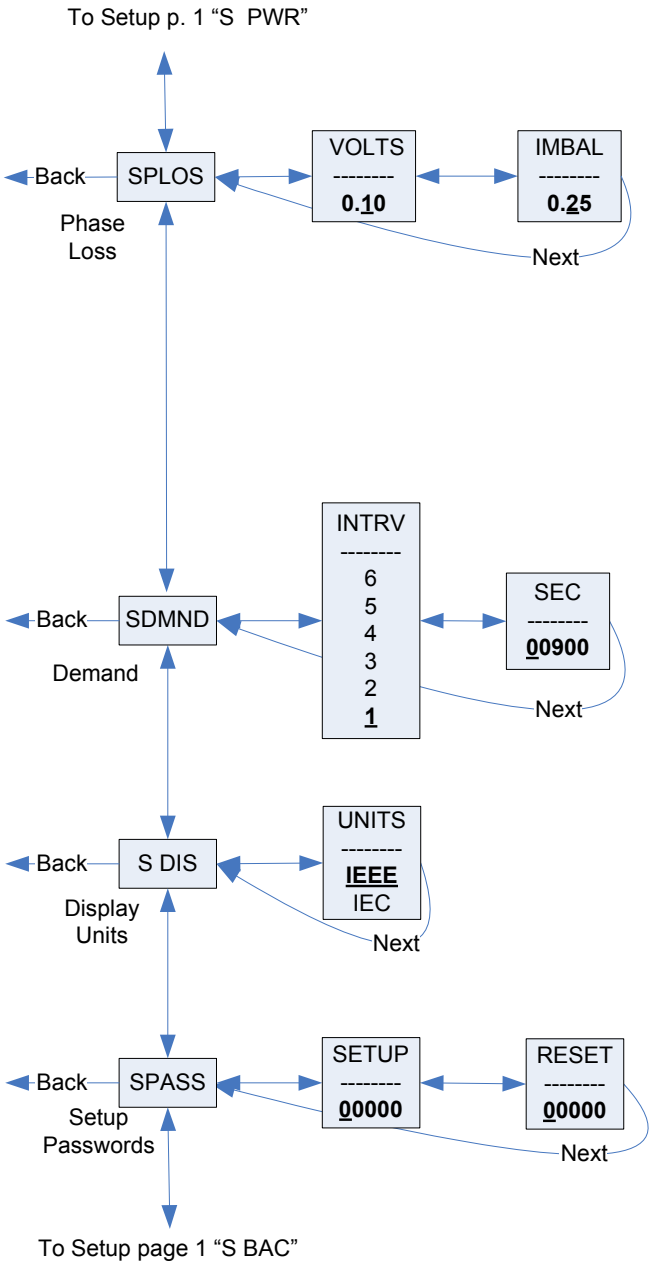
Set Potential Transfomer Ratio:
RATIO – Potential transformer step down is RATIO:1. Default is 1:1 (No PT installed). See Install for wiring diagrams. This value must be set before the System Voltage (if used).

Set System Voltage:
V LL – The nominal Line to Line Voltage for the system. This is used by the meter to calculate the theoretical maximum system power, and as the reference voltage for setting the Phase Loss threshold. Maximum is 32000 Volts. For system type 1+N (10), this is a Line to Neutral Voltage, indicated by "V LN". Note: the meter will reject settings that are not within the meter's operating range when divided by the PT ratio.

System Power:
MX KW – The theoretical Maximum System Power is calculated by the meter from the System Voltage, CT size, and System Type. Power Factor is assumed to be unity. The value of System Power is used to determine which combinations of pulse weight and duration are valid and will keep up with the maximum power the meter will see. This value is read only.

Note: **Bold** is the Default.

UI for Setup (cont.)



Set Phase Loss:
VOLTS - Phase Loss Voltage: The fraction of the system voltage below which Phase Loss Alarm is on. For system types with neutral, the Line to Neutral voltage is also calculated and tested. If the System Voltage is 600 and the fraction is set to 0.10, then the Phase Loss threshold will be 60 volts.
IMBAL - Phase Loss Imbalance: The fractional difference in Line to Line voltages above which Phase Loss Alarm is on. For system types with neutral, the Line to Neutral voltages are also tested. For system types 1+N (10) and 2 (11) , imbalance is not tested.

Set Demand Interval:
INTRV - The number of Sub-Intervals (1 to 6) in a Demand Interval**.** Default is 1 (block demand).
SEC - Sub-Interval length in seconds. Default is 900 (15 minutes). Set to 0 for external sync-to-comms.

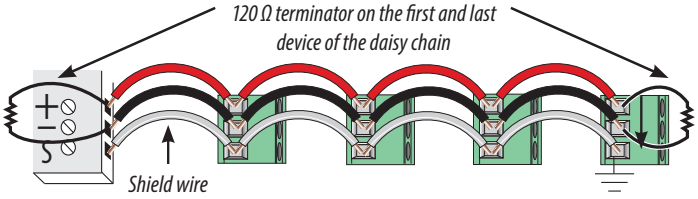
Set Display Units: +/- to switch between:
IEEE – VLL VLN W VAR VA Units.
IEC - U V P Q S Units.

Set Passwords:
SETUP - The Password to enter the SETUP menu.
RESET - The Password to enter the RESET menu.

RS-485 Communications

Daisy-chaining Devices to the Power Meter

The RS-485 slave port allows the power meter to be connected in a daisy chain with up to 63 2-wire devices.

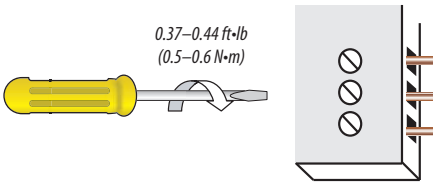


Notes

- The terminal's voltage and current ratings are compliant with the requirements of the EIA RS-485 communications standard.
- The RS-485 transceivers are ¼ unit load or less.
- RS-485+ has a 47 kΩ pull up to +5V, and RS-485- has a 47 kΩ pull down to Shield (RS-485 signal ground).
- Wire the RS-485 bus as a daisy chain from device to device, without any stubs. Use 120 Ω termination resistors at each end of the bus (not included).
- Shield is not internally connected to Earth Ground.
- Connect Shield to Earth Ground somewhere on the RS-485 bus.

For all terminals:

- When tightening terminals, apply the correct torque: 0.37 to 0.44 ft·lb (0.5-0.6 N·m).
- Use 14-24 gauge (2.1-0.2 mm^2) wire.



BACnet Default Settings

Setting	Default Value*	BACnet Object
Setup Password	00000	n/a
Reset Password	00000	n/a
System Type	40 (3 + N) Wye	AV2
CT Primary Ratio	100A	AV3
CT Secondary Ratio	1V	AV4
PT Ratio	1:1 (none)	AV5
System Voltage	600 V L-L	AV6
Max. Theoretical Power	Calculated from AV2, AV3, AV5 & AV6 (with all default settings, this would be 103.92 kW)	AI45
Display Mode	1 (IEEE Units)	AV7
Phase Loss Voltage Threshold	10% of System Voltage	AV8
Phase Loss Voltage Threshold	25% Phase to Phase Imbalance	AV9
Demand: number of subintervals per interval	1 (block mode)	AV10
Demand: sub-interval length	900 sec (15 min) (AV11 default value is 90000 [1/100 seconds])	AV11
BACnet MAC Address	001	n/a
BACnet MS/TP Baud Rate	76.8 kBaud	n/a
BACnet MS/TP Max_Master	127	Device
BACnet Device_ID	Pseudo-random value from 1,000,000 to 3,097,151	Device
BACnet Device Location	Installed location not yet identified	Device
Trend_Log Object 1 Log_Device_Object_ Property **	AI1 (Real Energy)	TL1
Trend_Log Object 2 Log_Device_Object_ Property **	AI27 (Reactive Energy)	TL2
Trend_Log Object 3 Log_Device_Object_ Property **	AI34 (Total Real Present Demand)	TL3

** Default values are preset at the factory. Once changed, there is no way to automatically reset defaults. They must be restored individually. The baud rate and MAC address are set through the user-interface screens, and the others are set by re-writing each Object (see BACnet Programming Information section, next page).*

*** These values are available only on the E50H5. The E50H2 does not support the data logging functions.*

BACnet Programming Information

The E50Hx is programmable via BACnet protocol and can easily be connected to a BACnet MS/TP network using an off-the shelf BACnet router. It uses five types of BACnet objects. A standard PICS (below) describes the required characteristics of the BACnet implementation, but this additional descriptive context may be helpful to the integrator.

In addition to the required properties, the device object utilizes some optional properties to support other functionality, Time Synchronization (primarily used for data/trend logging on the device) and Description and Location properties to simplify installation and maintenance. Configure all of the meter's functions, other than Data Logging and writable Device Properties, by writing the Present_Value of the 11 Analog_Value objects. These values (except for the configuration register, AV1, which always returns zero when read) are all readable and stored in nonvolatile memory so that they are retained if power to the device is interrupted.

Data values other than log information and alerts are all accessed by reading the Present_Value of the 52 Analog_Input objects. Most of these values are instantaneous readings of measured service parameters. Some of them, (AI1, AI26, AI27, AI37-AI45, AI47, AI50 and AI51) represent accumulated values and are stored in nonvolatile memory as well. If power to the device is interrupted, these values are retained, but no additional information accumulates until the device completes its re-initialization.

Alerts are used to indicate conditions of potential concern to the installer or the system, such as input voltage or current on any phase that exceeds the meter's measurement range, phase voltage below the Phase Loss Threshold set by the user, or Power Factor below 0.5 on any phase. Alerts are accessible individually by reading the Present_Value of the Binary_Input objects or as a group by reading the Present_Value of Analog_Input object 52. Alerts are not latched and do not generate events to system. They indicate presence of these conditions at the time they are read, but the device does not latch and store them until they are read (if the condition changes before they are read, the alert will go away).

All Analog_Value, Analog_Input, and Binary_Input objects implement the reliability property and use it to indicate that the Present_Value properties are functional, valid and current. For complete assurance, check the Reliabilty property for a No_Fault_Detected status before reading the Present_Value of any AV, AI or BI objects.

The E50H5 includes data logging capability, which is implemented using three Trend_Log objects. These are described in more detail in the section on data logging.

BACnet Protocol Implementation Conformance Statement (PICS)

Date:	January 1, 2013
Vendor Name:	Veris Industries, LLC
Product Name:	E50Hx Energy Meter
Product Model Number:	E50Hx
Applications Software Version:	1
Firmware Revision:	x.xxx
BACnet Protocol Revision:	4
Product Description:	3-phase electrical energy meter

BACnet Standardized Device Profile (Annex L): BACnet Application Specific Controller (B-ASC)

List all BACnet Interoperability Building Blocks Supported (Annex K): DS-RP-B, DS-RPM-B, DS-WP-B, DM-DDB-B, DM-DOB-B, DM-DCC-B, T-VMT-I-B (E50H5 only),
DM-TS-B, DM-RD-B

Segmentation Capability: Segmentation not supported

BACnet Programming Information (cont.)

Standard Object Types Supported: No dynamic Creation or Deletion supported; no proprietary properties or object types

1. Device Object:

   Optional Properties Supported: Max_Master, Max_Info_Frames, Description, Location, Local_Time, Local_Date
   Writable Properties: Object_Identifier, Object_Name, Max_Master, Location
   Property Range Restrictions: Object_Identifier – May only write values from 1 to 4,193,999; Location – (limited to 64 characters); Max_Master – May only write values from 1 to 127

2. Analog_Input Objects:

   Optional Properties Supported: Description, Reliability
   No Writable Properties.

3. Analog_Value Objects:

   Optional Properties Supported: Description, Reliability
   Writable Properties: Only the Present_Value is writable.
   Property Range Restrictions:
   AV1: May only write 30078, 21211, 21212 and 16498.
   AV2: May only write 10, 11, 12, 31 and 40.
   AV3: May only write values from 5 to 32000.
   AV4: May only write values 1 and 3.
   AV5: May only write values from 0.01 to 320.0
   AV6: May only write values such that AV6/AV5 is from 82 to 660 (absolute range is 82-32000). To ensure AV6 accepts/rejects the proper values, set AV5 first.
   AV7: May only write values 0 and 1.
   AV8: May only write values from 1 to 99.
   AV9: May only write values from 1 to 99.
   AV10: May only write values from 1 to 6.
   AV11: May only write the value 0 or a value from 1000 to 3276700 in multiples of 100.
   The Record_Count of the Trend_Logs (TL1 to TL3) is reset when this object is written (E50H5 only).

4. Binary_Input Objects:

   Optional Properties Supported: Description, Reliability
   No Writable Properties

5. Trend_Log Objects (E50H5 only):

   Optional Properties Supported: Description,
   Writable Properties: Log_Enable, Start_Time, Stop_Time, Log_DeviceObjectProperty, Log_Interval, Stop_When_Full, Record_Count
   Property Range Restrictions:
   Log_DeviceObjectProperty: May only be set to the Present_Value of local objects AI1 through AI75 (only the Present_Value of objects AI1 through AI75 may be logged).
   Log_Interval: May only write the value 0 or values from 1000 to 3276700 in multiples of 100.

Data Link Layer Options: MS/TP master (Clause 9), baud rate(s): 9600, 19200, 38400, 76800, 115200

Device Address Binding: Static device binding is not supported. (No client functionality is included).

Networking Options: None

Character Sets Supported: ANSI X3.4

BACnet Programming Information (cont.)

Legend

R/W R=read only; R/W=read or write

NV Value is stored in non-volatile memory. The value are still available if the meter experiences a power loss and reset.

Units Lists the physical units that a register holds.

Device Object

Property	R/W	NV	Value Returned	Additional information
Object_Identifier	R/W	NV	Device<n>	n is the 7 digit ID # set in the ID1 & ID2 setup screens on the meter. The BACnet Device ID is a decimal number from 1 to 4,193,999 that can be entered or viewed on the user screens or through this property. The default value set at the factory is a psuedo-random number from 1,000,000 to 3,097,151 to reduce the likelihood of conflicts if multiple units are installed using their default IDs.
Object_Type	R	NV	Device (8)	
Object_Name	R	NV	Veris E50 Series Energy Meter - S/N: <serial number>	
Vendor_Name	R	NV	Veris Industries, LLC	
Vendor_Identifier	R	NV	133	
Model_Name	R	NV	E50Hx Energy Meter	
Firmware_Revision	R	NV	<Current Revision #>	"xyyy". This is the BACnet processor firmware version in the format <xyyy>, with an implied decimal point between the first two digits (x.yyy)
Application_Software_ Version	R	NV	<Current version #>	"RS= xyyy, OS=xyyy, BACnet Gateway=xyyy" The format <xyyy> has an implied decimal point between the first two digits (x.yyy)
Location	R/W	NV	<Location>	Limted to 64 Characters - Default value is "Installed location not yet identified"
Description	R	NV	Veris E50Hx DIN-Rail Energy Meter S/N: <serial number>	
Protocol_Version	R	NV	1	BACnet Protocol Version 1
Protocol_Revsion	R	NV	4	BACnet Protocol Revision 4
Local_Date	R		Date	Set via BACnet Time Synchronization only - reverts to Jan 1, 2000 if control power drops
Local_Time	R		Time	Set via BACnet Time Synchronization only - reverts to 12:00:00 AM if control power drops
Segmentation_Supported	R	NV	NO_SEGMENTATION (3)	Segmentation is not supported
Max_Master	R/W	NV	1-127 (Factory Default is 127)	Highest possible MAC Address for Master nodes on the local MS/TP network
Max_Info_Frames	R	NV	1	Maximum number of information frames allowed before passing the MS/TP token
Max_APDU_Length_Accepted	R	NV	480	
APDU_Timeout	R	NV	60000	
Number_of_APDU_Retries	R	NV	0	
System_Status	R	NV	Operational (0)	
Protocol_Sevices_Supported	R	NV	0b00000000000010110100000000000000 011110000	
Protocol_Object_Types_Supported	R	NV	0b10110000100000000000010000000000	

BACnet Programming Information (cont.)

Property	R/W	NV	Value Returned	Additional information
Object_List	R	NV	DE1,AI1,AI2,AI3,AI4,AI5,AI6,AI7,AI8,AI9,AI10,AI11,AI12,AI13,AI14,AI15,AI16,AI17,AI18,AI19,AI20,AI21,AI22,AI23,AI24,AI25,AI26,AI27,AI28,AI29,AI30,AI31,AI32,AI33,AI34,AI35,AI36,AI37,AI38,AI39,AI40,AI41,AI42,AI43,AI44,AI45,AI46,AI47,AI48,AI49,AI50,AI51,AI52,AV1,AV2,AV3,AV4,AV5,AV6,AV7,AV8,AV9,AV10,AV11,BI1,BI2,BI3,BI4,BI5,BI6,BI7,BI8,BI9,BI10,BI11,BI12,BI13,BI14,BI15,TL1,TL2,TL3	BI15, TL1, TL2, and TL3 are present in the E50H5 only.
Device_Address_Binding	R	NV	{}	
Database_Revsion	R	NV	0	

Analog_Value Objects

Use the Present_Value property of the Analog_Value object for all writable variables in the meter other than those used specifically for BACnet configuration, Time Synchronization (in the Device Object), or Data Logging (in the Trend_Log objects).

Values are checked when written, and errors are returned for invalid entries. This table describes how the meter uses those variables, what values are valid, and what their defaults are. When writing values to the Present_Value properties of Analog_Value BACnet objects, there is a delay of up to about two seconds to validate and store the new value. An immediate read of the same property before that delay has elapsed can return the prior value (even if the new value was accepted). To read a value immediately after writing it, check the Reliability property first. When it reports a No_Fault_Detected status, the Present_Value of the object is current.

These objects support the Description and Reliability object properties and all required Analog_Value object properties, but Present_Value is the only writable property.

#	Name	Description	R/W	NV	Units	Range	Factory Default Value	Additional information
AV1	Config	Configuration	R/W		n/a	n/a	Always returns "0" when read	Command Register: - Write 30078 (0x757E) to clear all energy accumulators to 0 (All). - Write 21211 (0x52DB) to begin new Demand Sub-Interval calculation cycle and log another data value on Trend_Log objects TL1-TL3 (when the meter is in Manual "Sync-to Comms" mode). This takes effect at the end of the next 1 second calculation cycle. Write no more frequently than every 10 seconds. Trend_Log values are only present on the E50H5 model. - Write 21212 (0x52DC) to reset Max Demand values to Present Demand Values. Takes effect at the end of the next 1 second calculation cycle. Write no more frequently than every 10 seconds. - Write 16498 (0x4072) to clear pulse counters to 0.
AV2	System_Type	System Type	R/W	NV	n/a	40, 31, 12, 11, 10	40	System_Type: - Write 10 for Single-Phase: A + N - Write 11 for Single-Phase: A + B - Write 12 for Split-Phase: A + B + N - Write 31 for 3-Phase Δ: A + B + C, no N - Write 40 for 3-Phase Y: A + B + C + N
AV3	CT_Ratio_ Primary	CT Ratio - Primary	R/W	NV	Amps	5-32000	100	Current Transducer Size - Primary Current Range (Default is set for 100 A CTs)
AV4	CT_Ratio_ Secondary	CT Ratio - Secondary	R/W	NV	1/Volts	1,3	1	Current Transducer Type – Secondary Interface - Enter 1 for CTs with 1V outputs (Default) - Enter 3 for CTs with 1/3V outputs
AV5	PT_Ratio	PT Ratio	R/W	NV	Value	0.01 - 320.0	1	Potential Transformer Ratio - The default is 1.00 (1:1), which is no PT attached. Set this value before setting the System Voltage (below).

BACnet Programming Information (cont.)

#	Name	Description	R/W	NV	Units	Range	Factory Default Value	Additional information
AV6	System_ Voltage	System Voltage	R/W	NV	Volts	from 82 (times the PT_Ratio in AV5) to 660 (times the PT_Ratio in AV5 - absolute limits are 82-32000)	600	System Voltage – This voltage is Line to Line unless in System Type 10 (in object AV2), in which case it is Line to Neutral. This value is used to by the meter to calculate the full scale power for the analog outputs and pulse configuration (see below), and as full scale for phase loss (in object AV8). Do not set the meter to voltages outside the range of 82-660 volts times the PT Ratio in object AV5.
AV7	Display_ Units	Display Units	R/W	NV	n/a	0,1	1	Display Units: 0 = IEC (U, V, P, Q, S), 1 = IEEE (default: VLL, VLN, W, VAR, VA)
AV8	Phase_Loss_ Voltage_ Threshold	Phase Loss Voltage Threshold	R/W	NV	Percent	1-99	10	Phase Loss Voltage Threshold in percent of System Voltage (in object AV6). Default is 10 (10%). Any phase (as configured in AV2) whose level drops below this threshold triggers a Phase Loss alert - i.e. if the System voltage is set to 480 V L-L, the L-N voltage for each phase should be 277 V. When the threshold is set to 10%, if any phase drops more than 10% below 277 V, (less than 249 V), or if any L-L voltage drops more than 10% below 480 V (less than 432 V) the corresponding phase loss alarm bit will be true.
AV9	Phase_Loss_ Imbalance_ Threshold	Phase Loss Imbalance Threshold	R/W	NV	Percent	1-99	25	Phase Loss Imbalance Threshold in Percent. Default is 25% phase to phase difference. For a 3-phase Y (3 + N) system type (40 in object AV2), both Line to Neutral and Line to Line voltages are tested. In a 3-phase Δ System type (31 in object AV2), only Line to Line voltages are examined. In a single split-phase (2 + N) system type (12 in object AV2), only the line to neutral voltage are compared.
AV10	Subintervals	Number Subintervals Per Demand Interval	R/W	NV		1-6	1	Number of Sub-Intervals per Demand Interval. Sets the number of sub-intervals that make a single demand interval. For block demand, set this to 1. Default is 1. When Sub-Interval Length (in object AV11) is set to 0 (sync-to-comms mode), the meter ignores this value.
AV11	Subinterval_ Length	Subinterval Length	R/W	NV	hundreths of a second	0, 10-32767	90000	Sub-Interval Length in hundredths of a second. For sync-to-comms mode, which allows manual triggerring of demand intervals and the logging of another Trend_Log record, set this value to 0 and write 21211 to the reset register (object AV1) each time the sub-interval must be externally reset. Default is 90000 (15 minutes). This variable is tied directly to the Log_Interval property of all three Trend_Log objects (their value is always the same as this one). Changing any of these four properties changes all of them. Trend_Log values are only used on the E50H5 model.

BACnet Programming Information (cont.)

Analog_Input Objects

Use the Present_Value property of the Analog_Input objects for all read-only numeric variables in the meter other than those used specifically for device configuration (in the Device Object) or data logging (in the Trend_Log objects). Only the E50H5 supports the data logging capability.

These objects support the Description and Reliability object properties and all required Analog_Input object properties. None of them are writable. The values that are not instantaneous (i.e., Accumulated Energy, Max Demand, Pulse Input Counts) are non-volatile. They are not updated while control power is inactive, but their past values are retained when power is restored. The Present_Value of the accumulated data objects (AI1, AI26-AI27 and AI42-AI44) use floating-point data types (all AI objects use floating point data points). The resolution of the accumulated values decreases as the value grows larger over time and more of the significant digits precede the decimal point. If the size of the value limits the resolution unacceptably, read and store the current value offline and reset the accumulators to restore finer resolution.

For complete assurance, check the Reliabilty property for a No_Fault_Detected status before reading the Present_Value. If the line voltage or input frequency of the system being monitored falls out of the supported range, the corresponding alert bits (BI1-BI7) are set and the reliability property of any values that cannot be accurately measured under those conditions returns Unreliable_Other.

#	Object_Name	Description	R/W	NV	Units	Range	Additional information
AI1	Energy	Real Energy Consumption	R	NV	kWh	0 - 3.4+E38	
AI2	kW_Total	Total Real Power	R		kW	0 - Max_Power (AI45)	
AI3	kVAR_Total	Total Reactive Power	R		kVAR	0 - Max_Power (AI45)	
AI4	kVA_Total	Total Apparent Power	R		kVA	0 - Max_Power (AI45)	
AI5	PF_Total	Total Power Factor	R		Power Factor	0.00 - 1.00	1.00 for 100%
AI6	Volts_LL_Avg	Voltage L-L Average	R		Volts		
AI7	Volts_LN_Avg	Voltage L-N Average	R		Volts		
AI8	Current_Avg	Current Average	R		Amps		
AI9	kW_A	Real Power Phase A	R		kW	0 - Max_Power (AI45)	
AI10	kW_B	Real Power Phase B	R		kW	0 - Max_Power (AI45)	
AI11	kW_C	Real Power Phase C	R		kW	0 - Max_Power (AI45)	
AI12	PF_A	Power Factor Phase A	R		Power Factor	0.00 - 1.00	1.00 for 100%
AI13	PF_B	Power Factor Phase B	R		Power Factor	0.00 - 1.00	1.00 for 100%
AI14	PF_C	Power Factor Phase C	R		Power Factor	0.00 - 1.00	1.00 for 100%
AI15	Volts_AB	Votlage Phase A-B	R		Volts		
AI16	Volts_BC	Voltage Phase B-C	R		Volts		
AI17	Volts_AC	Voltage Phase A-C	R		Volts		
AI18	Volts_AN	Voltage Phase A-N	R		Volts		
AI19	Volts_BN	Voltage Phase B-N	R		Volts		
AI20	Volts_CN	Voltage Phase C-N	R		Volts		
AI21	Current_A	Current Phase A	R		Amps		
AI22	Current_B	Current Phase B	R		Amps		
AI23	Current_C	Current Phase C	R		Amps		
AI24	Reserved_AI24	Reserved	R		n/a		Returns QNAN or any value
AI25	Frequency	Frequency	R		Hz	45.0-65.0	Returns QNAN if frequency is out of range (or no voltage input present on Phase A)

BACnet Programming Information (cont.)

#	Object_Name	Description	R/W	NV	Units	Range	Additional information
AI26	kVAh	Apparent Energy Consumption	R	NV	kVAh	0 - 3.4+E38	The UNITS property of object AI26 reports that these units are kWh because there is no unit type in the BACnet standard for kVAh.
AI27	kVARh	Reactive Energy Consumption	R	NV	kVARh	0 - 3.4+E38	The UNITS property of object AI27 reports that these units are kWh because there is no unit type in the BACnet standard for kVARh.
AI28	kVA_A	Apparent Power Phase A	R		kVA	0 - Max_Power (AI45)	
AI29	kVA_B	Apparent Power Phase B	R		kVA	0 - Max_Power (AI45)	
AI30	kVA_C	Apparent Power Phase C	R		kVA	0 - Max_Power (AI45)	
AI31	KVAR_A	Reactive Power Phase A	R		kVAR	0 - Max_Power (AI45)	
AI32	KVAR_B	Reactive Power Phase B	R		kVAR	0 - Max_Power (AI45)	
AI33	KVAR_C	Reactive Power Phase C	R		kVAR	0 - Max_Power (AI45)	
AI34	KW_Present_ Demand	Total Real Power Present Demand	R		kW	0 - Max_Power (AI45)	
AI35	KVAR_Present_ Demand	Total Reactive Power Present Demand	R		kVAR	0 - Max_Power (AI45)	
AI36	KVA_Present_ Demand	Total Apparent Power Present Demand	R		kVA	0 - Max_Power (AI45)	
AI37	KW_Max_ Demand	Total Real Power Maximum Demand	R	NV	kW	0 - Max_Power (AI45)	This retains the largest value measured for Total Real Power Demand (AI34) for any single demand interval since the Max Demand was last explicitly reset via AV1 (this is also reset when the demand interval is changed).
AI38	KVAR_Max_ Demand	Total Reactive Power Maximum Demand	R	NV	kVAR	0 - Max_Power (AI45)	This retains the largest value measured for Total Reactive Power Demand (AI35) for any single demand interval since the Max Demand was last explicitly reset via AV1 (this is also reset when the demand interval is changed).
AI39	KVA_Max_ Demand	Total Apparent Power Maximum Demand	R	NV	kVA	0 - Max_Power (AI45)	This retains the largest value measured for Total Apparent Power Demand (AI36) for any single demand interval since the Max Demand was last explicitly reset via AV1 (this is also reset when the demand interval is changed).
AI40	E50H2: Pulse Count E50H5: Pulse_ Count_1	E50H2: Pulse Count E50H5: Pulse Count #1	R	NV	#	0 - 4294967040	Running count of contact closures on Pulse1 input since last reset. Write 16498 (0x4072) to the Present_Value property of Analog_Value object AV1 to reset both Pulse Counters to 0.
AI41	E50H2: Reserved E50H5: Pulse_ Count_2	E50H2: Reserved E50H5: Pulse Count #2	R	NV	#	0 - 4294967040	E50H2: Reserved E50H5: Pulse Count 2; Running count of contact closures on Pulse2 input since last reset. Write 16498 (0x4072) to the Present_Value property of Analog_Value object AV1 to reset both Pulse Counters to 0.
AI42	KWH_A	Real Energy Consumption Phase A	R	NV	kWh	0 - 3.4+E38	
AI43	KWH_B	Real Energy Consumption Phase B	R	NV	kWh	0 - 3.4+E38	

BACnet Programming Information (cont.)

#	Object_Name	Description	R/W	NV	Units	Range	Additional information
AI44	KWH_C	Real Energy Consumption Phase C	R	NV	kWh	0 - 3.4+E38	
AI45	Max_Power	Theoretical Maximum System Power	R	NV	kW	0 - 1.84467e19	Theoretical Maximum System Power – This is the theoretical maximum power the meter expects to see on a service. It is calculated by the meter from the System Type (in object AV2), CT Size (in object AV3), and System Voltage (in object AV6) - Power Factor is assumed to be unity. The register is updated whenever the user changes any of these parameters.
AI46	Reserved_AI46	Reserved	R				Returns QNAN or any value
AI47	Energy Resets	Count of Energy Accumulator Resets	R	NV		0 - 32767	Running count of how many times the energy counter has been reset
AI48	Reserved_AI48	Reserved	R				Returns QNAN or any value
AI49	Reserved_AI49	Reserved	R				Returns QNAN or any value
AI50	Power Up Count	Power Up Counter	R	NV		0 - 32767	Running count of product power-up cycles (Control Power)
AI51	Ouput Config	Ouput Configuration	R	NV		0 - 15	E50H2 returns "11" E50H5 returns "10"
AI52	Alarm_Bitmap	Alarm_Bitmap	R			0 - 32767	This contains a decimal value that represents the status of all Binary_Object alert values in one number that can be read without having to access mulitple objects (the E50H2 has 14 values, the E50H5 has 15). It is a decimal representation of a 14-bit or 15-bit hexidecimal value produced by combining the alert bits into one number, where the bit value of Object BI1 is the least significant bit and BI14 or BI15 is the most significant bit.

Binary_Input Objects

Use the Present_Value properties of the Binary_Input objects as alerts for conditions of potential concern regarding to the system measurement. These values are dynamic and are not latched, so if the condition is resolved, the alert will go inactive, whether it has been read or not.

These objects support the Description and Reliability object properties and all required Binary_Input object properties. None of them are writable. For complete assurance, check the Reliabilty property for a No_Fault_Detected status before reading the Present_Value.

To test the meter's alert status, read the Present_Value of each of the Binary_Input objects representing the alert bits of interest, or read the Present_Value of AI52, which combines all these bits into a single decimal value. AI52 represents the status of all 14 or 15 Binary_Object alert values in one number that can be read without having to access mulitple objects. The bit value of Object BI1 is the least significant bit and BI14 or BI15 is the most significant bit (BI15 is only present on the E50H5).

#	Name	Description	R/W	Range	Additional information
BI1	Volts_Error_A	Voltage Out of Range Phase A	R	0=INACTIVE, 1=ACTIVE	Phase A Input Voltage exceeds meter's measurement range
BI2	Volts_Error_B	Voltage Out of Range Phase B	R	0=INACTIVE, 1=ACTIVE	Phase B Input Voltage exceeds meter's measurement range
BI3	Volts_Error_C	Voltage Out of Range Phase C	R	0=INACTIVE, 1=ACTIVE	Phase C Input Voltage exceeds meter's measurement range
BI4	Current_Error_A	Current Out of Range Phase A	R	0=INACTIVE, 1=ACTIVE	Phase A Current out of range
BI5	Current_Error_A	Current Out of Range Phase B	R	0=INACTIVE, 1=ACTIVE	Phase B Current out of range
BI6	Current_Error_A	Current Out of Range Phase C	R	0=INACTIVE, 1=ACTIVE	Phase C Current out of range
BI7	Frequency_Error	Frequency Error	R	0=INACTIVE, 1=ACTIVE	Phase A Frequency out of range
BI8	Reserved_BI8	Reserved	R	0=INACTIVE, 1=ACTIVE	Returns "INACTIVE"

BACnet Programming Information (cont.)

#	Name	Description	R/W	Range	Additional information
BI9	Phase_Loss_A	Phase Loss Phase A	R	0=INACTIVE, 1=ACTIVE	Phase Loss - Phase A voltage dropped below the Phase Loss Threshold set by user
BI10	Phase_Loss_B	Phase Loss Phase B	R	0=INACTIVE, 1=ACTIVE	Phase Loss - Phase B voltage dropped below the Phase Loss Threshold set by user
BI11	Phase_Loss_C	Phase Loss Phase C	R	0=INACTIVE, 1=ACTIVE	Phase Loss - Phase C voltage dropped below the Phase Loss Threshold set by user
BI12	Power_Factor_A	Low Power Factor Phase A	R	0=INACTIVE, 1=ACTIVE	Phase A Power Factor less than 50% (commonly due to mis-wiring of CTs/PTs to meter)
BI13	Power_Factor_B	Low Power Factor Phase B	R	0=INACTIVE, 1=ACTIVE	Phase B Power Factor less than 50% (commonly due to mis-wiring of CTs/PTs to meter)
BI14	Power_Factor_C	Low Power Factor Phase C	R	0=INACTIVE, 1=ACTIVE	Phase C Power Factor less than 50% (commonly due to mis-wiring of CTs/PTs to meter)
BI15	RTC_Reset (E50H5 only)	RTC Reset	R	0=INACTIVE, 1=ACTIVE	Real-Time Clock reset. This activates when the meter is powered after an interruption (since it does not use a battery backup). It indicates that the real-time clock has re-initialized to a default setting (00:00:00:00 on Jan 1, 2000) and should not be relied upon. The clock runs, the meter operates and even logs data (E50H5A only), but the date and time are not correct until a Time_Synchronization occurs.

Data Logging (E50H5 only)

The E50H5 includes a data logging feature that records three meter parameters, accessible via BACnet using Trend_Log objects. All three Trend_Log objects utilize shared data logging resources in the meter, so all three are controlled in unison. All writable properties other than Log_Device_Property_Object are common to all three Trend_Log obects. Changes to these properties (Log_Enable, Start_Time, Stop_Time, Log_Interval, Stop_When_Full or Record Count) for any one of the objects will be reflected in the corresponding property of all three objects. The Log_Interval property is also common with the Demand_Subinterval (Present_Value of AV11), since logging records are updated synchronously with demand calculations.

Default settings cause logging to begin immediately, with 15 minute intervals and no stop time. When full, the buffer will wrap and overwrite the oldest data first (unless the Stop_When_Full property is used).

Configuration:

Use Log_Device_Object_Property to select the meter parameter to log with each object. Set this property to point to Present_Value property of any of the Analog_Input objects. The default the values for the Log_Device_Object_Property of the three Trend_Log objects are set as follows:

- TL1 = Real Energy Consumption (AI1 Present_Value)
- TL2 = Reactive Energy Consumption (AI27 Present_Value)
- TL3 = Total Real Power Present Demand (AI34 Present_Value)

The Log_Interval (& Demand Subinterval) can be set from 10 seconds to 32767 seconds (values of 1000 to 3276700). The subinterval timer, which determines how often the meter's demand accumulators are updated, also triggers writing to the Trend_Log log buffers. Use the Log_Interval property to set the data logging time subinterval, in units of hundredths of a second (0.01 seconds). The default subinterval is 15 minutes (a value of 90000 in the Log_Interval property). The Buffer_Length is fixed at 5760, so at a 15 minute interval setting, the buffers hold 60 days of data.

Use the Stop_When_Full property to select either Single Shot (Stop_When_Full = TRUE) or Continuous mode (Stop_When_Full = FALSE) for data logging. The default mode is Continuous. In Single Shot mode, the meter records data only until the buffer is full. Data for this time period is kept, but newer energy information is lost. In Continuous mode, the meter continues to record energy data as long as the meter is operating. The buffer can only hold 5760 entries at one time, however, so when the number of records exceeds 5760, the oldest entry is deleted to make room for the newest.

To start data logging with any of the three Trend_Log objects, set the Log_Enable property to TRUE or set the Start_Time and Stop_Time properties appropriately and wait for logging to commence at Start_Time.

BACnet Programming Information (cont.)

By default, the Record_Count property of the Trend_Log objects is initialized to Zero.

Reading Data:

Access logged data with corresponding timestamps via the Log_Buffer property of the Trend_Log object using the BACnet ReadRange service. The E50H5 supports both the "by Position" and "by Sequence Number" modes of the ReadRange service, but not the "by Time" mode.

Trend_Log Objects

Trend_Log Properties Used	R/W	Units	Additional information
Object_Name	R	Trend_Log_<n>	Where n is 1-3 (there are three instances of Trend_Log objects available)
Description	R	Trend_Log <n>	Where n is 1-3 (there are three instances of Trend_Log objects available)
Log_Enable	W	Binary	Set this to TRUE to enable logging or FALSE to disable logging. The default is TRUE. The value is set to FALSE internally if logging stops for other reasons (i.e. buffer is full).
Start_Time	W	Date/Time	Sets the Date/Time when data logging will Start (if Log_enable is TRUE). Set to a Date/Time earlier than the Local_Date/Local_Time properites of the Device object and Set Log_Enable TRUE to start logging immediately.
Stop_Time	W	Date/Time	Sets the Date/Time when data Logging will STOP (if still running). Stop_Time will be ignored if "wildcard" values are used in any of the fields.
Log_Device_Object_ Property	W	BACnetDeviceObjectProptertyReference	Set (point) this to the Present_Value of any of objects AI1 through AI49 to establish which parameter to log. Default values are: TL1 = Real Energy Consumption (Array of AI1 Present_Value) TL2 = Reactive Energy Consumption (Array of AI27 Present_Value) TL3 = Total Real Power Present Demand (Array of AI34 Present_Value)
Log_Interval	W	0.01 seconds	Logging period in hundredths of a second. Default is 90000 (15 minute intervals); minimum value is 1000 (10 seconds). This property can also be set to Zero, which changes all three Trend_Logs and the Demand calculation to a manual mode (sometimes referred to as "Sync to Comms"). In manual mode, the demand interval is updated and another record is logged upon a manual command, which is issued by writing the value 21211 to the Present_Value of object AV1.
Stop_When_Full	W	Binary	Set this to TRUE to stop logging when the buffer is full (single-shot mode) or FALSE to continue when full (wrap & overwtrite oldest data entries).
Buffer_Size	R	5760	Length of Log Data buffer (# of records).
Log_Buffer	R	List of BACnetLongRecord	Contains the data values logged, with timestamps
Record_Count	W	Unsigned 32-bit integer	This is an integer count of how many records logged since the Trend_Log objects were last reset. Writing a Zero to this property resets the logs of all three objects. This value defaults to Zero, but, by default, logging starts automatically at 15 minute intervals.
Total_Record_Count	R	Unsigned 32-bit integer	This is an integer count of how many records logged since the Trend_Log objects were created (the factory state of the meter). This count is unaffected by resetting the Record Count or by power failures.
Event_State	R	Binary	

Troubleshooting

Problem	Cause	Solution
The maintenance wrench icon appears in the power meter display.	There is a problem with the inputs to the power meter.	See the Alert sub-menu or the Diagnostic Alert BACnet Binary_Input objects
The display is blank after applying control power to the meter.	The meter is not receiving adequate power.	Verify that the meter control power is receiving the required voltage. Verify that the heart icon is blinking. Check the fuse.
The data displayed is inaccurate.	Incorrect setup values	Verify the values entered for power meter setup parameters (CT and PT ratings, system type, etc.). See the Setup section.
	Incorrect voltage inputs	Check power meter voltage input terminals to verify adequate voltage.
	Power meter is wired improperly.	Check all CTs and PTs to verify correct connection, PT polarity, and adequate power. See the Wiring Diagrams section for more information.
Cannot communicate with power meter from a remote personal computer.	Power meter address is incorrect.	Verify that the meter is correctly addressed. See the Setup section.
	Power meter baud rate is incorrect.	Verify that the baud rate of the meter matches that of all other devices on its communications link (see Setup section).
	Communications lines are improperly connected.	Verify the power meter communications connections. See the Communications section. Verify the terminating resistors are properly installed on both ends of a chain of units. Do not use a terminator on units in the middle of a chain. Verify shield ground connection between all units.

China RoHS Compliance Information (EFUP Table)

部件名称	产品中有毒有害物质或元素的名称及含量Substances					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯(PBB)	多溴二苯醚(PBDE)
电子线路板	X	0	0	0	0	0

0 = 表示该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T11363-2006 标准规定的限量要求以下.

X = 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006标准规定的限量要求.

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