

3333 BROADWAY

3333 Broadway
New York, NY 10031

As-Built July 2020

Submitted to:

Frontier Energy
2695 Bingley Road
Cazanovia, NY 13035

Submitted by:

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Measurement & Verification Plan for CHP System at 3333 Broadway

1. Introduction

Tecogen, Inc. (Tecogen) provided equipment to support the installation of a combined heat and power (CHP) system at 3333 Broadway. The site is receiving an incentive from NYSERDA, of which the first two milestones have been paid out in full. The CHP system includes five (5) INV-e+ 100kW engine generator units. The system was installed as an N+1 installation, so the design is around four (4) units operating. The inverter-based system is intended to produce a gross output of 400 kW and recover engine jacket water and exhaust heat recovery for:

- a) Pre-heating the space heating hot water loop which in turn heats:
 - i. DHW heating
 - ii. Common and Residential Corridor Space Heating

The CHP system will provide power in parallel with the existing utility service, as well as the capabilities to operate in island-mode and provide backup power during an outage scenario.

2. Instrumentation

In order to quantify the performance of the CHP system, the CHP system fuel input, net electrical output, and useful thermal output will be measured. To capture that data, Tecogen supplied the meters and instrumentation listed in **Table 1 on page 4**.

Data Logger

Readings for the installed instrumentation are recorded by a CHPInsight datalogger provided by Tecogen and installed by MMI. The computer samples all sensors approximately once per 30 seconds and records the information. The readings of heat recovery temperatures and flow rates will be used to provide an accurate calculation of heat transfer on the heat recovery loops, which are all continuous flow loops. Based on the number of monitored data points, the logger will have sufficient memory to store 3-days of data if communications with the logger are interrupted.

The data will be downloaded from CHPInsight once per day via an Internet connection provided by the Site. The data will be loaded into a Tecogen database for long term storage and checked for validity.

Onsite Installation

MMI installed a CHPInsight panel in the cogen room right next to the CHP units. The monitoring system panel is approximately 2 ft x 16 in x 10 in. The panel is supplied with 120 VAC power (it requires 1 amp or less). The panel is conveniently located relative to the sensors listed above as well as the communications line provided by the site.

Communications

The CHPInsight has a connection to the Internet. An IP address has been supplied. The logger uploads data every night to the Tecogen servers, is compiled into a csv file, and then distributed on an annual basis and provided to NYSERDA based on their monitoring requirements.

Measurement & Verification Plan for CHP System at 3333 Broadway

On Site Support

The facility has assisted in providing a network connection for the CHPInsight. MMI is responsible for providing a complete monitoring installation. Tecogen will support trips to verify sensors or service the monitoring system.

Table 1. Overview of CHP System Monitoring Instrumentation

Data Point	Tecogen Label	Description	Units	Instrument / Sensor	Output Type	Location
P _{NET}	EM-1	Generator NET Electrical Output	kW/ kWh	Veris E50C2	ModBus	Electric Room
P _{OUT1}	INV1	Generator Gross Electrical Output	kW/ kWh	InVerde SN 301025	On-Board	CHP Room
P _{OUT2}	INV1	Generator Gross Electrical Output	kW/ kWh	InVerde SN 301026	On-Board	CHP Room
P _{OUT3}	INV1	Generator Gross Electrical Output	kW/ kWh	InVerde SN 301027	On-Board	CHP Room
P _{OUT4}	INV1	Generator Gross Electrical Output	kW/ kWh	InVerde SN 301028	On-Board	CHP Room
P _{OUT5}	INV1	Generator Gross Electrical Output	kW/ kWh	InVerde SN 301029	On-Board	CHP Room
G _{IN}	GM-1	Net Generator Fuel Input	CF	3M Roots Meter	Pulse	Building side of the new service
T _{OUT1}	BTU-S1	Engine Heating Module Supply Temperature	°F	Onicon System-10	ModBus	Existing Boiler/CHP Room
T _{RET1}	BTU-R1	Engine Heating Module Return Temperature	°F	Onicon System-10	ModBus	Existing Boiler/CHP Room
F _{NET1}	BTU-1	Engine Heating Module System Flow	GPM	Onicon System-10	ModBus	Existing Boiler/CHP Room
Q _{NET1}	BTU-1	CHP Engine Heat Supplied	BTUh	Onicon System-10	ModBus	Existing Boiler/CHP Room

3. Data Analysis

The collected data listed in Table 1 on page 4 will be used to determine the net power output of the system as well as the fuel conversion efficiency (FCE).

Peak Demand or Peak kW

The peak electric output or demand for each power reading will be taken as the average kW in a fixed 15-minute interval (0:00, 0:15, 0:30, etc.), defined as:

Measurement & Verification Plan for CHP System at 3333 Broadway

$$kW = \frac{\sum_{15 \text{ min}} kWh}{\Delta T} = \frac{kWh \text{ per interval}}{0.25h}$$

Net Power Output

The power meter will measure the generator power output (P_{OUT}). The internal generator meter will measure the gross output of the engine generator as a check.

The parasitic power (P_{PAR}) is estimated to be 10 kW. The net power (P_{NET}) can be determined by subtracting parasitic power (P_{PAR}) from the total power output ($P_{OUT1} + P_{OUT2} + P_{OUT3} + P_{OUT4} + P_{OUT5}$)

$$kW_{NET} = (P_{OUT1} + P_{OUT2} + P_{OUT3} + P_{OUT4} + P_{OUT5}) - P_{PAR}$$

Heat Recovery Rates

The heat recovery rates will be calculated based on the 30 second interval data collected. The piping arrangement at this site allows for the total recoverable heat rate to be determined at one location as there is no heat rejection unit included with the installation:

The rate of useful heat recovery in Btu/h is defined as:

$$Q_{NET} = C_p \times \sum (F_{NET} \times (T_{OUT} - T_{RET}) \times n)$$

where: $C_p = \sim 500$ Btu/h-gpm-°F for pure water;
 n = Number of 1-minute intervals included in period of interest

The heat recovery loop fluid is expected to be pure water.

Any heat recovery measurement can be calculated for an interval sum (Btu) by the following:

Calculated Quantities

The fuel conversion efficiency (FCE) of the CHP system, based on the higher heating value of the fuel, will be defined as:

$$FCE = \frac{Q_{NET} + (3413 \times P_{NET})}{G_{IN} \times HHV_{GAS}}$$

where: Q_{NET} = Total Useful heat recovery (Btu) (QU)
 P_{NET} = Engine generators' net output (kWh)
 G_{IN} = Generator gas consumption (Std CF)
 HHV_{gas} = Higher heating value for natural gas (~ 1020 Btu/CF)

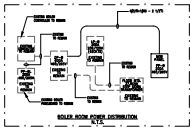
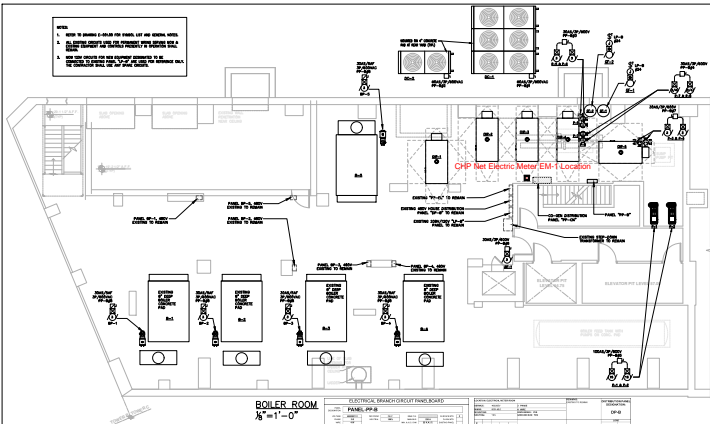
The FCE can be calculated for any time interval of interest (hourly, daily, monthly, etc.), depending on the resolution available for the gas meter reading.

Appendix A

System Schematics

NOTES:

1. REFER TO DRAWING E-101-01 FOR PANEL, LIT AND GENERAL NOTES.
2. ALL CIRCUIT BREAKERS SHALL BE PERMITTED TO BE OPENED WITH A CIRCUIT BREAKER TOOL OR SIMILAR DEVICE TO PREVENT THE CIRCUIT FROM CLOSING.
3. REFER TO DRAWING FOR THE EQUIPMENT CONNECTIONS TO BE CONNECTED TO EXISTING PANEL, 7P-01, AND VERIFY THE EQUIPMENT SHALL BE CONNECTED TO THE CORRECT WIRE AND WIRE GAUGE.



BOILER ROOM
1/8" = 1'-0"

ELECTRICAL BRANCH/CIRCUIT PANELBOARD

PANEL PP-01

NO.	DESCRIPTION	TYPE	AMPERES	VOLTS	PHASES	WIRING	TERMINALS	NOTES
1	MAIN INFEED	CB	100	120	3	1/2"	4	
2	CHP NET ELECTRIC METER	EM	100	120	3	1/2"	4	
3	CONTROL BOX CB-01	CB	10	120	3	1/2"	4	
4	CONTROL BOX CB-02	CB	10	120	3	1/2"	4	
5	CONTROL BOX CB-03	CB	10	120	3	1/2"	4	
6	CONTROL BOX CB-04	CB	10	120	3	1/2"	4	
7	EXISTING TO REMAIN							

EXISTING ELECTRICAL EQUIPMENT

NO.	DESCRIPTION	TYPE	AMPERES	VOLTS	PHASES	WIRING	TERMINALS	NOTES
1	CHP NET ELECTRIC METER	EM	100	120	3	1/2"	4	
2	CONTROL BOX CB-01	CB	10	120	3	1/2"	4	
3	CONTROL BOX CB-02	CB	10	120	3	1/2"	4	
4	CONTROL BOX CB-03	CB	10	120	3	1/2"	4	
5	CONTROL BOX CB-04	CB	10	120	3	1/2"	4	

- 1. VERIFY
- 2. VERIFY
- 3. VERIFY
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- 5. VERIFY
- 6. VERIFY
- 7. VERIFY
- 8. VERIFY
- 9. VERIFY
- 10. VERIFY

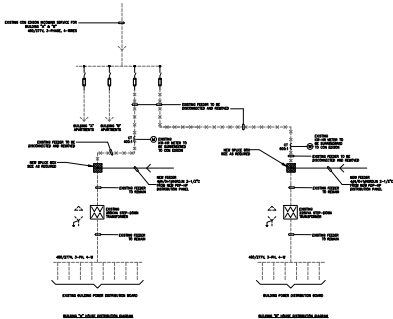


DATE: JUNE 11, 2018
SCALE: 1/8" = 1'-0"

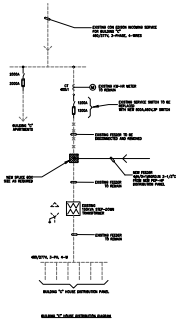
EXISTING BOILER ROOM POWER PLAN

E-101.00

THIS PLAN IS APPROVED ONLY FOR THE USE OF THE APPLICABLE EQUIPMENT AND IS VALID AT THE TIME OF THE ORIGINAL ISSUE OF THE CONTRACT AND SUBJECT TO ANY CHANGES TO THE ORIGINAL CONTRACT.



ELECTRICAL RISER DIAGRAM FOR BUILDING. "A" & "B"



ELECTRICAL RISER DIAGRAM FOR BUILDING. "C"

- 1. REVIEWED BY: []
- 2. CHECKED BY: []
- 3. DESIGNED BY: []
- 4. DRAWN BY: []
- 5. DATE: []
- 6. SCALE: []
- 7. PROJECT: []
- 8. SHEET: []
- 9. TOTAL SHEETS: []
- 10. DATE: []



CHECKED BY: D.S.

DRAWN BY: A.B./J.O.

DATE: JUNE 11, 2010

SCALE: N.T.S.

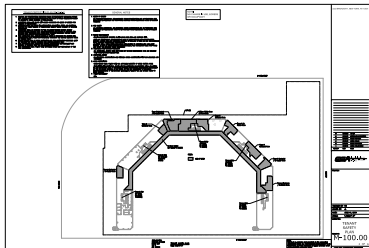
ELECTRICAL RISER
MODIFICATION FOR
BLDG. A, B & C

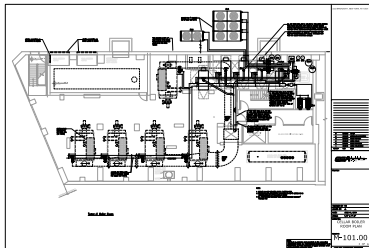
PROJECT:
E-501.00

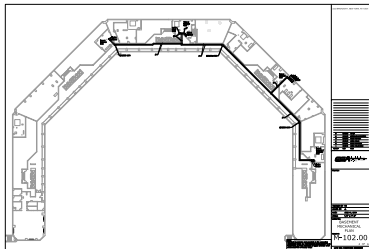
8 OF 9

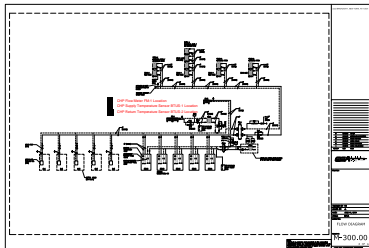
THIS PLAN IS APPROVED ONLY FOR WORK ON THE SPECIFIC PROJECT IDENTIFIED HEREIN. IT IS VOID AND OF NO FORCE OR EFFECT FOR ANY OTHER PROJECTS. ANY CHANGES OR MODIFICATIONS SHALL BE APPROVED BY SEA CONSULTING ENGINEERS.

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Appendix B

Cut Sheets for Key Sensors and Instruments



System-10 BTU Meter

ONICON's SYSTEM-10 BTU METER is the premier platform for accurately measuring and reporting the thermal energy usage, flow and temperatures required by today's High Performance Buildings.



• Chilled Water • Hot Water • Condenser Water •



DESCRIPTION

The System-10 BTU Meter provides highly accurate thermal energy measurement in chilled water, hot water and condenser water systems based on signal inputs from two matched temperature sensors (included) and any of ONICON's insertion or inline flow meters which are ordered separately. The basic model provides a local indication of energy, flow and temperature data through an alphanumeric display. An isolated solid state dry contact is provided for energy total. Optional analog outputs and network communications are also available.

Whether it's used for chiller plant optimization, CEP monitoring and control, or sub-metering the hydronic energy use across a campus, the System-10 has the versatility and functionality required to integrate seamlessly with your BMS/EMS.

APPLICATIONS

Chilled water, hot water and condenser water systems for:

- Commercial office tenant billing
- Central plant monitoring
- University campus monitoring
- Institutional energy cost allocation
- Performance/efficiency evaluations
- Performance contracting energy monitoring

CALIBRATION

Flow meters and temperature sensors are individually calibrated followed by a complete system calibration.

Field commissioning is also available.

FEATURES

Simple Installation and Commissioning - Factory programmed and ready for use upon delivery. All process data and programming functions are accessible via front panel display and keypad.

Single Source Responsibility - One manufacturer is responsible for every aspect of the energy measurement process ensuring component compatibility and overall system accuracy.

NIST[®] Traceable Calibration with Certification - Each BTU measurement system is individually calibrated using application specific flow and temperature data and is provided with a certificate of calibration.

Precision Solid State Temperature Sensors - Custom calibrated and matched to an accuracy better than $\pm 0.15^{\circ}\text{F}$ over the calibrated range.

Highly Accurate Flow Meters - ONICON offers a wide variety of insertion and inline type flow measurement technologies including turbine, electromagnetic and ultrasonic sensing. Each type offers unique advantages depending on the application. All ONICON flow meters are individually wet calibrated and designed to operate over a wide flow velocity range with accuracies ranging from $\pm 0.2\%$ to $\pm 2.0\%$ of rate depending on the model.

Complete Installation Package - All mechanical installation hardware, color coded interconnecting cabling and installation instructions are provided to ensure error-free installation and accurate system performance.

Serial Communications - Optional: Provides complete energy, flow and temperature data to the control system through a single network connection, reducing installation costs.



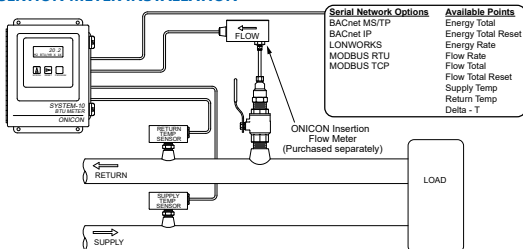
Smart button technology simplifies menu page navigation

SPECIFICATIONS*

TEMPERATURE	Overall differential temperature measurement uncertainty of $\leq \pm 0.15^{\circ}\text{F}$ over the stated range (Includes uncertainty associated with the sensors, transmitters, cabling and calculator input circuitry) Temperature sensors meet EN1434/CSA C900.1 accuracy requirements for 1K sensors for cooling applications, 32°F to 77°F. Temperature sensors meet EN1434/CSA C900.1 accuracy requirements for 2K sensors for heating applications, 140°F to 212°F.
CALCULATOR	Computing nonlinearity within $\pm 0.05\%$ Calculator meets EN1434 / CSA C900.1 class 1 accuracy requirements for 2K sensors for all applications.
PROGRAMMING	Factory programmed for specific application Field programmable via front panel interface
MEMORY	Non-volatile EEPROM memory retains all program parameters and totaled values in the event of power loss.
DISPLAY	Alphanumeric LCD displays total energy, total flow, energy rate, flow rate, supply temperature, return temperature, serial number and alarm status Alpha: 16 character, 0.2" high Numeric: 8 digit, 0.4" high Rate Display Range: 0 - 9,999,999 Total Display Range: 0 - 9,999,999
OUTPUT SIGNALS	Isolated solid state dry contact for energy total Contact rating: 100 mA, 50 V Contact duration: 0.5, 1, 2, or 6 sec Analog Output(s) (4-20 mA, 0-10 V or 0-5 V): One or four analog output(s) available for flow rate, energy rate, supply/return temps, or delta-T
SERIAL COMMUNICATIONS	BACnet® IP or MS/TP, MODBUS® RTU RS485 or TCP/IP, LONWORKS - TP/FT-10F, Siemens Apogee - P1, Johnson Controls Metasys - N2
TEMPERATURE SENSORS	Solid state sensors are custom calibrated using NIST traceable temperature standards. Current based signal (mA) is unaffected by wire length.
TEMPERATURE RANGE	Liquid temperature ranges based on application. See Meter Ordering Information on next page. Ambient temperature range: -20°F to 140°F
LIQUID FLOW SIGNAL INPUT	Pulse (frequency) or 4-20 mA input
MECHANICAL	Available Electronics Enclosures: Steel NEMA 13, wall mount, 8"x10"x4" NEMA 4 Approximate weight: 12 lbs Temperature Sensor Thermowell Kits: Thermowells and other kit components vary by fluid type, fluid temperature, pipe material and pipe size. Commonly used kits are listed on the previous page. Contact ONICON for additional thermowell kit options, including Hot Tap Installation Kits for retrofit installations.
ELECTRICAL	Input Power: Based on BTU meters configured for network connection without the analog outputs: 24 VAC, 50/60 Hz, 500 mA 120 VAC, 50/60 Hz, 200 mA 240 VAC, 50 Hz, 150 mA Internal Supply: Provides 24 VDC at 200 mA to electronics and select flow meters Wiring: Temperature signals: Use 18-22 ga twisted shielded pair Flow signals: Use 18-22 ga - see flow meter specification sheet for number of conductors.

* SPECIFICATIONS subject to change without notice.

TYPICAL INSERTION METER INSTALLATION



COMPATIBLE FLOW METERS

AVAILABLE OUTPUTS



METER ORDERING INFORMATION

Meter Model Number Coding = SYS-10-ABCD-EFGG

A = Electronics Enclosure

- 1 = NEMA 13 enclosure with LCD display
- 2 = NEMA 4 enclosure with LCD display

B = Input Power

- 1 = 24 VAC, 12 VA
- 2 = 120 VAC, 15 VA
- 3 = 240 VAC, 17.5 VA

C = Serial Communications

- 0 = No serial communications provided
- 1 = RS485, BACnet MS/TP
- 2 = RS485, MODBUS RTU
- 3 = BACnet IP
- 4 = MODBUS TCP/IP
- 5 = DualNet serial communications, IP and RS485
- 8 = LonWorks

D = Analog Output

- 0 = No analog output
- 1 = Single (1) isolated analog output
- 2 = Four (4) isolated analog outputs (Not available when C=5)

E = Auxiliary Pulse Inputs

- 0 = (1) Directional pulse input only
- 1 = (1) Directional pulse and auxiliary pulse input

F = Auxiliary Pulse Outputs

- 1 = Three (3) pulse outputs, dry contact

GG = Temperature Sensor

- 01 = Matched pair of current (mA) based sensors, CHW/CW range
- 02 = Matched pair of current (mA) based sensors, HHW range
- S1 = Matched pair of current (mA) based sensors, 122°F to 302°F range
- S4 = Matched pair of current (mA) based sensors, 80°F to 400°F range

E5X SERIES

Versatile Energy Monitoring Solution



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 communications or power failure elsewhere in the system. Combinations of serial communication, pulse output, and phase alarms are provided to suit a wide variety of applications. Additional pulse inputs on E5xHx and E50Fx 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.

SPECIFICATIONS

INPUTS

Control Power, AC	50/60 Hz; 5 VA max.; 90 V min.; UL Maximums: 600 V _{L-N} (347 V _{L-L}); CE Maximum: 300 V _{L-N}
Control Power, DC	3W max.; UL and CE: 125 to 300 Vdc (external DC current limiting required)
Voltage Input	UL: 90 V _{L-N} to 600 V _{L-L} ; CE: 90 V _{L-N} to 300 V _{L-N}

CURRENT INPUT

Scaling	5 A to 32,000 A
Input Range	0 to 0.333 V or 0 to 1 V (selectable) CTs must be rated for use with Class 1 voltage inputs
Pulse Inputs E5xHx & E50Fx only	Contact inputs to pulse accumulators (one set with E5xH2 and E50F2; two sets with E5xH5 and E51F5)*

ACCURACY

Real Power & Energy	0.2% (ANSI C12.20, IEC 62053-22 Class 0.25)
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OUTPUTS

E50B1 & E5xCx	Real Energy Pulse: N.O. static**; Alarm contacts: N.C. static**
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Revenue grade measurements

Meets ANSI C12.20 Class 0.2 standards

High reliability

ANSI C12.20 0.2% accuracy, IEC 62053-22 Class 0.25 on E5xx5

Easy installation

DIN rail or screw mounting options

Multiple applications

Real energy output and phase loss alarm output on E50Bx and E5xCx models...one device serves multiple applications

Data logging

Ensures long term data retrieval and safeguards during power failures (E5xC3 and E5xx5)

Wide CT compatibility

Compatible with CTs from 5 A to 32000 A

APPLICATIONS

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

E50Bx	Reactive energy pulse 30 Vac**
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)
E50Fx	2-wire LON FT

MECHANICAL

Mounting	DIN Rail or 3-point screw mount
ENVIRONMENTAL	
Altitude of Operation	3000 m
Operating Temp Range	-30 to 70 °C (-22 to 158 °F)
Storage Temp Range	-40 to 85 °C (-40 to 185 °F)
Humidity Range	<95% RH non-condensing
Mounting Location	Not suitable for wet locations. For indoor use only.

WARRANTY

Limited Warranty	5 years
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AGENCY APPROVALS

Agency Approvals	UL 508 (Open Type Device), IEC/EN 61010-1, California CSI Solar, ANSI C12.20, Cat III, Pollution Degree 2
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*10 kV Vac/dc to 4 to 10 Vdc.

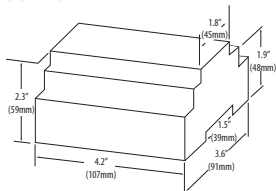
**30 Vac/dc, 100 mA max. (AC: 50/60Hz).



ORDERING INFORMATION

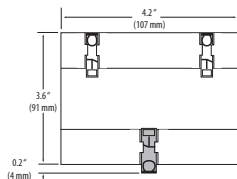
	E50B1	E50C2	E50C3	E50F2	E50F5	E50H2	E50H6	E51C2	E51C3	E51H2	E51H5
MEASUREMENT CAPABILITY - FULL DATA SET											
Bi-directional Energy Measurements											
Power (3-phase total and per phase): Real (kW) Reactive (kVAR), and Apparent (kVA)	•	•	•	•	•	•	•	•	•	•	•
Power Factor: 3-phase average & per phase	•	•	•	•	•	•	•	•	•	•	•
Present Power Demand: Real (kW), Reactive (kVAR), and Apparent (kVA)	•	•	•	•	•	•	•	•	•	•	•
Import and Export totals of Present Power Demand: Real (kW), Reactive (kVAR), & 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	•	•	•	•	•	•	•	•	•	•	•
ANSI C12.20 0.2% accuracy, IEC 62053-22 Class 0.2s	•	•	•	•	•	•	•	•	•	•	•
Accumulated Net Energy: Real (kWh), Reactive (kVARh), and Apparent (kVAh)	•	•	•	•	•	•	•	•	•	•	•
Accumulated Real Energy by phase (kWh)	•	•	•	•	•	•	•	•	•	•	•
Import and Export Accumulators of Real and Apparent Energy	•	•	•	•	•	•	•	•	•	•	•
Reactive Energy Accumulators by Quadrant (3-phase total & 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



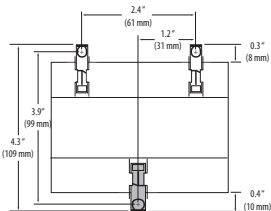
DIN MOUNT CONFIGURATION

Mounting Diagram



SCREW MOUNT CONFIGURATION

Mounting Diagram



DATA SHEET

SERIES B3: 3MI75 ROOTS® Meter

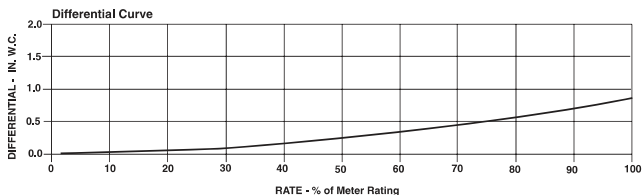
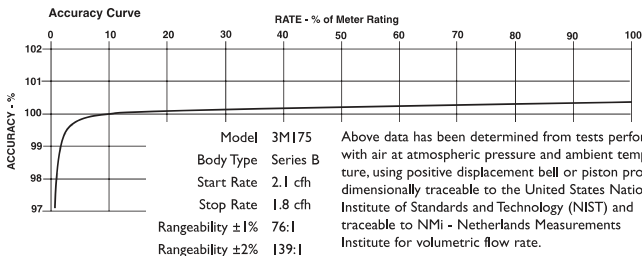
	UNITS	Imperial	UNITS	Metric
Temperature Range	deg. F	-40 to +140	deg. C	-40 to +60
Base Rating (Q Max.)	acfh	3000	m ³ /h	85
Max. Operating Pressure (MAOP)	psig	175	kPa	1200
Leak Test (125% MAOP)	psig	219	kPa	1510
Static Test (2 x MAOP)	psig	350	kPa	2400
Rangeability +/- 1%	ratio	76:1	ratio	76:1
Rangeability +/- 2%	ratio	139:1	ratio	139:1
Start Rate	cfh	2.1	m ³ /h	0,0595
Stop Rate	cfh	1.8	m ³ /h	0,0510
Flow Rate @ 0.5" w.c., Gas	cfh	2580	m ³ /h	73,1
Avg. Differential, 100% Flow	in. w.c.	1.1	mbar	2,6
Max. Pressurization Rate	psig/sec	5	kPa/sec	35
Max. Operating Speed	rpm	2000	rpm	2000
Gear Ratio	ratio	400:1	ratio	141,1764:1
Displaced Volume/Revolution	cf	0.025	m ³	0,000708
Drive Rate, CD	cf/rev	10	m ³ /rev	0,1
Drive Rate, TD	cf/rev	100	m ³ /rev	1
Temp. Compensating Range (TC,TD)	deg. F	-20 to +120	deg. C	-29 to +49
Min. Odometer Reading	cf	0.2	m ³	0,002
Odometer Turnover	yrs.	3.8	yrs.	1,34
Nominal Pipe Size	in.	2	mm	50,8
Flange-to-Flange	in.	6-3/4	mm	172
Flange Connection	ANSI	125#FF	ANSI	125#FF
Bolts per Flange	qty.	4	qty.	4
Bolt Size ¹	in.	5/8 - 11	in.	5/8 - 11
Flange Bolt Hole Depth	in.	15/16	mm	23,8
Bolt Torque: Lubricated/Non-Lub.	ft.-lb.	55/60	N-m	74/81
Restricting Orifice (120%)	in.	17/32	mm	9,525
Oil Capacity – Side Inlet	oz.	1.25	ml	37
Oil Capacity – Top Inlet	oz.	7.65	ml	226
Counter Version (CTR) ²				
Net Weight	lbs.	29	kg	13,2
Shipping Weight	lbs.	31	kg	14,1
Carton Size	in.	27 x 11 x 9	cm	69 x 28 x 23
Counter with Instrument Drive (CD) ²				
Net Weight	lbs.	33	kg	15,0
Shipping Weight	lbs.	38	kg	17,2
Carton Size	in.	31 x 15 x 13	cm	79 x 38 x 33

NOTES:

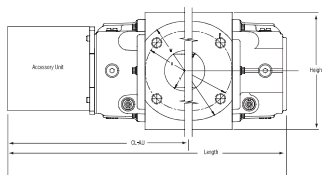
¹ Bolt Length varies by application.

² Weights and dimensions available for

CPS, TC, TD, TPS upon request.



3M175 Series B3	Overall Length		Overall Height		Width (Flange/Flange)		Centerline to Accessory End (CL-AU)		Request Detailed Drawing Number
	inches	mm	inches	mm	inches	mm	inches	mm	
CTR / TC	17-1/8	435	6-31/32	177	6-3/4	172	10-7/8	276	D054517-000
CD / TD	20-31/32	533	6-31/32	177	6-3/4	172	14-23/32	374	D054431-000
CPS / TPS	9-1/4	489	6-31/32	177	6-3/4	172	13	330	D054670-000
IMC/C	20-5/8	524	6-31/32	177	6-3/4	172	14-3/8	365	D056486-000
IMC/W	21-5/8	549	6-31/32	177	6-3/4	172	15-3/8	391	D056702-000



To order

Specify: Meter Series, Size and Type (i.e., ROOTS Meter Series B3 3M175 CD).

For CD or TD, specify Inlet (Top or Side) and ID Rotation (CW-B or CCW-A).

For Pulsar, specify Single or Dual Connectors and Connector Type (MS Circular, Conduit or Cable Gland).

For more specific ordering information on the electronic products, request: TS:SSP, TS:IMC/C or S:IMC/W.

Contact the factory for other available information, options, or special requests.



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