MEASUREMENT AND VERIFICATION PLAN

FOR

DG/CHP SYSTEM
AT
GEORGETOWN PLAZA

May 2013

Submitted to:

New York State Energy Research and Development Authority
17 Columbia Circle
Albany, NY 12203-6399

Submitted by:

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1. Introduction

DSM Engineering Associates (DSMEA) is designing and overseeing the installation of a combined heat and power (CHP) system at Georgetown Plaza at 60 East 8th St. in New York. The site is receiving an incentive from NYSERDA under the CHP Demonstration program.

The proposed CHP system includes two (2) 100 kW Tecogen InVerde INV-100 engine generator units. The inverter-based systems are intended to produce a gross output of 200 kW and recover jacket water engine heat for 1.) pre-heating the space heating hot water loop, 2.) a 72-ton hot-water absorption chiller, and 3.) DHW preheating. The CHP system will provide power in parallel with the existing utility service.

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, the Site (or its monitoring contractor) will supply the meters and instrumentation listed in Table 1.

Table 1. Overview of CHP System Monitoring Instrumentation

Point	Instrument / Sensor	Output Type	Location	Notes
Generator Power Output	Tecogen Inverde Sensor	Modbus RTU	At each generator	· WG1, WG2
Parasitic Load Electrical Consumption	WattNode WNB-3Y-208-P	Pulse	CTs in Panel EDP-CHP	· WPAR
Combined Generator Fuel Input	Utility Meter	Pulse	Meter at Natural Gas service	· FG · **Obtain gas meter utility pulse output demarcation from Con Ed**
Heat Recovery Loop Flow Rates	Onicon F1211	Analog	Dual turbine insertion flow meter on heat recovery loop	· FL1, FL2 · Onicon dual turbine meters are preferred because they are in the center line of flow making them more accurate, and they are easily removed for cleaning
Heat Recovery Loop Temperatures	Veris TI 10k T2 Thermistor	Analog	Insertion meters on heat recovery loop	· TLS, TLR1, TLR2, TLR3, TLR4, TLR5 · Temperature sensors and thermowells supplied by CDH Energy
Total Facility Energy / Power	Utility Meter	Web Download		· WT · Typically from 15-minute data accessed by ConEd's Demand Monitoring Software
Ambient Temperature				· TAO · Hourly weather data from www.wunderground.com

Data Logger

Readings for the installed instrumentation will be recorded by an Obvius AcquiSuite datalogger provided and installed by CDH Energy. The datalogger samples all sensors approximately once per second and record one-minute totals (for pulse or digital sensors) or averages (for analog sensors). The one minute readings of heat recovery temperatures and flows 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 (14), the logger will have sufficient memory to store 30 days of data if communications with the logger are interrupted. The data will be downloaded from the datalogger once per day via an Internet connection provided by the Site.

The data will be loaded into a database, checked for validity, and posted on the NYSERDA web site.

Onsite Installation

CDH Energy will install a datalogger panel at a location in the cogeneration room agreeable to the site and developer. The monitoring system panel is approximately 2 ft x 2 ft x 1 ft. The panel will be mounted near a 120 VAC power receptacle (it requires 1 amp or less). The panel will be conveniently located relative to the sensors listed above as well as the communications line provided by the site.

Communications

The datalogger will require a connection to the Internet. A dedicated static IP address is desired, but not required. If a dynamic IP address is used, the logger will upload data every night to the CDH Energy servers, but CDH personnel will not be able to access the logger for remote configuration purposes.

On Site Support

The facility is expected to assist in providing a network connection for the datalogger. The site will be responsible for providing access to all areas necessary to complete the monitoring installation, as well as any access for return trips to verify sensors or service the monitoring system.

3. Data Analysis

The collected data listed in Table 2 will be used to determine the net power output of the system as well as the fuel conversion efficiency (FCE).

Table 2. Summary of Monitored Data Points

No.	Data Point	DSMEA ID	Description	Units
1	WG1		CHP Unit 1 Electrical Output	kW
2	WG2		CHP Unit 2 Electrical Output	kW
3	WPAR		Parasitic Load Electrical Consumption - CHP AUX	kW/kWh
4	FG		Combined Generator Fuel Input	CF
5	FL1	F-CHPBTU	Heat Recovery Loop Total Flow Rate	GPM
6	FL2	F-CHPHBR	Heat Recovery Loop Flow Rate In Heat Rejection Loop	GPM
7	TLS	TS1	Heat Recovery Loop Supply Temperature	deg F
8	TLR1	TS10	Heat Recovery Loop Return Temperature from NE and SW Converters	deg F
9	TLR2	TS17	Heat Recovery Loop Return Temperature from Abs Chiller	deg F
10	TLR3	TS30	Heat Recovery Loop Return Temperature from HX-CHPDHW	deg F
11	TLR4	TS40	Heat Recovery Loop Return Temperature from heat rejection units	deg F
12	TLR5	TS45	Heat Recovery Loop Return Temperature to CHP Units	deg F
13	WT		Total Facility Energy / Power	kW/kWh
14	TAO		Ambient Temperature	deg F

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:

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

Net Power Output

The generator power meters will measure the individual gross output of the two engine generators. The net power delivered (WG_{net}) is determined by adding together the two individual generator power measurements (WG1, WG2) and subtracting out the parasitic power measurement (WPAR).

$$WGnet = (WG1 + WG2) - WPAR$$

Heat Recovery Rates

The heat recovery rates will be calculated based on the one-minute data collected. The piping arrangement at this site allows for multiple heat rates to be determined with six (6) temperature sensors and two (2) flow readings on the heat recovery loop:

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

$$QU = K \times \frac{\sum_n [FL1 \times (TLS - TLR5)]}{n} - \text{QD}$$

The rate of rejected (unused) heat recovery in Btu/h is defined as:

$$QD = K \times \frac{\sum_n [FL2 \times (TLR3 - TLR4)]}{n}$$

where: K = ~ 500 Btu/h-gpm-°F for pure water;
~480 Btu/h-gpm-°F for 20% glycol
n = Number of 1-minute intervals included in period of interest

The heat recovery loop fluid is expected to be pure water. The factor K will be determined based on a periodic reading of the fluid properties with a refractometer to determine the glycol concentration as well as the operating temperature.

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

$$Q_{int} = \sum_N Q \cdot \Delta t$$

where: N = Number of intervals in in period of interest
Δt = interval duration (hrs)

In addition to the useful heat recovery and the dumped heat, the heat recovered for the specific loads can also be calculated using the equations above with different temperatures and flow rates:

Heating Load	Flow Rate	Temperature Difference
Heat to space heating (via HX-CHPSW and HX-CHPNE)	FL1	TLS – TLR1
Heat to hot-water absorption chiller	FL1	TLR1 – TLR2
Heat to DHW loop (via HX-CHPDHW)	FL2	TLR2 – TLR3

Calculated Quantities

The fuel conversion efficiency of the CHP system, based on the lower heating value of the fuel, will be defined as:

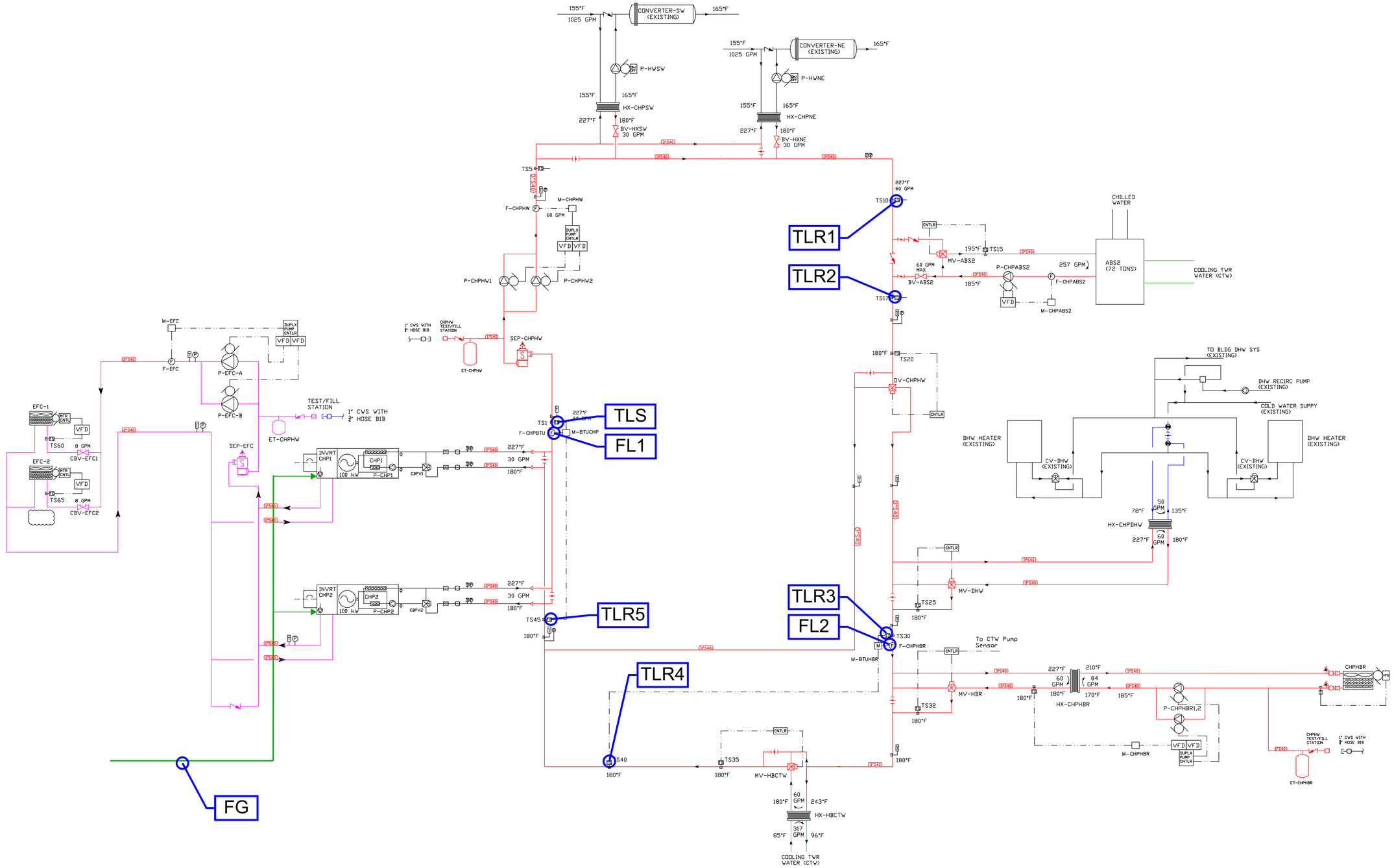
$$FCE = \frac{QU_{int} + 3413 \times (WG_{net})}{0.9 \times HHV_{gas} \times FG}$$

where:
- QU_{int} = Useful heat recovery (Btu) (QU)
- WG_{net} = Engine generator net output (kWh)
- FG = Generator gas consumption (Std CF)
- HHV_{gas} = Higher heating value for natural gas (~1030 Btu/CF)
  Where 0.9 is the conversion factor between HHV and LHV

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 Schematic and Cut Sheets for Key Sensors and Instruments



NOTES:

GENERAL NOTES:
1. DO NOT SCALE DRAWINGS
2. ALL DIMENSIONS AND LOCATIONS TO BE VERIFIED IN THE FIELD
3. DRAWINGS ARE PROVIDED FOR THE PURPOSE OF CONSTRUCTION. DRAWINGS ARE SUBJECT TO MODIFICATIONS AFTER FINAL FIELD MEASUREMENTS AS DIRECTED BY THE ENGINEER.
4. ALL CONSTRUCTION AND INSTALLATION TO BE DONE IN ACCORDANCE WITH ALL PROJECT DRAWINGS, SPECIFICATIONS, AND MANUFACTURER REQUIREMENTS WHERE APPLICABLE.

DRAWING NOTES:
1. DRAWING PROVIDES GENERAL SCHEMATIC SYSTEM INFORMATION. CHECK ALL PROJECT DRAWINGS AND PROJECT SPECIFICATIONS) FOR ADDITIONAL INSTALLATION DETAILS AND INFORMATION.
2. DETAILS FOR INSTALLATION OF COMPONENTS, PIPING, SYSTEM EQUIPMENT ARE NOT SHOWN IN THIS DRAWING.
3. CONTROL VALVES ARE REPRESENTED SCHEMATICALLY ONLY. PORT DESIGNATIONS AND OTHER DETAILS ARE NOT SHOWN. VERIFY PORT ORIENTATION FOR INDICATED SERVICE FROM MANUFACTURER DOCUMENTATION

NO.	REVISION DESCRIPTION	DATE
6		
5		
4		
3		
2	NEW EQUIPMENT ADDED	07/02/12
1	REM EFC3 TXT	3/28/12

Professional Seal

ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

DSM Engineering Associates PC
"Low Carbon" Engineering Specialists
1363-26 Veterans Memorial Highway
Hauppauge, New York 11788
631-360-1208

WWW.DSMEA.COM

Project Name and Address

MECHANICAL SCHEMATIC
CHP 1-LINE SCHEMATIC

GEORGETOWN PLAZA
CHP/BOILER/CHILLER PROJECT

60 EAST 8TH STREET
NEW YORK, NY 10003

BLOCK: **00548** LOT: **7501**

Project No:
Drawing Number: **M-300.00**
Date: **01/26/12**
Scale: **NTS**
Drawn by: **JA**
Approved by:
Sheet #: of

LEGEND

27	Undervoltage Relay
32R	Reverse Power Relay
42	Contactor
47	Phase Unbalance
50	Instantaneous Overcurrent
51	Time Overcurrent
52	AC Circuit Breaker
59	Overvoltage Relay
81 U/O	Under/Over Frequency Relay
89S	Line Switch
89L	Lockable Load Break Switch
	Circuit Breaker (Drawout)
	Circuit Breaker (Fixed Mount)
	Puller-head Fuse
	Fused Disconnect
	Twin Fused Disconnect
AS/AF	Amp Switch/Amp Fuse (Fused disconnect)
AF/AT	Amp Frame/Amp Trip (Circuit Breaker)
	Contactor
C	Contactor Coil
D	Open
M	Metering Device
UVR	Undervoltage Release
CC	Close Coil
K K	Key Interlock
N.O.	Normally Open
N.C.	Normally Close
O.O.S.	Out Of Service
	Inverter
	Cloud Indicates Proposed New Work
	Reactor

CON ED SERVICE
208Y/120V, 3Ø, 4W

METER#
CT1HM6443408

WT

(3) 2A

27-1 / 27-2 | 59-1 / 59-2 | 81U / 81O | 32R 1 | 32R 2

6-#12 AWG Cu

4-#14 AWG Cu

(3) 2000/5

2500AS

2000AF KRP

32 X

OUT 1

OUT 2

BECKWITH M-3410A

(3) 10A
*SEE NOTE 7

2-4/C-600 kcmil Cu
*SEE NOTE 7

"52IT-1"
800AF
800AT
3P, 240V
200 kAIC

2-4/C-600 kcmil Cu
PLUS GND

200AS
175AF

EDP-CHP
208Y/120V, 800A, 3Ø, 4W

52G-1	52G-2	52E-1	52E-2	52E-3	52E-4
400AF 400AT	400AF 400AT	225AF 100AT	125AF 100AT	225AF 175AT	225AF 200AT

WPAR

30AS COMPACTOR
30AS
30AS COMPACTOR
60AS ML PANEL
200AS LOBBY PANEL
200AS LAUNDRY PANEL
400AS LOW RISE ELEVATOR
600AS PANEL P

60AS PANEL G UPPER
60AS PANEL G LOWER
100AS AL PANEL
100AS HL PANEL
200AS ANTENNA
200AS
800AS

FIRE PUMP

800AS
601AF

2-4/C-500 kcmil Cu

4/C-#3/0 AWG Cu

4/C-600 kcmil Cu
PLUS GND
112.5 kVA
480-208Y/120V
3/C-4/0 AWG Cu
PLUS GND

89L-1
200AS/175AF (AJT)
3PST, 600 V
LOCKABLE HEAVY DUTY
DISCONNECT SWITCH
BY TECOGEN

3/C-4/0 AWG Cu
PLUS GND

WG1

CONTROL & PROTECTION MODULE
CONTACTOR (42) CONTROL & PROTECTION
LOAD SHED
PARALLEL
STAND ALONE
52IT-1 b

RUN
BLOCK CLOSE 52IT-1

STOP PB

400-4.0

CHP-UNIT 1
TECOGEN INV-100
100 kW CONTINUOUS
125 kVA
3Ø, 480V, 150A, Wye
NYS SIR APPROVED

4/C-600 kcmil Cu
PLUS GND
112.5 kVA
480-208Y/120V
3/C-4/0 AWG Cu
PLUS GND

89L-2
200AS/175AF (AJT)
3PST, 600 V
LOCKABLE HEAVY DUTY
DISCONNECT SWITCH
BY TECOGEN

3/C-4/0 AWG Cu
PLUS GND

WG2

CONTROL & PROTECTION MODULE
CONTACTOR (42) CONTROL & PROTECTION
LOAD SHED
PARALLEL
STAND ALONE
52IT-1 b

RUN
BLOCK CLOSE 52IT-1

STOP PB

400-4.0

CHP-UNIT 2
TECOGEN INV-100
100 kW CONTINUOUS
125 kVA
3Ø, 480V, 150A, Wye
NYS SIR APPROVED

4/C-#2 AWG Cu

CHP AUX
100A MLO
208Y/120V

PANEL EM
100A MLO
208Y/120V

NEW SUPPLY FOR
1. WATER PUMP
2. SECURITY SYSTEM
3. TELEPHONE SYSTEM

ATS-LTG
200A
3PDT, 240V

CORRIDOR LIGHTING

ATS-ELEV
800A
3PDT, 240V

HIGH RISE ELEVATOR

208Y/120V, 3Ø, 4W

100A BLOWER 1
100A BLOWER 2
30A COMPRESSOR 1
30A COMPRESSOR 2
30A OIL HEATER 1
30A OIL HEATER 2
30A BOILER PANEL

DP-BR
208Y/120V, 3Ø, 4W

200AS/175AF COMPACTOR
200AS SPARE
200AS/175AF COOLING TOWER
200AS/175AF CONDENSER PUMP 2
200AS CONDENSER PUMP 1
200AS/200AF PANEL PP-B

200AS
PUMP 4 SOUTH WEST ZONE

NOTES:
1. THIS PROJECT INSTALL TWO NEW 100 kW CHP MODULES AND ALL NECESSARY EQUIPMENT TO PROVIDE PARALLEL OPERATION WITH CON EDISON AND ISOLATED OPERATION IN THE EVENT OF A UTILITY OUTAGE.
2. ALL FUSES INDICATED WILL PROVIDE SELECTIVE COORDINATION, AND HAVE 200 kAIC RATING.
3. THE GENERATORS ARE TO BE INSTALLED IN ACCORDANCE WITH NEW YORK STATE STANDARD INTERCONNECTION REQUIREMENTS AND CON ED ED-2115. GENERATOR MAY RUN DURING UTILITY OUTAGE ONLY AFTER 52IT-1 IS IN THE OPEN POSITION,
4. UNLESS NOTED, ALL EQUIPMENT IS EXISTING, AND WILL REMAIN IN USE AND IS PREVIOUSLY APPROVED.
5. ALL ELECTRICAL CONSTRUCTION TO BE IN COMPLIANCE WITH 2008 NEC, AS AMENDED BY THE NYC DOB.
6. BOND XO BUSHING TO SERVICE ENTRANCE THROUGH NEUTRAL CONDUCTOR, DO NOT GROUND AT TRANSFORMER.
7. CABLE TAPS AND FUSING TO BE IN ACCORDANCE WITH SECTION 240 NFPA 70 (NEC).
8. TRANSFER LOAD, AS REQUIRED BY OWNER, TO PANEL EM.
9. REFER TO DRAWING E-1.0E FOR OPERATION DURING CON EDISON OUTAGE.

NOT FOR CONSTRUCTION

DSM Engineering Associates P.C.
1363-26 Veterans Memorial Highway
Hauppauge, NY. 11788

Rev No.	Date:	Description	By:
0	02/02/12	ISSUE FOR REVIEW AND COMMENTS	-

PE STAMP/SEAL

ONE-LINE DIAGRAM
GEORGETOWN PLAZA
200 kW DISTRIBUTED GENERATION
60 EAST 8th STREET
NEW YORK, NY

CSA ENGINEERING SERVICES, LLC
15 TROWBRIDGE DRIVE BETHEL, CT 06801
PHONE: (203) 798-0419 FAX: (203) 743-2325

Drawn By:	Scale:	
KT	NONE	E-1.0

Georgetown Plaza CHP M&V Instrumentation Plan

No.	Data Point	Description	Units	Sensor	Signal Type	Multiplier/ Pulse Rate	Note	Est Price	Supplied By
1	WG1	CHP Unit 1 Electrical Output	kW/kWh	WattNode WNB-3Y-208-P	Pulse	TBD			Applicant
2	WG2	CHP Unit 2 Electrical Output	kW/kWh	WattNode WNB-3Y-208-P	Pulse	TBD			Applicant
3	WPAR	Parasitic Load Electrical Consumption - CHP AUX	kW/kWh	WattNode WNB-3Y-208-P	Pulse				Applicant
4	FG	Combined Generator Fuel Input	CF	Utility Meter	Pulse	TBD	If generator gas use metered separately by Con Ed, add a pulse output to the utility meter ($700) **Alternatively,** an Itron DATTUS fM2 gas meter will be installed ($1,500 - $2,000)		Applicant
5	FL1	Heat Recovery Loop Flow Rate	GPM	Onicon F1211	Analog	TBD	Dual turbine insertion flow meter on heat recovery loop Onicon dual turbine meters are preferred because they are in the center line of flow making them more accurate, and they are easily removed for cleaning F-CHPBTU		Applicant
6	FL2	Heat Recovery Loop Flow Rate	GPM	Onicon F1211	Analog	TBD	Dual turbine insertion flow meter on heat recovery loop Onicon dual turbine meters are preferred because they are in the center line of flow making them more accurate, and they are easily removed for cleaning F-CHPHBR		Applicant
7	TLS	Heat Recovery Loop Supply Temperature	deg F	Veris TI 10k T2 Thermistor	Analog	TBD	Temperature sensors and thermowells supplied by CDH Energy TS1		CDH Energy
8	TLR1	Heat Recovery Loop Return Temperature from NE and SW Converters	deg F	Veris TI 10k T2 Thermistor	Analog	TBD	Temperature sensors and thermowells supplied by CDH Energy TS10		CDH Energy
9	TLR2	Heat Recovery Loop Return Temperature from Abs Chiller	deg F	Veris TI 10k T2 Thermistor	Analog	TBD	Temperature sensors and thermowells supplied by CDH Energy TS17		CDH Energy
10	TLR3	Heat Recovery Loop Return Temperature from HX-CHPDHW	deg F	Veris TI 10k T2 Thermistor	Analog	TBD	Temperature sensors and thermowells supplied by CDH Energy TS30		CDH Energy
11	TLR4	Heat Recovery Loop Return Temperature from second heat rejection unit (HX-HBCTW)	deg F	Veris TI 10k T2 Thermistor	Analog	TBD	Temperature sensors and thermowells supplied by CDH Energy TS40		CDH Energy
12	TLR5	Heat Recovery Loop Return Temperature to CHP Units	deg F	Veris TI 10k T2 Thermistor	Analog	TBD	Temperature sensors and thermowells supplied by CDH Energy TS45		CDH Energy
13	WT	Total Facility Energy / Power	kW/kWh	Utility Meter	Web Download		Typically from 15-minute data accessed by ConEd's Demand Monitoring Software **Alternatively,** a meter & CTs can be purchased or a pulse output can be added		Applicant
14	TAO	Ambient Temperature	deg F				Hourly weather data from www.wunderground.com		

Note:

CHP Efficency Calculations:

Net Power WG_{net} = (WG1 + WG2) - WPAR

Useful Heat QU = [k x FL1 x (TLS - TLR5)] - QD k = 500 Btu/h-gpm-deg F for pure water at 180 deg F

Dumped Heat QD = k x FL2 x (TLR3 - TLR4)

Fuel Conversion $$FCE = \frac{QU \cdot \Delta t + 3.412 \cdot (WGnet)}{LHV_{gas} \cdot FG}$$ LHV = 0.9 * HHV = 927 Btu/CF

Continental Control Systems

WattNode®

Advanced Pulse Output AC Power Measurement

277/480 VAC

120/240

The WattNode is a true RMS AC watt-hour transducer with pulse output (solid state relay closure) proportional to kWH consumed. The WattNode provides accurate measurement at low cost to meet your needs for sub-metering, energy management and performance contract applications.

Easy Installation saves you time and money. The WattNode is small enough to fit entirely within a standard electrical panel and the screw terminals unplug for easy wiring.

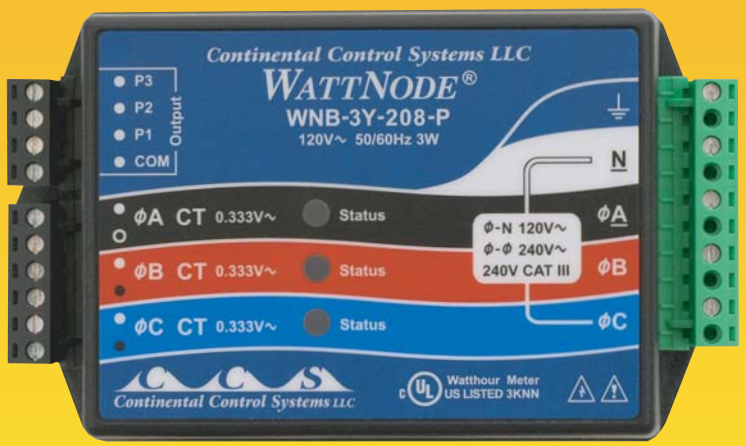
The Advanced Output includes separate pulse channels for positive and negative power, for net metering and PV metering. Optional models are available with one pulse output channel per measurement phase, which can be used to monitor each phase independently or to monitor three separate single-phase circuits with one WattNode.

Our Diagnostic LEDs provide a per-phase indication of power (green flashing), negative power (red flashing), and advanced diagnostics (yellow flashing) to help troubleshoot connection problems, like swapped CTs, or excessive line voltage. See the User's Guide for a full description.

The Pulse Series family measures 1, 2, or 3 phases in 2, 3 or 4 wire configurations. With voltage ratings from 120 to 600 VAC and current transformer (CT) rating from 5 to 4000 amps, there is a WattNode combination to meet your AC power measurement requirements.

Accuracy of the WattNode is is 0.5% of reading over a wide range of power factors and harmonic content. You get true kWH measurements even with switching power supplies and variable speed drives.

Our Safe CTs, with internal burden resistors produce a voltage proportional to the load current. At rated current voltage is only 0.333 VAC. Split-core CTs quickly install on existing wiring and solid-core CTs cost less for new wiring.



c UL us LISTED

(888) 928-8663

Continental Control Systems LLC

3131 Indian Road, Suite A
Boulder, CO 80301 USA
(888) 928-8663 Fax (303) 444-2903
sales@ccontrolsys.com

www.ccontrolsys.com

- **Advanced Pulse Output**
  Separate pulse channels for positive and negative power. Optional models are available with one pulse output channel per measurement phase.
- **Small Size**
  Can be installed in existing service panels or junction boxes.
- **Uses Safe CTs**
  Output limited to one volt.
- **Line Powered**
  No external power supply required.
- **Digital Signal Processing**
  Accurate kWH measurement over a wide harmonic range.
- **Detachable Terminal Blocks**
  Easy to install and remove.

SPECIFICATIONS

WattNode®

Advanced Pulse Output AC Power Measurement

Measurement Configurations
- Single phase: 2-wire or 3-wire
- Three phase: 3-wire or 4-wire

Electrical
- Line Powered
- Operating Voltage Range: +15%, -20% of nominal
- Power Line Frequency: 50/60 Hz
- CT Input: 0.333 VAC

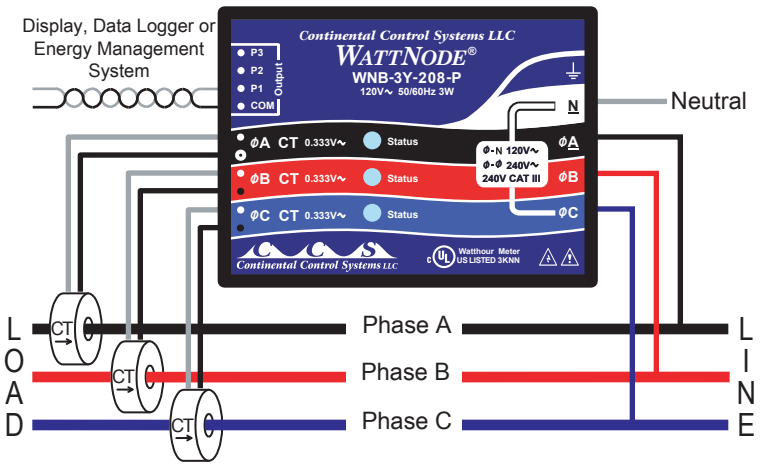
Pulse Output
- Optoisolated, solid state relay closures handle up to maximum 60 VDC & to 5mA
- Standard: 4.00 Hz Bidirectional Output
- Optional: 0.01 Hz to 600 Hz Bidirectional Output Models
- Optional: Per-Phase Output Models 0.01 Hz to 150 Hz available

Accuracy
- Normal Operation: Line voltage: 80% - 115% of nominal
- Power factor: 1.0
- Frequency: 50- 60 Hz
- Ambient Temperature: 25°C
- Current: 5% - 100% of rated current
- Accuracy: ±0.5% of reading

Environmental
- Operating Temperature: -30°C to +55°C (-22°F to 131°F)
- Operating Humidity: 5 to 90% (RH)

Mechanical
- Enclosure: High impact, UL rated, ABS plastic
- Size: 3.3" x 5.6" x 1.5"
- Connectors: UL, CSA recognized, detachable, screw terminals (14AWG), 600V

Optional LCD Display
- Display: Eight digits, each 0.43" high
- Reset: Wired remote and configurable front panel button
- Enclosure: Panel mount box, 2.95" x 1.52"
- Battery: Lithium 2/3A, replace every four years



WattNode

Model	VAC Line To Neutral	VAC Line To Line	Phases	Wires
WNB-3Y-208-P	120	208-240	3	4
WNB-3Y-400-P	230	400	3	4
WNB-3Y-480-P	277	480	3	4
WNB-3Y-600-P	347	600	3	4
WNB-3D-240-P	120	208-240	3	3
WNB-3D-400-P	230	400	3	3
WNB-3D-480-P	277	480	3	3

LCD Displays

Model	Displays	Units
LCDA-E	Energy	WH, kWH, or MWH
LCDA-P	Power	W or kW
LCDA-EP	Energy & Power	WH, kWH, or MWH & W or kW

Opening Current Transformers (Split-Core)

Model	Inside Diameter	Rated Amps
CTS-0750	0.75"	5, 15, 30, 50, 70, 100, 150
CTS-1250	1.25"	70, 100, 150, 200, 250, 300, 400, 600
CTS-2000	2.00"	600, 800, 1000, 1200, 1500
CTB	Bus Bar	600, 800, 1200, 2000, 3000 (custom)

Toroidal Current Transformers (Solid-Core)

Model	Inside Diameter	Rated Amps
CTT-0300	0.30"	5, 15, 30
CTT-0500	0.50"	15, 30, 50, 60
CTT-0750	0.75"	30, 50, 70, 100
CTT-1000	1.00"	50, 70, 100, 150, 200
CTT-1250	1.25"	70, 100, 150, 200, 250, 300, 400

Current Transformer Output Voltage: 0 - 0.333 VAC @ rated current

MADE IN THE USA

(888) 928-8663

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sales@ccontrolsys.com
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DATTUS® III

Commercial & Industrial Gas Meter

Building upon its proven lineage, Itron is proud to introduce the third-generation DATTUS, a solid-state gas meter suited for commercial and industrial gas measurement applications. The DATTUS III is built upon an electronics platform that includes a new solid chip thermal sensor, built-in temperature compensation, and datalogging as capabilities–standard.

The DATTUS meter uses fluidic oscillation technology. With no moving parts, the DATTUS meter is ideal for applications where continuous gas flow to the customer is required.

The DATTUS III incorporates a new sensor technology with a solid chip design. The sensor is encapsulated in glass but sensitive enough to detect gas oscillations critical for measurement. The glass coating offers excellent resistance to all types of solid and liquid contaminants.

Meter Type Options

» Basic – Offers uncorrected measurement along with fixed-factor capability

» Basic TC – Same as Basic, but programmed to include temperature compensation

Operational Advantages

» Safety – Because the DATTUS uses solid-state technology, the meter cannot "lock up" or stop gas flow. This may be necessary in some applications such as gas measurement for hospitals, schools, or other applications where continuous gas service may be critical

» Robustness – The DATTUS meter may be subjected to many times its rated capacity without any damage to the meter; only an alarm is displayed letting the user know the meter was in an "overflow" condition. The DATTUS will measure normally once the flow is back within its operating range. With the new and improved solid sensor chip technology, the likelihood of damage from contamination is significantly reduced

» Application – Without mechanical elements impeding gas flow, the meter performs very well in applications where slam-shut or slam-open loads are created because of the downstream equipment used

» Ease of Installation – Having completely aligned flanges is not necessary, nor is leveling of the meter. Neither torsion on the meter case or a non-level setting will affect meter performance

» Low Maintenance – Since the DATTUS meter doesn't have any rotating or moving parts, there are no associated maintenance requirements, such as oil changes that may be required for other meter types. Batteries are the only regular maintenance item for DATTUS, with battery life expectancy at nine to ten years for the DATTUS Basic and Basic TC models

DATTUS III fM1

DATTUS III fM2

DATTUS III fM3

FEATURES AND BENEFITS

- Static measurement technology
- Built-in temperature compensation
- Data logging standard
- Four channels of configurable pulse outputs
- Capacity sizes from 8C to 56M
- Field upgradable meter capacity without service interruption
- 9-10 year battery life
- Configurable index orientation
- MODBUS communication
- Programmable fixed pressure compensation
- Highly robust sensor design

Pulse Outputs

- 4 pulse output channels
- Open drain N channel MOSFET, non-isolated
- Dry contact
- Switch off resistance > 2 Mohms
- Switch on resistance ~ 250 ohms
- Pulse duration: 10ms to 2 seconds or 50% duty cycle
- Pulse value: user configurable for volume pulse or alarm output

Data Logging

- Data logging is standard
- Four individually configurable loggers
- Intervals from 30 seconds up to monthly
- Four items may be logged in addition to uncorrected volume, including temperature, corrected volume, maximum flow rate, and battery voltages
- Total of 2730 records available

Event logging

- Records and time stamps meter alarms
- Records and time stamps configuration changes
- Uses a circular log
- Additional “last occurrence” log

Temperature Compensation

- Temperature sensing chip included on the sensor board and mounted in the gas stream
- May enable or disable temperature compensation via software
- Accuracy of +/- 1.8 degrees Fahrenheit

Specifications

Model	fM1 CFH (m3/h)	fM2 CFH (m3/h)	fM3 CFH (m3/h)
Start Flow	8 (0.23)	18 (0.51)	45 (1.27)
Flow rate for +/- 2% acc	10 (0.28)	22 (0.62)	60 (1.70)
Flow rate for +/- 1% acc.	35 (0.99)	60 (1.70)	100 (2.83)
Maximum Capacity	3750 (106)	13750 (389)	57000 (1614)

Meter	Meter Weight	Shipped Weight	MAOP	Operating Temperature Range	Approvals for Intrinsic Safety
fM1	34 lbs. (15.4 kg)	38 lbs. (17.2 kg)	175 PSIG, 12 Bar	-40˚ to +140˚ F, -40˚ to + 60˚ C	UL 913 Class I Div I, CSA 22.2 No. 157
fM2	37 lbs. (16.8 kg)	42 lbs. (19.1 kg)	150 PSIG, 10.3 Bar		
fM3	114 lbs. (51.7 kg)	128 lbs. (58.1 kg)	175 PSIG, 12 Bar		

Meter Sizing – fM1

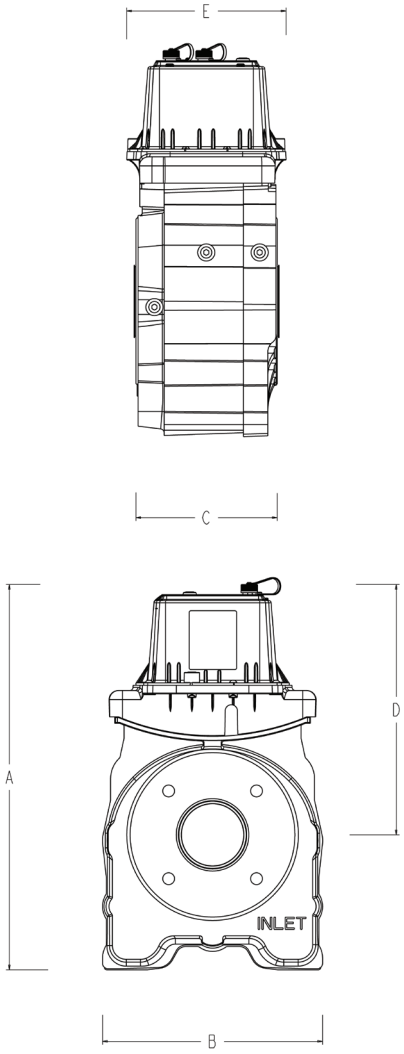
Meter Size Base Rating	**8C** acfh (m^3/h)	**1M** acfh (m^3/h)	**1.5M** acfh (m^3/h)	**2M** acfh (m^3/h)	**3M** acfh (m^3/h)
	800 (22.7)	1000 (28.3)	1500 (42.5)	2000 (56.6)	3000 (85.0)
Meter Pressure psig (Bar)	**Metering Capacity** MSCFH(m^3/h)	MSCFH(m^3/h)	MSCFH(m^3/h)	MSCFH(m^3/h)	MSCFH(m^3/h)
1 (0.07)	0.9 (24.2)	1.1 (30.2)	1.6 (45.4)	2.1 (60.5)	3.2 (90.7)
2 (0.14)	0.9 (25.7)	1.1 (32.2)	1.7 (48.2)	2.3 (64.3)	3.4 (96.5)
3 (0.21)	1.0 (27.3)	1.2 (34.1)	1.8 (51.1)	2.4 (68.2)	3.6 (102.3)
5 (0.34)	1.1 (30.3)	1.3 (37.9)	2.0 (56.9)	2.7 (75.9)	4.0 (113.8)
10 (0.69)	1.3 (38.0)	1.7 (47.5)	2.5 (71.3)	3.4 (95.1)	5.0 (142.6)
15 (1.03)	1.6 (45.7)	2.0 (57.2)	3.0 (85.7)	4.0 (114.3)	6.1 (171.5)
20 (1.38)	1.9 (53.4)	2.4 (66.8)	3.5 (100.1)	4.7 (133.5)	7.1 (200.3)
25 (1.72)	2.2 (61.1)	2.7 (76.4)	4.0 (114.6)	5.4 (152.8)	8.1 (229.1)
45 (3.10)	3.2 (91.9)	4.1 (114.8)	6.1 (172.2)	8.1 (229.7)	12.2 (344.5)
60 (4.13)	4.1 (114.9)	5.1 (143.7)	7.6 (215.5)	10.1 (287.3)	15.2 (431.0)
90 (6.20)	5.7 (161.1)	7.1 (201.3)	10.7 (302.0)	14.2 (402.7)	21.3 (604.0)
100 (6.89)	6.2 (176.4)	7.8 (220.6)	11.7 (330.8)	15.6 (441.1)	23.4 (661.7)
150 (10.3)	8.9 (253.3)	11.2 (316.7)	16.8 (475.0)	22.4 (633.4)	33.5 (950.0)
175 (12.1)	10.3 (291.8)	12.9 (364.7)	19.3 (547.1)	25.8 (729.5)	38.6 (1094.2)

Meter Sizing – fM2

Meter Size Base Rating	**2M** acfh (m^3/h)	**3M** acfh (m^3/h)	**5M** acfh (m^3/h)	**7M** acfh (m^3/h)	**11M** acfh (m^3/h)
	2000 (56.6)	3000 (85.0)	5000 (141.6)	7000 (198.2)	11000 (311.5)
Meter Pressure psig (Bar)	**Metering Capacity** MSCFH(m^3/h)	MSCFH(m^3/h)	MSCFH(m^3/h)	MSCFH(m^3/h)	MSCFH(m^3/h)
1 (0.07)	2.1 (60.5)	3.2 (90.7)	5.3 (151.2)	7.5 (211.7)	11.7 (332.6)
2 (0.14)	2.3 (64.3)	3.4 (96.5)	5.7 (160.8)	8.0 (225.1)	12.5 (353.8)
3 (0.21)	2.4 (68.2)	3.6 (102.3)	6.0 (170.4)	8.4 (238.6)	13.2 (374.9)
5 (0.34)	2.7 (75.9)	4.0 (113.8)	6.7 (189.6)	9.4 (265.5)	14.7 (417.2)
10 (0.69)	3.4 (95.1)	5.0 (142.6)	8.4 (237.7)	11.8 (332.8)	18.5 (523.0)
15 (1.03)	4.0 (114.3)	6.1 (171.5)	10.1 (285.8)	14.1 (400.1)	22.2 (628.7)
20 (1.38)	4.7 (133.5)	7.1 (200.3)	11.8 (333.8)	16.5 (467.4)	25.9 (734.4)
25 (1.72)	5.4 (152.8)	8.1 (229.1)	13.5 (381.9)	18.9 (534.6)	29.7 (840.2)
45 (3.10)	8.1 (229.7)	12.2 (344.5)	20.3 (574.1)	28.4 (803.8)	44.6 (1263.1)
60 (4.13)	10.1 (287.3)	15.2 (431.0)	25.4 (718.3)	35.5 (1005.6)	55.8 (1580.3)
90 (6.20)	14.2 (402.7)	21.3 (604.0)	35.5 (1006.7)	49.8 (1409.4)	78.2 (2214.7)
100 (6.89)	15.6 (441.1)	23.4 (661.7)	38.9 (1102.8)	54.5 (1543.9)	85.7 (2426.2)
150 (10.3)	22.4 (633.4)	33.5 (950.0)	55.9 (1583.4)	78.3 (2216.8)	123.0 (3483.5)

Dimensions

	fM1 in (mm)	**fM2** in (mm)	**fM3** in (mm)
A	17.2 (437)	18.6 (472)	25.2 (640)
B	8.8 (224)	10.6 (269)	16.5 (419)
C	6.75 (171)	6.75 (171)	9.5 (241)
D	11.25 (286)	12.1 (307)	16.7 (424)
E	7.6 (193)	7.6 (193)	7.6 (193)
Flange:	ANSI 125 2”	ANSI 125 2” or 3”	ANSI 125 4”



Dimensions fM2

Meter Sizing – fM3

Meter Size Base Rating	7M acfh (m^3/h)	11M acfh (m^3/h)	16M acfh (m^3/h)	23M acfh (m^3/h)	38M acfh (m^3/h)	56M acfh (m^3/h)
	7000 (198.2)	11000 (311.5)	16000 (453.1)	23000 (651.3)	38000 (1076.1)	56000 (1585.8)
Meter Pressure			**Metering Capacity**			
psig (Bar)	MSCFH(m^3/h)	MSCFH(m^3/h)	MSCFH(m^3/h)	MSCFH(m^3/h)	MSCFH(m^3/h)	MSCFH(m^3/h)
1 (0.07)	7.5 (211.7)	11.7 (332.6)	17.1 (483.8)	24.6 (695.5)	40.6 (1149.1)	
2 (0.14)	8.0 (225.1)	12.5 (353.8)	18.2 (514.6)	26.1 (739.7)	43.2 (1222.2)	63.6 (1801.1)
3 (0.21)	8.4 (238.6)	13.2 (374.9)	19.3 (545.4)	27.7 (783.9)	45.7 (1295.2)	67.4 (1908.7)
5 (0.34)	9.4 (265.5)	14.7 (417.2)	21.4 (606.9)	30.8 (872.4)	50.9 (1441.3)	75.0 (2124.1)
10 (0.69)	11.8 (332.8)	18.5 (523.0)	26.9 (760.7)	38.6 (1093.5)	63.8 (1806.6)	94.0 (2662.3)
15 (1.03)	14.1 (400.1)	22.2 (628.7)	32.3 (914.5)	46.4 (1314.5)	76.7 (2171.8)	113.0 (3200.6)
20 (1.38)	16.5 (467.4)	25.9 (734.4)	37.7 (1068.3)	54.2 (1535.6)	89.6 (2537.1)	132.0 (3738.9)
25 (1.72)	18.9 (534.6)	29.7 (840.2)	43.2 (1222.0)	62.0 (1756.7)	102.5 (2902.4)	151.0 (4277.2)
45 (3.10)	28.4 (803.8)	44.6 (1263.1)	64.9 (1837.2)	93.3 (2641.0)	154.1 (4363.4)	227.1 (6430.3)
60 (4.13)	35.5 (1005.6)	55.8 (1580.3)	81.2 (2298.6)	116.7 (3304.3)	192.8 (5459.2)	284.1 (8045.1)
90 (6.20)	49.8 (1409.4)	78.2 (2214.7)	113.8 (3221.4)	163.5 (4630.7)	270.2 (7650.8)	398.2 (11274.8)
100 (6.89)	54.5 (1543.9)	85.7 (2426.2)	124.6 (3529.0)	179.1 (5072.9)	296.0 (8381.3)	436.2 (12351.4)
150 (10.3)	78.3 (2216.8)	123.0 (3483.5)	178.9 (5066.9)	257.2 (7283.7)	425.0 (12033.9)	626.3 (17734.2)
175 (12.1)	90.2 (2553.2)	141.7 (4012.2)	206.1 (5835.9)	296.3 (8389.1)	489.5 (13860.2)	721.3 (20425.6)

Pressure loss across meter exceeds supply pressure

Pressure loss across meter in excess of 50% of supply pressure

Pressure Drop

0.6 specific gravity natural gas @ atmospheric pressure

Flowrate CFH (m^3/h)	fM1, 2"	fM2, 2"	fM2, 3"	fM3, 4"
	Pressure Loss in Inches W.C. (millibar)			
800 (22.7)	0.23 (0.57)	0.08 (0.20)	0.06 (0.15)	<0.01 (<0.01)
1000 (28.3)	0.35 (0.87)	0.11 (0.27)	0.08 (0.20)	<0.01 (0.01)
1500 (42.5)	0.75 (1.87)	0.22 (0.55)	0.17 (0.42)	0.02 (0.05)
2000 (56.6)	1.30 (3.24)	0.37 (0.92)	0.29 (0.72)	0.03 (0.07)
3000 (85.0)	2.85 (7.10)	0.78 (1.94)	0.61 (1.52)	0.09 (0.22)
5000 (141.6)	** (**)	2.02 (5.03)	1.62 (4.04)	0.26 (0.65)
7000 (198.2)	** (**)	3.85 (9.59)	3.12 (7.77)	0.54 (1.35)
11000 (311.5)	** (**)	9.27 (23.09)	7.56 (18.83)	1.38 (3.44)
16000 (453.1)	** (**)	** (**)	** (**)	2.99 (7.45)
23000 (651.3)	** (**)	** (**)	** (**)	6.26 (15.59)
38000 (1076.1)	** (**)	** (**)	** (**)	17.28 (43.04)
56000 (1585.8)	** (**)	** (**)	** (**)	37.76 (94.06)

Itron

At Itron, we're dedicated to delivering end-to-end smart grid and smart distribution solutions to electric, gas and water utilities around the globe. Our company is the world's leading provider of smart metering, data collection and utility software systems, with over 8,000 utilities worldwide relying on our technology to optimize the delivery and use of energy and water.

To realize your smarter energy and water future, start here: **www.itron.com**

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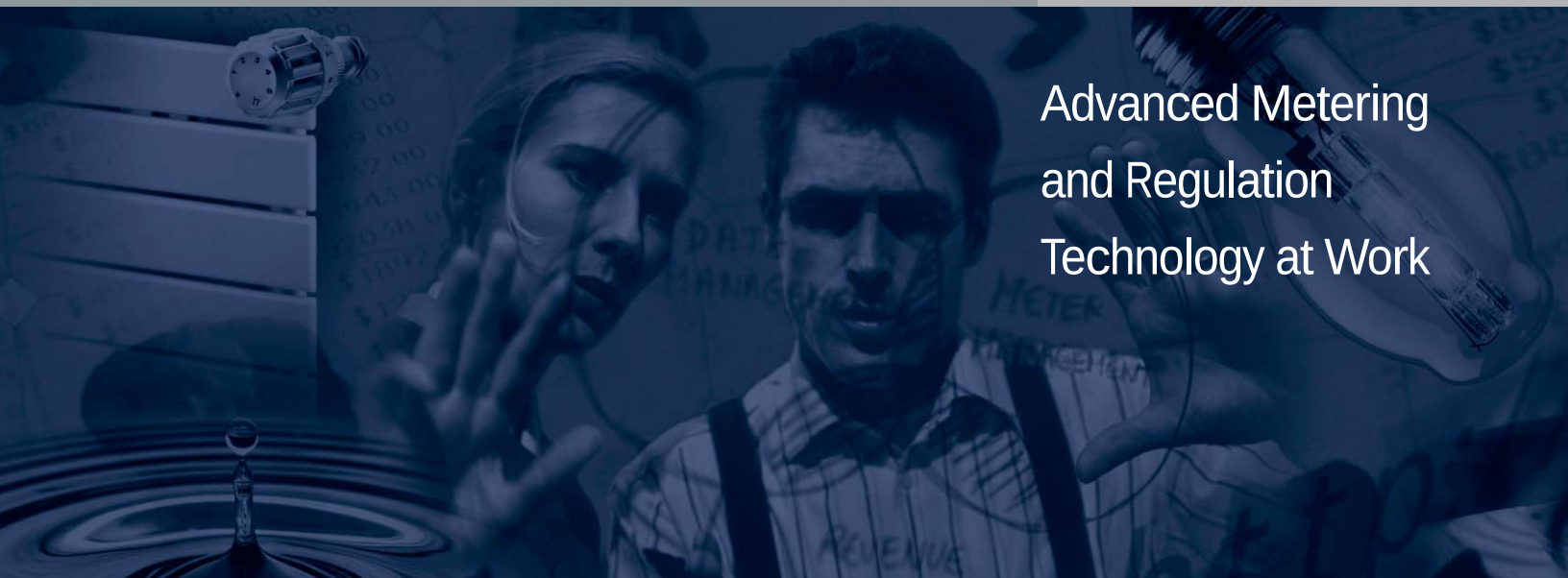
ACTARIS
metering systems

Dattus™ fM2 Commercial & Industrial Gas Meter



Advanced Metering and Regulation Technology at Work

Committed to Delivering the Best Possible Results

At Actaris Metering Systems, we are driven to help our customers succeed. As a global leader in measurement systems, we offer over 100 years of experience in the resource measurement business. We use that experience to bring the right combination of people, resources, and technology to deliver results that track to your bottom line.

Our drive to succeed has spawned innovations like the Dattus™ fM2 Gas Meter, the latest generation of electronic gas meters. With no moving parts, this meter offers numerous advantages over existing technologies. The Dattus fM2 can replace current rotary and diaphragm meters (3,000 - 9,000 cfh capacity rated) in many situations, thereby reducing the number of different size meters needed in inventory. In addition Dattus is available with the Gas Micro electronic volume corrector mounted directly in place of the index.

From gas, to electricity, water, and heat, Actaris is the name of quality that millions of customers rely on every day.

Features

- Compact Design
- No Moving Parts
- Integrated Functionality (Pressure, Temperature, Compressibility Correction and Data Logging)
- Fixed Factor Correction
- Volume and Alarm Pulse Outputs
- Configurable Index Orientation
- Instant Flow Rate Display
- Nominal 7-10 Years Battery Life
- Pressure Up to 150 psi
- Capacity Up to 9,000 cfh (base rating)
- Large Rangeability, 400:1

Dattus™ fM2 Gas Meter

Operating Principle

The operation of the Dattus meter is based on the fluidic oscillation principle. The measurement unit is comprised of three functional elements:

- Flow conditioner
- Jet nozzle formation
- Fluidic oscillator chamber

Gas enters (1) the meter and divides into two separate flow paths (2). These two flows recombine (3) as they exit the flow conditioner and enter the fluidic oscillation chamber through the nozzle. This process of dividing the flows eliminates upstream disturbances and creates a well-conditioned flow.

In the fluidic oscillation chamber, a jet is formed (4) as the gas enters through the nozzle. The jet then starts oscillating back and forth (5).

Thermal sensors, located just after the nozzle, detect a temperature variance as the gas jet passes from one side to the other. The volume of gas passed through the meter is obtained by counting the number of oscillations detected by the sensors.

Meter Configuration

Dattus gas meters are available as:

- Basic—the standard meter features and fixed factor capabilities
- Temperature Correction—the basic version with temperature probe mounted in the gas flow.

Standard Features

The basic meter performs volume metering based on the gas pressure and temperature in the meter. The functions available are shown below:

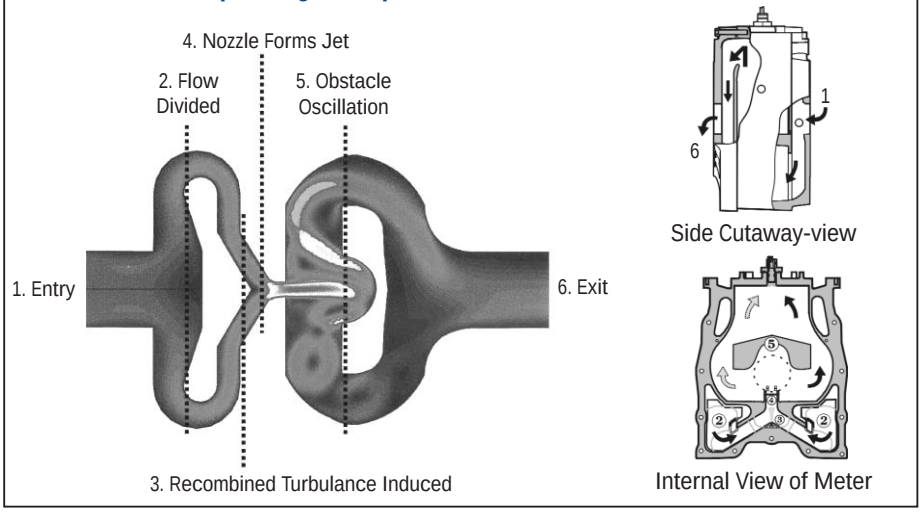
- Gas volume totaling
- Fixed factor correction
- Non-volatile memory for storing values and data
- Optical communication port for reading/writing of values
- Eight item programmable display
- Magnetic switch to change display values

Optional Features:

In addition to the standard functionality of the basic configuration, the following options can be added:

- Temperature correction using a temperature probe mounted in the gas flow
- Volume and alarm pulse outputs
- Push button to change display values
- Gas Micro electronic volume corrector (EVC)

Operating Principle of the Measurement Unit



Specifications

Meter Type:	Dattus
Meter Model:	fM2
Comparable Meters:	3,000 acfh to 9,000 acfh
Flanges:	2" and 3" ANSI 125
Flange to Flange Length:	6.75"
Maximum Allowable Operating Pressure (MAOP):	150 psig
Temperature Range:	-40°F to 140°F
Display:	Configurable up to 8 digits to show meter quantities and alarms

Rangeability

Dynamic Range:	400:1
Minimum Flow Rate:	22 acfh
Maximum Flow Rate:	9,000 acfh

Pulse Output

Pulse type:	Low frequency, standard Namur
Form type:	A
Pulse duration:	250 ms
Pulse Value:	User Scalable

Temperature Probe

Type:	PT1000, platinum resistance thermistor (RTD)
Typical accuracy:	0.1% of absolute measurement

Construction

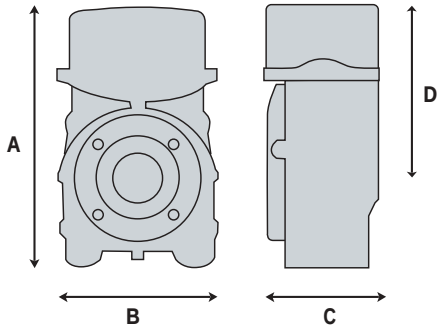
Measurement Unit:	Cast aluminum A356T6
External Cover:	ASA (Acrylonitrile Styrene Acrylate)
Index Housing:	UV stabilized polycarbonate

Weight

37 Lbs.

Dattus fM2 Dimensions (Inches)

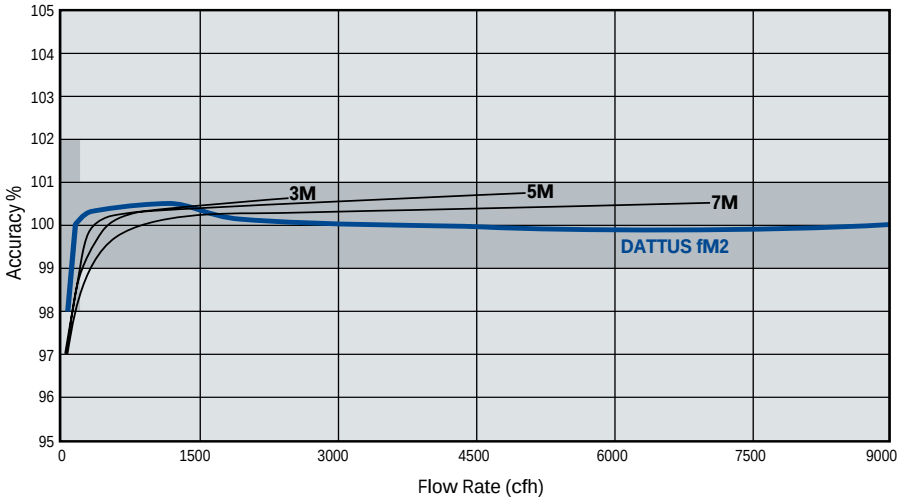
A	B	C	D	Thread Depth
16.5"	10.6"	6.75"	10.0"	1.00"



Flange Type	Bolt Pattern Diameter*
ANSI 125 2"	4.75"
ANSI 125 3"	6.00"

Note: Flanges receive four 1-3/4" x 5/8"-11 UNC 2B Bolts

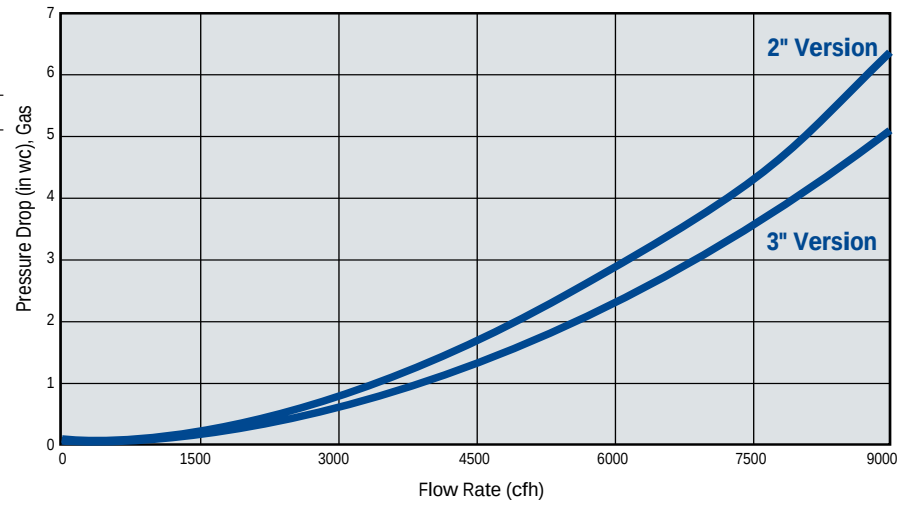
Dattus Accuracy and Rotary Meter Comparison



Pressure Drop, Gas (0.6 Specific Gravity) @ Atmospheric Conditions

Dattus Model	Flange Version	Flow Rate (acfh)	Pressure Drop gas (in w.c.)	Dynamic Range, +/- 2%	Dynamic Range, +/- 1%
fM2	2"	**9000**	**6.38**	**409:1**	**150:1**
		7968	5.00	362:1	133:1
		7000	**3.89**	**318:1**	**116:1**
		5000	**2.06**	**227:1**	**83:1**
		4918	2.00	225:1	82:1
		3481	1.00	158:1	58:1
		3000	**0.75**	**136:1**	**50:1**
		2457	0.50	112:1	41:1
	3"	**9000**	**5.06**	**409:1**	**150:1**
		8905	5.00	405:1	148:1
		7000	**3.14**	**318:1**	**116:1**
		5535	2.00	252:1	92:1
		5000	**1.64**	**227:1**	**83:1**
		3871	1.00	176:1	65:1
		3000	**0.61**	**136:1**	**50:1**
		2750	0.50	125:1	46:1

Pressure Drop (2" and 3" Version)



Dattus Capacities at Indicated Metering Pressures

Metering Pressure PSIG	1	5	25	60	100	150	175
MSCFH	9.6	12.0	24.3	45.7	70.1	100.6	115.9

Warranty

Actaris Metering Systems, 970 Highway 127 North, Owenton, Kentucky 40359-9802, warrants this gas product against defects in materials and workmanship for the earlier of one (1) year from the date the product is shipped by Actaris or a period of one year from the date the product is installed by Actaris at the original purchaser's site. During such one-year period, provided that the original purchaser continues to own the product, Actaris will, at its sole option, repair any defects, replace the product or repay the purchase price.

This warranty will be void if the purchaser fails to observe the procedures for installation, operation or service of the product as set forth in the Operating Manual and Specifications for the product or if the defect is caused by tampering, physical abuse or misuse of the product.

Actaris specifically disclaims all implied warranties including those of merchantability or of fitness for a particular purpose. Under no circumstances will Actaris be liable for incidental or consequential damages of any kind whatsoever.

Actaris' liability for any claim of any kind, including negligence and breach of warranty for the sale and use of any product covered by or furnished, shall in no case exceed the price allocable to the product or part thereof which gives rise to the claim.

In the event of a malfunction of the product, consult your Actaris Service Representative or Actaris Metering Systems, 970 Highway 127 North, Owenton, Kentucky 40359-9802. (800) 490-0657

Reference Information

- Dattus™ Technical Reference Guide document no. GA-0007-GB-04.01, part no. DO202201

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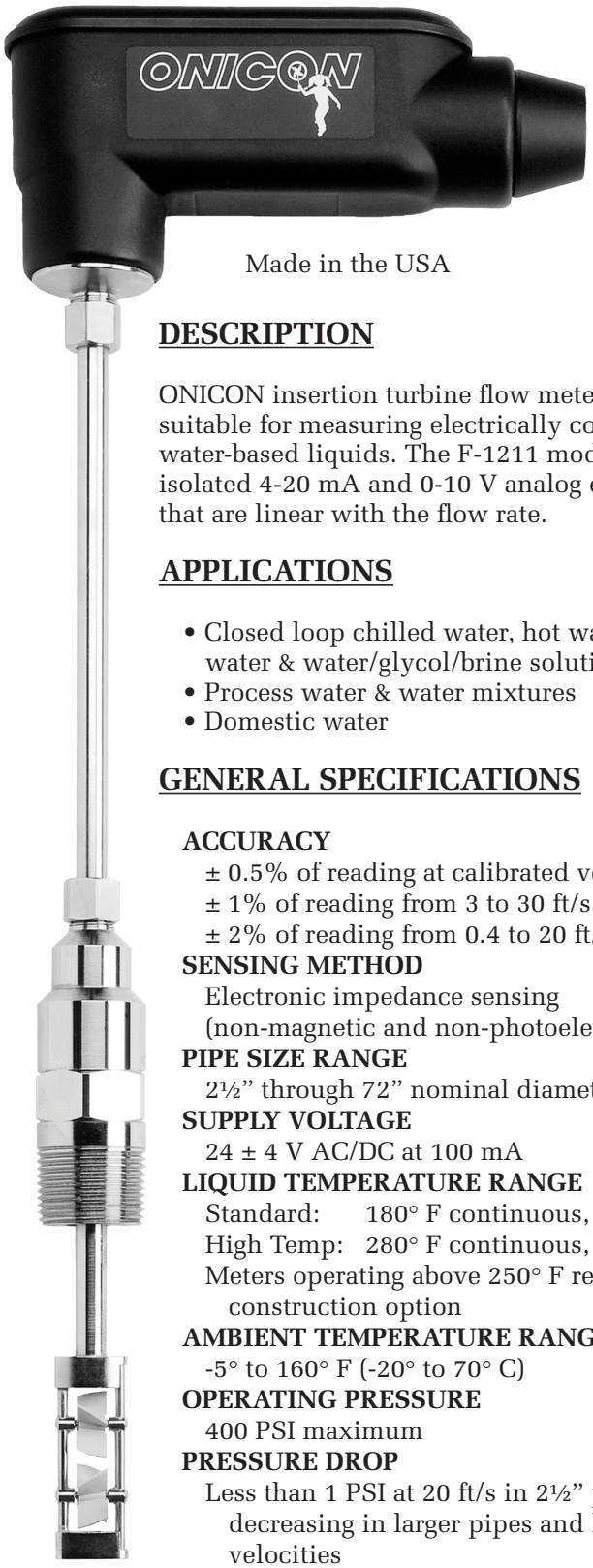
ACTARIS
metering systems



• F-1211 DUAL TURBINE •
INSERTION FLOW METER
ISOLATED ANALOG OUTPUT

ONICON INCORPORATED

Made in the USA

DESCRIPTION

ONICON insertion turbine flow meters are suitable for measuring electrically conductive water-based liquids. The F-1211 model provides isolated 4-20 mA and 0-10 V analog output signals that are linear with the flow rate.

APPLICATIONS

- Closed loop chilled water, hot water, condenser water & water/glycol/brine solutions for HVAC
- Process water & water mixtures
- Domestic water

GENERAL SPECIFICATIONS

ACCURACY
± 0.5% of reading at calibrated velocity
± 1% of reading from 3 to 30 ft/s (10:1 range)
± 2% of reading from 0.4 to 20 ft/s (50:1 range)

SENSING METHOD
Electronic impedance sensing
(non-magnetic and non-photoelectric)

PIPE SIZE RANGE
2½" through 72" nominal diameter

SUPPLY VOLTAGE
24 ± 4 V AC/DC at 100 mA

LIQUID TEMPERATURE RANGE
Standard: 180° F continuous, 200° F peak
High Temp: 280° F continuous, 300° F peak
Meters operating above 250° F require 316 SS construction option

AMBIENT TEMPERATURE RANGE
-5° to 160° F (-20° to 70° C)

OPERATING PRESSURE
400 PSI maximum

PRESSURE DROP
Less than 1 PSI at 20 ft/s in 2½" pipe, decreasing in larger pipes and lower velocities

OUTPUT SIGNALS PROVIDED
Analog Output (isolated)
Voltage output: 0-10 V (0-5 V available)
Current output: 4-20 mA
Frequency Output
0 – 15 V peak pulse, typically less than 300 Hz

(continued on back)

CALIBRATION

Every ONICON flow meter is wet calibrated in our flow laboratory against primary volumetric standards that are directly traceable to N.I.S.T. A certificate of calibration accompanies every meter.

FEATURES

Unmatched Price vs. Performance - Custom calibrated, highly accurate instrumentation at very competitive prices.

Excellent Long-term Reliability - Patented electronic sensing is resistant to scale and particulate matter. Low mass turbines with engineered jewel bearing systems provide a mechanical system that virtually does not wear.

Industry Leading Two-year "No-fault" Warranty - Reduces start-up costs with extended coverage to include accidental installation damage (miswiring, etc.) Certain exclusions apply. See our complete warranty statement for details.

Simplified Hot Tap Insertion Design - Standard on every insertion flow meter. Allows for insertion and removal by hand without system shutdown.

OPERATING RANGE FOR COMMON PIPE SIZES
0.17 TO 20 ft/s
±2% accuracy begins at 0.4 ft/s

Pipe Size (Inches)	Flow Rate (GPM)
2 ½	2.5 - 230
3	4 - 460
4	8 - 800
6	15 - 1,800
8	26 - 3,100
10	42 - 4,900
12	60 - 7,050
14	72 - 8,600
16	98 - 11,400
18	120 - 14,600
20	150 - 18,100
24	230 - 26,500
30	360 - 41,900
36	510 - 60,900

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www.onicon.com • sales@onicon.com

F-1211 SPECIFICATIONS cont.

MATERIAL

Wetted metal components:
- Standard: Electroless nickel plated brass
- Optional: 316 stainless steel

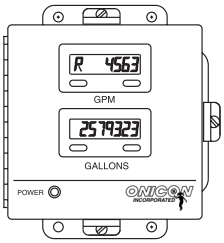
ELECTRONICS ENCLOSURE
- Standard: Weathertight aluminum enclosure
- Optional: Submersible enclosure

ELECTRICAL CONNECTIONS

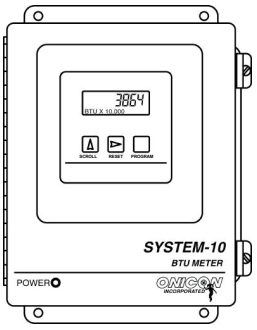
4-wire minimum for 4-20 mA or 0-10 V output

Second analog output and/or frequency output requires additional wires
- Standard: 10' of cable with ½" NPT conduit connection
- Optional: Indoor DIN connector with 10' of plenum rated cable

ALSO AVAILABLE



Display Modules



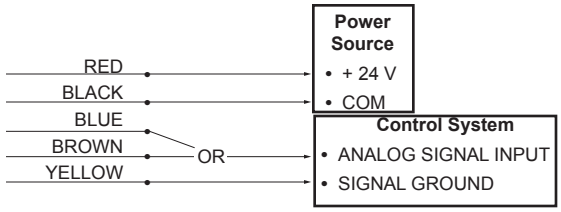
Btu Measurement Systems

F-1211 Wiring Information

WIRE COLOR	DESCRIPTION	NOTES
RED	(+) 24 V AC/DC supply voltage, 100 mA	Connect to power supply positive
BLACK	(-) Common ground (Common with pipe ground)	Connect to power supply negative
GREEN	(+) Frequency output signal: 0-15 V peak pulse	Required when meter is connected to local display or Btu meter
BLUE	(+) Analog signal: 4-20 mA (isolated)	Use yellow wire as (-) for these signals. Both signals may be used independently.
BROWN	(+) Analog signal: 0-10 V (isolated)	
YELLOW	(-) Isolated ground	Use for analog signals only
DIAGNOSTIC SIGNALS		
ORANGE	Bottom turbine frequency	These signals are for diagnostic purposes - connect to local display or Btu meter
WHITE	Top turbine frequency	

F-1211 Wiring Diagram

Flow meter in control system (no display or Btu meter)



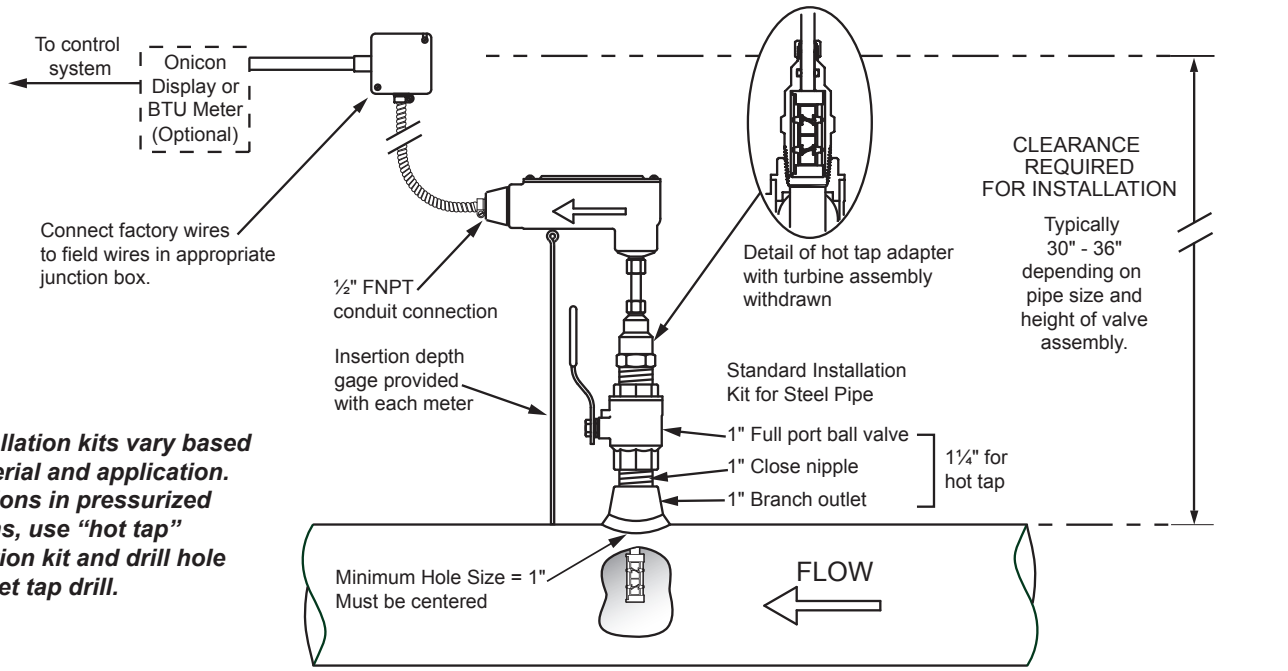
NOTE: 1. Black wire is common with the pipe ground (typically earth ground.)

2. Frequency output required for ONICON display module or Btu meter, refer to wiring diagram for peripheral device.

Typical Meter Installation
(New construction or scheduled shutdown)

- Acceptable to install in vertical pipe
- Position meter anywhere in upper 240° for horizontal pipe

Horizontal Run Pipe



NOTE: Installation kits vary based on pipe material and application. For installations in pressurized (live) systems, use "hot tap" 1¼" installation kit and drill hole using a 1" wet tap drill.

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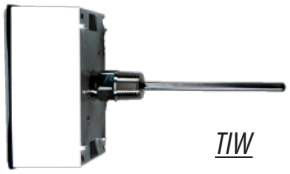
TI SERIES


TID


TIG


TIW


TIH

NOTICE

- This product is not intended for life or safety applications.
- Do not install this product in hazardous or classified locations.
- Read and understand the instructions before installing this product.
- Turn off all power supplying equipment before working on it.
- The installer is responsible for conformance to all applicable codes.

TI SERIES

Immersion Temperature Sensors

Installer's Specifications

Wiring		22AWG; 2-wire:RTD Thermistor, 4-20mA; 3-wire: Voltage output models
Probe		Stainless Steel
Test Pressure		200psi
Linitemp:		
Input Power		5 to 30VDC
Output		1µA/°C or 10mV/°C
Operating Temperature		-25° to 105°C (-13° to 221°F)
Accuracy	Calibration Error:	1.5°C (35°F) typical; 2.5°C (37°F) max. at 25°C (77°F)*
	Error over Temperature:	1.8°C typical (35°F); 3.0°C (34°F) max. over 0° to 70°C (32° to 158°F) range 2.0°C (35°F) typical, 3.5°C (38°F) max. over -25° to 105°C (-13° to 221°F) range

**Room temperature error documented on each unit.*

QUICK INSTALL

1. Thread assembly into a pipe fitting.
2. Wire as shown (see Wiring section).

PRODUCT IDENTIFICATION

TI [ ] [ ] [ ] [ ] [ ] [ ]

Enclosure	Immersion Probe Length "L"	Thermowell	Sensor Type	Options: Cal Certificate	Options: Threads
D = Duct	A = 2 1/2" (64mm)	0 = None	B = 100R Platinum, RTD	0 = None	Blank = NPT
G = Service Entry Body	B = 4" (102mm)	1 = Add Thermowell	C = 1k Platinum, RTD	1 = 1 point Cal validation	A = BSPT
H = Threaded NPT Only	C = 6" (152mm)		D = 10k T2, Thermistor	2 = 2 point Cal validation	B = DIN 2999
W = Water resistant housing	D = 8" (203mm)		E = 2.2k, Thermistor		
	E = 12" (305mm)		F = 3k, Thermistor		
			G = 10k CPC, Thermistor		
			H = 10k, T3, Thermistor		
			J = 10k Dale, Thermistor		
			K = 10k w/11k shunt,Thermistor		
			M = 20k NTC, Thermistor		
			N = 1800 ohm, Thermistor		
			P = 10mV/°C, Linitemp		
			R = 10k US, Thermistor		
			S = 10k 3A221, Thermistor		
			T = 100k, Thermistor		
			U = 20k "D", Thermistor		

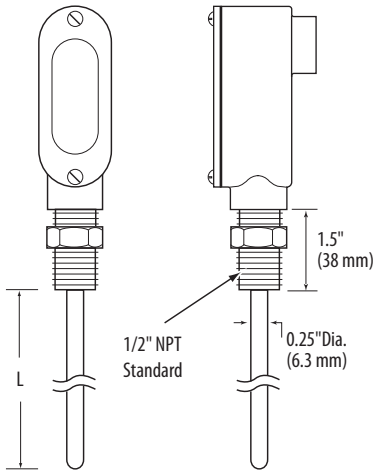
Thermowell Sizing

	Probe Length	Thermowell Length
A	(2 1/2") (64mm)	1 1/2" (38mm)
B	(4") (102mm)	3" (76mm)
C	(6") (152mm)	5" (127mm)
D	(8") (203mm)	7" (178mm)
E	(12") (305mm)	11" (279mm)

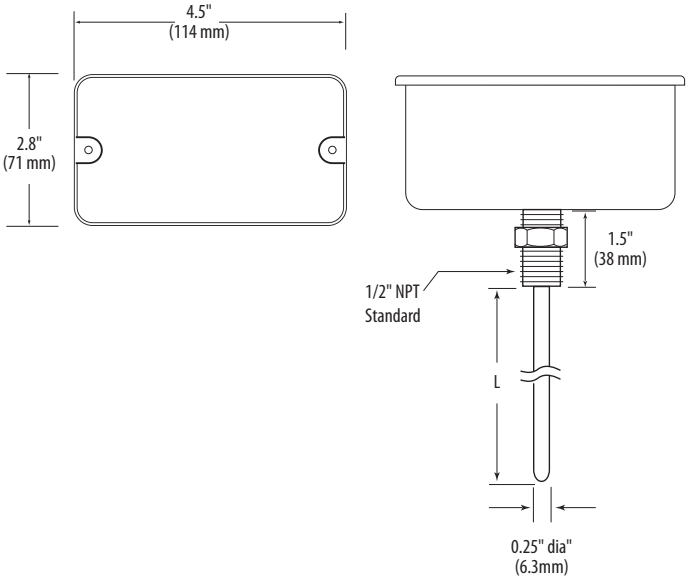
  USA 800.354.8556 or +1(0)503.598.4564 / support@veris.com

DIMENSIONS

TIG Model

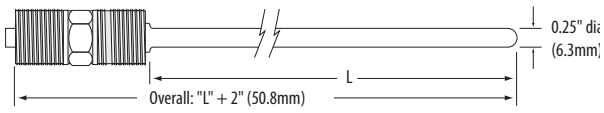


TIW Model

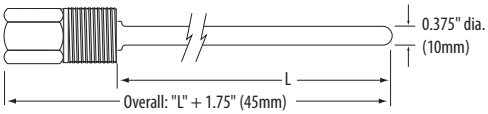


TIH Model

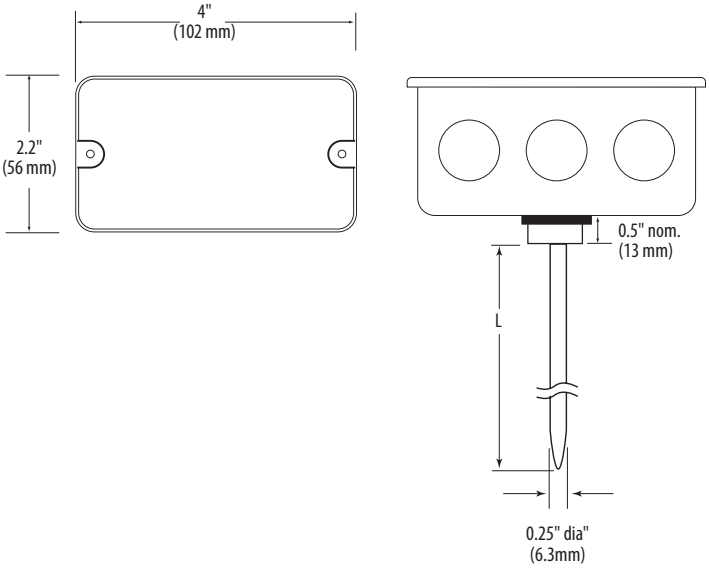
Immersion Probes



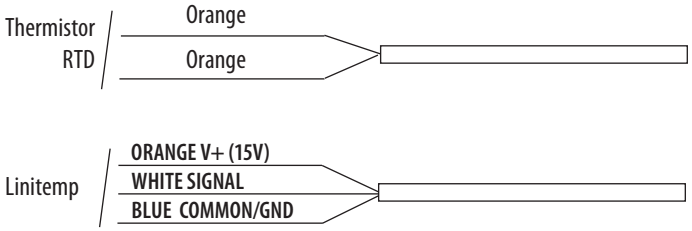
Thermowells



TID Model

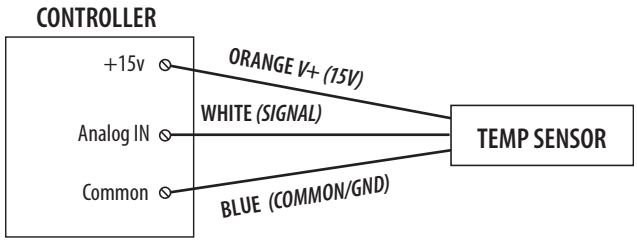


WIRING



NOTE: All linitemp units are standard 3-wire 10m V/C. For 1µ A/C (2-wire) connect +15V (orange) and (white) signal wire. The (blue) wire is not connected.

3-Wire 10m V/C



2-Wire 1µ A/C