

# LeFrack West Side Manor

70 West 95<sup>th</sup> Street

New York, NY 10025

As-Built December 2020

*Submitted to:*

**Frontier Energy**  
2695 Bingley Road  
Cazanovia, NY 13035

*Submitted by:*

**Tecogen, Inc.**  
45 First Ave  
Waltham, MA 02451  
781.466.6400  
[www.Tecogen.com](http://www.Tecogen.com)

# ***Measurement & Verification Plan for CHP System at West Side Manor***

---

## **Project Team:**

### **Principal Engineer:**

MGE Engineering D.P.C.  
116 West 32nd Street  
New York, NY 10001  
T: 212.643.9055  
<https://www.mgedpc.net/>

### **Developer/Contractor:**

Rick Christian  
Application Engineer Manager  
Tecogen, Inc.  
45 First Avenue  
Waltham, MA 02451  
T: 732.208.8548  
E: [rchristian@tecogen.com](mailto:rchristian@tecogen.com)

### **Site Contact:**

Jared Rodriguez  
Realty Operations Group  
40 W 57<sup>th</sup> Street  
15<sup>th</sup> Floor  
New York, NY 10019  
T: 212.708.6697  
E: [JRodriguez@realtyoperations.com](mailto:JRodriguez@realtyoperations.com)

# Measurement & Verification Plan for CHP System at West Side Manor

---

## 1. Introduction

Tecogen, Inc. (Tecogen) provided equipment and managed the installation of a combined heat and power (CHP) system at West Side Manor. The Principal engineer designed the project and oversaw the installation. The site is receiving an incentive from NYSERDA, of which the first two milestones have been paid out in full. The CHP system includes one (1) Tedom Micro T35 engine generator unit. The induction-based system is intended to produce a gross output of 35 kW and recover engine jacket water and exhaust heat recovery for the Domestic Hot Water system. A single load DHW load module was designed and provided by Tecogen for integration into the site's hot water system.

The CHP system will provide power in parallel with the existing utility service only, with no capabilities to energize itself during outages. This system will not be providing backup power to the site..

## 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 and installed by Tecogen. 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

Tecogen installed a CHPInsight panel in the cogen room right next to the CHP unit. 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 West Side Manor

## On Site Support

The facility has assisted in providing a network connection for the CHPInsight. Tecogen is responsible for providing a complete monitoring installation, as well as any access for return 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 <sub>NET</sub>	EM-1	Generator NET Electrical Output	kW/ kWh	Veris E50C2	ModBus	CHP Room
P <sub>OUT</sub>	POWER	Generator Gross Electrical Output	kW/ kWh	Tedom Micro T-35	On-Board	CHP Room
G <sub>IN</sub>	GM-1	Net Generator Fuel Input	CF	3M175TC Roots Meter with Adam4150 Counter	Pulse	Garage/Gas Inlet
T <sub>OUT1</sub>	TS2-BTU	Engine Heating Module Supply Temperature	°F	Onicon System-10	ModBus	CHP Room
T <sub>RET1</sub>	TS1-BTU	Engine Heating Module Return Temperature	°F	Onicon System-10	ModBus	CHP Room
F <sub>NET1</sub>	FM-1	Engine Heating Module System Flow	GPM	Onicon System-10	ModBus	CHP Room
Q <sub>NET1</sub>	BTU-1	CHP Engine Heat Supplied	BTUh	Onicon System-10 Calculation	ModBus	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:

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

#### Net Power Output

The power meter will measure the generator power output (P<sub>OUT</sub>). The internal generator meter will measure the gross output of the engine generator as a check.

The parasitic power (P<sub>PAR</sub>) is estimated to be 1.5 kW. The net power (P<sub>NET</sub>) can be determined by subtracting parasitic power (P<sub>PAR</sub>) from the power output (P<sub>OUT</sub>).



# Measurement & Verification Plan for CHP System at West Side Manor

---

$$kW_{NET} = P_{OUT} - P_{PAR}$$

## 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 generator net output (kWh)  
 $G_{in}$  = Generator gas consumption (Std CF)  
 $HHV_{gas}$  = Higher heating value for natural gas ( $\sim 1020$  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*







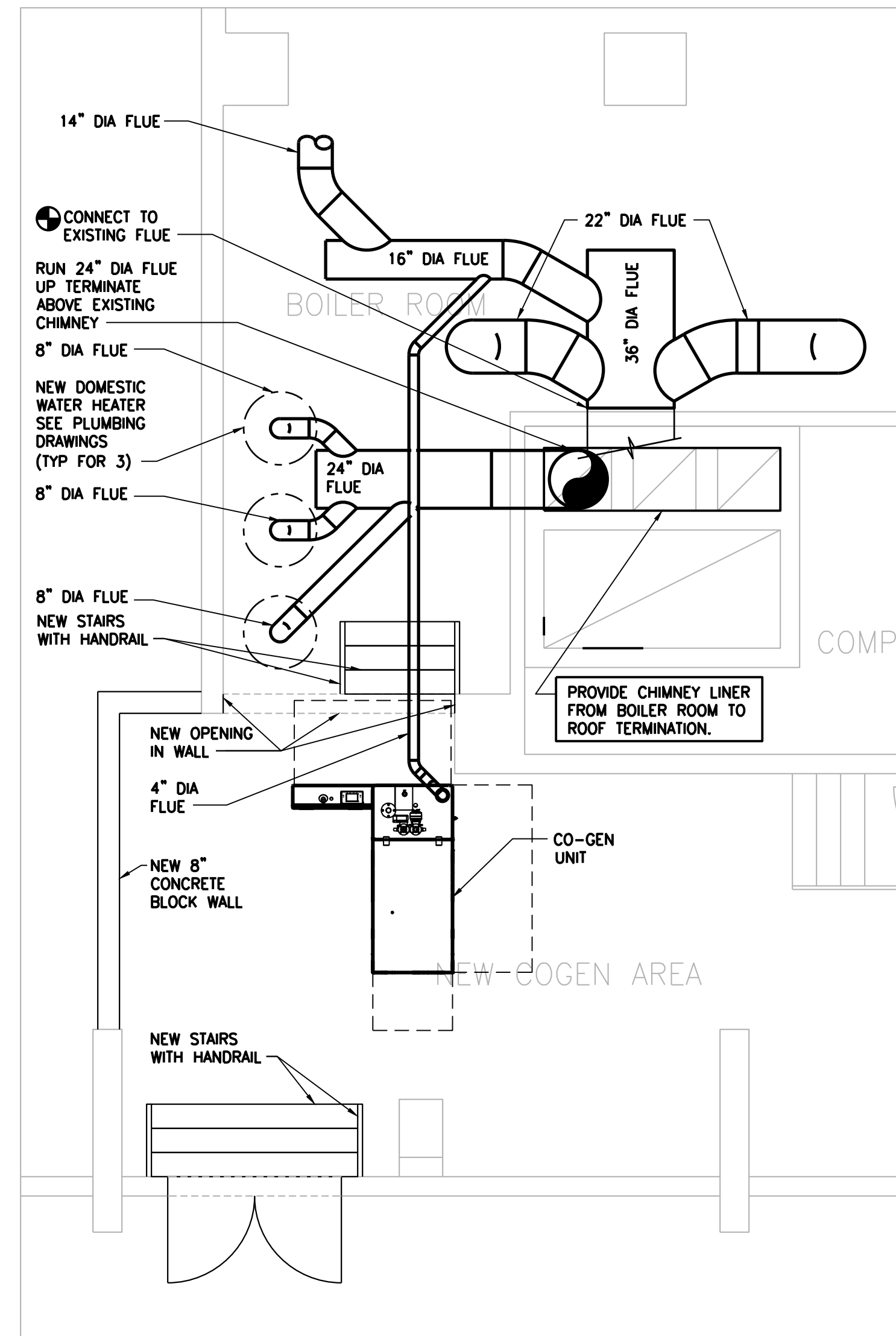
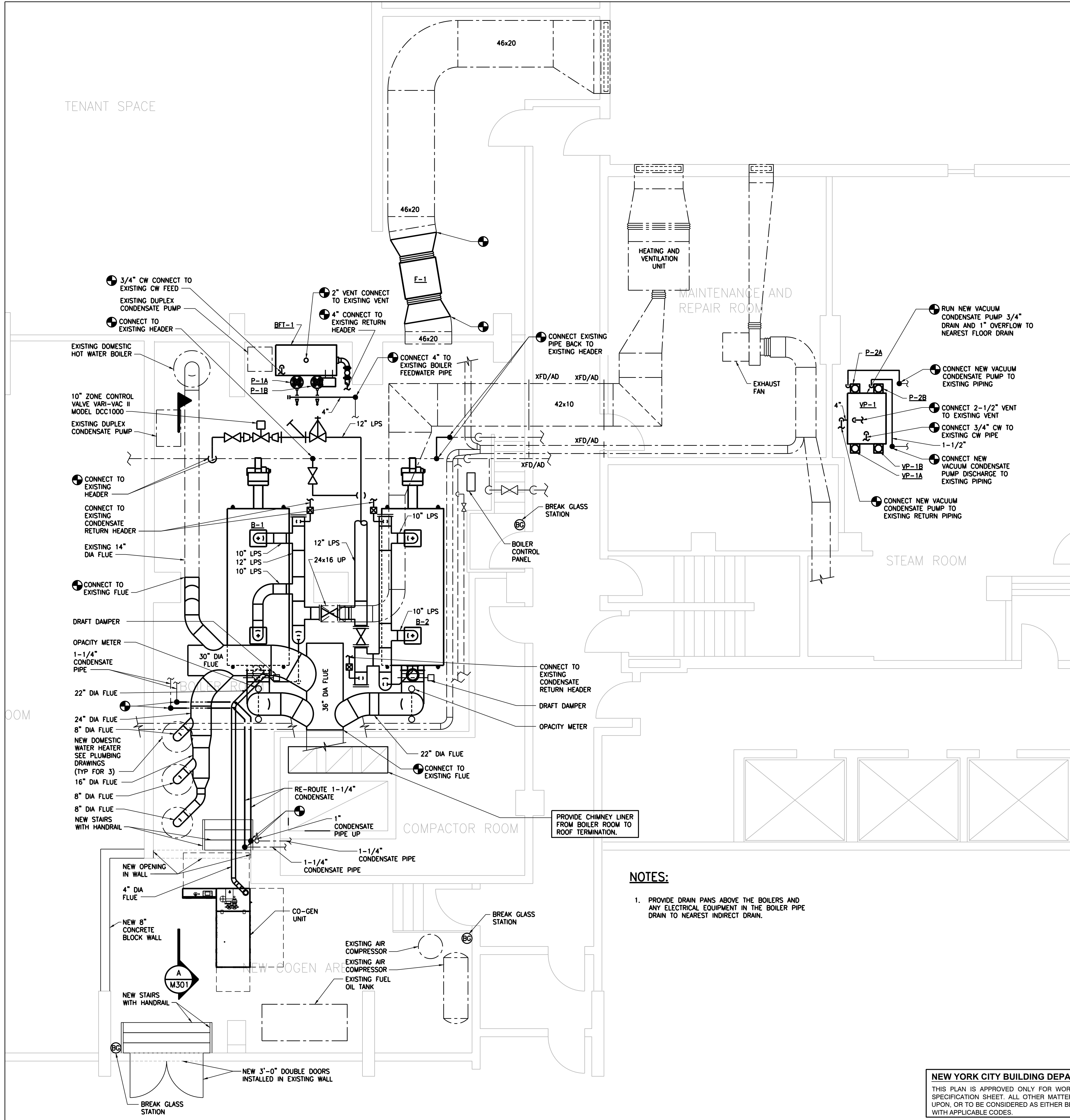








TENANT SPACE



**ADD ALTERNATE NO.1 - SEPARATE STACK FOR DOMESTIC WATER HEATERS**  
 SCALE: 1/4"=1'-0"

**NOTES:**

1. PROVIDE DRAIN PANS ABOVE THE BOILERS AND ANY ELECTRICAL EQUIPMENT IN THE BOILER PIPE DRAIN TO NEAREST INDIRECT DRAIN.

**NEW YORK CITY BUILDING DEPARTMENT APPROVAL NOTE**  
 THIS PLAN IS APPROVED ONLY FOR WORK INDICATED ON THE APPLICATION SPECIFICATION SHEET. ALL OTHER MATTERS SHOWN ARE NOT TO BE RELIED UPON, OR TO BE CONSIDERED AS EITHER BEING APPROVED OR IN ACCORDANCE WITH APPLICABLE CODES.

**NEW YORK CITY ENERGY CONSERVATION CODE**  
 TO THE BEST OF MY KNOWLEDGE, BELIEF AND PROFESSIONAL JUDGMENT, THESE PLANS AND SPECIFICATIONS ARE IN COMPLIANCE WITH THE 2016 NEW YORK CITY ENERGY CONSERVATION CODE.

05/11/17	ISSUED FOR BID	
04/28/17	ISSUED FOR 90%	
04-03-17	ISSUED FOR REVIEW	
NO.	DATE	REVISION

PROJECT:  
**BOILER UPGRADE**  
 70 WEST 95TH STREET, NEW YORK, NY

DRAWING TITLE:  
**BASEMENT MECHANICAL NEW WORK PLAN**

SEAL & SIGNATURE:	DATE: 02.22.2017
	PROJECT No: 7720.00
	DRAWING BY: JJT
	CHK BY: TJF
	SCALE: 1/4"=1'-0"
	DWG No:
	<b>M-101.00</b>
CADD FILE:	DOB page: 2 OF 9













**Basic Characteristics**

The Micro series CHP units are combined energy sources that produce heat and power by combusting gas. Basic properties of the Micro Series CHP Units: high efficiency, compactness, long service life of the oil charge and associated long service interval, they all rank these products among the state-of-the-art energy sources intended to heat the smaller buildings.



**Basic Technical Data**

Description of CHP unit:  
The CHP unit is intended for the natural gas combustion, AP - fitted with asynchronous generator operating in parallel to the grid.

	Imperial	Metric
Nominal electrical output		35 kW
Maximum heat output	238,000 BTU	69.9 kW
Fuel input	375,000 BTU	110 kW
Heat Rate	10,700 BTU/kWh	
Electrical efficiency		32.0 %
Heat efficiency		63.5 %
Total efficiency (fuel utilization)		95.5 %
Gas consumption at 100% output	411.4 CFH	11.6 m <sup>3</sup> /hr
Gas consumption at 75% output	340.4 CFH	9.6 m <sup>3</sup> /hr
Gas consumption at 50% output	258.8 CFH	7.3 m <sup>3</sup> /hr

The Basic Technical Data are applicable for the standard conditions pursuant to the "Technical instructions" document  
The required min. permanent electrical output is 50 % of the nominal output  
Gas consumption is expressed under the conditions (15°C, 101.325 kPa / 59°F, 14.7 PSI; Low Heat Value of 912.18 BTU/CF)  
The technical data are specified for the temperatures ranging within 65/85°C

**Observance of Emission Limits**

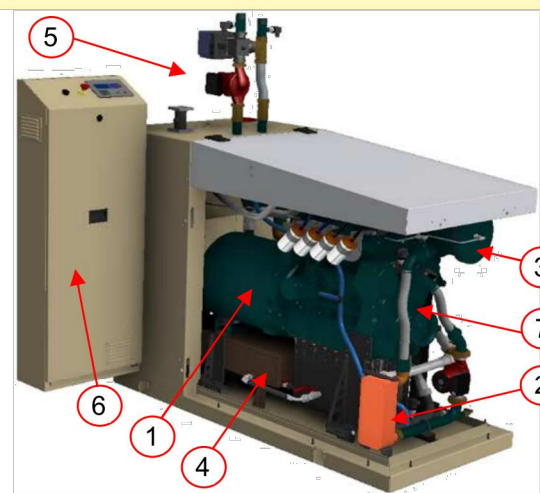
CHP unit complies with the emission limits according to the new source performance standards (NSPS) for stationary internal combustion engines (SICE), - 40 CFR Part 60 Subpart JJJJ:

Emissions	CO	NOx	VOC
At 15 % O <sub>2</sub> in exhaust gas	2 g/bHp - hr	1 g/bHp - hr	0.7 g/bHp - hr
Option	0.05 g/bHp - hr	0.05 g/bHp - hr	0.7 g/bHp - hr

**Reference Description of CHP Unit**

The CHP unit is composed of the engine-generator set, complete heating unit, including the power switchboard that allows parallel operation to the 480V/60Hz grid. All the elements are installed under the sound enclosure. The hot-water circuits are adapted to the temperature drop of 20°C/36 °F.

- 1) Generator
- 2) Plate heat exchanger
- 3) Exhaust heat exchanger
- 4) Oil tank
- 5) Connection interface (see the last sheet)
- 6) Power switchboard
- 7) Combustion engine



**Engine**

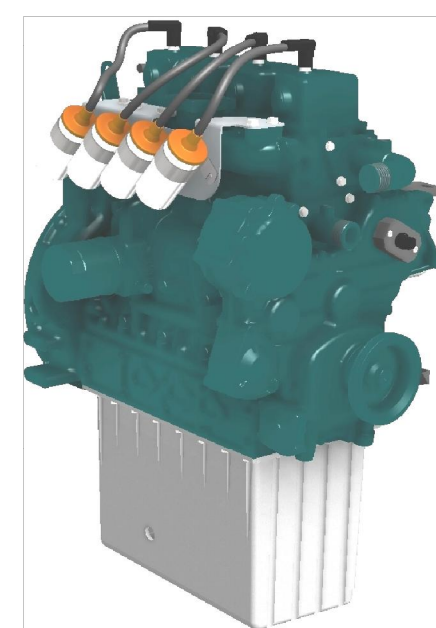
The V3800 gas combustion engine, the product of TEDOM, used to drive the CHP unit has the basic parameters given in the table below:

Number of cylinders	4
Arrangement of cylinders	in line
Bore x Stroke	100x 120 mm
Displacement	230 cui
Compression ratio	13 : 1
Speed	1800 rpm
Oil consumption, normal / max.	0.3/0.6 g/kWh
Max. mechanical engine output	40 kW

**Generator**

Electrical energy is supplied by the AS 225 type asynchronous generator manufactured by Zanardi, Italy, with the basic parameters given in the table below:

Generator output	36 kW
Cos φ	0.81
Efficiency in the working point	92.9 %
Winding switched on by	Y/D switch
Voltage	280 / 480 V
Frequency	60 Hz



Illustrative picture

**Thermal System**

In terms of the heat output extraction (obtained by cooling the combustion engine and exhaust gases), the CHP unit's thermal system consists of the hydraulic circuit which ensures delivery of the heat output of the CHP unit to the user's heating system. The CHP unit allows operation in various temperature modes. The CHP unit's thermal system is equipped with circulating pump.

**Hydraulic Circuit Parameters:**

	Imperial	Metric
Total system heat recovery	238,000 BTU/hr	69.9 kW
Nominal flow rate	13.16 GPM	0.83 kg/s
Max. working pressure	87 PSI	600 kPa
Water volume in CHP unit circuit	6.6 gal	25 l
Pressure loss at the nominal flow rate <sup>1)</sup>	4.4 PSI	30 kPa
Pressure reserve at the nominal flow rate <sup>2)</sup>	7.3 PSI	50 kPa
Maximum return water temperature	158°F	70 °C
Min. admissible return water temperature	104°F	40 °C
Nominal temperature drop between output and return water	36°F	20 °C

1) If the circuit pump is not used  
2) If the circuit pump is used

If marginal operation modes do not allow removal of the circuit's complete heat output, this output, or its part, can be removed by the emergency cooling unit that can be delivered separately.

**Fuel, Gas Inlet**

Technical parameters given in this Specification are applicable for the natural gas of the properties stated below.

	Imperial	Metric
Low Heat value	912.18 BTU/CF	34 MJ/m <sup>3</sup>
Min. methane number	80	
Gas pressure	0.3 + 1.45 PSI	2 + 10 kPa
Max. pressure change under varying consumption	10 %	
Max. gas temperature	95°F	35 °C

Gas train of the unit is composed according to the NFPA 37 and contains gas filter, combined gas armature, which fulfill following functions:

- double quick-closing electromagnetic valve for gas inlet closing at unit stop
- zero governor suitable for mixing
- elastic connection by metal hose with gas mixer

Gas fixture of suitable size with adequate accumulation volume is required for the correct operation of CHP unit to avoid gas pressure drop in the distribution system at the moment of incremental gas uptake. The gas fixture must be terminated with manual gas stop and fitted with pressure gauge.

**Combustion Air, Exhaust Gas and Condensate Outlet**

Combustion air is sucked from surrounding through cold space of the unit. The exhaust gases are removed from unit by the exhaust piping (duct system) connected on the CHP unit flange. Exhaust piping from unit flange to chimney uptake has to be tight. The piping must be down-graded in the direction from the CHP unit. Eventually, the condensate, which could arise at CHP unit operation is evaporated and blow-off together with exhaust gases. Material of exhaust piping and heat isolation of duct system in machine room must be resistant to temperatures up to 200°C / 392°F at least. Maximal pressure loss of whole duct system cannot exceed 10 mbar / 0.15 PSI. Machine construction does not request any forced ventilation.

	Imperial	Metric
Amount of combustion air	62.3 CFM	106 Nm <sup>3</sup> /hr
Required combustion air rate <sup>1)</sup>	50 to 95 °F	35 °C
Exhaust gas temperature, nominal / max	248/302 °F	120/150 °C
Max. back-pressure of exhaust gases downstream the flange	0.15 PSI	10 mbar
Amount of exhaust gases	69 CFM	117 Nm <sup>3</sup> /hr

**Oil and Coolants**

	Imperial	Metric
Amount of lubrication oil in the engine	7.9 gal	30 l
Extension oil tank volume	5.3 gal	20 l
Amount of coolant in the primary circuit	2.4 gal	9 l

The heating water to charge the hydraulic circuit must be treated; its composition must correspond to the "Technical instructions" document.

**Noise Parameters**

Noise parameters indicate the acoustic pressure level measured in a free acoustic field. The noise may contain a tone component.

CHP unit's sound enclosure at 1 m	62dB(A)
Exhaust gas outlet at 1m from flange	59 dB(A)

**Color Version**

Engine, generator, inner parts of CHP unit, frame and tank	RAL 5001 (blue)
Sound enclosure	RAL 1001, 1013 (beige)

**Unit Dimensions and Weights**

	Imperial	Metric
Length (standard version)	76.8 in	1950 mm
Width, total	64.8 in	1645 mm
Height	72.3 in	1835 mm
Transport weight	2.426 lb	1100 kg

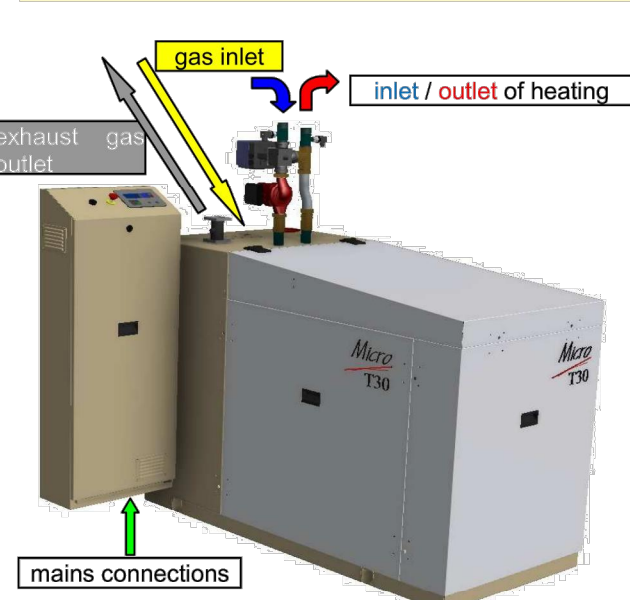
**Linked Source Materials**

- Dimensional sketch: MICRO T35 Drawing number R1504
- Generally binding documents according to the "Technical instructions" document

**Scope of Delivery**

- Standard**
- Complete CHP unit module
- Beyond the standard scope**
- Dry cooler for emergency cooling
  - Additional exhaust silencer

**Connection Points**



**TEDOM MICRO T35**  
Small Natural Gas Driven CHP Units\*

\* Biogas Micro T35 units are also available



Good sites for CHP have continuous demand for both electricity and hot water or heating.

- Hotels
- Condos, Co-ops & Apartments
- Hospitals & Nursing Homes
- Schools & Colleges
- Housing Authorities
- Swimming Pools
- Health Clubs & Fitness Centers
- Correctional Facilities
- Industrial Facilities
- Agricultural Operations
- Laundries

**Key Features & Benefits**

- **Total efficiency of more than 94% (LHV)** because you use the power and the heat. A remote and inefficient power plant can be only about 30% efficient.
- **"Plug and play"**. All in one design allows for very easy connection of the CHP unit into the building's heating system.
- **Very compact footprint**, easy access design with removable covers and a flexible control panel placement allow for installation in very restricted areas.
- **Constant engine speed**. The reliable industrial engine provides outstanding service life by running at a constant speed.
- **Super-silent operation** allows the unit to be located in noise sensitive areas.
- **Low emissions** meet even strict local emissions requirements.
- **Advanced engineering** with industry leading technology .
- **Remote monitoring and fast maintenance and repair** service from Tecogen's local network of service technicians.



**Micro T35 - Small Natural Gas CHP Units**

**Specifications: 1**

Fuel		Natural Gas	
Engine	TGE V3800 - manufactured by Tedom		
Generator	Asynchronous - AS 225 - manufactured by Zanardi Synchronous - ATEW 3414 1S - manufactured by Zanardi		
Electrical Output	35 kW	35 kW	
	SP	AP	
Maximum Heat Output		246,300 Btu/hr	238,500 Btu/hr
Electrical Efficiency	(HHV) <sup>2</sup>	27.6%	28.6%
	(LHV) <sup>2</sup>	30.9%	32.0%
Overall Efficiency	(HHV) <sup>2</sup>	84.6%	85.7%
	(LHV) <sup>3</sup>	94.8%	95.5%
Fuel Input	(HHV) <sup>2</sup>	432,200 Btu/hr	417,800 Btu/hr
	(LHV) <sup>3</sup>	385,000 Btu/hr	375,000 Btu/hr
Required Gas Pressure		4-40" wc	
Hot Water Flow	13.6 gpm	13.16 gpm	
Minimum Entering Water Temperature	104° F		
Maximum Leaving Water Temperature	194° F		
Emissions (SCAQMD & NJ DEP Compliant)			
NOx	1.0 / 0.15 <sup>1</sup> lb/MWh	1.0 / 0.15 <sup>1</sup> lb/MWh	
CO	2.0 / 0.15 <sup>1</sup> lb/MWh	2.0 / 0.15 <sup>1</sup> lb/MWh	
VOC	2 lb/MWh	2 lb/MWh	
Dimensions		76.8" L x 64.8" W x 72.3" H	
Weight		2,426 lbs	
Operating Temperature Range		50° F / 95° F	
Acoustic Level *	Sound Enclosure	62 dBa	
	Exhaust Gas	59 dBa	

1 All specification are +/- 5% and are subject to change without notice.  
2 HHV of 1020 Btu/scf (38 MJ/m<sup>3</sup>)  
3 LLV of 912.5 Btu/scf (38 MJ/m<sup>3</sup>)  
4 Lower emissions option

NYSIR Certified  
NFPA-70 Certified  
UL 2200 Certified  
CSAC22.2 No 14 Certified, CSAC22.2 No 100 Certified  
Lloyd's Register Quality Assurance - ISO9001 and ISO14001

For more information please visit [www.TTCogen.com](http://www.TTCogen.com) or call 781.466.6400

TTCogen is a joint venture of TEDOM & Tecogen  
45 First Avenue, Waltham, MA 02451

**NEW YORK CITY BUILDING DEPARTMENT APPROVAL NOTE**  
THIS PLAN IS APPROVED ONLY FOR WORK INDICATED ON THE APPLICATION SPECIFICATION SHEET. ALL OTHER MATTERS SHOWN ARE NOT TO BE RELIED UPON, OR TO BE CONSIDERED AS EITHER BEING APPROVED OR IN ACCORDANCE WITH APPLICABLE CODES.

**NEW YORK CITY ENERGY CONSERVATION CODE**  
EXEMPTION WHEN COMPLIANCE WITH FIRE PROTECTION, DETECTION, ALARM AND/OR SUPPRESSION REQUIREMENTS OF TITLE 28 AND/OR THE 2014 NEW YORK CITY CONSTRUCTION CODES CONFLICTS WITH 2016 NYCECC COMPLIANCE, THE TITLE 28 AND/OR 2014 CONSTRUCTION CODES SAFETY PROVISIONS WILL TAKE PRECEDENCE OVER CONFLICTING PROVISIONS IN 2016 NYCECC.



MGE Engineering D.P.C. / we engineer success  
116 West 32nd Street, 12th Floor, New York, N.Y. 10001  
P 212.643.9055 F 212.643.0503 www.mgedpc.net

05/11/17	ISSUED FOR BID	
04/28/17	ISSUED FOR 90%	
04-03-17	ISSUED FOR REVIEW	
NO.	DATE	REVISION

PROJECT: **BOILER UPGRADE**  
70 WEST 95TH STREET, NEW YORK, NY

DRAWING TITLE:  
**COGEN DETAILS**

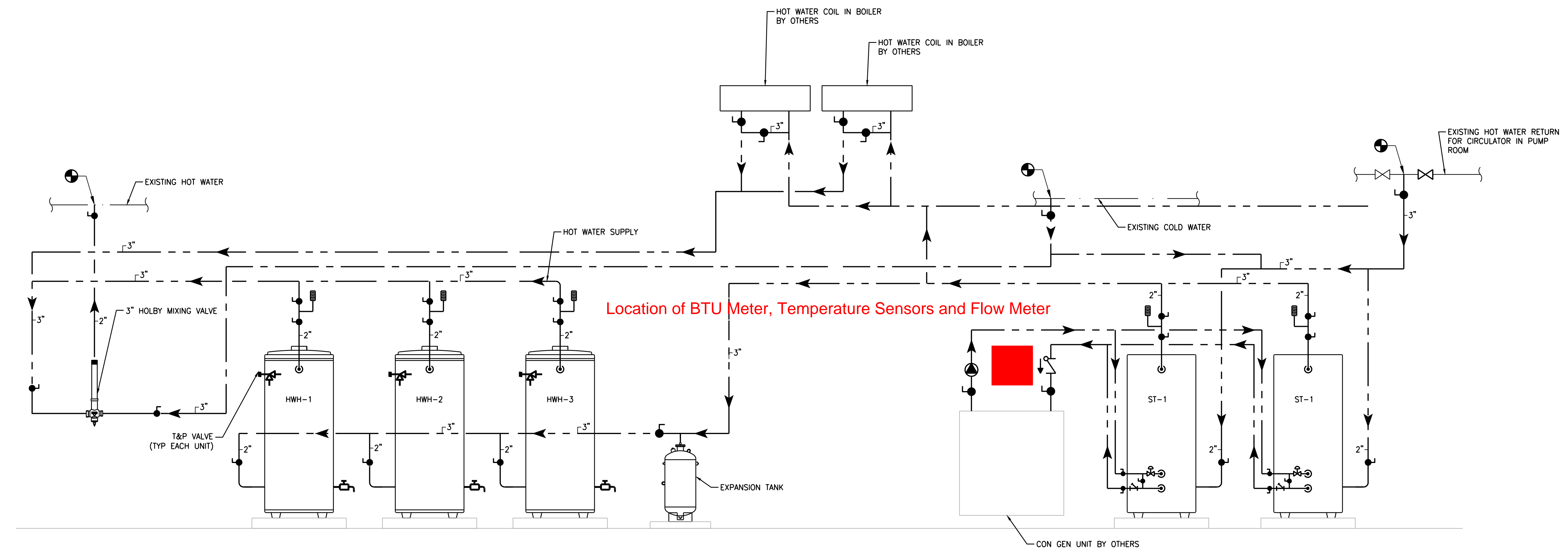
SEAL & SIGNATURE:	DATE: 02.22.2017
	PROJECT No.: 7720.00
	DRAWING BY: PTB
	CHK BY: PTB
	SCALE: N.T.S.
	DWG No:
	<b>P-501.00</b>
CADD FILE:	DOB page: 3 OF 5





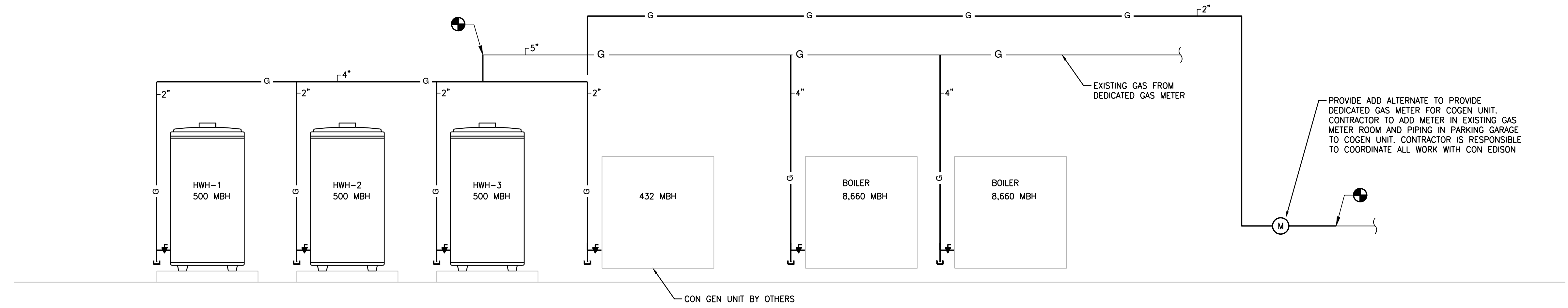
HOT WATER HEATER SCHEDULE											
HWH	LOCATION	TYPE	SERVICE	GPH	MBH	ELECTRICAL DATA				MODEL	REMARKS
						AMPS	PHASE	CYCLE	VOLTS		
HWH-1,2,3	BOILER ROOM	GAS	BUILDING	485	500	20	1	60	120	AO SMITH MASTER-FIT BTR-500	1. REFER TO MECHANICAL DRAWINGS FOR FLUE CONNECTIONS

HOT WATER WATER-TO-WATER HEAT EXCHANGER						
HWH	LOCATION	TYPE	SERVICE	GALLONS	MODEL	REMARKS
ST-1, 2	BOILER ROOM	WATER TO WATER	BUILDING	200	LOCINVAR GVG0200JR	1. PROVIDE WATER TO WATER CONTROL PACKAGE, INCLUDE ISOLATION VALVES, 2-WAY SELF-OPERATED TEMPERATURE REGULATOR, INLET WYE STRAINER AND ALL NECESSARY PIPING, TEMPERATURE & PRESSURE GAUGE



- NOTES:**
1. PREFERRED PIPING DIAGRAM.
  2. THE TEMPERATURE AND PRESSURE RELIEF VALVE SETTING SHALL NOT EXCEED PRESSURE RATING OF ANY ANY COMPONENT IN THE SYSTEM.
  3. SERVICE VALVES ARE SHOWN FOR SERVICING UNIT. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.
  4. PROVIDE REMOTE TYPE THERMOMETERS IF MOUNTED HIGHER THAN 6FT. ABOVE FLOOR.
  5. INSTALL THERMOMETERS AND AQUASTATS IN OVERSIZED TEES.

**DOMESTIC HOT FLOW DIAGRAM**



**GAS RISER DIAGRAM**

**NEW YORK CITY BUILDING DEPARTMENT APPROVAL NOTE**  
 THIS PLAN IS APPROVED ONLY FOR WORK INDICATED ON THE APPLICATION SPECIFICATION SHEET. ALL OTHER MATTERS SHOWN ARE NOT TO BE RELIED UPON, OR TO BE CONSIDERED AS EITHER BEING APPROVED OR IN ACCORDANCE WITH APPLICABLE CODES.

**NEW YORK CITY ENERGY CONSERVATION CODE**  
 EXEMPTION WHEN COMPLIANCE WITH FIRE PROTECTION, DETECTION, ALARM AND/OR SUPPRESSION REQUIREMENTS OF TITLE 28 AND/OR THE 2014 NEW YORK CITY CONSTRUCTION CODES CONFLICTS WITH 2016 NYCECC COMPLIANCE, THE TITLE 28 AND/OR 2014 CONSTRUCTION CODES SAFETY PROVISIONS WILL TAKE PRECEDENCE OVER CONFLICTING PROVISIONS IN 2016 NYCECC.

NO.	DATE	REVISION
05/11/17	ISSUED FOR BID	
04/28/17	ISSUED FOR 90%	
04-03-17	ISSUED FOR REVIEW	

PROJECT: **BOILER UPGRADE**  
 70 WEST 95TH STREET, NEW YORK, NY

DRAWING TITLE:  
**PLUMBING RISER DIAGRAM AND DETAILS PLAN**

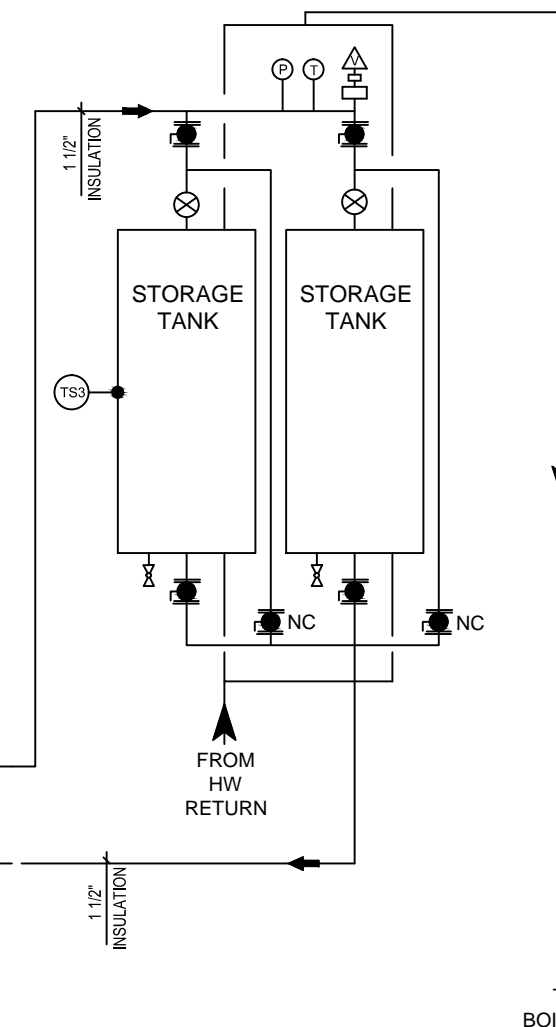
SEAL & SIGNATURE:	DATE: 02.22.2017
	PROJECT No: 7720.00
	DRAWING BY: PTB
	CHK BY: PTB
	SCALE: N.T.S.
	DWG No:
	<b>P-601.00</b>
CADD FILE:	DOB page: 3 OF 4

PLATE HEAT EXCHANGER		
MODEL	DW 5x20-70	
TYPE	BRAZED PLATE AND FRAME	
MATERIAL	STAINLESS STEEL	
SERVICE	DOMESTIC HOT WATER	
SIDE	HOT	COLD
FLUID TYPE	NON-POTABLE WATER	POTABLE WATER
FLUID FLOW	13.2 GPM	12.8 GPM
TEMP IN	FJI ∅	FHF ∅
TEMP OUT	Fí ∅	Fî ∅
PRESSURE DROP	0.7 PSI	0.6 PSI

PUMP SCHEDULE				
PUMP NO.	SERVICE	FLOW	CONNECTION	PUMP MODEL
P-1	CHP MODULE PUMP	13.16 GPM	FLANGE 1 1/4"	MAGNA 1 32 - 80F
P-2	DOMESTIC LOOP HEATING	12.8 GPM	FLANGE 1 1/4"	UP 26 -99

THERMISTOR SCHEDULE	
TS NO.	SERVICE
TS-1	CHP RETURN
TS-2	CHP SUPPLY
TS-3	ON / OFF PUMP P-2

TANK SCHEDULE		
PUMP NO.	SERVICE	CAPACITY
AT-1	CHP LOOP FILL TANK	17 gal
ET-1	CHP LOOP EXPANSION	6.6 gal
CSF	COGEN SHOT FEEDER	2 gal



MECHANICAL ENGINEER

ELECTRICAL ENGINEER

PE STAMP/SEAL

DATE	REV	DESCRIPTION

West Side Marquis  
70 W 95th St.  
New York, NY 10025  
PROJECT

9/11/17      RJC  
DATE              DRAWN BY

FLOW DIAGRAM  
DRAWING TITLE

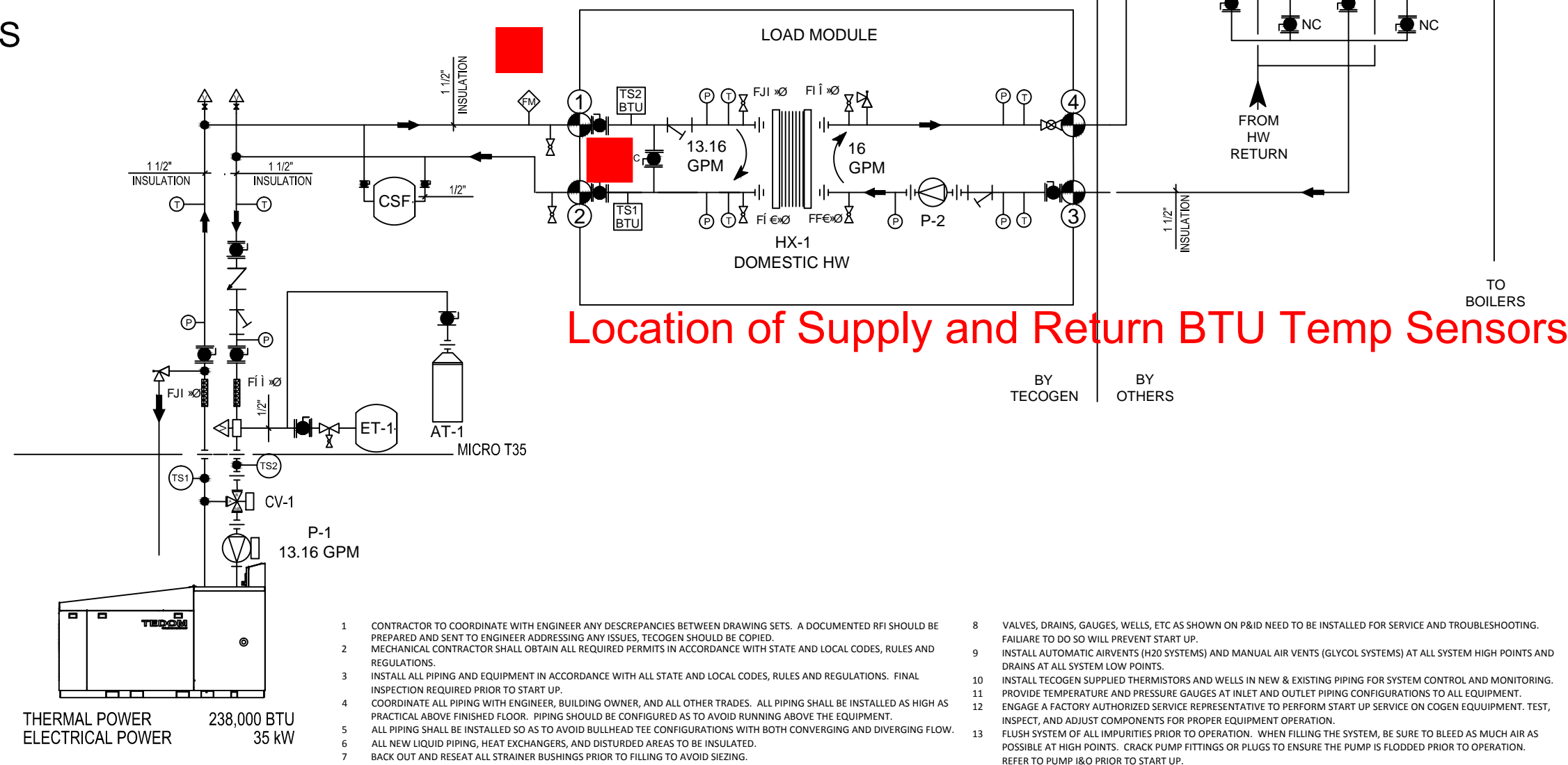
**P&ID**  
DRAWING NUMBER

Locaton of Flow Meter

Location of Supply and Return BTU Temp Sensors

PIPING SYMBOLS

- NEW CONNECTION
- #D PIPING CONNECTION
- BALL VALVE
- TRIPLE DUTY VALVE
- BALANCE VALVE
- CHECK VALVE
- STRAINER
- UNION
- BOILER DRAIN
- BALL VALVE w/DRAIN
- PRESSURE RELIEF
- AIR SCOOP w/VENT
- VENT w/SHUTOFF
- PRESSURE GAUGE
- THERMOSENSOR
- THERMOMETER
- FLEX CONNECTION
- MOTORIZED 3-WAY VALVE



THERMAL POWER 238,000 BTU  
ELECTRICAL POWER 35 kW

- 1 CONTRACTOR TO COORDINATE WITH ENGINEER ANY DISCREPANCIES BETWEEN DRAWING SETS. A DOCUMENTED RFI SHOULD BE PREPARED AND SENT TO ENGINEER ADDRESSING ANY ISSUES, TTCOGEN SHOULD BE COPIED.
- 2 MECHANICAL CONTRACTOR SHALL OBTAIN ALL REQUIRED PERMITS IN ACCORDANCE WITH STATE AND LOCAL CODES, RULES AND REGULATIONS.
- 3 INSTALL ALL PIPING AND EQUIPMENT IN ACCORDANCE WITH ALL STATE AND LOCAL CODES, RULES AND REGULATIONS. FINAL INSPECTION REQUIRED PRIOR TO START UP.
- 4 COORDINATE ALL PIPING WITH ENGINEER, BUILDING OWNER, AND ALL OTHER TRADES. ALL PIPING SHALL BE INSTALLED AS HIGH AS PRACTICAL ABOVE FINISHED FLOOR. PIPING SHOULD BE CONFIGURED AS TO AVOID RUNNING ABOVE THE EQUIPMENT.
- 5 ALL PIPING SHALL BE INSTALLED SO AS TO AVOID BULLHEAD TEE CONFIGURATIONS WITH BOTH CONVERGING AND DIVERGING FLOW.
- 6 ALL NEW LIQUID PIPING, HEAT EXCHANGERS, AND DISTURBED AREAS TO BE INSULATED.
- 7 BACK OUT AND RESEAT ALL STRAINER BUSHINGS PRIOR TO FILLING TO AVOID SIEZING.
- 8 VALVES, DRAINS, GAUGES, WELLS, ETC AS SHOWN ON P&ID NEED TO BE INSTALLED FOR SERVICE AND TROUBLESHOOTING. FAILURE TO DO SO WILL PREVENT START UP.
- 9 INSTALL AUTOMATIC AIRVENTS (H2O SYSTEMS) AND MANUAL AIR VENTS (GLYCOL SYSTEMS) AT ALL SYSTEM HIGH POINTS AND DRAINS AT ALL SYSTEM LOW POINTS.
- 10 INSTALL TTCOGEN SUPPLIED THERMISTORS AND WELLS IN NEW & EXISTING PIPING FOR SYSTEM CONTROL AND MONITORING.
- 11 PROVIDE TEMPERATURE AND PRESSURE GAUGES AT INLET AND OUTLET PIPING CONFIGURATIONS TO ALL EQUIPMENT.
- 12 ENGAGE A FACTORY AUTHORIZED SERVICE REPRESENTATIVE TO PERFORM START UP SERVICE ON COGEN EQUIPMENT. TEST, INSPECT, AND ADJUST COMPONENTS FOR PROPER EQUIPMENT OPERATION.
- 13 FLUSH SYSTEM OF ALL IMPURITIES PRIOR TO OPERATION. WHEN FILLING THE SYSTEM, BE SURE TO BLEED AS MUCH AIR AS POSSIBLE AT HIGH POINTS. CRACK PUMP FITTINGS OR PLUGS TO ENSURE THE PUMP IS FLOODED PRIOR TO OPERATION. REFER TO PUMP I&O PRIOR TO START UP.

MECHANICAL ENGINEER

ELECTRICAL ENGINEER

PE STAMP/SEAL

DATE REV DESCRIPTION

5/3/18 0 ISSUE FOR REVIEW

5/25/18 1 UPDATED PER CON ED

70 W 95TH ST  
NEW YORK, NY 10025

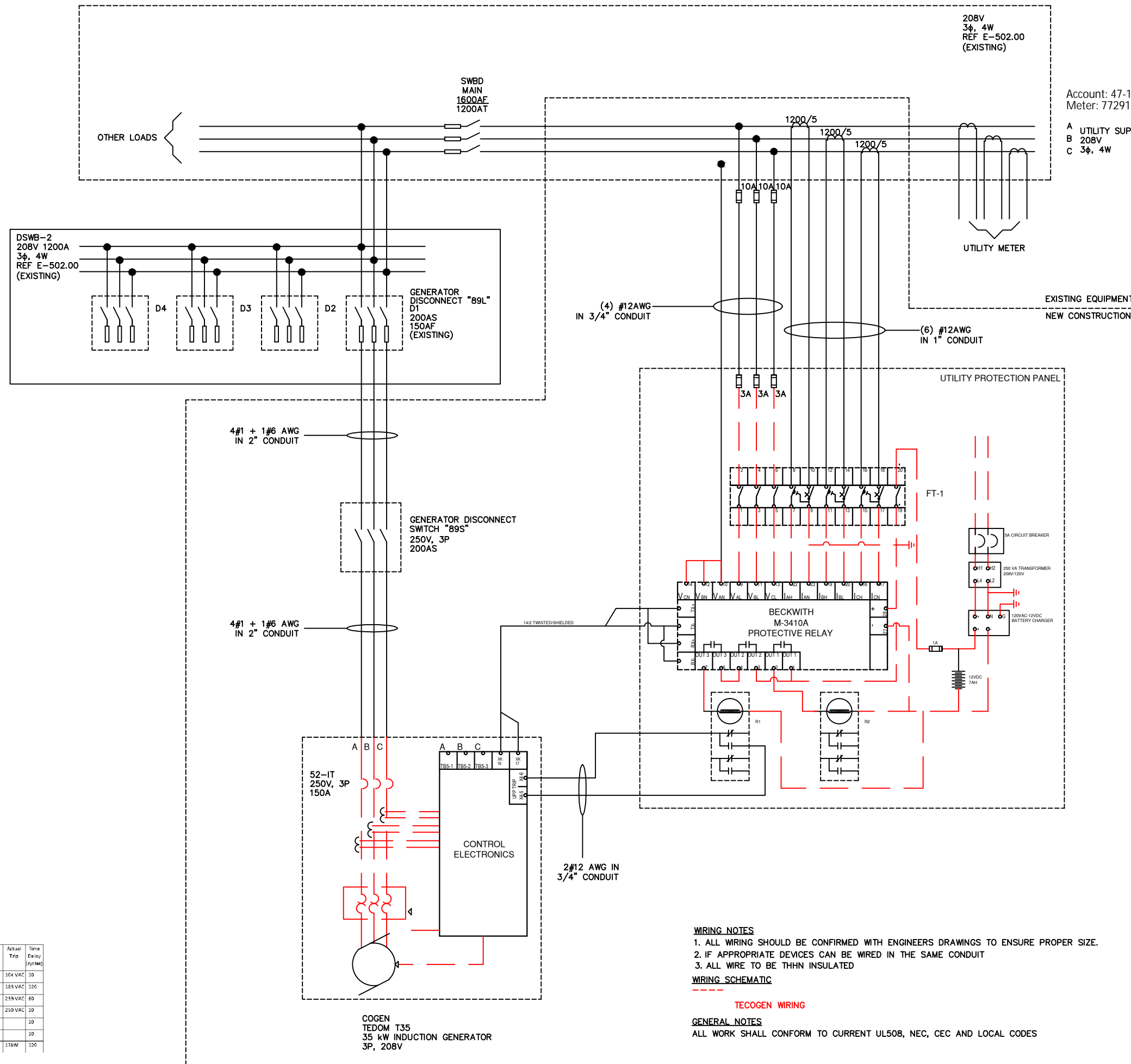
PROJECT

5/3/18  
DATE

TWC  
DRAWN BY

3 LINE DIAGRAM  
DRAWING TITLE

E-502.1



Element	Pickup	Actual Trip	Time Delay (cycles)
27-1	< 50% V <sub>nom</sub>	104 VAC	10
27-2	< 88% V <sub>nom</sub>	185 VAC	120
55-1	> 115% V <sub>nom</sub>	289 VAC	60
59-2	> 120% V <sub>nom</sub>	250 VAC	30
310	60.5 Hertz		30
320	59.3 Hertz		30
325(1)	-0.03 per unit	131W	120

- WIRING NOTES**
1. ALL WIRING SHOULD BE CONFIRMED WITH ENGINEERS DRAWINGS TO ENSURE PROPER SIZE.
  2. IF APPROPRIATE DEVICES CAN BE WIRED IN THE SAME CONDUIT
  3. ALL WIRE TO BE THHN INSULATED

**WIRING SCHEMATIC**

**TECOGEN WIRING**

- GENERAL NOTES**
- ALL WORK SHALL CONFORM TO CURRENT UL508, NEC, CEC AND LOCAL CODES

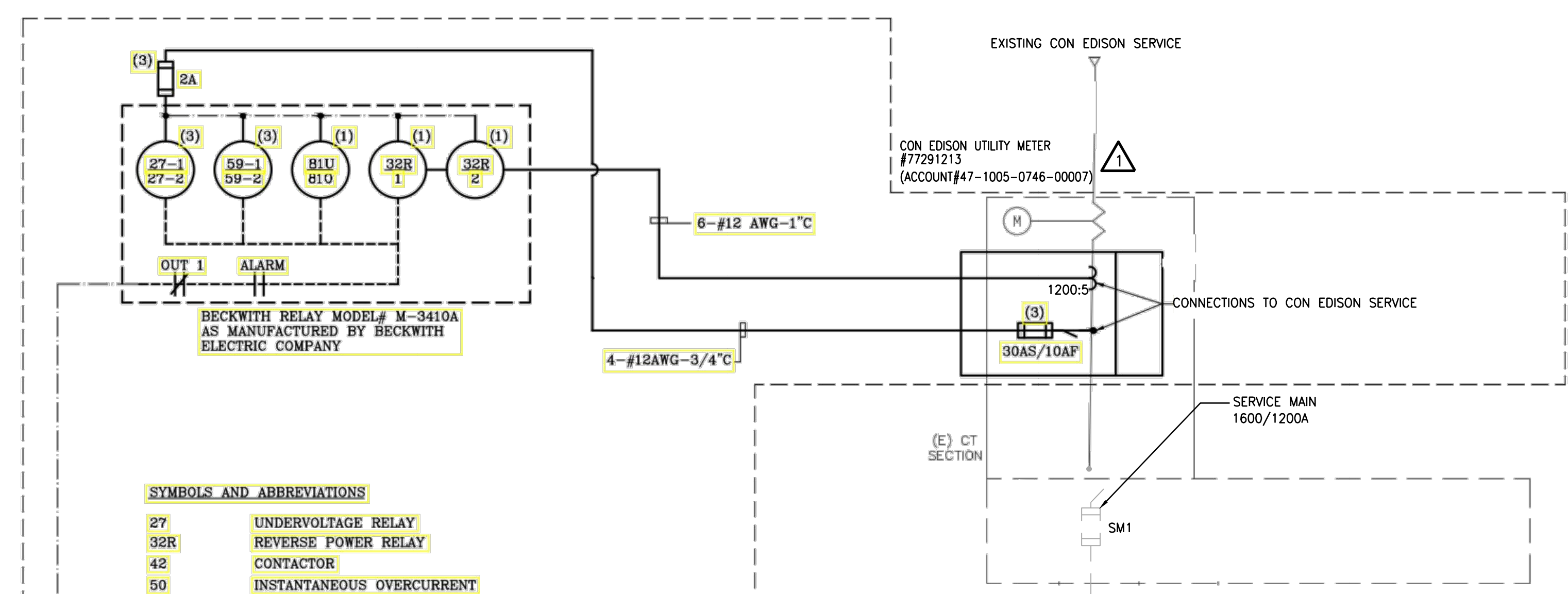
Account: 47-1005-0746-0000-7  
Meter: 7729123

A UTILITY SUPPLY  
B 208V  
C 3φ, 4W

EXISTING EQUIPMENT  
NEW CONSTRUCTION

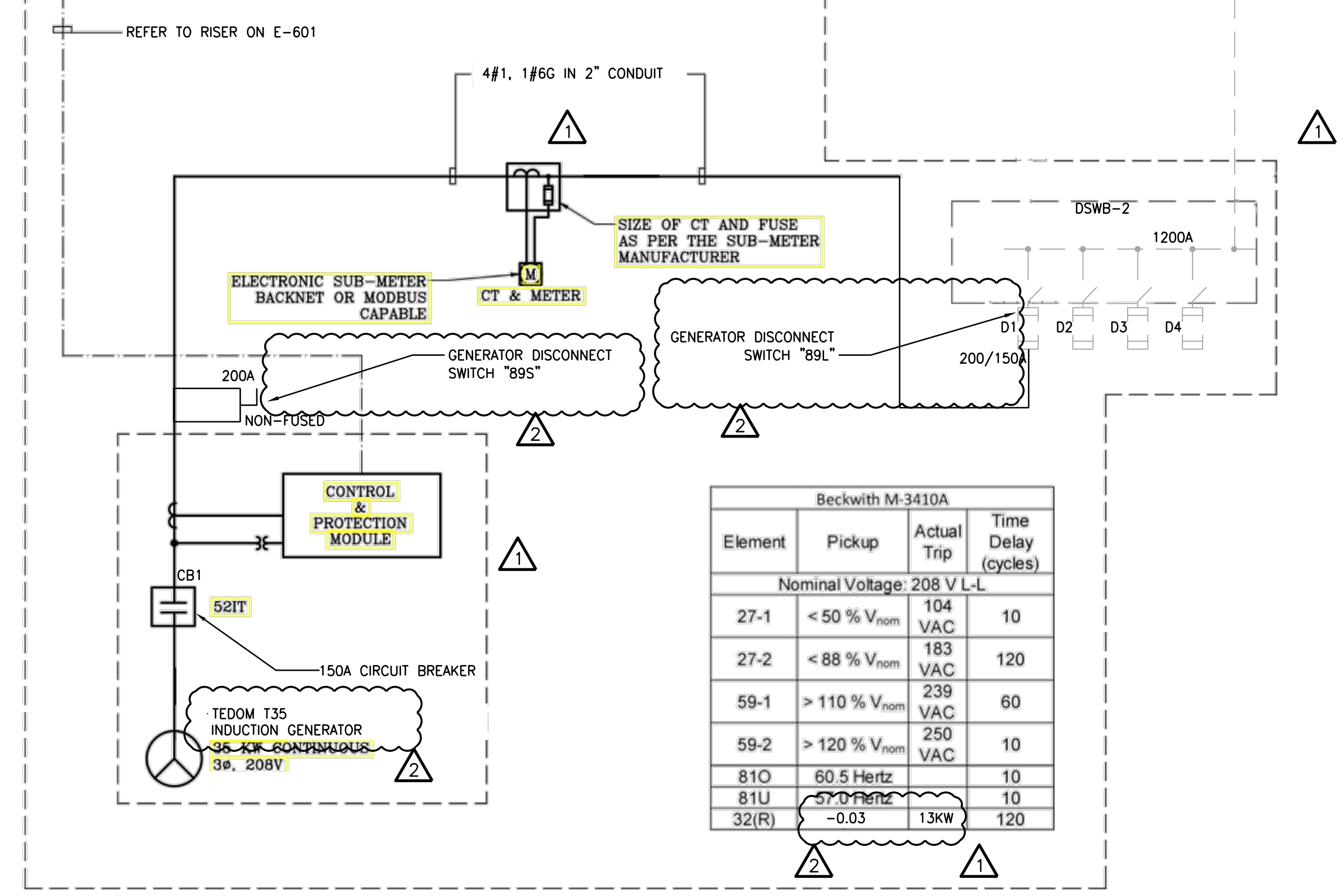
COGEN  
TEDOM T35  
35 kW INDUCTION GENERATOR  
3P, 208V





**SYMBOLS AND ABBREVIATIONS**

27	UNDERVOLTAGE RELAY
32R	REVERSE POWER RELAY
42	CONTACTOR
50	INSTANTANEOUS OVERCURRENT
51	REVERSE POWER RELAY
52	AC CIRCUIT BREAKER
59	OVERVOLTAGE RELAY
81 U/O	UNDER/OVER FREQUENCY RELAY
89S	LINE SWITCH
89L	LOCKABLE LOAD BREAK SWITCH
	CIRCUIT BREAKER (FIXED MOUNT)
	FUSED DISCONNECT
AS/AF	AMP SWITCH/AMP FUSE (FUSED DISCONNECT)
AF/AT	AMP FRAME/AMP TRIP (CIRCUIT BREAKER)
	CONTACTOR
	METERING DEVICE
K1	KEY INTERLOCK
N.O.	NORMALLY OPEN
N.C.	NORMALLY CLOSED
O.O.S.	OUT OF SERVICE
	INVERTER



Beckwith M-3410A

Element	Pickup	Actual Trip	Time Delay (cycles)
Nominal Voltage: 208 V L-L			
27-1	< 50 % V <sub>nom</sub>	104 VAC	10
27-2	< 88 % V <sub>nom</sub>	183 VAC	120
59-1	> 110 % V <sub>nom</sub>	239 VAC	60
59-2	> 120 % V <sub>nom</sub>	250 VAC	10
81O	60.5 Hertz		10
81U	57.0 Hertz		10
32(R)	-0.03	13KW	120

NO.	DATE	REVISION
Δ	05/29/18	REVISED AS PER CON EDISON COMMENTS
Δ	05/02/18	REVISED AS PER CON EDISON COMMENTS
	05/11/17	ISSUED FOR BID
	04/28/17	ISSUED FOR 90%

PROJECT:  
**BOILER UPGRADE**  
 70 WEST 95TH STREET, NEW YORK, NY

DRAWING TITLE:  
**ELECTRICAL  
 DETAILS SHEET#2**

SEAL & SIGNATURE:	DATE: 02.22.2017
	PROJECT No: 7720.00
	DRAWING BY: SEC
	CHK BY: SEC
	SCALE: NTS
	DWG No:
	<b>E-502.00</b>
CADD FILE:	DOB page: 5 OF 10

**NEW YORK CITY ENERGY CONSERVATION CODE**  
 TO THE BEST OF MY KNOWLEDGE, BELIEF AND PROFESSIONAL JUDGMENT, THESE PLANS AND SPECIFICATIONS ARE IN COMPLIANCE WITH THE 2016 NEW YORK CITY ENERGY CONSERVATION CODE.

**Appendix B**

*Cut Sheets for Key Sensors and Instruments*

**• SYSTEM-10-MOD BTU METER •**  
**MODBUS RTU RS485 or MODBUS TCP/IP COMPATIBLE**



**FEATURES**

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

**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.

**N.I.S.T. Traceable Calibration with Certification** - Each Btu measurement system is individually calibrated using application specific flow and temperature data and is provided with calibration certificates.

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

**Highly Accurate Flow Meters** - ONICON offers a variety of insertion and inline type flow meters including turbine, electromagnetic and vortex sensing. Each type offers unique advantages. All ONICON flow meters are individually wet calibrated and operate over a wide flow range. Accuracies range 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.

\*HS version with restricted functions available for use in U.S. government facilities and other installations where enhanced security is required.

**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 (ordered separately). The System-10-MOD provides energy, flow and temperature data on a local alphanumeric display and to the network via the MODBUS RTU RS485 or MODBUS TCP/IP communications adapter. An optional auxiliary input is also available to totalize pulses from another device and communicate the total directly to the network.

**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

**ORDERING INFORMATION**

The System-10 BTU Meter is sold complete with temperature sensors. Thermowell installation kits and flow meters are purchased separately.

ITEM #	DESCRIPTION
SYSTEM-10-MOD*	System-10 BTU Meter, MODBUS Compatible
SYSTEM-10-OPT8	High temperature sensors (over 200° F)
SYSTEM-10-OPT9	Add one analog output
SYSTEM-10-OPT10	Add four analog outputs
<b>Choose from the following commonly used thermowell installation kits:</b>	
SYSTEM-10-OPT4	Upgrade to outdoor thermowells (pair)
BTU-ST-INSTL32	Brass kit for welded steel pipe (¾" - 5")
BTU-ST-INSTL52	Brass kit for threaded steel pipe (¾" - 2½")
BTU-ST-INSTL34	SS kit for welded steel pipe (¾" and up)
BTU-ST-INSTL36	Brass kit for copper tube (¾" - 2")
BTU-ST-INSTL37	Brass kit for copper tube (2½" - 3")
<b>Choose from the following flow meters:</b>	
F-1100/F-1200	Insertion Turbine Flow Meter (1¼" - 72")
F-1300	Inline Turbine Flow Meter (¾" - 1")
F-3000 Series	Inline Electromagnetic Flow Meter (¼" - 48")
F-3500	Insertion Electromagnetic Flow Meter (3" - 72")
F-4200	Clamp-on Ultrasonic Flow Meter (½" - 48")
F-2000 Series	Inline Vortex Flow Meter (½" - 12")
Refer to catalog for flow meter installation kits. Consult with ONICON for additional thermowell installation kit and flow meter options.	



# SYSTEM-10-MOD BTU METER SPECIFICATIONS



## CALIBRATION

Flow meters and temperature sensors are individually calibrated followed by a complete system calibration. Field commissioning is also available.

## ACCURACY

### 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 - 77° F  
Temperature sensors meet EN1434 / CSA C900.1 accuracy requirements for 2K sensors for heating applications, 140 - 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 totalized 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  
The totals will roll over to zero when the maximum count is exceeded.

## OUTPUT SIGNALS

### Network Interface:

Protocol: MODBUS RTU  
Connection: RS485: 2-wire (half duplex)  
TCP/IP: 10 Base T, 10 Mbps, RJ45 Connection  
Baud Rate for RS485: 9600, 19200, 38400, 57600 and 115200

### Partial MODBUS Holding Register List:

NAME	Available Units
Total Energy	Btu, kW-hrs & ton-hrs
Energy Rate	Btu/hr, kW & tons
Total Flow	Gallons, liters & meters <sup>3</sup>
Flow Rate	gpm, gph, mgd, l/s, l/m, l/hr & m <sup>3</sup> /hr
Supply & Return Temperature	°F and °C
Operating Mode	Single, Dual or Bi-directional
Mode Status	Heating/Cooling or Forward/Reverse Flow
Auxiliary Input Total	Not Applicable
Energy Total Reset	Not Applicable
Flow Total Reset	Not Applicable
Auxiliary Total Reset	Not Applicable

### Isolated solid state dry contact for energy total:

Contact rating: 100 mA, 50 V  
Contact duration: 0.5, 1, 2, or 6 seconds

### Optional 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.

## LIQUID FLOW SIGNAL INPUT

0-15 V pulse output from any ONICON flow meter.

## TEMPERATURE SENSORS

Solid state sensors are custom calibrated using N.I.S.T. traceable temperature standards.  
Current based signal (mA) is unaffected by wire length.

## TEMPERATURE RANGE

Standard liquid temperature range: 32° to 200° F  
Optional extended temperature ranges available.  
Ambient temperature range: -20° to 140° F

## MECHANICAL

### Electronics Enclosure:

Standard: Steel NEMA 13, wall mount, 8"x 10"x 4"  
Optional: NEMA 4 (Not UL listed)  
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\*:

Standard: 24 VAC 50/60 Hz, 500 mA  
Optional: 120 VAC 50/60 Hz, 200 mA  
230 VAC, 50 Hz, 150 mA

\*Based on Btu meters configured for network connection without the optional analog outputs

### Internal Supply:

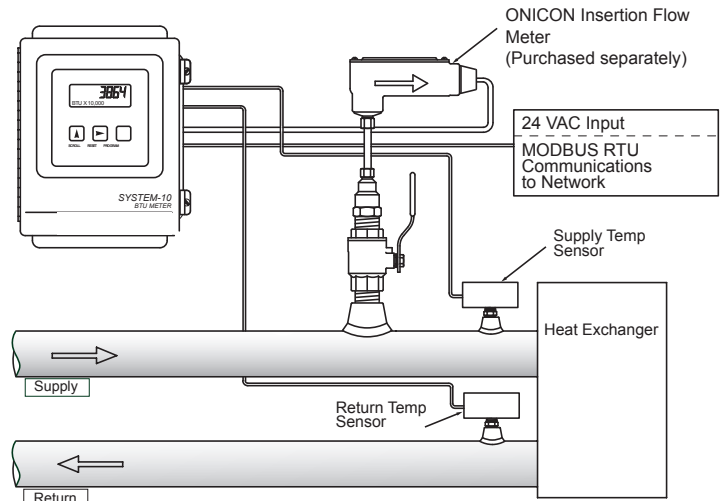
Provides 24 VDC at 200 mA to electronics and flow meter

### Wiring:

Temperature signals: Use 18-22 ga twisted shielded pair  
Flow signals: Use 18-22 ga shielded - see flow meter specification sheet for number of conductors

Note: Specifications are subject to change without notice.

## TYPICAL INSTALLATION



Insertion turbine flow meter shown. Any ONICON flow meter may be used with the System-10 BTU Meter. Consult with ONICON for additional flow meter types.

# E5X SERIES

## Versatile Energy Monitoring Solution



E50/E51

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

<b>INPUTS</b>	
Control Power, AC	50/60 Hz; 5 VA max.; 90 V min.; UL Maximums: 600 V <sub>L-L</sub> (347 V <sub>L-N</sub> ); CE Maximum: 300 V <sub>L-N</sub>
Control Power, DC	3W max.; UL and CE: 125 to 300 Vdc (external DC current limiting required)
Voltage Input	UL: 90 V <sub>L-N</sub> to 600 V <sub>L-L</sub> ; CE: 90 V <sub>L-N</sub> to 300 V <sub>L-N</sub>
<b>CURRENT INPUT</b>	
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)*
<b>ACCURACY</b>	
Real Power & Energy	0.2% (ANSI C12.20, IEC 62053-22 Class 0.2S)
<b>OUTPUTS</b>	
E50B1 & E5xCx	Real Energy Pulse: N.O. static**; Alarm contacts: N.C. static**

## Revenue grade measurements

Meets ANSI C12.20 Class 0.2 standards

## High reliability

ANSI C12.20 0.2% accuracy, IEC 62053-22 Class 0.2S on E5xxx

## 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
------------------	---------

### AGENCY APPROVALS

Agency Approvals	UL 508 (Open Type Device), IEC/EN 61010-1, California CSI Solar, ANSI C12.20, Cat III, Pollution Degree 2
------------------	---



\*10 kΩ Vac/dc to 4 to 10 Vdc.

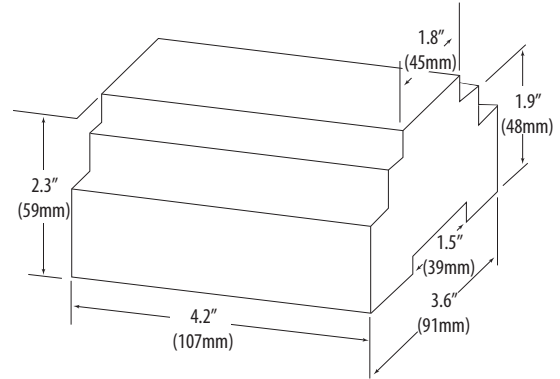
\*\*30 Vac/dc, 100 mA max. (AC: 50/60Hz).



**ORDERING INFORMATION**

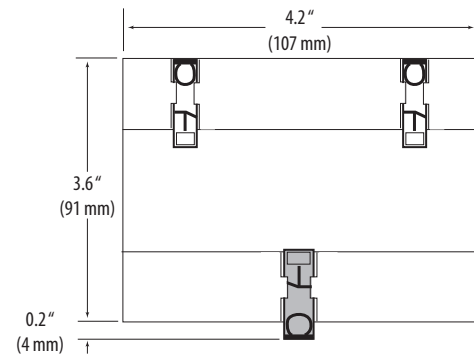
	E50B1	E50C2	E50C3	E50F2	E50F5	E50H2	E50H5	E51C2	E51C3	E51H2	E51H5	
<b>MEASUREMENT CAPABILITY - FULL DATA SET</b>												
Bi-directional Energy Measurements										•	•	•
Power (3-phase total and per phase): Real (kW) Reactive (kVAR), and Apparent (kVA)	•	•	•	•	•	•	•	•	•	•	•	•
Power Factor: 3-phase 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		•	•	•	•	•	•	•	•	•	•	•
<b>DATA LOGGING</b>												
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			•		•		•		•			•
<b>OUTPUTS</b>												
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)				•	•							
<b>INPUTS</b>												
2 Pulse Contact Accumulator Inputs					•		•					•
1 Pulse Contact Accumulator Input				•		•				•		

**DIMENSIONAL DRAWING**



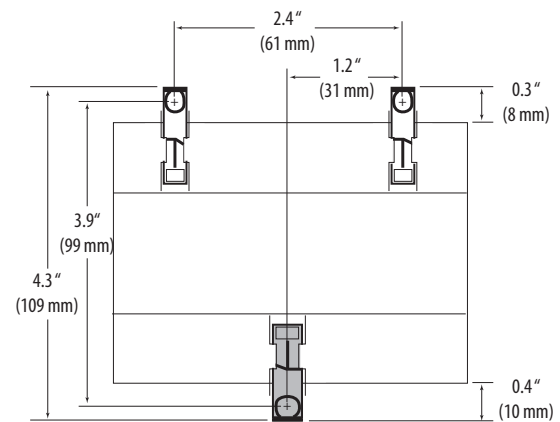
**DIN MOUNT CONFIGURATION**

Mounting Diagram



**SCREW MOUNT CONFIGURATION**

Mounting Diagram





# ROOTS Meters & Instruments

## DATA SHEET

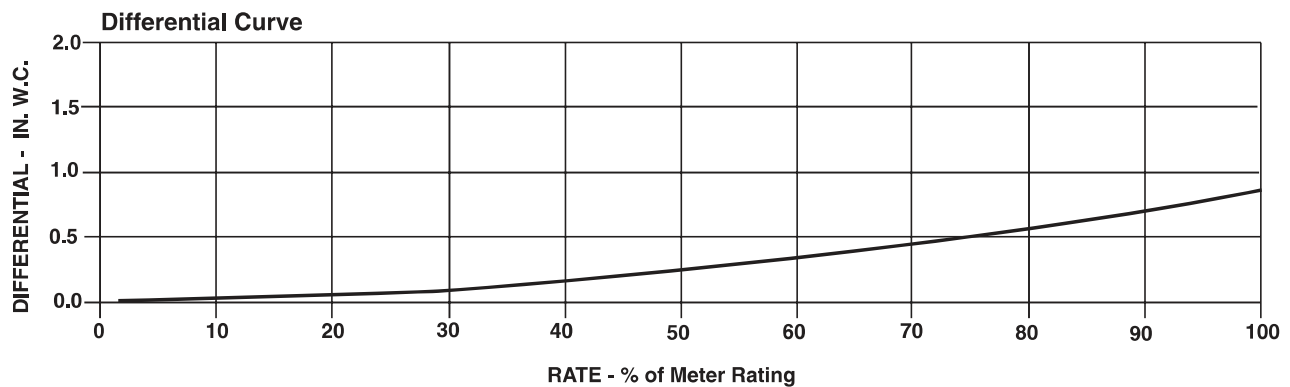
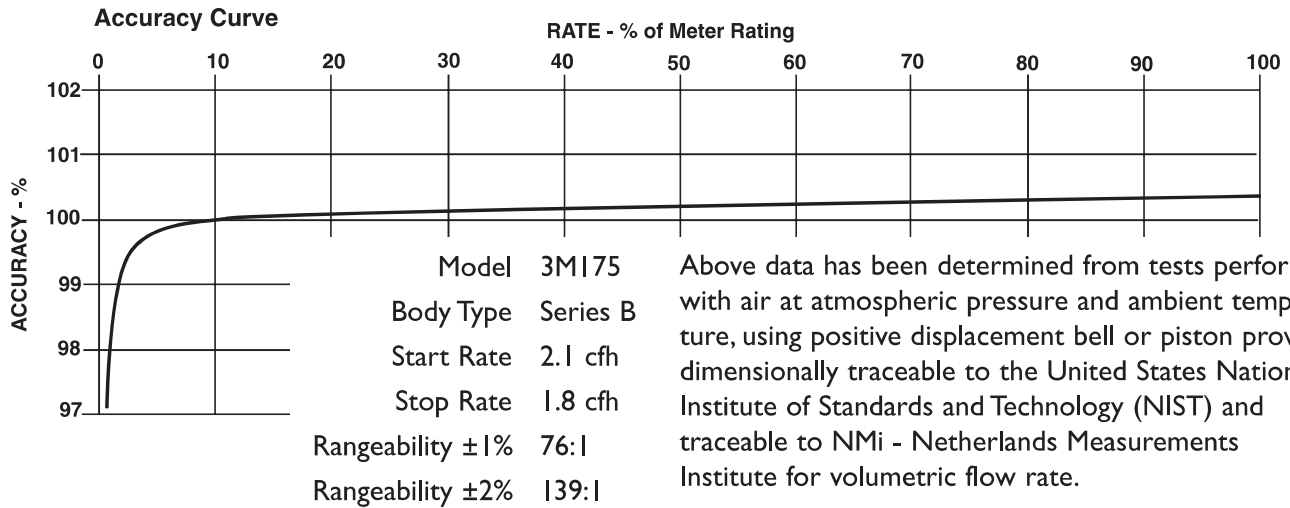
### SERIES B3: 3MI75 ROOTS® Meter

	UNITS Imperial	UNITS Metric
Temperature Range	deg. F -40 to +140	deg. C -40 to +60
Base Rating (Q Max.)	acfh 3000	m <sup>3</sup> /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 <sup>3</sup> /h 0,0595
Stop Rate	cfh 1.8	m <sup>3</sup> /h 0,0510
Flow Rate @ 0.5" w.c., Gas	cfh 2580	m <sup>3</sup> /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 <sup>3</sup> 0,000708
Drive Rate, CD	cf/rev 10	m <sup>3</sup> /rev 0,1
Drive Rate, TD	cf/rev 100	m <sup>3</sup> /rev 1
Temp. Compensating Range (TC,TD)	deg. F -20 to +120	deg. C -29 to +49
Min. Odometer Reading	cf 0.2	m <sup>3</sup> 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 <sup>1</sup>	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
<i>Counter Version (CTR)<sup>2</sup></i>		
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
<i>Counter with Instrument Drive (CD)<sup>2</sup></i>		
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

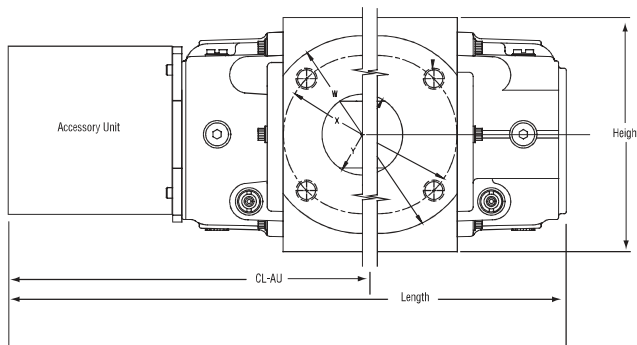
NOTES:

<sup>1</sup> Bolt Length varies by application.

<sup>2</sup> 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.



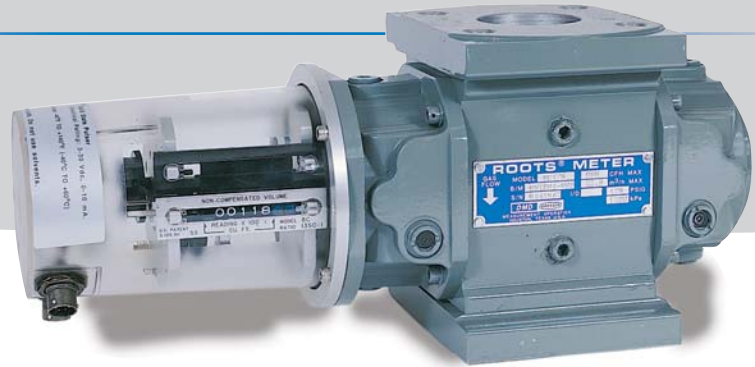
### Process Valve & Equipment Co. | Manufacturer's Rep. & Stocking Distributor

7205 Chagrin Road  
 Chagrin Falls, Ohio 44023  
<http://www.processvalve.com>

Ph: 1-800-922-8897 Fax: 1-440-247-7305  
[sales@processvalve.com](mailto:sales@processvalve.com)



# ROOTS® Solid State Pulser



## Features

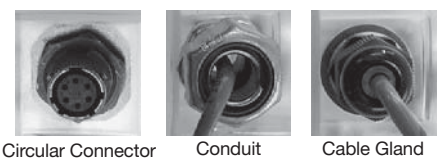
- Bounceless Switch
- Internal Mounting
- No Battery
- No Moving Parts
- Reliable Wiegand Technology
- Rugged, Weatherproof Housing
- Corrected & Uncorrected Outputs
- Universal Interface

The ROOTS® Solid State Pulser+ generates low frequency pulses which represent volumetric information necessary for remote data collection units. Solid state construction eliminates mechanical switches and ensures maximum reliability. No battery and no maintenance are required.

The dual connector option allows one connector to be used with your AMR system and a separate connector for your customer. These pulsers are available for our Series B3 (Life-Lubed™) meters and Series A1 (LM-MA) meters.

## Specifications

<b>Loop Voltage</b>	3-30 VDC
<b>Maximum Loop Current</b>	10 mA
<b>Contact Bounce</b>	0 msec
<b>Min. Pulse Width</b>	50 msec or 50% of Duty Cycle (whichever is smaller)
<b>Switch Closed</b>	R < 10 OHMS
<b>Switch Opened</b>	R > 1 MEGA OHM
<b>Temperature Range</b>	-40°F to +140°F -40°C to +60°C
<b>Humidity</b>	95% non-condensing
<b>Output*</b>	Form C
<b>Series 3 &amp; 1 TC (Temp. Comp.) Version</b>	Non-compensated and Compensated Pulse
<b>Counter (CTR) Version</b>	Non-compensated Pulse
<b>Outputs</b>	Single or Dual Connectors (Circular, Conduit, or Cable Gland)



Circular Connector

Conduit

Cable Gland

+ U.S. Patent Number; 5,530,298

\* Form A wiring acceptable. A two-wire Form B will not function properly.

Note: Solid State Pulser can be purchased in a conversion kit or factory installed on a ROOTS® Meter.

# ROOTS® Solid State Pulsar

Version	Type	# Connectors	P/N Amph. Conn. #399 Kit	P/N Conduit Conn. #399 Kit	Meter Size	Pulse Rate (English)	Pulse Rate (Metric)	Non-Comp. Pulse Wiring	Comp. Pulse Wiring
<b>Series B3 (Life-Lubed)</b>	Counter	Single	057128-060	057128-130	8C-3M	10 cf	0.1 m <sup>3</sup>	ABC	
	Counter	Single	057128-060	057128-130	5M-11M	10 cf	1.0 m <sup>3</sup>	ABC	
	Counter	Single	057128-060	057128-130	16M-38M	100 cf	1.0 m <sup>3</sup>	ABC	
	Counter	Single	057128-060	057128-130	56M	100 cf	10.0 m <sup>3</sup>	ABC	
	Counter	Dual	057128-070	057128-130	8C-3M	10 cf	0.1 m <sup>3</sup>	ABC	
	Counter	Dual	057128-070	057128-130	5M-11M	10 cf	1.0 m <sup>3</sup>	ABC	
	Counter	Dual	057128-070	057128-130	16M-38M	100 cf	1.0 m <sup>3</sup>	ABC	
	Counter	Dual	057128-070	057128-130	56M	100 cf	10.0 m <sup>3</sup>	ABC	
	TC	Single	057128-310	057128-260	8C-3M	10 cf	.1 m <sup>3</sup>	ABC	DEF
	TC	Single	057128-310	057128-260	5M-11M	10 cf	1.0 m <sup>3</sup>	ABC	DEF
	TC	Single	057128-310	057128-260	16M	100 cf	1.0 m <sup>3</sup>	ABC	DEF
	TC	Dual	057128-320	057128-260	8C-3M	10 cf	.1 m <sup>3</sup>	ABC	DEF
	TC	Dual	057128-320	057128-260	5M-11M	10 cf	1.0 m <sup>3</sup>	ABC	DEF
	TC	Dual	057128-320	057128-260	16M	100 cf	1.0 m <sup>3</sup>	ABC	DEF

Note: For Series 3 Pulsar-Ready Accessory Units, a credit may be applied for deduction of magnets from SSP #399 Kits.

## Application Guide

### HAZARDOUS LOCATION

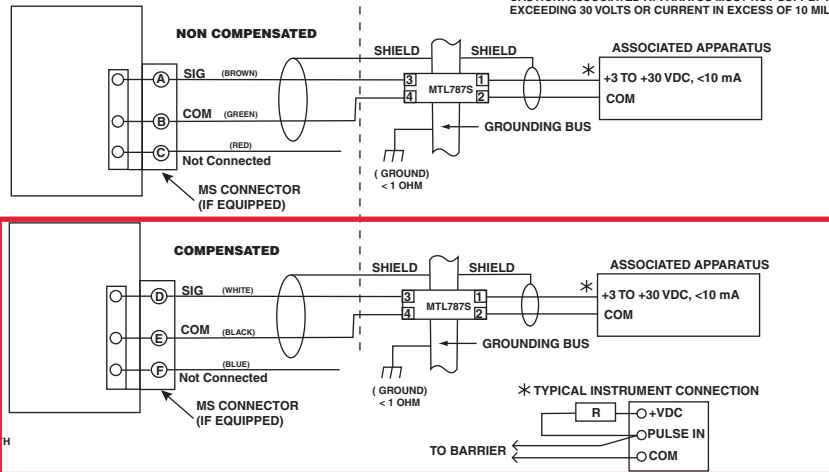
INSTALLATION MUST BE IN ACCORDANCE WITH ANS/ISA RP 12.60 OR NEC ANS/INFA 79, ARTICLE 504. FOR INSTALLATION IN CANADA, INSTALL IN ACCORDANCE WITH THE CANADIAN ELECTRICAL CODE, PART 1.

USE CSA APPROVED POSITIVE BARRIERS HAVING THE FOLLOWING PARAMETERS:  
28 Vdc (Max), 300 ohms (Min)  
EXAMPLE: MTL787S (CONNECTIONS SHOWN IN DIAGRAM)

### NON-HAZARDOUS LOCATION

MAXIMUM SAFE AREA VOLTAGE 250V RMS

CAUTION: ASSOCIATED APPARATUS MUST NOT SUPPLY VOLTAGE EXCEEDING 30 VOLTS OR CURRENT IN EXCESS OF 10 MILLI-AMPS



NOTE: ACCESSORY MODEL SSP FOR USE WITH ROOTS® SERIES B3 GAS METERS.

INSTALL IN ACCORDANCE WITH THE BARRIER MANUFACTURER'S INSTRUCTIONS.

IF RESISTOR MUST BE INSTALLED, CHOOSE VALUE BY  $R = VDC/.01$

EXAMPLE: IF VDC IS 5 VOLTS,

$R = 5/.01 = 500 \text{ OHMS}$ .

DO NOT USE A VALUE SMALLER THAN THIS.

PRELIMINARY INFORMATION. APPROVALS NOT YET GRANTED

Field Wiring Diagram Solid State Pulsar Customer Installation	Drawing Number A057159-000
---	-------------------------------

### Dresser, Inc.

16240 Port Northwest Drive  
Houston, Texas 77041-2645 USA  
Inside US Ph: 800.521.1114 Fax: 800.335.5224  
Outside US Ph: 832.590.2303 Fax: 832.590.2494



©2009 Dresser, Inc. All rights reserved.

Roots and Dresser are registered trademarks of Dresser, Inc.

www.dresser.com

TS: SSP  
11.09

# ADAM-4118

# ADAM-4150

# ADAM-4168

**Robust 8-ch Thermocouple Input Module with Modbus**

**Robust 15-ch Digital I/O Module with Modbus**

**Robust 8-ch Relay Output Module with Modbus**



ADAM-4118



ADAM-4150



ADAM-4168



## Specifications

### General

- **Certification** FCC, CE, UL, UL Class I Division 2
- **Power Consumption** 0.5W @ 24 V<sub>DC</sub>

### Analog Input

- **Channels** 8 differential and independent configuration channels
- **Input Impedance** Voltage: 20 M $\Omega$   
Current: 120  $\Omega$
- **Input Type** T/C, mV, V, mA
- **Input Range** Thermocouple

<b>J</b>	0 ~ 760°C	<b>R</b>	500 ~ 1,750°C
<b>K</b>	0 ~ 1,370°C	<b>S</b>	500 ~ 1,750°C
<b>T</b>	-100 ~ 400°C	<b>B</b>	500 ~ 1,800°C
<b>E</b>	0 ~ 1,000°C		

- **Accuracy** Voltage mode:  $\pm 15$  mV,  $\pm 50$  mV,  $\pm 100$  mV,  $\pm 500$  mV,  $\pm 1$  V,  $\pm 2.5$  V  
Current mode:  $\pm 20$  mA, 4 ~ 20 mA
- **Resolution** 16-bit
- **Sampling Rate** 10/100 samples/sec (selected by Utility)
- **CMR @ 50/60 Hz** 92 dB
- **NMR @ 50/60 Hz** 60 dB
- **Overshoot Protection**  $\pm 60$  V<sub>DC</sub>
- **High Common Mode** 200 V<sub>DC</sub>
- **Span Drift**  $\pm 25$  ppm/ $^{\circ}$ C (Typical)
- **Zero Drift**  $\pm 6$   $\mu$ V/ $^{\circ}$ C
- **Built-in TVS/ESD Protection**
- **Burnout Detection**

## Specifications

### General

- **Certification** FCC, CE, UL, UL Class I Division 2
- **Power Consumption** 0.7 W @ 24 V<sub>DC</sub>

### Digital Input

- **Channels** 7
- **Input Level** Dry contact: Logic level 0: Close to GND  
Logic level 1: Open  
Wet contact: Logic level 0: 3 V max  
Logic level 1: 10 ~ 30 V  
(Note: The Digital Input Level 0 and 1 status can be inverted)
- **Supports 3 kHz Counter Input (32-bit + 1-bit overflow)**
- **Supports 3 kHz Frequency Input**
- **Supports Invert DI Status**
- **Over Voltage Protection** 40 V<sub>DC</sub>

### Digital Output

- **Channels** 8, open collector to 40 V (0.8A max. load)
- **Power Dissipation** 1W load max
- **RON Maximum** 150 m $\Omega$
- **Supports 1 kHz Pulse Output**
- **Supports High-to-Low Delay Output**
- **Supports Low-to-High Delay Output**

## Specifications

### General

- **Certification** FCC, CE, UL
- **Power Consumption** 1.8 W @ 24 V<sub>DC</sub>

### Relay Output

- **Output Channels** 8 Form A
- **Contact Rating (Resistive)** 0.5 A @ 120 V<sub>AC</sub>  
1 A @ 30 V<sub>DC</sub>  
0.3 A @ 110 V<sub>DC</sub>
- **Breakdown Voltage** 750 V<sub>AC</sub> (50/60 Hz)
- **Initial Insulation Resistance** 1 G  $\Omega$  min. @ 500 V<sub>DC</sub>
- **Relay Response Time (Typical)** On: 3ms  
Off: 1ms
- **Total Switching Time** 10 ms
- **Supports 100 Hz pulse output**
- **Maximum Operating Speed** 50 operations/min (at related load)

## Common Specifications

### General

- **Power Input** Unregulated 10 ~ 48 V<sub>DC</sub>
- **Watchdog Timer** System (1.6 second) & Communication
- **Connector** 2 x plug-in terminal blocks (#14 ~ 22 AWG)
- **Isolation Voltage** 3,000 V<sub>DC</sub>
- **Interface (B version)** RS-485, micro USB

- **Supported Protocols** ASCII Command and Modbus/RTU

### Environment

- **Operating Humidity** 5 ~ 95% RH
- **Operating Temperature** -40 ~ 85 $^{\circ}$ C (-40 ~ 185 $^{\circ}$ F)
- **Storage Temperature** -40 ~ 85 $^{\circ}$ C (-40 ~ 185 $^{\circ}$ F)

## Ordering Information

- **ADAM-4118** Robust 8-ch Thermocouple Input Module w/ Modbus
- **ADAM-4150** Robust 15-ch Digital I/O Module with Modbus
- **ADAM-4168** Robust 8-ch Relay Output Module with Modbus