MEASUREMENT AND VERIFICATION PLAN

FOR

DG/CHP SYSTEM
AT
MILLENNIUM HILTON CHURCH STREET

March 2014

Submitted to:

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

Submitted by:

CDH Energy Corp.
PO Box 641
2695 Bingley Rd
Cazenovia, NY 13035
(315) 655-1063
www.cdhenergy.com

Project Team:

NYSERDA Project Manager:

Joanna Moore
Energy Efficiency Services
NYSERDA
1-866-NYSERDA x. 3220
Email: jm1@nyserda.org

Project Team:

Developer/Applicant:
Greenwood Energy
134 East 40th Street
New York, NY 10016

CRC Engineering
1261 Broadway
7th Floor
New York, NY 10001

Broadway Electric
1261 Broadway
6th Floor
New York, NY 10001

Site:
Millennium Hilton
55 Church St, New York, NY 10007

ENK Solutions
21 Main Street
East Brunswick, NJ 08816

SET Environmental, Inc.
43 Houston Place
Haworth, NJ 07641

NYSERDA QC Contractor:
John DeFrees
Modern Energy Technologies
315-662-3243 (office)
315-569-3243 (cell)
John@modernenergyllc.com

NYSERDA M&V Contractor:
Adam Walburger, CDH Energy
PO Box 641
2695 Bingley Rd
Cazenovia, NY 13035
315-655-1063

1. Introduction

SDP/Greenwood Energy is in the process of installing a combined heat and power (CHP) system at the Millennium Hilton at 55 Church St, New York, NY 10007 with the assistance of several subcontractors providing various technical and implementation services.

The proposed CHP system is configured on two (2) 250 kW reciprocating engine-generator sets. The system is intended to produce a gross output of 500 kW and recover heat as hot water for domestic hot water (DHW) service, space heating, and hot water absorbtion chiller operation. The CHP system will run in parallel with the existing utility service.

Peak operation of the CHP system will result in the following performance:

Gross electrical output:	500 kW
Parasitic electrical input (estimated):	-20 kW
Hot water output at 190°F:	2.65 MMBtu/h
Fuel input:	4.89 MMBtu/h LHV

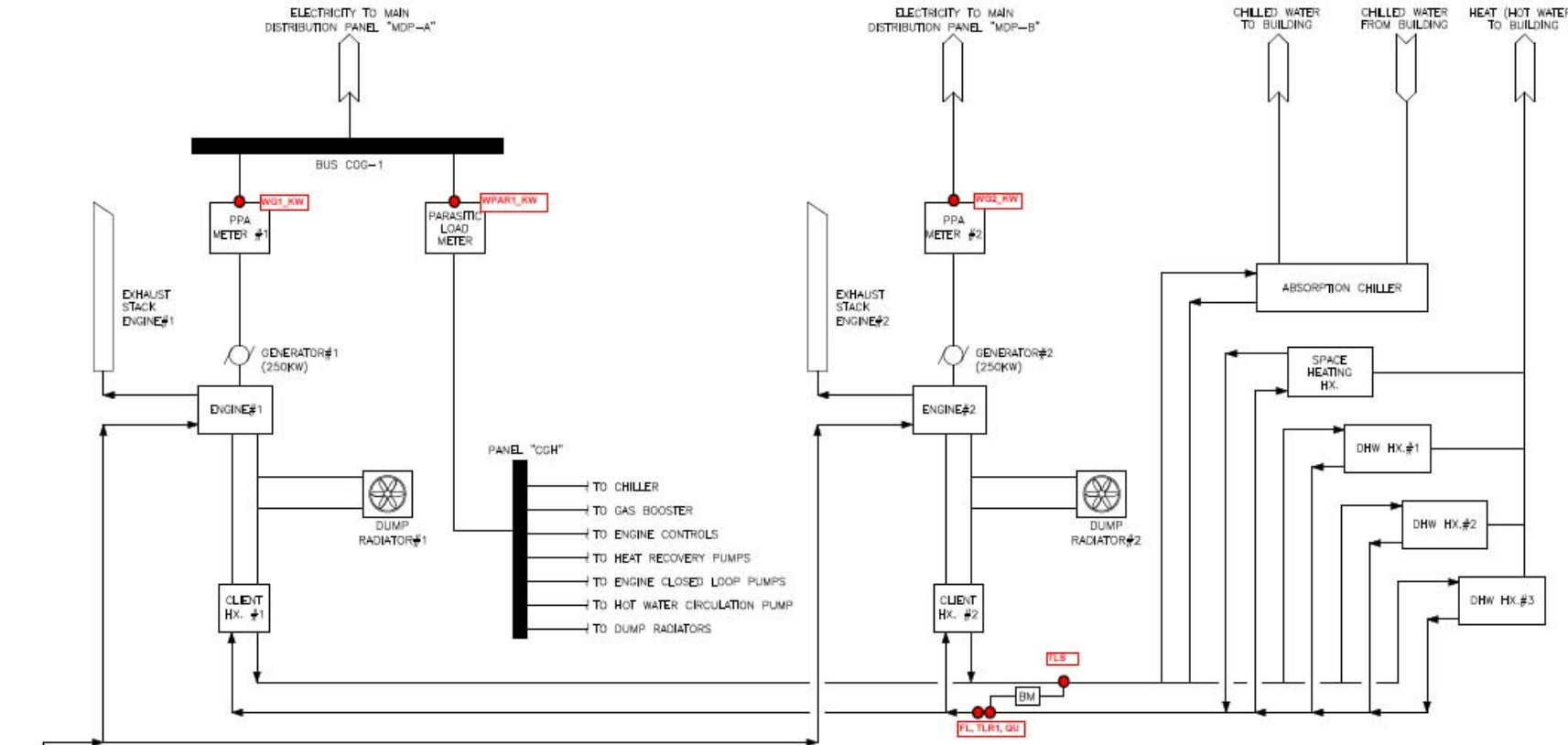
2. Instrumentation

In order to quantify the performance of the proposed CHP system, the CHP system fuel input, net electrical output, and useful thermal output must be measured. To capture these energy flows, an instrumentation plan was developed by the applicant, Greenwood Energy (based on information provided by CRC Engineering). The instrumentation plan covers the location and type of sensors necessary to provide the appropriate measurements of the energy flows of the system.

In accordance with the instrumentation plan, Greenwood Energy will supply the instrumentation listed in Table 1 below for use in meeting the NYSERDA CHP program monitoring requirements.

Table 1. Instrumentation Supplied By Greenwood Energy

Point	Instrument	Output Type	Sensor Location	Notes
Generator Power Output	Satec PM174	Modbus	CTs in BUS COG-1, MDP-B	· WG1, WG2
Parasitic Load Electrical Consumption	Schneider Electric Power Logic Ion 6200	Pulse	CTs in Panel CGH	· WPAR1
Combined Generator Fuel Input	Fox Instruments FT2-061E-SS-ST-E2-DD-BO-G3	4 - 20 mA	Meter located at CHP skid	· FG
Heat Recovery	Btu calculated in DDC Controller		Calculated from TLS, TLR1, FL	· QHUW
Hot Water Flow	SDI SDI1D1n10200 Paddlewheel		Load Side HW Header	. FL
Hot Water Loop Temperature	BAPI BA/10K-3-I-4" 10k type 2 thermistor		Load Side HW Header	. TLS, TLR1
Heat Recovery	Btu calculated in DDC Controller		Calculated recovered heat based on the engine loop readings	· QE1, QE2
Heat Rejection	Btu calculated in DDC Controller		Calculated rejected heat based on the engine loop readings	· QD1, QD2
Chiller Useful Recovered Heat	Btu calculated in DDC Controller		Calculated recovered heat based on the chiller loop readings	. QCW
Total Facility Energy / Power				· WT · From ConEd Bills
Ambient Temperature	Kele/Precon ST-R3R Thermistor	Resistance		· TAO



M&V EQUIPMENT	MAKE AND MODEL
WG1 & WG2	SATEC PM174
WP	POWERLOGIC ION 6200
FG	FOX FT2 MASS FLOW METER
FHW1 & FHW2	BADGER SDI1D1N FLOW SENSOR WITH TRANSMITTER
T1HW(1,2&3) & T2HW(1,2&3)	BAPI BA/10K-3-I-4" TEMPERATURE TRANSMITTERS

NOMENCLATURE	FUNCTION
METER FG	FLOW METER FOR NATURAL GAS INTO PLANT
PPA METER #1	ELECTRIC METER FOR ELECTRICITY PRODUCED BY COGEN#1
PPA METER #2	ELECTRIC METER FOR ELECTRICITY PRODUCED BY COGEN#2
PARASITIC LOAD METER	ELECTRIC METER FOR PARASITIC ELECTRICITY USED
BM	BTU METER FOR TOTAL THERMAL ENERGY USAGES

Data Logger

The Millennium Hilton Church Street CHP project is being provided with a server based BACnet DDC system. Individual data gathering panels will track, trend and archive usage at a web based server installed in a secure IT room in the hotel. System graphics and analytic software is also being provided to facilitate monitoring the performance of the new CHP plant. SET Environmental is providing the server, software, graphics, programming, sensors and meters as well as control valves. All field instrumentation and other devices for this project are being installed by the electrical and mechanical contractors.

The monitoring system samples specified sensors and calculated values approximately once per second and record total/average data every 15 minutes. The 15-minute readings of heat recovery temperatures and flows are 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 system has sufficient memory to store data continuously if remote communications with the logger are interrupted. Archived data storage capacity will be limited only to hard drive space on the server. The server provided with this system has a 350 GB drive, which could store data for many years.

The data are downloaded from the monitoring system once per day via FTP connection over the Owner's secured internet connection provided by the facility. An FTP script transfers calculated, formatted data to the NYSERDA verification server. The data are then loaded into a database, checked for validity, and posted on the NYSERDA web site.

Onsite Installation

Monitoring panels will be installed by the electrical contractor in owner approved locations. These panels are in general proximity to the systems they monitor. Sensors and meters are installed by the mechanical contractor. Electric meters, electronic sensors and current transducers are installed be the electrical contractor. All sensors and monitoring equipment will be provided as part of the CHP project.

Communications

The monitoring system will be connected to the Internet over an owner provided connection. A dedicated static IP address is being provided by the owner.

On-Site Support

The system being furnished by SET Environmental is web based and will be accessible to remote users through the owner's secured connection, with a static IP address and will be password protected with multiple levels of access available. SET's programmers, engineers and technicians will have access to multiple levels of the system for remote support.

The site will be responsible for providing access to all areas necessary for verification of sensors.

3. Data Analysis

The collected data 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	Description	Units
1	WG1	Gross Generator Output - Cogen Unit #1	kWh
2	WG2	Gross Generator Output - Cogen Unit #2	kWh
3	WPAR1	Parasitic Loads	kWh
4	FG	Natural Gas to Generators	cf/int
5	FL	Hot Water Loop Flow	gpm
6	TLS	Hot Water Loop Supply Temp	^{0}F
7	TLR1	Hot Water Loop Return Temp	^{0}F
8	QHUW	Total Useful Recovered Heat	Mbtu/hr
9	QE1	Useful Recovered Heat - Engine #1	Mbtu/hr
10	QE2	Useful Recovered Heat - Engine #2	Mbtu/hr
11	QD1	Rejected Heat - Engine #1	Mbtu/hr
12	QD2	Rejected Heat - Engine #2	Mbtu/hr
13	QCW	Useful Recovered Heat - Chilled Water Loop	Mbtu/hr

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:

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

The generator power meters will measure the individual gross output of the two engine generators. The net power delivered is determined by adding together the two individual generator power measurements and subtracting out the parasitic power measurements.

Heat Recovery Rates

The heat recovery rates will be calculated offline based on the 15 minute data collected. The piping arrangement for this CHP system uses individual circulation loops for each engine jacket water, with common secondary loops for the useful hot water delivered to the hotel. Dump radiators are located on each engine loop, downstream of the interconnection HX.

The rate of useful (delivered to the building) hot water loop heat recovery in Btu/h will be defined as:

$$QHUW = K \times \frac{\sum [FL \times (TLS - TLR1)]}{n}$$

where: K = ~ 489 Btu/h-gpm-°F for water
n = Number of scan intervals included in each recording interval (unitless) (e.g. with 1 sec scans and 15-minute data, n=4)

The loop fluid for both useful hot water heat recovery and rejected heat recovery is hot water. The factor K will be determined using temperature data.

A BTU meter is installed on the building load side of the CHP isolation HXs. This meter measures the entire heat transferred to the building thermal loads.

BTU measurements are performed on the total output of the engines (QE1 and QE2), as well as the heat rejected from each dump radiator (QD1 and QD2). No supporting flow and temperature

data are provided for these measurements. Total rejected heat from the system is calculated as the sum of the individual dump radiator heat transfers reported.

The rate of unused (rejected to atmosphere) hot water loop heat recovery in MBtu/h will be defined as:

$$QD = \sum[(QD1 + QD2)$$

where: QD1 = Dump radiator #1 heat rejection (reported by control system) (MBtu/h)
QD2 = Dump radiator #2 heat rejection (reported by control system) (MBtu/h)

Calculated Quantities

The net power output from the CHP system, WG_{net}, will be defined as the sum of gross power from each engine, WG1, WG2, minus the parasitic power, WPAR1.

WG_{net} = WG1 + WG2 – (WPAR1)

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

$$FCE = \frac{QHUW + 3{,}412 \cdot (WG_{net})}{0.9 \cdot HHV_{gas} \cdot FG}$$

where:
QHUW = Useful heat recovery (Btu)
WG_{net} = Engine generator net output (kWh)
(WG1 + WG2) - (WP)
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 average FCE can be calculated for any time interval. When converting to daily, monthly, or annual values, the each value is summed and then the formula is applied:

$$FCE = \frac{\sum^{N} QHUW + 3{,}412 \cdot \sum^{N} (WG_{net})}{0.9 \cdot HHV_{gas} \cdot \sum^{N} FG}$$

where: N = The desired interval (e.g. day, month)

Appendix A

System Schematic and Cut Sheets for Key Sensors and Instruments

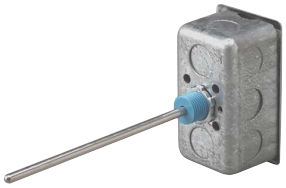
Immersion Units

Temperature Sensors

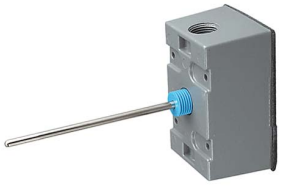
Rev. 05/28/08

Features & Options

- Probe Lengths: 2”, 4” and 8” (fit standard BAPI Thermowell lengths)
- Series 304 Stainless Steel Probes
- Four Enclosure Styles
- Limited Lifetime Warranty
- Double Encapsulated Sensors & Etched Teflon Leadwires
- Wide Selection of Temperature Sensing Elements



J-Box



Weatherproof (WP) Enclosure

Weather Tight (EU) Enclosure

BAPI-Box (BB) Enclosure

Immersion Units are available in 2”, 4” and 8” probe lengths. The sensor is potted inside a 1/4” stainless steel probe with thermally conductive epoxy. All Immersion Units have etched Teflon leadwires and double encapsulated sensors to create a watertight package that can withstand high humidity and condensation.

Enclosure Styles

Immersion Units come standard with a 2”x4” steel J-Box but are also available with three styles of enclosure: Weatherproof (**WP**), Weather Tight (**EU**) or BAPI-Box (**BB**). The metal **WP** enclosure carries a NEMA 3R rating, while the ABS polymer **EU** carries an IP66 rating and is available in a UV-resistant material (**EUO**). The BAPI-Box (**BB**) is made of UV-resistant polycarbonate and carries an IP66 rating. BAPI also offers optional liquid-tight fittings. For a comparison of the enclosure styles, please see the App. Notes section.

BAPI Thermowells

Immersion Unit Probes are designed to be inserted into a Thermowell. BAPI Thermowells are available in machined stainless steel or brass, or welded stainless steel, in lengths to match our Immersion Unit Probe Lengths. For more info, see page A50.

For detailed specs on the individual Sensors & Transmitters, turn to the “Sensors” section.

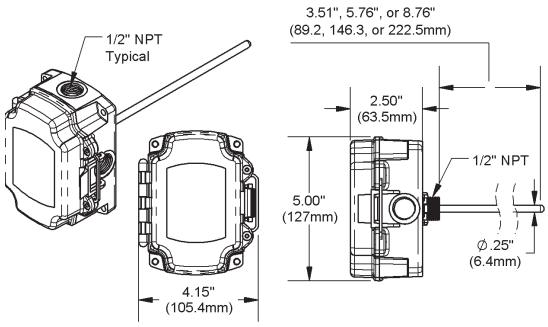
*Some items may not be CE compliant, call BAPI for additional information.

Specifications

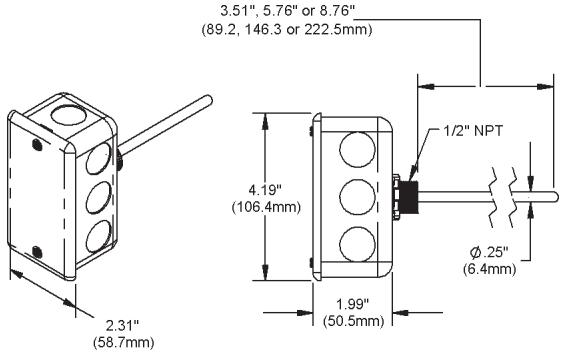
Encl. Material:
J-Box Model: Galv. Steel
WP Model: Cast Aluminum
EU Model: ABS Plastic, UL94, V-0
BB Model: UV-resistant polycarbonate, UL94, V-0

Encl. Rating: WP Model: NEMA 3R
EU & BB Model: IP66

Environmental Operation Range:
Temperature:
EU & BB Enclosure: -40 °C to 85 °C
J-Box, WP Enclosure: -40 °C to 85 °C
Humidity: 0 to 100%, non-condensing



Immersion Unit with BAPI-Box (BB)

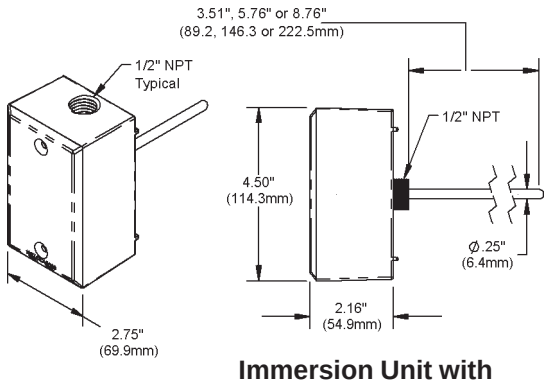


Immersion Unit with J-Box

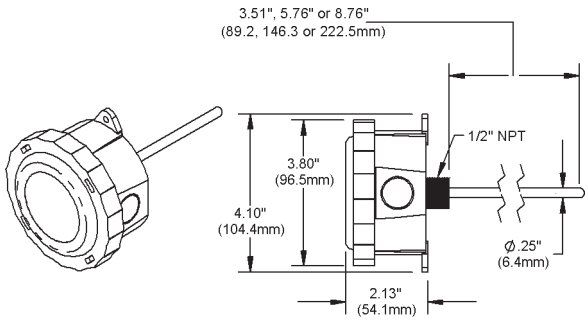
Building Automation Products, Inc., 750 North Royal Avenue, Gays Mills, WI 54631 USA
Tel: +1-608-735-4800 • Fax: +1-608-735-4804 • E-mail:sales@bapihvac.com • Web:www.bapihvac.com

Rev. 05/28/08

Specifications



Immersion Unit with Weather Proof (WP) Enclosure



Immersion Unit with Weathertight (EU) Enclosure

Ordering Information — Immersion Units - Temperature

BA/

Sensor Type — Use the designator number (shown to the left in bold) to indicate the sensor

#		THERMISTORS		RTDs
	1.8K	1.8K Ω @ 25 °C	**100**	100 Ω Platinum @ 0 °C, .385 Ω/°C temp. coeff.
	3K	3K Ω @ 25 °C	**100[3W]**	3 Wire 100 Ω Plat. @ 0 °C, .385 Ω/°C temp. coeff.
	3.3K	3.3K Ω @ 25 °C	**1K[375]**	1K Ω Platinum @ 0 °C, 3.75 Ω/°C temp. coeff.
	10K-2	10K Ω @ 25 °C	**1K[NI]**	1K Ω Nickel @ 21°C, 5 Ω/°C temp. coeff.
	10K-3	10K Ω @ 25 °C	**1K**	1K Ω Platinum @ 0 °C, 3.85 Ω/°C temp. coeff.
	10K-3[11K]	5,238 Ω @ 25 °C	**2K**	2K Ω Silicon @ 20 °C, 8 Ω/°C temp. coeff.
	20K	20K Ω @ 25 °C		
	50K	50K Ω @ 25 °C		**SEMICONDUCTORS**
	100K	100K Ω @ 25 °C	**334**	LM334 Semiconductor
			592	AD592 Semiconductor, 273 µA @ 0 °C
			592-10K	AD592 Semicond. w/ 10 kΩ shunt resistor, 2.73 V @ 0 °C

TEMPERATURE TRANSMITTERS ***Must include a "range" figure***

T100[range]	100 Platinum RTD, 100 Ω @ 0 °C with 4 to 20 mA Output
T100M[range]	100 Platinum RTD, 100 Ω @ 0 °C with MATCHED* 4 to 20 mA Output
T1K[range]	1K Platinum RTD, 1,000 Ω @ 0 °C with 4 to 20 mA Output
T1KM[range]	1K Platinum RTD, 1,000 Ω @ 0 °C with MATCHED* 4 to 20 mA Output
T10K[range]	10K Thermistor, 10,000 Ω @ 25 °C with 4 to 20 mA Output

TEMPERATURE TRANSMITTER RANGES

Custom temperature transmitter ranges are available. Common ranges are listed below

30 TO 81F	-1 TO 27C	32 TO 212F	0 TO 100C
0 TO 100F	-18 TO 38C	40 TO 240F	4 TO 116C
20 TO 120F	-7 TO 48C	50 TO 250F	10 TO 121C
32 TO 134F	0 TO 57C		

Configuration

-I-2"	2" length of ¼" Diameter, Stainless Steel Probe
-I-4"	4" length of ¼" Diameter, Stainless Steel Probe
-I-8"	8" length of ¼" Diameter, Stainless Steel Probe
-I-XX	Custom lengths of ¼" Diameter, Stainless Steel Probe are available. Call for Details.

Options — *2"x4" J-Box comes standard*

-BB	BAPI-Box Enclosure - IP66 rated, UV-resistant polycarbonate
-EU	Weather Tight Enclosure - IP66 rated ABS polymer enclosure
-EUO	Weather Tight Enclosure - IP66 rated UV-resistant enclosure
-WP	Weatherproof Enclosure - NEMA 3R rated metal enclosure

EXAMPLE

BA/	**10K-2**	**-I-8"**	**-EU**	

Part Number: BA/10K-2-I-8"-EU

Your Part Number:

Call BAPI if you have questions about the above ordering grid or the configuration of the product you are ordering.

FOX FT2

Model FT2 Gas Mass Flowmeter & Temperature Transmitter

- ✗ Measures gas flow rate in SCFM, NM^3/Hr, Kg/Hr, & many more
- ✗ Measures process gas temperature
- ✗ Outputs: 2 x 4 to 20 mA - one for flow rate and one for temperature; pulse output for flow/total
- ✗ RS232 for connecting a Palm Handheld or computer; RS422/ RS485-Modbus, Profibus-DP, DeviceNet & Ethernet
- ✗ Insertion and in-line models
- ✗ All welded, 316 SS sensor construction; Hastelloy C276 optional
- ✗ Microprocessor based, field programmable
- ✗ On-board 2 x 16 character, backlit display with configuration panel to view/set readings and parameters
- ✗ Palm handheld terminal available to view/set readings and parameters when on-board display & configuration panel is not ordered
- ✗ NEMA 4X enclosure; designed for Class I, Division 2, Groups B, C, & D hazardous areas
- ✗ NIST traceable calibration; CE approved
- ✗ Low-end sensitivity – leak detection
- ✗ Negligible pressure drop
- ✗ No moving parts

FOX THERMAL INSTRUMENTS, INC.

PRODUCT DESCRIPTION

The Fox Model FT2 Thermal Gas Mass Flowmeter and Temperature Transmitter measures two important process variables in one rugged instrument. The FT2 measures gas flow rate in standard units without the need for temperature or pressure compensation. It provides isolated 4 to 20 mA and pulse outputs for flow rate and a 4 to 20 mA output for process gas temperature. You choose the flow rate and temperature engineering units. An optional on-board 2 x 16 characters, backlit display is available to view flow rate, total, elapse time, process gas temperature, and alarms. The display is also used in conjunction with the Configuration Panel to configure flowmeter settings such as 4 mA and 20 mA for flow rate and temperature, pulse output frequency scaling, pipe area, zero flow cutoff, flow filtering (dampening), display configurations, diagnostics and high or low alarm limits. If you prefer, you can view measurements and set parameters with an optional Palm PDA instead of the on-board Display and Configuration Panel.

The FT2 is available in insertion and in-line models. The insertion meter is easily installed by drilling a ¾"hole in the pipe and welding on a ¾" NPT coupling. A Fox supplied compressing fitting secures the probe in place. The in-line model is available in ¼-inch to 6-inch sizes and include built in flow conditioners that eliminate the need for long, straight pipe runs. The meter can be ordered with flange or NPT end connections. Both models are supplied with 316 stainless steel wetted materials standard or Hastelloy C-276 as an option.

RS232 for connecting a Palm PDA or computer; RS422/RS485-Modbus, Profibus-DP, DeviceNet and Ethernet give the FT2 flexible communications capability. The FT2 is an advanced Thermal Mass Flowmeter and Temperature Transmitter for your most challenging gas flow measurement applications.

Common Gases: Air, ammonia, biogas, butane, chlorine, compressed air, carbon monoxide, carbon dioxide, digester gas, ethane, ethylene, helium, hydrogen, methane, natural gas, nitrogen, oxygen, propane, and many more

SPECIFICATIONS

Performance Specs

Flow Accuracy:

± 1% of reading ± 0.2 % of full scale*

* Point velocity for insertion flowmeters. Fox recommends a minimum of 15 diameters of straight pipe upstream of the flowmeter and 10 diameters downstream for insertion flowmeters. Fox recommends a minimum of 8 diameters of straight pipe upstream of the flowmeter and 4 diameters downstream for inline flowmeters.

Flow Repeatability:

± 0.2% of full scale

Flow Response Time:

0.9 seconds (one time constant)

Temperature Accuracy:

± 1.8° F (± 1.0° C) over -40 to 300° F (-40 to 149° C); ± 3.6° F (± 2.0° C) over 300 to 500° F (149 to 260° C). Minimum velocity 60 SFPM.

Operating Specs

Units of Measurement:

SCFM, SCFH, NM3H, NM3M, KG/HR, KG/M, KG/S, LBS/H, LBS/M, LBS/S, NLPH, NLPM, SLPM, SFPM, NMPS, SMPS, MMSCFD

Flow Rates for Insertion Flowmeter:

0 to 32,000 sfpm (163 nmps) - Air at 70F & 1 ATM

To determine if an Insertion Flowmeter will operate properly, divide the maximum flow rate by the pipe area. The application is acceptable if the velocity is within the velocity range above. Here are flow rates for common pipe sizes:

Pipe size	scfm	nm^3/hr
1-1/2" (40mm)	0-450	0-760
2" (50mm)	0-750	0-1280
3" (80mm)	0-1600	0-2720
6" (150mm)	0-6400	0-10870
8" (200mm)	0-11100	0-18860
10" (250mm)	0-18200	0-30920
12" (300mm)	0-24900	0-42300

Full Scale Flow Ranges for In-Line Flowmeters:

Size	scfm	nm^3/hr
0.25"	0-16	0-27
0.5"	0-48	0-82
.75"	0-120	0-204
1"	0-192	0-326
1.5"	0-450	0-760
2"	0-750	0-1280
2.5"	0-1090	0-1855
3"	0-1600	0-2720
4"	0-2880	0-4893
6"	0-6400	0-10870

Note: Standard conditions of air at 70°F and one atmosphere. Consult factory for other gases and for flow ranges above and below those listed above.

Gas Pressure (maximum):

Insertion Flowmeter:

300 psig (21.0 barg)

In-Line, Flowmeter:

NPT: 300 psig (21.0 barg)

150# Flange: 230 psig (16.0 barg)

Note: Pressure ratings stated for temperature of 100°F (38°C).

Temperature:

Std sensor: -40 to 250°F (-40 to 121°C)

HS Sensor: 32 to 400°F (0 to 204°C)

HT Sensor: 32 to 650°F (0 to 343°C)

Enclosure: -40 to 158°F (-40 to 70°C) without display, 32 to 140°F, (0 to 60°C) with display

Input Power:

24 VDC, ± 10%, 0.75 amp standard; 85 to 250VAC 50/60Hz, 20 watts optional

Output:

2 x isolated 4 to 20 mA outputs (1 for flow & 1 for temperature); isolated pulse output 0 to 100Hz, 10 volts p/p for flow (the pulse output can be used as an isolated contact discrete output for alarms)

RS232 for connecting a Palm PDA or computer; optional RS422/RS485-Modbus, Profibus-DP, DeviceNet & Ethernet

Physical Specs

Sensor material:

316 stainless steel standard; Hastelloy C276 optional

Enclosure:

NEMA 4X, designed for Class I, Division 2, Groups B, C & D hazardous areas. CE approved.
Remote with explosion-proof sensor J-box, J-box enclosure designed for Class I, Division 1, Groups B, C & D hazardous areas.

Cabling:

To Fox remote enclosure: 5 conductor, 22 AWG, shielded, 50 feet maximum

To remote PD696 rate/totalizer display: 2 conductor, shielded, 22 AWG, 3000 feet maximum

Retractor assemblies:

Packing gland assembly: 60 psig maximum – see figure 6

High pressure (crank) retractor: NPT 600 psig, ANSI 150 & ANSI 300 - see figure 7

Dimensional

Insertion Flowmeters:

Probe diameter: 1/2"

Equation for selecting Insertion Flowmeter probe length:

Probe length = ½ pipe ID (in inches) + 2" + thickness of insulation (if any) + dimension of retractor (if supplied). Round up to the next standard probe length available.

Assuming there is no insulation or retractor, Fox recommends the following probe lengths:

Pipe Size	Probe Length
1-1/2" (40mm) to 2" (50mm)	4-inch
3" (75mm) to 6" (150mm)	6-inch
8" (200mm) to 14" (350mm)	9-inch
16" (400mm) to 20" (500mm)	12-inch
Use the equation above for larger pipe sizes	

Insertion Flowmeter Probe Lengths (LL) – see figure 1
= 4.0(10.2), 6.0(15.2), 9.0(22.9), 12.0(30.5), 15.0 (38.1), 18.0(45.7), 24.0(61.0), 30.0(76.2), 36.0(91.4)

Inline Flowmeter Dimensions – see figures 2, 3 & 5			
Pipe size	**L**	**H**	**HH**
0.25"	7.90 (20.0)	12.5 (31.8)	11.8 (30.0)
0.5"	12.0 (30.5)	12.5 (31.8)	11.8 (30.0)
0.75"	12.0 (30.5)	12.5 (31.8)	11.8 (30.0)
1"	15.0 (38.1)	12.5 (31.8)	11.8 (30.0)
1.5"	12.0 (30.5)	12.5 (31.8)	11.8 (30.0)
2"	12.0 (30.5)	12.5 (31.8)	11.8 (30.0)
2.5"	18.0 (45.7)	12.5 (31.8)	11.8 (30.0)
3"	18.0 (45.7)	12.5 (31.8)	11.8 (30.0)
4"	18.0 (45.7)	14.0 (35.6)	13.3 (33.8)
6"	24.0 (61.0)	15.0 (38.1)	14.3 (36.3)

Note: Dimensions in inches. Dimensions in parenthesis are centimeters. For certified drawings, consult factory.

Theory of Operation

Fox Flowmeters use a Constant Temperature Differential (ΔT) technology. The sensor has two elements. The Reference RTD measures the gas temperature. The electronics heats the heated element above the gas temperature. It is the job of the electronics to maintain a constant ΔT between the gas temperature and the heated element. As the mass flow increases, the increased numbers of gas molecules remove more heat from the heated element.

The electronics senses this temperature reduction and adds additional power to the heated element in order to maintain a constant ΔT. The amount of power delivered to the heated element is proportional to the mass flow rate. The microprocessor then linearizes this signal to deliver a linear output.

Pressure Drop Charts for Inline Flowmeters

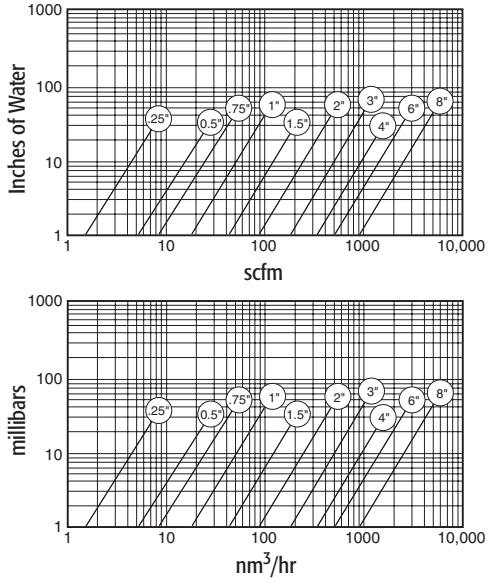


Figure 1: Insertion 4" to 36" (10.2 to 91.4 cm)

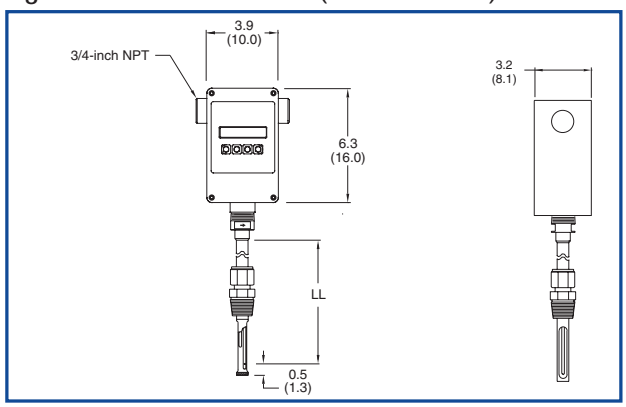
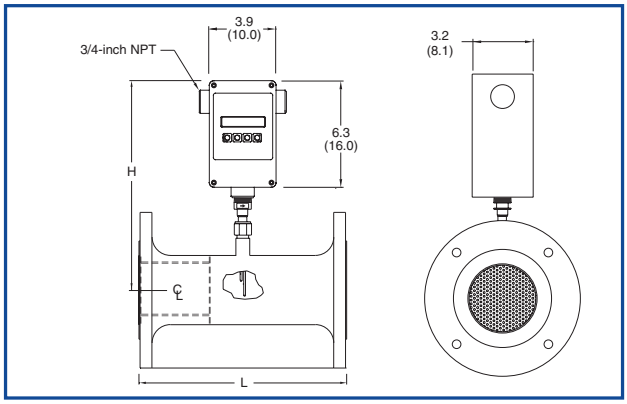


Figure 2: In-Line with 150# Flanges – sizes 0.5" to 6"



DIAGRAMS

Figure 3: In-Line with NPT Fittings – sizes 0.25" to 6"

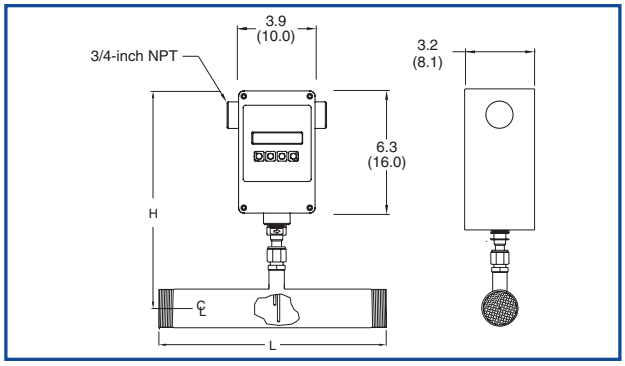


Figure 4: PD693 Rate/Totalizer

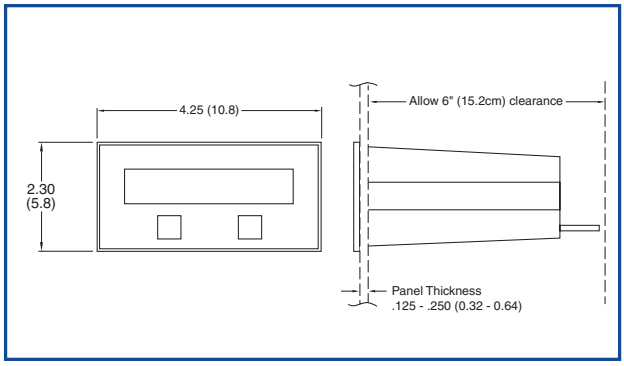


Figure 5: Remote Enclosure

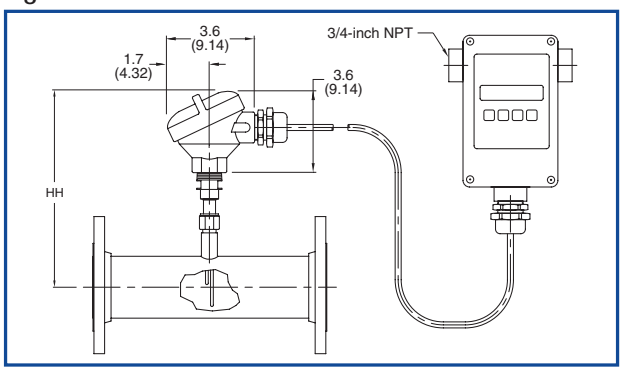


Figure 5A: Remote Explosion-proof Sensor J-Box

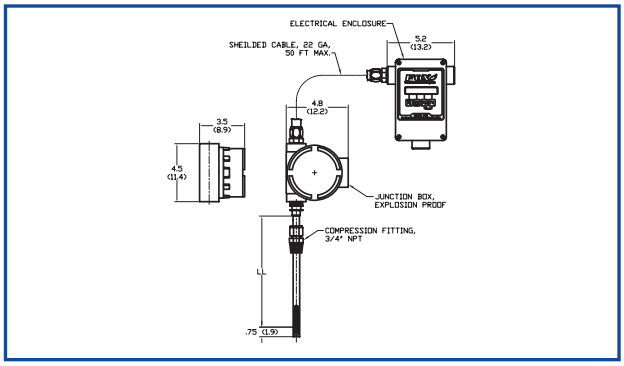


Figure 6: Packing gland assembly - 60 psig maximum

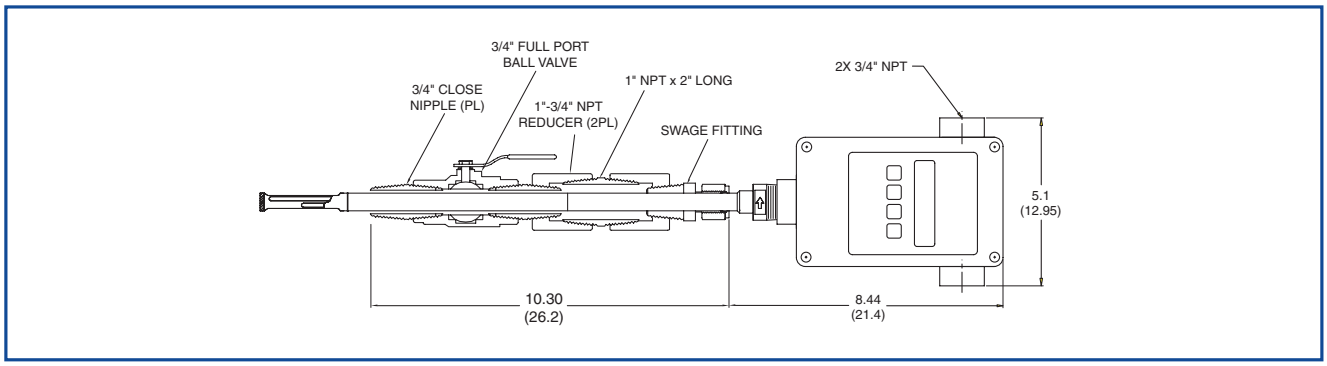
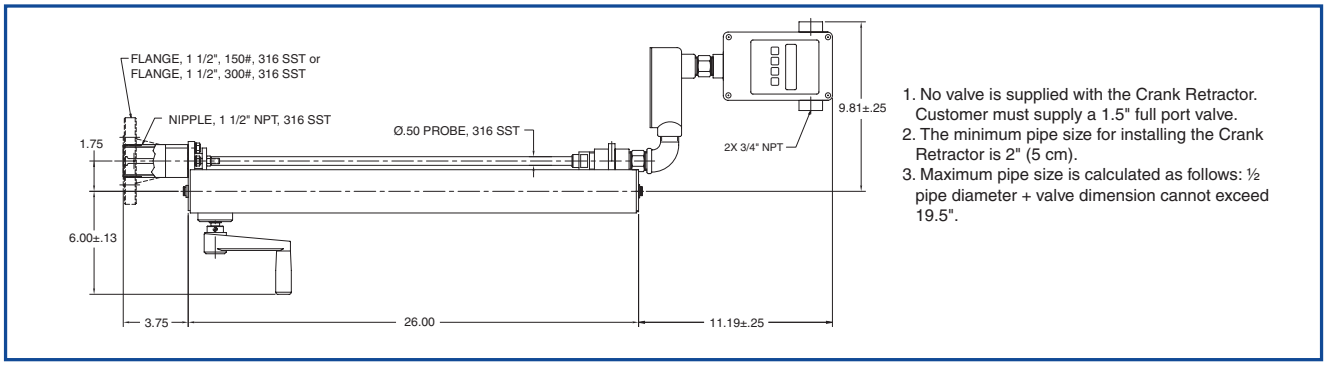


Figure 7: Crank Retractor - NPT 600 psig, ANSI 150 & ANSI 300



1. No valve is supplied with the Crank Retractor. Customer must supply a 1.5" full port valve.
2. The minimum pipe size for installing the Crank Retractor is 2" (5 cm).
3. Maximum pipe size is calculated as follows: ½ pipe diameter + valve dimension cannot exceed 19.5".

FOX THERMAL INSTRUMENTS, INC.

FOX THERMAL INSTRUMENTS, INC.
399 RESERVATION ROAD ✗ MARINA, CA 93933 ✗ USA
Phone: 831-384-4300 ✗ Fax: 831-384-4312
E-MAIL: sales@foxthermalinstruments.com
www.foxthermalinstruments.com

FLOW SENSOR WITH INTEGRAL FLOW TRANSMITTER

SDI SERIES

DESCRIPTION

The **SDI Series** flow sensor has an integral transmitter and is available in either brass or stainless steel. Hot tap stainless steel models include isolation valve and mounting hardware which enables flowmeter installation and removal while the piping system is pressurized; system shutdown is unnecessary. Hot tap stainless steel models are also available for bidirectional flow measurement. The impeller is rugged and non-fouling and requires no custom calibration. The **SDI Series** is available with a frequency output, analog output, and scaled-pulse output and the display is optional. Stainless steel models are available with a PEEK (polyetheretherketone) tip for high (up to 300 °F) fluid temperatures.

SDI Series

FEATURES

- ***Direct insertion or hot tap installation***
- ***Fits pipe sizes 1.5" to 36"+ (3.8 to 91+ cm)***
- ***Mounts in 1" NPT tap, weld-on or pipe saddle***
- ***Low pressure drop***
- ***Optional 8 character 3/8" (0.95 cm) LCD***
- ***NEMA 4X enclosure standard***
- ***Bidirectional models available***
- ***Field programmable with optional software***

SPECIFICATIONS

Supply Voltage	8-35 VDC
Supply Current	25 mA
Maximum Output Impedance	750Ω @ 24 VDC
Output Signal	Models with standard frequency pulse, two-wire 4-20 mA, scaled pulse, or bi-directional (hot-tap models only)
Wiring Terminations	Screw terminals
Conduit Connection	1/2" FNPT
Configuration	A-SDI Programming software kit, includes 20' cable
Accuracy	± 1% of flow rate
Repeatability	± 0.5%
Display	One line, eight character 3/8" (.95 cm) LCD, annunciators for rate, total, input, output
Operating Temperature	14° to 150°F (20° to 65°C)
Velocity Range	0.3 to 20 fps (.09 to 6.1 mps)
Installation	Install in straight pipe section with a minimum distance of 10 pipe diameters upstream and 5 pipe diameters downstream to any bend, obstruction or transition
Mounting	1" MNPT, mount in Thredolet® or pipe saddle
Media Temperature Range	Maximum 300°F (149°C) for PEEK tip; 180°F (82°C) for PPS tip
Maximum Pressure	1000 psig (6895 kPa) for stainless steel, 600 psig (4137 kPa) for brass
Pressure Drop	0.5 psid (3.5 kPa), or less, at 10 fps velocity
Materials Of Construction	Polypropylene enclosure with Viton® sealed dacrylic cover, probe and sensor materials vary by model number (see ORDERING INFORMATION)
Enclosure Rating	NEMA 4X
Warranty	1 year

ORDERING INFORMATION

MODEL	DESCRIPTION
SDI	Flow sensor with integral transmitter
	MATERIAL
	0D1N Stainless steel insertion with PPS tip for 1.5" to 10" pipes
	0D2N Stainless steel insertion with PPS tip for 12"" to 36" pipes
	0D3N Stainless steel insertion with PPS tip for 36"+ pipes
	1D1N Brass insertion with PPS tip for 1.5" to 10" pipes
	1D2N Brass insertion with PPS tip for 12" to 36" pipes
	1D3N Brass insertion with PPS tip for 36"+ pipes
	2D1N Stainless steel insertion with PEEK tip for 1.5" to 10" pipes
	2D2N Stainless steel insertion with PEEK tip for 12" to 36" pipes
	2D3N Stainless steel insertion with PEEK tip for 36"+ pipes
	0H1N Stainless steel hot tap with PPS tip for 1.5" to 10" pipes
	0H2N Stainless steel hot tap with PPS tip for 12" to 36" pipes
	0H3N Stainless steel hot tap with PPS tip for 36"+ pipes
	2H1N Stainless steel hot tap with PEEK tip for 1.5" to 10" pipes
	2H2N Stainless steel hot tap with PEEK tip for 12" to 36" pipes
	2H3N Stainless steel hot tap with PEEK tip for 36"+ pipes
	OUTPUT
	0 Standard frequency pulse
	1 4-20 mA
	2 Scaled pulse
	5 Bidirectional, 4-20 mA + direction (hot tap, PPS tip only)
	6 Bidirectional, scaled pulse (hot tap, PPS tip only)
	DISPLAY
	0 No display
	1 LCD option (not available with output option 0)
	CONSTRUCTION
	0200 Viton O-ring, Carbide shaft, stainless steel impeller, Torlon bearing (std)
	1200 EPDM O-ring, Carbide shaft, stainless steel impeller, Torlon bearing

SDI | 2D1N | 1 | 1 | 0200

Example: SDI2D1N11200 Flow sensor with integral transmitter, stainless steel insertion with PEEK tip, 4-20 mA output, display, standard construction.

ACCESSORIES

8132030	Replacement ball valve for hot tap install
A-1027	Hot tap adapter nipple, required for hot tap
A301-20	Flow/BTU transmitter programming kit, Includes cable

Low-cost, ultra compact meter with power, energy and demand measurements?

PowerLogic® ION6200 meters

Retail

Buildings

Medical Center

SQUARE D

by Schneider Electric

PowerLogic ION6200

power and energy meter

The PowerLogic ION6200 meter offers outstanding quality, versatility and functionality in a low-cost, ultra-compact unit. The meter is simple to use and offers a big, bright LED display for superior readability in poor lighting conditions.

Complete with four-quadrant power, demand, energy, power factor and frequency measurements, the ION6200 meter is available in a variety of flexible configurations including ANSI and Measurement Canada certification for use as a revenue meter.

This versatile unit is easy to wire and mount. It offers an excellent upgrade path, allowing you to start with a low-cost base model and add enhanced functionality over the long term.

The ION6200 is the industry's first basic meter that lets you upgrade functionality in the field by activating the base unit. Rather than carry a large inventory of pre-configured meters, genset and electrical equipment manufacturers, panel shops, EMS manufacturers and energy service providers can each adapt meter functionality to specific applications, as required.

Applications summary

- Revenue metering and sub-metering

  The low cost and highly accurate ION6200 meter with optional revenue certification and simple retrofit installation provides economical power monitoring for commercial and residential tenants. The meter easily integrates with existing energy management systems and RTUs, and allows you to increase property values by eliminating previously uncontrolled expenses.

- Replace multiple analog meters

  An ideal replacement for analog meters, the ION6200 meter can be used for stand-alone metering in custom panels, switchboards, switchgear, gensets, motor control centers and UPS systems.

- Basic metering

  The ION6200 meter offers high-accuracy power, energy and demand measurements. These revenue-accurate values can be used for bill verification, monitoring backup power for critical systems and cost effective energy solutions.

- Cost allocation

  Perfect for monitoring right down to the tool level, the ION6200 meter can help monitor cost centers, identify opportunities for demand control and check energy consumption patterns. Revenue certification is available if required.

- Substation monitoring

  A megawatt and kilovolt readings option is available for high-voltage applications.

Features

> Modularity
- Simple retrofit
- Low initial investment that can still meet future needs
- Retrofitable upgrades add functionality as required

> Ease of use
- Fast setup via display or software
- Free configuration software
- Bright, easy to read LED display

> Revenue certification
- ANSI and Measurement Canada options
- Factory-sealed version available in Canada

> Communications
- RS-485 port
- Modbus RTU for integration with energy management systems

> Management systems
- ION® compatible protocol for use with PowerLogic ION Enterprise® software

> Pulse outputs
- 2 outputs for kWh, kVARh or kVAh pulsing

> Patented ION technology
A modular, flexible architecture that offers extensive user programmability.
- Uniquely addresses complex monitoring and control applications
- Adapts to changing needs, avoiding obsolescence

Base unit

> Physical configurations
- Integrated models have a built-in display and fit in an ANSI 10cm (4") and DIN 96 cutout
- Transducer (TRAN) models have no display and can be fastened to a flat surface with a 10cm (4") ANSI bolt pattern or mounted to a DIN rail. A remote display module (RMD) can be ordered for the TRAN and mounted through an ANSI 10cm (4") and DIN 96 cutout. A 4.3m (14ft) cable is standard with this option.

> Front panel display
Bright LED display with twelve 19mm (3/4") high digits
- Displays all basic power parameters
- Easy setup for common configuration parameters
- Password protection on setup parameters
- Password protection for demand reset

> Pulse outputs
- Optional kWh, kVARh and/or kVAh pulsing via two Form A outputs

> Communications
- Optional RS-485 port with standard Modbus® RTU and ION compatible protocol
- Baud rates from 1,200bps to 19,200bps

> Plug-in power supplies
- 100 to 240Vac (50 to 60Hz)/110 to 300Vdc
- Optional 20 to 60DC (±10%)
- Optional 480Vac (60Hz)

Measurements

> Metering
- 64 samples/cycle
- IEC 60687 class 0.5 accuracy
- ANSI C12.20 0.5 compliant
- Four-quadrant energy and demand
- 49 real-time, true RMS electrical parameters
- Per phase voltage, current, peak current demand, watts, VARs, kWh and more*
- Neutral current, THD, frequency, power factor and more
- Megawatt option measures in MW and kV

Specifications

> Accuracy
- Voltage: L-N 0.3% reading, L-L 0.5% reading
- Frequency: ±0.1Hz
- Current:
  - ≥5% of full scale: 0.3% reading
  - <5% of full scale: 0.3% reading + 0.05% full scale
  - I4 derivation: 0.6% reading + 0.05% full scale
- Power factor: 1.0% reading
- Total harmonic distortion (THD): ±1.0%
- Power and energy measurements:
  - (kW, kVA, kVAR, kWh, kVAh, kVARh). Complies with IEC 60687 Class 0.5 and ANSI 12.20 Class 0.5 (0.5% reading)

> Environmental conditions
- Operating temp: -20°C to 70°C (-4°F to 158°F)
- Storage: -40°C to 85°C (-40°F to 185°F)
- Humidity: 5% to 95% non-condensing

> Installation and input ratings
- 64 samples/cycle true RMS
- Autoranging voltage inputs allow direct connection to 400/690Vac systems (the meter is calibrated for 60 to 400Vac L-N connections)
- Supports Direct 4-Wire Wye, 3-Wire Wye, 3-Wire Delta, Direct Delta and single-phase configurations
- 3-phase voltage and current inputs
- Impedance: 2MΩ/phase
- Burden: 0.05VA (typical) @ 5A RMS
- 5A nominal/10A full scale/20% overrange full accuracy
- Current overload rating 120A for 1sec
- Standard terminal strip covers

> Dimensions and shipping
- Basic unit installed depth: 106.7 x 106.7 x 40.6mm (4.2" x 4.2" x 1.6")
- Remote display: 106.7 x 106.7 x 22.9mm (4.2" x 4.2" x 0.9")
- Shipping weight: 0.68kg (1.5lb)

> Software
- Download free ION Setup™ configuration software from our web site
- Integrate the ION6200 into PowerLogic ION Enterprise, our monitoring, analysis and control software

*Per phase energy values not available in Delta volts mode

PowerLogic ION6200 meter standard and enhanced measurements

Standard and enhanced measurements		Standard	EP #1	EP #2
Voltage L-N	average	■	■	■
	per phase	■	■	■
Voltage L-L	average	■	■	■
	per phase	■	■	■
Frequency		–	■	■
Current	average	■	■	■
	per phase	■	■	■
I4		–	■	■
kW/MW	total	–	■	■
	per phase	–	–	■
kVAR/MVAR	total	–	–	■
	per phase	–	–	■
kVA/MVA	total	–	–	■
	per phase	–	–	■
kWh/MWh	total	–	■	■
Del/rec (imp/exp)	per phase	–	–	■
kVARh/MVARh	total	–	–	■
Del/rec (imp/exp)	per phase	–	–	■
kVAh/MVAh	total	–	–	■
	per phase	–	–	■
kW/MW	demand	–	–	■
	peak	–	■	■
kVAR/MVAR	demand	–	–	■
	peak	–	–	■
kVA/MVA	demand	–	–	■
	peak	–	–	■
Current demand	average	–	■	■
	per phase	–	■	■
Current peak demand	average	–	■	■
	per phase	–	■	■
Power factor	total	–	■	■
	per phase	–	–	■
Voltage THD	per phase	–	–	■
Current THD	per phase	–	–	■

Software integration

- PowerLogic ION Enterprise software
- ION Setup software

Safety & Security. Reliability & Productivity.
Aesthetics & Comfort. Efficiency & Sustainability.

Whatever your need Schneider Electric has the solution. To find genuine Schneider Electric and Square D Brand products, go to www.squared.com to find your nearest authorized distributor or call 1-888-SquareD.

File# 002188

Schneider Electric - North American Operating Division

295 Tech Park Drive
LaVergne, TN 37086
Tel: 615-287-3500
www.PowerLogic.com

Document Number 3000BR0606R11/09

11-09 tk

Model PM174 Advanced Power Quality Monitor

Model PM174 PQ Monitor

The Model PM174 Advanced Power Quality Monitor is SATEC'S new generation of power instrumentation that fully complies with the IEEE-1159 power quality category to define phase, magnitude and duration of events. The extensive features of the Model PM174 Series make it ideal for applications such as feeder, switchgear monitoring, revenue billing, PQ monitoring and utility SCADA. It is also ideal for substation automation because of its support for the industry standard DNP3.0 and Modbus RTU protocols. The PQ monitor fits the ANSI C39.1 4-inch round cutout for easy analog meter replacement. Its galvanically isolated voltage, current, and power supply inputs make it extremely durable and reliable even in the harshest substation environment.

STANDARD FEATURES

Measurements

- Class 0.2S revenue accuracy
- 128 samples per cycle true RMS measurements
- Fast, real-time, cycle by cycle measurements, averaging values of 8, 16, or 32 cycles, selectable via the front panel
- Four-Quadrant measurements
- Min/Max values (instantaneous & demands)

Wiring configurations

- Each model accepts all wiring configurations, selectable via the front panel
- Supports Wye and Delta in 2-element, 2½-element, and 3-element wiring configurations

Digital Inputs

- 2 Dry Contact Digital Inputs
- Status or breaker monitoring
- Time stamp operation to 1ms
- Pulse counting and accumulation with user configurable weighting factors

Relay Outputs

- 2 programmable Form A relays
- Energy pulsing output (Wh, VARh, VAh)
- Alarming via programmable setpoint triggers such as phase loss, low volts demands, etc
- Manual control via communication commands
- Fail Safe mode

Integrated / Remote Display Module

- Display module can be integrated with the base unit or mounted remotely
- 3 line high-visibility 7-segment LED display, fully visible under bright sunlight
- Two 4-digit and one 6-digit window
- Simultaneous display of 3 phase parameters for quick phase balance assessment
- 6-digit Energy readings
- Configurable 8-segment LED % Load Bar mimics analog meter needle
- Energy pulse LED
- Communications activity LEDs
- Kilo and Mega LEDs for scaling indicators
- Menu driven selection with password
- Automatic scrolling with adjustable scroll time or fixed display
- User configurable, simple two-button Demand RESET operation
- Adjustable update time from 0.1 to 10 seconds
- Supports a second remote display module over RS485

Setpoints

- 16 user programmable set points with actions
- Independent Operate & Release Limits
- Independent Operate & Release Time Delays
- Logical AND/OR conditions
- Fast 10 ms update
- Choice of actions:
  - Close / Open relay
  - Increment / Clear counters

Demands

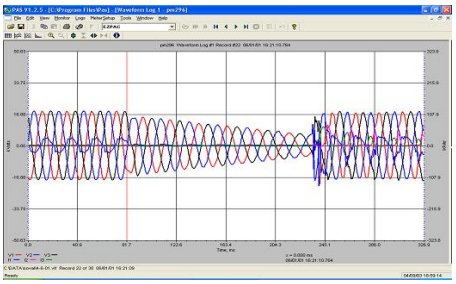
- Configurable demand calculation to match utility settings
  - Demand period from 1 to 60 minutes.
  - Number of demand periods from 1 to 15
- External synchronization for demand interval with Status Input or via communications

Communications

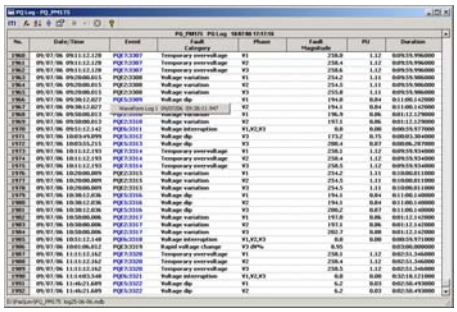
- Two independent communication ports
- **COM1** - optically isolated RS232/422/485 port, selectable via the front panel
  - Optional 10BaseT Ethernet-Modbus/TCP, DNP3/TCP protocols
  - Optional 56K modem
  - Optional Profibus DP
- **COM2** - optically isolated RS422/485 port
- Supports industry standard Modbus RTU & ASCII, DNP3.0,
- Unique "Assignable Register Map" allows users to assign registers from different ranges into a single contiguous Modbus address space or a DNP Class 0, 1, 2, or 3 poll, limiting the amount of data passed over the communications line and therefore making efficient use of the available bandwidth
- Supports up to 2 AX8 Analog Expanders for an additional 16 analog output channels
- Firmware upgrade via communications, eliminating chip replacement

Advanced Power Quality Functions

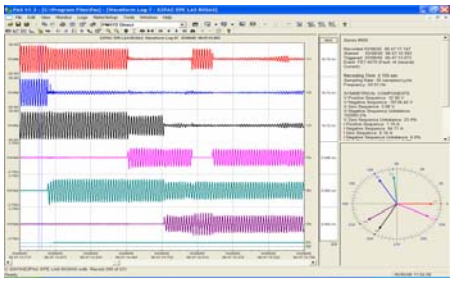
- Transient recording (minimum width: 130us @ 60Hz)
- Sag/Swell detection as per IEEE-1159 PQ categories: detailed description of event, phase, magnitude and duration
- Flicker (IEC 61000)
- ITI curves (CBEMA)
- Statistical Report Writer
- Export to PQDIF & COMTRADE format



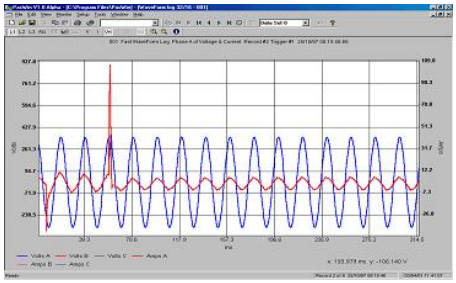
Sag/Swell Recording



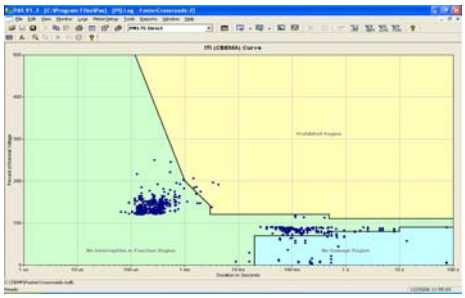
IEEE-1159 Categories - PQ Log



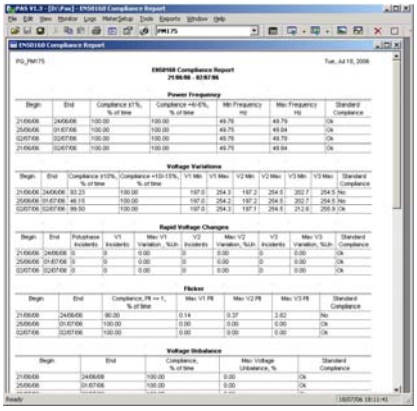
Detailed waveform capture



Transient Capture



ITI Plot (CBEMA)



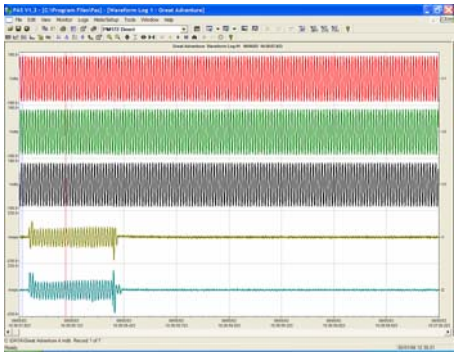
Statistical Compliance Report

SATEC
Powerful Solutions

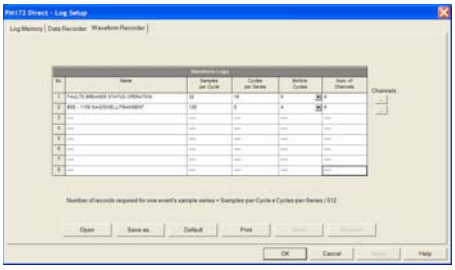
Model PM174 Advanced Power Quality Monitor

Waveform Logs

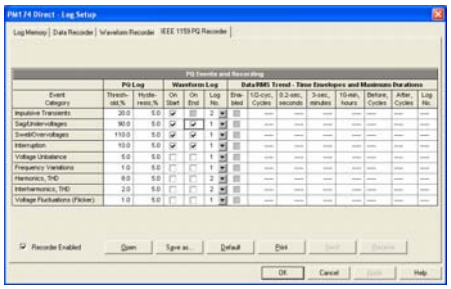
- Two independent, simultaneous waveform recorders, each recording the complete 3-phase voltage and current waveforms
- Recording resolution at 32, 64 and 128 samples/cycle
- Up to 20 pre-fault cycles
- Any number of post-fault cycles, limited only by available memory
- Supports Wrap-Around and Stop-on-Full recording modes



Motor Startup



Waveform Log Setup



PQ Setup Tab

Log Memory

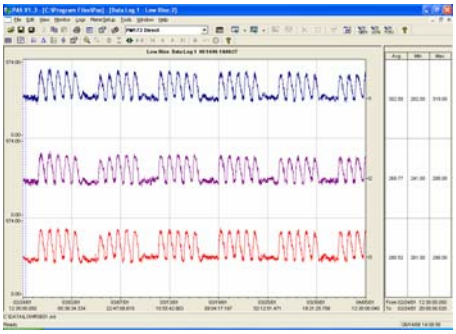
- 1MB of non-volatile log memory with battery backup. Up to 140 days of trending & load profile (16 measurements @ 15 minute interval)
- User-partitionable for Event Log, Data Logs, and Waveform Log Files

Event Log

- 1 Event Log of programmable depth

Data Logs

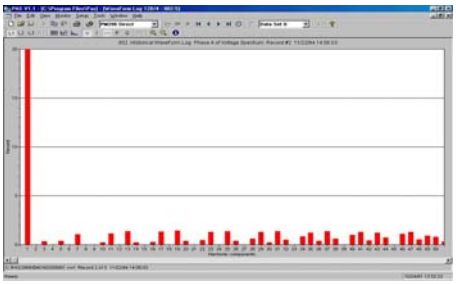
- 16 Data Logs of 16 parameters each
- Configurable depth
- Recording intervals from 1 to 9999 seconds
- Supports wrap-around and Stop-on-Full recording modes



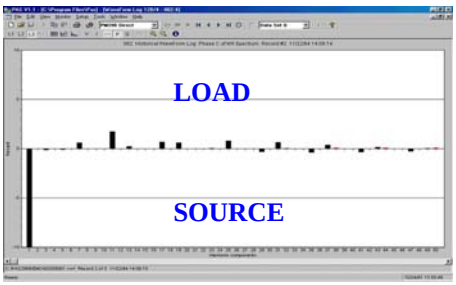
Log Profile / Data Trend

Advanced Harmonic Measurements

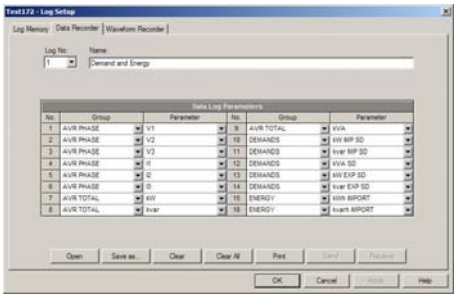
- Individual Harmonics up to 63rd, Amplitude & Phase
- Harmonic Power Direction (Load/Source)
- Total Harmonic Power and Energies



Harmonics Spectrum



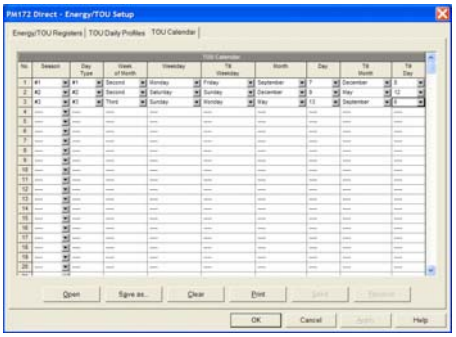
Directional Harmonics



Data Log Setup

Time Of Use (TOU)

- Configurable to match any utility billing profile
- 8 Energy and Maximum Demand Registers
- 8 tariffs for each energy register



TOU Calendar with Daily Profiles

Optional Inputs/Outputs

Analog Outputs (optional)

- 2 isolated, programmable Analog Outputs
- Fast 1-cycle update time
- Settable to any electrical measurement
- Programmable HI/LO Ranges

Analog Inputs (optional)

- 2 isolated, programmable Analog Inputs
- Fast 1-cycle scan time
- For monitoring substation and transformer temperature, oil level and pressure, etc

Software and Integration

System Integration

- Easy integration with Energy Management or SCADA systems via Modbus RTU, ASCII, DNP3.0 protocols
- Remote display and logging of all measured parameters
- Automatic/Remote Alarm & Control
- Remote configuration

PAS Software

- Included with every SATEC device
- Easy to use remote configuration software
- Supports off-line programming to allow easy downloading of a standard configuration to multiple meters
- Supports scheduled polling, viewing of real-time data, and automatic retrieval of historical and waveform logs
- Provides the ability to export waveform and data logs to COMTRADE and PQDIF formats
- Advanced Power Quality Analysis

Installation & Connections

- Each model accepts all wiring configurations, selectable from the front panel
- Analog meter replacement. Mounting standard to both ANSI C39.1 4-inch round and DIN 96x96 mm² cutouts
- Direct connection up to 400/690V or via PT
- Configurable PT and CT ratios via front panel
- Optional switchboard case for retrofit situations

Contact factory for details

SATEC
Powerful Solutions

Model PM174 Advanced Power Quality Monitor

Accuracy

Voltage: 0.2% reading + 0.01% F.S.
(10% to 120% Nominal)
Range: 0 to 1,150,000V
Starting Voltage: 1.5% F.S.

Current: 0.2% reading + 0.02% F.S.
(1% to 200% Nominal)
Range: 0 to 10,000A
Starting Current: 0.1% F.S.

I Neutral: 0.6% F.S. (2% to 150% Nominal)

Frequency: 0.02% reading (15 to 480 Hz)

PF: 0.2% F.S. (|PF| ≥ 0.5)

THD: 1.5% reading + 0.1% F.S.
THD ≥ 1%
V ≥ 10% F.S.V
I ≥ 10% F.S.I.

TDD: 1.5% F.S.
TDD ≥ 1%
I ≥ 10% F.S.I.

Watts: 0.2% reading + 0.02% F.S.
(|PF| ≥ 0.5)
-10,000,000 to +10,000,000 kW

VARs: 0.3% F.S. (|PF| ≤ 0.9)
-2,000,000 to +2,000,000 kVAR

VAs: 0.2% F.S. (|PF| ≥ 0.5)
0 to +2,000,000 kVA

Wh: Class 0.2S as per IEC 62053-22: 2003
-999,999,999 to +999,999,999 MWh

VARh: Class 0.2S as per IEC 62053-22:2003
-999,999,999 to +999,999,999 MVARh

VAh: Class 0.2S as per IEC 62053-22: 2003
0 to 999,999,999 MVAh

INPUT SPECIFICATIONS

Power Supply:

- 85-265V AC/DC universal power supply
  - 85-265VAC 50/60Hz, 88-290VDC, 10W
  - Isolation:
    - Input to output: 3000VAC
    - Input to ground: 2000VAC
- Options:
  - 12VDC: 10-16VDC
  - 24VDC: 18-36VDC
  - 48VDC: 36-72VDC

Voltage:

Direct Input:	Up to 400V-In/690V-ll
Input impedance:	500 kΩ
PT Ratio:	1.0-6500
Range:	1-999,000V
Burden:	<0.4VA for 400VAC <0.04VA for 120VAC
Overload withstand:	1000VAC continuous 2000VAC for 1 second
Galvanic Isolation:	3500VAC
Wire size:	Up to 12AWG (2.5mm^2)

Current:

5A secondary:

Operating Range:	Continuous 10A RMS
Burden:	< 0.1VA
Overload:	15A continuous 300A RMS for 1 second

1A secondary:

Operating Range:	Continuous 2A RMS
Burden:	< 0.02VA
Overload:	6A continuous 80A RMS for 1 second

CT Ratio:	1-50,000A
Range:	0-60,000A
Galvanic Isolation:	3500VAC
Wire size:	Up to 12AWG (2.5mm^2)

Digital Inputs:

- 2 dry contact digital inputs
- Internal supply: 15V
- Scan time: 1ms
- Isolation: 2000V RMS
- Wire size: Up to 14AWG (1.5mm^2)

Analog Inputs (optional):

- 2 optically isolated analog inputs
  - 0-1mA (100% overload)
  - ±1mA (100% overload)
  - 0-20mA
  - 4-20mA
- Accuracy: 0.5% F.S.
- Scan time: 1 cycle
- Isolation: 2000V RMS
- Wire size: Up to 14AWG (1.5mm^2)

OUTPUT SPECIFICATIONS

Relay Outputs:

- 2 Form A relays for alarming and control
- 3A @ 250VAC/30VDC
- Galvanic Isolation:
  - 2000VAC/1min. between contacts and coil
  - 1000VAC between open contacts
- Operate time: 10 ms max.
- Release time: 5 ms max.
- Update time: 1 cycle

Analog Outputs (optional):

- 2 optically isolated analog outputs
  - ±1mA, max. load 5kΩ (100% overload)
  - 0-20mA, max. load 510Ω
  - 4-20mA, max. load 510Ω
  - 0-1mA, max. load 5kΩ (100% overload)
- Accuracy 0.5% F.S.
- Update time: 1 cycle
- Isolation: 2000V RMS
- Wire size: Up to 14 AWG (1.5mm^2)

COMMUNICATION:

2 independent and simultaneous connections

COM1

- Standard
  - Optically isolated RS-232/422/485 port
  - Isolation: 2000V RMS
  - Selectable baud rate to 115,200 maximum
  - 7/8 bit even parity or 8 bit no parity
  - Protocols supported: Modbus RTU & ASCII, and DNPV3.0
- Optional Ethernet
  - Transformer-isolated 10/100BaseT
  - Connector: RJ45
  - Protocols supported: Modbus TCP, DNP3/TCP
  - 2 simultaneous connections
- Optional Dial-up Modem
  - Transformer-isolated 56KB modem
  - Connector: RJ11
  - Protocols supported: Modbus RTU, Satec ASCII, and DNPV3.0
- Optional Profibus DP (IEC 61158)
  - RS-485 optically isolated Profibus interface
  - Connector: DB9
  - Baud rate: 9600 - 12Mbps auto detection
  - 32 bytes input, 32 bytes output
  - Protocol supported: Profibus DP

COM2

- Optically isolated RS-422/RS-485 port
- Isolation: 2000V RMS
- Connector: 5-pin removable connector
- Selectable baud rate to 115,200 maximum
- 7/8 bit even parity or 8 bit no parity
- Protocols supported: Modbus RTU & ASCII, and DNPV3.0
- Wire size: up to 14 AWG (1.5mm²)

Real-time clock:

- Accuracy: 15 seconds per month @ 25°C (25ppm)

Standards of Compliance:

UL Recognized – E129258 (pending)
UL61010B-1

CE EMC: 89/336/EEC as amended by 92/31/EEC and 93/68/EEC
LVD: 73/23/EEC as amended by 93/68/EEC and 93/465/EEC

Harmonized standards to which conformity is declared:

EN EN55011: 1991; EN 50082-1: 1992;
EN61010-1: 1993; A2/1995
EN50081-2: 1994 Generic Emission Standard – Industrial Environment
EN50082-2: 1995 Generic Immunity Standard – Industrial Environment
EN55011:1994 Class A
EN61000-4-2: 1995 Electrostatic Discharge
EN61000-4-4: 1995 Electrical Fast Transient
EN61000-4-8: 1993 Radio Frequency Electromagnetic Field, Amplitude Modulated.
ENV50140: 1995 (200Hz) Radio Frequency Electromagnetic Field, Pulse Modulated
ENV50204: 1995 (900MHz)
ENV50141: 1993 Radio Frequency Common Mode, Amplitude Modulated

ANSI C37.90.1: 1989 Surge Withstand Capability

ANSI C62.41: 1991 Standard Surge

MISCELLANEOUS

Warranty:

3 Year limited warranty

Environmental Conditions

Operating Temp.:	-4 to 140°F (-20 to +60°C)
Storage Temp.:	-13 to 176°F (-25 to +80°C)
Humidity:	0 to 95% non-condensing

Construction

Case enclosure:	Plastic PC/ABS blend
Display body:	Plastic PC/ABS blend
Front panel:	Plastic PC
PCB:	FR4 (UL94-V0)
Terminals:	PBT (UL94-V0)
Plug-in connectors:	Polyamide PA6.6 (UL94-V0)
Dimensions:	5x5x5.8" (127x127x147mm)
Mounting:	ANSI 4" round DIN 92x92mm cutout
Weight:	1.23kg (2.7 lb.)

SATEC
Powerful Solutions

Model PM174 Advanced Power Quality Monitor

Optional RDM172E Remote Display Module

ADVANCED POWER QUALITY MONITOR
Model PM174 as per IEEE-1159 Categories

PM174 – ☐ ☐ ☐ ☐ ☐

Options:

CALIBRATION
- 50HZ 50Hz
- 60HZ 60Hz

CURRENT INPUTS
- 5 5 Amps
- 1 1 Amps

POWER SUPPLY
- AC/DC 85-265VAC/85-290VDC
- 1DC 10-18 VDC
- 2DC 18-36 VDC
- 3DC 38-72 VDC

ANALOG OUTPUT OR INPUT
- 00 No Analog Output or input

Analog Outputs
- AO1 ±1mA
- AO2 0-20mA
- AO3 0-1mA
- AO4 4-20mA

Analog Inputs
- AI1 ±1mA
- AI2 0-20mA
- AI3 0-1mA
- AI4 4-20mA

COM1
- 00 RS232/422/485
- MOD Dial up modem 56K
- ETH Ethernet
- PRO Profibus

EXAMPLES:
PM174-60HZ-5-ACDC-AO4-ETH
PM174-50HZ-1-3DC-AO4-MOD

SATEC, INC.
10 Milltown Court, Union, NJ, 07083
US Toll Free: 1-888-OK-SATEC
Tel: (908) 686-9510
Fax: (908) 686-9520
Email: satec@oksatec.com
www.oksatec.com

Your Local Representative

Measurements	
Measurements	**PM174**
Voltage L-L per phase	▪
Voltage L-N per phase	▪
Current per phase	▪
Neutral current	▪
Frequency	▪
Phase Rotation	▪
Relay Status	▪
Counters	▪
TxD, RxD Comm Status	▪
Alarm Trigger Code	▪
PF per phase and total	▪
kW per phase and total	▪
KVAR per phase and total	▪
KVA per phase and total	▪
Voltage Unbalance	▪
Current Unbalance	▪
%THD Volts per phase	▪
%THD Amps per phase	▪
%TDD Amps per phase	▪
K-Factor per phase	▪
Fundamental Volts, Amps per phase	▪
Fundamental kW, kVAR, kVA per phase & total	▪
Displacement PF per phase and total	▪
Voltage & Current Phasors	▪
Volts Demands	▪
Amps Demands	▪
kW, kVAR, kVA Demands	▪
V, I THD Demands	▪
kWh Imp/Exp, per phase & total	▪
kVARh Imp/Exp, per phase & total	▪
kVAh per phase and total	▪
TOU parameters	▪
16 Data Logs	▪
1 Event Log	▪
2 Waveform Logs	▪
Individual I Harmonics to 63rd	▪
Individual V Harmonics to 63rd	▪
Total harmonic kW and kVA	▪
Total harmonic kWh Import, Export	▪
Total harmonic kVAh Total	▪
Waveform Capability 32/64/128 samples/cycle	▪
Up to 20 pre-cycles	▪
PQ event Categories (IEEE-1159)	▪
Flicker (61000)	▪
Compliance Report via PAS	▪

Appendix B

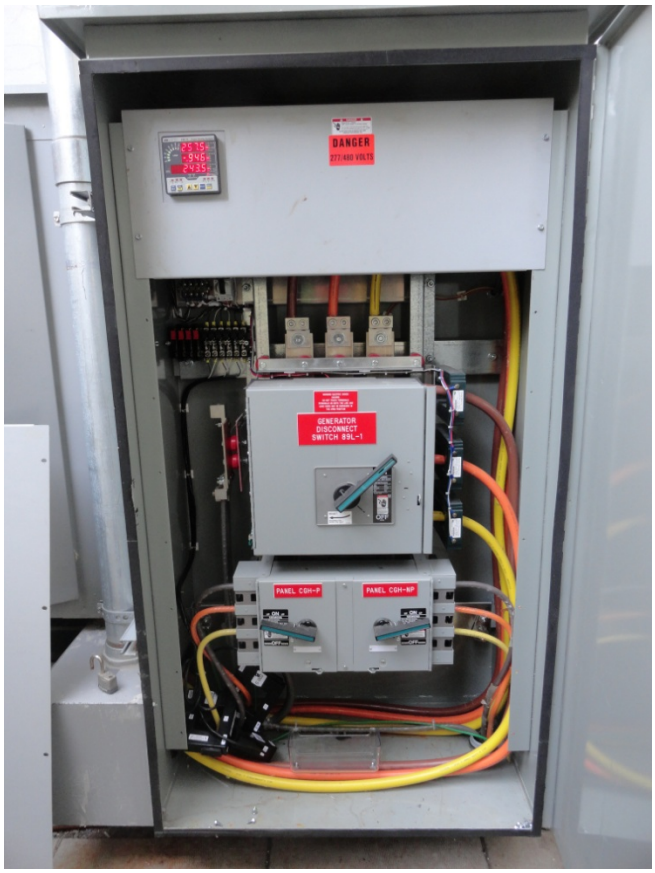
Site Photos and Verification Measurements

SDP 250 kW CHP Engine Generators

Dump Radiators

Hot Water Abs Chiller

Hot Water Abs Chiller and Cooling Tower



CHP Unit #1 Power Transducer and CTs (1 of 2 typ) – Also WPAR Cts

Parasitic Power Transducer – Located in Pump Skid

Natural Gas Meter

Main Hot Water Header Temperatures

Main Hot Water Header – BTU meter

Ultrasonic Flow Meter Installation and Flow Verification

Meter Verification – March 6, 2014

Church Street Verification - 3/6/2014

	Meter (kW)	Fluke (kW)
Generator Power - WG1	248	252
Generator Power - WG2	235	231

Note: Both generators electrically load follow and ramp power up and down making coincident measurement difficult.

Parasitic Power - WPAR	17.9	18.6

	BMS (F)	Fluke (F)
Loop Supply Temp - TLS	178	176.5
Loop Supply Temp - TLR	167	167

Note: Surface temperature on steel pipe.

	BMS (GPM)	Portaflow (GPM)
Loop Flow - FL	261.5	260-265

	Meter (CFH)	
Gas Flow	5,015	n/a

	BMS/Meter Readings	CDH Readings
Computed FCE elec (HHV)	30.7%	30.6%
Computed CHP elec (HHV)	57.3%	53.8%

Note: Surface temperature on steel pipe results in lower FCE. Temperature readings are sufficently close to BMS temperatures that BMS temperatures can be assumed accurate.