MEASUREMENT AND VERIFICATION PLAN

FOR

DG/CHP SYSTEM
AT
THE NEW YORK HILTON

November 2012

Submitted to:

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

Submitted by:

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1. Introduction

UTS Bid Energy, LLC is in the process of installing a combined heat and power (CHP) system at the New York Hilton at 1335 Avenue of the Americas, New York, New York with the assistance of several subcontractors providing various technical and implementation services.

The proposed CHP system is configured on seven (7) 250 kW reciprocating engine-generator sets. The system is intended to produce a gross output of 1.75 MW and recovery heat for heat for domestic hot water (DHW) service as well as supplementing the facility's steam loads via heat recovery steam generator (HRSG) steam generation. 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:	1,750 kW
Parasitic electrical input (estimated):	-70 kW
Hot water output at 180°F:	5.98 MMBtu/h
Steam output at 15-psig:	3.34 MMBtu/h
Fuel input:	17.13 MMBtu/h HHV (16,630 CFH)

Annually the system is anticipated to displace 12,745,525 kWh and 28 MMlbs of utility supplied steam (equivalent to 351,552 therms). Annual fuel consumption is 1,279,708 therms.

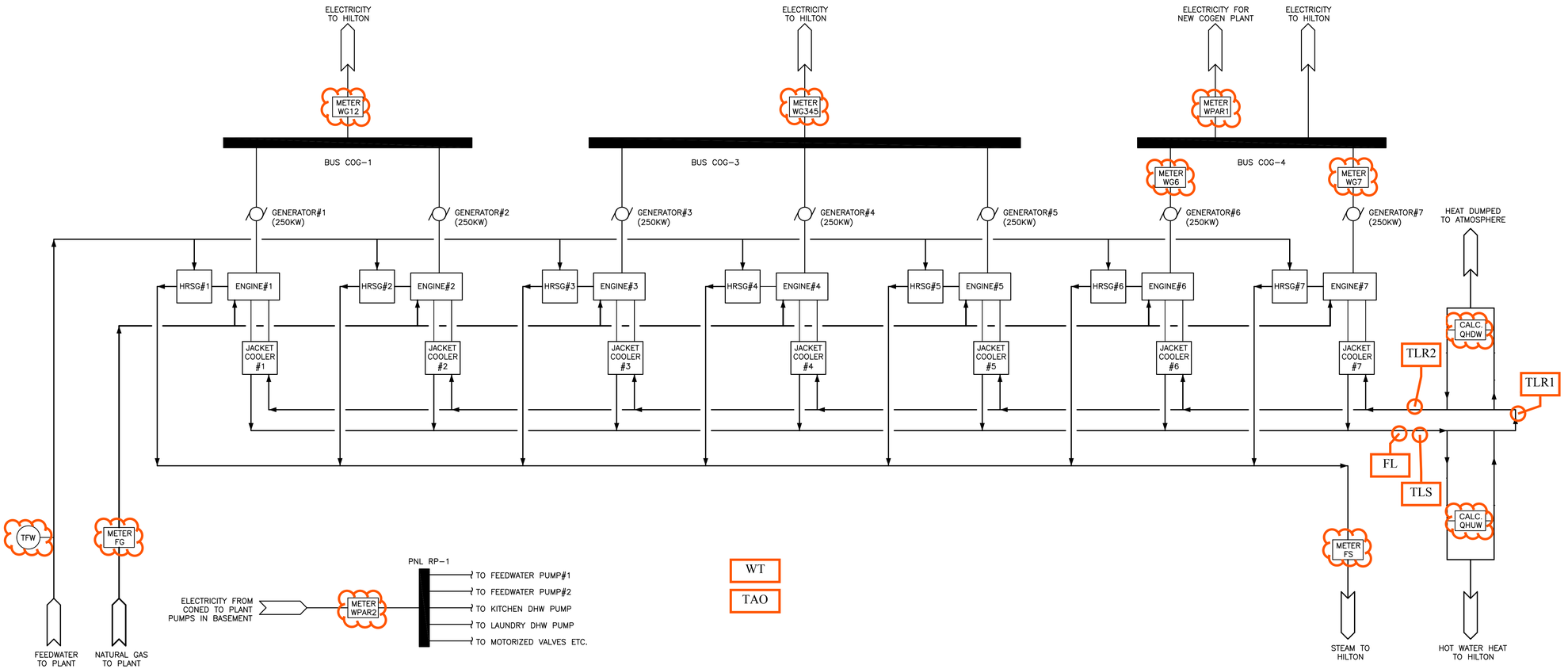
2. Instrumentation

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 CDH Energy and presented to the applicant, UTS Bid Energy, LLC. 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, UTS Bid Energy, LLC will supply the instrumentation listed in Table 1 below for use in meeting the NYSERDA CHP program monitoring requirements.

Table 1. Instrumentation Supplied By UTS Bid Energy, LLC

Point	Instrument	Output Type	Sensor Location	Notes
Generator Power Output	Satec PM174	Modbus	CTs in BUS COG-1, BUS COG-3, and BUS COG-4	· WG12, WG345, WG6, WG7
Parasitic Load Electrical Consumption	Schneider Electric Power Logic Ion 6200	Pulse	CTs in Panel PPH and Panel MP1	· WPAR1, WPAR2
Combined Generator Fuel Input	Rosemount Orifice Plate 2051CFCDCS040N065	4 - 20 mA 0 - 22,000 CFH	Meter located at CHP skid	· FG
Hot Water Heat Recovery	Btu calculated in DDC Controller		Calculated from TLS, TLR1, FL	· QHUW
Hot Water Heat Rejection	Btu calculated in DDC Controller		Calculated from TLR1, TLR2, FL	· QHDW
Glycol Loop Flow Rates	Badger Insertion Flow Meter SDI 1D1N10200	4 - 20 mA 0 - 400 GPM	Insertion meter on main heat recovery loop	· FL
Glycol Loop Temperatures	BAPI BA/10k-3-I-4" Thermistor	Resistance	Insertion meter on main heat recovery loop	· TLS, TLR1, TLR2
HRSG Steam Flow Meter	Sierra Vortex 241-VTP-LS-E2-DD-PV1	4 - 20 mA 0 - 3600 lbs./h	Mass vortex flow meter downstream of all generators on steam line to building	· FS · Temperature Compensated
Steam Heat Recovery	Btu calculated in database		Calculated from TFW, FS	· QHD
Feedwater Temperature	BAPI BA/10k-3-I-4" Thermistor	Resistance	On feedwater line	· TFW, h_f
Total Facility Energy / Power				· WT · From ConEd Bills
Ambient Temperature	Kele/Precon ST-R3R Thermistor	Resistance		· TAO



THE NEW YORK HILTON
1335 AVENUE OF THE AMERICAS
NEW YORK, NEW YORK 10019

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NO.	DATE	REVISION
0	01/31/12	NYSERDA SUBMISSION

PROJECT:
INSTALLATION OF 7-NEW NATURAL GAS FIRED COGENERATION UNITS ON FOURTH FLOOR SETBACK ROOF

M&V PLAN

SEAL & SIGNATURE

DATE:	01-31-11
PROJECT No.:	IMS-10100
DRAWING BY:	NPG
CHK BY:	CN
DWG No.:	**M&V-1**
CAD FILE No:	MV-1.DWG

NOTES:

1. REFER TO DRAWING E-300.00, E-301.00 & E-302.00 FOR THE THREE LINE DIAGRAM AND ADDITIONAL INFORMATION.
2. FOR ADDITIONAL NOTES, SYMBOLS AND ABBREVIATIONS, SEE DRAWING E001.00 AND E002.00.

13.8 KV | 13.8 KV | 13.8 KV | 13.8 KV | 13.8 KV

NW | NW | NW | NW | NW

480/277, 3ø, 4W

CON-EDISON | CON-EDISON SERVICE#1 | CON-EDISON SERVICE#2 | CON-EDISON SERVICE#3 | CON-EDISON SERVICE#4

M CON EDISON CT3CX6651763

EXISTING GFCI 5000A FUSES

M CON EDISON METER CT3CM7141591

200A

NEXTEL

M CON EDISON CT3CX7354860

EXISTING 5000A GFCI

M CON EDISON CT3CX6651867

EXISTING GFCI 5000A FUSES

M CON EDISON CT3CX6653793

EXISTING GFCI 5000A FUSES

SERVICE #1 BECKWITH 34101A OPTION B2 NYC SIR APPROVED

SERVICE #3 BECKWITH 34101A OPTION B2 NYC SIR APPROVED

SERVICE #4 BECKWITH 34101A OPTION B2 NYC SIR APPROVED

ABB FT1 SWITCH-1A | ABB FT1 SWITCH-1B | ABB FT1 SWITCH-3A | ABB FT1 SWITCH-3B | ABB FT1 SWITCH-4A | ABB FT1 SWITCH-4B

30A | 20A | 3A | 2000/5 | 32R | 81U 81O | 59 | 27

SERVICE #1/BECKWITH TRIP SEQUENCE WIRING — TO THE 89S-1

SERVICE #3/BECKWITH TRIP SEQUENCE WIRING — TO THE 89S-3

SERVICE #4/BECKWITH TRIP SEQUENCE WIRING — TO THE 89S-4

86 — ANSI 86 LOCKOUT RELAY #1

2#12 TO CON EDISON BLACK BOX

TO ANSI 86 LOCKOUT RELAY

TO DC POWER SUPPLY FUSE PANEL

COMAP IMNT PLC

TO COGEN-6/7

EXISTING FUEL CELL BECKWITH RELAY

FROM COGEN-1/2

NEW TAP AT END OF BUS 5000A BUS 480/277,3ø ,4W

FROM COGEN-3/4/5

MAIN SWITCHBOARD "A"

MAIN SWITCHBOARD "B"

MAIN SWITCHBOARD "C"

MAIN SWITCHBOARD "D" 5000A BUS 480/277,3ø ,4W

NEW TAP AT END OF BUS

EXISTING | EXISTING | EXISTING | EXISTING

FROM ANSI 86

TO DC POWER SUPPLY FUSE PANEL

400A | 600A | 800A | --A | 800A | 600A | 800A | 800A | 400A | 200A | 600A | 800A

(E)MSA-1 | (E)FIRE PUMP #1 | (E)FIRE PUMP #2 | (E)MSA-1A | (E)MSB-6 | (E)MSA-10 | (E)MSA-7 | (E)MSA-8 | (E)MSA-11 | (E)CHWP-3 | (E)MSA-9 | (E)MSA-12

NO NC 800A 89S-1

600A | 400A | 600A | 600A | 800A | 800A | 800A | 800A | 800A | 1200A | --A

(E)MSC-5 | (E)MSC-6 | (E)MSB-2 | (E)SPARE | (E)MSB-5 | (E)MSC-8 | (E)MSC-9 | (E)MSB-4 | (E)MSC-10 | (E)CHILLER4 | (E)MSC-1A

NO NC 1200A 89S-3

400A | 400A | 400A | 600A | 600A | 600A | 600A | 1200A | 800A | 800A | 600A | 600A | 800A

(E)S-16 GUEST ROOMS | (E)PASS ELEVATOR 456 CARS | (E)16 GUEST ROOMS | (E) FAN ROOM2 | (E)CHWP1&2 | (E)CWP-3 | (E)ENG ROOM MCC | (E)CHILLER#1 | (E)MSD-1 | (E)MSD-3 | (E)MSD-10 | (E)MSD-2 | (E)MSD-5

FROM ANSI 86

NO NC 3P 800A/ 800A 89S-4

2 SETS OF 250KCMIL

3P 400A 400A 89L

TO EXISTING FUEL CELL ON ROOF

COG-4 1600A, 3ø, 4W 480Y/277V NYC APPROVED FUSE PANEL

WG6 | WG7

120V PPL-11 | 120V PPL-13

PPA METER #3 | PPA METER #4

89L-6 | 89L-7

400A | 400A | 400A

TO COMAP CONTROLLER

250KW COGEN #6 | 250KW COGEN #7

WPAR1

WG345

120V PPL-7

PPA METER #2

89L-3 | 89L-4 | 89L-5

400A | 400A | 400A

NYC APPROVED COLLECTOR PANEL COG-3 1200A, 3ø, 4W 480Y/277V

TO COMAP CONTROLLER

250KW COGEN #3 | 250KW COGEN #4 | 250KW COGEN #5

480 PRI-120/208V SEC. 30KVA TRANSF.

PPH (SECTIONS 1 & 2) 277/480 V, 3ø, 4W, 400A, 65KAIC

50A | 30A | 30A | 30A | 30A | 30A | 30A | 30A | 15A | 15A | 15A | 15A | 15A | 15A | 15A | 50A | 50A | 20A | 60A

30/30A | 30/30A | 30/30A | 30/30A | 30/30A | 30/30A | 30/30A | 30/15A | 30/15A | 30/15A | 30/15A | 30/15A | 30/15A | 30/15A | 60/50A | 60/50A | 30/20A | 60/60A

JACKET COOLER PUMP #1 | JACKET COOLER PUMP #2 | JACKET COOLER PUMP #3 | JACKET COOLER PUMP #4 | JACKET COOLER PUMP #5 | JACKET COOLER PUMP #6 | JACKET COOLER PUMP #7 | HRSG PUMP #1 | HRSG PUMP #2 | HRSG PUMP #3 | HRSG PUMP #4 | HRSG PUMP #5 | HRSG PUMP #6 | HRSG PUMP #7 | JACKET WATER PUMP #1 | JACKET WATER PUMP #2 | GAS BOOSTER PUMP | DRY COOLER

WG12

120V PPL-9

PPA METER #1

89L-1 | 89L-2

400A | 400A

NYC APPROVED COLLECTOR PANEL COG-1 800A, 3ø, 4W 480Y/277V

TO COMAP CONTROLLER

250KW COGEN #1 | 250KW COGEN #2

PPL-1 PANEL 208/120V, 3ø, 4W, 100A, 22KAIC

100A

KEYED NOTES

1. 3#12 & #12G – 3/4"C
2. 3#10 & #10G – 3/4"C
3. 3#6 & #10G – 1"C
4. 4#2 & #8G – 1 1/2"C
5. 3#6 & #10G – 1"C
6. (4) 600 KCMIL & #2G – 4"C
7. (2 SETS) (4) 600 KCMIL & #1/0G – 4"C
8. (3 SETS) (4) 600 KCMIL & #3/0G – 4"C
9. SATEC PPA METER #PM174-N-60-5-ACDC-00-00-ETH NYSERDA APPROVED.
10. (4 SETS) (4) 500 KCMIL & #1/0G – 4"C
11. (4 SETS) (4) 500 KCMIL & #3/0G – 4"C
12. ETHERNET CAT 6 TO NEAREST DATA ROOM IDF RACK.
13. RS-485 TO HONEYWELL EQUIPMENT.

ELECTRICAL SINGLE LINE DIAGRAM

NYC DOB Number:	TO THE BEST OF MY KNOWLEDGE, BELIEF AND PROFESSIONAL JUDGMENT, THESE PLANS AND SPECIFICATIONS ARE IN COMPLIANCE WITH THE NEW YORK CITY ENERGY CONSERVATION CODE.
NYC 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 EITHER AS BEING APPROVED OR IN ACCORDANCE WITH APPLICABLE CODES.	WARNING: IT IS A VIOLATION OF THE NEW YORK STATE EDUCATION LAW FOR ANY PERSON, UNLESS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER ANY ITEM ON THESE PLANS IN ANY WAY. IF ALTERATIONS TO THESE PLANS ARE MADE, THE ALTERATIONS SHALL BE MADE IN ACCORDANCE WITH ARTICLE 145 – SUBSECTION 7209 OF THE NEW YORK STATE EDUCATION LAW.

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EMAIL: info@enksolutions.com — N.Y. CERTIFICATE #5463096

UTS | INTERSTATE MECHANICAL SERVICES INC.

BROADWAY ELECTRIC LLC — The Power of Three Generations

NYC ELECTRICAL ADVISORY BOARD REVIEWED 11/09/11

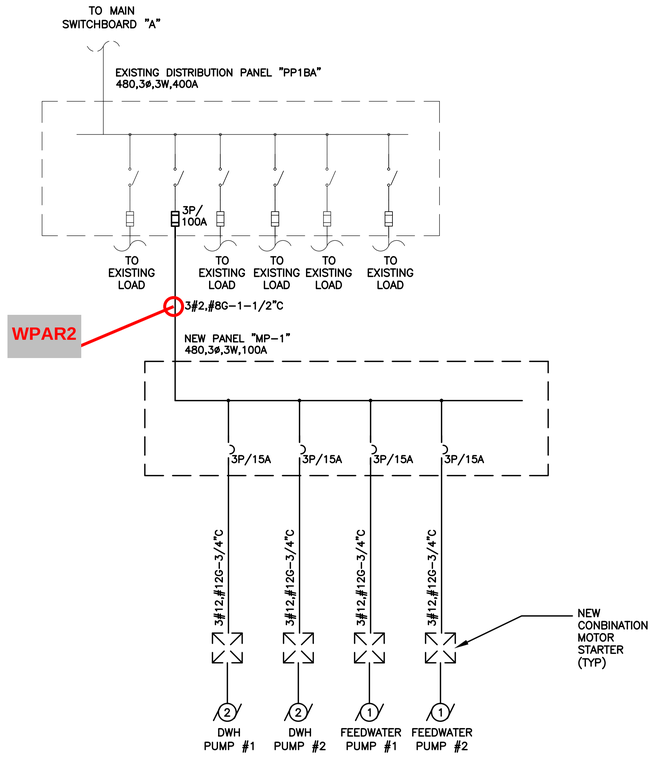
NO.	DATE	REVISION
4	11/09/11	ELECTRICAL ADVISORY BOARD
3	10/28/11	CON-EDISON REVIEW SET 3

PROJECT
HILTON HOTEL
NATURAL GAS ENGINE COGEN PLANT

DRAWING TITLE
ELECTRICAL COGEN PLANT-SINGLE-LINE DIAGRAM (SHEET 1 OF 2)

SCALE	DATE	DRAWN
NTS	10/28/11	MFA
JOB No. / FILENAME: ENK-2894		CHECKED: ENK

DRAWING NUMBER
E-400.00



BASEMENT BOILER ROOM – SINGLE LINE DIAGRAM | Scale: NO SCALE | Drawing: E-401 | Detail: 01

PANEL: MP-1 | LOCATION: BOILER ROOM | BUILDING: | FED FROM: SEE SINGLE LINE DIAGRAM | FEEDER SIZE: SEE SINGLE LINE DIAGRAM
480 /277 VOLTS, 3 PHASE, 4 WIRE | MOUNTING: [X] SURFACE [ ] FLUSH | BUS [X] COPPER [ ] ALUMINUM | GROUND BUS [X] [ ] THRU-FEED LUGS | ISOL.GND. BUS [ ] * SHUNT TRIP BRKR.
MAIN BUS 100 AMPS | MAIN BRK ____ AMPS ____ P | NEUTRAL 100% AIC 22,000 | [X] MAIN LUGS ONLY | FEED: [X] TOP [ ] BTM

CKT NO	TRIP AMPS	DESCRIPTION OF LOAD	LOAD (VA)	PER PHASE (VA) A	B	C	LOAD (VA)	DESCRIPTION OF LOAD	TRIP AMPS	CKT NO
1			950	1900			950			2
3	15/3	DWH PUMP #1 (2 HP)	950		1900		950	DWP PUMP #2 (2 HP)	15/3	4
5			950			1900	950			6
7			600	1200			600			8
9	15/3	FEED WATER PUMP #1 (1 HP)	600		1200		600	FEED WATER PUMP #2 (1 HP)	15/3	10
11			600			1200	600			12
13	20/1	SPARE	0	0			0	SPARE	20/1	14
15	20/1	SPARE	0		0		0	SPARE	20/1	16
17	20/1	SPARE	0			0	0	SPARE	20/1	18
MULT FACTOR			TOTAL BY PHASE	3100	3100	3100	SPARE FACTOR			
TOTAL LTG.	0	1.00 0					TOTAL DEMAND	9300 X 1.25		
TOTAL MISC.	9300	1.00 9300					TOTAL LOAD	11625 VA	14 AMPS	
TOTAL REC.	0	Per NEC 0								
TOTAL HVAC	0	0.70 0								
TOTAL HTG	0	1.00 0								

PANEL: PPL | LOCATION: PENTHOUSE ELEC ROOM | BUILDING: | FED FROM: SEE SINGLE LINE DIAGRAM | FEEDER SIZE: SEE SINGLE LINE DIAGRAM
208 /120 VOLTS, 3 PHASE, 4 WIRE | MOUNTING: [X] SURFACE [ ] FLUSH | BUS [X] COPPER [ ] ALUMINUM | GROUND BUS [X] [ ] THRU-FEED LUGS | ISOL.GND. BUS [ ] * SHUNT TRIP BRKR.
MAIN BUS 100 AMPS | MAIN BRK 100 AMPS 3 P | NEUTRAL 100% AIC 22,000 | [ ] MAIN LUGS ONLY | FEED: [ ] TOP [ ] BTM

CKT NO	TRIP AMPS	DESCRIPTION OF LOAD	LOAD (VA)	PER PHASE (VA) A	B	C	LOAD (VA)	DESCRIPTION OF LOAD	TRIP AMPS	CKT NO
1	20/1	ELEC. ROOM RECEPTACLES	720	1020			300	GENERATOR #1 BATT. CHARGER	20/1	2
3	20/1	HRSG ROOM RECEPTACLES	720		1020		300	GENERATOR #2 BATT. CHARGER	20/1	4
5	20/1	OUTSIDE RECEPTACLES	360			660	300	GENERATOR #3 BATT. CHARGER	20/1	6
7	20/1	SATEC #1	180	480			300	GENERATOR #4 BATT. CHARGER	20/1	8
9	20/1	SATEC #2	180		480		300	GENERATOR #5 BATT. CHARGER	20/1	10
11	20/1	SATEC #3	180			480	300	GENERATOR #6 BATT. CHARGER	20/1	12
13	20/1	SATEC #4	180	480			300	GENERATOR #7 BATT. CHARGER	20/1	14
15	20/1	2 UNIT HEATERS	600		1200		600	EXHAUST FAN	20/1	16
17	20/1	SUPPLY FAN	400			400	0	SPARE	20/1	18
19	20/1	SPARE	0	0			0	SPARE	20/1	20
21	20/1	SPARE	0		0		0	SPARE	20/1	22
23	20/1	SPARE	0			0	0	SPARE	20/1	24
MULT FACTOR			TOTAL BY PHASE	1980	2700	1540	SPARE FACTOR			
TOTAL LTG.	0	1.00 0					TOTAL DEMAND	5740 X 1.25		
TOTAL MISC.	2100	1.00 2100					TOTAL LOAD	7175 VA	20 AMPS	
TOTAL REC.	2520	Per NEC 2520								
TOTAL HVAC	1600	0.70 1120								
TOTAL HTG	0	1.00 0								

PANEL: PPH (SECTION 1) | LOCATION: PENTHOUSE ELEC. ROOM | BUILDING: | FED FROM: SEE SINGLE LINE DIAGRAM | FEEDER SIZE: SEE SINGLE LINE DIAGRAM
480 /277 VOLTS, 3 PHASE, 4 WIRE | MOUNTING: [X] SURFACE [ ] FLUSH | BUS [X] COPPER [ ] ALUMINUM | GROUND BUS [ ] [X] THRU-FEED LUGS | ISOL.GND. BUS [ ] * SHUNT TRIP BRKR.
MAIN BUS 400 AMPS | MAIN BRK ____ AMPS ____ P | NEUTRAL 100% AIC 65,000 | [X] MAIN LUGS ONLY | FEED: [ ] TOP [ ] BTM

CKT NO	TRIP AMPS	DESCRIPTION OF LOAD	LOAD (VA)	PER PHASE (VA) A	B	C	LOAD (VA)	DESCRIPTION OF LOAD	TRIP AMPS	CKT NO
1			942	1884			942			2
3	15/3	HRSG #1 (2 HP)	942		1884		942	HRSG #5 (2 HP)	15/3	4
5			942			1884	942			6
7			942	1884			942			8
9	15/3	HRSG #2 (2 HP)	942		1884		942	HRSG #6 (2 HP)	15/3	10
11			942			1884	942			12
13			942	1884			942			14
15	15/3	HRSG #3 (2 HP)	942		1884		942	HRSG #7 (2 HP)	15/3	16
17			942			1884	942			18
19			942	6759			5817			20
21	15/3	HRSG #4 (2 HP)	942		6759		5817	JACKET WATER LOOP PUMP #1 (15 HP)	40/3	22
23			942			6759	5817			24
25	20/1	LIGHTING	676	6493			5817			26
27	20/1	LIGHTING	1152		6969		5817	JACKET WATER LOOP PUMP #2 (15 HP)	40/3	28
29	1P	SPACE	0			5817	5817			30
31	1P	SPACE	0	0			0	SPACE	1P	32
33	1P	SPACE	0		0		0	SPACE	1P	34
35	1P	SPACE	0			0	0	SPACE	1P	36
37	1P	SPACE	0	0			0	SPACE	1P	38
39	1P	SPACE	0		0		0	SPACE	1P	40
41	1P	SPACE	0			0	0	SPACE	1P	42
MULT FACTOR			TOTAL BY PHASE	18904	19380	18228	SPARE FACTOR			
TOTAL LTG.	0	1.00 0					TOTAL DEMAND	40106.8 X 1.25		
TOTAL MISC.	0	1.00 0					TOTAL LOAD	50134 VA	60 AMPS	
TOTAL REC.	0	Per NEC 0								
TOTAL HVAC	54684	0.70 38278.8								
TOTAL HTG	1828	1.00 1828								

PANEL: PPH (SECTION 2) | LOCATION: PENTHOUSE ELEC. ROOM | BUILDING: | FED FROM: SEE SINGLE LINE DIAGRAM | FEEDER SIZE: SEE SINGLE LINE DIAGRAM
480 /277 VOLTS, 3 PHASE, 4 WIRE | MOUNTING: [X] SURFACE [ ] FLUSH | BUS [X] COPPER [ ] ALUMINUM | GROUND BUS [ ] [ ] THRU-FEED LUGS | ISOL.GND. BUS [ ] * SHUNT TRIP BRKR.
MAIN BUS 400 AMPS | MAIN BRK ____ AMPS ____ P | NEUTRAL ____ AIC 65,000 | [X] MAIN LUGS ONLY | FEED: [ ] TOP [ ] BTM

CKT NO	TRIP AMPS	DESCRIPTION OF LOAD	LOAD (VA)	PER PHASE (VA) A	B	C	LOAD (VA)	DESCRIPTION OF LOAD	TRIP AMPS	CKT NO
43			3878	7756			3878			44
45	30/3	JACKET COOLER PUMP #1 (10 HP)	3878		7756		3878	JACKET COOLER PUMP #5 (10 HP)	30/3	46
47			3878			7756	3878			48
49			3878	7756			3878			50
51	30/3	JACKET COOLER PUMP #2 (10 HP)	3878		7756		3878	JACKET COOLER PUMP #6 (10 HP)	30/3	52
53			3878			7756	3878			54
55			3878	7756			3878			56
57	30/3	JACKET COOLER PUMP #3 (10 HP)	3878		7756		3878	JACKET COOLER PUMP #7 (10 HP)	30/3	58
59			3878			7756	3878			60
61			3878	9695			5817			62
63	30/3	JACKET COOLER PUMP #4 (10 HP)	3878		9695		5817	GAS BOOSTER PUMP (7.5 HP)	40/3	64
65			3878			9695	5817			66
67	1P	SPACE	0	11400			11400			68
69	1P	SPACE	0		11400		11400	DRY COOLER	60/3	70
71	1P	SPACE	0			11400	11400			72
73	1P	SPACE	0	0			0	SPACE	1P	74
75	1P	SPACE	0		0		0	SPACE	1P	76
77	1P	SPACE	0			0	0	SPACE	1P	78
79	1P	SPACE	0	0			0	SPACE	1P	80
81	1P	SPACE	0		0		0	SPACE	1P	82
83	1P	SPACE	0			0	0	SPACE	1P	84
MULT FACTOR			TOTAL BY PHASE	44363	44363	44363	SPARE FACTOR			
TOTAL LTG.	0	1.00 0					TOTAL DEMAND	93162.3 X 1.25		
TOTAL MISC.	0	1.00 0					TOTAL LOAD	116453 VA	140 AMPS	
TOTAL REC.	0	Per NEC 0								
TOTAL HVAC	133089	0.70 93162.3								
TOTAL HTG	0	1.00 0								

NYC DOB Number:

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

NYC 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 EITHER AS BEING APPROVED OR IN ACCORDANCE WITH APPLICABLE CODES.

WARNING: IT IS A VIOLATION OF THE NEW YORK STATE EDUCATION LAW FOR ANY PERSON, UNLESS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER ANY ITEM ON THESE PLANS IN ANY WAY. IF ALTERATIONS TO THESE PLANS ARE MADE, THE ALTERATIONS SHALL BE MADE IN ACCORDANCE WITH ARTICLE 145 – SUBSECTION 7209 OF THE NEW YORK STATE EDUCATION LAW.

SEAL & SIGNATURE

THE NEW YORK HILTON
1335 AVENUE OF THE AMERICAS
NEW YORK, NEW YORK 10019

CRC Engineering, P.C.
1261 Broadway, Suite 608
New York, NY 10001

ENK SOLUTIONS, LLC
PROFESSIONAL CONSULTING ENGINEERS & SECURITY CONSULTANTS
1261 Broadway, Suite 608 New York, N.Y. 10001 Phone: (212) 889-8400 Fax: (212) 889-8401
21 Main Street East Brunswick N.J. 08816 Phone: (732) 387-3416 Fax: (732) 387-3417
EMAIL: info@enksolutions.com N.Y. CERTIFICATE #5463096

UTS
INTERSTATE MECHANICAL SERVICES INC.
BROADWAY ELECTRIC LLC The Power of Three Generations

NO.	DATE	REVISION
1	1/17/12	ISSUED FOR CONSTRUCTION
0	11/21/11	ISSUED FOR DOB SUBMISSION

PROJECT:
INSTALLATION OF 7-NEW NATURAL GAS FIRED COGENERATION UNITS ON FOURTH FLOOR SETBACK ROOF

ELECTRICAL COGEN PLANT – SINGLE-LINE DIAGRAM (SHEET 2 OF 2)

DATE: 12-05-11
PROJECT No.: IMS-10100
DRAWING BY:
CHK BY:
DWG No.:
E-401.00
CAD FILE No: /E-401.00.DWG

Data Logger

The New York Hilton Cogeneration 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 Cogeneration 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 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 Hilton. 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

The system architecture is described on SET drawing SET-012-004-02, Communications Riser. 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.

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. Refer to SET drawing SET-12-004-02 for architecture and connection detail.

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	WG12	Generator #1 & #2 Electrical Output	kW/kWh
2	WG345	Generator #3, #4, & #5 Electrical Output	kW/kWh
3	WG6	Generator #6 Electrical Output	kW/kWh
4	WG7	Generator #7 Electrical Output	kW/kWh
5	WPAR1	Parasitic Load Electrical Consumption - Panel PPH	kW/kWh
6	WPAR2	Parasitic Load Electrical Consumption - Panel MP1	kW/kWh
7	FG	Combined Generator Fuel Input	CFH/CF
8	QHUW	Hot Water Heat Recovery (Calculated)	Btu/h / Btu
9	FL	Glycol Main HR Loop Flow Rate	GPM
10	TLS	Glycol Loop Supply Temperature	deg F
11	TLR1	Glycol Loop Return Temperature (downstream of loads)	deg F
12	QHD	Dumped Heat (Calculated)	Btu/h / Btu
13	TLR2	Glycol Loop Return Temperature (downstream of Dry Cooler)	deg F
14	FS	HRSG Steam Flow Meter	lbs./h
15	TFW	Feedwater to Steam Generator Temperature	deg F
16	QHUS	Steam Heat Recovery (Calculated)	Btu/h / Btu
17	WT	Total Facility Energy / Power	kW/kWh
18	TAO	Ambient Temperature	deg F

Peak Demand or Peak kW

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

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

The generator power meters will measure the individual gross output of the seven engine generators with four measurements. The net power delivered is determined by adding together the four individual generator power measurements and subtracting out the sum of 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 a common circulation header for the engine jacket water, with individual secondary loops for the useful hot water delivered to the hotel, and for heat rejection through a dump radiator. Each of the engine generators are connected to the common header in parallel.

The piping arrangement at this site requires for the jacket water heat supplied to the building, or the heat rejected to atmosphere to be measured using separate flow and temperature difference measurements.

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

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

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

$$QHD = K \times \frac{\sum[FL \times (TLR1 - TLR2)]}{n}$$

where:

	K	=	~ 480 Btu/h-gpm-°F for 20% glycol
	n	=	Number of scan intervals included in each recording interval (unitless) (e.g. with 1 sec scans and 1-minute data, n=60)

The loop fluid for both useful glycol heat recovery and rejected heat recovery is expected to be glycol. The factor K will be determined based on a periodic reading of the fluid properties with a refractometer to determine the glycol concentration.

Heat is also recovered from the engine exhaust to produce 15-psig steam using exhaust gas heat recovery steam generators (HRSGs). The steam is injected directly into the building steam system and displaces Con Ed Steam purchases, therefore all steam production is considered useful heat recovery.

The rate of useful steam heat recovery in Btu/h will be defined as:

$$QHUS = \frac{\sum[FS \times (h_g - h_f))]}{n}$$

where:

n	=	Number of scan intervals included in each recording interval (unitless) (e.g. with 1 sec scans and 1-minute data, n=60)
h_g	=	Enthalpy of steam (*f*(15-psig saturated)) (1,164 Btu/lb)
h_f	=	Enthalpy of feedwater (*f*(TFW)) (Btu/lb)

The enthalpy of gaseous steam (h_g) is stipulated to be 1,164 Btu/lb, corresponding to dry-saturated steam at 15-psig. Temperature of the feedwater will be used to calculate the entering feedwater enthalpy, to determine the entire exhaust heat transfer. The assumption is made that system pressure will remain constant, and periodic readings of the pressure will be made for verification.

Any of the above heat recovery measurements in Btu can be calculated for an interval by the following:

$$Q_{int} = \sum_{0}^{N} \frac{\dot{Q}}{N}$$

where:

$\dot{Q}$	=	Heat recovery rate
N	=	Number of intervals in 1 hour (1/h) (e.g. to determine the total heat recovery for one minute, N=60/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, WG12, WG345, WG6, and WG7, minus the sum of the parasitic power, WPAR1, WPAR2.

WG_{net} = WG12 + WG345 + WG6 + WG7 – (WPAR1 + WPAR2)

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

$$FCE = \frac{QHU + 3{,}413 \cdot (WG_{net})}{0.9 \cdot HHV_{gas} \cdot FG}$$

where:
- QHU = Useful heat recovery (Btu) (QHUW+QHUS)
- WG_{net} = Engine generator net output (kWh) (WG12 + WG345 + WG6 +WG7) - (WPAR1 + WPAR2)
- 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:

$$FCE = \frac{\sum^{N} QU + 3{,}413 \cdot \sum^{N} (WG_{net})}{0.9 \cdot HHV_{gas} \cdot \sum^{N} FG}$$

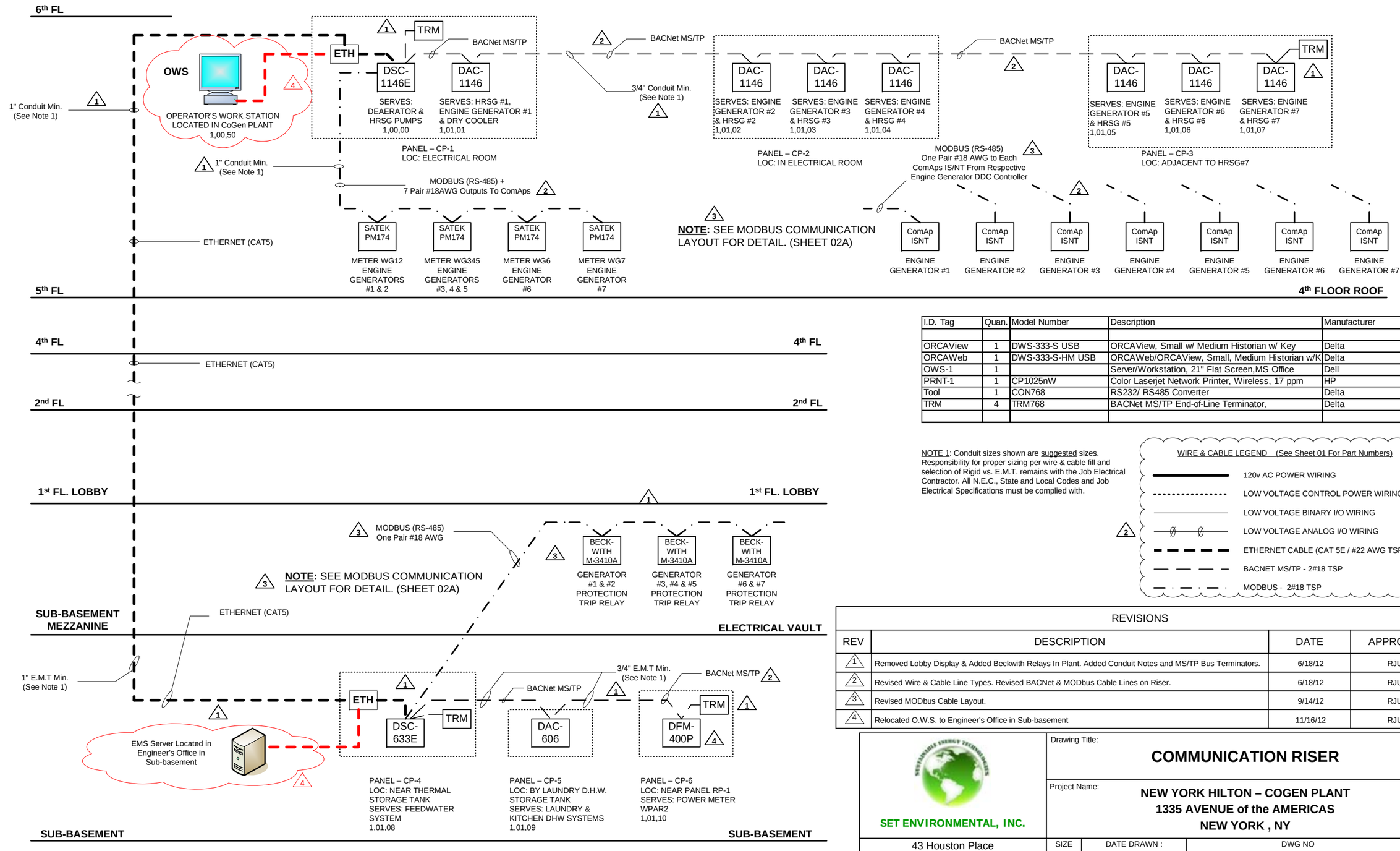
where:
- N = The desired interval (e.g. day, month)

Appendix A

SET Environmental System Architecture DWG SET-012-004-02

System Schematic and Cut Sheets for Key Sensors and Instruments

COMMUNICATION RISER



I.D. Tag	Quan.	Model Number	Description	Manufacturer	Vendor
ORCAView	1	DWS-333-S USB	ORCAView, Small w/ Medium Historian w/ Key	Delta	Delta
ORCAWeb	1	DWS-333-S-HM USB	ORCAWeb/ORCAView, Small, Medium Historian w/K	Delta	Delta
OWS-1	1		Server/Workstation, 21" Flat Screen,MS Office	Dell	Dell
PRNT-1	1	CP1025nW	Color Laserjet Network Printer, Wireless, 17 ppm	HP	CDW
Tool	1	CON768	RS232/ RS485 Converter	Delta	Delta
TRM	4	TRM768	BACNet MS/TP End-of-Line Terminator,	Delta	Delta

NOTE 1: Conduit sizes shown are suggested sizes. Responsibility for proper sizing per wire & cable fill and selection of Rigid vs. E.M.T. remains with the Job Electrical Contractor. All N.E.C., State and Local Codes and Job Electrical Specifications must be complied with.

WIRE & CABLE LEGEND (See Sheet 01 For Part Numbers)

- 120v AC POWER WIRING
- LOW VOLTAGE CONTROL POWER WIRING
- LOW VOLTAGE BINARY I/O WIRING
- LOW VOLTAGE ANALOG I/O WIRING
- ETHERNET CABLE (CAT 5E / #22 AWG TSP)
- BACNET MS/TP - 2#18 TSP
- MODBUS - 2#18 TSP

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
1	Removed Lobby Display & Added Beckwith Relays In Plant. Added Conduit Notes and MS/TP Bus Terminators.	6/18/12	RJU
2	Revised Wire & Cable Line Types. Revised BACNet & MODbus Cable Lines on Riser.	6/18/12	RJU
3	Revised MODbus Cable Layout.	9/14/12	RJU
4	Relocated O.W.S. to Engineer's Office in Sub-basement	11/16/12	RJU

SET ENVIRONMENTAL, INC.
43 Houston Place
Haworth, NJ 07641
Ph. 201-501-8060
Fax 201-501-8061

Drawing Title: **COMMUNICATION RISER**

Project Name: **NEW YORK HILTON – COGEN PLANT**
1335 AVENUE of the AMERICAS
NEW YORK , NY

SIZE	DATE DRAWN :	DWG NO	REV
B	06 / 06 / 12	SET-12-004-02	0

ENGR. BY	RJU	DRWN. BY	RJU	SHEET	02 of

Innova-Mass® Model 240 & 241

Multivariable Mass Vortex Flow Meter

Features

- Volumetric or mass flow monitoring of gases, liquids and steam
- Smart electronics extends range down to a Reynolds number of 5000
- Ideal for steam applications
- Selectable outputs for five process parameters in one integrated meter:
  - –mass flow rate
  - –volumetric flow rate
  - –temperature
  - –pressure
  - –density
- Field-configurable ranges, alarms, outputs and displays
- Field configurable via six push buttons or magnet through explosion-proof window
- Rangeability up to 30:1
- Temperature -330° F up to 750° F
- Pressure up to 1500 psig
- In-line (1/2" to 8") and insertion (into pipes > 2") configurations
- FMC and ATEX approval
- Flow computer integrates AGA-8 equations for natural gas
- Full implementation of HART protocol
- Optional MODBUS protocol

SIERRA

EXPERIENCE OUR PASSION FOR FLOW!

ISO REGISTERED 9001

For information online...

www.sierrainstruments.com

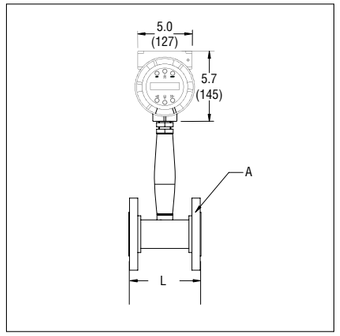
Description

Sierra Instruments' Innova-Mass® Multivariable mass vortex flow meter provides a reading of up to five process parameters from a single entry point in the pipeline. The meter can measure the fluid's velocity, temperature, and pressure and calculate mass flow rate, volumetric flow rate and density. Sensing all process parameters at a single location in one integrated meter greatly improves measurement accuracy and reduces total installed cost.

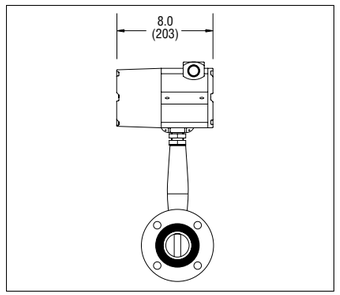
The Innova-Mass Model 240 in-line meters are available in 0.5, 0.75, 1, 1.5, 2, 3, 4, 6 and 8-inch sizes with ANSI or DN16 flanges or wafer flow bodies. The Series 241 insertion meters can be used on pipe sizes from two inches and greater. Optional "hot-tap" hardware including packing gland probe seal, retractor, and isolation valves is also available.

In-Line Dimensional Specifications

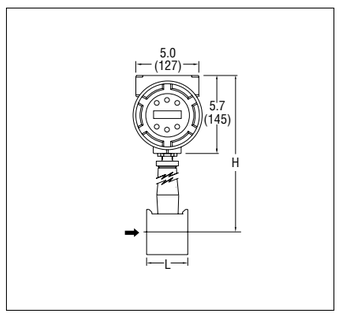
240 Flanged In-line–Side View



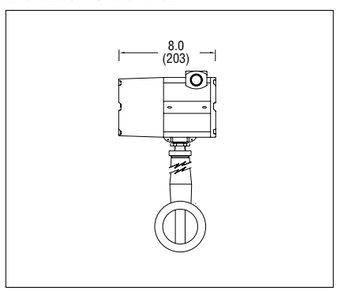
240 Flanged In-line–Outlet View



240 Wafer–Side View



240 Wafer–Outlet View



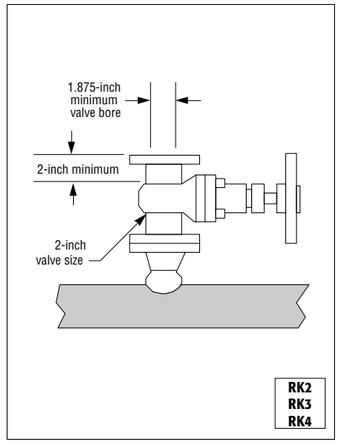
All dimensions are inches. Millimeters are in parentheses. Certified drawings are available on request.

In-Line Table

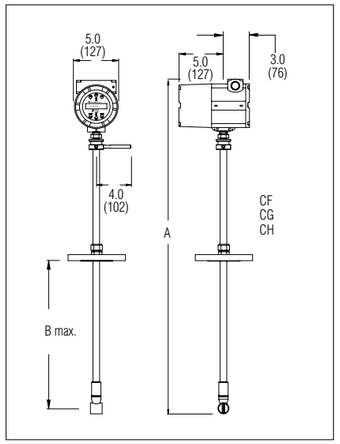
240 INNOVA-FLO® SIZES			
Flow Body Size	**A**	**L**	**H**
0.5-inch SCH. 80	150 lb Flange	4.56 (116)	14.8 (376)
	300 lb Flange	4.56 (116)	14.8 (376)
	600 lb Flange	4.56 (116)	14.8 (376)
	1.4 Wafer O.D.	4.56 (116)	14.8 (376)
0.75-inch SCH. 80	150 lb Flange	4.8 (122)	15.0 (381)
	300 lb Flange	4.8 (122)	15.0 (381)
	600 lb Flange	4.8 (122)	15.0 (381)
	1.7 Wafer O.D.	4.8 (122)	15.0 (381)
1-inch SCH. 80	150 lb Flange	4.94 (126)	15.0 (381)
	300 lb Flange	4.94 (126)	15.0 (381)
	600 lb Flange	4.94 (126)	15.0 (381)
	2.0 Wafer O.D.	2.8 (71)	14.8 (376)
1.5-inch SCH. 80	150 lb Flange	5.5 (140)	15.1 (384)
	300 lb Flange	5.5 (140)	15.1 (384)
	600 lb Flange	5.5 (140)	15.1 (384)
	2.9 Wafer O.D.	2.8 (71)	15.1 (384)
2-inch SCH. 80	150 lb Flange	6.0 (153)	15.3 (389)
	300 lb Flange	6.0 (153)	15.3 (389)
	600 lb Flange	6.0 (153)	15.3 (389)
	3.7 Wafer O.D.	3.0 (76)	15.3 (389)
3-inch SCH. 80	150 lb Flange	6.9 (175)	15.8 (401)
	300 lb Flange	6.9 (175)	15.8 (401)
	600 lb Flange	6.9 (175)	15.8 (401)
	5.0 Wafer O.D.	4.0 (102)	15.8 (400)
4-inch SCH. 80	150 lb Flange	8.0 (203)	16.2 (411)
	300 lb Flange	8.0 (203)	16.2 (411)
	600 lb Flange	8.0 (203)	16.2 (411)
	6.2 Wafer O.D.	4.7 (119)	16.2 (412)
6-inch SCH. 80	150 lb Flange	9.0 (229)	17.3 (439)
	300 lb Flange	9.0 (229)	17.3 (439)
	600 lb Flange	9.0 (229)	17.3 (439)
8-inch SCH. 80	150 lb Flange	10.5 (267)	18.2 (462)
	300 lb Flange	10.5 (267)	18.2 (462)
	600 lb Flange	10.5 (267)	18.2 (462)

Insertion Dimensional Specifications

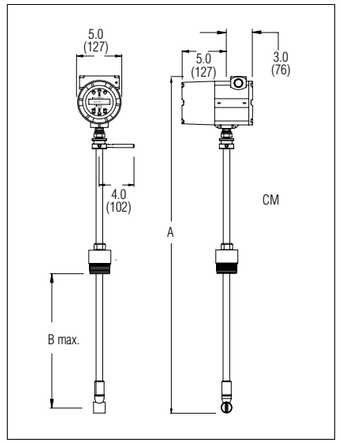
Gate Valve



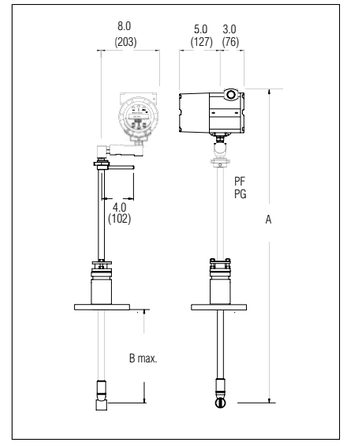
241 Compression, Flange



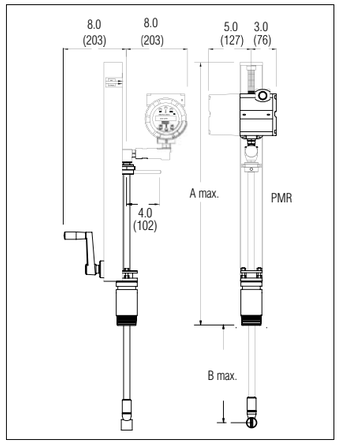
241 Compression, Male NPT



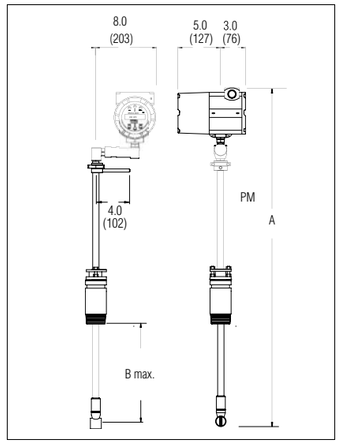
241 Packing Gland, Flange



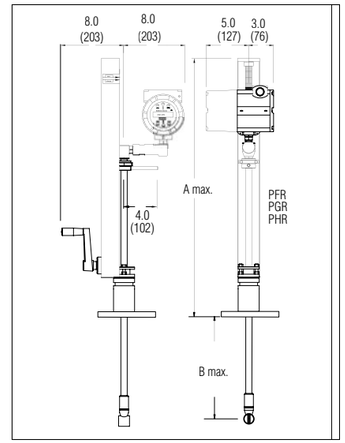
241 Packing Gland, Male NPT, Retractor



241 Packing Gland, Male NPT



241 Packing Gland, Flange, Retractor



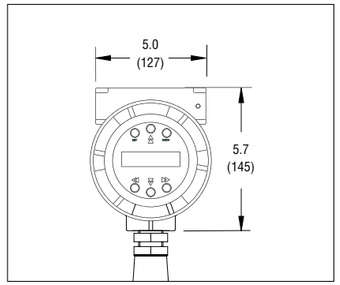
Insertion Table

241 INNOVA-MASS® SIZES						
	Standard Probe		Compact Probe		Extended Probe	
Model Code / Probe Seal / Process Connection	**A**	**B**	**A**	**B**	**A**	**B**
CM / Compression / Two-inch Male NPT	**41.0 (1041.0)**	**26.2 (665.0)**	**24.6 (625.0)**	**9.8 (249.0)**	**53.0 (1340.0)**	**38.2 (920.0)**
CF / Compression / 150 lb flange	**41.0 (1041.0)**	**27.3 (639.0)**	**24.6 (625.0)**	**10.9 (277.0)**	**53.0 (1340.0)**	**39.3 (998.0)**
CG / Compression / 300 lb flange	**41.0 (1041.0)**	**27.2 (691.0)**	**24.6 (625.0)**	**10.8 (274.0)**	**53.0 (1340.0)**	**39.2 (996.0)**
CH / Compression / 600 lb flange	**41.0 (1041.0)**	**26.8 (681.0)**	**24.6 (625.0)**	**10.4 (264.0)**	**53.0 (1340.0)**	**38.8 (986.0)**
PM / Packing Gland / Two-inch Male NPT [1]	**40.5 (1029.0)**	**21.5 (546.0)**	**N/A**	**N/A**	**52.5 (1334.0)**	**33.5 (850.9)**
PMR / Packing Gland / Two-inch Male NPT with Retractor [2]	**40.5 (1029.0)**	**21.5 (546.0)**	**N/A**	**N/A**	**52.5 (1334.0)**	**33.5 (850.9)**
PF / Packing Gland / 150 lb flange [1]	**40.5 (1029.0)**	**21.1 (536.0)**	**N/A**	**N/A**	**52.5 (1334.0)**	**33.1 (841.0)**
PFR / Packing Gland / 150 lb flange with Retractor [2]	**40.5 (1029.0)**	**21.1 (536.0)**	**N/A**	**N/A**	**52.5 (1334.0)**	**33.1 (841.0)**
PG / Packing Gland / 300 lb flange [1]	**40.5 (1029.0)**	**21.1 (536.0)**	**N/A**	**N/A**	**52.5 (1334.0)**	**33.1 (841.0)**
PGR / Packing Gland / 300 lb flange with Retractor [2]	**40.5 (1029.0)**	**21.1 (536.0)**	**N/A**	**N/A**	**52.5 (1334.0)**	**33.1 (841.0)**
PHR / Packing Gland / 600 lb flange with Retractor [2]	**40.5 (1029.0)**	**21.1 (536.0)**	**N/A**	**N/A**	**52.5 (1334.0)**	**33.1 (841.0)**

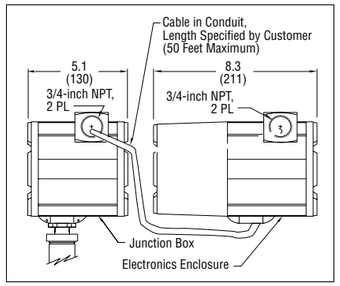
Notes: (1) Can be used with removable retractor.
(2) Retractor is permanently mounted to meter.

Dimensional Specifications

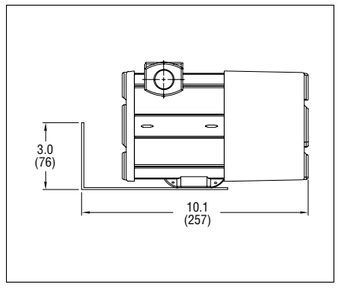
240/241 Remote–Front View



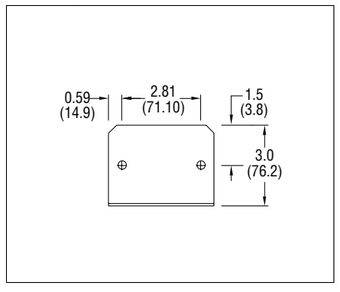
240/241 Remote–Side View



Remote Rear Bracket Mounted Electronics



Mounting Holes for Remote Rear Bracket



STRAIGHT PIPE LENGTH REQUIREMENTS (In Number of Internal Diameters, D)		
	Upstream	Downstream
One 90° elbow before meter	10 D	5 D
Two 90° elbows before meter	15 D	5 D
Two 90° elbows before meter out of plane (If three 90° bends present, double recommend length)	25 D	10 D
Reduction before meter	10 D	5 D
Expansion before meter	20 D	5 D
Regulator or valve partially closed before meter (If valve wide open, base length requirements on fitting directly preceding it)	25 D	10 D

Weight

240 IN-LINE METER						
Connection Size	ANSI 150 lb		ANSI 300 lb		ANSI 600 lb	
	lb	kg	lb	kg	lb	kg
0.5-inch flange	12.0	5.5	12.5	5.7	13	5.9
0.75-inch flange	13.0	5.9	14.0	6.4	14.5	6.6
1-inch flange	13.5	6.1	16.4	7.4	16.4	7.4
1.5-inch flange	14.6	6.6	22.7	10.3	24.8	11.2
2-inch flange	19.5	8.8	26.9	12.2	33.2	15.1
3-inch flange	27.5	12.5	39.5	17.9	56.3	25.5
4-inch flange	43.5	19.7	60.5	27.4	96.2	43.6
6-inch flange	48.4	22.0	96.2	43.6	178	80.8
8-inch flange	71.0	32.2	149	67.4	300	136
1-inch wafer	—	—	—	—	10.1	4.6
1.5-inch wafer	—	—	—	—	11.8	5.4
2-inch wafer	—	—	—	—	14.2	6.4
3-inch wafer	—	—	—	—	22.7	10.3
4-inch wafer	—	—	—	—	33.0	15.0

241 INSERTION METER		
Connection Size	lb	kg
Compression Fitting, Male NPT	13.8	6.2
Compression Fitting, 150 lb Flange	16.3	7.3
Compression Fitting, 300 lb Flange	18.3	8.3
Compression Fitting, 600 lb Flange	19.3	8.7
Packing Gland, Male NPT	15.8	7.1
Packing Gland, Male NPT with Retractor	25.3	11.5
Packing Gland, 150 lb Flange	20.8	9.4
Packing Gland, 150 lb Flange with Retractor	30.3	13.7
Packing Gland, 300 lb Flange	24.8	11.3
Packing Gland, 300 lb Flange with Retractor	34.3	15.5
Packing Gland, 600 lb Flange with Retractor	35.3	16.0

All dimensions are inches. Millimeters are in parentheses. Certified drawings are available on request.

Performance Specifications

Accuracy

Process Variables	240 Series In-Line Meters		241 Series Insertion Meters(1)	
	Liquids	Gas and Steam	Liquids	Gas and Steam
Mass Flow Rate	+/- 1% of rate over a 30:1 range(3)	+/- 1.5% of rate(2) over a 30:1 range(3)	+/- 1.5% of rate over a 30:1 range(3)	+/- 2% of rate(2) over a 30:1 range(3)
Volumetric Flow Rate	+/- 0.7% of rate over a 30:1 range(3)	+/- 1% of rate over a 30:1 range(3)	+/- 1.2% of rate over a 30:1 range(3)	+/- 1.5% of rate over a 30:1 range(3)
Temperature	+/- 2° F (+/- 1° C)	+/- 2° F (+/- 1° C)	+/- 2° F (+/- 1° C)	+/- 2° F (+/- 1° C)
Pressure	0.4% of transducer full scale	0.4% of transducer full scale	0.4% of transducer full scale	0.4% of transducer full scale
Density	0.3% of reading	0.5% of reading(2)	0.3% of reading	0.5% of reading(2)

Notes: (1) Accuracies stated are for the total mass flow through the pipe.
(2) Over 50 to 100% of the pressure transducer's full scale.
(3) Nominal rangeability is stated. Precise rangeability depends on fluid and pipe size.

Repeatability

Mass Flow Rate..... +/- 0.2% of reading
Volumetric Flow Rate .. +/- 0.1% of reading
Temperature..... +/- 0.2° F (+/- 0.1° C)
Pressure ..... +/- 0.05% of full scale
Density ..... +/- 0.1% of reading

Stability Over 12 Months

Mass Flow Rate..... +/- 0.2% of reading maximum
Volumetric Flow Rate .. Negligible error
Temperature..... +/- 0.1° F (+/- 0.5° C) maximum
Pressure ..... +/- 0.1% of full scale maximum
Density ..... +/- 0.1% of reading maximum

Response Time

Adjustable from 1 to 100 seconds

Operating Specifications

Material Compatibility

240 ..... Any gas, liquid or steam compatible with 316L stainless steel, C276 Hastalloy® or A105 carbon steel. Not recommended for multi-phase fluids.
241..... Any gas, liquid or steam compatible with 316L stainless steel. Not recommended for multi-phase fluids.

Flow Rates

Typical mass flow ranges are given in the following table. Precise flow ranges depend on the fluid and pipe size. 241 insertion meters are applicable to pipe sizes from 2-inch and greater. Consult factory for sizing program.

WATER MINIMUM AND MAXIMUM FLOW RATES									
	0.5-In.	0.75-In.	1-Inch	1.5-Inch	2-Inch	3-Inch	4-Inch	6-Inch	8-Inch
gpm	0.9	3	2.2	5.5	9.2	21	36	81	142
	22	40	67	166	276	618	1076	2437	4270
m^3/hr	0.2	0.7	0.5	1.3	2.1	4.7	8.1	18	32
	5	9	15	38	63	140	244	554	970

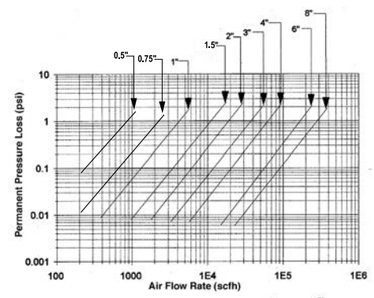
AIR MINIMUM AND MAXIMUM FLOW RATES (scfm) (1)									
Pressure	0.5-In.	0.75-In.	1-Inch	1.5-Inch	2-Inch	3-Inch	4-Inch	6-Inch	8-Inch
0 psig	1.8	3	5	13	22	50	88	198	347
	17	40	90	221	369	826	1438	3258	5708
100 psig	4.9	9	15	37	62	138	240	543	952
	135	318	701	1728	2879	6447	11222	25421	44536
200 psig	7	12	20	50	83	185	322	730	1279
	255	608	1313	4740	5389	12067	21006	47585	67122
300 psig	8.5	15	24	59	98	220	382	866	1518
	375	893	1924	4750	7900	17687	30789	48821	64552
400 psig	10	17	27	66	110	247	430	975	1708
	500	1178	2535	6246	10410	23308	31141	46884	61990
500 psig	11	21	29	72	120	270	469	1063	1862
	620	1464	3147	7752	12920	22592	29834	44915	59387

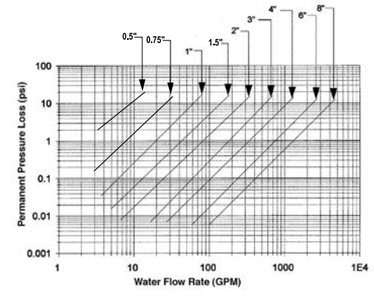
Note: (1) Standard conditions are 70° F and 1 atmosphere.

SATURATED STEAM MINIMUM AND MAXIMUM FLOW RATES (lb/hr)									
Pressure	0.5-In.	0.75-In.	1-Inch	1.5-Inch	2-Inch	3-Inch	4-Inch	6-Inch	8-Inch
5 psig	5.7	12	20	49	82	183	319	722	1265
	52	122	265	652	1087	2434	4237	9598	16815
100 psig	7.1	28	46	112	187	419	729	1651	2893
	270	639	1385	3413	5688	12735	22168	50219	87980
200 psig	13	37	61	151	252	565	984	2229	3905
	495	1164	2524	6217	10362	23200	40385	91485	160275
300 psig	19	45	74	182	304	681	1185	2685	4704
	718	1690	3662	9021	15035	33664	58601	132750	232570
400 psig	25	52	85	209	349	781	1359	3078	5393
	944	2220	4814	11859	19764	44253	77033	174505	305721
500 psig	30	58	95	233	389	870	1515	3433	6014
	1176	2640	5986	14745	24575	55025	95784	216983	331080

Differential Pressure Requirements, △P

Permanent pressure loss of in-line meters for air at 68°F (20°C) and 14.70 psi (1.104 bara).
Permanent pressure loss of in-line meters for water at 68°F (20°C).





Linear Range

Smart electronics corrects for lower flow down to a Reynolds number of 5,000. The Reynolds number is calculated using the fluid's actual temperature and pressure monitored by the meter. Rangeability depends on the fluid, process connections and pipe size. Consult factory for your application. Velocity rangeability under ideal conditions is as follows:

Liquids 30:1 . . . . . 1 foot per second velocity minimum
30 feet per second velocity maximum
Gases 30:1 . . . . . 10 feet per second velocity minimum
300 feet per second velocity maximum

Process Fluid Pressure

240 PRESSURE RATINGS		
PROCESS CONNECTION	**MATERIAL**	**RATING**
Flanged	316L SS, A105 Carbon Steel, C276 Hastalloy®	150, 300, 600 lb
Wafer	316L SS, A105 Carbon Steel, C276 Hastalloy®	600 lb

241 PRESSURE RATINGS				
Probe Seal	**Process Connection**	**Material**	**Rating**	**Ordering Code**
Compression Fitting	2-inch Male NPT	316 L SS	ANSI 600 lb	CM
	2-inch 150 lb flange	316 L SS	ANSI 150 lb	CF
	2-inch 300 lb flange	316 L SS	ANSI 300 lb	CG
	2-inch 600 lb flange	316 L SS	ANSI 600 lb	CH
Packing Gland	2-inch Male NPT	316 L SS	50 psig	PM
	2-inch 150 lb flange	316 L SS	50 psig	PF
	2-inch 300 lb flange	316 L SS	50 psig	PG
Packing Gland with Removable Retractor	2-inch Male NPT	316 L SS	ANSI 300 lb	PM, RR
	2-inch 150 lb flange	316 L SS	ANSI 150 lb	PF, RR
	2-inch 300 lb flange	316 L SS	ANSI 300 lb	PG, RR
Packing Gland with Permanent Retractor	2-inch Male NPT	316 L SS	ANSI 600 lb	PMR
	2-inch 150 lb flange	316 L SS	ANSI 150 lb	PFR
	2-inch 300 lb flange	316 L SS	ANSI 300 lb	PGR
	2-inch 600 lb flange	316 L SS	ANSI 600 lb	PHR

Pressure Transducer Ranges

PRESSURE SENSOR RANGES(1), psia(bara)			
Full Scale Operating Pressure		**Maximum Over-Range Pressure**	
psia	**(bara)**	**psia**	**(bara)**
30	2	60	4
100	7	200	14
300	20	600	41
500	34	1000	69

Note: (1) To maximize accuracy, specify the lowest full scale operating pressure range for the application. To avoid damage, the flow meter must never be subjected to pressure above the over-range pressure shown above.

Power Requirements

12 to 36 VDC, 100 mA (add 20mA per output up to 60mA)
100 to 240 VAC, 50/60 Hz, 25 watts

Display

Alphanumeric 2 x 16 LCD digital display
Six push buttons switches (up, down, right, left, enter, exit) operable through the display glass of the explosion-proof enclosure Viewing at 90° mounting intervals

Teflon is a registered trademark of DuPont.

Process Fluid & Ambient Temperature

Process Fluid. . . . . Standard Temperature Sensor:
-330°F to 500°F (-200° to 260°C)
High Temperature Sensor:
-40°F to 750°F (40° to 400°C)
Ambient . . . . . Operating: -5°F to 140°F (–20° to 60°C)
Storage: –40°F to 150°F (–40° to 65°C)
0-98% relative humidity, non-condensing conditions

Output Signals(1)

Analog. . . . . One to three field rangeable, simultaneous linear 4-20 mA output signals (1000 ohms maximum loop resistance) selected by user from the five parameters–mass flow rate, volumetric flow rate, temperature, pressure and density
Pulse . . . . . Pulse output for totalization is a 50-millisecond duration pulse operating a solid-state relay capable of switching 40 VDC, 40 mA maximum HART standard , Optional MODBUS RTU.

Note: (1) All outputs are optically isolated and require external power for operation

Alarms

Up to three programmable solid-state relays for high, low or window alarms capable of switching 40 VDC, 40 mA maximum

Totalizer

Based on user-determined flow units, nine full digits, with rollover at 4, 294, 967, 295. Total stored in non-volatile memory

Physical Specifications

Wetted Materials

240 . . . . . 316L stainless steel standard
C276 hastalloy® or A105 carbon steel optional
Teflon-based thread sealant on pressure transducer
241. . . . . 316L stainless steel
Teflon® packing gland below 500°F (260°C)
Graphite packing gland above 500°F (260°C)
Teflon-based thread sealant on pressure transducer

Enclosure

NEMA 4x/7 (IP65) cast enclosure

Electrical Ports

Two 3/4-inch female NPT ports

Mounting Connections

240 . . . . . Wafer or 150, 300, 600 lb ANSI flange
241. . . . . Permanent Installation:
Two inch Male NPT; 150, 300, 600 lb ANSI flange with compression fitting probe seal
Hot Tap(1) Installation:
Two inch Male NPT; 150, 300, 600 lb ANSI flange; and optional retractor with packing gland probe seal

Note: (1) Removable under line pressure.

Mounting Position

240 . . . . . No effect
241. . . . . Meter must be perpendicular within +/- 5° of the pipe centerline

FMC Approval

Explosion proof for Class I, Division 1, Groups B, C & D.
Dust-ignition proof for Class II/III, Division 1, Groups E, F & G.
NEMA Type 4x/7 and IP66
T6 at Tamb=60°C

ATEX Approval

II 2 G Ex d II B + H2 T6
II 2 D Ex t D A 21 IP66 T6
KEMA 08 ATEX 0143

CE Approval

0344

Optional Certifications

Construction and Inspection (ANSI/ASME B31.3)
Materials (NACE MR-01-75(90)

Ordering the Model 240 In-Line

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PARENT MODEL NUMBER

240	Innova-Mass™ Multivariable In-line Mass Vortex Flow Meter

PROCESS FLUID

V	Volumetric Vortex Flow Meter
VT	Velocity and Temperature Sensors
VTP	Velocity, Temperature and Pressure Sensors
VTEP	Velocity and Temperature Sensors with external pressure sensor output
VT EMS	VT Meter plus Energy meter Package.
VTP EMS	VTP Meters plus Energy meter package.

FLOW BODY–316L STAINLESS STEEL

F2	1/2-inch ANSI 150 lb Flanged, 316L
F3	3/4-inch ANSI 150 lb Flanged, 316L
F4	1-inch ANSI 150 lb Flanged, 316L
F5	1.5-inch ANSI 150 lb Flanged, 316L
F6	2-inch ANSI 150 lb Flanged, 316L
F7	3-inch ANSI 150 lb Flanged, 316L
F8	4-inch ANSI 150 lb Flanged, 316L
F9	6-inch ANSI 150 lb Flanged, 316L
F10	8-inch ANSI 150 lb Flanged, 316L
Also available in C276 Hastalloy. Consult Factory For Pricing/Delivery	
G2	1/2-inch ANSI 300 lb Flanged, 316L
G3	3/4-inch ANSI 300 lb Flanged, 316L
G4	1-inch ANSI 300 lb Flanged, 316L
G5	1.5-inch ANSI 300 lb Flanged, 316L
G6	2-inch ANSI 300 lb Flanged, 316L
G7	3-inch ANSI 300 lb Flanged, 316L
G8	4-inch ANSI 300 lb Flanged, 316L
G9	6-inch ANSI 300 lb Flanged, 316L
G10	8-inch ANSI 300 lb Flanged, 316L
Also available in C276 Hastalloy. Consult Factory For Pricing/Delivery	
H2	1/2-inch ANSI 600 lb Flanged, 316L
H3	3/4-inch ANSI 600 lb Flanged, 316L
H4	1-inch ANSI 600 lb Flanged, 316L
H5	1.5-inch ANSI 600 lb Flanged, 316L
H6	2-inch ANSI 600 lb Flanged, 316L
H7	3-inch ANSI 600 lb Flanged, 316L
H8	4-inch ANSI 600 lb Flanged, 316L
H9	6-inch ANSI 600 lb Flanged, 316L
H10	8-inch ANSI 600 lb Flanged, 316L
Also available in C276 Hastalloy. Consult Factory For Pricing/Delivery	
W2	0.5-inch Wafer connection, 316L
W3	3/4-inch Wafer connection, 316L
W4	1-inch Wafer connection, 316L
W5	1.5-inch Wafer connection, 316L
W6	2-inch Wafer connection, 316L
W7	3-inch Wafer connection, 316L
W8	4-inch Wafer connection, 316L
Also available in C276 Hastalloy. Consult Factory For Pricing/Delivery	
FC4	1-inch ANSI 150 lb Flanged, Carbon Steel
FC5	1.5-inch ANSI 150 lb Flanged, Carbon Steel
FC6	2-inch ANSI 150 lb Flanged, Carbon Steel
FC7	3-inch ANSI 150 lb Flanged, Carbon Steel
FC8	4-inch ANSI 150 lb Flanged, Carbon Steel
FC9	6-inch ANSI 150 lb Flanged, Carbon Steel
FC10	8-inch ANSI 150 lb Flanged, Carbon Steel
Also available in C276 Hastalloy. Consult Factory For Pricing/Delivery	

FLOW BODY–316L STAINLESS STEEL (CONTINUED)

GC4	1-inch ANSI 300 lb Flanged, Carbon Steel
GC5	1.5-inch ANSI 300 lb Flanged, Carbon Steel
GC6	2-inch ANSI 300 lb Flanged, Carbon Steel
GC7	3-inch ANSI 300 lb Flanged, Carbon Steel
GC8	4-inch ANSI 300 lb Flanged, Carbon Steel
GC9	6-inch ANSI 300 lb Flanged, Carbon Steel
GC10	8-inch ANSI 300 lb Flanged, Carbon Steel
Also available in C276 Hastalloy. Consult Factory For Pricing/Delivery	
HC4	1-inch ANSI 600 lb Flanged, Carbon Steel
HC5	1.5-inch ANSI 600 lb Flanged, Carbon Steel
HC6	2-inch ANSI 600 lb Flanged, Carbon Steel
HC7	3-inch ANSI 600 lb Flanged, Carbon Steel
HC8	4-inch ANSI 600 lb Flanged, Carbon Steel
HC9	6-inch ANSI 600 lb Flanged, Carbon Steel
HC10	8-inch ANSI 600 lb Flanged, Carbon Steel
Also available in C276 Hastalloy. Consult Factory For Pricing/Delivery	
FD2	DN15/PN16 Flanged, 316L
FD3	DN20/PN16 Flanged, 316L
FD4	DN25/PN16 Flanged, 316L
FD5	DN40/PN16 Flanged, 316L
FD6	DN50/PN16 Flanged, 316L
FD7	DN80/PN16 Flanged, 316L
FD8	DN100/PN16 Flanged, 316L
FD9	DN150/PN16 Flanged, 316L
FD10	DN200/PN16 Flanged, 316L
Also available in C276 Hastalloy. Consult Factory For Pricing/Delivery	
GD2	DN15/PN40 Flanged, 316L
GD3	DN20/PN40 Flanged, 316L
GD4	DN25/PN40 Flanged, 316L
GD5	DN40/PN40 Flanged, 316L
GD6	DN50/PN40 Flanged, 316L
GD7	DN80/PN40 Flanged, 316L
GD8	DN100/PN40 Flanged, 316L
GD9	DN150/PN40 Flanged, 316L
GD10	DN200/PN40 Flanged, 316L
Also available in C276 Hastalloy. Consult Factory For Pricing/Delivery	
HD2	DN15/PN64 Flanged, 316L
HD3	DN20/PN64 Flanged, 316L
HD4	DN25/PN64 Flanged, 316L
HD5	DN40/PN64 Flanged, 316L
HD6	DN50/PN64 Flanged, 316L
HD7	DN80/PN64 Flanged, 316L
HD8	DN100/PN64 Flanged, 316L
HD9	DN150/PN64 Flanged, 316L
HD10	DN200/PN64 Flanged, 316L
Also available in C276 Hastalloy. Consult Factory For Pricing/Delivery	

Ordering the Model 240 In-Line (Continued)

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ELECTRONICS ENCLOSURE
- **E2** NEMA 4x/7/7 (IP65) Enclosure - Mounted on Probe
- **E4** Remote Electronics NEMA 4x/7 (IP65) includes NEMA 4x/7 (IP65) on Probe
  Specify cable length in parentheses, maximum 50 feet (17m).

DISPLAY OPTION
- **NR** No Display
- **DD** Digital Display

INPUT POWER
- **PV1L** 12-36 VDC LOOP POWERED (available only with V4LH)
- **PV1** 12-36 VDC
- **PS** 100-240 VAC, 50/60 Hz Line Power, 25 Watts

OUTPUT
- **V4LH** One analog output (4-20 mA), one pulse, HART. LOOP POWERED
- **V4H** One analog output (4-20 mA), one alarm, one pulse and HART Communication. NOT LOOP POWERED
- **V4M** One analog output (4-20 mA), one alarm, one pulse, and MODBUS.
- **V6M** Three analog outputs (4-20 mA), three alarms, one pulse, MODBUS
- **V6H** Three analog outputs (4-20 mA), three alarms, one pulse, HART Protocol Communication

PROCESS TEMPERATURE
- **ST** Standard temperature
  Process temperature -330° to 500°F (-200° to 260°C)
- **HT** High Temperature
  Process temperature -40° to 750°F (-40° to 400°C)

PROCESS PRESSURE
- **MP0** No Pressure Sensor Used with VT process fluid.
- **MP1** Maximum 30 psia (2 bara), Proof 60 psia (4 bara)
- **MP2** Maximum 100 psia (7 bara), Proof 200 psia (14 bara)
- **MP3** Maximum 300 psia (20 bara), Proof 600 psia (41 bara)
- **MP4** Maximum 500 psia (34 bara), Proof 1000 psia (64 bara)
- **MP5** Maximum 1500 psia (100 bara), Proof 1500 psia (100 bara)

ACCESSORIES (Consult Factory) Removable Retractors, Isolated Gate Valves, Mounting Kits, Material Certificates, Pressure Certificates, Certificate of Conformance, NACE Certification

Ordering the Model 241 Insertion

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PARENT MODEL NUMBER

241	Innova-Mass™ Insertion Mass Vortex Flow Meter

PROCESS FLUID

V	Vortex Flow Meter
VT	Velocity and Temperature Sensors
VTP	Velocity, Temperature and Pressure Sensors
VTEP	Velocity and Temperature Sensors with external pressure sensore output
VT EMS	VT Meter plus energy meter Package.
VTP EMS	VTP Meters plus Energy meter package.

PROBE LENGTH

LS	Standard Probe
LC	Compact Probe (available only for compressions fitting connections CM, CF, CG and CH
LE	Extended Probe (consult factory if for PMR, PFR, PGR or PHR)

ELECTRONICS ENCLOSURE

E2	NEMA 4x/7/7 Enclosure. Mounted on Probe.
E4 ( )	Remote Electronics NEMA 4x/7/7 (IP65) includes NEMA 4x/7/7 (IP65) on probe . Specify

DISPLAY OPTION

NR	No Display
DD	Digital Display

INPUT POWER

PV1L	12-36 VDC LOOP POWERED (available only with V4LH).
PV1	12-36 VDC
PS	100-240 VAC, 50/60 Hz Line Power, 25 Watts

OUTPUT POWER

V4LH	One analog output (4-20mA), one pulse, HART, LOOP POWERED
V4H	One analog output (4-20 mA), one alarm, one pulse HART Communication, NOT LOOP POWERED.
V4M	One analog output (4-20 mA), one alarm, one pulse and MODBUS
V6M	Three analog outputs (4-20 mA), three alarms, one pulse and MODBUS
V6H	Three analog outputs (4-20 mA), three alarms, one pulse and HART Protocol Communication.

PROCESS TEMPERATURE

ST	Standard Temperature. Process temperature -330° to 500°F (-200° to 260°C)
HT	High Temperature. Process temperature -40° to 750°F (-40° to 400°C)

PROCESS PRESSURE

MP0	No Pressure Sensor Used with VT process fluid.
MP1	Maximum 30 psia (2 bara), Proof 60 psia (4 bara)
MP2	Maximum 100 psia (7 bara), Proof 200 psia (14 bara)
MP3	Maximum 300 psia (20 bara), Proof 600 psia (41 bara)
MP4	Maximum 500 psia (34 bara), Proof 1000 psia (64 bara)
MP5	Maximum 1500 psia (100 bara), Proof 1500 psia (100 bara)

ACCESSORIES (Consult Factory) Removable Retractors, Isolated Gate Valves, Mounting Kits, Material Certificates, Pressure Certificates, Certificate of Conformance, NACE Certification

Ordering the Model 241Insertion

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PROCESS CONNECTION

CM Compression Fitting
2-inch Male NPT, 600 lb pressure rating.

CF Compression Fitting
2-inch 150 lb Flange.

CG Compression Fitting
2-inch 300 lb Flange.

CH Compression Fitting
2-inch 600 lb Flange.

PM Packing Gland
2-inch Male NPT, 50 psig (3.5 barg) maximum process pressure without removable retractor.

PMR Packing Gland
2-inch Male NPT with Retractor, 600 lb pressure rating.

PMR-LE Packing Gland
2-inch Male NPT with Retractor, 600 lb pressure rating. (for LE)

PF Packing Gland
2-inch 150 lb Flange, 50 psig (3.5 barg) maximum process pressure without removable retractor

PFR Packing Gland
2-inch 150 lb Flange with Retractor

PFR-LE Packing Gland 2-inch 150 lb Flange with Retractor
For use with Extended probe length (see LE option)

PG Packing Gland
2-inch 300 lb Flange, 50 psig (3.5 barg) maximum process pressure without removable retractor.

PGR Packing Gland
2-inch 300 lb Flange with Retractor

PGR-LE Packing Gland 2-inch 300 lb Flange with Retractor
For use with Extended probe length (see LE option)

PH Packing Gland
2-inch 600 lb Flange, 50 psig (3.5 barg) maximum process pressure without removable retractor

PHR Packing Gland
2-inch 600 lb Flange with Retractor

PHR-LE Packing Gland 2-inch 600 lb Flange with Retractor
For use with Extended probe length (see LE option)

CFD Compression Fitting
DN50/PN16 Flange.

CGD Compression Fitting
DN50/PN40 Flange.

CHD Compression Fitting
DN50/PN64 Flange.

PFD Packing Gland
DN50/PN16 Flange, 50 psig (3.5 barg) maximum process pressure

PFDR Packing Gland
DN50/PN16 Flange, with retractor.

PFDR-LE Packing Gland
DN50/PN16 Flange, with retractor. For use with Extended probe length (see LE option)

PGD Packing Gland
DN50/PN40 Flange, 50 psig (3.5 barg) maximum process pressure

PGDR Packing Gland
DN50/PN40 Flange, with retractor.

PGDR-LE Packing Gland
DN50/PN40 Flange, with retractor. For use with Extended probe length (see LE option)

PHD Packing Gland
DN50/PN64 Flange, 50 psig (3.5 barg) maximum process pressure

PHDR Packing Gland
DN50/PN64 Flange, with retractor.

PHDR-LE Packing Gland
DN50/PN64 Flange, with retractor. For use with Extended probe length (see LE option)

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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

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Document Number 3000BR0606R11/09

11-09 tk

SATEC
Powerful Solutions

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

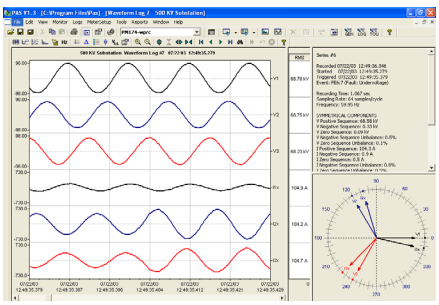
- Configurable demand calculation to match utility settings
  - Demand period from 1 to 60 minutes.
  - Number of demand periods from 1 to 15
- External synchronization for demand interval with Status Input or via communications

Communications

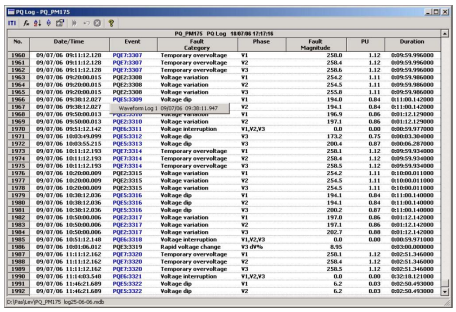
- Two independent communication ports
- **COM1** - optically isolated RS232/422/485 port, selectable via the front panel
  - Optional 10BaseT Ethernet-Modbus/TCP, DNP3/TCP protocols
  - Optional 56K modem
  - Optional Profibus DP
- **COM2** - optically isolated RS422/485 port
- Supports industry standard 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

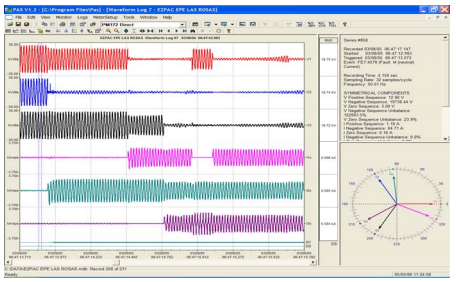
- Transient recording (minimum width: 130us @ 60Hz)
- Sag/Swell detection as per IEEE-1159 PQ categories: detailed description of event, phase, magnitude and duration
- Flicker (IEC 61000)
- ITI curves (CBEMA)
- Statistical Report Writer
- Export to PQDIF & COMTRADE format



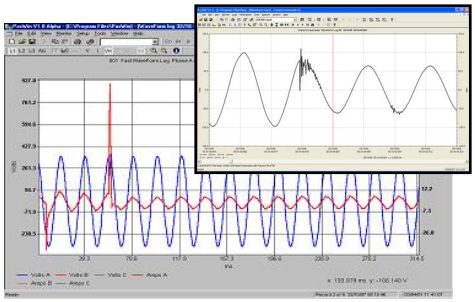
Real-Time "Scope Mode"



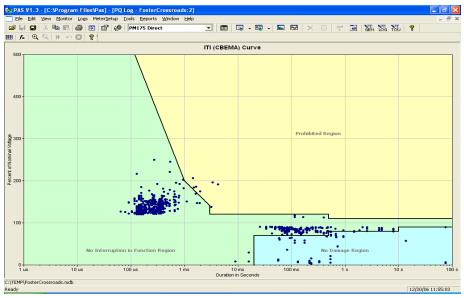
IEEE-1159 Categories - PQ Log



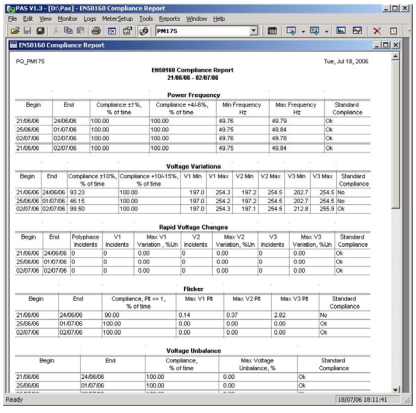
Detailed Waveform Capture



Transient Capture



ITI Plot (CBEMA)



Statistical Compliance Report

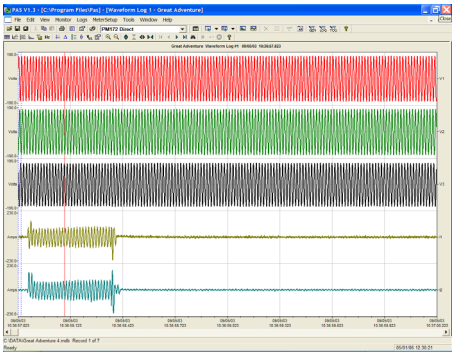
SATEC PM174 July 2010

SATEC
Powerful Solutions

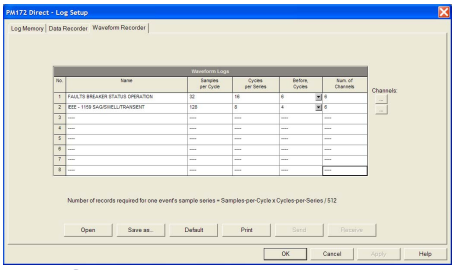
Model PM174 Advanced Power Quality Monitor

Waveform Logs

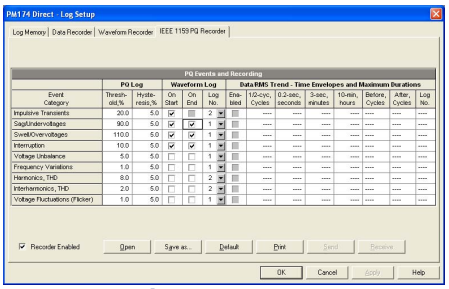
- Two independent, simultaneous waveform recorders, each recording the complete 3-phase voltage and current waveforms
- Recording resolution at 32, 64 and 128 samples/cycle
- Up to 20 pre-fault cycles
- Any number of post-fault cycles, limited only by available memory
- Supports Wrap-Around and Stop-on-Full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



Motor Startup



Waveform Log Setup



PQ Setup Tab

Log Memory

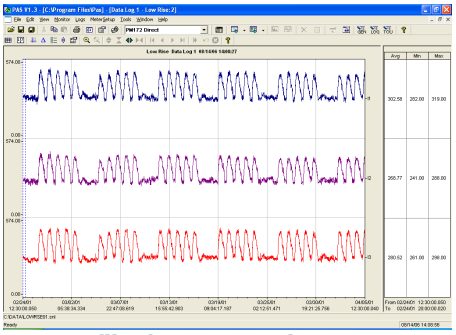
- 1MB of non-volatile log memory with battery backup. Up to 140 days of trending & load profile (16 measurements @ 15 minute interval)
- User-partitionable for Event Log, Data Logs, and Waveform Log Files

Event Log

- 1 Event Log of programmable depth

Data Logs

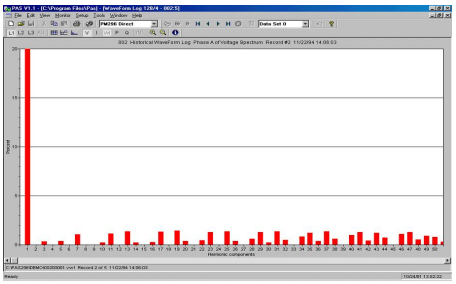
- 16 Data Logs of 16 parameters each
- Configurable depth
- Recording intervals from 1 to 9999 seconds
- Supports wrap-around and Stop-on-Full recording modes



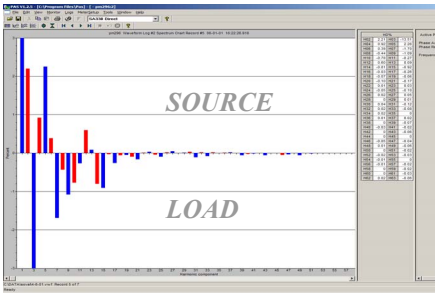
Log Profile / Data Trend

Advanced Harmonic Measurements

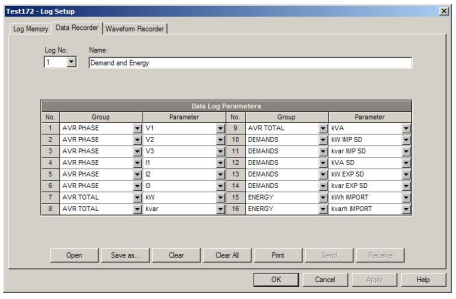
- Individual Harmonics up to 63rd, Amplitude & Phase
- Harmonic Power Direction (Load/Source)
- Total Harmonic Power and Energies



Harmonics Spectrum



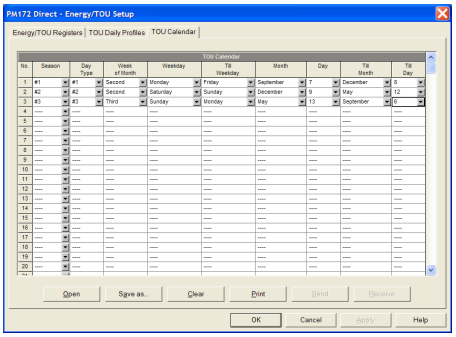
Directional Harmonics



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
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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 E129258
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

RDM172E – LED Remote Display

RDM312 – Multi-Window Remote Display

Optional Remote Display Modules

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.satec-global.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	▪

Immersion Probes w/ nylon fitting

Temperature Sensors

Rev. 06/09/11

Features & Options

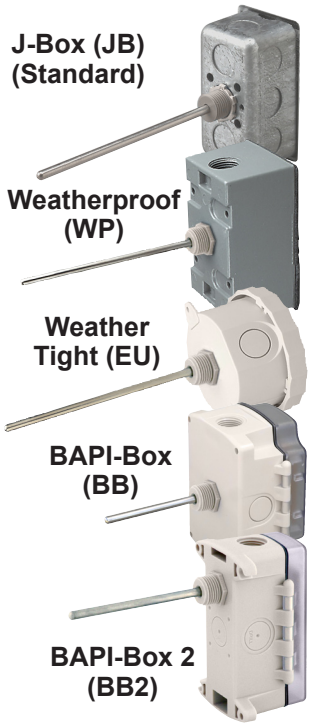
- Probe Lengths: 2”, 4” & 8” (fit standard BAPI Thermowell lengths)
- Series 304 Stainless Steel Probes and Five Enclosure Styles
- Double Encapsulated Sensors & Etched Teflon Leadwires
- Wide Selection of Temperature Sensing Elements

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 compound. All Immersion Units have etched Teflon leadwires and double encapsulated sensors to create a watertight package that can withstand high humidity and condensation.

Immersion Units come standard with a 2”x4” steel J-Box **(JB)** but are also available with four styles of watertight enclosure: Weatherproof **(WP)**, Weather Tight **(EU)**, BAPI-Box **(BB)** or BAPI-Box 2 **(BB2)**. BAPI also offers optional liquid-tight fittings. For more on the enclosure styles, please see the App. Notes section.

BAPI Thermowells

Immersion Unit Probes are designed to be inserted into a Thermowell. For more info on Thermowells, see page A60.



* All Passive Thermistors 10K Ω and smaller are CE compliant.

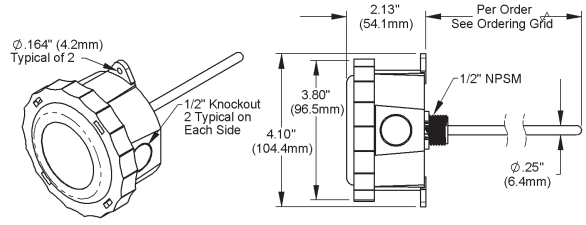
For detailed specs on the individual Sensors & Transmitters, turn to the “Sensors” Section.

Specifications

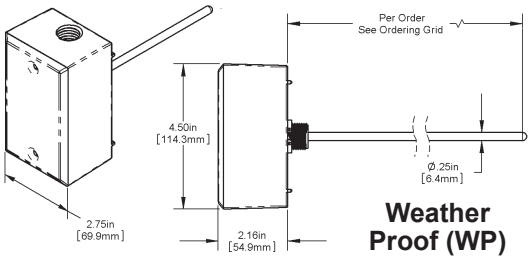
Encl. Material:
J-Box Model: Galv. Steel
WP Model: Cast Aluminum
EU Model: ABS Plastic, UL94, V-0
BB & BB2: UV-resistant polycarbonate, UL94, V-0

Encl. Rating: J-Box: NEMA 1 • WP Model: NEMA 3R
EU, BB & BB2 Models: IP66, NEMA 4

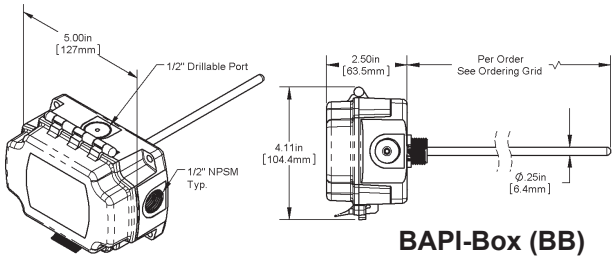
Environmental Operation Range:
Temperature Sensor: -40 ºC to 85 ºC
Temperature Transmitter: -20 ºC to 70 ºC
Humidity: 0 to 100%, non-condensing



Weathertight (EU)

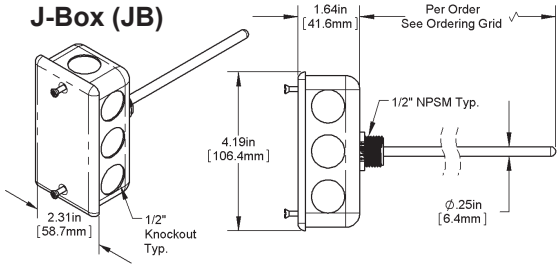


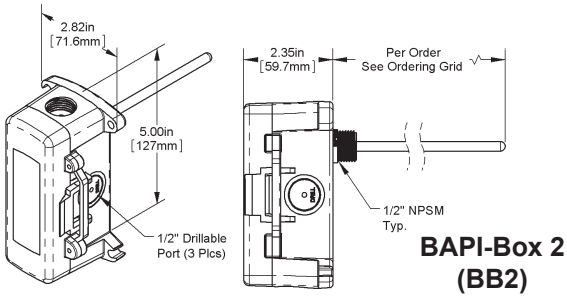
Weather Proof (WP)



BAPI-Box (BB)

J-Box (JB)





BAPI-Box 2 (BB2)

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. 06/09/11

Ordering Information **Immersion Units - Temperature**

BA/

Sensor Type **Required selection** **Use the designator number (shown to the left in bold) to indicate the sensor**

#

THERMISTORS

1.8K	1.8K Ω @ 25 °C
2.2K	2.2K Ω @ 25 °C
3K	3K Ω @ 25 °C
3.25K	3.25K Ω @ 25 °C (T30 type)
3.3K	3.3K Ω @ 25 °C
10K-2	10K Ω @ 25 °C
10K-3	10K Ω @ 25 °C
10K-3[11K]	5,238 Ω @ 25 °C
20K	20K Ω @ 25 °C
47K	47K Ω @ 25 °C
50K	50K Ω @ 25 °C
100K	100K Ω @ 25 °C

RTDs

100	100 Ω Platinum @ 0 °C, .385 Ω/°C temp. coeff.
100[3W]	3 Wire 100 Ω Plat. @ 0 °C, .385 Ω/°C temp. coeff.
1K[375]	1K Ω Platinum @ 0 °C, 3.75 Ω/°C temp. coeff.
1K[NI]	1K Ω Nickel @ 21°C, 5 Ω/°C temp. coeff.
1K	1K Ω Platinum @ 0 °C, 3.85 Ω/°C temp. coeff.
2K	2K Ω Silicon @ 20 °C, 8 Ω/°C temp. coeff.

SEMICONDUCTORS

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. Requires an enclosure.***

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**
T10K5[range]	10K Thermistor, 10,000 Ω @ 25 °C with 0-5 VDC Output**
T10K10[range]	10K Thermistor, 10,000 Ω @ 25 °C with 0-10 VDC 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 49C**	**50 TO 250F**	**10 TO 121C**
32 TO 134F	**0 TO 57C**		

Configuration	**Required selection**		
-I-2"	2" length of ¼" Diameter, Stainless Steel Probe (Use 2" BAPI Well)		
-I-4"	4" length of ¼" Diameter, Stainless Steel Probe (Use 4" BAPI Well)		
-I-8"	8" length of ¼" Diameter, Stainless Steel Probe (Use 8" BAPI Well)		
-I-XX	Custom lengths of ¼" Diameter, Stainless Steel Probe are available. Call for Details (Custom well required)		
	Enclosure Options ***2"x4" J-Box comes standard***		
		-BB	BAPI-Box Enclosure - IP66 rated, UV-resistant polycarbonate
		-BB2	BAPI-Box 2 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
		Optional Terminal Block **An enclosure is required**	
		-TS	Terminal Strip Connection (BB or BB2 required for units with a Thermistor, RTD or Semiconductor)***

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.

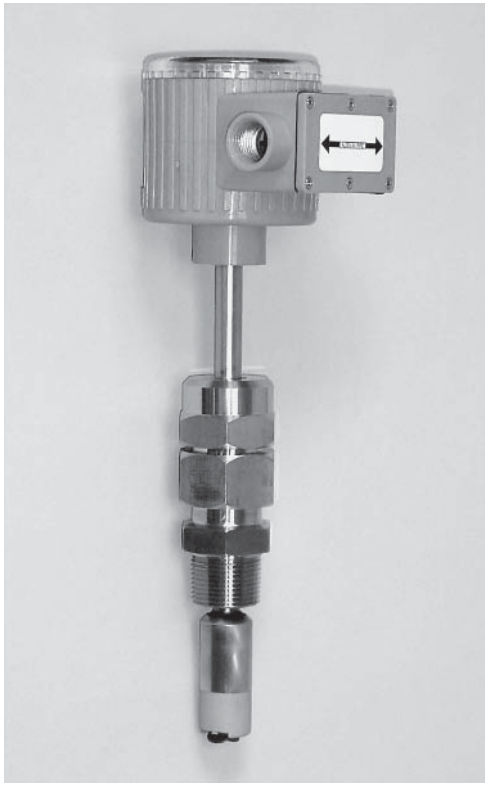
*Transmitters with matched outputs require a Class A sensor.

**Range is limited to -40 to 185°F (-40 to 85°C)

***TS option is not available with the 100[3W] RTD sensor, the 592-10K Semiconductor sensor or the T10K transmitters.

Badger® SDI Series	SDI Insert Flow Sensor	Technical Brief

The Badger® SDI Series flow sensor offers accurate liquid flow measurement in closed pipe systems in an easy to install economical package. Impeller sensors offer a quick response to changes in flow rate and are well suited to flow control and batch type applications in addition to flow monitoring. The new four-bladed impeller design is rugged, non-fouling and does not require custom calibration. Coupled with the proprietary patented digital detection circuit, the sensor measures flows from under 0.3 ft/sec to over 20 ft/sec regardless of the conductivity or turbidity of the liquid. The standard frequency output produces a low impedance square wave signal proportional to flow rate that may be transmitted up to 2000 feet without amplification.



Insert Sensors
SDI insert style flow sensors are intended for general flow measurement applications. They are available in either brass or stainless steel construction. The insert style sensors are intended for direct installation into pipelines through a 1" tap. The pipeline must be out of service and not under pressure at the time of installation. For any pipeline that is in service at the time of installation or cannot be de-pressurized and drained for service, Data Industrial recommends the use of our SDI hot tap models that are equipped with isolation valves.

Standard sensor stem lengths accommodate pipe sizes from 1½" through 10" in diameter or 12" through 36" depending on pipe material and tapping methods. Larger sizes usually require the use of hot tap models.

When the flow sensor is installed at the correct insertion depth and properly aligned, in pipe sections with at least 10 diameters of straight pipe upstream of the sensor and 5 diameters of straight pipe downstream, accuracies of +/-1 % of rate may be achieved.

Output Configurations
Standard Frequency
Sensor output is a pulse proportional to flow. The signal is similar to all 200 Series Badger Meter flow sensors and will interface with all existing Data Industrial transmitters and monitors. The power supply to the sensor and the output signal from the sensor is carried on the same two wires. Wire connections are made at screw terminals on removable headers inside the NEMA 4X housing.

Analog Output
The sensor is also available with a two-wire loop powered 4-20 mA output. The analog output is produced by an on-board micro-controller for precise, drift-free signals.

The unit is programmed from a computer using Windows® based software and a connection cable. Units may be pre-programmed at the factory or field programmed. All information is stored in non-volatile memory in the flow sensor.

Scaled Pulse Output
The scaled pulse is produced by an on-board micro-controller for precise, accurate outputs. This option may be programmed to produce an isolated solid state contact closure scaled to any number of engineering units of measure. Sensors may be pre-programmed at the factory or field programmed using a Data Industrial connection cable and a Windows based software program. All information is stored in non-volatile memory in the flow sensor. This is a four-wire option.

Display Options
All models except the standard frequency output version may also be equipped with a display. Integrated into the NEMA 4X housing, the 8 digit LCD may be programmed to show rate of flow, flow total or toggle between the two.

SPECIFICATIONS

Wetted Materials:
Sensor stem and mounting adapter:
- 316 Stainless steel
- Brass, B16, UNS, C36000

Sensor Tip:
- Polyphenylene Sulfide (PPS)
- Polyetheretherketone (PEEK)

O-rings,bearings,shaft:
- See ordering matrix

Maximum Temperature Ratings:
Fluid measured:
- +300° F (149°C) See Chart

Operating temperature: Electronics:
- +14°F (-10°C) - +150°F (65°C)

Operating temperature: LCD:
- -20°C - +65°C

Pressure Drop:
- 0.5 psi or less @ 10 ft/sec for all pipe sizes 1.5" dia and up.

Accuracy:
- Standard: to +/- 1% of rate over optimum flow range
- Custom wet calibration: On request

Straight Pipe Requirement:
- Install sensor in straight pipe section with a minimum distance of 10 diameters upstream and 5 diameters downstream to any bend, transition, or obstruction.

Repeatability:
+/- 0.5%

Enclosure:
- Polypropylene with Viton® sealed acrylic cover. Meets NEMA 4X specifications

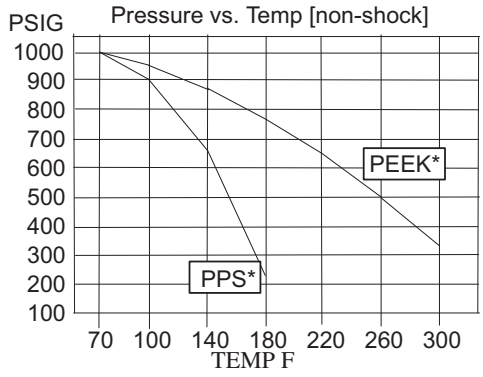
Wire Connections:
- All wire connections are made to screw type terminals within the electronics housing, ½" conduit thread provided

Programming:
- All programmable models utilize Badger Meter A301 connector cable and SDI Series software

Display: (optional)
- 8 character, 3/8" LCD
- STN (Super twisted Nematic) display
- Annunciators for:
  rate, total, input, output

Accessories
- ASDI-20 Programming Kit
  contains software and A301 programming cable

Maximum Pressure Rating for SST Stem
(Note: PPS or PEEK Tip)



* Max. Pressure Temp. Ratings for Brass:
- 600 PSI up to 140°F
- 225 PSI up to 180°F

Power Specifications

	Raw Pulse Option 0	Analog Loop Option 1	Scaled Pulse Option 2
Number of wire connections	2	2	4
Pulse Units			
Operating Voltage	8-35 VDC	N/A	12-30 VAC 12-35 VDC
Overvoltage protection	30 VAC ±40 VDC	±40 VDC	30 VAC ±40 VDC
Quiescent Current Draw @12VDC or 24VAC	330uA TYP	Software Controlled Current of 3.5-20.5mA	< 2mA
Short Circuit Current	50mA TYP	N/A	> 100 mA
Output Frequency	800 Hz max	N/A	Scaled By Customer
Output Pulse Width	5 mS Below 100 Hz	N/A	Adjustable 50mS to 5.0 Second in 50 mS Increments
Output Isolation	N/A	N/A	Opto-isolated
Analog Units			
Operating Voltage	N/A	8-35 VDC	N/A
Output Response Time	N/A	Varies with Programmable Filter	N/A

SDI Series Direct Insert Ordering Matrix

SDI	0	D1	N	0	0	-	0	2	0	0
Material										
Stainless Steel/PPS Tip	0									
Brass/PPS Tip	1									
Stainless Steel/PEEK Tip	2									
Type										
Direct Insert for Pipe 1-1/2" thru 10" *		D1								
Direct Insert for Pipe 12" thru 36" *		D2								
Direct Insert 36" and UP*		D3								
Electronic Housing										
NEMA 4X			N							
Output										
Standard Frequency Pulse				0						
Analog 4-20mA				1						
Scaled Pulse				2						
Display										
No Display					0					
LCD Option [not available with output option 0]					1					
O-Ring										
Viton®							0			
Shaft										
Tungsten Carbide [Standard]								2		
Hastelloy® C-276 [optional - consult factory]								1		
Zirconia Ceramic [optional - consult factory]								0		
Impeller										
Stainless Steel									0	
Bearing										
Torlon®										0

*Pipe size for reference only. Depending on pipe material, tapping saddle, or existing hardware, longer sensor length may be required.

For material details, consult the factory.

Data Industrial®

Please see our website at **www.badgermeter.com** for specific contacts.

Due to continuous research, product improvements and enhancements, Badger Meter reserves the right to change product or system specifications without notice, except to the extent an outstanding contractual obligation exists.

BadgerMeter, Inc.
P.O. Box 581390, Tulsa, Oklahoma 74158
(918) 836-8411 / Fax: (918) 832-9962
www.badgermeter.com

Rosemount 2051 Pressure Transmitter

- *Coplanar™ platform enables integration of primary elements, manifolds, and remote seal solutions*
- *Best in Class performance with up to 0.065% high accuracy option*
- *Local Operator Interface (LOI) offers easy to use configuration capabilities at the transmitter*
- *Protocols available include HART® 4-20 mA, FOUNDATION™ fieldbus, PROFIBUS PA, HART 1-5 Vdc Low Power*
- *Selectable HART Revision prepares your plant for the latest HART capabilities while ensuring seamless integration with today's systems*
- *SIL2 safety certification to IEC 61508 is available with the full 4-20 mA HART offering to simplify compliance*

Contents

Specifications

PERFORMANCE SPECIFICATIONS

This product data sheet covers HART, FOUNDATION fieldbus, and PROFIBUS PA protocols unless specified.

Conformance To Specification (±3σ (Sigma))

Technology leadership, advanced manufacturing techniques, and statistical process control ensure specification conformance to at least ±3σ.

Reference Accuracy

Stated reference accuracy equations include terminal based linearity, hysteresis, and repeatability. For FOUNDATION fieldbus and PROFIBUS PA devices, use calibrated range in place of span.

Models	Standard	High Performance Option, P8	
2051C			
Ranges 2-5	±0.075% of span For spans less than 10:1, accuracy = $\pm\left[0.025 + 0.005\left(\frac{URL}{Span}\right)\right]$% of Span	Ranges 2-5	High Accuracy Option, P8 ±0.065% of span For spans less than 10:1, accuracy = $\pm\left[0.015 + 0.005\left(\frac{URL}{Span}\right)\right]$% of Span
Range 1	±0.10% of span For spans less than 15:1, accuracy = $\pm\left[0.025 + 0.005\left(\frac{URL}{Span}\right)\right]$% of Span		
2051T			
Ranges 1-4	±0.075% of span For spans less than 10:1, accuracy = $\pm\left[0.0075\left(\frac{URL}{Span}\right)\right]$% of Span	Ranges 1-4	High Accuracy Option, P8 ±0.065% of span For spans less than 10:1, accuracy = $\pm\left[0.0075\left(\frac{URL}{Span}\right)\right]$% of Span
Range 5	±0.075% of span For spans less than 10:1, accuracy = $\pm\left[0.0075\left(\frac{URL}{Span}\right)\right]$% of Span		
2051L			
Ranges 2-4	±0.075% of span For spans less than 10:1, accuracy = $\pm\left[0.025 + 0.005\left(\frac{URL}{Span}\right)\right]$% of Span		

Flow Performance - Flow Reference Accuracy

2051CFA Annubar Flowmeter		
Ranges 2-3		±2.00% of Flow Rate at 5:1 flow turndown
2051CFC Compact Orifice Flowmeter – Conditioning Option C		
Ranges 2-3	β =0.4	±2.25% of Flow Rate at 5:1 flow turndown
	β =0.65	±2.45% of Flow Rate at 5:1 flow turndown
2051CFC Compact Orifice Flowmeter – Orifice Type Option P(1)		
Ranges 2-3	β =0.4	±2.50% of Flow Rate at 5:1 flow turndown
	β =0.65	±2.50% of Flow Rate at 5:1 flow turndown
2051CFP Integral Orifice Flowmeter		
Ranges 2-3	β <0.1	±3.10% of Flow Rate at 5:1 flow turndown
	0.1< β <0.2	±2.75% of Flow Rate at 5:1 flow turndown
	0.2< β <0.6	±2.25% of Flow Rate at 5:1 flow turndown
	0.6< β <0.8	±3.00% of Flow Rate at 5:1 flow turndown

(1) For smaller line sizes, see Rosemount Compact Orifice

Long Term Stability

± 50 °F (28 °C) temperature changes and up to 1000 psi (6,9 MPa) line pressure.

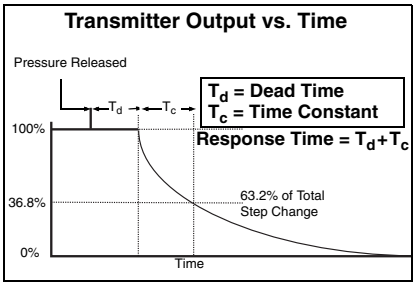
Models	Standard	High Performance Option, P8
2051C		
Range 1 (CD)	±0.2% of URL for 1 year	
Ranges 2-5	±0.1% of URL for 2 years	±0.125% of URL for 5 years
2051T		
Ranges 1-5	±0.1% of URL for 2 years	±0.125% of URL for 5 years

Dynamic Performance

	4-20 mA HART(1) 1-5 Vdc HART Low Power	FOUNDATION fieldbus and PROFIBUS PA protocols (3)
Total Response Time (T_d + T_c)(2):		
2051C, Range 3-5:	115 ms	152 ms
Range 1:	270 ms	307 ms
Range 2:	130 ms	152 ms
2051T:	100 ms	152 ms
2051L:	See *Instrument Toolkit®*	See *Instrument Toolkit*
Dead Time (Td)	60 ms (nominal)	97 ms
Update Rate	22 times per second	22 times per second

(1) Dead time and update rate apply to all models and ranges; analog output only
(2) Nominal total response time at 75 °F (24 °C) reference conditions.
(3) Transducer block response time, Analog Input block execution time not included.

Typical HART Transmitter Response Time



Line Pressure Effect per 1000 psi (6,9 MPa)

For line pressures above 2000 psi (13,7 MPa) and Ranges 4-5, see user manual (Document number 00809-0100-4001 for HART, 00809-0100-4774 for FOUNDATION fieldbus, and 00809-0300-4101 for PROFIBUS PA)

Models	Line Pressure Effect
2051CD, 2051CF	Zero Error(1)
Ranges 2-3	±0.05% of URL/1000 psi (68.9 bar) for line pressures from 0 to 2000 psi (0 to 13.7 MPa)
Range 1	±0.25% of URL/1000 psi (68.9 bar)
	Span Error
Ranges 2-3	±0.1% of reading/1,000 psi (68.9 bar)
Range 1	±0.4% of reading/1,000 psi (68.9 bar)

(1) Can be calibrated out at line pressure.

Ambient Temperature Effect per 50 °F (28 °C)

Models	Ambient Temperature Effect	High Performance Option, P8
2051C, 2051CF		
Ranges 2-5	±(0.025% URL + 0.125% span) from 1:1 to 5:1 ±(0.05% URL + 0.25% span) from 5:1 to 100:1	±(0.0125% URL + 0.0625% span) from 1:1 to 5:1 ±(0.025% URL + 0.125% span) from 5:1 to 100:1
Range 1	±(0.1% URL + 0.25% span) from 1:1 to 30:1	
2051T		
Range 2-4	±(0.05% URL + 0.25% span) from 1:1 to 30:1 ±(0.07% URL + 0.25% span) from 30:1 to 100:1	±(0.025% URL + 0.125% span) from 1:1 to 30:1 ±(0.035% URL + 0.125% span) from 30:1 to 100:1
Range 1	±(0.05% URL + 0.25% span) from 1:1 to 10:1 ±(0.10% URL + 0.25% span) from 10:1 to 100:1	±(0.025% URL + 0.125% span) from 1:1 to 10:1 ±(0.05% URL + 0.125% span) from 10:1 to 100:1
Range 5	±(0.1% URL + 0.15% span)	
2051L	See *Instrument Toolkit*	

Mounting Position Effects

Models	Mounting Position Effects
2051C	Zero shifts up to ±1.25 inH_2O (3.1 mbar), which can be calibrated out. No span effect.
2051T	Zero shifts up to ±2.5 inH_2O (6.2 mbar), which can be calibrated out. No span effect.
2051L	With liquid level diaphragm in vertical plane, zero shift of up to 1 inH_2O (2.49 mbar). With diaphragm in horizontal plane, zero shift of up to 5 inH_2O (12.43 mbar) plus extension length on extended units. Zero shifts can be calibrated out. No span effect.

Vibration Effect

Less than ±0.1% of URL when tested per the requirements of IEC60770-1 field or pipeline with high vibration level (10-60 Hz 0.21mm displacement peak amplitude / 60-2000 Hz 3g).

Power Supply Effect

Less than ±0.005% of calibrated span per volt.

Electromagnetic Compatibility (EMC)

Meets all relevant requirements of EN 61326 and NAMUR NE-21.

Transient Protection (Option Code T1)

Meets IEEE C62.41, Category Location B

- 6 kV crest (0.5 μs - 100 kHz)
- 3 kA crest (8 × 20 microseconds)
- 6 kV crest (1.2 × 50 microseconds)

TEMPERATURE

ENCAPSULATED THERMISTOR AND RTD SENSORS

ST-R, ST-R*R SERIES*

DESCRIPTION

Precon Encapsulated Sensors provide precision remote temperature sensing for building automation systems and mechanical equipment room instrumentation. The active sensing element is a highly stable precision thermistor material or platinum RTD.

The sensor is encapsulated with a low mass, high conductivity compound for good heat transfer characteristics. It is enclosed in a tough, miniature cylinder, 0.17" in (0.43 cm) diameter, which is small enough to be installed in most HVAC thermostat enclosures.

ST-R*

ST-R*R

FEATURES

- ***Lifetime warranty***
- ***Wide selection of thermistor and RTD curves***
- ***Adaptable miniature sensor***
- ***High heat dissipation constant***
- ***Easy to mount with clips***
- ***Pre-aged, highly stable thermistor material***

OPTIONS

- ***25' (7.6m) of 24 AWG zipcord***
- ***Matched sensor pairs***
- ***Rugged sensor coating***

APPLICATION

ST-R*

The Model **ST-R*** Encapsulated Thermistor Sensor (white) is intended for indoor use only, in areas not subject to moisture or condensation. The sensor may be installed under the cover of an existing pneumatic thermostat. Caution should be exercised when applying the sensor to existing electric thermostats. Heat is often generated by anticipators or other electronics that will affect the sensor reading. The sensor operating range is 35° to 140°F (2° to 60°C). Do not use in conditions below 35°F (2°C) or where condensation could occur.

ST-R*R

The Model **ST-R*R** Ruggedized Encapsulated Thermistor Sensor (red) is suitable for temperature extremes and is immune to the effects of moisture and condensation. PreCon uses a three-stage, ruggedized coating process to moisture proof any sensor which is to be used below ambient dewpoint. The sensor operating range is -30° to 230°F (-34° to 110°C).

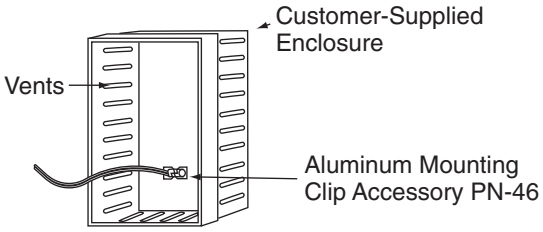
SPECIFICATIONS

Accuracy	
Thermistor	±0.36°F (0.2°C)
RTD	
Type 63	±0.72°F (0.40°C)
Type 71	±0.054°F (0.03°C)
Type 81, 85	±0.27°F (0.15°C)
Type 91	±0.54°F (0.30°C)
Sensor Type	
Thermistor	2.252 kΩ, 3 kΩ, 10 kΩ, 20 kΩ, 100 kΩ
RTD	
Type 63	1000Ω Nickel
Type 71, 81	100Ω Pt 385 Curve
Type 85	1000Ω Pt 385 Curve
Type 91	1000Ω Pt 375 Curve
Temperature Range	
Thermistor	10° to 230°F (-12° to 110°C)
RTD	
Type 63	-76° to 392°F (-60° to 200°C)
Type 71	-58° to 572°F (-50° to 300°C)
Type 81, 85, 91	-67° to 240°F (-55° to 115°C)

Temperature Coefficient	
Thermistor	Negative temperature coefficient
RTD	Positive temperature coefficient
Temperature Stability	
Thermistor	0.24°F (0.13°C) over 5 years
RTD	<0.09°F (0.05°C) over 5 years
Heat Dissipation	2.7 mW/°C (power needed to raise the temperature by 1°C)
Mounting	Directly to wall or customer supplied enclosure using customer supplied clips
Wiring Terminations	8' (2.4m) of 24 AWG pigtails with prestripped ends, type 71 & 81 have 18" leads
Approvals	CE
Weight	0.8 oz (22.7 g), 0.16 oz (4.5 g)
Warranty	Lifetime

MOUNTING

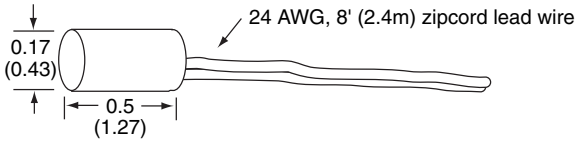
Mounting
Secure to enclosure or wall using cable ties, clips, or brackets. To obtain optimum performance, the sensor enclosure/assembly must be highly conductive. Any sensor element surrounded by insulating media will not perform properly at all temperatures or with the proper temperature response times. An accurate room sensor must have good ventilation and a high thermal-conducting metal which is in direct contact with the sensor. The enclosure must be insulated from the building mounting surface to limit wall temperature influence on the sensor.



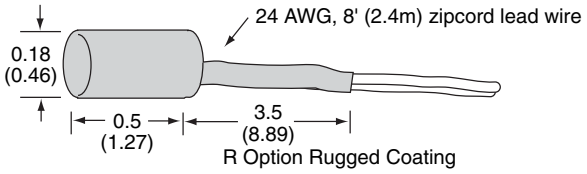
Rear View

DIMENSIONS

in
(cm)



ST-R*



ST-R*R

ORDERING INFORMATION

MODEL	DESCRIPTION
ST-R3	10,000Ω encapsulated thermistor @ 77°F (25°C), Type III (gray leads)
ST-R21	2252Ω encapsulated thermistor @ 77°F (25°C), Type II (green leads)
ST-R22	3000Ω encapsulated thermistor @ 77°F (25°C), Type II (blue leads)
ST-R24	10,000Ω encapsulated thermistor @ 77°F (25°C), Type II (yellow leads)
ST-R27	100,000Ω encapsulated thermistor @ 77°F (25°C), Type II (gray leads)
ST-R42	20,000Ω encapsulated thermistor @ 77°F (25°C), Type IV (green leads)
ST-R63	1000Ω nickel encapsulated RTD @ 70°F (21°C), (yellow leads)
ST-R71	100Ω ultra high accurate encapsulated RTD @ 32°F (0°C), 385 platinum curve (blue leads)
ST-R81	100Ω encapsulated RTD @ 32°F (0°C), 385 platinum curve (yellow leads)
ST-R85	1000Ω encapsulated RTD @ 32°F (0°C), 385 platinum curve (blue leads)
ST-R91	1000Ω encapsulated RTD @ 32°F (0°C), 375 platinum curve (green leads)
	OPTIONS (List options in alphabetical order with dashes)
R	Rugged (3.5" moistureproof coating; adding a **#** following the **R** extends the coating in feet)
QD¼	Nylon insulated quick disconnect ¼"
R	Rugged moistureproof coating 3.5"
R#	Rugged moistureproof coating. # equals number of feet of the coating
X25	25' (7.6m) lead length 24 AWG
XN	NIST certificate of conformance
XN1	NIST certificate, one reference point 32°F (0°C)
XN2	NIST certificate, two reference points 32°F/158°F (0°C/70°C)
XN3	NIST certificate, three reference points 32°F/77°F/158°F (0°C/25°C/70°C)
XP	Matched sensor pair, matched to ±0.1°F, 0.05°C (must order two sensors)
XPA	Ultra high accuracy, thermistors only, ±0.135˚F (0.075˚C)
XZ	Three wire RTD connections (Optional only on Type 81, standard on Type 71)

ST-R3 – **R** – **X25**

Example: **ST-R3R-X25** 10,000Ω Type III thermistor with 3.5" rugged coating and 25' (7.6m) cable length