MEASUREMENT AND VERIFICATION (M&V) PLAN

FOR

GLOVERSVILLE-JOHNSTOWN JOINT WASTEWATER TREATMENT FACILITY

March 2010

Submitted to:

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

Submitted by:

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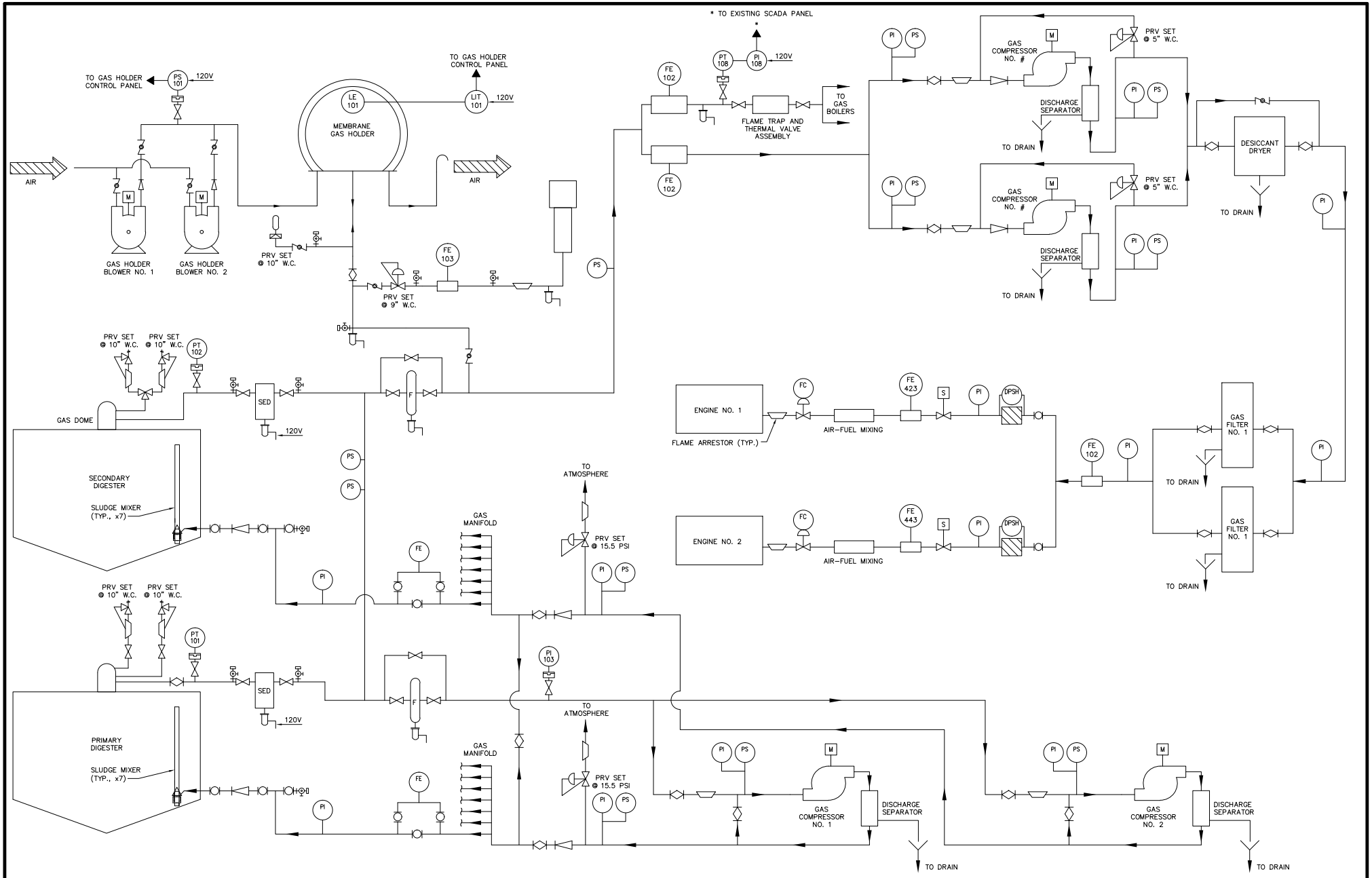
Introduction

This plan describes the approach to monitor the performance of the anaerobic digester gas (ADG) to electricity system that is being installed at the Gloversville-Johnstown Joint Wastewater Treatment Facility (GJJWWTF). Biogas will be used to drive an engine-generator to produce power that will be consumed on site. A monitoring system will be installed to measure and collect the data necessary to quantify the electric power produced by the engine-generator. The data will serve as the basis for payment of three (3) years of performance incentive payments, which the Gloversville-Johnstown Joint Sewer Board, has applied for under a Standard Performance Contract (SPC) with the New York State Energy Research and Development Authority (NYSERDA) based on a total contracted capacity of 460 kW.

ADG System Description

The Anaerobic-to-Digester Gas (ADG) System is comprised of one primary digester with an effective volume of approximately 1,500,000 gallons and one secondary digester with an effective volume of approximately 1,300,000 gallons. Both digesters are equipped with mixing, heating and gas collection equipment and appurtenances. Under normal operation the primary digester is continually mixed and heated, while the secondary digester is only mixed periodically. The primary digester is equipped with a floating steel, truss type, duodeck cover, while the secondary digester's cover was fixed in place and biogas storage provided by a dual membrane gas holder with an approximate working volume of 47,000 cubic feet (ft^3) at a working pressure of 11 inches of water column (w.c.). Biogas is collected from both the primary and secondary digesters prior to storage, utilization or flaring. The digester mixing system compresses biogas with a liquid ring pump to approximately 13 pounds per square inch (psi) for use with the confined gas bubble mixing systems. Refer to Figure 1, for a system schematic of the biogas system.

The combined heat and power system will be utilized to produce electricity and recover waste heat from engine generators to heat the digesters to approximately 98^o Fahrenheit (F). Biogas to be utilized in the engine generators will be compressed to 5 psi with liquid rings pumps. Biogas from anaerobic digesters has a high relative humidity, nearly 100 percent. The relative humidity will be reduced to approximately 55 percent with the use of a desiccant drying system. Any



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MEASUREMENT & VERIFICATION PLAN

BIOGAS SYSTEM SCHEMATIC

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FIGURE 1

liquid or solid particulates greater than 0.3 microns (µm) will be removed from the biogas by two coalescing filters. The liquid ring pumps, desiccant filter and coalescing filters will be located on the second floor of the existing digester building.

Table 1. Cogeneration System

Digester	Two-stage anaerobic digesters, mixed, covered, heated
Feedstock	Thickened primary, secondary and recuperative sludge
Engine-Generators	(2) Caterpillar Model No. 3508 350 kW output on biogas, total 700 kW 480 VAC, 3 phase
Biogas Conditioning	(1) Van Air Systems Model No. D48 Deliquescent Dryer (2) Burgess Manning Model No. 3900V-12-1150 UltraSep Coalescing Filter Separator
Engine Backup/startup Fuel	Natural Gas
Heat Recovery Use	Digester heating
Exhaust Heat Recovery	(2) Cain Industries Model No. UTRI-606A.5SSP 528 MBtu/hr
Engine Heat Recovery	(2) ITT Industries Model No. P22 1.4 MBtu/hr

The engine generators and heat recovery systems will be located in the existing energy recovery building adjacent to the digester building. Each generator is a Caterpillar Model No. SR4B, 350 kW rated, synchronous generator equipped with a Caterpillar Model No. 3508 ultra low emissions gas engine. The generators are designed to operate in any of the following modes of operation:

Utility Parallel Mode

The engine generators will operate in parallel with the utility power supply. The PLC based controls will not allow the generator load level to exceed the facility's electrical demand and prevent kW export to the utility. As the utility import power approaches zero the PLC based controls will automatically reduce the base setpoint to prevent export. This dynamic setting will allow the generators to increase power if the utility load increases at the facility.

Standby Mode

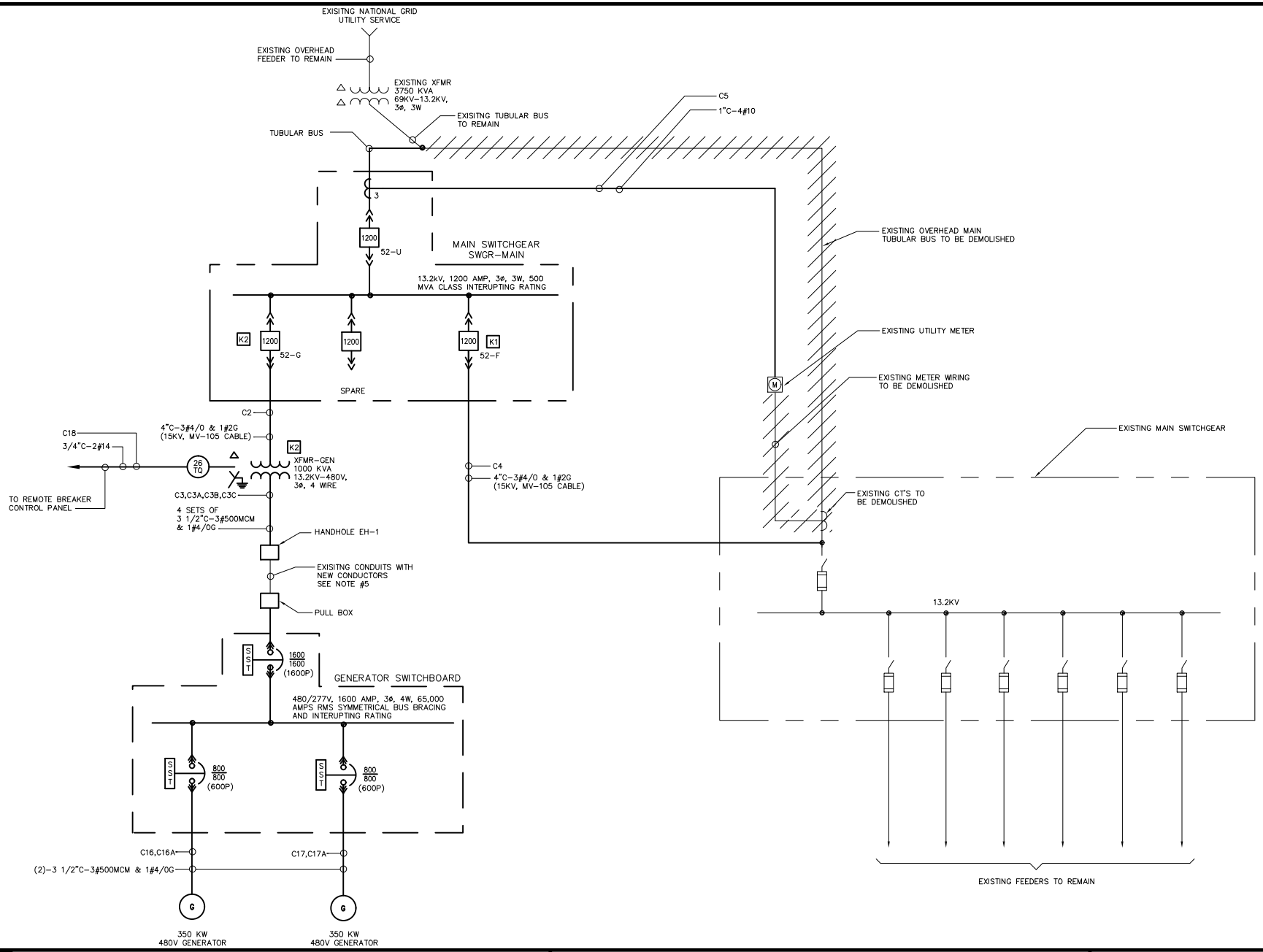
The engine generators will operate for standby service should the utility power supply fail, as sensed by the intertie protective relays the utility control panel, located by the facility high voltage service yard. The utility control panel protective devices will trip the 13.2 KV breaker after relaying time delays have expired. With the main breaker open, both engines will automatically start and ramp to rated voltage and frequency. The first to reach operating voltage and frequency will connect to the bus, becoming the synchronizing reference for the remaining generator. If the facility power load is greater than the demand of a single generator, the second generator will connect to the bus. Standby operation will continue until the utility power is restored either automatically or through operator override.

Island Mode

Isolated bus operation will occur whenever the engines are running and the utility power is interrupted. The engine generators will immediately revert to isochronous load sharing of the bus load. Load controls will be in place to prevent overload of the generator bus.

The engine generators will be connected to the existing high service yard where the main utility power switchgear is located to feed the entire facility depending on the electrical demands. The voltage will be increased from 480V to 13.2KV by a 1000 KVA transformer. Refer to Figure 2, for a one -line diagram of the facility main switchgear and generator interconnection.

The engine generators will produce a significant amount of waste heat depending on the energy load at the facility that can be recovered for digester heating. Each heat dump radiator, one per engine generator, is sized to reject 1,540,000 Btu/hr when the heat loads for the digesters are minimal. Based on a 0^{o} F day the heating load to the primary digester is 1,850,000 Btu/hr and the existing spiral sludge heat exchanger has a rated capacity of 2,250,000 Btu/hr. Refer to Figure 3, for a schematic of a typical engine generator cooling loop. The after cooler and jacket cooling loops are a 50/50 ethylene glycol/water mixtures that transfer heat to an intermediate recovery loop that is comprised of water. The intermediate recovery loop transfers heat to the sludge heating loop, refer to Figure 4. The intermediate cooling loop is provided to separate sludge from the engine generator cooling loops and to avoid contamination of the piping.



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MEASUREMENT & VERIFICATION PLAN

OVERALL ONE LINE DIAGRAM

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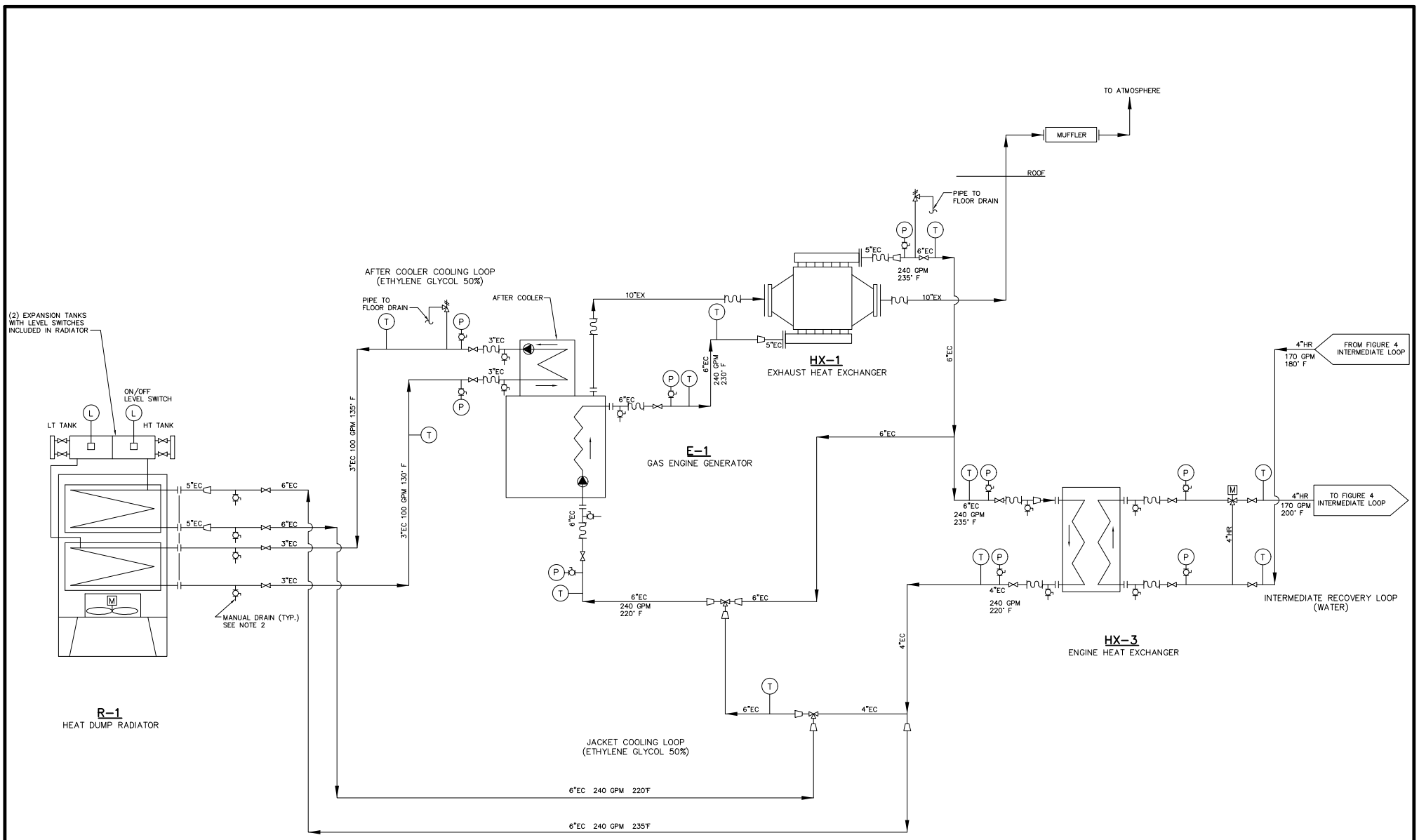
FIGURE 2



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MEASUREMENT & VERIFICATION PLAN

TYPICAL ENGINE GENERATOR COOLING SYSTEM SCHEMATIC

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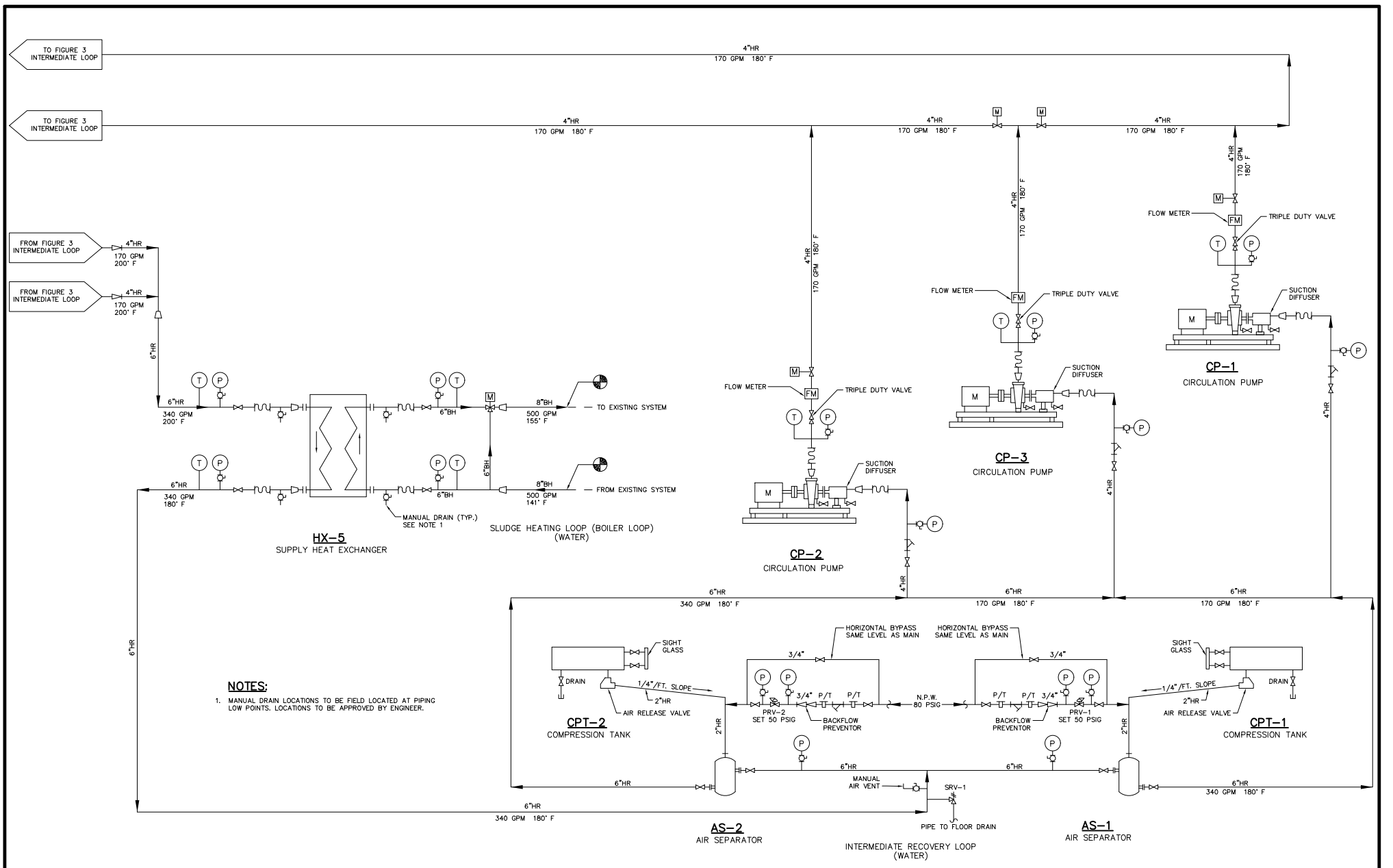
FIGURE 3



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MEASUREMENT & VERIFICATION PLAN

HEAT RECOVERY SYSTEM INTERNAL LOOP

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FIGURE 4

Monitoring System Equipment, Installation, Operation, and Maintenance

Figure 1 also shows the locations of the engine fuel flow meters that will be used throughout the duration of the contract to monitor biogas consumption. Electrical meters will be provided on each of the skid-mounted generators that will be used throughout the duration of the contract to monitor electrical production. There is a gas analyzer that will be provided on the common biogas feed to the two engine generators that will monitor the methane (CH_4) content of the biogas and be interconnected to the Woodard air fuel ratio controller on each engine generator. The amount of CH_4 in the biogas directly correlates to the fuel heating value of the biogas and Woodard controller will adjust the timing of the engines to maximize performance. Information on these data monitoring points is shown in Table 2.

Table 2. Electrical and Biogas Monitoring Points

Point Type	Point Name	Description	Instrument	Accuracy	Expected Range
Real	-	Engine-Generator Power	Basler Model No. BE1-GPS100 Meter Function with 3 CTs, 600A	±1% at unity PF	0-350 kW
Real	-	Engine-Generator Power	Basler Model No. BE1-GPS100 Meter Function with 3 CTs, 600A	±1% at unity PF	0-350 kW
Analog	FIT 423 FE 423	Engine Fuel Flow	FCI Model No. GF90 Standard Conditions 70°F, 14.7 psi	±1% reading + 0.5% full scale	0-120 SCFM
Analog	FIT 443 FE 443	Engine Fuel Flow	FCI Model No. GF90 Standard Conditions 70°F, 14.7 psi	±1% reading + 0.5% full scale	0-120 SCFM

The electrical output of each engine will be measured with an electronic wattmeter, utilizing the current transformers (CTs) and potential transformers (PTs) located in the rear of the switchgear and integral to the protective relay configuration of the system. The real time meter provides Watt, Watt-hr, VAR, VAR-hr, voltage and amperage measurements. Display of the data can be accessed by the Basler BE1-GPS100 protective relay's Human Machine Interface (HMI) or the main control panel HMI mounted on the front door of the switchgear.

The gas input to the engine generators will be measured by FCI Model No. GF90 direct mass flow meter. The meter has dual calibrations for both digester and natural gas and provides an output as a function of the velocity, standard volume, and mass flow. The electrical meters,

engine fuel flow meters and the gas analyzer, all have been supplied by the engine generator manufacturer, Southworth-Milton, Inc.

The NYSERDA CHP Website Contractor (CDH Energy) will install an Obvius AcquiLite datalogger to compile and log the data from the monitoring points listed in Table 2. Cut sheets of the datalogger are attached in the Appendix. The datalogger will be programmed to record the totalized data for each monitoring point for each 15-minute interval. A record of all multipliers and datalogger settings will be maintained. The datalogger will be located in the electrical room next to the control panel, and will be connected to an uninterruptible power supply (UPS) to ensure the datalogger retains its settings and data in the event of a power outage. The UPS is capable of powering the data logger for at least one day. Gloversville-Johnstown Joint Wastewater Treatment Plant will provide a dedicated phone line (or an Ethernet connection with fixed IP address) that will be used to communicate with the datalogger. CDH Energy will communicate with the datalogger nightly to extract monitored data from the datalogger and transfer the data to the NYSERDA CHP Website. If communications are lost, the Obvius datalogger is capable of holding at least 15 days of 15 minute interval data.

Management of Monitoring System Data

Gloversville-Johnstown Joint Wastewater Treatment Facility personnel will perform the following quality assurance and quality control measures to ensure the data produced from the monitoring system accurately describes system performance.

On a daily basis, a Chief Operator, or his designated representative, will perform inspections of the digesters and engine generator equipment and record findings into the project log. On a weekly basis the Shift Operator will record the value of the CH_4 in the biogas.

On a weekly basis, the Manager of Maintenance, or his designated representative, will perform inspections of the M&V meter installations and complete the routine maintenance on the meters, noting any abnormalities or unexpected readings. Gloversville-Johnstown Joint Wastewater Treatment Facility will also maintain a weekly log of the cumulative power generation (kWh) from, and biogas and natural gas flow (ft^3) to engine generators in the event that data transfer to the NYSERDA CHP Website fails or other anomalies occur.

On a weekly basis, the Manager of Wastewater Programs will review the data stored in the NYSERDA CHP Website (chp.nyserda.org) to ensure it is consistent with their observed performance of the ADG system and logged readings. Data will be reviewed using the reporting features at the web site, including:

- Monitored Data – Plots and Graphs and
- RPS: Customer-Sited Tier Anaerobic Digester Gas-to-Electricity Program NYSERDA Incentive Program Reports

In addition, the Manager of Wastewater Programs will also setup and use the email reports that are available to help the track system performance, including:

- a periodic email report summarizing system performance and the estimated incentive,
- an email report sent out if data are not received at web site or do not pass the quality checks

The CHP website will automatically take the data collected from the datalogger and evaluate the quality of the data for each interval using range and relational checks. The expected ranges for the sensors, which will be used for the range checks, are listed in Table 2. The relational check will compare the kWh production data and gas production data for each interval to ensure both meters always provide non-zero readings at the same time (e.g., a meter has failed). Only data that pass the range and relational quality checks are used in the incentive reports listed above. However, all hourly data are available from the NYSERDA CHP Website using the "Download (CSV file)" reporting option.

In the event of a communications or meter failure, the Gloversville-Johnstown Joint Wastewater Treatment Facility personnel will work with CDH to resolve the issue in a few days.

If unanticipated loss of data occurs when the engine-generator continues to produce electricity, Gloversville-Johnstown Joint Wastewater Treatment Facility will follow the procedures outlined in Exhibit D of their contract, i.e. using data from similar periods – either just before or after the outage – to replace the lost data. Gloversville-Johnstown Joint Wastewater Treatment Facility understands that they can use this approach for up to two 36 hour periods within each 12-month

performance reporting period. If more than two such data outages occur, Gloversville-Johnstown Joint Wastewater Treatment Facility will provide information from other acceptable data sources (e.g., weekly recorded logs) to definitively determine the amount of power that was produced from biogas during the period in question.

Annual M&V Reports

Gloversville-Johnstown Joint Wastewater Treatment Facility will prepare the Annual M&V Report, which will include a table showing the monthly kWh production biogas sent to the engine, and other data listed in Table 3. The WWTF may use the NYSERDA Incentive Program Reports found on the CHP website. Alternatively, they may provide their own summary of the data (using hourly CSV data downloaded from the Website) along with a narrative justifying why their data and calculations are more appropriate. The methods for calculating these values are provided below.

Table 3. Summary of Data for Annual M&V Report

Month	Electricity Production, kWh	Biogas to Engines ft^3	Natural Gas to Engines, ft^3	Biogas LHV, (BTU/ft^3)	Biogas Energy Content, (BTU)	Natural Gas Energy Content, (BTU)	Adjusted Electricity Production, kWh
Month 1							
Month 2							
Month 3							
….							
….							
….							
Month 12							

Gloversville Johnstown will utilize data collected from the gas analyzer to determine the lower heating value of the biogas, and total energy content of the biogas as follows.

Monthly Biogas Lower Heating Value

Gloversville-Johnstown Joint Wastewater Treatment Facility will use the readings of CH_4 percentages in the biogas gathered in real time by the gas analyzer to estimate Biogas Lower Heating Value using the following equation:

$$LHV_{biogas} = LHV_{methane} \cdot (F_{CH4})$$

where,

$LHV_{methane}$: lower heating value of methane (911 Btu/ft^3 at standard conditions, 60 °F and 1 atm)

F_{CH4} : monthly average fraction of biogas that is CH_4 based on the gas analyzer

Monthly Biogas Energy Content

Gloversville-Johnstown Joint Wastewater Treatment Facility will calculate the average monthly Biogas Energy Content using the following equation:

$$Q_{biogas} = CF \cdot LHV_{biogas}$$

where,

CF : volume (ft^3) of biogas delivered to engines in a month (standard cubic feet)

Monthly Natural Gas Energy Content

Gloversville-Johnstown Joint Wastewater Treatment Facility will calculate the average monthly Natural Gas Energy Content using the following equation:

$$Q_{NG} = CF \cdot \left[1{,}028 \frac{Btu_{LHV}}{ft^3} \right]$$

where,

CF : natural gas consumption in the month (standard cubic feet)

Monthly Adjusted Electricity Production

Gloversville-Johnstown Joint Wastewater Treatment Facility will calculate the monthly adjusted electricity production using the following equation:

$$kWh_{adjusted} = kWh_{generator} \left[\frac{Q_{biogas}}{Q_{biogas} + Q_{NG}} \right]$$

where,

$kWh_{generator}$: actual electricity production

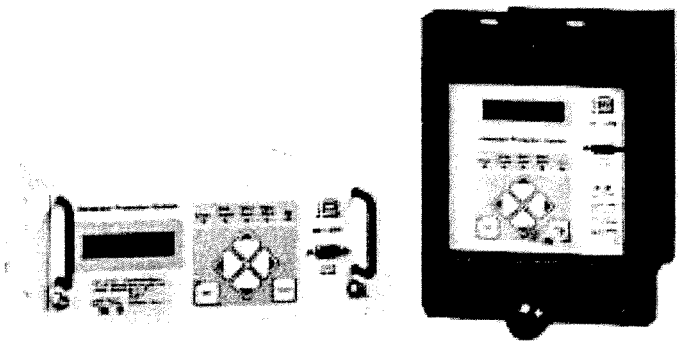
Appendix

Cut sheets for:

Basler Model No. BE1-GPS100

FCI Model No. GF90

AquiLite Data Acquisition Server – A7801-1



BE1-GPS100 GENERATOR PROTECTION SYSTEM

The BE1-GPS100 is a multifunction, programmable numerical protection, meter, and control relay. Functions provided include three phase voltage controlled, voltage restrained, or standard overcurrent, phase residual and independent ground overcurrent, negative sequence overcurrent, breaker failure, over/underfrequency, phase over/undervoltage, zero sequence over/undervoltage, and negative sequence overvoltage, forward or reverse power, loss of excitation, volts per hertz, sync check, sensitive third harmonic ground fault monitoring, breaker monitoring and control and metering functions, all in an integrated system.

ADVANTAGES

- BESTlogic provides the user with very high flexibility in configuring a protection and control system.
- Substantial functionality in a small package, useful where space is very limited but high functionality is needed.
- Programmable LCD display allows the relay to replace local indication and control functions, such as panel metering, alarm annunciation, and control switches.
- Three independent communication ports with protocol support allows integration with distributed control systems.
- Provides optional separate ground current input for those applications where this is required.
- Includes frequency tracking and voltage restrained overcurrent for backup and cogeneration applications.
- Includes Real Time Clock with 8 hour capacitor ride through and optional battery backup.
- Available in fully drawout half rack case. Two Basler Electric half rack IEDs (Intelligent Electronic Devices) can be dovetailed together to mount in a standard 19-inch equipment rack with no special mounting hardware.
- Available in fully drawout S1 and S1 double-ended cases with test paddles for retrofit applications. The S1 case, with available adapter plates, fits cutout, drilling and behind panel projection dimensions for common Basler Electric, GE and Westinghouse unit case relays.

WINDOWS® SOFTWARE

Interface for setting and communicating with Basler protection products.
Request BESTCOMS for BE1-GPS100.

ADDITIONAL INFORMATION

INSTRUCTION MANUAL
Request publication 9318700990

TIMING CURVES
Request publication 9252000999

MODBUS™ INSTRUCTION MANUAL
Request publication 9318700991

DNP 3.0 INSTRUCTION MANUAL
Request publication 9318700992

FEATURES
Pages 2 and 3

APPLICATIONS
Page 3

FUNCTIONAL DESCRIPTION
Pages 4 - 6

BESTlogic
Pages 8 and 9

SPECIFICATIONS
Pages 7, 10 - 11

ORDERING INFORMATION
Page 12

Basler Electric
P. O. BOX 269 HIGHLAND, ILLINOIS, U.S.A. 62249 PHONE 618-654-2341 FAX 618-654-2351

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8-03

FEATURES

PROTECTION

- Phase and Neutral Instantaneous Overcurrent elements with settable time delay: 50TP, 50TN
- Phase, Neutral, and Negative Sequence Time Overcurrent elements: 46, 51P, 51N, 151N
- Phase overcurrent element (51P) includes capability of voltage restraint or voltage control.
- Internally calculated phase residual, 3I0, available on all relays. Optional independent ground input available. Neutral overcurrent elements (50TN, 51N, 151N) monitor either ground or calculated residual.
- Negative sequence overcurrent element (46) includes algorithm for timing based on generator K factors or may use standard TOC curves.
- All U.S. and IEC timing curves plus user programmable curve.
- Phase Undervoltage and Overvoltage elements: 27P, 127P, 59P, 159P. Elements use a 1 of 3, 2 of 3, or 3 of 3 logic, and monitor either line-line or line-ground voltages.
- Auxiliary Undervoltage and Overvoltage elements: 27X, 127X, 59X, 159X. Elements monitor either fundamental or third harmonic on the optional auxiliary 4th VT input, or fundamental phase residual, 3V0, of the phase inputs.
- Negative Sequence Overvoltage element: 47
- Overexcitation, Volts per Hertz element: 24
- Four Under/Overfrequency elements: 81, 181, 281, 381
- Forward/Reverse Power: 32, 132
- Loss of Excitation (offset sloped VAR flow algorithm): 40Q, 140Q
- Breaker Failure protection function: BF
- 4 general purpose logic timers: 62, 162, 262, 362
- Inadvertent energization protection using 50 elements supervised by 81 and/or 27 elements
- 100% stator ground fault protection using auxiliary voltage elements for ground overvoltage and 3rd harmonic ground undervoltage
- Sync check and/or dead bus close supervision 25, 27X (Requires optional 4th VT sensing circuit)
- Programmable Logic using BESTlogic
- Two protection settings group controllable via relay logic, 43 Aux switches, and hardwired inputs. Setting group selection may control tripping logic.
- Fuse loss detection (60FL) protects against false trip due to loss of voltage sensing.

CONTROL

- Virtual breaker control switch—controllable from both HMI and com. ports: 101
- Four virtual selector switches—controllable from both HMI and com. ports: 43, 143, 243, 343
- Communication port control of 101 and #43 switches allows for SCADA control of relay and breaker.

INSTRUMENTATION

- Real time A, B, C phase current, voltage; frequency; and derived neutral and negative sequence current and voltage.
- Real Time 3 phase Watts, VARs, and Power Factor.

REPORTS

- Current demands for phase, ground, and negative sequence currents, and forward and reverse Watts and VARs—magnitudes and time stamps are recorded for today's peak, yesterday's peak, and peak since reset.
- kWh and kVARh, forward and reverse
- Breaker operations counter and contact interruption duty. Breaker operate time also available.

FAULT RECORDING

- 255 event sequence of events report with I/O and alarm sub-reports
- Fault Reporting; 1 or 2 oscillography records per fault report
- 16 fault summary reports; two most recent Fault Summary Records saved to non-volative memory
- Total number of fault and oscillography records settable from 6 to 16
- Total of 240 cycles oscillography memory @ 12 samples/cycle
- COMTRADE format

COMMUNICATION PORTS

- Three independent general purpose communication ports
  - Front RS-232 ASCII communications
  - Rear RS-232 ASCII communications
  - Rear RS-485 ASCII, Modbus®, DNP®3.0, and TNP protocols
- IRIG-B time sync (unmodulated)

SELF TEST AND ALARM FUNCTIONS

- Relay fail, major alarm, and minor alarm LEDs, and fail-safe alarm output contact.
- Extensive internal diagnostics monitor all internal functions of the relay.
- More than 20 additional alarm points—programmable for major or minor priority including:
  - User defined logic state alarms that may be associated with any user specified relay logic state or relay protective element status.
  - Phase current, and forward and reverse Watt and VAR demand alarm.
  - Neutral and negative sequence unbalance demand alarms.

FEATURES, continued

- Three breaker alarm points programmable for slow trip, interruption duty threshold, or operations counter.
- Trip circuit voltage and continuity monitor.

PROGRAMMABLE I/O

- Four programmable inputs.
- Five programmable outputs and one dedicated programmable alarm output.

HARDWARE FEATURES

- Three case configurations
  - S1: Basler/GE style (with test plug)
  - S1 Double ended: Basler/GE style (with test plug)
  - H1: Half Rack
- Active CT technology for low burden and increased dynamic range.
- Flash Memory for upgrading embedded programming without changing chips.
- Real Time Clock with 8 hour capacitor ride through and optional battery backup.
- Integral HMI with 2x16 character display and keypad for editing settings and resetting targets and alarms.
- Wide range ac/dc power supply options provide long hold up time to ride through dips on power source. (100 ms with 4 output relays energized, upon complete loss of source. Starting voltage 125Vac for Option 1 (48/125Vac/dc) and 250Vac for Option 2 (125/250Vac/dc))
- Automatically adjusts sampling rate for sensed line frequency over the range of 10-75 Hz to provide high accuracy of protective elements over a wide operating range.

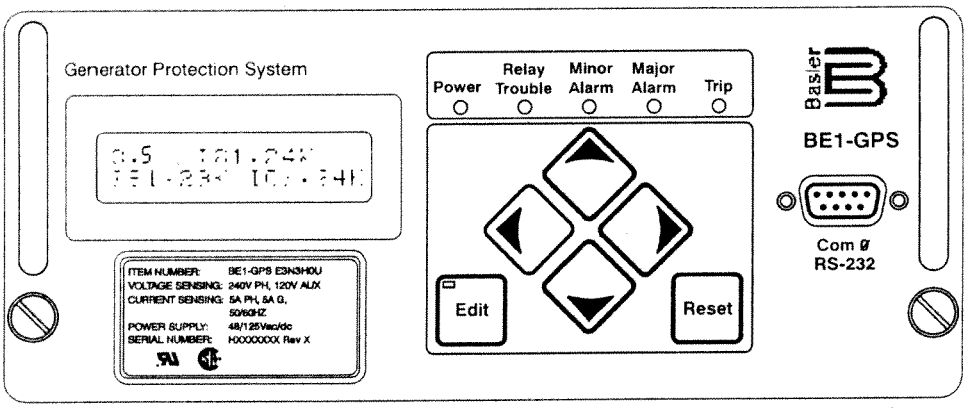


Figure 1 - Advanced HMI (Human Machine Interface)

APPLICATIONS

The BE1-GPS100 Generator Protection System provides three phase, ground, and negative sequence overcurrent, voltage, frequency, reverse power, loss of excitation, volts per hertz, and sync check protection and is intended for use in any generator protection application. Its unique capabilities make it ideally suited for applications with the following requirements:

- Applications that require the flexibility provided by wide setting ranges, multiple setting groups, multiple coordination curves, and an extremely versatile programmable logic, in one unit.
- Applications that require the economy and space savings provided by a multifunction unit. This one unit can provide all of the protection, control, metering, and local and remote indication functions required in many typical units.
- Retrofit applications requiring the features and functions of the GPS-100 in an S1 case.
- Applications where the small size and limited behind-panel projection facilitates modernizing protection, metering, and control systems in existing substations.
- Applications that wish to have the protection redundancy provided by having differential relaying in an independent protective relaying package.
- Applications that require communications and protocol support.
- Applications where drawout construction is desirable.
- Applications that require high accuracy across a wide frequency range.
- Applications where the capabilities of intelligent electronic devices (IEDs) are used to decrease relay and equipment maintenance costs.

FUNCTIONAL DESCRIPTION

The BE1-GPS100 is a multifunction, numerical relay that provides a comprehensive mix of protective functions to detect generator faults and abnormal operating conditions along with control and metering functions in an integrated system. This system is suitable for any generator application and many utility/cogeneration facility intertie applications. Twelve sample per cycle digital signal processing, with frequency compensation, extracts the fundamental component for high accuracy with distorted waveforms and at off-nominal frequency operation.

The unit has one set of three phase current and voltage sensing inputs to provide all common protective functions except generator differential, 87G (which, provided as a separate relay, prevents the "all your eggs in one basket" pitfall). The voltage sensing circuits automatically configure themselves internally for 1 phase, 3 phase 3 wire, or 3 phase 4 wire VT circuits. An optional 4th auxiliary voltage input is available for either generator ground sensing or bus voltage sensing.

The BE1-GPS100 can also be ordered with an optional independent ground current input, typically used for application with a separate ground CT such as a flux balancing window CT or to provide ground backup protection for the generator step up transformer.

The S1 and half rack cases are fully drawout with current circuit shorting provisions. Two Basler Electric half rack IEDs (Intelligent Electronic Devices) such as primary and backup BE1-GPS100s or the BE1-851 or -951 Overcurrent Protection Systems can be dovetailed together to mount in a standard 19" equipment rack with no special mounting hardware. Replacing an obsolete GE or Westinghouse single function relay with a GPS-100 in an S1 case upgrades existing protection and monitoring without having to cut the panel.

Three independent communications ports, along with built-in support for Modbus® and other common protocols, provide easy access to integrating the protection, control, metering, and status monitoring functions into a substation automation system. The standard IRIG-B port provides time synchronization from a master clock.

Real time metering provides Watt, Watt-hour, VAR, VAR-hour, voltage, amp, and unbalance loading telemetry for the protected circuit. Contact sensing inputs and alarm monitoring functions provide real time status information. Remote control is provided by virtual control and selector switches with select-before-operate control of programmable outputs.

BESTlogic

BESTlogic programmable logic provides the user with high flexibility in configuring a protection and control system.

Each of the protection and control functions in the BE1-GPS100 is implemented as an independent function block that is equivalent to its single function, discrete device counterpart. Each independent function block has all of the inputs and outputs that the discrete component counterpart might have. Figures 8A and 8B show each of the independent function blocks available for use in the BE1-GPS100 and their associated logic I/O. Programming BESTlogic is equivalent to choosing the devices required by your protection and control scheme and drawing schematic diagrams to connect the logic inputs and outputs to obtain the desired operational logic.

The BE1-GPS100 relay can store, as user settings, one user programmable, custom logic scheme. To save you time and provide guidance, preprogrammed logic schemes have also been provided. Any of the preprogrammed schemes can be copied into the logic settings, then modified to the application's needs. User-programmable variable and virtual switch names make relay event reports user-friendly.

BESTlogic provides the protection engineer with the flexibility to set up this powerful multifunction system with the same freedom that was once enjoyed with single function, discrete devices. It is no longer necessary to compromise your standard protection and operating practices to work within the limitations in programmability of previous multifunction devices.

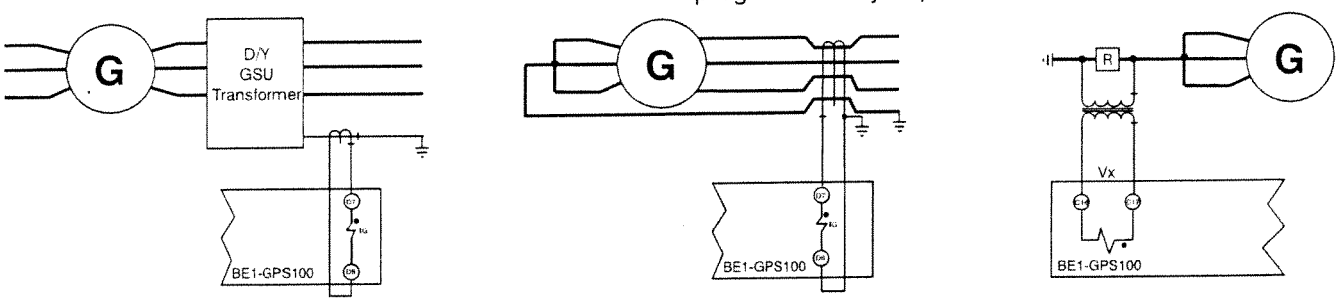
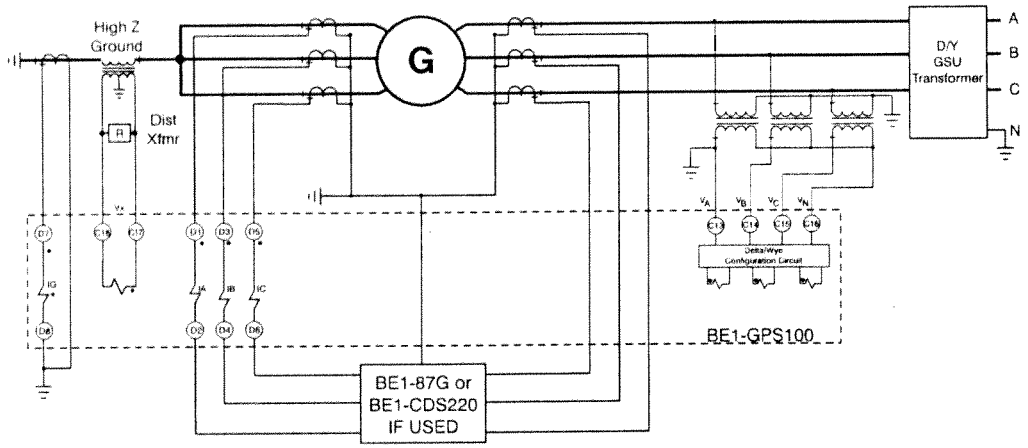


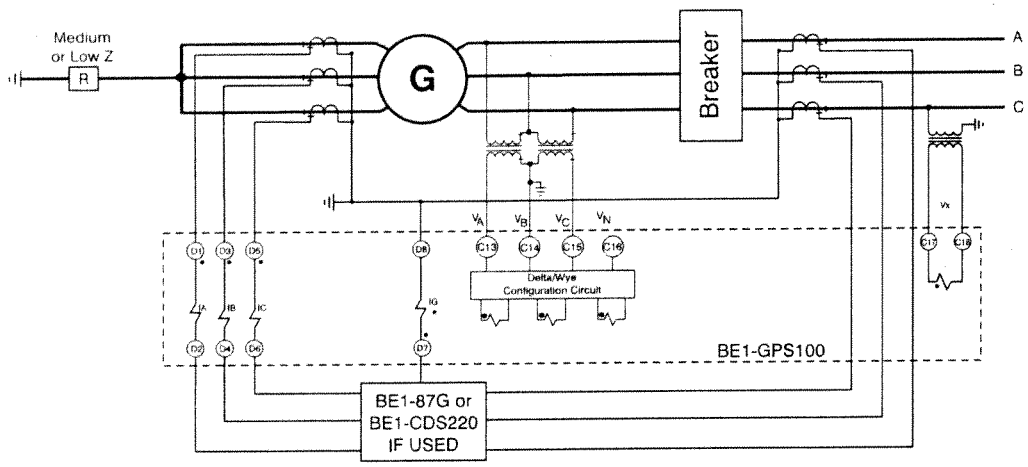
Figure 2A - Typical Alternate Connections for Vx and IG

FUNCTIONAL DESCRIPTION, continued



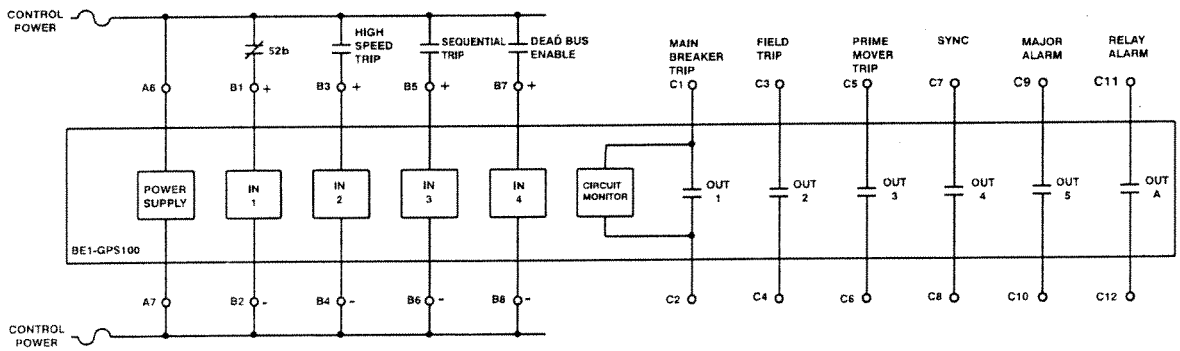
* Independent Ground input is optional.

Figure 2B - Typical External Sensing Connections, with Vx and IG Used for Stator Ground Fault



* Independent Ground input is optional.

Figure 2C - Typical External Sensing Connections, with Vx Used for Sync Check and IG Used for Ground Differential Overcurrent



NOTES:

1.) CONNECTIONS SHOWN ARE FOR USE WITH PRE-PROGRAMMED LOGIC SCHEME LZ-W-25. LZ-W-25 PROVIDES LOW IMPEDANCE GROUNDED GENERATOR PROTECTION WITH SEQUENTIAL TRIP AND SYNC CHECK LOGIC. ALL INPUTS AND OUTPUTS ARE FULLY PROGRAMMABLE USING BESTlogic.

Figure 3 - Typical External Connections

FUNCTIONAL DESCRIPTION, continued

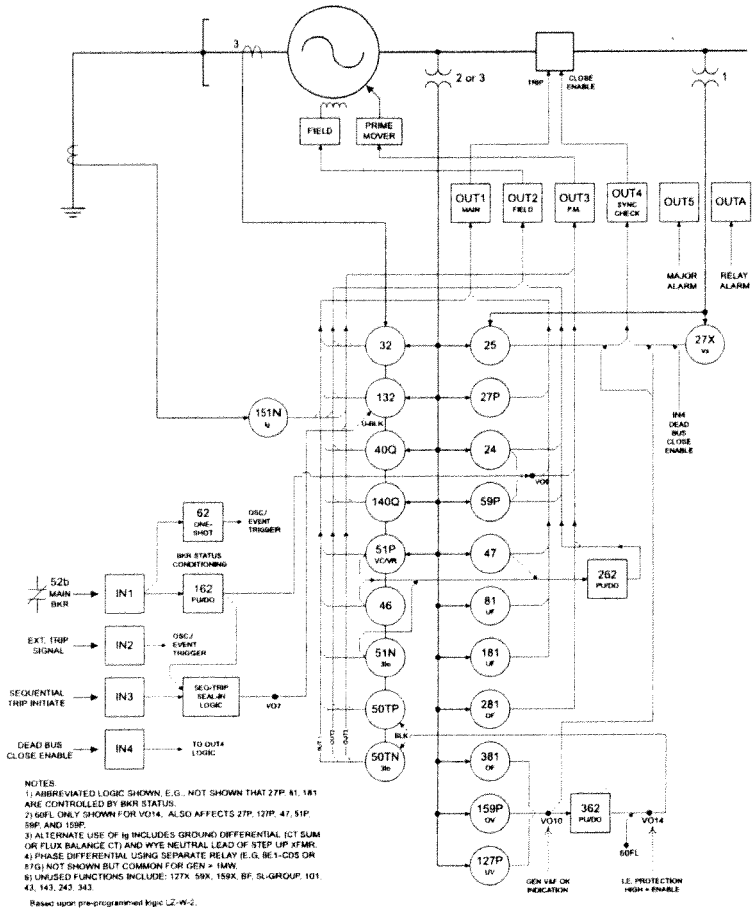


Figure 4 - Typical Application, Single Line

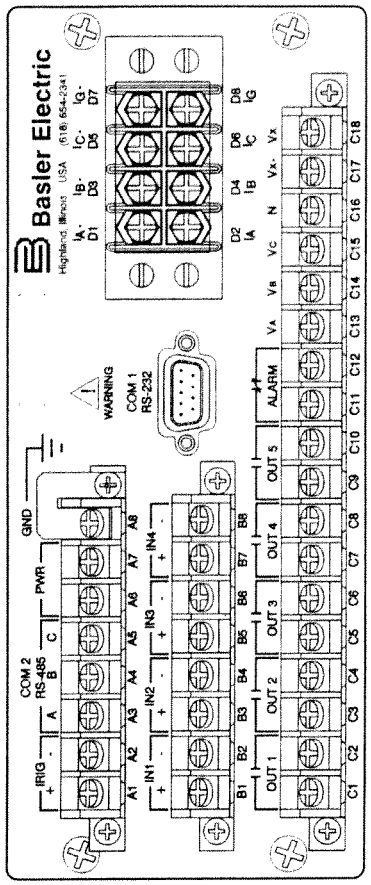


Figure 5 - BE1-GPS100 Rearl Panel Connections

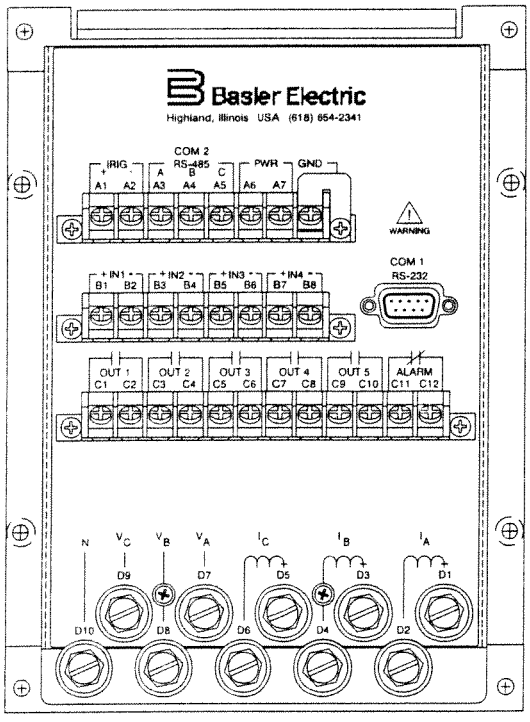


Figure 6 - BE1-GPS100 S1 Rear Panel Connections

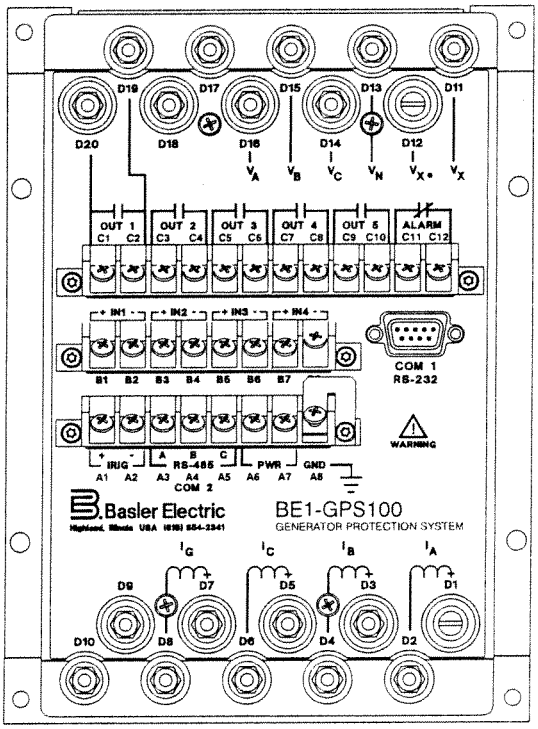


Figure 7 - BE1-GPS100 S1 Double-Ended Rear Panel Connections

GENERAL SPECIFICATIONS

5 Amp CURRENT INPUTS

Continuous rating:	20A
One Sec. Rating:	400A
Saturation limit:	150A
Burden:	<10milliohms

1 Amp CURRENT INPUTS

Continuous rating:	4A
One Sec. rating:	80A
Saturation limit:	30A
Burden:	<22milliohms

PHASE AC VOLTAGE INPUTS

Continuous:	300V, Line to Line
One Sec. rating:	600V, Line to Neutral
Burden:	Less than 1VA @ 300Vac

AUXILIARY AC VOLTAGE INPUT

Continuous:	150V
One Sec. rating:	600V
Burden:	Less than 1VA @ 150Vac

A/D CONVERTER

Sampling Rate:	12/cycle, adjusted to input frequency 10-75Hz

POWER SUPPLY

Option 1:	DC range 35 - 150V AC range 55 - 135V
Option 2:	DC range 90 - 300V AC range 90 - 270V
Option 3:	DC range 17 - 32V (down to 8V for momentary dips)
Burden:	6 watts continuous, 8 watts maximum with all outputs energized

TRIP CONTACTS

Make and carry:	30A (0.2sec)
Continuous:	7A
Break:	0.3A DC (L/R=0.04)

CONTROL INPUTS

Wetting voltage range: Same as control power supply option.

Power Supply Option	Low Range		High Range	
	Turn-on Voltage Range	Burden	Turn-on Voltage Range	Burden
1) 48/125Vac/Vdc	26-38V	13k ohms	69-100V	24k ohms
2) 125/250Vac/Vdc	69-100V	25k ohms	138-200V	54k ohms
3) 24Vdc	5-8Vdc	7k ohms	N/A	N/A

Control inputs recognize both DC and AC voltages.

COMMUNICATION PORTS

Response time:	<100mSec for metering and control functions
Baud rate:	300 - 19200

ELECTRICAL ENVIRONMENT

- IEEE C37.90-1989 Standard for Relays and Relay Systems Associated with Electric Power Apparatus
- IEC 255-5 Insulation Test for Electrical Relays Impulse and Dielectric Strength (2000Vac at 50/60Hz)
- IEEE C37.90.1-1989 Standard Surge Withstand Capability Tests for Relays and Relay Systems Associated with Electric Power Apparatus
- IEC 255-22-1 1MHz Burst Disturbance Tests for Electrical Disturbance Tests for Measuring Relays and Protection Equipment
- EN 61000-4-4 Electrical Fast Transient/Burst Immunity Test
- EN 61000-4-3 Radiated, Radio-frequency, Electromagnetic Field Immunity Test
- Type tested using a 5-watt, hand-held transceiver in the ranges of 144 and 440MHz with the antenna placed within 6 inches of the relay.
- IEEE C37.90.3 (Jan. 01) Draft Standard Electrostatic Discharge Tests for Protective Relays
- EN 61000-4-2 Electrostatic Discharge Immunity Test

MECHANICAL ENVIRONMENT

- Operating temperature range: -40°C to 70°C* (-40°F to 158°F)
  *LCD Display is inoperative below -20°C.
- Storage temperature range: -40°C to 70°C (-40°F to 158°F)
- Humidity: Qualified to IEC 68-2-38, 1st Edition 1974, Basic Environmental Test Procedures, Part 2: Test Z/AD: Composite Temperature Humidity Cyclic Test
- Qualified to IEC 255-21-1 (Class 1) Vibration Tests for Electrical Relays
- Qualified to IEC 255-21-2 (Class 1) Shock and Bump Tests for Electrical Relays

CERTIFICATIONS

UL Recognized, File E97033
CSA Certified, File LR23131
DNP 3.0 IED Certified, Subset Level 2, 6/20/00, by SUBNET Solutions, Inc.

CASE SIZE

H1: 10.50"W x 3.47"H x 9.10"D with mounting flanges (8.5"W without mounting flanges)
S1: 6.65"W x 9.32"H x 9.51"D
S1 double ended: 6.65"W x 9.32"H x 9.51"D (includes relay cover)

SHIPPING WEIGHT

H1: Approx. 10 pounds
S1: Approx. 11.2 pounds
S1 double-ended: 12.8 pounds

WARRANTY

7 years

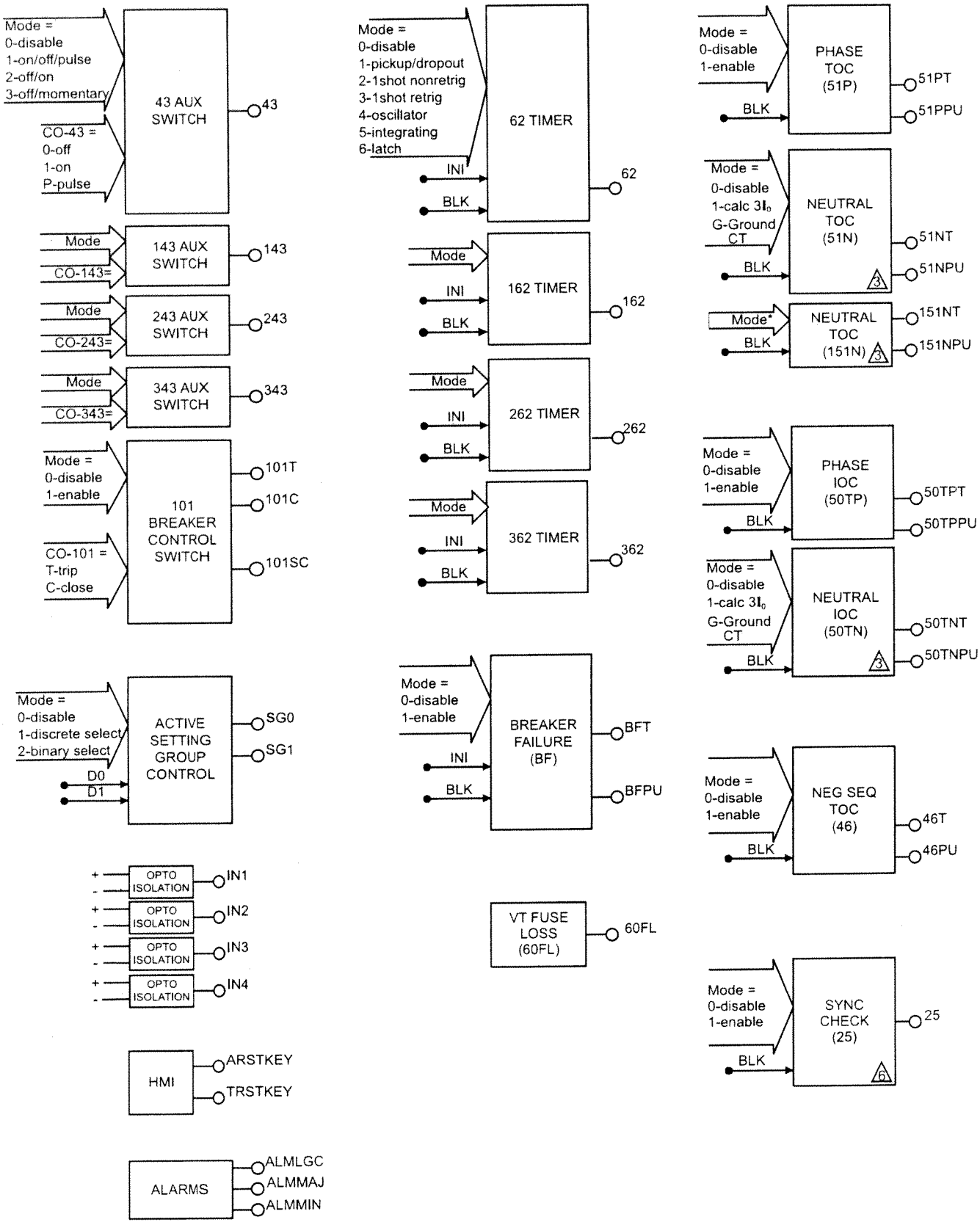
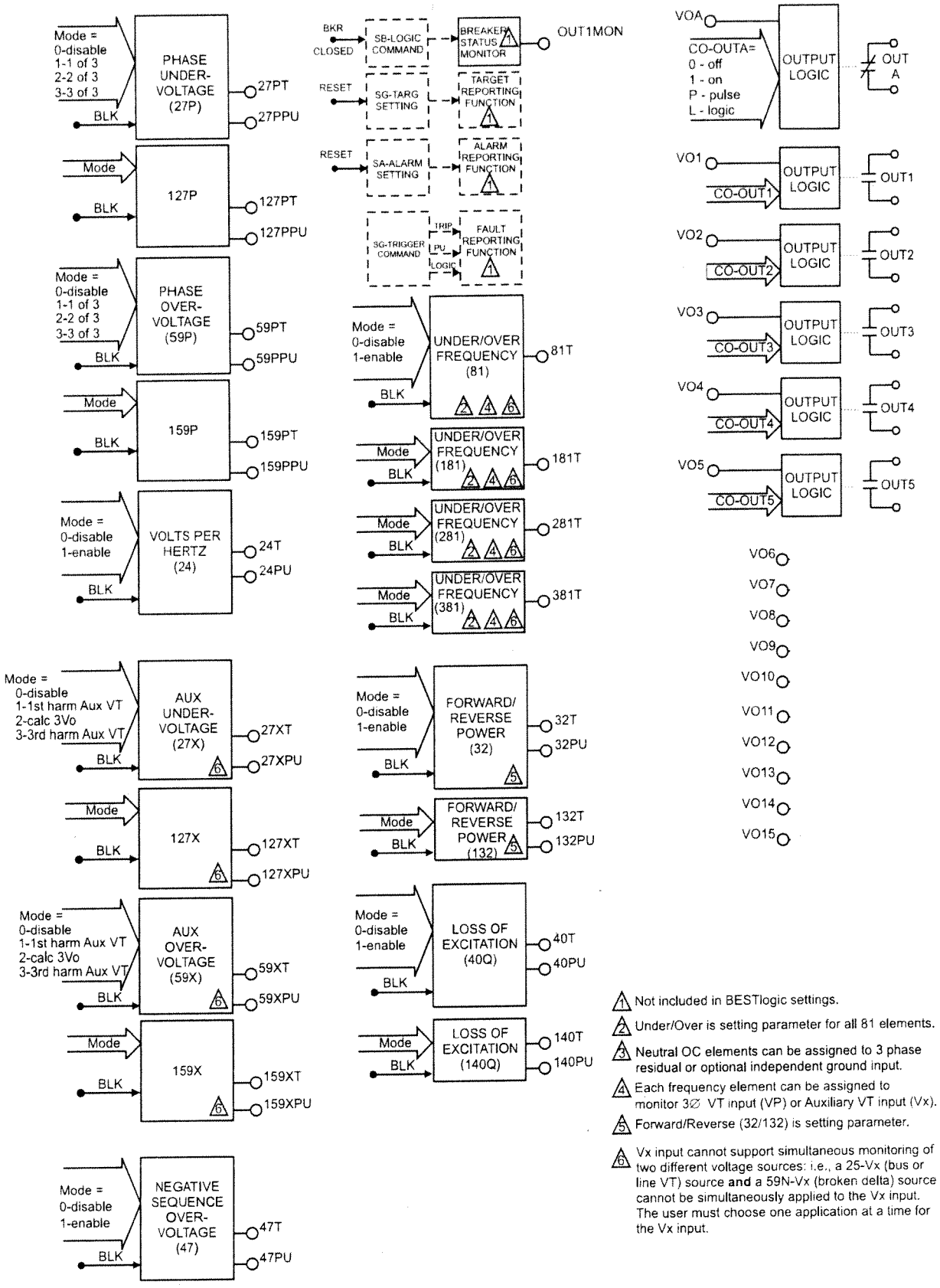


Figure 8A - BESTlogic Function Blocks



1 Not included in BESTlogic settings.

2 Under/Over is setting parameter for all 81 elements.

3 Neutral OC elements can be assigned to 3 phase residual or optional independent ground input.

4 Each frequency element can be assigned to monitor 3∅ VT input (VP) or Auxiliary VT input (Vx).

5 Forward/Reverse (32/132) is setting parameter.

6 Vx input cannot support simultaneous monitoring of two different voltage sources: i.e., a 25-Vx (bus or line VT) source **and** a 59N-Vx (broken delta) source cannot be simultaneously applied to the Vx input. The user must choose one application at a time for the Vx input.

Figure 8B - BESTlogic Function Blocks

PERFORMANCE SPECIFICATIONS

INSTANTANEOUS OVERCURRENT WITH SETTABLE DELAY (50TP, 50TN)

Pickup: 5A CT 0.5 - 150.0A
1A CT 0.1 - 30.0A

PU time with TD=0.000 Sec
2 cyc for P&G @ 5 x PU
3 cyc for N&Q @ 5 x PU

Delay time: 0.000 - 60 sec

Time Accuracy: ±0.5% or ±½ cyc for P & N
±0.5% or ±1 cyc for Q

TIME OVERCURRENT (51P, 51N, 151N)

Pickup: 5A CT 0.5 - 16.0A
1A CT 0.1 - 3.20A

Time dial: TD=K=0 - 99 for 46 curve
TD=0.0 - 9.9 for all other curves

Time-Current Characteristics:

The following expression describes the inverse time current characteristic for each curve:

$$T_T = \frac{AD}{M^N - C} + BD + K = \text{Time to trip}$$

$$T_R = \frac{RD}{M^2 - 1} = \text{Time for decaying reset}$$

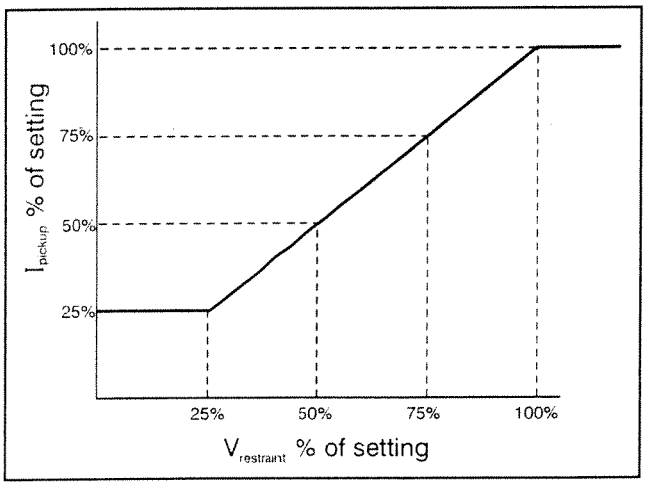
where D = Time dial, M = Multiple of PU and A, B, C, N, K and R are constants that govern the shape of each curve. The protection engineer can set the constants for the P (programmable) curve to achieve virtually any characteristic.

51P VOLTAGE CONTROL (27R)

Control Modes: Uncontrolled, voltage controlled, voltage restrained.

Control/Restraint Range: 30 - 250V

Restrained Mode Characteristic: (see below)



Curve Type	Constants					
	A	B	C	N	K	R
S1	0.2663	0.03393	1.000	1.2969	0.028	0.5000
S2	0.0286	0.02080	1.000	0.9844	0.028	0.0940
L1	5.6143	2.18592	1.000	1.000	0.028	15.750
L2	2.3955	0.00000	1.000	0.3125	0.028	7.8001
D	0.4797	0.21359	1.000	1.5625	0.028	0.8750
M	0.3022	0.12840	1.000	0.5000	0.028	1.7500
I1	8.9341	0.17966	1.000	2.0938	0.028	9.0000
I2	0.2747	0.1042	1.000	0.4375	0.028	0.8868
V1	5.4678	0.10814	1.000	2.0469	0.028	5.5000
V2	4.4309	0.0991	1.000	1.9531	0.028	5.8231
E1	7.7624	0.02758	1.000	2.0938	0.028	7.7500
E2	4.9883	0.0129	1.000	2.0469	0.028	4.7742
A	0.01414	0.00000	1.000	0.0200	0.028	2.0000
B	1.4636	0.00000	1.000	1.0469	0.028	3.2500
C	8.2506	0.00000	1.000	2.0469	0.028	8.0000
G	12.1212	0.00000	1.000	1.000	0.028	29.000
F	0.0000	1.00000	0.000	0.0000	0.028	1.0000
46	*	0	0	2	0.028	100
P	0 to 600	0 to 25	0 to 1	.5 to 2.5	0.028	0 to 30

S1, S2 = CO Short Inv, IAC Short Inv
L1, L2 = CO Long Inv, IAC Long Inv
D = CO Definite Time
M = CO Moderately Inverse
I1, I2 = CO Inverse, IAC Inverse
V1, V2 = CO Very Inv, IAC Very Inv
E1, E2 = CO Ext Inverse, IAC Ext. Inverse
A = IEC Standard Inverse
B = IEC Very Inverse
C = IEC Extremely Inverse
G = IEC Long Time Inverse
F = Fixed Time
46 = Negative Sequence Overcurrent
P = Programmable

* Constant A is variable for the 46 curve and is determined as necessary based on generator full load current, minimum pickup, and K factor settings.

NEGATIVE SEQUENCE OVERCURRENT (46)

Pickup: 5A CT 0.1-16.0A
1A CT 0.02 - 3.20A

Time dial: TD=K=0 - 99 for 46 curve
TD=0.0 - 9.9 for all other curves

Time-Current Characteristics: Same curves as 51 elements

BREAKER FAILURE (BF)

Time: 50 - 999mSec

Dropout: 5A CT 0.5A
1A CT 0.1A

Time Accuracy: ±0.5% or +1¼ cyc / -½ cyc

VOLTS/HZ (24)

Pickup: 0.5 - 6V/Hz

Delay Time: Inverse Squared Curve

$$T_T = \frac{D_T}{(M-1)^2} \qquad T_R = D_R \times \frac{ET}{FST} \times 100$$

T_T = Time to Trip
T_R = Time to Reset
D_T = Time Dial, Trip
D_R = Time Dial, Reset

$$M = \frac{\text{Actual V/Hz}}{\text{Pickup V/Hz}}$$

ET = Elapsed Time
FST = Full Scale Trip Time (T_T)

PERFORMANCE SPECIFICATIONS, continued

SYNC CHECK (25)

Delta Phase Angle:	1 - 25 degrees
Delta Voltage Magnitude:	1 - 20V
Delta Frequency:	0.01 - 0.50Hz

PHASE OVER/UNDERVOLTAGE (27P, 127P, 59P, 159P)

Mode:	1 of 3; 2 of 3; 3 of 3
Pickup:	10.0-300V_{L-L} or 10.0-300V_{L-N}
Delay Time:	0.050 - 600sec.

NEGATIVE SEQUENCE OVERVOLTAGE (47)

Pickup:	1.0 - 300V_{L-N}
Delay Time:	0.050 - 600sec.

AUXILIARY / 3V0 OVER/UNDERVOLTAGE (27X, 127X, 59X, 159X)

Mode:	Fundamental V_X, Phase 3V0, 3rd Harmonic V_X
Pickup:	1.0 - 150V
Delay Time:	0.050 - 600 Sec.

FREQUENCY (81, 181, 281, 381)

Mode:	Over, Under
Pickup:	40.00 - 70.00 Hz
Delay Time:	0.000 - 600 Sec.
Time Accuracy:	±0.5% or +1 cyc / -0 cyc

(Min. trip time affected by minimum 3 cyc security count)

POWER (32, 132)

Mode:	Forward, Reverse
Pickup:	5A: 1.0 - 6000 Watts, 3 ph
	1A: 1.0 - 1200 Watts, 3 ph
Pickup Accuracy:	±3%
Delay Time:	0.050 - 600 Sec.

UNDEREXCITATION (40Q, 140Q)

Pickup:	5A: 1.0 - 6000 VARs, 3 ph
	1A: 1.0 - 1200 VARs, 3 ph
Pickup Accuracy:	±3%
Delay Time:	0.050 - 600 Sec.

GENERAL PURPOSE LOGIC TIMERS (62, 162, 262, 362)

Mode:	PU,DO
	1 Shot, Non-Retrig.
	1 Shot, Retrig.
	Integrating
	Latch
T1 and T2 Delay TIme:	0.000 - 9999 Sec.
Time Accuracy:	±0.5% or ±¾ cyc

CURRENT PICKUP ACCURACY (All 46, 50 and 51)

Phase and Ground:	5A	2% or 50mA
	1A	2% or 10mA
Neutral and Negative Sequence:	5A	3% or 75mA
	1A	3% or 75mA

VOLTAGE PICKUP ACCURACY (All 27, 47 and 59)

±2% or ±0.5V

DEFINITE TIME ACCURACY UNLESS OTHERWISE STATED (All 27, 32, 40Q, 47 and 59)

Definite Time Accuracy: ±0.5% or ±1 cyc

SETTING GROUPS

Setting Groups:	2
Control Modes:	External: Discrete input logic; Binary: Input logic

METERING

Current Range:	5A	0.5 to 15.0
	1A	0.1 to 3.0
Current Accuracy:	±1%	
Phase Voltage Range:	3W	0 - 300 V_{L-L}
	4W	0 - 300 V_{L-L}
		0 - 173 V_{L-N}
Phase Voltage Accuracy:	±0.5% for 50V<V_{L-L}<300V	
Auxiliary Voltage Range:	0 - 150V	
Auxiliary Voltage Accuracy:	±0.5% for 50V<V<150V	
Watt/VAR:	5A	0 to ±7500
	1A	0 to ±1500
Watt Accuracy:	1% @ Unity PF	
VAR Accuracy:	1% @ Zero PF	
Energy:	0 to ±1.0E12 (F/R registers)	
Frequency:	10 - 75Hz	
Frequency Accuracy:	0.01Hz	

DEMANDS (IA, IB, IC, IN, IQ, Fwd Watts, Rvs Watts, Fwd VARs, Rvs VARs)

Demand Interval:	1 - 60 min.
Demand Mode:	Thermal

BREAKER MONITORING

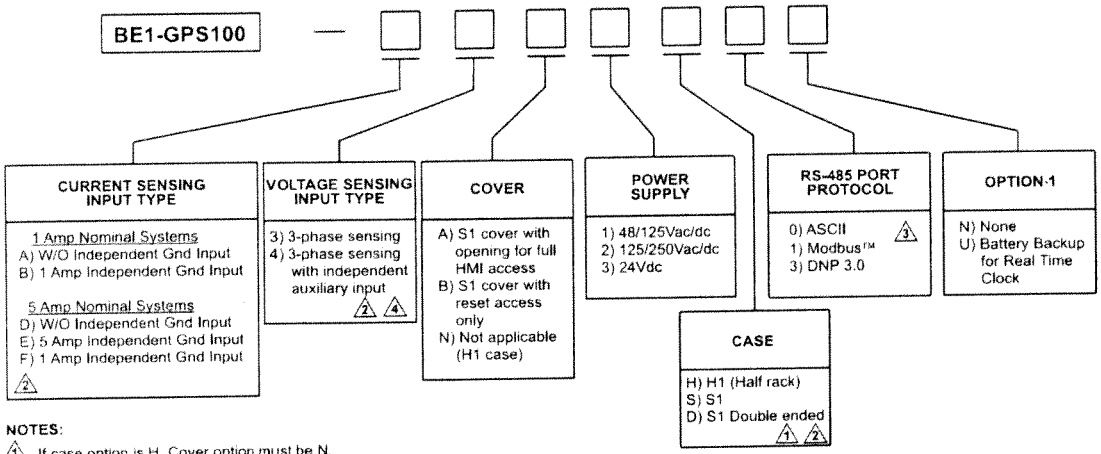
Duty Mode:	I or I^2
Duty Alarm Range:	0 - to 100%
Op Counter Alarm Range:	0 - 99999
Trip Time Alarm Range:	20 - 1000mSec

ORDERING

SAMPLE STYLE NUMBER

The style number identification chart defines the electrical characteristics and operation features included in BE1-GPS100 relay. If the style number were **BE1-GPS100 E3N1H0U**, the device would have the following:

- **(E)** - 5 Amp nominal system with 5 Amp Independent Ground Input
- **(3)** - Three phase voltage sensing
- **(N)** - Not applicable
- **(1)** - 48/125Vac/Vdc power supply
- **(H)** - Half Rack drawout case
- **(0)** - ASCII Communications
- **(U)** - Battery backup for real time clock



NOTES:

1. If case option is H, Cover option must be N.
2. Case option must be H or D for Current Sensing Input Type B, E, or F or voltage sensing option to be 4.
3. ASCII communication is standard on Com0 (front RS-232) and Com1 (rear RS-232) ports.
4. Aux VT input adds 25 Sync-Check option (case option H or D).

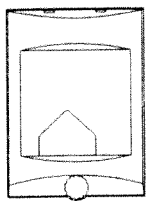


Figure 9A Cover option A.

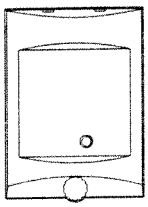
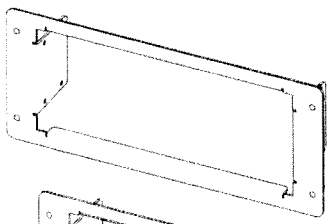


Figure 9B Cover option B.

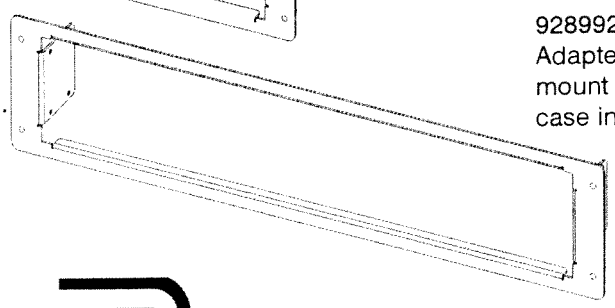
STANDARD ACCESSORIES

9334818100 Battery Backup Replacement kit (if "U" is chosen for Option 1)
9180400108 H1 Test Case with 1 CT Terminal Block and 18-position Bottom Terminal Block
9289922100 Test box to facilitate bench testing.
9108551021 Adapter plate to mount an S1 case in a GE S2 or Westinghouse FT-21 cutout.
9108550122 Adapter plate to mount an S1 case in a Westinghouse FT-32 cutout.

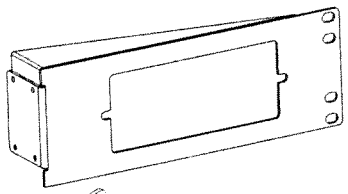
9289900017
Escutcheon plate to panel mount one H1 relay.



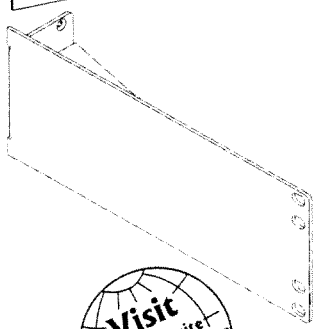
9289900016
Escutcheon plate to panel mount two dovetailed H1 relays.



9289929100
Adapter bracket with cutout for ABB FT test switch, to mount a single H1 case in a 19" rack.



9289924100
Adapter bracket to mount a single H1 case in a 19" rack.



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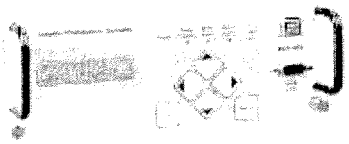

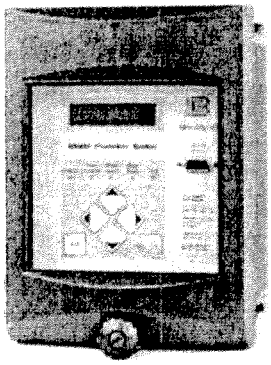

BE1-IPS100 INTERTIE PROTECTION SYSTEM

DEVICE FUNCTIONS

24	25	27	32
47	50	51	59
60	62	67	BF
79	81	DNP Option	Modbus RTU Option

The BE1-IPS100 is a multifunction numerical Intertie Protection System that meets protection and control requirements outlined in IEEE Intertie Protection Standard 1547-2003 for the majority of applications. The IPS100 relay provides three phase, ground, and negative sequence directional or non-directional time and instantaneous overcurrent protection with sync check and conditional voltage reclosing. Also included are single or three phase, forward or reverse, over or under power protection, breaker failure, over/under/rate of change frequency, over/undervoltage, overexcitation, and breaker monitoring and control, sequence-of-events recording, fault reporting, and metering functions, all in a compact integrated system.

ADVANTAGES

- Two sensitive, single or three phase, forward or reverse, over or under power elements for directional intertie power flow and islanding detection.
- Two phase over/under voltage elements for intertie voltage limits and islanding detection.
- Two neutral voltage elements for V_0 detection.
- Negative sequence voltage function for reverse phase rotation or single phasing detection.
- Six over/under frequency elements for over and under frequency intertie limits, islanding detection, and automatic load shed schemes.
- Six rate of change frequency elements for islanding detection that can be set for positive, negative, or "either" rate of change. Also used in load shed schemes.
- Multiple time and instantaneous overcurrent elements that can be individually set for forward or reverse directional or non-directional control for maximum flexibility in any application.
- Sync-check and conditional voltage reclosing.
- BESTlogic provides the user with complete flexibility in configuring a protection and control system. User programmable variable and switch names make these relays completely self-documenting.
- Programmable LCD display allows the relay to replace local indication and control functions, such as panel metering, alarm annunciation, and control switches.
- Three independent communication ports and support for several popular protocols allow integration with distributed control systems.
- Real Time Clock with 8-hour capacitor ride-through and optional battery backup.
- Available in fully drawout half-rack case. Two Basler Electric half-rack IEDs (Intelligent Electronic Devices) can be dovetailed together to mount in a standard 19-inch equipment rack with no special mounting hardware.
- Available in fully drawout S1 double-ended case with test paddles for retrofit applications. The S1 case, with available adapter plates, fits cutout, drilling and behind panel projection dimensions for common Basler Electric, GE and Westinghouse unit case relays.

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APPLICATIONS Page 3

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BESTlogic Pages 8 and 9

SPECIFICATIONS Pages 7, 10-11

ORDERING INFORMATION Page 12

WINDOWS® SOFTWARE

Interface for setting and communicating with Basler protection products

Request BESTCOMS for BE1-IPS100 (includes "settings compare" feature)

ADDITIONAL INFORMATION

INSTRUCTION MANUAL

Request publication 9365900990

MODBUS™ INSTRUCTION MANUAL

Request publication 9365900992

DNP 3.0 INSTRUCTION MANUAL

Request publication 9365900991

Basler Electric

P. O. BOX 269 HIGHLAND, ILLINOIS, U.S.A. 62249 PHONE 618-654-2341 FAX 618-654-2351

URB-6
7-07

FEATURES

PROTECTION

- 2 each Phase, Neutral, and Negative Sequence Instantaneous Overcurrent elements with settable time delay: 50TP, 150TP, 50TN, 150TN, 50TQ, 150TQ
- 1-Phase (see 151P note), 2-Neutral, and 1-Negative Sequence Time Overcurrent elements: Dual Mode 51P, or 51V (restrained or controlled), 51N, 151N, 51Q. *Note:* If 51P is set directional, a second pickup level (151P) can be set. Trip direction of the 151P is fixed opposite the 51P. See IPS100 instruction manual, Section 4, for details.
- Each overcurrent element can be set for forward, reverse, or nondirectional control (67P, 67N, 67Q). Directional control is by Positive (671), Negative (672), Zero Sequence Voltage (670V) and Zero Sequence Current (670I) polarized directional units.
- All U.S. and IEC timing curves plus user programmable curve
- Unique design minimizes transient overreach and overtravel on overcurrent elements
- Optional separate ground current input provides zero sequence current polarization and/or ground overcurrent protection for a separate ground CT.
- Phase Undervoltage and Overvoltage elements: 27P, 127P, 59P, 159P. Elements use a 1 of 3, 2 of 3, or 3 of 3 logic, and monitor either line-line or line-ground voltages. The 27P and 127P elements have an undervoltage inhibit setting.
- Auxiliary Undervoltage and Overvoltage elements: 27X, 59X, 159X. Elements monitor either fundamental or third harmonic on the auxiliary 4th VT input, or fundamental phase residual, 3V0, of the phase inputs. The 27X element has an undervoltage inhibit setting.
- Overexcitation, volts per Hertz element: 24 inverse and definite time.
- Single or Three phase, Forward or Reverse, Over or Under Power elements: 32/132
- Negative Sequence Overvoltage element: 47
- Over/Under/Rate of Change Frequency elements: 81, 181, 281, 381, 481, 581. Rate of change can be set for positive, negative, or either.
- Each 81 element can be assigned to monitor 3 phase VT input (VP) or Auxiliary voltage input (Vx).
- Breaker Failure protection function: BF
- Two general purpose logic timers: 62, 162
- Programmable Logic using BESTlogic
- Two protection setting groups with external or automatic (cold load pickup, load, and unbalance) selection modes
- Sync check with dead line/dead bus voltage monitor logic, 25, 25VM
- Fuse loss detection protects against false trip due to loss of voltage sensing: 60FL

CONTROL

- Four shot recloser with zone sequence coordination and sequence controlled protective element blocking functions
- Virtual breaker control switch—controllable from both HMI and com. ports: 101
- Two virtual selector switches—controllable from both HMI and com. ports: 43, 143.
- Communication port control of 101, 43, and 143 switches allows for SCADA control of relay and breaker

INSTRUMENTATION

- Real time A, B, C phase current, voltage, and frequency calculated neutral, positive, and negative sequence current and voltage, and angles for all quantities.
- Real Time per phase and 3 phase Watts, Vars, and 3 phase Power Factor

REPORTS

- Current demands for phase, neutral, and negative sequence currents, and forward and reverse watts and vars—magnitudes and time stamps are recorded for today's peak, yesterday's peak, and peak since reset
- Optional 4000 point log of demand readings
- kWh and kvarh, forward and reverse
- Breaker operations counter and contact interruption duty. Max. torque angle between the polarizing current and voltage is continuously adjustable between 0° and 90°.

FAULT RECORDING

- 255 event sequence of events report with I/O and alarm sub-reports
- Fault Reporting; 1 or 2 oscillography records perfault report
- 16 fault summary reports; two most recent Fault Summary Records saved to non-volatile memory
- Total number of oscillography records settable from 6 to 16
- Total of 240 cycles oscillography memory @ 12 samples/cycle
- COMTRADE format
- Load compensated distance to fault

COMMUNICATION PORTS

- Three independent general purpose communication ports
  - Front RS-232 ASCII communications
  - Rear RS-232 ASCII communications
  - Rear RS-485 ASCII, Modbus™ and DNP® 3.0 protocols
- IRIG-B time sync (unmodulated)

SELF TEST AND ALARM FUNCTIONS

- Relay fail, major alarm, and minor alarm LEDs, and fail-safe alarm output contact (closed or open)
- Extensive internal diagnostics monitor all internal functions of the relay
- More than 20 additional alarm points—programmable for major or minor priority
  Including:
  - Phase current, and forward and reverse watt and var demand alarm
  - Neutral and negative sequence unbalance demand alarms
  - Three breaker alarm points programmable for slow trip, interruption duty threshold, or operations counter
  - Trip circuit voltage and continuity monitor
  - Close circuit monitor via BESTlogic

FEATURES, continued

PROGRAMMABLE I/O

- Four programmable inputs
- Five programmable outputs and one dedicated programmable alarm output

HARDWARE FEATURES

- Two case configurations
  - S1: Double ended, Basler/GE style (with test plugs)
  - H1: Half Rack
- Active CT technology for low burden and increased dynamic range
- Flash Memory for upgrading embedded programming without changing chips
- Real Time Clock with 8 hour capacitor ride through and optional battery backup
- Integral HMI with 2x16 character display
- Wide range ac/dc power supply options provide long holdup time to ride through dips on ac power source. (100 ms with 4 output relays energized, upon complete loss of source.

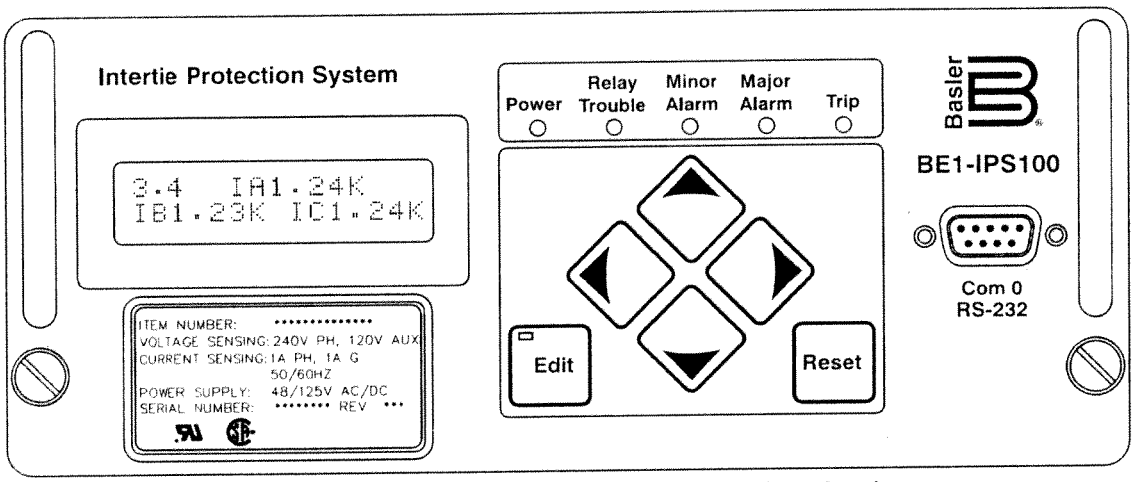


Figure 1 - Advanced HMI (Human Machine Interface)

APPLICATIONS

The BE1-IPS100 Intertie Protection System provides three phase, ground, and negative sequence overcurrent, voltage and frequency protection, including directional power, and is intended for use in intertie applications covered by IEEE 1547 or any directional or non-directional overcurrent protection application. Its unique capabilities make it ideally suited for applications with the following requirements:

- Intertie protection at the point of common coupling (PCC) between non-utility distributed generation (DG) and the electric utility/Area Electric Power System (Area EPS).
- Underfrequency load shed applications supervised, or tripped directly, by "True" Rate of Change frequency.
- Applications that require low burden to extend the linear range of CTs.
- Applications that require high accuracy across a wide frequency range such as for motor, generator, and generator step-up transformer protection or in intertie facilities.
- Applications that require the flexibility provided by wide setting ranges, multiple setting groups, and multiple coordination curves in one unit.
- Applications that require the economy and space savings provided by a compact multifunction, multiphase unit. This one unit can provide all of the protection, control, metering, and local and remote indication functions required on a typical circuit.
- Applications that require directional control with continuously adjustable angle of maximum torque.
- Applications that require fault locating.
- Transformer backup applications where overexcitation protection is required.
- Applications that require communications and protocol support.
- Applications where the capabilities of a digital multifunction relay are required, yet drawout construction is also desirable.
- Applications where bus protection is provided by a high speed overcurrent blocking scheme on the transformer bus mains instead of a dedicated bus differential circuit.
- Applications where the small size and limited behind-panel projection facilitates modernizing protection and control systems in existing substations or equipment.

FUNCTIONAL DESCRIPTION

The BE1-IPS100 is a multifunction, numeric relay system that provides a comprehensive mix of protective functions (IEEE 1547 compliant) to detect faults and abnormal operating conditions at the intertie point (PCC) between a DG and an electric utility, along with control and metering functions, in an integrated system. Additional features such as single or three phase dual forward/reverse over/under power (32/132), dual over/under voltage (27/59P, 127/159P), six over/under/rate of change frequency elements (81, 181...581), along with dual mode directional time overcurrent, directional instantaneous overcurrent protection, and sync check reclose with voltage conditions make this product ideal for intertie applications on distribution and subtransmission systems. Other protection applications would include feeder, transformer, generator, bus, and load shedding. Twelve sample per cycle digital signal processing with frequency compensation extracts the fundamental component for high accuracy with distorted waveforms and at off-nominal frequency operation.

The unit has one set of three phase current and voltage sensing inputs to provide all common pro-tective functions for substation and feeder applications. The voltage sensing circuits are configured internally for 1 phase, 3 phase 3 wire, or 3 phase 4 wire VT circuits.

The BE1-IPS100 also can be ordered with an optional independent ground current input, typically used for application with a separate ground CT such as a flux balancing window CT, or to provide ground backup protection for the neutral or tertiary of a transformer.

The fourth Auxiliary Voltage input can be connected to line side potential for sync check (25) and dead line (25VM) closing supervision or to a ground sensing VT connection for ground fault protection on the delta side of a cogeneration intertie transformer.

For directional applications, all overcurrent elements can be independently set for forward, reverse, or non-directional control. For directional applications, all overcurrent elements can be independently set for forward, reverse, or nondirectional control. *Note*: If 51P is set directional, a second pickup level (151P) can be set. The 151P includes separate user settings for PU, TD, and curve, but trip direction is fixed opposite the 51P. See the IPS100 instruction manual, Section 4, for details. The target reporting function in the BE1-IPS100 automatically adapts the targets as appropriate. For example, if the 150TP and the 51P functions are set for directional control, they post targets for an A phase fault as "167A" for directional instantaneous trip or "67TA" for directional time trip respectively. Directional control is by sequence directional elements. The zero sequence current polarized element uses the optional independent ground input for its polarization signal. The zero sequence voltage polarized element requires that the VT connection be 4W. The positive sequence directional element has memory voltage to provide reliable directional control for close in balanced three phase faults. The maximum torque angles, normally derived from the positive/negative and zero sequence line impedances, are continuously adjustable between 0 and 90 degrees.

Three independent communications ports, along with built-in support for DNP®3.0 or Modbus™ protocols, provide easy access to integrating the protection, control, metering, and status monitoring functions into a substation automation system. The standard IRIG-B port can provide time synchronization from a master clock.

Real time metering provides Watt, Watt-hour, VAR, VAR-hour, voltage, amp, and unbalance loading telemetry for the protected circuit. Contact sensing inputs and alarm monitoring functions provide real time status information. Remote control is provided by virtual control and selector switches with select-before-operate control of programmable outputs.

BESTlogic

BESTlogic programmable logic provides the user with high flexibility in configuring a protection and control system.

Each of the protection and control functions in the BE1-IPS100 is implemented as an independent function block that is equivalent to its single function, discrete device counterpart. Each independent function block has all the inputs and outputs that the discrete component counterpart might have. Figures 7A and 7B show each of the independent function blocks available for use in the BE1-IPS100. Programming BESTlogic is equivalent to choosing the devices required by your protection and control scheme and drawing schematic diagrams to connect the inputs and outputs to obtain the desired operational logic.

The BE1-IPS100 relay can store, as user settings, one user programmable, custom logic scheme. To save you time, a preprogrammed intertie logic scheme has also been provided. The preprogrammed scheme may be copied into the logic setting without making any additional BESTlogic settings or can be modified to meet the user's needs.

BESTlogic provides the protection engineer with the flexibility to set up this powerful multifunction system with the same freedom that was once enjoyed with single function, discrete devices. It is no longer necessary to compromise your standard protection and operating practices to deal with the limitations in programmability of previous multifunction devices.

Figures 2A, 2B, and 3 show typical external connections, and Figure 4 shows rear panel connections.

FUNCTIONAL DESCRIPTION, continued

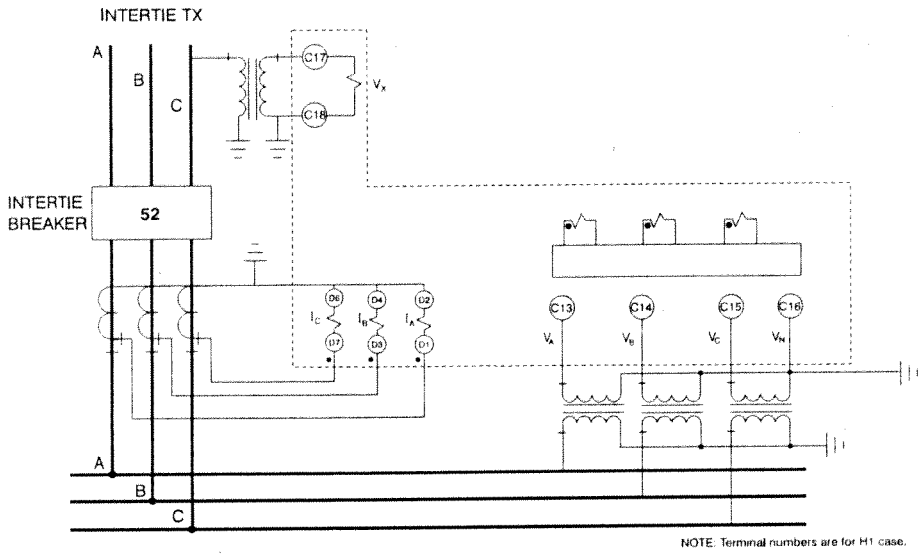


Figure 2A - Typical External Sensing Connections - Intertie Protection Application

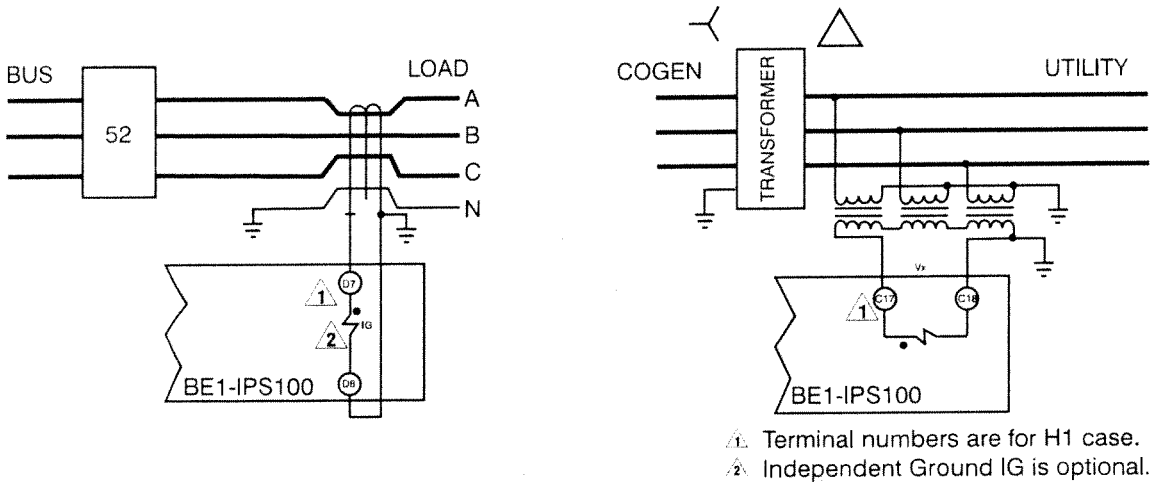
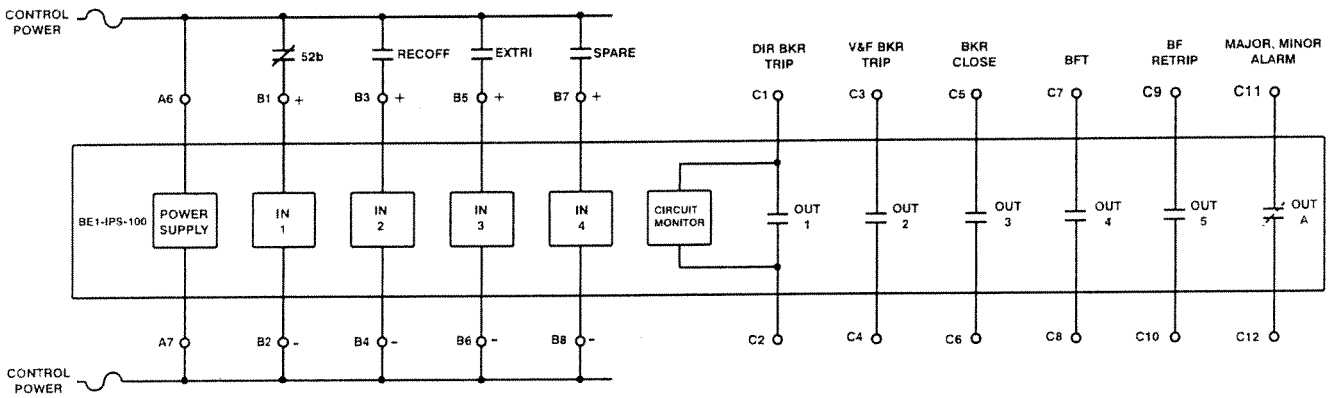


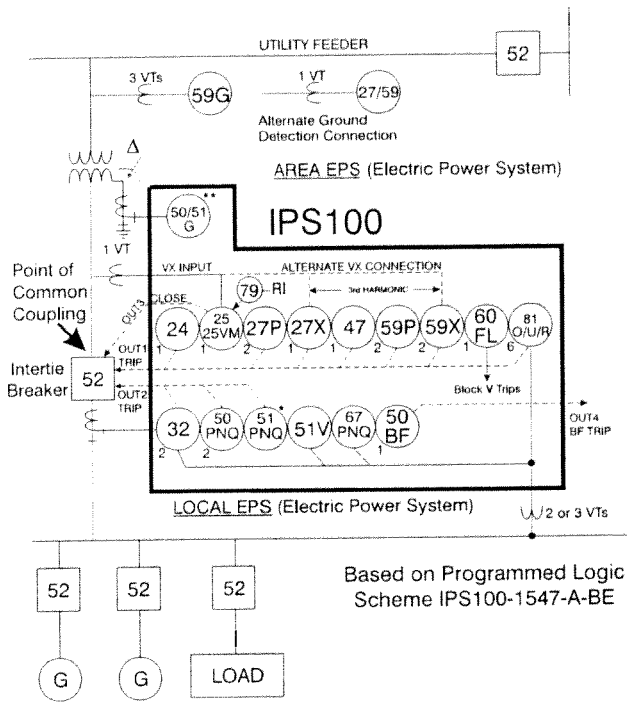
Figure 2B - Typical Alternate Connections for V_x and I_G



NOTE: Connections shown for BE1-IPS100-1547-A-BE Pre-programmed Logic Scheme

Figure 3 - Typical External Connections

FUNCTIONAL DESCRIPTION, continued



NOTE: ** One of two elements shown in BKR C.T. Circuit. Optional I_G Input.
* 1 - 51P, Q element, 2 - 51N elements.
To activate 151P setting, 51P element must be set directional.

Figure 4 - Typical Application Single Line

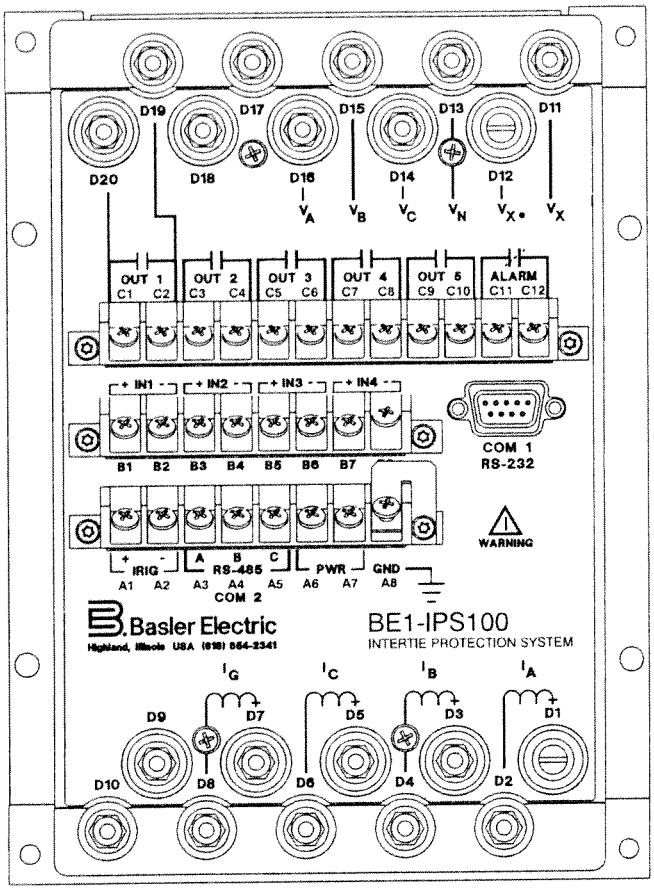


Figure 5 - S1 Double-ended Case, Rear Panel Connections

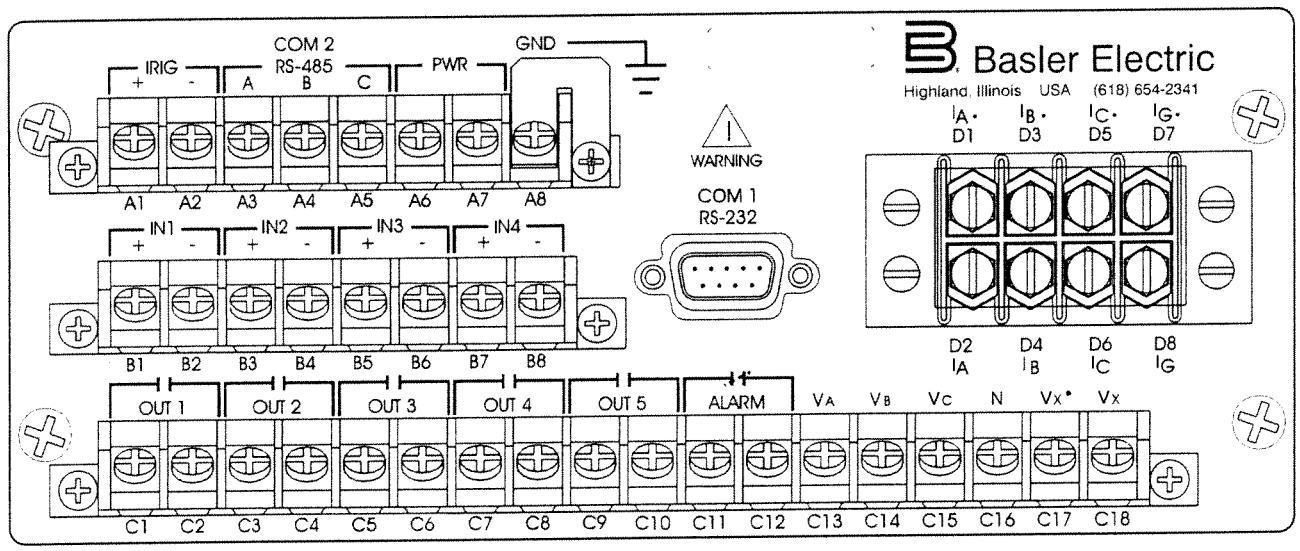


Figure 6 - H1 Rear Panel Connections

GENERAL SPECIFICATIONS

5 Amp CURRENT INPUTS

Continuous rating:	20A
One Sec. Rating:	400A
Saturation limit:	150A
Burden:	<10 milliohms

1 Amp CURRENT INPUTS

Continuous rating:	4A
One Sec. rating:	80A
Saturation limit:	30A
Burden:	10 milliohms or less

PHASE AC VOLTAGE INPUTS

Continuous:	300V, Line to Line
One Sec. rating:	600V, Line to Neutral
Burden:	Less than 1VA @ 300Vac

AUXILIARY AC VOLTAGE INPUT

Continuous:	150V
One Sec. rating:	600V
Burden:	Less than 1VA @ 150Vac

A/D CONVERTER

Sampling Rate:	12/cycle, adjusted to input frequency 10-75Hz

POWER SUPPLY

Option 1:	DC range 35 - 150V AC range 55 - 135V
Option 2:	DC range 90 - 300V AC range 90 - 270V
Option 3:	DC range 17 - 32V (down to 8V for momentary dips)
Burden:	6 watts continuous, 8 watts maximum with all outputs energized

TRIP CONTACTS

Make and carry:	30A (0.2sec)
Continuous:	7A
Break:	0.3A DC (L/R=0.04)

CONTROL INPUTS

Wetting voltage range: Same as control power supply option.

Power Supply Option	Low Range		High Range	
	Turn-on Voltage Range	Burden	Turn-on Voltage Range	Burden
1) 48/125Vac/Vdc	26-38V	13k ohms	69-100V	24k ohms
2) 125/250Vac/Vdc	69-100V	25k ohms	138-200V	54k ohms
3) 24Vdc	5-8Vdc	7k ohms	N/A	N/A

Control inputs recognize both DC and AC voltages.

COMMUNICATION PORTS

Response time:	<100mSec for metering and control functions
Baud rate:	300 - 19200

ELECTRICAL ENVIRONMENT

- IEEE C37.90-1989 Standard for Relays and Relay Systems Associated with Electric Power Apparatus
- IEC 255-5 Insulation Test for Electrical Relays Impulse and Dielectric Strength (2000Vac at 50/60Hz)
- IEEE C37.90.1-1989 Standard Surge Withstand Capability Tests for Relays and Relay Systems Associated with Electric Power Apparatus
- IEC 255-22-1 1MHz Burst Disturbance Tests for Electrical Disturbance Tests for Measuring Relays and Protection Equipment
- EN 61000-4-4 Electrical Fast Transient/Burst Immunity Test
- EN 61000-4-3 Radiated, Radio-frequency, Electro-magnetic Field Immunity Test
- Type tested using a 5-watt, hand-held transceiver in the ranges of 144 and 440MHz with the antenna placed within 6 inches of the relay.
- IEEE C37.90.3 (Jan. 01) Draft Standard Electrostatic Discharge Tests for Protective Relays
- EN 61000-4-2 Electrostatic Discharge Immunity Test

MECHANICAL ENVIRONMENT

- Operating temperature range: -40°C to 70°C* (-40°F to 158°F)
  *LCD Display is inoperative below -20°C.
- Storage temperature range: -40°C to 70°C (-40°F to 158°F)
- Humidity: Qualified to IEC 68-2-38, 1st Edition 1974, Basic Environmental Test Procedures, Part 2: Test Z/AD: Composite Temperature Humidity Cyclic Test
- Qualified to IEC 255-21-1 (Class 1) Vibration Tests for Electrical Relays
- Qualified to IEC 255-21-2 (Class 1) Shock and Bump Tests for Electrical Relays

CERTIFICATIONS

UL Recognized, File E97033
CSA Certified, File LR23131
Gost R Certified, #POCC US.ME05.B03391
DNP 3.0 IED Certified, Subset Level 2, 6/20/00, by SUBNET Solutions, Inc.

CASE SIZE

H1: 10.5" (267mm) W x 3.47" (88 mm) H x 9.1" (231 mm) D with mounting flanges (8.5" (216 mmm) W without mounting flanges)
S1: 6.65" (169 mm)W x 9.32" (237 mm) H x 9.51" (241 mm) D (includes relay cover)

SHIPPING WEIGHT

H1: Approx. 12 (4.536 kg) pounds
S1: Approx. 12.8 (5.806 kg) pounds

WARRANTY

7 years

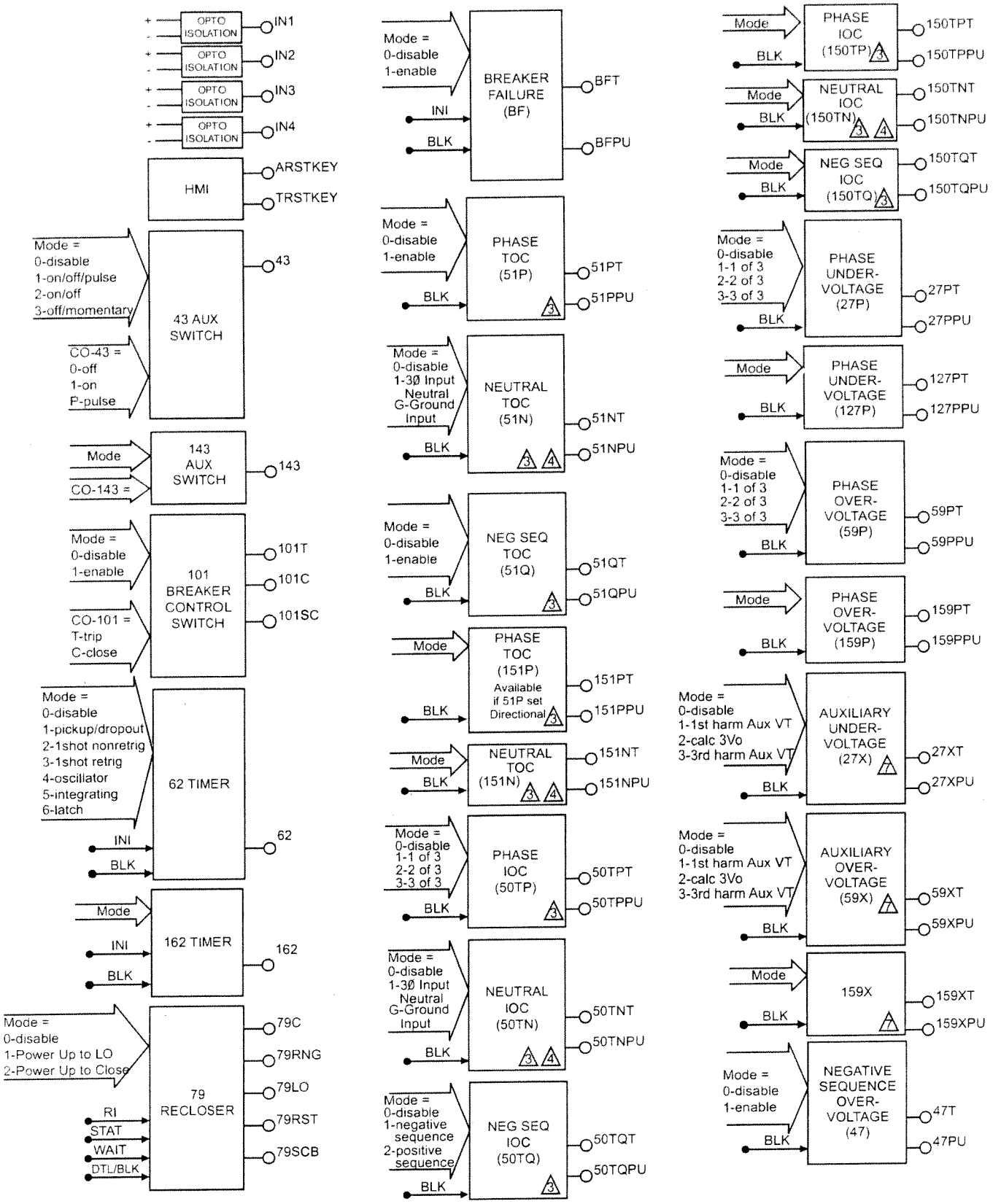
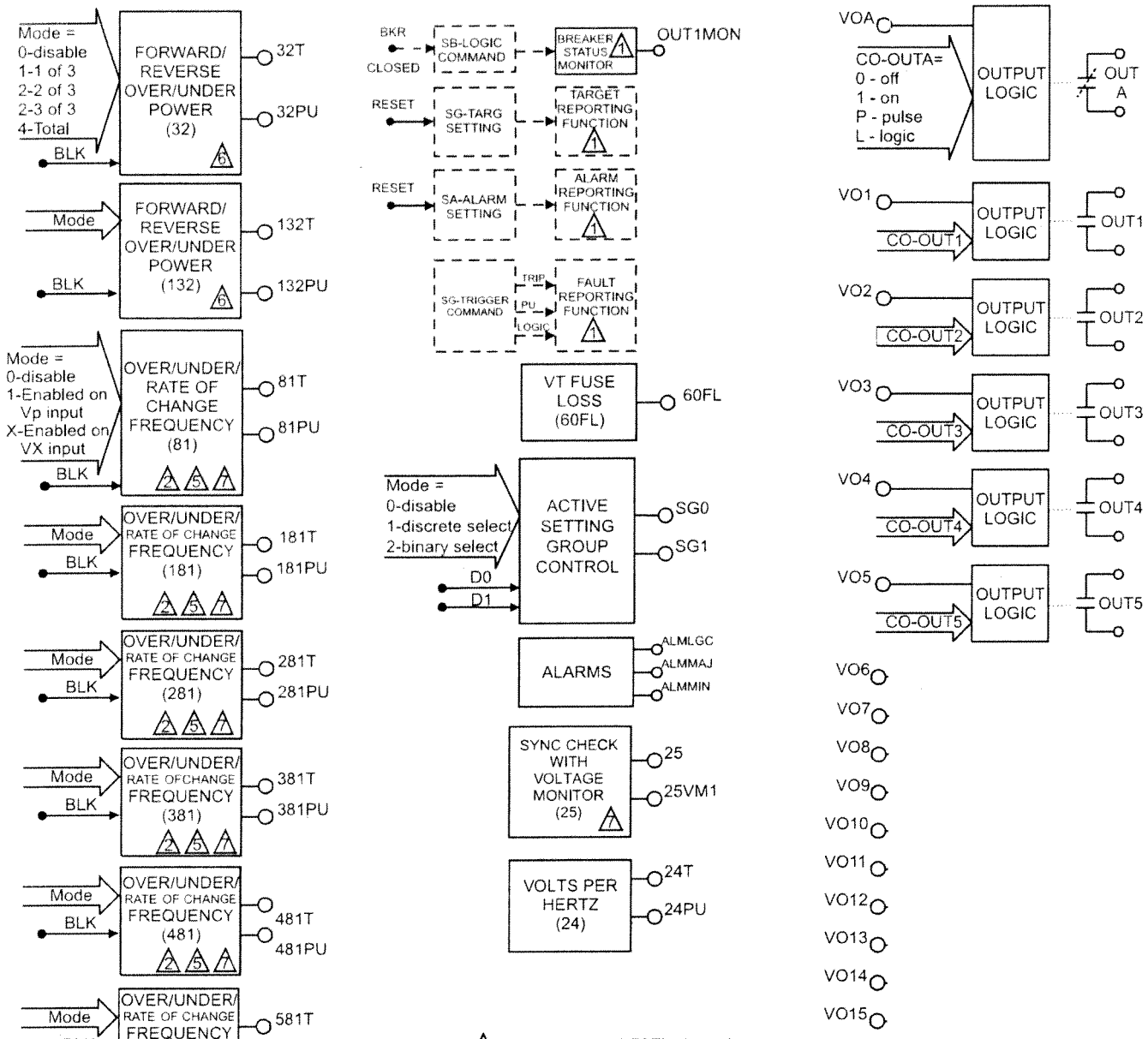


Figure 7A - BESTlogic Function Blocks



1 Not included in BESTlogic settings.

2 Under/Over/Rate of Change is setting parameter for all 81 elements.

3 FWD/RVS/Nondirectional (67) is setting parameter for all 50 and 51 elements. *Note:* 151P is not a phase overcurrent element. It is a second setting for the 51P element, when set directional. Trip direction of the 151P is fixed opposite the 51P. See Instruction Manual for details.

4 Neutral OC elements can be assigned to 3 phase residual or optional independent ground input.

5 Each frequency element can be assigned to monitor 3∅ VT input (VP) or Auxiliary VT input (VX).

6 Forward/Reverse, Over/Under (32/132) are setting parameters.

7 Vx input cannot support simultaneous monitoring of two different voltage sources: i.e., a 25-VX (bus or line VT) source **and** a 59N-VX (broken delta) source cannot be simultaneously applied to the VX input. The user must choose one application at a time for the VX input.

Figure 7B - BESTlogic Function Blocks

PERFORMANCE SPECIFICATIONS

INSTANTANEOUS OVERCURRENT WITH SETTABLE DELAY (50TP, 150TP, 50TN, 150TN, 50TQ, 150TQ)

Pickup: 5A CT 0.5 - 150.0A
1A CT 0.1 - 30.0A

PU time with TD=0.000 Sec
2 cyc for P, N &G @ 5 x PU
3 cyc for Q @ 5 x PU

Delay time: 0.000 - 60 sec

Time Accuracy: ±0.5% or ±½ cyc for P and N
±0.5% or ±1 cyc for Q

TIME OVERCURRENT (51P, 151P, 51N, 151N, 51Q)

Note: 151P is not a phase overcurrent element. It is a second setting for the 51P element, when set directional. Trip direction of the 151P is fixed opposite the 51P. See Instruction Manual for details.

Pickup: 5A CT 0.5 - 16.0A
1A CT 0.1 - 3.20A

Time dial: TD=K=0 - 99 for 46 curve
TD=0.0 - 9.9 for all other curves

Time-Current Characteristics:

The following expression describes the inverse time current characteristic for each curve:

$$T_T = \frac{AD}{M^N - C} + BD + K = \text{Time to trip}$$

$$T_R = \frac{RD}{M^2 - 1} = \text{Time for decaying reset}$$

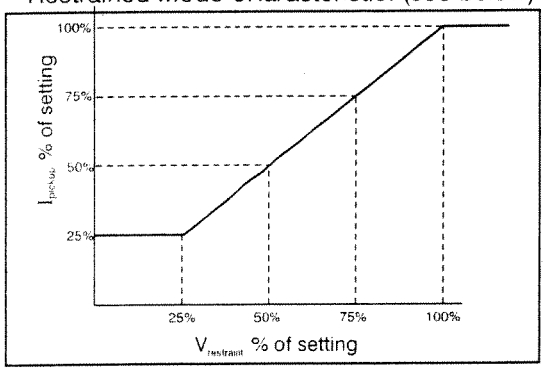
where D = Time dial, M = Multiple of PU and A, B, C, N, K and R are constants that govern the shape of each curve. The protection engineer can set the constants for the P (programmable) curve to achieve virtually any characteristic.

51P VOLTAGE CONTROL (27R)

Control Modes: Uncontrolled, voltage controlled, voltage restrained.

Control/Restraint Range: 30 - 250V

Restrained Mode Characteristic: (see below)



DIRECTIONAL CONTROL (ALL OVERCURRENT)

Mode: Forward, Reverse, Nondirectional

Curve Type	Constants					
	A	B	C	N	K	R
S1	0.2663	0.03393	1.000	1.2969	0.028	0.5000
S2	0.0286	0.02080	1.000	0.9844	0.028	0.0940
L1	5.6143	2.18592	1.000	1.000	0.028	15.750
L2	2.3955	0.00000	1.000	0.3125	0.028	7.8001
D	0.4797	0.21359	1.000	1.5625	0.028	0.8750
M	0.3022	0.12840	1.000	0.5000	0.028	1.7500
I1	8.9341	0.17966	1.000	2.0938	0.028	9.0000
I2	0.2747	0.1042	1.000	0.4375	0.028	0.8868
V1	5.4678	0.10814	1.000	2.0469	0.028	5.5000
V2	4.4309	0.0991	1.000	1.9531	0.028	5.8231
E1	7.7624	0.02758	1.000	2.0938	0.028	7.7500
E2	4.9883	0.0129	1.000	2.0469	0.028	4.7742
A	0.01414	0.00000	1.000	0.0200	0.028	2.0000
B	1.4636	0.00000	1.000	1.0469	0.028	3.2500
C	8.2506	0.00000	1.000	2.0469	0.028	8.0000
G	12.1212	0.00000	1.000	1.000	0.028	29.000
F	0.0000	1.00000	0.000	0.0000	0.028	1.0000
46	*	0	0	2	0.028	100
P	0 to 600	0 to 25	0 to 1	.5 to 2.5	0.028	0 to 30

S1, S2 = CO Short Inv, IAC Short Inv
L1, L2 = CO Long Inv, IAC Long Inv
D = CO Definite Time
M = CO Moderately Inverse
I1, I2 = CO Inverse, IAC Inverse
V1, V2 = CO Very Inv, IAC Very Inv
E1, E2 = CO Ext Inverse, IAC Ext. Inverse
A = IEC Standard Inverse
B = IEC Very Inverse
C = IEC Extremely Inverse
G = IEC Long Time Inverse
F = Fixed Time
46 = Negative Sequence Overcurrent
P = Programmable

* Constant A is variable for the 46 curve and is determined as necessary based on system full load current setting, minimum pickup, and K factor settings.

67P Polarization: Positive Sequence w/Memory
Negative Sequence

67Q Polarization: Negative Sequence

67N Polarization: Selectable any combination:
Zero Sequence Voltage
Negative Sequence Voltage
Zero Sequence Current
(Requires IG)

BREAKER FAILURE (BF)

Time: 50 - 999mSec

Dropout: 5A CT 0.5A
1A CT 0.1A

Time Accuracy: ±0.5% or +1¼ cyc / - ½ cyc

VOLTS/HZ (24)

Inverse Time:

Range: 0.5 to 6 V/Hz
Accuracy: ±2%
Inverse Time Curves: $(M-1)^2$, $(M-1)^1$, $(M-1)^{0.5}$
Time Dial: 0.0 to 9.9 V/Hz
Integrating Time Delay Reset
Reset Dial: 0.0 to 9.9 V/Hz
Accuracy: 5% or 4 cycles, whichever is greater

Definite Time #1 and #2, and Alarm:

Range: 0.5 to 6 V/Hz
Time Delay: 0.05 second to 600 seconds
Accuracy: 0.5% or 3 cycles,whichever is greater

PERFORMANCE SPECIFICATIONS, continued

Sync Check (25)

Delta Phase Angle:	1 - 99 degrees
Delta Voltage Magnitude:	1 - 20V
Delta Frequency:	0.01 - 0.50Hz

Sync Check, Voltage Monitor (25VM)

Dead Threshold:	10 - 150V
Live Threshold:	10 - 150V
Dropout Time Delay:	0.050 - 60.0sec
Logic:	Dead Phase/Dead Aux. Dead Phase/Live Aux. Live Phase/Dead Aux.

Phase Over/Undervoltage (27P, 59P, 127P, 159)

Mode:	1 of 3; 2 of 3; 3 of 3
Pickup:	10.0-300V_{L-L} or 10.0-300V_{L-N}
Delay Time:	0.050 - 600sec.
27P/127P UV Inhibit:	10-300VAC

Negative Sequence Overvoltage(47)

Pickup:	1.0 - 300V_{L-N}
Delay Time:	0.050 - 600sec.

Auxiliary / 3V0 Over/Undervoltage (27X, 59X, 159X)

Mode:	Fundamental V_X , 3 phase Residual (3V0), 3rd Harmonic V_X
Pickup:	1.0 - 150V
Delay Time:	0.050 - 600 Sec.
27X UV Inhibit:	1.0-150VAC

Power (32/132)

Mode:	1 of 3; 2 of 3; 3 of 3; Total
Operation direction:	Forward or Reverse, Over or Under
Pickup:	5A: 1.0 - 6000 Watts, 3 ph 1A: 1.0 - 1200 Watts, 3 ph
Pickup Accuracy:	±3%
Delay Time:	0.050 - 600 Sec.

General Purpose Logic Timers (62, 162)

Mode:	PU/DO, 1 Shot, Non-Retrig. 1 Shot, Retrig. Integrating Latch
T1 and T2 Delay Time:	0.000 - 9999 Sec.
Time Accuracy:	±0.5% or ±¾ cyc

Recloser (79)

Mode:	Power up to close, Power up to lockout
Reclose Shots:	0 - 4
Reclose, Reset, Fail, Max. Cycle Timers:	0.100 - 600 Sec.
Time Accuracy:	±0.5% or +1¾ cyc/-0 cyc

Current Pickup Accuracy (All 50 and 51)

Phase and Ground:	5A 2% or 50mA 1A 2% or 10mA
Neutral and Negative Sequence:	5A 3% or 75mA 1A 3% or 75mA

Voltage Pickup Accuracy (All 27, 47 and 59)

Phase (V_{L-L} or V_{L-N}):	±2% or ±1 Volt
Phase 3V0 and V2:	±2% or ±1 Volt

Definite Time Accuracy Unless Otherwise Stated (All 27, 47 and 59)

Definite Time Accuracy:	±0.5% or ±1 cyc

Setting Groups

Setting Groups:	2
Control Modes:	Automatic:CLP; Dynamic load or unbalance. External: Discrete input logic; Binary: Input Logic

Metering

Current Range:	5A 0.5 to 15.0 1A 0.1 to 3.0
Current Accuracy:	±1%
Phase Voltage Range:	3W 0 - 300 V_{L-L} 4W 0 - 300 V_{L-L}
Phase Voltage Accuracy:	±0.5% for 50V<V_{L-L}<300V
Watt/VAR:	5A 0 to ±7500 1A 0 to ±1500
Watt Accuracy:	1% @ Unity PF
VAR Accuracy:	1% @ Zero PF
Energy:	0 to ±1.0E12 (F/R registers)
Frequency:	10 - 75Hz
Frequency Accuracy:	0.01Hz

Demands (IA, IB, IC, IN, IQ, Fwd Watts, Rvs Watts, Fwd VARs, Rvs VARs)

Demand Interval:	1 - 60 min.
Demand Mode:	Thermal

Breaker Monitoring

Duty Mode:	I or I^2
Duty Alarm Range:	0 - to 100%
Op Counter Alarm Range:	0 - 99999
Trip Time Alarm Range:	20 - 1000mSec

Over/Under/ROC Frequency (81, 181, 281, 381, 481, 581)

O/U:

Range: 40-70 Hz
Increment: 0.01 Hz
Accuracy: ±0.5% or 1 cycle, whichever is greater

ROC:

Range: 0.2 - 20 Hz/sec (pos, neg, or either)
Increment: 0.01 Hz/sec
Accuracy: 0.15 Hz/sec or ±2% of setting, whichever is greater
Neg. Seq. Inhibit Range: 0-99% of nominal voltage
Accuracy: ±2% or 1 V
Over/Under Frequency Inhibit Range: 46-64 Hz

O/U/ROC:

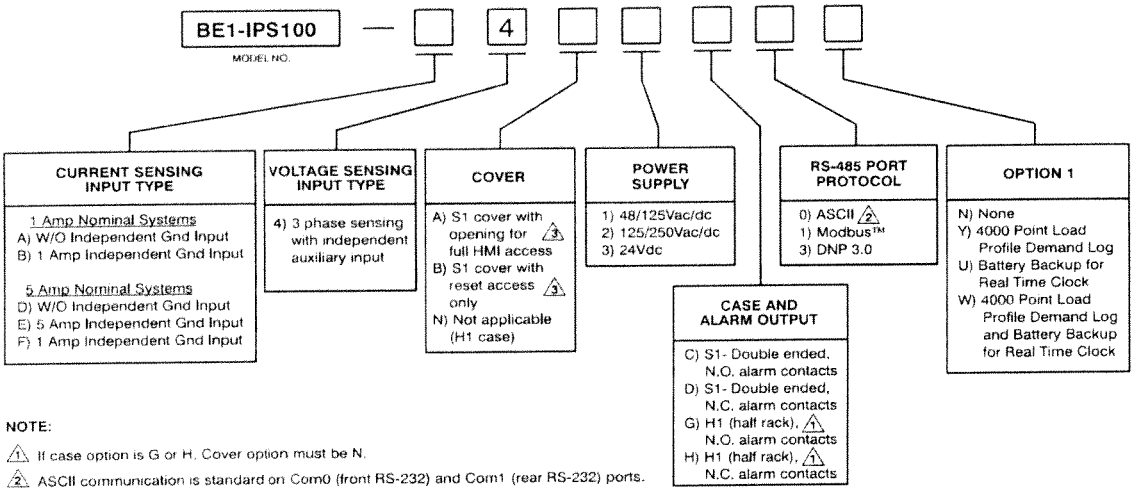
Time Delay Range: 0 to 600 seconds
Accuracy: 0.5% or 1 cycle, whichever is greater
Voltage Inhibit Range: 15 to 300 V
Accuracy: ±2% or 1 Volt, whichever is greater

ORDERING

SAMPLE STYLE NUMBER

The style number identification chart defines the electrical characteristics and operation features included in BE1-IPS100 relays. For example, if the style number were BE1-IPS100 **E4N1H0Y**, the device would have the following: BE1-IPS100

- **(E)** - 5 Amp nominal system with 5 Amp Independent Ground Input
- **(4)** - Three phase voltage sensing with independent aux. input
- **(N)** - Not applicable
- **(1)** - 48/125Vac/Vdc power supply
- **(H)** - Half Rack Case
- **(0)** - ASCII Communications
- **(Y)** - 4000 point Load Profile Demand Log



NOTE:

1. If case option is G or H, Cover option must be N.
2. ASCII communication is standard on Com0 (front RS-232) and Com1 (rear RS-232) ports.
3. See Figures 8A and 8B.

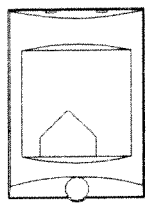


Figure 8A
Cover option A.

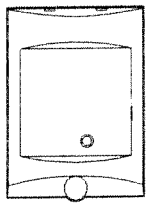
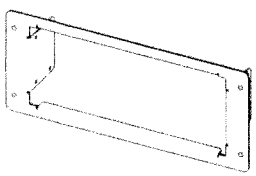


Figure 8B
Cover option B.

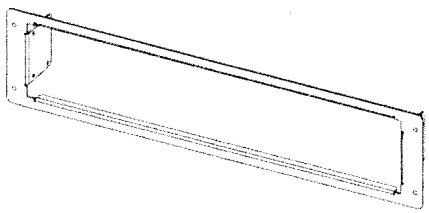
STANDARD ACCESSORIES

9334818100 Battery Backup Replacement Kit (if "U" or "W" is chosen for Option 1).

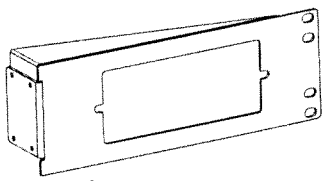
9289900017
Escutcheon plate to panel mount one H1 relay.



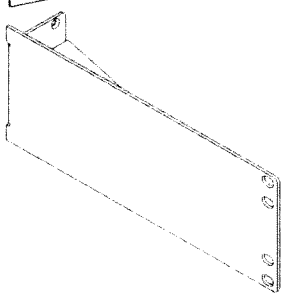
9289900016
Escutcheon plate to panel mount two dovetailed H1 relays.



9289929100
Adapter bracket with cutout for ABB FT test switch, to mount a single H1 case in a 19" rack.



9289924100
Adapter bracket to mount single H1 case in 19" rack.



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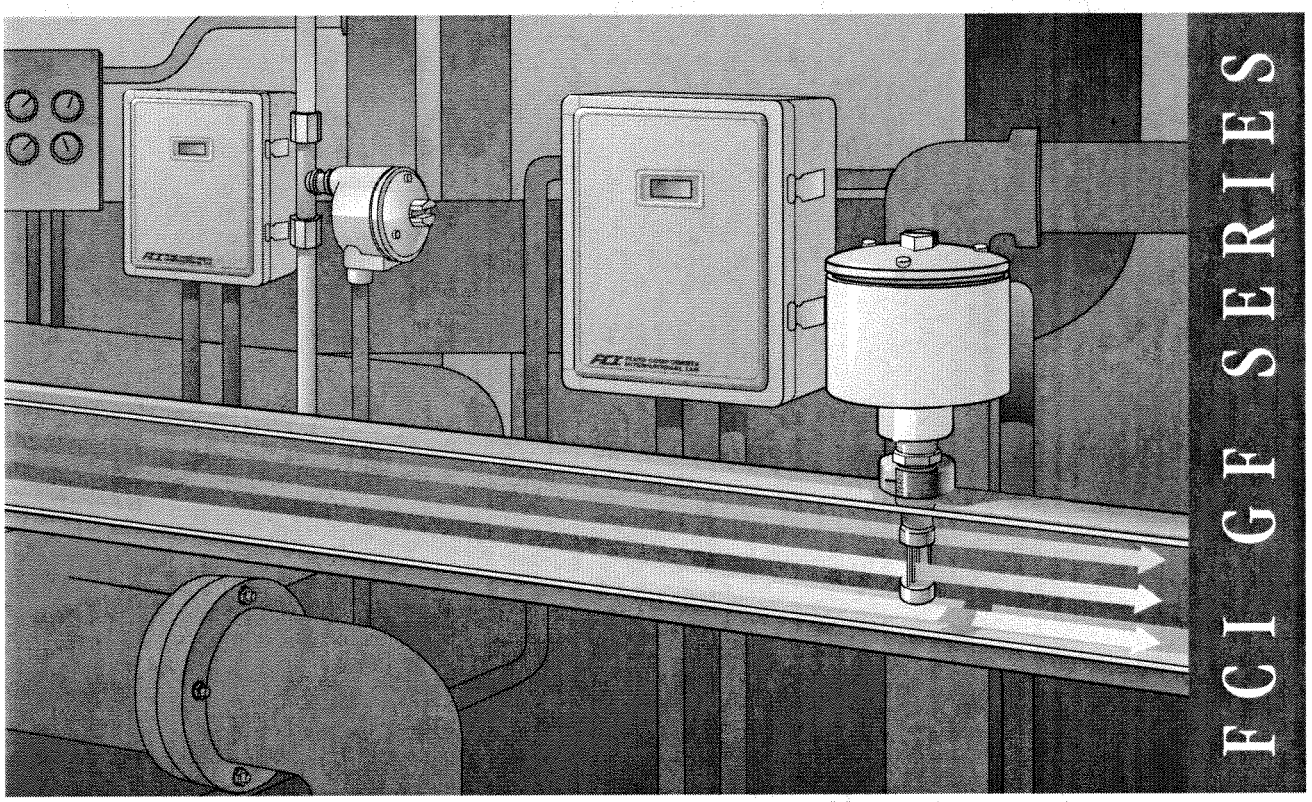
NEW
Now Includes
VeriCal™ In-Situ Calibration
Verification Option
for GF90 & GF03

FCI GF Series:

The Versatile

High Performance



Mass Flow Meter

for Gas Applications.

FCI® FLUID COMPONENTS INTERNATIONAL LLC

The GF Series Gas Mass flow meters combine FCI's highly reliable Thermal Dispersion, no-moving-parts flow element design with an advanced microprocessor-based programmable transmitter. Performance and durability are unmatched in tough industrial applications ranging from exhaust stack gas to digester gas to hydrogen make-up gas flow metering.

Reliability, Flexibility in Industrial Applications The GF Series Mass flow meters are available in two models: the GF90 with an insertion flow element and the GF92 with an inline flow element. Both models feature standard 316 stainless steel, nickel braze construction. Corrosion- and abrasion-resistant alloys and all-welded construction are available for select service in harsh process environments.

FCI's advanced constant power Thermal Dispersion technology provides the GF Series Mass flow meters with turndowns up to 1000:1, repeatability of ±0.5% reading or better, and flow rate accuracy of ±1% reading plus 0.5% full scale.

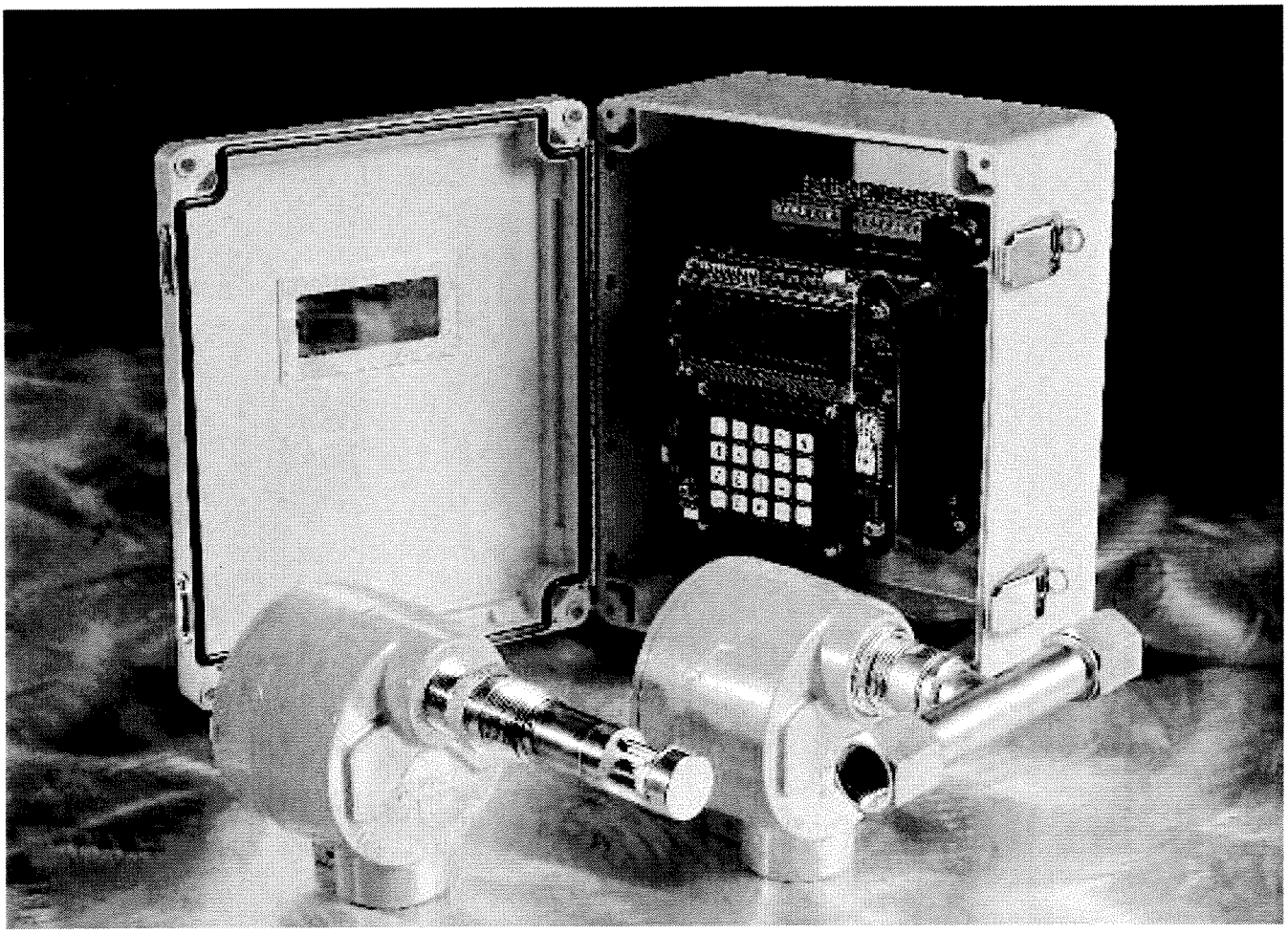
The GF Insertion Model The GF90 is available for use in ducts or pipe sizes with a suggested minimum 2 inch [50 mm] nominal inside diameter. The standard flow element has a 1 inch male NPT process connection and an application specific insertion length. Flange connections and field retractable packing gland assemblies are also available.

Flow sensitivity ranges from 0.25 to 1600 SFPS [0.08 to 488 NMPS] at a standard temperature of 70° F and pressure of 14.7 psia [21.1° C and pressure of 1.013 bar(a)].

The GF92 Inline Model The GF92 is used for gas mass flow metering in pipe lines or tubing sizes from 0.125 to 3 inches [3.2 to 76 mm]. It has a standard body length of 7.25 inches [184 mm] for installation in 1 inch [25 mm] flow tubes and 12 inches [305 mm] length for 1.5 to 3 inch pipe sizes. Custom lengths are also available.

Flow sensitivity ranges from 0.006 to 2000 SCFM [0.01 to 3398 NCMH] at a standard temperature of 70° F and pressure of 14.7 psia [21.1° C and pressure of 1.013 bar (a)]. Contact FCI or an FCI representative for the specific flow range sensitivity for your application.

Smart Electronics The GF Series' microprocessor-based electronics are easily addressable via a built-in keypad or through the serial ports and allow complete in-field reconfiguration to the instrument's performance parameters (i.e., the changing of relay set points, output zeros and spans, display units, and installation and



operation parameters within the calibrated instrument range). RS-232C serial port provides the ability to interface with a computer or any ASCII-oriented terminal.

Two independent analog outputs can be set in the field. Modes include: 4-20 mA, 0-10 Vdc, 0-5 Vdc, or 1-5 Vdc. Process flow rate, temperature and all GF Series functions are simultaneously available through the RS-232C serial ports.

Smart Features Outstanding features of FCI's GF Series microprocessor-based electronics include:

User-Friendly Operation and Maintenance. Start-up, verification and operation are easily performed through the friendly menu-driven display.

Indicator Display. Four lines by twenty character liquid crystal display indicates flow rate, total flow, temperature, relay status, current calibration mode and sample rate. Flow rate, total flow and temperature can be independently set to English or Metric (SI) units.

In-Field Programming. The built-in keypad permits easy touch, in-field programming to change zero, span, switch points, units of measurement, two totalizer modes, instrument verification, trouble shooting and other critical instrument functions.

Built-In Testing and Diagnostics. Built-in testing and diagnostic capabilities ensure accurate and reliable performance. Diagnostics include out of range detection and forced relay status.

Non-Volatile Memory. Non-volatile memory prevents the loss of valuable application data and totalized flow due to loss of power.

Security. Pass-code protection offers security against both unauthorized access and equipment tampering.

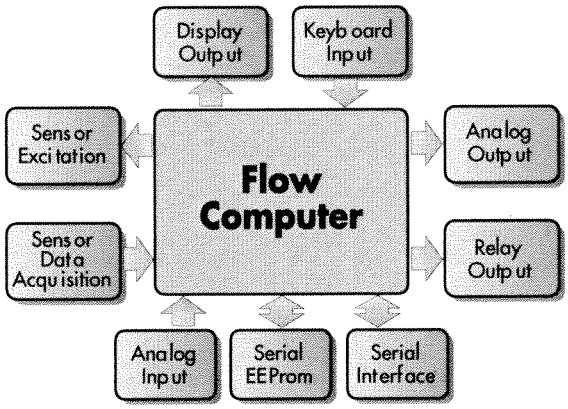
Multiple Calibration Groups. Up to three calibration groups can be stored in a single GF Series transmitter. Each group can be independently configured for a specific calibration range, media, switch point settings, etc. For example, a hydrogen line that requires periodic purging with nitrogen gas can be measured with a single GF Series Mass flow meter. The complete calibration data for each gas can be stored in one of three available groups. Each calibration group can be manually or automatically selected to provide an accurate indication of a specific process gas.

The three calibration groups can also be utilized to enhance or preserve accuracy over wide flow turndowns. Accurate flows with turndown ratios of 1000:1 are possible through group linkage. In addition, automatic switching between groups can also be controlled by process temperature variations.

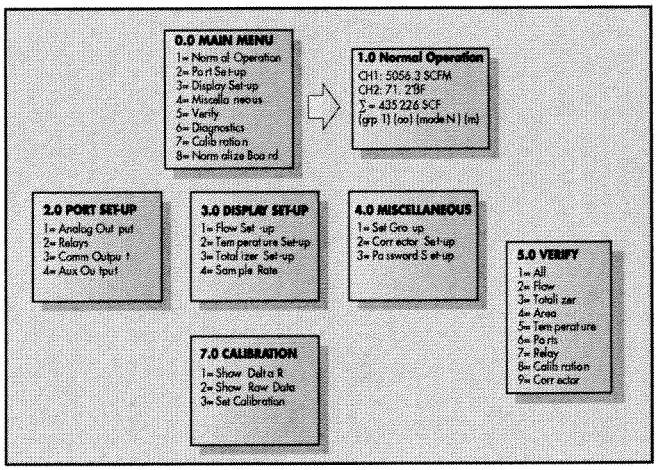
Auxiliary Input Terminal. An auxiliary input terminal is available for connection to an external signal source. This terminal provides a method for remotely switching between calibration groups.

System Approvals. Local flow element and remote transmitter enclosures that meet hazardous location explosion-proof protection are available. Agency system approvals for FCI's GF Series Mass flow meters include Factory Mutual Research (FM), ATEX and CE Mark. Other agency approvals are available for special applications. A fiberglass NEMA/CSA Type enclosure is standard. All aluminum and stainless steel enclosures are rated for hazardous location use.

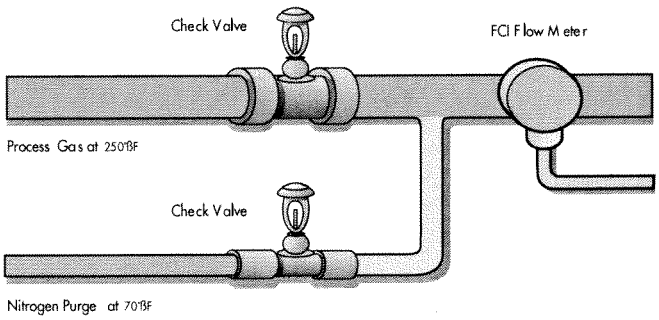
GF Series Top Level Block Diagram



GF Series User-Friendly Menu Structure -- First Level



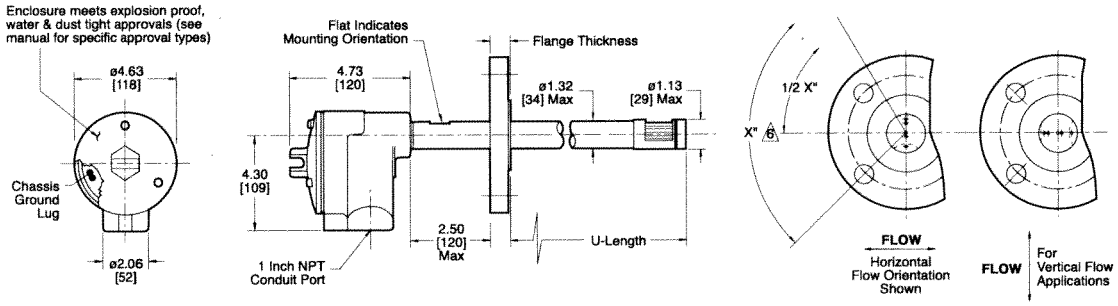
Typical Multi-Calibration Group Application



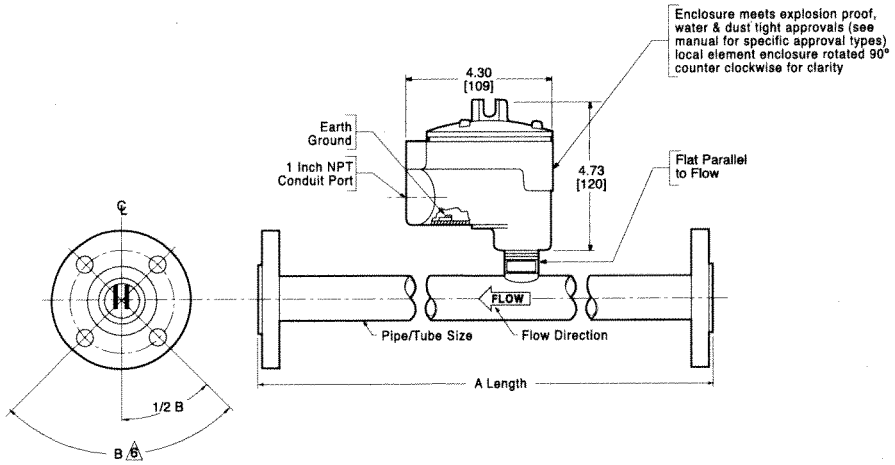
Typical GF90/GF92 Mass Flow Metering Applications

- Flare Gas
- Combustion Air to Boilers & Furnaces
- Preheater Air to Boilers & Furnaces
- Fuel Gas
- Scrubber Balancing
- Landfill Vapor Recovery
- Exhaust Stacks
- Hydrogen Make-up Gas
- Natural Gas Pipeline Transmission
- Compressor Fuel
- Wastewater Digester Gas or Biogas
- Process Gas
- Heavy Industrial HVAC
- Nitrogen Purge
- Other Gas Applications

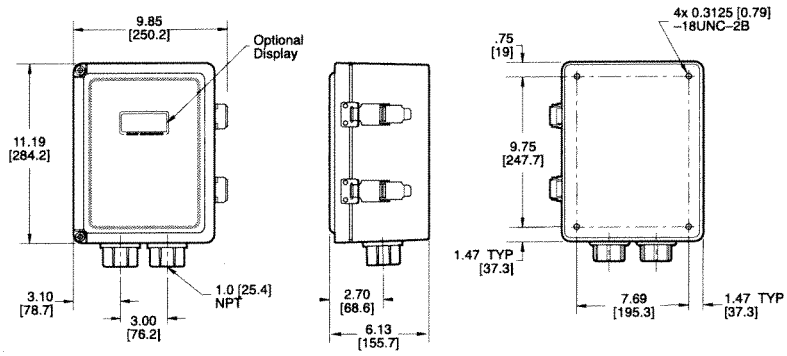
GF90 Flow Element



GF92 Flow Element



GF Remote Transmitter Enclosure



GF Series Mass Flow Meter Specifications

Application

Gas Mass Flow Measurement:

GF90: In ducts or pipes sizes with a minimum 2 inch [51 mm] nominal inside diameter.

GF92: In pipe lines or tubing sizes from 0.125 to 2 inches [3.2 to 51 mm].

Flow Elements

Process Connection:

GF90: 1 inch male NPT standard. Flange connections and field retractable packing gland assemblies available.

GF92: 3/4 inch female NPT standard. 1, 1.5, 2 and 3 inch male or female NPT, flange connections available.

Insertion Length -- GF90: Variable length. Specify insertion "U" length (dimension from the process connection to the tip of the flow element) to extend the tip of the flow element 1 inch [25 mm] past the centerline of the process pipe.

Body Length -- GF92: 7.25 inches [184 mm] for 1 inch flow tubes; 12 inches [305 mm] for 1.5 to 3 inch pipe spool pieces. Variable A-lengths available.

Material of Construction: All wetted surfaces are 316 stainless steel with nickel braze. Corrosion-resistant alloys are available with factory specified all welded construction or compatible brazes.

Flow Range:

GF90: 0.25 to 1600 SFPS [0.08 to 488 NMPS] for most gases at a standard temperature of 70° F and pressure of 14.7 psia [21.1°C and pressure of 1.013 bar(a)].

GF92: 0.006 to 2000 SCFM [0.01 to 3398 NCMH] for most gases at a standard temperature of 70°F and pressure of 14.7 psia [21.1°C and pressure of 1.013 bar(a)].

Actual velocity for both the GF90 and GF92 must be limited to a maximum of 200 feet per second [61 meters per second].

Operating Temperature: −50° to +350°F [−45° to +177°C] with the standard temperature flow element. The GF90 is available in a High Temperature Flow Element configuration for service in process temperatures from −100° to +850° F [−73° to +454°C].

Operating Pressure: To 1000 psig [69 bar(g)].

Transmitter

Signal Output:

Analog: Two independent signal outputs available that may be field set from the following listed selection:

4-20 mA, 600 ohms maximum load

0-10 Vdc, 5000 ohms minimum load

0-5 Vdc, 2500 ohms minimum load

1-5 Vdc, 2500 ohms minimum load

Digital: RS-232C serial port.

HART or Profibus Communications: Optional

Switch Points (Dual Alarms): The switch points may be field set by programming the GF90 or GF92 to alarm at high, low or windowed flow or at high, low or windowed process temperature.

Relays: Two independently adjustable 2 amp at 115/230 Vac or 24 Vdc; gold plated contacts.

Slave Relay Energization Terminals: Customer provided relay may be energized at programmable values connecting to points on the output terminal strip.

+External Relay: 20 Vdc, sourcing up to 100 mA total both relay outputs.

−External Relay: Open/Ground (switching).

Power Input: 115 Vac, ±15 Vac, 16 watts maximum or 230 Vac, ±30 Vac, 16 watts maximum, or 24 Vdc, −2 and +6 Vdc, 16 watts maximum as selected by the power input switch and terminal selection.

Indicator Display & Built-In Keypad: 4 lines by 20 character liquid crystal display that may be programmed to indicate flow rate, total flow, temperature, and switch point status in customer determined English or Metric (SI) values. Keypad permits easy touch programming to change zero, span, switch points, and units of measurement and for instrument verification, trouble shooting and other critical instrument functions.

Electrical Enclosures

Fiberglass NEMA/CSA Type 4X is standard. All aluminum and stainless steel enclosures are rated for hazardous location use (Class I and II, Division 1 and 2, Groups B, C, D, E, F and G; and EEx d IIC) and resists the effect of weather and corrosion (NEMA/CSA Type 4X and equivalent to IP66).

Electrical Connection: 1 inch female NPT.

Temperature Range: 0° to 150° F [−18° to +66° C].

Flow

Accuracy: ±1% reading + 0.5% full scale.

Repeatability: ±0.5% reading or better.

Turndown Ratio: Field set to within specified flow range from 2:1 to 100:1. Turndown ratios up to 1000:1 are possible in some applications. Signal output may be field set to be zero or non-zero based. Up to three independent calibrations may be stored in the GF Series transmitter and selected via the built-in keypad, RS-232C Serial Port or Auxiliary Input Terminal (4-20 mA).

Calibration Adjustment: Up to three independent calibration groups are available. Each group is precisely calibrated at the factory in accordance with the submitted Application Data Sheet to turndown ratios as high as 1000:1. Most calibrations are performed in the actual process fluid and process conditions described by the customer's specification. Adjustment to zero and span are made easily in the field by using the keypad to input revised flow or temperature range information.

Temperature

Accuracy: ±2° F [±1°C]. Valid only above minimum flowing conditions of 5 SFPS [1.5 NMPS].

Repeatability: ±1° F [±0.55°C].

Agency Approvals

Factory Mutual Research(FM), CSA (Class I, Division 2, Groups A, B, C, D; Class II, Division 1 and 2, Groups E, F, G.), ATEX (EExd IIc T4); CE Mark.

Test and Calibration Laboratory | Fluid Components International maintains an extensive, instrument test and calibration laboratory at its headquarters in San Marcos, California. Utilizing the latest in advanced, computerized data acquisition systems and calibration test equipment, this facility permits comprehensive product development, testing, and calibration. Any FCI product can be calibrated in accordance with customer specifications. Laboratory standards are maintained with NIST (National Institute of Standards and Technology) traceable Cavitating Venturis (CVs) and precisely calibrated, pressure and temperature corrected turbine flow meters.

Combustible and non-combustible gas calibration flow stands allow for the calibration of FCI products in a wide range of gases and gas mixtures in flow stand line sizes as small as 1/8 inch to 30 inches [3 to 760 mm] in diameter. A variety of flow profiles from laminar to turbulent conditions are generated to duplicate actual field conditions. Flow rates from 0 to 20,000+ SCFM [0 to 34,000 NCMH], velocities from 0 to 800 SFPS [0 to 240 NMPS], pressures from vacuum to 3000 psig [200 bar(g)], and temperatures from -100° to +900°F [-70° to +480°C] are available.

On-Site Calibration and Training | In-situ calibration is available from FCI's Field Service engineers where precise test and calibration is accomplished in actual media conditions.

FCI's Training Department can provide on-site or at the factory Product Knowledge Workshops for our customers. The workshops cover installation, setup, and troubleshooting skills, and include hands-on exercises using real products, under actual operating conditions.

24 Hour Customer Service Access Available

FCI FLUID COMPONENTS INTERNATIONAL LLC

NIST Net

Web: www.fluidcomponents.com
1755 La Costa Meadows Drive, San Marcos, California 92078 USA | **Phone:** 760-744-6950 | **Toll free:** 800-854-1993 | **Fax:** 760-736-6250
European Office: Persephonestraat 3-01 5047 TT Tilburg, The Netherlands | **Phone:** 31-13-5159989 | **Fax:** 31-13-5799036

ISO 9001:2000 and AS9100 certified

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VeriCal™

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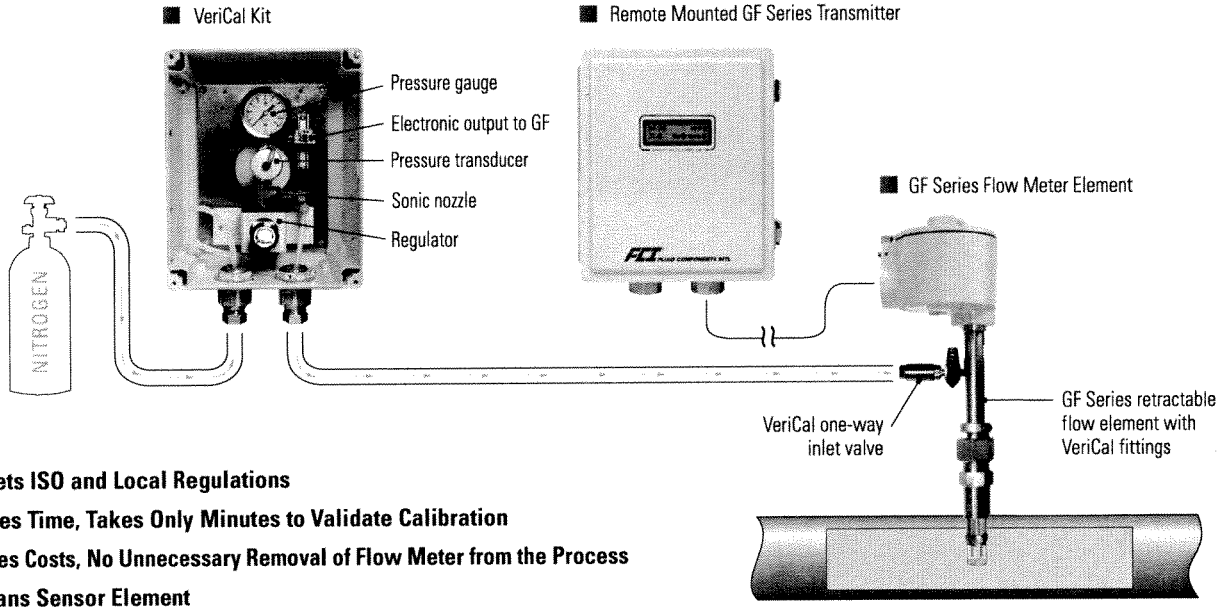
760-744-6950* / 800-854-1993 Fax: 760-736-6250
Please note: new area code for FCI "442" effective January 1, 2009
www.fluidcomponents.com

In-Situ Calibration Verification Option for Model GF90 and GF03 Gas Flow Meters



- **Meets ISO and Local Regulations**
- **Saves Time, Takes Only Minutes to Validate Calibration**
- **Saves Costs, No Unnecessary Removal of Flow Meter from the Process**
- **Cleans Sensor Element**

Validate Flow Meter Performance In The Installation

FCI's GF90 and GF03 gas flow meter models can be optionally provided with a unique and FCI-patented* in-situ calibration verification system. The VeriCal option provides periodic field validation and verification of the flow meter's measuring performance and calibration, all without extracting the flow meter from the pipe or process. In gas flow processes with procedures or regulations requiring periodic calibration verifications, the GF90 or GF03, outfitted with the VeriCal option, provide the most convenient and lowest cost solution.

A secondary benefit of the VeriCal system is that sensor elements are cleaned by the nitrogen gas, which helps ensure performance and reduce routine maintenance.

The VeriCal option is comprised of three components:

- A specially modified and fitted GF flow element. This special flow element includes a welded and sealed inlet valve, internal tubing, and an exit port near the flow sensors, plus additional calibration steps and documentation. After the GF90 or GF03 system has been precision calibrated in FCI's NIST traceable flow laboratory, the lab also flows nitrogen to obtain five (5) base line measurement points across the flow range to which all field checks using the VeriCal system can be compared. With each VeriCal outfitted GF90 or GF03 element, FCI provides a printed document showing the five base line flow readings for use by your field technicians.
- A VeriCal kit with fixtures and fittings to meter and control a precise flow of nitrogen** across the GF flow element. The VeriCal kit provides a specially designed 100 psig [6.9 bar (g)] pressure regulator, a high accuracy pressure transducer with a 4-20mA output, a sonic nozzle, and pressure gauge packaged in a NEMA 4 (IP66) rated enclosure. The kit is fully portable, or can be permanently mounted. The VeriCal kit also includes a 25 foot [7,6 m] air hose with quick disconnect fittings to connect the kit to the GF flow element, and a 25 foot [7,6 m] 2-conductor cable to connect the kit's electronic output to the GF transmitter's auxiliary input terminals *(order part number 020849-01)*. In applications where an electronic output to the GF's transmitter is not desired or cannot be implemented, and less accuracy is acceptable, a VeriCal kit without the pressure transducer and output cable is available† *(order part number 020849-02)*.
- A user-supplied nitrogen source with a hose, regulated 125 to 150 psig [8,6 to 10,3 bar(g)], either from an installed plant line or a portable supply tank. Typical test requires approximately 40 ft^3 [1,1 m^3] of nitrogen. *Consult your local FCI representative about available refillable nitrogen supply options.*

How It Works

With the VeriCal kit attached to the GF90/GF03 flow meter and to the nitrogen** source, a positive pressure nitrogen injection is introduced. The GF90/GF03 digital display provides a precise readout of the pressure from the pressure transducer's output†, the flow rate, and temperature. With the GF90/GF03 flow element fully retracted from the actual flow stream, and the GF operating in the VeriCal mode, the user adjusts the pressure to inject small controlled doses of nitrogen at a specified pressure. The nitrogen flow passes directly by the GF90/GF03 flow element at highly repeatable rates and the measured flow readings on the GF90/GF03 display are compared to the base line readings in the document provided by FCI. This procedure can be performed as often as desired.

* *VeriCal is manufactured in accordance with U.S. Patent Number 7,201,033B2*

** *Other gases may be used; Contact FCI for specification information*

† *In VeriCal kit without the pressure transducer, no digital readout of pressure is displayed, and the user adjusts pressure based on the analog dial of the gauge in the kit.*

VeriCal Specifications

Pressure Range: 0 to 100 psig [0 to 6.9 bar (g)]

Process Temperature Range: Procedure is conducted at ambient temperature.

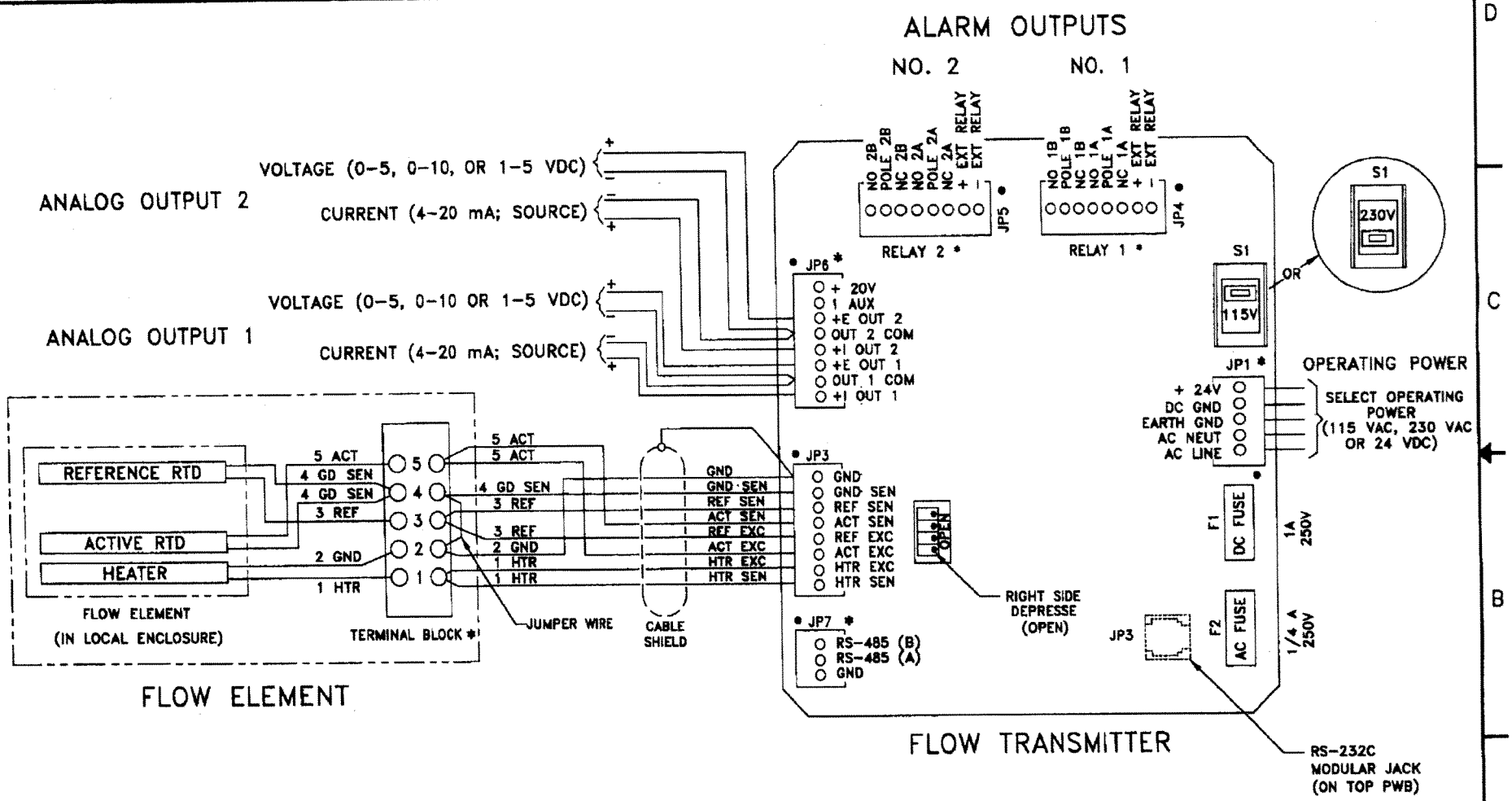
Agency Approvals: FM, CSA, ATEX pending for VeriCal system. Contact FCI for availability.

GF Flow Element:

Material of Construction: 316L Stainless steel
Process Connection: Retractable packing gland
Process Temperature: 350°F [177°C] maximum

0708 5K **Doc No. 02MK011530B**

ZONE	REV	DESCRIPTION	DATE	APPROVED
	B	REVISED AND REDRAWN	5-24-95	



* CUSTOMER CONNECTIONS.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
DECIMALS X ±.1 XX ±.03 XXX ±.010
ANGULAR ±1/2°
MATERIAL
DO NOT SCALE DRAWING

APPROVALS	DATE	APPROVALS	DATE
CONTRACT		DESIGN C.R.GONZALES	1-25-93
SEAL		CHECK J IZUMI	6-9-93
MFG J HOSFIELD	6-9-93	DRWN/ENGR	
QA J KEAIRNES	6-9-93	ENGRG B DENKE	6-9-93
		COMP	

CONTRACT NO.

	GF90/92
NEXT ASSY	USED ON
APPLICATION	

FLUID COMPONENTS INTL
a limited liability company
SAN MARCOS, CA 92069

TITLE ELECTRICAL SYSTEM INSTALLATION DIAGRAM, GF90/92 SERIES, REMOTE

SIZE	CAGE CODE	DWG NO.	REV
A	64818	015354	B
RELEASE DATE:	SCALE NA	SHEET 1 OF 1	

A7801-1 AcquiLite Data Acquisition Server

DESCRIPTION
The AcquiLite™ data acquisition server is the perfect "do-it-yourself" solution for:

- Web-enabling new and existing electricity, gas and water meters
- Verification of energy savings and utility costs
- Cost allocation to departments or tenants

The server combines the flexibility of Ethernet LAN, WAN or modem communications with the lowest total installed cost for logging building data such as:

- Electrical usage and costs
- Natural gas usage and costs
- Water usage and costs
- Combine KWH and KVARH pulse inputs to calculate power factor

AcquiLite™ brings "plug and play" capability to the data acquisition market, dramatically reducing the time and training required to put a typical building on line. In most applications, the building engineer or contractor can do the installation in less than 2 hours. The server scales to accept any pulse input.

After installation, data from the connected devices is time stamped and stored in nonvolatile memory on user selected intervals. This interval data is stored at the local site until the nextscheduled upload to the SQL database server.

Using the built-in modem or Ethernet port, data is sent via either the network or phone lines to the Building Manager Online™ server (or to other third party software providers).
At the BMO site, the newly gathered data is combined with historical information that is available to authorized users from anywhere in the world using standard browsers and the Internet. No additional software is required to develop customized views of operational and energy data from one or more buildings.

Applications

- Web-enabling of energy information from new and existing meters from local or remote sites
- Submetering tenants or departments
- Verification of utility usage and charges
- Developing load profiles for energy purchases
- Cost allocation of energy usage

Easy installation saves time and money

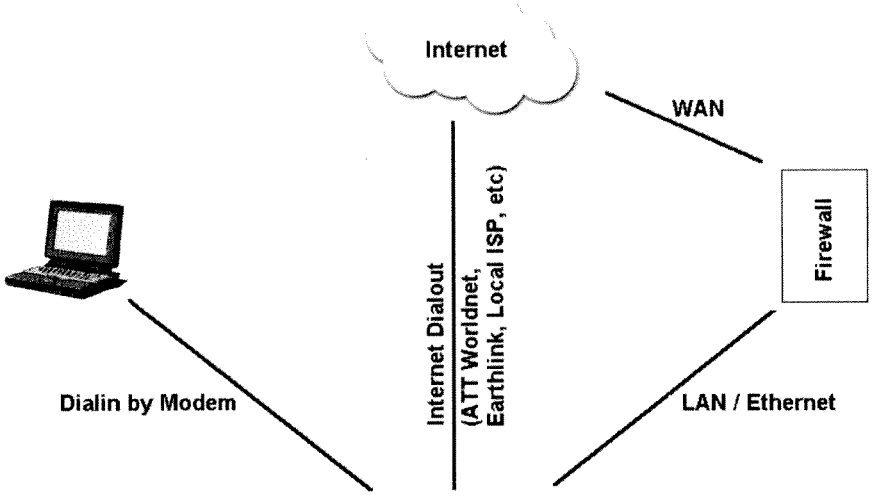
- Simple "plug and play" connectivity means that the system can be installed and configured in minutes
- Industry standard pulse inputs allow the user to gather a wide range of energy information
- AcquiLite hardware and software is designed to provide data in flexible, industry standard formats for databases, spreadsheets, etc.
- Uploads of "near real-time" information on a local LAN provide immediate response to problems
- Convenient LCD display provides ease of installation and troubleshooting without the need for a laptop or special software
- Integrated web server provides setup and configuration using any industry standard web browser (i.e., Netscape™ or Internet Explorer™)

Internet display of key building parameters

- Buildingmanageronline.com™ allows authorized users to see building performance data in an easy to use graphical format

Secure data and flexible comunications

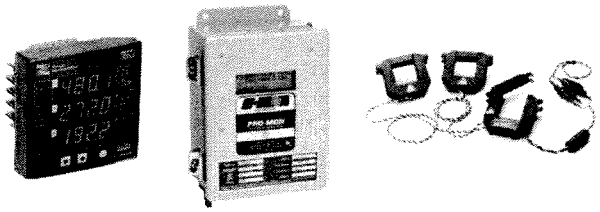
- All data is stored at the site in nonvolatile memory , insuring protection of data in case of power loss
- Wide range of communication options via the modem and Ethernet ports
- Password protection provides security for confidential information
- AcquiLite provides the flexibility to connect to existing meters
- TCP/IP protocols permit easy interface of collected data to spreadsheets, databases, text files, etc.



AcquiLite A7801

Data Acquisition Server

4 pulse inputs
Ethernet
Modem 33.6kbps
LCD Display and configuration



Pulse Output Meters
(Power, gas, water, BTU, etc)

Specifications:

Processor	R2000 - 8bit embedded cpu, 22Mhz.
Memory	512K flash, 512k sram.
LED	4x pulse input, 4x modem activity, power, alive, ethernet
Console	2 x 16 LCD, two pushbuttons
Communications:	33,600 bps modem, 10base-T half duplex Ethernet
Protocols	TCP/IP, PPP, HTTP/HTML, NTP
Power Requirement	110-120VAC Transformer included, 9VDC, Class2 transformer
Pulse Inputs	4x dry contact (consumption/rate/min/max)
Utility sync input	1x dry contact.
Size	8" x 9.25" x 2.5"

20811 N.W. Cornell Road #700, Hillsboro, OR 97124
Ph: +1-503-601-2099 toll free: 1-866-204-8134

website: http://www.obvius.com

AcquiLite – Data Acquisition Server

Obvius, LLC

Installation and Operation Manual

Model A7801

Date Sep 29, 2009

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Overview

The AcquiLite™ data acquisition system is designed to allow owners and managers of commercial and industrial facilities with a cost-effective means of gathering crucial information in a timely manner. To meet these requirements, the AcquiLite™ system provides the installer with all the tools necessary to install and configure the hardware and software with a minimum of time and investment.

Installation Checklist

An AcquiLite™ system installation has the following components:

Required hardware

- AcquiLite™ A7801-1 Data Acquisition Server (required)
- Data connection (ethernet or phone line).
    - Ethernet Cat 5 cable (required for connection to existing Local Area Network); or
    - Ethernet Cat 5 Crossover cable (required for direct laptop-to-AcquiLite connection); or
    - Phone line and cord (required for modem connection)

External hardware

- Pulse output transducers for measuring gas, electricity, water, etc. from existing meters and sensors. Make sure to obtain the pulse output scale, or multiplier for each device you will be using.

Next, choose one or more of the following connection methods.

For LAN installations only:

- Ethernet 10Mbit half-duplex connection point (hub or switch)
- IP, Netmask, gateway, and DNS addresses (check with system administrator)
- HTTP Proxy address (optional), may be required if the AcquiLite is behind a firewall (check with system administrator)

For dialout installations only: (AcquiLite initiates a phone call to your ISP or modem server)

- Phone line with dialtone. May be shared with other devices such as a fax machine.
- Phone cord for connection to phone system
- Dial out access prefixes, and long distance access code if required. (ie, dial 9 for local line)
- Internet dialup account or Modem Server phone number (check with ISP)
- Time to dial. If phone line is shared, choose a time of day when other devices are not in use, such as 4am.
- A regular telephone for line testing and diagnostics

For dialin installations only: (AcquiLite receives/answers a phone call from your computer)

- Phone line with dialtone. Must be NOT shared with other devices. (or use appropriate line sharing device)
- Phone cord for connection to phone system.
- Telephone number for the phone line that the AcquiLite will be attached to. (so you can call the AcquiLite)
- Make note of the AcquiLite dialin IP/Netmask for future use.
- A regular telephone for line testing and diagnostics

Hardware Overview

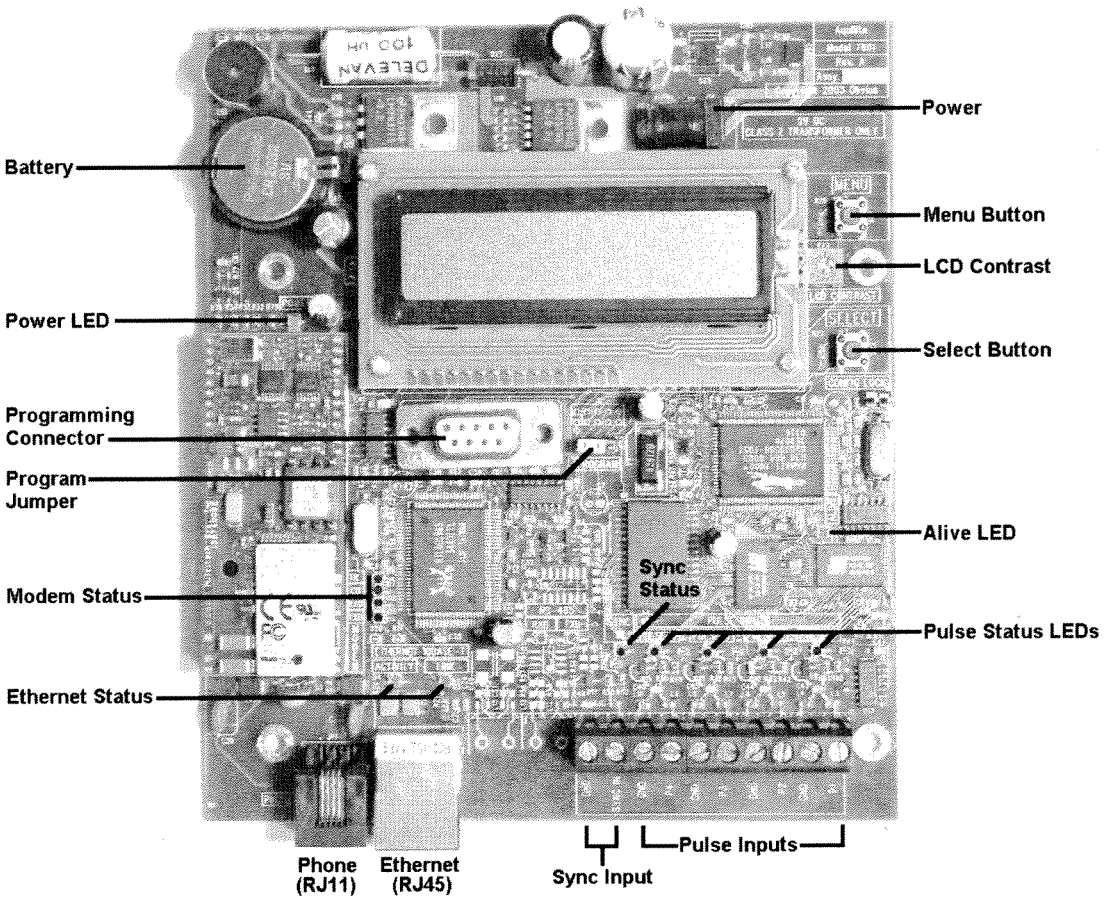
A7801 Features and Specifications

Processor	R2000 - 8bit embedded cpu, 22Mhz.
Memory	512K flash, 512k sram.
LED	4x pulse input, 4x modem activity, power, alive, Ethernet link/act
Console	2 x 16 LCD (passive), two pushbuttons
LAN	10base-T Ethernet, half duplex
Modem	V.34 bis, 33,600 bps
Protocols	TCP/IP, PPP, HTTP/HTML, NTP
Power Supply	12VDC, 500mA, class 2 wall brick transformer. North America: 110-120VAC, 60hz, primary. (standard, included)
Interval Recording	User selectable 1-60 minutes. Default 15 minute interval
Inputs[1]	
Pulse Inputs	4 pulse count inputs intended for use with dry contact outputs. (consumption/rate/runtime/status) Standard and KYZ modes for form A and C relay outputs Maximum rate: 10hz, minimum pulse width 50ms Contact closure threshold: 600Ω
Utility sync input	1x input intended for use with dry contact output.
Environmental	North America: Indoor, temperature 0° - 50°c, 0 - 95% humidity, non-condensing.
Size	8" x 9.25" x 2.5"

[1] inputs are intended for low voltage class 2 outputs.

[2] if the product is used in a manner not specified by the manufacture, the protection provided by the equipment may be impaired.

Electrical Connections



Hardware Installation

Step 1 - Unpack materials: Remove all materials from shipping box and verify all required components are available

Step 2 - Mount the AcquiLite on the wall or other appropriate location.

Step 3 - Connect the pulse output devices. For KYZ pulse output meters, attach the normally-open circuit to the AcquiLite. These are usually the K and Z terminals. Note: if the meter is a true KYZ meter (form C) you must check the kyz checkbox in the pulse input configuration page. Please refer to the pulse input section of this document for further details.

A special Sync Input contact closure input is provided for "End of demand interval" signal from the utility or other source. When this contact is closed, the AcquiLite will immediately begin a log cycle and record data for each meter. Using this pulse input will override the log cycle period option in the logger/setup configuration page. The terminal block and LED are labeled "Sync Input" in the electrical connections illustration above. The Sync Input status LED will blink whenever a contact closure is detected on this input.

Step 4 - Power-up and diagnostics: After power is applied, the green power light on the AcquiLite should come on and the LCD display will display a series of diagnostic screens ending with the following message on the LCD display (this boot sequence may require up to 10 seconds to complete):

```
AcquiLite Ready
192.168.40.44
```

This indicates that the AcquiLite has loaded properly and is ready for configuration and connection to the network and sensors. If the "power" light does not come on or the LCD display does not cycle to the above screen, verify that the power cord is plugged in. If after cycling the power the unit still does not power up (or if an error message appears in the LCD display) contact technical support.

The Alive LED should blink once per second during normal operation. Contact closure on pulse inputs will cause the red pulse status LEDs to blink. Verify each pulse input is functioning properly by observing the pulse status LEDs.

- **Alive:** The alive LED indicates the system is operating correctly.
- **Modem TR**: the modem is being monitored or operated by the AcquiLite, off when the modem is idle. This LED will be on when a dialout call is in progress, or when dialin is enabled and waiting for an inbound call.
- **Modem CD:** the modem has a carrier connection to a remote system.
- **Modem TX/RX:** data is being sent or received on the modem.
- **Ethernet Link:** The ethernet port is connected to another device such as an ethernet hub, or a computer with a crossover cable.
- **Ethernet Activity**: This yellow LED blinks when network packets are sent or received via the Ethernet port.
- **Pulse 1-4:** pulse input status, LED is on when contacts are closed.

Step 5 - If all devices are connected properly, it is now time to connect the server to the network or phone line for remote reporting and configuration.

Note: For normal operation, the program Jumper must be positioned to the right. (away from the Programming Connector). The programming connector is a standard DB9 RS232 serial port, and is only used to update the firmware in the AcquiLite. Please refer to the Firmware Update section of this manual for further information.

Basic Network Configuration

Step 1 - Determine the IP addressing needs: The IP address of the AcquiLite™ server can be implemented using one of three methods. Check with the network administrator to determine which method applies. For phone installations, use "direct connection to laptop" to allow initial configuration.

- Static IP address - this is a fixed IP address which is assigned by a network administrator and "hard-coded" into the AcquiLite; or
- Direct connection between the AcquiLite and a single temporary computer such as a laptop. (primary connection will be dialin or dialout by modem)

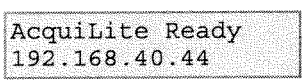
You will need the following information from your network administrator: The addresses will be in the form of "###.###.###.###"), where "#" refers to the numbers 0 to 9.

Network Address Worksheet:

Static IP Address	**Direct Connection to Laptop**
IP address: ___.___.___.___	IP Address: 192.168.40.44
Netmask: ___.___.___.___	Netmask: 255.255.255.0
Gateway: ___.___.___.___	Gatway: 192.168.40.1
DNS server: ___.___.___.___	DNS: 70.99.203.62
DNS server: ___.___.___.___	HTTP Proxy: [blank]
HTTP Proxy _____	(factory default settings)
proxy server port: _____	

Step 2 - Configure the IP address as selected from the table above. For Direct Connection to Laptop, the address settings above are set as the factory default, and you may be able to skip to the "Laptop/Computer Setup" section if the factory default settings are present.

To begin configuration, make sure that the server displays the start screen:



If this screen does not appear on the LCD display, press and hold the menu (top) button on the server for several seconds and the message should appear.

To change the IP address to the static address assigned by the network administrator, do the following:

A. Press the menu (top) button once to get the TCP/IP configuration menu

```
[Main Menu]
TCP/IP Config
```

B. Press the select (bottom) button once to get the IP config menu:

```
[TCP/IP Config]
IP Address
```

C. Press the select button again to see the IP address menu:

```
[IP Address]
192.168.40.44
```

D. At this point, the cursor on the display will be blinking on the first number in the IP address on the second line.

E. To change the number, press the menu (top) button and the display will cycle through the digits 0-9 as well as ".". Once the correct digit is displayed, press the select (lower) button to advance to the next digit and repeat the process until all the digits are correct.

F. Once the IP address on the server matches the assigned IP address, press the select (bottom) button once more to return to the main TCP/IP menu.

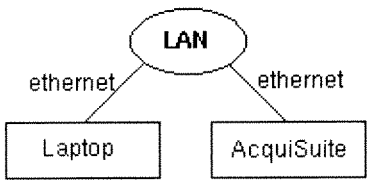
Step 3 - Set the Netmask, gateway, and DNS server address as noted in the chart "Network Address Worksheet" shown above by repeating steps A-E. The only change is that after Step B, press the menu (top) button multiple times to see the netmask setup menu, then push the select button to set the option.

Step 4 - After the address information has been set, the changes take effect immediately.

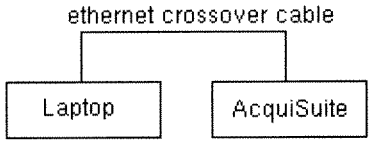
Laptop/Computer Setup

Step 1 - You must have a computer to access and configure the AcquiLite. This computer must have an ethernet connection (on the LAN or by direct connection) and must have a web browser installed such as Internet Explorer or Netscape.

Note: If your building already has an existing LAN that the AcquiLite is attached to, you can use that existing computer on that LAN. Check with your network administrator for details. If this option is available, use that computer and skip to step 10 below.



LAN connected AcquiSuite



Direct Connected AcquiSuite

The remainder of this section will assume the installer has brought a laptop to the site, and will connect the laptop to the building LAN, or directly to the AcquiLite. Attach the laptop to the AcquiLite or LAN as shown in figure 6, Ethernet hookup.

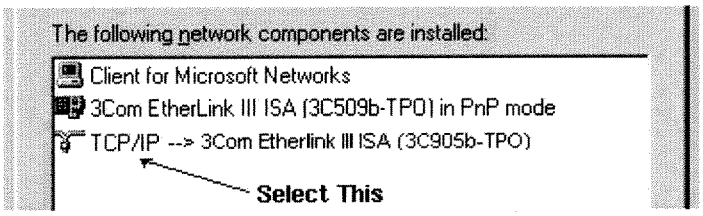
Step 2 - Attach the Laptop to the AcquiLite or to the LAN. If the Laptop is to be attached to an existing LAN, use a standard (direct) ethernet patch cable. If the Laptop is to be attached directly to the AcquiLite as shown in the second figure, use an ethernet "Crossover" cable.

If the Laptop is to be attached to an existing LAN, obtain a static IP address (or use DHCP addressing) from the network administrator.

Static IP Address for the laptop	**DHCP**	**Direct Connection to Laptop**
Specify an IP address IP address: ___.___.___.___ Netmask: ___.___.___.___	Obtain an IP address automatically. (All other required settings are assigned by the DHCP server)	IP Address: 192.168.40.1 Netmask: 255.255.255.0 (AcquiLite factory default settings)

Step 3 - Configure the laptop IP address using the following steps. Note: Only MS Windows is detailed below, however you can use any OS/Browser you wish such as MacOS or Linux. Details on network setup for non-windows operating systems is beyond the scope of this document however.

A. From the Windows start menu, select the "Settings/Control Panel" option. Double click the network icon in the displayed window.
   Note: If you are using Windows 2000 or Windows XP, select the 'Local Area' connection icon in the network folder, then click the "Properties" button.
B. In the network setup dialog, there should be a list of items including adapters, clients and protocols. Locate the protocol labeled "TCP/IP".
   Note: If you have multiple ethernet cards, you may have multiple lines labeled "TCP/IP --> ethernet card". Locate the ethernet card that corresponds to the physical connection to the AcquiLite and then select the TCP/IP option that is linked with that ethernet card.



C. Double click the TCP/IP option you selected in step B above. An example is shown in figure 8 above. Set the IP and Netmask from figure 7 (laptop network address worksheet) above. It would be helpful to make note of your previous settings in this dialog so you may set them back after you are done with the AcquiLite Configuration.
D. Close the TCP/IP settings dialog, and Network dialog. If you are using Windows 95, 98, or ME, you will be required to reboot your computer.

AcquiLite Administration Overview

The AcquiLite should now be available on the local area network for you to access using a web browser such as Internet Explorer or Netscape.

Step 1 - Use your web browser to connect to the AcquiLite by entering

http://192.168.40.44/setup/
Where 192.168.40.44 is the IP address displayed on the on the AcquiLite LCD display.

Step 2 - When prompted, use the following default login information

Login: admin
Password: admin

Step 3 - Your web browser should now display the AcquiLite configuration menu. To the left, a list of configuration options are available. On the right, a specific configuration page will be shown. The first page is a welcome message with some system status information. Proceed with the configuration of the AcquiLite using your web browser.

Step 4 – In the left side menu, under the accounts section, select the Admin account, and click 'Change Password'. All units are shipped with the same factory default password, and it should be changed to prevent unwanted access.

Step 5 - Expand the Networking option, and select setup. Verify the addresses are consistent with those in the "Network Address Worksheet."

Step 6 - Select the PulseInput/Setup menu option. Specify the System Loop Name. This will become the name of the AcquiLite. This is the name that will appear on the BMO website service (if subscribed). Specify the data logging period. The default is 15 minutes.

Step 7 – Decide upon a method of data transfer. (see section later in this document) . If you select the HTTP/Post method to send data to the BMO website, you can configure this by selecting the LogFileData/ SetupUpload page.

A. Make note of the AcquiLite serial number.
B. Select upload options as needed for time of day to upload the data and retry control.
C. Specify the "Target address to upload data." This is the website address where the AcquiLite will send the collected data. If you have an in-house data collection service, you should enter the address of your data server in this field. Obvius also provides a service called Building Manager Online that can collect and report data for you. If you are using the BMO service, the target address to upload data should be set to http://www.buildingmanageronline.com/upload.php
D. When configuring the AcquiLite to send data to the BMO site or your own data collection server, the AcquiLite will authenticate itself with the server by using the serial number and a password. This password must be supplied here, and can be obtained when you subscribe for the BMO service, or by your database administrator.
E. Click "Apply" to save your changes.

If you select a manual transfer method, remove (blank out) the target address in the LogFileData/SetupUpload page.

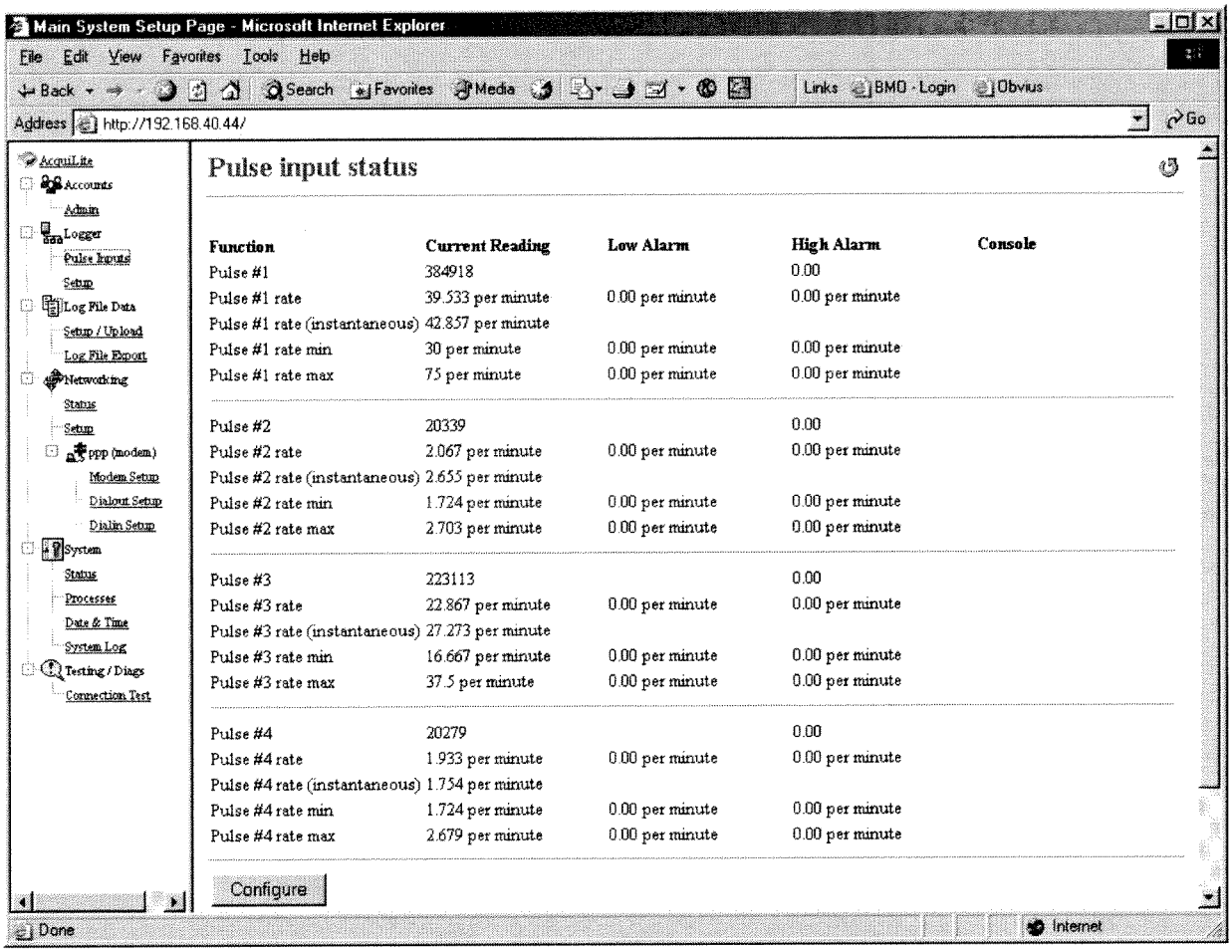
Security

The AcquiLite has one level of security. Once logged in, a user may change any of the AcquiLite settings. . When using a browser to access the AcquiLite, basic http authentication is used to prompt your browser for a username and password. The admin account uses "admin" as the default password. To change the password, select the Accounts menu from the left side tree display. Click the "Change Password" button to set a new password for the selected account.

Logger

Pulse Inputs - Status

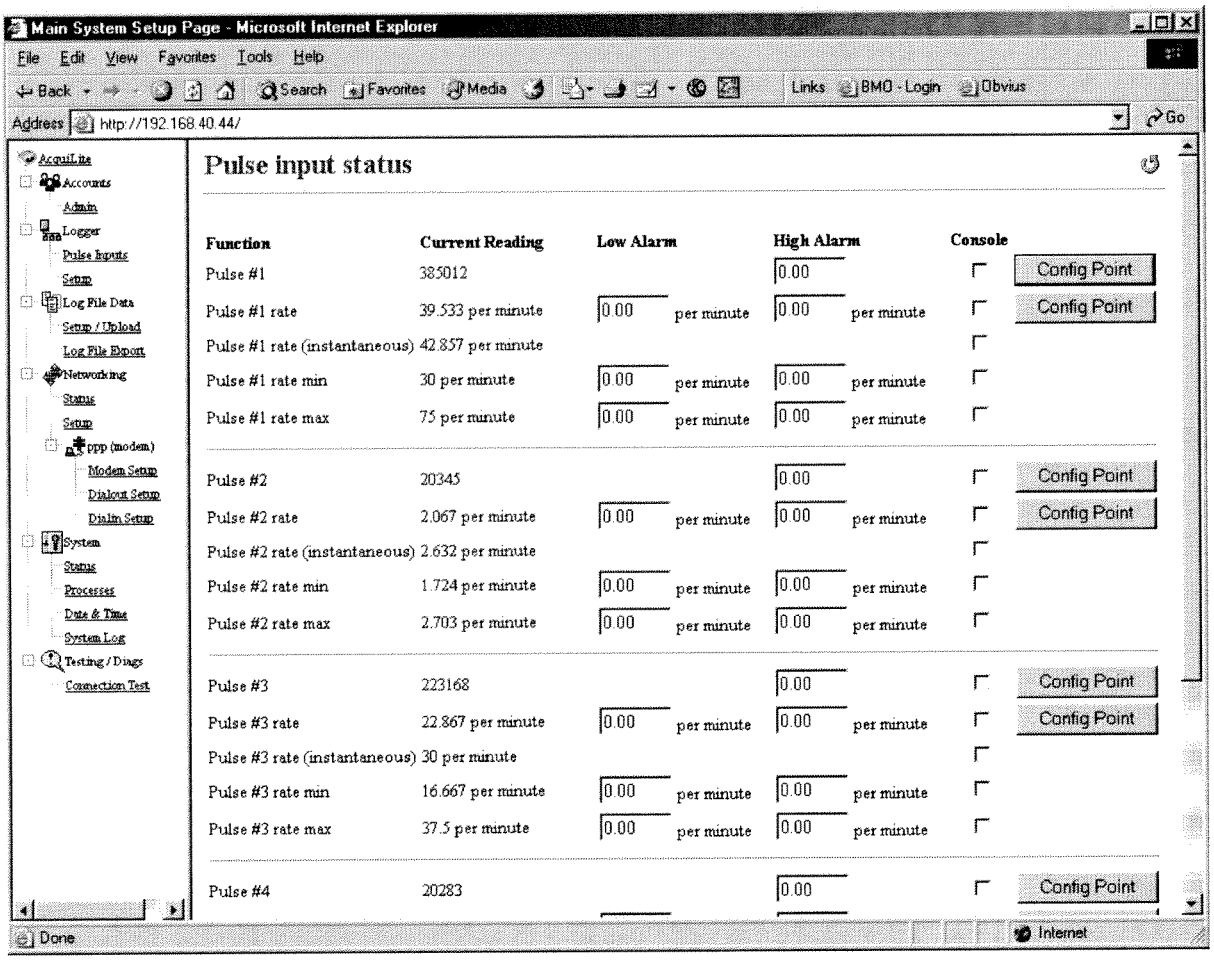
The pulse input listing page provides a view of all the data points that are present in the AcquiLite. These are grouped by the pulse input, numbers 1 through 4. The following screen shot shows this grouping.



For each pulse input, there are five data points. These are as follows:

- Consumption. This value is updated when a new pulse is counted by the AcquiLite.
- Rate of consumption: average rate during the log interval. For kwh, this is the block demand. This value is updated at the end of the logging interval.
- Rate instantaneous: the instantaneous rate based on how fast the last 5 pulses arrived. This value is updated when a new pulse is counted by the AcquiLite. This point may be invalid if no pulses were counted during the log interval.
- Rate Minimum: minimum instantaneous rate observed during the log interval. This value is updated at the end of the logging interval. This point may be invalid if no pulses were counted during the log interval.
- Rate Maximum: maximum instantaneous rate observe during the log interval. This value is updated at the end of the logging interval. This point may be invalid if no pulses were counted during the log interval.

To configure a pulse input, click the configure button at the bottom of the page. The page will be redrawn with options for alarm and pulse configuration.

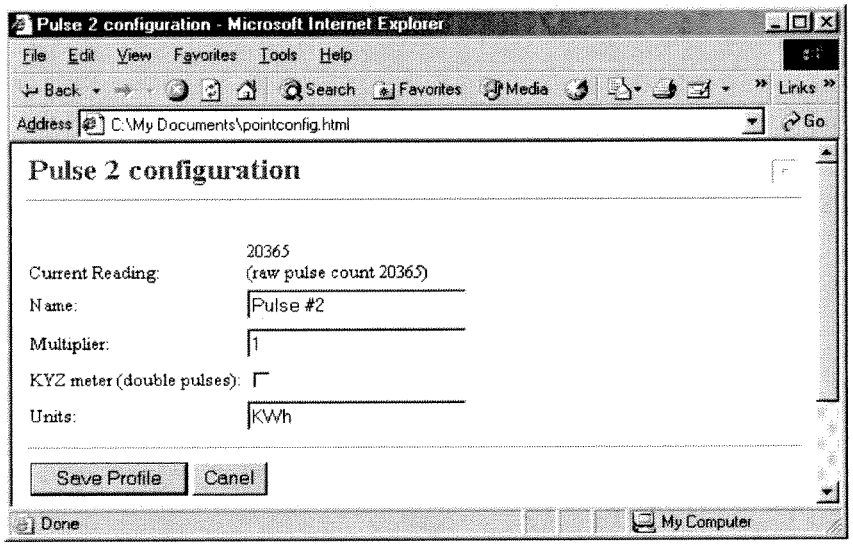


Set the alarm levels as needed. If both low and high alarms are zero, no alarm will be checked.

Check the "console" check box for data points that should be presented on the AcquiLite LCD screen. Names and values of these data points will be scrolled about every ten seconds on the LCD.

Pulse Input

Click the "Configure Point" button to the right of the pulse input consumption point as shown in the previous image.



In this configuration page, you may set the **name** of the pulse input. This will allow you to give the data point a name that represents the function of the meter. "Main Building Power" for example.

The **multiplier** is used to convert the pulses to engineering unit data. For example, if your meter provides one pulse per 0.01KWH, then a multiplier of 0.01 is required. Each model of power meter is different and has a different multiplier. You must obtain the correct pulse multiplier from the meter manufacturer prior to configuring the AcquiLite.

Some power meters have an option to configure the multiplier. Options often include 1, 0.1, 0.01, kwh per pulse. The best method to configure the pulse is to select the smallest multiplier available, considering the maximum load and pulse rate. To calculate the pulse rate,use the following formula:

pulses per second = KW ÷ 3600 ÷ multiplier.

For example, if you have a meter on a 100KW load and a multiplier of 0.01kwh/p

100KW ÷ 3600 ÷ 0.01 = 2.7 pulses per second.

The AcquiLite can count pulses at speeds of 5 pulses per second, however it is best to scale the pulse multiplier to that one pulse per second is the maximum rate. Counting pulses at a higher rate than 5 pulses per second will cause the AcquiLite to miss pulses.

The AcquiLite can count a maximum of 2^32 (4.295 billion) pulses. At a rate of 5 pulses per second, the AcquiLite counter will roll over in approximately 27 years. Needless to say, rollover should never be an issue.

The **KYZ** option, when checked, will cause the AcquiLite to count both the leading and trailing edge of the pulse. By default, this option is unchecked, and only contact closures are counted. (not contact openings). If you have a true KYZ meter, each opening is counted as a pulse, and each closure is another pulse. For further details on KYZ meters, please review the technote on the topic at www.obvius.com.

The **Units** field is used to configure the engineering units for this input. e.g. KWH, Gallons, Cubic Feet, etc.

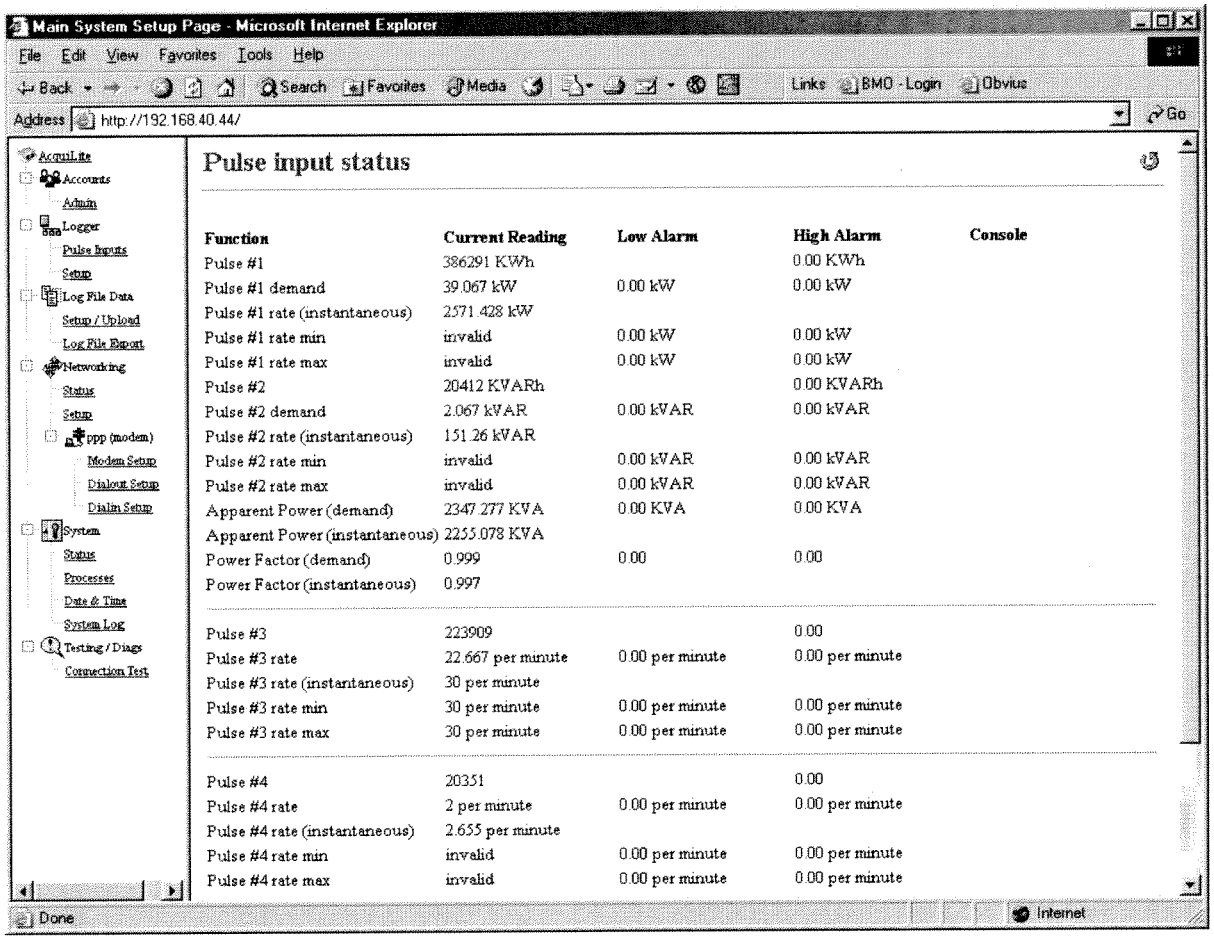
Pulse Input Rate configuration

A second "Config Point" button is present next to the pulse rate data point. This option will allow you to configure the unit of measure for the Rate point, as it pertains to the consumption point. For most units of measure, the rate is automatically calculated and this option will not be present. For example, if the consumption is measured in KWH, the rate will be KW.

To configure this option, click the Config Point button. You may select a rate "per minute" or "per hour" to correctly scale the measure. Thus, if your consumption units are "gallons", the rate will be "gallons per minute".

Pulse Grouping

The AcquiLite has the ability to track related pulse inputs from KWH and KVARH meters. To enable this, check the group option in the Logger/setup page. The following change will be shown in the Pulse Input – status page.



Notice that there are now four new data points after pulse inputs one and two. The AcquiLite will calculate the following based on the two points in the group.

- Apparent Power (demand): The apparent power is calculated at the end of the logging interval, that shows the average KVA during that period.
- Apparent Power (instantaneous): The instantaneous apparent power is calculated the same way as the demand value, however the instantaneous rate points are used in the calculation. This point is updated every time a new pulse arrives at the AcuqiLite inputs. This point may be invalid if no pulses were counted on either input during the log interval.
- Power Factor (demand): The power factor is calculated at the end of the logging interval, that shows the average during that period.
- Power Factor (instantaneous): The instantaneous power factor is calculated the same way as the demand value, however the instantaneous rate points are used in the calculation. This point is updated every time a new pulse arrives at the AcuqiLite inputs. This point may be invalid if no pulses were counted on either input during the log interval.

Note: when configuring the pulse inputs in a group, the KWH pulse input must be attached to input one or three, and the KVARH pulse input must be attached to input two or four.

Logger Setup

Serial Number: This is the Unique serial number of the AcquiLite. It is also used as the Ethrenet MAC address. The

Serial Number is used in all log file descriptors when uploaded to a central database website such as BMO.

System Name: This is the name of the AcquiLite. This name will be present on all log file descriptors when uploaded to a central database website such as BMO. It is helpful to name the AcquiLite based on the physical location of the system, or building.

Log Interval: This option sets the log interval for the AcquiLite. Options range from once per minute to once per hour. All of the selections are evenly divisible by one hour. The AcquiLite calculates the next log time by finding the next multiple of the log period past the start of the hour. For example, if the log period is 15 minutes, log readings will be taken at 0, 15, 30 and 45 minutes past the hour. The log period is not calculated based on "15 minutes after the last reading"

When the AcquiLite is first started, it will take an initial reading immediately. Following that, the next log reading will be calculated as a multiple of the log period after the hour. The initial reading is taken to allow the AcquiLite to gather information for meters that require demand calculations, as well as provide accurate information starting when the AcquiLite is booted.

Instantaneous calculation history: By default, the AcquiLite calculates the instantaneous rate of consumption based on how long it took for the last 5 pulses to be counted. You can change this to calculate based on the last 2 to 20 pulses. Setting this to a smaller number causes the instantaneous rate to jump around in value more than a larger number.

Group KWh/KVARh inputs 1 and 2, (and 3+4): point 1=kwh, point2=kvarh, calculate kva, and power factor for the 'group'. For further details, see the previous section on point groups.

Demo Mode: When checked, the AcquiLite will generate pulses internally, and blink the pulse input LEDs. This is useful for demonstrating the AcquiLite to a customer, or creating log data to review the log file formats. This option should not be enabled in devices that are deployed as working units.

Networking

Network Status

This page displays the current status of the AcquiLite network connections. The basic network address and netmask will be shown for both the ethernet connection and PPP connection. If the AcquiLite has not made a PPP connection, the PPP address and gateway will be zero. Otherwise it will show the value of the current or last connection.

```
Gateway address: 192.168.40.1
DNS: 70.99.203.62

Interface table:

# IP addr.         Mask             Up  Type  MTU  Flags  Peer/router
- --------------- ---------------- --- ----- ---- ------ ---------------
0 192.168.40.44   255.255.255.0    yes eth    600 *      192.168.40.1
6 0.0.0.0         255.255.255.255 no  ppp    600        0.0.0.0
```

Ethernet setup

The ethernet setup page has the following options:

- IP Address: The ip address of the ethernet interface: Default 192.168.40.50
- Netmask: The netmask of the ethernet network. Default 255.255.255.0
- Gateway Address: The gateway is the routing device that moves traffic from the LAN to the internet. The default is 192.168.40.1. If you do not have an internet connection for your lan, or you are using a crossover ethernet cable, leave this field blank.
- DNS: This is the DNS server address. If you are using a dialout connection, these will be overridden by the address provided by your dialup isp. If you only use the AcquiLite on a crossover cable and/or dialin mode, you should leave these blank.
- HTTP Proxy. If your LAN is connected to the internet using a sophisticated firewall, you may need to use the HTTP proxy feature. Check with your LAN administrator first, however if you don't have a proxy set on your computer (MSIE/Tools/Connections-tab/LAN-Settings) then you most likely don't need to configure the AcquiLite to use a proxy.

If in doubt, leave this blank first, and try the connection test. If it fails, ask your LAN administrator about proxy servers, if any.

After changing any of the settings on this page, you will be required to reboot the AcquiLite Use the system/status web configuration page, or the LCD console to reboot the AcquiLite.

Troubleshooting Ethernet Problems

After reconfiguring the ethernet settings you experience problems accessing the AcquiLite with your web browser, check the following items.

- Verify that you rebooted the AcquiLite after making the changes to the network settings.
- Use the AcquiLite LCD console. Check the IP address and Netmask. Verify these are correct.
- Verify the network connection in your computer has the proper IP address, on the same subnet, to access the AcquiLite.

Modem Setup

This configuration option will allow you to configure specific features in the modem if needed. For most applications, the default settings are ok. The options are as follows:
Modem type: multitech: A MultiTech modem was detected. (default on all A7801 AcquiLite devices)
Modem Speed: Select the maximum baud rate to use. On noisy phone lines, try setting this to 14.4kbps for a more reliable connection.
Modem setup string: This option allows the use of specialized modem setup strings. The default "AT" is sufficient for most applications. Click the "use default" button to enter the default setup string.
Speaker Volume: This option sets whether the speaker is on or off.

Modem PPP Dialout

The AcquiLite has a dialout feature that will allow the AcquiLite to place an outboud call and upload data to a central database server. If the dialout feature is enabled, the dialout connection will be initiated before the data upload process is started. Dialout connections allow the AcquiLite to connect to a generic PPP server such as a RAS system, or an internet service provider (ATT Worldnet, Earthlink, Netcom, etc.) Internet services that require custom software such as AOL, Juno, and ATT Global are not supported. To test if a dialup service is supported, simply use the MS Windows built in dialup-networking feature and attempt to establish a connection. If successful, the AcquiLite should work with the service. You may wish to test the dialup account phone number, username and password with windows first to verify that the account works correctly.

Enable/Disable: turn on or off the ability to place an outbound call to an ISP. Note, when enabling this feature, the default gateway in the network setup webpage is removed. You must reboot after enabling or disabling dialout support to make the change take effect.
Phone number to dial: This is the phone number to call. A comma can be used to pause for 1 second, useful after dialing 9 for an outside line.
Username: the login or username of the dialup account at your ISP.
Password: The passowrd for the ISP account.

Example Dialout to an ISP or RAS

The AcquiLite has the ability to place phone calls to a Remote Access Server (RAS) or ISP in order to upload data that has been collected from the pulse output devices. This feature is useful when using the AcquiLite on a phone line with the Building Manager Online service, or with your own data collection server. Dialout configuration is not useful if you do not have a central database server to send the data to.

Step 1: Collect the necessary information. You will need some details about the ISP or RAS you will be calling.

Dialout server details

Dialout prefix and long distance access code (if needed) ie dial 9 for an outside line _____
ISP or RAS telephone number: _____
ISP or RAS DNS server: ___.___.___.___ (optional)
ISP or RAS login name _____
ISP or RAS password _____

Dialout worksheet

Step 2: Plug a regular telephone into the phone line that the AcquiLite is to use. Verify the line has dialtone. Attempt dialing the ISP or RAS phone number, and confirm a modem answers the phone. If so, hangup, attach the AcquiLite to the phone line and proceed to the next step.

Step 3: Select the Network/PPP0/ModemSetup option from the AcquiLite configuration webpage. Set the "setup string" by clicking on the "use default" button. The default is simply "AT". Set the "limit carrier speed" option to 33600. If the phone line is noisy, and dialout connections are failing, you may want to reduce this setting. Click apply changes to save the setting.

Step 4: Select the Network/PPP0/DialoutSetup option from the AcquiLite configuration webpage. Verify the basic configuration page is shown (the default). If the "show basic" button is present in the lower right, click it to reduce the number of choices to the following.

A. Check the box to enable dialout.
B. Enter the phone number in the space provided.
C. Enter the login name and password to the isp dialup account in the space provided.
D. Click Apply Changes to save the settings.

Step 5: Select the Network/Setup option from the AcquiLite configuration webpage. Set the DNS server(s) to the addresses provided by your dialup ISP account provider. Click the "Apply" button to save your changes. You will be prompted to reboot the AcquiLite for the changes to take effect. The DNS server address is required for dialup connections to be able to locate the buildingmanageronline.com website for data uploading. Reboot the AcquiLite (using the system/status page, or the console pushbutton menu.)

Step 6: Use the Connection Test page in the Testing/Diags menu on the AcquiLite for a full report of the dialout connection progress. Even if you are not using the BMO service, you can still test dialout with this feature. You may however receive an error that the AcquiLite is not allowed to transfer data to the BMO server. Further information on the connection test is provided in the connection test section of this manual.

Modem PPP Dialin

The AcquiLite is designed to allow incomming connections from any generic PPP system including MacOS, Linux, Windows 9x, XP and 2000. The dialin feature is disabled by default, and must be enabled from LCD console or the dialin options menu in order to receive calls. Dialin options include the following.

Enabled: Check this checkbox to enable dialin support. When checked, the AcquiLite will answer any ring on the phone line, after the first ring. If not checked, the AcquiLite will never answer a ring on the phone line.

Local IP address: This is the IP address assigned to the AcquiLite side of the dialin connection. This address is the one which you must use on the computer in the web browser address line when remotely accessing the AcquiLite with a dialin connection. The default is 192.168.238.1

Remote IP address: This is the IP address assigned to the calling computer. The default is 192.168.238.2

Netmask: The netmask that defines the subnet for both the local and remote ip addresses. The default is 255.255.255.0

Unless you have specific requirements, the default IP, remote IP and Netmask should be sufficient.

Example Dialin from a Win98/ME computer

The AcquiLite has the ability to receive and answer phone calls from a Windows computer in order to allow remote configuration, or to collect data that has been logged from the pulse output devices. This feature is useful when using the AcquiLite on a phone line and a central database server is not present. The dialin feature will support the Windows builtin dialup networking features, and can be used as easily as a dialup ISP service.

Step 1: Collect the necessary information. You will need some details about the ISP or RAS you will be calling.

Dialin details

A dedicate phone line is required, and can not be shared with a fax machine or other device.
Telephone number: _____ (the phone line the AcquiLite is attached to)
Static IP address: 192.168.238.1 (the AcquiLite PPP IP address)
Static Netmask: 255.255.255.0
Remote Address: 192.168.238.2 (the IP address assigned to the calling computer)
Admin password: _____

Dialin Address Worksheet..

Step 2: Plug a regular telephone into the phone line that the AcquiLite is to use. Verify the line has dialtone. Use a second telephone and dial the AcquiLite phone number and verify the first telephone rings, and can be answered. If it does not ring, verify the telephone number dialed is actually associated with physical phone line. If the line tests ok, hangup, attach the AcquiLite to the phone line and proceed to the next step.

Step 3: Select the Network/PPP0/ModemSetup option from the AcquiLite configuration webpage. set the "setup string" by clicking on the "use default" button. Click apply changes to save the setting.

Step 4: Select the Network/PPP0/DialinSetup option from the AcquiLite configuration webpage.

A. Check the "dialin enabled" option
B. Set the IP, Netmask, and Remote Address as shown in Figure 9 - Dialin Address Worksheet. The IP addresses shown (factory default) will work for most dialup connections. If you make changes to the IP address, make note of it for future use.
C. Click "Apply" to save your changes.

Step 5: Dialing into the AcquiLite with Windows:

A. From a Windows 95/98/ME computer, select the Start Menu, and then select the Control Panel. Double click the "dialup networking" folder.
B. Click "Make a new connection"
C. Name the connection with an appropriate name for the AcquiLite. Click Next.
D. Enter the phone number used to call the AcquiLite as shown in the Dialin Address Worksheet. Click Next, then Finish.
E. Double click the new connection icon in the dialup networking folder.
F. Verify the phone number is accurate
G. Enter "admin" as the login name, When prompted, enter the password to the AcquiLite admin account. (default is "admin"
H. Click Properties to show a configuration dialog for the connection.
I. Click the Network tab, verify the dialup server type is "PPP" and the TCP/IP protocol is the only item checked in the "allowed protocols area"
J. Click TCP/IP Properties, and verify the connection uses a server assigned IP address.
K. Click OK to close this dialog.
L. Click the "Connect" button to dialin to the AcquiLite.

Once the connection is established, use your web browser to connect to the AcquiLite by entering

http://192.168.238.1/setup/
Where 192.168.238.1 is the Static IP address listed in the Dialin Address Worksheet.

Your browser will now be able to access the AcquiLite the same way as you did in the LAN/Direct Connection setup in previous sections of this manual.

Example Dialin from a WinXP computer

The AcquiLite is designed to allow connections from any generic PPP system including MacOS, Linux, Windows 9x, XP and 2000.

We have found that windows XP/2000 has a timeout issue that affects some computers but not others. When calling the AcquiLite with windows XP/2000 you may receive an error message stating that a loopback error was detected, preceded by windows hanging up promptly after connecting to the AcquiLite. If that is the case, a slight delay in the dial process for windows will correct the problem. Adding this delay in a dial script is detailed in steps #1 and #3 below. It is recommended that you test the dialout configuration first without the delay script first, and add it only if required.

Step 1: (optional) Using notepad, create a text file called "c:\windows\system32\ras\AcquiLite.scp". In that text file, add the following script

```
proc main
```

```
    delay 2
endproc
```

Save and close the file

Step 2: Create a windows networking connection.

A. From the control panel, select Network Connections. Click "Create a new connection"
B. The "Connection Wizard" will appear with a welcome screen and no options. Click next.
C. Select "Connect to the internet" and click next
D. Select "Set up my connection manually" and click next
E. Select "Connect using a dialup modem" and click next
F. Enter "My AcquiLite" for the ISP name. (you may want to name each AcquiLite connection by the name of the building where it resides.) Click next.
G. Enter the phone number of the phone line attached to the AcquiLite. Click next.
H. Enter "admin" for the username, and the admin password in the password field. Uncheck the option "Make this the default internet connection." Click next.
I. The connection wizard will show you that the setup is complete. Click Finish.

Step 3: (optional) Configure connection details.

A. Right click on the "My AcquiLite" connection icon you created in step 2 above. (you may also click the properties button in the dialout dialog box.
B. General Tab: defaults are ok.
C. Options Tab: Verify the option "include windows login domain" is not checked. Set any timeout values if desired.
D. Security Tab: Security: Use "Typical", allow unsecured password. At the bottom of the dialog box, in the section "Interactive Login and Scripting". Check the "Run Script" checkbox. Click the browse button below the script name. Select the AcquiLite.scp file created in step one above. Click the open button. The script name should appear to the right of the Run Script checkbox.
E. Networking Tab: defaults are ok.
F. Advanced Tab: defaults are ok.
G. Click Ok to save the changes.

Step 4: Dial the connection.

A. Double click the "My AcquiLite" connection icon.
B. Complete the password field if it is blank. The password is the Admin password of the AcquiLite.
C. Click the dial button. The modem usually takes between 40 and 60 seconds to establish a connection.

Once the connection is established, use your web browser to connect to the AcquiLite by entering

http://192.168.238.1/setup/
Where 192.168.238.1 is the Static IP address listed in Figure 9 - Dialin Address Worksheet.

Your browser will now be able to access the AcquiLite the same way as you did in the LAN/Direct Connection setup in previous sections of this manual.

System Options

Status

The system status page shows the current memory and flash disk utilization values, system up-time, battery status, and current time.

Processes

The system process table is shown in both tree and tabular formats. The process list is useful when contacting Obvius technical support.

Date and Time

The AcquiLite keeps time using UTC or Universal time. All log files are recorded in UTC time as well. Timestamps shown on the AcquiLite local configuration pages are converted to local time for the convenience of the installer. The date/time

configuration page provides the following options.

Date/time in UTC and Local time. Use the dropdown menu to set the time manually if needed. (click apply when done)

Time Server: Specify the dns name or ip address of your time server. The default "time.obvius.com" can be used if the AcquiLite has a connection to the Internet. The AcquiLite will attempt to synchronize time with the time server every time an upload session. This will ensure that the clock is checked and adjusted at a minimum of once per day. Typically, the synchronization will align the clock to within +-1 second of the internet time source or atomic clock. You may need to verify if your firewall will allow NTP packets to pass through. Generally, it is better to use a local time server if possible. The time server time.obvius.com supports both NTP and Rdate time protocols.

Note: the AcquiLite only supports the NTP time protocol.

Universal Time Is Your Friend

Log data is stored in UTC time. This allows data collection services such as BMO to collect data from multiple sites in different time zones. If you are operating your own database system to store log data from the AcquiLite, it is best to store the data in UTC time in the database as well, and only convert it to local time when generating the final report or graph for the user.

If you store data in Local time, you will have the following issues.

1) Local time is relative. Is Local the time where the AcquiLite exists, or Local to where the data is stored. If local to the AcquiLite, you must shift each AcquiLite data set depending on its location.
2) There are about 11 time zones in the US. Some observe DST, others do not. These include Alaska, Aleutian, Arizona, Central, Eastern, Hawaii, Indiana, Michigan, Mountain, Pacific, and Samoa.
3) When converting to local time, there will be one hour of overlapping data in the fall when the time is adjusted for Daylight Savings time. ie, log entries run 12:45, 1:00, 1:15, 1:30, 1:45, 1:00, 1:15, 1:30, 1:45, 2:00am. This will prevent you from sorting your data by time in your database.
4) In the spring, you will have a gap in the data from 1:59 to 3:00am. This can cause problems if you are calculating demand values based on consumption.
5) Converting Local time to any other timezone usually involves converting it to UTC first.

Using UTC time solves these problems elegantly. The best practice is to store data in the database in UTC format and then convert the information when generating a report for the user.

For example, if you wish to draw a graph of KW over Time, prompt the user for a date range, say Jan 1 midnight to Jan 2 midnight. Take the user specified end points and convert these times from Local time to UTC. Next, create an SQL query using the new UTC formatted data as your select statement. ie:

SELECT * from TABLE where time > '2003-01-01 08:00:00' and time < '2003-01-02 08:00:00'

Note the time is 8 hours ahead of local time. This example is for Pacific which is 8 hours off from UTC. This will return a list of data points between the two specified time ranges. Next, plot the data on a graph, using the UTC times for start and end points. Lastly, when drawing the 'time' legend on the graph, convert the values back to Local time before displaying. Ie, 2003-01-01 00:00:00 to 2003-01-02 00:00:00. Any division lines on the time axis can be handled the same way. The advantage of using this technique is that it will properly draw a graph across DST change boundaries. The graph axis is based on UTC time with no DST, and will not show a gap or overlap a the time of the change. The axis labeling will be correct as well, matching the UTC times precisely.

Another way to handle the conversion is to query and convert all the returned timestamps to local time before drawing the graph. This is useful if you do not have detailed control over the graph legend drawing process. This technique will not properly graph across DST changes as the graph is based on local time including DST changes.

System logs

The AcquiLite can keep several log files that report the general operation of the system, not related to the normal data logs. These include the following:

- System Messages: A list of system log messages related to the operation of the AcquiLite. These include the upload log messages, dialin/out, time changes, and any system errors that have ocurred.
- Logger Configuration File: This page allows you to view, in text format, the configuration options of the system.
- Pulse input configuration file: This page allows you to view, in text format, the configuration options of the pulse inputs.

- Pulse log data (html): This page will allow you to view, in a web page, all the stored pulse log data on the AcquiLite.
- Pulse log data mb-001.log (export) This page will provide the pulse log data in text (csv) format. You may need to right-click on the mb-001.log link and select "save target as" from the menu to save the log data to your computer hard disk.

Purge Log Files: This button will clear all the system log files listed on this page, but not the meter data log files. (deletes kernel, boot, ftp, messages, upload log files)

Diagnostics

Connection Test

The connection test page will attempt to establish an HTTP session with the specified upload server. Click the "begin test" to start this process. Information will be printed in black. Success responses will be printed in Green, failure messages will be printed in Red. A sample upload test follows:

```
Note: Use the System/SystemLog page to set the log report level to Debug for more detailed information.
'2004-03-13 00:03:59',upload,INFO,ProcessUpload: Starting session: v0.04.0312b
'2004-03-13 00:03:59',upload,INFO,ProcessUpload: Logfile upload attempt 1 (max 3) started.
'2004-03-13 00:03:59',upload,INFO,ProcessUpload: HTTP session trace enabled.
'2004-03-13 00:03:59',upload,INFO,ProcessUpload: PPP Dialout disabled, connecting by Ethernet LAN.
'2004-03-13 00:03:59',upload,INFO,GetConnectionDetails: Upload URL looks ok,
                                  resolving address for www.buildingmanageronline.com
'2004-03-13 00:04:02',upload,INFO,SendAcquiLiteStatus: sending info to remote server.
'2004-03-13 00:04:02',upload,INFO,TCPConnect: connecting to server at 70.99.203.62:80
'2004-03-13 00:04:03',upload,INFO,ReadUploadResult: Finished reading data from remote host.
'2004-03-13 00:04:03',upload,INFO,ReadUploadResult: Got: SUCCESS
'2004-03-13 00:04:03',upload,INFO,SendAcquiLiteStatus: AcquiLite status information was uploaded.
'2004-03-13 00:04:03',upload,INFO,UploadAllLogFiles: creating log file to upload
'2004-03-13 00:04:03',upload,INFO,UploadAllLogFiles: Start upload 3 records
'2004-03-13 00:04:03',upload,INFO,TCPConnect: connecting to server at 70.99.203.62:80
'2004-03-13 00:04:03',upload,INFO,SendDataFile: original log filesize = 291,  total bodysize = 1479
'2004-03-13 00:04:04',upload,INFO,ReadUploadResult: Finished reading data from remote host.
'2004-03-13 00:04:04',upload,INFO,ReadUploadResult: Got: SUCCESS
'2004-03-13 00:04:04',upload,INFO,UploadAllLogFiles: 3 Log data records were uploaded successfully
'2004-03-13 00:04:04',upload,INFO,UploadAllLogFiles: Finished file upload procedure.
'2004-03-13 00:04:04',upload,INFO,SyncAllConfigFiles: Starting config file sync with remote server.
'2004-03-13 00:04:04',upload,INFO,TCPConnect: connecting to server at 70.99.203.62:80
'2004-03-13 00:04:05',upload,INFO,GetConfigManifest: finished sending manifest request, reading result.
'2004-03-13 00:04:05',upload,INFO,GetConfigManifest: config file loggerconfig.ini checksum match.
'2004-03-13 00:04:06',upload,INFO,GetConfigManifest: config file mb-001.ini differs
'2004-03-13 00:04:06',upload,INFO,GetConfigManifest: local file is newer by 31418 seconds.
'2004-03-13 00:04:06',upload,INFO,SyncAllConfigFiles: Remote configuration files are allowed.
'2004-03-13 00:04:06',upload,INFO,GetConfigManifest: config file manifest download complete
'2004-03-13 00:04:06',upload,INFO,TCPConnect: connecting to server at 70.99.203.62:80
'2004-03-13 00:04:07',upload,INFO,SendConfigFile: Start upload mb-001.ini
'2004-03-13 00:04:08',upload,INFO,ReadUploadResult: Finished reading data from remote host.
'2004-03-13 00:04:08',upload,INFO,ReadUploadResult: Got: SUCCESS
'2004-03-13 00:04:08',upload,INFO,SendConfigFile: config file uploaded successfully
'2004-03-13 00:04:08',upload,INFO,SyncTime: adjusted clock drift 0 seconds
'2004-03-13 00:04:08',upload,INFO,ProcessUpload: Upload process completed in 9 seconds
'2004-03-13 00:04:08',upload,INFO,ProcessUpload: Upload results: 2 ok, 0 fail
'2004-03-13 00:04:08',upload,INFO,ProcessUpload: Next upload scheduled for Mar 13, 2004 0:12:08 UTC.
```

Note in the last section where SUCCESS is indicated. (highlighted in this example for clarity).

LCD Console

The AcquiLite has an LCD console and two push buttons labeled "menu" and "select". These can be used to configure some of the basic features of the AcquiLite. The intended purpose of the console is to configure the AcquiLite to a point where a computer can communicate with it for further detailed configuration.

When the AcquiLite is running, it will show "AcquiLite Ready" and the current time alternated with the ethernet IP address. If you choose to enable the console display of data points, the LCD will also show the selected point names and current reading values. The display will change to the next listed item about once every 10 seconds. If a data point name is longer than will fit on the 16 character wide display, it will be scrolled. Pressing the select button will cause the display to change to the next configured item. Pressing the select button quickly will skip through multiple display points.

Pressing the Menu button will cause the main menu to appear. Once [Main Menu] is shown on the console, the menu button will change the menu option, and the select button will take action on the currently displayed option. Some options provide sub menus, others allow you to edit the option value. The following is a tree display of the main menu and sub menus.

```
[Main Menu]
TCP/IP Config
          [TCP/IP Config]
          IP Address
          Netmask
          Gateway
          DNS Server
          (previous menu)
Dialout
          [Dialout]
          Dialout On/Off
          Phone Number
          Username
          Password
          (previous menu)
Dialin
          [Dialin]
          Dialin On/Off
          (previous menu)
Data Upload
          [Data Upload]
          Show Serial#
          Upload URL
          Upload Password
          Retries
          Upload Now
          (previous menu)
System
          [System]
          System Name
          Log Interval
          Demo Mode
          Show Firmware
          (previous menu)
Shutdown
(previous menu)
```

The **TCP/IP sub menu** will allow you to configure the ethernet settings for the AcquiLite. To edit the IP settings, use the menu button to change options, and press the select button to edit the option. Once selected, you will see the curent value displayed and a blinking square cursor on the first character. Press the menu button to change the character or digit. Press the select button to use the digit and move the cursor to the right one space. If you press the select button multiple times, the cursor will move right a similar number of spaces, allowing you to skip over characters that may be correct based on the previous settings. When you are finished entering the IP address, select a blank space with the menu button, and press select. Any characters still remaining to the right of the cursor will be eliminated. (ie, if changing 128.193.100.200 to 10.0.0.1, the new ip address will be several digits shorter than the old one.

Dialin: This menu provides the ability to enable or disable dialin support. From the console, the installer can enable dialin support and allow a remote user the ability to call the AcquiLite and configure the options without requiring a computer on site. For more information on connecting to the AcquiLite review the "Modem/PPP Dialin" section of this manual.

Shutdown: This option will stop the data logging processes and secure the flash memory. When secured, the console will state that the power may be disconnected. It is important to shut down the AcquiLite cleanly prior to disconnecting the power from the device. It is important to select this option before removing the battery from the AcquiLite.

The AcquiLite has an advanced menu that can be used to perform system checks and clear all configuration options to the default settings. To access the advanced menu, wait until the LCD shows "AcquiLite Ready" and press both the Menu and Select buttons at the same time. Hold both down together for about 10 seconds. When the advanced menu is displayed, you may release the two buttons. The following is a tree display of the advanced menu.

```
[Advanced Menu]
Reset Config
Clear Log
(previous menu)
```

The **Reset Config** option will remove all the user settings, data, and passwords that have been configured and will return the AcquiLite to the factory default settings. This is mainly useful when reconfiguring an AcquiLite that has been used previously on a different job or project.

Log File Data

The AcquiLite stores interval data in non-volatile memory. The system battery maintains this memory when the power is disconnected. When the memory is 100% full, the oldest data records are overwritten by new records. The system can store approximately 37 days of data when logging every 15 minutes.

Log File Status

The AcquiLite can display a list of log files in the "log file data/status" web configuration page. A bar graph will show the amount of storage capacity that is used by the existing log data.

Log File Format

Once you have downloaded the data from the AcquiLite, you will need to process it. The file is an ASCII text file with comma delimited data. One line is recorded for each log cycle.

```
'2002-01-31 18:30:00',0,0,0,-0.00,89.29,39.05,49.11,0,0,0,0
'2002-01-31 18:35:00',0,0,0x02,-0.01,104.24,39.05,49.11,0,0,0,0
'2002-01-31 18:40:00',0,0,0,NULL,87.82,39.05,49.11,0,0,0,0
'2002-01-31 18:45:00',161,NULL,NULL,NULL,NULL,NULL,NULL,NULL,NULL,NULL,NULL
```

In this example, the first line shows a regular log entry. The second line shows a high range alarm for data point 2. The third column shows point 1 as invalid, and the fourth line shows the time when the AcquiLite was rebooted.

Notice the following columns are shown.

1. Date/Time in UTC (GMT) time. This field is quoted to handle the space in the middle. The format is YYYY-MM-DD HH-MM-SS
2. Log error (if any). 0=no-error, see table below.
3. Low Range alarm bitmap (hex notation).
4. High Range alarm bitmap (hex notation)
5. Data point 1
6. Data point 2
7. - - -
8. Data point N

Comments:

Date/Time: The date/time column reports the time at which data was logged from the pulse input device.

The log date/time is in Universal time. (UTC) This means that the data is logged with no shift for daylight savings time, and must be converted to local time for reporting purposes. When importing into a database, data should be kept in UTC time for ease of use. When reporting the final data, you should adjust the time to reflect the local timezone for which you are reporting. The data export option on the BMO website will prompt you for a timezone when you export the data, and will adjust the log date/time accordingly. Note: UTC is sometimes referred to as GMT. (Greenwich Mean Time)

Error: If the error value is not 0, the remainder of the columns for this line will be reported as NULL.

160 Start log (Entry in log file after AcquiLite starts up)
161 Stop log (Entry in log file if AcquiLite is shut down properly)

Low/High Range Alarms: This number is a hex representation showing which data points are out of range. 0x01 shows

data point 1 in alarm state. 0x04 shows data point 3 in alarm state.

Data Points: Data points are shown in the same order as the pulse input configuration display in the AcquiLite configuration web page. Data is displayed in floating point form. When a specific point is unavailable (4A4P-M broken wire alarm) or the point is not supported as part of the configuration (phase B current on a single phase H8163 meter hookup) the point will be logged as NULL. This preserves the column structure of the file, and allows notation of invalid data. SQL databases often accept NULL as a valid entry in a data table to represent invalid data.

For data exported from the BMO website, the columns that are invalid (NULL) are reported as blank fields. This makes it easier to import into MS Excel as blank cells. At some point in the future, the AcquiLite will be converted to report blank fileds rather than "NULL" to make direct import of data from the AcquiLite easier, as well as reduce the file size. Developers intending to use data files from the AcquiLite should handle both the word "NULL" as well as a blank column as indications of an invalid data point.

Log Storage Capacity

The AcquiLite stores approximately 3500 interval data records. At a 15 minute logging interval, this will allow about 37 days of data to be collected.

Uploading data to the BMO website.

After the AcquiLite has been configured and has logged some data, you will want to collect the data for analysis. There are several ways of collecting the data from the AcquiLite including the Building Manager Online service. Other methods are noted in the data collection FAQ. This section details configuring the AcquiLite for use with the BMO service.

Step 1: First, use your browser to connect to the AcquiLite. Select the logger/setup page and in the "System Name" field enter a name for this AcquiLite to uniquely identify it on the BMO website. Because the BMO site can show multiple AcquiLite devices, it is important to have a descriptive name in this field.

Step 2: Select the Upload Data menu option. The following features are available:

- **AcquiLite Serial Number:** This is the serial number that uniquely identifies this AcquiLite. This number can not be changed. When uploading data to the BMO website, this serial number is used to identify the AcquiLite to the BMO server.
- **Scheduled upload time:** This option allows you to control when the AcquiLite will initiate the upload process. You can select any hour of the day, and the AcquiLite will select some time at random within that hour to start the upload. The random feature allows multiple AcquiLite devices to share a single dialup account or phone line by not starting the dialout at the same time for all devices. If the AcquiLite is on a LAN connection (DSL, Cable Modem, T1, etc) an upload time of "hourly" may be selected.
- **Upload data on alarm status change** will cause the AcquiLite to initiate the upload process if any point on any pulse input data value enters or leaves an alarm state. This allows the AcquiLite to send data when an alarm is detected, and will upload that information to the BMO website in a timely manner. The BMO website will then send email notifications if necessary. If this option is disabled, the BMO website may not be able to send notifications until the end of the day when the AcquiLite calls in at its specified upload time.
- **Upload data on low disk alarm:** This feature will cause the AcquiLite to attempt a data upload immediately if the log file storage area is more than 75% full.
- **Allow remote device configuration:** If enabled, users may remotely configure alarms, multipliers, and other system features on the BMO website. When the AcquiLite uploads data to the BMO website, it will also download any new configuration information as needed. Note: if configuration changes are made to the AcquiLite, those changes will be uploaded to the BMO site. If configuration changes are made at both the AcquiLite and the BMO website, the most recent changes will be used.
- **Target Address to upload data:** This is the website URL to upload data to. This should always be set to "http://www.buildingmanageronline.com/upload.php" unless you are configuring the AcquiLite to send data to your own internal database server. (see the Data Collection FAQ at obvius.com)
- **Password to upload data:** This password is used by the BMO webserver to verify the AcquiLite device authentication before accepting the uploaded data. You should select a password other than the default, and make note of it for future reference.
- **Number of times to retry:** In the event of a failure (often due to dialup problems, busy signals, etc) this option specifies the number of retries to attempt the upload again. If all retries fail, the AcquiLite will wait until the next scheduled upload time before trying again.
- **Time to wait before retry:** In the event of a failure, the AcquiLite can be configured to wait for a specified period of time before attempting another connection. This option specifies how long to wait before retrying.

Step 3: Contact the Obvius Technical Support department. Please have the *AcquiLite serial number* and *password to upload data* handy. Your tech support representative will confirm your BMO account and will add the AcquiLite to one of your client databases.

Step 4: Click the "Upload Data Now" button. Your data should be sent to the BMO webserver.

Step 5: For more detailed information about the transfer process, use the Connection Test page in the Testing/Diags menu on the AcquiLite for a full report of the data upload progress.

Retrieving Data From the AcquiLite

Overview of how the system was designed to work.

Now that you have installed your AcquiLite and configured it to collect data from your meters and sensors, you will want to collect the data from your AcquiLite. This document will provide an overview for collecting data from the AcquiLite. Processing the data for billing reports, summaries, and other data processing are beyond the scope of this document.

Three basic ways to collect data from the AcquiLite:

- HTTP download from the AcquiLite with a browser (pull)
- HTTP Post: The AcquiLite uploads data to a database/webserver. (push)

HTTP Direct from the AcquiLite

The AcquiLite has the ability to export log file data to a web browser directly from the setup web pages. To use this feature, access the AcquiLite setup menu with your web browser. Select the "Log File Export" page from the Log File Data menu on the left side of the page.

For each device, a separate log file will be saved. Select the device from the dropdown list provided. Specify Comma or Tab delimited data, and indicate if column headers are required. Click the download button to download the data.

The log file format is the same as the format used by the BMO web site. Note: All timestamps are in UTC.

When importing log files into Microsoft Excel, be sure to specify the log data is comma separated, and use a single quote mark as the text delimiter.

HTTP/Post Upload To Building Manager Online

- AcquiLite sends data to the BMO website
- The BMO Website stores the data in a SQL database.
- Quick reporting from our website
- Includes remote AcquiLite configuration service.
- Includes alarm notification by email.
- Data available for download in CSV/Tab delimited format upon your request.
- For pricing and to sign up for service, contact sales@buildingmanageronline.com or call +1-503-601-2099

HTTP/Post Upload To Your Database Server

- AcquiLite uploads data directly to your webserver or database server.
- You must supply a script to process the incoming data. Sample script for Linux/PHP is available upon request.
- Requires Webserver, CGI Scripting and, database (SQL) knowledge
- Alarm processing available by processing data on your server when data is uploaded
- Designed for integration with existing energy reporting systems.

Enertrax download direct from the AcquiSuite

Obvius provides a free tool called Enertrax DL that can automate the process of downloading log data from the AcquiSuite to your Windows PC hard drive. Enertrax DL can merge new log data into existing log files on your computer as well as

provide configuration information about the AcquiSuite. Enertrax DL can also be configured to make LAN or Dilaup calls to one or more AcquiSuite or AcquiLite data acquisition servers. Enertrax DL can be obtained from the Obvius.com website in the Products section.

Removing Data From the AcquiLite

When using an HTTP/Post method to allow the AcquiLite to push data to a database server, the AcquiLite will automatically remove log files from its' flash memory once the AcquiLite has confirmed that the file was received by the database server. Enertrax DL also has an option to delete data from the AcquiLite

Linking to AcquiLite Device Status Pages

It may be helpful to create a shortcut or a hyperlink on another web page that will direct the browser to bring up a specific device status page in your browser. To do this, right click on the page and select properties. The url for the page will be shown on that dialog. Simply copy/paste this url into your link.

To format a URL that will bypass the username/password prompt, you can include the login information in the URL itself. Note however that this will allow any one to discover the password for the AcquiLite. Consider using the password in the url with caution.. This technique is shown in the following example:

```
http://mypassword:admin@192.168.40.50/setup/loggersetup.cgi
```

Note: To allow the user to be prompted for the login/password, remove "mypassword:admin@" from the example URL.

More recent versions of web browsers may not allow passwords to be specified in the URL and may prompt the user to enter the password when accessing the device.

Firmware Update

From time to time, Obvius may release firmware updates with additional features and system changes. To find out what firmware your AcquiLite has installed, view the system status page in your web browser, or select the "Show Firmware" option from the LCD console in the System menu. Firmware update files may be obtained from Obvius technical support.

The firmware update process requires an RS232 serial port and a windows computer to run the firmware update utility. Before starting this process, verify your computer has a serial port available. You may need to deactivate other software such as the palm pilot utility or ups monitor software. Some USB connected serial ports are not as fast or reliable as standard computer serial ports. We recommend using the Obvius **A89-USB232** adapter product.

To update the firmware, use the following procedure.

Step 1: download your log data from the AcquiLite. Log data stored in the AcquiLite memory will not be preserved after the firmware update begins. In addition, you may wish to backup your AcquiLite configuration. Although most firmware updates will preserve the AcquiLite configuration, some updates may require changes to the config storage in the AcquiLite memory.

Step 2: Select the shutdown option from the AcquiLite LCD console. Note: do not simply power down the unit. Selecting the shutdown option causes the AcquiLite to make a backup copy of the pulse count and configuration in flash, so that it will be preserved while the firmware is being updated.

Step 3: Disconnect the power from the AcquiLite. Move the program jumper to the left two pins (closest to the programming connector), Attach a standard serial cable from the AcquiLite programming connector to your computer serial port. Use a DB9 male to DB9 female straight through cable, not a null-modem cable. After the AcquiLite is connected to the computer, reconnect the power to the AcquiLite. The power led on the AcquiLite will turn on, however the LCD will not show any message, nor will the Alive LED blink.

For USB to Ethernet adapters, use the system/device manager control panel to set the com port to a value of 1-4.

Step 4: Install the RFU update utility on your windows computer. The installation consists of simply unziping the RFUzip file to a directory on your C drive. Several files should be present in the same directory, including rfu.exe, flash.ini, coldload.bin, pilot.bin. Note: RFU v2.45 or later is required.

Step 5: Run the RFU.exe utility. Select the setup menu, and choose Communications. In the Communications Options, use the following settings.

Use Serial Connection
Baud Rate: 57600 (Default) most computers can run at 115200 however.
Comm port: Comm1 (use the comm port that you attached to the AcquiLite in step 3 above)
Check "enable processor detection"
Check "Use USB to Serial Converter"
Click OK to save your options.

Step 6: Select the Setup menu, and choose "File locations". The files are should be located in the RFU directory, however you may need to select them manually. The file locations to use are as follows:

Cold Loader: coldload.bin
Pilot BIOS: pilot.bin
Flash Table: flash.ini.

To select each file location, click the "..." button to the right of the file name area, select the file from the RFU directory, and click ok. Click the OK button when finished with this dialog.

Step 7: From the File menu, select the "Load Flash Image" option.

Step 8: A dialog box with a file location item will be shown. Click the "..." button to the right and select the AcquiLite firmware image file. The firmware image file name will be "AL-1.09.0912.bin" or similar. Click OK when finished.

Step 9: A progress dialog will be shown. The RFU utility will download the image to the AcquiLite. If any problems are encountered, a dialog box will appear to alert you to the issue. When complete, the RFU utility will simply close the progress dialog.

Step 10: Disconnect the AcquiLite from the power connector. Remove the serial cable from the programming connector. Move the program jumper to the right two pins, (away from the programming connector).

Step 11: Reconnect the power to the AcquiLite. The AcquiLite should start up and continue operation. To verify the firmware, press the menu button until the "System" menu is shown, then press select. Next, press the Menu button until "show firmware" is displayed and press select. The new firmware version number will be shown on the LCD. Using a web browser, confirm your system configuration options; the AcquiLite should now be ready for service.

Johnstown / Gloversville Addendum

Site Events

Date	Event
6/11/2010	Internet connection w/ static IP provided
7/1/2010	Install Data Logger, Receive First File

Hardware

Device	Strip	PLC Outputs	Output (units)	Data Point
Basler Model #: BE1-GPS100	TM-4	17,18	kWh (acc)	WG
FCI Model #: GF90	TM-4	19,20	CF & CFM	FGE

Database Setup

Chan Name	Device	column
WG,	mb-001,	0
FG,	mb-001,	5

Sensor Verification

Power Meters

Being measured in the main fenced / barbed wire 13,000 volt panel.

Flow Meters

One installed, one had problems and is being replaced. Biogas flow in display of PLC is only gas to one engine untill second meter is reinstalled.

Photos

Caterpillar engine / generator. Both are identical.

Generator display / power quality

PLC cabinet display

Biogas flowmeter - one (1) per engine

Biogas flow meter displays - one currently installed.

Breakers - Generators 1 & 2, and feeder to facility.

Inside PLC / control system panel. Pulse outputs wired on left - TM4, inputs 17-20

Power displays (left to right) - kW purchased from utility, kW generated (both generators), total facility demand.

13,000 panel - location of CT's measuring engine output