Bitronics

PowerPlex II Synchronizing Ethernet Transducer and Display

User Manual

May 3, 2021
ML0044B Document Revision J

NovaTech®
Bitronics ◆ D/3 ◆ Orion

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POWERPLEX II MANUAL SET

ML0044B	PowerPlex II User Manual
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VERSION HISTORY (ABRIDGED)

V1.00.0	2014-07-29	Initial release
V1.30.0	2014-10-22	Minor feature upgrades and bug fixes
V2.06.0	2015-05-21	Minor feature upgrades
V2.12.0	2016-02-22	Support for IEC 61850, universal power supply, IRIG-B and display ports
V2.20.0	2016-10-04	Support for serial port and digital I/O
V2.21.0	2016-10-26	Minor feature upgrades and bug fixes
V2.22.0	2017-03-15	Added support for KYZ Energy Counter and Energy LED.
V2.23.0	2017-06-21	Energy resets did not work without an IO card; 2-Element mode enabled for 3-phase averages
V2.24.0	2017-08-15	Added Average L-L Volts, Average L-N Volts and Average Amps to protocols
V2.25.0	2017-11-15	Added trend recorder
V2.30.0	2018-05-14	Added support for EtherNet/IP
V2.57.0	2021-01-13	Added Device Level Ring (DLR) support

CERTIFICATION

Bitronics LLC certifies that the calibration of our products is based on measurements using equipment whose calibration is traceable to the United States National Institute of Standards Technology (NIST).

INSTALLATION AND MAINTENANCE

Bitronics LLC products are designed for ease of installation and maintenance. As with any product of this nature, installation and maintenance can present electrical hazards and should be performed only by properly trained and qualified personnel. If the equipment is used in a manner not specified by Bitronics LLC, the protection provided by the equipment may be impaired.

In order to maintain UL Listing (which shall be dependent upon the product evaluation by UL, the following Conditions of Acceptability shall apply:

a) After installation, all hazardous live parts shall be protected from contact by personnel or enclosed in a suitable enclosure.

WARRANTY AND ASSISTANCE

This product is warranted against defects in materials and workmanship for a period of one-hundred-and-twenty (120) months from the date of their original shipment from the factory. Products repaired at the factory are likewise warranted for eighteen (18) months from the date the repaired product is shipped, or for the remainder of the product's original warranty, whichever is greater. Obligation under this warranty is limited to repairing or replacing, at our designated facility, any part or parts that our examination shows to be defective. Warranties only apply to products subject to normal use and service. There are no warranties, obligations, liabilities for consequential damages, or other liabilities on the part of Bitronics LLC except this warranty covering the repair of defective materials. The warranties of merchantability and fitness for a particular purpose are expressly excluded.

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TRADEMARKS

SAFETY SECTION

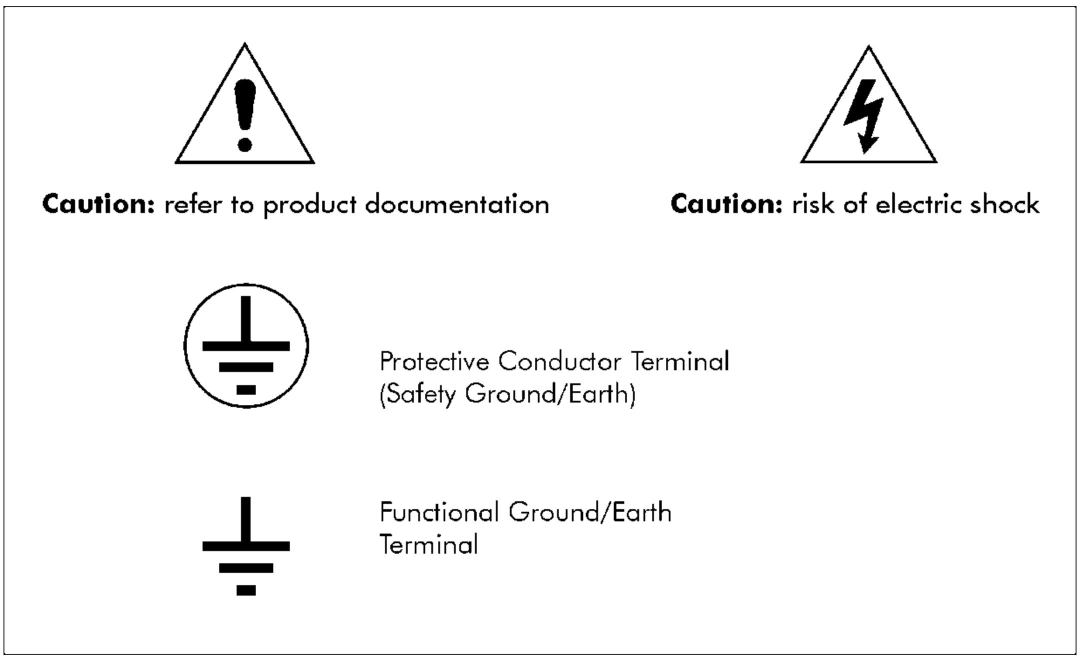
This Safety Section should be read before commencing any work on the equipment.

Health and safety

The information in the Safety Section of the product documentation is intended to ensure that products are properly installed and handled in order to maintain them in a safe condition. It is assumed that everyone who will be associated with the equipment will be familiar with the contents of the Safety Section.

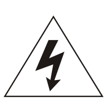
Explanation of symbols and labels

The meaning of symbols and labels that may be used on the equipment or in the product documentation is given below.



Installing, Commissioning and Servicing

Equipment connections



Personnel undertaking installation, commissioning or servicing work on this equipment should be aware of the correct working procedures to ensure safety. The product documentation should be consulted before installing, commissioning or servicing the equipment.

Terminals exposed during installation, commissioning and maintenance may present a hazardous voltage unless the equipment is electrically isolated.

If there is unlocked access to the equipment, care should be taken by all personnel to avoid electric shock or energy hazards.

Voltage and current connections should be made using insulated crimp terminations to ensure that terminal block insulation requirements are maintained for safety. To ensure that wires are correctly terminated, the correct crimp terminal and tool for the wire size should be used.

Before energizing the equipment, it must be grounded (earthed) using the protective ground (earth) terminal, or the appropriate termination of the supply plug in the case of plug connected equipment. Omitting or disconnecting the equipment ground (earth) may cause a safety hazard.

The recommended minimum ground (earth) wire size is 2.5 mm^2 (#12 AWG), unless otherwise stated in the technical data section of the product documentation.

Before energizing the equipment, the following should be checked:

Voltage rating and polarity

CT circuit rating and integrity of connections

Protective fuse rating

Integrity of ground (earth) connection (*where applicable*)

Equipment operating conditions

The equipment should be operated within the specified electrical and environmental limits.

Current transformer circuits

Do not open the secondary circuit of a live CT since the high voltage produced may be lethal to personnel and could damage insulation.

Insulation and dielectric strength testing

Insulation testing may leave capacitors charged up to a hazardous voltage. At the end of each part of the test, the voltage should be gradually reduced to zero, to discharge capacitors, before the test leads are disconnected.

Do not attempt to perform installation, maintenance, service or removal of this device without taking the necessary safety precautions to avoid shock hazards. De-energize all live circuit connections before work begins.

Fiber optic communication

Where fiber optic communication devices are fitted, these should not be viewed directly. Optical power meters should be used to determine the operation or signal level of the device.

WARNING: EMISSIONS – CLASS A DEVICE (EN55011)

This is a Class A industrial device. Operation of this device in a residential area may cause harmful interference, which may require the user to take adequate measures.

DECOMMISSIONING AND DISPOSAL

1. Decommissioning

The auxiliary supply circuit in the equipment may include capacitors across the supply or to ground (earth). To avoid electric shock or energy hazards, after completely isolating the supplies to the meter (both poles of any dc supply), the capacitors should be safely discharged via the external terminals before decommissioning.

2. Disposal

It is recommended that incineration and disposal to watercourses is avoided. The product should be disposed of in a safe manner. Any products containing batteries should have them removed before disposal, taking precautions to avoid short circuits. Particular regulations within the country of operation may apply to the disposal of lithium batteries.

1.0 DESCRIPTION & SPECIFICATIONS

1.1 Introduction

The PowerPlex II (PPX II) is a synchronizing Ethernet transducer with two sets of three-phase voltages and 1-cycle measurement update speeds. It offers superior communications flexibility and easy setup.

The following Model number of the product named PowerPlex II (PPX II) is covered in this manual:
MTWDN7C – Synchronizing Ethernet Transducer DC (option 'D' in 8th character of model number) and Universal powered (option 'P' in 8th character of model number) versions.

1.2 Features

1. Full basic measurement set with special synchronizing measurements
2. 0.2% revenue class accuracy
3. Updates every cycle
4. Two sets of three-phase voltage inputs, 0-600 Vac phase-phase
5. Ethernet Switch: Two RJ-45 10/100Mb Ethernet Ports
6. Ethernet protocol support for DNP3 TCP or Modbus TCP
7. Options for IEC 61850 and EtherNet/IP (with or without Device Level Ring, DLR)
8. Web Based configuration via standard Ethernet service port
9. 24V dc (MTWDN7C**D***) or Universal 48-250V dc/69-240V ac power supply (MTWDN7C**P***)
10. Rugged aluminum case
11. One model covers all wiring options
12. Optional display and IRIG-B port
13. Optional RS-232/RS-485 (programmable) serial port with DNP3 or Modbus protocol
14. Optional 4 digital inputs/4 digital outputs or 8 digital inputs
15. Optional trend recording

1.3 Specifications

DC PWR (Low Voltage Vdc) - Power Supply Input (Auxiliary Voltage) – terminals (+) and (-) (Intended for connection to 12V or 24V battery voltages)

Nominal:	12-40V dc
Operating Range:	8-40V dc
Burden:	5W max

Overcurrent protection (Required) : Refer to section 2.4

AUX PWR (Universal – Hi Range Power Supply) - Power Supply Input (Auxiliary Voltage) – terminals L1(+) and L2(-)

Installation Category/Overvoltage Category (Auxiliary Power Supply) – CAT II

Nominal:	48-250V dc, 69-240V ac (50/60Hz)
Operating Range:	37-300V dc, 55-275V ac (45-65Hz)
Burden:	8W max, 24VA max

Overcurrent protection (Required) : Refer to section 2.4

Optional Display (PPX II-TD):	3 lines of 5 digits, Red LED, 0.56” High 1 line 8-character alphanumeric, Red LED, 0.20” High
Display Interface (PPX II-TD):	4 buttons
Display Communication:	RS232, full duplex 19200 baud 8 bit, No parity, 1 stop bit
Display Distance:	30 ft. (9m) RS232
Display Addressability:	1 Display Address
Display Power Supply:	DC power is derived from P1 Display port jack (RJ11) located on PPX II.

Nominal:	5Vdc, powered from PPX II Display Port
Operating Range:	5-15Vdc
Current:	400mA max

Input Signals – Measurement Inputs			
CT Current Inputs	Configuration	All Inputs	3 Inputs. 3 Phase Currents (IA, IB, IC).
	Nominal	Input Option 1	1A ac
		Input Option 5	5A ac
	Range	Input Option 1	0 to 2A rms continuous at all rated temperatures
		Input Option 5	0 to 10A rms continuous at all rated temperatures
	Withstand	All Inputs	Withstands 30A ac continuous, Under fault condition, can withstand 400Aac for 2 seconds
	Isolation	All Inputs	2500V ac, minimum.
	Burden	Input Option 1	0.0016VA @ 1A rms, 60Hz (0.0016ohms @ 60Hz)
		Input Option 5	0.04VA @ 5A rms, 60Hz (0.0016ohms @ 60Hz)
	Frequency	All Inputs	20-75 Hz
VT (PT) Voltage Inputs	Configuration		8 Inputs, Measures 2 Buses, 3 or 4 Wire. 3 Phase Voltages (VA, VB, VC, VN). See Appendix A1 Connection Diagrams.
	Nominal		120Vac
	Range		0 to 600V rms
	System Voltage		Intended for use on nominal system voltages up to 600V rms
	Common Mode Input Voltage		Accurate to 1000V peak, input-to-case (ground)
	Impedance		>12M ohms, input-to-case (ground)
	Voltage Withstand		2.5kV rms 1min, input-to-case (ground) 2kV rms 1min, input-to-input
	Frequency		20-75 Hz

Input Signals – Time Sync		
IRIG-B Input time synchronization		Refer to section on IRIG-B Time Sync for Electrical Specifications

Accuracy		
Accuracies are specified at nominal Frequency and 25C, (unless otherwise noted). Unless noted, all values are true RMS and include Harmonics to the 31st (minimum).		
Voltage		AC: Better than 0.1% of reading (20 to 600V rms, input-to-case). (+/- 25ppm/DegC)
Current	Option 1 Input	Better than 0.1% of reading +/- 20uA (>0.1A to 2.0A, -20C to 70C)
		Better than 0.1% of reading +/- 50uA (0.01A to 0.1A, -20C to 70C)
		Minimum reading 1mA
	Option 5 Input	Better than 0.1% of reading +/- 100uA (>0.5A to 10.0A, -20C to 70C)
		Better than 0.1% of reading +/- 250uA (0.05A to 0.5A, -20C to 70C)
		Minimum reading 5mA
Frequency		+/- 0.001 Hertz
Power		Meets or exceeds IEC 62053-22, -23, 0.2S

Sampling System		
Sample Rate	64 samples per cycle	
Data Update Rate	Amps, Volts	Available every cycle
	Watts, VAs, VARs, PF	Available every cycle
Number of Bits	16	

Communication Ports	
Ethernet (Standard)	Dual ports; copper 10/100 Base-TX (standard)
Serial Port (6-pin, Option, extended chassis only)	RS232, RS485 Software configurable ports
	Baud rate: 9600 bps to 115.2 kbps for Display or SCADA Mode
Display Port (Option)	Display or RS232 SCADA port
	Baud rate: Display Mode: 19.2 kbps; SCADA Mode 9600 bps – 115.2 kbps
IRIG-B Port (Option)	BNC connector (See section 3.6.1); auto detects between modulated and demodulated signal.

Environmental	
Operating Temperature	-40C to 70C
Relative Humidity	0-95% non-condensing
Measurement Inputs (VTs, CTs) Installation/Measurement Category	CAT III (Distribution Level) Refer to definitions below (at the end of this section).
Pollution Degree	Pollution Degree 2 Refer to definitions below (at the end of this section).
Enclosure Protection (to IEC60529: 2001) Applies to PPX II and Optional PPX II-TD Display	IP20 to IEC60529:2001 When equipment is mounted in an appropriately rated protective enclosure to NEMA or IP protection classifications, as required for the installation. Ratings are applicable for enclosure category 2 (see definitions)
Altitude	Up to and including 2000m above sea level
Intended Use	Indoor use; Indoor/Outdoor use when mounted in an appropriately rated protective enclosure to NEMA or IP protection classifications, as required for the installation. Class 1 equipment to IEC61140: 2001

Physical		
Connections	Protective Conductor Terminal	A #8-32 screw terminal is provided on the AUX PWR terminal block for connection with protective earth ground. Recommended Torque: 9 In-Lbs, 1.02 N-m Cable temperature rating: 85C minimum
	Current (CT)	10-32 Studs for current inputs. Recommended Torque: 12 In-Lbs, 1.36 N-m Cable temperature rating: 85C minimum
	Voltage (VT) & (AUX PWR)	Terminal Block accepts #22-10 AWG (0.35 to 5mm^2) wire, or terminal lugs up to 0.375" (9.53mm) wide. Precautions must be taken to prevent shorting of lugs at the terminal block. A minimum distance of 1/4" (6.3mm) is recommended between uninsulated lugs to maintain insulation requirements. Recommended Torque: 9 In-Lbs, 1.02 N-m Cable temperature rating: 85C minimum
	Ethernet	RJ45, 8 position modular jack, Category 5 for copper connection; 100m (328 ft.) UTP (unshielded twisted pair) cable.
Option Connectors	Display Port	RJ11, 6 position modular jack, 4 connected (positions 2-5 are used, positions: 1, 6 are not used); connects remotely through unshielded cable to PPXII-TD Tethered Display (Optional Accessory). Maximum 30 ft (9m)
	IRIG-B port	BNC connector, connects coax cable with time source (i.e. gps time and frequency receiver)
	Serial Port (extended chassis only)	6 position removable terminal block, accepts 26-14AWG solid or 26-12 AWG stranded wire. Recommended Torque 7 in-lbs, 0.79 N-m.
	Digital Input (extended chassis only)	6 position removable terminal block, accepts 26-14AWG solid or 26-12 AWG stranded wire. Recommended Torque 7 in-lbs, 0.79 N-m.
	Digital Ouptput (extended chassis only)	9 position removable terminal block, accepts 26-14AWG solid or 26-12 AWG stranded wire. Recommended Torque 7 in-lbs, 0.79 N-m.

Weight (typical)	PowerPlex II: 2.3 lbs (1.04 kg) standard chassis; 3.5 lbs (1.59 kg) in extended chassis (with optional I/O and serial port) PPXIITD Tethered Display (Optional Accessory): 0.65 lbs (0.30 kg)
Size	PowerPlex II (Figure 2) Standard Chassis: 5.28"H x 5.60"W x 5.63"D – overall depth including handle is 5.75"D (134mm H x 142mm W x 143mm D – overall depth including handle is 146mm D). Extended chassis (with I/O and serial port): 5.2" H x 8.5" W x 5.9" D (132mm H x 216mm W x 150mm D). Torque setting for square drive corner screws securing front panel to chassis (4 Places – ground bond): 15 in-lbs (1.7 N-m). PPXII-TD Tethered Display (Optional Accessory, Figure 4): 4.5"H x 4.5"W x 1.8"D – overall depth. Depth extends 1.5" behind panel. Allow an additional clearance depth of 2" for RJ11 display connectors and cable access behind the rear panel of the display.

Definitions:

Enclosure Category 2: Enclosures where no pressure difference relative to the surrounding air is present.

Measurement/Installation Category III (Overvoltage Category III) or CAT III: Distribution Level, fixed installation, with smaller transient overvoltages than those at the primary supply level, overhead lines, cable systems, etc.

Pollution: Any degree of foreign matter, solid, liquid, or gaseous that can result in a reduction of electric strength or surface resistivity of the insulation.

Pollution Degree 2: Only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation is to be expected.

1.4 Digital I/O (optional) – Extended Chassis only

1.4.1 Inputs

4 or 8 uni-directional inputs in banks of 4 inputs. These banks of four inputs are isolated from each other on the eight input option or from the outputs on the four input option. Input terminals have internal 510V clamp. Channels 1-4 have a common return, and on the eight input option, 1-4 and 5-8 each have a common return per group of four. The recommended torque ratings for the terminal block wire fasteners are listed in the Physical Specifications table (section 1.3).

Voltage Range:

Input Range:	0 to 250Vdc
Threshold Voltage:	15V dc +/-1V or 80V dc +/-5V (at 25C)
Input Resistance:	33kohm

Input Channel-to-Channel Time Resolution: 200μs (maximum)

Input De-bounce Time: Selectable from 0ms to 2s in 1ms increments.

Input Delay Time (from terminals): <2ms

Refer to figures 1 and 2 below for simplified circuitry and terminal wiring assignments.

1.4.2 Outputs

4 outputs, 3 Normally Open (NO), 1 isolated, can be wired for Normally Closed (NC) or Normally Open (NO) operation for energized or de-energized condition. Output terminals have internal 510V clamp. Channels 1-3 share a common return, however, channel 4 has an independent return. One additional channel is for alarming. The recommended torque ratings for the terminal block wire fasteners are listed in the Physical Specifications table (section 1.3).

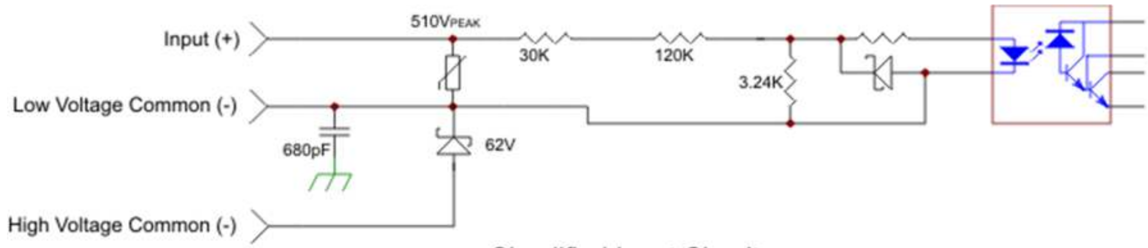
Output Maximum Switched Current (Resistive)

Voltage	Tripping (C37.90 Resistive)	Continuous Carry	Break (Inductive)
24Vdc	30A	5A	8A
48Vdc	30A	5A	700mA
125Vdc	30A	5A	200mA
250Vdc	30A	5A	100mA

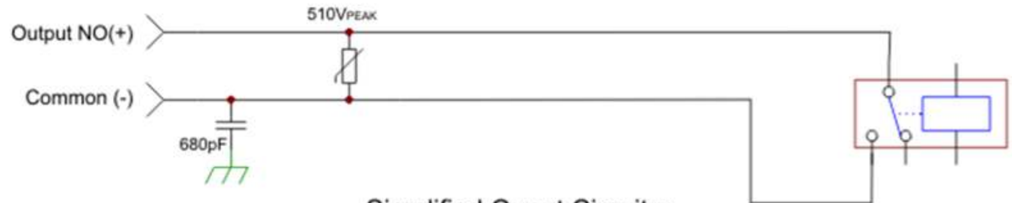
Output Operate Time (does not include protocol delays)
- Assert (Close time "N.O."): 8ms
- Release (Open time "N.O."): 3ms

Isolation
- I/O Terminals to Case: 2000Vac, 1min
- Input Channels 1-4 to Input Channels 5-8: 2000Vac, 1min
- Input Channels 1-4 to Output Channels 1-4: 2000Vac, 1min
- Output Channel 4 to other Output Channels: 2000Vac, 1min

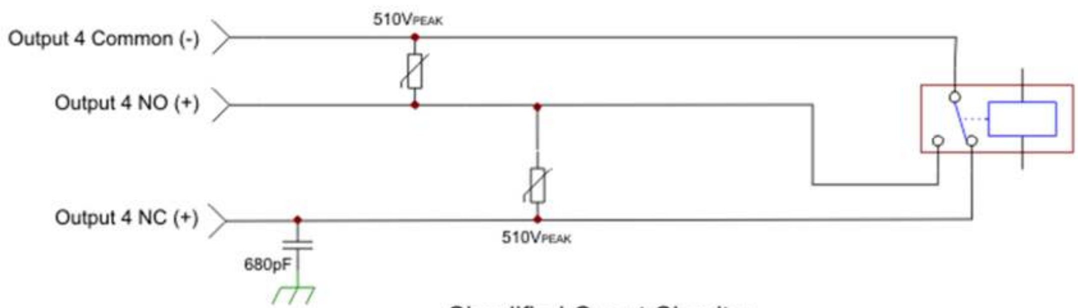
Refer to figures 1 and 2 below for simplified circuitry and terminal wiring assignments.



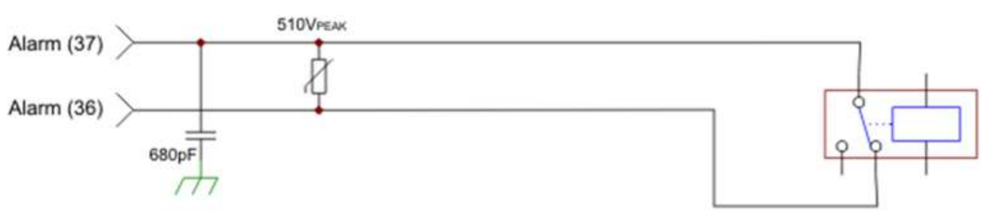
Simplified Input Circuitry -
Inputs 1 - 4 (with a Common connection shared respectively across the first set of 4 channels
and Inputs 5 - 8 (with a Common connection shared respectively across the second set of 4 channels)



Simplified Ouput Circuitry -
Outputs 1 - 3 (with a Common connection shared respectively with output channels 1-3)



Simplified Ouput Circuitry -
Output 4 (with a separate Common connection isolated from output channels 1-3)



Simplified Ouput Circuitry -
Alarm contact Normally Closed (NC)

Figure 1 – Simplified Circuitry for Input and Output Options

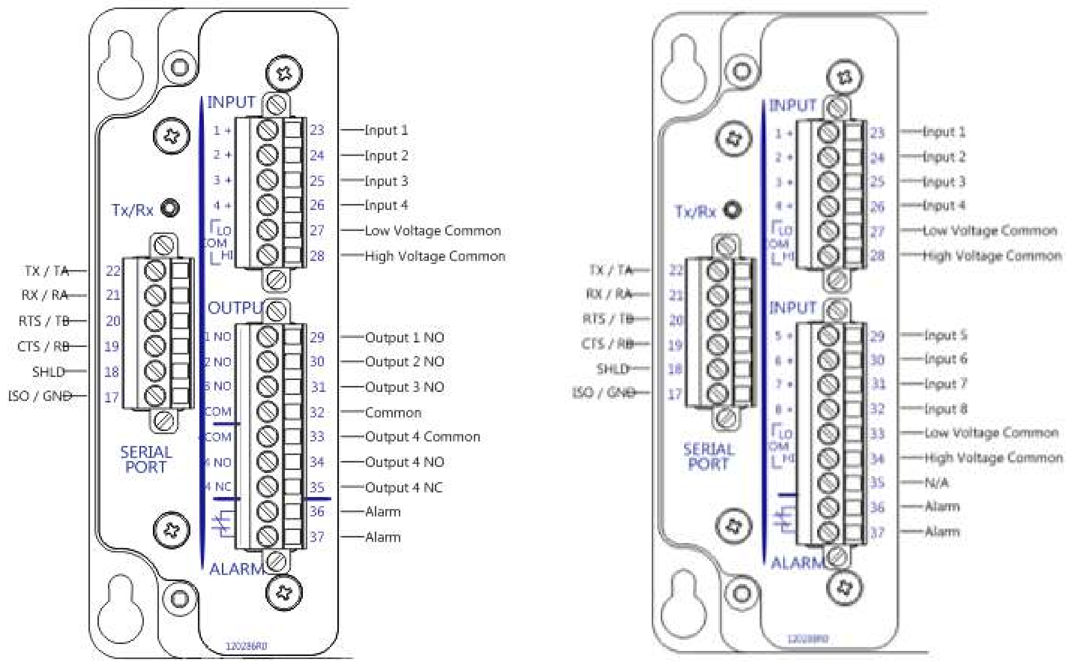


Figure 2 - Wiring Terminal Assignments for Input and Output Options

1.5 Standards and Certifications

1.5.1 Revenue

The PowerPlex II exceeds the accuracy requirements of ANSI C12.20 and IEC 62053-22.

Type	Nominal Current	Certification
MTWDN7C	1A, 5A, (Class 2, Class 10)	ANSI C12.20, 0.2CA IEC 62053-22, 0,2S IEC 62053-23, 0,2S (Reactive)

The PowerPlex II was tested for compliance with the accuracy portions of the standards only. The form factor of the PowerPlex II differs from the physical construction of revenue meters specified by the ANSI/IEC standards and no attempt has been made to comply with the standards in whole. Contact customer service for more information.

1.6 Environment

UL/CSA Listed, File Number E164178 (applies to standard chassis, does not apply to extended chassis with I/O and serial port)
UL61010-1, Edition 3, Issue Date 2012/05/11
Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements
UL61010-2-30, Edition 1 – Issue Date 2012/05/11
Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2: Particular Requirements for Testing and Measuring Circuits

CSA C22.2 No. 61010-1-12-CAN/CSA, Edition 3, Issue Date 2012/05/01
CAN/CSA Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements
CSA C22.2 No. 61010-2-30-12-CAN/CSA, Edition 1 – Issue Date 2012/05/01
Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2-030: Particular Requirements for Testing and Measuring Circuits

If applicable, the CE mark must be prominently marked on the case label.

European Community Directive on EMC (EMCD) 2014/30/EU, superceding 2004/108/EC and Directive 91/263/EC [TTE/SES].
European Community Directive on Low Voltage (LVD) 2014/35/EU, superceding 2006/95/EC.

The object of the declaration described above is in conformity with the relevant Union harmonisation legislation: Directives 2004/108/EC & 2006/95/EC (until April 19th, 2016) and Directives 2014/30/EU &, 2014/35/EU (from April 20th, 2016).

<u>Product and Generic Standards</u>
The following product and generic standards were used to establish conformity:

Low Voltage (Product Safety)
IEC/EN 61010-1, Edition 3, Issue Date 2010
Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements
IEC/EN 61010-2-30, Edition 1 – Issue Date 2010
Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2-030: Particular Requirements for Testing and Measuring Circuits

EMC: EN 61326-1: 2013 (Supersedes EN 61326-1: 2006),
EN 61000-6-2: 2005 + AC: 2005,
EN 61000-6-4: 2007 + A1:2011 (IEC date 2010)

Radiated Emissions Electric Field Strength
EN 55011: 2009 + A1: 2010
EN 55011: 2016
EN 61000-6-4: 2007 + A1:2011 (IEC date 2010)
Group 1, Class A
Frequency: 30 - 1000 MHz

AC Powerline Conducted Emissions
(Applicable on VT inputs - Bus1/ Bus 2 and AUX PWR (Universal Hi Range AC/DC Power supply)
EN 55011: 2009 + A1: 2010
EN 55011: 2016
EN 61000-6-4: 2007 + A1:2011 (IEC date 2010)
Group 1, Class A
Frequency: 150 kHz – 30 MHz

Conducted Emissions, Telecommunication ports (Ethernet ports 1 & 2)
EN 55022: 2010 + AC: 2011
EN 55032: 2012 + AC: 2013
EN 55032: 2015 + AC: 2016-07
Group 1, Class A
Frequency: 150 kHz – 30 MHz

AC Supply Voltage Dips and Short Interruptions
EN 61000-4-11: 2004
Not applicable to AUX PWR powered by DC Battery
Signal Input Ports (VTs – Bus 1/Bus2) were tested (Measurement ports)
Mains AUX PWR (Universal Hi Range AC/DC Power supply) was tested

Electrostatic Discharge (ESD)
EN 61000-4-2: 2009
Discharge voltage: ± 8 KV Air; ± 4 KV Contact & Additionally meets ± 6 KV Contact

Immunity to Radiated Electromagnetic Energy (Radio Frequency)
(Including optional display, display port and IRIG-B port)

EN 61000-4-3: 2006 + A1: 2008 + A2:2010, Class III
Frequency: 80 – 1000 MHz, Amplitude: 10.0 V/m, Modulation: 80% AM @ 1 kHz
Frequency: 1400 – 2000 MHz, Amplitude: 3.0 V/m, Modulation: 80% AM @ 1 kHz
Frequency: 2000 – 2700 MHz, Amplitude: 1.0 V/m, Modulation: 80% AM @ 1 kHz
Digital Radio Telephones:
Frequency: 900 MHz & 1890 MHz, Amplitude: 10.0 V/m, 3.0 V/m, Modulation: 80% AM @1kHz

Electrical Fast Transient / Burst Immunity (Including optional display, display port and IRIG-B port)
EN 61000-4-4: 2012 (supersedes EN 61000-4-4: 2004 + A1:2010)
Burst Frequency: 5 kHz
Amplitude, Signal Ports (VTs): ± 2 KV (Severity Level 3)
Amplitude Signal Input Ports (CTs): ± 1 KV
Amplitude, Telecom ports (Ethernet): ± 1 KV
Amplitude, AUX PWR port (DC PWR): Not applicable for battery cable < 2m. Tested at ± 2 KV.
Amplitude, Mains AUX PWR (Universal Hi Range AC/DC Power supply): ± 2 KV (Severity Level 3), and additionally meets ± 4 KV.
Amplitude, Display port: ± 1 KV
Amplitude. IRIG-B port: ± 1 KV

Current/Voltage Surge Immunity
EN 61000-4-5: 2014 (supersedes EN 61000-4-5: 2006)
Open Circuit Voltage: 1.2 / 50 μs
Short Circuit Current: 8 / 20 μs
Amplitude, Signal Input Ports (Installation Class 3) (VTs): ± 2 KV common mode, ± 1 KV differential mode
Amplitude, Signal Input Ports (CTs): ± 2 KV common mode
Amplitude, AUX PWR port (DC PWR): Not applicable for battery cable < 2m.
Amplitude, Mains AUX PWR port (Universal Hi Range AC/DC Power supply): ± 2 KV common mode, ± 1 KV differential mode

Immunity to Conducted Disturbances Induced by Radio Frequency Fields
EN 61000-4-6: 2014 (supersedes EN 61000-4-6: 2009)
Level: 3
Frequency: 150 kHz – 80 MHz
Amplitude: 10 V rms
Modulation: 80% AM @ 1 kHz

Power Frequency Magnetic Fields
EN 61000-4-8: 2010
Amplitude: 30A/m
Frequency: 50 and 60 Hz

Surge Withstand Capability Test For Protective Relays and Relay Systems
ANSI/IEEE C37.90.1: 2002 (2.5 kV oscillatory wave and 4 kV EFT)

Mechanical – Vibration & Shock (Applicable only to PPX II with Low Voltage DC power supply without Display port & IRIG-B option)
EN 60255-21-1 & EN 60255-21-2

2.0 PHYSICAL CONSTRUCTION & MOUNTING

The PPX II are packaged in rugged aluminum case specifically designed to meet the harsh conditions found in utility and industrial applications.

The connection view is shown in Figure 3A and 3B (depending on options) for the standard chassis and Figure 3C for the extended chassis. The mechanical dimensions are shown in Figures 4A (standard chassis) and 4B (extended chassis).

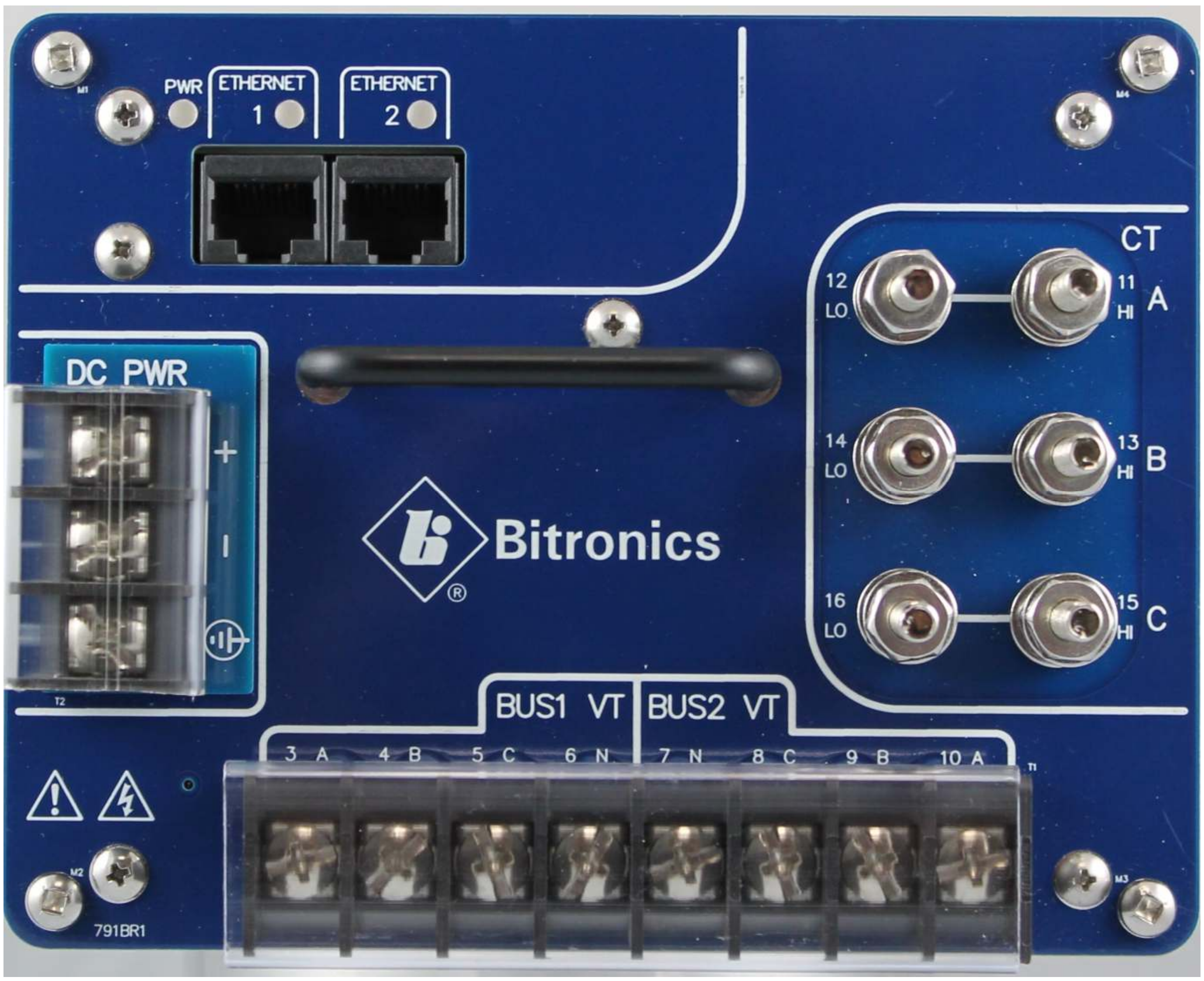


Figure 3A – PPX II Connection View (Low Voltage)

Figure 3B – PPX II Connection View with Options in Standard chassis for Display port, IRIG-B port, Energy Pulse LED

Figure 3C – PPX II Connection View in extended chassis with Options for Display port, IRIG-B port, Energy Pulse LED, serial port and digital I/O

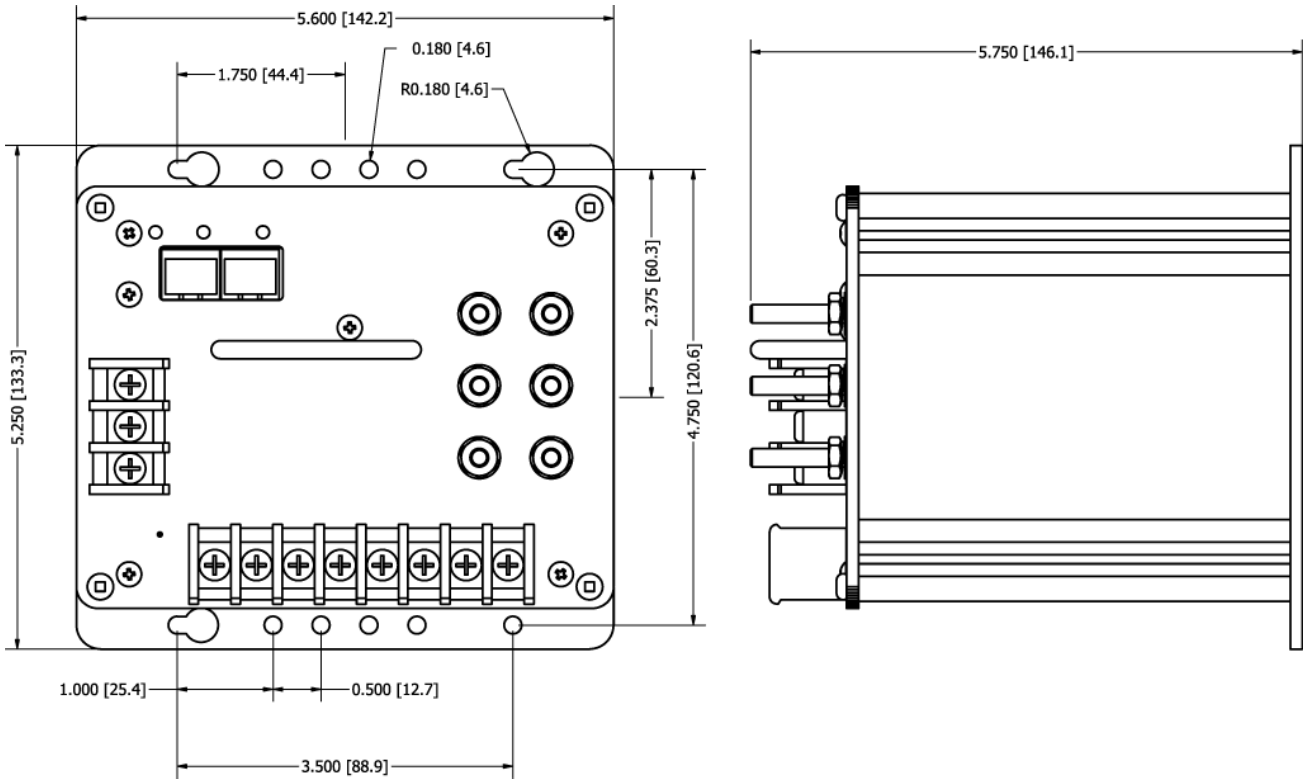


Figure 4A - Mounting and Overall Dimensions PPX II in Standard Chassis
(back panel may vary as a result of options ordered)

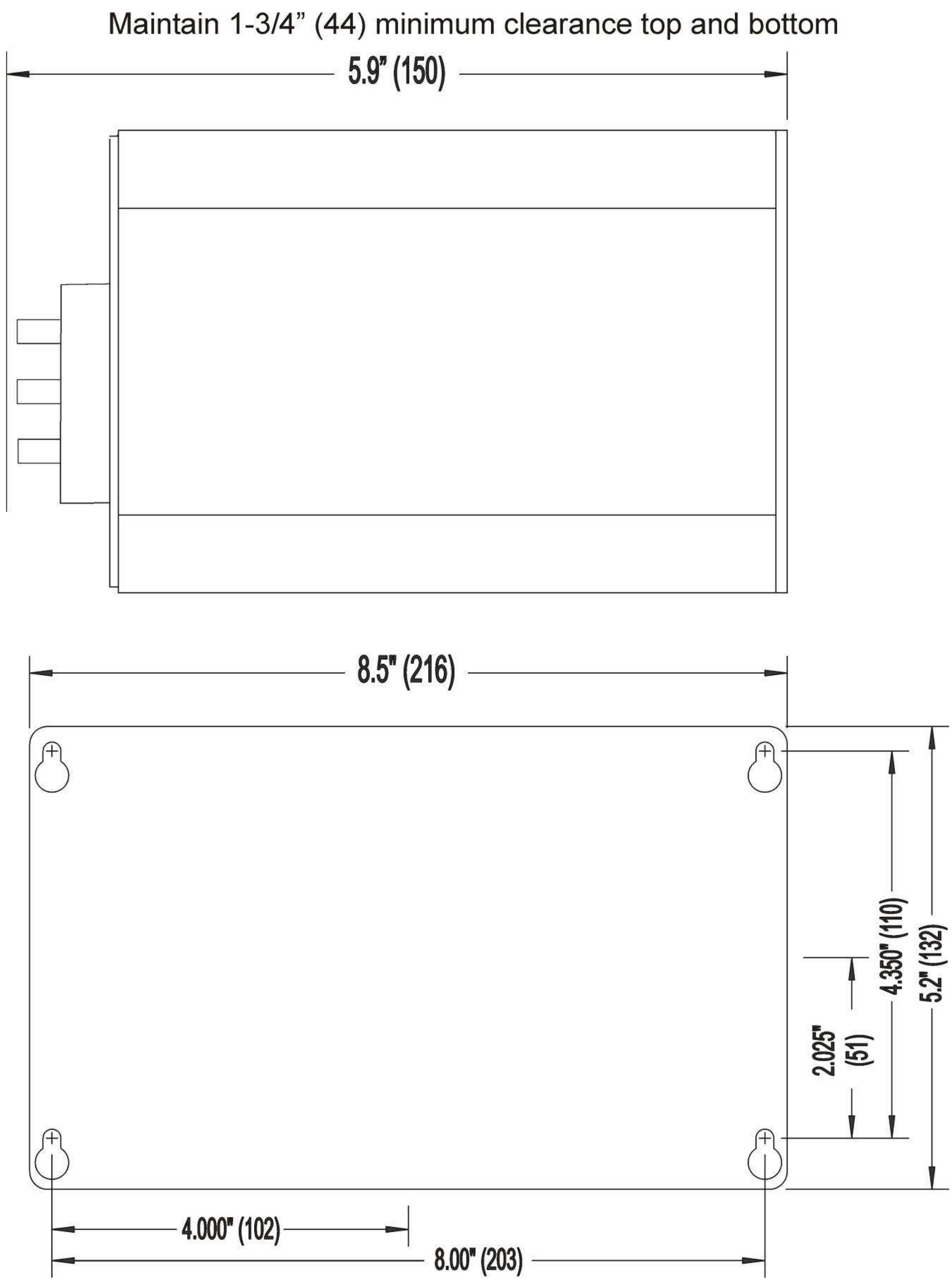
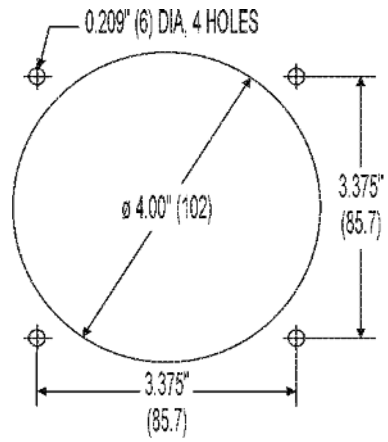
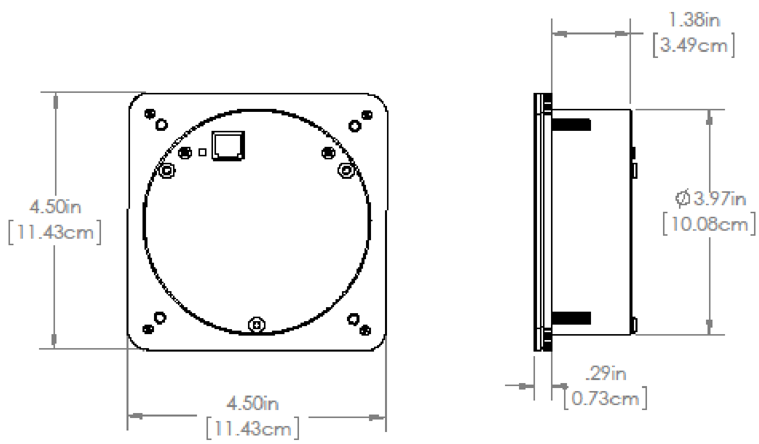


Figure 4B – Mounting and Overall Dimensions PPX II in Extended Chassis (back panel may vary as a result of options ordered)

The Front panel view for the optional PowerPlex II Tethered Display (PPX II-TD) is shown in Figure 5. The mechanical dimensions are shown in Figure 6.

Figure 5 – Front View of the PPX IITD





PX2 Tethered Display Dimensions

Figure 6 - Mounting and Overall Dimensions of Optional PPX IITD

2.1 Installation

WARNING - INSTALLATION AND MAINTENANCE SHOULD ONLY BE PERFORMED BY PROPERLY TRAINED OR QUALIFIED PERSONNEL.

2.2 Initial Inspection

Bitronics instruments are carefully checked and "burned in" at the factory before shipment. Damage can occur however, so please check the instrument for shipping damage as it is unpacked. Notify Bitronics LLC immediately if any damage has occurred, and save any damaged shipping containers.

2.3 Protective Ground/Earth Connections

The device must be connected to Protected Earth Ground. The minimum Protective Ground wire size is 2.5 mm^2 (#12 AWG). Bitronics LLC recommends that all grounding be performed in accordance with ANSI/IEEE C57.13.3-2005.

2.4 Overcurrent Protection

2.4.1 Overcurrent Protection - Voltage Signal Measurement Inputs (VTs)

VT inputs should only be connected to voltage systems with nominal Line to Neutral voltages of 600Vac or less. If the nominal Line to Neutral voltage will be greater than 300Vac, external fuses shall be provided at the input to the VT terminal for all live conductors.
<u>For UL/CSA</u>: Bitronics recommends UL 248 certified fuses, rated 600V, 3A, fast acting (F), no time-delay fuses (such as Bussmann KTK-3).
<u>For CE</u>: Bitronics recommends fuses certified to IEC 60269, rated 690V, 3A, fast acting (F), high-breaking capacity (such as Mersen FR10GR69V3).
The fuses shall additionally be enclosed in an appropriate fuse holder to prevent the possibility of a fuse shattering and spraying metal pieces. The fuse and fuse holder must carry a voltage rating appropriate for the power system on which it is to be used. A fast acting fuse with a current rating lower than 3 Ampere is permitted.

2.4.2 Overcurrent Protection – DC PWR (Low Voltage DC Power)

To maintain the safety features of this product an external fuse shall be provided at the input to the positive (+) DC PWR terminal. Bitronics recommends UL 248 certified fuse rated 32Vdc (min or greater), 10A fast acting (F), no time delay fuse or fuse certified to IEC 60127 rated 32Vdc (min or greater), 6.3 Ampere fast acting (F) no time delay fuse. The fuse shall additionally be enclosed in an appropriate fuse holder to prevent the possibility of a fuse shattering and spraying metal pieces. The fuse and fuse holder must carry a voltage rating that is appropriate for the dc circuit on which it is being used.

2.4.3 Overcurrent Protection – AUX PWR (Universal - High Range Power Supply)

To maintain the safety features of this product an external fuse shall be provided at the AUX PWR supply input and must be connected in series with the ungrounded/non-earthed (hot) side of the supply input terminals prior to installation.
For UL/CSA, Bitronics recommends a UL 248-4 certified fuse, Class CC, rated 600 Vac/300 Vdc, 3 Ampere time delay (T) fuse (such as Littelfuse CCMR003 or Mersen ATDR3).
For CE, Bitronics recommends a fuse certified to IEC 60127-2 Sheet 3, rated 250 Vac (min or greater), 3.15 Ampere time delay (T) fuse.
The fuse shall additionally be enclosed in an appropriate fuse holder to prevent the possibility of a fuse shattering and spraying metal pieces. The fuse and fuse holder must carry a voltage rating that is appropriate for the power system on which it is being used.

2.5 Supply/Mains Disconnect – AUX PWR (Universal – Hi Range Power Supply)

Equipment shall be provided with a Supply/Mains Disconnect that can be actuated by the operator and simultaneously open both sides of the mains input line. The Disconnect should be UL Recognized in order to maintain any UL product approval. The Disconnect should be acceptable for the application and adequately rated for the equipment.

2.6 Instrument Mounting

The instrument may be mounted on a 19" Rack panel if desired. Two PPX II units will fit side by side on a standard 5.25" high (3U) panel. See Figure 2 for dimensions. The unit should be mounted with four #10-32 (M4) screws. *Make sure that any paint or other coatings on the panel do not prevent electrical contact.*

2.7 Cleaning

Cleaning the exterior of the instrument shall be limited to the wiping of the instrument using a soft damp cloth applicator with cleaning agents that are not alcohol based, and are non-flammable and non-explosive.

3.0 CONNECTIONS & WIRING

The connection view of the PPX II is shown in figure 3.

See Appendix A1 for detailed wiring diagrams covering the CT/VT measurement inputs.

3.1 Auxiliary Power

The PPX II is powered by connections to L1(+) and L2(-). A green LED Power (PWR) indicator is provided on the front panel to indicate that the unit is powered ON.

3.1.1 Specifications (per section 1.3)

Power Supply Input (Auxiliary) Voltage – terminals L1(+) and L2(-)

DC PWR (Low Voltage Vdc) - Power Supply Input (Auxiliary Voltage - intended for connection to 12V or 24V battery voltages)

Nominal:	12-40V dc
Operating Range:	8-40V dc
Burden:	5W max

Overcurrent protection (Required) : Refer to section 2.4

AUX PWR (Universal) - Power Supply Input (Auxiliary Voltage)

Nominal:	48-250V dc, 69-240V ac (50/60Hz)
Operating Range:	37-300V dc, 55-275V ac (45-65Hz)
Burden:	8W max, 24VA max

Overcurrent protection (Required) : Refer to section 2.4

3.2 VT Inputs – VA, VB, VC, VN (See Appendix A1 and Section 1.3)

The PPX II is capable of monitoring two voltage buses, designated as Bus 1 (Terminals 3-6) and Bus 2 (Terminals 7-10). Voltage signals are measured using a 12.06Mohm (12Mohm/60.3Kohm) resistor divider with a continuous voltage rating of 7kV. This ideal impedance provides a low burden load for the VT circuits supplying the signals. Grounding of VT & CT signals per ANSI/IEEE C57.13.3-2005 is recommended. The polarity of the applied signals is important to the function of the instrument.

3.3 CT Inputs – IA, IB, IC (See Appendix A1 and section 1.3)

The instrument should be connected directly with the secondary of an external current transformer (CT). Connections to the measurement Current (CT) signal inputs on the PPX II are made at terminals 11-16. The current terminals require the use of #10 rings lugs.

The 1 or 5 Amp current inputs feature 10-32 terminals to assure reliable connections. This results in a robust current input (CT) connection with negligible burden to ensure that the user's external CT circuit can't ever open-circuit, even under extreme fault conditions. Grounding of CT signals per ANSI/IEEE C57.13.3-2005 is required.

Current inputs: The current inputs are 1 or 5 Amp nominal input with internal current isolation transformer, constructed with 10-32 studs as the current terminals. It is intended that this meter connect to the output from the secondary circuit of permanently installed Current Transformers (CTs).

WARNING: Current transformer circuits:
Do not open the secondary circuit of a live CT since the high voltage produced may be lethal to personnel and could damage insulation.

WARNING: DO NOT loosen existing 10-32 hardware that secures the current input studs to the front panel. When making connections to the current input studs, use #10 ring lugs. Fasten ring lugs with the 10-32 bagged hardware (flat washer, lock washer, and nut) provided. DO NOT OVERTORQUE. HAND Tighten with a standard nut driver. 12 inch-pounds (1.36 N-m) is recommended, MAXIMUM torque is 15 inch-pounds (1.69 N-m). .

3.4 Ethernet – with built in port switches

The PPX II Ethernet ports meet or exceed all requirements of ANSI/IEEE Std 802.3 (IEC 8802-3:2000) and additionally meet the requirements of part 8-1 TCP/IP T-profile for physical layer 1 (Ethernet copper interface).

PPX II is offered with dual standard Ethernet 10/100 Megabit (Mb) RJ45 (copper) interfaces (10BASE-T and 100BASE-TX) which automatically selects the most appropriate operating conditions via auto-negotiation. This interface is capable of operating either as half-duplex (compatible with all Ethernet infrastructure) or full-duplex interfaces (which allow a potential doubling of network traffic). Note that the meters come with the port setup as a service port, with Modbus TCP/IP or DNP3 TCP/IP or UDP software.

The PPX II has a built in three port 10/100 copper based Ethernet switch. One of the ports connects internally allowing the PPX II to communicate to other devices. The remaining two ports are on the front panel of the PPX II, labeled Ethernet 1 and Ethernet 2. Either port may be connected to the network to allow communications with the PPX II. The remaining port can be used to extend the network to another device, without the need for a separate external Ethernet switch.

3.4.1 Network settings

The PPX II come preconfigured for interconnection to an HTML web server with default settings for IP address, SUBNET mask, and ROUTER (GATEWAY) address.

Network Default (Preconfigured) Settings		
IP Address	Subnet mask	Router (Gateway) Address
192.168.0.171	255.255.255.0	192.168.0.1

It is very important that the network have no duplicate IP addresses, so an IP address conflict is NOT created for your network. Changing the stored Configuration of these network addresses may be accomplished by using the following method

<u>Enter the IP Address for the meter through a standard web browser:</u>

Before entering an IP address with this method make sure the current IP address and the new IP address to be assigned to the meter will not cause IP address conflicts on your local network. To connect to the web server, enter the meter's current IP Address in your web browser's address bar. When the web server screen appears click on the "Settings" tab. Type the new Network settings (IP address, Subnet mask, Gateway) in the appropriate fields and click the "**Apply**" button to send the new network settings to the meter. Reboot the meter for the configuration change to take effect.

The PPX II uses the following port numbers for each type of protocol:

Protocol	Port Number
DNP3	20000 (TCP, UDP)
HTML	80 (TCP)
Modbus	502 (TCP)

Determining the IP Address if unknown:

Bitronics has created a utility program to request the IP address for a specific MAC address on an Ethernet network. This program can be used with the PPX II. The program is available on the company website (http://www.novatechweb.com/downloads/inarp/) .
The program uses the Inverse Address Recognition Protocol to perform the lookup and thus is called inarp. The InARP protocol definition can be found at www.apps.ietf.org/rfc/**rfc2390**.html. The inarp utility can also scan an Ethernet network for a range of MAC addresses, printing the IP address for any devices which respond.

The general form of inarp is defined below, followed by some usage examples.

inarp usage:

inarp [-i <if_ipaddr>] [-n <cnt>] [-p <ms>] [-v] <mac-spec>

where
<if_ipaddr> := interface ip address (default is 1st Ethernet interface)
<cnt> := count of addresses to poll (default 1)
<ms> := period between polls (100ms)
<mac-spec> := <6ByteMac> | <[3-5]ByteMac> | <macRangeName>
<6ByteMac> := xx:xx:xx:xx:xx:xx - <cnt> can specify a range to scan
<5ByteMac> := xx:xx:xx:xx:xx - default <cnt> is 256
...
<3ByteMac> := xx:xx:xx - default <cnt> is 16,777,216
<macRangeName> := "50series"
50Series MAC base (00:d0:4F:03), default <cnt> is 65,536
-v := request verbose information

CTRL-C stops a scan.
The inarp utility requires the WinPcap and Packet libraries which are bundled in the WinPcap "Installer for Windows." This can be downloaded from www.winpcap.org.

Installation requires Administrator privileges.

Examples:

to poll the 1st IPv4 interface,
inarp -v 50series
CTRL-C stops the scan

to poll the IPv4 interface associated with 192.168.1.1, use
inarp -v -i 192.168.1.1 50series

or to poll a specific mac, use
inarp -v -i 192.168.1.1 00:D0:4F:03:00:15

3.4.2 Indicators – Ethernet (ACT) LEDs

There are 2 LEDs on the front panel to indicate activity is occurring on the communication ports. These LEDs are useful in determining that there is activity occurring on the ports. The LEDs are labeled “Ethernet 1” and “Ethernet 2” to correspond to each of the Ethernet ports. The appropriate LED will flash to indicate there is activity on an Ethernet RJ45 port. It will also indicate that a link has been established on the appropriate port.

A troubleshooting guide is found in Appendix A2, which may be useful in establishing Ethernet connections.

3.4.3 Firmware upgrades and saving and loading configuration files – Ethernet service port

New versions of firmware may be released by Bitronics from time to time, either to add new functionality or to correct errors in code that may have escaped detection prior to commercial release. Consult the factory for detailed information pertaining to the availability of firmware upgrades. In cases such as this, it is desirable to support a mechanism for new firmware to be installed remotely. The ability to upgrade Firmware is done over the Ethernet port. The PPX II utilizes a page in the Web Server interface to upload and install new firmware.

The complete PPX II configuration, which includes all user-configurable parameters, can be saved in a single file on your computer. This allows you to save a backup of your configuration and to restore it at a later time, as needed. This also allows you to configure one PPX II and then transfer the configuration to multiple other PPX II’s.

Before initiating the firmware upgrade, if you are planning to use a configuration that has already been setup in the PPX II, then you should first go to the Load/Store Settings page and click on the Get File button to save the IED configuration to your computer (if you will be using a default configuration this step is not necessary). Use the File Save dialog window to select the location on your computer to save the configuration file. Once you have saved the file, it is recommended that you load the file back to the PPX II to validate that it was saved correctly. Click the Browse or Choose File button and use the File Open dialog window to select the configuration file you just saved. Click the Submit button. If the “Configuration upload success” message appears, the configuration file is confirmed to have saved correctly. Once the configuration file is saved to your computer, or even if you don’t need to save the configuration, you should restore the meter to the factory defaults. On the Load/Store settings page, select Restore All Defaults to bring the meter back to default settings.

To upload the new firmware, first obtain a copy of the firmware image. The firmware image is a binary file, less than 2 MB in length, that can be attached to email, distributed on a CD, or downloaded from an FTP site as circumstances dictate. Place a copy of the firmware image on your computer then access the upload page from the Firmware Upload link on the Configuration Settings page.

This will take you to the Firmware Upload page, which looks like the screen capture in Figure 7.

Figure 7 – Bitronics PPX II Firmware Upload Page

Once the Firmware Upload page is visible, use the Browse button to locate the firmware image on your computer. Next use the Submit button to initiate the file transfer and installation process. The instrument must be rebooted to make the new firmware active. At the completion of the file transfer and installation process, the instrument will prompt you to reset the instrument remotely by displaying the dialog box below after the firmware has been successfully installed.

It is strongly recommended that you clear your web browser's cache (delete the temporary internet files) after updating the firmware so that the new content will be loaded into your browser. Please refer to your browser's help file on how to clear the cache. A useful keyboard shortcut common to Internet Explorer, Firefox and Chrome is CONTROL + SHIFT + DELETE, which will take you directly to the relevant dialog panel. Carefully select the items to be cleared. Be sure to check the boxes that clear "temporary internet files", "cache" or "website data" and uncheck any boxes that preserve data.

If you had a previously saved configuration that you wish to now load to your PPX II, you should now go back to the Load/Store Settings page and go to the top box "Select a configuration file". Click on the box "Load network settings from file" and then browse to find the configuration file you wish to load. Once selected, click on Submit, and then you will need to reboot the unit.

3.5 Optional Serial Port (option includes Digital IO) – Extended Chassis Only

The PPX II has an optional serial port that is user configurable for RS232 or RS485, and support baud rates up to 115200. See section 4.4 for screen shot showing web configuration for serial port. The RS-232 drivers support full and half duplex modes. See Figure 2 in the Digital IO section for signal assignments for the serial port.

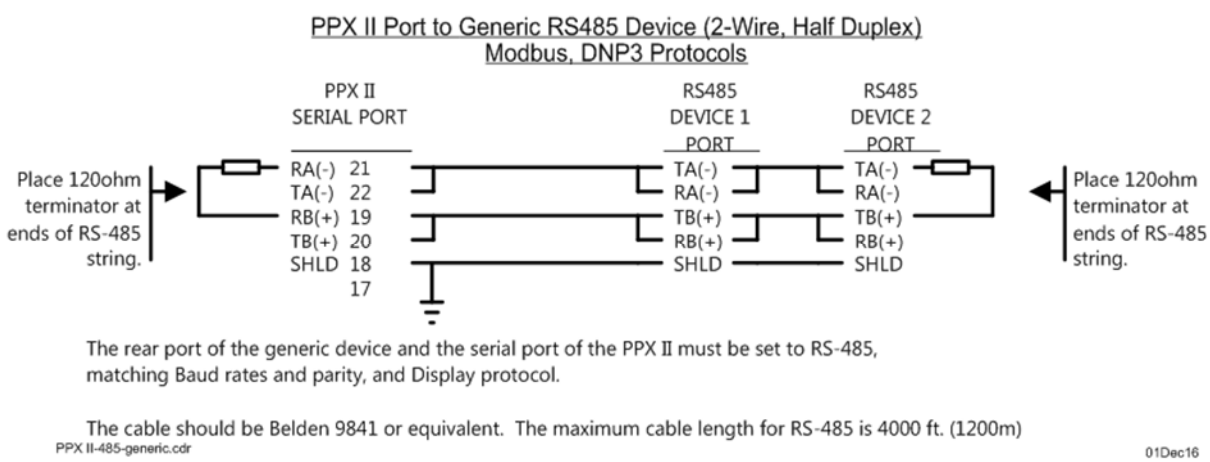
Serial cable requirements for RS485 connection:
Tie RS-485 cable shields (pin 18) to earth ground at one point in system.

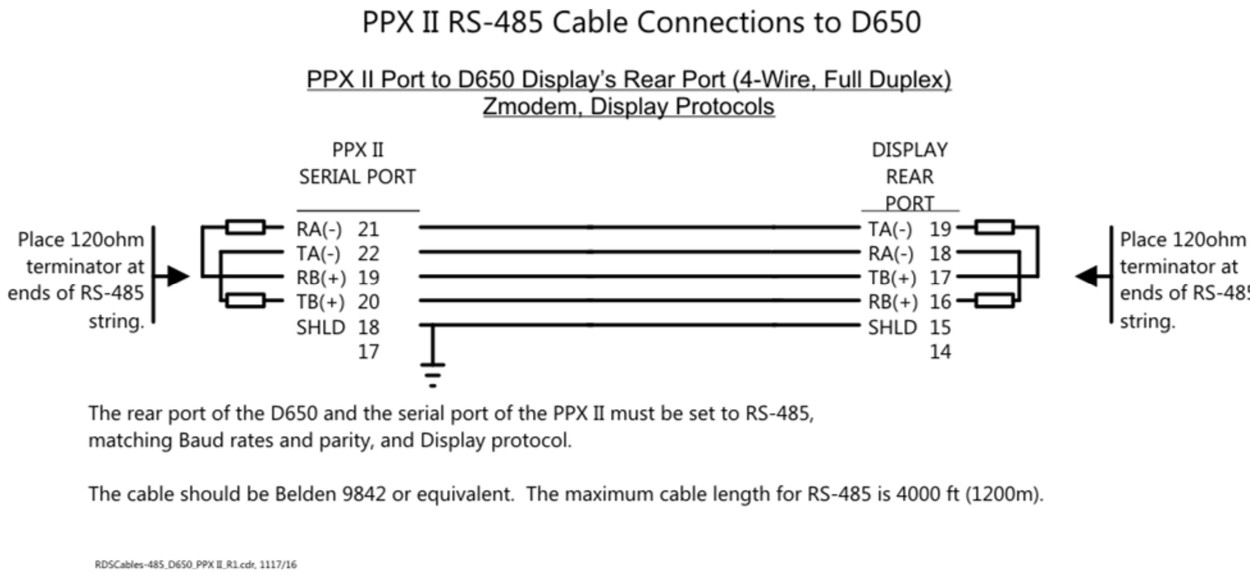
The recommended torque rating for the terminal block wire fasteners are listed in the Physical Specifications table (section 1.3).

A Transient Voltage Suppressor (TVS) clamp device is used on the serial port as the method of protection.

3.5.1 RS485 Connections (Extended Chassis Only)

Note that various protocols and services have different port connection requirements. When making connections to serial ports for Modbus or DNP3 over RS485, 2-wire half duplex is required. This is because it is imperative to maintain a minimum time period (3 1/3 characters) from the time the transmitter shuts off to the next message on the bus in order to guarantee reliable communications. However, when using ZMODEM or connecting to the remote display, asynchronous 2-way communications are required, and therefore a 4-wire full duplex (technically RS422) connection is needed. See figure 8 below for RS485 cable wiring diagrams showing both 2 and 4 wire.





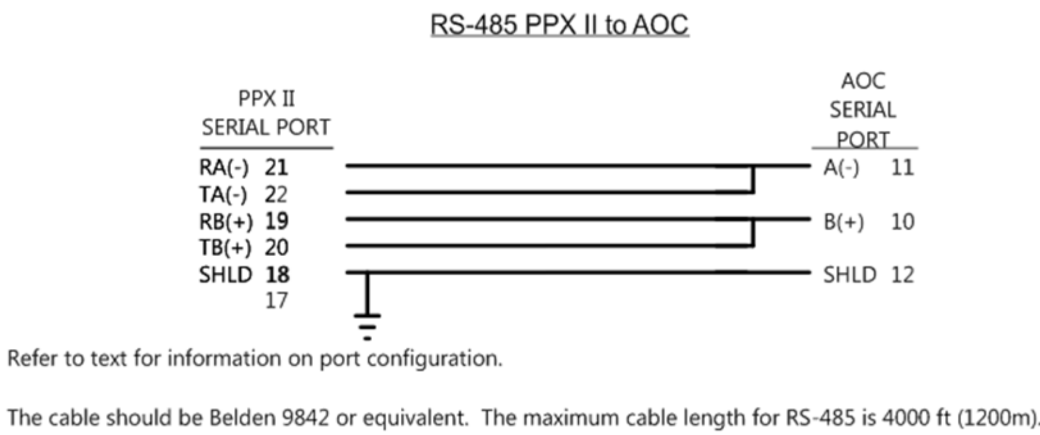
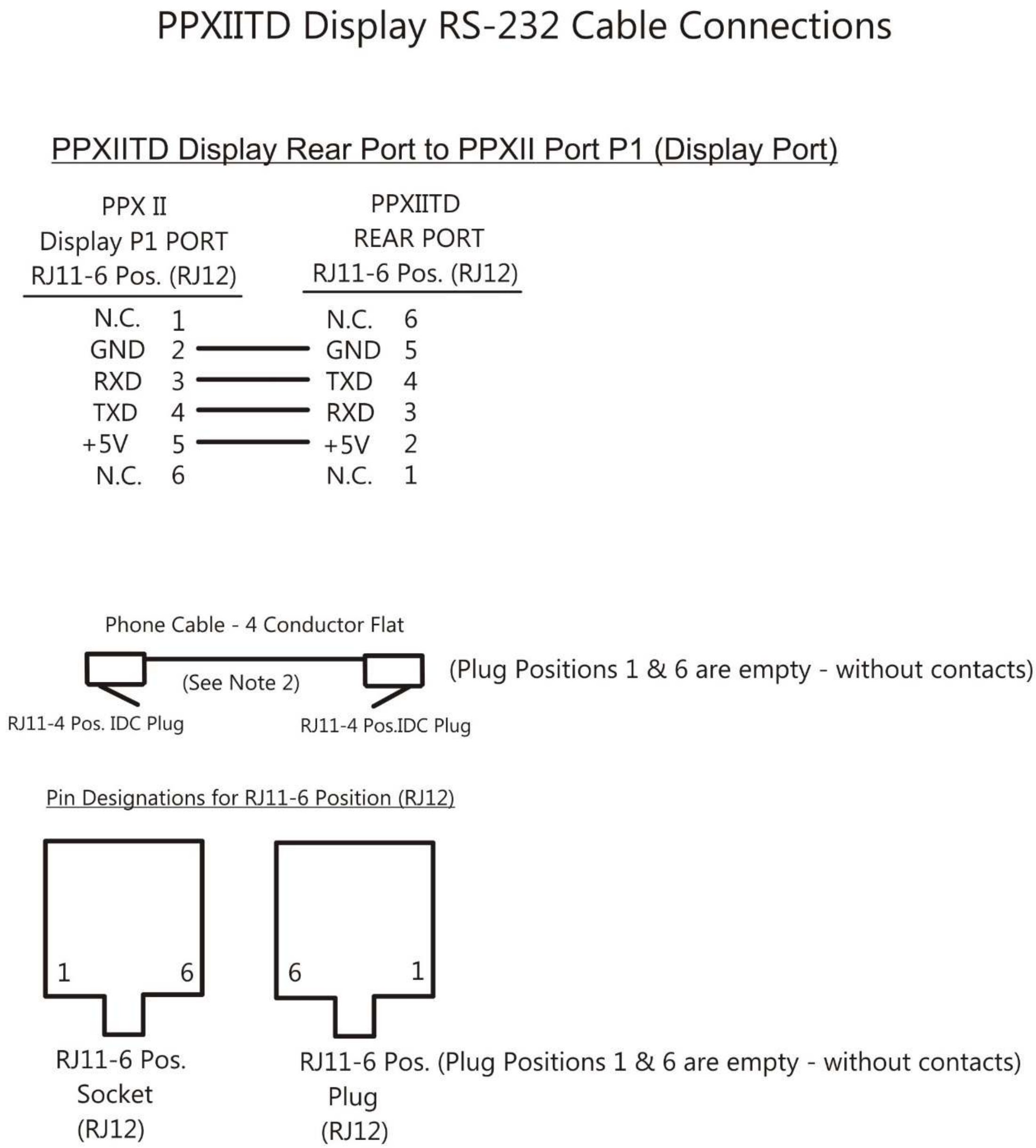


Figure 8 - Typical RS-485 Cable Wiring

3.6 Optional Display Port (option includes IRIG-B and Energy Pulse LED)

The PPX II has an option for adding a display port for use with the tethered display or for using as a RS232 serial port. When ordering this, an IRIG-B port is also added along with and Energy Pulse LED. Following is a description of the display port:

- The Display port (P1) is an RJ11, 6 position modular jack; maximum distance is 30 ft (9 m) for RS232 connection used to interface to a PPX IITD display or for Modbus or DNP3 protocol.
- Baud rate is 19.2 kbps



1. The rear port of the PPXIITD Display and the Display P1 (Host) port of the PPXII must be set to RS-232, matching Baud rates, parity, and Display protocol.

2. The maximum cable length for RS-232 is 50 ft. (15m). Cable is offered in 7 ft or 25 ft standard lengths.

PPXIITD_RDSCablesR2-232_Rev3.cdr, 6 Jan 2016

Figure 9 – Tethered Display: PPX IITD Cable Wiring Diagram

3.6.1 Display Screens (Optional Display)

The PPXIITD can display several per-phase and total quantities for the circuit being monitored. In order to make all quantities available, the display scrolls from quantity to quantity approximately every 5 seconds. The quantities are refreshed once a second. The Alphanumeric display at the bottom of the instrument indicates to the user what quantity is being displayed. The Alphanumeric display also provides the user with primary engineering units (Watts, kWatts, MWatts, etc.). Listed in Appendix A4 are standard screens available in the PPXIITD. Configurable screen enable settings allow the user to enable or disable each of the display screens, in order to view only a selected subset of all the measurements the meter is capable of displaying. Refer to the A3 on Setup Mode for instructions on programming Screen Enable Settings (Setup menu - [1.6] Scrn Ena) and setting Custom Screens.

The following screens are enabled by default:

Amps A,B,C
Volts AN,BN,CN
Volts AB,BC,CA
Total Watts / Total Vars
VAs Total / Power Factor
Frequency
Demand Amps A,B,C

The Default HOME screen is:

Amps A,B,C.

The screens that are displayed in the scrolling mode can be programmed (ENABLED/DISABLED) by the user. This programming can be done by using the front panel buttons of the device or through the web server.

<u>Enable/Disable Display Mode Screens via the front buttons on Display:</u>
The Screens can be enabled or disabled (refer to Section 5.5) via the front display buttons by entering the setup mode section and going to the Screen Enable menu (1.6, Scrn Ena). This setup can also be accomplished via the web interface through the Ethernet service port by going to the appropriate setup page.

<u>Enable/Disable Display Mode Screens via the Web Server:</u>
The screens can be enabled/disabled via the web server (Refer to section A3). From the web page, select the Settings tab then click on Screen Enable in the menu list.

For all the Watt, VAR and/or PF displays the "SIGN" of the quantity is indicated by the center segment of the left most digit, which will be illuminated to produce a "-" for negative quantities. Positive quantities will have no polarity indication. This restricts the display to 4 digits in the Watt and/or VAR display, however this is a restriction for the display only, internally the instrument still carries full precision.

3.6.2 Overview – Buttons Functions (Optional Display)

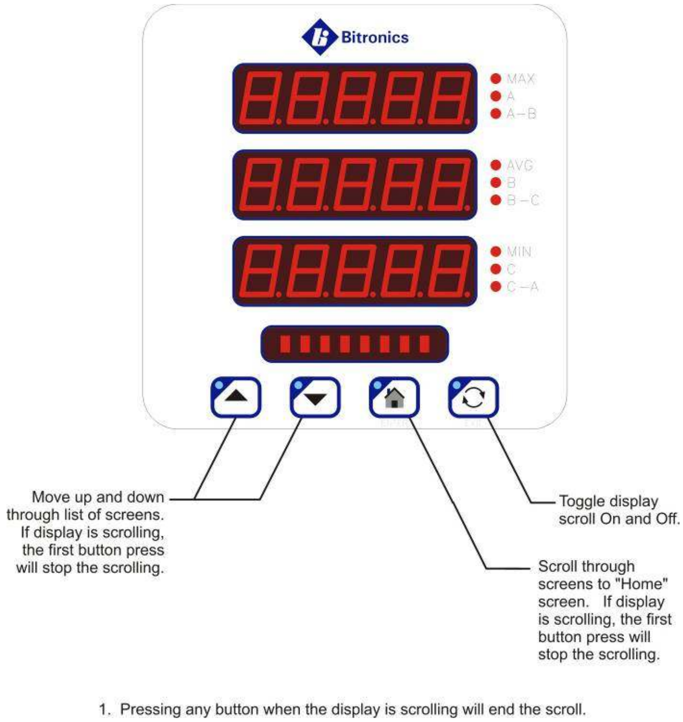


Figure 10 – Button functions for Display Mode

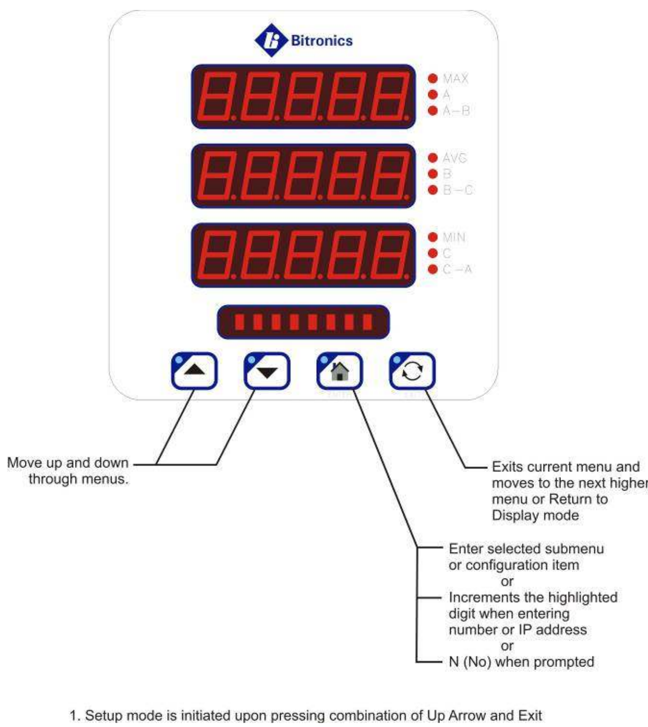


Figure 11 – Button functions in Set-up Mode

3.6.3 Keypad Functions for Display Mode (Optional Display)

Measurements screens may be stepped through manually by pushing the up and down arrow keys. Pushing the Toggle (Exit) key turns the scroll function off and on. When the scroll function is activated, the measurement screens will automatically step through the user-defined screens. Auto scroll state (ON/OFF) is stored in non-volatile memory. Pressing the Home (Enter) key will bring up the home screen. The factory default home screen will be Amps A, B, C. If a user enables or disables screens via the front display buttons from Setup Mode - 1.6 Scrn Ena, then the home screen will automatically become the 1^{st} enabled screen. The home screen can be setup as any one of the enabled screens by simultaneously pressing the Home (Enter) and Toggle (Exit) buttons when on the desired screen and can also be done through the web server Settings tab.

Table 1 –Button Functions

Button	Display Mode Function	Setup Mode Function
Up Arrow	Next measurement/value	Next menu item
Down Arrow	Previous measurement/value	Previous menu item or Y (Yes) when prompted
Home (Enter) Enter	Scroll to designated home screen	Enter selected submenu (or configuration item), or Increments the hightlighted digit when entering number, or IP address, or N (No) when prompted
Toggle (Exit) EXIT	Toggle Auto Scroll On/Off	Exits current menu selection and moves up to next higher menu level. Returns to display mode on exit from main setup menu
Combination Up and Exit keys	Enter Setup Mode (Resets and configuration setting are done in the setup menu)	
Combination Up and Down Keys	Resets Demand Values	
Combination Home (Enter) and Toggle (Exit) keys	Designate the displayed screen as “Home Screen”	

Resets are found in setup menu

3.6.4 Display Error Messages

Error messages from self test are shown on the display (PPX II). The table below summarizes the errors and the messages displayed:

SELF TEST RESULT SUMMARY FOR PPX II DEVICES

Fault	Fault Indication	Effects of Fault	Corrective Action
Display Oveflow	Display flashes 9999	Measured quantity is too large to be displayed. Communication option output may still be accurate, if overload does not exceed meter input ratings	Correct fault external to instrument.
Input gain calibration checksum error	G CAL	Calibration constants for the input gain are in error. The display and the communication option output are reduced in accuracy to approximately +/-3%.	Return to factory for repair
Input phase calibration checksum error	P CAL	Calibration constants for the phase are in error. The display and the communication option output are reduced in accuracy to approximately +/-3%.	Return to factory for repair
Analog outputs calibration checksum error	A CAL	Calibration constants for the analog outputs are in error. The analog output option is reduced in accuracy to approximately +/-3%.	Return to factory for repair
Input Over-Range	CLIP	Peak input quantity exceeds the range of the instrument. Both display and communication option output accuracy reduced by an amount depending upon the degree of over-range.	Verify input signals are within range. If within range, return to factory for repair.
Protocol Configuration Error	P CFG	Instrument protocol configuration may be corrupted and inaccurate. This may cause communication errors.	Reset configuration.
Firmware Download in Progress	FLASH	Will be displayed during download and will disappear shortly after user reboots meter	Reboot meter when prompted.

3.7 Optional IRIG-B Port

The IRIG-B option allows PPX II system time to be regulated by an IRIG-B clock source. If the clock source is synchronized by GPS, PPX II system time can be aligned with other devices with great precision.

Unmodulated IRIG-B input allows system time regulation to 1us, IRIG-B 1kHz modulated input allows system time regulation to 1ms.

PPX II IRIG-B input decodes a signal as defined in the IRIG Standard 200-04, with support for IEEE 1344 extensions. C37.118-1-2011 elements are parsed, but are currently unused.

IRIGB has 10Ms bit rate, 100 bits per frame, with 1 frame per second.

IRIGB has a 3 digit suffix. The suffixes supported by PPX II are:

Modulation
- 0 DCLS (Direct Current Level Shift) - allows 1us regulation
- 1 Sine wave carrier - allows 1ms regulation

Carrier frequency
- 0 no carrier (DCLS)
- 2 1kHz carrier

Coded Expressions
- 0 BCD, CF, SBS
- 1 BCD, CF
- 2 BCD
- 3 BCD, SBS
- 4 BDC, BCD_Year, CF, SBS
- 5 BCD, BCD_Year, CF
- 6 BCD, BCD_Year
- 7 BCD, BCD_Year, SBS

PPX II supports the following IRIG-B formats:
B000 thru B007 and B120 thru B127

PPX II automatically detects demodulated (DCLS) and modulated input, switching as appropriate. Modulated input is indicated by the 'IRIG-B MOD' led on the front panel.

Any absent or malformed input frame causes the IRIG-B to flag the IRIG-B input as invalid. One complete valid frame must be decoded before declaring IRIG-B input valid.

If the IRIGB input frame contains century data, it is used, otherwise the system time year is used (initially obtained at boot from the RTC chip).

Valid decoded IRIG-B information is passed to the PPX II system time process. The system time process uses the highest precision valid input to regulate system time.

There are no configurable parameters for IRIG-B (signal propagation delay will need to be added).

3.7.1 IRIG-B Electrical Specifications (Option)

Pulse Width Coded Signal

Absolute Maximum Input Voltage:	-25 Volts to +25 Volts
Receiver Input Threshold Low:	0.8 Volts (min)
Receiver Input Threshold High:	2.4 Volts (max)
Receiver Input Hysteresis:	0.6 Volts (typical)
Receiver Input Resistance:	5 kohms (typical)

Amplitude Modulated Signal

Input impedance: >10K ohm

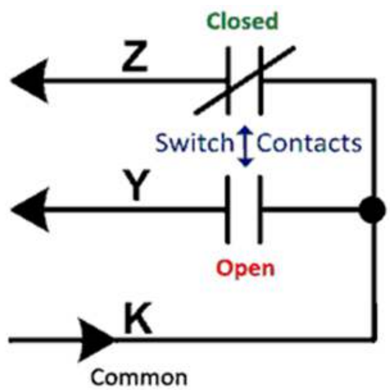
Input Format:	IRIG B000-B007, B120-B127 1kHz modulated sine wave, amplitude 3Vpp – 10Vpp, modulation ratio 3:1 600 uSec (Program this offset in Configurator)
Connector:	BNC (Standard BNC cable from Master to PPX II)

3.8 Optional Energy Pulse Infrared LED

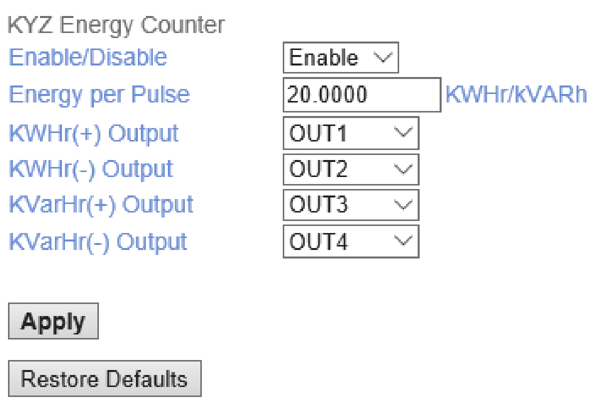
An Energy Pulse Infrared (IR) LED is located on the PPX II front panel to the top right side marked as ENERGY. There is also a visible LED behind the IR LED that illuminates. The visible LED makes it evident to the user that Energy Pulses are occurring on the Infrared LED. This visual feedback insures that ENERGY pulses are occurring in agreement with the Energy pulse setting. Energy values entered from the webpage settings screen determine the trigger setting for pulses to occur on the ENERGY LED. An infrared receiver is necessary to read the energy pulses transmitted by the PPX II. Following is some general information on pulse energy meters:

Pulse output meters are consumption monitoring devices. A pulse output power meter will indicate the number of kWhs used by the system load. Historically, rotating meters could report their power information remotely, using a pair of contact closures attached to a KYZ line. In this scheme, line “K” is attached to two single-pole single-throw switches “Y” and “Z”. “Y” and “Z” open and close as the meter’s disk rotates. As the meter rotates in one direction, Y closes, then Z closes, then Y opens, then Z opens. When it rotates in the opposite direction, showing export of power, the sequence reverses. The KY element refers to a two-wire variant of KYZ, where only the K and Y wires are used in a “normally open” configuration.

The intent of both KY and KYZ elements are mainly for meter verification and the output of energy pulses are sent to an external counter.



KYZ configuration in the PPX II is achieved by navigating to the Settings / Input screen of the instruments webserver.



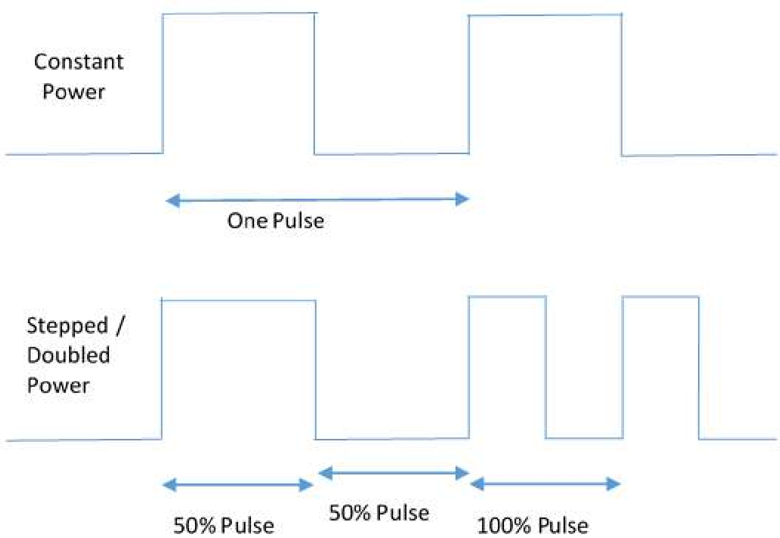
When the 4 digital in/4 digital out option is ordered, the positive and negative KWHr and KVarHr can be assigned to any of the four outputs in whatever order is desired. The energy pulse LED is tied only to KWHr. Each of the outputs can be disabled if there is no desire to tie the energy to the digital outputs, while still enabling the LED. When the output option is not ordered, the four outputs will show as Disabled and can’t be changed.

Explanation of KYZ Parameters

Energy per Pulse (EPP)

- The EPP parameter has a range of 10^{-5} to 10^{4} with units of KWhr / kVARhr.
- The default value of EPP is 10 KWhr / kVARhr primary engineering units.

- The time between rising edges defines the length of the energy pulse as shown below.
- Shorter pulses indicate a faster rate of consumption as shown in the stepped power square wave.



4.0 FUNCTIONAL DESCRIPTION

4.1 Configuration

Setup of the PPX II is most easily performed using the web interface via the Ethernet service port. Basic configuration can also be handled from the front display by entering the setup mode.

4.2 HTML Web Server

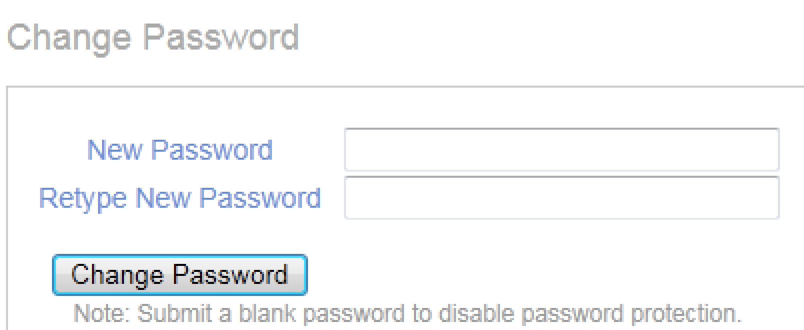
The PPX II incorporates an internet-compatible HTML web page.

4.3 Passwords

Passwords can be setup through the web interface in the PPX II for use in controlling access to configuration and other functions available through the Ethernet port. Passwords may be comprised of the 95 printable ASCII characters as defined by http://en.wikipedia.org/wiki/ASCII#ASCII_printable_characters which includes 0-9, a-z, A-Z, and special characters with the exception of the tilde character (~). Passwords may have maximum length of 20 characters and a minimum of 1 character. Passwords prompts are disabled by leaving the new password field blank and clicking the 'Change Password' button. The default from the factory is to have no password set.

The password is used to authenticate a session when prompted. The session authentication will last until the user clicks the 'Log Out' link on the upper right corner of the Web Interface or after five minutes elapses. Authentication will be required when attempting the following actions:

- Resetting demand and energy values on the Web Interface Resets page
- Applying changes to any settings on the Web Interface Settings tab
- Uploading new firmware on the Firmware Upload page
- Changing the password on the Password Security page
- Rebooting the IED



4.4 Performing set-up through the web page interface

This section will assume you are able to use the factory default IP address of 192.168.0.171 to connect to the web page using an HTML web server. If this is not the case you may need to refer to section 3.5.1 (Network settings) to change your network configuration settings.

Enter the PPX II's IP address into your internet browser to connect with the PPX II web page interface. Internet browsers supported are Firefox, Internet Explorer, Safari and Google Chrome. The Home page screen should appear as shown below.

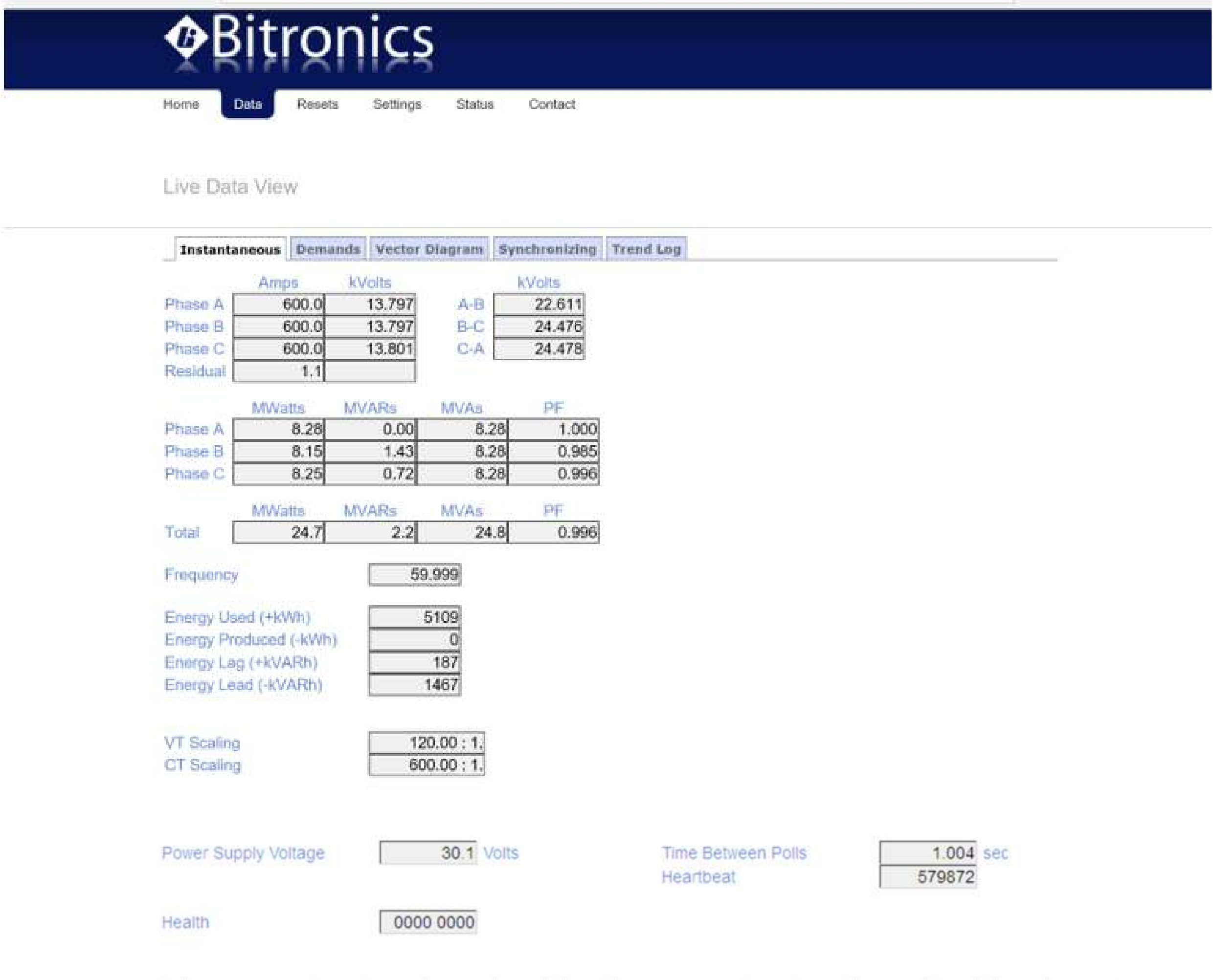
Home page:

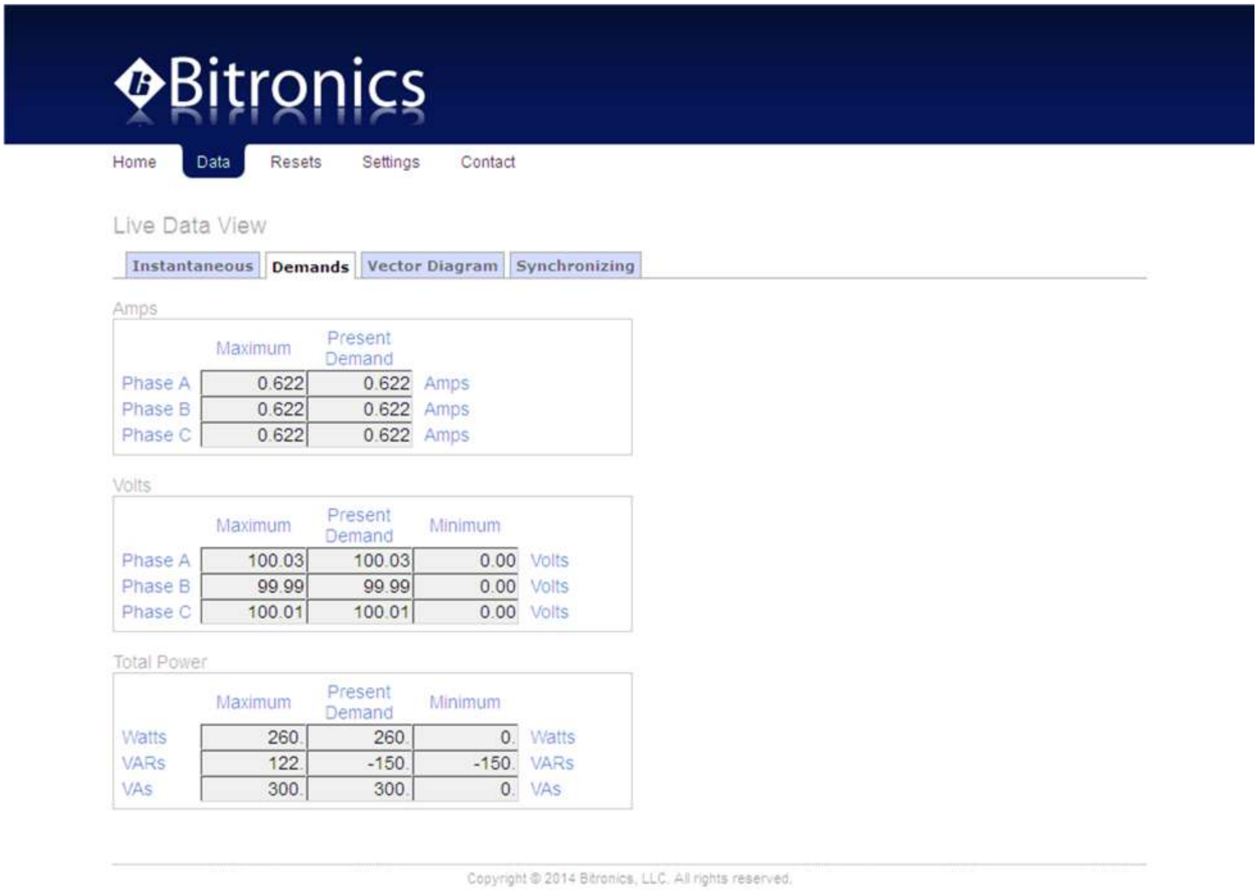
From the home screen you can select from the following tabs:

- Data – This page displays current data measurements
- Resets – This page allows certain quantities to be reset
- Settings – This page allows the user to change the configuration settings. Making PPX II configuration changes require the unit to be rebooted. Configuration settings for the PPX II are stored in flash memory.
- Status – This page displays the status of the IEC 61850 communications interface and the health status. If the meter does not include the IEC 61850 option, the status is displayed as 'Model does not include option'
- Contact – This page indicates how to contact Bitronics

NOTE: Some screen shots shown below may not exactly match the appearance of those from your actual meter.

Data page: Five views – Instantaneous, Demands, Vector Diagram, Synchronizing, and Trend Log





Amps

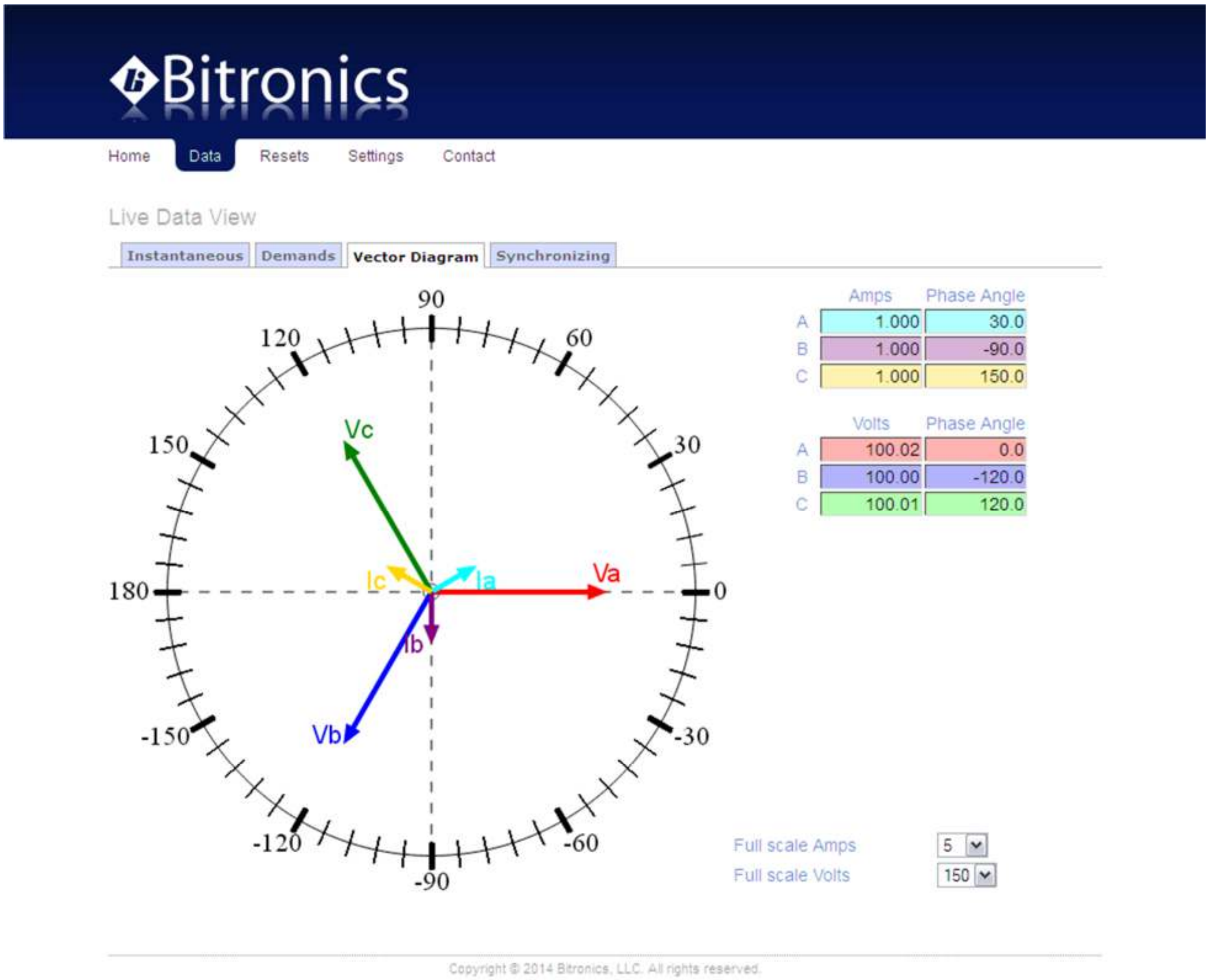
	Maximum	Present Demand	
Phase A	0.622	0.622	Amps
Phase B	0.622	0.622	Amps
Phase C	0.622	0.622	Amps

Volts

	Maximum	Present Demand	Minimum	
Phase A	100.03	100.03	0.00	Volts
Phase B	99.99	99.99	0.00	Volts
Phase C	100.01	100.01	0.00	Volts

Total Power

	Maximum	Present Demand	Minimum	
Watts	260.	260.	0.	Watts
VARs	122.	-150.	-150.	VARs
VAs	300.	300.	0.	VAs


Bitronics
Home
Data
Resets
Settings
Contact
Live Data View
Instantaneous
Demands
Vector Diagram
Synchronizing
Amps
Phase Angle
A 1.000 30.0
B 1.000 -90.0
C 1.000 150.0
Volts
Phase Angle
A 100.02 0.0
B 100.00 -120.0
C 100.01 120.0
Va
Vb
Vc
Ia
Ib
Ic
Full scale Amps 5
Full scale Volts 150
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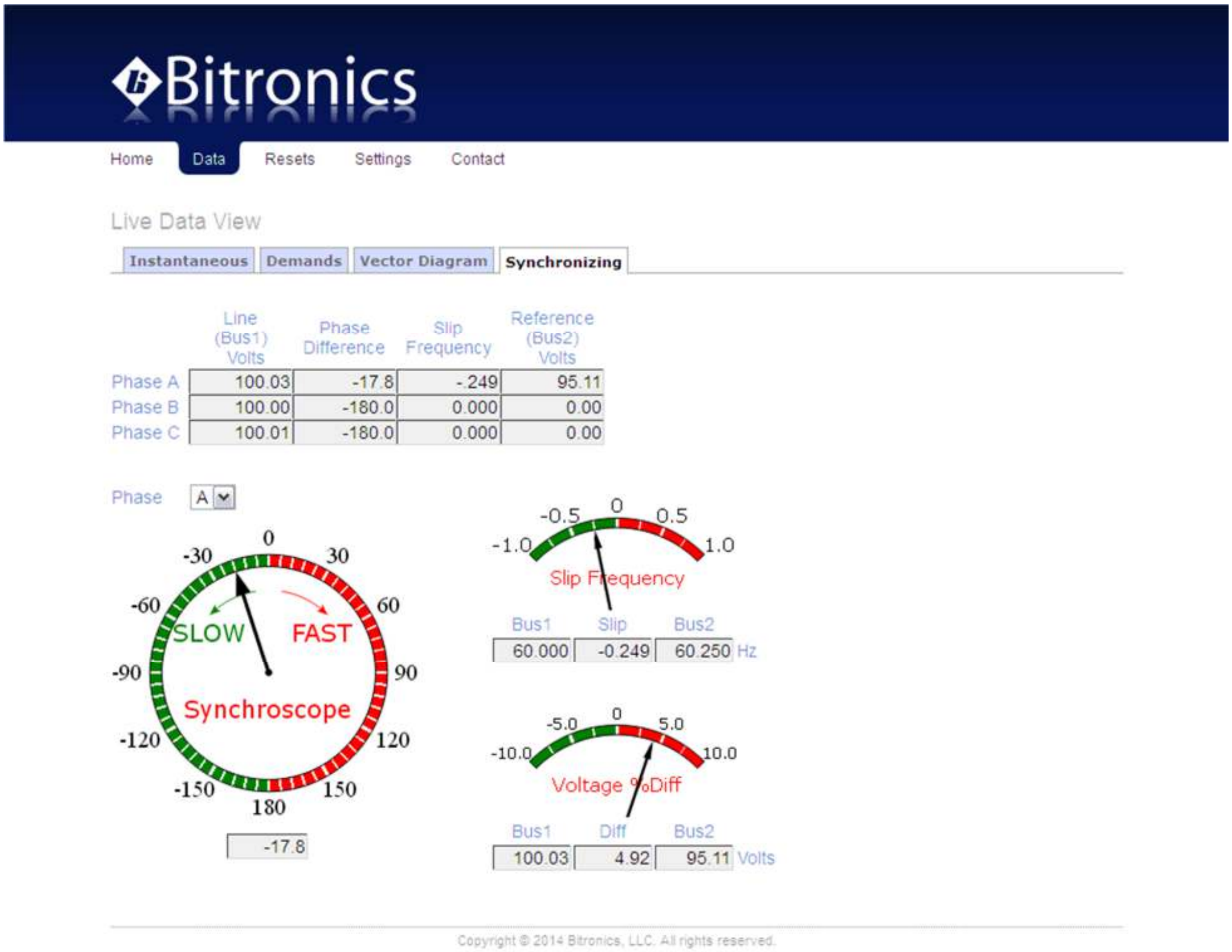
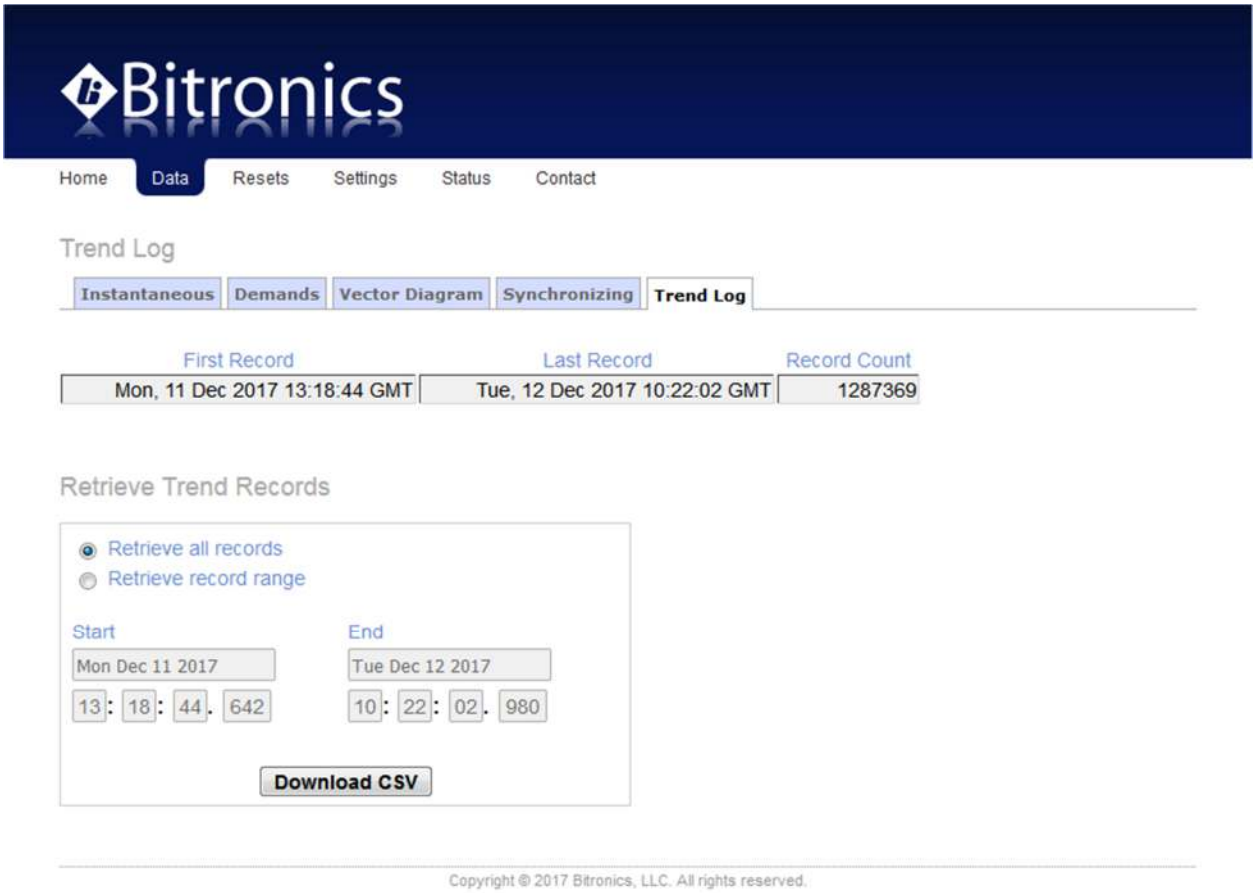
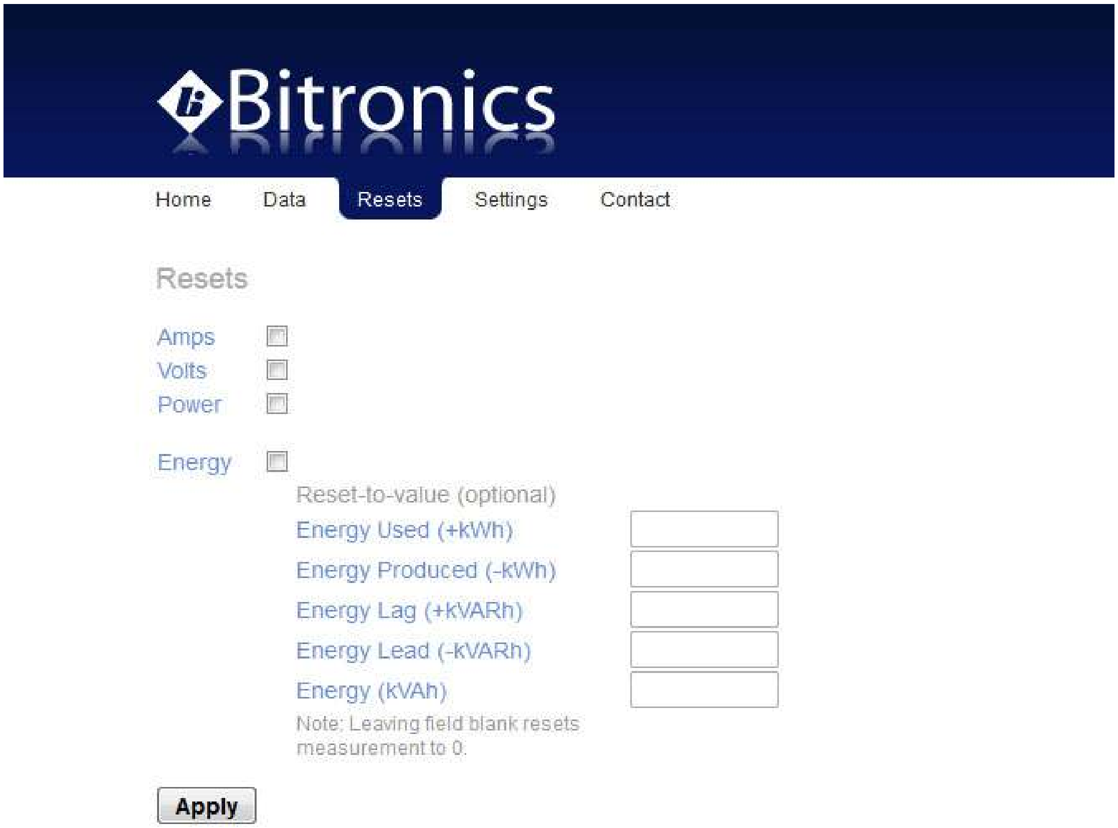

Bitronics
Home
Data
Resets
Settings
Contact
Live Data View
Instantaneous
Demands
Vector Diagram
Synchronizing
Line (Bus1) Volts
Phase Difference
Slip Frequency
Reference (Bus2) Volts
Phase A 100.03 -17.8 -.249 95.11
Phase B 100.00 -180.0 0.000 0.00
Phase C 100.01 -180.0 0.000 0.00
Phase A
SLOW
FAST
Synchroscope
-17.8
Slip Frequency
Bus1 Slip Bus2
60.000 -0.249 60.250 Hz
Voltage %Diff
Bus1 Diff Bus2
100.03 4.92 95.11 Volts
Copyright © 2014 Bitronics, LLC. All rights reserved.



The data page for trend recording gives information about the trend record, but also provides for retrieving it, or part of it via start and end times, in .csv format.

- One trend record contains a timestamp and values for all measurements that are selected for recording for that instant or time interval, depending on the configuration.
- When downloading a CSV file, navigating away from the log page will terminate the download.
- During a CSV download, the web interface will not respond to any other requests. For example, one cannot open another browser window and make configuration changes or view the other data pages.
- It is up to 4x faster to download a CSV file with the trend recorder disabled than to download while the trend recorder is actively recording at intervals of every sample or every-other-sample. Active recording at intervals of 1 second or greater will not slow down the CSV download.

Resets page: From this page select the quantity to be reset and click apply. Optionally, Energy values can be reset to specific non-zero values by entering the desired reset value in the appropriate field as a whole number and clicking Apply. Any fields that are left blank will be reset to zero.



Settings page: Click on one of the settings categories (Identity, Input, Network, Display, etc.) to be taken to the next page.

Contact Page:

Settings Page Selections:
From the Settings page screen you can select one of the following selections:

Identity– This page allows the user to enter information that is necessary to identify the meter. It gives an identity to a particular PPX II. Each PPX II should have different information entered for its identity.

Input – This page allows for the selection of wiring configuration, setup of CT and PT ratios, demand intervals, and TDD denominator. It is also used for setting up loss compensation, binary input de-bounce (if input option is ordered) and energy pulse output.

Network – This page allows the user to change the network configuration settings for IP address, gateway and router address.

Serial Port – This page allows user setup of the serial port (serial port mode, baud rate, parity, etc.)

Protocol – This page allows user configuration of the protocols – DNP or Modbus

IEC61850 – This page allows user to download and upload ICD and CID files (if option is ordered)

Screen Enable - Allows the screens shown on the PPXIITD or the D650 (if either ordered) to be enabled/disabled by the user. The Screen Enable tab/link only appears if the PPX II has the display port or optional serial port. Refer to Appendix A3.

Custom Screens – Allows the user to set up custom display screens if the standard screens don't meet their needs (if either the PPXIITD or D650 is ordered). The Custom Screens tab/link only appears if PPX II has the display port or optional serial port. Refer to Appendix A3

Time Sync – This page allows the user to set time

Load/Store Settings – This page allows you to save and retrieve settings

Security – This page allows the user to set a password

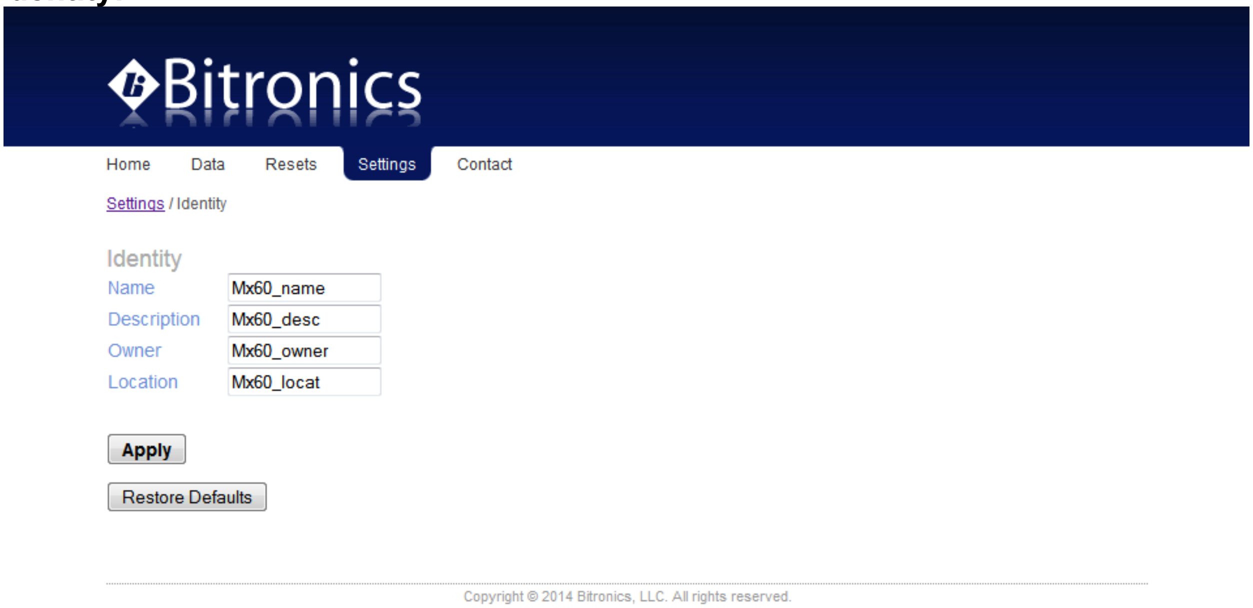
Firmware Upload – This page allows the user an interface to browse for or type in the location on their PC of new firmware for purposes of uploading to the unit.

Trend Recorder – This page allows for configuring the trend recorder settings.

Screen shots showing the selections to be made for each of the above selections follow on the next few pages. Default values are shown where applicable.

PPX II configuration changes require the unit to be rebooted. Configuration settings for the PPX II are stored in flash memory.

Identity:


Bitronics
Home
Data
Resets
Settings
Contact
Settings / Identity
Identity
Name
Mx60_name
Description
Mx60_desc
Owner
Mx60_owner
Location
Mx60_locat
Apply
Restore Defaults
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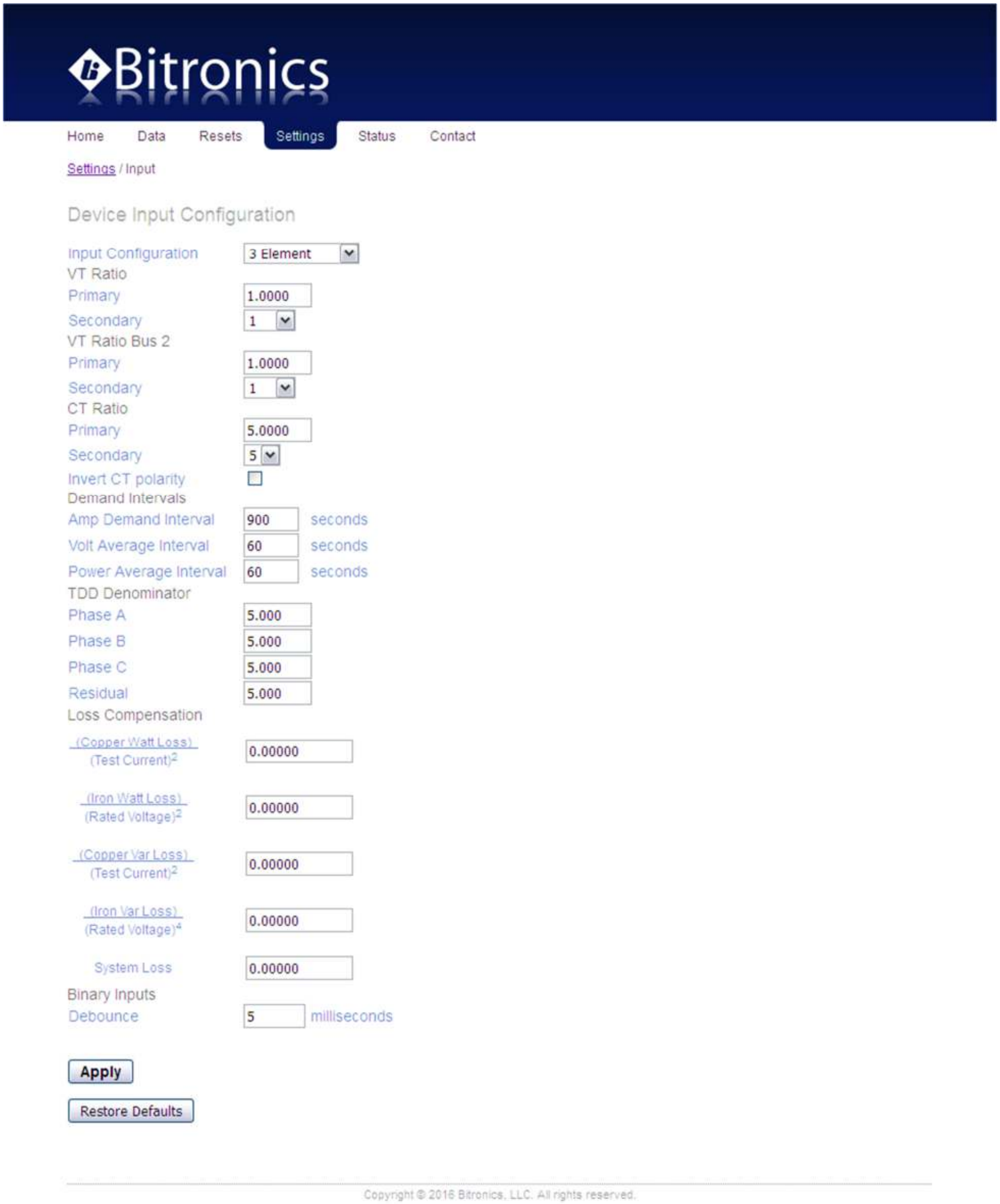
Input:



Bitronics

Home Data Resets Settings Status Contact

Settings / Input

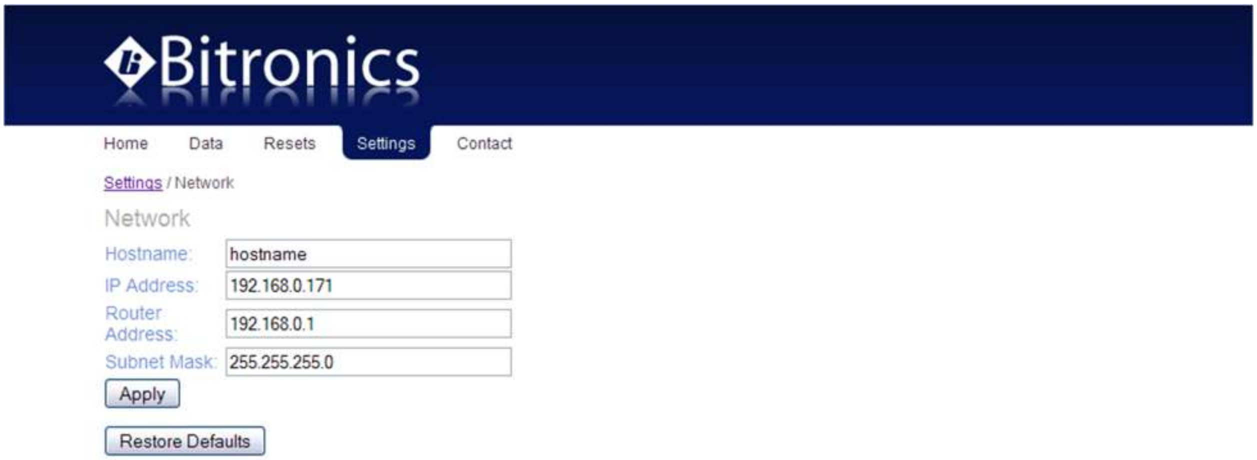
Device Input Configuration

Input Configuration	3 Element	
VT Ratio		
Primary	1.0000	
Secondary	1	
VT Ratio Bus 2		
Primary	1.0000	
Secondary	1	
CT Ratio		
Primary	5.0000	
Secondary	5	
Invert CT polarity	☐	
Demand Intervals		
Amp Demand Interval	900	seconds
Volt Average Interval	60	seconds
Power Average Interval	60	seconds
TDD Denominator		
Phase A	5.000	
Phase B	5.000	
Phase C	5.000	
Residual	5.000	
Loss Compensation		
$\frac{\text{(Copper Watt Loss)}}{\text{(Test Current)}^2}$	0.00000	
$\frac{\text{(Iron Watt Loss)}}{\text{(Rated Voltage)}^2}$	0.00000	
$\frac{\text{(Copper Var Loss)}}{\text{(Test Current)}^2}$	0.00000	
$\frac{\text{(Iron Var Loss)}}{\text{(Rated Voltage)}^4}$	0.00000	
System Loss	0.00000	
Binary Inputs		
Debounce	5	milliseconds

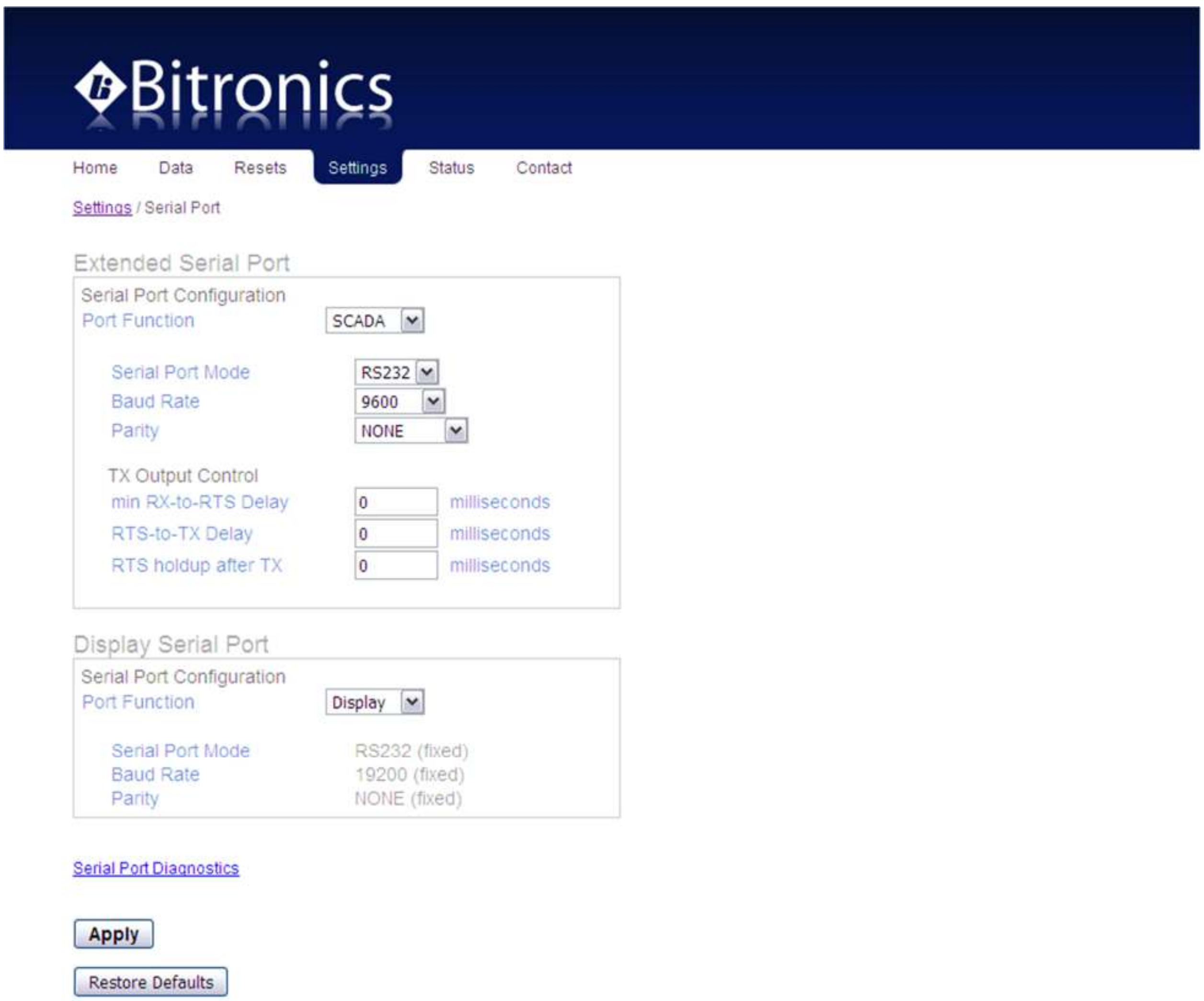
Apply

Restore Defaults

Network:



Serial Port (if option ordered):

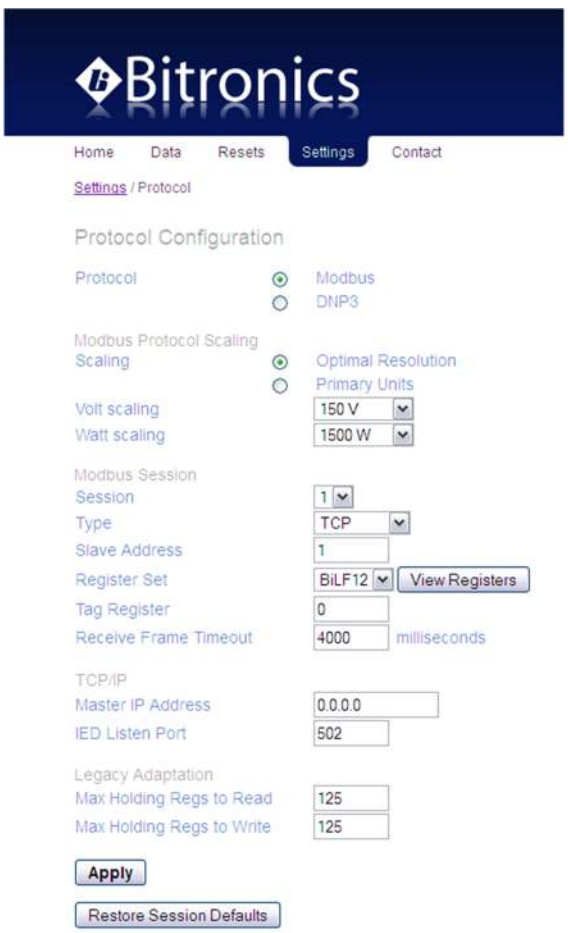


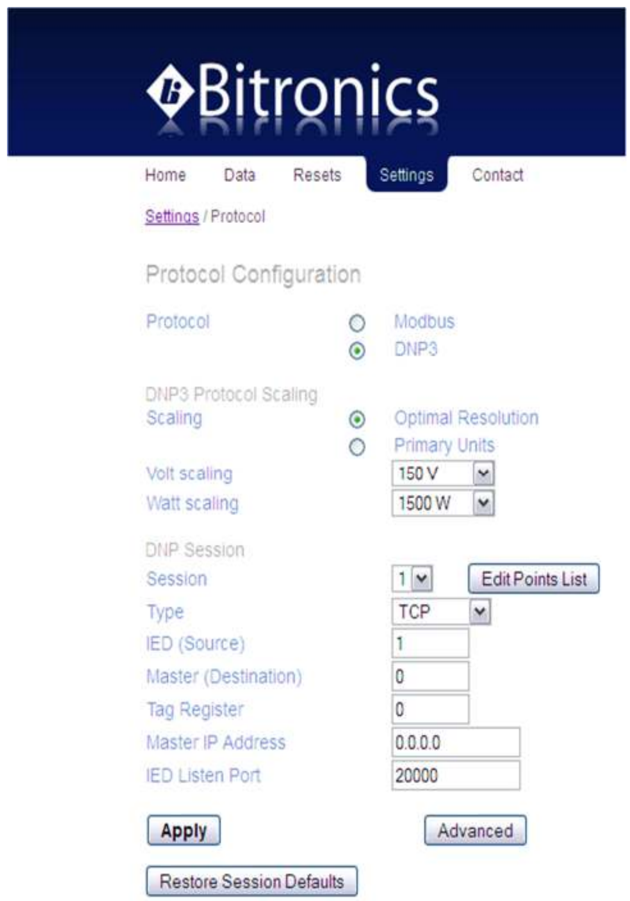
Select the function of each serial port and set the corresponding serial parameters. The serial port functions are SCADA, Display, and Disabled. Please note that only one serial port may function as a display port at a time. The Display port only supports RS232.

Protocol Selection:

First select between Modbus or DNP3. You will then select Optimal Resolution (default) or Primary Units. Next you will choose a session. Under Type, there will be 4 different selections for Modbus and 3 for DNP3. Under Modbus the options are Disabled, TCP, ASCII, or RTU. For DNP3 the selections are Disabled, Serial, or TCP. Under DNP3, clicking on the Advanced button reveals more advanced functions that may or may not need to be changed. Clicking on the Basic button hides the advanced functions. A detailed description of the setup parameters for Modbus and DNP3 can be found in the Appendix of the respective protocol manuals.

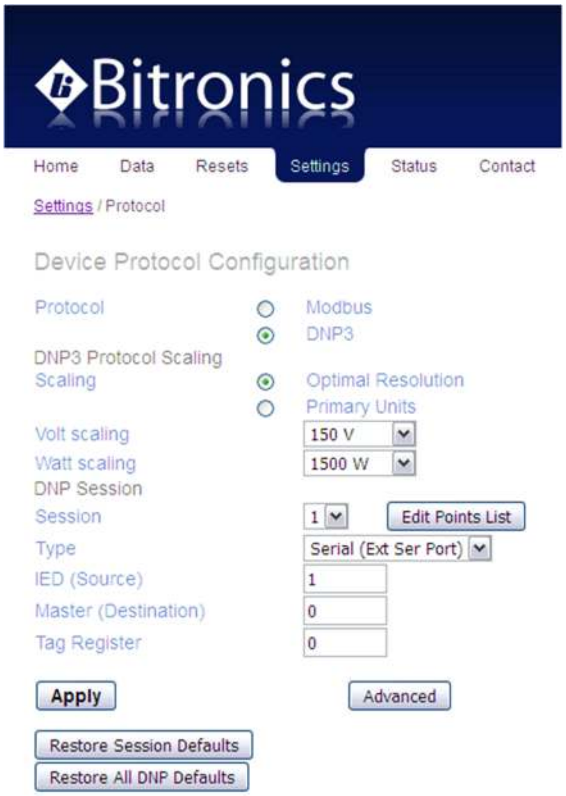
There are both fixed and configurable register/point lists. Please refer to the appropriate protocol manual for more information regarding how to view or edit the register/point list.





Modbus TCP

DNP3 TCP

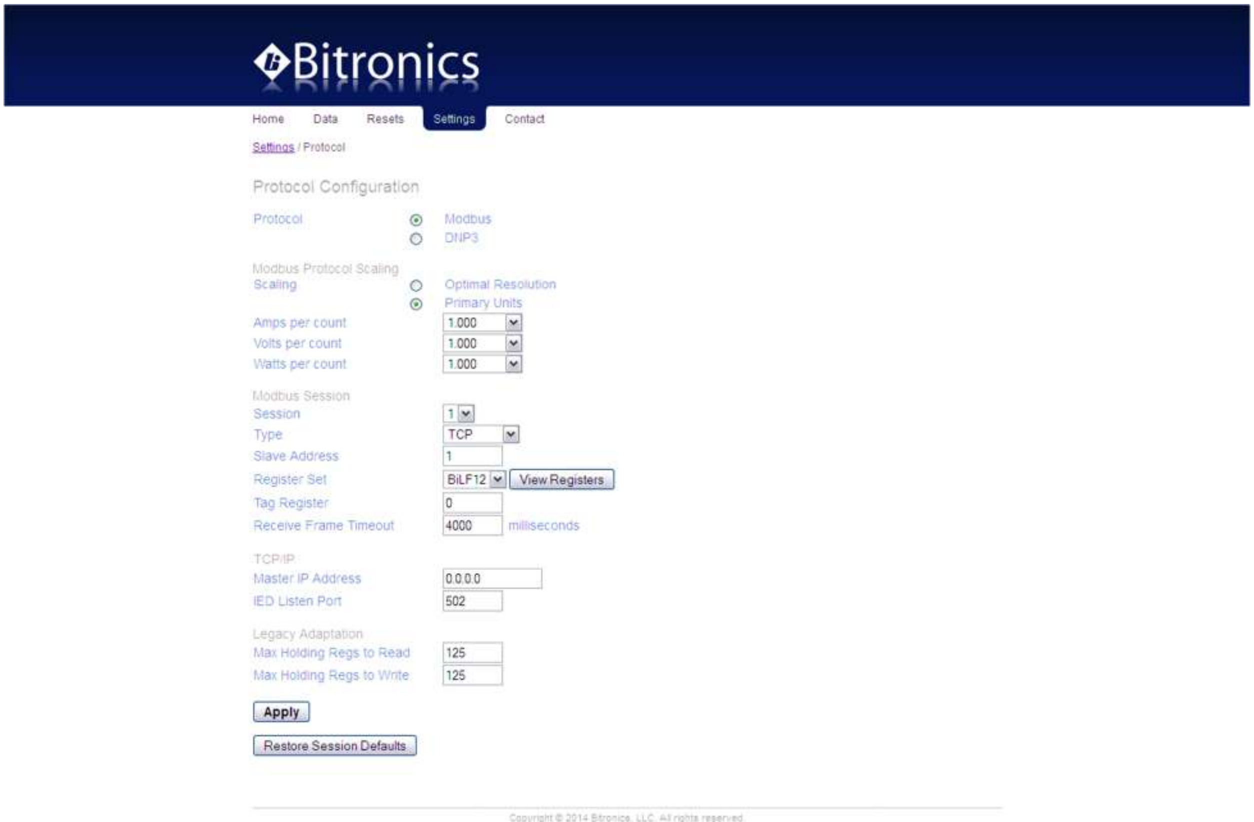


DNP3 Serial – Basic

Modbus Serial

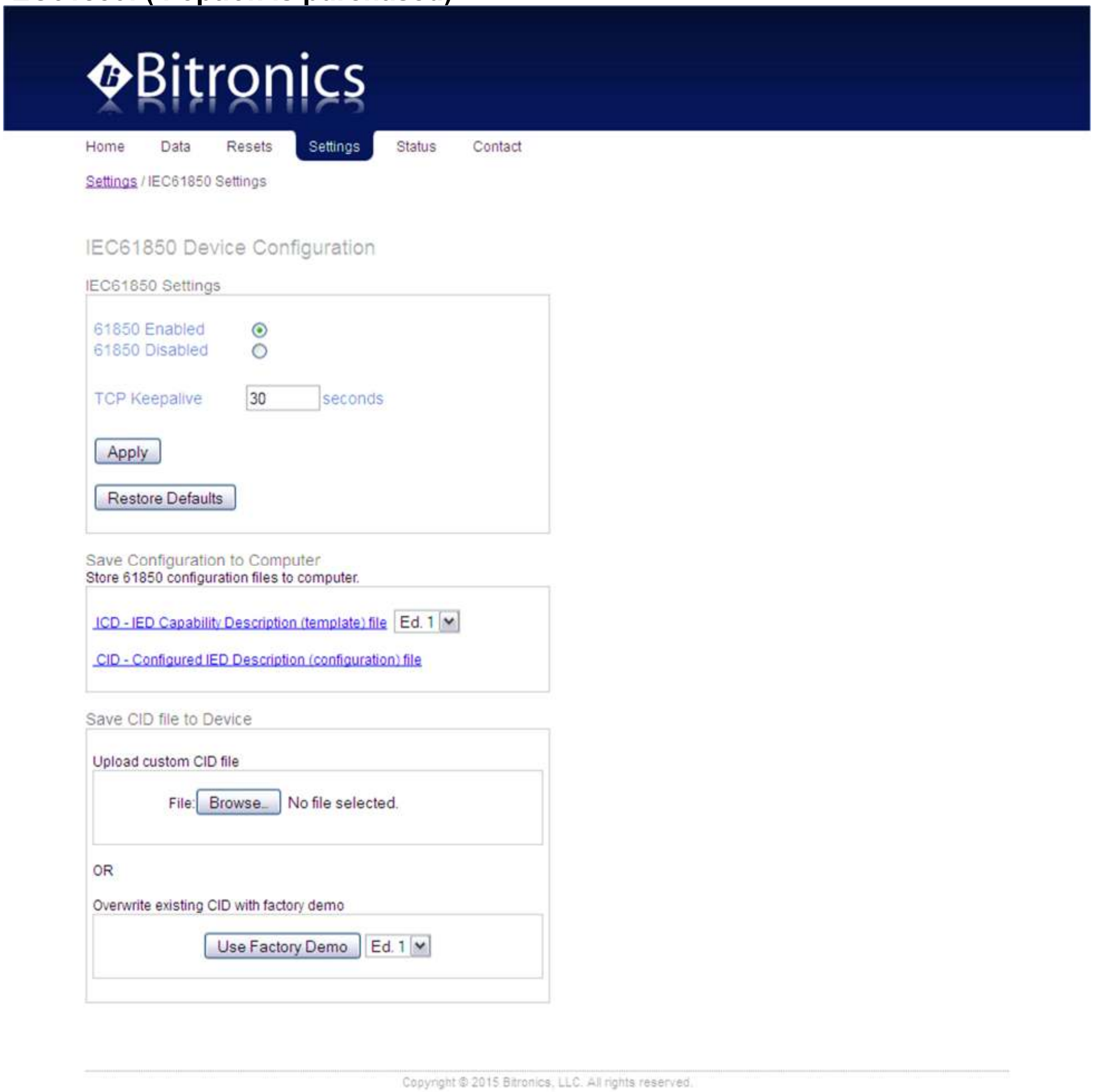
DNP TCP - Advanced

DNP Serial - Advanced



Modbus TCP - Primary Units

IEC61850: (If option is purchased)



IED Capability Description (ICD) file: The PPX II ICD file is an IEC61850 Substation Configuration Language (SCL) file which contains the IEC61850 'capability' description of the PPX II IED. It is used by the IEC61850 IED Configurator tool to perform an IEC61850 configuration. The ICD file is stored on the PPX II IED in flash memory. The ICD file can be downloaded from the IED using the built-in web interface.

The IEC61850 IED Configuration tool uses the ICD file as a template from which it can create an IEC61850 device configuration. After configuration is completed and verified, the user should export that configuration as a CID file to the local PC.

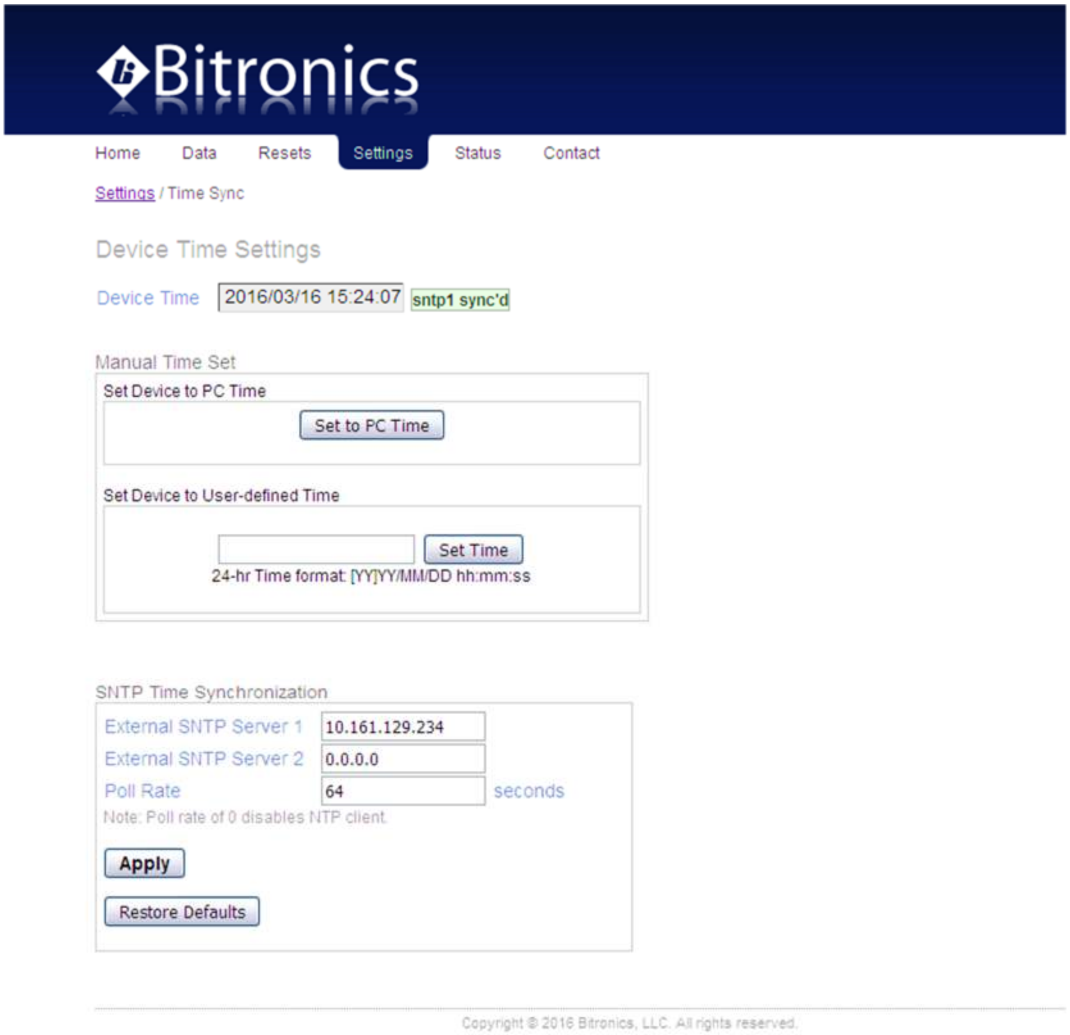
The built-in Web browser in the PPX II IED is then used to upload the configuration file from the PC and reboot the PPX II device. The CID file is stored in flash memory of the PPX II device after reboot, and will remain the active configuration until a new configuration is uploaded or the user overwrites the configuration with a built-in demo configuration.

The user can select between an Edition 1 or Edition 2 version of the ICD file and can overwrite an existing CID file with either an Edition 1 or Edition 2 version of the factory demo (default) file. The dropdown box only affects which file will be downloaded when the user clicks on the ICD file link. The user does not have to specify which edition of the CID file is being uploaded -- whatever is uploaded will be read and interpreted.

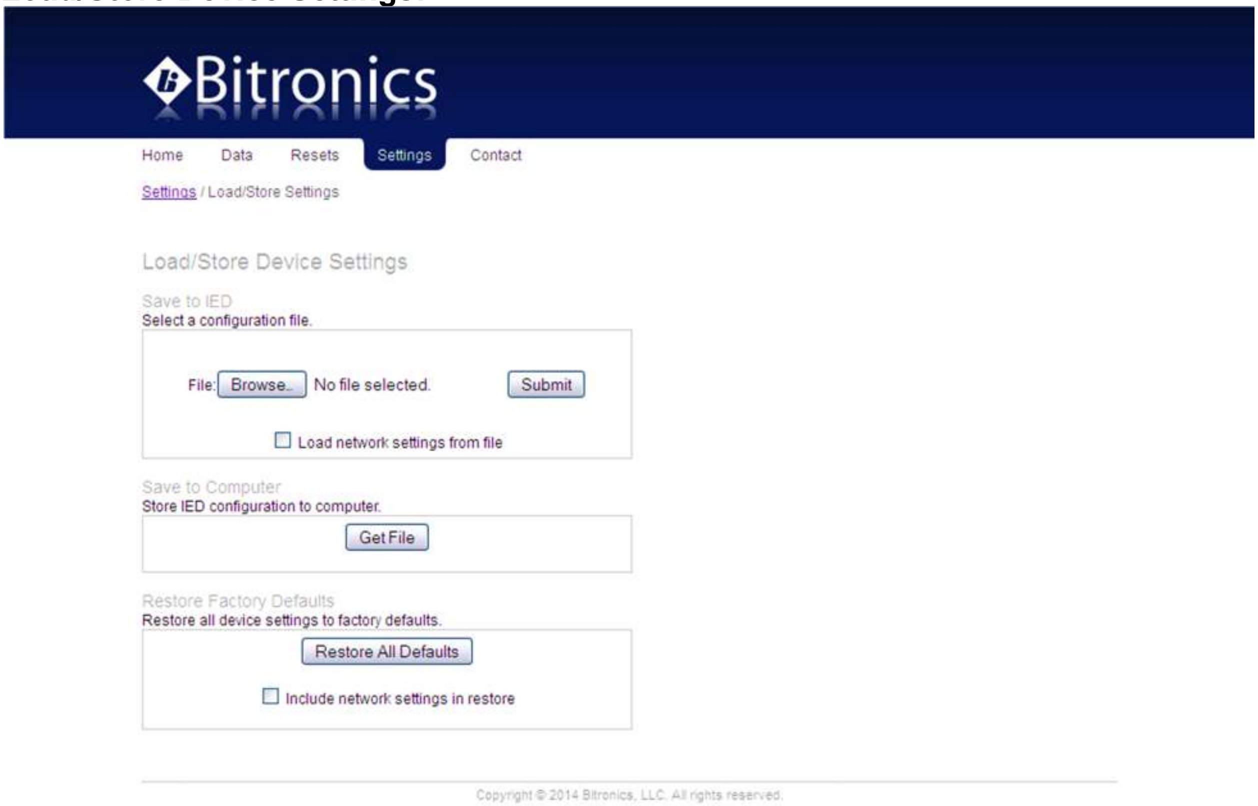
Screen Enable:
Refer to Appendix A3

Custom Display Screen Settings: Two Sections – Build/Edit and Summary
Refer to Appendix A3

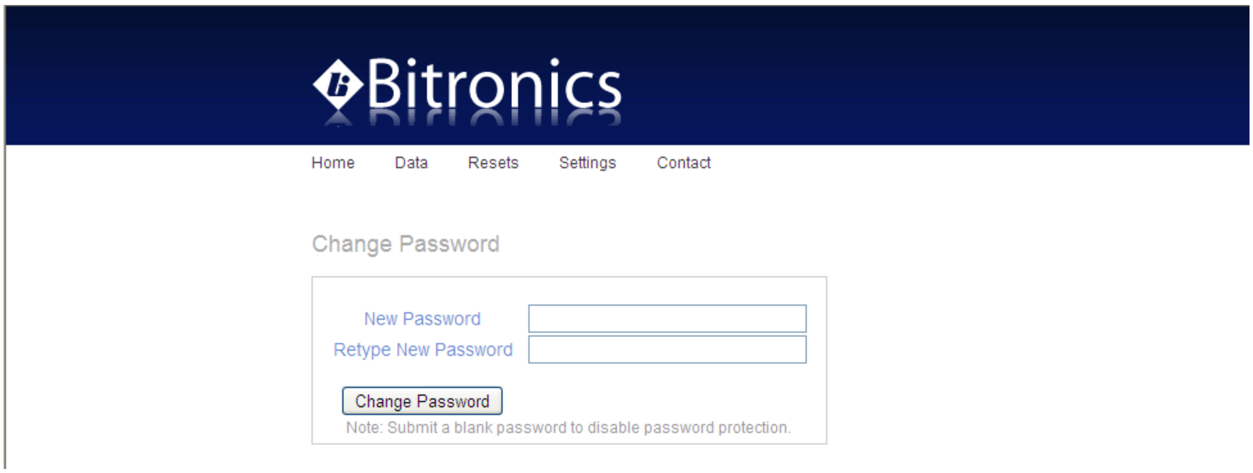
Time Sync Settings:
The time may be set by manually entering the time in the box for “User-defined time” or may be “Set to PC time” by clicking on that selection



Load/Store Device Settings:



Password Security Settings:

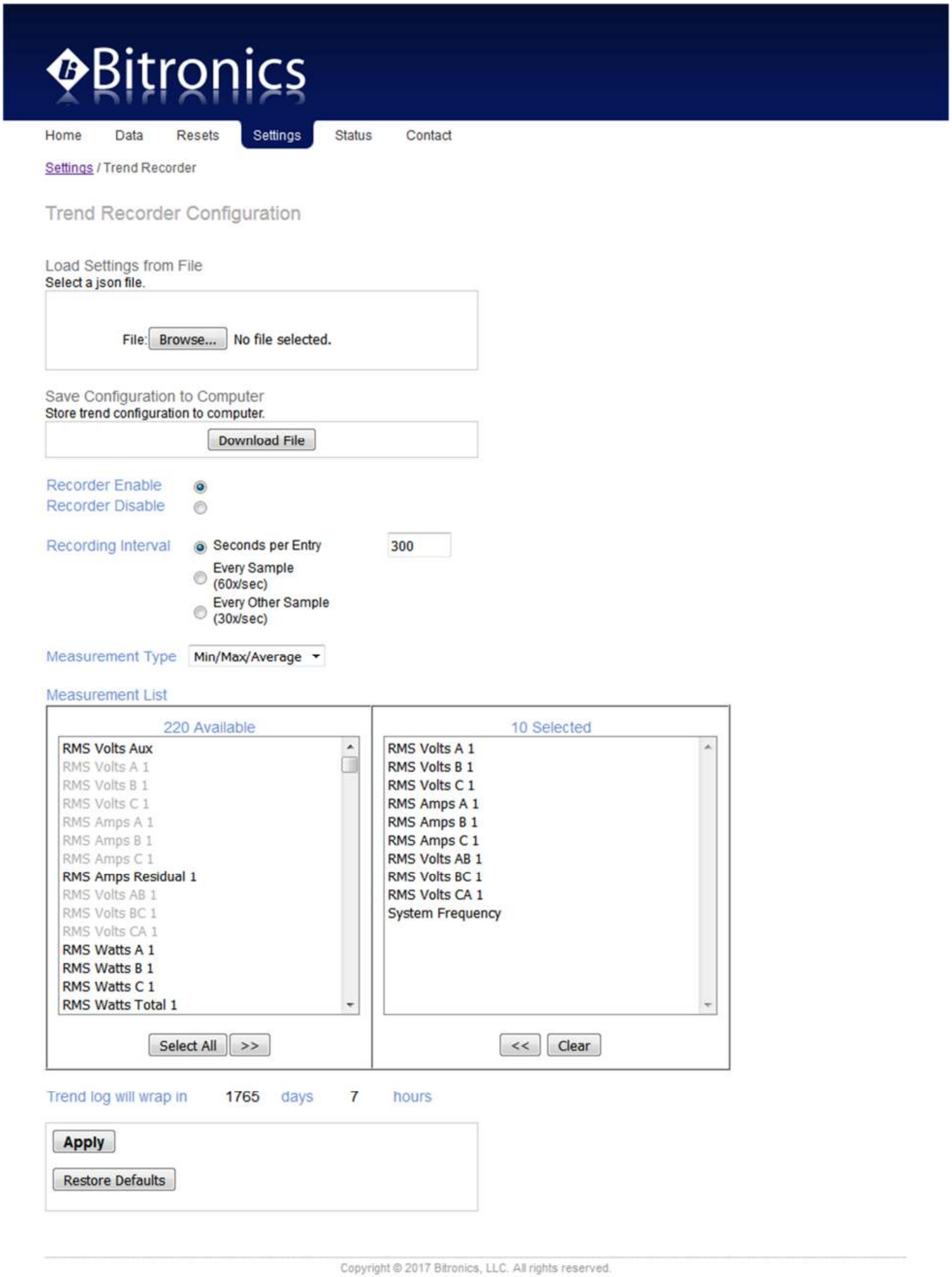


Firmware Upload:

Trend Recorder:

The trend recorder allows up to 65 of the 200+ available measurements to be recorded at intervals of once per second or slower. The maximum is 10 measurements at intervals of once every other cycle or once per cycle (30x/sec or 60x/sec, respectively, at 60 Hz, and 25x/sec or 50x/sec at 50 Hz). Changing the configuration, including recording interval, measurement type, or selected measurements, will cause all existing trend records to be erased from the log at reboot. Enabling or disabling the recorder will not cause the log to be erased.

The trend log is circular. That is, when the entire trend log memory is full, it wraps around and overwrites the oldest entries in the log. The amount of time that it takes until the log wraps around depends on how much data are written to each log entry and the frequency with which the entries are written. The calculated wrap time is displayed on the trend recorder configuration page and is updated as changes are made to the configuration.


Bitronics
Home
Data
Resets
Settings
Status
Contact
Settings / Trend Recorder
Trend Recorder Configuration
Load Settings from File
Select a json file.
File: Browse... No file selected.
Save Configuration to Computer
Store trend configuration to computer.
Download File
Recorder Enable
Recorder Disable
Recording Interval
Seconds per Entry
300
Every Sample (60x/sec)
Every Other Sample (30x/sec)
Measurement Type
Min/Max/Average
Measurement List
220 Available
RMS Volts Aux
RMS Volts A 1
RMS Volts B 1
RMS Volts C 1
RMS Amps A 1
RMS Amps B 1
RMS Amps C 1
RMS Amps Residual 1
RMS Volts AB 1
RMS Volts BC 1
RMS Volts CA 1
RMS Watts A 1
RMS Watts B 1
RMS Watts C 1
RMS Watts Total 1
Select All
>>
10 Selected
RMS Volts A 1
RMS Volts B 1
RMS Volts C 1
RMS Amps A 1
RMS Amps B 1
RMS Amps C 1
RMS Volts AB 1
RMS Volts BC 1
RMS Volts CA 1
System Frequency
<<
Clear
Trend log will wrap in 1765 days 7 hours
Apply
Restore Defaults
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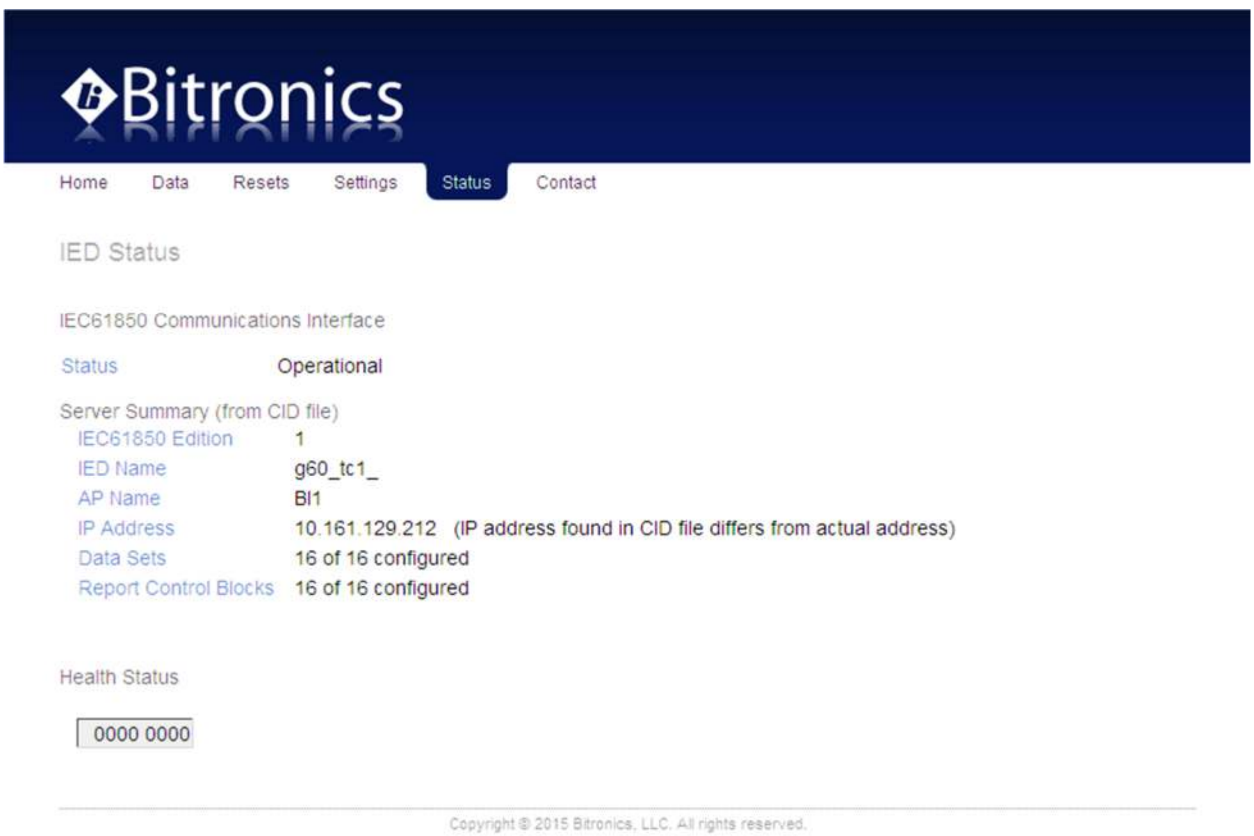
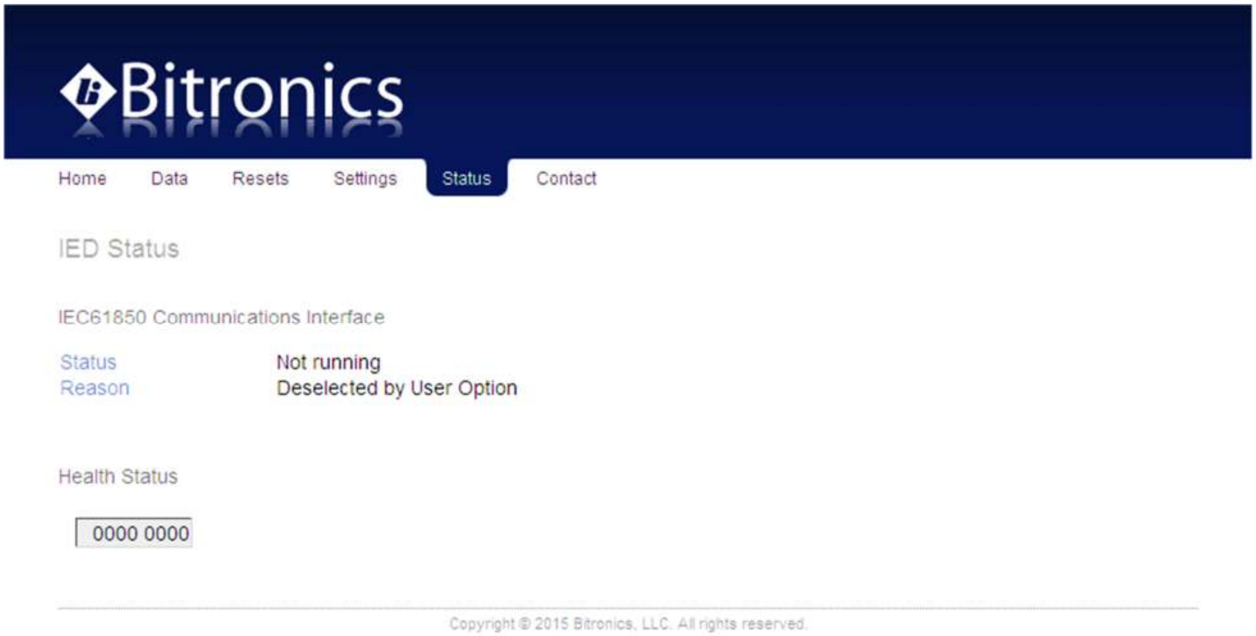
Status Page:
The IED Status page shows the status of the IEC61850 communications interface (if option ordered) and the health status. The IEC61850 status states are Operational and Not Running. When the 61850 stack is not running, the reason is displayed. When the 61850 stack is not able to start due to an error, the startup log is displayed for additional detail.

In the PPX II, the firmware upgrade and measurements offline bits have been separated. A protocol configuration error bit has also been added.

0, "Analog output calibration error"
2, "Gain calibration error"
4, "Phase calibration error"
12, "Firmware upgrade in progress"
13, "Measurements offline"
15, "Protocol configuration error"




Bitronics
Home
Data
Resets
Settings
Status
Contact
IED Status
IEC61850 Communications Interface
Status
Not running
Reason
Deselected by User Option
Health Status
0000 0000
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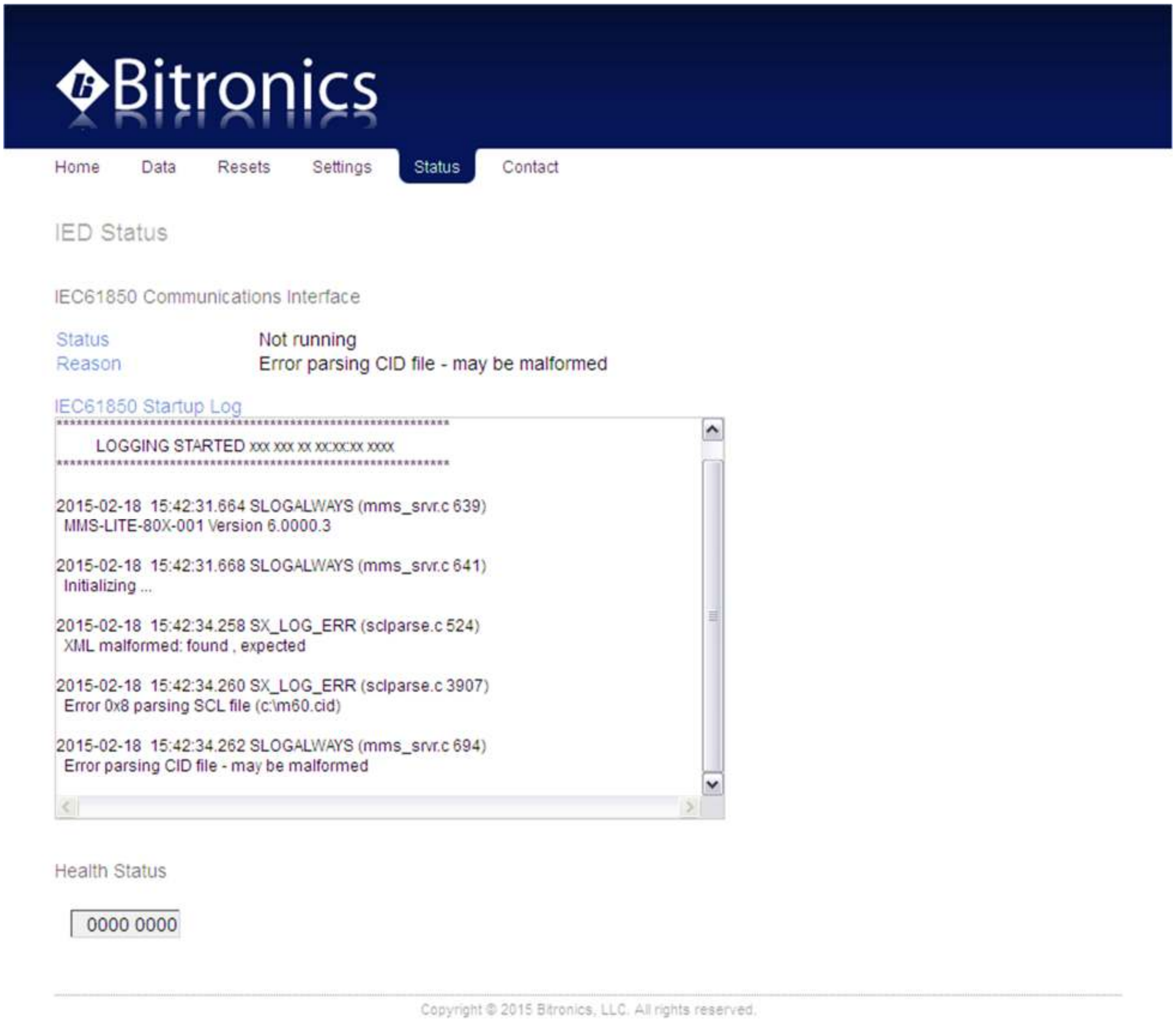
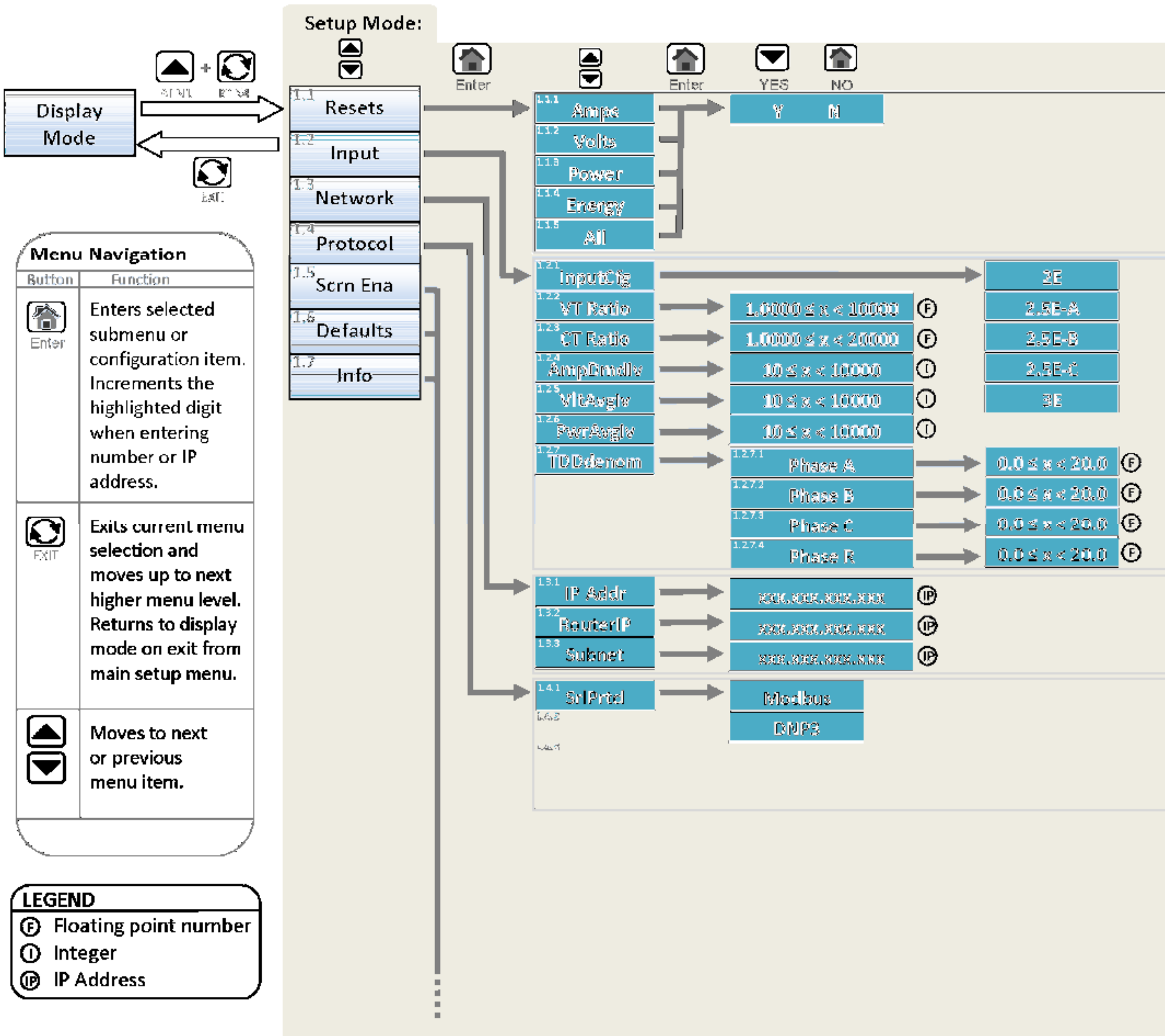
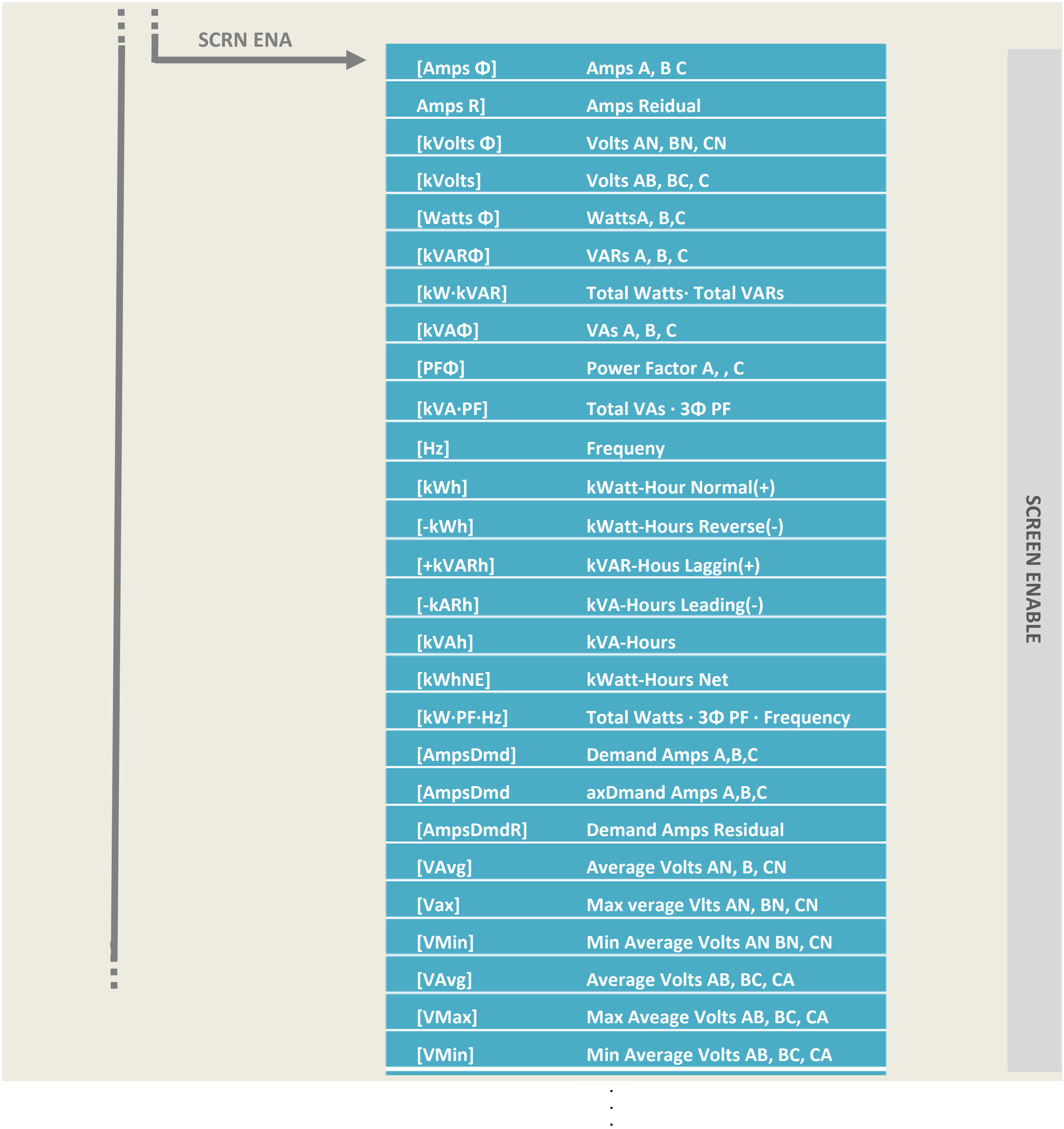

Bitronics
Home
Data
Resets
Settings
Status
Contact
IED Status
IEC61850 Communications Interface
Status
Not running
Reason
Error parsing CID file - may be malformed
IEC61850 Startup Log
LOGGING STARTED xxx xxx xx xx:xx:xx xxxx
2015-02-18 15:42:31.664 SLOGALWAYS (mms_srvr.c 639)
MMS-LITE-80X-001 Version 6.0000.3
2015-02-18 15:42:31.668 SLOGALWAYS (mms_srvr.c 641)
Initializing ...
2015-02-18 15:42:34.258 SX_LOG_ERR (sclparse.c 524)
XML malformed: found , expected
2015-02-18 15:42:34.260 SX_LOG_ERR (sclparse.c 3907)
Error 0x8 parsing SCL file (c:\m60.cid)
2015-02-18 15:42:34.262 SLOGALWAYS (mms_srvr.c 694)
Error parsing CID file - may be malformed
Health Status
0000 0000
Copyright © 2015 Bitronics, LLC. All rights reserved.

4.5 Navigating the PPX IITD's setup menu from the front panel

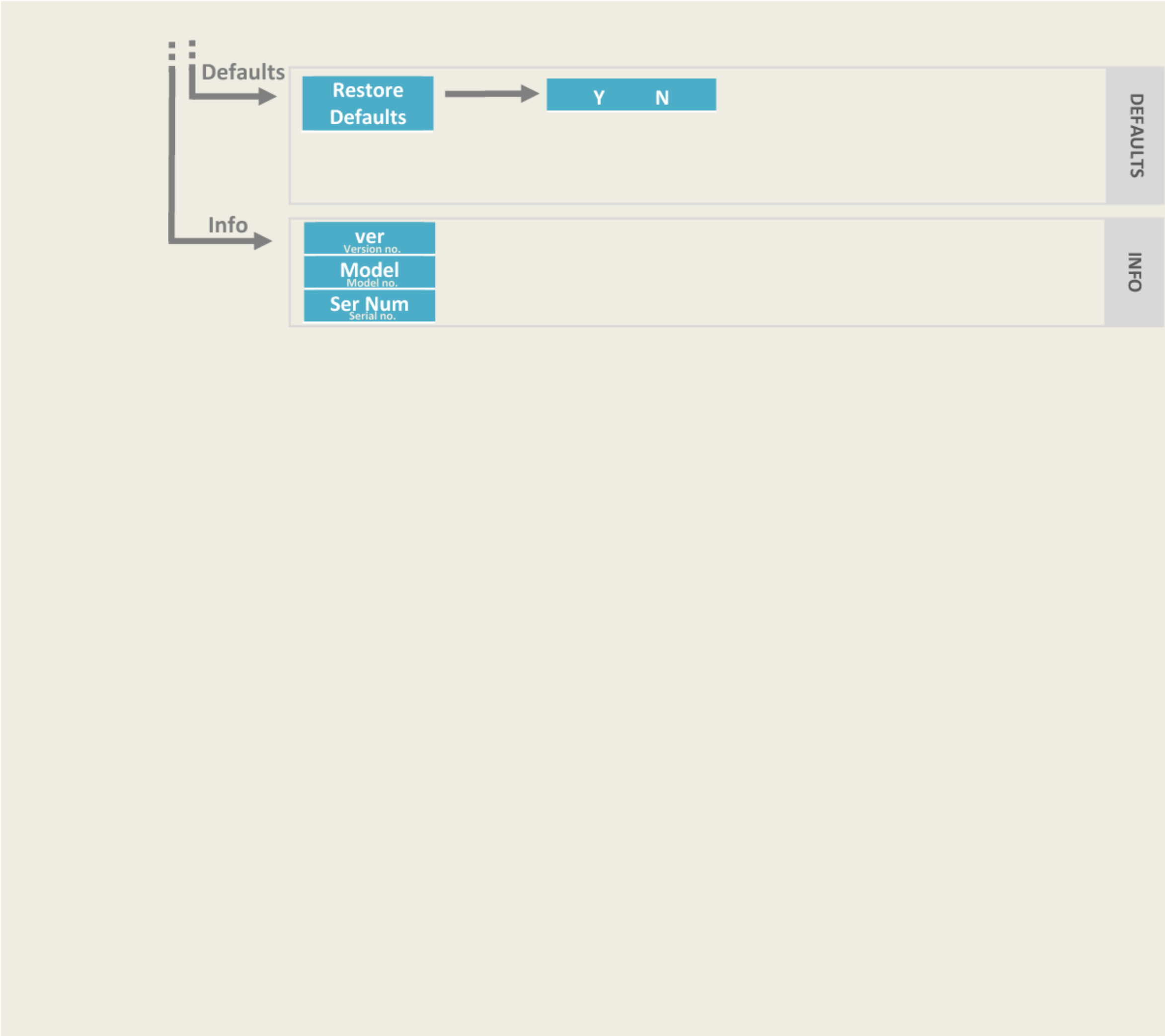



SCRN ENA
[Amps Φ] Amps A, B C
Amps R] Amps Reidual
[kVolts Φ] Volts AN, BN, CN
[kVolts] Volts AB, BC, C
[Watts Φ] WattsA, B,C
[kVARΦ] VARs A, B, C
[kW·kVAR] Total Watts· Total VARs
[kVAΦ] VAs A, B, C
[PFΦ] Power Factor A, , C
[kVA·PF] Total VAs · 3Φ PF
[Hz] Frequeny
[kWh] kWatt-Hour Normal(+)
[-kWh] kWatt-Hours Reverse(-)
[+kVARh] kVAR-Hous Laggin(+)
[-kARh] kVA-Hours Leading(-)
[kVAh] kVA-Hours
[kWhNE] kWatt-Hours Net
[kW·PF·Hz] Total Watts · 3Φ PF · Frequency
[AmpsDmd] Demand Amps A,B,C
[AmpsDmd axDmand Amps A,B,C
[AmpsDmdR] Demand Amps Residual
[VAvg] Average Volts AN, B, CN
[Vax] Max verage Vlts AN, BN, CN
[VMin] Min Average Volts AN BN, CN
[VAvg] Average Volts AB, BC, CA
[VMax] Max Aveage Volts AB, BC, CA
[VMin] Min Average Volts AB, BC, CA
SCREEN ENABLE

...contd.

[kWTot]	Average Watts Max · Total · Min
[kVARTot]	Average VARs Max · Total · Min
[kVATot]	Average VAs Max · Total · Min
[FndAmps]	Fund Amps A, B, C
[FndAmpsR]	Fund Amps Residual
[FndV]	Fund Volts AN, BN, CN
[FndV]	Fund Volts AB, BC, CA
[%TDDI]	TDD Amps A,B,C
[%THDV]	THD Volts AN, BN, CN
[%THDV]	THD Volts AB, BC, CA
[K-Factor]	K-Factor Amps A,B,C
[DispPFΦ]	Displacement Power Factor A,B,C
[DispPFT]	Displacement Power Factor Total
[FndDmdIΦ]	Fund Demand Amps A,B,C
[FndDmdIR]	Max Fund Demand Amps Residual
[FndDmdIΦ]	Max Fund Demand Amps A,B,C
[kWAvg]	Average Watts A, B, C
[kWMax]	Max Average Watts A, B, C
[kWMin]	Min Average Watts A, B, C
[kVARAvg]	Average VARs A. B, C
[kVARMax]	Max Average VARs A. B, C
[kVARMin]	Min Average VARs A. B, C
[kVAAvg]	Average VAs A, B, C
[kVAMax]	Max Average VAs A, B, C
[kVAMin]	Min Average VAs A, B, C
[VAux]	Volts Aux
[SecVolts]	Secondary Volts AN, BN, CN
[SecVolts]	Secondary Volts AB, BC, CA
[All]	All on/off

SCREEN ENABLE


Defaults
Restore Defaults
Y N
DEFAULTS
Info
ver
Version no.
Model
Model no.
Ser Num
Serial no.
INFO

How to Enter an Integer:

Increment highlighted digit by 1.

Highlight Previous/Next digit.

Exit to menu

How to Enter a Floating Point Number:

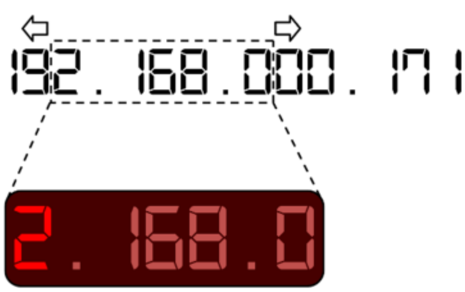
Increment highlighted digit by 1.

Shifts decimal point one place to right. Decimal moves to left-most digit when right-most digit is passed.

Highlight Next digit. Highlights left-most digit when right-most digit is passed.

Exit to menu

How to Enter an IP address:



Increment highlighted digit by 1.

Highlight Previous/Next digit. Numbers scroll left and right to follow highlighted digit.

Exit to Network menu

5.0 MEASUREMENTS

Basic measurement quantities are calculated and updated every cycle. These quantities include RMS Amperes and RMS Volts, Watts, VARs, VAs, Power Factor, all harmonic-based measurements (such as fundamental-only quantities), Energy, and Frequency, and Phase Angle.

Note: For all of the following measurements, it is important to keep in mind that the specific protocol used to access the data may affect the data that is available, or the format of that data. No attempt is made here to describe the method of accessing measurements - always check the appropriate protocol manual for details.

5.1 Changing Transformer Ratios

The PPX II has the capability to store values for Current Transformer (CT) and Potential Transformer (VT) turns ratios. The VT and CT values are factory set to 1:1 CT and 1:1 VT. These values can be entered into the PPX II over the network or via front display buttons or web page, and will be stored in internal non-volatile memory. All measurements are presented in primary units, based on these ratios. The web interface allows you to choose either 1A or 5A for the denominator, and the primary value is entered directly. The PT ratio is to 1 when entering through the front display. The web allows other denominators (110, 115, or 120) to be used. Refer to the appropriate protocol manual for more information on changing transformer ratios.

5.2 Current

The PPX II has three current inputs, with an internal CT on each channel. These inputs can read to 2x nominal ($2A_{RMS}$ for 1A input, $10A_{RMS}$ for 5A input (symmetrical)) under all temperature and input frequency conditions. No range switching is used, allowing a high dynamic range.

The current signals are transformer coupled, providing a true differential current signal. Additionally, a continuous DC removal is performed on all current inputs. Instrument Transformer Ratios can be entered for each current input, as described above.

The average of the 3 current phases ((Ia + Ib + Ic)/3) is also available on a per cycle basis.

5.2.1 Residual Current

The PPX II calculates the vector sum of the three phase currents, which is known as the Residual Current. The Residual Current is equivalent to routing the common current return wire through the neutral current input on systems without separate current returns for each phase.

5.3 Voltage Channels

The PPX II uses a unique voltage connection method, which is combined with simultaneous sampling to provide an extremely flexible voltage measurement system. All voltage inputs are measured relative to a common reference level (essentially panel ground). See Appendix 1 for input connection information. Because all signals are sampled at the same instant in time, common mode signals can be removed by subtraction of samples in the DSP, instead of the more traditional difference amplifier approach. This greatly simplifies the external analog circuitry, increases the accuracy, and allows measurement of the Neutral-to-Ground voltage at the panel. The 7kV input divider resistors are accurate to within +/- 25ppm/DegC, and have a range of $600V_{PEAK}$, from any input to panel ground. Each sample is corrected for offset and gain using factory calibration values stored in non-volatile memory on the board. Additionally, a continuous DC removal is performed on all inputs.

The PPX II calculates voltages in PRIMARY units, based on the VT Ratio entered. There is one VT Ratio that covers all inputs on both buses. Ratio can be entered via a network and protocol (refer to the specific protocol manual for details) or via the web interface.

The advantages of this method of voltage measurement are apparent when the PPX II is used on the common 2, 2-1/2, and 3 element systems (refer to Section 5.6). The PPX II is always calculating Line-to-Neutral, Line-to-Line, and Bus-to-Bus voltages with equal accuracy. On 2 element connections, any phase can serve as the reference phase. Further, the PPX II can accommodate WYE connections on one Bus, and DELTA connections on the other Bus.

On 2-1/2 element systems, one of the phase-to-neutral voltages is missing, and the PPX II must create it from the vector sum of the other two phase-to-neutral voltages. In order to configure the PPX II for 2-1/2 element mode and which phase voltage is missing, a "0" is written to the phase-to-neutral VT Ratio for the missing phase voltage.

The average of the 3 voltage phases ((Va + Vb + Vc)/3) is also available for bus 1 and 2, and is made available on a per cycle basis.

5.4 Voltage Aux (V DC)

The PPX II provides a measurement for the voltage connected to the power supply terminals. This is a differential voltage. The DC value measured depends upon the power supply voltage source.

5.5 Power Factor

The per-phase Power Factor measurement is calculated using the "Power Triangle", or the per-phase WATTS divided by the per-phase VAs. The Total PF is similar, but uses the Total WATTS and Total VAs instead. The sign convention for Power Factor is shown in Figure 12.

5.6 Watts / Volt-Amperes (VAs) / VARs (Uncompensated)

On any power connection type (2, 2½, and 3 element), the PPX II calculates per-element Watts by multiplying the voltage and current samples of that element together. This represents the dot product of the voltage and current vectors, or the true Watts. The per-element VAs are calculated from the product of the per-element Volts and Amps. The per-element VARs are calculated from fundamental VARs.

In any connection type, the Total Watts and Total VARs is the arithmetic sum of the per-element Watts and VARs. The sign conventions are shown in Figure 12.

When used on 2-element systems, the reference phase voltage (typically phase B) input, is connected to the Neutral voltage input, and effectively causes one of the elements to be zero. ***It is not required to use any particular voltage phase as the reference on 2-element systems. When used on 2-element systems the per-element Watts, VARs, and VAs have no direct physical meaning***, as they would on 2½ and 3 element systems where they represent the per-phase Watts, VARs, and VAs.

When used on 2½ element systems, one of the phase-to-neutral voltages is fabricated, as described in Section 5.3. In all other respects, the 2½ element connection is identical to the 3 element connection.

5.6.1 Geometric VA Calculations

$$GEOMETRIC\ VA_{TOTAL} = \sqrt{Watts_{TOTAL}{}^2 + VARs_{TOTAL}{}^2}$$

This is the traditional definition of Total VAs for WYE or DELTA systems, and is the default method for Total VAs calculation. The value of Total VAs calculated using this method does not change on systems with amplitude imbalance, relative to a balanced system.

There is also a relationship to the Total Power Factor, which is described in Section 5.4. Total Power Factor calculations using the Geometric VA method will still indicate a "1" on a system with phase amplitude imbalance, or canceling leading and lagging loads.

For example, on a system with a lagging load on one phase and an equal leading load on another phase, the Geometric VA result will be reduced relative to a balanced system, but the Total Power Factor will still be "1".

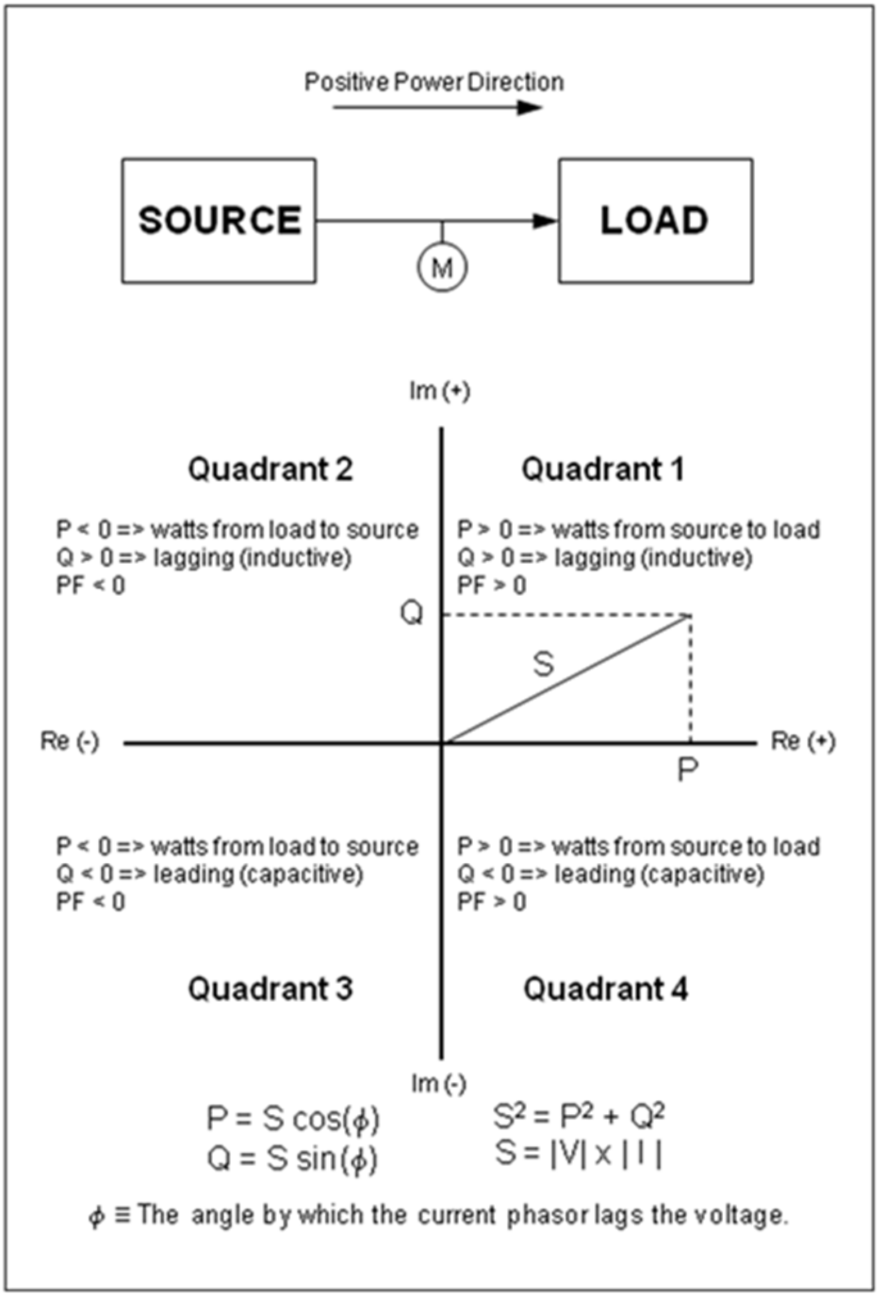


Figure 12 - Sign Conventions for Power Measurements

(P is Power, Q is VARS and S is VA)

5.7 Compensated Watts and VARs (Line and Transformer Loss Compensation)

The total Watt and Var losses can be calculated using five user entered parameters and measured current and voltage values. These losses are added or subtracted to/from the measured Total Watts and Total Vars when accumulating Energy.

Loss compensation on the PPX II takes the following general form:

$$P_{COM} = P_{UNC} + A \cdot I^2 + B \cdot V^2 + E \cdot P_{UNC}$$
$$Q_{COM} = Q_{UNC} + C \cdot I^2 + D \cdot V^4 + E \cdot Q_{UNC}$$

Where:

P_{COM} Compensated three-phase total watts. Note the accumulators for +kWh and –kWh in the PPX II are calculated by integrating the P_{COM} measurement over time.

P_{UNC} Uncompensated three-phase total watts measured at the point where the meter is connected.

Q_{COM} Compensated three-phase total VARs. Note the accumulators for +kVARh and –kVARh in the PPX II are calculated by integrating the Q_{COM} measurement over time.

Q_{UNC} Uncompensated three-phase total VARs measured at the point where the meter is connected.

I RMS line current measured at the point where the meter is connected.

V RMS *line-line* voltage measured at the point where the meter is connected.

A **Meter setting** that accounts for the sum of the full-load-watt-losses from all sources.

B **Meter setting** that accounts for the transformer's no-load-watt-losses.

C **Meter setting** that accounts for the sum of the full-load-VAR-losses from all sources.

D **Meter setting** that accounts for the transformer's no-load-VAR-losses.

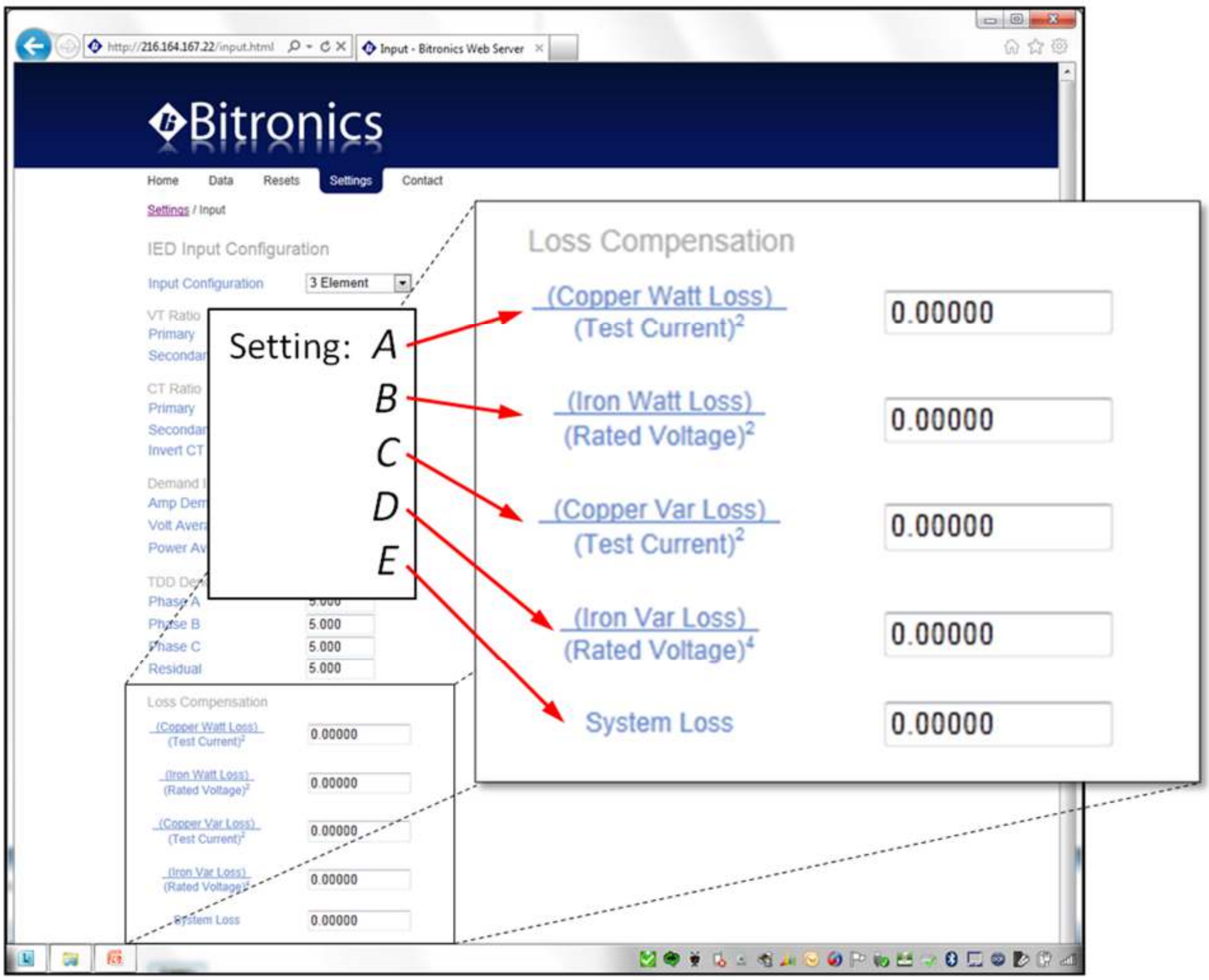
E **Meter setting** that accounts for any "system" losses, proportional to the uncompensated power.

Configuring the meter to perform loss compensation simply requires the user to calculate the coefficients *A, B, C, D,* and *E* defined above, and enter them in the appropriate fields in the PPX II's webserver interface on the Settings/Input page as shown in the screen shot below

The *sign* of the settings *A*, *B*, C, *D*, and *E* determines whether losses will be added to or subtracted from the uncompensated measurements in order to determine the compensated power and energy. To add losses, be sure the settings are all positive. To subtract losses, be sure the settings are all negative. Settings should always have the same sign.

Making all of the settings equal to zero *turns off* loss compensation.

System losses (*E*) are a fixed percentage, mutually agreed upon between two electric utilities, about an interchange point that lies on a branched line. As such, *E* is not a physical property of any particular line, transformer or the meter, so no further guidance on how best to calculate the coefficient *E* can be provided here. All instructions following will be concerned only with the calculation of the coefficients *A, B, C,* and *D*. Users who do not intend to use system losses should simply set *E* equal to zero.



A detailed application note on loss compensation in the PPX II can be found in the documentation library of the Novatech website, www.novatechweb.com.

5.8 Energy

Separate values are maintained for both positive and negative Watt-hours, positive and negative VAR-hours, and VA-hours, for each feeder. These energy quantities are calculated every cycle from the Total Watts, Total VARs, and Total VAs, and the values are stored into non-volatile memory every 15 seconds. Energy values may be reset. All values are reset simultaneously. Refer to the appropriate protocol manual for details.

5.9 Frequency

Frequency is calculated every cycle for every input. The PPX II monitors the change in Phase Angle per unit time using the Phase Angle measurement for the fundamental generated by the FFT. The System Frequency is the frequency of the input used for synchronizing the sampling rate.

5.10 Demand Measurements

The traditional thermal demand meter displays a value that represents the logarithmic response of a heating element in the instrument driven by the applied signal. The most positive value since the last instrument reset is known as the maximum demand (or peak demand) and the lowest value since the last instrument reset is known as the minimum demand. Since thermal demand is a heating and cooling phenomenon, the demand value has a response time T, defined as the time for the demand function to change 90% of the difference between the applied signal and the initial demand value. For utility applications, the traditional value of T is 15 minutes, although the PPX II can accommodate other demand intervals (Section 6.10.5).

The PPX II generates a demand value using modern microprocessor technology in place of heating and cooling circuits, it is therefore much more accurate and repeatable over a wide range of input values. In operation, the PPX II continuously samples the basic measured quantities, and digitally integrates the samples with a time constant T to obtain the demand value. The calculated demand value is continuously checked against the previous maximum and minimum demand values. This process continues indefinitely, until the demand is reset or until the meter is reset (or power removed and reapplied). The demand reset and power-up algorithms are different for each measurement. These routines are further described in following paragraphs. The maximum and minimum demand values are stored in non-volatile memory on the Host Processor module.

NOTE: Changing VT or CT ratios does NOT reset demand measurements to zero.

Demand Quantity	Phase Reference	Function
Amperes	Phase, Residual	Present, Max
Fundamental Amperes	Phase, Residual	Present, Max
Volts (Bus 1 only)	Phase - Neutral, Phase - Phase	Present, Max, Min
Total Watts (A, B, C, Total)	Phase, Total	Present, Max, Min

Demand Quantity	Phase Reference	Function
Total VARs (A, B, C, Total)	Phase, Total	Present, Max, Min
Total VAs (A, B, C, Total)	Phase, Total	Present, Max, Min

5.10.1 Ampere and Fundamental Ampere Demand

Present Ampere Demands are calculated via the instantaneous measurement data used to calculate the per-phase Amperes.

Upon power-up, all Present Ampere Demands are reset to zero. Maximum Ampere Demands are initialized to the maximum values recalled from non-volatile memory. Upon Ampere Demand Reset, all per-phase Present and Maximum Ampere Demands are set to zero. When Ampere Demands are reset, Fundamental Current Demands are also reset.

5.10.2 Volt Demand

Present Volt Demands are calculated via the instantaneous measurement data used to calculate the per-phase Volts. Upon power-up all Present Volt Demands are reset to zero. The Maximum Volt Demands and Minimum Volt Demands are initialized to the minimum and maximum values recalled from non-volatile memory. In order to prevent the recording of false minimums a new Minimum Volt Demand will not be stored unless two criteria are met. First, the instantaneous voltage for that particular phase must be greater than $20V_{rms}$ (secondary). Second, the Present Demand for that particular phase must have dipped (Present Demand value must be less than previous Present Demand value). Upon Voltage Demand Reset, all per-phase Maximum Voltage Demands are set to zero. Minimum Voltage Demands are set to full-scale.

5.10.3 Power Demands (Total Watts, VARs, and VAs)

Present Total Watt, VAR, and VA Demands are calculated via the instantaneous measurement data. The Total VA Demand calculation type is based on the instantaneous Total VA calculation type (Section 6.6)

Upon power-up, all Present Total Watt, VAR, and VA Demands are reset to the average of the stored Maximum and Minimum values. The Maximum and Minimum Demands are initialized to the minimum and maximum values recalled from non-volatile memory. Upon a demand reset, the Maximum and Minimum Demands are set equal to the Present Total Watt, VAR, and VA Demand values. A demand reset does not change the value of the Present Total Watt, VAR, and VA Demands.

5.10.4 Demand Resets

The demand values are reset in 3 groups: current, voltage, and power. This can be accomplished via the front display or from a web browser.

5.10.5 Demand Interval

The PPX II uses 900 seconds (15 minutes) as the default demand interval for current. The default for average volts and average power measurements is 60 seconds. Three separate, independent demand intervals may be set for current, voltage, and power. The range of demand intervals is 10 to 9999 seconds. These settings can be accomplished by using the front display or web server setup.

5.11 Harmonic Measurements

All harmonic and harmonic related measurements are calculated every cycle. In the following sections, Harmonic 0 indicates DC, Harmonic 1 indicates the fundamental, and Harmonic N is the nth multiple of the fundamental.

5.11.1 Voltage Distortion (THD)

Voltage Harmonic Distortion is measured by phase in several different ways. The equation for Total Harmonic Distortion (THD) is given in Equation 1. Note the denominator is the fundamental magnitude.

$$\%THD = \frac{\sqrt{\sum_{h=2}^{63} V_h^2}}{V_1} \times 100\%$$

Equation 1 - Voltage THD

5.11.2 Current Distortion (THD and TDD)

Current Harmonic Distortion is measured by phase in several different ways. The first method is Total Harmonic Distortion (THD). The equation for THD is given in Equation 2. Note the denominator is the fundamental magnitude.

$$\%THD = \frac{\sqrt{\sum_{h=2}^{63} I_h^2}}{I_1} \times 100\%$$

Equation 2 - Current THD

Alternatively, Current Harmonic Distortion can be measured as Demand Distortion, as defined by IEEE-519/519A. Demand Distortion differs from traditional Harmonic Distortion in that the denominator of the distortion equation is a fixed value. This fixed denominator value is defined as the average monthly

$$\%TDD = \frac{\sqrt{\sum_{h=2}^{63} I_h^2}}{I_L} \times 100\%$$

Equation 3 - Current TDD

peak demand. By creating a measurement that is based on a fixed value, TDD is a "better" measure of distortion problems. Traditional THD is determined on the ratio of harmonics to the fundamental. While this is acceptable for voltage measurements, where the fundamental only varies slightly, it is ineffective for current measurements since the fundamental varies over a wide range. Using traditional THD, 30% THD may mean a 1 Amp load with 30% Distortion, or a 100 Amp load with 30% Distortion. By using TDD, these same two loads would exhibit 0.3% TDD for the 1 Amp load and 30% TDD for the 100 Amp load (if the Denominator was set at 100 Amps). In the PPX II, Current Demand Distortion is implemented using Equation 3. The TDD equation is similar to Harmonic Distortion (Equation 2), except that the denominator in the equation is a user-defined number. This number, I_L, is meant to represent the average load on the system. The denominator I_L is different for each phase and neutral, and is set by changing the denominator values within the PPX II.

Note that in Equation 3, if I_L equals the fundamental, this Equation becomes Equation 2 - Harmonic Distortion. In the instrument this can be achieved by setting the denominator to zero amps, in which case the instrument will substitute the fundamental, and calculate Current THD.

Note that there is a separate, writeable denominator for each current input channel. The TDD Denominator Registers are set by the factory to 5 Amps (secondary), which is the nominal full load of the CT input with a 1:1 CT. These writeable denominators can be used in conjunction with the distortion measurements to obtain the magnitudes of harmonics, in other words, convert from percent to amps. This is simply done by multiplying the percent TDD by the TDD Denominator for that phase, and the result will be the actual RMS magnitude of the selected harmonic(s). This technique can also be used if the THD mode (denominator set to zero) is used, by multiplying the percent THD by the Fundamental Amps for that phase.

5.11.3 Fundamental Current

Fundamental Amps are the nominal component (50/60 Hz) of the waveform. The PPX II measures the magnitude of the fundamental amps for each phase. These measurements can be used in conjunction with the distortion measurements to obtain the magnitudes of harmonics, in other words, convert from percent to amps. As was mentioned previously, this is simply done by multiplying the percent THD by the Fundamental Amps for that phase (which is the denominator), and the result will be the actual RMS magnitude of the selected harmonic.

5.11.4 Fundamental Voltage

Fundamental Volts are the nominal component (50/60Hz) of the waveform. The PPX II measures the magnitude of the fundamental phase-to-neutral and phase-to-phase volts. These measurements can be used in conjunction with the distortion measurements to obtain the magnitudes of harmonics, in other words, convert from percent to volts. This is simply done by multiplying the percent THD by the

Fundamental Volts for that phase (which is the denominator), and the result will be the actual RMS magnitude of the selected harmonic.

Fundamental Volts and Amps can be used in conjunction to obtain Fundamental VAs, and when used with Displacement Power Factor can yield Fundamental Watts and Fundamental VARs.

5.11.5 K-Factor

K-Factor is a measure of the heating effects on transformers, and it is defined in ANSI/IEEE C57.110-1986. Equation 4 is used by the PPX II to determine K-Factor, where "h" is the harmonic number and "I_h" is the magnitude of the h^{th} harmonic. K-Factor is measured on each of the three phases of amps, however there is no "Total" K-Factor. K-Factor, like THD and PF, does not indicate the actual load on a device, since all three of these measurements are ratios. Given the same harmonic ratio, the calculated K-Factor for a lightly loaded transformer will be the same as the calculated K-Factor for a heavily loaded transformer, although the actual heating on the transformer will be significantly different.

$$K - Factor = \frac{\sum_{h=1}^{63} I_h^2 \times h^2}{\sum_{h=1}^{63} I_h^2}$$

Equation 4 - K-Factor

5.11.6 Displacement Power Factor

Displacement Power Factor is defined as the cosine of the angle (phi) between the Fundamental Voltage Vector and the Fundamental Current Vector. The sign convention for Displacement Power Factor is the same as for Power Factor, shown in Figure 12.

The Total Displacement Power Factor measurement is calculated using the "Power Triangle", or the three-phase Fundamental WATTS divided by the three-phase Fundamental VAs. The per-phase Fundamental VA measurement is calculated from the product of the per-phase Fundamental Amp and Fundamental Volts values. The three-phase Fundamental VA measurement is the sum of the per-phase Fundamental VA values (Arithmetic VAs).

5.11.7 Phase Angles

The PPX II measures the Fundamental Phase Angles for all Currents, Line-to-Neutral Voltages, and Line-to-Line Voltages. The Phase Angles are in degrees, and all are referenced to the V_{A-N} Voltage, which places all Phase Angles in a common reference system. Values are from -180 to +180 Degrees.

In addition, the Phase Angle is calculated for the Bus 1 to Bus 2 per-phase Fundamental Voltages and Fundamental Voltage to Fundamental Current. It is the Bus 1 Fundamental Voltage angle minus either the Bus 1 Fundamental Current or Bus 2 Fundamental Voltage angle for a given phase. Values are from -180 to +180 Degrees. Note that all the phase angles are only available in the TUC register set and use calculation type T8 (see Modbus and DNP3 Protocol manuals for more detail).

5.11.8 Slip Frequency (1-Cycle Update)

The Slip Frequency is the difference in the Frequency of a phase of Bus 1 Voltage to Bus 2 Voltage. Values are + when Bus 1 Frequency is greater.

5.12 Heartbeat and Health Check

PPX II meters provide a Heartbeat State Counter Register that allows the user to determine the time between successive polls. This counter will increment by the number of milliseconds that have elapsed since the last time the data was updated. Another use of this register is as a visual indicator that the data is changing; it allows users of certain MMIs to identify disruption in the polling of the instrument. The Heartbeat State Counter is a full 32-bit counter that rolls over at 4,294,967,295 (4,294,967 seconds). The counter starts at zero on power-up, and is NOT stored in non-volatile memory.

PPX II have several self-tests built in to ensure that the instrument is performing accurately. The results of these self-tests are available in the Health Check register which is a simple 16-bit binary value. Each bit represents the results of a particular self-test, with "0" indicating the test was passed, and "1" indicating the test was failed. If Health status failures occur, the meter may have experienced an operational failure. The table below provides a reference of error codes. The Health Check value shown in the PPX II web live data page is a hexadecimal representation of the binary value. For example, a Health Check value of 0000 0014 is the equivalent of the binary value 000000000010100. The “1” shown in bit 2 and bit 4 represents a failed test in those bits which indicates a checksum error for both the gain and phase on the calibration. Contact the factory for further instructions.

SELF TEST RESULT/HEALTH CHECK ERROR CODES FOR PPX II DEVICES

Fault	Bit	Effects of Fault	Corrective Action
Input gain calibration checksum error	2	Calibration constants for the input gain are in error. The communication option output is reduced in accuracy to approximately +/-3%.	Return to factory for repair
Input phase calibration checksum error	4	Calibration constants for the phase are in error. The communication option output is reduced in accuracy to approximately +/-3%.	Return to factory for repair
Input Over-Range	5	Peak input quantity exceeds the range of the instrument. Communication option output accuracy reduced by an amount depending upon the degree of over-range.	Verify input signals are within range. If within range, return to factory for repair.
Protocol Configuration Error	15	Instrument protocol configuration may be corrupted and inaccurate. This may cause communication errors.	Reset configuration.
Firmware Download in Progress	12	Indicates firmware download in progress and measurements are offline; will disappear shortly after user reboots meter	Reboot meter when prompted.

5.13 List of Available Measurements & Settings

Available Measurements	
Alarm Output	Heartbeat
Amps A, B, C, Residual	K-factor Amps A, B, C, Residual
Average 3-phase Amps	Meter Type
Average 3-Phase Volts (1 & 2), L-L, L-N	Phase Angle Amps A, B, C
Average Volts AN, BN, CN, AB, BC, CA (Bus 1 & 2)	Phase Angle Volts A, B, C
Average (Max.) Volts AN, BN, CN, AB, BC, CA (Bus 1 & 2)	Phase Angle Volts AB, BC, CA
Average (Min.) Volts AN, BN, CN, AB, BC, CA (Bus 1 & 2)	Phase Angle Volts A 1-2, B 1-2, C 1-2
Average Watts A, B, C, Total	Power Factor A, B, C, Total
Average (Max.) Watts A, B, C, Total	Protocol Version
Average (Min.) Watts A, B, C, Total	PT Scale Factor
Average VARs A, B, C, Total	PT Scale Factor Divisor
Average (Max.) VARs A, B, C, Total	Slip Frequency Volts A 1-2, B 1-2, C 1-2
Average (Min.) VARs A, B, C, Total	Symmetrical Components (Zero, Positive, Negative Sequence) Bus 1 & 2 Volts (Magnitude and Angle)
Average VAs A, B, C, Total	Symmetrical Components (Zero, Positive, Negative Sequence) Current (Magnitude and Angle)
Average (Max.) VAs A, B, C, Total	Tag Register
Average (Min.) VAs A, B, C, Total	TDD Amps A, B, C, Residual
Binary Input (1 – 8)	TDD Denominator A, B, C
Binary Output (1 – 4)	THD Volts A, B, C, AB, BC, CA (1 & 2)
Class 0 Response Setup	Unbalance Amps
CT Scale Factor	Unbalance Volts (1 & 2)
CT Scale Factor Divisor	Uncompensated VARs, Total
Demand (Max.) Amps A, B, C, Residual	Uncompensated Watts, Total
Demand (Max.) Fund. Amps A, B, C, Residual	VA-Hrs
Demand Amps A, B, C, Residual	VAR-Hrs Lag
Demand Fundamental Amps A, B, C, Residual	VAR-Hrs Lead
Displacement Power Factor A, B, C	VARs A, B, C, Total
Displacement Power Factor Total	VAs A, B, C, Total
Factory Version Hardware	Volts AN, BN, CN, AB, BC, CA (1 and 2)
Factory Version Software	Volts Aux1-Aux2
Frequency (System)	Watt-Hrs Net
Frequency Volts A, B, C (1 & 2)	Watt-Hrs Normal
Fund. Amps A, B, C, Residual	Watt-Hrs Reverse
Fund. Volts AN, BN, CN, AB, BC, CA (1 & 2)	Watts A, B, C, Total
Health	

5.14 Calibration

Routine re-calibration is not recommended or required. A field calibration check every few years is a good assurance of proper operation.

5.15 Instantaneous Measurement Principles

The PPX II measures all signals at an effective rate of 64 samples/cycle, accommodating fundamental signal frequencies from 20 to 75Hz. Samples of all bus signals are taken using a 16-Bit A/D converter, effectively creating 64 "snapshots" of the system voltage and current per cycle.

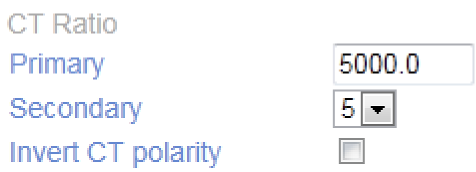
5.15.1 Sampling Rate and System Frequency

The sampling rate is synchronized to the frequency of any of the bus voltages prioritized as follows: $V1_{A-N}$, $V1_{B-N}$, $V1_{C-N}$. This is the frequency reported as the "System Frequency". The sampling rate is the same for all channels.

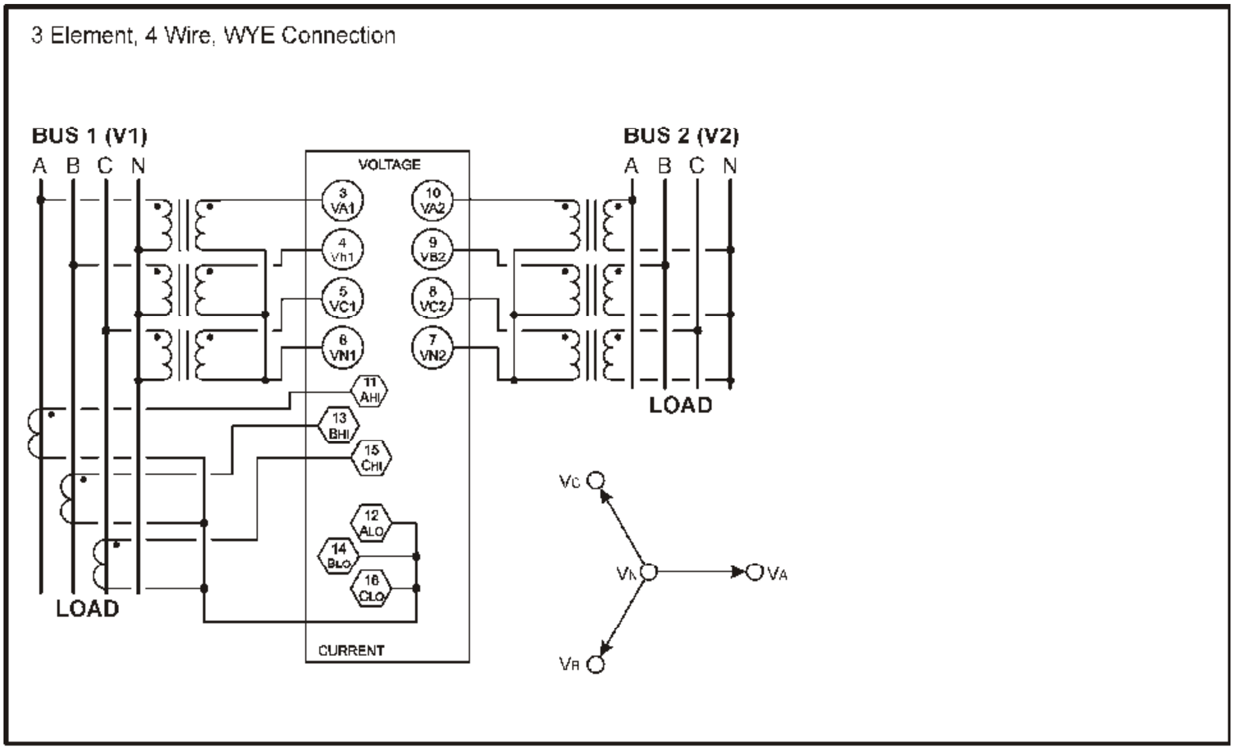
APPENDIX

A1 CT/VT Connection Diagrams

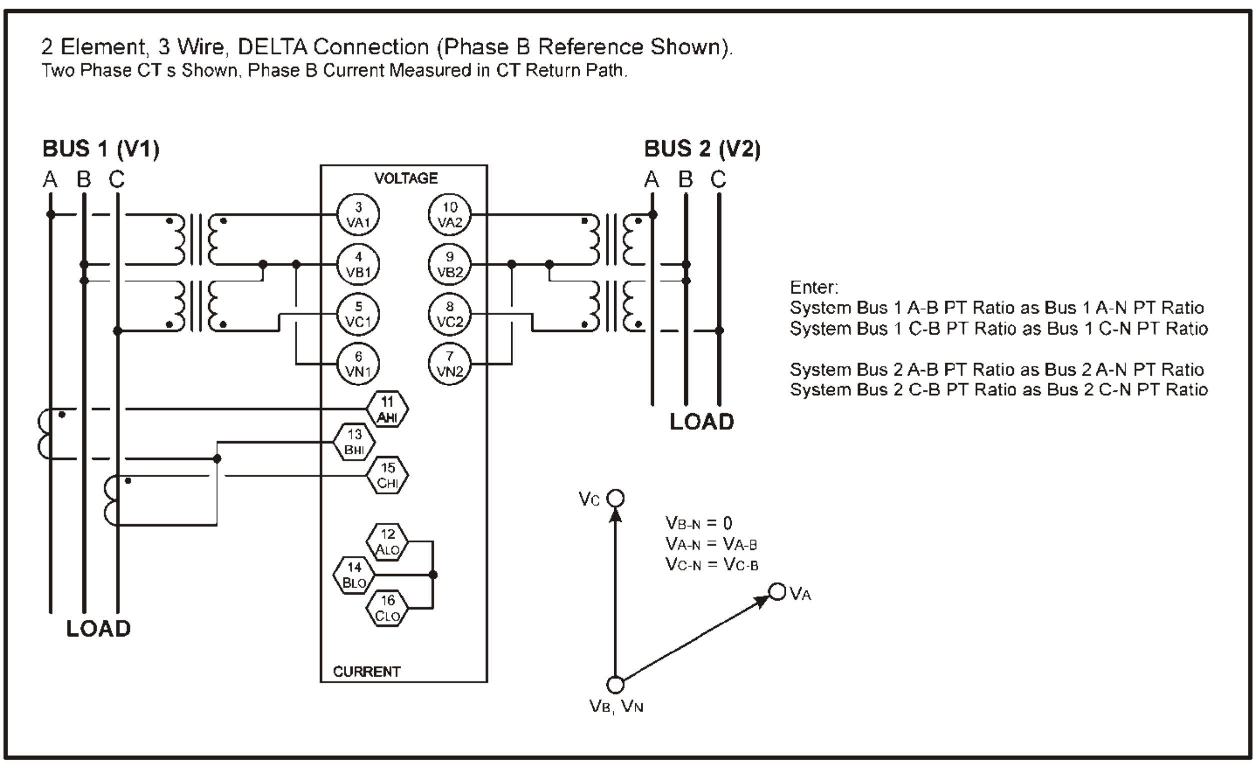
Please note that there is an option on the Settings/Input page to invert the CT Polarity (see screen shot clip below). This option is the equivalent of swapping the connections in the connection diagrams below at the HI and LO terminals for each CT input, that is, swapping 11 and 12 (IA), 13 and 14 (IB), and 15 and 16 (IC). The effect is a 180 degree phase shift in the current signals.



Please note that when viewing the following wiring diagrams there is no need for connection to multiple devices using the same CTs. Also, Bus 1 can be considered the generator (CTs and PTs) and the Bus 2 the bus (PTs only). For synchronizing, you can connect to just one phase.



CT's and PT's SHOULD BE GROUNDED PER ANSI/IEEE C57.13.3



ME71 Wire SCH2 CDR 12-13-04

Figure 13 - Signal Connections – PPX II

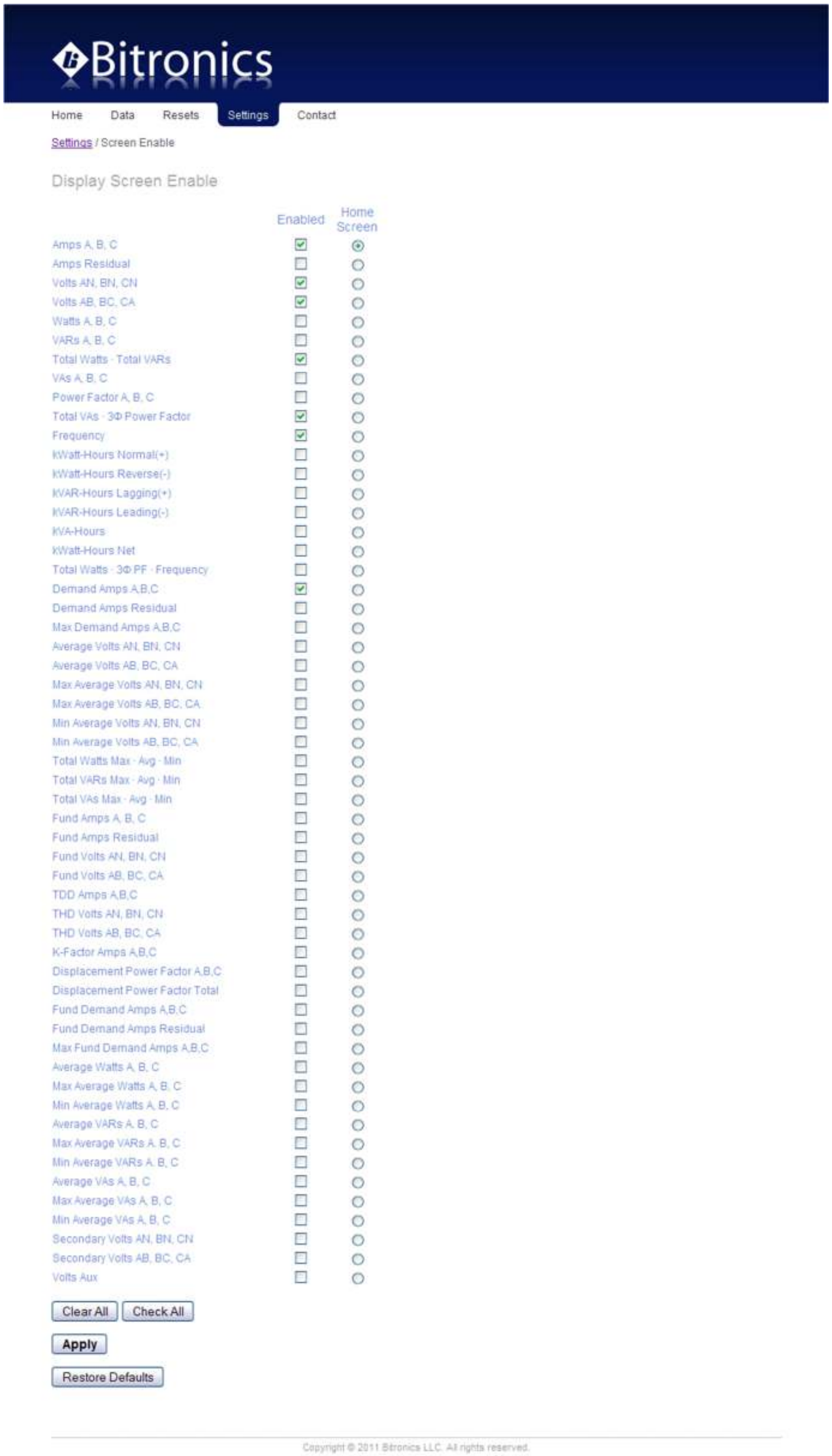
A2 Ethernet Troubleshooting

If the Link LED fails to illuminate, this is an indication that there is trouble with the connection and communication will not proceed without solving the problem. If a copper connection is used between the PPX II and the hub/switch, check the following items:

1. Verify that the connectors are fully engaged on each end.
2. Verify that the cable used is a "straight-through" cable connected to a "normal" port. Alternatively, a "cross-over" cable *could* be connected to an "uplink" port (this could later cause confusion and is not recommended).
3. Verify that both the PPX II and hub/switch are powered.
4. Try another cable.
5. If a long CAT-5 cable is used, verify that is has never been kinked. Kinking can cause internal discontinuities in the cable.
6. If a copper connection is used to an external fiber converter:
7. Verify that the LINK LED on the converter is lit on at least one side. Both sides need to be lit for a valid connection to be established.
8. At least one brand of converters will not output an optical idle unless it receives a forced 10 Mb copper link pulse (for some reason, auto-negotiation pulses confuse it). Some hubs/switches will not output an optical idle unless they receive an optical idle. This then inhibits the converter from outputting a copper link pulse enabling the PPX II to link. In this condition, no device completes the link.
9. Verify that the fiber converter(s) and/or fiber hub/switch are matched for the same type of fiber connections. A 100BASE-FX port will NEVER inter-operate with the 10BASE-FL port (fiber auto-negotiation does not exist).
10. On the fiber connection, try swapping the transmit and receive connector *on one end*.
11. Verify that the fiber converter(s) and/or fiber hub/switch use the proper optical wavelength (100BASE-FX should be 1300nm).

A3 Setting Screen configurations on PowerPlex II for PPXIITD – Screen Enable & Custom Display Screens

Screen Enable:



Custom Display Screen Settings: Two Sections – Build/Edit and Summary

The Custom Display Screen Configuration page contains two sections: the Build/Edit panel and the Summary panel. One custom display screen is built at a time in the Build/Edit panel and is then added to the Summary panel, which presents a list of all the custom screens that have been built. The Build/Edit panel is presented if there are no custom screens stored on the IED when the page is loaded; otherwise, the Summary panel is presented. Only one panel is visible at a time.

Build/Edit panel
Select a measurement to be displayed on each display line from the dropdown lists and enter an alphanumeric label that describes the display screen.

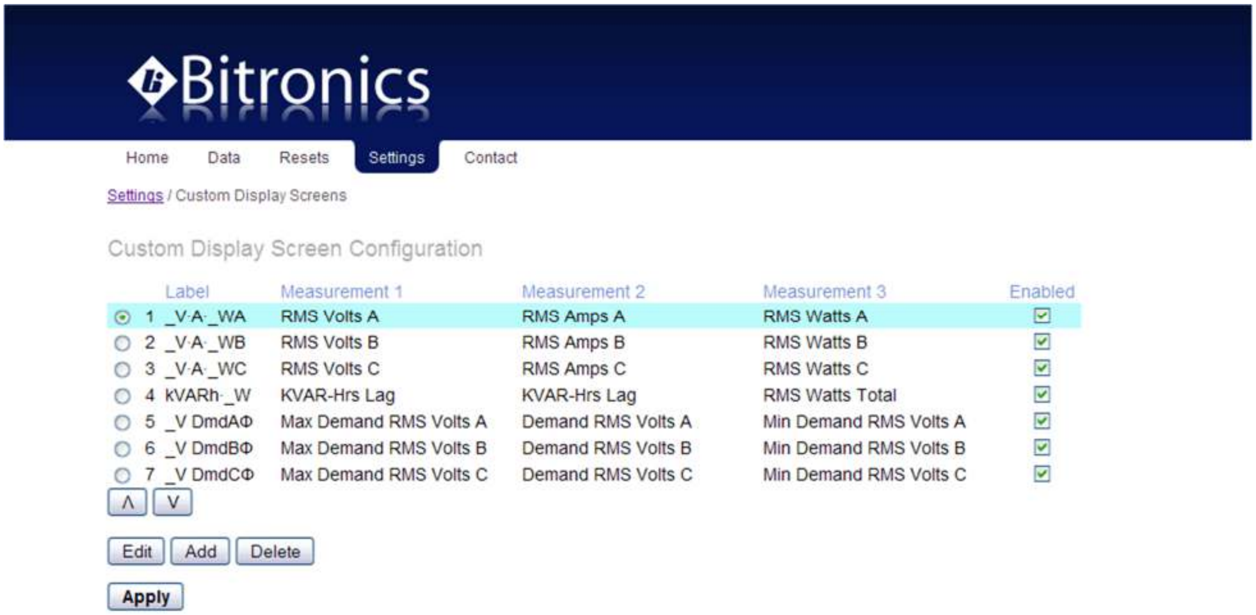
Special character buttons insert the characters shown on the buttons into the “Label” field. The “k/M/G” (kilo/Mega/Giga) button inserts an underscore character into the “Label” field, which is automatically replaced with the appropriate unit prefix when displayed on the IED’s front panel. The dot character is used to separate parts of a single label into multiple labels that apply to the different display lines. It is necessary to place dots between underscore that apply to different display lines.

The MIN, MAX, AVG, line and phase LEDs are automatically lit by the IED, based on the selected measurements.

Click the “Next >” button to view the summary panel.

Summary panel
Screens are saved to IED once the “Apply” button has been clicked. A row (screen) from the summary table can be selected for viewing, editing or deleting by clicking its radio button.

The order of the screens can be changed by selecting a screen from the list and clicking on the up or down arrows.



A4 PowerPlex II Display Screens – Standard Formats

INSTANTANEOUS DISPLAY SCREENS

	Format	Quantity
1.	00000	Phase A Amperes
	00000	Phase B Amperes
	00000	Phase C Amperes
	AmpsΦ	
2.	00000	Residual Amperes [1]
	□□□□□	Unused
	□□□□□	Unused
	AmpsR	
3.	00000	Phase A Volts [1]
	00000	Phase B Volts
	00000	Phase C Volts
	xVolts	
4	00000	Phase A-B Volts
	00000	Phase B-C Volts
	00000	Phase C-A Volts
	xVolts	
5.	00000	Phase A Watts [1]
	00000	Phase B Watts
	00000	Phase C Watts
	xWatts Φ	
6.	00000	Phase A VARs [1]
	00000	Phase B VARs
	00000	Phase C VARs
	xVAR Φ	
7.	00000	Total Watts
	00000	Total VARs
	□□□□□	Unused
	xW·xVAR	

8.	00000	Phase A VAs [1]
	00000	Phase B VAs
	00000	Phase C VAs
	xVA Φ	
9.	00000	Phase A PF [1]
	00000	Phase B PF
	00000	Phase C PF
	PF Φ	
10.	00000	Total VAs
	00000	3Φ PF
	□□□□□	Unused
	xVAs·PF	
11.	00.000	Frequency
	□□□□□	Unused
	□□□□□	Unused
	Hz	
12.	12345	⎫ Positive
	6789A.	⎭ kWh
	□□□□□	Unused
	+kWh	
13.	12345	⎫ Negative
	6789A.	⎭ kWh
	□□□□□	Unused
	-kWh	
14.	12345	⎫ Positive
	6789A.	⎭ kVARh
	□□□□□	Unused
	+kVARh	
15.	12345	⎫ Negative
	6789A.	⎭ kVARh
	□□□□□	Unused
	-kVARh	

16.	000.00	VA hours (Most significant half)
	000.00	VA hours (Least significant half)
	□□□□□	Unused
	kVAh	
17.	00000	Watt hours Net (Most significant half)
	00000	Watt hours Net (Least significant half)
	□□□□□	Unused
	kWh NET	
18.	00000	Total Watts
	00000	3Φ PF
	0000	Frequency
	xW·PF·Hz	

[1] - Screen available on WYE meters only
x - indicates blank, (k)ilo, (M)ega, or (G)iga

DEMAND DISPLAY SCREENS

	Format	Quantity
19.	000.00	Phase A Amps Demand
	000.00	Phase B Amps Demand
	000.00	Phase C Amps Demand
	Amps Dmd	
20.	00000	Phase A Maximum Amperes Demand
	00000	Phase B Maximum Amperes Demand
	00000	Phase C Maximum Amperes Demand
	Amps MAX	
21.	000.00	Residual Amps Demand Maximum
	000.00	Residual Amps Demand
	□□□□□	Unused
	AmpsDmdR	
22.	000.00	Phase A Average Voltage
	000.00	Phase B Average Voltage
	000.00	Phase C Average Voltage
	xV Avg	
23.	00000	Phase A Maximum Volts Demand [1]
	00000	Phase B Maximum Volts Demand
	00000	Phase C Maximum Volts Demand
	xV MAX	
24.	00000	Phase A Minimum Volts Demand [1]
	00000	Phase B Minimum Volts Demand
	00000	Phase C Minimum Volts Demand
	xV MIN	
25.	000.00	Phase A-B Average Voltage
	000.00	Phase B-C Average Voltage
	000.00	Phase C-A Average Voltage
	xV Avg	
26.	00000	Phase A-B Maximum Volts Demand
	00000	Phase B-C Maximum Volts Demand
	00000	Phase C-A Maximum Volts Demand
	xV MAX	
27.	00000	Phase A-B Minimum Volts Demand
	00000	Phase B-C Minimum Volts Demand

	00000	Phase C-A Minimum Volts Demand
	xV MIN	
28.	00000	Total Maximum Watt Demand
	00000	Total Watts (Also on Screen 7)
	00000	Total Minimum Watt Demand
	xW · ↑ · ↓	
29.	00000	Total Maximum VAR Demand
	00000	Total VARs (Also on Screen 7)
	00000	Total Minimum VAR Demand
	xVAR · ↑ · ↓	
30.	00000	Total Maximum VAs
	00000	Total VAs (Also on Screen 10)
	00000	Total Minimum VAs
	xVA · ↑ · ↓	

[1] - Screen available on WYE meters only
x - indicates blank, (k)ilo, (M)ega, or (G)iga

HARMONIC SUMMARY DISPLAY SCREENS

	Format	Quantity
31.	00000	Phase A Fundamental Amperes
	00000	Phase B Fundamental Amperes
	00000	Phase C Fundamental Amperes
	Fnd Amps	
32.	00000	Fundamental Residual Amperes [1]
	□□□□□	Unused
	□□□□□	Unused
	FndN · Amps	
33.	00000	Phase A Fundamental Volts
	00000	Phase B Fundamental Volts
	00000	Phase C Fundamental Volts
	Fnd xV	
34.	000.00	Phase A-B Fundamental Voltage
	000.00	Phase B-C Fundamental Voltage
	000.0	Phase C-A Fundamental Voltage
	Fnd xV	
35.	000.00	Phase A Current %Total Demand Distortion (%TDD)
	000.00	Phase B Current %Total Demand Distortion (%TDD)
	000.00	Phase C Current %Total Demand Distortion (%TDD)
	%TDD I	
36.	000.00	Phase A Voltage %Total Harmonic Distortion (%THD)[1]
	000.00	Phase B Voltage %Total Harmonic Distortion (%THD)
	000.00	Phase C Voltage %Total Harmonic Distortion (%THD)
	%THD V	
37.	000.00	Phase A-B Voltage %Total Harmonic Distortion (%THD)
	000.00	Phase B-C Voltage %Total Harmonic Distortion (%THD)
	000.00	Phase C-A Voltage %Total Harmonic Distortion (%THD)
	%THD V	
38.	00.000	K-Factor Phase A (Current)
	00.000	K-Factor Phase B (Current)

00.000 K-Factor	K-Factor Phase C (Current)

[1] - WYE meters only
x - indicates blank, (k)ilo, (M)ega, or (G)iga

HARMONIC SUMMARY DISPLAY SCREENS (Cont'd)

	Format	Quantity
39.	0.0000	Phase A Displacement PF [1]
	0.0000	Phase B Displacement PF
	0.0000	Phase C Displacement PF
	DispPF Φ	
40.	00000	3Φ Displacement PF
	□□□□□	Unused
	□□□□□	Unused
	DispPF T	
41.	000.00	Phase A Fundamental Demand Amps
	000.00	Phase B Fundamental Demand Amps
	000.00	Phase C Fundamental Demand Amps
	FndDmdIΦ	
42.	000.00	Phase A Maximum Fundamental Demand Amps
	000.00	Phase B Maximum Fundamental Demand Amps
	000.00	Phase C Maximum Fundamental Demand Amps
	FndDmdIΦ	
43.	000.00	Maximum Fundamental Demand Amps Residual
	000.00	Fundamental Demand Amps Residual
	□□□□□	Unused
	FundDmdIR	
44.	000.00	Phase A Average Watts
	000.00	Phase B Average Watts
	000.00	Phase C Average Watts
	xW Avg	
45.	000.00	Phase A Maximum Average Watts
	000.00	Phase B Maximum Average Watts
	000.00	Phase C Maximum Average Watts
	xW Max	

46.	000.00	Phase A Minimum Average Watts
	000.00	Phase B Minimum Average Watts
	000.00	Phase C Minimum Average Watts
	xW Min	
47.	000.00	Phase A Average VARs
	000.00	Phase B Average VARs
	000.00	Phase C Average VARs
	xVAR Avg	
48.	000.00	Phase A Maximum Average VARs
	000.00	Phase B Maximum Average VARs
	000.00	Phase C Maximum Average VARs
	xVAr Max	
49.	000.00	Phase A Minimum Average VARs
	000.00	Phase B Minimum Average VARs
	000.00	Phase C Minimum Average VARs
	xVAR Min	
50.	000.00	Phase A Average VAs
	000.00	Phase B Average VAs
	000.00	Phase C Average VAs
	xVA Avg	
51.	000.00	Phase A Maximum Average VAs
	000.00	Phase B Maximum Average VAs
	000.00	Phase C Maximum Average VAs
	xVA Max	
52.	000.00	Phase A Minimum Average VAs
	000.00	Phase B Minimum Average VAs
	000.00	Phase C Minimum Average VAs
	xVA Min	
53.	00000	Phase A Secondary Volts[1]
	00000	Phase B Secondary Volts
	00000	Phase C Secondary Volts
	SecVolts	

54. 00000 Phase A-B Secondary Volts
00000 Phase B-C Secondary Volts
00000 Phase C-A Secondary Volts
SecVolts

55. 000.00 Auxiliary Voltage
□□□□□ Unused
□□□□□ Unused
V aux

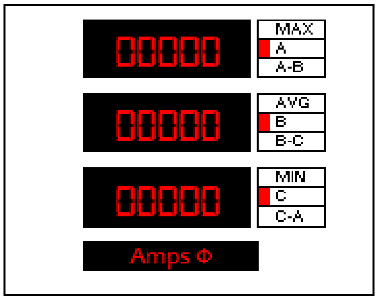
[1] - Screen available on WYE meters only
x - indicates blank, (k)ilo, (M)ega, or (G)iga

A5 PowerPlex II Standard Display Screens – Visual Representations PPXIITD

Screen

1

Amps A, B, C



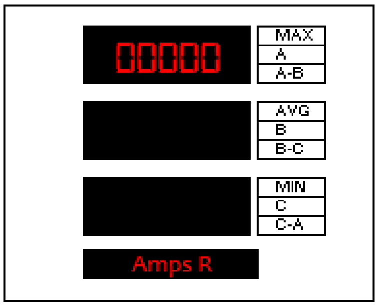
Phase A Amps

Phase B Amps

Phase C Amps

2

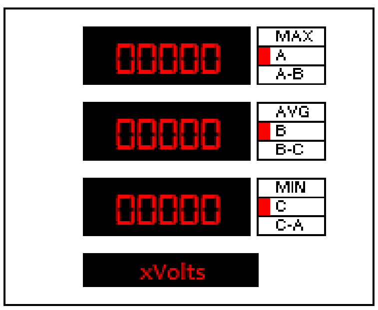
Amp Residual



Amps Residual

3

Volts AN, BN, CN



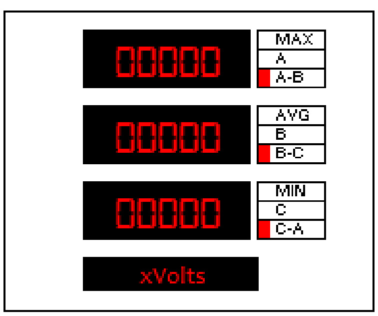
Volts A

Volts B

Volts C

4

Volts AB, BC, CA



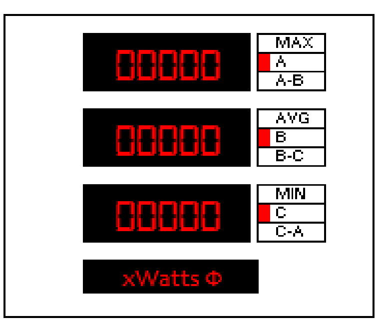
Volts AB

Volts BC

Volts CA

5

Watts A, B, C

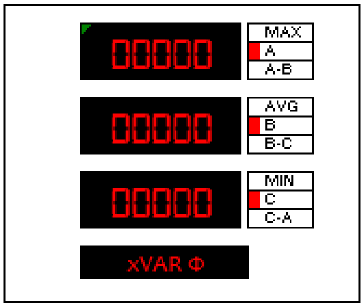


Watts A

Watts B

Watts C

VARs A, B, C

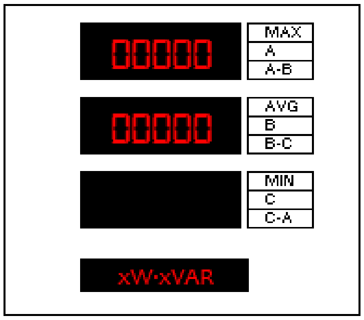
6 

VARs A

VARs B

VARs C

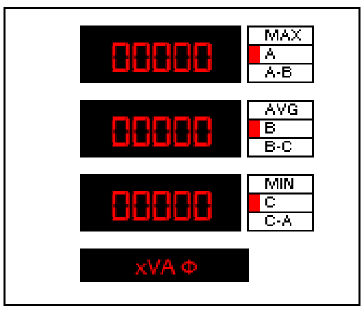
Total Watts - Total VARs

7 

Total Watts

Total Vars

VAs A, B, C

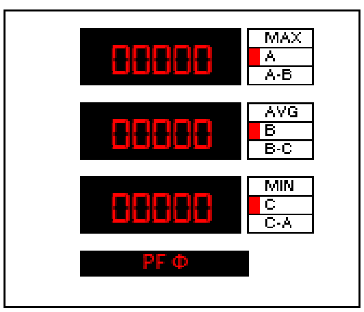
8 

VAs A

VAs B

VAs C

Power Factor A, B, C

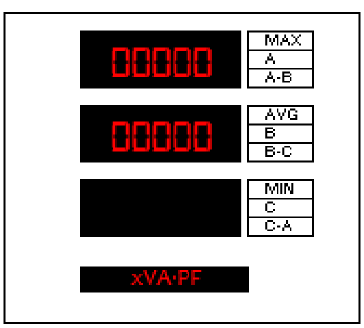
9 

PF A

PF B

PF C

Total VAs - 3Φ PF

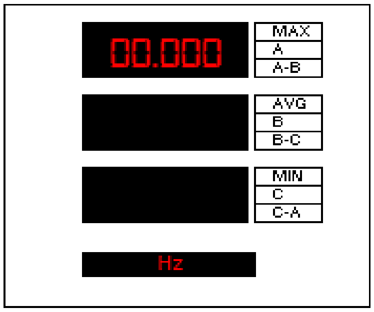
10 

VAs Total

3Φ PF

Frequency

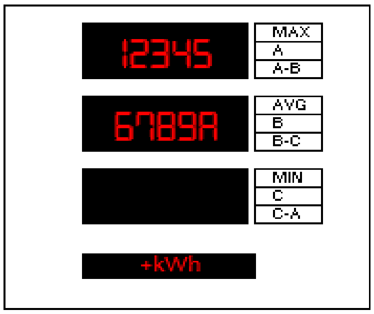
11



Frequency

Watt Hrs Normal (+)

12

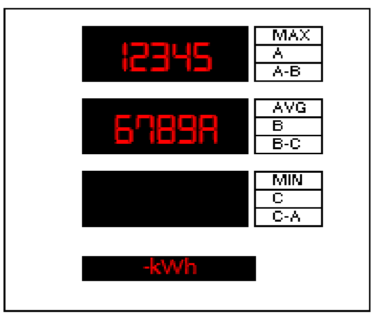


Most significant half

Least significant half

Watt Hrs Reverse (-)

13

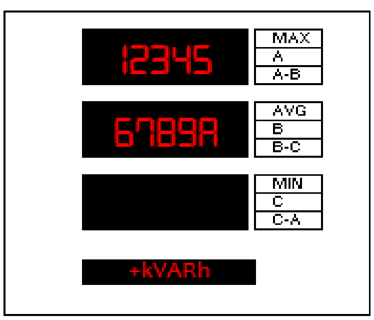


Most significant half

Least significant half

VAR Hrs Lagging (+)

14

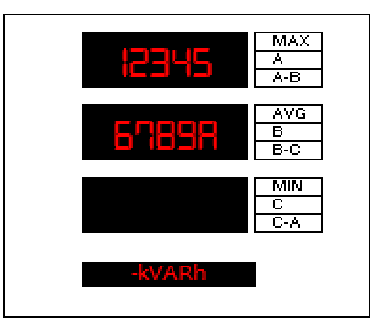


Most significant half

Least significant half

VAR Hrs Leading (-)

15

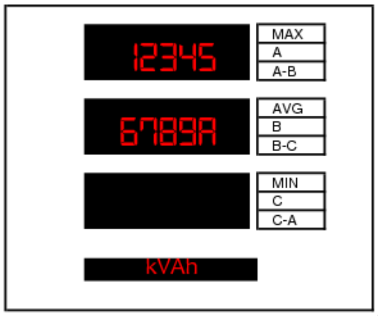


Most significant half

Least significant half

kVA Hrs

16

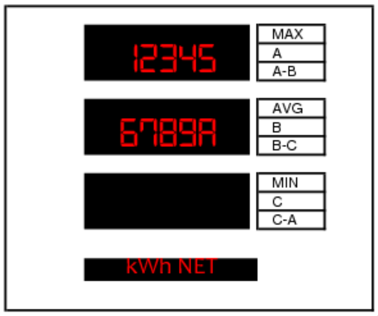


Most significant half

Least significant half

kWatt Hrs Net

17

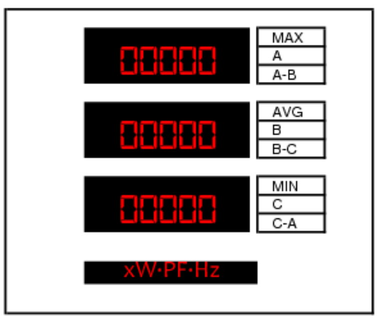


Most significant half

Least significant half

Total Watts · 3Φ PF · Frequency

18



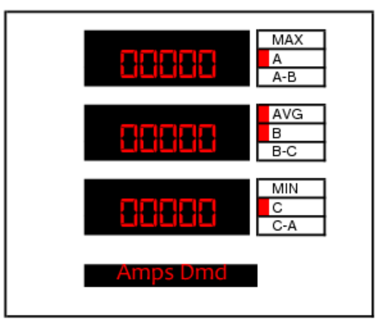
Total Watts

3Φ PF

Frequency

Demand Amps A, B, C

19



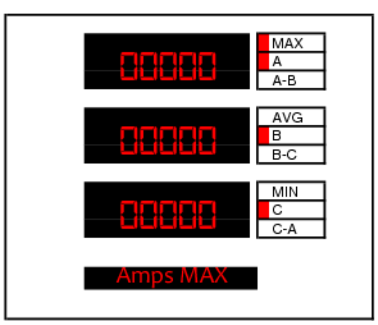
Demand Amps A

Demand Amps B

Demand Amps C

Max Dmd Amps A,B,C

20



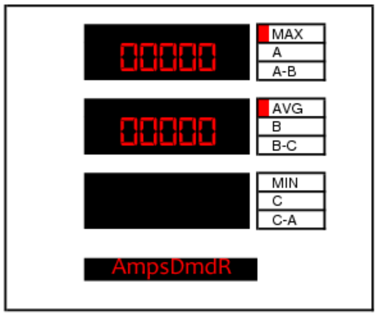
Dmd Amps A Max

Dmd Amps B Max

Dmd Amps C Max

Demand Amps Residual

21

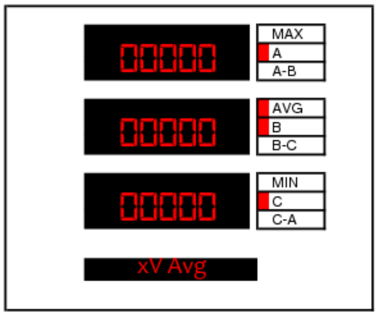


Demand Amps R MX

Dmd Amps R

Average Volts AN, BN, CN

22



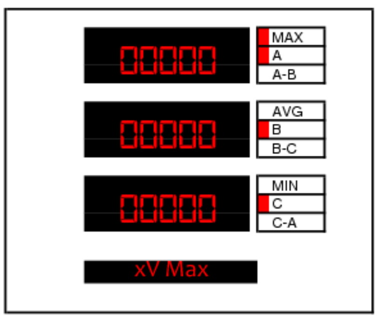
Volts A

Volts B

Volts C

Max Average Volts AN, BN, CN

23



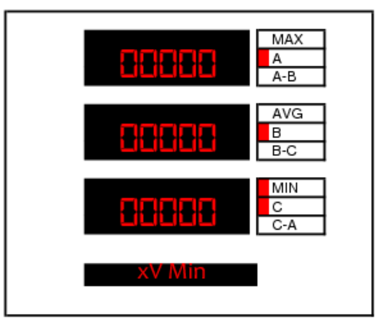
Volts A

Volts B

Volts C

Min Average Volts AN, BN, CN

24



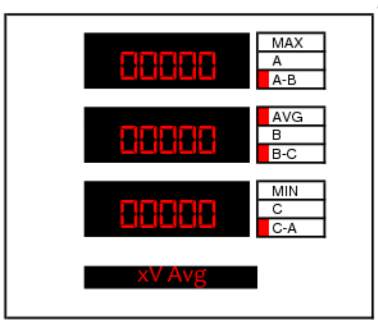
Volts A

Volts B

Volts C

Average Volts AB, BC, CA

25



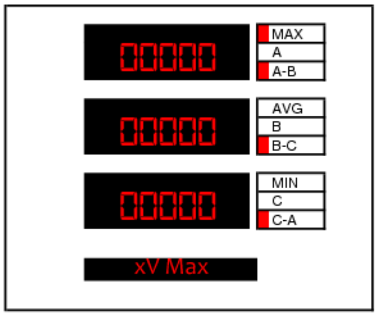
Volts AB

Volts BC

Volts CA

Max Average Volts AB, BC, CA

26



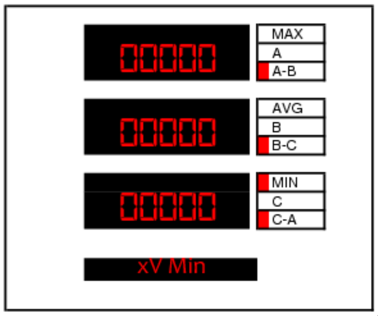
Volts AB

Volts BC

Volts CA

Min Average Volts AB, BC, CA

27



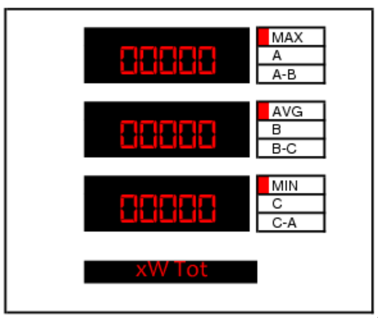
Volts AB

Volts BC

Volts CA

Total Watts Max · Avg · Min

28



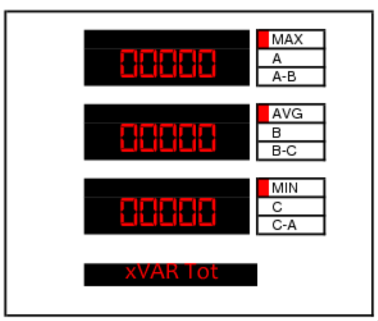
Average Watts Max

Average Watts Avg

Average Watts Min

Total VARs Maxl · Avg · Min

29



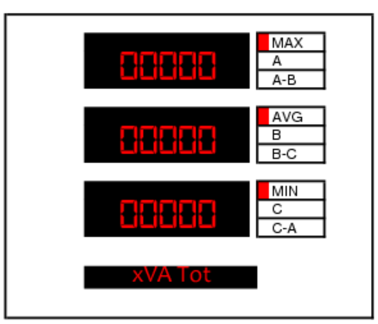
Average VARs Max

Average VARs Avg

Average VARs Min

Total VAs Max· Avg · Min

30

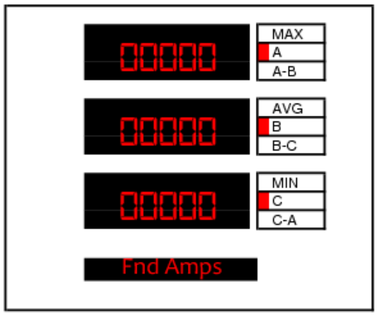


Average VAs Max

Average VAs Avg

Average VA Min

Fundamental Amps A, B. C

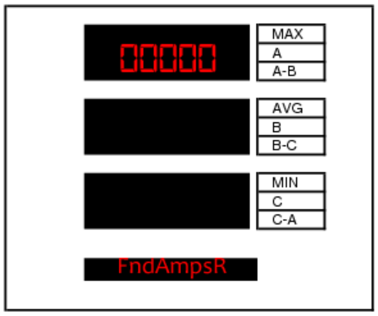
31


Fnd Amps A

Fnd Amps B

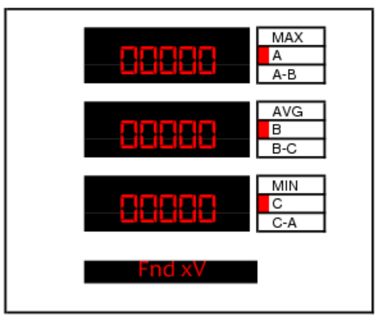
Fnd Amps C

Fundamental Amps Residual

32


Fnd Amps Residual

Fund. Volts AN, BN, CN

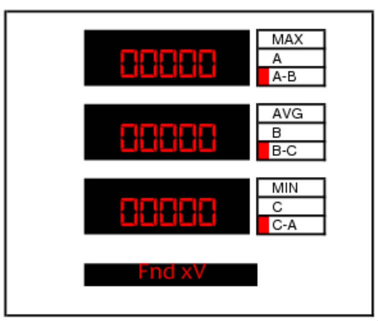
33


Fnd Volts A

Fnd Volts B

Fnd Volts C

Fund. Volts AB, BC, CA

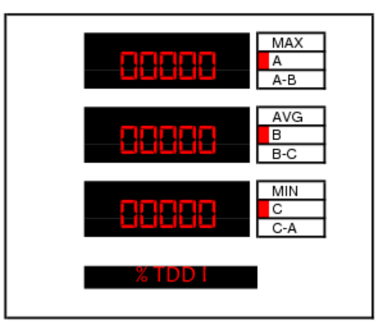
34


Fnd Volts AB

Fnd Volts BC

Fnd Volts CA

TDD Amps A, B, C

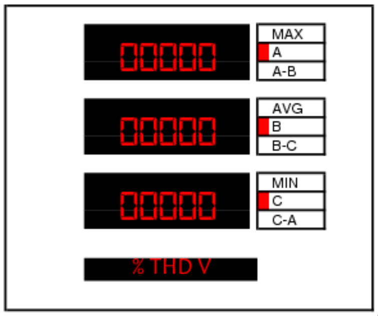
35


TDD Amps A

TDD Amps B

TDD Amps C

THD Volts AN, BN, CN

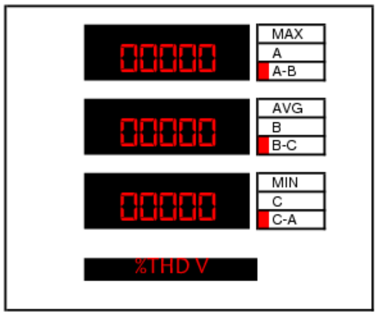
36 

THD Volts AN

THD Volts BN

THD Volts CN

THD Volts AB, BC, CA

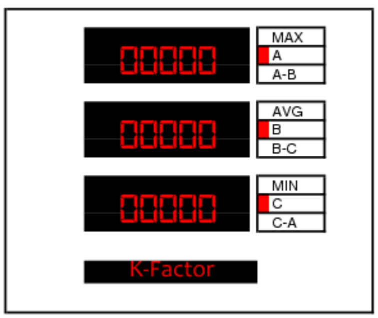
37 

THD Volts AB

THD Volts BC

THD Volts CA

K-Factor Amps A, B, C

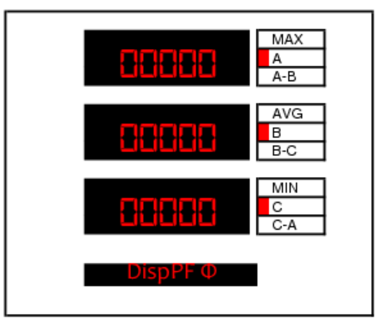
38 

K-Factor A

K-Factor B

K-Factor C

Displacement Power Factor A, B, C

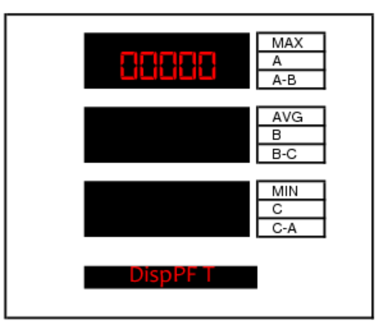
39 

Displacement PF A

Displacement PF B

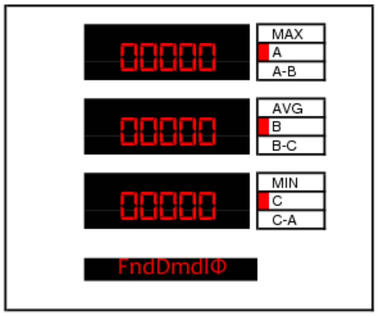
Displacement PF C

Displacement Power Factor Total

40 

Displacement PF T

Fund. Demand Amps A, B, C

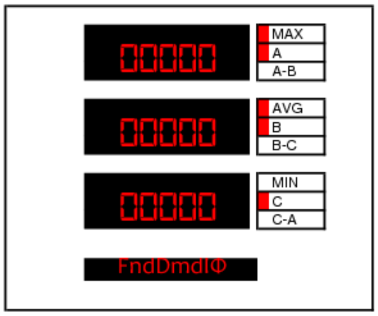
41 

Fnd Dmd Amps A

Fnd Dmd Amps B

Fnd Dmd Amps C

Max Fund. Demand Amps A, B. C

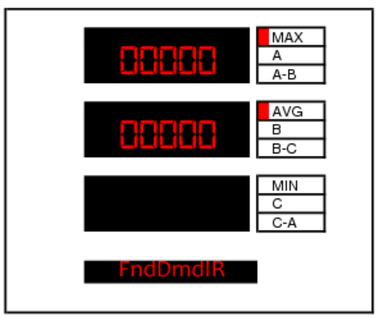
42 

Fnd Dmd Amps A

Fnd Dmd Amps B

Fnd Dmd Amps C

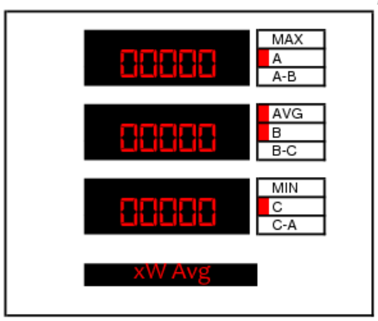
Max Fund. Demand Amps Residual

43 

Fnd Dmd Amps R

Fnd Dmd Amps R

Average Watts A, B, C

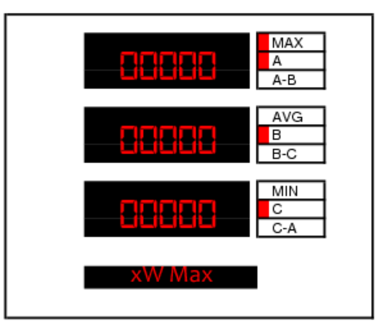
44 

Watts A

Watts B

Watts C

Max Average Watts A, B, C

45 

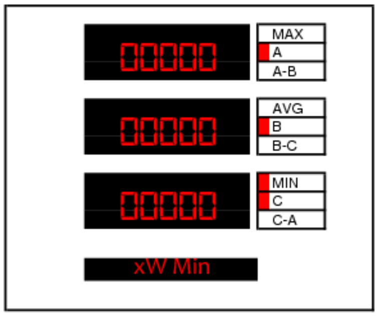
Watts A

Watts B

Watts C

Min Average Watts A, B, C

46



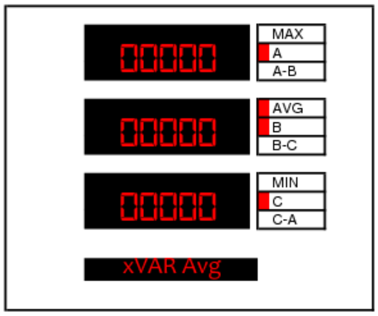
Watts A

Watts B

Watts C

Average VARs A. B, C

47



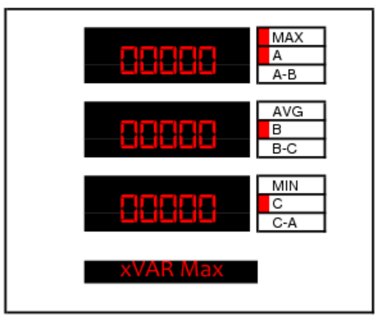
VARs A

VARs B

VARs C

Max Average VARs A. B, C

48



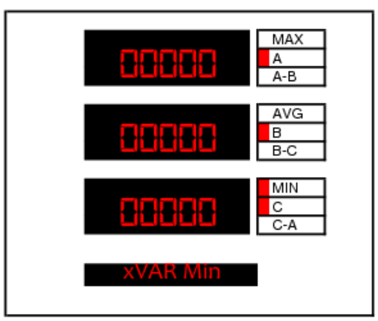
VARs A

VARs B

VARs C

Min Average VARs A. B, C

49



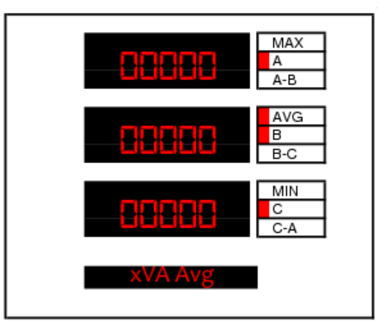
VARs A

VARs B

VARs C

Average VAs A, B, C

50



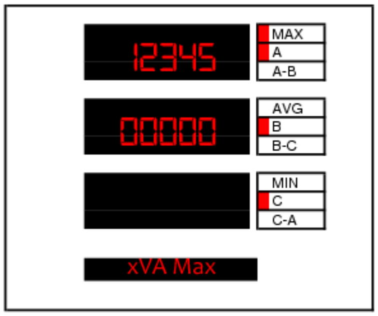
VAs A

VAs B

VAs C

Max Average VAs A, B, C

51



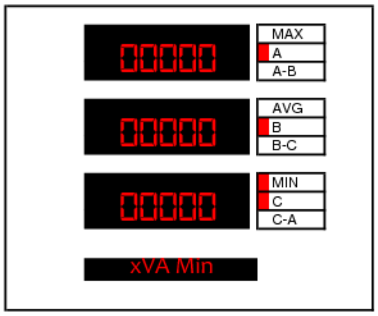
VAs A

VAs B

VAs C

Min Average VAs A, B, C

52



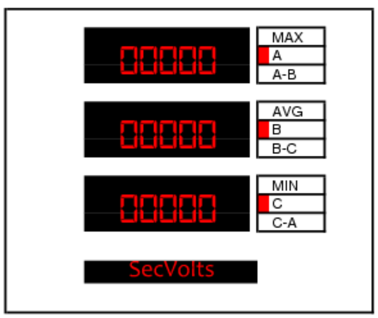
VAs A

VAs B

VAs C

Secondary Volts AN, BN, CN

53



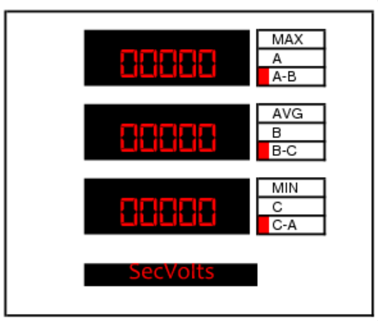
SecVolts A

SecVolts B

SecVolts C

Secondary Volts AB, BC, CA

54



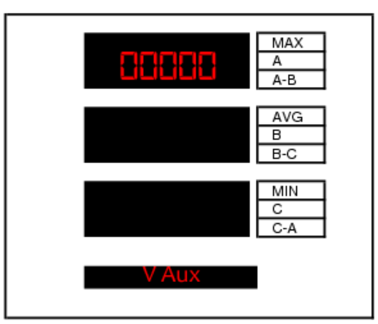
SecVolts AB

SecVolts BC

SecVolts CA

Volts Aux

55



V Aux

EC Declaration of Conformity

This declaration of conformity is issued under the sole responsibility of the manufacturer.

We, the undersigned:

Manufacturer:	**Bitronics LLC** 261 Brodhead Road Bethlehem, PA 18017-8698 USA **T** +610.997.5100 **F** +610.997.5450 **E** bitronics@novatechweb.com	**Authorized Representative in the European Union:**	**NovaTech Europe BVBA** Kontichsesteenweg 71 2630 Aartselaar Belgium **T** +32.3.458.0807 **F** +32.3.458.1817 **E** info.europe@novatechweb.com

hereby declare that the following product(s) :

Product type :	PowerPlex II
Description :	Sychronizing Ethernet Transducer, 3-Phase (Measuring Equipment)
Models	**MTWDN7C constructed of either of the following as the AUX PWR voltage input option:**: Low V DC Auxiliary voltage input (AUX PWR or DC PWR) **when 8th character is D**; Universal Hi Range AC/DC Auxiliary voltage input (AUX PWR) **when 8th character is P**. **including the following features as standard**: Auxiliary voltage monitoring; Measurement signal inputs for 3-Phase Voltages (2 BUS), and Current (CT) inputs rated for Nominal input current of 5A ac (internal isolation of current inputs); Dual copper RJ45 Ethernet ports.. **including the following features as optional**: IRIG-B time sync input; Display port (RJ-11); Energy Pulse Infared LED. **including the following accessory as optional**: PowerPlex II Tethered Display Model PPXII-TD with interconnecting cable (RJ11).

Conform(s) with the protection requirements of the following directive(s) :

1. European Community Directive on EMC (EMCD) 2014/30/EU, superceding 2004/108/EC and Directive 91/263/EC [TTE/SES]. Fulfilment of the essential requirements set out in Annex I has been demonstrated.
2. European Community Directive on Low Voltage (LVD) 2014/35/EU, superceding 2006/95/EC. Fulfilment of the safety objectives referred to in Article 3 and set out in Annex I has been demonstrated.

The object of the declaration described above is in conformity with the relevant Union harmonisation legislation: Directives 2004/108/EC & 2006/95/EC (until April 19th, 2016) and Directives 2014/30/EU &, 2014/35/EU (from April 20th, 2016).

Reference Number :	DOC B006	**Issue :**	B
Date of issue :	30-June-2016		

Form BIDOC_F 1

The following route(s) were used to establish conformity :

1. **2014/30/EU: In accordance with** Article 14, Annex II **(**internal production control supported by a Technical File), superceding 2004/108/EC, in accordance with Article 7, Annex II.

Technical File No. :	TF B006
Date Issued or Revised :	30-June-2016 or later (original issue 14-Oct-2014)
Conformity Assessment Body : **(C.A.B.)**	Underwriters Laboratories, LLC, WiSE, Melville Division 1285 Walt Whitman Road, Melville, NY 11747-3081 USA
Compliance Certificate / Test Report:	10216568, PowerPlex II, EMC Assessment, Model MTWDN7CD
Conformity Assessment Body : **(C.A.B.)**	Underwriters Laboratories, LLC, Consumer Technology Division (CTECH), 12 Laboratory Drive, Research Triangle Park, NC 27709, USA
Compliance Certificate / Test Report:	10921409, PowerPlex II, EMC Assessment, Model MTWDN7CP

2. **2014/35/EU: Self Certification supported by a Technical File,** superceding 2006/95/EC.

Technical File No. :	TF B006
Date Issued or Revised :	30-June-2016 or later (original issue 14-Oct-2014)
Conformity Assessment Body : **(C.A.B.)**	Underwriters Laboratories of Canada, Inc. 7 Underwriters Rd., Toronto, Ontario, M1R 3B4, Canada
Compliance Certificate / Test Report: **(Superceded)**	CB Certificate No. CA10239-UL issued by National Certification Body: UL (CA), 7 Underwriters Road, Toronto, M1R-3B4 Ontario, CANADA / CB Test Report E164178-A5-CB-1, PowerPlex II Model MTWDN7CD, Product Safety Assessment, Project 4786306596
Conformity Assessment Body : **(C.A.B.)**	Underwriters Laboratories, LLC, 1285 Walt Whitman Road, Melville, NY 11747-3081 USA
Compliance Certificate / Test Report:	CB Certificate No. CA10239-A1-UL issued by National Certification Body: UL (CA), 7 Underwriters Road, Toronto, M1R-3B4 Ontario, CANADA / CB Test Report E164178-A5-CB-1-Amendment 1, Corrections 1 & 2, PowerPlex II Models MTWDN7CD & MTWDN7CP, Product Safety Assessment, Project 4787048869

Reference Number : DOC B006 **Issue :** B

Date of issue : 30-June-2016

Form BIDOC_F 2

The following standards were used for reference and to establish conformity :

IEC 61010-1, Edition 3, 2013/02/01 UL 61010-1, Edition 3, 2012/05/11 CAN/CSA No. 22.2, No. 61010-1-12, Ed. 3, 2012/05/01	Safety requirements for electrical equipment for measurement, control, and laboratory use. Part 1: General requirements
IEC 61010-2-030, Edition 1, 2010/06/02 UL 61010-2-030, Edition 1, 2012/05/11 CAN/CSA No. 22.2, No. 61010-2-030-12, Ed. 1, 2012/05/01	Safety requirements for electrical equipment for measurement, control and laboratory use. Part 2-030: Particular requirements for testing and measuring circuits
EN 61326-1: 2013	Electrical Equipment for measurement, control and laboratory use – EMC requirements
EN 61000-6-4: 2007 / A1: 2011	Electromagnetic compatibility Part 6-4: Generic emission standard – Industrial environment.
EN 61000-6-2: 2005	Electromagnetic compatibility (EMC) Part 6-2: Generic standards - Immunity for Industrial
EN 55011: 2009 / A1: 2010, Group 1 Class A	Radiated Emissions Electric Field Strength,
EN 55011: 2009 / A1: 2010, Group 1 Class A (Conducted on VT inputs Bus1/Bus2)	AC Powerline Conducted Emissions
EN 55022: 2011 Group 1 Class A (Conducted on Ethernet ports 1 & 2)	Conducted Emissions, Telecom ports
EN 61000-4-2: 2009	Electrostatic Discharge (ESD)
EN 61000-4-3: 2006 / A1: 2008 / A2: 2010 Class III	Immunity to Radiated Electromagnetic Energy (Radio Frequency)
EN 61000-4-4: 2012, Severity Level 3 (Measurment Signal Inputs – VTs & Mains AUX PWR)	Electrical Fast Transient / Burst Immunity
EN 61000-4-5: 2014, Installation Class 3 (VT Inputs & Mains AUX PWR)	Surge Immunity
EN 61000-4-6: 2014 Level 3	Immunity to Conducted Disturbances Induced by Radio Frequency Fields
EN 61000-4-8: 2010	Immunity to Power Frequency Magnetic Fields
EN 61000-4-11: 2004 (VT Inputs & Mains AUX PWR)	AC Supply Voltage Dips and Short Interruptions
ANSI / IEEE C37.90.1: 2002	Surge Withstand Capability Test for Protective Relays and Relay Systems

Signed for and on behalf of the Company :	Alan Staatz, Vice President, Engineering *Alan Staatz* Novatech, LLC

CE Marking Year 2014, 2016

Reference Number : DOC B006 Issue : B

Date of issue : 30-June-2016

Form BIDOC_F 2

Revision	Date	Changes	By
A	10/29/2014	Original Issue	E. DeMicco
B	10/19/15 – 7/18/16	Added PPX IITD display and new PPX II options (display port, IRIG-B port) Added Hi-Range Power supply specifications, overcurrent protection and Supply/Mains Disconnect. Added specifications for PPX II-TD display and IRIG-B. Added Figure for PPX II with options; added Figure for display dimensions. Revised Overcurrent protection for Universal Power supply Added section on Energy Pulse LED. Revised screen for Settings page; added screen for time sync page. Made other Misc. revisions Revised section 2.4 for Overcurrent protection associated with UL branch circuit protection. Added appropriate Manufacturer fuse types. Provided updated front panel photos. Made manual reference ML0044B. Note that DOC needs to be revised to cover AUX PWR Hi Range Power supply and IRIG-B, Display port, Energy Pulse Infared LED options and accessory PPXII-TD Tethered Display. Added time sync screen shot Updated EMC section 1.5 Added information for PPXIITD display in Appendix A3 through A5 Clarified model numbers between DC and universal power supply options in sections 1.1 and 1.2	E. DeMicco R. Fisher

		Added screw torque spec (ground bond) in section 1.3 table under Physical/Size description. Section 1.5 revision for the following: New Directives 2014/30/EU (EMCD) and 2014/35/EU (LVD), AC Power Line Conducted Emissions, AC Dips & Interruptions, EFT, and Surge; Revised applicable dates pertaining to Surge and Conducted Disturbances standards. Removed Ethernet port from surge test under Section 1.5. Changed Power Supply Installation Category information on page 12 to CAT II Added new Declaration of Conformity	
C	10/18/16	Added information on new serial port and digital I/O options, additional measurements	E. DeMicco
D	12/16/16	Added information on serial ports and RS485 diagrams; updated section 4.4; reference changes in section 1.6; updated information in section 3.8	E. DeMicco
E	5/22/17	Updated firmware version information, corrected reference in section 1.6	E. DeMicco
F	8/17/17	Removed information on indicator LEDs on page 21 listed in error.	E. DeMicco
G	9/25/17	Added/updated information on 3-phase average voltages and currents; corrected information on allowable password character	E. DeMicco
H	12/1/17	Added information on trend recorder	E. DeMicco
J	5/3/21	Added information on 1A input	E. DeMicco

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Bitronics ◆ D/3 ◆ Orion

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