PowerPlex II Synchronizing Ethernet Transducer

DNP3 Protocol Manual

November 20, 2014
ML0045 Document Revision A

NovaTech®
Bitronics ◆ D/3 ◆ Orion

TABLE OF CONTENTS

PPX II MANUAL SET

ML0044	PPX II User Manual
ML0045	PPX II DNP3 Protocol
ML0046	PPX II Modbus Protocol

VERSION HISTORY (ABRIDGED)

V1.00.0	2014-07-29	Initial Release
V1.30.0	2014-10-22	Minor feature upgrades and bug fixes

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.

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.

For assistance, contact Bitronics LLC at:

Telephone: 610.997.5100
Fax: 610.997.5450
Email: bitronics@novatechweb.com
Website: www.novatechweb.com/bitronics

Shipping:

261 Brodhead Road
Bethlehem, PA 18017-8698
USA

SAFETY SECTION

Please refer to the M650 User Manual (ML0035), the M350 User Manual (ML0038), or the M651 User Manual (ML0039) for information regarding safety, installation, commissioning and decommissioning.

1.0 DNP INTERFACE

1.1 Description

The DNP network is a "MASTER" to "SLAVE" network; that is to say, one node asks a question and a second node answers. A NODE is a DNP device (RTU, Computer, PPX II, etc.) that is connected to the network. Each DNP NODE has an ADDRESS in the range of 0 to 65519, and it is this address that allows a MASTER to selectively request data from any other device. DNP uses the address range 65533-65536 for broadcast functions. Broadcast requests never generate DNP responses.

The DNP implementation in the PPX II conforms to DNP3 specifications as defined by DNP.org (derived from the Harris IED (Intelligent Electronics Devices) implementation guidelines). Data obtained by the **DNP READ CLASS 0** command is configurable. Individual items can also be read using **READ BINARY OUTPUT STATUS** or **READ ANALOG INPUT** or **READ COUNTER** or **READ ANALOG OUTPUT STATUS** or **READ BINARY INPUT** or **READ FROZEN COUNTER** commands.

The Energy values can be reset to zero by issuing the **DIRECT OPERATE**, **DIRECT OPERATE NO ACKNOWLEDGE,** or **SELECT BEFORE OPERATE** by using the *CONTROL RELAY OUTPUT BLOCK* object.

The Demand values can be reset by issuing the same **DIRECT OPERATE**, **DIRECT OPERATE NO ACKNOWLEDGE,** or **SELECT BEFORE OPERATE** command to the other points of this object.

Four legacy values are also presented. They are CT Scale Factor Normalized Ratio and Divisor, and VT Scale Factor Normalized Ratio and Divisor. They are derived from the PT scale and CT scale configured through the browser interface.

The **SELECT BEFORE OPERATE** arm timeout value is configurable from zero to 64 seconds.

1.2 DNP Address

Setting the address is done via a web browser.

Each DNP instrument responds to a single destination address in the range 0-65519. Each instrument on a DNP link must have a unique address. PPX II will allow any of the 65520 addresses to be selected. DNP instruments also use a BROADCAST address range of 65533-65535. Requests sent to a BROADCAST address cause the instrument to execute the function but not generate a response.

1.3 Transaction Timing

PPX II completes a set of calculations approximately every cycle. Incoming messages are parsed every 5 ms.

1.4 Object Format

PPX II reports all static measurements via the use of three static objects. These objects include COUNTER (object 20, variations 1, 2, 5 and 6), ANALOG INPUT (object 30, variations 1, 2, 3 and 4) and BINARY INPUT (object 2, variations 1 and 2). These objects are read only and cannot be modified by DNP MASTER devices.

Pseudo output points (such as demand and energy resets) are reported using the BINARY OUTPUT STATUS (object 10, variation 2).

PPX II is capable of reporting ANALOG CHANGE EVENTS (object 32, variations 1 through 4). Any ANALOG INPUT can be configured to report as a CLASS-1, CLASS-2, or CLASS-3 ANALOG CHANGE EVENT. Point, Class, Analog Deadband Values and Object Variation are all selectable by use of the Ethernet service port and web browser. The default Object Variations are selectable by Object (not by point). All ANALOG CHANGE EVENTS can be configured to report with or without time.

PPX II supports frozen counter events (object 21, variations 1, 2, 5 and 6 which are 16 or 32-bit with or without time).

PPX II supports one BINARY INPUT (object 1, variations 1 and 2) and one BINARY INPUT CHANGE event (object 2, variations 1, 2, and 3). The single binary input is derived from the OR of the bits from the Health status word.

The DNP protocol allows each device to determine the best method of data transfer. The PPX II supports this by selecting the most appropriate response variation when either the requested variation is 0 or a CLASS-0 read is requested. Both COUNTER and ANALOG INPUT objects allow optional flags to be used. If a value is requested as variation 0, the PPX II responds as selected with the default variation selected through the browser.

When reading objects, the Health Check point (object 30, point 0) should always be read and checked before interpreting data, since some failure modes will cause erroneous data to be presented (See Section 1.8). The majority of the points are represented in Normalized 2's complement format. For conversion of the point data into engineering units, please refer to Section 1.6. Appendix A provides the Legacy or Bitronics Legacy Fixed (BiLF) point set used in the PPX II.

NOTE: Unless otherwise specified, all points are READ ONLY.

1.4.1 DNP3 Calculation-Type Codes

The DNP3 Type codes for Optimal Resolution that are applicable to the point assignments in the appendix tables are highlighted within the following Calculation Type table:

Type	Description
T1	Unsigned 16-Bit Integer
T2	Signed 16-Bit Integer - 2's Complement - Saturation 10
	Float Value = ((Integer Value) / 32768) * Scale * 10)
	Example: 5.0 A stored as 16384 when Amp Scale = 1:1
T3	Signed 16-Bit Integer - 2's Complement - Saturation 15
	Float Value = ((Integer Value) / 32768) * Scale * 15)
	Example: 150 A stored as 16384 when Amp Scale = 20:1
T4	Signed 16-Bit Integer - 2's Complement - Saturation 150
	Float Value = ((Integer Value) / 32768) * Scale * 150)
	Example: 119.998 V stored as 26214 when Volt Scale = 1:1
T5	Signed 16-Bit Integer - 2's Complement - Saturation 1500
	Float Value = ((Integer Value) / 32768) * Scale * 1500)
	Example: -750.0 W stored as -16384 when Volt Scale = 1:1, Amp Scale 1:1
T6	Signed 16-Bit Integer - 2's Complement - Saturation 4500
	Float Value = ((Integer Value) / 32768) * Scale * 4500)
	Example: -90.0 kW stored as -8192 when Volt Scale = 20:1, Amp Scale 4:1
T7	Signed 16-Bit Integer - 2's Complement - 3 Decimal Places
	Example: -12.345 stored as -12345
T8	Signed 16-Bit Integer - 2's Complement - 2 Decimal Places
	Example: 123.45 stored as 12345
T9	Signed 16-Bit Integer - 2's Complement -1 Decimal Place
	Example: -1234.5 stored as -12345
T10	Unsigned 16-Bit Integer - Normalized Ratio
	ratio = (Normalized Ratio / Ratio Divisor)
	Example : 1.234, 12.34, 123.4, and 1234 are all stored as 1234
T11	Unsigned 16-Bit Integer - Ratio Divisor
	ratio = (Normalized Ratio / Ratio Divisor); valid Ratio Divisors are 1,10,100,1000
	Example: X.XXX stored as 1000, XX.XX stored as 100, XXX.X stored as 10
T12	Signed 16-Bit - 2's Complement - Saturation 2
	Gain Value = Integer Value /16384)
	Example: -0.250 stored as -4096

Type	Description
T13	Unsigned 16-Bit Integer - 12 Bit Offset Binary - Saturation 10
	Float Value =((Integer Value - 2047) / (2048)) * Scale * 10
	Example: 5.0 A stored as 3071 when Amp Scale 1:1
T14	Unsigned 16-Bit Integer - 12 Bit Offset Binary - Saturation 150
	Float Value =((Integer Value - 2047) / (2048)) * Scale * 150
	Example: 119.97 V stored as 3685 when Volt Scale 1:1
T15	Unsigned 16-Bit Integer - 12 Bit Offset Binary - Saturation 1000
	Float Value =((Integer Value - 2047) / (2048)) * Scale * 1000
	Example: -500 W stored as 1023 when Volt Scale = 1:1, Amp Scale = 1:1
T16	Unsigned 16-Bit Integer - 12 Bit Offset Binary - Saturation 3000
	Float Value =((Integer Value - 2047) / (2048)) * Scale * 3000
	Example: 349.10 kW stored as 3040 when Volt Scale = 6:1, Amp Scale = 40:1
T17	Unsigned 16-Bit Integer - 12 Bit Offset Binary - Saturation 15
	Float Value =((Integer Value - 2047) / (2048)) * Scale * 15
	Example: 11.79 A stored as 2369 when Amp Scale 5:1
T18	Unsigned 16-Bit Integer - 12 Bit Offset Binary -1 Decimal Place
	Float Value = ((Integer Value - 2047) / (10))
	Example: 121.4 degrees stored as 3261
T19	Unsigned 16-Bit Integer - 12 Bit Offset Binary -3 Decimal Place
	Float Value = ((Integer Value - 2047) / (1000))
	Example: 0.978 Power Factor stored as 3025
T20	Unsigned 16-Bit Integer - Bit Control/Status
	0' - stored as zero; '1' - stored as 65536
T21	Unsigned 16-Bit Integer - 3 Decimal Places
	Example: 54.321 stored as 54321
T22	Bit
	Example: 1-bit is set, 0-bit is clear
T23	Signed 16-Bit Integer – 2's complement – Saturation 300
	Float Value = ((Integer Value)/32768) * Scale * 300)
	Example: 207.846 V stored as 22702 when Volt Scale = 1:1
T24	Signed 16-Bit Integer – 2's Complement – 3 Decimal Places, offset by 60
	Float Value = (Integer Value)/1000) + 60.0)
	Example: 60.005Hz stored as 5
T25	Unsigned 16-Bit Integer - 12 Bit Offset Binary - Saturation 750

Type	Description
	Float Value =((Integer Value - 2047) / (2048)) * Scale * 750
	Example: 649.67 V stored as 3821 when Volt Scale 1:1
T26	Unsigned 16-Bit Integer - 12 Bit Offset Binary - Saturation 10000
	Float Value =((Integer Value - 2047) / (2048)) * Scale * 10000
	Example: -5000 W stored as 1023 when Volt Scale = 1:1. Amp Scale = 1:1

1.5 Configuration

1.5.1 Setting CT and VT Ratios

PPX II is capable of internally storing and recalling CT and VT ratios. The CT and VT ratios are configured through the Web interface or front panel, and are stored in non-volatile memory on the CT/VT section of the power supply board Each ratio is stored in two points, one for the Normalized Ratio and the other for the Ratio Divisor. Allowable constants for the normalized ratios are 1000 to 9999. The Ratio Divisors may be 1, 10, 100, or 1000 only. The number stored will be the high side rating of the CT Ratio or VT Ratio. Both a 500:5 ratio CT and a 100:1 CT will have a value of 100 stored. For example, to calculate a CT and VT ratio for Phase A from the data stored in the M650 meters, use the following equation:

$$Phase\ A\ CT_{RATIO} = \frac{Phase\ A\ CT\ Value(AO:21)}{Phase\ A\ CT\ \ Ratio\ Divisor\ (AO:22)}$$

$$Phase\ A\ VT_{RATIO} = \frac{Phase\ A\ VT\ Value(AO:05)}{Phase\ A\ VT\ \ Ratio\ Divisor\ (AO:06)}$$

PPX II calculate all measured quantities in secondary units (except energy), like other Bitronics instruments such as MultiComm and PowerPlex. The CT and VT ratio information is used to calculate the primary values.

In the event of a CT/VT Ratio Checksum Failure, the value in the Normalized CT Ratio and Normalized VT Ratio points default to 1000, and the value in the CT Ratio Divisor and VT Ratio Divisor default to 1000. This results in a 1:1 CT Ratio and 1:1 VT Ratio.

1.5.2 Resetting Energy and Demands

The Energy and Demand registers can be reset by issuing a *CONTROL RELAY OUTPUT BLOCK* to the appropriate BINARY OUTPUT.

Reset Functions
Reset Energy
Reset Demand Amps
Reset Demand Volts
Reset Demand Power

1.5.3 Tag Registers

The PPX II provides a "TAG" BINARY OUTPUT for user identification purposes. DNP sessions have an additional tag register (“Tag Register 1”). Tag registers are also writeable through the web interface.

1.6 Converting Data to Engineering Units

As mentioned in Section 1.5, the majority of the data is stored in a normalized 2's complement format. When displaying these values at another location, it may be desirable to convert this format into engineering units. This conversion is readily accomplished using the following simple scaling equations:

BASIC EQUATION FOR NORMALIZED ANALOG INPUTS:

$$Engineering\ Units = \frac{Value}{32768} \times Default\ Full\ Scale_{SECONDARY} \times \frac{Normalized\ Scale\ Factor}{Scale\ Factor\ Divisor}$$

The **Value** referred to in the equations would be the value stored in the point that you wished to convert to engineering units. For example if you wanted to convert Phase A Amperes into engineering units, Value would be the value in ANALOG-INPUT point.

ENERGY is stored as 32-BIT values in static COUNTER points. Energy values are in units of PRIMARY kWh or kVARh.

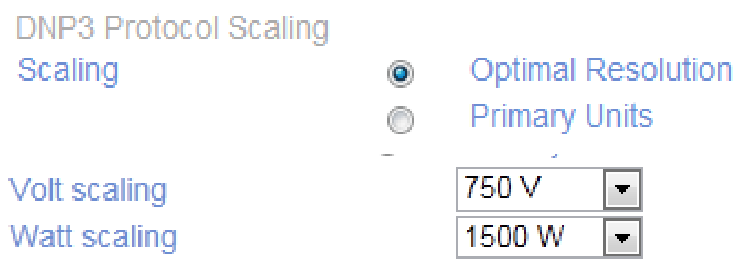
FREQUENCY is stored as a single binary value that is the actual frequency times 100.

POWER FACTOR is stored as the value times 1000. Negative power factors indicate that the VARs are positive. The sign of the Power Factor is the inversion of the Exclusive-OR of the Watts and VARs (i.e. if either or both of the Watts or VARs are negative, then the Power Factor will be negative).

When using Optimal Resolution mode, the user may choose the Full Scale values for Voltage and Power measurements. As with Primary Unit mode (see section 1.7 below), the selection causes a substitution of calculation types. As an example, using TUC (totally user configurable) to select bus two voltages, when 150V is used as the Full Scale value the calculation type T14 above applies resulting in the following:

001	RMS Volts A 2	B16_2S_150_M150
002	RMS Volts B 2	B16_2S_150_M150
003	RMS Volts C 2	B16_2S_150_M150

If 750V is chosen as the full scale value instead from the drop down in the web page (see screen shot below), then the calculation type T25 applies and the results are shown below:



001	RMS Volts A 2	B16_2S_750_M750
002	RMS Volts B 2	B16_2S_750_M750
003	RMS Volts C 2	B16_2S_750_M750

The table below summarizes the changes in calculation type that result when either the 750V or the 10000W full scale options are selected:

Default Optimal Resolution Calculation Type	**Replaced by 750V Full Scale Calculation Type**	**Replaced by 10000W Full Scale Calculation Type**
B16_2S_150_M150	B16_2S_750_M750	
B16_2S_300_M300	B16_2S_750_M750	
B16_2S_600_M600	B16_2S_750_M750	
B16_2S_1500_M1500		B16_2S_10000_M10000
B16_2S_4500_M4500		B16_2S_10000_M10000

3 and 2 ½ ELEMENT EQUATIONS (5Amp CTs):

$$AMPEREs_{(Inst, Fund, Demand, \mathrm{Max})} = \frac{Value}{32768} \; x \; 10^{*} \; x \; CT_{RATIO}$$

$$AMPEREs_{N\,(Inst, Fund, Demand, \mathrm{Max})} = \frac{Value}{32768} \; x \; 15^{*} \; x \; CT_{RATIO}$$

$$VOLTs_{L\text{-}N\,(Inst, Fund, Demand, \mathrm{Min}, \mathrm{Max})} = \frac{Value}{32768} \; x \; 150 \; x \; PT_{RATIO}$$

$$VOLTs_{L\text{-}L\,(Inst, Demand, \mathrm{Min}, \mathrm{Max})}(SCALED) = \frac{Value}{32768} \; x \; 150 \; x \; PT_{RATIO} \; x \; \sqrt{3}$$

$$WATTs\,(VARs)\,(VAs)_{TOTAL\,(Inst, Demand, \mathrm{Min}, \mathrm{Max})} = \frac{Value}{32768} \; x \; 4500^{*} \; x \; PT_{RATIO} \; x \; CT_{RATIO}$$

$$WATTs\,(VARs)\,(VAs)_{PER\ PHASE\,(Inst)} = \frac{Value}{32768} \; x \; 1500^{*} \; x \; PT_{RATIO} \; x \; CT_{RATIO}$$

$$FREQUENCY = \frac{Value}{100}$$

$$POWER\ FACTOR_{(True, Displacement)} = \frac{Value}{1000}$$

$$kWh\,(kVARh) = Value$$

$$THD, TDD_{(Amps, Volts, Inst, Demand, \mathrm{Max})} = \frac{Value}{10}$$

$$K\text{ - }Factor = \frac{Value}{100}$$

** For One Amp CT Option, divide this value by 5*

2 ELEMENT EQUATIONS (5Amp CTs) :

$$AMPEREs_{(Inst, Fund, Demand, \mathrm{Max})} = \frac{Value}{32768} \; x \; 10^{*} \; x \; CT_{RATIO}$$

$$VOLTs_{L\text{-}L\,(Inst, Demand, \mathrm{Min}, \mathrm{Max})} = \frac{Value}{32768} \; x \; 150 \; x \; PT_{RATIO}$$

$$WATTs\,(VARs)\,(VAs)_{TOTAL\,(Inst, Demand, \mathrm{Min}, \mathrm{Max})} = \frac{Value}{32768} \; x \; 3000^{*} \; x \; PT_{RATIO} \; x \; CT_{RATIO}$$

$$FREQUENCY = \frac{Value}{100}$$

$$POWER\ FACTOR_{(True, Displacement)} = \frac{Value}{1000}$$

$$kWh\,(kVARh) = Value$$

$$THD, TDD_{(Amps, Volts, Inst, Demand, \mathrm{Max})} = \frac{Value}{10}$$

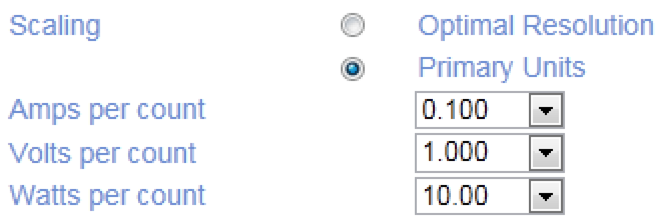
$$K\text{ - }Factor = \frac{Value}{100}$$

$$*\ For\ One\ Amp\ CT\ Option, divide\ this\ value\ by\ 5$$

The above equations provide answers in fundamental units (VOLTs, AMPs, WATTs, VARs, VAs and Hz). If the user desires other units such as KILOVOLTS, KILOWATTS or KILOVARS, the answers given by the equations should be divided by 1,000. If the user desires MEGAWATTS or MEGAVARS, the answers given by the equations should be divided by 1,000,000. Energy values are in units of kWh or kVARh.

1.7 Primary Units

An option exists to choose Primary Units instead of the pre-existing scaling mode, 'Optimal Resolution' adding the concept of 'scaling modes' to PPX II. The pre-existing scaling mode is called 'Optimal Resolution' on the basis that resolution of the protocols are optimized based on secondary full scale and therefore independent of CT and VT settings. The 'Primary Units' mode creates protocol values that include CT and VT settings, which requires the user to choose a scaling factor (in multiples of 10). The scaling factor must be selected such that it achieves the desired resolution and does not cause an overflow in the protocol value. The Scaling mode selection and the scaling factors are maintained separately for both Modbus and DNP and are configured on the Settings/Protocol webpage. Below is a screen shot and explanation of the Primary Units mode:



There are three new configurable parameters:

- Amps per count – APC
- Volts per count – VPC
- Watts per count - WPC

There are three new calculation types:

- Currents - B16_2S_PRIMARY_I
  $Measurement = Protocol\ Value * APC$
- Voltages - B16_2S_PRIMARY_V
  $Measurement = Protocol\ Value * VPC$
- Powers - B16_2S_PRIMARY_P
  $Measurement = Protocol\ Value * WPC$

When Primary Unit mode is selected, appropriate calculation types are substituted per the following table. This substitution occurs across all pre-defined and user configured register sets. Note, other calculation types are unaffected as they represent their values (such as Frequency, Power factor) in primary units even in Optimal Resolution mode. Also, since the 12-bit calculation types are not included in the substitution this means that the Modbus BiLF12 register set is not affected.

Modbus Manual	DNP Manual	Optimal Resolution Calculation Type	Replaced by Calculation Type	Note
T2	T2	B16_2S_10_M10	B16_2S_PRIMARY_I	
T3	T3	B16_2S_15_M15	B16_2S_PRIMARY_I	
T4	T4	B16_2S_150_M150	B16_2S_PRIMARY_V	
T23	T23	B16_2S_300_M300	B16_2S_PRIMARY_V	
na	na	B16_2S_600_M600	B16_2S_MULT_10	Power supply voltage
T5	T5	B16_2S_1500_M1500	B16_2S_PRIMARY_P	
T6	T6	B16_2S_4500_M4500	B16_2S_PRIMARY_P	

1.8 Data Sets and Data Types

The PPX II is shipped with a pre-defined set of data points and data types. These fixed points do not change. The List of Available Measurements may be found in the PPX II User Manual. The Ethernet port and web browser are required to create the configurable points list. See section 1.11 for more detail.

For users who wish to use PPX II on systems configured for other Bitronics products, a Legacy point list may be selected. This Legacy list cannot be modified, and will cause the PPX II to emulate the response of a Bitronics MultiComm or PowerPlex unit.

1.8.1 Configuring the Class-0 Response

The Class-0 request is a very short request to "give all essential data". Since the PPX II is capable of providing a significant amount of data, provisions have been made to tailor the response to this request. A web browser interfacing to the Ethernet service port is required to change the Class-0 response. The Legacy Class-0 response can also be configured.

When selecting a Legacy points list, the user will be prompted to enter a BiLF Class0 mask. The following table shows what bits must be set to get the legacy class0 response.
In Legacy mode, a zero BiLF Class0 mask returns a fairly small collection of points. As each bit is set, more points are added to the response.

BiLF Class0 Bitmask

Configuration Bit	Description		Objects
Always included in Class0 scan.	Resets	CLASS0 RESPONSE CONFIGURATION	BO:0-3
	Health, Volts, Amps, Watts, VARs, Frequency		AI:0-20
	Configuration Settings		AO:4, 6
Bit 0	Energy & Heartbeat (Counter Objects)		CT:0,1,2,3,4
Bit 1	Instantaneous VA & PF		AI:21 - AI:28
Bit 2	RMS Demands		AI:29 - AI:54
Bit 3	Maintenance Information		AI:55 - AI:58 AO:0-3, 10 – 14
Bit 14	Include all data in Class0 poll		Include all data in Class0 poll

1.8.2 Configuring Class-1, Class-2 and Class-3 Events

ANALOG INPUT points can be monitored for ANALOG CHANGE EVENTs by assigning the point to CLASS-1, CLASS-2, or CLASS-3.

ANALOG INPUT events are logged when a change in the input exceeds the DEADBAND associated with the point. DEADBANDs can be adjusted through the browser.

FROZEN COUNTERS can be assigned to CLASS-1, 2, or 3.

FROZEN COUNTER events are logged and enabled when a running counter is frozen.

BINARY INPUT events are logged and enabled whenever an enabled binary input changes state.

1.9 Health Check

The 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 (AO:00), 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. Contact the factory for further instructions.

A logical OR of the individual health check bits is available as a Binary input, with “0” indicating that all tests have passed, and “1” indicating that at least one test failed.

Health Check Error Codes	
Bit	Description
0	N/A (related to transducer output options not available in PPX II)
2	Checksum error on gain calibration of inputs
4	Checksum error on phase calibration of inputs
12	Indicates firmware download in progress and measurements are offline
15	Protocol configuration error

1.10 Heartbeat State Counter

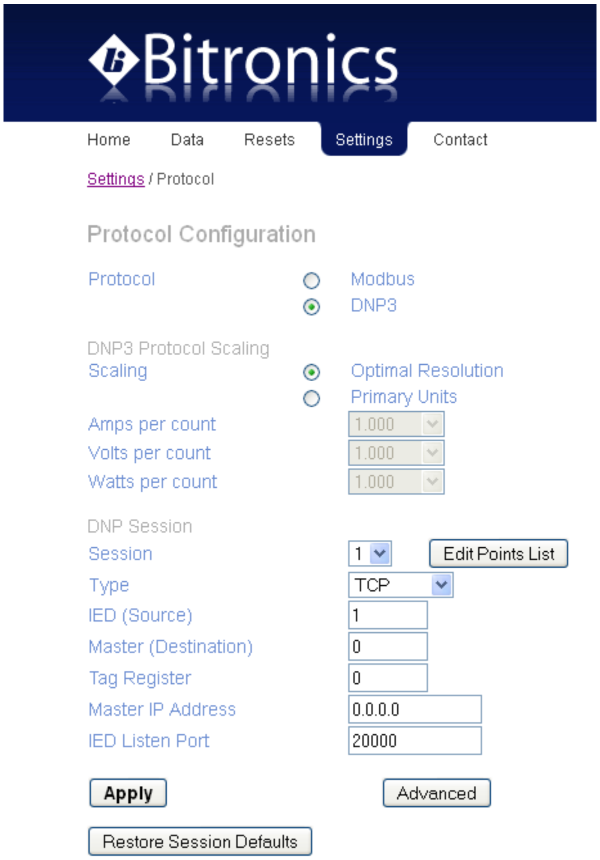
PPX II provides a Heartbeat State Counter Register that allows the user to determine the time between successive polls. This counter will increment by the number of milliseconds that have elapsed since the last time the data was updated. Another use of this register is as a visual indicator that the 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.

1.11 Meter ID Register

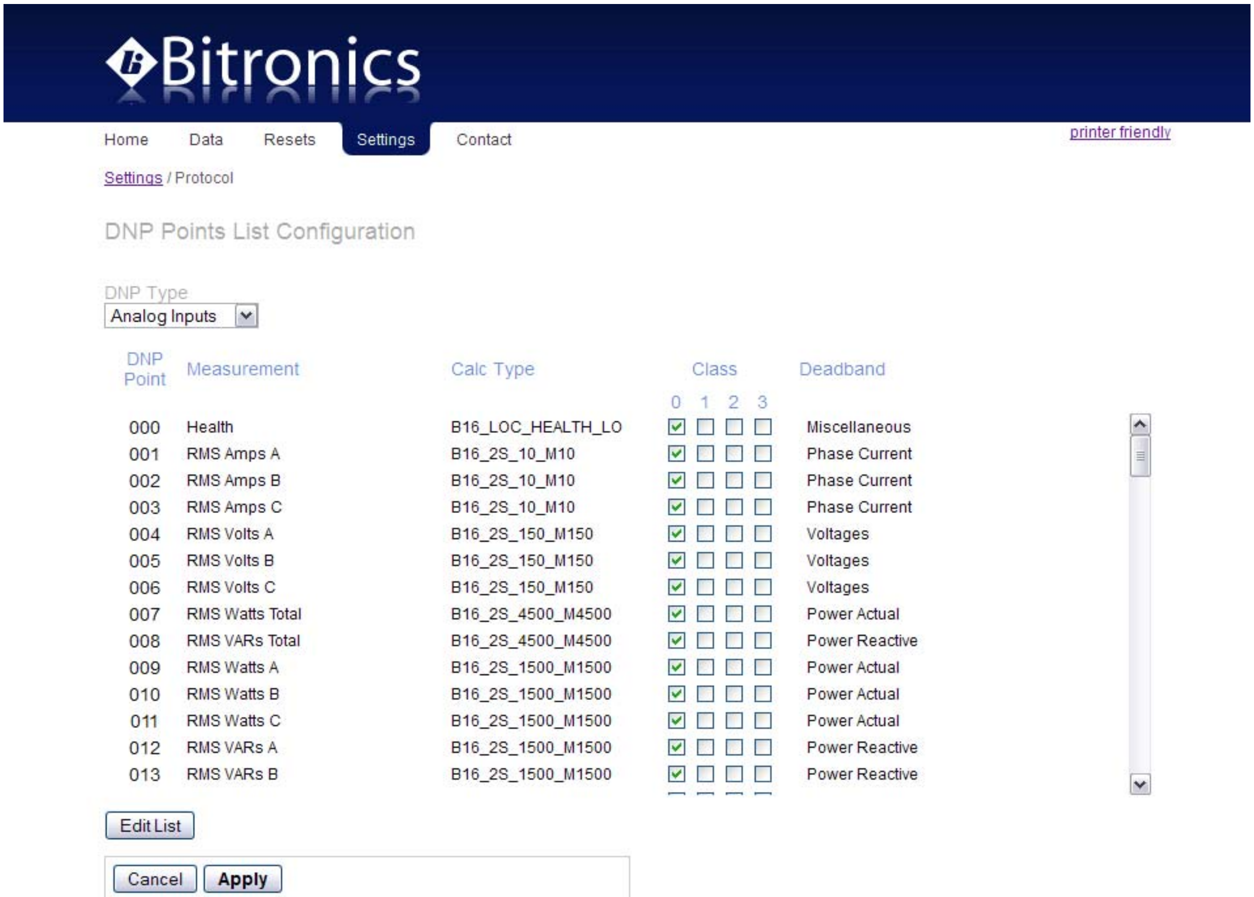
PPX II provides a "Meter Type ID" register for model identification purposes (AI:55) which returns a value of 600 (BiLF12 Modbus, BiLF DNP), 601 (BiLF16 Modbus), or 602 (TUC DNP/Modbus).

1.12 Custom Points Lists

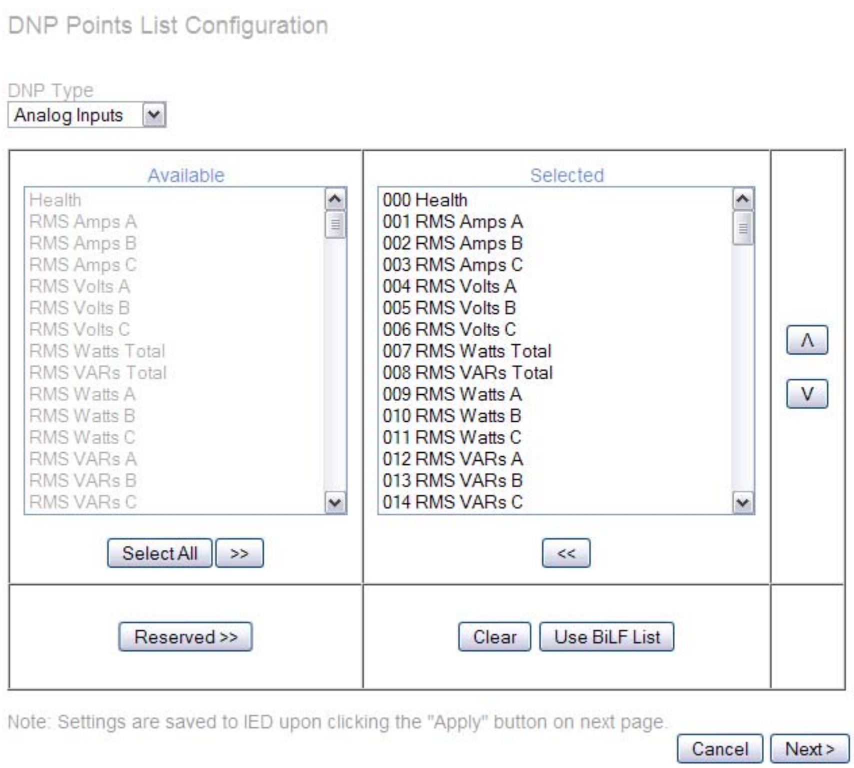
A custom points list can be defined for each DNP session. Select the session from the Session dropdown box and click the “Edit Points List” button to begin editing the selected session’s points list.



The DNP Points List Configuration summary page is displayed by object. Select the DNP object you would like to edit from the “DNP Type” dropdown box. The properties of the selected object appear in separate columns in the summary list.



Click on the “Edit List” button to modify the list.



All available measurements and data are displayed in the “Available” list in the left-hand pane. The present points list configuration is shown in the “Selected” list in the right-hand pane. Measurement and data items can be added to and removed from the “Selected” list using the buttons on the page:

- [Select All] – Highlights all measurement/data items in “Available” list
- [>>] – Places highlighted measurement/data items from “Available” list into the “Selected” list.
- [Reserved >>] – Places a “Reserved” placeholder item in the “Selected” list.
- [<<] – Removes highlighted items from the “Selected” list.
- [Λ] – Shifts highlighted items in the “Selected” list up by one point position.
- [V] – Shifts highlighted items in the “Selected” list down by one point position.
- [Clear] – Clears the “Selected” list for selected DNP Type.
- [Use BiLF List] – Replaces the entire “Selected” list with the standard BiLF points list. A “Class 0 Enable” can be entered to programmatically configure Class 0 for all items in the list (see BiLF Class0 Bitmask table in section 1.7.1 above).

NOTES

- ❖ Multiple items can be selected at once using the shift or control keys.
- ❖ Any item that appears in the “Selected” list appears gray in the “Available” list.
- ❖ The same data item can be used in multiple different points.
- ❖ Items added to the “Selected” list will be placed *above* the first highlighted item.
- ❖ If no items are highlighted in the “Selected” list, items are added to the end of the list.

2.0 DNP PROTOCOL

2.1 Introduction

DNP3 (Distributed Network Protocol) is an open standard that was designed by Harris Controls Division and then placed in the public domain. DNP defines a command-response method of communicating digital information between a master and slave device. The electrical connection between devices is known as a bus. In DNP, two types of devices attach to the bus: one master and one or more slave devices. A master device issues commands to slaves. A slave device, such as a PPX II, issues responses to master commands that are addressed to them. Each bus must contain exactly one master and may contain as many slaves as the electrical standards permit. DNP over TCP creates one logical “bus” per connection providing a TCP tunnel for DNP data. *NOTE: Much of the following information is general in nature and does not apply to the PPX II since it does not have a serial port. It has been left in as general information.*

All devices on a bus must operate according to the same electrical standards (i.e. all must be RS-232C or all must be RS-485). RS-232C standards specify that only two devices may be connected to a bus (i.e. only one slave is allowed). RS-485 specifications allow up to 32 devices (31 slaves) on a bus.

Detailed information regarding DNP3 is available in a document titled "Basic 8 Document Set" which can be obtained from the DNP Users Group. The remainder of this chapter provides a brief overview of the protocol as implemented in the PPX II.

2.2 Overall Protocol Structure

DNP is a 3-layer protocol based upon the standard IEC 870-5 (Telecontrol Equipment and Systems - Transmission Protocols). The three layers comprise the Enhanced Performance Architecture (EPA) and is a subset of the more familiar ISO-OSI 7-layer protocol. The three layers are the physical, data link, and application layers. The physical layer is responsible for transmission of raw 8-bit bytes (octets) across the network medium. The data link layer is responsible for reliably maintaining connectivity between two devices. The application layer defines standardized messages that flow between devices. DNP further defines an extra layer known as the transport layer that allows long messages to be broken down into smaller pieces.

2.3 DNP Request/Response Overview

The PPX II DNP implementation supports a wide variety of messages. The most general method to extract information from a PPX II is to issue a **READ CLASS-0** request. DNP devices respond with the points configured to be returned in the Class-0 response. See Section 1.7.1 for more details on Class-0 configuration. This allows the MASTER to quickly retrieve important data from the instrument and determine whether the output points are online (i.e. whether energy/demand resets or ratio setup requests can be honored). A PPX II also allows READs of individual objects specifying all points (variation 6) or individual points (other variations). PPX II executes the energy clear function and demand resets using the **DIRECT OPERATE**, **DIRECT OPERATE NO ACKNOWLEDGE**, or **SELECT BEFORE OPERATE** functions to the *CONTROL RELAY OUTPUT BLOCK* object points. Tag registers writes are made via **DIRECT OPERATE**, **DIRECT OPERATE NO ACKNOWLEDGE**, or **SELECT BEFORE OPERATE** to the *ANALOG OUTPUT*

BLOCK object points. Configuration setups are also made via the **DIRECT OPERATE**, **DIRECT OPERATE NO ACKNOWLEDGE**, or **SELECT BEFORE OPERATE** object. The DNP function code WRITE is also supported by the PPX II.

A PPX II will attempt to respond with the same object variation and qualifier as in the request. Exceptions to this rule include class scans, read all points (var 6), and events. These responses use the default variations configured for each session through the web browser.

3.0 DNP3 OVER ETHERNET (TCP)

If the PPX II has the Ethernet SCADA protocols option, then it will respond to DNP3 commands via TCP. The PPX II can support either DNP3 or Modbus, and HTML protocols over the Ethernet link. The table below lists the default port assignments for all Ethernet based protocols supported by the PPX II.

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

3.1 DNP/IP

The DNP/IP (DNP Over TCP/IP) interface allows up to 3 DNP Masters to communicate with the PPX II. Each remote IP Master may communicate with the PPX II via TCP. If multiple Masters share an IP address, each Master must connect to a unique IED Listen port

For each protocol session, the Master IP address and the IED Listen Port number may be specified. The current Settings for each session can be viewed or changed from the web browser. Use the Settings tab to navigate to the Protocol Configuration page. A radio button selects the protocol. If the Master IP address is set to 0.0.0.0 a Master connection will be accepted from any IP address. The default IED listen port number for DNP3 is 20000 (see table above).

After establishment of a TCP connection from a DNP Client, the PPX II can verify contact by periodically sending REQUEST LINK STATUS messages. This period is configured using each DNP Session's "Link Status Period" parameter (default is 300 seconds).

See appendix B for DNP configuration parameters.

4.0 DNP3 EVENTS OVERVIEW

DNP3 provides for a method of reporting data only when it may be of interest to the application. This can significantly reduce the network bandwidth required by eliminating the redundant polling of data and only polling data when it changes enough to be consider relevant, generating an event.

Events are pre-assigned to one of three CLASSes, (CLASS-1, CLASS-2, or CLASS-3). When an event occurs, the data point and OBJECT type are placed in a buffer and the event's specific CLASS BIT (BIT1, BIT2, or BIT3 of the first IIN octet) is set in the IED's Internal Indications (IIN) field. DNP3 master devices monitor the IIN bits and will issue a specific CLASS-1, CLASS-2, or CLASS-3 poll when the respective CLASS IIN bit is set. The IED will respond to the specific CLASS poll with all data buffered for the CLASS requested and than clear the associated CLASS IIN bit.

PPX II supports 3 types of DNP events:

1.) Analog Input Events, which are triggered when a change in the corresponding Analog Inputs exceed the Analog Input group deadband. The deadband group values are set in the session's advanced section.
2.) Frozen Counter Events, which are triggered by any freeze of an enabled running counter.
3.) Binary Input Events, which are triggered by any change of an enabled binary input point.

Each of the three DNP sessions has storage for 200 Analog Input Events, 100 Frozen Counter Events, and 20 Binary Input events.

Events can be reported in two modes: thru master polling and Unsolicited Responses. A session can be configured to generate an Unsolicited Response when event timing and count criteria have been satisfied. A connection (serial or TCP/IP socket) must exist for Unsolicited Responses to be reported. Connection continuity can be monitored using Link Status Period described in 3.1.

4.1 ANALOG CHANGE EVENTS

ANALOG CHANGE events occur when an ANALOG INPUT that is assigned to CLASS-1, CLASS-2, or CLASS-3 changes by more than its configured DEADBAND value since the last event. Once the ANALOG INPUT's value changes by more than the configured DEADBAND, the specific ANALOG INPUT point number and the new value are placed in the ANALOG CHANGE EVENT BUFFER as an ANALOG CHANGE EVENT. The M650 meters can be configured to report The ANALOG CHANGE EVENT Data Object in one of two Variations, either 16-BIT ANALOG CHANGE EVENT WITHOUT TIME (object 32, variation 2) or 16-BIT ANALOG CHANGE EVENT WITH TIME (object 32, variation 4). All ANALOG CHANGE EVENTS will be reported with the same configured VARIATION. The default ANALOG CHANGE EVENT variation (with or without time) can be set using a web browser. The browser is also used to set the DEADBAND value for each configured ANALOG CHANGE EVENT.

4.2 FROZEN COUNTER EVENTS

PPX II supports the DNP3 FROZEN COUNTER Object. Each DNP3 BINARY COUNTER (OBJECT 20) Point configured will automatically have an associated FROZEN COUNTER (OBJECT 21) Point configured. The BINARY COUNTER and its associated FROZEN COUNTER will have the same point number (FROZEN COUNTER Point ‘0’ will contain the value frozen from BINARY COUNTER Point ‘0’).

PPX II will support the IMMEDIATE FREEZE (FC-07), IMMEDIATE FREEZE – NO ACKNOWLEDGEMENT (FC-08), FREEZE AND CLEAR (FC-09), and FREEZE AND CLEAR – NO ACKNOWLEDGEMENT (FC-10) Function Codes. Freeze commands and FROZEN COUNTERS can use any of the same QUALIFIERS and VARIATIONS as the BINARY COUNTERS.

Each DNP3 master communication session will have its own unique set of FROZEN COUNTERs. Once a DNP3 master initiates communication with the PPX II, a communications session is established. This communication session allocates a dedicated set of FROZEN COUNTERs specifically for the new DNP3 master. When the DNP3 master issues a FREEZE or FREEZE AND CLEAR command, only the FROZEN COUNTERs allocated for that DNP3 master are frozen (and cleared depending on the command). This allows multiple masters to maintain their own FROZEN COUNTERS and prevents one DNP3 master from inadvertently clearing another DNP3 master’s counter(s).

All FROZEN COUNTERs are volatile. As previously mentioned, the FROZEN COUNTERs are initialized to zero at start up. Any FROZEN COUNTERS that are part of a re-started communication session are initialed to zero as well. Any values frozen but not read prior to the PPX II restarting or that were not read prior to the communication session closing are lost. BINARY COUNTERs are also resynchronized with the energy measurement values at system start up and session start up.

4.3 BINARY INPUT CHANGE EVENTS

BINARY INPUT CHANGE events can be generated by the PPX II BINARY INPUT. This input is the OR of the individual HEALTH STATUS bits defined in 1.9 Health Check.

APPENDIX A BITRONICS LEGACY DNP3 POINT ASSIGNMENTS

Bitronics Legacy DNP3 Point Assignments											
DNP Point		Contents	Data	Scale	Ind	Values/Dependencies	Type	Min	Max	Step	Class 0
AI:00		Health 0	T1		Bit-0	Non zero = Error	Data	0-Norm	1-Fail	1	Always
					Bit-1	Non zero = Error					
					Bit-2	Non zero = Error					
					Bit-3	Non zero = Error					
					Bit-4	Non zero = Error					
					Bit-5	Non zero = Error					
					Bit-6	Non zero = Error					
					Bit-7	Non zero = Error					
					Bit-8	Non zero = Error					
					Bit-9	Non zero = Error					
					Bit-10	Non zero = Error					
					Bit-11	Non zero = Error					
					Bit-12	Non zero = Error					
					Bit-13	Non zero = Error					
					Bit-14	Non zero = Error					
					Bit-15	Non zero = Error					
AI:01		Amps A	T2	Amp Scale			Data	0	32767	((1/32768) * 10 * Amp Scale) A	Always
AI:02		Amps B	T2	Amp Scale			Data	0	32767	((1/32768) * 10 * Amp Scale) A	Always
AI:03		Amps C	T2	Amp Scale			Data	0	32767	((1/32768) * 10 * Amp Scale) A	Always
AI:04		Volts A	T4	Volt Scale			Data	0	32767	((1/32768) * 150 * Volt Scale) V	Always
AI:05		Volts B	T4	Volt Scale			Data	0	32767	((1/32768) * 150 * Volt Scale) V	Always
AI:06		Volts C	T4	Volt Scale			Data	0	32767	((1/32768) * 150 * Volt Scale) V	Always
AI:07		Watts Total	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 4500 * Amp Scale * Volt Scale) W	Always
AI:08		VARs Total	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 4500 * Amp Scale * Volt Scale) vars	Always
AI:09		Watts A	T5	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) W	Always
AI:10		Watts B	T5	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) W	Always
AI:11		Watts C	T5	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) W	Always
AI:12		VARs A	T5	Amp Scale * Volt			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) vars	Always

Bitronics Legacy DNP3 Point Assignments											
DNP Point		Contents	Data	Scale	Ind	Values/Dependencies	Type	Min	Max	Step	Class 0
				Scale							
AI:13		VARs B	T5	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) vars	Always
AI:14		VARs C	T5	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) vars	Always
AO:00		CT Value	T10				Data	1000	9999	1	3
AO:01		CT Ratio Divisor	T11				Setting	1	1000	Multiply by 10 (valid values are 1,10,100,1000)	3
AO:02		PT Value	T10				Data	1000	9999	1	3
AO:03		VT Ratio Divisor	T11				Setting	1	1000	Multiply by 10 (valid values are 1,10,100,1000)	3
AI:19		Amps Residual	T3	Amp Scale			Data	0	32767	((1/32768) * 15 * Amp Scale) A	Always
CT:0		Watt-Hrs Normal (High Word)	T1				Data	0	65536	65536 KiloWattHours	0
CT:1		Watt-Hrs Reverse (High Word)	T1				Data	0	65536	65536 KiloWattHours	0
CT:2		VAR-Hrs Lag (High Word)	T1				Data	0	65536	65536 KilovarHours	0
CT:3		VAR-Hrs Lead (High Word)	T1				Data	0	65536	65536 KilovarHours	0
AI:20		System Frequency	T8				Data	2000	8000	0.01 Hz	Always
AI:64		Reserved	T4	Volt Scale			Data	0	32767	((1/32768) * 150 * Volt Scale) V	Never
AI:71		Reserved	T9				Data	-1800	1800	0.1 Degrees	Never
AI:70		Reserved	T8				Data	2000	8000	0.001 Hz	Never
CT:4		Heart Beat	T1				Data	0	4,294,967,295	1 msec	0
AI:21		VAs A	T5	Amp Scale * Volt Scale			Data	0	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VAs	1
AI:22		VAs B	T5	Amp Scale * Volt Scale			Data	0	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VAs	1
AI:23		VAs C	T5	Amp Scale * Volt Scale			Data	0	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VAs	1
AI:24		VAs Tot. Geom	T6	Amp Scale * Volt Scale			Data	0	32767	((1/32768) * 4500 * Amp Scale * Volt Scale) VAs	1
AI:25		Power Factor A	T7				Data	-1000	1000	0.001	1
AI:26		Power Factor B	T7				Data	-1000	1000	0.001	1
AI:27		Power Factor C	T7				Data	-1000	1000	0.001	1
AI:28		Power Factor Tot. Geom	T7				Data	-1000	1000	0.001	1
AI:15		Amp Scale Factor	T10				Setting	1000	9999	1	Always
AI:16		Amp Scale Factor Divisor	T11				Setting	1	1000	Multiply by 10 (valid values are 1,10,100,1000)	Always

Bitronics Legacy DNP3 Point Assignments

DNP Point		Contents	Data	Scale	Ind	Values/Dependencies	Type	Min	Max	Step	Class 0
AI:17		Volt Scale Factor	T10				Setting	1000	9999	1	Always
AI:18		Volt Scale Factor Divisor	T11				Setting	1	1000	Multiply by 10 (valid values are 1,10,100,1000)	Always
AI:29		Demand Amps A	T2	Amp Scale			Data	0	32767	((1/32768) * 10 * Amp Scale) A	2
AI:30		Demand Amps B	T2	Amp Scale			Data	0	32767	((1/32768) * 10 * Amp Scale) A	2
AI:31		Demand Amps C	T2	Amp Scale			Data	0	32767	((1/32768) * 10 * Amp Scale) A	2
AI:32		Demand (Max) Amps A	T2	Amp Scale			Data	0	32767	((1/32768) * 10 * Amp Scale) A	2
AI:33		Demand (Max) Amps B	T2	Amp Scale			Data	0	32767	((1/32768) * 10 * Amp Scale) A	2
AI:34		Demand (Max) Amps C	T2	Amp Scale			Data	0	32767	((1/32768) * 10 * Amp Scale) A	2
AI:35		Demand Amps Residual	T3	Amp Scale			Data	0	32767	((1/32768) * 15 * Amp Scale) A	2
AI:36		Demand (Max) Amps Residual	T3	Amp Scale			Data	0	32767	((1/32768) * 15 * Amp Scale) A	2
AI:37		Demand Volts A	T4	Volt Scale			Data	0	32767	((1/32768) * 150 * Volt Scale) V	2
AI:38		Demand Volts B	T4	Volt Scale			Data	0	32767	((1/32768) * 150 * Volt Scale) V	2
AI:39		Demand Volts C	T4	Volt Scale			Data	0	32767	((1/32768) * 150 * Volt Scale) V	2
AI:40		Demand (Max) Volts A	T4	Volt Scale			Data	0	32767	((1/32768) * 150 * Volt Scale) V	2
AI:41		Demand (Max) Volts B	T4	Volt Scale			Data	0	32767	((1/32768) * 150 * Volt Scale) V	2
AI:42		Demand (Max) Volts C	T4	Volt Scale			Data	0	32767	((1/32768) * 150 * Volt Scale) V	2
AI:43		Demand (Min) Volts A	T4	Volt Scale			Data	0	32767	((1/32768) * 150 * Volt Scale) V	2
AI:44		Demand (Min) Volts B	T4	Volt Scale			Data	0	32767	((1/32768) * 150 * Volt Scale) V	2
AI:45		Demand (Min) Volts C	T4	Volt Scale			Data	0	32767	((1/32768) * 150 * Volt Scale) V	2
AI:46		Demand Watts Total	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 4500 * Amp Scale * Volt Scale) W	2
AI:47		Demand (Max) Watts Total	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 4500 * Amp Scale * Volt Scale) W	2
AI:48		Demand (Min) Watts Total	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 4500 * Amp Scale * Volt Scale) W	2
AI:49		Demand VARs Total	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 4500 * Amp Scale * Volt Scale) vars	2
AI:50		Demand (Max) VARs Total	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 4500 * Amp Scale * Volt Scale) vars	2
AI:51		Demand (Min) VARs Total	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 4500 * Amp Scale * Volt Scale) vars	2
AI:52		Demand VAs Total	T6	Amp Scale * Volt Scale			Data	0	32767	((1/32768) * 4500 * Amp Scale * Volt Scale) VAs	2
AI:53		Demand (Max) VAs Total	T6	Amp Scale * Volt Scale			Data	0	32767	((1/32768) * 4500 * Amp Scale * Volt Scale) VAs	2
AI:54		Demand (Min) VAs Total	T6	Amp Scale * Volt Scale			Data	0	32767	((1/32768) * 4500 * Amp Scale * Volt Scale) VAs	2
AI:55		Meter Type	T1		600	Legacy points list	Data	600	602	0	3

Bitronics Legacy DNP3 Point Assignments										
DNP Point	Contents	Data	Scale	Ind	Values/Dependencies	Type	Min	Max	Step	Class 0
AI:56	Protocol Version	T21				Data	0	65536	0.001	3
AI:57	Factory Version Software	T21				Data	0	65536	0.001	3
AI:58	Reserved	T21				Data	0	65536	0.001	3
AI:59	Volts N-G	T4	Volt Scale			Data	0	32767	((1/32768) * 150 * Volt Scale) V	Never
AI:60	Volts A-B	T23	Volt Scale			Data	0	32767	((1/32768) * 300 * Volt Scale) V	Never
AI:61	Volts B-C	T23	Volt Scale			Data	0	32767	((1/32768) * 300 * Volt Scale) V	Never
AI:62	Volts C-A	T23	Volt Scale			Data	0	32767	((1/32768) * 300 * Volt Scale) V	Never
AI:63	System Frequency (1mHz)	T24				Data	-32768	32767	0.001Hz	Never
AI:65	Reserved	T4	Volt Scale			Data	0	32767	((1/32768) * 150 * Volt Scale) V	Never
AI:66	Reserved	T4	Volt Scale			Data	0	32767	((1/32768) * 150 * Volt Scale) V	Never
AI:67	Reserved	T4	Volt Scale			Data	0	32767	((1/32768) * 150 * Volt Scale) V	Never
AI:68	Reserved	T4	Volt Scale			Data	0	32767	((1/32768) * 150 * Volt Scale) V	Never
AI:69	Reserved	T4	Volt Scale			Data	0	32767	((1/32768) * 150 * Volt Scale) V	Never
AO:04	BiLF Class 0 Mask	T1				Setting	0	65536	1	Always
AO:06	Tag Register	T1				Setting	0	65536	1	Always
BO:00	Reset Energy	T22		0	Normal	Setting	0	1	1	Always
				1	Reset Energy Counters					
BO:01	Reset Demand Amps	T22		0	Normal	Setting	0	1	1	Always
				1	Reset Amp Demands					
BO:02	Reset Demand Volts	T22		0	Normal	Setting	0	1	1	Always
				1	Reset Volt Demands					
BO:03	Reset Demand Power	T22		0	Normal	Setting	0	1	1	Always
				1	Reset Power Demands					
AI:72	Demand Volts AB	T23	Volt Scale			Data	0	32767	(1/32768) * 300 * Volt Scale) V	Never
AI:73	Demand Volts BC	T23	Volt Scale			Data	0	32767	(1/32768) * 300 * Volt Scale) V	Never
AI:74	Demand Volts CA	T23	Volt Scale			Data	0	32767	(1/32768) * 300 * Volt Scale) V	Never
AI:75	Demand (Max) Volts AB	T23	Volt Scale			Data	0	32767	(1/32768) * 300 * Volt Scale) V	Never
AI:76	Demand (Max) Volts BC	T23	Volt Scale			Data	0	32767	(1/32768) * 300 * Volt Scale) V	Never

Bitronics Legacy DNP3 Point Assignments

DNP Point		Contents	Data	Scale	Ind	Values/Dependencies	Type	Min	Max	Step	Class 0
AI:77		Demand (Max) Volts CA	T23	Volt Scale			Data	0	32767	(1/32768) * 300 * Volt Scale) V	Never
AI:78		Demand (Min) Volts AB	T23	Volt Scale			Data	0	32767	(1/32768) * 300 * Volt Scale) V	Never
AI:79		Demand (Min) Volts BC	T23	Volt Scale			Data	0	32767	(1/32768) * 300 * Volt Scale) V	Never
AI:80		Demand (Min) Volts CA	T23	Volt Scale			Data	0	32767	(1/32768) * 300 * Volt Scale) V	Never
AI:81		Volts Aux	T4				Data	0	32767	((1/32768) * 600) V	Never
AI:82		Watt-Hours Net (Signed)	T1				Data	0	65536	65536 KiloWattHours	Never
AI:83		VA-Hours	T1				Data	0	65536	65536 KiloVAHours	Never
AI:84		Max Average Watts A	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) W	Never
AI:85		Max Average Watts B	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) W	Never
AI:86		Max Average Watts C	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) W	Never
AI:87		Max Average VARs A	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VARs	Never
AI:88		Max Average VARs B	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VARs	Never
AI:89		Max Average VARs C	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VARs	Never
AI:90		Max Average VAs A	T6	Amp Scale * Volt Scale			Data	0	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VAs	Never
AI:91		Max Average VAs B	T6	Amp Scale * Volt Scale			Data	0	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VAs	Never
AI:92		Max Average VAs C	T6	Amp Scale * Volt Scale			Data	0	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VAs	Never
AI:93		Average Watts A	T5	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) W	Never
AI:94		Average Watts B	T5	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) W	Never
AI:95		Average Watts C	T5	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) W	Never
AI:96		Average VARs A	T5	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VARs	Never

Bitronics Legacy DNP3 Point Assignments											
DNP Point		**Contents**	**Data**	**Scale**	**Ind**	**Values/Dependencies**	**Type**	**Min**	**Max**	**Step**	**Class 0**
AI:97		Average VARs A	T5	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VARs	Never
AI:98		Average VARs A	T5	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VARs	Never
AI:99		Average VAs A	T6	Amp Scale * Volt Scale			Data	0	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VAs	Never
AI:100		Average VAs B	T6	Amp Scale * Volt Scale			Data	0	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VAs	Never
AI:101		Average VAs C	T6	Amp Scale * Volt Scale			Data	0	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VAs	Never
AI:102		Min Average Watts A	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) W	Never
AI:103		Min Average Watts B	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) W	Never
AI:104		Min Average Watts C	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) W	Never
AI:105		Min Average VARs A	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VARs	Never
AI:106		Min Average VARs B	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VARs	Never
AI:107		Min Average VARs C	T6	Amp Scale * Volt Scale			Data	-32768	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VARs	Never
AI:108		Min Average VAs A	T6	Amp Scale * Volt Scale			Data	0	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VAs	Never
AI:109		Min Average VAs B	T6	Amp Scale * Volt Scale			Data	0	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VAs	Never
AI:110		Min Average VAs C	T6	Amp Scale * Volt Scale			Data	0	32767	((1/32768) * 1500 * Amp Scale * Volt Scale) VAs	Never

When connected to 2 Element (DELTA or 3-wire) systems, the Per-Element quantities may have no direct physical meaning. All points are available in M650/M651 (although some don't apply to B3). Points available in M350 A3 or V3 are indicated under Meter.

APPENDIX B DNP3 CONFIGURATION PARAMETERS

Configuration Parameter	Description	Default or Options
DNP Session		
Session	The number of the session you are configuring	Option of 1, 2, or 3
Type	The session type	Option Serial, TCP, or UDP
IED (Source)	The source address for the selected session	Default is 1
Master (Destination)	The destination address for the selected session. If Validate Source Address (see below) is selected, this will be the address to compare the master's source address to. If Validate Source Address is not selected, this address will be used as the address to send unsolicited responses. All other responses will be sent to the source address received from the master.	Default is 0
Tag Register	Location of the tag register	0 to 65535
Tag Register 1	Secondary tag registrer	0 to 65535
Link Status Period (Seconds)	How often to send link status requests if no DNP3 frames have been received on this session. In DNP3 IP Networking spec this is called keep-alive interval.	Default is 300 seconds
Validate Source Address	Specify whether or not to validate source address in received frames. DNP3 frames contain both a source address field and a destination address field. If the box is not checked, DNP3 does not validate the source address and frames whose destination address matches a configured slave session will be accepted. Setting this to TRUE (checking the box) requires both source and destination addresses to match a local slave session before the frame is accepted.	Default is box unchecked (disabled). Checking the box enables the function.
Enable Self Address	Specify whether or not to enable self address functionality on this slave device as specified by DNP Technical Bulletin 2003-003 Self-Address Reservation. Slave will respond to address 0xfffc as though it received a request for its configured address. It will respond with its own address so the master can automatically discover the slave address	Default is false (box not checked), checking the box enables this function.
Delete Oldest Event	Selects whether or not the oldest event is deleted when a session's event buffer overflows (setting BUFFER OVERFLOW IIN)	Default is box unchecked, checking the box enables this function.
Allow Resets	Selects whether resets are allowed	Default is box checked. Unchecking the box disables the function.

Configuration Parameter	Description	Default or Options
Allow Time Set	Selects whether time set is allowed	Default is box checked. Unchecking the box disables the function.
Set Needtime IIN	Specifies whether this device will set the Need Time IIN bit in response to this session at startup and after the clock valid period has elapsed. If this bit is set the slave will request time synchronization from the master by setting the Need Time IIN bit in responses. Typically this parameter should be true for one session for each slave device. Set this parameter to FALSE (box unchecked) if report by exception is not supported or there is no reason this device needs to be synchronized from the master.	Default is box checked. Unchecking the box disables the function.
Deadbands		
Phase Current	In Optimal Resolution mode, deadbands are in percents with a minimum value of .01%. In Primary Units mode, deadbands are in per count integers.	1.00%
Neutral Current	In Optimal Resolution mode, deadbands are in percents with a minimum value of .01%. In Primary Units mode, deadbands are in per count integers.	.10%
Voltages	In Optimal Resolution mode, deadbands are in percents with a minimum value of .01%. In Primary Units mode, deadbands are in per count integers.	1.00%
Power Reactive	In Optimal Resolution mode, deadbands are in percents with a minimum value of .01%. In Primary Units mode, deadbands are in per count integers.	1.00%
Power Actual	In Optimal Resolution mode, deadbands are in percents with a minimum value of .01%. In Primary Units mode, deadbands are in per count integers.	1.00%
Frequency	In Optimal Resolution mode, deadbands are in percents with a minimum value of .01%. In Primary Units mode, deadbands are in per count integers.	1.00%
Miscellaneous	In Optimal Resolution mode, deadbands are in percents with a minimum value of .01%. In Primary Units mode, deadbands are in per count integers.	1.00%
Timeouts		
Needtime (minutes)	Specifies how long (in minutes) the local clock will remain valid after receiving a time synchronization.	Default is 30 minutes.
Application Confirm (ms)	Application confirm timeout specifies how long the slave DNP device will wait for an application layer confirmation from the master. This, in combination with unsolicited Retry Timeout or unsolicited Offline Timeout, will determine how frequently an unsolicited response will be resent.	Default is 10 seconds
Select (ms)	Select Timeout specifies the maximum amount of time that a select will remain valid before the corresponding operate is received. If an operate request is received after this period has elapsed,	Default is 5 seconds

Configuration Parameter	Description	Default or Options
	the operate request will fail.	
Unsolicited Response		
UR Enable	Determines whether unsolicited responses are allowed. If unsolicited Response Enable is FALSE, no unsolicited responses will be generated and requests to enable or disable unsolicited responses will fail.	Default is box unchecked, checking the box enables this function.
Enable Initial Null	Determines whether unsolicited null responses will be sent when session comes online. Specs say send initial unsolicited null response on restart. Previous versions of SCL would also send unsolicited null response when a session came back online. Add this configuration to allow user to maintain that behavior by setting this to TRUE if desired.	Default is box unchecked, checking the box enables this function.
Class1 Count	When unsolicited response is enabled, the maximum number of events that are stored before an unsolicited response is generated.	Default is 5, maximum is 255.
Class1 Timeout (ms)	When unsolicited response is enabled, the maximum amount of time (in ms) after an event before an unsolicited response is generated.	Default is 5000 ms
Class2 Count	When unsolicited response is enabled, the maximum number of events that are stored before an unsolicited response is generated.	Default is 5, maximum is 255.
Class2 Timeout (ms)	When unsolicited response is enabled, the maximum amount of time (in ms) after an event before an unsolicited response is generated.	Default is 5000 ms
Class3 Count	When unsolicited response is enabled, the maximum number of events that are stored before an unsolicited response is generated.	Default is 5, maximum is 255.
Class3 Timeout (ms)	When unsolicited response is enabled, the maximum amount of time (in ms) after an event before an unsolicited response is generated.	Default is 5000 ms
Max Retries	The maximum number of unsolicited retries before changing to the 'Offline Timeout' period described below. This parameter allows you to specify up to 65535 retries. If you want an infinite number of retries set Offline Timeout to the same value as Retry Timeout.	Default is 3
Retry Timeout (ms)	Specifies the time, in milliseconds, to delay after an unsolicited confirm timeout before retrying the unsolicited response.	Default is 5000 ms
Offline Timeout (seconds)	Specifies the time, in seconds, to delay after an unsolicited timeout before retrying the unsolicited response after the Max Retries listed above have been attempted. To disable retries after Max Retries set this value to the maximum value of 65535.	Default is 30 seconds
Default Variations	Specifies the variation that will be used for unsolicited responses and in response to a read	

Configuration Parameter	Description	Default or Options
	requesting variation 0.	
Binary Input		With flags
Binary Input Event		With absolute time
Binary Output		Output status with flags
Counter		32-bit without flag
Frozen Counter		32-bit without flag
Counter Event		32-bit with flag
Frozen Counter Event		32-bit with flag
Analog Input		16-bit without flag
Analog Input Event		16-bit without time
Analog Output Status		16-bit with flag
Transmit/Receive		
Receive Fragment Size	Maximum receive fragment size.	Default is 2048 (max)
Transmit Fragment Size	Maximum transmit fragment size.	Default is 2048 (max)
Receive Frame Size	Receive link layer frame size. This includes room for link header and CRCs	Default is 292 (max)
Transmit Frame Size	Transmit link layer frame size. This includes room for link header and CRCs	Default is 292 (max)
Receive Frame Timeout (ms)	Maximum amount of time (ms) to wait for a complete frame after receiving valid frame sync characters	Default is 15,000 milliseconds
First Character Timeout (ms)	Minimum time, in milliseconds, after receiving a character before we will attempt to transmit a character on this channel. This is generally useful when using a modem or some other communication device that requires a minimum time between receive and transmit.	Default is 0 milliseconds
Link Confirm Mode	When should we ask for link layer confirmations? The options are: NEVER (not for any frame) SOMETIMES (multi-frame fragments) ALWAYS (for all frames)	Default is Never
Link Confirm Timeout (ms)	Maximum amount of time (ms) to wait for a link level confirm if requested. Even if the Link Confirm Mode is set to NEVER this will still be used for Link Test Frame and Request Link Status if they are sent.	Default is 2000 ms
Link Retries	Maximum number of link layer retries if link layer confirm times out.	Default is 3
Link Offline Poll Period (ms)	Specifies how often (ms) a session that is offline will attempt to reestablish communication. This includes attempting to open/reopen a channel and/or issuing request status messages as appropriate for the current configuration.	Default is 10,000 ms

Configuration Parameter	Description	Default or Options
TCP/IP and UDP		
Master IP Address	The IP address to accept TCP connection from. May be *.*.*.* (0.0.0.0) indicating accept connection from any client.	Default listing is 0.0.0.0
IED Listen Port	On server and Dual End Point Device the port to listen on	Default value of 20000
IP Connect Timeout (ms)	Number of milliseconds to wait for TCP connect to succeed or fail	Default is 1000 ms
UDP Broadcast Address	Destination IP address for UDP broadcast requests. This is only used by a DNP Master when TCP and UDP are supported. If UDP ONLY is configured, IP Address will be used as destination for all requests.	Default listing is 0.0.0.0
UDP Local Port	Local port for sending and receiving UDP datagrams on. If this is set to NONE(0), UDP will not be enabled.	Default value of 20000
UDP Destination Port	If TCP and UDP are configured, this is not used. If UDP ONLY is configured this specifies the destination UDP/IP port to send responses to.	Default value is 2
UDP Initial Unsolicited Port	If UDP ONLY is configured this specifies the destination UDP/IP port to send the initial Unsolicited Null response to. After receiving a UDP request from master, UDP Destination Port (which may indicate the use of src port) will be used for all responses.	Default value of 20000
UDP Validate Address	Whether or not to validate source address of received UDP datagram.	Default value is box unchecked

DNP V3

DEVICE PROFILE DOCUMENT

Vendor Name: **Bitronics LLC**

Device Name: **PowerPlex II**

Highest DNP Level Supported:	Device Function:
For Requests: **Level 2** For Responses: **Level 2**	☐ Master ☒ **Slave**

Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported:

For static (non-change-event) object requests, request qualifier codes 00 and 01 (start-stop), 07 and 08 (limited quantity), and 17 and 28 (index) are supported in addition to request qualifier code 06 (no range). Static object requests sent with qualifiers 00, 01, 06, 07, or 08, will be responded with qualifiers 00 or 01. Static object requests sent with qualifiers 17 or 28 will be responded with qualifiers 17 or 28. For change-event object requests, qualifiers 17 or 28 are always responded.

16-bit Analog Change Events may be requested.
Binary Change Events may be requested.
Frozen Counter Events may be requested.
The read function code for Object 50 (Time and Date), variation 1, is supported.

Maximum Data Link Frame Size (octets):	Maximum Application Fragment Size (octets):
Transmitted: **292** Received **292**	Transmitted: **2048** Received **2048**

Maximum Data Link Re-tries:	Maximum Application Layer Re-tries:
☐ None ☐ Fixed ☒ **Configurable from 0 to 255**	☒ **None** ☐ Configurable

Requires Data Link Layer Confirmation:

- ☐ Never
- ☐ Always
- ☐ Sometimes
- ☒ **Configurable as: Never, Only for multi-frame messages, or Always**

Requires Application Layer Confirmation:

- ☐ Never
- ☐ Always
- ☐ When reporting Event Data (Slave devices only)
- ☐ When sending multi-fragment responses (Slave devices only)
- ☐ Sometimes
- ☒ **Configurable as: “Only when reporting event data”, or “When reporting event data or multi-fragment messages.”**

Timeouts while waiting for:

Data Link Confirm:	☐ None	☐ Fixed at _	☐ Variable	☒ **Configurable**
Complete Appl. Fragment:	☒ **None**	☐ Fixed at _	☐ Variable	☐ Configurable
Application Confirm:	☐ None	☐ Fixed at _	☐ Variable	☒ **Configurable**
Complete Appl. Response:	☒ **None**	☐ Fixed at _	☐ Variable	☐ Configurable

Others: **Transmission Delay, configurable.**
Arm Select Timeout, configurable.

Sends/Executes Control Operations:

WRITE Binary Outputs	☐ Never	☒ **Always**	☐ Sometimes	☐ Configurable
SELECT/OPERATE	☐ Never	☒ **Always**	☐ Sometimes	☐ Configurable
DIRECT OPERATE	☐ Never	☒ **Always**	☐ Sometimes	☐ Configurable
DIRECT OPERATE–NO ACK	☐ Never	☒ **Always**	☐ Sometimes	☐ Configurable
Count > 1	☒ **Never**	☐ Always	☐ Sometimes	☐ Configurable
Pulse On	☐ Never	☒ **Always**	☐ Sometimes	☐ Configurable
Pulse Off	☐ Never	☒ **Always**	☐ Sometimes	☐ Configurable
Latch On	☒ **Never**	☐ Always	☐ Sometimes	☐ Configurable
Latch Off	☒ **Never**	☐ Always	☐ Sometimes	☐ Configurable
Queue	☒ **Never**	☐ Always	☐ Sometimes	☐ Configurable
Clear Queue	☒ **Never**	☐ Always	☐ Sometimes	☐ Configurable

Attach explanation if 'Sometimes' or 'Configurable' was checked for any operation.

Reports Binary Input Change Events when no specific variation requested:

- ☐ **Never**
- ☐ Only time-tagged
- ☐ Only non-time-tagged
- ☒ Configurable

Reports time-tagged Binary Input Change Events when no specific variation requested:

- ☐ **Never**
- ☐ Binary Input Change With Time
- ☐ Binary Input Change With Relative Time
- ☒ Configurable

Sends Unsolicited Responses:

- ☐ Never
- ☐ Configurable
- ☐ Only certain objects
- ☐ Sometimes (attach explanation)
- ☒ ENABLE/DISABLE UNSOLICITED Function codes supported

Sends Static Data in Unsolicited Responses:

- ☒ **Never**
- ☐ When Device Restarts
- ☐ When Status Flags Change

No other options are permitted.

Default Counter Object/Variation:

- ☐ No Counters Reported
- ☐ Configurable
- ☒ **Default Object:** 20
  Default Variation: 5
- ☐ Point-by-point list attached

Counters Roll Over at:

- ☐ No Counters Reported
- ☐ Configurable (attach explanation)
- ☐ 16 Bits
- ☒ **32 Bits**
- ☐ Other Value: _____
- ☐ Point-by-point list attached

Sends Multi-Fragment Responses:

- ☒ **Yes**
- ☐ No

Revision	Date	Changes	By
A	11/20/14	Original Release	E. DeMicco

Bitronics • D/3 • Orion

Bitronics LLC, 261 Brodhead Road, Bethlehem, PA. 18017
(610) 997-5100 Fax (610) 997-5450
www.novatechweb.com/bitronics