

# 7700 ION

Advanced Digital Power  
Instrumentation Package

**7700 ION / DNP V3.00**

Device Profile

Version 1.1



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## Revision History

The following versions of this document have been released:

<b>Revision #</b>	<b>Revision Date</b>	<b>Description of Changes</b>	<b>By</b>
Revision 0.1	June 15, 1998:	Initial Draft	Mike Teachman
Revision 0.2	June 24, 1998:	Added section on Master communication settings.	Mike Teachman
Revision 0.3	July 13, 1998:	Corrections to Implementation Table.	Mike Teachman
Revision 0.4	July 14, 1998:	Added section on accuracy of time functions	Mike Teachman
Revision 0.5	July 20, 1998:	Added Select timeout data	Mike Teachman
Revision 0.6	July 22, 1998:	Added Time Sync Request information	Mike Teachman
Revision 0.7	July 24, 1998:	Updated time sync information	Mike Teachman
Revision 1.0	Sept 10, 1998	First production release	Mike Teachman
Revision 1.1	May 25, 2000	Minor corrections to section 4 and section 5.2	Mike Teachman

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## 1. Introduction

This document describes the DNP V3.00 communications protocol employed by the 7700 ION. The 7700 ION requires the Xpress card option to support DNP. The DNP protocol can be selected for one of the two serial communication ports on the Xpress card.

It is assumed that the reader is familiar with the DNP V3.00 protocol and serial communications in general.

### 1.1 7700 DNP V3.00 Communications Protocol Revisions

Date	Description
September 1998	Initial Release.

## 2. DNP Device Profile

<h1>DNP V3.00</h1> <h2>DEVICE PROFILE DOCUMENT</h2>	
Vendor Name: <b>Power Measurement Ltd</b>	
Device Name: <b>7700 ION</b>	
Highest DNP Level Supported: For Requests    Level 2 <sup>1</sup> For Responses   Level 2	Device Function: <input type="checkbox"/> Master <input checked="" type="checkbox"/> Slave
Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table): Please refer to section “ <b>Details on Customizing DNP V3.00 Configuration</b> ” on page 13.	
Maximum Data Link Frame Size (octets): Transmitted 292 Received        (must be 292)	Maximum Application Fragment Size (octets): Transmitted    2048 (configurable: 15 to 2048 octets) Received        2048
Maximum Data Link Re-tries: <input type="checkbox"/> None <input type="checkbox"/> Fixed at _____ <input checked="" type="checkbox"/> Configurable, range 0 to 15	Maximum Application Layer Re-tries: <input checked="" type="checkbox"/> None <input type="checkbox"/> Configurable, range ____ to ____ (Fixed is not permitted)

<sup>1</sup> The device can be configured to support some DNP Objects not defined in DNP V3.00 Subset 2 –requests and responses for these objects are highlighted with “\*\*\*” in the Implementation Table which follows. Users have control over the objects returned by the device to make sure that it only responds with objects parsable by a Subset 2 master.

Requires Data Link Layer Confirmation:

- Never
- Always
- Sometimes      If 'Sometimes', when? \_\_\_\_\_

■ Configurable If 'Configurable', how?

User option to set Data Link Confirmation to:

- **Always** – device will always request Data Link Confirmations.
- **Multi-packet only** – the device will request Data Link Confirmations when sending multi-packet responses.
- **Never** – the device will never request Data Link Confirmations.

Requires Application Layer Confirmation:

- Never
- Always (not recommended)
- When reporting Event Data (Slave devices only)
- When sending multi-fragment responses (Slave devices only)
- Sometimes      If 'Sometimes', when? \_\_\_\_\_
- Configurable If 'Configurable', how? \_\_\_\_\_

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 \_\_\_\_\_

Attach explanation if 'Variable' or 'Configurable' was checked for any timeout

- **Data Link Confirm timeout** is configurable: 0.1s to 30s

<p><b>Sends/Executes Control Operations:</b></p> <table style="width: 100%; border: none;"> <tr> <td style="width: 30%;">WRITE Binary Outputs</td> <td style="width: 10%;"><input checked="" type="checkbox"/> Never</td> <td style="width: 10%;"><input type="checkbox"/> Always</td> <td style="width: 10%;"><input type="checkbox"/> Sometimes</td> <td style="width: 10%;"><input type="checkbox"/> Configurable</td> </tr> <tr> <td>SELECT/OPERATE</td> <td><input type="checkbox"/> Never</td> <td><input checked="" type="checkbox"/> Always</td> <td><input type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> <tr> <td>DIRECT OPERATE</td> <td><input type="checkbox"/> Never</td> <td><input checked="" type="checkbox"/> Always</td> <td><input type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> <tr> <td>DIRECT OPERATE - NO ACK</td> <td><input type="checkbox"/> Never</td> <td><input checked="" type="checkbox"/> Always</td> <td><input type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> <tr><td colspan="5"> </td></tr> <tr> <td>Count &gt; 1</td> <td><input checked="" type="checkbox"/> Never</td> <td><input type="checkbox"/> Always</td> <td><input type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> <tr> <td>Pulse On</td> <td><input type="checkbox"/> Never</td> <td><input checked="" type="checkbox"/> Always</td> <td><input type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> <tr> <td>Pulse Off</td> <td><input checked="" type="checkbox"/> Never</td> <td><input type="checkbox"/> Always</td> <td><input type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> <tr> <td>Latch On</td> <td><input type="checkbox"/> Never</td> <td><input checked="" type="checkbox"/> Always</td> <td><input type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> <tr> <td>Latch Off</td> <td><input type="checkbox"/> Never</td> <td><input checked="" type="checkbox"/> Always</td> <td><input type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> <tr><td colspan="5"> </td></tr> <tr> <td>Queue</td> <td><input checked="" type="checkbox"/> Never</td> <td><input type="checkbox"/> Always</td> <td><input type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> <tr> <td>Clear Queue</td> <td><input checked="" type="checkbox"/> Never</td> <td><input type="checkbox"/> Always</td> <td><input type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> </table> <ul style="list-style-type: none"> <li>• <b>Select timeout</b> period is configurable: 0s to 30s</li> </ul>		WRITE Binary Outputs	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable	SELECT/OPERATE	<input type="checkbox"/> Never	<input checked="" type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable	DIRECT OPERATE	<input type="checkbox"/> Never	<input checked="" type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable	DIRECT OPERATE - NO ACK	<input type="checkbox"/> Never	<input checked="" type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable						Count > 1	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable	Pulse On	<input type="checkbox"/> Never	<input checked="" type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable	Pulse Off	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable	Latch On	<input type="checkbox"/> Never	<input checked="" type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable	Latch Off	<input type="checkbox"/> Never	<input checked="" type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable						Queue	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable	Clear Queue	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable
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Queue	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable																																																														
Clear Queue	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable																																																														
<p><b>FILL OUT THE FOLLOWING ITEMS FOR SLAVE DEVICES ONLY:</b></p>																																																																		
<p>Reports Binary Input Change Events when no specific variation requested:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Never</li> <li><input type="checkbox"/> Only time-tagged</li> <li><input type="checkbox"/> Only non-time-tagged</li> <li><input checked="" type="checkbox"/> Configurable to send both, one or the other (explanation below)</li> </ul> <p>User option to have all Binary Input Change Events returned as either:</p> <ul style="list-style-type: none"> <li>• time-tagged OR</li> <li>• non-time-tagged</li> </ul>	<p>Reports time-tagged Binary Input Change Events when no specific variation requested:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Never</li> <li><input checked="" type="checkbox"/> Binary Input Change With Time</li> <li><input type="checkbox"/> Binary Input Change With Relative Time</li> <li><input type="checkbox"/> Configurable (attach explanation)</li> </ul>																																																																	
<p>Sends Unsolicited Responses:</p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Never</li> <li><input type="checkbox"/> Configurable (attach explanation)</li> <li><input type="checkbox"/> Only certain objects</li> <li><input type="checkbox"/> Sometimes (attach explanation)</li> </ul> <p><input type="checkbox"/> ENABLE/DISABLE UNSOLICITED Function codes supported</p>	<p>Sends Static Data in Unsolicited Responses:</p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Never</li> <li><input type="checkbox"/> When Device Restarts</li> <li><input type="checkbox"/> When Status Flags Change</li> </ul> <p>No other options are permitted.</p>																																																																	

<p>Default Counter Object/Variation:</p> <ul style="list-style-type: none"><li><input type="checkbox"/> No Counters Reported</li><li><input checked="" type="checkbox"/> Configurable (explanation below)</li><li><input type="checkbox"/> Default Object _____ Default Variation _____</li><li><input type="checkbox"/> Point-by-point list attached</li></ul> <p>User option to return all static counters in one of the following variations:</p> <ul style="list-style-type: none"><li>• 32-Bit Binary Counter</li><li>• 32-Bit Binary Counter Without Flag</li><li>• 16-Bit Binary Counter</li><li>• 16-Bit Binary Counter Without Flag</li></ul>	<p>Counters Roll Over at:</p> <ul style="list-style-type: none"><li><input type="checkbox"/> No Counters Reported</li><li><input checked="" type="checkbox"/> Configurable (explanation below)</li><li><input type="checkbox"/> 16 Bits</li><li><input type="checkbox"/> 32 Bits</li><li><input type="checkbox"/> Other Value _____</li><li><input type="checkbox"/> Point-by-point list attached</li></ul> <p>User option to select roll over:</p> <ul style="list-style-type: none"><li>• 32 bit counters roll over at 2<sup>32</sup>.</li><li>• 16 bit counters roll over at 2<sup>16</sup></li></ul>
<p>Sends Multi-Fragment Responses: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>	

## 2.1 Implementation Table

### Level 2 Implementation (DNP-L2)

OBJECT			REQUEST (slave must parse)		RESPONSE (master must parse)	
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)
1	0	Binary Input - All Variations	1	00,01,06		
1	1	Binary Input	1	00,01,06	129	00, 01
1	2	Binary Input with Status	1	00,01,06	129	00, 01
2	0	Binary Input Change - All Variations	1	06,07,08		
2	1	Binary Input Change without Time	1	06,07,08	129	17
2	2	Binary Input Change with Time	1	06,07,08	129	17
2	3	Binary Input Change with Relative Time	1	06,07,08		
10	0	Binary Output - All Variations	1	00,01,06		
10	1	Binary Output				
10	2	Binary Output Status	1	00,01,06	129	00,01
12	0	Control Block - All Variations				
12	1	Control Relay Output Block	3,4,5,6	17,28	129	echo of request
12	2	Pattern Control Block				
12	3	Pattern Mask				
20	0	Binary Counter - All Variations	1,7,8, 9,10	00,01,06		
20	1	32-Bit Binary Counter	1	00,01,06	129	00,01
20	2	16-Bit Binary Counter	1	00,01,06	129	00,01
20	3	32-Bit Delta Counter				
20	4	16-Bit Delta Counter				
20	5	32-Bit Binary Counter without Flag	1	00,01,06	129	00,01
20	6	16-Bit Binary Counter without Flag	1	00,01,06	129	00,01
20	7	32-Bit Delta Counter without Flag				
20	8	16-Bit Delta Counter without Flag				

OBJECT			REQUEST (slave must parse)		RESPONSE (master must parse)	
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)
21	0	Frozen Counter - All Variations	1	00,01,06		
21	1	32-Bit Frozen Counter	1	00,01,06	129	00,01
21	2	16-Bit Frozen Counter	1	00,01,06	129	00,01
21	3	32-Bit Frozen Delta Counter				
21	4	16-Bit Frozen Delta Counter				
21	5	32-Bit Frozen Counter with Time of Freeze	1	00,01,06	129	00,01
21	6	16-Bit Frozen Counter with Time of Freeze	1	00,01,06	129	00,01
21	7	32-Bit Frozen Delta Counter with Time of Freeze				
21	8	16-Bit Frozen Delta Counter with Time of Freeze				
21	9	32-Bit Frozen Counter without Flag	1	00,01,06	129	00,01
21	10	16-Bit Frozen Counter without Flag	1	00,01,06	129	00,01
21	11	32-Bit Frozen Delta Counter without Flag				
21	12	16-Bit Frozen Delta Counter without Flag				
22	0	Counter Change Event - All Variations	1	06,07,08		
22	1	32-Bit Counter Change Event without Time	1	06,07,08	129	17
22	2	16-Bit Counter Change Event without Time	1	06,07,08	129	17
22	3	32-Bit Delta Counter Change Event without Time				
22	4	16-Bit Delta Counter Change Event without Time				
22	5	32-Bit Counter Change Event with Time	1	06,07,08	129	17
22	6	16-Bit Counter Change Event with Time	1	06,07,08	129	17
22	7	32-Bit Delta Counter Change Event with Time				
22	8	16-Bit Delta Counter Change Event with Time				

\*\*2

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<sup>2</sup> The device can be configured to respond with the object/variations marked with “\*\*\*”. Note that these object/variations are not listed in the DNP V3.00 Subset 2 definitions. If the meter is configured to respond with these objects care must be taken to insure sure that the master can parse the response.

OBJECT			REQUEST (slave must parse)		RESPONSE (master must parse)		
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)	
23	0	Frozen Counter Event - All Variations	1	06,07,08			**
23	1	32-Bit Frozen Counter Event without Time	1	06,07,08	129	17,28	**
23	2	16-Bit Frozen Counter Event without Time	1	06,07,08	129	17,28	**
23	3	32-Bit Frozen Delta Counter Event without Time					
23	4	16-Bit Frozen Delta Counter Event without Time					
23	5	32-Bit Frozen Counter Event with Time	1	06,07,08	129	17	**
23	6	16-Bit Frozen Counter Event with Time	1	06,07,08	129	17	**
23	7	32-Bit Frozen Delta Counter Event with Time					
23	8	16-Bit Frozen Delta Counter Event with Time					
30	0	Analog Input - All Variations	1,7,8	00,01,06			
30	1	32-Bit Analog Input	1	00,01,06	129	00,01	
30	2	16-Bit Analog Input	1	00,01,06	129	00,01	
30	3	32-Bit Analog Input without Flag	1	00,01,06	129	00,01	
30	4	16-Bit Analog Input without Flag	1	00,01,06	129	00,01	
31	0	Frozen Analog Input - All Variations	1	00,01,06			**
31	1	32-Bit Frozen Analog Input	1	00,01,06	129	00,01	**
31	2	16-Bit Frozen Analog Input	1	00,01,06	129	00,01	**
31	3	32-Bit Frozen Analog Input with Time of Freeze	1	00,01,06	129	00,01	**
31	4	16-Bit Frozen Analog Input with Time of Freeze	1	00,01,06	129	00,01	**
31	5	32-Bit Frozen Analog Input without Flag	1	00,01,06	129	00,01	**
31	6	16-Bit Frozen Analog Input without Flag	1	00,01,06	129	00,01	**
32	0	Analog Change Event - All Variations	1	06,07,08			
32	1	32-Bit Analog Change Event without Time	1	06,07,08	129	17	
32	2	16-Bit Analog Change Event without Time	1	06,07,08	129	17	
32	3	32-Bit Analog Change Event with Time	1	06,07,08	129	17	**
32	4	16-Bit Analog Change Event with Time	1	06,07,08	129	17	**

OBJECT			REQUEST (slave must parse)		RESPONSE (master must parse)		
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)	
33	0	Frozen Analog Event - All Variations	1	06,07,08	129	17	**
33	1	32-Bit Frozen Analog Event without Time	1	06,07,08	129	17	**
33	2	16-Bit Frozen Analog Event without Time	1	06,07,08	129	17	**
33	3	32-Bit Frozen Analog Event with Time	1	06,07,08	129	17	**
33	4	16-Bit Frozen Analog Event with Time	1	06,07,08	129	17	**
40	0	Analog Output Status - All Variations	1	00,01,06			
40	1	32-Bit Analog Output Status	1	00,01,06	129	00,01	**
40	2	16-Bit Analog Output Status	1	00,01,06	129	00,01	
41	0	Analog Output Block - All Variations					
41	1	32-Bit Analog Output Block	3,4,5,6	17,28	129	echo of request	**
41	2	16-Bit Analog Output Block	3,4,5,6	17,28	129	echo of request	
50	0	Time and Date - All Variations					
50	1	Time and Date	2	07 where quantity = 1			
50	2	Time and Date with Interval					
51	0	Time and Date CTO - All Variations					
51	1	Time and Date CTO					
51	2	Unsynchronized Time and Date CTO					
52	0	Time Delay - All Variations					
52	1	Time Delay Coarse			129	07, quantity=1	
52	2	Time Delay Fine			129	07, quantity=1	
60	0						
60	1	Class 0 Data	1	06,07,08			
60	2	Class 1 Data	1	06,07,08			
60	3	Class 2 Data	1	06,07,08			
60	4	Class 3 Data	1	06,07,08			

OBJECT			REQUEST (slave must parse)		RESPONSE (master must parse)	
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)
70	1	File Identifier				
80	1	Internal Indications	2	00 index=7		
81	1	Storage Object				
82	1	Device Profile				
83	1	Private Registration Object				
83	2	Private Registration Object Descriptor				
90	1	Application Identifier				
100	1	Short Floating Point				
100	2	Long Floating Point				
100	3	Extended Floating Point				
101	1	Small Packed Binary-Coded Decimal				
101	2	Medium Packed Binary-Coded Decimal				
101	3	Large Packed Binary-Coded Decimal				
No Object (Cold Restart)			13			
No Object (Warm Restart)			14			
No Object (Delay Measurement)			23			

### 3. Time Sync Information

Parameter	Time
Maximum time base drift over a 10 minute interval	18ms
Maximum difference between meter time base and master station time base after time set from DNP protocol	1s <sup>3</sup>
Maximum delay measurement error	20ms

#### 3.1 Time Sync Request Configuration

The time interval which the device waits before requesting a time sync from the master (using IIN bit #4) is configurable from 1 second to 1 day (in 1 second intervals). The factory default is 1 day.

A Setup option in the **DNP Slave Options ION Module** is used to configure the Time Sync Request period.

#### 3.2 Configuring DNP Comm Port to Accept Time Syncs

Setup options in the ION Clock Module need to be configured before DNP Time Syncs to be processed correctly:

- ◆ **TimeSyncSource** identifies the communications port running the DNP Protocol.
- ◆ **TimeSyncType** indicates if the time syncs are sent in local time or universal time format.

<sup>3</sup> For the 7700 ION, this time is defined by the report-by-exception (RBE) scan time which is 1 second. The on-board time base will differ by a maximum of 20ms compared to the master time base after a timeset, however, this time becomes academic when the RBE scan time is longer (the only use of time stamps in DNP is for event time stamping). Hence, the RBE scan time is entered here.

## 4. 7700 ION Default DNP Configuration

The 7700 ION is shipped from the Factory with the following DNP static objects defined. These objects are returned in response to a Class 0 Poll. Note that the protocol of the desired communications port must set to “DNP 3.0” before the meter will respond to DNP master requests.

Analog Input Objects (16-Bit Analog Input without Flag) (Object 30, Variation 4)		
Point	Measurement	Scaling
0	Vln a	x1
1	Vln b	x1
2	Vln c	x1
3	Vln avg	x1
4	VII a	x1
5	VII b	x1
6	VII c	x1
7	VII avg	x1
8	I a	x1
9	I b	x1
10	I c	x1
11	I avg	x1
12	kW a	x1
13	kW b	x1
14	kW c	x1
15	kW tot	x1
16	kVAR a	x1
17	kVAR b	x1
18	kVAR c	x1
19	kVAR tot	x1
20	kVA a	x1
21	kVA b	x1
22	kVA c	x1
23	kVA tot	x1
24	PFsign a	x1
25	PFsign b	x1
26	PFsign c	x1
27	PFsign tot	x1
28	V unbal	<b>x10</b>
29	I unbal	<b>x10</b>
30	I4	x1
31	Freq	<b>x10</b>
32	kW sd del-rec <sup>4</sup>	x1
33	kVAR sd del-rec <sup>4</sup>	x1
34	kVA sd del-rec <sup>4</sup>	x1

Binary Counter Objects (16-Bit Binary Counter without Flag) (Object 20, Variation 6)		
Point	Measurement	Scaling
0	kWh del (Import)	x1
1	kWh rec (Export)	x1
2	kWh del+rec (Total)	x1
3	kWh del-rec (Net)	x1
4	kVARh del (Import)	x1
5	kVARh rec (Export)	x1
6	kVARh del+rec (Total)	x1
7	kVARh del-rec (Net)	x1
8	kVAh del+rec (Total)	x1

<sup>4</sup> Note : These are instantaneous demand quantities, not peak (maximum) demand.

## 5. Details on Customizing DNP V3.00 Configuration

The 7700 with Xpress card is factory configured with the basic DNP objects as outlined in “**7700 ION Default DNP Configuration**” on page 12. The 7700 ION DNP configuration can be further customized to take advantage of other DNP features.

### 5.1 Customizing the DNP Point map

The 7700 configuration can be modified to define which measurements are mapped to DNP Static points – this allows a user to exactly control the number of objects returned in a Class 0 poll. ION Modules are used to map 7700 measurements to DNP points as follows:

- ◆ Up to **64** 7700 measurements can be mapped to DNP Static points. The **DNP Slave Export ION Module** is used to map 7700 measurements to DNP Binary Input, Binary Counter, or Analog Input points. A DNP Static point is defined for each 7700 measurement that is “linked” to a DNP Slave Export ION Module. The type of DNP Static point is a setup option of the DNP Slave Export ION Module.
- ◆ Up to **16** relays can be controlled through DNP. The **DNP Slave Import ION Module** is used to map DNP Control Relay Output Block, and Analog Output Block points to 7700 relay and analog output hardware.

### 5.2 Report-by-exception processing (DNP Events)

Any DNP Static point can be configured to create DNP Event objects on value changes. Binary Input Change Events are created when a DNP Binary Input point changes state. Counter and Analog Change Event objects are created when the corresponding Static object changes by more than a programmable deadband value. Deadbands can be set on a per-object basis. Further, Event objects can be assigned as either Class 1, Class 2, or Class 3 on a per-object basis.

Setup options in the **DNP Slave Export ION Module** are used to enable Events, define deadband values, and assign DNP Event Classes.

Setup options in the **DNP Slave Options ION Module** are used to select the Object/Variations of Events that will be produced.

The “scan time” for Binary Counter and Analog Input Points is 1 second.

The “scan time” for Binary Input Points is 20ms.

Event capacities are:

- ◆ Binary Input Change Events – 100 events
- ◆ Frozen Counter Events – 100 events
- ◆ Counter Change Events – 100 events
- ◆ Analog Change Events – 200 events

### 5.3 Control Relay Output Block

Both ‘1 point per address’ and ‘2 points per address’ modes of addressing are supported for Control Relay Output Block objects. A setup option in the **DNP Slave Import ION Module** selects the addressing mode.

## 5.4 Freezing Binary Counter Points

Any DNP Binary Counter Point can be configured to support the freeze command. When a Binary Counter is frozen it copies its value into a DNP Frozen Counter point. These Frozen Counter points are returned in a Class 0 poll. Freeze, Freeze/Clear, Freeze/No-Ack, and Freeze/Clear/No-Ack functions are supported.

A Setup option in the **DNP Slave Export ION Module** is used to give freeze capabilities to the associated Static point.

A Setup option in the **DNP Slave Options ION Module** is used used to select the Object/Variation of the Frozen Static object.

## 5.5 Scaling

Counter and Analog Input objects can be scaled on a per-object basis. Scaling can be used to maintain resolution in floating point measurements. For example, Frequency measurements can be multiplied by 10 to obtain 1 decimal place of resolution.

## 6. Glossary of Terms

<b>application</b>	A piece of software (a program) consisting of one or more processes and supporting functions.
<b>Binary</b>	A number system having only two symbols (1 and 0), and where values are expressed in the base two number system.
<b>Bit</b>	Abbreviation of binary digit. The smallest unit of information in a binary system. Has a value of either one (1) or zero (0).
<b>Master</b>	The client or host station or computer, with which the RTU equipment communicates. Also referred to as a host or host computer.
<b>Non-volatile</b>	A semi-permanent type of data storage
<b>random-access memory</b>	(memory) that is backed up by batteries to maintain stored data even if system power is lost. Can be both read and changed by the system. Abbreviated as NVRAM.
<b>Random-access memory</b>	A type of temporary data storage (memory) that can be read and changed while the computer is in use. Data stored in random-access memory is lost if the system loses power. Abbreviated as RAM.
<b>Remote terminal unit</b>	A piece of equipment located at a distance from a master station to monitor and control the status of outlying equipment, and to communicate the information back to the master station or host. Abbreviated as RTU.
<b>Sequence of events</b>	A time-tagged change of state, logged as part of a chronological record of significant changes in the condition of a particular point or points being monitored. Abbreviated as SOE.

## 7. List of Acronyms and Abbreviations

<b>DNP</b>	distributed network protocol
<b>IED</b>	intelligent electronic device
<b>NVRAM</b>	non-volatile random-access memory
<b>OSI</b>	open systems interconnect
<b>RAM</b>	random-access memory
<b>RTU</b>	remote terminal unit
<b>SOE</b>	sequence of events







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