

Atop Technologies, Inc.

Protocol Gateway DNP3.0 Client/Server

Protocol and eNode Designer configuration

eNode Configuration Manual

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<u>Configuration Guide</u>

Interoperability

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We have checked the contents of this manual for agreement with the hardware and the software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual is reviewed regularly and any necessary corrections will be included in subsequent editions.

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1 Introduction

Thank you for Buying Atop's Protocol Gateway.

The product is bundled with the following three user manuals:

- 1) Hardware specific installation user manual, **not covered in this document.** It covers Atop's hardware installation procedure, wiring, power connection etc.
- 2) Getting started with Atop's Protocol Gateway user manual configuration tool introduction, web configuration, software architecture introduction not covered in this document. This manual covers the introduction, installation, network set-up maintenance and using of the configuration tool software, including the procedure to be followed for uploading new configurations to Atop's device.
- 3) Protocol specific user manual (This Manual). One protocol-specific manual will be provided for each protocol installed on the device. This manual covers:
 - a. Basic device network configuration
 - b. Step-by-step protocol set-up for in eNode designer
 - c. Description of the protocol-specific software features, the device profile and the implementation table of supported functionalities.

This manual is for **DNP3.0 Client/Server** and describes how to use the **DNP3 eNode Designer Module** to configure Atop's *DNP3 ADH Application* within the eNode Designer configuration tool.

1.1 Scope

This document is divided into 3 major sections:

- General Description;
- Configuration Guide; and
- DNP3.0 Client Device Profile/ Implementation table and
- DNP3.0 Server Device Profile/ Implementation table

1.2 Document Reference

- [1] Document Title: Getting started User Manual: 197-0100 Revision: Version 1.00 or higher
- [2] Document Title: DNP3 Specification Revision: 2.05, 24th June 2009

1.3 List of Abbreviations

ADH	= Application Data Hub
DNP3	= Distributed Network Protocol 3
IED	= Intelligent Electronic Device
IP	= Internet Protocol

TCP = Transmission Control Protocol

2 General Description

The DNP3 eNode Module can be used to configure the DNP3 ADH Application as a master or slave. For naming consistency across eNode Designer, the master is called a client, and the slave is called a server.

The DNP3 client can communicate with many DNP3 server IEDs, all of whose data point details can be configured using this module.

2.1 Configuration Theory

Most configuration properties describe a *server*. When configuring the ADH application server, you are configuring the properties of the server itself. Atop protocol gateway supports one server application per protocol per port. When configuring the ADH Application client, you are describing the properties of all the remote servers with whom the client is communicating.

Configuring the protocol-specific information, such as object addresses, is handled in the module. This is explained in this document.

Communication port properties (such as Baud Rate) are configured on the communication port itself. The Device module handles the communication port properties, so heavy details are outside the scope of this document. Port configuration instructions are provide in the eNode Designer general user manual.

Screenshots of the typical configuration method are anyway shown in section 4. The relevant properties of the communication ports automatically apply to the application. For example, in a DNP3 server application, the IP Address the application binds to is taken from the parent Ethernet port.

2.2 General Screen Description

A small configuration example is shown below to better help describe the layout of the screen.

Node Designer 2022 120		×
File Settings Help		
Project		
PG5901: (1)		2
• 🗰 DNP3 (C): (1)	Slave Address: 1 - Link Layer Timeout (ms): 2000 - Application Layer Timeout (ms):	10000
LED [1]	Class123 Poll Interval (ms): 1000 - None Class / Class0123 Interval (ms): 10000 - IP Address: Port:	20000
COM1	Data Point	
	Tag Group Start Address Count	Operation Mode
	3	
	Commands	
	Tag Group Start Address Count	Operation Mode
	Add +1 Delete Modify Selected Points Move Up Move Down	
	I	•

Figure 2-1 - Example Screen

1 Tabs

Server IED Properties – Describes the protocol-specific properties of the server IED.

Data Table and buttons – Shows all (information) data associated with the IED, and shows the buttons to be used to modify them.

Commands Table and buttons – Shows all commands associated with the IED, and shows the buttons to be used to modify them.

The user is able edit contents of the data and commands tables freely.

3 DNP3 Configuration Guide

3.1 Adding the Module in eNode Designer

The DNP3 module can be added to both Ethernet and Serial ports.

The application can be set up as a Client or a Server. The choice will be presented when adding it to the project.



Figure 3-1 - Adding the module in eNode Designer.

- Right click the desired communication port.
- Open the Add ADH Application menu.
- 3 Select DNP3.
- A Select **Client** or **Server** from the drop-down menu.
- 5 Click OK.

3.2 Server IED Properties

The server IED properties are at the top of the module screen. The options available are limited to what is relevant for the communication port.

Serial port example:		
	Slave Address: 2	
Ethernet port example:		
Slave Address: 2 -	IP Address: 192 . 168 . 1 . 123	IP Port: 20000 -

Each property is described in detail below.

3.2.1.1 Slave Address

Description	The slave address of the server IED. For servers it describes its own slave address. For clients, it describes the slave address of the remote server.
Data Entry	Integer
Range	0 to 65519
Input Option	Mandatory

3.2.1.2 IP Address

Ethernet and Client only		
Description	The IP Address of the remote server IED. This option is only available in clients, since in servers, the IP Address is taken from the Ethernet port.	
Data Entry	IP Address String	
Range	Valid IPv4 Addresses (0.0.0.0 to 255.255.255.255)	
Input Option	Mandatory	

3.2.1.3 IP Port

Ethernet only

Description	The IP Port used by the server IED.		
Data Entry	Integer		
Range	1 to 65535. Default: 20000		
Input Option	Mandatory		

3.3 Client Configuration

Adding a DNP3 client application will immediately show the following figure. The first tab shows the settings that apply to the whole client application. Each tab after this shows a single DNP3 server with which the client is communicating. Each tab is named "IED [{X}]" where {X} is the slave address.

SETTINGS IED [1] × +				
Protocol Settings				
Master Address	2 -			
Communications Medium	Serial 💌			
SETTINGS IED [1] × +				
SETTINGS IED [1] × + Protocol Settings				
SETTINGS IED [1] × + Protocol Settings Master Address				

Figure 3-2 - Client settings panel (serial above; Ethernet below).

Selecting the IED tab will show the following view.

Settings 🔥 IED [1] × +					
Slave Address: 1 Class123 Poll Interval (ms): 1000 None	Link Layer Timeout (ms): 200 Class / Class0123 Interval (ms): 1000	0 - Appl 0 - IP Address:	ication Layer Timeout (ms):	10000 ~ 20000 ~	
Data Point					
Tag	Group	Start Address	Count	Operation Mode	
Commands					
Tag	Group	Start Address	Count	Operation Mode	
Add +1 Delete Modify Selected Points Move Up Move Down					

Figure 3-3 - Client IED panel (Ethernet).

Here the "Add" and "+1" button can be used to add data points. Adding data points is explained in the "Add data points" section, and the other buttons are described in section 6: Reference Guide.

3.3.1.1 Master Address

Description	The DNP3 master address to use.	
Data Entry	Integer	
Range	0 to 65519	
Input Option	Mandatory	

3.3.1.2 Communication Medium

Description	The communication method to use. The list will automatically be restricted based on the parent's port type.
Data Entry	Drop down menu
Options	Serial, TCP, UDP
Input Option	Mandatory

3.3.1.3 Enable Unsolicited After Connection Establish

Description Whether the client enables the server's unsolicited message or not.	
Data Entry	Checkbox
Types	Checked or not (default: checked)
Input Option	Mandatory

3.3.2 IED Settings

3.3.2.1 Slave Address

Description	n The DNP3 address of IED to use.	
Data Entry	Integer	
Range	0 to 65519 (default: 1)	
Input Option	Mandatory	

3.3.2.2 Link Layer Timeout (ms)

Description The timeout for a data link layer confirmation in milliseconds.	
Data Entry	Integer
Range	100 to 65535 (default: 2000)
Input Option	Mandatory

3.3.2.3 Application Layer Timeout (ms)

Description	Description The timeout for an application layer confirmation in milliseconds.	
Data Entry Integer		
Range	2000 to 65535 (default: 10000)	
Input Option	Mandatory	

Description	The poll interval of the event classes: class 1, 2 and 3. Every poll interval all event classes are polled. Measured in milliseconds.
Data Entry	Integer
Range	1000 to 65535 (default: 1000)
Input Option	Mandatory

3.3.2.4 Class 1, 2, 3 Poll Interval (ms)

3.3.2.5 None Class / Class 0123 Poll Interval (ms)

Description The poll interval of static data and all events. Every poll interval all data is its present value: class 0, 1, 2 and 3. Measured in milliseconds.	
Data Entry Integer	
Range	1000 to 65535 (default: 10000)
Input Option	Mandatory

1

3

3.3.3 Adding Data Points

To add data points, left click the "**Add**" button beneath the tables in the main view. Doing so will show the following window. The window is used to add many data points at once with the specified values. For details on the meaning of each column, see section 6.2.

	Folints			
review		G		
Tag	Group	Start Address	Count	Operation Mode
nable_Input1	Binary Input			Status Only
nable_Input2	Binary Input			Status Only
nable_Input3	Binary Input			Status Only
able_Input4	Binary Input			Status Only
able_Input5	Binary Input			Status Only
hable_Input6	Binary Input			Status Only
ew values				
ew values				
w values Tag	Group	Start Address	Count	Operation Mode
w values Tag nable Input[X]	Group Binary Input	Start Address 2	Count	Operation Mode Status Only
ew values Tag nable Input[X]	Group Binary Input	Start Address 2	Count	Operation Mode Status Only
ew values Tag nable Input[X] umber of rows:	Group Binary Input	Start Address 2	Count	Operation Mode Status Only
Tag Tag nable Input[X] Imber of rows:	Group Binary Input 6	Start Address 2	Count	Operation Mode Status Only 11".
Tag nable input[X] umber of rows: ou can use "[X]" as a Define counter [X]	Group Binary Input 6	Start Address 2 d [Z] work similarly. Use [3X] to pr e counter [Y]	Count Toduce values like "00	Operation Mode Status Only 11". 4
Tag nable input[X] Imber of rows: Iu can use "[X]" as a Define counter [X] Start at:	Group Binary Input 6 	Start Address 2 2 2 4 [Z] work similarly. Use [3X] to pr e counter [Y] rt at: 1 - Step by:	Count roduce values like "00 Define coun 1 - Start at:	Operation Mode Status Only 11". 4 ter [Z] 1 ÷ Step by: 1 ÷

Figure 3-4 - Add data points window.

Preview Area – Shows the preview of the data points that will be added.

New values – This area is used to enter values. Tag, Start Address and Count use manual data entry (click the box and type new values). Group, Operation Mode use drop-down menus. Entering an integer into the address column will start at that number and automatically increment in each successive point.

Number of rows - This counter can be used to add many data points at once.

Automatic Counters – These counters can be used to add many data points at once. The starting values and step values can be changed in this area. See also 5 Using Auto-increment Counters.

OK button – to accept the new data points.

3.3.4 Servers (Remote IEDs)

Each slave IED is represented by a single tab and a tree node in the eNode Designer project tree.

eNode Designer - 2022_120	06_Test.EDP	
Project • • • • PG5901: (1) • • • ETH1 • • • • DNP3 (C): (1) • • • • DNP3 (C): (1)	Settings IED [1] IED [3] IED [3] Slave Address: 1 - Class123 Poll Interval (ms): 1000 -	Link Layer Tim Class / Class0123 Int
← IED [3] ← IED [4] ← IETH2 ← COM1	Data Point Tag	Gro Binary Input

Figure 3-5 - Multiple connected servers example.

To modify the connected IEDs list follow the instructions below:

To add a new remote IED, click the "+" tab at the end of the existing remote server(s) list.



Figure 3-6 - Add a connected server.

To remove a remote IED, it must have no data points specified. If there are data points in the table and you still wish to remove the IED, you will have to remove such data points first.

To **remove** a remote IED, click the cross on the right side of the tab of the IED you wish to remove.

SETTINGS IED [12] ×	IED [1] × +	SETTINGS	IED [12] ×	+
Slave Address: 1	Link Layer Time	 Slave Addre	ess: 12 -	Link La
Class123 poll Interval:	1000 - Class	Class123 p	oll Interval:	1000 ÷

Figure 3-7 – Remove a connected server.

3.4 Server Configuration

A DNP3 server application outputs data from the ADH database, receives commands and passes them into the ADH system to command another application to perform the operation. Therefore, all server operations use data point *references* to already existing data points that have been created by other application clients or client-servers. Atop protocol gateway supports one server application per protocol per device.

The options describe the local server itself. The settings tab can be used to set the local settings, while the IED tab is similar to the client-tab. Example figures of both are shown below.

Settings Server	
Protocol Settings	
Name	
Slave Address	1
Master Address	2
Enable Self Address	V
Command Timeout (ms)	3000 -
Class 1 Event Buffer Size	1000 -
Class 1 Event Buffer Overflow Percentage	90 -
Class 2 Event Buffer Size	1000 -
Class 2 Event Buffer Overflow Percentage	90 -
Class 3 Event Buffer Size	1000 -
Class 3 Event Buffer Overflow Percentage	90 -
Time Sync Interval (s)	300 -
Ethernet Port Number	20000

Figure 3-8 - Server settings panel extract.

Settings Server					
Data Point					
	Tag	Group	Count	Operation Mode	Analog Input Deadband
Commands	Tag	Croup	Count	Operation Mode	SBO Timeout
Add Reference	Delete Modify Selected P	oints Move Up Move D	own		

Figure 3-9 – Server IED panel.

Here the "Add Reference" button can be used to add data point references. The procedure is explained fully in the next section. The other buttons are described in section 6: Reference Guide.

3.4.1 Server Settings

All server settings are explained in the headings below.

3.4.1.1 Master Address

Description	The DNP3 master address to be used.
Data Entry	Integer
Range	0 to 65519
Input Option	Mandatory

3.4.1.2 Communication Medium

Description	The communication method to be used. The list will automatically be restricted based on the parent's port type.
Data Entry	Drop down menu
Options	Serial, TCP, UDP
Input Option	Mandatory

3.4.1.3 Enable Self Address

Description	The value of the "Enable self address" flag when the application is started. When
Description	unsolicited responses are enabled, unsolicited messages may be sent.

Data Entry	Checkbox
Range	Checked or not (default: checked)
Input Option	Mandatory

3.4.1.4 Class {X} Event Buffer Size

Description	The buffer size for class {X}: the maximum number of events to store.
Data Entry	Integer
Range	10 - 65535
Input Option	Mandatory

3.4.1.5 Class {X} Event Buffer Overflow Percentage

Description	If the buffer for class {X} fills to this percentage, a buffer overflow event is sent to the master station.
Data Entry	Integer
Range	25-100. Recommended 50-95. Default: 90
Input Option	Mandatory

3.4.1.6 Default Static Variations

Description	The default static variations.					
Data Entry	Drop down menus					
	Binary Input	"With Flags"				
	Double Binary Input	"With Flags"				
	Counter Input	"32-bit With Flag", "16-bit With Flag", "32-bit Without Flag", "16-bit Without Flag"				
	Frozen Counter Input	"32-bit With Flag", "16-bit With Flag", "32-bit With Flag and Time", "16-bit With Flag and Time", "32-bit Without Flag", "16-bit Without Flag"				
Options	Analog Input	"32-bit With Flag", "16-bit With Flag", "32-bit Without Flag", "16-bit Without Flag", "Single-prec Flt-pt With Flag"				
	Analog Input Deadband	"16-bit", "32-bit", "Single-prec Flt-pt"				
	Binary Output	"With Flags"				
	Analog Output	"32-bit With Flag", "16-bit With Flag", "Single-prec Flt-pt With Flag"				
Input Option	Mandatory					

3.4.1.7 Default Event Variations

Description	The default event variations.					
Data Entry	Drop down menus					
Options	Binary Input	"Without Time", "With Absolute Time", "With Relative Time"				

Counter Input	"32-bit With Flag", "16-bit With Flag", "32-bit With Flag and Time", "16-bit With Flag and Time"
Frozen Counter Input	"32-bit With Flag", "16-bit With Flag", "32-bit With Flag and Time", "16-bit With Flag and Time"
Analog Input	"32-bit Without Time", "16-bit Without Time", "32-bit With Time", "16-bit With Time", "Single-prec Flt-pt Without Time", "Single-prec Flt-pt With Time"

3.4.2 Adding Data Point References

To add new data point references, left click the "Add Reference" button underneath the tables in the main view. This will bring up the Add References window defined by the eNode Designer main application. It should appear similar to the following figure. Here we are adding references to data points created by an IEC 60870-5-104 client.

DG5901: (1)	Add new refer	ance to whi	h points?					
e ETH1	Data Index	Select A	Application	Tag	Exchange Type	Data Type	Map	
· ······ DNP3 (C): (1)	2		PG5901: (1) / ETH1 / DNP3 (C): (1) / I	Tag	Data	Boolean	0	
ED [1]	3		PG5901: (1) / ETH1 / DNP3 (C): (1) / I	Tag_1	Data	Boolean	0	
IED [3]	4 (1)		PG5901: (1) / ETH1 / DNP3 (C): (1) / I	Tag	Data	Double Point	0	
IED [4]	5		PG5901: (1) / ETH1 / DNP3 (C): (1) / I	Tag_3	Data	Boolean	0	
FTH2	6	2	PG5901: (1) / ETH1 / DNP3 (C): (1) / I	Tag_4	Data	Boolean	0	
DND2 (Ch (4)	7		PG5901: (1) / ETH1 / DNP3 (C): (1) / I	Tag 5	Data	Boolean	0	
100 DNP3 (S): (1)	8		PG5901: (1) / ETH1 / DNP3 (C): (1) / I	Tag 7	Data	Boolean	0	
COM1	9		PG5901: (1) / ETH1 / DNP3 (C): (1) / I	Tag 9	Data	Boolean	0	
	10		PG5901: (1) / ETH1 / DNP3 (C): (1) / I	Tag_10	Data	Boolean	0	
	11		PG5901: (1) / ETH1 / DNP3 (C): (1) / 1	Tag_11	Data	Double Point	0	
	12		PG5901: (1) / ETH1 / DNP3 (C): (1) / IE	Tag	Command	Int32	0	
	13		PG5901: (1) / ETH1 / DNP3 (C): (1) / I	Tag	Command	Boolean	0	
	14		PG5901: (1) / ETH1 / DNP3 (C): (1) / I	Tag 12	Command	Boolean	0	
	15		PG5901: (1) / ETH1 / DNP3 (C): (1) / I	Tag 13	Command	Boolean	0	
	16		PG5901: (1) / ETH1 / DNP3 (C): (1) / I	Tag 14	Command	Boolean	0	
	17		PG5901: (1) / ETH1 / DNP3 (C): (1) / I	Tag_15	Command	Boolean	0	
	18		PG5901: (1) / ETH1 / DNP3 (C): (1) / I	Tag_16	Command	Boolean	0	
	Mapped with:							
	Data Index		Appli	cation			Map	

Figure 3-10 - Add new references window.

- Select Data Points Adding a reference to a point creates a "mapping" to that point. Select which data points the server application is interested in using.
 - Left Click **OK** when done to accept the new references.

The data points that will appear in the list and that will be available for mapping are those whose data point type is compatible with the DNP3 application. For the table matching DNP3 data types to ADH types, see section 0.

Data Point				
Tag	Group	Count	Operation Mode	Analog Input Deadband
Tag	Binary Input	1	Status Only	0
Tag	Binary Input	1	Status Only	0
Tag_4	Binary Input	1	Status Only	0
Tag_7	Binary Input	1	Status Only	0
Tag_9	Binary Input	1	Status Only	0
Commands				
Tag	Group	Count	Operation Mode	SBO Timeout
Tag	Binary Output	1	Direct Operate/SBO	1000

Figure 3-11 - Data point references added.

All properties will be automatically defined based on the data point's values.

3.5 Miscellaneous Common

3.5.1 Incomplete, Conflicting and not needed Information

Incomplete or conflicting information is shown in red, and will cause warning symbols on the tab and in the project tree. Hovering over the warning icons will show further details about the cause of the warning. This allows the user to quickly fix invalid information.

eNode Designer - 2022_120	6_Test.EDP			
Project PG5901: (1) ETH1 C(): (1) A IED (1) C(): PAddress Invalid	Settings IED [1] IED [3] IED [3]	Link Layer Timeout (ms): 200 Class / Class0123 Interval (ms): 1000	00 - 2 Appl 00 - IP Address:	ication Layer Timeout (ms):
	Tag	Group	Start Address	Count
COM1	Tag	Binary Input	1	1
COMI	Tag	Binary Input	2	1
	Tee	Dauble land	2	4

S eNode Designer - 2022_1206_Test.EDP − □ ×					
File Settings Help					
Project	Settings Server			3	
• Image: First state	Tag Tag Tag Tag Tag_4 Tag_7 Tag_9	Group Binary Input Binary Input Binary Input Binary Input Binary Input	Count 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Operation Mode Status Only Status Only Status Only Status Only Status Only	Analog Input Deadband 0 0 0 0 0

Mouse-over a warning to show a tooltip explaining the warning.

Invalid Data shows in red. The darker red means the data is invalid, and the lighter red means there is an address conflict.

Unneeded Data is hidden and not editable. For example, the SBO timeout is not required for direct operates. These table cells have a grey background, no contents and cannot be edited.

3.5.2 Modify Selected Points Window

The "Modify Selected Points" window is used to change many row properties in one single step.

Select the data points you want to change, and then press the "Modify Selected Points" button beneath the tables. It will generate the following window.

<u> R</u> ename Points					×
Original					
Tag	Group	Start Address	Count	Operation Mode	
Тад	Binary Input	1	1	Status Only	-
Тад	Binary Input	2	1	Status Only	
Tag	Double Input	3	1	Status Only	
Tag	Binary Input	4	1	Status Only	
Tan	Binary Input	5	1	Status Only	-
Preview		\frown			
Tag	Group	Stal 2 ress	Count	Operation Mode	
Тад	Binary Input	1	1	Status Only	-
Tag	Binary Input	2	1	Status Only	
Tag	Double Input	3	1	Status Only	_
Tag	Binary Input	4	1	Status Only	
Tag	Binary Input	5	1	Status Only	–
New values		3			
Tag	Group	Start Address	Count	Operation Mode	
Tag	[N]	[N]	1	Status Only	
You can use "[N]" as the or	iginal text of the cell.		G	\ \	
You can use "[X]" as an aut	to increment counter. [Y] and [Z] work similarly. Use [3X] to prod	fuce values like "001". 4)	
Define counter [X]	Define	counter [Y]	Define counter [Z]		
Start at: 1 - St	tep by: 1 - Start	at: 1 · Step by: 1	Start at: 1	Step by: 1 -	
			5	OK Cancel	

Figure 3-12 - Modify data points window example.

- Original data table Shows the original data table.
 - **Preview** Shows the new data table that will be used if the modifications are accepted. These fields update automatically according to the contents of (3).
- 3 New values Contain the new values for the table cells. "[N]" can be used to maintain the original value of the cell, and the auto-incrementing counters [X], [Y] and [Z] can be used to add numbers. For details, see Using Auto-increment.
- Counter properties Sets the initial values and step amounts of the counters [X], [Y] and [Z].
- **OK button** to accept the modifications.

Data point references always use the *tag* of the "real" point. Consequently, these values will not be changed by a server application. The object addresses in the server are required to be contiguous, so the addresses cannot be changed using this window either. See server configuration for details.

2

4 Communication Port Properties

The device module handles the communication port properties. The typical method is described briefly below.

<mark>と</mark> eNode Desigr	ner		- 0	×
File Edit View Tools Settings	s Help			
Project PG5901: (1) ETH1 ETH2 COM1 COM1 P WW DNP3 (C): (1) ETD [1]	Operate mode: Baud rate: Parity: Data Bits: Stop Bits:	RS232 ▼ 9600 ▼ None ▼ 8 ▼ 1 ▼	Pre transmission delay (ms): Post transmission delay (ms): Inter-character delay: Message timeout (ms): Message retries: Character timeout (ms): Character retries:	

Figure 4-1 - Serial port properties.

- Select the communication port in the project tree This will typically cause the central panel to show the port's properties.
 - Properties The communication port's properties can be set.

Similarly, the Ethernet properties are shown below.

📩 eNode Design	er		—	×
File Edit View Tools Settings	Help			
Project • • • PG5901: (1) • • • ETH1 • • • • DNP3 (C): (1)	IP Address: Subnet mask: Gateway:	192 . 168 . 1 . 2 255 . 255 . 255 . 0 192 . 168 . 1 . 1		

Figure 4-2 – Ethernet port properties.

5 Using Auto-increment Counters

The following is a full example showing how auto-increment works. The example given shows the IEC 60870-5-104 window, however the DNP3 auto-increment works in the same way.

ray	Group	Start Address	Count	Operation Mode
cample tag 0	Binary Input	0	1	Status Only
ample_tag_2	Binary Input	10	2	Status Only
cample_tag_4	Binary Input	20	3	Status Only
cample_tag_6	Binary Input	30	4	Status Only
cample_tag_8	Binary Input	40	5	Status Only
Tag	Group	Start Address	Count	Operation Mode
Tag (ample_tag_[X]	Group Binary Input	Start Address [Y]	Count [Z]	Operation Mode Status Only
Tag (ample_tag_[X]	Group Binary Input	Start Address Y]	Count [Z]	Operation Mode Status Only
Tag ample_tag_[X] imber of rows:	Group Binary Input	Start Address [Y]	Count [Z]	Operation Mode Status Only
Tag tample_tag_[X] umber of rows:	Group Binary Input	Start Address Y] and [Z] work similarly. Use [3X	Count [Z]] to produce values like "00	Operation Mode Status Only
Tag ample_tag_[X] umber of rows: u can use "[X]" as a Define counter [X]	Group Binary Input	Start Address [Y] and [Z] work similarly. Use [3X efine counter [Y]	Count [Z]] to produce values like "00 Define court	Operation Mode Status Only 01".

Figure 5-1 – Using Auto Increment when adding Data Points or Commands.

The Number of Rows can be modified to set the number of data points or commands created from the New values section. As shown in the example above, five data points/commands are created and shown in the preview section as the Number of Rows is set to 5.

When using the auto increment counters by default, they will start at one and increment by one. Anyway autoincrement value has its own section for configuration. Adjusting *Start At* will change the value that the first data point/command receives. Adjusting *Step By* will change the value that the second and subsequent values will be incremented by.



In this example, the [X] counter is used. The *Start At* value has been set to 0 and the *Step By* value has been set to 2. This results in the values seen in the preview section.

It is also possible to include a number within the square brackets and before the X, Y or Z while using auto increment. This will produce values that contain the entered number of digits. Any digit that is not taken up by the value determined by the *Start At* and *Step By* values will be shown as zeros.



In this example, the [Y] counter has been used with the integer 4 to indicate the number structure. This results in the values shown in the preview section.

In this example, the [Z] counter has been used. The Start At and Step By values have been left at default, this results in the values shown.

If no auto increment value is entered in any field, each data point/command field value will be created the same with the exception of *Tag* and *IOA*. The first new data point/command's *Tag* value will represent what was entered in the *New value* section. However, the subsequent data points/commands will contain the initial *Tag* value followed by an underscore and a number incrementing by one from 1 onwards. (Example: tag, tag_1, tag_2 etc.). This is an artefact of eNode Designer ensuring all data point tag names are unique.

5.1 Automatic Increments in Constant Values

In the DNP3 eNode module, the following fields will be automatically increased by one for each row, even if a constant value is entered in the "New value" field.

Address

6 Reference Guide

6.1 Table Buttons

Client Options: Add +1 Delete	Modify Selected Points Move Up Move Down
Server Options: Add Reference Description	elete Modify Selected Points Move Up Move Down
Add +1 Add Reference Delete Modify Selected Points Move Up Move Down	Adds new data points in the client. See section 3.3.2. Adds a single new data point in the client. See section 3.3.2. Adds a new data point reference in the server. See section 3.4.2. Deletes the selected data points Modify the properties of the selected data points. See section 3.5.2. Moves the selected data points up one row in the table Moves the selected data points down one row in the table

6.2 Table Columns

6.2.1.1 Tag

Description	A unique Tag name for each data point.
Data Entry	String
Min Length	1
Max Length	N/A
Input Option	Mandatory

6.2.1.2 Groups

Description	The DNP3 point type.
Data Entry	Drop Down Menu
Groups	Binary Input, Double Input, Counter Input, Analog Input, Binary Output, Analog Output
Input Option	Mandatory

6.2.1.3 Start Address

Description	The DNP3 starting <i>index</i> in the DNP3 point type.
Data Entry	Integer

Start Address	n/a
Count	0 to 65535 (the max Address starting from "start addr"+"count" can't exceed 65535)
Input Option	Mandatory

6.2.1.4 Count

Description	The request address
Data Entry	Integer
Options	0~65000
Input Option	Mandatory

6.2.1.5 Operation Mode

Description Assigns the command type to a command point.		
Data Entry Drop down menu		
Range Direct Operate, Select Before Operate		
Input Option	Mandatory for commands	

6.2.1.6 Analog Input Deadband

Server Data Only

Description	The dead-band of the Analog input. An event is triggered when the Analog input changes an amount greater than the deadband value.
Data Entry	Floating point number
Range	0.0 or greater
Input Option	Mandatory for Analog inputs

6.2.1.7 SBO Timeout (ms)

Server commands only	
Description	The timeout to wait for a SBO (Select before operate) to complete in milliseconds.
Data Entry	Integer
Range	0 to 65000
Input Option	Mandatory if command type is Select Before Operate

6.3 DNP3's Related ADH Types

The DNP3 data types correspond to the ADH types given in the table below.

DNP3 Point Type	ADH Data Type	ADH Exchange Type			
Binary Input	Single Point	Data			

Double Input	Double Point	Data
Counter Input	Unsigned 32	Data
Analog Input	Float 32	Data
Binary Output	Single Point	Command
Analog Output	Float 32	Command

Table 6-1 – DNP3 data types relation to ADH data point types.

7 DNP3 Client Properties

7.1 Device Profile

This document defines the options of the DNP3 protoc an implementation table.	ol used by Atop DNP3 devices and must be accompanied by
Vendor Name: Atop Technologies, Inc.	
Device Name: PG59XX Series DNP3 Server over Etherne	t or Serial
Device Function: ■ Master Outstation	
DNP Levels Supported for: Request and Response None Level 1 Level 2 Level 3 Level 4	 Supported Function Blocks: Self-Address Support Data Sets File Transfer Virtual Terminals Mapping to IEC61850 Object Models defined in a DNP3 XML file Function code 31, activate configuration Authentication
Connections Supported: ■ Serial ■ IP Networking	
Serial Connections: Serial Connection Parameters: ■ Asynchronous – 8 Data Bits, 1 Start Bit, 1 Stop B	it, No Parity
Baud Rate: fixed ■ Configurable – 110 to 115200	
Flow Control: ■ None Hardware flow control Software flow control	
Interval to Request Link Status: ■ Not supported Fixed at seconds Configurable – 0 to 2147483647	
Supports DNP3 Collision Avoidance: ■ No Yes, using back-off time = (Min + Random) meth	nod
Receiver Inter-character Timeout: ■ Not checked No gap permitted	

Fine die hit time en	
Fixed a bit times	
Fixed a ms	
Configurable	
Inter-character Gap in Transmission:	
■ None	
Maximum bit times	
Maximum ms	
ID Natworking:	
Type of End Point:	
■ TCP Initiating	
■ TCP Listening	
UDP datagram	
TCP Listen Port Number:	
Fixed at 20000	
Configurable, range 1 to 65535 (default 20000)	
TCD Keen alive timer:	
TCP Keep-alive timer:	
■ Fixed at 19000 ms	
Configurable, range to ms	
Local UDP Port:	
Fixed at 20000	
■ Configurable, range 1 to 65535 (default 20000)	
Multiple Outstation Connections:	
Multiple Outstation Connections.	
Supports multiple outstations (maximum is 64)	
Time Synchronization Support:	
Not supported	
DNP3 LAN Procedure	
■ DNP3 Write Time	
Data Link Address:	Self-Address Support using address OxEEEC
Fixed at 202	
Fixed at 292	
\blacksquare Configurable, range 0 to 65519 (default 2)	NO
Sends Contirmed User Data Frames:	Data Link Layer Confirmation Timeout:
■ Never	■ None
Sometimes, explain	Fixed at 2000 ms
Always	Configurable, range to ms
	ö , ö <u>——</u> <u>——</u>
Maximum Data Link Retries:	
Nover Potries	
Fixed at 2	
Configurable range to	
Maximum number of octets Transmitted in a Data Link	Maximum number of octets that can be Received in a Data
Frame:	Link Frame:
■ Fixed at 292	■ Fixed at 292
Configurable range to	Configurable range to
(U	

Maximum number of octets Transmitted in an	Maximum number of octets that can be Received in an
Application Layer Fragment:	Application Layer Fragment:
■ Fixed at 2048	■ Fixed at 249
Configurable, range to	Configurable, range to
Timeout waiting for Complete Application Layer Fragm	nent:
None	
Fixed at 6000 ms	
■ Configurable, range _1000_ to _65535_ ms	
Ocurtural Otativa Ocura a Ocura a stadu	
Control Status Codes Supported:	
1 – TIMEOUT	■ 11 – PROCESSING_LIMITED
■ 2 – NO_SELECT	■ 12 – OUT_OF_RANGE
■ 3 – FORMAT_ERROR	13 – DOWNSTREAM_LOCAL
4 – NOT_SUPPORTED	14 – ALREADY_COMPLETE
■ 5 – ALREADY_ACTIVE	15 – BLOCKED
■ 6 – HARDWARE_ERROR	16 – CANCELLED
■ 7 – LOCAL	17 – BLOCKED_OTHER_MASTER
8 – TOO_MANY_OBJS	18 – DOWNSTREAM_FAIL
■ 9 – NOT_AUTHORIZED	■ 126 – RESERVED
10 – AUTOMATION_INHIBIT	■ 127 – UNDEFINED

7.2 Implementation Table

	2	<u> </u>	<u> </u>	-	Obj ect	
•	0	2	<u>→</u>	0	Var iati on	
Distant Issue Obassas without Times	Binary Input Change - All Variations (Default variation)	Binary Input with Status	Binary Input - Packed Format	Binary Input - All Variations (Variation 0 is used to request default variation)	Description	OBJECT
7	1	-		1(Read), 22(Assign Class)	Application Layer Function Codes (Decimal)	REQUES (Library will pa
00 70 00	06,07,08	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	Qualifier Codes (hex)	r arse)
100 120 /I Insolinited	129	129	129,	129(Response)	Application Layer Function Codes (Decimal)	RESPOI (Library will res
17 28	17, 28	00, 01 17, 28	00, 01 17, 28	00, 01 17, 28	Qualifier Codes (hex)	NSE pond with)

4	ω	ω	ω	2	2		Obj ect	
0	N	<u> </u>	0	ω	2		Var iati on	
Double-bit Binary Input Change - All Variations (Default variation)	Double-bit Binary Input	Double-bit Binary Input – Packed Format	Double-bit Binary Input - All Variations (Variation 0 is used to request default variation)	Binary Input Change with Relative Time	Binary Input Change with Time		Description	OBJECT
1	-		1(Read), 22(Assign Class)				Application Layer Function Codes (Decimal)	REQUEST (Library will pa
06,07,08	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	06,07,08	06,07,08		Qualifier Codes (hex)	r arse)
129	129	129,	129(Response)	129, 130	129, 130	Response)	Application Layer Function Codes (Decimal)	RESPON (Library will resp
17, 28	00, 01 17, 28	00, 01 17, 28	00, 01 17, 28	17, 28	17, 28		Qualifier Codes (hex)	JSE pond with)

DNP3

10	10	10	4	4	4	ect	
2	<u>→</u>	0	ω	2	_	Var iati on	
Binary Output Status	Binary Output	Binary Output - All Variations	Double-bit Binary Input Change with Relative Time	Double-bit Binary Input Change with Time	Double-bit Binary Input Change without Time	Description	OBJECT
		1(Read), 22(Assign Class)				Application Layer Function Codes (Decimal)	REQUEST (Library will pa
00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	06,07,08	06,07,08	06,07,08	Qualifier Codes (hex)	rse)
129,	129,	129	129, 130	129, 130	129, 130 (Unsolicited Response)	Application Layer Function Codes (Decimal)	RESPON (Library will res)
00, 01 17, 28	00, 01 17, 28	00, 01 17, 28	17, 28	17, 28	17, 28	Qualifier Codes (hex)	uSE pond with)

20	20	20	12	12	Obj ect	
2	<u>→</u>	0		0	Var iati on	
16-Bit Binary Counter	32-Bit Binary Counter	Binary Counter - All Variations	Control Relay Output Block	Control Block - All Variations	Description	OBJECT
1,	, ,	1(Read), 22(Assign Class) 7(Immediate Freeze - No Response), 9 (Freeze and Clear), 10 (Freeze and Clear – No Response)	3(Select), 4(Operate), 5 (Direct Operate), 6 (Direct Operate NR)		Application Layer Function Codes (Decimal)	REQUES1 (Library will pa
00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	17, 28		Qualifier Codes (hex)	rse)
129,	129,	129	129		Application Layer Function Codes (Decimal)	RESPON (Library will res
00, 01 17, 28	00, 01 17, 28	00, 01 17, 28	echo of request		Qualifier Codes (hex)	vSE pond with)

21	21	20	20	ect Obj	
	0	0	J	Var iati on	
32-Bit Frozen Counter	Frozen Counters - All Variations	16-Bit Binary Counter without Flag	32-Bit Binary Counter without Flag	Description	OBJECT
	1(Read), 22(Assign Class)	-		Application Layer Function Codes (Decimal)	REQUEST (Library will pa
00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	Qualifier Codes (hex)	r arse)
129,	129(Response)	129,	129,	Application Layer Function Codes (Decimal)	RESPON (Library will res
00, 01 17, 28	00, 01 17, 28	00, 01 17, 28	00, 01 17, 28	Qualifier Codes (hex)	VSE pond with)

21	21	21	21		ect	
Q	o	J	N		Var iati on	
32-Bit Frozen Counter without Flag	16-Bit Frozen Counter with Time of Freeze	32-Bit Frozen Counter with Time of Freeze	16-Bit Frozen Counter		Description	OBJECT
_ _					Application Layer Function Codes (Decimal)	REQUEST (Library will pa
00, 01 (start-stop) 06 (no range, or all)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	17, 28 (index)	Qualifier Codes (hex)	rse)
129,	129,	129,	129,		Application Layer Function Codes (Decimal)	RESPON (Library will res)
00, 01 17, 28	00, 01 17, 28	00, 01 17, 28	00, 01 17, 28		Qualifier Codes (hex)	USE pond with)

		OBJECT	REQUEST (Library will pa	r arse)		RESPON (Library will resp
Obj ect	Var iati on	Description	Application Layer Function Codes (Decimal)	Qualifier Codes (hex)	Application Layer Function Codes (Decimal)	Qualifier ((hex
				07, 08 ,(limited qty) 17, 28 (index)		
21	10	16-Bit Frozen Counter without Flag	<u> </u>	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	129,	00
22	0	Counter Change Event - All Variations	1	06,07,08	129	17
22	1	32-Bit Counter Change Event without Time	_	06,07,08	129, 130	17
22	2	16-Bit Counter Change Event without Time	_	06,07,08	129, 130	17
22	ъ	32-Bit Counter Change Event with Time	1	06,07,08	129, 130	17
22	6	16-Bit Counter Change Event with Time	1	06,07,08	129, 130	17
23	0	Frozen Counter Events - All Variations		06,07,08	129	17
23	-	32-Bit Frozen Counter Event without Time	→	06,07,08	129, 130	17

r

30	30	30	23	23	23	Obj ect	
2	<u>→</u>	0	6	сл	2	Var iati on	
16-Bit Analog Input	32-Bit Analog Input	Analog Input - All Variations	16-Bit Frozen Counter Event with Time	32-Bit Frozen Counter Event with Time	16-Bit Frozen Counter Event without Time	Description	OBJECT
1	-	1(Read), 22(Assign Class) 7(Immediate Freeze -, No Response), 9 (Freeze and Clear), 10 (Freeze and Clear – No Response)	1	1	1	Application Layer Function Codes (Decimal)	REQUES1 (Library will pa
00, 01 (start-stop) 06 (no range, or all)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	06,07,08	06,07,08	06,07,08	Qualifier Codes (hex)	r arse)
129,	129,	129(Response)	129, 130	129, 130	129, 130	Application Layer Function Codes (Decimal)	RESPON (Library will resp
00, 01 17, 28	00, 01 17, 28	00, 01 17, 28	17, 28	17, 28	17, 28	Qualifier Codes (hex)	JSE pond with)

31	30	30	30		Obj ect	
0	Cī	4	ω		Var iati on	
Frozen Analog Input - All Variations	Single-precision float –point with flag	16-Bit Analog Input without flag	32-Bit Analog Input without flag		Description	OBJECT
1(Read), 22(Assign Class)			_		Application Layer Function Codes (Decimal)	REQUES1 (Library will pa
00, 01 (start-stop)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	07, 08 ,(limited qty) 17, 28 (index)	Qualifier Codes (hex)	irse)
129(Response)	129,	129,	129,		Application Layer Function Codes (Decimal)	RESPON (Library will resp
00, 01,	00, 01, 17, 28	00, 01, 17, 28	00, 01 17, 28		Qualifier Codes (hex)	USE pond with)

31	<u>3</u>	31	31		Obj ect	
4	ω	N	<u>ب</u>		Var iati on	
16-Bit Frozen Analog Input with Time of	32-Bit Frozen Analog Input with Time of Freeze	16-Bit Frozen Analog Input	32-Bit Frozen Analog Input		Description	OBJECT
		-	-		Application Layer Function Codes (Decimal)	REQUEST (Library will pa
	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	Qualifier Codes (hex)	r irse)
129,	129,	129,	129,		Application Layer Function Codes (Decimal)	RESPON (Library will res)
	00, 01, 17, 28	00, 01, 17, 28	00, 01, 17, 28	17, 28	Qualifier Codes (hex)	VSE pond with)

31	31	31		Obj ect	
7	0	Сл		Var iati on	
Single-precision float –point with flag	16-Bit Frozen Analog Input without Flag	32-Bit Frozen Analog Input without Flag	Freeze	Description	OBJECT
_	_			Application Layer Function Codes (Decimal)	REQUEST (Library will pa
00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	Qualifier Codes (hex)	Irse)
129,	129,	129,		Application Layer Function Codes (Decimal)	RESPON (Library will res)
00, 01, 17, 28	00, 01, 17, 28	00, 01, 17, 28	00, 01, 17, 28	Qualifier Codes (hex)	USE pond with)

Г

17, 28	129, 130	06,07,08	1	32-Bit Frozen Analog Event without Time		33
17, 28	129	06,07,08	1	Frozen Analog Event - All Variations	0	33
17, 28	129, 130	06,07,08	1	Single-precision float-point Analog Change Event with Time	7	32
17, 28	129, 130	06,07,08	1	Single-precision, float –point Analog Change Event with out Time	5	32
17, 28	129, 130	06,07,08	1	16-Bit Analog Change Event with Time	4	32
17, 28	129, 130	06,07,08	1	32-Bit Analog Change Event with Time	3	32
17, 28	129, 130	06,07,08	1	16-Bit Analog Change Event without Time	2	32
17, 28	129, 130	06,07,08	1	32-Bit Analog Change Event without Time		32
17, 28	129	06,07,08	1	Analog Change Event - All Variations	0	32
Qualifier Codes (hex)	Application Layer Function Codes (Decimal)	Qualifier Codes (hex)	Application Layer Function Codes (Decimal)	Description	Var iati on	Obj ect
ISE pond with)	RESPON (Library will res)	r arse)	REQUES1 (Library will pa	OBJECT		

		OBJECT	REQUEST	- Irse)	RESPON (Librarv will res)	ISE bond with)
Obj ect	Var iati on	Description	Application Layer Function Codes (Decimal)	Qualifier Codes (hex)	Application Layer Function Codes (Decimal)	Qualifier Codes (hex)
33	2	16-Bit Frozen Analog Event without Time	→	06,07,08	129, 130	17, 28
33	မ	32-Bit Frozen Analog Event with Time	1	06,07,08	129, 130	17, 28
33	4	16-Bit Frozen Analog Event with Time	1	06,07,08	129, 130	17, 28
33	5	Single-precision_float -point Frozen Analog Change Event with out Time	1	06,07,08	129, 130	17, 28
33	7	Single-precision_float -point_Frozen Analog Change Event with Time	1	06,07,08	129, 130	17, 28
40	0	Analog Output Status - All Variations	1(Read), 22(Assign Class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	129(Response)	00, 01, 17, 28
40	1	32-Bit Analog Output Status		00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty)	129,	00, 01, 17, 28

vectVar intDescriptionApplication Layer Codes (Decimal)Qualifier Codes (nee)Application Layer (nee)Qualifier Codes (nee)Qualifier Codes (nee)			OBJECT	/I ibrary will pa		(1 ihrarv will rest	ISE
	Obj ect	Var iati on	Description	Application Layer Function Codes (Decimal)	Qualifier Codes (hex)	Application Layer Function Codes (Decimal)	Qualifier (he)
40216-Bit Analog Output Status100, 01 (start-stop) 06 (no range, or all) 07, 08, (limited qty)129, $00, 01, 01, 00, 01, 00, 01, 00, 00, 00, $					17, 28 (index)		
403Single-precision float -point Analog Output 11 $00, 01$ (start-stop) 06 (no range, or all) $07, 08$ (limited qty) $00, 01$, 06 (no range, or all) $17, 28$ (index) $00, 01$, $17, 28$ $00, 01$, 129 $00, 01$, $17, 28$ $00, 01$, 	40	N	16-Bit Analog Output Status	<u> </u>	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	129,	00, 01, 17, 28
411 32 -Bit Analog Output Block $3, 4, 5, 6$ $17, 28$ 129 echo of rec 41 216-Bit Analog Output Block $3, 4, 5, 6$ $17, 28$ 129 echo of rec 41 3Analog Output - Single-precision float - point Output - Single-precision float - $3, 4, 5, 6$ $17, 28$ 129 echo of rec 50 1Time and Date $2(Write)$ $2(Write)$ 07 (Quantity = 1) 129 07 (quantity = 1)	40	ω	Status Precision floatpoint Analog Output	<u>→</u>	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	129,	00, 01, 17, 28
41216-Bit Analog Output Block $3, 4, 5, 6$ $17, 28$ 129 echo of rec413Analog Output - Single-precision float - point Guint - Single-precision float - $3, 4, 5, 6$ $17, 28$ 129 echo of rec501Time and Date $2(Write)$ 07 (Quantity = 1) 129 07 (quantity = 1)	41	-	32-Bit Analog Output Block	3, 4, 5, 6	17, 28	129	echo of rec
413Analog Output – Single-precision float – point $3, 4, 5, 6$ 17, 28129echo of rec501Time and Date $2(Write)$ 07 (Quantity = 1) 129 07 (quantity = 1)	41	2	16-Bit Analog Output Block	3, 4, 5, 6	17, 28	129	echo of req
50 1 Time and Date 2(Write) 07 Quantity = 1) 129 07 Quantity	41	3	Analog Output - Single-precision float - point	3, 4, 5, 6	17, 28	129	echo of rec
	50	-	Time and Date	2(Write)	07 (Quantity = 1)	129	07 (quanti

	129	06,07,08		Class 1 Data	2	60
	129	06		Class 0 Data		60
	200	2			•	2
Qualifier Codes (hex)	Application Layer Function Codes (Decimal)	Qualifier Codes (hex)	Application Layer Function Codes (Decimal)	Description	Var iati on	Obj ect
VSE pond with)	RESPON (Library will res	Г arse)	REQUES ⁻ (Library will pa	OBJECT		

8 DNP3 Server Properties

8.1 Device Profile

DNP3 Device Profile

This document defines the options of the DNP3 protocol used by Atop DNP3 devices and is accompanied by an implementation table.

Vendor Name: Atop Technologies, Inc.	
Device Name: PG59XX Series DNP3 Server over Ethernet or Serial	
Device Function: Master ■ Outstation	
 DNP Levels Supported for: Request and Response None Level 1 Level 2 Level 3 Level 4 	Supported Function Blocks: ■ Self-Address Support Data Sets File Transfer Virtual Terminals Mapping to IEC61850 Object Models defined in a DNP3 XML file Function code 31, activate configuration Authentication
Connections Supported: ■ Serial ■ IP Networking	
Serial Connections: Serial Connection Parameters: ■ Asynchronous – 8 Data Bits, 1 Start Bit, 1 Stop	o Bit, No Parity
Baud Rate: fixed ■ Configurable – 110 to 115200	
Flow Control: ■ None Hardware flow control Software flow control	
Interval to Request Link Status: ■ Not supported Fixed at seconds Configurable – 0 to 2147483647	
Supports DNP3 Collision Avoidance: ■ No Yes, using back-off time = (Min + Random) m	ethod

Receiver Inter-character Timeout	
Not checked	
No gap permitted	
Fixed a bit times	
Configurable 0 to 60000	
Inter-character Gap in Transmission	
■ None	
Maximum bit times	
Maximum ms	
IP Networking:	
Type of End Point:	
TCP Listening	
■ UDP datagram	
TCP Listen Port Number:	
Fixed at 20000	
■ Configurable, range 1 to 65535 (default 20000)	
TCP Keep-alive timer:	
■ Fixed at 19000 ms	
Configurable, range to ms	
Local UDP Port:	
Fixed at 20000	
■ Configurable, range 1 to 65535 (default 20000)	
Multiple Master Connections:	
Not supported	
Supports multiple masters (maximum is 5)	
Time Synchronization Support:	
Not supported	
DNP3 LAN Procedure	
DNP3 White Time	
Data Link Address:	Self-Address Support using address 0xFFFC:
	■ Yes
■ Configurable, range 0 to 65519 (default 1)	NO
Sends Confirmed User Data Frames:	Data Link Layer Confirmation Timeout:
Sometimes evoluin	■ None Fixed at 2000 ms
Always	Configurable, range to ms
Maximum Data Link Retries:	
Fixed at 3	
Configurable, range to	
Maximum number of octets Transmitted in a Data	Maximum number of octets that can be Received in a
LINK Frame:	Data Link Frame:
Configurable range to	Configurable, range to

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Maximum number of octets Transmitted in an Application Layer Fragment: Fixed at 2048 Configurable, range to	Maximum number of octets that can be Received in an Application Layer Fragment: ■ Fixed at 249 Configurable, range to
Timeout waiting for Complete Application Layer Fragm None ■ Fixed at 6000 ms Configurable, range to ms	ent:
Timeout waiting for Application Confirm of solicited re ■ None Fixed at 6000 ms Configurable, range 0 to 2147483647 ms (defau	sponse message: Ilt 10000)
Requests Application Confirmation for event response Yes No Configurable	and non-final fragments:
Sends Multi-Fragment Responses: ■ Yes No	Last Fragment Confirmation: Always ■ Sometimes, Only when it contains events Never
Maximum number of objects allowed in a single contro ■ Fixed at 16 Configurable, range to	I request for CROB (group 12):
Maximum number of objects allowed in a single contro ■ <i>Fixed at 16</i> <i>Configurable, range to</i>	I request for Analog Outputs (group 41):
Control Status Codes Supported: 1 – TIMEOUT 2 – NO_SELECT 3 – FORMAT_ERROR 4 – NOT_SUPPORTED 5 – ALREADY_ACTIVE 6 – HARDWARE_ERROR 7 – LOCAL 8 – TOO_MANY_OBJS 9 – NOT_AUTHORIZED 10 – AUTOMATION_INHIBIT	 11 – PROCESSING_LIMITED 12 – OUT_OF_RANGE 13 – DOWNSTREAM_LOCAL 14 – ALREADY_COMPLETE 15 – BLOCKED 16 – CANCELLED 17 – BLOCKED_OTHER_MASTER 18 – DOWNSTREAM_FAIL 126 – RESERVED 127 – UNDEFINED
Supports Unsolicited Reporting: ■ Not Supported Configurable, selectable from On and Off	
Unsolicited Response Confirmation Timeout: Fixed at ms Configurable, range 0 to 4294967295 ms	Number of Unsolicited Retries: Fixed at 5 Configurable, range to
 Event Buffer Overflow Behavior: Discard the oldest event Discard the newest event Other, explain 	

Event Buffer Org	anization:				
Per Object					
Per Class					
Class 1:	Fixed at	Configurable,	range 50 to 6553	35	
Class 2:	Fixed at	Configurable,	range 50 to 6553	35	
Class 3:	Fixed at	Configurable,	range 50 to 6553	35	
Single Buffe Fixed at Configurab	er ole, range to				
Outstation Unso	licited Response Trigge	er Conditions:			
(Number of eve	ents)				
class 1: ■ Not	used to trigger Unsolici	ted Response	Fixed at	Configurable	
class 2: ■ Not	used to trigger Unsolici	ited Response	Fixed at	Configurable	
ciass 3: ■ Not	used to trigger Unsolici	itea Kesponse	Fixed at	Configurable	

8.2 Implementation Table

		OBJECT	REQUEST (Library will pa	rse)	RESPON (Library will res	VSE pond with)
Obj ect	Var iati on	Description	Application Layer Function Codes (Decimal)	Qualifier Codes (hex)	Application Layer Function Codes (Decimal)	Qualifier Codes (hex)
	0	Binary Input - All Variations (Variation 0 is used to request default variation)	1(Read), 22(Assign Class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gtv</u>) 17, 28 (index)	129(Response)	00, 01 17, 28
	<u>د</u>	Binary Input - Packed Format	4	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gtx</u>) 17, 28 (index)	129,	00, 01 17, 28
	N	Binary Input with Status	7	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gtx</u>) 17, 28 (index)	129	00, 01 17, 28
2	0	Binary Input Change - All Variations (Default variation)	1	06,07,08	129	17, 2

			1	1				-
	Obj ect	N	Ν	2	ω	ω	ω	4
	Var iati on	<u>→</u>	2	ω	O	-	2	0
OBJECT	Description	Binary Input Change without Time	Binary Input Change with Time	Binary Input Change with Relative Time	Double-bit Binary Input - All Variations (Variation 0 is used to request default variation)	Double-bit Binary Input – Packed Format	Double-bit Binary Input	Double-bit Binary Input Change - All
REQUES	Application Layer Function Codes (Decimal)	-			1(Read), 22(Assign Class)		-	
r arse)	Qualifier Codes (hex)	06,07,08	06,07,08	06,07,08	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gtX</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	06,07,08
RESPOI (Library will res	Application Layer Function Codes (Decimal)	129, 130 (Unsolicited Response)	129, 130	129, 130	129(Response)	129,	129	129
;pond with)	Qualifier Codes (hex)	17, 28	٦٢, 28	17, 28	00, 01 17, 28	00, 01 17, 28	00, 01 17, 28	17, 28

	Obj ect	4	4	4	10	10	10
	Var iati on		2	ω	0		N
OBJECT	Description	Double-bit Binary Input Change without Time	Double-bit Binary Input Change with Time	Double-bit Binary Input Change with Relative Time	Binary Output - All Variations	Binary Output	Binary Output Status
REQUES: (Library will pa	Application Layer Function Codes (Decimal)	-		_	1(Read), 22(Assign Class)	-	-
r arse)	Qualifier Codes (hex)	06,07,08	06,07,08	06,07,08	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)
RESPOI (Library will res	Application Layer Function Codes (Decimal)	129, 130 (Unsolicited Response)	129, 130	129, 130	129	129,	129,
pond with)	Qualifier Codes (hex)	17, 28	17, 28	17, 28	00, 01 17, 28	00, 01 17, 28	00, 01 17, 28

20	20	20	12	12	Obj ect	
N	د_	0	<u>ــ</u>	0	Var iati on	
16-Bit Binary Counter	32-Bit Binary Counter	Binary Counter - All Variations	Control Relay Output Block	Control Block - All Variations	Description	OBJECT
د.	,	1(Read), 22(Assign Class) 7(Immediate Freeze), 8 (Immediate Freeze - No Response), 9 (Freeze and Clear), 10 (Freeze and Clear – No Response(3(Select), 4(Operate), 5 (Direct Operate), 6 (Direct Operate NR)		Application Layer Function Codes (Decimal)	REQUES1 (Library will pa
00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gtx</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	17, 28		Qualifier Codes (hex)	rse)
129,	129,	129	129		Application Layer Function Codes (Decimal)	RESPOI (Library will res
00, 01 17, 28	00, 01 17, 28	00, 01 17, 28	echo of request		Qualifier Codes (hex)	vse pond with)

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21	21	20	20	Obj ect	
<u>ــ</u>	0	თ	СЛ	Var iati on	
32-Bit Frozen Counter	Frozen Counters - All Variations	16-Bit Binary Counter without Flag	32-Bit Binary Counter without Flag	Description	OBJECT
-	1(Read), 22(Assign Class)	L	-	Application Layer Function Codes (Decimal)	REQUEST (Library will pa
00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	Qualifier Codes (hex)	rse)
129,	129(Response)	129,	129,	Application Layer Function Codes (Decimal)	RESPOI (Library will res
00, 01 17, 28	00, 01 17, 28	00, 01 17, 28	00, 01 17, 28	Qualifier Codes (hex)	ipond with)

21	21	21	21	Obj ect	
Q	თ	СЛ	N	Var iati on	
32-Bit Frozen Counter without Flag	16-Bit Frozen Counter with Time of Freeze	32-Bit Frozen Counter with Time of Freeze	16-Bit Frozen Counter	Description	OBJECT
		-		Application Layer Function Codes (Decimal)	REQUES1 (Library will pa
00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gtx</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	Qualifier Codes (hex)	rse)
129,	129,	129,	129,	Application Layer Function Codes (Decimal)	RESPON (Library will res
00, 01 17, 28	00, 01 17, 28	00, 01 17, 28	00, 01 17, 28	Qualifier Codes (hex)	vse pond with)

		OBJECT	REQUEST (Library will pa	rse)	RESPON (Library will res	uSE pond with)
Obj ect	Var iati on	Description	Application Layer Function Codes (Decimal)	Qualifier Codes (hex)	Application Layer Function Codes (Decimal)	Qualifier Codes (hex)
21	10	16-Bit Frozen Counter without Flag	-	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gtv</u>) 17, 28 (index)	129,	00, 01 17, 28
22	0	Counter Change Event - All Variations	-1	06,07,08	129	17, 28
22	-	32-Bit Counter Change Event without Time	-	06,07,08	129, 130	17, 28
22	2	16-Bit Counter Change Event without Time		06,07,08	129, 130	17, 28
22	5	32-Bit Counter Change Event with Time		06,07,08	129, 130	17, 28
22	6	16-Bit Counter Change Event with Time		06,07,08	129, 130	17, 28
23	0	Frozen Counter Events - All Variations	-	06,07,08	129	17, 28
23	-	32-Bit Frozen Counter Event without Time		06,07,08	129, 130	17, 28
23	2	16-Bit Frozen Counter Event without Time		06,07,08	129, 130	17, 28
23	5	32-Bit Frozen Counter Event with Time		06,07,08	129, 130	17, 28

30	30	30	23	Obj ect	
Ν	<u>ب</u>	0	6	Var iati on	
16-Bit Analog Input	32-Bit Analog Input	Analog Input - All Variations	16-Bit Frozen Counter Event with Time	Description	OBJECT
-	-	1(Read), 22(Assign Class) 7(Immediate Freeze), 8 (Immediate Freeze - No Response), 9 (Freeze and Clear), 10 (Freeze and Clear – No Response)	-	Application Layer Function Codes (Decimal)	REQUES (Library will pa
00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>qty</u>) 17, 28 (index)	06,07,08	Qualifier Codes (hex)	r arse)
129,	129,	129(Response)	129, 130	Application Layer Function Codes (Decimal)	RESPOI (Library will res
00, 01 17, 28	00, 01 17, 28	00, 01 17, 28	17, 28	Qualifier Codes (hex)	pond with)

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<u>3</u>	SU	30	30	φO	
				C D	-
0	σ	4	ω	Var on	
Frozen Analog Input - All Variations	Single-precision Tloat -point with Tlag	16-Bit Analog Input without flag	32-Bit Analog Input without flag	Description	OBJECT
1(Read), 22(Assign Class)	-	-	-	Application Layer Function Codes (Decimal)	REQUES1 (Library will pa
00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>qty</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	Qualifier Codes (hex)	rse)
129(Response)	129,	129,	129,	Application Layer Function Codes (Decimal)	RESPO (Library will res
00, 01, 17, 28	00, 01, 17, 28	00, 01, 17, 28	00, 01 17, 28	Qualifier Codes (hex)	NSE spond with)

2	Obj ect	31	31	31	31
:	Var iati on		N	ω	4
OBJECT	Description	32-Bit Frozen Analog Input	16-Bit Frozen Analog Input	32-Bit Frozen Analog Input with Time of Freeze	16-Bit Frozen Analog Input with Time of Freeze
REQUES (Library will pa	Application Layer Function Codes (Decimal)	~	-	-	
	Qualifier Codes (hex)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>aty</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>qty</u>) 17, 28 (index)
RESPON (Library will res	Application Layer Function Codes (Decimal)	129,	129,	129,	129,
ipond with)	Qualifier Codes (hex)	00, 01, 17, 28	00, 01, 17, 28	00, 01, 17, 28	00, 01, 17, 28

-	Obj ect	31	31	ن ا	32	32	
	Var iati on	5	o		0	-	
OBJECT	Description	32-Bit Frozen Analog Input without Flag	16-Bit Frozen Analog Input without Flag	Single-precision Tloat -point with Tlag	Analog Change Event - All Variations	32-Bit Analog Change Event without Time	
REQUES: (Library will pa	Application Layer Function Codes (Decimal)	-	_	-	-	1	
arse)	Qualifier Codes (hex)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited <u>gty</u>) 17, 28 (index)	06,07,08	06,07,08	
RESPO (Library will re:	Application Layer Function Codes (Decimal)	129,	129,	129,	129	129, 130	200
spond with)	Qualifier Codes (hex)	00, 01, 17, 28	00, 01, 17, 28	00, 01, 17, 28	17, 28	17, 28	17, 28

		OBJECT	REQUEST (Library will pa	rse)	RESPON (Library will rest	oond with)
Obj ect	Var iati on	Description	Application Layer Function Codes (Decimal)	Qualifier Codes (hex)	Application Layer Function Codes (Decimal)	Qualifier Codes (hex)
32	З	32-Bit Analog Change Event with Time	-1	06,07,08	129, 130	17, 28
32	4	16-Bit Analog Change Event with Time	1	06,07,08	129, 130	17, 28
32	5	Single-precision float –point Analog Change Event without Time	1	06,07,08	129, 130	17, 28
32	7	Single-precision float -point Analog Change Event with Time		06,07,08	129, 130	17, 28
33	0	Frozen Analog Event - All Variations	1	06,07,08	129	17, 28
33	-	32-Bit Frozen Analog Event without Time	1	06,07,08	129, 130	17, 28
33	2	16-Bit Frozen Analog Event without Time	1	06,07,08	129, 130	17, 28
33	З	32-Bit Frozen Analog Event with Time	1	06,07,08	129, 130	17, 28
33	4	16-Bit Frozen Analog Event with Time	1	06,07,08	129, 130	17, 28
33	5	Single-precision float -point Frozen Analog Change Event without Time	1	06,07,08	129, 130	17, 28
33	7	Single-precision float –point Frozen Analog Change Event with Time	<u> </u>	06,07,08	129, 130	17, 28

Obi	ect	40	40	40	40
Var	Var iati on	0	-	N	ω
OBJECT	Description	Analog Output Status - All Variations	32-Bit Analog Output Status	16-Bit Analog Output Status	Single-precision float –point Analog Output Status
REQUES1 (Library will pa	Application Layer Function Codes (Decimal)	1(Read), 22(Assign Class)		~	
nrse) Dualifier Codes	Qualifier Codes (hex)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)	00, 01 (start-stop) 06 (no range, or all) 07, 08 ,(limited qty) 17, 28 (index)
RESPON (Library will res Annlication Laver	Application Layer Function Codes (Decimal)	129(Response)	129,	129,	129,
NSE pond with) Dualifier Codes	Qualifier Codes (hex)	00, 01, 17, 28	00, 01, 17, 28	00, 01, 17, 28	00, 01, 17, 28

80		60		60		60	60	50	41	41	41	Obj ect	
-		4		ω		2		1	З	Ν	-	Var on	
Internal Indications		Class 3 Data		Class 2 Data		Class 1 Data	Class 0 Data	Time and Date	Analog Output – Single-precision float – point	16-Bit Analog Output Block	32-Bit Analog Output Block	Description	OBJECT
	20 (Enable Unsolicited), 21,(Disable Unsolicited)		20 (Enable Unsolicited), 21,(Disable Unsolicited)		20 (Enable Unsolicited), 21,(Disable Unsolicited)			2(Write)	3, 4, 5, 6	3, 4, 5, 6	3, 4, 5, 6	Application Layer Function Codes (Decimal)	REQUES1 (Library will pa
00 index=7	06	06,07,08	06	06,07,08	06	06,07,08	06	07 (Quantity = 1)	17, 28	17, 28	17, 28	Qualifier Codes (hex)	r arse)
		129		129		129	129	129	129	129	129	Application Layer Function Codes (Decimal)	RESPOI (Library will res
								07 (quantity = 1)	echo of request	echo of request	echo of request	Qualifier Codes (hex)	pond with)



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