

# ActionNET – DNP 3.0

## Master Communication Protocol

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## 1. GENERAL INFO

### 1.1 Summary

**Communication Driver Name:** DNP30.

**Current Version:** 2016.2.

**Implementation DLL:** T.ProtocolDriver.DNP30.dll.

**Protocol:** DNP3.0 Master standard protocol.

**Interface:** TCP/IP or Serial.

**Description:** This driver is used for communication with remote IEDs (Intelligent Electronic Devices) using the protocol DNP 3.0 Level 2. Communication can be done through multi-point serial channel or LAN using Ethernet and TCP-IP. In the last case, each IED has an IP address.

**IEDs types supported:** Any compatible DNP 3 IED.

**Communication block size:** Maximum 250 bytes, FT 1.2 format.

**Protocol Options:** Mode "LinkConfirm" and master station address.

**Multi-threading:** User defined, five threads per communication node, by default.

**Max number of nodes:** User defined.

**PC Hardware requirements:** Standard PC Ethernet interface board, RS485 or RS232 port.

**PC Software requirements:** ActionNET system

### 1.2 Data Objects Supported

The table below shows the DNP objects and variants supported by this implementation. Objects labeled L4 are implemented, but are defined at the L4 level.

Objet			Request (Master)		Answer (Slave)	
Obj.	Var	Description	Function Codes (decimal)	Qualifier Codes (Hex)	Function Codes (decimal)	Qualifier Codes (Hex)
1	0	Binary Input (any variation)	1	00,01,06		
			22	00,01,06		
1	1	Single Bit Binary Input (packed)	1	00,01,06	129	00, 01
1	2	Binary Input with status	1	00,01,06	129	00, 01
2	0	Binary Input event (any variation)	1	06,07,08		
2	1	Binary Input change without time	1	06,07,08	129,130	17,18
2	2	Binary Input change with Absolut time	1	06,07,08	129,130	17,18
2	3	Binary Input change with relative time	1	06,07,08	129,130	17,18
3	0	Double bit Binary input – Any variation –L4	22	00,01,06		
3	1	Double-bit Binary Input – Packed –L4	1	00,01,06	129	00, 01
3	2	Double-bit Binary Input – With flags–L4	1	00,01,06	129	00, 01
4	0	Double-bit Binary Input Event – Any Variation–L4	1	06,07,08		

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4	1	Double-bit Binary Input Event – whitout time–L4	1	06,07,08	129,130	17,18
4	2	Double-bit Binary Input Event- with Absolut time–L4	1	06,07,08	129,130	17,18
4	3	Double-bit Binary Input Event - with relative time–L4	1	06,07,08	129,130	17,18
10	1	Binary Output – Any Variation	1	00,01,06		
10	2	Binary Output – status with flags	1	00,01,06	129	00,01
12	1	Control relay output block	3,4,5,6	17,28	129	Echo of request
20	0	Binary Counter – all variations	1,7,8,9,10			
20	1	Counter – 32-bit with flag	1	00,01,06	129	00, 01
20	2	Counter – 16-bit with flag	1	00,01,06	129	00, 01
20	5	Counter – 32-bit without flag	1	00,01,06	129	00, 01
20	6	Counter – 16-bit without flag	1	00,01,06	129	00, 01
21	0	Frozen counter – all variations	1,22			
21	1	Frozen Counter – 32-bit with flag	1	00,01,06	129	00, 01
21	2	Frozen Counter – 16-bit with flag	1	00,01,06	129	00, 01
21	9	Frozen Counter – 32-bit without flag	1	00,01,06	129	00, 01
21	10	Frozen Counter – 16-bit without flag	1	00,01,06	129	00, 01
22	0	Counter Event – Any Variation	1	06		
22	1	Counter Event – 32-bit with flag	1	06,07,08	129,130	17,18
22	2	Counter Event – 16-bit with flag	1	06,07,08	129,130	17,18
23	0	Frozen Counter Event – Any Variation	1	06,07,08		
23	1	Frozen Counter Event – 32-bit with flag	1	06,07,08	129,130	17,18
23	2	Frozen Counter Event – 16-bit with flag	1	06,07,08	129,130	17,18
30	0	Analog Input – all variations	1, 22	00,01,06		
30	1	32 Bits Analog Input	1	00,01,06	129	00, 01
30	2	16 Bit Analog input with flag	1	00,01,06	129	00, 01
30	3	32 Bits 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
30	5	Short Floating Point (32bits) – L4	1	00,01,06	129	00, 01
32	0	Analog Input event – all variations	1	06,07,08		
32	1	Analog Input event - 32 Bits without time	1	06,07,08	129,130	17,18
32	2	Analog event without flag – 16 Bits – Without time	1	06,07,08	129,130	17,18
32	3	32 Bit Analog event with flag – L4	1	06,07,08	129,130	17,18
32	4	16 Bit Analog event with flag– L4	1	06,07,08	129,130	17,18
32	5	Analog input event single float –without time– L4	1	06,07,08	129,130	17,18
32	7	Analog input event single float –with time– L4	1	06,07,08	129,130	17,18

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40	0	Analog Output Status-any variation	1			
40	1	Analog Output Status – 32bits with flag	1	00,01,06	129	00, 01
40	2	Analog Output Status -16bits with flag	1	00,01,06	129	00, 01
40	3	Analog output status – Single float with flag –L4	1	00,01,06	129	00, 01
41	1	Analog output block - 32Bit	3,4,5,6	17,28	129	Echo of request
41	2	Analog output block - 16 Bit	3,4,5,6	17,28	129	Echo of request
41	3	Analog output block – Single float - L4	3,4,5,6	17,28	129	Echo of request
50	1	Time and Data – Absolut time	1,2	0x07	129	07
51	1	Time and Date CTO – Absolute time, synchronized			129,130	07
51	2	Time and Date CTO – Absolute time, unsynchronized			129,130	07
52	1	Time Delay – Coarse			129	07
52	2	Time Delay – Fine			129	07
60	1	Class 0 data	1	0x06		
60	2	Class 1 data	1,20,21	06,07,08		
60	3	Class 2 data	1,20,21	06,07,08		
60	4	Class 3 data	1,20,21	06,07,08		
80	1	Internal indications	1,2	00,01	129	01

In the master mode protocol implementation, master only performs the requests highlighted in blue. The server equipment responds using the answers highlighted in yellow. Note that it is up to the server equipment deciding how to respond and the master must support all the features of level 2 to be used as a possible answer.

The objects, object variations, function codes and qualifiers have their standard meanings in DNP. Tables with the function code and qualifiers are shown below:

Function Code	Description	Origin
1	Read	Master
2	Write	Master
3	Select	Master
4	Oper	Master
5	Direct Oper (without selection)	Master
6	Direct Oper (without ack)	Master
7	Freeze Immediately	Master
8	Freeze Immediately (without ack)	Master
9	Freeze and Clear	Master

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10	Freeze and Read	Master
13	Restart (Cold)	Master
14	Restart (Warm)	Master
20	Enable non requested messages	Master
21	Disable non requested messages	Master
22	Assigns class for an object	Master
23	Measurement with delay	Master
129	Response	Slave
130	Non Requested Response (doesn't exist on level 2)	Slave

Qualifier Code	Use on Request	Use on Response
00,01	Static Points range (class 0) or a single point with a number	Static Object
06	All points	Invalid
07,08	A limited number of events A single point without number (this is a timestamp)	A single point without number (this is a timestamp)
17,28	Controls (one or more unrelated points)	Event Objects (one or more unrelated points)

DNP has the concept of data classes, defined four classes:

**Class 0:** Corresponds to the static points, analog or digital. Its content is the value of a variable analog or digital, input or output in a given time.

**Class 1, 2 e 3:** Events corresponding to class 0 variables transitions, state transitions or internal relay situations that causes an event.

A common practice in the DNP IEDs is to associate the state variation of digital variables or dead band pass of analog variable to classes 1, 2 or 3 events. Thus, modifying the state / value of these variables will cause events to be transmitted at the request of the respective classes of events (60 / 2 60 / 3 and 60 / 4). Periodically, it may be requested a class 0 reading (60 / 1), for checking integrity.

**Comments:**

Static variables not assigned to a class do not cause events.

Class to variable association should be done on the IED, using a proper program. Action.Net SCADA runs data acquisition through the classes, however, without defining which variable belongs to a class.

### 1.3 General Operation

The normal master sequence operation is showed below:

- Once started, as the first step, it sends read request for events of class 1, 2 and 3 (60 / 2 60 / 3 and 60 / 4), for all IEDs;
- In sequence, sends class 0 read request (read integrity - 60 / 1) for all IEDs;
- Periodically, with time intervals as defined in the initialization file, makes classes 0, 1, 2 and 3 (60 / 1 to 60 / 4) readings;
- When it has received a message with IIN (Internal Indication) stating that IED requires synchronization, sends timing message (50.1). This message is only sent at the request of a remote IED;
- When it's received a message with IIN stating that a restart has occurred, a "clear device flag" write (80/1) is done, and goes back to the first step;
- When the user commands a digital output or an analog output, is sent the respective request to the IED (12/1 or 41/2);

## 2. CHANNEL SETTINGS

### 2.1 Protocol Options

**LinkConfirmMode** – Protocol mode in which, in link layer, all requests should be confirmed by the remote IED. The default content is “Enabled”.

**Accept Unsolicited DNP** – Enabling this option leads to the dispatch of a Enable Unsolicited Messages message (Function Code = 20) from the master to the slave at the start of a channel execution, right after the Class 0 request and every time the master receives “RESTART” indication in the Internal Indications field.

**MasterStationID** - Number between 1 and 65534, univocal and correspondent to the master station address. This way, the master informs his own address to the slave when sending him a message. Some slaves reply to the master disregarding this number, others demand that the address declared on the slave matches the one from the master. The default for this field is “65534”.

**Quality changes timestamp** – Enabling this option will lead to alteration in the tag present timestamp when a new reading of a flagged object is received, even if there is no alteration on the tag status (value), but there is quality alteration

**Logging Level** – You can choose from this list the logging mode created by the communication module.

Logging level	Debug	All messages are logged in the LOG.
	Info	Only Info, Warning and Error messages are logged in the LOG.
	Warning	Only Warning and Error messages are registered in the LOG.
	Error	Only Error messages are registered in the LOG.

**IED time bias from GMT** – in Action.NET, internally, all timestamps are stored with GMT (UTC) dates. IEDs, usually, send these dates also in GMT, and no correction is made. The default for this option is Zero. If in the current deployment the IEDs send the timestamps in their local time, the difference between this time and GMT time must be specified here. For example in Brasilia, the local time is 3 hours shorter than GMT. For this case, -3 should be specified in this table.

**Password for commands:** To increase the security of sending commands, normally initiated only by a change in the state of a tag, it is possible here to specify a password of up to 9 digits, which will be verified by the communication module against the current value, at the moment of receiving the command with the *EstimatedValue* attribute tag involved in command. Therefore, in the operation of sending a command through a window, script, etc. this number must be loaded in this attribute. The communication module, after executing the command, changes the value of *EstimatedValue* to ZERO. Leaving this option with zero, the verification will not be done.

**Synchronization LAN** – Indicates the synchronization method to be used by the driver, according to the device to which it communicates. Choose **ENABLE** to use the LAN Synchronization method.



## Channel Settings

**Timeout (ms)** –Waiting time in milliseconds for receiving a response after sending any request. It is a functional check, which does not take into account the type of request or response, only verifies if there are responses being received in the channel.

**Dnp30 Level** - By default, the Level 3 profile is used. If you want the operation as in level 2, you can enter here the number 2. The client will not use objects and functions available in level 3, such as enabling and disabling Dynamic Unsolicited and requests of several classes in the same message.

DNP30		ProtocolOptions
LinkConfirmMode	Disabled	▼
Accept Unsolicited DNP	Disabled	▼
MasterStationID	65	
Quality changes timestamp	Disabled	▼
Logging Level	Info	▼
IED time bias from GMT	-3	
Password for commands	967543	
Synchronization LAN	Enabled	▼
Timeout(ms)	50000	
DNP Level	2	

Figure 1 – Protocol Options

## 2.2 Settings

### Serial and Multiserial Channel:

Com: Communication Port used on the computer;

BaudRate

DataBits: 8

StopBits: 1 or 2

Parity: None, Even Odd;

DTR: on, off

RTS: on, off

CTS: on, off

Port configuration must match with remote IEDs configurations.

CANAL2	DNP30	LinkConfirmMode=Ena...	Serial	Settings																											
CANAL1	DNP30	LinkConfirmMode=Ena...	TCP/IP	<table border="1"> <tbody> <tr> <td>Com</td> <td>com1</td> <td>▼</td> </tr> <tr> <td>Baud Rate</td> <td>9600</td> <td>▼</td> </tr> <tr> <td>DataBits</td> <td>8</td> <td>▼</td> </tr> <tr> <td>Stop Bits</td> <td>1</td> <td>▼</td> </tr> <tr> <td>Parity</td> <td>even</td> <td>▼</td> </tr> <tr> <td>DTR</td> <td>DtrOn</td> <td>▼</td> </tr> <tr> <td>RTS</td> <td>RtsOff</td> <td>▼</td> </tr> <tr> <td>CTS</td> <td><input type="checkbox"/></td> <td></td> </tr> <tr> <td>CtsWait</td> <td>100</td> <td></td> </tr> </tbody> </table>	Com	com1	▼	Baud Rate	9600	▼	DataBits	8	▼	Stop Bits	1	▼	Parity	even	▼	DTR	DtrOn	▼	RTS	RtsOff	▼	CTS	<input type="checkbox"/>		CtsWait	100	
Com	com1	▼																													
Baud Rate	9600	▼																													
DataBits	8	▼																													
Stop Bits	1	▼																													
Parity	even	▼																													
DTR	DtrOn	▼																													
RTS	RtsOff	▼																													
CTS	<input type="checkbox"/>																														
CtsWait	100																														

Figure 2 – Serial Channel Settings

TCP/IP channels:

- ShareNodeSameIP: Accepts IED with the same IP.
- Preferably, leave settings used by default.

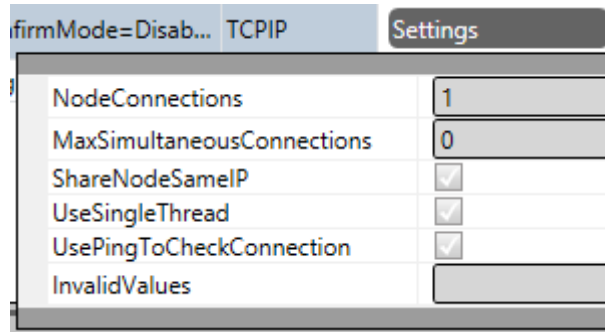


Figure 3 – TCP/IP Settings

### 2.3 Timeout

Defines limit times for transmission and reception of message characters and the number of retries.

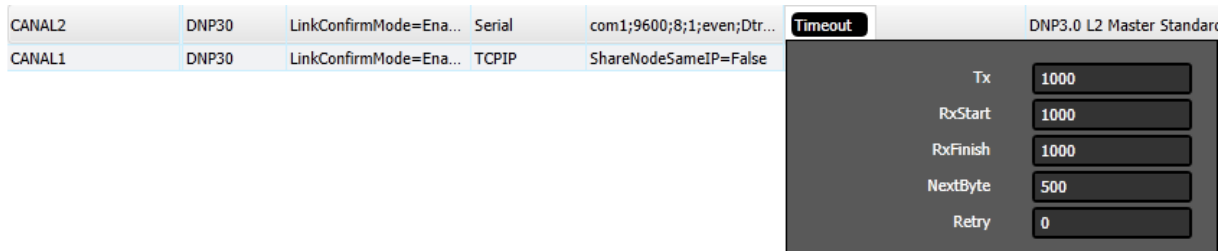


Figure 4 –Timeout Attributes

### 2.4 Initial State

Defines how the channel will initiate: enabled or disabled. If the channel is disabled, no message will be sent or received through it. In other words, the channel will be deactivated.

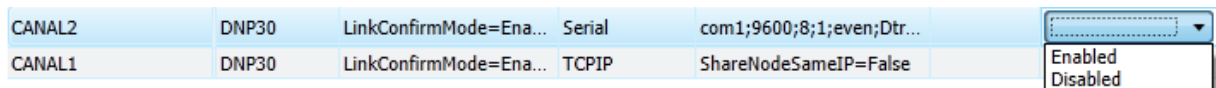


Figure 5 – Channel Initial State

### 3. NODES SETTINGS

Each node represents a remote station (IED). The user can configure multiple workstations into a single channel for serial communication. In the case of TCP-IP communication, only one node is supported for each channel. In this case, there must be set as many channel, as there are nodes.

#### 3.1 Channel Data (Primary and Backup)

Attribute set associated to the node (channel), which refers to its address and other attributes presented below:

IP	192.168.0.110
Port	20000
SlaveID	12
IgnoreBitOnLine	Disabled
WaitForIdleToCmd	Enabled
AI sample time(ms)	0
BI sample time(ms)	0
Class 0 sample time(ms)	30000
Class 1 sample time(ms)	2000
Class 2 sample time(ms)	3000
Class 3 sample time(ms)	0
Counters sample time(ms)	0
Time-date sample time(ms)	0
BI Event sample time(ms)	0
BO sample time(ms)	0
AO sample time(ms)	0
AI Event sample time(ms)	0
Frozen Counter sample time(ms)	0
Counter Event sample time(ms)	0
DBI sample time(ms)	0
DBI Event sample time(ms)	0
Request Link Status sample time(ms)	10000
Tag for comm status	Tag.TGDNP30.COMMC
Enable Unsolicited sample time(ms)	0

Figure 6 – Channel Data

In case of TCP-IP Communication:

**IP Address** – Type the IP Address of the IED server.

**Port** – Input the port number on which the IED will receive communication.

**Note:** In the case of serial communication, these two first fields do not exist.

For any case:

**SlaveID** - Address of the server IED (slave mode) at the application layer.

**IgnoreBitOnLine** - If "enabled," indicates that the driver should ignore the "BitOnLine" indication that is inserted by the IED when a fault or normality occurs at a point, according to the IED criterion.

**WaitForIdleToCmd** – if “enabled”, indicates that a command will only be sent when the sampling communication is stopped, i.e. not occurring.

**AI sample time (ms)** – Time in milliseconds between 2 consecutives analog points' values requests (type 30 objects request, all variations).

**BI sample time (ms)** - Time in milliseconds between 2 consecutives digital points' values requests (type 1 Objects request, all variations).

**Class 0 sample time (ms)** – Time in milliseconds between 2 consecutive all points requests.

**Class 1 sample time (ms)** – Time in milliseconds between 2 consecutive class 1 points requests.

**Class 2 sample time (ms)** – Time in milliseconds between 2 consecutive class 2 points requests.

**Class 3 sample time (ms)** – Time in milliseconds between 2 consecutive class 3 points requests.

**Counters sample time (ms)** - Time in milliseconds between 2 consecutives counters values requests (Object type 21 request, all variations).

**Time-Date sample time (ms)** – Time in milliseconds between two consecutive synchronization sends, i.e. sending the current date and time to IED (object 50), Time is sent only in GMT.

**BI Event sample time (ms)** – Time in milliseconds between two consecutive requests, requesting to send the current EVENTS of the digital points (request for Type 2 objects, all variations).

**BO sample time (ms)** - Time in milliseconds between two consecutive requests, requesting to send the current states of the Binary Outputs points (request of Type 10 objects, all variations).

**AO sample time (ms)** - Time in milliseconds between two consecutive requests, requesting to send the current values of the points Analog Outputs (request of Objects type 40, all variations).

**AI Event sample time (ms)** - Time in milliseconds between two consecutive requests, requesting the sending of the current values of the Analog Events points (request of Objects type 32, all variations).

**Frozen Counter sample time (ms)** - Time in milliseconds between two consecutive requests, requesting to send the current values of frozen counters (request for Type 23 objects, all variations).

**Counter Event sample time (ms)** - Time in milliseconds between two consecutive requests, requesting the sending of current counters events (request of Type 22 objects, all variations).

## Nodes Settings

**DBI sample time (ms)** - Time in milliseconds between two consecutive requests, requesting the sending of the current states of the double digital points (request of Type 03 objects, all variations).

**DBI Event sample time (ms)** - Time in milliseconds between two consecutive requests, requesting to send the current EVENTS of the double digital points (request of Objects type 04, all variations).

**Request Link Status sample time (ms)** – Time in milliseconds between two consecutive requests, requesting the current status of the link (link status).

**Tag for Comm status** - In this field the name of an existing tag in the project can be indicated to receive indication of success / failure in communication, from a functional point of view. When requests are made, the module waits for a maximum of Timeout milliseconds (defined in Protocol Options, above) to receive a response. In case of failure, the value of this tag will be set to ZERO. In case of success, the value will be placed in ONE.

**Enable Unsolicited sample time (ms)** - Time in milliseconds between two consecutive submissions, from request to enable Unsolicited Submission (function 22), to classes 1, 2 and 3.

**Backup Station** – The same settings made for the master station can be made for an alternate backup IED station, with identical point configuration if it exists in the installation.

## 4. POINTS SETTINGS

### 4.1 General

The points can be input or output.

The entry points, i.e. points that are acquired through the protocol have, basically, two main parameters: The point type and address.

The output points, used for remote controls, have a "Control Code" parameter in addition to the type and address. In the address map of an IED the addresses restart for each type of point.

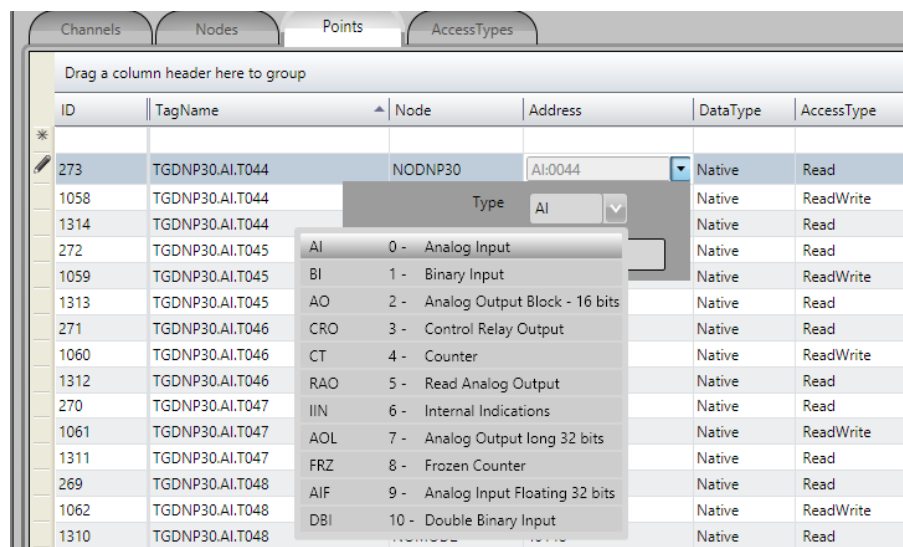
The states or values of the points are reported by the IED by Information Objects defined in the protocol. These objects have variations such as with or without timestamp. Whenever the IED reports with "timestamp" it will be used in the corresponding attribute of a point in Action.NET. When it does not come "timestamp" the driver will put the current time of the computer where the driver is running as "timestamp".

Action.Net communication module on master mode, implements:

- Digital points read;
- Analog points read;
- Counters read;
- Analog and Digital points commands;
- Select Before Operate commands

### 4.2 Point Types

The implemented Action.Net point types, listed below, are defined based on the data objects defined in the standard. For each type of point, whichever are the object variation received on the IED, with or without "flag", with or without timestamp, the acquired values will be placed in points with the types listed below. On the **Points** table, the field "**Address**" is used to choose the type of point and to specify its address.



ID	TagName	Node	Address	DataType	AccessType
273	TGDNP30.AI.T044	NODNP30	AI:0044	Native	Read
1058	TGDNP30.AI.T044			Native	ReadWrite
1314	TGDNP30.AI.T044			Native	Read
272	TGDNP30.AI.T045			Native	Read
1059	TGDNP30.AI.T045			Native	ReadWrite
1313	TGDNP30.AI.T045			Native	Read
271	TGDNP30.AI.T046			Native	Read
1060	TGDNP30.AI.T046			Native	ReadWrite
1312	TGDNP30.AI.T046			Native	Read
270	TGDNP30.AI.T047			Native	Read
1061	TGDNP30.AI.T047			Native	ReadWrite
1311	TGDNP30.AI.T047			Native	Read
269	TGDNP30.AI.T048			Native	Read
1062	TGDNP30.AI.T048			Native	ReadWrite
1310	TGDNP30.AI.T048			Native	Read

Figure 7 – Options for Points Type

## Points Settings

### AI- Analog Input

Scalar Analog measurement used for transmission of analog quantities. Used to receive data sent through objects 30 and 32 and all its variations. They are numbers 16 or 32-bit integers.

### BI - Binary Input

Simple binary entry point, value 0 or 1. Used to receive data sent through objects 1 and 2 and all its variations.


### DBI - Double Binary Input

Dual binary input point, value between 0 and 3. Used to receive data sent through objects 3 and 4 and all its variations.

### RAO – Read Analog Output

Point for reading the contents of analog output of 16 bits or 32 bits. Used for the reception of objects of types 40 and 41.

### CRO - Control Relay Output

Digital output point used to control the switches and circuit breakers. The DNP object 12, including a Control Code (8 bits), is used to indicate the type of command and execution details. When chosen, a field will show requesting this code information. After clicking on the right arrow (  ), a window with the selected attributes for the present value will appear. If the user changes the selected attributes.

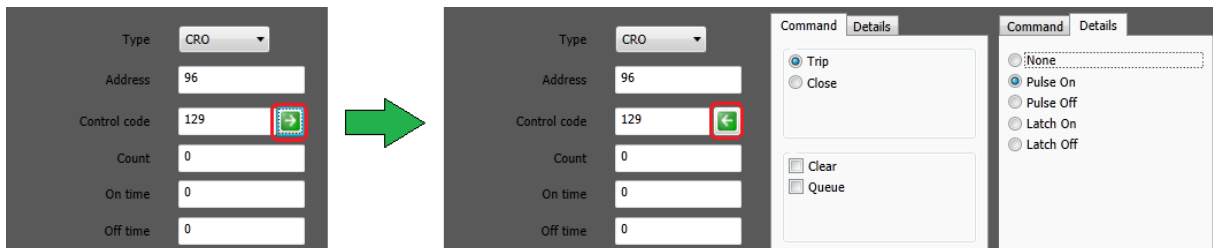


Figure 8 – Command Attribute

The possible values are presented in the table below with the respective associated actions:

Control Code	Action
1	Output Pulse ON
2	Output Pulse OFF
3	Output Latch ON
4	Output Latch OFF
65	Output Pulse ON + Close
66	Output Pulse OFF + Close
67	Output Latch ON + Close
68	Output Latch OFF + Close
129	Output Pulse ON + Trip
130	Output Pulse OFF + Trip

131	Output Latch ON + Trip
132	Output Latch OFF + Trip
+ 16	Queue + Trip
+ 32	Clear + Trip

**funcCode** – In the commands one can also define the operation to be executed in the command according to the following table:

funcCode	Action
3	Select
4	Operate
5	Direct Operation (no selection)
6	Direct Operation (without ack)
34	Select and Operate

Note: If no code is chosen it will be considered code 5.

#### CT – Counter

Binary counter 16 or 32 bits, received from the IEDs through the 20 objects and all their variations. This number has the last state of counter, in the instant it is read.

#### FRZ - Frozen Counter

Binary counter 16 or 32 bits, received from the IED through the object 21 and its variations, which contains information of a counter in the last time it was "frozen." The frozen value shows the value of the counter (the same index) when the last freeze operation was performed on the counter of slave IED.

#### AO - Analog Output Status or Block (16bits)

Analog output for a 16-bit DA converter, using type 40 objects (actual value to be applied to the drive) or 41 (amount required to be achieved in the analogue output), both on variation 2 (16 bits).

#### AOL - Analog Output long (32 bits)

Analog output for a 32-bit DA converter, using type 40 objects (actual value to be applied to the drive) or 41 (amount required to be achieved in the analogue output), both on variation in 1 (32 bits).

#### AIF - Analog Input Floating (32 bits)

Measurement used for analog transmission of analog quantities. Used to receive data sent over type 100 objects and all their variations. Floating point numbers are 32 or 64-bit IEEE-754 format.

#### CRS – Control Relay Signaling

It is a type defined for Action.NET for setting the match between the output tag and the input tag that makes the signaling, as a result of the command. When the CRS type is chosen, in the definition of the Address column, a different menu appears with the fields to define the necessary parameters.



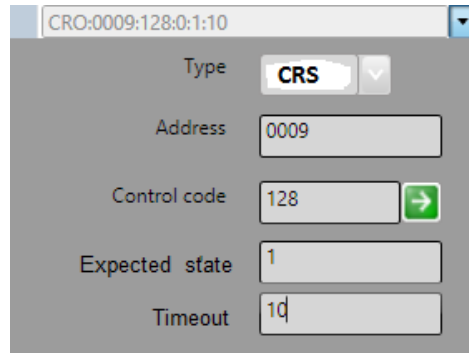


Figure 9 – CRS Type

The following figure shows the setting in the POINTS table. The signaling comes in tag A2.DJ.DJ that is of type DBI. The two lines in yellow show the definition of the signaling of commands with the same address (0009) and control code (128 - Open and 64 - Close).

These two lines are used to load the protocol module to create a static list with all matches on the node. Their information does not create new points in real time.

Channels Nodes Points AccessTypes							
Drag a column header here to group							Filter
TagName	Node	Address	Data Type	AccessType	Modifiers	Sc	
A2.DJ.CMD	NODNP30	CRO:0009:128:0:0:0	Native	Write			
A2.DJ.CML	NODNP30	CRO:0009:64:0:0:0	Native	Write			
A2.DJ.DJ	NODNP30	DBI:0302	Native	Read			
A2.DJ.DJ	NODNP30	CRS:0009:128:1:10:0	Native	Write			
A2.DJ.DJ	NODNP30	CRS:0009:64:2:10:0	Native	Write			

Figure 10 – CRS Type

Nothing else is required for setup. With this list, the module will automatically call the transaction creation and verification methods.

The command signaling is only used for digital CRO commands and digital signals BI and DBI.

### IIN - Internal Indications

On this implementation, it is possible to get access to the Internal Indication statuses or to the response status of commands defining tags with IIN type, for these to receive these informations from the communication module.

These IED internal indication statuses are reported through flags placed on the transmitted objects on the communication.

In order to receive the IIN, an analog int tag must be defined with IIN type and 65000 address. This tag will receive the register with the bits whose meaning are presented in the following table.

In order to receive the statuses from the most recently sent commands, an analog int tag must be defined with IIN type and 65001 address.

**IIN: 16 16 bits sent in every slave answer with control data - Address: 65000**

BIT	Origin	Description	Content
0	IIN	Broadcast	Returns 1 if slave receives a broadcast message (address = FFFF)
1	IIN	Class 1	Returns 1 if slave has class 1 events
2	IIN	Class 2	Returns 1 if slave has class 2 events
3	IIN	Class 3	Returns 1 if slave has class 3 events
4	IIN	Clock Synchronization	Returns 1 if slave asks for clock synchronization
5	IIN	Outputs set to local	Returns 1 if slave has any output set to local
6	IIN	Problem	Returns 1 if slave has a problem
7	IIN	Restart	Returns 1 if slave has restarted
8	IIN	Function not Implemented	Returns 1 if a function asked by the master, was not implemented in the slave
9	IIN	Unknown Object	Returns 1 if slave has not certain object at all or in a specific class
10	IIN	Invalid Data	Returns 1 if slave has an invalid parameter in the qualifier or the address range is invalid
11	IIN	Overflow	Returns 1 if slave buffer has an overflow
12	IIN	Busy	Returns 1 if the request was received but is already running
13	IIN	Corrupted Data	Returns 1 if the parametric data was corrupted
14	IIN	Reserved	Always 0
15	IIN	Reserved	Always 0

**Status field: 8 bits sent as answer to a command. Address: 65001**

Value in the Byte	Origin	Description	Content
0	Status	Accepted Command	after a correct command
1	Status	Not Accepted Command	occurred a timeout between select and operate
2	Status	Select Fault	occurred a operate without prior select
3	Status	Format Error	command has an format error
4	Status	Control not supported	operation is not supported
5	Status	Full Queue	the request queue on the slave is full or the point is already active
6	Status	Hardware Error	occurred a hardware error while the command was processed
7 to 127		Not used	

These IIN can be defined in dictionaries and showed on event lists and/or alarms. This way, for example purpose, a dictionary associated to a variable which contain the resulting status of a command is showed below. In sequence, the definition of this variable and a template of its declation on the Device table points.

OriginalText	TranslatedText
0	CMD - OK
1	CMD - NOT OK
2	CMD - NO SELECT
3	CMD - ERR FORMAT
4	CMD - NOT SUPPORTED
5	CMD - OVERFLOW
6	CMD - ERR HARDWARE

Figure 11 – Dictionary associated to Command Attribute

Name	Type	Array	Parameters	Category	Description
IIN_CMD	AnalogInt		Dictionary=DNP_IIN_CMD;		Status dos Comandos
ALM_GROUP	Digital		Dictionary=SEL_PROTECTION;	AN_GRUALM...	Alarme de grupo

Figure 12 – Variable Tag which receives a Command Result

TagName	Node	Address	DataType	Modifiers	AccessType	Scaling
SEL_LINHA_01.IIN_CMD	SEL_311L_01	IIN:99998	Native		Read	None
SEL_LINHA_01.IIN_VALUE	SEL_311L_01	IIN:99999	Native		Read	None
SEL_LINHA_01.ANA.FP	SEL_311L_01	Ai:15	Native		Read	None
SEL_LINHA_01.ANA.VAR	SEL_311L_01	Ai:8	Native		Read	None
SEL_LINHA_01.ANA.W	SEL_311L_01	Ai:7	Native		Read	None
SEL_LINHA_01.ANA.FREQ	SEL_311L_01	Ai:6	Native		Read	None
SEL_LINHA_01.ANA.V_CA	SEL_311L_01	Ai:5	Native		Read	None
SFI_LINHA_01.ANA.V_RC	SFI_311L_01	Ai:4	Native		Read	None

Figure 13 – Declaration of a point which receiver the result of a DNP3 command

**Note:** For an event to always occur in this tag, the communication module always places the value 99 in the tag before starting to send a command. After, it puts in the tag the result obtained in the response to the command.

### 4.3 Address of Points

The **Address** field to be filled in the registration of a point is what the standard calls “Index”. It means a 16-bit number that is the indicative index [0 to n-1] of each of the points of the same type mapped within the IED.

For example, purposes, a points table filled with several types of points is presented below. The digital output type points (CRO), as mentioned above, have their control code, besides the address.

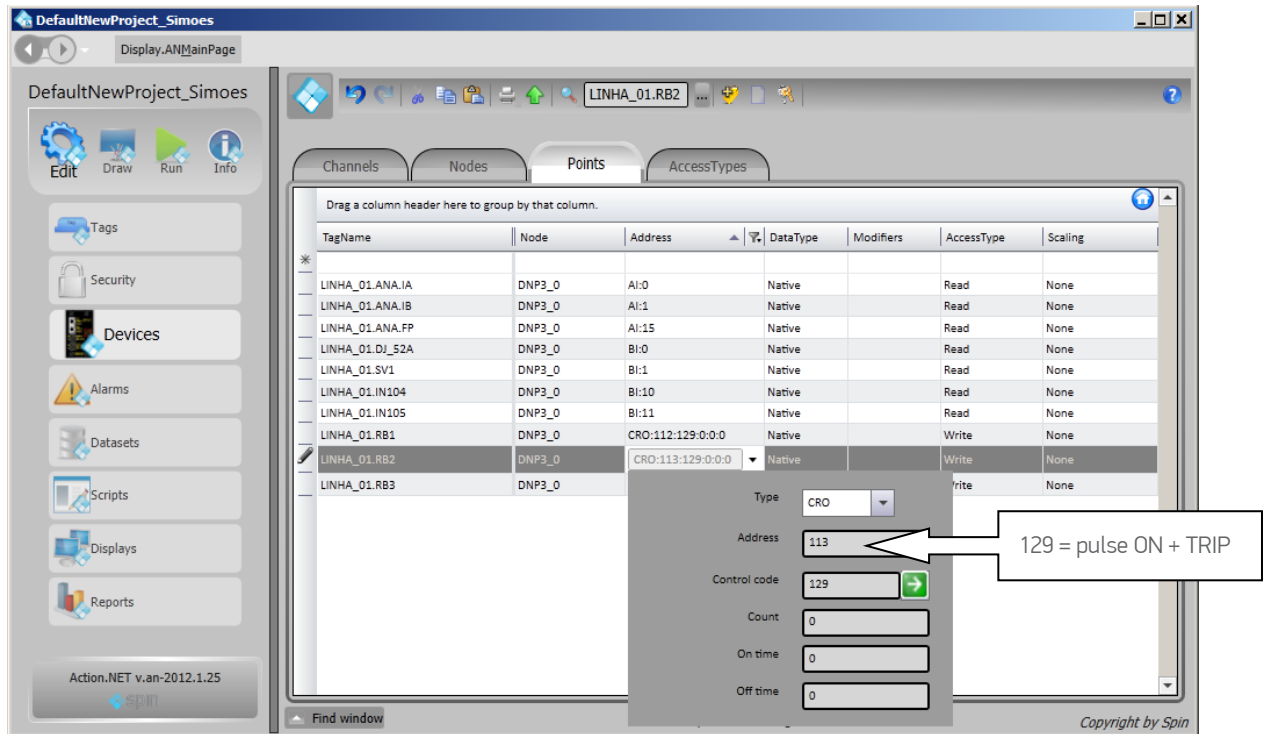


Figure 14 – Points table example with different types of points

To implement discrete digital input points, it is enough to use the “Bit” attribute of a tag, for each of the points that define the discrete digital input value. Therefore, for example, a switch with two contacts that define its state:

Tag	Address	Complement
SEL_LINHA_01.SC89_1	8	Switch Open
SEL_LINHA_01.SC89_1	9	Switch Closed

It is defined as an AnalogInt Tag and the Bit attribute of this 16-bits variable (AnalogInt) is used on the node table to address two points, as in the figure below:

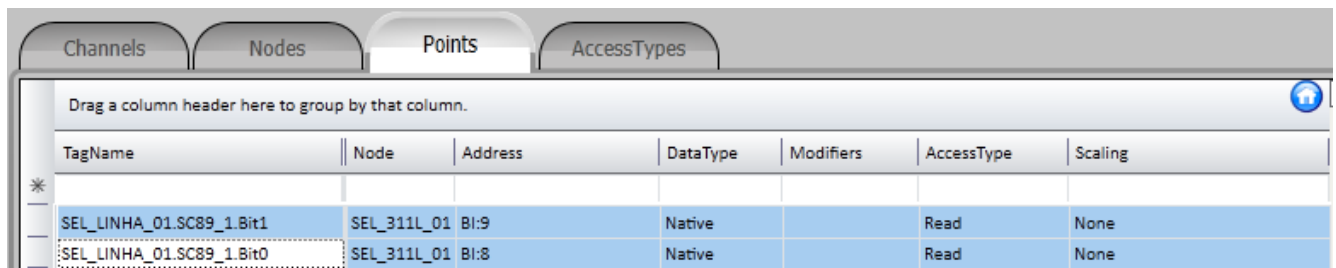


Figure 15 – Bit Attribute

The values assumed by the SEL\_LINHA\_01.SC89\_1 variable will be:

TAG	Bit 0	Bit 1	VALUE	MEANING
SEL_LINHA_01.SC89_1	0	0	0	UNDEFINED
SEL_LINHA_01.SC89_1	1	0	1	OPEN
SEL_LINHA_01.SC89_1	0	1	2	CLOSED
SEL_LINHA_01.SC89_1	1	1	3	ERROR

## 4.4 Access Type

Since it is a communication module in client mode, there is need for a few own characteristics for parametrization of the Access Type field on the **Points table**:

**For reading type points, the Access Type must be defined:**

ReadOnStartup= On;

ReadPooling= Always;

ReadPoolongRate: 500 milliseconds

WriteEvent= Changed;

AccepUnsolicitited = On;

**For command type points (CRO, AO and AOL), the Access Type must be defined:**

ReadPooling = Never;

WriteEnable = On

WriteEvent= Changed;