RightWON DNP3 Protocol Manual V2.3.1

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Revision History

Date (yy-mm-dd)	Comments	Author
2011-07-22	V1.0: Initial release	C. Archambault
2011-08-29	V2.0: Translation of parameter names from English to French.	C. Archambault
2011-11-15	V2.1: Updates to referenced documents and removal of Glossary.	C. Archambault
2012-05-11	V2.2: Correction of Session ID for Slave configuration.	M. Raymond
2013-05-28	V2.3: Added configuring DNP3 commands topics. Added descriptions of new parameters of the communication ports.	C. Archambault
2013-05-30	V2.3.1: Updated images	C. Archambault

Document Applicability

This document applies to the following RightWON Configuration Suite software versions:

Document version	Product version	Comments
V1.0	1.6	
V2.0 to V2.2	1.7 to 1.8	
V2.3	1.9 and higher	

Introduction

The DNP3 protocol is used to exchange data reliably between partners on a link or over a communication network. The following topics are addressed in this document:

1- Introduction to the DNP3 protocol, which describes static data, events, event stacks, classes of events, variations, groups, objects, reading the data, protocol functions, unsolicited responses and levels of implementation.

2- Integrating the DNP3 protocol in the RightWON, which describes the interrelationships between the IEC 61131-3 PLC application, fieldbus manager, DNP3 stack, network management link and the equipment. It describes the licenses that are available for using the protocol. It presents an example that will be used in this manual to show how the DNP3 protocol is configured.

3- Tutorial on DNP3 Slave configuration, which describes installation of license key, insertion and basic configuration of the DNP3 Slave, the DNP3 port, a Session and variables, with an example of configuring the DNP3 protocol in static or event mode.

4- Tutorial on DNP3 Master configuration, which describes installation of the license key, insertion and basic configuration of the DNP3 Master, the DNP3 port, a Session and variables, with an example of configuring the DNP3 protocol in static or event mode.

5- Example of the data exchange between Master and Slave, which describes operations between a Master and a Slave using the DNP3 example.

6- Configuring a project in Master/Slave mode, which describes the configuration of a DNP3 Master/Slave application.

1.1. Introduction to the DNP3 protocol

The DNP3 protocol is used to exchange data reliably between a Master and one or more Slaves. The DNP3 protocol provides functions for exchanging data using a standardized format. The protocol allows the exchange of static data and events.

1.1.1. Static data

Static data refers to snapshots of data values. For example, a static binary input refers to the current state (e.g. On or Off) of a device. A static analog input refers to the value of a measurement at the moment it is exchanged between the Slave and the Master (e.g. the value of the current or voltage on a pole). The DNP3 protocol permits retrieval of some or all of the static data from a Slave station.

1.1.2. Events

Events are associated with something significant that is happening at the outstation. Examples are state changes on binary inputs, analog values that exceed certain thresholds, the most recent information available, etc. An event occurs when a binary input changes value (e.g. On to Off) or when an analog value undergoes a change that is greater than its allocated deadband.

1.1.3. Event stacks

Since several successive events can occur on the same point during communication exchanges between partners, the events are stored in FIFO (First-In First-Out) stacks. DNP3 offers event stack reporting with or without timestamps, so the Master can have the chronology of events. The Master can request DNP3 event reporting on demand. Usually, a Master will update more

rapidly if it requests events from the outstation most of the time, with the occasional request for retrieval of static data to ensure integrity.

1.1.4. Event classes

DNP3 divides events into three **classes**: Class 1 events are considered the highest priority, followed by events in classes 2 and 3, the latter being the lowest priority. The Master can send requests to retrieve specific class 1, 2 or 3 events or any combination of these.

1.1.5. Variations

DNP3 has provisions for representing data in different formats, called **variations**. Thus **static analog data** (present values) can be represented as follows:

1. A 32-bit integer value with the status
2. A 16-bit integer value with the status
3. A 32-bit integer value
4. A 16-bit integer value
5. A 32-bit real value with the status
6. A 64-bit real value with the status

The status is a single-byte field that indicates whether the measurement source is online, whether the data source has been renewed, whether communications with a downstream source have been lost, whether the data has been forced and whether the value is above threshold.

Not all DNP3 devices support the 6 data variations, but all devices must be able to transmit the simplest variation so that any receiver can interpret the message.

Analog event data can be represented by the following variations:

1. A 32-bit integer value with the status
2. A 16-bit integer value with the status
3. A 32-bit integer value with the status and timestamp
4. A 16-bit integer value with the status and timestamp
5. A 32-bit real value with the status
6. A 64-bit real value with the status
7. A 32-bit real value with the status and timestamp
8. A 64-bit real value with the status and timestamp

1.1.6. Groups

Groups permit the differentiation of static data from events, for example, to distinguish variations 1 and 2 of analog events from variations 1 and 2 of static analog values.

For example, static analog values may be assigned to group 30 while analog events are assigned to group 32. Group 30 can be formatted in one of the 6 variations, and group 32 can be formatted in one of the 8 variations associated with analog events.

When a Slave transmits a response message that contains data, the message identifies the group number and variation for each data value in the message. Group and variation numbers are also assigned to counters, binary inputs, controls and analog outputs. In fact, all types of valid data and DNP3 formats are identified by group numbers and their variation.

1.1.7. Objects

The objects in a message are the coded representation of data obtained from a point or other structure. The format of the object depends on the group and selected variation number. Thus when transmitting data, the sender must properly encode the information so that the receiver can correctly analyze and interpret the data. The bits and bytes associated with the dataset in the message are called objects.

1.1.8. Reading the data

The DNP3 Master formulates requests that indicate to a Slave station what function it must perform, such as reading, while specifying the type of data to be obtained. The request may specify the desired number of objects, specific objects or a series of objects from index number X to Y.

In the RightWON, requests from the Master are function blocks that interact with the DNP3 stack. Upon receipt of a request, the Slave station validates it to prevent errors, then assembles the response message from Variables identified in the profile.

1.1.9. DNP3 protocol functions

Reading the data was dealt with briefly in the previous section, but DNP3 software is designed to manage other functions, as well. Among other things, the Master can perform the following functions:

- Synchronize the clock on the Slave station(s),
- Request to freeze running counters to prevent data loss between two successive requests for a read of the counters,
- Send control operations over digital output points or settings over analog outputs using the “Select-Before-Operate” or “Direct-Operate” operating sequences,
- Request a read of a class,
- Request a read of a group in a specific session,
- Request a read of one or more data items in a specific session,
- Send a binary command in a specific session,
- Send a binary command,
- Send an analog command,
- Write a character string in a specific session.

1.1.10. Unsolicited responses

Unsolicited responses are the transmission of unsolicited messages. This is an operating mode where the Slave station spontaneously transmits data without prior receipt of a specific request from the Master. Not all DNP3 Slave stations have this capability. This mode is useful when the Master communicates with several Slaves and requires notification as soon as possible after an event has been triggered. Rather than waiting for a polling cycle from the Master, the Slave station sends an unsolicited message. Before configuring a system for unsolicited messages, system interoperability and communication link specifications must be considered.

1.1.11. Levels of implementation

The DNP3 organization (www.dnp.org) acknowledges that the support of all features offered by the protocol is not necessary for all applications. The DNP3 organization has defined three levels of application complexity:

- Level 1 simply provides the basic functions; all others are optional.
- Level 2 offers more features concerning groups and variations.

- Level 3 is the most sophisticated.

Each level limits the request/response combinations in order to simplify implementation and ensure system interoperability.

1.2. Document scope

This document describes the integration of the DNP3 communication protocol in the RightWON system using the RightWON Configuration Suite software.

1.2.1. Other documents

For further details on the information in this document, refer to the specific manuals below:

Reference No.	Document Name
RWM000010-MA	RightWON Configuration Suite Manual
RWM000020-MA	RightWON – User Guide
RWM000050-MA	RightWON Satellite – User Guide
RWM000060-MA	RightWON Engine IEC61850-3 – User Guide
RWM000061-MA	RightWON Engine Rackmount – User Guide
RWM000062-MA	RightWON Engine Standalone – User Guide
RWM000080-MA	RightWON Configuration Suite – Application Guide

1.3. Document conventions

To facilitate the reading of this document the following conventions are used:

- Menu/dialog controls and items are in **bold**, e.g. **Options / Advanced settings...**, as are buttons, e.g. **OK**
- Names of Categories, Users, Sectors and Tags defined by the system integrators are in *italics*, e.g. *John Smith*, *Generator*
- Application-specific items such as Sector, Tag, Category and User group begin with a capital letter
- Hyperlinks are in blue
- The ⚠ symbol is used to raise the reader's attention.

1.4. Safety precautions

To ensure the safety of personnel and products, and to prevent the risk of accident, you must strictly follow the cautions and warnings written on product labels, in the manuals and on the RightWON product packaging.

To ensure proper operations of the RightWON product, read this manual in its entirety before proceeding to the other stages of learning, hardware installation, configuration or operation. Make sure that you fully understand the product and all information provided in this manual. For further information, contact your representative (certain fees and conditions may apply, depending on the type of service requested).

1.4.1. Warnings ⚠

RightWON products are not designed for safety management applications or as security devices. Mishandling of this product could cause critical situations leading to personal, equipment or property damage, network failure, loss of data, electrical shock, serious injury or even death. To prevent such events from occurring:

- Take all possible measures to ensure the security of your systems through the use of appropriate equipment that meets the requirements of the application. This will help preserve the integrity of your systems in the event of product failure or other external factors.
- To prevent the risk of explosion, do not use RightWON products in areas where explosives are stored without taking appropriate measures as defined by the standards and regulations in effect, obtained from the proper local authorities.
- To prevent damage to electronic components, do not expose this product to open flame or submit it to environmental factors that exceed the recommended levels.
- Batteries may explode if they are not handled with care. Do not recharge, disassemble or dispose of in fire. We recommend that you recycle these items by taking them to the appropriate collection service.

1.4.2. Cautions ⚠

- Make sure that RightWON products are managed by qualified personnel who have been properly trained to install, configure and troubleshoot them.
- Always configure and operate this product within the technical specifications and operating criteria recommended by Vizimax, as cited in this manual and the other technical documents available.
- Use homologated external emergency devices, including but not limited to: emergency stop, emergency signaling, interlock and safety circuitry.
- Properly connect and secure removable cables and connectors. Loose connections could overheat and catch fire.
- Protect all power supplies and connect to ground on the equipment using an appropriate connection. Failure to protect and/or ground the equipment could lead to fatal electrical shock.
- Take all possible measures to prevent foreign materials from falling into the product interior (liquids, flammable materials, metal objects, etc.).
- Turn the equipment off and disconnect all sources of power before undertaking any procedure whatsoever on the equipment.

Integrating the DNP3 protocol in the RightWON

2.1. DNP3 management

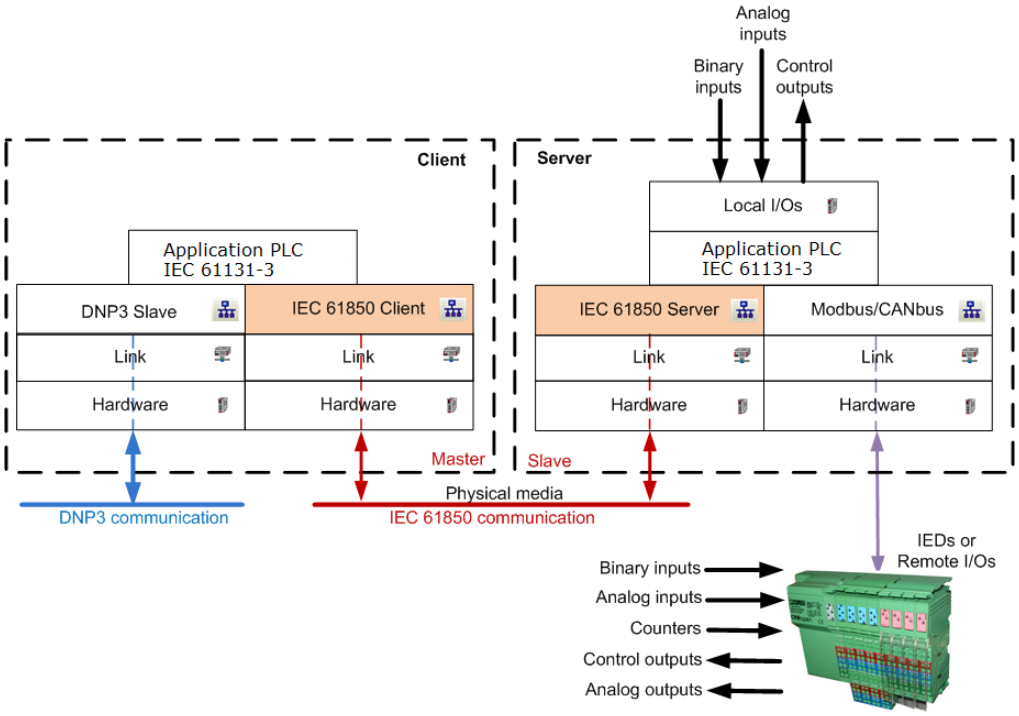
DNP3 protocol support is an optional component of the RightWON which requires a license key for the Master, the Slave, or a combination of the two. The RightWON supports all three operating modes of the DNP3 communication protocol:

1. Master mode: Allows the RightWON to exchange data with one or more intelligent devices operating in Slave mode. This may be a measurement device, another RightWON, etc. Master mode is typically used for carrying out communication gateway functions, such as those between an IEC 61850 client and a DNP3 Slave.
2. Slave mode: Allows the RightWON to manage the information and exchange it with the Master. This information can come from local inputs/outputs integrated with the RightWON, remote inputs/outputs on the CANbus, or intelligent electronic devices (IEDs or PLCs) connected to the RightWON. Slave mode is typically used to meet the needs of intelligent RTUs.
3. Master/Slave mode: Allows the RightWON to run in mode 1 and, in addition, act as a bridge to the outside so as to exchange the data gathered from RightWON Slave stations with another external link that uses the DNP3 protocol.

In the following figure the three operating modes: Master, Slave and combined Master/Slave, are illustrated in typical applications.

Error! Objects cannot be created from editing field codes.

All data carried by the DNP3 protocol are translated into variables in the IEC 61131-3 PLC application. Thus, the protocols are managed using the fieldbus manager **Error! Objects cannot be created from editing field codes.** under the supervision of PLC automation programs. The fieldbus manager exchanges the variables between the DNP3 stack and the PLC application. The correspondence between variables and addresses/protocol functions is established in the fieldbus manager environment.



In the application the Master protocol is managed using function blocks that are specific to the DNP3 protocol. For example, a specific function allows the Master to send a control command to a point on a Slave outstation. The PLC application that manages the Master thus has an active role in protocol management and initiates the transactions. However, only one assignment of variables to addresses/protocol functions is required, using a communication profile .

The RightWON supports the DNP3 Master and Slave protocol on several types of communication links:

1. Ethernet link using TCP/IP.
2. PPP connection, which permits establishing a network connection over a serial connection (modem or cellular telephone).
3. Direct RS-232 or RS-485 serial connection.

The **Links** manager in the Network Configurator **Error! Objects cannot be created from editing field codes.** allows you to select the type of communication link provided by the RightWON hardware configuration.

2.2. DNP3 protocol in static or event mode

Here are two basic methods for using the DNP3 protocol on a Master and Slave that communicate together:

Slave and Master in static mode: In this case all static points (variables) on the Slave station are retrieved periodically when the Master station sends an integrity data poll.

If event Variables are declared in a Slave station configured in static mode, the Slave transmits the events.

Slave and Master in event mode: As soon as the Master and Slave are connected, the Slave sends the events to the Master station. When new events occur in the Slave station, they are sent to the Master station according to the configuration and the event class priority.

If static Variables are also declared, the Master must be configured to execute an integrity data poll to periodically retrieve all static Variables.

2.3. License key for the DNP3 protocol

DNP3 protocol support on the RightWON platform requires prior installation of a license key (dongle) that is chosen according to the platform model and the protocol operating mode. A license key is required for each RightWON unit. The RWU-Protocol dongle is intended for the modular RightWON CPU (RWU 010000) and the RWE-Protocol dongle is for the RightWON Engine series (RWE 04xxxx).

Product Description	Product No.	Comments
RWU/PROT/DNP3/SLAVE	RWC 00AR00	
RWU/PROT/DNP3/MASTER	RWC 00AS00	
RWU/PROT/DNP3/MASTER+SLAVE	RWC 00AT00	
RWE/PROT/DNP3/SLAVE	RWC 00AR01	Supports up to ten (10) concurrent Slave sessions.
RWE/PROT/DNP3/MASTER	RWC 00AS01	
RWE/PROT/DNP3/MASTER+SLAVE	RWC 00AT01	
RWU/SAT/PROT/ALL	RWC 00BS00	This license permits the use of all available communication protocols for a limited period of two weeks for one RightWON unit.
RWE/PROT/ALL	RWC 00BS01	This protocol is available for system integrators and the sales network.

You can obtain the license key from your Vizimax representative. You must register the license key on the platform before you can use it.

2.4. DNP3 tutorial example presentation

The tutorial example on DNP3 configuration includes one Slave and one Master that communicate with each other via the DNP3 protocol over a serial communication port. In this example, the Slave simulates an anemometer. Variables include the wind speed (*rWindSpd*), wind direction (*diWindDir*), and the opening/closing of a circuit breaker (*bOpenBreaker*) and pressure valve (*bOpenCloseValve*). The anemometer measures the wind speed (*rWindSpd*) and direction (*diWindDir*). The Slave sends events to the Master, or the Master performs an integrity poll to retrieve data from the Slave. When the Slave requests the opening or closing of the circuit breaker, the Master sends a binary command to change the status of the circuit breaker (*bBreakerSts*). When the Slave requests the opening or closing of the pressure valve, the Master sends an analog command to change the pressure of the valve in the Slave (*rPressureValve*).

Tutorial on DNP3 Slave configuration

Configuration of a DNP3 Slave in the RightWON requires the following steps:

1. Installing the license key for the DNP3 protocol
2. Adding the DNP3 Slave protocol to the RightWON configuration
3. Configuration parameters for the DNP3 Slave
4. Inserting a communication port
5.

3.1. Installing the license key for the DNP3 protocol

To activate the license key for the DNP3 protocol, follow the steps provided in the section *Activate your RightWON advanced features license* of the document *RWM000010-MA-en, RightWON Configuration Manual*.

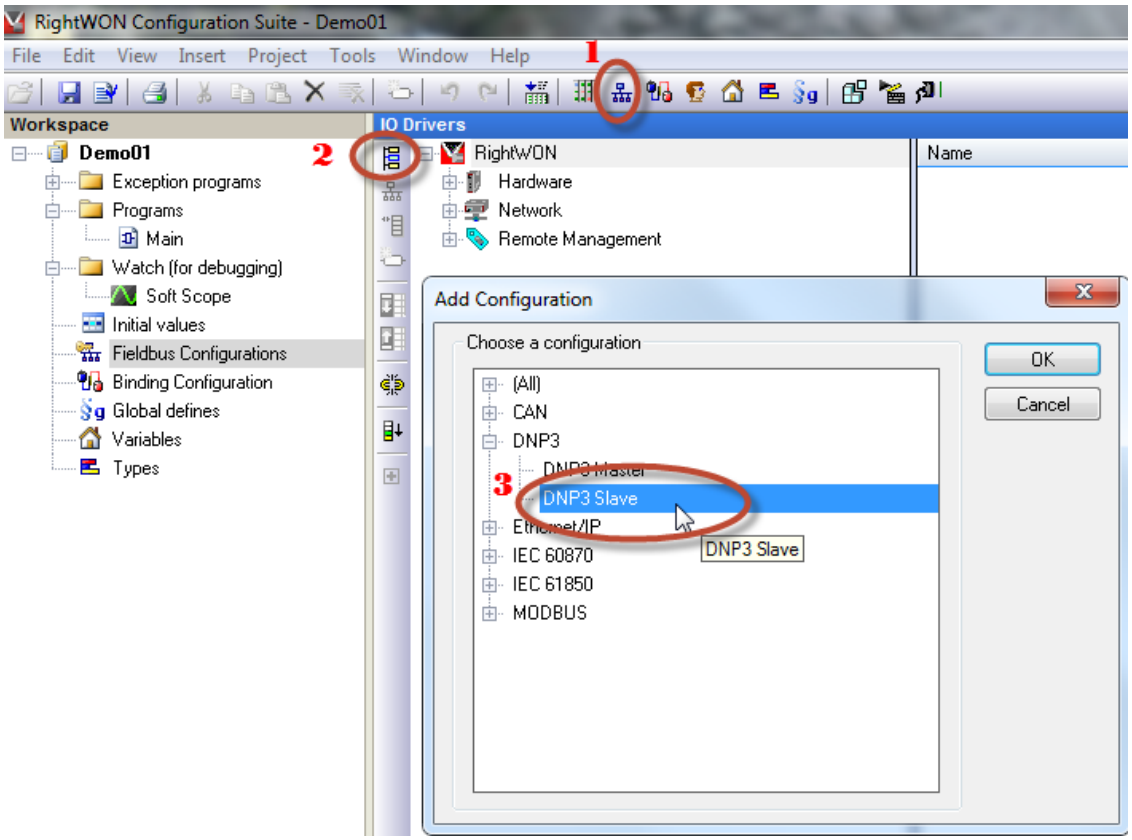
3.2. Adding the DNP3 Slave protocol to the RightWON configuration

The DNP3 Slave can be added to the RightWON configuration when a new project is created, or through the fieldbus manager by carrying out the following operations:

1- Start the fieldbus configurator by clicking **Fieldbus Configurations** in the toolbar.

2- Click **Insert Configuration...** in the editing area toolbar.

3- Expand the **DNP3** configuration in the new **Add Configuration** window and double-click on the **DNP3 Slave** protocol.

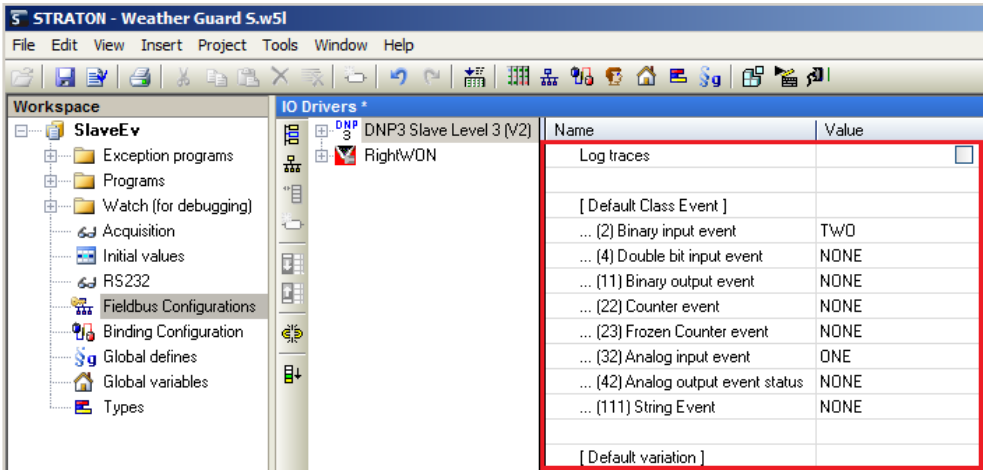


4- Next, you must configure the DNP3 Slave protocol.

3.3. Configuration parameters for the DNP3 Slave

After adding the DNP3 protocol, you can configure it using **Fieldbus Configurations**  . The DNP3 protocol can be configured in static or event mode. To view the parameters to configure, click on the **DNP3 Slave** in the **IO Drivers** window.

Double-click a parameter to configure it. Enter the data in the field and press **Enter** on the keyboard. To enable (checked box) or disable the parameter, click on the box.



Here is the list of available parameters on the right side of the **IO Drivers** window:

1. ***Log traces:*** The log messages are displayed in the runtime tab of the output window of the RightWON Configuration Suite. This should be reserved for troubleshooting.
2. ***Default Class Event*:** Defines the property of a class of points that will be used if the default is selected for the Variable, with the following options:
   - ***NONE****:* Class 0 defines the static points.
   - ***ONE****:* Class 1 defines points in high-priority events.
   - ***TWO****:* Class 2 defines points in medium-priority events.
   - ***THREE****:* Class 3 defines points in low-priority events.
3. ***Default variation:*** Defines the variation that will be used if the default option is selected for a point that has the static variation or event variation property. The objects for a point's static variation or event variation properties are divided into two (2) groups:
   a. Static Objects: 1, 3, 10, 20, 21, 30 and 40.
   b. Event Objects: 2, 4, 22 and 32.

[Default variation]	
... (1) Binary input	1 : Packed format
... (2) Binary input ev...	1 : Without time
... (3) Double bit input	1 : Packed format
... (4) Double bit input...	2 : With absolute time
... (10) Binary output	2 : Output status with flags
... (11) Binary output ...	1 : Status without time
... (20) Counter	5 : 32-bit without flag
... (21) Frozen Counter	9 : 32-bit without flag
... (22) Counter event	1 : 32-bit with flag
... (23) Frozen Counte...	5 : 32-bit with flag and time
... (30) Analog input	5 : Single-prec flt-pt with flag
... (32) Analog input ...	1 : 32-bit without time
... (40) Analog output...	1 : 32-bit with flag
... (42) Analog output...	1 : 32-bit without time

4. ***Event mode:*** Defines the event mode that will be used for unsolicited messages. There are two options:
    a. ***ALL:*** Sends all events in chronological order.
    b. ***MOST RECENT:*** Sends only the most recent event for each point.
5. ***Max Event Count:*** Defines the maximum number of events in unsolicited messages for each group.
6. ***Device attributes:*** Allows the Master station to read specific information from the Slave, using the following user-configured parameters:
    a. ***User-assigned location name:*** Name of the location assigned by the user.
    b. ***User-assigned ID:*** Identification of the slave station assigned by the user.
    c. ***User-assigned device name:*** Name of the device assigned by the user.
7. ***Misc:*** Permits defining various global parameters on the Slave station, such as:
    a. ***Clock valid period:*** Specifies the delay after receiving a clock synchronization before the DNP3 protocol will request another clock synchronization.
    b. ***Output select timeout:*** Corresponds to the maximum time allowed between selection and execution during an SBO command.
    c. ***Integrity poll response groups:*** Permits defining the groups of static objects that will respond to a data poll request from the Master.

8. ***Use VSI for flags and TimeStamp:*** Permits using status flags and timestamps according to the following options:
    - ***Don't use VSI:*** Do not use standard variable status bits (VSI)
    - ***Use VSI:*** Use standard VSI
    - ***Use Std VSI and User bits (1-8):*** Use standard VSI and user bits (1-8)

    The following is the list of DNP3 user bits and their associated variable bits. For definitions of the variable bits, see **List of status bits** in the RightWON Configuration Suite Help by pressing the **F1** key.

DNP3 user bits	Variable bits: ID
Bit 0: Online	Bit 18 reversed: _VSB_I_BIT
Bit 1: Restart	Bit 16:_VSB_GR
Bit 2: Communication lost	Bit 46: _VSB_NT_BIT
Bit 3: Forced to remote	Bit 45: _VSB_SP_BIT
Bit 4: Forced to local	Bit 2: _VSB_ST_M2
Bit 5: Over range	Bit 47: _VSB_OV_BIT

Bit 5: Chatter filter	Bit 3: _VSB_ST_M2
Bit 5: Counter overflow	(not linked)
Bit 6: Reference check	Bit 1: _VSB_ST_M2

3.3.1. Activate status bits

To activate status bits management:

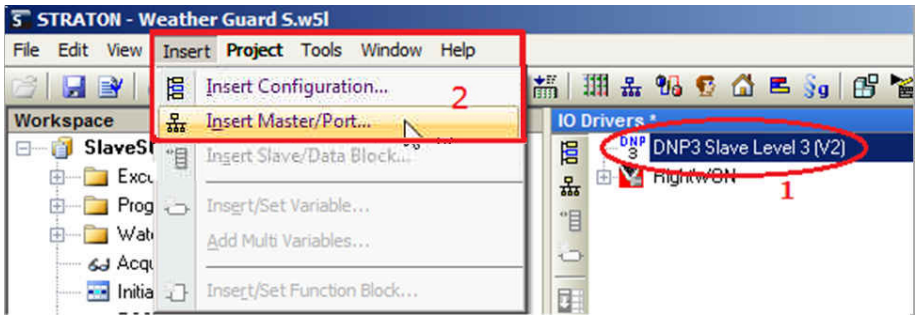
1. Select **Project>Settings**.
2. In **Compiler** section, double-click on **Allocate status flags for variables with embedded properties**.
3. Click **OK**.

3.4. Inserting a communication port

A Slave can have only one port for communicating with a Master. A Master can have up to two communication ports. Inserting a port (Channel) for DNP3 is carried out as follows:

1- In the **Fieldbus Configurations**, click on **DNP3** in the **IO Drivers** window.

2- Under the **Insert** menu, click **Insert Master/Port...**



3- You must now configure the port in either serial or Ethernet mode.

3.5. Configuring the communication port

After adding a port to the DNP3 protocol, it must be configured in either serial mode or Ethernet mode (TCP/IP). The Slave and Master must be configured with the same communication mode to be able to communicate together. If several Slaves are configured with a port in serial mode and several others in Ethernet mode, the Master can have one serial port and one Ethernet port.

3.5.1. Configuring the DNP3 port in Serial mode

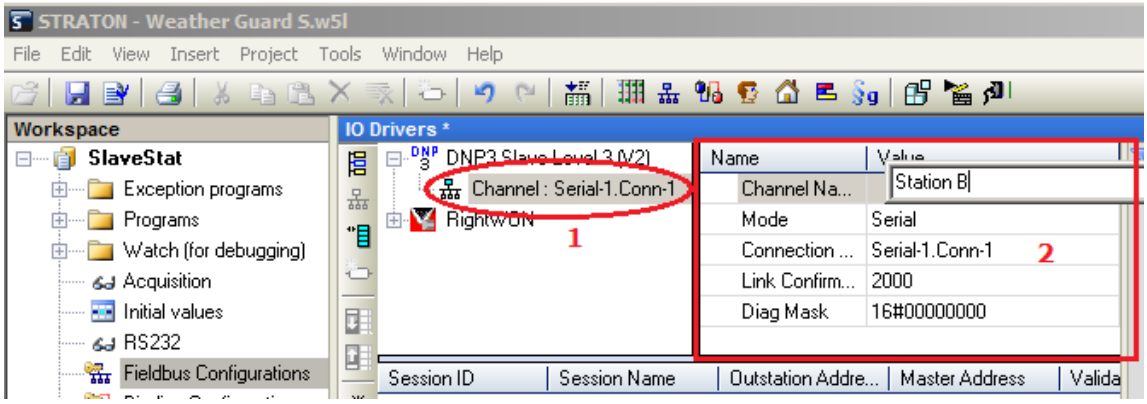
After inserting the port, you can configure it in serial mode using the **Fieldbus Configurations**, by carrying out the following steps:

1- Click on the **Channel** in the **IO Drivers** window.

2- Double-click the **Channel Name** field. Enter a meaningful and unique port name, then press the **Enter** key.

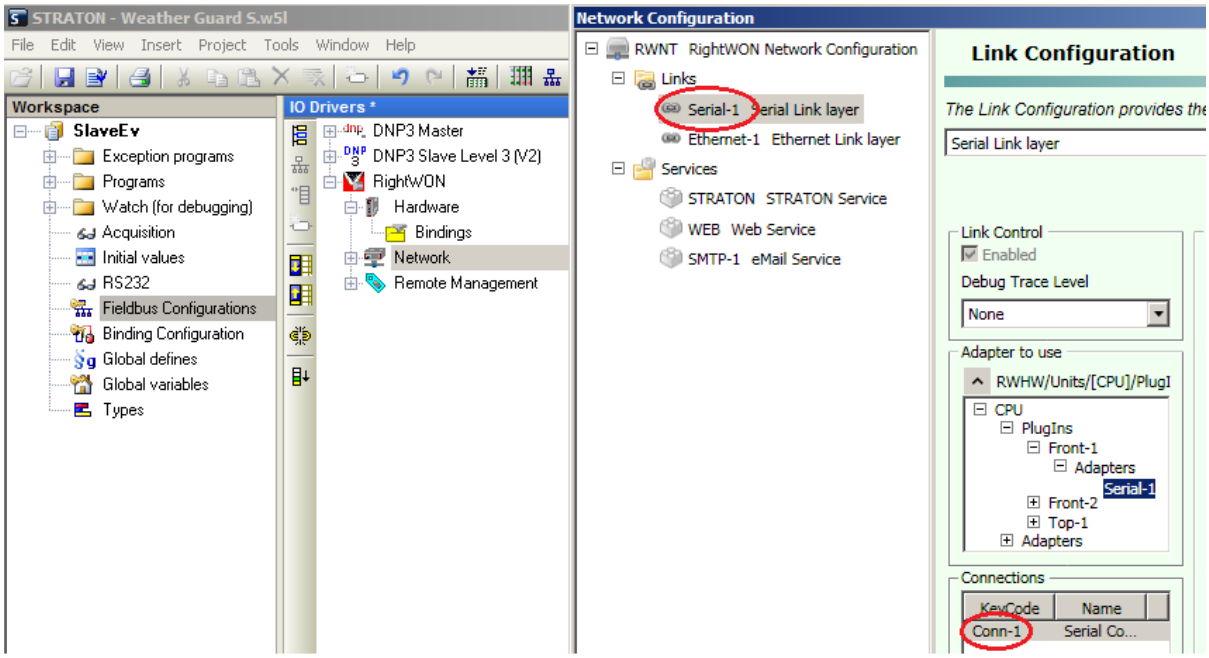
3- Double-click the **Mode** field. Select the **Serial** communication mode, which is valid for RS-485/RS-232 communication.

Note: The communication mode must be the same between a Master and a Slave.



4- Double-click the **Connection Settings** field. Enter the name of the serial connection, using the name defined in the network configurator (see Note). Press the **Enter** key.

Note: Open the **Network Configuration** and select the **Serial-x** link under **Links**. In the **Adapter to use** area, expand the tree. Click on **Serial-x** under **Front-1** or **Front-2**, depending on where the serial communication module is installed. Concatenate the **Serial-x** name in the **Links** section with the **Conn-x** name in the **Connections** section (e.g. Serial-1.Conn-1 in the figure below).

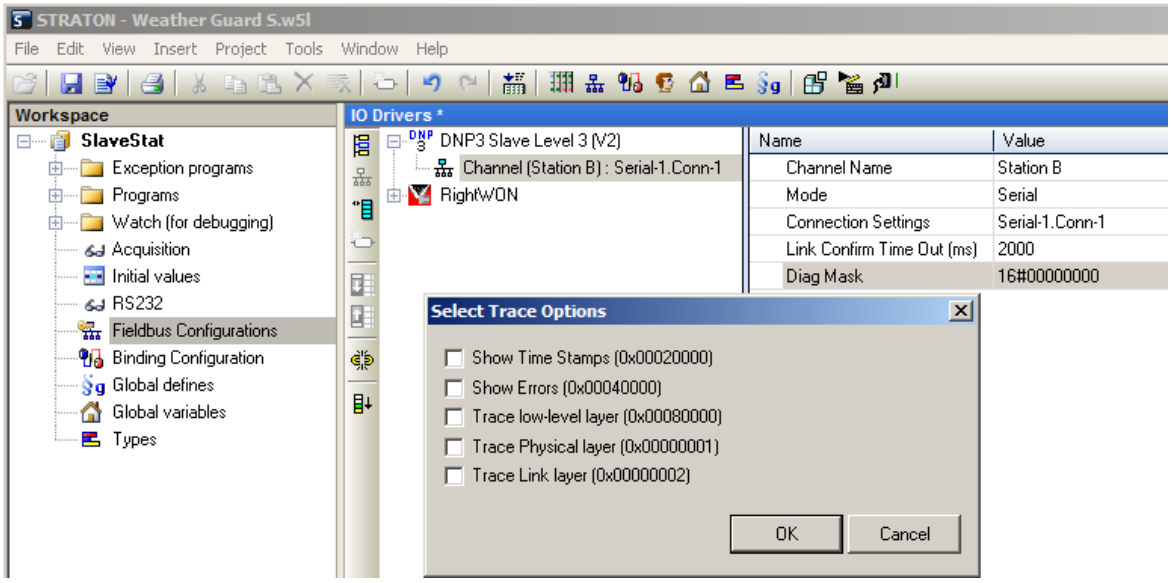


5- Double-click the **Link Confirm Time Out (ms)** field. Enter the timeout (in milliseconds) for verifying the status of the communication link. Press **Enter** on the keyboard.

6- The **Diag Mask** field contains the mask for diagnostics of the various communication layers (default 16#00000000: no diagnostics). To configure it, double-click the field. A **Select Trace Options** window opens. Click the following fields to activate them, if desired:

- **Show Time Stamps:** Displays the timestamps
- **Show Errors:** Displays the errors
- **Trace low-level layer:** Traces the low-level layers of the OSI model
- **Trace Physical layer:** Traces the physical layer of the OSI model
- **Trace Link layer:** Traces the link layer of the OSI model

Then click **OK**.



3.5.2. Configuring the DNP3 port in Ethernet (TCP/IP) mode

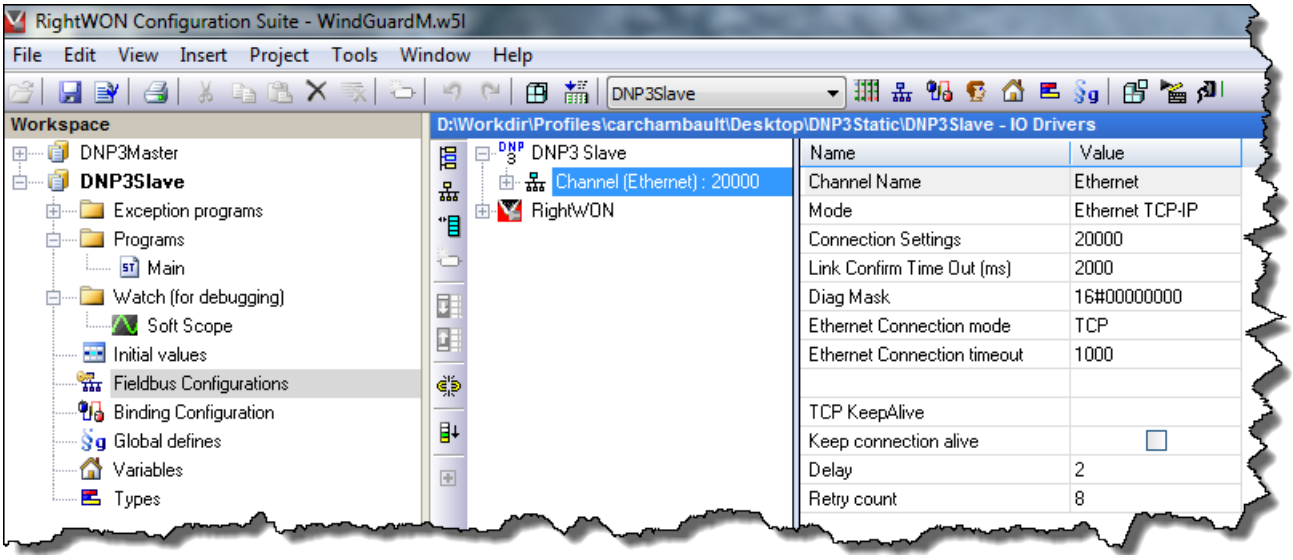
After inserting a DNP3 port, you can configure the port in Ethernet (TCP/IP) mode using the **Fieldbus Configurations**, by carrying out the following steps:

1- Click on the **Channel** in the **IO Drivers** window.

2- Double-click the **Channel Name** field. Enter a meaningful and unique port name (e.g. Ethernet), then press the **Enter** key.

3- Double-click the **Mode** field to select the communication mode between the Master station and the Slave stations. Choose **Ethernet TCP-IP** mode.

Note: The communication mode must be the same between a Master and a Slave.



4- Double-click the **Connection Settings** field.

   a. For the Slave, enter the DNP3 port number (default 20000).

   b. For the Master, enter the IP address of the Slave.

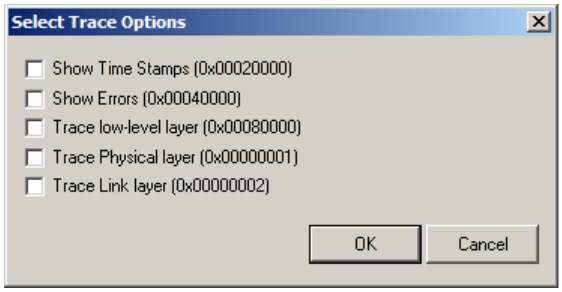
   Press the **Enter** key.

5- Double-click the **Link Confirm Time Out (ms)** field. Enter the timeout (in milliseconds) for verifying the status of the communication link. Press the **Enter** key.

6- The **Diag Mask** field contains the diagnostics mask for the various communication layers (default 16#00000000: no diagnostics). To configure it, double-click the field. A **Select Trace Options** window opens. Click on the following fields to activate them, if desired:

   - **Show Time Stamps:** Displays the timestamps
   - **Show Errors:** Displays the errors
   - **Trace low-level layer:** Traces the low-level layers of the OSI model
   - **Trace Physical layer:** Traces the physical layer of the OSI model
   - **Trace Link layer:** Traces the link layer of the OSI model

   Then click **OK**.



7- For **Ethernet Connection mode**, double-click to change between **TCP** or **UDP**. For GSM, It is recommended to use UDP.

8- For **Ethernet Connection timeout**, double-click to enter the time, in ms, before a timeout is declared. If your connection link is slow such as a GSM link, enter a longer time to allow the channel to connect.

9- To verify if the connection is active, configure **TCP Keep alive**:

   a. Enable TCP Keep alive by checking **Keep connection alive**.

   b. Enter the **Delay** in seconds between signals.

   c. Enter the number of consecutive **Retry count** attempts without response before closing the connection.

3.6. Inserting a data block (Session) on the DNP3 port

A Slave can have only one session for communicating with a Master. The Master can have one session for each Slave with which it exchanges data.

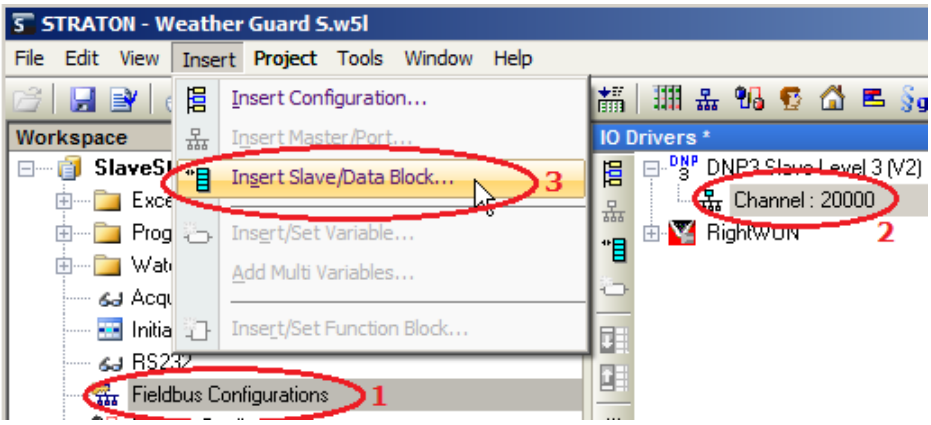
To insert a Session on a port, carry out the following steps:

1- From **Fieldbus Configurations**, click on the **Channel** in the **IO Drivers** window.

Note: To communicate with each other, the Master and Slave must be configured with the same type of port. For the Master, click on the DNP3 Master **Channel** that corresponds to the same type of port configured in the DNP3 Slave.

2- Click **Insert Slave/Data Block...** under the **Insert** menu.

3- A new **Session** window appears. In this window, click **OK** to create the new configuration.

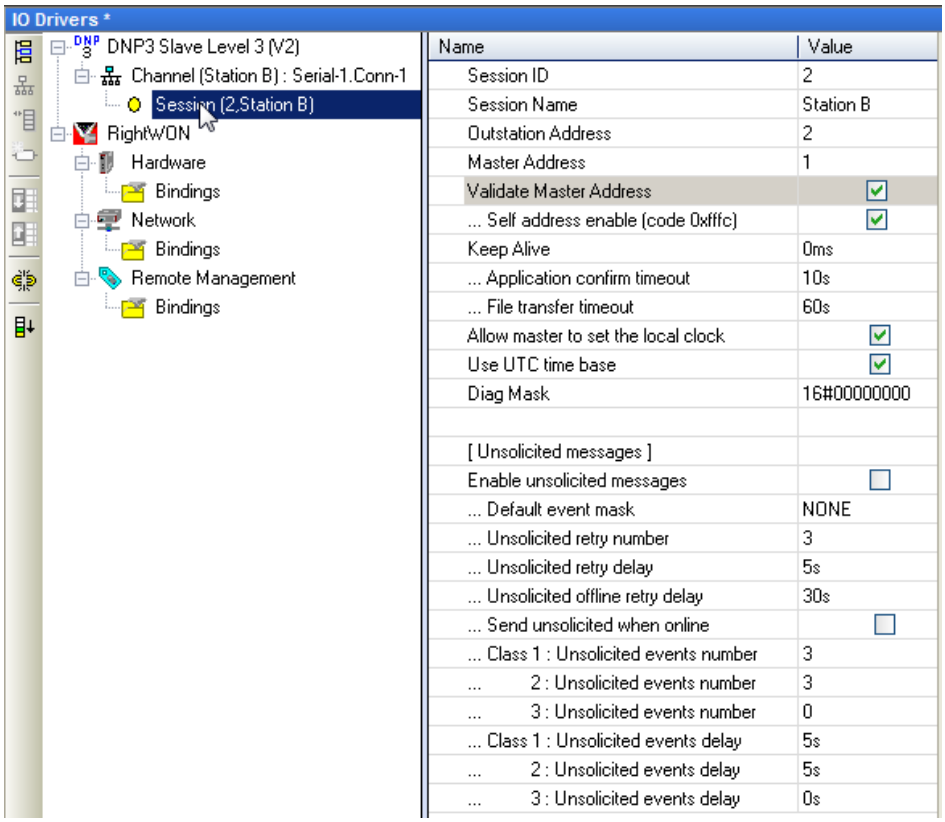


4- You must now configure the session as either a DNP3 Slave Session or a DNP3 Master Session.

3.7. Configuration parameters for a Slave Session

After inserting a session, you can configure it using the **Fieldbus Configurations**  . The DNP3 protocol can be configured in Static or Event mode. To view the configuration parameters, click **Session** in the I/O Drivers window.

Double-click a parameter to configure it. Enter the data in the field and press the **Enter** key. To enable (checked box) or disable a parameter, click on the box.



Here is the list of available parameters on the right side of the **IO Drivers** window:

1- ***Session ID:*** Enter a unique identification number for the session. The first session must be 0 and the second, 1. Other session numbers must follow in numerical order.

2- ***Session Name:*** Enter the name of the session.

3- ***Outstation Address:*** Enter the address of the Slave station.

4- ***Master Address:*** Enter the address of the Master station that will be used for sending unsolicited messages. If ***Validate Master Address*** is false (unchecked), the address specified in the received frame will be used for sending unsolicited messages. If ***Validate Master Address*** is true (checked), then:

- If the ***Master Address*** matches the address in the received frame, the responses will be sent to the Master station address.
- If the ***Master Address*** does not match the address in the received frame, no response will be sent.

5- ***Validate Master Address:*** Permits validating the Master station address in received frames with the address specified by the ***Master Address***. If false (unchecked), DNP3 does not validate the Master address, and frames with a Slave station address matching

the ***Outstation Address*** will be accepted. If true (checked), the address of the Master and Slave stations must match for the frames to be accepted.

6- ***Self address enable (code 0xfffc):*** The Slave responds to address 0xfffc as if it received a request for its configured address. The Slave responds with its own address, which allows the Master to automatically detect the address of the Slave.

7- ***Keep Alive*****:** Enter the time (in milliseconds) between signals that verify the status of the connection between the Master and Slave (**Link Confirm Time Out** on the Channel).

8- ***Application confirm timeout:*** Specifies the time (in seconds) that the DNP3 Slave will wait after receiving an acknowledgment from the Master.

Note: This parameter in combination with ***Unsolicited retry delay*** and ***Unsolicited offline retry delay*** determines how often an unsolicited response will be resent.

9- ***File transfer timeout:*** Enter the time (in seconds) allocated for transferring a file before declaring a file transfer failure (timeout).

Note: The time must be adjusted to the type of communication mode selected (Serial or Ethernet).

10-***Allow master to set the local clock:*** The Slave allows the Master station to synchronize the clock on the Slave station.

11-***Use UTC time base:*** Allows this Session to use UTC (Coordinated Universal Time) for messages sent and received.

12-***Diag Mask:*** Contains the diagnostics mask for the various communication layers (default 16#00000000: no diagnostics). To configure it, double-click the field. A **Select Trace Options** window opens for selecting the traces to be activated. Click on the following fields to activate them, if desired:

- **Show Time Stamps:** Displays the timestamps
- **Show Errors:** Displays the errors
- **Trace low-level layer:** Traces the low-level layers of the OSI model
- **Trace Physical layer:** Traces the physical layer of the OSI model
- **Trace Link layer:** Traces the link layer of the OSI model

Then click **OK**.

13-***Unsolicited messages:*** The following fields define the event messages.

a. ***Enable unsolicited messages:*** Activates the transfer of unsolicited messages from the Slave station to the Master station. The Slave station sends unsolicited messages without request from the Master station. The Slave sends an unsolicited message on startup to announce the Restart IIN bit, and whenever unsolicited events meet the specifications of the ***Class X: Unsolicited events number*** or ***Class X: Unsolicited events delay*** parameters.

Remark: Whatever the value of this parameter, the DNP3 Master can also poll for events using Class 1, 2, 3 or an object group of specific events.

b. If the parameter *Enable unsolicited messages* is enabled, then configure the following parameters:

Unsolicited messages parameters	Description
Default event mask	Specifies the event class that will be sent in unsolicited messages, with the following options (default: NONE): • ***NONE****:* Class 0 defines the static points. • **ONE**: Class 1 defines points in high-priority events. • **TWO**: Class 2 defines points in medium-priority events. • **THREE**: Class 3 defines points in low-priority events. • **ALL**: All classes

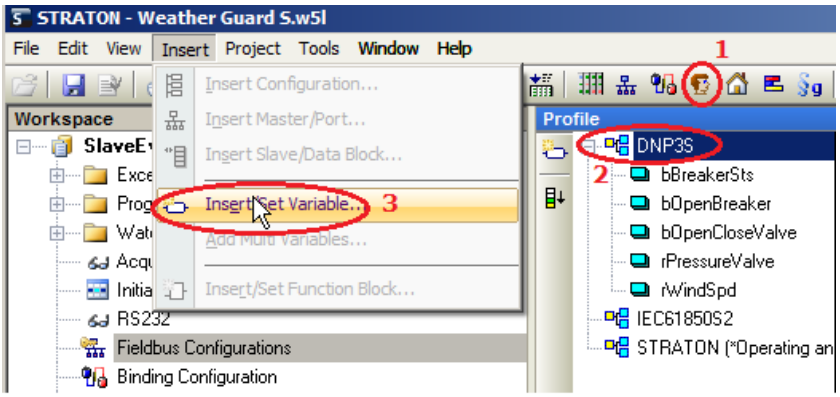
Unsolicited retry number	The number of times that the Slave station will attempt to send the same unsolicited message to the Master station without receiving an acknowledgment. The wait time before the next attempt depends on the ***Unsolicited retry delay***.
Unsolicited retry delay	Wait time (in seconds) before the Slave executes a retry after an unsuccessful transmission, without receiving an acknowledgment from the Master.
Unsolicited offline retry delay	Wait time (in seconds) after the ***Unsolicited retry number*** has been reached before trying again.
Send unsolicited when online	If true, sends unsolicited messages (or an empty message) as soon as the connection between the Slave station and the Master station is established, without request from the Master station (see *Note). If false, unsolicited messages will be sent only if there are any messages pending in the queue. **Note:** Once the DNP3 Master and Slave applications have been loaded in the RightWON, the connection is established without requiring that the application program be up and running first.
Class 1: Unsolicited events number	Specifies the maximum number of Class events permitted before generating an unsolicited message for the Class.
Class 2: Unsolicited events number	
Class 3: Unsolicited events number	
Class 1: Unsolicited events delay	Wait time (in seconds) after a Class event has been received, before sending unsolicited messages for the Class.
Class 2: Unsolicited events delay	
Class 3: Unsolicited events delay	

3.8. Adding a Variable

Add variables to the DNP3S protocol using the DNP3S communication profile:

1- Click **Profile** in the toolbar to access the Profile window.

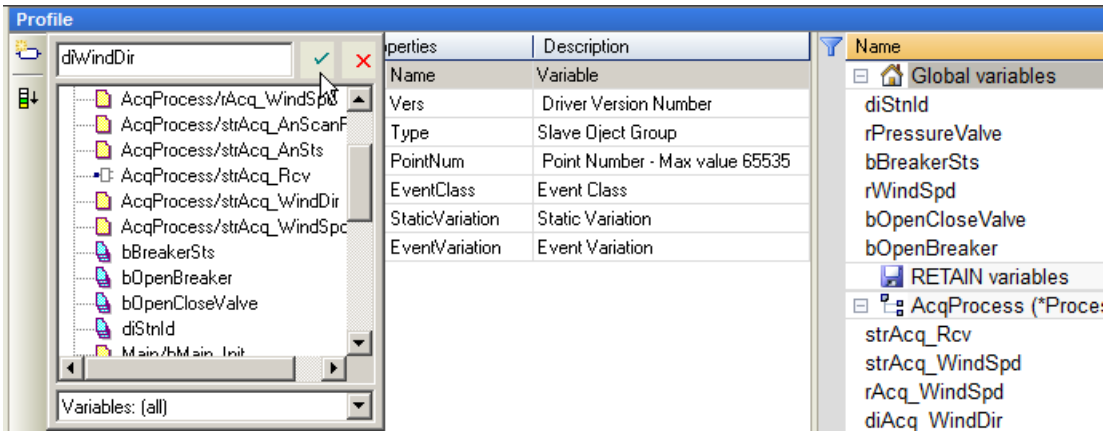
2- Click on the **DNP3S** communication profile.



3- Click **Insert/Set Variable...** under the **Insert** menu in the toolbar.

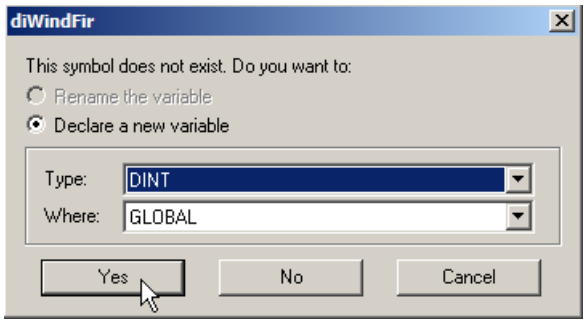
a. Select a Variable from the list and click on √.

b. To create a Variable, type its name and click on √. It is preferable to have a naming convention for the Variables. For example, you could prefix DINT variables with *di* and BOOL variables with *b* to declare *diWindDir* or *bBreakerSts*.



A new window will open; select the Variable **Type** and location '**Where**' (GLOBAL or RETAIN), then click **Yes**.

Note: Declare all Variables globally so that all functions including DNP3S can access them as required.



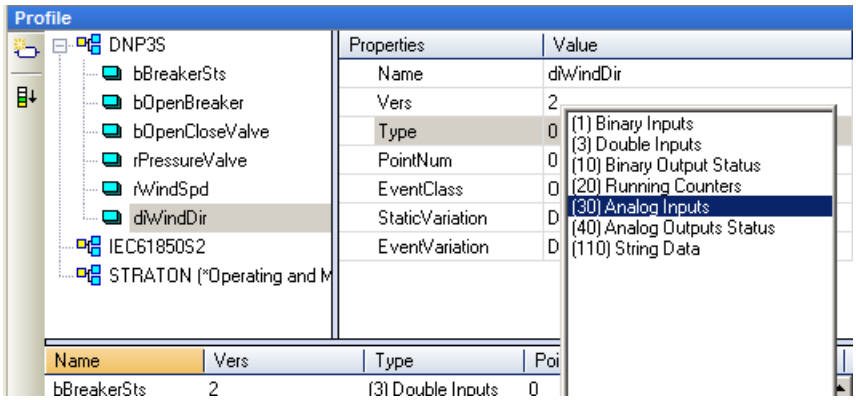
3.9. Configuring a Variable

1- Click **Profile** in the toolbar to access the Profile window.

2- Click on the **DNP3S** communication profile.

3- Click on the Variable. The Variable properties are presented on the right side of the **Profile** window, as follows:

a- **Type:** Select the type of static data associated with the Variable. This can be a single or double binary input (e.g. circuit breaker status), a binary status output, a running counter, an analog input or output, or a character string. Each type of Variable is associated with a group.



b- ***PointNum:*** Select the address of the point (Variable) based on the Type of group. The point number must be unique for each Variable of the same type.

c- ***EventClass:*** Select the event class:

- **NONE:** Static Variable; no event is associated with the point. These points are retrieved only on request from the Master.
- **ONE, TWO, THREE:** Event Variable. Select Class 1 (high priority), 2 or 3 (low priority) for the Variable.
- **Default:** Uses the ***Default Class Event*** of the DNP3 Slave protocol.
- **Persistent:** Stores the events in memory during a restart of the application or the device.

d- ***StaticVariation:*** The variation to return when the Master requests variation 0 in an integrity data poll (for static values).

- **Default:** Uses the static variation defined by the ***Default variation*** of the DNP3 protocol.
- **1 to 9:** The variation to return.

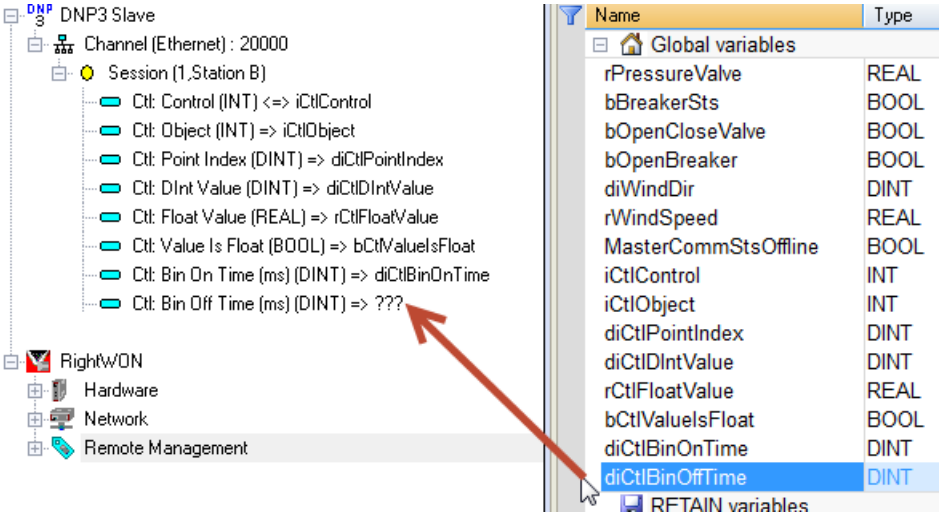
e- ***EventVariation:*** The variation to return when the Master requests variation 0 in an integrity data poll (for event values).

- **Default:** Uses the event variation defined by the ***Default variation*** of the DNP3 protocol.
- **1 to 9:** The variation to return.

3.10. Configuring DNP3 commands from the Master station

The Slave receives commands from the Master station(s) through the IEC 61131-3 PLC application in the RightWON.

1. Right-click on **Session** and click **Add Variable…**
2. In **Type**, select **Ctl: Control (INT).**
3. In **Variable**, enter the name of the variable (e.g.: *iCtlControl*).
   Note: the variable must previously be created in global variables. If not, don't enter a name. Then, create the variables in global variables and drag-drop the variable on **???.**
4. Repeat from step 1 to add all of the following variables:



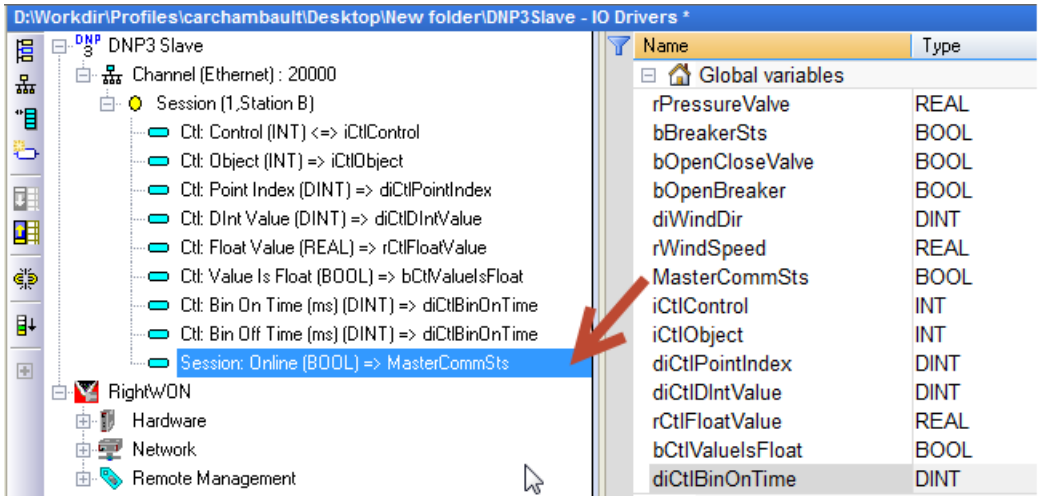
5. To automatically write the information from the command in the slave variable, create a structured text (ST) language program:

```
//Refer in the OEM librairy to:
//Control Variable : Incoming Request Function Code
//Control Variable : Returned Response
case iCtlControl of
  DNP3S_CONTROL_REQ_IDLE:;//Idle
  DNP3S_CONTROL_REQ_SELECT://Select
     iCtlControl:=DNP3S_CONTROL_RESPONSE_SUCCESS_AUTO_WRITE;
  DNP3S_CONTROL_REQ_OPER:;//Operate
     iCtlControl:=DNP3S_CONTROL_RESPONSE_SUCCESS_AUTO_WRITE;
  DNP3S_CONTROL_REQ_DIRECT_OPER://Direct Operate
     iCtlControl:=DNP3S_CONTROL_RESPONSE_SUCCESS_AUTO_WRITE;
  DNP3S_CONTROL_REQ_DIRECT_OPER_NO_ACK://Direct Operate No Ack
     iCtlControl:=DNP3S_CONTROL_RESPONSE_SUCCESS_AUTO_WRITE;
  DNP3S_CONTROL_REQ_CANCEL://Cancel
     iCtlControl:=DNP3S_CONTROL_RESPONSE_SUCCESS_AUTO_WRITE;
   else;
end_case;
```

3.11. Configuring error report variables

The configure error report variables:

1. Right-click on **Session** and click **Add Variable…**
2. In **Type**, select an error report:
   - Session: Online (BOOL)
   - Link: Force Rx (BOOL)
   - Link: TxPending (BOOL)
3. In **Variable**, enter the name of the variable (e.g.: *MasterCommSts*).
   Note: the variable must previously be created in global variables. If not, don't enter a name. Then, create the variables in global variables and drag-drop the variable on **???.**



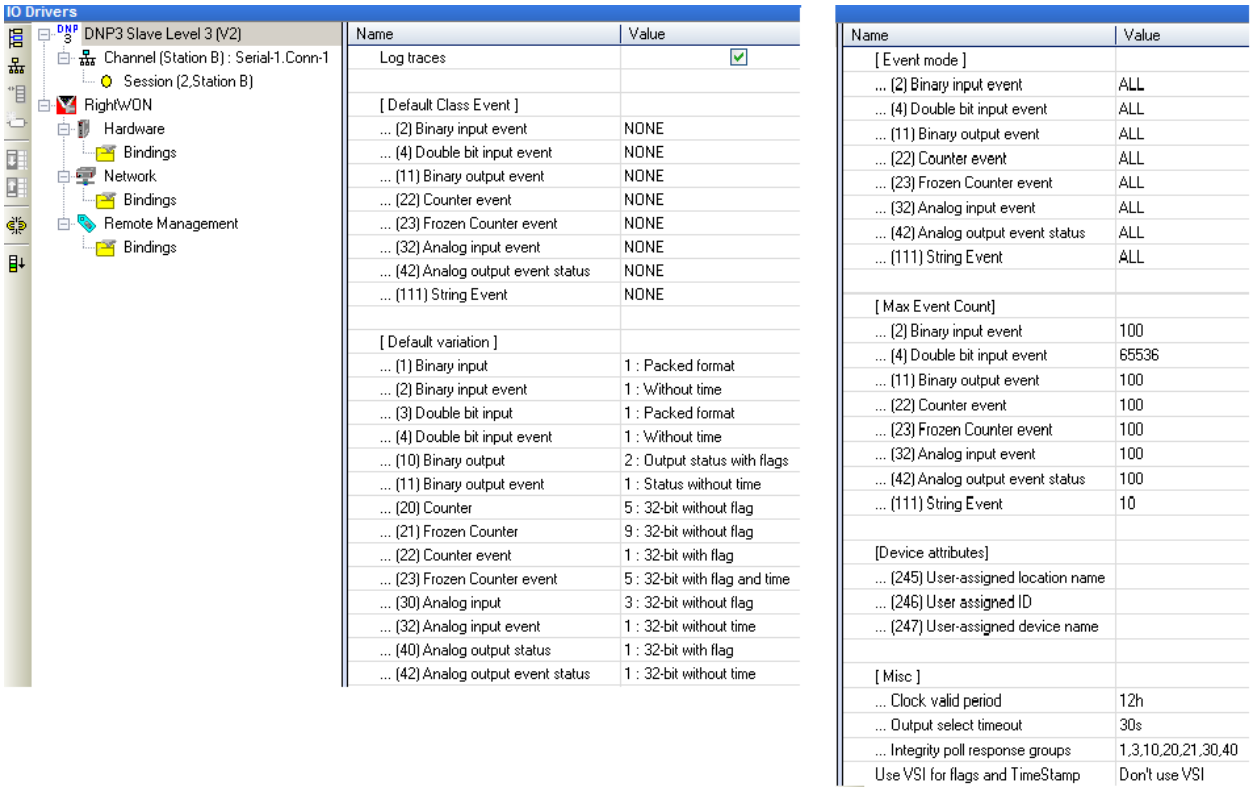
3.12. Example of DNP3 Slave static configuration

In the DNP3 example presented in the 'Static' file, the DNP3 protocol is configured in static mode. The Master must also be configured in static mode to be able to execute an integrity data poll of the Slave. Here is an example of the Slave configuration:

1- Example of configuring a static DNP3 Slave
2- Configuring the port in serial or Ethernet mode
3- Example of configuring a static Session
4- Example of configuring static Variables

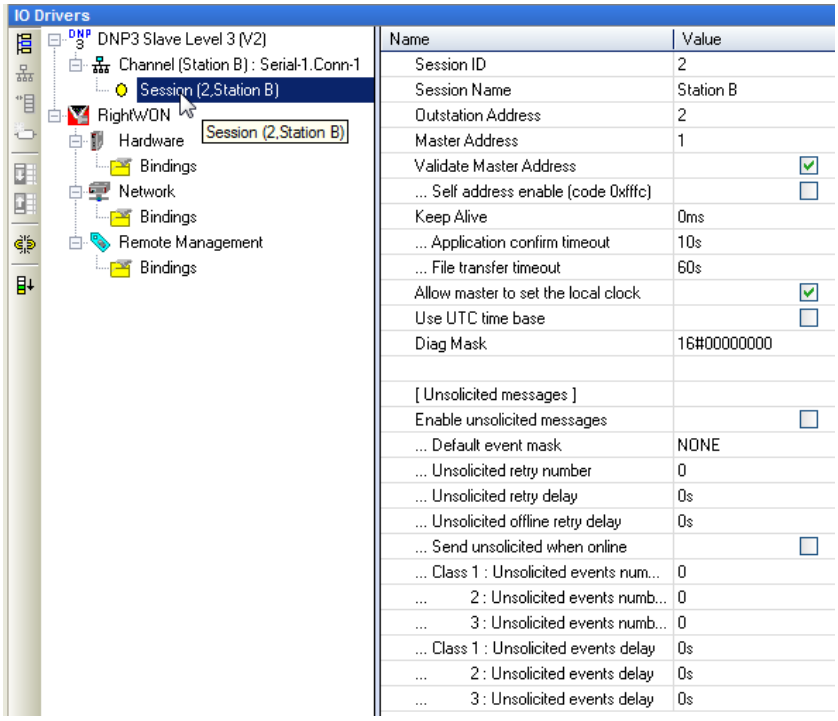
3.12.1. Example of configuring a static DNP3 Slave

The default event class (***Default Class Event***) must be zero (**NONE**) for each type of Variable. In this way, the variables will be declared static if the default option is selected for the event class of the point.



3.12.2. Example of configuring a static Session

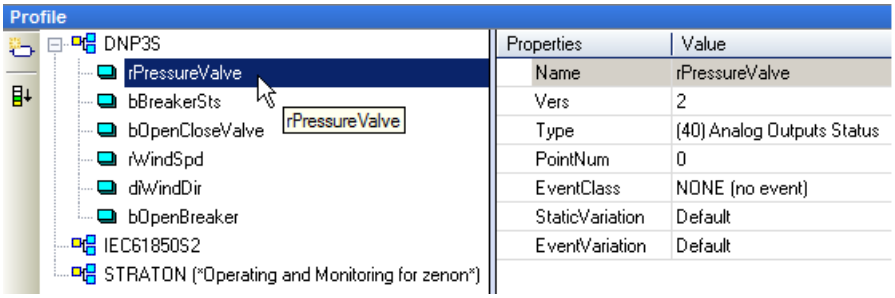
Event messages are disabled (***Enable unsolicited messages*** is unchecked).



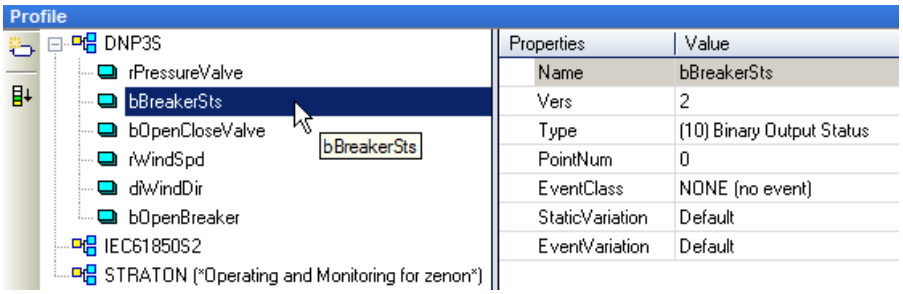
3.12.3. Example of configuring static Variables

Variables must be in event class zero (**EventClass** set to **NONE**) to be static Variables. A Variable can also be put in the **Default** class if the default event class of the DNP3 Slave is configured as static. Here are some configuration examples of different types of static Variables: binary input, binary output, analog input and analog output. The point number is unique for each Variable of the same type.

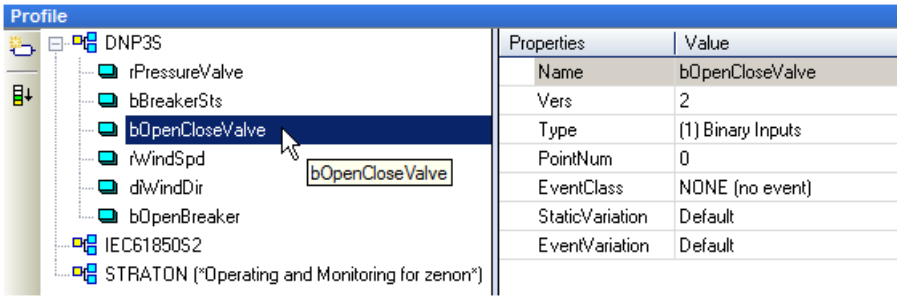
Analog output Variable with point number 0:



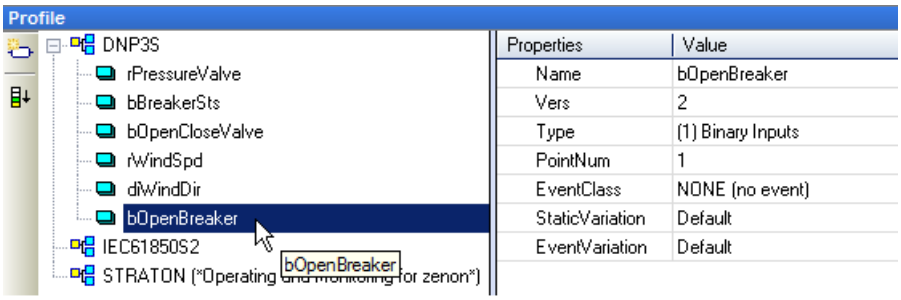
Binary output Variable with point number 0:



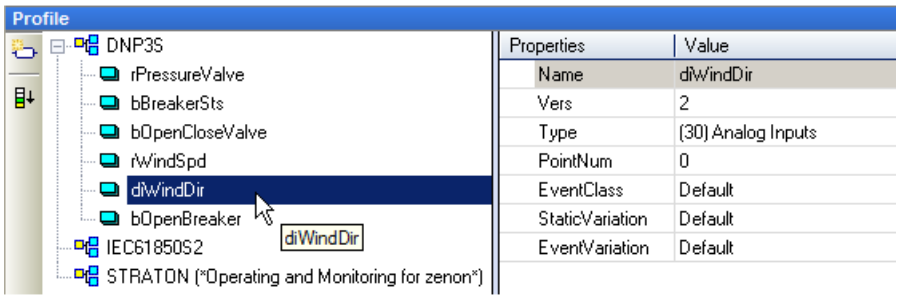
Binary input Variable with point number 0:



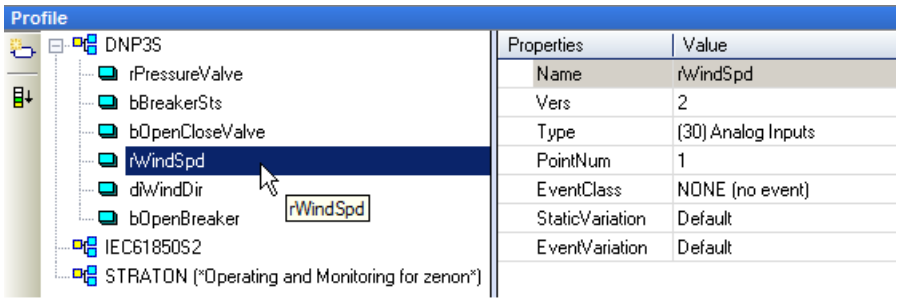
Binary input Variable with point number 1:



Analog input Variable with point number 0:



Analog input Variable with point number 1:



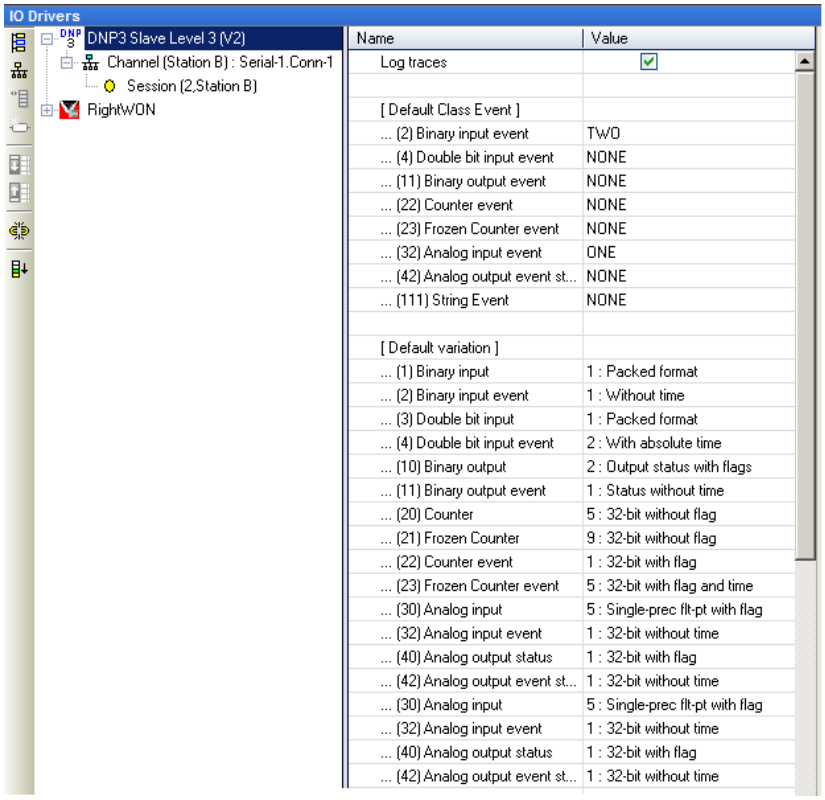
3.13. Example of DNP3 Slave event configuration

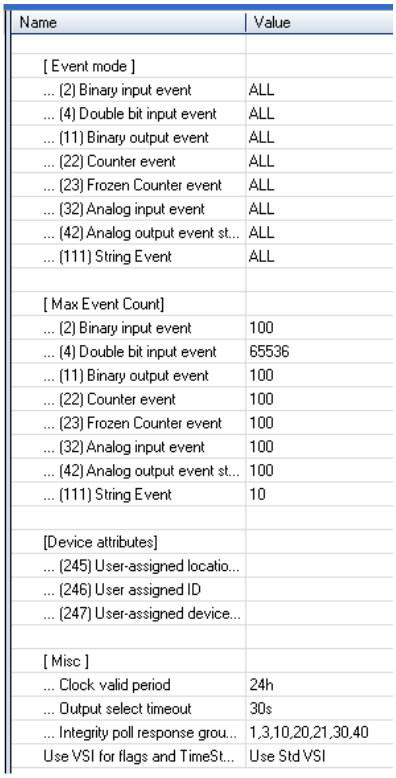
In the DNP3 example presented in the 'Event' file, the DNP3 protocol is configured in event mode. Events are sent to the Master as unsolicited messages. The Master must therefore be configured in event mode to receive the events. Here is an example of the Slave configuration:

1- Example of configuring an event DNP3 Slave
2- Configuring the port in serial or Ethernet mode
3- Example of configuring an event Session
4- Example of configuring event and static Variables

3.13.1. Example of configuring an event DNP3 Slave

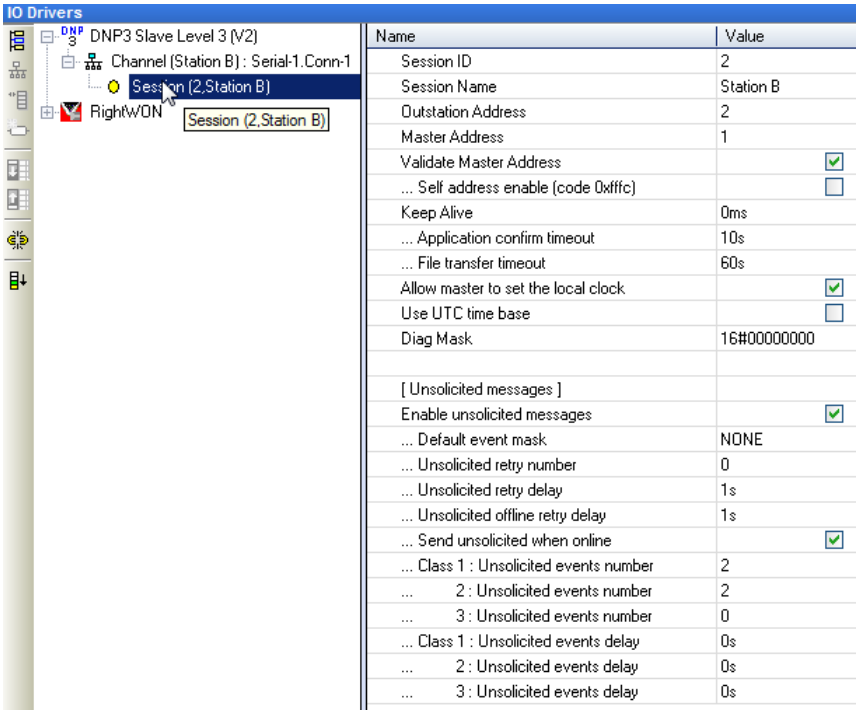
The default event class (***Default Class Event***) must be 1, 2 or 3 (***ONE***, ***TWO*** or ***THREE***) for each type of variable to be an event variable. In this way, event variables will be declared if the default option is selected for the event class of the point. Event class 0 (***NONE***) is static.





3.13.2. Example of configuring an event Session

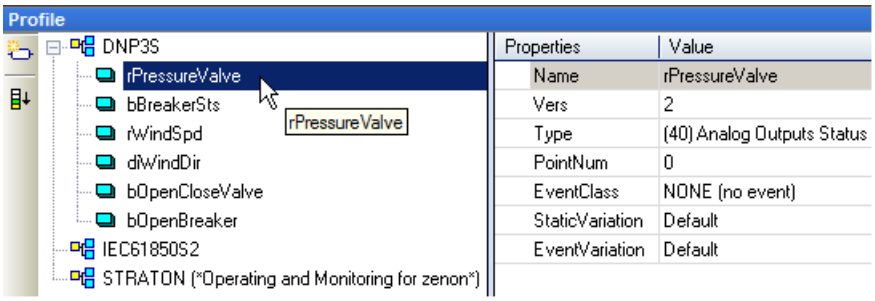
Event messages are enabled (***Enable unsolicited messages*** is checked). You must also configure the ***Unsolicited messages*** section as required by the application.



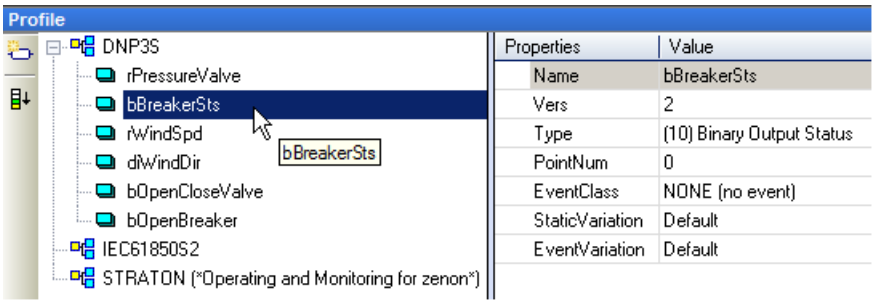
3.13.3. Example of configuring event and static Variables

Variables must be in event class zero (**EventClass** set to **NONE**) to be static Variables and in class 1, 2 or 3 (**ONE**, **TWO** or **THREE**) to be event Variables. A Variable can also be put in the **Default** class if the default event class of the DNP3 Slave is configured as an event class. Here are some configuration examples of different types of event Variables: binary input, binary output, analog input and analog output. The point number is unique for each Variable of the same type.

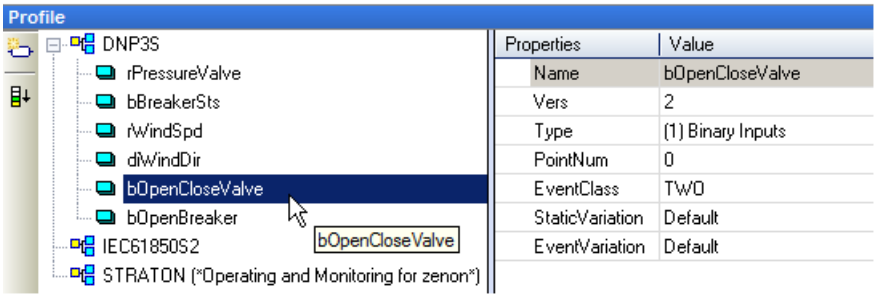
Analog output Variable with point number 0 (static):



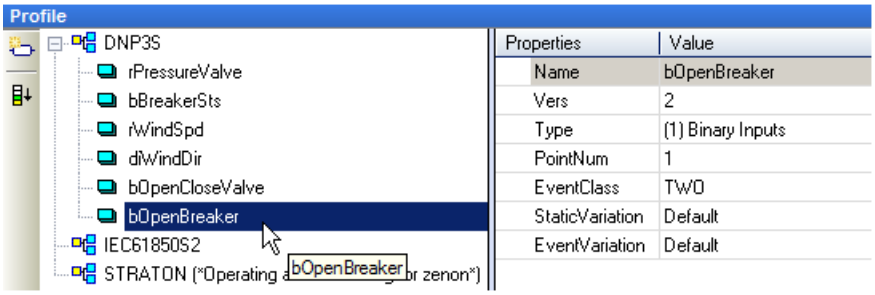
Binary output Variable with point number 0 (static):



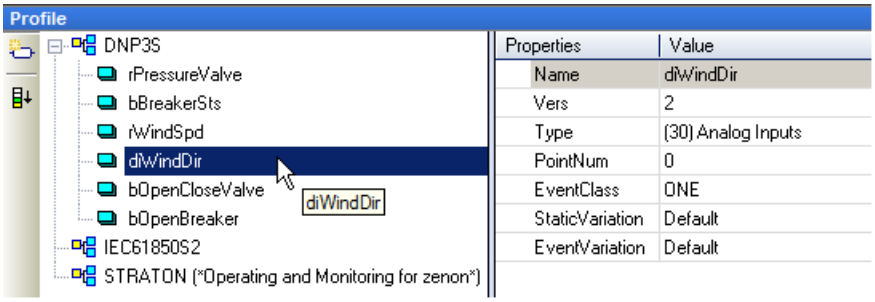
Binary input Variable with point number 0:



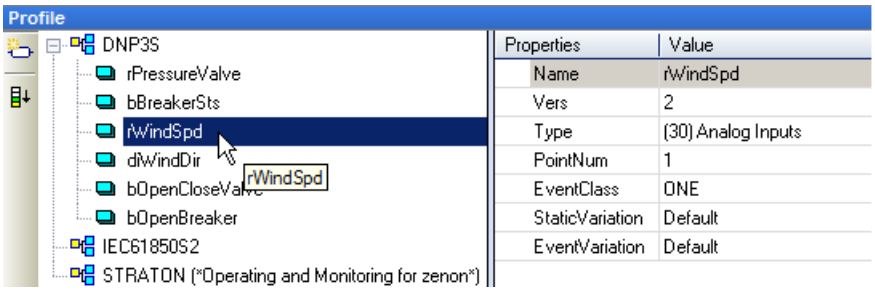
Binary input Variable with point number 1:



Analog input Variable with point number 0:



Analog input Variable with point number 1:



Tutorial on DNP3 Master configuration

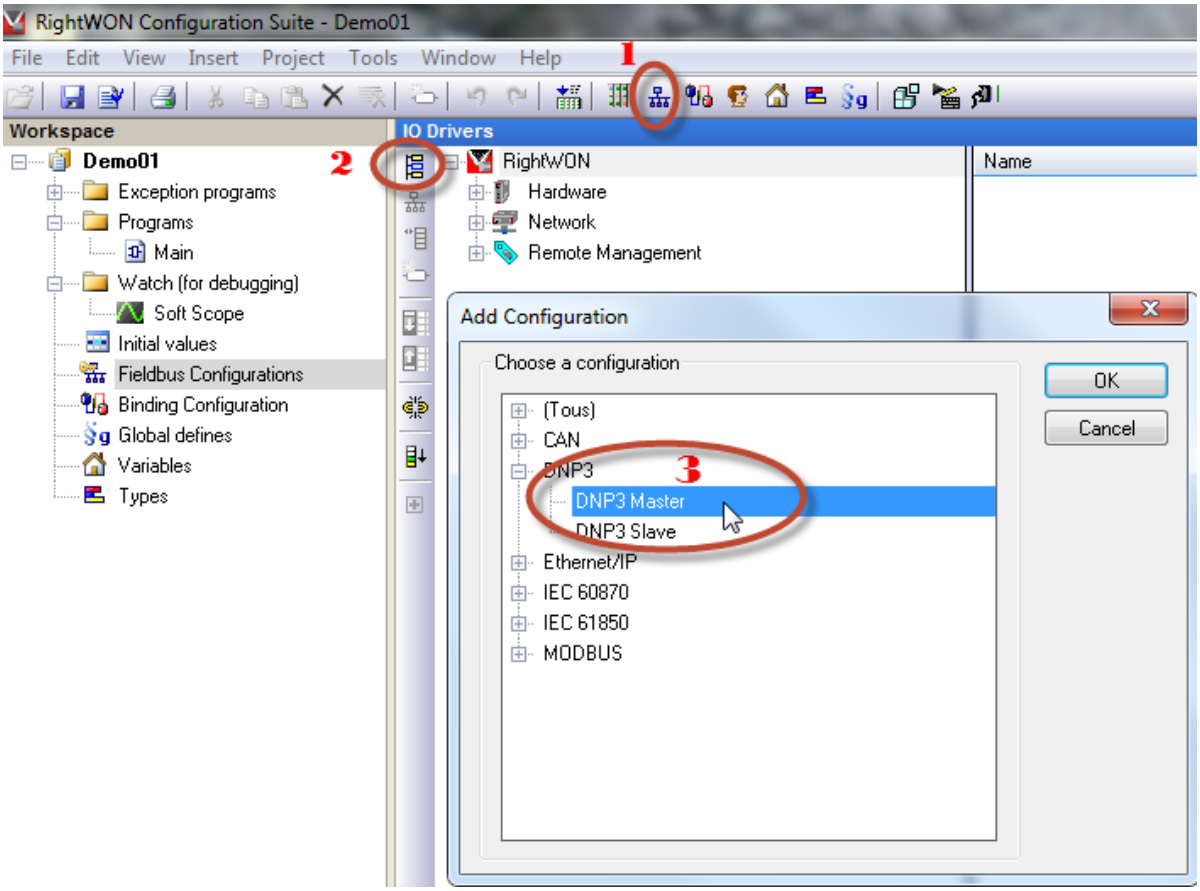
Configuration of a DNP3 Master in the RightWON requires the following steps:

1- Installing the license key for the DNP3 protocol
2- Adding the DNP3 Master protocol to the RightWON configuration
3- Configuration parameters for the DNP3 Master
4- Inserting a communication port (Channel) on the DNP3 Master protocol
5- Configuring the communication port
6- Inserting a data block (Session) on the communication port
7- Configuration parameters for a Session
8- Adding Variables to the Session
9- Configuring DNP3 commands to the Slave station.
10- Configuring error report variables.
11- Example of configuring a DNP3 Master in static or event mode

4.1. Adding the DNP3 Master protocol to the RightWON configuration

The DNP3 Master can be added to the RightWON configuration when a new project is created, or through the fieldbus manager by carrying out the following operations:

1- Start the fieldbus configurator by clicking **Fieldbus Configurations** in the toolbar.
2- Click **Insert Configuration...** in the editing area toolbar.
3- In the new window, expand the DNP3 configuration and double-click on the **DNP3 Master** protocol.



4.2. Configuration parameters for the DNP3 Master

Several parameters are available for configuring the DNP3 Master. To view these parameters, double-click on **DNP3 Master**. Here is the list of available parameters:

- ***Log traces:*** The log messages are displayed in the output window of the RightWON Configuration Suite. This takes time and should be reserved for troubleshooting.
- ***Use VSI for flags and TimeStamp:*** Permits using status flags and timestamps according to the following options:
  - ***Don't use VSI:*** Do not use standard variable status bits (VSI)
  - ***Use VSI:*** Use standard VSI
  - ***Use Std VSI and User bits (1-8):*** Use standard VSI and user bits (1-8)

4.2.1. Activate status bits

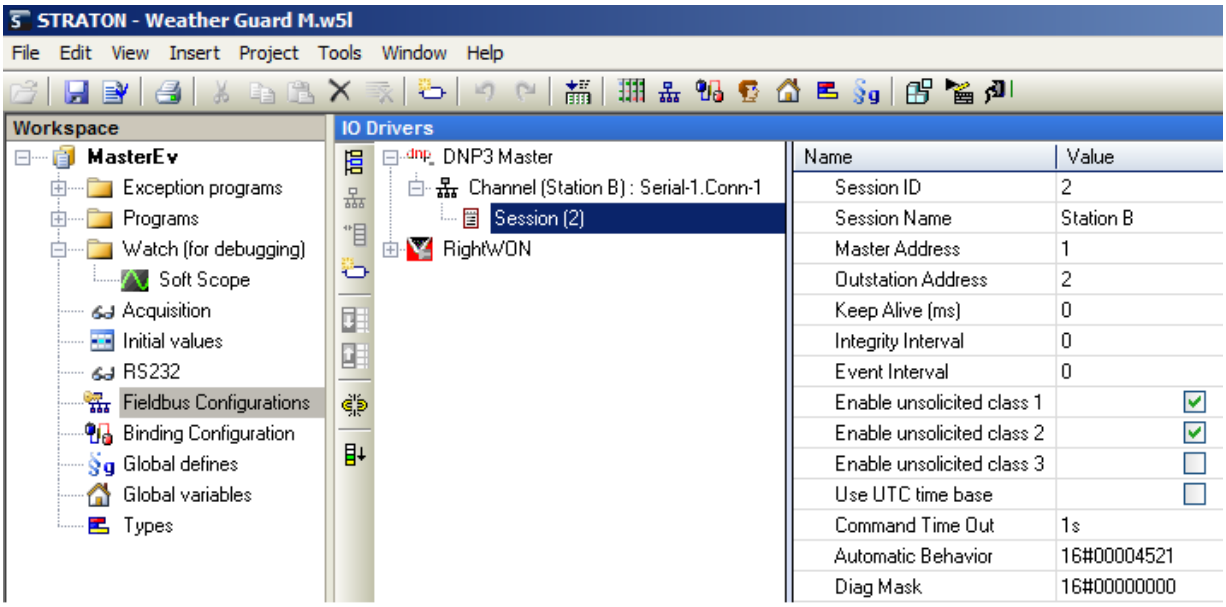
To activate status bits management:

1. Select **Project>Settings**.
2. In **Compiler** section, double-click on **Allocate status flags for variables with embedded properties**.
3. Click **OK**.

4.3. Configuration parameters for a Master Session

After inserting a session, you can configure it using the **Fieldbus Configurations**  .

Note: The Master should have one session for each Slave that the Master station controls. Each session of the DNP3 Master protocol must be configured to process the information of the Slave station. Thus the DNP3 protocol is configured in the same way as for the Slave, in static or event mode.



Click **Session** in the **IO Drivers** window. To set a parameter, double-click it. Enter the data in the field and press **Enter** on the keyboard. To enable (checked box) or disable a parameter, click on the box. Here is the list of parameters to configure:

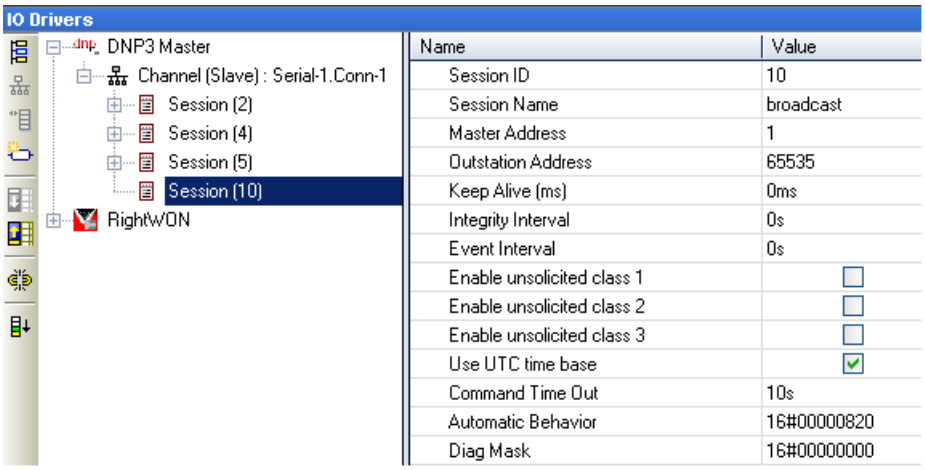
1- ***Session ID:*** Enter a unique identification number for the session.

2- ***Session Name:*** Enter the name of the session.

3- ***Master Address:*** Enter the address of the Master station.

4- ***Outstation Address:*** Enter the address of the Slave station.

Note: For broadcast messaging, create a session and enter 65535 in the ***Outstation Address*** field. A broadcast permits data transmission only to all Slave stations. The DNP3 status is not returned from the Slave stations.



5- ***Keep Alive*:** Enter the time (in milliseconds) between signals that verify the status of the connection between the Master and Slave (**Link Confirm Time Out** on the Channel).

6- ***Integrity Interval:*** Delay (in seconds) before polling the static points.

7- ***Event Interval:*** Delay before polling the events and for receiving an acknowledgment.

8- ***Enable unsolicited class 1:*** Enables unsolicited Class 1 messages.

9- ***Enable unsolicited class 2:*** Enables unsolicited Class 2 messages.

10-***Enable unsolicited class 3:*** Enables unsolicited Class 3 messages.

11-***Use UTC time base:*** Allows this Session to use UTC (Coordinated Universal Time).

12-***Command Time Out:*** The time allotted for executing a request generated by the Session before declaring a failure.

13-***Automatic Behavior:*** The mask used to enable/disable automatic processing of requests. To configure it, double-click the field. The ***Select Automatic Behavior*** window opens. Click on the following fields to activate them, if desired:

Automatic Behavior parameters	**Description**
Clear IIN restart bit	Resets the IIN restart bit to 0. (INN: “Internal Information”)
Issue integrity data poll on restart	Issues a data poll after a restart.
Issue integrity data poll after local IIN bit was set and cleared	Issues a data poll after the local IIN bit has been set to 1 and then reset to 0.
Issue integrity data poll on timeout	Issues a data poll when a timeout expires.
Issue integrity data poll on buffer overflow	Issues a data poll when a buffer overflows.
Use delay measurement in time sync	When synchronizing the time, uses a measurement of the time it takes for a request to travel from the Master to the Slave.
Perform time sync on need time using serial method	Performs time synchronization on request from the Slave, using a serial transmission method.
Issue event data poll when class 1,2, or 3 IIN bit is set	Issues a data poll when the IIN bit in Class 1, 2 or 3 is set to 1.
Automatically enable unsolicited events upon remote or master device startup	Enables unsolicited events automatically on startup of the Slave or Master station. Unsolicited responses must also be permitted on the Slave station.
Automatically disable unsolicited events upon remote device startup, Not necessary, outstation should be disable at start-up	Automatically disables unsolicited events during startup of the Slave station. This parameter is not required, since the Slave station should already be disabled on startup.

	Note: Whatever the value of this parameter, the Session can also poll events using Class 1, 2, 3 or an object group of specific events.
Enable/Disable automatic generation of application layer confirmations	Enables/Disables automatic generation of confirmations from the application layer
Perform time sync on need time using LAN method	Performs time synchronization on request from the Slave, using a LAN transmission method.
Exchange data set prototypes and descriptors with slave when IIN restart bit is set or when master restarts	Exchanges the data set prototypes with the Slave when the IIN restart bit is set to 1 or on restart of the Master.
Issue integrity data poll when session becomes 'online', meaning connected	Issues a data poll when the session is 'online', that is, connected.
Master unsolicited Startup	Executes an unsolicited startup sequence on the Master.
Request Obj 50 with integrity poll to Time Stamp values	Adds the timestamp to a data poll of static objects.

14- ***Diag Mask:*** Contains the diagnostics mask for the various communication layers (default 16#00000000: no diagnostics). To configure it, double-click the field. A **Select Trace Options** window opens. Click on the following fields to activate them, if desired:

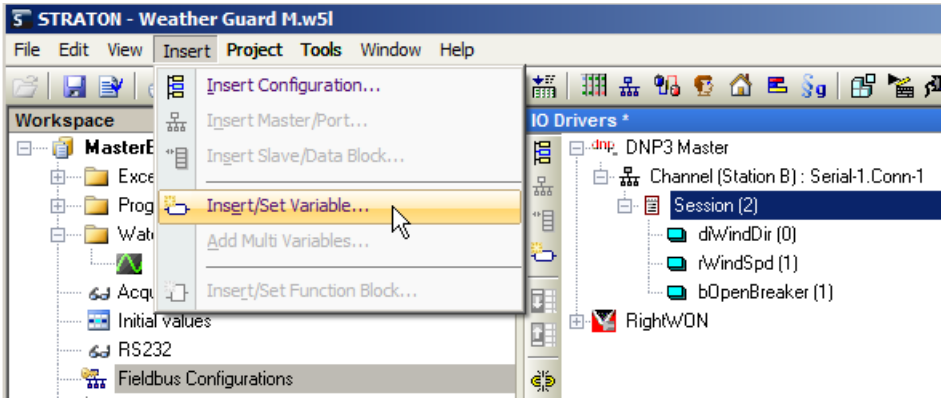
- **Show Time Stamps:** Displays the timestamps
- **Show Errors:** Displays the errors
- **Trace Transport layer:** Traces the transport layer of the OSI model
- **Trace Application layer:** Traces the application layer of the OSI model
- **Trace User level layer:** Traces the user-level layer (traces Requests and Responses)
- **Display Static Data Header:** Displays the headers for static data.
- **Display Static Data Values:** Displays the values of the static data.
- **Display Event Data Header:** Displays the headers for event data.
- **Display Event Data Values:** Displays the values of the event data.

4.4. Adding and configuring an input Variable

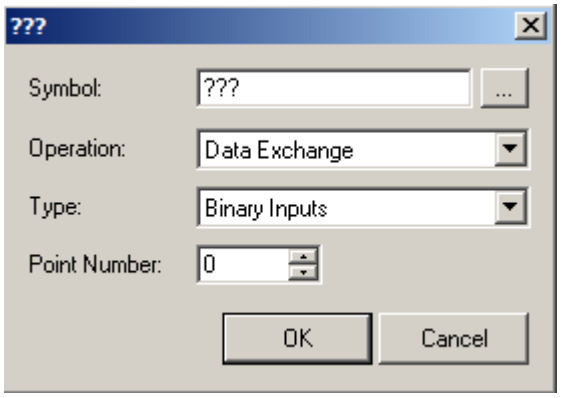
Add variables to the Session by executing the following steps:

1- Using the **Fieldbus Configurations** , click **Session** in the expanded tree under **DNP3 Master** in the **IO Drivers** window.

2- Click **Insert/Set Variable…** under the **Insert** menu, or click the icon in the toolbar.

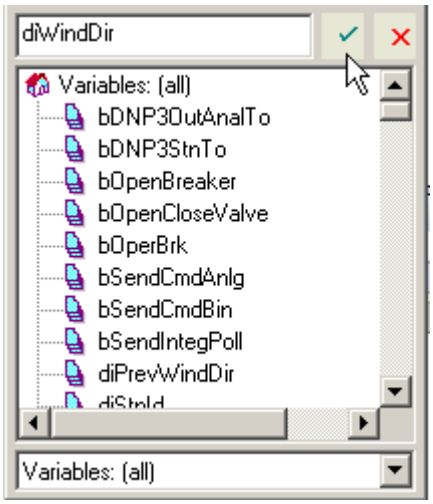


3- A new window will open. For the **Symbol** field, click on ... and either:



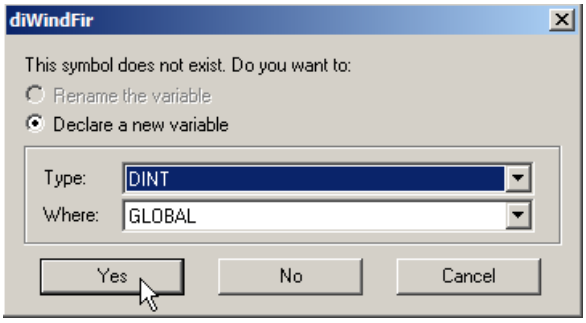
a. Select a Variable from the list and click on √. (e.g. *bOpenCloseValve*)

b. Create a Variable by typing its name and clicking on √. It is preferable to have a naming convention for the Variables. For example, you could prefix DINT variables with *di* and BOOL variables with *b* to declare *diWindDir*.



A new window will open; select the Variable **Type** and location '**Where**' (GLOBAL or RETAIN), then click **Yes**.

Note: Declare all Variables globally so that all functions including DNP3S can access them as required.

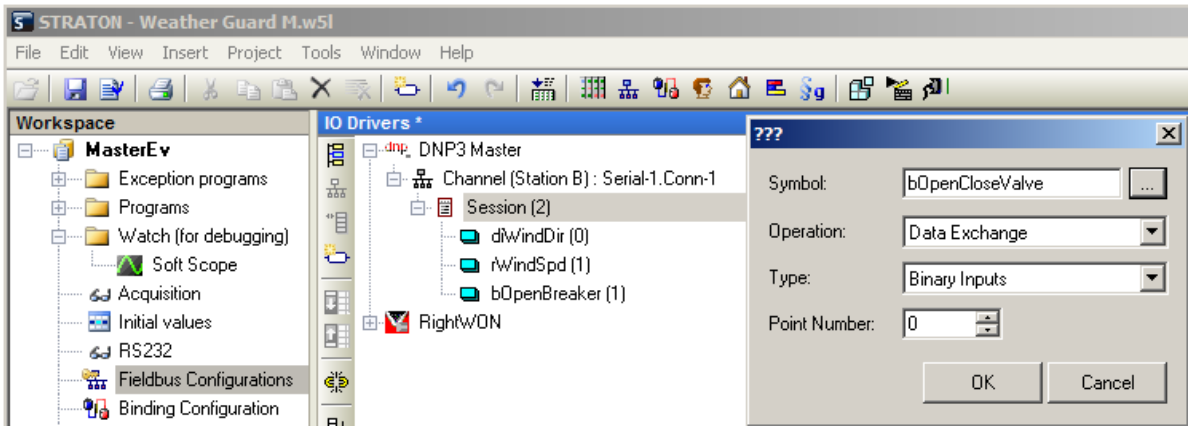


4- Select the type of **Operation**: Data Exchange (Read data) or Error Log.

5- Enter the **Type** and the **Point Number**.

Note: You must enter the same **Type** and **Point Number** that are defined in the Slave station for the point. The Master uses these two pieces of information to exchange data with the Slave concerning this point.

6- Click **OK**.

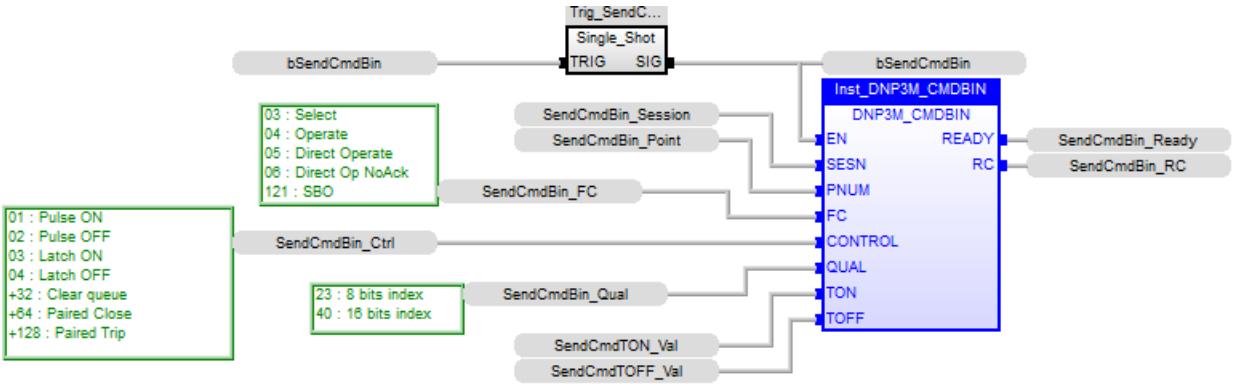


4.5. Configuring DNP3 commands to the Slave station

The Master sends commands to the Slave station(s) through the IEC 61131-3 PLC application in the RightWON. The following commands are examples that show how commands can be used to allow the Master to exchange data with the Slave. For more information on DNP3 commands, see **DNP3 Master function blocks** in the RightWON Configuration Suite Help by pressing the **F1** key.

Example of a binary output command:

In a function block diagram (FBD) program, declare the following program.



Execution of a binary output command, written in structured (ST) language program:

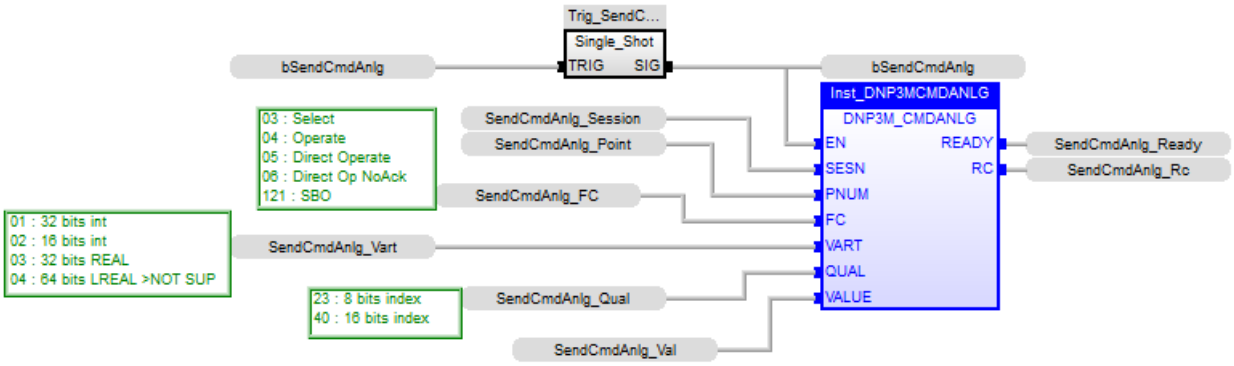
//The following command example allows controlling the variable *bBreakerSts* in the Slave.

```
//Refers to DNP3 Library defines (OEM) to get more info.
   if ( SendCmdBin_Ready ) then
     SendCmdBin_Session:=0;    //Session number
     if bToggleValue then
        SendCmdBin_Ctrl:=DNP3M_CROB_CTRL_LATCH_ON; //Refer to Binary Controls in OEM Library
     else
        SendCmdBin_Ctrl:=DNP3M_CROB_CTRL_LATCH_OFF; //Refer to Binary Controls in OEM Library
     end_if;
     SendCmdBin_Point:=0;  //Point Number of the variable
     SendCmdBin_FC:=DNP3M_FC_DIRECT_OP_NOACK; //Refer to Master Function Codes in OEM Library
     SendCmdBin_Qual:=DNP3M_QUAL_16BIT_INDEX;
                          //Refer to Analog/Binary Control Qualifiers in OEM Library
     SendCmdTON_Val:=t#1s;//On duration
     SendCmdTOFF_Val:=t#1s;//Off duration
     bSendCmdBin:=true; //Activate the trigger to send the command

      //To verify if the command was successful. Refer to Response values in OEM Library
      if(SendCmdBin_RC = DNP3M_RESP_STATUS_SUCCESS ) then
         bBinCmdSts:=true;
         bToggleValue:= NOT(bToggleValue);
      else
         bBinCmdSts:=false;
      end_if;
   end_if;
```

Example of an analog output command

In a (FBD) function block diagram program, declare the following program.



Execution of an analog output command, written in structured (ST) language:

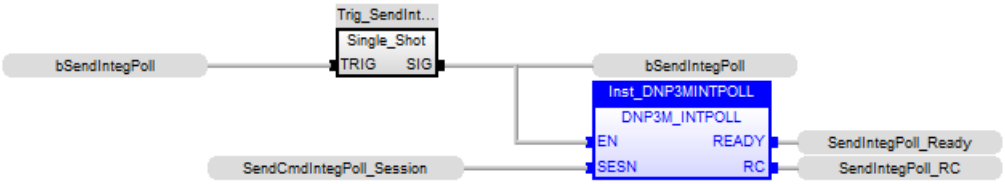
//The following command example allows controlling the variable rPressueValve in the Slave.

```
//Refers to DNP3 Library defines (OEM) to get more info. Refer to Response values in OEM Library.
if SendCmdAnlg_Ready then
  SendCmdAnlg_Session:=0;  //Session number
  SendCmdAnlg_Point:=0; //Point Number
  SendCmdAnlg_FC:=DNP3M_FC_DIRECT_OP_NOACK; //Refer to Master Function Codes in OEM Library
  SendCmdAnlg_Vart:= DNP3M_AN_OUT_VARIATION_32BIT_REAL;
                     //Refer to Master Function Codes in OEM Library
  SendCmdAnlg_Qual:= DNP3M_QUAL_16BIT_INDEX;
                     //Refer to Analog Controls Variations in OEM Library
  SendCmdAnlg_Val:=r_AnaValue; //Analog value to be sent to the Slave station.
  bSendCmdAnlg:=true; //Activate the trigger to send the command

//Return the analog output status
   if SendCmdAnlg_RC = DNP3M_RESP_STATUS_SUCCESS then
      bCmdSts:=true;
   else
      bCmdSts:=false;
   end_if;
end_if;
```

Example of an integrity poll command:

This command is used for retrieving static values from the Slave station(s) instead of using the *Integrity Interval* parameter in the master session.

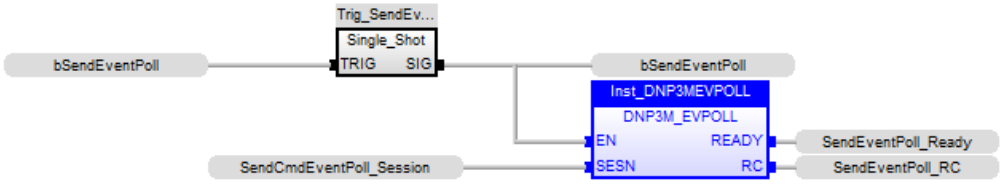


Execution of an integrity poll command, written in structured language:

```
SendCmdIntegPoll_Session:=0;      //Session number
if SendIntegPoll_Ready then
      bSendIntegPoll:=true;
else
      return;
end_if;
```

Example of an event poll command:

This command is used for retrieving events values from the Slave station(s) instead of using the *Event Interval* parameter in the master session.



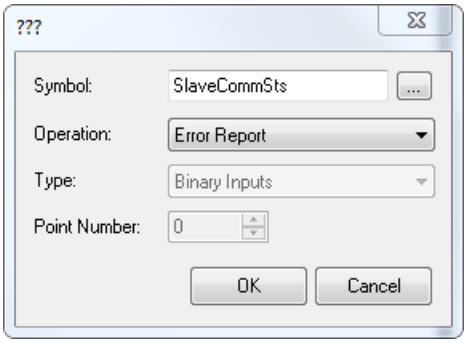
Execution of an event poll command, written in structured language:

```
SendCmdEventPoll_Session:=0;      //Session number
if SendEventPoll_Ready then
      bSendEventPoll:=true;
else
      return;
end_if;
```

4.6. Configuring error report variables

The configure error report variables:

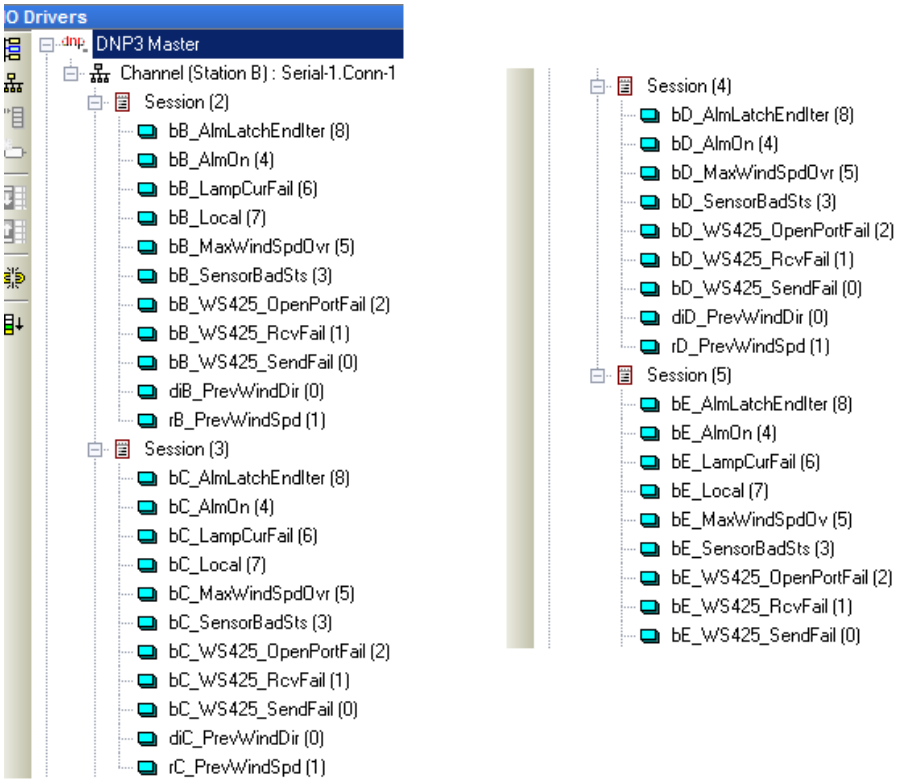
1. Right-click on **Session** and click **Add Variable…**
2. In **Operation**, select **Error Report**
3. In **Symbol**, enter the name of the variable (e.g.: *SlaveCommSts*).



4.7. Example of multiple DNP3 Sessions in the Master station

In the Master station, a port (**Channel**) can carry more than one session. This allows the Master station to exchange with more than one Slave station. You can configure multiple sessions (**Session**) on one port in Ethernet mode and other sessions on the other port in serial mode.

In the example below, each Session on the Master communicates with a different Slave station over the same serial communication port.

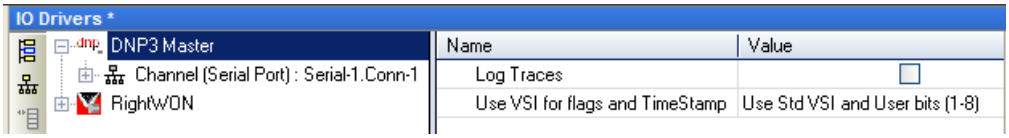


4.8. Example of configuring a DNP3 Master in static or event mode

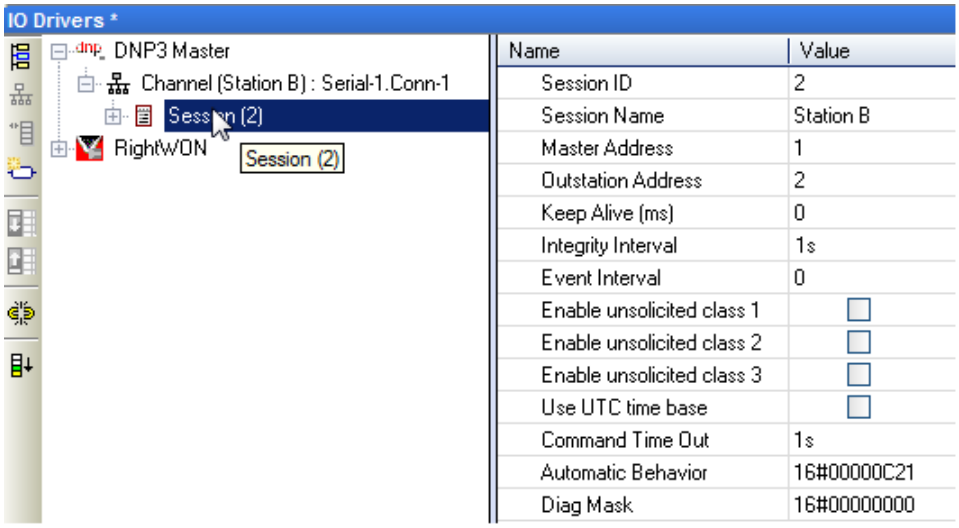
The DNP3 Master protocol can be configured in static or event mode. Here is how the examples are configured:

1- Example of configuring a DNP3 Master
2- Configuring the port in serial or Ethernet mode
3- Example of configuring a Session in either:
   - Static mode
   - Event mode
4- Example of configuring the Variables

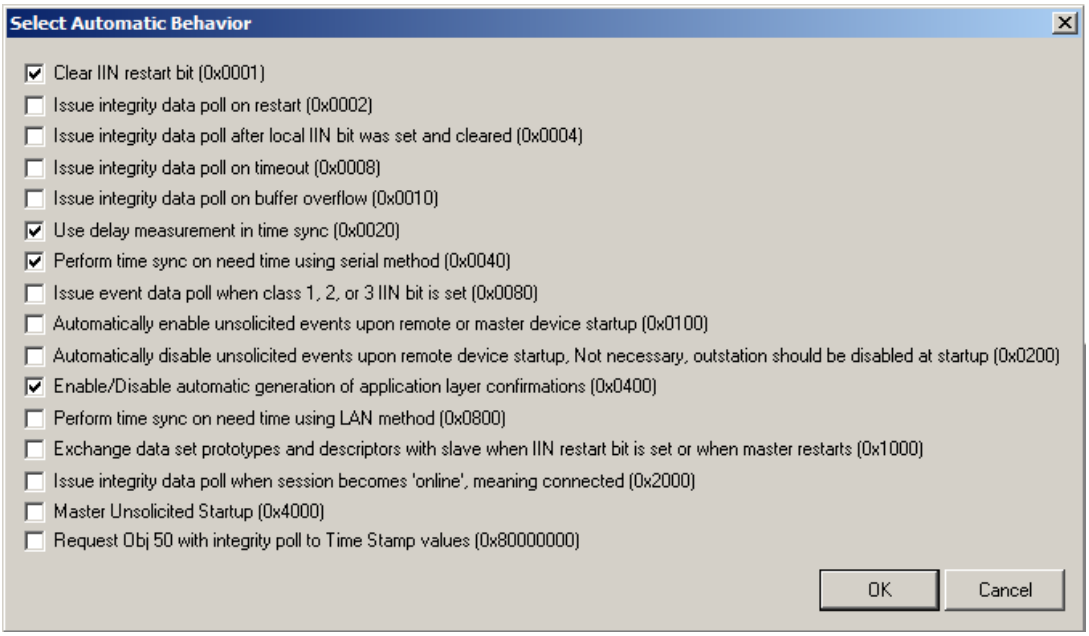
4.8.1. Example of configuring a DNP3 Master



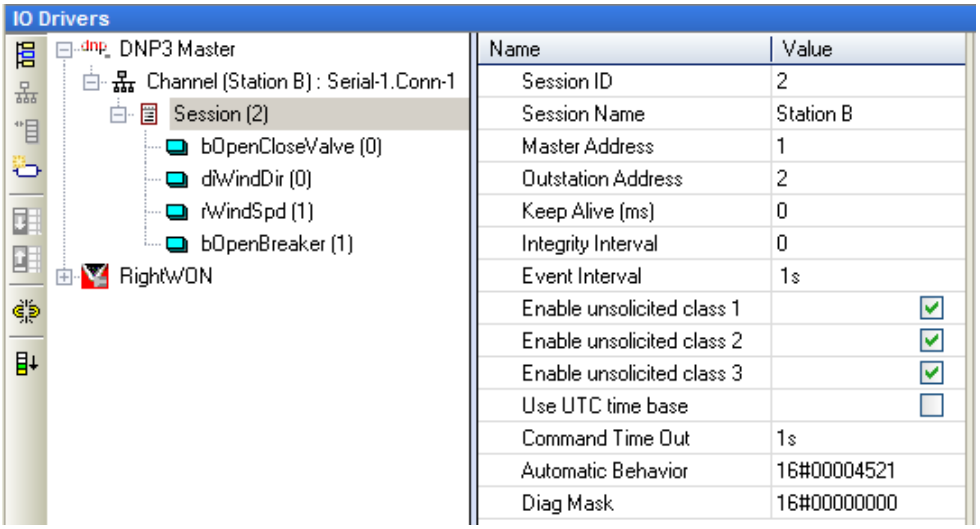
4.8.2. Example of configuring a static Session



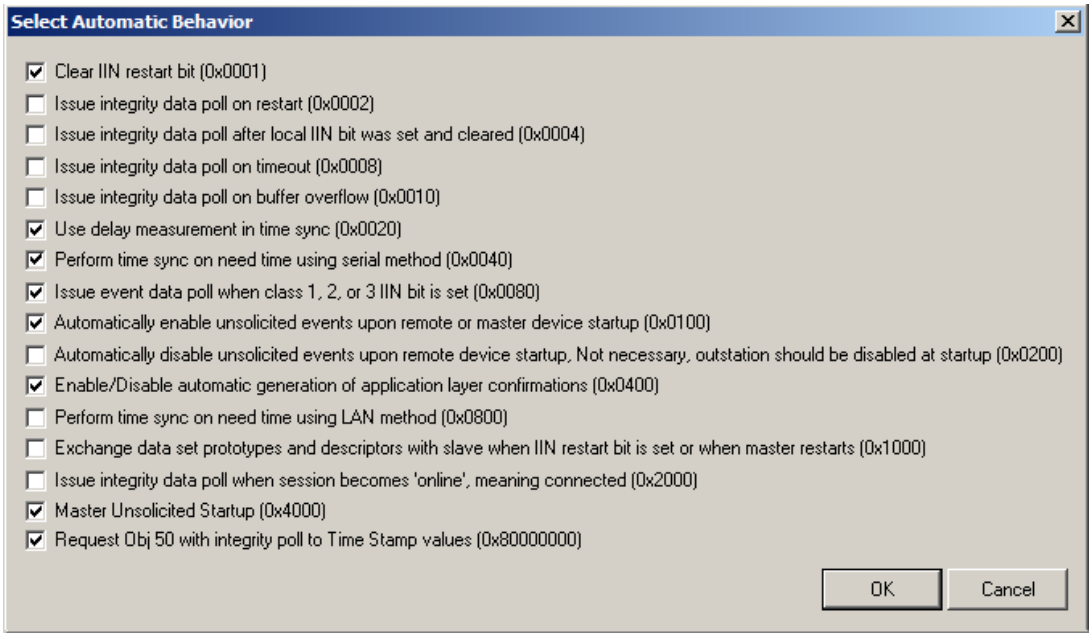
The following configuration options are available in the **Automatic Behavior** window for automatic processing of requests:



4.8.3. Example of configuring an event Session



The following configuration options are available in the **Automatic Behavior** window for automatic processing of requests:

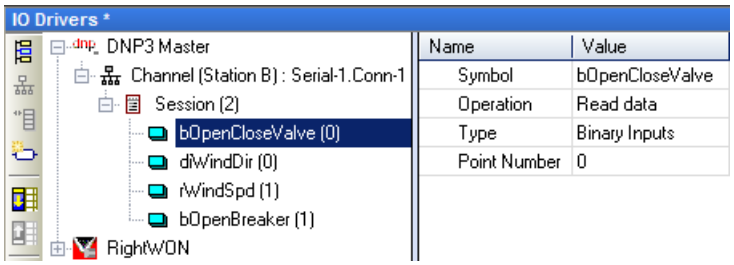


4.8.4. Example of configuring Variables in a Master Session

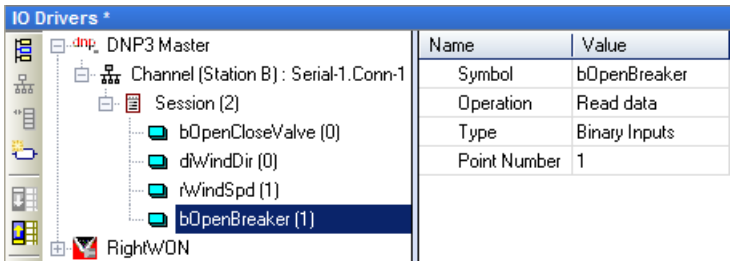
Here are some configuration examples for Variables of **Type** binary input and analog input. The **Point Number** is unique for each Variable of the same type. The ***bBreakerSts*** and ***rPressureValve*** Variables are not added to the Master session, since it is the Master that modifies these variables by sending commands to the Slave.

Note: The Variable **Type** and **Point Number** must be identical on the Slave.

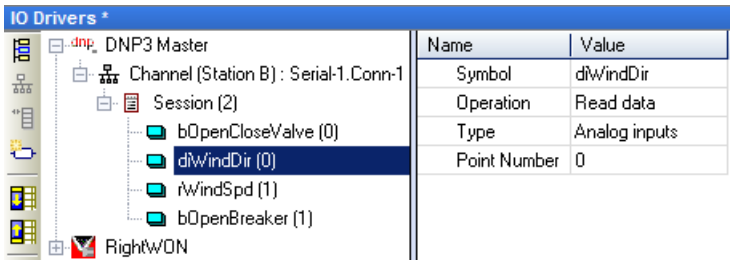
Binary input Variable with point number 0:



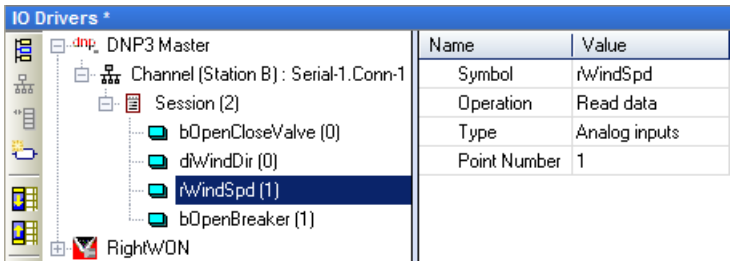
Binary input Variable with point number 1:



Analog input Variable with point number 0:



Analog input Variable with point number 1:

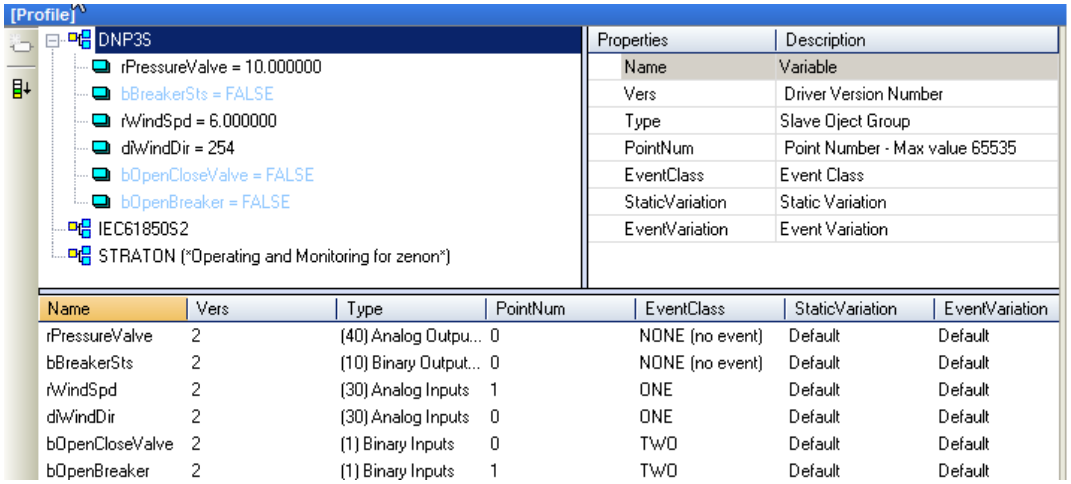


Example of the data exchange between Master and Slave

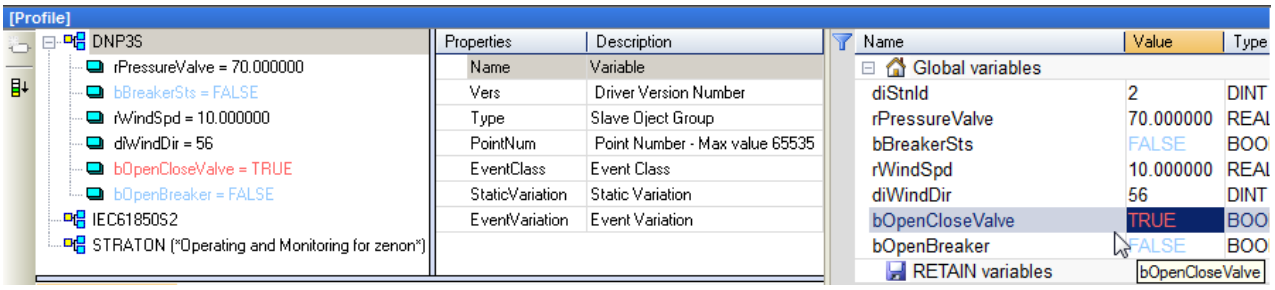
The Master and Slave communicate with each other via a serial communication port. They exchange data in either static or event mode. In event mode, the Slave station periodically sends events to the Master station without prior request from the Master. In static mode, the Master station periodically sends a poll to retrieve the data from the Slave station.

5.1. Example of Master and Slave operations in event mode

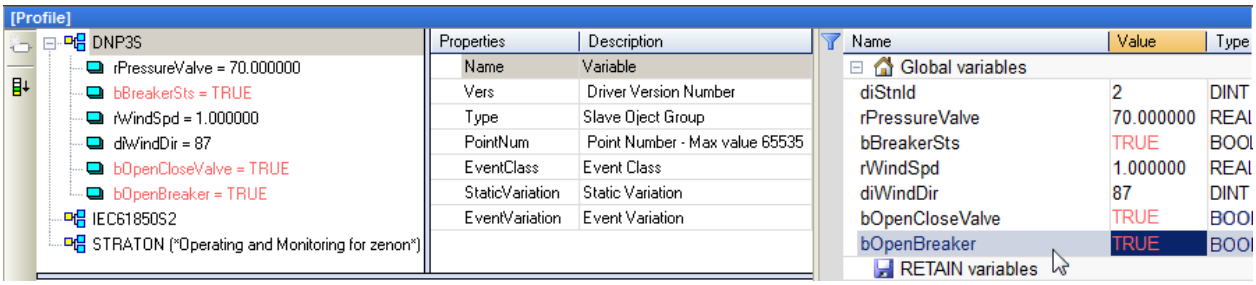
Operations at the Slave station: When the wind speed (*rWindSpd*) and wind direction (*diWindDir*) variables change in the Slave station, it generates an event that will be sent to the Master station. These events are sent according to the parameters of the Class they are defined in (Class 1, 2 or 3). Class 1 has the highest priority, and Class 3 the lowest.



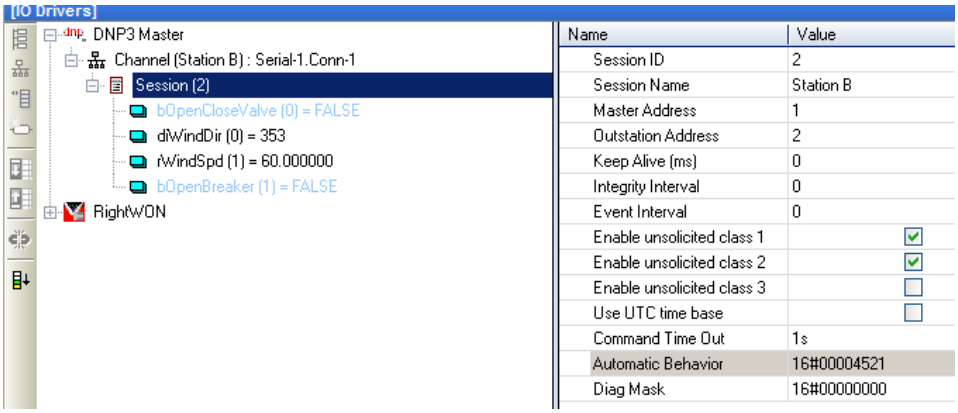
Pressure valve opening: To open the valve at the Slave station, click *bOpenCloseValve* and change its status from False ➔ **True**. An event is then sent to the Master station.



Circuit breaker opening: To open the circuit breaker at the Slave station, click *bOpenBreaker* and change its state from False ➔ **True**. The status is then transferred to the Master station as an event.



Operations at the Master station: The Master receives the events from the Slave station, which notify it of the new Variable values. The data of the *rWindSpd*, *diWindDir*, *bOpenBreaker* and *bOpenCloseValve* Variables are then written to the corresponding Variables in the Master.



Pressure valve opening: In the program of the master, change the value of the analog point '*rPressureValve*' to 70.0. Then, the Master station sends an analog command to the Slave station.

Circuit breaker opening: In the program of the master, change the state of the binary point '*bBreakerSts*' from False ➔ **True**. A binary command is sent to the Slave station.

5.2. Example of Master and Slave operations in static mode

Operations at the Slave station: The Variables for wind speed (*rWindSpd*) and wind direction (*diWindDir*) change periodically in the Slave station. In the static mode example, the Slave does not send the events.

Pressure valve opening: To open the valve at the Slave station, click *bOpenCloseValve* to change its status from False ➔ **True**.

Circuit breaker opening: To open the circuit breaker at the Slave station, click *bOpenBreaker* to change its state from False ➔ **True**.

Operations at the Master station: The Master station periodically polls the points (*rWindSpd*, *diWindDir*, *bOpenBreaker* and *bOpenCloseValve*) at the Slave station. The Master retrieves the values of the Slave station points in this way. The data of these points are then stored in the corresponding Variables in the Master. The Master executes the following commands:

Pressure valve opening: In the program of the master, change the value of the analog point '*rPressureValve'* to 70.0. Then, the Master station sends an analog command to the Slave station.

Circuit breaker opening: In the program of the master, change the state of the binary point '*bBreakerSts'* from False ➔ **True**. A binary command is sent to the Slave station.

Configuring a project in Master/Slave mode

This mode allows a RightWON to exchange data with one or more Slave stations and, in addition, to exchange the data with a Master.

To configure the RightWON in Master/Slave mode, simply carry out the following steps in the same RightWON:

Note: The license key needs to be installed only once for a DNP3 Master/Slave project.

1- Add and configure the DNP3 Slave in the RightWON configuration

2- Add and configure the DNP3 Master in the RightWON configuration

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