DNP3

User and Reference Manual

CONTROL
MICROSYSTEMS

SCADA products… for the distance

Table of Contents

1   Using This Manual

The manual details implementation of the Distributed Network Protocol (DNP3) on SCADAPack controllers. The manual describes the functionality of SCADAPack controllers under certain DNP network topologies and fully details each DNP configuration parameter available on SCADAPack controllers. Although we continuously add tidbits of relevant information, especially when explaining each SCADAPack parameter in the overall scheme of the DNP3 concept, this manual does not serve as a complete DNP3 Technical Reference guide.

The manual is arranges as follows:

Section **2- *DNP3 Overview*** provides background information on DNP.

Section **3-*DNP Network*** describes network configurations for using DNP in a SCADA system.

Section **4-*Configuration of DNP*** Operation Modes describes the configuration guidelines for using SCADAPack controllers in DNP networks.

Section **5-*DNP Configuration*** is the complete reference for the DNP Configuration command when selected in TelePACE, ISaGRAF, and RealFLO applications.

Section **6.1-*DNP Status*** is the complete reference for the DNP Status command when selected in TelePACE, ISaGRAF, and RealFLO applications. DNP Status provides run-time DNP diagnostics and current data values for the local DNP points.

Section **6.2-*DNP Master Status*** section is the complete reference for the DNP Master Status command when selected in TelePACE, ISaGRAF, and RealFLO applications. DNP Status provides run-time DNP diagnostics and status of the DNP outstations defined in the Master station and current data values for the DNP points in these outstations.

Section **7-*DNP Device Profile Document - Master*** contains the DNP device profile for SCADAPack DNP master stations. All objects and function codes supported by the DNP master are listed in this document.

Section **8-*DNP Device Profile Document - Slave*** contains the DNP device profile for SCADAPack DNP slave stations. All objects and function codes supported by the DNP slave are listed in this document.

2   DNP3 Overview

DNP, the Distributed Network Protocol, is a standards-based communications protocol developed to achieve interoperability among systems in the electric utility, oil & gas, water/waste water and security industries. This robust, flexible non-proprietary protocol is based on existing open standards to work within a variety of networks.

DNP offers flexibility and functionality that go far beyond conventional communications protocols. Among its robust and flexible features DNP 3.0 includes:

- Multiple data types (Data Objects) may be included in both request and response messages.

- Multiple master stations are supported for outstations.

- Unsolicited responses may be initiated from outstations to master stations.

- Data types (Objects) may be assigned priorities (Class) and be requested based on the priority.

- Addressing for over 65,000 devices on a single link.

- Time synchronization and time-stamped events.

- Broadcast messages

- Data link and application layer confirmation

2.1   DNP Architecture

DNP is a layered protocol that is based on the Open System Connection (OSI) 7-layer protocol. DNP supports the physical, data link and application layers only and terms this the Enhanced Performance Architecture (EPA). In addition to these three layers an additional layer, the pseudo-transport layer, is added to allow for larger application layer messages to be broken down into smaller frames for the data link layer to transmit.

Object Library	The data objects (Binary Inputs, Binary Outputs, and Analog Inputs etc.) that reside in the master or outstation.
Application Layer	Application tasks for sending of solicited requests (master messages) to outstations or sending of unsolicited responses from outstations. These request and response messages are referred to as fragments in DNP.
Pseudo-Transport Layer	Breaks the application layer messages into smaller packets that can be handled by the data link layer. These packets are referred to as frames in DNP.
Data Link Layer	Handles the transmission and reception of data frames across the physical layer.
Physical Layer	This is the physical media, such as serial or Ethernet, which DNP communicates.

These layers are described in the following sections of this manual.

2.1.1   Object Library

The data types that are used in DNP are broadly grouped together into Object Groups such as Binary Input Objects and Analog Input Objects etc. Individual data points, or objects within each group, are further defined using Object Variations such as Binary Input Change with Time and 16-Bit Analog Inputs for example.

The data objects and variations supported by the SCADAPack series controllers are found in the *DNP Device Profile Document - Slave* and *DNP Device Profile Document - Master* sections of this user manual.

In general there are two categories of data within each data type, static objects and event objects. Static objects contain the current value of the field point or software point. Event objects are generated as a result of the data changing.

In addition to the object group and variation data objects can be assigned to classes. In DNP there are four object classes, Class 0, Class 1, Class 2 and Class 3. Class 0 contains all static data. Classes 1, 2 and 3 provide a method to assign priority to event objects. While there is no fixed rule for assigning classes to data objects typically class 1 is assigned to the highest priority data and class 3 is assigned to the lowest priority data.

This object library structure enables the efficient transfer of data between master stations and outstations. The master station can poll for high priority data (class 1) more often than it polls for low priority data (class 3). As the data objects assigned to classes is event data when the master polls for a class only the changed, or event data, is returned by the outstation. For data in an outstation that is not assigned a class the master uses a class 0 poll to retrieve all static data from the outstation.

DNP allows outstations to report data to one or more master stations using unsolicited responses (report by exception) for event data objects. The outstation reports data based on the assigned class of the data. For example the outstation can be configured to only report high priority class 1 data.

2.1.1.1 Internal Indication (IIN) Flags

An important data object is the Internal Indications (IIN) object. The Internal Indication (IIN) flags are set by a slave station to indicate internal states and diagnostic results. The following tables show the IIN flags supported by SCADAPack controllers. All bits except *Device Restarted* and *Time Synchronization required* are cleared when the slave station receives any poll or read data command.

The IIN is set as a 16 bit word divided into two octets of 8 bits. The order of the two octets is:

First Octet	Second Octet

2.1.1.1.1 IIN First Octet

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | Bit Number

First Octet Bit	Description
0	last received message was a broadcast message
1	Class 1 data available
2	Class 2 data available
3	Class 3 data available
4	Time Synchronization required
5	not used (returns 0)
6	Device trouble • Indicates memory allocation error in the slave, or • For master in mimic mode indicates communication failure with the

First Octet Bit	Description
	slave device.
7	Device restarted (set on a power cycle)

2.1.1.1.2   IIN Second Octet

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | Bit Number |
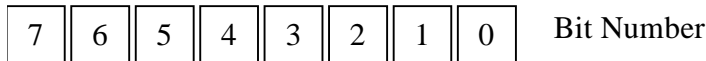
Second Octet Bit	Description
0	Function Code not implemented
1	Requested object unknown or there were errors in the application data
2	Parameters out of range
3	Event buffer overflowed Indicates event buffer overflow in the slave or master. The slave will set this bit if the event buffer in the slave is overflowed. The master will set this bit if the event buffer in the master has overflowed with events read from the slave. Ensure the event buffer size, in the master and slave, is set to a value that will ensure the buffer does not overflow and events are lost.
4	not used (returns 0)
5	not used (returns 0)
6	not used (returns 0)
7	not used (returns 0)

2.1.2   Application Layer

The application layer in DNP is responsible for the processing of complete messages for requesting, or responding to requests, for data.

The following shows the sequence of Application Layer messages between one master and one outstation.

```
Master                                             Outstation

Send Request            -------------------->  Accept request and process
                        <-------------------   Optional Application
                                               Confirmation

Accept response         <-------------------   Send Response
Optional Application
Confirmation            -------------------->


                        Important change detected

Accept response         <-------------------   Send Unsolicited Response
Optional Application
Confirmation            -------------------->
```
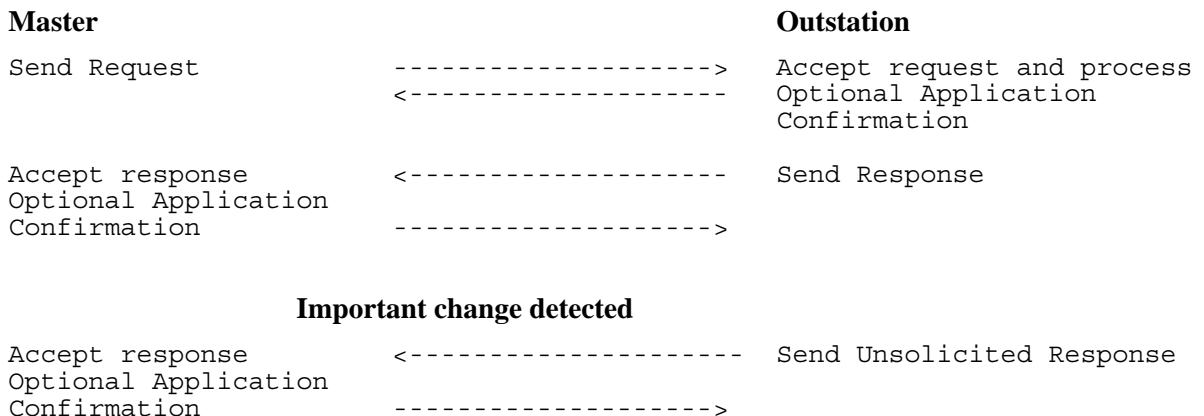
The complete messages are received from and passed to the pseudo-transport layer. Application layer messages are broken into fragments with each fragment size usually a maximum of 2048 bytes. An application layer message may be one or more fragments in size and it is the responsibility of the application layer to ensure the fragments are properly sequenced.

Application layer fragments are sent with or without a confirmation request. When a confirmation is requested the receiving device replies with a confirmation indicating the message was received and parsed without any errors.

2.1.3 Pseudo-Transport Layer

The pseudo-transport layer formats the larger application layer messages into smaller packets that can be handled by the data link layer. These packets are referred to as frames in DNP. The pseudo-transport layer inserts a single byte of information in the message header of each frame. This byte contains information such as whether the frame is the first or last frame of a message as well as a sequence number for the frame.

2.1.4 Data Link Layer

The data link layer handles the transmission and reception of data frames across the physical layer. Each data link frame contains a source and destination address to ensure the receiving device knows where to send the response. To ensure data integrity data link layer frames contain two CRC bytes every 16 bytes.

Data link layer frames are sent with or without a confirmation request. When a confirmation is requested the receiving device replies with a confirmation indicating the message was received and the CRC checks passed.

2.1.5 Physical Layer

The physical layer handles the physical media, such as serial or Ethernet, which DNP communicates.

2.2 Modbus Database Mapping

In SCADAPack series controllers static DNP objects such as binary input, analog input, binary counter and analog output are associated with Modbus registers. Whenever a DNP object is created an associated Modbus register(s) is also assigned. Application programs executing in the SCADAPack controller, C or logic, are able to assign physical I/O to Modbus registers using the TelePACE Register Assignment or the ISaGRAF I/O Connection and these physical I/O points can then be assigned to DNP objects. User application data such as runtimes, flow totals etc. may be also be assigned to DNP objects.

This architecture enables DNP master stations and outstations to pass not only physical data points between them but also to monitor and control user applications executing in the SCADAPack controller. For example a master station can monitor a level in an outstation and then, based on the application program, send a setpoint value to another outstation to control the level.
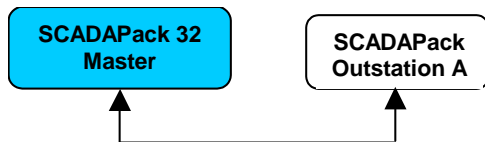
3 DNP Network Architectures

This section of the manual describes some of the DNP networks in which SCADAPack controllers are used. The network descriptions provide an overview of network. A step-by-step procedure for configuring a SCADAPack for each network implementation is described in proceeding sections.

3.1 DNP Master and Outstation

This configuration is a simple DNP Master (Client) and Outstation (Server). The SCADAPack DNP Master may be configured to periodically poll the SCADAPack Outstation for Class 0, 1, 2, and 3 data objects and receive unsolicited responses from the outstation. The SCADAPack outstation may be configured to report change event data to the master station using unsolicited responses.

The arrowed line between the Master and Outstation in the diagram below represents a communication path connecting the two stations. This communication medium may be any type that is supported by both controllers, such as direct serial, leased line modem, dial-up modem and radio for example.

See the sections *DNP Master* and *DNP Outstation* for configuration details on this type of network.

```
┌──────────────┐      ┌──────────────┐
│ SCADAPack 32 │      │  SCADAPack   │
│    Master    │      │ Outstation A │
└──────┬───────┘      └──────┬───────┘
       ↑                     ↑
       └─────────────────────┘
```

> **Note:** A DNP Master can be configured on SCADAPack 350 and SCADAPack32 controllers only.

3.2 DNP Master and Multidrop Outstations

This configuration is a modification of the above example. In this configuration a DNP Master is connected to a number of Outstations. The SCADAPack DNP Master may be configured to periodically poll each SCADAPack Outstation for Class 0, 1,2, and 3 data objects and receive unsolicited responses from the outstations. The SCADAPack Outstations may be configured to report change event data to the master station using unsolicited responses.

The arrowed line between the Master and Outstations in the diagram below represents the communication path connecting the stations. This communication path may be any type that is supported by the controllers, such as leased line modem, dial-up modem and radio for example.

See the sections *4.2- DNP Master* and *4.1-DNP Outstation* for configuration details.

```
┌──────────────┐   ┌──────────────┐  ┌──────────────┐  ┌──────────────┐
│ SCADAPack 32 │   │  SCADAPack   │  │  SCADAPack   │  │  SCADAPack   │
│    Master    │   │ Outstation A │  │ Outstation B │  │ Outstation C │
└──────┬───────┘   └──────┬───────┘  └──────┬───────┘  └──────┬───────┘
       ↑                  ↑                 ↑                 ↑
       └──────────────────┴─────────────────┴─────────────────┘
```
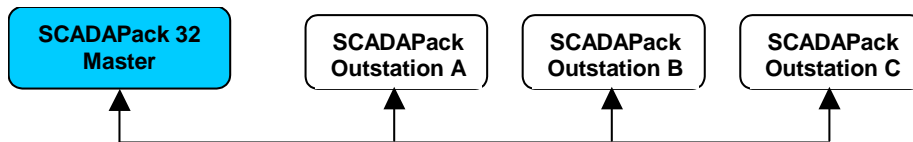
> **Note:** A DNP Master can be configured on SCADAPack 350 and SCADAPack32 controllers only.

3.3 DNP Mimic Mode

In a typical DNP network a SCADA Host master communicates with a number of outstations. The SCADA Host will poll each outstation for data and may receive change event data in the form of unsolicited responses from the outstations. This type of DNP network is shown in the following diagram.
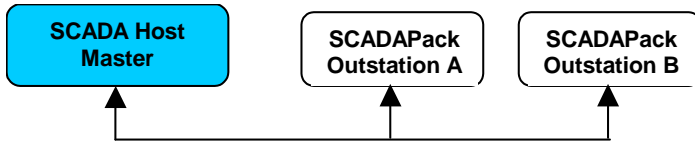
In the above configuration the SCADA Host manages the communication path with each outstation as represented by the arrowed lines in the diagram. When the communication path is slow, such as with dial-up communication, or subject to high error rates, such as with some radio communication the data update rate at the SCADA host can become very slow.

Adding a SCADAPack 32 master configured for Mimic Mode to the network, for instance, allows for the SCADA Host Master to poll the SCADAPack 32 (Mimic Master) for all outstation data instead. The following diagram shows the addition of the SCADAPack 32 master.
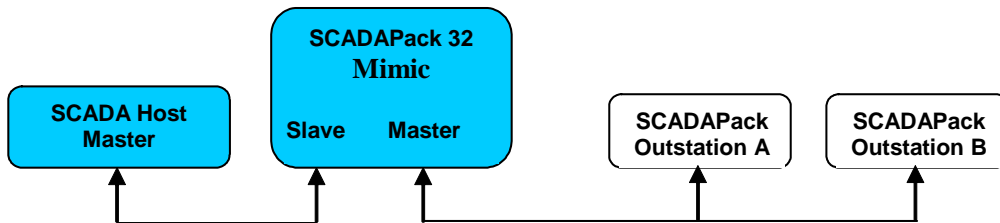
In this configuration the outstation side of the network has been decoupled from the host side of the network, as the SCADAPack 32 mimic master now manages all the communication with the outstations. The SCADA Host still communicates as before, through one link, targeting each outstation. However the SCADAPack 32 master now intercepts all these messages, and responds on behalf of the targeted outstation. From the perspective of the SCADA Host, the response is coming back from the remote outstation.

In order to provide current outstation data to the SCADA Host, the SCADAPack mimicking master independently communicates with each outstation to update a local copy of its database with data from the outstations. This communication may be initiated by the SCADAPack mimicking master, either by polling each outstation in turn using solicited messages; or the outstations could initiate unsolicited messages back to the mimicking master. There could also be a combination of solicited and unsolicited messages between the mimicking master and the outstations.

In the Mimic mode diagram above the SCADAPack mimic master polls each outstation, A and B, for data and holds images of this data in its memory. When the SCADA Host poll outstations A and B for data, the mimic master replies from its own images of the outstations. The SCADA Host can also poll the SCADAPack master for its own local data. See Section *4.4-DNP Mimic Mode Configuration* for configuration details on the Mimic Mode.

Typically the messaging strategy chosen will depend on the relative importance of the data, and the required maximum end-to-end delays for data being transferred through the network. If the requirement is for a reasonably short end-to-end delay for all data points, a round-robin polling scheme is best, without any unsolicited messages. If there are some data points, which are higher priority and must be transferred as fast as possible, unsolicited messages should be used.

The advantage of having the SCADA system communicating with the SCADAPack 32 mimic, instead of direct communication to the outstations is that communication delays and high error rates are effectively removed. The physical connection between the SCADA system and mimic master SCADAPack is typically a direct high-speed reliable connection and all message transactions are fast. Outstations may often be connected via slow PSTN or radio links, and therefore message transactions are subject to substantial delays. They may also be unreliable communication links subject to high error rates.

By having a multiple-level network the communication between the SCADAPack master and outstations is separated from communication between SCADA system and the SCADAPack master. The delays and error rates, which may be inherent in the outstation communication paths, can be isolated from communications with the SCADA system, thereby increasing overall system performance.

One particular advantage of Mimic Mode is that the master SCADAPack does not need to know, or be configured with, any details of the DNP points configured in the outstations. This makes it relatively simple to insert such a SCADAPack master into any existing DNP network. The SCADAPack master in Mimic Mode behaves transparently to the higher-level SCADA system, and can easily be configured with communication paths and polling instructions for each connected outstation.

3.4 DNP Routing

DNP Routing is similar to DNP Mimic mode in that the SCADA Host has only one connection to a SCADAPack configured for DNP routing. The following diagram shows a simple DNP routing system.
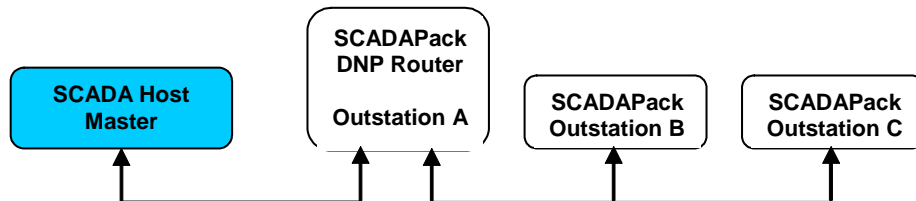
In this configuration the SCADAPack DNP router (Outstation A above) manages all the communication with the outstations. The SCADAPack DNP router receives messages from the SCADA Host for each outstation and *routes* the messages to the outstations. Change event data in the form of unsolicited responses from the outstations are routed by the SCADAPack DNP router, to the SCADA Host in the same manner.

As with Mimic mode, the advantage of using DNP Routing is that the responsibility of managing multiple communications paths is removed from the SCADA Host. The SCADAPack DNP router handles all communications paths to outstations, including such tasks as dial-up radio communication. In contrast to Mimic mode, however, the SCADA Host system still has to handle the long delays and high error rates that may be present on the communications links to the outstations.

See the section *DNP Data Router* for configuration details for using DNP Routing in a SCADA system.

3.5 DNP Address Mapping

Setting up a SCADAPack controller as a DNP Mimic Master or even a DNP router is relatively straight forward, as one does not need to explicitly map data from the remote devices into the local DNP database of the SCADAPack master.

In certain cases, however, data from the remote DNP devices may need to be accessible to an application program running in the master SCADAPack controller. DNP Address Mapping allows this capability, by providing a method to map outstation DNP points into local Modbus registers in the SCADAPack master controller.

By configuring the Address Mapping table these remote DNP points are mapped to local Modbus registers in the SCADAPack master. As mapped Modbus points the data is available for use in application programs such as TelePACE and ISaGRAF. In addition a Modbus SCADA Host polling the SCADAPack master may access these points. See the Section *5.5- Address Mapping* for information on configuring DNP Address Mapping.

The following diagram shows a simple DNP Address Mapping network.
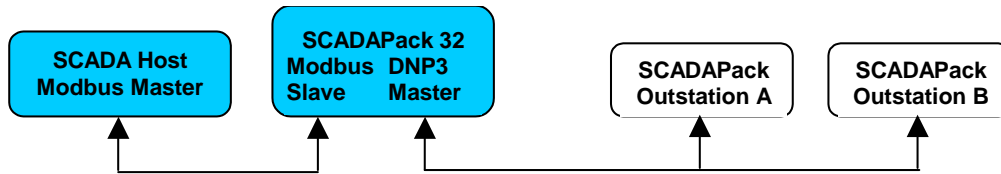
In this network the SCADAPack master updates is local database with mapped outstation data. The manner and frequency with which the SCADAPack master updates the local Modbus registers, depends on the number and type of I/O object types the registers are mapped to.

For 'Input' object types, address mapping simply links the remote DNP points to local Modbus Input registers (1xxxx or 3xxxx). These local Modbus registers are updated after the corresponding DNP point gets updated (usually by a class 0 poll to the remote DNP device).

For 'Output' object types, there is a similar relationship between the local Modbus registers (0xxxx or 4xxxx) and the remote DNP point, with one significant difference in the way local changes are propagated to the remote DNP device. Changes made to the local Modbus register will affect the value of the associated DNP point, subsequently triggering a DNP Write message to the remote DNP outstation.

It is, therefore, necessary to ensure that all local Modbus addresses mapped to a remote device via Address Mapping, are associated with a local DNP address.

Note:	Mapping numerous local Modbus output registers (0xxxx and 4xxxx), to a remote DNP device may cause frequent communications between the master and the slave, if the associated registers are being changed frequently in the master. On limited bandwidth or radio networks, care must be taken to ensure that your network capacity can handle all the traffic that will be generated from these local changes.

4   Configuration of DNP Operation Modes

SCADAPack controllers support a number of DNP operating modes. In this section of the user manual the operating modes supported and the steps required to configure the operating modes is explained.

The DNP operating modes described in this section include:

- DNP Outstation

- DNP Master

- DNP Data Router

- DNP Mimic Mode

4.1   DNP Outstation Configuration

A DNP outstation is the basic configuration for a SCADAPack controller operating in a DNP network. When configured as a DNP outstation a SCADAPack controller is able to:

- Map physical I/O data to DNP points.

- Define DNP points as Class 1, Class 2 or Class 3 data types.

- Respond to requests from one or more master stations such as a SCADA hosts or SCADAPack 32 controllers that are configured for DNP master operation.

- Initiate unsolicited responses to one or more master stations.

See the section *DNP Network* for examples of where an outstation may be used in typical DNP networks.

The following describes the general steps required to configure a SCADAPack series controller as a DNP outstation.

4.1.1   Configuration Steps

The steps below provide an outline of the configuration needed for an outstation. References are made to sections of this manual and to other user manuals. These sections and manual should be referred to for complete information.

1. **Enable DNP for the serial or Ethernet port.**

The SCADAPack controller is connected to a DNP network through one of the serial ports or in the case of a SCADAPack 32 controller through a serial port or Ethernet port. The serial or Ethernet ports need to be set to use DNP protocol and to enable DNP Routing.

- For TelePACE applications see the section **Controller Menu >> Serial Ports** and **Controller Menu >> IP Configuration** in the TelePACE User and Reference Manual.

- For ISaGRAF Applications see the section **Controller Menu Commands >> Controller Serial Port Command** and **Controller Menu Commands >> Controller IP** in the ISaGRAF User and Reference Manual.

2. **Configure Register Assignment or I/O Connections.**

The physical I/O for a SCADAPack controller is made available to application programs and protocols by assigning the physical I/O to Modbus registers in TelePACE and to Dictionary Variables (with Modbus network addresses) in ISaGRAF. SCADAPack controllers use the Modbus addresses when DNP objects are created.

- For TelePACE applications see the section **Controller Menu >> Register Assignment** in the TelePACE User and Reference Manual.

- For ISaGRAF Applications see the section **I/O Connection Reference** in the ISaGRAF User and Reference Manual.

3. Configure Application Layer Parameters.

The application layer parameters primarily define how the application layer communicates; how often time synchronization is done, whether the station initiates unsolicited responses and if application layer confirmation is used in the communication. In addition the global Operate Timeout parameter is set for Select Before Operate binary output objects and the Dial Up parameters are set if dial up communication is used.

- See the section **DNP Configuration >> Application Layer Configuration** in this manual for information on the parameters used in the Application layer.

4. Configure Data Link Layer Parameters.

The data link layer parameters define the outstation DNP address, the master station address(s) the outstation will communicate with and whether data link layer confirmation will be used in the communication.

- See the section **DNP Configuration >> Data Link Layer Configuration** in this manual for information on the parameters used in the Data Link Layer.

5. Configure DNP Routing.

SCADAPack controllers use DNP routing to direct DNP messages based on instructions in the routing table. The routing table defines which serial port or Ethernet port messages will be sent to other DNP stations. In the case of an outstation DNP routing defines the station address of the master station and the communication port to be used when communicating with the master station.

- See the section **DNP Configuration >> Routing** in this manual for information on the routing table and adding entries to the routing table.

6. Configure Data Objects.

The SCADAPack controller physical I/O and user application data may be assigned to DNP objects and given DNP point addresses. DNP input points can be assigned a class (1,2 or 3) for event data. These change events can be sent to the master station(s) if unsolicited responses are enable for the assigned class.

The DNP objects that are supported in the SCADAPack controller are shown below. See the appropriate section in the **DNP Configuration** section of this manual for complete information on configuring DNP data objects.

- Binary Inputs

- Binary Outputs

- 16-bit Analog Inputs

- 32-bit Analog Inputs

- Short Floating Point Analog Inputs

- 16-bit Analog Outputs

- 32-bit Analog Outputs

- Short Floating Point Analog Outputs

- 16-bit Counter Inputs

- 32-bit Counter Inputs

4.2 DNP Master Configuration

This option is available on the SCADAPack 350 and SCADAPack 32 controllers only.

The SCADAPack 350 and SCADAPack 32 controllers can be configured as a DNP master station in a DNP network. When configured as a DNP master station the controller is able to:

- Map local physical I/O data to DNP points.

- Define local DNP points as Class 1, Class 2 or Class 3 data types.

- Respond to requests from one or more master stations such as a SCADA hosts or other controllers that are configured for DNP master operation.

- Initiate unsolicited responses to one or more master stations.

- Poll DNP outstations for static (Class 0) data and Class 1, 2 and 3 event data.

- Accept unsolicited response messages from polled outstations.

- Map Outstation DNP data to local DNP points and Modbus registers. This data can then be used in application programs executing in the local controller or made available to other DNP master station(s) that poll this local controller.

See Section *3-DNP Network Architectures* for examples of where a DNP master may be used in typical DNP networks.

The following describes the general steps required to configure a SCADAPack controller as a DNP master station.

> **Note:** Only the SCADAPack 350 or SCADAPack32 controller can be configured as a DNP master.

4.2.1 Configuration Steps

The steps below provide an outline of the configuration needed for a SCADAPack master station. References are made to sections of this manual and to other user manuals. These sections and manual should be referred to for complete information.

1. Enable DNP for the serial or Ethernet port.

The SCADAPack controller is connected to a DNP network through one of the serial ports or the Ethernet port. The serial or Ethernet ports need to be set to use DNP protocol and to enable DNP Routing.

- For TelePACE applications see the section **Controller Menu >> Serial Ports** and **Controller Menu >> IP Configuration** in the TelePACE User and Reference Manual.

- For ISaGRAF Applications see the section **Controller Menu Commands >> Controller Serial Port Command** and **Controller Menu Commands >> Controller IP** in the ISaGRAF User and Reference Manual.

2. Configure Register Assignment or I/O Connections.

The physical I/O for a SCADAPack controller is made available to application programs and protocols by assigning the physical I/O to Modbus registers in TelePACE and to Dictionary

Variables (with Modbus network addresses) in ISaGRAF. SCADAPack controllers use the Modbus addresses when DNP objects are created.

- For TelePACE applications see the section **Controller Menu >> Register Assignment** in the TelePACE User and Reference Manual.

- For ISaGRAF Applications see the section **I/O Connection Reference** in the ISaGRAF User and Reference Manual.

3. Configure Application Layer Parameters.

The application layer parameters primarily define how the application layer communicates; how often time synchronization is done, whether the station initiates unsolicited responses and if application layer confirmation is used in the communication. In addition the global Operate Timeout parameter is set for Select Before Operate binary output objects and the Dial Up parameters are set if dial up communication is used.

- See the section **DNP Configuration >> Application Layer Configuration** in this manual for information on the parameters used in the Application layer.

4. Configure Data Link Layer Parameters.

The data link layer parameters define the SCADAPack outstation DNP address, the master station address(es) the SCADAPack master will communicate with and whether data link layer confirmation will be used in the communication.

- See the section **DNP Configuration >> Data Link Layer Configuration** in this manual for information on the parameters used in the Data Link Layer.

5. Configure Master Parameters (Applicable for SCADAPack 350 and SCADAPack 32 only)

There are two Master parameters, Mimic Mode enable or disable and the Base Poll Interval. The concept behind Mimic Mode operation is described in section *3.3-DNP Mimic Mode*.

The Base Poll interval is used to determine the frequency of master polling of outstations. Each type of master poll, Class 0, 1, 2 or 3 is polled at a frequency that is based on the Base Poll Interval.

- See the section **DNP Configuration >> Master** in this manual for information on the parameters used in the Master.

6. Configure Master Poll Parameters

The Master Poll parameters define how often the master station polls each outstation, how often to request time synchronization and whether unsolicited responses are accepted from the outstation. The polling frequency is configured independently for outstation Class 0,1,2 and 3 data. Master polling interval, or frequency, is based on the number of base poll intervals as set in the Master parameters.

- See the section DNP Configuration >> Master Poll in this manual for information on the parameters used in for the Master Poll.

7. Configure Address Mapping Parameters

The Address Mapping parameters define the mapping rules, which allow outstation DNP objects to be mapped into local SCADAPack master Modbus registers. This allows the outstation data to be used locally in application programs.

- See the section **DNP Configuration >> Address Mapping** in this manual for information on the parameters used in for Address Mapping.

8. Configure DNP Routing.

SCADAPack controllers use DNP routing to direct DNP messages based on instructions in the routing table. The routing table defines which serial port or Ethernet port messages will be sent to other DNP outstations or master stations. The DNP routing table defines the station address of the master station and the communication port to be used when communicating with the master station and the station addresses of the outstations the SCADAPack master station is polling.

9. See the section DNP Configuration >> Routing **in this manual for information on the routing table and adding entries to the routing table.**

10. Configure Data Objects.

The SCADAPack controller physical I/O and user application data may be assigned to DNP objects and given DNP point addresses. DNP input points can be assigned a class (1,2 or 3) for event data. These change events can be sent to the master station(s) if unsolicited responses are enable for the assigned class.

The DNP objects that are supported in the SCADAPack controllers are shown below. See the appropriate section in the **DNP Configuration** section of this manual for complete information on configuring DNP data objects.

- Binary Inputs
- Binary Outputs
- 16-bit Analog Inputs
- 32-bit Analog Inputs
- Short Floating Point Analog Inputs
- 16-bit Analog Outputs
- 32-bit Analog Outputs
- Short Floating Point Analog Outputs
- 16-bit Counter Inputs
- 32-bit Counter Inputs

4.3   DNP Data Router Configuration

All SCADAPack controllers can be configured as a DNP Router. When configured as a DNP router a SCADAPack controller is able to:

- Map local physical I/O data to DNP points.
- Define local DNP points as Class 1, Class 2 or Class 3 data types.
- Respond to requests from one or more master stations such as a SCADA hosts or other SCADAPack 32 controllers that are configured for DNP master operation.
- Initiate unsolicited responses to one or more master stations.
- Route DNP messages as defined in the Routing table.

See the Section *3-3-Modbus Database Mapping* for examples of where a DNP Data Router may be used in typical DNP networks.

The following describes the general steps required to configure a SCADAPack series controller as a DNP Data Router.

4.3.1 Configuration Steps

The steps below provide an outline of the configuration needed for a SCADAPack DNP router. References are made to sections of this manual and to other user manuals. These sections and manual should be referred to for complete information.

1. **Enable DNP for the serial or Ethernet port.**

The SCADAPack controller 32 is connected to a DNP network through one of the serial ports or the Ethernet port. The serial or Ethernet ports need to be set to use DNP protocol and to enable DNP Routing.

- For TelePACE applications see the section **Controller Menu >> Serial Ports** and **Controller Menu >> IP Configuration** in the TelePACE User and Reference Manual.

- For ISaGRAF Applications see the section **Controller Menu Commands >> Controller Serial Port Command** and **Controller Menu Commands >> Controller IP** in the ISaGRAF User and Reference Manual.

2. **Configure Register Assignment or I/O Connections.**

The physical I/O for a SCADAPack 32 controller is made available to application programs and protocols by assigning the physical I/O to Modbus registers in TelePACE and to Dictionary Variables (with Modbus network addresses) in ISaGRAF. SCADAPack controllers use the Modbus addresses when DNP objects are created.

- For TelePACE applications see the section **Controller Menu >> Register Assignment** in the TelePACE User and Reference Manual.

- For ISaGRAF Applications see the section **I/O Connection Reference** in the ISaGRAF User and Reference Manual.

3. **Configure Application Layer Parameters.**

The application layer parameters primarily define how the application layer communicates; how often time synchronization is done, whether the station initiates unsolicited responses and if application layer confirmation is used in the communication. In addition the global Operate Timeout parameter is set for Select Before Operate binary output objects and the Dial Up parameters are set if dial up communication is used.

- See the section **DNP Configuration >> Application Layer Configuration** in this manual for information on the parameters used in the Application layer.

4. **Configure Data Link Layer Parameters.**

The data link layer parameters define the SCADAPack 32 outstation DNP address, the master station address(s) the SCADAPack 32 master will communicate with and whether data link layer confirmation will be used in the communication.

- See the section **DNP Configuration >> Data Link Layer Configuration** in this manual for information on the parameters used in the Data Link Layer.

5. **Configure DNP Routing.**

SCADAPack series controllers use DNP routing to direct DNP messages based on instructions in the routing table. The routing table defines which serial port or Ethernet port messages will be sent to other DNP outstations or master stations. The DNP routing table defines the station address of each outstation and the communication port to be used when communicating with outstations.

- See the section **DNP Configuration >> Routing** in this manual for information on the routing table and adding entries to the routing table.

6. Configure Data Objects.

The SCADAPack controller physical I/O and user application data may be assigned to DNP objects and given DNP point addresses. DNP input points can be assigned a class (1,2 or 3) for event data. These change events can be sent to the master station(s) if unsolicited responses are enable for the assigned class.

The DNP objects that are supported in the SCADAPack controller are shown below. See the appropriate section in the **DNP Configuration** section of this manual for complete information on configuring DNP data objects.

- Binary Inputs

- Binary Outputs

- 16-bit Analog Inputs

- 32-bit Analog Inputs

- Short Floating Point Analog Inputs

- 16-bit Analog Outputs

- 32-bit Analog Outputs

- Short Floating Point Analog Outputs

- 16-bit Counter Inputs

- 32-bit Counter Inputs

4.4   DNP Mimic Mode Configuration

This option is applicable to the SCADAPack 350 and SCADPack32 controllers only.

The SCADAPack 350 and SCADAPack 32 controller can be configured as a DNP master station, in mimic mode, in a DNP network. When configured as a Mimic Mode DNP master station a SCADAPack 32 controller is able to:

- Map local physical I/O data to DNP points.

- Define local DNP points as Class 1, Class 2 or Class 3 data types.

- Respond to requests from one or more master stations such as a SCADA hosts or other SCADAPack controllers that are configured for DNP master operation.

- Initiate unsolicited responses to one or more master stations.

- Poll DNP outstations for static (Class 0) data and Class 1, 2 and 3 event data.

- Accept unsolicited response messages from polled outstations.

- Respond directly to SCADA Host polls that are destined for outstations that are defined in its Master Poll table.

See Section *3-DNP Network Architectures* for examples of where a DNP master may be used in typical DNP networks.

The following describes the general steps required to configure a SCADAPack controller as a Mimic Mode DNP master station.

4.4.1　　　　　Configuration Steps

The steps below provide an outline of the configuration needed for a SCADAPack DNP Mimic Mode master station. References are made to sections of this manual and to other user manuals. These sections and manual should be referred to for complete information.

1. Enable DNP for the serial or Ethernet port.

The SCADAPack controller is connected to a DNP network through one of the serial ports or the Ethernet port.

- For TelePACE applications see the section **Controller Menu >> Serial Ports** and **Controller Menu >> IP Configuration** in the TelePACE User and Reference Manual.

- Enable **Routing** on the serial or Ethernet ports that have been configured for DNP communication.

- For ISaGRAF Applications see the section **Controller Menu Commands >> Controller Serial Port Command** and **Controller Menu Commands >> Controller IP** in the ISaGRAF User and Reference Manual.

2. Configure Register Assignment or I/O Connections.

The physical I/O for a SCADAPack controller is made available to application programs and protocols by assigning the physical I/O to Modbus registers in TelePACE and to Dictionary Variables (with Modbus network addresses) in ISaGRAF. SCADAPack controllers use the Modbus addresses when DNP objects are created.

- For TelePACE applications see the section **Controller Menu >> Register Assignment** in the TelePACE User and Reference Manual.

- For ISaGRAF Applications see the section **I/O Connection Reference** in the ISaGRAF User and Reference Manual.

3. Configure Application Layer Parameters.

The application layer parameters primarily define how the application layer communicates; how often time synchronization is done, whether the station initiates unsolicited responses and if application layer confirmation is used in the communication. In addition the global Operate Timeout parameter is set for Select Before Operate binary output objects and the Dial Up parameters are set if dial up communication is used.

- See the section **DNP Configuration >> Application Layer Configuration** in this manual for information on the parameters used in the Application layer.

4. Configure Data Link Layer Parameters.

The data link layer parameters define the SCADAPack outstation DNP address, the master station address(s) the SCADAPack Mimic master will communicate with and whether data link layer confirmation will be used in the communication.

- See the section **DNP Configuration >> Data Link Layer Configuration** in this manual for information on the parameters used in the Data Link Layer.

5. Configure Master Parameters

There are two Master parameters, Mimic Mode enable or disable and the Base Poll Interval. The Mimic Mode must be set to enable for Mimic Mode. Mimic Mode operation is described in Section *4.4-DNP Mimic Mode.*

he Base Poll interval is used to determine the frequency of master polling of outstations. Each type of master poll, Class 0, 1, 2 or 3 is polled at a frequency that is based on the Base Poll Interval.

- See the section **DNP Configuration >> Master** in this manual for information on the parameters used in the Master.

6. Configure Master Poll Parameters

The Master Poll parameters define how often the master station polls each outstation, how often to request time synchronization and whether unsolicited responses are accepted from the outstation. The polling frequency is configured independently for outstation Class 0,1,2 and 3 data. Master polling interval, or frequency, is based on the number of base poll intervals as set in the Master parameters.

- See the section **DNP Configuration >> Master Poll** in this manual for information on the parameters used in for the Master Poll.

7. Configure Address Mapping Parameters

The Address Mapping parameters define the mapping rules, which allow outstation DNP objects to be mapped into local SCADAPack master Modbus registers and DNP points. This allows the outstation data to be used locally in application programs.

- See the section **DNP Configuration >> Address Mapping** in this manual for information on the parameters used in for Address Mapping.

8. Configure DNP Routing.

SCADAPack controllers use DNP routing to direct DNP messages based on instructions in the routing table. The routing table defines which serial port or Ethernet port messages will be sent to other DNP outstations or master stations. The DNP routing table defines the station address of the master station and the communication port to be used when communicating with the master station and the station addresses of the outstations the SCADAPack master station is polling.

- See the section **DNP Configuration >> Routing** in this manual for information on the routing table and adding entries to the routing table.

9. Configure Data Objects.

The SCADAPack controller physical I/O and user application data may be assigned to DNP objects and given DNP point addresses. DNP input points can be assigned a class (1,2 or 3) for event data. These change events can be sent to the master station(s) if unsolicited responses are enable for the assigned class.

The DNP objects that are supported in the SCADAPack controller are shown below. See the appropriate section in the **DNP Configuration** section of this manual for complete information on configuring DNP data objects.

- Binary Inputs

- Binary Outputs

- 16-bit Analog Inputs

- 32-bit Analog Inputs

- Short Floating Point Analog Inputs

- 16-bit Analog Outputs

- 32-bit Analog Outputs

- Short Floating Point Analog Outputs

- 16-bit Counter Inputs

- 32-bit Counter Inputs

5   DNP Configuration Menu

The DNP command is used to configure the DNP protocol settings for the controller. When selected the DNP Settings window is opened, as shown below.

The DNP Settings window has a tree control on the left side of the window. The tree control appears differently depending on the controller type selected. The SCADAPack 350, SCADAPack 32 and SCADAPack 32P controllers support DNP master and include the bolded items in the following list. Other SCADAPack controllers do not support DNP master and do not include the bolded items. This tree control contains headings for:

- Application Layer

- Data Link Layer

- **Master**

- **Master Poll**

- **Address Mapping**

- Routing

- Binary Inputs

- Binary Outputs

- 16-Bit Analog Inputs

- 32-Bit Analog Inputs

- Short Floating Point Analog Inputs

- 16-Bit Analog Outputs

- 32-Bit Analog Outputs

- Short Floating Point Analog Outputs

- 16-Bit Counter Inputs

- 32-Bit Counter Inputs

When a tree control is selected by clicking the mouse on a heading a property page is opened for the header selected. From the property page the DNP configuration parameters for the selected header is displayed.

As DNP objects are defined they are added as leaves to the object branch of the tree control. When an object is defined the object branch will display a collapse / expand control to the left of the branch.

The **Allow Duplicate Modbus Addresses** checkbox (in the bottom left corner) determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

Uncheck the box if you want to be warned about duplicate addresses. If an attempt is made to use a Modbus address that has already been used for another DNP point the following warning is displayed.
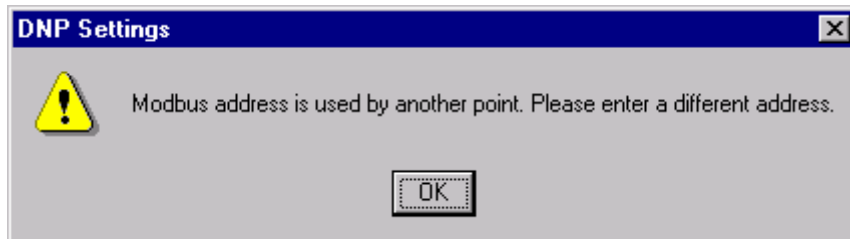
5.1   Application Layer Configuration

The Application Layer property page is selected for editing by clicking Application Layer in the tree control section of the DNP Settings window. When selected the Application Link Layer property page is active.
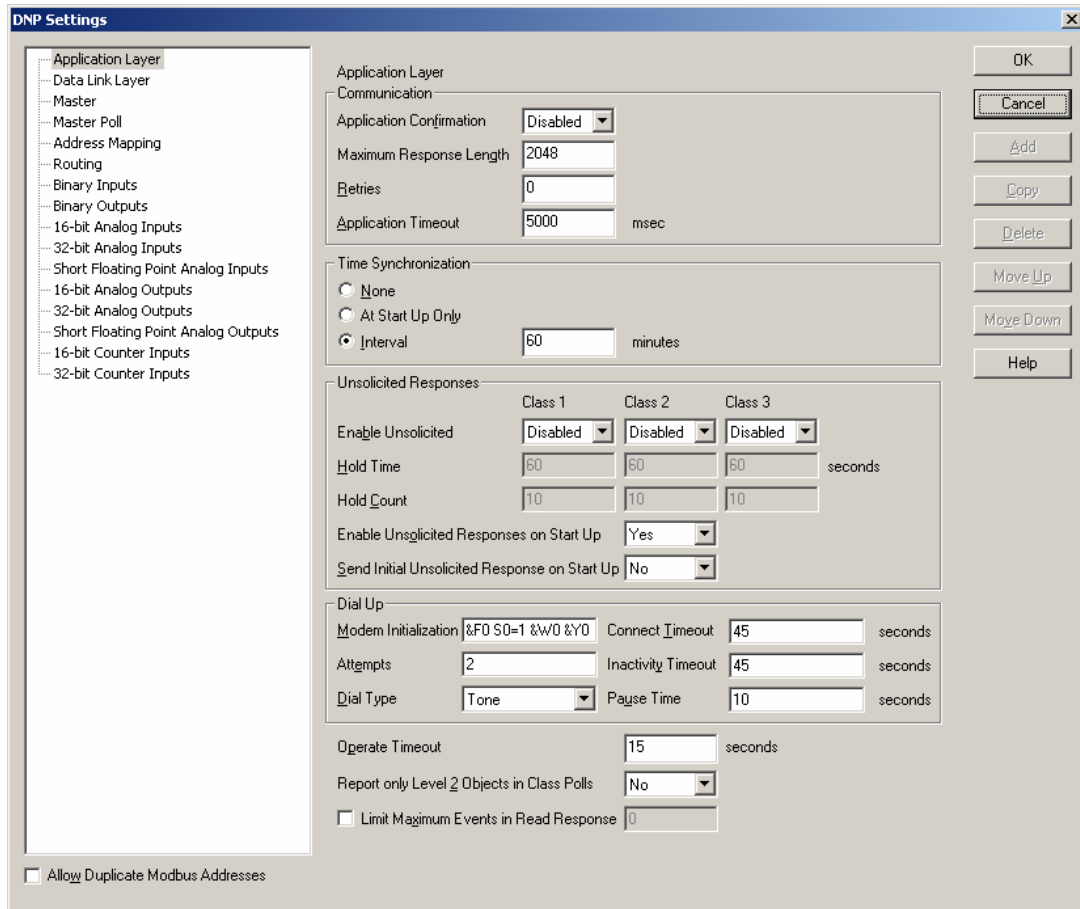
Application Layer parameters are set in this property page. Each parameter is described in the following paragraphs.

The **Communication** section of the dialog contains the configurable application layer communication parameters.

When the **Application Confirmation** feature is enabled, the SCADAPack controller requests a confirmation from the master station for any data transmitted. When it is disabled, the controller does not request a confirmation from the master station and assumes that the master receives the data it sends successfully. However if the data includes event data (including unsolicited messages), the controller requests a confirmation from the master regardless of whether this feature is enabled or disabled. Valid selections for this parameter are:

- Enabled
- Disabled

The **Maximum Fragment Length** is maximum size of a single response fragment that the RTU will send. If the complete response message is too large to fit within a single fragment, then the SCADAPack controller will send the response in multiple fragments. Valid values are between 100 and 2048 bytes.

This parameter is adjustable to allow for interoperability with simple DNP3 devices that require smaller application layer fragments. Devices with limited memory may restrict the application layer fragment size to as low as 249 bytes.

Note:	The Maximum Fragment Length parameter applies to responses from read commands only. It does not affect unsolicited responses.

The **Retries** entry maximum number of times the application layer will retry sending a response or an unsolicited response to the master station. This does not include any retries performed by the data link layer. Valid values are between 0 and 255.

Note:	Using application layer Confirmation and Retries is inherently more efficient than using data link layer Confirmation and Retries. Each fragment sent by the Application layer may require as many as 10 data link layer frames to be sent, each with its own confirmation message. The application layer is typically preferred for message confirmation for this reason.

The **Application Timeout** is the expected time duration (in milliseconds) that the master station's application layer requires to process and respond to a response from the SCADAPack controller. This SCADAPack controller uses this value in setting its time-out interval for master station responses. This value should be large enough to prevent response time-outs. The value must be kept small enough so as not to degrade system throughput. The value of this element is dependent on the master station. Valid values are between 100 and 60000 milliseconds.

The **Time Synchronization** section of the dialog defines when and how often the SCADAPack outstation prompts the master station to synchronize the SCADAPack controller time. Messages must be sent between the Master and Remote stations for Time Synchronization to work. Valid selections for this parameter are:

- The **None** selection will cause the SCADAPack controller to never request Time Synchronization.

- The **At Start Up Only** selection will cause the SCADAPack controller to request Time Synchronization at startup only.

- **The Interval** selection will cause the SCADAPack controller to request Time Synchronization at startup and then every **Interval** minutes after receiving a time synchronization from the master. Valid entries for Interval are between 1 and 32767 minutes. The default value is 60 minutes.

Note:	Time Synchronization may instead be initiated by the Master for each Outstation. This may be selected in the Add/Edit Master Poll dialog. It is not required to enable Time Synchronization at both the Master and the Outstation.

The Un**solicited Response** section of the dialog defines which **class** objects are enabled or disabled from generating report by exception responses. Unsolicited responses are individually configured for Class 1, Class 2, and Class 3 data.

The **Enable Unsolicited** controls enables or disables unsolicited responses for Class 1, Class 2 or Class 3 data. If unsolicited responses are disabled for a Class the controller never sends unsolicited responses for that Class. If unsolicited responses are enabled the controller does not start sending responses until the master enables the classes to report. Valid selections are:

- Enabled

- Disabled

The **Hold Time** parameter is used only when unsolicited responses are enabled for a Class. This parameter defines the maximum period (in seconds) the RTU will be allowed to hold its events before reporting them to the DNP master station. When the hold time has elapsed since the first event

occurred, the RTU will report to the DNP master station all events accumulated up to then. This parameter is used in conjunction with the **Hold Count** parameter in customizing the unsolicited event reporting characteristics. The value used for the Hold Time depends on the frequency of event generation, topology and performance characteristics of the system. The valid values for this parameter are 0 - 65535. The default value is 60 seconds.

The **Hold Count** parameter is used only when unsolicited responses are enabled for a Class. This parameter defines the maximum number of events the RTU will be allowed to hold before reporting them to the DNP master station. When the hold count threshold is reached, the RTU will report to the master, all events accumulated up to that point. This parameter is used in conjunction with the **Hold Time** in customizing the unsolicited event reporting characteristics. To guarantee an unsolicited response is sent as soon as an event occurs, set the Hold Count parameter to 1. The valid values for this parameter are 1 - 65535. The default value is 10.

The **Enable Unsolicited Responses on Start Up** parameter enables or disables unsolicited responses on startup. This affects the default controller behaviour after a start-up or restart. Some hosts require devices to start up with unsolicited responses enabled. It should be noted this is non-conforming behaviour according to the DNP standard. Valid selections are:

- Yes

- No

        The default selection is Yes.

The **Send Initial Unsolicited Response on Startup** parameter enables or disables Send Initial unsolicited responses on startup. This parameter controls whether an initial unsolicited response with null data is sent after a start-up or restart. Valid selections are:

Yes

No

The default selection is No.

The **Dial Up** section of the dialog defines modem parameters used when a dial up modem is used to communicate with stations that use dial up communication. The phone numbers for the stations are defined in the Routing table.

The **Modem Initialization** is the string that will be sent to the modem prior to each call. This is an ASCII null-terminated string. The maximum length of the string is 64 characters, including the null terminator.

The **Attempts** controls the maximum number of dial attempts that will be made to establish a Dial Up connection. The valid values for this parameter are 1 – 10. The default value is 2.

The **Dial Type** parameter controls whether tone or pulse dialing will be used for the call. Valid values are Tone dialing or Pulse dialing. The default value is Tone dialing.

The **Connect Timeout** controls the maximum time (in seconds) after initiating a dial sequence that the firmware will wait for a carrier signal before hanging up. The valid values for this parameter are 1 – 65535. The default value is 45.

The **Inactivity Timeout** controls the maximum time after message activity that a connection will be left open before hanging up. The valid values for this parameter are 1 – 65535 seconds. The default value is 45 seconds.

The **Pause Time** controls the delay time (in seconds) between dial events, to allow time for incoming calls. The valid values for this parameter are 1 – 65535. The default value is 10.

The **Operate Timeout** parameter specifies the timeout interval between a Select and Operate request from the Master. If after receiving a valid *Select* control output request from the master, the RTU does not receive the corresponding *Operate* request within this time-out interval, the control output request fails. The value of this parameter, expressed in seconds, is dependent on the master station, the data link and physical layer. Valid values are 1 to 6500 seconds. The default value is 15 seconds. The Master must have the Select/Operate functionally in order to use this feature.

The **Report only Level 2 Compliant Objects in Class Polls** parameter affects how Short Float Analog Input, Short Float Analog Output, and 32-bit Analog Output objects are reported. These objects are converted to 32-bit Analog Input and 16-bit Analog Output objects when this parameter is selected. Valid selections are:

- Yes

- No

The default selection is No.

The **Limit Maximum Events in Read Response** parameter allows limiting the number of events in a read response. Select the checkbox to enable the limit. Valid values are 1 to 65535. The default value is disabled.

Note:	The Maximum Events parameter applies to responses from read commands only. It does not affect unsolicited responses.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

- Click the **OK** button to accept the configuration changes and close the DNP Settings dialog.

- Click the **Cancel** button to close the dialog without saving any changes.

5.2   Data Link Layer Configuration

The Data Link Layer property page is selected for editing by clicking Data Link Layer in the tree control section of the DNP Settings window. When selected the Data Link Layer property page is active.
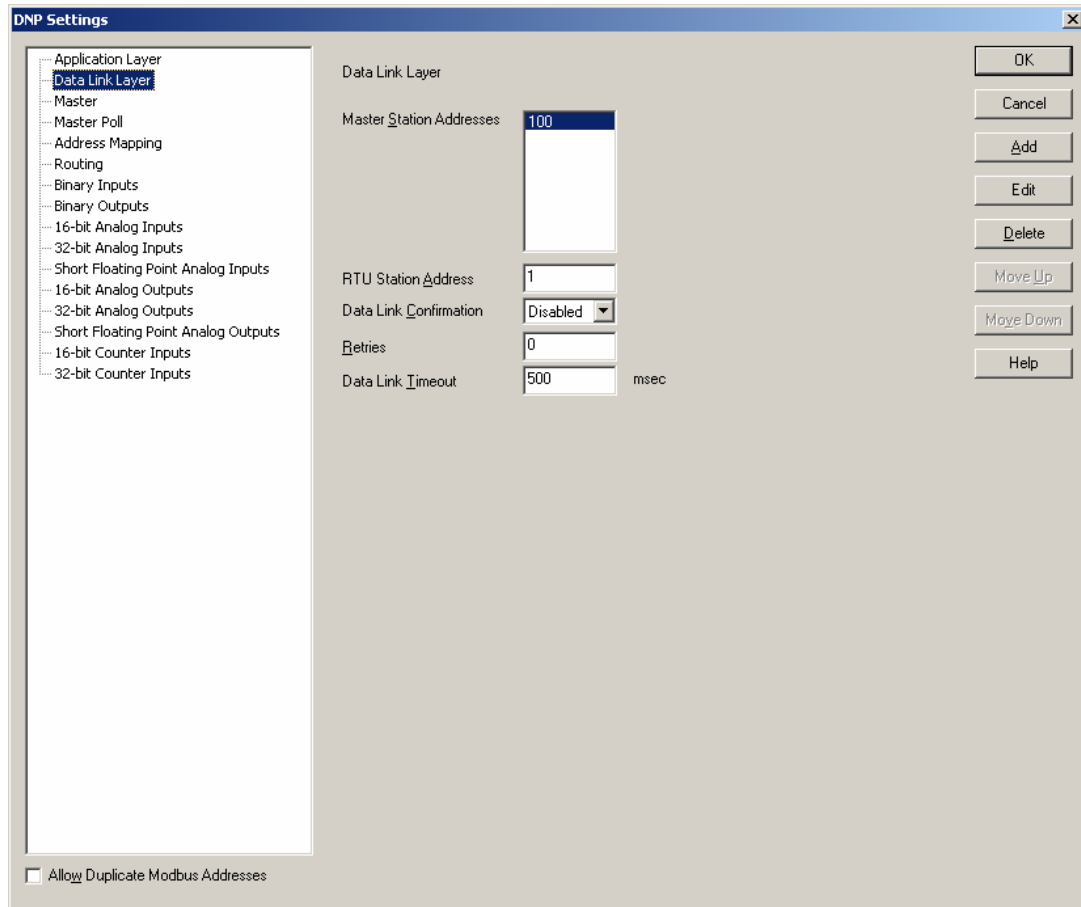
Data Link Layer parameters are set in this property page. Each parameter is described in the following paragraphs.

The **Master Station Addresses** list box contains a list of Master station addresses that the SCADAPack controller will respond to. The default list contains one master address of 100. This address may be edited, or changed, and up to 8 master stations may be added to the list. Valid entries for Master Station Addresses are 0 to 65519.

- When a master station polls for event data, the controller will respond with any events that have not yet been reported to that master station.

- When an unsolicited response becomes due, it will be sent to each configured master station in turn. A complete unsolicited response message transaction, including retries, will be sent to the first configured master station. When this transaction has finished, a complete unsolicited response message transaction including retries will be sent to the next configured master station, and so on for all the configured master stations.

- Change events will be retained in the event buffer until they have been successfully reported to all configured master stations.

Select the **Add** button to enter a new address to the Master Station Address list. Selecting the Add button opens the **Add Master Station Address** dialog. Up to 8 entries can be added to the table. An error message is displayed if the table is full.

Select the **Edit** button to edit address in the Master Station Address list. Selecting the Edit button opens the **Edit Master Station Address** dialog. The button is disabled if there are no entries in the list.
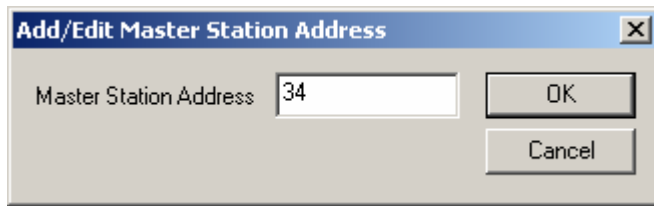
The **Master Station Address** edit box specifies the Master Station Address. Enter any valid Station address from 0 to 65519.

- The **OK** button adds the Master Station Address to the list and closes the dialog. An error is displayed if the Master Station Address is invalid, if the address is already in the list, or if the address conflicts with the RTU station address.

- The **Cancel** button closes the dialog without making any changes.

The **RTU Station Address** parameter specifies the address of this RTU. It is the source address used by this DNP driver when communicating with a master station. Each DNP station in a network must have a unique address, including the Master station. Valid entries for RTU Station Address are 0 to 65519.

The **Data Link Confirmation** parameter specifies whether or not the RTU requests the underlying data link transmitting its response to use a high quality service, which generally means that the data link requires the receiving data link to confirm receipt of all messages.

The **Retries** parameter specifies the maximum number of times the data link layer will retry sending a message to the master station. This parameter is only used when responding to a request from a Master station, when there is no corresponding entry in the Routing dialog for that station. This is independent of the application layer retries. The valid values for this parameter are 0 - 255. Setting the value to 0 disables sending retries.

Note:	Using data link layer Confirmation and Retries is inherently less efficient than application layer Confirmation and Retries. Each fragment sent by the Application layer may require as many as 10 data link layer frames to be sent, each with its own confirmation message. The data link layer is typically not used for message confirmation for this reason.

The **Data Link Timeout** parameter specifies the expected time duration that the master station's data link layer requires to process and respond to a message from the RTUs data link layer. It is used by the RTU in setting its time-out interval for master station responses. This value should be large enough to prevent response time-outs. The value must be kept small enough so as not to degrade system throughput. The value of this element is dependent on the master station. It is expressed in milliseconds. Valid values are 10 to 60000 milliseconds. The default value is 500 milliseconds.

- Click the **OK** button to accept the configuration changes and close the DNP Settings dialog.

- Click the **Cancel** button to close the dialog without saving any changes.

- Click the **Delete** button to remove the selected rows from the list. This button is disabled if there are no entries in the list.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

5.3 Master

The Master property page is selected for editing by clicking Master in the tree control section of the DNP Settings window. This selection is only visible if the controller type is SCADAPack 350, SCADAPack 32 or SCADAPack 32P. These controllers support DNP Master. When selected the Master Application Link Layer property page is active.
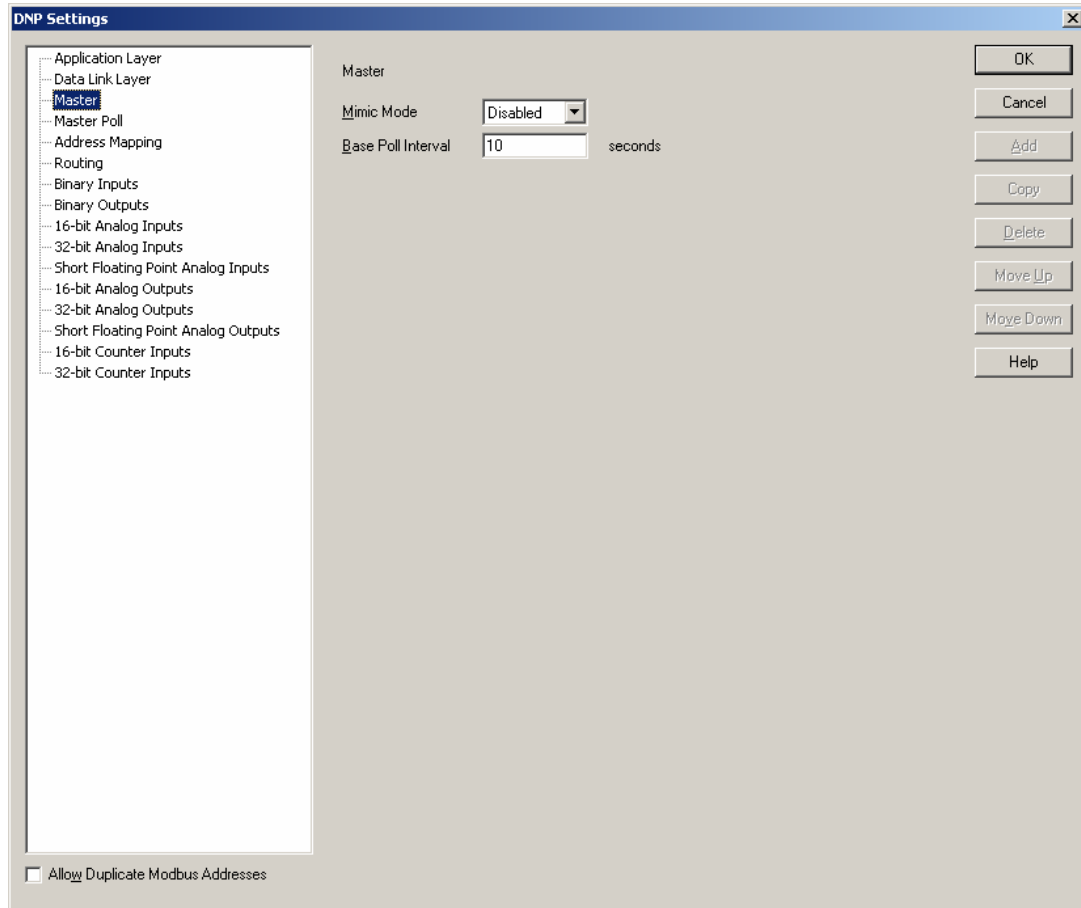
Master parameters are set in this property page. Each parameter is described in the following paragraphs.

The **Mimic Mode** parameter specifies the DNP Mimic Mode. The valid selections are Enable or Disable. When DNP Mimic Mode is enabled the controller will intercept DNP messages destined for a remote DNP station address, and will respond directly, as though the controller were the designated target. For read commands, the controller will respond with data from its Remote DNP Objects corresponding with the intended target address. For write commands, the controller will write data into its Remote DNP Objects, and issue a direct response to acknowledge the command. It will then issue a new command to write the data to the designated target. See Section *3.3-DNP Mimic Mode* section for an explanation of the concept around Mimic Mode. The default selection is Disabled.

The **Base Poll Interval** parameter is the base interval (in seconds) for polling slave devices. The poll rates and issuing time synchronisation will be configured in multiples of the base poll interval. The

slave devices with the same poll rates will be polled in the order they appear in the poll table. The valid values for this parameter are 1 to 65535. The default value is 10 seconds.

5.4 Master Poll

The Master Poll property page is selected for editing by clicking Master Poll in the tree control section of the DNP Settings window. This selection is only visible if the controller type is a SCADAPack 350, SCADAPack 32 or SCADAPack 32P. These controllers support DNP Master. When selected the Master Poll property page is active and button Copy is renamed to Edit.
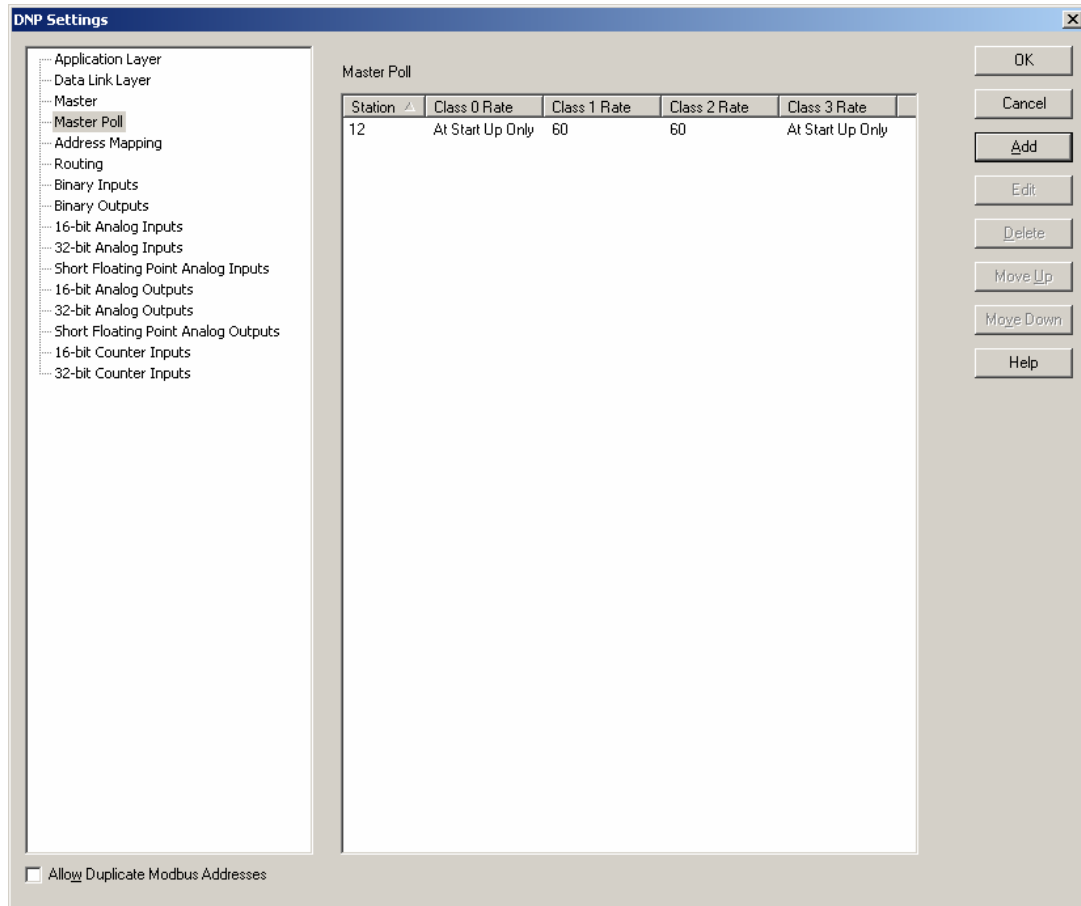
The Master Poll displays slave devices to be polled by this master station as a row, with column headings, in the table. The table may have up to 1000 entries. A vertical scroll bar is used if the list exceeds the window size.

| **Note:** | All slave devices in the Master Poll table need to be added to the Routing table. |

The **Station** column displays the address of the DNP slave device to be polled. Each entry in the table should have unique DNP Station Address.

The **Class 0 Rate** column displays the rate of polling for Class 0 data, as a multiple of the base poll interval.

The **Class 1 Rate** column displays the rate of polling for Class 1 data, as a multiple of the base poll interval.

The **Class 2 Rate** column displays the rate of polling for Class 2 data, as a multiple of the base poll interval.

The **Class 3 Rate** column displays the rate of polling for Class 3 data, as a multiple of the base poll interval.

- The **OK** button saves the table data and closes the DNP Settings dialog.

- The **Cancel** button closes the dialog without saving changes.

Select the **Add** button to enter a new row in the Master Poll. Selecting the Add button opens the **Add/Edit Master Poll** dialog.

Select the **Edit** button to modify the selected row in the Master Poll. Selecting the Edit button opens the **Add/Edit Master Poll** dialog containing the data from the selected row. This button is disabled if more than one row is selected or if there are no entries in the table.

The **Delete** button removes the selected rows from the table. This button is disabled if there are no entries in the table.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

Click on the column headings to sort the data. Clicking once sorts the data in ascending order. Clicking again sorts the data in descending order.

5.4.1 Add/Edit Master Poll Dialog

This dialog is used to edit an entry or add a new entry in the Master Poll.

The **Station** edit control displays the address of the DNP slave device to be polled. Valid values are 0 to 65519.

The **Class 0 Polling** section of the dialog specifies the type and rate of polling for Class 0 data.

- The **None** selection disables class 0 polling for the slave station. This is the default selection.

- The **At Start Up Only** selection will cause the master to poll the slave station at startup only.

- The **Interval** selection will cause the master to poll the slave station at startup and then every **Interval** of the base poll interval. For example if the base poll interval is 60 seconds and the Interval parameter is set to 60 then the master will poll the slave station every hour. Valid values are 1 to 32767. The default value is 60.

- The **Poll Offset** parameter is used to distribute the load on the communication network. The Poll Offset is entered in multiples of the base poll interval. Valid values for this parameter are 0 to the Poll Interval value minus 1. Any non-zero value delays the start of polling for the specified objects by that amount. The default value is 0. This control is disabled when None is selected, and enabled otherwise. For an example of using the Poll Offset parameter see the *Poll Offset Example* at the end of this section.

The **Class 1 Polling** section of the dialog specifies the type and rate of polling for Class 1 data.

- The **None** selection disables class 1 polling for the slave station. This is the default selection.

- The **At Start Up Only** selection will cause the master to poll the slave station at startup only.

- The **Interval** selection will cause the master to poll the slave station at startup and then every **Interval** of the base poll interval. For example if the base poll interval is 60 seconds and the Interval parameter is set to 60 then the master will poll the slave station every hour. Valid values are 1 to 32767. The default value is 60.

- The **Poll Offset** parameter is used to distribute the load on the communication network. The Poll Offset is entered in multiples of the base poll interval. Valid values for this parameter are 0 to the Poll Interval value minus 1. Any non-zero value delays the start of polling for the specified objects by that amount. The default value is 0. This control is disabled when None is selected, and enabled otherwise. For an example of using the Poll Offset parameter see the ***Poll Offset Example*** at the end of this section.

- **Limit Maximum Events** allows limiting the number of events in poll responses for Class 1/2/3 data. The checkbox is not checked by default, meaning there is no limit on the number of events. Select the checkbox to specify a limit. The valid values for this parameter are 1 to 65535. The default value is 65535. This control is disabled when None is selected, and enabled otherwise. The Maximum Events parameter can be used to manage communication load on a system.

  Consider the example of a master polling some data logging remotes, and the case where one of the remotes has been offline for a long time. The remote will have built up a large number of buffered events. If the master polled it for all events, the reply might take a long time, and cause an unwanted delay in the master's polling cycle. However if the master limits the number of events returned, the reply message duration will be more deterministic and the master can ensure its poll loop timing is maintained. In this case, the event retrieval from the data logger will be distributed over a number of poll cycles.

The **Class 2 Polling** section of the dialog specifies the type and rate of polling for Class 2 data.

- The **None** selection disables class 1 polling for the slave station. This is the default selection.

- The **At Start Up Only** selection will cause the master to poll the slave station at startup only.

- The **Interval** selection will cause the master to poll the slave station at startup and then every **Interval** of the base poll interval. For example if the base poll interval is 60 seconds and the Interval parameter is set to 60 then the master will poll the slave station every hour. Valid values are 1 to 32767. The default value is 60.

- The **Poll Offset** parameter is used to distribute the load on the communication network. The Poll Offset is entered in multiples of the base poll interval. Valid values for this parameter are 0 to the Poll Interval value minus 1. Any non-zero value delays the start of polling for the specified objects by that amount. The default value is 0. This control is disabled when None is selected, and enabled otherwise. For an example of using the Poll Offset parameter see the ***Poll Offset Example*** at the end of this section.

- **Limit Maximum Events** allows limiting the number of events in poll responses for Class 1/2/3 data. The checkbox is not checked by default, meaning there is no limit on the number of events. Select the checkbox to specify a limit. The valid values for this parameter are 1 to 65535. The default value is 65535. This control is disabled when None is selected, and enabled otherwise.

  The Maximum Events parameter can be used to manage communication load on a system. Consider the example of a master polling some data logging remotes, and the case where one of the remotes has been offline for a long time. The remote will have built up a large number of buffered events. If the master polled it for all events, the reply might take a long time, and cause an unwanted delay in the master's polling cycle. However if the master limits the number of events returned, the reply message duration will be more deterministic and the master can ensure its poll loop timing is maintained. In this case, the event retrieval from the data logger will be distributed over a number of poll cycles.

The **Class 3 Polling** section of the dialog specifies the type and rate of polling for Class 3 data.

- The **None** selection disables class 1 polling for the slave station. This is the default selection.

- The **At Start Up Only** selection will cause the master to poll the slave station at startup only.

- The **Interval** selection will cause the master to poll the slave station at startup and then every **Interval** of the base poll interval. For example if the base poll interval is 60 seconds and the Interval parameter is set to 60 then the master will poll the slave station every hour. Valid values are 1 to 32767. The default value is 60.

- The **Poll Offset** parameter is used to distribute the load on the communication network. The Poll Offset is entered in multiples of the base poll interval. Valid values for this parameter are 0 to the Poll Interval value minus 1. Any non-zero value delays the start of polling for the specified objects by that amount. The default value is 0. This control is disabled when None is selected, and enabled otherwise. For an example of using the Poll Offset parameter see the *Poll Offset Example* at the end of this section.

- **Limit Maximum Events** allows limiting the number of events in poll responses for Class 1/2/3 data. The checkbox is not checked by default, meaning there is no limit on the number of events. Select the checkbox to specify a limit. The valid values for this parameter are 1 to 65535. The default value is 65535. This control is disabled when None is selected, and enabled otherwise.

  The Maximum Events parameter can be used to manage communication load on a system. Consider the example of a master polling some data logging remotes, and the case where one of the remotes has been offline for a long time. The remote will have built up a large number of buffered events. If the master polled it for all events, the reply might take a long time, and cause an unwanted delay in the master's polling cycle. However if the master limits the number of events returned, the reply message duration will be more deterministic and the master can ensure its poll loop timing is maintained. In this case, the event retrieval from the data logger will be distributed over a number of poll cycles.

The **Time Synchronization Rate** section of the dialog specifies the rate of issuing a time synchronization to this device, as a multiple of the base poll interval. Valid selections for this parameter are:

- The **None** selection will disable issuing a time sync to this device. This is the default selection.

- The **At Start Up Only** selection will cause issuing a time synchronization at startup only.

- The **Interval** selection will cause the RTU to issue a time synchronization at startup and then every **Interval** of the base poll interval seconds. Valid entries for **Interval** are between 1 and 32767 the base poll interval seconds. The default value is 60.

The **Unsolicited Responses** section is used in conjunction with the Enable Unsolicited Responses on Start Up parameter on the Application Layer page. Certain non-SCADAPack slave devices are designed to start with their Enable Unsolicited Responses on Start Up parameter set to No. Selecting Enabled for any class causes the master to (after it detects the slave come online) send a command allowing the slave to begin sending Unsolicited Responses of that class.

With SCADAPack slaves the Enable Unsolicited Responses on Start Up parameter may be set to Yes, and the Accept Class parameters may be left at Disabled.

- The **Accept Class 1** selection displays the enable/disable status of unsolicited responses from the slave device for Class 1 events. The default selection is disabled.

- The **Accept Class 2** selection displays the enable/disable status of unsolicited responses from the slave device for Class 1 events. The default selection is disabled.

- The **Accept Class 3** selection displays the enable/disable status of unsolicited responses from the slave device for Class 1 events. The default selection is disabled.

The **Save IIN Flags** checkbox enables storing the IIN (Internal Indications) flags from the slave station in a Modbus database register. When this parameter is checked the IIN flags are saved to the entered Modbus register address. Valid entries are Modbus register addresses 30001 to 39999 and 40001 to 49999. The default value is 0.

The IIN flags are set by the slave to indicate the events in the following table. The events are bit mapped to the Modbus register. All bits except *Device Restarted* and *Time Synchronization required* are cleared when the slave station receives any poll or read data command. The master will write to bits 5 and 11 depending on the local conditions in the master.

Bit	Description
0	last received message was a broadcast message
1	Class 1 data available
2	Class 2 data available
3	Class 3 data available
4	Time Synchronization required
5	not used (returns 0)
6	Device trouble Indicates memory allocation error in the slave, or For master in mimic mode indicates communication failure with the slave device.
7	Device restarted (set on a power cycle)
8	Function Code not implemented
9	Requested object unknown or there were errors in the application data
10	Parameters out of range
11	Event buffer overflowed Indicates event buffer overflow in the slave or master. The slave will set this bit if the event buffer in the slave is overflowed. The master will set this bit if the event buffer in the master has overflowed with events read from the slave. Ensure the event buffer size, in the master and slave, is set to a value that will ensure the buffer does not overflow and events are lost.
12	not used (returns 0)
13	not used (returns 0)
14	not used (returns 0)
15	not used (returns 0)

The **OK** button checks the data for this table entry. If the data is valid the dialog is closed. If the table data entered is invalid, an error message is displayed and the dialog remains open. The table entry is invalid if any of the fields is out of range. The data is also invalid if it conflicts with another entry in the table. Such conflict occurs when the station number is not unique. The ordering of items in this table is important.

The **Cancel** button closes the dialog without saving changes.

5.4.2   *Poll Offset Example*

The Poll Offset parameter enhances the control over timing of master poll messages, by allowing master poll messages to be staggered.

For example, a master station may have 10 slaves to poll, and must poll them every hour. If these are included in the poll table without any poll offset, they will all be polled in quick succession on the hour – resulting in a large burst of communication activity once per hour. On some types of

communications networks (particularly radio) it is desirable to distribute communication load more evenly, to minimize the chance of collisions and to avoid the possibility of consuming bandwidth continuously for an extended period of time.

The poll offset parameter enables you to distribute the communication load evenly. In the above example, it is possible to stagger the master polls so slave stations are polled at 6-minute intervals. To do this, set the base poll interval to 6 minutes, and for each slave station set the poll rate and poll offset parameters as follows:

Base Poll	Poll Rate	Poll Offset
6	10	0
6	10	1
6	10	2
6	10	3
6	10	4
6	10	5
6	10	6
6	10	7
6	10	8
6	10	9

5.5   Address Mapping

The Address Mapping property page is selected for editing by clicking Address Mapping in the tree control section of the DNP Settings window. This selection is only visible if the controller type is a SCADAPack 350, SCADAPack 32 or SCADAPack 32P. These controllers support DNP Master.
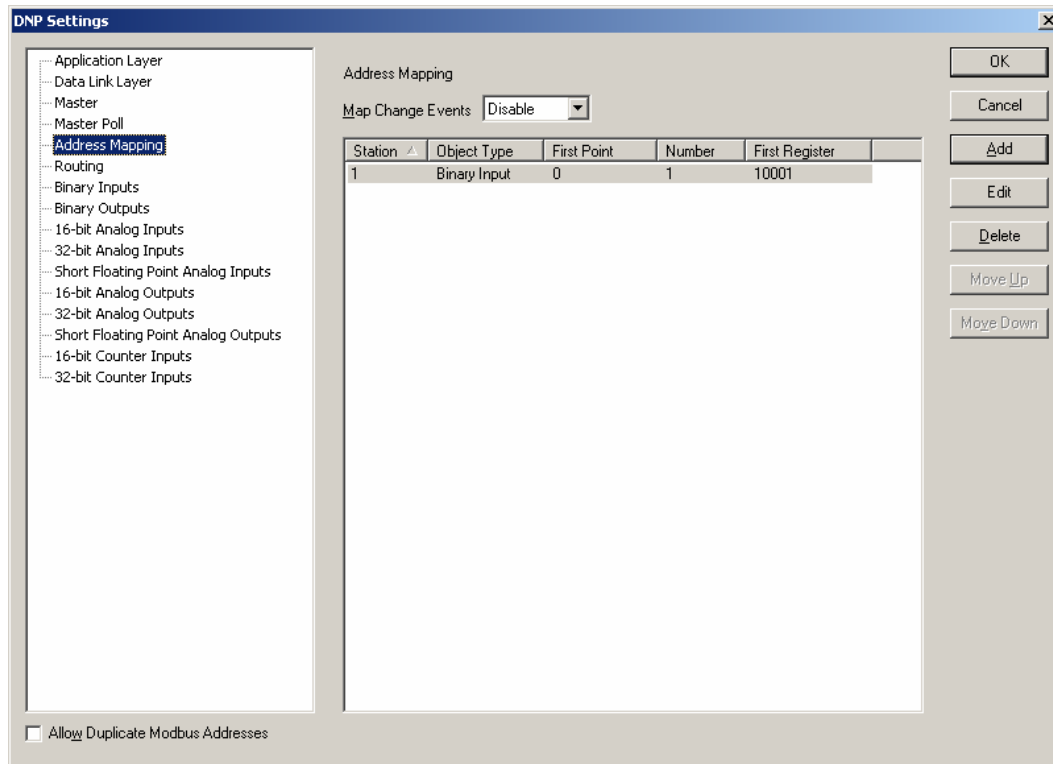
The Address Mapping contains a set of mapping rules, which will allow the Remote DNP Objects to be mapped into local Modbus registers. This makes the data accessible locally, to be read and/or

written locally in logic. It is also possible to perform data concentration – to map the remote DNP Objects into the local DNP address space – by defining local DNP objects and then mapping the remote DNP objects to the same Modbus registers. Change events can also be mapped in the same way - there is a configuration option to allow mapping of change events from a remote DNP slave into the local DNP change event buffer. The table may have up to 1000 entries. See the *DNP Address Mapping* section for further information. A vertical scroll bar is used if the list exceeds the window size.

The **Station** column displays the address of the remote DNP station.

The **Object Type** column displays the DNP data object type.

The **First Point** column displays the starting address of the remote DNP data points.

The **Number** column displays the number of remote points to be mapped.

The **First Register** column displays the starting address of local Modbus register where the remote data points are to be mapped.

The **Map Change Events** combo box enables or disables mapping of change events from a remote DNP slave into the local DNP change event buffer. Mapped change events may trigger an Unsolicited message to be sent, after the Hold Count or Hold Time is reached. It may be desired instead to map only static (live) values into local Modbus registers. The default selection is Disabled.

The default selection is Disabled.

The **OK** button saves the table data. No error checking is done on the table data.

The **Cancel** button closes the dialog without saving changes.

Select the **Add** button to enter a new row in the Address Mapping. Selecting the Add button opens the **Add/Edit Address Mapping** dialog.

Select the **Edit** button to modify the selected row in the Address Mapping. Selecting the Edit button opens the **Add/Edit Address Mapping** dialog containing the data from the selected row. This button is disabled if more than one row is selected. This button is disabled if there are no entries in the table.

The **Delete** button removes the selected rows from the table. This button is disabled if there are no entries in the table.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

Click on the column headings to sort the data. Clicking once sorts the data in ascending order. Clicking again sorts the data in descending order.

5.5.1 Add/Edit Address Mapping Dialog

This dialog is used to edit an entry or add a new entry in the Address Mapping.

The **Station** edit control displays the address of the remote DNP station. Valid values for this field are from 0 to 65519.

The **Object Type** combo box displays the DNP data Object Type. The list of available types includes: Binary Input, Binary Output, 16-bit Analog Input, 32-bit Analog Input, Short Floating Point Analog Input, 16-bit Analog Output, 32-bit Analog Output, Short Floating Point Analog Output, 16-bit Counter Input, 32-bit Counter Input. The Default selection is Binary Input.

The **First Point** edit control displays the starting address of the remote DNP data points. Valid values are from 0 to 65519.

The **Number** edit control displays the number of remote points to be mapped. Valid values for this field are from 1 to 9999.

The **First Register** edit control displays the starting address of local Modbus register where the remote data points are to be mapped. Valid values depend on the selection of DNP Object Type and are as follows:

For Binary Inputs valid range is from 10001 to 14096.

For Binary Outputs valid range is from 00001 to 04096.

For Analog Inputs and Counter Inputs valid range is from 30001 to 39999.

For Analog Outputs valid range is from 40001 to 49999.

The **OK** button checks the data for this table entry. If the data is valid the dialog is closed. If the table data entered is invalid, an error message is displayed and the dialog remains open. The table entry is invalid if any of the fields is out of range. The data is also invalid if it conflicts with another entry in the table. Such conflict occurs when the combination of station number, object type, and object address is not unique. The ordering of items in this table is not important.

The **Cancel** button closes the dialog without saving changes.

5.6 Routing

In a typical application the SCADAPack controller, configured for DNP, will act as a DNP slave station in a network. The SCADA system will communicate directly with all the DNP slave stations in the SCADA system.

DNP routing is a method for routing, or forwarding, of messages received from the SCADA system, through the SCADAPack controller, to a remote DNP slave station. The SCADAPack DNP slave station will respond to all messages sent to it from the SCADA system, as well as broadcast messages. When it receives a message that is not sent to it the message is sent on the serial port defined in the routing table. See section *3.4-DNP Routing* for an explanation of using and configuring DNP Routing.

The advantage of this routing ability is that the SCADA system can communicate directly with the SCADAPack controller and the SCADAPack controller can handle the communication to remote DNP slave stations.

The DNP Routing table displays each routing translation as a row, with column headings, in the table. Entries may be added, edited or deleted using the button selections on the table. The table will hold a maximum of 128 entries.

The DNP Routing property page is selected for editing by clicking DNP Routing in the tree control section of the DNP Settings window. When selected the DNP Routing property page is displayed.

Notes:

- Routing must be enabled for the controller serial port in order to enable DNP routing.

- TelePACE version 2.63 cannot open files created with version 2.64, unless the Routing table is empty.

- TelePACE version 2.64 cannot open files created with version 2.65, unless the Routing table is empty.
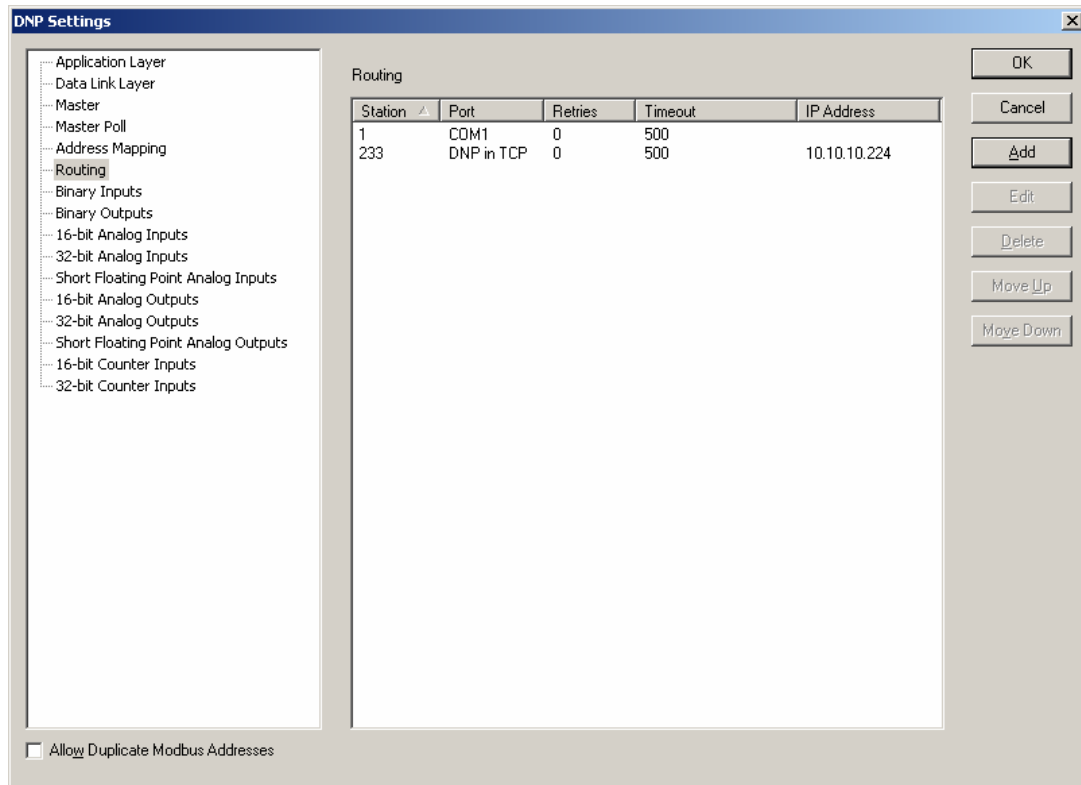
The **Station** column displays the address of the remote DNP station.

The **Port** column displays the serial communications port, which should be used to communicate with this DNP station.

The **Retries** column displays the maximum number of Data Link retries, which should be used for this DNP station in the case of communication errors.

The **Timeout** column displays the maximum time (in milliseconds) to wait for a Data Link response before retrying or failing the message.

The **IP Address** column displays the IP address of the remote DNP station.

The **OK** button saves the table data. No error checking is done on the table data.

The **Cancel** button closes the dialog without saving changes.

Select the **Add** button to enter a new row in the DNP Routing table. Selecting the Add button opens the **Add/Edit DNP Route** dialog.

Select the **Edit** button to modify the selected row in the DNP Routing table. Selecting the Edit button opens the **Add/Edit DNP Route** dialog containing the data from the selected row. This button is disabled if more than one row is selected. This button is disabled if there are no entries in the table.
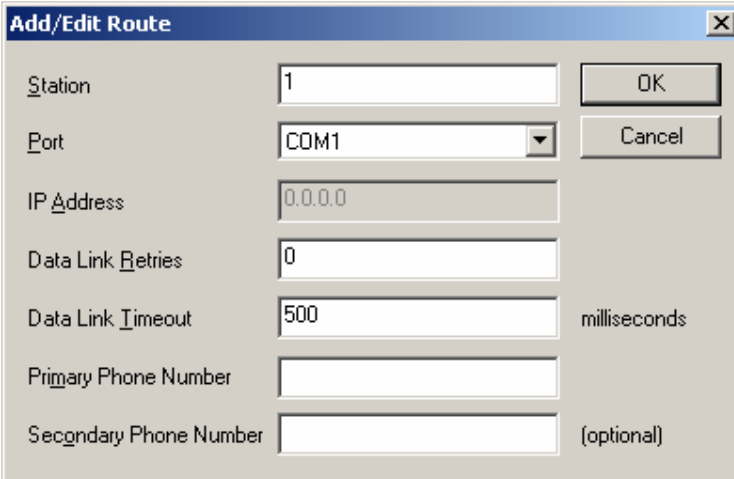
The **Delete** button removes the selected rows from the table. This button is disabled if there are no entries in the table.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

Click on the column headings to sort the data. Clicking once sorts the data in ascending order. Clicking again sorts the data in descending order.

5.6.1 Add/Edit DNP Route Dialog

This dialog is used to edit an entry or add a new entry in the DNP Routing table.

The **Station** edit control displays the address of the remote DNP station. Valid values for this field are from 0 to 65519.

The **Port** combo box displays the communications port, which should be used to communicate with the remote DNP station. This combo box contains list of the valid communications ports, which will depend on the type of controller. For SCADAPack 350, SCADAPack 32 and SCADAPack 32P controllers the list will contain DNP in TCP and DNP in UDP in addition to the serial port designations, COM1, COM2 etc.

The **IP Address** edit control is only enabled if the controller type is a SCADAPack 350, SCADAPack 32 or SCADAPack 32P. Enter the IP address of the remote DNP station.

The **Data Link Retries** edit control displays the maximum number of Data Link retries which should be used for this DNP station in the case of communication errors. This field overrides the

Data Link Retries field in the global DNP parameters set in the Data Link Layer configuration. Valid values for this field are 0 to 255.

The **Data Link Timeout** edit control displays the maximum time (in milliseconds) to wait for a Data Link response before retrying or failing the message. This field overrides the Data Link Timeout field in the global DNP parameters in the Data Link Layer configuration. Valid values for this field are 100 to 60000, in multiples of 100.

The phone number parameters allow automatic dialing for stations that use dial-up ports. The Phone Number parameters are enabled only when the Port selected is a serial port.

The **Primary Phone Number** is the dialing string that will be used for the primary connection to the station. The controller will make 1 or more attempts, as configured in the Application layer, to connect using this number. If this connection fails then the Secondary Phone Number will be dialed, if it is entered.

Valid values are any ASCII string. The maximum length is 32 characters. Leave this blank if you are not using a dial-up connection. The default value is blank. The serial port type must be set to RS-232 Modem for dial-up operation.

The **Secondary Phone Number** is the dialing string that will be used for the secondary connection to the station. The controller will make 1 or more attempts, as configured in the Application layer, to connect using this number. This number is used after the primary connection fails on all attempts.

Valid values are any ASCII string. The maximum length is 32 characters. Leave this blank if you are not using a dial-up connection. The default value is blank. The serial port type must be set to RS-232 Modem for dial-up operation.

The **OK** button checks the data for this table entry. If the data is valid the dialog is closed. If the table data entered is invalid, an error message is displayed and the dialog remains open. The table entry is invalid if any of the fields is out of range. The data is also invalid if it conflicts with another entry in the table.

The **Cancel** button closes the dialog without saving changes.

5.6.2   Dynamic Routing

In addition to the configured routing table, there is an internal *dynamic* routing entry. This entry is not shown in the routing table. The dynamic routing entry listens to incoming messages and learns the address of the remote station and the communication port used for communicating with it.

If there is no entry in the routing table, the RTU will use the dynamic routing entry to respond to a message on the same communication port as the incoming message.

The dynamic routing entry is not cleared on initialization. This is deliberate, and is important for controllers that need to be remotely reconfigured. In this case the host can initialize the controller without losing the communications link.

Note:	Dynamic routing should not be used in a master station. Configure all slave stations in the routing table.

5.7   Binary Inputs Configuration

The Binary Inputs property page is selected for editing by clicking Binary Inputs in the tree control section of the DNP Settings window. When selected the Binary Inputs property page is active.
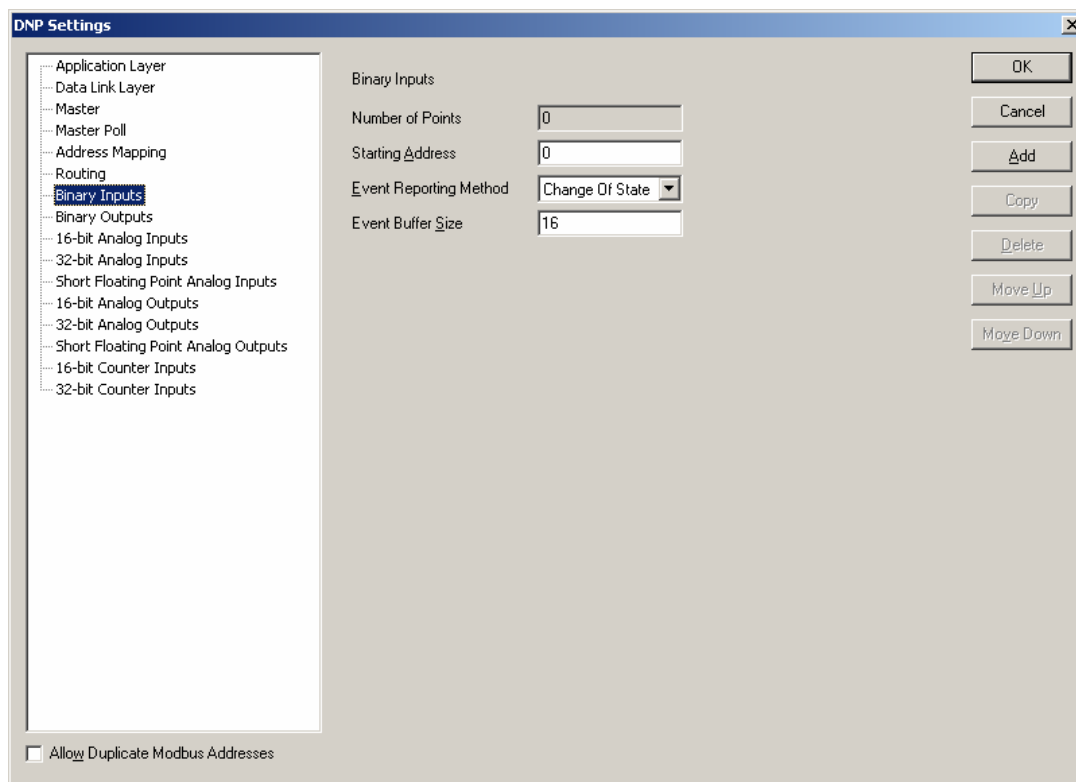
Binary Inputs parameters are set in this property page. Each parameter is described in the following paragraphs.

The **Number of Points** displays number of binary inputs reported by this RTU. This value will increment with the addition of each configured Binary Input point. The maximum number of points is 9999. The maximum number of actual points will depend on the memory available in the controller.

The **Starting Address** parameter specifies the starting DNP address of the first Binary Input point.

The **Event Reporting Method** selection specifies how binary input events are reported. A *Change Of State* event is an event object, without time, that is generated when the point changes state. Only one event is retained in the buffer for each point. If a subsequent event occurs for a point, the previous event object will be overwritten. The main purpose of this mode is to allow a master station to efficiently poll for changed data. A *Log All Events* is event object with absolute time will be generated when the point changes state. All events will be retained. The main purpose of this mode is to allow a master station to obtain a complete historical data log. The selections are:

- Change of State
- Log All Events

The **Event Buffer Size** parameter specifies the maximum number of binary input change events buffered by the RTU. The buffer holds all binary input change events, regardless of the class to which they are assigned. If the buffer is completely full the RTU will lose the oldest events and retain the newest; the 'Event Buffer Overflowed' IIN flag will also be set to indicate that the buffer has overflowed. The Event Buffer size should be at least equivalent to the number of binary inputs defined as Change of State type. This will allow all binary inputs to change simultaneously without losing any events. The value of this parameter depends on how often binary input change events

occur and the rate at which the events are reported to the master station. The valid values for this parameter are 0 - 65535. Default value is 16.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

5.7.1 Adding Binary Inputs

Binary Inputs are added to the DNP configuration using the Binary Input property page. To add a Binary Input:

- Select **Binary Inputs** in the tree control section of the DNP Settings window.

- Click the **Add** button in the Binary Inputs property page.

- The **Binary Input** property page is now displayed.

- Edit the Binary Input parameters as required and then click the **Add** button.

As Binary Inputs are defined they are added as leaves to the Binary Inputs branch of the tree control. When Binary Inputs are defined the Binary Inputs branch will display a collapse / expand control to the left of the branch. Click this control to display all defined Binary Inputs.
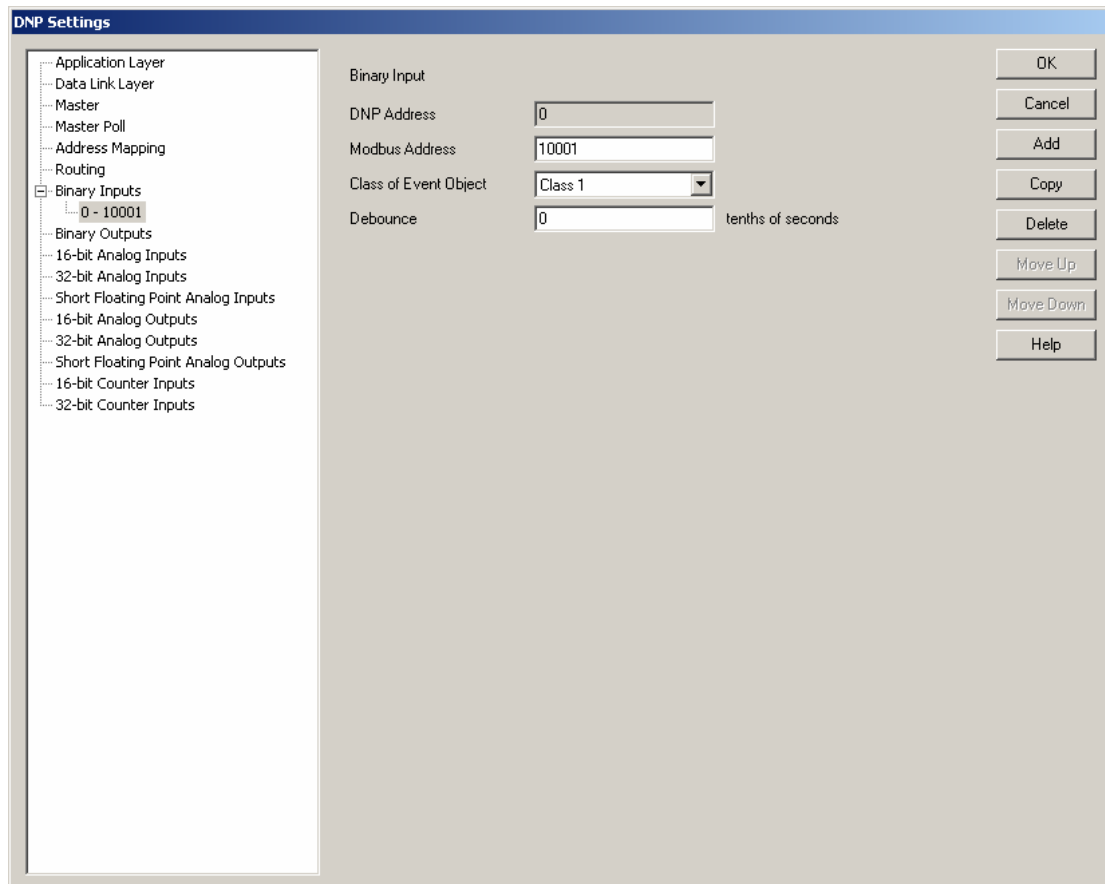
The Binary Input parameters are described in the following paragraphs.

The **DNP Address** window displays the DNP Binary Input address of the point. Each Binary Input is assigned a DNP address as they are defined. The DNP point address starts at the value defined in the Binary Inputs configuration dialog and increments by one with each defined Input.

The **Modbus Address** parameter specifies the Modbus address of the Binary Input assigned to the DNP Address. The SCADAPack and Micro16 controllers use Modbus addressing for all digital inputs. Refer to the *I/O Database Registers* section of the *TelePACE Ladder Logic Reference and User Manual* for complete information on digital input addressing in the SCADAPack and Micro16 controllers. Valid Modbus addresses are:

- 00001 through 09999

- 10001 through 19999

The **Class of Event Object** parameter specifies the event object class the Binary Input is assigned. The selections are:

- None

- Class 1

- Class 2

- Class 3

The **Debounce** parameter limits the frequency of change events. The input must remain in the same state for the debounce time for a change of state to be detected. Note that the input is sampled every 0.1s. Changes shorter than the sample time cannot be detected. Valid values are 0 to 65535 tenths of seconds. The value 0 means no debounce. The default value is 0.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

Click the **OK** button to accept the Binary Input parameters and close the DNP Settings dialog.

Click the **Cancel** button to close the dialog without saving any changes.

Click the **Add** button to add the current Binary Input to the DNP configuration.

Click the **Copy** button to copy the current Binary Input parameters to the next DNP Address.

Click the **Delete** button to delete the current Binary Input.

Click the **Move Up** button to move the current Binary Input up one position in the tree control branch.

Click the **Move Down** button to move the current Binary Input down one position in the tree control branch.

5.8   Binary Outputs Configuration

The Binary Outputs property page is selected for editing by clicking Binary Outputs in the tree control section of the DNP Settings window. When selected the Binary Outputs property page is active.
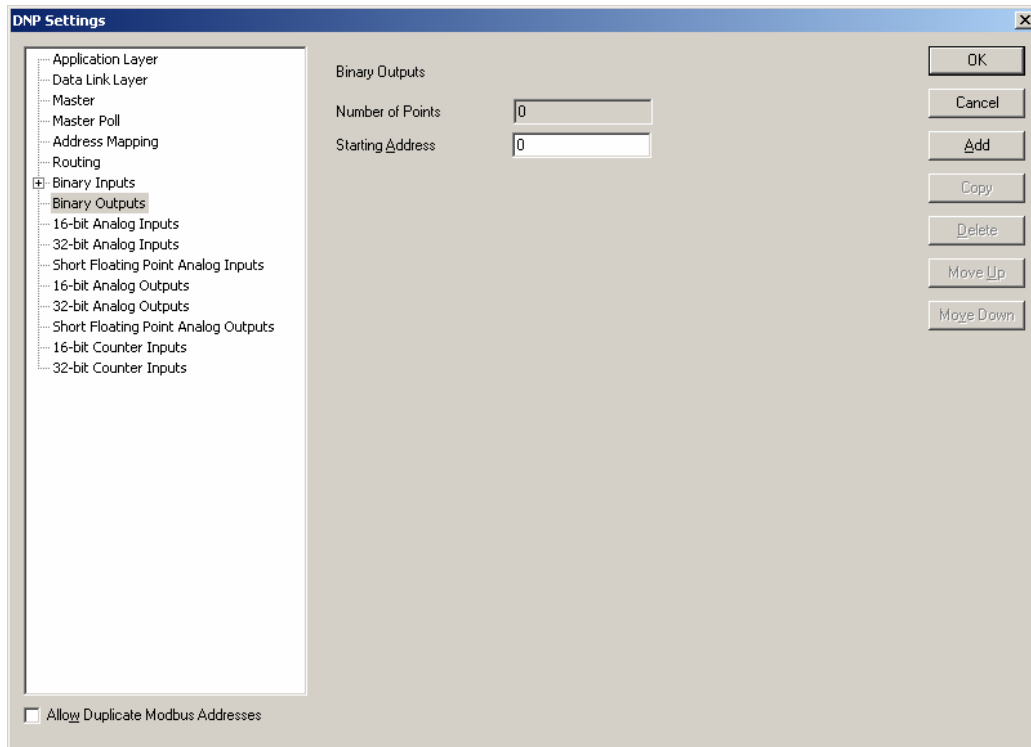
Binary Outputs parameters are viewed in this property page.

The **Number of Points** displays the number of binary outputs reported by this RTU. This value will increment with the addition of each configured Binary Output point. The maximum number of points is 9999. The maximum number of actual points will depend on the memory available in the controller.

The **Starting Address** parameter specifies the starting DNP address of the first Binary Output point.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

5.8.1 Adding Binary Outputs

Binary Outputs are added to the DNP configuration using the Binary Output property page. To add a Binary Output:

- Select **Binary Outputs** in the tree control section of the DNP Settings window.
- Click the **Add** button in the Binary Outputs property page.
- The Binary Output property page is now displayed.
- Edit the Binary Output parameters as required and then click the **Add** button.

As Binary Outputs are defined they are added as leaves to the Binary Outputs branch of the tree control. When Binary Outputs are defined the Binary Outputs branch will display a collapse / expand control to the left of the branch. Click this control to display all defined Binary Outputs.
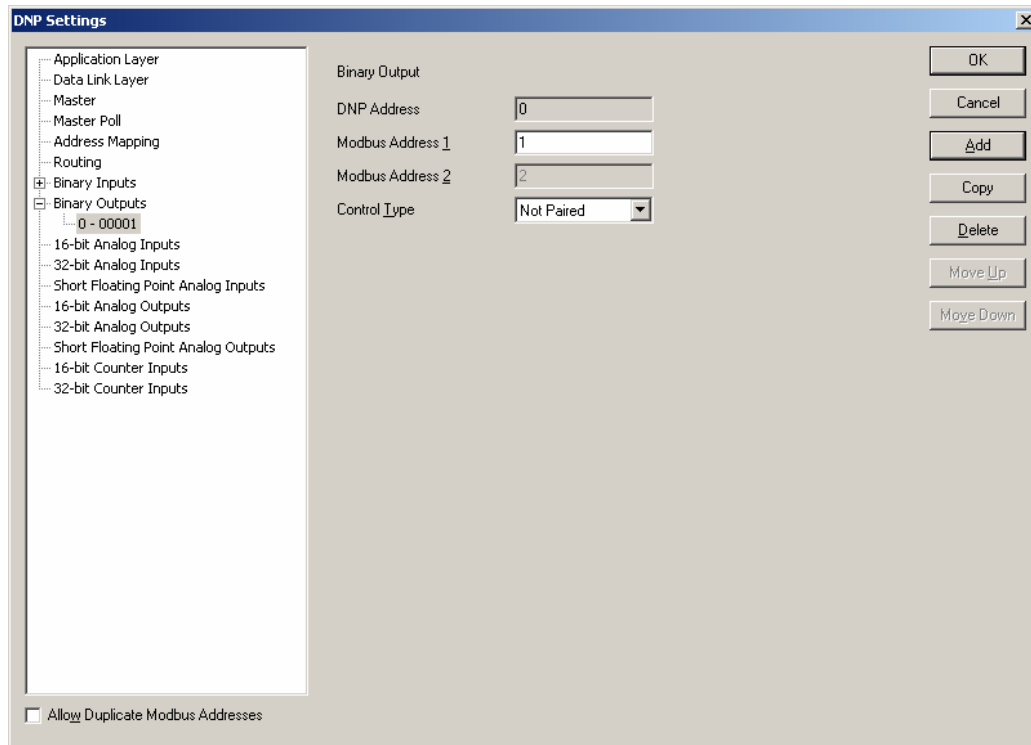
The Binary Output parameters are described in the following paragraphs.

The **DNP Address** window displays the DNP Binary Output address of the point. Each Binary Output is assigned a DNP address as they are defined. The DNP point address starts at the value defined in the Binary Outputs dialog and increments by one with each defined Output.

The **Modbus Address 1** parameter specifies the Modbus address of the Binary Output assigned to the DNP Address. The SCADAPack and Micro16 controllers use Modbus addressing for all digital outputs. Refer to the *I/O Database Registers* section of the *TelePACE Ladder Logic Reference Manual* for complete information on digital output addressing in the SCADAPack and Micro16 controllers. Valid Modbus addresses are:

- 00001 through 09999

The **Modbus Address 2** parameter specifies the second Modbus address of the second Binary Output assigned to the DNP Address when the Paired control type is selected. This selection is not active when the control type is Not Paired. Valid Modbus addresses are:

- 00001 through 09999

The **Control Type** parameter specifies whether the Binary Output is a paired control or not. If it is a paired control, i.e. trip/close output type, this means that the DNP address is associated to two physical control outputs and requires two Modbus addresses per DNP address. Control type selections are:

- Paired

- Not Paired

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

Click the **OK** button to accept the Binary Output parameters and close the DNP Settings dialog.

Click the **Cancel** button to close the dialog without saving any changes.

Click the **Add** button to add the current Binary Output to the DNP configuration.

Click the **Copy** button to copy the current Binary Output parameters to the next DNP Address.
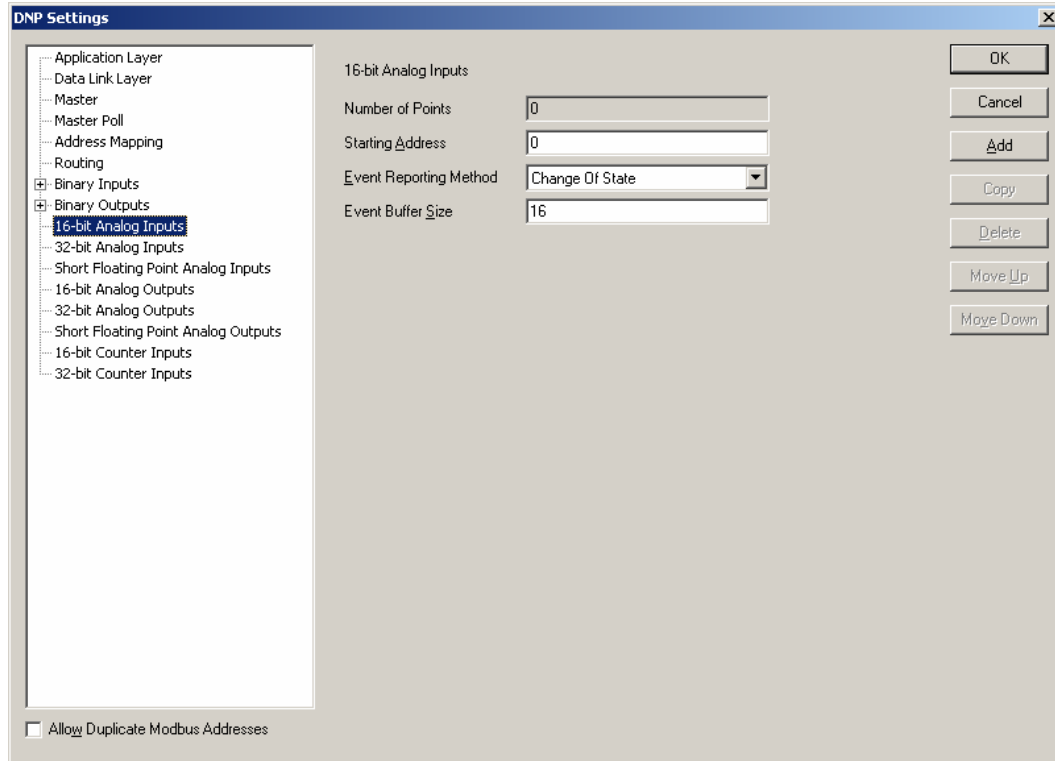
Click the **Delete** button to delete the current Binary Output.

Click the **Move Up** button to move the current Binary Output up one position in the tree control branch.

Click the **Move Down** button to move the current Binary Output down one position in the tree control branch.

5.9   16–Bit Analog Inputs Configuration

The 16-Bit Analog Inputs property page is selected for editing by clicking 16-Bit Analog Inputs in the tree control section of the DNP Settings window. When selected the 16-Bit Analog Inputs property page is active.

16-Bit Analog Inputs parameters are set in this property page. Each parameter is described in the following paragraphs.

The **Number of Points** displays the number of 16 bit analog inputs reported by the RTU. This value will increment with the addition of each configured 16-Bit Analog Input point. The maximum number of points is 9999. The maximum number of actual points will depend on the memory available in the controller.

The **Starting Address** parameter specifies the DNP address of the first 16-bit Analog Input point.

The **Event Reporting Method** selection specifies how 16-bit Analog Input events are reported. A *Change Of State* event is an event object, without time, that is generated when the point changes state. Only one event is retained in the buffer for each point. If a subsequent event occurs for a point, the previous event object will be overwritten. The main purpose of this mode is to allow a master station to efficiently poll for changed data. A *Log All Events* event object with absolute time will be generated when the point changes state. All events will be retained. The main purpose of this mode is to allow a master station to obtain a complete historical data log. The selections are:

- Change of State

- Log All Events

The **Event Buffer Size** parameter specifies the maximum number of 16-Bit Analog Input change events buffered by the RTU. The buffer holds all 16-Bit Analog Input events, regardless of the class to which they are assigned. If the buffer is completely full the RTU will lose the oldest events and retain the newest; the 'Event Buffer Overflowed' IIN flag will also be set to indicate that the buffer has overflowed. The Event Buffer size should be at least equivalent to the number of 16-Bit Analog Inputs defined as Change of State type. That will allow all 16-Bit Analog Inputs to exceed the deadband simultaneously without losing any events. The value of this parameter is dependent on how often 16-Bit Analog Input events occur and the rate at which the events are reported to the master station. The valid values for this parameter are 0 - 65535. Default value is 16.

For SCADAPack 32 and SCADAPack 32P controllers analog input events are processed by the DNP driver at a rate of 100 events every 100 ms. If more than 100 analog input events need to be processed they are processed sequentially in blocks of 100 until all events are processed. This allows the processing of 1000 analog input events per second.

For SCADASense Series of controllers, SCADAPack 100, SCADAPack LP, SCADAPack and Micro16 controllers analog input events are processed by the DNP driver at a rate of 20 events every 100 ms. If more than 20 analog input events need to be processed they are processed sequentially in blocks of 20 until all events are processed. This allows the processing of 200 analog input events per second.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

5.9.1   Adding 16-Bit Analog Inputs

16-Bit Analog Inputs are added to the DNP configuration using the 16-Bit Analog Input property page. To add a 16-Bit Analog Input:

- Select **16-Bit Analog Inputs** in the tree control section of the DNP Settings window.

- Click the **Add** button in the 16-Bit Analog Inputs property page.

- The **16-Bit Analog Input** property page is now displayed.

- Edit the 16-Bit Analog Input parameters as required and then click the **Add** button.

As 16-Bit Analog Inputs are defined they are added as leaves to the 16-Bit Analog Inputs branch of the tree control. When 16-Bit Analog Inputs are defined the 16-Bit Analog Inputs branch will display a collapse / expand control to the left of the branch. Click this control to display all defined 16-Bit Analog Inputs.
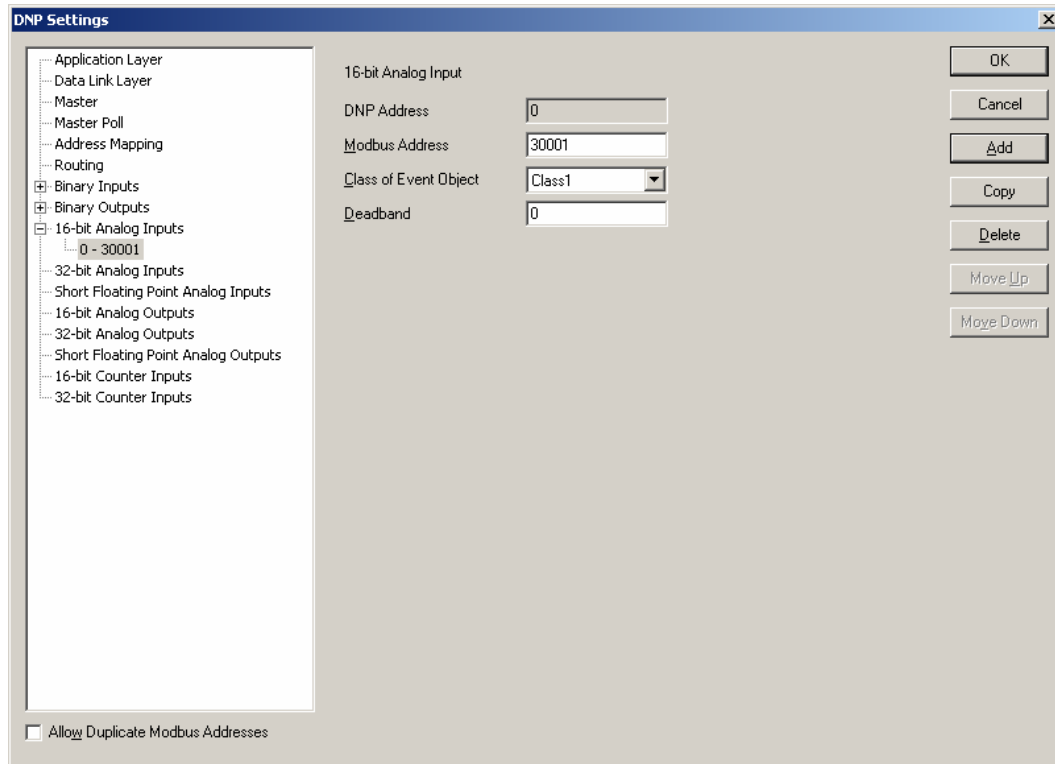
The 16-Bit Analog Input parameters are described in the following paragraphs.

The **DNP Address** window displays the DNP 16-Bit Analog Input address of the point. Each 16-Bit Analog Input is assigned a DNP address as they are defined. The DNP point address starts at the value set in the 16-bit Analog Input configuration dialog and increments by one with each defined 16-Bit Analog Input.

The **Modbus Address** parameter specifies the Modbus address of the 16-Bit Analog Input assigned to the DNP Address. The SCADAPack and Micro16 controllers use Modbus addressing for all analog inputs. Refer to the *I/O Database Registers* section of the *TelePACE Ladder Logic Reference and User Manual* for complete information on analog input addressing in the SCADAPack and Micro16 controllers. Valid Modbus addresses are:

- 30001 through 39999
- 40001 through 49999

The **Class of Event Object** parameter specifies the event object class assigned to the 16-Bit Analog Input is assigned. If Unsolicited reporting is not required for a point, it is recommended to set its Class to **None**. All data points automatically become members of Class 0 or **None** (static data). The selections are:

- None
- Class 1
- Class 2
- Class 3

The **Deadband** parameter specifies the minimum number of counts that the 16-Bit Analog Input must change since it was last reported in order to generate an event. Valid deadband values are 0 to 65535. A deadband of zero will cause any change to create an event.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

Click the **OK** button to accept the 16-Bit Analog Input parameters and close the DNP Settings dialog.

Click the **Cancel** button to close the dialog without saving any changes.

Click the **Add** button to add the current 16-Bit Analog Input to the DNP configuration.

Click the **Copy** button to copy the current 16-Bit Analog Input parameters to the next DNP Address.

Click the **Delete** button to delete the current 16-Bit Analog Input.

Click the **Move Up** button to move the current 16-Bit Analog Input up one position in the tree control branch.

Click the **Move Down** button to move the current 16-Bit Analog Input down one position in the tree control branch.

5.10   32-Bit Analog Inputs Configuration

The 32-Bit Analog Inputs property page is selected for editing by clicking 32-Bit Analog Inputs in the tree control section of the DNP Settings window. When selected the 32-Bit Analog Inputs property page is active.
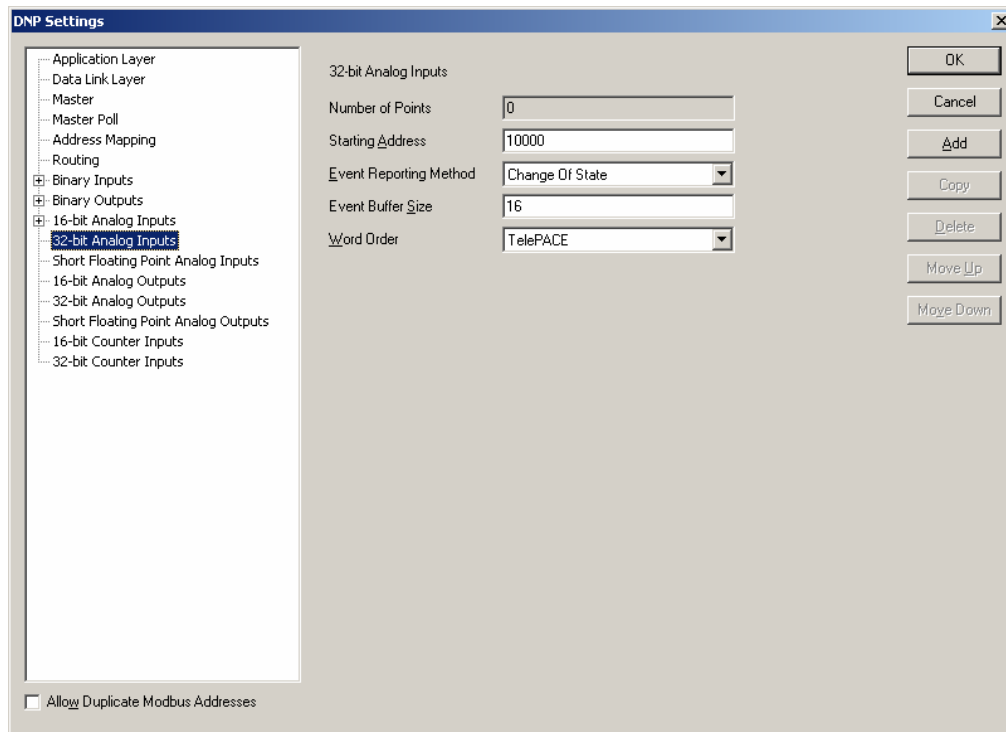
32-Bit Analog Inputs parameters are set in this property page. Each parameter is described in the following paragraphs.

The **Number of Points** displays the number of 32- bit analog inputs reported by the RTU. This value will increment with the addition of each configured 32-Bit Analog Input point. The maximum number of points is 9999. The maximum number of actual points will depend on the memory available in the controller.

The **Starting Address** parameter specifies the DNP address of the first 32-bit Analog Input point.

The **Event Reporting Method** selection specifies how 32-bit Analog Input events are reported. A *Change Of State* event is an event object, without time, that is generated when the point changes state. Only one event is retained in the buffer for each point. If a subsequent event occurs for a point, the previous event object will be overwritten. The main purpose of this mode is to allow a master station to efficiently poll for changed data. A *Log All Events* is event object with absolute time will be generated when the point changes state. All events will be retained. The main purpose of this mode is to allow a master station to obtain a complete historical data log. The selections are:

- Change of State

- Log All Events

The **Event Buffer Size** parameter specifies the maximum number of 32-Bit Analog Input change events buffered by the RTU. The buffer holds all 32-Bit Analog Input events, regardless of the class to which they are assigned. If the buffer is completely full the RTU will lose the oldest events and retain the newest; the 'Event Buffer Overflowed' IIN flag will also be set to indicate that the buffer has overflowed. The Event Buffer size should be at least equivalent to the number of 32-Bit Analog Inputs defined as Change of State type. That will allow all 32-Bit Analog Inputs to exceed the deadband simultaneously without losing any events. The value of this parameter is dependent on how often 32-Bit Analog Input events occur and the rate at which the events are reported to the master station. The valid values for this parameter are 0 - 65535. Default value is 16.

For SCADAPack 32 and SCADAPack 32P controllers analog input events are processed by the DNP driver at a rate of 100 events every 100 ms. If more than 100 analog input events need to be processed they are processed sequentially in blocks of 100 until all events are processed. This allows the processing of 1000 analog input events per second.

For SCADASense Series of controllers, SCADAPack 100, SCADAPack LP, SCADAPack and Micro16 controllers analog input events are processed by the DNP driver at a rate of 20 events every 100 ms. If more than 20 analog input events need to be processed they are processed sequentially in blocks of 20 until all events are processed. This allows the processing of 200 analog input events per second.

The **Word Order** selection specifies the word order of the 32-bit value. The selections are:

- **TelePACE** Least Significant Word in first register.

- **ISaGRAF** Most Significant Word in first register.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

5.10.1   Adding 32-Bit Analog Inputs

32-Bit Analog Inputs are added to the DNP configuration using the 16-Bit Analog Input property page. To add a 32-Bit Analog Input:

- Select **32-Bit Analog Inputs** in the tree control section of the DNP Settings window.

- Click the **Add** button in the 32-Bit Analog Inputs property page.

- The **32-Bit Analog Input** property page is now displayed.

- Edit the 32-Bit Analog Input parameters as required and then click the **Add** button.

As 32-Bit Analog Inputs are defined they are added as leaves to the 32-Bit Analog Inputs branch of the tree control. When 32-Bit Analog Inputs are defined the 32-Bit Analog Inputs branch will display a collapse / expand control to the left of the branch. Click this control to display all defined 32-Bit Analog Inputs.
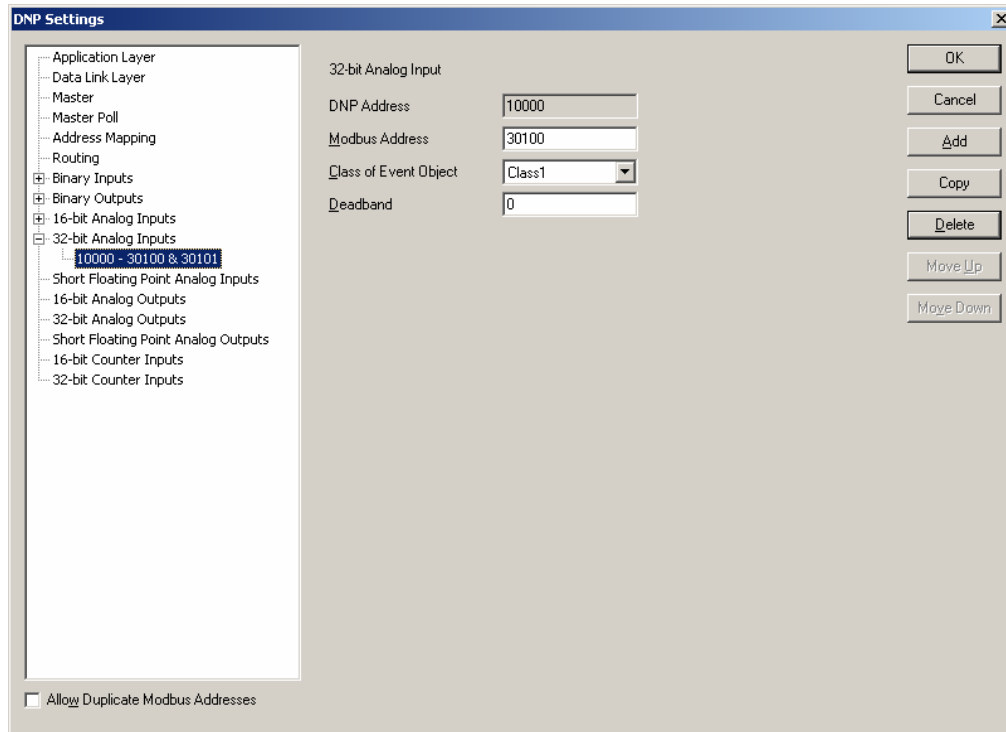
The 32-Bit Analog Input parameters are described in the following paragraphs.

The **DNP Address** window displays the DNP 32-Bit Analog Input address of the point. Each 32-Bit Analog Input is assigned a DNP address as they are defined. The DNP point address starts at the value set in the 32-bit Analog Input configuration dialog and increments by one with each defined 32-Bit Analog Input.

The **Modbus Address** parameter specifies the Modbus addresses of the 32-Bit Analog Input assigned to the DNP Address. 32-Bit Analog Inputs use two consecutive Modbus registers for each assigned DNP Address, the address that is entered in this box and the next consecutive Modbus register. The SCADAPack and Micro16 controllers use Modbus addressing for all analog inputs. Refer to the *I/O Database Registers* section of the *TelePACE Ladder Logic Reference and User Manual* for complete information on analog input addressing in the SCADAPack and Micro16 controllers. Valid Modbus addresses are:

- 30001 through 39998
- 40001 through 49998

The **Class of Event Object** parameter specifies the event object class the 32-Bit Analog Input is assigned. If Unsolicited reporting is not required for a DNP point, it is recommended to set its Class 0 or **None**. All data points automatically become members of Class 0 or **None** (static data).The selections are:

- None
- Class 1

- Class 2

- Class 3

The **Deadband** parameter specifies whether the RTU generates events. The value entered is the minimum number of counts that the 32-Bit Analog Input must change since it was last reported. Valid deadband values are 0 to 4,294,967,295. A deadband of zero will cause any change to create an event.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

Click the **OK** button to accept the 32-Bit Analog Input parameters and close the DNP Settings dialog.

Click the **Cancel** button to close the dialog without saving any changes.

Click the **Add** button to add the current 32-Bit Analog Input to the DNP configuration.

Click the **Copy** button to copy the current 32-Bit Analog Input parameters to the next DNP Address.

Click the **Delete** button to delete the current 32-Bit Analog Input.

Click the **Move Up** button to move the current 32-Bit Analog Input up one position in the tree control branch.

Click the **Move Down** button to move the current 32-Bit Analog Input down one position in the tree control branch.

5.11 Short Floating Point Analog Inputs

The Short Floating Point Analog Inputs property page is selected for editing by clicking Short Floating Point Analog Inputs in the tree control section of the DNP Settings window. When selected the Short Floating Point Analog Inputs property page is active.
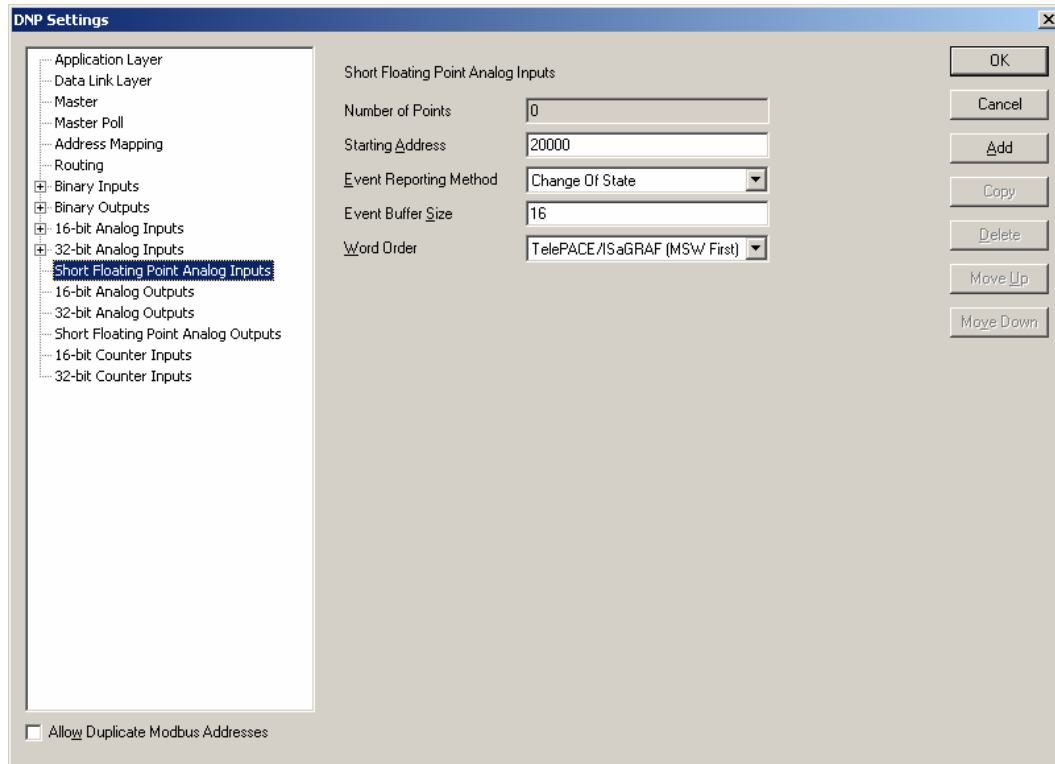
Short Floating Point Analog Input parameters are set in this property page. Each parameter is described in the following paragraphs.

The **Number of Points** displays the number of Short Floating Point Analog Inputs reported by the RTU. This value will increment with the addition of each configured Short Floating Point Analog Input point. The maximum number of points is 9999. The maximum number of actual points will depend on the memory available in the controller.

The **Starting Address** parameter specifies the DNP address of the first Short Floating Point Analog Input point.

The **Event Reporting Method** selection specifies how Short Floating Point Analog Input events are reported. A *Change Of State* event is an event object, without time, that is generated when the point changes state. Only one event is retained in the buffer for each point. If a subsequent event occurs for a point, the previous event object will be overwritten. The main purpose of this mode is to allow a master station to efficiently poll for changed data. A *Log All Events* is event object with absolute time will be generated when the point changes state. All events will be retained. The main purpose of this mode is to allow a master station to obtain a complete historical data log. The selections are:

- Change of State

- Log All Events

The **Event Buffer Size** parameter specifies the maximum number of Short Floating Point Analog Input change events buffered by the RTU. The buffer holds all Short Floating Point analog input events, regardless of the class to which they are assigned. If the buffer is completely full the RTU will lose the oldest events and retain the newest; the 'Event Buffer Overflowed' IIN flag will also be set to indicate that the buffer has overflowed. The Event Buffer size should be at least equivalent to the number of Short Floating point analog inputs defined as Change of State type. That will allow all Short Floating Analog Point Inputs to exceed the deadband simultaneously without losing any events. The value of this parameter is dependent on how often Short Floating Point Analog Input

events occur and the rate at which the events are reported to the master station. The valid values for this parameter are 0 - 65535. Default value is 16.

For SCADAPack 32 and SCADAPack 32P controllers analog input events are processed by the DNP driver at a rate of 100 events every 100 ms. If more than 100 analog input events need to be processed they are processed sequentially in blocks of 100 until all events are processed. This allows the processing of 1000 analog input events per second.

For SCADASense Series of controllers, SCADAPack 100, SCADAPack LP, SCADAPack and Micro16 controllers analog input events are processed by the DNP driver at a rate of 20 events every 100 ms. If more than 20 analog input events need to be processed they are processed sequentially in blocks of 20 until all events are processed. This allows the processing of 200 analog input events per second.

The **Word Order** selection specifies the word order of the 32-bit value. The selections are:

- **TelePACE / ISaGRAF (MSW First)**   Most Significant Word in first register.

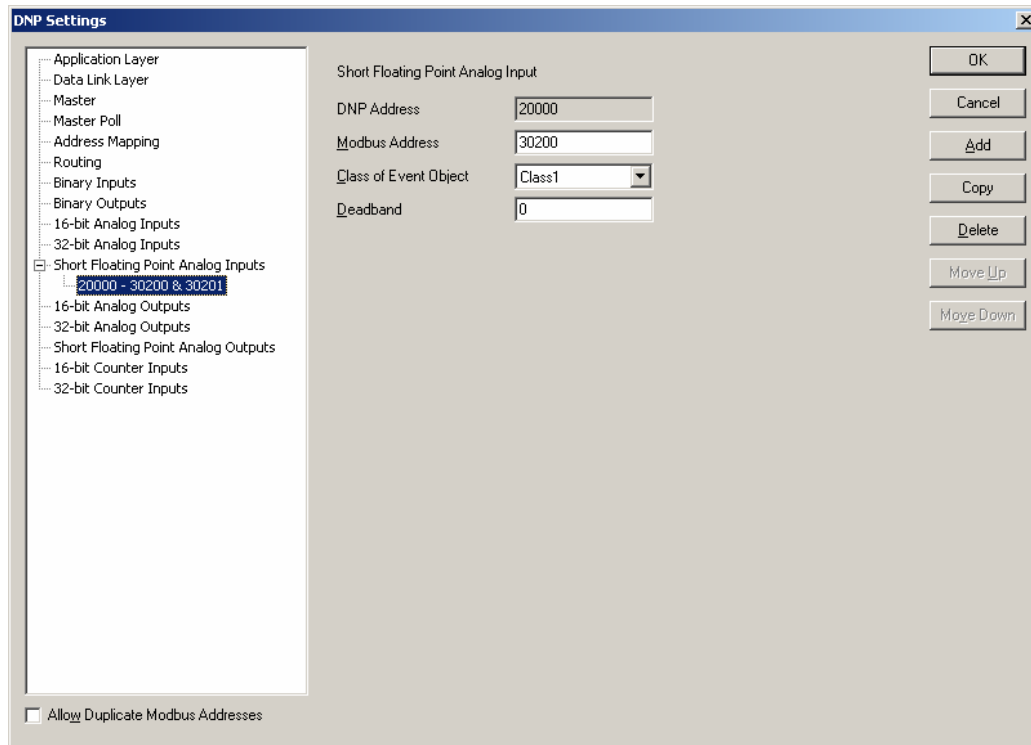- **Reverse (LSW First)**   Least Significant Word in first register.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

5.11.1   Adding Short Floating Point Analog Inputs

Short Floating Point Analog Inputs are added to the DNP configuration using the 16-Bit Analog Input property page. To add a Short Floating Point Analog Input:

- Select **Short Floating Point Analog Input** in the tree control section of the DNP Settings window.

- Click the **Add** button in the Short Floating Point Analog Inputs property page.

- The **Short Floating Point Analog Input** property page is now displayed.

- Edit the Short Floating Point Analog Input parameters as required and then click the **Add** button.

As Short Floating Point Analog Inputs are defined they are added as leaves to the Short Floating Point Analog Inputs branch of the tree control. When Short Floating Point Analog Inputs are defined the Short Floating Point Analog Inputs branch will display a collapse / expand control to the left of the branch. Click this control to display all defined Short Floating Point Analog Inputs.

The Short Floating Point Analog Input parameters are described in the following paragraphs.

The **DNP Address** window displays the DNP Short Floating Point Analog Input address of the point. Each Short Floating Point Analog Input is assigned a DNP address as they are defined. The DNP point address starts at the value set in the Short Floating Point Analog Input configuration dialog and increments by one with each defined Short Floating Point Analog Input.

The **Modbus Address** parameter specifies the Modbus addresses of the Short Floating Point Analog Input assigned to the DNP Address. Short Floating Point Analog Inputs use two consecutive Modbus registers for each assigned DNP Address, the address that is entered in this box and the next consecutive Modbus register. The SCADAPack and Micro16 controllers use Modbus addressing for all analog inputs. Refer to the *I/O Database Registers* section of the *TelePACE Ladder Logic Reference and User Manual* for complete information on analog input addressing in the SCADAPack and Micro16 controllers. Valid Modbus addresses are:

- 30001 through 39998

- 40001 through 49998

The Class of Event Object parameter specifies the event object class the Short Floating Point Analog Input is assigned. If Unsolicited reporting is not required for a DNP point, it is recommended to set its Class 0 or **None**. The selections are:

- None

- Class 1

- Class 2

- Class 3

The **Deadband** parameter specifies whether the RTU generates events. The value entered is the minimum number of counts that the Short Floating Point Analog Input must change since it was last

reported. Setting this value to zero disables generating events for the Short Floating Point Analog Inputs.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

Click the **OK** button to accept the Short Floating Point Analog Input parameters and close the DNP Settings dialog.

Click the **Cancel** button to close the dialog without saving any changes.

Click the **Add** button to add the current Short Floating Point Analog Input to the DNP configuration.

Click the **Copy** button to copy the current Short Floating Point Analog Input parameters to the next DNP Address.
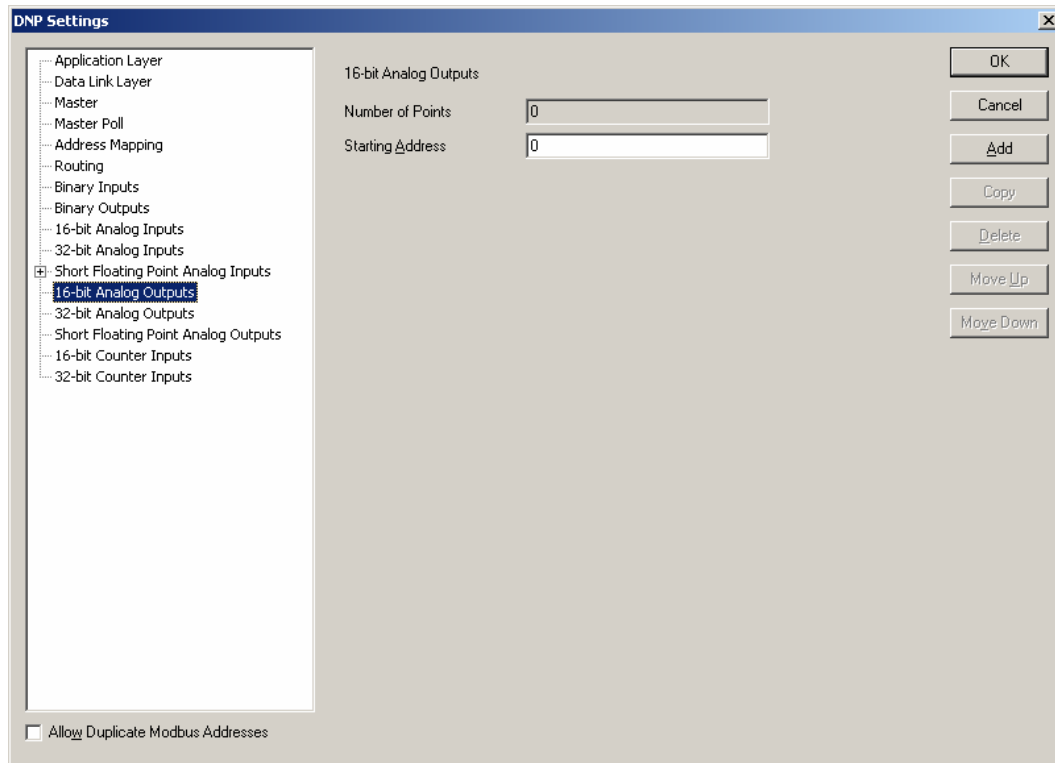
Click the **Delete** button to delete the current Short Floating Point Analog Input.

Click the **Move Up** button to move the current Short Floating Point Analog Input up one position in the tree control branch.

Click the **Move Down** button to move the current Short Floating Point Analog Input down one position in the tree control branch.

5.12   16-Bit Analog Outputs Configuration

The 16-Bit Analog Outputs property page is selected for editing by clicking 16-Bit Analog Outputs in the tree control section of the DNP Settings window. When selected the 16-Bit Analog Outputs property page is active.

16-Bit Analog Outputs parameters are viewed in this property page.

The **Number of Points** displays the number of 16-Bit Analog Outputs reported by this RTU. This value will increment with the addition of each configured 16-Bit Analog Input point. The maximum number of points is 9999. The maximum number of actual points will depend on the memory available in the controller.

The **Starting Address** parameter specifies the DNP address of the first 16-bit Analog Output point.
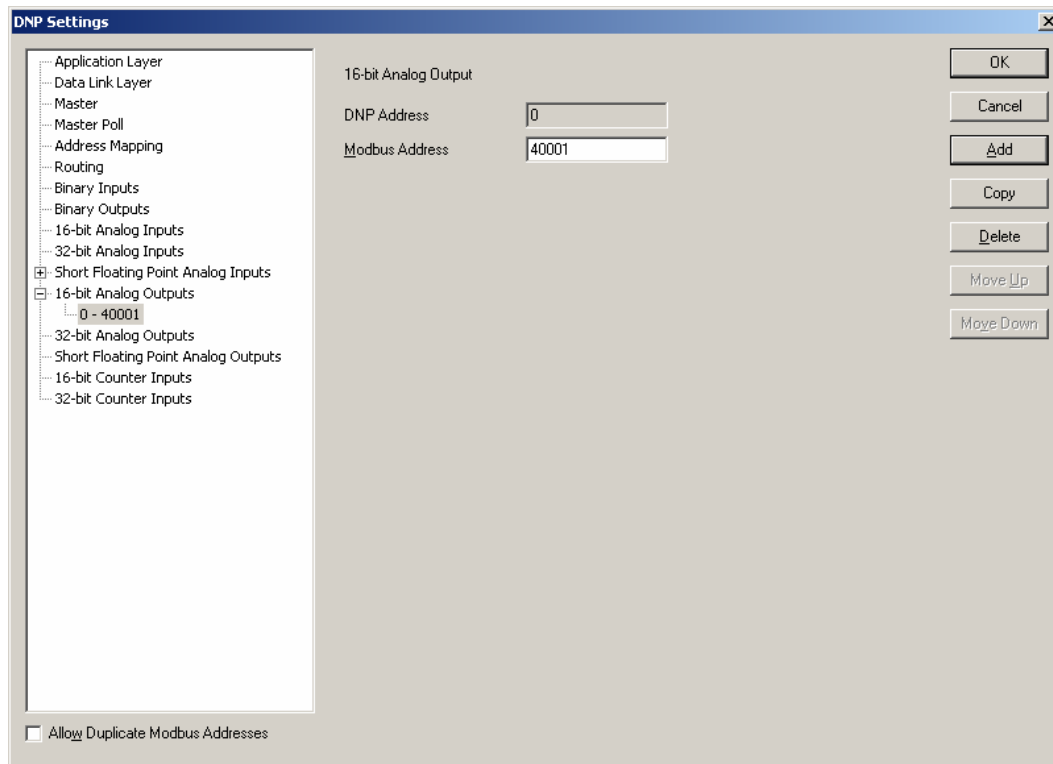
The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

5.12.1 Adding 16-Bit Analog Outputs

16-Bit Analog Outputs are added to the DNP configuration using the 16-Bit Analog Outputs property page. To add a 16-Bit Analog Output:

- Select **16-Bit Analog Outputs** in the tree control section of the DNP Settings window.

- Click the **Add** button in the 16-Bit Analog Outputs property page.

- The **16-Bit Analog Output** property page is now displayed.

- Edit the 16-Bit Analog Outputs parameters as required and then click the **Add** button.

As 16-Bit Analog Outputs are defined they are added as leaves to the 16-Bit Analog Output branch of the tree control. When 16-Bit Analog Outputs are defined the 16-Bit Analog Outputs branch will display a collapse / expand control to the left of the branch. Click this control to display all defined 16-Bit Analog Outputs.

The 16-Bit Analog Outputs parameters are described in the following paragraphs.

The **DNP Address** window displays the DNP 16-Bit Analog Output address of the point. Each 16-Bit Analog Output is assigned a DNP address as they are defined. The DNP point address starts at

the value set in the 16-bit Analog Output configuration dialog and increments by one with each defined 16-Bit Analog Output.

The **Modbus Address** parameter specifies the Modbus address of the 16-Bit Analog Output assigned to the DNP Address. The SCADAPack and Micro16 controllers use Modbus addressing for all analog outputs. Refer to the *I/O Database Registers* section of the *TelePACE Ladder Logic Reference and User Manual* for complete information on analog output addressing in the SCADAPack and Micro16 controllers. Valid Modbus addresses are:

- 40001 through 49999

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

Click the **OK** button to accept the 16-Bit Analog Output parameters and close the DNP Settings dialog.

Click the **Cancel** button to close the dialog without saving any changes.

Click the **Add** button to add the current 16-Bit Analog Output to the DNP configuration.

Click the **Copy** button to copy the current 16-Bit Analog Output parameters to the next DNP Address.

Click the **Delete** button to delete the current 16-Bit Analog Output.

Click the **Move Up** button to move the current 16-Bit Analog Output up one position in the tree control branch.

Click the **Move Down** button to move the current 16-Bit Analog Output down one position in the tree control branch.

5.13   32-Bit Analog Outputs Configuration

The 32-Bit Analog Outputs property page is selected for editing by clicking 32-Bit Analog Outputs in the tree control section of the DNP Settings window. When selected the 32-Bit Analog Outputs property page is active.
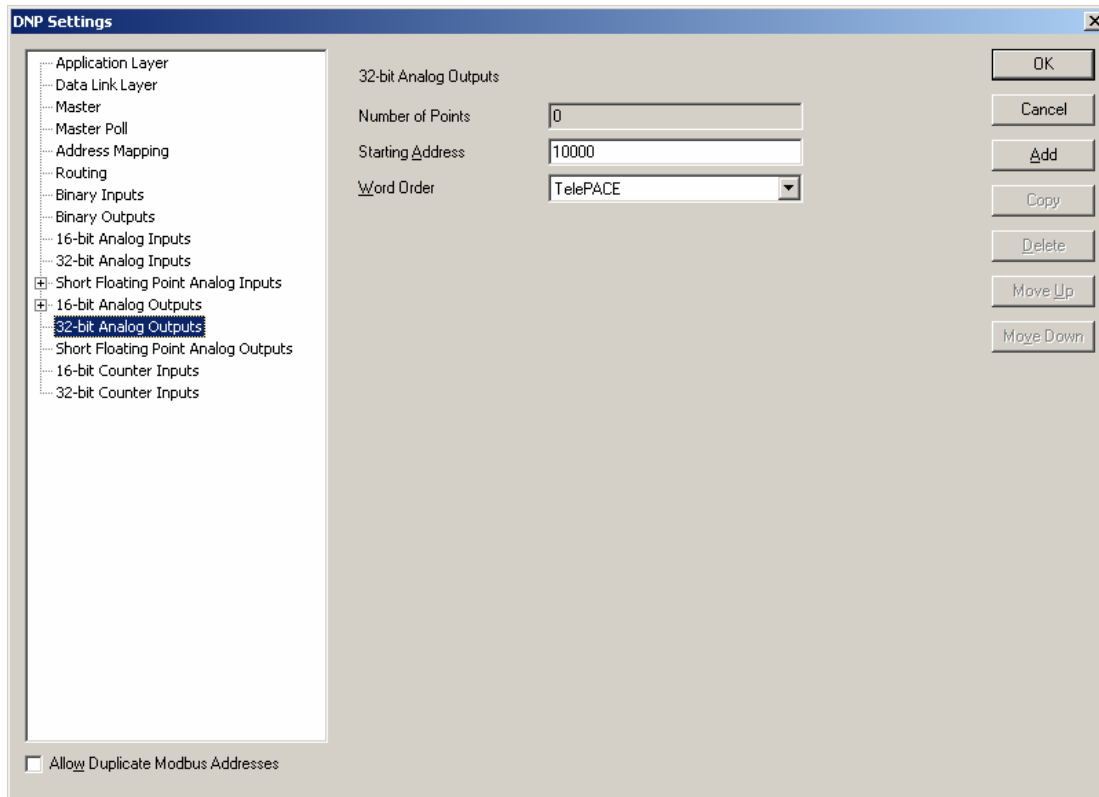
32-Bit Analog Outputs parameters are viewed in this property page.

The **Number of Points** displays the number of 32-Bit Analog Outputs reported by this RTU. This value will increment with the addition of each configured 32-Bit Analog Output point. The maximum number of points is 9999. The maximum number of actual points will depend on the memory available in the controller.

The **Starting Address** parameter specifies the DNP address of the first 16-bit Analog Output point.

The **Word Order** selection specifies the word order of the 32-bit value. The selections are:

- **TelePACE** Least Significant Word in first register.

- **ISaGRAF** Most Significant Word in first register.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.
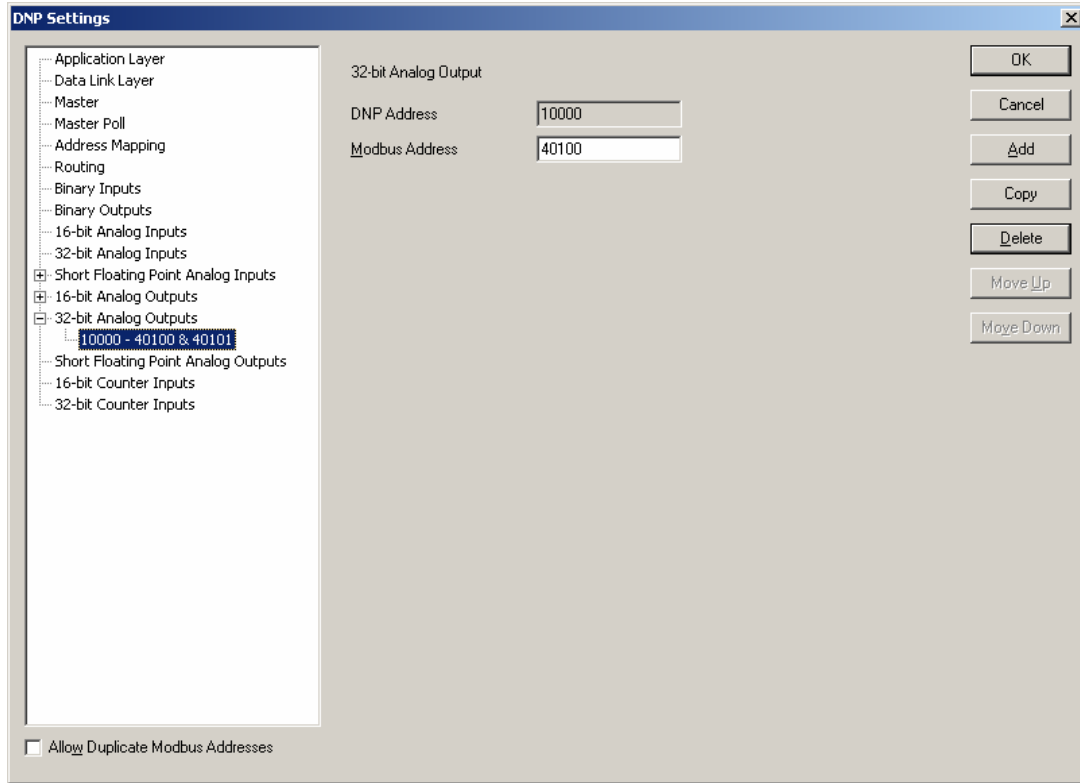
5.13.1 Adding 32-Bit Analog Outputs

32-Bit Analog Outputs are added to the DNP configuration using the 32-Bit Analog Outputs property page. To add a 32-Bit Analog Output:

- Select **32-Bit Analog Outputs** in the tree control section of the DNP Settings window.

- Click the **Add** button in the 16-Bit Analog Outputs property page.

- The **32-Bit Analog Output** property page is now displayed.

- Edit the 32-Bit Analog Outputs parameters as required and then click the **Add** button.

As 32-Bit Analog Outputs are defined they are added as leaves to the Binary Inputs branch of the tree control. When 32-Bit Analog Outputs are defined the 32-Bit Analog Outputs branch will display a collapse / expand control to the left of the branch. Click this control to display all defined 32-Bit Analog Outputs.

The 32-Bit Analog Outputs parameters are described in the following paragraphs.

The **DNP Address** window displays the DNP 32-Bit Analog Output address of the point. Each 16-Bit Analog Output is assigned a DNP address s they are defined. The DNP point address starts at the value set in the 32-bit Analog Output configuration dialog and increments by one with each defined 32-Bit Analog Output.

The **Modbus Address** parameter specifies the Modbus address of the 32-Bit Analog Output assigned to the DNP Address. 32-Bit Analog Outputs use two consecutive Modbus registers for each assigned DNP Address, the address that is entered in this box and the next consecutive Modbus register. The SCADAPack and Micro16 controllers use Modbus addressing for all analog outputs. Refer to the *I/O Database Registers* section of the *TelePACE Ladder Logic Reference and User Manual* for complete information on analog output addressing in the SCADAPack and Micro16 controllers. Valid Modbus addresses are:

- 40001 through 49998

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

Click the **OK** button to accept the 16-Bit Analog Output parameters and close the DNP Settings dialog.

Click the **Cancel** button to close the dialog without saving any changes.

Click the **Add** button to add the current 32-Bit Analog Output to the DNP configuration.

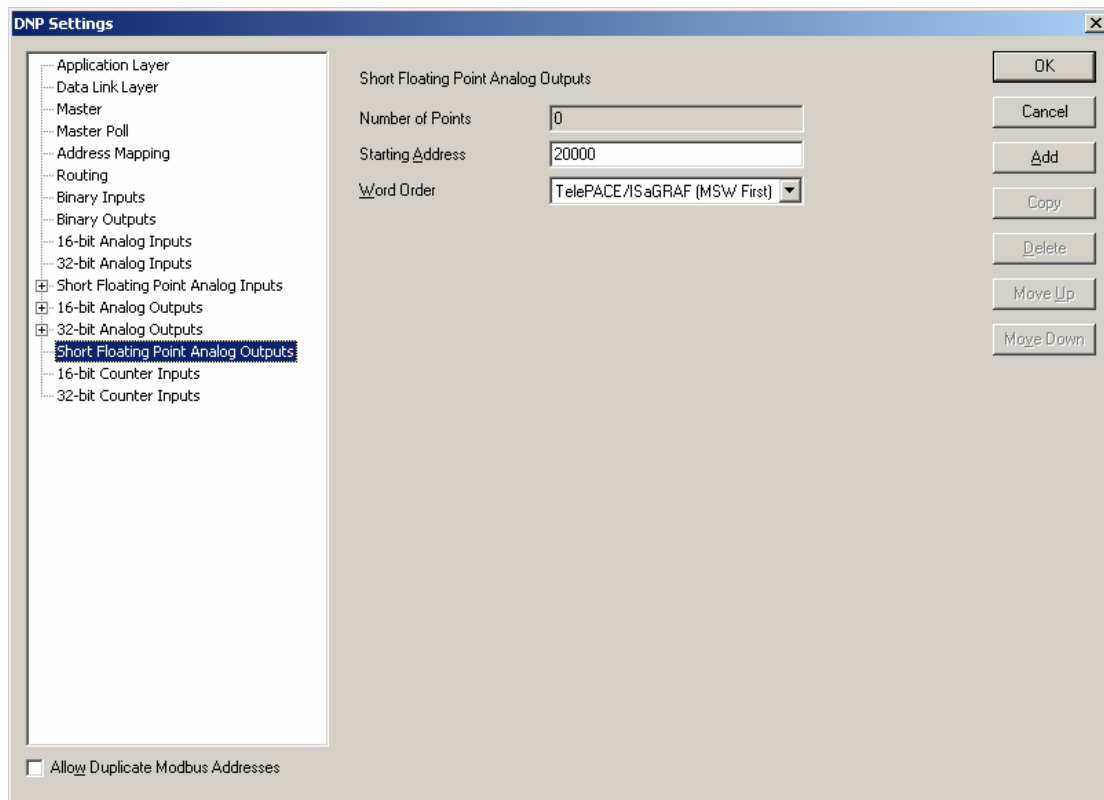Click the **Copy** button to copy the current 32-Bit Analog Output parameters to the next DNP Address.

Click the **Delete** button to delete the current 32-Bit Analog Output.

Click the **Move Up** button to move the current 32-Bit Analog Output up one position in the tree control branch.

Click the **Move Down** button to move the current 32-Bit Analog Output down one position in the tree control branch.

5.14 Short Floating Point Analog Outputs

The Short Floating Point Analog Outputs property page is selected for editing by clicking Short Floating Point Analog Outputs in the tree control section of the DNP Settings window. When selected the Short Floating Point Analog Outputs property page is active.

Short Floating Point Analog Output parameters are set in this property page. Each parameter is described in the following paragraphs.

The **Number of Points** displays the number of Short Floating Point Analog Outputs reported by the RTU. This value will increment with the addition of each configured Short Floating Point Analog Input point. The maximum number of points is 9999. The maximum number of actual points will depend on the memory available in the controller.

The **Starting Address** parameter specifies the DNP address of the first Short Floating Point Analog Output point.

The **Word Order** selection specifies the word order of the 32-bit value. The selections are:

- **TelePACE / ISaGRAF (MSW First)**   Most Significant Word in first register.

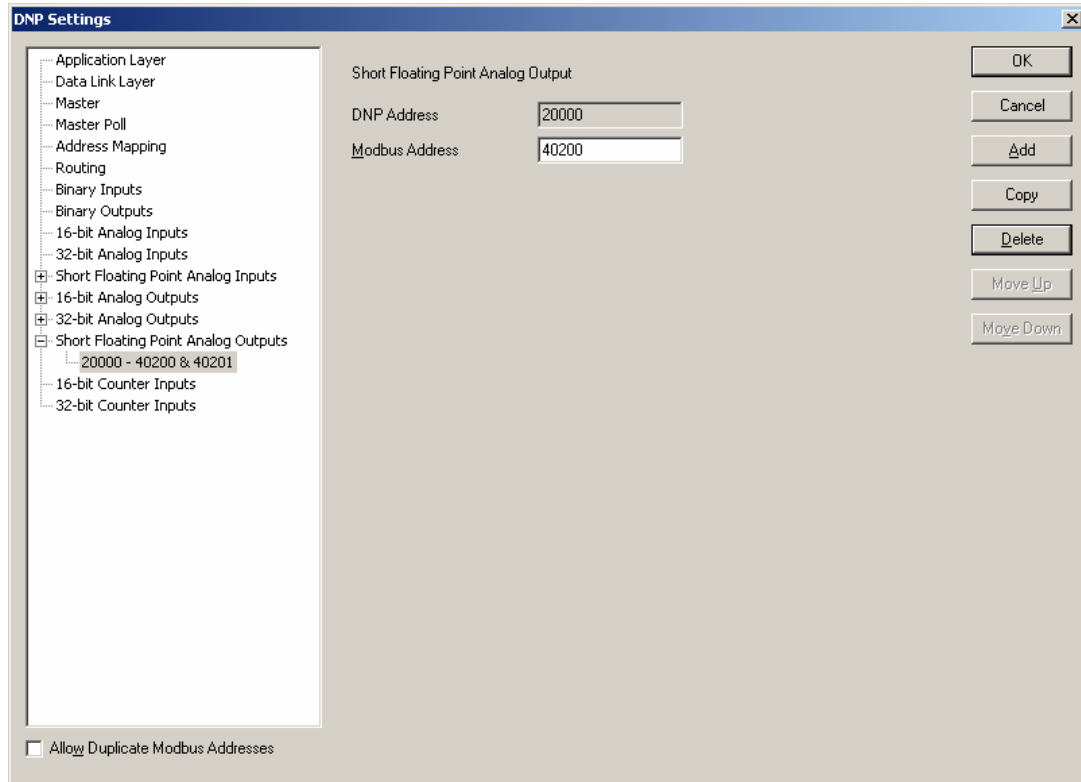- **Reverse (LSW First)**   Least Significant Word in first register.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

5.14.1   Adding Short Floating Point Analog Outputs

Short Floating Point Analog Outputs are added to the DNP configuration using the Short Floating Point Analog Output property page. To add a Short Floating Point Analog Output:

- Select **Short Floating Point Analog Output** in the tree control section of the DNP Settings window.

- Click the **Add** button in the Short Floating Point Analog Inputs property page.

- The **Short Floating Point Analog Output** property page is now displayed.

- Edit the Short Floating Point Analog Output parameters as required and then click the **Add** button.

As Short Floating Point Analog Outputs are defined they are added as leaves to the Short Floating Point Analog Outputs branch of the tree control. When Short Floating Point Analog Outputs are defined the Short Floating Point Analog Outputs branch will display a collapse / expand control to the left of the branch. Click this control to display all defined Short Floating Point Analog Outputs.

The Short Floating Point Analog Output parameters are described in the following paragraphs.

The **DNP Address** window displays the DNP Short Floating Point Analog Output address of the point. Each Short Floating Point Analog Output is assigned a DNP address as they are defined. The

DNP point address starts at the value set in the Short Floating Point Analog Output configuration dialog and increments by one with each defined Short Floating Point Analog Output.

The **Modbus Address** parameter specifies the Modbus addresses of the Short Floating Point Analog Output assigned to the DNP Address. Short Floating Point Analog Outputs use two consecutive Modbus registers for each assigned DNP Address, the address that is entered in this box and the next consecutive Modbus register. The SCADAPack and Micro16 controllers use Modbus addressing for all analog inputs. Refer to the *I/O Database Registers* section of the *TelePACE Ladder Logic Reference and User Manual* for complete information on analog input addressing in the SCADAPack and Micro16 controllers. Valid Modbus addresses are:

- 30001 through 39998

- 40001 through 49998

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

Click the **OK** button to accept the Short Floating Point Analog Input parameters and close the DNP Settings dialog.

Click the **Cancel** button to close the dialog without saving any changes.

Click the **Add** button to add the current Short Floating Point Analog Input to the DNP configuration.

Click the **Copy** button to copy the current Short Floating Point Analog Input parameters to the next DNP Address.

Click the **Delete** button to delete the current Short Floating Point Analog Input.

Click the **Move Up** button to move the current Short Floating Point Analog Input up one position in the tree control branch.

Click the **Move Down** button to move the current Short Floating Point Analog Input down one position in the tree control branch.

5.15 16–Bit Counter Inputs Configuration

The 16-Bit Counter Inputs property page is selected for editing by clicking 16-Bit Counter Inputs in the tree control section of the DNP Settings window. When selected the 16-Bit Counter Inputs property page is active.
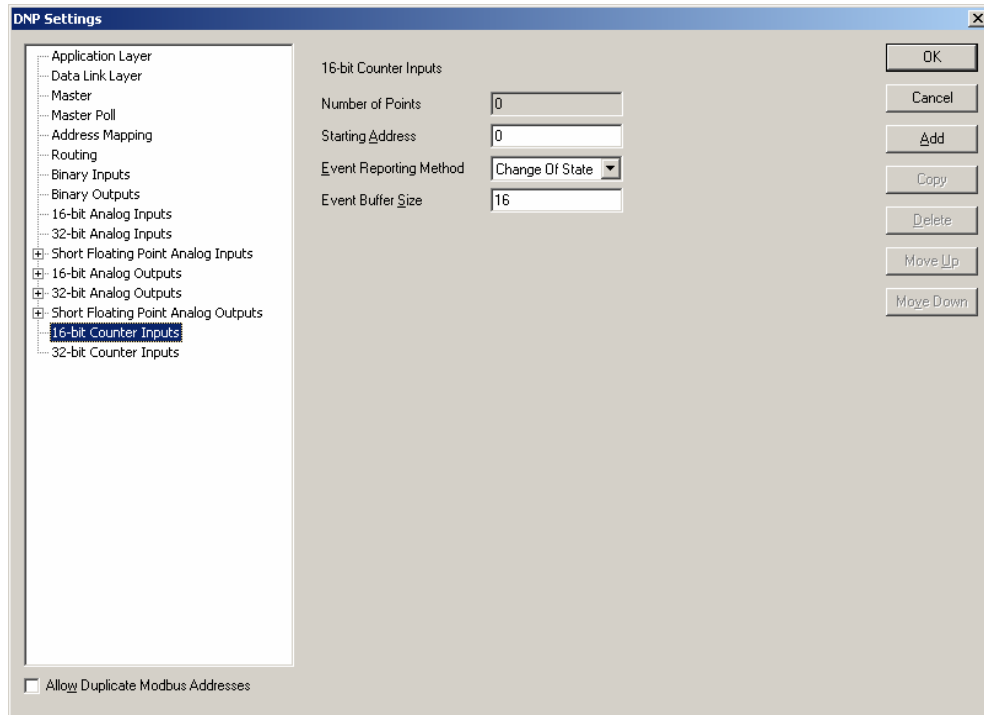
16-Bit Counter Inputs parameters are set in this property page. Each parameter is described in the following paragraphs.

The **Number of Points** displays the number of 16-Bit Counter Inputs reported by the RTU. This value will increment with the addition of each configured 16-Bit Counter Inputs point. The maximum number of points is 9999. The maximum number of actual points will depend on the memory available in the controller.

The **Starting Address** parameter specifies the DNP address of the first 16-Bit Counter Input point.

The **Event Reporting Method** selection specifies how 16-Bit Counter Input events are reported. A *Change Of State* event is an event object, without time, that is generated when the point changes state. Only one event is retained in the buffer for each point. If a subsequent event occurs for a point, the previous event object will be overwritten. The main purpose of this mode is to allow a master station to efficiently poll for changed data. A *Log All Events* is event object with absolute time will be generated when the point changes state. All events will be retained. The main purpose of this mode is to allow a master station to obtain a complete historical data log. The selections are:

- Change of State
- Log All Events

The **Event Buffer Size** parameter specifies the maximum number of 16-Bit Counter Input change without time events buffered by the RTU. The buffer holds all 16-Bit Counter Input events, regardless of the class to which they are assigned. If the buffer fills to 90 percent the RTU will send a buffer overflow event to the master station. If the buffer is completely full the RTU will lose the oldest events and retain the newest. The Event Buffer size should be at least equivalent to the number of 16-Bit Analog Inputs defined as Change of State type. That will allow all 16-Bit Counter Inputs to exceed the threshold simultaneously without losing any events. The value of this parameter is dependent on how often 16-Bit Counter Input events occur and the rate at which the events are reported to the master station. The valid values for this parameter are 0 - 65535. Default value is 16.

For SCADAPack 32 and SCADAPack 32P controllers counter input events are processed by the DNP driver at a rate of 100 events every 100 ms. If more than 100 counter input events need to be processed they are processed sequentially in blocks of 100 until all events are processed. This allows the processing of 1000 counter input events per second.

For SCADASense Series of controllers, SCADAPack 100, SCADAPack LP, SCADAPack and Micro16 controllers counter input events are processed by the DNP driver at a rate of 20 events every 100 ms. If more than 20 counter input events need to be processed they are processed sequentially in blocks of 20 until all events are processed. This allows the processing of 200 counter input events per second.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

5.15.1 Adding 16-Bit Counter Inputs

16-Bit Counter Inputs are added to the DNP configuration using the 16-Bit Counter Inputs property page. To add a 16-Bit Counter Input:

- Select **16-Bit Counter Inputs** in the tree control section of the DNP Settings window.

- Click the **Add** button in the 16-Bit Counter Inputs property page.

- The **16-Bit Counter Input** property page is now displayed.

- Edit the 16-Bit Counter Inputs parameters as required and then click the **Add** button.

As 16-Bit Counter Inputs are defined they are added as leaves to the 16-Bit Counter Inputs branch of the tree control. When 16-Bit Counter Inputs are defined the 16-Bit Counter Inputs branch will display a collapse / expand control to the left of the branch. Click this control to display all defined 16-Bit Counter Inputs.
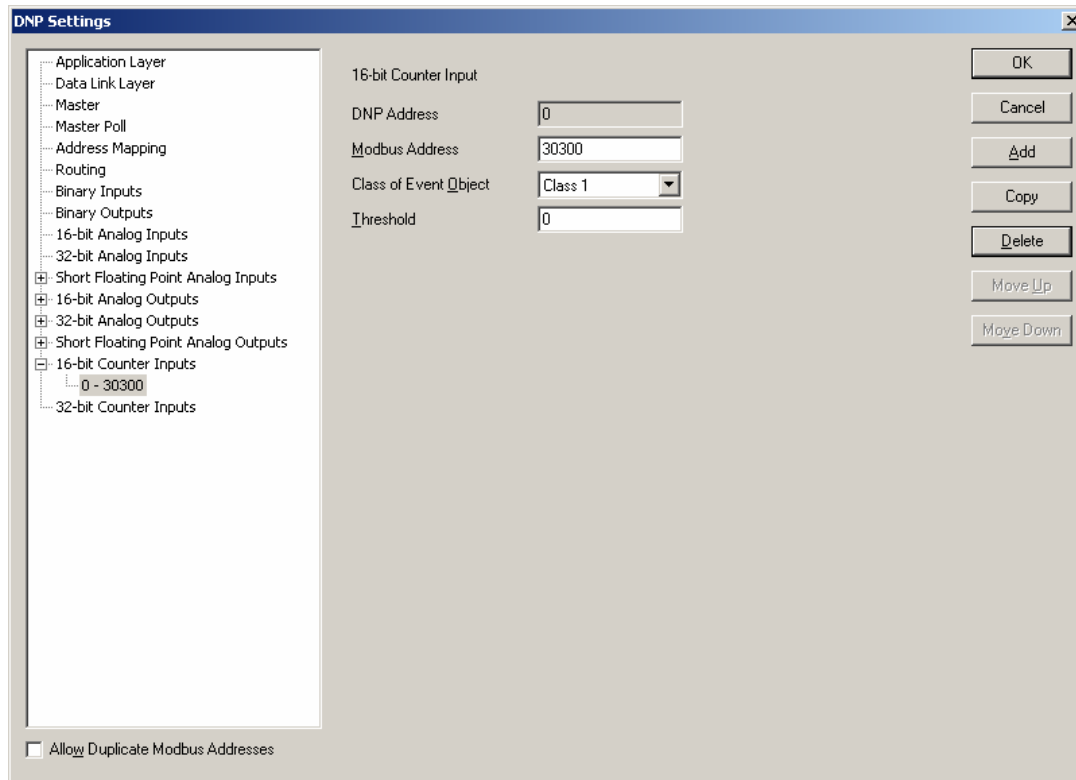
The 16-Bit Counter Input parameters are described in the following paragraphs.

The **DNP Address** window displays the DNP 16-Bit Counter Input address of the point. Each 16-Bit Counter Input is assigned a DNP address s they are defined. The DNP point address starts at the value set in the 16-Bit Counter Input configuration dialog and increments by one with each defined 16-Bit Counter Input.

The **Modbus Address** parameter specifies the Modbus address of the 16-Bit Counter Input assigned to the DNP Address. The SCADAPack and Micro16 controllers use Modbus addressing for all counter inputs. Refer to the *I/O Database Registers* section of the *TelePACE Ladder Logic Reference and User Manual* for complete information on analog input addressing in the SCADAPack and Micro16 controllers. Valid Modbus addresses are:

* 30001 through 39999
* 40001 through 49999

The **Class of Event Object** parameter specifies the event object class the 16-Bit Counter Input is assigned. If Unsolicited reporting is not required for a DNP point, it is recommended to set its Class 0 or **None**. The selections are:

* None
* Class 1
* Class 2
* Class 3

The **Threshold** parameter specifies whether the RTU generates events. The value entered is the minimum number of counts that the 16-Bit Counter Input must change since it was last reported.

Setting this value to zero disables generating events for the 16-Bit Counter Input point. Valid deadband values are 0 to 65535.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

Click the **OK** button to accept the 16-Bit Analog Counter parameters and close the DNP Settings dialog.

Click the **Cancel** button to close the dialog without saving any changes.

Click the **Add** button to add the current 16-Bit Analog Input to the DNP configuration.

Click the **Copy** button to copy the current 16-Bit Analog Input parameters to the next DNP Address.

Click the **Delete** button to delete the current 16-Bit Analog Input.

Click the **Move Up** button to move the current 16-Bit Analog Input up one position in the tree control branch.

Click the **Move Down** button to move the current 16-Bit Analog Input down one position in the tree control branch.

5.16   32-Bit Counter Inputs Configuration

The 32-Bit Counter Inputs property page is selected for editing by clicking 32-Bit Counter Inputs in the tree control section of the DNP Settings window. When selected the 32-Bit Counter Inputs property page is active.
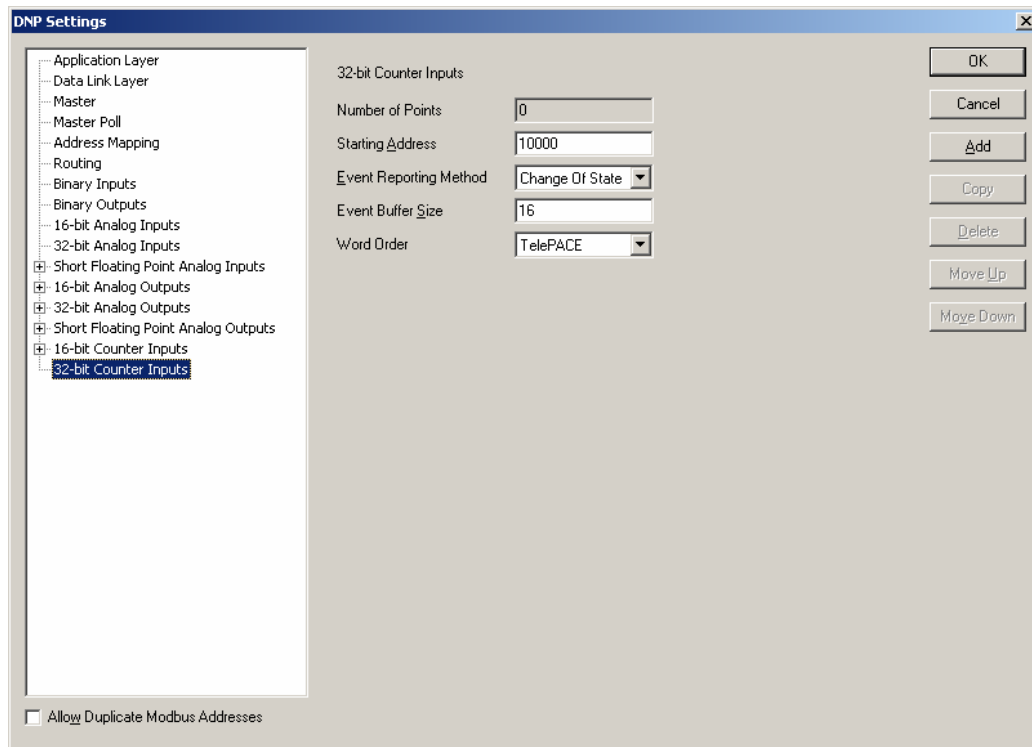
32-Bit Counter Inputs parameters are set in this property page. Each parameter is described in the following paragraphs.

The **Number of Points** displays the number of 32-Bit Counter Inputs reported by the RTU. This value will increment with the addition of each configured 32-Bit Counter Inputs point. The maximum number of points is 9999. The maximum number of actual points will depend on the memory available in the controller.

The **Starting Address** parameter specifies the DNP address of the first 32-Bit Counter Input point.

The **Event Reporting Method** selection specifies how 32-Bit Counter Input events are reported. A *Change Of State* event is an event object, without time, that is generated when the point changes state. Only one event is retained in the buffer for each point. If a subsequent event occurs for a point, the previous event object will be overwritten. The main purpose of this mode is to allow a master station to efficiently poll for changed data. A *Log All Events* is event object with absolute time will be generated when the point changes state. All events will be retained. The main purpose of this mode is to allow a master station to obtain a complete historical data log. The selections are:

- Change of State

- Log All Events

The **Event Buffer Size** parameter specifies the maximum number of 32-Bit Counter Input change events buffered by the RTU. The buffer holds all 32-Bt Counter Input events, regardless of the class to which they are assigned. If the buffer is completely full the RTU will lose the oldest events and retain the newest; the 'Event Buffer Overflowed' IIN flag will also be set to indicate that the buffer has overflowed. The Event Buffer size should be at least equivalent to the number of 32-Bit Counter Inputs defined as Change of State type. That will allow all 32-Bit Counter Inputs to exceed the deadband simultaneously without losing any events. The value of this parameter is dependent on how often 32-Bit Counter Input events occur and the rate at which the events are reported to the master station. The valid values for this parameter are 0 - 65535. Default value is 16.

For SCADAPack 32 and SCADAPack 32P controllers counter input events are processed by the DNP driver at a rate of 100 events every 100 ms. If more than 100 counter input events need to be processed they are processed sequentially in blocks of 100 until all events are processed. This allows the processing of 1000 counter input events per second.

For SCADASense Series of controllers, SCADAPack 100, SCADAPack LP, SCADAPack and Micro16 controllers counter input events are processed by the DNP driver at a rate of 20 events every 100 ms. If more than 20 counter input events need to be processed they are processed sequentially in blocks of 20 until all events are processed. This allows the processing of 200 counter input events per second.

The **Word Order** selection specifies the word order of the 32-bit value. The selections are:

- **TelePACE** Least Significant Word in first register.

- **ISaGRAF** Most Significant Word in first register.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

5.16.1 Adding 32-Bit Counter Inputs

32-Bit Counter Inputs are added to the DNP configuration using the 16-Bit Counter Input property page. To add a 32-Bit Analog Input:

- Select **32-Bit Counter Inputs** in the tree control section of the DNP Settings window.

- Click the **Add** button in the 32-Bit Counter Inputs property page.

- The **32-Bit Counter Input** property page is now displayed.

- Edit the 32-Bit Counter Input parameters as required and then click the **Add** button.

As 32-Bit Counter Inputs are defined they are added as leaves to the 32-Bit Counter Inputs branch of the tree control. When 32-Bit Counter Inputs are defined the 32-Bit Counter Inputs branch will display a collapse / expand control to the left of the branch. Click this control to display all defined 32-Bit Counter Inputs.
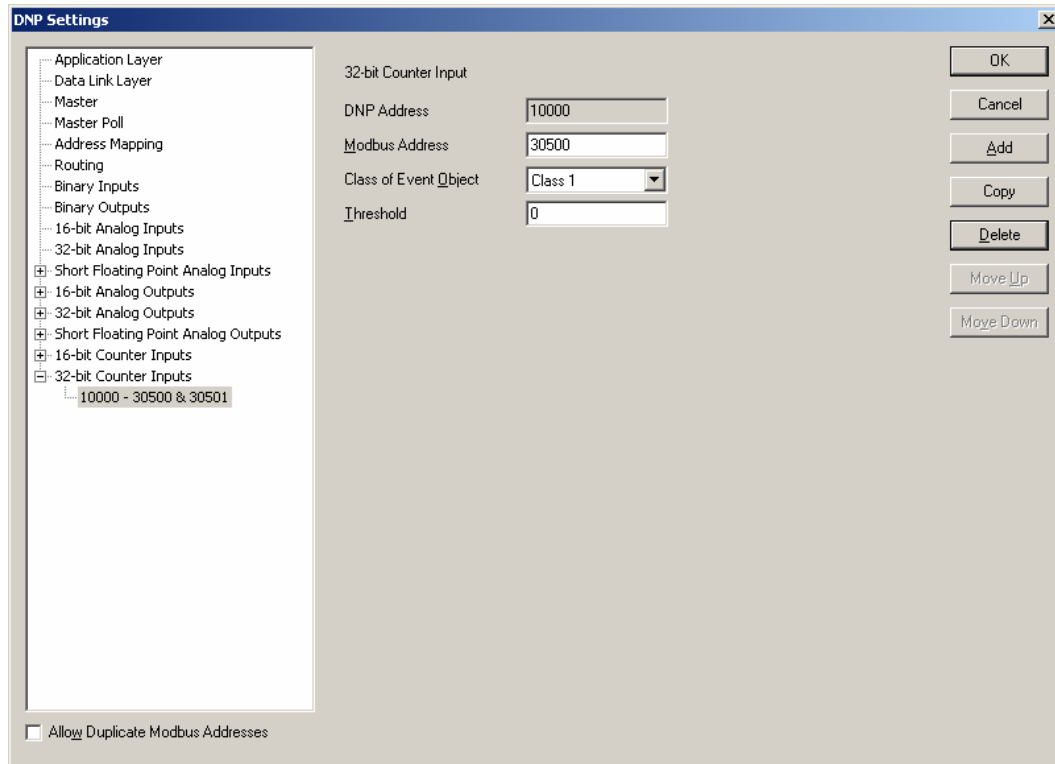
The 32-Bit Counter Input parameters are described in the following paragraphs.

The **DNP Address** window displays the DNP 32-Bit Counter Input address of the point. Each 32-Bit Counter Input is assigned a DNP address as they are defined. The DNP point address starts at the value set in the 32-Bit Counter Input configuration dialog and increments by one with each defined 32-Bit Counter Input.

The **Modbus Address** parameter specifies the Modbus addresses of the 32-Bit Counter Input assigned to the DNP Address. 32-Bit Counter Inputs use two consecutive Modbus registers for each assigned DNP Address, the address that is entered in this box and the next consecutive Modbus register. The SCADAPack and Micro16 controllers use Modbus addressing for all counter inputs. Refer to the *I/O Database Registers* section of the *TelePACE Ladder Logic Reference and User Manual* for complete information on analog input addressing in the SCADAPack and Micro16 controllers. Valid Modbus addresses are:

- 30001 through 39998

- 40001 through 49998

The **Class of Event Object** parameter specifies the event object class the 32-Bit Counter Input is assigned. If Unsolicited reporting is not required for a DNP point, it is recommended to set its Class 0 or **None**. The selections are:

- None

- Class 1

- Class 2

- Class 3

The **Threshold** parameter specifies whether the RTU generates events. The value entered is the minimum number of counts that the 32-Bit Counter Input must change since it was last reported. Setting this value to zero disables generating events for the 32-Bit Counter Input point. Valid threshold values are 0 to 4,294,967,295.

The **Allow Duplicate Modbus Addresses** checkbox determines if the Modbus I/O database addresses assigned to the DNP data points must be unique. Check this box if you want to allow more than one point to use the same Modbus address.

Click the **OK** button to accept the 32-Bit Counter Input parameters and close the DNP Settings dialog.

Click the **Cancel** button to close the dialog without saving any changes.

Click the **Add** button to add the current 32-Bit Counter Input to the DNP configuration.

Click the **Copy** button to copy the current 32-Bit Counter Input parameters to the next DNP Address.

Click the **Delete** button to delete the current 32-Bit Counter Input.

Click the **Move Up** button to move the current 32-Bit Counter Input up one position in the tree control branch.

Click the Move Down button to move the current 32-Bit Counter Input down one position in the tree control branch.

6   DNP Diagnostics

DNP Diagnostics provide Master station and Outstation DNP diagnostics. The diagnostics provide detailed information on the status of DNP communication and DNP data points. This information is useful when debugging DNP station and network problems that may arise.

DNP diagnostics are available for local DNP information using the **DNP Status** command.

- For TelePACE applications select **Controller >> DNP Status** from the menu bar. See the section *DNP Status* for information on DNP Status diagnostics.

- For ISaGRAF applications select **Tools >> Controller >> DNP Status** from the program window menu bar. See the section *DNP Status* for information on DNP Status diagnostics.

SCADAPack 32 controllers support DNP master operations. DNP diagnostics are available for master stations using the **DNP Master Status** command.

- For TelePACE applications select **Controller >> DNP Master Status** from the menu bar. See the section *DNP Master Status* for information on DNP Master Status diagnostics.

- For ISaGRAF applications select **Tools >> Controller >> DNP Master Status** from the program window menu bar. See the section *4.2- DNP Master Status* for information on DNP Master Status diagnostics.

DNP Diagnostics require firmware version 2.20 or newer for SCADAPack controllers and firmware version 1.50 or newer for SCADAPack 32 controllers. When an attempt is made to select the DNP Status or DNP Master Status command for controllers with firmware that does not support the commands an error message is displayed. An example of the error message is shown below.
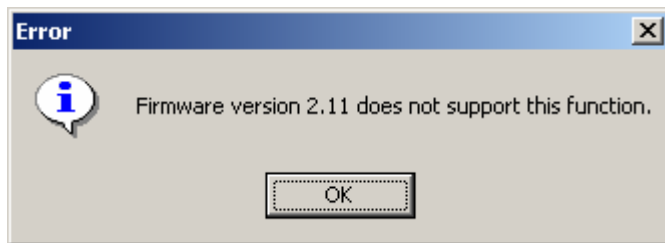
To enable the use of DNP diagnostics you will need to upgrade the firmware in the controller to the newer version.

6.1   DNP Status

When the DNP Status command is selected the DNP Status dialog is displayed. This dialog shows the run-time DNP diagnostics and current data values for the local DNP points.

The DNP Status dialog has a number of selectable tabs and opens with the Overview tab selected. The following tabs are displayed.

- Overview

- Binary In (binary inputs information)

- Binary Out (binary outputs information)

- AIN-16 (16-bit analog inputs information)

- AIN-32 (32-bit analog inputs information)

- AIN-Float (short float analog inputs information)

- AOUT-16 (16-bit analog outputs information)

- AOUT-32 (32-bit analog outputs information)

- AOUT-Float (short float analog outputs information)

- Counter-16 (16-bit counter inputs information)

- Counter-32 (32-bit counter inputs information)

Clicking on any tab opens the tab and displays the selected information.

6.1.1   Overview Tab

The Overview Tab displays the run-time diagnostics for the local DNP station. The Overview display is divided into five areas of diagnostic information: DNP Status, Internal Indications, Communication Statistics, Last Message and Event Buffer. Each of these is explained in the following paragraphs.
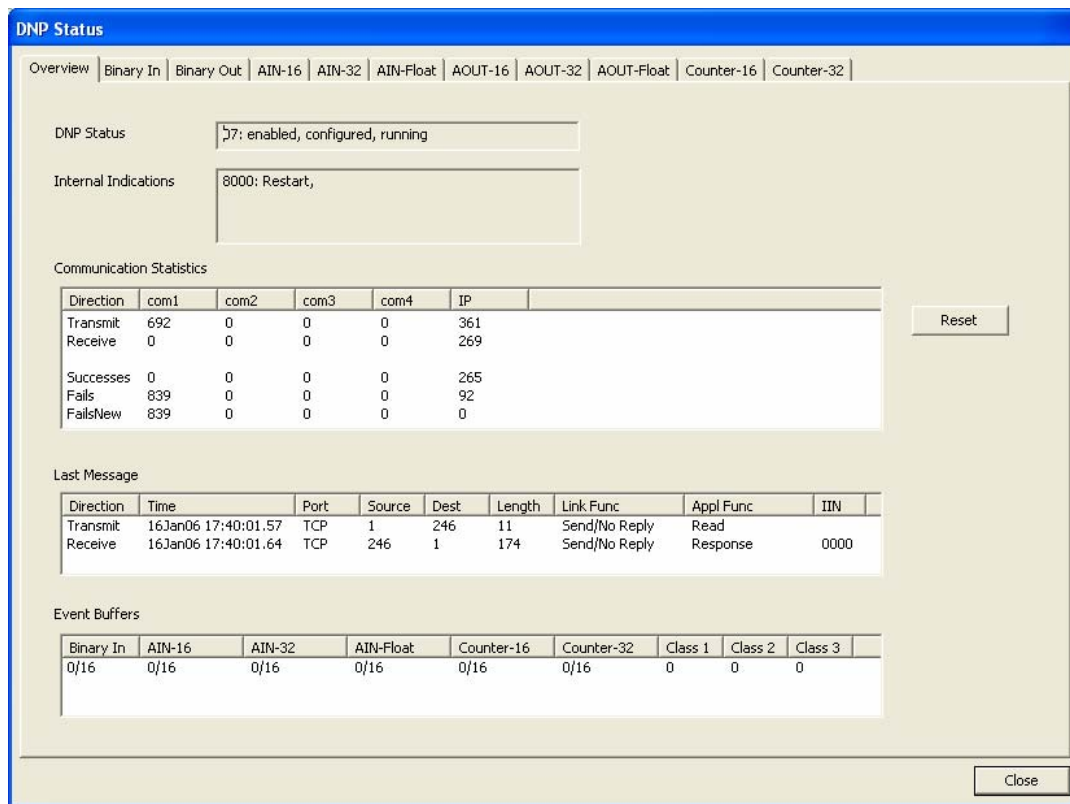
The **DNP Status** window provides information on the status of the DNP protocol running in the controller. Depending on the status the window may contain the following text.

- **Enabled** or **Disabled** indicates whether the controller firmware supports DNP protocol.

- **Configured** or **Not Configured** indicates whether the controller has been configured with DNP protocol on at least one communications port.

- **Running** or **Not Running** indicates whether the DNP tasks are running in the controller.

The **Internal Indications** window displays the current state of the DNP internal indications (IIN) flags in the controller. For a detailed description of the IIN flags see the section *Internal Indication*

(IIN) Flags section of this manual. Note that bits 0 – 7 (the first octet) are displayed on the left, then bits 8 - 15 (second octet) on the right.

The **Communication Statistics** window displays the message statistics for each DNP communication port. The statistics include the total number of messages transmitted and received and the total number of successes, failures, and failures since last success (which will only be updated for messages sent by this controller) for each communication port. The counters increment whenever a new DNP message is sent or received on the port, and roll over after 65535 messages.

- Click the **Reset** button to reset the counters to zero.

The **Last Message** window displays information about the most recent DNP message. The information is updated each time a new message is received or transmitted. The Last Message window contains the following information.

- **Direction** displays whether the message was received or transmitted.

- **Time** displays the time at which the message was received or sent.

- **Port** displays which communication port was used for the message.

- **Source** displays the source DNP station address for the message.

- **Dest** displays the destination DNP station address for the message.

- **Length** displays the message length in bytes.

- **Link Func** displays the Link Layer function code.

- **Appl Func** displays the Application Layer function code.

- **IIN** displays the Internal indications received with the last message

The **Event Buffers** window displays the number of events in each type of event buffer and the allocated buffer size. The event buffers displayed are:

- Binary In (binary inputs)

- AIN-16 (16-bit analog inputs)

- AIN-32 (32-bit analog inputs)

- AIN-Float (floating point analog inputs)

- Counter-16 (16-bit counter inputs)

- Counter-32 (32-bit counter inputs)

- Class 1 (class 1 events)

- Class 2 (class 2 events)

- Class 3 (class 3 events)

6.1.2   *Point Status Tabs*

The point status tabs display the state of each point of the selected type in the controller. The following tabs are displayed.

- Binary In (binary inputs information)

- Binary Out (binary outputs information)

- AIN-16 (16-bit analog inputs information)

- AIN-32 (32-bit analog inputs information)

- AIN-Float (short float analog inputs information)

- AOUT-16 (16-bit analog outputs information)

- AOUT-32 (32-bit analog outputs information)

- AOUT-Float (short float analog outputs information)

- Counter-16 (16-bit counter inputs information)

- Counter-32 (32-bit counter inputs information)

Each of the tabs displays information in the same format. The example below shows the appearance of the binary input page.
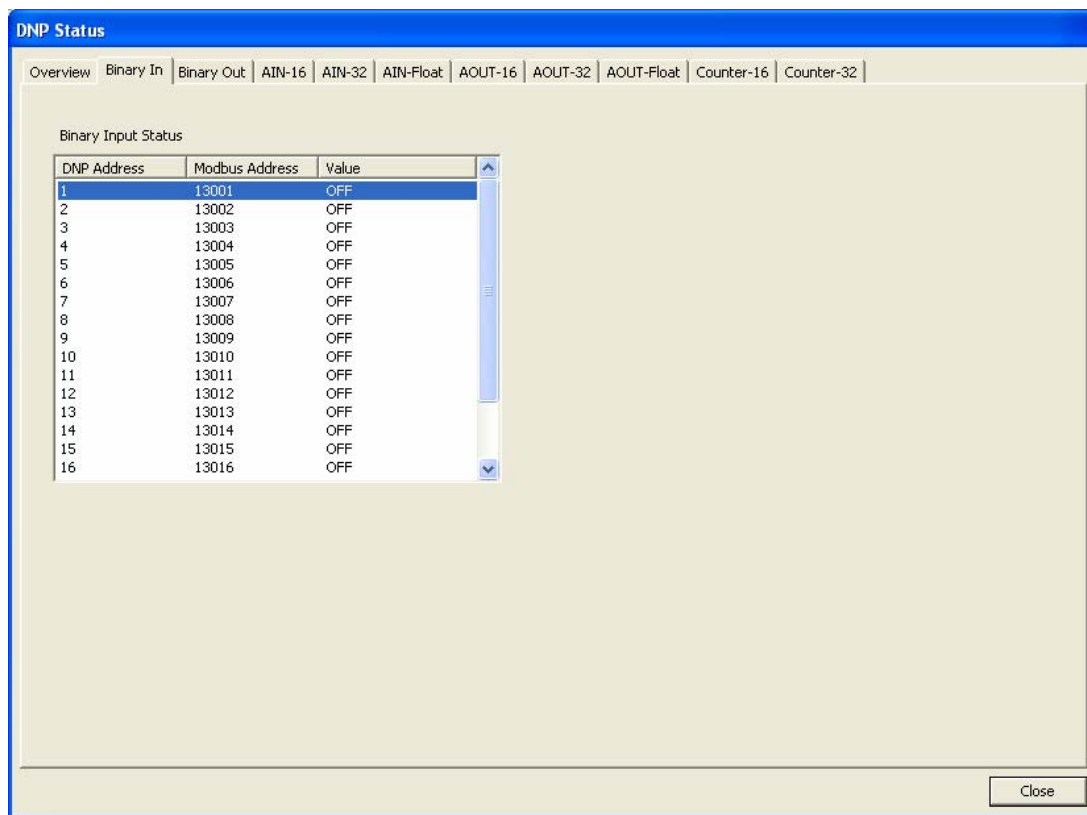
The **DNP Address** column shows the DNP address of the point.

The **Modbus Address** column shows the Modbus register address of the point.

The **Value** column shows the value of the point. Binary points are shown as OFF or ON. Numeric points show the numeric value of the point.

6.2 DNP Master Status

When the DNP Master Status command is selected the **DNP Master Status** dialog is displayed. This dialog shows the run-time DNP diagnostics and status of the DNP outstations and current data values for the DNP points in these outstations.

The DNP Master Status dialog has a number of selectable tabs and opens with the All Stations tab selected. The following tabs are displayed.

- All Stations

- Remote Overview

- Binary In (binary inputs information)

- Binary Out (binary outputs information)

- AIN-16 (16-bit analog inputs information)

- AIN-32 (32-bit analog inputs information)

- AIN-Float (short float analog inputs information)

- AOUT-16 (16-bit analog outputs information)

- AOUT-32 (32-bit analog outputs information)

- AOUT-Float (short float analog outputs information)

- Counter-16 (16-bit counter inputs information)

- Counter-32 (32-bit counter inputs information)

6.2.1   All Stations Tab

The **All Stations** tab displays the run-time communications diagnostics for all outstations polled by the master or outstations reporting unsolicited data to the master.
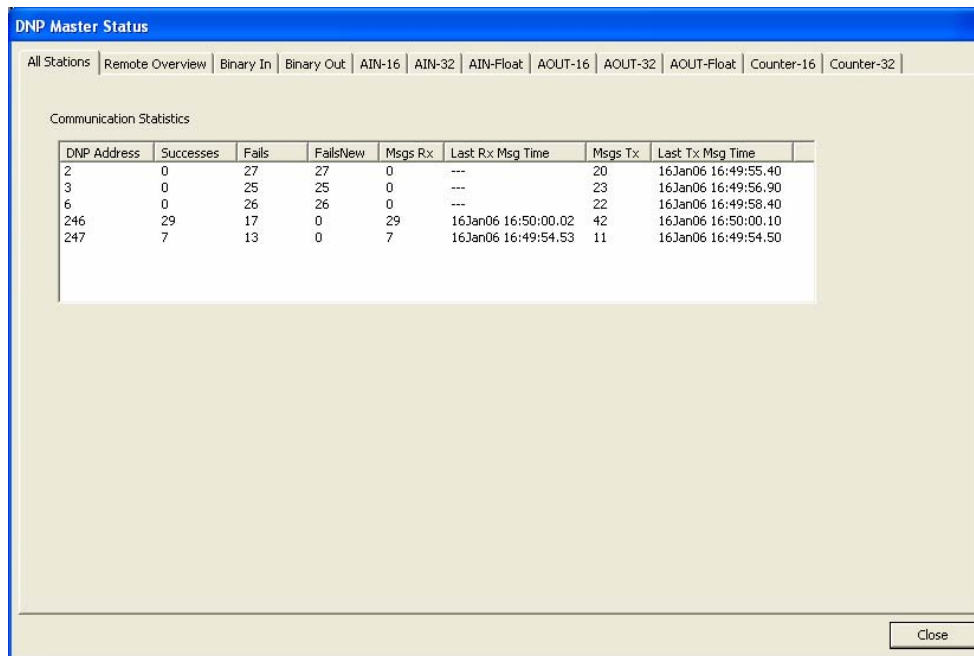
The **Communication Statistics** window displays a list of all outstations and the communication statistics for each station in the list. The statistics counters increment whenever a new DNP message is sent or received, and roll over after 65535 messages. The following statistics are displayed.

- **DNP Address** displays the DNP address of the outstation.

- **Successes** display the number of successful message transactions between this master and the corresponding remote station. This number includes master polls to the remote station and unsolicited responses from the outstation.

- **Fails** displays the number of failed message transactions between this master and the corresponding remote station. This counter increments by 1 for a failed message transaction irrespective of the number of application layer retries.

- **FailsNew** displays the number failed message transactions between this master and the corresponding remote station since the last successful poll.

- **Msgs Rx** displays the number of DNP packets (frames) received from the outstation station. This number includes frames containing unsolicited responses from the outstation.

- **Last Rx Msg Time** displays the time the last DNP packet (frame) was received from the outstation.

- **Msgs Tx** displays the number of DNP packets (frames) sent to the outstation.

- **Last Tx Msg Time** displays the time the last DNP packet (frame) was sent to the outstation.

Note:	The **Msgs Tx** and **Msgs Rx** counters could be greater than or equal to the Successes and Fails counters.

6.2.2   Remote Overview Tab

The Remote Overview tab displays the run-time diagnostics and current data values for a selected remote station. The data shown is from the image of the data in the master station.

The **Remote Station** window is where the DNP address of the remote station is entered. When the Remote station field is changed all data fields on this tab and the following I/O tabs are updated with the values for the newly selected Remote Station.

The **Internal Indications** window displays the current state of the DNP internal indications (IIN) flags for the selected remote station. For a detailed description of the IIN flags see the section *Internal Indication (IIN) Flags* section of this manual.

The **Communication Statistics** window displays communication statistics for the remote station selected. The statistics counters increment whenever a new DNP message is sent or received, and roll over after 65535 messages. The following statistics are displayed.

- **Successes** displays the number of successful messages received in response to master polls sent to the station. This number includes unsolicited responses from the outstation.

- **Fails** displays the number of failed or no responses to master polls sent to the outstation.

- **FailsNew** displays the number failed or no responses to master polls sent to the outstation since the last successful poll.

- **Msgs Rx** displays the number of messages received from the outstation station. This number includes unsolicited responses from the outstation.

- **Last Rx Msg Time** displays the time the last message was received from the outstation.

- **Msgs Tx** displays the number of messages sent to the outstation station.

- **Last Tx Msg Time** displays the time the last message was sent to the outstation.

Click **Reset** to reset the counters to zero.

Event Buffers shows the number of events in each type of event buffer and the allocated buffer size. The buffers shown are for binary inputs, 16-bit analog inputs, 32-bit analog inputs, Floating point analog inputs, 16-bit counter inputs, and 32-bit counter inputs, and Class 1, 2, and 3 events.

The **Event Buffers** window displays the number of events in each type of event buffer and the allocated buffer size for the selected remote station. The event buffers displayed are:

- Binary In (binary inputs)

- AIN-16 (16-bit analog inputs)

- AIN-32 (32-bit analog inputs)

- AIN-Float (floating point analog inputs)

- Counter-16 (16-bit counter inputs)

- Counter-32 (32-bit counter inputs)

- Class 1 (class 1 events)

- Class 2 (class 2 events)

- Class 3 (class 3 events)

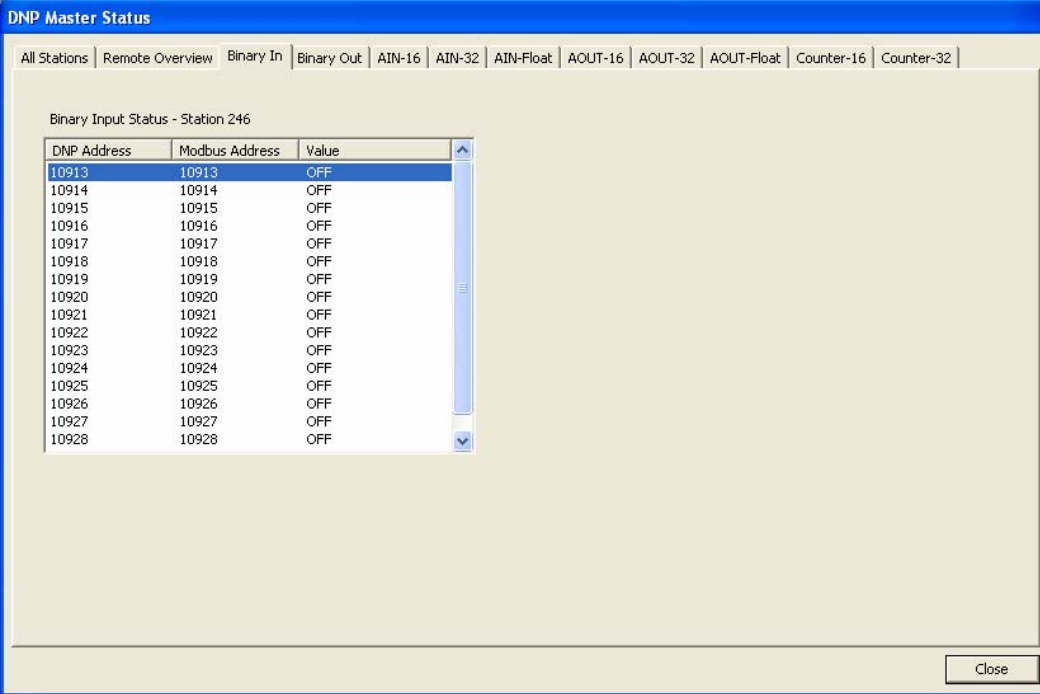|	
Note:	Due to a limitation of the DNP3 protocol, an Unsolicited message from an outstation is not capable of including information stating which data class generated the message. As a result, all Unsolicited events when received by the master will be counted as Class 1 events. Events which are polled by the master, however, do contain class information and will be counted in the Event Buffer for the appropriate class.

6.2.3 Remote Point Status Tabs

The point status tabs show the state of each point of the selected type in the remote station selected on the Remote Overview tab. The values shown are from the image of the remote station in the master station.

Note:	Class 0 polling of an outstation must be enabled in the master in order to allow that outstation's DNP points to be listed on these tabs. This is the only way for the master to retrieve a complete list of all points in an outstation.

The example below shows the appearance of the Binary In tab.

The **DNP Address** column shows the DNP address of the point.

The **Modbus Address** column shows the Modbus register address of the point. This is only relevant for points that have an address mapping in the master station. For points that have an address mapping, this will show the Modbus register address of the point. For points which do not have an address mapping, this will show '---'.

The **Value** column shows the value of the point. Binary points are shows as OFF or ON. Numeric points show the numeric value of the point.

7   DNP Device Profile Document - Master

DNP v3.00
DEVICE PROFILE DOCUMENT

Vendor Name: Control Microsystems Inc.

Device Name: SCADAPack controllers

Highest DNP Level Supported:	Device Function:
For Requests 2	■ Master □ Slave
For Responses 2	

Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table):

- Function code 14 (warm restart)
- Function code 20 (Enable Unsolicited Messages) for class 1, 2, 3 objects only.
- Function code 21 (Disable Unsolicited Messages) for class 1, 2, 3 objects only.
- Object 41, variation 1 (32-bit analog output block)

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

Maximum Data Link Re-tries:	Maximum Application Layer Re-tries:
☐ None ☐ Fixed at ■ Configurable, range 0 to 255	☐ None ■ Configurable, range 0 to 255

Requires Data Link Layer Confirmation:

☐ Never
☐ Always
☐ Sometimes   If 'Sometimes', when?

■ Configurable for Always or Never

Requires Application Layer Confirmation:

☐ Never
☐ Always (not recommended)
☐ When reporting Event Data (Slave devices only)
☐ When sending multi-fragment responses (Slave devices only)

☐ Sometimes   If 'Sometimes', when?
_____

■Configurable for always or only when Reporting Event Data and Unsolicited Messages

---

Timeouts while waiting for:

Data Link Confirm	☐ None ☐ Fixed at _____	☐ Variable	■ Configurable
Complete Appl. Fragment	☐ None ☐ Fixed at _____	☐ Variable	■ Configurable
Application Confirm	☐ None ☐ Fixed at _____	☐ Variable	■ Configurable
Complete Appl. Response	☐ None ☐ Fixed at _____	☐ Variable	■ Configurable

Others _____

Sends/Executes Control Operations:

WRITE Binary Outputs	☐ Never	☐ Always	☐ Sometimes	■ Configurable
SELECT/OPERATE	☐ Never	☐ Always	☐ Sometimes	■ Configurable
DIRECT OPERATE	☐ Never	☐ Always	☐ Sometimes	■ Configurable
DIRECT OPERATE - NO ACK	☐ Never	☐ Always	☐ Sometimes	■ Configurable
Count > 1	☐ Never	☐ Always	☐ Sometimes	■ Configurable

Pulse On	☐ Never	☐ Always	☐ Sometimes	■ Configurable
Pulse Off	☐ Never	☐ Always	☐ Sometimes	■ Configurable
Latch On	☐ Never	☐ Always	☐ Sometimes	■ Configurable
Latch Off	☐ Never	☐ Always	☐ Sometimes	■ Configurable
Queue	■ Never	☐ Always	☐ Sometimes	☐ Configurable
Clear Queue	■ Never	☐ Always	☐ Sometimes	☐ Configurable

FILL OUT THE FOLLOWING ITEM FOR MASTER DEVICES ONLY:

Expects Binary Input Change Events:

■   Either time-tagged or non-time-tagged for a single event
☐   Both time-tagged and non-time-tagged for a single event
☐   Configurable (attach explanation)

FILL OUT THE FOLLOWING ITEMS FOR SLAVE DEVICES ONLY:

Reports Binary Input Change Events when no specific variation requested:	Reports time-tagged Binary Input Change Events when no specific variation requested:
☐ Never ☐ Only time-tagged ☐ Only non-time-tagged ☐ Configurable to send both, one or the other (attach explanation)	☐ Never ☐ Binary Input Change With Time ☐ Binary Input Change With Relative Time ☐ Configurable (attach explanation)
Sends Unsolicited Responses:	Sends Static Data in Unsolicited Responses:
☐ Never ☐ Configurable by class ☐ Only certain objects ☐ Sometimes (attach explanation) ■ ENABLE/DISABLE UNSOLICITED	☐ Never ☐ When Device Restarts ☐ When Status Flags Change No other options are permitted.
Default Counter Object/Variation:	Counters Roll Over at:
☐ No Counters Reported ☐ Configurable (attach explanation) ☐ Default Object 20 Default Variation 05	☐ No Counters Reported ☐ Configurable (attach explanation) ☐ 16 Bits ☐ 32 Bits

☐	Point-by-point list attached	☐	16 Bits for 16-bit counters
			32 Bits for 32-bit counters
		☐	Point-by-point list attached

| Sends Multi-Fragment Responses: ■ Yes ☐ No |

DNP V3.00
DEVICE PROFILE DOCUMENT

IMPLEMENTATION OBJECT
This table describes the objects, function codes and qualifiers used in the device:

OBJECT			REQUEST (slave must parse)		RESPONSE (master must parse)	
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)
1	0	Binary Input - All Variations	1	06		
1	1	Binary Input			129, 130	00, 01
1	2	Binary Input with Status			129, 130	00, 01
2	0	Binary Input Change - All Variations	1	06,07,08		
2	1	Binary Input Change without Time	1	06,07,08	129, 130	17, 28
2	2	Binary Input Change with Time	1	06,07,08	129, 130	17, 28
2	3	Binary Input Change with Relative Time	1	06,07,08	129, 130	17, 28
10	0	Binary Output - All Variations	1	06		
10	1	Binary Output				
10	2	Binary Output Status			129, 130	00, 01
12	0	Control Block - All Variations				
12	1	Control Relay Output Block	3, 4, 5, 6	17, 28	129	echo of request
12	2	Pattern Control Block				
12	3	Pattern Mask				
20	0	Binary Counter - All Variations	1, 7, 8, 9, 10	06		
20	1	32-Bit Binary Counter			129, 130	00, 01
20	2	16-Bit Binary Counter			129, 130	00, 01
20	3	32-Bit Delta Counter				
20	4	16-Bit Delta Counter				
20	5	32-Bit Binary Counter without Flag			129, 130	00, 01
20	6	16-Bit Binary Counter without Flag			129, 130	00, 01
20	7	32-Bit Delta Counter without Flag				

DNP V3.00
DEVICE PROFILE DOCUMENT

IMPLEMENTATION OBJECT
This table describes the objects, function codes and qualifiers used in the device:

OBJECT			REQUEST (slave must parse)		RESPONSE (master must parse)	
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)
20	8	16-Bit Delta Counter without Flag				
21	0	Frozen Counter - All Variations	1	06		
21	1	32-Bit Frozen Counter			129, 130	00, 01
21	2	16-Bit Frozen Counter			129, 130	00, 01
21	3	32-Bit Frozen Delta Counter				
21	4	16-Bit Frozen Delta Counter				
21	5	32-Bit Frozen Counter with Time of Freeze				
21	6	16-Bit Frozen Counter with Time of Freeze				
21	7	32-Bit Frozen Delta Counter with Time of Freeze				
21	8	16-Bit Frozen Delta Counter with Time of Freeze				
21	9	32-Bit Frozen Counter without Flag			129, 130	00, 01
21	10	16-Bit Frozen Counter without Flag			129, 130	00, 01
21	11	32-Bit Frozen Delta Counter without Flag				
21	12	16-Bit Frozen Delta Counter without Flag				
22	0	Counter Change Event - All Variations	1	06,07,08		
22	1	32-Bit Counter Change Event without Time			129, 130	17, 28
22	2	16-Bit Counter Change Event without Time			129, 130	17, 28
22	3	32-Bit Delta Counter Change Event without Time				
22	4	16-Bit Delta Counter Change Event without Time				
22	5	32-Bit Counter Change Event with Time				
22	6	16-Bit Counter Change Event with Time				
22	7	32-Bit Delta Counter Change Event with Time				
22	8	16-Bit Delta Counter Change Event with Time				

DNP V3.00
DEVICE PROFILE DOCUMENT

IMPLEMENTATION OBJECT
This table describes the objects, function codes and qualifiers used in the device:

Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)
		OBJECT	**REQUEST** (slave must parse)		**RESPONSE** (master must parse)	
23	0	Frozen Counter Event - All Variations				
23	1	32-Bit Frozen Counter Event without Time				
23	2	16-Bit Frozen Counter Event without Time				
23	3	32-Bit Frozen Delta Counter Event without Time				
23	4	16-Bit Frozen Delta Counter Event without Time				
23	5	32-Bit Frozen Counter Event with Time				
23	6	16-Bit Frozen Counter Event with Time				
23	7	32-Bit Frozen Delta Counter Event with Time				
23	8	16-Bit Frozen Delta Counter Event with Time				
30	0	Analog Input - All Variations	1	06		
30	1	32-Bit Analog Input			129, 130	00, 01
30	2	16-Bit Analog Input			129, 130	00, 01
30	3	32-Bit Analog Input without Flag			129, 130	00, 01
30	4	16-Bit Analog Input without Flag			129, 130	00, 01
30	5	Short Floating Point Analog Input			129, 130	00, 01
31	0	Frozen Analog Input - All Variations				
31	1	32-Bit Frozen Analog Input				
31	2	16-Bit Frozen Analog Input				
31	3	32-Bit Frozen Analog Input with Time of Freeze				
31	4	16-Bit Frozen Analog Input with Time of Freeze				
31	5	32-Bit Frozen Analog Input without Flag				
31	6	16-Bit Frozen Analog Input without Flag				
32	0	Analog Change Event - All Variations	1	06,07,08		
32	1	32-Bit Analog Change Event without Time			129,130	17,28
32	2	16-Bit Analog Change Event without Time			129,130	17,28

DNP V3.00
DEVICE PROFILE DOCUMENT

IMPLEMENTATION OBJECT
This table describes the objects, function codes and qualifiers used in the device:

OBJECT			REQUEST (slave must parse)		RESPONSE (master must parse)	
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)
32	3	32-Bit Analog Change Event with Time			129,130	17,28
32	4	16-Bit Analog Change Event with Time			129,130	17,28
32	5	Short Floating Point Analog Change Event without Time			129,130	17,28
33	0	Frozen Analog Event - All Variations				
33	1	32-Bit Frozen Analog Event without Time				
33	2	16-Bit Frozen Analog Event without Time				
33	3	32-Bit Frozen Analog Event with Time				
33	4	16-Bit Frozen Analog Event with Time				
40	0	Analog Output Status - All Variations	1	06		
40	1	32-Bit Analog Output Status			129, 130	00, 01
40	2	16-Bit Analog Output Status			129, 130	00, 01
40	3	Short Floating Point Analog Output Status			129, 130	00, 01
41	0	Analog Output Block - All Variations				
41	1	32-Bit Analog Output Block	3, 4, 5, 6	17, 28	129	echo of request
41	2	16-Bit Analog Output Block	3, 4, 5, 6	17, 28	129	echo of request
41	3	Short Floating Point Analog Output Block	3, 4, 5, 6	17, 28	129	echo of request
50	0	Time and Date - All Variations				
50	1	Time and Date	2 (see 4.14)	07 where quantity = 1		
50	2	Time and Date with Interval				
51	0	Time and Date CTO - All Variations				
51	1	Time and Date CTO			129, 130	07, quantity=1

DNP V3.00
DEVICE PROFILE DOCUMENT

IMPLEMENTATION OBJECT
This table describes the objects, function codes and qualifiers used in the device:

Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)
		OBJECT	**REQUEST** (slave must parse)		**RESPONSE** (master must parse)	
51	2	Unsynchronized Time and Date CTO			129, 130	07, quantity=1
52	0	Time Delay - All Variations				
52	1	Time Delay Coarse			129	07, quantity=1
52	2	Time Delay Fine			129	07, quantity=1
60	0					
60	1	Class 0 Data	1	06		
60	2	Class 1 Data	1 20,21	06,07,08 06		
60	3	Class 2 Data	1 20,21	06,07,08 06		
60	4	Class 3 Data	1 20,21	06,07,08 06		
70	1	File Identifier				
80	1	Internal Indications	2	00 index=7		
81	1	Storage Object				
82	1	Device Profile				
83	1	Private Registration Object				
83	2	Private Registration Object Descriptor				
90	1	Application Identifier				
100	1	Short Floating Point				
100	2	Long Floating Point				
100	3	Extended Floating Point				
101	1	Small Packed Binary-Coded Decimal				
101	2	Medium Packed Binary-Coded Decimal				

DNP V3.00
DEVICE PROFILE DOCUMENT

IMPLEMENTATION OBJECT
This table describes the objects, function codes and qualifiers used in the device:

OBJECT			REQUEST (slave must parse)		RESPONSE (master must parse)	
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)
101	3	Large Packed Binary-Coded Decimal				
		No Object	13			
		No Object	14			
		No Object	23 (see 4.14)			

DNP V3.00
TIME SYNCHRONISATION PARAMETERS
This table describes the worst-case time parameters relating to time synchronisation, as required by DNP Level 2 Certification Procedure section 8.7

PARAMETER	VALUE
Time base drift	+/- 1 minute/month at 25°C +1 / -3 minutes/month 0 to 50°C
Time base drift over a 10-minute interval	+/- 14 milliseconds at 25°C +14 / -42 milliseconds 0 to 50°C
Maximum delay measurement error	+/- 100 milliseconds
Maximum internal time reference error when set from the protocol	+/- 100 milliseconds
Maximum response time	100 milliseconds

8   DNP Device Profile Document - Slave

DNP v3.00
DEVICE PROFILE DOCUMENT

Vendor Name: Control Microsystems Inc.

Device Name: SCADAPack controllers

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

Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels
Supported (the complete list is described in the attached table):

Function code 14 (warm restart)
Function code 20 (Enable Unsolicited Messages) for class 1, 2, 3 objects only.
Function code 21 (Disable Unsolicited Messages) for class 1, 2, 3 objects only.
Object 41, variation 1 (32-bit analog output block)

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

Maximum Data Link Re-tries:	Maximum Application Layer Re-tries:
☐ None ☐ Fixed at ■ Configurable, range 0 to 255	☐ None ■ Configurable, range 0 to 255

Requires Data Link Layer Confirmation:

☐ Never
☐ Always
☐ Sometimes   If 'Sometimes', when?

■ Configurable for Always or Never

Requires Application Layer Confirmation:

☐ Never
☐ Always (not recommended)
☐ When reporting Event Data (Slave devices only)
☐ When sending multi-fragment responses (Slave devices only)

☐ Sometimes   If 'Sometimes', when?
_____

■ Configurable for always or only when Reporting Event Data and Unsolicited Messages

Timeouts while waiting for:

Data Link Confirm Configurable	☐ None	☐ Fixed at _____	☐ Variable	■
Complete Appl. Fragment	☐ None	☐ Fixed at _____	☐ Variable	■ Configurable
Application Confirm	☐ None	☐ Fixed at _____	☐ Variable	■ Configurable
Complete Appl. Response	☐ None	☐ Fixed at _____	☐ Variable	■ Configurable

Others _____

Sends/Executes Control Operations:

WRITE Binary Outputs	☐ Never	☐ Always	☐ Sometimes	■ Configurable
SELECT/OPERATE	☐ Never	☐ Always	☐ Sometimes	■ Configurable
DIRECT OPERATE	☐ Never	☐ Always	☐ Sometimes	■ Configurable
DIRECT OPERATE - NO ACK	☐ Never	☐ Always	☐ Sometimes	■ Configurable

Count > 1	☐ Never	☐ Always	☐ Sometimes	■ Configurable
Pulse On	☐ Never	☐ Always	☐ Sometimes	■ Configurable
Pulse Off	☐ Never	☐ Always	☐ Sometimes	■ Configurable
Latch On	☐ Never	☐ Always	☐ Sometimes	■ Configurable
Latch Off	☐ Never	☐ Always	☐ Sometimes	■ Configurable
Queue	■ Never	☐ Always	☐ Sometimes	☐ Configurable
Clear Queue	■ Never	☐ Always	☐ Sometimes	☐ Configurable

FILL OUT THE FOLLOWING ITEM FOR MASTER DEVICES ONLY:

Expects Binary Input Change Events:

☐   Either time-tagged or non-time-tagged for a single event
☐   Both time-tagged and non-time-tagged for a single event
☐   Configurable (attach explanation)

FILL OUT THE FOLLOWING ITEMS FOR SLAVE DEVICES ONLY:

Reports Binary Input Change Events when no specific variation requested:	Reports time-tagged Binary Input Change Events when no specific variation requested:
☐ Never ☐ Only time-tagged ■ Only non-time-tagged ☐ Configurable to send both, one or the other (attach explanation)	■ Never ☐ Binary Input Change With Time ☐ Binary Input Change With Relative Time ☐ Configurable (attach explanation)
Sends Unsolicited Responses: ☐ Never ■ Configurable by class ☐ Only certain objects ☐ Sometimes (attach explanation) ■ ENABLE/DISABLE UNSOLICITED	Sends Static Data in Unsolicited Responses: ■ Never ☐ When Device Restarts ☐ When Status Flags Change No other options are permitted.
Default Counter Object/Variation: ☐ No Counters Reported ☐ Configurable (attach explanation) ■ Default Object 20	Counters Roll Over at: ☐ No Counters Reported ☐ Configurable (attach explanation) ☐ 16 Bits

	Default Variation 05	☐	32 Bits
☐	Point-by-point list attached	■	16 Bits for 16-bit counters
			32 Bits for 32-bit counters
		☐	Point-by-point list attached

Sends Multi-Fragment Responses: ■ Yes ☐ No

DNP V3.00
DEVICE PROFILE DOCUMENT

IMPLEMENTATION OBJECT
This table describes the objects, function codes and qualifiers used in the device:

OBJECT			REQUEST (slave must parse)		RESPONSE (master must parse)	
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)
1	0	Binary Input - All Variations	1	06		
1	1	Binary Input			129, 130	00, 01
1	2	Binary Input with Status			129, 130	00, 01
2	0	Binary Input Change - All Variations	1	06,07,08		
2	1	Binary Input Change without Time	1	06,07,08	129, 130	17, 28
2	2	Binary Input Change with Time	1	06,07,08	129, 130	17, 28
2	3	Binary Input Change with Relative Time	1	06,07,08	129, 130	17, 28
10	0	Binary Output - All Variations	1	06		
10	1	Binary Output				
10	2	Binary Output Status			129, 130	00, 01
12	0	Control Block - All Variations				
12	1	Control Relay Output Block	3, 4, 5, 6	17, 28	129	echo of request
12	2	Pattern Control Block				
12	3	Pattern Mask				
20	0	Binary Counter - All Variations	1, 7, 8, 9, 10	06		
20	1	32-Bit Binary Counter			129, 130	00, 01
20	2	16-Bit Binary Counter			129, 130	00, 01
20	3	32-Bit Delta Counter				
20	4	16-Bit Delta Counter				
20	5	32-Bit Binary Counter without Flag			129, 130	00, 01
20	6	16-Bit Binary Counter without Flag			129, 130	00, 01
20	7	32-Bit Delta Counter without Flag				

DNP V3.00
DEVICE PROFILE DOCUMENT

IMPLEMENTATION OBJECT
This table describes the objects, function codes and qualifiers used in the device:

OBJECT			REQUEST (slave must parse)		RESPONSE (master must parse)	
Obj	**Var**	**Description**	**Func Codes (dec)**	**Qual Codes (hex)**	**Func Codes**	**Qual Codes (hex)**
20	8	16-Bit Delta Counter without Flag				
21	0	Frozen Counter - All Variations	1	06		
21	1	32-Bit Frozen Counter			129, 130	00, 01
21	2	16-Bit Frozen Counter			129, 130	00, 01
21	3	32-Bit Frozen Delta Counter				
21	4	16-Bit Frozen Delta Counter				
21	5	32-Bit Frozen Counter with Time of Freeze				
21	6	16-Bit Frozen Counter with Time of Freeze				
21	7	32-Bit Frozen Delta Counter with Time of Freeze				
21	8	16-Bit Frozen Delta Counter with Time of Freeze				
21	9	32-Bit Frozen Counter without Flag			129, 130	00, 01
21	10	16-Bit Frozen Counter without Flag			129, 130	00, 01
21	11	32-Bit Frozen Delta Counter without Flag				
21	12	16-Bit Frozen Delta Counter without Flag				
22	0	Counter Change Event - All Variations	1	06,07,08		
22	1	32-Bit Counter Change Event without Time			129, 130	17, 28
22	2	16-Bit Counter Change Event without Time			129, 130	17, 28
22	3	32-Bit Delta Counter Change Event without Time				
22	4	16-Bit Delta Counter Change Event without Time				
22	5	32-Bit Counter Change Event with Time				
22	6	16-Bit Counter Change Event with Time				
22	7	32-Bit Delta Counter Change Event with Time				
22	8	16-Bit Delta Counter Change Event with Time				

DNP V3.00

DEVICE PROFILE DOCUMENT

IMPLEMENTATION OBJECT
This table describes the objects, function codes and qualifiers used in the device:

OBJECT			REQUEST (slave must parse)		RESPONSE (master must parse)	
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)
23	0	Frozen Counter Event - All Variations				
23	1	32-Bit Frozen Counter Event without Time				
23	2	16-Bit Frozen Counter Event without Time				
23	3	32-Bit Frozen Delta Counter Event without Time				
23	4	16-Bit Frozen Delta Counter Event without Time				
23	5	32-Bit Frozen Counter Event with Time				
23	6	16-Bit Frozen Counter Event with Time				
23	7	32-Bit Frozen Delta Counter Event with Time				
23	8	16-Bit Frozen Delta Counter Event with Time				
30	0	Analog Input - All Variations	1	06		
30	1	32-Bit Analog Input			129, 130	00, 01
30	2	16-Bit Analog Input			129, 130	00, 01
30	3	32-Bit Analog Input without Flag			129, 130	00, 01
30	4	16-Bit Analog Input without Flag			129, 130	00, 01
30	5	Short Floating Point Analog Input			129, 130	00, 01
31	0	Frozen Analog Input - All Variations				
31	1	32-Bit Frozen Analog Input				
31	2	16-Bit Frozen Analog Input				
31	3	32-Bit Frozen Analog Input with Time of Freeze				
31	4	16-Bit Frozen Analog Input with Time of Freeze				
31	5	32-Bit Frozen Analog Input without Flag				
31	6	16-Bit Frozen Analog Input without Flag				
32	0	Analog Change Event - All Variations	1	06,07,08		
32	1	32-Bit Analog Change Event without Time			129,130	17,28
32	2	16-Bit Analog Change Event without Time			129,130	17,28

DNP V3.00
DEVICE PROFILE DOCUMENT

IMPLEMENTATION OBJECT
This table describes the objects, function codes and qualifiers used in the device:

OBJECT			REQUEST (slave must parse)		RESPONSE (master must parse)	
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)
32	3	32-Bit Analog Change Event with Time			129,130	17,28
32	4	16-Bit Analog Change Event with Time			129,130	17,28
32	5	Short Floating Point Analog Change Event without Time			129,130	17,28
33	0	Frozen Analog Event - All Variations				
33	1	32-Bit Frozen Analog Event without Time				
33	2	16-Bit Frozen Analog Event without Time				
33	3	32-Bit Frozen Analog Event with Time				
33	4	16-Bit Frozen Analog Event with Time				
40	0	Analog Output Status - All Variations	1	06		
40	1	32-Bit Analog Output Status			129, 130	00, 01
40	2	16-Bit Analog Output Status			129, 130	00, 01
40	3	Short Floating Point Analog Output Status			129, 130	00, 01
41	0	Analog Output Block - All Variations				
41	1	32-Bit Analog Output Block	3, 4, 5, 6	17, 28	129	echo of request
41	2	16-Bit Analog Output Block	3, 4, 5, 6	17, 28	129	echo of request
41	3	Short Floating Point Analog Output Block	3, 4, 5, 6	17, 28	129	echo of request
50	0	Time and Date - All Variations				
50	1	Time and Date	2 (see 4.14)	07 where quantity = 1		
50	2	Time and Date with Interval				
51	0	Time and Date CTO - All Variations				
51	1	Time and Date CTO			129, 130	07, quantity=1

DNP V3.00
DEVICE PROFILE DOCUMENT

IMPLEMENTATION OBJECT
This table describes the objects, function codes and qualifiers used in the device:

OBJECT			REQUEST (slave must parse)		RESPONSE (master must parse)	
Obj	**Var**	**Description**	**Func Codes (dec)**	**Qual Codes (hex)**	**Func Codes**	**Qual Codes (hex)**
51	2	Unsynchronized Time and Date CTO			129, 130	07, quantity=1
52	0	Time Delay - All Variations				
52	1	Time Delay Coarse			129	07, quantity=1
52	2	Time Delay Fine			129	07, quantity=1
60	0					
60	1	Class 0 Data	1	06		
60	2	Class 1 Data	1 20,21	06,07,08 06		
60	3	Class 2 Data	1 20,21	06,07,08 06		
60	4	Class 3 Data	1 20,21	06,07,08 06		
70	1	File Identifier				
80	1	Internal Indications	2	00 index=7		
81	1	Storage Object				
82	1	Device Profile				
83	1	Private Registration Object				
83	2	Private Registration Object Descriptor				
90	1	Application Identifier				
100	1	Short Floating Point				
100	2	Long Floating Point				
100	3	Extended Floating Point				
101	1	Small Packed Binary-Coded Decimal				
101	2	Medium Packed Binary-Coded Decimal				

DNP V3.00
DEVICE PROFILE DOCUMENT

IMPLEMENTATION OBJECT
This table describes the objects, function codes and qualifiers used in the device:

OBJECT			REQUEST (slave must parse)		RESPONSE (master must parse)	
Obj	Var	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes	Qual Codes (hex)
101	3	Large Packed Binary-Coded Decimal				
		No Object	13			
		No Object	14			
		No Object	23 (see 4.14)			

DNP V3.00
TIME SYNCHRONISATION PARAMETERS
This table describes the worst-case time parameters relating to time synchronization, as required by DNP Level 2 Certification Procedure section 8.7

PARAMETER	VALUE
Time base drift	+/- 1 minute/month at 25°C +1 / -3 minutes/month 0 to 50°C
Time base drift over a 10-minute interval	+/- 14 milliseconds at 25°C +14 / -42 milliseconds 0 to 50°C
Maximum delay measurement error	+/- 100 milliseconds
Maximum internal time reference error when set from the protocol	+/- 100 milliseconds
Maximum response time	100 milliseconds