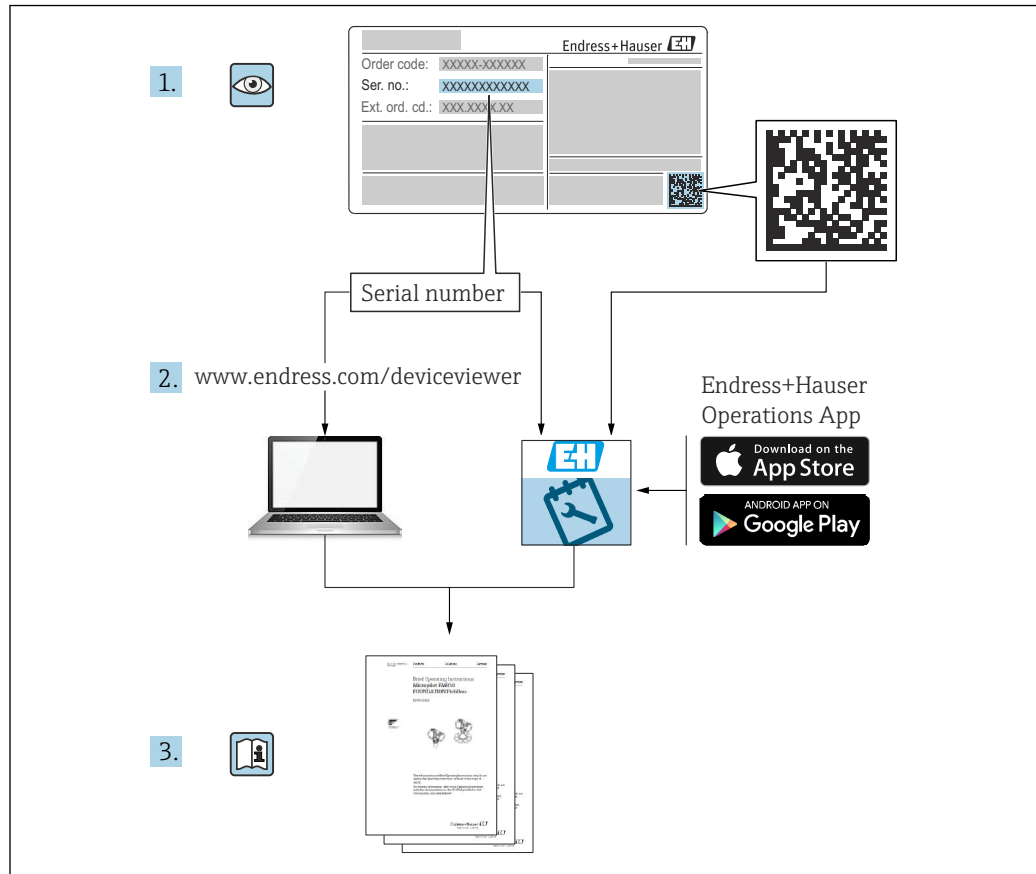


Operating Instructions

Tankvision Multi Scan NXA83B

Tank Gauging
DCC Communications Configuration





A0023555

- Make sure the document is stored in a safe place such that it is always available when working on or with the device
- Avoid danger to individuals or the facility: read the "Basic safety instructions" section carefully, as well as all other safety instructions in the document that are specific to working procedures

The manufacturer reserves the right to modify technical data without prior notice. The Endress+Hauser sales organization will supply you with current information and updates to these instructions.

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1 About this document

1.1 Document function

This manual is giving detailed information on the system capabilities and architecture. It supports project and sales engineers in designing the system architecture during acquisition and execution phase. Furthermore during operation time of the system all servicing personnel in need of detailed knowledge about the system capabilities.

1.2 Symbols

1.2.1 Safety symbols



This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.



This symbol alerts you to a potentially dangerous situation. Failure to avoid this situation can result in serious or fatal injury.



This symbol alerts you to a potentially dangerous situation. Failure to avoid this situation can result in minor or medium injury.



This symbol alerts you to a potentially harmful situation. Failure to avoid this situation can result in damage to the product or something in its vicinity.

1.2.2 Symbols for certain types of information



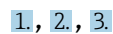
Tip
Indicates additional information



Reference to documentation



Notice or individual step to be observed



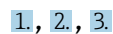
Series of steps



Result of a step

1.2.3 Symbols in graphics

1, 2, 3, ...
Item numbers



Series of steps

A, B, C, ...
Views

1.3 List of abbreviations

- BPM
Bi-Phase Mark
- DCC
Data Communications Controller
- DCS
Distributed Control System
- LPG
Liquefied Petroleum Gas
- RTDB
Real-Time Database
- VCF
Volume Correction Factor

1.4 Documentation

 For an overview of the scope of the associated Technical Documentation, refer to the following:

- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

The following document types are available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads), depending on the product configuration:

Document type	Purpose and content of the document
Technical Information (TI)	Planning aid This document contains all the technical data on the product and provides an overview of everything that can be ordered with the product.
Brief Operating Instructions (KA)	Quick guide to obtaining the first measured value The Operating Instructions contain all the essential information about the product from incoming acceptance to initial commissioning.
Operating Instructions (BA)	Reference The Operating Instructions contain the information that is required in the various phases of the life cycle of the product: From product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.
Description of Device Parameters (GP)	Reference for parameters The document contains detailed explanations of readable or configurable parameters in the product. The description is aimed at those who work with the product over its entire life cycle and perform specific configurations.
Safety Instructions (XA)	Safety Instructions for electrical equipment in hazardous areas are supplied with the product depending on the approval. These are an integral part of the Operating Instructions.  The nameplate indicates the Safety Instructions (XA) that are relevant to the product.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is an integral part of the product documentation.

1.5 Change history

BA01292G_01.14

- 3.0.10
- Initial version

BA01292G_02.15

- 3.0.12
- Change of order code structure

BA01292G_03.16

- 3.1.0 and 4.0.0
- Old V1 support and simplified configuration

BA01292G_04.17

- 3.3.0 and 4.3.0
- Extended Modbus Slave Configuration

BA01292G_05.18

- 3.4.0 and 4.4.0
- Changes to V1 Driver and GBT calculations

BA01292G_06.21

- 5.0.0
- Migration to Windows 10 IoT operating system

BA01292G_07.23

- 5.1.0
- Introduction of a new Webserver

BA01292G_08.26

- 5.1.0
- Minor changes to document structure

1.6 Registered trademarks

Microsoft®, Windows® and Edge®

Microsoft®, Windows®, Edge® and the Microsoft logo are registered trademarks of the Microsoft Corporation.

Modbus®

Registered trademark of SCHNEIDER AUTOMATION, INC.

Java®

Registered trademark of Sun Microsystems, Inc.

Mozilla® Firefox®

Registered trademark of the Mozilla Foundation

Enraf, Honeywell, Rosemount, Emerson, L&J, GPE, Varec, Ensite are registered trademarks and trademarks of these organizations and companies.

All other marks are property of their respective owners.

2 Basic safety requirements

2.1 Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:

- ▶ Trained, qualified specialists must have a relevant qualification for this specific function and task.
- ▶ Are authorized by the plant owner/operator.
- ▶ Are familiar with federal/national regulations.
- ▶ Before starting work, read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- ▶ Follow instructions and comply with basic conditions.

The operating personnel must fulfill the following requirements:

- ▶ Are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- ▶ Follow the instructions in this manual.

2.2 Intended use

2.2.1 Applications

Inventory control

By using Tankvision Multi Scan to monitor the tank level and stored volume of valuable liquids remotely, owners or operators of tank farms or terminals for petroleum products and chemicals (liquids) can visualize the volume of the stored medium in real time. The data can be used to plan the inventory and distribution. The data can also be used to manage tank farm operations like pumping or transferring products. Tankvision has its unique concept using network technology. Without using proprietary software, the users can visualize and manage their valuable liquids stored in the tanks by a web browser. Tankvision Multi Scan is a flexible and cost effective solution due to its scalable architecture. The application coverage goes from small depots with only a few tanks up to refineries.

Inventory Calculations

Tankvision Multi Scan calculates based on measured variables and tank capacity tables:

- Observed or gross volumes
- Net volumes
- Mass

of products like:

- Hydrocarbons
- Liquefied gases
- Asphalt

They are corrected according to international standards, including API/ASTM tables 5A, 5B/6, 53A, 53B/54, 23/24, LPG.

This includes temperature corrections at 15 °C (60 °F) and alternative temperatures. Additionally, available pump able volumes and water volume are calculated.

Remote configuration of measuring equipment

Some on-site operations can be avoided using remote configuration of measuring equipment during commissioning or maintenance (the availability of this feature may depend on the system configuration).

Application areas

- Tank farms in refineries
- Ship loading terminals
- Marketing and distribution terminals
- Pipeline terminals
- Logistic terminals for tanks storing products like crude oils, refined white and black products, chemicals, LPG

2.3 Workplace safety

For work on and with the device:

- ▶ Wear the required personal protective equipment according to federal/national regulations.

Before connecting or disconnecting the device:

- ▶ Switch off the supply voltage.

2.4 Operational safety

Risk of injury!

- ▶ Operate the device only if it is in proper technical condition, free from errors and faults.
- ▶ The operator is responsible for interference-free operation of the device.

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers!

- ▶ If modifications are nevertheless required, consult with the manufacturer.

Repair

To ensure continued operational safety and reliability:

- ▶ Carry out repairs on the device only if they are expressly permitted.
- ▶ Observe federal/national regulations pertaining to the repair of an electrical device.
- ▶ Use only original spare parts and accessories.

2.5 Product safety

This state-of-the-art device is designed and tested in accordance with good engineering practice to meet operational safety standards. It left the factory in a condition in which it is safe to operate.

The device fulfills general safety requirements and legal requirements. It also complies with the EU directives listed in the device-specific EU Declaration of Conformity.

Endress+Hauser confirms this fact by affixing the CE mark to the device.

2.6 IT security

The manufacturer warranty is valid only if the product is installed and used as described in the Operating Instructions. The product is equipped with security mechanisms to protect it against any inadvertent changes to the settings.

IT security measures, which provide additional protection for the product and associated data transfer, must be implemented by the operators themselves in line with their security standards.

3 Incoming acceptance and product identification

3.1 Incoming acceptance

On receipt of the delivery:

1. Check the packaging for damage.
 - ↳ Report all damage immediately to the manufacturer.
Do not install damaged components.
2. Check the scope of delivery using the delivery note.
3. Compare the data on the nameplate with the order specifications on the delivery note.
4. Check the technical documentation and all other necessary documents, e.g. certificates, to ensure they are complete.



If one of the conditions is not satisfied, contact the manufacturer.

3.2 Product identification

The following options are available for identification of the device:

- Nameplate specifications
- Order code with breakdown of the device features on the delivery note
- Enter the serial numbers from the nameplates in *Device Viewer*
(www.endress.com/deviceviewer): all the information about the device is displayed.

3.2.1 Nameplate

Do you have the correct device?

The nameplate provides you with the following information on the device:

- Manufacturer identification, device designation
- Order code
- Extended order code
- Serial number
- Tag name (TAG) (optional)
- Technical values such as supply voltage, current consumption, ambient temperature, communication-specific data (optional)
- Degree of protection
- Approvals with symbols
- Reference to Safety Instructions (XA) (optional)

- ▶ Compare the information on the nameplate with the order.

3.2.2 Manufacturer address

Endress+Hauser SE+Co. KG

Hauptstraße 1

79689 Maulburg, Germany

Place of manufacture: See nameplate.

3.3 Order code and product version



To find out the version of your product, enter the order code indicated on the nameplate in the search screen at the following address:

www.products.endress.com/order-ident

4 Data Communications Controller

The Data Communications Controller (DCC) sub-system consists of a number of services which are responsible for transmitting tank data to and from the Multi Scan NXA83B.

The 3 main services are:

- **DCC Host** - responsible for retrieving data from gauges and storing it in the database
- **DCC Slave** - responsible for sending tank data to other computer systems
- **OPC Server** - responsible for providing tank data to OPC clients

The first 2 are automatically started when the Multi Scan NXA83B is booted, whilst the OPC Server is started when an OPC client tries to connect to the tank gauging system.

There are a number of other services that are grouped within the DCC sub-system but are not concerned with data communications:

- **Hermes** – Responsible for synchronising data between an in-memory real time database (RTDB) and the main SQL Server database
- **RTDB Accessor** – This service is used by other services (such as the Events Server) to access the RTDB database directly
- **Events Server** – Responsible for distributing alarms/events to any Alarm Event Viewer displays running on this system or on client machines

The Hermes and RTDB Accessor services require no configuration.

After the DCC has been configured there is relatively little interaction between it and the users. However some maintenance operations may be required from time to time.

5 DCC Host Configuration

The DCC Host module is responsible for collecting data from the field, calculating Tank Inventory, originating alarms and events, and processing command requests from the client.

All tanks configured in the Gauge Configuration screens require at least one COM port to be defined. This is the primary port that DCC Host will poll for data for that tank. For gauges that require redundant operation then a backup COM port may also be configured.

Each COM port must be defined in the DCC Host sub-system, and may be a direct connection via an RS232 (or RS485 etc.) port on the Multi Scan NXA83B or be a remote connection using a modem. Network and OPC connections are also supported and are treated in a similar way to physical COM ports.

The DCC Host service is capable of polling on multiple COM ports simultaneously, but before it can do so they must be configured within the service.

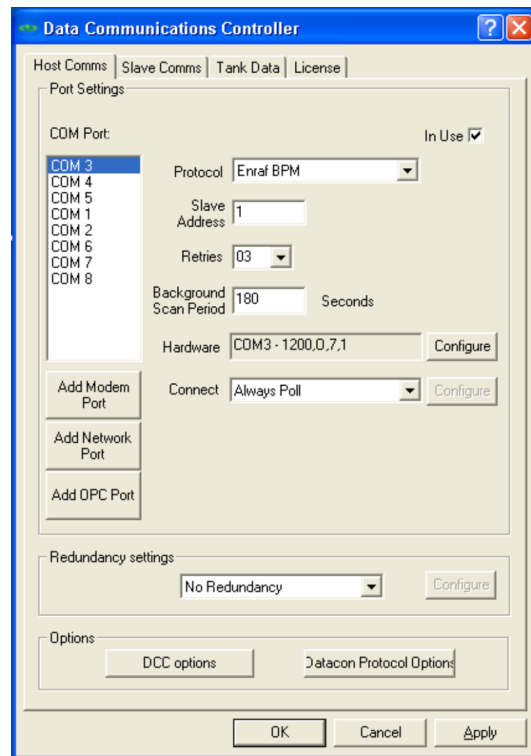
5.1 Configuring Host COM Ports

The DCC Host service requires the selection and configuration of the communication ports that are to be used. These may be RS232/485 serial ports, Enraf BPM, SAAB etc. or may be modems used to dial up remote devices.

Multiple ports and modems may be configured, up to the maximum licensed.

Ports must be configured using the Tankvision Multi Scan Configurator by selecting the **Communications** → **Port Configuration** menu item, and then clicking on the **Host Comms** tab.

A list of all physical COM ports (RS232/485/422 etc.) will be displayed together with any logical Modem, Network and OPC ports configured (they will have an offset of 40 for modems, 70 for network and 110 for OPC connections i.e. COM 41, 71 etc.). See the later sections on Modem Ports ("Configuring Host Modem Ports") and Network connections ("Configuring Host Network Ports") for details on how to add and configure these ports.



1. Select the COM port to be configured and make sure the **In Use** box is ticked.
 ↳ The protocol and communications parameters can now be edited.

Protocol

This field determines what is to be connected to the COM port. The current selection options are:

- Datacon
- Enraf CIU – also types Prime/Prime Modbus
- Enraf BBPM
- Whessoe (WM550/WM500/ASCII)
- Modbus (also LNG Modbus)
- Hart
- GPE
- L & J
- Hectronic
- OPC TG (Generic gauges from an OPC server)
- Varec Mark/Space
- TankMaster Serf
- FMS2000
- MCS4000 and MCS5000
- MTS DDA
- SAAB FCU (range of type supported)
- V1
- Veeder Root TLS
- Tokyo Keiso
- Tank Scanner NXA820

Slave Address

This only applies to Datacon devices. It will be enabled if a Datacon device is selected and should be set to the address of that device.

Retries

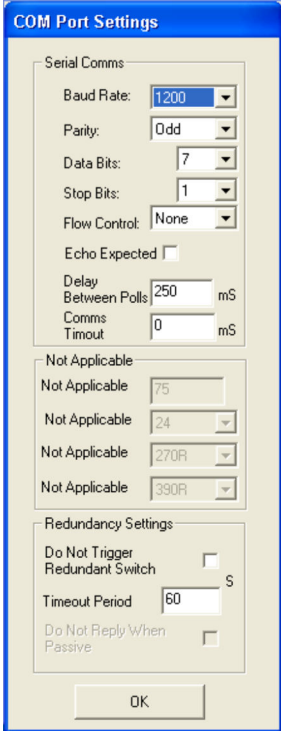
Determines the number of consecutive failed polls before a communications failed alarm is generated.

Background Scan Period

Determines the update times for certain gauge parameters, including:

- Density
- Observed Temperature
- Pressures
- Vapor Temperature
- Multi-Element Temperatures
- Water Level

The communication parameters will be displayed in the **Hardware** section. For a serial COM port the baud rate, data bits, parity and stop bits will be displayed. These should be set to the same settings of that of the Datacon, CIU or gauges being polled. They may be altered by clicking on the **Configure** button to the right and editing the parameters in the dialog screen.



The image shows a 'COM Port Settings' dialog box with the following fields and options:

- Serial Comms:**
 - Baud Rate: 1200 (dropdown)
 - Parity: Odd (dropdown)
 - Data Bits: 7 (dropdown)
 - Stop Bits: 1 (dropdown)
 - Flow Control: None (dropdown)
 - Echo Expected: ☐
 - Delay Between Polls: 250 mS
 - Comms Timeout: 0 mS
- Not Applicable:**
 - Not Applicable: 75
 - Not Applicable: 24 (dropdown)
 - Not Applicable: 270R (dropdown)
 - Not Applicable: 390R (dropdown)
- Redundancy Settings:**
 - Do Not Trigger Redundant Switch: ☐
 - Timeout Period: 60 S
 - Do Not Reply When Passive: ☐

An 'OK' button is located at the bottom of the dialog.

Echo Expected

If the serial communications hardware produces an echo of sent characters (i.e. some RS485 or 20 mA current loop devices) tick this field to tell the driver to handle the echoed characters.

Delay Between Polls

This field allows the minimum time for each poll to be set. For instance if this is set to 250 ms and it takes 100 ms to carry out a poll, (i.e. send a request and receive a reply), then DCC will pause for the remainder of the time (150 ms) before carrying out the next poll.

Comms Timeout

This field allows time to wait for a response to be defined. This should normally be left as 0, in which case the protocol driver software will automatically use the standard timeout period for that protocol.

Modem ports will display the telephone number in the **Hardware** section. The telephone number and modem may be configured via the **Configure** button. See the later section on Modem Ports for more details.

Network ports will display in the **Hardware** section the slave computer name (or IP address) and the port it will use to communicate. These may be configured via the **Configure** button.

The **Connect** section determines when to connect to the COM port or Modem and poll the gauges; usually this will be **Always Poll** for direct serial ports and **Scheduled** for modem ports. The **Always Poll** option will set the interface to always try to connect and continue polling for gauge data. See the later section on Scheduling Connections for more details.

2. Select the **Redundancy settings** as required; usually this will be left as **No Redundancy**. See section on Host Redundancy for more details.
 - ↳ A warning message may be displayed if a new interface is added by selecting the **In Use** box and this exceeds the number of licensed host interfaces.



3. When all host interfaces have been configured or modified, click on the **Apply** or **OK** buttons to save any changes.
 - ↳ There may be a momentary delay whilst the details are saved and the DCC Host service automatically re-configures itself with the new configuration.

5.2 Configuring Host Modem Ports

The DCC Host service can have interfaces configured to poll gauges on remote sites using dial-up Modems. These are added to the Host as software COM ports denoted by an offset of 40, thus the first modem COM port will be COM 41.

They are treated as if they were physical COM ports on the Multi Scan NXA83B but the difference being that multiple software COM ports may use the same physical modem device. The reason for this is that each software COM port is configured with a single telephone number and so if multiple remote sites need to be polled then a number of software COM ports can be configured to share the same local modem. Multiple modems are also supported, and necessary if a permanent connection to a modem port is required.

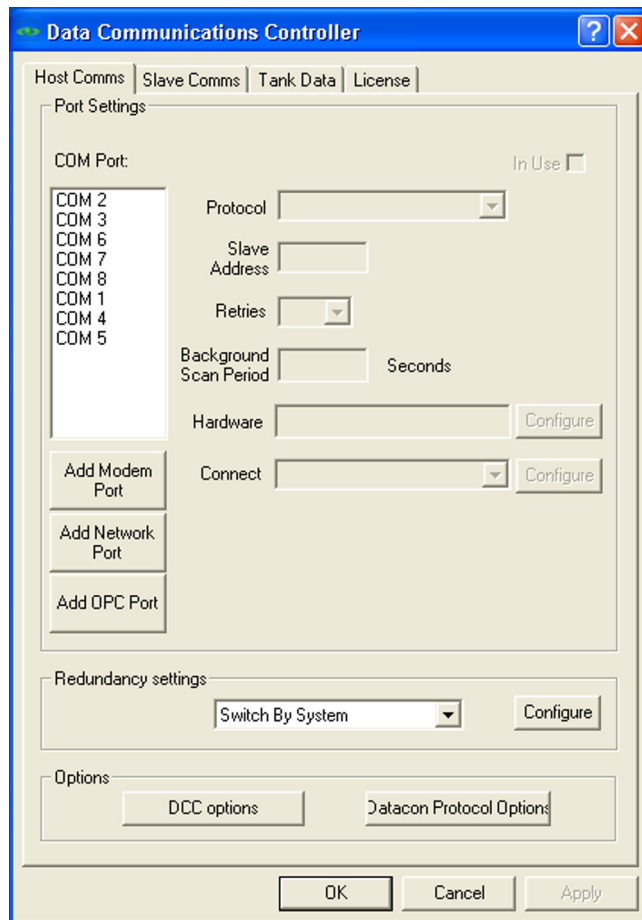
i Software COM ports are the only way of using modem communications in DCC Host.

Where an external modem is used, do NOT use the actual physical COM port it is connected to. Always add the modem to the operating system then add a new software COM port to DCC Host.

Software COM ports are treated the same as real COM ports with regards to licensing.

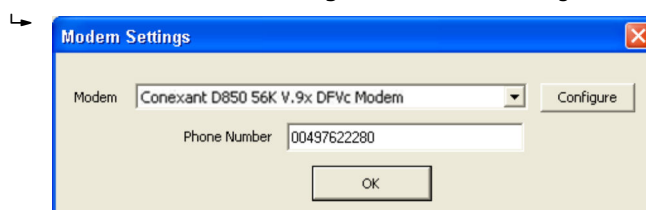
1. To configure the Modem ports, run the Port Configuration tool as above, and click on the **Host Comms** tab.
 - ↳ Any existing Modem ports will appear in the COM port list as COM 41, 42 etc.

2. To add a new software COM port, click on the **Add Modem Port** button.
 ↳ A new COM port will be added, starting at COM 41.



The **Protocol** type, **Slave Address**, **Retries**, **Background Scan Period** and **Redundancy settings** fields all function in the same way as for a normal COM port and have been described in the previous section.

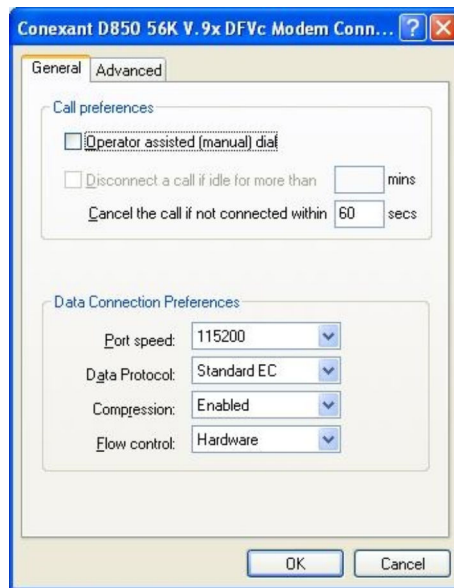
3. The **Hardware** section requires configuring with the modem device on the Multi Scan NXA83B and the telephone number of the remote site or system.
 To do this click on the **Configure** button to the right of the **Hardware** field.



4. Select the **Modem** from the drop-down list of all modems configured on the Multi Scan NXA83B. This will be an external modem and may be connected to a physical COM or USB port. To appear in the list modems should be added to the operating system via the **Phone and Modem** options item in the Control Panel.
5. Enter the **Phone Number** of the remote site or device. This should include the area code and any external line code if using a local switchboard (a direct outside line is not required).

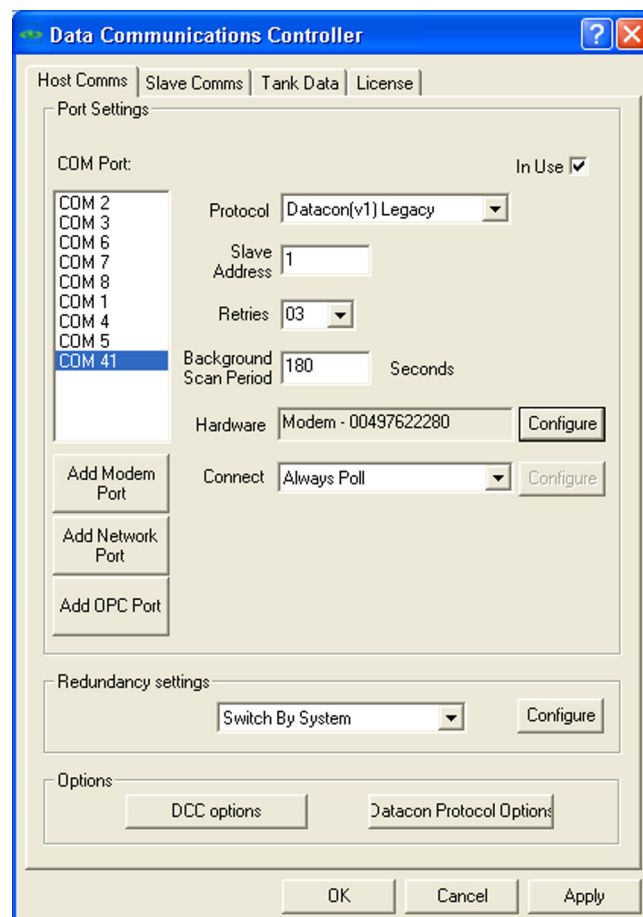
The modem settings can be configured via the standard control panel item **Phone and Modem** options and it is generally recommended that these settings should be used for all interfaces using that modem. However certain settings can be overridden for the individual interface by clicking on the **Configure** button, which will display the standard windows

screens for configuring modems. These may be modified and saved for this interface and are then used when it accesses the modem.



Refer to the windows help for details of the modem settings. Click **OK** to save any settings.

6. After the modem has been selected and the phone number entered, click **OK** to save the new details.
 - The phone number will now be displayed in the **Hardware** field.



The **Connect** field should normally be set to **Scheduled** for a modem interface, see the section on Connections for further details ("Configuring Connections").

5.3 Configuring Host Network Ports

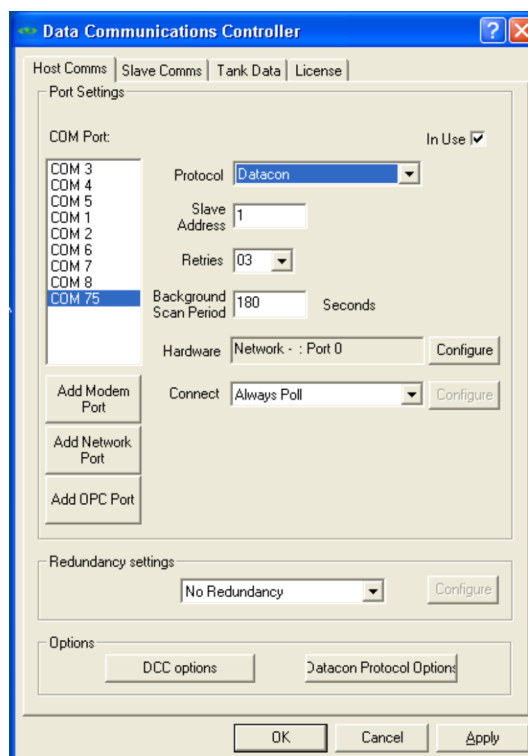
The DCC Host service can have interfaces configured to poll gauges via a standard network connection. These are added to the Host as software COM ports denoted by an offset of 70, thus the first network COM port will be COM 71.

They are treated as if they were physical COM ports on the Multi Scan NXA83B with the difference being that multiple software COM ports may use the same physical network adapter. There is no support for multiple network adapters on the Multi Scan NXA83B.

Software COM ports are treated the same as real COM ports with regards to licensing.

A network port makes no difference to the protocol selected to run on that port, except for the Modbus protocol. If Modbus is selected the Multi Scan NXA83B will automatically switch from Modbus RTG to Modbus TCP.

1. To configure the Network ports, run the DCC Configuration tool and click on the **Host Comms** tab.
 - ↳ Any existing Network ports will appear in the COM port list as COM 71, 72 etc.
2. To add a new software COM port, click on the **Add Network Port** button.
 - ↳ A new COM port will be added, starting at COM 71.



The **Protocol** type, **Slave Address**, **Retries**, **Background Scan Period** and **Redundancy settings** fields all function in the same way as for a normal COM port and have been described in a previous section.

3. The **Hardware** section requires configuring with the network name or IP address of the remote network device and the IP port that it will use to communicate. To do this click on the **Configure** button to the right of the **Hardware** field.

4. Enter the **Network Address** of the remote network device (i.e. PC) to connect to. This may be entered as the name of the device (i.e. PC name) or as its TCP/IP address, for example 192.168.1.250. If the name of the remote device is to be used, ensure that it is known to the system that DCC Host is running. This is usually the case if both systems use the same DNS server.

The **Port** field defines the IP port that the remote system is listening on.

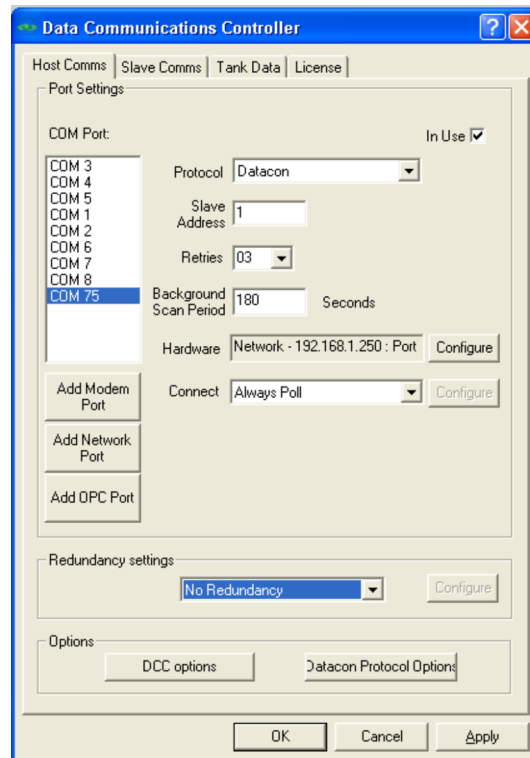
Communications via the network is usually extremely fast, in the order of a few milliseconds to poll for tank data. For various reasons this may be a problem (network traffic too high, excessive CPU time used on this process etc.) and can be slowed down by entering a **Delay Between Polls** time. It is not recommended that this figure is reduced below 100 ms.

The **Comms Timeout** field allows the time to wait for a response to be defined. This should normally be left as 0, in which case the protocol driver software will automatically use the standard timeout period for that protocol.

The **Modbus Settings** section only applies if the protocol has been selected as Modbus. Network ports will use the Modbus TCP protocol unless the **Do Not Use TCP Variant** box is ticked, in which case Modbus RTU will be used instead.

5. Click **OK** to save the network settings.
 ➔ The Network details will be displayed in the **Hardware** section.

The **Connect** field may be set as required, as the network port will support scheduled and permanent connections. See the section on Connections for further details ("Connection Status").



5.4 Configuring OPC Network Ports

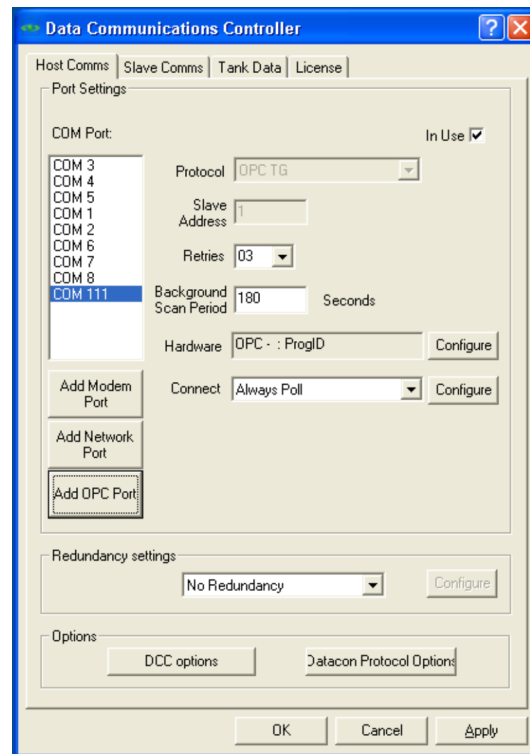
The DCC Host service can have interfaces configured to poll gauges from an OPC Data Access (DA) server via standard network connection. These are added to the Host as software COM ports denoted by an offset of 110, thus the first network COM port will be COM 111.

They are treated as if they were physical COM ports on the Multi Scan NXA83B but the difference being that multiple software COM ports may use the same physical network adapter.

Software COM ports are treated the same as real COM ports with regards to licensing.

1. To configure the OPC ports, run the DCC Configuration tool and click on the **Host Comms** tab.
 - ↳ Any existing OPC COM ports will appear in the COM port list as COM 111, 112 etc.

2. To add a new OPC COM port, click on the **Add OPC Port** button.
 - ↳ A new COM port will be added, starting at COM 111.



The **Protocol** type will always be set to **OPC TG**. The **Retries**, **Background Scan Period** and **Redundancy settings** fields all function in the same way as for a normal COM port and have been described in a previous section.



The **Hardware** section requires configuring for the OPC server settings. For more information on these settings and for full details on configuring an OPC TG interface, refer to the separate manual "OPC Tank Data Server" (BA01289G).

The **Connect** field may be set as required, as the OPC port will support scheduled and permanent connections. See the section on Connections for further details ("Connection Status").

5.5 Configuring Connections

Interfaces configured in DCC Host will normally be set to being **Always** connected to the gauges. This means that as soon as the interface is started it will connect to the serial COM port, dial out on a modem or connect to the remote network device, and then continue polling the gauges indefinitely. If it becomes disconnected from the gauges (i.e. a modem loses the line or the network device is disconnected) it will keep trying to re-connect and poll the gauges. This type of connection should be configured on interfaces using local COM ports to communicate to gauges.

Interfaces may be set to **Scheduled** connection, where the interface will connect and poll the gauges only at user defined times. Once connected it will poll the gauges for all primary and background data and then disconnect i.e. hang up the modem connection. This type of connection is usually configured where an interface uses a modem to dial up remote sites.

Normally interfaces all poll the gauges simultaneously. Interfaces may be grouped together and connect **Sequentially** to poll the gauges, this is useful for allowing 2 or more interfaces to share the same cable run.

Network ports may be configured as any type.

- To configure the connection type of an interface, run the DCC Configuration tool then click on the **Host Comms** tab and select the port to be configured.

The **Connect** field will normally default to **Always Poll** (or **Always Listen** in the **Slave Comms** tab).

To alter this, select from the options in the drop-down list for the field. These include:

- **Always Listen** – Mode for slave interfaces
- **Always Listen or Poll** – Not supported at the moment
- **Always Poll** – Interface will always try to be connected and polling the gauges
- **Manual** – Interface will only connect and poll gauges if manually commanded by user
- **Scheduled by Hour** – Interface will connect on the hours selected by the user
- **Scheduled by Interval** – Interface will connect periodically
- **Sequential Poll Group 1** – Interfaces on this group will poll sequentially. Only 1 interface will be connected at any time
- **Sequential Poll Group 2** – As above
- **Sequential Poll Group 3** – As above

If either of the **Scheduled** options has been selected, connection times must be configured. To do this click on the **Configure** button that will have been enabled to the right of the **Connect** field.

If the **Scheduled by Hour** option was selected, the hours on which the interface will connect may be defined in the dialog box below.

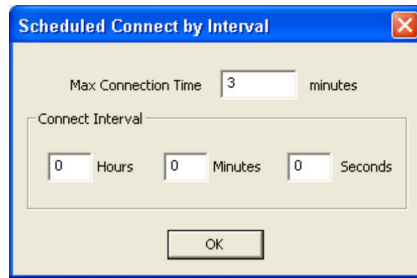
The dialog box is titled "Scheduled Connect by Hour". It features a "Max Connection Time" field set to "3" minutes. Below this is a section labeled "Connect at selected Hours" containing a 5x4 grid of checkboxes for each hour of the day (0:00 to 23:00). At the bottom of this section is a "minutes" field set to "0". An "OK" button is located at the bottom center of the dialog.

The **Max Connection Time** field defines the maximum time in minutes that the interface will remain connected and polling the gauges before it will disconnect. Normally the interface will disconnect automatically after it has retrieved all data from the gauges, so this field should be set longer than the time it takes to update all data. Its main use is as a limit to the time a modem will remain connected, if problems occur polling the gauges.

The **minutes** field in the **Connect at selected Hours** section defines the minutes past the hour that the connection will take place.

If there are problems with scheduled connections where some data is not being retrieved, it may be that the **Max Connection Time** is too short and should be set longer.

If the **Scheduled by Interval** option was selected, the interval between connections must be defined in the dialog box below.



The **Max Connection Time** is the same as for the hourly connection display.

5.6 Redundancy

The DCC Host service supports redundant communications to gauges using a number of different modes.

The mode can be selected in the **Redundancy Settings** field, which can be set to the following:

- **Switch By Gauge** – Gauges will switch individually between 2 ports on the same system
- **Switch By Interface** – Gauges will switch between 2 ports on the same system only if ALL gauges have failed on a port



The modes defined above apply only to ports running on the same system, and have no connection with other systems.

Switch By System – This mode is used to control 2 identical systems where gauges will be polled on only one live system. The other non-live system will retrieve its data from the live system. This mode is normally used for embedded systems and is more fully explained in a separate manual on redundancy.

If the **Redundancy setting** is configured as **No Redundancy** then a gauge will NOT switch between interfaces regardless of whether it has been configured with a backup port.

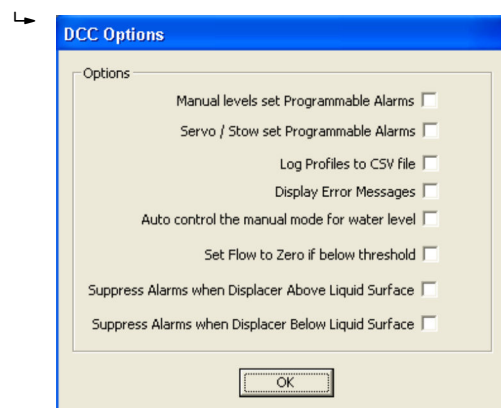


Please refer to the separate manual on Redundancy (BA01296G) for more details on the configuration and operation of redundant systems.

5.7 DCC Options

A set of options that alter the way DCC Host operates may be configured. These are global settings that apply to all interfaces in DCC Host.

- Click on the **DCC Options** button in the **Options** section.

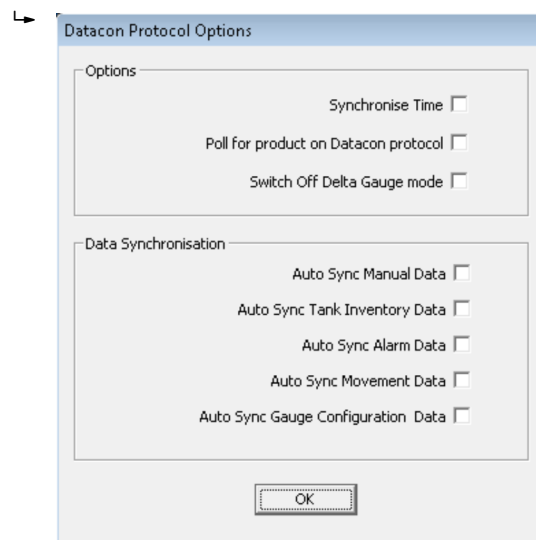


Current supported Options include:

- **Manual levels set Programmable Alarms** – by default a manual value will not trigger a programmable alarm, ticking this option will reverse this functionality
- **Servo / Stow set Programmable Alarms** – by default when a gauge is moving due to a stow/unstow or servo command, programmable level alarms will be suppressed. Ticking this option will reverse this functionality so that the current position of the sensing head will be used to trigger alarms.
- **Log Profiles to CSV file** – when this option is ticked, the results of profile scans (Density, Pressure, Temperature etc.) will be saved as CSV data files. The file is stored in **D:\Historical\Profiles** using a filename of the format:
`<Tankname>_<Gauge Number>_<Date>_<Time>.csv`
- **Display Error Messages** – this option causes a pop-up message box to be displayed with any error information if DCC Host crashes
- **Auto control the manual mode for water level** – ticking this option will set DCC to automatically set the water field into manual mode if the value from the field is invalid
- **Set Flow to Zero if below threshold** – by default all flow data will be saved regardless of what the value is. This may lead to a flow being displayed that is due to the "ripple" of the product. Ticking this option will set DCC to clamp all flow rates to 0 if the value is below the flow rate threshold value entered in the System Settings.
- **Suppress Alarms when Displacer Above Liquid Surface** – ticking this option will set DCC to ignore any level alarms returned from the gauge, but only when the displacer is above the product surface i.e. not following level. For instance when servoing or stowing etc.
- **Suppress Alarms when Displacer Below Liquid Surface** – ticking this option will set DCC to ignore any level alarms returned

There are also a number options that apply only if the Datacon protocol is used to get live data from a remote system, including Data Synchronisation.

- Click on the **Datacon Protocol Options** button in the **Options** section.



Current supported Options include:

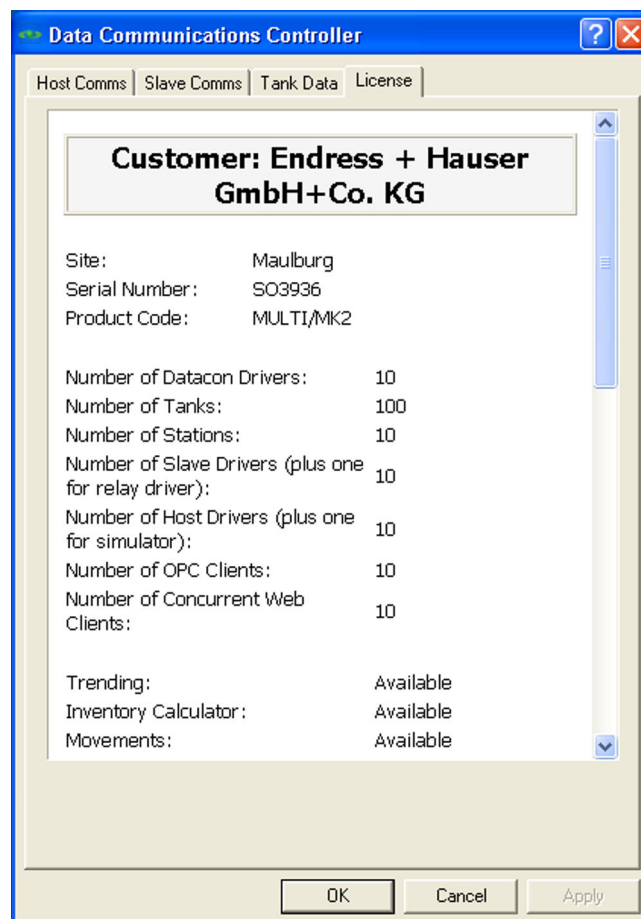
- **Synchronise Time** – The time will be automatically set in the remote system to the current time in this system. This will be carried out once per day, at midnight.
- **Poll for product on Datacon protocol** – The product selected for a tank will be retrieved from the remote system. Not currently supported by the Multi Scan NXA83B.
- **Switch Off Delta Gauge mode** – The Delta Gauge mode allows for gauges with data that has changed to be polled at an enhanced rate. Delta Gauge polls will be interleaved between the standard polling in a similar way to gauges on Fast Scan. By default the Delta Gauge mode is enabled, ticking this option will disable the mode. This option applies to the Slave interface.

Current supported Data Synchronisation options include:

- **Auto Sync Manual Data** – When selected, any changes made to manual data (e.g. setting fields to Manual/Auto or setting manual values) on the Host computer will also be set on the Multi Scan NXA83B.
- **Auto Sync Tank Inventory Data** – When selected, any changes made to tank inventory data (e.g. Changing Tank Capacity Tables) on the Host computer will also be set on the Multi Scan NXA83B.
- **Auto Sync Alarm Data** – When selected, any changes made to alarm data (e.g. Alarm setpoints or activating/deactivating alarms) on the Host computer will also be set on the Multi Scan NXA83B.
- **Auto Sync Movement Data** – When selected, any changes made to movement data (e.g. flow rate set-point) on the Host computer will also be set on the Multi Scan NXA83B.
- **Auto Sync Gauge Configuration Data** – When selected, any changes made to gauge configuration data (e.g. tank name or product) on the Host computer will also be set on the Multi Scan NXA83B.

5.8 Viewing the license details

The license details for the DCC services and indeed the whole tank gauging installation can be viewed by clicking on the **License** tab. There are no configurable items on this tab.



Licensing items that are used within the DCC communications sub-system include:

- **Number of Host Drivers** – This is the total number of host ports that can be configured. Please note that 1 host license is always used for the built in Simulator port. Therefore the number of host ports that can be configured via DCC Config is always 1 less than figure displayed here
- **Number of Slave Drivers** – This is the total number of slave ports that can be configured. Please note that 1 slave license is always used for an internal digital driver. Therefore the number of slave ports that can be configured via DCC Config is always 1 less than figure displayed here
- **Number of OPC Clients** – This is total number of OPC clients that may be connected at the same time

5.9 Modbus TG protocol configuration

Modbus TG gauges are assigned to Modbus TG interface ports and are used to poll for tank data from slave devices using the standard Modbus protocol. These slaves may be PLCs, Remote I/O units or gauges equipped with a Modbus interface.

Modbus TG gauges are often used as Auxiliary gauges, to bring in background data items for primary gauges and may require more configuration than other gauges due to their generic nature.

There are 2 steps to configuring a gauge:

- Step 1: Configuring gauges on the port with a basic Modbus map, using the standard Gauge Configuration screens
- Step 2: If required, configuring an advanced Modbus register map in an XML config file

5.9.1 Modbus TG Basic Map

Gauges must be configured to use the Modbus TG driver. This can be done in the normal way using the standard **Gauge Configuration** screens.

The screenshot shows the 'Device Configuration' window for a Modbus TG gauge. The window is divided into several sections:

- Left Panel:** Contains fields for 'Device Number' (dropdown), 'Device Type' (dropdown, set to 'Modbus TG'), 'Tank Id' (dropdown, set to 'TK400'), 'Comm Port' (text box, set to '1'), 'Device Address' (text box, set to '1', with a 'HEX' label), 'Level Address' (text box, set to '0', with a 'HEX' label), 'Data Type' (text box, set to 'S'), 'Modbus Function' (text box, set to '4'), 'Multi Gauges' (checkbox, unchecked), and 'Poll For Temp. Elements' (checkbox, unchecked).
- Background Scan:** A section with a title bar containing 'Temperature' (text box, set to '02') and eight 'Auxiliary' fields (Auxiliary 2 through Auxiliary 8, all empty).
- Change Dimensions:** A section with four dropdown menus: 'Level' (set to 'AUTO'), 'Temp.' (set to 'AUTO'), 'Density' (set to 'Observed'), and 'Pressure' (set to 'Absolute').
- Buttons:** On the right side, there are buttons for 'Edit', 'Copy', 'Add', 'Delete', 'Cancel', and 'Save'. At the bottom right, there is an 'Advanced' button.
- Bottom:** An 'Instrument Tag' text box and a set of navigation buttons: '<<', '<', '>', '>>', and 'Exit'.

A very basic Modbus map may be defined for the gauge using the following fields:

- **Device Type** – The gauge must be set to **Modbus TG**
- **Device Address** – The Modbus RTU address of the slave device
- **Level Address** – The Modbus address of the register that returns Product Level. This starts from 0 and should not include the Modbus function code offset. For example, a Modbus register full address of 40 001 should be entered as 0 (and Modbus Type should be set to 3)
- **NOTE** – Not used for Auxiliary duty gauges!
- **Data Type** – Set to **S**
- **Modbus Function** – The Modbus function code to be used for the Level register (and temperature if used) i.e. 3 or 4
- **Temperature** – An optional field that defines the Modbus address of the register that returns the temperature

This will set the Modbus TG to poll for the level data (for non-Auxiliary duty gauges only) using a standard set of decoding parameters:

- Input range 0 to 32 000 in millimeters
- Encoded as a 2 byte Short with Little Endian format
- A value outside the range 0 to 32 000 will be decoded as a bad value

If the **Temperature** field has been entered then the Modbus TG will poll for temperature data using a standard set of decoding parameters:

- Input range $\pm 3\,200\text{ }^{\circ}\text{C}$ sent times 10, i.e. $32\text{ }^{\circ}\text{C}$ encoded as 320
- Encoded as a 2 byte Short with Little Endian format
- A value of 8 000 Hex will be decoded as an illegal value

 If the above encoded format for level (and temperature if enabled) is supported by the slave device and no other data (e.g. density etc.) is required, no other configuration is needed for the ModbusTG driver.

 Level will never be polled for Auxiliary duty gauges.

5.9.2 Modbus TG Advanced Map

If the very basic Modbus map defined when the gauges are added to the system is not enough, it may be overridden with a much more advanced map, defined in a separate XML format file. This allows more flexible encoding of data to be defined and also permits a much greater range of data parameters to be polled for.

A configuration tool, **Modbus TG Configuration**, is available to allow the user to configure the XML file. This is accessed through the Configurator tools.

The advanced map consists of a set of Interfaces, each of which may have:

- A set of default parameter details which apply to ALL gauges on the interface
- A set of gauge parameter details which apply only to the selected gauge

All parameters are optional and need not be defined in the map, as they will default to a set of standard values (defined later in this document).

5.9.3 Modbus Configuration Tool

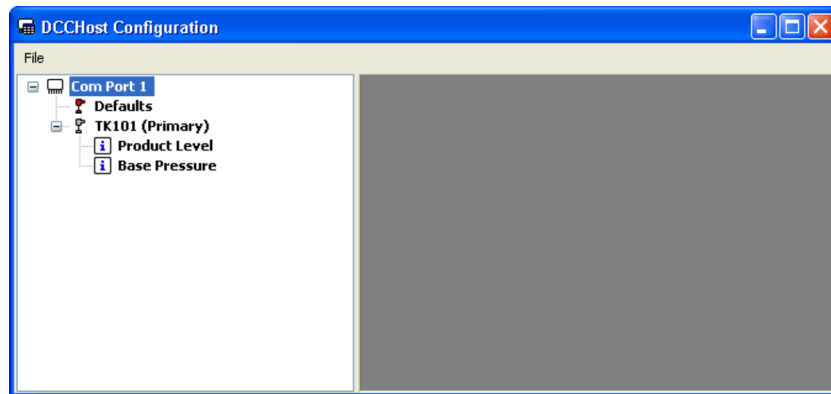
To configure the advanced Modbus map, select the menu option **Communication** → **Advanced Gauge Configuration**.

The DCC Host Configuration page allows advanced configuration of certain host drivers, including the Modbus TG driver.

A list of all COM ports having drivers that require advanced configuration will be shown in the left hand panel. This will include all Modbus TG interfaces that have at least one Modbus TG gauge assigned to them.

 If no Modbus TG interfaces appear in the list, ensure that all Modbus TG interfaces have been defined and at least one gauge of type **Modbus TG** has been assigned to each interface.

The list of COM ports can be expanded to display all gauges assigned to that port.



Each COM port will have a list of all tanks assigned (including the gauge duty, i.e. Primary, Secondary etc.) and also a section called **Defaults**.

The Modbus fields that are to be polled for each gauge will be displayed beneath the gauge they apply to. These fields include product level, temperature, pressure etc. and will only be polled by the Modbus TG interface if they are added to the configuration in this tool.



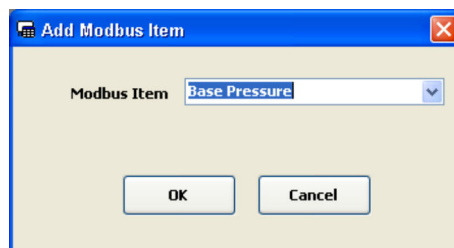
For non Auxiliary duty gauges, Product Level will always be polled for, even if not configured here – see section on Modbus TG Basic Map.

The **Defaults** section allows the user to configure Modbus field definitions that will be added to ALL gauges on this Modbus TG interface. If a field is added to the **Defaults** section it will be polled by a gauge even if the field has not been added to the individual gauge.

Each gauge can be configured with Modbus field definitions that apply only to that gauge. All field data entered for an individual gauge will override data entered in the **Defaults** section. Thus data common to all gauges may be entered in the **Defaults** section, then individually tailored for each gauge as required.

Adding a Modbus Field

1. To add a new Modbus field to a gauge or the **Defaults**, then right click on the field and select **Add** from the pop-up menu.
2. Then select the field from the **Add Modbus Item** dialog displayed.



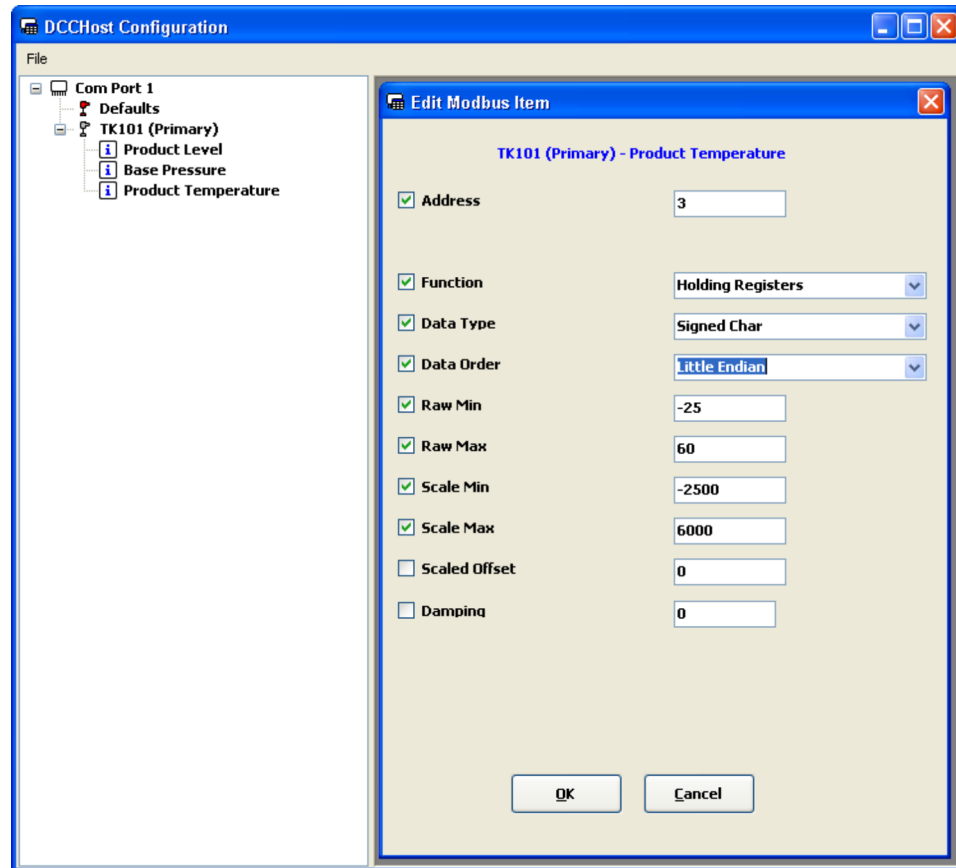
The new field will be displayed in the left hand panel.

Deleting a Modbus Field

- To delete a Modbus field, right click on the field and select **Delete** from the pop-up menu.

Editing a Modbus Field

1. To edit a Modbus field, right click on the field and select **Edit** from the pop-up menu.
 - This will display the current set of definitions for the field in a window in the right hand panel. Multiple Modbus fields may be edited at the same time (a separate window will open for each).



The parameters are optional and are only used if the left hand box is ticked. Any parameters not ticked will use the default values, defined later in this section.

The range of parameters displayed will depend on the data field selected.

Common to most Modbus fields are the following parameters:

- **Address** – The Modbus address of the register or coil, from 0
- **Function** – The Modbus function type i.e. **Holding Registers**, **Coil** etc.
- **Data Type** – The format of the data to be requested. May be one of the following:
 - **Signed Char** --> range -127 to 127 using 1 register
 - **Unsigned Char** --> range 0 to 255 using 1 register
 - **Short** --> range -32 767 to 32 767 using 1 register
 - **Unsigned Short** --> range 0 to 65 535 using 1 register
 - **Integer** --> range -2 147 483 647 to 2 147 483 647 using 2 registers
 - **Unsigned Integer** --> range 0 to 4 294 967 295 using 2 registers
 - **Float** --> using 2 registers
 - **Double** --> using 4 registers
- **Data Order** – The byte order of the data, may be one the following:
 - **Little Endian** --> Standard format for MS Windows based systems
 - **Big Endian**
 - **Little Logical**
 - **Big Logical** --> often used by DCS systems for Float data types
- **Raw Min** and **Raw Max** – The raw data range. Used in scaling data (see below). If the value is outside the raw limits then the value will be set to illegal, i.e. DN04

- **Scaled Min and Scaled Max** - The scaled data range. The Scaled value must be converted to the default units used within the Tank Gauging database (Level = mm, Density = Kg/l, Pressure = BarA, and Temperature = °C etc.). For status fields it is recommended that these should be set to the same as the raw limits. Data will be converted using the formula:

$$S_V = ((R_V - R_{Min}) \div (R_{Max} - R_{Min})) \times (S_{Max} - S_{Min}) + S_{Min}$$

Where:

S_V = Scaled Value, R_V = Raw Value, R_{Max} = Raw Max, R_{Min} = Raw Min, S_{Max} = Scaled Max and S_{Min} = Scaled Min

- **Scaled Offset** – An optional offset to be applied to the scaled value, in the database units for the data type (Level = mm, Temperature = °C, Density = Kg/l, Pressure = BarA)
- **Damping** – Not used for status values. A percentage value that is used to damp values that fluctuate rapidly. This field should be entered in the range 0 to 100, with 0 and 100 being treated the same as NO damping. Formula used is:

$$\text{Damped Value} = \text{Old Value} + ((\text{New Value} - \text{Old Value}) \times \text{damping} \div 100)$$

If the Modbus field is a Status (i.e. Base Pressure Status, Product level Status etc.) then the following parameters will also be available:

- **Status Type** – Only used for status fields. Defines the test used on the input value to determine if the field is valid i.e. Good. If the test is true for illegal or bad then the field is Invalid and will be set to DNO4.
May be one of the following:
 - None
 - One illegal value
 - Bits set good
 - Bits set bad
- **Status Test Value** – Only used for status fields. Defines the value used to test any special case for validity, depending on the value of statustype. If statustype is 3 or 4 then any of the bits in this value will be tested.

If the Modbus field is an Alarm (i.e. Level High High, Temp High etc.), the following parameters will also be available:

- **Alarm Type** – defines the test used on the input value to determine if the alarm is active.
May be one of the following:
 - None
 - Equals Value Sets Alarm
 - Bits set Alarm (i.e. Any of bits in Alarm Test Value will set the alarm)
 - Bits Cleared set Alarm
 - Greater Than Value Sets Alarm
 - Less Than Value Sets Alarm
- **Alarm Test Value** – the value used to test the alarm activation status of the incoming data
- **Hysteresis** – the value used to determine when alarm is cleared. Only used for types "Greater Than Value Sets Alarm" and "Less Than Value Sets Alarm"

Any Field parameters not defined for an individual gauge will use those defined in the Defaults section.

If the Field parameter has not been defined in the **Defaults** section, the following defaults will be used by the Modbus TG interface when polling for data:

- slaveaddress = **Device Number** entered in **Gauge Configuration** screen
- address = 0
- function = 4
- dataorder = Short
- rawmin = 0
- rawmax = 32 000
- scaledmin = 0
- scaledmax = 32 000

- `statustype` = One Illegal Value (status fields only)
- `statusvalue` = 8000 hex (status fields only)
- `damping` = 0 (i.e. not used) (value fields only)

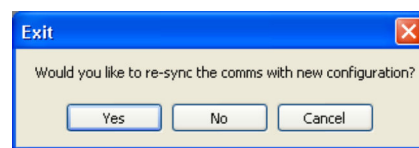
i For Product Level the default values will be those set in the **Gauge Configuration** screens. If **Product Temperature** has been defined in the **Gauge Configuration** screens then those defaults will be used.

i The Modbus PLC address for the field will be the **Device Address** field entered in the **Gauge Configuration** screen.

2. Click **OK** in the edit box to save the parameters for the Modbus field.

Saving the Modbus Map

1. To save the new Modbus configuration to the Modbus xml file, close the DCC Host Configuration tool.
 - ↳ If any changes have been made, the following will be displayed.



2. Click **Yes** to save the data and load the new Modbus map for any Modbus TG interfaces into the DCC Host service.

5.9.4 Field Definitions

The Defaults section and any Gauge mode can contain a set of Modbus fields which will be polled by the Modbus TG.

Each field node can contain one or more attributes which define what the field is and how the Modbus TG driver will decode the incoming data when polled.

The Modbus TG interface is specifically designed to poll for tank gauge data and thus data fields are polled in a defined way.

There are 3 basic types of fields in the Modbus TG driver, which operate in slightly different ways. The fields are:

- **Data Fields** – used to get the actual value of a data item, such as level, temperature etc.
- **Status Field** – optional, used to get the validity of an associated data item. A status field is denoted by name ending in 'Status'.
- **Alarm Field** – used to bring in an alarm. An alarm field requires the Alarm Test Value (setpoint) and Alarm Type to be configured.

Certain fields are polled at high priority, and will always be polled regardless of whether they have been added to the advanced Modbus map or not. These are:

- Product Level
- Product Level Status

i The above fields will NEVER be polled for an auxiliary duty gauge.

The following fields will be polled at high priority if they have been defined in the advanced Modbus map:

- Product Temperature
- Product Temperature Status
- Density High
- Density Low
- Level High
- Level High High
- Level Low
- Level Low Low

- Temp High
- Temp Low
- Gauge Status

Other fields are only polled on background scans, and only if they have been defined in the Modbus advanced map. The background scan period is defined per interface and defaults to 3 minutes. These fields include:

- Base Pressure
- Base Pressure Status
- Free Water Level
- Free Water Level Status
- Density
- Density Status
- Observed Temperature
- Observed Temperature Status
- Product Pressure
- Product Pressure Status
- Vapour Pressure
- Vapour Pressure Status
- Vapour Temperature
- Vapour Temperature Status
- Element Temperature 1 to 16
- Element Temperature 1 to 16 Status

From the above list it can be seen that most fields are in pairs, with a value field and a status field. Thus the Product Level field has a corresponding Product Level Status field etc.

The validity of a value field is determined by the following:

- If the incoming data is outside the raw scaling limits, the value will be set to illegal status i.e. DN04
- If a status field has been added (i.e. level status added as well as level value) then it determines the status of the value

A status field may be added to the map in addition to the value field. These are generally used in cases where the status of the data is set in a separate Modbus field (coil or register). However the status field may be set to the same Modbus address as the value.

For status fields there are an extra set of parameters that determine how to decode the status. They work in the following manner:

- If the status is outside the raw scaling limits then the value will be set to illegal status i.e. DN04
- If the status is within the raw limits then the Status Type parameter will be used to determine how to test for illegal status using the Status Test Value

Many Modbus maps implemented by slave devices do not have separate status registers (or bits) but instead set the value to some error figure (i.e. full scale etc.). In this case the status field should be set to the same Modbus address and parameters of the value field (i.e. same raw scaling parameters).

Alarm fields must have the **Alarm Type** and **Test Value** fields configured. They are used to test the incoming data to check whether the alarm is active or inactive. In this case if the data tests Good then the alarm is active, if it tests Bad then the alarm is inactive.

5.9.5 User Defined Alarms

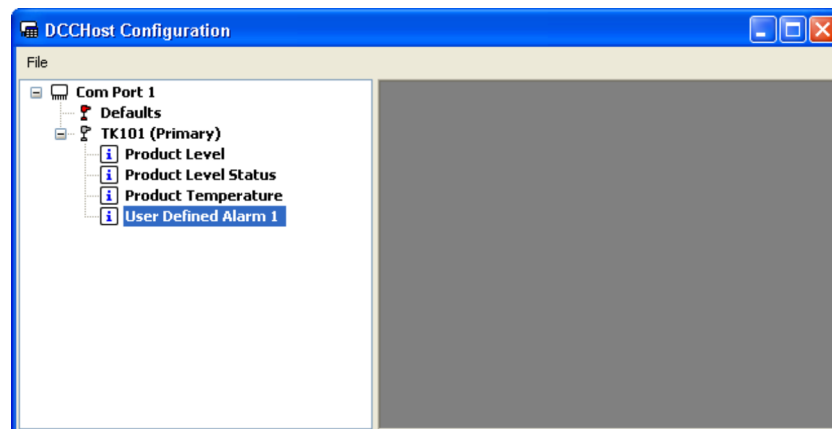
User Defined Alarms are a set of alarms generated by certain gauge type, the user may configure the text to be displayed when the alarm is activated and cleared using the **Event Server Config** tool (see the Configuration manual, BA01291G).

There are 8 such alarms per gauge:

- User Defined Alarm 1
- User Defined Alarm 2
- User Defined Alarm 3
- etc. ... up to
- User Defined Alarm 8

The alarms are available in the database for all gauge types; however whether they can be used depends on the physical gauge type. Currently only the Modbus TG, Modbus IO block, OPC TG and OPC IO block gauge type running on the direct interface support the use of User Defined Alarms.

To configure a Modbus TG gauge to poll for 1 of the 8 User Defined Alarms, select the menu option **Communication** → **Advanced Gauge Configuration** and add the point to the required gauge.



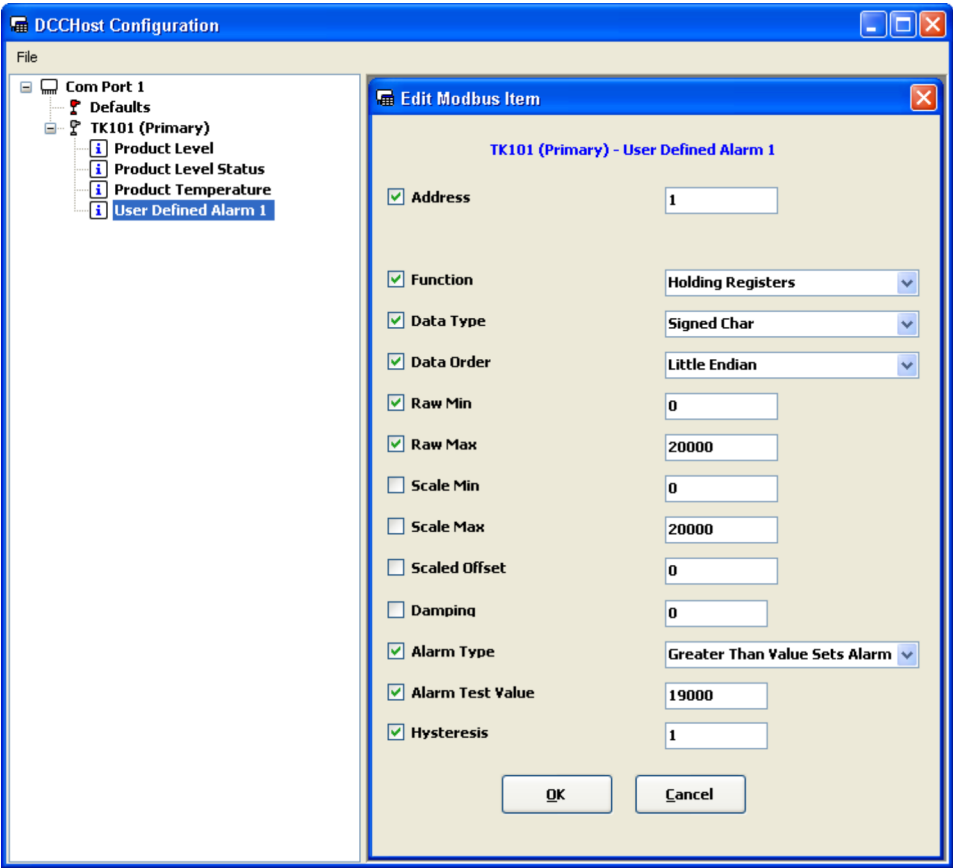
These may be configured to read individual coils.

In the configuration below, **User Defined Alarm 1** will be generated from an Input Status coil at address 1.

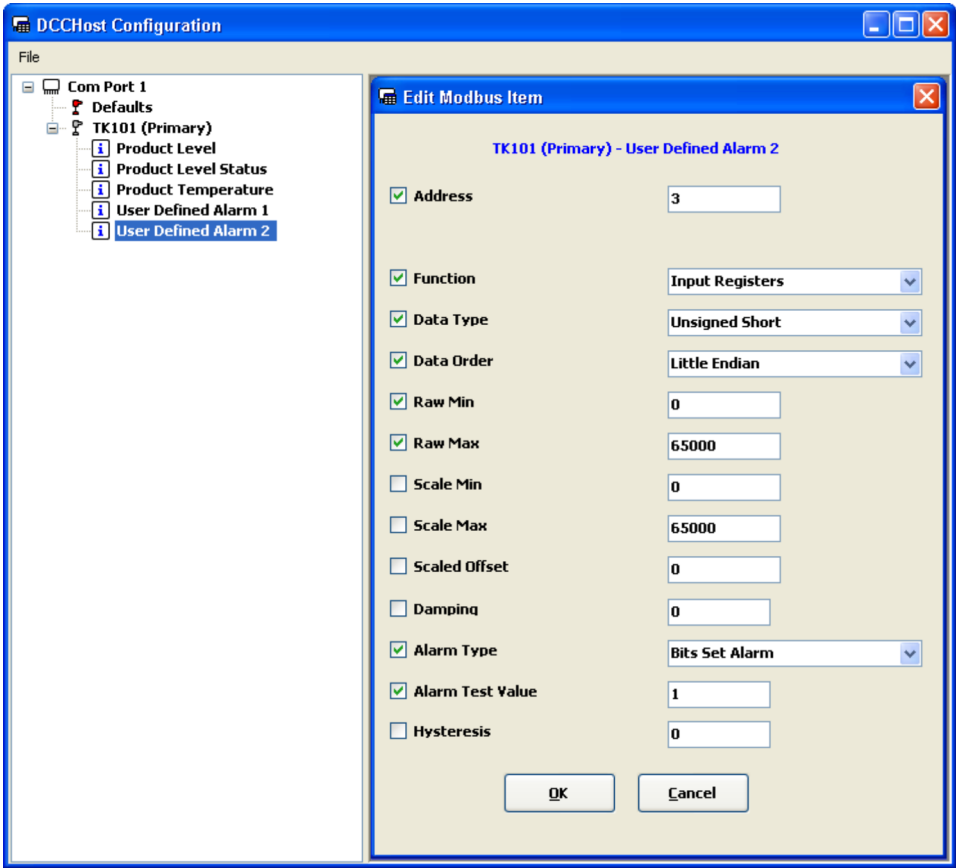
The **Alarm Type** field is used to set the activation of the alarm.

The **Alarm Test Value** will be used to test the incoming data to see whether the alarm is active.

Therefore in this case **Alarm Type** is set to **Greater Than Value Sets Alarm** and the test value is 19 000. So if a value of >19 000 is received, the alarm will be activated, any value of ≤19 000 will clear the alarm. The Address of 1 could be e.g. the Modbus address of the product level therefore this alarm may be a Product High Level Alarm.



User defined alarms may also be configured to read individual bits within a bit-mapped register. In that case the **Data Type** would be set to **Unsigned Short**, and the **Status Type** will define the bits to be tested.



In the above configuration **User Defined Alarm 2** will be generated from Bit 1 of an Input Register at address 3.

6 Communications Monitor

6.1 Introduction

The Multi Scan NXA83B has the ability to monitor the communications status of all COM ports used to communicate with gauges and other devices.

This monitoring is carried out using the utility called **Communications Monitor** which is shipped with all Multi Scan NXA83B, and may be run from a normal windows remote control session.

The monitor can be useful in diagnosing any communications issues and can also be used to view and log the raw communications bytes passed between the Multi Scan NXA83B and the gauges.

This feature can be used when there are communication issues that require advanced analysis, and may often be requested by Endress+Hauser when investigating a support issue. For the following chapters it is assumed the user has already started a remote control session with the Multi Scan NXA83B and has closed the Operator displays.



Refer to the Configuration manual BA01291G for details on how to do this.



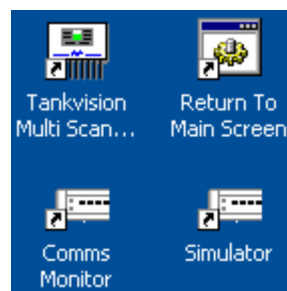
This utility only monitors field device ports (i.e. data coming into the Multi Scan NXA83B), it does not monitor ports used to communicate with DCS/Scada systems (i.e. data going out of the Multi Scan NXA83B).

6.2 Communications Monitor

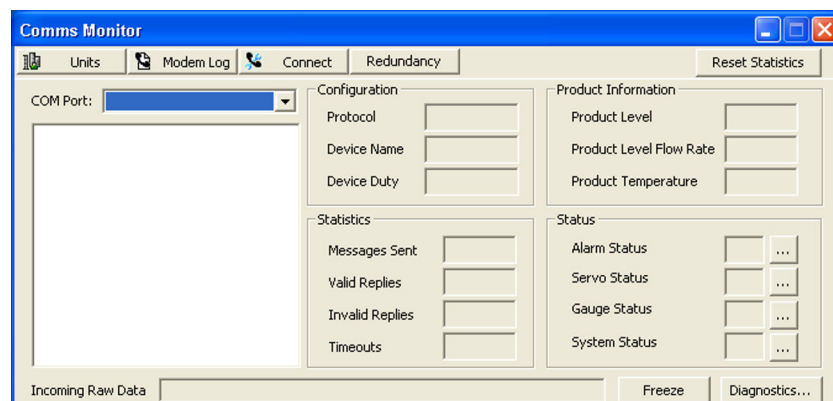
To view the Communications Monitor double click on the **Comms Monitor** icon on the Windows desktop.



This may alternatively be named **DCC Monitor** depending on the firmware/hardware version.



This will display the following window.

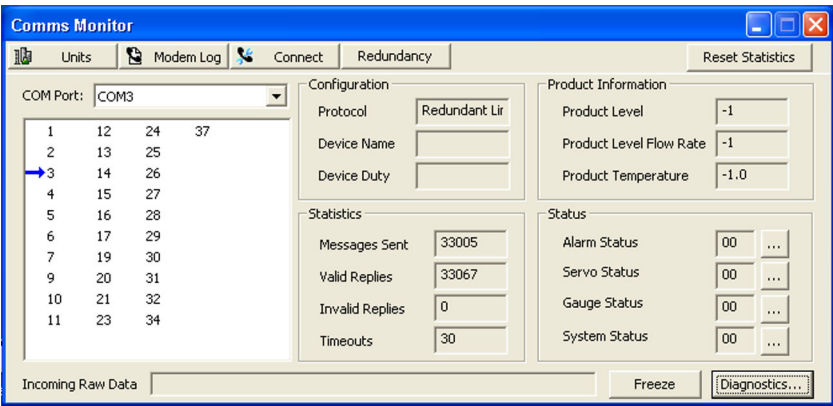


The Communications Monitor module allows the user to view the data communication that occurs between the Multi Scan NXA83B and any connected devices such as tank gauges.

6.2.1 Viewing port data

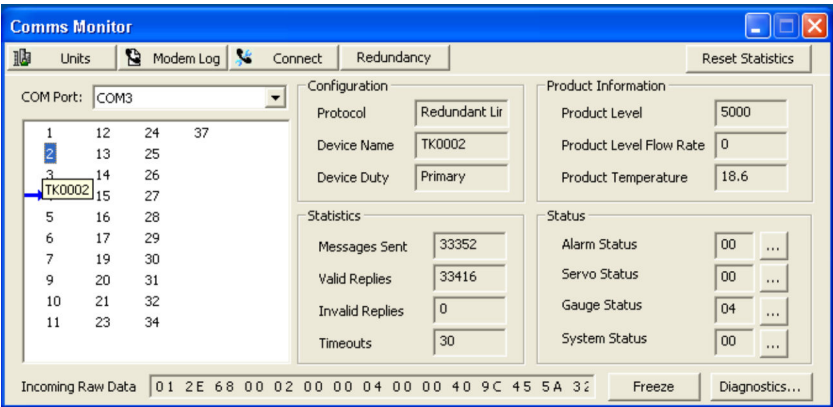
To view port communications, select the desired **COM Port** from the drop-down list, e.g. COM 1. A list of gauges being polled on the selected COM port will be displayed in the box below.

One item always available in the **COM Port** drop-down list is **SIMULATOR**, this is a software feature which simulates gauges within DCC Host and is treated exactly the same as a normal COM port.



A blue arrow scrolls through the device list to indicate the gauge currently being polled. A red arrow will be displayed against a device being polled on fast scan. A red arrow will also be displayed when a Delta Gauge poll occurs on a Datacon protocol interface. This occurs when moving tanks are polled in between the standard gauge requests.

The numbers in the list of gauges refers to the Tank Address of each gauge entered in the **Gauge Configuration** screens. To display the name of the gauge in the list, hover the mouse over the Tank Address of the gauge.



The screen shows data for both the COM port and for any selected individual gauge on the port.

The following sections apply to the COM port as a whole:

- The **Configuration** section shows:
 - **Protocol** – the protocol configured for this port
 - **Device Name** – the name of the device currently selected
 - **Device Duty** – the duty of the device currently selected
- The **Statistics** section shows the number and validity of all messages and responses since the COM Port was selected. This section applies to the COM port as a whole, and not just to any selected gauge.

The **Product Information**, **Status** and **Raw Data** sections will only be updated if a gauge is selected to be watched, see next section for details.

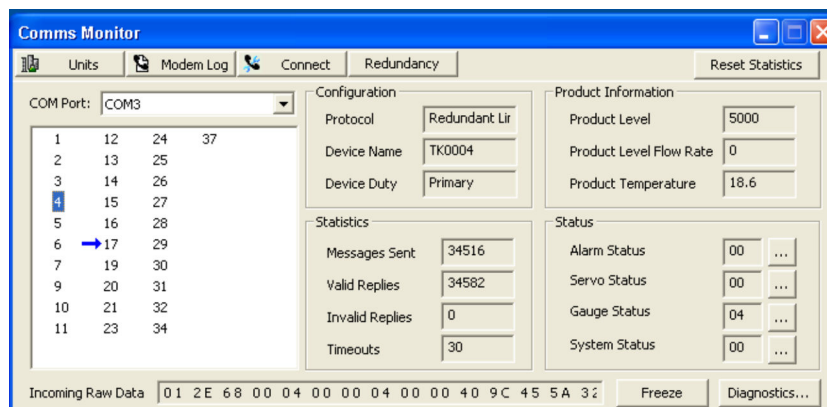
If no gauge is selected to be watched then the **Raw Data** section will display the connection status of interface, this will be one of the following:

- Disconnected
- Connecting
- Connected
- Disconnecting

If an interface is not in the connected state then no messages will be sent to any gauges on that interface.

6.2.2 Viewing gauge data

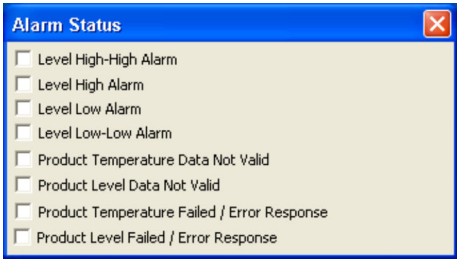
To view data for an individual gauge, click on the gauge number in the list.



Each time the DCC Host polls that gauge the response and data will be captured and displayed in the sections described below.

The **Product Information** section shows the Level, Flow Rate and Temperature of the selected gauge. If no gauge is selected this section will not be updated and will either remain blank or display –1 to indicate no valid data.

The **Status** section shows the current status of the selected gauge. If any status flags have been set, a number will appear in the corresponding box. Detailed status analysis can be obtained by clicking on the button next to the status.

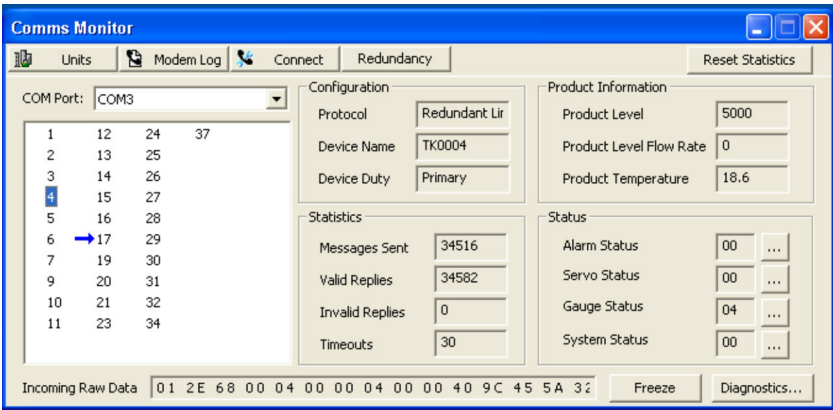


The **Incoming Raw Data** section shows the raw data received from the gauge. This field is only a simplified view of the raw data, refer to the next sections on viewing the full raw communications data.

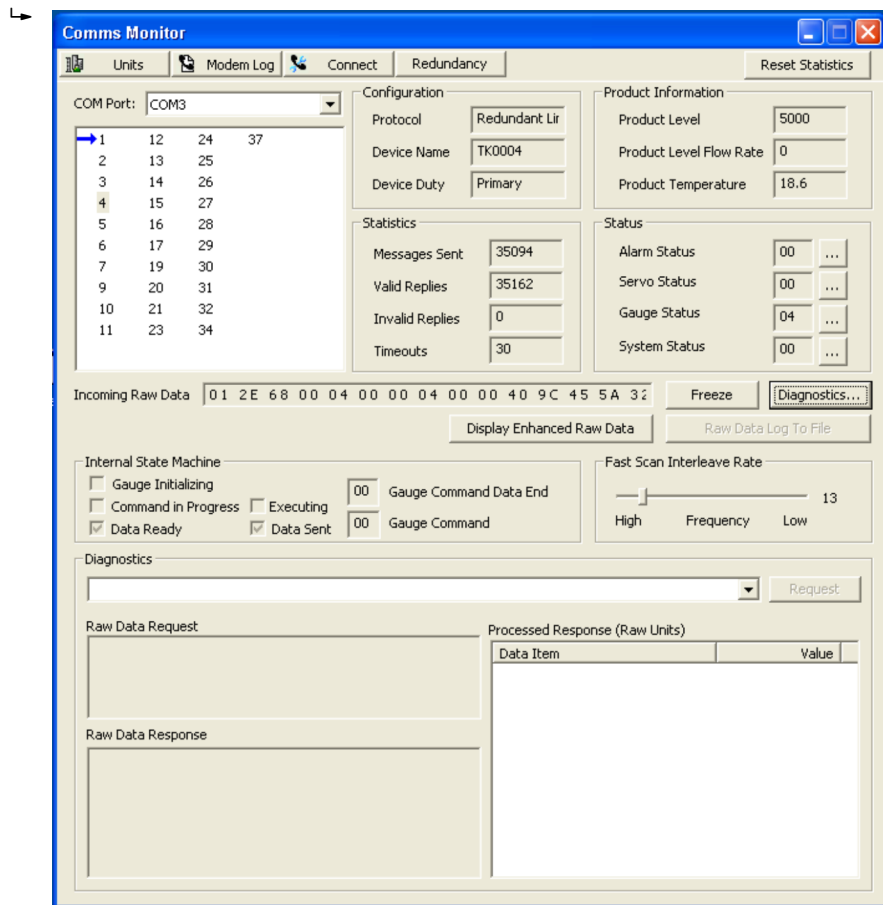
To aid analysis this field can be frozen by clicking on the **Freeze** button. This does not stop the devices from being polled, but they will not be displayed in the field.

6.2.3 Viewing enhanced raw communications data

- 1. To view the raw communications data, select the desired Host COM port from the drop-down list, e.g. COM 1.
 - A list of gauges being polled on the selected COM port will be displayed in the box below.

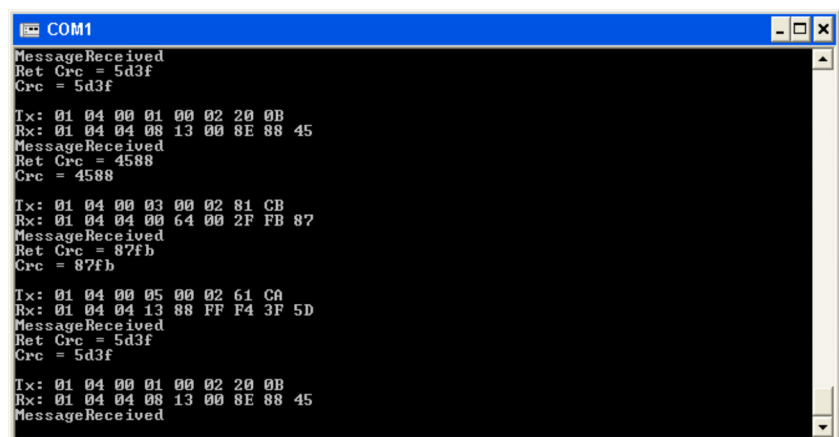


2. Click on the **Diagnostics...** button.



3. Click on the **Display Enhanced Raw Data** button.

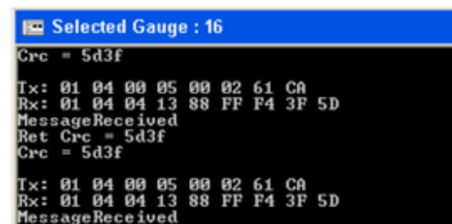
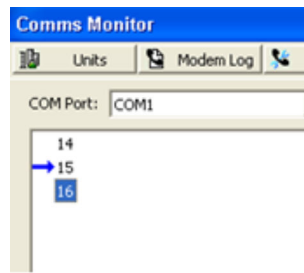
- This will display a window showing the raw data bytes being transferred between the gauges and the Multi Scan NXA83B, together with more protocol specific diagnostic text.



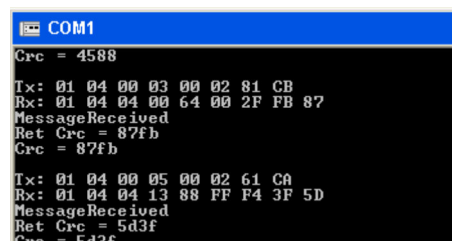
This will scroll upwards as the messages are sent and received. There are a number of actions that may be used in this mode.

4. To freeze the raw display output click on the **Freeze** button. This will not stop polling, but will only stop the update of this screen.
5. To resume the screen update click on the **Resume** button.

6. To show communications only for one gauge then select an individual item in the list of devices for this port.
- ↳ The device will now be shown at the top of the Raw data box.



7. To change it back to logging all gauges on the port, reselect the port in the **COM Port** list.
- ↳ The COM port will now be shown at the top of the Raw data box.



6.2.4 Logging raw communications data

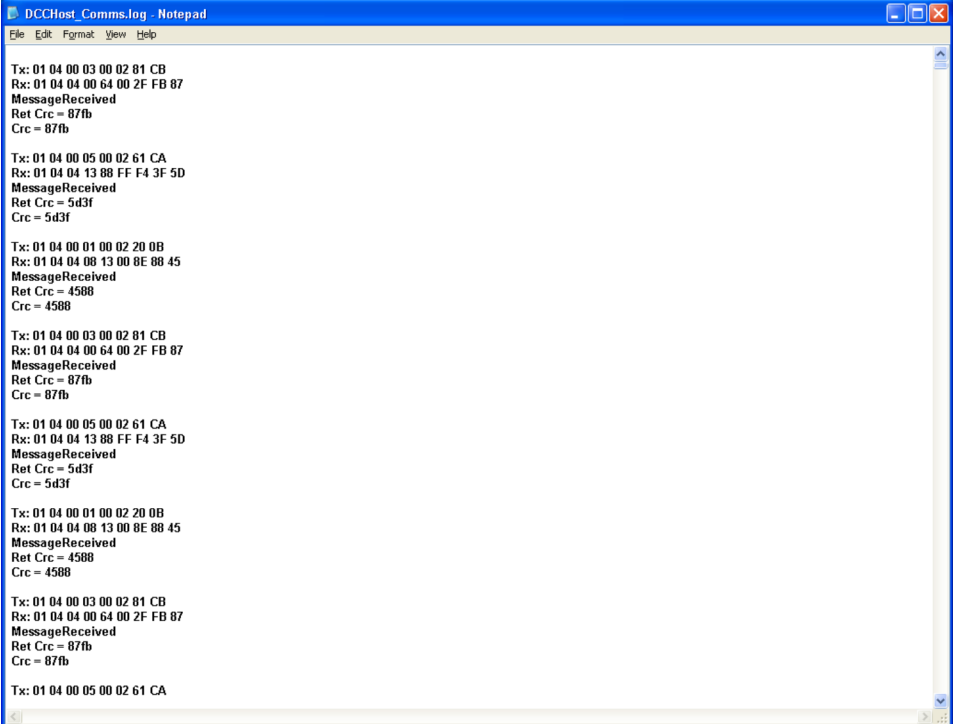
To log the raw communications data output to a file, first select the port/gauge to be viewed, as defined in the previous section. Then click on the **Raw Data Log To File** button.

The output displayed in the raw data screen will now be saved to a file called:
DCCHost_Comms.log

Located in the directory:

- Before Firmware 4.0.0
C:\Program Files\Tanks
- From Firmware version 4.0.0 onwards
D:\Program Files\Runtime

The file will be constantly updated as new messages are logged on the raw data screen. This is a simple text file and can be displayed using notepad or any similar text editor program.



```

DCCHost_Comms.log - Notepad
File Edit Format View Help

Tx: 01 04 00 03 00 02 81 CB
Rx: 01 04 04 00 64 00 2F FB 87
MessageReceived
Ret Crc = 87fb
Crc = 87fb

Tx: 01 04 00 05 00 02 61 CA
Rx: 01 04 04 13 88 FF F4 3F 5D
MessageReceived
Ret Crc = 5d3f
Crc = 5d3f

Tx: 01 04 00 01 00 02 20 0B
Rx: 01 04 04 08 13 00 8E 88 45
MessageReceived
Ret Crc = 4588
Crc = 4588

Tx: 01 04 00 03 00 02 81 CB
Rx: 01 04 04 00 64 00 2F FB 87
MessageReceived
Ret Crc = 87fb
Crc = 87fb

Tx: 01 04 00 05 00 02 61 CA
Rx: 01 04 04 13 88 FF F4 3F 5D
MessageReceived
Ret Crc = 5d3f
Crc = 5d3f

Tx: 01 04 00 01 00 02 20 0B
Rx: 01 04 04 08 13 00 8E 88 45
MessageReceived
Ret Crc = 4588
Crc = 4588

Tx: 01 04 00 03 00 02 81 CB
Rx: 01 04 04 00 64 00 2F FB 87
MessageReceived
Ret Crc = 87fb
Crc = 87fb

Tx: 01 04 00 05 00 02 61 CA

```

To stop logging to the file, click on the **Stop logging Raw Data** button. If the **Log Raw Data** button is then clicked, it will delete the existing log file and start logging again. If the **Comms Monitor** program is closed then all logging will be stopped.

If multiple logs are to be taken, the existing log file should be renamed to something else before starting a new log, so it is not overwritten.

If the log file(s) are required to be copied off the Multi Scan NXA83B (i.e. to send to Endress+Hauser), then simply copy the files to a removable USB memory drive.



If using firmware versions before 3.0.11, it is necessary to do a COMMIT after copying the files, otherwise they may not be saved permanently on the USB drive. From version 3.0.11 this is not required.

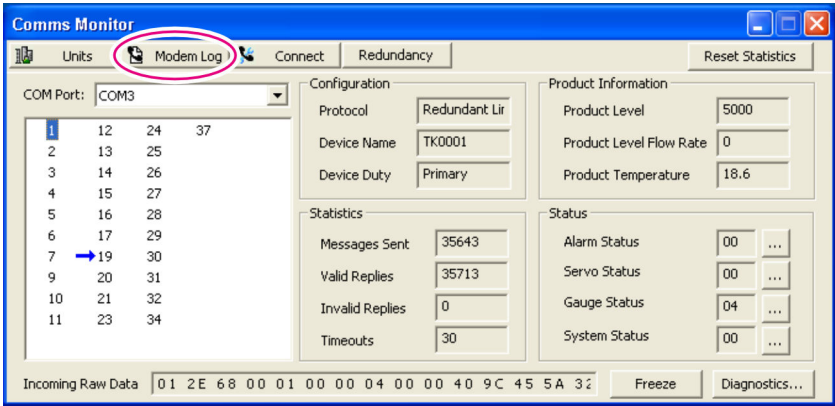
6.2.5 Viewing Modem Log

DCC Host maintains a log of the connection status of all interfaces and it is sometimes useful to view this log, especially for interfaces using a modem and scheduled connection.



Although it is referred to as "Modem Log" it actually applies to ALL interfaces within DCC Host, including those using serial ports on the local Multi Scan NXA83B.

To view the log of all connections since DCC Host was started, click on the button **Modem Log** at the top of the **Comms Monitor** screen.



The file will then be automatically displayed using Notepad.



The file contains a date/time stamped log of any changes in connection status for all interfaces in DCC Host. It is especially useful for interfaces using Modem dial-up to connect to remote sites, as it details all the modem state changes and any line failures etc.

Any time that an interface is connected or disconnected it will be logged here, whether it be from a scheduled connection or from a manual user command.

 All entries for COM 100 refer to the simulator, built in to DCC Host, which is treated the same as any other interface.

6.2.6 Connection Status

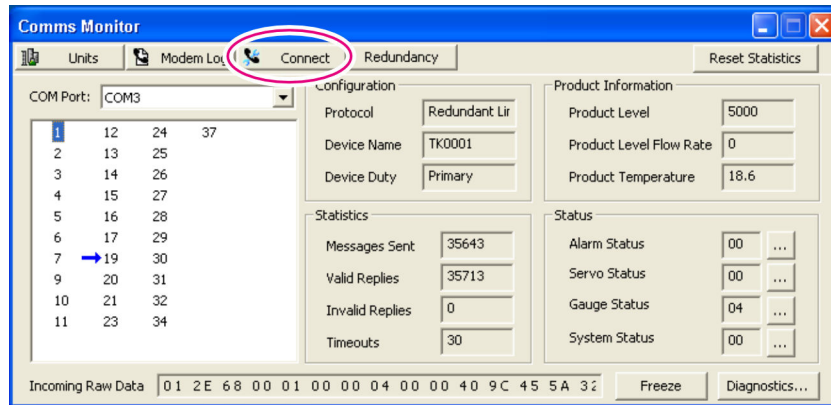
Gauges will only be polled when an interface is connected to the hardware it uses to communicate. This hardware could be local serial port on the Multi Scan NXA83B or a network/modem port used to connect a remote site.

The connection type of an interface is automatically set during the configuration of DCC Host (using DCC Config) and may be **Always** connected, **Manually** connected or connected at **Scheduled** times. However the user may manually override the automatic settings and command an interface to connect/disconnect at any time.

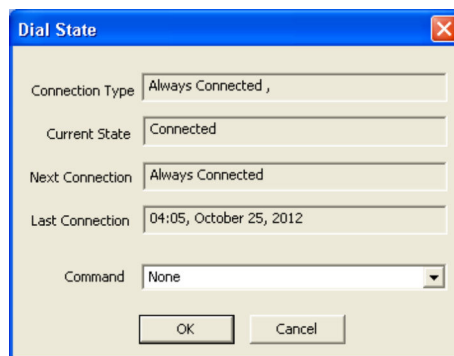
The connection status of a tank is normally displayed on the main home page, but this may vary depending on the tankgauging system.

If the tank displays any other status than **Connected** the data is NOT live for that tank, but will be the values polled when the interface was last connected.

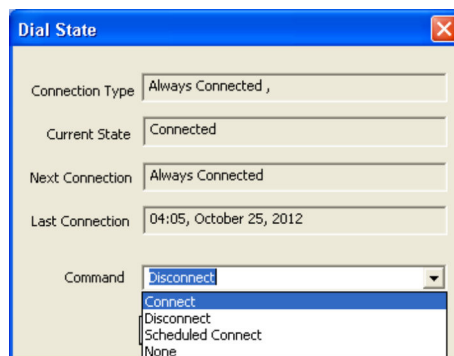
The connection status of an interface in DCC Host may also be viewed and modified via the **Comms Monitor**. To view the connection status, select the COM port of the interface from drop-down list then click on the **Connect** button at the top of the dialog.



The connection details for the interface will be shown, including the **Connection Type**, the **Current State**, the time of the **Last Connection** and time when the **Next Connection** if the interface has been configured for scheduled connections.



The **Command** field allows the connection state to be changed. To change, select the new state from the drop-down list.



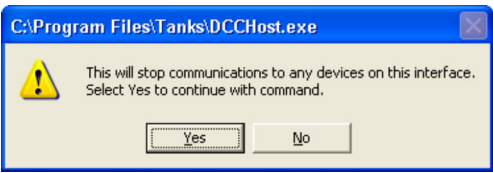
The states selectable are:

- **Connect** – this will connect and stay connected permanently or until commanded to disconnect by the user
- **Disconnect** – this will disconnect the interface
- **Scheduled Once** – this will connect and then automatically disconnect after it has retrieved all data from the gauges
- **None** – no change in connection state

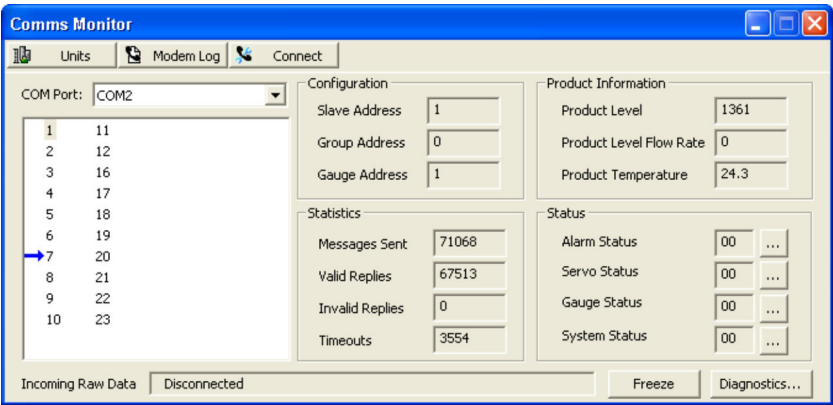
Select a command then click on **OK** to activate new state.

This command will apply to the interface as a whole and thus will affect ALL gauges on that interface. If the **Disconnect** option is selected a confirmation dialog will be displayed

warning the user that this will result in the gauges no longer being polled. Data on screen will be frozen for those tanks.

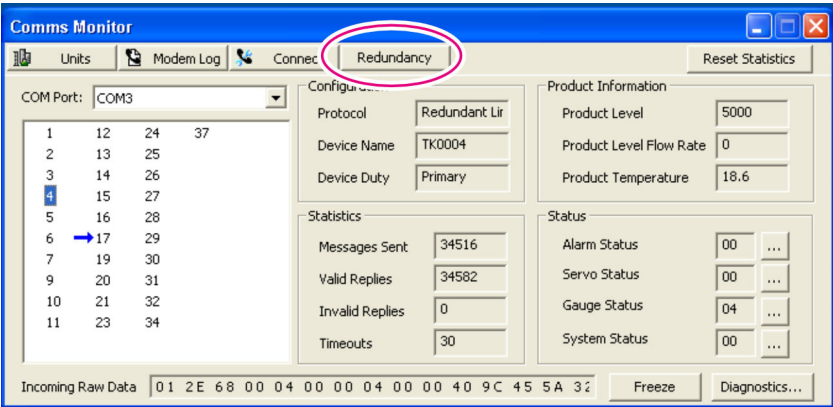


Once an interface has been disconnected then NO gauges will be polled. If the port is selected in the **Comms Monitor**, there will be no comms activity shown and **Disconnected** will be displayed in the **Raw Data** field.



6.2.7 Redundancy Status

If a Multi Scan NXA83B is configured as part of a redundant pair then the redundancy status can be viewed and controlled via the Comms Monitor. To view the redundancy status click on the **Redundancy** button at the top of the dialog.



The redundancy details for the Multi Scan NXA83B will be shown, including the **Redundancy Type**, the current **System Polling State**, the time of the Last Switch and details of the last switch.

The dialog box titled "Redundancy State" contains the following fields:

- Redundancy Type: Switch By System , Dynamic
- System Polling State: PASSIVE
- Last Switch Time: 10:23, December 15, 2016
- Last Fail Reason: Field Port Failed
- Last Field Port Fail: COM5
- Command: None (dropdown menu)

Buttons: OK, Cancel

The fields displayed on this screen will include the following:

- **Redundancy Type** – this shows the type of redundancy configured for this Multi Scan NXA83B. It will also show the current switching mode if the redundancy is set to **Switch By System**.
- **System Polling State** – this shows the current polling state. It will always show ACTIVE if the redundancy type is **Switch By System**.
- **Last Switch Time** – the time that the last switchover occurred in a **Switch By System** redundant system. If the redundancy type is not **Switch By System** or a switchover has not occurred then this field will be blank.
- **Last Fail Reason** – If a switchover has occurred then this will indicate the cause, such as a Field Port Failed or a Manual command. If the redundancy type is not **Switch By System** or a switchover has not occurred then this field will be blank.
- **Last Field Port Fail** – this COM port number of the last field port to fail and trigger a redundant switchover

The **Command** field allows a set of redundant actions to be selected.

The dialog box titled "Redundancy State" shows the Command dropdown menu open with the following options:

- None
- Set System ACTIVE
- Set System PASSIVE
- Set Dynamic Switching
- Set No Switching
- None

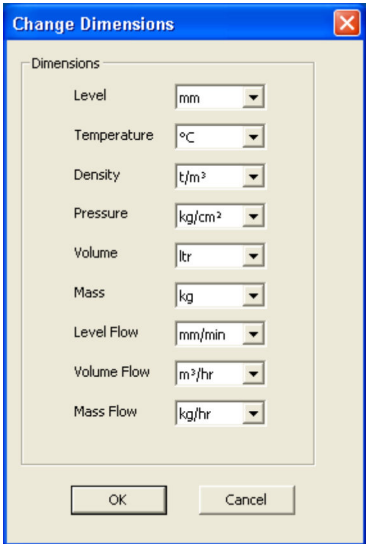
Select a command then click on **OK** to activate the command.



Refer to the separate Redundancy manual BA01296G for more details on the data shown in this screen.

6.2.8 Display Units

The units of data displayed in the **Comms Monitor** may be changed by clicking on the **Units** button at the top left of the screen.



These units only apply to data displayed in the **Comms Monitor**, they do not affect data saved in the database or displayed in the standard screens.

6.3 Operator Screen Communications Monitor

The Communications Monitor is available to be viewed from the Operator touch screen, but with limited functionality. Therefore certain features will not be available from the Operator screen version, including such items as Raw Data viewing/logging, modem log and Connect details.

 This feature is only available from firmware versions 3.2.0/4.2.0 onwards.

To view the Communications Monitor from the Operator screen click on the **Comms Monitor** icon in the right hand drop-down menu.



A version of the Communications monitor that is formatted for use on a touch screen will be displayed.

The screenshot shows the 'Comms Monitor' window. On the left, there is a 'COM Port' dropdown menu. Below it is a large empty rectangular area. To the right of this area is a 'Statistics' section with four input fields: 'Messages Sent', 'Valid', 'Invalid Replies', and 'Timeouts'. On the far right, there are three sections: 'Configuration' with fields for 'Protocol', 'Device Name', and 'Duty'; 'Product Information' with fields for 'Product Level', 'Product Level Flow Rate', and 'Product Temperature'; and 'Status' with four rows of status indicators (Alarm Status, Servo Status, Gauge Status, System Status) each with a numeric input and a '...' button. At the bottom right are 'Reset' and 'Redundancy' buttons.

This screen operates in a similar way to the full Communications Monitor, in that a COM port can be selected from the drop-down list. The screen will then show the details of that port. The redundancy details can be viewed by clicking on the **Redundancy** button. This screen operates in a similar way to the full Communications Monitor.

This screenshot shows the 'Comms Monitor' window with 'COM3' selected in the dropdown. The large rectangular area now displays a table of data:

1	10	19	28
2	11	20	29
3	12	21	30
4	13	23	31
5	14	24	32
6	15	25	34
7	16	26	37
8	17	27	

A blue arrow points to the row containing '8'. The 'Statistics' section now shows numerical values: 'Messages Sent' (47839), 'Valid' (47958), 'Invalid Replies' (0), and 'Timeouts' (15). The 'Configuration' section now shows 'Protocol' set to 'Redundant Link Control'. The 'Status' section shows all status indicators set to '00'. The 'Redundancy' button is highlighted.

6.4 Slave Communications Debugging

The DCC Monitor utility is only concerned with field communications and at present cannot be used to monitor slave interfaces. However there is a way to view simple debug output from slave interfaces, but it should be used with care as it has an effect on the normal operation of the Multi Scan NXA83B.

Slave debug monitoring is much more limited in function than the DCC monitor utility and should only be used by experienced users, generally restricted to the commissioning phase.

It permanently stops the service, DCC Slave, which is used for all slave interfaces to DCS, PLCs etc. and requires a reboot of the Multi Scan NXA83B to return to normal operation.

To switch the DCC Slave service into debug mode there are 2 batch files located in the directory "**C:\Program Files\Tanks**":

- **DCCSlave DEBUG display.bat** – this runs the debug output to a terminal window on screen
- **DCCSlave DEBUG log to file.bat** – this saves the output to a file called "**DCCSlave_Comms.log**"

If these files are not available pre-installed on the Multi Scan NXA83B, contact Endress+Hauser to obtain copies.

 From firmware version 4.0.0 these files will be located in the directory "**D:\Program files\Runtime**".

 After running the DCC Slave in debug mode, a reboot is required to return to normal operation mode.

7 DCC Slave Configuration

The DCC Slave sub-system is related to the DCC Host and shares many of its control features. But whereas DCC Host is responsible for getting tank data into the system, DCC Slave is used to get data out of the system and into a Scada, DCS or similar system.

The DCC Slave is a standard sub-system within the application, running as a system service which will be automatically started when the Multi Scan NXA83B starts. It is responsible for running multiple slave serial interfaces that allow other master systems (i.e. SCADA or DCS) to retrieve data from the systems real-time database (RTDB).

Multiple interfaces may be configured to communicate using one of the protocols currently available within DCC Slave, these being:

- Modbus (see note below)
- Enraf Host
- Datacon protocol
- Extended Modbus
- Alarm Relay Output (Modbus and internal relay card)
- TankMaster
- Enraf CIU Slave

The DCC Slave service is capable of servicing master systems on multiple COM ports, modems and network connections simultaneously, but before it can do so they must be configured within the service.

 When the Modbus protocol is selected for a network port, then the variant protocol known as Modbus TCP will actually be used.

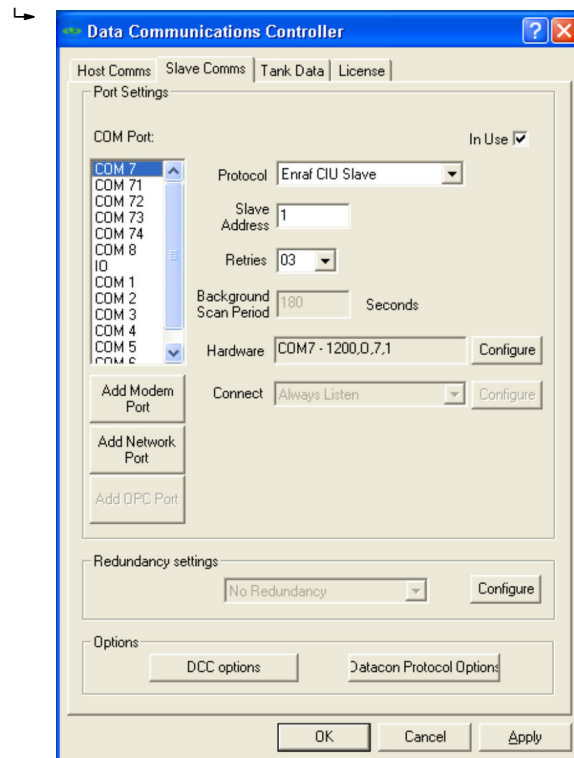
7.1 Configuring Slave COM Ports

The DCC Slave service requires the selection and configuration of the communication ports that are to be used.

Multiple serial ports, modems and network connections may be configured, up to the maximum licensed.

1. To configure the ports, run the Tankvision Multi Scan Configurator tool and select menu item **Communications** → **Port Configuration**.

2. Click on the **Slave Comms** tab.



A list of all physical COM ports (RS232/485/422 etc.) will be displayed together with any logical Modem and Network ports configured (these will have an offset of 40 for modems and 70 for networks i.e. COM 41 etc.).

See the later sections on Modem ("Configuring Modem Ports") and Network Ports ("Configuring Network Ports") for details on adding and configuring these ports.

3. Select the COM port to be configured and make sure the **In Use** box is ticked.

→ The protocol and communications parameters can now be edited.

The Protocol field determines what is to be connected to the COM port. The current selection options are:

- Modbus
- Enraf Host Protocol
- Enraf CIU Slave
- Datacon
- Extended Modbus
- Modbus Alarm Output
- Redundant Link Control
- ASCII Alarm Output

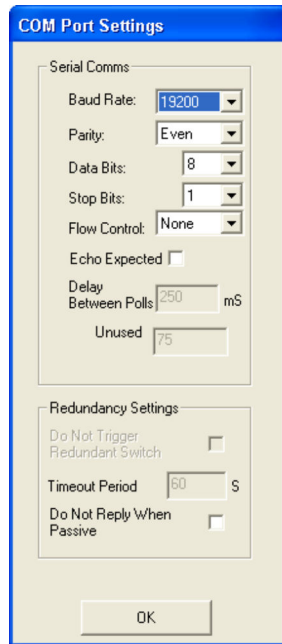
i When the Modbus protocol is selected for a network port, then the variant protocol known as Modbus TCP will actually be used.

i Redundant Link Control is only ever used if the **Switch By System** redundancy mode is selected.

The **Slave Address** must be set for all Modbus based protocols and also for the Datacon protocol. This is the device address that the interface will reply to.

The **Retries** field does not apply to most protocols at the present time.

The communication parameters will be displayed in the **Hardware** section. For a serial COM port the baud rate, data bits, parity and stop bits will be displayed. These should be set to the same settings as that of the master system that will poll this slave interface. They may be altered by clicking on the **Configure** button to the right, and editing the parameters in the dialog screen.



If the serial communications hardware produces an echo of sent characters (i.e. some RS485 or 20 mA current loop devices), tick the **Echo Expected** field to tell the driver to handle the echoed characters.

Modem ports will display only the word **Modem** in the **Hardware** section. The modem may be configured via the **Configure** button. See the later section on Modem Ports for more details.

Slave interfaces are **Always** connected to the serial COM port or modem they use to communicate, therefore the **Connect** field will be fixed in this mode.

A warning message may be displayed if a new interface is added by selecting the **In Use** box and the number of licensed host interfaces has been exceeded.



When all slave interfaces have been configured or modified, click on the **Apply** or **OK** buttons to save any changes. There may be a momentary delay whilst the details are saved and the DCC Slave service automatically re-configures itself with the new configuration.

7.2 Configuring Modem Ports

Ports in DCC Slave can be configured to automatically accept connections from remote clients using locally connected modems. They will then reply to all requests from remote master until it hangs up the line.

Modem ports are to DCC Slave as software COM ports denoted by an offset of 40, thus the first modem COM port will be COM 41.

They are treated as if they were physical COM ports on the Multi Scan NXA83B, with only one slave interface accessing one physical modem device.

i Once a modem has been assigned to a slave interface it can **ONLY** be used by that interface. No other interfaces in DCC Slave or DCC Host can use that modem. The reason for this is that when a slave interface starts it takes control of the modem and answers any incoming calls on that device.

Configuring modem ports in DCC Slave is very similar to configuring modem port in DCC Host. For details, see "Configuring Host Modem Ports". The only differences are that no **Phone Number** need be entered and the **Connect** field will be fixed as **Always Listen**.

7.3 Configuring Network Ports

Ports in DCC Slave can be configured to automatically accept connections from remote clients using network socket connections. They will then reply to all requests from remote client until it disconnects the network socket.

Network ports are to DCC Slave as software COM ports denoted by an offset of 70, thus the first network COM port will be COM 71.

Software COM ports are treated the same as real COM ports with regards to licensing.

A network port makes no difference to the protocol selected to run on that port, except for the Modbus protocol. If that protocol is selected then it will use the Modbus variant called Modbus TCP.

Configuring network ports in DCC Slave is very similar to configuring network ports in DCC Host. For details, see "Configuring Host Network Ports". However there are a number of differences when configuring the network settings.

Network Settings

Network Address:

Port:

Delay Between Polls: mS

Timeout for inactive connections: Minutes

Comms Timeout: mS

Maximum Connections:

Modbus Settings

Do Not Use TCP Variant: ☐

Redundancy Settings

Do Not Trigger Redundant Switch: ☐

Timeout Period:

Do Not Reply When Passive: ☐

OK

The parameters consist of:

- **Port** – This is the TCP/IP Port that the slave interface will listen on, in the range 1 to 65 000
- **Timeout for inactive connections** – If no requests have been received in the slave for longer than the timeout value, the socket will be automatically disconnected. The recommended value is 1 minute.
- **Comms Timeout** – If a full modbus request message is not received within the Comms Timeout period then the port will flush the received characters and reset to expecting the start of a new message. Leave as 0 in normal circumstances.
- **Maximum Connections** – The maximum number of simultaneous client connections to this IP port. By default it will be set to one and should in normal circumstances be left as this unless there is a definite requirement for more modbus client systems, in which case it can be increased to a maximum of 9.

Ensure that the **Port** value does not clash with any ports already in use with other programs or services on the Multi Scan NXA83B. The range for the port field is 1 to 65 000, although normally it is set less than 10 000, and it is recommended that it should be above 1 000 to avoid a range of addresses commonly used by system processes.

If in doubt start the command prompt and type in **netstat -a**. The second column will show all ports currently in use.

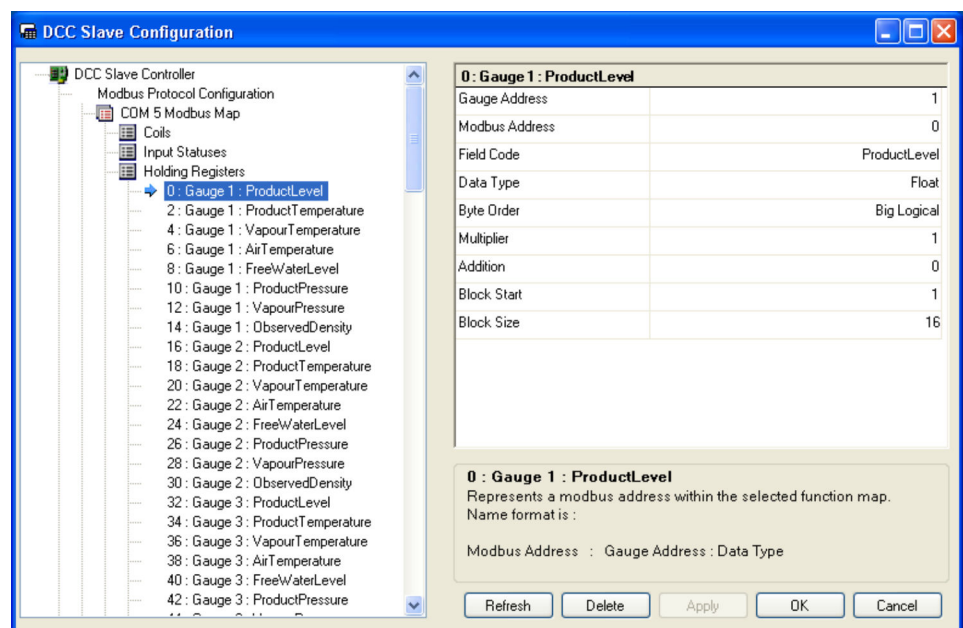
7.4 Protocol Configuration

Most communication protocols in DCC Slave require some configuration data to be entered, which is specific to that protocol (i.e. Modbus requires a register/coil map to be set up). To configure any protocol specific data, select **Slave Interface Configuration** item from the **Communications** menu.

The display consists of a left hand panel with a tree list of all protocols supported by DCC Slave and a right hand panel where selected data may be edited. To navigate through the tree structure simply left click on the item to expand it.

Expanding each protocol will display a list of all COM ports currently configured for that protocol.

Under each COM port entry will be displayed the currently configured protocol specific data for the interface running on that port. The protocol specific data options are described in the relevant section on that protocol, further on in this document.

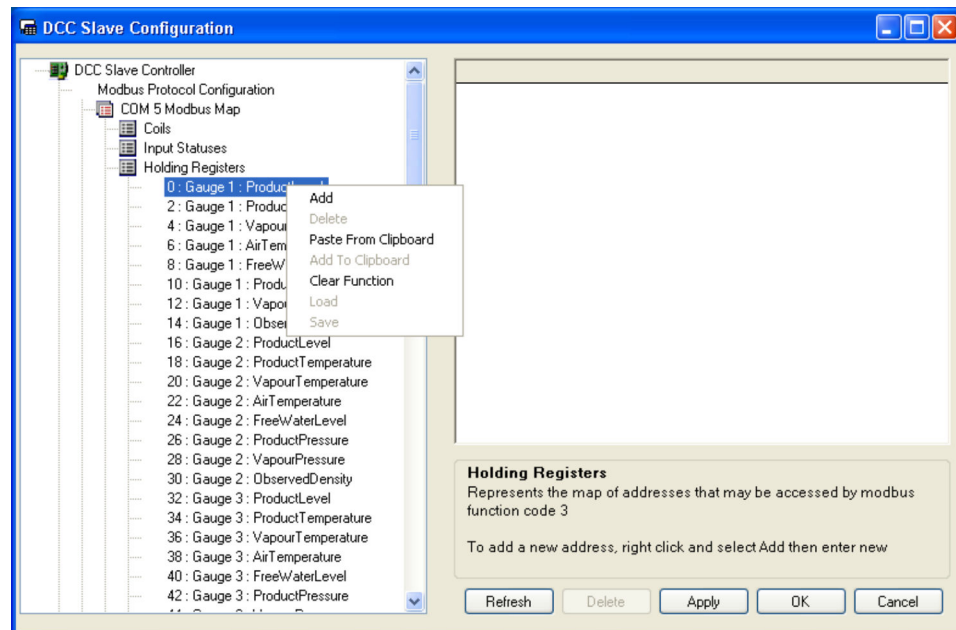


If there are any configurable items associated with a currently selected tree item then they will be displayed in the right hand panel.

To edit configuration data displayed in the right hand panel simply click on that item and either edit the text or select from the drop-down list.

To save any data to the database, click on the **Apply** button. To save data and refresh the left hand panel tree display, click on the **Refresh** button. This button will also update the display if a new interface has been added to DCC Slave using the control panel applet while in this program.

Right clicking on tree items will display a pop-up menu with any allowed actions available for that item. The actions depend on the protocol and are detailed later in this document.



7.5 Modbus Slave Configuration

The Multi Scan NXA83B can be configured to reply to requests for data from other systems, such as SCADA or DCS, using the Modbus protocol. Any number of Modbus slave interfaces can be configured, depending on the number of physical serial ports and licenses purchased.

The full range of data from the Multi Scan NXA83B can be accessed via the Modbus output(s) and each one can have its own map defined.

The Modbus output is available via the following physical connections:

- RS232
- RS485
- RS422
- Ethernet (see below)

 When the Modbus protocol is selected for an ethernet port, then the variant protocol known as Modbus TCP will actually be used.

All Modbus interfaces have to be configured with its own map to participate in any communication with a host system.

The following sections offer a quick getting started guide to configuring Modbus slave interfaces in the Multi Scan NXA83B, however they assume a degree of prior knowledge of the Modbus protocol.

Configuration of Modbus interfaces is carried out using the **Tankvision Multi Scan Configurator**, and it is assumed that the user already has knowledge of how to use this.



Refer to the Configuration manual (BA01291G) for more information on starting and using the Configurator tool.

7.5.1 Modbus Protocol

The DCC Slave implementation of the Modbus protocol will respond to requests for the following functions:

- 01 Read Coil Status
- 02 Read Input Status
- 03 Read Holding Register
- 04 Read Input Register
- 05 Force Single Coil
- 06 Preset Single Register
- 08 Diagnostics – sub-task 00 only
- 16 Preset Multiple Registers

All other tasks are not supported and will be returned with an appropriate exception response.

The following exception codes are supported:

- 01 Illegal Function
- 02 Illegal data address
- 03 Illegal data value

The following Modbus protocol variants are supported:

- RS232/RS485/RS422 Serial ports: Modbus RTU
- Ethernet port: Modbus TCP

Serial ports support the following communications parameters:

- Baud Rate: 300, 600, 1 200, 4 800, 9 600, 19 200, 38 400
- Parity: None, Odd, Even
- Data bits: 8
- Stop bits: 1

The Ethernet port supports multiple simultaneous Modbus connections.

Planning

Successful dialogue between the Multi Scan NXA83B and a computer using the Modbus protocol does require some pre-planning.

In particular, the following issues will need to be defined and agreed with the supplier of the Modbus Host:

- Modbus link communication settings
- Modbus Slave Address
- Data Items to be transferred for each tank
- Engineering units for each data item
- Data type for each data item
- Register addresses for each data item

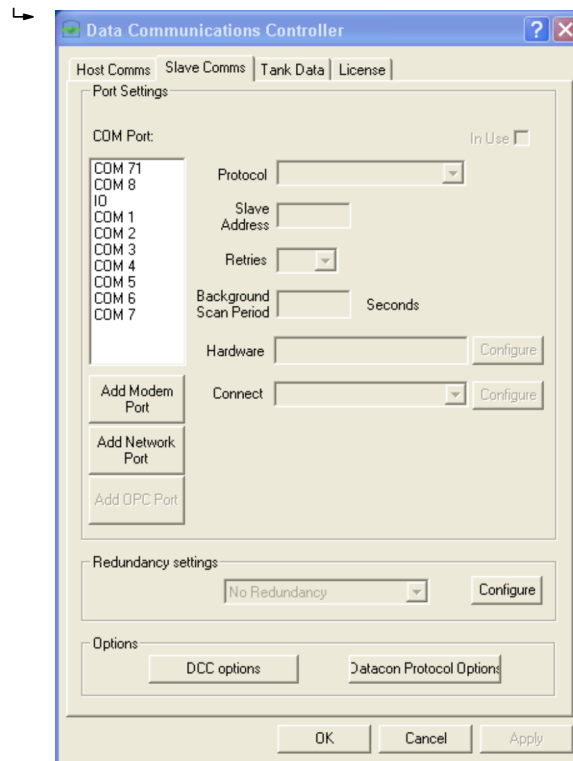
Although the Modbus Slave driver allows the user to have any data item in any order, it is often wise to order them in contiguous and consecutive addresses. Certainly in this case it is more efficient to process the data when they are ordered in ascending order of Modbus Address.

7.5.2 Configuring a Modbus Slave port

Each Modbus interface must be first be added to the DCC Slave service as a COM port, whether it is a real serial port or running on the Ethernet connection. This involves the selection of the port and configuration of the communication parameters to be used. This is slightly different depending on hardware types.

Configuring a Modbus interface on a serial port

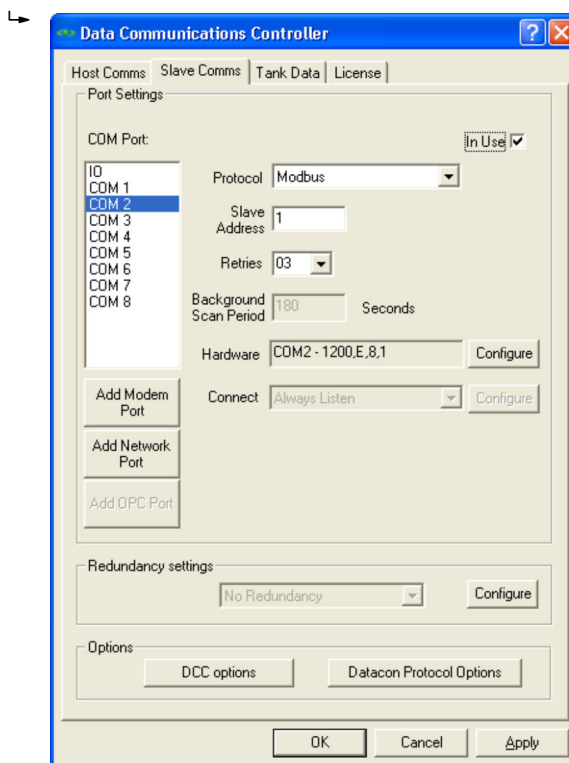
1. To configure a port on a physical serial port, run the Tankvision Multi Scan Configurator tool and select menu item **Communications** → **Port Configuration**.
2. Click on the **Slave Comms** tab.



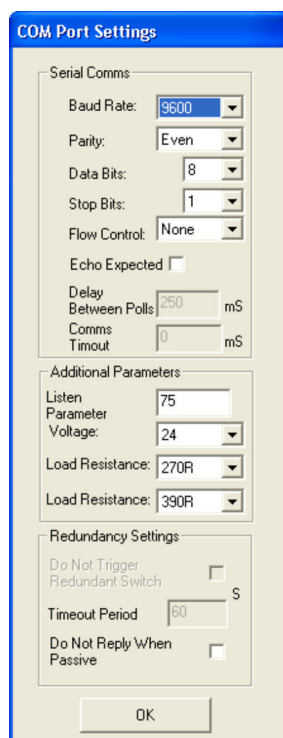
A list of all physical COM ports will be displayed together with any logical Modem and Network ports configured. Physical serial ports (RS232, RS485 and RS422) will be in the range COM 1 to COM 36.

3. Select the COM port to be configured and tick the **In Use** box.
 - ↳ If the port is already used as a field port a message will be displayed saying the port is already in use.
4. The **Protocol** field should be set to **Modbus**.

5. The **Slave Address** field should be set to the Modbus PLC address that this port will respond to. The **Retries** field does not apply to a Modbus port.



The communication parameters will be displayed in the **Hardware** section. For a serial COM port the baud rate, data bits, parity and stop bits will be displayed. These should be set to the same settings as that of the master system that will poll this slave interface. They may be altered by clicking on the **Configure** button to the right, and editing the parameters in the dialog screen.



6. Set the **Baud Rate**, **Parity**, **Data Bits** and **Stop Bits** fields the same as the master system that is polling the Multi Scan NXA83B.

7. The **Flow Control** field should be set to **None**.
8. The **Echo Expected** field should normally be left unticked unless the serial communications hardware produces an echo of sent characters (i.e. some RS485 or 20 mA current loop devices).
9. Click **OK** to save the COM Port settings, then click **OK** to save Modbus interface settings.

Configuring a Modbus interface on the Ethernet connection

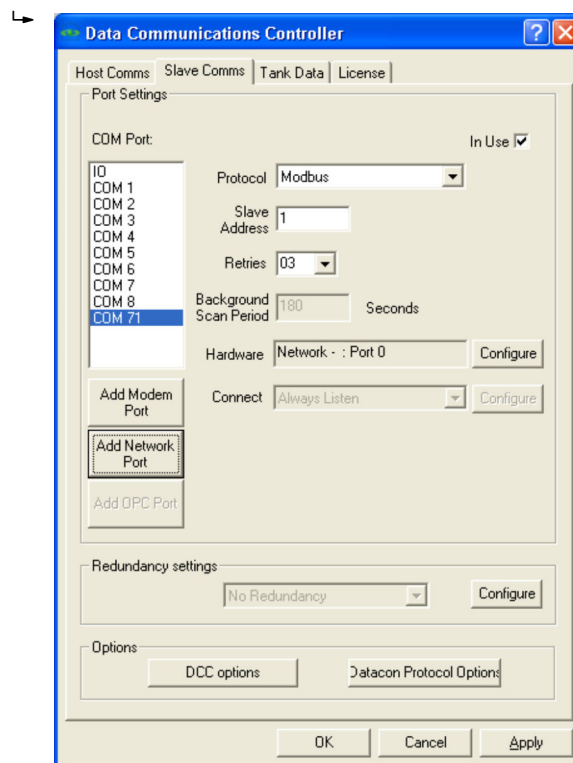
Modbus interfaces in DCC Slave can be configured to automatically accept connections from remote clients using network socket connections. They will then reply to all requests from remote client until it disconnects the network socket.

Network ports are treated as virtual COM ports in the Multi Scan NXA83B and are denoted by an offset of 70, thus the first network port will be COM 71.

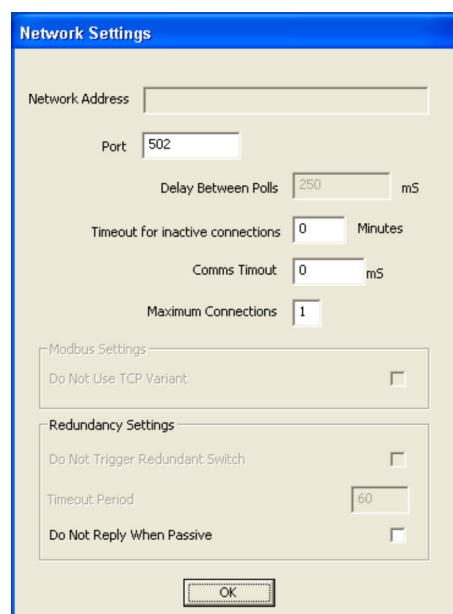
 When a Modbus interface is configured on a Network port it will use the Modbus TCP protocol variant.

1. To configure a port on Ethernet connector, run the Tankvision Multi Scan Configurator tool and select menu item **Communications** → **Port Configuration**.
2. Click on the **Slave Comms** tab.
 - ↳ A list of all existing Ethernet network virtual COM ports will be displayed. These will be in the range COM 71 to COM 96.
3. To add a new network port, click on the **Add Network Port** button. A new port will be created, allocated from the next free port above COM 70. Virtual COM ports are treated the same as real COM ports with regards to licensing.
4. The **In Use** box should already be ticked.
5. The **Protocol** field should be set to **Modbus**.

6. The **Slave Address** field should be set to the Modbus PLC address that this port will respond to. The **Retries** field does not apply to a Modbus port.



The IP Port that the Modbus interface will listen on will be displayed in the **Hardware** section. This may be altered by clicking on the **Configure** button to the right, and editing the parameters in the dialog screen.



The parameters consist of:

- **Port** – This is the TCP/IP Port that the slave interface will listen on and will normally be port 502 for ModbusTCP, however if required this may be changed to any value in the range 1 to 65 000.
- **Timeout for inactive connections** – If no requests have been received in the slave for longer than the timeout value, the socket will be automatically disconnected. The recommended value is 1 minute.
- **Comms Timeout** – If a full modbus request message is not received within the Comms Timeout period then the port will flush the received characters and reset to expecting the start of a new message. Leave as 0 in normal circumstances.
- **Maximum Connections** – The maximum number of simultaneous client connections to this IP port. By default it will be set to one and should in normal circumstances be left as this unless there is a definite requirement for more modbus client systems, in which case it can be increased to a maximum of 9.

7.5.3 Configuring the Modbus Map

The map must be configured for each port in DCC Slave configured to use the Modbus protocol. This is carried out using the DCC Slave Configuration tool, which is included as part of the Tankvision Multi Scan Configurator.

Each Modbus interface has its own map, which can be configured in a completely free format, with any data item from any gauge being allocated to registers. Therefore there is no fixed formatting.

The DCC Slave Configuration tool can be started by selecting the following menu item in the Configurator:

Communications → Slave Interface Configuration

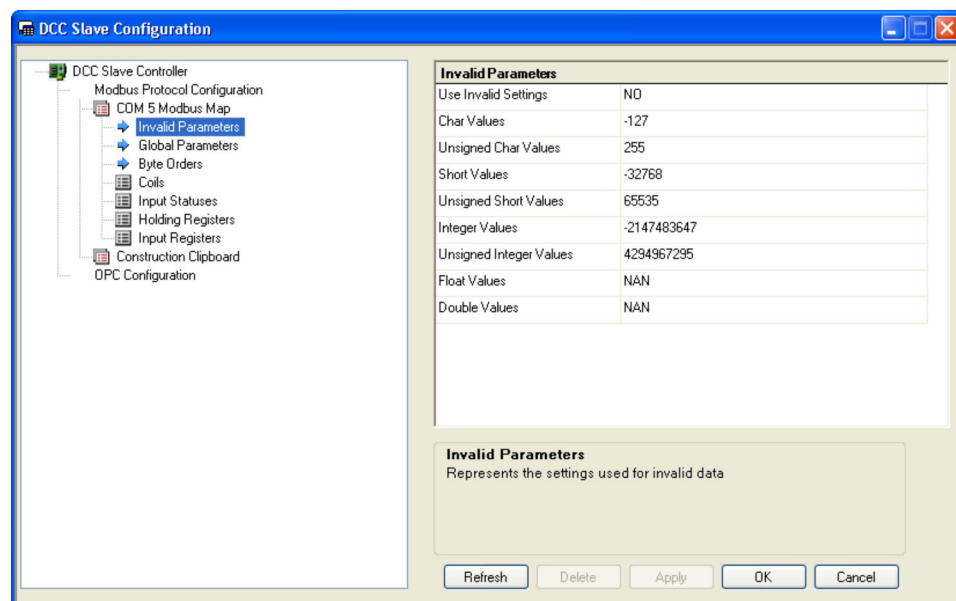


Refer to the Configuration manual (BA01291G) for a general introduction to the use of the DCC Slave Configuration tool.

Configuring the Map

Start the **DCC Slave Configuration** module.

This module can be used to configure the map for any Modbus slave interface in DCC Slave.



The DCC Slave configuration tool consists of a tree list of all protocols on the left and an edit section on the right. Included in the list will be the item **Modbus Protocol**

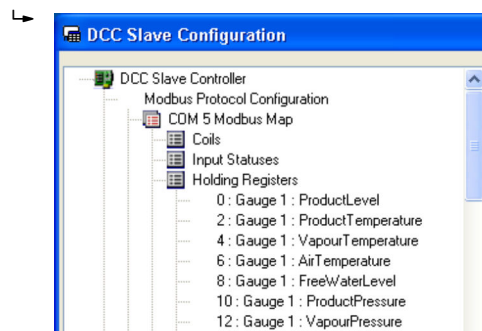
Configuration, under which is a list of all COM ports using the Modbus protocol, plus the Construction Clipboard.

Each COM port item consists of a set Modbus map functions and addresses containing the actual map that the Modbus interface will use, split into the 4 Modbus function types:

- Coils
- Input Statuses
- Holding Registers
- Input Registers

The Construction Clipboard is a set of temporary maps that may be pasted to the actual Modbus map to speed up the configuration of large sites.

1. To display the map for a particular function type, click on it in the tree structure.



Each address will be displayed with the following naming convention:

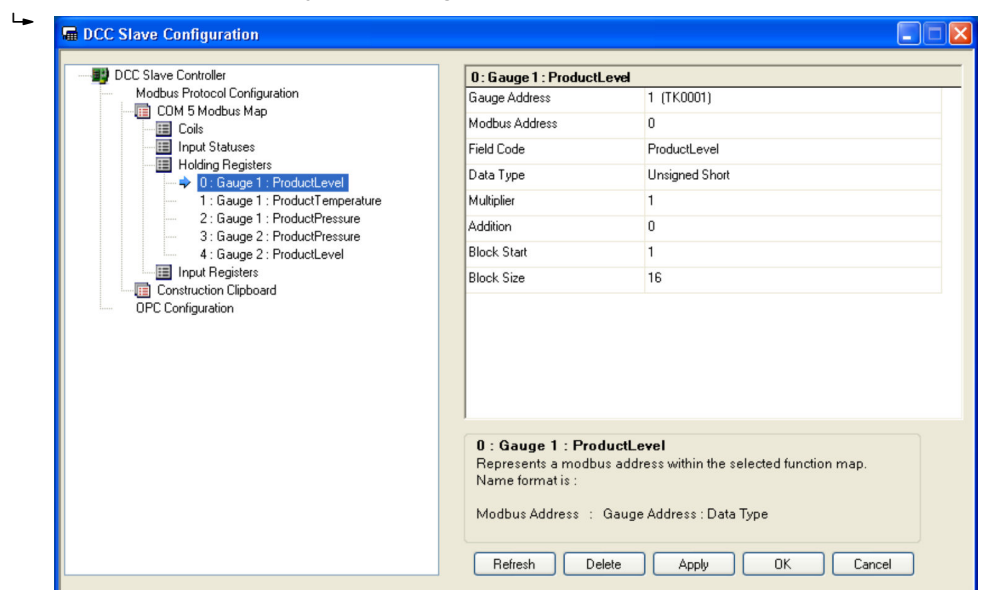
Address : Gauge Number : Data Type

The address is the Modbus address in the selected function map. The Gauge Number is the value assigned to a gauge for the field "Tank Address" in the database.

For Example, the item **0 : Gauge 1 : ProductLevel** in the Holding registers function map is the first holding register, which will return the Level for the gauge which has a "Tank Address" of 1.

Each address has a set of parameters used to format the data when sent to the host PC.

2. To display the parameters for an address, click on that address in the left hand box and the data will be displayed in the right hand edit box.



The data will consist of:

- **Gauge Address** – A drop-down list of all current gauges in the database, displayed with gauge address first, then the tank name
- **Modbus Address** – This is a fixed field and cannot be modified
- **Field Code** – A drop-down list of all fields accessible for gauge. This list has a very large range of items and for ease of use may be filtered. See later for some notes on certain field types.
- **Data Type** – A drop-down list of the data formats for the data. Note that some formats may take more than one address (i.e. Floats, Doubles etc.), thus care should be taken when adding more addresses to allow for this.
- **Multiplier** – see **Addition**
- **Addition** – Real (decimal) number factors which are used to scale and offset values transferred over the Modbus network. Values read from the database are first multiplied by the Multiplier and then have the Addition factor added. The resulting value is then passed to the Modbus master device. Conversely, values sent from the Modbus master device have the Addition factor subtracted and then are divided by the Multiplier before being stored in the database.
- **Block Start** – see **Block Size**
- **Block Size** – These parameters are only required for block type fields such as profile data and skin temperatures. They should be ignored for all other types. They define the start position in the profile table (from 1 to 256) for the first point in the block and the number of consecutive points after that i.e. the size of the block.

3. Data may be modified then saved by clicking on the **Apply** button.

 Previous versions of the Modbus Slave interface also showed the **Byte Order** in the above list. The **Byte Order** is now configured globally.

Filtering Field Code Selection

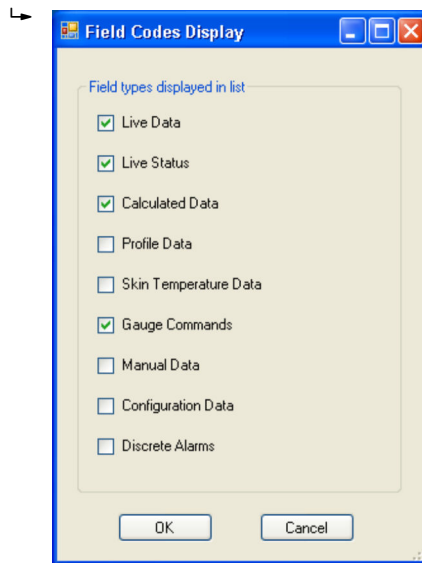
There are a large amount of options to select from the **Field Code** drop-down menu.

To simplify this selection procedure, the drop-down list may be filtered to display only certain groups of field codes types, defined below:

- **Live Data** – Data generally returned from the gauges i.e. levels, temperatures densities etc.
- **Live Status** – Status fields for the gauges
- **Calculated Data** – Data calculated by the tank gauging system i.e. volumes etc.
- **Profile Data** – Data from gauges that can carry out density/temperature profiles
- **Skin Temperature Data** – Data from temperature multiplexors
- **Gauge Commands**
- **Manual Data**
- **Configuration Data**
- **Discrete Alarms** – Live data alarms that may be accessed as individual bits

By default all fields will be displayed.

1. To change the filter, click on the **Field Code** line in the data parameter table.

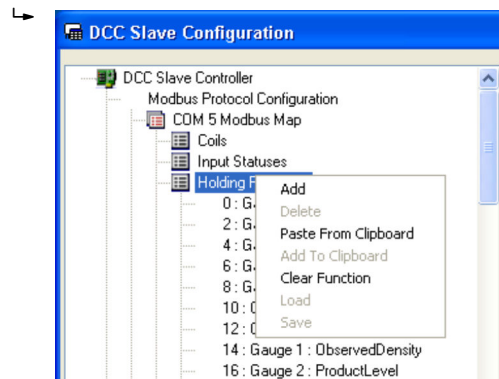


2. Make sure the required groups to be displayed are ticked and click **OK**.

Adding and Deleting Entries

1. To add a new entry to the Modbus map click on the Modbus function for which the address is to be added.

2. Right click to display the pop-up menu and select **Add**.



The **Add New Address** dialog will be displayed, allowing the new address parameters to be entered.

Modbus Address	5
Gauge Address	-1 (All Gauges)
Field Code	BasePressure
Data Type	Signed Char
Multiplier	1
Addition	0
Block Start	1
Block Size	16

Data Type
Defines the format of the data. Some formats use multiple addresses :

- Int - 2
- Float - 4
- Double - 8
- Text - 16

OK Cancel

The data will initially be set to default values or the last address added, except for the **Modbus Address** field which will be set to the next free address in the function map.

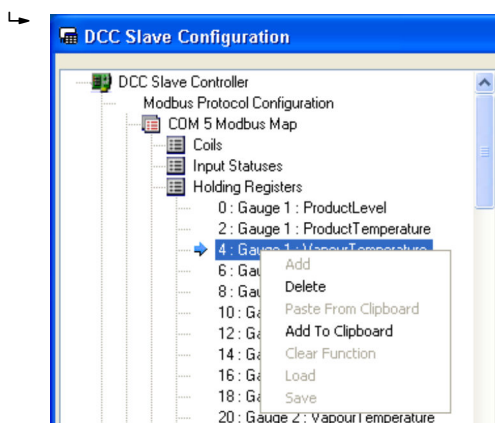
3. After all parameters have been entered, click on **OK** to add the new address to the map.

If an illegal parameter has been entered, a warning message will be displayed. This applies particularly to the Modbus address which must be a unique value within the function map.

i The address must be unique and if this data item is immediately following the previous one the next Modbus Address must take account of the size of the previous Data Type. E.g., for an Integer the Modbus Address increments by 1, for a Float the Modbus Address increments by 2 etc.

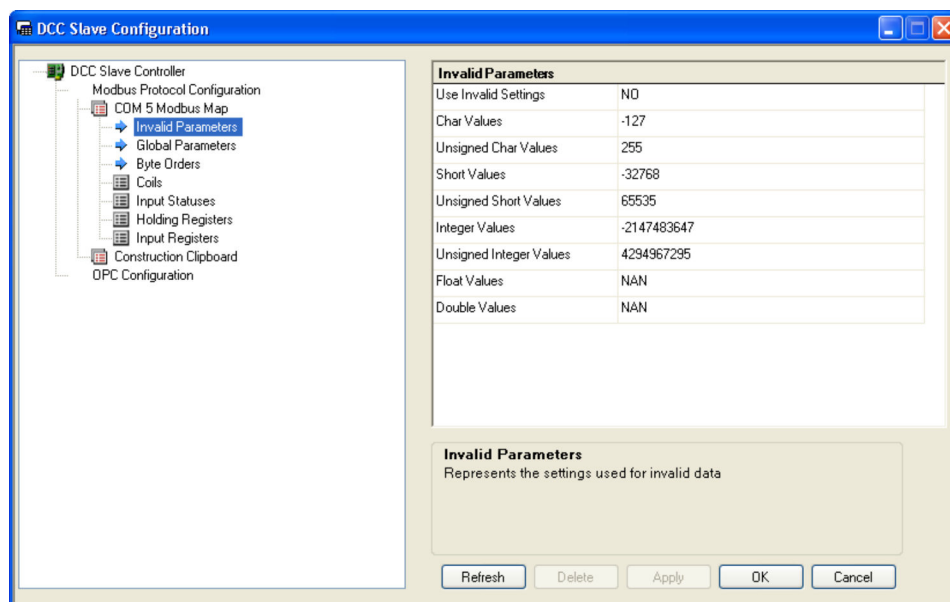
1. To delete an existing entry in the Modbus map, click on the address to be deleted.

2. Then right click to display the pop-up menu and select **Delete**.



Setting Invalid Parameter Values

Each COM port Modbus map has an entry where the invalid data settings can be modified.



These parameters are the values that data will be set to if they have an invalid status, depending on their configured Data Type. E.g., if the **Char Values** field was set to -127 then any data configured as a char in the Modbus map would be set to -127 when its status is invalid.

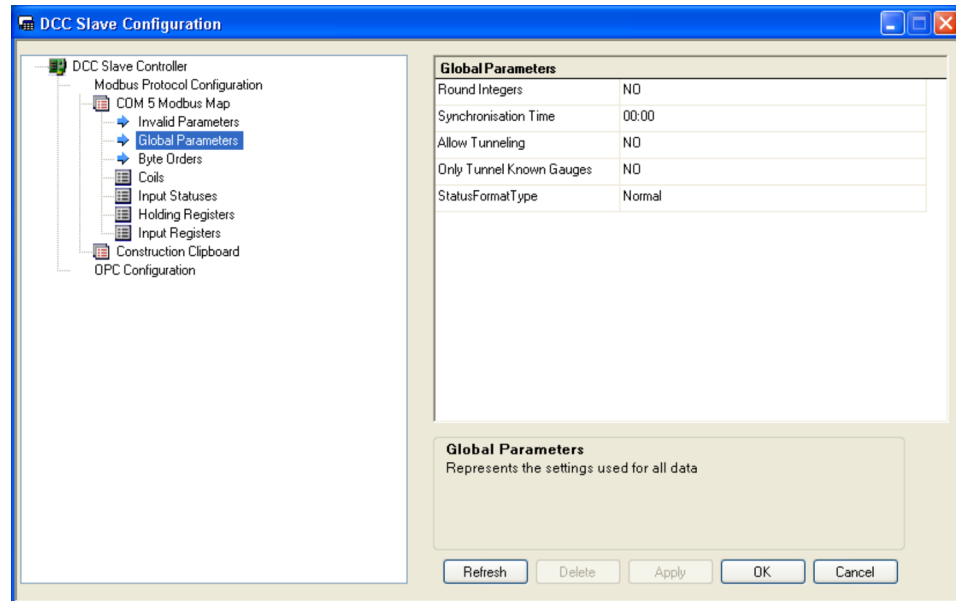
By default the **Use Invalid Settings** field will be set to NO, which means that the invalid data settings will be not be used, and the data will retain its last good value. The status field for that data item would then have to be checked.

Changing the **Use Invalid Settings** field to YES will set all data fields to use invalid data values.

Float and Double values may be set to 0, NAN (Not a Number) or Infinity. All these values are defined as part of the standard IEEE754 definition of floating point numbers.

Setting Global Parameter Values

Each COM port Modbus map has an entry where the any global parameters settings can be modified. These are settings that apply to the interface as a whole.



The parameters are as follows:

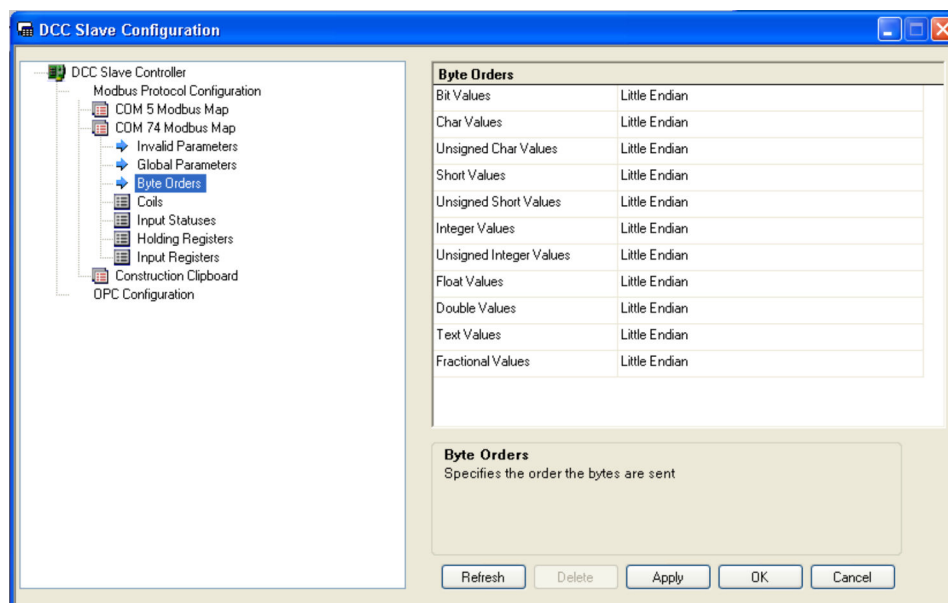
- **Round Integers** – Defaults to NO, in which case any parameters configured as integers in the Modbus interface will be truncated when the value is extracted from the tank gauging database. If this parameter is set to YES values will be rounded to the nearest integer.
- **Synchronisation Time** – This is the time that the system will be set to when the "time synchronisation" field is written to. See later section on Time Synchronisation for more details.
- **Allow Tunneling** – Defaults to NO, in which case any modbus requests for PLC addresses other than this slave interface will be ignored. If set to YES then any modbus requests for addresses other than this slave interface will be tunneled to all gauge interfaces that run the modbus protocol. The reply from the gauge will be returned on this interface. This is mainly used with SAAB gauges.
- **Only Tunnel Known Gauges** – Defaults to NO. Tunneling must be enabled to use this parameter. If set to YES, tunnel requests will only be sent to any gauge that exists in the database. If set to NO, the tunnel request is broadcast to ALL gauge interfaces.
- **StatusFormatType** – Defaults to Normal. This sets the formatting for the parameter status fields.

The current options are:

- **Normal:** A decimal number where
 - 1 = data is valid
 - 0 to 255 = Diagnostic code for invalid data (i.e. the DN number displayed on screen)
- **Bit:** Bit-mapped, where
 - Bit 1 Set = data is valid
 - Bit 2 Set = data is manual
 - Bit 9 Set = no reply from device (i.e. DN00)
 - Bit 10 Set = data not ready (i.e. DN01)
 - Bit 11 Set = data invalid (i.e. DN04)
- **Datacon:** Bit-mapped, where
 - Bit 7 Set = data invalid (i.e. DN04)
 - Bit 8 Set = no reply from device (i.e. DN00)
- **Enraf:** Formatted as per the Enraf CIU Prime Modbus specification
- **SAAB:** Bit-mapped, where
 - Bit 16 Set = data is valid

Setting Byte Order Values

Each COM Port Modbus map has an entry where the Byte Order settings can be modified. These settings apply to any field which uses the appropriate Data Type.



These parameters define the order of the data bytes for each Data Type. Refer to a later section for a more detailed description of byte ordering (see "Byte Ordering").

 These parameters used to be set individually for each register field.

Construction Clipboard

The Construction Clipboard allows common blocks of information to be pasted to the Modbus function maps repeatedly, thus reducing the time taken to create a large map.

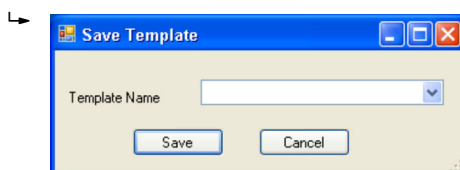
There are a number of ways to add addresses to the clipboard:

- Hold down the CTRL key and click on each address to be added to the clipboard
- Right click on an address and select the **Add To Clipboard** option from the pop-up menu
- Select a Function in the Clipboard and add a new address in exactly the same manner as described previously in "Adding and Deleting Entries"

Any addresses added by the above methods will automatically be added to the same function type in the Clipboard as the source function. Thus if addresses from the Holding Registers function map are added to the Clipboard, they will be added to the Holding Registers function.

Once a set of blocks have been created for the Construction Clipboard, they may be saved to a Template for later use.

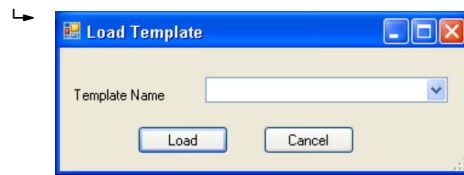
1. To do this right click on the **Construction Clipboard** item and select **Save** from the pop-up menu.



2. Enter the **Template Name** to save the Template under, or select an existing name from the drop-down list.
3. Then select **Save** to store this Template. Various different Templates may be saved.

Previous Templates may be loaded in the Construction Clipboard.

1. To do this, right click on the **Construction Clipboard** item and select **Load** from the pop-up menu.

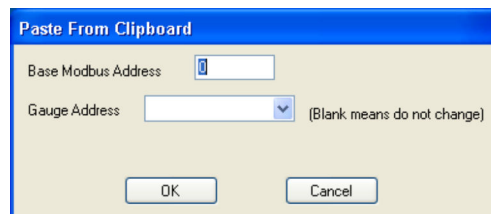


2. Enter the **Template Name** of the Template to load or select from the list, then click **Load**.

↳ The existing clipboard entries will be cleared and new ones will be loaded from the Template.

1. To use a template to paste addresses to the Modbus map, right click on the function map to be added to, and select **Paste From Clipboard** from the pop-up menu.

↳ This will display the following dialog:



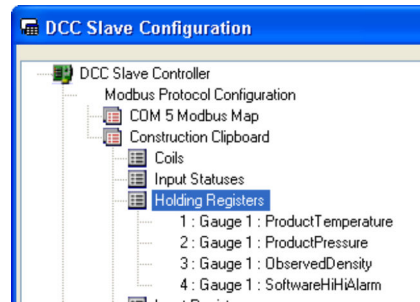
The **Base Modbus Address** is used to offset all the addresses in the clipboard when pasting to the destination.

If a Gauge Address is selected then all addresses pasted from the clipboard will have their **Gauge Address** field set to this value. Leaving this field blank will mean the gauge addresses will be as per the values in the Clipboard.

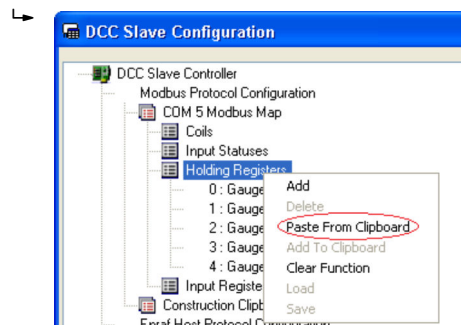
2. Click **OK** to add the addresses from the Clipboard to the map.

EXAMPLE:

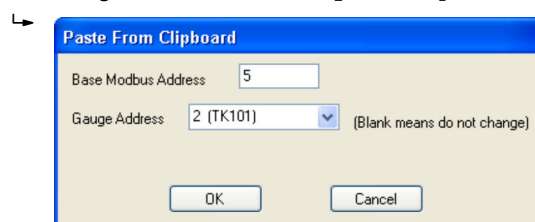
If the Clipboard was setup for the Holding Registers as shown below:



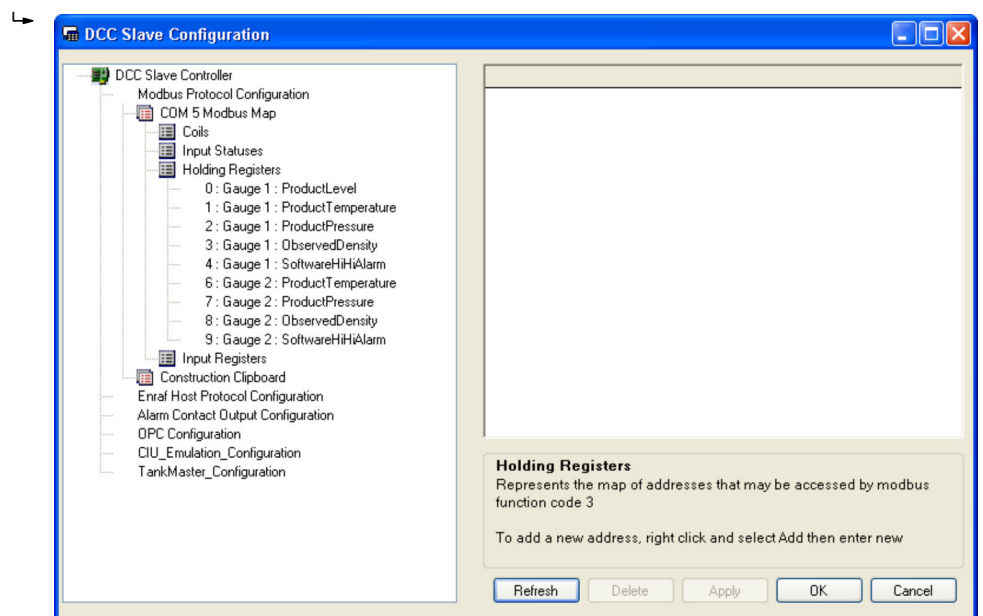
1. To paste these registers to the actual Modbus map, select the Holding register's function map and right click to display the pop-up menu.



2. Selecting the **Paste From Clipboard** option displays the settings dialog.



3. After entering the required data, in this example a **Base Modbus Address** of 5 and using gauge 2, then clicking on **OK** will add the registers as shown below.



All 4 registers have been added, with the correct Modbus addresses starting from 6 (SoftwareHiHiAlarm is a double register) and with a source Gauge address set to 2.

Making Changes

The configuration of the Modbus map can be modified at any time using the **DCC Slave Configuration** tool.

The changes only take effect after the **OK** or **Apply** button has been pressed in the tool and the DCC Slave service stopped and re-started.



The project must be "Set As Runtime Database" to make the changes permanent.

Clearly any changes made to the Modbus Map need to be made at the host end as well.

Field Codes

A field code must be defined for every address within the Modbus map, which determines what data item within a gauge is used as the source for the address. There are a large number of selections available and some knowledge of the database structure is required to determine which fields are required in the Modbus map.

This section will give an outline of some of the standard fields for such items as live data parameters returned from the gauge, calculated volumes, profiles and gauge commands.

Live Data Parameters

These parameters are the raw data returned from the gauge or may be manually entered (see next section "Manual Data Parameters").

Each parameter will have 2 field codes:

- **Data Value** – The actual value of the data
- **Status** – The status/validity of the data

The formatting of the **Status** fields depends on the selection in the **StatusFormatType** field in the globals section. Refer to section on Global Parameters (see "Setting Global Parameter Values") for details of the possible format types.

The name of the fields will be **Param** and **ParamStatus**, where **Param** is the name of the parameter.

For example, the ProductLevel parameter has field codes available, named ProductLevel and ProductLevelStatus.

The full set of parameters available are shown below, but gauges usually supply only a subset of these. It is up to the configurator to determine which are required:

- ProductLevel
- ProductTemperature
- DisplacerPosition (no manual mode)
- FreeWater
- ReferenceDensity
- ObservedDensity
- ObservedTemperature
- GaugedDensity (no manual mode)
- ProductPressure
- AirPressure
- VapourPressure
- VapourTemperature
- AirTemperature
- LngCurrentDensity
- OilDepth

Manual Data Parameters

All the parameters in the previous section (Live Data Parameters) have corresponding manual and mode values which may be added to the modbus map. These fields are writable using modbus tasks 6 and 16.

The manual data values are as follows:

- **Manual Value** – The manually entered value of the data
- **Mode**
 - 0 = data is live from gauge
 - 1 = data is manual entered

The name of the 2 fields will be **ManualParam**, **ParamMode**, where **Param** is the name of the parameter.

For example the ProductLevel parameter has 2 corresponding manual field codes available, named **Manual Product Level**, **Product Level Mode**.

If the mode is set to 1, then the manual data value will appear also in the live data field and the status field will always be valid.

 By default the manual parameters do not appear in the field code drop-down list. See section on Filtering Field Code Selection for details on how to display them.

Watchdog

As part of the live parameters section there are a number of fields that indicate if the DCC communications sub-system is healthy. These include:

- **Watchdog** – This is a special field which will be incremented every time it is read, indicating that DCC is healthy.
If the DCC sub-system is not healthy (i.e. DCC Host or Hermes services fail) then this field will stop incrementing, in which case ALL data returned on the Modbus link should be regarded as suspect.
The watchdog field has a range 0 to 65 535 (i.e. 2 bytes, unsigned) and will wrap around to 0. When using this field in a Modbus link, the actual value is not important, as long as it is different to the last value read.
- **SystemHealthy**
 - 0 = Watchdog tripped (i.e. not incrementing)
 - 1 = System is Healthy
Both fields indicate the same information, but in a different format, so that the client system can choose which one to use.

Redundancy Status

The Redundancy Status is a bit-mapped global field that indicates the status of a Multi Scan NXA83B when used as part of a redundant pair. It should be only added once to the Modbus map and applies to the Multi Scan NXA83B itself, not to individual gauges.

The definition of the field is as follows:

Bit	Redundancy Status Description
0	System is in LIVE polling mode
1	System is in PASSIVE mode
2	Passive system is active
3	Watchdog tripped, Comms sub-system failure
4	No redundancy configured
5	SwitchByGauge redundancy configured
6	SwitchByInterface redundancy configured
7	SwitchBySystem redundancy configured

Time Synchronisation

As part of the live parameters section there is a field that can be used to synchronise the time between the 2 systems connected by the Modbus interface. The field is called either **Synchronise Time Command** or **TimeSync**, depending on the software version. As it is a

global field, it only needs to be added once to the Modbus map (the tank assigned to it is irrelevant).

When this field has a value written to it (it does not matter what value), the time on the Modbus slave system will be set to the time configured in the modbus setting:

Global Parameters → Synchronisation Time

Thus the field should only ever be written to once per day at this time.

The field can be configured as a coil or a register in the Modbus map.

Live Status Parameters

These parameters are the raw status data returned from the gauge, they include the field codes:

- AlarmStatus
- GaugeStatus
- ExtendedAlarmStatus
- ServoStatus
- ServoAlarmStatus
- SystemStatus
- SystemGaugeStatus
- GaugeDigitalInputs
- UserDefinedAlarms
- ProfileStatus
- FCULevelStatus
- FCUTemperatureStatus
- FCUDiagnostic
- ScanMode
- Stratification Status
- Stratification Severity
- ExtendedAlarmStatus2
- EHGaugeStatus

All these fields have a fixed format and are not affected by the **StatusFormatType** setting section (see "Setting Global Parameter Values") on Global Parameters.

They are all bit mapped values with the following meanings:

Bit	Alarm Status Description
0	Level Hi Hi Alarm
1	Level Hi Alarm
2	Level Low Alarm
3	Level Low Low Alarm
4	Roof Alarm (Software)
5	Float Alarm (Software)
6	Difference Alarm (Software)
7	Unauthorised Movement (Software)
8	Level Hi Hi Alarm (Software)
9	Level Hi Alarm (Software)
10	Level Low Alarm (Software)
11	Level Low Low Alarm (Software)
12	Hi Temperature Alarm (Software)
13	Lo Temperature Alarm (Software)
14	Hi Flow Alarm (Software)
15	Lo Flow Alarm (Software)

Bit	Gauge Status Description
0	Config Command Data Ready
1	ConfigCommand Data Executing
2	Gauge Command Data Ready
3	Gauge Command Executing
4	Gauge Initialising
5	Fast Scan
6	Manual Scan Complete
7	Offline/Offscan

Bit	Extended Alarm Status Description
0	Low Density (Gauge)
1	High Density (Gauge)
2	Low Temperature (Gauge)
3	High Temperature (Gauge)
4	High Density (Software)
5	Low Density (Software)
6	Density Deviation (Software)
7	Temperature Deviation (Software)
8	High Water (Software)
9	Low Water (Software)
10	Temperature Deviation (Gauge)
11	Density Deviation (Gauge)
12	Time To Variable (Software)
13	No Reply from gauge (Software)
14	Theft Detected (Software)
15	LNG Rollover (Software) NOT SUPPORTED, reserved for future use

Bit	Extended Alarm Status 2 Description
0	No Flow (Software)
1	Unauthorised Level Movement (software)
2	Tank mode Timer (Software)
3	–
4	–
5	–
6	–
7	–
8	Gauge Specific Alarm 1 (Gauge)
9	Gauge Specific Alarm 2 (Gauge)
10	Gauge Specific Alarm 3 (Gauge)
11	Gauge Specific Alarm 4 (Gauge)
12	Gauge Specific Alarm 5 (Gauge)
13	Gauge Specific Alarm 6 (Gauge)

Bit	Extended Alarm Status 2 Description
14	Gauge Specific Alarm 7 (Gauge)
15	Gauge Specific Alarm 8 (Gauge)
16	User Defined Alarm 1 (Software)
17	User Defined Alarm 2 (Software)
18	User Defined Alarm 3 (Software)
19	User Defined Alarm 4 (Software)
20	User Defined Alarm 5 (Software)
21	User Defined Alarm 6 (Software)
22	User Defined Alarm 7 (Software)
23	User Defined Alarm 8 (Software)
24	Skin Sensor Low Temperature (Software)
25	Skin Sensor High Temperature (Software)
26	Skin Sensor Hot Spot (Software)
27	Skin Sensor Leak (Software)
28	–
29	–
30	–
31	–

Bit	Servo Status Description
0	Servo up
1	Servo down
2	Servo Top Limit
3	Servo Bottom Limit
4	Off-Level
5	Water/Interface Mode
6	Testing/Stowing/Calibrating
7	Blocked/Frozen

Bit	Servo Alarm Status Description
0	Level Hi Hi Alarm
1	Level Hi Alarm
2	Level Low Alarm
3	Level Low Low Alarm
4	Product Temperature Data Not Valid
5	Product Level Data Not Valid
6	Product Temperature No Response
7	Product Level No Response
8	Servo up
9	Servo down
10	Servo Top Limit
11	Servo Bottom Limit

Bit	Servo Alarm Status Description
12	Off-Level
13	Water/Interface Mode
14	Testing/Stowing/Calibrating
15	Blocked/Frozen

Bit	System Status Description
0	Servo Check Passed
1	Servo Check Failed
2	Config Command Failed
3	Gauge Command Failed
4	Gauge Fault
5	Switch By System Redundancy, set=Passive, clear= Live Polling
6	Switch By System Redundancy, set=Fixed, clear=Dynamic
7	General Fault

Bit	System Gauge Status Description
0	Config Command Data Ready
1	ConfigCommand Data Executing
2	Gauge Command Data Ready
3	Gauge Command Executing
4	Gauge Initialising
5	Fast Scan
6	Manual Scan Complete
7	Offline/Offscan
8	Servo Check Passed
9	Servo Check Failed
10	Config Command Failed
11	Gauge Command Failed
12	Gauge Fault
13	Switch By System Redundancy, set=Passive, clear= Live Polling
14	Switch By System Redundancy, set=Fixed, clear=Dynamic
15	General Fault

Bit	Profile Status Description
0	Profiling
1	Profile Data Ready: ■ Cleared when profiling ■ Set when profile data has been read at end of profile
2	–
3	–
4	–
5	–

Bit	Profile Status Description
6	–
7	–

Bit	FCU Level Status Description
0	–
1	–
2	–
3	–
4	–
5	–
6	–
7	Product Level Valid

Bit	FCU Temperature Status Description
0	Element 1 Invalid
1	Element 2 Invalid
2	Element 3 Invalid
3	Element 4 Invalid
4	Element 5 Invalid
5	Element 6 Invalid
6	Element 7 Invalid
7	Element 8 Invalid
8	Element 9 Invalid
9	Element 10 Invalid
10	Element 11 Invalid
11	Element 12 Invalid
12	Element 13 Invalid
13	Element 14 Invalid
14	–
15	Product Temperature Valid

Bit	FCU Diagnostic Description
0	–
1	–
2	–
3	Watchdog Tripped
4	–
5	–
6	–
7	–
8	–
9	–

Bit	FCU Diagnostic Description
10	–
11	–
12	Passive System is Active
13	–
14	–
15	–

Bit	Scan Mode Description
0	–
1	Fast Scan Mode
2	–
3	Offscan
4	–
5	–
6	–
7	Offscan mode
8	Connected
9	Connecting
10	Disconnecting
11	Not Connected
12	–
13	–
14	–
15	Offline

Bit	Gauge Digital Inputs Description
0	Input 1
1	Input 2
2	Input 3
3	Input 4
4	–
5	–
6	–
7	–

Bit	User Defined Alarms Description
0 to 31	User Defined Alarms 1 - 32 (Gauge)

The EHGaugeStatus field is not bit-mapped, but is a discrete number corresponding to one of the following codes.

Bit	E+H Gauge Status
1	Displacer at reference position
2	Displacer hoisting up
4	Displacer stop
5	Level measurement balanced
6	Upper interface level balanced
7	Lower interface level balanced
8	Bottom measurement balanced
9	Upper density done
11	Middle density done
12	Release overtension
13	Calibration activated
14	Seek level
15	Follow Level
19	Seek upper interface level
20	Follow upper interface level
21	Seek lower interface level
22	Follow lower interface level
23	Seek bottom level
25	Stopped at high stop
26	Stopped at low stop
27	Repeatability testing
28	Seek water level
29	Water dip finished
32	Maintenance mode
33	Startup
34	Water level error
35	Slow hoist up
36	Level found
37	Bottom done
38	Profile done
39	Above liquid
40	Overtension released
41	Temporary balanced
42	Lower density error
43	Middle density error
44	Profile error
45	Upper density error
46	Wait for level
47	Seek standby position
48	Move to target

Bit	E+H Gauge Status
49	Measure density
50	Measure in air
51	Bottom error

In addition to the standard status data there are a number of status fields that have no fixed mapping, but instead have a "free form" bit allocation dependent on the type of gauge being polled gauge.

These codes include:

- ExtendedGaugeStatus
- GaugeMode

At present most gauges do not implement these fields. Those that do are defined below.

Scientific Instruments 6280 and 6290 LTD gauges

Bit	Extended Gauge Status Description
0	Bottom Reference
1	Lower Sensor
2	Upper Sensor
3	Interlock
4	6280 = Master Enable 6290 = Medium Speed
5	Metric, 1 =metric, 0 = Imperial. Note 6290 only
6	Drive Disable. Note 6290 only
7	Disable Reel Alarm
8	Reel Alarm
9	Probe Uncalibrated
10	6280 = System Change Enabled 6290 = High Speed
11	Interval Timer
12	Probe At Liquid Level
13	Unit Not Responding
14	Bit test/Alarm bit test mode. Note 6290 only
15	Simulator mode. Note 6290 only

Bit	Gauge Mode Description
0	Manual Mode
1	Calibrate Mode
2	Auto Mode (Follow Level)
3	Program Mode (Profile)
4	Drive Up
5	Stopped
6	Drive Down
7	Topscan Mode (Profile)

ITG 60/70 gauges

Bit	Extended Gauge Status Description
0	Density Sensor
1	Temperature Sensor
2	BSW Sensor
3	Datum Sensor
4	–
5	–
6	–
7	–
8	1 Minute Warning
9	Configuration Warning
10	Liquid State, 1 = Homogeneous, 0 = Stratified
11	Liquid State unknown
12	Intelligent Sensing Head Fitted
13	Novram Error
14	–
15	–

Bit	Gauge Mode Description
0	Seeking Level
1	Doing Profile
2	Doing Dip
3	Finding BSW
4	Following BSW
5	Finding Datum
6	Following Level
7	–

Enraf 854 gauge

Bit	Gauge Mode Description
0	–
1	–
2	Following Level
3	Doing Profile
4	–
5	–
6	–
7	–

E+H Proservo gauges using V1 protocol

Bit	Extended Gauge Status Description
0	Balanced
1	Over Tension
2	Under Tension
3	Encoder Error
4	Hall Sensor Error
5	Alarm 1
6	Alarm 2
7	–
8	External Input S1
9	External Input S2
10	External Input S3
11	External Input S4
12	–
13	–
14	–
15	–

Bit	Gauge Mode Description
0	–
1	–
2	–
3	Doing Profile (upper density)
4	–
5	–
6	–
7	–

Whessoe 1146 LTD gauge

Bit	Extended Gauge Status Description
0	Lever Low Stop Limit
1	Reed Switch Low Stop Limit
2	Software low Stop Limit
3	Level High Stop Limit
4	Software High Stop Limit
5	1 = Moving Up, 0 = Moving Down
6	Sensor Disconnected
7	No Encoder Movement
8	Over Current
9	Mode Manu
10	Profile in progress
11	Gauge Moving

Bit	Extended Gauge Status Description
12	Probe at Liquid level
13	Above Level (in vapour)
14	Densitometer mode
15	Follow Level mode

Bit	Gauge Mode Description
0	Manual Mode
1	–
2	Auto Mode (follow level)
3	Program Mode (profile)
4	Drive Up
5	Stopped
6	Drive Down
7	–

Port Status

The Port Status field is a composite bit-mapped field that shows the current status of 16 field ports. Each bit corresponds to one status of one COM port, with the actual ports depending on the value of the Block Start field.

So for instance if the Block Start field is set to 1, the bits will be:

Bit 1 = COM 1

Bit 2 = COM 2

etc.

Bit 16 = COM 16

If Block Start was set to 17:

Bit 1 = COM 17

Bit 2 = COM 18

etc.

Bit 16 = COM 32

The appropriate bit will be set if the following are true:

- The port is in use and connected
- At least one gauge is active on the port
- At least one gauge on the port has received valid replies

If the above are not valid then the bit will cleared.

Stratification Status parameters

These parameters indicate the status of the product layering within the tank, and are calculated after a profile has been carried out. They are only relevant if the gauge has the ability to carry out density and temperature profiles.

Stratification Status:

- 0 = unknown
- 1 = Homogenous
- 2 = Stratified

Stratification Severity:

NOT SUPPORTED AT THE MOMENT

Calculated Volume/Mass Parameters

These parameters are calculated from the raw data parameters returned from the gauge. They will be set to -1 if not valid, otherwise they will contain an analogue value and are thus best set as float or double data types.

- DensityCorrectionFactor
- FreeWaterVolume
- GaugeVolume
- GrossMass
- GrossObservedVolume
- GrossStandardVolume
- GrossWeight
- NetMass
- NetObservedVolume
- NetStandardVolume
- NetWeight
- StandardUllageVolume
- StandardUsableVolume
- TotalCalculatedVolume
- TotalGrossStandardVolume
- TotalObservedVolume
- UllageLevel
- UllageMass
- UllageWeight
- UllageVolume
- UsableMass
- UsableWeight
- UsableVolume
- VapourMass
- VapourStandardVolume
- VCF

Profile Data Parameters

Some gauges can carry out profiles of the temperature and density in a tank. These are saved in the database as a set of tables for level, temperature and density, and may be accessed via the Modbus Slave interface.

The following parameters show the current profiling state:

- Profiling
- ProfileDataReady
- ProfileStatus

When a profile is in progress the Profiling field will be set to 1 and the ProfileDataReady field will be 0. When the profile is completed the Profiling will be set to 0. When the profile data is uploaded then ProfileDataReady will be set to 1.

ProfileStatus is a bit-mapped field that combines the Profiling and ProfileDataReady states as follows.

Bit	Gauge Mode Description
0	Profiling
1	ProfileDataReady
2	–
3	–
4	–
5	–
6	–
7	–

The Time and Date that the last profile occurred is available in the following fields:

- ProfileYear
- ProfileMonth
- ProfileDay
- ProfileHour
- ProfileMinute
- ProfileSecond

The profile data for the last profile is available in a set of user defined blocks. The field codes are:

- DensityProfileBlock1
- DensityProfileStatusBlock1
- LevelProfileBlock1
- LevelProfileStatusBlock1
- TempProfileBlock1
- TempProfileStatusBlock1

Each block requires certain parameters to be defined:

- **Block Start:** The index within the profile table (1 to 256 range) for the first position in the block
- **Block Size:** The number of profile points after the start position to be included in the block, up to a maximum of 256

Thus if the gauge supports 10 profile points (i.e. an Enraf 854 gauge) then the **Block Start** should be set to 1 and the **Block Size** to 10.

The status blocks are coded as per Live Data status, i.e. -1 = valid, 0 to 255 = invalid.

When profile blocks are added to the map, multiple ADDRESSES will be added according to the **Block Size** field. I.e. if LevelProfileBlock1 is added at address 0, with a Block Size of 10 and its data type is float then the next free address is 20 (float = 2 addresses × 10 profile points in block).

Profile blocks may be added in the normal way, being assigned for each gauge in the database, but this may take up a very large amount of addresses. Thus there is a second method of using the profiles in the Modbus map, using the **ProfileSelector** field.

To enable this mode add the **ProfileSelector** field code to the map ONCE only, the gauge address does not matter. The Profile blocks should then be added to the map ONCE only, again the gauge address is selected for the map does not matter.

The profile blocks get their data from the gauge whose address is currently stored in the ProfileSelector point. Thus to read the profile data for a gauge, the master should first write the gauges address to the ProfileSelector point, then read the profile blocks.

Skin Temperature Data

Some gauges can return a set of skin temperatures from around the surface of the tank, up to maximum of 250 individual points. These are updated in DCC Host on the background scan cycle, defaulting to every 3 minutes.

The skin temperature data is available via the Modbus slave and may be added to the Modbus map in user defined blocks.

- SkinTempBlock1
- SkinTempStatusBlock1

Each block requires certain parameters to be defined:

- **Block Start:** The index within the skin temperature table (1 to 256 range) for the first position in the block
- **Block Size:** The number of temperature points after the start position to be included in the block, up to a maximum of 256

The status blocks are coded as per Live Data status, i.e. -1 = valid, 0 to 255 = invalid.

Skin Temperature blocks are treated in the same way as Profile blocks in the Modbus map. Therefore refer to the section on Profile Data (see "Profile Data Parameters") for more

details on the formatting of blocks. This also includes the **ProfileSelector** method. If this is used then it also applies to Skin Temperature blocks.

Multi-Element Temperature Parameters

Gauges that have multi-element or multi-spot temperature transmitters fitted can return a table of up to 16 temperatures. This data is available via the Modbus slave and may be added to the Modbus map in a single block of sixteen addresses.

The field codes are:

- TempElementBlock
- TempElementStatusBlock

The TempElementBlock contains the 16 temperature points in the table, with the status block having the 16 corresponding status fields coded as per Live Data status, i.e. -1 = valid, 0 to 255 = invalid.

When adding a multi-element temperature block to the map it must be taken into account that 16 ADDRESSES will actually be added i.e. if TempElementBlock is added at address 0 and its data type is float then the next free address is 32 (float = 2 addresses × 16 profile points in block.)

Gauge Commands

A range of fields are available which are used to issue commands to control any connected gauges. These fields can be written to as well as read and are split into 2 basic types.

1. Simple Gauge Commands

These fields allow only a limited set of simple commands to be sent to the gauges, and are typically used if the commands are to be mapped to coils. They can be used as coils or registers.

The fields are:

- AlarmTestCommand
- CalibrateCommand
- CancelTestCommand
- CombinedProfileCommand (profile includes find water)
- FreezeCommand
- LowerCommand
- ProfileCommand
- RaiseCommand
- ServoTestCommand
- StowCommand
- UnfreezeCommand
- UnstowCommand
- WaterCommand

Simply writing ANY value to one of these fields will send the appropriate command to the gauge.

2. Advanced Gauge Commands

These fields allow the full range of gauge commands to be sent to the gauges, together with extra arguments which give more control of the command to be carried out. They can only be used as registers.

The fields are:

- GaugeCommand
- Arg0
- Arg1
- Arg2
- Arg3

A command will be sent to the gauge when the **GaugeCommand** field is written to.

Args 0 to 3 contain optional arguments required for certain commands and should be set BEFORE writing to the **GaugeCommand** field.

The **GaugeCommand** field consists of an ASCII character which may be one of the following:

ASCII character	Meaning
A	Alternate (Fast) Scan
B	Basic (Normal) Scan
O	Single Scan (for Off-Scan gauge)
X	Exclude from Scan/Off-Scan
T	Test Gauge (Servo Check)
C	Cancel Test
F	Freeze
N	Un-freeze
S	Stow
U	Un-Stow
R	Raise
L	Lower
Q	Calibrate
1	Interface 1 (air – product)
2	Interface 2 (tank bottom)
3	Interface 3 (product – water)
M	Store current Level, Temperature and Alarm Status
E	Update Element Temperatures
I	Update Tank/Interface Profile Levels
K	Update Tank/Interface Profile Temperatures
P	Update Tank/Interface Profile Densities
D	Dip mode (level/temperature dip)
V	Profile Scan (temperature/density/water/datum, etc.)
W	Water Dip
Y	Datum Dip (zero level)
Z	Initialise Gauge (Initialise Gauge Comms – does not reset the gauge itself)
–	Cancel current command
(sp)	No command active (status indication - not actually sent as a command)

S → Stow/Lock Test Gauge	Meaning
Arg0	0 = Stow Gauge to Top Limit Cut-out
	1 = Lock Test to Level
	2 = Stow Gauge to Top Limit Cut-out then return to Product Level
	3 = Lock Test to Level then return to Product Level
Arg1 → Lock Test Level (mm)	0 = Lock Test to Top Limit Cut-out

T → Test Gauge (Servo Check)	Meaning
Arg0 → Servo Check/Test Distance (mm)	0 = use default 300 mm
Arg1 → Servo Check/Test Tolerance (mm)	0 = use default ±5 mm
Arg2 → Servo Check/Test Timeout (seconds)	0 = use default 90 seconds

V → Profile Scan (Temperature/Density/Water)	Meaning
Arg0 → bit 0	0 = Tank Profile
	1 = Interface Profile
Arg0 → bit 1	0 = Downwards Scan
	1 = Upwards Scan
Arg0 → bit 2	0 = Exclude Water Level Dip
	1 = Include Water Level Dip
Arg0 → bit 3	0 = Exclude Datum Level Dip
	1 = Include Datum Level Dip
Arg0 → bit 4	0 = Include Temperature Profile Scan
	1 = Exclude Temperature Profile Scan
Arg0 → bit 5	0 = Include Density Profile Scan
	1 = Exclude Density Profile Scan
Arg0 → bit 6	not used: set to 0
Arg0 → bit 7	0 = Profile Scan Limit Levels Use Absolute Positions
	1 = Profile Scan Limit Levels Use Relative Positions
Arg1 → Profile Lower Limit Level (mm)	0 = use value pre-configured in gauge ProServo gauges only (NMS5 and NMS8), and only if Interface Profile flag set in Arg0 ■ 0 = Interface Profile ■ 1 = Manual Interface Profile ■ 2 = Upper Density ■ 3 = Middle Density ■ 4 = Lower Density ■ 5 = Upper Interface ■ 6 = Middle Interface ■ 7 = Lower Interface
Arg2 → Profile Upper Limit Level (mm)	0 = use value pre-configured in gauge
Arg3	≥ 1 and ≤ 64 Number of Profile Points
	≥ 65 Profile Interval (mm)
	0 = use value pre-configured in gauge

W → Water Dip	Meaning
Arg0	Water Interface Level Offset

Alternative Format Gauge Commands

The Gauge Command field can also be written to with a non ASCII decimal number (range 0 to 15) that corresponds to an Endress+Hauser specific command, shown below.

Number	Command
0	Level
1	Up

Number	Command
2	Stop
3	Bottom Level
4	Upper Interface Level
5	Lower Interface Level
6	Upper Density
7	Middle Density
8	Lower Density
9	Repeatability
10	Water Dip
11	Release Overtension
12	Tank Profile
13	Interface Profile
14	Manual Profile
15	Level Standby

Alarm Configuration Parameters

Programmable alarm configuration parameters may be accessed via the Modbus interface.

These are listed below, and all may be written to (using Modbus tasks 5 and 16) as well as read:

- FlowAlarmEnabled
- FlowHigh
- FlowLow
- FlowHysteresis
- LeakAlarmEnabled
- LeakThreshold
- DifferenceAlarmEnabled
- DifferenceAllowableTolerance
- DifferenceHysteresis
- LevelAlarmEnabled
- LevelHiHi
- LevelHi
- LevelLo
- LevelLoLo
- LevelHysteresis
- TemperatureAlarmEnabled
- TemperatureHigh
- TemperatureLow
- TemperatureHysteresis
- FloatAlarmEnabled
- FloatLevel
- FloatHysteresis
- FloatDirection
- RoofAlarmEnabled
- RoofHysteresis
- WaterAlarmEnabled
- WaterHigh
- WaterLow
- WaterHysteresis
- ProfileDeviationAlarmEnabled
- TemperatureProfileDeviation
- DensityProfileDeviation

- DensityAlarmEnabled
- DensityHigh
- DensityLow
- DensityHysteresis

All the Fields containing the "Enabled" key word are coded as follows:

- 0 = Alarm Disabled
- 1 = Alarm Enabled

All other fields are setpoint values, and will use the default units for the type of alarm, i.e. Level setpoints are in mm, density setpoints in kg/l, etc.

Byte Ordering

Within a data item which has a length of more than one byte, the bytes which make up that data item may be placed into registers in various sequences for transfer over the Modbus network. Such detail is not specified in the Modbus Protocol Reference Guide. The Modbus drivers provide a selection of different byte ordering methods to cater for Modbus devices which store data internally in different ways. Always consult the documentation of the Modbus device in order to determine which method of byte ordering the device employs.

In the following description, the "first" register is that with the numerically lowest address used for the data item and the "last" register is that with the numerically highest address. When registers are transferred over the Modbus network, they are sent in ascending numerical order within the messages.

In the examples of the encoding of a 32 bit number. **A** represents the address of the first register used to hold the data item value and **A+1** represents the next, i.e. last register so used. The bytes of the data item value are represented by **MSB** (Most Significant Byte), **NMSB** (Next Most Significant Byte), **NLSB** (Next Least Significant Byte) and **LSB** (Least Significant Byte). The Most Significant Byte of a data value is that byte which contains the part of the number which would be leftmost if the number were in written form (e.g. in the number 1234, the "1" is the most significant digit).

The byte ordering within a data item may be set to one of the following:

Little Endian

- Least significant byte of data value in low byte of first register
- Most significant byte of data value in high byte of last register

Example:

Register	Byte	Content
A	high byte	contains data value NLSB
A	low byte	contains data value LSB
A+1	high byte	contains data value MSB
A+1	low byte	contains data value NMSB

Big Endian

- Most significant byte of data value in low byte of first register
- Least significant byte of data value in high byte of last register

Example:

Register	Byte	Content
A	high byte	contains data value NMSB
A	low byte	contains data value MSB
A+1	high byte	contains data value LSB
A+1	low byte	contains data value NLSB

Little Logical

- Least significant byte of data value in high byte of first register
- Most significant byte of data value in low byte of last register

Example:

Register	Byte	Content
A	high byte	contains data value LSB
A	low byte	contains data value NLSB
A+1	high byte	contains data value NMSB
A+1	low byte	contains data value MSB

Big Logical

- Most significant byte of data value in high byte of first register
- Least significant byte of data value in low byte of last register

Example:

Register	Byte	Content
A	high byte	contains data value MSB
A	low byte	contains data value NMSB
A+1	high byte	contains data value NLSB
A+1	low byte	contains data value LSB

The encoding of Time/Date values conforms to ODBC standards, where the time and date is represented by an 8 byte floating point number. The whole number part of this represents the number of days since 1st January 1900. The fractional part represents the time as a fraction of 24 hours.

Floating point numbers are encoded in accordance with the IEEE754 specification. It should however be noted that there are numerous other methods of encoding floating point numbers but these are relatively uncommon. Some of these alternative methods are significantly different from the IEEE754 specification such that values so encoded would be immediately obvious as being wrong. There are however, a small number of encoding methods which are similar to IEEE754 and which may only manifest erroneous values in subtle ways. Always consult the documentation for the Modbus device to verify the encoding method used.

Data Types

The following data type identifiers are currently supported in the Modbus interface:

Type	Range	No. of Registers used	Notes
Bit	0-1	1 Coil	Should only be used for Coils or Input Status maps
Signed Char	-127 to 127	1	-
Unsigned Char	0 to 255	1	-
Short	-32 768 to 32 767	1	-
Unsigned Short	0 to 65 535	1	-
Int	-2 147 483 648 to 2 147 483 647	2	-
Unsigned Int	0 to 4 294 967 295	2	-
Float	$-3.4 \cdot 10^{38}$ to $3.4 \cdot 10^{38}$ (7 digits)	2	-

Type	Range	No. of Registers used	Notes
Double	$-1.797 \cdot 10^{308}$ to $1.797 \cdot 10^{308}$ (15 digits)	4	–
Text	12 ASCII characters	6	Each register is packed with 2 ASCII characters
Fractional	0.0000 to 65 535.9999	2	Data is converted to 4 byte value. HiWord (top 2 bytes) is integer value = 0 to 65 535 LoWord (lower 2 bytes) is decimal places = 0 to 9 999 Number of decimal places sent is defined in the Block Size field, up to a maximum of 4 places (default is 3) For Example: If using 4 decimal places then a Volume value of 40 052.7148 m³ will be converted to HiWord = 40052 and LoWord = 7148 The bytes sent (in hex notation) on the Modbus interface will depend on the Byte Order selected: ■ Little Endian = 9C 74 1B EC ■ Big Endian = EC 1B 74 9C ■ Little Logical = 74 9C EC 1B ■ Big Logical = 1B EC 9C 74

7.6 Enraf Protocol Configuration

DCC Slave implements the Enraf Host Communications protocol as defined in the Enraf document "Host Communications Manual ENTIS+, Version 5.23x" (file name HO-523x).

This defines an ASCII protocol for communication between a Master system and the slave interface running on the tank gauging system.

The following sections offer a quick start guide to configuring interfaces in DCC Slave that use the Enraf Host protocol. They assume a degree of prior knowledge of the protocol and it is recommended that a copy of the definition document is available when configuring the interface.

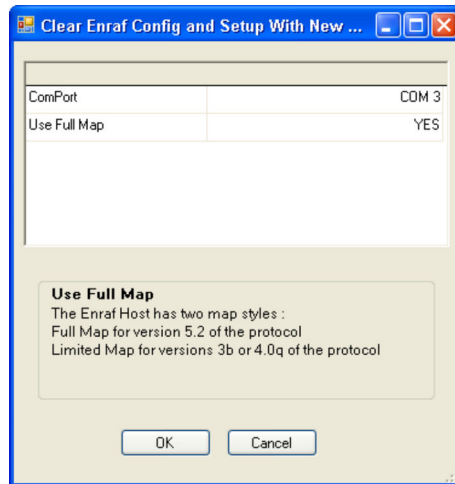
DCC Slave supports a sub-set of the full protocol, this includes:

- Full support of all Communication Parameter configuration options
- Tank Data configuration formats for versions 3b , 4.0q and 5.21
- All Tank data items supported, except:
Inlet and Outlet valve data
- Packet types supported:
 - Packet type 1 (Entity Request)
 - Packet type 3 (Download Command)
 - Packet type 7 (Entity Command)

7.6.1 Configuring Communication and Data Format

Start the DCC Slave Configuration module.

If one or more Enraf Hosts have been newly added to the DCC Slave and currently have no configuration details then the following screen will automatically be displayed, prompting the user to select the map type.

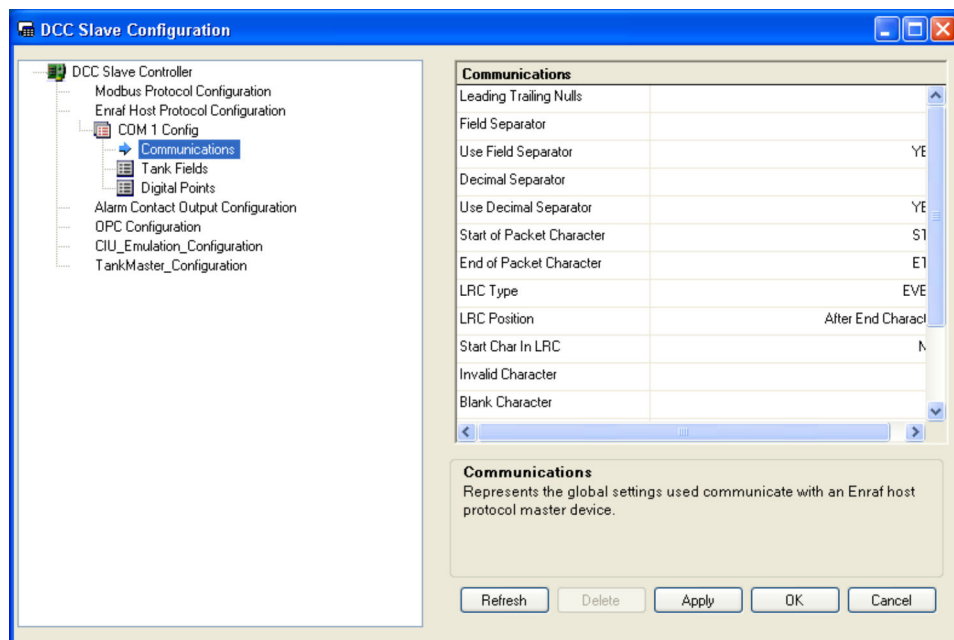


The COM port is fixed and cannot be changed but the **Use Full Map** fields may be set to **YES** or **NO**.

If set to **YES** then the tank configuration map will be initialized to that defined for version 5.21 of the protocol, if **NO** then to version 3b/4.0q (see section 3.3 of the Enraf definition document HO-523x).

Once all new Enraf interfaces have been initialized then the main configuration screen will be displayed. Expand the **Enraf Host Protocol Configuration** item to display all COM ports currently assigned to use this protocol.

To edit the configuration of an interface, click on the COM port item for the interface and select the **Communications** item.



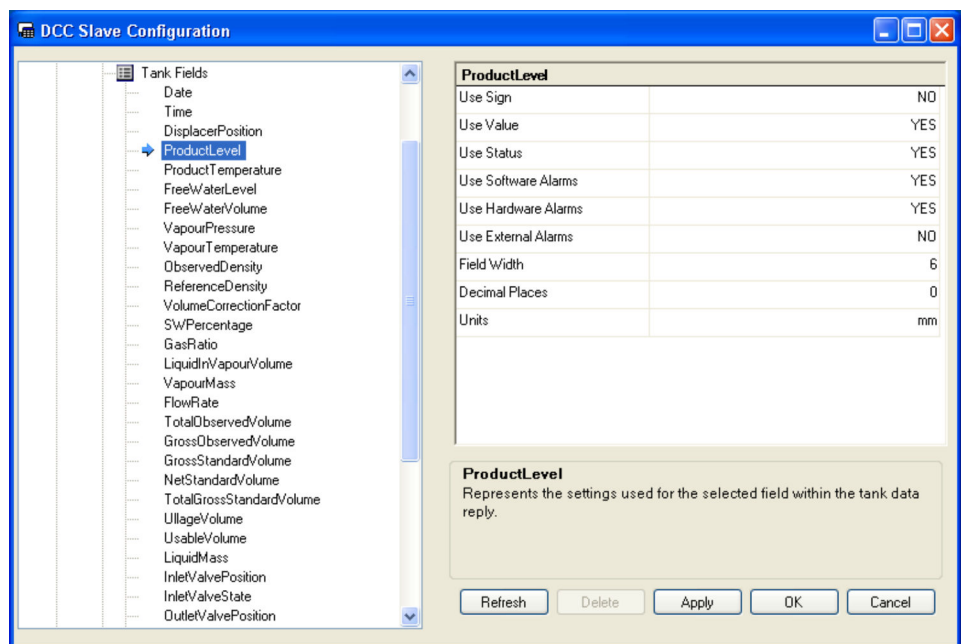
This allows all the Enraf specific communications fields to be edited in the right hand edit panel:

- **Leading Training Nulls** – Number of null characters to be sent before and after the reply message
- **Field Separator** – ASCII character to send in between each tank data field in the reply message
- **Use Field Separator** – Enables or disables the field separator

- **Decimal Separator** – ASCII character to use a decimal point in data fields that have decimal places
- **Use Decimal Separator** – Enables or disables the decimal separator
- **Start of Packet Character** – ASCII character that signifies a start of a packet
- **End of Packet Character** – ASCII character that signifies an end of a packet
- **LRC Type** – Defines the type of Longitudinal Redundancy Check for error detection
- **LRC Position** – The LRC character can be located before or after the end character in the packet
- **Start Char in LRC** – Include the packet start character in the LRC calculations
- **Invalid Character** – Any data field that is undefined or invalid such as when a tank entity requested is not found in the database
- **Blank Character** – All data fields are right-justified and the remaining spaces are filled with the blank character
- **Profile Not Avail Field** – Not Supported at the moment
- **Profile Data Separator** – Not Supported at the moment
- **Name Length** – The character length of the entity names in a transmitted packet i. e. Tank Names in the system. Names are left-justified
- **Mass in Air** – If set to yes then all mass fields in the interface will refer to weights (i. e. mass in air), otherwise mass will be used (i. e. mass in vacuum)

For a fuller description of these fields see section 3.2 of the Enraf definition document HO-523x.

After configuring the communications parameters, the tank data format needs to be defined. This is displayed as a list of all possible data that can be returned per tank and can be edited by clicking on the **Tank Fields** item.



For each data field there is a number of formatting parameters that can be configured by clicking on the field and editing the data in the Right hand panel.

The order of the data fields in the list is the order that they are sent in a tank reply. Each data field can have optional elements enabled:

- Sign
- Value
- Status
- Software Alarms
- Hardware Alarms
- External Alarms

If all elements in a data field are set to **NO** (not set to be used), no data from that field is transmitted.

Each data field also has 3 parameters that define the format of the data Value if it is enabled:

- Field Width
- Decimal Places
- Units

All other elements of the field (Sign, Status, Sw, Hw, Ex) are one character in length.

For a fuller description of these fields see section 3.3 of the Enraf definition document HO-523x.

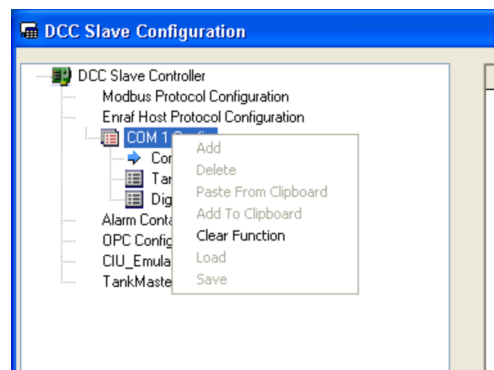
 External alarms are not supported and will always return the "-" character if enabled for a field.

Click on the **Apply** button to save any changes to the database.

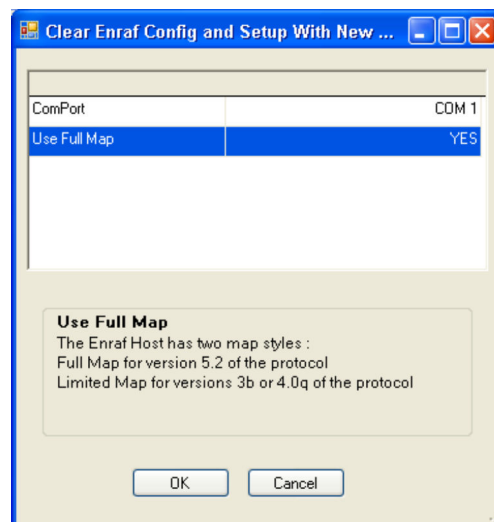
DCC Slave must be re-started for the changes to take effect, however changes will only be permanent one Comit has been performed.

7.6.2 Resetting the Configuration

If for any reason the configuration data for an Enraf interface needs to be reset back to defaults, this can be carried out in DCC Slave Configuration by right clicking on the interface in the **Enraf Host Protocol Configuration** section and selecting **Clear Function** from the pop-up menu.



This will display a dialog where the new map type may be selected.



Select the map type then click **OK**. This will set all communications parameters and Tank Fields back to the standard default values.

As always any changes will only be saved when the **OK** button is clicked.

7.6.3 Tank Field Codes

The following table defines the connections between the tank field codes defined in an Enraf Host interface and the database.

Enraf Host Tank Field	Database Field
Date, Time	No connection to database. Generated when reply message created.
Product Level	Product Level
Displacer	Displacer Position
Product Temperature	Product Temperature
Water Level	Water Level
Water Volume	Water Volume
Vapour Pressure	Vapour Pressure
Vapour Temperature	Vapour Temperature
Observed Density	Observed Density
Ref Density (or Density at ref)	Reference Density
Volume Correction factor	Volume Correction factor (VCF)
S&W percentage	Not Supported
Gas Ratio	Not Supported
Liquid in Vapour Volume	Vapour (Gross) Standard Volume
Vapour Mass	Vapour (Gross) Standard Volume or Not Supported if MassInAir setting = yes
Flow Rate	Volume Flow rate (m3FlowRate)
Total Observed Volume	Total Observed Volume
Gross Observed Volume	Gross Observed Volume
Gross Standard Volume	Gross Standard Volume
Net Standard Volume	Net Standard Volume
Total Gross Standard Volume	Total Gross Standard Volume
Room Available	Ullage Volume
Available Volume	Usable volume
Liquid Mass	Gross Mass - Vapour (Gross) Standard Volume or Gross weight if MassInAir setting = yes
Inlet Valve Position	Not Supported
Inlet Valve State	Not Supported
Outlet Valve Position	Not Supported
Outlet Valve State	Not Supported
Product Name	Not Supported
Product Code	Volume Correction Control See Note Below
Ref Temperature	Volume Correction Control See Note Below
Thermal expansion Coeff	Not Supported in Interface

Enraf Host Tank Field	Database Field
Mass calculation	"V" or "A" if MassInAir setting = yes
Total Mass	Gross Mass or Gross Weight if MassInAir setting = yes
Ullage/Innage Level Type	Bit 1 of Inventory Control Settings

Product Code is supported for the following values only.

Value	Product Code
A	API table A
B	API table B
C	API table C
D	API table D
M	Manually entered VCF
X	No volume correction, VCF = 1

Ref Temperature will be determined from the selected Volume Correction Method, except for tables with a variable reference temperature which will not be supported.

Only the following characters will be supported for the Status of tank field data items.

Character	Status of Tank Field Data items
–	All fields
&	Levels, Temperatures, Pressures and Densities only
B	Level only
C	Level only
F	All fields
S	Level only
T	Level only
W	W Level only

Only the following characters will be supported for the Software Alarm (Sw) of tank field data items.

Character	Software Alarm (Sw) of Tank Field Data items
–	All fields
F	All fields
H	Level only
H	Level, Temperature, Flow rate, Water Level, Ref and Obs Density only
L	Level, Temperature, Flow rate, Water Level, Ref and Obs Density only
L	Level only
N	Level, Temperature, Flow rate, Water Level, Ref and Obs Density only

Only the following characters will be supported for the Hardware Alarm (Hw) of tank field data items.

Character	Hardware Alarm (Hw) of Tank Field Data items
–	All fields
F	All fields
H	Level only
H	Level, Temperature, Ref and Obs Density only
L	Level, Temperature, Ref and Obs Density only
L	Level only

The External Alarm (Ex) of tank field data items will not be supported for any fields.

Downloading to Tank Fields

The following tank fields may be written to be the master system using Packet type 3 (Download Command):

- Product Code
- Reference Density *
- Thermal Expansion Coeff.
- Water Volume *
- VCF *
- Product Level *
- Product Temperature *
- Vapour Pressure *
- Vapour Temperature *
- Product Name
- Water Level *

Fields MUST be enabled in the map before they can be downloaded to using Packet type 3.



Those fields marked with a * in the above list must be set to manual mode in the database, otherwise the downloaded data will be discarded.

7.7 Extended Modbus Configuration

DCC Slave implements an extended version of the Modbus protocol as defined in the Enraf document "Specification Extended Modbus Communication for ENTIS+". It is configured using a special tool called "EMBConfiguration.exe" located in the standard system installation directory.

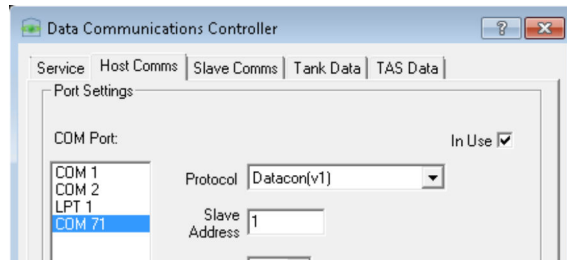
This feature is not currently supported on the Multi Scan NXA83B.

7.8 Datacon Slave Configuration

DCC Slave can be configured to respond on one or more serial ports/modems as if it were a slave Datacon device.

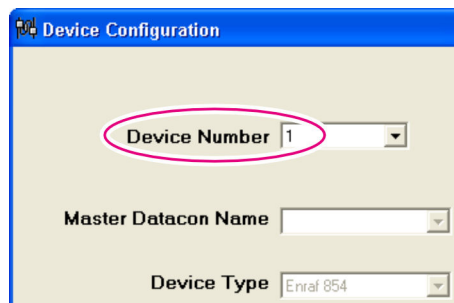
There is no configuration required other than:

- Select Datacon for the protocol type
- Set the slave address to that requested by the master system
- If Delta gauge mode is not required, then disable it (see "DCC Options")

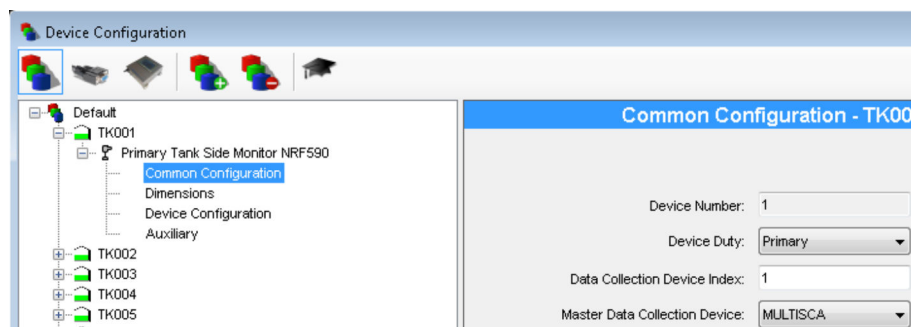


Gauges are addressed using the **Device Number**, as defined in the **Gauge Configuration** screen.

The master system would configure gauges with the **Datacon Collection Device Index** set to the same value as the **Device Number** in the receiver system acting as a Datacon slave.



1 Multi Scan NXA83B



2 Master System

This option can often be useful if one Tank Gauging system requires tank data from a second remote Tank Gauging system, especially so if there is no network connection between the 2 systems.

This option is the standard method of connecting Tank gauging software running on a PC with a Multi Scan NXA83B.

7.8.1 Delta Gauge mode

The Delta Gauge mode allows gauges that have changing data to be polled more frequently than other gauges, in a similar way to the Fast Scan functionality except that only one extra poll will be interleaved between normal polls. This should ensure that changes occurring on the slave system will be updated quicker on the master system.

The Delta Gauge polls can be viewed in the DCC Monitor tool and are indicated with a red arrow instead of the normal blue one.

Delta Gauge mode is enabled by default, and is the recommended mode to use, however it can be disabled via the DCC Options dialog.

7.9 Relay Contact Output Configuration

DCC Slave sub-system currently supports relay contact outputs using the following types of hardware:

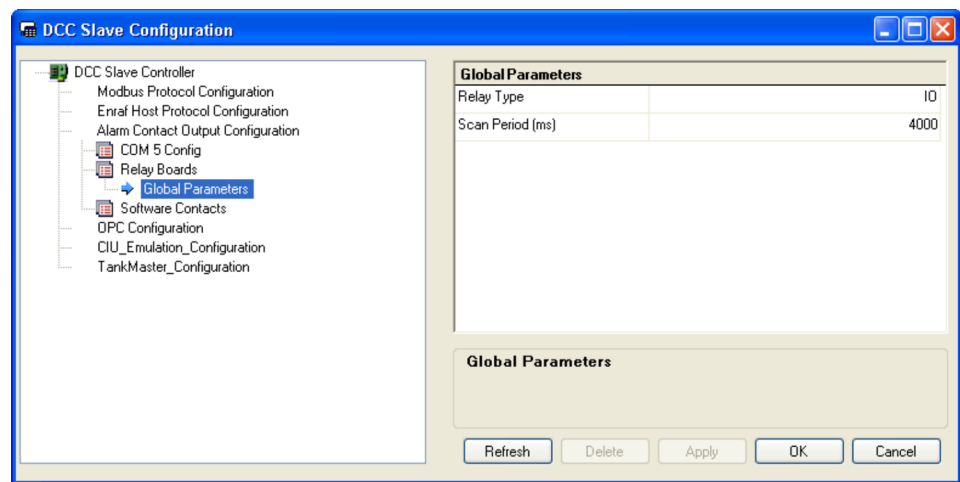
External Relay units – Relays connected via a serial port on the PC and using the Modbus protocol to communicate as slave devices. Multiple devices may be connected on the same port if RS485/RS422 hardware is used. Multiple serial ports are also supported.

The relays may then be configured to be activated by any gauge alarm, software alarm or certain other tank status signals.

 These devices should not be used in safety critical operations.

7.9.1 Configuring Relay Boards

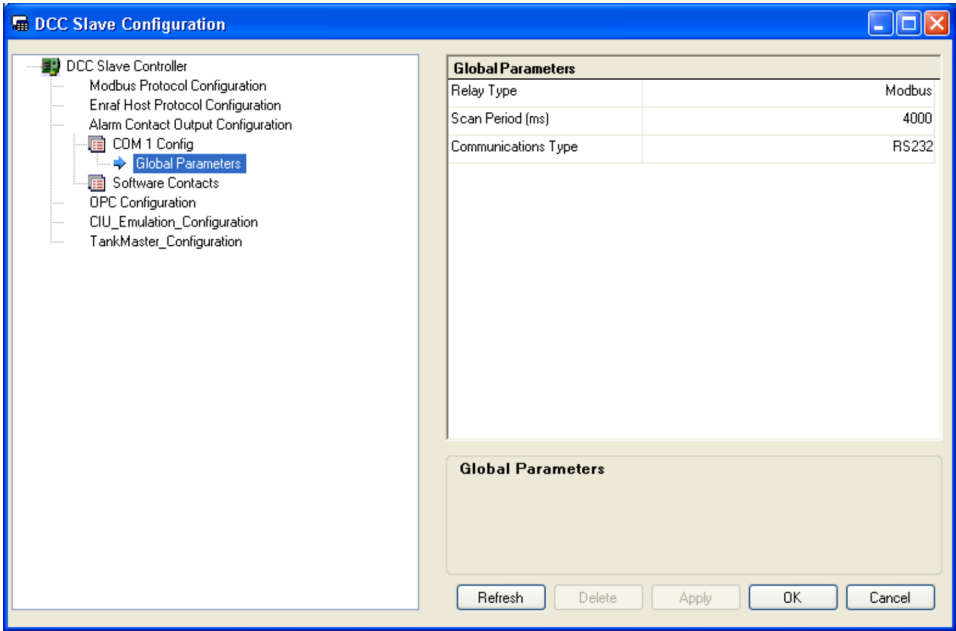
Relay contact outputs may be controlled by any combination of gauge/tank alarm states, and are configured using the **Communications** → **Slave Interface Configuration** utility.



7.9.2 Configuring Modbus Devices

Relay contact outputs may be controlled by any combination of gauge/tank alarm states, and are configured using the **DCC Slave Configuration** utility.

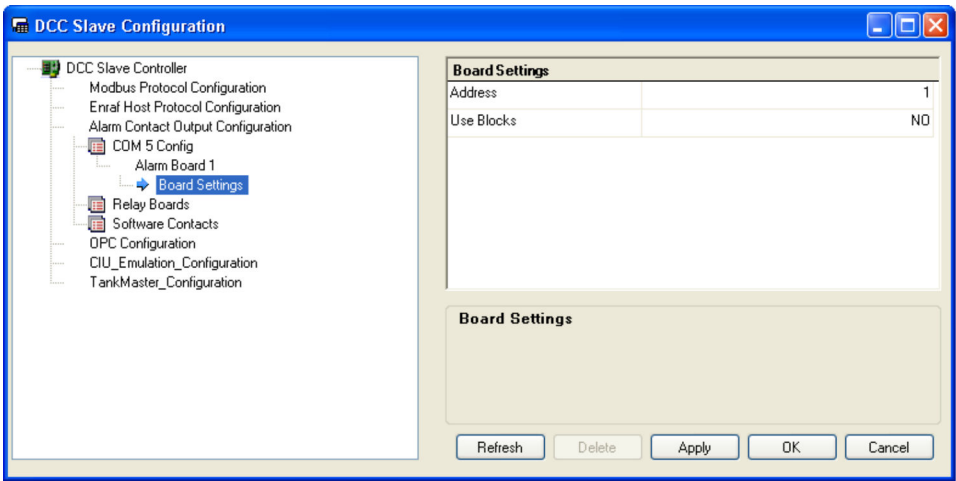
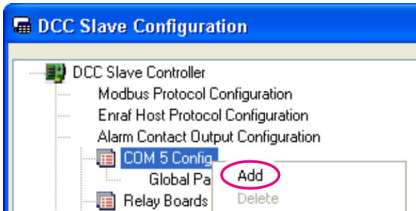
All EXTERNAL Modbus alarm device configuration is contained within the **Alarm Contact Output Configuration** section, and each COM port configured for Modbus Alarm Output devices will have an entry under this section. For example **COM 5 Config**.



Under each COM port config section there are a set of **Global Parameters** that apply to all Modbus devices connected on that port.

- **Relay Type** – This will be fixed as Modbus
- **Scan Period (ms)** – The scan time in milliseconds for checking the relay states, defaulting to 4 000 milliseconds
- **Communications Type** – Set to RS485 if an echo of requests is expected, otherwise set to RS232

Alarm Boards must be added to the DCC Slave sub-system before they can be configured. To do this, right click on the required COM port section and select **Add** from the pop-up menu.



Each Alarm Board represents a Modbus device connected on the serial link.

The Board Settings are as follows:

- **Address** – Defines the Modbus RTU address of the device
- **Use Blocks** – Determines if individual Modbus COILS are to be used to control relay outputs OR outputs may be set in blocks using REGISTERS

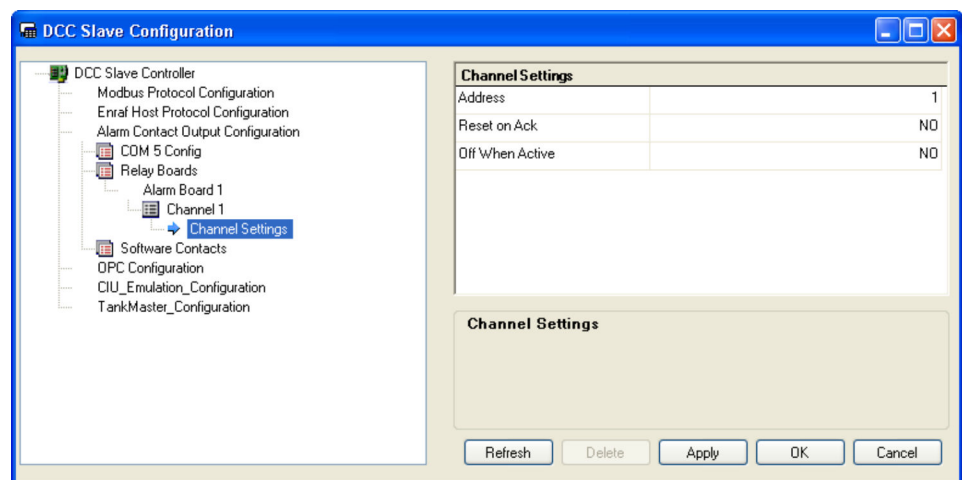
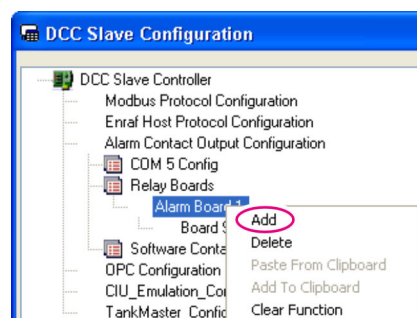
Multiple boards may be added.

Boards may be deleted by right clicking on the board and selecting **Delete** from the pop-up menu.

Each relay on a board is referred to as a Channel and these must be added and configured. If **Use Blocks** is set to **NO** then each Channel is an individual Modbus coil, if set to **YES** then a Channel is a block of 16 bits within a Modbus register.

7.9.3 Configuring Channels

Each relay contact on a board is defined as a Channel. To add a new channel to a board, right click on the **Alarm Board** where the relay is located and select **Add** from the pop-up menu.



The Channel Settings define the operation of the relay as follows:

- **Address** – For EXTERNAL Modbus devices this is the address of the coil or register.
- **Reset on Ack:**
 NO = Relay is set to inactive state when all source fields (i.e. alarms) are cleared will this line continue to the end
 YES = Relay is set to inactive state when all source fields (alarms) have been acknowledged, even if the alarm is still active
- **Off When Active:**
 NO = Relay is energised when in active state
 YES = Relay is de-energised when in active state

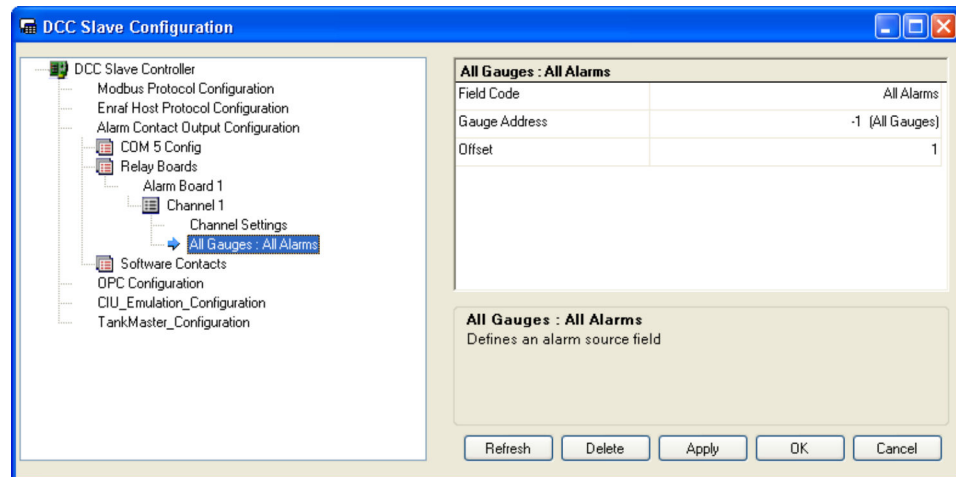
All channels must be configured for the alarms or status values that will trigger/control it. These are referred to as Fields, and each channel may have multiple fields controlling it.

7.9.4 Configuring Fields

Each relay channel must have at least one source Field defined. Various different fields may be assigned to a channel.

Each Field defines an alarm or status point from a tank/gauge that will be used to control the channel.

To add a Field to a channel, right click on the **Channel** and select **Add** from the pop-up menu.



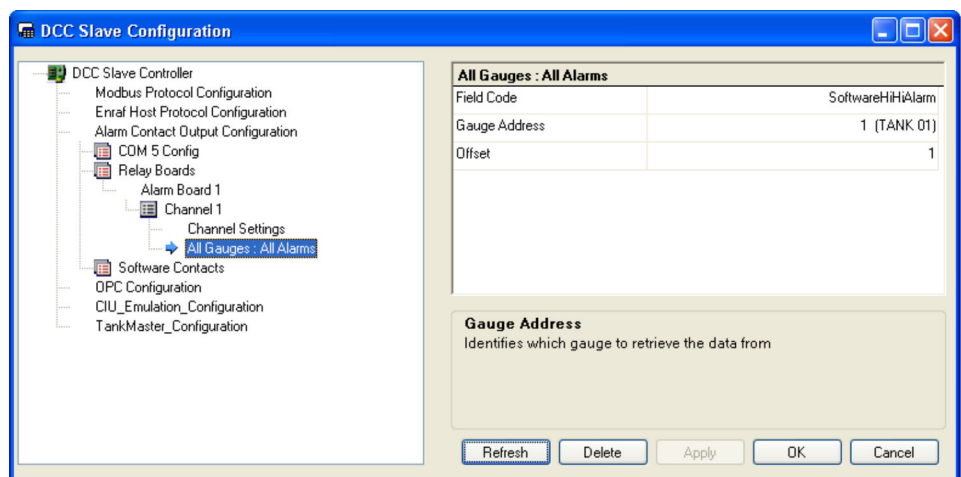
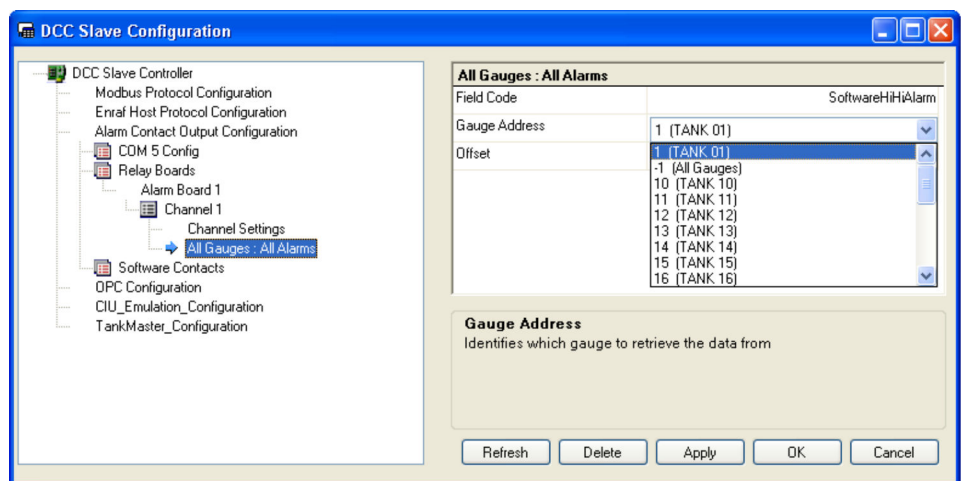
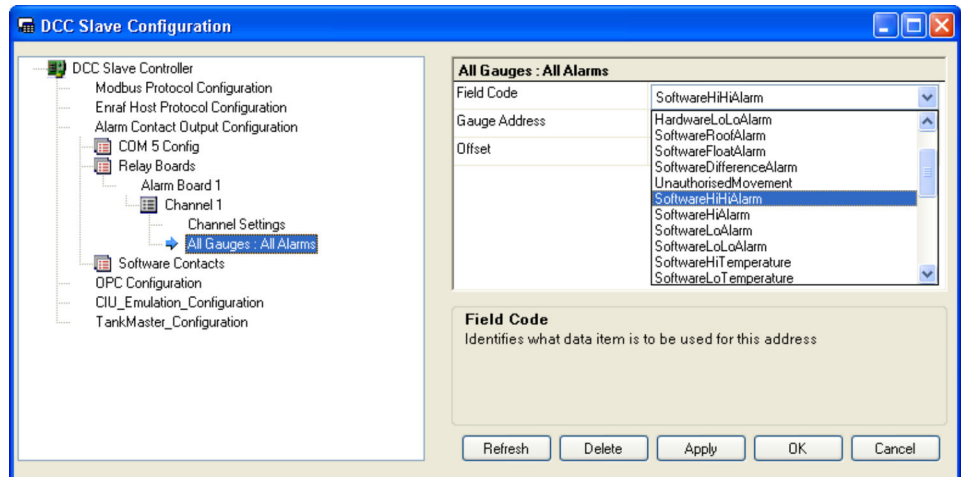
Each Field will be displayed as the source tank, followed by the source alarm.

The parameters for each Field are defined as:

- **Field Code** – The name of the source alarm to test for. A value of "All Alarms" means all alarms will be checked
- **Gauge Address** – The tank number to check for the alarm. This should be the same as the Gauge Number from the Gauge Configuration screens. A value of –1 means ALL Gauges will be checked
- **Offset** – This is the bit number (1 to 16) within a block of 16 bits. It is only used if the Alarm Board settings have Use Blocks set to YES. If blocks are not used then set this always to 1. For Modbus devices using blocks this means that this is the bit number within the register

When adding a new Field it will default to All Gauges and All Alarms as the source. This may then be modified to select individual alarms and/or gauges as required. A number of fields may be added to the same channel, with each field defining an individual alarm and gauge.

For example if the relay channel was required to activate on the Programmable HI HI alarm for tank TK001 only then set the following:



7.10 TankMaster Configuration

The TankMaster interface in DCC Slave is based on the Modbus protocol, with a preconfigured map. It supports up to 256 tanks, each with its own Tank Index position (range 0 to 255) in the modbus register map.

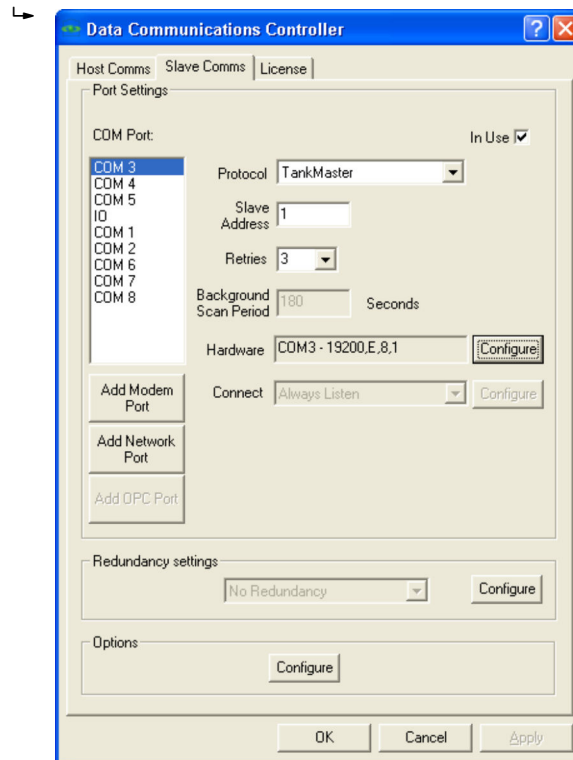
The interface is defined in the document "SP0142-12 - ICD Iss 1-0-0". Please refer to this document for a full definition of the functionality supported.

The only configuration required in DCC for the TankMaster interface is to define how the tanks in the Tankgauging database are mapped to the Tank Index positions in the predefined TankMaster map.

Using TankMaster

In order to use TankMaster, the driver has to be enabled for the serial port (or ports) in DCC Slave.

1. Open the Multi Scan NXA83B Configurator and select the **Communications** → **Port Configuration** menu item.
2. Then select the **Slave Comms** tab.

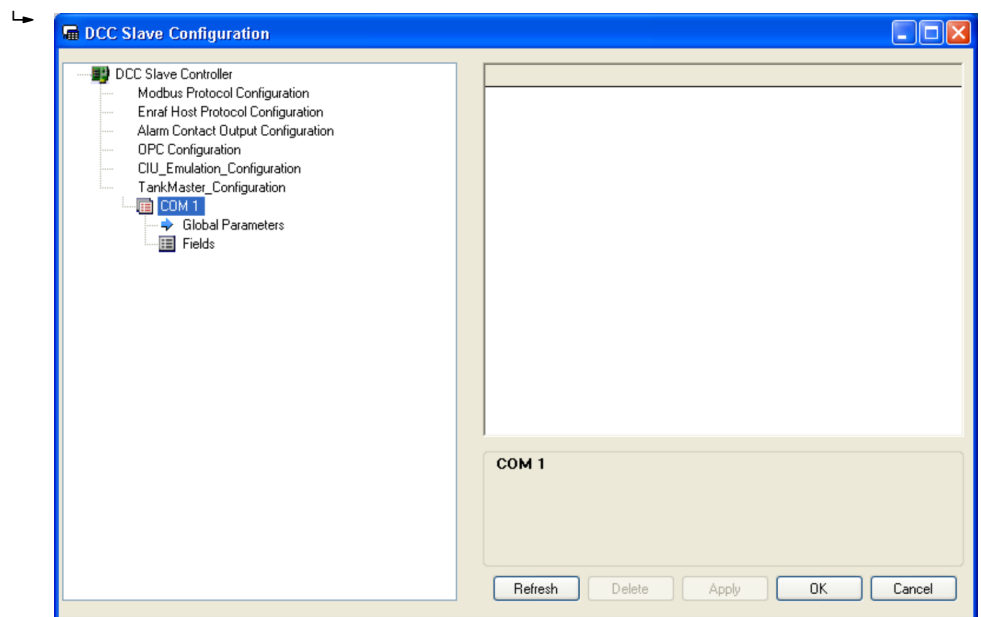


3. Select the **COM Port** that is to be used to communicate to the host device and ensure that the **In Use** box is ticked.
4. Set the **Protocol** to **TankMaster**.
5. Set the **Hardware** communication parameters (Baud rate, parity etc.) to those used by the Modbus device.
6. The **Slave Address** should be set to match the address configured in the host. The **Retries** field is not required.
7. Repeat for any other COM ports to be used for TankMaster communications.

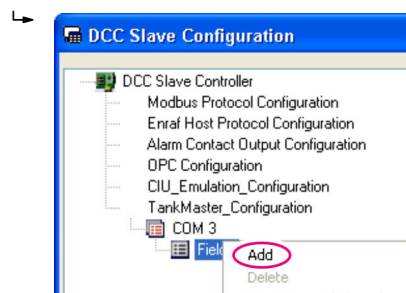
7.10.1 Advanced Tank Index mapping

Individual TankMaster interfaces may have their own Tank Index allocation via the **DCC Slave Configuration** screen.

1. To configure a Tank Index map for a port, select the COM port under the TankMaster item.

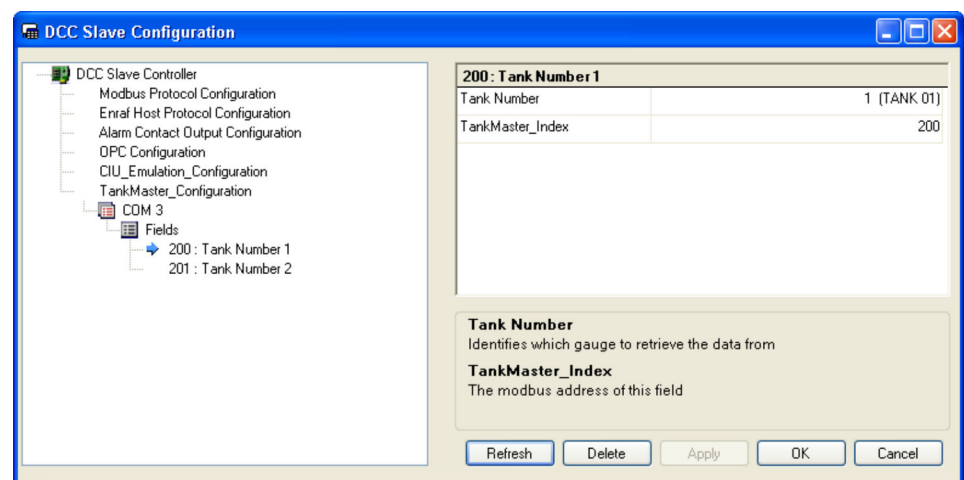


2. Add all the Indexes required in the **Fields** section. To add a Field, right click on **Fields** and select **Add** from the pop-up menu.



Each entry consists of a pair of items:

- **Tank Number** – Select from the drop-down menu
- **TankMaster Index** – Enter the Modbus address for this tank

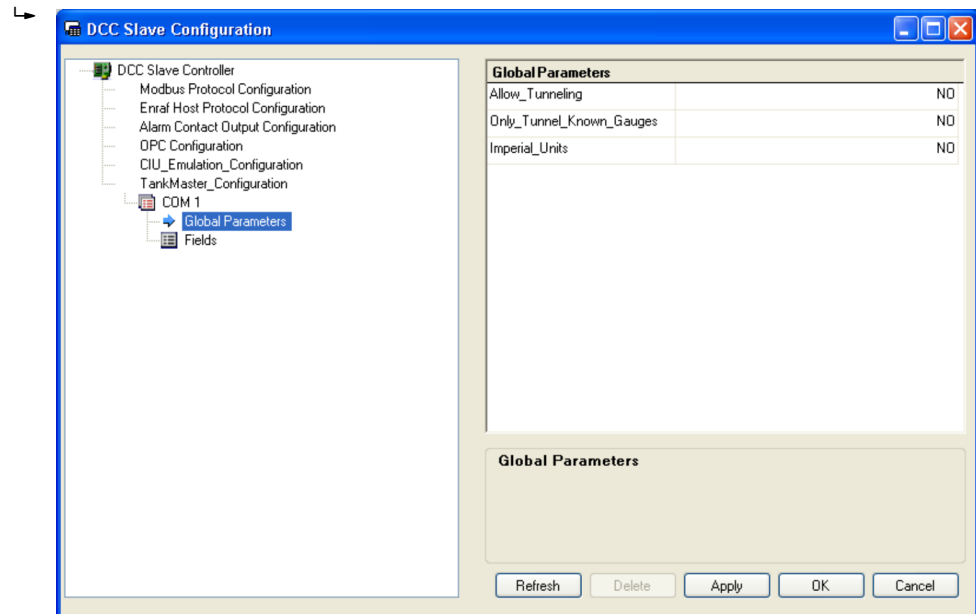


The TankMaster interface running on that COM port will now use the map defined in the **DCC Slave Configuration** tool, and will NOT use any Datacon Gauge Index values.

7.10.2 Other Advanced Configuration

The **DCC Slave Configuration** screen can also be used to configure a number of other parameters for individual ports.

- Click on the **Global Parameters** section for the port.



The following items may be configured:

- **Allow Tunneling** – If set to YES, requests for Modbus Slave IDs different to the one for the TankMaster interface will be tunneled to all Modbus protocol master interfaces. The reply from any gauge will be returned
- **Only Tunnel Known Gauges** – If set to YES, Modbus IDs will only be tunneled for gauges that are configured in the database
- **Imperial Units** – By default a TankMaster interface will format all data in metric units. Set this field to YES to format in Imperial/English units

7.10.3 Alternative (Simple) Tank Index mapping

By default the Index position in the TankMaster map is defined in the field **TankMaster Index** in the **Device Configuration** screen.

This should start at 0 for the first index position in the TankMaster map.

Each gauge must have a unique index position. Thus, when the TankMaster interface is used, every gauge in the database must have a value entered in the **TankMaster Index** field.

All TankMaster interfaces configured in DCC Slave will use the same Tank Indexing as described above, unless individual interfaces are configured using the advanced mapping. Advanced mapping will always override the simple mapping.



www.addresses.endress.com
