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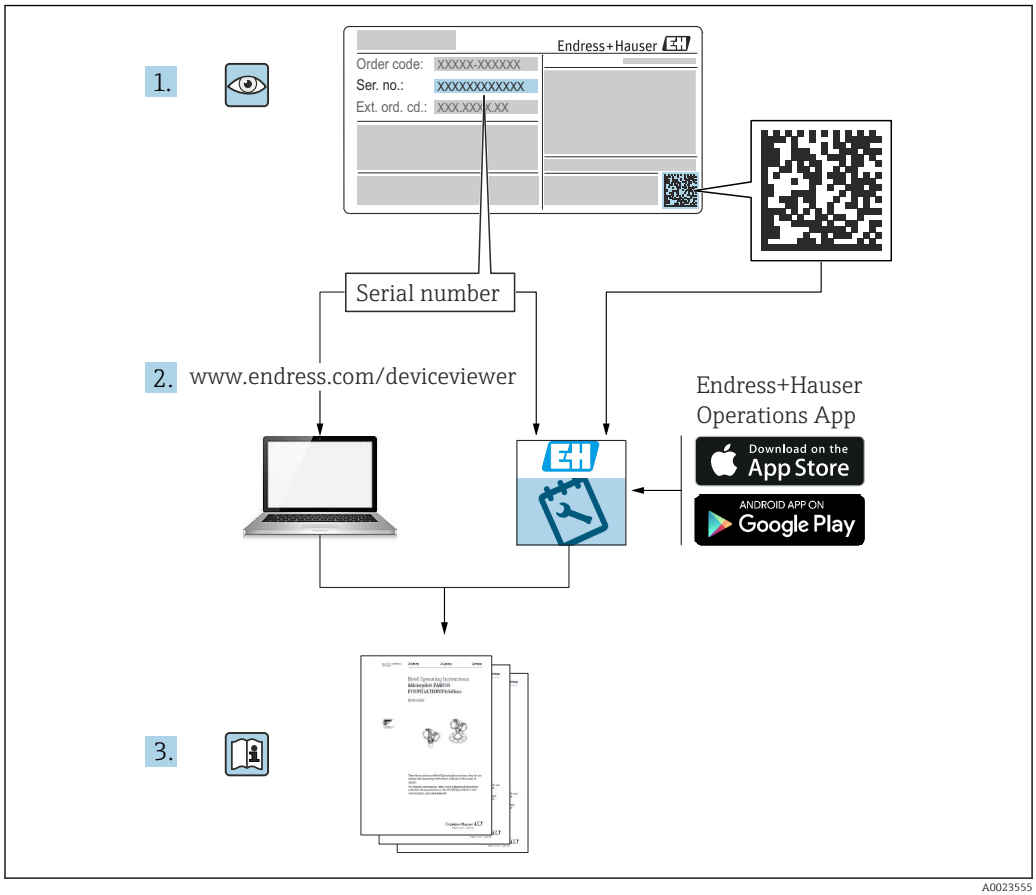
Valid as of version
18.3.2

Operating Instructions
Tankvision Professional NXA85
Tankvision LMS NXA86B

Tank Gauging
DCC Communications Configuration

Endress+Hauser
People for Process Automation



- 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.

Change history

BA00391G_20.20
- Valid for software version: 18.3.1
- Changes to the previous version:
  Content added: Alarm Acknowledge Status description

BA00391G_21.22
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- Changes to the previous version:
  Added items: Device number and family, Lowest element position in chapter Device Configuration. Use last good temperature when level below lowest temperature element in chapter DCC Host Options.

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- Valid for software version: 18.3.2
- Changes to the previous version:
  Minor changes

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1 About this document

1.1 Document function

This manual should support during the configuration of Tankvision Professional NXA85 and LMS NXA86B.

1.2 Target audience

Beside basic PC operating knowledge no special training is needed to perform the Tank Gauging System operations. Nevertheless it is recommended receiving a training on the system by Endress+Hauser.

1.3 Software versions and certification

Due to the certification process with weights and measures agencies, the latest software version might only be certified at a later stage. Also some features might be incompatible with the weights and measures regulations and can therefore not be combined.

1.4 Symbols

1.4.1 Safety symbols

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

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

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

NOTICE
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.

1.4.2 Electrical symbols

⎓ Direct current

~ Alternating current

⏚

Ground connection

A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.

⏚ **Protective earth (PE)**

Ground terminals that must be connected to ground prior to establishing any other connections.

The ground terminals are located on the interior and exterior of the device:
- Interior ground terminal: protective earth is connected to the mains supply.
- Exterior ground terminal: device is connected to the plant grounding system.

1.4.3 Symbols for certain types of information

Tip
Indicates additional information

Reference to documentation

▶
Notice or individual step to be observed

1., 2., 3.
Series of steps

Result of a step

1.4.4 Symbols in graphics

1, 2, 3, ...
Item numbers

1., 2., 3.
Series of steps

A, B, C, ...
Views

1.5 List of abbreviations

- COR
  Carrier On Relay
- DCF
  Density Correction Factor
- GOV
  Gross Observed Volume
- GSV
  Gross Standard Volume
- GUI
  Graphical User Interface
- JIS
  Japanese Industrial Standards
- MDP
  Marine Digital Platform
- ODBC
  Open Database Connectivity
- PTT
  Push-to-Talk
- ROB
  Radio Output Board
- RTDB
  Real-time Database
- TCF
  Temperature Correction Factor

- TOV
  Total Observed Volume
- VCF
  Volume Correction Factor
- WCF
  Weight Correction Factor

1.6 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 device version:

Document type	Purpose and content of the document
Technical Information (TI)	**Planning aid for your device** The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.
Brief Operating Instructions (KA)	**Guide that takes you quickly to the 1st measured value** The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.
Operating Instructions (BA)	**Your reference document** The Operating Instructions contain all the information that is required in various phases of the life cycle of the device: 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 your parameters** The document provides a detailed explanation of each individual parameter. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.
Safety instructions (XA)	Depending on the approval, safety instructions for electrical equipment in hazardous areas are also supplied with the device. These are an integral part of the Operating Instructions. The nameplate indicates which Safety Instructions (XA) apply to the device.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is a constituent part of the device documentation.

1.7 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 are registered trademarks and trademarks of these organizations and companies.

All other marks are property of their respective owners.

2 Basic safety instructions

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 Intended use of Tankvision Professional NXA85 software

Tankvision Professional is specifically designed for operators of bulk storage facilities, marketing terminals, refineries and pipelines. It is designed to handle all the data acquisition, supervisory control and monitoring required in a single fully integrated solution.

Tankvision Professional integrates all major types of tank measurement instruments into one system.

All measured and calculated tank parameters are accessible to your tank farm and terminal operators as well as to connected host systems.

Multi-user operation is provided by the inbuilt Web Server offering the opportunity to access data at any connected location (local/remote) e.g. for administrative and accounting purposes.

2.2.2 Intended use of Tankvision LMS NXA86B software

Tankvision LMS is a total LNG Tank Storage and Management solution for Peak Shaving, Receiving and Production LNG facilities. The LMS system has been designed to interface to all instruments commonly found on LNG storage tanks, and to collect and present the instrument data through a range of intuitive graphical user interfaces. A typical LNG Tank will have a wide range of measurement instruments to measure Liquid Level, Liquid Density, Liquid and Vapour Temperature, Liquid and Vapour Pressure, Skin Temperature and much more.

Typically each tank would be fitted with an LTD gauge, two further level gauges configured as a Primary and Secondary, and an Alarm Gauge. The LTD gauge is a servo operated unit mounted on the tank roof. The purpose of the LTD gauge is to take accurate profiles of temperature and density throughout the liquid, and whilst not profiling provide continuous liquid level, temperature and density measurement. The Primary and Secondary gauges can be either servo and or radar operated units also mounted on the tank roof. The purpose of these gauges is to provide continuous liquid level measurement, and average liquid temperature measurement. They provide redundancy on the measurement of level and temperature. The average liquid temperature is derived from a

multi point temperature sensor device. The alarm gauge is often a servo or radar based gauge configured to provide volt free contact alarm status to an independent system.

An LMS system can operate in a simple standalone configuration or as a fully redundant system where security and integrity are of paramount importance. The LMS system has a flexible and scalable architecture allowing it to be tailored to a number of different applications easily.

2.3 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 software:

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

For an overview of the technical documentation provided, enter the serial number from the nameplate in the *Device Viewer* (www.endress.com/deviceviewer).

3.2.1 Nameplate

The information that is required by law and is relevant to the product is shown on the nameplate, e.g.:
- Manufacturer identification
- Product name
- Order code
- Extended order code
- Serial number
- Barcode

3.2.2 Manufacturer address

Endress+Hauser SE+Co. KG
Hauptstraße 1
79689 Maulburg, Germany

Place of manufacture: See nameplate.

3.2.3 Order code and product version

To find out the version of your software, 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 PC.

The DCC sub-system is required for both standalone and client server configurations. In a standalone environment all DCC services run on the same PC as the Tankvision Professional/LMS client modules.

In a client server environment all DCC services run on the PC dedicated as the database server.

The 3 main services are:
- **DCC Host** - Responsible for retrieving data from gauges and storing it in the Tankvision Professional/LMS database.
- **DCC Slave** - Responsible for sending tank data to other computer systems.
- **OPC Server** - Responsible for providing tank data to OPC.

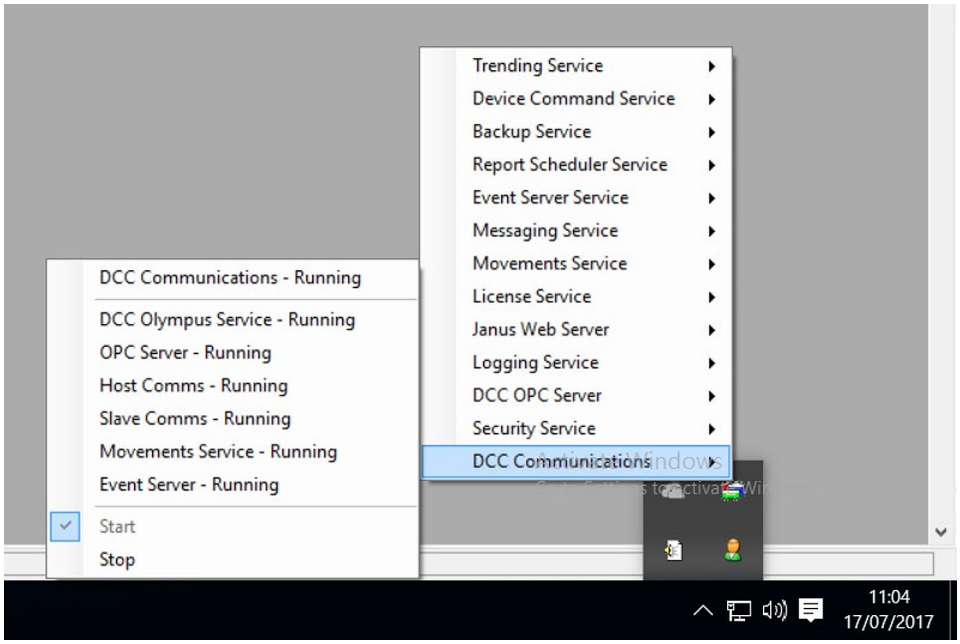
The first 2 are automatically started when the PC is booted, whilst the OPC Server is started when an OPC client tries to connect to the tank gauging system or by stop/start services in DCC.

There are a number of other services that are grouped within the DCC sub-system but are not concerned with data communications:
- **Mercury** - Responsible for synchronising data between an in-memory real time database (RTDB) and the main SQL Server database. It also allows 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.
- **Movements Server** - Responsible for creating alarms/events for the movements application.

The Mercury service requires no configuration for communications. 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.

4.1 Controlling the DCC Services

The status of the DCC Services can be viewed and controlled via the Service Manager application, located as an icon in the Windows system tray. To show the current state of the services, right click on the icon and select the **DCC Communications** menu item.



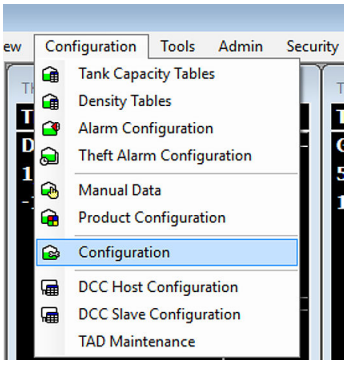
The DCC runs as a set of services, therefore when the PC is restarted they are automatically started. However there may be times when it is required to stop or restart the services.

To Stop the DCC services, click on the **Stop** menu item. All services will be stopped in the correct order and during this process the statuses will be updated in the Service Manager.

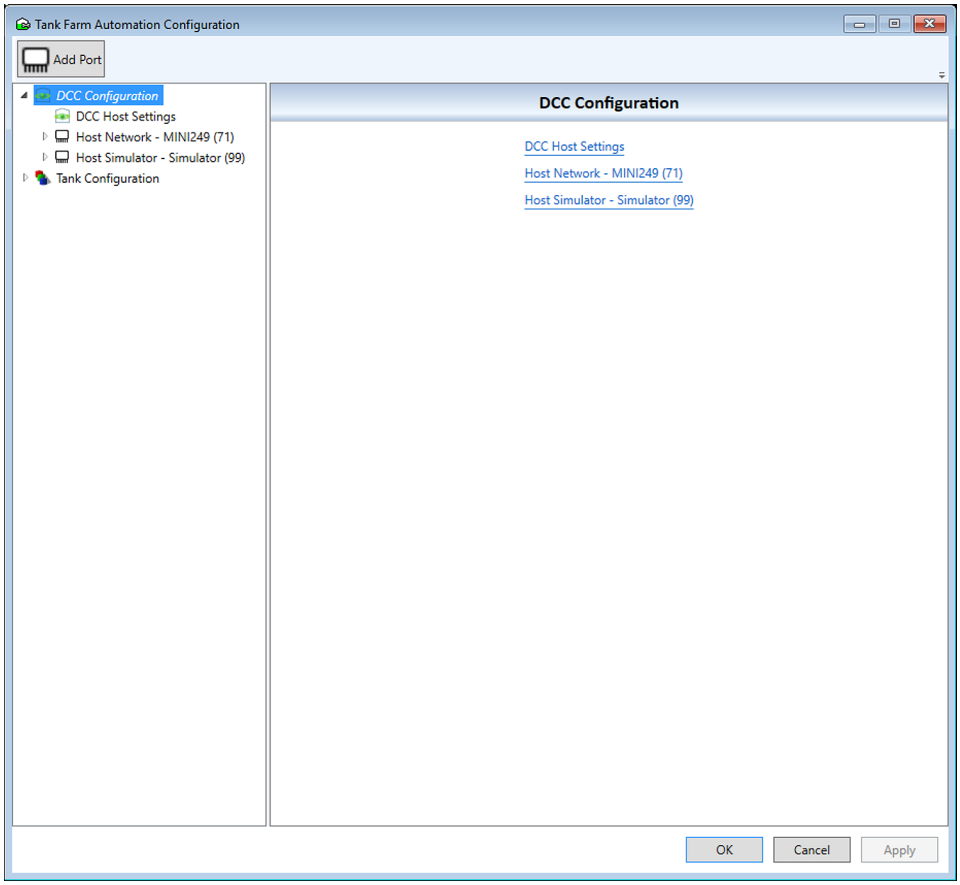
The services can be started by clicking on the **Start** menu item.

5 DCC Configuration

The various services which make up the DCC sub-system are configured using the **Tank Farm Automation Configuration** module, which can be started from the **Configuration** menu:



The **Tank Farm Automation Configuration** module allows the following to be configured:
- DCC Host Settings that apply to the service as a whole
- Host Communication Ports, and all the devices connected
- Slave Communication Ports



The module has a tree panel on the left hand side, with the **DCC Configuration** section located under the tree item called by that name. Click on that item to expand, showing all configured ports and the DCC Host settings.

Care should be used when editing parameters in these screens, as wrong data could stop services from operating correctly, possibly causing loss of data on screen.

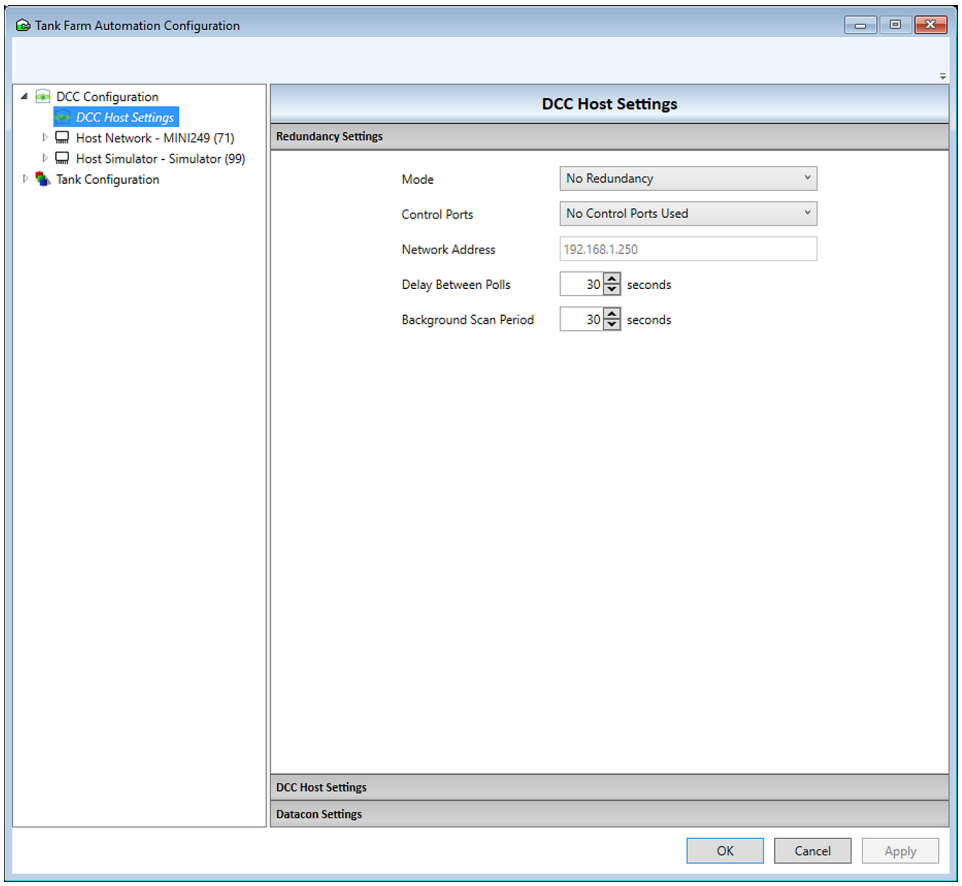
All changes will be saved when the **OK** or **Apply** buttons are clicked. If there have been major changes to the DCC Configuration, such as ports being added or deleted, then it is recommended that the services be restarted.

Only system configurators or similar should use the DCC Configuration screens.

5.1 DCC Host Settings

▶ Click on the **DCC Host Settings** item to configure parameters that set the operating mode of the DCC Host service.

These include the following:
- Redundancy Settings
- DCC Host Settings
- Datacon Settings



5.2 Redundancy Settings

The DCC Host service supports a number of redundancy modes that communicate to devices using a redundant pair of ports (Physical COM ports or Network connections) or a pair of separate server systems.

The redundancy **Mode** field can be used to set one 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 passive 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.
- **No Redundancy**: No port redundancy. Any backup port configured will be ignored.

When **Switch by Gauge** or **Switch By Interface** mode is selected then devices must be configured with a primary and a backup port. Only one port at a time will be used to poll for data, initially this will be the primary port. If this port fails then the gauge will be polled on the backup port until that fails, when it will switch back to the primary and so forth. If both ports have failed then it will keep switching between the 2 ports until one responds.

When **Switch By System** mode is selected then a set of Control Ports must be configured, which are used to communicate between the 2 server systems. Use the **Control Ports** field to select the ports to be used, as follows:

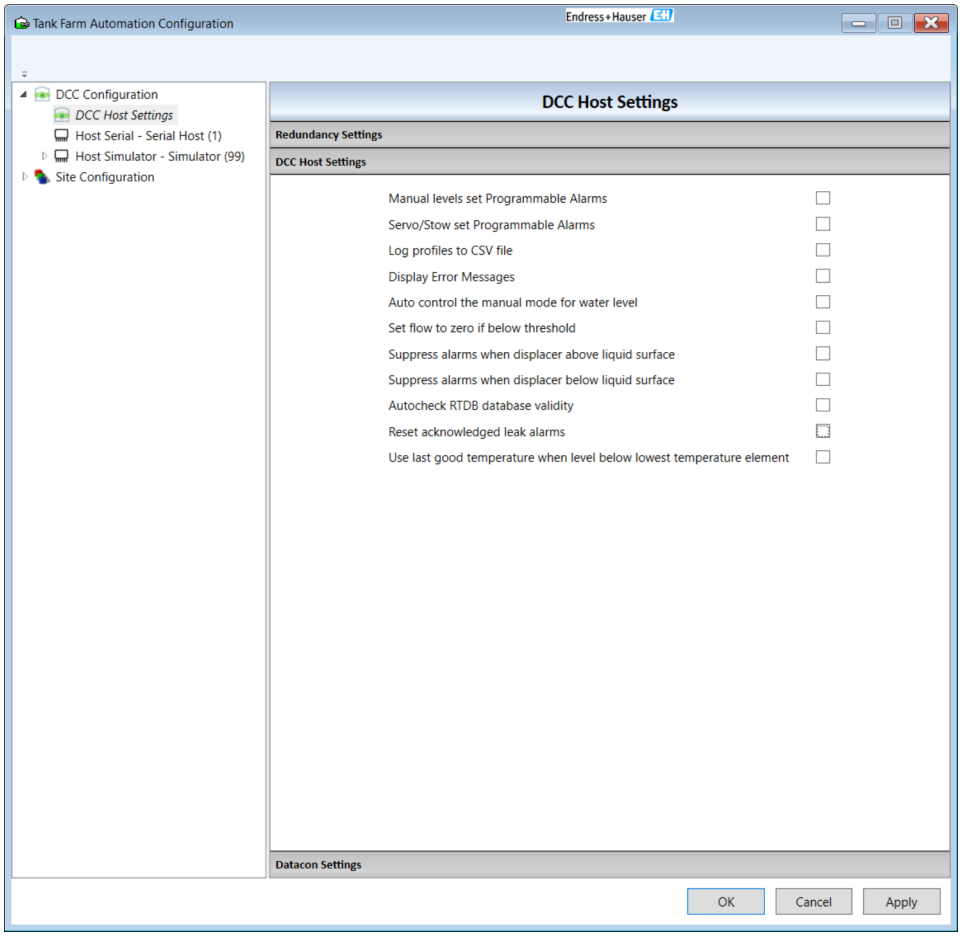
- **COM Ports 1 and 2 used for Control Ports**: The system automatically configures and uses COM 1 and COM 2 ports for redundancy control. Ensure that COM 1 and COM 2 are NOT configured for use as either Host or Slave ports.
- **COM Ports 7 and 8 used for Control Ports**: The system automatically configures and uses COM 1 and COM 2 ports for redundancy control. Ensure that COM 7 and COM 8 are NOT configured for use as either Host or Slave ports.
- **Manual Selection of Control Ports**: This option must be selected when the control ports have been manually configured. There must be 2 control ports configured:
  - 1 DCC Host port configured as a **Redundant Link Control protocol**.
  - 1 DCC Slave port configured as a **Redundant Link Control protocol**.
    These can be either standard RS232 COM ports (recommended for manual configuration) or Network ports. The communication parameters should be set identically for both server systems.
- **Network used for Control Ports**: The system automatically configures and uses 2 network ports for redundancy. Both Server Systems must be connected to the same network, or have a Network Cross-over lead connected between the Ethernet ports of the 2 systems. This is the recommended method of connecting the control links.
- The **Network Address** of the second server system is normally configured when the 2 servers are installed, and cannot be directly changed in this screen. If this address has to be changed then use the **System Configuration** application located in the **Tank Farm Automation** → **Common** folder. Refer to the installation manual for more details.
- **No Control Ports Used**: If this option is selected both systems will default to Live polling mode. This option should NOT be used for **Switch By System** redundancy.

The **Delay Between Polls** and **Background Scan Period** fields apply to any control ports and set to scanning rates for the Passive system.

5.3 DCC Host Options

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

► Click on the **DCC Host Options** page to show the settings.



Current supported options include:

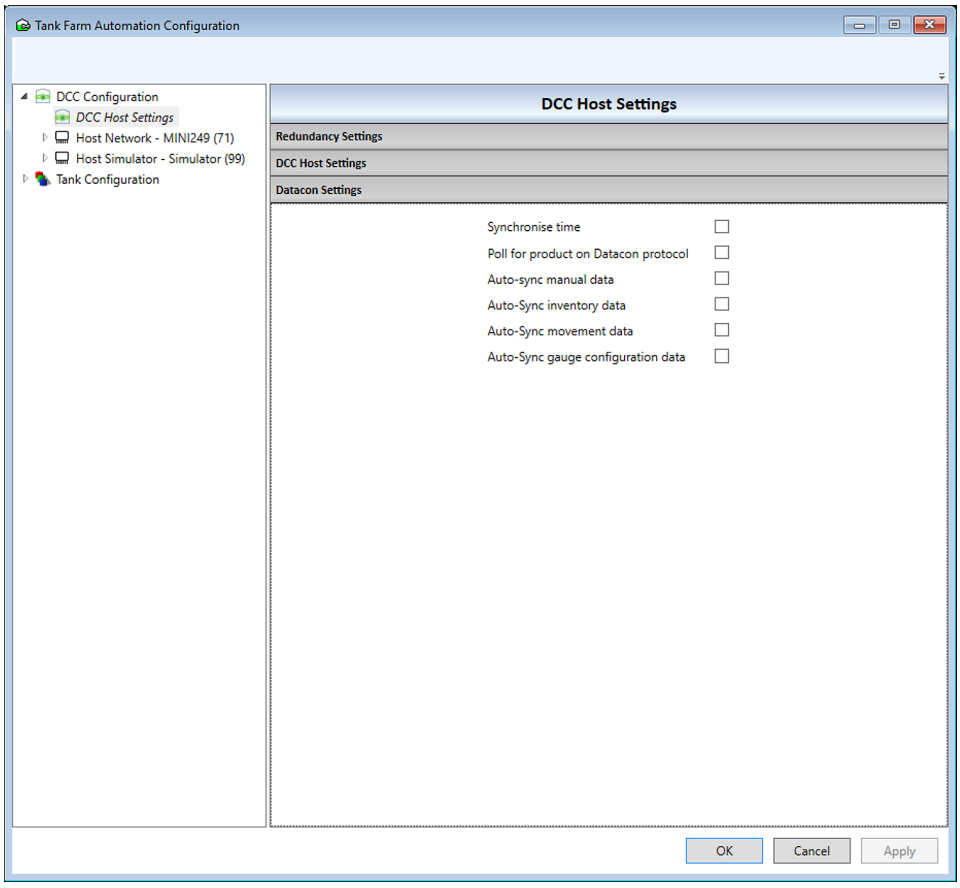
- **Manual Levels set Programmable Alarms**: By default a manual value will not trigger a programmable alarm, ticking this option will reverse this functionality.
- **Servo / Stow set Programmable Alarms**: By default when a gauge is moving due to a stow/unstow or servo command, programmable level alarms 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.
- **Use last good temperature when level below lowest temperature element**: Ticking this option will set DCC to the last valid value when the level drops below the Lowest Element Position for the device. If no valid value has been saved prior to the level dropping below this threshold then temperature will be set to DN99.

5.4 Datacon Settings

A set of options that apply only if the Datacon protocol is used to get live data from a remote system, including Data Synchronization.

▶ Click on the **Datacon Settings** page to show the settings.



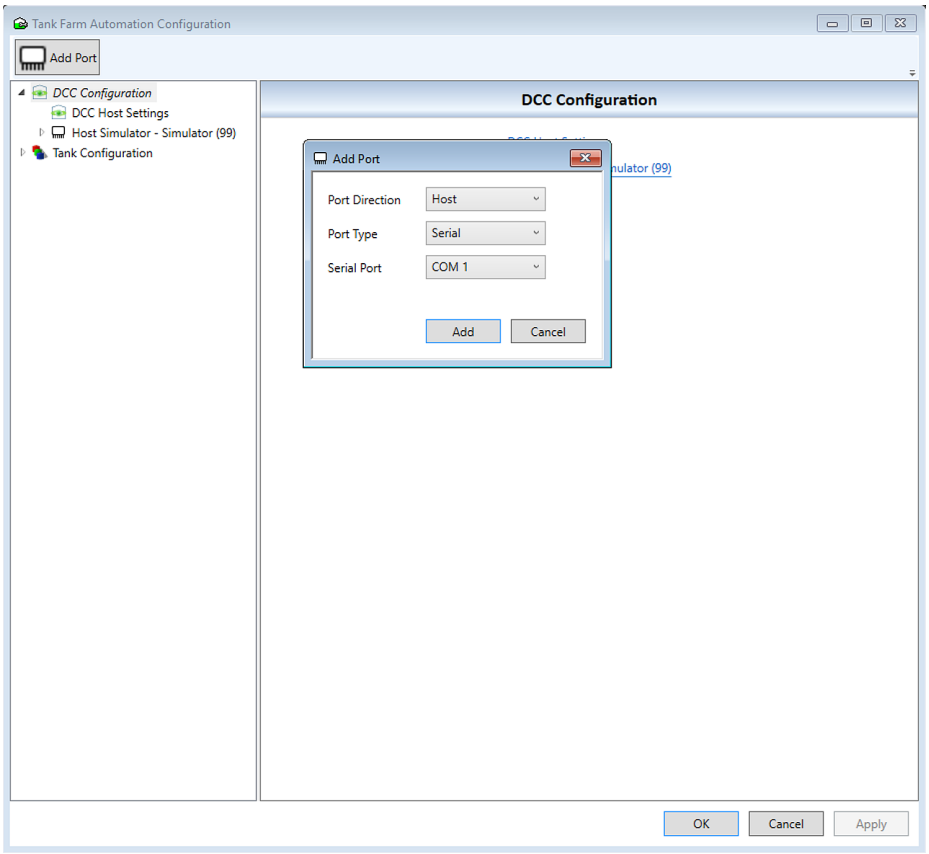
Current supported options include:

- **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.
- **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 remote system.

- **Auto-Sync 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 remote system.
- **Auto-Sync movement data**: When selected, any changes made to movement data (e.g. flow rate setpoint) on the Host computer will also be set on the remote system.
- **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 remote system.

5.5 Adding a port

1. To add a new port, select the **DCC Configuration** item then click on the **Add Port** item in the tool bar.



2. Configure the parameters for the port.

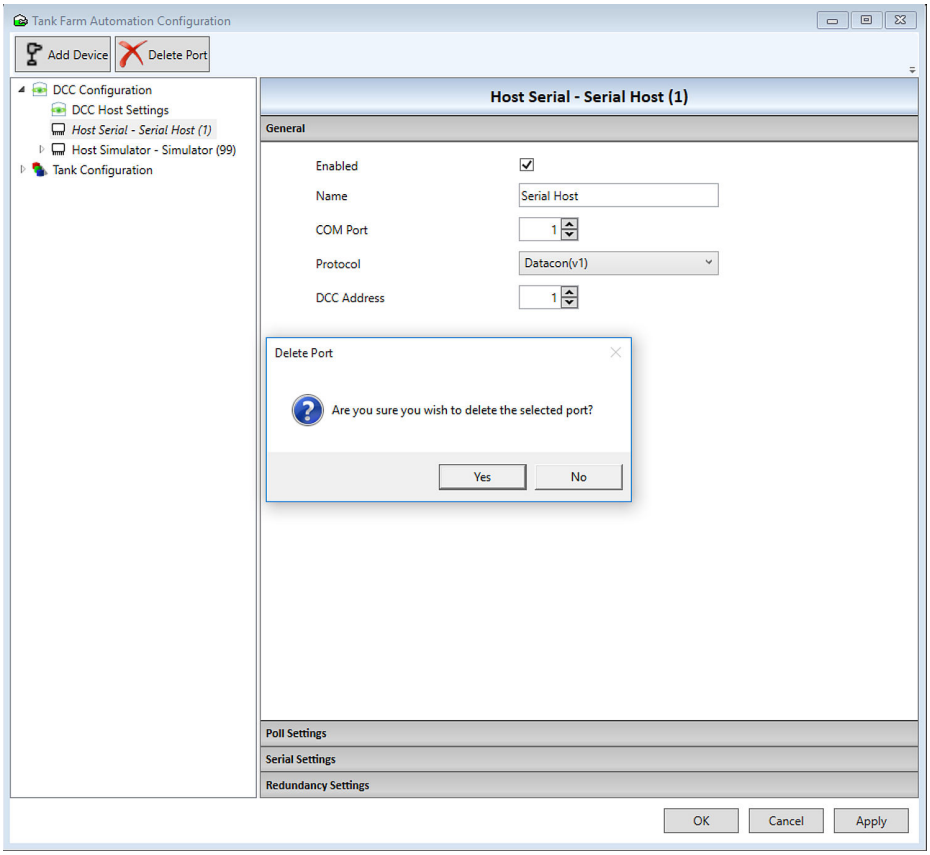
- **Port Direction**: Select either **Host** or **Slave**.
  Host Ports are responsible for collecting data from Datacons and gauges, calculating Tank Inventory, and processing command requests from the system client.
  Slave Ports are responsible for sending data to other computer systems, such as the main DCS for the refinery, using protocol such as Modbus.
- **Port Type**: Select from the list.
  - **Serial** port if using an standard RS232/422/485 port on the system.
  - **Network** port if using a standard network for communications.
  - **OPC** port if connecting to an OPC server via a network connection. Only available for Host ports.
  - **XML** port if connecting to a server via a network connection, to read XML format data. Only available for Host ports.
  - **Relay (SeaLevel)** port if using an internal relay board. Only available for Slave ports.
- **Serial Port**: When the port type is **Serial** then select the physical COM port number on the PC. Other port types will use auto-assigned virtual COM port number.

3. Click **Add** to add the new port to the list of configured ports.
   ↳ The new port will not be permanently saved until the **OK** or **Apply** buttons have been clicked.

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

5.6 Deleting a port

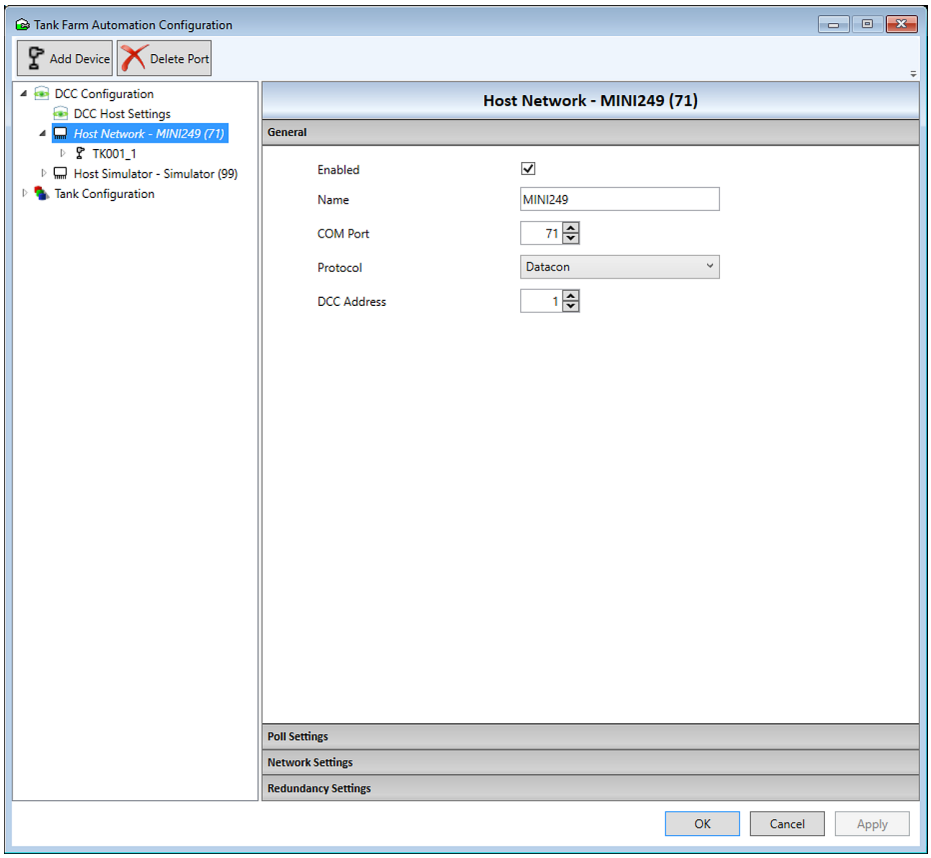
1. To delete an existing port, click on that port in the list of ports then click on the **Delete Port** item in the tool bar.
   ↳



2. Click **Yes** on the confirmation dialog to delete the port and any devices configured on that port.
   ↳ The port will be removed from the list of ports, however the change will not be saved permanently until the **OK** or **Apply** buttons have been clicked.

5.7 Configuring a Host or Slave port

▶ To configure an existing port, click on that port in the list of ports.



Any changes will not be saved permanently until the **OK** or **Apply** buttons have been clicked. For details on configuring the ports, refer to later sections in this manual.

5.8 Adding or Deleting Devices on a Host port

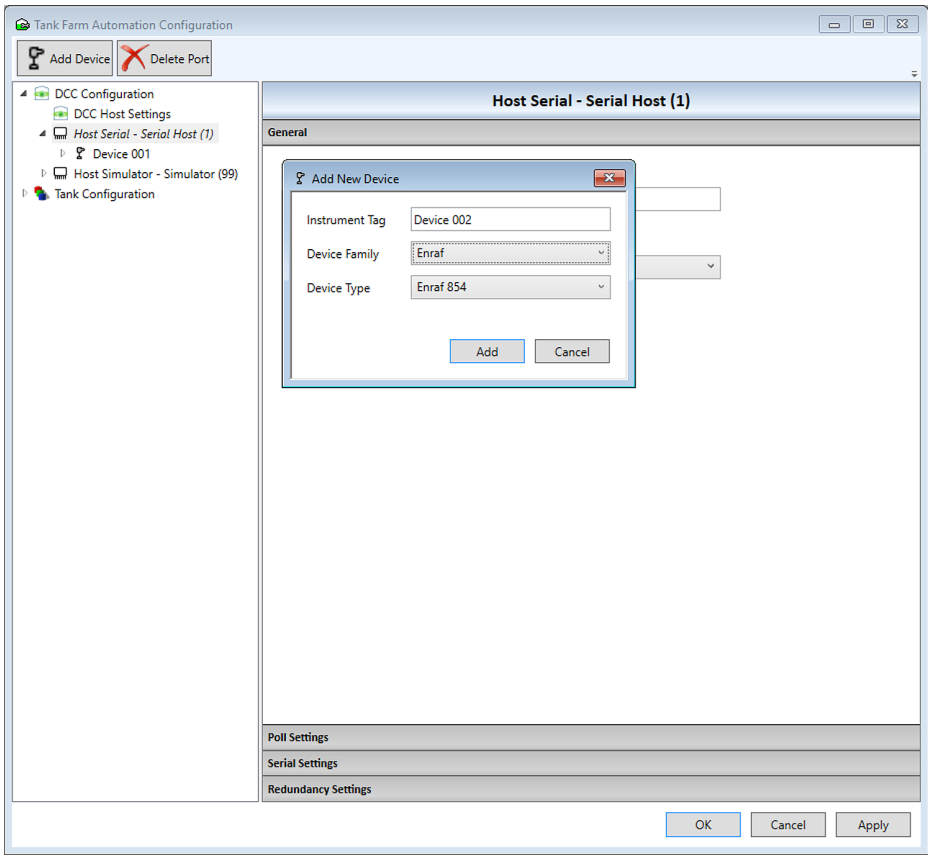
Devices must be assigned to Host ports, so that they are then polled for field data on that port. Generally they will be added to just one Host port, however if the redundancy mode is set to **Switch By Gauge** or **Switch by Interface** then a second backup port must also be defined.

Devices do not need to be added to a Slave port.

Devices assigned to Host ports are then available to be assigned to tanks in the Tank Configuration section.

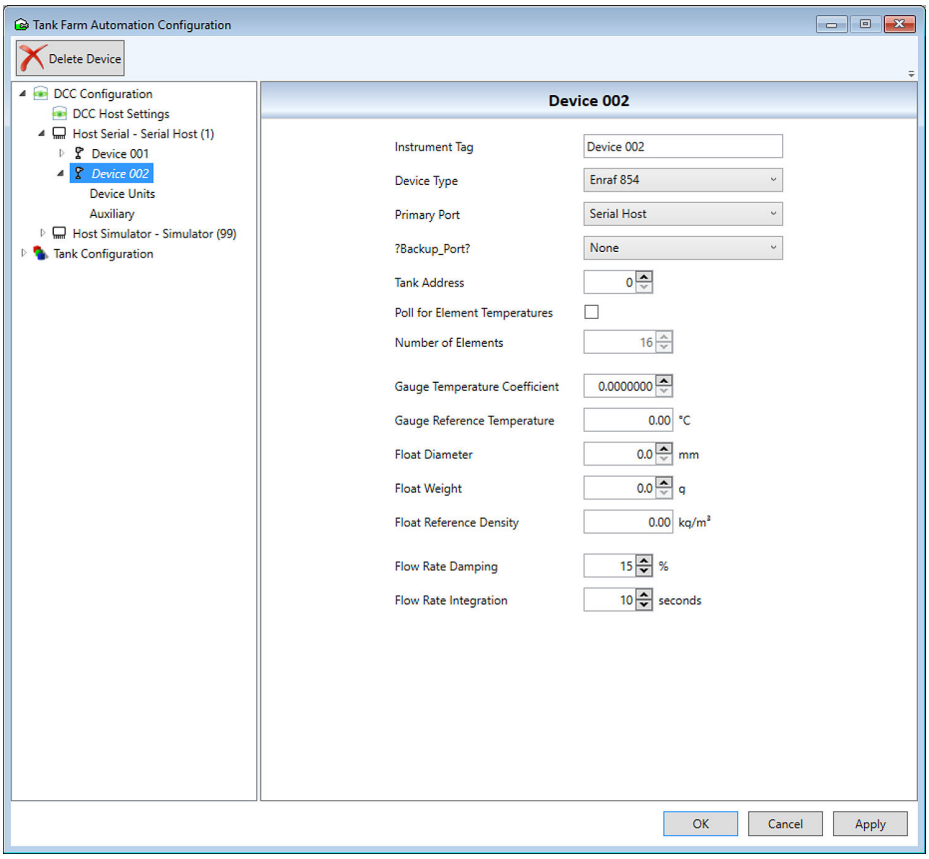
Refer to the Configuration manual BA00390G for details of how to configure tanks.

1. To add a device to a port, select the host port in the DCC Configuration list then click on the **Add Device** button in the toolbar or right-click on the desired port and select **Add Device**.
   ↳ A dialog box will be displayed.



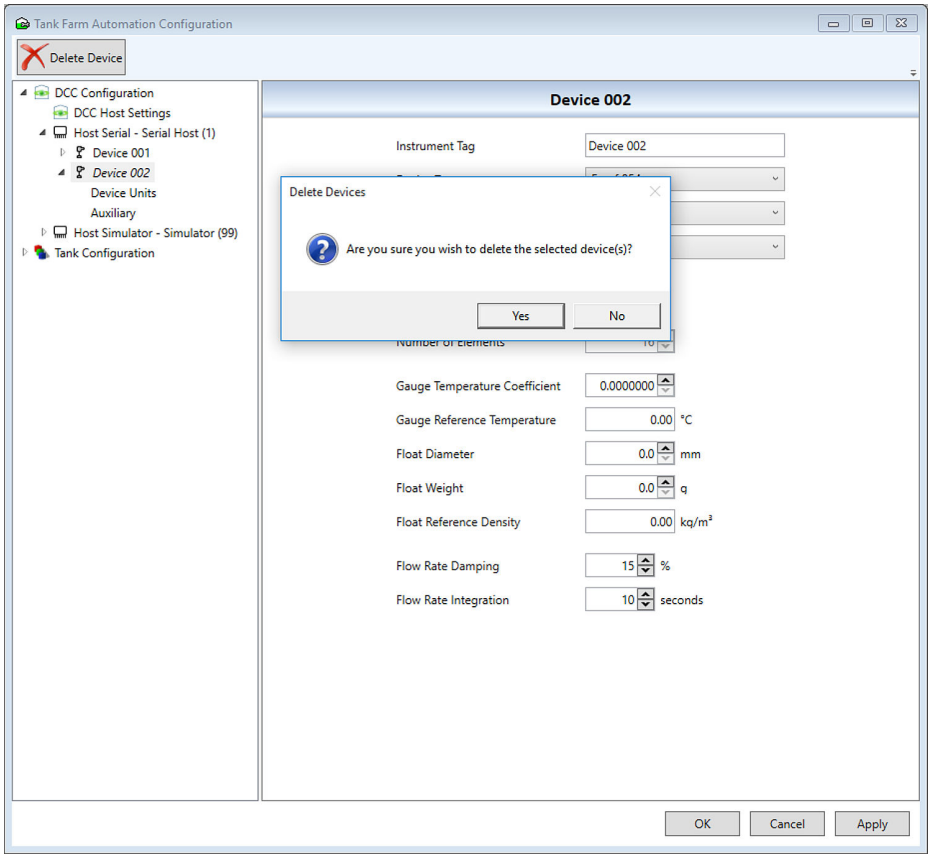
2. Enter an **Instrument Tag** to identify the device, then select the **Device Family**.
   ↳ This will then allow a device from that family to be selected in the **Device Type** field.

3. Click on the **Add** button to add the device to the list of devices on the host port



The device parameters can now be configured as required, described in a later section of this manual.

1. Devices can be deleted from a port by selecting the device and clicking on the **Delete Device** button in the toolbar.
   ↳ A confirmation dialog will be displayed.



2. Click **Yes** to delete.

Any changes to devices are not saved permanently until the **OK** or **Apply** buttons are clicked.

6 DCC Host Configuration

6.1 DCC Host

The DCC Host service is responsible for collecting data from gauges and other devices, calculating Tank Inventory, and processing command requests from the client.

Each port used for communications must be defined in the DCC Host sub-system, these can be a direct COM port connection via a physical RS232 (or RS485 etc.) port on the PC or virtual ports via Network, OPC or XML connections.

When using virtual ports then the COM port number will be auto-assigned in the ranges:
- **Network** Ports - COM71 +
- **OPC** Ports - COM110 +
- **XML** Ports - COM200 +

Virtual ports are treated as if they were physical COM ports on the PC with the difference that multiple virtual COM ports may use the same physical network adapter. There is no support for multiple network adapters on the PC except when using network sharing software.

There is also a built in simulator port that can simulate data for any devices assigned to the port.

Devices must be added to a port to allow DCC Host to communicate with them. This is the primary port that DCC Host will poll for data for that tank. For gauges configured for redundant operation modes **Switch By Gauge** and **Switch By Interface**, a backup COM port must also be configured.

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.

6.2 Configuring Host COM Ports

To add a host port select the **DCC Configuration** item and click on **Add Port**. Refer to a previous section for more details.

To configure an existing host port click on the item in the DCC Configuration ports list, which will show all devices attached to that port. In the right hand panel a range of pages showing the port configuration parameters will be available, depending on the port type.

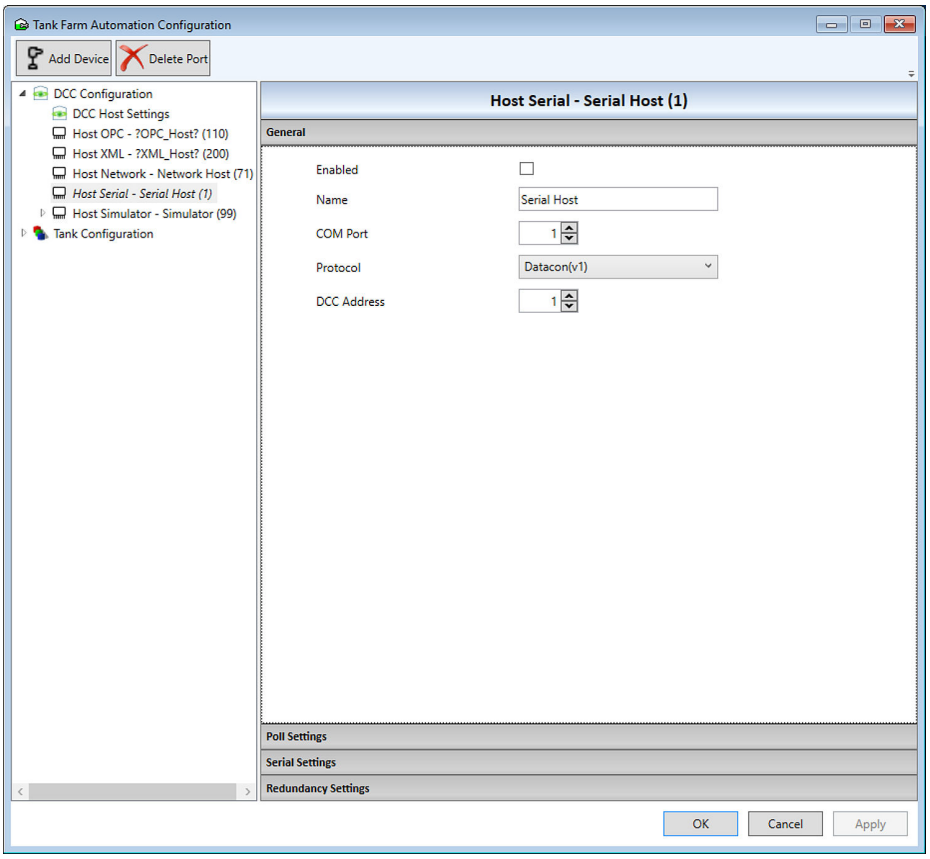
These will include:
- **General**
- **Poll Settings**
- **Redundancy Settings**
- **Serial Settings**
- **Network Settings**
- **OPC Settings**
- **XML Settings**

6.3 General Settings

A set of general options that apply to the communications port.

▶ Click on the **General** page to show the settings.

↳



Current supported options include:

- **Enabled**: This must be ticked for the port to be active. If it is not ticked then the port will not be loaded into DCC Host and will not be shown in the DCC Monitor. It will be straightforward to identify the disabled port as the foreground colour in the left hand panel will be red. In this case the port will be listed at the bottom of the panel. If 2 or more ports are disabled these ones will be sorted by name and still appear at the bottom of the list.
- **Name**: An optional name to help in identifying the port.
- **COM Port**: The COM port on which this port will run. It is generally set when the port is added but may be changed here if required.
- **Protocol**: The protocol to be used on the port.
- **DCC Address**: Applies only if the Datacon protocol is used and should be set to the address of the remote device.

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

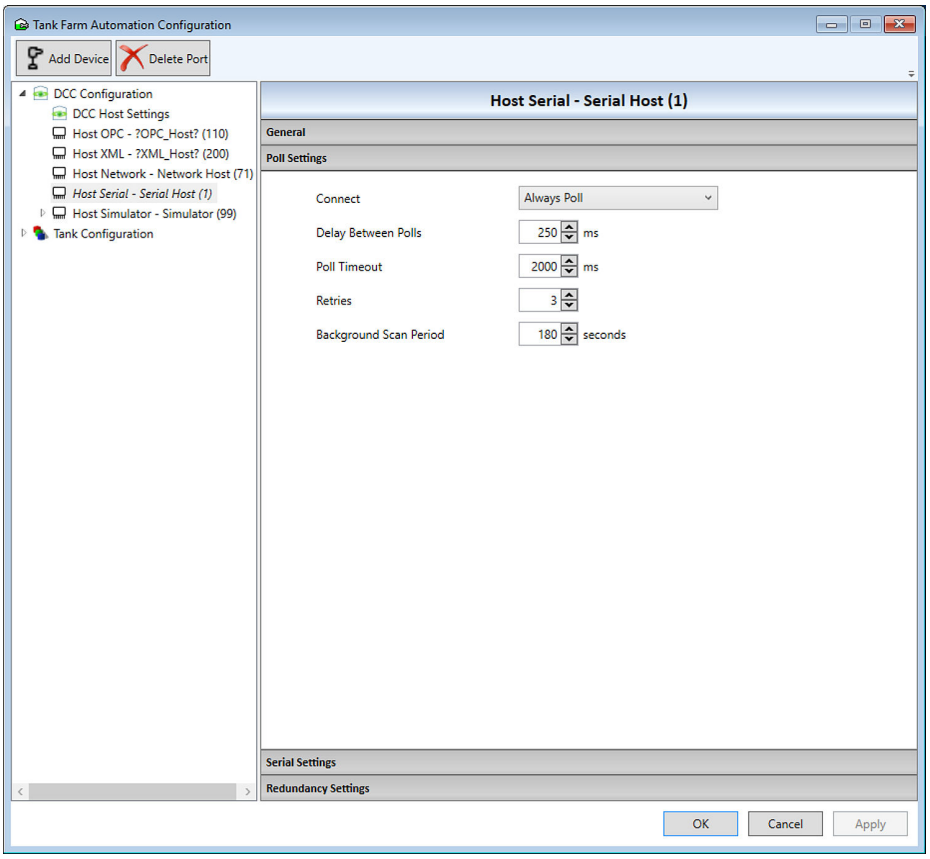
- ASCII Alarm Output
- Avery Hardoll
- Contrec SLIP
- Danload 6000
- Datacon
- Datacon (v1) Legacy
- Enraf 867 STIC
- Enraf BPM
- Enraf CIU
- Enraf CIU Prime (GPU)
- Enraf CIU Prime (Modbus)
- FMS 2000
- Generic XML
- GPE
- Hart

- Hectronic
- Isoil Rfid-A Protocol
- L & J
- LNG Modbus (SI 6280 and 6290 gauges etc.)
- M+F IDT_95
- MCS 4000
- MCS 5000
- Mercury 2 ASCII
- Modbus
- Modbus Automation
- OPC TG (Generic gauges from an OPC server)
- Redundant Link Control
- SAAB FCU
- SAAB FCU FBM
- SAAB FCU TM
- SI 62x0
- Smith Meter Mini Computer
- Smith Meter Terminal Host
- Tank Scanner NXA820
- TankMaster Serf
- V1 (new)
- Varec Mark/Space
- Veeder Root TLS
- Whessoe ASCII
- Whessoe WM500
- Whessoe WM550

6.4 Poll Settings

A set of options that apply to the communications port and determine the polling rate and connection type.

▶ Click on the **Poll Settings** page to show the settings.



Current supported options include:

- **Connect**: The connection mode for the port. For Host ports this should normally be set to **Always Poll**.
- **Delay Between Polls**: This is the minimum time for each poll. 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.
- **Poll Timeout**: The time to wait for a response to a poll. If this field is set to 0 then the default timeout based on the protocol will be used.
- **Retries**: The number of consecutive failed polls before a communications failed alarm is generated.
- **Background Scan Period**: The update time for background parameters, including: Density, Temperatures , Pressures, Water Level etc. It defaults to 180 seconds and reducing this time may interfere with the update of the level data, therefore do not set too low. Never set below 10 seconds.

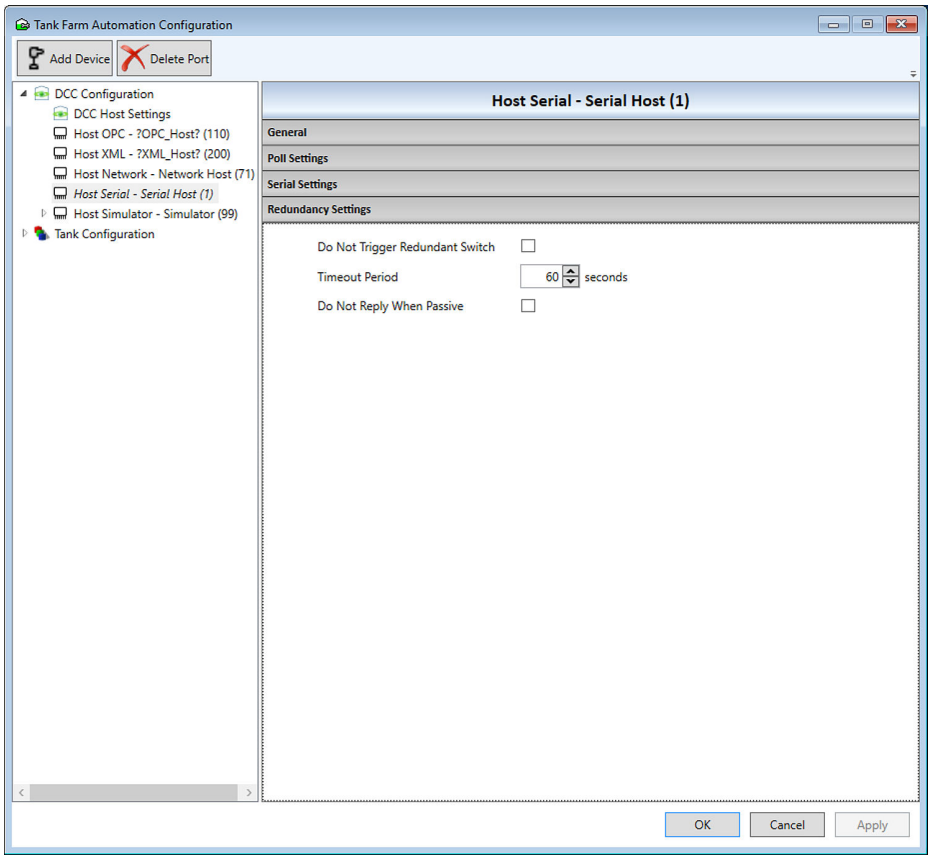
The **Connect** field should normally be set to **Always Poll**, but there are a number of other options:

- **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.
- **Always Listen**: Generally used if another system is polling the devices on the data loop. In which case this port will listen for data.
- **Always Listen or Poll**: Not supported at the moment.
- **Sequential Poll Group X**: Ports in DCC Host normally simultaneously, however if multiple ports are assigned to a poll group then devices on the ports will be polled sequentially.

6.5 Redundancy Settings

These settings apply if the redundancy mode has been set to **Switch By System**, and determine how this port will affect the redundant operation.

▶ Click on the **Redundancy Settings** page to show the settings.



Current supported options include:

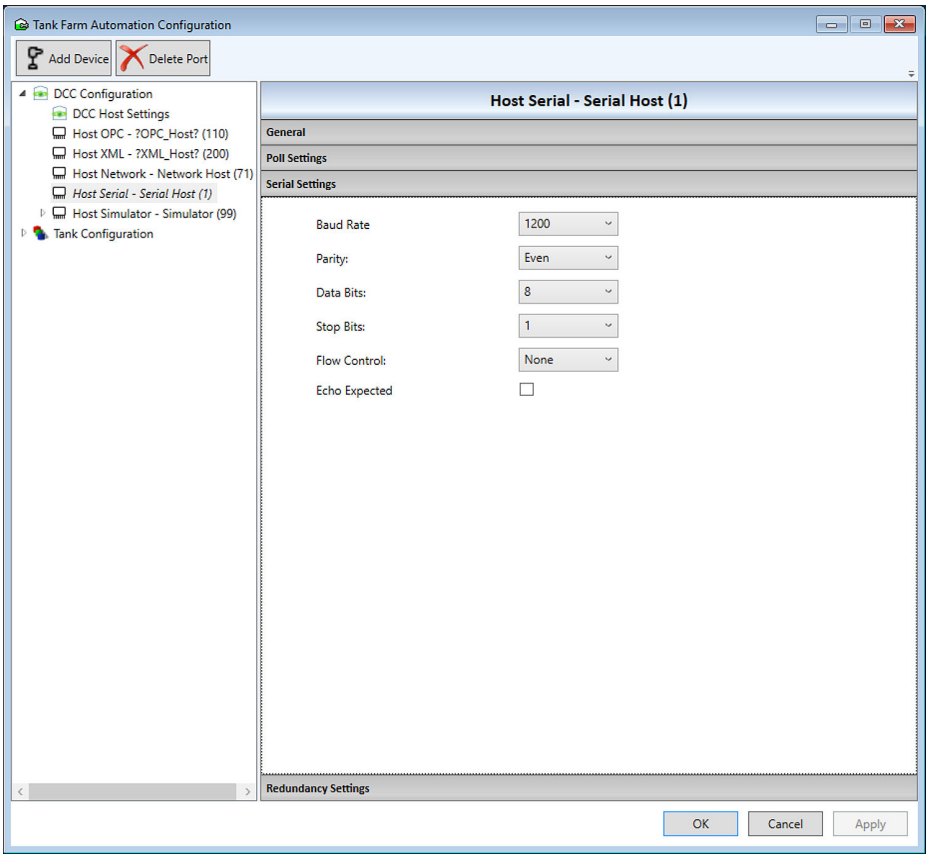
- **Do Not Trigger Redundant Switch**: If ticked then the port will not initiate a redundant switchover if it is considered failed.
- **Timeout Period**: The time period, during which no valid replies are received, before a port is considered failed and a redundant switch-over is initiated. (i.e. The system will switch to passive mode.)
- **Do Not Reply When Passive**: Does not apply to Host ports.

6.6 Serial Settings

A set of options that apply to the communications port using a physical serial port, including parameters such as Baud Rate, Parity, Stop bits etc. These should be set to the same as the devices on the data loop.

▶ Click on the **Serial Settings** page to show the settings.

↳



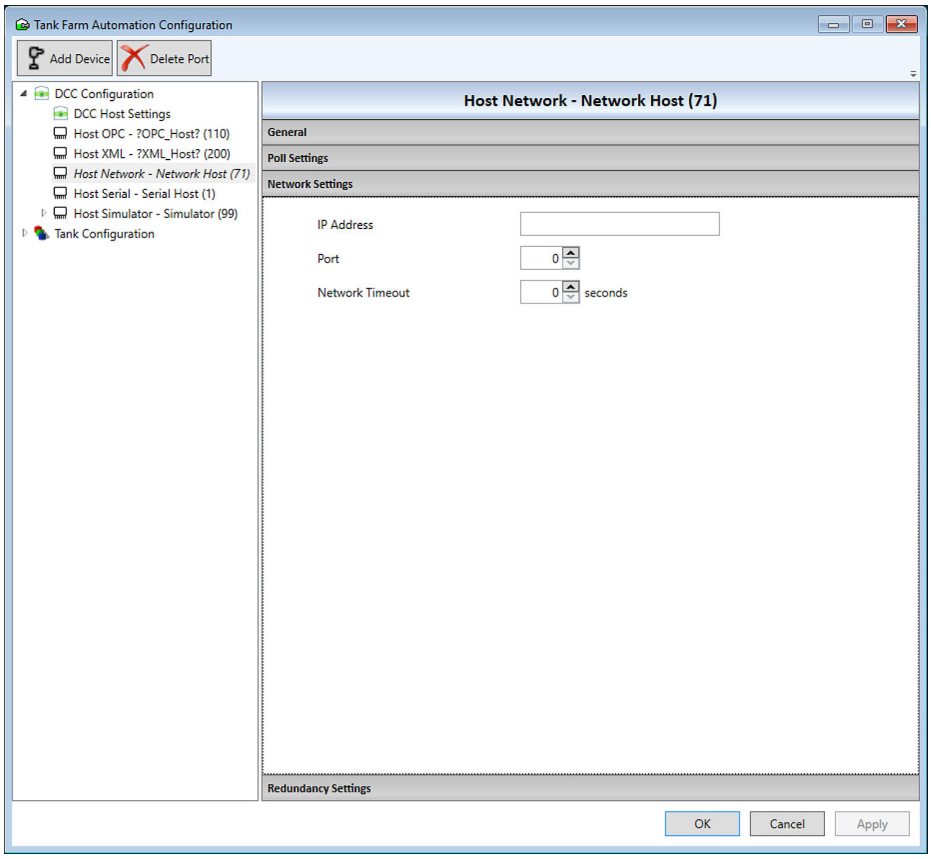
Current supported options include:

- **Baud Rate**
- **Parity**
- **Data Bits**
- **Stop Bits**
- **Flow Control**: Should normally be left as **None**.
- **Echo Expected**: If the serial communications hardware produces an echo of sent characters (i.e. some RS485 or 20 mA current loop devices) then tick this field to tell the driver to handle the echoed characters.

6.7 Network Settings

A set of options that apply to the communications port using a network connection.

▶ Click on the **Network Settings** page to show the settings.



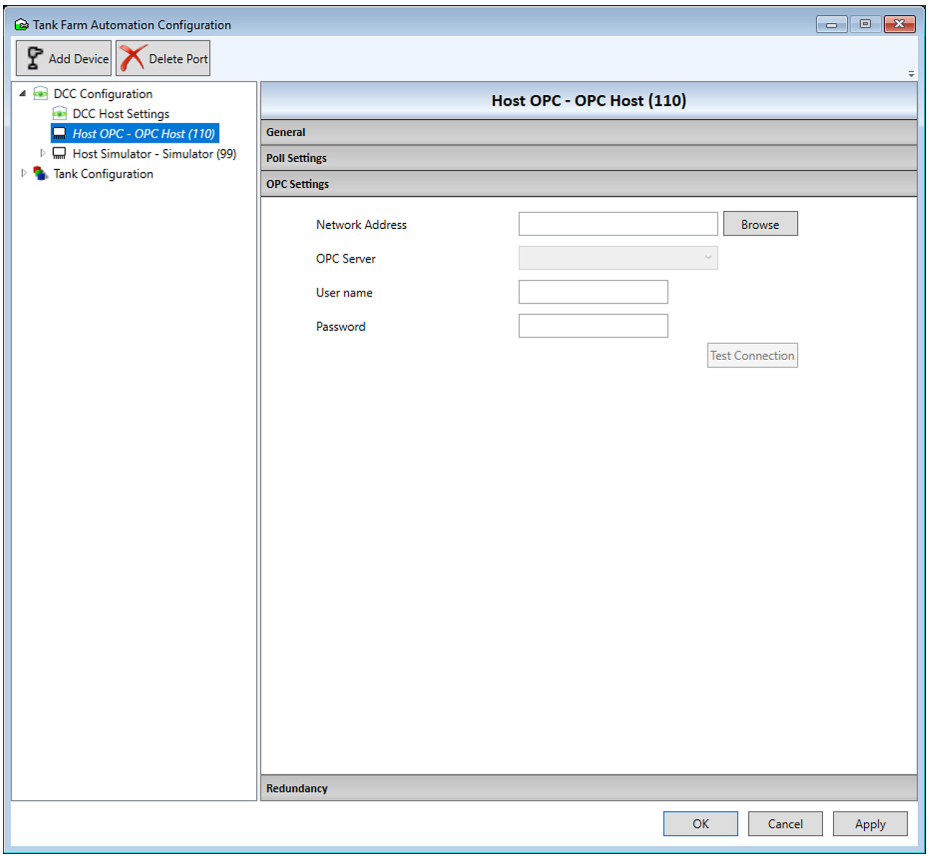
Current supported options include:
- **IP Address**: IP address of the remote network device that will be connected to.
- **Port**: The IP Port on the remote device.
- **Network Timeout**: Not used on a Host port.

6.8 OPC Settings

A set of options that apply to the communications port connecting to an OPC server via a network connection.

▶ Click on the **OPC Settings** page to show the settings.

↳



Current supported options include:

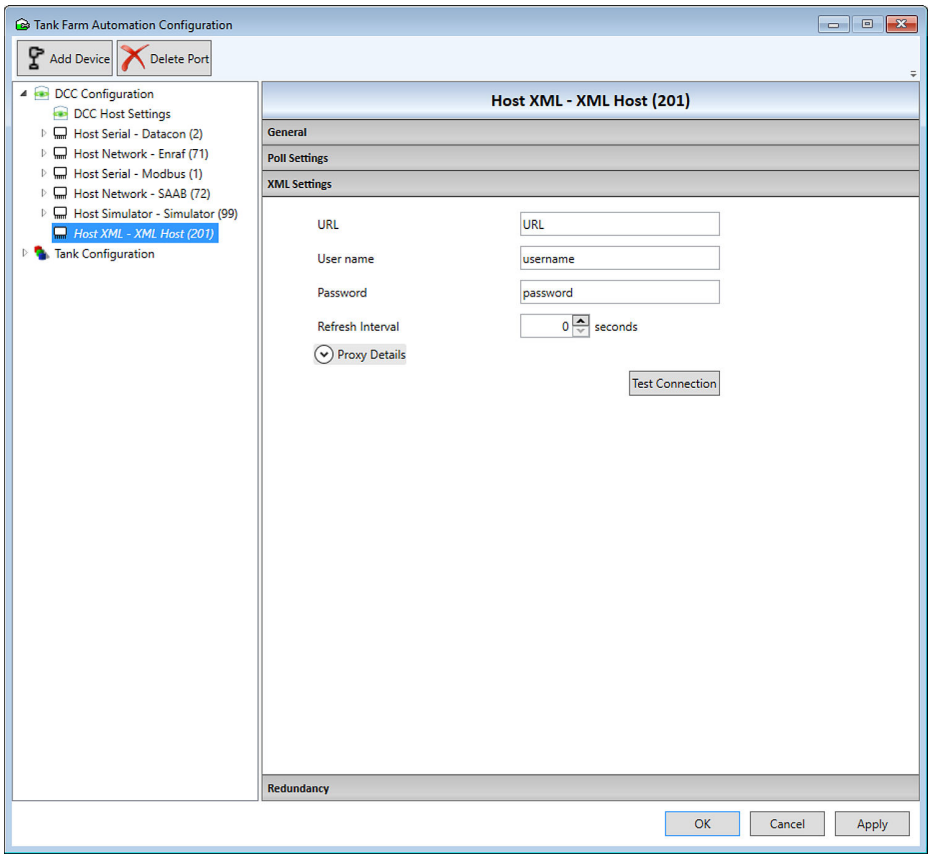
- **Network Address**: IP address of the system running the OPC Server. This may be entered as the name of the device (i.e. PC name) or as its TCP/IP address. If the OPC server is running on the local system leave field this as blank.
- **OPC Server**: The name of the OPC DA server on the remote system.
  If the **Network Address** field is valid then **Browse** button may be used to populate the drop down list with all OPC servers available on the remote system.
- **User Name**: User account on remote system to allow connection to OPC Server.
- **Password**: Password for user account on remote system to allow connection to OPC Server.

For more information on OPC ports in DCC Host, refer to the separate manual OPC TG Client Configuration BA01294G.

6.9 XML Settings

A set of options that apply to the communications port connecting to an remote XML server system via a network connection.

▶ Click on the **XML Settings** page to show the settings.



Current supported options include:
- **URL**: URL of the server to connect to.
- **Refresh Interval**: The required time interval between file reads.
- **User Name**: Authentication details for the URL server.
- **Password**: Authentication details for the URL server.

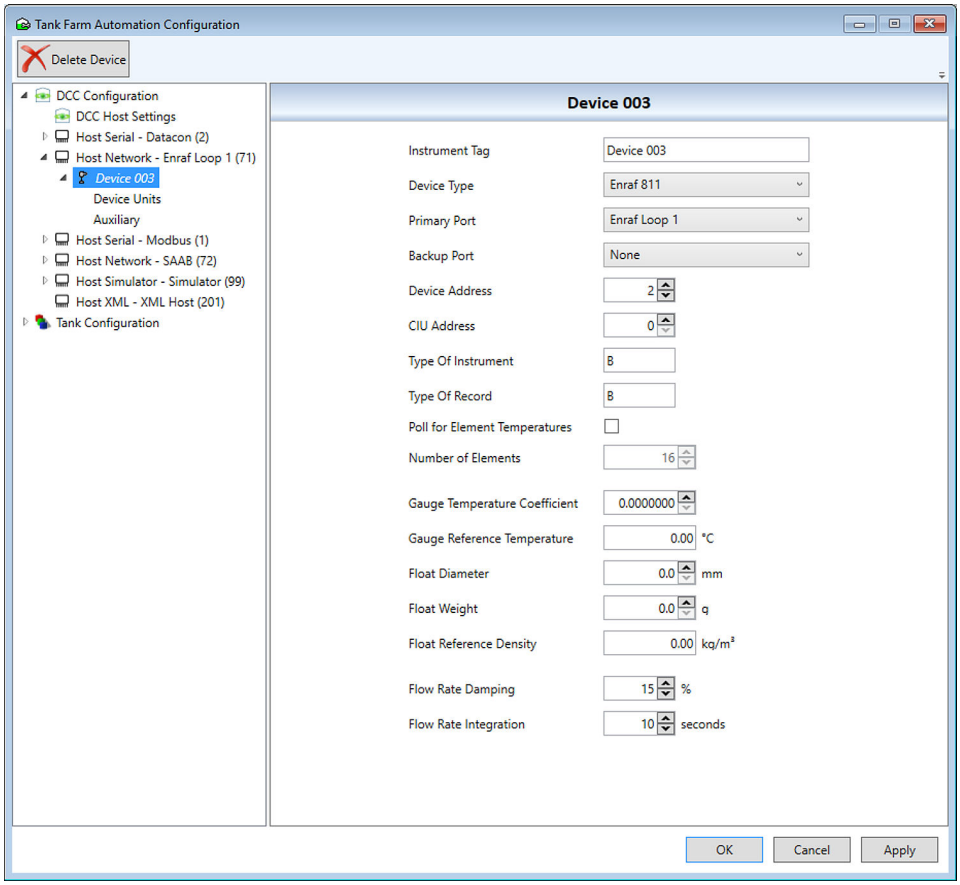
If a proxy server is used, then click on the **Proxy Details** item to expand it and display the following fields:
- **Address**: Address of the proxy server.
- **Port**: The IP port used on the proxy server.
- **User Name**: Authentication details for the proxy server.
- **Password**: Authentication details for the proxy server.

The **Test Connection** button may be used to validate the details entered are correct by attempting to connect to the XML server and read the XML file.

6.10 Device Configuration

Devices must be assigned to Host ports, so that they are then polled for field data on that port. Details of how to add devices to ports are given in a previous section. They must then be configured with the correct parameters, such as CIU Address, Gauge Address, etc. so that they can communicate with the device on the field loop.

To do this click on the device in the list of devices for the host port. This will expand the tree list to show the **Device Units** and **Auxiliary** items below the Device. It will also display the configuration details for the device in the right hand panel.



The fields displayed for devices will vary depending on the device type and the protocol of the host port, however there are some common fields that will be displayed. These are defined below:

- **Instrument Tag**: The name of the device.
- **Device Number**: The number of the device.
- **Device Family**: The family of the device.
- **Device Type**: The type of the device.
- **Port**: The number of the host port that this device is assigned to. If this field is altered then the device will be removed from the current port and moved to the new port number.
- **Primary Port**: This replaces the Port field if the redundancy mode is set to **Switch By Gauge** or **Switch By Interface** and is the primary port that will be used for communicating to the device.
- **Backup Port**: This is only displayed if the redundancy mode is set to **Switch By Gauge** or **Switch By Interface** and is the secondary port that will be used for communicating to the device.
- **Poll for Element Temperatures**: Tick this box if the device supports Multi-Element temperatures and the individual elements need to be read via the communications and saved/displayed in the system. If ticked the values will be polled on the background scan cycle. If this field is not ticked the Product Temperature will still be updated in the system, it just means the individual elements will not be available for view.
- **Number of Elements**: If the Poll for Element Temperatures field is enabled then enter the number of elements supported by the device.

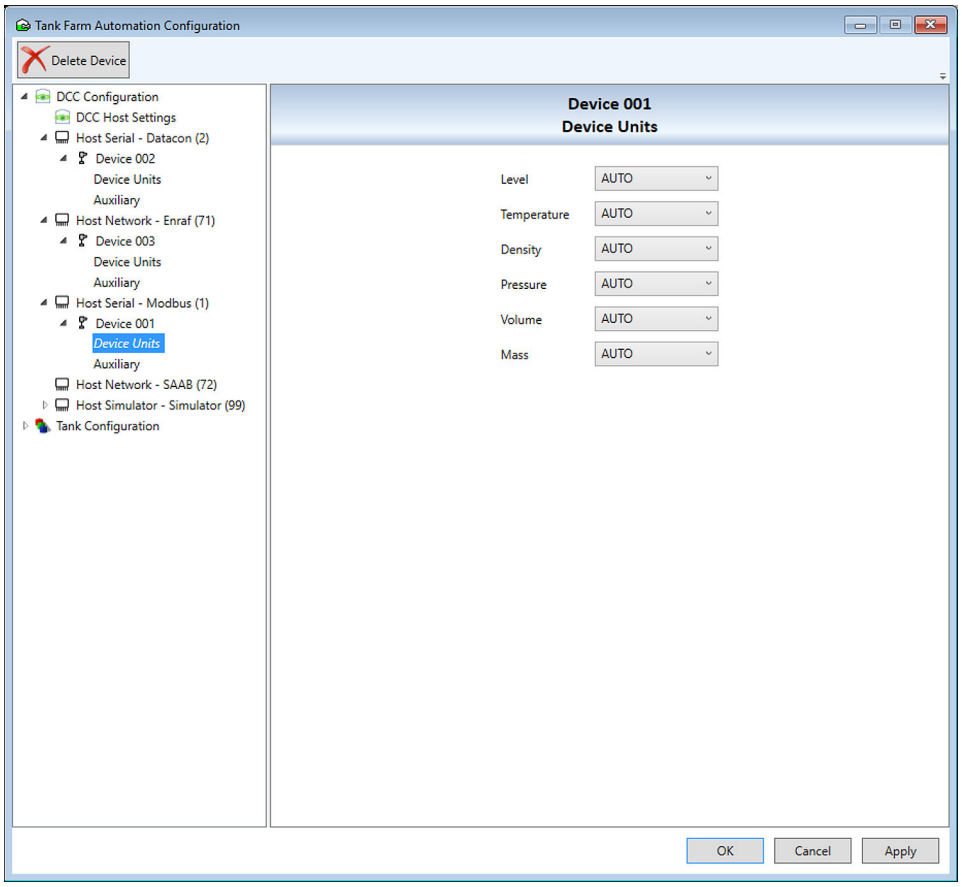
- **Lowest Element Position**: The level of the lowest temperature element. If the level falls below this value, then the Product Temperature is marked as invalid, represented by a DN99 error code on screen.
- **Flow Rate Damping**: Used in the level flow rate calculations and is a measure of how much of the current instantaneous flow rate reading is incorporated into the filtered value, as a percentage. Increasing the figure increases the responsiveness of the resulting flow rates but reduces the effective damping. In most cases the default value (15 %) is acceptable.
- **Flow Rate Integration**: Used in the level flow rate calculations and is a time in seconds, up to 240 seconds maximum (4 minutes), used to increase the effect of damping where the level readings/flow rate calculations are performed at shorter intervals depending upon the number of devices present on the particular communications port. In most cases the default value (10) is acceptable.

The following fields are used for tank/gauge corrections in the inventory calculations:

- **Gauge Temperature Coefficient**: The linear coefficient of thermal expansion for the gauge and it's mountings.
  The typical values are the same as those for Shell Expansion Coefficient.
- **Gauge Reference Temperature**: The temperature at which the gauge was calibrated.
- **Float Diameter**: Diameter of the gauge float.
- **Float Weight**: Weight of the gauge float.
- **Float Reference Density**: The density of the fluid in which the float was calibrated.

6.11 Device Units

This page can be used to define the units of the data types being returned from the device, such as Levels, Temperatures, Pressures etc. By default the units are set to **AUTO**, and in nearly all cases these should not be changed, as DCC Host will either know the units or will automatically get the units from the device itself.

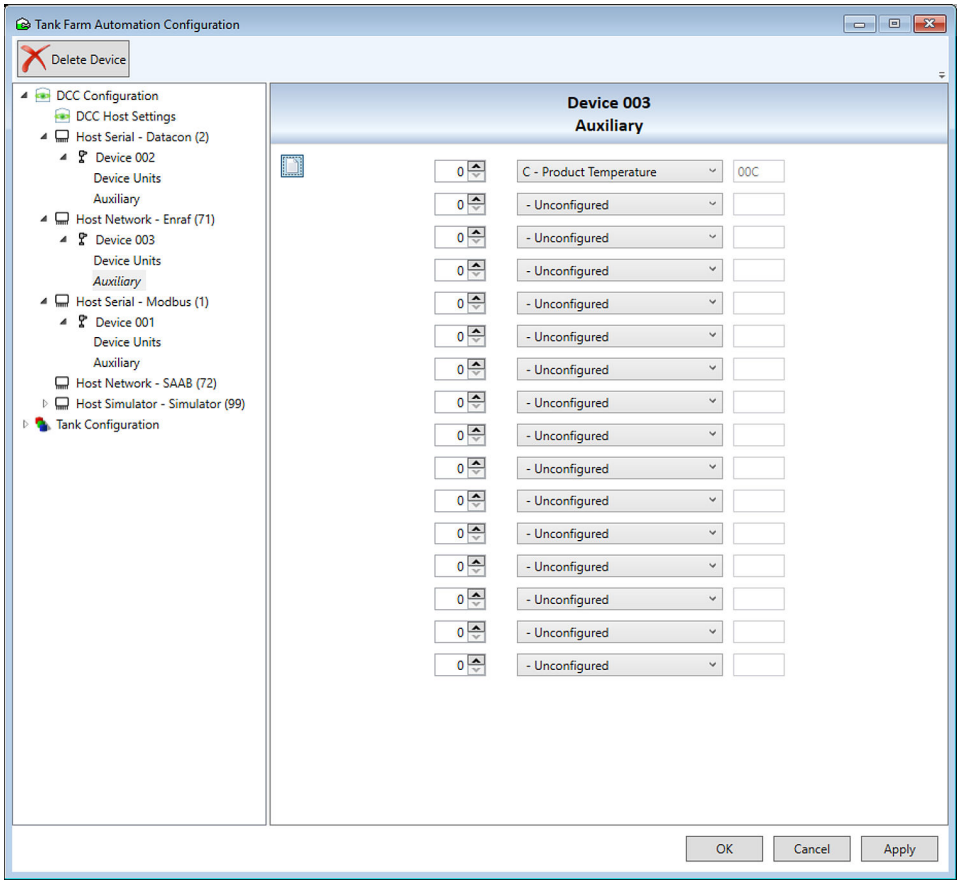


There are some device types, for instance an Enraf 811 gauge, where the units have to be explicitly set in this page. The application note for the device/protocol will normally specify if these need settings.

These units apply only for data returned from the gauge which is then converted to standard database units. They do not define the units displayed on any screens in the Tank Gauging system.

6.12 Device Auxiliary

This page can be used to define any auxiliary settings for the device.



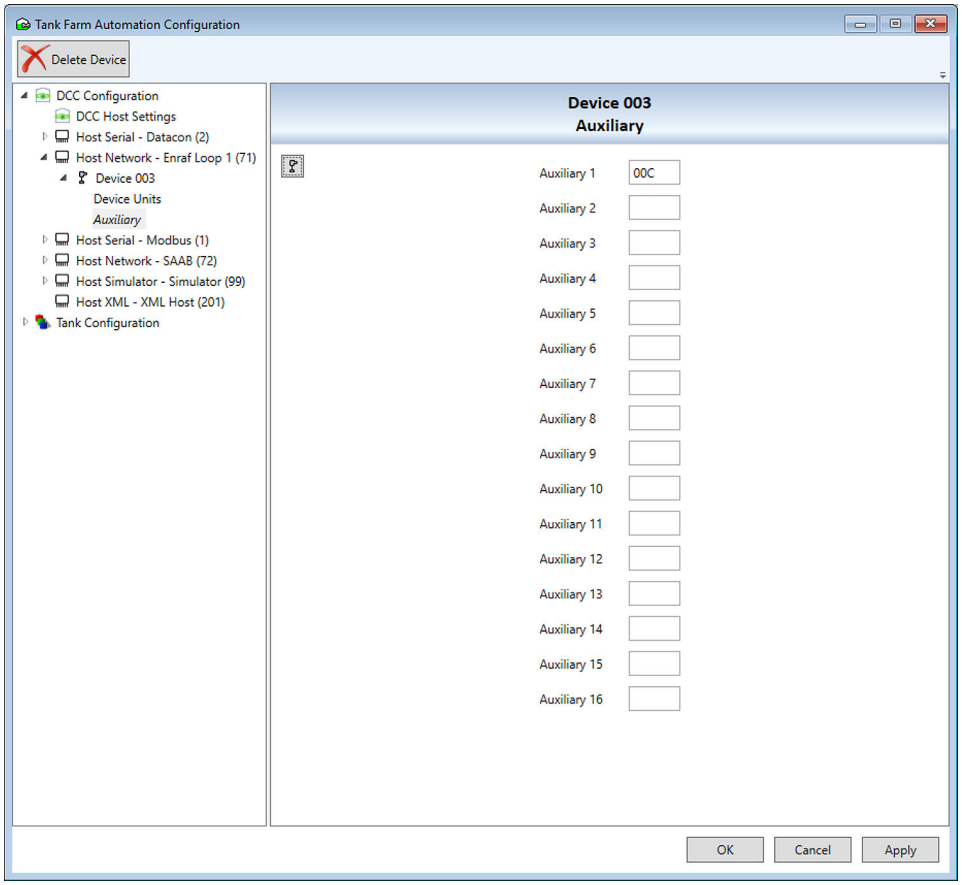
The Auxiliary settings are used to read data parameters other than Product Level from the device at lesser frequency than the level, called the Background Scan. Product Level is the primary data item and is the default item polled from the device by the system. Polls for other items may be inserted periodically by the system dependent upon the settings of the Auxiliary items. Where used, Auxiliary 1 is assumed to be for Product (Average) Temperature, and is typically polled at half to quarter of the rate of Product Level. The other items Auxiliary 2 to Auxiliary 16 are inserted into the normal polling sequence at the Background Scan rate.

The background scan interval can be modified in the **DCC Host Settings** page. The Auxiliary scans are typically used to read Free Water Level, Density, Vapour Pressure, Vapour Temperature, etc.

The layout of the auxiliary page is dependent on the device/protocol being configured and is designed to make the selection of the auxiliary item codes as user friendly as possible.

However the settings can always be viewed in 'classic' view by clicking on the icon in the top left hand corner of the page.

In the 'classic' view, each auxiliary item is a 4 character code which can be a combination of numbers and letters. The codes very much depend on the device/protocol being configured and are defined in the relevant application note for the Tankvision Multi Scan.



6.13 Datacon protocol configuration

The Datacon protocol is used to transfer device data between tank gauging systems, such as connecting to a Tankvision Multi Scan.

To connect to a Tankvision Multi Scan a host port must be configured with the Datacon protocol, selected from one of the options below:

- **Datacon(v1)**: Version 1 is an old version of the protocol which has been superseded by version 2, but may be selected when there are problems connecting to a very old Tankvision Multi Scan using the standard Datacon protocol option.
- **Datacon(v2)**: The latest version of the protocol, this option should only be selected if there are problems autodetecting the version using the standard **Datacon** option.
- **Datacon**: This is normally the protocol option to select when connecting to a Tankvision Multi Scan, as it will autodetect the correct version to use.

The Datacon protocol option should generally be used when connecting to a Tankvision Multi Scan. Only in very rare cases it is required to select v1 or v2 explicitly.

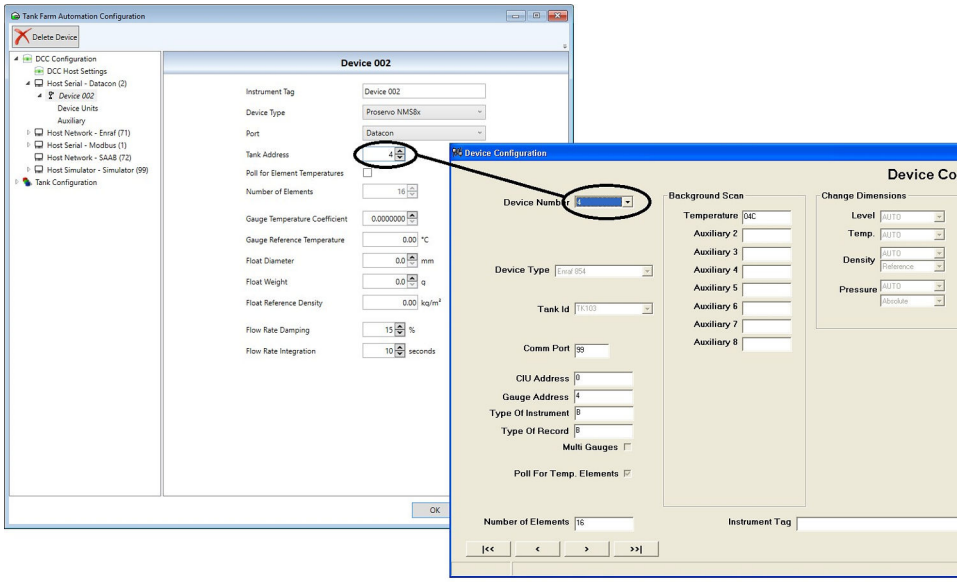
Both serial and network connections are supported by the Tankvision Multi Scan and when using a network connection the IP Port used is normally 6001, however this may be changed as required.

The **DCC Address** field in the **Port Settings** page should be set to be the same as the Slave Address configured for the slave datacon port on the Tankvision Multi Scan, although this is normally just left as the default value of 1.

6.13.1 Configuring Devices

Devices have the same configuration parameters on a datacon protocol port, regardless of the device family and type. All that is required is linking the device to the device index in the Tankvision Multi Scan, which can be one of 2 methods:

- **Tank Address**: Set the Tank Address field to be the same as the Device Number field in the Tankvision Multi Scan (see figure below). This is the normal method of configuring a device for the datacon protocol.
- **Instrument Tag**: If the **Tank Address** field is left as 0, then the link will be made using the Instrument Tag.



6.14 Endress+Hauser gauge configuration

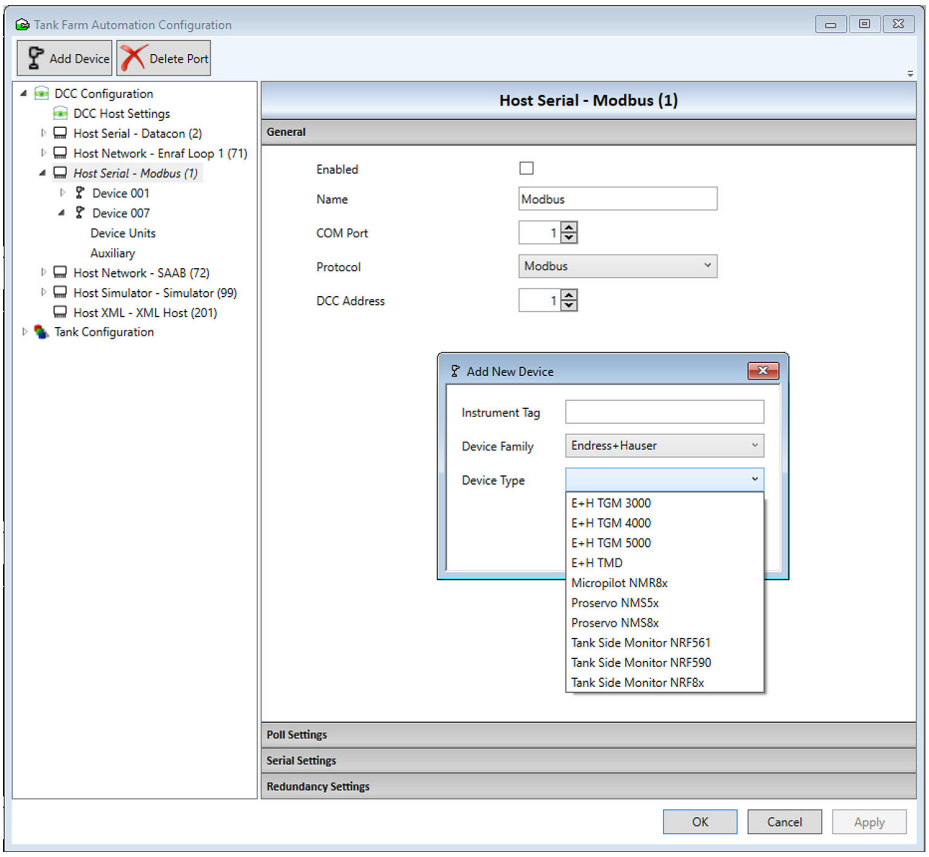
Endress+Hauser gauges can be connected to the system in a number of ways, these include:

- Connect to a Tankvision Multi Scan using the datacon protocol, which then polls the gauges via the V1 or Modbus protocols.
- Connect directly to the gauges using the Modbus protocol.

For the first method refer to the previous section on the datacon protocol for configuration details. The second method is covered in this section.

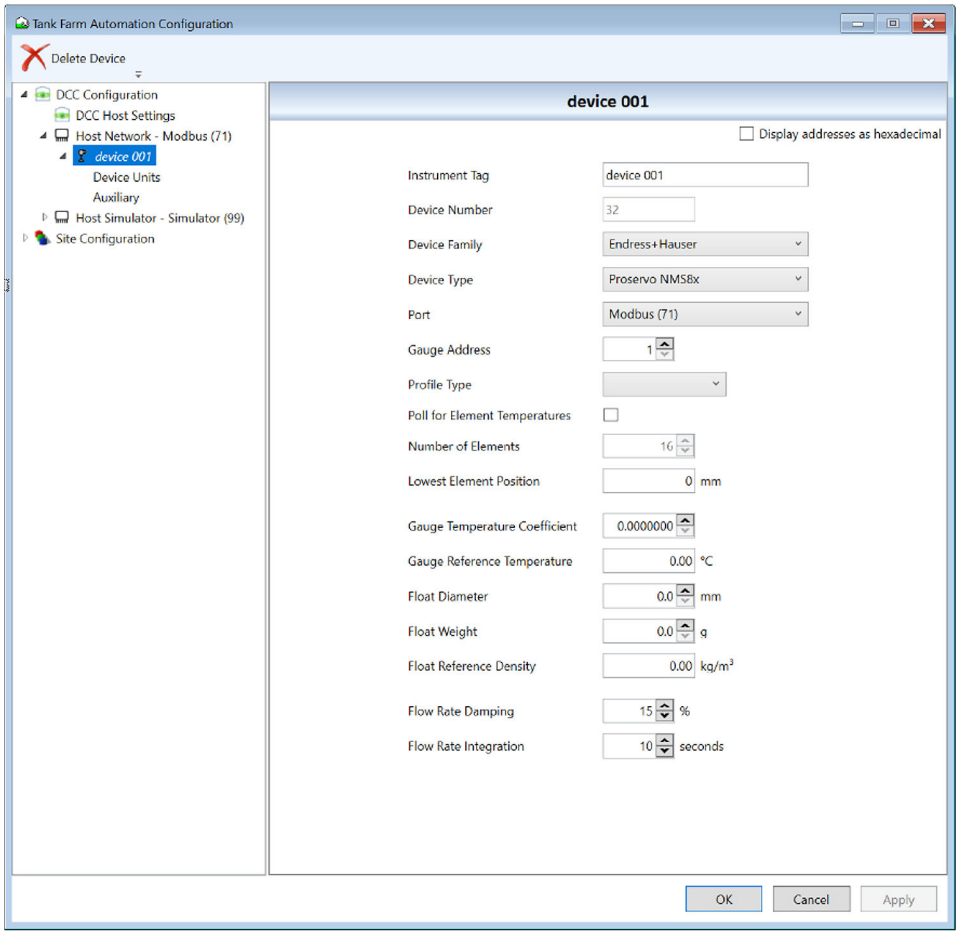
1. To add an Endress+Hauser device, right click on the modbus port and select **Add Device**.

2. Select the **Device Family** as Endress+Hauser, then select the gauge type.



Devices require the following parameters to be configured:

- **Gauge Address**: The device address of the gauge, in the range 1 to 255.
- **Profile Type**: Specifies the type of profile supported by the gauge.
  This field is only required for servo type gauges and can be one of the following options:
  - **Profile**: for gauges that support full density profiling.
  - **Spot**: for gauges that support only the older spot type densities.
  - **No Profile**



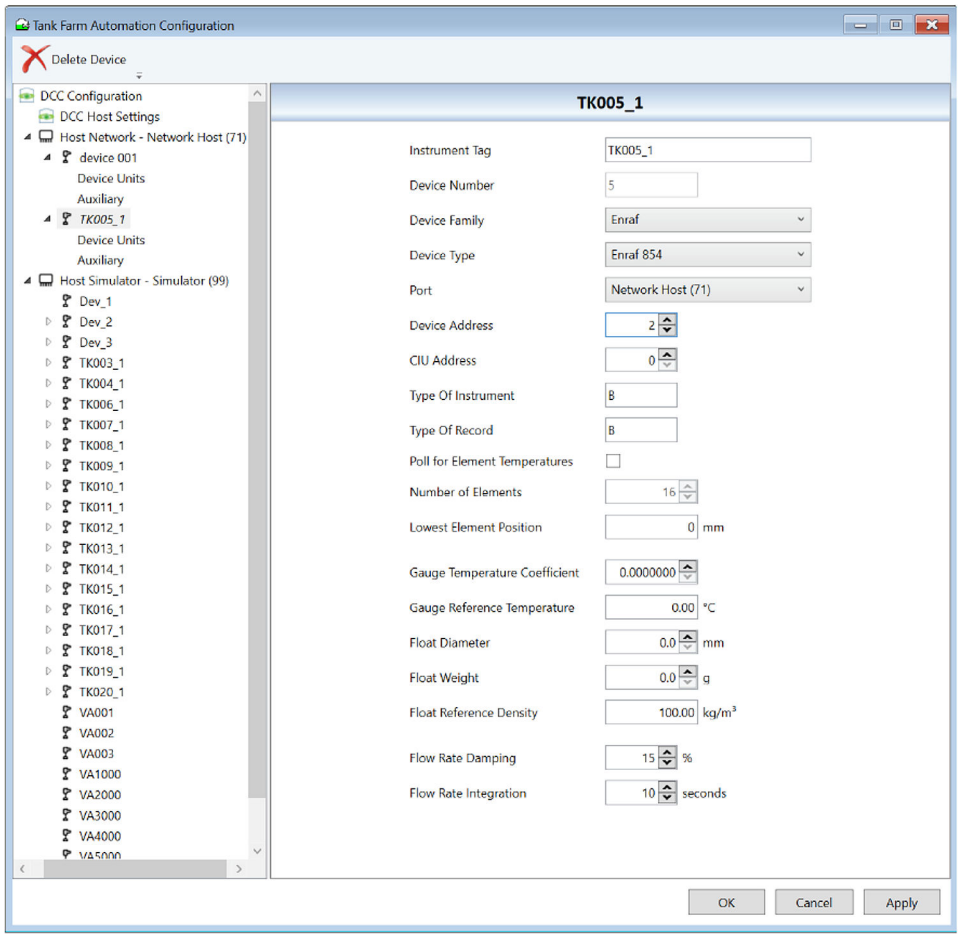
The auxiliary items must be configured if background parameters such as Water Level, Pressures, Vapour Temperature etc. are required.

Refer to the application note on Endress+Hauser gauges for more information.

6.15 Enraf protocols configuration

Devices connected to Host ports using one of the Enraf protocols, such as Enraf BPM or Enraf CIU, require the following parameters to be configured:

- **CIU Address**: The address of the CIU device, in the range 0 to 99. Only required when using the Enraf CIU protocol.
- **Device Address**: The transmission address of the gauge, in the range 0 to 99.
- **Type Of Instrument**: Specifies the Enraf protocol variant to be used. Values can be:
  '**A**' = GPP
  '**B**' = GPU
  The default value of '**B**' is normally correct.
- **Type Of Record**: Specifies the request item to use for Level and should typically be left as '**B**'.



When the **Device Type** is set to Enraf 811 device type, the units fields for Level and Temperature must be explicitly set, they cannot be left as AUTO.

Refer to the application note on Enraf gauges for more information.

6.16 Modbus TG protocol configuration

Modbus TG gauges are assigned as devices to Host 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.

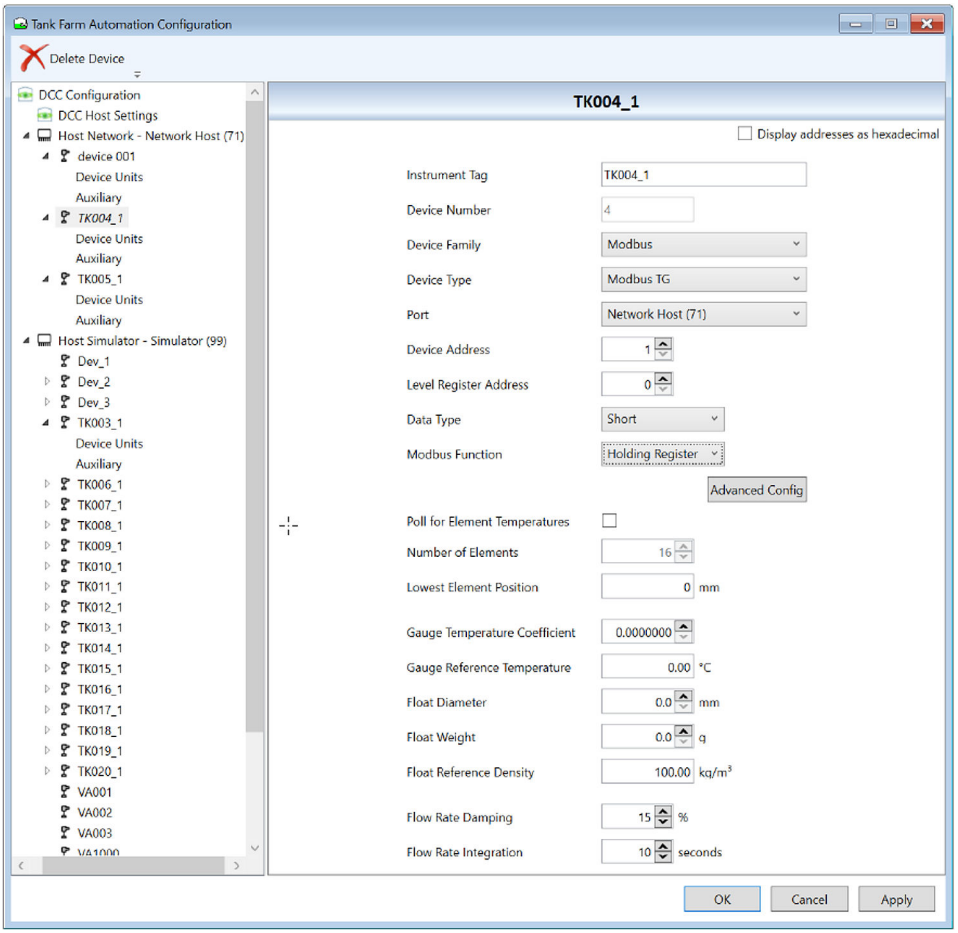
Modbus TG gauges are often used as Auxiliary gauges, to bring in background data items for primary gauges.

Modbus TG gauges may require more configuration than other gauges due to their generic nature. There are 2 steps to configuring a gauge:

1. Configuring devices on the port with a basic modbus map, using the standard Device Configuration screens.
2. If required, configuring an advanced modbus register map in an XML config file.

6.16.1 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 Device Configuration screens.



A very basic Modbus map may be defined for the gauge using the following fields:
- **Device Family**: The device family must be set to **Modbus**.
- **Device Type**: The device must be set to **Modbus TG**.
- **Device Address**: The **Modbus RTU** address of the slave device.
- **Level Register 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).

This parameter is 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.

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 Auxiliary 1 field has been entered then the **Modbus TG** will poll for temperature data using a standard set of decoding parameters:
- Input range ±3 200 °C sent times 10, i.e. +32 °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, then no other configuration is needed for the **Modbus TG** driver.

Level will never be polled for Auxiliary duty gauges.

6.16.2 Modbus TG Advanced Map

If the very basic Modbus map defined when the gauges are added to the system is not enough then 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, DCC Host Configuration is available to allow the user to configure the Modbus Map.

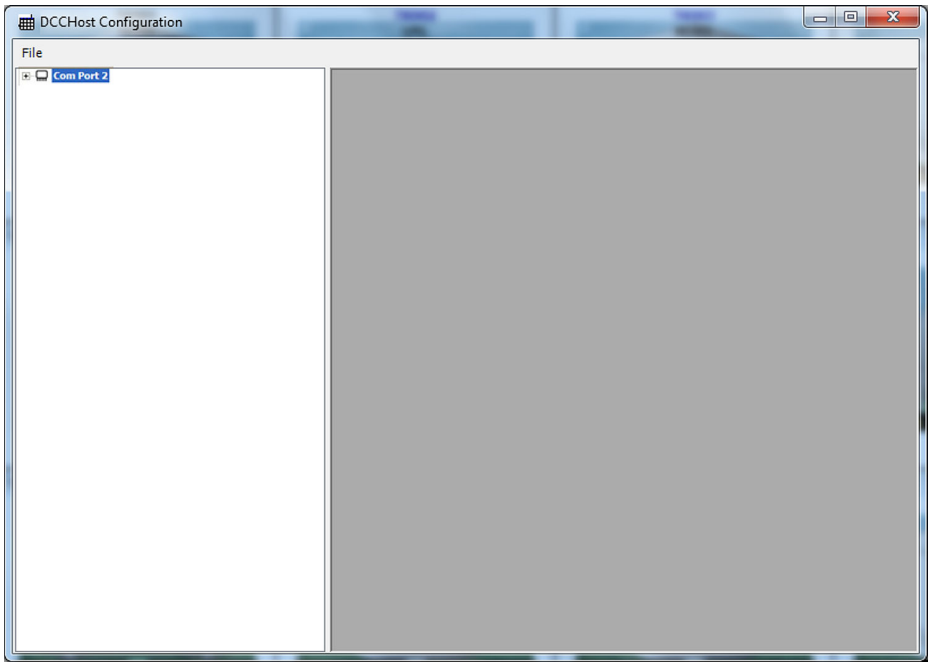
The advanced map consists of a set of Interfaces, each of which may have:
- A set of default parameter details which apply to ALL gauges on the interface.
- A set of gauge parameter details which apply only to the selected gauge.

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).

Launching the Modbus Configuration Tool

To launch the Modbus Configuration Tool, proceed as follows:

▶ Select the menu option **Configuration** → **DCC Host Configuration** or click on the **Advanced Config** button in the device configuration screen.



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

A list of all COM ports that have 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, then 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").

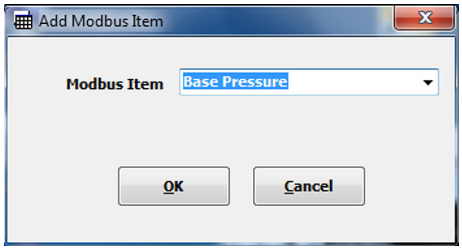
The **Defaults** section allows the user to configure Modbus field definitions that will be added to ALL gauges on this **Modbus TG** interface. If a field is added to the Defaults section it will be polled by a gauge even if the field has not been added to the individual gauge.

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

To add a new modbus field to a gauge or the Defaults, proceed as follows:

1. 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

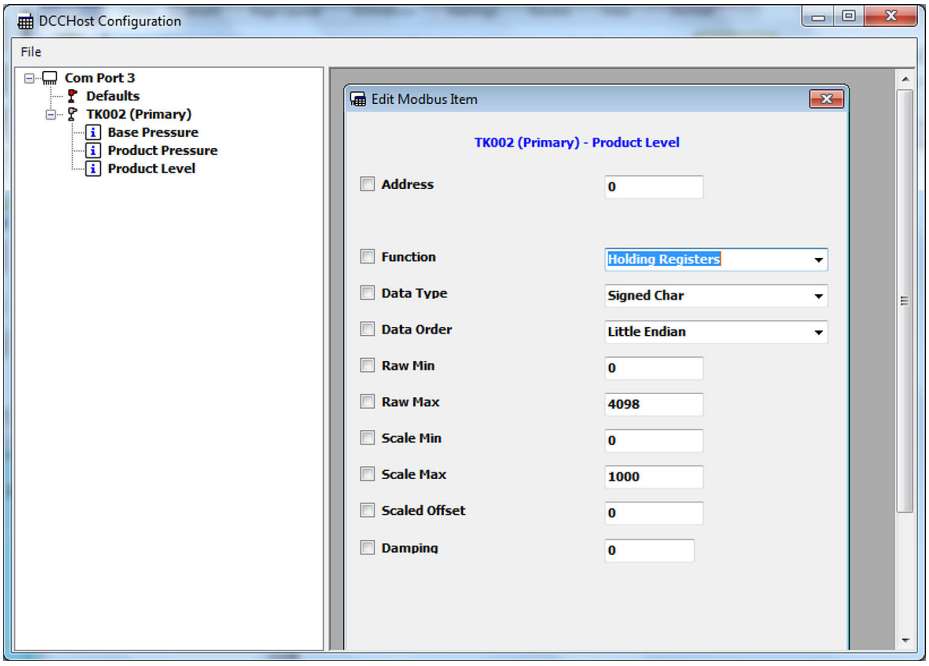
To delete a Modbus field, proceed as follows:

- Right click on the field and select **Delete** from the pop-up menu.

Editing a Modbus Field

To edit a modbus field, proceed as follows:

1. 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.



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.

After setting all required parameters, click **OK** in the edit box to save the parameters for the Modbus field.

Common Modbus fields for most gauges

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 Register, Coil etc.
- **DataType**: 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 datatypes)
- **Raw Min** and **Raw Max**: The raw data range. Used in scaling data (see below) and also if the value is outside the raw limits then the value will be set to illegal, i.e. DN04

- **Scale Min** and **Scale Max**: The scaled data range. The Scaled value must be converted to the default units used within the Tank Gauging database (Level=mm, Temperature=DegC, Density=Kg/l, Pressure=BarA). 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:
  Scaled Value = ((Raw Value - Raw Min) × (Scale Max - Scale Min) / (Raw Max - Raw Min)) + Scale Min
- **Scaled Offset**: An optional offset to be applied to the scaled value, in the database units for the data type (Level=mm, Temperature=DegC, 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:
  Damped Value = Old Value + ((New Value - Old Value) × Damping / 100)

Fields for Status parameters

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 DN04.
  May be one of the following:
  - None
  - One illegal value
  - One good 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 Status Type. If Status Type is 3 or 4 then any of the bits in this value will be tested.

Fields for Alarm parameters

If the Modbus field is an Alarm (i.e. Level High High, Temp High etc.) then 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 the 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 determine when alarm is cleared. Only used for types **Greater Than Value Sets Alarm** and **Less Than Value Sets Alarm**.

Default values

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 then the following defaults will be used by the **Modbus TG** interface when polling for data:

- **slaveaddress** = Device No. entered in Device Configuration screen
- **address** = 0
- **function** = 4
- **dataorder** = Short
- **rawmin** = 0
- **rawmax** = 32 000
- **scalemin** = 0
- **scalemax** = 32 000

- **statustype** = 1 (status fields only)
- **statusvalue** = 8000 hex (status fields only)
- **damping** = 0 (i.e. not used) (value fields only)

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

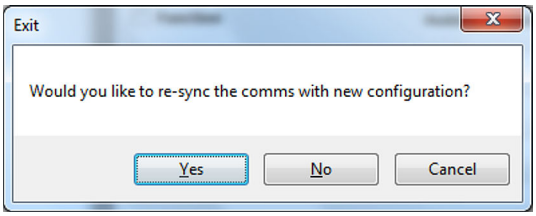
The Modbus PLC address for the field will be the Device Address field entered in the Device Configuration screen.

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

Saving the Modbus Map

To save the new Modbus configuration to the Modbus xml file, proceed as follows:

1. Close the DCC Host Configuration tool.
   ↳ If any changes have been made then the following dialog will be displayed:



2. Click **Yes** to save the data and automatically force the DCCHost service to reload the new Modbus map for any **Modbus TG** interfaces.

6.16.3 Modbus TG Field Definitions

The **Defaults** section and any Gauge node 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 is denoted by 'Alarm' in name of field.

Fields polled at high priority

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

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
- DensityHigh Alarm

- DensityLow Alarm
- LevelHigh Alarm
- LevelHighHigh Alarm
- LevelLow Alarm
- LevelLowLow Alarm
- TempHigh Alarm
- TempLow Alarm
- GaugeStatus

Fields polled in background scans

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:
- BasePressure
- BasePressureStatus
- FreeWaterLevel
- FreeWaterLevelStatus
- Density
- DensityStatus
- ObservedTemperature
- ObservedTemperatureStatus
- ProductPressure
- ProductPressureStatus
- VapourPressure
- VapourPressureStatus
- VapourTemperature
- VapourTemperatureStatus
- ElementTemperature1 - 16
- ElementTemperature1 - 16Status

Validity of fields

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 then 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 the 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 **Status Type** and **Status Test Values** 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.

6.16.4 Modbus TG 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 Configuration tool (see the System Configuration manual BA00390G).

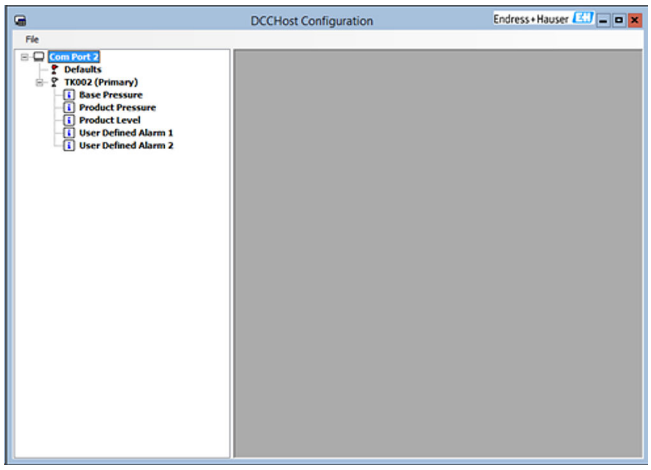
There are 32 such alarms per gauge:
- User Defined Alarm 1
- User Defined Alarm 2
- User Defined Alarm 3
- Etc. etc. up to:
- User Defined Alarm 32

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

Polling for User Defined Alarms

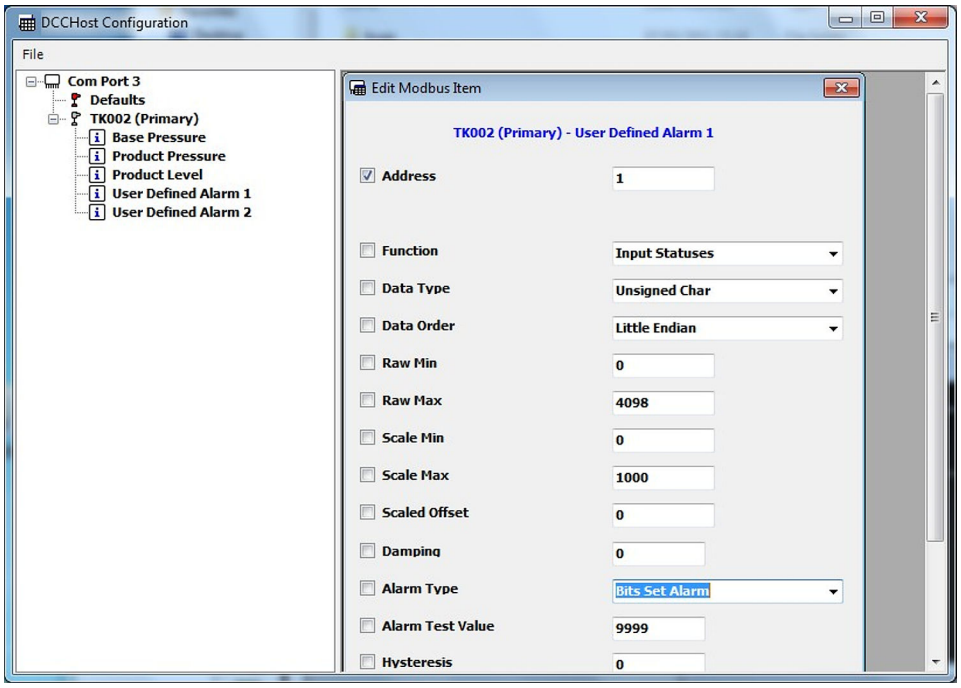
To configure a **Modbus TG** gauge to poll for one of the 8 User Defined Alarms, proceed as follows:

1. Select the menu option **Configuration** → **DCC Host Configuration** (which will open the screen below).
2. Add the point to the required gauge.



These may be configured to read individual coils.

Example 1



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

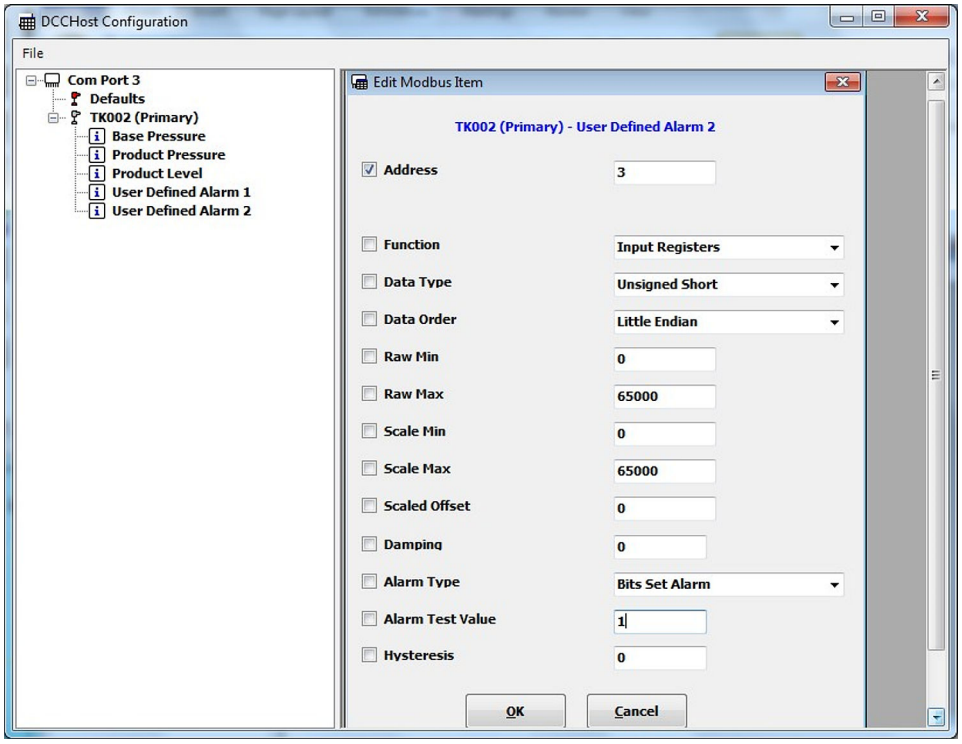
The **Alarm Type** field is used to set the activation of the alarm.

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 **Bits Set Alarm** and the test value is one. So if a value of 1 is received then the alarm will be activated, any other value will clear the alarm. The incoming value is a coil therefore it will be either 1 or 0.

Example 2

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 defined 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.

7 DCC Host Runtime

7.1 DCC Host

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 Tankvision Professional/LMS client.

The DCC Host can communicate to a wide range of field gauges via an Datacon device or directly to some gauge types using the manufacturers protocols. Current protocols supported include:
- Datacon protocol
- Enraf CIU
- Whessoe 550
- Whessoe 500
- Generic Modbus

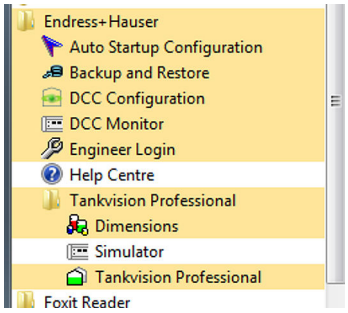
The connection between the DCC Host module and the Datacon/gauges is normally by means of a physical hard wired serial interface connection, but may also be via a dial-up modem.

The DCC Host has the responsibility of determining the status of all gauge and system alarms. Furthermore the DCC Host module writes to the Events database.

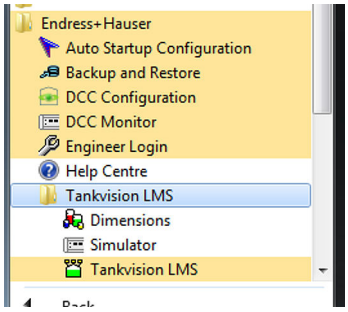
7.2 Comms Monitor

To view the DCC Host Comms Monitor, proceed as follows:

1. To view the DCC Host Comms Monitor select **All Programs** → **Endress + Hauser** → **DCC Monitor** from the windows start menu.

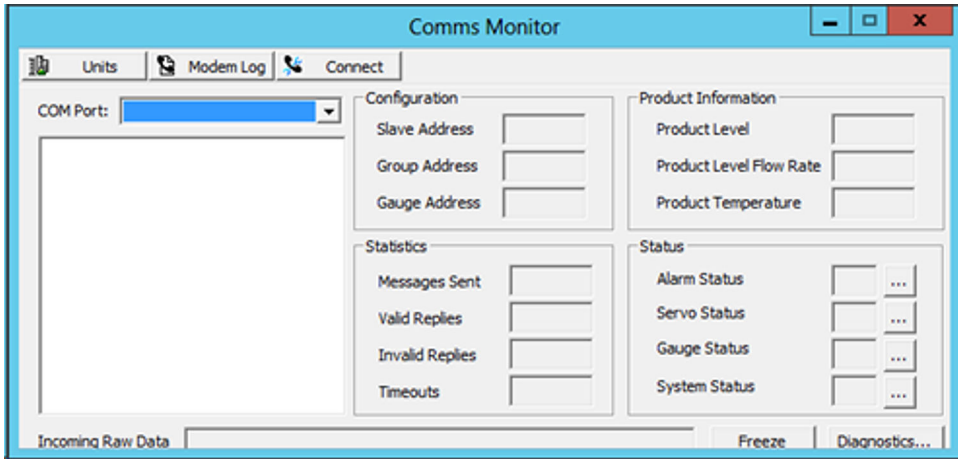


DCC Monitor menu item for Tankvision Professional



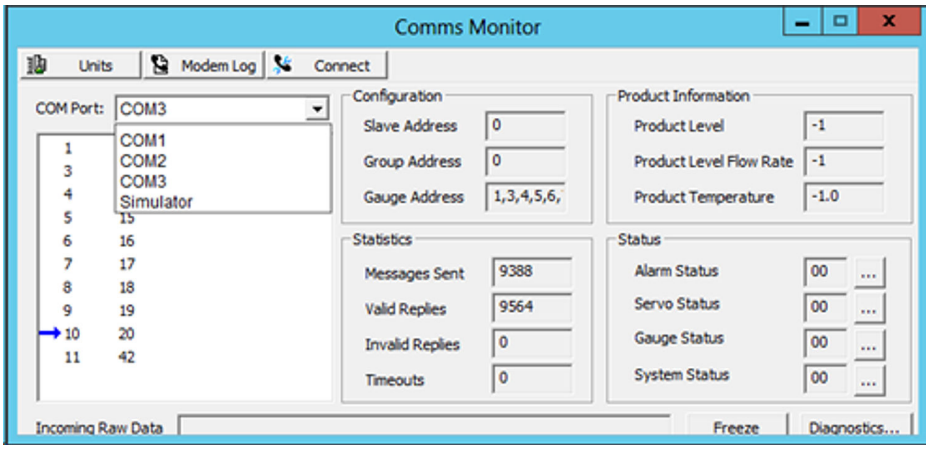
DCC Monitor menu item for Tankvision LMS

This will bring up the following screen:



The DCC Host module allows the user to view the data communications that occurs between the PC and any connected devices such as Datacons or directly connected gauges.

2. From the drop down list select the **COM Port** you chose for communication (e.g. COM 1).
   ↳ A list of gauges being polled on that **COM Port** will be displayed in the box below. One of the COM port selections available is the **Simulator**, this is a feature which simulates gauges within DCC Host and is treated exactly the same as a normal COM port.



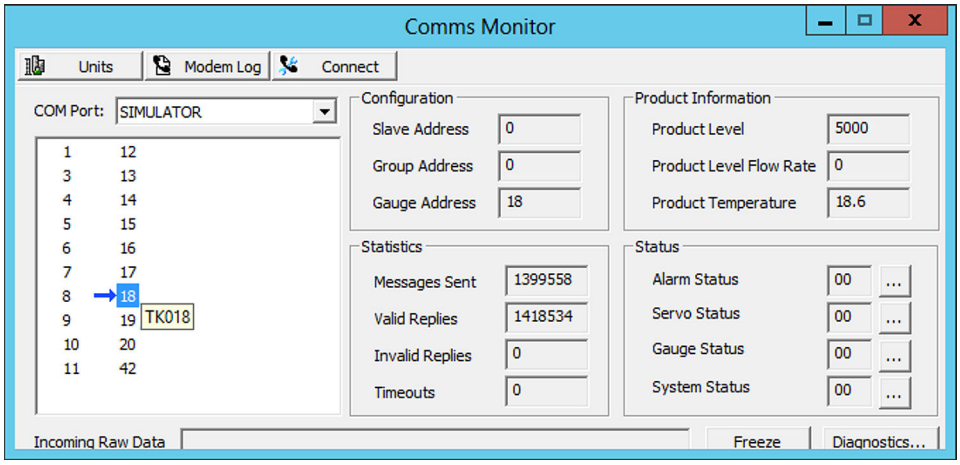
The blue arrow indicates the gauge currently being polled. A red arrow will be displayed if a gauge is being polled on fast scan.

The **Statistics** section shows the current number of messages and responses since the interface was started. The **Product Information**, **Status** and **Raw Data** sections will only be updated if a gauge is selected to be watched. See the next section for details.

If no gauge is selected to be watched then the **Incoming 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.

The list of gauges actually displays the Tank Address of each gauge entered in the **Device Configuration** screens. To display the name of the gauge in the list, hover the mouse over the Tank Address of the gauge.



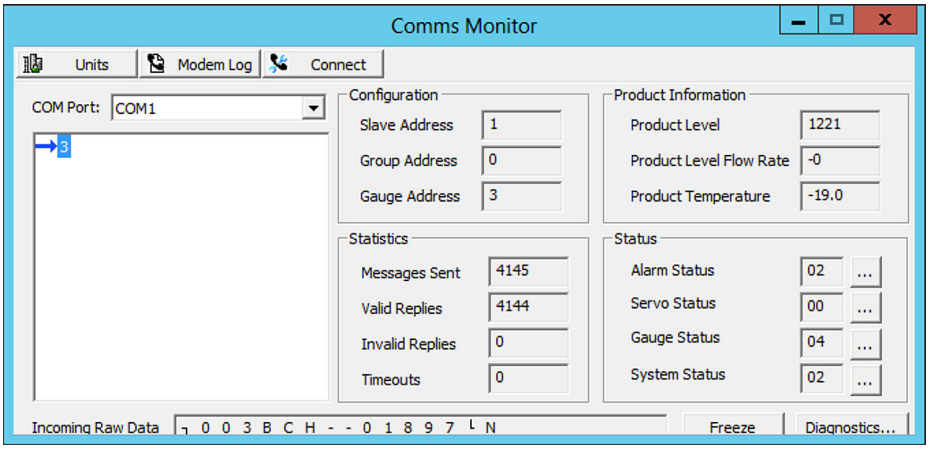
Viewing data in the DCC Host **Comms Monitor** is only really useful for maintenance and diagnostic reasons.

For general operations we do not recommend using the DCC Host **Comms Monitor**.

7.3 Watching a Tank

Sometimes it is useful to watch a specific tanks data.

- Click on the Tank number to be viewed (e.g. Tank 3) as shown below.



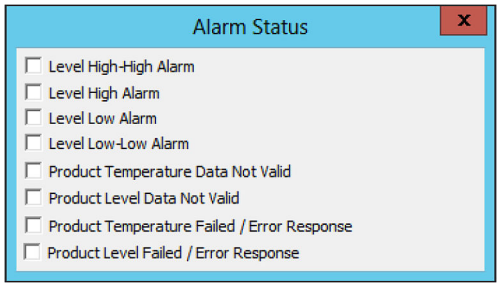
Each time the DCC Host polls that gauge (either directly or via a Datacon) the response and data will be captured and displayed.

The **Product Level** value shows the measured level read from the field device. If the device is an ullage level device then this value will represent the ullage level measurement.

The **Incoming Raw Data** field will display the raw data from the device, and to aid analysis can be frozen by clicking on the **Freeze** button. This does not stop the devices from being polled, but they will not be displayed on the screen.

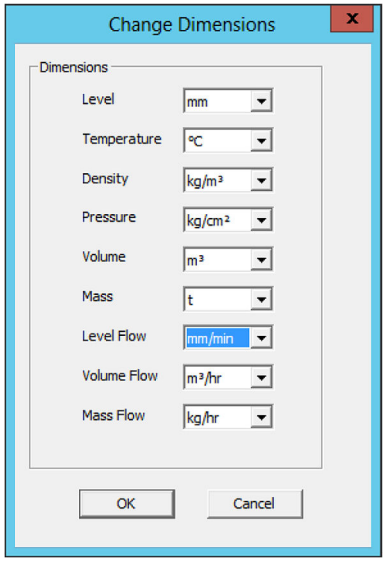
The transmitted data from the Datacon or gauge can then be analysed. This will require a detailed knowledge of the protocol being used.

The status fields returned by the device can be viewed in more detail by clicking on the button to the right of the required status.



Any status fields that are currently active (i.e. set) will be ticked.

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 Tankvision Professional/LMS screens.

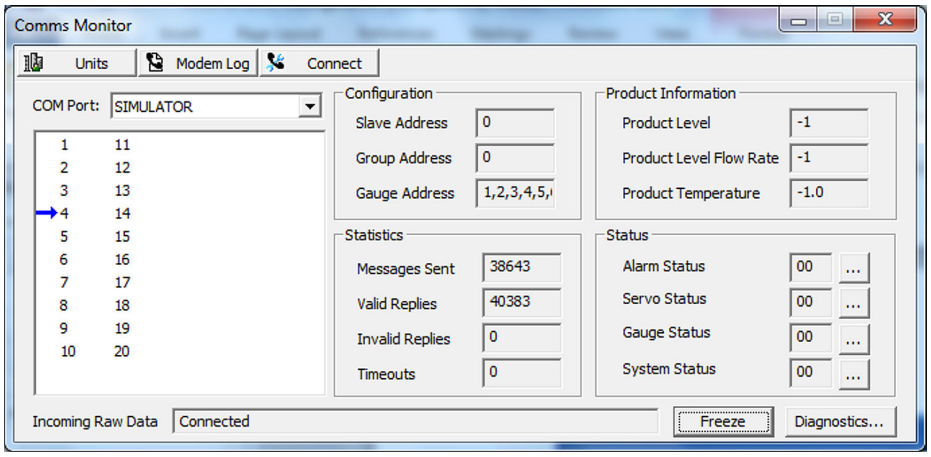
7.4 Viewing Modem Log

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.

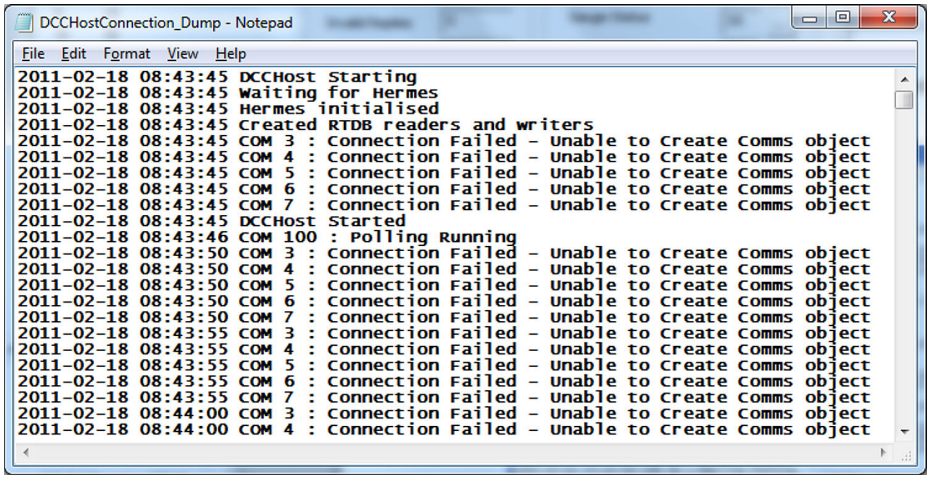
Although it is referred to as **Modem Log** it actually applies to ALL interfaces within DCC Host, including those using serial ports on the local PC.

To view the log of all connections since DCC Host was started, proceed as follows:

- Click on the button **Modem Log** at the top of the **Comms Monitor** screen.



The file will be automatically displayed using Notepad.



The file contains a date and 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.

7.5 Connection Status

Gauges will only be polled when an interface is connected to the hardware it uses to communicate. This hardware could be an RS232 serial port on the PC or it could be a modem used to dial up 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.

7.5.1 Indication of the connection status

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

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

7.5.2 Changing the connection status

The connection status of an interface may be manually changed by the user by right clicking on any tank on that interface, and selecting either **Connect**, **Disconnect** or **Connect Once** from the **Gauge Commands** menu.

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 and data on screen will be frozen for those tanks.

The difference between **Connect** and **Connect Once** is as follows:
- **Connect**: This will connect and stay connected permanently or until commanded to disconnect by the user.
- **Connect Once**: This will connect and then automatically disconnect after it has retrieved all data from the gauges.

7.5.3 Viewing/modifying the status via the Comms Monitor

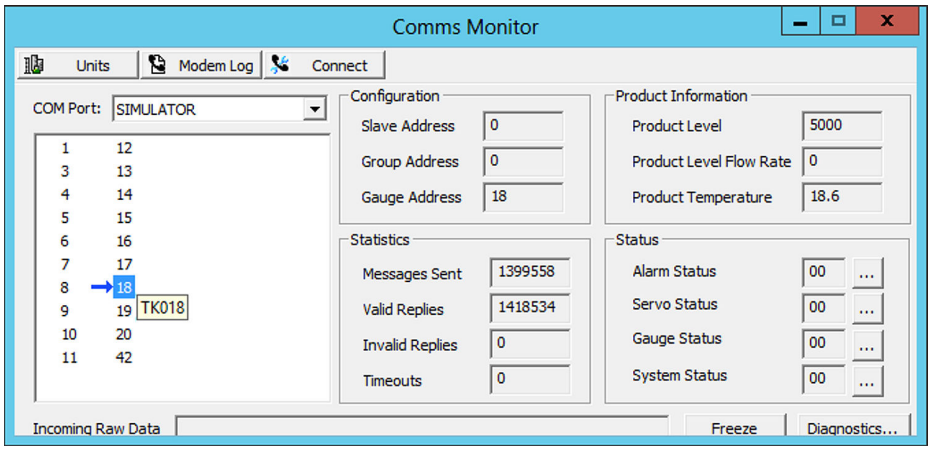
The connection status of an interface in DCC Host may also be viewed and modified via the **Comms Monitor**.

Viewing the connection status

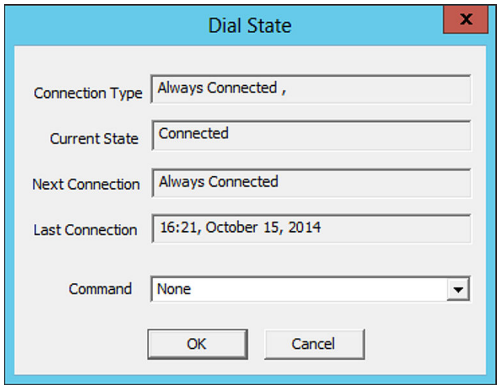
To view the connection status, proceed as follows:

1. Select the **COM Port** of the interface from drop down menu.

2. Click on the **Connect** button at the top of the dialog.



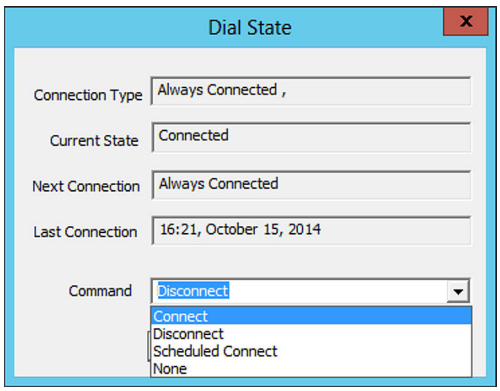
The connection details for the interface will be shown, including the **Connection Type**, the **Current State**, the time of the **Last Connection** and time when the **Next Connection** will take place. This last field will only be meaningful if the interface has been configured for scheduled connections.



Modifying the connection status

The **Command** field allows the connection state to be changed.

1. To change, select the new state from the drop down list.

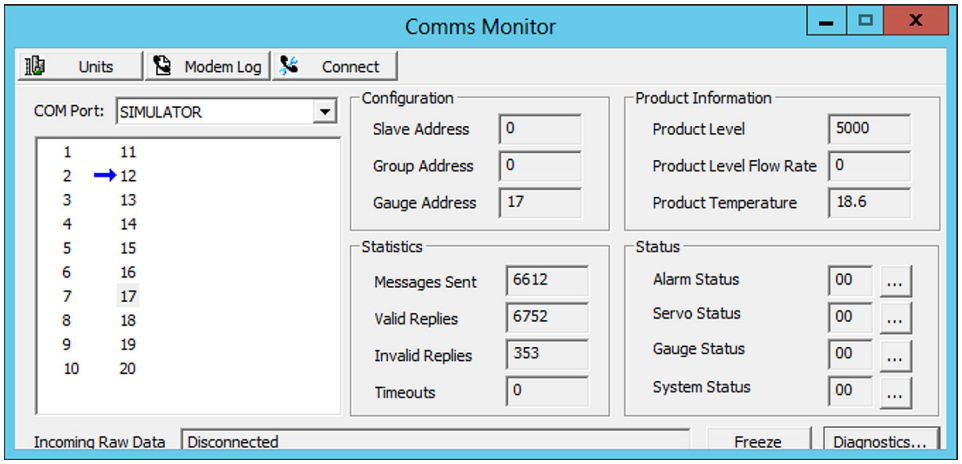


The states selectable are:

- **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

2. Once the command has been selected click on **OK** to activate new state.
   ↳ If the command is **Disconnect** then a confirmation dialog will be displayed.

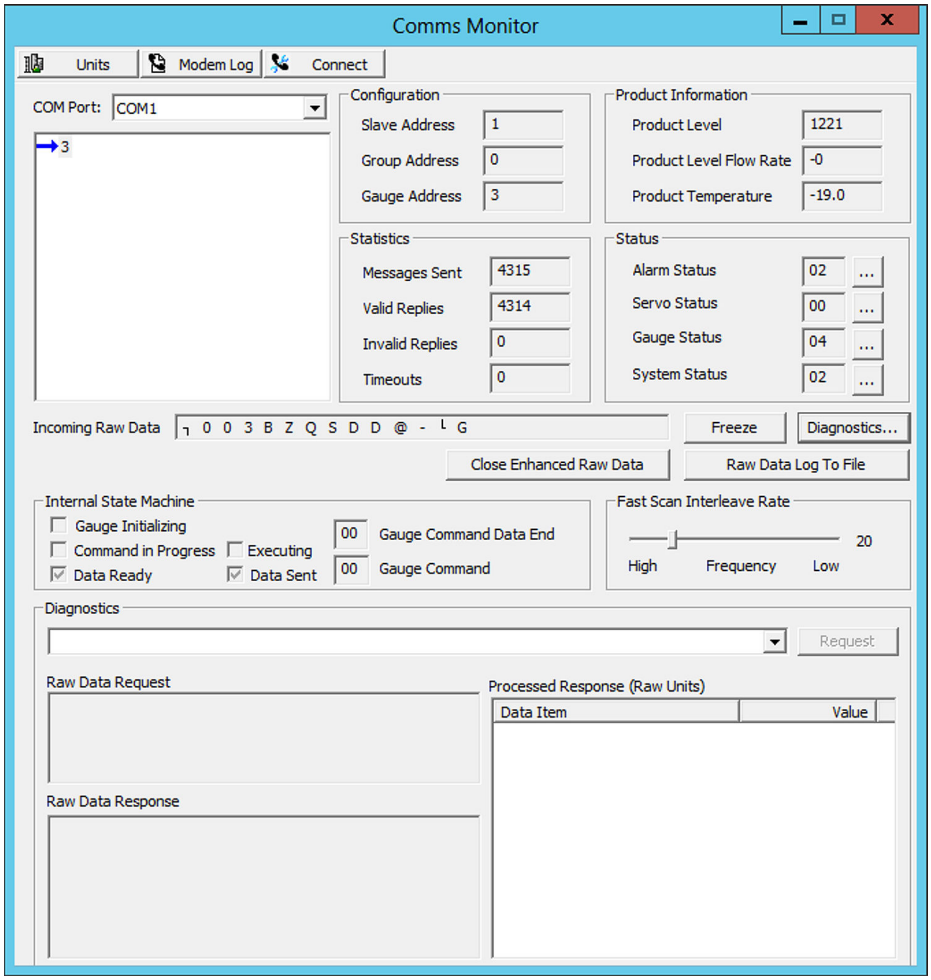
Once an interface has been disconnected then NO gauges will be polled. If the port is selected in the **Comms Monitor** there will be no communications activity shown and **Disconnected** will be displayed in the **Incoming Raw Data** field.



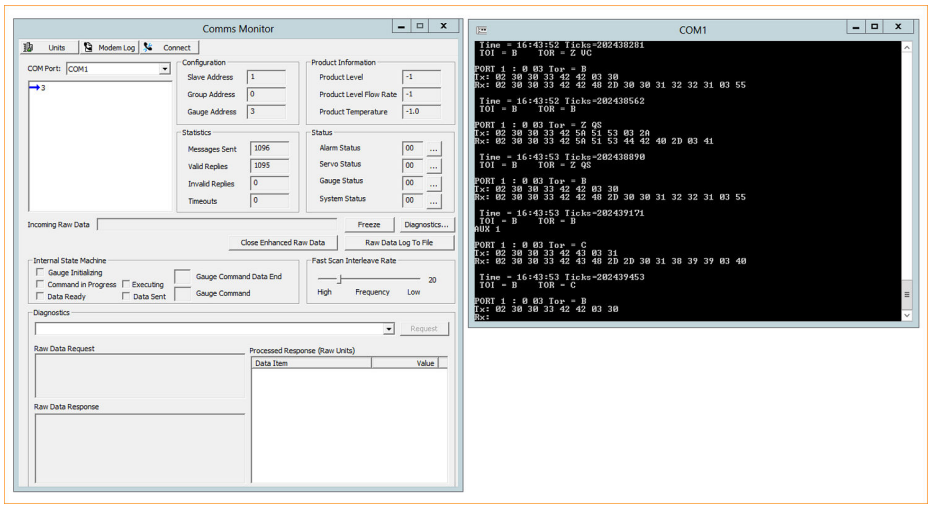
7.6 Enhanced Raw Data

To view the raw data bytes transmitted and received on a serial port, proceed as follows:

1. Click on the **Diagnostics** button.
   ↳ This will show an extended **Comms Monitor** dialog.



2. Click on the **Display Enhanced Raw Data** button.
   ↳ This will display a text box showing raw communication data and status.



This is a live screen that will scroll the new lines of data as they occur.

If tank is set to watch (i.e. a gauge is selected in the gauge list box) then only raw data for that tank will be displayed, and that Gauge ID will be shown in the title for the raw data text box. If no gauge is selected then all raw data for all gauges will be shown, and the title box will display just the COM port number.

1. To close the raw data text box use the **Close Enhanced Raw Data** button.

DO NOT use the close 'X' button on the raw data windows since this can corrupt the DCC Host service.

2. To freeze the display so that it may be viewed, click on the **Freeze** button.

Freezing the raw display does not stop the actual communications to the gauges.

3. Click on the **Resume** button to carry on updating the text box.
4. To log the raw data output to a file, click on the button **Raw Data Log To File**.
   ↳ The logged data will be saved to a file called "DCCHost_Comms.txt". This will be located in the same directory as the DCCHost executable module. This location depends on the system and installation type, but is normally:
   C:\Program Files\Common Files\Tank Farm Automation\Server
   Or for embedded systems:
   C:\Program Files\Tanks
5. Click on the button **Raw Data Log To File** again to stop logging to file.

8 DCC Slave Configuration

8.1 DCC Slave

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 Tankvision Professional/LMS system, DCC Slave is used to get data out of Tankvision Professional/LMS and into a Scada, DCS or similar system.

The DCC Slave is a standard sub-system within Tankvision Professional/LMS, running as a system service which will be automatically started when the PC 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 Tankvision Professional/LMS real-time database (RTDB).

Multiple interfaces may be configured to communicate using one of the protocols currently available within DCC Slave, these being:
- Modbus
- Modbus (Device Tunneling) (see note below)
- Enraf CIU Emulation
- Enraf Host
- Datacon protocol
- Modbus (Enraf Extended)
- Alarm Relay Output (Modbus and internal relay card)
- Remote Configuration Protocol

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.

8.2 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 and network connections may be configured, up to the maximum licensed.

To add a slave port, proceed as follows:

▶ Select the **DCC Configuration** item and click on **Add Port**. Refer to a previous section for more details.

To configure an existing slave port, proceed as follows:

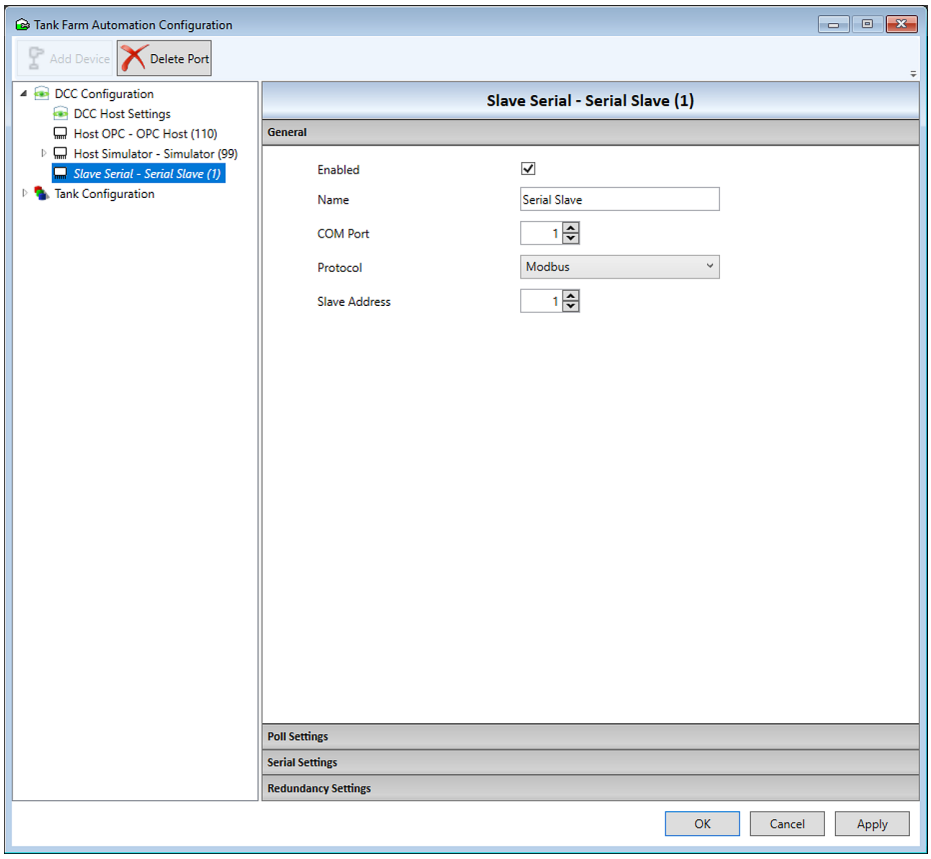
▶ Click on the item in the DCC Configuration ports list.
  ↳ In the right hand panel a range of pages showing the port configuration parameters will be available, depending on the port type. These will include:

- **General**
- **Poll Settings**
- **Redundancy Settings**
- **Serial Settings**
- **Network Settings**

8.3 General Settings

A set of general options that apply to the communications port.

▶ Click on the **General** page to show the settings.



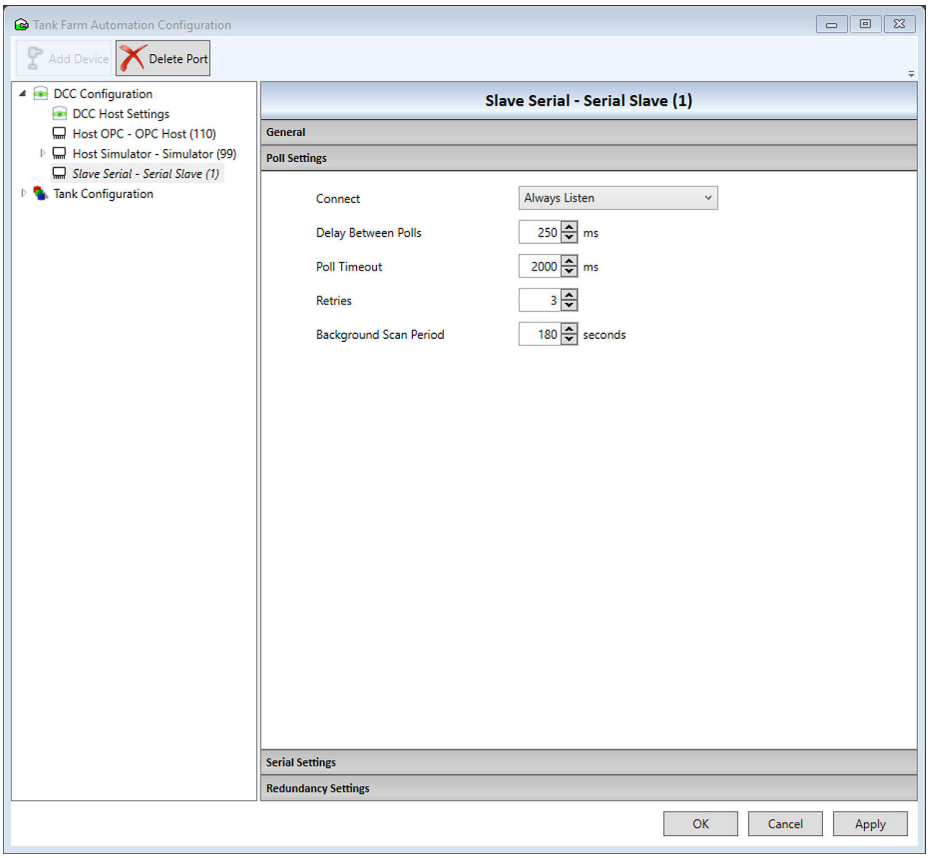
Current supported options include:

- **Enabled**: This must be ticked for the port to be active. If it is not ticked then the port will not be loaded into DCC Slave and cannot be used for communications.
- **Name**: An optional name to help in identifying the port.
- **COM Port**: The COM port on which this port will run. It is generally set when the port is added but may be changed here if required.
- **Protocol**: The protocol to be used on the port.
- **Slave Address**: The address that this system will reply to on the port. It is protocol dependent, so only some protocols will require this field. For instance the datacon and modbus protocols both require it.

8.4 Poll Settings

A set of options that apply to the communications port and determine the polling rate and connection type.

▶ Click on the **Poll Settings** page to show the settings.



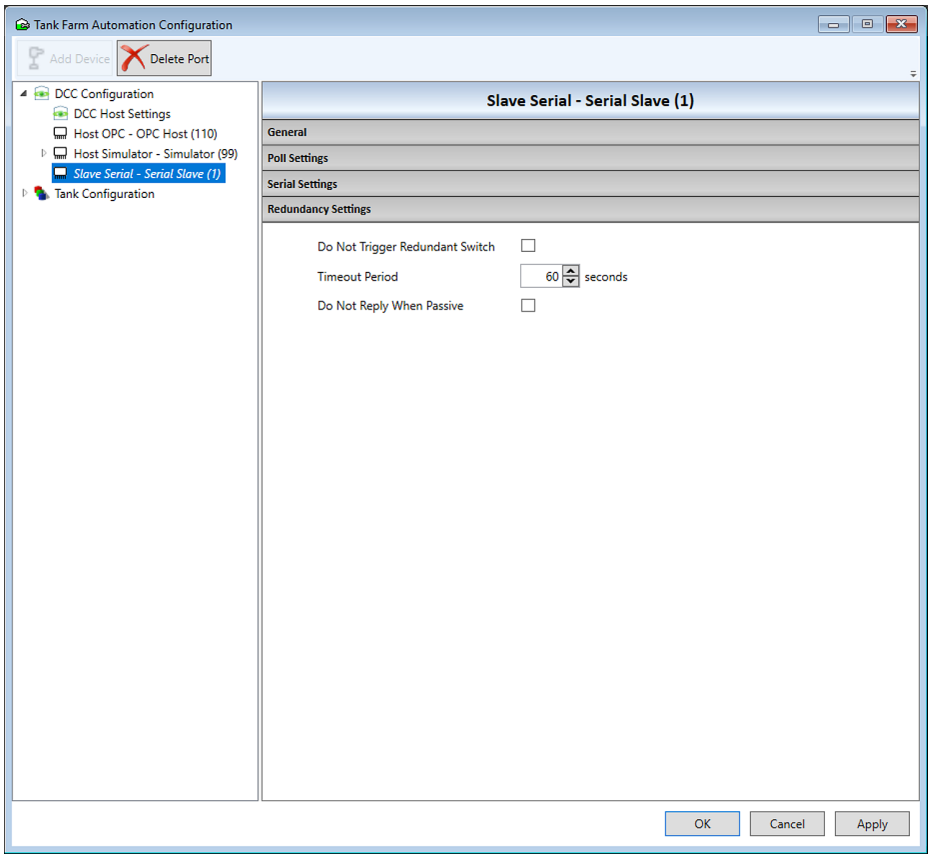
Current supported options include:

- **Connect**: The connection mode for the port. For Slave ports this should always be set to **Always Listen**.
- **Delay Between Polls**: Not used.
- **Poll Timeout**: The time to wait for a full message.
- **Retries**: Not used.
- **Background Scan Period**: Not used.

8.5 Redundancy Settings

These settings apply if the redundancy mode has been set to **Switch By System**, and determine how this port will affect the redundant operation.

▶ Click on the **Redundancy Settings** page to show the settings.



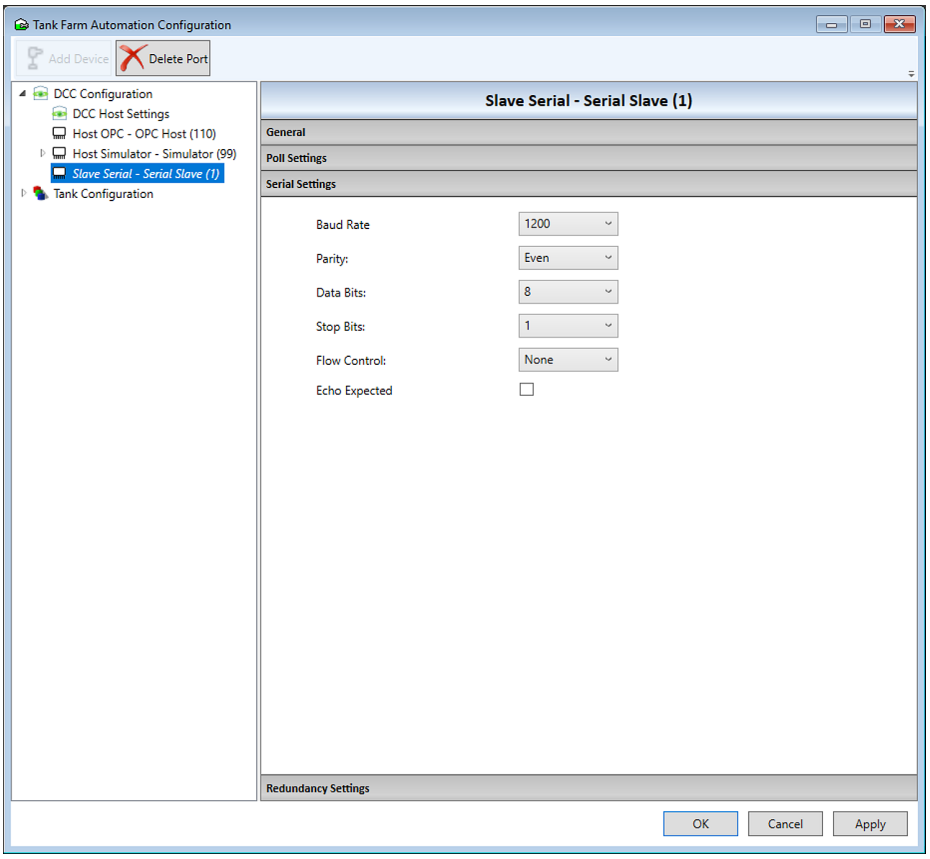
Current supported options include:
- **Do Not Trigger Redundant Switchover**: Not used.
- **Timeout Period**: Not used.
- **Do Not Reply When Passive**: If ticked then this port will not reply to any requests when the system is passive.

8.6 Serial Settings

A set of options that apply to the communications port using a physical serial port, including parameters such as Baud Rate, Parity, Stop bits, etc. These should be set to the same as the polling system.

▶ Click on the **Serial Settings** page to show the settings.

↳



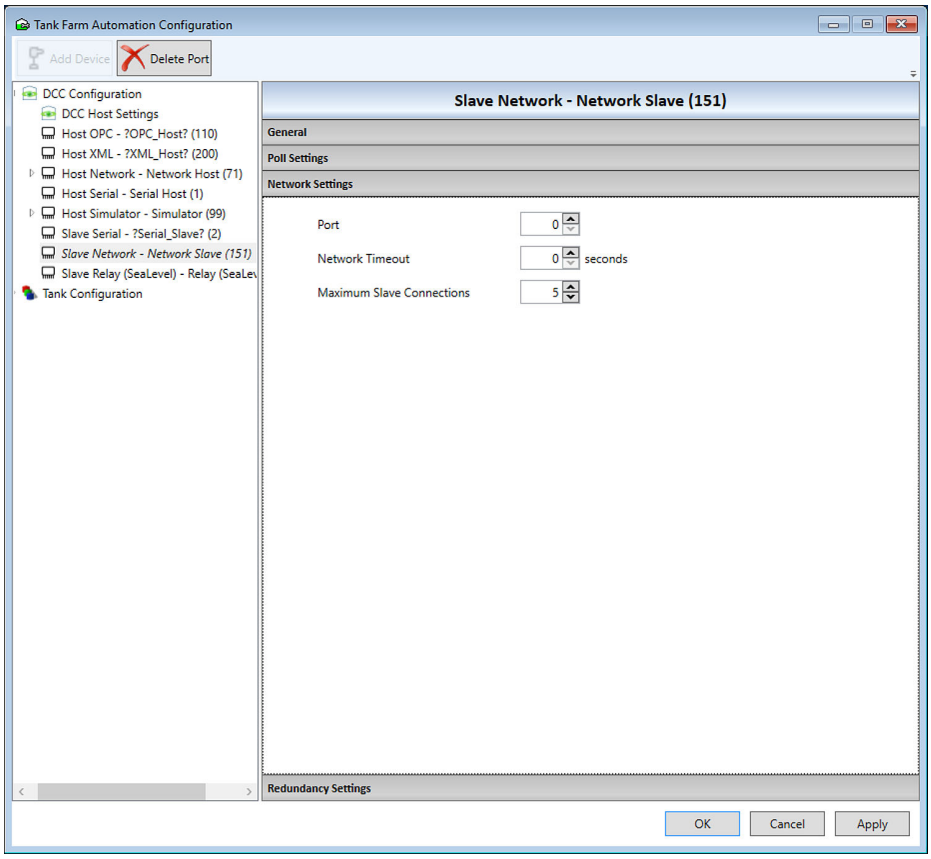
Current supported options include:

- **Baud Rate**
- **Parity**
- **Data Bits**
- **Stop Bits**
- **Flow Control**: Should normally be left as **None**.
- **Echo Expected**: If the serial communications hardware produces an echo of sent characters (i.e. some RS485 or 20 mA current loop devices) then tick this field to tell the driver to handle the echoed characters.

8.7 Network Settings

A set of options that apply to the communications port using a network connection. 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.

▶ Click on the **Network Settings** page to show the settings.



Current supported options include:

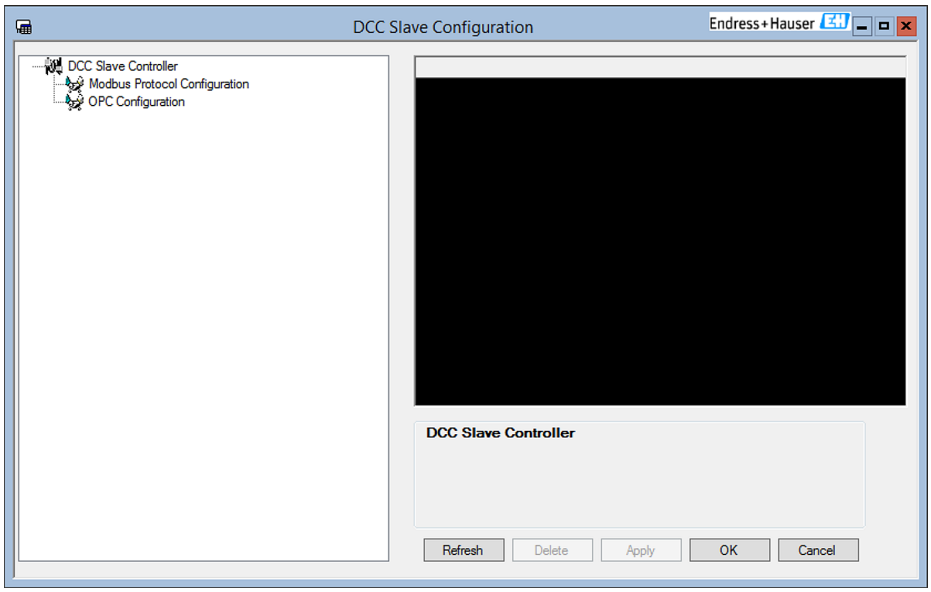
- **Port**: The IP Port used to listen for data requests.
- **Network Timeout**: If no requests have been received in the slave for longer than the timeout value, then the socket will be automatically disconnected. It should not be reduced too low, as this may affect the stability of the connection. Generally keep this value above at least 10 seconds and the recommended value is 60 (60 000 ms). A value of 0 disables this feature.
- **Maximum Slave Connections**: The maximum number of simultaneous connections allowed on this IP Port.

Ensure that the **Port** value does not clash with any ports already in use with other programs or services on the PC. 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.

8.8 Protocol Configuration

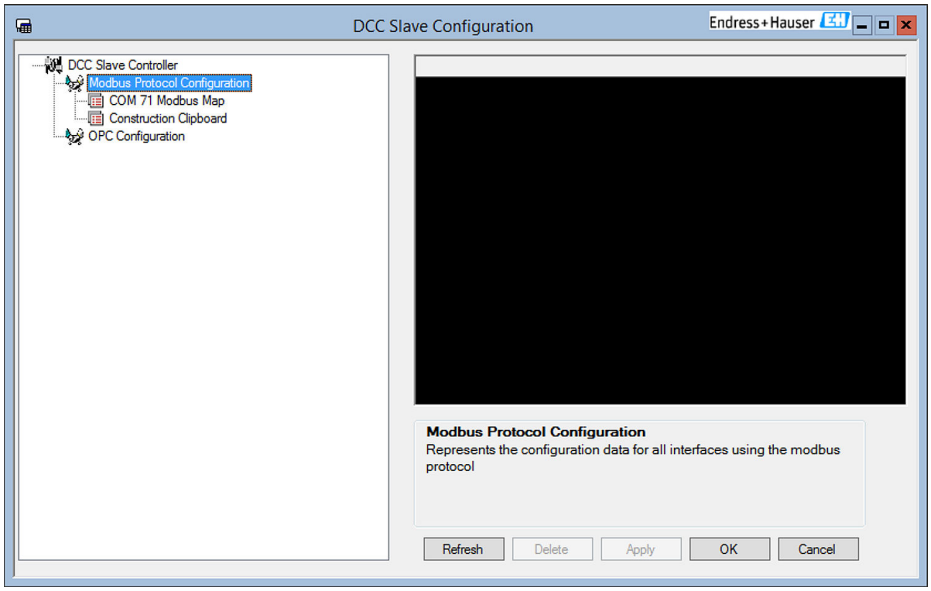
Most communication protocols in DCC Slave require some configuration data to be entered, which is specific to that protocol (i.e. Modbus requires a register/coil map to be set up). To configure any protocol specific data, proceed as follows:

1. Select the **DCC Slave Configuration** item from the **Configuration** menu.
   ↳



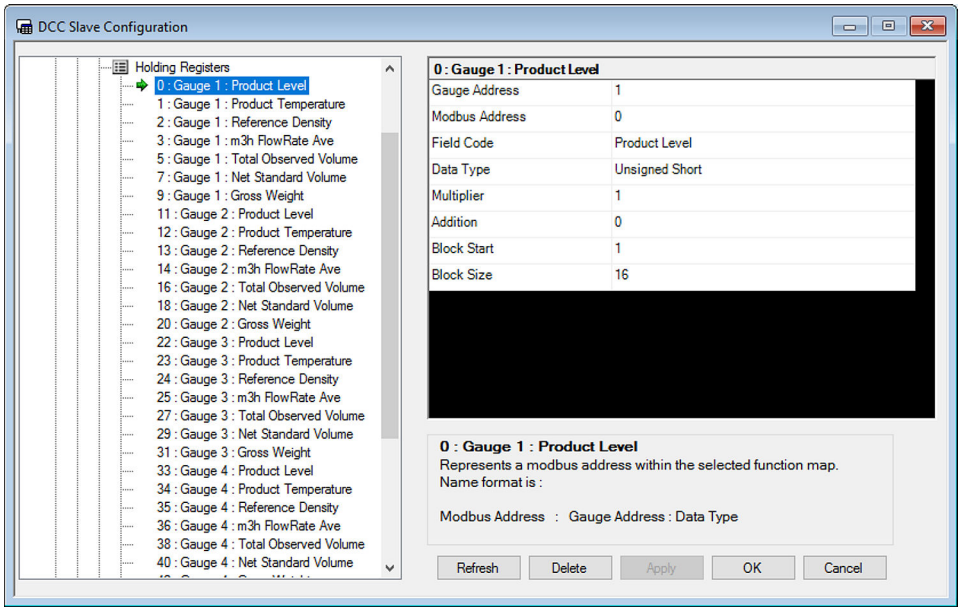
   The display consists of a left hand panel with a tree list of all protocols supported by DCC Slave and a right hand panel where selected data may be edited.

2. 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.

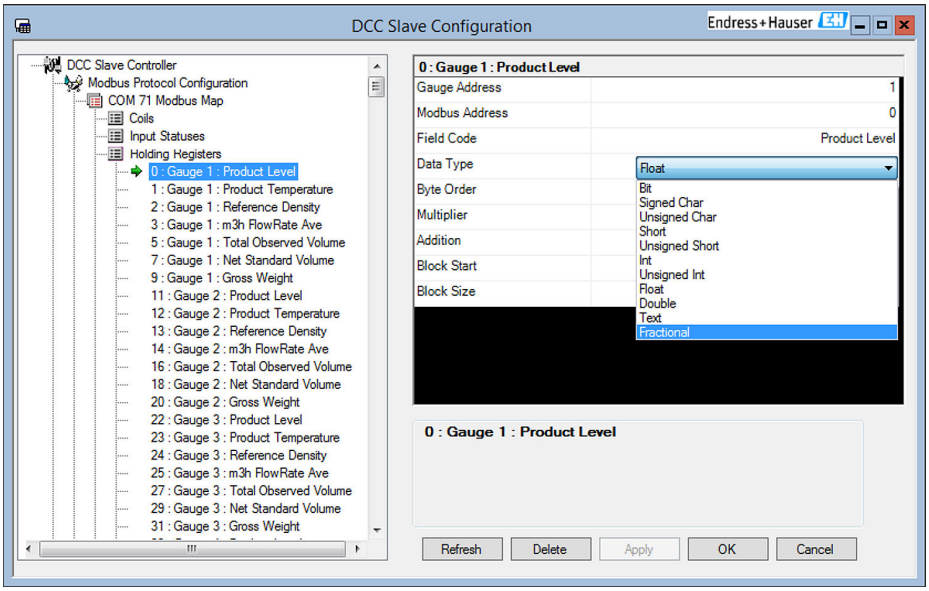


Under each COM port entry will be displayed the currently configured protocol specific data for the interface running on that port. The protocol specific data options are described in the relevant section on that protocol, further on in this document.

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

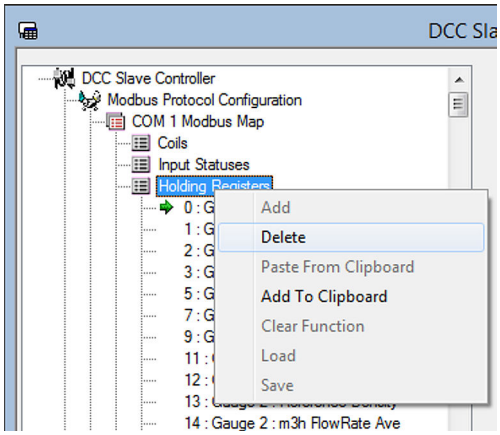


3. To edit configuration data displayed in the right hand panel simply click on that item and either edit the text or select from the drop down list.



4. To save any data to the database, click on the **Apply** button.
5. 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.

6. 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.



8.9 Modbus Protocol Configuration

The DCC Slave implementation of the Modbus protocol currently supports 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

The following sections offer a quick getting started guide to configuring interfaces in the **DCC Slave** that use the Modbus Datacon protocol.

The COM port parameters are configured in the standard control panel applet common to all protocols. Protocol specific data however, must be configured using the **DCCSlaveConfigGUI** application. They assume a degree of prior knowledge of the Modbus protocol.

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

8.9.1 Planning

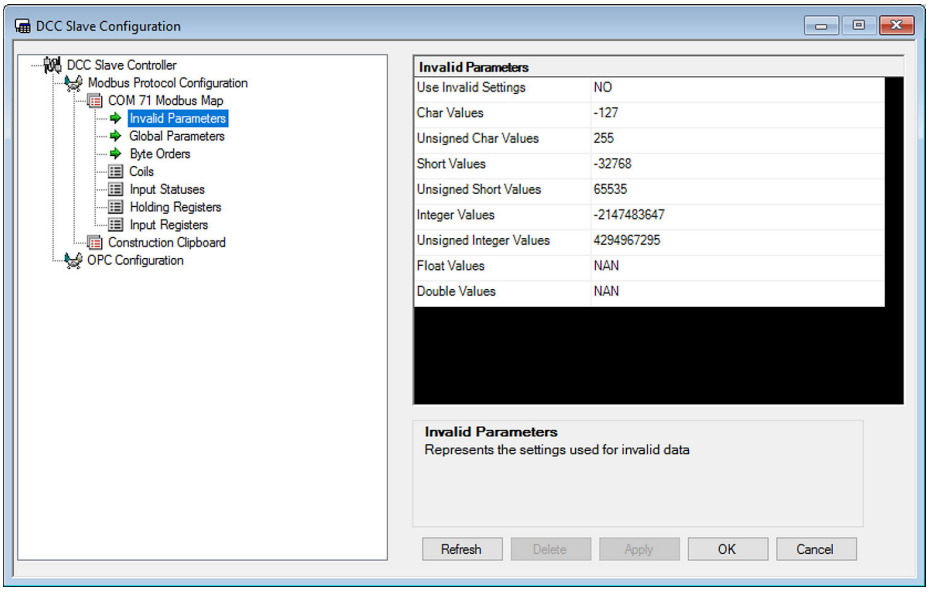
Successful dialogue between 2 computers using the Modbus protocol does require some pre-planning.

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.

8.9.2 Configuring the Map

1. Start the DCCSlaveConfigGUI.exe module.
   ↳ This module can be used to configure the map for any Modbus slave interface in DCC Slave.

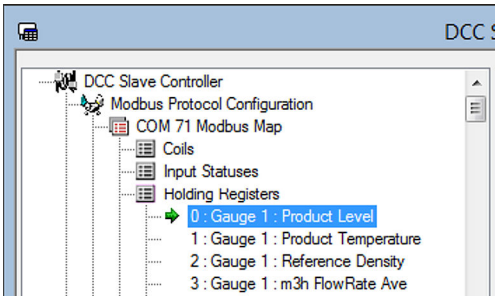


The **DCC Slave Configuration** tool consists of a tree list of all protocols on the right and an edit section on the left. Included in the list will be the item **Modbus Protocol Configuration**, under which is a list of all COM ports using the Modbus protocol, plus the **Construction Clipboard**.

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.

2. 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

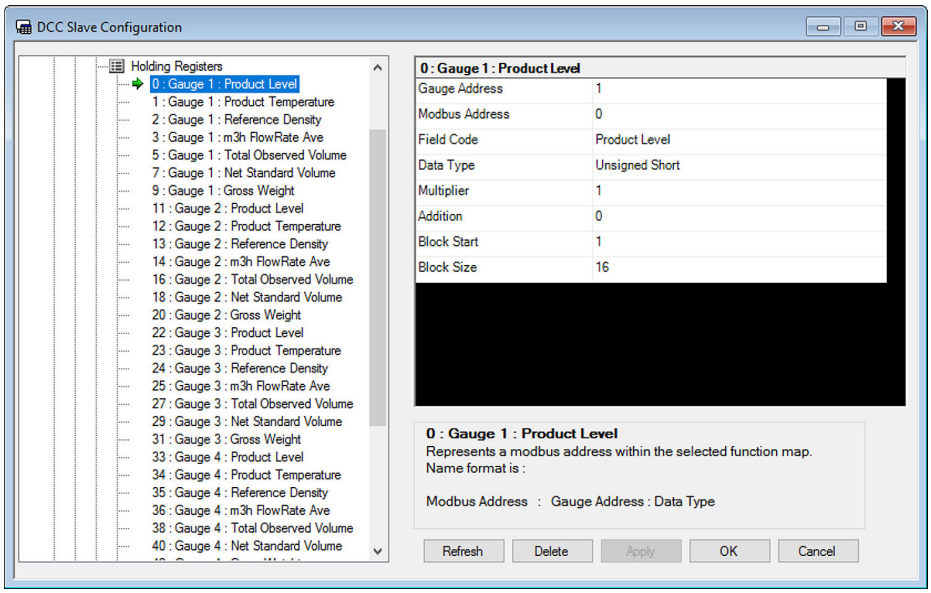
The address is the Modbus address in the selected function map. The Gauge Number is the value assigned to a gauge for the field **Tank Address** in the Tankvision Professional/LMS database.

Example
0 : Gauge 6 : Product Level

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 6.

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

3. To display the parameters for an address, click on that address in the left hand box.
   ↳ 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. For some notes on certain field types, refer to "Filtering Field Code Selection", "Field Codes".
- **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**: A value by which the read data will be multiplied.
- **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**: The start block number.
- **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).

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

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

8.9.3 Filtering Field Code Selection

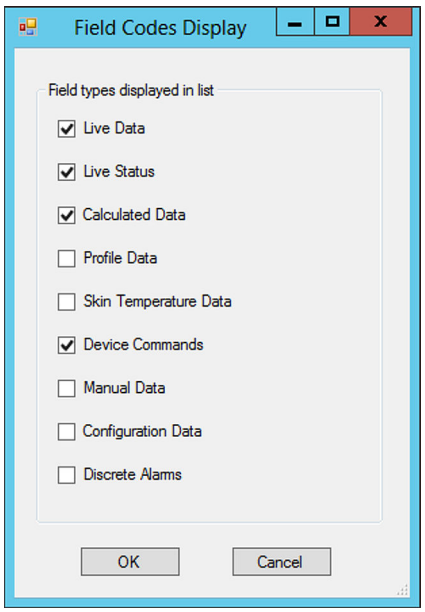
There are a large amount of options to select from the **Field Code** drop down menu.

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**: Gauge commands
- **Manual Data**: Manual data
- **Configuration Data**: Configuration data
- **Discrete Alarms**: Live data alarms that may be accessed as individual bits

By default only **Live Data**, **Live Status**, **Calculated Data** and **Gauge Commands** will be displayed.

▶ To change the filter click on the **Field Code** line in the data parameter table. Make sure those groups to be displayed are ticked.

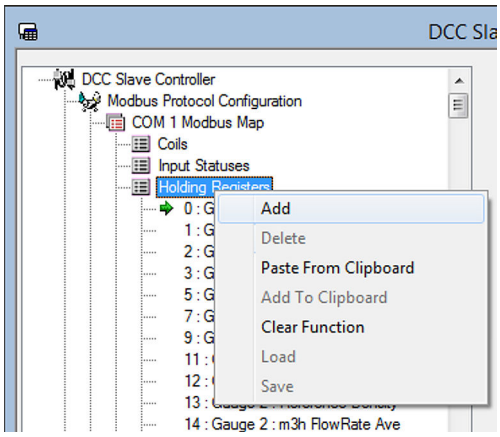


8.9.4 Adding and Deleting Entries

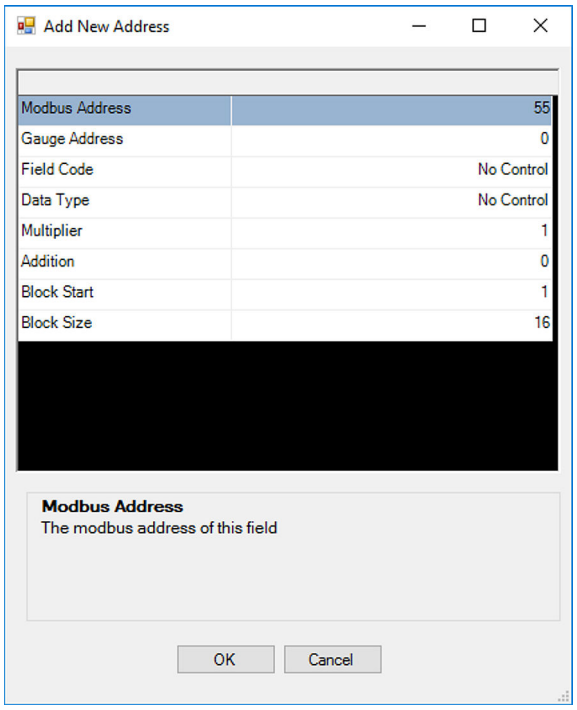
To add a new entry to the Modbus map, proceed as follows:

1. 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.



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 then a warning message will be displayed. This applies particularly to the Modbus address which must be a unique value within the function map.

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. For example, for an Integer the Modbus Address increments by 1, for a Float the Modbus Address increments by 2 etc.

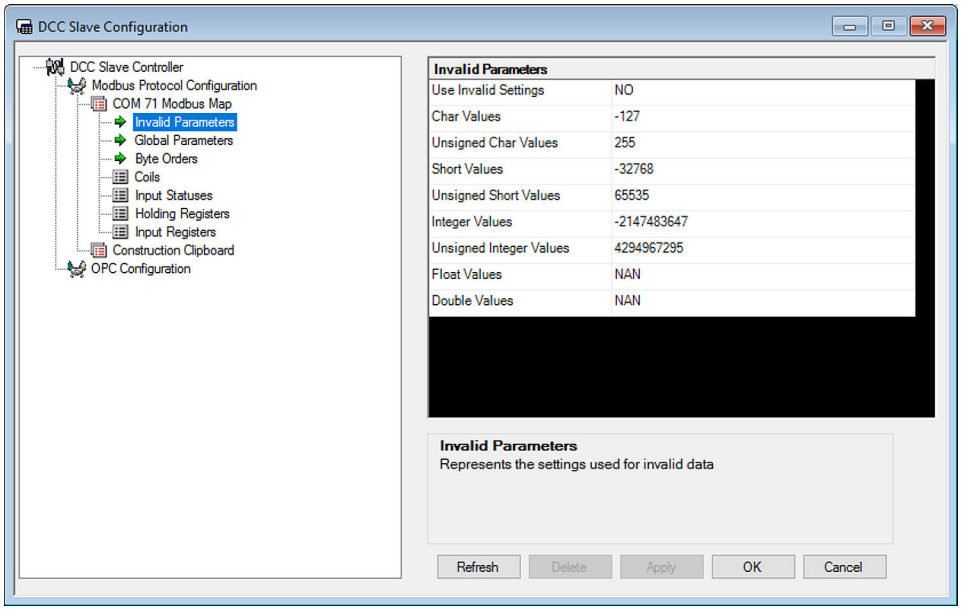
To delete an existing entry in the modbus map, proceed as follows:

1. Click on the address to be deleted.

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

8.9.5 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. For instance 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.

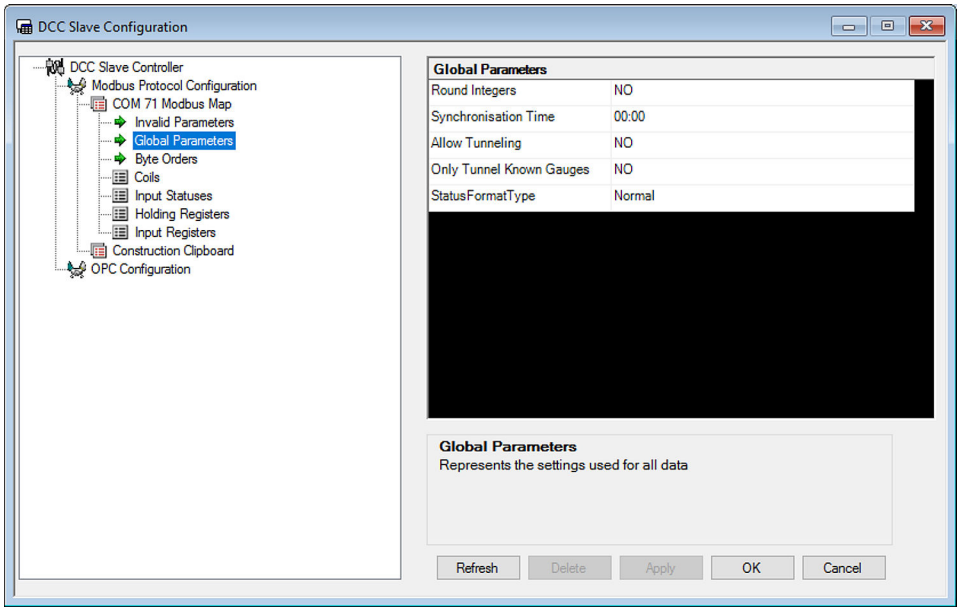
By default the **Use Invalid Settings** field will be set to **NO**, which means that the invalid data settings will not be used, and the data will retain its last good value. The status field for that data item would then have to be checked.

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 **Zero**, **NAN** (Not a Number) or **Infinity**. All these values are defined as part of the standard IEEE754 definition of floating point numbers.

8.9.6 Setting Global Parameter Values

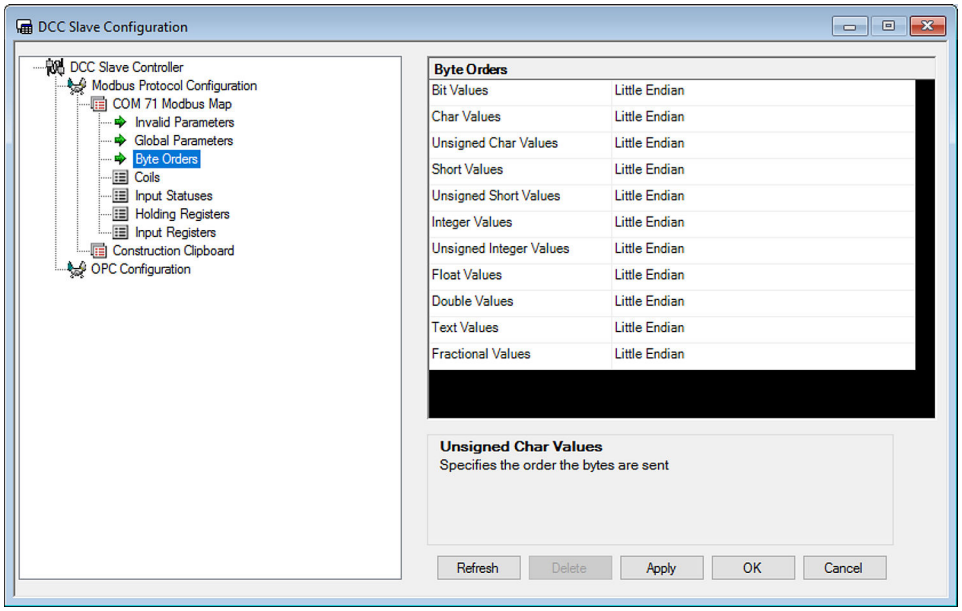
Each COM port Modbus map has an entry where any global parameters settings can be modified. These are settings that apply to the interface as a whole.



- **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 set to **YES** then values will be rounded.
- **Synchronisation Time**: This is the time that the system will be set to when the time syncronisation field is written to. See later section on Time Synchronisation for more details ("Byte Ordering").
- **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 a 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** then tunnel requests will only be sent to any gauge that exists in the database. If set to **NO** then 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

8.9.7 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.

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

8.9.8 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 New Modbus Entries.

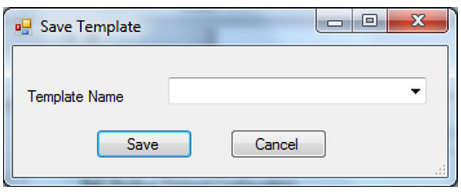
Any addresses added by the above methods will automatically be added to the same function type in the Clipboard as the source function. Thus if addresses from the Holding Registers function map are added to the Clipboard, they will be added to the **Holding Registers** function.

Creating templates

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

To do this, proceed as follows:

1. Right click on the **Construction Clipboard** item and select **Save** from the pop-up menu.



2. Enter the name to save the Template under, or select an existing name from the drop down list.

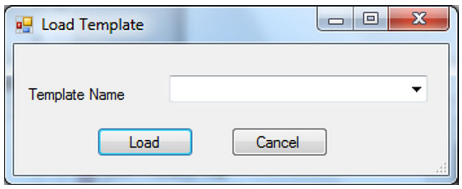
3. Select **Save** to store this Template. There is no limit on the number of different Templates that may be saved.

Loading templates to the Construction Clipboard

Previous Templates may be loaded in the Construction Clipboard.

To do this, proceed as follows:

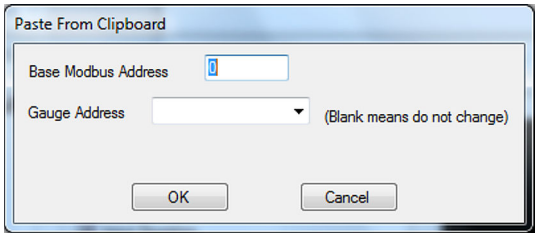
1. Right click on the **Construction Clipboard** item and select **Load** from the pop-up menu.



2. Enter the 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.

Using templates

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 dialog shown below:

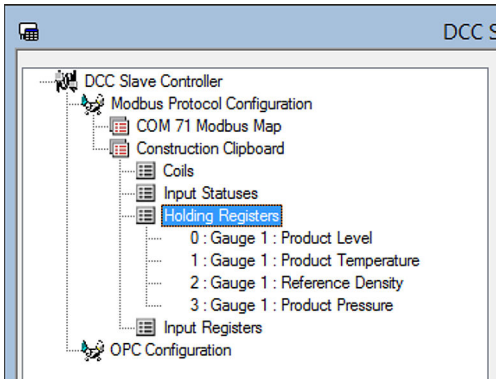


The **Base Modbus Address** is used to offset all the addresses in the clipboard when pasting to the destination.
If a **Gauge Address** is selected then all addresses pasted from the clipboard will have their Gauge Address field set to this value. Leaving this field blank will mean the gauge addresses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

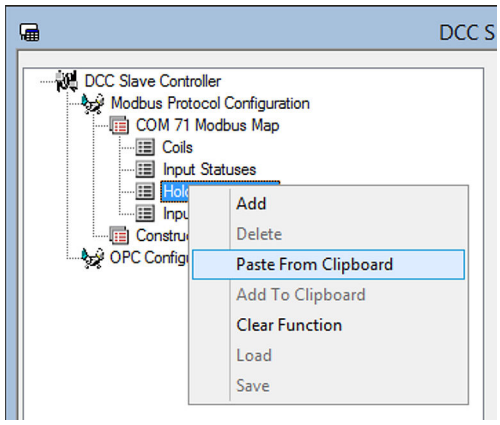
2. Click **OK** to add the addresses from the Clipboard to the map.

Example

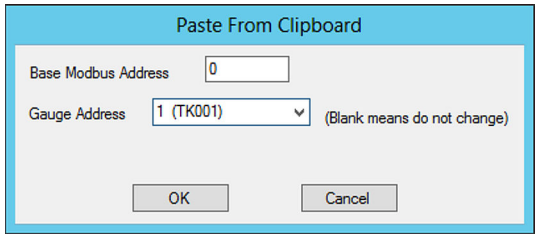
In this example the Clipboard was setup for the Holding Registers as shown below:



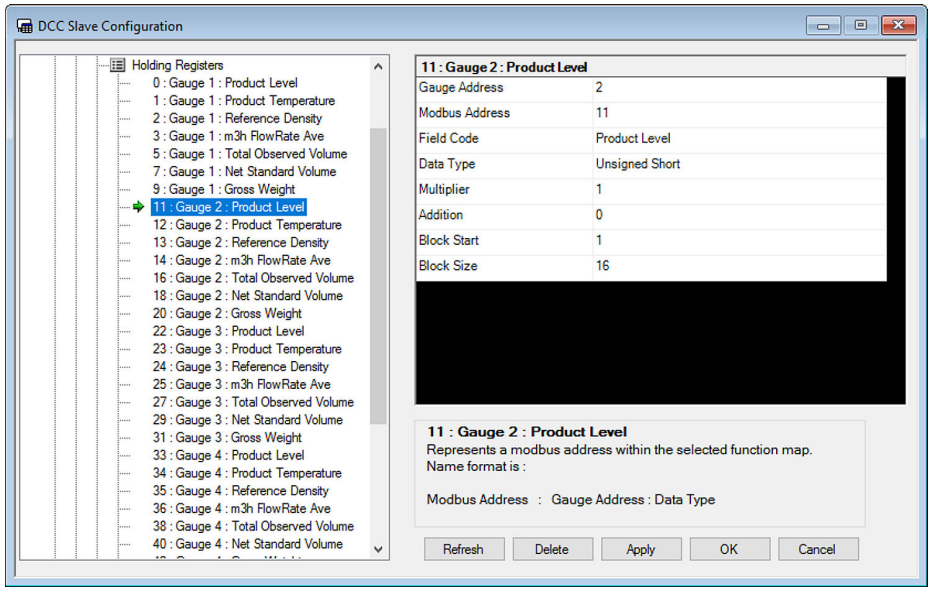
1. To paste these registers to the actual Modbus map, select the **Holding registers** function map and right click to display the pop-up menu.



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



3. After entering the required data, in this example a base address of 0 and using gauge 1, then clicking on **OK** will add the registers as shown below:



All 4 registers have been added, with the correct Modbus addresses starting from 0 and with a source Gauge address set to 1.

8.9.9 Making Changes

The configuration of the Modbus map can be modified at any time using the **DCCSlaveConfigGUI** 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.

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

8.9.10 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 things 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. Each parameter will have 3 field codes:

- **Data Value**: The actual value of the data.
- **Mode**: 0 = data is live from gauge, 1 = data is manually entered
- **Status**: The status of the data. The format is defined by the global setting Status Format Type.

The names of the 3 fields will be Param, ParaMode and ParamStatus, where Param is the name of the parameter.

For example the Product Level parameter has 3 field codes available, named Product Level, Product Level Mode and Product Level Status.

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.

- Product Level
- Product Temperature
- Displacer Position (no mode available)
- Free Water
- Reference Density
- Observed Density
- Observed Temperature
- Product Pressure
- Air Pressure
- Vapour Pressure
- Vapour Temperature
- Air Temperature
- LNG Current Density
- Oil Depth

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.
- **System Healthy**: 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

Bit	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	"Switch By Gauge" redundancy configured
6	"Switch By Interface" redundancy configured
7	"Switch By System" redundancy configured

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

The definition of the field is shown in the table below.

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 **Time Sync**, 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 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:

- Alarm Status
- Gauge Status
- Servo Status
- System Status
- Extended Alarm Status
- Extended Alarm Status 2 (including software user defined alarms)
- Gauge User Defined Alarms (**not** software user defined alarms!)
- System Gauge Status
- Servo Alarm Status
- Profile Status
- FCU Level Status
- FCU Temperature Status
- FCU Diagnostic
- Scan Mode
- Stratification Status
- Stratification Severity

All these fields have a fixed format and are not affected by the **Status Format Type** setting in Global Parameters. They are all bit mapped values.

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	Config Command Data Executing
2	Gauge Command Data Ready
3	Gauge Command Executing
4	Gauge Initialising
5	Fast Scan
6	Manual Scan Complete
7	Unauthorised Movement (Software)

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	System Status Description
0	Servo Check Passed
1	Servo Check Failed

Bit	System Status Description
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	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)
14	Gauge Specific Alarm 7 (Gauge)
15	Gauge Specific Alarm 8 (Gauge)

Bit	Extended Alarm Status 2 Description
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	Gauge User Defined Alarms Description
0 to 31	User Defined Alarms 1 to 32 (Gauge)

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
12	Off-Level
13	Water/Interface Mode
14	Testing/Stowing/Calibrating
15	Blocked/Frozen

Bit	System Gauge Status Description
0	Config Command Data Ready
1	Config Command Data Executing
2	Gauge Command Data Ready

Bit	System Gauge Status Description
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
2	–
3	–
4	–
5	–
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

Bit	FCU Temperature Status Description
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	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	FCU Diagnostic Description
0	–
1	–
2	–
3	Watchdog Tripped
4	–
5	–
6	–
7	–
8	–
9	–
10	–
11	–
12	Passive System is Active

Bit	FCU Diagnostic Description
13	–
14	–
15	–

In addition to the standard status data there are a number of status fields that have no fixed mapping, but rather have a "free form" bit allocation dependent on the type of gauge being polled. These codes include:
- Gauge Mode
- Extended Gauge Status

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

Scientific Instruments 6280 and 6290 LTD gauges

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	–

ITG 60/70 gauges

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	–

Movement Alarm Ack Status Description

Bit	Description
0	Movement Time To Target 1
1	Movement Time To Target 2
2	Movement Approaching Target 1
3	Movement Approaching Target 2
4	Movement Target Level Achieved
5	Movement Target Level Exceeded
6	Movement Low Flow
7	Movement Reverse Flow
8	Movement Transfer Quantity
9	Movement Activity Time To Finish 1

Bit	Description
10	Movement Activity Time To Finish 2
11	Movement Activity Completed
12	Movement Activity Overdue
13	–
14	–
15	–

Alarm Acknowledge Status

The acknowledge Status of alarms can be read as a range of bit-mapped register fields. The definition of the bits will be the same as the corresponding alarm status field, with the bit set indicating that the alarm is un-acknowledged.

The following alarm acknowledge fields are available, shown together with their corresponding alarm status fields defined in the previous section:
- Alarm Ack Status, corresponds to Alarm Status
- Extended Alarm Ack Status, corresponds to Extended Alarm Status
- Extended Alarm Ack Status 2, corresponds to Extended Alarm Status 2
- Movement Alarms Ack Status (see below)

The Movement Alarm Ack Status field has no corresponding alarm status field and is defined in table above (Movement Alarm Ack Status Description).

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
- ...
- Bit 16 = COM 16

If **Block Start** was set to 17:
- Bit 1 = COM 17
- Bit 2 = COM 18
- ...
- 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.

- Density Correction Factor
- Free Water Volume
- Gauge Volume
- Gross Mass
- Gross Observed Volume
- Gross Standard Volume
- Gross Weight
- Net Mass
- Net Observed Volume
- Net Standard Volume
- Net Weight
- Standard Ullage Volume
- Standard Usable Volume
- Total Calculated Volume
- Total Gross Standard Volume
- Total Observed Volume
- Ullage Level
- Ullage Mass
- Ullage Weight
- Ullage Volume
- Usable Mass
- Usable Weight
- Usable Volume
- Vapour Mass
- Vapour Standard Volume
- 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. The profile data for the last profile command is available via the Modbus slave and may be added to the Modbus map in user defined blocks.

The field codes are:
- Density Profile Block 1
- Density Profile Status Block 1
- Level Profile Block 1
- Level Profile Status Block 1
- Temp Profile Block 1
- Temp Profile Status Block 1

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 adding profile blocks to the map it must be taken into account that multiple ADDRESSES will actually be added depending on the Block Size field, (i.e. if Level Profile Block 1 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 Profile Selector field.

To enable this mode, add the Profile Selector field code to the map ONCE only, the gauge address does not matter. Then the Profile blocks should be added to the map ONCE only, again which 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 Profile Selector point. Thus to read the profile data for a gauge, the master should first write the gauges address to the Profile Selector 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.
- Skin Temp Block 1
- Skin Temp Status Block 1

Each block requires certain parameters to be defined:
- **Block Start**: the index within the skin tempature 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. Refer to the section on Profile Data for more details on the formatting of blocks. This also includes the Profile Selector 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:
- Temp Element Block
- Temp Element Status Block

The Temp Element Block 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 Temp Element Block 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

There are a number of fields used to issue commands to control a gauge and are currently the only fields that may be written to as well as read. The fields are:
- Gauge Command
- Arg0
- Arg1
- ...
- Arg9

A command will be sent to the gauge when the Gauge Command field is written to.

Args 0 to 9 contain optional arguments required for certain commands and should be set BEFORE writing to the Gauge Command field.

List of Gauge commands

The Gauge Command field consists of an ASCII character which may be one of the following:
- 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)

Arguments for the "Stow/Lock Test Gauge" command (S)

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

Arguments for the "Test Gauge (Servo Check)" command (T)

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 s

Arguments for the "Profile Scan (Temperature/Density/Water)" command (V)

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

Arg1
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 ≤ 64: Number of Profile Points
- ≥ 65: Profile Interval (mm)
- 0 = use value pre-configured in gauge

Arguments for the "Water Dip" command (W)

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.

0 Level
1 Up
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.

- Flow Alarm Enabled
- Flow High
- Flow Low
- Flow Hysteresis

- Leak Alarm Enabled
- Leak Threshhold

- Difference Alarm Enabled
- Difference Allowable Tolerance
- Difference Hysteresis

- Level Alarm Enabled
- Level High High
- Level High
- Level Low
- Level Low Low
- Level Hysteresis

- Temperature Alarm Enabled
- Temperature High
- Temperature Low
- Temperature Hysteresis

- Float Alarm Enabled
- Float Level
- Float Hysteresis
- Float Direction

- Roof Alarm Enabled
- Roof Early Warning
- Roof Hysteresis
- Float Direction

- Density Alarm Enabled
- Density High
- Density Low
- Density Hysteresis
- Water Alarm Enabled
- Water High
- Water Low
- Water Hysteresis
- Profile Deviation Alarm Enabled
- Temperature Profile Deviation
- Density Profile Deviation

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.)

8.9.11 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 so as 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 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.

Encoding of a 32 bit number

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)
- 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
- **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
- **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
- **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

This can be summarized as follows:

Register	Byte	Data value			
		Little Endian	Big Endian	Little Logical	Big Logical
A	high	NLSB	NMSB	LSB	MSB
	low	LSB	MSB	NLSB	NMSB
A+1	high	MSB	LSB	NMSB	NLSB
	low	NMSB	NLSB	MSB	LSB

Encoding of Time/Date values

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.

Encoding of floating point numbers

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.

8.9.12 Modbus data types

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

Bit
Range: 0 or 1
Number of registers used: 1 Coil
Encoding method: Should only be used for Coils or Input Status maps.

Signed char
Range: −127 to +127
Number of Registers Used: 1
Encoding method: –

Unsigned char
Range: 0 to 255
Number of registers used: 1
Encoding method: –

Short
Range: –32 768 to 32 767
Number of registers used: 1
Encoding method: –

Unsigned short
Range: 0 to 65 535
Number of registers used: 1
Encoding method: –

Int
Range: –2 147 483 648 to 2 147 483 647
Number of registers used: 2
Encoding method: –

Unsigned int
Range: 0 to 4 294 967 295
Number of registers used: 2
Encoding method: –

Float
Range: $\pm 3.4 \cdot 10^{38}$ (7 digits)
Number of registers used: 2
Encoding method: –

Double
Range: $\pm 1.7 \cdot 10^{308}$ (15 digits)
Number of registers used: 4
Encoding method: –

Text
Range: 12 ASCII characters
Number of registers used: 6
Encoding method: Each register is packed with 2 ASCII characters.

Fractional
Range: 0.0000 to 65 535.9999
Number of registers used: 2
Encoding method: 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 4dp then a Volume value of 40 052.7148 m^3 will be converted to
HiWord = 40 052
LoWord = 7 148
The bytes sent (in hex notation) on the Modbus interface will depend on the Byte Order selected: Little Endian = 9C 74 1B EC

8.10 Enraf Protocol Configuration

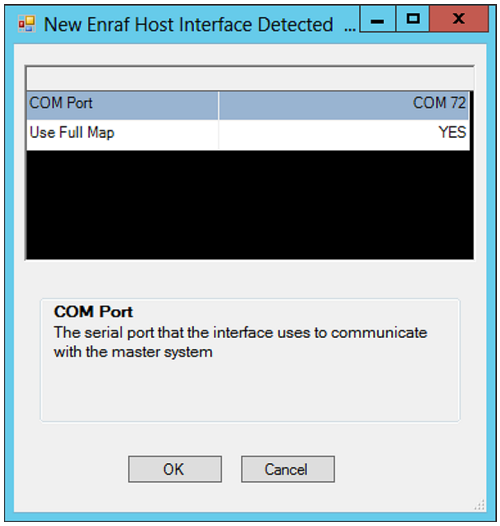
DCC Slave implements the Enraf Host Communications protocol as defined in the Enraf document "Host Communications Manual ENTIS+, Version 5.23x" (file name HO-523x). This defines an ASCII protocol for communication between a Master system and the slave interface running on the Tankvision Professional/LMS system.

The following sections offer a quick getting started guide to configuring interfaces in the 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)

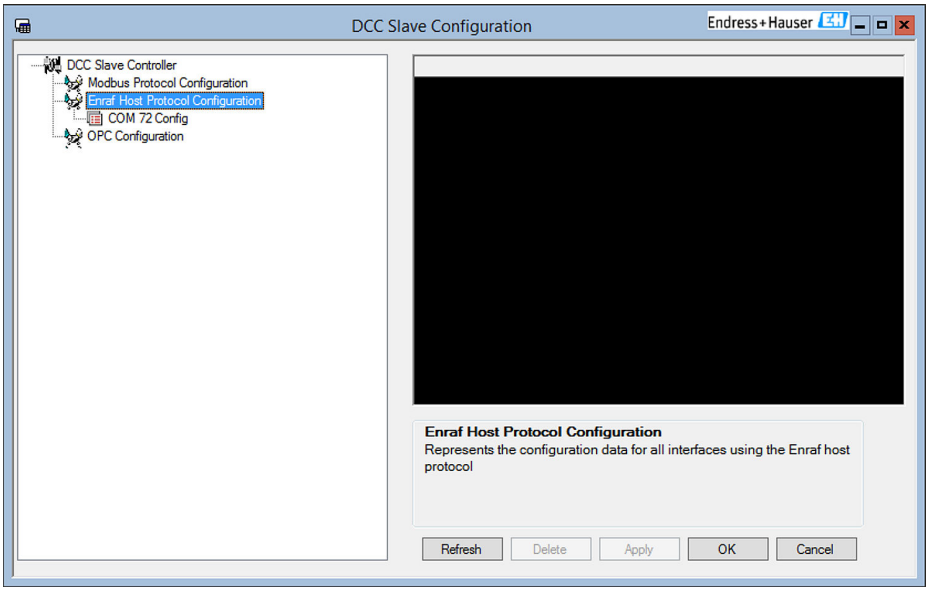
8.10.1 Configuring Communication and Data Format

1. Start the **DCCSlaveConfigGUI** 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.

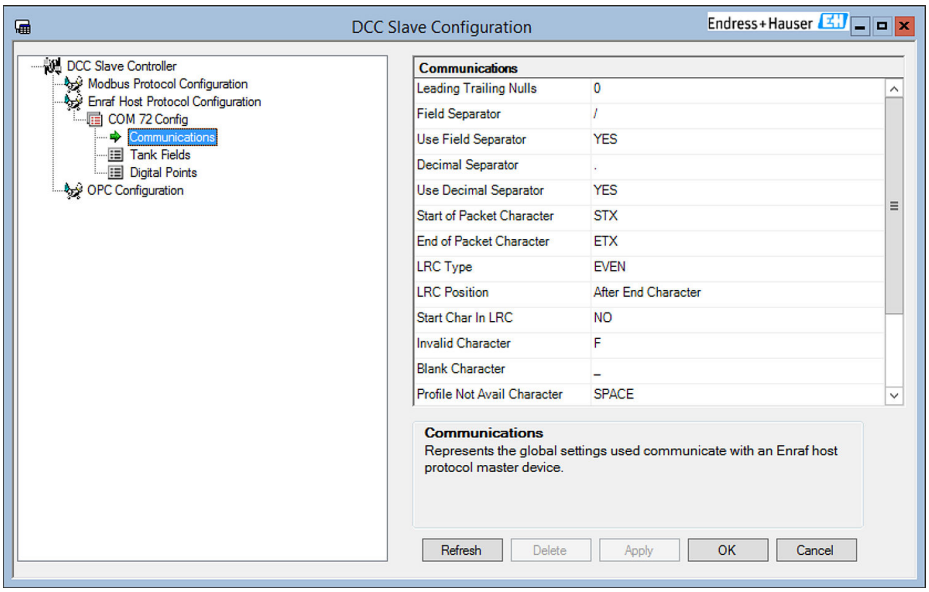


2. The **COM Port** is fixed and cannot be changed but the **Use Full Map** field may be set to **YES** or **NO**.
   ↳ If set to **YES** then the tank configuration map will be initialized to that defined for version 5.21 of the protocol, if **NO** then to version 3b/4.0q (see section 3.3 of the Enraf definition document HO-523x).

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



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



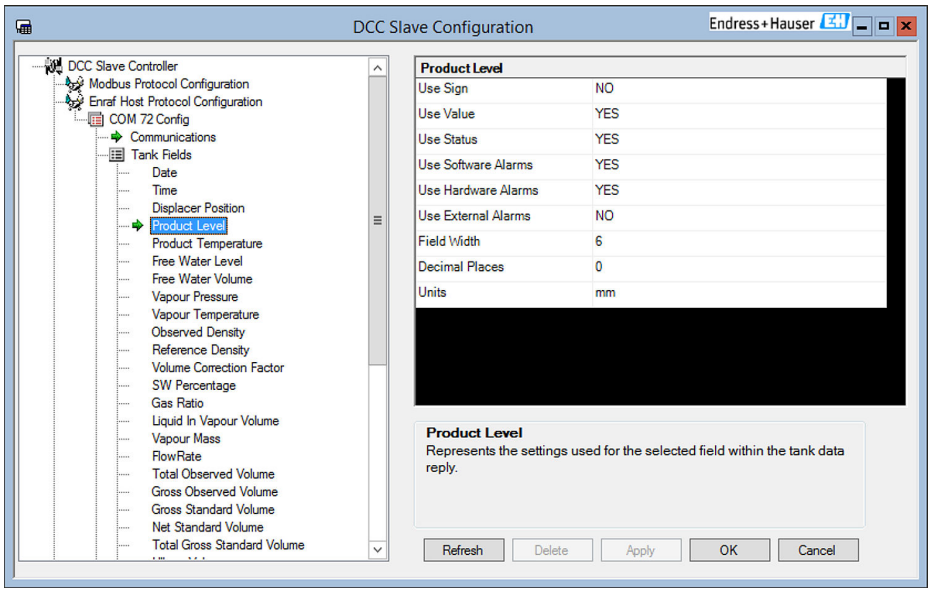
This allows all the Enraf specific communications fields to be edited in the right hand edit panel:

- **Leading Trailing 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 Char**: ASCII character that signifies a start of a packet.
- **End of Packet Char**: ASCII character that signifies a 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 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 Character**: 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 Tankvision Professional/LMS system. Names are left-justified.
- **Mass in Air**: If set to yes then all mass fields in the interface will be refer to weights (i.e. mass in air) in Tankvision Professional/LMS, otherwise mass will be used (i.e. mass in vacuum).

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

5. After configuring the communications parameters, the tank data format has 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.
6. 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 left 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 6 optional elements enabled:
- Sign
- Value
- Status
- Software Alarms
- Hardware Alarms
- External Alarms

If all 5 elements in a data field are set not to be used then 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.

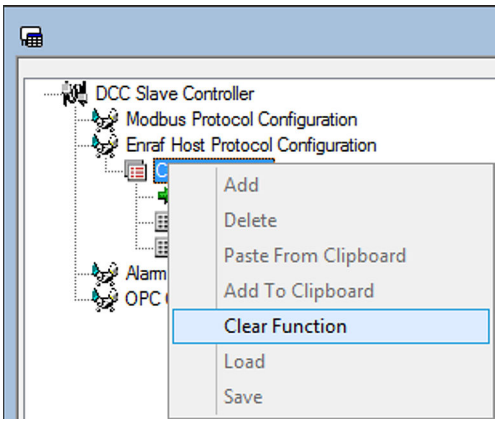
For a more comprehensive description of these fields see section 3.3 of the Enraf definition document HO-523x.

External alarms are not supported in Tankvision Professional/LMS and will always return the '-' character if enabled for a field.

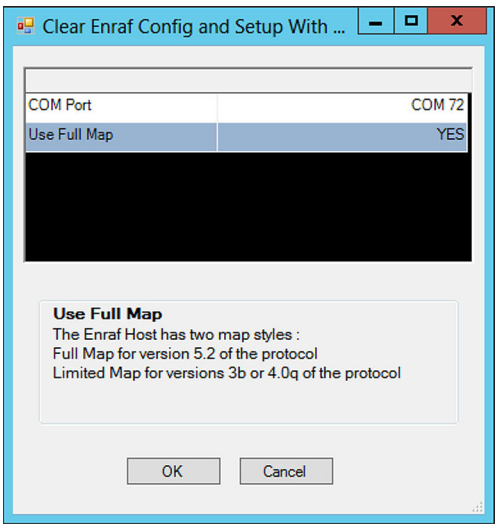
7. Click on the **Apply** button to save any changes to the Tankvision Professional/LMS database.
   ↳ If DCC Slave is running when any changes are saved then it must be re-started before those changes will be used.

8.10.2 Resetting the Configuration

1. If for any reason the configuration data for an Enraf interface needs to be reset back to defaults then this can be carried out in DCCSlaveConfigGUI 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:



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

3. As always any changes will only become permanent when the **Apply** button is clicked.

8.10.3 Tank Field Codes

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

Enraf Host Tank Field	Tankvision Professional/LMS Database Field
Date, Time	No connection to database. Generated when reply message created
Product Level	Product Level
Displacer Level	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 in Tankvision Professional/LMS
Gas Ratio	Not Supported in Tankvision Professional/LMS
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 in Tankvision Professional/LMS
Inlet Valve State	Not Supported in Tankvision Professional/LMS
Outlet Valve Position	Not Supported in Tankvision Professional/LMS
Outlet Valve State	Not Supported in Tankvision Professional/LMS
Product Name	Not Supported in Tankvision Professional/LMS
Product Code	Volume Correction Control See Note Below
Ref Temperature	Volume Correction Control See Note Below
Thermal expansion Coeff	Not Supported in Interface
Mass calculation	'V' or 'A' if MassInAir setting = yes

Enraf Host Tank Field	Tankvision Professional/LMS Database Field
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:
- 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.

Status of tank field data items

Only the following characters will be supported for the 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: Level only

Software Alarm of tank field data items

Only the following characters will be supported for the 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

Hardware Alarm of tank field data items

Only the following characters will be supported for the 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

External Alarm of tank field data items

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

8.10.4 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 an asterisk in the above list must be set to manual mode in the database, otherwise the downloaded data will be discarded.

8.11 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+".

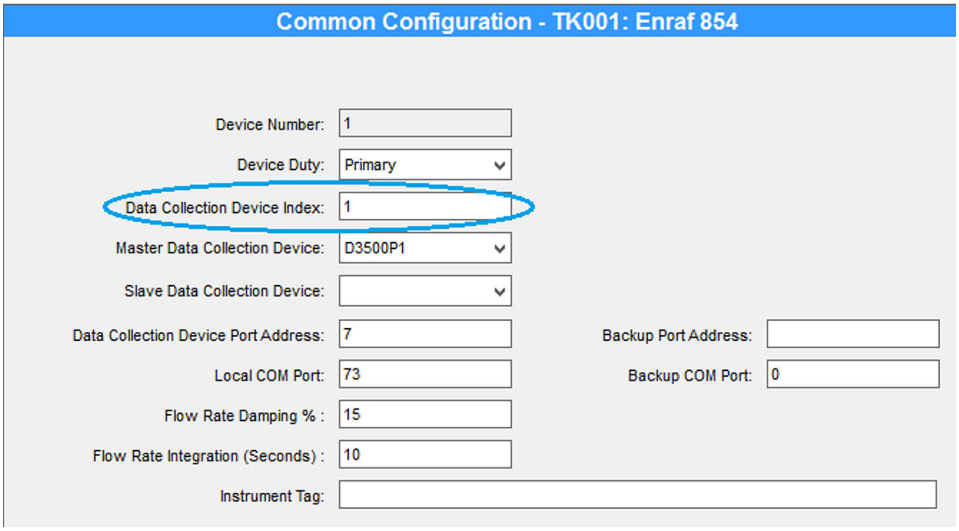
It is configured using a special tool called **EMBConfiguration** located in the standard Tankvision Professional/LMS installation directory.

8.12 Datacon Slave Configuration

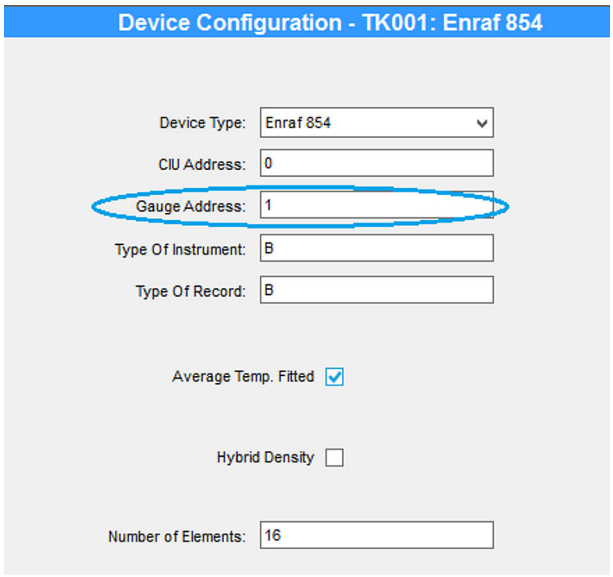
DCC Slave can be configured to respond on one or more serial ports/modems as if it were an slave Datacon device.

There is no configuration required other than:
- Select Datacon for the protocol type
- Set the slave address to that requested by the master system

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



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



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

8.13 Relay Contact Output Configuration

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

- **Internal relay boards**
  The currently recommended internal relay board is the Sealevel PCI Express
- **External relay units** 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.

8.13.1 Using Modbus Devices

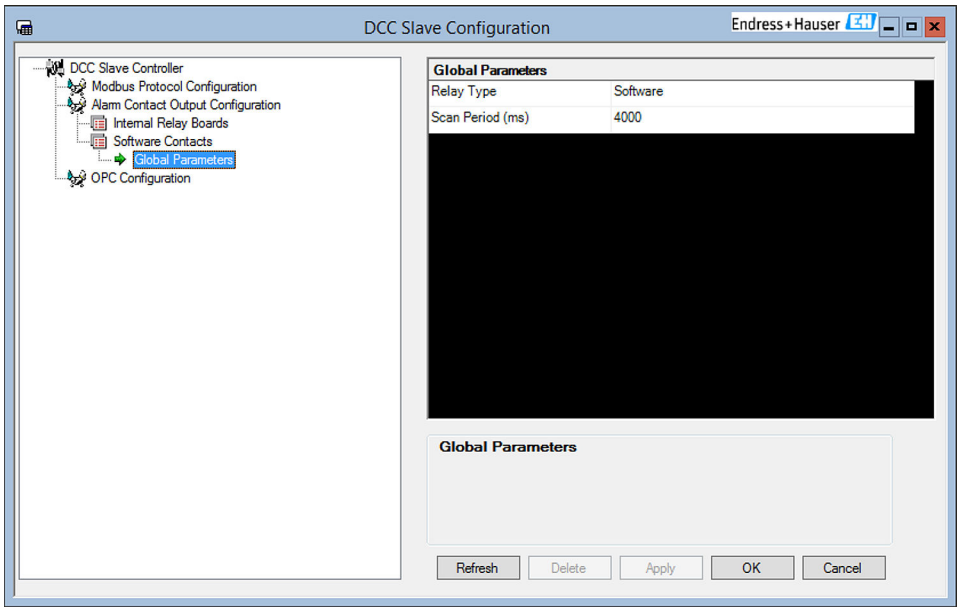
In order to use any remote Modbus devices, the driver has to be enabled for the serial port (or ports) in DCC Slave.

To do so, proceed as follows:

1. Add a slave port with the **Protocol** set to **Modbus Alarm Output** (see "Configuring a Host or Slave port").
2. Set the **Hardware** communication parameters (Baud rate, parity etc.) to those used by the Modbus device. The **Slave** Address and **Retries** fields are not required.
3. Repeat for any other COM ports to be used for Modbus Relay devices.

8.13.2 Configuring Relay Boards

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



All relay board configuration is contained within the **Alarm Contact Output Configuration** section, and if at least one INTERNAL relay board has been installed AND enabled then there will be a **Relay Boards** entry under this section.

Global Parameters

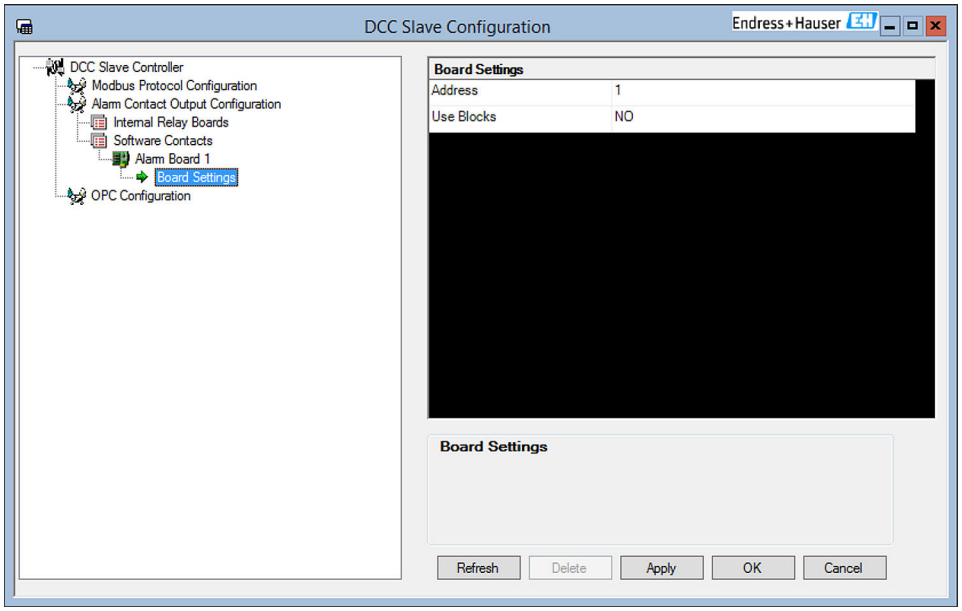
Under the Relay Boards section there are a set of Global Parameters that apply to all relay boards:

- **Relay Type**: Sealevel PCI Express board
- **Scan Period**: the scan time in milliseconds for checking the relay states, defaulting to 4000 milliseconds

Adding and configuring relay boards

Relay boards must be added to the DCC Slave sub-system before they can be configured. To do this, proceed as follows:

► Right click on the **Relay Boards** section and select **Add** from the pop-up menu.



Relay boards are addressed from 1, with the relay board plugged into the first PCI slot having this address and all subsequent boards having their address incremented by one. The **Use Blocks** section is not supported at the moment, and cannot be changed.

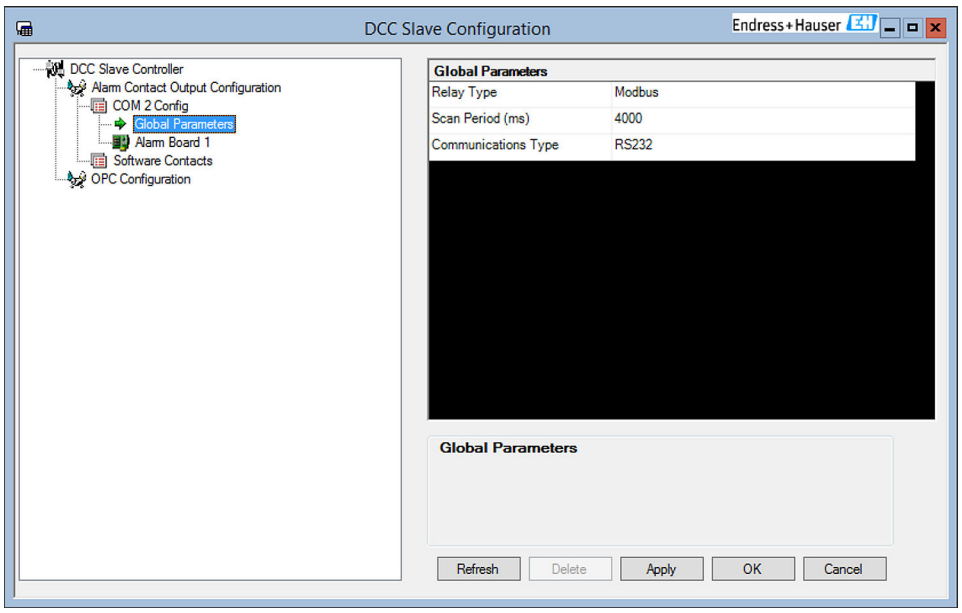
Multiple boards may be added.

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.

8.13.3 Configuring Modbus Devices

Relay contact outputs may be controlled by any combination of gauge/tank alarm states, and are configured using the **DCCSlaveConfigGUI** 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 6 Config**.

Global Parameters

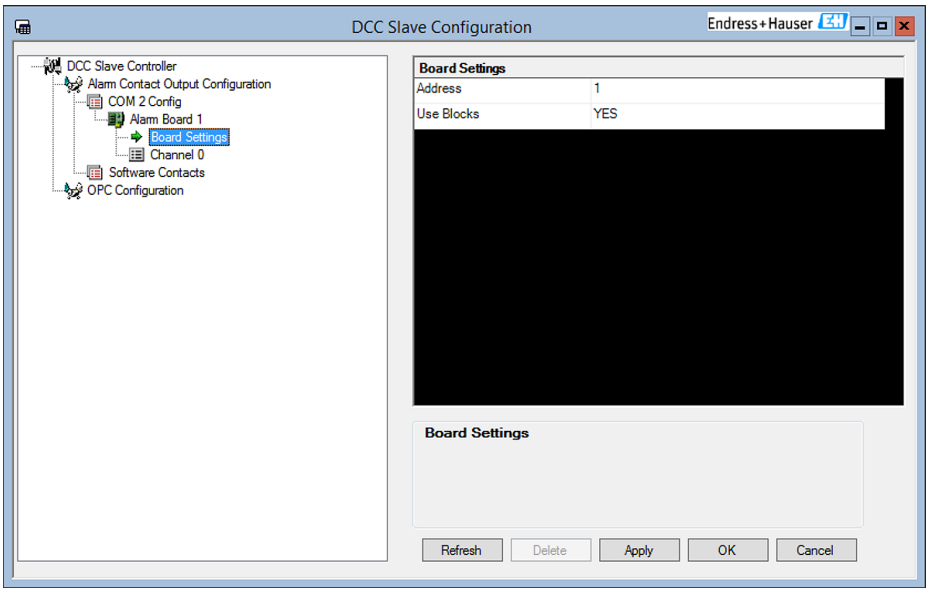
Under each COM port config section there are a set of **Global Parameters** that apply to all modbus devices connected on that port:

- **Relay Type**: Fixed as Modbus
- **Scan Period**: The scan time in milliseconds for checking the relay states, defaulting to 4000 milliseconds
- **Communcations Type** Set to RS485 if an echo of requests is expected, otherwise set to RS232

Adding and configuring alarm boards

Alarm Boards must be added to the DCC Slave sub-system before they can be configured.

▶ 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.

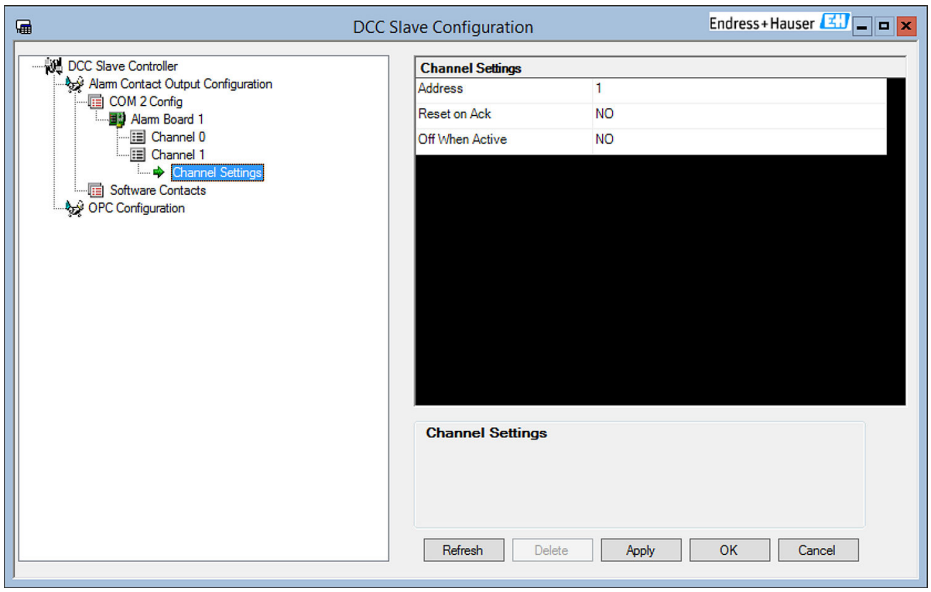
Boards may be deleted by right clicking on the board and selecting **Delete** from the pop-up menu.

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.

8.13.4 Configuring Channels

Each relay contact on a board is defined as a Channel. To add a new channel to a board, proceed as follows:

- 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 INTERNAL relay boards this is the relay channel number on the selected board, from 1, up to a maximum of 8 per board. 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
  - **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.

8.13.5 Configuring Fields

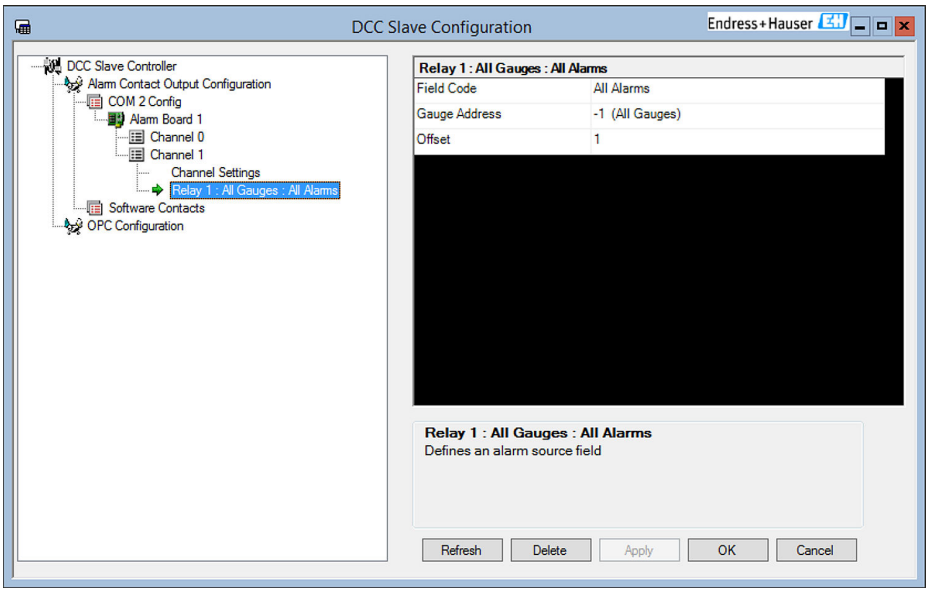
Each relay channel must have at least one source Field defined. There is no limit to the number of fields assigned to a channel.

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

Adding a field to a channel

To add a Field to a channel, proceed as follows:

▶ 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.

Field parameters

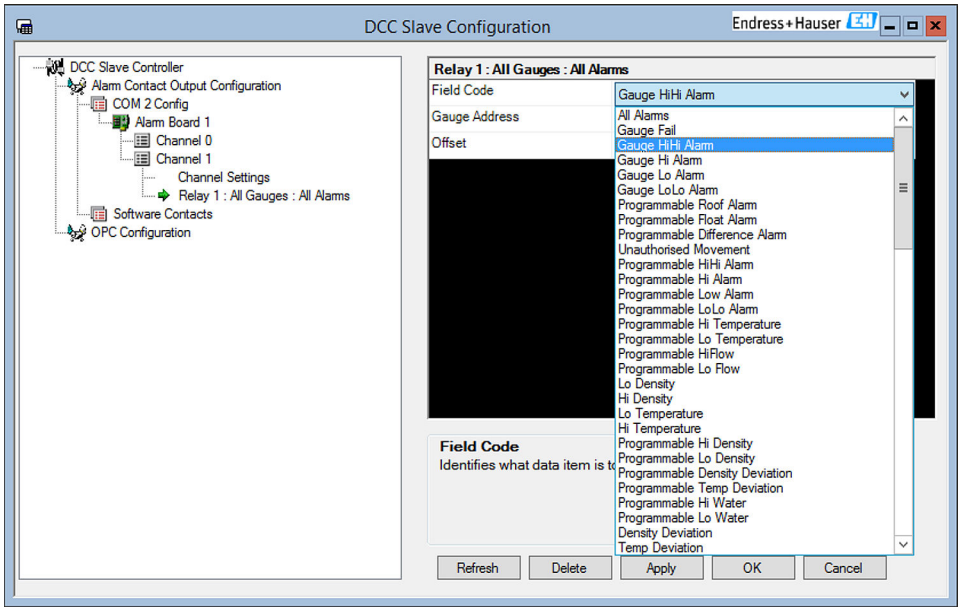
The parameters for each Field are defined as:

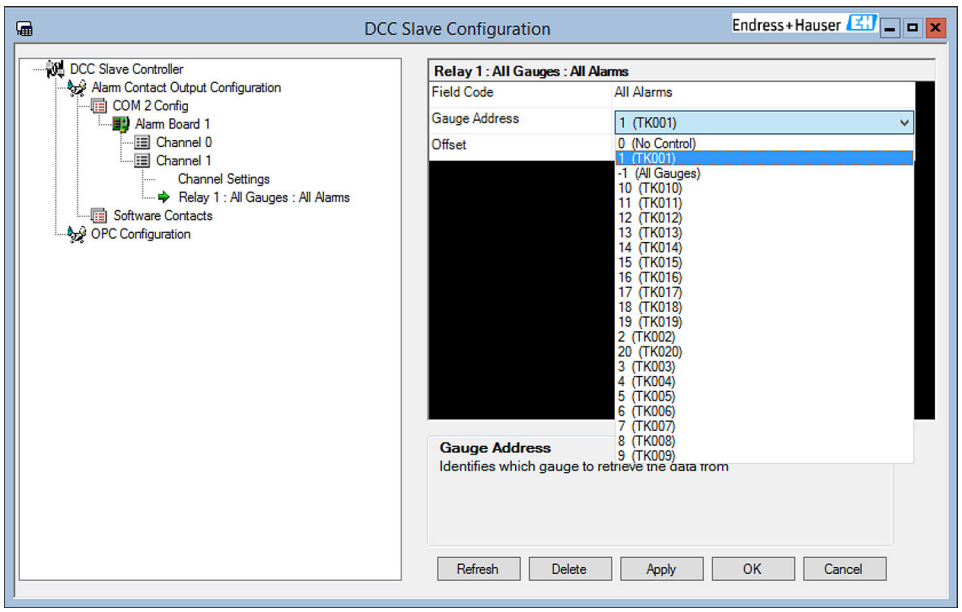
- **Field Code**: The name of the source alarm to test for. A value of **All Alarms** means all alarms will be checked.
- **Gauge Address**: The tank number to check for the alarm. This should be the same as the Gauge Number from the Device Configuration screens. A value of −1 means ALL Gauges will be 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 has **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.

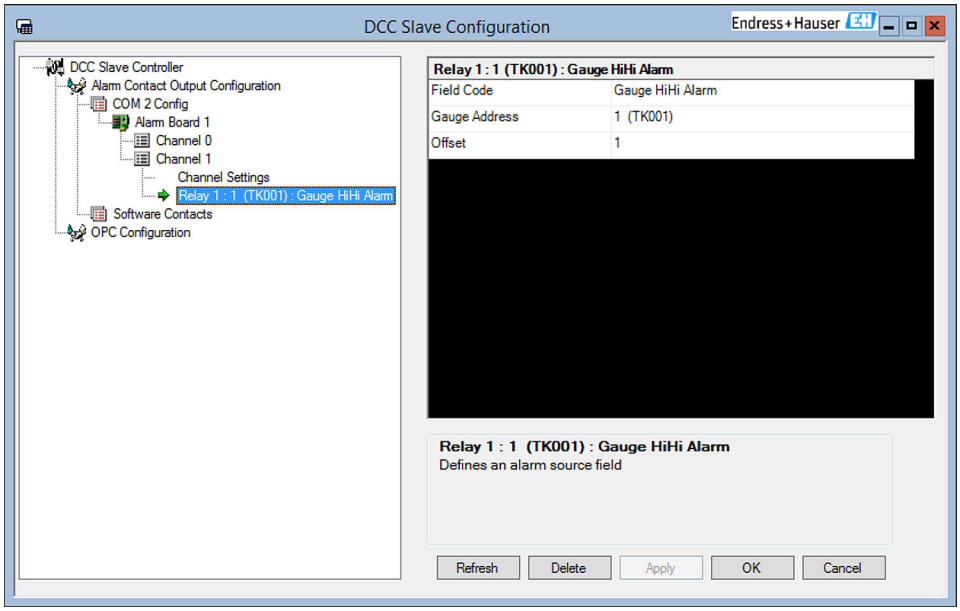
When adding a new Field it will default to **All Gauges** and **All Alarms** as the source. This may then be modified to select individual alarms and/or gauges as required. A number of fields may be added to the same channel, with each field defining an individual alarm and gauge.

Example

For instance if the relay channel was required to activate on the HiHi Gauge alarm for tank TK001 only then set the following:


DCC Slave Configuration
Endress+Hauser
DCC Slave Controller
Alarm Contact Output Configuration
COM 2 Config
Alarm Board 1
Channel 0
Channel 1
Channel Settings
Relay 1 : All Gauges : All Alarms
Software Contacts
OPC Configuration
Relay 1 : All Gauges : All Alarms
Field Code
Gauge Address
Offset
Gauge HiHi Alarm
All Alarms
Gauge Fail
Gauge HiHi Alarm
Gauge Hi Alarm
Gauge Lo Alarm
Gauge LoLo Alarm
Programmable Roof Alarm
Programmable Float Alarm
Programmable Difference Alarm
Unauthorised Movement
Programmable HiHi Alarm
Programmable Hi Alarm
Programmable Low Alarm
Programmable LoLo Alarm
Programmable Hi Temperature
Programmable Lo Temperature
Programmable HiFlow
Programmable Lo Flow
Lo Density
Hi Density
Lo Temperature
Hi Temperature
Programmable Hi Density
Programmable Lo Density
Programmable Density Deviation
Programmable Temp Deviation
Programmable Hi Water
Programmable Lo Water
Density Deviation
Temp Deviation
Field Code
Identifies what data item is t
Refresh
Delete
Apply
OK
Cancel


DCC Slave Configuration
Endress+Hauser
DCC Slave Controller
Alarm Contact Output Configuration
COM 2 Config
Alarm Board 1
Channel 0
Channel 1
Channel Settings
Relay 1 : All Gauges : All Alarms
Software Contacts
OPC Configuration
Relay 1 : All Gauges : All Alarms
Field Code
All Alarms
Gauge Address
1 (TK001)
Offset
0 (No Control)
1 (TK001)
-1 (All Gauges)
10 (TK010)
11 (TK011)
12 (TK012)
13 (TK013)
14 (TK014)
15 (TK015)
16 (TK016)
17 (TK017)
18 (TK018)
19 (TK019)
2 (TK002)
20 (TK020)
3 (TK003)
4 (TK004)
5 (TK005)
6 (TK006)
7 (TK007)
8 (TK008)
9 (TK009)
Gauge Address
Identifies which gauge to retrieve the data from
Refresh
Delete
Apply
OK
Cancel



8.14 TankMaster Configuration

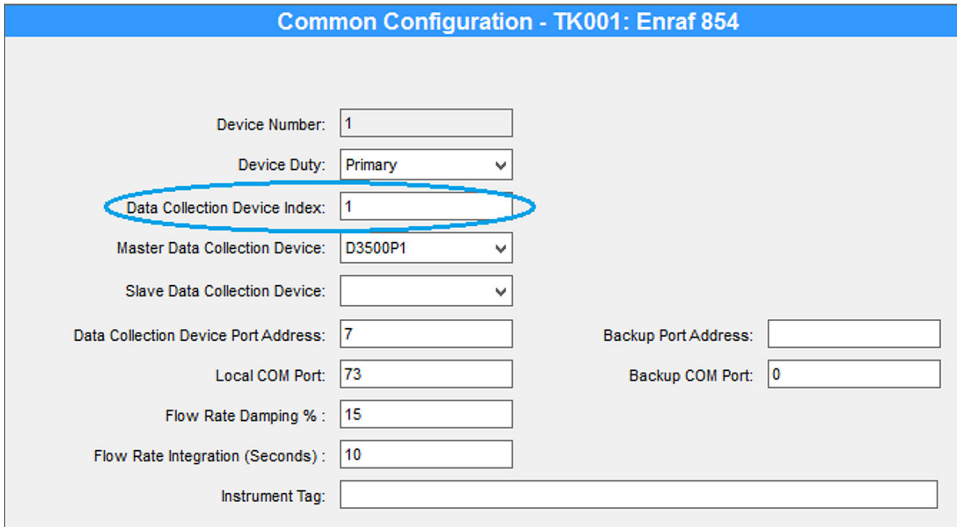
The TankMaster interface in DCC Slave is based on the Modbus protocol, with a preconfigured map. It supports up to 256 tanks, each with its own Tank Index position (range 0 to 255) in the modbus register map.

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.

8.14.1 Default Tank Index mapping

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



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

The **Datacon Gauge Index** field is only displayed if a **Master Datacon Name** is selected. If no datacon is used, then add a dummy datacon (such as the preconfigured BLANK datacon device in some systems). The Configuration screen will also require the **Port Address** to be entered, in this case just enter a value of 1 for this.

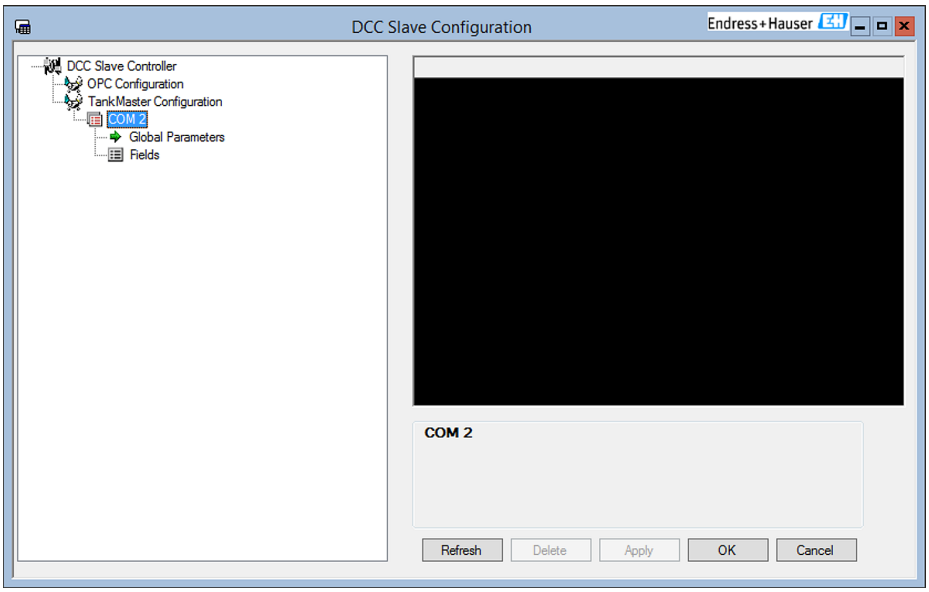
Each gauge must have a unique index position. Therefore, when the TankMaster interface is used, every gauge in the database should have a value entered in the **Datacon Gauge Index** field.

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.

8.14.2 Advanced Tank Index mapping

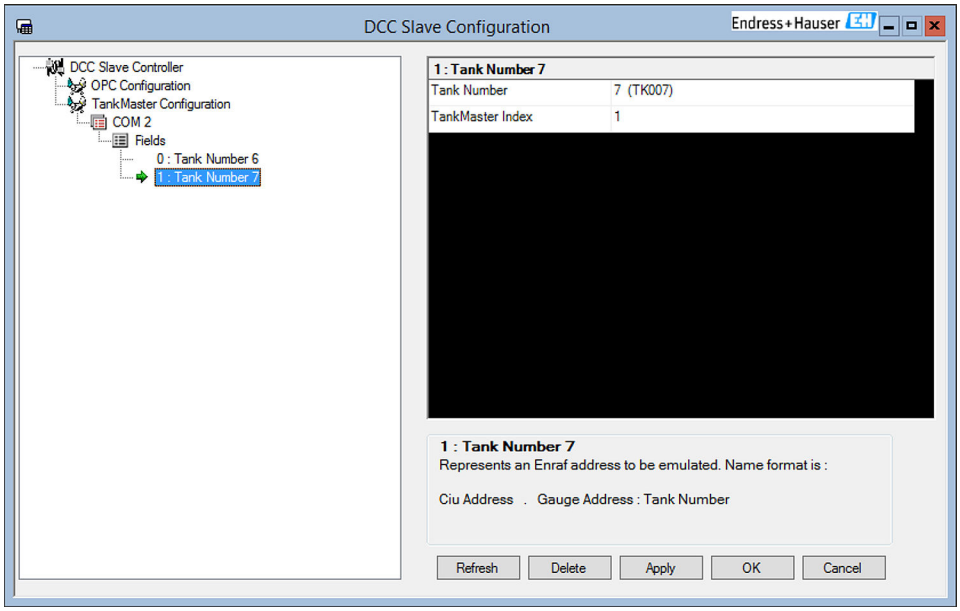
Individual TankMaster interfaces may have their own Tank Index allocation via the **DCC Slave Configuration** screen.

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. Each entry consists of a pair of items:

- **Tank Number** in the database
- **TankMaster Index** position

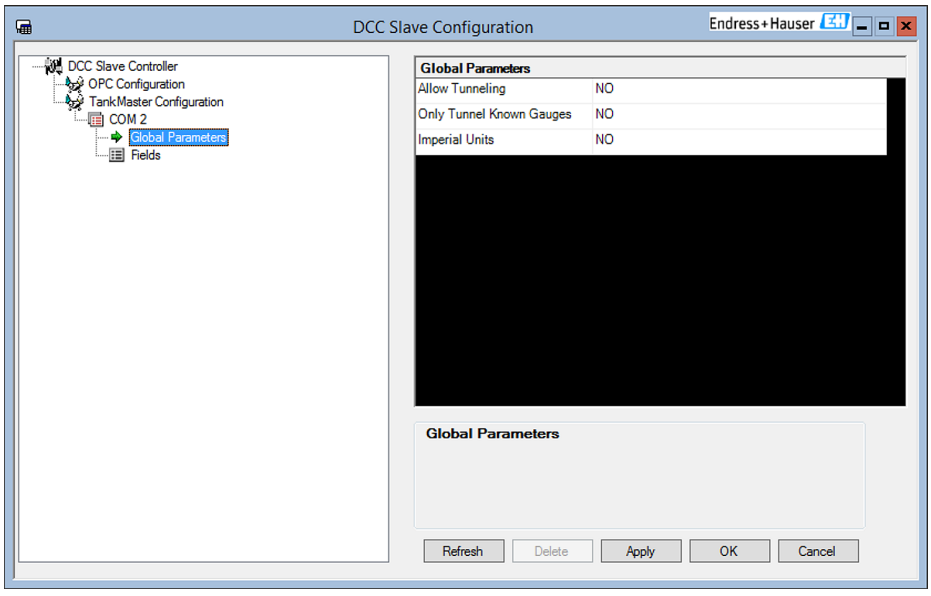


The TankMaster interface running on that COM port will now use the map defined in the DCC Slave Configuration tool, and will NOT use any Datacon Gauge Index values.

8.14.3 Other Advanced Configuration

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

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



2. The following items may be configured:

- **Allow Tunneling**: If set to **YES** then 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** then only Modbus IDs for gauges configured in the database will be tunneled.
- **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.

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