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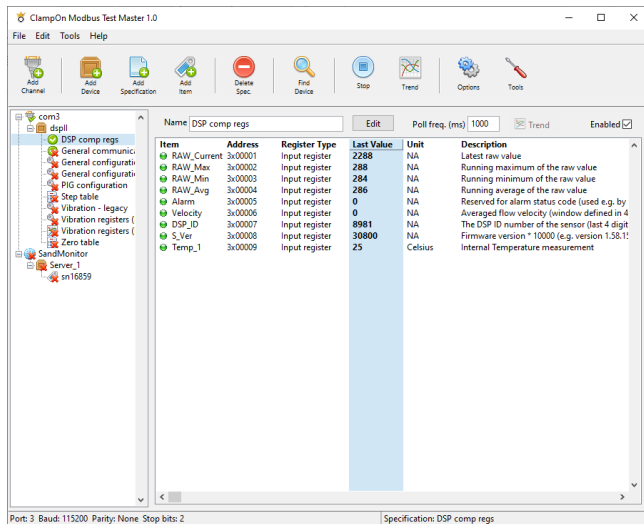
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1 GENERAL

1.1 Purpose

This document describes how to install, configure, and use Modbus Test Master.



1.2 Abbreviations

ASCII	American Standard Code for Information Interchange
COM	Communications Port
CRC	Cyclic Redundancy Check
FC	Function code
HW	Hardware
IP	Internet Protocol
LRC	Longitudinal Redundancy Check
ms	Milliseconds
NI	National Instruments
PC	Personal Computer
RTU	Remote Terminal Unit
RX	Receive
SW	Software
TCP	Transfer Control Protocol
TX	Transmit
U16	16 – bit Unsigned

1.3 Revisions

- 1 Issued for information. First issue.

1.4 Health, safety and environment

ClampOn aims to take all reasonable steps to protect the environment, people and other parties' assets and to prevent its operations, production, development and maintenance causing emissions to air, water and soil.

1.5 Support

ClampOn AS provide program support. Please contact: swsupport@clampon.com

1.6 About ClampOn

ClampOn AS is the leading worldwide supplier of topside and subsea non-invasive ultrasonic intelligent sensors. The company was established in 1993 and its head office is located in Bergen, Norway. A branch office, ClampOn Inc., is located in Houston, Texas, USA.

If you have any questions or require further information, please visit www.ClampOn.com for contact details.

1.7 Trademarks

Modbus® is a registered trademark of Schneider Electric Inc.

2 INTRODUCTION

Before using this manual you should have a working knowledge of the computer type that the program will be running on. You should know the basics of graphical user interfaces, file management, etc. You should also have an idea of how Modbus devices and networks operate.

Modbus Test Master provides easy access to Modbus devices for configuration, diagnostic and testing purposes. Once you have connected the hardware, noted the device slave ID and communication speed, you are ready to start.

2.1 Features

- Serial Modbus communication (RTU, ASCII, TCP)
- Device scanning
- Logging and decoding of communication
- Modbus specification display
- Create and modify Modbus specifications
- Create and copy device profiles
- Extended address format (3x00001)
- Legacy address format (30001)
- Both zero-based and one-based addressing
- Trending
- Plugin support

2.2 Installation kit

The Modbus Test Master 1.0 installation kit contains

- Modbus Test Master 1.0
- NI LabVIEW Runtime 2018 SP1 f5
- NI-VISA Runtime 20.0

2.3 Requirements

The minimum requirements to run Modbus Test Master 1.0:

- Pentium 4M/Celeron 866 MHz (or equivalent) or later (32-bit), Pentium 4 G1 (or equivalent) or later (64-bit)
- 256 MB RAM
- 620 MB free hard disk space
- Windows 10/8.1/8/7 SP1 (32-bit)
- 1024 x 768 resolution display

2.4 Installing Modbus Test Master

To install Modbus Test Master:

1. Start Windows
2. Insert the software installation medium (CD/USB drive), or download the installation set from a network location.
3. Browse to the installation set.
4. Double-click the setup.exe file.

The installation wizard will guide you through the rest of the installation process.

In this document, the recommended values are given but you are free to change these values as you wish. However, ClampOn recommends keeping the default values.

2.5 Starting Modbus Test Master

Alternative 1:

From the **Start** menu, select **All Programs > ClampOn > Modbus Test Master 1.0**

Alternative 2:

Start the program from the desktop by clicking the **Modbus Test Master 1.0** icon (see Figure 1).

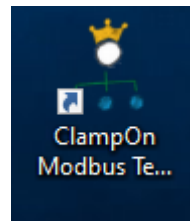


Figure 1: Desktop shortcut

2.6 License

Modbus Test Master comes with an evaluation period of 90 days or a maximum of 50 program start-ups, whichever comes first. There are no program limitations during the evaluation period.

A licence is required to use Modbus Test Master when the evaluation period has expired. The licence must be purchased online. To purchase, activate or just check the license information go to the **Help** menu and click **License**. See Figure 2.

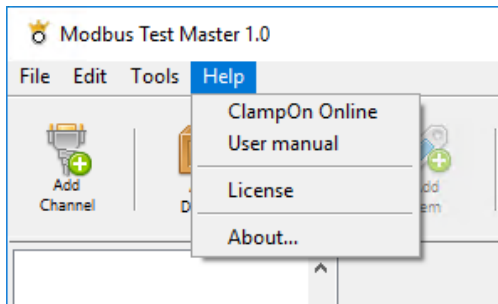


Figure 2: License information

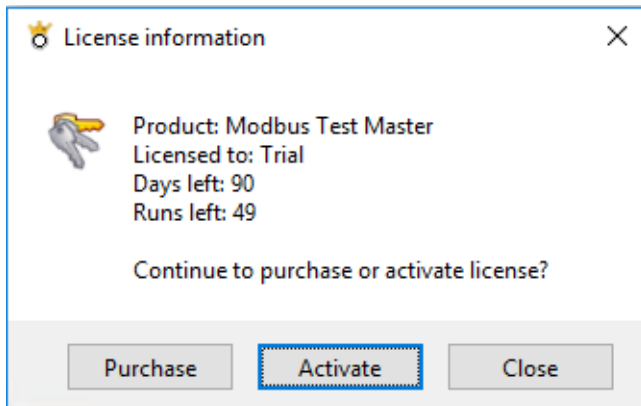


Figure 3: Purchase or activate a license.

1. **Purchase Modbus Test Master Online** – you will be re-directed to a shopping cart where you can purchase a Modbus Test Master license. You will receive a license ID and password to activate the software.
2. **Activate Modbus Test Master** – to activate Modbus Test Master, you must be online, and already have a licence ID and password. If you do not have an internet connection, Modbus Test Master can be activated through another online machine. Follow instructions in the dialog. Figure 4.

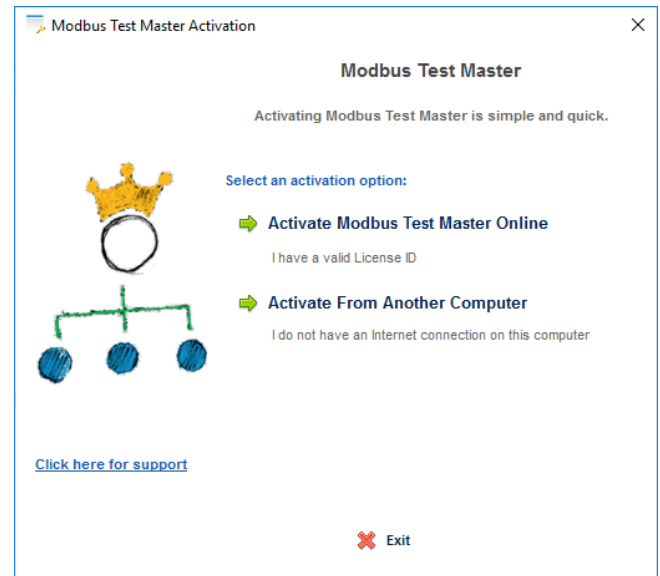


Figure 4: Activate licence.

2.7 Splash screen

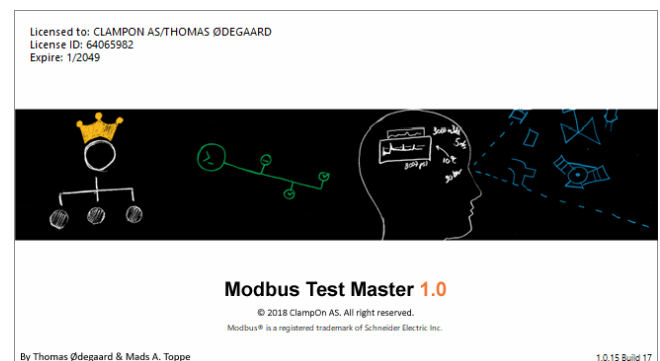


Figure 5: Splash screen

When you launch the application you will see a splash screen, which is shown for about 5 seconds while the rest of the application is loaded. It tells you which software version you are running, the names of the developers, etc. The full version number (in the lower right-hand corner of the splash screen) may be helpful if you contact ClampOn for support. The splash screen contains the link (blue text): List of copyrights.

When the application has been loaded the splash screen will disappear and the main window will appear.

To see the splash screen at any time, go to the **Help** menu and click **About**.

2.8 Main window

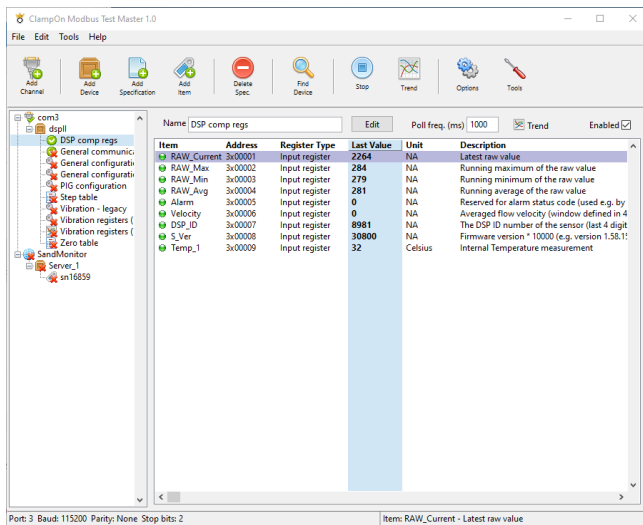


Figure 6: Main window

The main window comprises:

- Menu bar
- Main panel with buttons for adding, removing, discovering, starting
- List of channels with devices and Modbus specifications (left-hand pane)
- Information about channel, device and specification.
- Bus monitor showing all Modbus frames on bus (channel and device panes)

Right-click menus in each pane provide additional functions.

3 MODBUS TEST MASTER

3.1 General

In the Modbus Test Master program we talk about channels, devices, profiles, specifications and items. They form a hierarchy where devices are connected to a channel, a specification is linked to a device and an item is part of a specification.

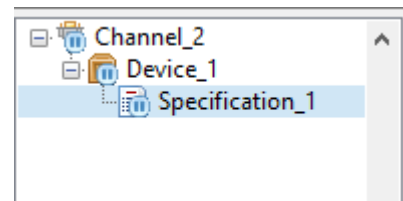


Figure 7: The hierarchy of channels, devices and specifications (channels three structure).

How to add, configure and use them are described in the following sections. But first, a brief introduction:

Channel: The physical port used for communication. This may be a COM port or a TCP/IP connection. You need to adjust the channel settings before the communication can start.

- **COM port:** Set port number, communication speed, protocol (RTU or ASCII), parity, stop bits, reply timeout and interframe delay.
- **TCP/IP connection:** Set IP address, port number, connection timeout, reply timeout and interframe delay.

Device: A device is the instrument that you communicate with through the **Channel**. You need to enter the slave ID (Modbus) of the device before the communication can start.

You may communicate with several devices on the same channel, but each device must have a unique slave ID.

Specification: A specification is a list of Modbus register addresses. You load (link) the specification to a device and the specification tells the Modbus Test Master program about what Modbus register addresses to poll from the device.

A specification is very flexible and can easily be modified during operation. You may also combine

identical Modbus addresses in several specifications loaded to the same device.

Specifications can be saved and used later on.

Profile: A profile is a set of specifications that you find that belongs together. You may create multiple device profiles for the same device.

As for the specifications, profiles can be saved and used later on.

Item: Items are more or less the Modbus register addresses that builds up the specification. But as an item may be both 16 – bit, 32 – bit and 64 – bit wide, an item may contain more than one Modbus register address.

The item also holds information about register type, data type, unit, description, word order and scaling.

3.2 Start Modbus Test Master

At start-up, the Modbus Test Master program will by default load the set-up from the last program session. But, the first time you use Modbus Test Master you have to configure channels and devices. Start with adding a channel, see 3.3.

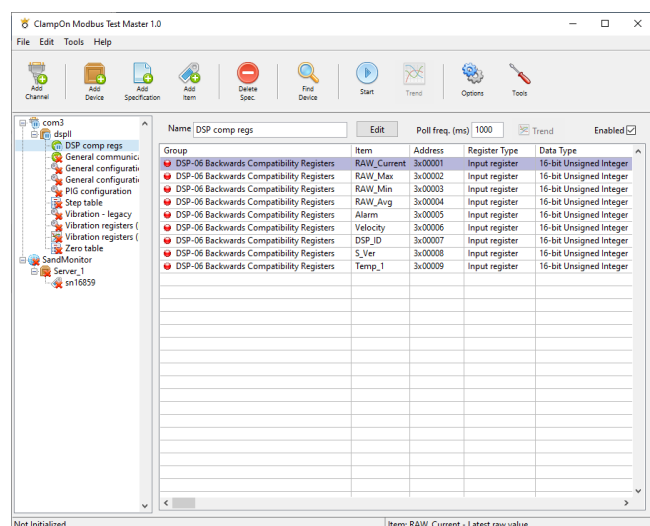


Figure 8: Starting Modbus Test Master - last session loaded.

3.3 Add a channel

To add a channel, click the **Add channel** button in the main window.

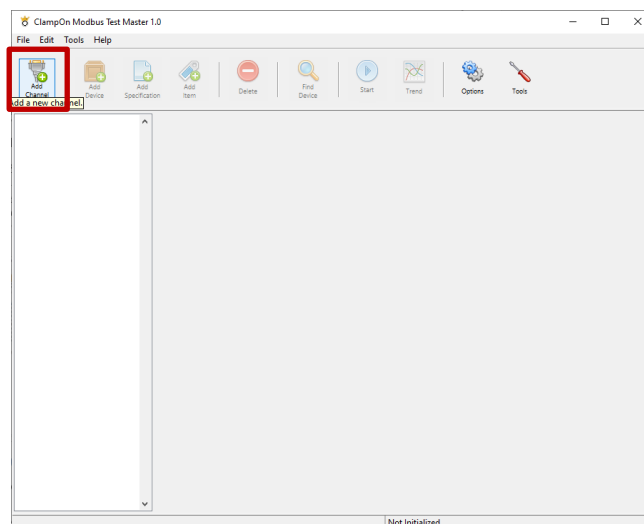


Figure 9: Add a channel.

A dialog for adding a new channel will pop-up.

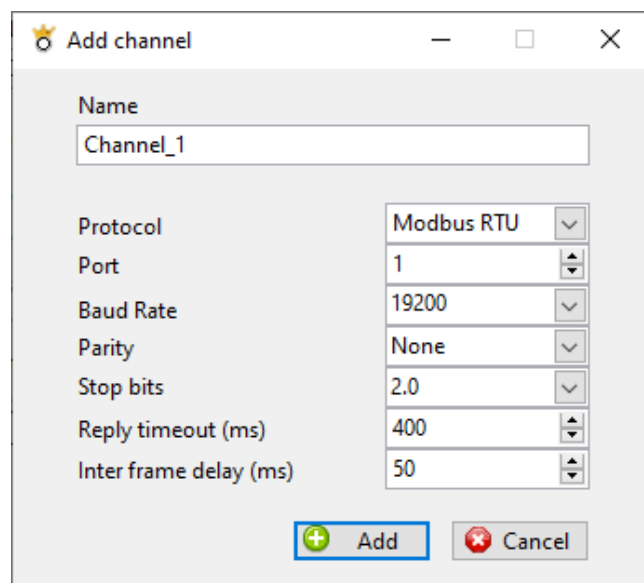


Figure 10: Channel settings for Modbus RTU and Modbus ASCII.

1. Enter a name for the new channel.
2. Select protocol (Modbus RTU, Modbus ASCII, Modbus TCP)

In case you select Modbus RTU or Modbus ASCII in 2, see Figure 10:

3. Set the applicable COM port for the channel.
4. Set the baud rate, parity, and the number of stop bits to configure the communication on the channel.

5. Set the reply timeout – the maximum time from a request to an answer on the channel.
6. Set the interframe delay, to configure when to collect a frame from the channel. (maximum time between two bytes)

In case you select Modbus TCP in 2, see Figure 11:

3. Set the IP address and the port number for the Modbus TCP server.
4. Set the connection timeout – the maximum time for establishing a connection to the server.
5. Set the reply timeout – the maximum time from a request to an answer on the channel.
6. Set the interframe delay, to configure when to collect a frame from the channel. (maximum time between two bytes)

Figure 11: Channel settings for Modbus TCP.

Click **Add** to add the new channel.

The new channel will be displayed in the List of channels, the main part of the window will show the channel settings. As default, a new channel is “enabled”, meaning that it is ready to be used.

Figure 12: A new channel is added.

3.4 Add a device

When a channel is ready the next step is to add a device to the channel. Click the **Add device** button in the main window.

Figure 13: Add a device.

A dialog for adding a new device will pop-up.

Figure 14: Device settings.

1. Enter a name for the new device.

2. Set the slave ID of the device.
3. Enter a description for the device.

Click **Add** to add the new device.

The new device will be displayed in the List of channels under its channel. The main part of the window will show the device settings. As default, a new device is “enabled”, meaning that it is ready to be used.

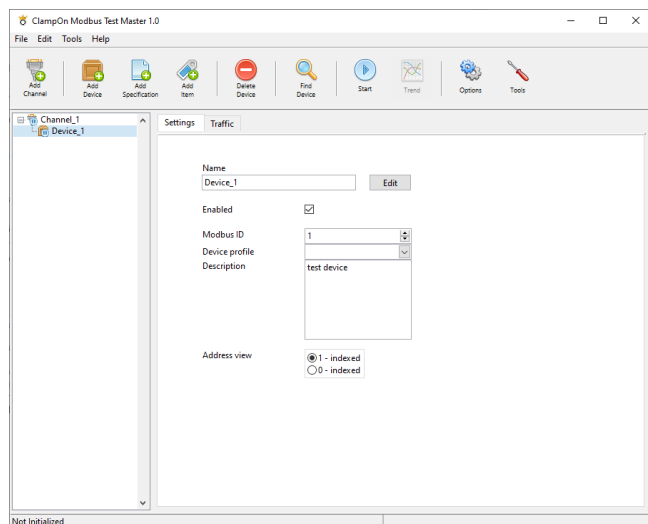


Figure 15: A new device is added.

In the device window you may load earlier used device profiles from the program memory.

You may also toggle between zero-based indexing and one-based indexing. That is, the item addressing will either start from zero or from one.

3.5 Add a specification

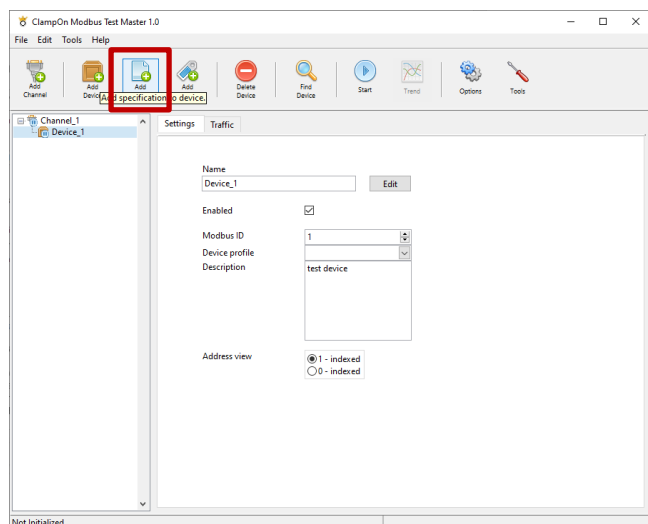


Figure 16: Add a specification.

Click the **Add specification** button in the main window. A dialog for adding a specification will pop-up. You will have two choices, either create a new specification or load an existing.

If you decide to create a new specification enter the “Specification name” and click the **Add** button. You will automatic be re-directed to enter an item(s). See also section 3.6.

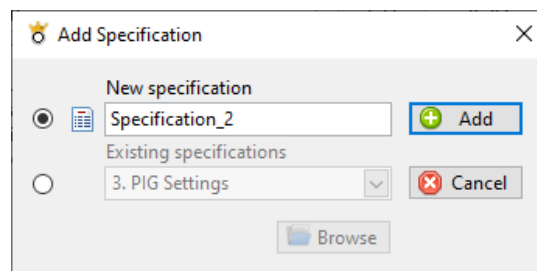


Figure 17: Add specification.

The new specification is by default enabled, meaning that it is ready to be used.

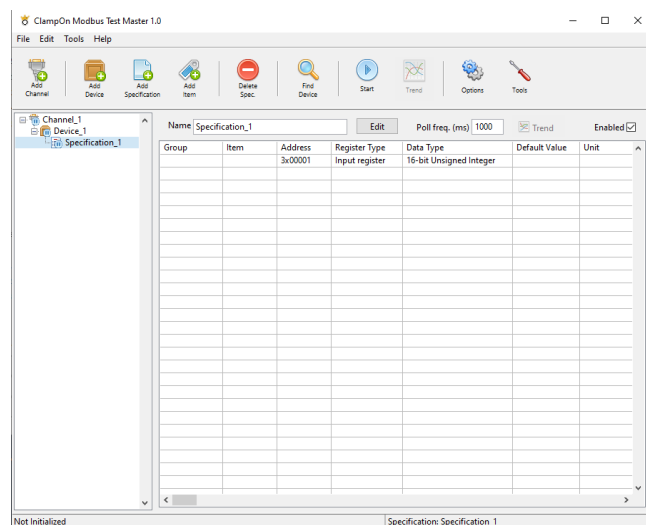


Figure 18: Specification added and displayed.

3.6 Add an item

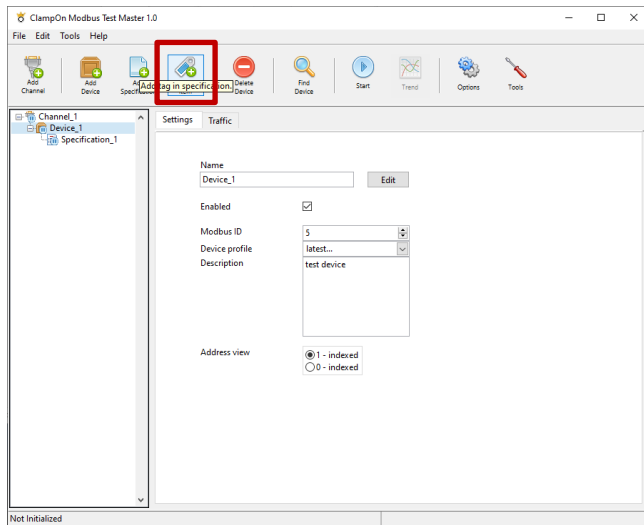


Figure 19: Add an item.

Click the **Add item** button in the main window.

In case you have a specification opened the new item(s) will be added to that specification. Otherwise, a new specification will be created containing the new item(s).

A dialog for adding the item will open. As a minimum you have to enter the Modbus-address, the type of register and the data type. It is important that these entries correspond to the settings in the device.

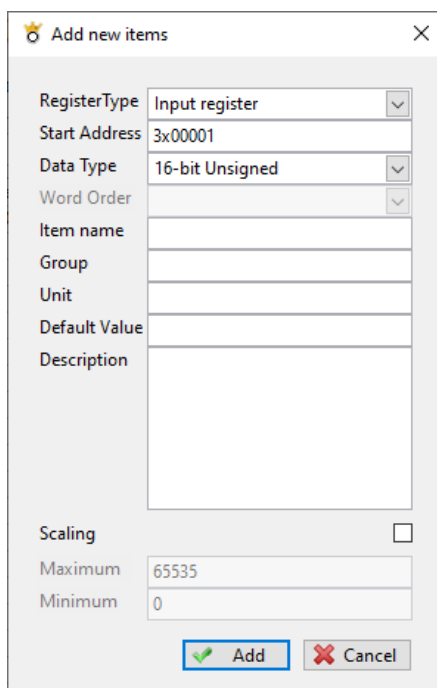


Figure 20: Add item(s).


Entries:

- **Register Type:** Input register, Holding register, Coil or Discrete Input.
- **Start Address:** The Modbus register address of the first item. A full range of 65535 addresses are supported. The prefix indicates the type of register ("0x – Coils", "1x – Discrete Input", "3x – Input Register" and "4x – Holding Register")
- **No. of Items:** The number of items you are adding. (starting from **Start Address**)
- **Data Type:** The data type tells the Modbus Test Master program how the data in each item is formatted. In case the data type is 32 – bits wide the data is contained in two 16 – bit Modbus – addresses.
- **Word Order:** In case an item is 32 – bits wide or more you have to specify the Word Order. That is, which Modbus register addresses contain the most- and least significant values (Words – U16). If word order is **Little endian** the least significant value is placed in the first Modbus register and the most significant value is placed in the last Modbus register. If word order is **Big Endian**, you have the opposite situation, the most significant value is placed in the first Modbus register and the least significant value is placed in the last Modbus register.
- **Item Name:** The name of the item.
- **Group:** You may group items together to visualize a relationship between them.
- **Unit:** The unit of the item value. (m/s, °C, kg, and so on)
- **Default Value:** The default item value.
- **Description:** A short description of the item.
- **Scaling:** As each Modbus-register only holds a 16 – bit integer value between 0 – 65535 scaling is used to extend the range, minimize the range (introduce digits of precision) and use negative numbers.
- **Maximum:** The maximum value of the item. (applicable if **Scaling** is checked)
- **Minimum:** The minimum value of the item. (applicable if **Scaling** is checked)

3.7 Start and stop monitoring

When you have prepared and enabled your channels, devices and specifications you are ready to start monitoring.

Click the **Start** button in the main window.

- The pause symbol  will disappear on the enabled channels, devices and specifications in the “Ports list”.
- The **Start** button will change to a **Stop** button.
- The specification will change layout. The item symbols change to a green light and the **Value** column is now visible in blue.

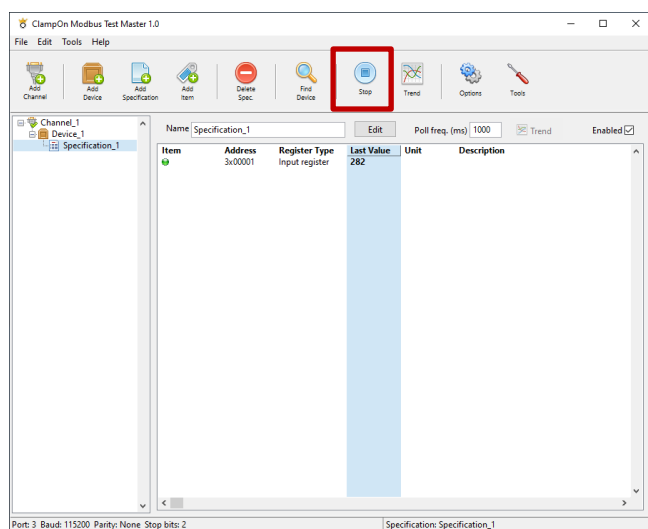



Figure 21: Monitoring mode.

To stop monitoring click the **Stop** button in the main window.

- The pause symbol  will appear on the enabled channels, devices and specifications in the “Ports list”.
- The **Stop** button will change to a **Start** button.
- The specification will change layout. The item symbols change to a red light and the **Value** column is now not visible.

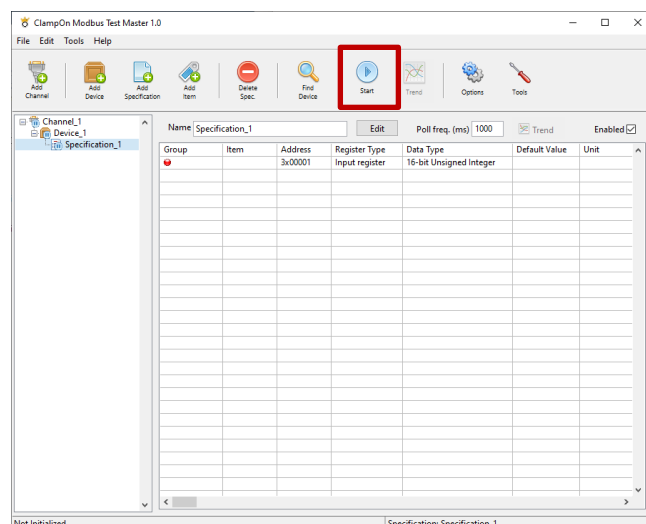


Figure 22: Monitoring disabled.

3.8 Write to an item

In monitoring mode, it is possible to write values to items of register type **coil** or **holding register**. Select an item followed by **Write to item** from the right-click menu.

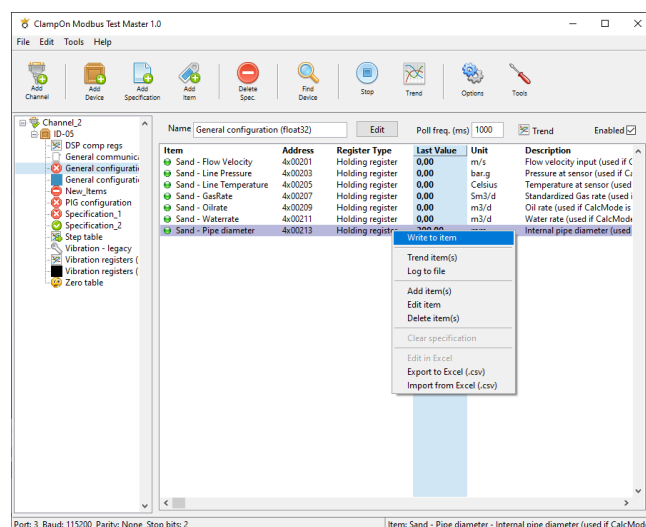


Figure 23: Write to an item.

A dialog will open where you enter the new value and then click the **Update** button.

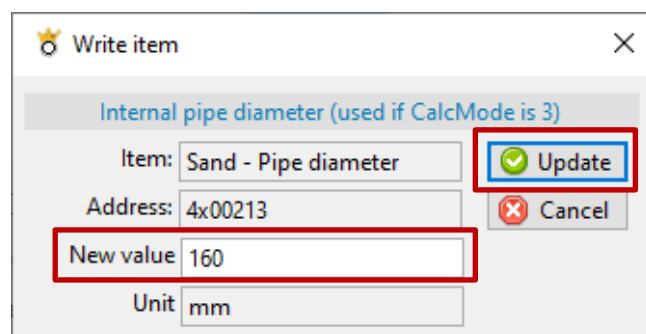


Figure 24: Write a value to an item.

3.9 Trending items

In monitoring mode, you may start the trending of items. Either click the **Trend** button among the main buttons on the top row or select an **Item** in the specification and click the specification's **Trend** button.

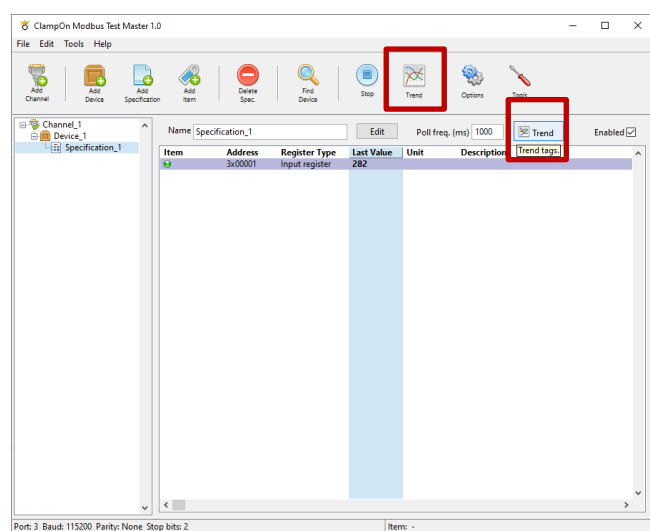


Figure 25: Trending items.

In case you clicked the main Trend button you will be re-directed to select items for trending. Browse to the wanted item(s) and enable by clicking the associated check-box. When you are ready click the **OK** button. A trend window with the selected items will open.

If you started trending directly from the specification, the trend window will automatic open with selected items.

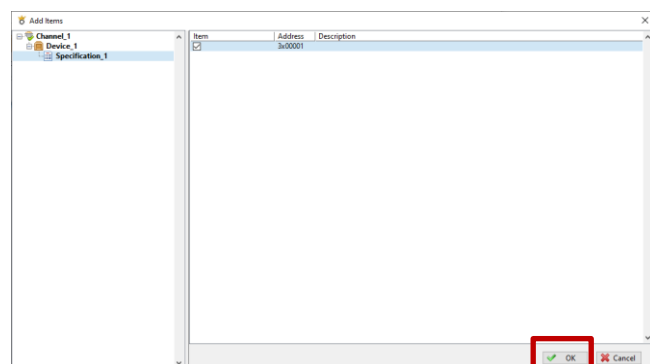


Figure 26: Select items to trend.

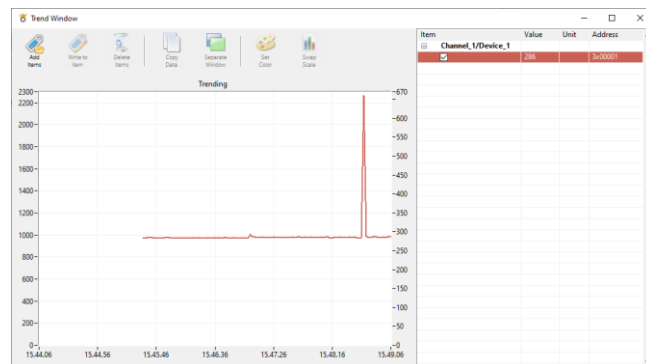


Figure 27: Trend window.

In the trend window you may add and remove trending items.

Add Items: If you click the **Add Items** button the window for selecting items will open, see Figure 26. You may choose items from different devices and trend them in the same trend window.

Write to Item: You may click the **Write to Item** button if the item type is a coil or a holding register. See Figure 23.

Delete items: Remove an item from the trend window by marking the item and then click the **Delete** button.

3.10 Find a device

Sometimes you do not have the necessary information to start to communicate with a device. Or more particular, you do not know the slave ID. A search tool is available to help you out.

Select the channel that the device is connected to and click on the **Find device** button. A new window will open where you can start to scan the channel.

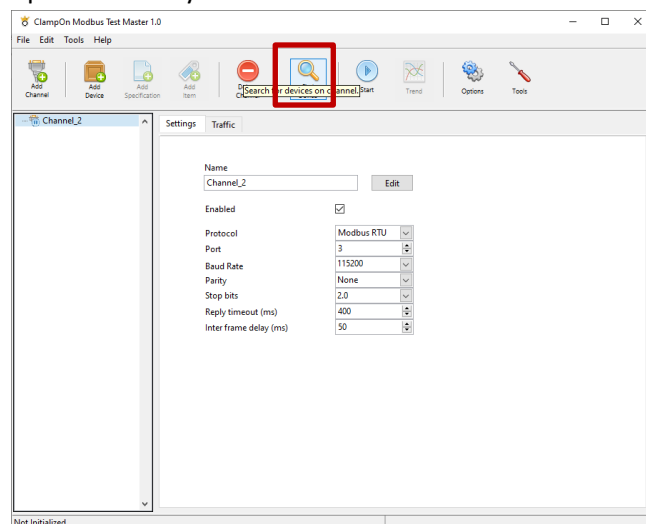


Figure 28: Find device.

Before you start the scan you have to choose protocol for the scan. If the channel is a COM port you may also select **Auto Detect**.

Auto Detect will switch between the protocols Modbus RTU and Modbus ASCII and scan through all available baud rates.

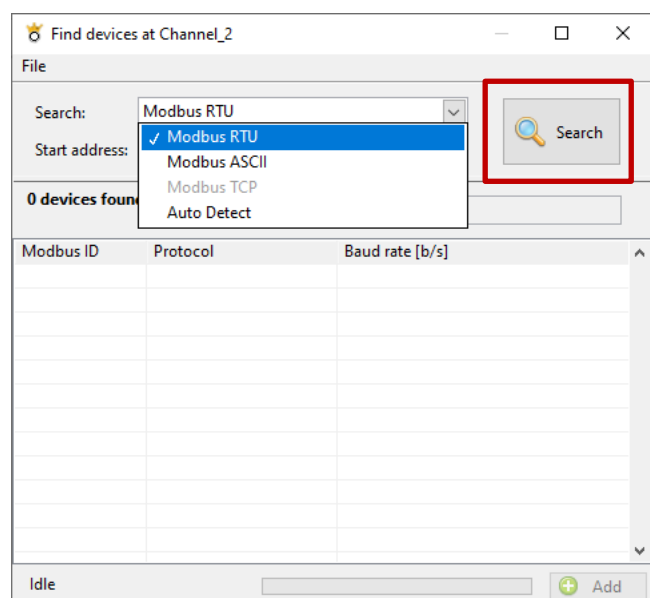


Figure 29: Device search window.

Click **Search** button to start the scan. You may anytime stop the scan by clicking on the **Stop** button.

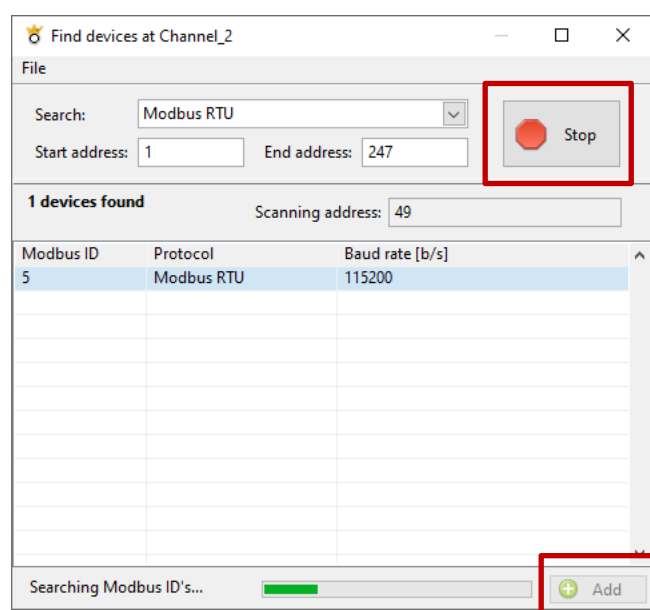


Figure 30: Scanning for devices.

When the scan is complete or you have stopped it manually, the discovered devices may be added to the channel. Select devices and click on the **Add** button.

The search window will close, and the new devices are added to the channel in the channels list.

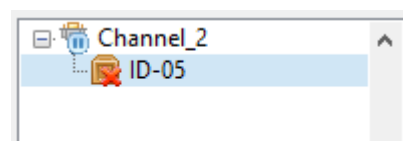


Figure 31: Device with Modbus ID 5 added to Channel_2.

3.11 Monitor bus traffic

Select the **Traffic** tab in the channel or device display. Both the channel and the device windows allow you to monitor communication on the channel. Only, that for the device window the communication is filtered to show communication only for the selected device.

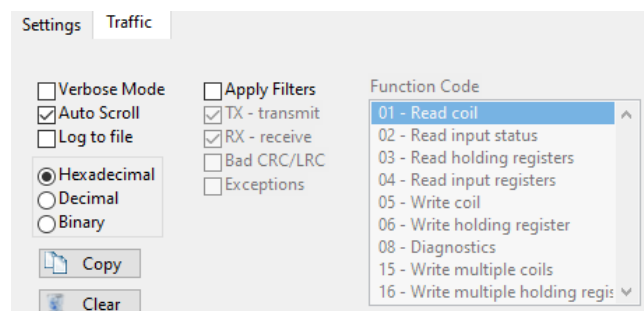


Figure 32: Options of the traffic monitor.

Verbose Mode: You may toggle between a standard mode and a verbose mode.

Default: disabled (unchecked)

- In standard mode each frame is displayed byte-wise with a timestamp and indication of TX/RX and protocol.
- In verbose mode the byte-wise presentation is decoded into slave ID, read/write, function code, register type, register address, data and CRC/LRC.

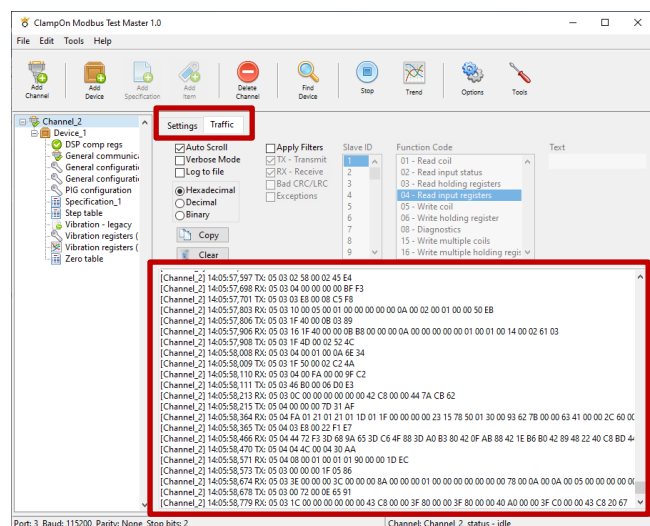


Figure 33: Monitoring bus traffic in standard mode.

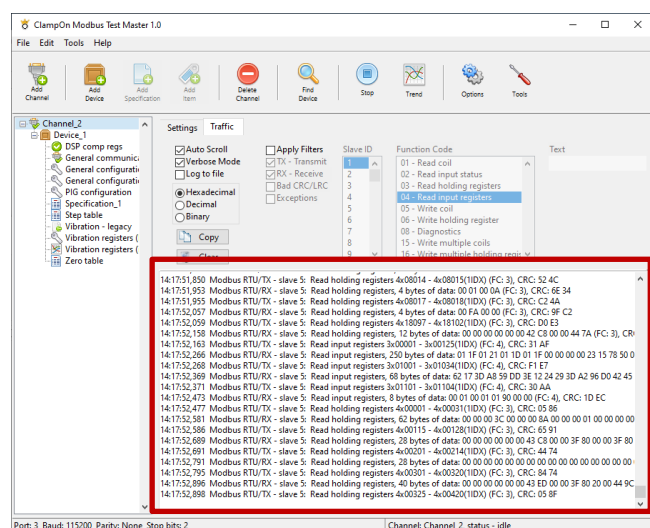


Figure 34: Monitoring bus traffic in verbose mode.

Auto Scroll: When enabled, communication will automatic scroll to the latest communication frames. Default: enabled (checked)

Log to file: Save the communication to file by checking the **Log to file** box. A log file will automatic be created at:

C:\Users\...\Documents\ClampOn\Modbus Test Master\ComLogs

Uncheck to stop the logging and to close the file.

Data formatting: Toggle between hexadecimal, decimal and binary presentation.

Copy to clipboard: If you click the **Copy** button the contents of the monitor window will be copied to the clipboard.

Clear: Click the **Clear** button to empty the monitor window.

Filter options: Check the **Apply Filters** box to start filtering the displayed communication.

- Display the communication frames transmitted from Modbus Test Master. Check the **TX** box.
- Display the communication frames received from a device. Check the **RX** box.
- Only display communication frames with a bad CRC or LRC. Check the **Bad CRC/LRC** box.
- Only display communication frames with exception codes. Check the **Exceptions** box.
- **Function code:** Mark the function codes that shall be displayed.
- **Text:** You may add a text filter that will be applied on top of the other filters. Enter your filtering text in the text box and press **Enter**.

3.12 Adjust program settings

Click the **Options** button to adjust the program settings. A window will open where you can change settings for **Trends**, **Startup** and **Table view**. When you have finished your adjustments click the **Apply** button.

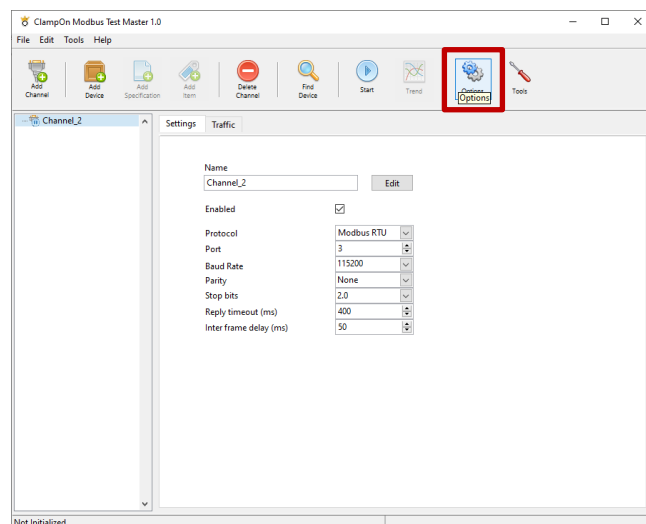


Figure 35: Adjust the program settings.

Trends: Startup settings when opening new trends.

- **Period:** The time span displayed on the graph (x-axis)
- **Refresh Rate:** How often check for new values and add them to the graph.

- **Override:** Override the refresh rate and instead use the polling frequency set in each specification.
- **Autoscaling:** Autoscaling of the Y-axis. (on/off)

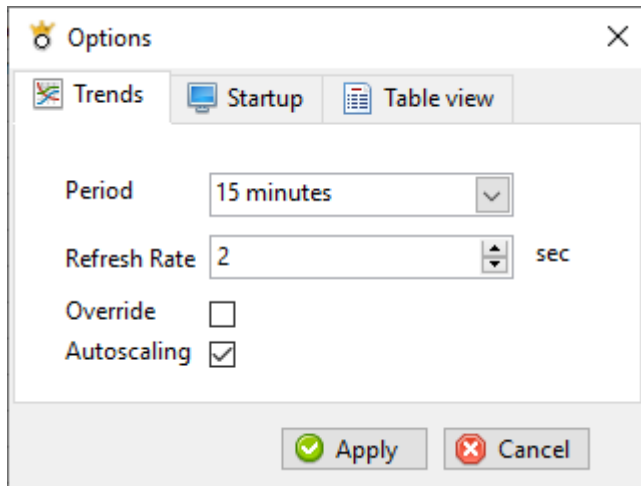


Figure 36: Trend settings.

Startup: Program settings when opening Modbus Test Master.

- **Maximize Window:** will maximize window at program startup.
- **Show splash-screen during startup:** Enable and disable of splash screen.

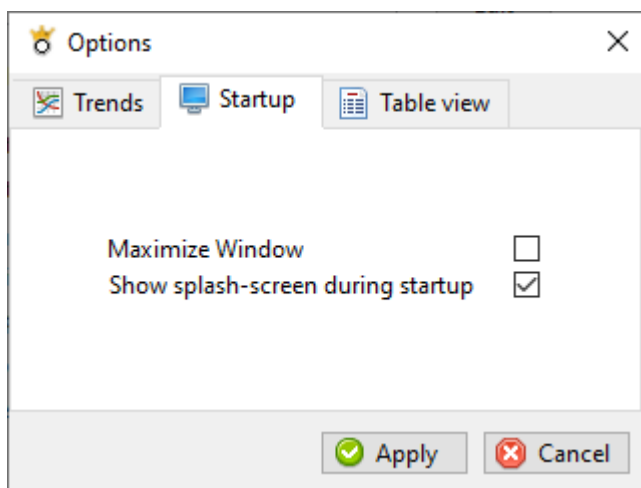


Figure 37: Startup settings.

Table view: Display- settings for the specifications.

- **Column order and visibility:** Click the **Settings** button to adjust column order and to enable or disable columns. In the **Column set-up** window (see Figure 39) you may check/uncheck columns and move them up/down to adjust their order.

Note that column settings only apply for enabled specifications.

- **Autoscale columns:** Check/uncheck to enable or disable auto-scaling of the column widths.
- **Address display format:** You may choose between two display formats for the Modbus register address. Either the extended address format (3x00001) or the legacy address format (30001)
- **Boolean display:** You may choose between two display formats for values of the boolean data type. Either as a "One" or a "Zero", or as a "True" or a "False".

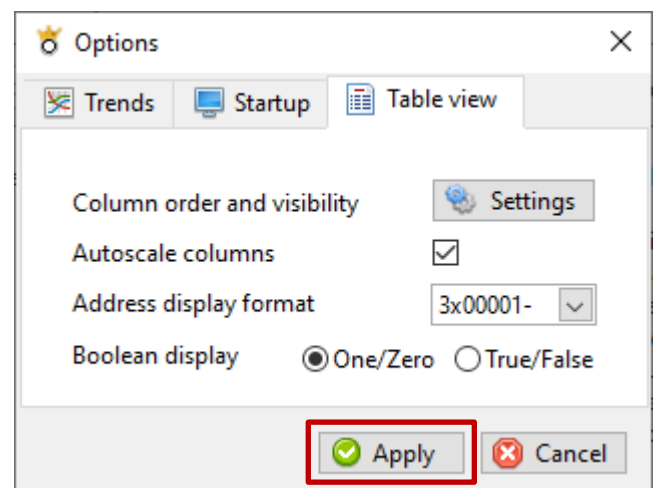


Figure 38: Display settings for the specification.

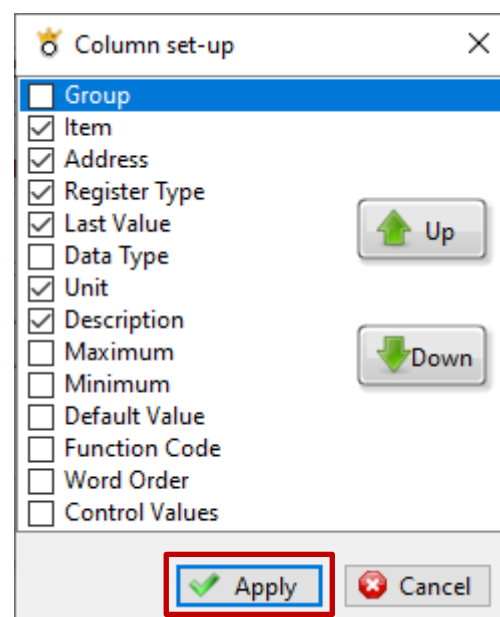


Figure 39: Adjust column order and enable or disable columns.

3.13 Additional Tools

Additional tools (PlugIns) may be added to the Modbus Test Master program by loading them into:

C:\Program Files (x86)\ClampOn\Modbus Test Master\Tools

The tools can then be found by clicking the **Tools** button.

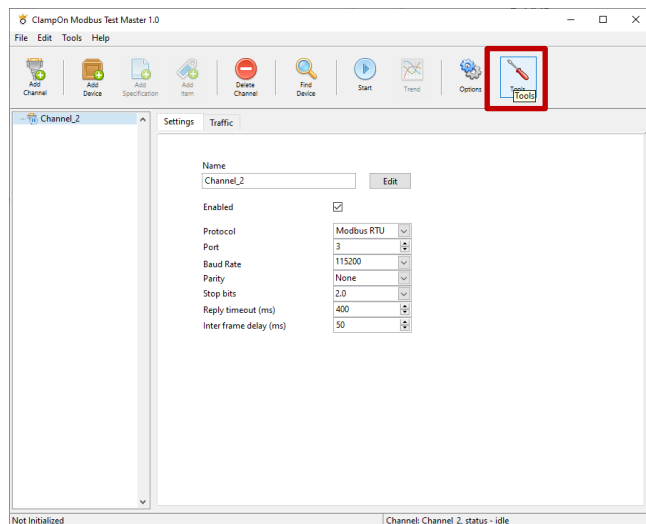


Figure 40: Open tools menu.

A window will open and list available tools. Use the mouse to click on a tool and it will automatic start.

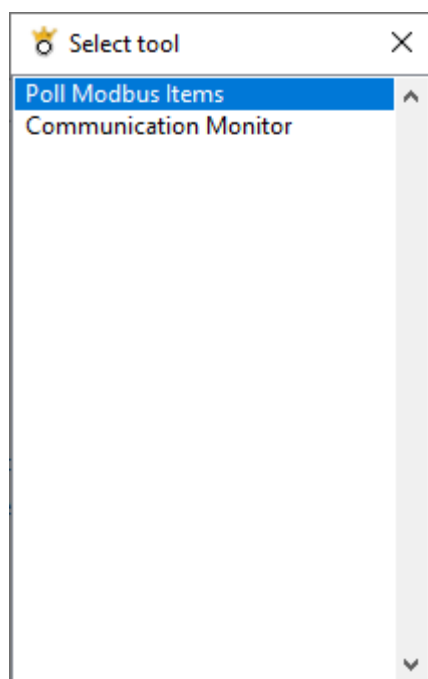


Figure 41: List of available tools.

4 MODBUS TEST MASTER TOOLS

The **Tools** menu (Figure 41) contains plugins that add functionality to the software. Some plugins are part of the Modbus Test Master 1.0 installer, while others can be added manually. The tools included in the Modbus Test Master 1.0 installer are:

- Communication Monitor
- Modbus Poll

Modbus Test Master 1.0 scans the Tool folder in the (see Figure 42), and then adds the found PlugIns to the **Tools** menu.

To add plugins to Modbus Test Master 1.0, copy and paste files into the **Tools** folder.

C:\Program Files (x86)\ClampOn\Modbus Test Master\Tools

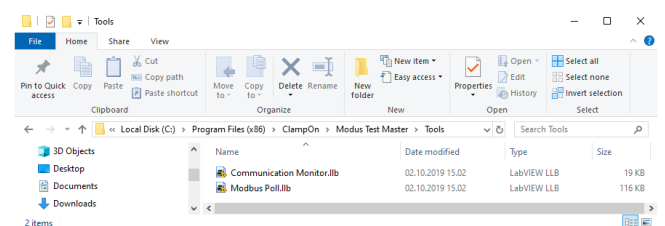


Figure 42: The Tools folder

4.1 Communication Monitor

The Communication Monitor tool displays all communication to and from Modbus Test Master. Each communication frame is displayed together with a timestamp, the channel name and TX/RX. (was the frame was transmitted or received?)

This tool provides information already covered by the traffic monitors included in channel and device windows. But it might be handy to have a freestanding window showing communication while using the Modbus Test Master program.

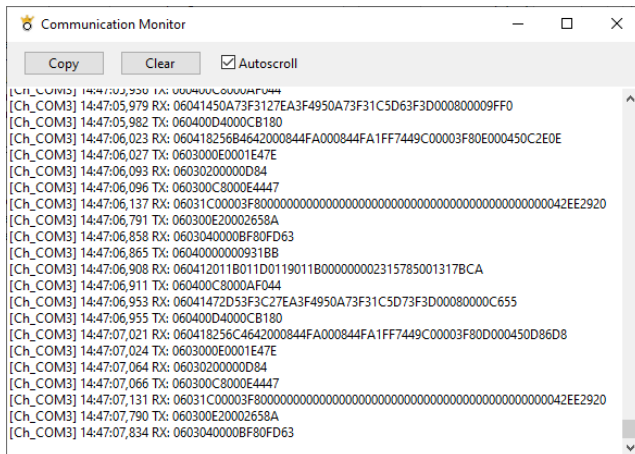


Figure 43: Communication Monitor.

4.2 Modbus Poll

The Modbus Poll tool is designed to poll data and write values to any address. You do not depend on specifications and their items. Just enter the start address and the number of items, and then click the **Start** button.

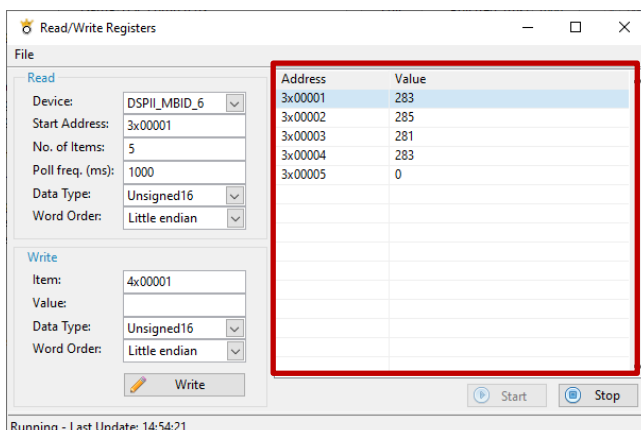


Figure 44: Modbus Poll.

In run mode the right part of window will populate addresses and their values.

Polling entries:

- **Device:** Select the device you want to poll.
- **Start Address:** The address of the first item to poll.
- **No. of Items:** Number of items starting from the address given in **Start address**.
- **Poll freq.(ms):** The update rate when polling. A poll frequency of 1000 ms means that Modbus Poll will update item values every second.
- **Data Type:** Information about how the received values shall be formatted by Modbus Poll.

- **Word Order:** In case an item is 32 – bits wide or more you have to specify the Word Order. That is, which Modbus register addresses contain the most- and least significant values (Words – U16).

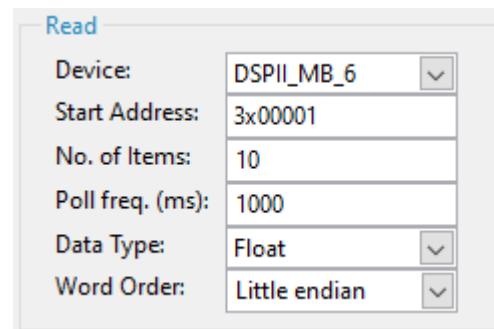


Figure 45: Configure the polling entries.

Write entries:

- **Device:** Select the device you want write values to.
- **Item:** The address of the item you will write a value to.
- **Value:** The value you will write to the item.
- **Data Type:** Information about how the value shall be formatted by Modbus Poll.
- **Word Order:** In case an item is 32 – bits wide or more you have to specify the Word Order. That is, which Modbus register addresses contain the most- and least significant values (Words – U16).

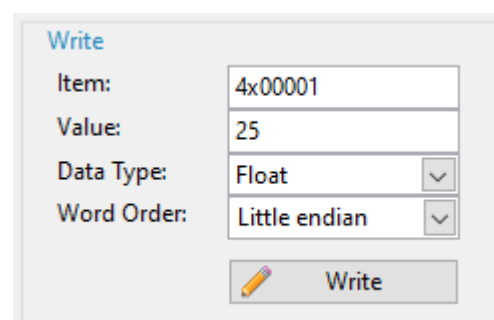












Figure 46: Select the item and set the value to write.

5 ADDITIONAL FEATURES

5.1 Symbols

Following symbols are implemented to indicate statuses and type of objects.

-  Channel (COM port)
-  Channel (network TCP/IP)
-  Device
-  Monitoring paused (enabled, not started)
-  Disabled (channel, device, specification)
-  Item - monitoring on (enabled, started)
-  Item - monitoring off (enabled, not started)
-  Item - trending
-  Item - logging to file
-  Warning

Regarding specifications you may select your own symbols. When you create a new specification a list of symbols is available in the **Add Specification** window. Hoover over the symbol and the symbol-list will open.

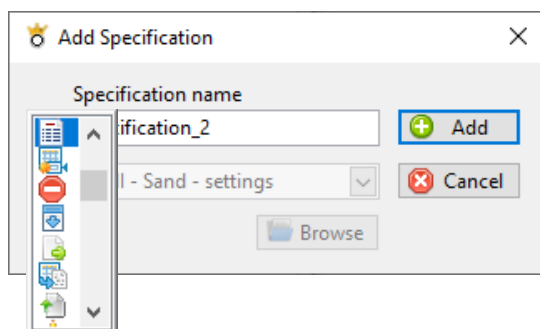


Figure 47: Select your own symbol for the specification.

The specification symbol may later be changed by selecting the specification followed by opening the symbol-list from the right-click menu. Select **Edit symbol**.

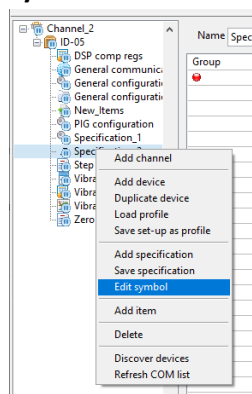


Figure 48: Change specification symbol

5.2 Edit specification in Excel

The Modbus Test Master 1.0 program is supplied with an Excel-template for editing specifications. Select **Edit in Excel** from the specifications right-click menu and the it will be opened in Excel.

Note that the **Edit in Excel** option is only available for disabled specifications.

In Excel you can do the same editing as in the **Edit item** window. But you may be able to speed up process by editing multiple items at the same time. The specification will be updated as you close the Excel-template.

Note: It is not necessary to save the Excel-template.

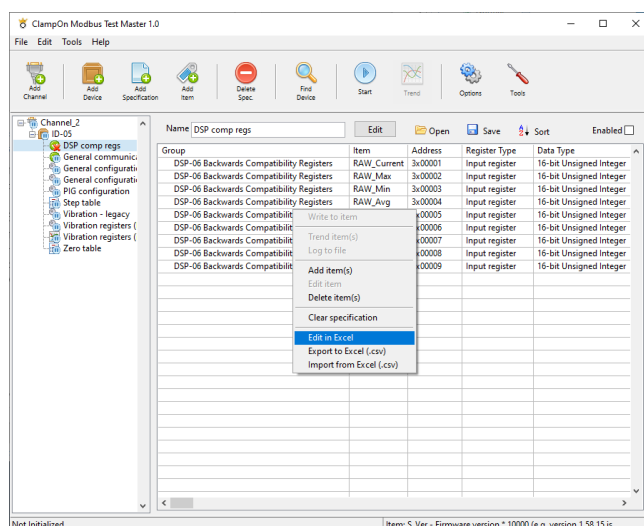


Figure 49: Select Edit in Excel from the right-click menu.

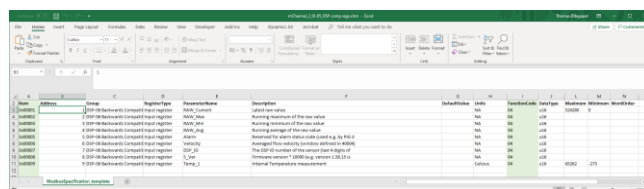


Figure 50: Specification opened in the Excel-template.

6 TERMINOLOGY

Coil¹: Holds a true/false status that you can both read and write.

Discrete input¹: Holds a true/false status that you can read.

Input register¹: Holds a 16-bit value (u16) that you can read.

Holding register¹: Holds a 16-bit value (u16) that you can read and write.

Item: In Modbus Test Master an item may be a coil, a discrete input, an input register and a holding register. In case the datatype is 32-bits or 64-bits wide the item will hold its value in 2 or 4 registers. (input or holding)

Specification: In Modbus Test Master a specification is a list of items.

Profile: In Modbus Test Master a profile is a list of specifications.

Device: In Modbus Test Master a device is the remote unit you “talk” to. You may open specifications or profiles for the device.

Channel: In Modbus Test Master a channel is the physical port that you use to communicate with the device. This may be COM port or network. (TCP/IP)

Protocol: There are three protocols designed for modbus; Modbus RTU, Modbus ASCII and Modbus TCP. Modbus TCP is made specific for network communication.

Slave address: On each channel every device must have a unique slave address. That is, a number between 1 – 247. The slave address starts every communication frame and ensures correct device addressing. How to set the slave address:

- Modbus Test Master: in the device window.

- Device: device specific.

Function code: A number that says if your addressing a coil, discrete input, input register or a holding register, and if this is a read or a write. The function code follows the slave address in the communication frame. Function codes:

- 01 – Read one or more coils.
- 02 – Read one or more discrete inputs.
- 03 – Read one or more holding registers.
- 04 – Read one or more input registers.
- 05 – Write one coil status.
- 06 – Write one holding register.
- 15 – Write multiple coils.
- 16 – Write multiple holding registers.

We also have the function code 08 for diagnostic purposes. As an example, the search command in Modbus Test Master use the diagnostics function code **08** and the sub-function code **00 – Return Query Data**.

¹ The coils and holding registers will typically be used for configuration of the device, while the discrete inputs and input registers holds data processed by the device.