IP Point HART

User Manual

A-IP.HART-I
A-IP.HART-O

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aparian

CONTENTS

1. Preface 6
1.1. Introduction 6
1.2. Architecture 7
1.3. Additional Information 9
1.4. References 10
1.5. Support 10
2. Installation 11
2.1. Module Layout 11
2.2. Module Mounting 12
2.3. Field Device Connection 12
2.3.1. 2-wire Field Device Connection 15
2.3.2. 4-wire Field Device Connection 15
2.4. Power Connection 15
2.5. Ethernet Connection 16
2.6. North American Hazardous Location Approval 18
3. Setup 19
3.1. Setup Configuration Software 19
3.2. Network Parameters 19
3.3. Creating a New Project 23
3.4. IP Point HART parameters 25
3.5. Advanced Mapping 30
3.5.1. Diagnostics 32
3.5.2. Multidrop 34
3.5.1. Custom 34
3.6. DNP3 Security 37
3.7. MultiDrop 39
3.8. Module Download 41
3.9. Logix Integration 43
3.9.1. Studio 5000 Configuration (Version 20+) 43
3.9.2. RSLogix 5000 Configuration (Pre-Version 20) 47
3.10. Mitsubishi Integration 52
3.10.1. Profile Registration 52
3.10.2. PLC Project 53
3.10.3. CC-Link IEF Basic - Ethernet Configuration 54

4. Operation 59
4.1. Logix 5000 59
4.1.1. Input Assembly 59
4.1.2. Output Assembly 62
4.1.3. HART Relay Message 62
4.1.4. Multidrop 67
4.1.5. HART Channel Command 70
4.1.6. HART Process Variable CIP Parameters 71
4.1.7. HART Custom Command 72
4.2. DNP3 Operation 74
4.2.1. DNP3 Security 76
4.3. Modbus TCP Operation 77
4.3.1. Multidrop 79
4.3.2. HART Custom Command 84
4.4. PCCC Operation 86
4.4.1. Multidrop 87
4.5. FTView Operation 90
4.5.1. Register EDS File 90
4.5.2. Configure FTView Communication 91
4.5.3. Displaying Process Variable 94
4.6. CC-Link Operation 96
4.6.1. Example Mapping Code 96
5. Diagnostics 99
5.1. LEDs 99
5.2. Module Status Monitoring in Slate 99
5.2.1. EtherNet/IP Status 102
5.2.2. DNP3 102
5.2.3. Modbus 105
5.2.4. PCCC 106
5.2.5. CC-Link 107
5.3. Channel Status 108
5.4. Device List 116
5.5. MultiDrop 117
5.6. Calibration 118
5.6.1. Input Calibration: 119

5.6.2. Output Calibration: 119
5.7. Module Event Log 120
5.8. Web Server....121
5.9. HART Packet Capture 122
6. Asset Management FDT– DTM Technology....125
7. What is HART 126
8. Technical Specifications 127
8.1. Dimensions....127
8.2. Electrical....128
8.3. Ethernet 128
8.4. Analog Input ChanneL (A-IP.HART-I)....129
8.5. Analog Output ChanneL (A-IP.HART-O) 129
8.6. Certifications....130
9. Index....131

Revision History

Revision	Date	Comment
1.0	13 Apr 2016	Initial document
1.1	11 August 2016	Added RoHS2 compliant to certifications
1.2	22 August 2016	Updated input assembly size
1.3	24 September 2016	Add ODVA Conformance mark
1.4	14 November 2016	Minor changes to V19 UDTs
1.5	22 November 2016	Added HART Advanced Diagnostics
1.6	3 April 2017	Updated error indicating that the IP Point module has 4 HART channels
1.7	23 May 2017	Update ODVA Marking
1.8	20 February 2018	Added support for multidrop Added device list Update Modbus/DNP3 Device Info addresses Added support for burst operation
1.9	23 July 2018	Added indication if channel is enabled and if HART is enabled on that channel.
1.10	21 September 2018	Updated Modbus Statistics
1.11	14 April 2019	Add 2-wire and 4-wire diagrams
1.12	2 May 2019	Added UL Mark for Class 1 Div 2

1.13	29 November 2019	Added FTView, PCCC, and CC Link interfaces Added updated Multidrop functionality for EtherNet/IP, Modbus, PCCC, and FTView.
1.14	6 December 2019	Updated DNP3 Table to show supported HART and Device Status Fixed DNP3 Counter Group number.
1.15	30 January 2020	Added 4-wire connection drawing
1.16	4 August 2022	Added information required for UL regarding open type device enclosures.
1.17	23 March 2023	Added HART packet capture Added Equal Bandwidth configuration Added Dual Master configuration Added configurable HART response timeout Added custom HART command Added Zero HART data option
1.18	13 November 2023	Added UKCA Conformance Mark
1.19	21 April 2026	Added UL North American Hazardous Location Approval.

1. PREFACE

1.1. INTRODUCTION

The IP Point HART module can convert any analog device into either EtherNet/IP, Modbus-TCP, or DNP3 TCP/UDP, PCCC (AB-ETH), or CC-Link protocols. This includes 4 to 20 mA input and output devices with or without HART communications as well as 0 to 20 ma devices without HART.

The IP Point HART is available in Input or Output variations:

1) **A-IP.HART-I** for HART input devices like process instruments.
2) **A-IP.HART-O** for HART output devices like valve positioners.

The conversion to EtherNet/IP enables a HART device to be added directly into a Rockwell Automation Logix IO tree. The Modbus-TCP option enables a HART field device to be viewed as a Modbus Slave. The DNP3 option converts a HART field device into a DNP3 Outstation. The DNP3 option, also supports Secure Authentication, ensuring secure communications across the Ethernet network.

The HART module supports PCCC (Allen Bradley legacy protocol – AB-ETH) which will allow an SLC / MicroLogix / PLC5 to read data from HART field device and write data to HART field devices.

The HART module also supports CC-Link and can operate as a CC-Link Slave allowing a CC-Link Master (eg. Mitsubishi controller) to connect to it and exchange data with the HART field device.

The IP Point HART modules support direct access from a FTView SCADA or PanelView to read and display data without the need for an intermediate PLC or controller.

In addition, a rich collection of process and diagnostic information is provided directly into Logix, without the use of any explicit messaging. HART commands can also be relayed to the device using an EtherNet/IP message relay object.

A DTM (Device Type Manager) is available further simplifying device configuration and management using an FDT frame. A built-in webserver provides detailed diagnostics of system configuration and operation as well as field device specific diagnostics.

A built-in webserver provides detailed diagnostics of system configuration and operation as well as field device specific diagnostics.

The IP-Point-Hart module is configured using the Aparian Slate application. This program can be downloaded from www.aparian.com free of charge.

Hereafter the IP-Point-HART module will be referred to as the **module**.

1.2. ARCHITECTURE

The figure below provides an example of the typical architecture for an IP Point HART interfacing to an EtherNet/IP device (e.g. Allen-Bradley Logix Controller).

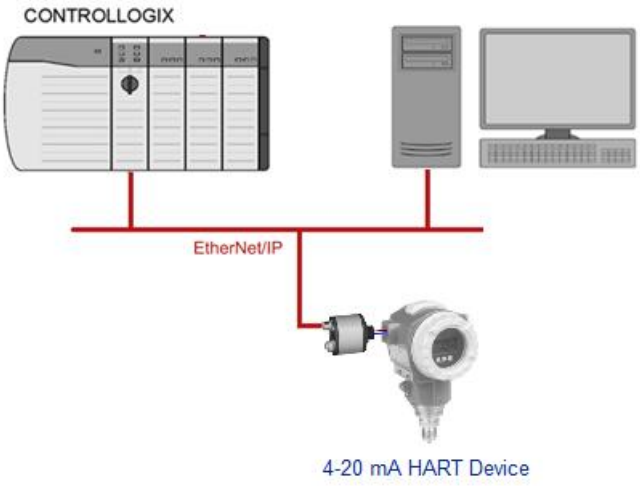


Figure 1.1 – IP Point HART EtherNet/IP architecture

The figure below provides an example of the typical architecture for a IP Point HART interfacing to a Modbus TCP Master.

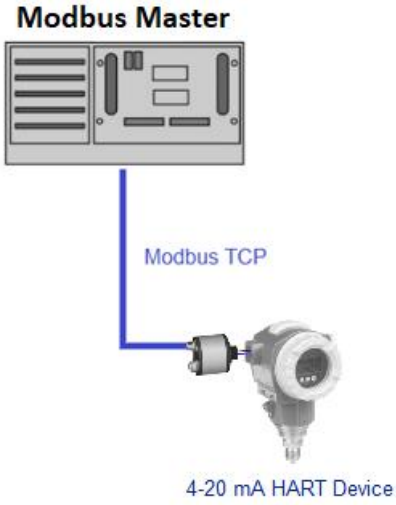


Figure 1.2 – IP Point HART Modbus interface architecture

The figure below provides an example of the typical architecture for a IP Point HART interfacing to a DNP3 Master SCADA.

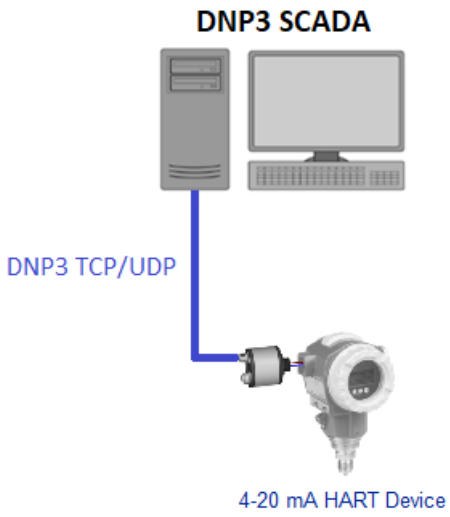


Figure 1.3 – IP Point HART DNP3 interface architecture

The figure below provides an example of the typical architecture for a IP Point HART interfacing to a SLC using PCCC.

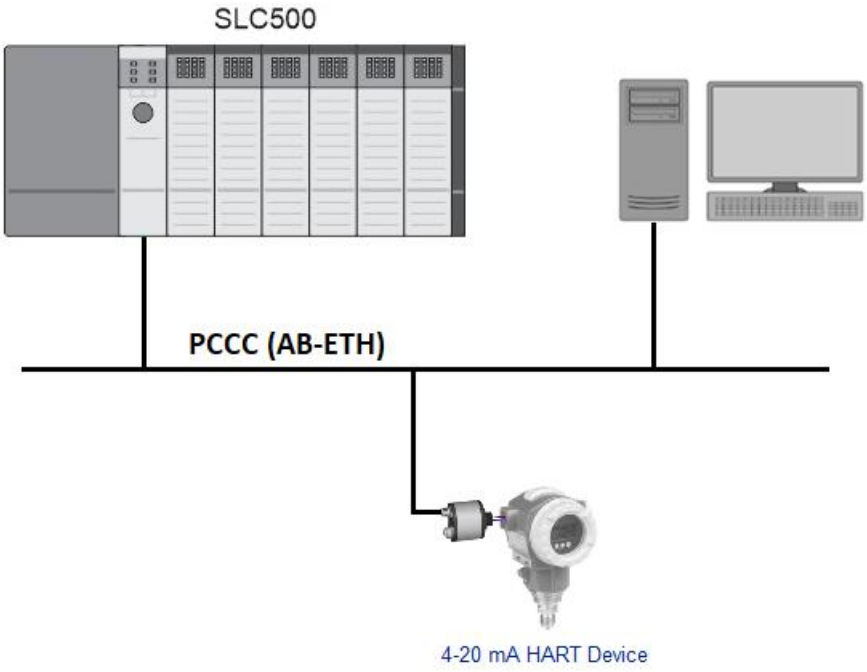


Figure 1.4 – IP Point HART PCCC interface architecture

The figure below provides an example of the typical architecture for a IP Point HART with multidrop HART devices.

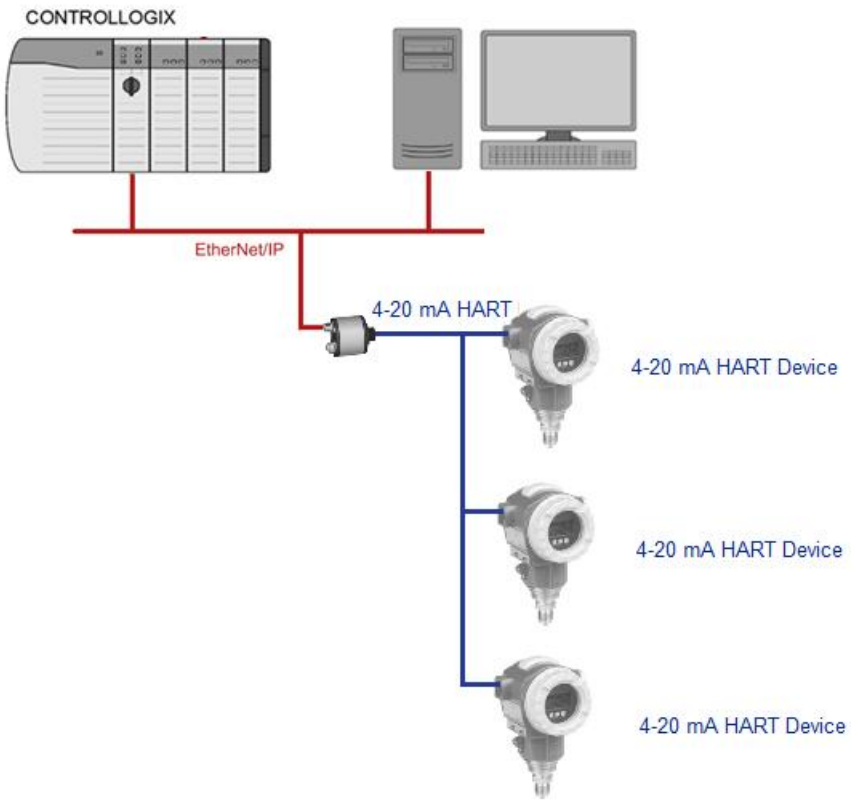


Figure 1.5 – IP Point HART Multidrop

1.3. ADDITIONAL INFORMATION

The following documents contain additional information that can assist the user with the module installation and operation.

Resource	Link
Slate Installation	http://www.aparian.com/software/slate
User Manual, Datasheet Example Code & UDTs	http://www.aparian.com/products/ippointhart
Ethernet wiring standard	www.cisco.com/c/en/us/td/docs/video/cds/cde/cde205_220_420/installation/guide/cde205_220_420_hig/Connectors.html

Table 1.1. - Additional Information

1.4. REFERENCES

Resource	Link
HART Communication Foundation	http://en.hartcomm.org/
DNP3	http://www.dnp.org
CIP Routing	The CIP Networks Library, Volume 1, Appendix C:Data Management
Modbus	http://www.modbus.org

Table 1.2. – References

1.5. SUPPORT

Technical support is provided via the Web (in the form of user manuals, FAQ, datasheets etc.) to assist with installation, operation, and diagnostics.
For additional support the user can use either of the following:

Resource	Link
Contact Us web link	www.aparian.com/contact-us
Support email	support@aparian.com

Table 1.3. – Support Details

2. INSTALLATION

2.1. MODULE LAYOUT

The waterproof module is designed to screw directly into the HART field device simplifying installation.

Power (24V) and Ethernet is connected to the device through the use of industry standard M12 connectors. The M12 connectors are supplied with the device and can be connected in the field.

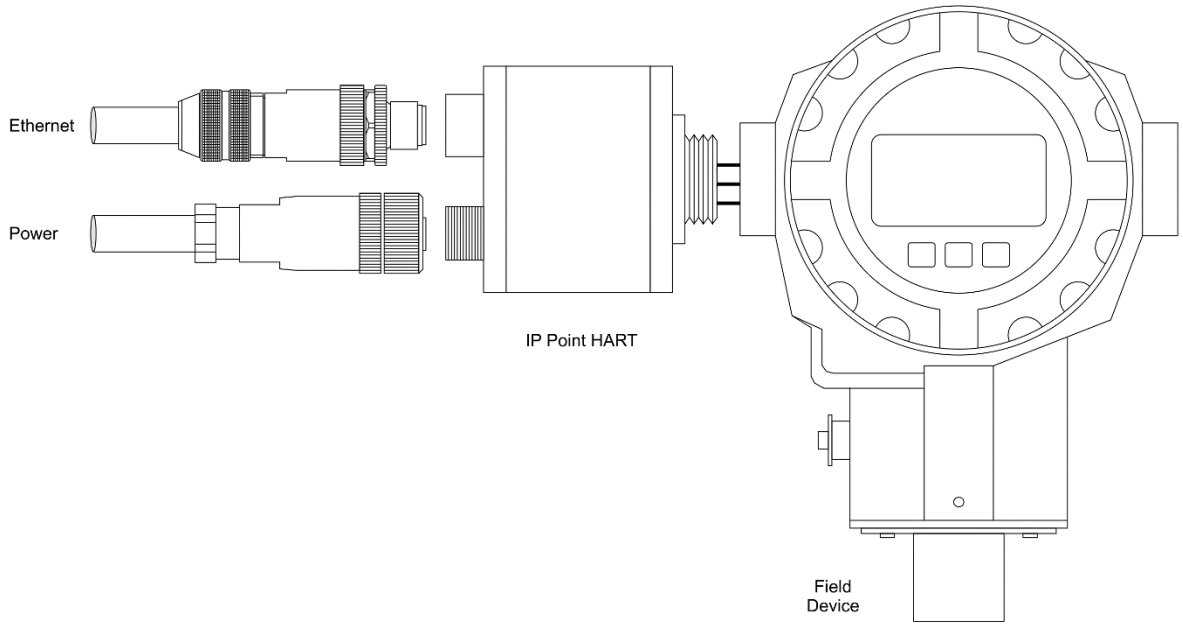


Figure 2.1. – IP Point HART Installation

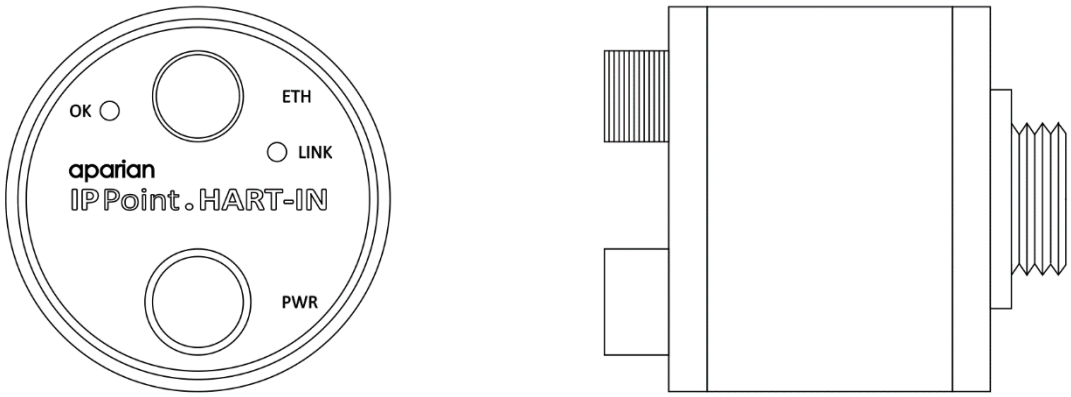


Figure 2.2. - IP Point HART module side and front view

The module provides two diagnostic LEDs as shown in the front view figure above. These LEDs are used to provide information on the system and HART operation and the Ethernet interface.

2.2. MODULE MOUNTING

NOTE: This module is an open-type device and is meant to be installed in an enclosure suitable for the environment such that the equipment is only accessible with the use of a tool.

The module is designed to screw directly into a field device using the industry standard M20 thread. The analog and earth wires are also pre-connected in the module simplifying installation.

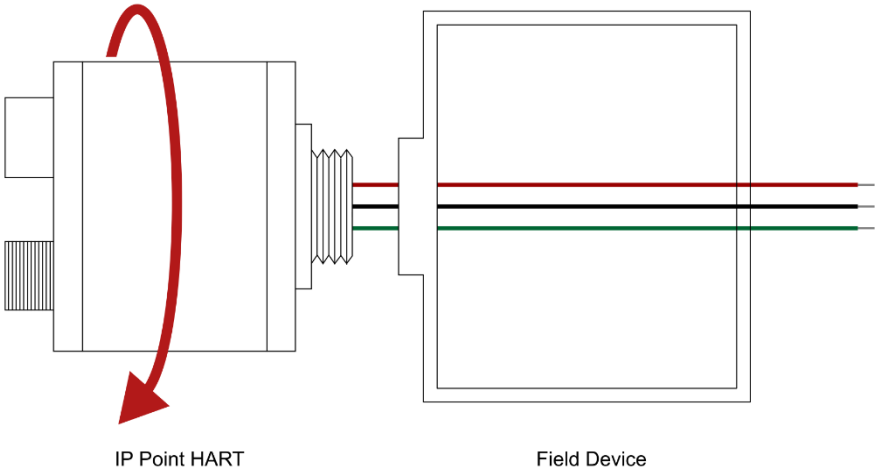


Figure 2.3 – IP Point HART Installation

To install the module, first remove the wiring cover of the field device. If the field device has a plastic cover on the M20 port, then remove that too. Feed the pre-connected wires (3) of the IP Point module through into the field device without terminating them. Then screw the module into the field device.

NOTE: It is important not to terminate the signal and earth wires before the module is screwed into the field device as this will cause the wires to twist excessively and may damage the internal connector.

2.3. FIELD DEVICE CONNECTION

For 2-wire devices, connect the power (red) wire to the field device positive and the signal (black) wire to the field device negative. Ensure that the 0V (blue) wire is not connected and suitably insulated. (See figure 2.4.)

For 4-wire devices, connect the signal (black) wire to the field device positive and the 0V (blue) wire to the field device negative. Ensure that the power (red) wire is not connected and

suitably insulated. (See figure 2.5.)

The earth (green) wire should be connected to the field device in both 2-wire and 4-wire configurations.

The wires should be cut to a suitable length, so as to allow some slack in the field device, but not too much to prevent the cover from fitting on.

NOTE: The additional 0V (blue) wire, required for 4-wire field devices, is present only on devices shipped after January 2020.

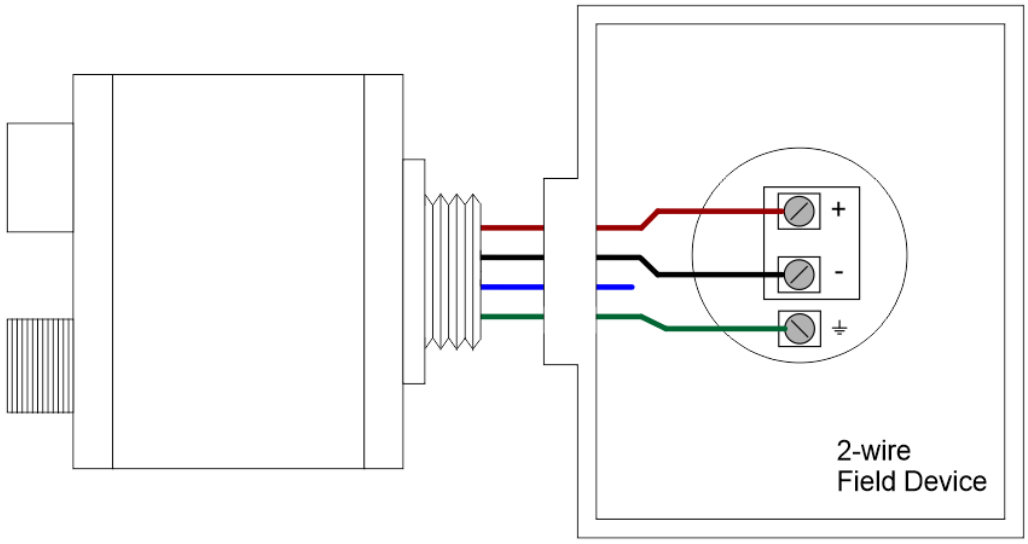


Figure 2.4 – Field device termination – 2-wire

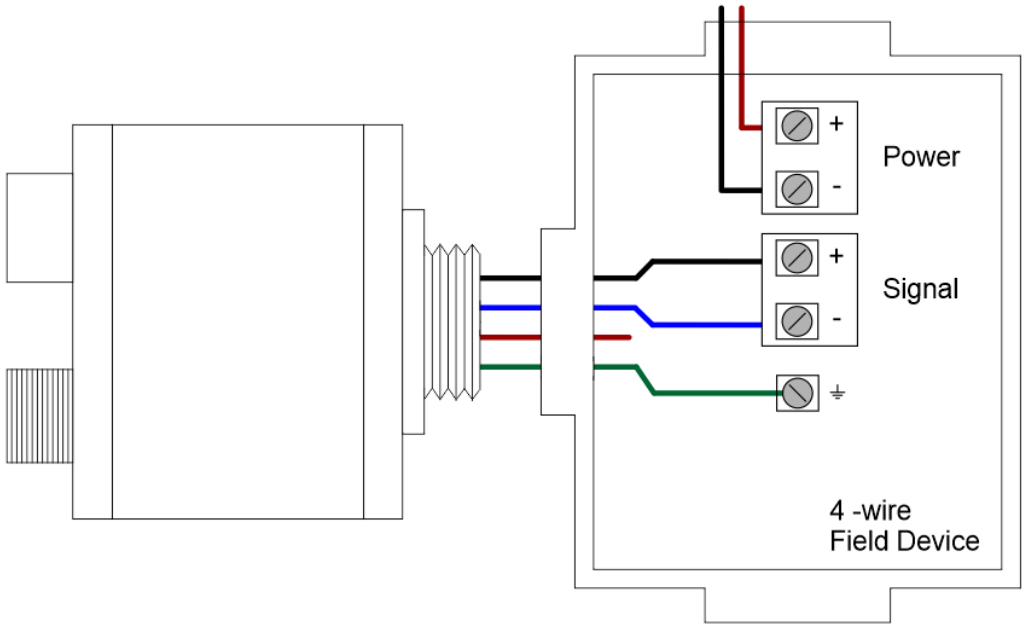


Figure 2.5 – Field device termination – 4-wire (Input)

The equivalent Analog Input and Output circuits are shown below.

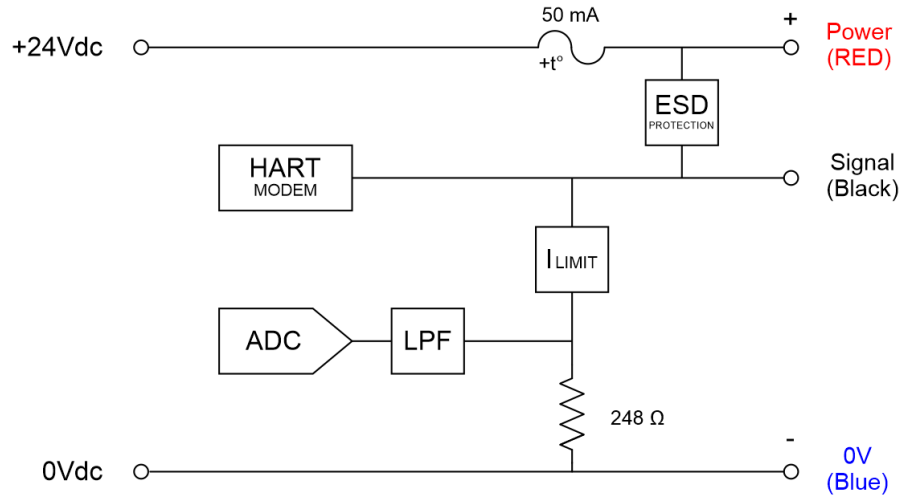


Figure 2.6 – Analog Input Equivalent Circuit

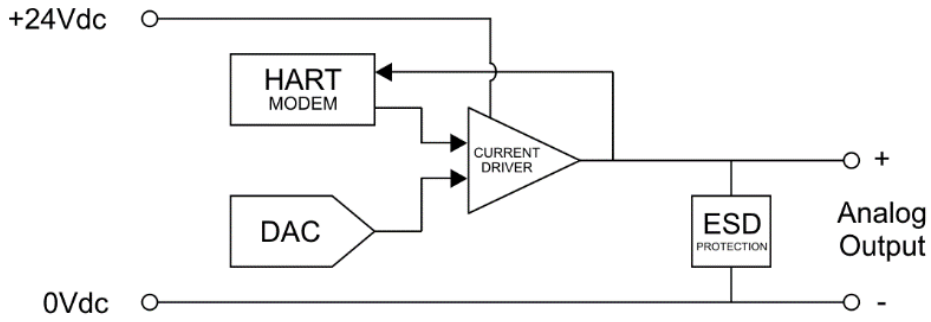


Figure 2.7 – Analog Output Equivalent Circuit

2.3.1. 2-WIRE FIELD DEVICE CONNECTION

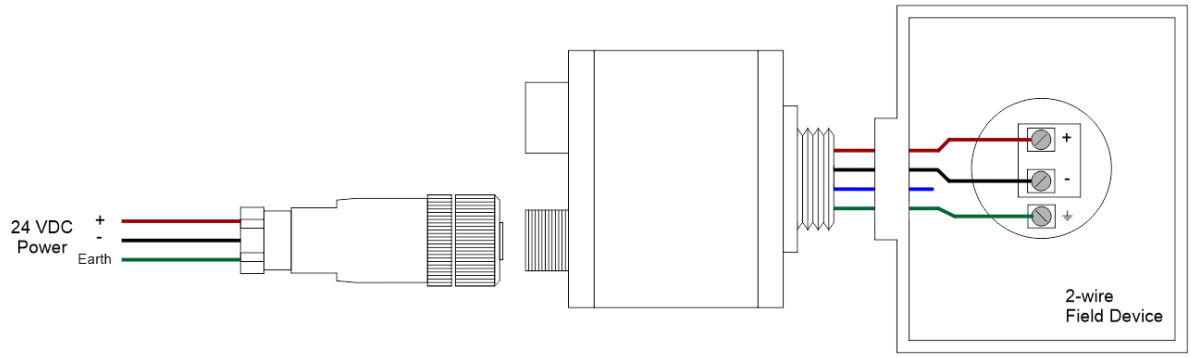


Figure 2.8 – 2-wire Field Device Connection

2.3.2. 4-WIRE FIELD DEVICE CONNECTION

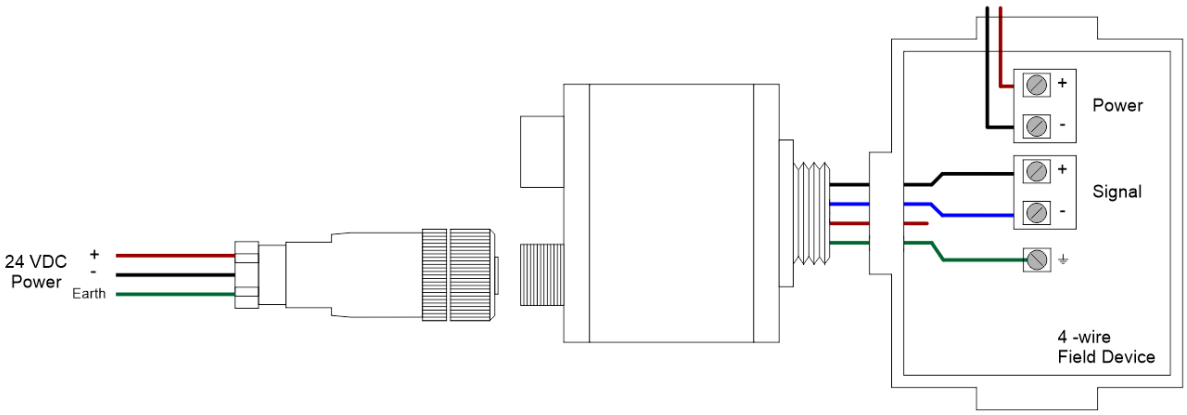


Figure 2.9 – 4-wire Field Device Connection

2.4. POWER CONNECTION

The module is powered by means of an M12 A-coded screw connector (Binder #99 0436 10 05) which is supplied with the product. Typically, the supply voltage should be 24Vdc, but the module can operate with an input voltage range of 12 – 28Vdc.

NOTE: Since the module's power is used to power the field device, the voltage requirements of the field device should be considered before attempting to depart from the standard 24Vdc supply voltage.

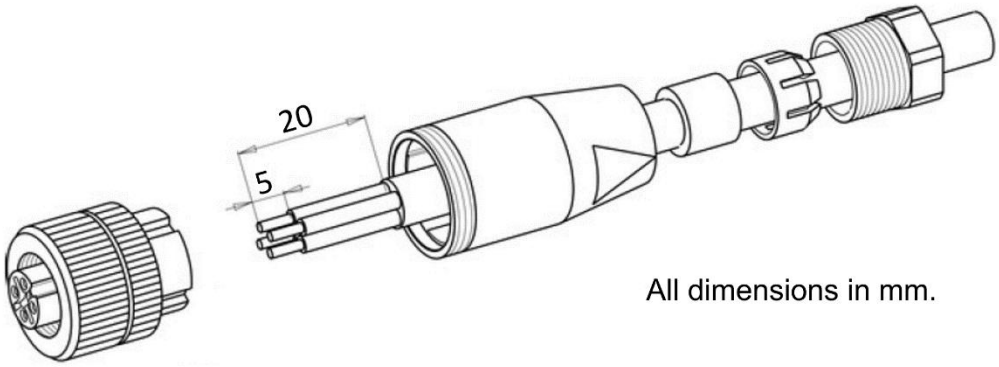


Figure 2.10 - Power connector assembly



Figure 2.11 - Power connector pinout (Viewed from rear)

Pin	Description
1	Earth
3	Positive terminal of 24 VDC supply.
4	Negative (0V) terminal of 24 VDC supply.

Table 2.1 - Power Conector Pinout

2.5. ETHERNET CONNECTION

The Ethernet connection is made using an industry standard M12 D-coded screw connector (Binder #99 3729 810 04) which is supplied with the product. This allows the use of standard Cat-5 cable which can be terminated in the field.

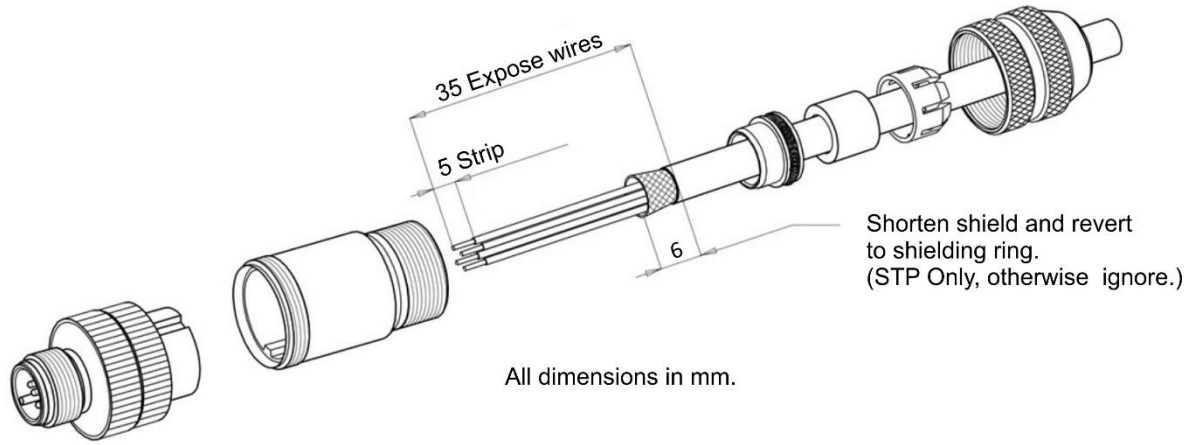


Figure 2.12 - Ethernet connector assembly



Figure 2.12 - Ethernet connector pinout

M12 Pin	RJ45 Pin	Description
1	1	Tx+
3	2	Tx-
2	3	Rx+
4	6	Rx-

Table 2.2 - Ethernet Conector Pinout

NOTE: It is important that the Tx+ and Tx- share a twisted wired pair, and that the Rx+ and Rx- share a twisted pair. Failure to do so will cause the Ethernet link to behave erratically or to not function at all.

2.6. NORTH AMERICAN HAZARDOUS LOCATION APPROVAL

The following information applies when operating the product in hazardous locations:

SUITABLE FOR USE IN CLASS I, DIVISION 2, GROUPS A, B, C AND D HAZARDOUS LOCATIONS, OR NONHAZARDOUS LOCATIONS ONLY.

-20°C to +70°C, T5A
Class 1, Div 2 Gps A, B, C, D

THIS EQUIPMENT IS OPEN-TYPE DEVICE AND IS MEANT TO BE INSTALLED IN AN ENCLOSURE SUITABLE FOR THE ENVIRONMENT SUCH THAT THE EQUIPMENT IS ONLY ACCESSIBLE WITH THE USE OF A TOOL.

WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT WHILE THE CIRCUIT IS LIVE OR UNLESS THE AREA IS KNOW TO BE FREE OF IGNITABLE CONCENTRATIONS.

WARNING - EXPLOSION HAZARD - SUBSTITUTION OF ANY COMPONENT MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.

3. SETUP

3.1. SETUP CONFIGURATION SOFTWARE

All the network setup and configuration of the module is achieved by means of the Aparian Slate device configuration environment. This software can be downloaded from http://www.aparian.com/software/slate.

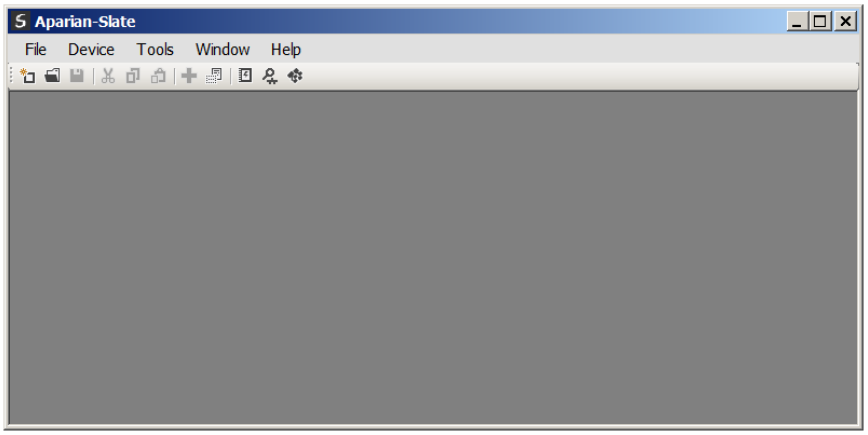


Figure 3.1. - Aparian Slate Environment

3.2. NETWORK PARAMETERS

The module will have DHCP (Dynamic Host Configuration Protocol) enabled as factory default. Thus, a DHCP server must be used to provide the module with the required network parameters (IP address, subnet mask, etc.). There are a number of DHCP utilities available, however it is recommended that the DHCP server in Slate be used.

Within the Slate environment, the DHCP server can be found under the Tools menu.

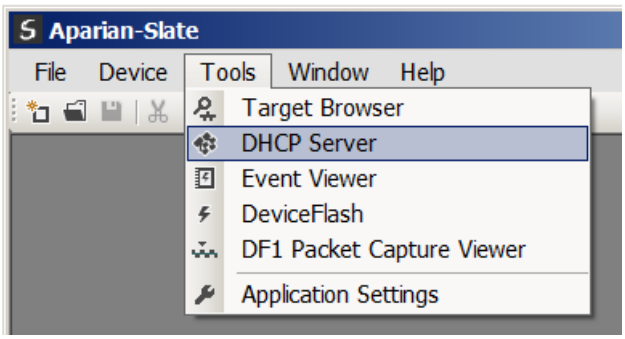


Figure 3.2. - Selecting DHCP Server

Once opened, the DHCP server will listen on all available network adapters for DHCP requests and display their corresponding MAC addresses.

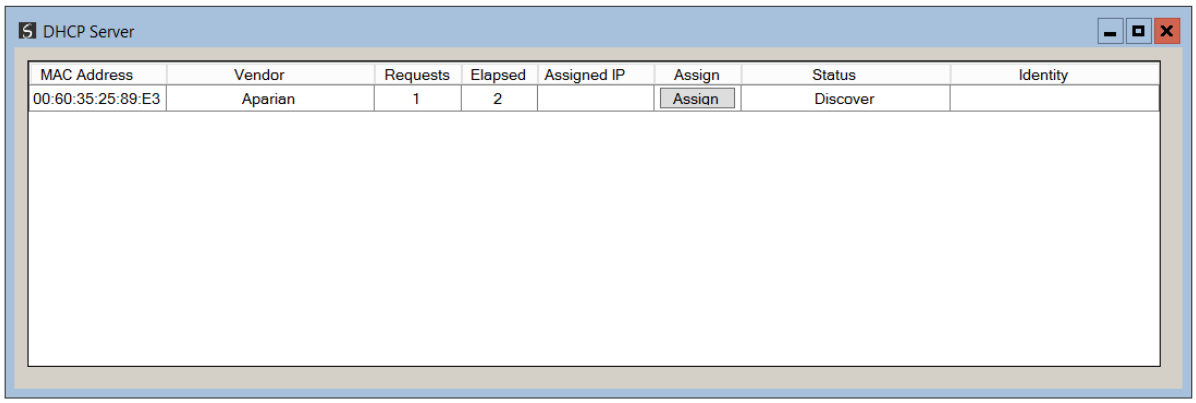


Figure 3.3. - DHCP Server

NOTE: If the DHCP requests are not displayed in the DHCP Server it may be due to the local PC's firewall. During installation the necessary firewall rules are automatically created for the Windows firewall. Another possibility is that another DHCP Server is operational on the network and it has assigned the IP address.

To assign an IP address, click on the corresponding "Assign" button. The IP Address Assignment window will open.

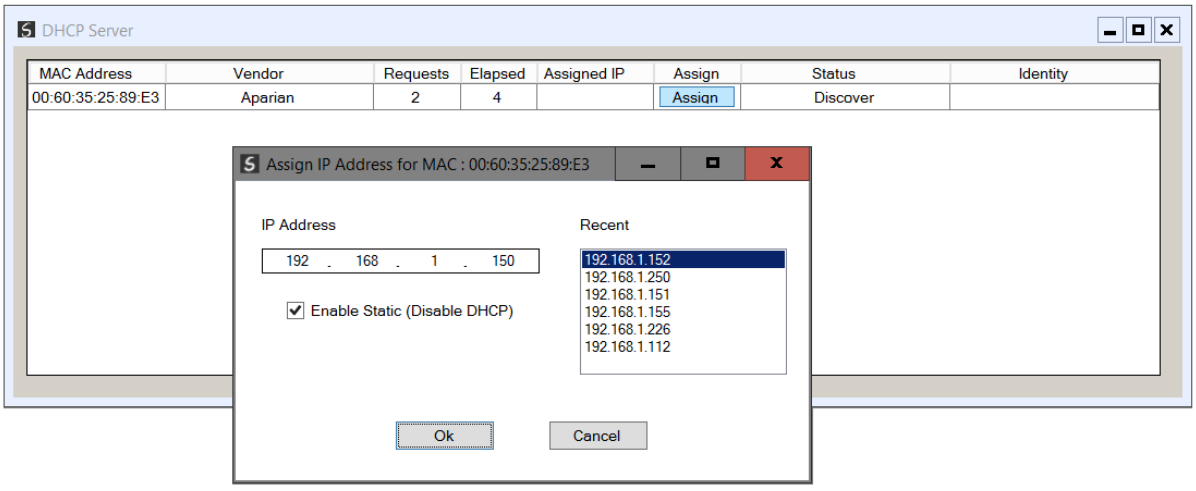


Figure 3.4. - Assigning IP Address

The required IP address can then be either entered, or a recently used IP address can be selected by clicking on an item in the Recent List. If the "Enable Static" checkbox is checked, then the IP address will be set to static after the IP assignment, thereby disabling future DHCP requests.

Once the IP address window has been accepted, the DHCP server will automatically assign the IP address to the module and then read the Identity object Product name from the device.

The successful assignment of the IP address by the device is indicated by the green background of the associated row.

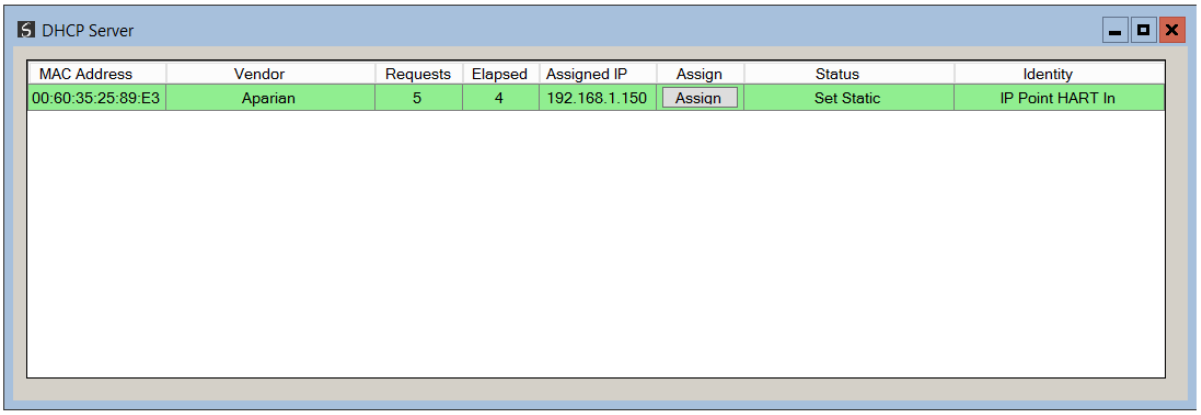


Figure 3.5. - Successful IP address assignment

In addition to the setting the IP address, a number of other network parameters can be set during the DHCP process. These settings can be viewed and edited in Slate's Application Settings, in the DHCP Server tab. Once the DHCP process has been completed, the network settings can be set using the Ethernet Port Configuration via the Target Browser.
The Target Browser can be accessed under the Tools menu.

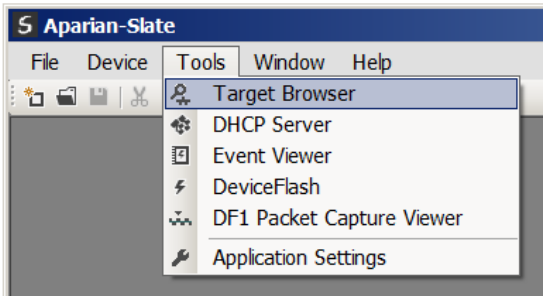


Figure 3.6. - Selecting the Target Browser

The Target Browser automatically scans the Ethernet network for EtherNet/IP devices.

NOTE: The Target Browser can be used to check if another DHCP server has set the IP address.

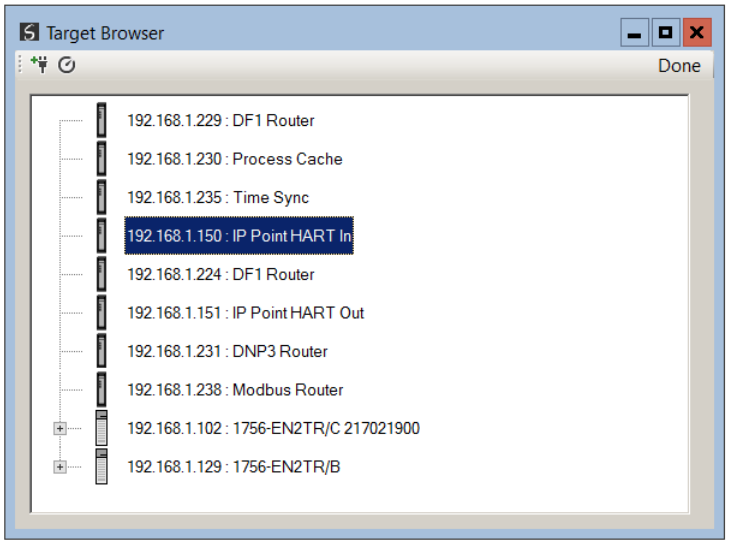


Figure 3.7. - Target Browser

Right-clicking on a device, reveals the context menu, including the Port Configuration option.

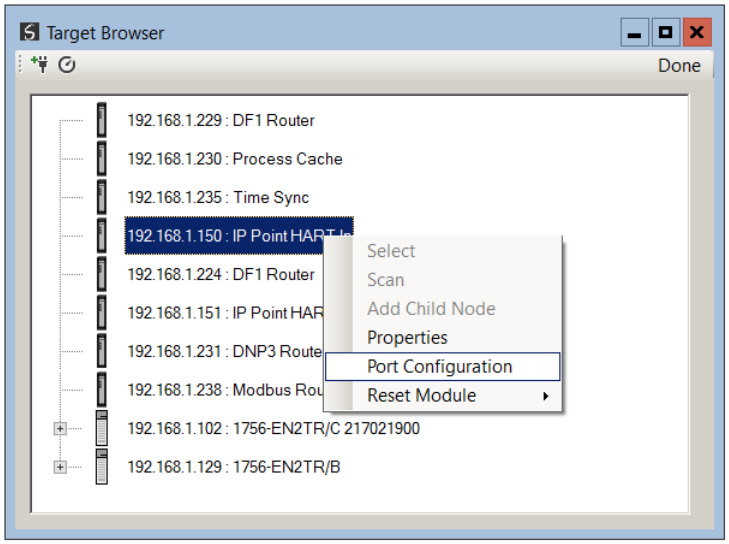


Figure 3.8. - Selecting Port Configuration

All the relevant Ethernet port configuration parameters can be modified using the Port Configuration window.

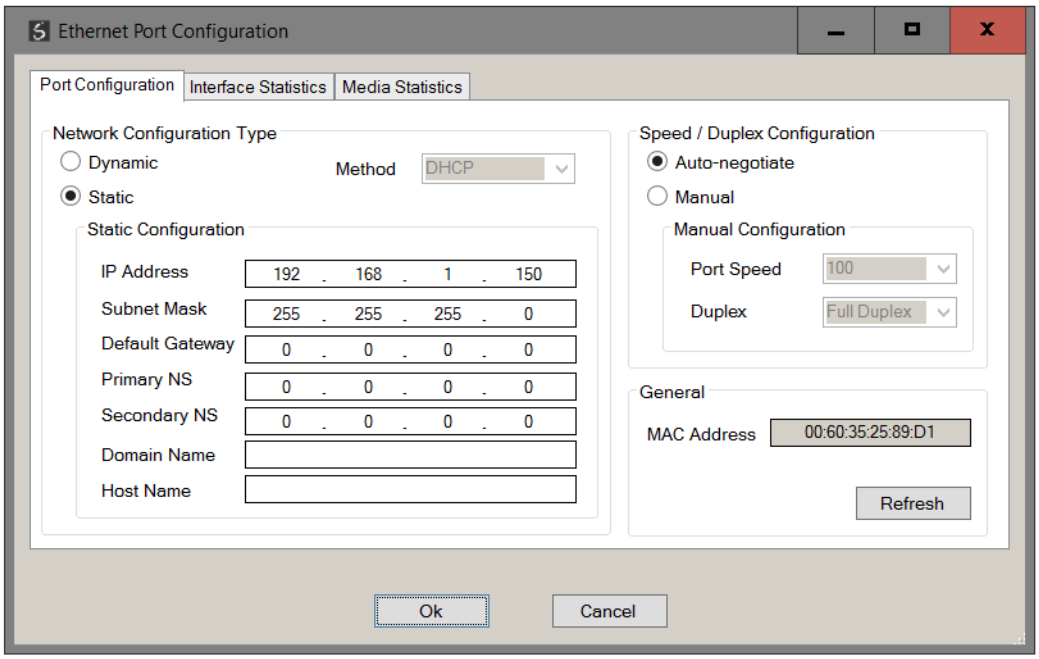


Figure 3.9. - Port Configuration

Alternatively, these parameters can be modified using Rockwell Automation's RSLinx software.

3.3. CREATING A NEW PROJECT

Before the user can configure the module, a new Slate project must be created. Under the File menu, select New.

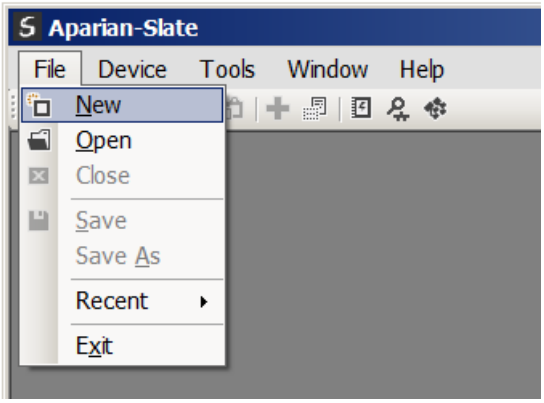


Figure 3.10. - Creating a new project

A Slate project will be created, showing the Project Explorer tree view. To save the project use the Save option under the File menu. A new device can now be added by selecting Add under the Device menu.

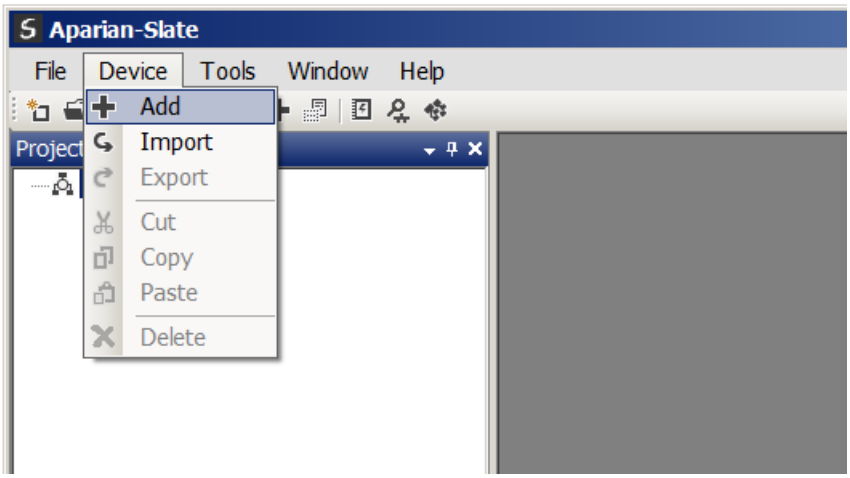


Figure 3.11. - Adding a new device

In the Add New Device window select the IP Point HART In or IP Point HART Out module, and click the Ok button. The configuration of the IP Point HART In and IP Point HART Out modules are almost identical and the two modules will be referred to as the IP Point HART module from here on.

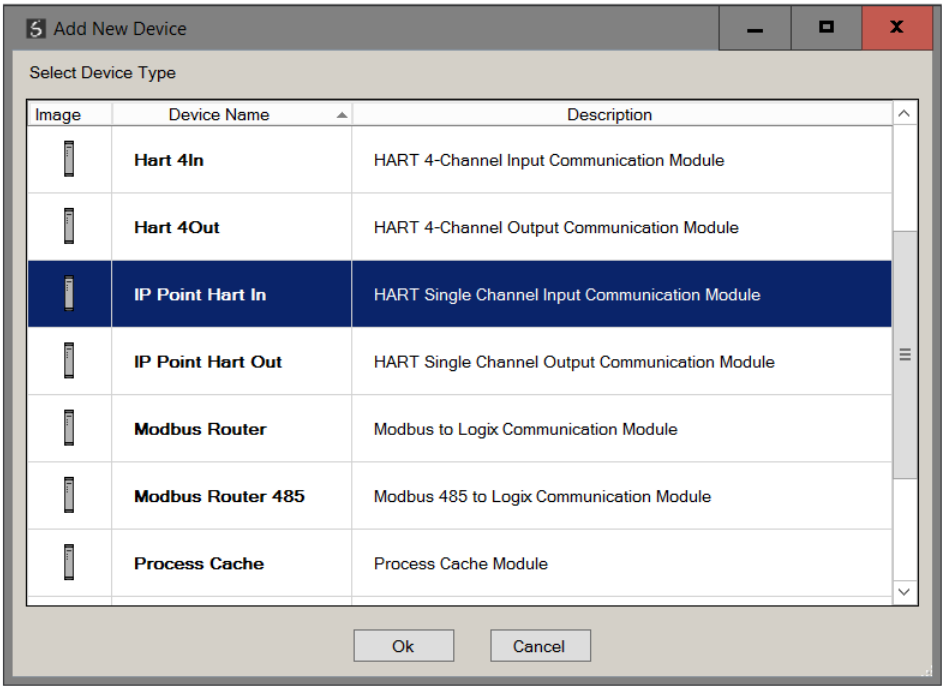


Figure 3.12 – Selecting a new IP Point HART module

The device will appear in the Project Explorer tree as shown below, and its configuration window opened. The device configuration window can be reopened by either double clicking the module in the Project Explorer tree or right clicking the module and selecting *Configuration*.

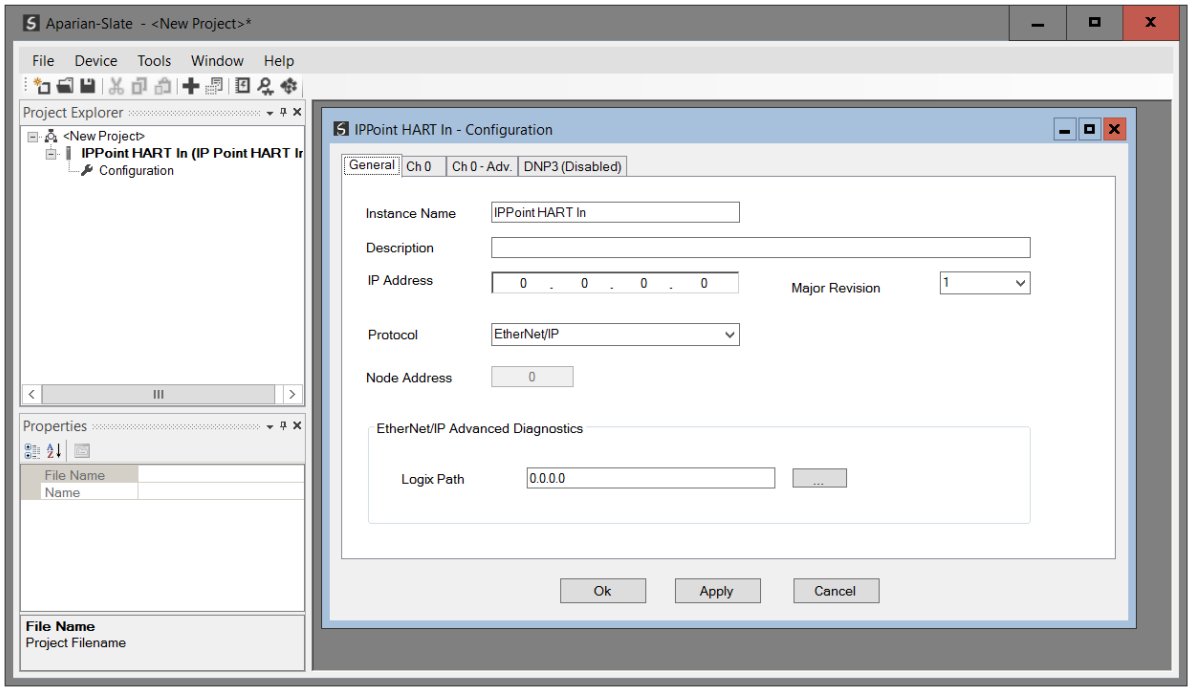


Figure 3.13. – IP Point HART In module configuration

Refer to the additional information section in this document for Slate's installation and operation documentation.

3.4. IP POINT HART PARAMETERS

The IP Point HART module parameters are configured using the Slate configuration utility. The configuration form is divided into multiple tabs to configure the general, DNP3 and channel specific parameters.

When downloading this configuration into the module it will be saved in non-volatile memory that persists when the module is powered down.



NOTE: When a firmware upgrade is performed the module will clear all IP Point HART configuration.

The general configuration consists of the following parameters:

Parameter	Description
Instance Name	This parameter is a user defined name to identify between various IP Point HART modules.
Description	This parameter is used to provide a more detail description of the application for the module.
IP Address	The IP address of the target module

Major Revision	The major revision of the module
Protocol	There are four protocols that can be selected for the IP Point HART module. **EtherNet/IP** This is the default setting and should be selected when the module is being used with the Rockwell Automation Logix family of controllers. **Modbus TCP** When selected, the device will respond as a Modbus TCP slave. **DNP3 TCP** When selected, the device will respond as a DNP3 Outstation using a TCP. **DNP3 UDP** When selected, the device will respond as a DNP3 Outstation using a UDP. **SLC500 / MicroLogix / PLC5** When selected, the device will respond to PCCC (AB-ETH) SLC Reads and Writes. **CC-Link IEF Basic** When selected, the device will connect to a CC-Link IE Field Basic Master.
Node Address	The Modbus/DNP3 node address of the device. Valid only when Modbus TCP or DNP3 TCP/UDP protocol has been selected.
Logix Path	The destination Logix path to where the Advanced Diagnostics will be written.

Table 3.1 - General configuration parameters

The general configuration is shown in the figure below. The IP Point HART general configuration window is opened by either double clicking on the module in the tree or right-clicking the module and selecting *Configuration*.

The Advanced Diagnostics Logix path can either be entered manually or the controller can be selected using the Target Browser button, located adjacent to the path.

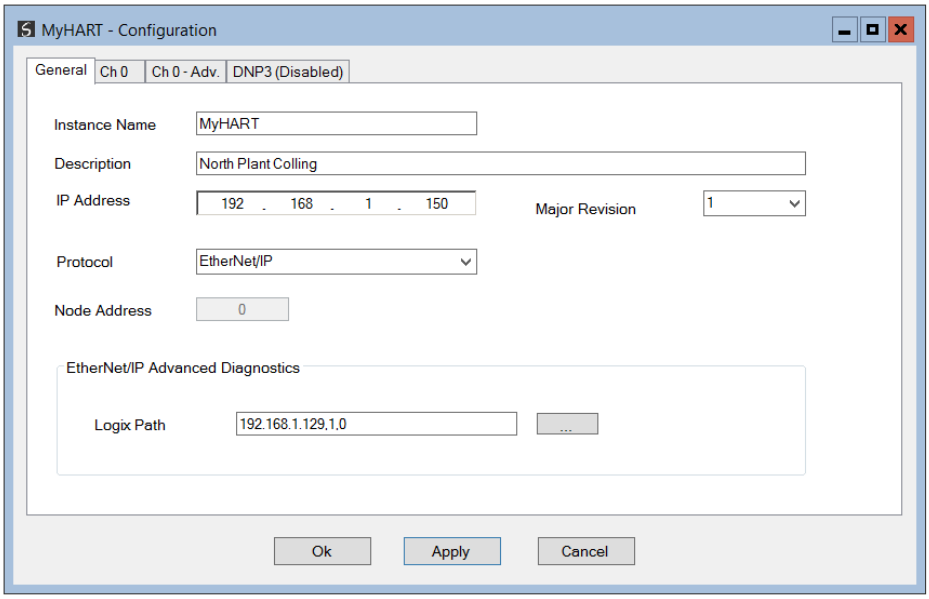


Figure 3.14. - General Configuration

The single channel configuration tabs consist of the following parameters:

Parameter	Description
Enable Channel	Used to Enable or Disable the entire analog channel.
Signal	
Range	Select either 4-20mA or 0-20mA. Note that HART communication will be disabled if the 0-20mA range has been selected.
Raw Max	The upper milliamp value to be used for the scaling to engineering units. The scaling to engineering units (EU) is calculated as follows: EU = EUMin + (RawValue – RawMin) * ((EUMax – EUMin) / (RawMax – RawMin))
Raw Min	The lower milliamp value to be used for the scaling to engineering units.
EU Max	The upper engineering value to be used for the scaling to engineering units. The scaled engineering value will equal this value when the current is equal to the Raw Max value.
EU Min	The lower engineering value to be used for the scaling to engineering units. The scaled engineering value will equal this value when the current is equal to the Raw Min value.
Filter	The time constant, in milliseconds, of the first order filter applied to the analog signal. A value of zero implies no filtering.
HART Communications	
Enable HART	Used to Enable or Disable the HART Communication. This should be disabled when using standard (non-HART) analog field devices.
Enable Dual Master	When this option is set, the IP-Point-HART module (as the primary HART Master) will allow communication to be shared with a secondary HART Master (e.g., a handheld programmer or calibrator).
Zero HART Data on Comms Fail	When this parameter is set, the process variables of the HART device (PV, SV, TV, and FV as well as the units) will be made zero when the communication to the HART device is lost.
MultiDrop Equal Bandwidth	When this parameter is set, the HART communication bandwidth will be equally shared between the “main” HART devices and the multidrop devices. The “main” HART device for the specific channel will use 50% of the HART communication bandwidth with this parameter cleared.
Response Timeout	The amount of time the IP-Point-HART module will wait for a HART slave device to respond before the message transaction has been set to failed.

Enable Relay Messages	Used to enable or disable pass through (Class 2) messages, either from Logix (message blocks) or DTMs.
PV Update Rate	The rate at which the HART process variables (PV, SV, TV and FV) are updated. Select from: • Fast (As fast as possible) • 1 second • 2 seconds • 5 seconds • 10 seconds Slowing this rate can enhance the performance of DTM communications. Care must be taken to not adversely affect the primary control.
Adv. Diag. Ratio	The number of process variable updates, between Advanced Diagnostic updates. **NOTE:** When *MultiDrop Equal Bandwidth* has been enabled, then this parameter is not applicable.
Fixed HART Address	The user can fix the address which the HART module will use to communicate with the attached field device. When this is not enable the HART module will search for the device from node address 0 to 63. **NOTE:** This is used with multidrop architecture.
Trend Defaults	
Source	The default source of the trend data can be one of the following: Raw Analog Current - The raw analog signal in milliamps. Filtered Scaled Value – The analog signal in engineering units. Digital Current – The current in milliamps reported by the field device (HART). PV – The Primary Variable in engineering units reported via HART. SV – The Secondary Variable in engineering units reported via HART. TV – The Third Variable in engineering units reported via HART. FV – The Fourth Variable in engineering units reported via HART.
Sample Rate	The period (milliseconds) between sample points. The trend data is a circular buffer of the latest 1000 points therefore the total trend time is 1000 * Sample Rate.
Note: The following items apply only to the IP Point HART Out module. ***Fail Mode***	
Prog / Fault Freeze	This configuration is used to determine the behaviour of the output analog signal when the Logix controller enters a faulted or program mode or when a CC-Link Master (eg. Mitsubishi controller) is in stopped mode. Enabling this option freezes the output value to its last state, when a program or fault state is detected. Disabling this option forces the output value to the adjacent Fail Value,

	when a program or fault state is detected. This option is only valid when using the EtherNet/IP and CC-Link protocols.
Fail Value (Prog. / Fault)	The value, in engineering units, to be applied to the output when a program or fault state is detected, and the above Freeze option is disabled.
Comm Fail Freeze	This configuration is used to determine the behaviour of the output analog signal when communication from the source (EtherNet/IP, DNP3 or Modbus, PCCC, CC-Link) is lost. Enabling this option freezes the output value to its last state, when communication is lost. Disabling this option forces the output value to the adjacent Fail Value when communication is lost.
Fail Value (Comm. Fail)	The value, in engineering units, to be applied to the output when communication from the source has been lost and the above Freeze option is disabled.
Time Out	The time, in milliseconds, since the last packet has been received from the source, before the communication is deemed to have been lost.

Table 3.2 - Channel configuration parameters

The Channel configuration is shown in the figure below. This window is opened by either double clicking on the module in the tree or right clicking the module followed by selecting *Configuration.* Once in the configuration window select the Channel 0 tab.

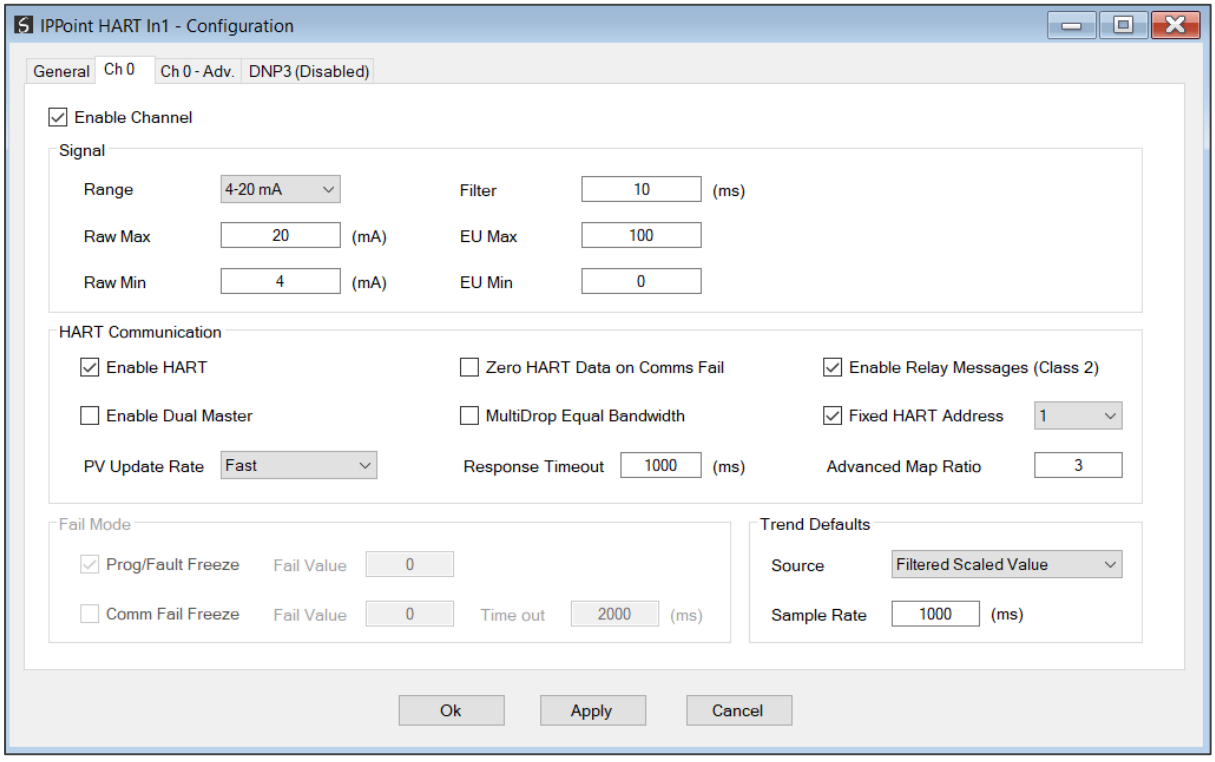


Figure 3.15 - Channel configuration (IP Point HART In)

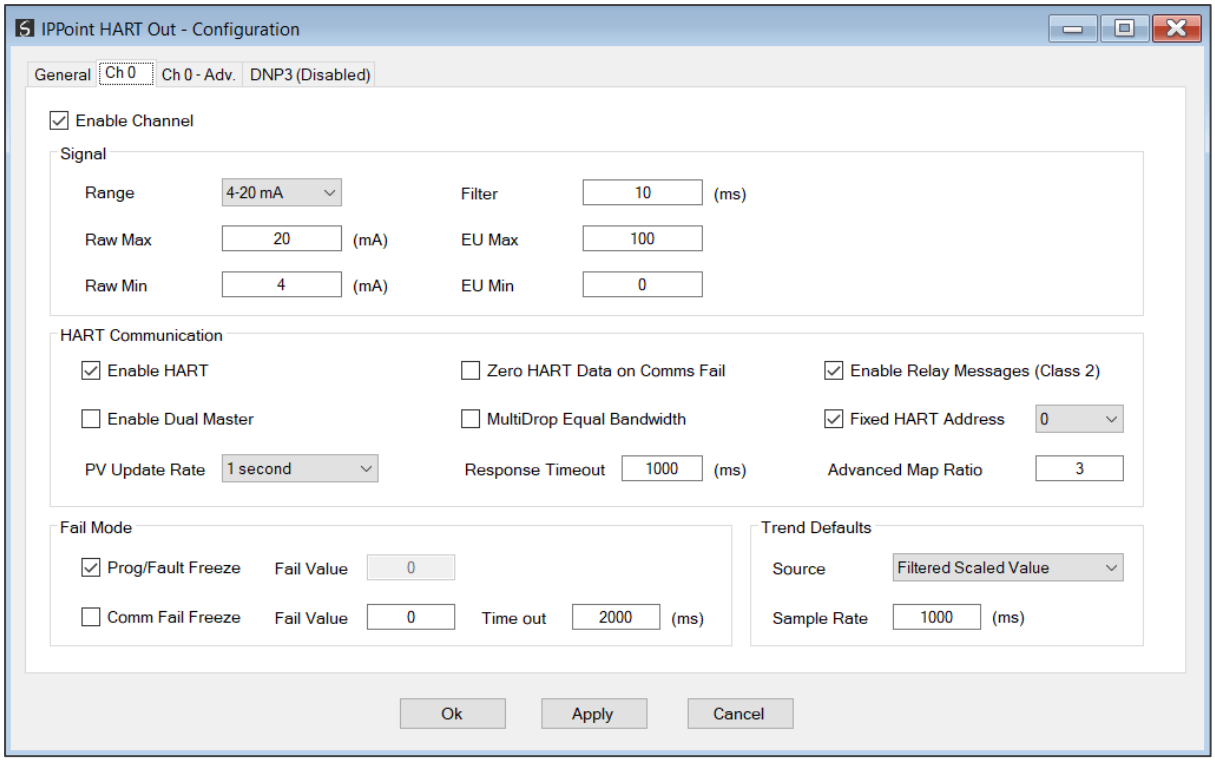


Figure 3.16 - Channel configuration (IP Point HART Out)

3.5. ADVANCED MAPPING

The module supports multidrop functionality on each channel (having multiple HART devices per channel), asynchronous reading of advanced diagnostic parameters (which are then written directly to Logix tags), and Custom HART messaging when using either EtherNet/IP or Modbus TCP.

NOTE: Advanced Mapping is **NOT** supported for the DNP3 or CC-Link interface protocol.

NOTE: Diagnostics is supported **ONLY** for the EtherNet/IP interface protocol.

NOTE: Custom HART messaging is **NOT** supported for the DNP3, CCLink, or PCCC interface protocol.

The Advanced Mapping configuration is shown in the figure below. The IP Point HART Advanced Mapping configuration window is opened by either double clicking on the module in the tree or right-clicking the module and selecting Ch 0 - *Adv*.

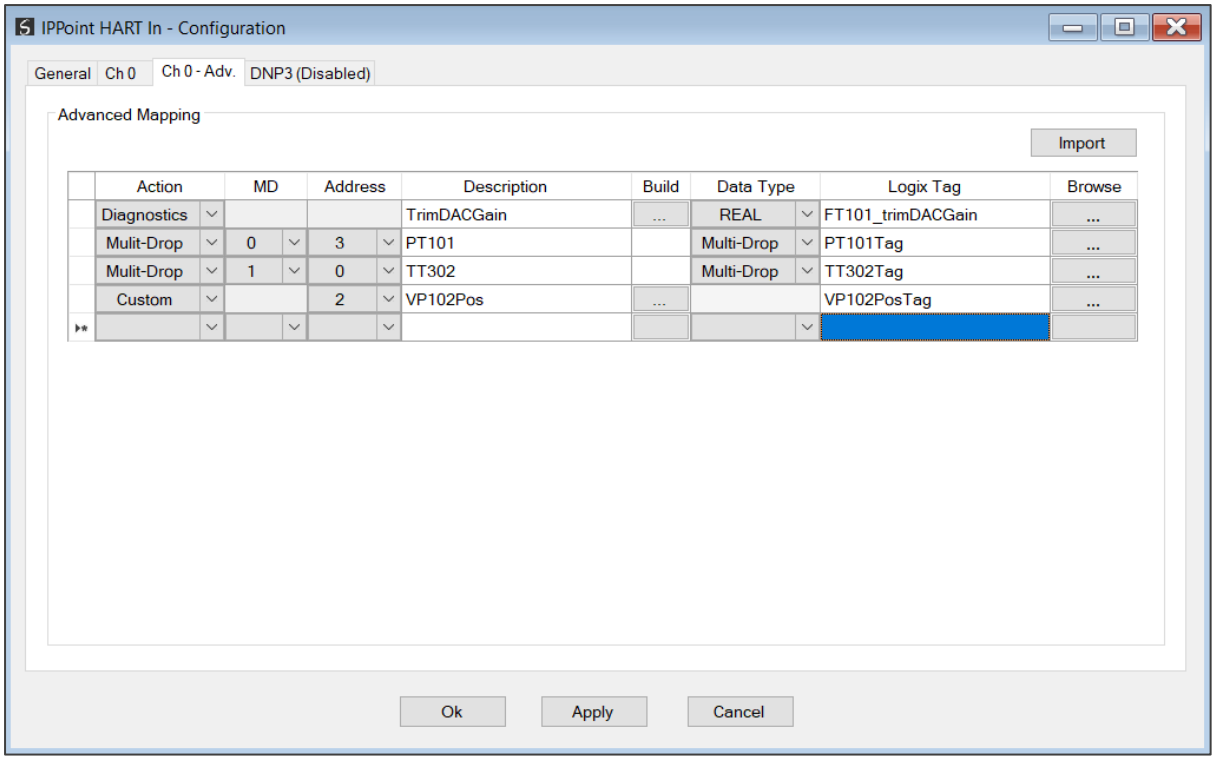


Figure 3.17 – Advanced Mapping Configuration

The Advanced Mapping configuration tab consists of a table comprising the following parameters:

Parameter	Description
Action	The user can select one of two actions: **Diagnostics** When the ***Diagnostics*** option is selected, the user will be able to configure a specific HART command that must be sent to the "main" device (usually at the specified fixed address). The result will then be written to a configured Logix tag thus allowing the user to extract device specific diagnostics from a field device. **Multi-Drop** When the ***Multidrop*** option is selected the module will automatically extract all the required information from the device at the specified address (see below), allowing the user to have multiple HART devices on a single HART channel. **Custom** When the ***Custom*** option is selected a custom HART message can be build with data being read from and/or written to the protocol interface. Custom messages are supported for EtherNet/IP and Modbus TCP. The user will need to select the HART device short address.
MD	This is the Multidrop Device Index for the specific HART device. There can be a maximum of 7 devices (0-6) per channel and each Multidrop Device Index will specify the location where the multidrop data is stored and can be accessed by the various interface protocols (see the multidrop section for more details). **Applicable only for Multi-Drop Action**

Address	This is the short node address of the HART device on the multidrop channel. The addresses can be found by using the Scan function in the Device List tab (see the Diagnostics and Multidrop sections for more details). **NOTE:** Connecting more than one device with the same short address will cause communication errors and prevent both devices from being detected during a scan. **Applicable only for Multi-Drop or *Custom* Action**
Description	A user description for the device or diagnostic parameter.
Build	This button launches the HART Advanced Diagnostics Builder which is used to create the HART message required to extract the needed parameter. (See Advanced Diagnostic Builder below.) **Applicable only for EtherNet/IP interface protocol when using *Diagnostics* Action or EtherNet/IP and Modbus TCP when using *Custom* Action.**
Data Type	The available Data Type options will depend on the selected Action **For Action – Diagnostics** The Logix tag data type required to accept the parameter. **For Action – Multi-Drop** The data type for the Logix tag needs to be the UDT supplied in the example Logix code. **Applicable only for EtherNet/IP interface protocol**
Logix Tag	The Logix tag name mapped to receive the parameter. **Applicable only for EtherNet/IP interface protocol**
Browse	This button launches the Tag Browser for the configured Logix controller. **Applicable only for EtherNet/IP interface protocol**

Table 3.3 – Advanced Diagnostics parameters

3.5.1. DIAGNOSTICS

When using the *Diagnostics* Action; to create a new Advanced Diagnostic item, select the Build button. The HART Advanced Diagnostic Builder will open.

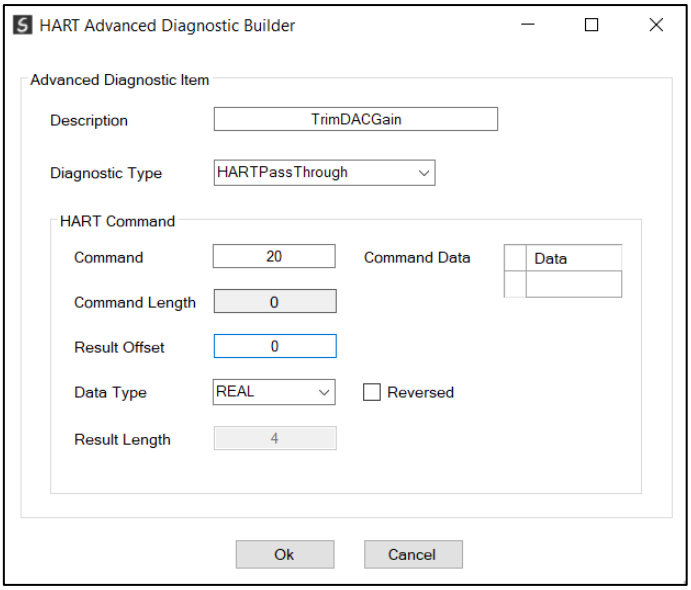


Figure 3.18 – Advanced Diagnostic Builder

The builder is used to generate the command, and to define the Data Type. The following parameters need to be configured:

Parameter	Description
Description	A user description for the advanced diagnostic parameter.
Diagnostic Type	Select ***HART Pass Through*** option.
HART Command	The HART command code (decimal).
Command Length	This is the length of the data that must be sent with the command.
Result Offset	The byte offset in the response where the required parameter starts.
Data Type	The Logix tag data type required to accept the parameter.
Response Length	This is the size of the data that must be copied to the Logix Tag. **NOTE:** This is only relevant for SINT Array Data Types.
Command Data	Additional request parameters required by the HART command.

Table 3.4 – Advanced Diagnostics Build parameters

Once accepted, the full command string will be built, and the current map item will be updated accordingly.

A Logix tag can now be associated with the Advanced Diagnostic parameter. This can be done by either entering the tag name or by using the Tag Browser to browse for a tag.



NOTE: It is important to ensure that the selected Logix tag type matches that of the expected HART command parameter. Failing to do so can cause unexpected results.

3.5.2. MULTIDROP

When using Modbus TCP or PCCC interface protocol, only Multidrop action is supported (see below). The data from each multidrop HART device will be placed at specific Modbus Registers or SLC File numbers (based on the Multidrop Device Index used). See the operational section for each protocol for the mapping of multidrop data.

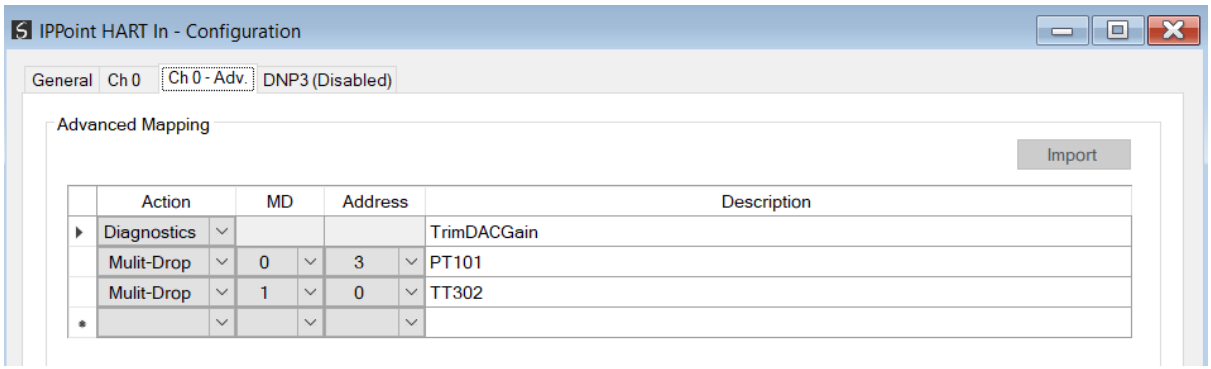


Figure 3.19 – Advanced Mapping (for Modbus TCP or PCCC)

3.5.1. CUSTOM

When using the *Custom* Action the user will need to create the custom HART command to send. To create a new Custom Command item, select the Build button. The HART Custom Builder will open.



NOTE: When adding a custom HART command, the user will need to also have the same device as either the main device or configured as one of the multidrop devices.

3.5.1.1. ETHERNET/IP

The required HART command will need to be entered into the builder window as shown below.

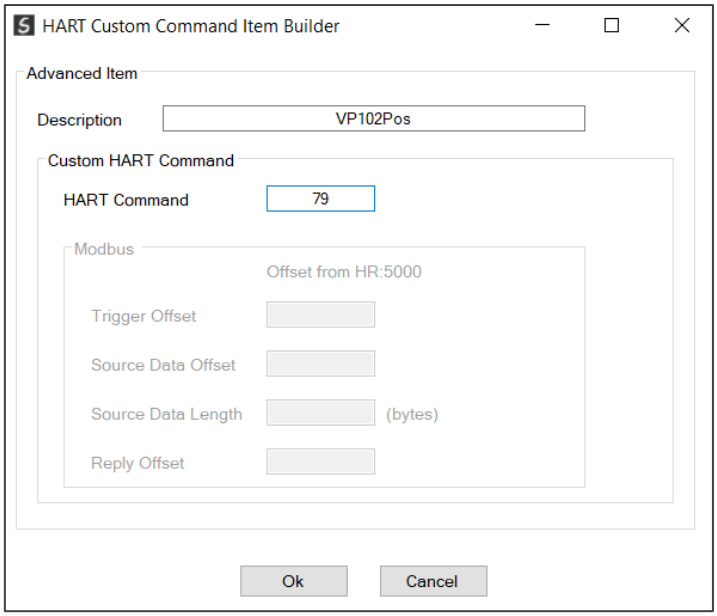


Figure 3.20 – Custom HART Command Builder Mapping (for EtherNet/IP)

The data to be send and returned will be exchanged with the Logix tag specified. The Logix Tag UDT will have all the required parameters to trigger the message execution, provide the source data, and update the returned data.

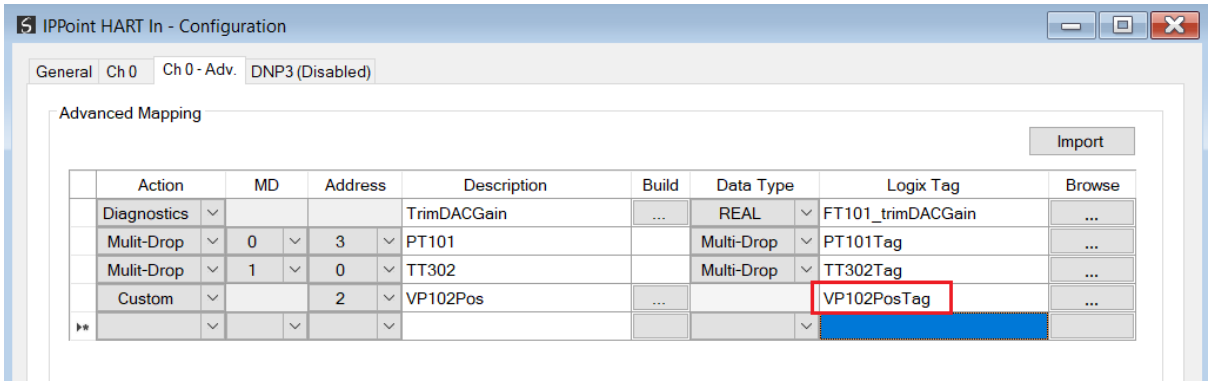


Figure 3.21 – Custom HART Command Logix Tag (for EtherNet/IP)

NOTE: It is important to ensure that the selected Logix tag type matches that of the expected HART custom command UDT type. Failing to do so can cause unexpected results.

3.5.1.2. MODBUS TCP

The required HART command and specific Modbus Offsets will need to be entered into the builder window as shown below.

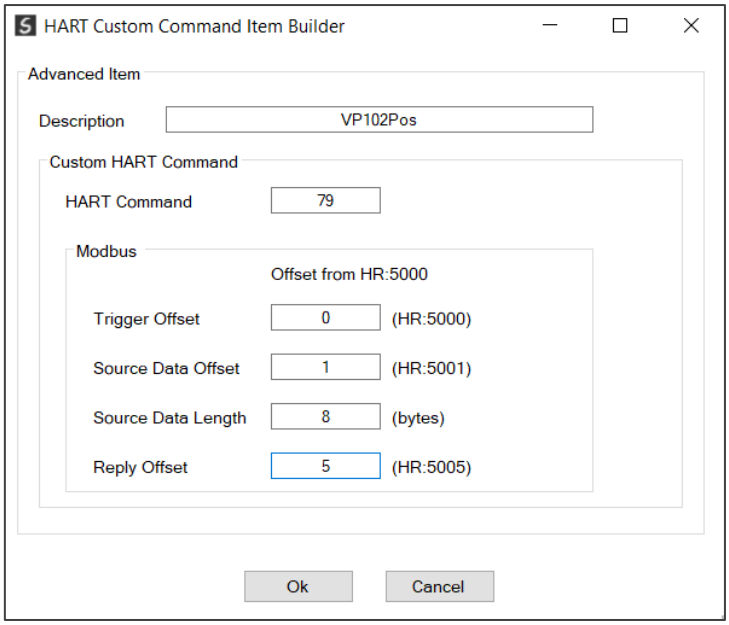


Figure 3.22 – Custom HART Command Builder Mapping (for Modbus TCP)

Each HART channel is allowed up to 500 bytes of mapping data for custom HART commands. The custom HART command Modbus Holding Register range for each HART channel is shown below:

HART Channel	Modbus HR Range
0	HR 5000 – HR 5249
1	HR 5250 – HR 5499
2	HR 5500 – HR 5749
3	HR 5750 – HR 5999

Table 3.5 – Custom HART Data Modbus Ranges

Each Custom HART command requires four mapping parameters in addition to the HART command:

Modbus Parameter	Description
Trigger Offset	The Trigger Offset parameter is the Modbus HR offset in the Modbus HR range (for the specific HART channel) for the trigger of the HART custom message. For example, if the trigger offset entered is 5 and the custom HART command is on HART channel 0, then the message trigger will be at Modbus HR 5005 (HR 5000 *for HART channel 0* + offset HR 5). If the trigger offset entered is 10 and the custom HART command is on HART channel 1, then the message trigger will be at Modbus HR 5260 (HR 5250 *for HART channel 1* + offset HR 10). The trigger parameter is used to trigger the start of the custom HART message execution. Each time the trigger Modbus HR is changed to a value different from the previous value, it will send the custom HART command. **NOTE:** Changing the trigger to value 0 will not trigger the custom HART command.

Source Data Offset	The source data offset parameter is the location in the Modbus HR range where the HART data to be sent is stored. For example, if the source data offset entered is 20 and the custom HART commands is on HART channel 0, then the HART message data to be sent will start at Modbus HR 5020 (HR 5000 *for HART channel 0* + offset HR 20).
Source Data Length	This is the length of the HART data to be sent in bytes. **NOTE:** A value of zero will result in no additional HART data being sent with the HART command.
Reply Offset	The reply offset parameter is the location in the Modbus HR range where the HART data returned (from the custom HART command) is stored. For example, if the reply offset entered is 40 and the custom HART commands is on HART channel 1, then the HART message data returned will start at Modbus HR 5290 (HR 5250 *for HART channel 1* + offset HR 40). See the Custom HART message operation section for details regarding the format of the reply data.

Table 3.6 – Custom HART command build parameters

3.6. DNP3 SECURITY

If one of the DNP3 protocols (DNP3 TCP or DNP3 UDP) have been selected, then the DNP3 Security tab will be enabled. This DNP3 Security configuration consists of the following parameters:

Parameter	Description
Enable Security	DNP3 Secure Authentication can be enabled or disabled. When enabled there will be no unsecured exchange of data (for critical functions).
Key Change Method	This setting determines the method by which security keys are exchanged between two devices. Currently the HART 4 only supports the Pre-Shared Key method. This method requires both devices to have update keys entered by means outside the DNP3 protocol, (i.e. using Slate Utility).
MAC Algorithm	The MAC algorithm is used to encrypt the challenge data for secure authentication. DNP3 allows for various encryption standards in different formats to be used for secure authentication: HMAC SHA-1 encryption (4 octets – serial) – for legacy support HMAC SHA-1 encryption (8 octets – serial) HMAC SHA-1 encryption (10 octets – networked) HMAC SHA-256 encryption (8 octets – serial) HMAC SHA-256 encryption (16 octets – networked) AES-GMAC (12 octets)
Key Wrap Algorithm	DNP3 uses various keys for secure authentication. The keys that are used for data exchange and called the session keys and these keys may be updated frequently. To exchange the session keys between two DNP3 devices the update key (refer to the Secure Authentication section for further detail) is used to encrypt the data and session keys before exchanging it between parties. DNP3 allows for two

	standards to encrypt the session keys: AES-128 Key Wrap AES-256 Key Wrap
Aggressive Mode	To reduce the bandwidth used for secure authentication the user can select aggressive mode which allows the message initiator to anticipate and provide the required authentication in the request message. Thus from a network point of view there is a two message exchange for secure authentication compared to the normal four message exchange for secure authentication.
Secure Optional Critical Functions	When secure authentication is enabled there are various mandatory and optional application functions that must be authenticated before data can be exchanged. The optional functions can be selected in the box. Mandatory functions, e.g. Operate, are therefore not included in the options list.

Table 3.7 – DNP3 configuration parameters

NOTE: For further information regarding the security settings refer to the Security section.

The security configuration is shown in the figure below. The DNP3 Security configuration window is opened by either double-clicking on the module in the tree or right clicking the module and selecting *Configuration.* Once in the configuration window select the *DNP3* tab at the top.

NOTE: The actual pre-shared key cannot be included in the configuration. It can only be written to the module when online via the Status window.

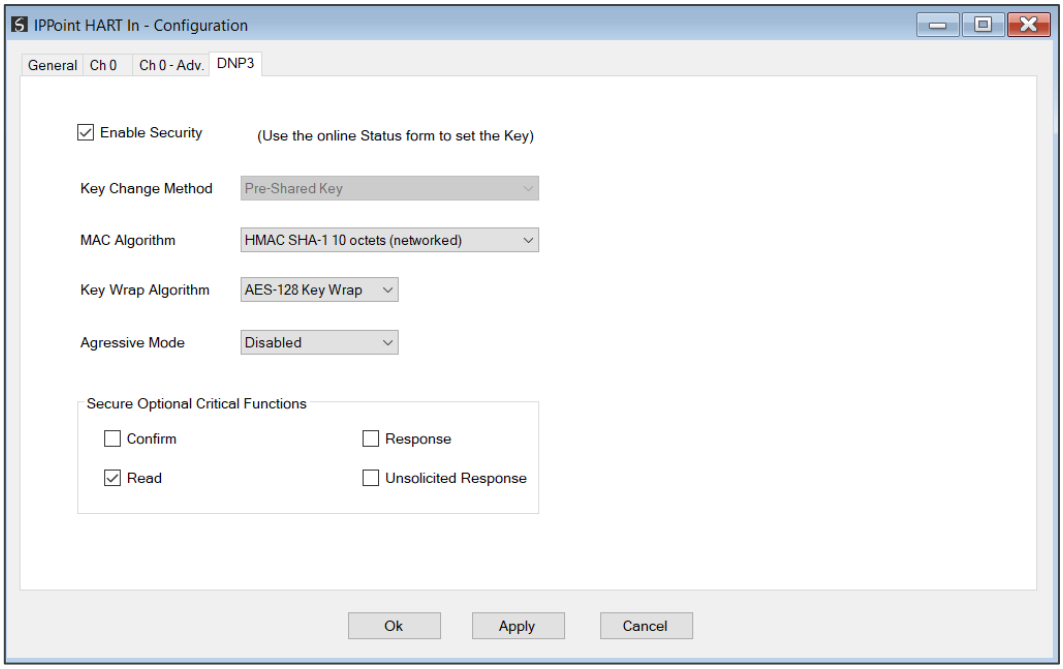


Figure 3.23 – DNP3 security configuration

3.7. MULTIDROP

When using Multidrop and requiring a HART device at a specific address to be the “main” HART device (e.g. which will be populated in the Logix Input Assembly), then the ***Fixed HART Address*** parameter must be used (see below). This will ensure that the specified address is used as the main. Should this not be specified, then the IP Point HART will scan the HART channel and use the first HART device found as the “main” HART device.

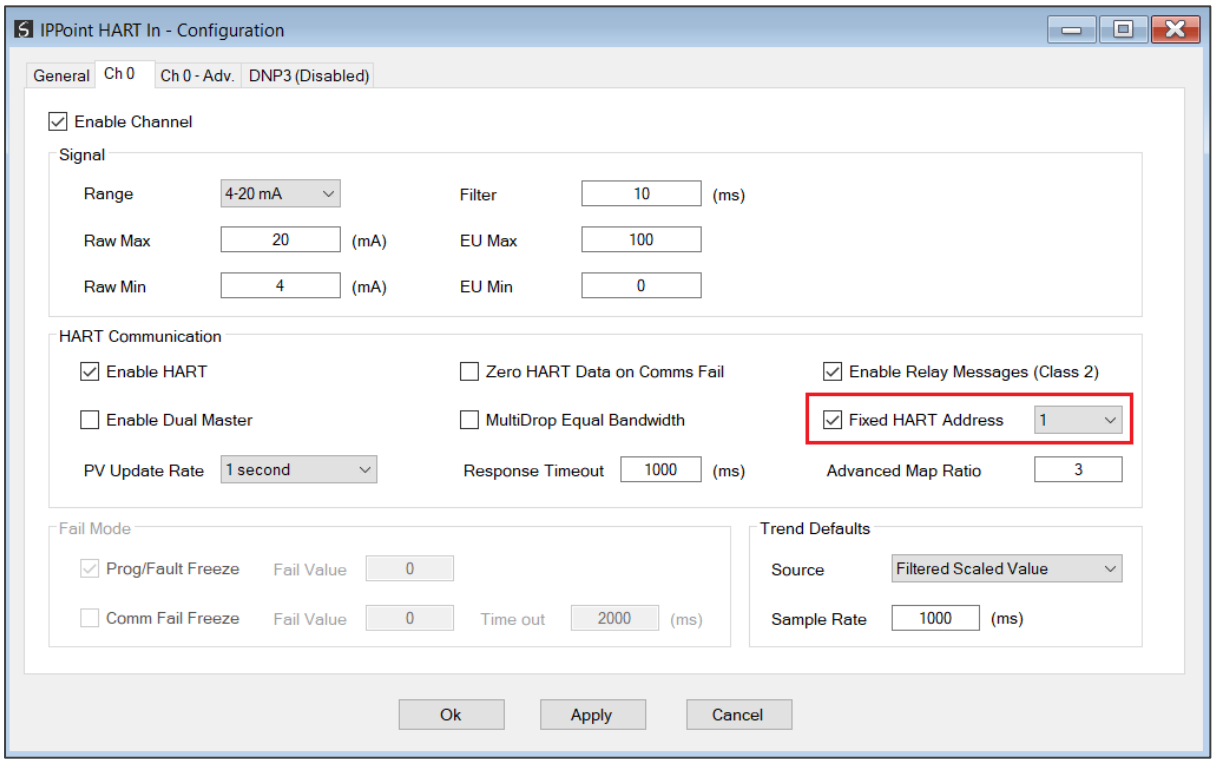


Figure 3.24 – Fixed HART address

The user will need to ensure that each field device on the drop has a unique node address. This can be verified by initiating a ***Device Scan*** and checking that each field device on the network has a unique address (as shown below):

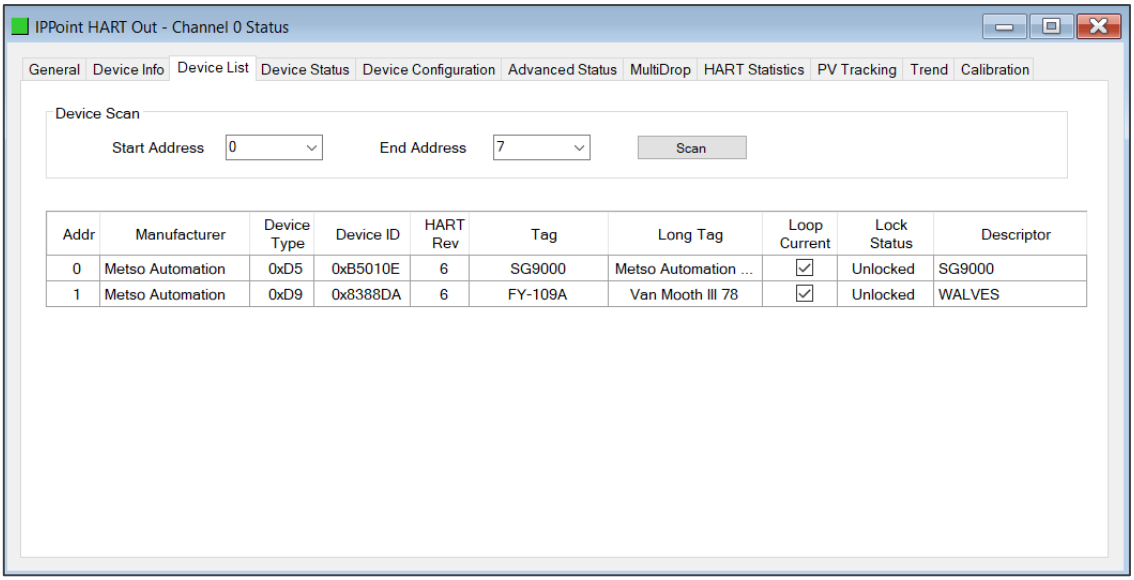


Figure 3.25 – HART Channel Scan

If needed, the user can set the node address of a module from the Slate Utility as shown below:

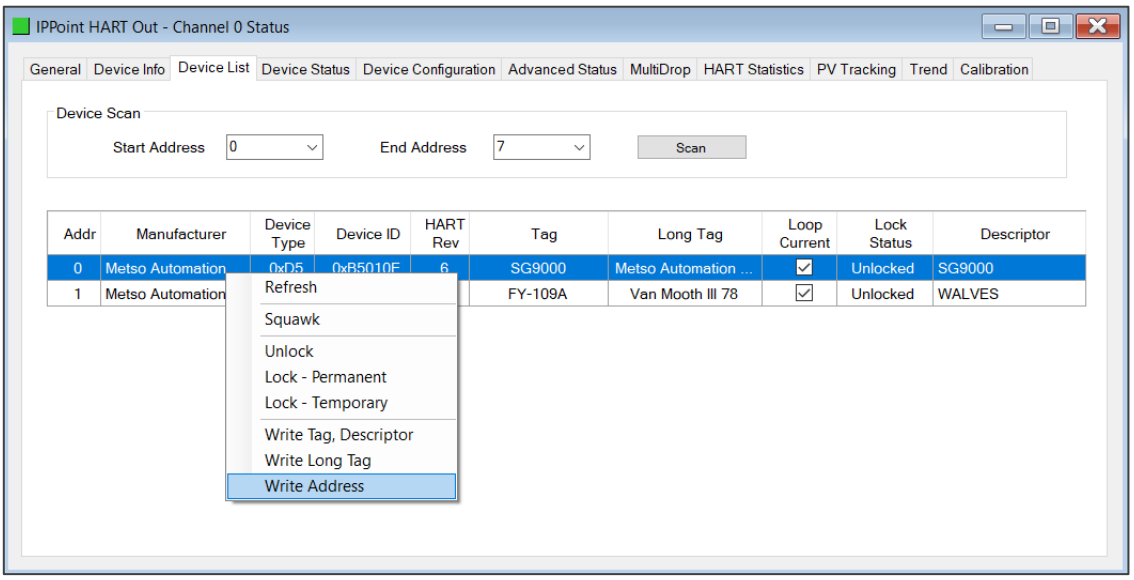


Figure 3.26 – Set Field Device Node Address

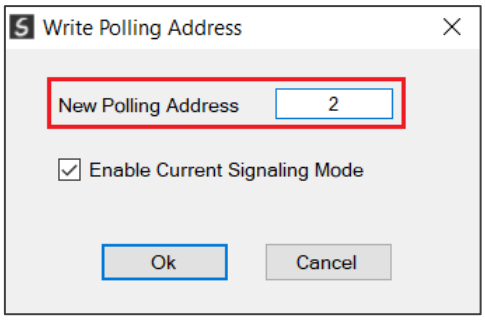


Figure 3.27 – Set Field Device Node Address

The user will also need to ensure that each field device on the drop has its loop current mode set to Multidrop and **NOT** Current Signalling Mode. This can be achieved by using the ***Write Address*** option (as shown above) and **unchecking** the loop current mode in the Slate Utility as shown below:

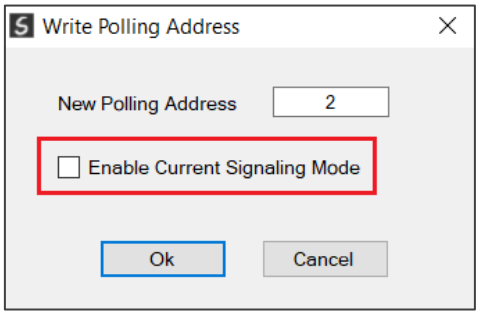


Figure 3.28 – Set Current Signalling Mode

3.8. MODULE DOWNLOAD

Once the IP Point HART module configuration has been completed, it must be downloaded to the module.

Before downloading the Connection Path of the module should be set. This path will automatically default to the IP address of the module, as set in the module configuration. It can however be modified, if the IP Point HART module is not on a local network.

The Connection path can be set by right-clicking on the module and selecting the Connection Path option.

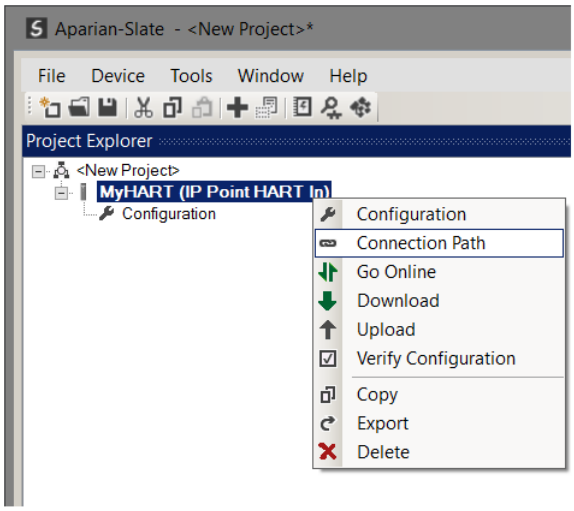


Figure 3.29. - Selecting Connection Path

The new connection path can then be either entered manually or selected by means of the

Target Browser.

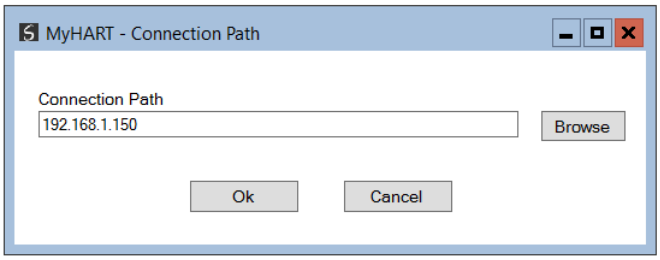


Figure 3.30. - Connection Path

To initiate the download, right-click on the module and select the Download option.

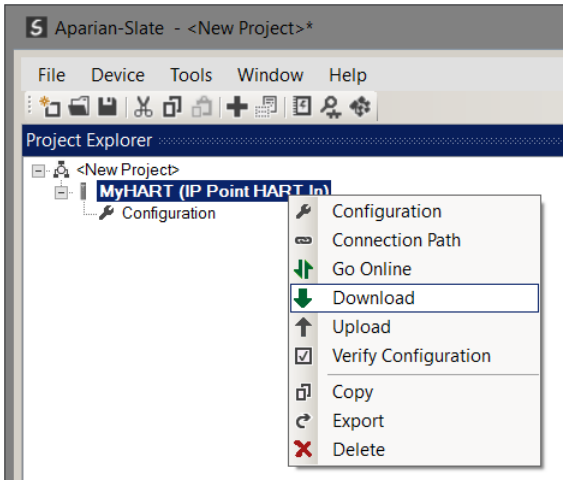


Figure 3.31. - Selecting Download

Once complete, the user will be notified that the download was successful.

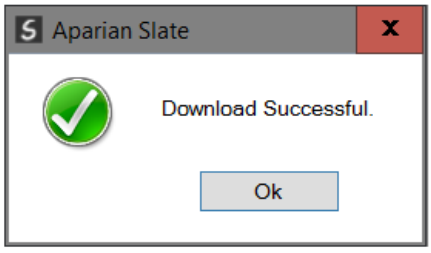


Figure 3.32. - Successful download

Within the Slate environment the module will be in the Online state, indicated by the green circle around the module. The module is now configured and will start operating immediately.

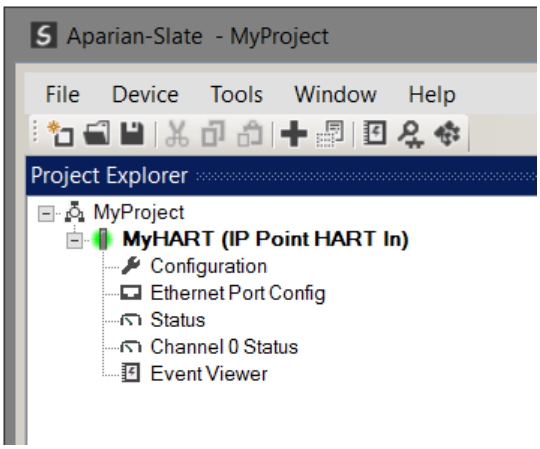


Figure 3.33. - Module Online

3.9. LOGIX INTEGRATION

The IP Point Hart modules can be easily integrated with Allen-Bradley Logix family of controllers. For Logix versions 20 and beyond, the modules can be added using the EDS Add-On-Profile (AOP), which is described in section 3.7.1.

For older versions (19 and below), the module must be added using a Generic Profile which is described in section 3.7.2.

3.9.1. STUDIO 5000 CONFIGURATION (VERSION 20+)

Integration with the Logix family in Studio5000 makes use of the EDS AOP. Before the module can be added to the tree the module's EDS file must be registered. Using RSLinx, the EDS file can be uploaded from the device after which the EDS Hardware Installation tool will be invoked to complete the registration.

Alternatively, the EDS file can be downloaded from the product web page at http://www.aparian.com/products/ippointhart and registered manually using the EDS Hardware Installation Tool shortcut under the Tools menu in Studio 5000.

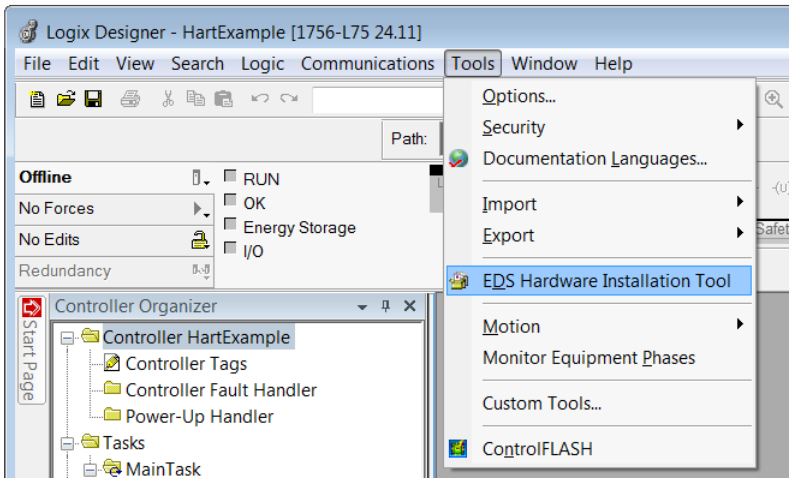


Figure 3.34 - EDS Hardware Installation Tool

After the EDS file has been registered, the module can be added to the Logix IO tree in Studio 5000. Under a suitable Ethernet bridge module in the tree, select the Ethernet network, right-click and select the New Module option.

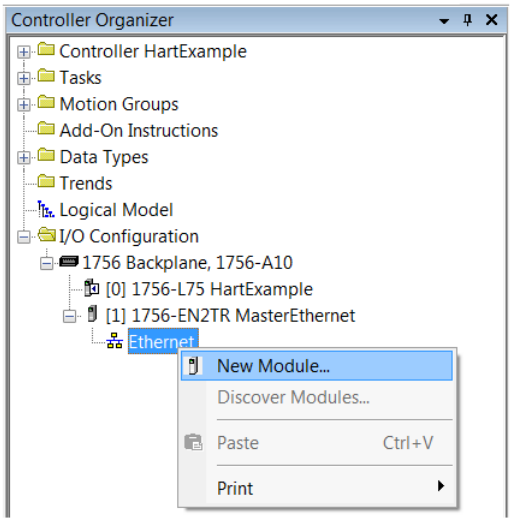


Figure 3.24 – Adding a module

The module selection dialog will open. To find the module more easily, use the Vendor filter to select only the Aparian modules as shown in the figure below.

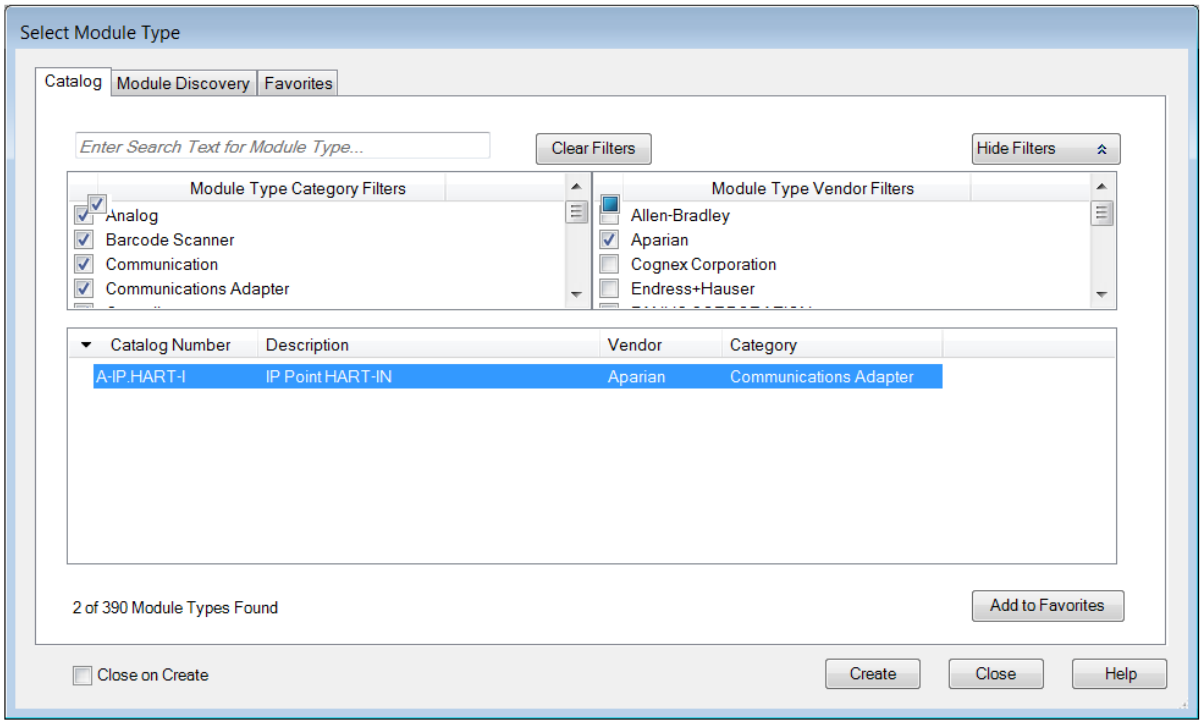


Figure 3.25– Selecting the module

Locate and select the IP Point HART-In or -Out module and select the ***Create*** option. The module configuration dialog will open, where the user must specify the Name and IP address as a minimum to complete the instantiation.

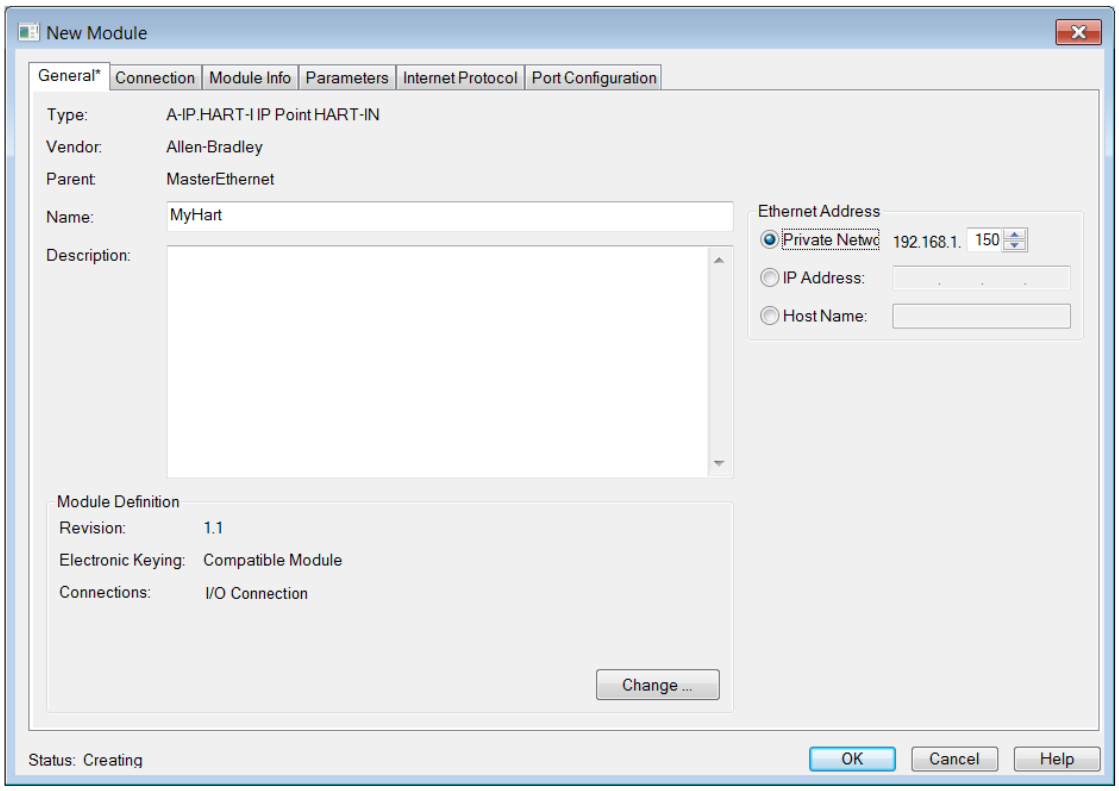


Figure 3.26 – Module instantiation

Once the instantiation is complete the module will appear in the Logix IO tree.

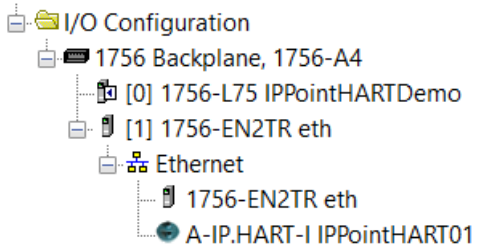


Figure 3.357 – Logix IO tree

The Module Defined Data Types will automatically be created during the instantiation process. These data types provide meaningful structures to the module data. An excerpt of the Input Image is shown in the following figure.

Name	Value	Style	Data Ty
IPPointHART01:I	{...}		_055A:A
IPPointHART01:I.ConnectionFaulted	0	Decimal	BOOL
IPPointHART01:I.InstanceNameLength	0	Decimal	DINT
IPPointHART01:I.Status	2#0000_0000_0000_0000_0000_0000_0000_0000	Binary	DINT
IPPointHART01:I.ConfigurationValid	0	Decimal	BOOL
IPPointHART01:I.Channel0Enabled	0	Decimal	BOOL
IPPointHART01:I.Reserved0	0	Decimal	BOOL
IPPointHART01:I.Reserved1	0	Decimal	BOOL
IPPointHART01:I.Reserved2	0	Decimal	BOOL
IPPointHART01:I.Channel0HARTEnabled	0	Decimal	BOOL
IPPointHART01:I.Reserved3	0	Decimal	BOOL
IPPointHART01:I.Reserved4	0	Decimal	BOOL
IPPointHART01:I.Reserved5	0	Decimal	BOOL
IPPointHART01:I.Temperature	0.0	Float	REAL
IPPointHART01:I.ManufacturerID	0	Decimal	SINT
IPPointHART01:I.ManufacturerDeviceType	0	Decimal	SINT
IPPointHART01:I.LiveList	0	Decimal	INT
IPPointHART01:I.DeviceID	0	Decimal	DINT
IPPointHART01:I.TagLength	0	Decimal	DINT
IPPointHART01:I.Descriptor	0	Decimal	DINT
IPPointHART01:I.DeviceStatus	2#0000_0000	Binary	SINT
IPPointHART01:I.LoopOpen	0	Decimal	BOOL
IPPointHART01:I.CurrentUnderRange	0	Decimal	BOOL
IPPointHART01:I.CurrentOverRange	0	Decimal	BOOL
IPPointHART01:I.LoopShorted	0	Decimal	BOOL
IPPointHART01:I.Calibration_Busy	0	Decimal	BOOL
IPPointHART01:I.CalibrationFaulted	0	Decimal	BOOL
IPPointHART01:I.HARTCommsFault	0	Decimal	BOOL

Figure 3.28 – Module Defined Data Type

3.9.2. RSLogix 5000 Configuration (Pre-Version 20)

3.9.2.1. ADD MODULE TO I/O CONFIGURATION

When using Logix versions prior to version 20, then the IP Point HART module must be added to the RSLogix 5000 I/O tree as a generic Ethernet module. This is achieved by right clicking on the Ethernet Bridge in the RSLogix 5000 and selecting *New Module* after which the *ETHERNET-MODULE* is selected to be added as shown in the figure below.

NOTE: See the next section for importing the configuration (L5X).

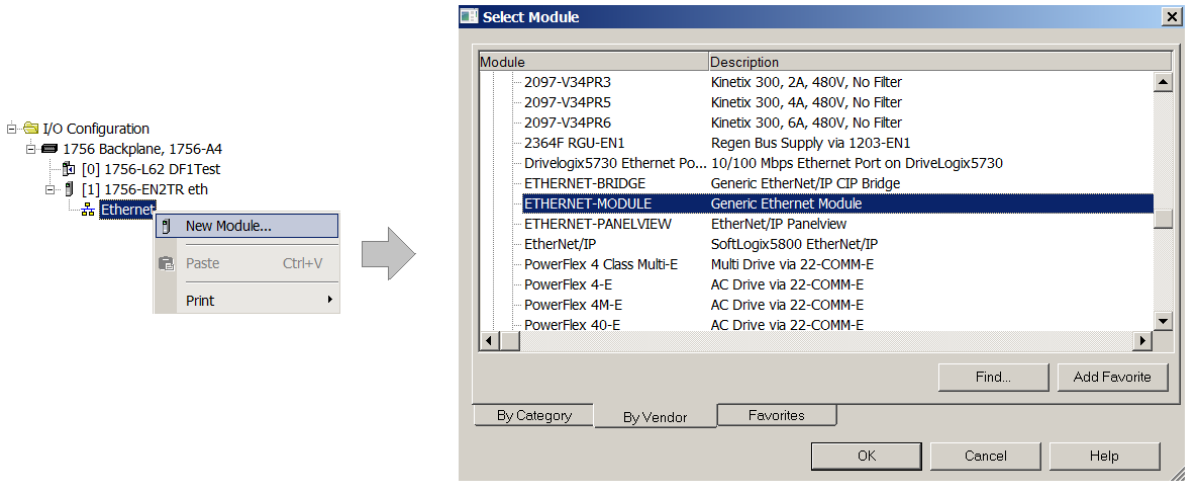


Figure 3.29 - Add a Generic Ethernet Module in RSLogix 5000

NOTE**:** The module configuration for the IP Point HART In and IP Point HART Out modules are **not** identical.

The user must enter the IP address of the IP Point HART module that will be used. The assembly instance and size must also be added for the input, output, and configuration in the connection parameters section.

The required connection parameters for the **IP Point HART In** module are shown below:

Connection Parameter	Assembly Instance	Size
Input	112	35 (32-bit)
Output	116	1 (32-bit)
Configuration	102	0 (8-bit)

Table 3.8 - RSLogix class 1 connection parameters for the **IP Point HART In** module

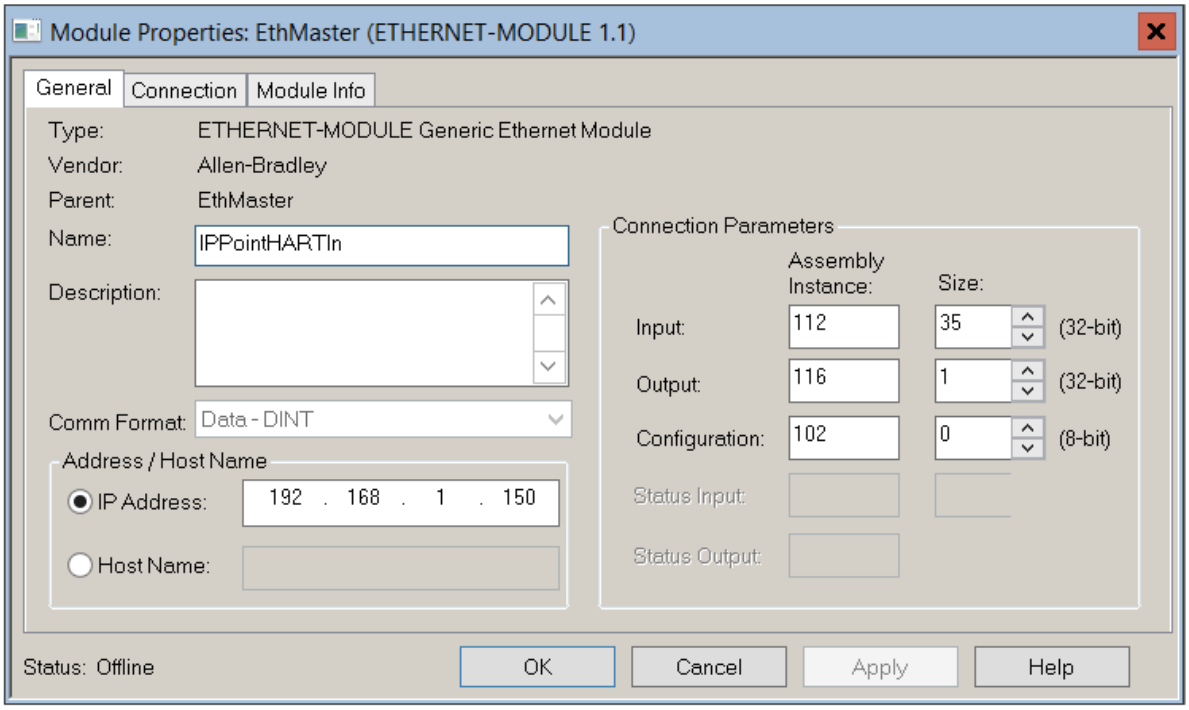


Figure 3.30 - RSLogix 5000 General module properties for **IP Point HART In** module

The required connection parameters for the **IP Point HART Out** module are shown below:**Connection Parameter**	**Assembly Instance**	**Size**
Input	112	35 (32-bit)
Output	114	1 (32-bit)
Configuration	102	0 (8-bit)

Table 3.9 - RSLogix class 1 connection parameters for the **IP Point HART Out** module

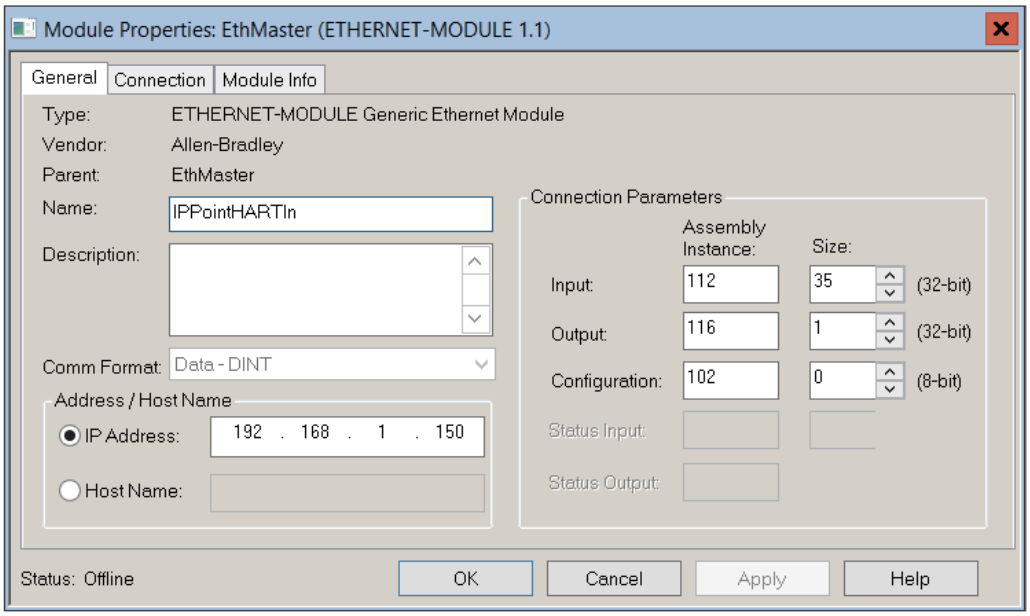


Figure 3.31 - RSLogix 5000 General module properties for **IP Point HART Out** module

NOTE: The user will need to enter the exact connection parameters before the module will establish a class 1 connection with the Logix controller.

Next the user needs to add the connection requested packet interval (RPI). This is the rate at which the input and output assemblies are exchanged. The recommended value is 200ms. Refer to the technical specification section in this document for further details on the limits of the RPI.

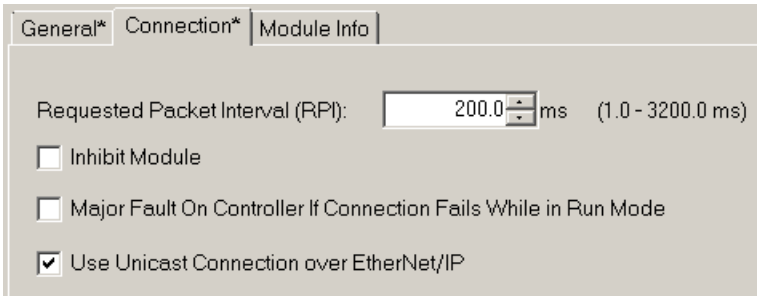


Figure 3.32 - Connection module properties in RSLogix 5000

Once the module has been added to the RSLogix 5000 I/O tree the user must assign the User Defined Types (UDTs) to the input and output assemblies. The user can import the required UDTs by right-clicking on *User-Defined* sub-folder in the *Data Types* folder of the I/O tree and selecting *Import Data Type*. The assemblies are then assigned to the UDTs with a ladder copy instruction (COP) as shown in the figures below.

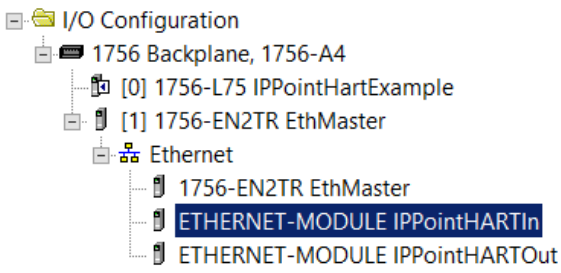


Figure 3.33 – RSLogix 5000 I/O module tree

3.9.2.2. IMPORTING UDTS AND MAPPING ROUTINES

To simplify the mapping of the input image, an RSLogix 5000 Routine Partial Import (L5X) file is provided. This file can be imported by right-clicking on the required Program and selecting the Import Routine option.

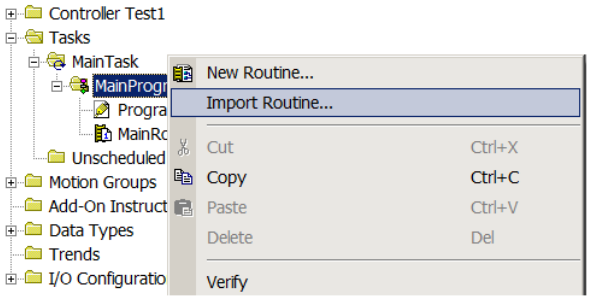


Figure 3.34 – RSLogix 5000 Importing IP Point HART module specific routine and UDTs

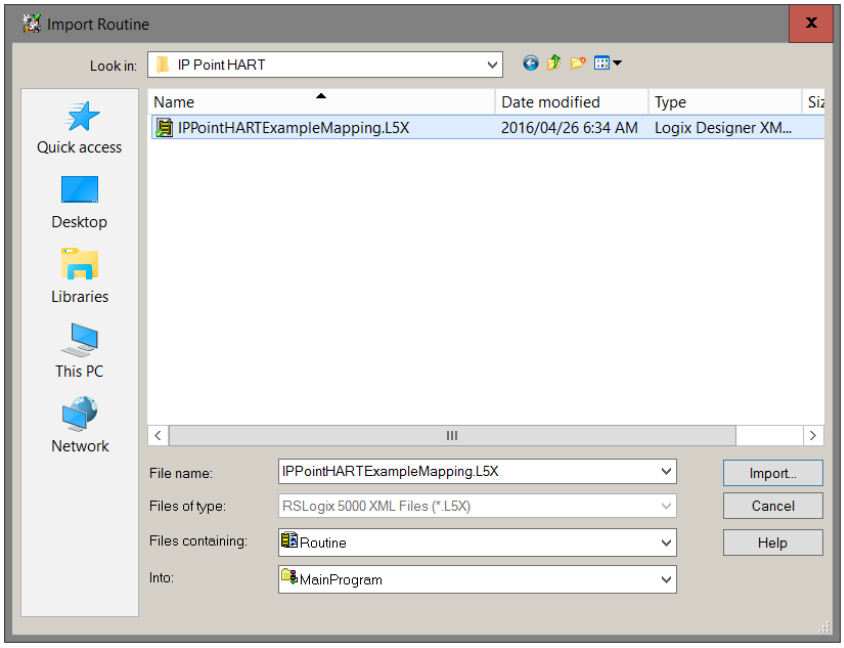


Figure 3.35 - Selecting partial import file

The import will create the following:

- The required UDTs (user defined data types)
- Controller tags representing the Input and Output assemblies.
- A routine mapping the IPPointHart-In and IPPointHart-Out modules to the aforementioned tags.

The user may need to change the routine to map to the correct IPPointHart module instance name, and make sure that the mapping routine is called by the Program's Main Routine.

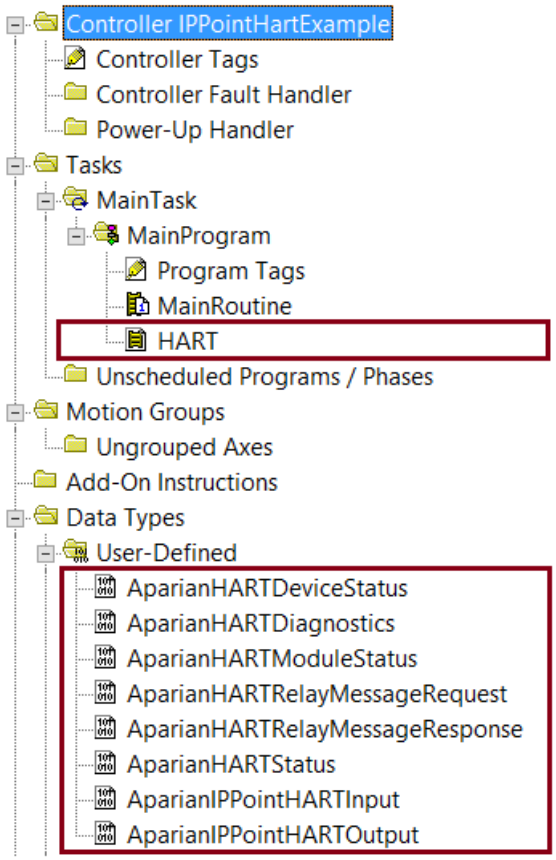


Figure 3.36. - Imported RSLogix 5000 objects

Refer to the additional information section of this document for an example RSLogix 5000 project as well as the required UDTs.

IPPointHartIn_I	{...}		AparianIPPointHARTInput
IPPointHartIn_I.Instance	''		AparianSTRING16
IPPointHartIn_I.Status	{...}		AparianHARTModuleStatus
IPPointHartIn_I.Temperature	0.0	Float	REAL
IPPointHartIn_I.ManufacturerID	0	Decimal	SINT
IPPointHartIn_I.ManufacturerDeviceType	0	Decimal	SINT
IPPointHartIn_I.DeviceID	0	Decimal	DINT
IPPointHartIn_I.Tag	''		AparianSTRING8
IPPointHartIn_I.Descriptor	''		AparianSTRING16
IPPointHartIn_I.DeviceStatus	{...}		AparianHARTDeviceStatus
IPPointHartIn_I.HARTStatus	{...}		AparianHARTStatus
IPPointHartIn_I.RawCurrent	0.0	Float	REAL
IPPointHartIn_I.ScaledValue	0.0	Float	REAL
IPPointHartIn_I.DigitialCurrent	0.0	Float	REAL
IPPointHartIn_I.PV	0.0	Float	REAL
IPPointHartIn_I.SV	0.0	Float	REAL
IPPointHartIn_I.TV	0.0	Float	REAL
IPPointHartIn_I.FV	0.0	Float	REAL
IPPointHartIn_I.PVUnitCode	0	Decimal	SINT
IPPointHartIn_I.SVUnitCode	0	Decimal	SINT
IPPointHartIn_I.TVUnitCode	0	Decimal	SINT
IPPointHartIn_I.FVUnitCode	0	Decimal	SINT
IPPointHartIn_I.Diagnostics	{...}		AparianHARTDiagnostics
IPPointHartIn_I.Diagnostics.DeviceSpecificStatus0_0	0	Decimal	SINT
IPPointHartIn_I.Diagnostics.DeviceSpecificStatus0_1	0	Decimal	SINT
IPPointHartIn_I.Diagnostics.DeviceSpecificStatus0_2	0	Decimal	SINT
IPPointHartIn_I.Diagnostics.DeviceSpecificStatus0_3	0	Decimal	SINT
IPPointHartIn_I.Diagnostics.DeviceSpecificStatus0_4	0	Decimal	SINT

Figure 3.36. – UDT Input Assembly

3.10. MITSUBISHI INTEGRATION

This section describes how the IP Point HART can be connected to a Mitsubishi PLC using CC-Link IEF Basic. It makes use of the Melsoft GX Works3 software tool.

NOTE: ***Mitsubushi*** and ***Melsoft iQ Works*** are registered trademarks of the Mitsubishi Electric Corporation.

3.10.1. PROFILE REGISTRATION

The first step is to register the IP Point HART device profiles. The profiles (one for IP Point HART – In and one for the – Out) are available on the Aparian website in the form of a CSP Archive viz.: ***Aparian CSP Archive.zip***.

Under the ***Tools*** menu, select ***Profile Management***, then select the ***Register*** option.

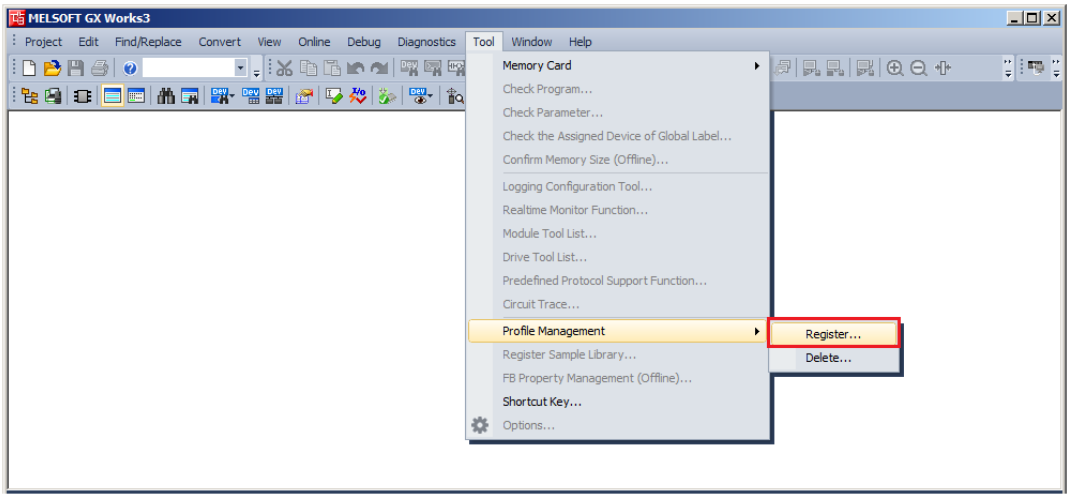


Figure 3.37 – Profile Management

Then navigate to, and select, the previously downloaded ***Aparian CSP Archive.zip*** file.

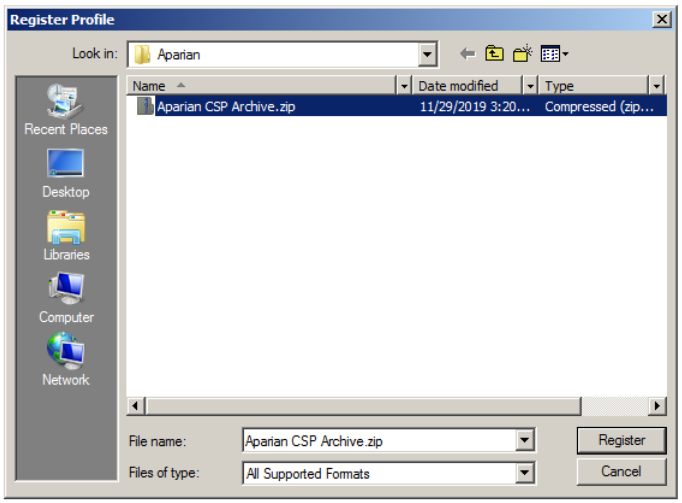


Figure 3.38 – Select CSP Archive File

3.10.2. PLC PROJECT

Then create a new or open an existing PLC project.

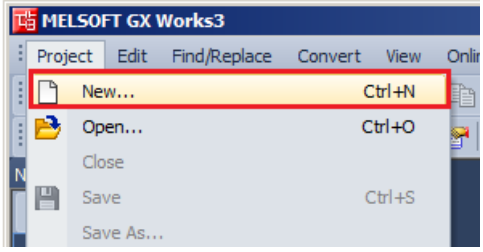


Figure 3.39 – Create New Project

In this example we will use the FX5CPU.

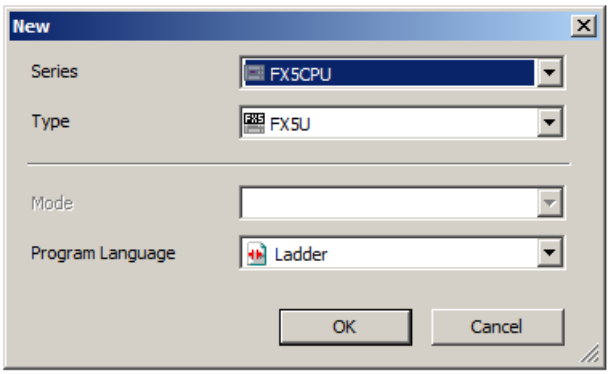


Figure 3.40 – Project Type

3.10.3. CC-Link IEF Basic - Ethernet Configuration

Using the Project explorer tree, navigate to the ***Ethernet Port*** item, which can be found under ***Parameter***…***FX5UCPU***…***Module Parameter*** item.

Set the required PLC's ***IP Address***, ***Subnet Mask*** and ***Default Gateway*** (if required).

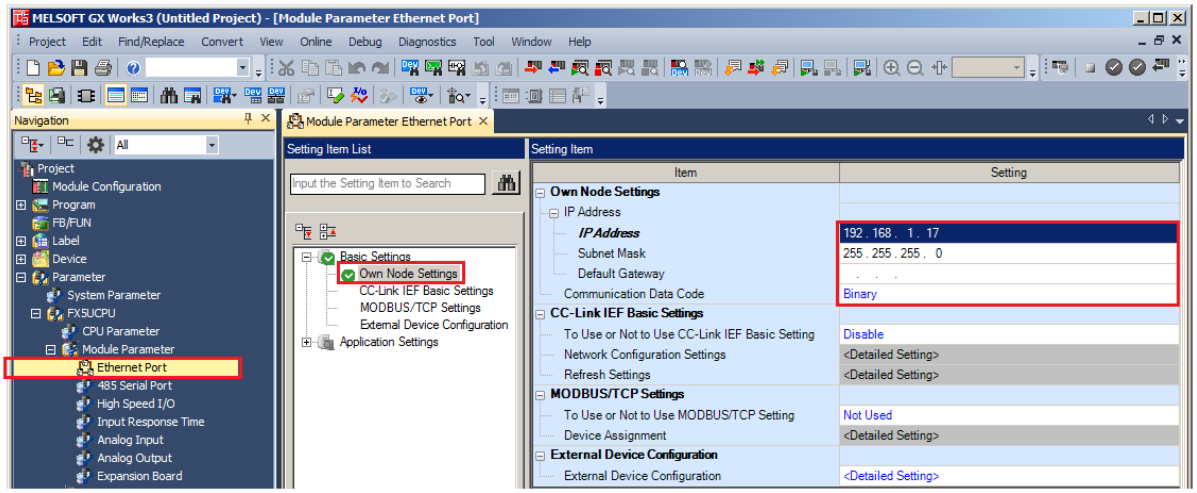


Figure 3.41 – PLC Ethernet Settings

Under the CC-Link IEF Basic Settings, ensure that the ***CC-Link IEF Basic*** is Enabled.

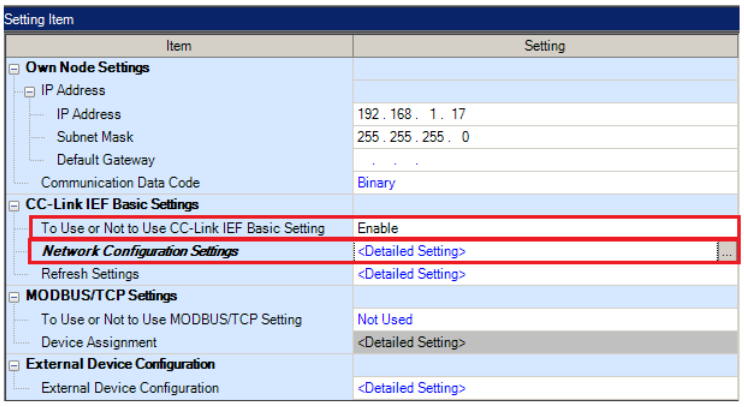


Figure 3.42 – CC-Link IEF Basic Settings

Then select the configuration button adjacent to the ***Network Configuration*** Settings. The CC-Link IEF Basic Configuration form will open.

In the ***Module List*** (right-hand side) the Aparian IP Point HART modules will be displayed, indicating that the Device Profiles were registered successfully.

The CC-Link configuration can be configured either manually (offline) or automatically (online) if the IP Point HART module/s are connected.

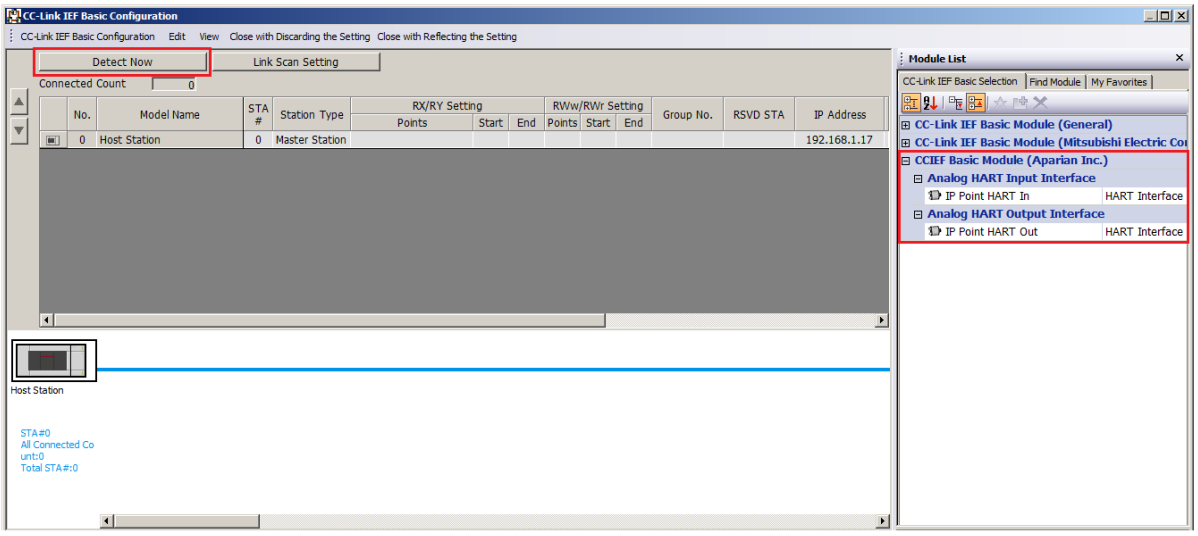


Figure 3.43 – CC-Link IEF Basic Configuration

With the IP Point HART module connected, select the ***Detect Now*** button, which will start the module detection (discovery) process.

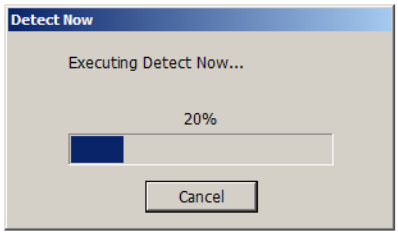


Figure 3.44 – Detect Now

The results of the module detection (discovery) will then be tabulated and should include the IP Point HART device as shown below.

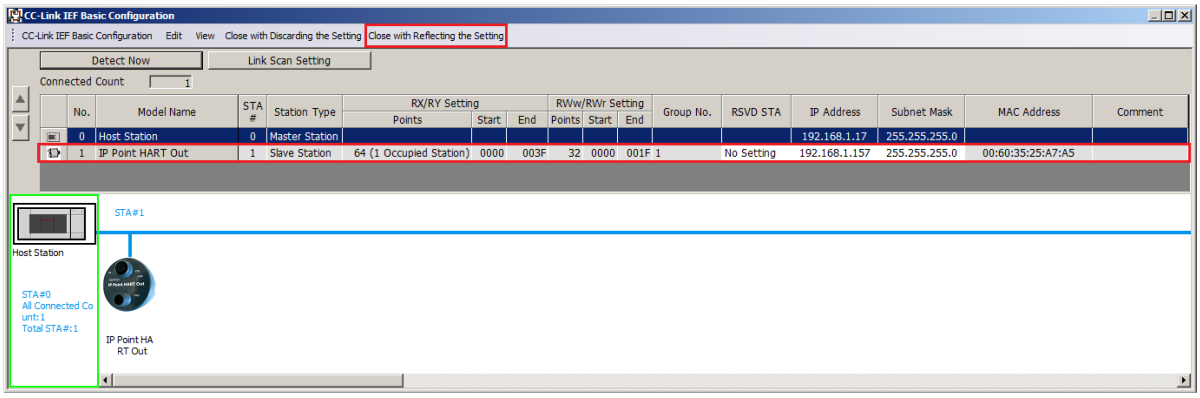


Figure 3.45 – Detection Complete

Select the ***Close with Reflecting the Setting*** button at the top of the window.

Then select the configuration button adjacent to the ***Refresh Settings*** item.

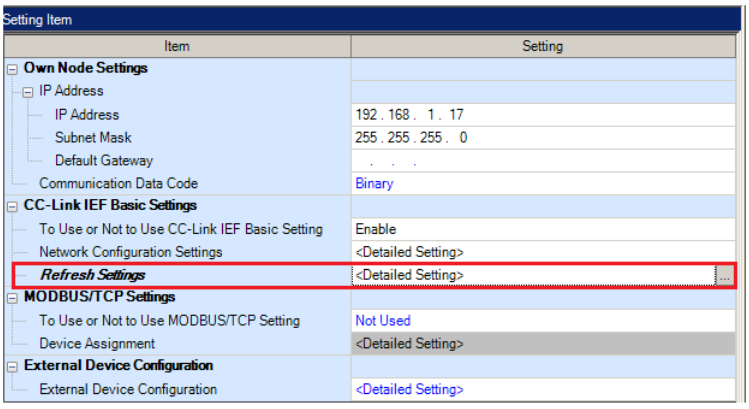


Figure 3.46 – Refresh Settings

The ***Refresh Settings*** are used to map the IP Point HART data to physical memory in the PLC.

The mapping can be changed to suit the application, the example mapping code provided assumes the following mapping:

Link Side					CPU Side				
Device Name	Points	Start	End		Target	Device Name	Points	Start	End
RX	64	00000	0003F		Specify Device	X	64	100	177
RY	64	00000	0003F		Specify Device	Y	64	100	177
RWr	32	00000	0001F		Specify Device	W	32	00040	0005F
RWw	32	00000	0001F		Specify Device	W	32	00080	0009F

Figure 3.47 – Example Mapping (Refresh Settings)

The IP Point Data map is defined as follows:

Digital Inputs (RX)		
Bit	*RX (Octal)*	*Description*
0	**00**	Config Ok
1	**01**	Channel Enabled
2	**02**	Channel HART Enabled
3	**03**	-
4	**04**	-
5	**05**	-
6	**06**	-
7	**07**	-
8	**10**	Loop Open/Current output fault
9	**11**	Current Under-range
10	**12**	Current Over-range
11	**13**	Loop Shorted
12	**14**	Calibration Busy
13	**15**	Calibration Failed
14	**16**	HART Comms Fault
15	**17**	Relay Message Inhibit
16	**20**	Parity Error
17	**21**	Overrun Error
18	**22**	Framing Error
19	**23**	Checksum Error
20	**24**	Rx Buffer Overflow
21	**25**	Value Too Large
22	**26**	Value Too Small
23	**27**	Not Enough Bytes In Command
24	**30**	Transmitter Specific Command Error
25	**31**	In Write Protect Mode
26	**32**	Update Failed
27	**33**	Applied Process Too High
28	**34**	Applied Process Too Low
29	**35**	In Multidrop Mode
30	**36**	Invalid Unit Code
31	**37**	Both Range Values Out Of Limits
32	**40**	Pushed Upper Range Value Over Limit
33	**41**	Access Restricted

34	**42**	Device Busy
35	**43**	Command Not Implemented
36	**44**	Device Malfunction
37	**45**	Configuration Changed
38	**46**	Cold Start
39	**47**	More Status Available
40	**50**	Loop Current Fixed
41	**51**	Loop Current Saturated
42	**52**	Non-Primary Variable Out of Limits
43	**53**	Primary Variable Out of Limits
Analog Inputs (RWr)		
Byte	*RWr (Hex)*	*Description*
0	**00**	Main - PV
4	**02**	Main - SV
8	**04**	Main - TV
12	**06**	Main - FV
16	**08**	Analog 4-20mA
20	**0A**	Scaled Value
24	**0C**	Device Temperature
Analog Outputs (RWw)		
Byte	*RWw (Hex)*	*Description*
0	**00**	Analog Out (IP Point HART Out Only)

Table 3.10 – CC-Link IEF Basic Mapping

4. OPERATION

Once the IP Point HART module has been configured it will exchange analog and HART information between the HART field device and a Logix controller, DNP3 Master or Modbus TCP master.

4.1. LOGIX 5000

When the module operates in a Logix “owned” mode the Logix controller will establish a class 1 cyclic communication connection with the IP Point HART module. An input and output assembly is exchanged at a fix interval.

As discussed in the previous chapter, the addition of the module to Logix can be achieved by either using the Generic profile and the UDTs provided, or by using the EDS AOP. Although the data transferred is the same, there are subtle naming differences between the two methods.

The EDS AOP method does not publish strings. To extract the strings, (e.g. Instance Name, Tag and Descriptor) the user must copy (COP) the string length to a standard Logix string data type.

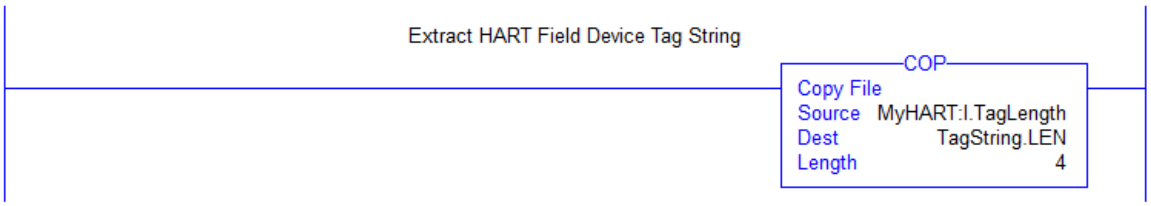


Figure 4.1. – Extraction of EDS AOP Strings

4.1.1. INPUT ASSEMBLY

The following parameters are used in the input assembly of the IP Point HART In and IP Point HART Out modules.

Parameter	Datatype	Description
Instance	STRING	The instance name of the module that was configured under the general IP Point HART module configuration in Slate. When using the EDS AOP method, the InstanceLength member must be copied to a standard string. (COP Length = 5 DINTs)
Module Status	DINT	Bit 0 – Configuration Valid

		Bit 1 – Channel 0 Enabled Bit 2 – Reserved Bit 3 – Reserved Bit 4 – Reserved Bit 5 – Channel 0 HART Enabled Bit 6 – Reserved Bit 7 – Reserved Bit 8 – Reserved
Temperature	REAL	The internal temperature of the module in °C.
ManufacturerID	SINT	The unique manufacturer identification code.
ManufacturerDeviceType	SINT	The device type code specified by the manufacturer.
LiveList	INT	When using Multidrop functionality this will indicate which of the configured devices are online. Note that each bit represents the configured Multidrop Device Index (see the Multidrop configuration in the Advanced Mapping section). For example, if bit 3 is set, then Multidrop device at MD 3 is online (for the specific channel).
DeviceID	DINT	The device identification code specified by the manufacturer.
Tag	STRING8	Tag name of the field device. When using the EDS AOP method, the TagLength member must be copied to a standard string. (COP Length = 3 DINTs)
Descriptor	STRING16	Descriptor of the field device. When using the EDS AOP method, the DescriptorLength member must be copied to a standard string. (COP Length = 5 DINTs)
DeviceStatus	SINT	Device Status comprising the following bits:
DeviceStatus.LoopOpen	BOOL	Loop open circuit detected. (Current < 3.6 mA)
DeviceStatus.CurrentUnderrange	BOOL	Loop current under range. (Current < 3.8 mA)
DeviceStatus.CurrentOverrange	BOOL	Loop current over range. (Current > 20.5 mA)
DeviceStatus.LoopShorted	BOOL	Loop short circuit detected. (Current > 21.0 mA)
DeviceStatus.CalibrationBusy	BOOL	Analog current calibration busy.
DeviceStatus.CalibrationFaulted	BOOL	Analog calibration failed.
DeviceStatus.HARTCommsFault	BOOL	HART communication failure.
DeviceStatus.RelayMessagesInhibited	BOOL	Relay HART messages inhibited, as set in configuration. This will prevent DTM and other class 2 communications.
HARTStatus	DINT	HART Status information as reported by field device.

HARTStatus.ParityError	BOOL	Parity error detected by field device.
HARTStatus.OverrunError	BOOL	Field device buffer overrun.
HARTStatus.FramingError	BOOL	HART Framing error detected by field device.
HARTStatus.ChecksumError	BOOL	Checksum error detected by field device.
HARTStatus.RxBufferOverflow	BOOL	Field device receive buffer overflow.
HARTStatus.ValueTooLarge	BOOL	Value too large in previous HART command.
HARTStatus.ValueTooSmall	BOOL	Value too small in previous HART command.
HARTStatus.NotEnoughBytesInCommand	BOOL	Insufficient bytes in previous HART command.
HARTStatus.TransmitterSpecificCmdError	BOOL	Specific error in previous HART command.
HARTStatus.InWriteProtectMode	BOOL	Previous command rejected due to field device being in Write-Protect mode.
HARTStatus.UpdateFailed	BOOL	Previous parameter update failed.
HARTStatus.AppliedProcessTooHigh	BOOL	Applied process too high or out of range.
HARTStatus.AppliedProcessTooLow	BOOL	Applied process too low or out of range.
HARTStatus.InMultidropMode	BOOL	Field device current in multi-drop mode.
HARTStatus.InvalidUnitCode	BOOL	Invalid unit code received in command.
HARTStatus.BothRangeValuesOutOfLimits	BOOL	Configured range units out of range.
HARTStatus.PushedUpperRangeValueOverLimit	BOOL	Upper range out of limits.
HARTStatus.AccessRestricted	BOOL	Access Restricted.
HARTStatus.DeviceBusy	BOOL	Device Busy.
HARTStatus.CommandNotImplemented	BOOL	Command not supported.
HARTStatus.DeviceMalfunction	BOOL	Device Malfunction.
HARTStatus.ConfigurationChanged	BOOL	Configuration changed.
HARTStatus.Coldstart	BOOL	Field device power failure or device reset has occurred.
HARTStatus.MoreStatusAvailable	BOOL	Additional status information is available.
HARTStatus.LoopCurrentFixed	BOOL	The Loop Current is set at a fixed value and is not responding to process variations
HARTStatus.LoopCurrentSaturated	BOOL	The Loop Current has reached its upper or lower limit.
HARTStatus.NonPrimaryVariableOutOFLimits	BOOL	A variable other than the PV is beyond its operating limits.
HARTStatus.PrimaryVariableOutOfLimites	BOOL	The PV is beyond its operating limits.
RawCurrent	REAL	Raw analog current in mA.
ScaledValue	REAL	Scaled and filtered PV in engineering units.

DigitialCurrent	REAL	The field device's target current.
PV	REAL	Primary Variable in engineering units.
SV	REAL	Secondary Variable in engineering units.
TV	REAL	Third Variable in engineering units.
FV	REAL	Fourth Variable in engineering units.
PVUnitCode	SINT	Primary Variable engineering units code.
SVUnitCode	SINT	Secondary Variable engineering units code.
TVUnitCode	SINT	Third Variable engineering units code.
FVUnitCode	SINT	Fourth Variable engineering units code.
Diagnostics.DeviceSpecificStatus0_0 - 5	SINTs	Additional device specific status information. Refer to the specific field device documentation.
Diagnostics.OperationalModes_0 - 1	SINTs	Operation mode of the field device.
Diagnostics.StandardizedStatus0	SINT	Standardized Status byte 0
Diagnostics.StandardizedStatus1	SINT	Standardized Status byte 1
Diagnostics.AnalogChannelSaturated	SINT	Relating to the Loop Current reaching its upper or lower limit.
Diagnostics.StandardizedStatus2	SINT	Standardized Status byte 2
Diagnostics.StandardizedStatus3	SINT	Standardized Status byte 3
Diagnostics.AnalogChannelFixed	SINT	Relating to the loop current being set at a fixed value and not responding to process variations
Diagnostics.DeviceSpecificStatus1_0 - 10	SINTs	Additional device specific status information. Refer to the specific field device documentation.

Table 4.1 – IP Point HART Logix 5000 input assembly parameters

4.1.2. Output Assembly

The following parameters are used in the output assembly of the IP Point HART Out module.

Parameter	Datatype	Description
OutputData	REAL	Analog output value (in engineering units) for Channel 0.

Table 4.2 – IP Point HART Out Logix 5000 output assembly parameters

4.1.3. HART Relay Message

The IP Point module supports the relaying of custom HART commands to the field device. This is achieved by building the HART command request and then sending it to the module using

an explicit message instruction. An example of this is shown in the figure below.

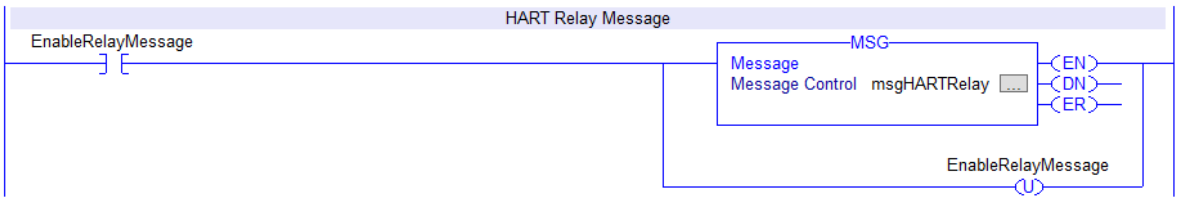


Figure 4.2. – Relay HART Message

The required attributes for the message instruction are as follows:

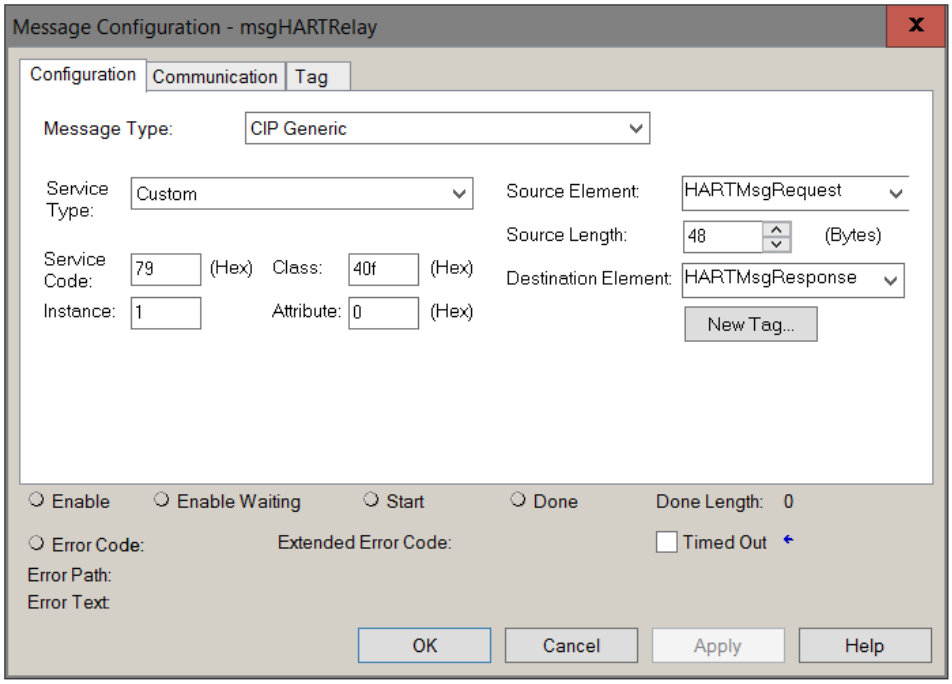


Figure 4.3. – Relay HART Message Configuration

Parameter	Value / Description
Message Type	CIP Generic
Service Type	Custom
Service Code	79 Hex (Relay HART Message service)
Class	40F Hex
Instance	1
Attribute	0
Source Element	Tag of type AparianHARTRelayMessageRequest

Source Length	48
Destination Element	Tag of type AparianHARTRelayMessageResponse

Table 4.3 – Relay HART Message Parameters

The required Request and Response HART Command structures are defined as follows:

HART Command Request		
Byte Offset	Data Type	Description
0	INT	Request Length
2	SINT	Start Character (0x82 for Long Address)
3	SINT	Long Address 0 (0x80 + Manufacturer ID)
4	SINT	Long Address 1 (Device Type Code)
5	SINT	Long Address 2 (Device ID Byte 0)
6	SINT	Long Address 3 (Device ID Byte 1)
7	SINT	Long Address 4 (Device ID Byte 2)
8	SINT	Command Code
9	SINT	Command Data Length (in bytes)
10…	SINT[]	Command Data (If required)

Table 4.4 – Relay HART Message Request Structure

HART Command Response		
Byte Offset	Data Type	Description
0	INT	Status (See table below)
2	INT	Packet Length
4	SINT	Start Character
5	SINT	Long Address 0
6	SINT	Long Address 1
7	SINT	Long Address 2
8	SINT	Long Address 3
9	SINT	Long Address 4
10	SINT	Command Code (Echoed)
11	SINT	Reply Data Length
12	INT	Status (Same as at byte 0 above).
14	SINT[]	Command Reply Data

Table 4.5 – Relay HART Message Response Structure

4.1.3.1. HART COMMAND STATUS ENCODING

The Status code returned in the HART relay command can be decoded as follows:

To determine which table to use, first examine the value of the bit 7 in the first byte.

If Byte 0 Bit 7 = 0 then:	
First Byte : Command Errors	
Value	Description
0	No error
1	(Undefined)
2	Invalid selection
3	Passed parameter too large
4	Passed parameter too small
5	Too few data bytes received
6	Transmitter specific error
7	In write-protect mode
8-15	Command specific error
16	Access restricted
32	Device is busy
64	Command not implemented
Second Byte : Device Status	
Bit	Description
0	PV out of limits
1	Variable (non-PV) out of limits
2	Analog output saturated
3	Output current fixed
4	(Undefined)
5	Cold Start
6	Configuration Changed

Table 4.6 - Status Decoding (when first byte bit 7 = 0)

If Byte 0 Bit 7 = 1 then:	
First Byte : Communication Errors	
Bit	Description
0	(Undefined)
1	Rx buffer overflow
2	(Undefined)
3	Checksum error
4	Framing error
5	Overrun error
6	Parity error
Second Byte : Not defined	
Value	Description
0	(Always zero)

Table 4.7 - Status Decoding (when first byte bit 7 = 1)

4.1.3.2. HART COMMAND EXAMPLE

In the example below a Logix message instruction is used to Read the Unique Identifier of the device. This makes use of the Universal Command #0. The field device is connected to channel 0, hence the Instance value set to 1.

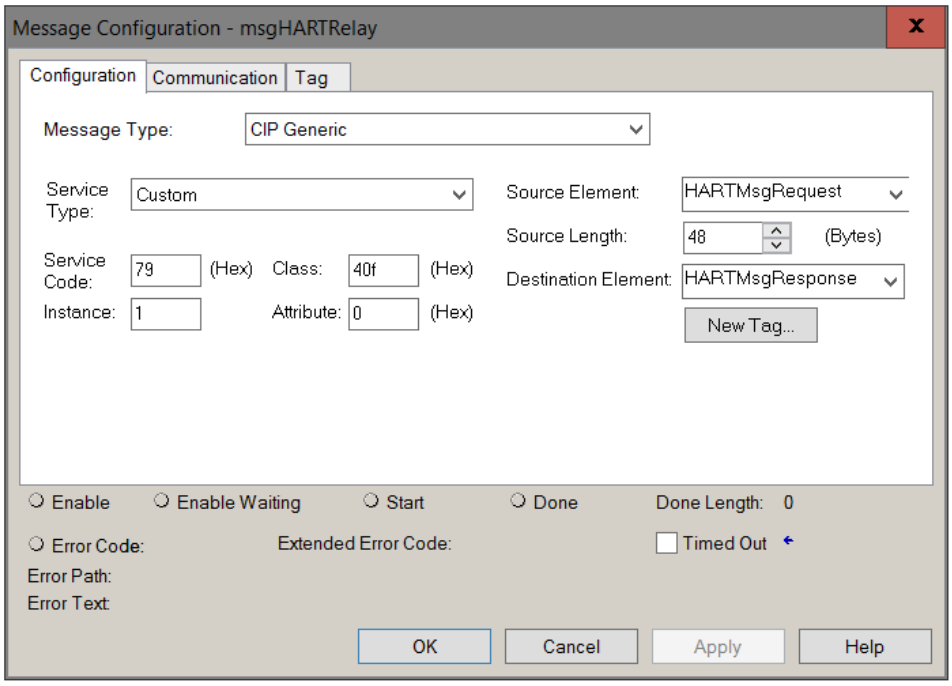


Figure 4.4. – Relay HART Message Example Configuration

HARTMsgRequest	{...}		AparianHARTRelayMessageRequest	
HARTMsgRequest.Length	8	Decimal	INT	Length = 8 bytes
HARTMsgRequest.StartCharacter	16#82	Hex	SINT	Start = 0x82 (Long Address)
HARTMsgRequest.AddressByte0	16#91	Hex	SINT	0x80 + ManufacturerID
HARTMsgRequest.AddressByte1	16#38	Hex	SINT	Device Type Code = 56 = 0x38
HARTMsgRequest.AddressByte2	16#79	Hex	SINT	DeviceID = 0xFF4F79
HARTMsgRequest.AddressByte3	16#4f	Hex	SINT	
HARTMsgRequest.AddressByte4	16#ff	Hex	SINT	
HARTMsgRequest.CommandData	{...}	Hex	SINT[40]	
HARTMsgRequest.CommandData[0]	16#00	Hex	SINT	Command = 0 Read Unique Identifier
HARTMsgRequest.CommandData[1]	16#00	Hex	SINT	Command Data Length = 0
HARTMsgRequest.CommandData[2]	16#00	Hex	SINT	Command Data (Not required for Cmd 0)
HARTMsgRequest.CommandData[3]	16#00	Hex	SINT	
HARTMsgRequest.CommandData[4]	16#00	Hex	SINT	
HARTMsgRequest.CommandData[5]	16#00	Hex	SINT	
HARTMsgRequest.CommandData[6]	16#00	Hex	SINT	

Figure 4.5. – Relay HART Command Example – Request

HARTMsgResponse	{...}		AparianHARTRelayMessageResponse	
HARTMsgResponse.Status	16#4000	Hex	INT	Status = 0x4000
HARTMsgResponse.PacketLength	32	Decimal	INT	
HARTMsgResponse.StartCharacter	16#86	Hex	SINT	Long Address
HARTMsgResponse.AddressByte0	16#91	Hex	SINT	
HARTMsgResponse.AddressByte1	16#38	Hex	SINT	
HARTMsgResponse.AddressByte2	16#79	Hex	SINT	
HARTMsgResponse.AddressByte3	16#4f	Hex	SINT	
HARTMsgResponse.AddressByte4	16#ff	Hex	SINT	
HARTMsgResponse.Command	0	Decimal	SINT	Command Echo
HARTMsgResponse.ByteCount	24	Decimal	SINT	Reply Length = 24
HARTMsgResponse.Data	{...}	Hex	SINT[50]	
HARTMsgResponse.Data[0]	16#00	Hex	SINT	Status = 0x4000 (repeated)
HARTMsgResponse.Data[1]	16#40	Hex	SINT	
HARTMsgResponse.Data[2]	16#fe	Hex	SINT	Command 0 Reply Data: Format 254
HARTMsgResponse.Data[3]	16#11	Hex	SINT	Command 0 Reply Data: ManufacturerID
HARTMsgResponse.Data[4]	16#38	Hex	SINT	Command 0 Reply Data: Device Type Code
HARTMsgResponse.Data[5]	16#05	Hex	SINT	Command 0 Reply Data: Number of Preambles
HARTMsgResponse.Data[6]	16#07	Hex	SINT	Command 0 Reply Data: Universal Cmd Rev
HARTMsgResponse.Data[7]	16#03	Hex	SINT	Command 0 Reply Data: Specific Cmd Rev
HARTMsgResponse.Data[8]	16#03	Hex	SINT	Command 0 Reply Data: Software Rev
HARTMsgResponse.Data[9]	16#08	Hex	SINT	Command 0 Reply Data: Hardware Rev

Figure 4.6. – Relay HART Command Example – Response

NOTE: The HART Long Address for a device is comprised of the Manufacturer ID, Device Type Code and Device ID. These values are displayed on the Channel Status screen in Slate when the device is Online.

4.1.4. MULTIDROP

When using Multidrop HART devices with Logix, the user must select the Logix Tag to be used to populate the HART device data.

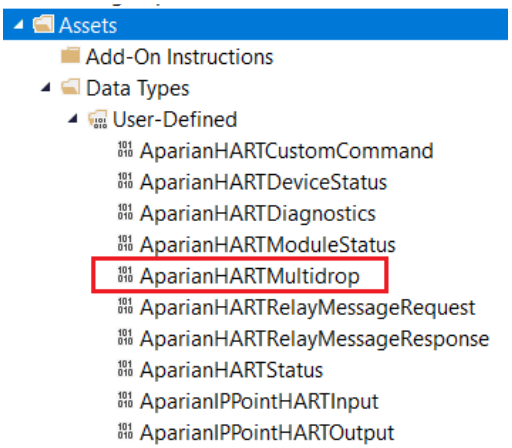


Figure 4.7 – Multidrop UDTs

NOTE: If the user does not use the provided UDTs it can result in unexpected behavior or no data updates.

Once the Logix tags for each multidrop HART device have been selected, the IP Point HART

will automatically update the Logix tags with the data from each multidrop HART device on the HART channel.

4.1.4.1. MULTIDROP UDT STRUCTURE

MultiDropDevice01	{...}	{...}		AparianHARTMulti...	
MultiDropDevice01.PollStatus	2#0000_0000		Binary	SINT	Auto-Polling command status bits
MultiDropDevice01.LastStatusByte	0		Decimal	SINT	Last first status byte received from device
MultiDropDevice01.LastSecond_StatusByte	0		Decimal	SINT	Last second status byte received from device
MultiDropDevice01.ManufactureIDCode	0		Decimal	SINT	Device's Manufacture ID Code
MultiDropDevice01.DeviceTypeCode	0		Decimal	SINT	Device Type Code
MultiDropDevice01.MinPreambles	0		Decimal	SINT	Minimum Number of Preambles
MultiDropDevice01.UniversalCMDMajor	0		Decimal	SINT	Universal Command Major Revision Number
MultiDropDevice01.DeviceRevision	0		Decimal	SINT	Device Revision Level
MultiDropDevice01.SoftwareRevision	0		Decimal	SINT	Software Revision Level
MultiDropDevice01.HardwareRevision	0		Decimal	SINT	Hardware Revision Level
MultiDropDevice01.DeviceFlags	0		Decimal	SINT	Device Flags
MultiDropDevice01.DeviceID	0		Decimal	DINT	Device ID
MultiDropDevice01.PreambleResponse	0		Decimal	SINT	Minimum Preambles Count to Response
MultiDropDevice01.MaxNumberDeviceVariables	0		Decimal	SINT	Maximum Number of HART Device Variables
MultiDropDevice01.ConfigChangeCount	0		Decimal	INT	Counter for Configuration Changes
MultiDropDevice01.ExtDeviceStatus	0		Decimal	SINT	Extended Field Device Status
MultiDropDevice01.PVUnits	0		Decimal	SINT	Primary Units Code
MultiDropDevice01.SVUnits	0		Decimal	SINT	Secondary Units Code
MultiDropDevice01.TVUnits	0		Decimal	SINT	Tertiary Units Code
MultiDropDevice01.FVUnits	0		Decimal	SINT	Quaternary Units Code
MultiDropDevice01.Tagname	''	{...}		AparianSTRING8	HART Device Tag Name
MultiDropDevice01.Descriptor	''	{...}		AparianSTRING16	HART Device Descriptor
MultiDropDevice01.TVUnits	0		Decimal	SINT	Tertiary Units Code
MultiDropDevice01.FVUnits	0		Decimal	SINT	Quaternary Units Code
MultiDropDevice01.Tagname	''	{...}		AparianSTRING8	HART Device Tag Name
MultiDropDevice01.Descriptor	''	{...}		AparianSTRING16	HART Device Descriptor
MultiDropDevice01.TagDescriptorDate	''	{...}		AparianSTRING8	HART Device Descriptor Date
MultiDropDevice01.SerialNumber	0		Decimal	DINT	Transducer Serial Number
MultiDropDevice01.TransducerLimits	0		Decimal	SINT	Transducer Limits
MultiDropDevice01.PVAlarms	0		Decimal	SINT	PV Alarm Counter
MultiDropDevice01.PVTransfer	0		Decimal	SINT	PV Transfer Counter
MultiDropDevice01.PVURLLRV_Units	0		Decimal	SINT	PV Upper and Lower Value Limits
MultiDropDevice01.WriteProtectionCode	0		Decimal	SINT	Write Protection Code
MultiDropDevice01.PrivateLabelCode	0		Decimal	SINT	Private Label Distributor Code
MultiDropDevice01.PVAnalogChFlag	0		Decimal	SINT	PV Analog Channel Flag
MultiDropDevice01.PV	0.0		Float	REAL	Primary Variable Value
MultiDropDevice01.SV	0.0		Float	REAL	Secondary Variable Value
MultiDropDevice01.TV	0.0		Float	REAL	Tertiary Variable Value
MultiDropDevice01.FV	0.0		Float	REAL	Quaternary Variable Value
MultiDropDevice01.UpperTransducerLimit	0.0		Float	REAL	Upper Transducer Limit
MultiDropDevice01.LowerTransducerLimit	0.0		Float	REAL	Lower Transducer Limit
MultiDropDevice01.MinimumSpan	0.0		Float	REAL	Minimum Span
MultiDropDevice01.PVUpperRange	0.0		Float	REAL	PV Upper Range Value
MultiDropDevice01.PVLowerRange	0.0		Float	REAL	PV Lower Range Value
MultiDropDevice01.PVDamping	0.0		Float	REAL	PV Damping Value

Figure 4.8 – Multidrop – UDT

Parameter	Datatype	Description
PollStatus	SINT	Bit 0 – When set this bit will indicate that the device is online
LastStatusByte	SINT	The first byte of the field device HART response status. See the HART section at the end of this document for details regarding the HART status.
LastSecond_StatusByte	SINT	The second byte of the field device HART response status. See the HART section at the end of this document for details regarding the HART status.
ManufactureIDCode	SINT	The unique manufacturer identification code.
DeviceTypeCode	SINT	The device type code specified by the manufacturer.
MinPreambles	SINT	Minimum Number of Preambles.
UniversalCMDMajor	SINT	Universal Command Major Revision Number.
DeviceRevision	SINT	Device Revision Number.
SoftwareRevision	SINT	Software Revision Number.
HardwareRevision	SINT	Hardware Revision Number.
DeviceFlags	SINT	Device Function Flags. Bit 0 – Multi Sensor device Bit 1 – EEPROM control required Bit 2 – Protocol Bridge Device
DeviceID	DINT	Device Identification Number
PreambleResponse	SINT	Number of Preambles.
MaxNumberDeviceVariables	SINT	Maximum Number of Device Variables
ConfigChangeCount	INT	Configuration Change Number
ExtDeviceStatus	SINT	Extended Device Status
PVUnits	SINT	Primary Variable engineering units code.
SVUnits	SINT	Secondary Variable engineering units code.
TVUnits	SINT	Third Variable engineering units code.
FVUnits	SINT	Fourth Variable engineering units code.
Tagname	STRING8	Tag name of the field device.
Descriptor	STRING16	Descriptor of the field device.
TagDescriptorDate	STRING8	Date of the field device.
SerialNumber	DINT	Sensor Serial Number
TransducerLimits	SINT	Sensor Limits and Minimum Span Units Code.
PVAlarms	SINT	PV Alarm Selection Code
PVTransfer	SINT	PV Transfer Function Code

PVURLLRV_Units	SINT	PV Upper and Lower Range Values Units Code
WriteProtectionCode	SINT	Write Protection Code
PrivateLabelCode	SINT	Private Label Distributor Code
PVAnalogChFlag	SINT	PV Analog Channel Flags
PV	REAL	Primary Variable in engineering units.
SV	REAL	Secondary Variable in engineering units.
TV	REAL	Third Variable in engineering units.
FV	REAL	Fourth Variable in engineering units.
UpperTransducerLimit	REAL	Upper Transducer Limit
LowerTransducerLimit	REAL	Lower Transducer Limit
MinimumSpan	REAL	Minimum Span
PVUpperRange	REAL	PV Upper Rage Value
PVLowerRange	REAL	PV Lower Range Value
PVDamping	REAL	PV Damping Value (s)

Table 4.8 – Multidrop UDT structure

4.1.5. HART CHANNEL COMMAND

The HART communication can dynamically be inhibited from the EtherNet/IP protocol interface. This is done by sending a Set Single Attribute to a specific CIP class, instance, and attribute. The data being send is 8 bytes where the first byte is the HART channel command and the remaining 7 bytes are reserved. When the first byte is set to 1, then the HART Communication on the specific channel will be inhibited. The instance will determine the target HART channel (which for the IP Point HART will always be instance 1 – Channel 0).

Parameter	**Value / Description**
Message Type	CIP Generic
Service Type	Set Single Attribute
Service Code	10 Hex (Set Single Attribute)
Class	40F Hex
Instance	Channel value + 1 (*1 for Channel 0*)
Attribute	14
Source Element	SINT[8] *SINT[0] – when set to 1 the HART communication will be inhibited.* *SINT[1] to SINT[7] – reserved.*

Source Length	8
Destination Element	None

Table 4.9 – HART Channel Command Parameters

4.1.6. HART PROCESS VARIABLE CIP PARAMETERS

The module supports additional CIP attributes which will allow the EtherNet/IP device to read all 4 process variables (PV, SV, TV, and FV) from the "main" HART device as well as each multidrop HART device for each respective HART channel (which for the IP Point HART will always be instance 1 – Channel 0).

Parameter	**Value / Description**
Message Type	CIP Generic
Service Type	Get Single Attribute
Service Code	0E Hex (Get Single Attribute)
Class	40F Hex
Instance	Channel value + 1 (*1 for Channel 0*)
Attribute	25 – Main HART device 35 – Multidrop Device Index 0 45 – Multidrop Device Index 1 55 – Multidrop Device Index 2 65 – Multidrop Device Index 3 75 – Multidrop Device Index 4 85 – Multidrop Device Index 5 95 – Multidrop Device Index 6
Source Element	None
Source Length	8
Destination Element	REAL[4] *REAL[0] – HART Device PV.* *REAL[1] – HART Device SV.* *REAL[2] – HART Device TV.* *REAL[3] – HART Device FV.*

Table 4.10 – HART Process Variable CIP Parameters

4.1.7. HART CUSTOM COMMAND

The module supports sending of custom HART commands to a field device. See the *Advanced Mapping setup* section for more details regarding the Custom Command parameters. When adding a custom HART command (with a EtherNet/IP interface), a Logix tag will need to be selected with the correct Logix UDT type (*AparianHARTCustomCommand*). See the IP Point HART Logix example code for the UDT.

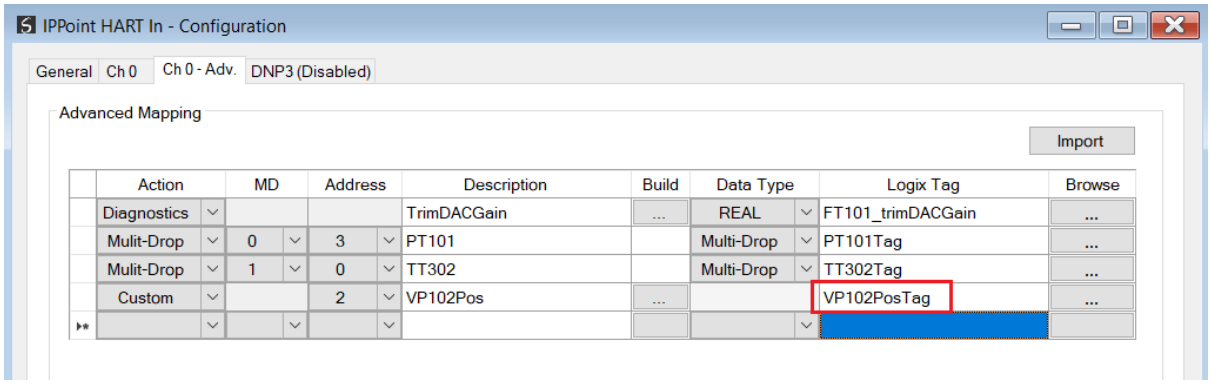


Figure 4.9 – Custom HART command selected Logix Tag

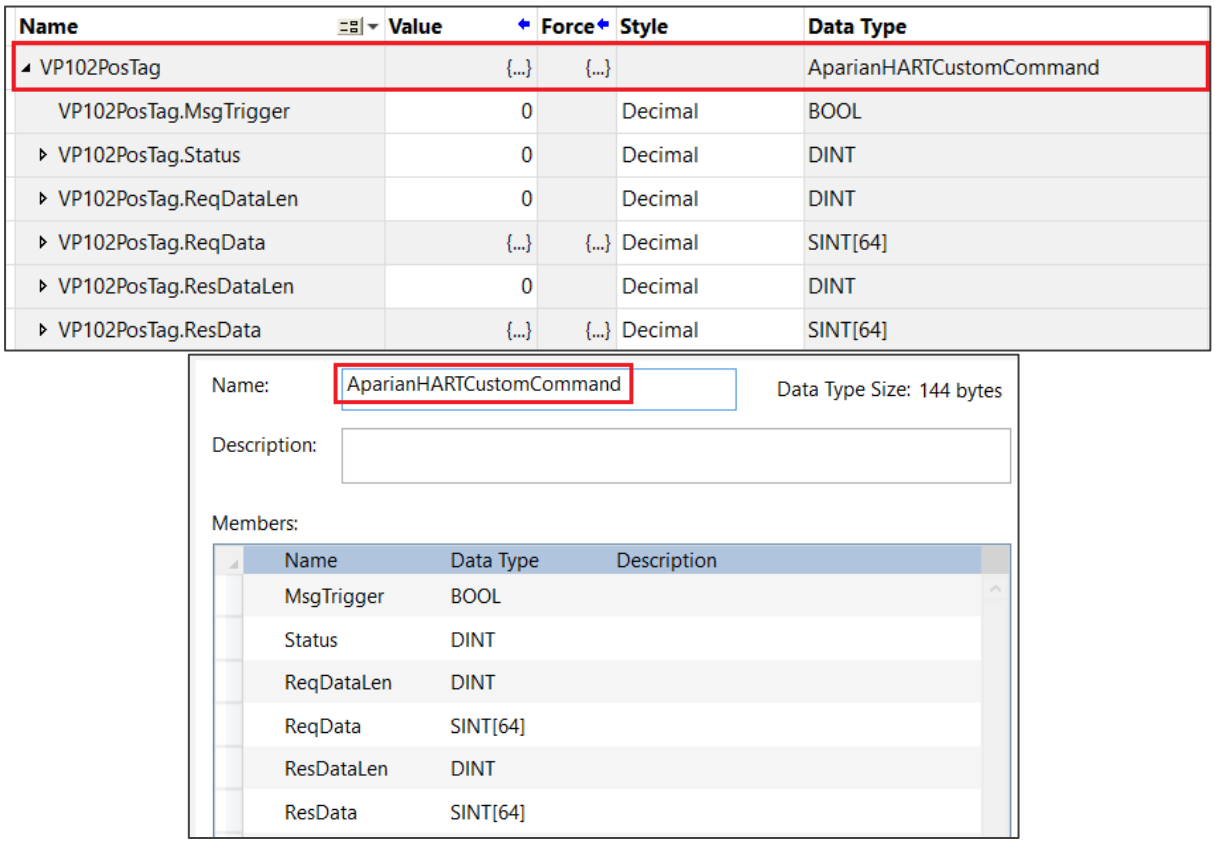


Figure 4.10 – Custom HART command Logix Tag

When the user wants to start the execution of the custom HART command, the MsgTrigger parameter must be set to 1. Once the message transaction has been completed, the

MsgTrigger parameter will be cleared back to zero. Once the message has been completed, the status parameter will also be updated to indicate the status of the transaction.

Below is the description of the various parameters in the UDT.

Parameter	Description
MsgTrigger	This is the trigger to start the execution of the custom HART command. When this parameter is set to 1 it will start sending the custom HART message. Once complete this parameter will automatically be cleared back to zero.
Status	Once the custom HART message transaction has completed, it will update the status field in the UDT to indicate the status of the transaction. 0 – Success 1 – Response Timeout 2 – HART device offline 3 – No Multidrop Device configured
ReqDataLen	This parameter indicate the number of bytes to be sent in the custom HART command. If this parameter is made zero, then no additional HART data will be sent other than the HART command.
ReqData	The ReqData parameter is a SINT array allowing for up to 64 bytes to be sent. **NOTE**: It is the user's responsibility to ensure that the data to be sent is in the correct format based on the HART command.
ResDataLen	This parameter indicate the number of bytes received from the custom HART command. If this parameter is made zero, then no HART data was received.
ResData	The ResData parameter is a SINT array allowing for up to 64 bytes to be returned.

Table 4.11 – Custom HART command UDT Parameters

4.2. DNP3 OPERATION

The DNP3 operation is enabled when the configuration protocol is set to either DNP3 TCP or DNP3 UDP. The IP Point HART module will then operate as a DNP3 Outstation supporting the following DNP3 objects.

Group:	**20 - Counters**	
Variation:	**5**	
Functions:	**Read**	
Parameter	Length	Item
Application Messages Received	1	0
Application Messages Sent	1	1
Critical Messages Received	1	2
Critical Messages Sent	1	3
Discarded Messages	1	4
Error Messages Sent	1	5
Error Messages Received	1	6
Checksum Error	1	7
HART Tx Count	1	20
HART Rx Count	1	21
Communication Errors	1	22
Command Errors	1	23
Time-Out Errors	1	24

Group:	**30 - Analog Inputs**	
Variation:	**1,2,3,4,5,6**	
Functions:	**Read**	
Parameter	Length	Item
Raw Current	1	10
Scaled Value	1	11
Digital Current	1	12
PV - Primary Value	1	13
SV - Secondary Value	1	14
TV - Tertiary Value	1	15
FV - Fourth Value	1	16

Group:	**41 - Analog Outputs**	
Variation:	**1,2,3,4**	
Functions:	**Select, Operate, Direct Operate, Direct Operate w/o Ack**	
Parameter	Length	Item
Output Value	1	0

Group:	**102 - Unsigned 8-bit Integers**	
Variation:	**1**	
Functions:	**Read**	
Parameter	Length	Item
Module Status *Bit 0 – Configuration Valid* *Bit 1 – Channel 0 Enabled* *Bit 2 – Reserved* *Bit 3 – Reserved* *Bit 4 – Reserved* *Bit 5 – Channel 0 HART Enabled* *Bit 6 – Reserved* *Bit 7 – Reserved* *Bit 8 – Reserved*	1	0
PV Units Code	1	10
SV Units Code	1	11
TV Units Code	1	12
FV Units Code	1	13
Manufacturer ID	1	100
Manufacturer Device Type Code	1	101
Number of Preambles Required	1	102
Universal Command Rev	1	103
Device Specific Command Rev	1	104
Software Rev	1	105
Hardware Rev	1	106
Device Function Flags	1	107
Device ID Number	3	108
Pad Byte	1	111
Sensor Serial Number	3	112
Units Code for Sensor	1	115
Sensor Upper Limit	4	116
Sensor Lower Limit	4	120
Sensor Minimum Span	4	124
Tag	8	128
Descriptor	16	136
Date	3	152
Device Status		
Device Status	1	500
HART Status	2	501
Device Specific Status 0	6	503
Operational Modes	2	509
Standardized Status 0	1	511
Standardized_status1	1	512
Analog channel saturated	1	513
Standardized_status2	1	514
Standardized_status3	1	515

Analog channel fixed	1	516
Device Specific Status 1	11	517

Table 4.12 - DNP3 Object Implementation

4.2.1. DNP3 SECURITY

DNP3 offers Secure Authentication for links at risk of being attacked. There are various Key Change methods, Message Authentication Code (MAC) algorithms, and Authentication methods provided in the DNP3 protocol specification.

Various keys are used in DNP3 Secure Authentication. Session keys are used most frequently as it is used for Authentication of the requests. These keys are updated by the DNP3 master at a certain interval or every time there has been a message failure. The DNP3 master encrypts these keys before sending them across the wire using the Key Wrap Algorithm selected and the Update key. The Update Key can be updated in numerous ways (including sending it across the wire with another set of Keys encrypting that message).

The IP Point HART modules support DNP3 Secure Authentication 5, using the Pre-Shared Key method for Key Changes. Thus, the Update Key needs to be entered into each device by means outside of the DNP3 protocol.

In Slate the user can write the Update Key into the IP Point HART module using the Key tab in the Online Status window. The key entered must match the Key Wrap Algorithm selected. Thus, if AES-128 Key Wrap was selected the Update Key must be 128-bit (16 bytes) long. If AES-256 Key Wrap was selected the Update Key must be 256-bit (32 bytes) long. The user can either enter a predetermined hexadecimal code of create a new code in Slate as shown below. This key is encrypted and sent to the IP Point HART module where it is saved into the NV memory of the module.



NOTE: The Key update method in Slate is a **write-only** function. Thus once the key has been downloaded the user will not be able to view the key again. Thus the user must make provision to document or save the key in a secure manner.



NOTE: The DNP3 master device must have the same Update Key and security configuration settings as that of the IP Point HART module. Failing to do this will result in failed data exchange for critical messages.

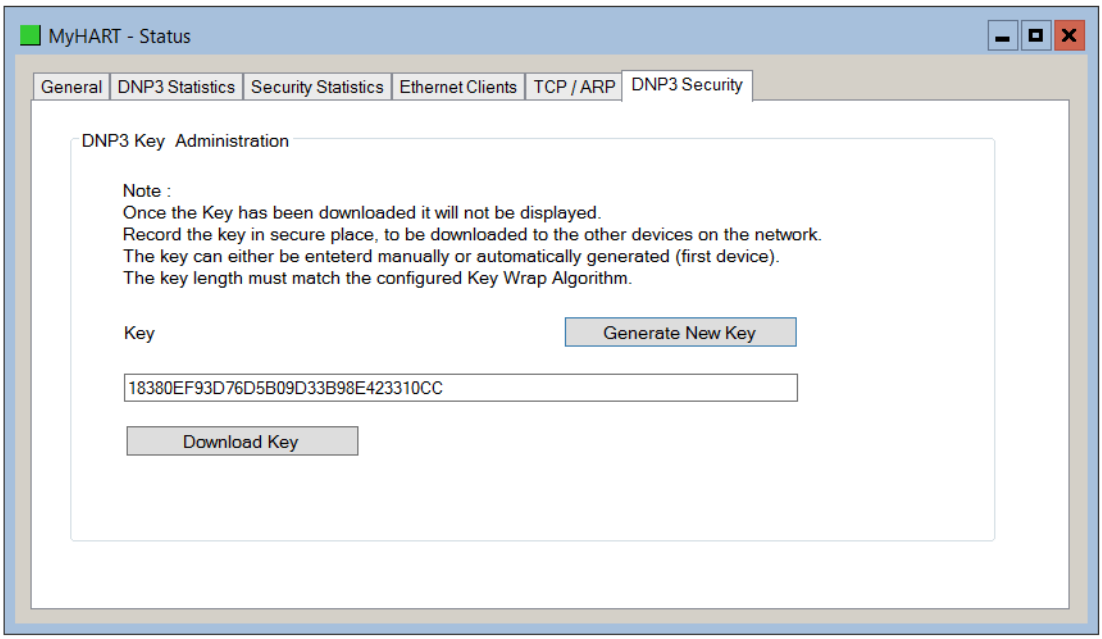


Figure 4.11 - IP Point HART DNP3 key update method.

The module supports all DNP3 MAC algorithms and Key Wrap algorithms. The module also supports Aggressive Authentication mode which reduces the amount of traffic on the network (which could be required on busy networks or serial communication).

4.3. MODBUS TCP OPERATION

The Modbus TCP operation is enabled when the configuration protocol is set to either Modbus TCP. The IP Point HART module will then operate as a Modbus TCP Slave supporting the following Modbus registers.

Register Type:	**Holding Registers**		
Parameter	Byte Length	Date Type	Register
Module Status *Bit 0 – Configuration Valid* *Bit 1 – Channel 0 Enabled* *Bit 2 – Reserved* *Bit 3 – Reserved* *Bit 4 – Reserved* *Bit 5 – Channel 0 HART Enabled* *Bit 6 – Reserved* *Bit 7 – Reserved* *Bit 8 – Reserved*	2	INT	0
Modbus Statistics			
Rx Packet Count	4	DINT	20
Tx Packet Count	4	DINT	22

Checksum Errors	4	DINT	24
Timeouts	4	DINT	26
Device Info			
Manufacturer ID	1	BYTE	100
Manufacturer Device Type Code	1	BYTE	
Number of Preambles Required	1	BYTE	101
Universal Command Rev	1	BYTE	
Device Specific Command Rev	1	BYTE	102
Software Rev	1	BYTE	
Hardware Rev	1	BYTE	103
Device Function Flags	1	BYTE	
Device ID Number	3	BYTE[3]	104
Pad Byte	1	BYTE	
Sensor Serial Number	3	BYTE[3]	106
Units Code for Sensor	1	BYTE	
Sensor Upper Limit	4	REAL	108
Sensor Lower Limit	4	REAL	110
Sensor Minimum Span	4	REAL	112
Tag	8	BYTE[8]	114
Descriptor	16	BYTE[16]	118
Date	3	BYTE[3]	126
HART Statistics			
HART Tx Count	4	DINT	500
HART Rx Count	4	DINT	502
Communication Errors	4	DINT	504
Command Errors	4	DINT	506
Parity Errors	4	DINT	508

Register Type:	**Input Registers**		
Parameter	Byte Length	Date Type	Register
Device Process Variables			
Raw current	4	REAL	0
Scaled Value	4	REAL	2
Digital current	4	REAL	4
PV	4	REAL	6
SV	4	REAL	8
TV	4	REAL	10
FV	4	REAL	12
PV units code	1	SINT	14
SV units code	1	SINT	
TV units code	1	SINT	15
FV units code	1	SINT	
Device Status			
Device Status	1	BYTE	400
HART Status	2	INT	401
Device Specific Status 0	6	BYTE[6]	402

Operational Modes	2	BYTE[2]	405
Standardized Status 0	1	BYTE	406
Standardized_status1	1	BYTE	
Analog channel saturated	1	BYTE	407
Standardized_status2	1	BYTE	
Standardized_status3	1	BYTE	408
Analog channel fixed	1	BYTE	
Device Specific Status 1	11	BYTE[11]	409

Output Data			
Output Process Variable	4	REAL	800

Table 4.13 - Modbus Register Map

4.3.1. MULTIDROP

When multidrop is being used for HART devices the data from each device will automatically be updated to the specific Multidrop Device Index (MD). The table below indicates the Modbus location for the associated data.

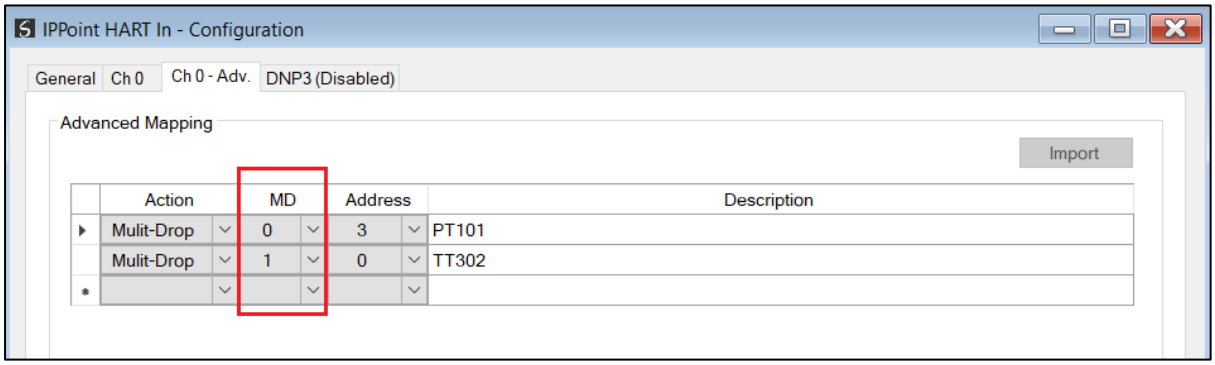


Figure 4.12 - Setting Multidrop Device Index

Register Type:	**Holding Registers**		
Parameter	Byte Length	Date Type	Register
Multidrop Device Index (MD) - 0			
Poll Status	2	INT	1000
Manufacturer ID	1	BYTE	1001
Mfg Device Type Code	1	BYTE	
Number of Preambles Required	1	BYTE	1002
Universal Command Rev	1	BYTE	
Device Specific Command Rev	1	BYTE	1003
Software Rev	1	BYTE	
Hardware Rev	1	BYTE	1004
Device Function Flags	1	BYTE	

Device ID Number	3	BYTE[3]	1005
Pad Byte	1	BYTE	
Sensor Serial Number	3	BYTE[3]	1007
Units Code for Sensor	1	BYTE	
Sensor Upper Limit	4	REAL	1009
Sensor Lower Limit	4	REAL	1011
Sensor Minimum Span	4	REAL	1013
Tag	8	BYTE[8]	1015
Descriptor	16	BYTE[16]	1019
Date	3	BYTE[3]	1027
Multidrop Device Index (MD) - 1			
Poll Status	2	INT	1100
Manufacturer ID	1	BYTE	1101
Mfg Device Type Code	1	BYTE	
Number of Preambles Required	1	BYTE	1102
Universal Command Rev	1	BYTE	
Device Specific Command Rev	1	BYTE	1103
Software Rev	1	BYTE	
Hardware Rev	1	BYTE	1104
Device Function Flags	1	BYTE	
Device ID Number	3	BYTE[3]	1105
Pad Byte	1	BYTE	
Sensor Serial Number	3	BYTE[3]	1107
Units Code for Sensor	1	BYTE	
Sensor Upper Limit	4	REAL	1109
Sensor Lower Limit	4	REAL	1111
Sensor Minimum Span	4	REAL	1113
Tag	8	BYTE[8]	1115
Descriptor	16	BYTE[16]	1119
Date	3	BYTE[3]	1127
Multidrop Device Index (MD) – 2			
Poll Status	2	INT	1200
Manufacturer ID	1	BYTE	1201
Mfg Device Type Code	1	BYTE	
Number of Preambles Required	1	BYTE	1202
Universal Command Rev	1	BYTE	
Device Specific Command Rev	1	BYTE	1203
Software Rev	1	BYTE	
Hardware Rev	1	BYTE	1204
Device Function Flags	1	BYTE	
Device ID Number	3	BYTE[3]	1205
Pad Byte	1	BYTE	
Sensor Serial Number	3	BYTE[3]	1207
Units Code for Sensor	1	BYTE	
Sensor Upper Limit	4	REAL	1209
Sensor Lower Limit	4	REAL	1211

Sensor Minimum Span	4	REAL	1213
Tag	8	BYTE[8]	1215
Descriptor	16	BYTE[16]	1219
Date	3	BYTE[3]	1227
Multidrop Device Index (MD) – 3			
Poll Status	2	INT	1300
Manufacturer ID	1	BYTE	1301
Mfg Device Type Code	1	BYTE	
Number of Preambles Required	1	BYTE	1302
Universal Command Rev	1	BYTE	
Device Specific Command Rev	1	BYTE	1303
Software Rev	1	BYTE	
Hardware Rev	1	BYTE	1304
Device Function Flags	1	BYTE	
Device ID Number	3	BYTE[3]	1305
Pad Byte	1	BYTE	
Sensor Serial Number	3	BYTE[3]	1307
Units Code for Sensor	1	BYTE	
Sensor Upper Limit	4	REAL	1309
Sensor Lower Limit	4	REAL	1311
Sensor Minimum Span	4	REAL	1313
Tag	8	BYTE[8]	1315
Descriptor	16	BYTE[16]	1319
Date	3	BYTE[3]	1327
Multidrop Device Index (MD) – 4			
Poll Status	2	INT	1400
Manufacturer ID	1	BYTE	1401
Mfg Device Type Code	1	BYTE	
Number of Preambles Required	1	BYTE	1402
Universal Command Rev	1	BYTE	
Device Specific Command Rev	1	BYTE	1403
Software Rev	1	BYTE	
Hardware Rev	1	BYTE	1404
Device Function Flags	1	BYTE	
Device ID Number	3	BYTE[3]	1405
Pad Byte	1	BYTE	
Sensor Serial Number	3	BYTE[3]	1407
Units Code for Sensor	1	BYTE	
Sensor Upper Limit	4	REAL	1409
Sensor Lower Limit	4	REAL	1411
Sensor Minimum Span	4	REAL	1413
Tag	8	BYTE[8]	1415
Descriptor	16	BYTE[16]	1419
Date	3	BYTE[3]	1427
Multidrop Device Index (MD) - 5			
Poll Status	2	INT	1500

Manufacturer ID	1	BYTE	1501
Mfg Device Type Code	1	BYTE	
Number of Preambles Required	1	BYTE	1502
Universal Command Rev	1	BYTE	
Device Specific Command Rev	1	BYTE	1503
Software Rev	1	BYTE	
Hardware Rev	1	BYTE	1504
Device Function Flags	1	BYTE	
Device ID Number	3	BYTE[3]	1505
Pad Byte	1	BYTE	
Sensor Serial Number	3	BYTE[3]	1507
Units Code for Sensor	1	BYTE	
Sensor Upper Limit	4	REAL	1509
Sensor Lower Limit	4	REAL	1511
Sensor Minimum Span	4	REAL	1513
Tag	8	BYTE[8]	1515
Descriptor	16	BYTE[16]	1519
Date	3	BYTE[3]	1527
Multidrop Device Index (MD) – 6			
Poll Status	2	INT	1600
Manufacturer ID	1	BYTE	1601
Mfg Device Type Code	1	BYTE	
Number of Preambles Required	1	BYTE	1602
Universal Command Rev	1	BYTE	
Device Specific Command Rev	1	BYTE	1603
Software Rev	1	BYTE	
Hardware Rev	1	BYTE	1604
Device Function Flags	1	BYTE	
Device ID Number	3	BYTE[3]	1605
Pad Byte	1	BYTE	
Sensor Serial Number	3	BYTE[3]	1607
Units Code for Sensor	1	BYTE	
Sensor Upper Limit	4	REAL	1609
Sensor Lower Limit	4	REAL	1611
Sensor Minimum Span	4	REAL	1613
Tag	8	BYTE[8]	1615
Descriptor	16	BYTE[16]	1619
Date	3	BYTE[3]	1627

Register Type:	**Input Registers**		
Parameter	Byte Length	Date Type	Register
Multidrop Device Index (MD) - 0			
PV	4	REAL	1000

SV	4	REAL	1002
TV	4	REAL	1004
FV	4	REAL	1006
PV units code	1	SINT	1008
SV units code	1	SINT	
TV units code	1	SINT	1009
FV units code	1	SINT	
Multidrop Device Index (MD) - 1			
PV	4	REAL	1100
SV	4	REAL	1102
TV	4	REAL	1104
FV	4	REAL	1106
PV units code	1	SINT	1108
SV units code	1	SINT	
TV units code	1	SINT	1109
FV units code	1	SINT	
Multidrop Device Index (MD) - 2			
PV	4	REAL	1200
SV	4	REAL	1202
TV	4	REAL	1204
FV	4	REAL	1206
PV units code	1	SINT	1208
SV units code	1	SINT	
TV units code	1	SINT	1209
FV units code	1	SINT	
Multidrop Device Index (MD) - 3			
PV	4	REAL	1300
SV	4	REAL	1302
TV	4	REAL	1304
FV	4	REAL	1306
PV units code	1	SINT	1308
SV units code	1	SINT	
TV units code	1	SINT	1309
FV units code	1	SINT	
Multidrop Device Index (MD) - 4			
PV	4	REAL	1400
SV	4	REAL	1402
TV	4	REAL	1404
FV	4	REAL	1406
PV units code	1	SINT	1408
SV units code	1	SINT	
TV units code	1	SINT	1409
FV units code	1	SINT	
Multidrop Device Index (MD) - 5			
PV	4	REAL	1500
SV	4	REAL	1502

TV	4	REAL	1504
FV	4	REAL	1506
PV units code	1	SINT	1508
SV units code	1	SINT	
TV units code	1	SINT	1509
FV units code	1	SINT	
Multidrop Device Index (MD) - 6			
PV	4	REAL	1600
SV	4	REAL	1602
TV	4	REAL	1604
FV	4	REAL	1606
PV units code	1	SINT	1608
SV units code	1	SINT	
TV units code	1	SINT	1609
FV units code	1	SINT	

Table 4.14 - Modbus Multidrop Register Map

4.3.2. HART CUSTOM COMMAND

The module supports sending of custom HART commands to a field device. See the *Advanced Mapping setup* section for more details regarding the Custom Command parameters. When adding a custom HART command (with a Modbus TCP interface), offset parameters will need to be configured for the Modbus Holding Registers.

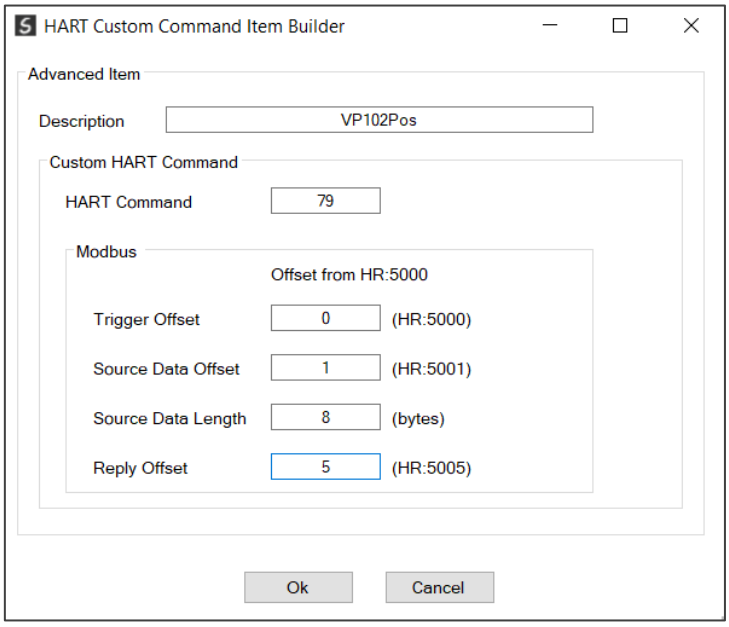


Figure 4.13 – Custom HART Command Builder Mapping (for Modbus TCP)

Each HART channel is allowed up to 500 bytes of mapping data for custom HART commands. The custom HART command Modbus Holding Register range for each HART channel is

shown below:

HART Channel	Modbus HR Range
0	HR 5000 – HR 5249
1	HR 5250 – HR 5499
2	HR 5500 – HR 5749
3	HR 5750 – HR 5999

Table 4.15 – Custom HART Data Modbus Ranges

Each Custom HART command requires four mapping parameters in addition to the HART command:

Modbus Parameter	Description
Trigger Offset	The Trigger Offset parameter is the Modbus HR offset in the Modbus HR range (for the specific HART channel) for the trigger of the HART custom message. For example, if the trigger offset entered is 5 and the custom HART command is on HART channel 0, then the message trigger will be at Modbus HR 5005 (HR 5000 *for HART channel 0* + offset HR 5). If the trigger offset entered is 10 and the custom HART command is on HART channel 1, then the message trigger will be at Modbus HR 5260 (HR 5250 *for HART channel 1* + offset HR 10). The trigger parameter is used to trigger the start of the custom HART message execution. Each time the trigger Modbus HR is changed to a value different from the previous value, it will send the custom HART command. **NOTE:** Changing the trigger to value 0 will not trigger the custom HART command.
Source Data Offset	The source data offset parameter is the location in the Modbus HR range where the HART data to be sent is stored. For example, if the source data offset entered is 20 and the custom HART commands is on HART channel 0, then the HART message data to be sent will start at Modbus HR 5020 (HR 5000 *for HART channel 0* + offset HR 20).
Source Data Length	This is the length of the HART data to be sent in bytes.
Reply Offset	The reply offset parameter is the location in the Modbus HR range where the HART data returned (from the custom HART command) is stored. For example, if the reply offset entered is 40 and the custom HART commands is on HART channel 1, then the HART message data returned will start at Modbus HR 5290 (HR 5250 *for HART channel 1* + offset HR 40). See the Custom HART message operation section for details regarding the format of the reply data.

Table 4.16 – Custom HART command build parameters

The reply data format (written to the Reply Offset Modbus Holding Register location) is shown below:

Modbus Holding Register Offset	Description
Reply Offset + 0	**Status** Once the custom HART message transaction has completed, it will update the status field in the UDT to indicate the status of the transaction. 0 – Success 1 – Response Timeout 2 – HART device offline 3 – No Multidrop Device configured

Reply Offset + 1	**Last Trigger Value** This is the last trigger value (read back from the trigger register) that was updated when the message was executed. **NOTE**: When the trigger value is zero the message will **not** execute even though the last trigger value in this register will be updated.
Reply Offset + 2	**Replay Data Size** The number of bytes returned from the HART custom command.
Reply Offset + 3	**Reply Data** The reply data from the HART custom command. The number of bytes returned will equal the previous parameter *Reply Data Size*.

Table 4.17 – Modbus Custom HART command Reply format

4.4. PCCC OPERATION

The PCCC operation is enabled when the configuration protocol is set to ***SLC 500 / MicroLogix / PLC5***. The IP Point HART module will then operate as a PCCC (AB-ETH) Slave allowing SLC500, MicroLogix, and PLC5 controllers to read and write data to the HART devices.

NOTE: Only ***SLC Typed Read*** and ***SLC Typed Write*** commands are supported by the IP Point HART when operating in PCCC mode.

The following PLC Files are supported for the main device.

Parameter	Files
Integers	
Device Status *Bit 0 - Loop Open/Current output fault* *Bit 1 - Current Underrange/reserved* *Bit 2 - Current Overrange/reserved* *Bit 3 - Loop Shorted/reserved* *Bit 4 - Calibration Busy* *Bit 5 - Calibration Failed* *Bit 6 - HART Comms Fault* *Bit 7 - Relay Message Inhibit*	N10:0
HART Status *See the HART section at the end of the document for information regarding the HART status.*	N10:1
Live List	N10:2

When using Multidrop functionality this will indicate which of the devices that have been configured are online. Note that each bit represents the configured Multidrop Device Index (see the Multidrop configuration in the Advanced Mapping section). *For example, if bit 3 is set, then Multidrop device at MD 3 is online (for the specific channel).*	
Manufacturer ID	N10:3
Device ID	N10:4
PV Unit	N10:5
SV Unit	N10:6
TV Unit	N10:7
FV Unit	N10:8
Floats	
PV Value	F20:0
SV Value	F20:1
TV Value	F20:2
FV Value	F20:3
Analog Value	F20:4
Scaled Value	F20:5
Digital Current	F20:6

Table 4.18 – PLC File Map

NOTE: With a HART output device (when using the IP Point HART Out), the user will need to write to the ***Scaled Value*** to update the analog signal being sent to the output HART device.

4.4.1. MULTIDROP

When multidrop is being used for HART devices the data from each device will automatically be updated to the specific Multidrop Device Index (MD). See below where the MD is set for each HART device for each HART channel.

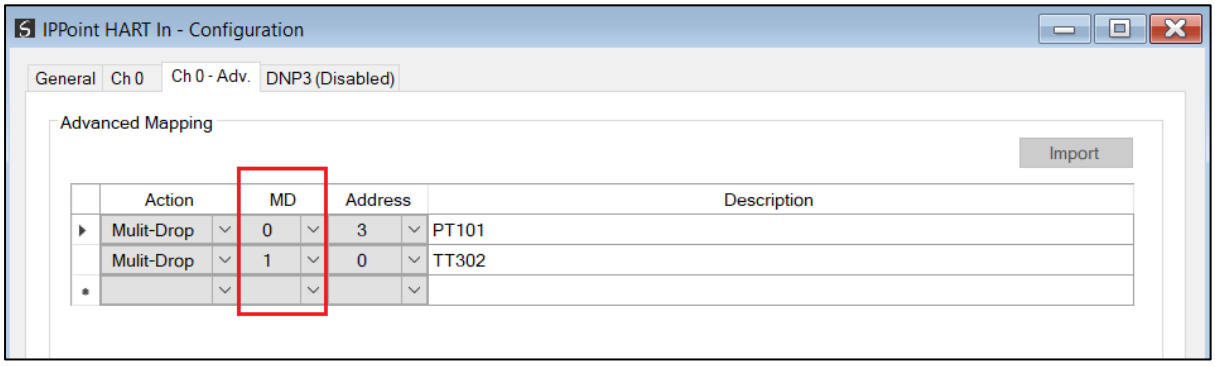


Figure 4.14 - Setting Multidrop Device Index

Parameter	Files
Integers	
Multidrop Device Index (MD) - 0	
Poll Status *Bit 0 – When set this bit will indicate that the device is online*	N10:10
Manufacturer ID	N10:11
Device ID	N10:12
PV Unit	N10:13
SV Unit	N10:14
TV Unit	N10:15
FV Unit	N10:16
Multidrop Device Index (MD) - 1	
Poll Status *Bit 0 – When set this bit will indicate that the device is online*	N10:17
Manufacturer ID	N10:18
Device ID	N10:19
PV Unit	N10:20
SV Unit	N10:21
TV Unit	N10:22
FV Unit	N10:23
Multidrop Device Index (MD) - 2	
Poll Status *Bit 0 – When set this bit will indicate that the device is online*	N10:24
Manufacturer ID	N10:25
Device ID	N10:26
PV Unit	N10:27
SV Unit	N10:28
TV Unit	N10:29
FV Unit	N10:30
Multidrop Device Index (MD) - 3	
Poll Status *Bit 0 – When set this bit will indicate that the device is online*	N10:31
Manufacturer ID	N10:32
Device ID	N10:33

PV Unit	N10:34
SV Unit	N10:35
TV Unit	N10:36
FV Unit	N10:37
Multidrop Device Index (MD) - 4	
Poll Status *Bit 0 – When set this bit will indicate that the device is online*	N10:38
Manufacturer ID	N10:39
Device ID	N10:40
PV Unit	N10:41
SV Unit	N10:42
TV Unit	N10:43
FV Unit	N10:44
Multidrop Device Index (MD) - 5	
Poll Status *Bit 0 – When set this bit will indicate that the device is online*	N10:45
Manufacturer ID	N10:46
Device ID	N10:47
PV Unit	N10:48
SV Unit	N10:49
TV Unit	N10:50
FV Unit	N10:51
Multidrop Device Index (MD) - 6	
Poll Status *Bit 0 – When set this bit will indicate that the device is online*	N10:52
Manufacturer ID	N10:53
Device ID	N10:54
PV Unit	N10:55
SV Unit	N10:56
TV Unit	N10:57
FV Unit	N10:58
Floats	
Multidrop Device Index (MD) - 0	
PV Value	F20:10
SV Value	F20:11
TV Value	F20:12
FV Value	F20:13
Multidrop Device Index (MD) - 1	

PV Value	F20:14
SV Value	F20:15
TV Value	F20:16
FV Value	F20:17
Multidrop Device Index (MD) - 2	
PV Value	F20:18
SV Value	F20:19
TV Value	F20:20
FV Value	F20:21
Multidrop Device Index (MD) – 3	
PV Value	F20:22
SV Value	F20:23
TV Value	F20:24
FV Value	F20:25
Multidrop Device Index (MD) - 4	
PV Value	F20:26
SV Value	F20:27
TV Value	F20:28
FV Value	F20:29
Multidrop Device Index (MD) - 5	
PV Value	F20:30
SV Value	F20:31
TV Value	F20:32
FV Value	F20:33
Multidrop Device Index (MD) - 6	
PV Value	F20:34
SV Value	F20:35
TV Value	F20:36
FV Value	F20:37

Table 4.19 – PLC File Map for Multidrop HART devices

4.5. FTVIEW OPERATION

The IP Point HART module supports direct EDS parameter access allowing FTView to read main and multidrop process variables directly.

4.5.1. REGISTER EDS FILE

Before FTView can access the HART data from the module, the module's EDS file must be registered on that system.

There are multiple ways to achieve this. One of which is to right-click on the HART module in

RSLinx Classic and select the ***Upload EDS file from device*** option.

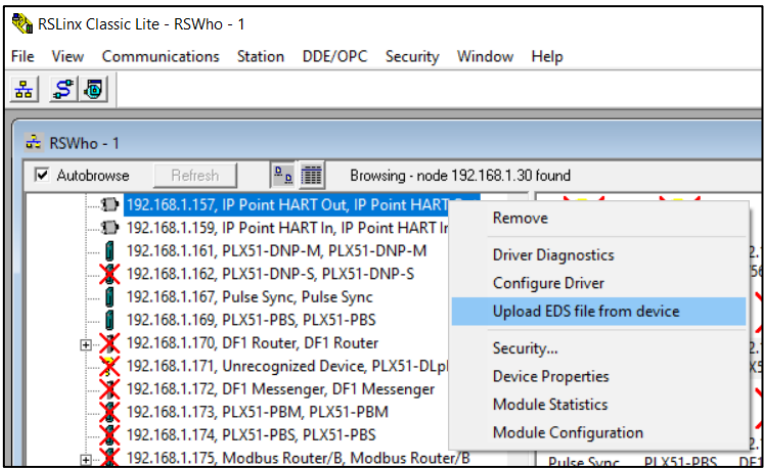


Figure 4.15 – Registering EDS file

This launches the Rockwell Automation EDS Wizard which will guide the user through the steps to complete the registration.

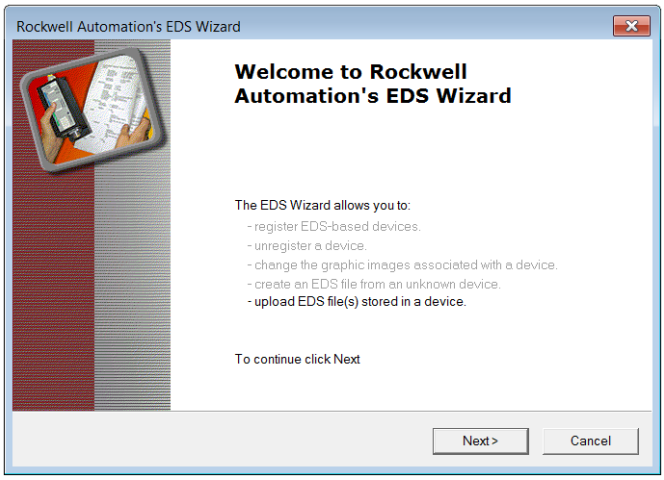


Figure 4.16 – EDS Registration wizard

4.5.2. CONFIGURE FTVIEW COMMUNICATION

Within the FTView environment, (either SE or ME,) using either a new or existing project ensure that the RSLinx Enterprise server has been added.

To add the RSLinx Enterprise communication server, right-click on the project server in the project tree and select the ***Add New Server*** option, and then the ***Rockwell Automation Device Server (RSLinx Enterprise)***.

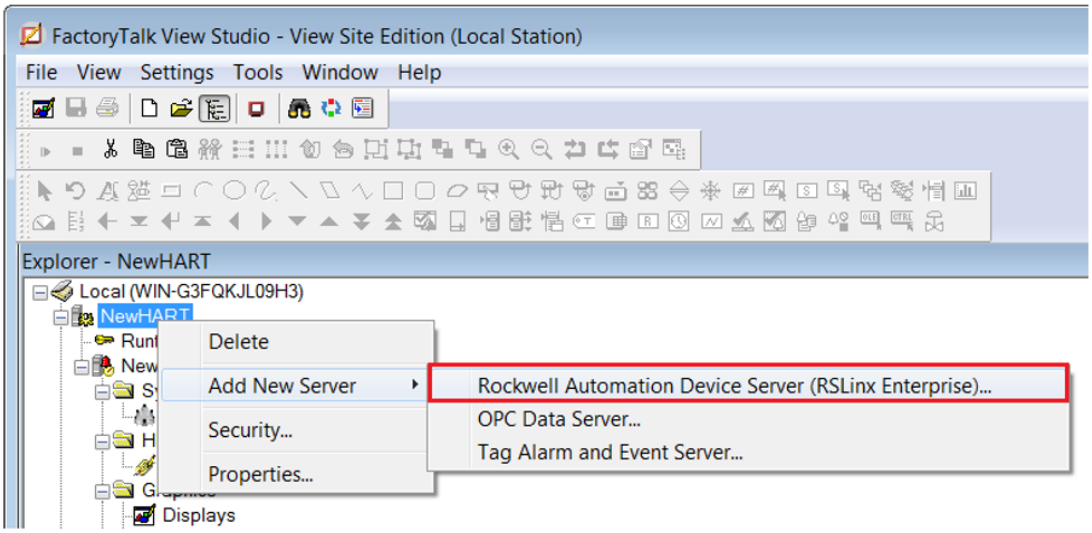


Figure 4.17 – Adding RSLinx Enterprise server

The ***RSLinx Enterprise Server Properties*** window will then open allowing additional configuration. All the default settings can be accepted.

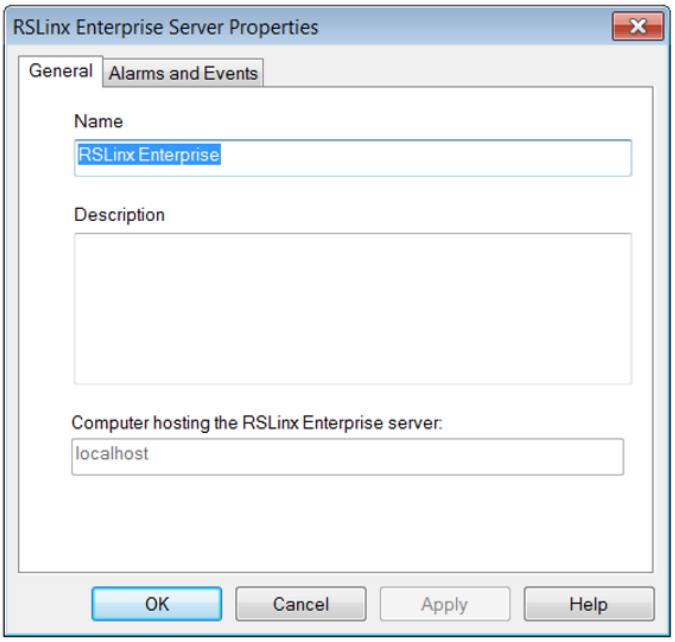


Figure 4.18 – Configuring RSLinx Enterprise

The ***RSLinx Enterprise*** item will then appear in the FTView project tree. Right-click on the ***Communication Setup*** option under this item.

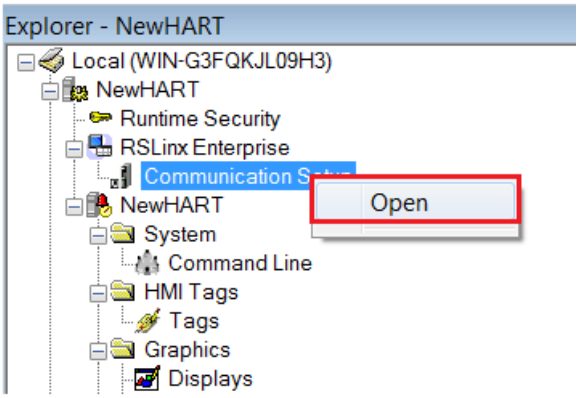


Figure 4.19 – Open Communication Setup

The ***Communication Setup*** window allows the user to associate a ***Device Shortcut*** to the physical IP Point HART module. This can be achieved by the following steps:

1. Under ***Device Shortcuts***, select the ***Add*** button.
2. Name the Device Shortcut, e.g. MyHART
3. Set the ***Shortcut Type*** to ***EDS Parameter***
4. On the right-hand side, navigate to, and select, the IP Point HART module
5. Select the ***Apply*** button (under Device Shortcuts)
6. Select ***Ok***.

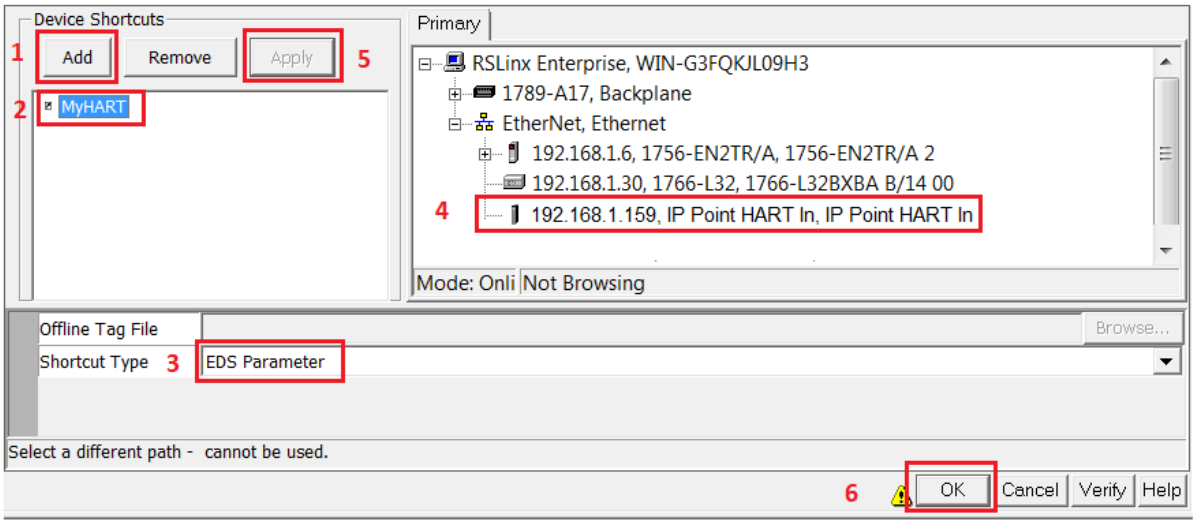


Figure 4.20 – Configuring communication shortcut

A warning, similar to the one below, will be shown. Select the ***Yes*** option to continue and accept the changes.

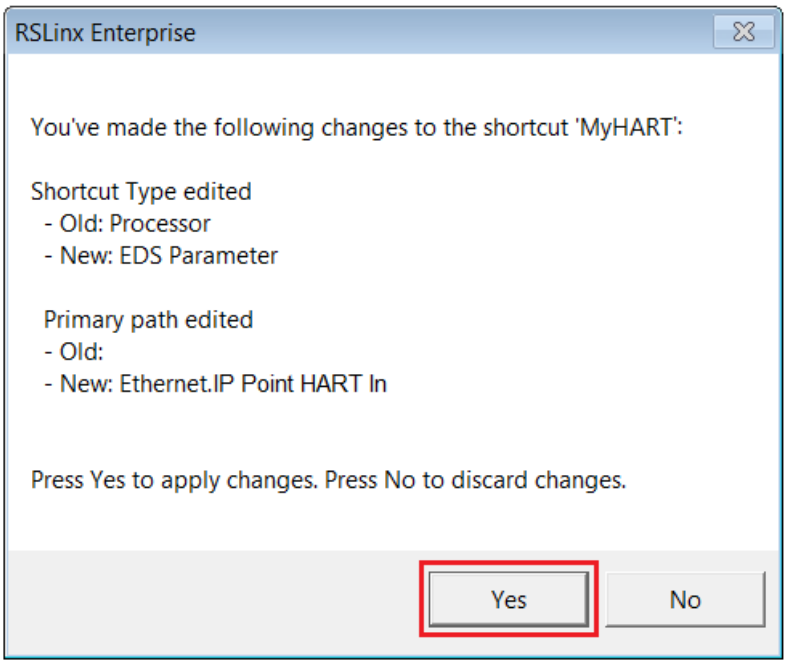


Figure 4.21 – Confirm RSLinx Enterprise shortcut

4.5.3. Displaying Process Variable

A ***Numeric Display*** can now be added to a FTView display to show a HART module parameter.

Open a new or existing display, and using the menu or toolbar, add a ***Numeric Display*** object. In the ***Numeric Display Properties*** window, select the ***Tags*** button.

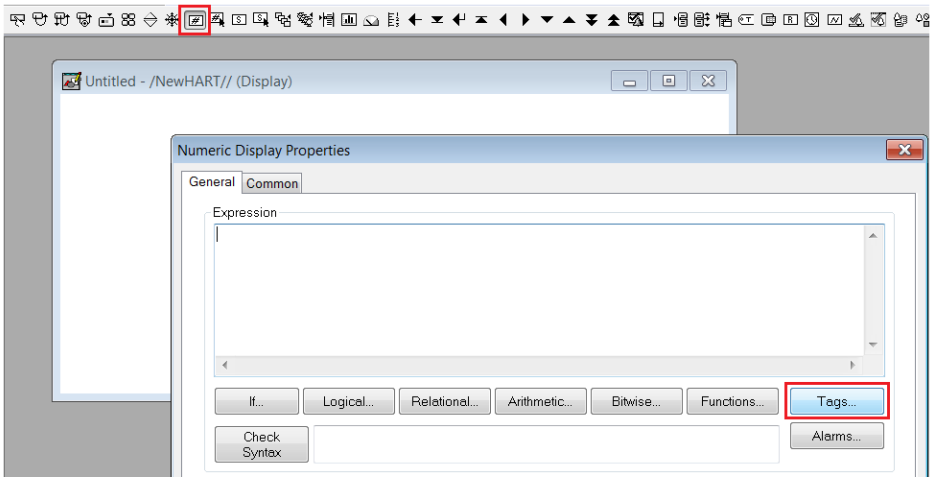


Figure 4.22 – Adding Numeric Display

The FTView ***Tag Browser*** will open. A refresh will be required the first time the ***Tag Browser*** is opened after any changes have been to the communication setup. Right-click on the ***Folders*** tree on the left and select the ***Refresh All Folders*** option.

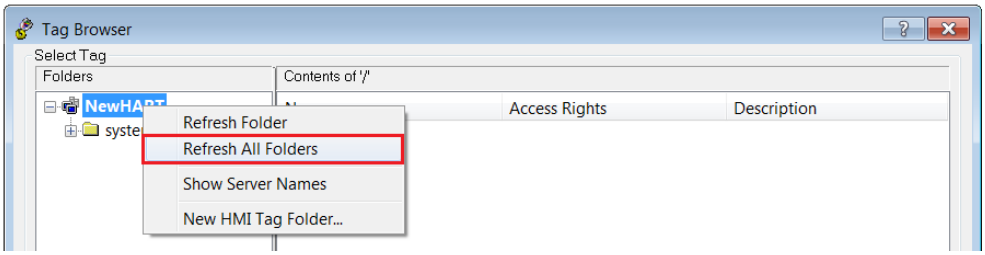


Figure 4.23 – Tag Browser – Refreshing All Folders

Once refreshed, all the HART module parameters will appear under the ***Offline*** section.

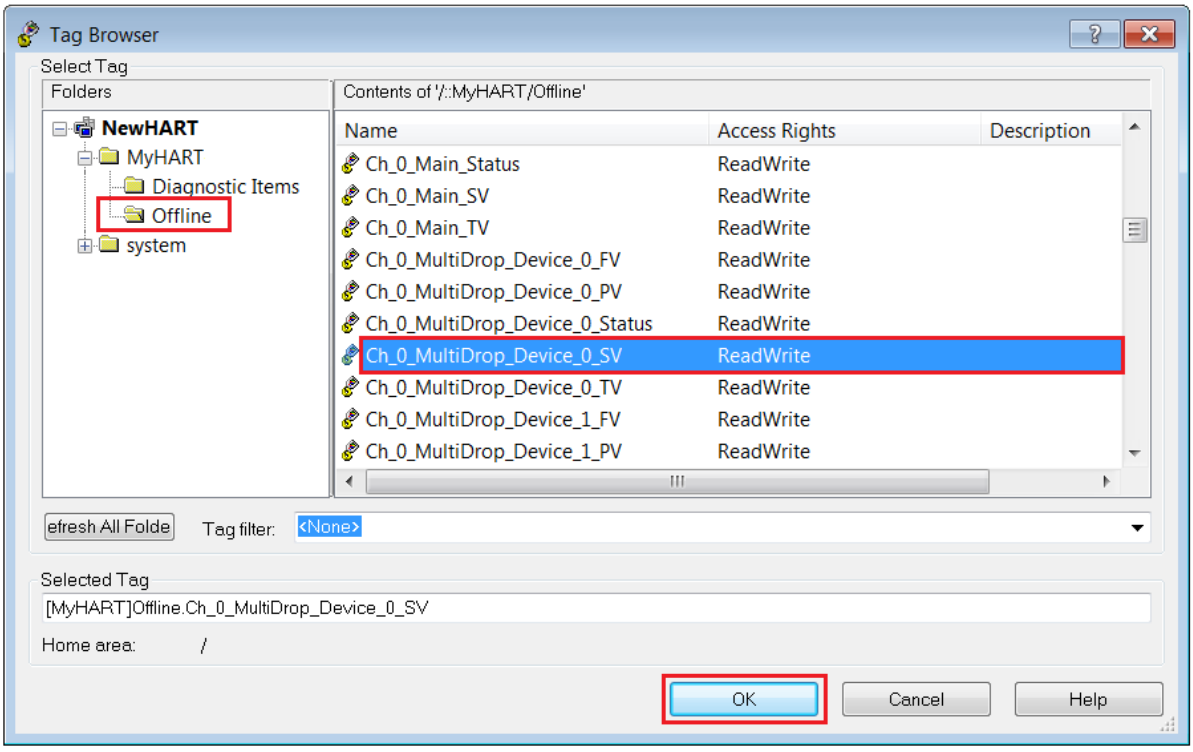


Figure 4.24 – Tag Browser – Select Tag

Select the required parameter (process variable or status) tag and press ***Ok***. The selected tag will appear in the Numeric Display's ***Expression*** textbox.

For a process variable, as in this example, it may be beneficial to set the format to ***Floating Point*** and select a suitable number of ***Decimal Places***.

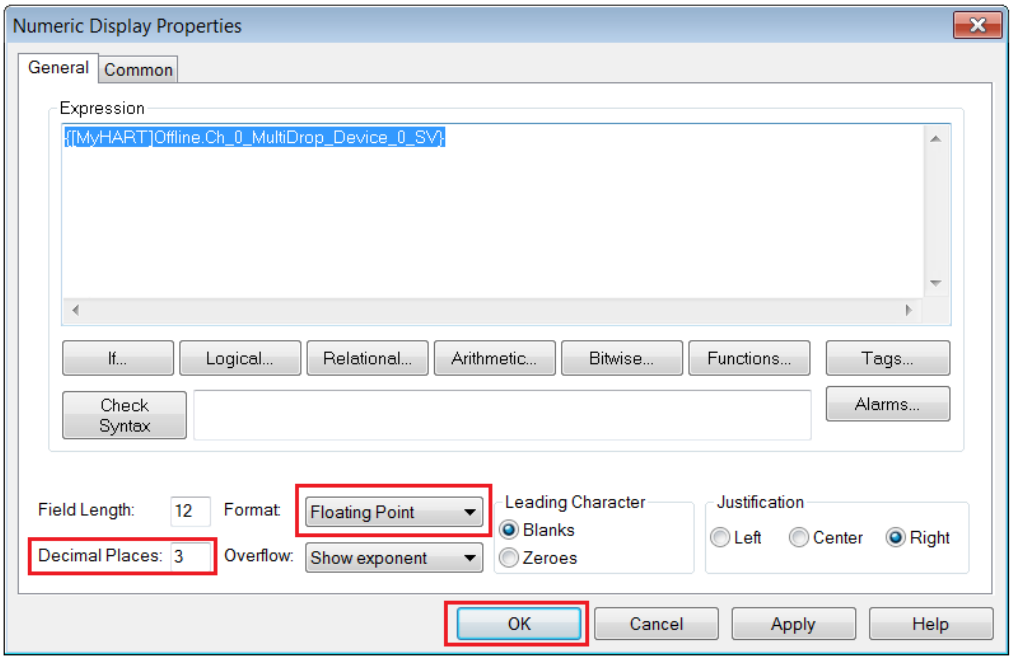


Figure 4.25 – Configure Numeric Display

The Numeric Display can be tested by using FTView's ***Test Display*** option. If the HART-4 module is online and configured correctly, the selected parameter will be displayed.

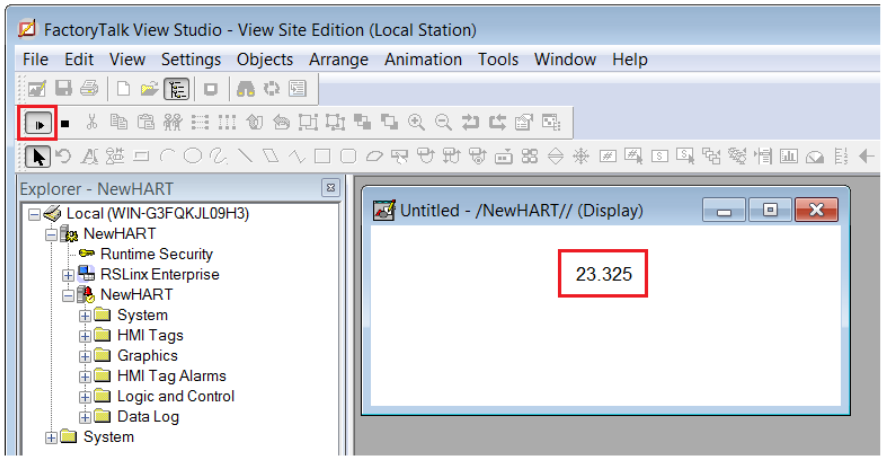


Figure 4.26 – Testing Display

4.6. CC-LINK OPERATION

4.6.1. EXAMPLE MAPPING CODE

An example project, viz.: ***IPPointGXW3Example.gx3***, including the CC-Link IEF Basic configuration and data mapping is available on the Aparian website.

Alternatively, the following individual items are also on the website and can be imported into an existing project.

- Structured Data Type: ***AparianIPPointHARTInput.csv***
- Global Labels: ***Global.csv***
- Program: ***ProgPou.csv***

Download the file ***Aparian IP Point CC-Link Mapping Items.zip*** and unzip the contents.

To import the Structured Data Type, navigate to ***Project…Label***, right-click on the ***Structured Data Types*** item and select the ***Import File*** option.

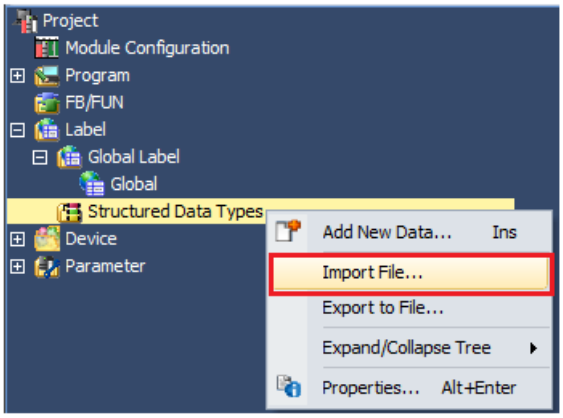


Figure 4.27 – Import Structured Data Types

Then select the ***AparianIPPointHARTInput.csv*** file.

To import the Global Labels (variables), navigate to ***Project…Label***, right-click on the ***Global Label*** item and select the ***Import File*** option.

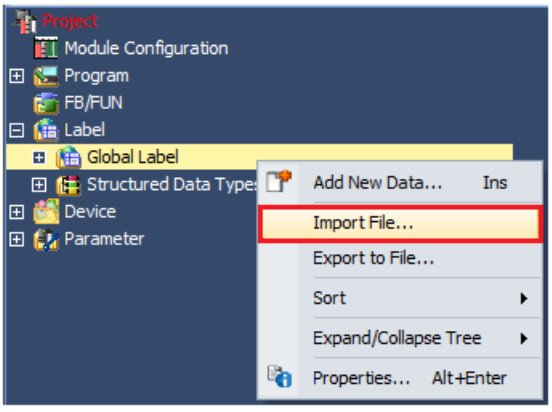


Figure 4.28 – Import Global Labels

Then select the ***Global.csv*** file.

To import the example Program (ladder), navigate to ***Project***…***Program***…***Scan***…***Main***, right-click on the ***ProgPou*** item and select the ***Import File*** …***Program*** option.

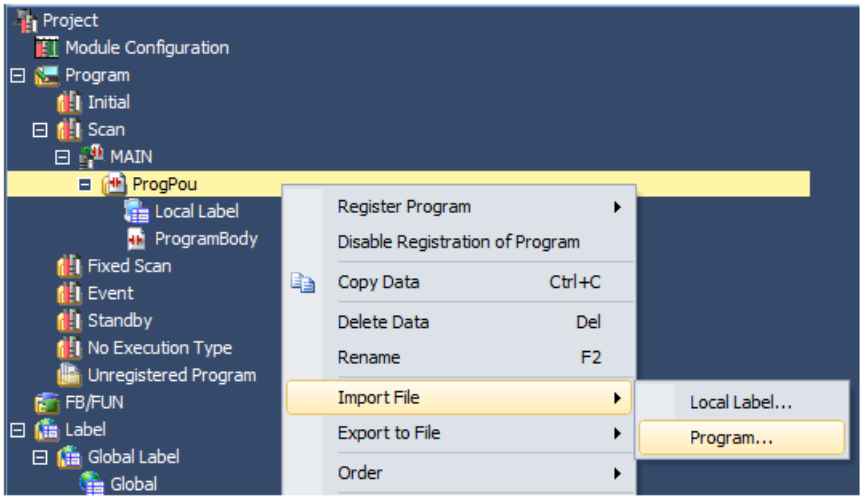


Figure 4.29 – Import Program (ProgPou)

Then select the ***ProgPou.csv*** file.

The project can then be compiled (Rebuild All) and downloaded to the PLC (Write to PLC).

Viewing the example mapping ladder with the Read Monitor option displays the live HART values.

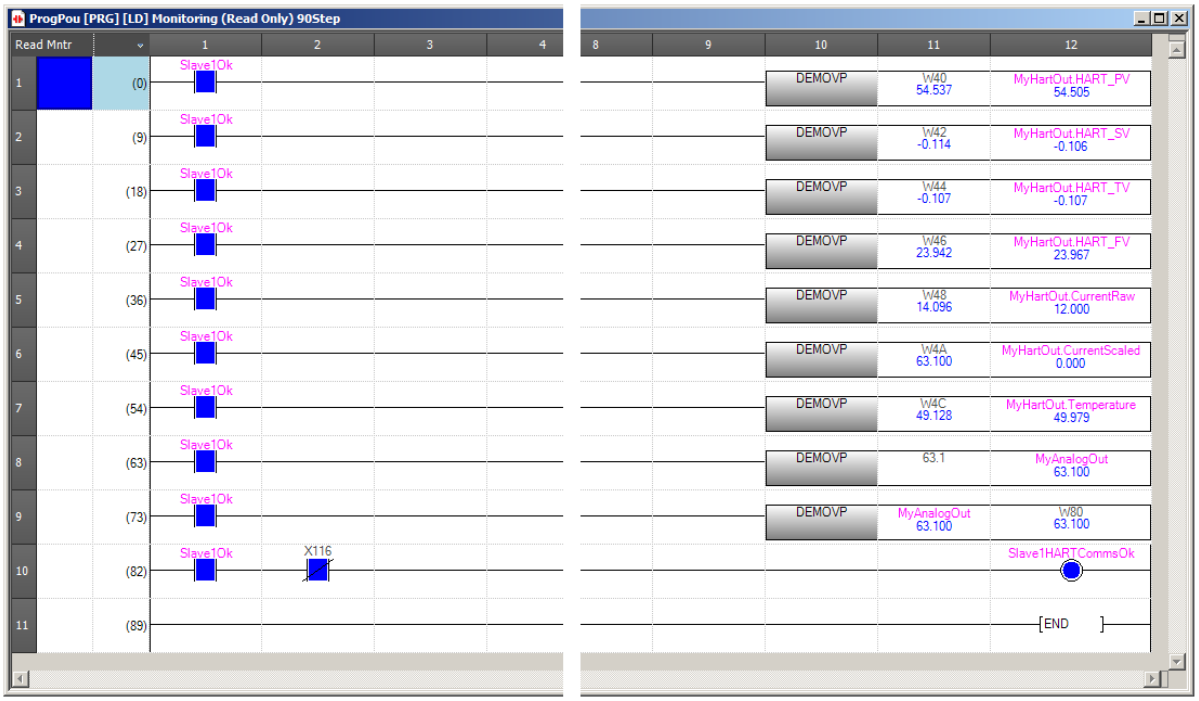


Figure 4.30 – Live HART Data Display

5. DIAGNOSTICS

5.1. LEDS

The module provides two LEDs for diagnostics purposes as shown in the front view figure below. A description of each LED is given in the table below.

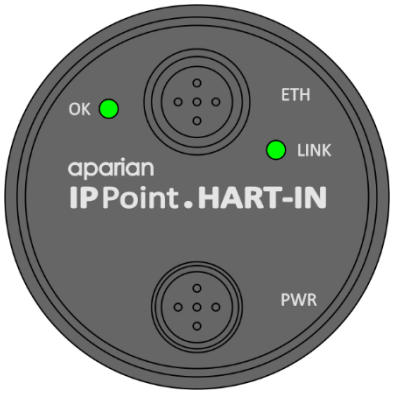


Figure 5.1 - IP Point HART module front view

LED	Description
Ok	The LED will be green when the loop current is within the acceptable range (3.8mA to 20.5 mA) and HART communication has been established to the field device. Otherwise the LED will be red. The LED will flash green each time a HART response was received from the connected field device. If there was a HART communication error (e.g. checksum failure) then the LED will flash red.
Ethernet	The Ethernet LED will light up when an Ethernet link has been detected (by plugging in a connected Ethernet cable). The LED will flash when traffic is detected.

Table 5.1 - Module LED operation

NOTE: If the module has not yet been configured, the LED will be red.

5.2. MODULE STATUS MONITORING IN SLATE

The IP Point HART module can provide a range of statistics which can assist with module operation, maintenance, and fault finding. The statistics can be accessed in full by Slate or using the web server in the module.

To view the module's status in the Aparian-Slate environment, the module must be online. If the module is not already Online (following a recent configuration download), then right-click on the module and select the *Go Online* option.

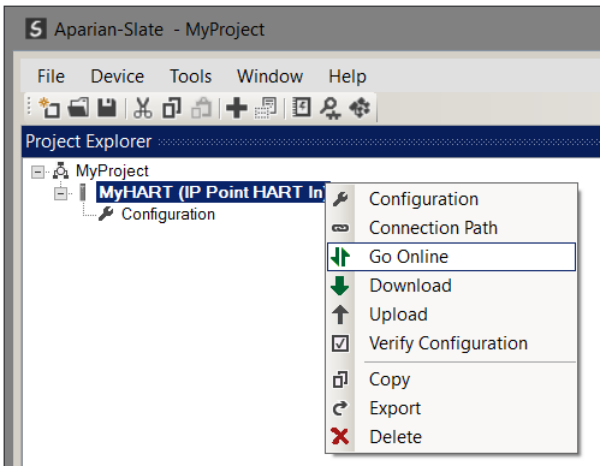


Figure 5.2. - Selecting to Go Online

The Online mode is indicated by the green circle behind the module in the Project Explorer tree.

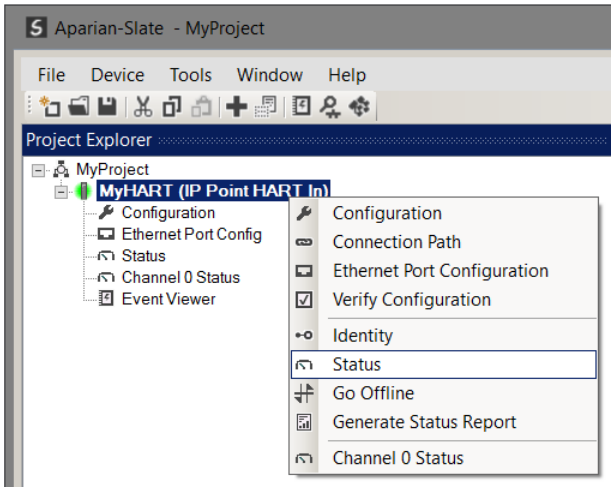


Figure 5.3. - Selecting online Status

The Status monitoring window can be opened by either double-clicking on the *Status* item in the Project Explorer tree, or by right-clicking on the module and selecting *Status*.

The status window contains multiple tabs to display the current status of the module. Most of these parameters in the status windows are self-explanatory or have been discussed in previous sections.

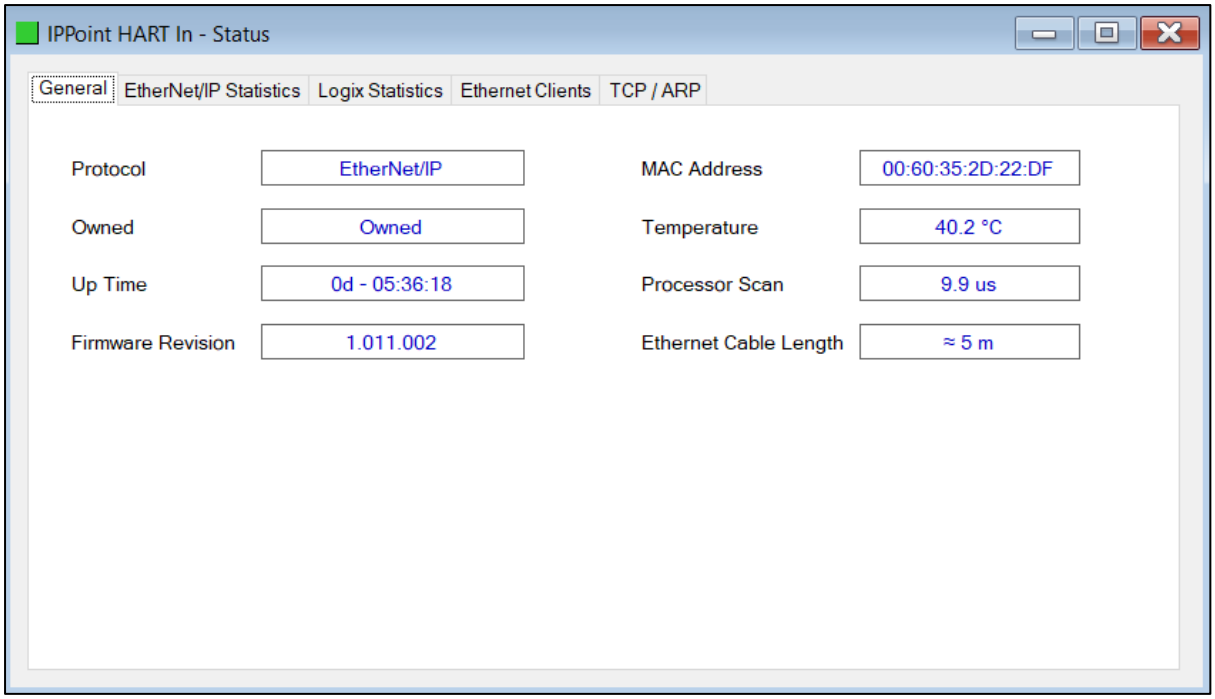


Figure 5.4. - Status monitoring - General

The General tab displays the following general parameters:

Parameter	Description
Protocol	Indicates the current configured protocol: EtherNet/IP DNP3 TCP DNP3 UDP Modbus TCP SLC500 / MicroLogix / PLC5 (PCCC) CC-Link IEF Basic
Owned	Indicates whether or not the module is currently owned (Class 1) by a Logix controller.
Up Time	Indicates the elapsed time since the module was powered-up.
Firmware Revision	The current application firmware revision running.
MAC Address	Displays the module's unique Ethernet MAC address.
Temperature	The internal temperature of the module.
Processor Scan	The amount of time (microseconds) taken by the module's processor in the last scan.
Ethernet Cable Length	An estimate on the Ethernet cable length. (From the device to switch or media converter.) The accuracy is approximately 5m. A large discrepancy in this length may be indicative of an Ethernet cable issue.

Table 5.2 - Parameters displayed in the Status Monitoring – General Tab

The subsequent Status tabs depend on the configured protocol.

5.2.1. EtherNet/IP Status

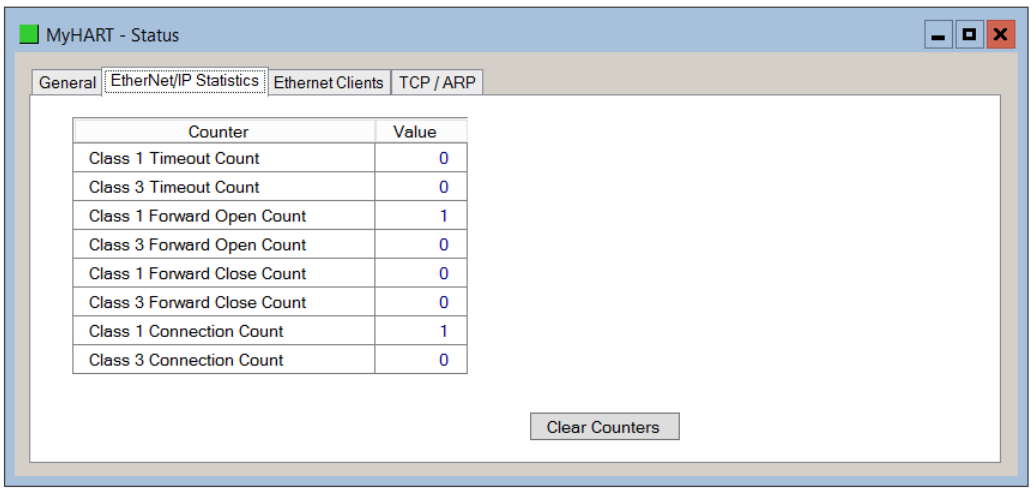


Figure 5.5 - EtherNet/IP Statistics

Statistic	Description
Class 1 Timeout Count	The number of Class 1 connections closed due to Timeouts.
Class 3 Timeout Count	The number of Class 3 connections closed due to Timeouts.
Class 1 Forward Open Count	The number of Class 1 Forward Open (connection establishment) messages sent.
Class 3 Forward Open Count	The number of Class 3 Forward Open (connection establishment) messages sent.
Class 1 Forward Close Count	The number of Class 1 Forward Close (connection termination) messages sent.
Class 3 Forward Close Count	The number of Class 3 Forward Close (connection termination) messages sent.
Class 1 Connection Count	The current number of active Class 1 connections.
Class 3 Connection Count	The current number of active Class 3 connections.

Table 5.3 - EtherNet/IP Statistics

5.2.2. DNP3

The DNP3 Statistics and DNP3 Security Statistics will be displayed if either of the two DNP3 protocols have been configured.

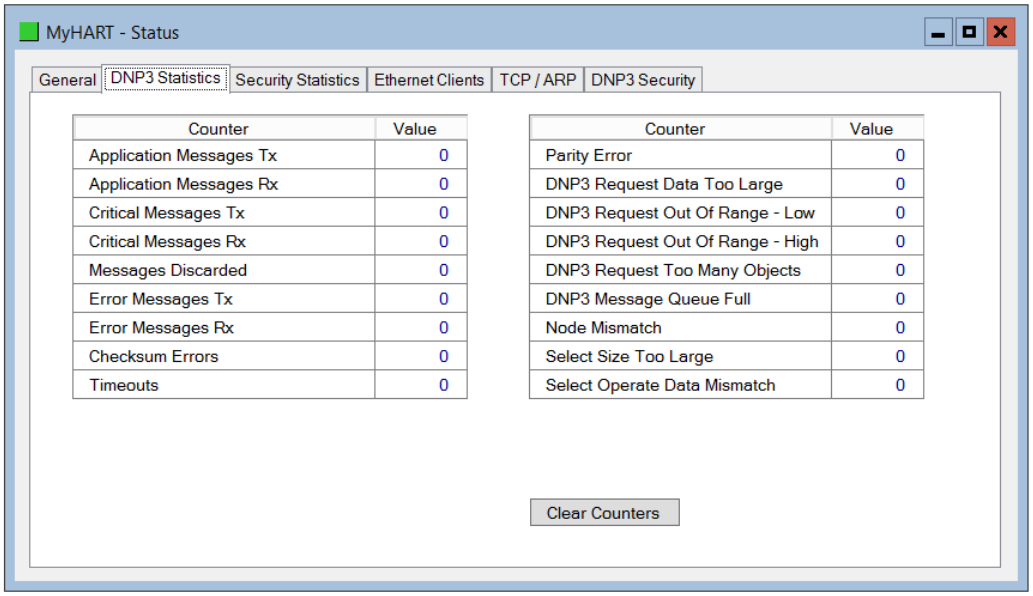


Figure 5.6 - DNP3 Statistics

Statistic	Description
Application Messages Tx	The number of application DNP3 packets sent by the module.
Application Messages Rx	The number of application DNP3 packets received by the module.
Critical Messages Tx	The number of critical DNP3 packets sent by the module when security is enabled.
Critical Messages Rx	The number of critical DNP3 packets received by the module when security is enabled.
Messages Discarded	The number of DNP3 packets discarded by the module.
Error Messages Tx	The number of error DNP3 packets sent by the module.
Error Messages Rx	The number of error DNP3 packets received by the module.
Checksum errors	The number of corrupted DNP3 packets received by the module.
Timeouts	The number of message response timeouts the module has encountered.
Parity errors	The number of bytes with parity errors received by the module.
DNP3 Request Data Too Large	The request/response data is too big. The module allows for a maximum of 1000 bytes per transaction.
DNP3 Request Out of Range – Low	The DNP3 request has a range that is outside of the implemented DNP3 bounds for the specific group and variation. This error is specific to the range being lower than the implemented range.
DNP3 Request Out of Range – High	The DNP3 request has a range that is outside of the implemented DNP3 bounds for the specific group and variation. This error is specific to the range being higher than the implemented range.
DNP3 Request Too Many Objects	The module supports a maximum of 10 DNP3 objects in a single DNP3 request. This statistics indicates that more than 10 DNP3 objects were

	found in a single request.
DNP3 Message Queue Full	The module has received too many simultaneous messages to process.
Node Mismatch	The received message node number did not match the module configured node address.
Select Size Too Large	When the Select/Operate functionality is used the module supports a maximum of 255 bytes per transaction (or one full DNP3 message).
Select Operate Data Mismatch	The Select/Operate functionality requires that the response to the Select function matches the Select request.

Table 5.4 – DNP3 statistics

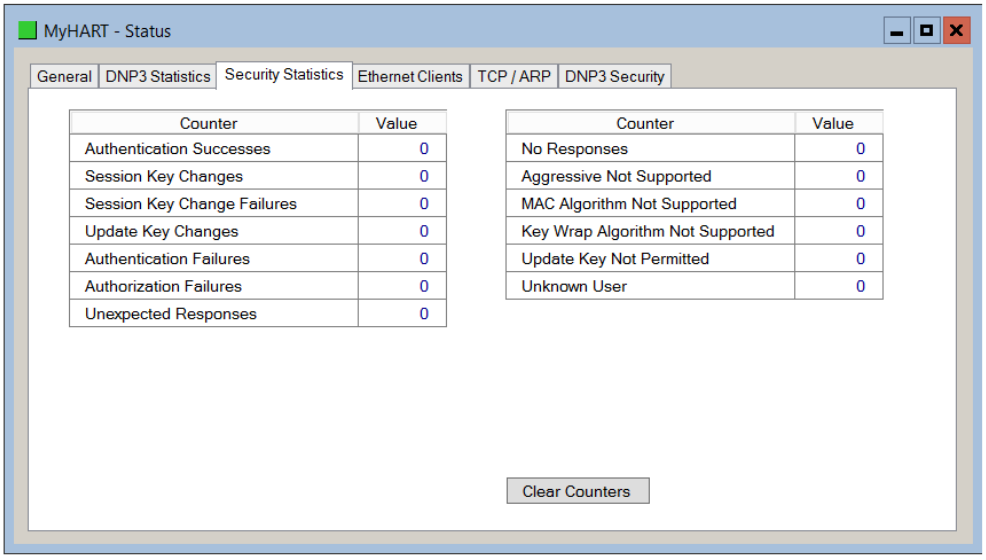


Figure 5.7 - DNP3 Security Statistics

Statistic	**Description**
Authentication Successes	Increases every time the device successfully authenticates a message.
Session Key Changes	When the session keys have been successfully updated.
Session Key Change Failures	When the session keys have failed to update.
Update Key Changes	The Update Key has changed.
Authentication Failures	The other device has provided invalid authentication information such as an incorrect MAC.
Authorization Failures	Increases when a user is not authorized to perform a requested operation.
Unexpected Responses	The other device has responded with a message that was not expected during the authentication process.
No Responses	The other device has not replied during the authentication process.
Aggressive Not Supported	When Aggressive Mode Authentication is not supported this will increase.
MAC Algorithm Not Supported	The MAC algorithm requested is not supported

Key Wrap Algorithm Not Supported	The Key Wrap algorithm requested is not supported.
Update Key Not Permitted	Updating of a key was not permitted.
Unknown User	The user used for authentication was unknown. The default user (1) is the only user supported.

Table 5.5 – DNP3 Security statistics

5.2.3. MODBUS

The Modbus Statistics will be displayed if the Modbus TCP protocol has been configured.

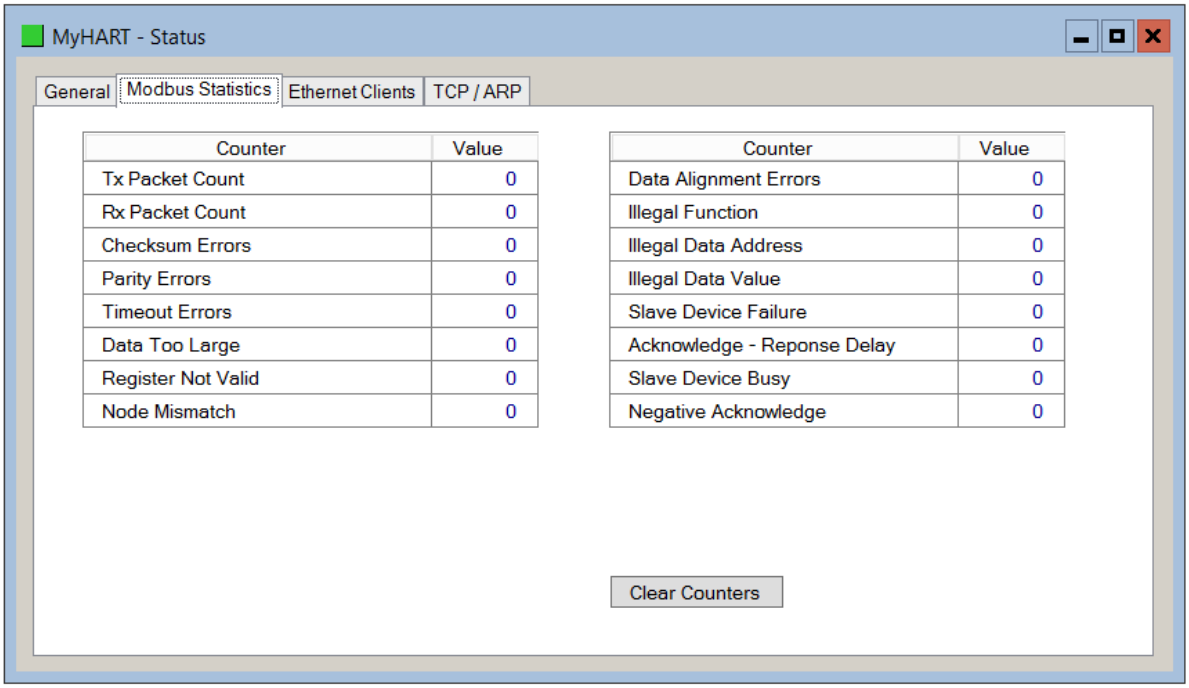


Figure 5.8. - Modbus Statistics

Statistic	**Description**
Tx Packet Count	The number of Modbus packets sent by the module.
Rx Packet Count	The number of Modbus packets received by the module.
Checksum errors	The number of corrupted Modbus packets received by the module.
Parity errors	The number of bytes with parity errors received by the module.
Timeout Errors	The number of message response timeouts the module has encountered.
Data Too Large	The number of Modbus requests or responses where the data was too large to process.
Register Not Valid	A request was received for a register which is not defined.

Node Mismatch	The received Modbus request did not match the module's Modbus node address.
Data Alignment Errors	The Modbus request and associated mapped item is not byte aligned with the destination.
Illegal Function	The number of times the Modbus device responded with an Illegal Function exception.
Illegal Data Address	The number of times the Modbus device responded with an Illegal Data Address exception.
Illegal Data Value	The number of times the Modbus device responded with an Illegal Data Value exception.
Slave Device Failure	The number of times the Modbus device responded with a Device Failure exception.
Acknowledge –Response Delay	The number of times the Modbus device responded with an Acknowledge exception.
Slave Device Busy	The number of times the Modbus device responded with a Slave Busy exception.
Negative Acknowledge	The number of times the Modbus device responded with a Negative Acknowledge exception.
Memory Parity Error	The number of times the Modbus device responded with a Memory Parity exception.

Table 5.6 – Modbus statistics

5.2.4. PCCC

The PCCC Statistics will be displayed if the PCCC protocol has been configured.

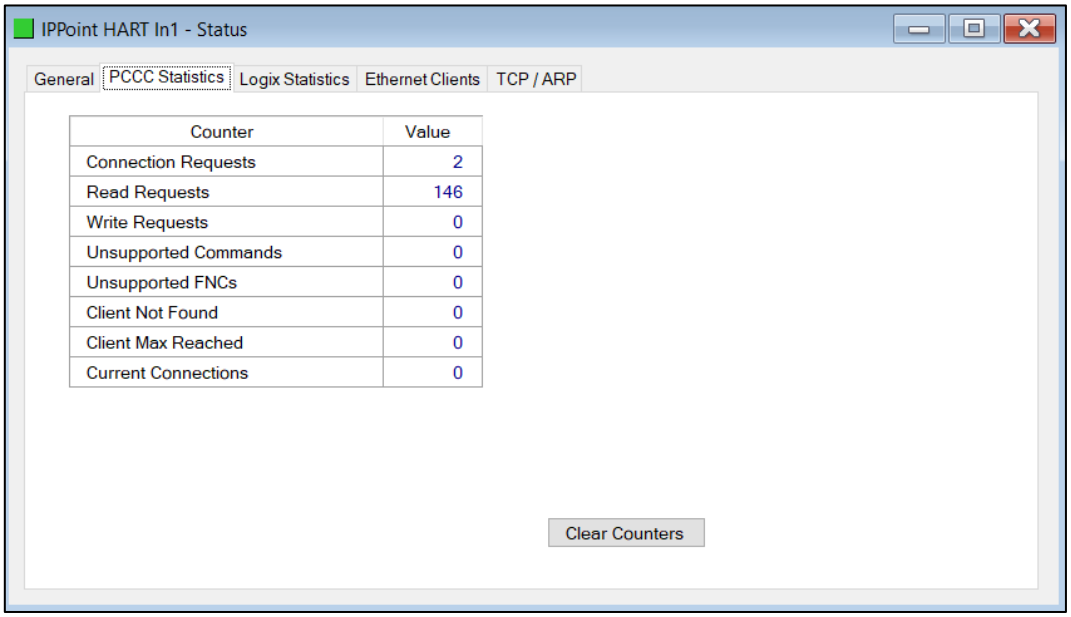


Figure 5.9 - PCCC Statistics

Statistic	Description
Connection Requests	The number of PCCC connection establishment requests received.
Read Requests	The number of Read requests received.
Write Requests	The number of Write requests received.
Unsupported Commands	The number of requests rejected due to an unsupported command.
Unsupported FNC Code	The number of requests rejected due to an unsupported function code.
Client Not Found	The number of requests rejected due to no matching connection.
Client Max Reached	The number of connection request rejections due to maximum connection count reached.
File Not Found	The number of requests rejected due to an unsupported PLC file number.
Current Connections	The current number of active connections.

Table 5.5 – PCCC statistics

5.2.5. CC-LINK

The CC-Link Statistics will be displayed if the CC-Link IEF Basic protocol has been configured.

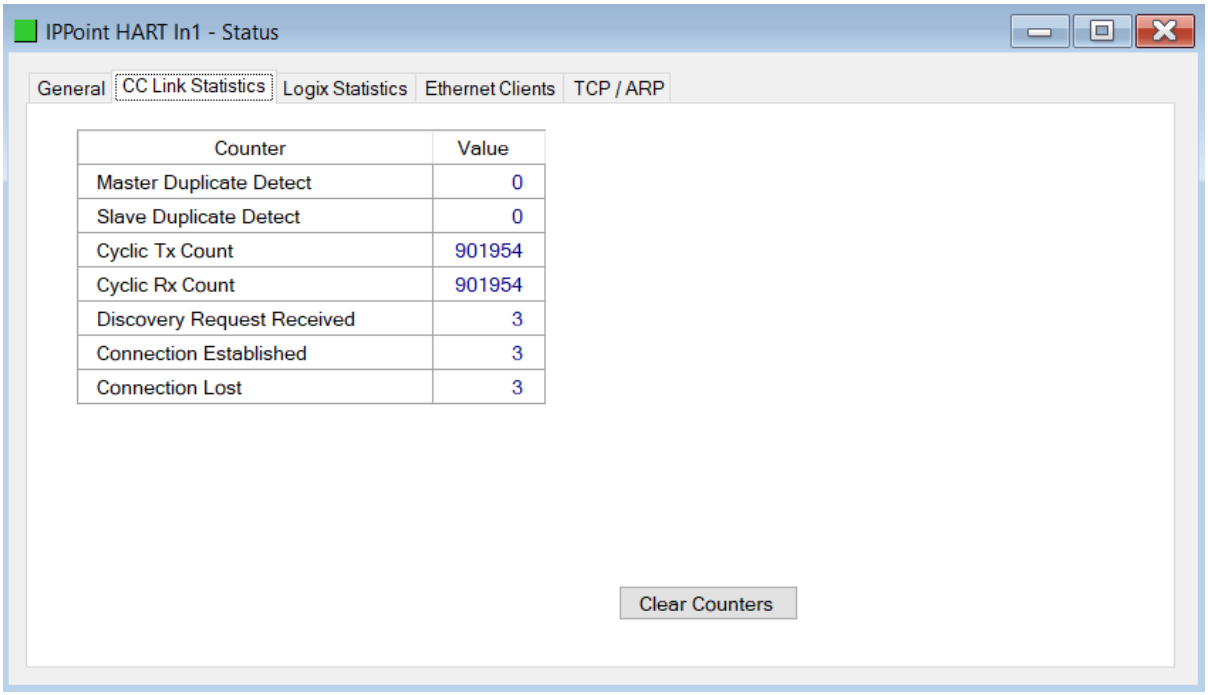


Figure 5.10 – CC-Link Statistics

Statistic	Description
Master Duplicate Detect	The number of times a duplicate CC-Link Master was detected.
Slave Duplicate Detect	The number of times a duplicate CC-Link Slave was detected.
Cyclic Tx Count	The number of Cyclic packets sent.
Cyclic Rx Count	The number of Cyclic packets received.
Discovery Request Received	The number of discovery requests received.
Connection Established	The number of times the Cyclic connection was established.
Connection Lost	The number of times the Cyclic connection was lost.

Table 5.6 – CC-Link statistics

5.3. CHANNEL STATUS

The status of the analog channel can be monitored by double-clicking on the *Channel 0 Status* in the tree, or by right-clicking on the device and selecting the *Channel 0 Status* item.

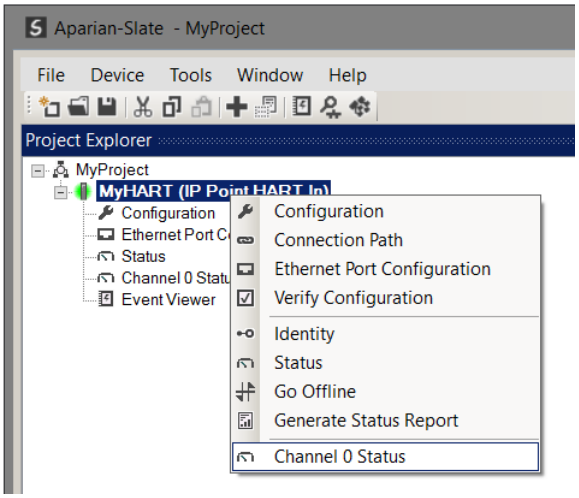


Figure 5.11 - Select Online Channel Status

The channel status window contains multiple tabs to display the current status of the channel. The General tab displays a summary of the common HART parameters.

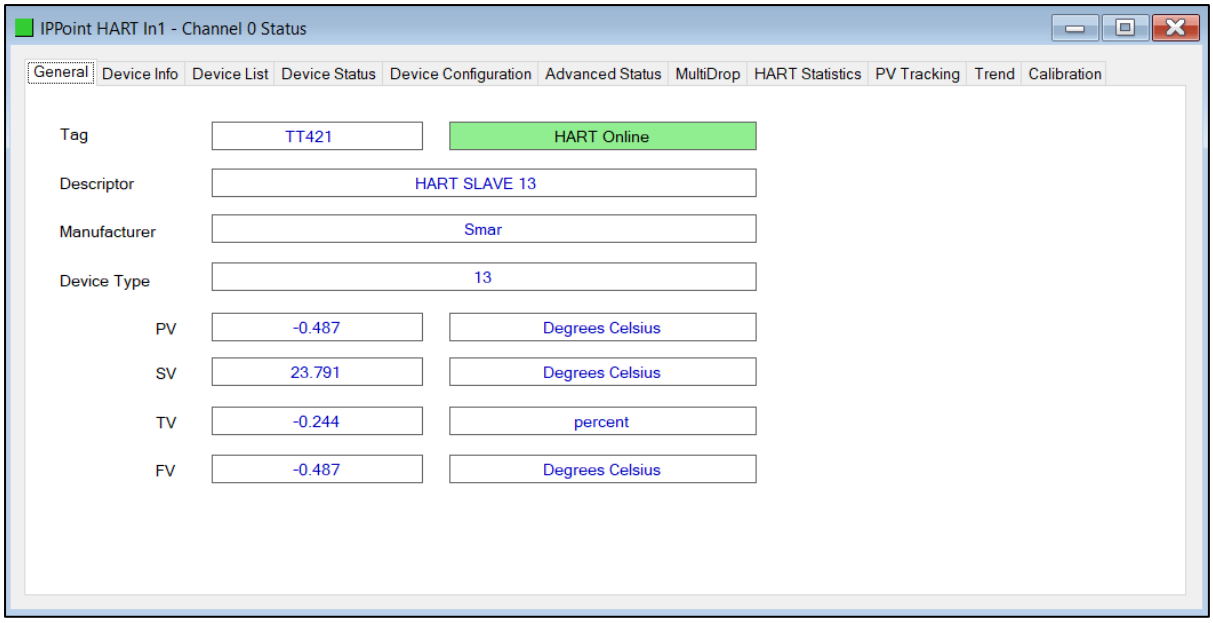


Figure 5.12 - Channel Status – General

Parameter	Description
Tag	The user tag name configured in the field device. (8 characters)
Status	The current status of the HART communication.
Descriptor	The user descriptor configured in the field device. (16 characters)
Manufacturer	The field device manufacturer.
Device Type	The device type code assigned by the manufacturer.
PV (and Units)	The primary variable displayed in engineering units, with the engineering unit enumeration.
SV (and Units)	The secondary variable displayed in engineering units, with the engineering unit enumeration.
TV (and Units)	The third variable displayed in engineering units, with the engineering unit enumeration.
FV (and Units)	The fourth variable displayed in engineering units, with the engineering unit enumeration.

Table 5.7 - Channel Status Parameters – General

The Device Info tab displays a more detailed information of the field device.

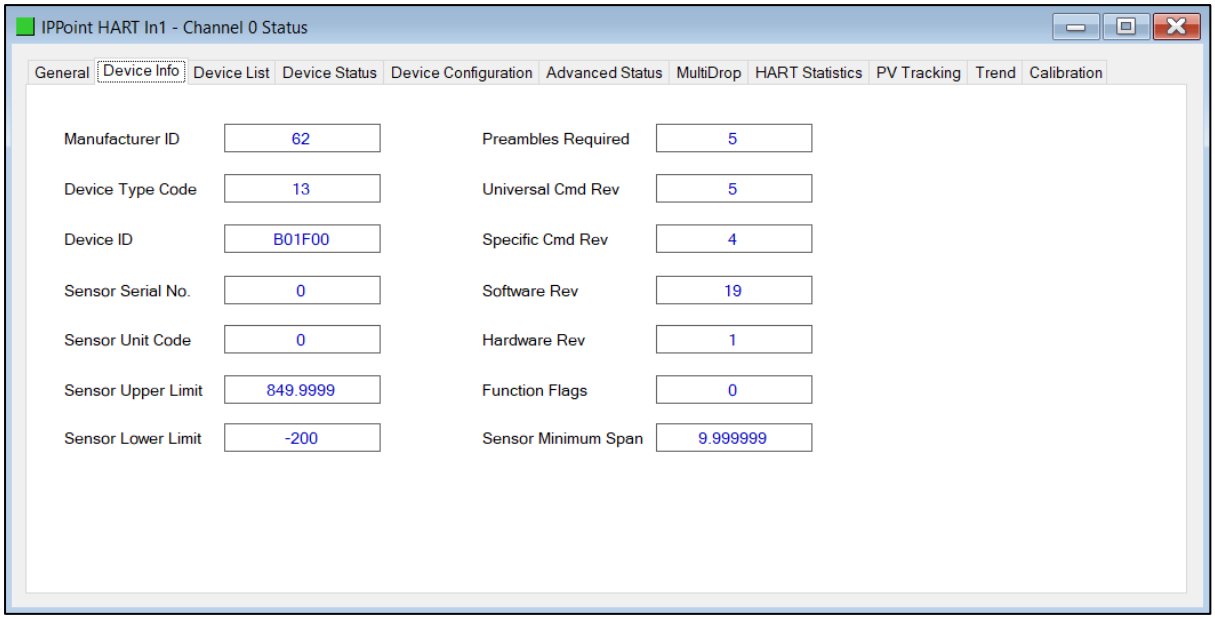


Figure 5.13 - Channel Status – Device Info

Parameter	Description
Manufacturer ID	The field device manufacturer unique identification code.
Device Type Code	The device type code assigned by the manufacturer.
Device ID	The device identification code assigned by the manufacturer.
Sensor Serial Number	The serial number of the field device sensor.
Sensor Unit Code	The engineering unit code used for the sensor limits.
Sensor Upper Limit	The upper limit of the sensor in the aforementioned engineering units.
Sensor Lower Limit	The lower limit of the sensor in the aforementioned engineering units.
Preambles Required	The minimum number of preambles required by the field device to process a HART request.
Universal Command Revision	The universal command revision supported by the field device.
Specific Command Revision	The specific command revision supported by the field device.
Software Revision	The software revision of the field device.
Hardware Revision	The hardware revision of the field device electronics.
Function Flags	The Device Function Flags as reported by the field device.
Sensor Minimum Span	The minimum span allowed by the sensor.

Table 5.8 - Channel Status Parameters – Device Info

The Device Status tab displays the status of the analog and HART interaction with the module.

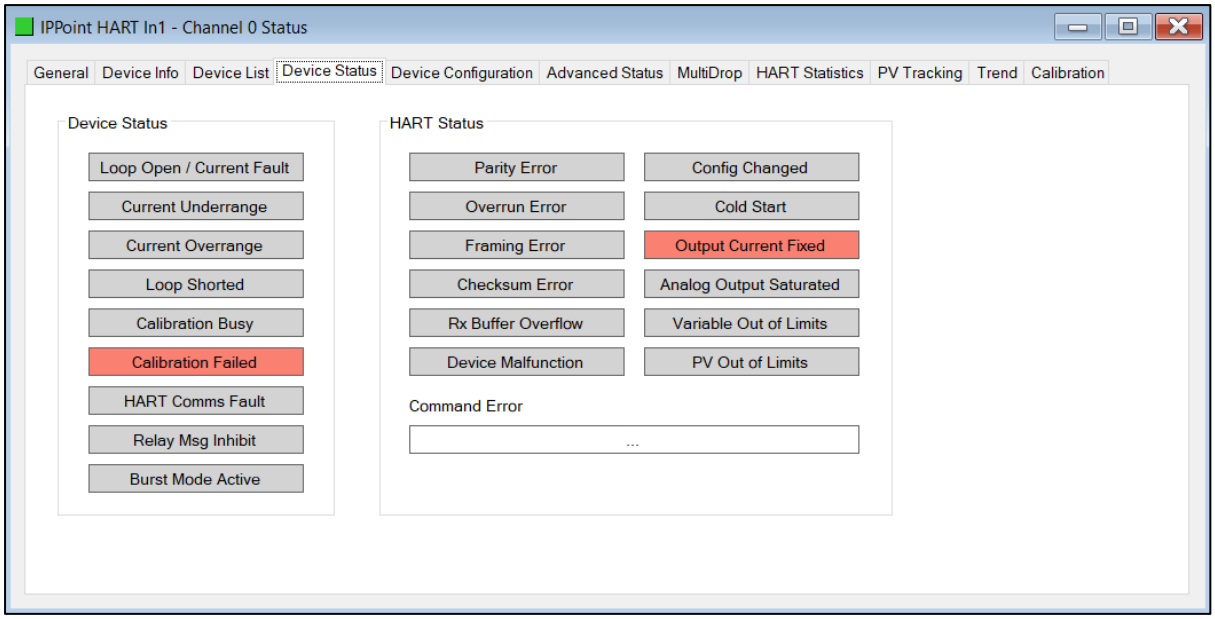


Figure 5.14 - Channel Status – Device Status

Parameter	Description
Loop Open / Current Fault	Flagged if the current loop is either below 3.6mA or above 21.0 mA.
Current Under-range	Flagged if the current is below 3.8mA.
Current Over-range	Flagged if the current is above 20.5 mA.
Loop Shorted	Flagged if a loop short is detected.
Calibration Busy	Flagged when the module is busy being calibrated.
Calibration Failed	Flagged if the calibration data is invalid or corrupt.
HART Comms Fault	Flagged if HART communication is enabled but not active.
Relay Message Inhibit	Flagged when Class 2 HART relay messages have been disabled in the configuration.
Burst Mode Active	Flagged if the field device is operating in burst mode.
Parity Error	Flagged if the field device received a message with a parity error
Overrun Error	Flagged if the field device receive buffer is overrun.
Framing Error	Flagged if the field device receives a message with an invalid stop delimiter.
Checksum Error	Flagged if the field device receives a message with an invalid checksum.
Rx Buffer Overflow	Flagged if the field device receives a message too long for the receive buffer.
Device Malfunction	Flagged if the field device has detected an error or suffered some hardware failure.
Config Changed	Flagged if an operation resulted in the configuration changing.
Cold Start	Flagged if the field device has experienced a power failure or reset.
Output Current Fixed	Flagged if the loop current is set at a fixed value and is not responding to

	process variations
Analog Output Saturated	Flagged if the Loop Current has reached its upper or lower limit
Variable Out of Limits	Flagged if a variable other than the PV is beyond its operating limits.
PV Out of Limits	Flagged if the PV is beyond its operating limits.
Command Error	An enumerated error in response to the last command issued.

Table 5.9 - Channel Status Parameters – Device Status

The Device Configuration tab provides the facility to display and modify common HART parameters in the field device.

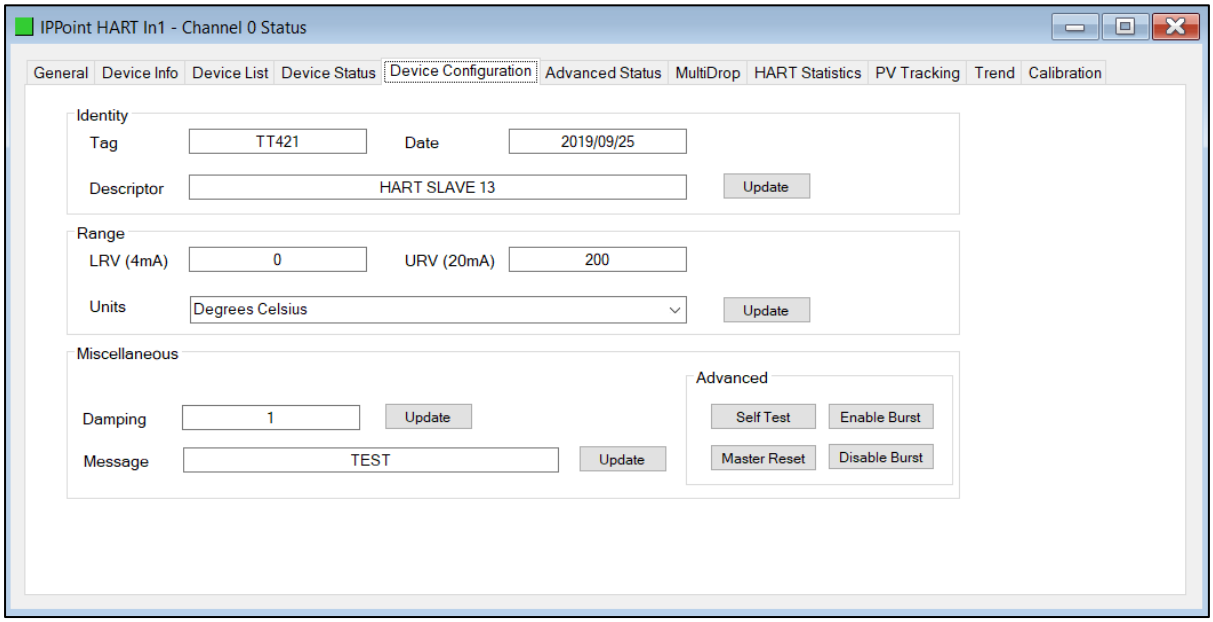


Figure 5.15 - Channel Status – Device Configuration

Parameter	Description
Tag	The user tag name configured in the field device. (8 characters). Note: The Tag, Descriptor and Date are updated together.
Descriptor	The user descriptor configured in the field device. (16 characters). Note: The Tag, Descriptor and Date are updated together.
Date	The date when the tag and descriptor configuration was last modified. Note: The Tag, Descriptor and Date are updated together.
LRV	The Lower Range Value in engineering units represented by the 4mA analog signal. Note: The LRV, URV and Range Units are updated together.
URV	The Upper Range Value in engineering units represented by the 20mA analog signal. Note: The LRV, URV and Range Units are updated together.

Range Units	The engineering units in which the LRV and URV values are specified. Note: The LRV, URV and Range Units are updated together.
Damping	The damping value specified in seconds. Damping refers to the digital filtering of process variables to remove transient and potentially erroneous deviations from the actual measure variable.
Message	A user defined 32 character message stored in the field device.
Master Reset	Resets the field device
Enable Burst Mode	This instructs the field device to enter burst mode. Note that only Burst of HART command 3 is supported
Disable Burst Mode	This instructs the field device to exit burst mode.

Table 5.10 - Channel Status Parameters – Device Configuration

A parameter can be modified by entering the new value into the appropriate text box and clicking the adjacent Update button. When the parameter is pending, that is, edited but not yet committed, then the text box will be shaded yellow. Once the value has been written (updated) the value will be written to the field device and then re-read from the field device, after which the parameter background will return to normal.

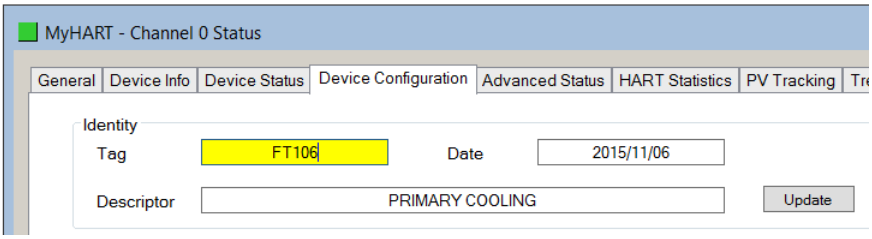


Figure 5.16 - Updating Device Parameters

The Advanced Status tab displays the advanced and device specific status information of the field device. Due to the manufacturer specific encoding of these parameters, consult the field device manufacturer's documentation for more information.

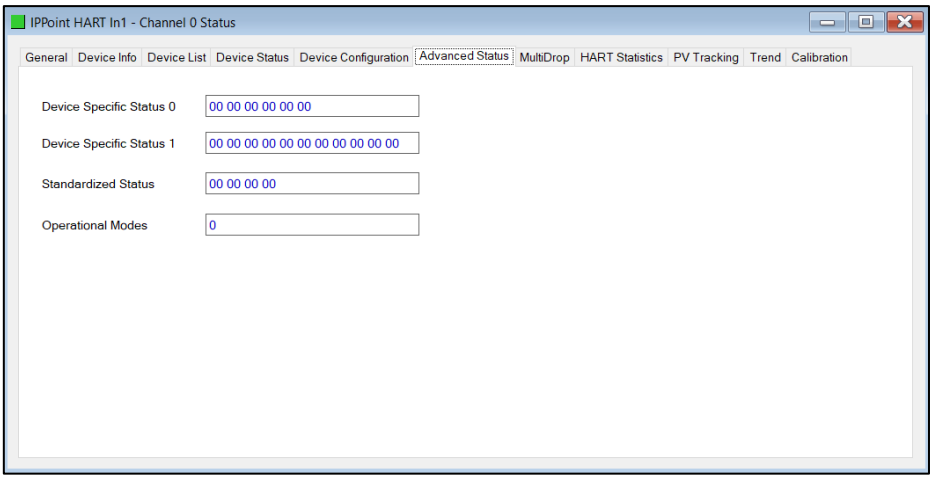


Figure 5.17 - Channel Status – Advanced Status

The HART Statistics tab displays the communication statistics.

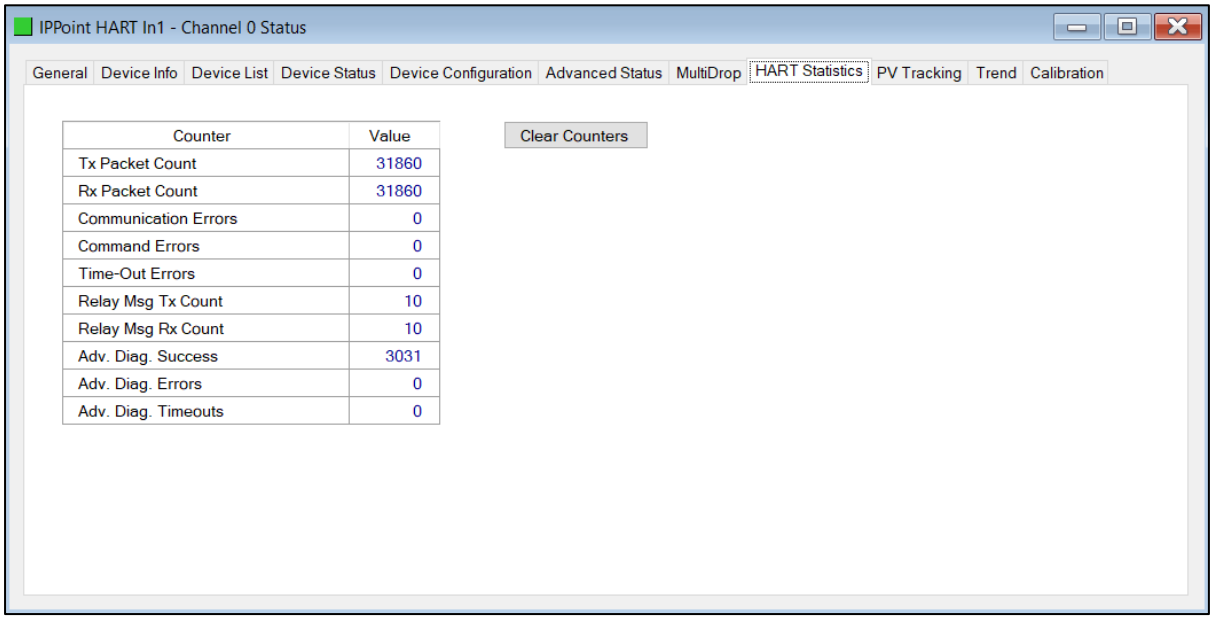


Figure 5.18 - Channel Status – HART Communication Statistics

Parameter	Description
Tx Packet Count	The number of HART packets sent.
Rx Packet Count	The number of HART packets received.
Communication Errors	The number of communication errors experienced.
Command Errors	The number of command errors experienced.
Time-Out Errors	The number of HART time-out errors experienced.
Relay Message Tx Count	The number of HART packets sent via relay (Class 2) messages (DTMs etc.)
Relay Message Rx Count	The number of HART packets received for relay (Class 2) messages (DTMs etc.)
Adv. Diag. Success	The number of successful advanced diagnostic reads.
Adv. Diag. Errors	The number of advanced diagnostic reads that failed. (Illegal HART command etc.)
Adv. Diag. Timeouts	The number of advanced diagnostic reads where no reply was received.

Table 5.11 - Channel Status Parameters HART Communication Statistics

The PV Tracking Status tab displays the current, minimum and maximum value of the common process variables. The Reset button can be used to reset the maximum and minimum values.

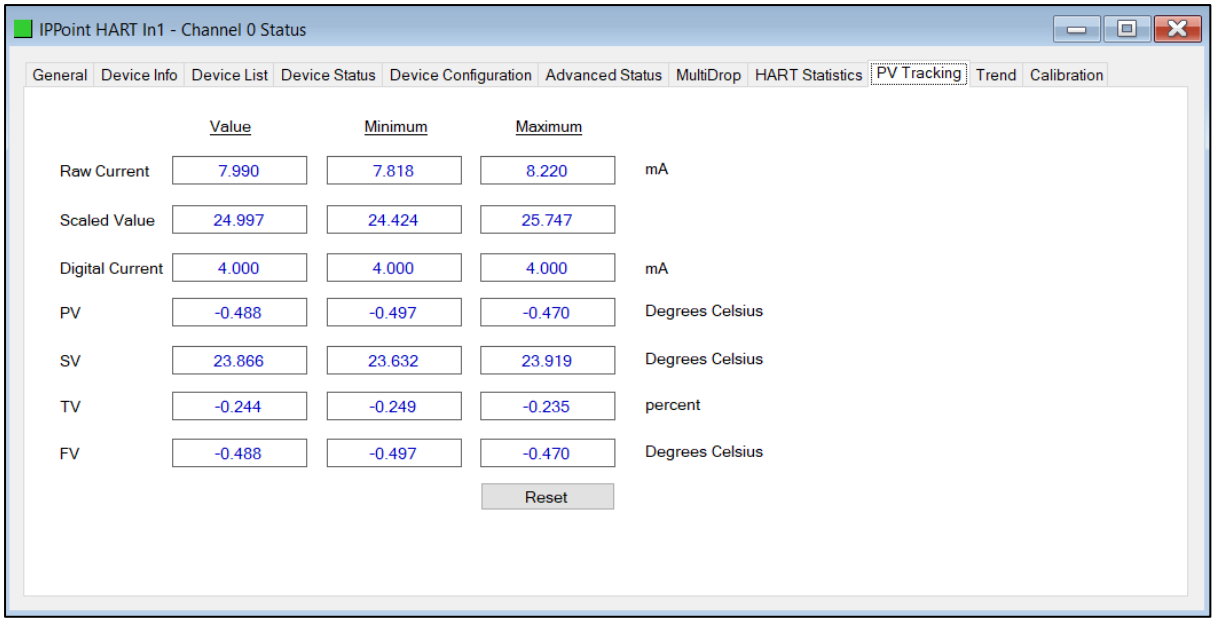


Figure 5.19 - Channel Status – PV Tracking

The Trend tab displays the status of the analog and HART interaction with the module. The IP Point HART module is capable of storing up to 1000 trend points which are sampled at a user-configurable interval. The user can choose between one of the following sources:

- Raw Analog Current (4-20mA)
- Filtered Scaled Value
- Digital Current
- Primary Variable (PV)
- Secondary Variable (SV)
- Third Variable (TV)
- Fourth Variable (FV)

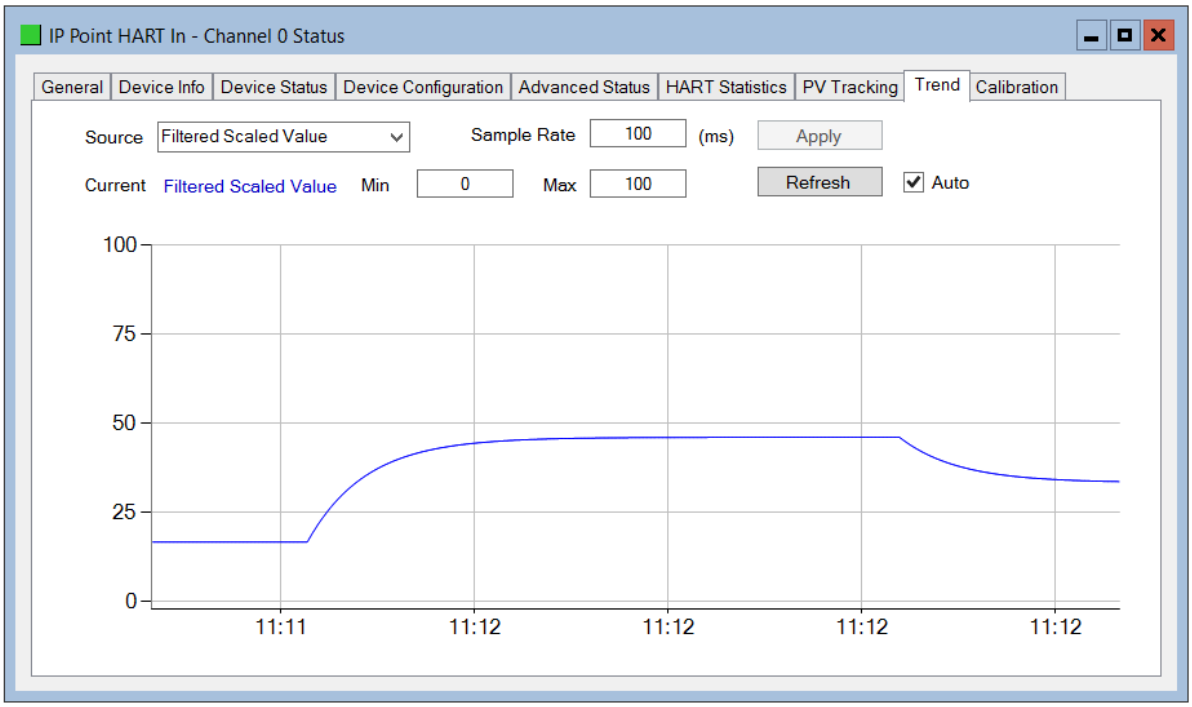


Figure 5.20 - Channel Status – Trend

Once the source or sample rate has been modified, the *Apply* button must be clicked for the changes to take effect. This will also result in the existing trend data being cleared.
The Y axis scale can be modified by adjusting the *Min* and *Max* value and clicking the *Refresh* button. To automatically update the trend every second, the *Auto* check box can be selected.

5.4. DEVICE LIST

The module supports scanning the channel to determine at which short address the field device(s) are. The user can select the start and end address to minimize the scan time. Once the scan is completed and a device is found the devices details will be displayed in the list as shown below. When the user is using multiple devices on a single channel then more than one device will be displayed in this list.

NOTE: When multiple devices are used on a single channel then the user must ensure that each device is at a unique address. The user can change the short node address in the options by right-clicking on the device and selecting Write Address.

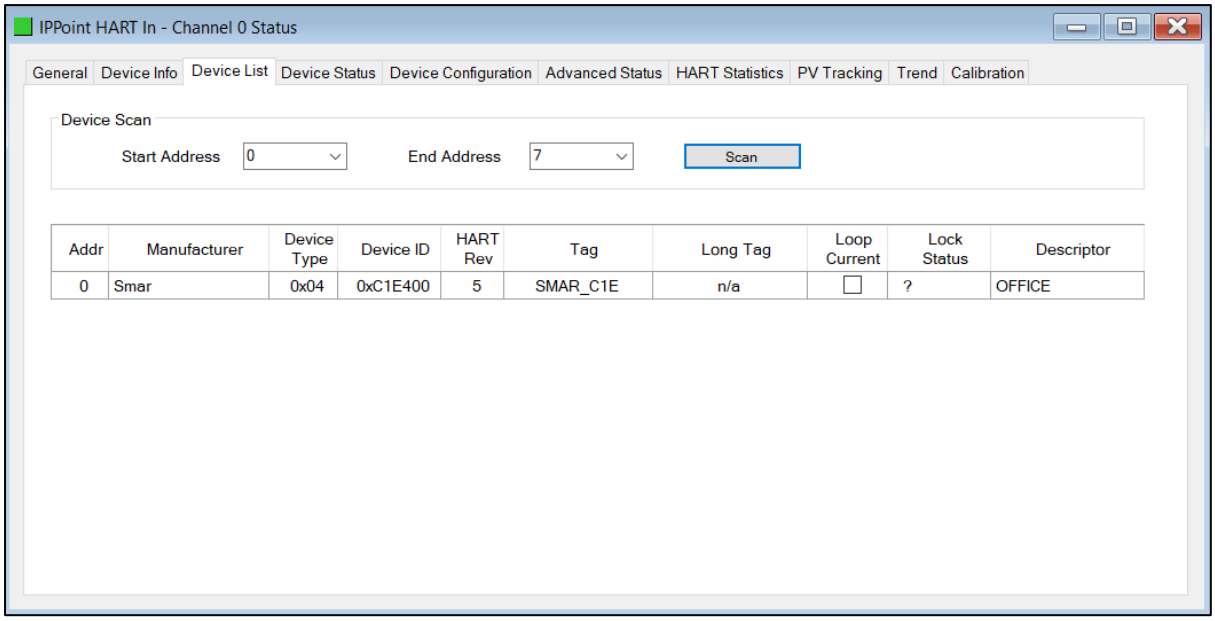


Figure 5.21 – Device List

There are various options the user can execute per device found in the device list. Some of the options will only be relevant depending on the HART Rev (eg. the Long Tag is only support with HART 6/7).

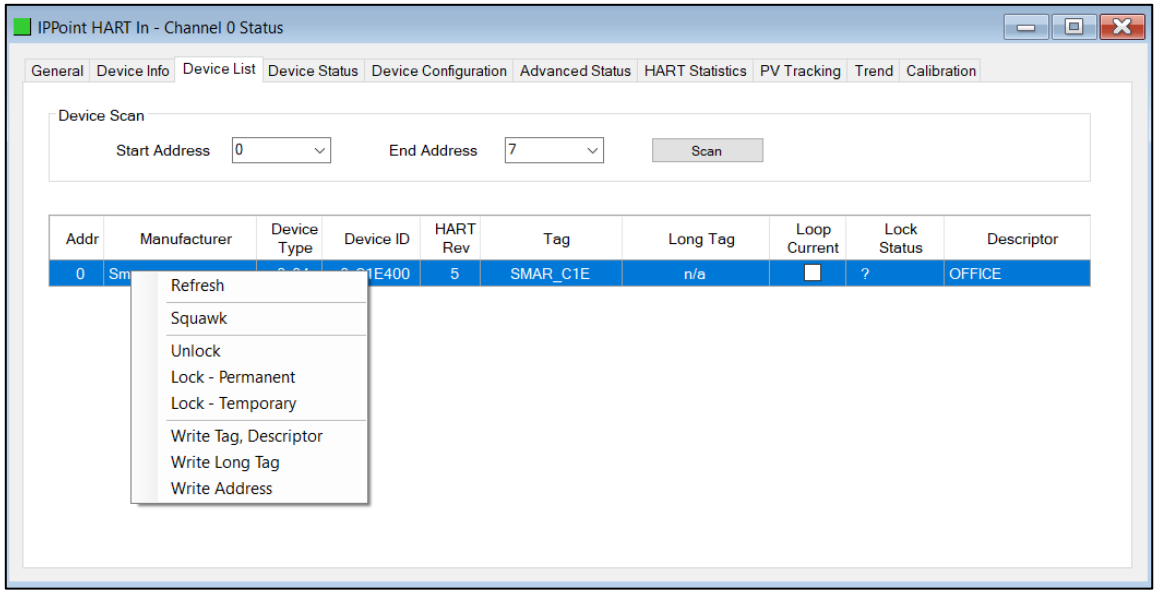
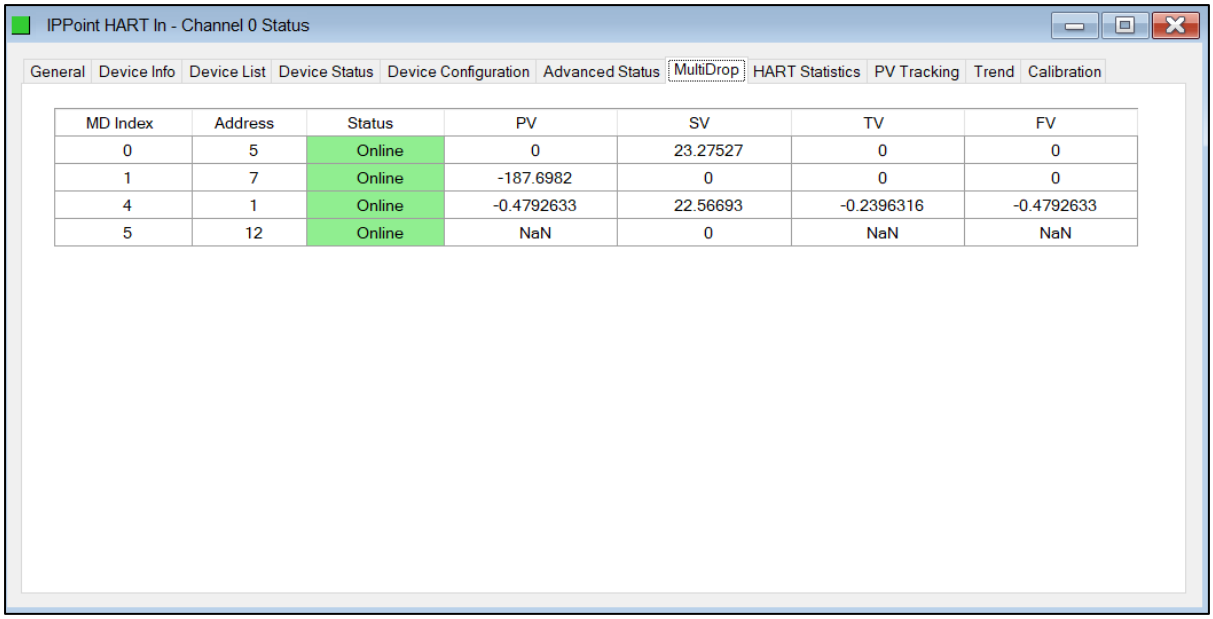


Figure 5.22 – Device List Options

5.5. MULTIDROP

The ***MultiDrop*** tab will have all the configured multidrop devices, their Status, as well as the four process variables for each multidrop HART device.



MD Index	Address	Status	PV	SV	TV	FV
0	5	Online	0	23.27527	0	0
1	7	Online	-187.6982	0	0	0
4	1	Online	-0.4792633	22.56693	-0.2396316	-0.4792633
5	12	Online	NaN	0	NaN	NaN

Figure 5.23 – Channel Status – MultiDrop

5.6. CALIBRATION

The Calibration tab in the Channel status monitoring form, can be used to display and modify the calibration parameters.

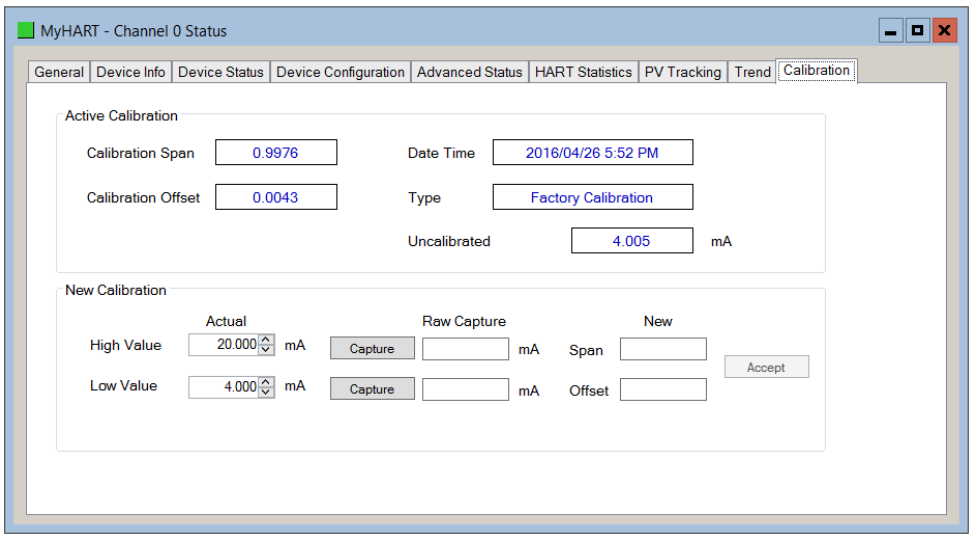


Figure 5.24 – Channel Status – Input Calibration

The module is Factory Calibrated should not require any further calibration before use. To re-calibrate the module, the User Calibration methods described below can be implemented.

5.6.1. INPUT CALIBRATION:

To re-calibrate a IP Point HART Input module,

1. Using an external milliamp source, adjust the current to 4mA, or as close as possible to 4mA.
2. Enter the exact milliamp value, read from an external meter, into the ***Low Value Actual*** numeric inputs.
3. Press the ***Low Value*** (4mA) ***Capture*** button, to capture the current (un-calibrated value) into the ***Raw Capture*** field.
4. Using the external milliamp source, adjust the current to 20mA, or as close as possible to 20mA.
5. Enter the exact milliamp value, read from an external meter, into the ***High Value Actual*** numeric inputs.
6. Press the ***High Value*** (20mA) ***Capture*** button, to capture the current (un-calibrated value) into the ***Raw Capture*** field.
7. The new ***Span*** and ***Offset*** calibration settings will be automatically calculated. (See figure below).
8. Press ***Accept*** to write these new calibration figures to the module.
9. The Calibration Type will then change to User Calibration, to reflect the changes.

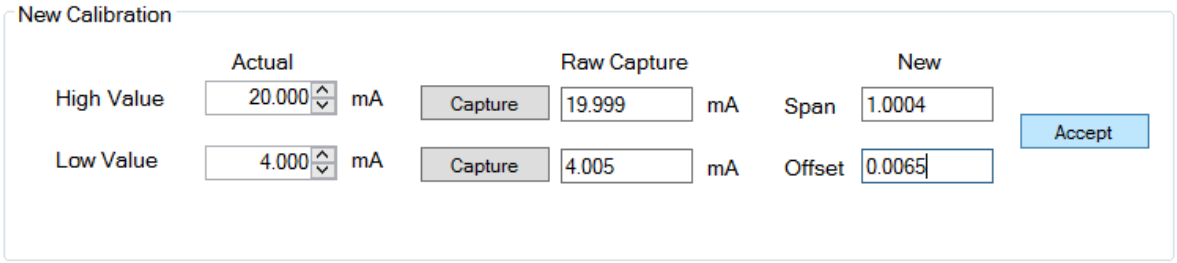


Figure 5.25 – User Calibration – Input

NOTE: Before commencing with input calibration ensure that it is safe to do so. The simulated current values could translate to extreme process variables in the connected control system which may cause unexpected results. Failure to do so could result in severe equipment damage and personal injury.

5.6.2. OUTPUT CALIBRATION:

To re-calibrate an IP Point HART Output module:

1. Ensure the channel configuration has both the ***Prog/Fault Freeze*** and ***Comm Fail Freeze*** options checked, and that the module is disconnected from the EtherNet/IP (Logix), DNP3 or Modbus source.
2. Click the ***Set 4mA*** button. The output current will change to 4mA.
3. Using an external meter, measure the actual loop current and enter the milliamp value in the ***Low Value*** (4mA) ***Actual Measured*** textbox.
4. Click the ***Set 20mA*** button. The output current will change to 20mA.
5. Using an external meter, measure the actual loop current and enter the milliamp value in the ***High Value*** (20mA) ***Actual Measured*** textbox.
6. The new ***Span*** and ***Offset*** calibration settings will be automatically calculated. (See figure below).
7. Press ***Accept*** to write these new calibration figures to the module.
8. The Calibration Type will then change to User Calibration, to reflect the changes.

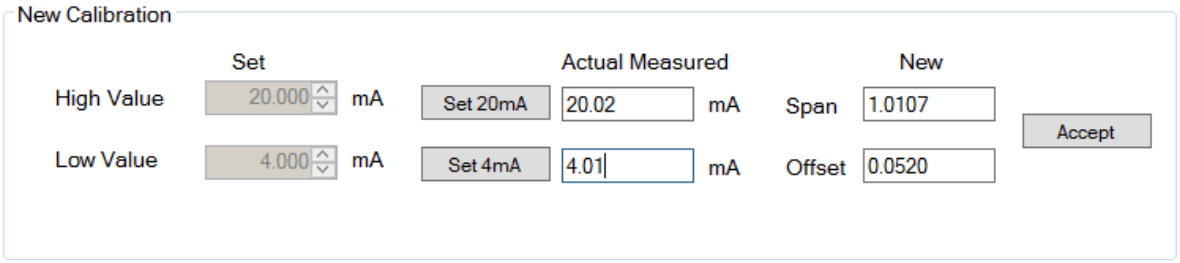


Figure 5.26 – User Calibration - Output

NOTE: Before commencing with output calibration ensure that it is safe to do so. The field device should be either isolated from the process mechanically or the process be in such a state that variations in the output signal cannot cause a disruption to the process. Failure to do so could result in severe equipment damage and personal injury.

NOTE: The ***Set 20mA*** and ***Set 4mA*** buttons will be disabled if the configuration has either the ***Prog/Fault Freeze*** or ***Comm Fail Freeze*** options not checked.

NOTE: If the module's data source (EtherNet/IP (Logix), DNP3 or Modbus) is not disconnected or disabled, then the simulated milliamp value will be constantly over-written negating the calibration procedure.

5.7. MODULE EVENT LOG

The IP Point HART module logs various diagnostic records to an internal event log. These logs are stored in non-volatile memory and can be displayed using Slate or via the web interface. To view them in Slate, select the Event Viewer option in the Project Explorer tree.

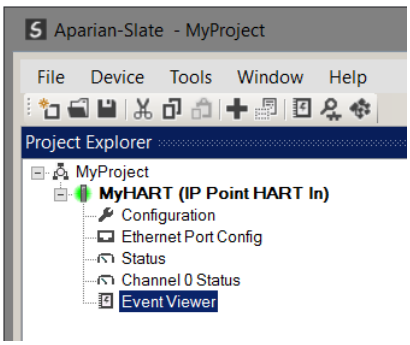
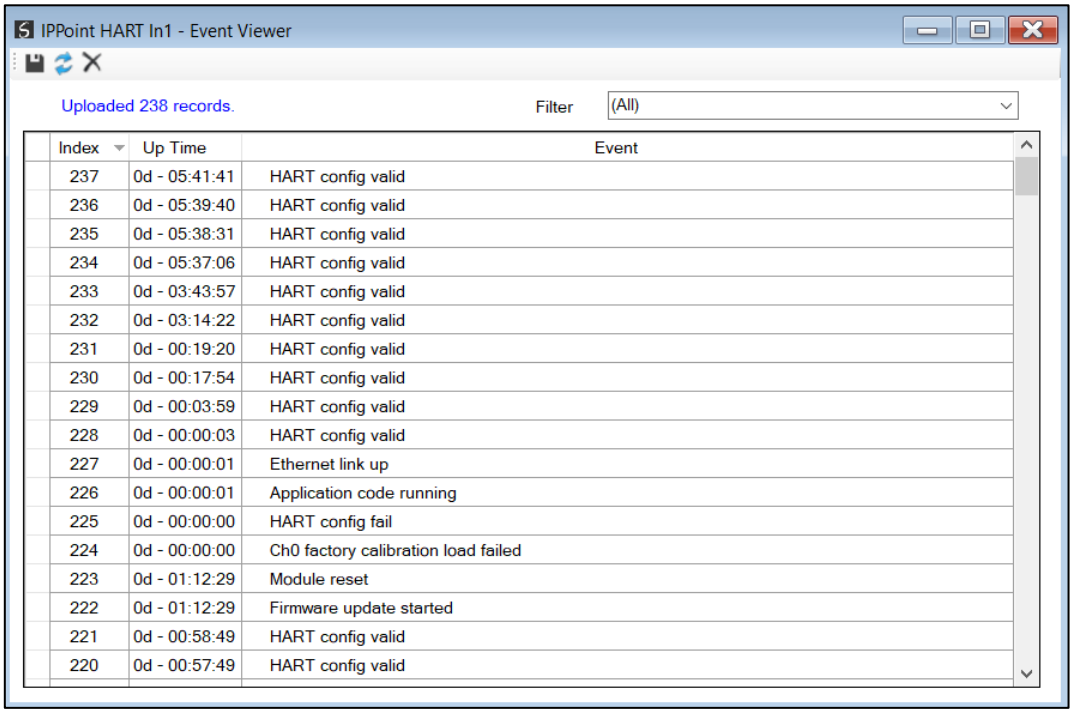


Figure 5.27. - Selecting the module Event Log

The Event Log window will open and automatically read all the events from the module. The

log entries are sorted so as to have the latest record at the top. Custom sorting is achieved by double-clicking on the column headings.



Index	Up Time	Event
237	0d - 05:41:41	HART config valid
236	0d - 05:39:40	HART config valid
235	0d - 05:38:31	HART config valid
234	0d - 05:37:06	HART config valid
233	0d - 03:43:57	HART config valid
232	0d - 03:14:22	HART config valid
231	0d - 00:19:20	HART config valid
230	0d - 00:17:54	HART config valid
229	0d - 00:03:59	HART config valid
228	0d - 00:00:03	HART config valid
227	0d - 00:00:01	Ethernet link up
226	0d - 00:00:01	Application code running
225	0d - 00:00:00	HART config fail
224	0d - 00:00:00	Ch0 factory calibration load failed
223	0d - 01:12:29	Module reset
222	0d - 01:12:29	Firmware update started
221	0d - 00:58:49	HART config valid
220	0d - 00:57:49	HART config valid

Figure 5.28. – Module Event Log

The log can also be stored to a file for future analysis, by selecting the Save button in the tool menu. To view previously saved files, use the Event Log Viewer option under the tools menu.

5.8. WEB SERVER

The IP Point HART module provides a web server allowing a user without Slate or RSLogix 5000 to view various diagnostics of the module. This includes Ethernet parameters, system event log, advanced diagnostics, and application diagnostics.

NOTE: The web server is view **only** and thus no parameters or configuration can be altered from the web interface.

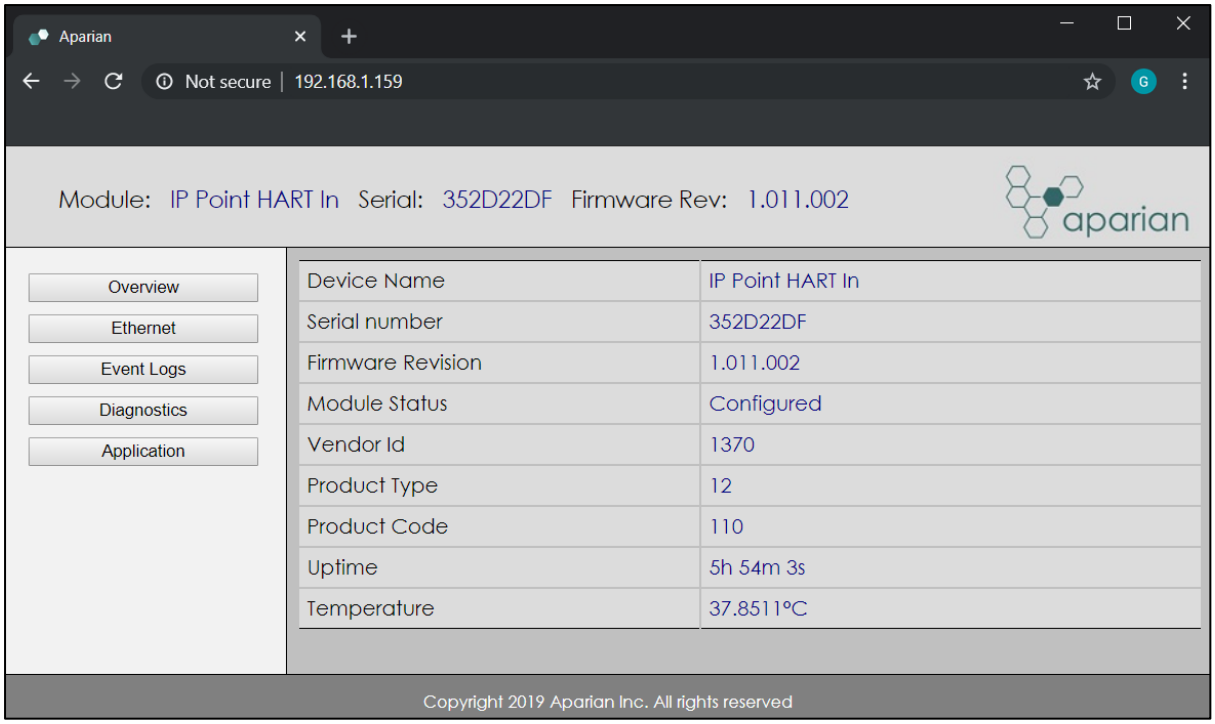


Figure 5.29. - Web interface

5.9. HART PACKET CAPTURE

The IP Point HART module provides the capability to capture the HART traffic for analysis. This will assist you and the support team to diagnose any possible issues. To invoke the capture of the module, right-click on the module (when online in Slate) and select the HART Packet Capture item.

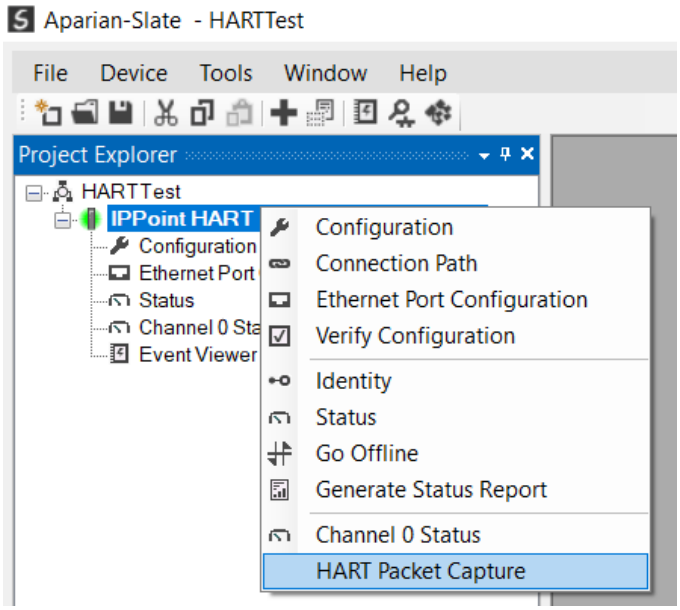


Figure 5.30 - Selecting HART Packet Capture

The HART Packet Capture window will open and automatically start capturing all HART packets.

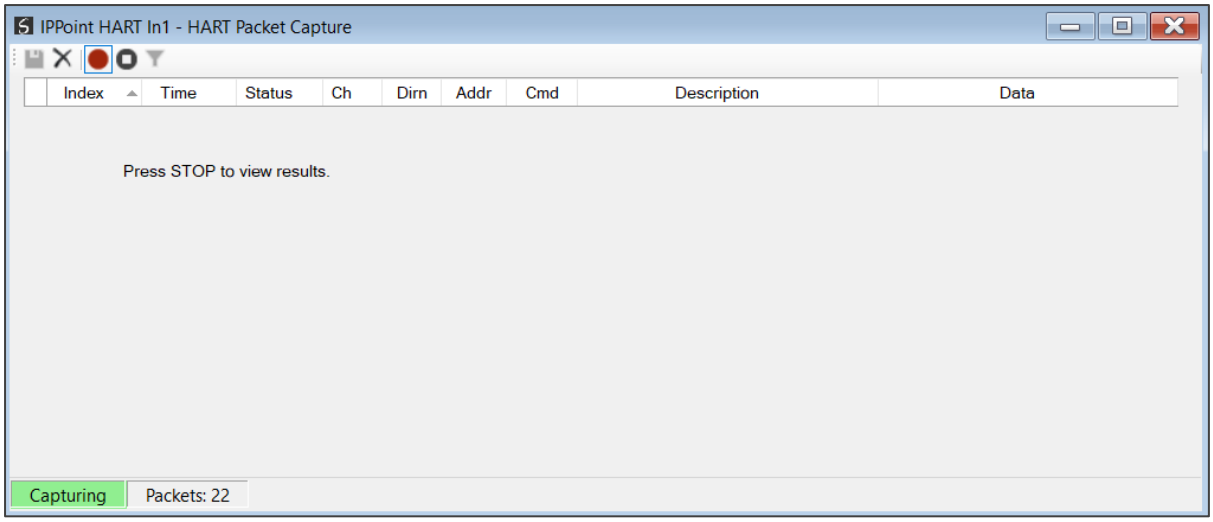


Figure 5.31 – HART Packet Capture

To display the captured HART packets, the capture process must first be stopped, by pressing the ***Stop*** button.

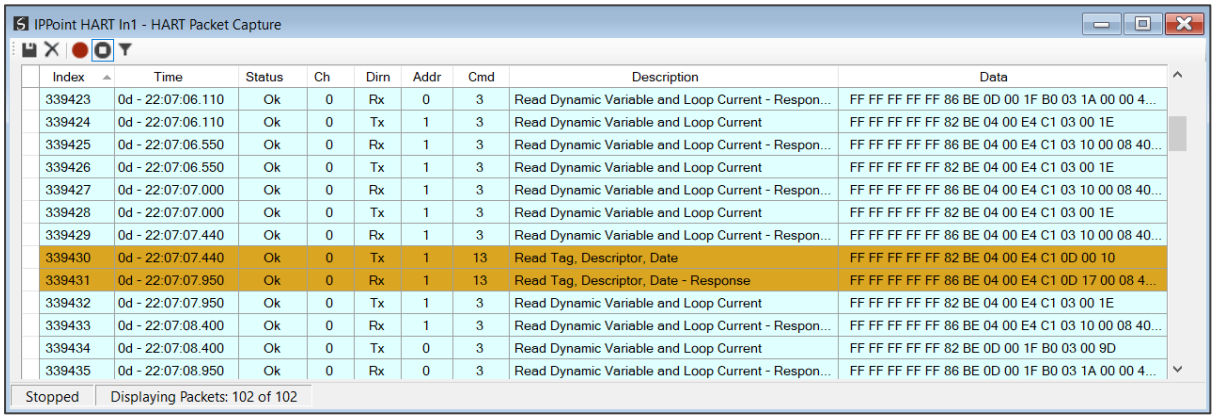


Figure 5.32 – HART Packet Capture complete

The captured HART packets are tabulated as follows:

Statistic	Description
Index	The packet index, incremented for each packet sent or received.
Time	The elapsed time since the module powered up.
Status	The status of the packet. Received packets are checked for valid HART constructs and valid checksums.
Ch	The HART channel where the packet was captured.
Dirn	The direction of the packet, either transmitted (Tx) or received (Rx).
Addr	The HART slave device short address.
Cmd	The HART command sent or received

Description	A basic description of the captured packet. If the user double-clicks on the description it will provide a more detailed description.
Data	The raw HART data.

Table 5.7 – HART Packet Capture fields

The packet capture can be saved to a file for further analysis, by selecting the ***Save*** button on the toolbar. Previously saved HART Packet Capture files can be viewed by selecting the HART ***Packet Capture Viewer*** option in the ***Tools*** menu.

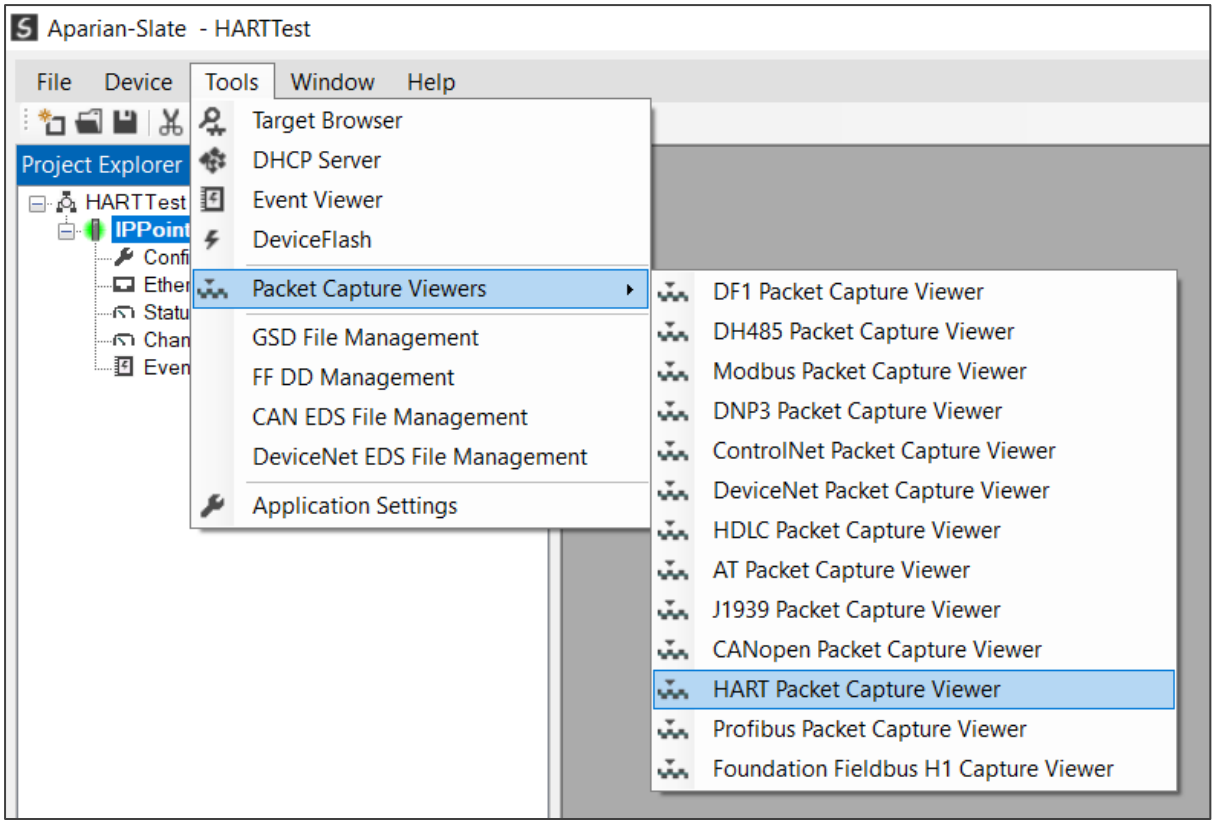


Figure 5.33 - Selecting the HART Packet Capture Viewer

6. ASSET MANAGEMENT FDT– DTM TECHNOLOGY

The IP Point HART module supports FDT / DTM technology, allowing the user to configure any field device using its DTM (Device Type Manager) in any standard FDT Frame (Field Device Tool).

To use a field device DTM with the IP Point HART module, the following Aparian DTMs will need to first be installed:

- EtherNet/IP CommDTM (Communication DTM)
- IP Point HART In/Out (Gateway DTM)

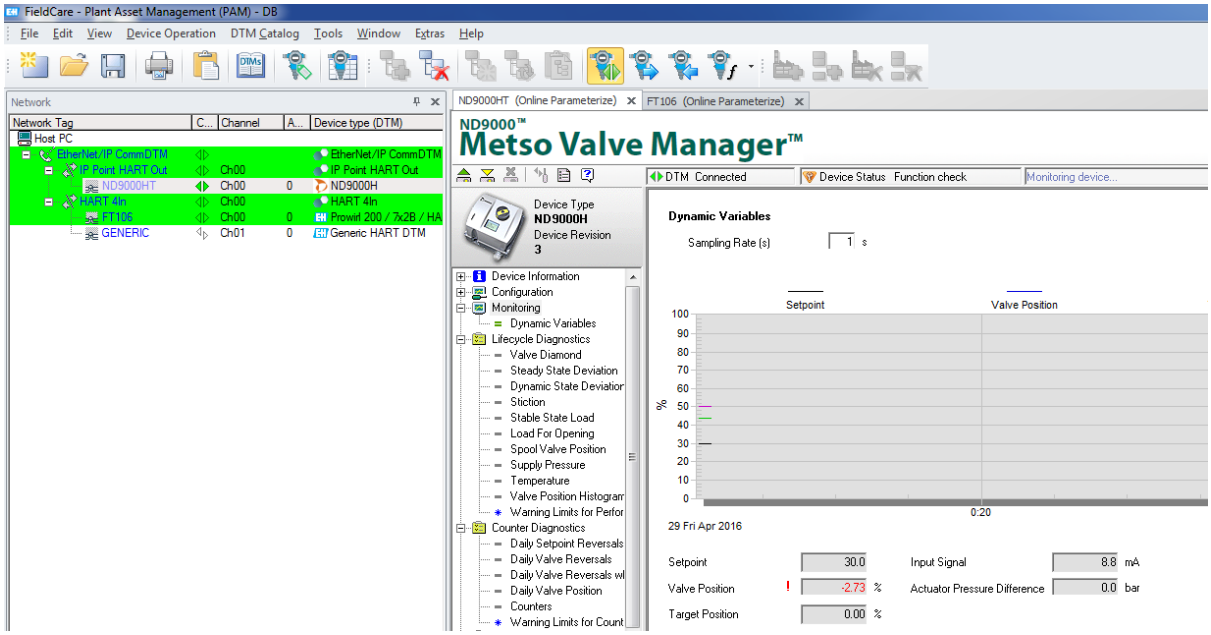


Figure 6.1 – FDT / DTM Example

7. WHAT IS HART

HART is an acronym for Highway Addressable Remote Transducer. HART is able to transfer digital information across a standard 4-20 mA loop, by superimposing the digital data on the analog signal using Frequency Shift Keying (FSK). As the name implies FSK changes the frequency of the carrier to represent the binary data 0 or 1. A frequency of 1200 Hz represents a logical 1 and a frequency of 2200 Hz represents a logic 0. Therefor HART has a maximum transfer rate of 1200 bits per second (bps).

The amplitude of the FSK modulation is typically 1mA. Due to the relatively high frequency in comparison to changes of the analog signal, a low pass filter can be employed to prevent the modulation from affecting the analog signal.

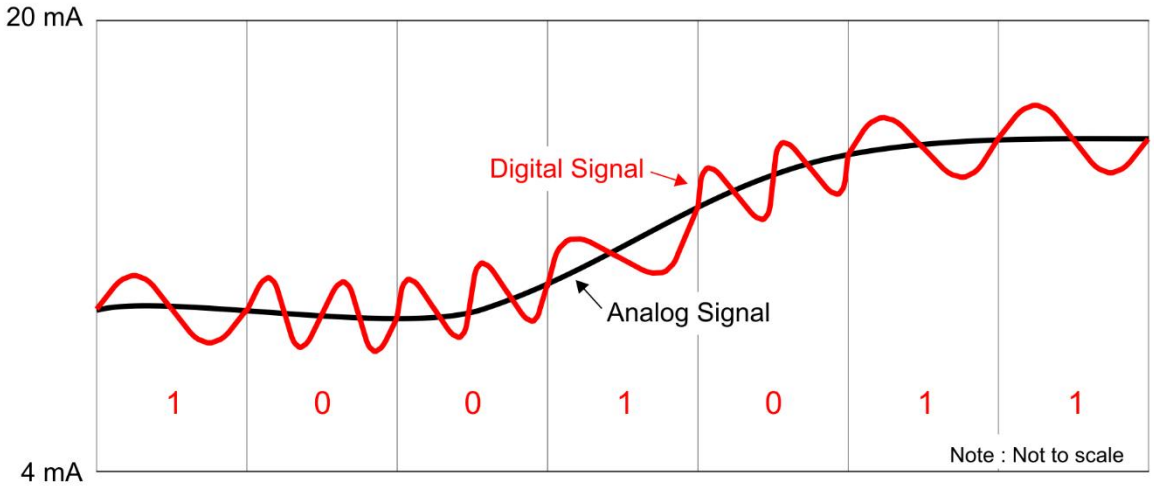


Figure 7.1. – HART FSK Modulation

8. TECHNICAL SPECIFICATIONS

8.1. DIMENSIONS

The figure below shows the IP Point HART dimensions.

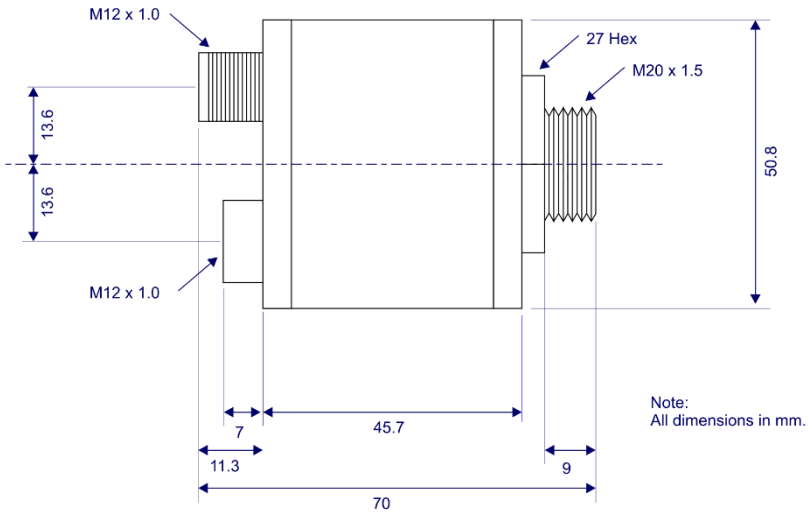


Figure 8.1 – IP Point HART module enclosure dimensions

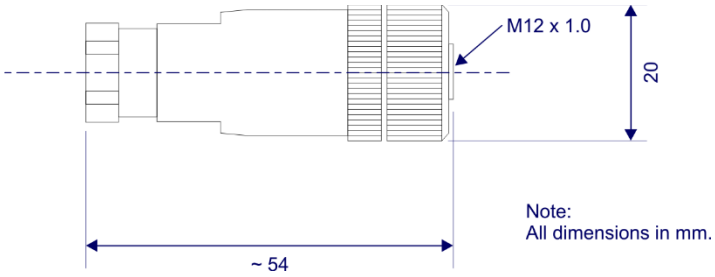


Figure 8.2 – Power connector dimensions

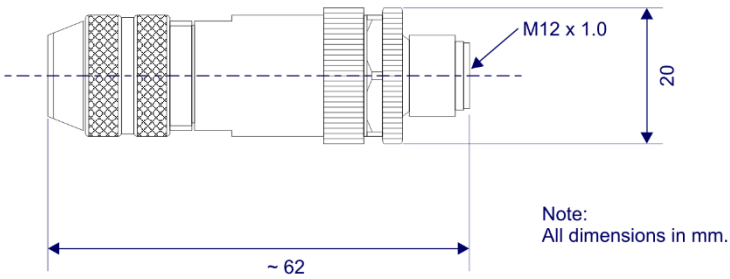


Figure 8.3 – Ethernet connector dimensions

8.2. ELECTRICAL

Specification	Rating
Power requirements	Input: 12 – 28V DC, 30mA @ 24 VDC – With no field device attached. 52mA @ 24 VDC - With a field device at 22mA each. 50mA @12 VDC - With no field device attached. 72mA @ 12 VDC - With a field device at 22mA each.
Power consumption	0.8 W – With no field device attached. 1.4 W – With a field device at 22mA each. 1.7 W – With input channel shorted. (IP Point HART In)
Connector (Power)	Binder M12-A, 5 contact, cable outlet: 4-6 mm, female cable connector, plastic lock, screw terminal connection. (Part Number: 99 0436 10 05)
Connector (Ethernet)	Binder M12-D, 4 contact, cable outlet: 6 - 8 mm, shieldable, CAT 5 screw terminal connection, static ring version (Part number : 99 3729 810 04)
Conductors (field device)	20 AWG (Red, Black, Green)
Enclosure rating	IP66
Temperature	-20 – 70 °C
Emissions	IEC61000-6-4
ESD Immunity	EN 61000-4-2
Radiated RF Immunity	IEC 61000-4-3
EFT/B Immunity	EFT: IEC 61000-4-4
Surge Immunity	Surge: IEC 61000-4-5
Conducted RF Immunity	IEC 61000-4-6

Table 8.1 - Electrical specification

8.3. ETHERNET

Specification	Rating
Connector	M12-D
Conductors	CAT5 STP/UTP
ARP connections	Max 20
TCP connections	Max 20
CIP connections	Max 10
Communication rate	10/100Mbps

Duplex mode	Full/Half
Auto-MDIX support	Yes

Table 8.2 - Ethernet specification

8.4. ANALOG INPUT CHANNEL (A-IP.HART-I)

Specification	**Rating**
Number of channels	1
ADC resolution	12 bit
Input impedance	247.5 Ω
Accuracy (calibrated 25°C)	< 0.15 %
Accuracy (uncalibrated)	< 0.30 %
Range	0 – 22 mA
Current limit	34 mA

Table 8.3 - Analog Input channel specification

8.5. ANALOG OUTPUT CHANNEL (A-IP.HART-O)

Specification	**Rating**
Number of channels	1
DAC resolution	16 bit
Drive	50 – 1170 Ω Resistive < 50 mH Inductive
Accuracy (calibrated 25°C)	< 0.15 %
Accuracy (uncalibrated)	< 0.30 %
Range	0 – 22 mA

Table 8.4 - Analog Output channel specification

8.6. CERTIFICATIONS

Certification	Mark
CE Mark	CE
RoHS2 Compliant	RoHS2
ODVA Conformance	EtherNet/IP™ * F/W 1.005
UL Mark File: E494895	c UL us LISTED CLASS 1, DIV 2, GROUPS A, B, C, D
UKCA	UKCA

Table 8.5 – Certifications

9. INDEX

A

AES-128, 38, 76
AES-256, 38
Aggressive Mode, 38, 104
assembly instance, 47
Authentication, 76, 77, 104

C

Calibration, 118
Channel configuration, 27
Contact Us, 10
Critical Functions, 38

D

DHCP, 19
dimensions, 127
DNP3, 10, 37, 38, 76, 77, 103, 104
DNP3 Mapping, 74
DNP3 Statistics, 102
DNP3 TCP, 26
DNP3 UDP, 26
DTM, 125

E

EDS AOP, 43
Ethernet Bridge, 47
Ethernet connector, 16
Ethernet Connector, 17
EtherNet/IP Statistics, 102
Event Log, 120

F

Fail Mode, 28
FDT, 125
FDT/DTM, 125
Firmware upgrade, 25

H

HART, 126
HART 4, 38
HART 4 general configuration, 30
HART Advanced Status, 113
HART Channel Status, 108
HART Device Configuration, 112
HART Device Info, 110
HART Device Status, 111
HART PV tracking, 115
HART relay message, 63
HART Statistics, 114
HART Status encoding, 65
HART Trending, 116

I

input assembly, 101, 102
Input assembly, 59
IP Point HART, 24, 47, 48, 59, 76
IP Point HART general configuration, 26
IP Point HART parameters, 25
IP-Point-HART, 6

K

Key Change Method, 37
Key Wrap Algorithm, 37, 76, 105

L

LED, 99
Logix Connection parameters, 47

M

M12 Connectors, 11
M20 port, 12
MAC Algorithm, 37, 104
MODBUS, 10, 105, 106
Modbus Mapping, 77, 86, 90
Modbus Statistics, 105, 106, 107
Modbus TCP, 26, 86

O

output assembly, 59, 62
Output assembly, 62

P

Power Connector, 16
Primary mode, 26

R

requested packet interval (RPI), 49
Rockwell Automation, 23
RSLinx, 23
RSLogix 5000, 47, 48, 49, 50, 51, 59, 62, 121

S

Secure, 37, 38, 76
Secure Authentication, 37, 76
Security, 37, 38, 76, 105
Session keys, 76
Slate, 25, 59, 76, 99, 121
Speed profile, 26
statistics, 99
Support email, 10

T

Trending, 28

U

UDT and Mapping, 50
Update Key, 76, 104, 105

User Defined Types (UDTs), 49

W

web server, 99, 121
Web server, 121