PA Link/B

PROFIBUS PA DPV0/DPV1 Master

User Manual

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Revision 1.10

aparian

CONTENTS

Revision History

Revision	Date	Comment
1.0	15 October 2019	Initial document
1.1	6 November 2019	Corrected Modbus Mapping
1.2	6 May 2020	Corrected Modbus Master Mode table
1.3	12 July 2020	Updated Response structure for CIP Message used to extract DP Slave Diagnostics Response
1.5	6 November 2020	Added M580 configuration.
1.6	7 December 2020	Added UL Class 1 Div 2 certification
1.7	6 January 2022	Update Modbus Device Enable for Holding Registers
1.8	4 March 2022	Added configurable Modbus TCP port Added option for Modbus Single Write Added option to zero PA device data when device is lost Added mapping of Modbus communication status. Added byte swap options for each PA Slave Device.
1.9	29 July 2022	Updated FDT/DTM section to include FactoryTalk Linx CommDTM
1.10	4 Aug 2022	Added information required for UL regarding open type device enclosures.

1. PREFACE

1.1. INTRODUCTION TO THE PA LINK

This manual describes the installation, operation, and diagnostics of the Aparian PA Link PROFIBUS PA DPV0/DPV1 Master.

The PA Link allows the user to interface PROFIBUS PA to EtherNet/IP or Modbus TCP (Master or Slave).

The PA Link can either operate as a PROFIBUS DPV0/DPV1 master allowing EtherNet/IP devices (e.g. Rockwell Logix platform) or Modbus devices to exchange process, alarming, and diagnostic data with PROFIBUS PA devices as well as provide parameterization and asset management of slave devices using Device Type Managers (DTMs).

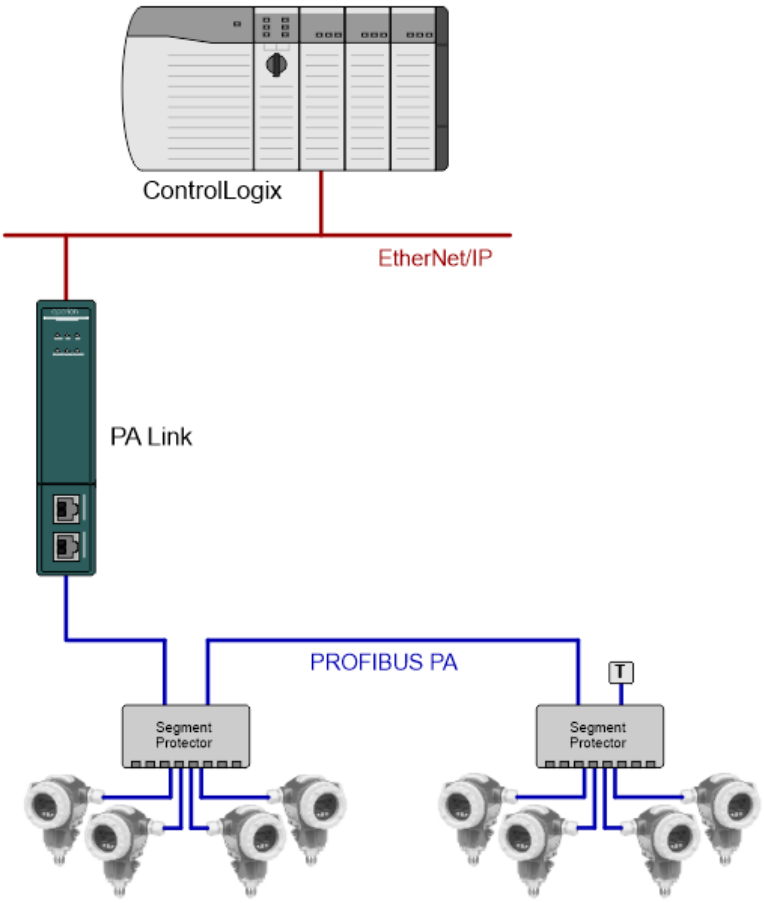


Figure 1.1 – PA Link typical PROFIBUS Master architecture

1.2. FEATURES

The PA Link will allow the user to interface PROFIBUS PA DPV0/DPV1 to either EtherNet/IP or Modbus.

The PA Link, when configured as a Master, can exchange up to 2 kilobytes of PROFIBUS PA device and status data.

It has two Ethernet ports allowing the user to have either a Linear or Ring (Device Level Ring – DLR) Ethernet topology. The Ethernet ports can also be setup for port mirroring allowing for better fault analysis.

The PA Link can synchronize to an NTP Server allowing for automatic time synchronization. It also supports an onboard non-volatile event log for improved fault finding.

The PA Link has a built-in Power Conditioner which can supply up to 420mA. The power conditioner is protected against a configurable overcurrent limit. The module also has a configurable built-in fieldbus terminator.

PROFIBUS PA Master
The PA Link can exchange process data (DPV0) with up to 32 PROFIBUS PA slave devices. The data is formatted into the engineering units for use in either a Logix platform or Modbus device by using the automatically generated mapping imports for Logix User Defined Data Types (UDTs) or padding for Modbus Registers. The latter ensures alignment with the 16-bit data structure.

The PA Link also provides DPV1 communication allowing the user to exchange DPV1 Class 1 and Class 2 data with each slave device. The PA Link Gateway DTM can be used to configure and parameterize each slave device using Device Type Manager (DTM) technology.

The PA Link will allow the user to monitor and extract DPV1 alarms from each slave device on the connected PROFIBUS PA fieldbus from either a Logix controller or Modbus Master device.

The PA Link provides a range of statistics and tools to provide a detailed diagnostic overview of each PA Link which speeds-up fault finding. The Slate configuration utility allows the user to perform a PROFIBUS PA packet capture of the running fieldbus which can be used to analyse the bus behaviour and packets received. The PA Link also provides global and device specific statistics.

1.3. ARCHITECTURE

The figures below provide an example of the typical network setup for a PROFIBUS Master architecture using either an EtherNet/IP or Modbus TCP Interface.

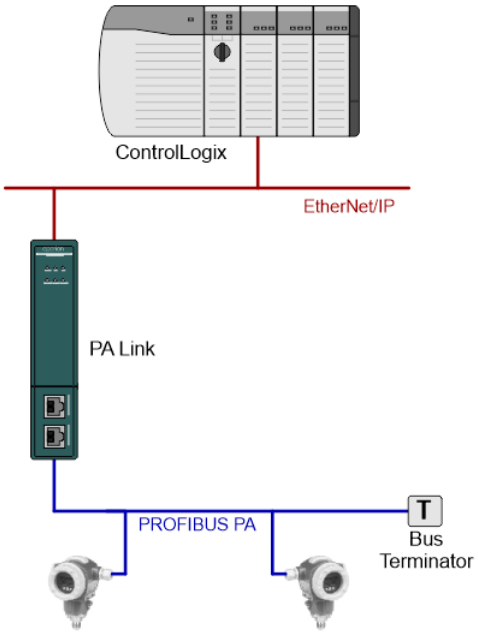


Figure 1.2 – PA Link PROFIBUS Master to EtherNet/IP architecture (Basic)

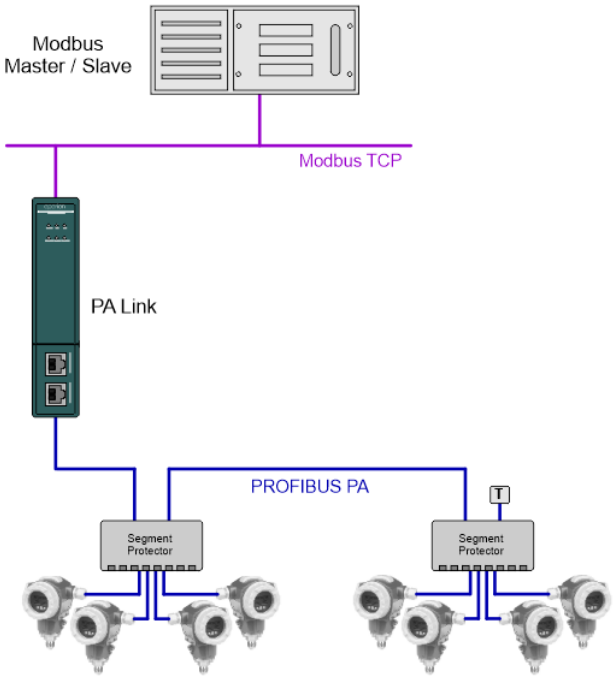


Figure 1.3 – PA Link PROFIBUS Master to Modbus TCP architecture

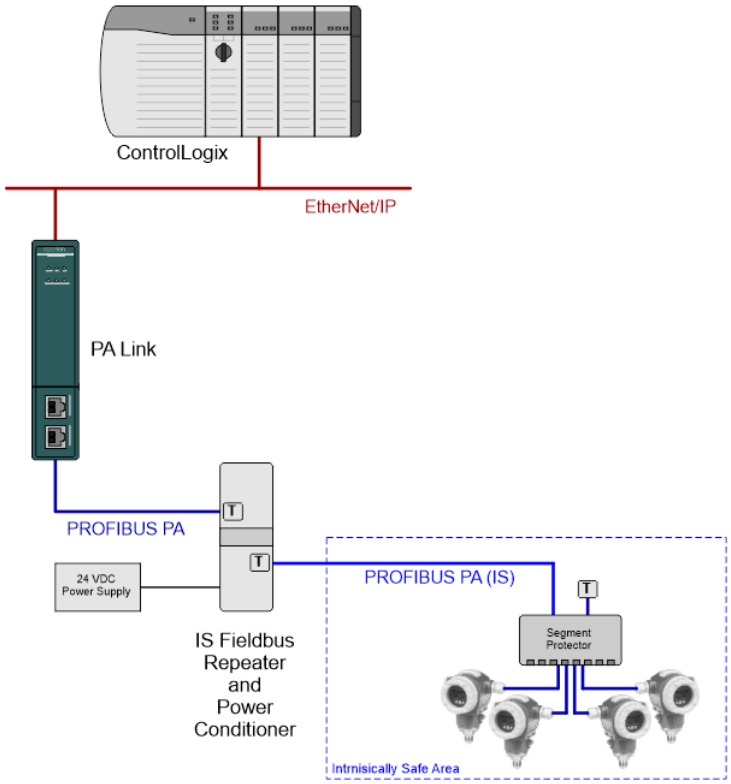


Figure 1.4 – PA Link PROFIBUS Master with External Intrinsically Safe Repeater

1.4. 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
PA Link User Manual PA Link Datasheet Example Code & UDTs	https://www.aparian.com/products/palinkb
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
CIP Routing	The CIP Networks Library, Volume 1, Appendix C:Data Management
Modbus	http://www.modbus.org

Table 1.1 - Additional Information

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 1.2 – Support Details

2. INSTALLATION

2.1. MODULE LAYOUT

The module has two Ethernet ports at the front of the module. The Ethernet cable must be wired according to industry standards which can be found in the additional information section of this document.

The modules provide six diagnostic LEDs as shown in the front view figure below. These LEDs are used to provide information regarding the module system operation, the Ethernet interface, the auxiliary communication (e.g. Modbus TCP), and the PROFIBUS network status.

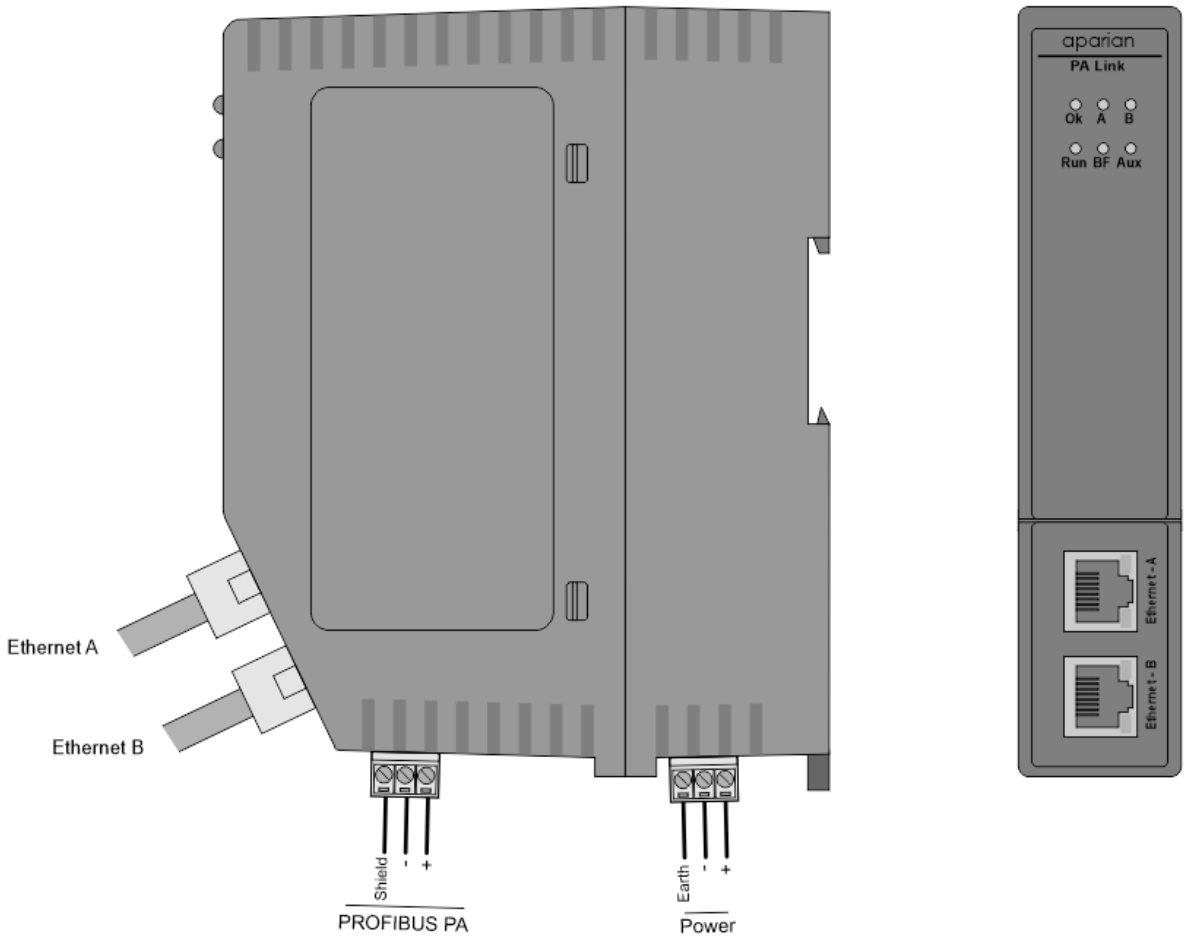


Figure 2.1 – PA Link Front and Side view

At the bottom of the PA Link modules, there is one 3-way power connector and one 3-way PROFIBUS PA connector.

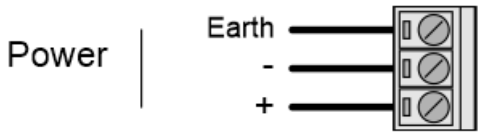


Figure 2.2 – PA Link Power connector

The PA Link has an input voltage range of 22-26 Vdc that needs to be applied to the module via the power connector. The power connector also provides an Earth connection for the PA Link.

NOTE: It is recommended to always have a good clean earth connected to the module via the Earth connector on the power connector.

Figure 2.3 – PA Link PROFIBUS PA communications connector

The PROFIBUS PA connector has two conductors (positive and negative) for the PROFIBUS PA network. The connector also has a shield connection for the PA network which is internally connected to the Power Connector Earth.

The module provides four DIP switches at the top of the enclosure as shown in the top view figure below.

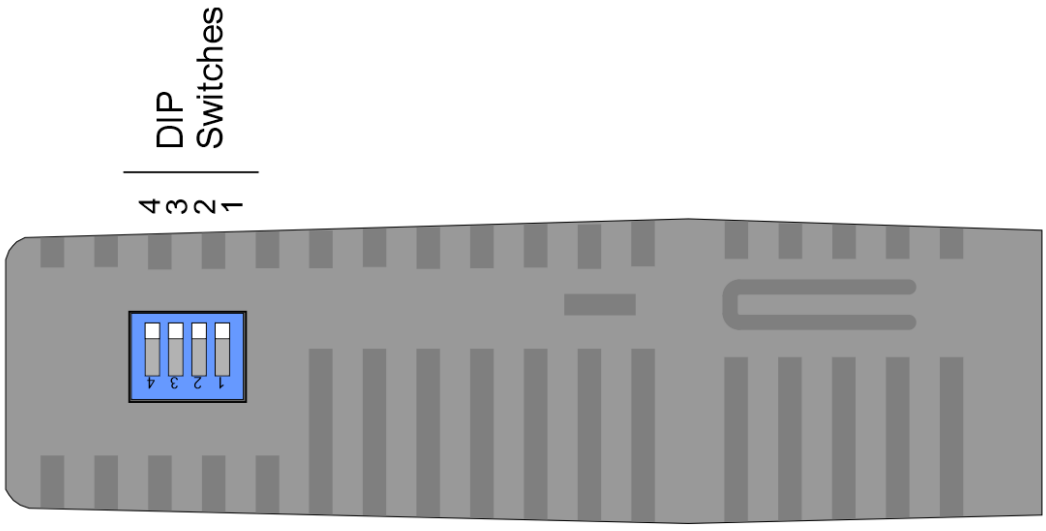


Figure 2.4 – PA Link Top view

DIP Switch	Description
DIP 1	Used to force the module into “Safe Mode”. When in “Safe Mode” the module will not load the application firmware and will wait for new firmware to be downloaded. This should only be used in the rare occasion when a firmware update was interrupted at a critical stage.
DIP 2	This will force the module into DHCP mode which is useful when the user has forgotten the IP address of the module.
DIP 3	This DIP Switch is used to lock the configuration from being overwritten by Slate. When set Slate will not be able to download to the PA Link module.
DIP 4	When this DIP Switch is set at bootup it will force the module Ethernet IP address to 192.168.1.100 and network mask 255.255.255.0. The user can then switch the DIP switch off and assign the module a static IP address if needed.

Table 2.1. - DIP Switch Settings

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 provides a DIN rail clip to mount onto a 35mm DIN rail.

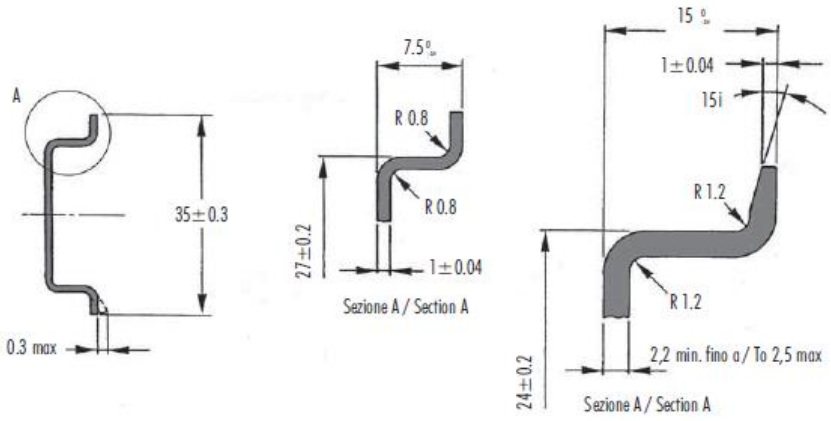


Figure 2.5 - DIN rail specification

The DIN rail clip is mounted on the bottom of the module at the back as shown in the figure below. Use a flat screwdriver to pull the clip downward. This will enable the user to mount the module onto the DIN rail. Once the module is mounted onto the DIN rail the clip must be pushed upwards to lock the module onto the DIN rail.

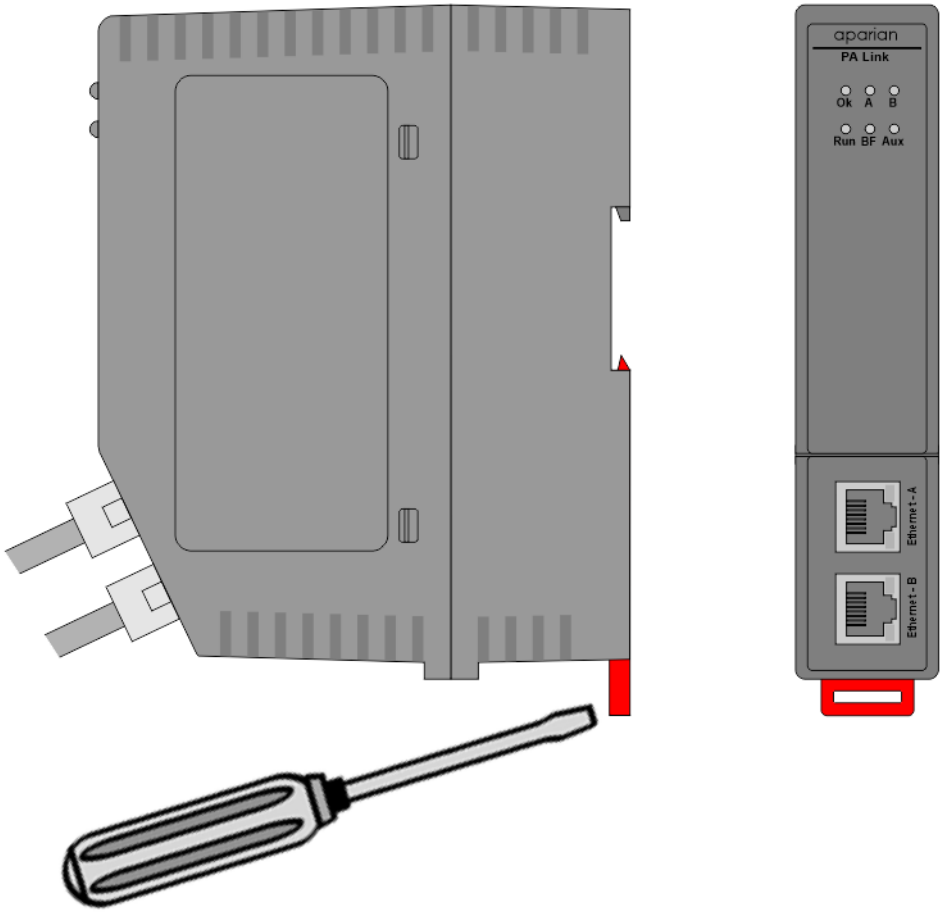


Figure 2.6 - DIN rail mouting

3. SETUP

3.1. INSTALL 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.

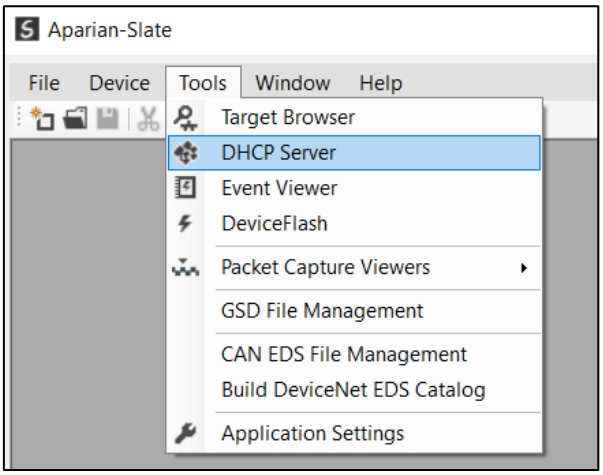


Figure 3.2 - Selecting DHCP Server

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

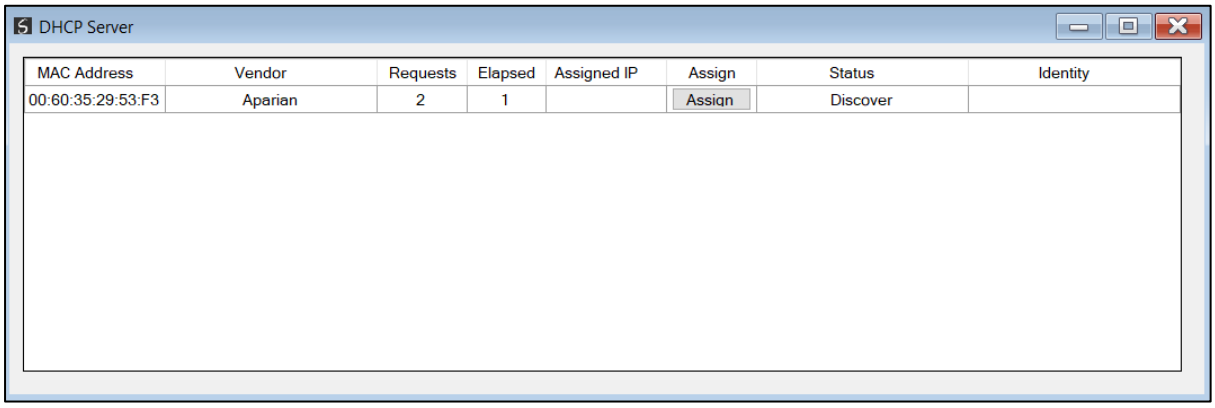


Figure 3.3 - DHCP Server

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.

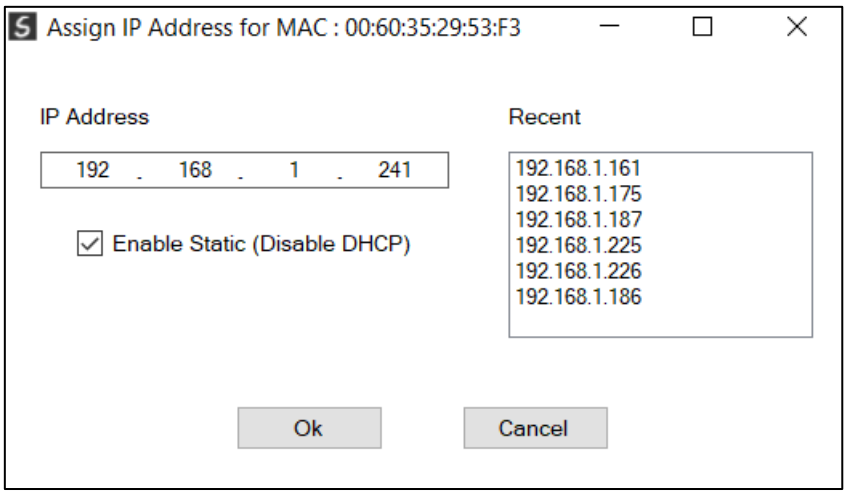


Figure 3.4 - Assigning IP Address

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.

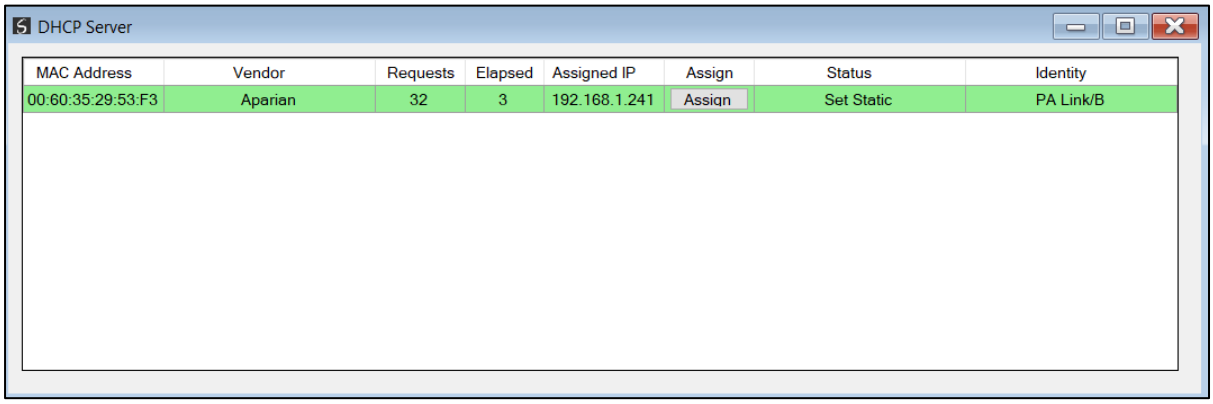


Figure 3.5 - Successful IP address assignment

It is possible to force the module back into DHCP mode by powering up the device with DIP switch 2 set to the ***On*** position.

A new IP address can then be assigned by repeating the previous steps.

NOTE: It is important to return DIP switch 2 back to Off position, to avoid the module returning to a DHCP mode after the power is cycled again.

If the module's DIP switch 2 is in the ***On*** position during the address assignment, the user will be warned by the following message.

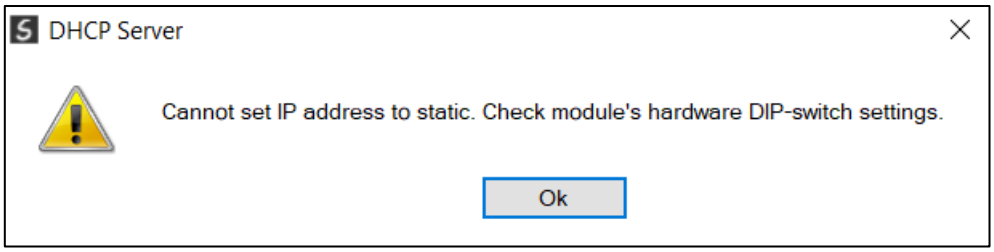


Figure 3.6 - Force DHCP warning

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.

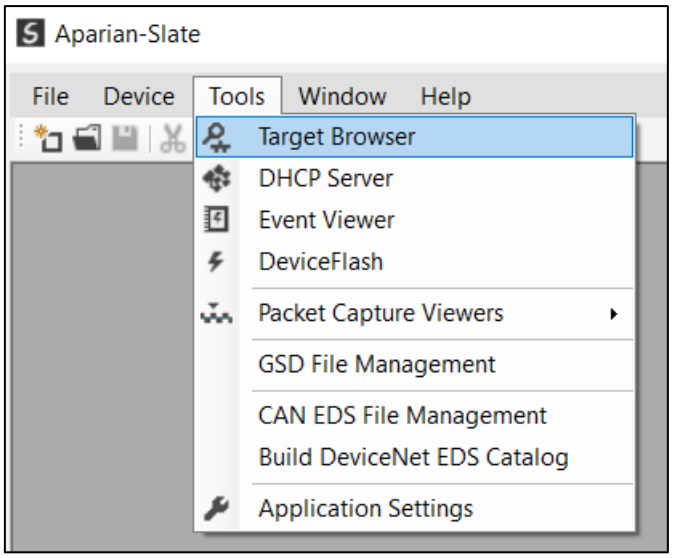


Figure 3.7 - Selecting the Target Browser

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

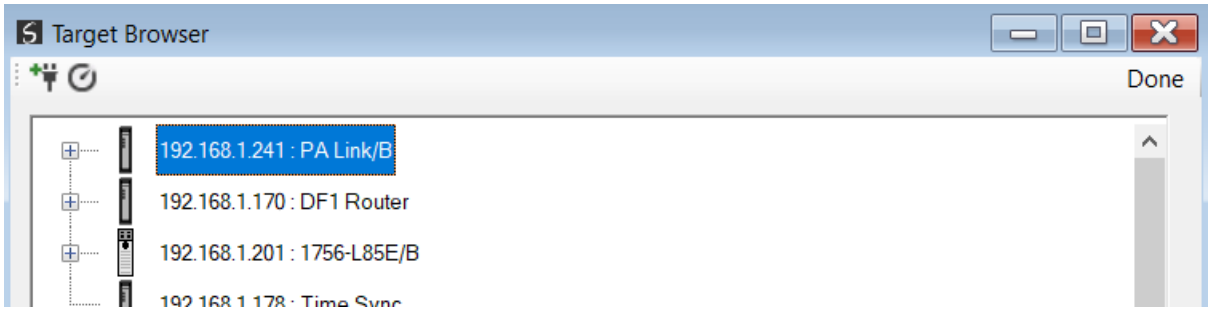


Figure 3.8 - Target Browser

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

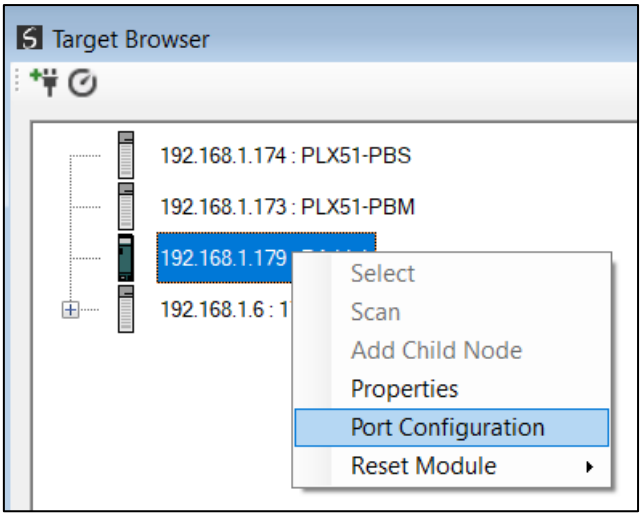


Figure 3.9 - Selecting Port Configuration

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

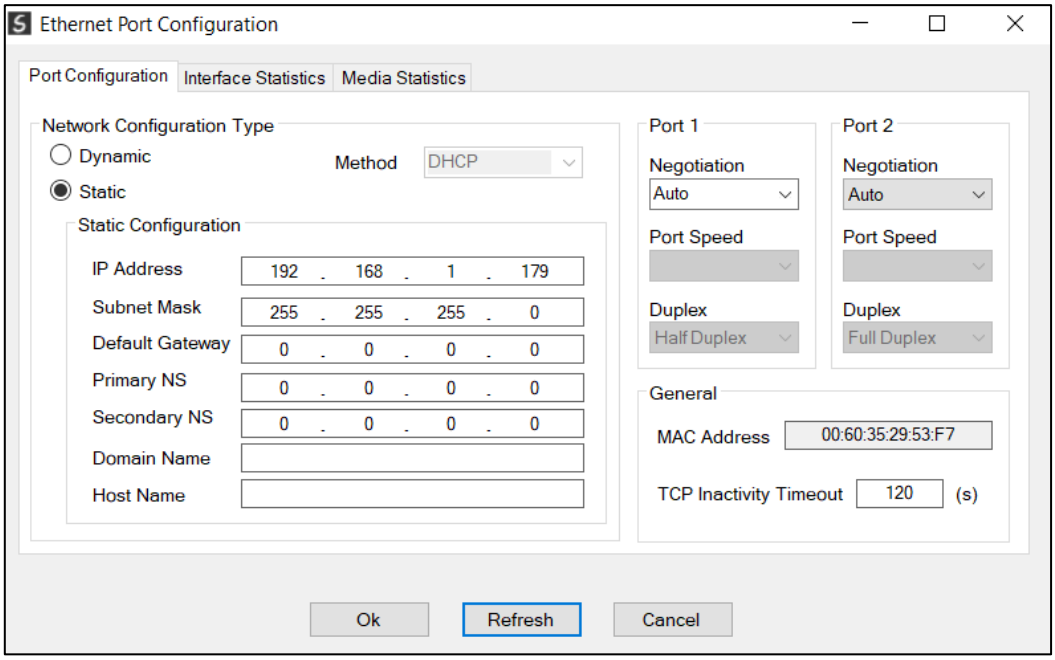


Figure 3.10 - Port Configuration

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

3.3. GSD FILE MANAGEMENT

Each PROFIBUS device has a GSD file that is required to provide information needed to configure the device for data exchange. Slate manages the GSD library which is used for adding devices to the PA Link.

The GSD File Management Tool is opened by selecting ***GSD File Management*** under the ***Tool*** menu in Slate.

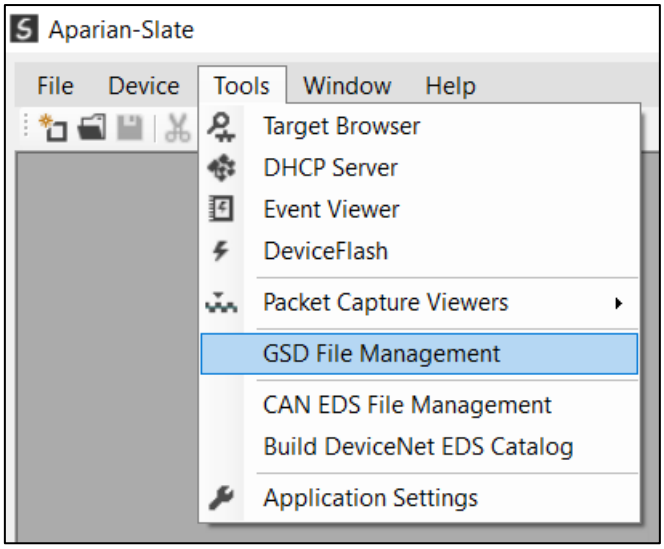
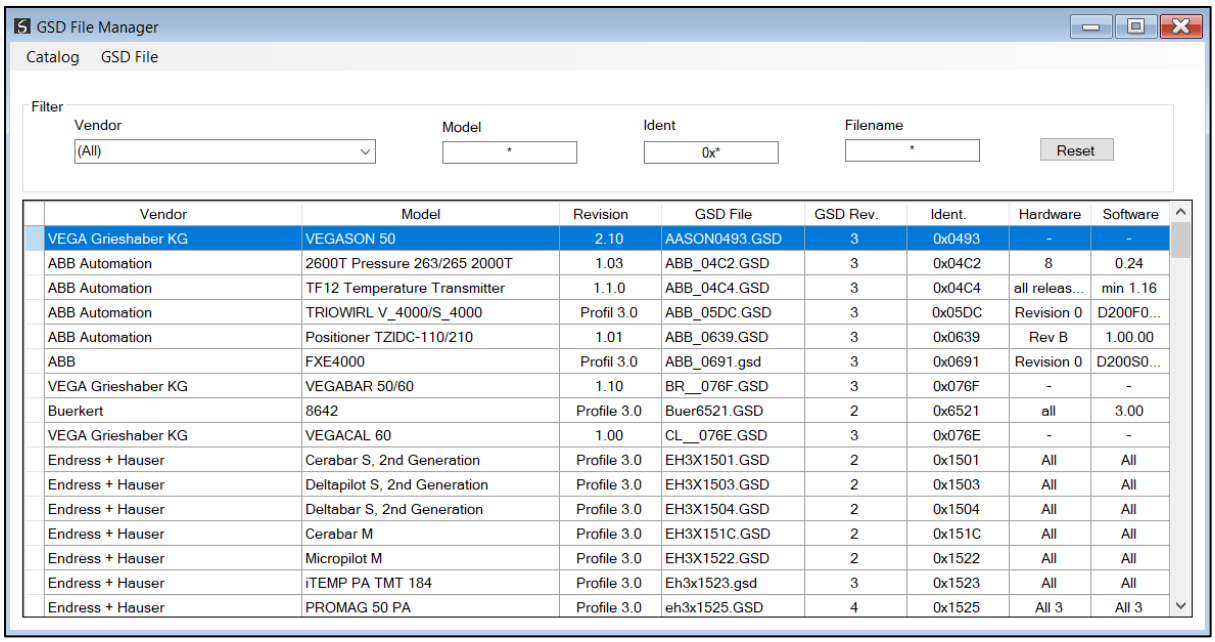


Figure 3.11 – Launching the GSD File Management Tool

Once the tool has been opened a list of slave devices already registered using their GSD files.



Vendor	Model	Revision	GSD File	GSD Rev.	Ident.	Hardware	Software
VEGA Grieshaber KG	VEGASON 50	2.10	AASON0493.GSD	3	0x0493	-	-
ABB Automation	2600T Pressure 263/265 2000T	1.03	ABB_04C2.GSD	3	0x04C2	8	0.24
ABB Automation	TF12 Temperature Transmitter	1.1.0	ABB_04C4.GSD	3	0x04C4	all releas...	min 1.16
ABB Automation	TRIOWIRL V_4000/S_4000	Profil 3.0	ABB_05DC.GSD	3	0x05DC	Revision 0	D200F0...
ABB Automation	Positioner TZIDC-110/210	1.01	ABB_0639.GSD	3	0x0639	Rev B	1.00.00
ABB	FXE4000	Profil 3.0	ABB_0691.gsd	3	0x0691	Revision 0	D200S0...
VEGA Grieshaber KG	VEGABAR 50/60	1.10	BR__076F.GSD	3	0x076F	-	-
Buerkert	8642	Profile 3.0	Buer6521.GSD	2	0x6521	all	3.00
VEGA Grieshaber KG	VEGACAL 60	1.00	CL__076E.GSD	3	0x076E	-	-
Endress + Hauser	Cerabar S, 2nd Generation	Profile 3.0	EH3X1501.GSD	2	0x1501	All	All
Endress + Hauser	Deltapilot S, 2nd Generation	Profile 3.0	EH3X1503.GSD	2	0x1503	All	All
Endress + Hauser	Deltabar S, 2nd Generation	Profile 3.0	EH3X1504.GSD	2	0x1504	All	All
Endress + Hauser	Cerabar M	Profile 3.0	EH3X151C.GSD	2	0x151C	All	All
Endress + Hauser	Micropilot M	Profile 3.0	EH3X1522.GSD	2	0x1522	All	All
Endress + Hauser	iTEMP PA TMT 184	Profile 3.0	Eh3x1523.gsd	3	0x1523	All	All
Endress + Hauser	PROMAG 50 PA	Profile 3.0	eh3x1525.GSD	4	0x1525	All 3	All 3

Figure 3.12 – GSD File Management Tool

To add a GSD file the user will need to select the ***Add*** option under the ***GSD File*** menu.

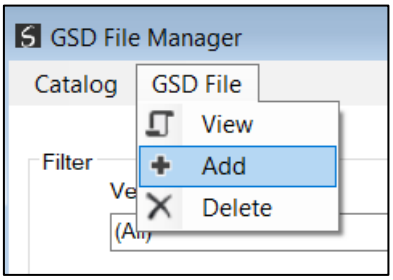


Figure 3.13 – GSD File Adding

The required GSD file will need to be selected as shown below:

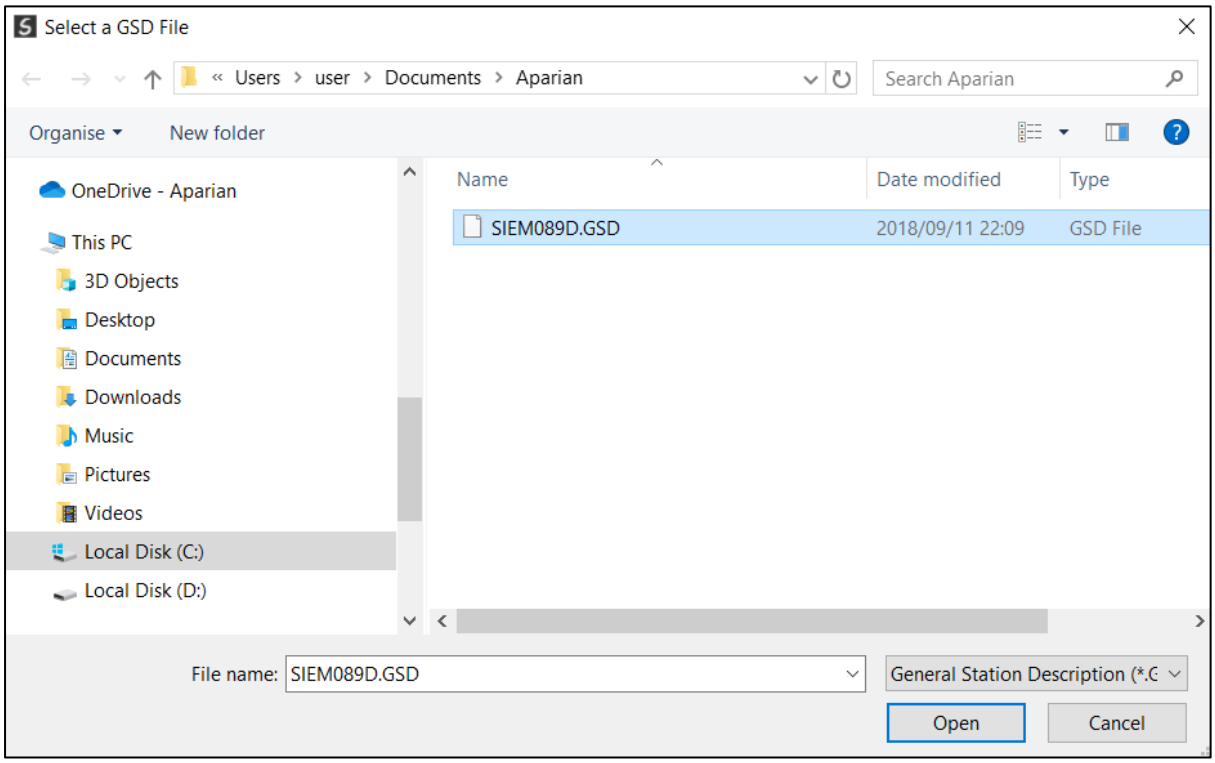


Figure 3.14 – GSD File Adding

Once the file has been selected the GSD File Management tool will add the slave device to the device list and recompile the GSD catalog.

A GSD catalog can be exported from another Slate by exporting the GSD catalog on one Slate and importing it in another. This is done by selecting either ***Import*** or ***Export*** under the ***Catalog*** menu as shown below:

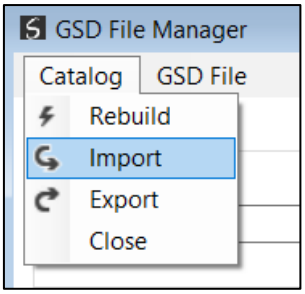


Figure 3.15 – GSD Catalog importing

3.4. CREATING A NEW PROJECT

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

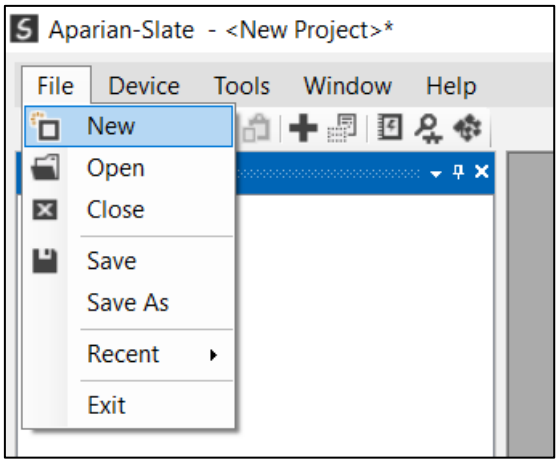


Figure 3.16 - Creating a new project

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.

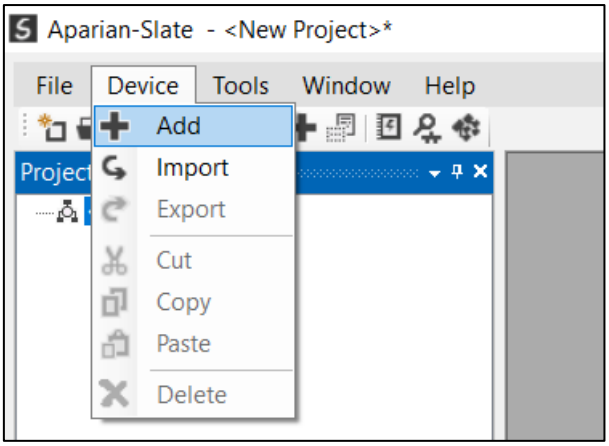


Figure 3.17 - Adding a new device

In the ***Add New Device*** window select the ***PA Link***, and click the ***Ok*** button.

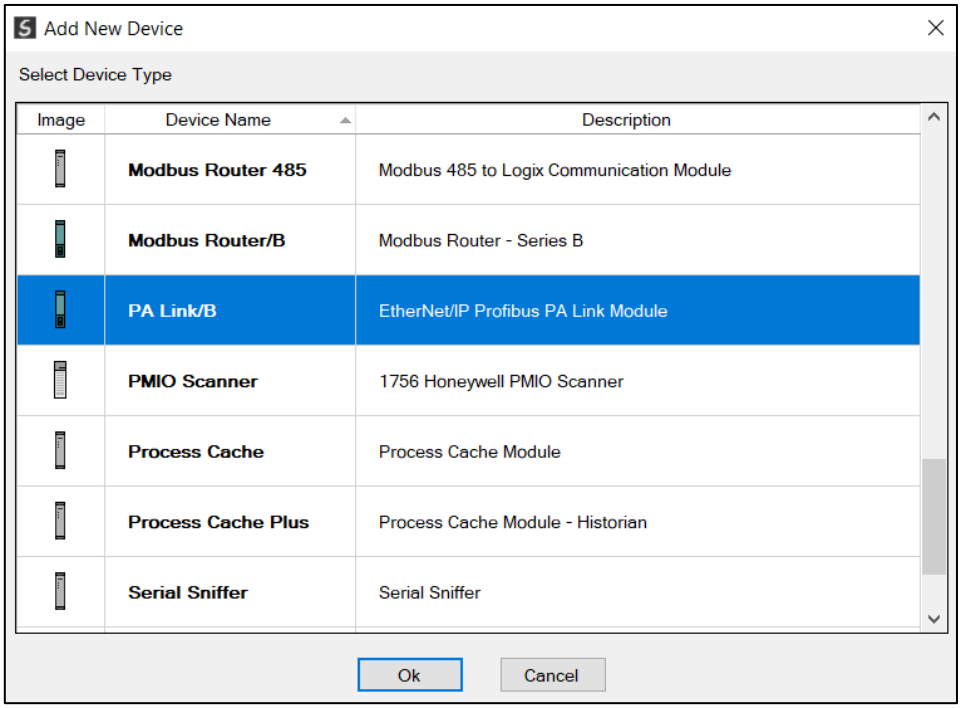


Figure 3.18 – Selecting a new PA Link

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***.

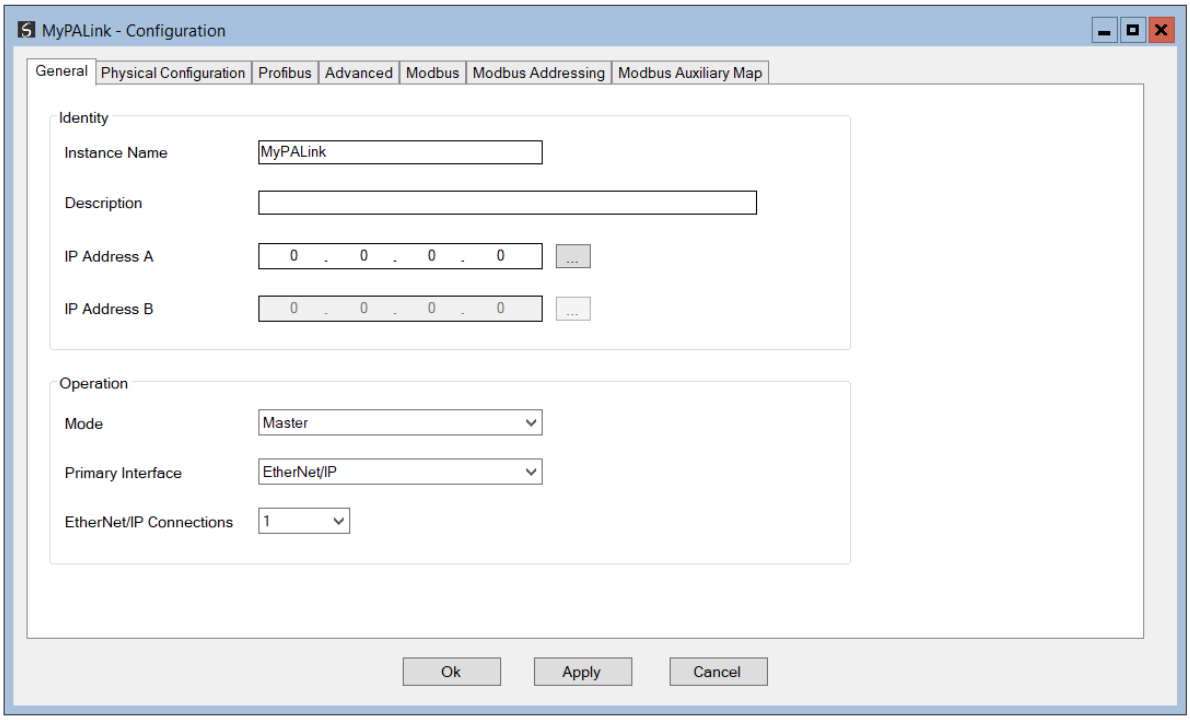


Figure 3.19 – PA Link Configuration

3.5. PA LINK PARAMETERS

The PA Link parameters are configured using the Slate configuration environment.

3.5.1. GENERAL

The General configuration is shown in the figure below. The PA Link ***Configuration*** window is opened by either double clicking on the module in the tree or right-clicking the module and selecting ***Configuration***.

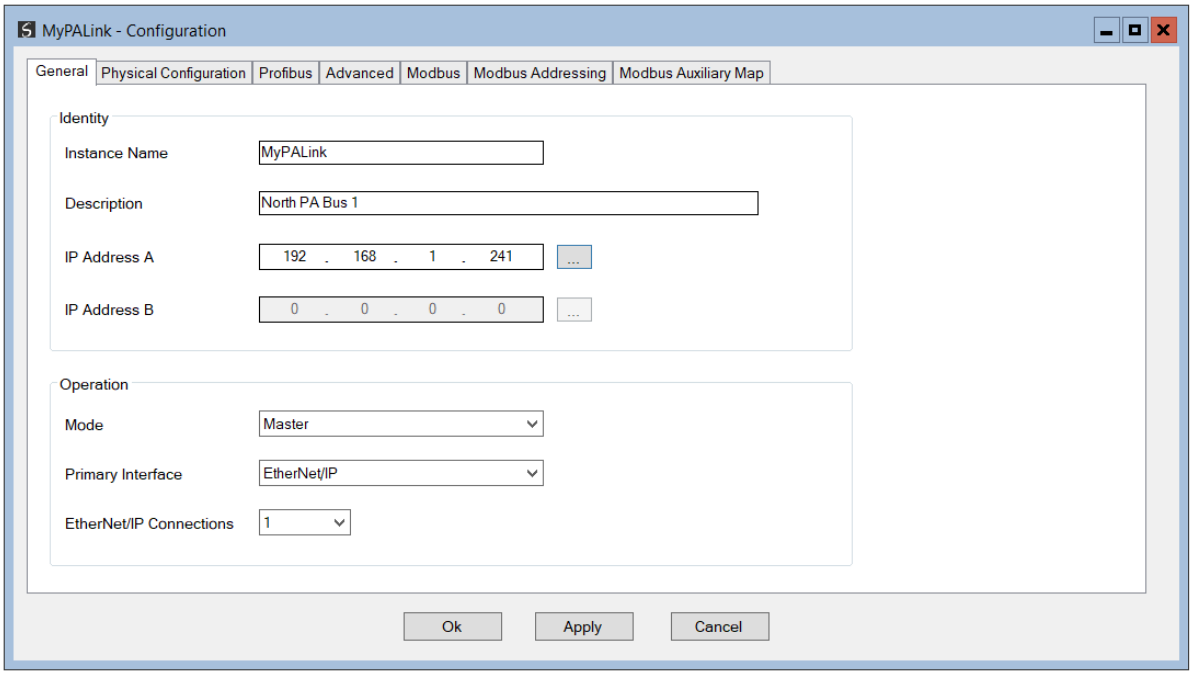


Figure 3.20 – PA Link General configuration

The General configuration consists of the following parameters:

Parameter	Description
Instance Name	This parameter is a user defined name to identify between various PA Link modules.
Description	This parameter is used to provide a more detail description of the application for the module.
IP Address A	The IP address of the module when in (Standalone) Master mode. When in Redundant Master mode this will be the IP address of the “A” PA Link module
IP Address B	The IP address of the “B” PA Link module when in Redundant Master mode.
Mode	The PA Link can operate in one of three modes: **Quiet** This mode allows the user to connect the PA Link to an active bus and run a PA packet capture. In this mode the PA Link will not communicate on the PA Bus, but rather only listen. **Master** In this mode the PA Link is the PA Master on the PROFIBUS network. When configured to interface to Modbus the PA Link will be a Modbus Master or Modbus Slave. **Redundant Master**

	In this mode the PA Link operates as one of two PA Masters on the PROFIBUS network. See the section on Redundant Masters for more information.
Primary Interface	This is the network the PA Link will interface the PROFIBUS network. • EtherNet/IP (Logix) • Modbus TCP Slave • Modbus TCP Master
EtherNet/IP Connections	The number of EtherNet/IP (CIP) Connections to be used in the exchange with Logix (1 to 4). **NOTE:** This value must match that configured in the Logix IO tree.

Table 3.1 - General configuration parameters

3.5.2. PHYSICAL CONFIGURATION

The Physical Configuration is shown in the figure below. This allows the user to configure the physical media operation (e.g. enabling a terminator).

The PA Link ***Physical Configuration*** window is opened by either double clicking on the module in the tree or right clicking the module and selecting ***Configuration***.

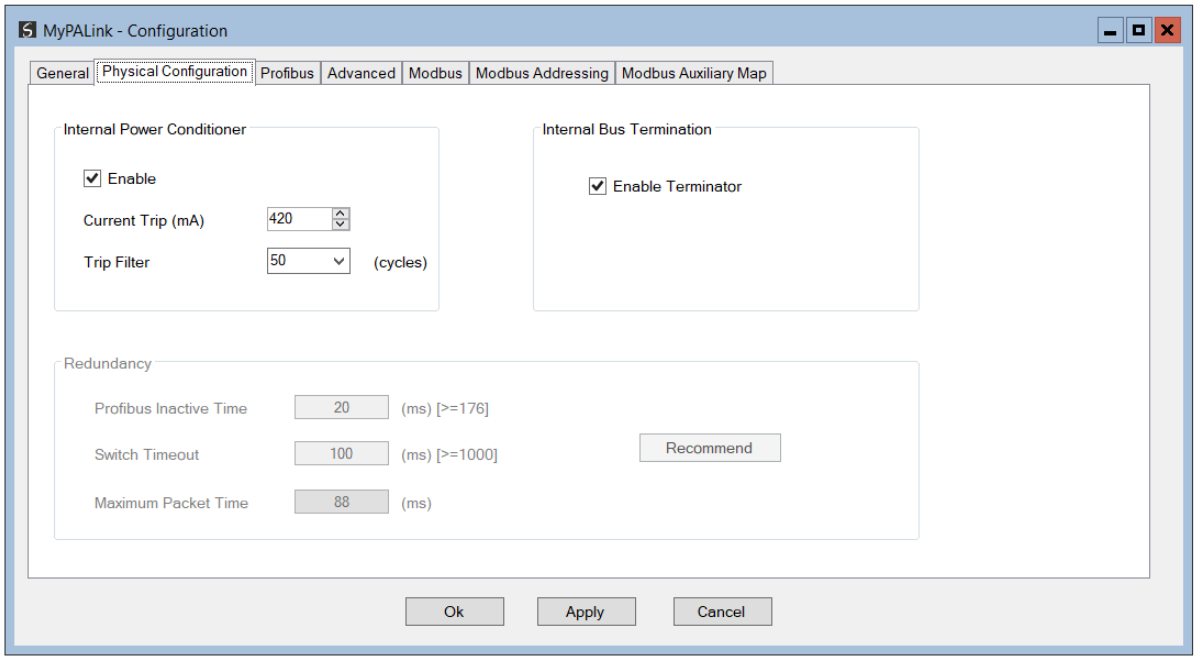


Figure 3.21 – PA Link Physcial Configuration configuration

The Physical Configuration consists of the following parameters:

Parameter	Description
Internal Power Conditioner	
Enable	This will enable/disable the internal power conditioner which will supply power to the PROFIBUS PA network. **NOTE:** When the internal power conditioner has been disabled the user will need to use and external power conditioner for the fieldbus to operate correctly.
Current Trip	The current limit (in mA) at which the PA Link will trip the fieldbus to protect against over current.
Trip Filter	The number of consecutive over current measurements cycles required before the fieldbus will be tripped and the power supply will be stopped. The cycle period is approximately 1ms. Valid Range 0-50.
Internal Bus Terminator	
Enable Terminator	Enables or Disables the fieldbus terminator required for PROFIBUS PA. Note that two terminators are required on the PA bus, one at each bus extremity. See the PROFIBUS section in the appendix for more detail.
Redundancy	
Profibus Inactive Time	**This is only relevant in Redundant Master mode** This parameter is the amount of time (in milliseconds) the standby Master will wait when the Profibus PA network is inactive before taking over as the ***Active*** Master. See Redundancy section.
Switch Timeout	**This is only relevant in Redundant Master mode** This parameter is the amount of time (in milliseconds) the Standby Master will be the active Master without the Logix output assembly indicating that the PA is the Master. After this time the module will revert to a Standby mode. See Redundancy section

Table 3.2 - Physcial Configuration parameters

3.5.3. PROFIBUS

The PROFIBUS configuration is shown in the figure below. The PA Link ***PROFIBUS*** configuration window is opened by either double clicking on the module in the tree or right-clicking the module and selecting *Configuration*.

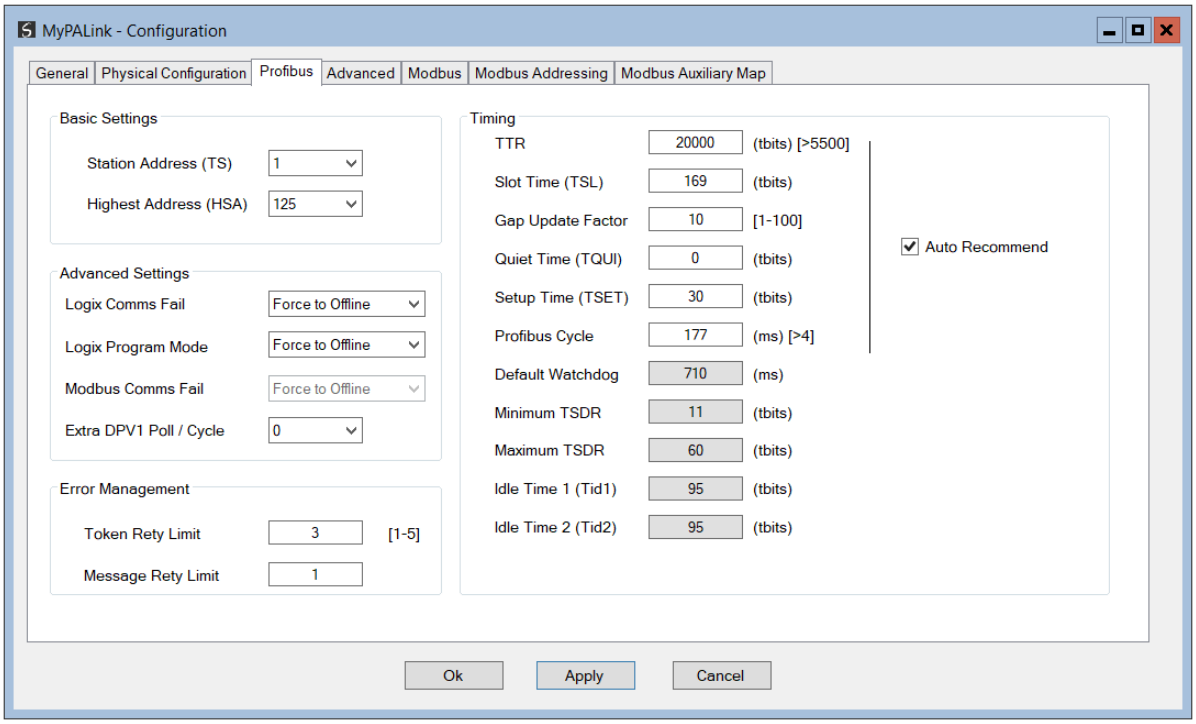


Figure 3.22 – PA Link PROFIBUS configuration

The PROFIBUS configuration consists of the following parameters:

Parameter	Description
	Basic Settings
Station Address (TS)	**PROFIBUS Station Address** for the PA Link module. TS should be different than any other slaves address on the PROFIBUS network, it should also be less-than or equal to the HSA below: Min: 0 Max: 126 Default: 1
Highest Address (HSA)	**Highest Station Address**. This is the highest station address of the active stations (masters). Passive stations (slaves) can have a higher address than the HSA. A low HSA is better for PROFIBUS performance. Min: 1 Max: 126 Default: 126
	Advanced Settings
Logix Comms Fail	Specifies the PROFIBUS Master behavior when losing communication with Logix, either: • Force to Offline • Force to Clear
Logix Program Mode	Specifies the PROFIBUS Master behavior when Logix is set in Program mode, either: • Force to Offline • Force to Clear
Modbus Comms Fail	Specifies the PROFIBUS Master behavior when losing communication with the Modbus device, either:

	• Force to Offline • Force to Clear
Extra DPV1 Poll / Cycle	The number of additional DPV1 Polls (Class 2) per PROFIBUS Cycle. Increasing this parameter results in faster Asset Management DTM updates.
Error Management	
Token Retry Limit	**Token Retry Limit** is the number of times that a PROFIBUS Master tries to pass the token before deciding that a station is not there. Value must be in the following range: Min: 1 Max: 5 Default: 3
Message Retry Limit	**Message Retry Limit** is the number of telegram repetitions if the address doesn't react. Value must be in the following range: Min: 0 Max: 15 Default: 1
Timing	
TTR	**Target Rotation Time** indicates the maximum time available for a token circulation (time for PROFIBUS token to be passed to another master and be back). It takes in account the number of slaves with their IO size (data exchanges telegram), different telegrams needed and their duration times (FDL status, global control, pass token), all mandatory timing with respect to the PROFIBUS standard (time slot, min and max Tsdr, Tqui, Tset, …) and a safety margin which allows bandwidth for acyclic messages (DPV1, …). Min: 0 Max: 16777215
Slot Time (TSL)	**Slot Time** (in tbits) is the maximum time the PA Link will wait, after the transmission of a request, for the reception of the first byte (Tchar) of an answer. (It allows detecting a timeout.) It can be increased when repeaters are used in the PROFIBUS network topology. The value must respect the rule: Min: 37 Max: 16383
Gap Update Factor	**Gap Update Factor:** The range of addresses between 2 consecutive active stations is called GAP. This GAP is submitted to a cyclic check during which the system identifies the station condition (not ready, ready or passive). Min: 1 Max: 100
Quiet Time (TQUI)	**Quiet time** (in tbits) is the time that a station may need to switch from sending to receiving. It must respect the rule: TQUI < MIN_TSDR Min: 0 Max: 255
Setup Time (TSET)	**Setup Time** (in tbits) is the reaction time on an event. Calculation of TSET must respect the rule: Min: 1 Max: 494
PROFIBUS Cycle	**PROFIBUS Cycle** (in ms) (read/Write) field defines the cyclic time the master will respect between two IO Data Exchange sequences. This parameter can be increased by the user when the PROFIBUS network load does not allow the processing of acyclic requests.
Auto Recommend	When Enabled, all timing parameters will be updated with recommended calculations when the Ok or Apply button is pressed.

	NOTE: When the user changes the BAUD Rate, **all** PROFIBUS timing parameters will be updated irrespective of the Auto Recommend check-box selection.
Default Watchdog (Read-Only)	**Default Devices Watchdog** (in ms) value defines the watchdog value assigned by default to all devices in the configuration.
Min TSDR (Read-Only)	**Smallest Station** (in tbits) is the minimum time that a PROFIBUS PA slave must wait before it may answer. It must respect the rule: TQUI < MIN_TSDR Min: 11 Max: 1023
Max TSDR (Read-Only)	**Largest Station** (in tbits) is the maximum time that a PROFIBUS PA slave may take in order to answer. Calculation of MAX_TSDR must respect the rule: Min: 37 Max: 65525
Idle Time 1 (Tid1) (Read-Only)	**Time Idle1** (in tbits) is the time between the acknowledgement frame or token frame reception and the transmission of the next frame. Tid1 = Max(Tsyn+Tsm, MIN_TSDR) with Tsyn= 33 Tsm= 2 + 2* TSET + TQUI
Idle Time 2 (Tid2) (Read-Only)	**Time Idel2** (in tbits) is the time between the transmission of an unconfirmed packet and the transmission of the next packet. Tid2 = Max (Tsyn+Tsm, MAX_TSDR) with Tsyn= 33 Tsm= 2 + 2* TSET + TQUI

Table 3.3 - PROFIBUS configuration parameters

3.5.4. ADVANCED

The Advanced configuration is shown in the figure below. The PA Link ***Advanced*** configuration window is opened by either double clicking on the module in the tree or right-clicking the module and selecting ***Configuration***.

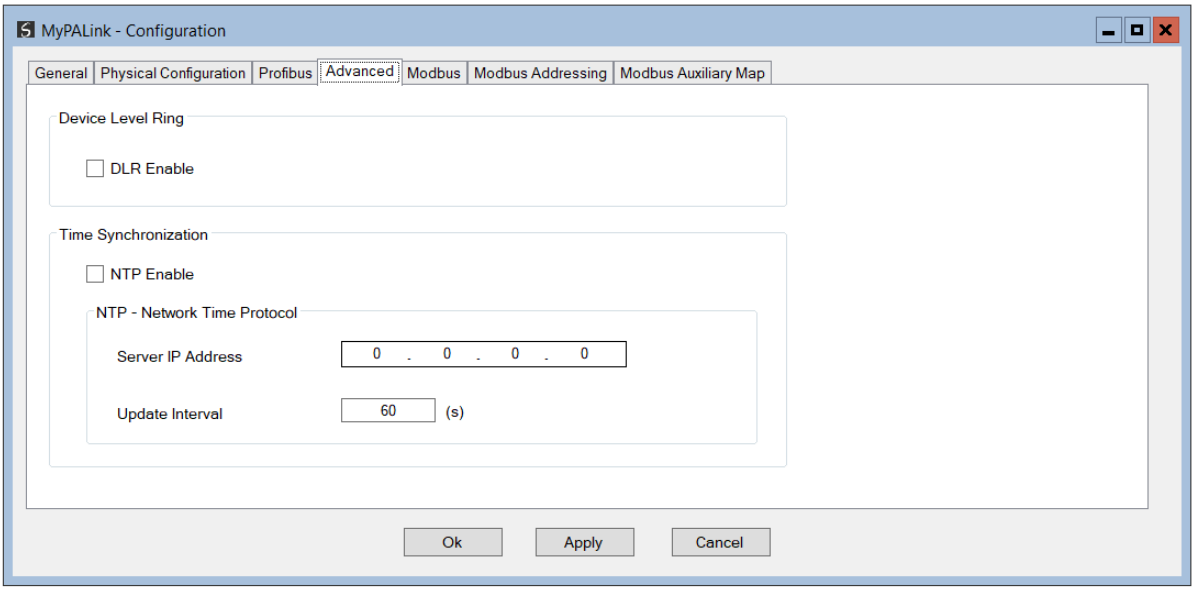


Figure 3.23 – PA Link Advanced configuration

The Advanced configuration consists of the following parameters:

Parameter	Description
DLR Enable	This must be set to enable Device Level Ring operation when the PA Link will be operating in an Ethernet DLR.
NTP Enable	The PA Link can synchronize its onboard clock to an NTP Server by enabling NTP.
NTP – Server IP Address	This setting is the IP address of the NTP Server which will be used as a time source.
NTP – Update Interval	This setting is the updated interval (in seconds) that the PA Link will request time from the NTP Server.

Table 3.4 - Advanced configuration parameters

3.5.5. MODBUS

The Modbus configuration is shown in the figure below. The Modbus configuration is used when the ***Primary Interface*** has been set to ***Modbus TCP Master*** or ***Modbus TCP Slave***. The PA Link Modbus configuration window is opened by either double clicking on the module in the tree or right-clicking the module and selecting ***Configuration***.

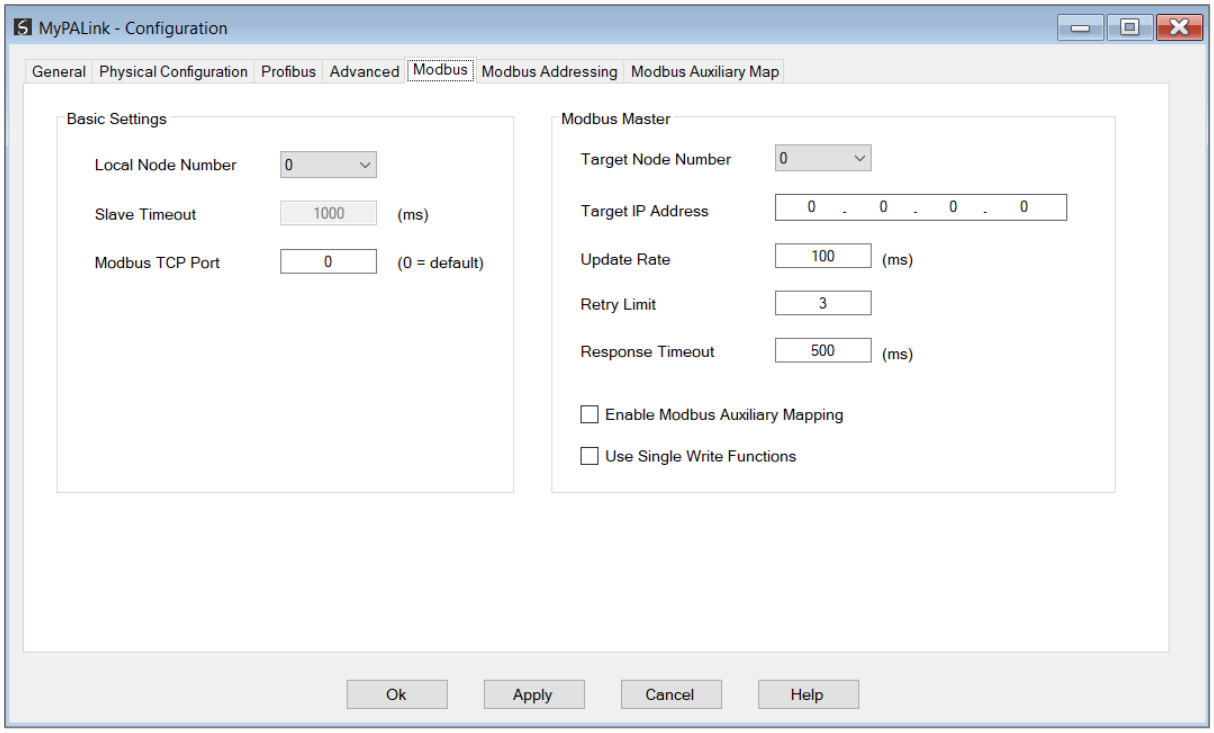


Figure 3.24 – PA Link Modbus Addressing configuration

The Modbus configuration consists of the following parameters:

Parameter	Description
Local Node Number	The Modbus Node Number assumed by the PA Link.
Slave Timeout	The slave timeout time in milliseconds. (Modbus TCP Slave only) If no communication from the remote Master is received within this time communication is deemed to have failed.
Modbus TCP Port	The TCP port to be used for the Modbus communication can be configured. If a zero is entered, the module will use the standard TCP port 502.
Modbus TCP Master	
Target Node Number	The remote Modbus node to poll.
Target IP Address	The remote Modbus IP Address to poll.
Update Rate	The period (in milliseconds) between master requests to the target Modbus device.
Retry Limit	The number of successive Modbus request retries.
Response Timeout	The time (in milliseconds) the module will wait for a Modbus response.
Enable Modbus Auxiliary Mapping	When this is enabled the PA Link will be able to write to multiple Modbus Slaves by using the Modbus Auxiliary Map tab. In this mode the automatically generated Modbus Poll strategy will be disabled.

Use Single Write Functions	When operating as a Modbus Master, the PA Link will use Modbus Single Write functions in the Modbus Auxiliary Map when this option has been selected and the write function has an element count of 1.

Table 3.5 - Modbus configuration parameters

3.5.6. MODBUS ADDRESSING

The Modbus Addressing configuration is shown in the figure below. The ***Modbus Addressing*** is used when the ***Primary Interface*** has been set to ***Modbus TCP Master*** or ***Modbus TCP Slave***. The PA Link ***Modbus Addressing*** configuration window is opened by either double clicking on the module in the tree or right-clicking the module and selecting ***Configuration***.

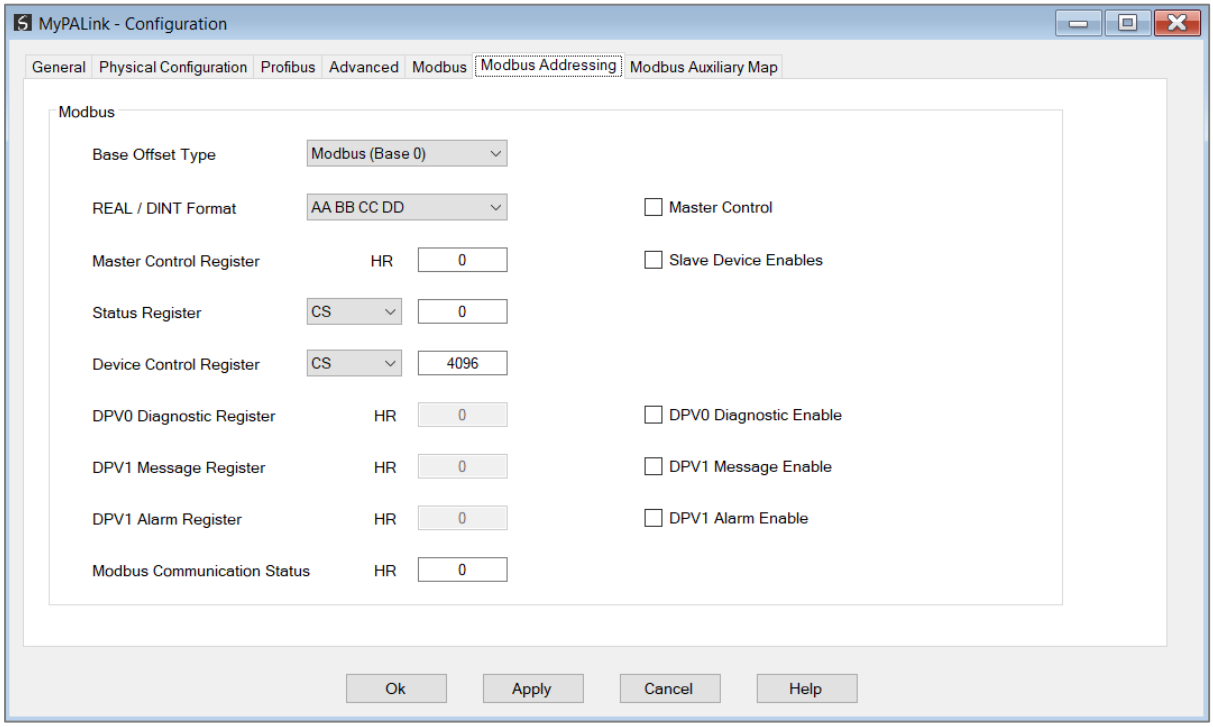


Figure 3.25 – PA Link Modbus Addressing configuration

The Modbus configuration consists of the following parameters:

Parameter	Description
Base Offset Type	Base Address Offset Type Modbus (Base 0) – Conventional Modbus addressing where the first address is 0. PLC (Base 1) – PLC addressing, where the first address is 1.
Real Format	For a Real (single floating point) number this setting shows the format of the data will be presented when using a Modbus Primary Interface. The format (byte re-ordering) options are as follows:

	• AA BB CC DD • BB AA DD CC • DD CC BB AA • CC DD AA BB
Master Control HR Offset	The Modbus Holding Register address starting offset for the Master Control.
Status Register	The Modbus (Holding or Coil) register address starting offset for the Module status.
Device Control Register	The (Holding or Coil) register address starting offset for the Slave Device Control bits.
DPV0 Diagnostic HR Offset	The Modbus Holding Register address starting offset for DPV0 Diagnostics. (PROFIBUS Master mode only)
DPV1 Message HR Offset	The Modbus Holding Register address starting offset for DPV1 Messaging. (PROFIBUS Master mode only)
DPV1 Alarm HR Offset	The Modbus Holding Register address starting offset for DPV1 Alarms. (PROFIBUS Master mode only)
Modbus Communication Status	The Modbus Holding Register address starting offset for Modbus Communication Status (when operating as a Modbus Master or Modbus Slave). This can be mapped to DPV0 data which can be used by the Profibus DP Master or Slave to take action when the Modbus communication is down or has faulted. See the *Modbus Operation* section for details regarding the Modbus data for the Modbus Communication Status.
Master Control	Enable the Master Control bits. (PROFIBUS Master mode only) When Enabled, the PROFIBUS operational state (Offline, Stop, Run, Clear) is controlled by the remote device. When Disabled, the PROFIBUS operational state is set to Run.
Slave Device Enables	Enables the individual Slave Device Enable bits. When Enabled, the remote device can enable/disable each slave device. When Disabled, all slave devices are enabled.
DPV0 Diagnostic Enable	This will allow the user to enable or disable the retrieving of PROFIBUS Diagnostics from a field device using DPV0 Diagnostic HR Offset.
DPV1 Message Enable	This will allow the user to enable or disable the retrieving of data using DPV1 Class 1 messaging from a field device using DPV1 Message HR Offset.
DPV1 Alarm Enable	This will allow the user to enable or disable the retrieving of PROFIBUS Alarms from a field device using DPV1 Alarm HR Offset.

Table 3.6 - Modbus Addressing configuration parameters

NOTE: The range of configured Modbus registers for each register type may not exceed 10,000.

3.5.7. MODBUS AUXILIARY MAP

The Modbus Auxiliary Map configuration is shown in the figure below. This table will be enabled when ***Enable Modbus Auxiliary Mapping*** has been enabled in the Modbus tab and configured for ***Modbus TCP Master***. This will allow the user to read and/or write any internal PA Link Modbus Register to any Modbus Slave. Up to 20 Modbus Slaves can be connected and up to 200 mapped items can be configured.

The PA Link ***Modbus Auxiliary Map*** configuration window is opened by either double clicking on the module in the tree or right-clicking the module and selecting ***Configuration***.

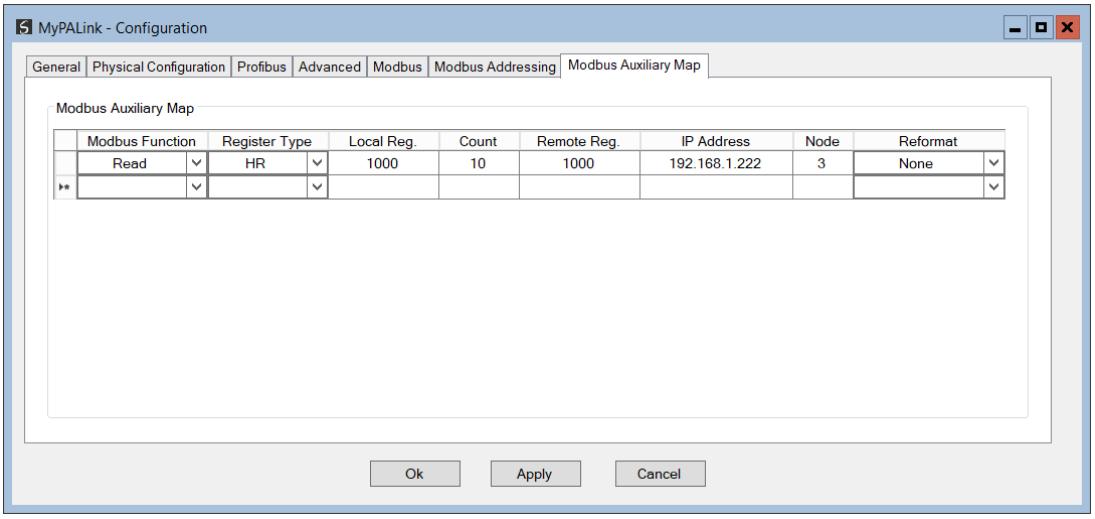


Figure 3.26 – PA Link Modbus Auxiliary Map configuration

The Modbus Auxiliary Map configuration consists of the following parameters:

Parameter	Description
Modbus Function	This is the Modbus function is the used with the Modbus Slave. **Read** – Read a Modbus Register (e.g. HR, IR, CS, or IR) from a Modbus Slave. **Write** – Write a Modbus Register (e.g. HR, IR, CS, or IR) to a Modbus Slave.
Register Type	Modbus Register Type: **CS** – Coil Status **IS** – Input Status **IR** – Input Register **HR** – Holding Register
Local Reg.	The local (internal) PA Link Modbus address.
Count	The number of Modbus elements to read or write.
Remote Reg.	The remote slave Modbus address.

IP Address	The IP address of the remote Modbus TCP slave.
Node	The Modbus Node address of the remote Modbus slave.
Reformat	How the data is formatted before reading or writing from/to the Modbus slave. **None** – No reformatting will be done. **BB AA** – 16-bit Byte swap **BB AA DD CC** – 32-bit Byte Swap **CC DD AA BB** – Word Swap **DD CC BB AA** – Word and Byte Swap

Table 3.7 - Modbus Auxiliary Map configuration parameters

3.6. MODULE DOWNLOAD

Once the PA Link configuration has been completed, it must be downloaded to the module. The configured IP address of the module will be used to connect to the module.

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

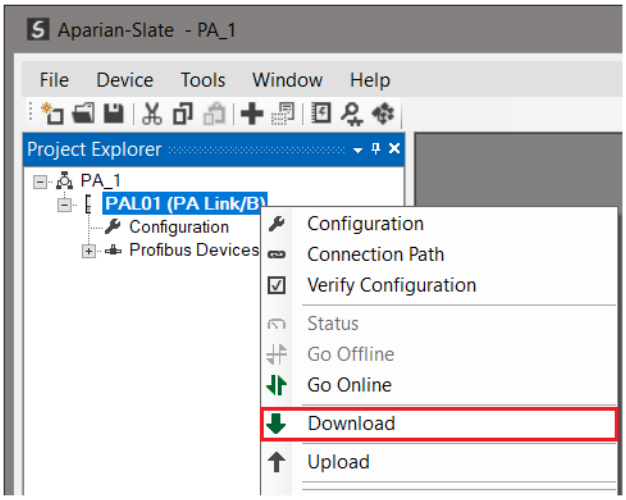


Figure 3.27 - Selecting Download

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

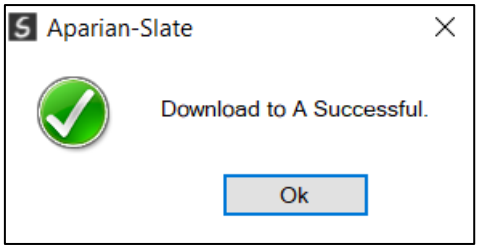


Figure 3.28 - Successful download

Within 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.

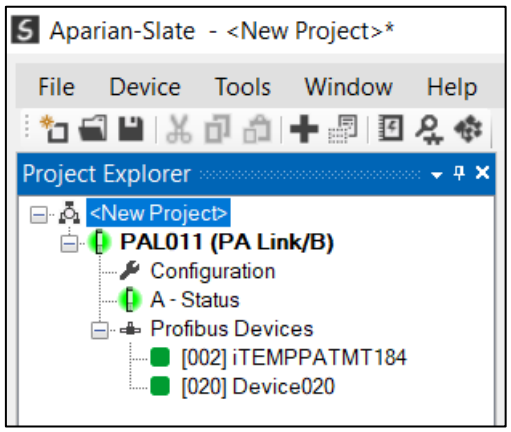


Figure 3.29 - Module online

3.7. DEVICE DISCOVERY (ONLINE)

Once online with the PA Link in Slate, the user will be able to scan the PROFIBUS network for PA slave devices.

NOTE: If the incorrect PROFIBUS parameters have been configured (e.g. slot time) then the PA Link will not be able to detect any slave devices on the PROFIBUS network.

3.7.1. DISCOVERY

The slave device discovery can be found by selecting the ***Discovered Nodes*** tab in the PA Link status window.

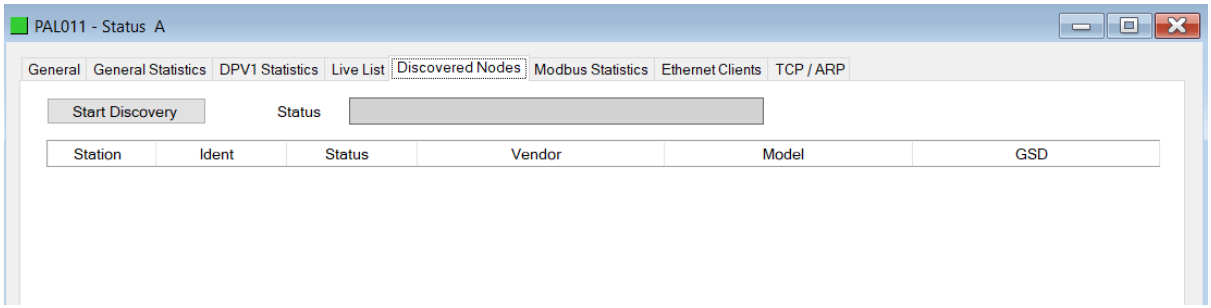


Figure 3.30 –Device Discovery

To start a new device discovery the ***Start Discovery*** button must be pressed. Once the discovery is done the slave devices found will be listed below.

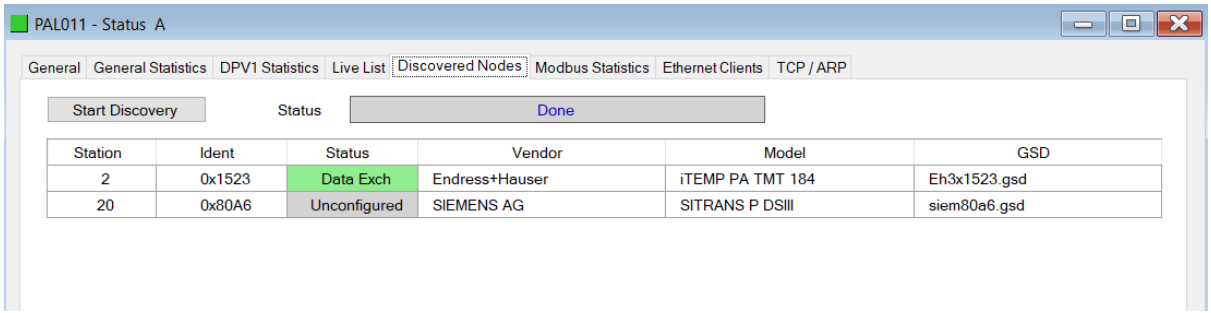


Figure 3.31 –Devices Found

If a device has been found that is not currently in the PA Link configured device list the user will be able to add the device from this window by right-clicking on the device and selecting ***Add Device***.

NOTE: The GSD file will need to be already registered before a device can be added to the PA Link configuration.

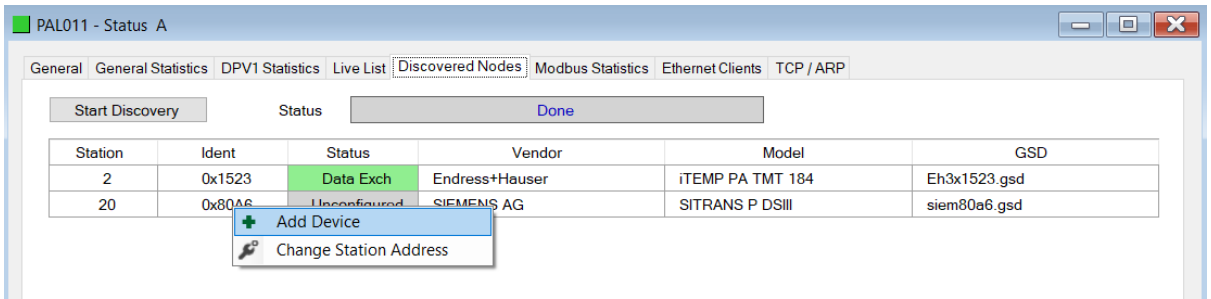


Figure 3.32 – Adding the Field Devices Found

The user will need to select the GSD file add the device to the PA Link configured device list.

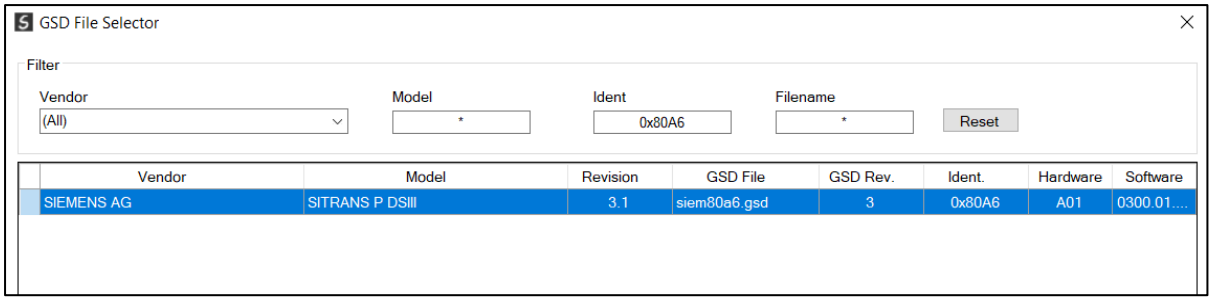


Figure 3.33 – Selecting the GSD for the slave device

Once the devices have been correctly set up (as well as the correct mapping is in Logix) the devices will show up as exchanging data.

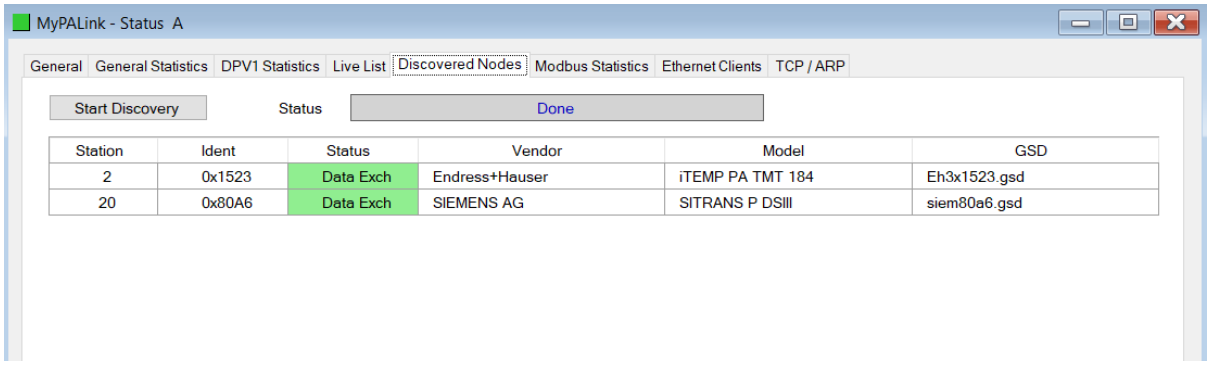


Figure 3.34 – Discovering running devices

3.7.2. Device Station Address Change

Certain devices can be set up to allow remotely changing of the station address. Devices with this option enabled, generally default to a station address of 126. The user can change the station address of a device (if the device is correctly setup) by right-clicking on the device in the Discovery List and selecting ***Change Station Address***.

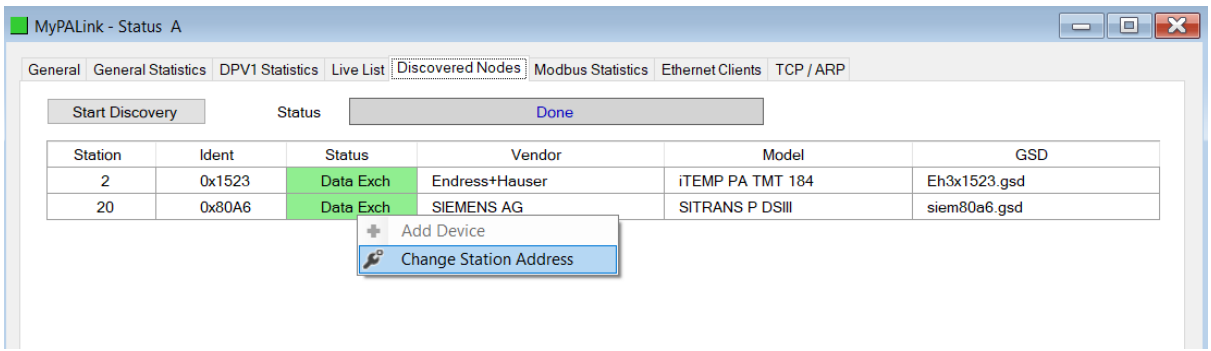


Figure 3.35 – Changing Station Address

Next the user will need to select the new station address for the device. Once selected press the ***Set*** button.

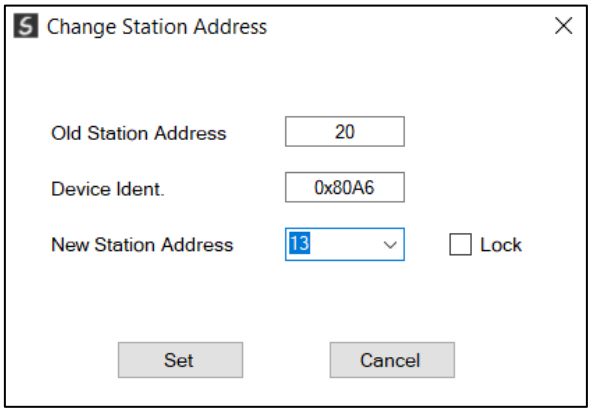


Figure 3.36 – Selecting new Station Address.

Once the request has been sent the user can either start a new network discovery to confirm the address has changed or monitor the ***LiveList*** (see the *Diagnostics* section).

NOTE: The amount of time for the device to appear at the new station address is device depended. In the ***LiveList*** there will be a period where both node addresses show up while the original station address is timing out.

NOTE: If the user sets the station address to an address that is already present on the PA network it will result in communication failure of both devices.

NOTE: Generally, the device will need to be in the correct state before it will accept a command to change its station address (i.e. must not be in data exchange state).

3.8. ADDING PROFIBUS PA DEVICES

The user will need to add each PROFIBUS device to the PA Link which can then be configured. This is done by right-clicking on the ***PROFIBUS Devices*** item in the tree and selecting ***Add PROFIBUS Device***.

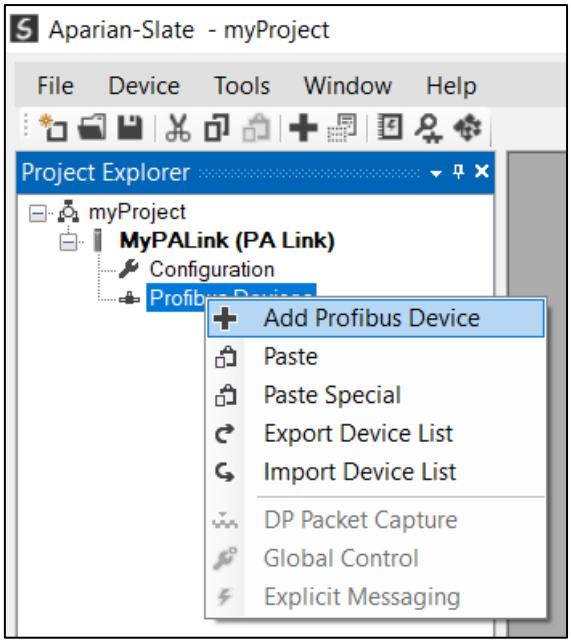


Figure 3.37 – Adding a PROFIBUS Field Device

Next the user will need to select the device to be added to the PA Link. This is done by selecting the device from the ***GSD File Selector*** and pressing ***Ok***.

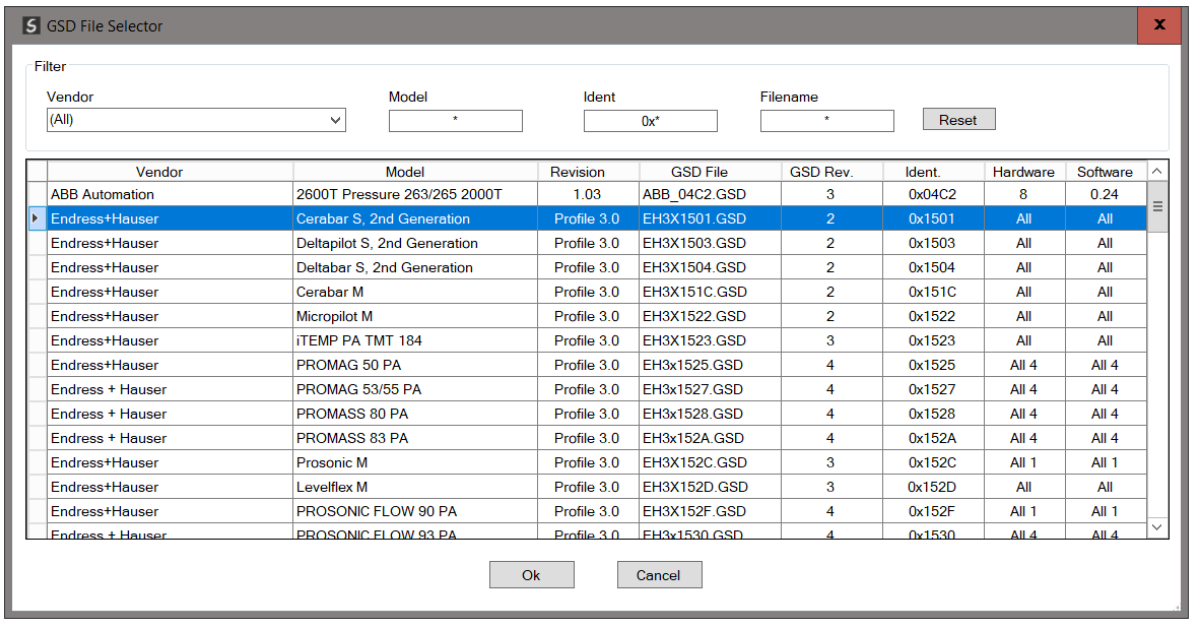


Figure 3.38 – Selecting a PROFIBUS PA Field Device

Once the device has been added the General Configuration page will be opened and the device will be added at the first open PROFIBUS Station Address.

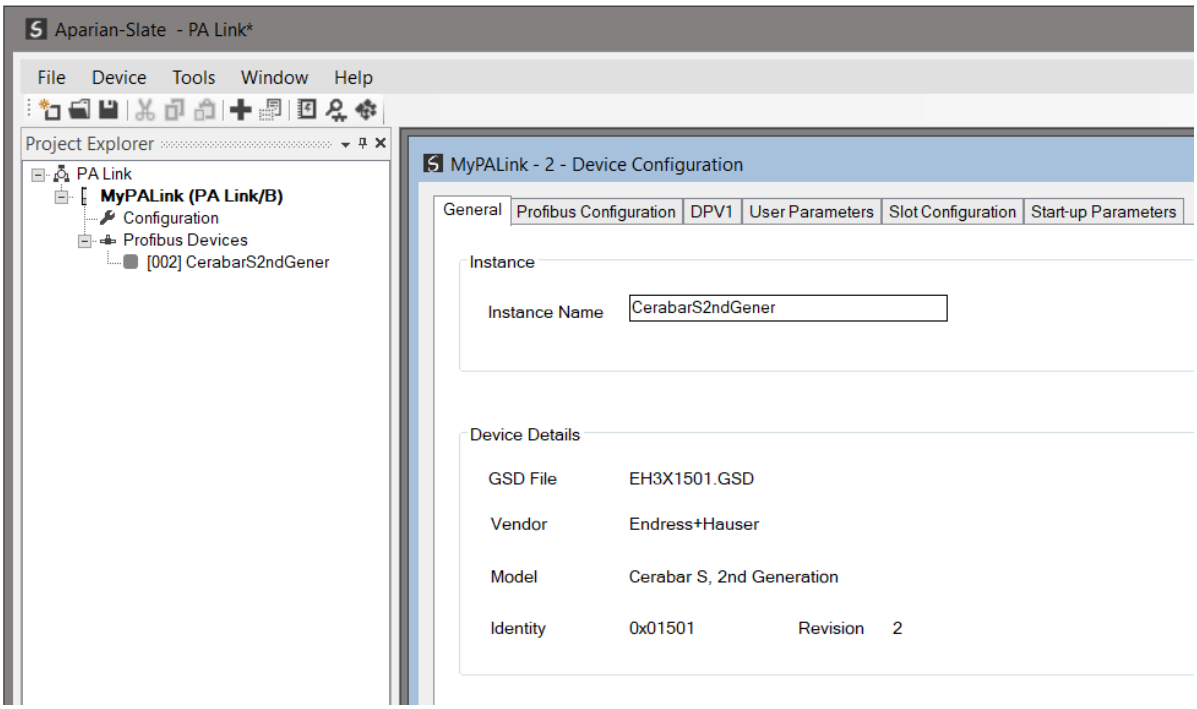


Figure 3.39 – PROFIBUS Field Device Added

3.8.1. GENERAL

The General configuration is shown in the figure below. The Device ***General*** configuration window is opened by either double clicking on the slave device in the tree or right-clicking the slave device and selecting ***Configuration***.

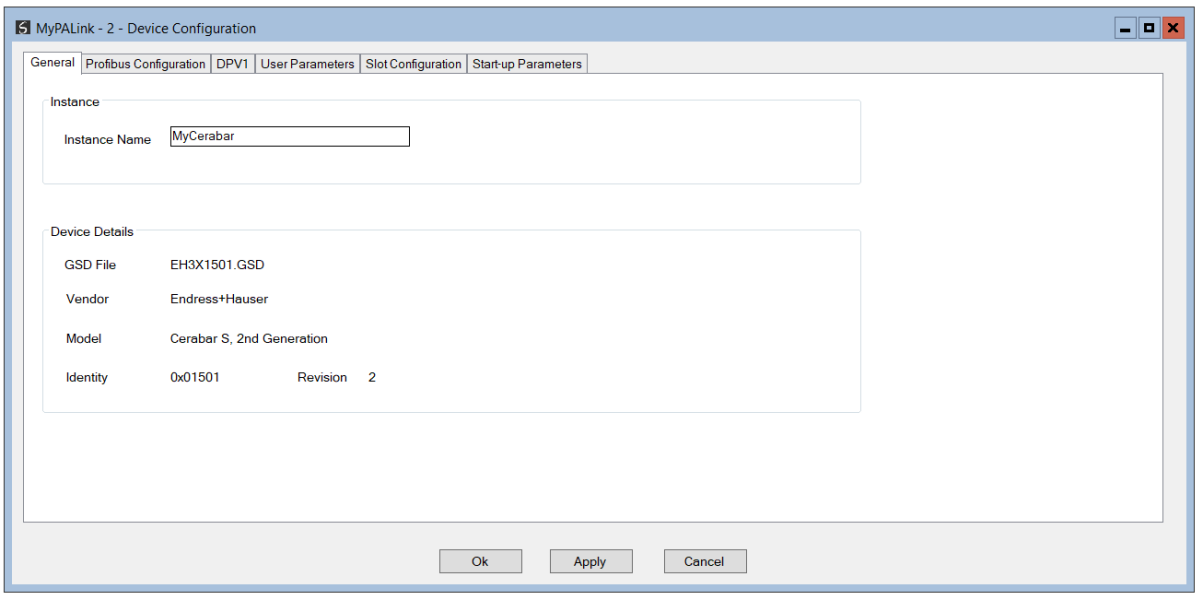


Figure 3.40 – Field Device General configuration parameters

The General configuration consists of the following parameters:

Parameter	Description
Instance Name	The device instance name which will be used to create the Tag names and UDTs in Logix.

Table 3.8 –Device General configuration parameters

3.8.2. PROFIBUS CONFIGURATION

The PROFIBUS configuration is shown in the figure below. The Device ***Profibus Configuration*** window is opened by either double clicking on the slave device in the tree or right-clicking the slave device and selecting ***Configuration***.

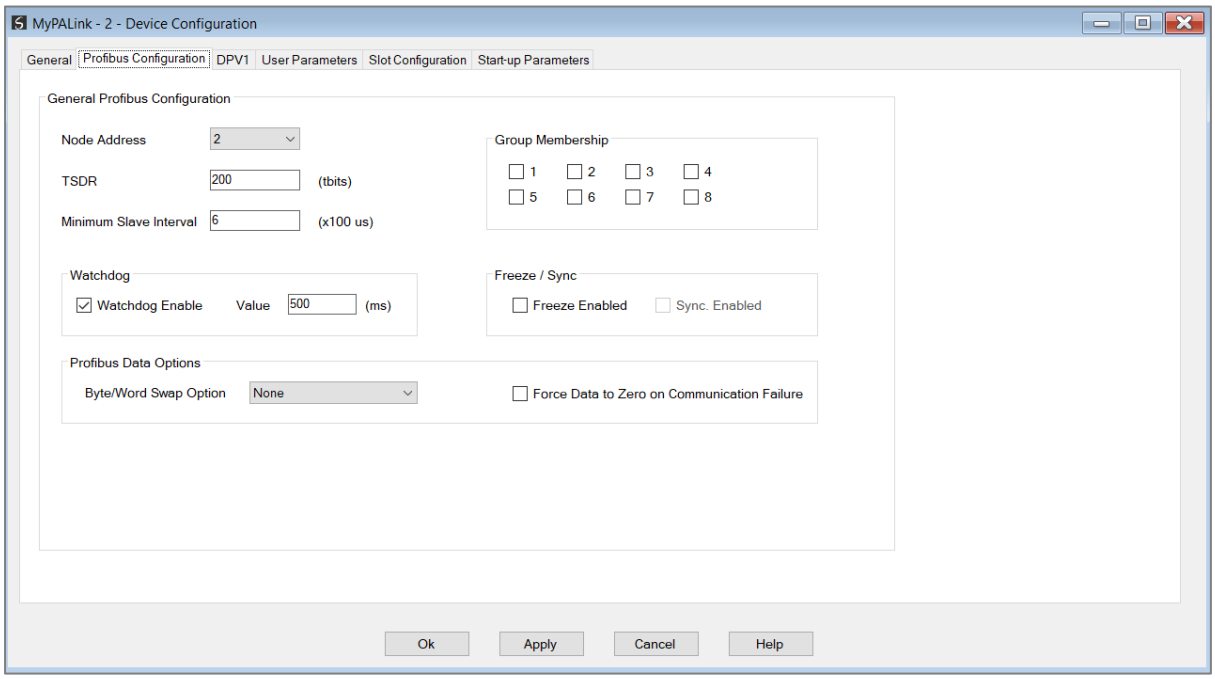


Figure 3.41 – Field Device PROFIBUS configuration parameters

The PROFIBUS configuration consists of the following parameters:

Parameter	Description
Node Address	This is the station address configured for the added device. This is the address the PA Link will use to look for and configure the device for Data Exchange.
TSDR	This parameter is the minimum time (bits) that a PROFIBUS-PA slave must wait before it responds. It must respect the rule: Min: 11 Max: 1023 Default: 11

Minimum Slave Interval	This is the minimal time that the PROFIBUS master must wait between two IO data exchanges with this device. The default value proposed comes from the GSD File. Min: 1 Max: 65535
Watchdog Enable	Enables the watchdog for the slave device data exchange. The slave device monitors the data exchange rate (PROFIBUS Cycle) and it must be less than the Watchdog Value else the slave device will change back into an unconfigured state.
Watchdog Value	Is used to monitor cyclic communication and must be significantly higher than the time required for one PROFIBUS cycle. If a slave does not receive a request frame for a period of time longer than the watchdog time, it will revert to its initial, power-up state and cyclic communication will have to be reestablished. The minimum and default values are defined by the PA Link Default Watchdog setting in the PA Link PROFIBUS configuration.
Group Membership	Specifies which groups the slave belongs to. A slave can be in multiple groups at a time (from 1 through 8). Groups are used by the master when it sends a Sync or Freeze command. PROFIBUS Group checkboxes are enabled when Sync Mode or Freeze Mode checkboxes are checked.
Freeze Enabled	User data transmission Synchronization control commands enable the synchronization of inputs. Freeze Mode field is unchecked by default.
Sync Enabled	User data transmission Synchronization control commands enable the synchronization of outputs. Sync Mode is unchecked by default.
Byte/Word Swap Option	This parameter will reformat the input and output Profibus DPV0 communication data. Below are the reformat options if the normal data format is AA BB CC DD: **None** **BB AA** **DD CC BB AA** **CC DD AA BB**
Force Data to Zero on Communication Failure	When this parameter is set it will force the last data received from a DP device to be forced to zero if the DPV0 communication to that specific device is lost.

Table 3.9 – Field Device PROFIBUS configuration parameters

3.8.3. DPV1

The DPV1 configuration is shown in the figure below. The slave device DPV1 configuration window is opened by either double clicking on the slave device in the tree or right-clicking the slave device and selecting ***Configuration***.

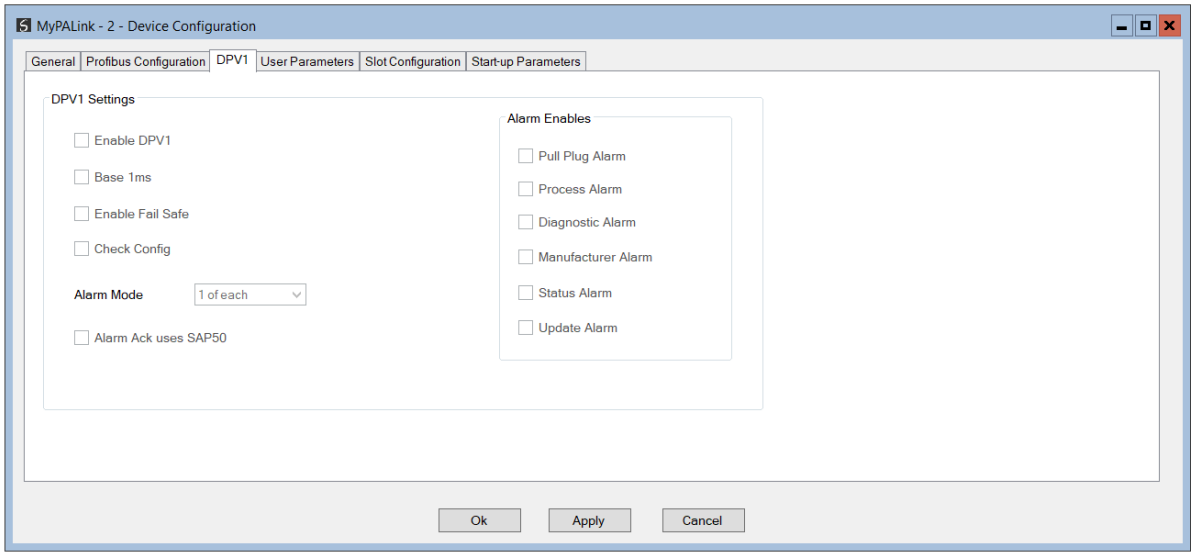


Figure 3.42 – Device DPV1 configuration parameters

The DPV1 configuration consists of the following parameters:

Parameter	Description
Enable DPV1	Indicates if the slave supports DPV1 Class 1 access (read and write) or alarms. **If the device does not support these DPV1 services, this parameter must be unchecked**. The default value is based on the information provided by the GSD File.
Base 1ms	Indicates if the device should use the 1ms base time for watchdog time calculation. See the chapter "**PROFIBUS Settings**" below for watchdog time calculation. By default, the field will be unchecked which sets the watchdog base to 10 ms. **Note**: the watchdog value is always shown in the configuration panel in ms regardless of this time base setting.
Enable Fail Safe	The failsafe mode determines the behavior of the PA Slave outputs when the PROFIBUS Master is in CLEAR state: • If the slave is configured to be failsafe and supports this feature, then it will apply its own fallback value (the Master sends outputs with 0 length data) • If not, the Master sends output data at 0 If this feature is supported by the device, the check box must be checked. **If the device does not support it, this parameter must be unchecked**. The default value is based on the information provided by the GSD File.
Check Config	This checkbox is used to define the reaction to the reception of configuration data. If the check box is not set, the check is as described in EN 50170. If the check box is set, the check is made according to a specific user definition. By default, the field will be unchecked.
Alarm Mode	This parameter specifies the maximum number of possible active alarms for the device.

Alarm Ack uses SAP50	This will force the PA Link to use Service Access Point (SAP) 50 to acknowledge alarms.
Alarm Enables	Enables specific alarms for the slave device to report on if active. The available alarms are listed below and are only available if specified in the device's GSD file: • Pull Plug Alarm • Process Alarm • Diagnostic Alarm • Manufacturer Alarm • Status Alarm • Update Alarm

Table 3.10 – Device DPV1 configuration parameters

3.8.4. User Parameters

The User Parameter configuration is shown in the figure below. The device ***User Parameter*** configuration window is opened by either double clicking on the slave device in the tree or right-clicking the slave device and selecting ***Configuration***.

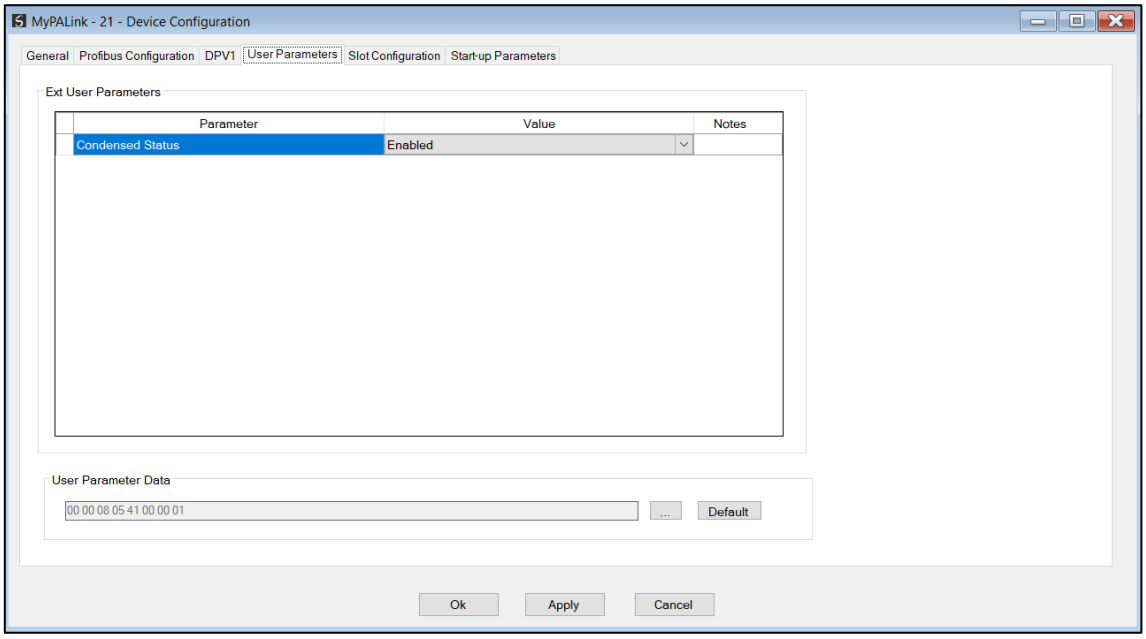


Figure 3.43 – Device User Parameter configuration parameters

The User Parameter configuration consists of the device specific user configuration. This is extracted from the device GSD file and can be used to configure device specific parameters. When one of the parameters is changed the User Parameter Data will be updated which is sent to the device in the Set Parameter telegram.

3.8.5. SLOT CONFIGURATION

Each slave device can have multiple slots that can be configured. A slot can be a place holder for a process variable or a placeholder for a specific piece of hardware. In the example below the PROFIBUS slave device added is an IO adapter which can have multiple additional IO modules which will be represented as additional slots.

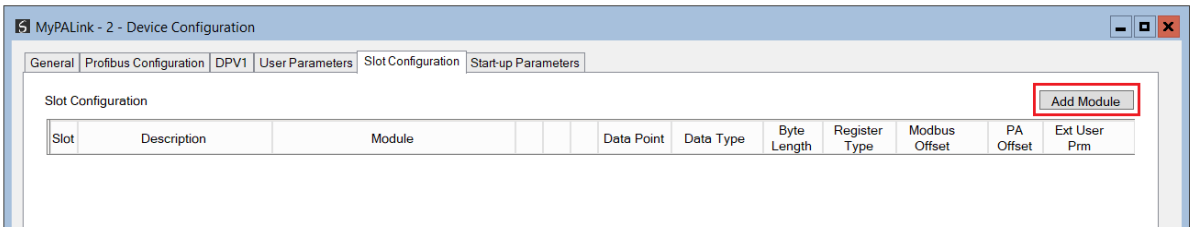


Figure 3.44 – Field Device Slot configuration start

To add a module, select the ***Add Module*** button. The module selection form will appear listing all the available modules from the GSD file.

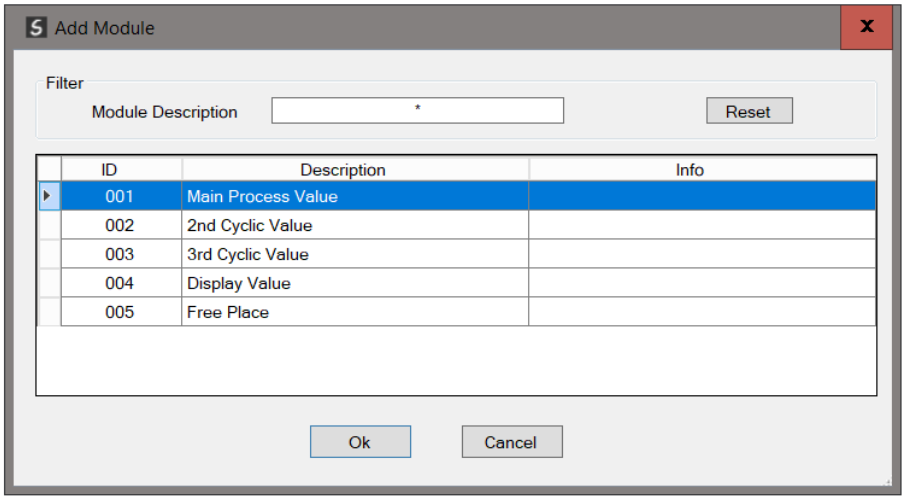


Figure 3.45 – Module Selection

The ***Module Description*** filter can be used in conjunction with the wildcard character (“***”) to easily locate the required module. Once the required module has been selected press the ***Ok*** button.

The module will be added to the Slot configuration. The layout of the slot configuration differs slightly depending on whether Logix or Modbus has been selected as the Primary Interface.

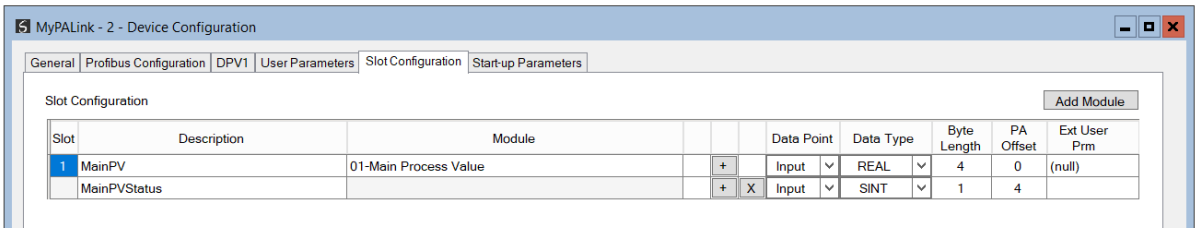


Figure 3.46 – Slot configuration – (Logix)

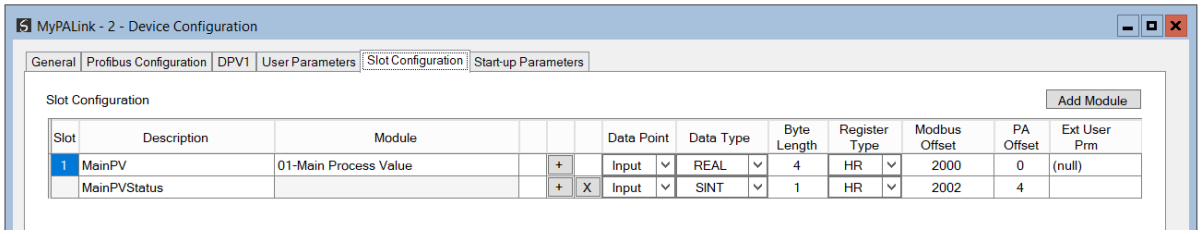


Figure 3.47 – Slot configuration – (Modbus)

SLOT CONFIGURATION - GENERAL

Each module added can consist of one or more Data Points. In the example below the module has two Data Points, one Input and one Output.

The description of each is based on the module name (from GSD file) but can be edited by the user. When using Logix this Description is used to create the member of the device specific UDTs and thus no illegal Logix characters are permitted. It is also important that these descriptions are unique within a device.

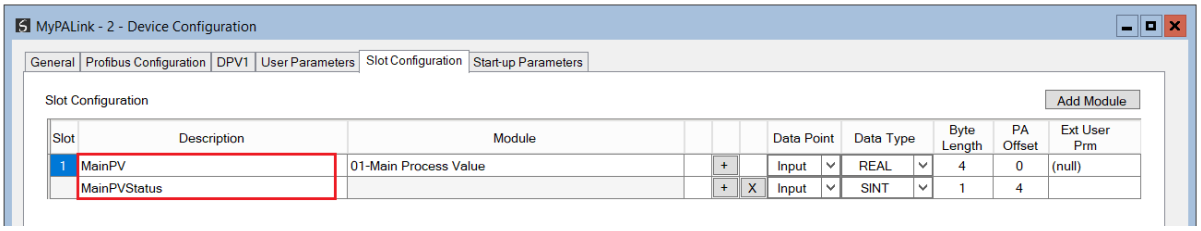


Figure 3.48 – Slot descriptions

Some modules provide module specific User Parameters to further configure the module. These parameters can be accessed by either clicking on the Configure (…) button or by right-clicking on the Module and selecting the ***Configure Module*** option in the context menu.

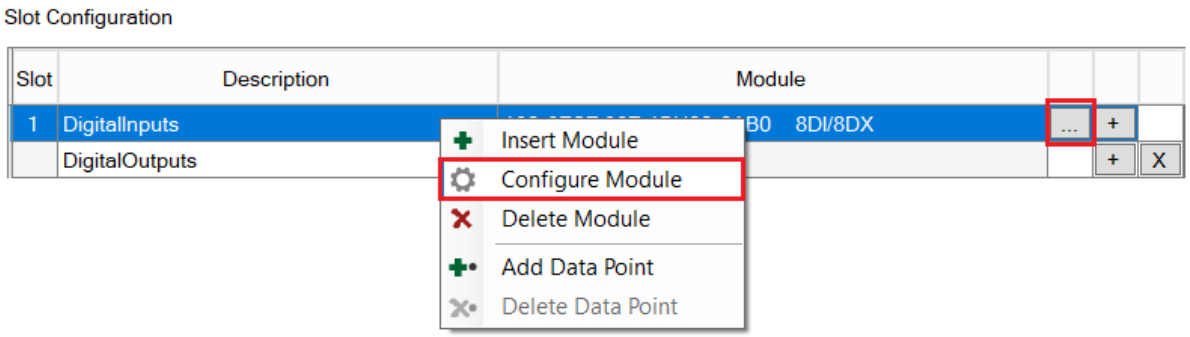


Figure 3.49 – Access Module Specific User Parameters

The Module User Parameter Editor will appear. The parameters and their enumerated options are derived from the GSD file.

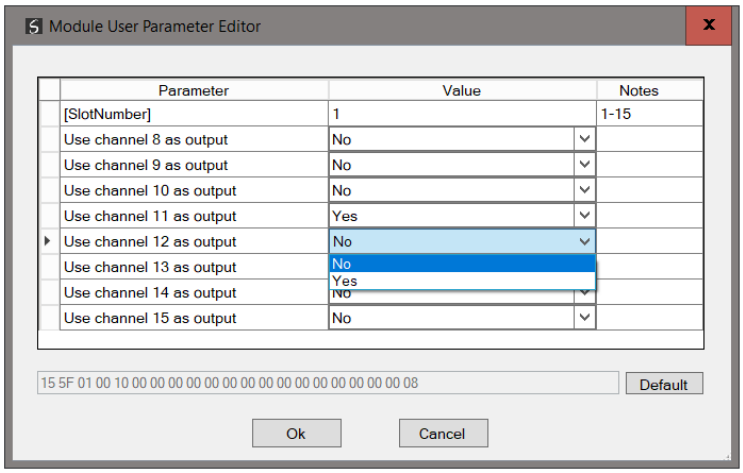


Figure 3.50 – Device Slot configuration additional parameters

Once the slot parameters have been updated the user can click the ***OK*** button which will update the Extended User Parameters and return to the Slot Configuration page.

When adding a slot, the data format and size will default to that of the selected module in the GSD file. Depending on the GSD file, the default configuration may not be preferred and can be changed by the user.

Formatting the modules data can be achieved by a combination of adding or removing Data Points and changing the Data Type of each.

Data Points can be added by either right-clicking on the module and selecting ***Add Data Point*** or by clicking on the "**+**" button.

Data Points can be removed by either right-clicking on the module and selecting ***Delete Data Point*** or by clicking on the "**X**" button.

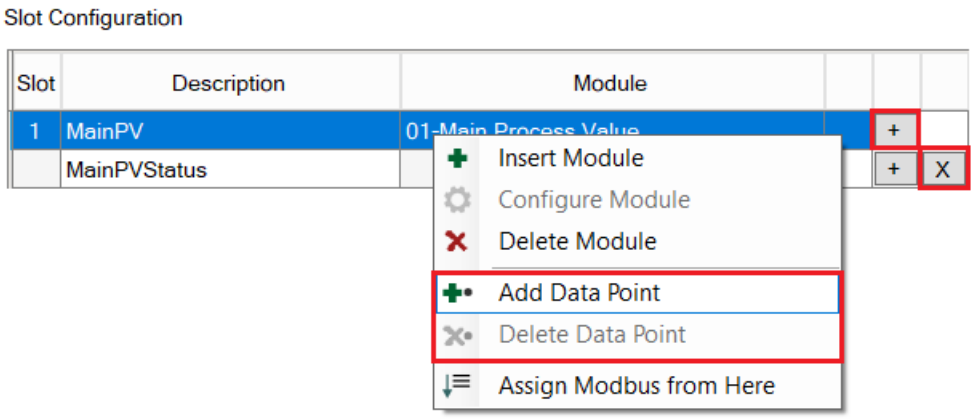


Figure 3.51 – Adding / Removing Data Points

NOTE: Each module must contain at least one Data Point.

After adding a new Data Point, the following should be configured:

- Description
- Data Point Type (Input, Output, None)
- Data Type
- Byte Length

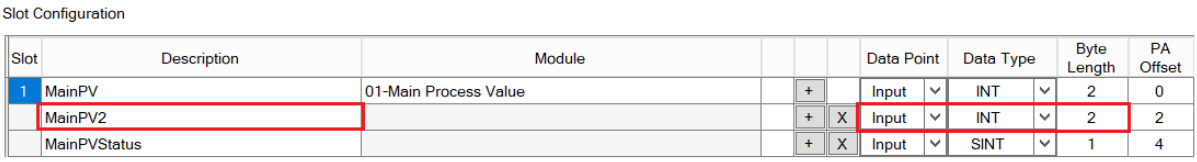


Figure 3.52 – Configuring Data Points

After updating the Data Type, the Byte Length will be set to match the selected Data Type. By modifying the Byte Length thereafter, an array of that Data Type can be configured. It is however important that the Byte Length is always a multiple of the base Data Length.

Data Type	Byte Length MUST be a multiple of:
BOOL	1
SINT	1
INT	2
DINT	4
REAL	4

Table 3.11 – Data Type – Byte Length Restrictions

NOTE: It is critical that the configured Byte Length be a multiple of the base Data Type.

NOTE: It is critical that the total sum of input and output bytes (of all the Data Points) match that required by the slave device. Not adhering to this could cause unexpected results.

NOTE: The PA (Byte) Offset for each the Data Point will be automatically calculated.

SLOT CONFIGURATION – LOGIX SPECIFIC

When using Logix as the Primary Interface, the PROFIBUS Data Points will be packed and padded to match a device-specific UDT. All the Inputs will be collated together and then all the Outputs.

NOTE: It is important that the Data Point Descriptions do not contain any illegal characters and are not duplicated within a device. Failing to do so will create errors when generating and importing the mapping L5X into Studio 5000.

Slot Configuration

Slot	Description	Module				Data Point	Data Type	Byte Length	PA Offset
1	MainPV	01-Main Process Value		+		Input	REAL	4	0
	MainPVStatus			+	X	Input	SINT	1	4

Figure 3.53 – Slot configuration – Logix Example

SLOT CONFIGURATION – MODBUS SPECIFIC

When using Modbus as the Primary Interface, it is important to configure the Modbus Register Type and Modbus Offset correctly to ensure that multiple Data Points are not mapped to the same Modbus data area.

Slot Configuration

Slot	Description	Module				Data Point	Data Type	Byte Length	Register Type	Modbus Offset	PA Offset	Ext User Prm
1	MainPV	01-Main Process Value		+		Input	REAL	4	HR	2000	0	(null)
	MainPVStatus			+	X	Input	SINT	1	HR	2002	4	

Figure 3.54 – Slot configuration – Modbus Example

NOTE: It is important that the Data Point Register Type and Modbus Offset does not result in multiple Data Points overlapping. Such conflicts will cause unexpected results.

NOTE: It is important that the Data Point Register Type is appropriate for the Data Type, Type (Input/Output) and Modbus interface type (Master/Slave).

NOTE: The range of configured Modbus registers for each register type may not exceed 10,000.

The Data Point Modbus Registers can be automatically assigned by right-clicking on a slot and selecting the ***Assign Modbus from Here*** option.

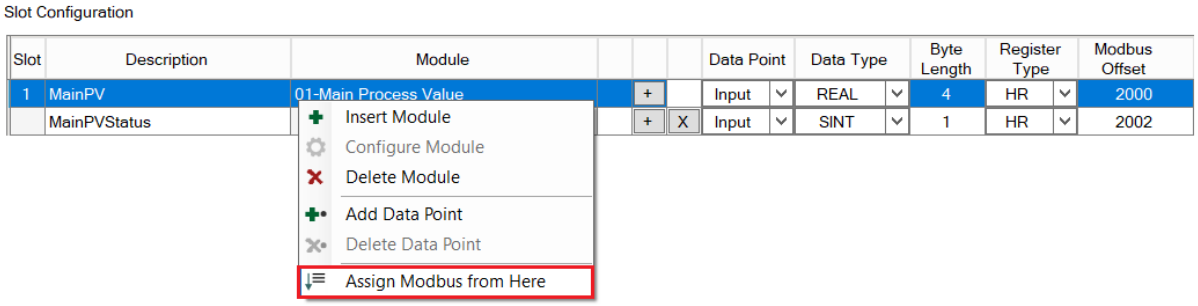


Figure 3.55 – Slot configuration – Automatic Modbus Assignment

The Modbus Assignment window will open where the user can select the Modbus ***Register Type*** and ***Starting Offset***.

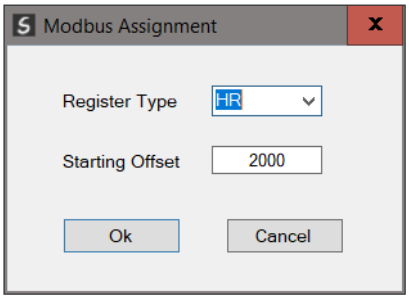


Figure 3.56 – Modbus Assignment

Selecting the ***Ok*** button will automatically assign Modbus registers to all the Slots and their respective Data Points from that point onwards.

3.8.6. START-UP PARAMETERS

Each slave device can have a set of start-up parameters associated with it which will be updated once Data Exchange is active using DPV1 Class 1 messaging. Thus, the user can have

specific parameters that must be updated after the device is initialized for data exchange which will simplify device replacement.

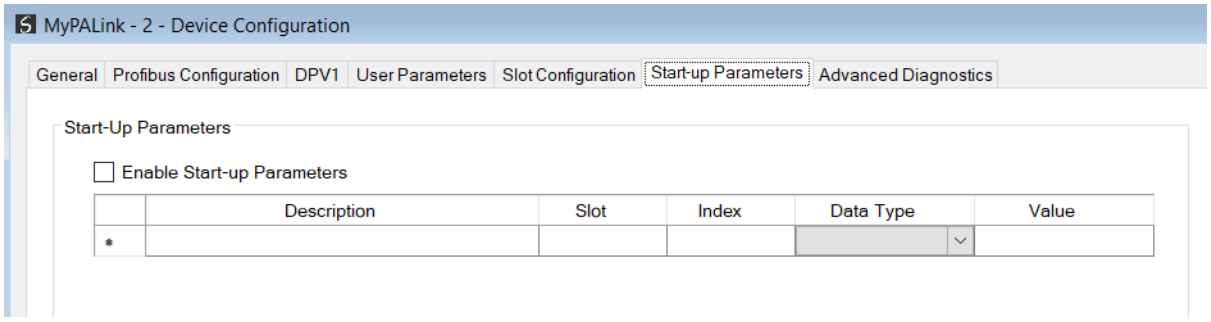


Figure 3.57 – Device Start-up Parameters

The user will need to enable the Start-up parameters by selecting the ***Enable Start-Up Parameters*** checkbox. Then the user will need to enter the required start-up parameters as shown below.

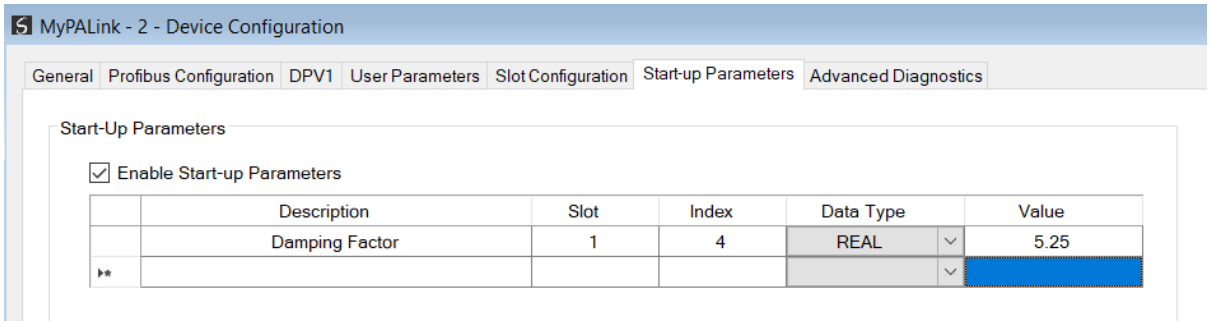


Figure 3.58 – Device Start-up Parameters Example

Once the slave device has been successfully parameterized and configured for Data Exchange the PA Link will update one parameter at a time for each slave device.

3.9. LOGIX CONFIGURATION

The PA Link module can be easily integrated with Allen-Bradley Logix family of controllers. Integration with the Logix family in Studio5000 makes use of the EDS Add-On-Profile (AOP) or a Generic Module Profile.

3.9.1. EDS AOP (LOGIX V21+)

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 www.aparian.com and registered manually using the ***EDS Hardware Installation Tool*** shortcut under the ***Tools*** menu in Studio 5000.

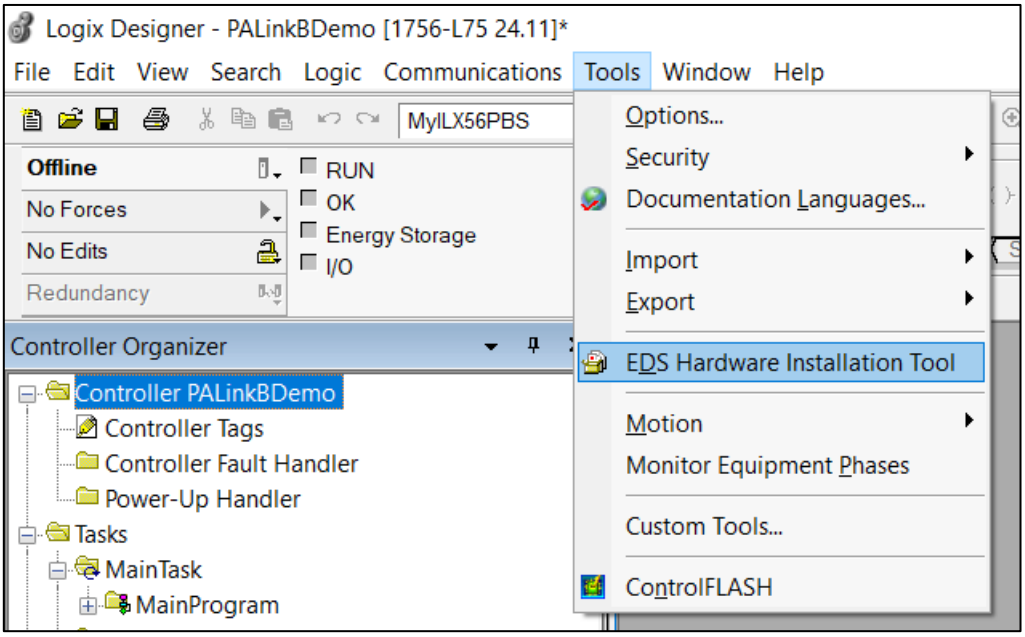


Figure 3.59 - EDS Hardware Installation Utility

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.

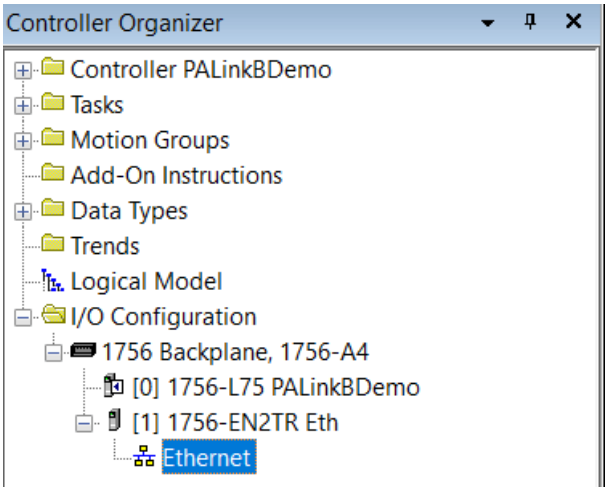


Figure 3.60 – Adding a module

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.

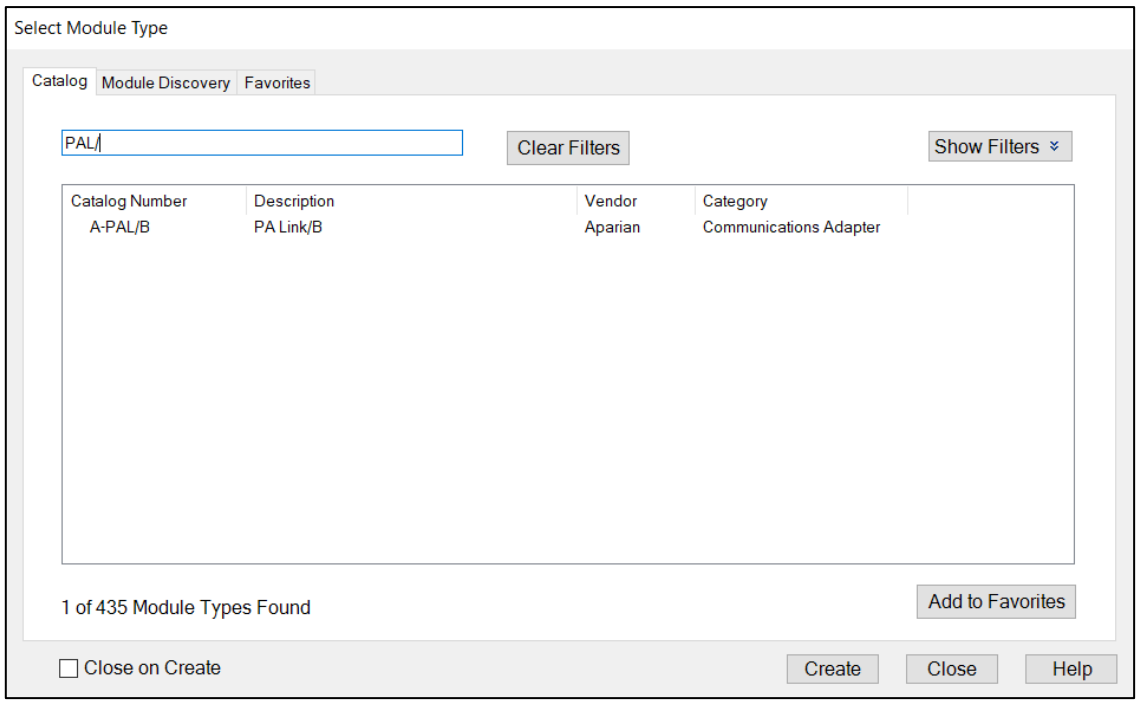


Figure 3.61 – Selecting the module

Locate and select the PA Link 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.

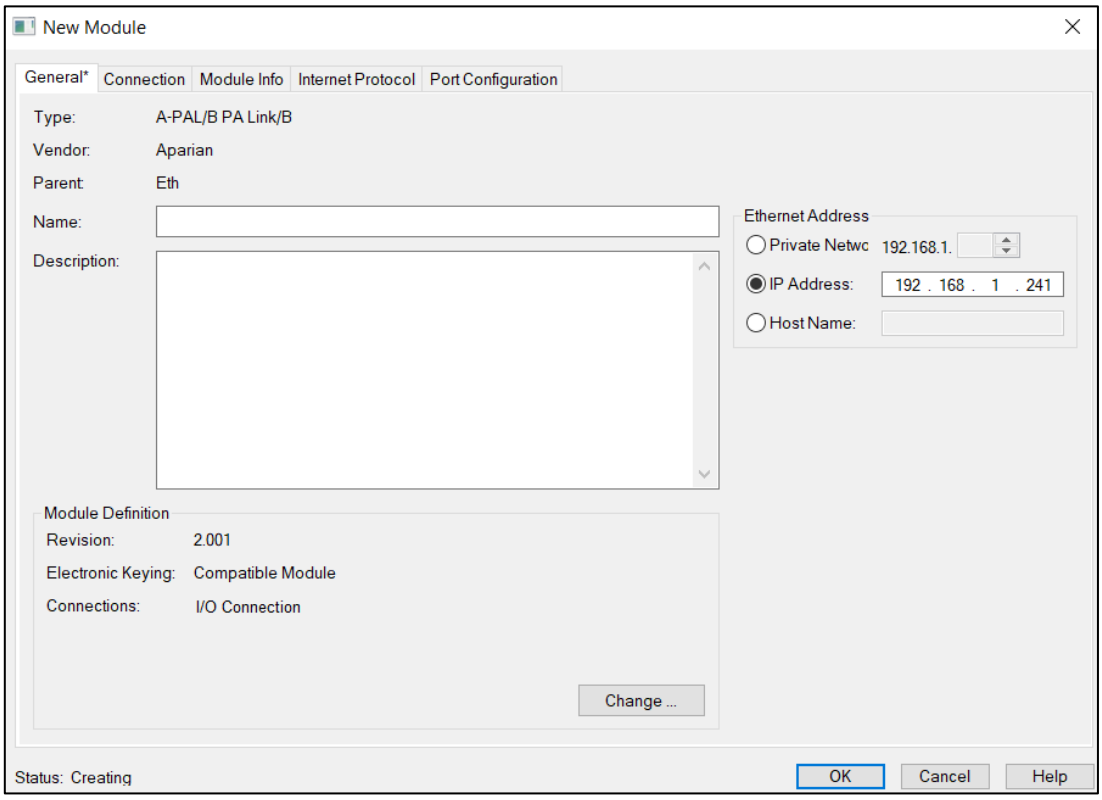


Figure 3.62 – Module instantiation

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

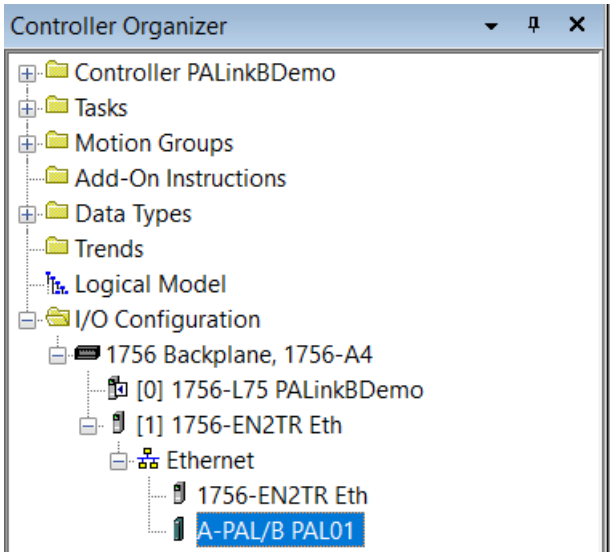


Figure 3.63 – Logix IO tree

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	Force Mask	Style	Data Type
PAL01:I1	{...}	{...}		_055A:A_PALB_7E6CF713:I:0
PAL01:I1.ConnectionFaulted	0		Decimal	BOOL
PAL01:I1.Data	{...}	{...}	Decimal	SINT[500]
PAL01:I2	{...}	{...}		_055A:A_PALB_7E6CF713:I:0
PAL01:I3	{...}	{...}		_055A:A_PALB_7E6CF713:I:0
PAL01:I4	{...}	{...}		_055A:A_PALB_7E6CF713:I:0
PAL01:O1	{...}	{...}		_055A:A_PALB_78F5E13D:O:0
PAL01:O2	{...}	{...}		_055A:A_PALB_78F5E13D:O:0
PAL01:O3	{...}	{...}		_055A:A_PALB_78F5E13D:O:0
PAL01:O4	{...}	{...}		_055A:A_PALB_78F5E13D:O:0

Figure 3.64 – Module Defined Data Type

3.9.2. Generic Module Profile (Logix Pre-V21)

NOTE: When using a Generic Module Profile only a **single** connection is supported limiting the total PROFIBUS data that can be exchanged.

NOTE: When using a Generic Module Profile, the user will need to modify the code generated by Slate to match the single connection profile. To do this the user must remove the connection number from the source and destination tag in the copy blocks (as shown in the example below).

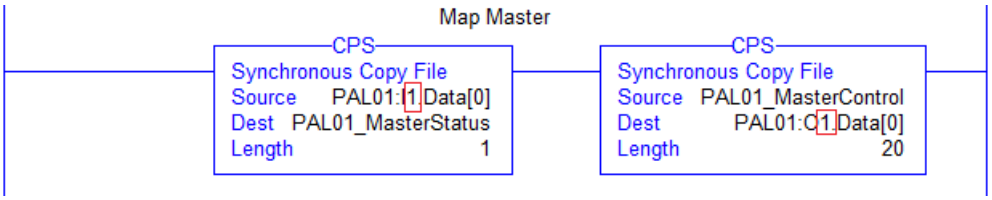


Figure 3.65 – Generated Logix Routine from Slate (highlight connection number)

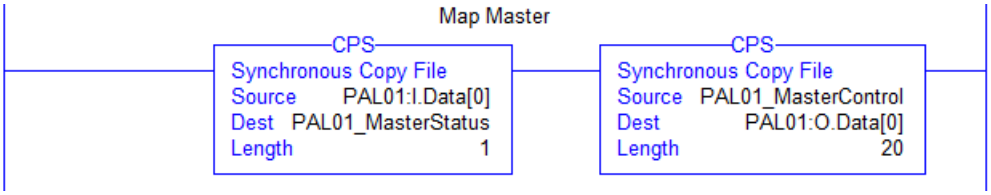


Figure 3.66 – Modified Logix Routine from Slate for Generic Module Profile

When using Logix versions prior to version 21, then the PA Link 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).

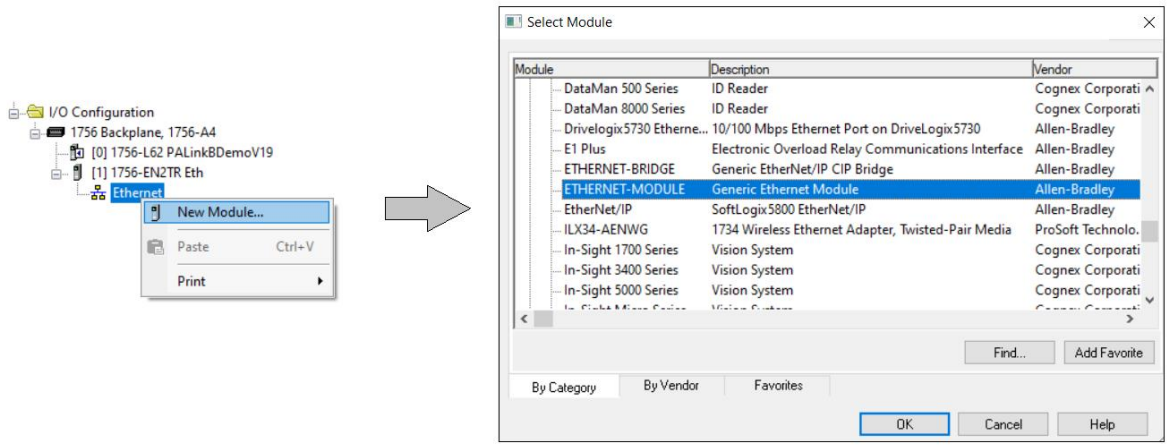


Figure 3.67 - Add a Generic Ethernet Module in RSLogix 5000

The user must enter the ***IP Address*** of the PA Link 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 PA Link module are shown below:

Connection Parameter	Assembly Instance	Size
Input	132	500 (8-bit)
Output	133	496 (8-bit)
Configuration	102	0 (8-bit)

Table 3.12 - RSLogix class 1 connection parameters for the PA Link module

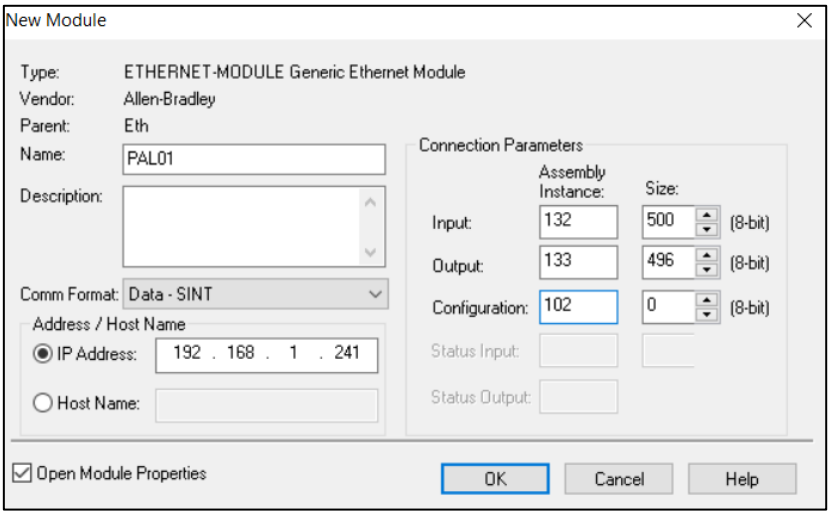


Figure 3.68 - RSLogix 5000 General module properties for PA Link module

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. Refer to the technical specification section in this document for further details on the limits of the RPI.

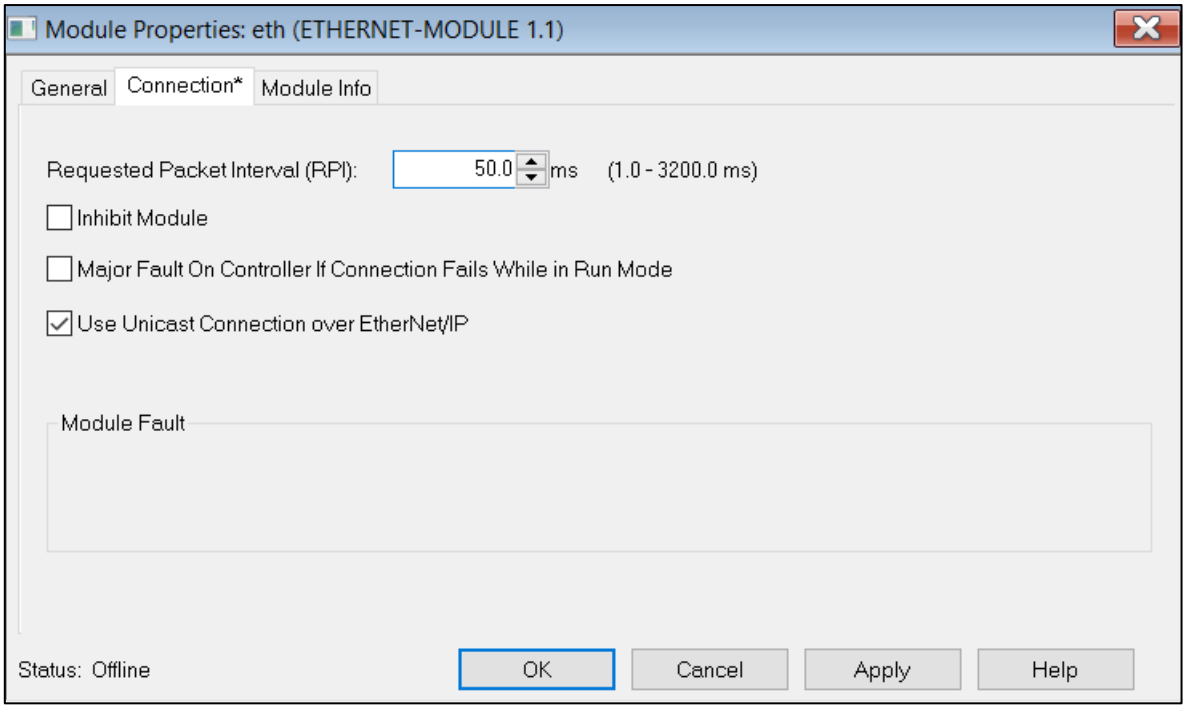


Figure 3.69 - Connection module properties in RSLogix 5000

Once the module has been added to the RSLogix 5000 I/O tree the Logix controller will be ready to connect to the PA Link with a Class 1 connection.

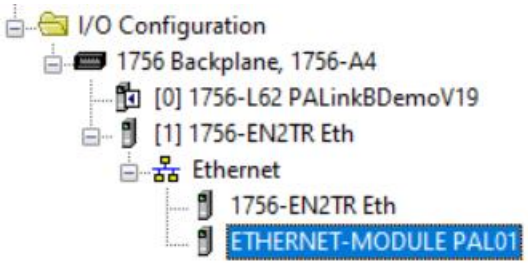


Figure 3.70 – RSLogix 5000 I/O module tree

3.9.3. Multi-Connection

The PA Link supports up to four Class 1 (cyclic data exchange) connections. This will allow the user to have more field devices per PA Link because more data can be exchanged between the Logix controller and the PA Link.

NOTE: This only applies when the user has implemented the PA Link into Logix using an EDS AOP. When using a Generic Module Profile in Logix (pre-Logix v21) the user will only be able to use 1 Logix Connection.

When the user verifies the Slate project (this is done by right-clicking on the device and selecting ***Verify Configuration***), the software will indicate if all the current configuration will fit into the selected ***EtherNet/IP Connection*** count. If not, the user will need to increase the connection count.

In Slate the user can set the number of ***EtherNet/IP Connections*** in the Logix tab of the configuration window (as shown below):

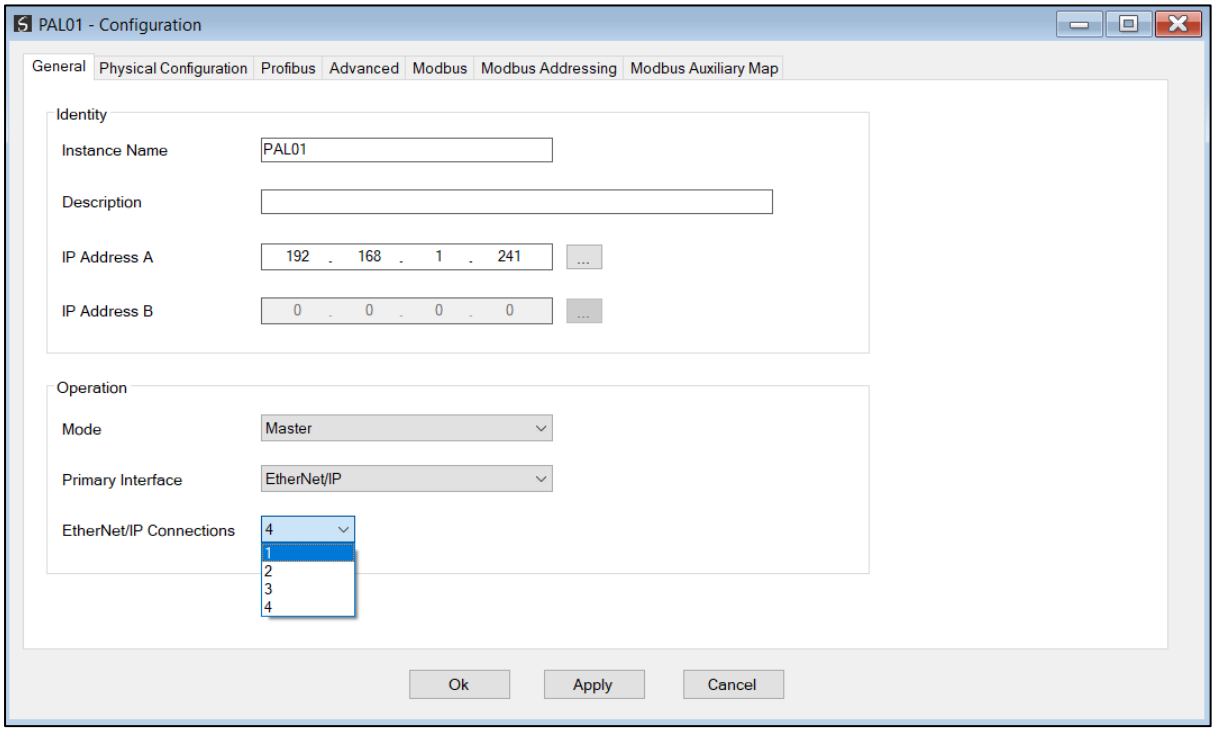


Figure 3.71 – Slate EtherNet/IP Connection Count

In Logix the user can increase/decrease the connection count using the EDS AOP (as shown below):

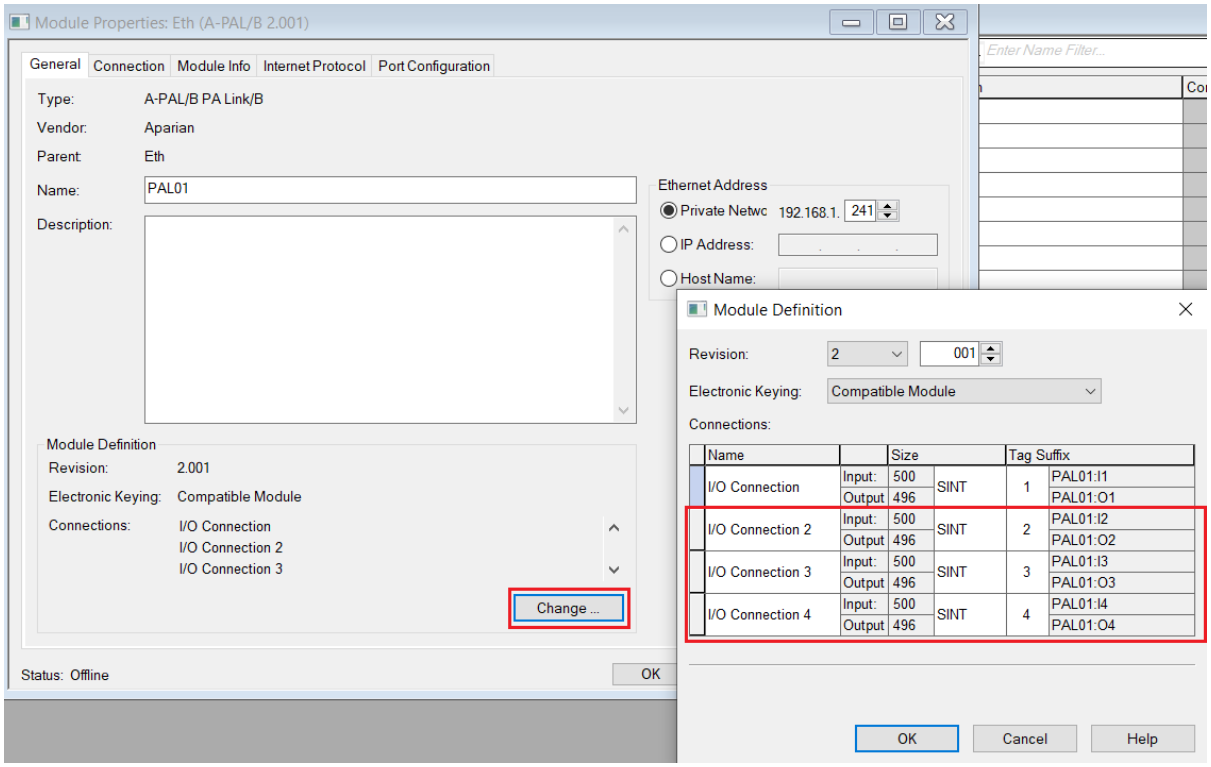


Figure 3.72 – Logix EtherNet/IP Connection Count

3.9.4. LOGIX MAPPING

Slate will generate the required UDTs and Routines (based on the PA Link configuration) to map the required PROFIBUS PA Slave input and output data. The user will need to generate the required Logix and UDTs by right-clicking on the module in Slate and selecting the ***Generate Logix L5X*** option.

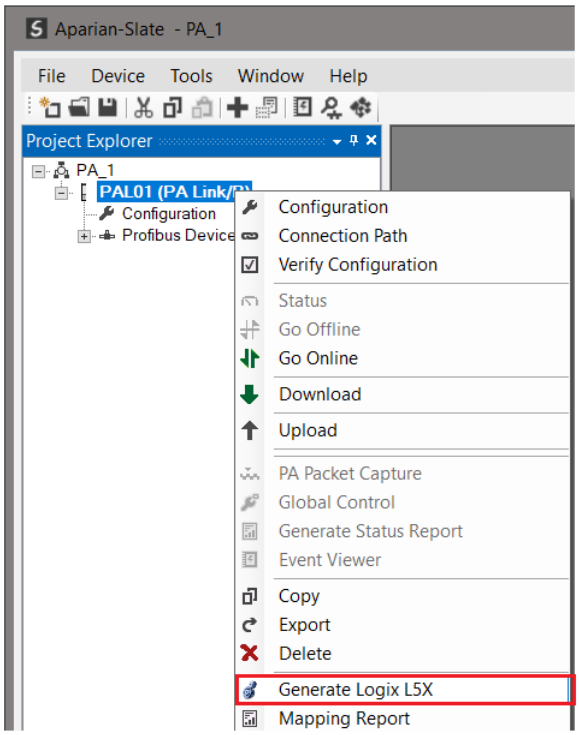


Figure 3.73 – Selecting Generate Logix L5X

The user will then be prompted to select a suitable file name and path for the L5X file.

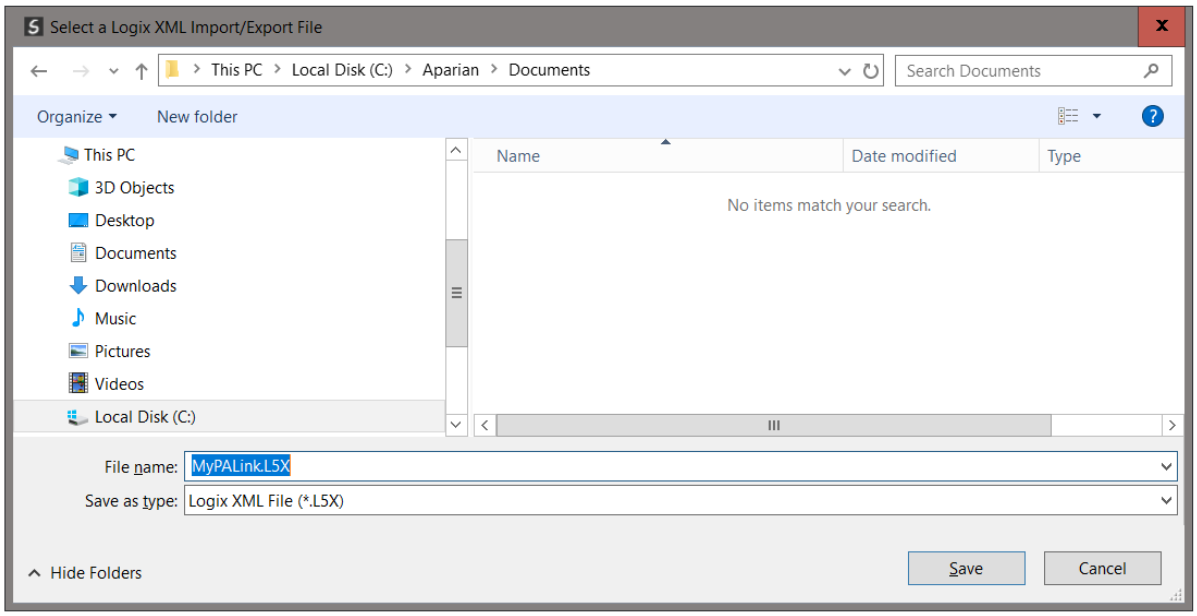


Figure 3.74 – Selecting the Logix L5X file name

This L5X file can now be imported into the Studio 5000 project by right-clicking on a suitable ***Program*** and selecting ***Add***, and then ***Import Routine***.

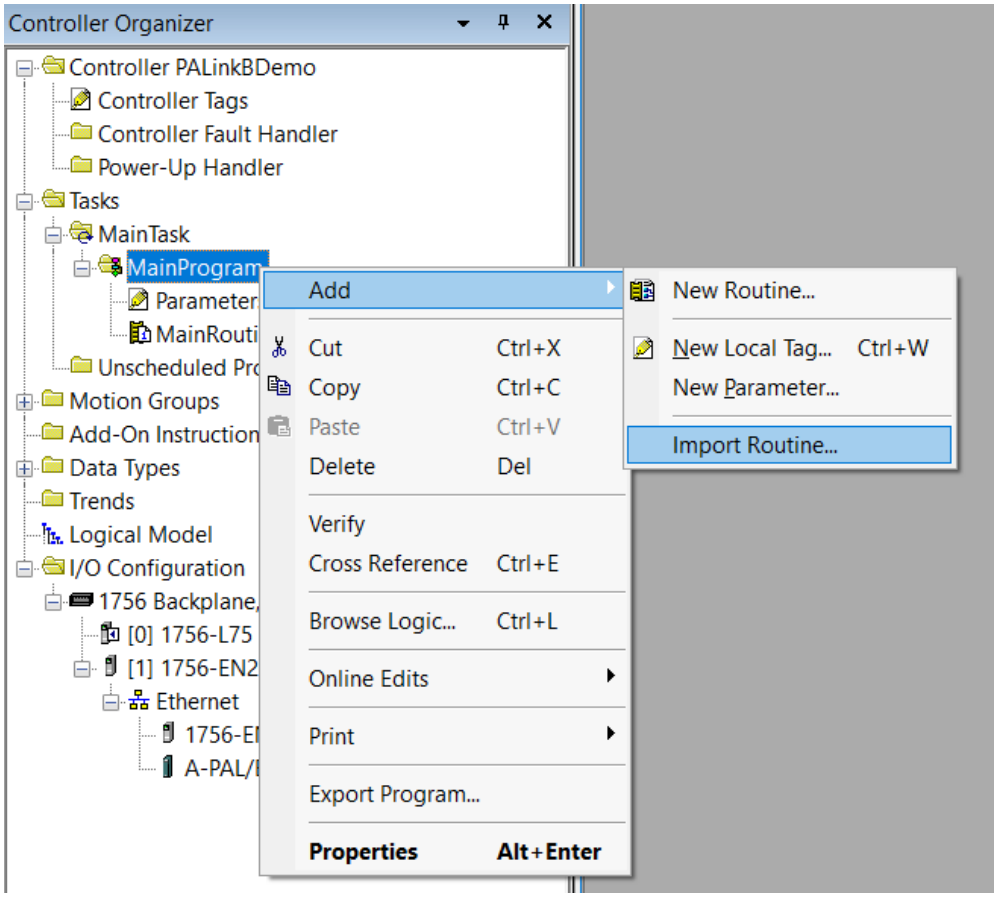


Figure 3.75 – Importing the L5X file into Studio 5000

In the file open dialog select the previously created L5X file and accept the import by pressing Ok.

The import will create the following:

- Mapping Routine
- Multiple UDT (User-Defined Data Types)
- Multiple Controller Tags

Since the imported mapping routine is not a Main Routine, it will need to be called from the current Main Routine.

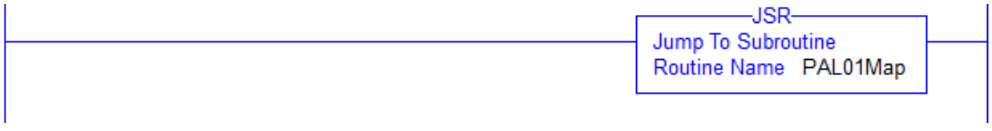


Figure 3.76 – Calling the mapping routine

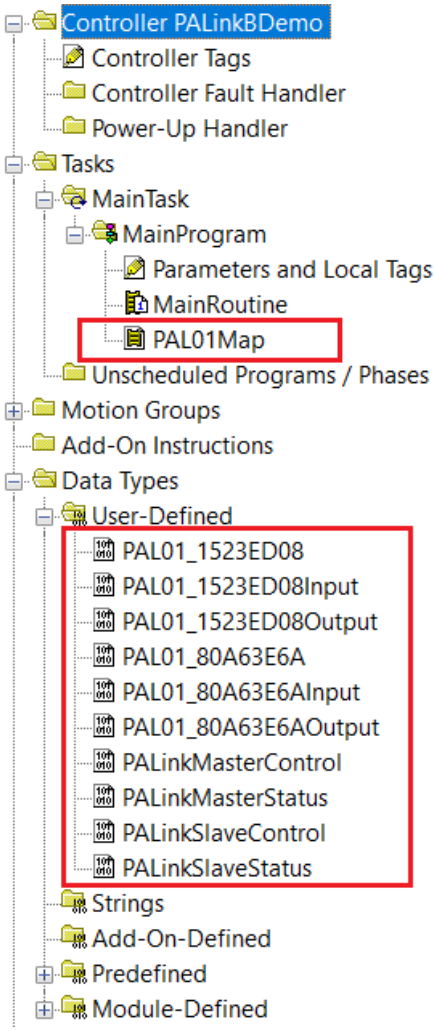


Figure 3.77 – Imported Logix Objects

A number of PA Link specific (UDT) tags are created.

The Master Control tag is used to set the PROFIBUS Mode and to Enable the individual Slave Devices.

PAL01_MasterControl	{ . . . }		PALinkMasterControl		
PAL01_MasterControl.MasterControl	3	Decimal	SINT	Master Control Command	
PAL01_MasterControl.DeviceEnable	{ . . . }	Decimal	BOOL[128]	Device Enable (0=Disable, 1=Enable)	
PAL01_MasterControl.DeviceEnable[0]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)	
PAL01_MasterControl.DeviceEnable[1]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)	
PAL01_MasterControl.DeviceEnable[2]	1	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)	
PAL01_MasterControl.DeviceEnable[3]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)	
PAL01_MasterControl.DeviceEnable[4]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)	
PAL01_MasterControl.DeviceEnable[5]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)	
PAL01_MasterControl.DeviceEnable[6]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)	
PAL01_MasterControl.DeviceEnable[7]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)	
PAL01_MasterControl.DeviceEnable[8]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)	
PAL01_MasterControl.DeviceEnable[9]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)	
PAL01_MasterControl.DeviceEnable[10]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)	

Figure 3.78 – Master Control tag

The Master Status tag displays the status of the PROFIBUS Master, including arrays to show the LiveList, Data Exchange Active, Alarm and Diagnostic pending status of each slave device.

Name	Value	Style	Data Type	Description
PAL01_MasterStatus	{...}		PALinkMasterStatus	
PAL01_MasterStatus.ConfigValid	1	Decimal	BOOL	Configuration Valid
PAL01_MasterStatus.Owned	1	Decimal	BOOL	Class 1 Ownership (0=Not Owned, 1=Owned)
PAL01_MasterStatus.DuplicateDPStation	0	Decimal	BOOL	Duplicate PA Master Station Detected
PAL01_MasterStatus.ProfibusFieldbusError	1	Decimal	BOOL	Profibus Fieldbus Error
PAL01_MasterStatus.ProfibusDeviceError	0	Decimal	BOOL	Profibus Device Error
PAL01_MasterStatus.ProfibusOffline	0	Decimal	BOOL	Profibus Offline
PAL01_MasterStatus.ProfibusStopped	0	Decimal	BOOL	Profibus Stopped
PAL01_MasterStatus.ProfibusClear	0	Decimal	BOOL	Profibus Clear
PAL01_MasterStatus.ProfibusOperational	1	Decimal	BOOL	Profibus Operational
PAL01_MasterStatus.PLCModeRun	1	Decimal	BOOL	PLC Mode Run
PAL01_MasterStatus.RedundancyEnabled	1	Decimal	BOOL	Redundancy Enabled
PAL01_MasterStatus.RedundancyStatus	1	Decimal	BOOL	Module is Active Master (0=Standby, 1=Active
PAL01_MasterStatus.PowerConditionerActive	1	Decimal	BOOL	Internal Power Conditioner Active
PAL01_MasterStatus.TerminatorActive	0	Decimal	BOOL	Internal Terminator Active
PAL01_MasterStatus.PortTripped	0	Decimal	BOOL	PA Bus Port Tripped
PAL01_MasterStatus.PortProtection	0	Decimal	BOOL	PA Bus Port Protection
PAL01_MasterStatus.BusVoltage	21.55166	Float	REAL	PA Bus Voltage (V)
PAL01_MasterStatus.BusCurrent	47.18135	Float	REAL	PA Bus Current (mA)
PAL01_MasterStatus.CPUTemperature	41.16309	Float	REAL	CPU Temperature
PAL01_MasterStatus.ConfigCRC	16#a20b	Hex	INT	Configuration Checksum
PAL01_MasterStatus.ActiveNodeCount	13	Decimal	SINT	Number of Active Slave Devices
PAL01_MasterStatus.SwitchOverTimeOut	2314	Decimal	INT	Redundancy Switch-Over Timeout
PAL01_MasterStatus.DeviceLiveList	{...}	Decimal	BOOL[128]	Live List (0=Not Live, 1=Live)
PAL01_MasterStatus.DeviceDataExchangeActive	{...}	Decimal	BOOL[128]	Data Exchange Active (0=Inactive, 1=Active)
PAL01_MasterStatus.DeviceAlarmPendingFlags	{...}	Decimal	BOOL[128]	Alarm Pending (0=Not Pending, 1=Pending)
PAL01_MasterStatus.DeviceDiagnosticPendingFlags	{...}	Decimal	BOOL[128]	Diagnostics Pending (0=Not Pending, 1=Pending)

Figure 3.79 – Master Status tag

There is also a tag created for each configured slave device. The structure of which comprises the following:

- Input Status - Status related to slave device
- Input Data – As specified in the Input Data Points in the Slot configuration
- Output Control – Used to trigger alarms
- Output Data – As specified in the Output Data Points in the Slot configuration

PAL01_iTEMPPATMT184	{...}		PAL01_1523ED08	
PAL01_iTEMPPATMT184.Input	{...}		PAL01_1523ED08Input	
PAL01_iTEMPPATMT184.Input.Status	{...}		PALinkSlaveStatus	
PAL01_iTEMPPATMT184.Input.Status.Online	0	Decimal	BOOL	Device Online (0=Offline, 1=Online)
PAL01_iTEMPPATMT184.Input.Status.DataExchangeActive	0	Decimal	BOOL	Data Exchange Active (0=Inactive, 1=Acti...
PAL01_iTEMPPATMT184.Input.Status.IdentMismatch	0	Decimal	BOOL	Device Identity Mismatch (0=Ok, 1=Mism...
PAL01_iTEMPPATMT184.Input.Status.DisabledByOutputAssembly	0	Decimal	BOOL	Disabled by Output (0=Enabled, 1=Disab...
PAL01_iTEMPPATMT184.Input.Status.DeviceError	0	Decimal	BOOL	Profibus Device Error (0=Ok, 1=Error)
PAL01_iTEMPPATMT184.Input.Status.AlarmPending	0	Decimal	BOOL	Alarm Pending (0=Not Pending, 1=Pendi...
PAL01_iTEMPPATMT184.Input.Status.DiagnosticsPending	0	Decimal	BOOL	Diagnostics Pending (0=Not Pending, 1=...
PAL01_iTEMPPATMT184.Input.Status.OutputAssemblyNodeAddrMismatch	0	Decimal	BOOL	Station Number Mismatch (0=Ok, 1=Mism...
PAL01_iTEMPPATMT184.Input.Status.MappingCRCMismatch	0	Decimal	BOOL	Mapping Checksum Mismatch (0=Ok, 1=...
PAL01_iTEMPPATMT184.Input.Status.SlaveClearOpMode	0	Decimal	BOOL	Slave Clear Operation Mode
PAL01_iTEMPPATMT184.Input.Status.SlaveAlarmAck	0	Decimal	BOOL	Slave Alarm Acknowledge
PAL01_iTEMPPATMT184.Input.Status.StationNumber	0	Decimal	SINT	Device Station Number
PAL01_iTEMPPATMT184.Input.Status.DeviceMappingCRC	16#0000	Hex	INT	Mapping checksum
PAL01_iTEMPPATMT184.Input.INTemperatureOUT	0.0	Float	REAL	
PAL01_iTEMPPATMT184.Input.INTemperatureOU1	0	Decimal	SINT	
PAL01_iTEMPPATMT184.Output	{...}		PAL01_1523ED08Out...	
PAL01_iTEMPPATMT184.Output.Control	{...}		PALinkSlaveControl	
PAL01_iTEMPPATMT184.Output.Control.StationNumber	0	Decimal	SINT	Device Station Number
PAL01_iTEMPPATMT184.Output.Control.AlarmTrigger	0	Decimal	BOOL	Device Alarm Trigger
PAL01_iTEMPPATMT184.Output.Control.DeviceMappingCRC	16#0000	Hex	INT	Mapping Checksum
PAL01_iTEMPPATMT184.Output.INTemperatureOU2	0.0	Float	REAL	
PAL01_iTEMPPATMT184.Output.INTemperatureOU3	0	Decimal	SINT	

Figure 3.80 – Slave Device-Specific tag

3.10. M580 CONFIGURATION

The PA Link module can be integrated with the M580 controller from Schneider Electric using the Generic EDS DTM.

3.10.1. REGISTER EDS FILE

The M580 specific EDS file "*AparianPALink_SE.eds*" can be downloaded from the product web page at **www.aparian.com**, it is contained in the zip file "*PALink EDS - SE.zip*".

To register the EDS file in EcoStruxure Control Expert, open the ***DTM Browser***, right-click on the host CPU and select ***Device menu***, ***Additional functions*** and then ***Add EDS to library***.

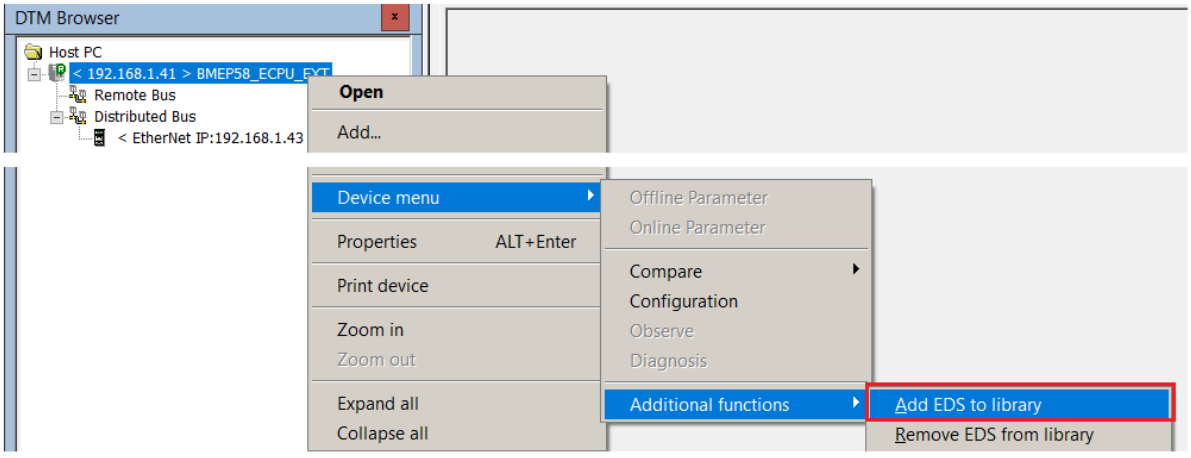


Figure 3.81 – Add EDS file

Using the file browser navigate to, and select, the downloaded and unzipped "*AparianPALink_SE.eds*" file.

Then open the ***Hardware Catalog***, select the ***DTM catalog*** tab, and click on the ***Update*** button.

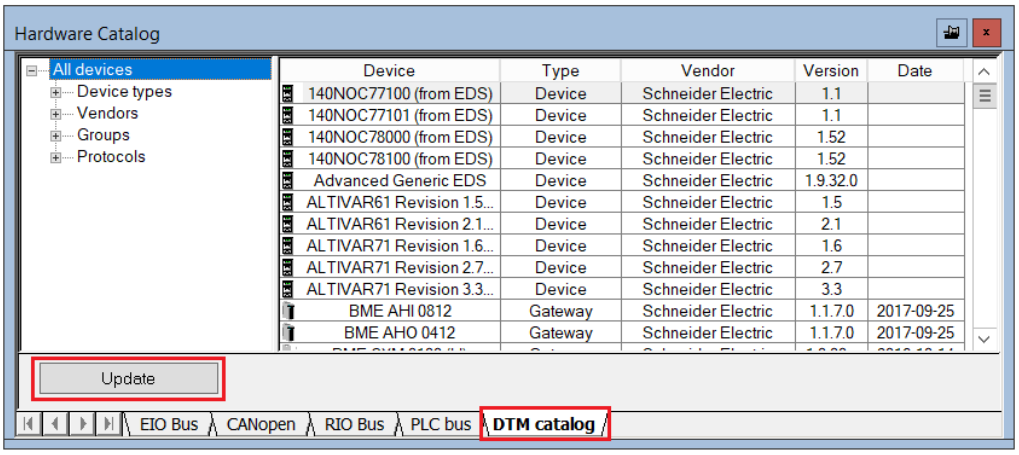


Figure 3.82 – Update DTM catalog

The PA Link/B DTM will then appear in the list and can be easily located by selecting the ***Aparian*** option under ***Vendors***.

3.10.2. PA LINK INSTANTIATION

To instantiate the module, drag the PA Link DTM from the ***Hardware Catalog*** to the host CPU in the ***DTM Browser***.

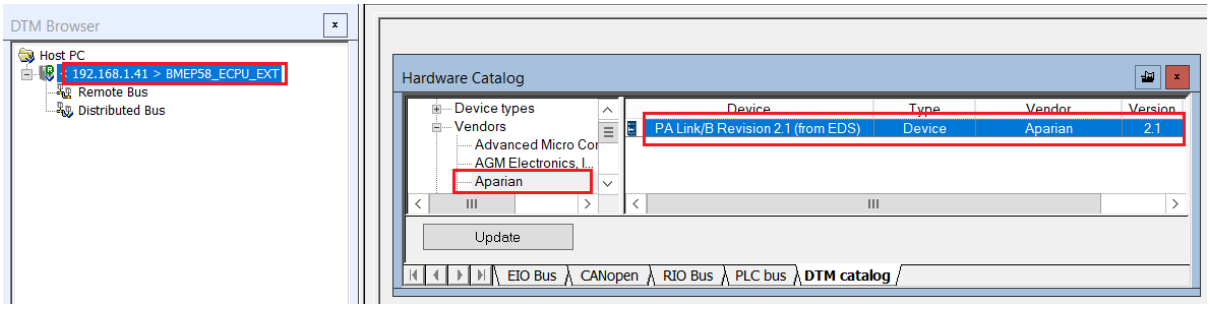


Figure 3.83 – Add PA Link

In the ***Properties of device***, enter a suitable DTM name. This name must be the same as the instance name configured for the PA Link module in the Slate configuration software.

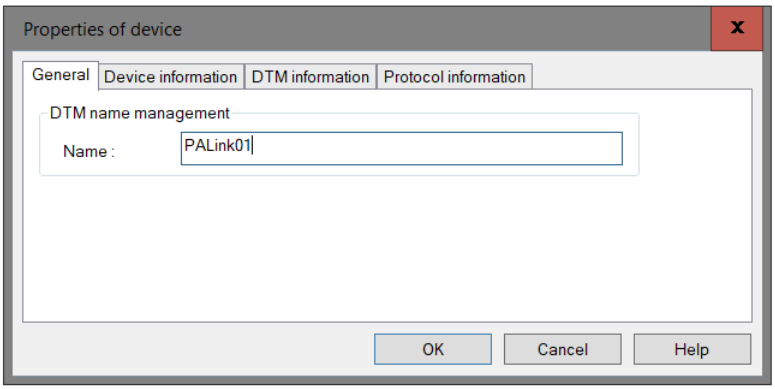


Figure 3.84 – DTM Properties

The PA Link instance will now appear in the DTM Browser.

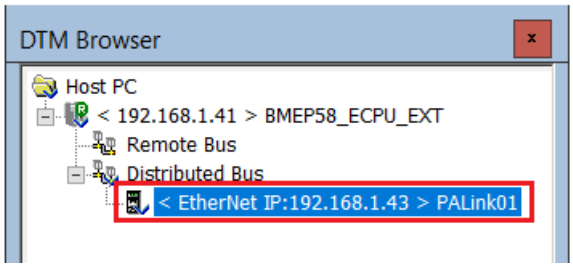


Figure 3.85 – DTM Browser

To configure the EtherNet/IP connections, double on the PALink item in the DTM browser.

In the I/O connection configuration, set the required ***RPI***, and the ***Input*** and ***Output Size***. The **Input Size must always be 500**, and **the Output Size must always be 496**.

NOTE: The Input and Output connection sizes configured in the DTM must be correct. Failure to do so will cause the PA Link module to not function correctly.

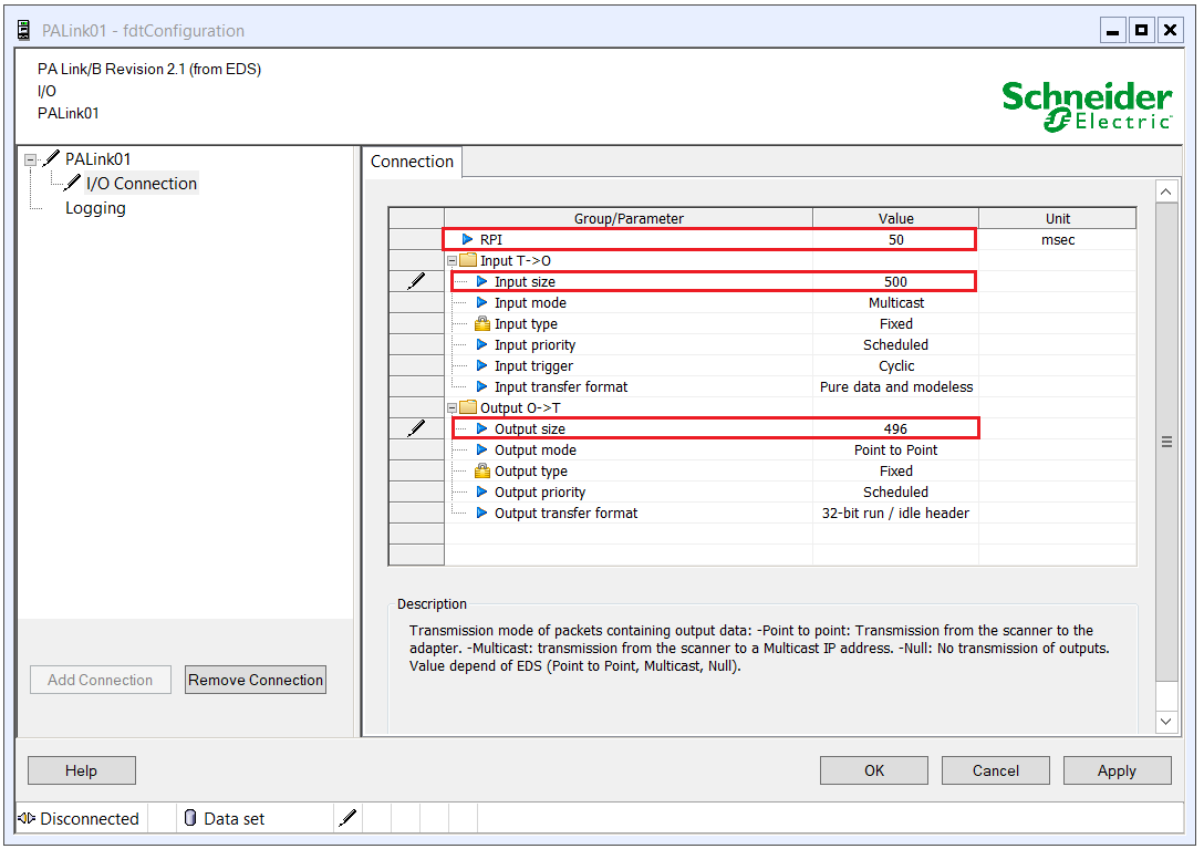


Figure 3.86 – PA Link I/O Conneciton settings

If the PA Link has been configured for more than connection, (that is, 2, 3 or 4 connections), then these connections must be added to match.

To add an additional connection, select the PA Link module (at the top of the tree) and then press the ***Add Connection*** button. Then select the appropriate I/O connection. For the second connection select ***I/O Connection 2***, for the third select ***I/O Connection 3 and*** for the fourth select ***I/O Connection 4***.

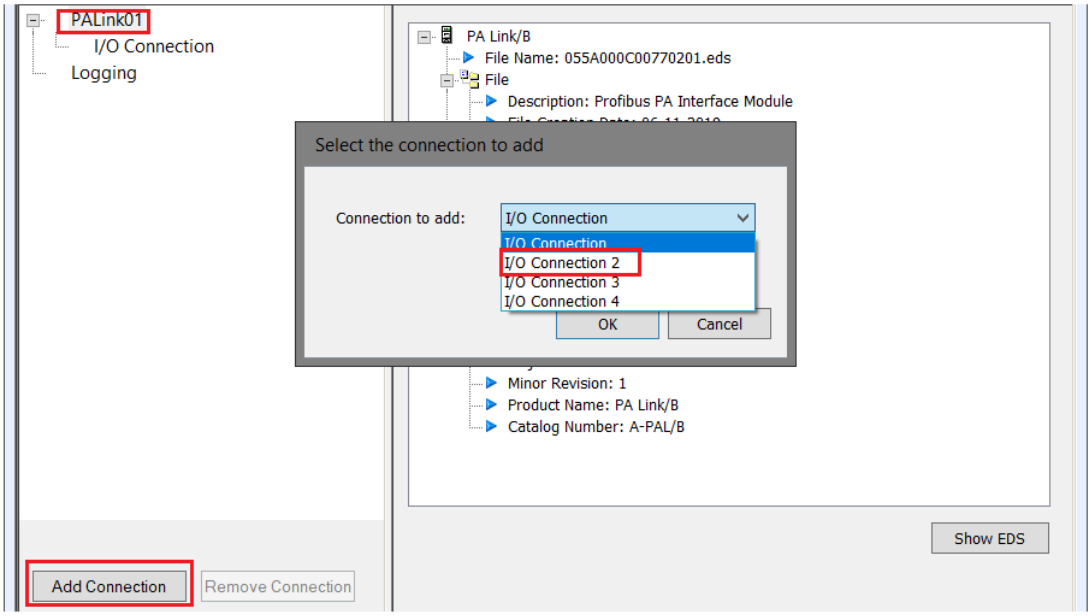


Figure 3.87 – Add multiple I/O Connections

Once the additional connections have been added, each connection must have the Input and Output sizes configured to 500 and 496 respectively.

NOTE: The number of connections configured in the DTM must match that configured in the Slate configuration software. Failure to do so will cause the PA Link module to not function correctly.

In the ***DTM Browser***, double-click on the host CPU, and select the newly added ***PA Link DTM*** in the ***Device List***.

In the ***Properties*** section, ensure that the ***Variable Name*** is set to the same ***Instance Name*** configured in the Slate configuration utility.

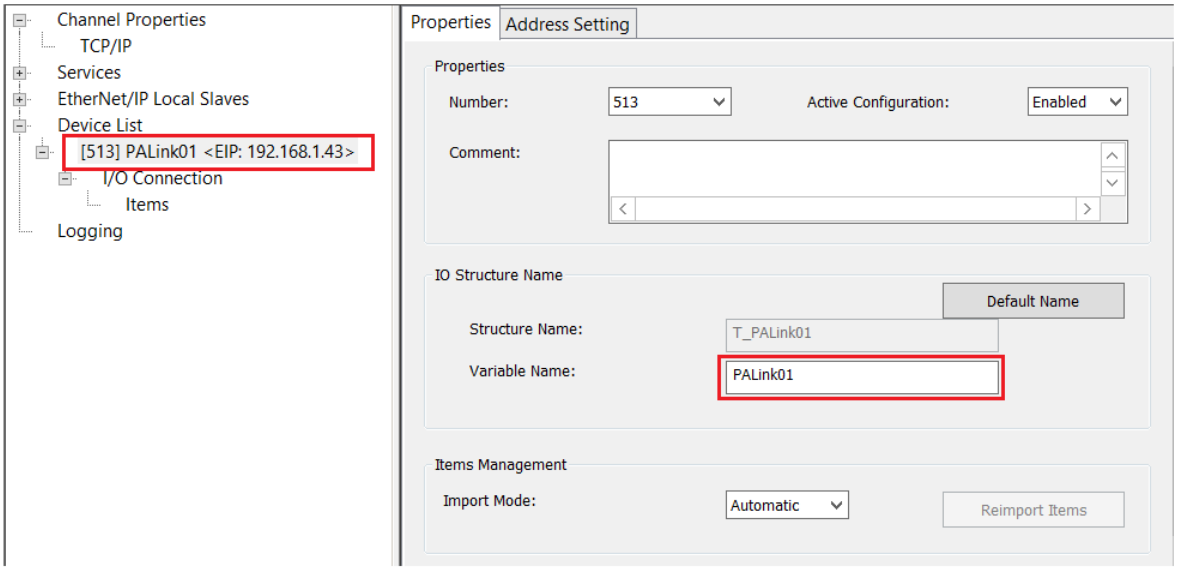


Figure 3.88 – PA Link – Variable name configuration

In the ***Address*** tab, set the ***IP Address*** of the module.

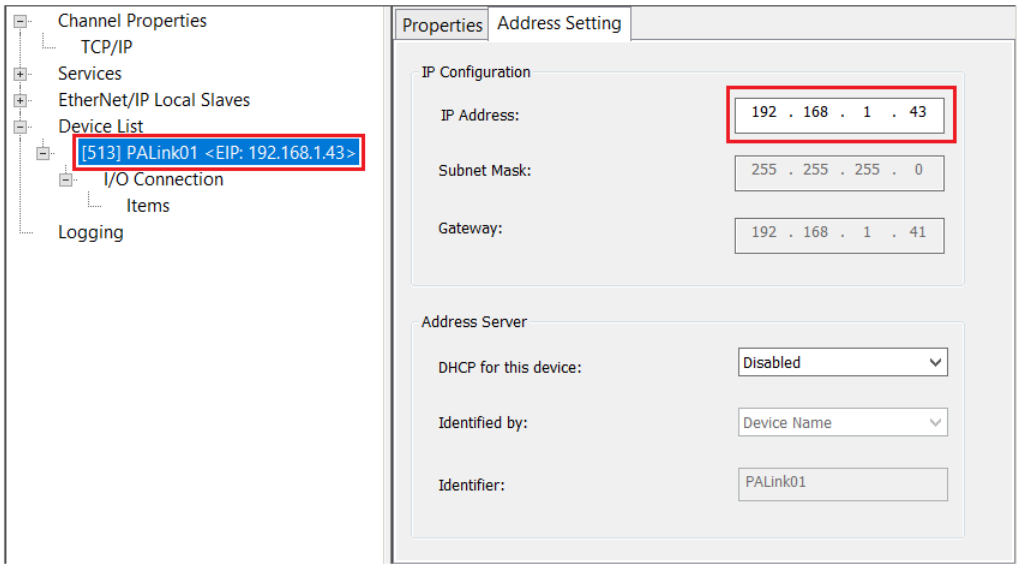


Figure 3.89 – PA Link – IP Address configuration

3.10.3. Redundant PA Link Master

When using a redundant PA Link master configuration, both the A and B PA Link modules must be added following the same aforementioned steps. The modules must be added with the same name as that in the Slate configuration utility but with the “A” and “B” suffix added respectively.

For example, if the Slate instance name is **PALink01**, then the DTM names will be **PALink01A** and **PALink01B** for the A and B modules respectively.

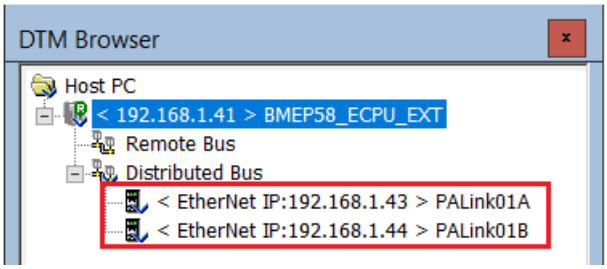


Figure 3.90 – Redundant PA Link pair

3.10.4. Importing Mapping Code

The PROFIBUS device specific mapping code is automatically generated by the Slate configuration software.

To generate the code, right-click on the PA Link in the Slate configuration software and select the ***Export Control Expert Mapping*** option.

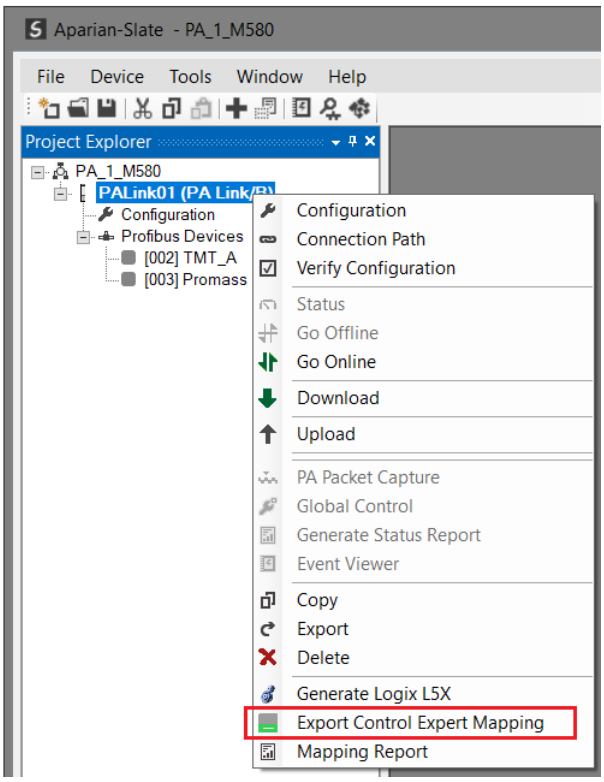


Figure 3.91 – Export Control Expert Mapping code

The ***Control Expert Export Options*** form will open. In addition to selecting the destination filename, the ***I/O Scan Mode*** and option to include the system variables can be selected.

The ***Add PALink System Objects*** automatically adds the required DFB, DDT and system variables required for the mapping. This **must** be selected for the first import into a Control Expert project, but may be unchecked for subsequent exports.

The ***I/O Scan Mode***, either ***Legacy*** or **Enhanced**, must match that in the ***Project Settings*** in the Control Expert project. This option can be found in the Project Settings' ***General…Build settings*** tab.

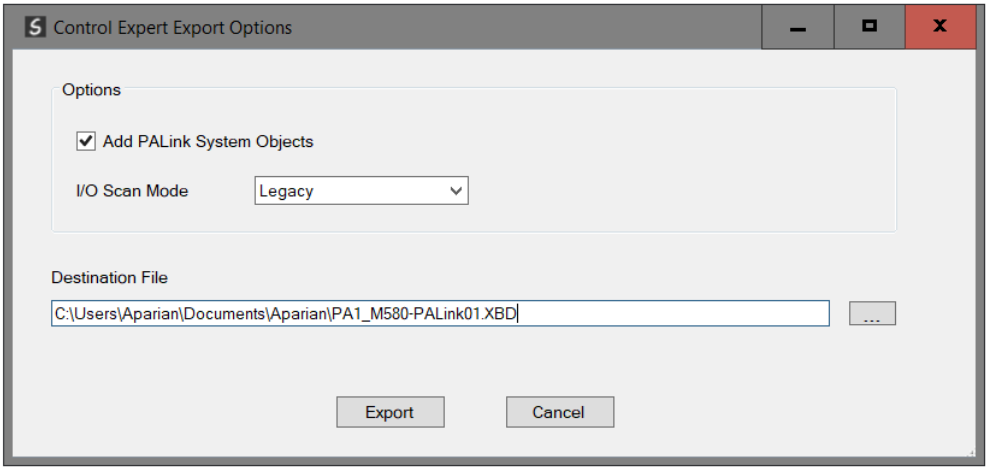


Figure 3.92 – Control Expert Export Options

In the Control Expert project, before the file can be imported, the ***Allow dynamic arrays*** option must be **enabled**. In Control Expert, under the ***Tools*** menu, select the ***Project Settings…*** option, and then navigate to ***Variables*** tab.

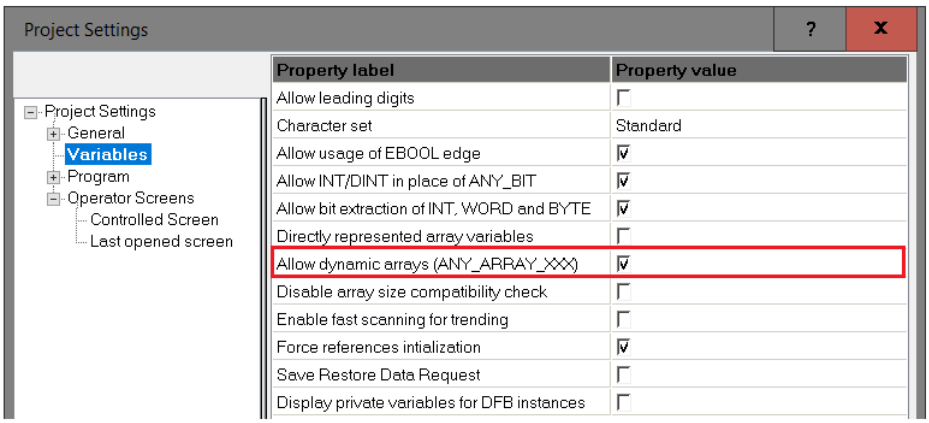


Figure 3.93 – Project Settings – Allow dynamic arrays

To import the file into Control Expert, right-click on the ***Logic*** item under the ***MAST*** task and select the ***Import…*** option.

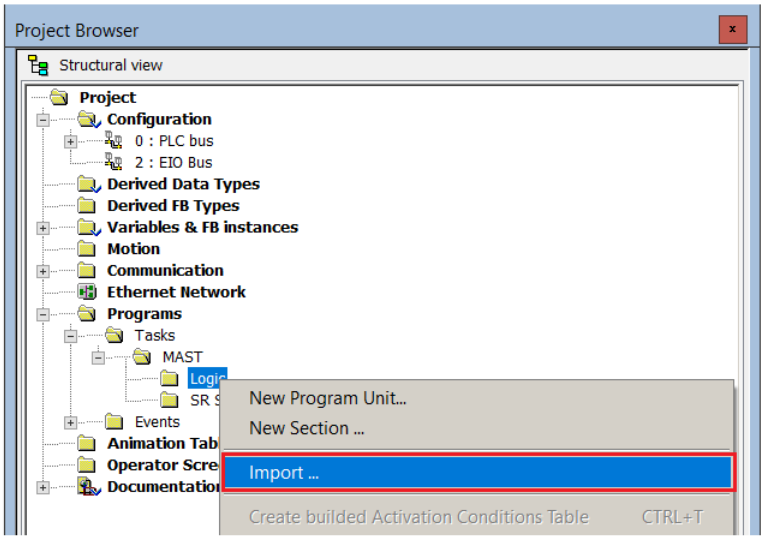


Figure 3.94 – Control Expert Import

Then select the file generated in the previous step.

Once the import process has completed, all the necessary DFBs, DDTs, variables and mapping function block instructions will be created.

The number of device specific DFBs and DDTs will depend on the number different PROFIBUS device configured.

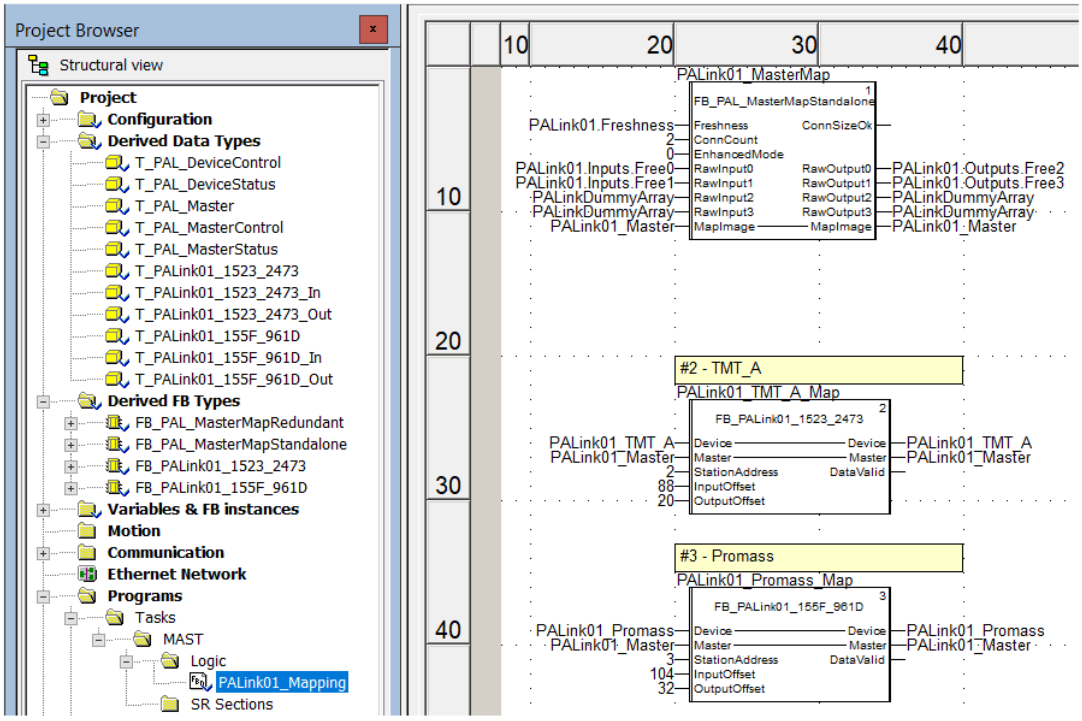


Figure 3.95 – Example Project

The project can then be built and downloaded to the M580 controller.

4. OPERATION

4.1. LOGIX OPERATION

When the PA Link has been setup for Logix communication (by setting the ***Primary Interface*** to ***EtherNet/IP***), it must also be added in Studio 5000 under an Ethernet bridge in the IO tree. The controller (e.g. ControlLogix or CompactLogix) will then establish one or more Class 1 connections to the PA Link module and will start exchanging data.

4.1.1. PROFIBUS PA

Once the PA Link and Logix controller have been correctly configured, the PA Link will start exchanging data with PROFIBUS PA slave devices.

NOTE: The module input and output assembly of each connection will be an undecorated array of data. The imported Logix routine (generated by Slate) will copy this data to the input and output assemblies.

MASTER STATUS

Below are the definitions of the tags in the Master Status UDT created by Slate.

Name	Value	Style	Data Type	Description
⊟ PAL01_MasterStatus	{...}		PALinkMasterStatus	
PAL01_MasterStatus.ConfigValid	1	Decimal	BOOL	Configuration Valid
PAL01_MasterStatus.Owned	1	Decimal	BOOL	Class 1 Ownership (0=Not Owned, 1=Owned)
PAL01_MasterStatus.DuplicateDPStation	0	Decimal	BOOL	Duplicate PA Master Station Detected
PAL01_MasterStatus.ProfibusFieldbusError	1	Decimal	BOOL	Profibus Fieldbus Error
PAL01_MasterStatus.ProfibusDeviceError	0	Decimal	BOOL	Profibus Device Error
PAL01_MasterStatus.ProfibusOffline	0	Decimal	BOOL	Profibus Offline
PAL01_MasterStatus.ProfibusStopped	0	Decimal	BOOL	Profibus Stopped
PAL01_MasterStatus.ProfibusClear	0	Decimal	BOOL	Profibus Clear
PAL01_MasterStatus.ProfibusOperational	1	Decimal	BOOL	Profibus Operational
PAL01_MasterStatus.PLCModeRun	1	Decimal	BOOL	PLC Mode Run
PAL01_MasterStatus.RedundancyEnabled	1	Decimal	BOOL	Redundancy Enabled
PAL01_MasterStatus.RedundancyStatus	1	Decimal	BOOL	Module is Active Master (0=Standby, 1=Active
PAL01_MasterStatus.PowerConditionerActive	1	Decimal	BOOL	Internal Power Conditioner Active
PAL01_MasterStatus.TerminatorActive	0	Decimal	BOOL	Internal Terminator Active
PAL01_MasterStatus.PortTripped	0	Decimal	BOOL	PA Bus Port Tripped
PAL01_MasterStatus.PortProtection	0	Decimal	BOOL	PA Bus Port Protection
PAL01_MasterStatus.BusVoltage	21.55166	Float	REAL	PA Bus Voltage (V)
PAL01_MasterStatus.BusCurrent	47.18135	Float	REAL	PA Bus Current (mA)
PAL01_MasterStatus.CPUTemperature	41.16309	Float	REAL	CPU Temperature
⊞ PAL01_MasterStatus.ConfigCRC	16#a20b	Hex	INT	Configuration Checksum
⊞ PAL01_MasterStatus.ActiveNodeCount	13	Decimal	SINT	Number of Active Slave Devices
⊞ PAL01_MasterStatus.SwitchOverTimeOut	2314	Decimal	INT	Redundancy Switch-Over Timeout
⊞ PAL01_MasterStatus.DeviceLiveList	{...}	Decimal	BOOL[128]	Live List (0=Not Live, 1=Live)
⊞ PAL01_MasterStatus.DeviceDataExchangeActive	{...}	Decimal	BOOL[128]	Data Exchange Active (0=Inactive, 1=Active)
⊞ PAL01_MasterStatus.DeviceAlarmPendingFlags	{...}	Decimal	BOOL[128]	Alarm Pending (0=Not Pending, 1=Pending)
⊞ PAL01_MasterStatus.DeviceDiagnosticPendingFlags	{...}	Decimal	BOOL[128]	Diagnostics Pending (0=Not Pending, 1=Pending)

Figure 4.1 – Logix Master Status tags

Tag	Description
ConfigValid	Configuration has been downloaded to the PA Link and is being executed. 1 – PA Link has been successfully configured. 0 – PA Link is not configured.
Owned	Indicates if the PA Link is owned by a Logix Controller with a connection count equal to that which has been configured in Slate. 1 – PA Link is connected. 0 – PA Link is not connected.
DuplicatePAStation	Indicates that the PA Link has detected another PROFIBUS PA station with the same station address as itself and has entered a temporary Back-off mode. 1 – Duplicate detected (Back-off mode active). 0 – Normal (No duplicate detected).  **NOTE**: In this condition the PA Link will not communicate on the PROFIBUS PA network. Although the back-off time is approximately 5 seconds, should the conflicting DP master remain active on the PROFIBUS network, the PA Link will continuously re-enter the back-off mode.
PROFIBUSFieldbusError	There is a PROFIBUS network issues (e.g. cable unplugged, under/over terminated, etc.). 1 – Fieldbus error detected. 0 – Normal (No errors detected).
PROFIBUSDeviceError	At least one slave device has a communication issue (e.g. offline, not exchanging process data, etc.) 1 – Device error detected. 0 – Normal (No errors detected).
PROFIBUSOffline	The PROFIBUS network is offline and the PA Link will not communicate on the network. 1 – PROFIBUS fieldbus state is OFFLINE. 0 – PROFIBUS fieldbus state is **not** OFFLINE.
PROFIBUSStopped	The PROFIBUS network is running and the PA Link is communicating on the network, but it will not exchange any process data with any slave device. 1 – PROFIBUS fieldbus state is STOPPED. 0 – PROFIBUS fieldbus state is **not** STOPPED.
PROFIBUSClear	The PROFIBUS network is running and the PA Link is communicating with all slave devices on the network, and if configured in the PA Link, the module will configure and exchange process data with each slave device. **NOTE**: In CLEAR mode the PA Link will not send any output data to any slave device. 1 – PROFIBUS fieldbus state is CLEAR. 0 – PROFIBUS fieldbus state is **not** CLEAR.

PROFIBUSOperational	The PROFIBUS network is running and the PA Link is communicating with all slave devices on the network, and if configured in the PA Link, the module will configure and exchange process data with each slave device. 1 – PROFIBUS fieldbus state is OPERATE. 0 – PROFIBUS fieldbus state is **not** OPERATE.
PLCModeRun	Logix controller in ***Run*** mode
RedundancyEnabled	Redundancy mode enabled in configuration.
RedundancyStatus	Redundancy Status 0 – Standby Master 1 – Active Master
PowerConditionerActive	Internal Power Conditioner Status 0 – Disabled 1 – Enabled
TerminatorActive	Internal Bus Terminator Status 0 – Disabled 1 – Enabled
PortTripped	Port Status 0 – Ok 1 – Tripped on over-current
PortProtection	Bus Port Protection Status 0 – Ok 1 – Bus Protection Active
BusVoltage	Bus Voltage (Volts)
BusCurrent	Bus Current supplied by the internal Power Conditioner (mA)
CPUTemperature	The internal temperature of the module's CPU.
ConfigCRC	The signature of the configuration currently executing on the module.
DeviceListList	Indicates the nodes that are online on the local PROFIBUS network. Each bit represents a node. When the specific bit is set '1' then the device is online and when the bit is off '0' the device is not on the PROFIBUS network. Bit 0 – Node 0 Online Bit 1 – Node 1 Online ……. Bit 126 – Node 126 Online
DeviceDataExchangeActive	Indicates the nodes that are online and exchanging DPV0 data on the local PROFIBUS network. Each bit represents a node. When the specific bit is set '1' then the device is online and exchanging data and when the bit is off '0' the device is not exchanging data on the PROFIBUS network. Bit 0 – Node 0 Exchanging DPV0 Data Bit 1 – Node 1 Exchanging DPV0 Data …….

	Bit 126 – Node 126 Exchanging DPV0 Data
DeviceAlarmPendingFlags	Indicates the nodes that have an alarm pending on the local PROFIBUS network. Each bit represents a node. When the specific bit is set '1' then the device has an alarm pending that must be unloaded and when the bit is off '0' the device does not have an alarm pending. Bit 0 – Node 0 has an alarm pending Bit 1 – Node 1 has an alarm pending ……. Bit 126 – Node 126 has an alarm pending
DeviceDiagnosticPendingFlags	Indicates the nodes that have diagnostics pending on the local PROFIBUS network. Each bit represents a node. When the specific bit is set '1' then the device has diagnostics pending that must be unloaded and when the bit is off '0' the device does not have any diagnostics pending. Bit 0 – Node 0 has diagnostics pending Bit 1 – Node 1 has diagnostics pending ……. Bit 126 – Node 126 has diagnostics pending

Table 4.1 – Logix Master Status tags

MASTER CONTROL

The user will need to set the PROFIBUS Operating mode from the PA Link Logix output assembly in the Logix controller.

PAL01_MasterControl	{...}		PALinkMasterControl	
PAL01_MasterControl.MasterControl	3	Decimal	SINT	Master Control Command
PAL01_MasterControl.DeviceEnable	{...}	Decimal	BOOL[128]	Device Enable (0=Disable, 1=Enable)
PAL01_MasterControl.DeviceEnable[0]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)
PAL01_MasterControl.DeviceEnable[1]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)
PAL01_MasterControl.DeviceEnable[2]	1	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)
PAL01_MasterControl.DeviceEnable[3]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)
PAL01_MasterControl.DeviceEnable[4]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)
PAL01_MasterControl.DeviceEnable[5]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)
PAL01_MasterControl.DeviceEnable[6]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)
PAL01_MasterControl.DeviceEnable[7]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)
PAL01_MasterControl.DeviceEnable[8]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)
PAL01_MasterControl.DeviceEnable[9]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)
PAL01_MasterControl.DeviceEnable[10]	0	Decimal	BOOL	Device Enable (0=Disable, 1=Enable)

Figure 4.2 – Master Control tags

Tag	**Description**
MasterControl	This tag is used to set the state of the fieldbus network. 0 – Set PROFIBUS network state to OFFLINE 1 – Set PROFIBUS network state to STOP 2 – Set PROFIBUS network state to CLEAR 3 – Set PROFIBUS network state to OPERATIONAL

DeviceEnable	These bits enable nodes on the PROFIBUS network for data exchange. Each bit represents a node. When the specific bit is set '1' then the device (if configured) will exchange data with the PA Link and when the bit is off '0' the device does exchange data with the PA Link. Bit 0 – Node 0 is enabled for data exchange Bit 1 – Node 1 is enabled for data exchange ……. Bit 126 – Node 126 is enabled for data exchange

Table 4.2 – Master Control tags

The user will be able to see if there are any faults (e.g. configured device not found) by viewing the LEDs of the PA Link (see the *Diagnostics* section for more details), by going online with the module in Slate and viewing the PA Link ***Master*** and ***Device Diagnostics***, or by viewing the input assembly of the PA Link in Logix.

STATUS AND DPV0 DATA EXCHANGE

The DPV0 data is exchanged with Logix using the Class 1 EtherNet/IP connection. The device-specific tag contains all the input and output data fields as well as important control and status information.

PAL01_iTEMPPATMT184	{...}		PAL01_1523ED08	
PAL01_iTEMPPATMT184.Input	{...}		PAL01_1523ED08Input	
PAL01_iTEMPPATMT184.Input.Status	{...}		PALinkSlaveStatus	
PAL01_iTEMPPATMT184.Input.Status.Online	0	Decimal	BOOL	Device Online (0=Offline, 1=Online)
PAL01_iTEMPPATMT184.Input.Status.DataExchangeActive	0	Decimal	BOOL	Data Exchange Active (0=Inactive, 1=Acti...
PAL01_iTEMPPATMT184.Input.Status.IdentMismatch	0	Decimal	BOOL	Device Identity Mismatch (0=Ok, 1=Mism...
PAL01_iTEMPPATMT184.Input.Status.DisabledByOutputAssembly	0	Decimal	BOOL	Disabled by Output (0=Enabled, 1=Disab...
PAL01_iTEMPPATMT184.Input.Status.DeviceError	0	Decimal	BOOL	Profibus Device Error (0=Ok, 1=Error)
PAL01_iTEMPPATMT184.Input.Status.AlarmPending	0	Decimal	BOOL	Alarm Pending (0=Not Pending, 1=Pendi...
PAL01_iTEMPPATMT184.Input.Status.DiagnosticsPending	0	Decimal	BOOL	Diagnostics Pending (0=Not Pending, 1=...
PAL01_iTEMPPATMT184.Input.Status.OutputAssemblyNodeAddrMismatch	0	Decimal	BOOL	Station Number Mismatch (0=Ok, 1=Mism...
PAL01_iTEMPPATMT184.Input.Status.MappingCRCMismatch	0	Decimal	BOOL	Mapping Checksum Mismatch (0=Ok, 1=...
PAL01_iTEMPPATMT184.Input.Status.SlaveClearOpMode	0	Decimal	BOOL	Slave Clear Operation Mode
PAL01_iTEMPPATMT184.Input.Status.SlaveAlarmAck	0	Decimal	BOOL	Slave Alarm Acknowledge
PAL01_iTEMPPATMT184.Input.Status.StationNumber	0	Decimal	SINT	Device Station Number
PAL01_iTEMPPATMT184.Input.Status.DeviceMappingCRC	16#0000	Hex	INT	Mapping checksum
PAL01_iTEMPPATMT184.Input.INTemperatureOUT	0.0	Float	REAL	
PAL01_iTEMPPATMT184.Input.INTemperatureOU1	0	Decimal	SINT	
PAL01_iTEMPPATMT184.Output	{...}		PAL01_1523ED08Out...	
PAL01_iTEMPPATMT184.Output.Control	{...}		PALinkSlaveControl	
PAL01_iTEMPPATMT184.Output.Control.StationNumber	0	Decimal	SINT	Device Station Number
PAL01_iTEMPPATMT184.Output.Control.AlarmTrigger	0	Decimal	BOOL	Device Alarm Trigger
PAL01_iTEMPPATMT184.Output.Control.DeviceMappingCRC	16#0000	Hex	INT	Mapping Checksum
PAL01_iTEMPPATMT184.Output.INTemperatureOU2	0.0	Float	REAL	
PAL01_iTEMPPATMT184.Output.INTemperatureOU3	0	Decimal	SINT	

Figure 4.3 – Slave Device-Specific tag

Tag	Description
Status	
Online	This bit indicates if the device is online on the PROFIBUS PA network. 1 – Device is online 0 – Device is not online
DataExchangeActive	This bit indicates if the device is configured and exchanging data on the PROFIBUS PA network. 1 – Device is active and exchanging data 0 – Device is not exchanging data The user must ensure that all application code making use of data from a slave device first checks that the ***DataExchangeActive*** bit is 1.
IdentMismatch	The device configured in Slate and the device at the configured node address do not match because they have different ident numbers. 1 – Online device Ident does not match configured device 0 – Online device and configured device ident match
DisabledByOutputAssembly	This bit indicates if the device has not been enabled for data exchange in the PA Link device enable control bits. 1 – Device has **not** been enabled for data exchange 0 – Device has been enabled for data exchange
DeviceError	This bit indicates an error with the device. 1 – Device has an error. 0 – Device has no error. The error flag will be set when one of the following conditions occur: • If there is an ident mismatch during slave parameterization, • When receiving any form of FDL fault (data link layer fault). For example: SAP Not Activated or Resource Not Available. • When the data size of the DPV0 data exchange does not match what has been configured in Slate. This Error flag is transient and will clear once a valid response is received.
AlarmPending	Indicates the device has an alarm pending on the local PROFIBUS network. When the specific bit is set ‘1’ then the device has an alarm pending that must be unloaded and when the bit is off ‘0’ the device does not have an alarm pending. 0 – The node has no alarm pending 1 – The node has an alarm pending
DiagnosticsPending	Indicates the device has diagnostics pending on the local PROFIBUS network. When the specific bit is set ‘1’ then the device has diagnostics pending that must be unloaded and when the bit is off ‘0’ the device does not have any diagnostics pending. 0 – The node has no diagnostics pending 1 – The node has diagnostics pending

OutputAssemblyNodeAddrMismatch	This bit indicates that there is a mismatch between the actual device station address and the expected Logix mapping station address. 0 – Station address matches 1 – Station address mismatch
MappingCRCMismatch	If there is a mismatch in the mapping between Logix and the PA Link it can result in data appearing in the incorrect location which means the user can be sending incorrect data to a device which can have unpredicted results. 0 – The mapping for the output data is correct. 1 – There is a mapping mismatch in the output data.
StationNumber	The station number of the specific slave device.
DeviceMappingCRC	The checksum of the mapping for the specific slave device.
DeviceSpecificInputDataFields	The tags created for the input data will be slave specific.

Table 4.3 – Device Input tags

Tag	**Description**
Control	
StationNumber	The station number entered by the Logix mapping code of the specific slave device.
DeviceMappingCRC	The checksum of the mapping that was applied by the generated Logix code used to verify if the mapping being used is valid.
DeviceSpecificOutputDataFields	The tags created for the output data will be slave specific.

Table 4.4 – Device Output tags

DPV1 EXPLICIT MESSAGING

The PA Link supports DPV1 Class 1 (MS1) and Class 2 (MS2) messaging which can be used to read / write parameters in a slave device. The PA Link DPV1 communication is achieved by using EtherNet/IP unconnected messaging (UCMM) or Class 3 connected messaging. The PA Link can buffer up to 10 DPV1 messages at a time.

NOTE: The slave device must support DPV1 messaging. The user must also set the DPV1 Enable bit in the user parameters of the slave device in Slate.

DPV1 CLASS 1 MESSAGING (MS1)

DPV1 Class 1 messaging will only be achievable if the slave device is in data exchange mode (i.e. the device is configured and exchanging cyclic data with the PA Link). Only the PA Master exchanging data with the slave device can read and write parameters using DPV1 MS1. Below

are the EtherNet/IP CIP message parameters as well as the request and response data structures.

A. DPV1 CLASS 1 READ

I. CIP MESSAGE:

Parameter	Description
Service Code	0x4B (Hex)
Class	0x432 (Hex)
Instance	1
Attribute	N/A
Request Data Length	8

Table 4.5 – DPV1 Class 1 Read Message

REQUEST DATA:

Parameter	Data Type	Description
Timeout	Long	The amount of time (in milliseconds) the PA Link waits for a DPV1 response before timing out and responding to the EtherNet/IP request with a Timeout Status.
Slave Address	Byte	The station number of the PROFIBUS device.
Slot Number	Byte	The DPV1 Slot number which must be read.
Index	Byte	The DPV1 Index number which must be read.
Data Length	Byte	The maximum number of bytes that must be read.

Table 4.6 – DPV1 Class 1 Read Request

RESPONSE DATA:

Parameter	Data Type	Description
Status	Byte	This is the status of the DPV1 data exchange. See appendix for the definitions of the returned status.
Extended Status	Byte[3]	This is the extended status of the DPV1 data exchange. See appendix for the definitions of the returned extended status.
Data Length	Byte	The length of the data returned.
Reserved	Byte	-

Data	Byte[]	The data from the DPV1 Read request. The number of bytes will be equal to the Data Length in the response.

Table 4.7 – DPV1 Class 1 Read Response

B. DPV1 CLASS 1 WRITE

I. CIP MESSAGE:

Parameter	Description
Service Code	0x4C (Hex)
Class	0x432 (Hex)
Instance	1
Attribute	N/A
Request Data Length	8 + Length of Data Payload

Table 4.8 – DPV1 Class 1 Write Message

REQUEST DATA:

Parameter	Data Type	Description
Timeout	Long	The amount of time (in milliseconds) the PA Link waits for a DPV1 response before timing out and responding to the EtherNet/IP request with a Timeout Status.
Slave Address	Byte	The station number of the PROFIBUS device.
Slot Number	Byte	The DPV1 Slot number for the write request.
Index	Byte	The DPV1 Index number for the write request.
Data Length	Byte	The number of bytes that must be written.
Data	Byte[]	The data that will be written to the specific address. The number of bytes will be equal to the Data Length in the request.

Table 4.9 – DPV1 Class 1 Write Request

RESPONSE DATA:

Parameter	Data Type	Description
Status	Byte	This is the status of the DPV1 data exchange. See appendix for the definitions of the returned status.
Extended Status	Byte[3]	This is the extended status of the DPV1 data exchange. See appendix for the definitions of the returned extended status.

Data Length	Byte	The length of the data that was written.

Table 4.10 – DPV1 Class 1 Write Response

DPV1 CLASS 2 MESSAGING (MS2)

DPV1 Class 2 messaging is possible from several PA masters simultaneously, but the connection must be established explicitly by each PA Master. Below are the EtherNet/IP CIP message parameters as well as the request and response data structures.

C. DPV1 INITIALIZE (ESTABLISH CONNECTION)

I. CIP MESSAGE:

Parameter	Description
Service Code	0x4C (Hex)
Class	0x432 (Hex)
Instance	1
Attribute	N/A
Request Data Length	20 + (2 + Source Net Address Length + Source MAC Address Length) + (2 + Destination Net Address Length + Destination MAC Address Length)

Table 4.11 – DPV1 Class 2 Initialize Message

REQUEST DATA:

Parameter	Data Type	Description
Timeout	Long	The amount of time (in milliseconds) the PA Link waits for a DPV1 response before timing out and responding to the EtherNet/IP request with a Timeout Status.
Slave Address	Byte	The station number of the PROFIBUS device.
Reserved	Byte[3]	-
Send Timeout	Short	Refer to the *PROFIBUS – DP Extensions to EN 50170 (DPV1)* for information regarding these parameters.
Features Supported	Short	
Profile Features Supported	Short	
Profile Ident Number	Short	
Source Type	Byte	
Source Address Length	Byte	

Destination Type	Byte	
Destination Address Length	Byte	
Source API	Byte	
Source SCL	Byte	
Source Net Address	Byte[]	
Source MAC Address	Byte[]	
Destination API	Byte	
Destination SCL	Byte	
Destination Net Address	Byte[]	
Destination MAC Address	Byte[]	

Table 4.12 – DPV1 Class 2 Initialize Request

RESPONSE DATA:

Parameter	Data Type	Description
Status	Byte	This is the status of the DPV1 data exchange. See appendix for the definitions of the returned status.
Extended Status	Byte[3]	This is the extended status of the DPV1 data exchange. See appendix for the definitions of the returned extended status.
Features Supported	Short	Refer to the *PROFIBUS – DP Extensions to EN 50170 (DPV1)* for information regarding these parameters.
Profile Features Supported	Short	
Profile Ident Number	Short	
Connection Reference	Byte	The connection reference is a reference number that must be used for further communication on this connection (e.g. Read, Write, or Abort).

Table 4.13 – DPV1 Class 2 Initialize Response

D. DPV1 CLASS 2 ABORT

I. CIP MESSAGE:

Parameter	Description
Service Code	0x4E (Hex)
Class	0x432 (Hex)
Instance	1
Attribute	N/A

Request Data Length	7

Table 4.14 – DPV1 Class 2 Abort Message

REQUEST DATA:

Parameter	Data Type	Description
Reserved	Long	-
Connection Reference	Byte	Connection Reference Received from the DPV1 Class 2 Initialize Response.
Subnet	Byte	Refer to the *PROFIBUS – DP Extensions to EN 50170 (DPV1)* for information regarding these parameters.
Instance Reason Code	Byte	

Table 4.15 – DPV1 Class 2 Abort Request

RESPONSE DATA:

Parameter	Data Type	Description
None	-	-

Table 4.16 – DPV1 Class 2 Abort Response

E. DPV1 CLASS 2 READ

I. CIP MESSAGE:

Parameter	Description
Service Code	0x4F (Hex)
Class	0x432 (Hex)
Instance	1
Attribute	N/A
Request Data Length	8

Table 4.17 – DPV1 Class 2 Read Message

REQUEST DATA:

Parameter	Data Type	Description
Timeout	Long	The amount of time (in milliseconds) the PA Link waits for a DPV1 response before timing out and responding to the EtherNet/IP request with a Timeout Status.
Connection Reference	Byte	Connection Reference Received from the DPV1 Class 2 Initialize Response.
Slot Number	Byte	The DPV1 Slot number which must be read.
Index	Byte	The DPV1 Index number which must be read.
Data Length	Byte	The maximum number of bytes that must be read.

Table 4.18 – DPV1 Class 2 Read Request

RESPONSE DATA:

Parameter	Data Type	Description
Status	Byte	This is the status of the DPV1 data exchange. See appendix for the definitions of the returned status.
Extended Status	Byte[3]	This is the extended status of the DPV1 data exchange. See appendix for the definitions of the returned extended status.
Data Length	Byte	The length of the data returned.
Reserved	Byte	-
Data	Byte[]	The data from the DPV1 Read request. The number of bytes will be equal to the Data Length in the response.

Table 4.19 – DPV1 Class 2 Read Response

F. DPV1 CLASS 2 WRITE

I. CIP MESSAGE:

Parameter	Description
Service Code	0x50 (Hex)
Class	0x432 (Hex)
Instance	1
Attribute	N/A
Request Data Length	8 + Length of Data Payload

Table 4.20 – DPV1 Class 2 Write Message

REQUEST DATA:

Parameter	Data Type	Description
Timeout	Long	The amount of time (in milliseconds) the PA Link waits for a DPV1 response before timing out and responding to the EtherNet/IP request with a Timeout Status.
Connection Reference	Byte	Connection Reference Received from the DPV1 Class 2 Initialize Response.
Slot Number	Byte	The DPV1 Slot number for the write request.
Index	Byte	The DPV1 Index number for the write request.
Data Length	Byte	The number of bytes that must be written.
Data	Byte[]	The data that will be written to the specific address. The number of bytes will be equal to the Data Length in the request.

Table 4.21 – DPV1 Class 2 Write Request

RESPONSE DATA:

Parameter	Data Type	Description
Status	Byte	This is the status of the DPV1 data exchange. See appendix for the definitions of the returned status.
Extended Status	Byte[3]	This is the extended status of the DPV1 data exchange. See appendix for the definitions of the returned extended status.
Data Length	Byte	The length of the data that was written.

Table 4.22 – DPV1 Class 2 Write Response

PROFIBUS DIAGNOSTICS

The PA Link will flag to the user when new diagnostics have been received. When new diagnostics have been flagged by the PA Link the user can extract the diagnostics message from the PA Link by using EtherNet/IP unconnected messaging (UCMM) or Class 3 connected messaging.

G. NOTIFICATION

The PA Link will notify the user of pending diagnostics as shown below.

I. MASTER UDT

In the Status part of the PA Link tags (see *Logix Mapping* section) there is a tag FieldDeviceDiagPending. This is an array of Boolean tags each of which represents a node on the network. Below is a description of the tag.

Tag	Description
FieldDeviceDiagPending	Indicates the nodes that have diagnostics pending on the local PROFIBUS network. Each bit represents a node. When the specific bit is set '1' then the device has diagnostics pending that must be unloaded and when the bit is off '0' the device does not have any diagnostics pending. Bit 0 – Node 0 has diagnostics pending Bit 1 – Node 1 has diagnostics pending ……. Bit 126 – Node 126 has diagnostics pending

Table 4.23 – PA Link Logix Tags Diagnostics Pending Indications

II. FIELD DEVICE UDT

In the Status part of the Device UDT (see *Logix Mapping* section) there is a tag DiagnosticsPending. Below is a description of the tag.

Tag	Description
DiagnosticsPending	Indicates the device has diagnostics pending on the local PROFIBUS network. When the specific bit is set '1' then the device has diagnostics pending that must be unloaded and when the bit is off '0' the device does not have any diagnostics pending. 0 – The node has diagnostics pending 1 – The node has diagnostics pending

Table 4.24 – PA Link UDT Diagnostics Pending Indications

H. EXTRACTION

The user can extract diagnostics by using the slave device node address. The user can also decide how the diagnostics data must be extracted. This is changed by updating the mode in the Diagnostics Request message. There are one of three modes that can be selected:

Mode	Description
0	Read the slave device diagnostics that has been buffered in the PA Link.
1	Read the slave device diagnostics that has been buffered in the PA Link and clear the Diagnostics Pending indication.

2	Force the PA Link to send a PROFIBUS Diagnostic Request to the specific slave device and return the diagnostics data received.

Table 4.25 – Diagnostics Extract Message

I. CIP MESSAGE

Below are the EtherNet/IP CIP message parameters as well as the request and response data structures.

MESSAGE:

Parameter	Description
Service Code	0x52 (Hex)
Class	0x432 (Hex)
Instance	1
Attribute	N/A
Request Data Length	6

Table 4.26 – Diagnostics Extract Message

REQUEST DATA:

Parameter	Data Type	Description
Timeout	Long	The amount of time (in milliseconds) the PA Link waits for a DPV1 response before timing out and responding to the EtherNet/IP request with a Timeout Status.
Slave Address	Byte	The station number of the PROFIBUS device.
Mode	Byte	0 – Read the slave device diagnostics that has been buffered in the PA Link. 1 – Read the slave device diagnostics that has been buffered in the PA Link and clear the Diagnostics Pending indication. 2 – Force the PA Link to send a PROFIBUS Diagnostic Request to the specific slave device and return the diagnostics data received.

Table 4.27 – Diagnostics Extract Request

RESPONSE DATA:

Parameter	Data Type	Description
Status	Byte	This is the status of the DPV1 data exchange. See appendix for the definitions of the returned status.
Reserved	Byte	-
Diagnostics data length	Byte	The number of diagnostic bytes that have been returned.
Reserved	Byte	-
Diagnostics Data	Byte[]	Refer to the *PROFIBUS Specification EN 50170* for information regarding the diagnostics.

Table 4.28 – Diagnostics Extract Response

GLOBAL CONTROL

Global control commands are multi-cast PROFIBUS commands which can be sent to a group of slave devices.

I. CIP MESSAGE

Below are the EtherNet/IP CIP message parameters as well as the request and response data structures.

MESSAGE:

Parameter	Description
Service Code	0x54 (Hex)
Class	0x432 (Hex)
Instance	1
Attribute	N/A
Request Data Length	6

Table 4.29 – Global Control Message

REQUEST DATA:

Parameter	Data Type	Description
Timeout	Long	The amount of time (in milliseconds) the PA Link waits for a response before timing out and responding to the EtherNet/IP request with a Timeout Status.

Control	Byte	The Global Control action: 0 - Release the Clear mode for the devices 2 - Force the Clear Mode of devices 4 - Freeze 8 - UnFreeze 12 - UnFreeze + 16 - Sync + 32 – UnSync + 48 - UnSync
Group	Byte	The destination Group.

Table 4.30 – Global Control Request

RESPONSE DATA:

Parameter	Data Type	Description
Status	Byte	This is the status of the Global Control transmission: 0x00 – Success 0x13 – Failed

Table 4.31 – Global Control Response

ALARMING

The PA Link will flag to the user when a new alarm has been received. When a new alarm has been flagged by the PA Link the user can extract the alarm from the PA Link by using EtherNet/IP unconnected messaging (UCMM) or Class 3 connected messaging.

NOTE: If there is more than one alarm pending then after extract the alarm the alarm pending will be set again to indicate there are more alarms to unload.

J. NOTIFICATION

The PA Link will notify the user of a pending alarm as shown below.

I. MASTER UDT

In the Status part of the PA Link tags (see *Logix Mapping* section) there is a tag FieldDeviceAlarmPending. This is an array of Boolean tags each of which represents a node on the network. Below is a description of the tag.

Tag	Description
FieldDeviceAlarmPending	Indicates the nodes that have an alarm pending on the local PROFIBUS network. Each bit represents a node. When the specific bit is set ‘1’ then

	the device has an alarm pending that must be unloaded and when the bit is off '0' the device does not have an alarm pending. Bit 0 – Node 0 has an alarm pending Bit 1 – Node 1 has an alarm pending ……. Bit 126 – Node 126 has an alarm pending

Table 4.32 – PA Link Tag Alarm Pending Indications

II. FIELD DEVICE UDT

In the Status part of the Device UDT (see *Logix Mapping* section) there is a tag AlarmPending. Below is a description of the tag.

Tag	Description
AlarmPending	Indicates the device has an alarm pending on the local PROFIBUS network. When the specific bit is set '1' then the device has an alarm pending that must be unloaded and when the bit is off '0' the device does not have an alarm pending. 0 – The node has an alarm pending 1 – The node has an alarm pending

Table 4.33 – Field Device UDT Alarm Pending Indications

K. EXTRACTION

I. CIP MESSAGE

The user can extract an alarm by using the slave device node address. Below are the EtherNet/IP CIP message parameters as well as the request and response data structures.

MESSAGE:

Parameter	Description
Service Code	0x51 (Hex)
Class	0x432 (Hex)
Instance	1
Attribute	N/A
Request Data Length	5

Table 4.34 – Alarm Extract Message

REQUEST DATA:

Parameter	Data Type	Description
Timeout	Long	The amount of time (in milliseconds) the PA Link waits for a DPV1 response before timing out and responding to the EtherNet/IP request with a Timeout Status.
Slave Address	Byte	The station number of the PROFIBUS device.

Table 4.35 – Alarm Extract Request

RESPONSE DATA:

Parameter	Data Type	Description
Status	Byte	This is the status of the DPV1 data exchange. See appendix for the definitions of the returned status.
Extended Status	Byte[3]	This is the extended status of the DPV1 data exchange. See appendix for the definitions of the returned extended status.
Alarm data length	Byte	The amount of alarm bytes that have been returned.
Alarm data	Byte[]	Refer to the *PROFIBUS Specification EN 50170* for information regarding the diagnostics. Below is the basic structure of the alarm data: **Byte 0 – Alarm Type** 1 – Diagnosis Alarm 2 – Process Alarm 3 – Pull Alarm 4 – Plug Alarm 5 – Status Alarm 6 – Update Alarm **Byte 1 – Slot Number** Range 0 - 254 **Byte 2 - Bit 0 to 1 – Alarm Specifier** 0 – No further differentiation 1 – Fault occurred and slot it not ok 2 – Fault disappeared, and slot is ok 3 – One fault disappeared, and slot is not ok **Byte 2 - Bit 3 to 7 – Sequence Number** Range 1 - 32 **Byte 3 to 59 – Alarm Data Description**

Table 4.36 – Alarm Extract Response

4.2. M580 OPERATION

When the PA Link has been configured for M580 communication (by setting the ***Primary Interface*** to ***EtherNet/IP***), and added in the Control Expert project, then the M580 controller will establish one or more Class 1 connections to the PA Link module and will start exchanging data.

4.2.1. PROFIBUS PA

The (imported) mapping FBD section will map the PA Link master status and Device status to the appropriately name tags.

MASTER STATUS

The master status is shown below:

Name	Value	Type	Comment
PALink01_Master		T_PAL_Master	
PALink01_Master.Status		T_PAL_MasterStatus	PALink Master Status
PALink01_Master.Status.Freshness	1	BOOL	PALink Connected and Updating.(0:Not updating, 1:Updating)
PALink01_Master.Status.DataValid	1	BOOL	Data Valid - (0:Not Valid, 1:Valid - PALink connected and mapping DFB executing)
PALink01_Master.Status.SourceIsB	0	BOOL	PALink Data Source (0:PALink A 1:PALink B)
PALink01_Master.Status.Connected	1	BOOL	PLC is Connected to PALink (0:Not Connected, 1:Connected)
PALink01_Master.Status.ConfigValid	1	BOOL	PALink Configuration is Valid. (0:Not Valid, 1:Valid)
PALink01_Master.Status.RedundancyConfigured	0	BOOL	PALink Configured for Redundancy. (0:Standalone, 1:Redundancy)
PALink01_Master.Status.RedundancyStatus	0	BOOL	Local PALink is Redundant Active. (0:Standby, 1:Active)
PALink01_Master.Status.ProfibusFieldbusError	0	BOOL	Profibus Network Issues (0:Ok, 1:Error)
PALink01_Master.Status.ProfibusDeviceError	0	BOOL	At least one device has communication issues (0:Ok, 1:Error)
PALink01_Master.Status.ProfibusOffline	0	BOOL	Profibus Network is Offline (0:Not Offline, 1:Offline)
PALink01_Master.Status.ProfibusStopped	0	BOOL	Profibus Network is Stopped (0:Not Stopped, 1:Stopped)
PALink01_Master.Status.ProfibusClear	0	BOOL	Profibus Network is Clear (0:Not Clear, 1:Clear)
PALink01_Master.Status.ProfibusOperational	1	BOOL	Profibus Network is Operational (0:Not Running, 1:Running)
PALink01_Master.Status.PLCModeRun	1	BOOL	PLC is conencted and in Run Mode(0:Stopped, 1:Run)
PALink01_Master.Status.PowerConditionerActive	1	BOOL	Internal Power Conditioner Active (0:Disabled, 1:Enabled)
PALink01_Master.Status.TerminatorActive	1	BOOL	Internal Bus Terminator Active (0:Disabled, 1:Active)
PALink01_Master.Status.PortTripped	0	BOOL	Port Tripped Status(0:Ok, 1:Tripped)
PALink01_Master.Status.PortProtection	0	BOOL	Port Protection Status (0:Ok, 1:Protection)
PALink01_Master.Status.BusVoltage	21.21812	REAL	Bus Voltage (V)
PALink01_Master.Status.BusCurrent	65.34813	REAL	Bus Current (mA)
PALink01_Master.Status.CPUTemperature	37.30043	REAL	CPU Temperature (degC)
PALink01_Master.Status.DuplicatePAMasterStation	0	BOOL	Duplicate Profibus Station Address Detected. (0:No Duplicate, 1:Duplicate Detected)
PALink01_Master.Status.MasterCRC	29677	UINT	Master Checksum of the PALink configuration.
PALink01_Master.Status.ActiveNodeCount	2	BYTE	Number of Profibus Slave Devices Online.
PALink01_Master.Status.LiveList		ARRAY[0..126] OF BOOL	Profibus Live List - Devices Online (Device 0 - 126)
PALink01_Master.Status.DataExch		ARRAY[0..126] OF BOOL	Profibus Data Exchange List - Devices Online and Exchanging Data(Device 0 - 126)
PALink01_Master.Status.AlarmPending		ARRAY[0..126] OF BOOL	Devices with Pending Alarms (Device 0 - 126)
PALink01_Master.Status.DiagPending		ARRAY[0..126] OF BOOL	Devices with Pending Diagnostics (Device 0 - 126)
PALink01_Master.Control		T_PAL_MasterControl	PALink Master Control

Figure 4.4 – M580 PA Link Master Status

The function of each tag is described in the previous section.

MASTER CONTROL

The user will need to set the PROFIBUS Operating mode in the Master Control section.

Name	Value	Type	Comment
PALink01_Master		T_PAL_Master	
PALink01_Master.Status		T_PAL_MasterStatus	PALink Master Status
PALink01_Master.Control		T_PAL_MasterControl	PALink Master Control
PALink01_Master.Control.MasterControl	3	BYTE	Profibus Command. (0:Offline, 1:Stop, 2:Clear, 3:Operational)
PALink01_Master.Control.RedundancyControl	0	BYTE	Profibus Redundancy Command.
PALink01_Master.Control.DeviceEnable		ARRAY[0..126] OF BOOL	Slave Device Enable array.
PALink01_Master.Control.DeviceEnable[0]	1	BOOL	
PALink01_Master.Control.DeviceEnable[1]	0	BOOL	
PALink01_Master.Control.DeviceEnable[2]	1	BOOL	
PALink01_Master.Control.DeviceEnable[3]	1	BOOL	
PALink01_Master.Control.DeviceEnable[4]	0	BOOL	

Figure 4.5 – M580 PA Link Master Control

The function of each tag is described in the previous section.

STATUS AND DPV0 DATA EXCHANGE

The DPV0 data is exchanged with the M580 using 1,2,3 or 4 Class 1 EtherNet/IP connections. The device-specific tag contains all the input and output data fields as well as important control and status information.

Name	Value	Type	Comment
PALink01_TMT_A.Status		T_PAL_DeviceStatus	Device Status
PALink01_TMT_A.Status.DataValid	1	BOOL	Mapping Valid and Data Fresh (0:Not Valid, 1:Valid)
PALink01_TMT_A.Status.Online	1	BOOL	Device Online on the Profibus network. (0:Offline, 1:Online)
PALink01_TMT_A.Status.DataExchangeActive	1	BOOL	Device is configured and exchanging data. (0:Not Exchanging, 1:Data Exchange Ok)
PALink01_TMT_A.Status.IdentMismatch	0	BOOL	Actual device Ident does not match that in the configuration. (0:Ok, 1:Ident Mismatch)
PALink01_TMT_A.Status.Disabled	0	BOOL	Device disabled by DeviceEnable bit (0:Enabled, 1:Disabled)
PALink01_TMT_A.Status.ErrorFlag	0	BOOL	Device Error. (0:Ok, 1:Error)
PALink01_TMT_A.Status.AlarmPending	0	BOOL	Device has an Alarm pending. (0:No Alarm, 1:Alarm Pending)
PALink01_TMT_A.Status.DiagnosticsPending	1	BOOL	Device has Diagnostics pending. (0:No Diagnostics, 1:Diagnostics Pending)
PALink01_TMT_A.Status.InputMappingMismatch	0	BOOL	Input Mapping checksum does not match that of the configuration DFB. (0:Ok, 1:Mismatch)
PALink01_TMT_A.Status.InputStationMismatch	0	BOOL	Input Station Address does not match that of the configuration DFB. (0:Ok, 1:Mismatch)
PALink01_TMT_A.Status.OutputMappingMismatch	0	BOOL	Output Mapping checksum does not match that of the PALink configuration. (0:Ok, 1:Mismatch)
PALink01_TMT_A.Status.OutputStationMismatch	0	BOOL	Output Station Address does not match that of the PALink configuration. (0:Ok, 1:Mismatch)
PALink01_TMT_A.Status.PADataPending	0	BOOL	Device has not received first Profibus cyclic data since RUN. (0:Data Ok, 1:Data Pending)
PALink01_TMT_A.Status.StationNumber	2	BYTE	Device Profibus Station Address.
PALink01_TMT_A.Control		T_PAL_DeviceControl	Device Control
PALink01_TMT_A.Input		T_PALink01_1523_2473_In	Device Input Data
PALink01_TMT_A.Input.TempPV	80.3049	REAL	
PALink01_TMT_A.Input.TempStatus	142	BYTE	
PALink01_TMT_A.Output		T_PALink01_1523_2473_...	Device Output Data
PALink01_TMT_A.Output.DisplayPV	0.0	REAL	
PALink01_TMT_A.Output.DisplayStatus	0	BYTE	

Figure 4.6 – M580 Slave Device-Specific tag

The function of each tag is described in the previous section.

4.3. MODBUS OPERATION

When the PA Link has been setup for Modbus communication it will exchange data with a remote Modbus device. Depending on the Primary Interface selection, the PA Link will either function as a Modbus Master or Modbus Slave.

NOTE: When configured as a Modbus Slave the Modbus Master device will need to read and write all required data from the configured Modbus address ranges. When configured as a Modbus Master the PA Link will automatically update the required Modbus registers in the configured remote target.

4.3.1. PROFIBUS PA

Once the PA Link and Modbus Master have been correctly configured, the PA Link will start exchanging data with PROFIBUS slave devices. The user will need to set the PROFIBUS Operating mode from the relevant Modbus Mapping Register.

MASTER AND SLAVE DEVICE STATUS

The Master Control command is set in Holding (HR) registers starting at the **Master Control HR Offset.**

HR Offset	Description
Master Control Command	
0	0 - Set PROFIBUS OFFLINE 1 - Set PROFIBUS STOP 2 - Set PROFIBUS CLEAR 3 - Set PROFIBUS OPERATIONAL

Table 4.37 – Modbus Master Control

The Master and Slave Status is populated in Coil (CS) or Holding (HR) registers starting at the ***Status Register*** offset**.**

CS Offset	HR Offset	Description
Master Status		
0	0.0	Configuration Valid
1	0.1	Owned
2	0.2	Duplicate DP Station
3	0.3	PROFIBUS Fieldbus Error
4	0.4	PROFIBUS Device Error
5	0.5	PROFIBUS OFFLINE
6	0.6	PROFIBUS STOPPED
7	0.7	PROFIBUS CLEAR
8	0.8	PROFIBUS OPERATIONAL
15	0.15	Power Conditioner Active
16	1.1	Terminator Active
17	1.2	Port Tripped
18	1.3	Port Protection
32 - 158	2	Live List Flags (Station Address 0 - 126)
160 - 286	10	Data Exchange Flags (Station Address 0 - 126)
288 - 414	18	Alarm Pending Flags (Station Address 0 - 126)
416 - 542	26	Diagnostic Pending Flags (Station Address 0 - 126)
Slave Device Status		

544 + (16 x [Station Address])	34 + (1 x [Station Address]).0	Online
545 + (16 x [Station Address])	34 + (1 x [Station Address]).1	Data Exchange Active
546 + (16 x [Station Address])	34 + (1 x [Station Address]).2	Ident Mismatch
547 + (16 x [Station Address])	34 + (1 x [Station Address]).3	Disabled by Output Assembly
548 + (16 x [Station Address])	34 + (1 x [Station Address]).4	Device Error
549 + (16 x [Station Address])	34 + (1 x [Station Address]).5	Alarm Pending
550 + (16 x [Station Address])	34 + (1 x [Station Address]).6	Diagnostics Pending
551 + (16 x [Station Address])	34 + (1 x [Station Address]).7	Output Assembly Station Address Mismatch
552 + (16 x [Station Address])	34 + (1 x [Station Address]).8	Mapping CRC Mismatch

Table 4.38 – Modbus - Master and Device Status

The Slave Device Enable is located in Coil (CS) or Holding (HR) registers starting at the ***Device Control Register*** offset.

CS Offset	HR Offset	Description
Device Enable		
0 + [Station Address]	0 + [Station Address / 16]	Device Enable (Station Address 0 - 126)

Table 4.39 – Modbus - Slave Device Control

NOTE: The when using Modbus HR for the Device Control Register, each bit in the MB Holding Register represents a station address. For example, if a MB Holding Register is used for the Device Control and station address 8 must be enabled, then 0x0100 (bit 8 set) must be written to the Device Control Holding Register with a zero offset. If station address 25 must be enabled, then 0x0200 (bit 9 set) must be written to the Device Control Holding Register with a one offset (bit offset 25).

DPV0 DATA EXCHANGE

The DPV0 data exchange for each slave device is configured in the slot configuration.

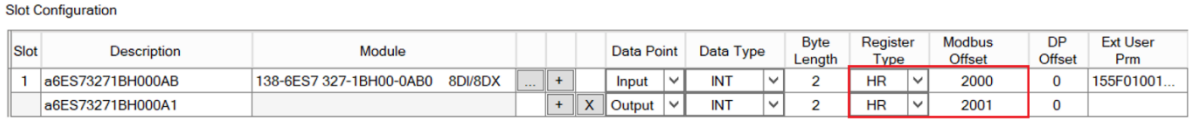


Figure 4.7 – Slave Device Slot configuration – Modbus

DPV1 CLASS 1 MESSAGING (MS1)

The user can exchange DPV1 Class 1 data with a field device using the configured Modbus Registers. The user will need to set the ***DPV1 Message Enable option*** and set the required ***DPV1 Message Register*** in the Modbus addressing tab of the Configuration window (see below).

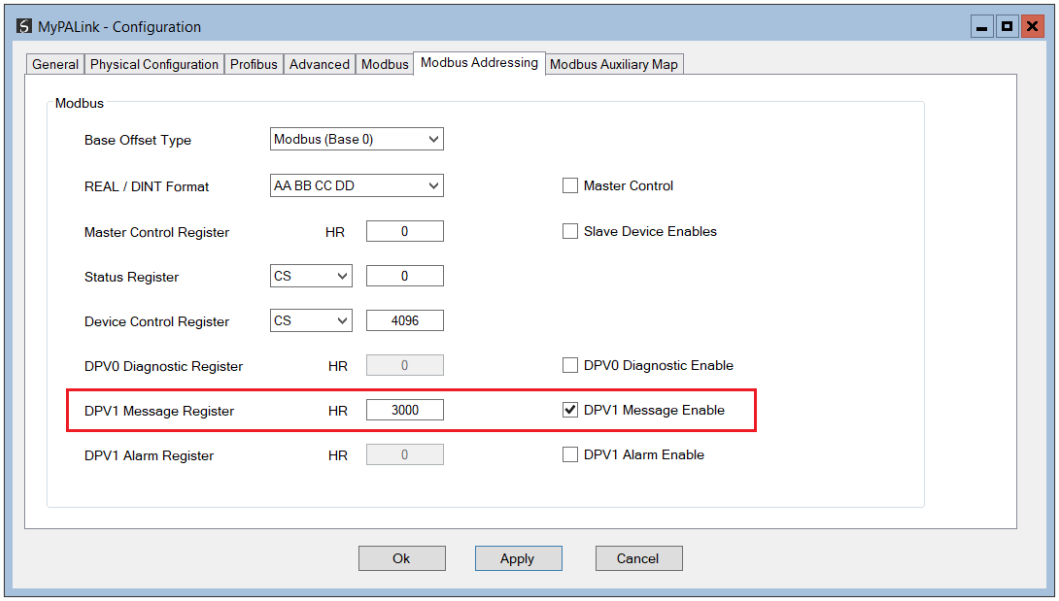


Figure 4.8 – DPV1 Message Holding Register parameters

The user will need to setup the required messaging parameters in the Holding Register fields and then set the trigger bit to enable the DPV1 Message transaction to begin. Once the transaction is complete the response part of the Holding Registers will be updated.

NOTE: The user will need to toggle the trigger Holding Register from 0 to 1 before the transaction will begin. This register is read every 10ms.

Below is the format of the Holding Registers used for DPV1 Class 1 Messaging.

DPV1 Request	Holding Register Offset	Description
Trigger	0	Bit 0 – Trigger Message Send
Timeout	1	The time in Milliseconds if no response has been received before the transaction times out
Slave Address	2	Target PROFIBUS Slave node address
Function	3	0 – Read 1 – Write

Data Size	4	Size of the data to follow
Data	5	Request data (e.g. Slot, Index, Size, and Data)

Table 4.40 – Modbus DPV1 Class 1 Request Message Holding Register Format

DPV1 Response	Holding Register Offset	Description
Response Size	128	Size of all bytes following
Status	129	This is the status of the DPV1 data exchange. See appendix for the definitions of the returned status.
Reserved	130	
Data Size	131	The size of the data to follow.
Data	132	The response data

Table 4.41 – Modbus DPV1 Class 1 Response Message Holding Register Format

PROFIBUS DIAGNOSTICS

The user can extract the PROFIBUS Diagnostics from a field device using the configured Modbus Registers. The user will need to set the ***DPV0 Diagnostic Enable*** and set the required ***DPV0 Diagnostic Register*** offset in the ***Modbus Addressing*** tab of the Configuration window (see below).

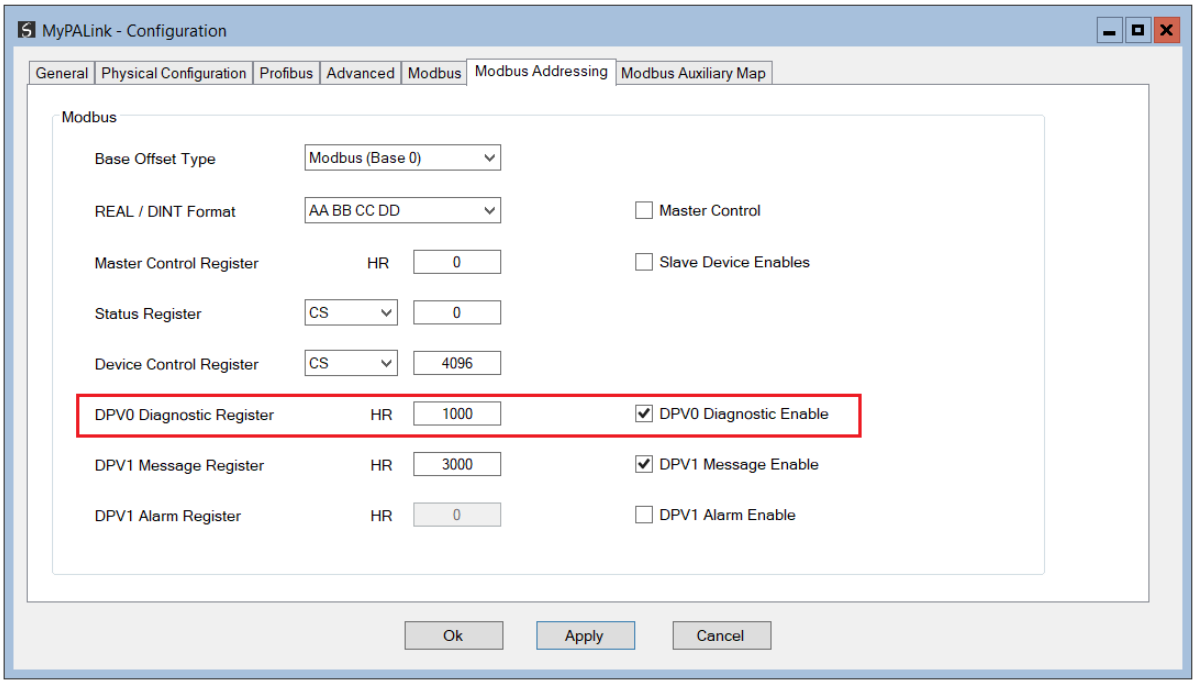


Figure 4.9 – DPV0 Diagnostic Holding Register parameters

The user will need to setup the required messaging parameters in the Holding Register fields and then set the trigger bit to extract the PROFIBUS Diagnostics from a field device. Once the transaction is complete the response part of the Holding Registers will be updated.

NOTE: The user will need to toggle the trigger Holding Register from 0 to 1 before the transaction will begin. This register is read every 10ms.

Below is the format of the Holding Registers used for retrieving DPV0 Diagnostics.

Diagnostic Request	Holding Register Offset	Description
Trigger	0	Bit 0 – Trigger Message Send
Timeout	1	The time in Milliseconds if no response has been received before the transaction times out
Slave Address	2	Target PROFIBUS Slave node address
Mode	3	0 – Read Diagnostic Buffer stored in the PA Link 1 – Read Diagnostic Buffer stored in the PA Link and Clear the Diagnostics Pending bit

Table 4.42 – Modbus DPV0 Diagnostic Request Message Holding Register Format

Diagnostic Response	Holding Register Offset	Description
Status	4	This is the status of the request. See appendix for the definitions of the returned status.
Data Size	5	The size of the diagnostics data to follow.
Data	6	The diagnostics data

Table 4.43 – Modbus DPV0 Diagnostic Response Message Holding Register Format

ALARMING

The user can extract DPV1 Alarm data from a field device using the configured Modbus Registers. The user will need to set the ***DPV1 Alarm Enable*** option and set the required ***DPV1 Alarm Register*** offset in the ***Modbus Addressing*** tab of the Configuration window (see below).

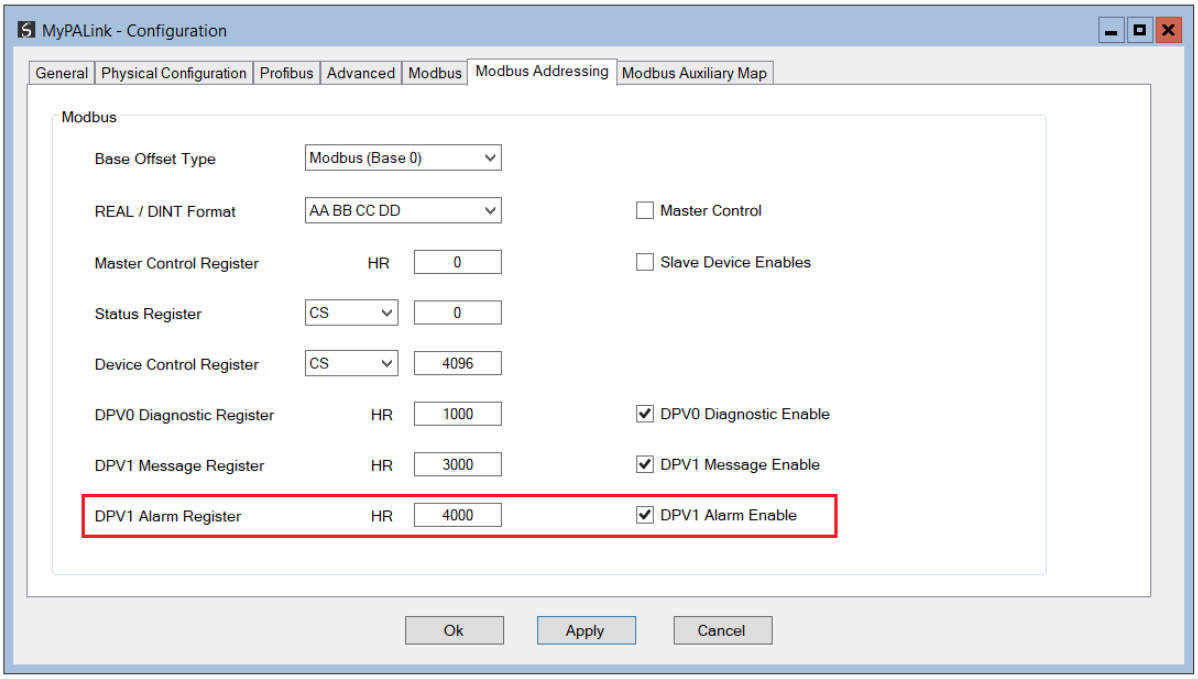


Figure 4.10 – DPV1 Alarm Holding Register parameters

The user will need to setup the required messaging parameters in the Holding Register fields and then set the trigger bit to enable the DPV1 Alarm retrieving to begin. Once the transaction is complete the response part of the Holding Registers will be updated.

NOTE: The user will need to toggle the trigger Holding Register from 0 to 1 before the transaction will begin. This register is read every 10ms.

Below is the format of the Holding Registers used for DPV1 Alarming.

Alarm Request	Holding Register Offset	Description
Trigger	0	Bit 0 – Trigger Message Send
Timeout	1	The time in Milliseconds if no response has been received before the transaction times out
Slave Address	2	Target PROFIBUS Slave node address

Table 4.44 – Modbus DPV1 Alarm Request Message Holding Register Format

Alarm Response	Holding Register Offset	Description
Status	3	This is the status of the DPV1 data exchange. See appendix for the definitions of the returned status.
Alarm Block Size	4	The size of the alarm data to follow.
Alarm Data	5	The retrieved alarm data. Below is the basic structure of the alarm data: **Byte 0 – Alarm Type** 1 – Diagnosis Alarm 2 – Process Alarm 3 – Pull Alarm 4 – Plug Alarm 5 – Status Alarm 6 – Update Alarm **Byte 1 – Slot Number** Range 0 - 254 **Byte 2 - Bit 0 to 1 – Alarm Specifier** 0 – No further differentiation 1 – Fault occurred and slot it not ok 2 – Fault disappeared, and slot is ok 3 – One fault disappeared, and slot is not ok **Byte 2 - Bit 3 to 7 – Sequence Number** Range 1 - 32 **Byte 3 to 59 – Alarm Data Description**

Table 4.45 – Modbus DPV1 Alarm Response Message Holding Register Format

4.4. EXPLICIT MESSAGING UTILITY

Slate provides a utility to initiate explicit messages to the PROFIBUS devices via the PA Link. The messaging options include the following:

- DPV1 Class 1 Read
- DPV1 Class 1 Write
- DPV1 Class 2 Read
- DPV1 Class 2 Write
- Read Diagnostics
- Read Alarms

To open this utility, right-click on a PROFIBUS device and select the ***Explicit Messaging*** option.

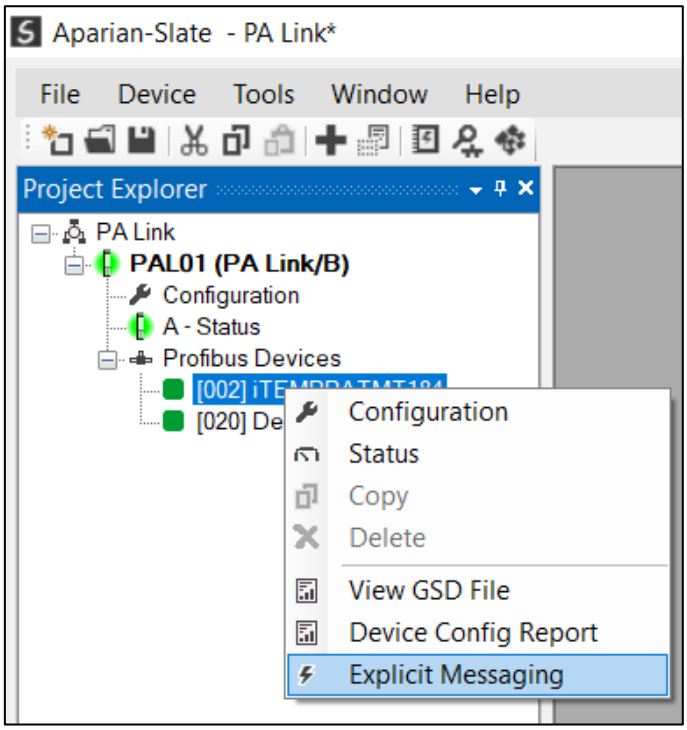


Figure 4.11 – Explicit Messaging Option

Use the ***Action*** combo-box to select the type of explicit message. Depending on the type selected, various other parameter controls will become available. Once the correct parameters have been entered select the ***Execute*** button to initiate the explicit exchange.

NOTE: For Class 2 messages, if a class 2 connection has not already been established, then a Class 2 Initialization message will first be sent. The class 2 connection will then remain open until either the station address is changed, the manual ***Abort*** button is selected, or the utility is closed.

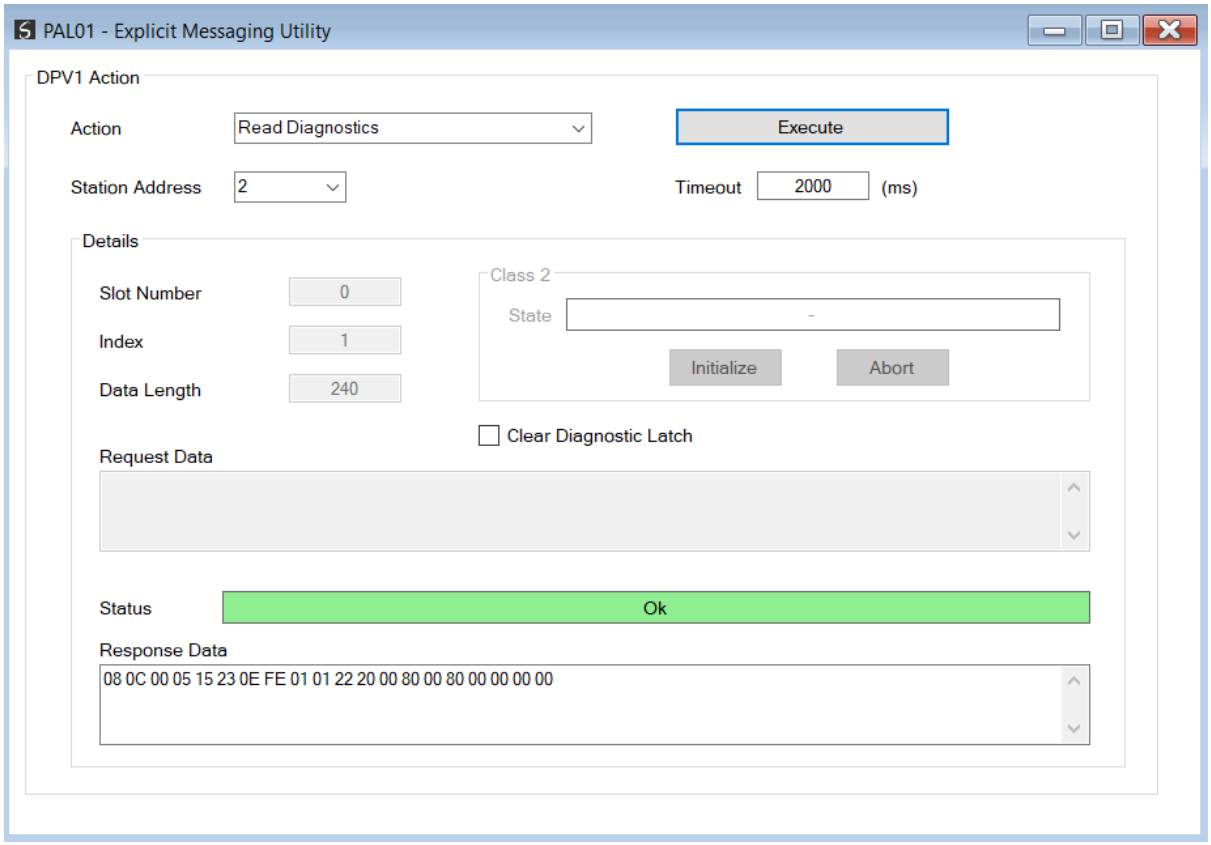


Figure 4.12 – Explicit Messaging Utility

4.5. FIRMWARE UPGRADING

The PA Link will allow the user to upgrade the module firmware in the field. If the firmware needs to be updated the user will need to use Slate to update it.

In Slate go to the ***Tools*** menu and select the ***DeviceFlash*** option.

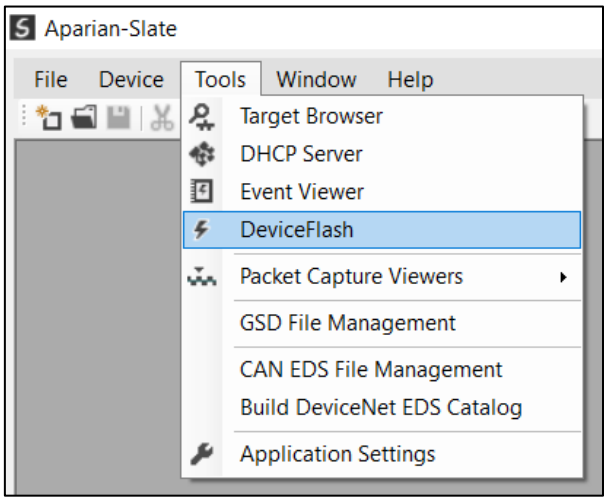


Figure 4.13 - DeviceFlash Tool

The user will need to select the appropriate AFB binary file which will be used to upgrade the PA Link firmware.

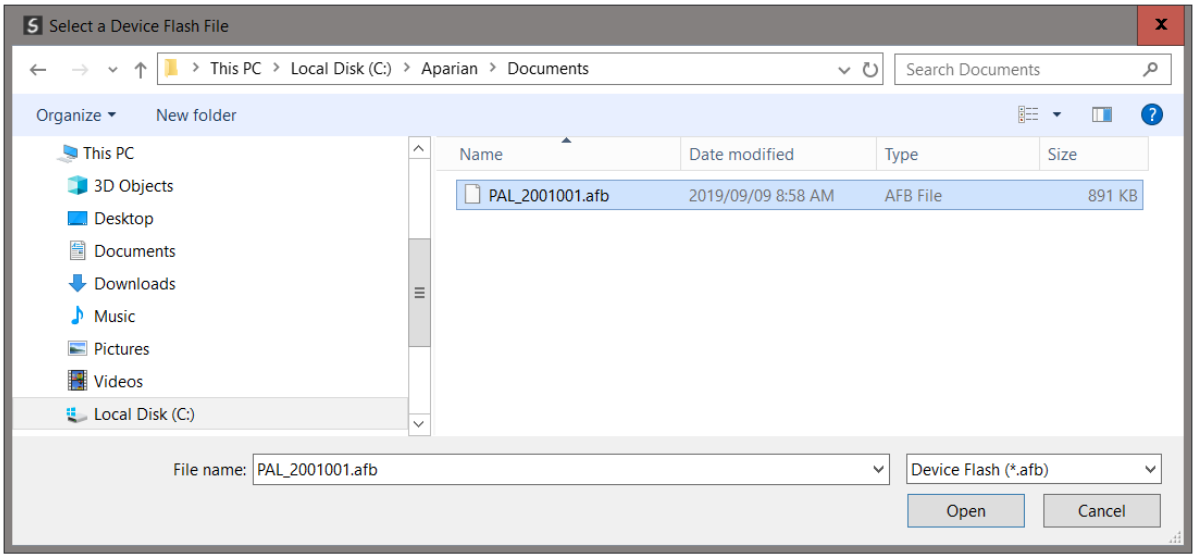


Figure 4.14 - Select the AFB binary

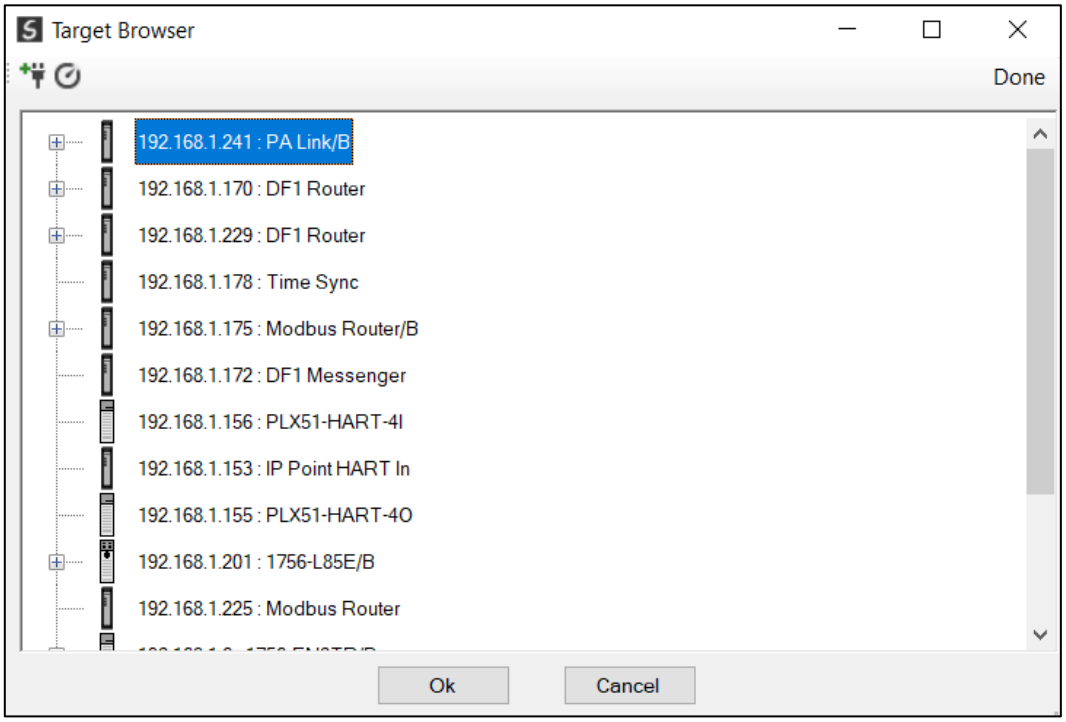


Figure 4.15 - Select the correct PA Link module

Once the module is done upgrading the firmware the Device Flash tool will provide the user with the details of the updated module.

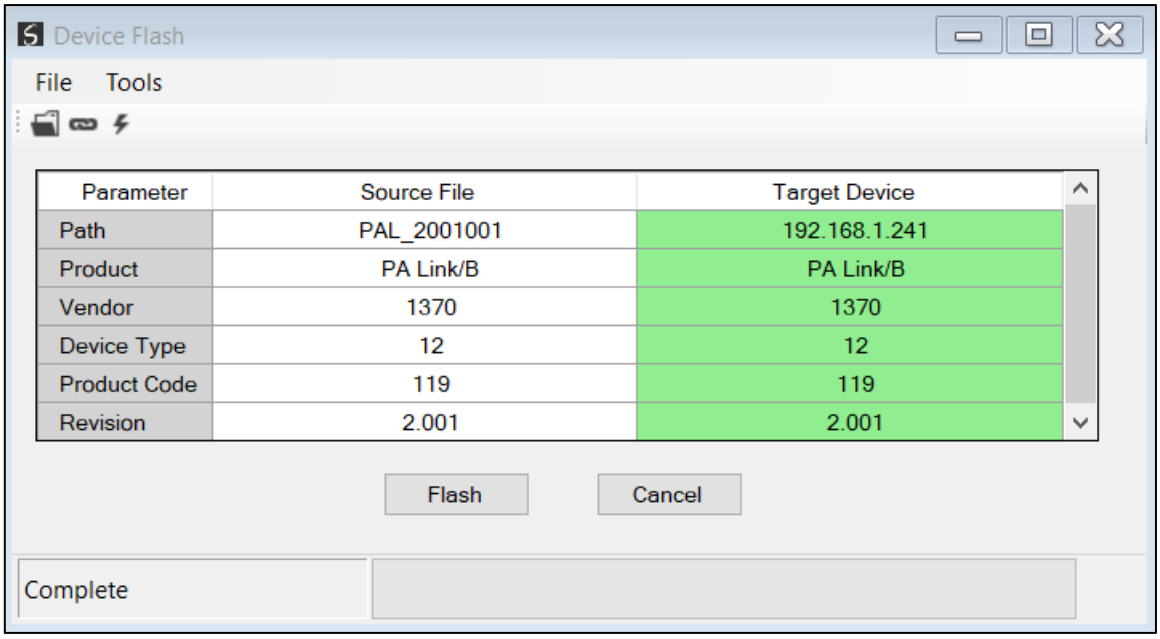


Figure 4.16 – PA Link successfully updated.

NOTE: The PA Link firmware is digitally signed so the user will only be able to flash the PA Link with authorized firmware.

5. PA MASTER REDUNDANCY

The PA Link module supports PA Master redundancy allowing two PA Link modules to be connected to the same PROFIBUS PA segment. The PA Link modules have the same configuration and operate in a one-active-one-standby strategy.

Using PA Link redundancy removes the single point failure associated with:

- Ethernet connection failure
- PA Link power failure
- PROFIBUS PA cable fault (open circuit)

NOTE: The PA Link redundancy functionality is available only when selecting EtherNet/IP as the Primary Interface. It is not available when a Modbus interface is selected.

5.1. REDUNDANCY STRATEGY

The PA Link redundancy strategy is based on two PA Link masters with the identical configuration. One in the ***Active*** state and the other in the ***Standby*** state.

The master selection between which PA Link module ("A" or "B") is the ***Active*** is generally made by redundancy Add-On-Instruction (AOI). However, because the switch-over of the PA Master functionality needs to happen asynchronously to the Logix AOI execution and module RPI, the Standby module will automatically take-over the Master role after it sees no valid traffic on the PA bus for a certain period. This parameter is the ***Profibus Inactive Time*** and is specified in milliseconds.

Once the Logix AOI detects the switch-over it will adjust the master selection to the new Active PA Master. This switch-over (confirmation) needs to occur within the ***Switch Timeout*** parameter to prevent the new Active master reverting to Standby and a disruption to the PA bus.

The necessary Logix code required to manage the redundancy, including the AOI is automatically generated by the Slate configuration software.

5.2. REDUNDANT ARCHITECTURE

The figure below shows a typical redundant PA Link architecture. Both PA Link module are connected to the same PROFIBUS PA segment.

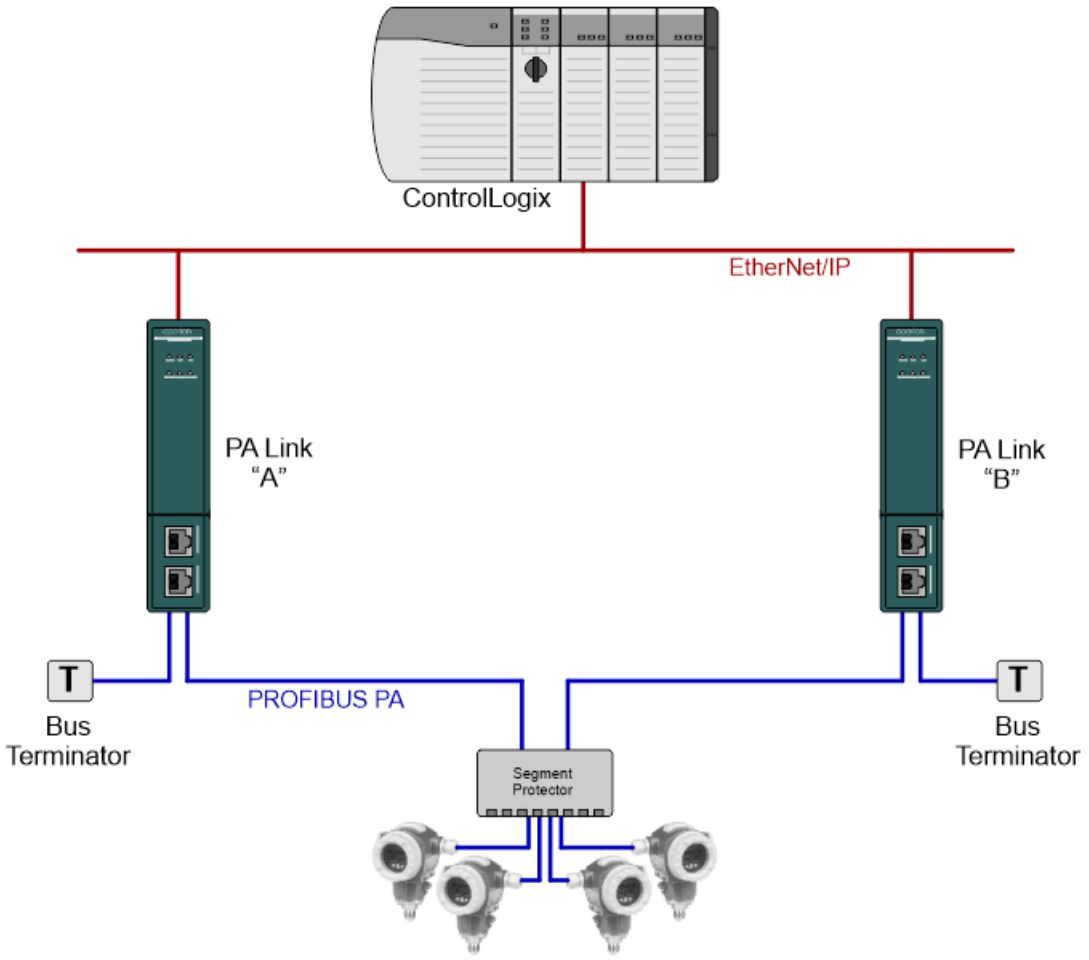


Figure 5.1 - Typical Redundant Architecture

The PA Link modules can be connected to the same Ethernet network and connected to Logix via the same Ethernet bridge module. For added redundancy, it is also possible to connect the PA Link module with separate ControlLogix Ethernet bridge modules using either the same or different physical Ethernet networks.

When using the PA Link's internal power conditioner, the required bus power will be shared by the two PA Link modules when both are powered and available. Should one PA Link module be disconnected or powered down, then the other PA Link module will supply all the required bus power.

NOTE: Although the PA bus power will be shared between the two PA Link modules, the bus current will not be shared equally.

When using PA Link redundancy, it is not recommended to use the internal Bus Terminator functionality, because removing power from one of the modules will reduce the total bus terminators to one making the PROFIBUS PA segment unstable.

It is also recommended that the two PA Link modules are fed from different 24V power supplies, and where possible these power supplies fed from different AC sources.

5.3. PA LINK CONFIGURATION

The configuration of a redundant PA Link is similar to that of a standalone with a few notable exceptions.

5.3.1. GENERAL CONFIGURATION

In the General tab of the PA Link configuration, set the ***Mode*** to ***Redundant Master***. Then configure the IP Addresses of both the PA Link modules "A" and "B".

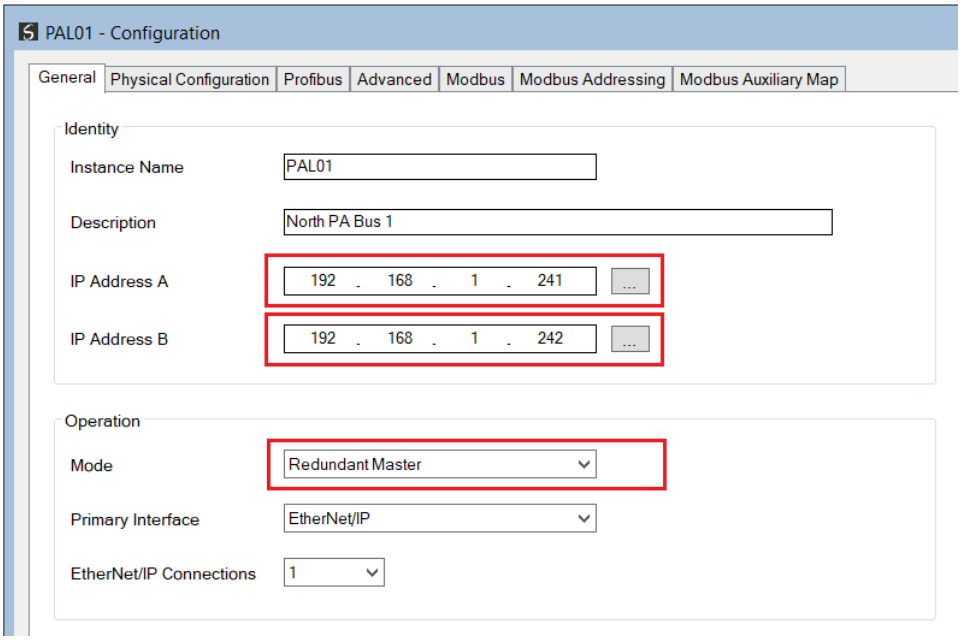


Figure 5.2 – Redundant Configuration - General

5.3.2. PHYSICAL CONFIGURATION

In the Physical Configuration tab, set the ***Profibus Inactive Time*** and ***Switch Timeout*** parameters.

Both these values can be set using the ***Recommend*** button.

The internal ***Bus Termination*** should not be used when using redundancy.

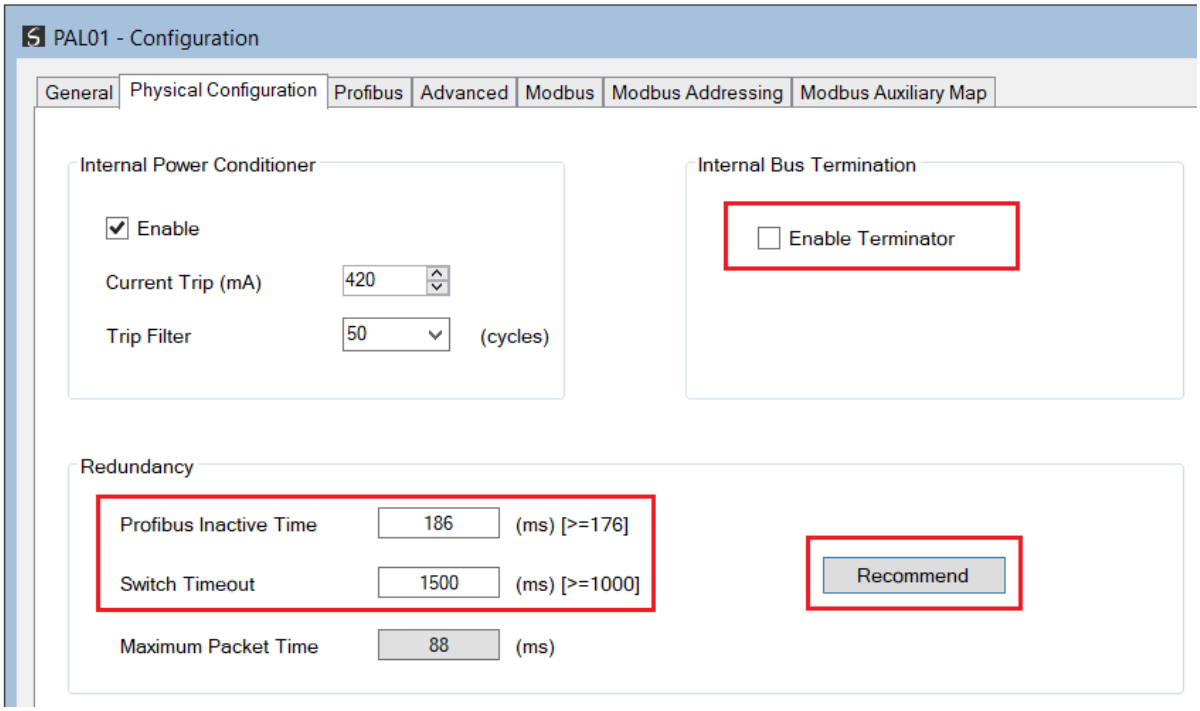


Figure 5.3 – Redundant Configuration - Physical Configuration

PROFIBUS INACTIVE TIME

The ***Profibus Inactive Time*** is used by the Standby Master to determine that there is no longer an Active master on the PA Bus. If no valid packets are received in this time, then a redundancy Switch will be triggered where the previously Standby PA Link will become Active. The parameter is specified in milliseconds.

This ***Profibus Inactive Time*** must be above the maximum PA Packet. The recommended value is 10 ms greater than twice the Maximum Packet Time, i.e.

***Profibus Inactive Time* = 10 + (2 x Maximum Packet Time)**

The ***Maximum Packet Time*** is shown on the configuration form for reference purposes.

NOTE: Failure to configure the ***Profibus Inactive Time*** correctly will result in unexpected behaviour of the PA Master including slave devices disconnecting.

NOTE: The Profibus Inactive Time should be reconfigured after adding or modifying PA slave devices.

NOTE: The user will need to ensure that the ***Watchdog*** timeout for each slave device is at least three times the ***Profibus Inactive Time*** to avoid the Profibus slaves timing out the DPV0 communication.

SWITCH TIMEOUT

The ***Switch Timeout*** is used by the module to override the Active / Standby command from the Logix AOI.

The ***Switch Timeout*** parameter is in milliseconds and should be the greater of 1000ms and 4 x the module RPI.

The minimum value is given as follows:

Switch Timeout = MaxOf(1000, (4 x RPI))

NOTE: The ***Recommend*** button function sets the ***Switch Timeout*** to 1500ms which may be inadequate when using larger RPI values. If the default RPI of 50ms is not used, then this value must be configured manually.

NOTE: Failure to configure the ***Switch Timeout*** correctly will result in unexpected behaviour during a redundancy switch.

5.3.3. PROFIBUS CONFIGURATION

In the Profibus configuration tab, ensure that the Logix Comms Fail parameter is set to Offline.

Failure to do so will cause both Masters to communicate on the PA Bus at the same time causing errors.

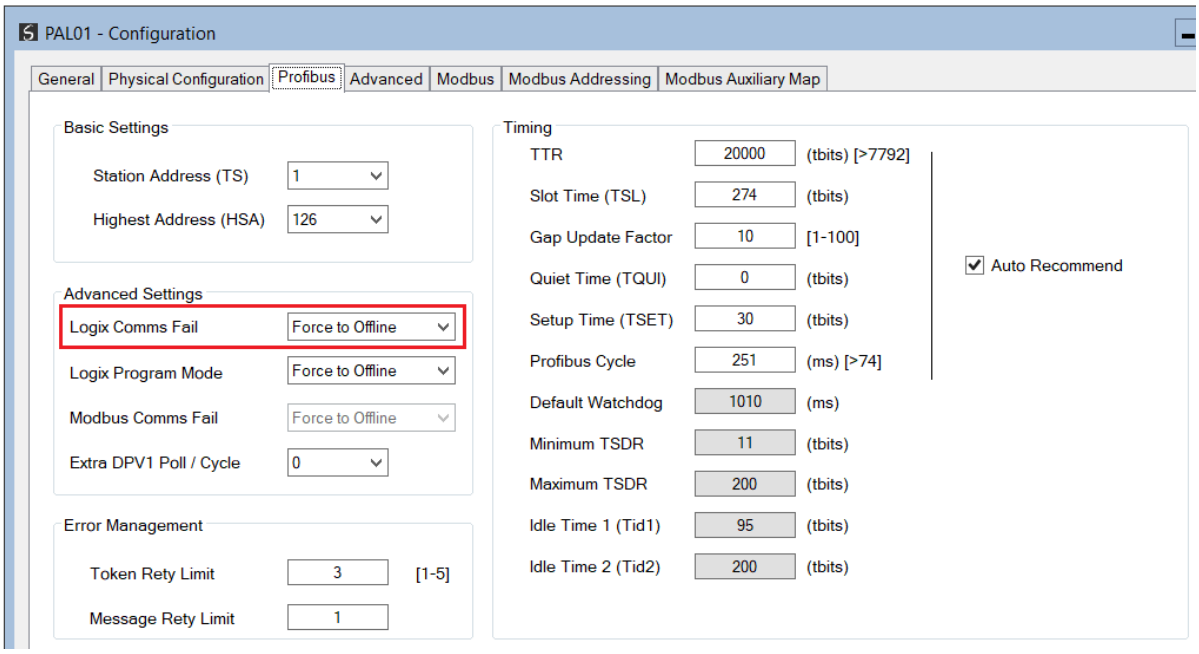


Figure 5.4 – Redundant Configuration - Profibus Configuration

5.4. LOGIX CONFIGURATION

The addition of a redundant PA Link module pair to the Logix IO tree follows the same procedure as a Standalone PA link module, except two instances of the module are added.

It is important to follow the correct naming convention to ensure the Logix code generated by Slate is valid. The “A” module must have the same name as specified in Slate, with an “A” suffix, similarly, the “B” module must have the same name as specified in Slate, with a “B” suffix.

In the example below, the names are as follows:

Slate Module (pair) name: **PAL01**
Logix IO Tree Module A: **PAL01A**
Logix IO Tree Module B: **PAL01B**

Ensure the IP addresses are configured correctly for the A and B modules and that the RPIs for all connections are identical.

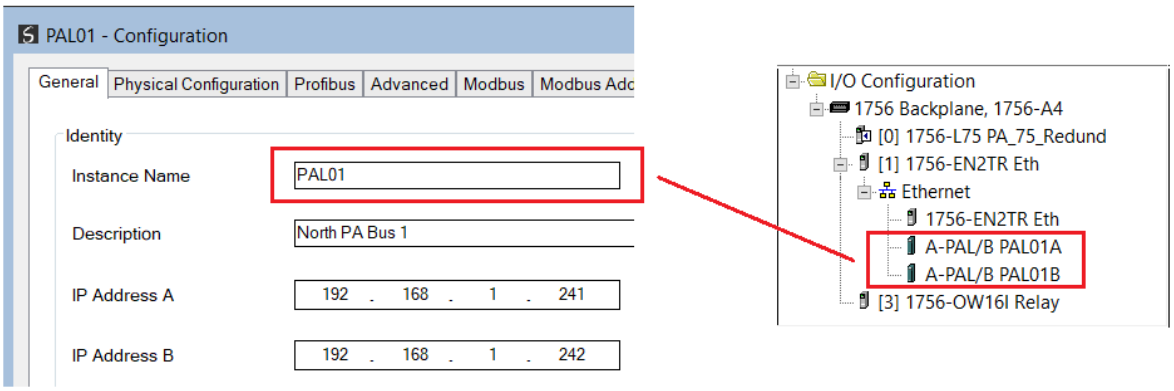


Figure 5.5 – Logix IO Tree – Redundant PA Link pair

After the PA Link modules have been added into the Logix IO tree, the mapping code can be imported. As in the case of the Standalone Master mode, the Logix code can be generated in Slate by right-clicking on the module and selecting the ***Generate Logix L5X*** option.

In addition to the slave device mapping code, the PALinkRedundancyMaster AOI will be instantiated. This AOI is responsible for controlling the redundancy and mapping the first IO connection.

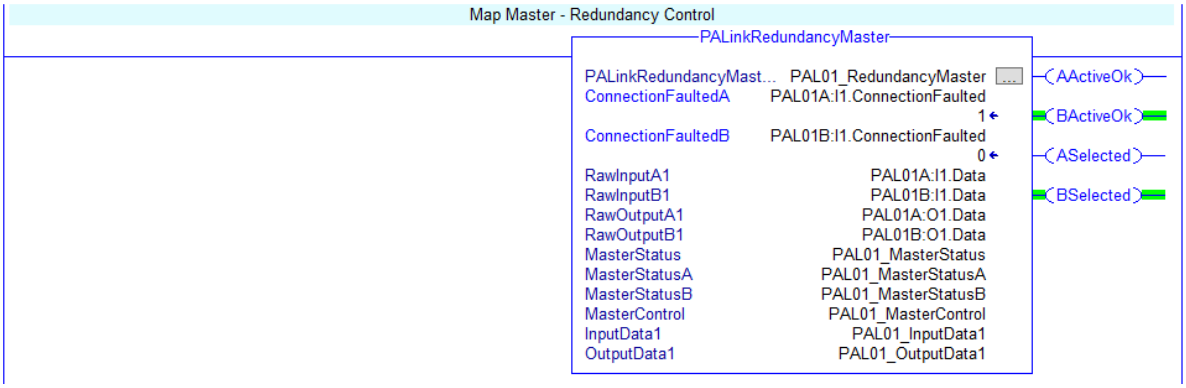


Figure 5.6 – Logix – Redundant Master AOI

If the PA Link configuration is making use of more than one EtherNet/IP Class 1 connection, then a ***PALinkRedundancyConnectionMap*** AOI will be instantiated for each additional class 1 connection.

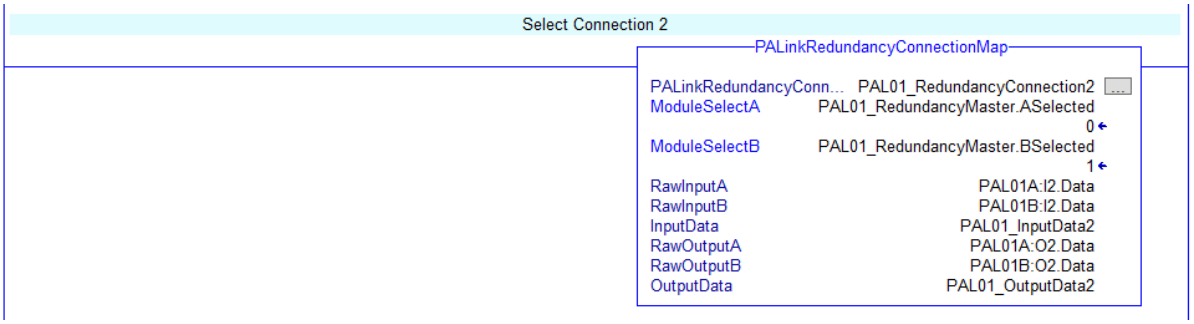


Figure 5.7 – Logix – Redundant Connection Map AOI

5.5. OPERATION

The operation of the PA Link module in redundancy mode is similar to that in standalone mode.

Once the Slate configuration has been finalised, it can be downloaded to the PA Link module pair. Before downloading it is important to confirm the connection paths to the two modules by right-clicking on the module pair a selecting Connection Path.

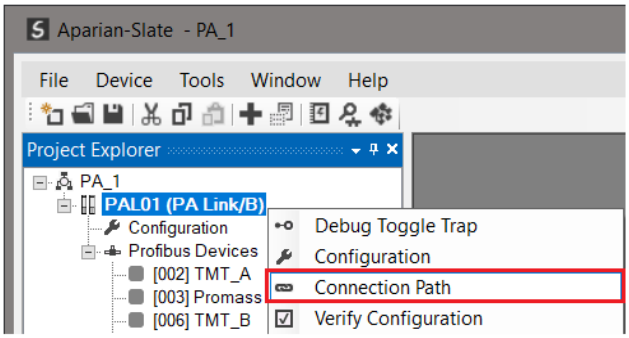


Figure 5.8 – Select Connection Path

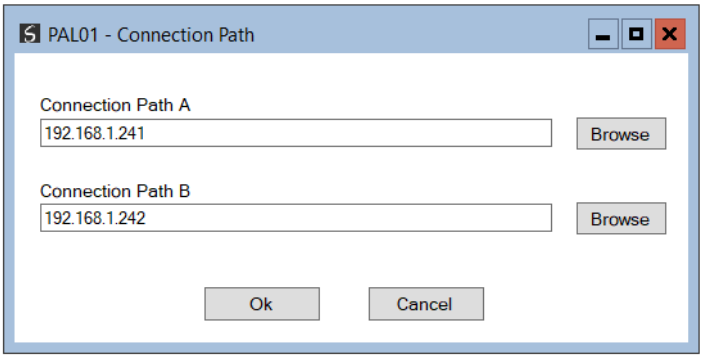


Figure 5.9 –Connection Path

The ***Download to Both*** option can then be selected, which will transfer the configuration to both the "A" and "B" PA Link modules.

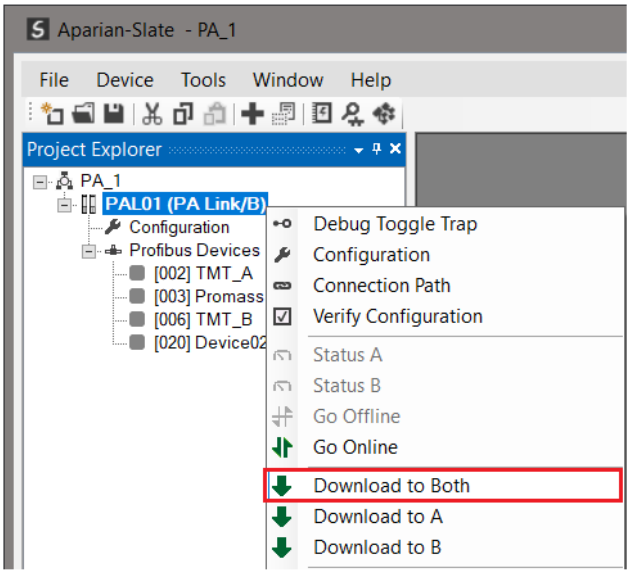


Figure 5.10 – Download to Both

6. DEVICE TYPE MANAGER (DTM)

The PA Link supports FDT / DTM technology, allowing the user to configure any slave device using its DTM (Device Type Manager) in any standard FDT Frame (Field Device Tool). To use a device DTM with the PA Link, the Aparian DTM pack must first be installed.

6.1. INSTALLATION

Installation of the Aparian DTM pack is achieved by executing the following installer:
Aparian DTM Pack 1.005 Setup.msi

The installation wizard will guide the user through the installation process.

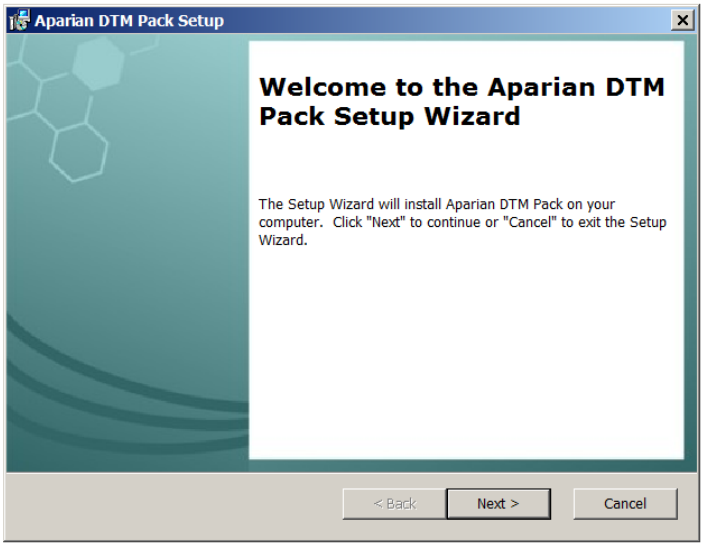


Figure 6.1 – Aparian DTM Pack Installation

6.2. CONFIGURATION

Once the DTM pack is installed, the selected FDT Frame would need to have its DTM Catalogue updated. The steps required for this action are slightly different for each FDT frame. Typically, one selects the ***DTM Catalogue*** or ***Device Catalogue*** and select ***Refresh*** or ***Rebuild***.

The PA Link provides two DTM options:

- **PA Link** (Direct) – Includes a built-in CommDTM with direct EtherNet/IP communication
- **PA Link-FT** – Requires the FactoryTalk Linx CommDTM (Rockwell Automation)

After the catalogue has been updated, then a new project can be created using either one of the PA Link DTMs.

With the exception of the initial instantiation, the **PA Link (Direct)** DTM and **PA Link-FT** DTM operate in an identical manner.

6.2.1. CONFIGURATION – PA LINK (DIRECT) DTM

To use the **PA Link (Direct)** DTM in a new project, select the ***Add Device*** function and then select the ***PA Link*** DTM. The example below makes use of PACTware FDT frame.

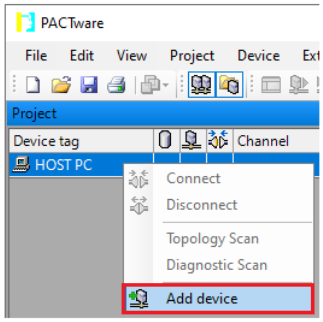


Figure 6.2 – Adding new device

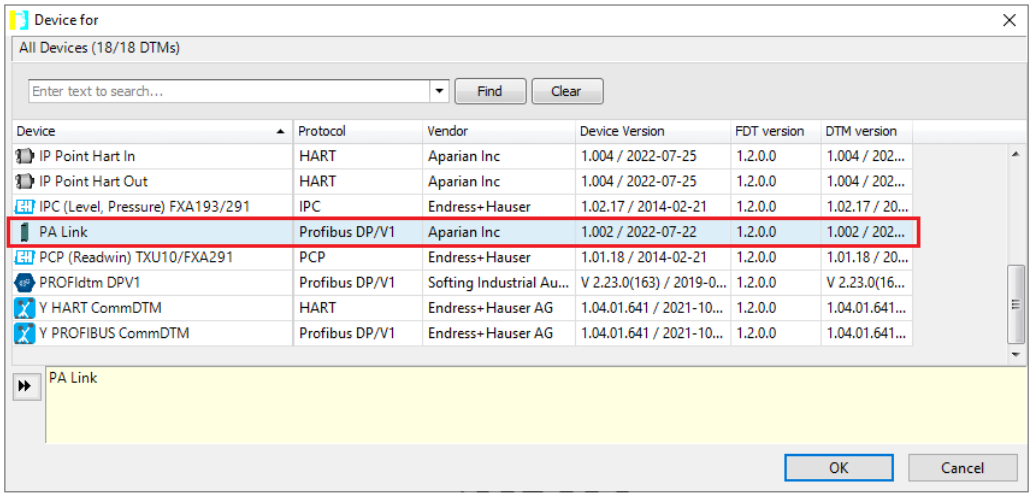


Figure 6.3 – Selecting PA Link DTM

After instantiating the PA Link DTM, select the ***Parameter*** option.

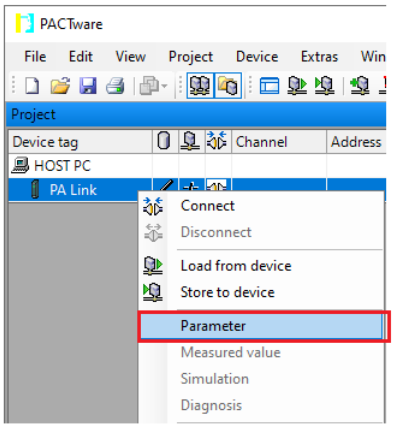


Figure 6.4 – Select Parameter option

The PA Link DTM's configuration allows the ***CIP Path*** to the PA Link to be configured. This is typically the IP address of the PA Link, but can include a more complex CIP path when, for example, routing through a ControlLogix chassis is required.

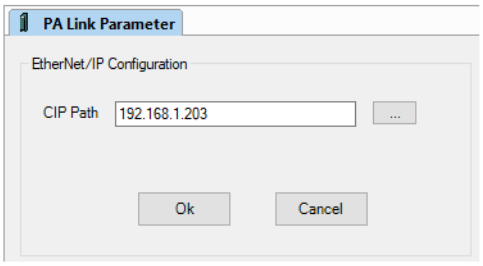


Figure 6.5 – PA Link CIP Path

The path can either be entered manually or the ***Browse*** "…" button can be used to open the ***Target Browser***, and then the PA Link can be selected.

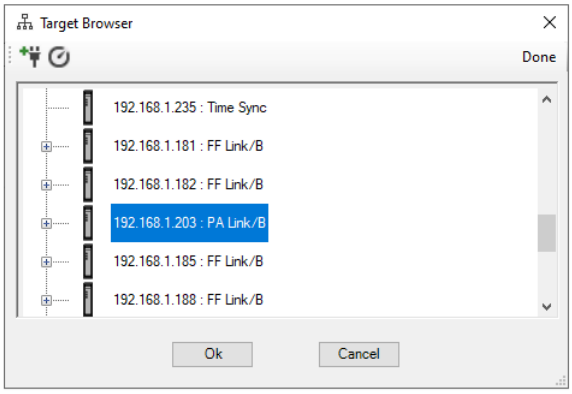


Figure 6.6 – Target Browser

The PA Link DTM is now ready to have device DTMs added under it.

6.2.2. CONFIGURATION – PA LINK-FT DTM

To use the PA Link-FT DTM in a new project, the Rockwell Automation **FactoryTalk Linx CommDTM** must first be instantiated. To do this select the ***Add Device*** function and then select the ***FactoryTalk Linx CommDTM*.**

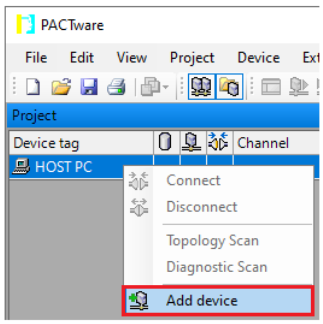


Figure 6.7 – Adding new device

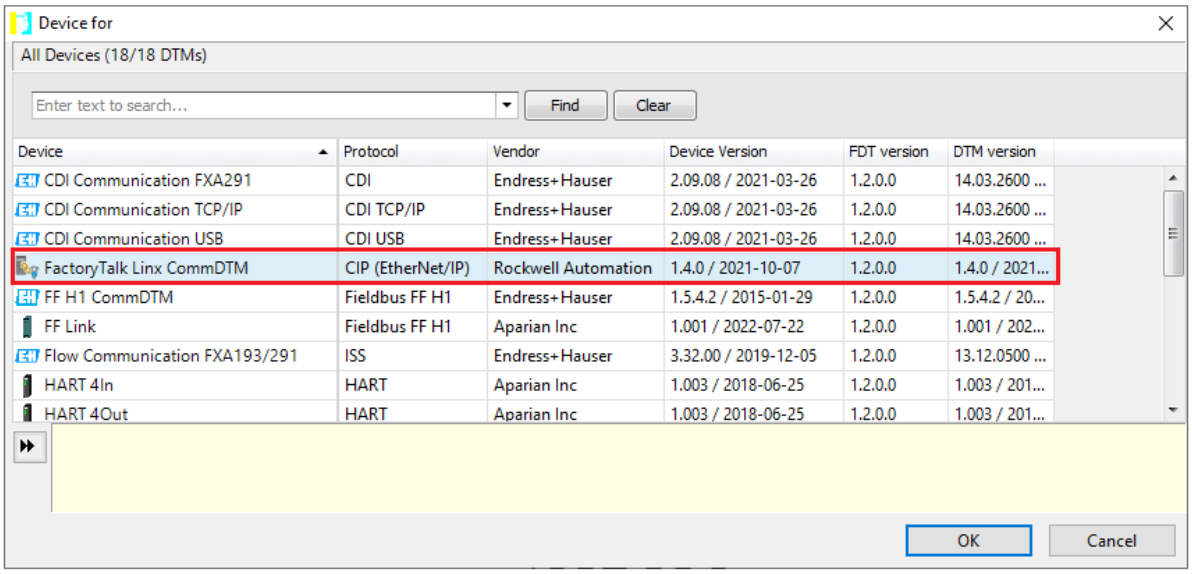


Figure 6.8 – Selecting FactoryTalk Linx CommDTM

Once added, right-click on the **FactoryTalk Linx CommDTM** and again select the ***Add Device*** option.

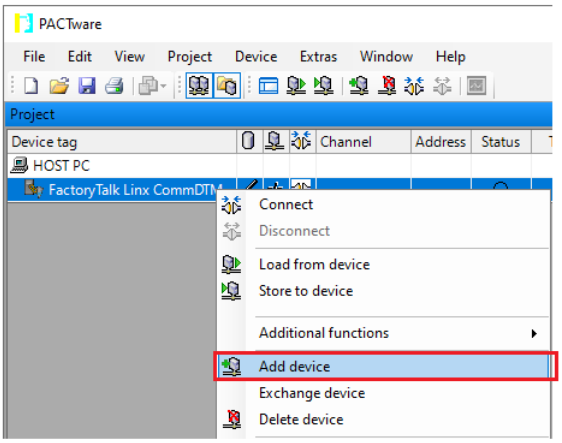


Figure 6.9 – Adding new device under FT Linx CommDTM

Then select the ***PA Link-FT*** DTM.

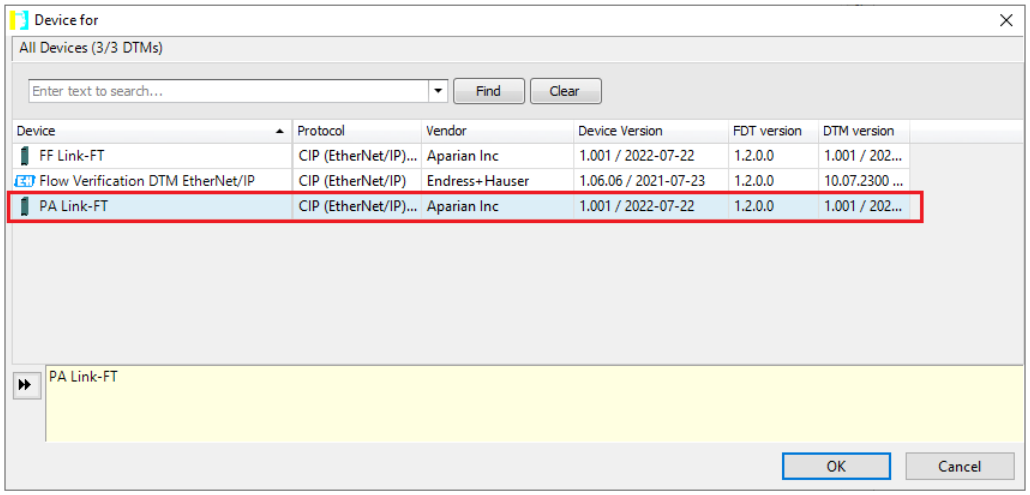


Figure 6.10 – Select PA Link-FT DTM

Once the DTM has been selected, the (FTLinx) Path to the PA Link device will need to be entered.

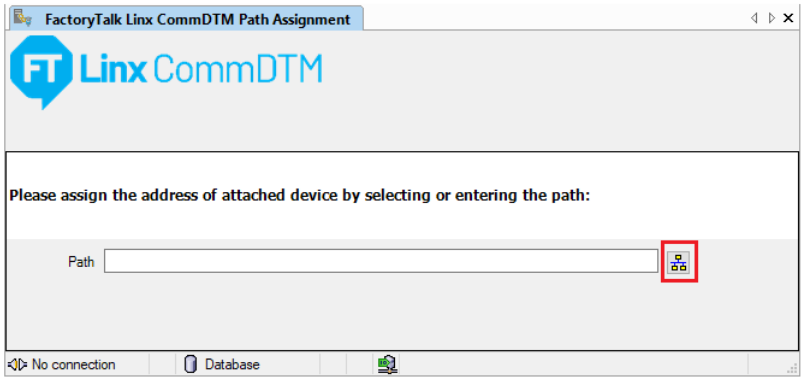


Figure 6.11 – Select FT Linx CommDTM - Path

Select the **RSWho Browse** button located to the right of the **Path**.

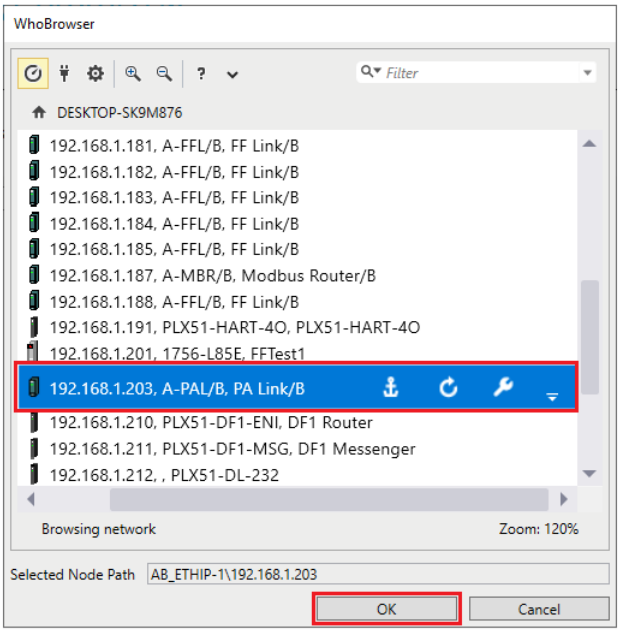


Figure 6.12 – FT Linx WhoBrowser

Select the ***PA Link*** in the WhoBrowser and click on the ***Ok*** button.

The PA Link-FT DTM is now ready to have device DTMs added under it.

6.2.3. Adding Device DTMs

After either the **PA Link (Direct)** DTM or **PA Link-FT** DTM has been configured, the child Device DTMs can be added by right-clicking on the PA Link (or PA Link-FT) DTM and selecting ***Add Device***.

The user can then select the matching device DTM.

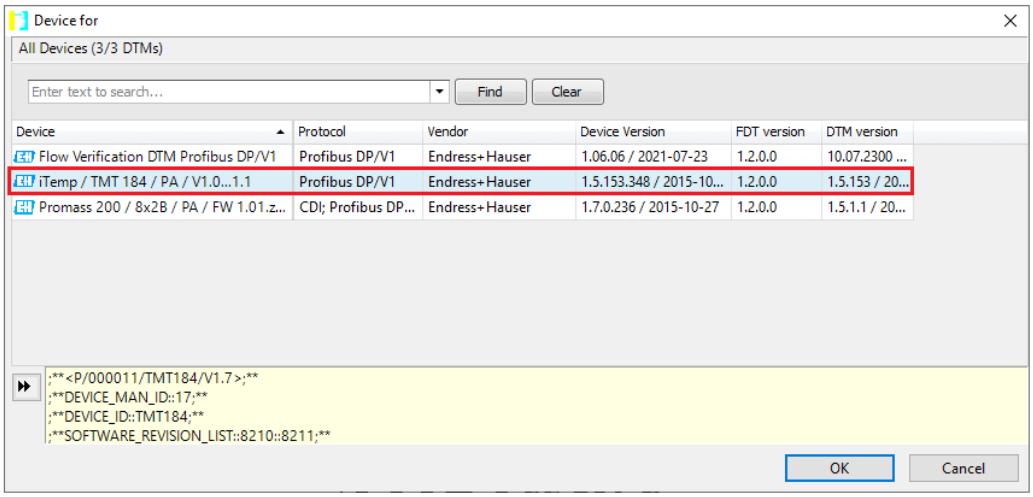


Figure 6.13 – Device DTM Selection

Once the child Device DTM has been added, a configuration window opens to set the ***Node Address***.

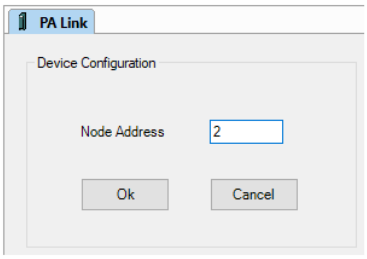


Figure 6.14 – Device DTM Node Address

6.3. OPERATION

After the FDT project has been configured, the DTMs can be placed online by selecting the ***Online*** or ***Connect*** option.

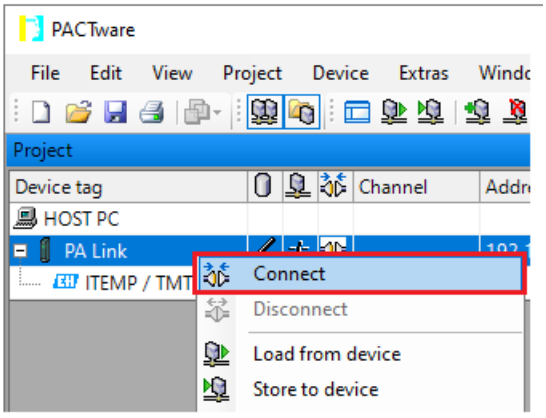


Figure 6.15 – DTM Connect

Once the **PA Link (Direct)** DTM or **PA Link-FT** DTM is online (connected) a number of diagnostic pages can be opened by selecting the ***Measured Value*** option.

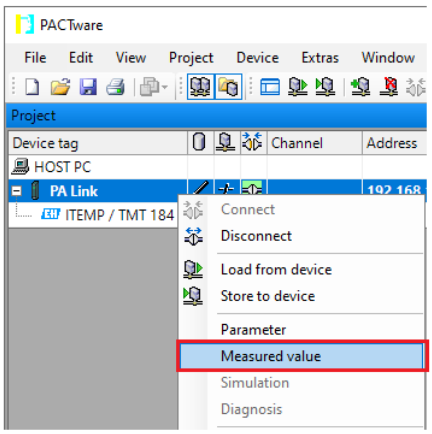


Figure 6.16 – Select Measured Value

The General page provides basic status information for the PA Link module.

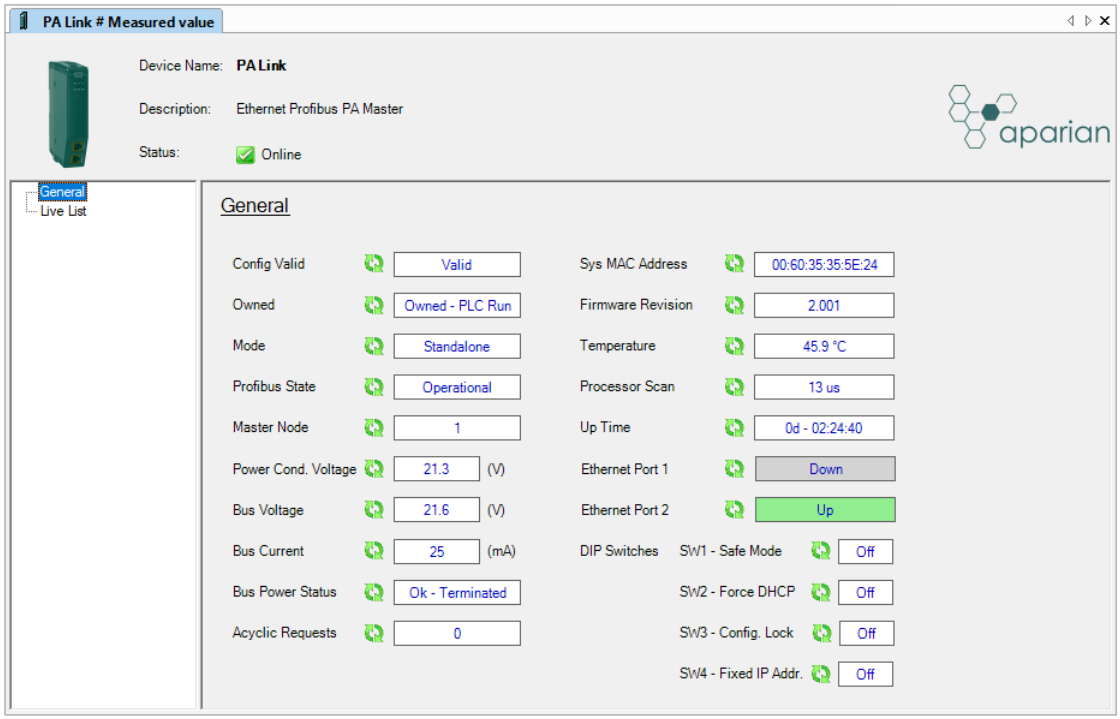


Figure 6.17 – PA Link DTM - General Status Page

The Live List page shows the state of the devices on the PROFIBUS network.

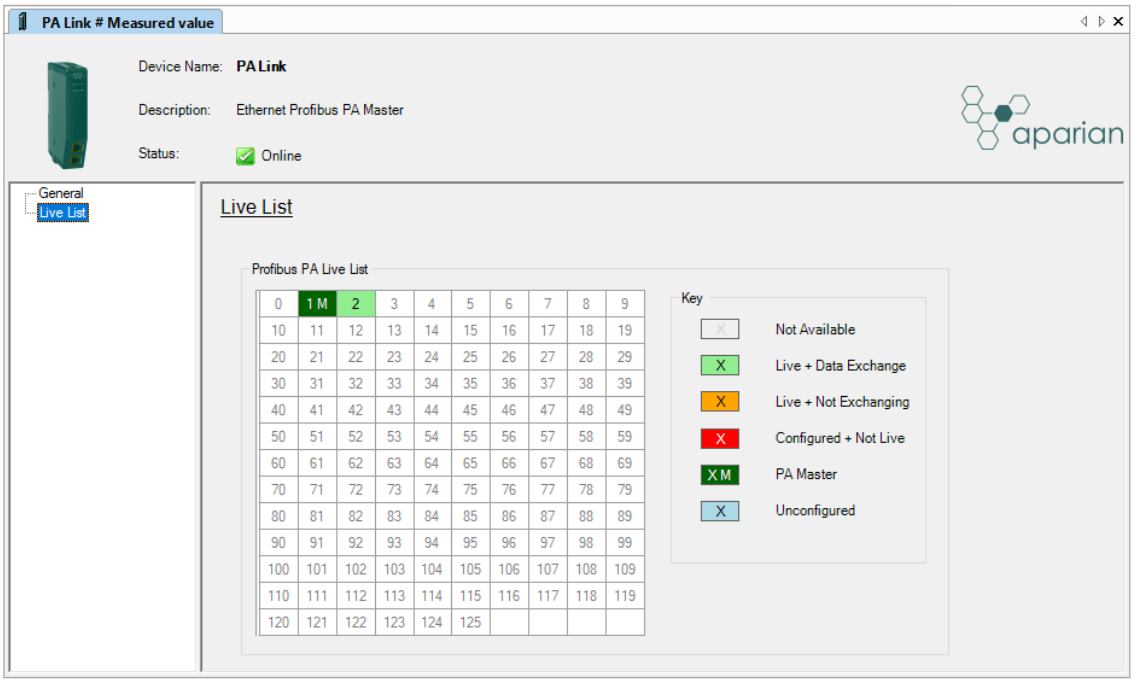


Figure 6.18 – PA Link DTM - Live List Page

A field Device DTM under the PA Link DTM can also be brought online by selecting the ***Online*** or ***Connect*** option.

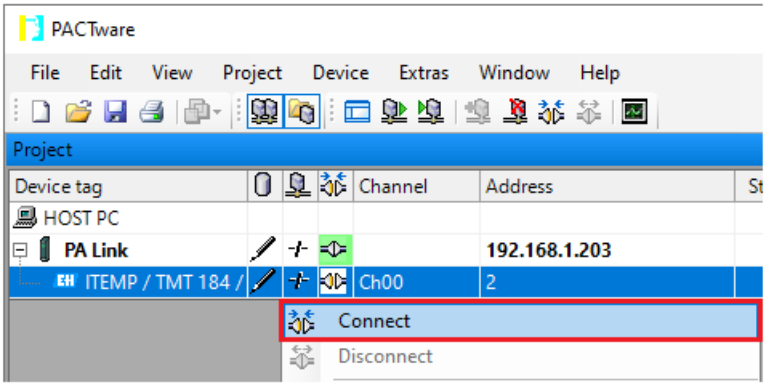


Figure 6.19 – Field Device DTM Connect

Depending on the device DTM, a number of function windows, for example, online parameters, diagnostics and measure variables, can be displayed.

These are accessed by right-clicking on the device DTM and selecting the required function.

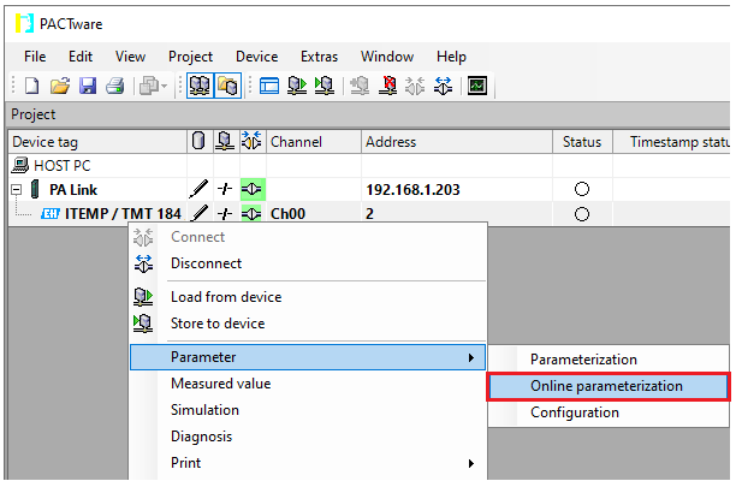


Figure 6.20 – Device DTM - Selecting Online Parameterization

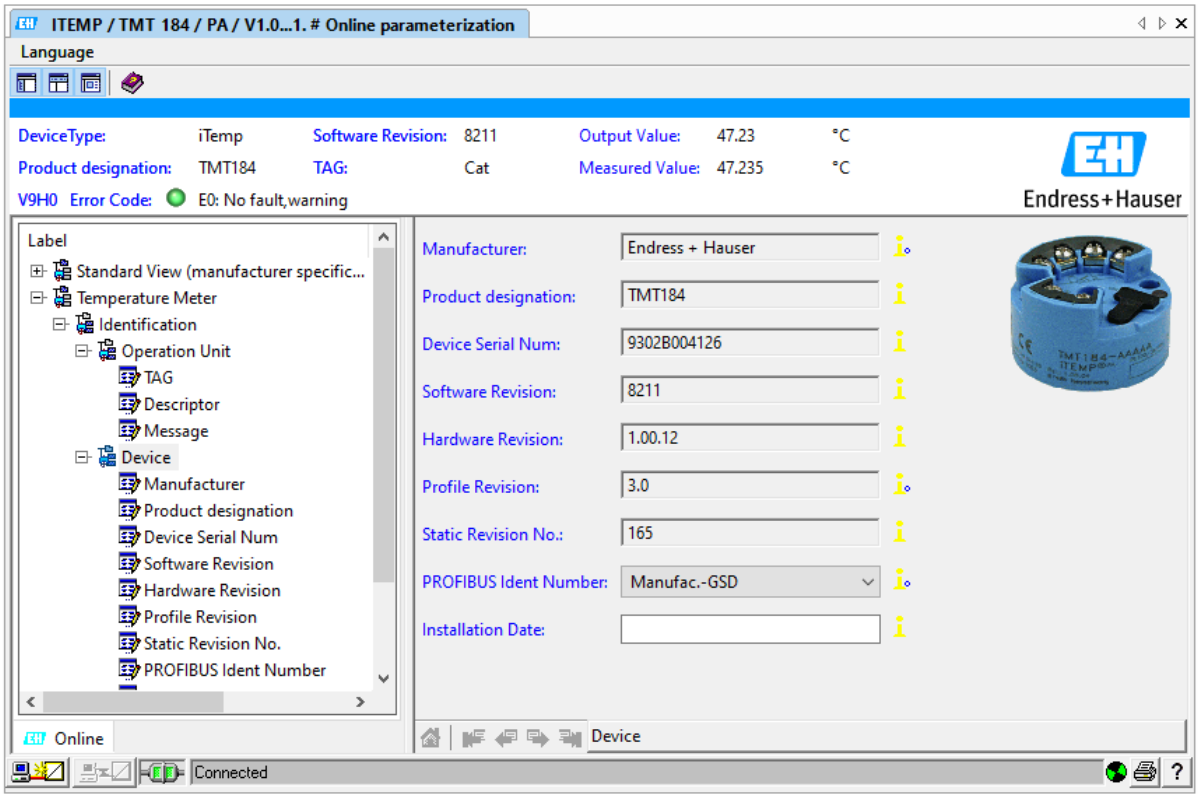


Figure 6.21 – Device DTM - Online Parameterization

7. DIAGNOSTICS

7.1. LEDS

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

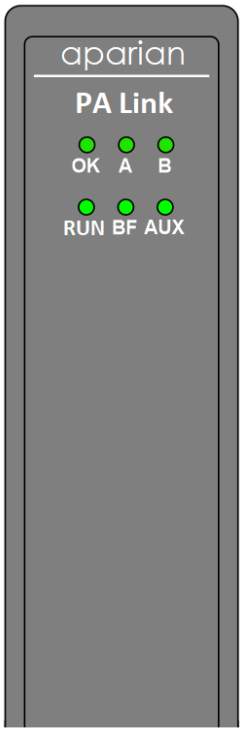


Figure 7.1 - PA Link LEDs

LED	Description
Ok	The module LED will provide information regarding the system-level operation of the module. If the LED is red, then the module is not operating correctly. For example, if the module application firmware has been corrupted or there is a hardware fault the module will have a red Module LED. If the LED is green (flashing), then the module has booted and is running correctly **without** any application configuration loaded. If the LED is green (solid), then the module has booted and is running correctly **with** application configuration loaded.
A / B	The Ethernet LED will light up when an Ethernet link has been detected (by plugging in a connected Ethernet cable). The LED will flash every time traffic was detected. This module has two Ethernet ports A and B. Each LEDs represents each specific port.

Run	This LED will indicate the PROFIBUS **operating mode**. Solid Red – The PROFIBUS network is in STOP mode. Flashing Green – The PROFIBUS network is in CLEAR mode. Solid Green – The PROFIBUS network is in OPERATE mode. Off - The PROFIBUS network is OFFLINE.
BF	This LED indicates the **status** of the PROFIBUS network Solid Red – There are bus communication errors Flashing Red – There are field device errors Flashing Green – The module is currently in Standby (redundancy) Off – There are no bus communication or device errors
Aux	The activity LED is used for the activity on the Primary Interface (e.g. EtherNet/IP or Modbus TCP). Thus, every time a valid packet is received from the Primary Interface the LED will toggle green. The LED will toggle red if a corrupted packet was received.

Table 7.1 - Module LED operation

7.2. MODULE STATUS MONITORING

The PA Link provides 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 Slate environment, the PA Link 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.

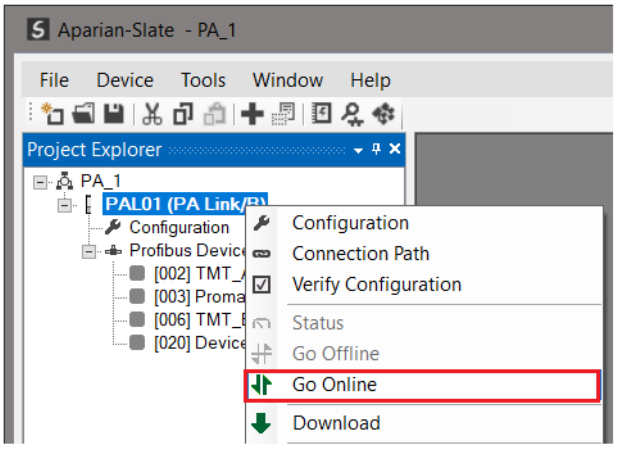


Figure 7.2 - Selecting to Go Online

The Online mode of the module/s is indicated by the icon in the Project Explorer tree.

7.2.1. Project Explorer – Non-Redundant Mode

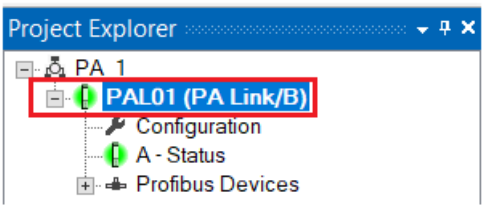


Figure 7.3 - Project Explorer - Non-Redundant

The status of the PA Link module in non-redundant mode is illustrated in the Project Explorer tree as follows:

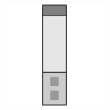
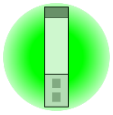
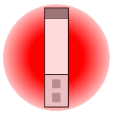
Icon	Description
	Offline
	Online
	Offline – Module was disconnected when previously online.

Table 7.2 – Project Explorer – Non-Redundant

7.2.2. Project Explorer – Redundant Mode

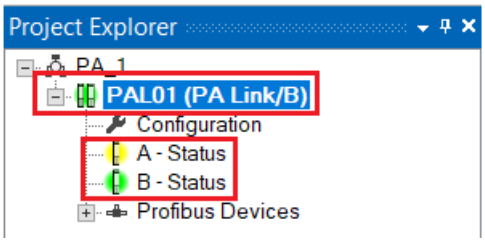


Figure 7.4 - Project Explorer - Non-Redundant

The status of the PA Link module pair in redundant mode is illustrated in the Project Explorer tree as follows:

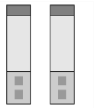
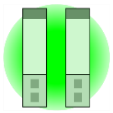
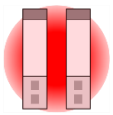
Icon	Description
	Offline
	Online (Both modules connected)
	Online – Partially (Only one of the modules connected)
	Offline – Modules were disconnected when previously online.

Table 7.3 – Project Explorer – Redundant Pair

The status of the individual PA Link modules in redundant mode is illustrated in the Project Explorer tree as follows:

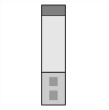
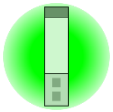
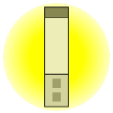
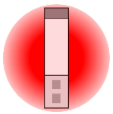
Icon	Description
	Offline
	Online and Active
	Online and Standby
	Offline – Module was disconnected when previously online.

Table 7.4 – Project Explorer – Redundant Module

7.2.3. PA Link Master

The Status monitoring window of the PA Link 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*.

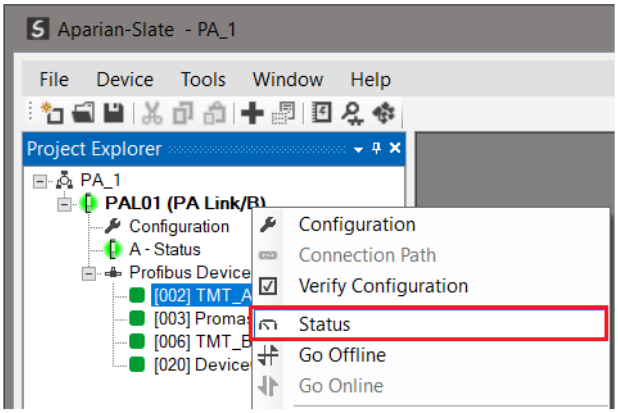


Figure 7.5 - Selecting PA Link online Status

The status window contains multiple tabs to display the current status of the module.

GENERAL

The General tab displays the following general parameters:

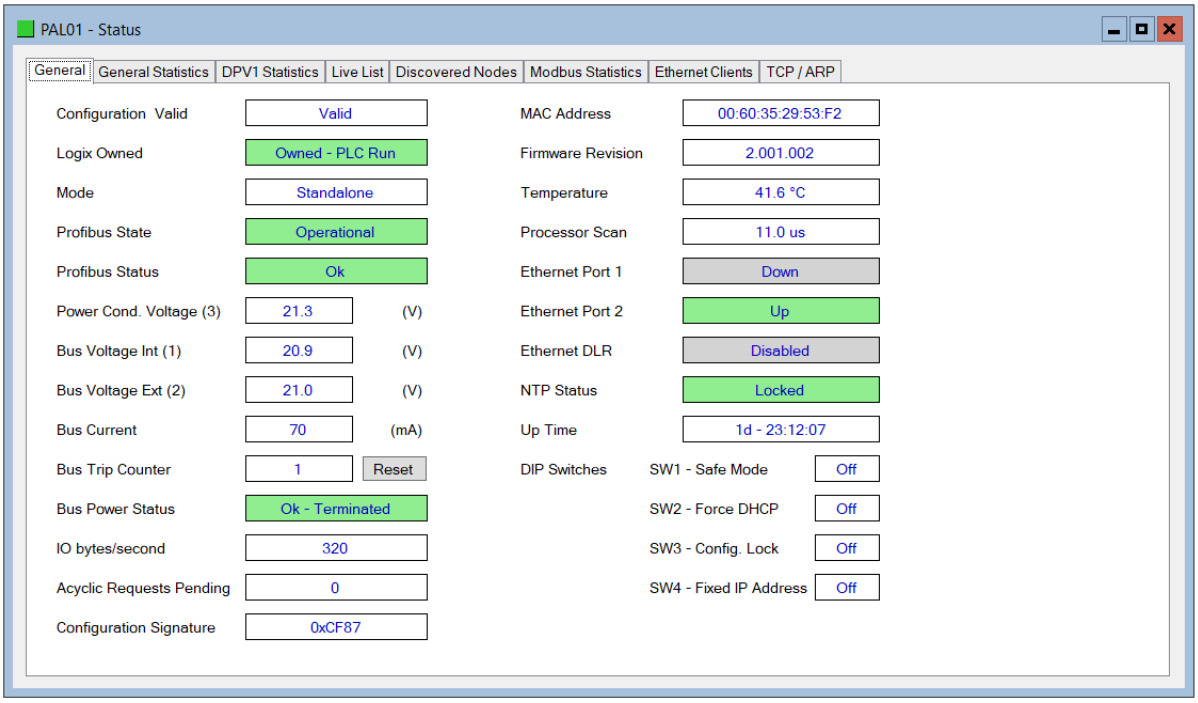


Figure 7.6 – PA Link Status monitoring - General

Parameter	Description
Config Valid	Indicates if the downloaded configuration is valid and executing.
Logix Owned	Indicates whether or not the module is currently owned (Class 1) by a Logix Controller and the current mode of the controller.

	Not Owned No connection from Logix controller **Owned – PLC Prog** Controller connected but not in Run mode **Owned – PLC Run** Controller connected and in Run mode
Mode	This is the mode of operation of the module. The following states can be returned: **Quiet** This mode allows the user to connect the PA Link to an active bus and run a PA packet capture. In this mode the PA Link will not communicate on the PA Bus but rather only listen. **Standalone** In this mode the PA Link is the PA Master on the PROFIBUS network. **Redundant - Active** The module is the **Active** PA Master in a redundant configuration. **Redundant - Standby** The module is the **Standby** PA Master in a redundant configuration.
PROFIBUS State	This is the operational state of the PROFIBUS network. The following states can be returned: **OFFLINE** The PROFIBUS network is offline and the PA Link will not communicate on the network. **STOP** The PROFIBUS network is running and the PA Link is communicating on the network, but it will not exchange any process data with any slave device. **OPERATE** The PROFIBUS network is running and the PA Link is communicating with all slave devices on the network, and if configured in the PA Link, the module will configure and exchange process data with each slave device.

	CLEAR The PROFIBUS network is running and the PA Link is communicating with all slave devices on the network, and if configured in the PA Link, the module will configure and exchange process data with each slave device. **NOTE**: In CLEAR mode the PA Link will not send any output data to any slave device.
Profibus Status	The status of the PROFIBUS network. **OK** No problems on the bus. **Duplicate PA Node** Another device with the same node number has been detected on the bus. **Fieldbus Error** No valid replies are being received on the PA bus. **Device Error** One or more PA devices are not exchanging data.
Power Cond Voltage	The internal isolated Power Conditioner voltage. **NOTE**: This voltage is still active even when the Power Conditioner is disabled.
Bus Voltage Int	The internal Bus Voltage. Measure before the bus protection circuitry.
Bus Voltage Ext	The external Bus Voltage. Measured on the port side of the bus protection circuitry.
Bus Current	The current supplied by the internal power conditioner when enabled. **NOTE**: This current is the sum of the external bus current and the internal PA Link MAU consumption. The latter accounts for 15-20 mA.
Bus Trip Counter	The number of occurrences of the power conditioner being tripped due to the total bus current exceeding the configured setpoint.
IO bytes/second	The number of process variable bytes being exchanged between the PA Link and slave devices per second.
Acyclic Requests Pending	The number of acyclic requests (DPV1 Class 1 and Class 2 requests) pending.
Configuration Signature	The signature of the configuration currently executing on the module.
MAC Address	Displays the module's unique Ethernet MAC address.

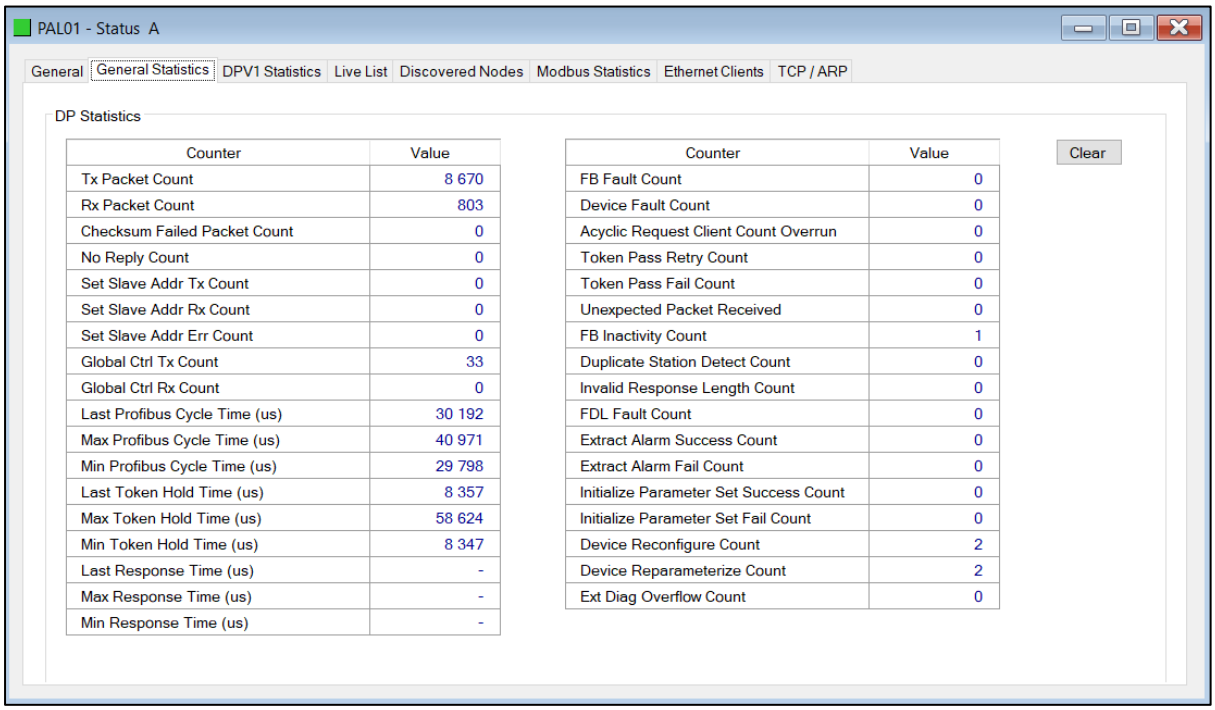
Firmware Revision	The application firmware revision currently executing.
Temperature	The internal temperature of the module.
Processor Scan	The amount of time (microseconds) taken by the module's processor in the last scan.
Ethernet Port 1/2	This is the status of each Ethernet port. **Down** The Ethernet connector has **not been** successfully connected to an Ethernet network. **Up** The Ethernet connector has successfully connected to an Ethernet network. **Mirror Enabled** The Ethernet port is mirroring the traffic on the other Ethernet port.
Ethernet DLR (Device Level Ring)	The status of the Ethernet DLR. **Disabled** Device Level Ring functionality has been disabled. **Linear** The DLR functionality has been enabled and the Ethernet network architecture is linear. **Ring – Fault** The DLR functionality has been enabled and the Ethernet network architecture is ring, but there is a fault with the network. **Ring – Ok** The DLR functionality has been enabled and the Ethernet network architecture is ring and is operating as expected.
NTP Status	The status of the local NTP Client. **Disabled** The NTP time synchronization has been disabled. **Locked** NTP time synchronization has been enabled and the PA Link has locked onto the target time server. **Not Locked** NTP time synchronization has been enabled and the PA Link has not locked onto the target time server.
Up Time	Indicates the elapsed time since the module was powered-up.

DIP Switch Position	The status of the DIP switches when the module booted. SW1 – Safe Mode SW2 – Force DHCP SW3 – Configuration Lock SW4 – Fixed IP Address

Table 7.5 - Parameters displayed in the Status Monitoring – General Tab

GENERAL STATISTICS

The General Statistics tab displays the following general parameters:



Counter	Value
Tx Packet Count	8 670
Rx Packet Count	803
Checksum Failed Packet Count	0
No Reply Count	0
Set Slave Addr Tx Count	0
Set Slave Addr Rx Count	0
Set Slave Addr Err Count	0
Global Ctrl Tx Count	33
Global Ctrl Rx Count	0
Last Profibus Cycle Time (us)	30 192
Max Profibus Cycle Time (us)	40 971
Min Profibus Cycle Time (us)	29 798
Last Token Hold Time (us)	8 357
Max Token Hold Time (us)	58 624
Min Token Hold Time (us)	8 347
Last Response Time (us)	-
Max Response Time (us)	-
Min Response Time (us)	-

Counter	Value
FB Fault Count	0
Device Fault Count	0
Acyclic Request Client Count Overrun	0
Token Pass Retry Count	0
Token Pass Fail Count	0
Unexpected Packet Received	0
FB Inactivity Count	1
Duplicate Station Detect Count	0
Invalid Response Length Count	0
FDL Fault Count	0
Extract Alarm Success Count	0
Extract Alarm Fail Count	0
Initialize Parameter Set Success Count	0
Initialize Parameter Set Fail Count	0
Device Reconfigure Count	2
Device Reparameterize Count	2
Ext Diag Overflow Count	0

Figure 7.7 – PA Link Status monitoring – General Statistics

Parameter	Description
Tx Packet Count	The number of PROFIBUS packets transmitted.
Rx Packet Count	The number of PROFIBUS packets received.
Checksum Failed Packet Count	The number of PROFIBUS packets that had a failed checksum.
No Reply Count	The number of PROFIBUS requests from the PA Link where the station did not respond.
Set Slave Addr Tx Count	The number of PROFIBUS Set Slave Address requests sent from the PA Link.
Set Slave Addr Rx Count	The number of successful PROFIBUS Set Slave Address responses received from the specific slave device.

Set Slave Addr Err Count	The number of failed PROFIBUS Set Slave Address responses received from the specific slave device.
Global Ctrl Tx Count	The number of PROFIBUS Global Control requests sent from the PA Link.
Global Ctrl Rx Count	The number of PROFIBUS Global Control requests received by the PA Link.
Last PROFIBUS Cycle Time	The time (in microseconds) the last PROFIBUS Cycle took to complete.
Max PROFIBUS Cycle Time	The maximum time (in microseconds) the PROFIBUS Cycle took to complete.
Min PROFIBUS Cycle Time	The minimum time (in microseconds) the PROFIBUS Cycle took to complete.
Last Token Hold Time	The time (in microseconds) the PA Link held the token in the last token rotation.
Max Token Hold Time	The maximum time (in microseconds) the PA Link held the token.
Min Token Hold Time	The minimum time (in microseconds) the PA Link held the token.
Last Response Time	In a Multi DP Master system, this is the time it took (in microseconds) to respond to the last token passed from another DP Master.
Max Response Time	In a Multi DP Master system, this is the maximum time it took (in microseconds) to respond to a token passed from another DP Master.
Min Response Time	In a Multi DP Master system, this is the minimum time it took (in microseconds) to respond to a token passed from another DP Master.
FB Fault Count	The number of fieldbus faults that have occurred (e.g. devices going offline, corrupted packets, etc.)
Device Fault Count	The number of slave device faults that have occurred (e.g. device stops communicating during data exchange).
Acyclic Request Client Count Overrun	The number of times more than 10 acyclic requests needed to be buffered in which case the PA Link will reject the 11^{th} request.
Token Pass Retry Count	In a Multi DP Master system, this is the number of times the token pass from the PA Link had to be retransmitted because the receiving DP Master did not respond in time.
Token Pass Fail Count	When the number of consecutive Token Pass Retries reaches the configured token pass retry count after which that DP Master will be assumed as offline.
Unexpected Packet Received	The number of times a response is received from a slave device that was not expected (e.g. incorrect response, response from a different node, etc.).
FB Inactivity Count	The number of times the PA Link has determined that there are no other DP Masters on the PROFIBUS network.

Duplicate Station Detect Count	The number of times the PA Link has detected that there is another station on the network with the same station address as the local PA Link.
Invalid Response Length Count	The number of times a response is received from a slave device where the length is not correct (for example if the slave device is configured to provide 10 bytes of process data and only 5 bytes are returned during data exchange).
FDL Fault Count	The number of Data Link Layer function code faults received. This occurs when the remote PROFIBUS device rejects a function request, e.g. if the device is not in the correct state, or if it does not support that function. A list of FDL errors is tabulated in chapter 9.
Extract Alarm Success Count	The number of alarms that have successfully been extracted from slave devices.
Extract Alarm Fail Count	The number of alarms that have **not** successfully been extracted from slave devices.
Initialize Parameter Set Success Count	The number of parameters that have successfully been set after the device has been configured for data exchange.
Initialize Parameter Set Fail Count	The number of parameters that have failed to set after the device has been configured for DPV0 data exchange.
Device Reconfigure Count	The number of times a slave device has been (re)configured for DPV0 data exchange.
Device Reparameterize Count	The number of times a slave device has been (re)parameterized for DPV0 data exchange.
Ext Diag Overflow Count	The number of times a slave device has returned diagnostics data that could not fit into a single PROFIBUS frame.

Table 7.6 - Parameters displayed in the Status Monitoring – General Statistics Tab

DPV1 STATISTICS

The DPV1 Statistics tab displays the following general parameters:

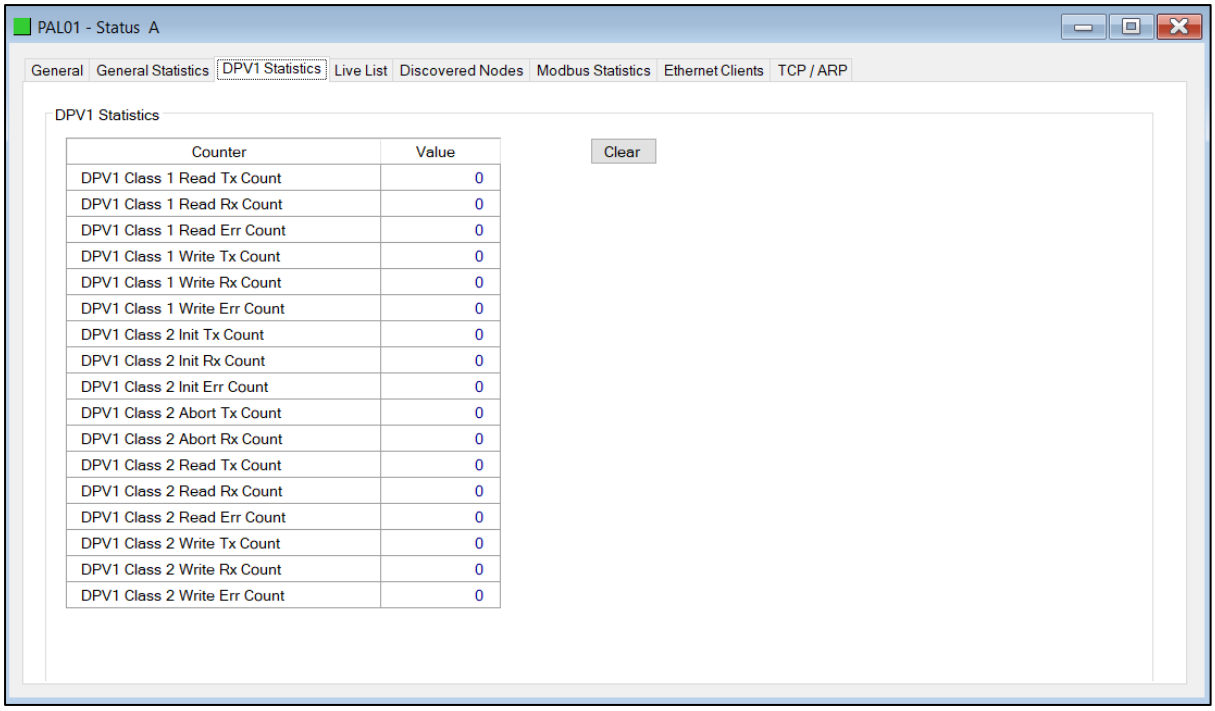


Figure 7.8 – PA Link Status monitoring – DPV1 Statistics

Parameter	Description
DPV1 Class 1 Read Tx Count	The number of PROFIBUS PAV1 Class 1 Read requests sent from the PA Link.
DPV1 Class 1 Read Rx Count	The number of successful PROFIBUS PAV1 Class 1 Read responses received by the PA Link.
DPV1 Class 1 Read Err Count	The number of failed PROFIBUS PAV1 Class 1 Read responses received by the PA Link.
DPV1 Class 1 Write Tx Count	The number of PROFIBUS PAV1 Class 1 Write requests sent from the PA Link.
DPV1 Class 1 Write Rx Count	The number of successful PROFIBUS PAV1 Class 1 Write responses received by the PA Link.
DPV1 Class 1 Write Err Count	The number of failed PROFIBUS PAV1 Class 1 Write responses received by the PA Link.
DPV1 Class 2 Init Tx Count	The number of PROFIBUS PAV1 Class 2 Initialize requests sent from the PA Link.
DPV1 Class 2 Init Rx Count	The number of successful PROFIBUS PAV1 Class 2 Initialize responses by the PA Link.
DPV1 Class 2 Init Err Count	The number of failed PROFIBUS PAV1 Class 2 Initialize responses received by the PA Link.
DPV1 Class 2 Abort Tx Count	The number of PROFIBUS PAV1 Class 2 Abort requests sent from the PA Link.
DPV1 Class 2 Abort Rx Count	The number of PROFIBUS PAV1 Class 2 Abort messages received by the PA Link.

DPV1 Class 2 Read Tx Count	The number of PROFIBUS PAV1 Class 2 Read requests sent from the PA Link.
DPV1 Class 2 Read Rx Count	The number of successful PROFIBUS PAV1 Class 2 Read responses received by the PA Link
DPV1 Class 2 Read Err Count	The number of failed PROFIBUS PAV1 Class 2 Read responses received by the PA Link.
DPV1 Class 2 Write Tx Count	The number of PROFIBUS PAV1 Class 2 Write requests sent from the PA Link.
DPV1 Class 2 Write Rx Count	The number of successful PROFIBUS PAV1 Class 2 Write responses received by the PA Link.
DPV1 Class 2 Write Err Count	The number of failed PROFIBUS PAV1 Class 2 Write responses received by the PA Link.

Table 7.7 - Parameters displayed in the Status Monitoring – DPV1 Statistics Tab

LIVE LIST

The Live List tab in the PA Link status monitoring provides the user with an overview of all slave devices and DP masters connected to the PROFIBUS network. Each station will be in one of six states that are provided in the Live List page.

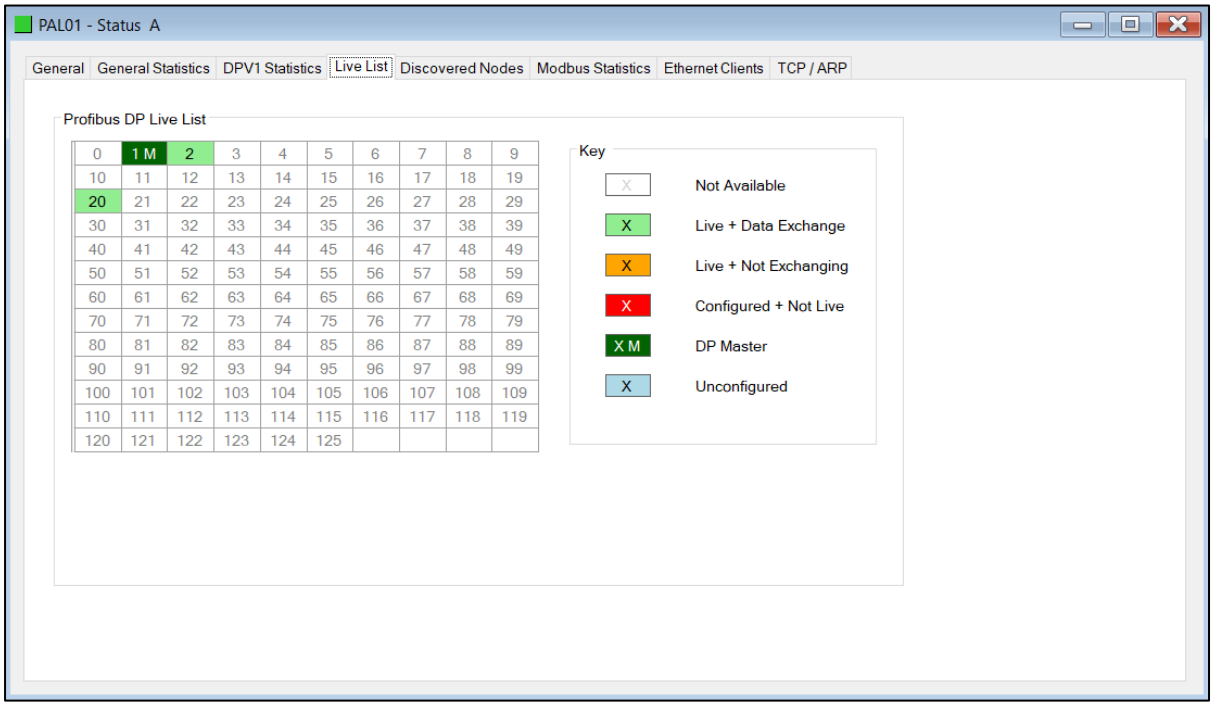


Figure 7.9 – PA Link Status monitoring – Live List

DISCOVERED NODES

The Discovered Nodes status page provides the user with more detail regarding each station on the PROFIBUS network (when compared to the live list). The user can scan the PROFIBUS network to extract further details from each device. From here the user can add the slave device or change the slave device station address. See the *Device Discovery* section.

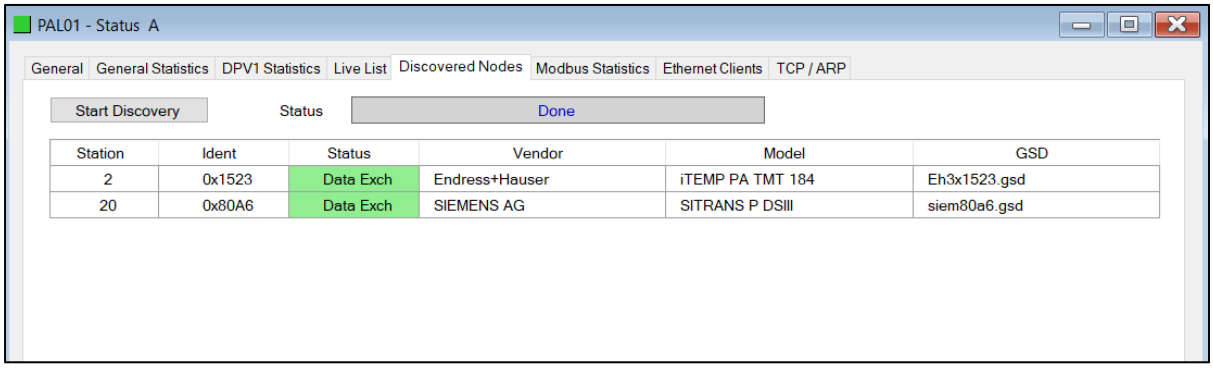


Figure 7.10 – PA Link Status monitoring – Discovered Nodes

MODBUS STATISTICS

The Modbus Statistics tab displays the statistics associated with the Modbus communication and mapping.

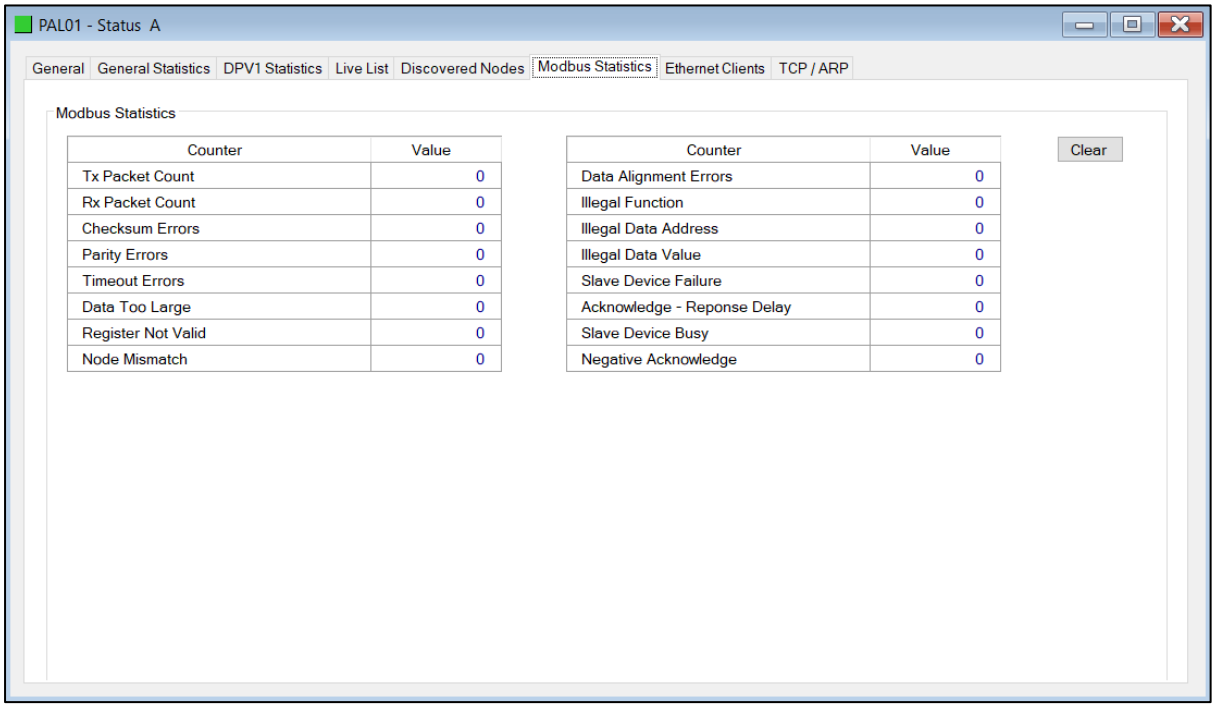


Figure 7.11 – PA Link Status monitoring – Modbus Statistics

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	The number of Modbus requests containing an invalid register.
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 Logix tag.
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.

Table 7.8 – Modbus statistics

ETHERNET CLIENTS

The Ethernet Clients tab displays details of the Ethernet and EtherNet/IP clients connected to the PA Link.

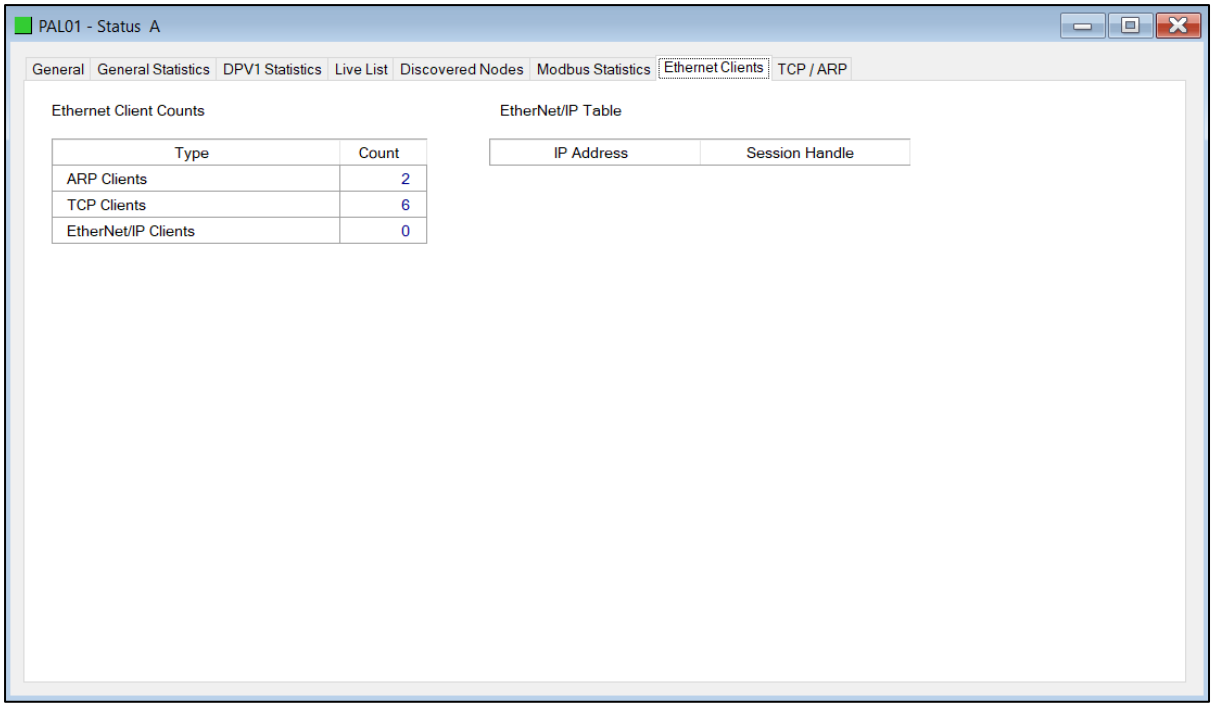


Figure 7.12 – PA Link Status monitoring – Ethernet Client Statistics

TCP/ARP

The TCP/ARP tab displays details of the internal Ethernet ARP and TCP lists of the PA Link.

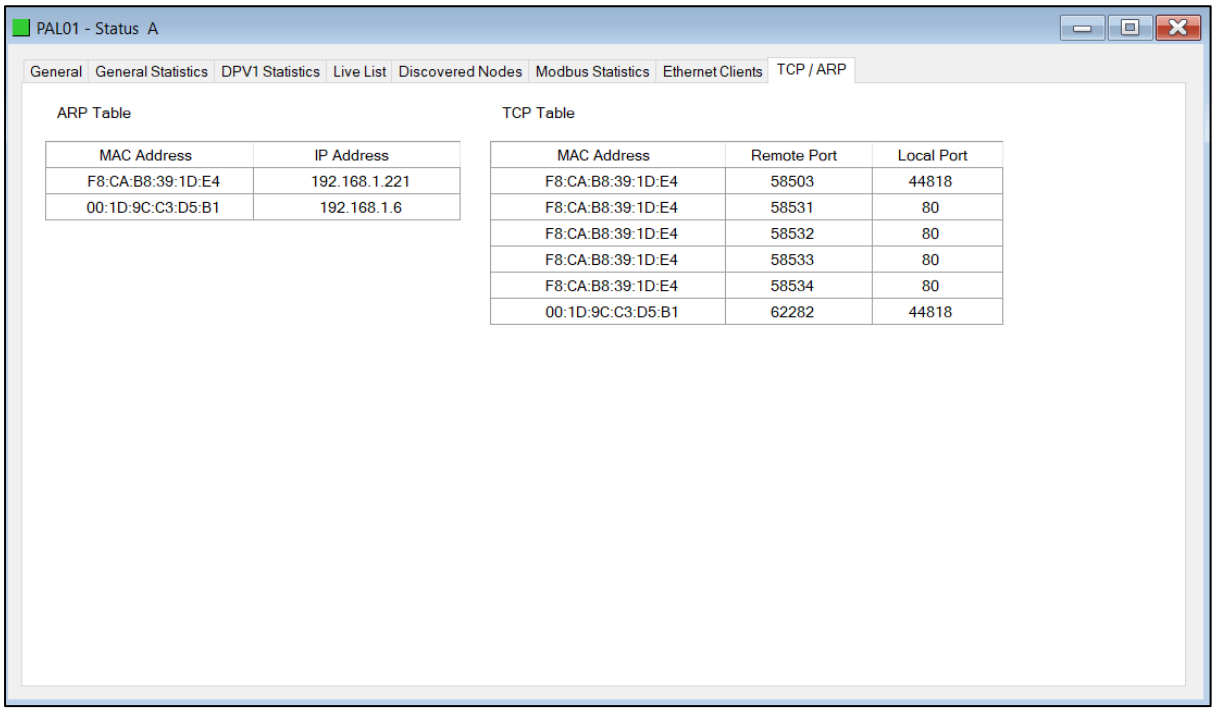


Figure 7.13 – PA Link Status monitoring – Ethernet TCP / ARP Statistics

7.2.4. DEVICE STATUS

The Status monitoring window of each PROFIBUS slave device connected to the PA Link can be opened by right-clicking on the specific slave device in Slate tree and selecting *Status*.

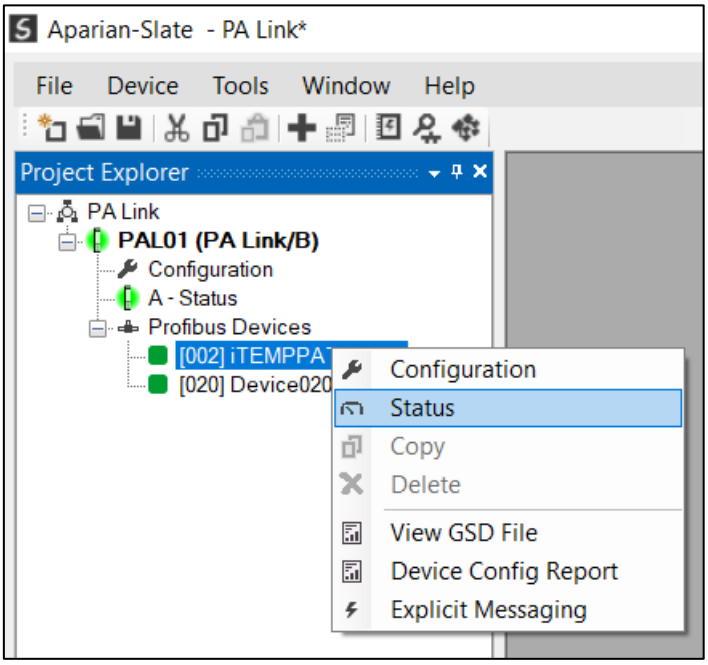


Figure 7.14 - Selecting slave device online Status

The device status window contains multiple tabs to display the current status of the specific slave device.

GENERAL – MASTER MODE

The General tab displays the following general parameters:

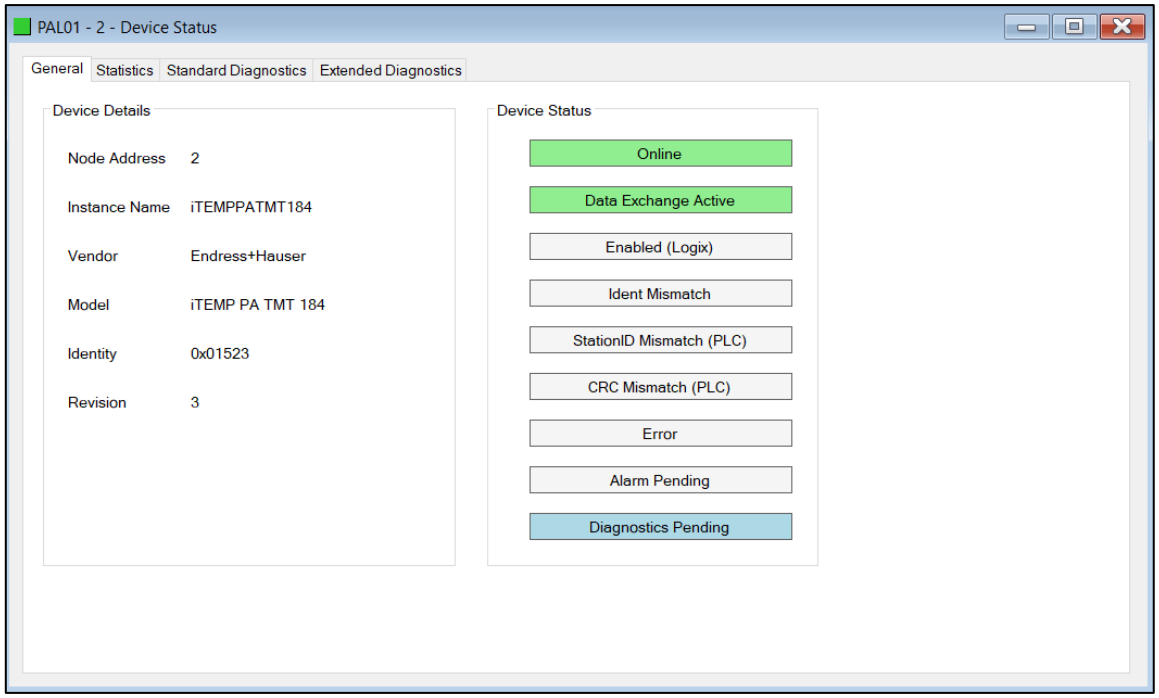


Figure 7.15 – Device Status monitoring - General

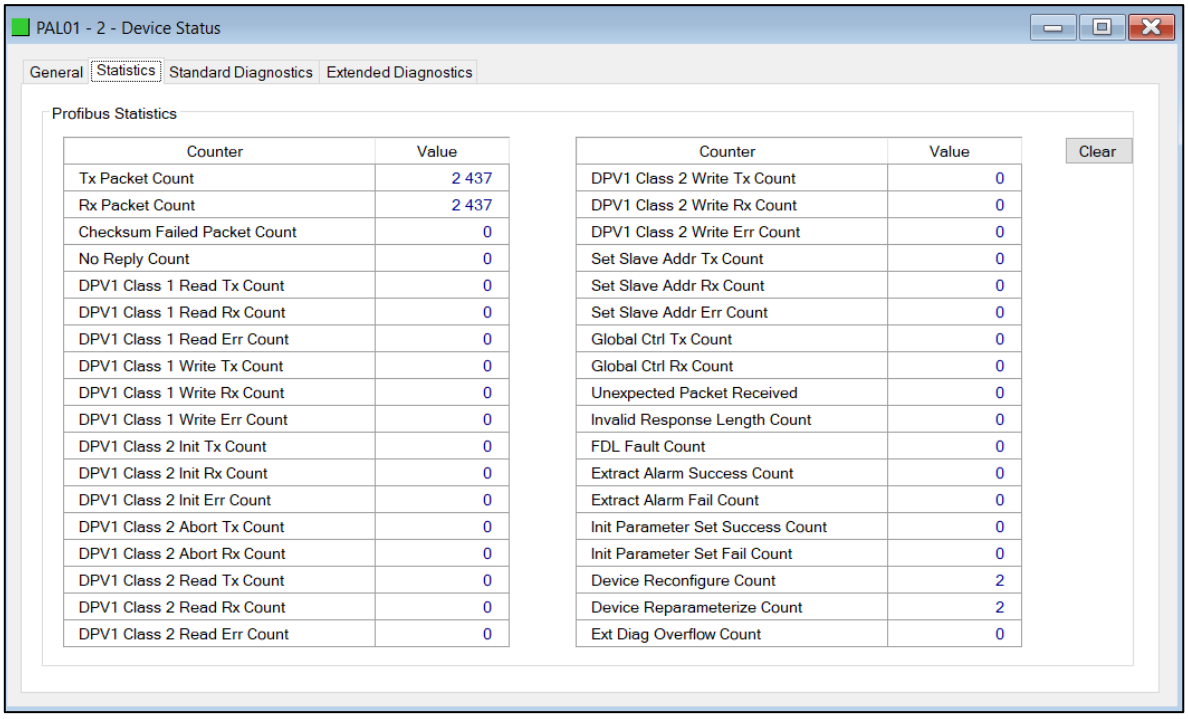
Parameter	Description
Node Address	The selected slave device station address
Instance Name	The configured instance name of the device
Vendor	The device Vendor name.
Model	The device Model name.
Identity	The device PNO identity.
Revision	The device revision.
Device Status	The current status of the device: **Online** The slave device is online. **Data Exchange Active** The slave device is exchanging DPV0 process data with the PA Link. **Disabled (PLC)** The slave device has been disabled from DPV0 data exchange from the Logix controller using the PA Link output assembly. **Identity Mismatch** The device configured in Slate and the device online at the specific station address do not match. **StationID Mismatch (PLC)** The station address entered from the Logix controller using the PA Link output assembly does not match the station address of the configured slave device.

	CRC Mismatch (PLC) Indicates the mapping from the Logix controller does not match the configured mapping. **Error** Device Error flag **Alarm Pending** An alarm is pending in the specific slave device. **Diagnostics Pending** There is new diagnostics pending in the slave device.

Table 7.9 - Device Status Monitoring – General Tab

STATISTICS

The Statistics tab displays the following general parameters:



Counter	Value
Tx Packet Count	2 437
Rx Packet Count	2 437
Checksum Failed Packet Count	0
No Reply Count	0
DPV1 Class 1 Read Tx Count	0
DPV1 Class 1 Read Rx Count	0
DPV1 Class 1 Read Err Count	0
DPV1 Class 1 Write Tx Count	0
DPV1 Class 1 Write Rx Count	0
DPV1 Class 1 Write Err Count	0
DPV1 Class 2 Init Tx Count	0
DPV1 Class 2 Init Rx Count	0
DPV1 Class 2 Init Err Count	0
DPV1 Class 2 Abort Tx Count	0
DPV1 Class 2 Abort Rx Count	0
DPV1 Class 2 Read Tx Count	0
DPV1 Class 2 Read Rx Count	0
DPV1 Class 2 Read Err Count	0

Counter	Value
DPV1 Class 2 Write Tx Count	0
DPV1 Class 2 Write Rx Count	0
DPV1 Class 2 Write Err Count	0
Set Slave Addr Tx Count	0
Set Slave Addr Rx Count	0
Set Slave Addr Err Count	0
Global Ctrl Tx Count	0
Global Ctrl Rx Count	0
Unexpected Packet Received	0
Invalid Response Length Count	0
FDL Fault Count	0
Extract Alarm Success Count	0
Extract Alarm Fail Count	0
Init Parameter Set Success Count	0
Init Parameter Set Fail Count	0
Device Reconfigure Count	2
Device Reparameterize Count	2
Ext Diag Overflow Count	0

Figure 7.16 – Device Status monitoring - Statistics

Parameter	Description
Tx Packet Count	The number of PROFIBUS packets transmitted.
Rx Packet Count	The number of PROFIBUS packets received.
Checksum Failed Packet Count	The number of PROFIBUS packets that had a failed checksum.
No Reply Count	The number of PROFIBUS requests from the PA Link where the station did not respond.

DPV1 Class 1 Read Tx Count	The number of PROFIBUS PAV1 Class 1 Read requests sent from the PA Link to the specific device.
DPV1 Class 1 Read Rx Count	The number of successful PROFIBUS PAV1 Class 1 Read responses received from the specific device.
DPV1 Class 1 Read Err Count	The number of failed PROFIBUS PAV1 Class 1 Read responses received from the specific device.
DPV1 Class 1 Write Tx Count	The number of PROFIBUS PAV1 Class 1 Write requests sent from the PA Link to the specific device.
DPV1 Class 1 Write Rx Count	The number of successful PROFIBUS PAV1 Class 1 Write responses received from the specific device.
DPV1 Class 1 Write Err Count	The number of failed PROFIBUS PAV1 Class 1 Write responses received from the specific device.
DPV1 Class 2 Init Tx Count	The number of PROFIBUS PAV1 Class 2 Initialize requests sent from the PA Link to the specific device.
DPV1 Class 2 Init Rx Count	The number of successful PROFIBUS PAV1 Class 2 Initialize responses received from the specific device.
DPV1 Class 2 Init Err Count	The number of failed PROFIBUS PAV1 Class 2 Initialize responses received from the specific device.
DPV1 Class 2 Abort Tx Count	The number of PROFIBUS PAV1 Class 2 Abort requests sent from the PA Link to the specific device.
DPV1 Class 2 Abort Rx Count	The number of PROFIBUS PAV1 Class 2 Abort messages received from the specific device.
DPV1 Class 2 Read Tx Count	The number of PROFIBUS PAV1 Class 2 Read requests sent from the PA Link to the specific device.
DPV1 Class 2 Read Rx Count	The number of successful PROFIBUS PAV1 Class 2 Read responses received from the specific device.
DPV1 Class 2 Read Err Count	The number of failed PROFIBUS PAV1 Class 2 Read responses received from the specific device.
DPV1 Class 2 Write Tx Count	The number of PROFIBUS PAV1 Class 2 Write requests sent from the PA Link to the specific device.
DPV1 Class 2 Write Rx Count	The number of successful PROFIBUS PAV1 Class 2 Write responses received from the specific device.
DPV1 Class 2 Write Err Count	The number of failed PROFIBUS PAV1 Class 2 Write responses received from the specific device.
Set Slave Addr Tx Count	The number of PROFIBUS Set Slave Address requests sent from the PA Link to the specific device.
Set Slave Addr Rx Count	The number of successful PROFIBUS Set Slave Address responses received from the specific device.
Set Slave Addr Err Count	The number of failed PROFIBUS Set Slave Address responses received from the specific device.
Global Ctrl Tx Count	The number of PROFIBUS Global Control requests sent from the PA Link to the specific device.

Global Ctrl Rx Count	The number of PROFIBUS Global Control requests received by the PA Link from the specific device.
Unexpected Packet Received	The number of times a response is received from the device that was not expected (e.g. incorrect response, response from a different node, etc.).
Invalid Response Length Count	The number of times a response is received from the device where the length is not correct (for example if the device is configured to provide 10 bytes of process data and only 5 bytes are returned during data exchange).
FDL Fault Count	The number of Data Link Layer function code faults received from the specific device.
Extract Alarm Success Count	The number of alarms that have successfully been extracted from the specific device.
Extract Alarm Fail Count	The number of alarms that have **not** successfully been extracted from the specific device.
Initialize Parameter Set Success Count	The number of parameters that have successfully been set after the device has been configured for data exchange for the specific device.
Initialize Parameter Set Fail Count	The number of parameters that have failed to set after the device has been configured for DPV0 data exchange for the specific device.
Device Reconfigure Count	The number of times the device has been (re)configured for DPV0 data exchange.
Device Reparameterize Count	The number of times the device has been (re)parameterized for DPV0 data exchange.
Ext Diag Overflow Count	The number of times the device has returned diagnostics data that could not fit into a single PROFIBUS frame.

Table 7.10 - Device Status Monitoring – Statistics Tab

STANDARD DIAGNOSTICS

The Standard Diagnostics tab displays the following general parameters:

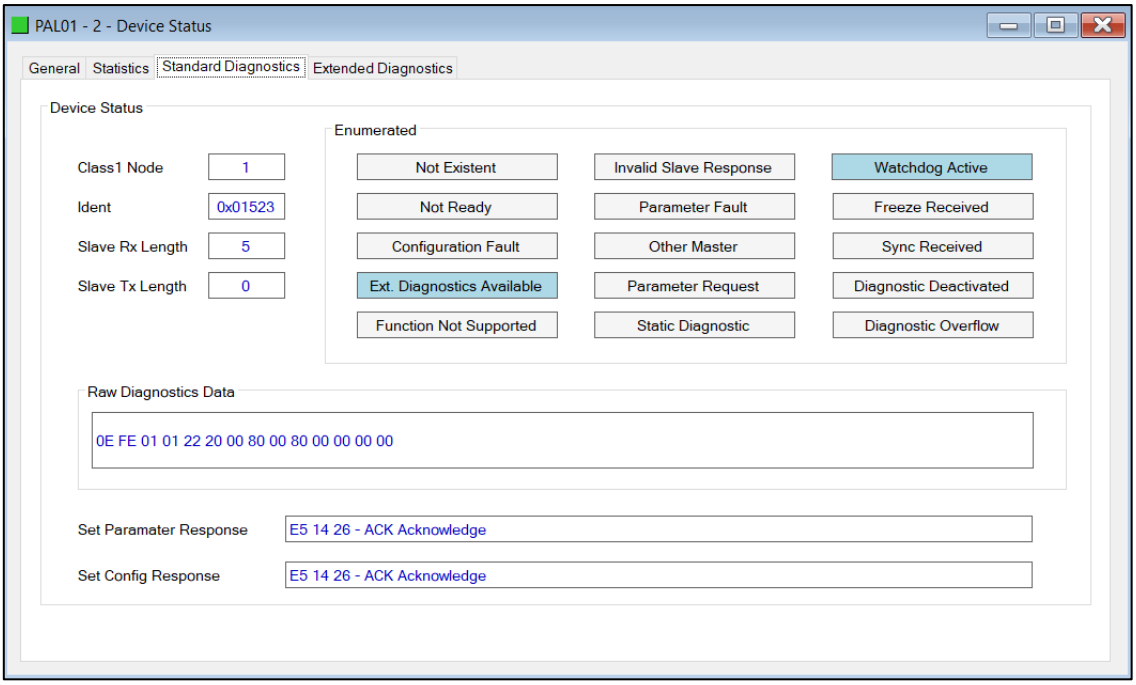


Figure 7.17 – Device Status monitoring – Standard Diagnostics

Parameter	Description
Class 1 Node	The station address of the DP Master that configured the specific device for DPV0 communication.
Ident	The PNO Identification number of the device on the PROFIBUS network.
Slave Rx Length	The number of process data (DPV0) bytes expected from the device.
Slave Tx Length	The number of process data (DPV0) bytes that will be sent to the device.
Enumerated	Refer to the *PROFIBUS Specification EN 50170* for information regarding the diagnostics.
Raw Diagnostics Data	The raw diagnostics in a hexadecimal data string.
Set Parameter Response	This is the last response from the specific field device to the last set parameter telegram.
Set Config Response	This is the last response from the specific field device to the last check config telegram.

Table 7.11 - Device Status Monitoring – Standard Diagnostics Tab

EXTENDED DIAGNOSTICS

The Extended Diagnostics are decoded and displayed in a table form. The diagnostics are decoded using the pre-configured GSD file.

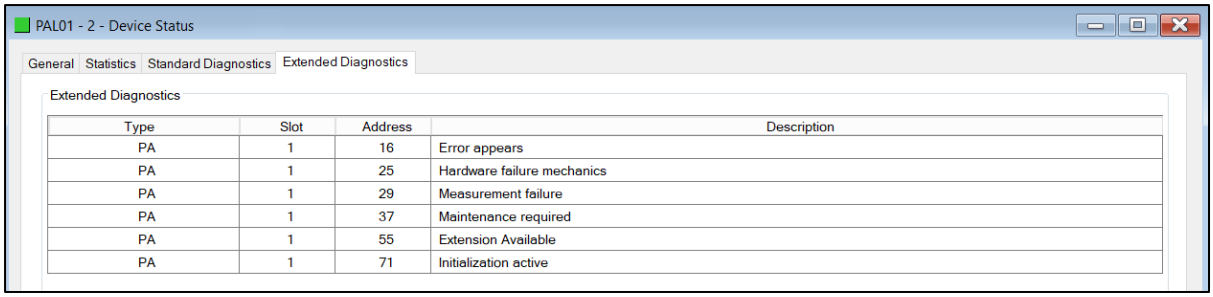


Figure 7.18 – Device Status monitoring – Extended Diagnostics

7.3. PROFIBUS PACKET CAPTURE

The module provides the capability to capture the PROFIBUS traffic for analysis. This will allow the user and the support team to view the packet stream. To invoke the capture of the module, double-click on the ***PA Packet Capture*** item in the Project Explorer tree.

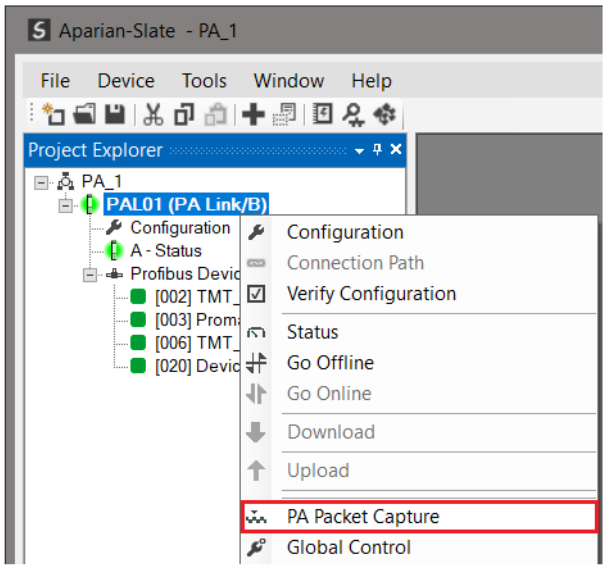


Figure 7.19 - Selecting PA Packet Capture

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

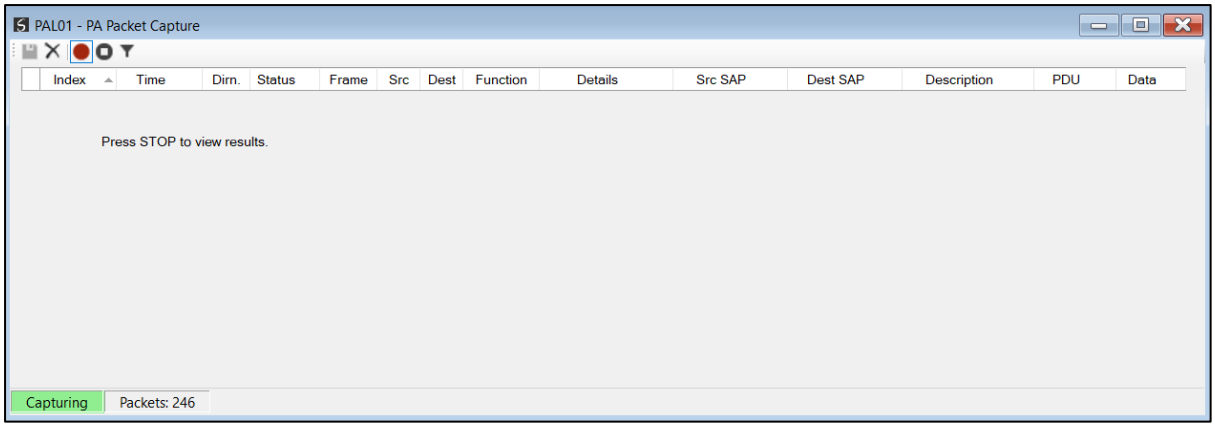


Figure 7.20 - PROFIBUS packet capture

NOTE: The module will capture packets until the user presses *Stop* or when 10,000 PA packets have been reached.

When the capture process is stopped then the PROFIBUS capture will be presented as shown below.

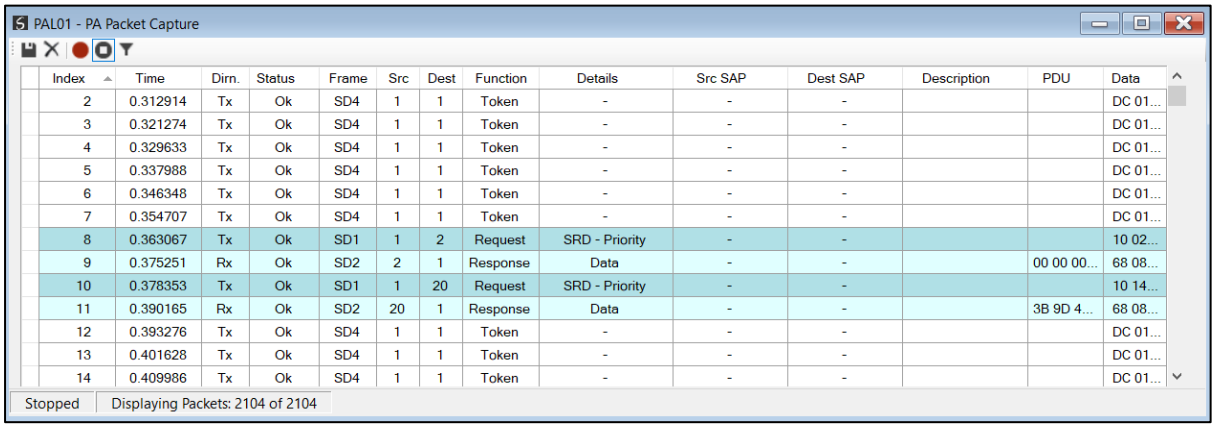


Figure 7.21 - PA Packet Capture complete

The captured PROFIBUS packets are tabulated as follows:

Statistic	Description
Index	The packet index incremented for each packet sent or received.
Time	The time is measured in microseconds (us) and is started at a fraction of a second and continued until the packet capture is done.
Dirn.	The direction of the packet, either transmitted (Tx) or received (Rx).
Status	The status of the packet. Received packets are checked for valid PROFIBUS constructs and valid checksums.
Frame	PROFIBUS Frame type. (e.g. SD1, SD2, SD3 etc)

Src	PROFIBUS node address of the message source.
Dest	PROFIBUS node address of the message destination.
Function	The PROFIBUS function (e.g. Token, Request, etc.)
Details	Additional details associated with the PROFIBUS command/function.
Src SAP	The source Service Access Point (SAP) when used.
Dest SAP	The destination Service Access Point (SAP) when used.
Description	A more detailed description of the packet payload. Only applicable to specific packet types.
PDU	The PROFIBUS packet payload.
Data	The packet's raw data displayed in space delimited hex.

Table 7.12 - PROFIBUS Packet Capture fields

Additional detail about specific packets can be viewed by either double-clicking or right-clicking on the packet and selecting the Show Detail option.

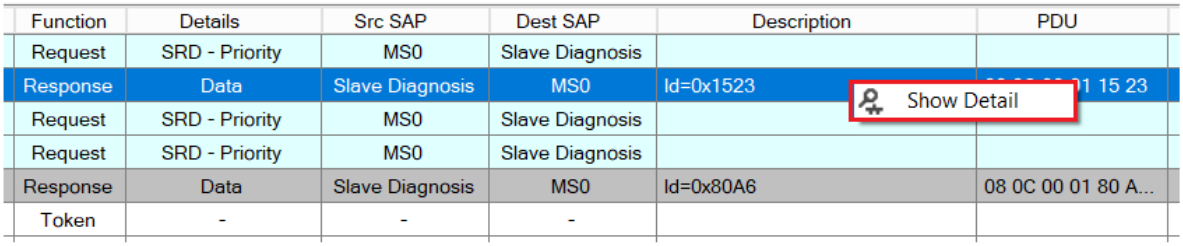


Figure 7.22 - PROFIBUS Packet Capture - Show Detail

A pop-up form will open displaying more relevant detail to the selected packet.

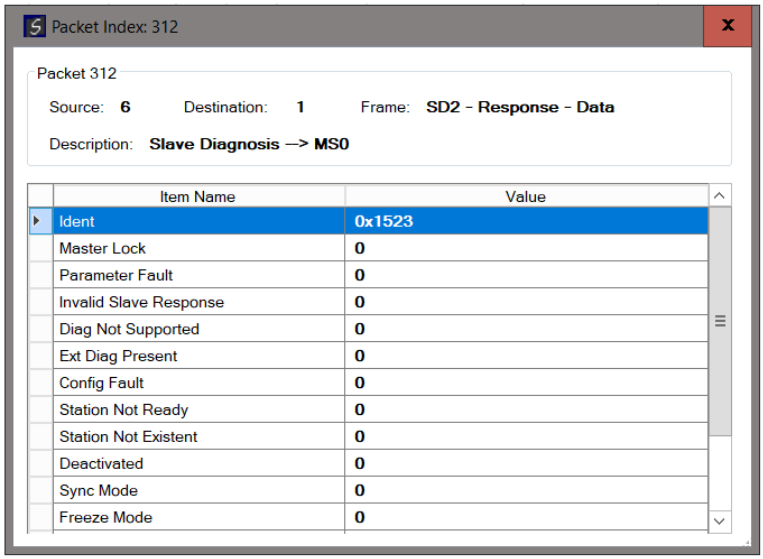


Figure 7.23 - PROFIBUS Packet Capture - Detail Example

The packet filter can be used to hide certain packet types. To open the packet filter click on the ***Filter*** icon in the toolbar.

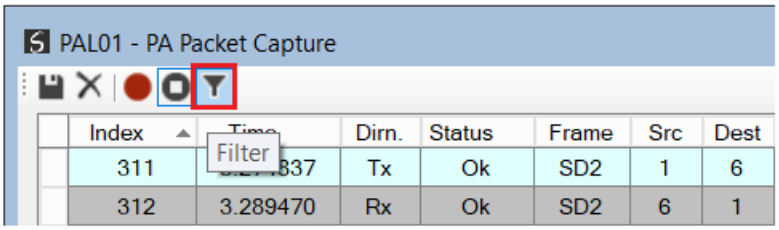


Figure 7.24 - PROFIBUS Packet Filter

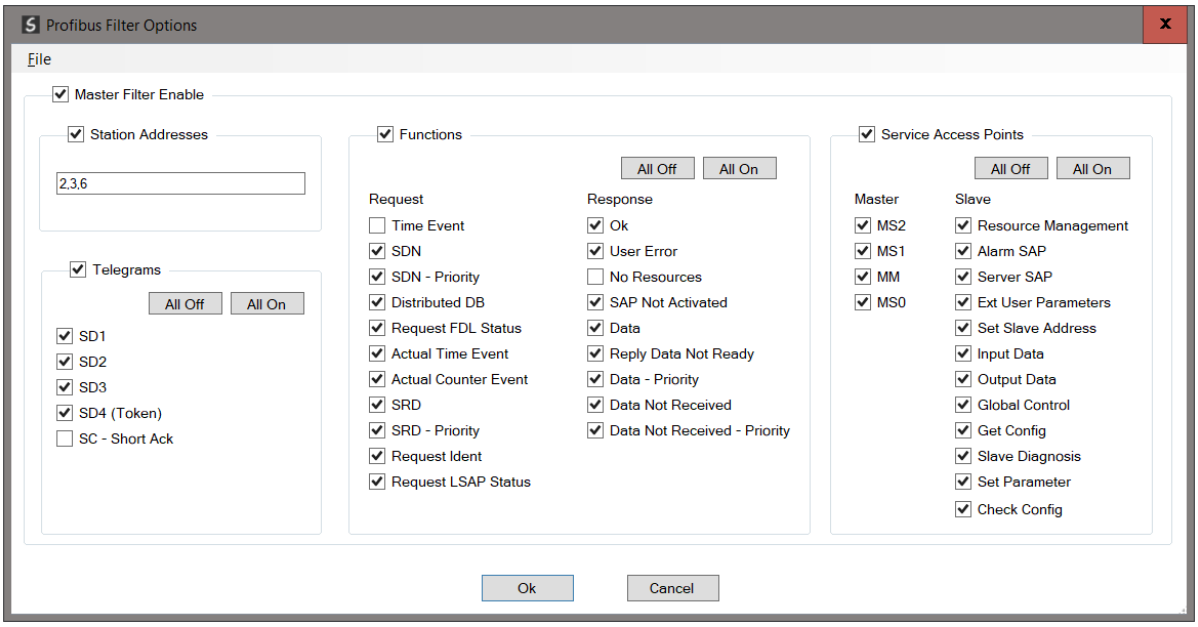


Figure 7.25 - PROFIBUS Packet Filter Options

PROFIBUS packets can be filtered on the following criteria:

- Station Address
- Telegram (Frame) Type
- Function
- Service Access Point

The selected Filter options can also be saved and re-opened for future use.

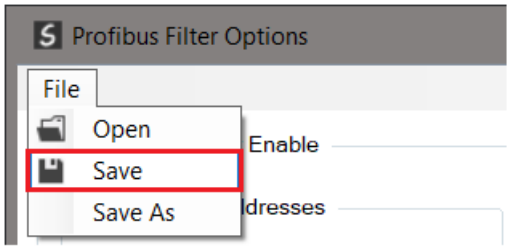


Figure 7.26 - PROFIBUS Packet Filter Options – Save / Open

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

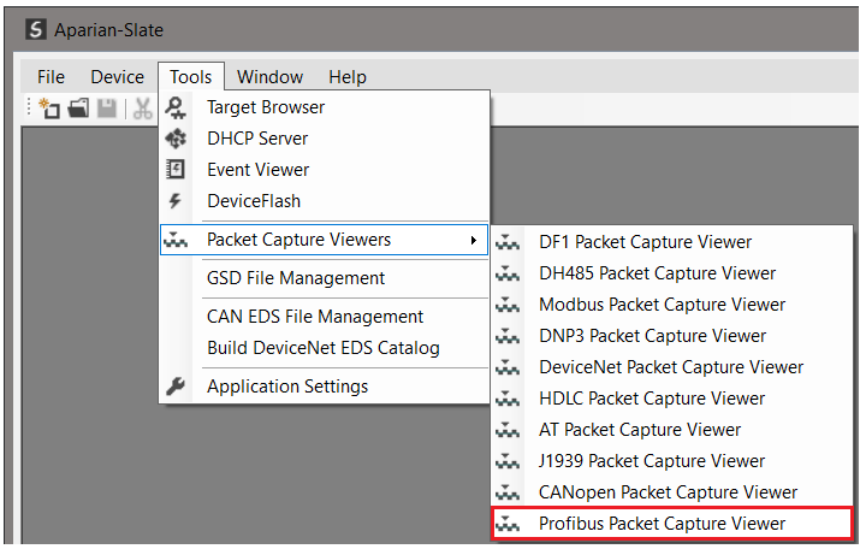


Figure 7.27 - Selecting the PROFIBUS Packet Capture Viewer

7.4. MODULE EVENT LOG

The PA Link 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, right-click on the module in the project Explorer and select the ***Event Viewer*** option.

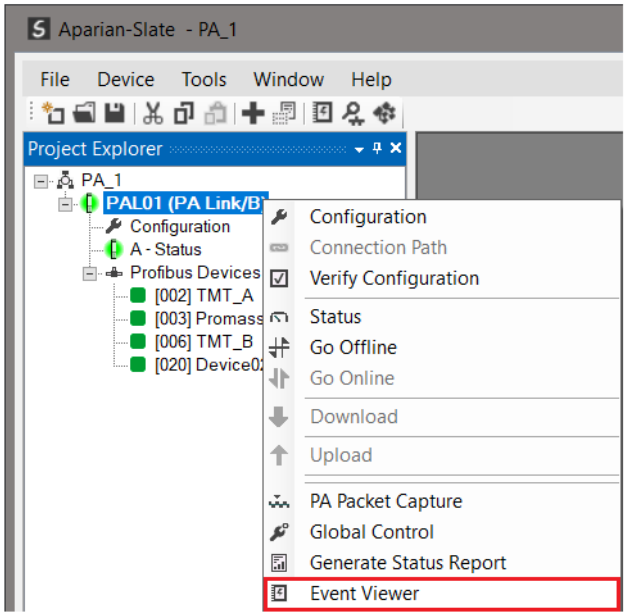
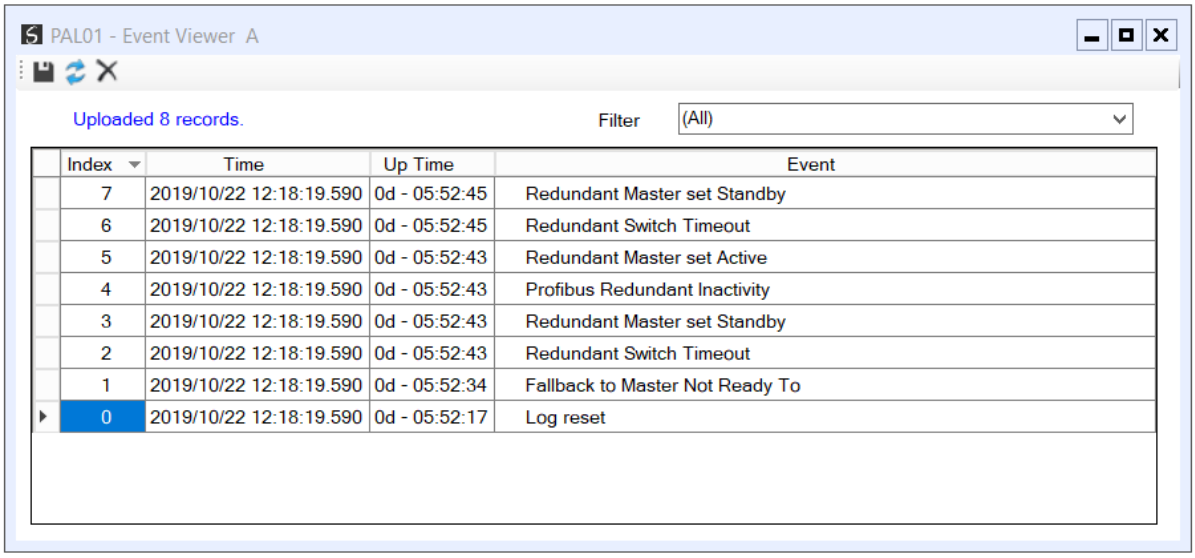


Figure 7.28. - Selecting the module Event Log

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	Time	Up Time	Event
7	2019/10/22 12:18:19.590	0d - 05:52:45	Redundant Master set Standby
6	2019/10/22 12:18:19.590	0d - 05:52:45	Redundant Switch Timeout
5	2019/10/22 12:18:19.590	0d - 05:52:43	Redundant Master set Active
4	2019/10/22 12:18:19.590	0d - 05:52:43	Profibus Redundant Inactivity
3	2019/10/22 12:18:19.590	0d - 05:52:43	Redundant Master set Standby
2	2019/10/22 12:18:19.590	0d - 05:52:43	Redundant Switch Timeout
1	2019/10/22 12:18:19.590	0d - 05:52:34	Fallback to Master Not Ready To
0	2019/10/22 12:18:19.590	0d - 05:52:17	Log reset

Figure 7.29. – 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.

7.5. WEB SERVER

The PA Link provides a web server allowing a user without Slate, Logix, or Modbus device to view various diagnostics of the module.

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

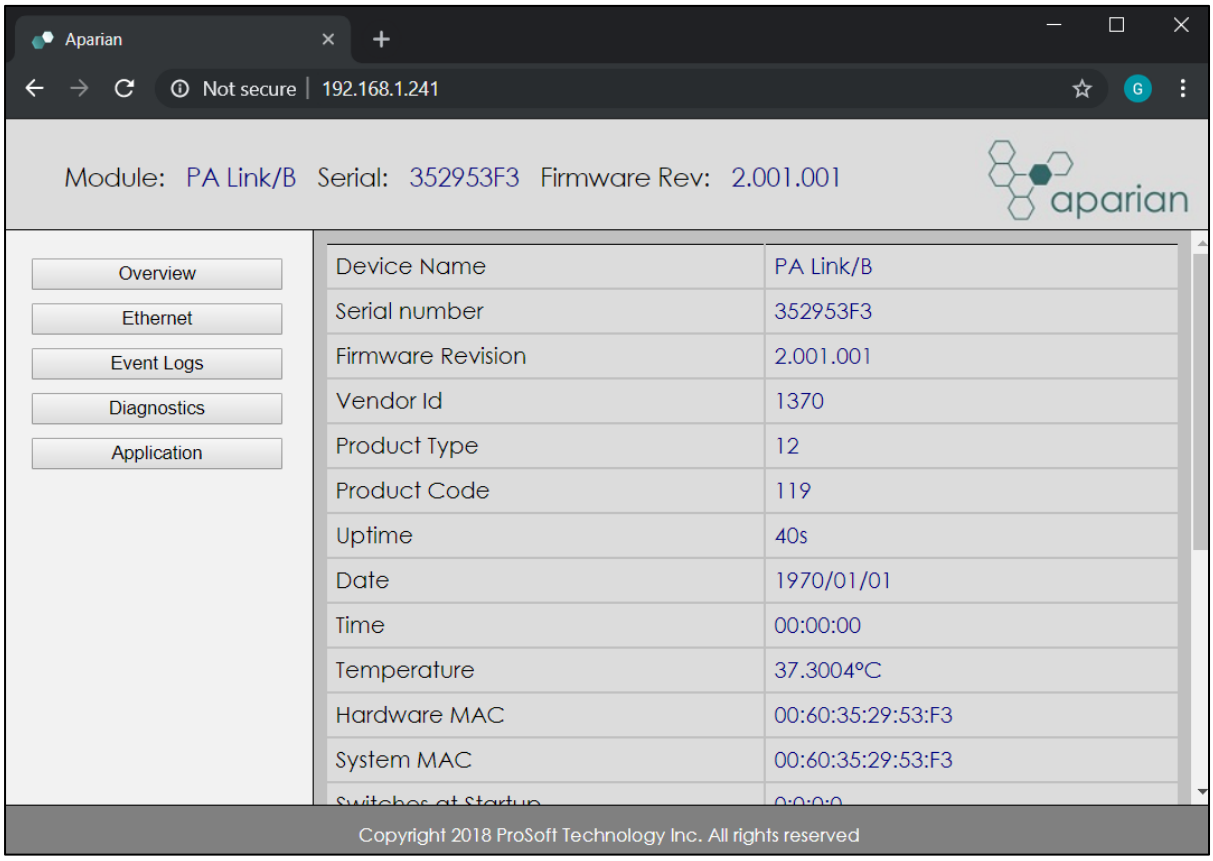


Figure 7.30 - Web interface

NOTE: The parameters and diagnostics in the webserver will match those in Slate status monitoring of the PA Link.

8. TECHNICAL SPECIFICATIONS

8.1. DIMENSIONS

Below are the enclosure dimensions. All dimensions are in millimetres.

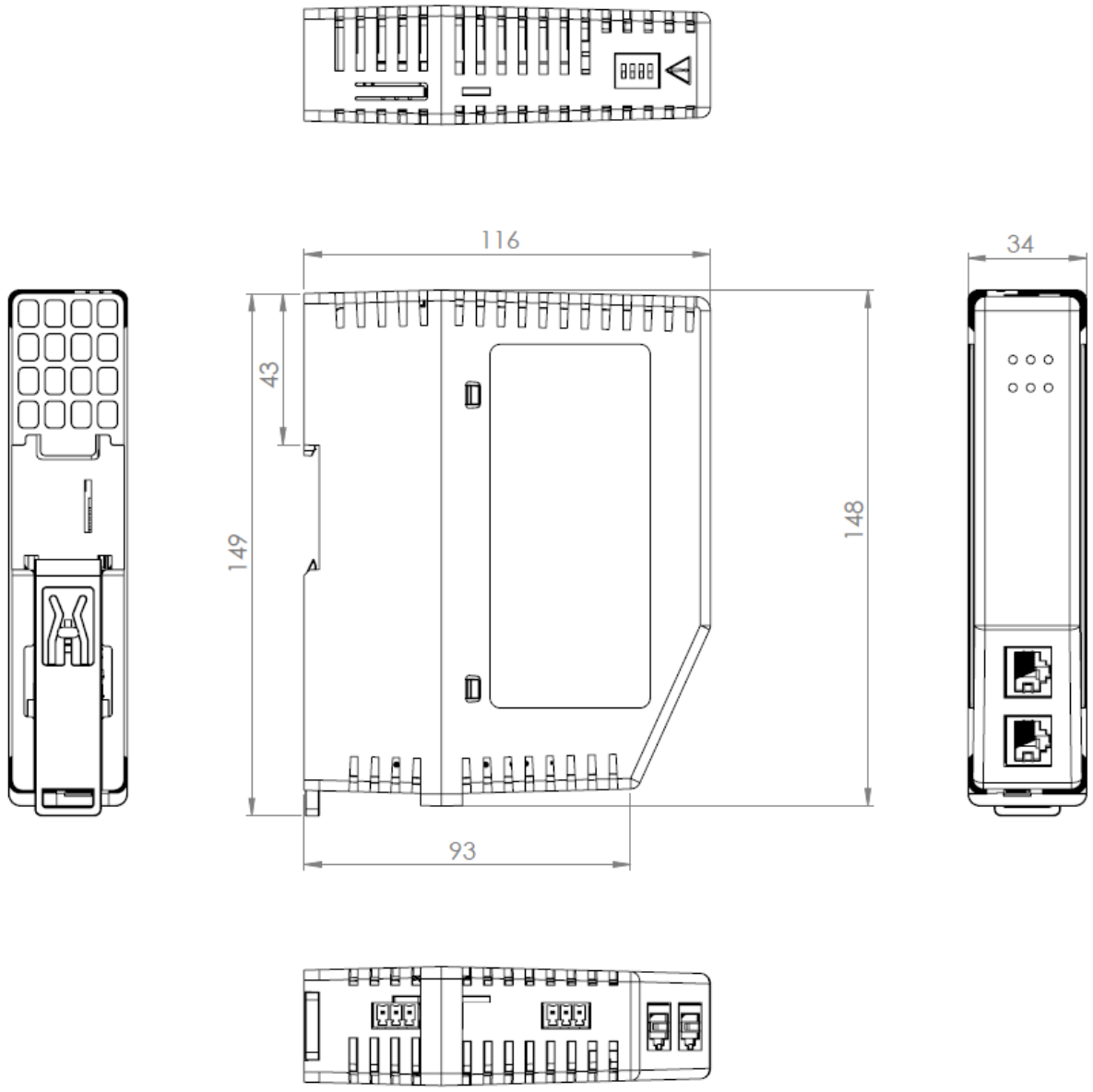


Figure 8.1 – PA Link enclosure dimensions

8.2. ELECTRICAL

Specification	Rating
Power requirements	Input: 22 – 26 V DC
Power consumption	Maximum: 135 mA @ 24V => 3.3 W (No Bus Load) Maximum: 580 mA @ 24V => 14.0 W (Full Bus Load of 400 mA)
Connector	3-way terminal
Conductors	24 – 18 AWG
Enclosure rating	IP20, NEMA/UL Open Type
Temperature	-20 – 70 °C (Power Conditioner Load <= 220 mA, Full Bus Load <= 200 mA) -20 – 60 °C (Power Conditioner Load <= 320 mA, Full Bus Load <= 300 mA) -20 – 50 °C (Power Conditioner Load <= 420 mA Full Bus Load <= 400 mA)
Earth connection	Yes, terminal based
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	RJ45
Conductors	CAT5 STP/UTP
ARP connections	Max 40
TCP connections	Max 40
CIP connections	Max 10
Communication rate	10/100Mbps
Duplex mode	Full/Half
Auto-MDIX support	Yes
Embedded switch	Yes, 2 x Ethernet ports

Table 8.2 - Ethernet specification

8.4. PROFIBUS PA

Specification	Rating
Connector	3-way terminal
Conductor	24 – 18 AWG
PA Master Mode Support	DPV0 Data Exchange DPV1 Class 1 Messaging DPV1 Class 2 Messaging DPV1 Alarming
Maximum Slave Devices	32
Isolated	Yes
Internal Power Conditioner Voltage	Maximum: 23.0 V DC Minimum: 19.0 V DC
Internal Power Conditioner Current	Maximum: 420 mA – Max. Ambient Temperature <= 50 °C Maximum: 320 mA – Max. Ambient Temperature <= 60 °C Maximum: 220 mA – Max. Ambient Temperature <= 70 °C Note: Includes 20mA for internal MAU
Internal Termination	100 Ω - Software Enabled

Table 8.3 – PROFIBUS PA specification

8.5. CERTIFICATIONS

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

Table 8.4 – Certifications

9. PROFIBUS

9.1. INTRODUCTION

PROFIBUS is a vendor-independent, open fieldbus standard for a wide range of applications in manufacturing, process and building automation. Vendor independence and openness are guaranteed by the PROFIBUS standard EN 50 170. With PROFIBUS, devices of different manufacturers can communicate without special interface adjustments. PROFIBUS can be used for both high-speed time critical data transmission and extensive complex communication tasks. The PROFIBUS family consists of three compatible versions.

PROFIBUS DP
Optimized for high speed and inexpensive hookup, this PROFIBUS version is designed especially for communication between automation control systems and distributed I/O at the device level. PROFIBUS-DP can be used to replace parallel signal transmission with 24 V or 4-20 mA.

OSI Layer		PROFIBUS		
7	Application	DPV0	DPV1	DPV2
6	Presentation			
5	Session			
4	Transport			
3	Network			
2	Data Link	FDL		
1	Physical	EIA-485	Optical	MBP

Table 9.1 – PROFIBUS Protocol (OSI model)

To utilize these functions, various service levels of the DP protocol were defined:

- DP-V0 provides the basic functionality of DP, including
  - cyclic data exchange,
  - station, module and channel-specific diagnostics

- DP-V1 contains enhancements geared towards process automation, in particular
  - acyclic data communication for parameter assignment
  - alarm handling

- DP-V2 for isochronous mode and data exchange broadcast (slave-to-slave communication)

PROFIBUS PA
PROFIBUS PA is designed especially for process automation. It permits sensors and actuators to be connected on one common bus line through a dedicated DP/PA gateway or link between the PROFIBUS DP and PROFIBUS PA networks, even in intrinsically-safe areas. PROFIBUS PA permits data communication and power over the bus using a 2-wire technology according to the international standard IEC 1158-2.

PROFIBUS FMS
PROFIBUS FMS is the general-purpose solution for communication tasks at the cell level. Powerful FMS services open up a wide range of applications and provide great flexibility. PROFIBUS FMS can also be used for extensive and complex communication tasks. This protocol is the first developed for PROFIBUS, but it is no longer currently used.

PROFIBUS specifies the technical and functional characteristics of a serial fieldbus system with which decentralized digital controllers can be networked together from the field level to the cell level.

9.2. PROFIBUS MASTER AND SLAVE

PROFIBUS distinguishes between master devices and slave devices.

Master devices determine the data communication on the bus. A master can send messages without an external request when it holds the bus access rights (the token). Masters are also called '**active stations**' in the PROFIBUS protocol.

Slave devices are peripheral devices. Typical slave devices include input/output devices, valves, drives and measuring transmitters. They do not have bus access rights and they can only acknowledge received messages or send messages to the master when requested to do so. Slaves are also called '**passive stations**'

9.3. PROFIBUS MASTER CLASS 1 (DPM1) OR CLASS 2 (DPM2)

PROFIBUS DP Master class 1 (DPM1)
A class 1 master handles the normal communication or exchange of data with the slaves assigned to it. This is typically a PLC.

It uses **cyclic communication** to exchange process data with its associated slaves. The class 1 master sets the baud rate and the slave's auto-detect this rate. Each slave device is assigned to one master and only that master may write output data to that slave. Other masters may read information from any slave but can only write output data to their own assigned slaves.

PROFIBUS DP Master class 2 (DPM2)
A class 2 master is a special device primarily used for commissioning slaves and for diagnostic purposes. This is typically a Supervisor. It uses **acyclic communication** over what is known as the **MS2 channel**. A DPM2 does not have to be permanently connected to the bus system.

9.4. CYCLIC COMMUNICATION

The DP master class 1 cyclically exchanges data with all of the slaves assigned to it. This service is configured. During the configuration process, master and slave addresses are assigned, the bus parameters are defined, the types and numbers of modules (in the case of modular slaves) are specified, user-selectable parameter choices are made, etc.

Before data exchange can take place, the master will send parameterization and configuration telegrams to all of its assigned slaves. These parameters and configuration data are checked by the slaves. If both are valid, the master will initiate cyclic I/O data communication with the slave devices.

9.5. ACYCLIC COMMUNICATION

In addition to the cyclic data exchange, the PROFIBUS protocol has the option of acyclic communication. This service is not configured. There are 2 different communication channels possible between the requested master and the slave:

- **MS1 channel** (MS1 connection): can only be established if cyclic data exchange is taking place between that master (DPM1) and the slave
- **MS2 channel** (MS2 connection): is possible with several masters simultaneously, but the connection must be established explicitly by the master.

Acyclic reading and writing of data requires an established MS1 or MS2 connection.
For the MS1 channel, 3 conditions must be satisfied:

- The slave device must support the MS1 channel (key *C1_Read_Write_supp* at 1 in the GSD file)
- The DPV1_enable bit must be set during the parameter assignment
- Data exchange is taking place

For the MS2 channel, the connection must be explicitly initiated by the master. The maximum number of possible MS2 connections to the slave must not be reached. The connection can be closed by either the master or the slave device.

9.6. TOPOLOGY OF PROFIBUS PA

PROFIBUS devices are connected in a bus structure. Up to 32 stations (master or slaves) can be connected in one segment. The bus is terminated by an active bus terminator at the beginning and end of each segment. Both bus terminations must always be powered. When more than 32 stations are used, repeaters (line amplifiers) must be used to connect the individual bus segments.

9.7. PROFIBUS PA CABLE DESCRIPTION

Only one type of cable can be used for PROFIBUS network:

Parameter	Type A
Cable Type	Shielded, Twisted Pair
Conductor Cross-Section Area	>0.8 mm² (AWG 18)
Characteristic Impedance at 31.25kHz	100 Ω ±20%
Maximum DC Resistance (loop)	44 Ω/km
Maximum Attenuation at 39 kHz	3 dB/km
Maximum Capacitive Imbalance	2 nF/km
Maximum Overall Length	1 900 m

Table 9.2 – PROFIBUS PA network cable

The maximum spur length depends on the number of cable stubs or spurs.

Total Spur Count	Maximum Spur Length
1 - 12	120 m
13 - 14	90 m
15 - 18	60 m
19 - 24	30 m
25 - 32	1 m

Table 9.3 – PROFIBUS PA Cable Spur Length

10.APPENDIX

10.1. DPV1 RESPONSE STATUS

DP Status	Description
00h	Successful
05h	FDL error (see extended error code)
06h	DPV1 Error (see extended error code)
07h	Another command is already in progress for this slave / class 2 connection.
11h	Online state expected
13h	Invalid slave response
17h	Timeout passed

Table 10.1 – DP Status Response codes

10.2. DPV1 EXTENDED STATUS CODES – FDL ERROR

DP Status – Byte 0	Description
0h	OK
1h	User error, SAP locked
2h	No resource for sending data, tried to send to SAP that was not configured
3h	No service available (SAP does not exist)
4h	Access point blocked

Table 10.2 – DP Extended Status Response codes (FDL Error)

NOTE: With an FDL Error, Extended Status bytes 2 and 3 will be zero.

10.3. DPV1 EXTENDED STATUS CODES – DPV1 ERROR

10.3.1. DPV1 READ/WRITE ERROR

DPV1 EXTENDED STATUS - BYTE 1

Value	Description
0 – 127	Reserved
128	DPV1
129 – 253	Reserved
254	PROFIBUS FMS
255	N/A

Table 10.3 – DP Extended Status Response codes (DPV1 Error) – Byte 1

DPV1 EXTENDED STATUS - BYTE 2

Bit 4 to 7 Value	Bit 0 to 3 Value	Description
0 - 9	-	Reserved
10	-	Application
	0	Read Error
	1	Write Error
	2	Module Failure
	3 - 7	Reserved
	8	Version Conflict
	9	Feature not supported
	10 - 15	User Specific
11	-	Access
	0	Invalid Index
	1	Write length error
	2	Invalid Slot
	3	Type conflict
	4	Invalid area
	5	State conflict

	6	Access Denied
	7	Invalid range
	8	Invalid parameter
	9	Invalid type
	10 - 15	User specific
12	-	Resource
	0	Read constrain conflict
	1	Write constrain conflict
	2	Resource busy
	3	Resource unavailable
	4 – 7	Reserved
	8 - 15	User specific
13 - 15	-	User specific

Table 10.4 – DP Extended Status Response codes (DPV1 Error) – Byte 2

NOTE: With a DPV1 Read/Write Error, Extended Status Byte 3 will be manufacturer specific.

10.3.2. DPV1 ABORT

DPV1 EXTENDED STATUS - BYTE 1 - SUBNET

Value	Description
0	No Subnet
1	Local Subnet
2	Remote Subnet
3 - 255	Reserved

Table 10.5 – DP Extended Status Response codes (DPV1 Error) – Byte 1 – Subnet

DPV1 EXTENDED STATUS - BYTE 2 – INSTANCE/REASON

Value	Description
Bit 6 – 7	Reserved
Bit 4 – 5	00 – FDL

	01 – MSAC_C2 10 – User 11 – Reserved
Bit 0 - 3	See EN 50170 Part 2

Table 10.6 – DP Extended Status Response codes (DPV1 Error) – Byte 2 – Instance/Reason

11.INDEX