J1939 Router

User Manual

A-J1939

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Revision 1.6

aparian

CONTENTS

Revision History

Revision	Date	Comment
1.0	22 May 2017	Initial document
1.2	5 October 2017	Add UL Class 1 Division 2
1.4	6 April 2022	Add note that node 255 is a broadcast address
1.5	4 August 2022	Added information required for UL regarding open type device enclosures.
1.6	10 August 2022	Updated Tag Mapping to have Ack Request and Node naming change.

1. PREFACE

1.1. INTRODUCTION TO THE J1939 ROUTER

This manual describes the installation, operation, and diagnostics of the Aparian J1939 Router module. The J1939 Router, (hereafter referred to as the **module**,) provides intelligent data routing between either EtherNet/IP and the SAE J1939 CAN bus network. This allows the user to integrate J1939 devices into a Rockwell Logix platform (e.g. ControlLogix or CompactLogix) with minimal effort.

The SAE J1939 protocol is primarily used in the heavy/industrial vehicle industry. It is used for communication and diagnostics between various components and/or sensors used in the vehicle system (e.g. Engine Controller). Due to is widespread popularity it is also used in diesel-power applications, marine propulsion, power generation, and industrial pumping. J1939 provides the user with Parameter Group Numbers (PGNs) which consists of various Suspect Parameter Numbers (SPNs). Numerous PGNs and SPNs are defined by the SAE group and are used to define the data received, scaling, ranges, etc. *[Source: www.sae.org]*

The J1939 Router provides auto extraction and scaling of SPNs for standard SAE defined PGNs. These SPNs can then be mapped to Logix UDTs Tags which can also be automatically generated by the Slate software. This allows the user to create a J1939 Router project with all the required PGNs and then export a Logix L5X file which contains all the required Tags and UDTs for that specific J1939 Router project. This L5X file can be imported into Logix removing the hassle of creating UDTs for the numerous PGNs.

The J1939 Router is configured using the Aparian Slate application. This program can be downloaded from www.aparian.com free of charge.

The J1939 Router allows the user to select standard specification defined PGNs (e.g. PGN 61444 – Electronic Engine Controller 1) from a list in the Slate software. This will automatically build the mapping and scaling for each SPN which can be downloaded to the module. The user can then export a Logix UDT from the Slate software which maps the PGN selected. This can be imported into a Logix application and used as a destination tag for the configured PGN (greatly simplifying the application setup).

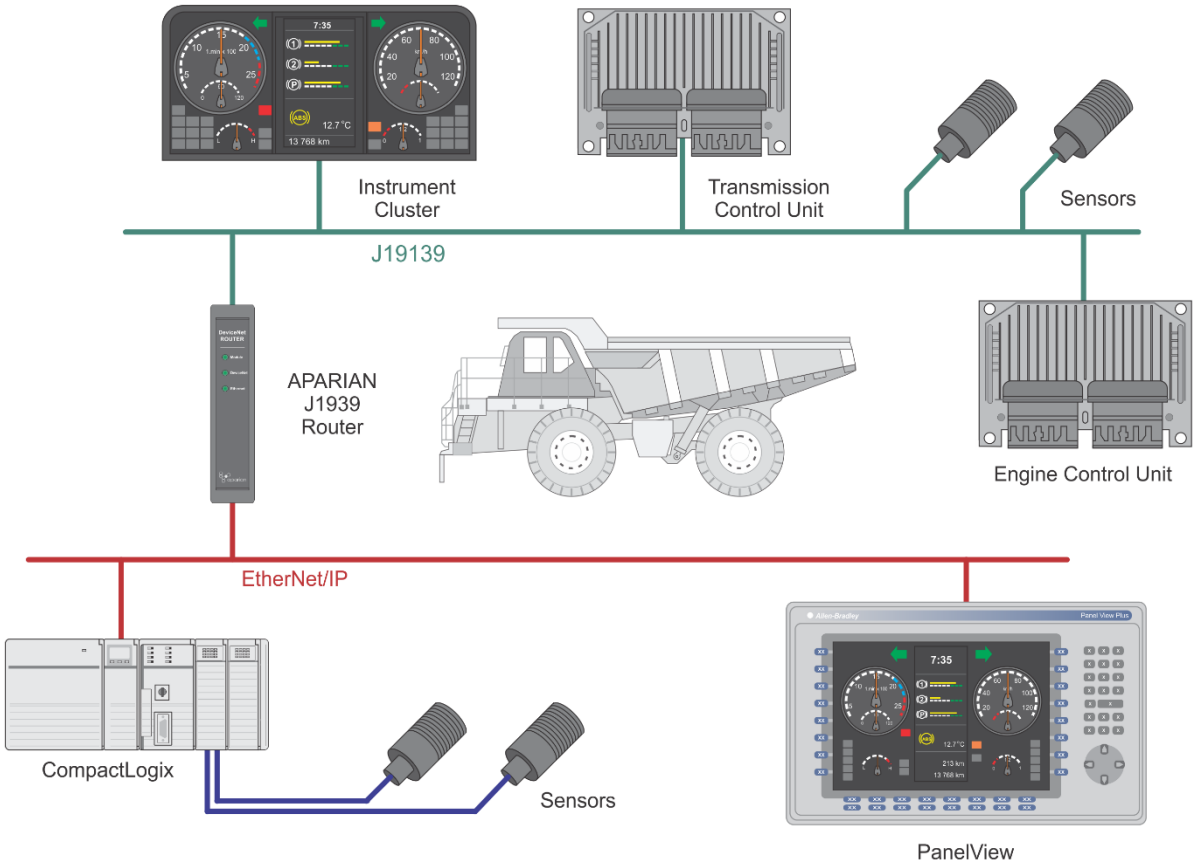


Figure 1.1. – Typical architecture using the J1939 Router

Slate also allows the user to map custom and/or propriety PGNs to a SINT array allowing the user to format the response data in the Logix environment. The module can be configured to either consume data from J1939 devices or produce data for other J1939 devices.

The module also provides a range of statistics to simplify the diagnostic process.

A built-in webserver provides detailed diagnostics of system configuration and operation, including the display of J1939 operation and communication statistics, without the need for any additional software.

1.2. ARCHITECTURE

The figure below provides an example of the typical network setup for connecting various J1939 devices to a Logix controller via the J1939 Router.

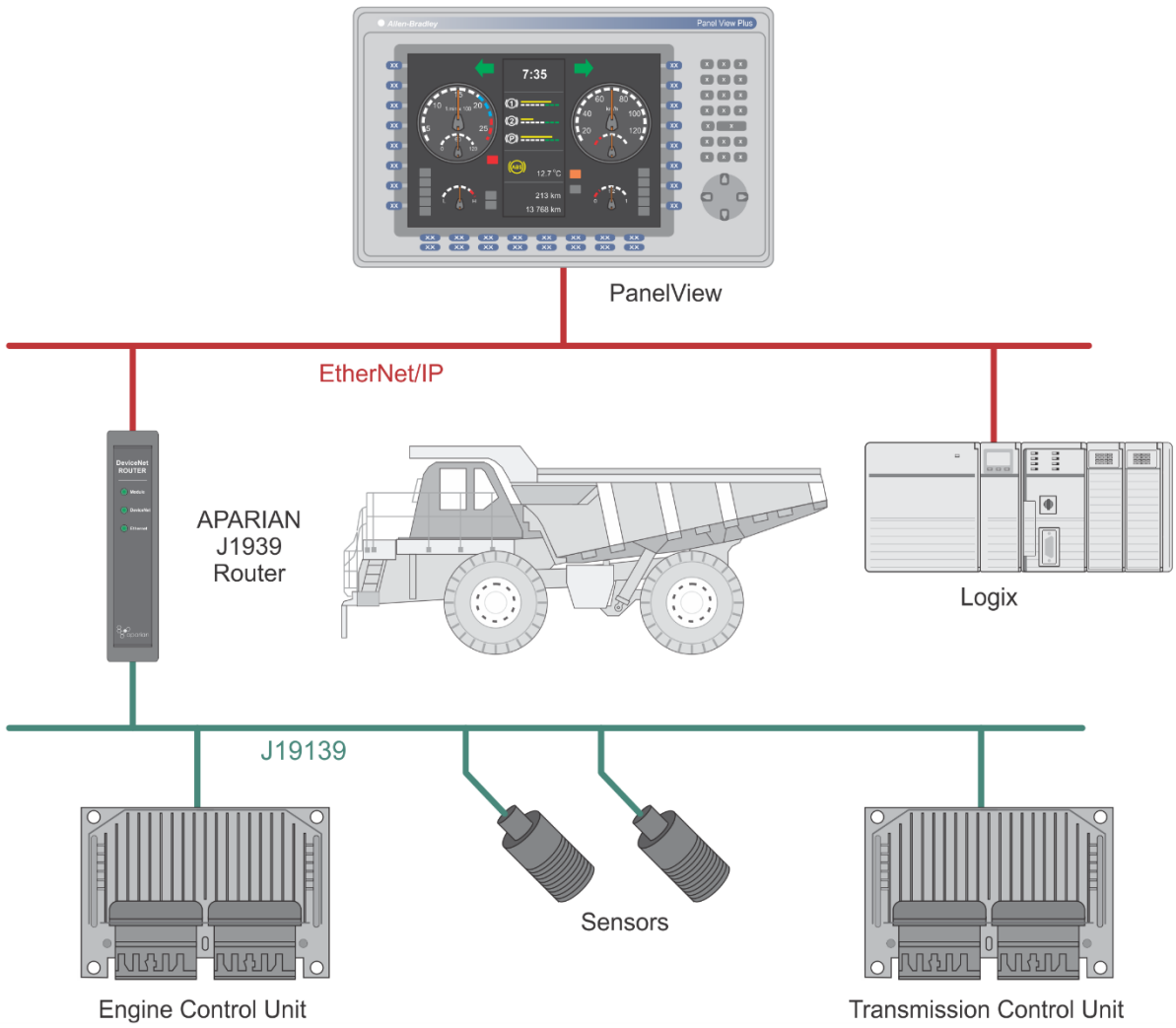


Figure 1.2. - Example of a typical network setup for connecting J1939 device to Logix

The next example illustrates how various sensors connected to Logix can produce J1939 data for the consumption of an Engine Control Unit (ECU).

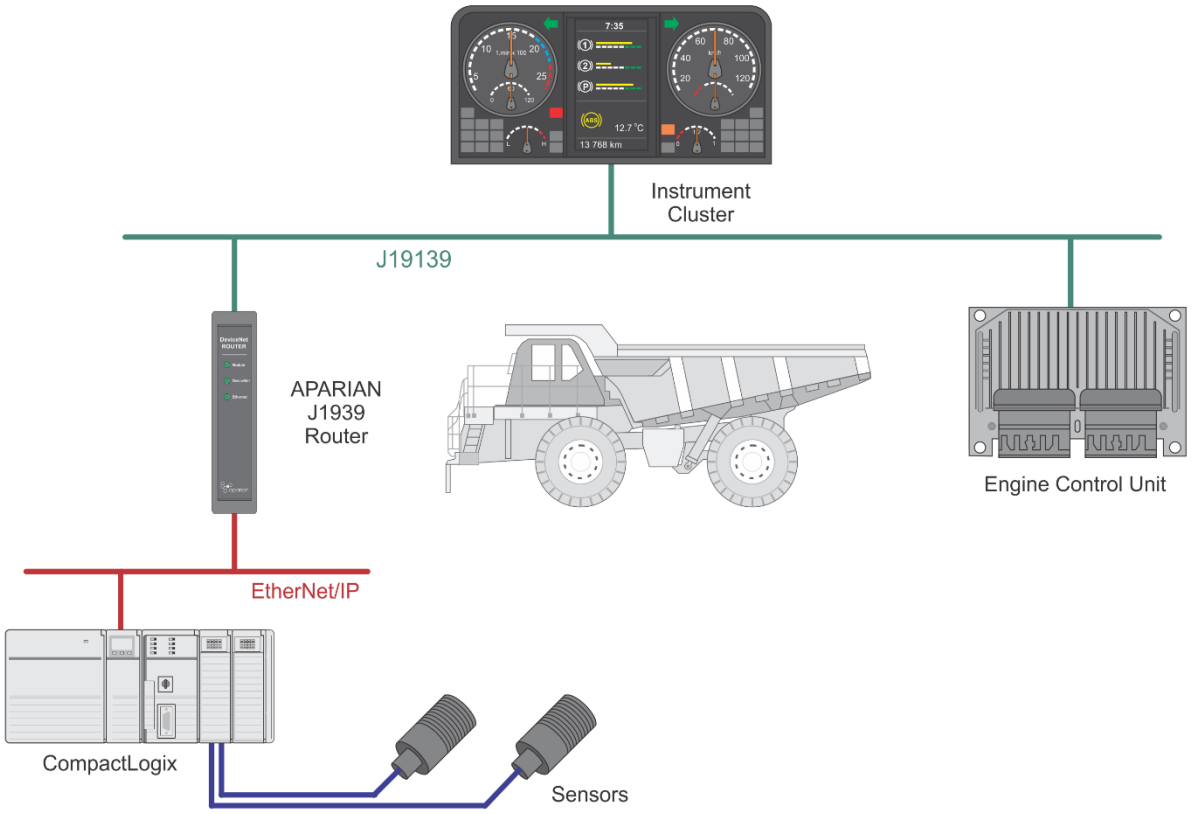


Figure 1.3. – Logix producing J1939 data

1.3. ADDITIONAL INFORMATION

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

Resource	Link
Slate Installation	http://www.aparian.com/software/slate
J1939 Router User Manual J1939 Router Datasheet Example Code & UDTs	http://www.aparian.com/products/j1939Router
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
SAE J1939 Standards	http://www.sae.org/standardsdev/groundvehicle/j1939a.htm

Table 1.1. - Additional Information

1.4. 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 ports at the bottom of the enclosure as shown in the figure below. The ports are used for Ethernet and SAE J1939. The 5-way connector also provides power to the module. The Ethernet cable must be wired according to industry standards which can be found in the additional information section of this document.

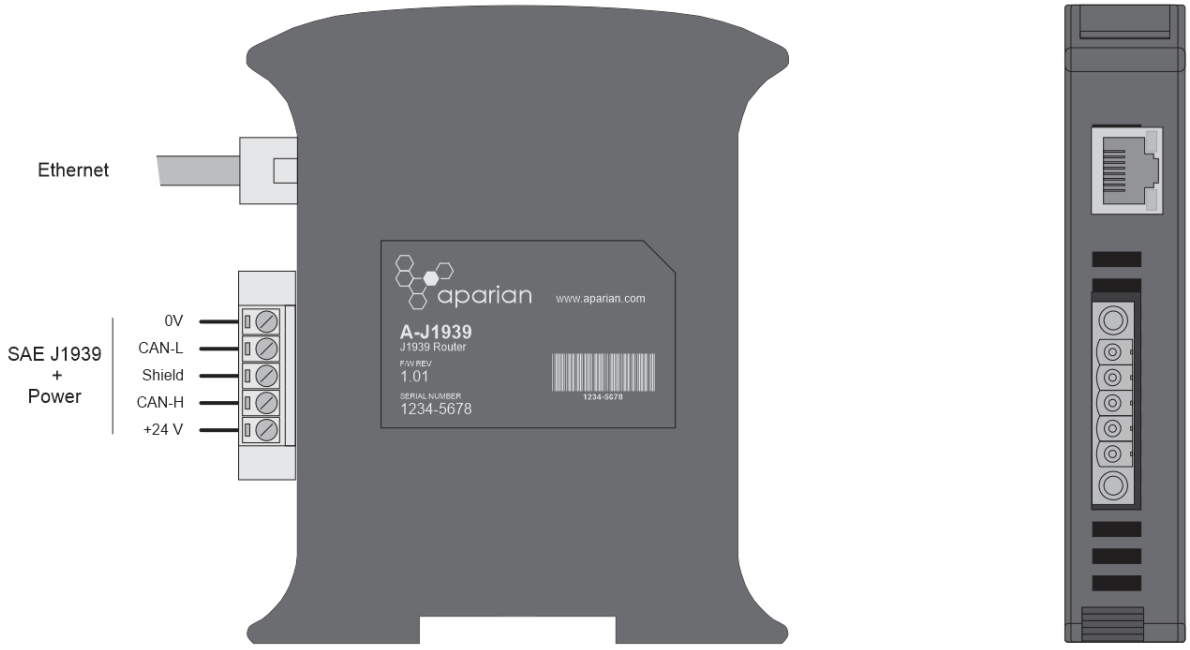


Figure 2.1. – J1939 Router side and bottom view

The module provides three 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, and the J1939 interface.

Figure 2.2. – J1939 Router front and top view

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

DIP Switch	Description
DIP Switch 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 Switch 2	This will force the module into DHCP mode which is useful when the user has forgotten the IP address of the module.
DIP Switch 3	Reserved
DIP Switch 4	Applies the 120Ω terminating resistor across the CAN network (switched between Can-H and Can-L). **NOTE: When the module is at the start or the end of the J1939 network the terminator must be switched on.**

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.

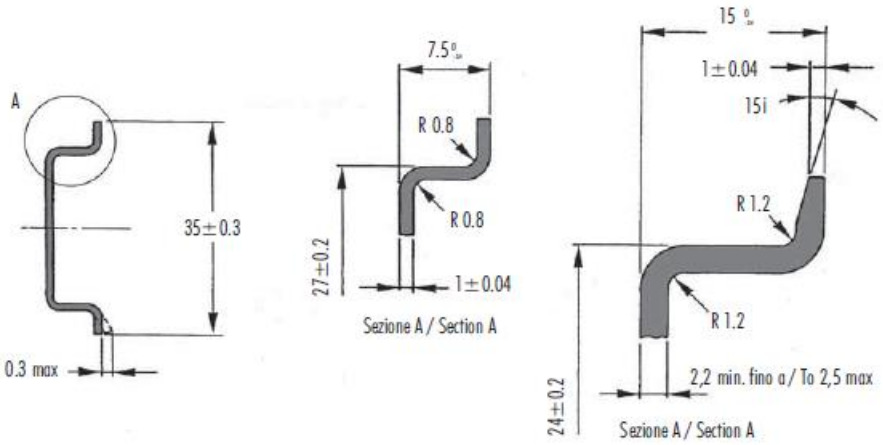


Figure 2.3 - DIN rail specification

The DIN rail clip is mounted on the bottom of the module at the back as shown in the figure below. Use a flat screw driver 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.

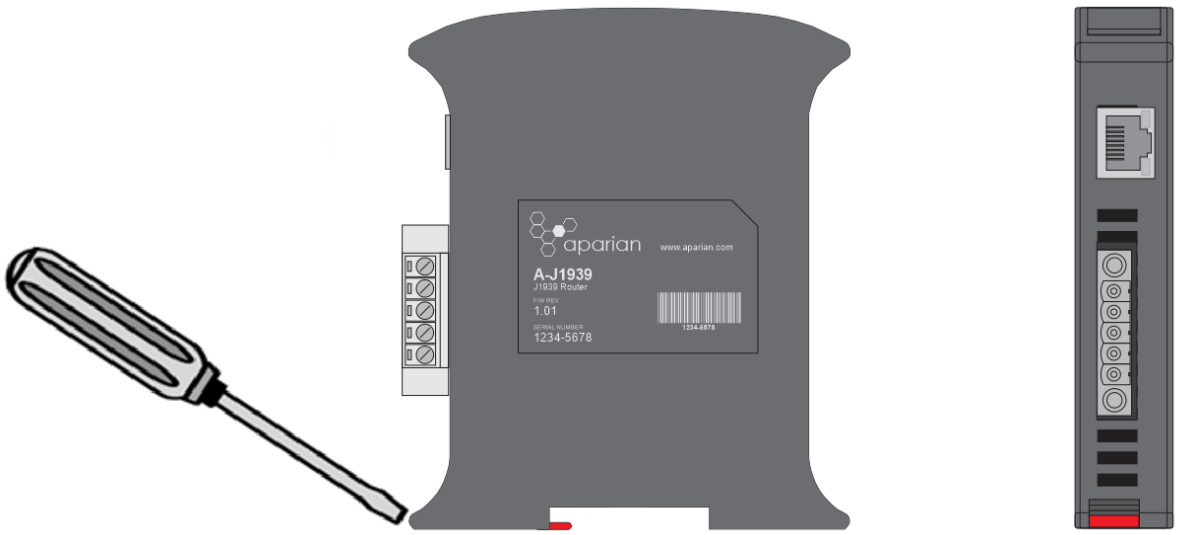


Figure 2.4 - DIN rail mouting

2.3. J1939 AND POWER

A five-way J1939 connector is used to connect the J1939 CAN bus network as well as the Power+, Power– (GND), and earth. The module requires an input voltage of 10 – 28Vdc. **Refer** to the technical specifications section in this document.

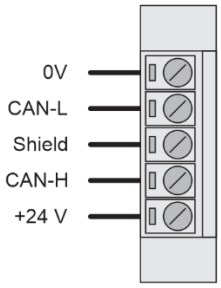


Figure 2.5 – J1939 and Power connector

2.4. ETHERNET PORT

The Ethernet connector should be wired according to industry standards. **Refer** to the additional information section in this document for further details.

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.

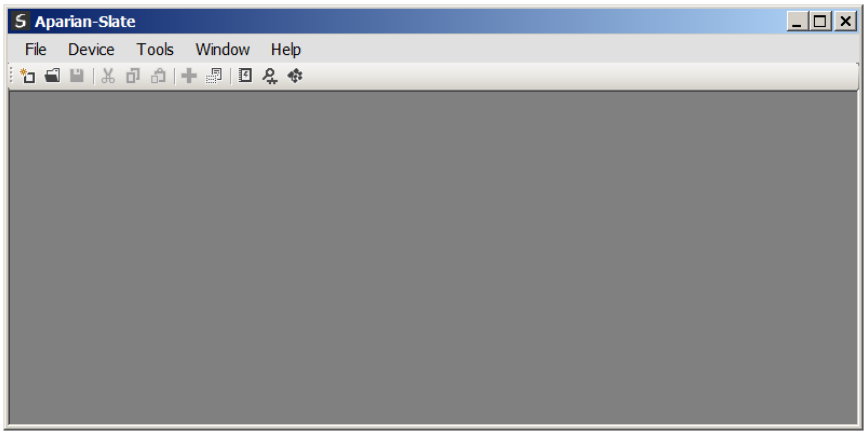


Figure 3.1. - Aparian Slate Environment

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.

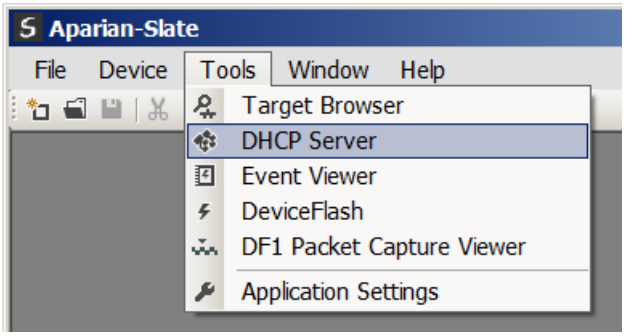


Figure 3.2. - Selecting DHCP Server

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

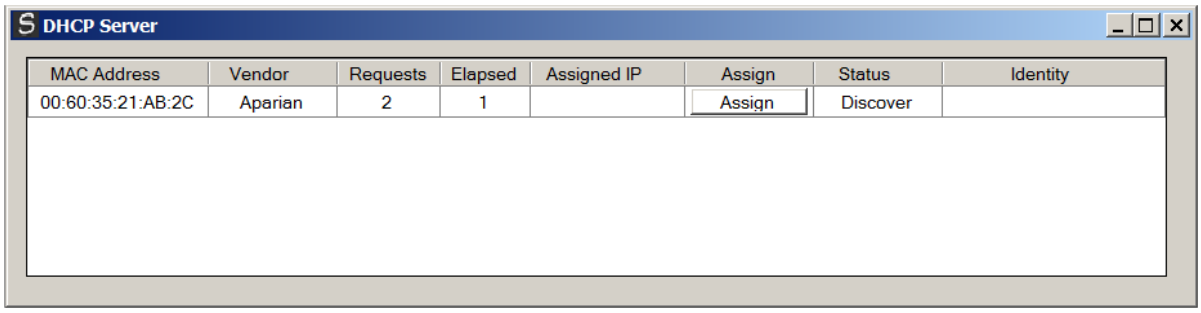


Figure 3.3. - DHCP Server

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.

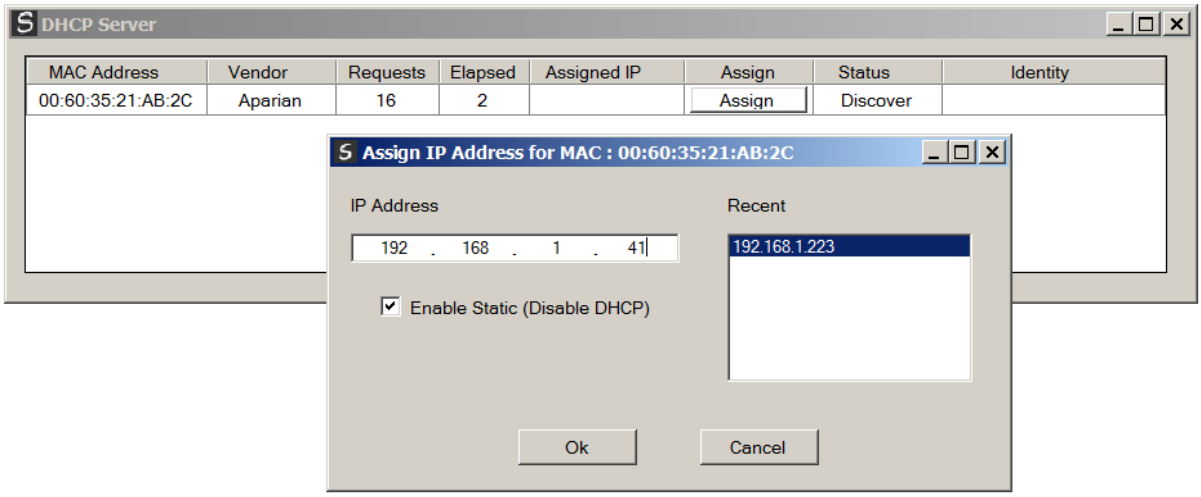


Figure 3.4. - Assigning IP Address

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.

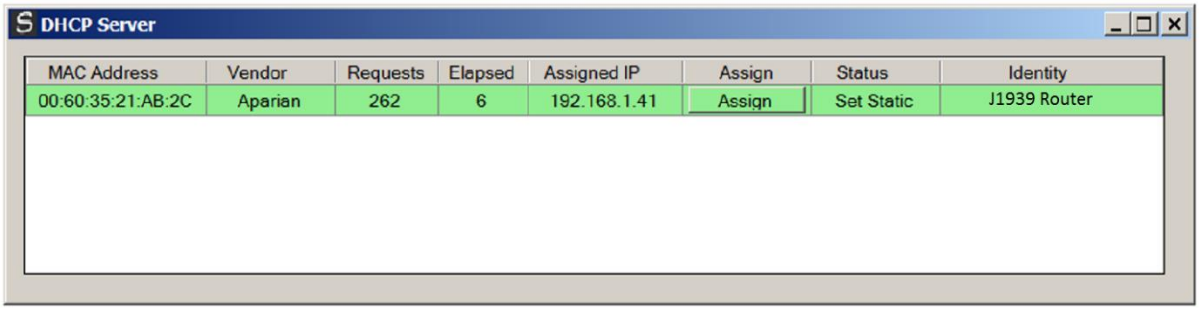


Figure 3.5. - Successful IP address assignment

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.

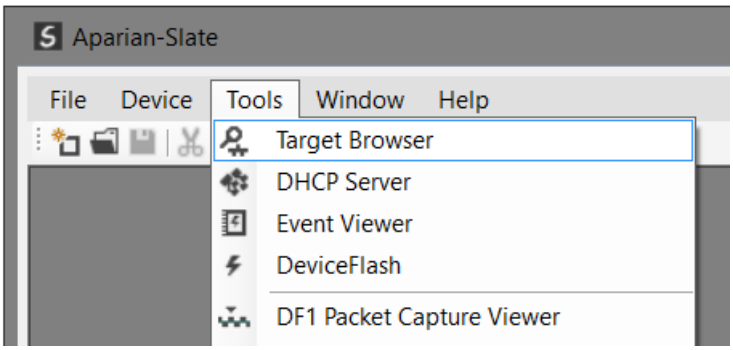


Figure 3.7. - Selecting the Target Browser

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

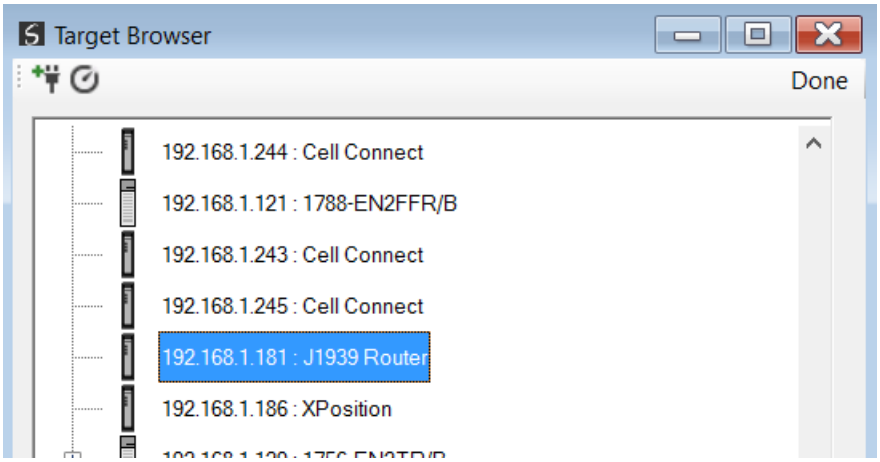


Figure 3.8. - Target Browser

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

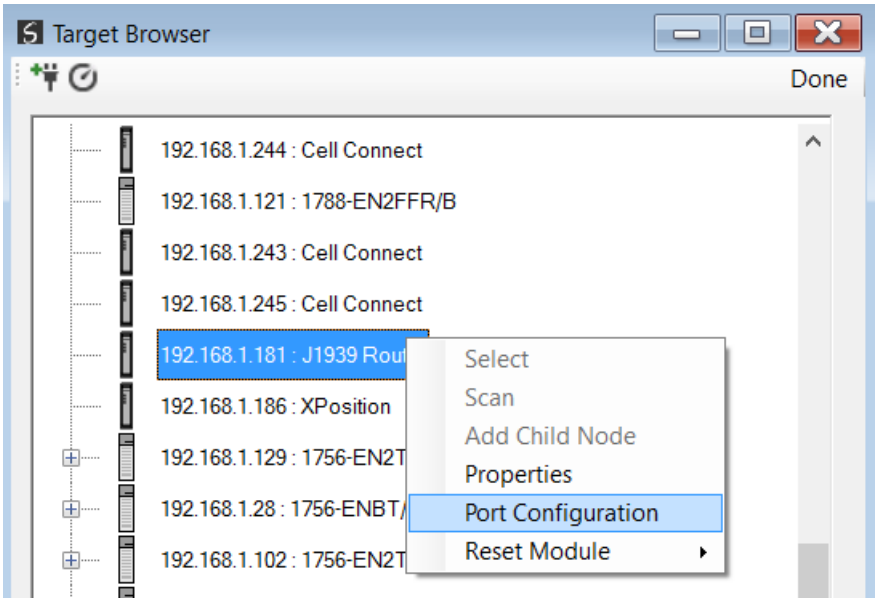


Figure 3.9. - Selecting Port Configuration

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

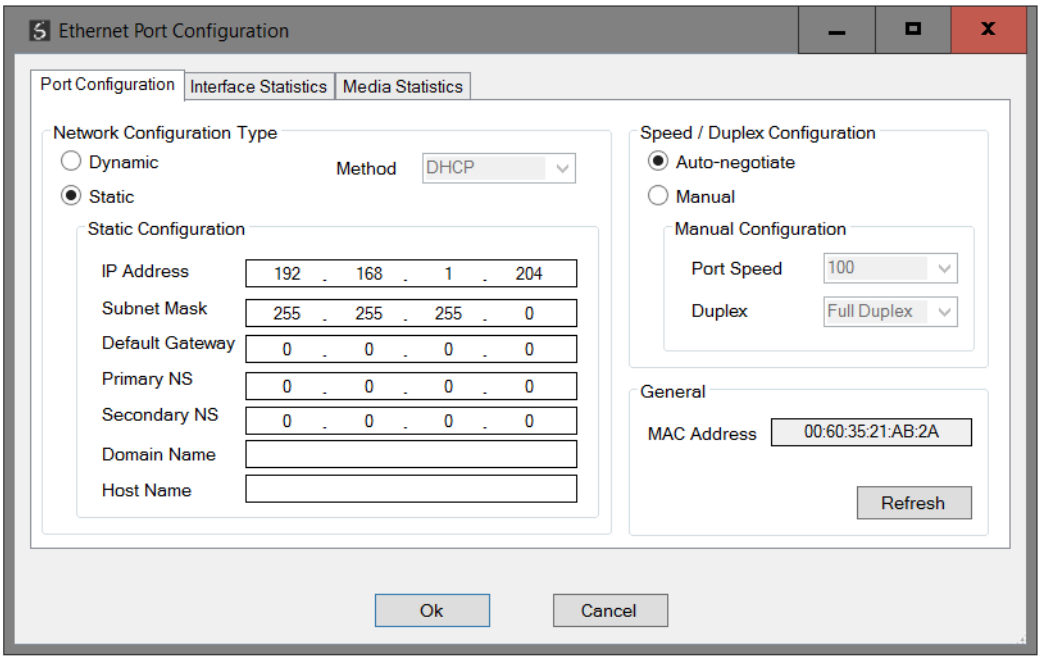


Figure 3.10. - Port Configuration

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

3.3. CREATING A NEW PROJECT

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

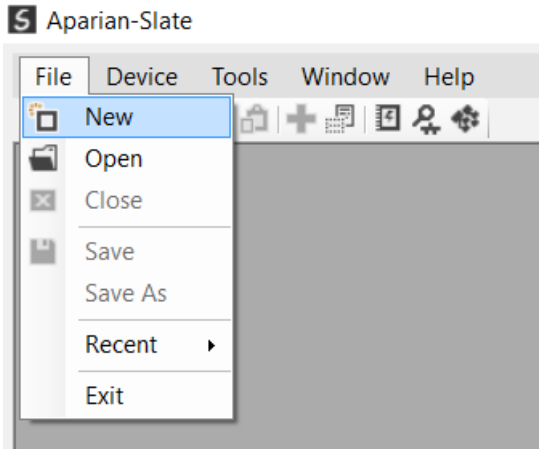


Figure 3.11. - Creating a new project

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.

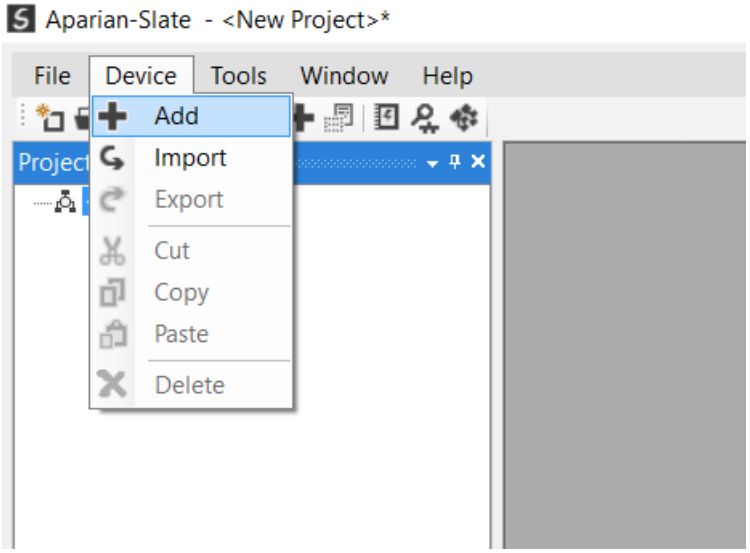


Figure 3.12. - Adding a new device

In the Add New Device window select the J1939 Router, and click the Ok button.

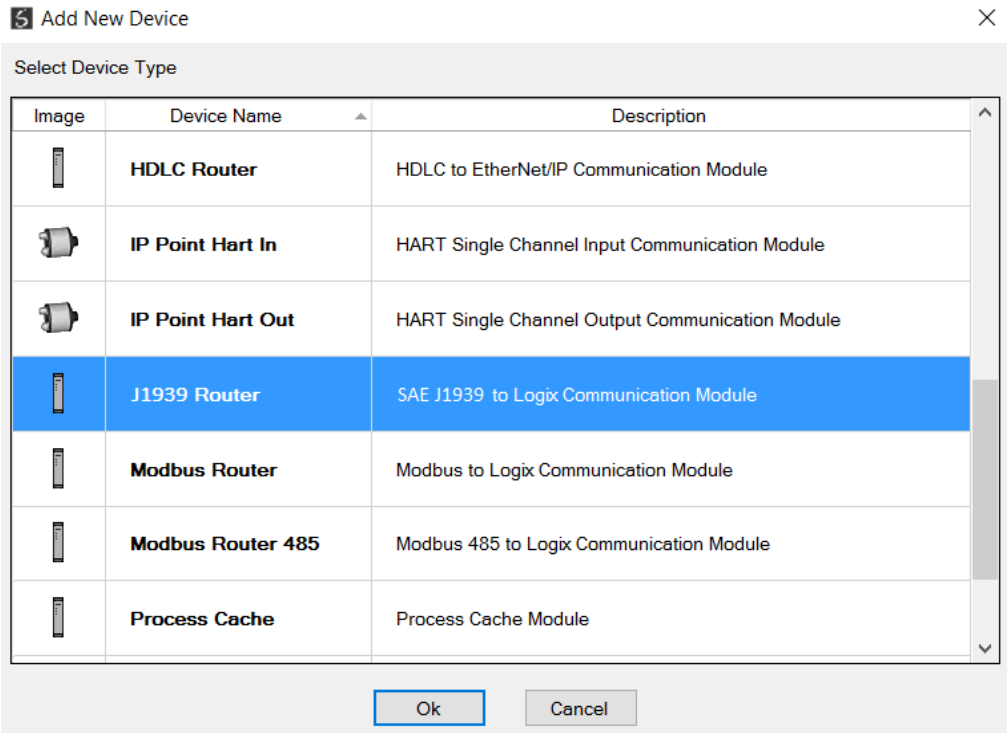


Figure 3.13 – Selecting a new J1939 Router

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*.

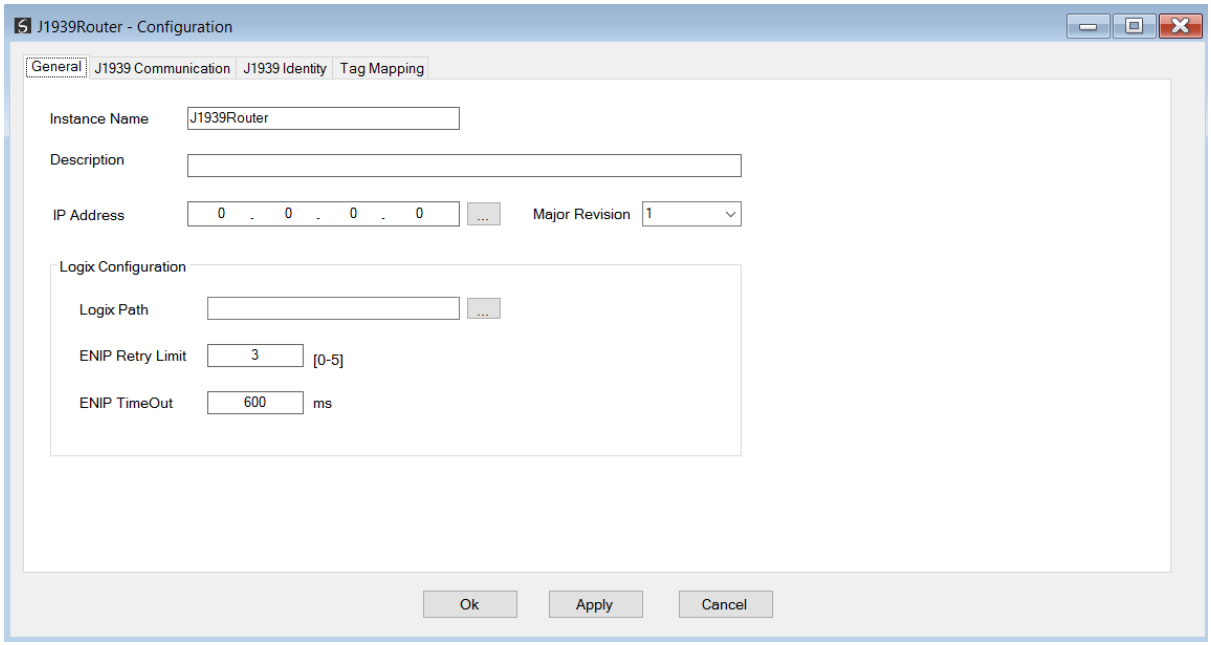


Figure 3.14. – J1939 Router configuration

3.4. J1939 ROUTER PARAMETERS

The J1939 Router parameters are configured using Slate. **Refer** to the additional information section for documentation and installation links for Aparian Slate. The J1939 Router parameter configuration consists of a general configuration, J1939 Communication configuration, J1939 Identity, and Tag Mapping. When downloading this configuration into the module it will be saved in non-volatile memory that persists when the module is powered down.

NOTE: When a firmware upgrade is performed, the module will clear all J1939 Router configuration and routing maps.

The general configuration consists of the following parameters:

Parameter	Description
Instance Name	This parameter is a user defined name to identify between various J1939 Router modules.
Description	This parameter is used to provide a more detail description of the application for the module.
IP Address	The IP address of the target module. The user can use the target browse button to launch the target browser to the select the J1939 Router on the network.
Major Revision	The major revision of the module
Logix Configuration	**Logix Path:** The Logix path is the CIP path to the Logix controller which will be used to exchange data with the various J1939 devices. The user can use the target browse button to launch the target browser to the select the Logix controller on the network. **ENIP Retry Limit** The number of EtherNet/IP retries the module will make once no response was received from the Logix Controller. **ENIP TimeOut** The time in milliseconds after which a retry is sent. Once the first retry is sent the next retry will be sent after the same amount of time. This will repeat until the ENIP Retry Limit is reached.

Table 3.1 - General configuration parameters

The general configuration is shown in the figure below. The J1939 Router general configuration window is opened by either double clicking on the module in the tree or right-clicking the module and selecting *Configuration*.

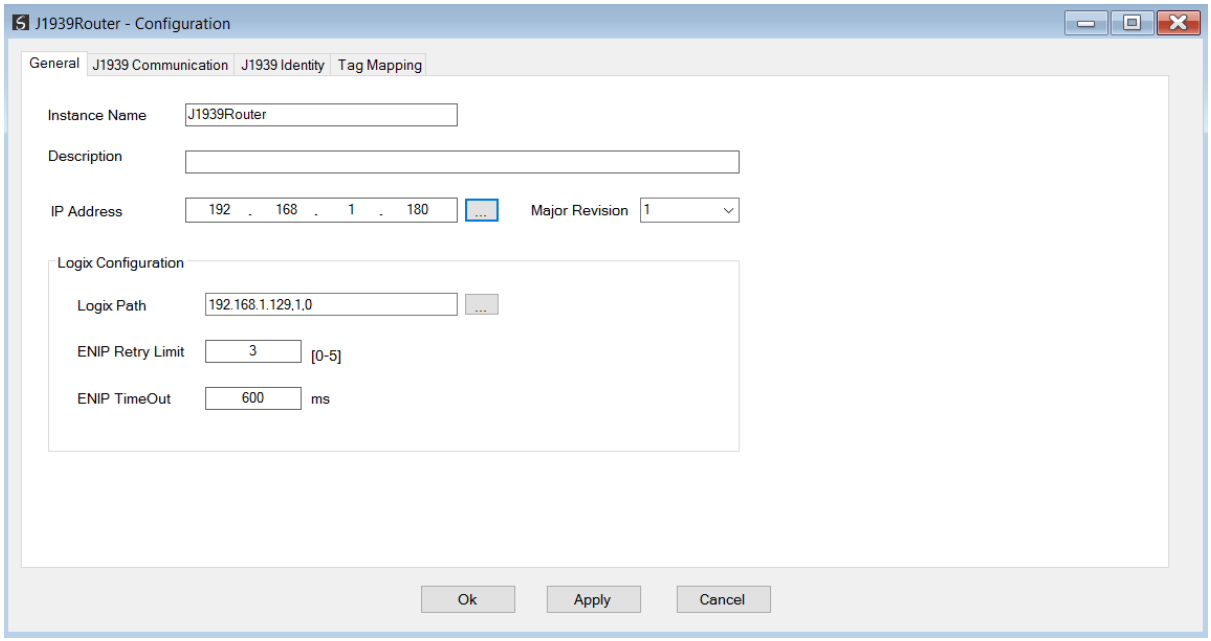


Figure 3.15. - General Configuration

The J1939 Communication configuration consists of the following parameters:

Parameter	Description
BAUD Rate	The J1939 CAN bus BAUD rate. The following options are available: • 250k • 500k
Node Address	The module's node address on the J1939 CAN bus network.
CAN Retry Limit	The number of retries that will be attempted before indicating the device is offline.
CAN Message Timeout	The response wait period in milliseconds before flagging a no response.
Arbitrary Address Capable	When this is set the J1939 Router module will start with the configured node address, but if there is a conflict and the J1939 Router has a lower priority it will change its Node address to an open slot and continue operation. **NOTE:** When this is **not** set the J1939 Router module will start with the configured node address, but if there is a conflict and the J1939 Router has a lower priority it will stop communicating until a new address has been configured and downloaded.

Table 3.2 – J1939 Communication parameters

The J1939 Communication configuration is shown in the figure below. The J1939 Communication configuration window is opened by either double clicking on the module in the tree or right-clicking the module and selecting *Configuration*.

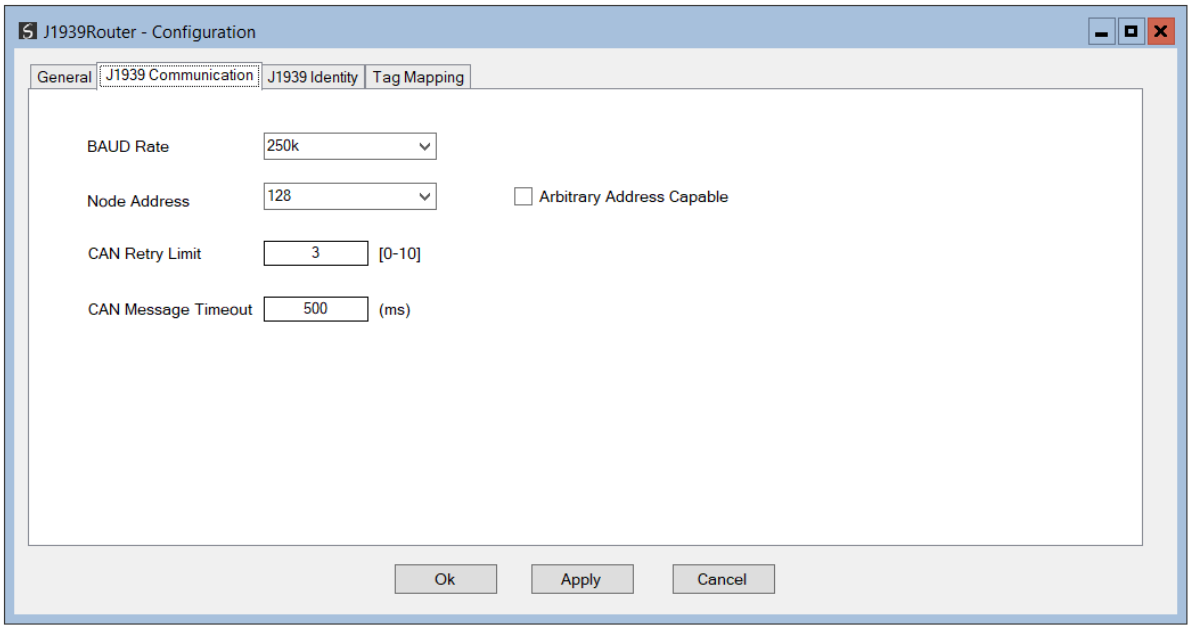


Figure 3.16 – J1939 Communication Configuration

The J1939 Identity configuration consists of the following parameters:

Parameter	Description
Industry Group	The J1939 Name consists of the following elements. These can be configured to provide the J1939 Router with a specific name. Refer to the J1939 specification (see section 1.3 for additional information).
Vehicle System	
Vehicle System Instance	
Function	
Function Instance	
ECU Instance	
Manufacturer Code	

Table 3.3 – J1939 Identity parameters

The J1939 Identity configuration is shown in the figure below. The J1939 Identity configuration window is opened by either double clicking on the module in the tree or right-clicking the module and selecting *Configuration*.

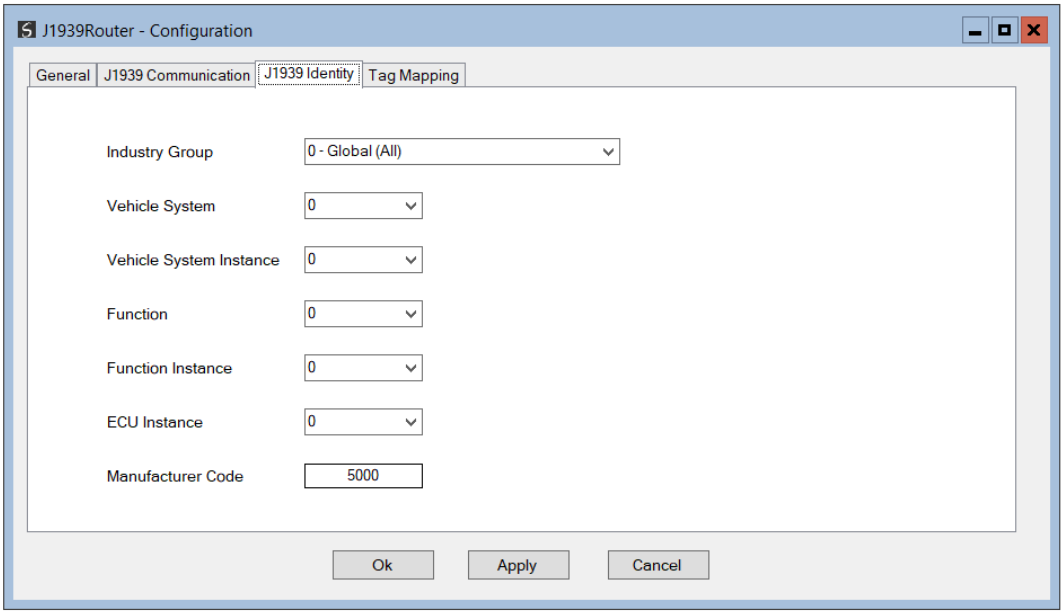


Figure 3.17 – J1939 Identity Configuration

3.5. MESSAGE ROUTING

The module can be configured to exchange data between a Logix controller and various J1939 devices. This will allow the user to read data from a J1939 device into a Logix controller and/or write data to a J1939 device from a Logix controller.

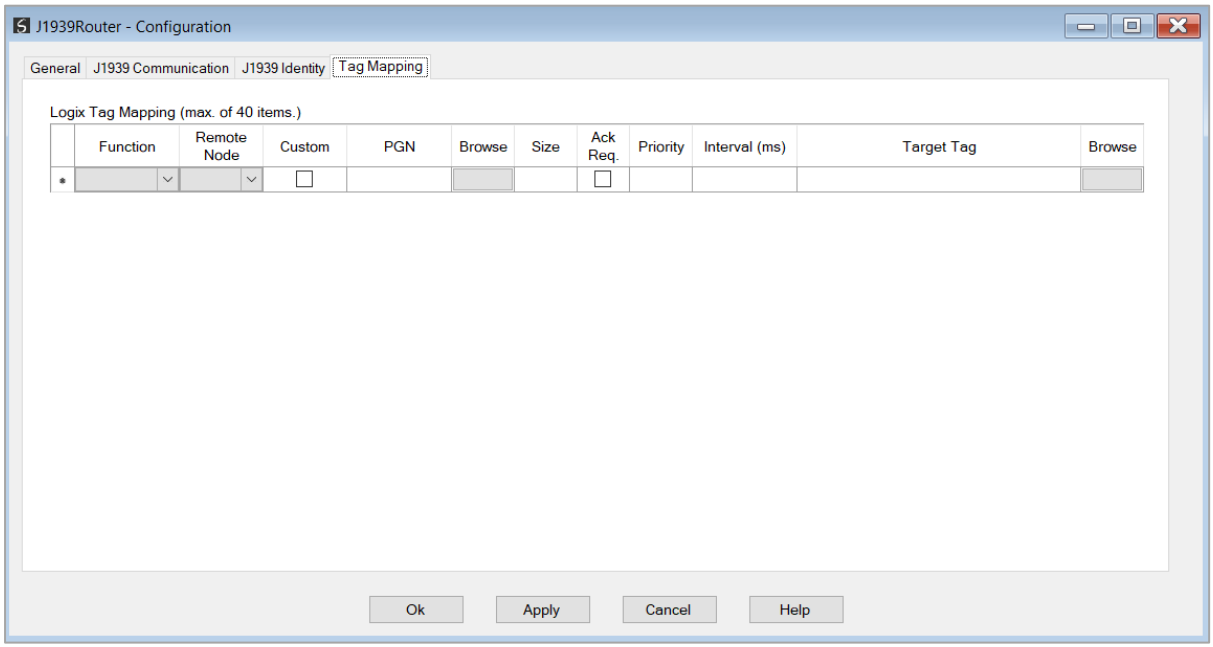


Figure 3.18 – Tag Mapping Configuration

Below is a description for each parameter in the Tag Mapping.

Parameter	Description
Function	The operation of the mapped item. **Consume** The J1939 Router will receive J1939 PGNs and write the data into Logix tags. **Produce** The J1939 Router will read data from Logix tags and transmit PGNs on the J1939 network. Refer to the *Consume Function* and *Produce Function* sections for more detail.
Remote Node	The destination node that the PGN is mapped to. **NOTE:** Node 255 is a broadcast address.
Custom	The user can select this option to either use a standard SAE defined PGN or a custom manufacturer defined PGN. When selecting the Custom PGN option the target Logix tag must be a SINT array and the user will need to decode the data in Logix. Refer to the *Custom vs Standard PGN* section for more detail.
PGN	The PGN number for the specific mapped item.
Size	The size (in bytes) of the PGN data that will be transmitted.
Ack Req.	Each Peer to Peer PGN mapping item to be selected to either send a J1939 ACK (Consume) or wait for a ACK (Produce).
Priority	The priority of the PGN that will be transmitted.
Interval	This is update interval for the specific PGN in milliseconds.
Target Tag	The Logix Tag that will be used to exchange data with the specific J1939 device. The target tag can either be entered manually or if online with the controller the target tag can be updated using the target browser. (See figure below).

Table 3.4 – J1939 Identity parameters

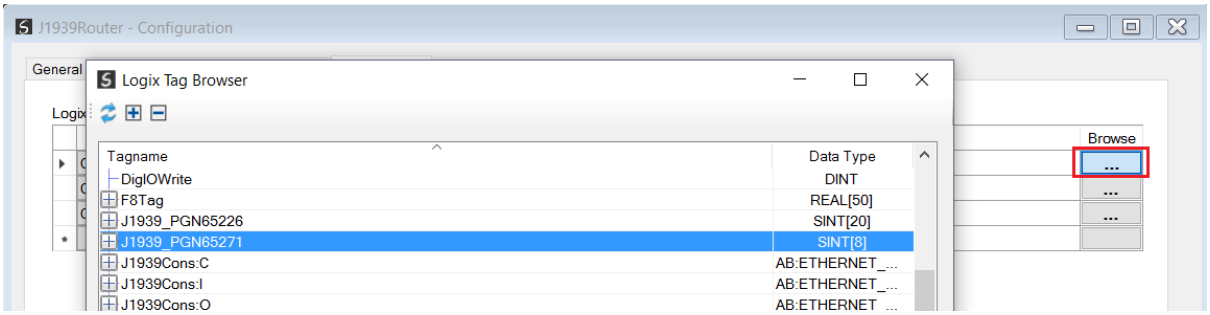


Figure 3.19 – Tag Mapping parameters

NOTE: If there are duplicate mapping items in the mapping list then only the first mapped item (of all the duplicates) will be executed. The other mapped items will keep requesting the PGN as they are not executing successfully.

3.5.1. CONSUME FUNCTION

When the user has selected the Consume function for a mapped item the J1939 Router will receive the specific PGN and write the data into a Logix tag as shown below.

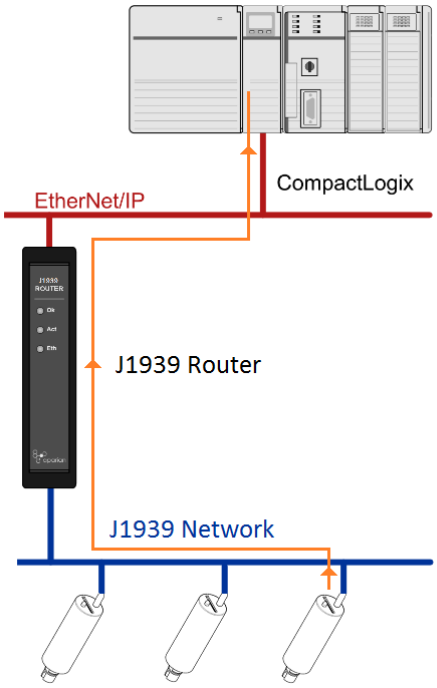


Figure 3.20 – Consume Function data flow

If no PGN is receive from the specified node within **three** update intervals the J1939 Router will request the mapped PGN from the configured node address.

NOTE: PGNs are made up of various SPNs, but many devices only support certain SPNs which means only certain parts of the PGN returned is valid. The industry norm is to make the SPNs not supported all 1s (e.g. a byte SPN that is not supported will be returned as 0xFF).

NOTE: Some PGNs are of variable length (e.g. PGN 65226 – Active Diagnostics). The user must ensure that the selected Logix tag (of type SINT array) is sufficiently large to accommodate the largest packet size for that specific PGN.

3.5.2. PRODUCE FUNCTION

When the user has selected the Produced function for a mapped item the J1939 Router will read data from a Logix tag and transmit the specific PGN (with the Logix Data reformatted) on the J1939 network as shown below.

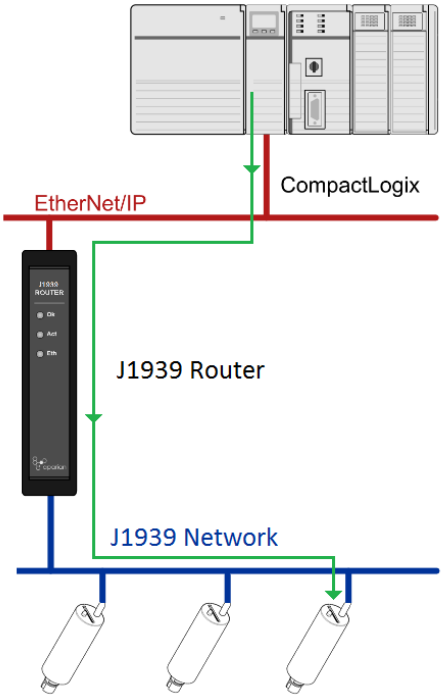


Figure 3.21 – Produce Function data flow

The mapped PGN will be transmitted on the J1939 network at the configured update interval.

3.5.3. CUSTOM VS STANDARD PGN

For each mapped item the user can select to either use a standard SAE defined PGN or a custom manufacturer defined PGN. When using a standard PGN the user can use the PGN browse button to select from the list of SAE defined PGNs as shown below.

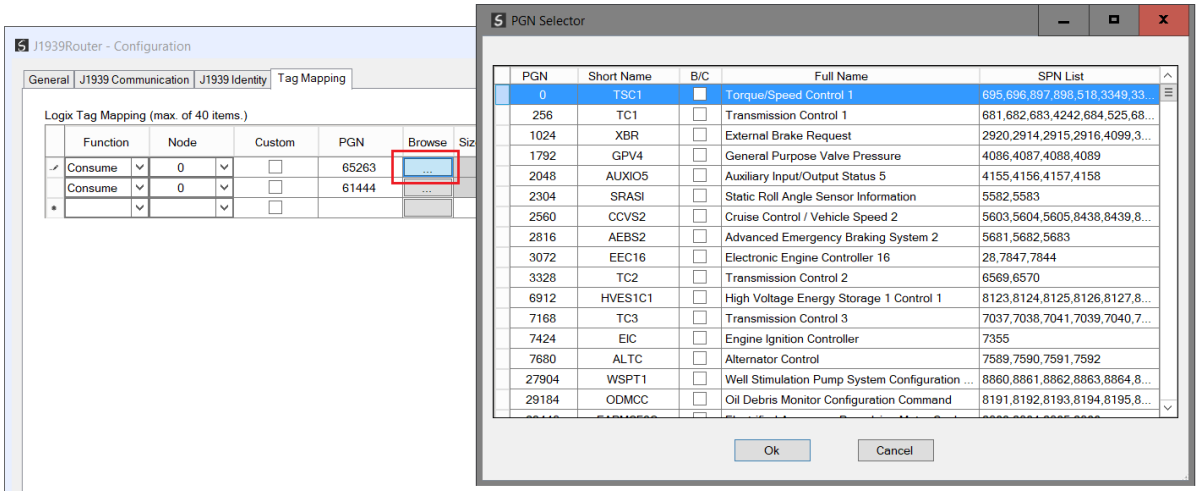


Figure 3.22 – PGN selection list

When selecting a standard SAE defined PGN a Logix UDT will be used to map the data from the PGN into Logix. Slate can automatically create the Logix UDTs and Tags (via a Logix L5X file) needed to accurately map the specific variable data (or SPNs). See the *Generating Logix L5X* section for more information regarding this feature.

The J1939 Router module will also automatically scale the J1939 data sent/received as per the SAE PGN standards and definitions.

NOTE: When using Standard SAE defined PGNs it is strongly recommended that the automatic UDT and Tag generation function is used to ensure the correct data structure mapping.

NOTE: Using an incorrectly formed UDT for J1939 data exchange can cause unexpected and dangerous results.

When selecting a custom PGN the Logix Data Type used is a SINT array. The user will need to extract, scale, and reformat the required data in the Logix environment.

NOTE: The L5X generation will also create the Tag (of data type SINT array) for custom PGNs.

3.5.4. Generating Logix L5X

The standard SAE specified PGN data received from, or being sent to, each J1939 device must be formatted and scaled as per the SAE Standards and Definitions. Each PGN consists of one or more SPNs each with its own data type and scaling. For this reason, a UDT must be used to map the received data in Logix.

Slate allows the user to create all the needed Logix UDTs and Tags for each J1939 Router by creating a Logix L5X export file which can simply be imported into Logix. Below are the required steps for generating and importing of the Logix UDTs and Tags required for a J1939 Router.

Once the user has created a J1939 Router project with the required PGN mappings the *Generate Logix L5X* option must be selected as shown below:

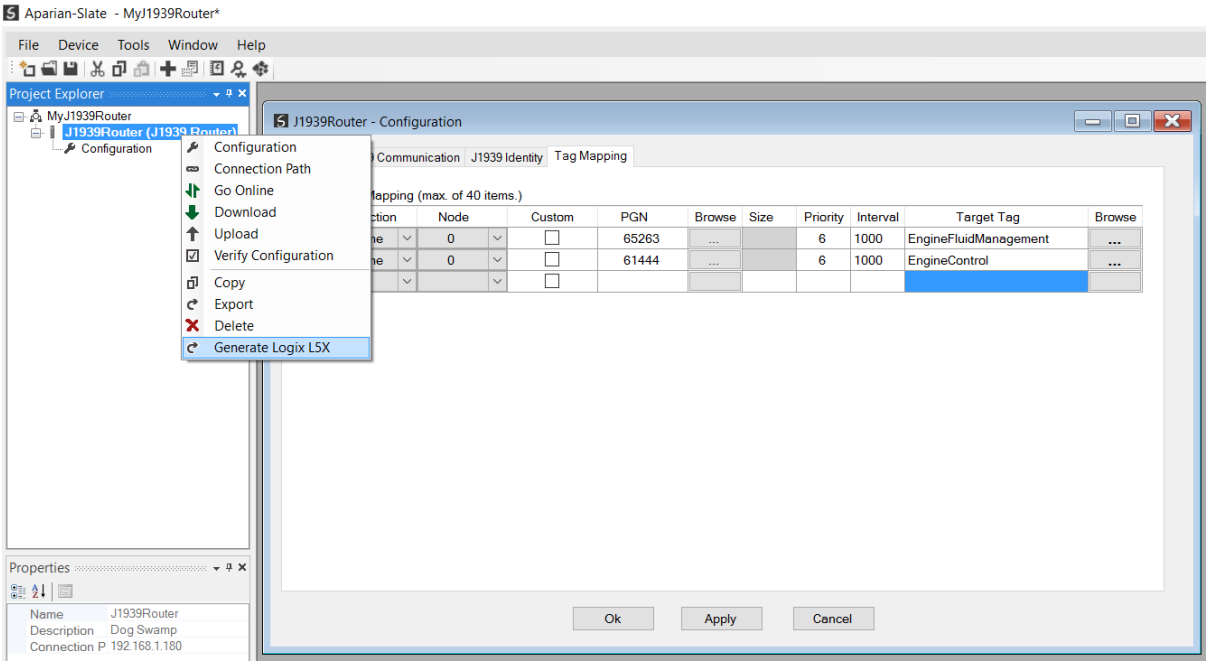


Figure 3.23 – Generate Logix L5X Option

Select the destination folder of the L5X export file and press the save button.

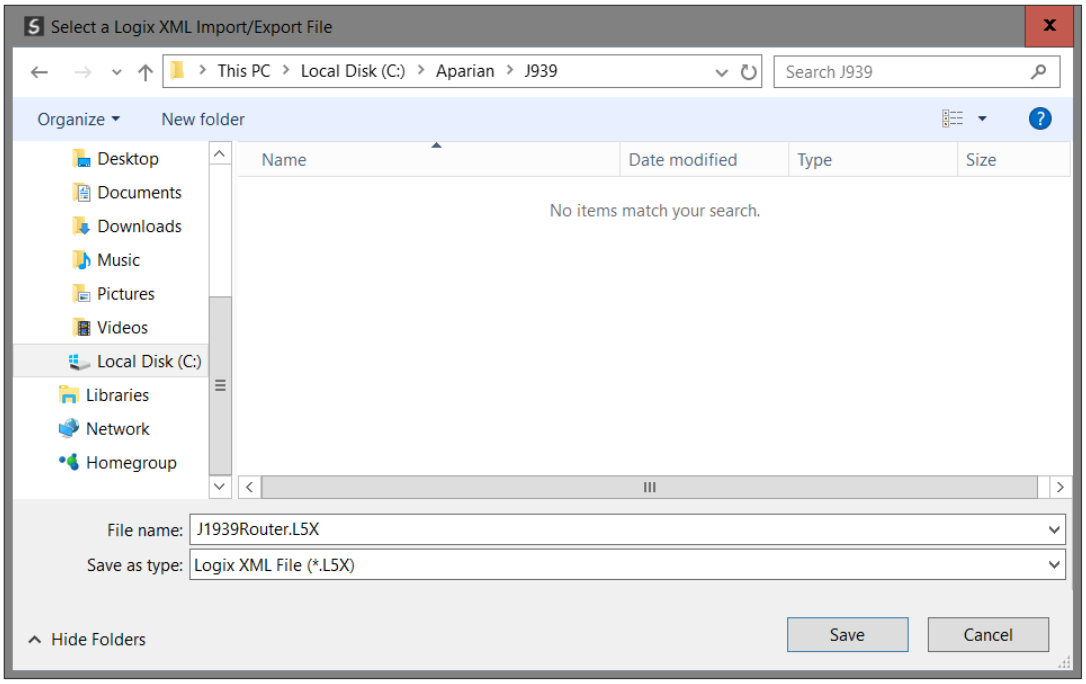


Figure 3.24 – Save L5X file

In the Logix environment right click on the User-Defined element under Data Types and select *Import Data Type*.

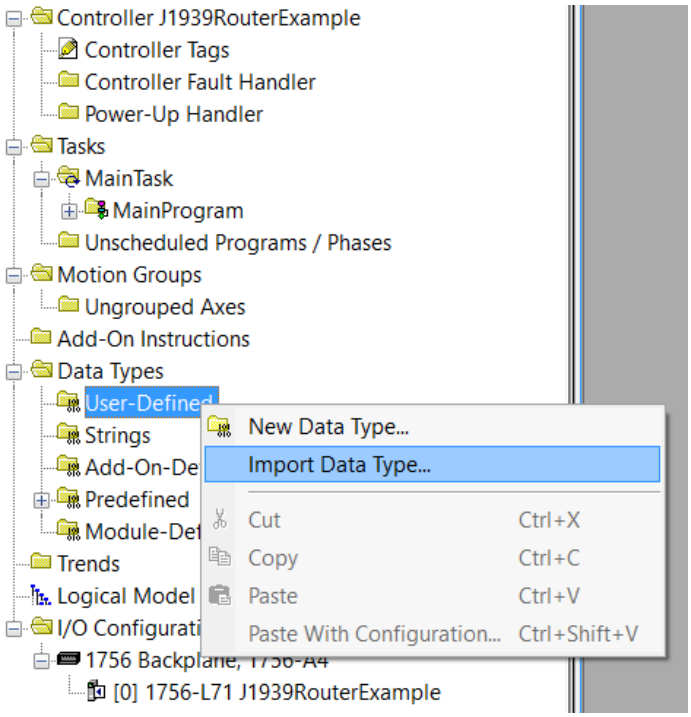


Figure 3.25 – Import L5X file into Logix

Select the previous generated L5X file and select open. The required UDTs and configured Tags have now been added to the Logix Controller which directly map to the J1939 Router Slate project configuration.

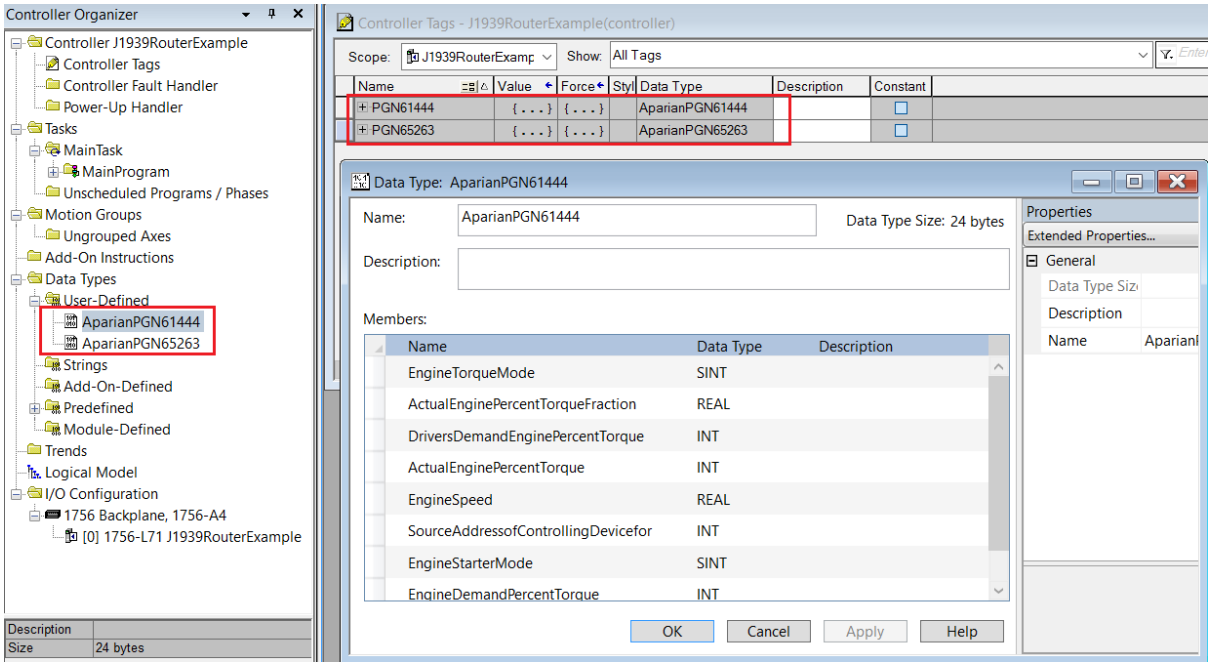


Figure 3.26 – Imported UDTs and Tags

3.6. MODULE DOWNLOAD

Once the J1939 Router configuration has been completed, it must be downloaded to the module.

Before downloading the Connection Path of the module should be set. This path will automatically default to the IP address of the module, as set in the module configuration. It can however be modified, if the J1939 Router is not on a local network.

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

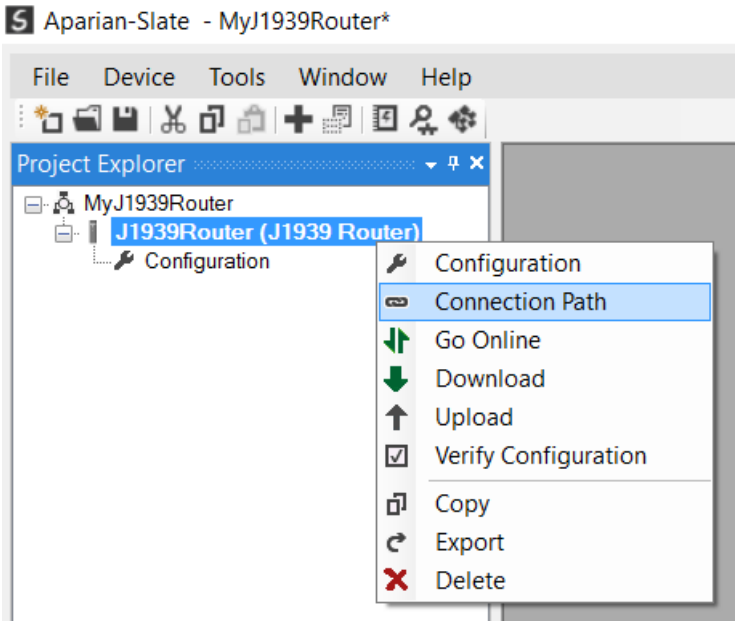


Figure 3.27 - Selecting Connection Path

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

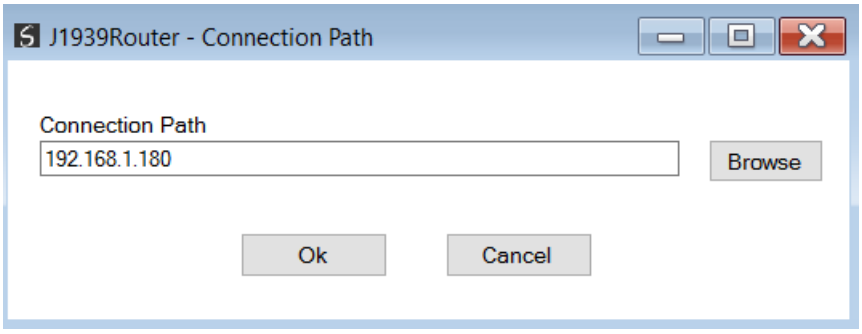


Figure 3.28 - Connection Path

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

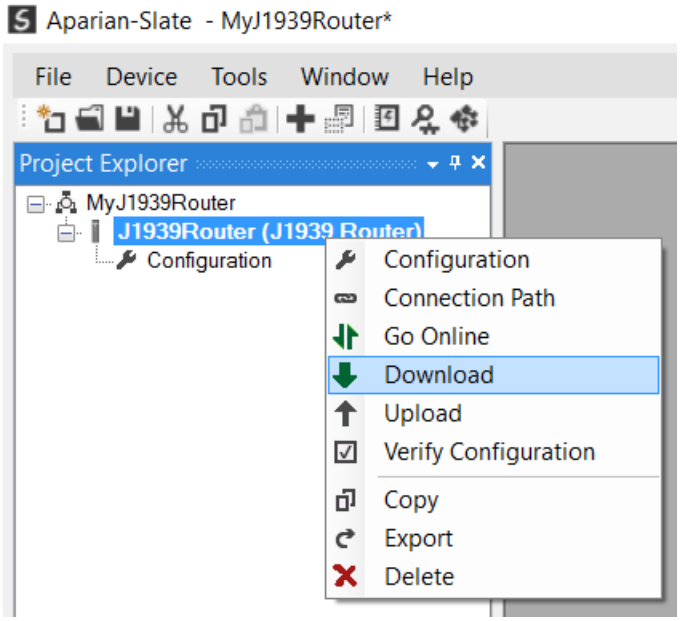


Figure 3.29 - Selecting Download

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

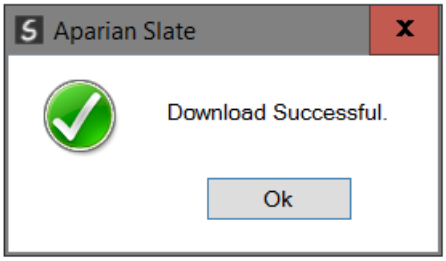


Figure 3.30 - Successful download

Within the Slate environment the module will be in the Online state, indicated by the green circle around the module.

The module is now configured and will start operating immediately.

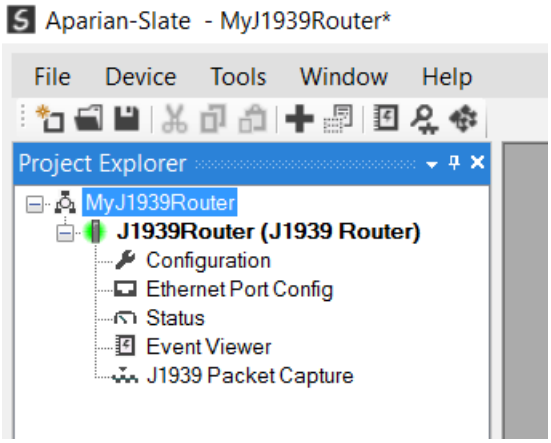


Figure 3.31 - Module online

3.7. LOGIX 5000 CONFIGURATION

3.7.1. ADD MODULE TO I/O CONFIGURATION

When the module operates in a Logix "owned" mode the J1939 Router will need to be added to the Logix 5000 I/O tree. The module will need to be added as a generic Ethernet module. This is done by right clicking on the Ethernet Bridge in the Logix 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).

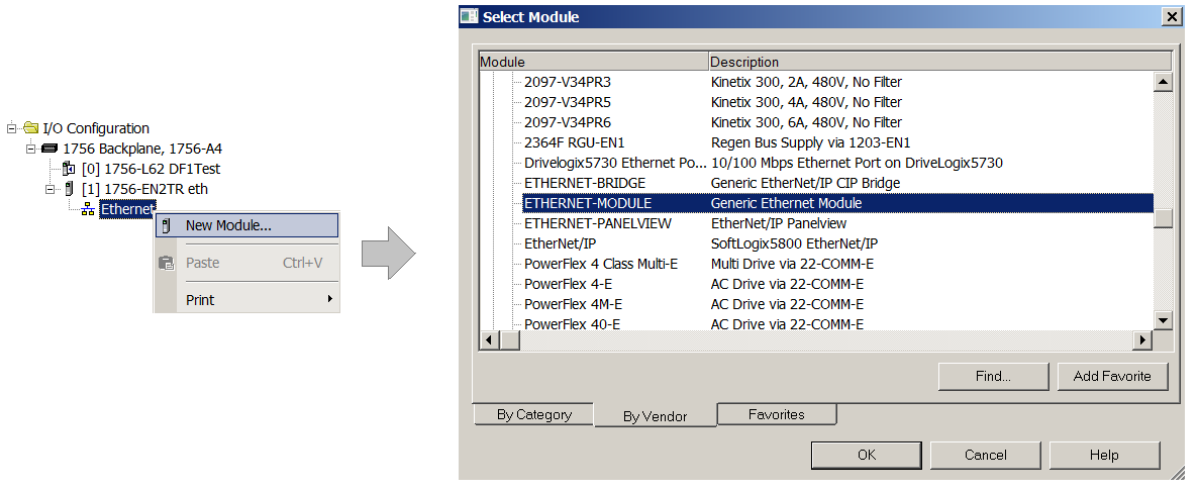


Figure 3.32 - Add a Generic Ethernet Module in Logix 5000

The user must enter the IP address of the J1939 Router that will be used. The assembly instance and size must also be added for the input, output, and configuration in the connection parameters section. Below are the required connection parameters.

Connection Parameter	Assembly Instance	Size
Input	123	31 (32-bit)
Output	101	1 (32-bit)
Configuration	102	0 (8-bit)

Table 3.5 - Logix class 1 connection parameters for the J1939 Router

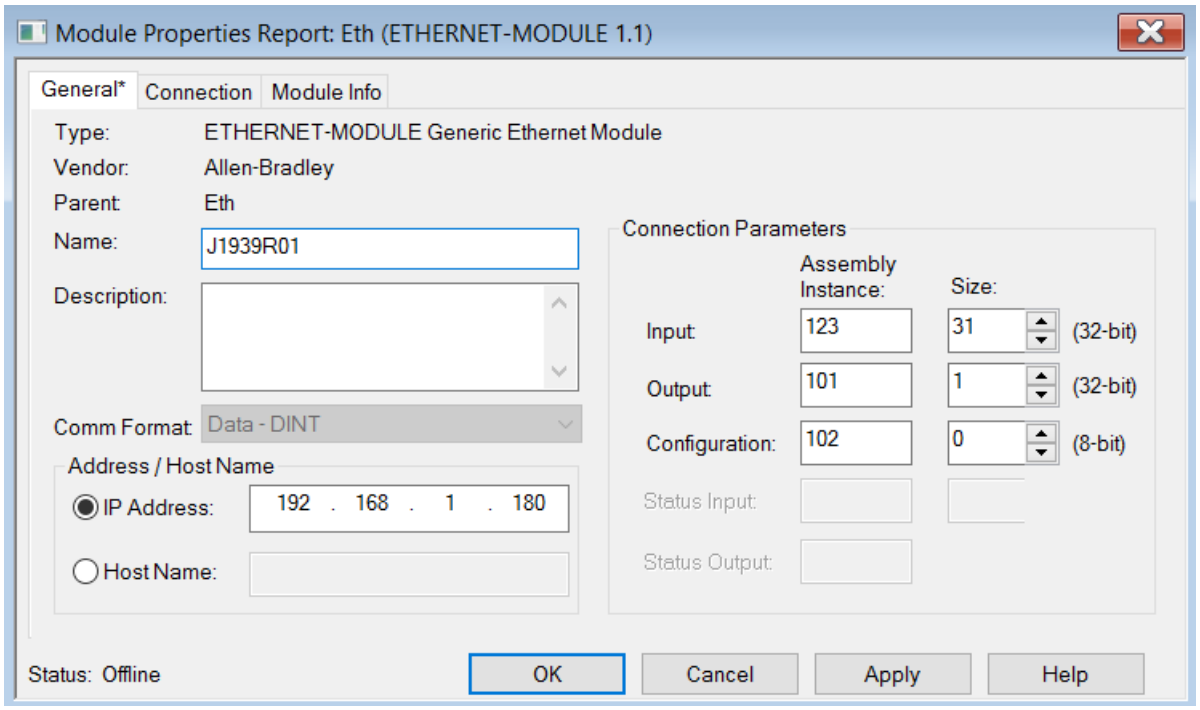


Figure 3.33 - Logix General module properties in Logix 5000

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

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

NOTE: Although the module is capable of running with an RPI of 10ms, it is recommended to set the RPI to 200ms, to avoid unnecessary loading of the module processor.

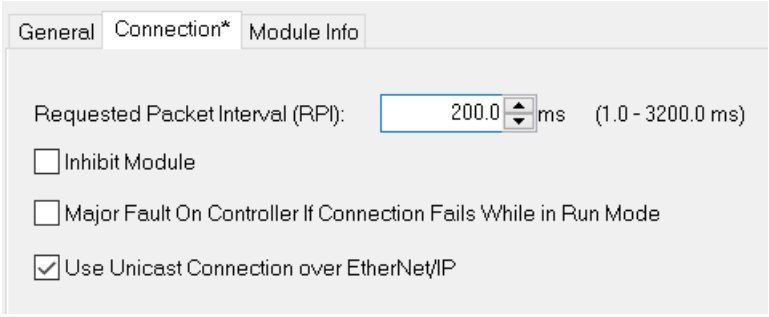


Figure 3.34 - Connection module properties in Logix 5000

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

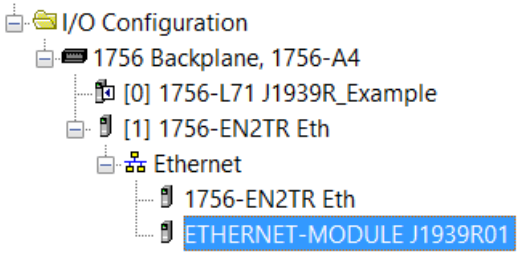


Figure 3.35 – Logix 5000 I/O module tree

3.7.2. Importing UDTs and Mapping Routines

To simplify the mapping of the input image, a Logix 5000 Routine Partial Import (L5X) file is provided.

This file can be imported by right-clicking on the required Program and selecting the Import Routine option.

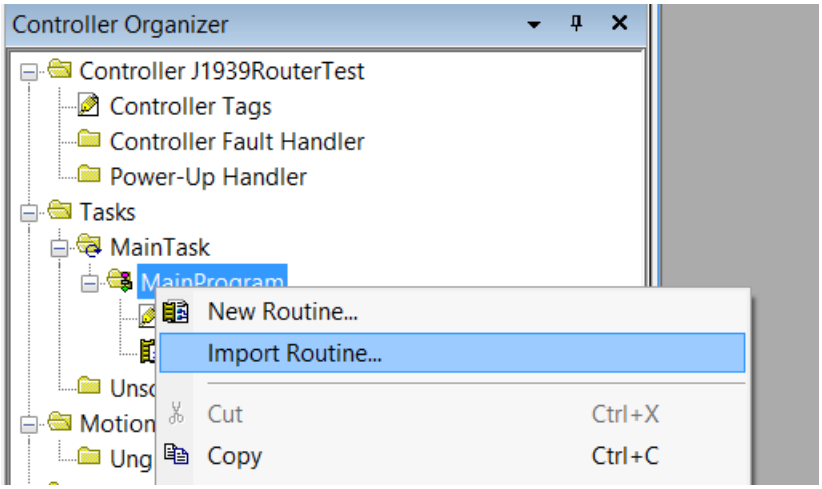


Figure 3.36 – Logix 5000 Importing J1939 Router specific routine and UDTs

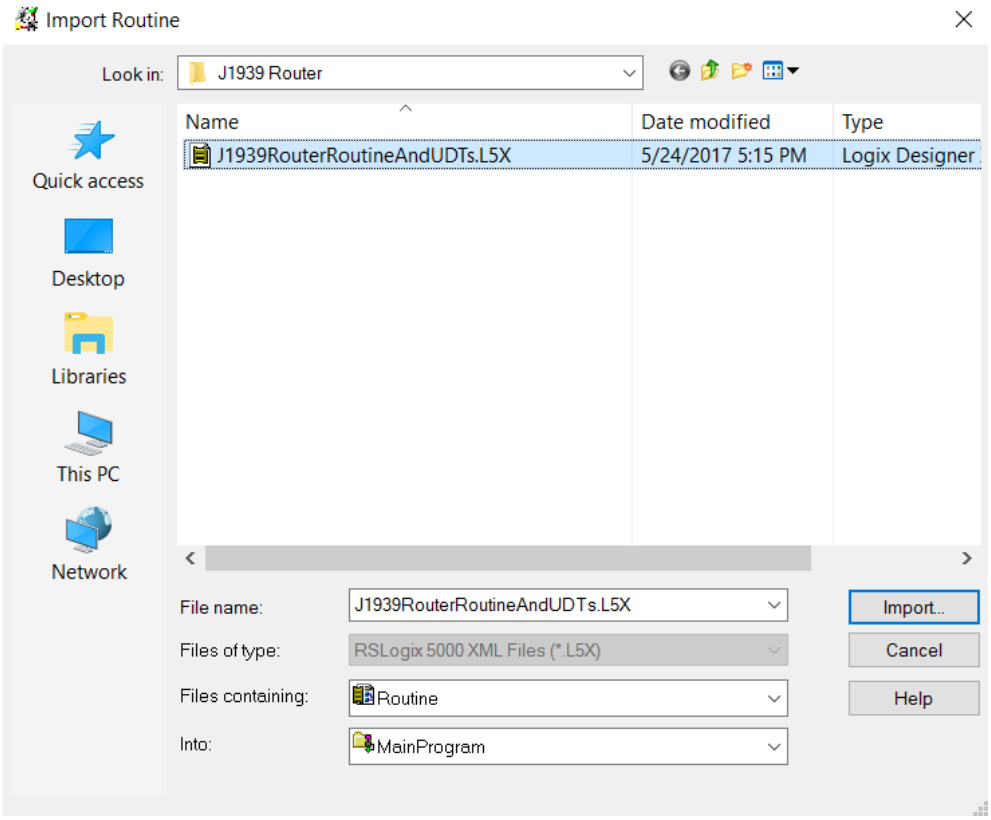


Figure 3.37 - Selecting partial import file

The import will create the following:

- The required UDTs (user defined data types)
- Two controller tags representing the Input and Output assemblies.
- A routine mapping the J1939 Router module to the aforementioned tags.

The user may need to change the routine to map to the correct J1939 Router module instance name, and make sure that the mapping routine is called by the Program's Main Routine.

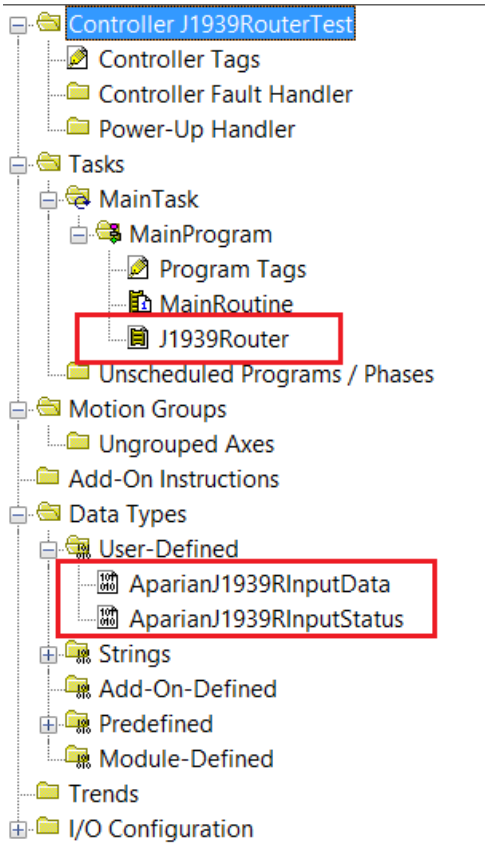


Figure 3.38 - Imported Logix 5000 objects

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

4. OPERATION

4.1. MESSAGE ROUTING

Once the module has been configured correctly, the J1939 Router will produce and consume configured PGNs on the J1939 network and route the data to and from the selected Logix tags. Once a transaction has been successfully completed the ***Transaction Ok*** bit in the mapped items status will be set. Refer to the diagnostics section of this document for a more detailed explanation of the various indicators that can be used to diagnose the module.

With each successful consume transaction the Tag Data will be updated as shown below:

PGN65263	{...}	{...}		PGN65263
PGN65263.FuelPressue	1020.0		Float	REAL
PGN65263.BlowbyPressure	12.75		Float	REAL
PGN65263.OilLevel	102.0		Float	REAL
PGN65263.OilPressure	1016.0		Float	REAL
PGN65263.CrankCasePressure	510.03906		Float	REAL
PGN65263.CoolantPressure	510.0		Float	REAL
PGN65263.CoolantLevel	102.0		Float	REAL

Figure 4.1 – J1939 Router Input and Output Assembly

4.2. LOGIX 5000 ASSEMBLIES

When the module operates in a Logix “owned” mode the Logix controller will establish a class 1 cyclic communication connection with the J1939 Router. An input and output assembly is exchanged at a fix interval (RPI). The UDTs provided will convert the input and output arrays into tag based assemblies. Refer to the additional information section in this document for the input and output UDTs.

4.2.1. INPUT ASSEMBLY

The following parameters are used in the input assembly of the module.

Parameter	Datatype	Description
InstanceNameLen	DINT	This parameter is the instance name length of the module that was configured under the general J1939 Router configuration in Slate.
InstanceName	SINT[16]	This parameter is the instance name of the module that was configured under the general J1939 Router configuration in Slate.

Status.ConfigValid	BOOL	Set if a valid configuration is executing in the module.
Status.DuplicateNode	BOOL	Set if a duplicate node is detected on the network.
TransactionRate	DINT	The transaction rate is the number of J1939 messages per second that the module is currently routing.
DeviceTemperature	REAL	The internal temperature of the J1939 Router module.
RxCANCount	DINT	Received CAN message count.
TxCANCount	DINT	Transmitted CAN message count.
CANCrcCount	DINT	CAN CRC failed message count.
CANBitError	DINT	CAN Bit error count.
CANStuffError	DINT	CAN Stuff error count.
J1939ReqTxCount	DINT	J1939 PGN Request Transmitted count.
J1939ReqRxCount	DINT	J1939 PGN Request Received count.
J1939ResTxCount	DINT	J1939 PGN Response Transmitted count.
J1939ResRxCount	DINT	J1939 PGN Response Received count.
TagReads	DINT	The total number of Logix tag reads executed by the module.
TagWrites	DINT	The total number of Logix tag writes executed by the module.
ConnectionFailures	DINT	The number of failed class 3 connection attempts. Note: Logix tag reading and writing requires the module to first establish a class 3 connection with the Logix Controller.
TagErrors	DINT	The number of failed tag access (read/write) requests. These may include privileged violations, non-existing tags, etc.
MappedItems	SINT[40]	Each mapped item has status bits to provide feedback of its operation. ***Bit 0 – Transaction Ok*** If this bit is set it means that the specific mapped item is successfully communicating between the J1939 device and the Logix controller. ***Bit 1-7 – Reserved*** These bits are reserved for future use.

Table 4.1 - Logix 5000 input assembly parameters

4.2.2. OUTPUT ASSEMBLY

The following parameters are used in the output assembly of the module.

Parameter	Datatype	Description
Reserved	DINT	This DINT is reserved for future use.

Table 4.2 - Logix 5000 output assembly parameters

An excerpt of the Input Image is shown in the following figure.

Name	Value	Force Mask	Style	Data Type
J1939R01Input	{...}	{...}		AparianJ1939RInputData
J1939R01Input.InstanceNameLen	0		Decimal	DINT
J1939R01Input.InstanceName	{...}	{...}	Decimal	SINT[16]
J1939R01Input.Status	{...}	{...}		AparianJ1939RInputStatus
J1939R01Input.Status.ConfigValid	0		Decimal	BOOL
J1939R01Input.Status.DuplicateNode	0		Decimal	BOOL
J1939R01Input.TransactionRate	0		Decimal	DINT
J1939R01Input.Temperature	0.0		Float	REAL
J1939R01Input.RxCANCount	0		Decimal	DINT
J1939R01Input.TxCANCount	0		Decimal	DINT
J1939R01Input.CANCrcCount	0		Decimal	DINT
J1939R01Input.CANBitError	0		Decimal	DINT
J1939R01Input.CANStuffError	0		Decimal	DINT
J1939R01Input.J1939ReqTxCount	0		Decimal	DINT
J1939R01Input.J1939ReqRxCount	0		Decimal	DINT
J1939R01Input.J1939ResTxCount	0		Decimal	DINT
J1939R01Input.J1939ResRxCount	0		Decimal	DINT
J1939R01Input.TagReadCount	0		Decimal	DINT
J1939R01Input.TagWriteCount	0		Decimal	DINT
J1939R01Input.TagConnFailCount	0		Decimal	DINT
J1939R01Input.TagErrorCount	0		Decimal	DINT
J1939R01Input.MappedItems	{...}	{...}	Decimal	SINT[40]

Figure 4.2 – J1939 Router Input and Output Assembly

5. DIAGNOSTICS

5.1. LEDS

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

Figure 5.1 - J1939 Router front view

LED	Description
Ok	The module Ok 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 then the module has booted and is running correctly.
Eth	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.
Act	The activity LED is used for indicating successful (green) or failed (red) routing transactions.

Table 5.1 - Module LED operation

5.2. MODULE STATUS MONITORING IN SLATE

The J1939 Router can provide a range of statistics which can assist with module operation, maintenance, and fault finding. The statistics can be accessed in full by Slate or using the web server in the module.

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

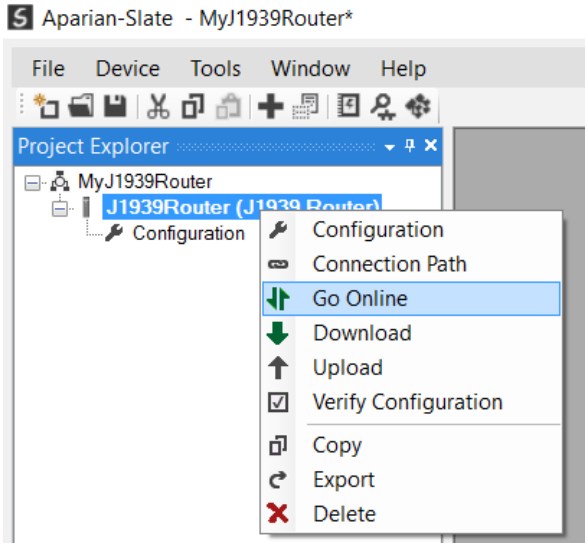


Figure 5.2. - Selecting to Go Online

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

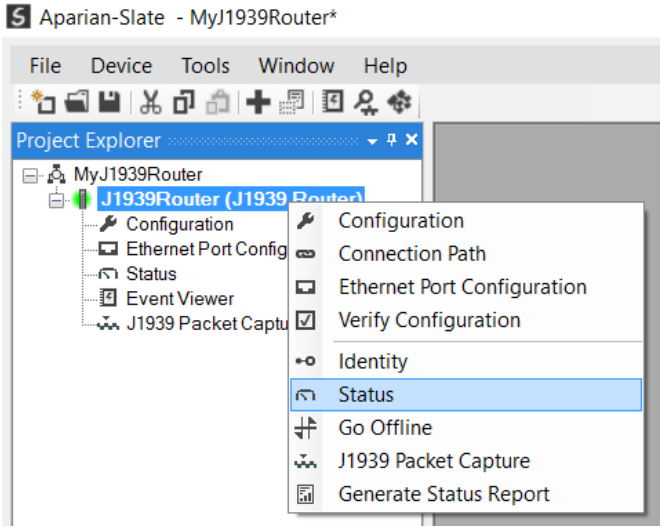


Figure 5.3. - Selecting online Status

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

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

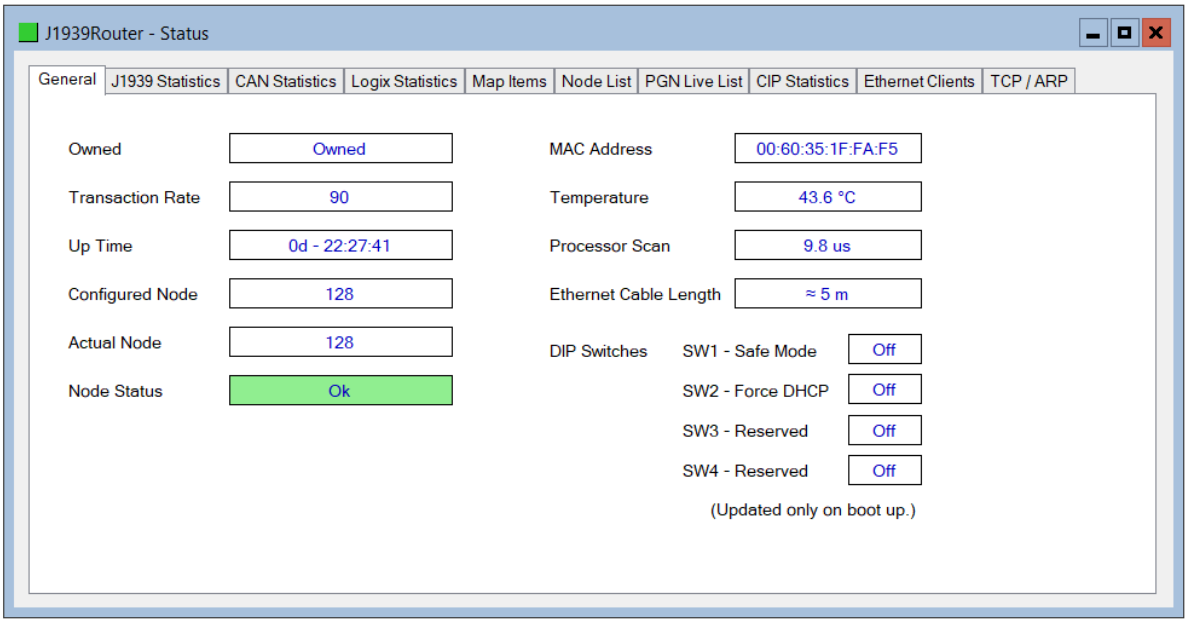


Figure 5.4. - Status monitoring - General

The General tab displays the following general parameters and can also be used to set the module time to the PC time:

Parameter	Description
Owned	Indicates whether the module is currently owned (Class 1) by a Logix controller.
Transaction Rate	The transaction rate is the number of J1939 messages per second that the module is currently routing.
Up Time	Indicates the elapsed time since the module was powered-up.
Configured Node	The user required node address as specified in the module configuration.
Actual Node	The actual node address currently being used by the module. Note: The actual node address may be different from the configured node address if a node conflict was detected and the module's Arbitrary Address Capable option has been enabled.
Node Status	Indicates if a node conflict has been detected.

MAC Address	Displays the module's unique Ethernet MAC address.
Temperature	The internal temperature of the module.
Processor Scan	The amount of time (microseconds) taken by the module's processor in the last scan.
Ethernet Cable Length	Approximate length of the Ethernet cable (accurate to 5m).
DIP Switch Position	The status of the DIP switches when the module booted. Note that this status will not change if the DIP switches are altered when the module is running.

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

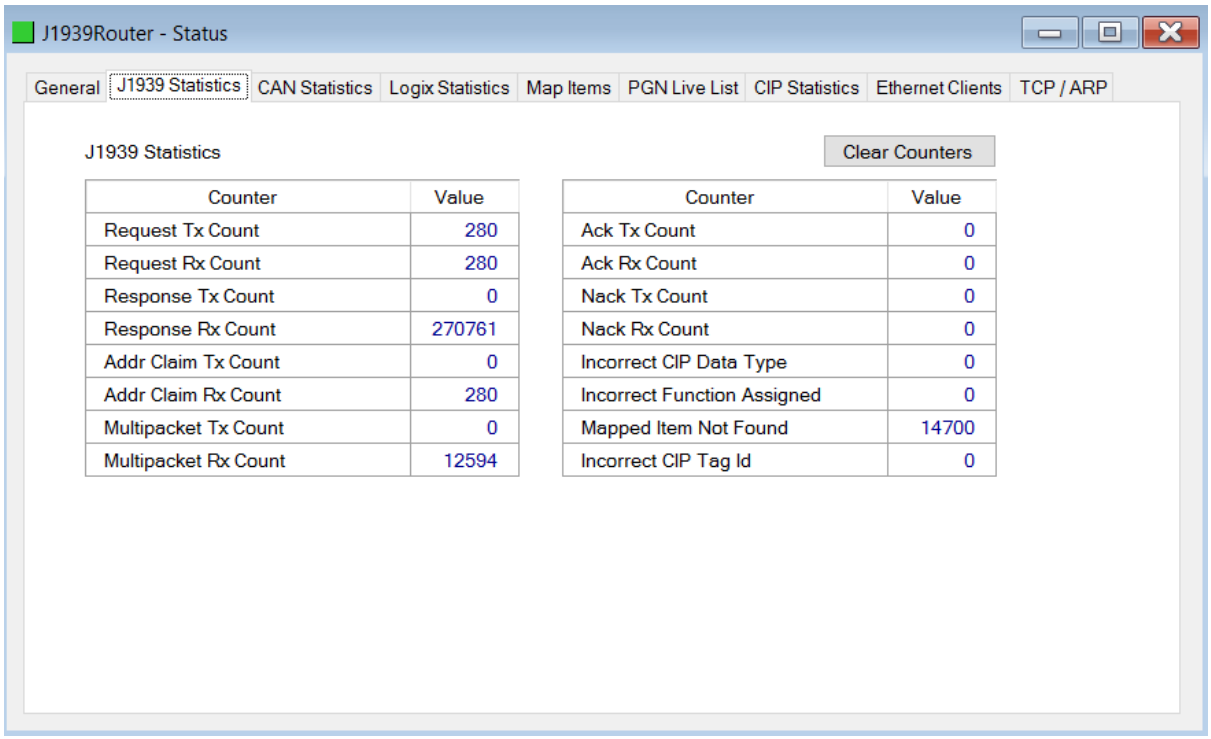


Figure 5.5. - Status monitoring – J1939 Statistics

The J1939 Statistics tab displays the following general parameters:

Parameter	**Description**
Request Tx Count	J1939 PGN Request Transmitted count.
Request Rx Count	J1939 PGN Request Received count.
Response Tx Count	J1939 PGN Response Transmitted count.
Response Rx Count	J1939 PGN Response Received count.
Addr Claim Tx Count	J1939 Address Claim messages sent.
Addr Claim Rx Count	J1939 Address Claim messages received.

Multipacket Tx Count	J1939 Connection Management packets sent.
Multipacket Rx Count	J1939 Connection Management packets received.
Ack Tx Count	J1939 Acknowledge messages sent.
Ack Rx Count	J1939 Acknowledge messages received.
Nack Tx Count	J1939 Negative Acknowledge messages sent.
Nack Rx Count	J1939 Negative Acknowledge messages received.
Incorrect CIP Data Type	Configured Data Type was not received from the specific tag.
Incorrect Function Assigned	A request was received for a consume function mapped item or a response was received for a produce function mapped item.
Mapped Item Not Found	A PGN and/or node was received that is not part of the mapped item list.
Incorrect CIP Tag Id	The expected CIP Tag Id was not received.

Table 5.3 - Parameters displayed in the Status Monitoring – J1939 Statistics Tab

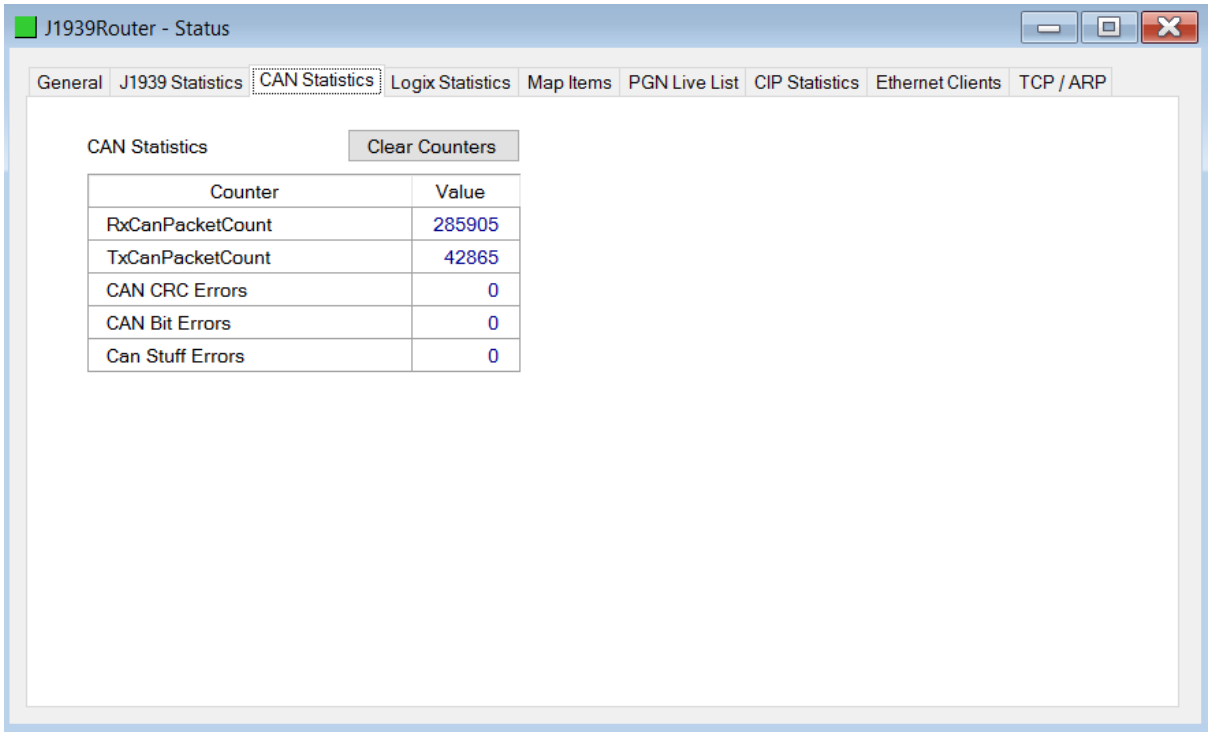


Figure 5.6. - Status monitoring – CAN Statistics

The CAN Statistics tab displays the following general parameters:

Parameter	**Description**
RxCANPacketCount	Received CAN message count.
TxCANPacketCount	Transmitted CAN message count.

CAN CRC Errors	CAN CRC failed message count.
CAN Bit Errors	CAN Bit error count.
CAN Stuff Errors	CAN Stuff error count.

Table 5.4 - Parameters displayed in the Status Monitoring – CAN Statistics Tab

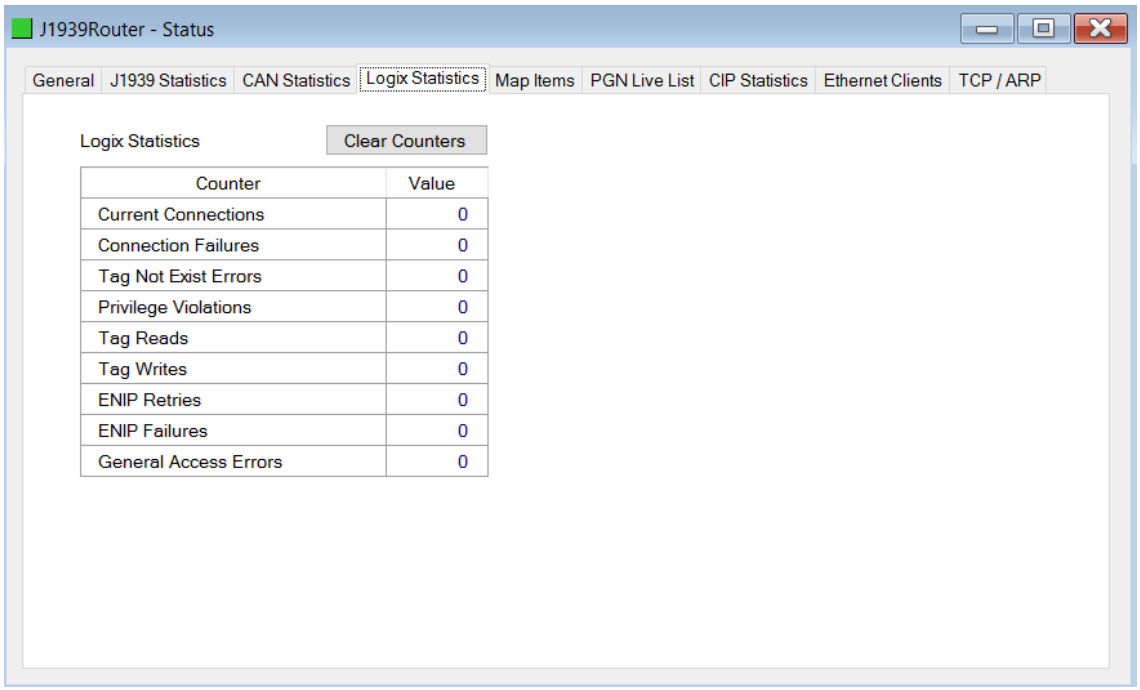


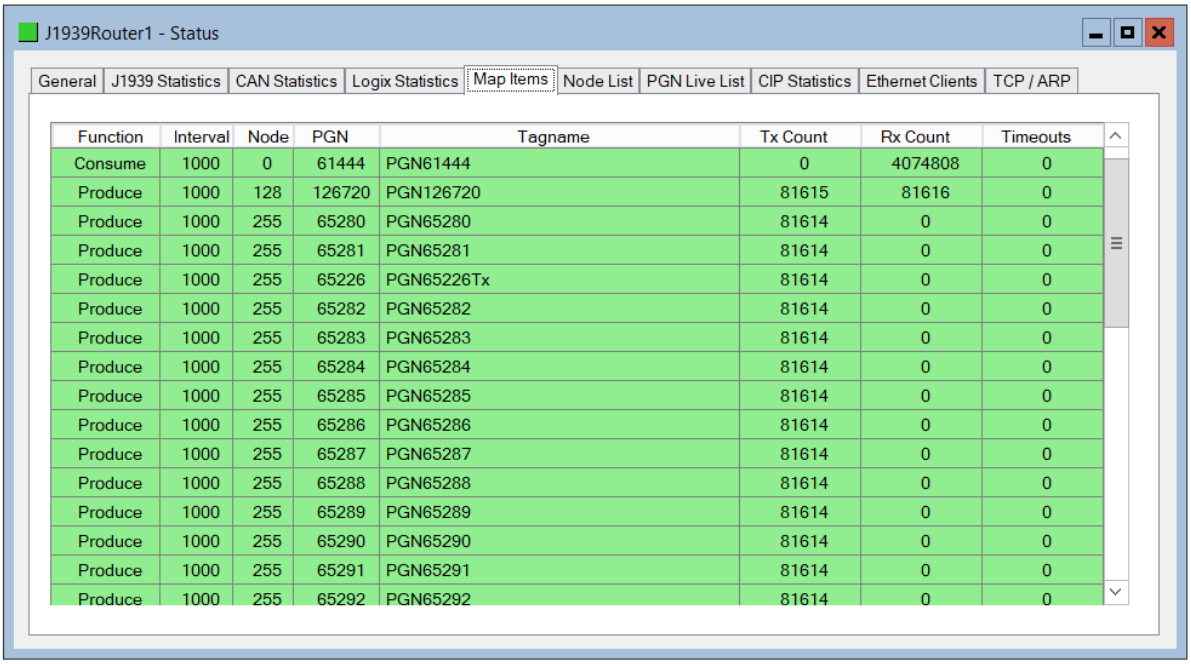
Figure 5.7. - Status monitoring – Logix Statistics

The Logix Statistics tab displays the following general parameters:

Parameter	**Description**
Current Connections	The number of current open class 3 connections.
Connection Failures	The number of failed attempts at establishing a class 3 connection with a Logix controller.
Tag Not Exist Errors	The number of tag read and tag write transactions that failed due to the destination tag not existing.
Privilege Violations	The number of tag read and tag write transactions that failed due to a privilege violation error. This may be caused by the External Access property of the Logix tag being set to either None or Read Only.
Tag Reads	The number of tag read transactions executed by the DF1 Router module.
Tag Writes	The number of tag write transactions executed by the DF1 Router module.

ENIP Retries	This count increases when no response was received from the Logix Controller by the time the ENIP timeout is reached.
ENIP Failures	This count increases when the ENIP Retry Limit is reached and no response has been received from the Logix Controller.
Tag Access General Error	This count increases when a tag cannot be accessed for any other reason not reported above.

Table 5.5 - Parameters displayed in the Status Monitoring – Logix Statistics Tab



Function	Interval	Node	PGN	Tagname	Tx Count	Rx Count	Timeouts
Consume	1000	0	61444	PGN61444	0	4074808	0
Produce	1000	128	126720	PGN126720	81615	81616	0
Produce	1000	255	65280	PGN65280	81614	0	0
Produce	1000	255	65281	PGN65281	81614	0	0
Produce	1000	255	65226	PGN65226Tx	81614	0	0
Produce	1000	255	65282	PGN65282	81614	0	0
Produce	1000	255	65283	PGN65283	81614	0	0
Produce	1000	255	65284	PGN65284	81614	0	0
Produce	1000	255	65285	PGN65285	81614	0	0
Produce	1000	255	65286	PGN65286	81614	0	0
Produce	1000	255	65287	PGN65287	81614	0	0
Produce	1000	255	65288	PGN65288	81614	0	0
Produce	1000	255	65289	PGN65289	81614	0	0
Produce	1000	255	65290	PGN65290	81614	0	0
Produce	1000	255	65291	PGN65291	81614	0	0
Produce	1000	255	65292	PGN65292	81614	0	0

Figure 5.8. - Status monitoring – Mapped Item Status

The Mapped Item tab displays the following general parameters:

Parameter	**Description**
Function	The operation of the mapped item. **Consume** The J1939 Router will receive PGNs and write the data into Logix tags. **Produce** The J1939 Router will read data from Logix tags and transmit PGNs onto the J1939 network. Refer to the *Consume Function* and *Produce Function* sections for more detail.
Interval	This is update interval for the specific PGN in milliseconds.

Node	The destination node that the PGN is mapped to.
PGN	The PGN number for the specific mapped item.
Controller	The Logix Controller used.
Tagname	The Logix Tag that will be used to exchange data with the specific J1939 device.
Tx Count	Request Data Count.
Rx Count	Receive Data Count.
Timeouts	The amount of times a PGN response was not received within the interval time.

Table 5.6 - Parameters displayed in the Status Monitoring – Mapped Item Tab

The Node List displays all the active nodes on the CAN bus network, and their current status and name information.

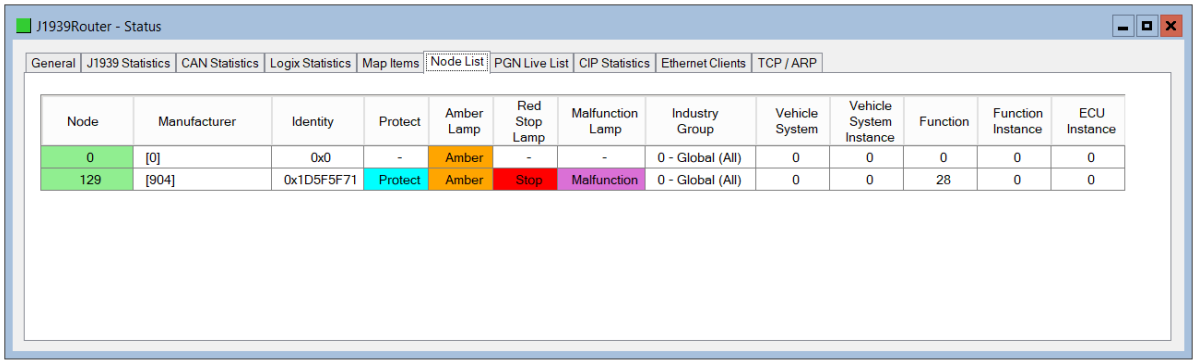


Figure 5.9. - Status monitoring – Node List

The PGN Live List provides the user with the PGNs being sent from each node on the network. Note that only the first 100 PGNs are displayed.
PGN and Node combinations that are included in the mapped configuration are displayed with a blue background.

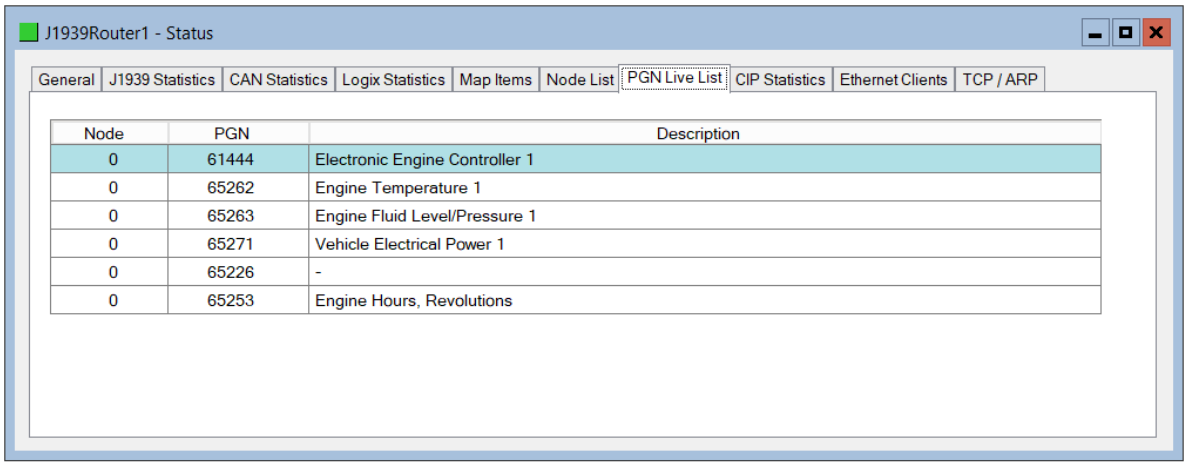


Figure 5.10. - Status monitoring – PGN Live List

5.3. J1939 PACKET CAPTURE

The module provides the capability to capture the J1939 traffic for analysis. The will allow the user and a remote support team to resolve any possible issues on site. To invoke the capture of the module, double-click on the J1939 Packet Capture item in the Project Explorer tree.

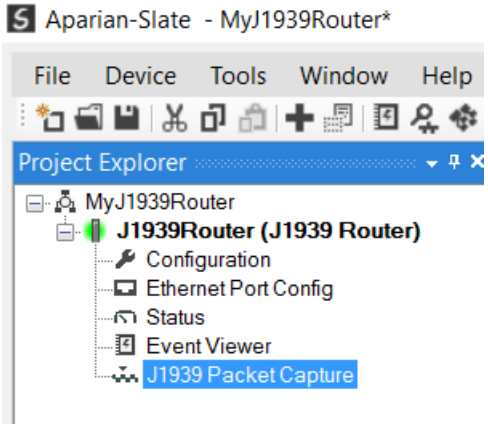


Figure 5.10 - Selecting J1939 Packet Capture

The J1939 Packet Capture window will open and automatically start capturing all J1939 packets.

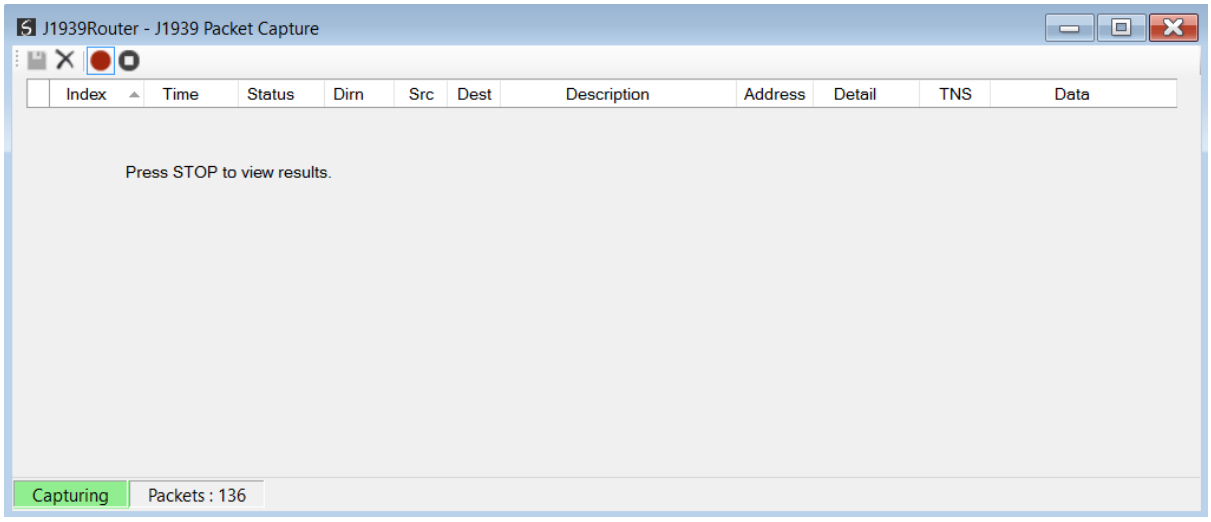


Figure 5.11 – J1939 packet capture

To display the captured J1939 packets, the capture process must first be stopped, by pressing the Stop button.

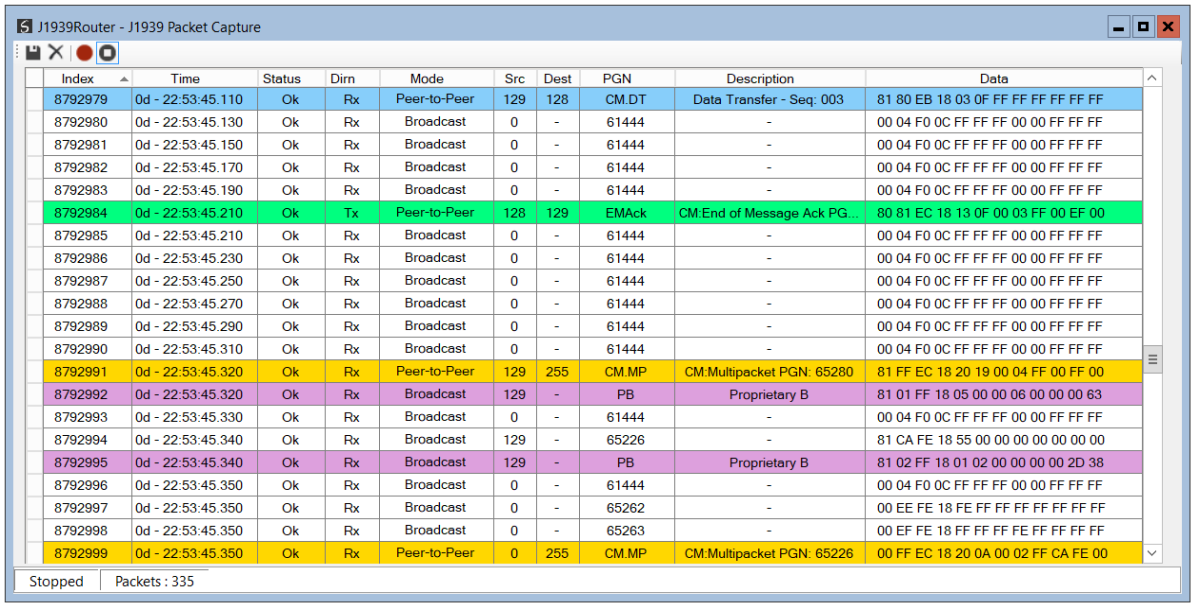


Figure 5.12 – J1939 Packet Capture complete

The captured J1939 packets are tabulated as follows:

Statistic	Description
Index	The packet index, incremented for each packet sent or received.
Time	The elapsed time since the module powered up.
Status	The status of the packet. Received packets are checked for valid J1939 constructs and valid checksums.

Dirn	The direction of the packet, either transmitted (Tx) or received (Rx).
Mode	The message can be either a Peer to Peer or Broadcast message.
Src	J1939 Source Address
Dest	J1939 Destination Address
PGN	The PGN Number used in the Message ID
Description	Description of the packet that was received.
Data	The raw packet data.

Table 5.7 – J1939 Packet Capture fields

The packet capture can be saved to a file for further analysis, by selecting the ***Save*** button on the toolbar. Previously saved J1939 Packet Capture files can be viewed by selecting the ***J1939 Packet Capture Viewer*** option in the tools menu.

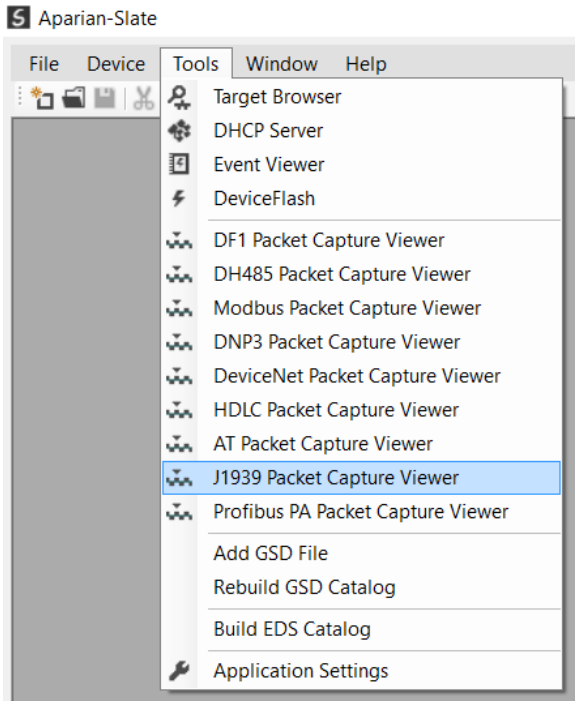


Figure 5.13 - Selecting the J1939 Packet Capture Viewer

5.4. MODULE EVENT LOG

The J1939 Router module logs various diagnostic records to an internal event log. These logs are stored in non-volatile memory and can be displayed using Slate or via the web interface. To view them in Slate, select the Event Viewer option in the Project Explorer tree.

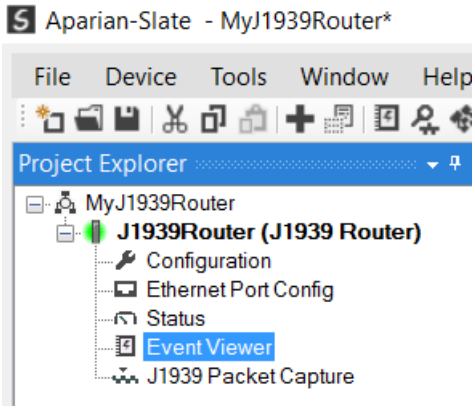


Figure 5.14. - Selecting the module Event Log

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.

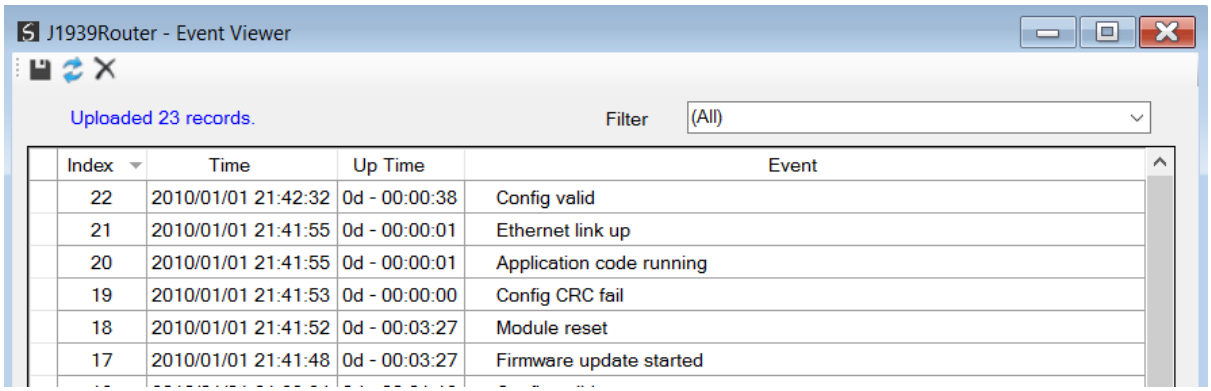


Figure 5.15. – Module Event Log

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

5.5. WEB SERVER

The J1939 Router provides a web server allowing a user without Slate or Logix 5000 to view various diagnostics of the module. This includes Ethernet parameters, system event log, advanced diagnostics, and application diagnostics (J1939 statistics).

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

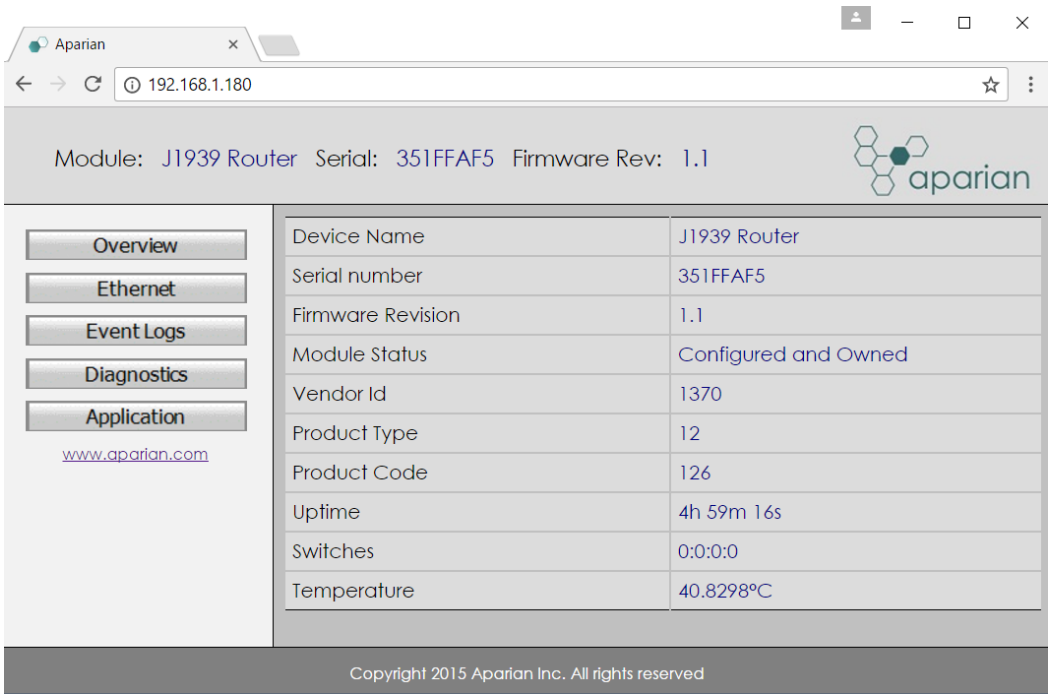


Figure 5.16. - Web interface

6. TECHNICAL SPECIFICATIONS

6.1. DIMENSIONS

Below are the enclosure dimensions as well as the required DIN rail dimensions. All dimensions are in millimetres.

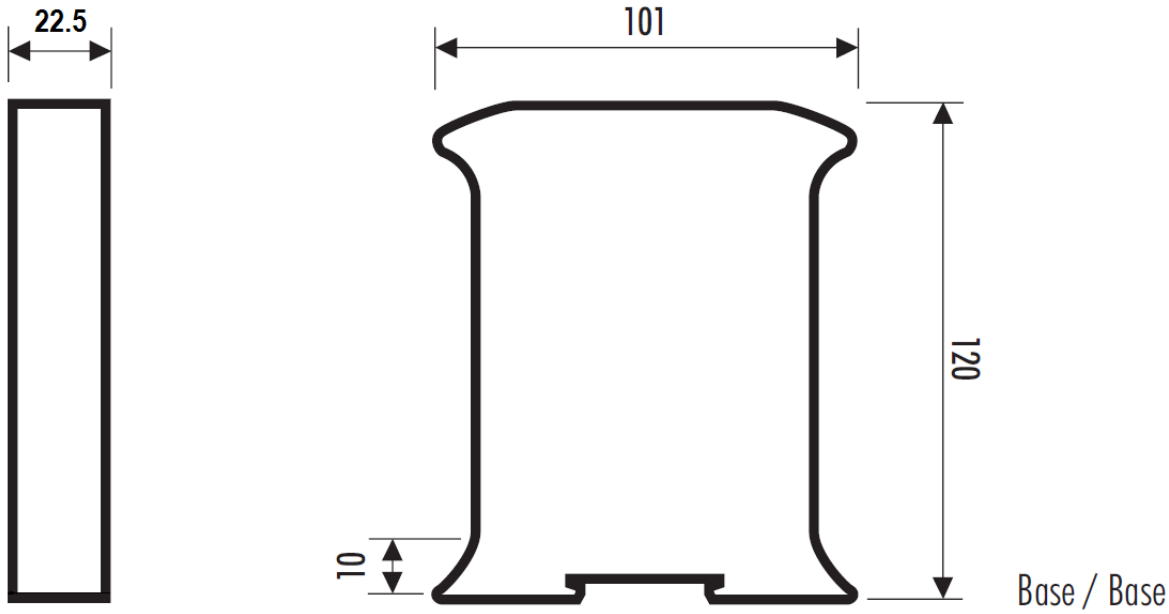


Figure 6.1 – J1939 Router enclosure dimensions

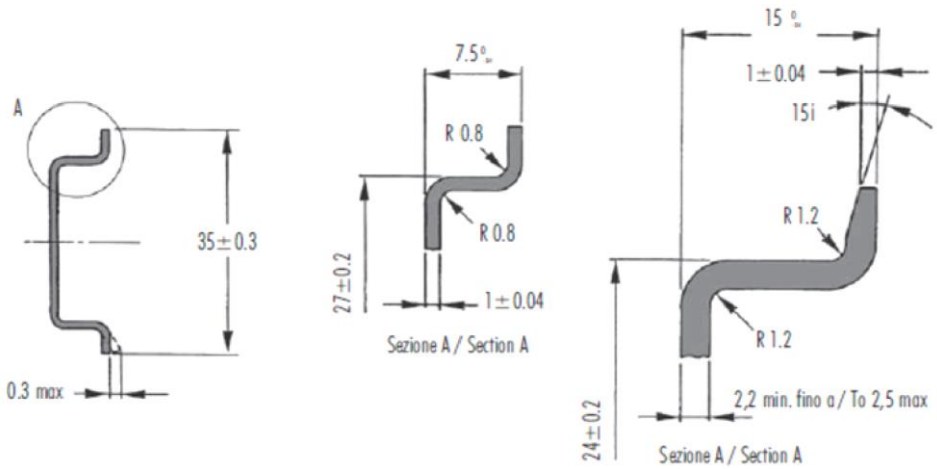


Figure 6.2 - Required DIN dimensions

6.2. ELECTRICAL

Specification	Rating
Power requirements	Input: 10 – 28V DC, (70 mA @ 24 VDC)
Power consumption	1.7 W
Connector	5-way terminal, 5.08mm pitch.
Conductors	24 – 18 AWG
Enclosure rating	IP20, NEMA/UL Open Type
Temperature	-20 – 70 °C
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 6.1 - Electrical specification

6.3. ETHERNET

Specification	Rating
Connector	RJ45
Conductors	CAT5 STP/UTP
ARP connections	Max 20
TCP connections	Max 20
CIP connections	Max 10
Communication rate	10/100Mbps
Duplex mode	Full/Half
Auto-MDIX support	Yes

Table 6.2 - Ethernet specification

6.4. J1939 NETWORK

Specification	Rating
Connector	5-way terminal, 5.08mm pitch.
Max PGN Mapping	40
Max PGN size supported	480 bytes
Supported Baud Rates	250k 500k
Arbitrary Address Capable	Yes
Support for multi-packets	Yes
Configurable J1939 Name	Yes

Table 6.3 – J1939 specification

6.5. CERTIFICATIONS

Certification	Mark
CE Mark	CE
RoHS2 Compliant	RoHS2
UL Mark File: E494895	c UL us LISTED CLASS 1, DIV 2, GROUPS A, B, C, D

Table 6.4 – Certifications

7. INDEX