DF1 Router

User Manual

A-DF1R

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aparian

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Revision History

Revision	Date	Comment
1.0	24 Feb 2015	Initial document
1.1	9 Mar 2015	Added new modes Unscheduled and Scheduled
1.2	29 May 2015	Increase maximum Logix Controller supported to 8 Support for Class 3 and UCMM connections when using PCCC messaging
1.3	26 June 2015	Add Scheduled mode Tag map status
1.4	20 July 2015	Add support for PLC-2 messaging in Reactive Tag mode Indication of serial data and stop bits supported
1.5	28 July 2015	Add support for PLC-2 Unprotected Bit Write command in Reactive Tag mode
1.6	25 August 2015	Add UL Listed mark
1.7	30 September 2015	Add support for EtherNet/IP retry statistics and configuration
1.8	8 February 2016	Updated various outdated screenshots
1.9	13 May 2016	Add ODVA Conformance mark
1.10	27 June 2016	Updated the temperature range
1.11	11 August 2016	Added RoHS2 compliant to certifications

1.12	22 August 2016	Added EDS AOP configuration.
1.13	22 November 2016	Added pass-through functionality (RSLogix 5/500 programming.)
1.14	21 February 2017	Added support for DF1 Radio Modem protocol
1.15	23 May 2017	Add support for two additional interface modes. Add RCM Conformance mark.
1.16	10 October 2017	Added UL Class 1 Division 2
1.17	25 October 2017	Added PCCC Direct option Added support for CIP Serial

1. PREFACE

1.1. INTRODUCTION TO THE DF1 ROUTER

This manual describes the installation, operation, and diagnostics of the Aparian DF1 Router. The DF1 Router provides intelligent data routing between EtherNet/IP and DF1 which can help simplify the migration from PLC2, PLC3, PLC5, and SLC systems to ControlLogix or CompactLogix platforms, where a DF1 interface is required.

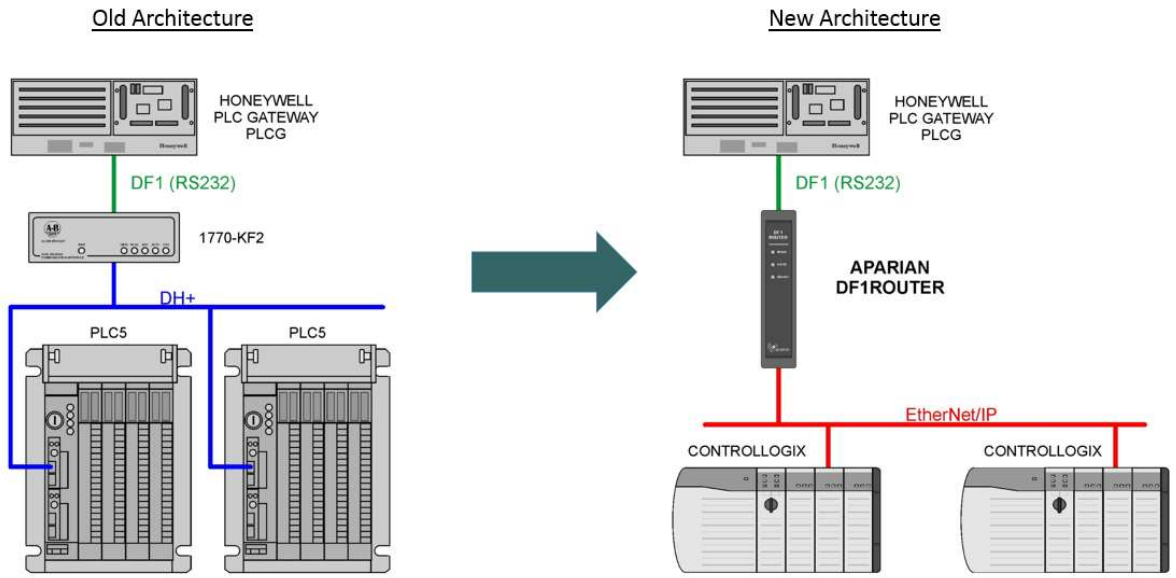


Figure 1.1. - Migration Path

The DF1 Router can also be used to program various Rockwell Automation controllers (ControlLogix, CompactLogx, MircoLogix, SLC, PLC5, and Mirco800) from Ethernet to Serial. This is especially useful with certain legacy controllers that do not support Ethernet as well as applications where controllers need to be accessed remotely over serial radios.

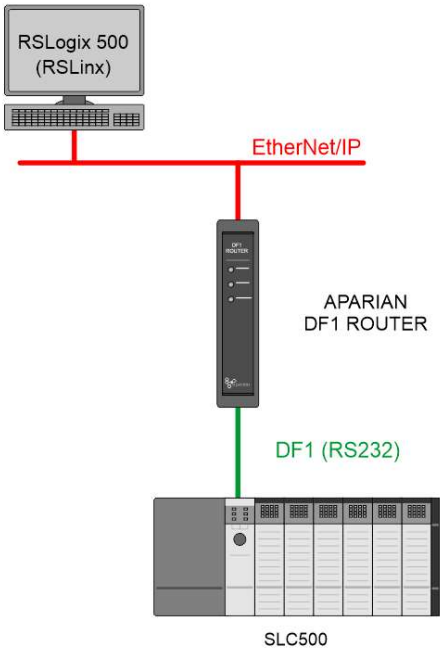


Figure 1.2. – Example of Programming a SLC500 Controller via the DF1 Router

The DF1 Router can also be used to connect newer PanelView Plus and PanelView 800 devices to a range of Rockwell Automation controllers. This is especially useful with newer PanelView Plus devices (supporting only Ethernet) which needs to connect to controllers (new and old) via serial.

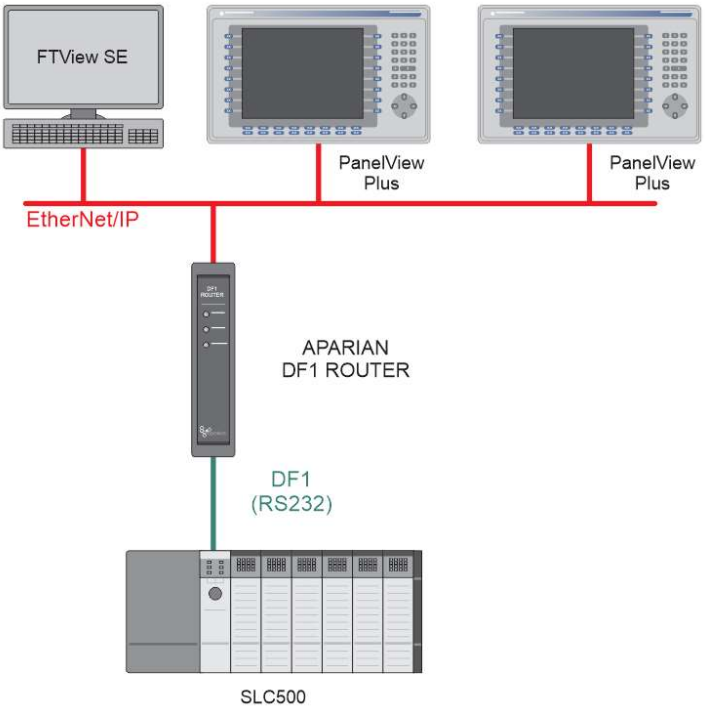


Figure 1.3. – Example of Connecting a PanelView to a SLC500 Controller via the DF1 Router

1.2. FEATURES

The DF1 Router is able to transfer data from a DF1 device to a maximum of eight Logix controllers. The module operates in one of four modes, simplifying the configuration for all applications.

Mode	Description	Message Initiator
Transparent PCCC	The DF1 Router will redirect DF1 PCCC messages to a Logix controller at a preconfigured EtherNet/IP path. Logix PLC Mapping configuration may also required. This mode also supports remote programming using RSLogix 5 / 500.	Remote Device
Reactive Tag	The DF1 Router will convert DF1 PCCC messages to Logix controller tag reads or tag writes. No Logix PLC Mapping configuration is required.	Remote Device
Scheduled Tag	The DF1 Router transfers data between a DF1 device and a number of Logix tags, using a preconfigured scheduled. No Logix or remote device configuration is required.	DF1 Router
Unscheduled	The DF1 Router transfers messages received from a Logix Message Instruction.	Logix (Msg)

Table 1.1. – Modes of Operation

In Transparent PCCC mode the user will be able to connect and program various Rockwell Automation controllers via the serial port (from Ethernet):

- ControlLogix
- CompactLogix
- MircoLogix
- SLC
- PLC5
- Mirco800

The DF1 Router is configured using the Aparian Slate application. This program can be downloaded from www.aparian.com free of charge. Slate offers various configuration methods, including a controller tag browser.

Hereafter the DF1 Router will be referred to as the **module**.

The module can operate in both a Logix “owned” and standalone mode. With a Logix connection the input and output assemblies will provide additional diagnostics information which will be available in the Logix controller environment.

The module uses isolated RS232 for DF1 communication providing better noise immunity. The RS232 port also uses a terminal block for convenient installation. The module can also be used in systems with redundant DF1 pathways.

A built-in webserver provides detailed diagnostics of system configuration and operation, including the display of received DF1 communication packets, without the need for any additional software.

1.3. ARCHITECTURE

The figure below provides an example of the typical network setup.

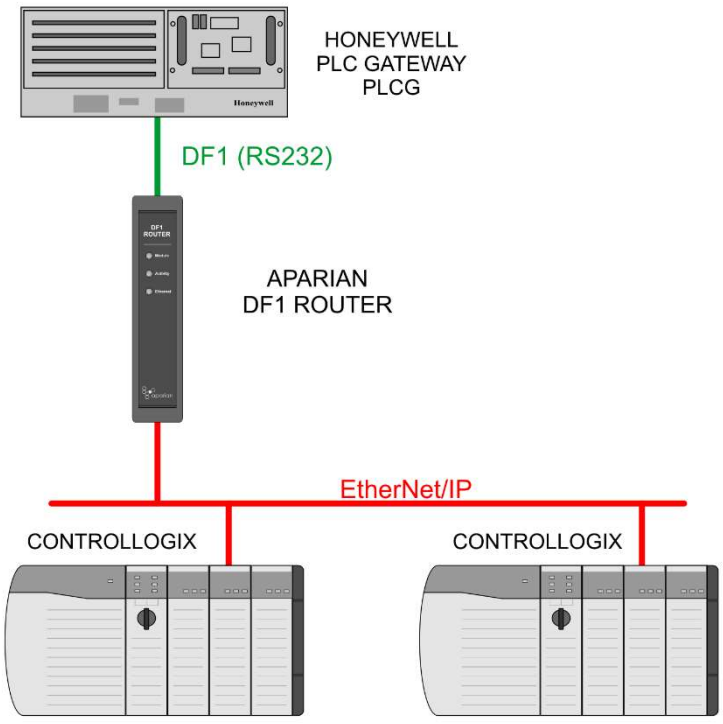


Figure 1.4. - Example of a typical network setup

By converting and redirecting serial DF1 messages from legacy devices to EtherNet/IP, the module provides an interface for data exchange to Allen-Bradley ControlLogix and CompactLogix platforms.

When connected to devices that provide more than one DF1 port, it is possible to implement DF1 communication redundancy with the use of two DF1 Routers. These can be configured in one of two modes, either Simultaneous or Active / Standby.

In the Simultaneous mode, both modules route the same traffic to the same Logix controller. Effectively the Logix controller will receive two of each message and process both of them.

Active / Standby mode requires both modes to be Logix “Owned”. One of the modules has its routing capability disabled, achieved by setting the Inhibit Routing bit in the output assembly. Logic in the Logix controller can monitor the connection and performance of the Active module, and if necessary and inhibit the Active module and un-inhibit the Standby module.

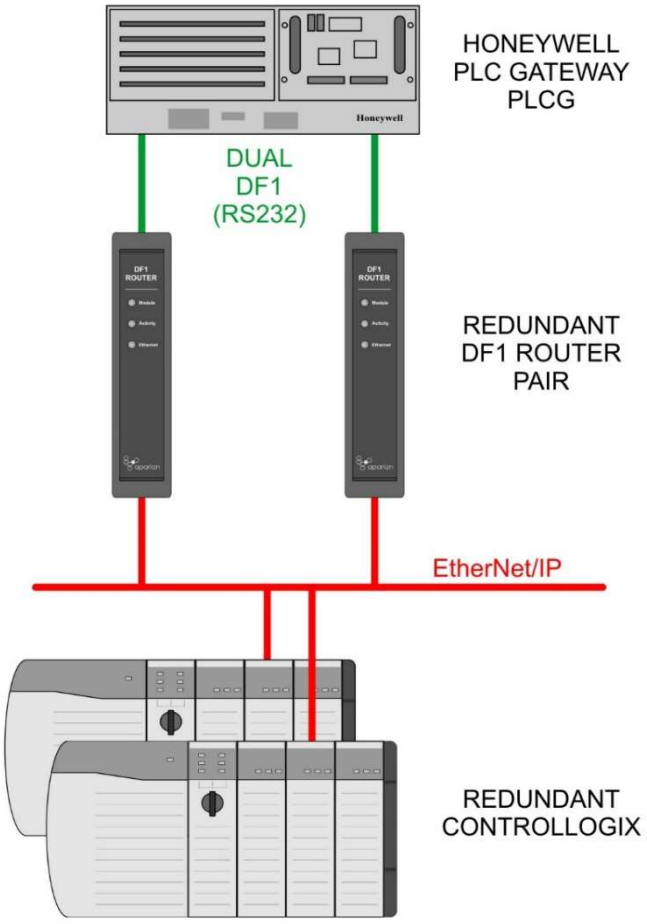


Figure 1.5. - Redundant Architecture

The DF1 Router can be used in redundant Logix controller systems.

Systems that rely on a central ControlLogix communicating to a number of remote DF1 devices, e.g. MicroLogix and SLC stations, may find the DF1 Router useful when upgrading to newer ControlLogix processors, which no longer have a serial port. These systems can easily be upgraded using the DF1 Router without affecting the existing and often costly wireless infrastructure.

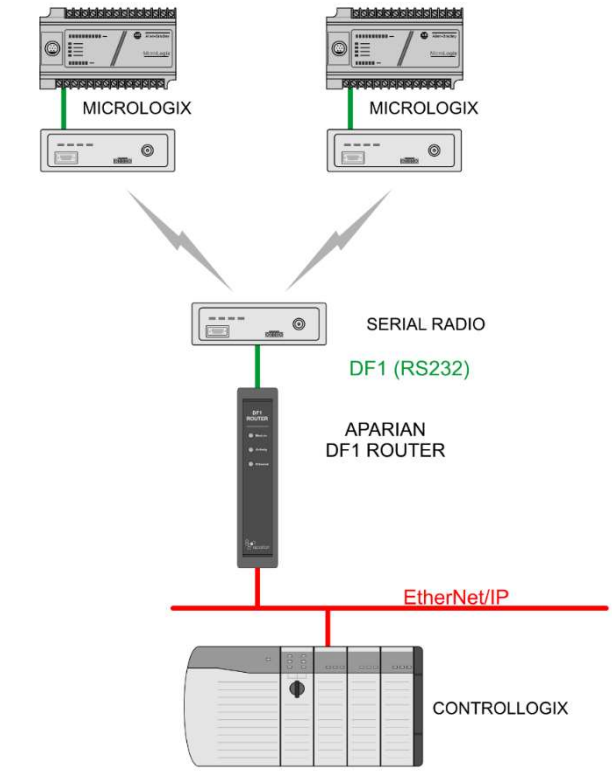


Figure 1.6. – Remote MicroLogix System

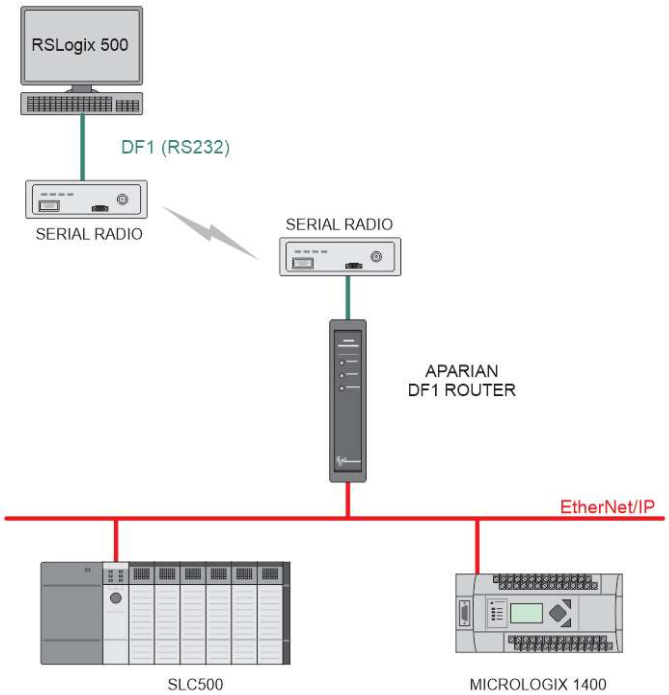


Figure 1.7. – Remote Programming (Half-duplex)

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
DF1 Router User Manual DF1 Router Datasheet Application Notes Example Code & UDTs	http://www.aparian.com/products/df1router
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
Map PLC/SLC messages	SLC to CompactLogix Migration Guide: Chapter 3 – Map PLC/SLC Messages (1769-ap001_-en-p.pdf) EtherNet/IP Network Configuration: Chapter 5 – Mapping Tags (enet-um001_-en-p.pdf)

Table 1.2. - 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 1.3. – Support Details

2. INSTALLATION

2.1. MODULE LAYOUT

The module has three ports at the bottom of the enclosure as shown in the figure below. The ports are used for Ethernet, RS232 serial, and power. The power port uses a three way connector which is used for the DC power supply positive and negative (or ground) voltage as well as the earth connection.

The RS232 port uses a four way connector. This provides connection for the communication transmit (TX), receive (RX), and ground (GND) conductors. The fourth connection is used for shielding the cable in high noise environments.

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. - DF1 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 auxiliary communication interface (RS232).



Figure 2.2. – DF1 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	Reserved

Table 2.1. - DIP Switch Settings

2.2. MODULE MOUNTING

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

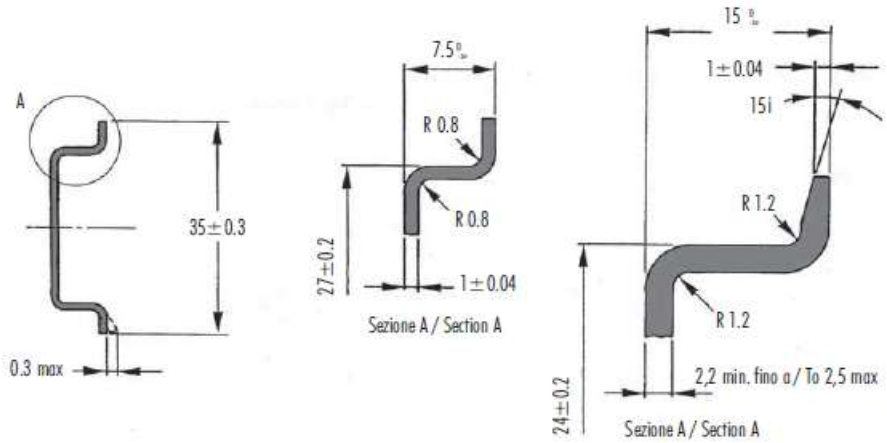


Figure 2.3 - DIN rail specification

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.

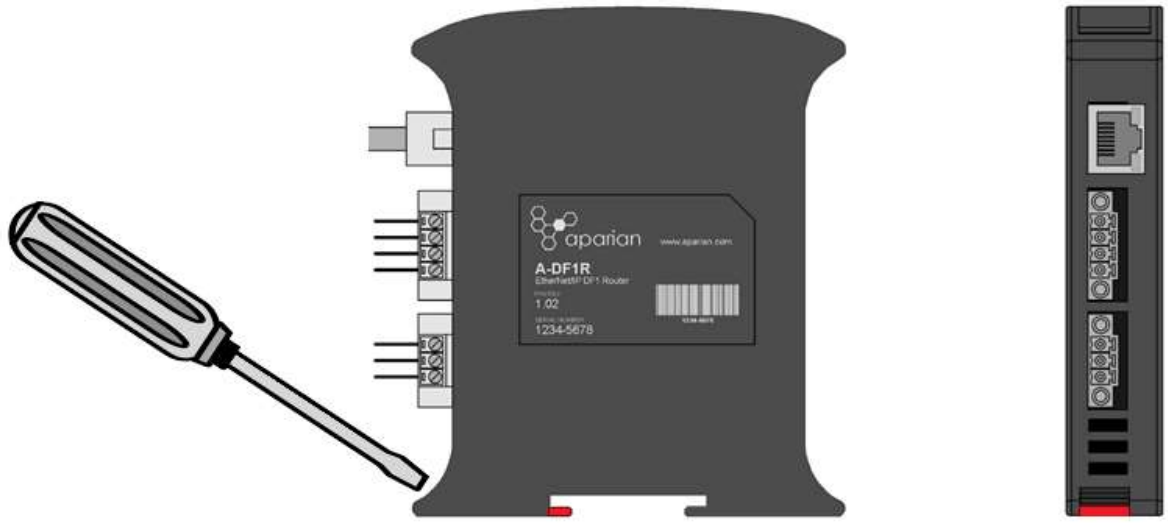


Figure 2.4 - DIN rail mouting

2.3. POWER

A three way power connector is used to connect Power+, Power– (GND), and earth. The module requires an input voltage of 10 – 28Vdc. **Refer** to the technical specifications section in this document.

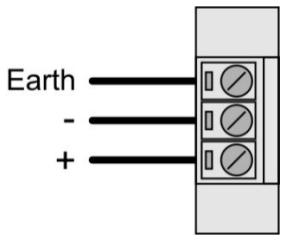


Figure 2.5 - Power connector

2.4. RS232 PORT

The four way RS232 connector is used to connect the transmit (TX), receive (RX), and GND conductors for serial communication. The shield terminal can be used for shielded cable in high noise environments.

NOTE: The shield of the RS232 port is internally connected to the power connector earth. Thus when using a shield it is important to connect the Earth terminal on the power connector to a clean earth. Failing to do this can lower the signal quality of the RS232 communication.

NOTE: When using a shielded cable, it is important that only one end of the shield is connected to earth to avoid current loops. It is recommended to connect the shield to the DF1 Router module, and not to the other DF1 device.

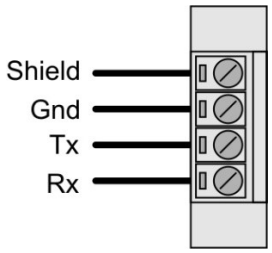


Figure 2.6 - RS232 connector

2.5. 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.

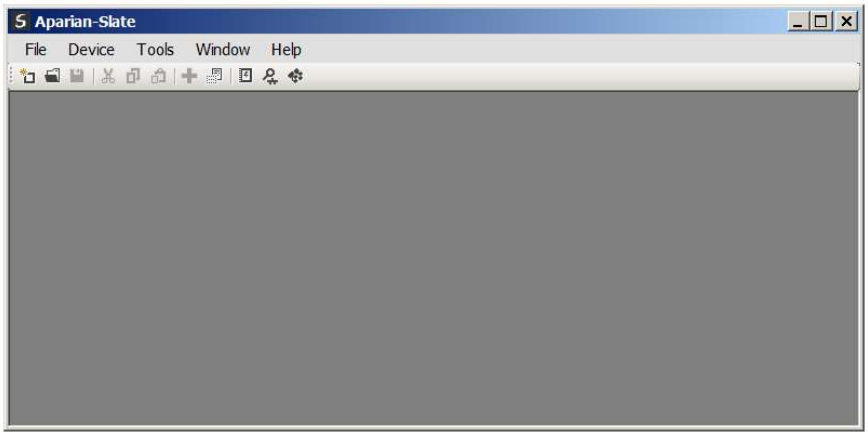


Figure 3.1. - Aparian Slate Environment

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.

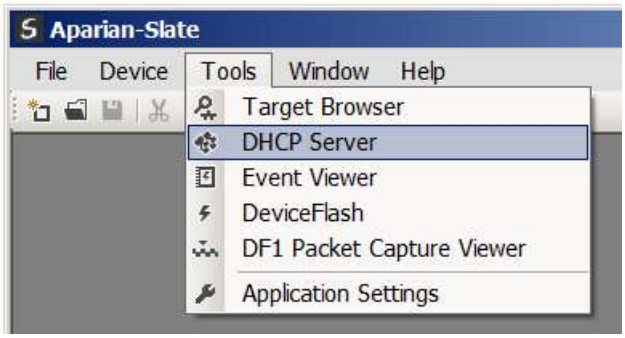


Figure 3.2. - Selecting DHCP Server

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

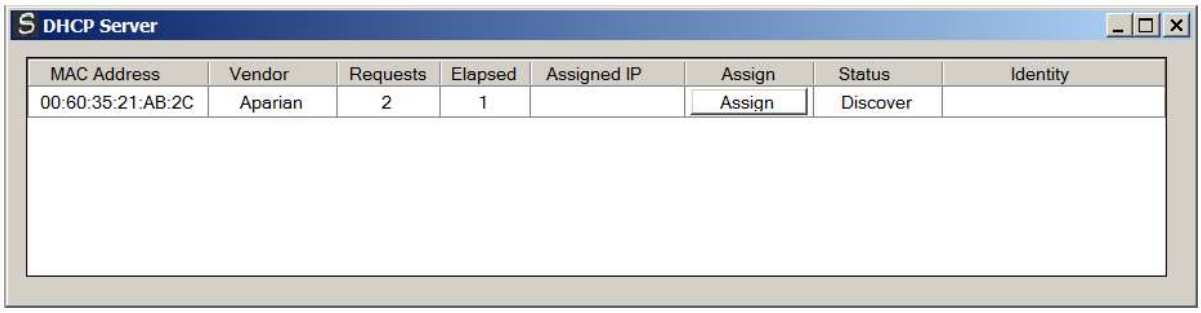


Figure 3.3. - DHCP Server

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.

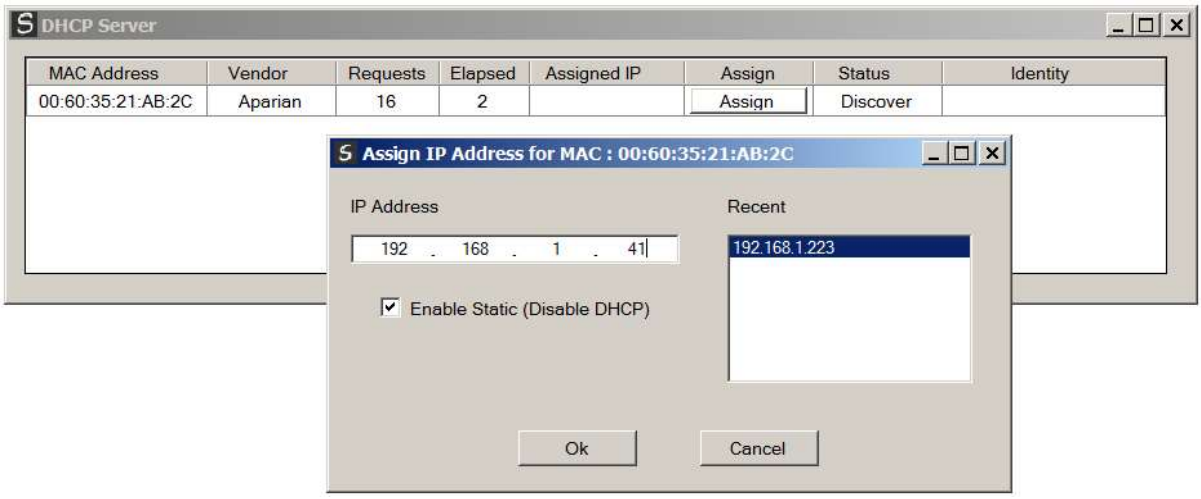


Figure 3.4. - Assigning IP Address

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.

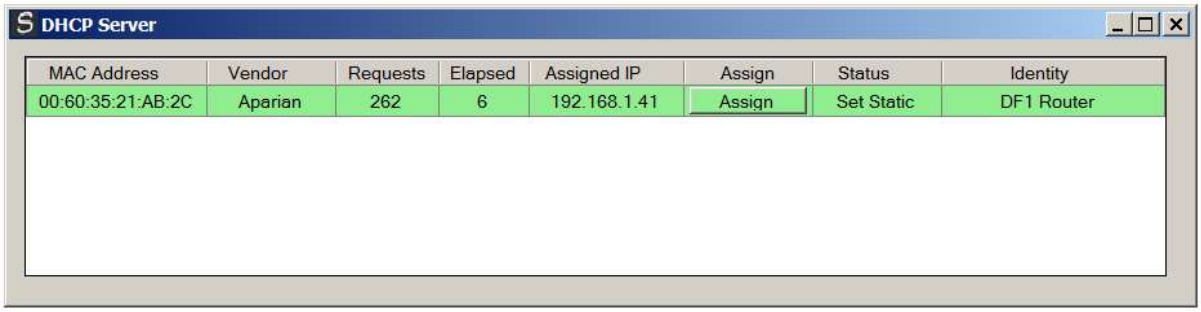


Figure 3.5. - Successful IP address assignment

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.

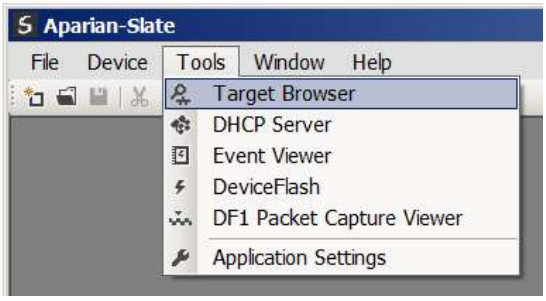


Figure 3.7. - Selecting the Target Browser

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

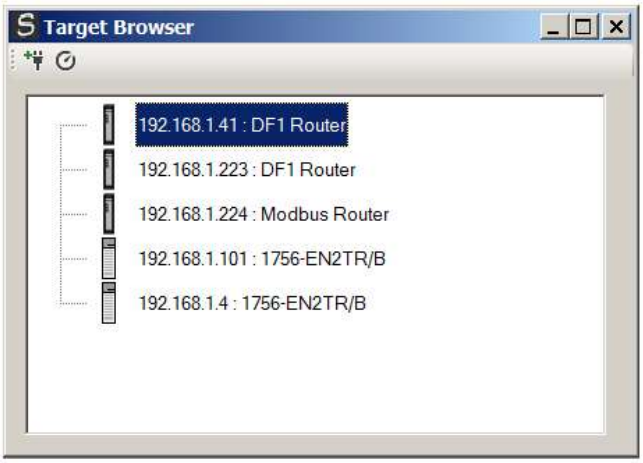


Figure 3.8. - Target Browser

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

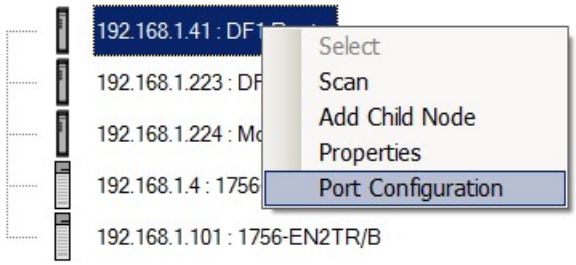


Figure 3.9. - Selecting Port Configuration

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

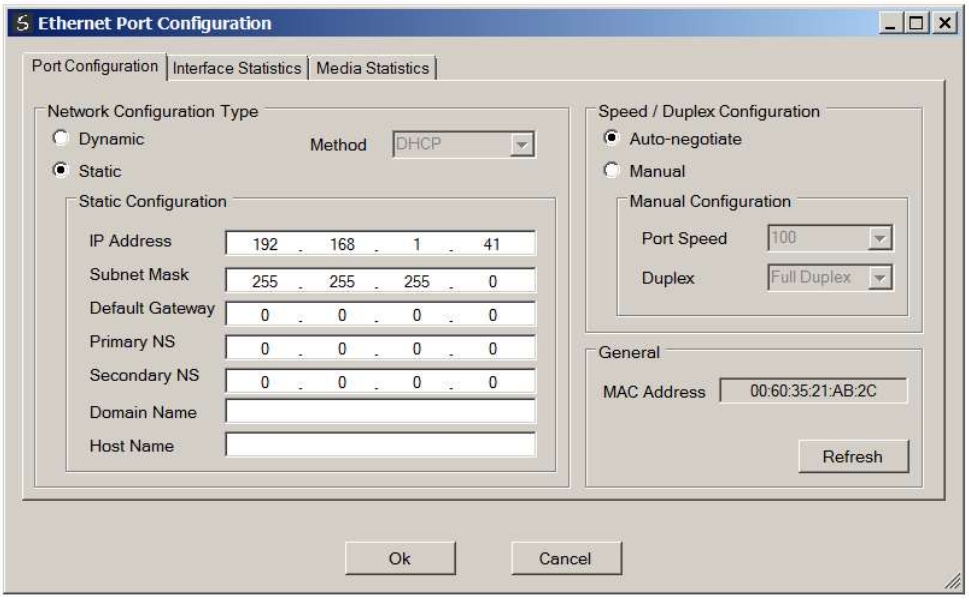


Figure 3.10. - Port Configuration

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.

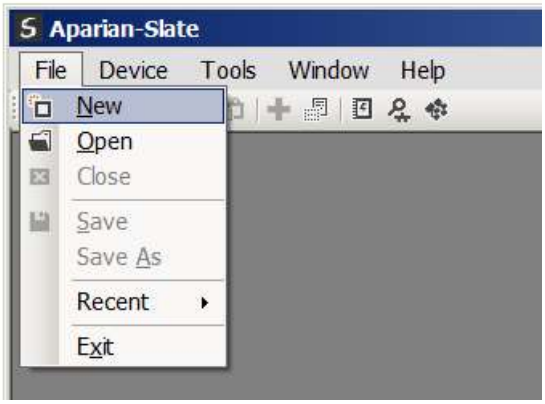


Figure 3.11. - Creating a new project

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.

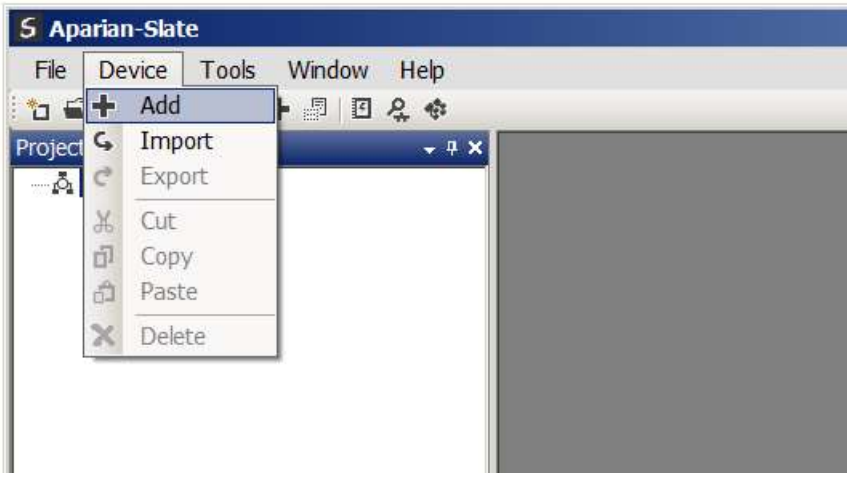


Figure 3.12. - Adding a new device

In the Add New Device window select the DF1 Router, and click the Ok button.

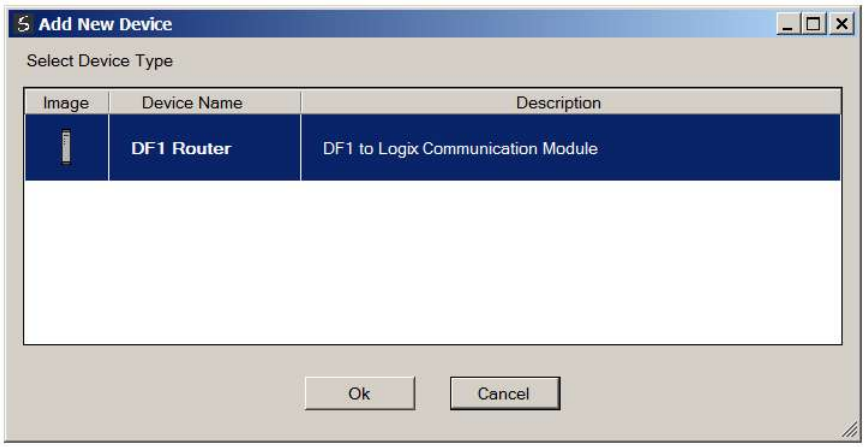


Figure 3.13 – Selecting a new DF1 Router

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*.

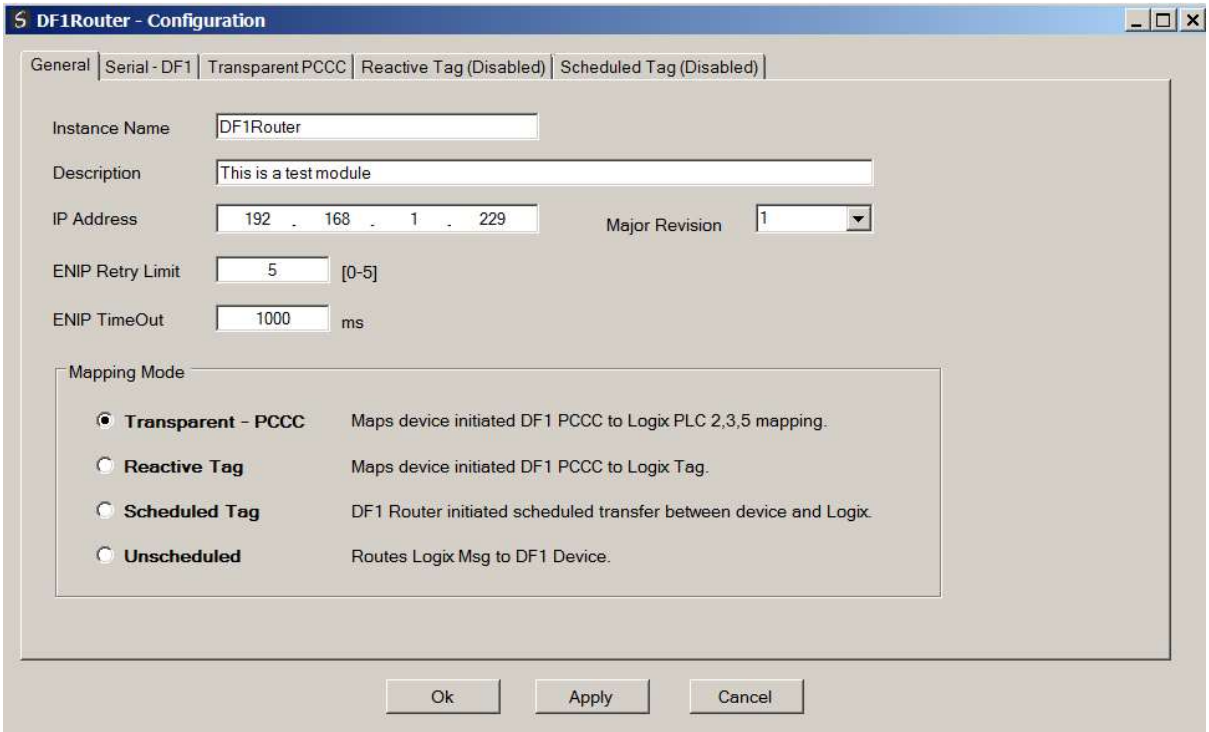


Figure 3.14. – DF1 Router configuration

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

3.4. DF1 PARAMETERS

The DF1 parameters will be configured by Slate. **Refer** to the additional information section for documentation and installation links for Aparian Slate. The DF1 parameter configuration consists of a general configuration as well as a serial configuration. 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 DF1 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 DF1 Routers.
Description	This parameter is used to provide a more detail description of the application for the module.
Major Revision	The major revision of the module
Mapping Mode	The mapping mode will determine how the DF1 messages are routed. When selecting Transparent (PCCC) mode the module will use the PCCC message exchange to read or write various tags in the Logix controller. Therefore, in this mode, the module will rely on the Logix controller to map the DF1 request to the preconfigured Logix tag. Communication in this mode is initiated by the remote DF1 device. In Reactive Tag mode the module will automatically route the DF1 message and function to the correct Logix tag. In this mode the DF1 Router will map the DF1 request to the preconfigured tag. Communication in this mode is initiated by the remote DF1 device. In Scheduled Tag mode, the DF1 Router will initiate the exchange between the remote DF1 device and Logix. Either by reading data from a DF1 device and writing it into a preconfigured Logix tag or vice versa. Communication in this mode is initiated by the DF1 Router. In Unscheduled mode the DF1 Router routes Logix messages to the remote DF1 device and returns the result. There is little configuration required in the DF1 Router as the routing information is configured by Logix for each message transaction. Communication in this mode is initiated by Logix. Refer to the message routing section of the document for a details explanation of the routing operation.

ENIP Retry Limit	The amount 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 DF1 general configuration window is opened by either double clicking on the module in the tree or right-clicking the module and selecting *Configuration*.

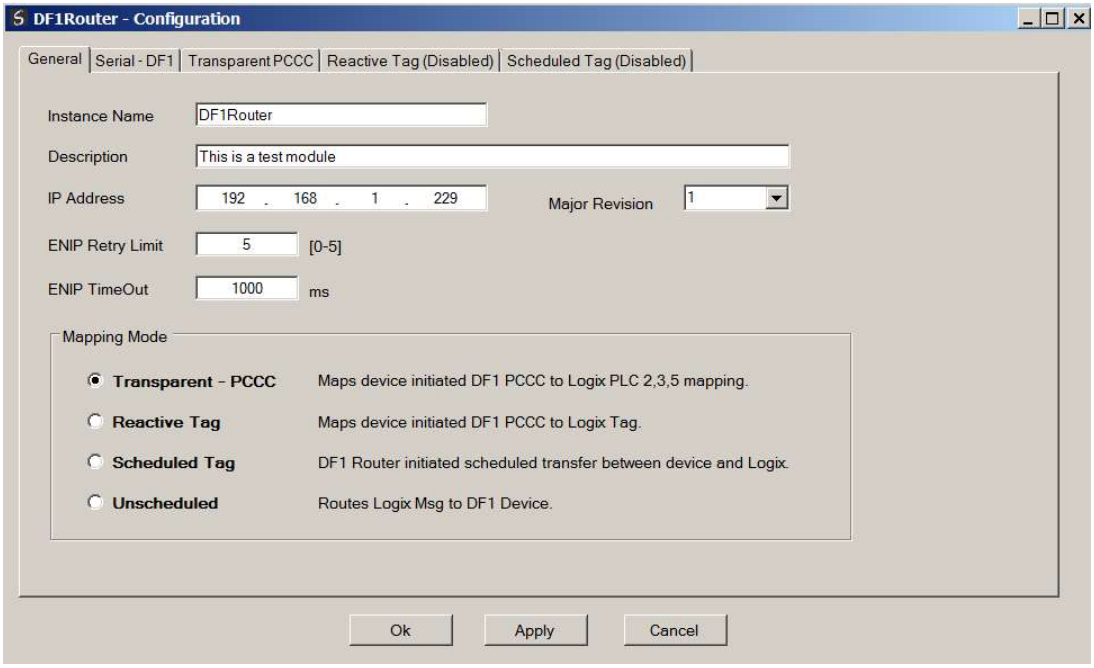


Figure 3.15. - General Configuration

The Serial – DF1 configuration consists of the following parameters:

Parameter	Description
Protocol	The protocol parameter will configure the module to operate in full duplex, half duplex, or Radio Modem mode on the DF1 network.
BAUD Rate	The BAUD rate will configure at what speed the data is send across the RS232 serial network. The module provides the following speeds: 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200
Parity	The parity parameter will configure the parity of the module's RS232 serial port. The module allows for Even, Odd, or None parity setting.
Error Detection	The module can be configured to perform either BCC or CRC checksum validation on incoming and outgoing packets. CRC checksums is a much stronger validation method when compared to BCC but is more processor intensive to perform.

Embedded Response	This parameter configures the module to add the acknowledge responses in the data payload. The user can configure the module to be Auto Detect or On. This function is only available in Full Duplex mode.
Node Address	The node address is only configurable in Unscheduled mode. In all other modes the node address is dynamically changed to suite the required mapping.
Retry Limit	The retry limit determines how many times the module must retry and message exchange before failing it.
ACK Timeout	The ACK timeout is used to determine the interval between retries when a message exchange has failed.
Reply Msg Wait	The reply message wait is the minimum delay before the DF1 reply is transmitted to the DF1 device.
Duplicate Detection	This parameter will configure the module to check for duplicate packets and flagging them when they occur.
Enable Store and Forward	When using the Radio Modem protocol the DF1 Router can be used to repeat messages from other nodes on the radio network (only relevant for DF1 Radio Modem protocol).
Repeat Delay	When repeating packets from other nodes on the Radio network, this setting determines the delay before repeating the packet (only relevant for DF1 Radio Modem protocol).
Nodes to Repeat	When Store and Forward has been enabled the Nodes to Repeat list is all the nodes numbers of the devices from which the DF1 Router must repeat the messages (only relevant for DF1 Radio Modem protocol).

Table 3.2 - Serial DF1 configuration parameters

The serial DF1 configuration is shown in the figure below. The DF1 Serial configuration window is opened by either double clicking on the module in the tree or right-clicking the module and selecting *Configuration.* Once in the configuration window select the second tab at the top *Serial – DF1*.

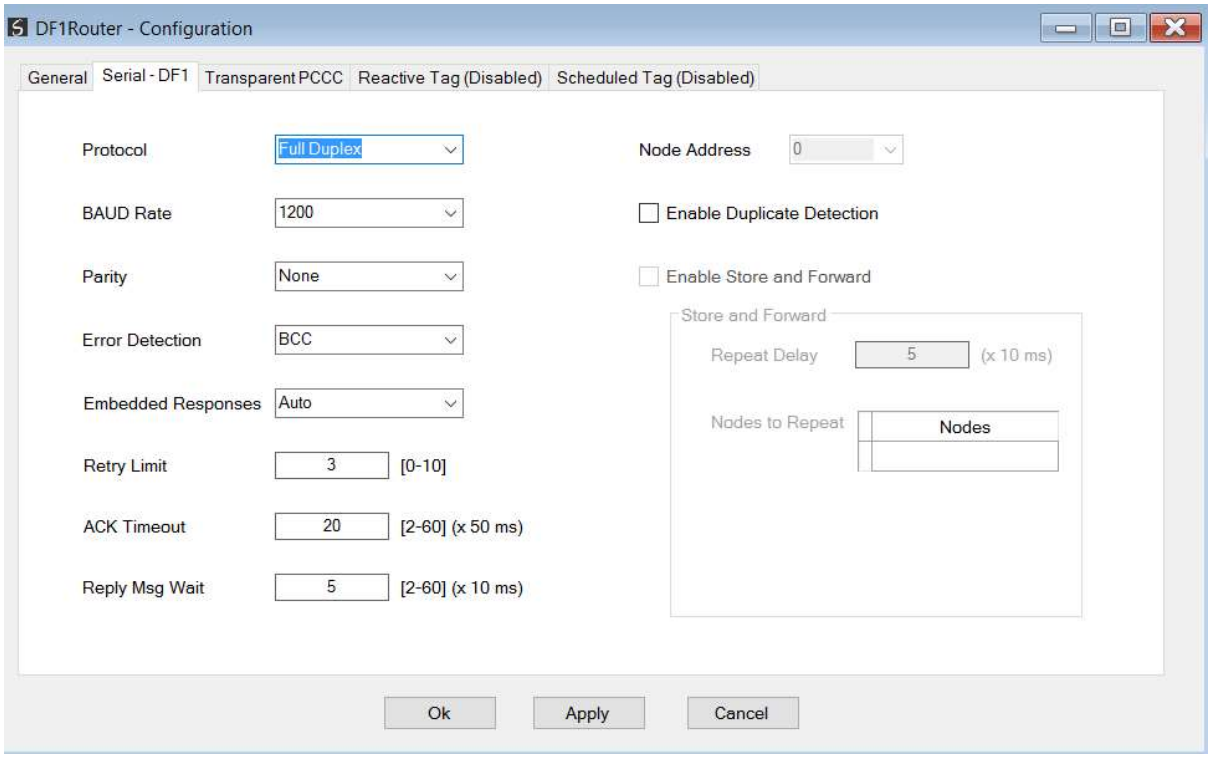


Figure 3.16 - Serial DF1 configuration

NOTE: If the DF1 Router supports 8 data bits and 1 stop bit.

3.5. MESSAGE ROUTING

The module can be configured to route DF1 data in one of four modes. As mentioned in the DF1 parameter section in this document the four modes are:

- Transparent (PCCC) mode
- Reactive Tag mode
- Schedule Tag mode
- Unscheduled mode

3.5.1. TRANSPARENT (PCCC) MODE

The Transparent Mode can be used for redirecting messages between the DF1 and Ethernet port. This mode allows for various remote programming options and well as mapping DF1 (PCCC) messages to a Logix controller when using the Logix PLC mapping feature.

To open the transparent map configuration window by double clicking on the module in the tree or right-clicking the module and selecting *Configuration.* Once in the configuration window select the third tab at the top *Transparent PCCC*. The transparent PCCC map configuration is shown in the figure below.

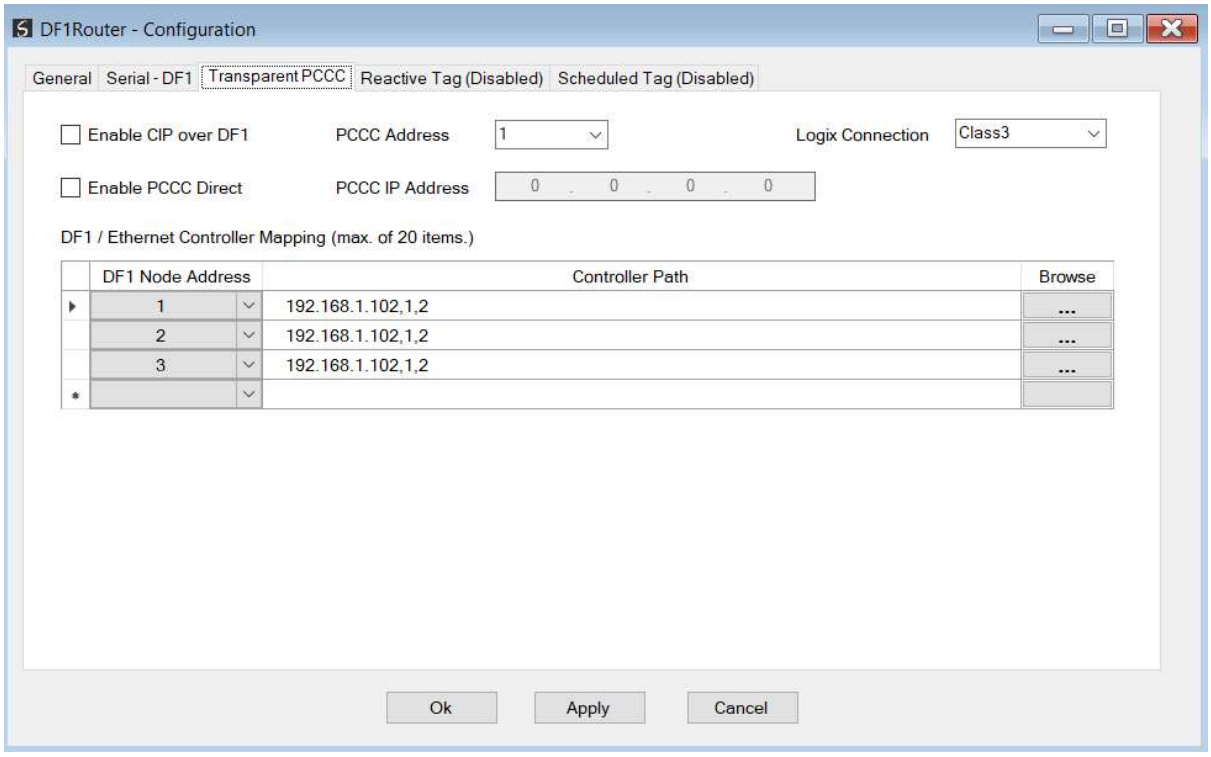


Figure 3.17 - Transparent map configuration

The module can emulate more than one destination DF1 Node Address, and thus route multiple messages to different Ethernet devices. For this reason it is important to enter the correct associate DF1 Node address in each mapping record.

When using PCCC data messaging the connection class can be configured by selecting either Class 3 or Unconnected (UCMM) messaging. This is done by selecting from the Connection drop-down box in the Transparent PCCC tab.

The controller paths can either be entered manually or the user can browse to them by clicking the Browse button. The Target Browser requires the controller to be available on the network. The Target Browser will open and automatically scan for all EtherNet/IP devices.

If the Ethernet/IP module is a bridge module, it can be expanded by right-clicking on the module and selecting the Scan option.

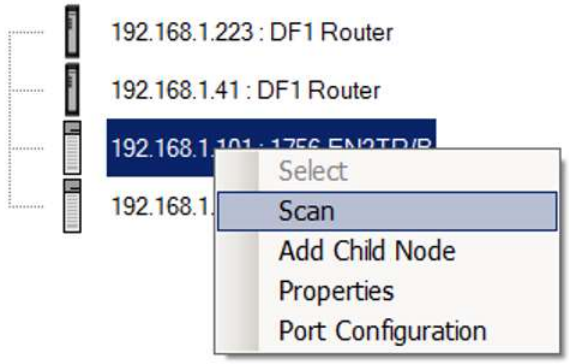


Figure 3.18. - Scanning node in the Target Browser

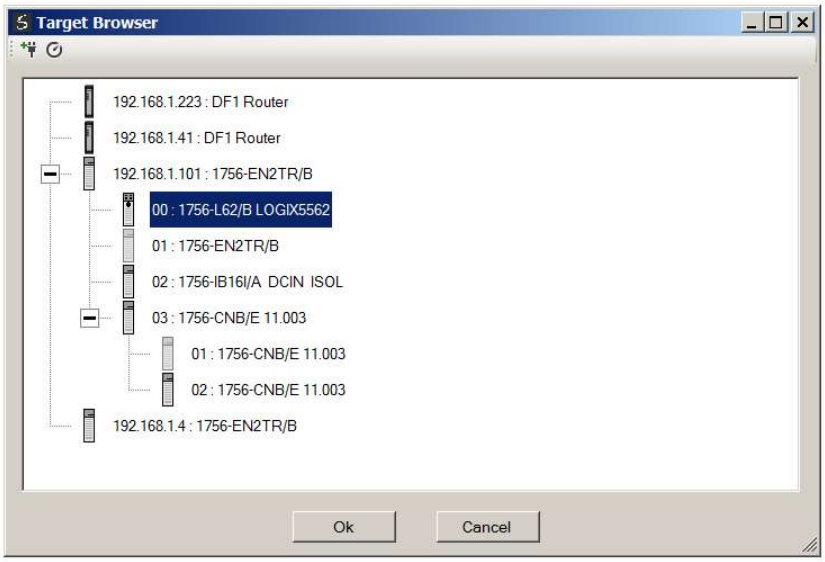


Figure 3.19. - Target Browser selection

The required controller can then be chosen by selecting it and clicking the Ok button, or by double-clicking on the controller module.

A maximum number of 20 mapping entries can be added.

Parameter	Description
DF1 Node Address	This parameter is one of the destination addresses that the DF1 Router will accept. When the DF1 message initiator sends a message to a specific DF1 node address that has been configured in the module, it will be accepted and routed to the paired Controller Path. This is the destination node address of the message, and not the source address of the DF1 device.
Controller Path	The Ethernet/CIP path to the end device (e.g. Logix controller). Refer to the additional information section in this document for references to details routed CIP path information. For example: If the controller (slot 0) is in a chassis with an Ethernet bridge (IP address 192.168.1.20) connected to the local network the user would follow the format; *Ethernet bridge IP address, chassis backplane port, module slot etc.* 192.168.1.20,1,0 For PLC5 and SLC500/MicroLogix devices, the path should contain only the device's IP address.
Enable CIP over DF1	This feature enables the DF1 Router to support CIP serial allowing the user to program ControlLogix and CompactLogix controllers via the Serial Port by using the DF1 Router. For more detail regarding the setup of this refer to the application note on the DF1 Router webpage.  **NOTE:** The user will not be able to have PCCC Direct and CIP over DF1 enabled at the same time. If CIP over DF1 is enabled the software will automatically disable the PCCC Direct option.
Enable PCCC Direct	The PCCC Direct option allows the DF1 Router to support the PCCC protocol on a separate IP address. The PCCC protocol will allow the DF1 Router to emulate a legacy controller (eg. SLC5/03) as if it is directly connected to the Ethernet network.
PCCC Address	The PCCC Address allows the user to force the destination address of the DF1 message which is routed either via the PCCC protocol or the CIP embedded PCCC message. This is useful when using certain RSLinx Enterprise drivers in FTView which does not allow the user to choose the destination DF1 Node address. For further information regarding this see the FTView application notes on the DF1 Router webpage.
PCCC IP Address	The IP address of the supported PCCC Protocol.  **NOTE:** The must not have this IP address the same as the module IP address as it can cause confusion with certain RSLinx drivers.
Logix Connection	The connection class used by the mapped items to the Logix controller.

Table 3.3 - Transparent Map parameters

3.5.1.1. TRANSPARENT MODE - REMOTE PROGRAMMING

The DF1 Router can also be used to program various Rockwell Automation controllers (ControlLogix, CompactLogx, MircoLogix, SLC, PLC5, and Mirco800) from Ethernet to Serial. For a detailed setup of the various Logix/CCW programming methods see the applications notes on the website for the DF1 Router.

The following example makes use of the DF1 Router to program multiple SLC / MicroLogix stations connected on Ethernet, across a serial DF1 radio network.

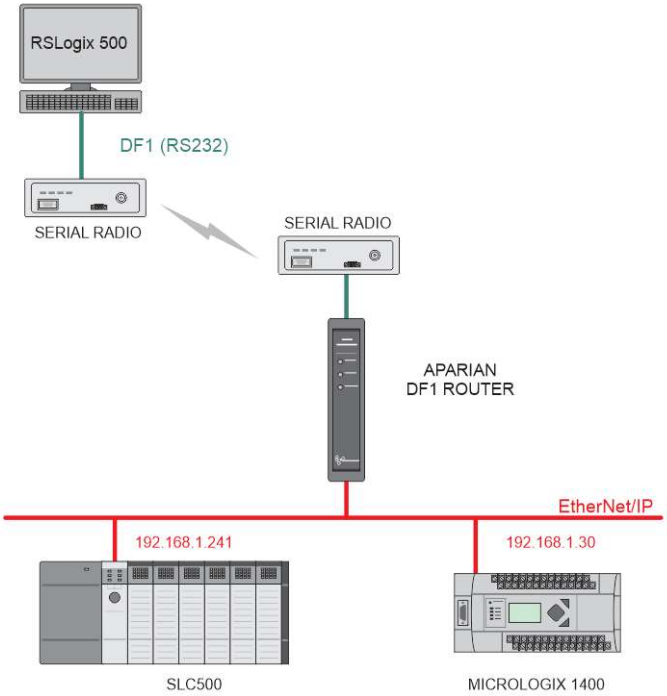


Figure 3.20. – Remote Programming Example 1

The DF1 Router is configured in a Half-Duplex mode, to allow multiple devices.
The Transparent Mode configuration is configured to map the virtual node address 1 to the SLC500 (192.168.1.241) and virtual node address 2 to (192.168.1.30).

DF1 / Ethernet Controller Mapping (max. of 20 items.) Connection Class3

	DF1 Node Address	Controller Path	Browse
▸	1	192.168.1.241	...
	2	192.168.1.30	...
*			

Figure 3.21. – Remote Programming Example 1 – Transparent Configuration

RSLinx is configured using the DF1 Polling Master Driver. The DF1 settings should match those configured in the DF1 Router, e.g. Half-Duplex, BAUD rate, parity, error checking etc.

The configured nodes (1 & 2) must also be added to the Polling list definition.

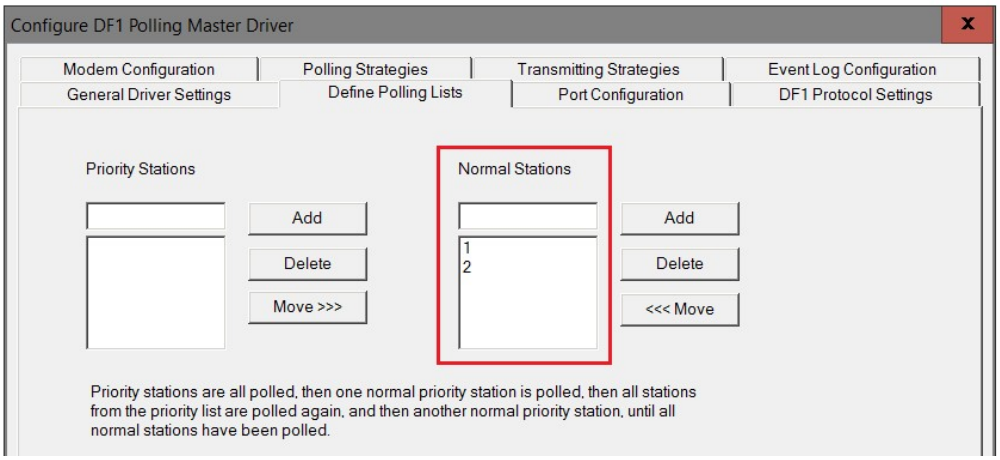


Figure 3.22. – Remote Programming Example 1 – RSLinx Configuration

Once configured the two remote stations will appear in the RSLinx RSWho browser and can be accessed by RSLogix 500.

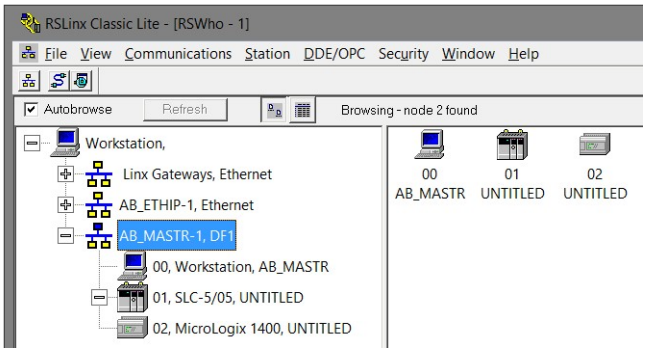


Figure 3.23. – RSLinx RSWho browser

The second remote example, (illustrated below,) allows a remote serial DF1 device (SLC500) to be programmed via a DF1 Router across an Ethernet network.

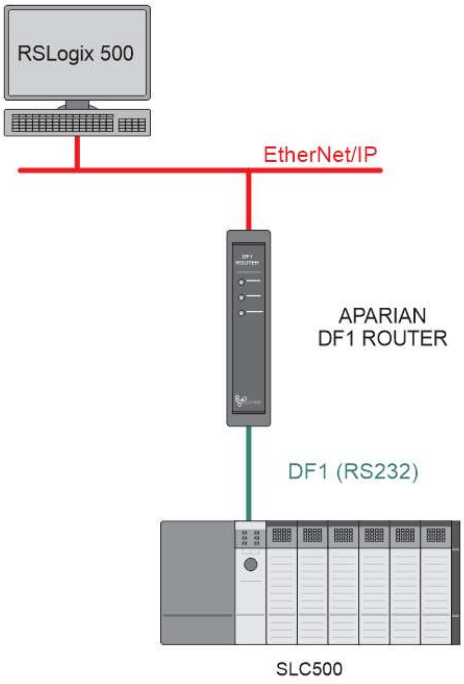


Figure 3.24. – Remote Programming Example 2

As with the previous example it is important that the DF1 settings of the remote device match that of the DF1 Router. The DF1 Router should be configured for Full-Duplex, and although using the Transparent mode, no mapping entries are required.

After adding the EtherNet/IP driver in RSLinx, the DF1 Router will automatically appear. For the routing to work, the EDS file must be installed, which can be uploaded from the device. The remote serial device will appear under the DF1 Router's DF1 Port in the RSLinx RSWho browser.

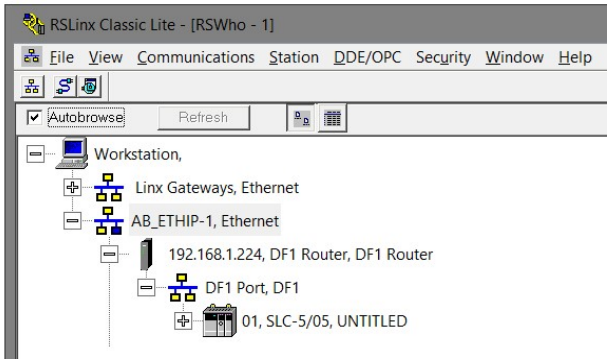


Figure 3.25. – Remote Programming Example 2 – RSLinx RSWho browser

3.5.1.2. TRANSPARENT MODE – DATA MAPPING

In transparent mode the DF1 Router will redirect a DF1 PCCC message to a Logix controller at a preconfigured path. Therefore, in this mode, the module will rely on the Logix controller to map the DF1 request to the preconfigured Logix tag.

The transparent map configuration is a two-step process. First the DF1 Router must be configured to route specific DF1 addresses to a controller path. The second step is to map the DF1 addresses to Logix tags using RSLogix 5000.

The DF1 message initiator (e.g. DCS gateway) will send a read or write request to a specific DF1 address on RS232. The user must configure the DF1 Router to route the message destined for a specific DF1 address to a Logix controller. This will allow the correct Logix controller to map the request to the Logix PLC/SLC mapped tag. For each route map the user must enter two parameters as described in the table below.

Below are two examples of how DF1 messages are routed to the Logix controller.

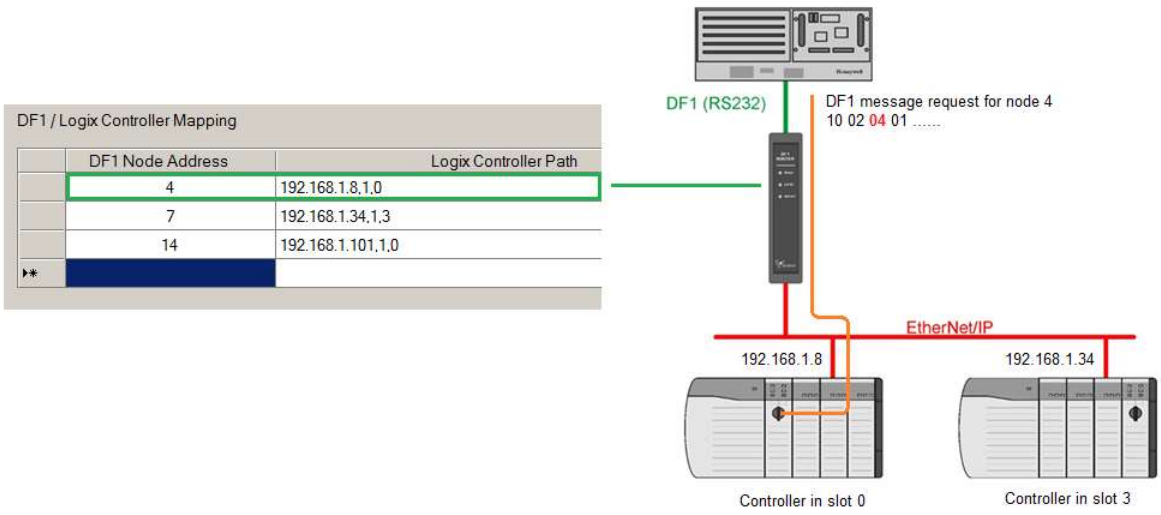


Figure 3.26 – Example 1 - Transparent routing map – node 4

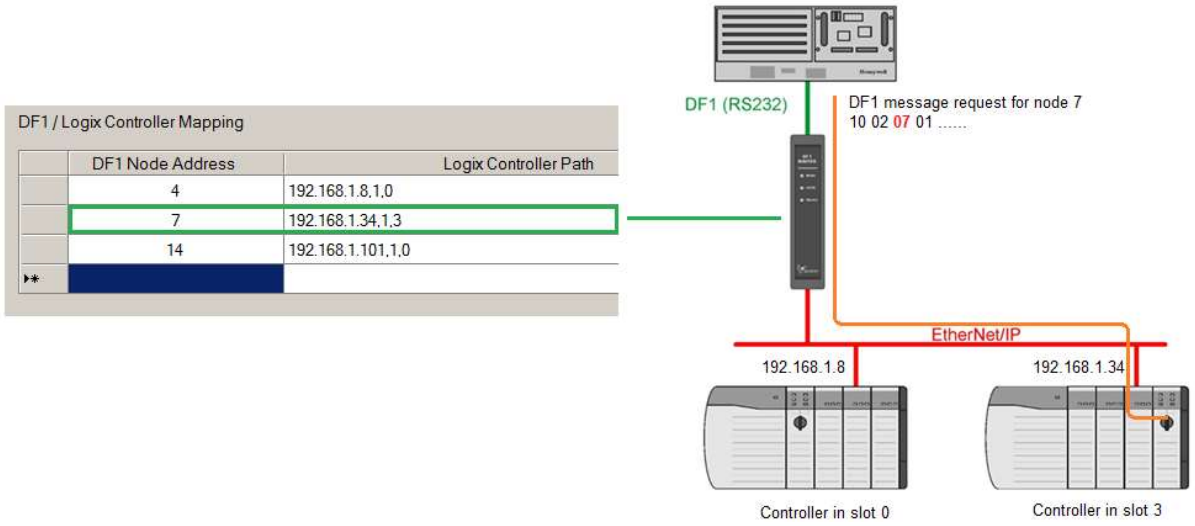


Figure 3.27 – Example 2 – Transparent routing map – node 7

The second part of the transparent routing map setup is to map the DF1 request received by the Logix controller to a Logix tag. This must be done in Rockwell Automation's RSLogix 5000. Refer to the additional information section in this document for further information regarding mapping of PLC/SLC messages in the Logix controller. Open the mapping table in RSLogix 5000 by selecting *Map PLC/SLC Messages* from the *Logic* menu item in the menu bar. The user must enter the requested file number and Logix tag name pair to ensure that the read or write request is routed to the correct Logix tag. Below is an example of the RSLogix 5000 PLC5/SLC mapping.

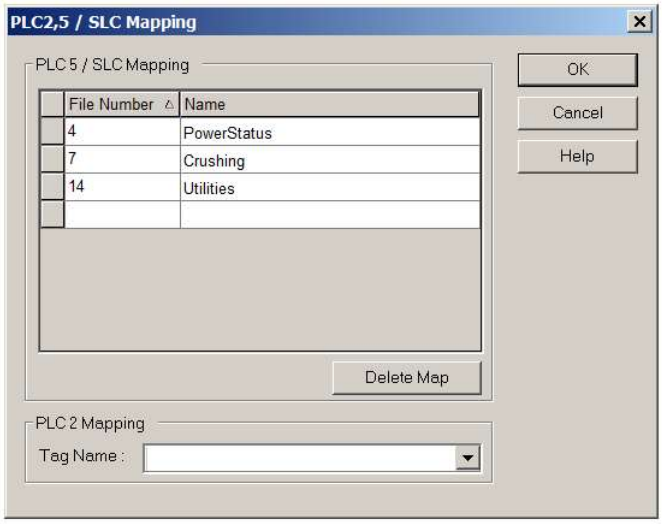


Figure 3.28 - Example of Mapping PLC/SLC Messages in RSLogix 5000

NOTE: It is the user's responsibility to ensure that the Logix tag array datatype and size matches that of the DF1 File Number. Failing to do this can result in communication faults.

3.5.2. REACTIVE TAG MODE

The Reactive Tag routing mode allows mapping of virtual Data Files to Logix tags across multiple controllers. This is similar to the Transparent PCCC mode except the mapping of data files to Logix tags, is no longer managed in Logix, but in the DF1 Router itself.

Thus the routing of the Node address to Logix controller as well as DF1 File Number to a Logix tag is managed by the DF1 Router where in transparent mode, the DF1 File Number was routed to a tag by the Logix controller. In the Reactive Tag mode the DF1 Router can operate completely independently from the Logix controller by directly reading and writing to Logix tags.

NOTE: The Reactive Tag mode will only work with PLC5, SLC Typed Read and Write messages as well as PLC2 Unprotected Read and Write messages.

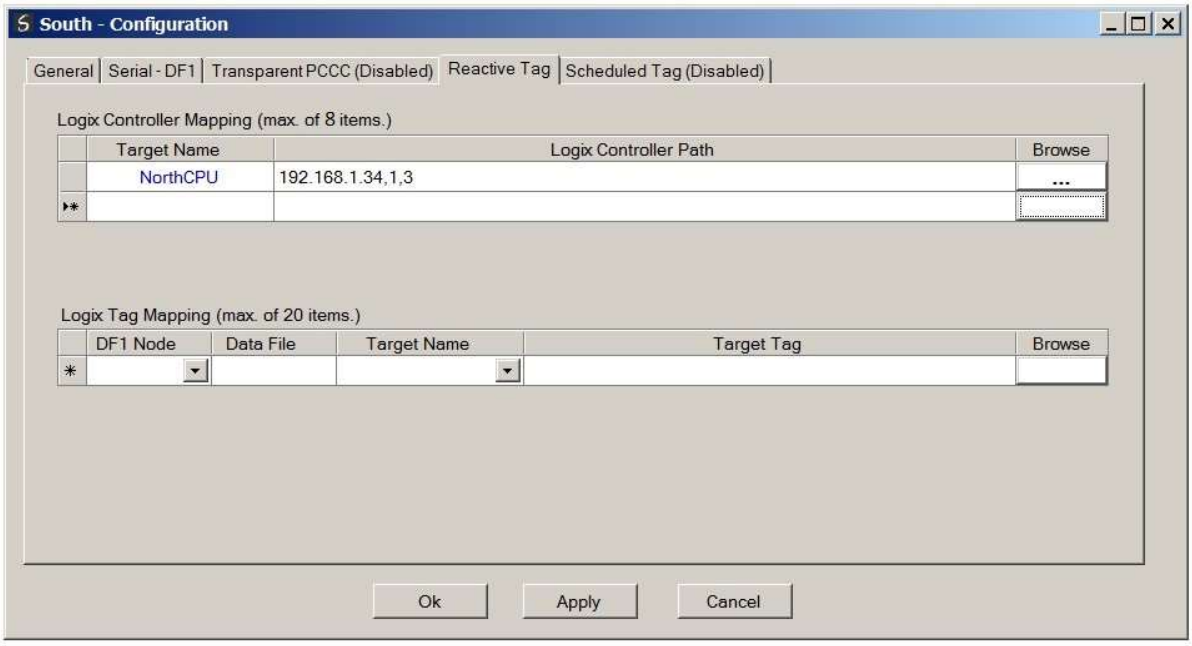


Figure 3.29. - Reactive Tag mode configuration

The Reactive Tag mode is configured in two steps. First the user must create a Target Name (CIP path to the destination Logix controller) which will be used to link the DF1 File Number to the destination Logix tag. When using PLC2 messages the Target will be linked to the DF1 Node Number. Therefore if the device sending out PLC2 requests wants to access multiple Target Tags it will need to differentiate by using different Node Numbers.

The Logix controller paths can either be entered manually or the user can browse to them by clicking the Browse button. The Target Browser will open and automatically scan for all available EtherNet/IP devices.

If the Ethernet/IP module is a bridge module, it can be expanded by right-clicking on the module and selecting the Scan option.

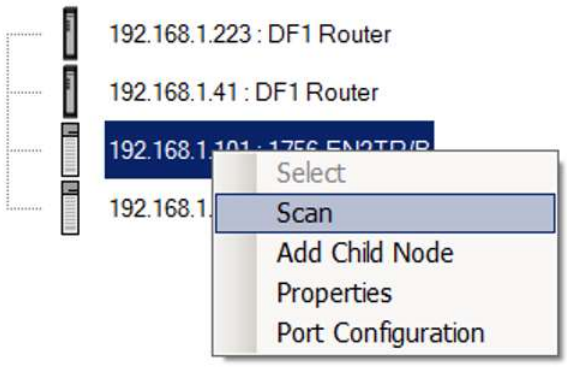


Figure 3.30. - Scanning node in the Target Browser

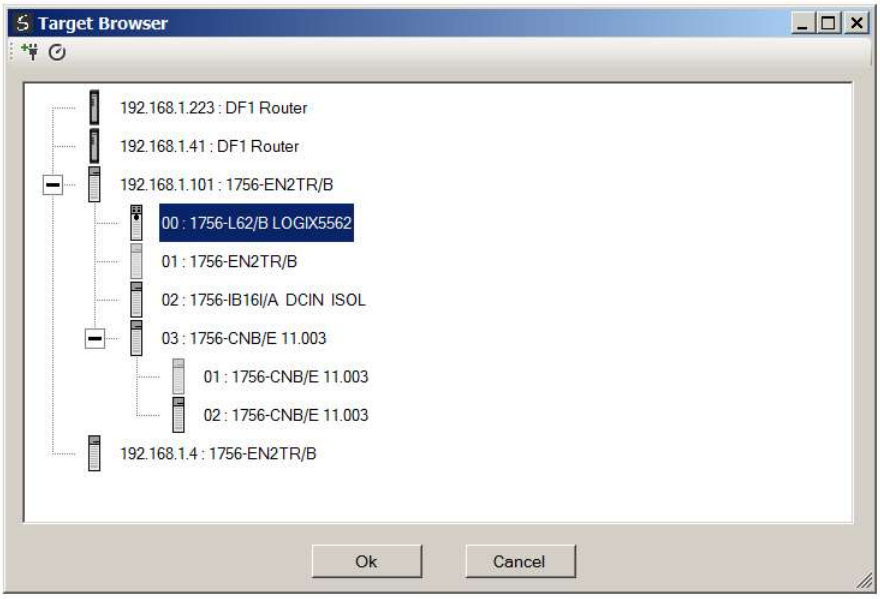


Figure 3.31. - Target Browser selection

The required Logix controller can then be chosen by selecting it and clicking the Ok button, or by double-clicking on the controller module.

A maximum number of 8 controller mapping entries can be added.

The second part of the Reactive Tag mode is to configure the link between a DF1 node and File Number combination to a Logix tag. This will allow the DF1 message initiator to effectively write to, or read from, a Logix tag using traditional File Numbers (e.g. N7, F8, etc.).

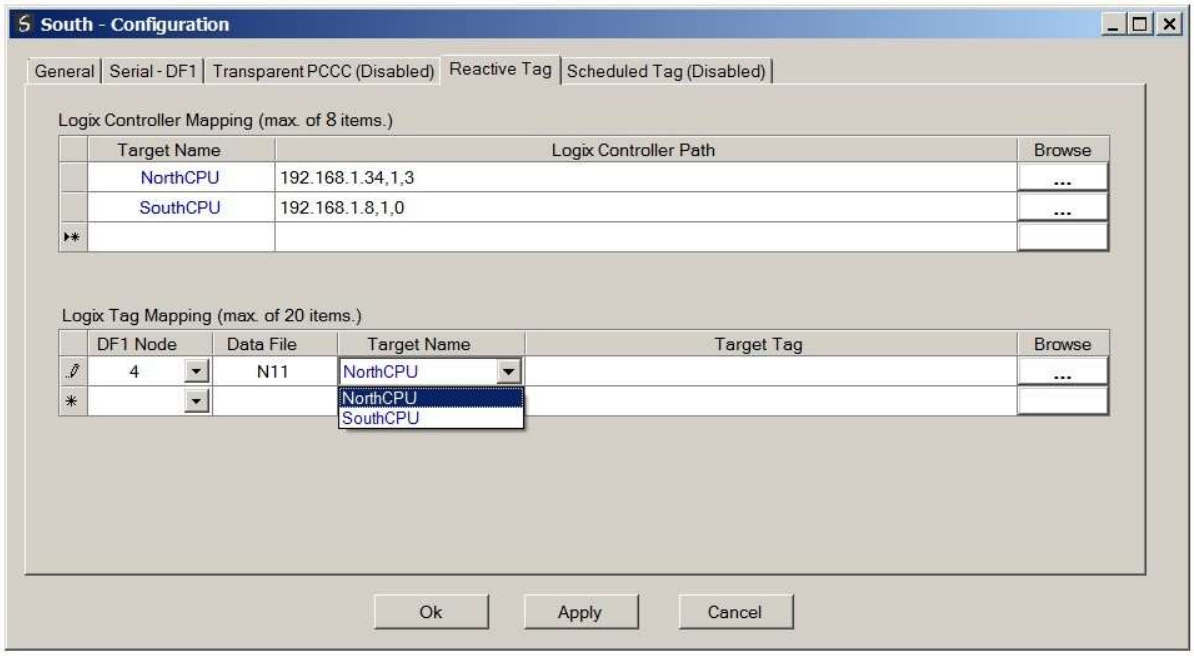


Figure 3.32. – Reactive Tag Mapping

NOTE: When using PLC-2 messages there are no data files. The user is required to enter **PLC2** in the space of the data file as shown below. Only the DF1 Node address will be used to link the selected Target Tag to the incoming PLC2 DF1 message.

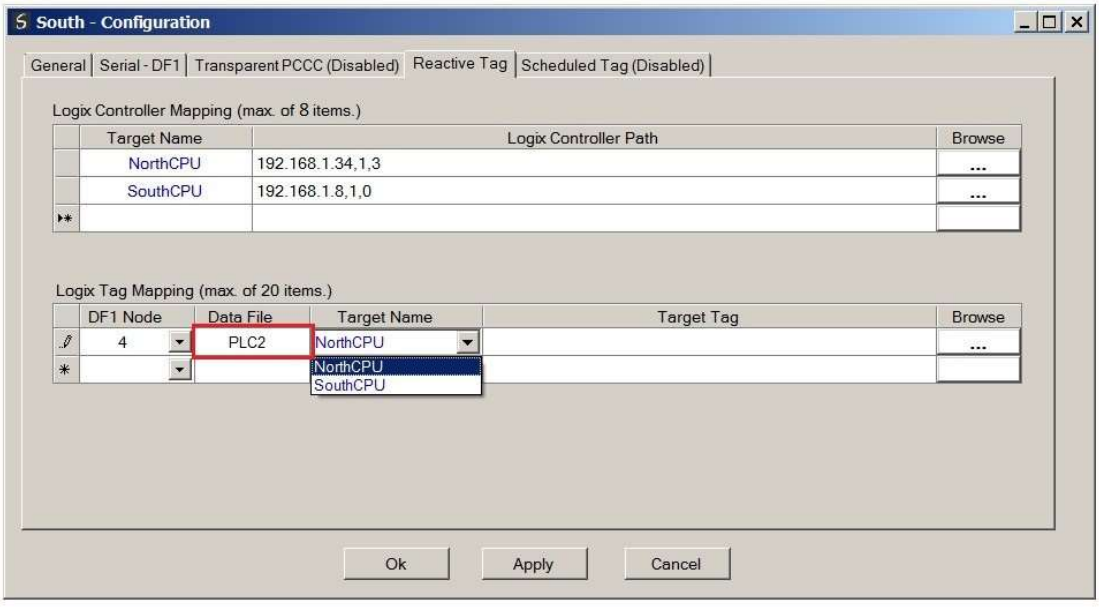


Figure 3.33 – Reactive Tag Mapping (PLC2 Messages)

NOTE: When using Unprotected Bit Write PLC-2 messages only one byte worth of bits can be written at a time.

The module can emulate more than one destination DF1 Node Address, and thus route multiple messages to different Logix controllers. For this reason it is important to enter the correct associate DF1 Node address in each mapping record.

The next column is used to enter the DF1 data file. It is important to enter only the file here (e.g. N11) and not a data word address (e.g. N11:0). The first element of the entered DF1 file (e.g. N11:0) will then map to the first element of the Logix array and so on. When using PLC2 messages simply type in “PLC2” into the Data File field as shown in figure 3.27.

Below is an example of the target tag selection. The Target Tag can be either entered manually or selected using the Tag Browser in Slate. The Tag Browser requires the controller to be available on the network.

To browse to the tag, click on the Browse button. The Tag Browser will open and scan all the tags inside that controller. If the controller has been recently scanned in this Slate session, then a cached version of the tags will be displayed. A rescan of the tags can be triggered by selecting the Refresh button in the Tag Browser’s toolbar.

All the non-array tags will be disabled, guiding the user to select a suitable tag.



NOTE: When mapping PLC5 Boolean files (e.g. B3) it is recommended that the destination Logix tag be a SINT array, rather than a Boolean array. Using the latter may result in unexpected results due to the packing format of Logix Boolean arrays.



NOTE: When mapping PLC2 messaging is used only INT datatypes will be supported. Thus the Target Tag must be an array of INTs.

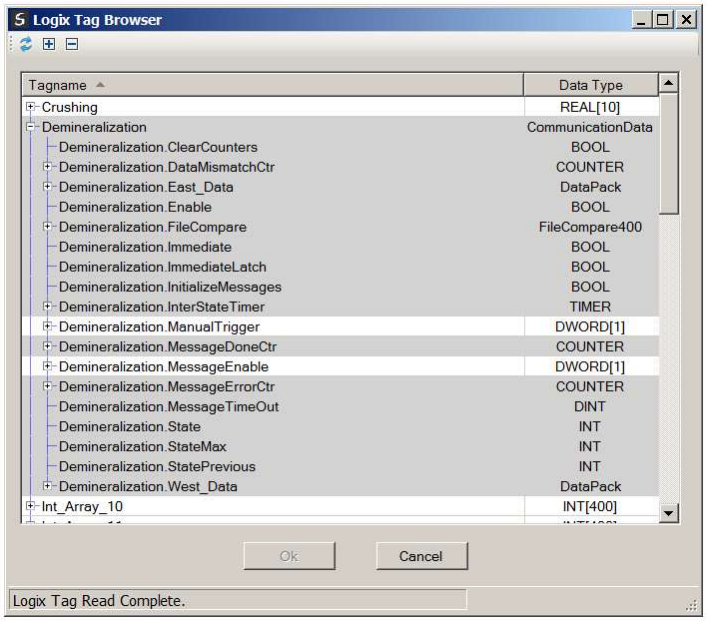


Figure 3.34 – Tag Browser tag selection

The two figure below is an example of how DF1 messages are routed to the Logix tags using the Reactive Tag Map mode.

NOTE: It is the user's responsibility to ensure that the Logix tag array datatype and size matches that of the DF1 File Number. Failing to do this can result in communication faults.

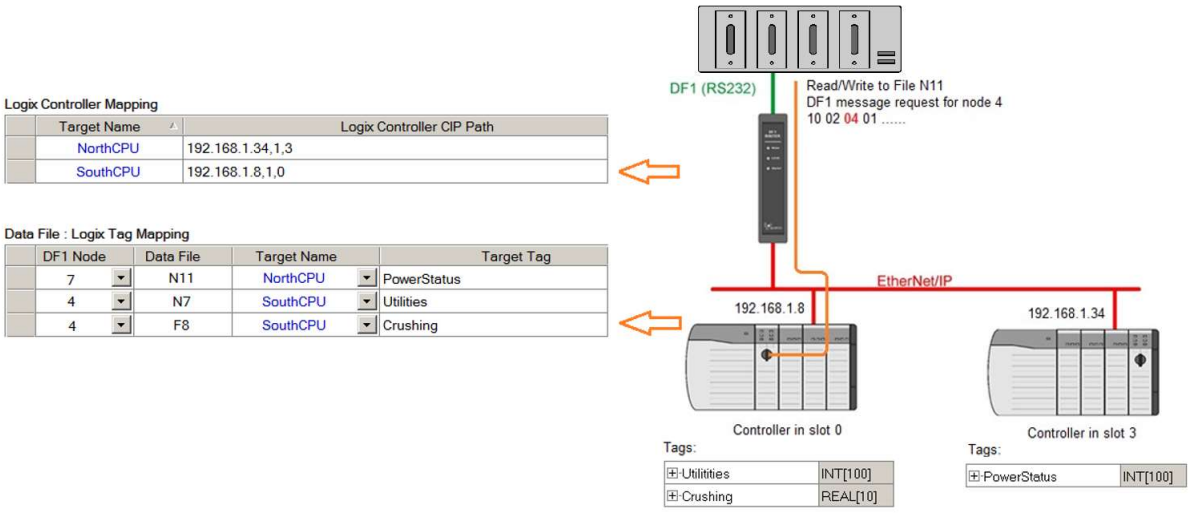


Figure 3.35 - Reactive Tag mode configuration in Slate

When receiving PLC2 messages the Data File entered into Slate will be "PLC2" because there are no Data Files in PLC2 message structures. Thus the DF1 Node address will be used to route the messages as shown below:

NOTE: It is the user's responsibility to ensure that the Logix tag array datatype and size matches that of the PLC2 DF1 request. Failing to do this can result in communication faults.

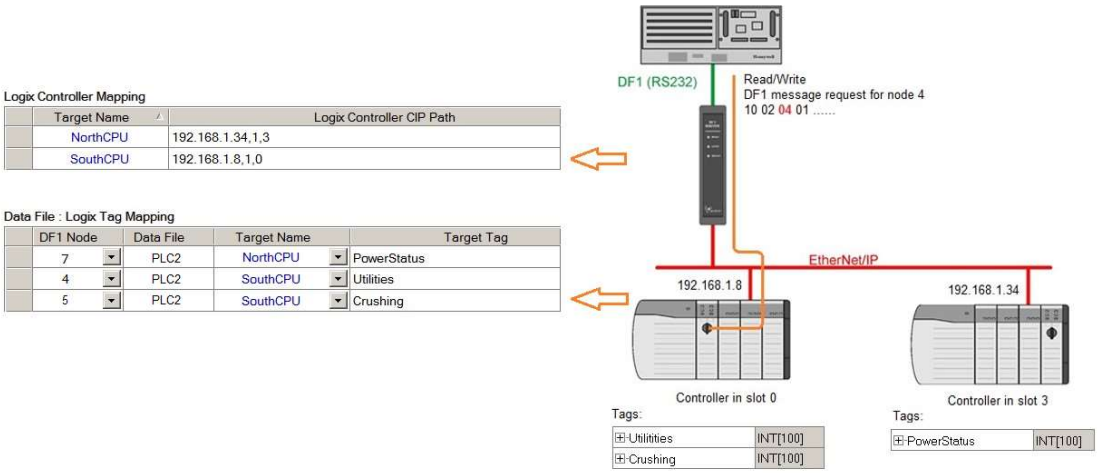


Figure 3.36 Reactive Tag mode configuration in Slate (PLC2 messages)

3.5.3. SCHEDULED TAG MODE

The Scheduled Tag routing mode transfers data between a DF1 device and one or more Logix controllers. Unlike the Transparent and Reactive tag mode, the DF1 Router when in the Scheduled Tag mode initiates the messaging.

In this mode the DF1 Router transfers data between a Logix controller and a DF1 device without any configuration or programming required in either the DF1 device or the Logix controller.

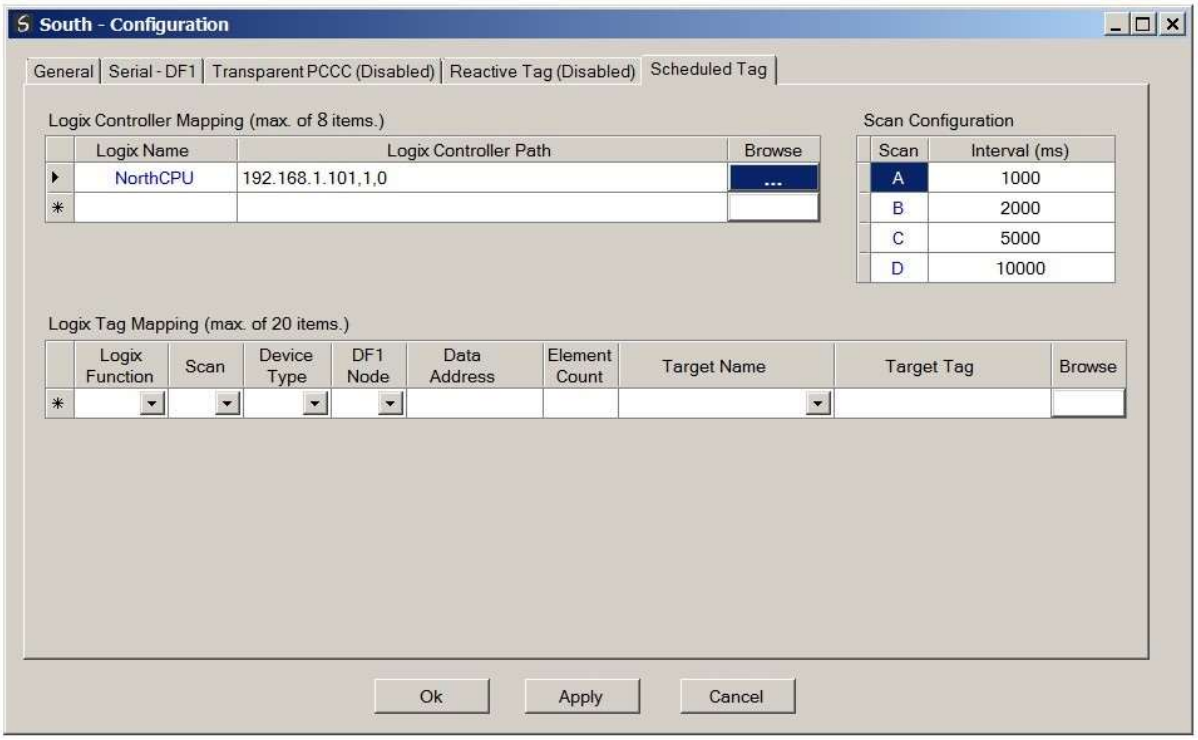


Figure 3.37 - Scheduled Tag configuration

The Schedule Tag mode is configured in three steps. First the user must create a Target Name (CIP path to the destination Logix controller) which will be used to link the DF1 File Number to the destination Logix tag.

The Logix controller paths can either be entered manually or the user can browse to them by clicking the Browse button. The Target Browser will open and automatically scan for all available EtherNet/IP devices.

If the Ethernet/IP module is a bridge module, it can be expanded by right-clicking on the module and selecting the Scan option.

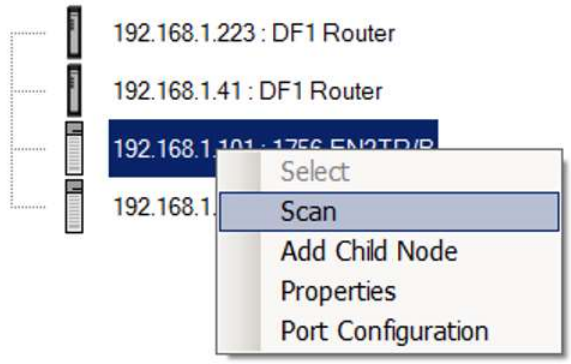


Figure 3.38 - Scanning node in the Target Browser

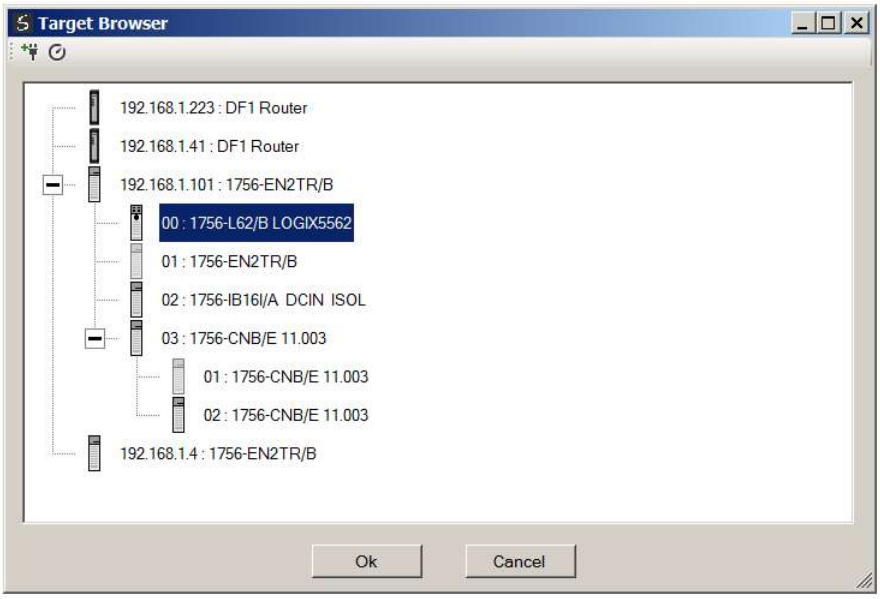


Figure 3.39 - Target Browser selection

The required Logix controller can then be chosen by selecting it and clicking the Ok button, or by double-clicking on the controller module.

A maximum number of 8 controller mapping entries can be added.

The second part of the Scheduled Tag mode setup is to configure the scan intervals. The scan intervals allow different data items to be transferred at different rates. There are 4 scan classes, viz. A, B, C and D. The intervals for each can be adjusted by entering the scan time in milliseconds. The interval must be between 200 milliseconds and 60 seconds.

The third part of the Scheduled Tag mode setup is to configure the link between a DF1 node and File Number combination to a Logix tag, and the associated action and scan required.

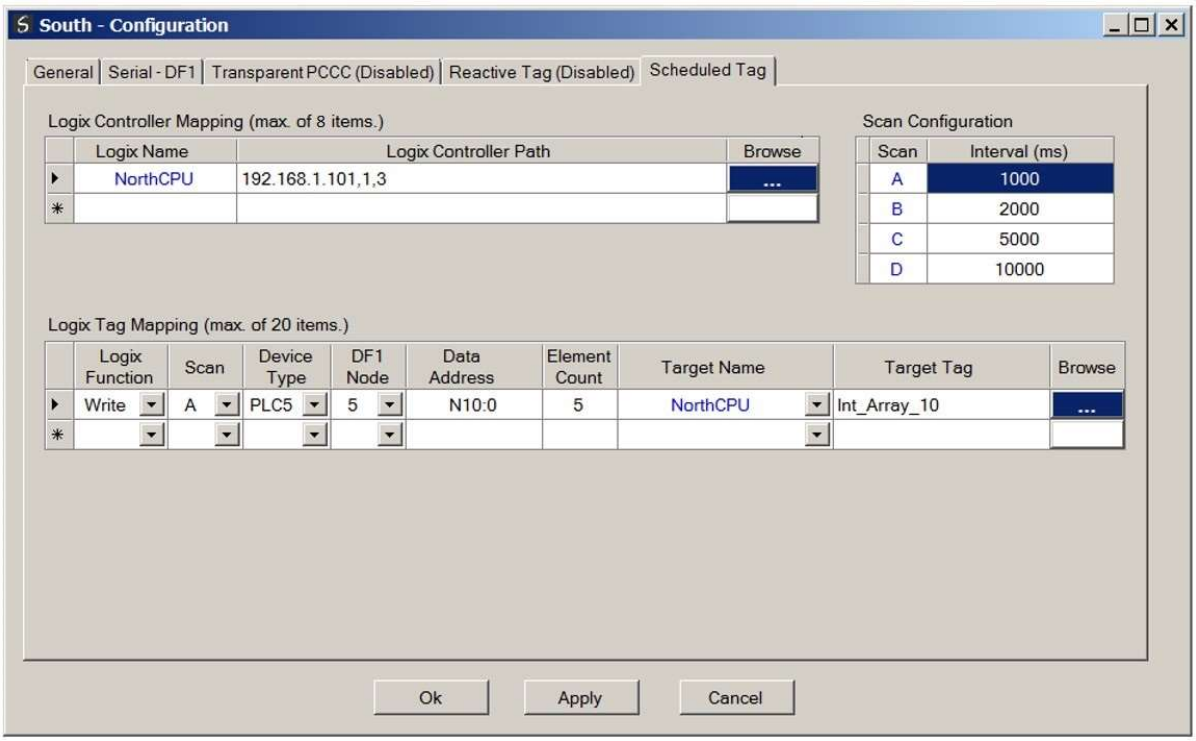


Figure 3.40 - Scheduled Tag Mapping

The Logix Function field specifies whether the transaction will result in a read or write from the Logix controller's perspective.

The Scan field specifies at what rate the transaction will be executed. Select a scan class letter that matches the required interval. Care must be taken to select a realistic scan interval, taking into account the configured Baud rate and message size.

The Device Type field specifies the type of message that will be sent to the DF1 device. There are two options, PLC5 and SLC. The latter should be selected when using a MicroLogix device.

The DF1 Node is the remote device's node.

The Data Address is the remote device's address and should be specified to the element level. For example, N10:0. Note that this differs from the Reactive Tag configuration where only the file is specified.

The Element Count is the number of items to be read or written. In the example above, with a Data Address of N10:0 and an Element Count of 5, then N10:0 through N10:4 will read from the DF1 device and written to Logix.

One of the Target Names configured in the first step can be selected by means of the target Name combo box.

The Target Tag can be either entered manually or selected using the Tag Browser in Slate. The Tag Browser requires the controller to be available on the network.

To browse to the tag, click on the Browse button. The Tag Browser will open and scan all the tags inside that controller. If the controller has been recently scanned in this Slate session, then a cached version of the tags will be displayed. A rescan of the tags can be triggered by selecting the Refresh button in the Tag Browser's toolbar.

Only tags of a relevant type will be enabled, guiding the user to select a suitable tag.

NOTE: When mapping PLC5 Boolean files (e.g. B3) it is recommended that the destination Logix tag be a SINT array, rather than a Boolean array. Using the latter may result in unexpected results due to the packing format of Logix Boolean arrays.

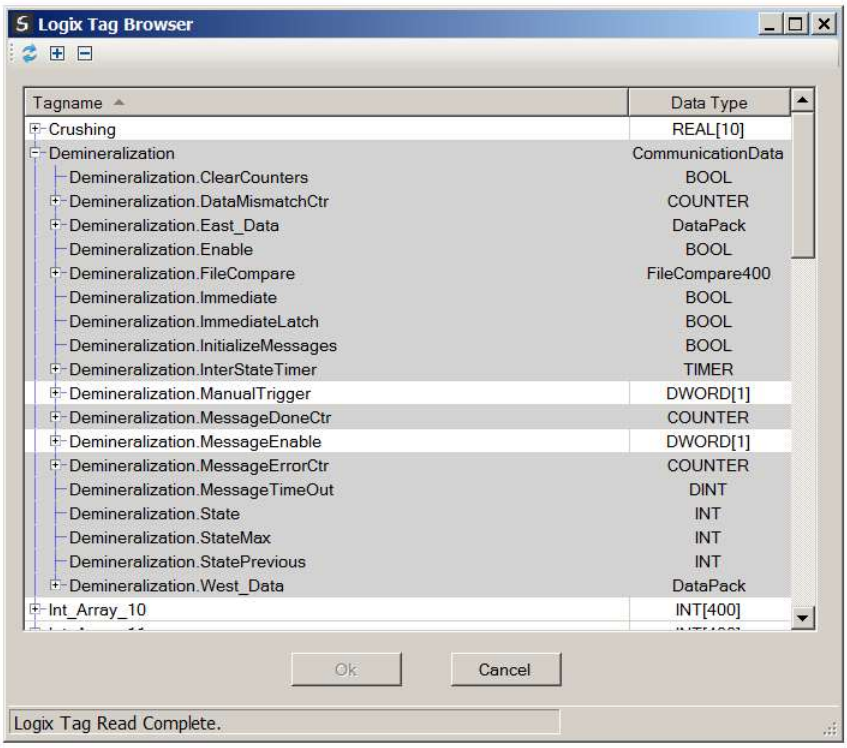


Figure 3.41 - Tag Browser tag selection

NOTE: It is the user's responsibility to ensure that the Logix tag array datatype and size matches that of the selected DF1 Data Address. Failing to do this can result in communication faults and unexpected results.

3.5.4. UNSCHEDULED MODE

There is no additional configuration required when using the Unscheduled Mode. The configuration required for the DF1 message is contained within the Message Block data, configured in Logix.

3.6. MODULE DOWNLOAD

Once the DF1 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 DF1 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.

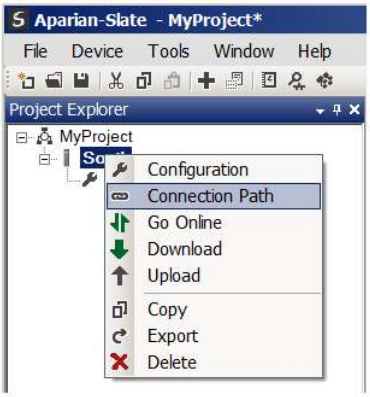


Figure 3.42 - Selecting Connection Path

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



Figure 3.43 - Connection Path

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

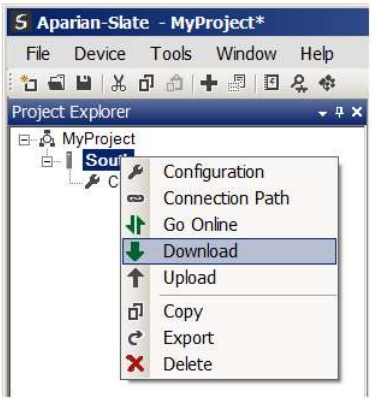


Figure 3.44 - Selecting Download

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



Figure 3.45 - Successful download

During the download process the module's time will be compared to that of the PC's time. Should the difference be greater than 30 seconds, the user will be prompted to set the module time to that of the PC time.

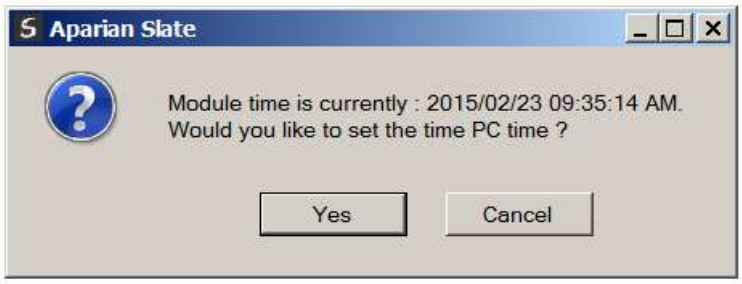


Figure 3.46 - Setting module time

The module time is used only for the event log.

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.

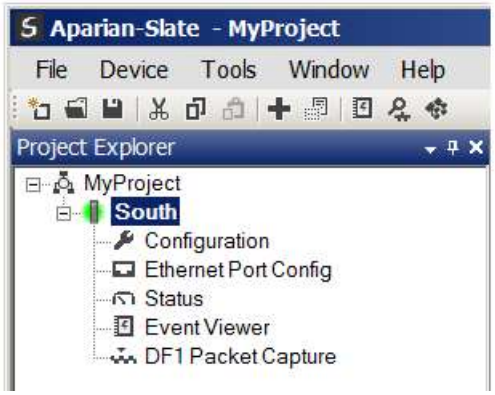


Figure 3.47 - Module online

3.7. RSLOGIX 5000 CONFIGURATION

The DF1 Router modules can be easily integrated with Allen-Bradley Logix family of controllers.
For Logix versions 20 and beyond, the modules can be added using the EDS Add-On-Profile (AOP), which is described in section 3.7.1.
For older versions (19 and below), the module must be added using a Generic Profile which is described in section 3.7.2.

3.7.1. STUDIO 5000 CONFIGURATION (VERSION 20+)

Integration with the Logix family in Studio5000 makes use of the EDS AOP. Before the module can be added to the tree the module's EDS file must be registered.
Using RSLinx, the EDS file can be uploaded from the device after which the EDS Hardware Installation tool will be invoked to complete the registration.
Alternatively, the EDS file can be downloaded from the product web page at http://www.aparian.com/products/df1router and registered manually using the EDS Hardware Installation Tool shortcut under the Tools menu in Studio 5000.

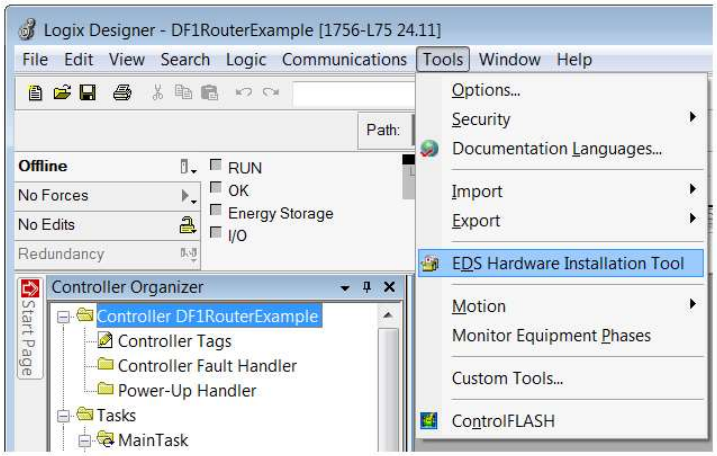


Figure 3.48 - EDS Hardware Installation Utility

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.

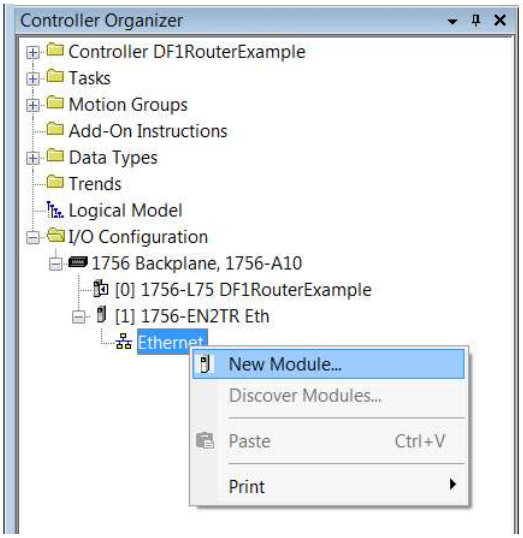


Figure 3.49 – Adding a module

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.

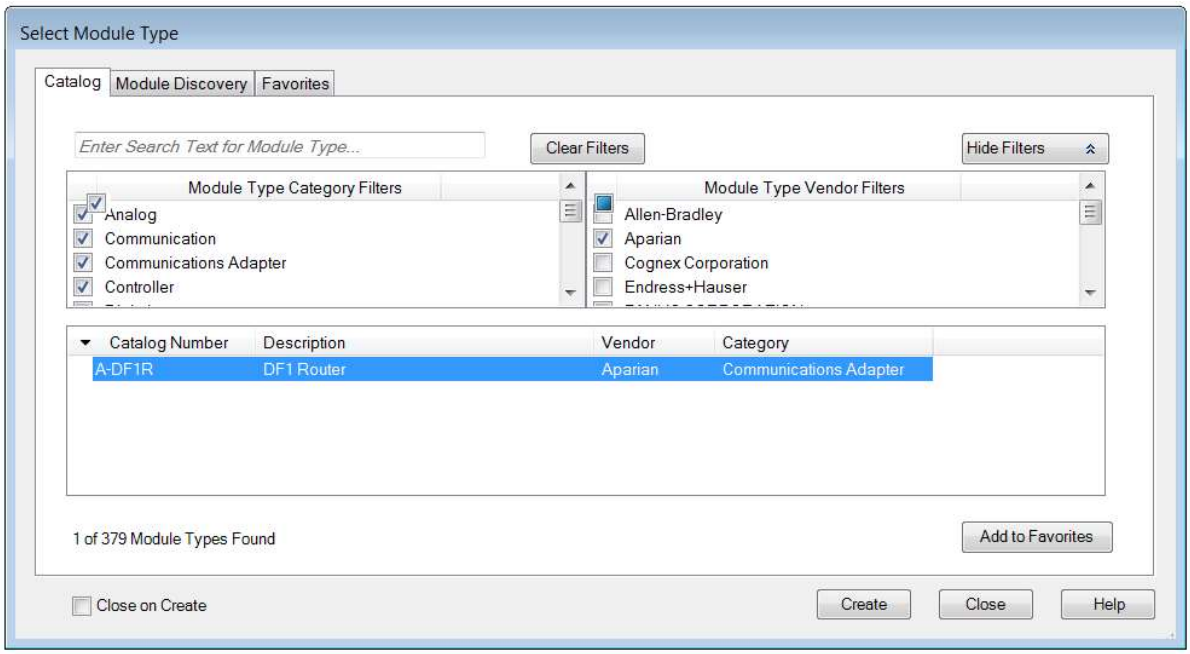


Figure 3.50 – Selecting the module

Locate and select the DF1 Router 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.

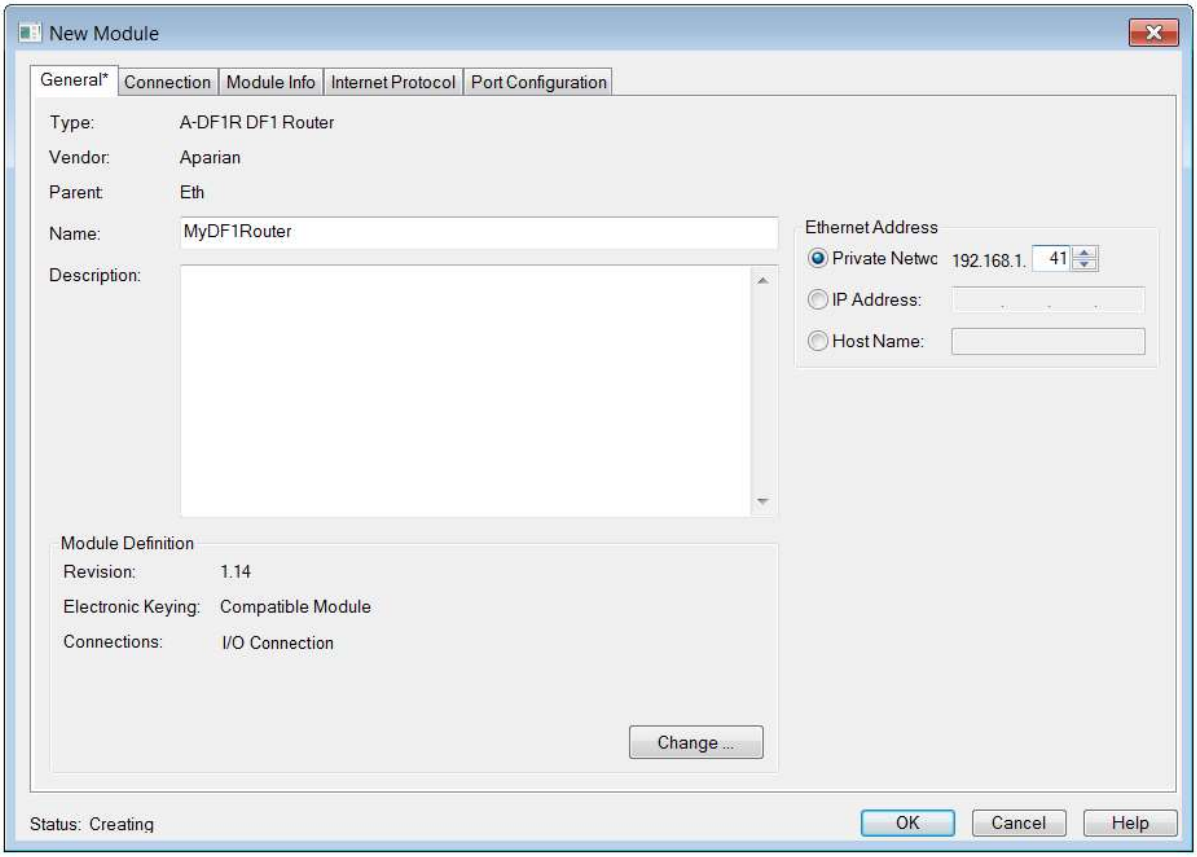


Figure 3.51 – Module instantiation

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

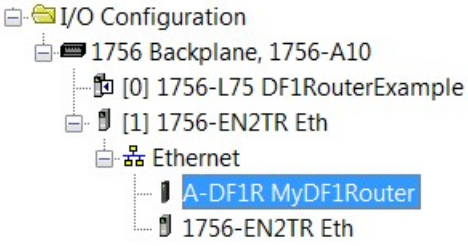


Figure 3.52 – Logix IO tree

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.

MyDF1Router:I	{...}	{...}		_055A:A_DF1R_E4C59A43:I:0
MyDF1Router:I.ConnectionFaulted	0		Decimal	BOOL
MyDF1Router:I.InstanceNameLength	0		Decimal	DINT
MyDF1Router:I.Status	2#0000_...		Binary	DINT
MyDF1Router:I.TransparentPCCCMode	0		Decimal	BOOL
MyDF1Router:I.ReactiveTagMode	0		Decimal	BOOL
MyDF1Router:I.ScheduledTagMode	0		Decimal	BOOL
MyDF1Router:I.UnscheduledMode	0		Decimal	BOOL
MyDF1Router:I.ConfigurationValid	0		Decimal	BOOL
MyDF1Router:I.RoutingInhibited	0		Decimal	BOOL
MyDF1Router:I.ScheduledTagStatus0	0		Decimal	BOOL
MyDF1Router:I.ScheduledTagStatus1	0		Decimal	BOOL
MyDF1Router:I.ScheduledTagStatus2	0		Decimal	BOOL
MyDF1Router:I.ScheduledTagStatus3	0		Decimal	BOOL
MyDF1Router:I.ScheduledTagStatus4	0		Decimal	BOOL
MyDF1Router:I.ScheduledTagStatus5	0		Decimal	BOOL
▪▪▪				
MyDF1Router:I.ScheduledTagStatus18	0		Decimal	BOOL
MyDF1Router:I.ScheduledTagStatus19	0		Decimal	BOOL
MyDF1Router:I.TransactionRate	0		Decimal	DINT
MyDF1Router:I.Temperature	0.0		Float	REAL
MyDF1Router:I.DF1RxPacketCount	0		Decimal	DINT
MyDF1Router:I.DF1TxPacketCount	0		Decimal	DINT
MyDF1Router:I.DF1ChecksumErrors	0		Decimal	DINT
MyDF1Router:I.PCCCRequests	0		Decimal	DINT
MyDF1Router:I.PCCCFailures	0		Decimal	DINT
MyDF1Router:I.TagReads	0		Decimal	DINT
MyDF1Router:I.TagWrites	0		Decimal	DINT
MyDF1Router:I.TagConnectionFailures	0		Decimal	DINT
MyDF1Router:I.TagErrors	0		Decimal	DINT

Figure 3.53 – Module Defined Data Type

3.7.2. RSLogix 5000 Configuration (Pre-Version 20)

3.7.2.1. ADD MODULE TO I/O CONFIGURATION

The module can operate in both a Logix “owned” and standalone mode. When the module operates in a Logix “owned” mode the DF1 Router will need to be added to the RSLogix 5000 IO 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 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).

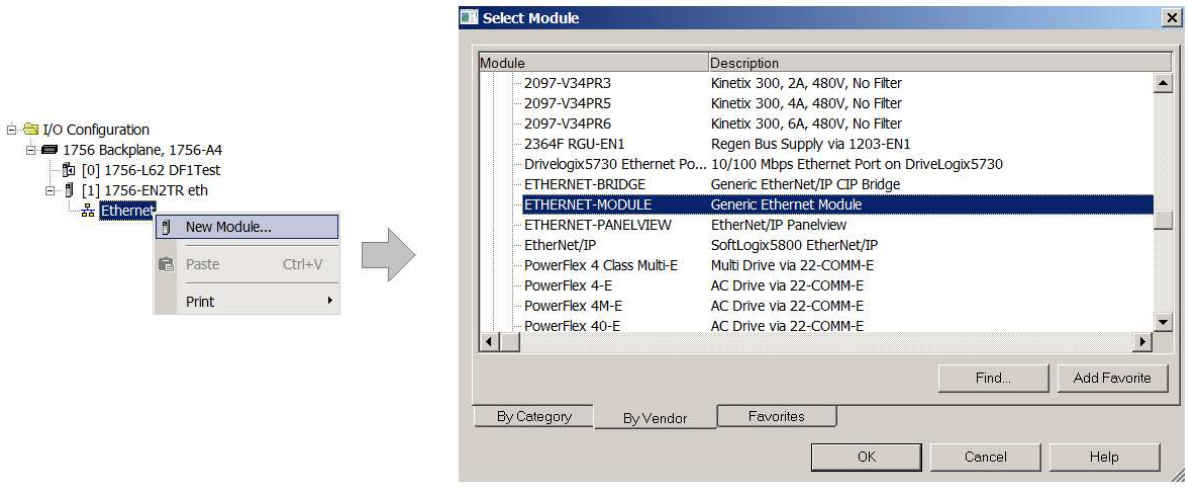


Figure 3.54 - Add a Generic Ethernet Module in RSLogix 5000

The user must enter the IP address of the DF1 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	100	34 (32-bit)
Output	101	1 (32-bit)
Configuration	102	0 (8-bit)

Table 3.4 - RSLogix class 1 connection parameters for the DF1 Router

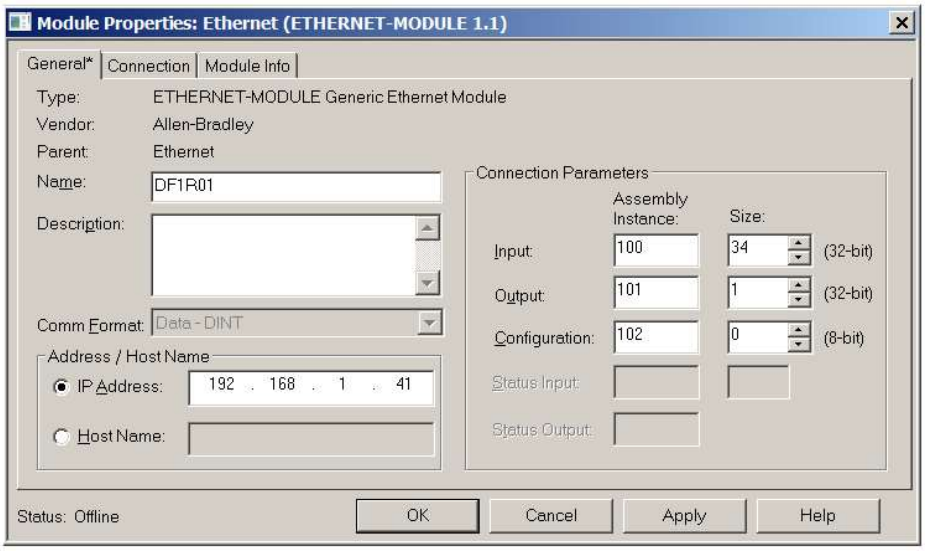


Figure 3.55 - RSLogix General module properties in RSLogix 5000

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 500ms. 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 500ms, to avoid unnecessary loading of the module processor.

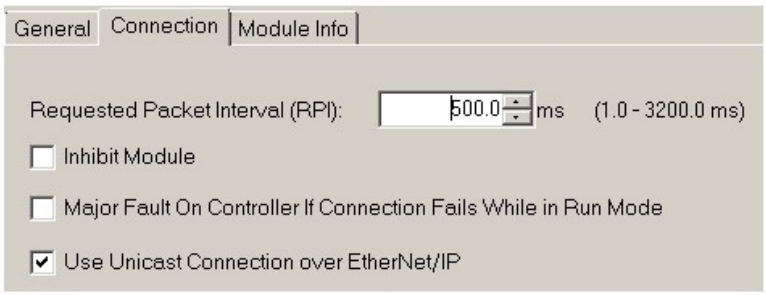


Figure 3.56 - Connection module properties in RSLogix 5000

Once the module has been added to the RSLogix 5000 IO 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.

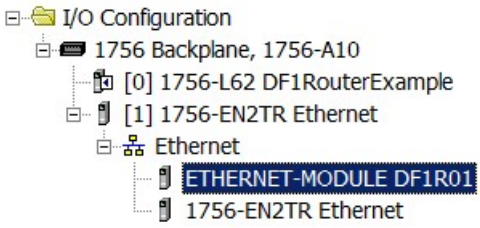


Figure 3.57 - RSLogix 5000 I/O module tree

3.7.2.2. IMPORTING UDTS AND MAPPING ROUTINES

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

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

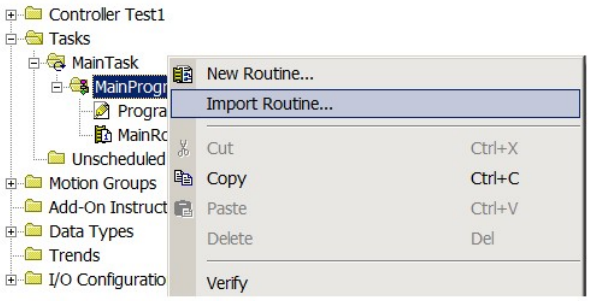


Figure 3.58 - RSLogix 5000 Importing DF1Router specific routine and UDTs

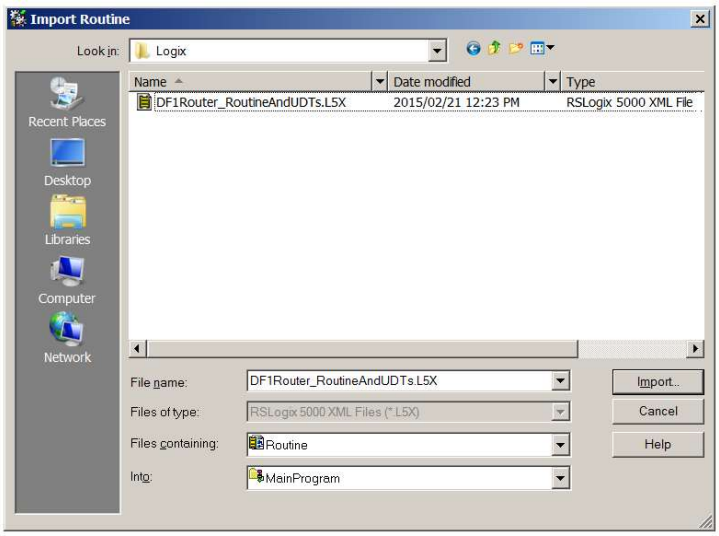


Figure 3.59 - Selecting partial import file

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 DF1Router module to the aforementioned tags.
- An example Unscheduled Message instruction with the associated Tags

The user may need to change the routine to map to the correct DF1 Router module instance name, and make sure that the mapping routine is called by the Program's Main Routine.

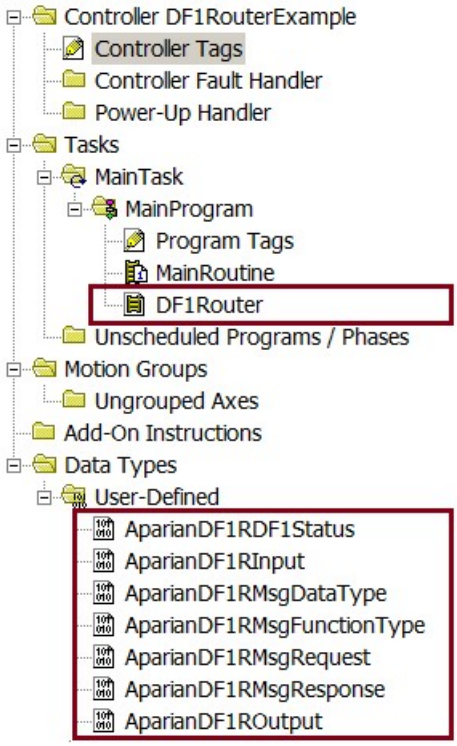


Figure 3.60 - Imported RSLogix 5000 objects

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

4. OPERATION

4.1. MESSAGE ROUTING

When the module has been correctly setup the DF1 message initiator will send a read/write to a certain DF1 address which will then be routed to a Logix tag. The messages send by the initiator must be completed with the correct data for successful operation. There are various indicators to determine if the mapping is routing the DF1 messages correctly. 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.

4.2. RSLOGIX 5000 ASSEMBLIES

When the module operates in a Logix “owned” mode the Logix controller will establish a class 1 cyclic communication connection with the DF1 Router. A input and output assembly is exchanged at a fix interval. 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.

DF1Input01	{...}	{...}		AparianDF1RIn...
DF1Input01.Instance	'DF1Router2'	{...}		STRING
DF1Input01.Status	{...}	{...}		AparianDF1RD...
DF1Input01.Status.TransparentPCCCMode	1		Decimal	BOOL
DF1Input01.Status.ReactiveTagMode	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagMode	0		Decimal	BOOL
DF1Input01.Status.UnscheduledMode	0		Decimal	BOOL
DF1Input01.Status.ConfigurationValid	1		Decimal	BOOL
DF1Input01.Status.RoutingInhibited	0		Decimal	BOOL
DF1Input01.Status.Reserved1	0		Decimal	BOOL
DF1Input01.Status.Reserved2	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus0	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus1	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus2	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus3	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus4	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus5	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus6	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus7	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus8	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus9	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus10	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus11	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus12	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus13	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus14	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus15	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus16	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus17	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus18	0		Decimal	BOOL
DF1Input01.Status.ScheduledTagStatus19	0		Decimal	BOOL
DF1Input01.TransactionRate	10		Decimal	DINT
DF1Input01.Temperature	42.31915		Float	REAL
DF1Input01.DF1RxPacketCount	83947		Decimal	DINT
DF1Input01.DF1TxPacketCount	83950		Decimal	DINT
DF1Input01.DF1ChecksumErrors	0		Decimal	DINT
DF1Input01.PCCCRequests	41978		Decimal	DINT
DF1Input01.PCCCFailures	0		Decimal	DINT
DF1Input01.TagReads	0		Decimal	DINT
DF1Input01.TagWrites	0		Decimal	DINT
DF1Input01.TagConnectionFailures	0		Decimal	DINT
DF1Input01.TagErrors	0		Decimal	DINT

Figure 4.1. – Input assembly UDT structure

4.2.1. INPUT ASSEMBLY

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

Parameter	Datatype	Description
Instance	STRING	This parameter is the instance name of the module that was configured under the general DF1 configuration in Slate.
Status.TransparentPCCCMode	BOOL	Set if the module is operating in Transparent PCCC mode.
Status.ReactiveTagMode	BOOL	Set if the module is operating in Reactive Tag mode.
Status.ScheduledTagMode	BOOL	Set if the module is operating in Scheduled Tag mode.

Status.UnscheduledMode	BOOL	Set if the module is operating in Unscheduled mode.
Status.ConfigurationValid	BOOL	Set if a valid configuration is executing in the module.
Status.RoutingInhibited	BOOL	Set when the module's routing function has been inhibited. Routing can be inhibited by setting a bit in the output assembly of the module.
Status.ScheduledTagStatus0…19	BOOL[20]	Each bit represents the status of the last scheduled transaction for that specific map item. A true value indicates success.
TransactionRate	DINT	The transaction rate is the number of DF1 messages per second that the module is currently routing.
DeviceTemperature	REAL	The internal temperature of the module.
DF1RxPacketCount	DINT	The total number of DF1 packets received by the module.
DF1TxPacketCount	DINT	The number of DF1 packets sent by the module.
DF1ChecksumErrors	DINT	The number of corrupted DF1 packets received by the module.
PCCCRequests	DINT	The total number of DF1 message routing requests received by the module when operating in Transparent mode.
PCCCFailures	DINT	The total number of DF1 message routing requests that resulted in errors when operating in Transparent mode.
TagReads	DINT	The total number of tag reads executed by the module when operating in Tag Map mode.
TagWrites	DINT	The total number of tag writes executed by the module when operating in Tag Map mode.
TagConnectionFailures	DINT	The number of failed class 3 connection attempts when operating in Tag Map mode. 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 when operating in tag Map mode. These may include privileged violations, non-existing tags, etc.

Table 4.1 - RSLogix 5000 input assembly parameters

4.2.2. OUTPUT ASSEMBLY

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

Parameter	Datatype	Description
RoutingInhibit	BOOL	This bit inhibits the module routing capabilities.

		When set, no DF1 messages will be routed. This may be required in applications running a redundant DF1 network where one of the DF1 Routers is to run in a hot-standby mode.

Table 4.2 - RSLogix 5000 output assembly parameters

4.3. UNSCHEDULED MESSAGING

When the DF1 Router is configured in Unscheduled Mode, it will process DF1 message requests sent from Logix via a message instruction.

To simplify the configuration of the required message a number of UDTs have been preconfigured, and are available on the Aparian DF1Router website.

The message instruction should be setup as follows :

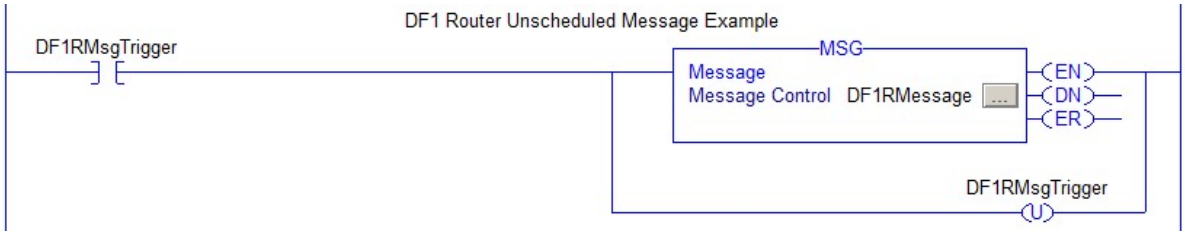


Figure 4.2. - Message Instruction

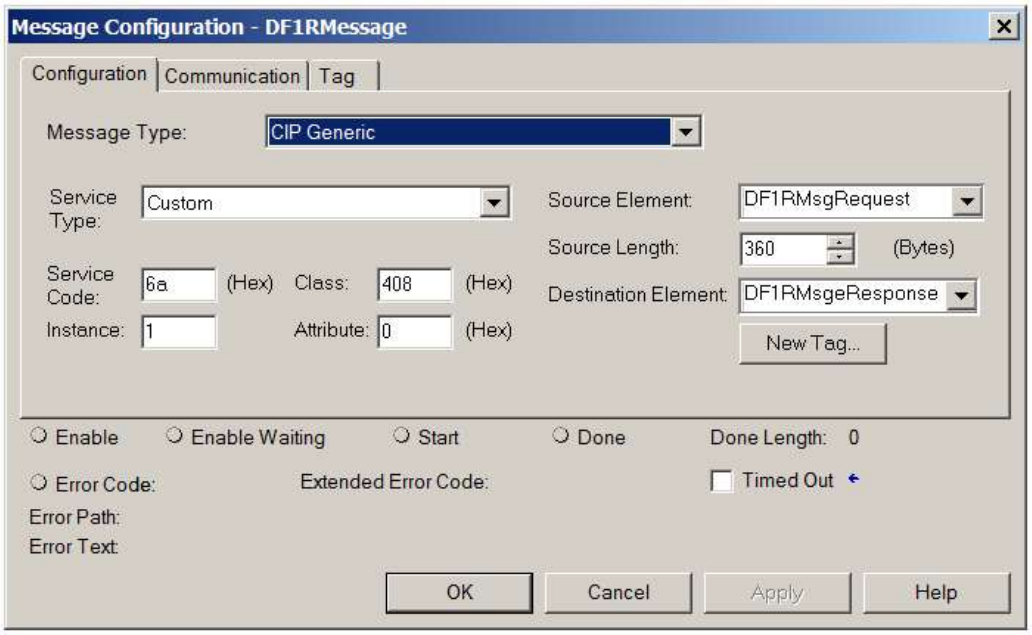


Figure 4.3. - Message Configuration

Parameter	Description
Message Type	CIP Generic
Service Type	Custom
Service Code	6A (Hex) - Unscheduled DF1 Pass-through
Class	408 (Hex)
Instance	1

Attribute	0
Source Element	The request tag instance. Must follow the structure of the AparianDF1RMsgRequest UDT.
Source Length	360
Destination Element	The response tag instance. Must follow the structure of the AparianDF1RMsgResponse UDT.

Table 4.3. - Message Configuration Paramaters

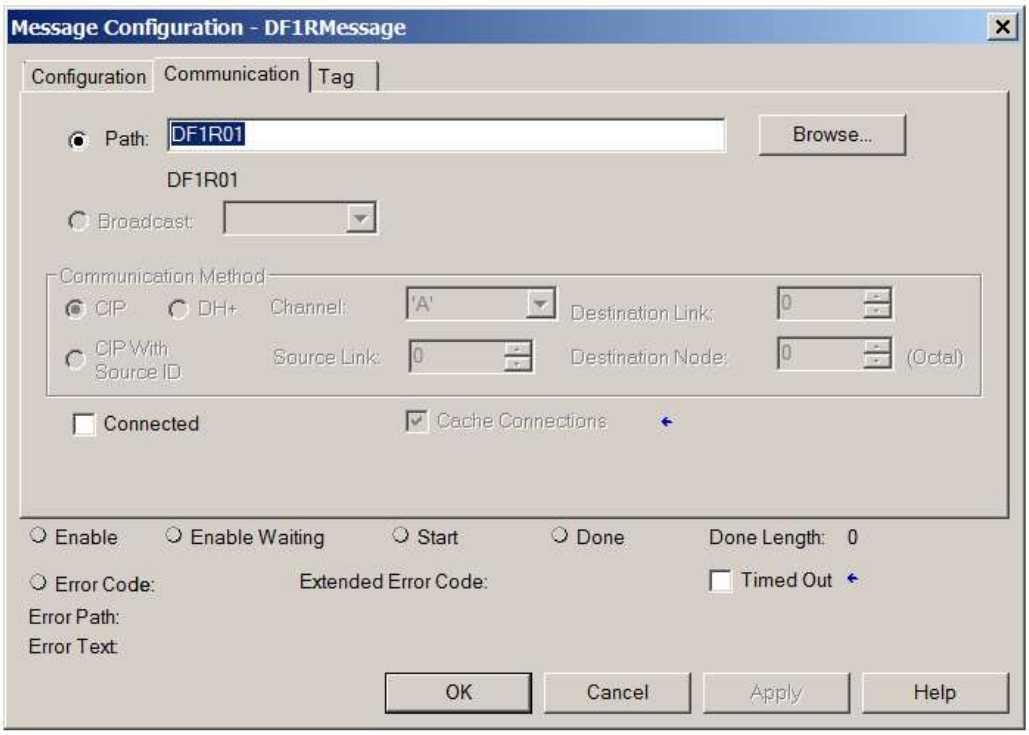


Figure 4.4. - Messsage Configuration - Communication

The Path must be configured to that of the DF1 Router. If the DF1 Router has been added in the I/O tree, then the Browse option can be used to select the path.
Alternatively, enter the CIP path in the format :

1,X,2,IP , where
1 represents the backplane port,
X represents the slot of the Ethernet bridge module,
2 represents the Ethernet port of the Ethernet bridge module and
IP represents the IP address of the DF1 Router.
e.g. **1,1,2,192.168.1.41**

The request tag (e.g. DF1RMsgrequest) should be configures as follows :

DF1RMsgRequest	{...}	AparianDF1RMsgRequest
DF1RMsgRequest.DestinationNode	5	SINT
DF1RMsgRequest.DF1DataFileAddress	'N10:0'	STRING
DF1RMsgRequest.Function	{...}	AparianDF1RMsgFunctionType
DF1RMsgRequest.Function.PLC5TypedRead	1	BOOL
DF1RMsgRequest.Function.PLC5TypedWrite	0	BOOL
DF1RMsgRequest.Function.SLCTypedRead	0	BOOL
DF1RMsgRequest.Function.SLCTypedWrite	0	BOOL
DF1RMsgRequest.DataType	{...}	AparianDF1RMsgDataType
DF1RMsgRequest.DataType.BOOLEAN	0	BOOL
DF1RMsgRequest.DataType.INT	1	BOOL
DF1RMsgRequest.DataType.REAL	0	BOOL
DF1RMsgRequest.ElementCount	16	INT
DF1RMsgRequest.RequestData	{...}	INT[128]

Figure 4.5. - Unscheduled Message Request Tag

Parameter	Description
Destination Node	The DF1 node address of the destination device.
Data File Address	A string representing the Data File Address of the destination DF1 device. E.g. N10:0
Function	Set the bit of the function required : PLC5 Typed Read PLC5 Typed Write SLC Typed Read SLC Typed Write Only one function can be set.
Data Type	Set the bit of the destination Data Type : Boolean Int (integer) Real (float) Only one function can be set.
Element Count	The number of destination elements defined in the Data Type field.
Request Data	The Data array (expressed as an IINT array) to be written to the destination node. This field is ignored for Reade functions.

Table 4.4. - Unscheduled Message Request Parameters

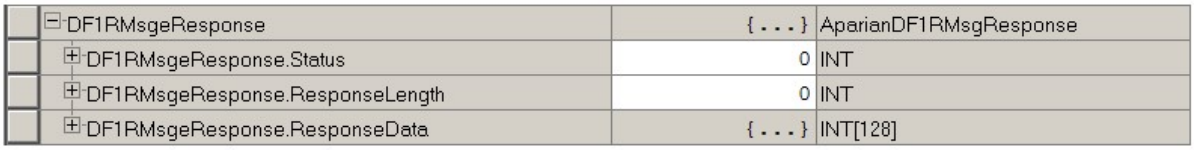


Figure 4.6. - Unscheduled Message Response Tag

Parameter	Description
Status	The status returned by the destination DF1 device. A value of zero indicates success.
Response Length	The number of bytes returned by the destination DF1 device.
Response Data	The data response from the destination DF1 device expressed as an INT array.

Table 4.5. - Unscheduled Message Response Parameters

After the message has been executed successfully (Msg.DN) the Response Data should be copied (using a COP instruction) to the required Data Tag of an appropriate data type.

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.

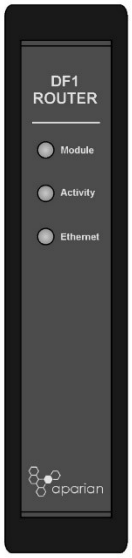


Figure 5.1 - DF1 Router front view

LED	Description
Module	The module LED will provide information regarding the system-level operation of the module. Thus 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.
Activity	The activity LED is used for the RS232 serial port. Thus every time a successful DF1 packet was received the LED will toggle green. The LED will toggle red if a corrupted packet was received (eg. failed checksum).
Ethernet	The Ethernet LED will light up when an Ethernet link has been detected (by plugging in a connected Ethernet cable). The LED will flash every time traffic was detected.

Table 5.1 - Module LED operation

5.2. MODULE STATUS MONITORING IN SLATE

The DF1 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.

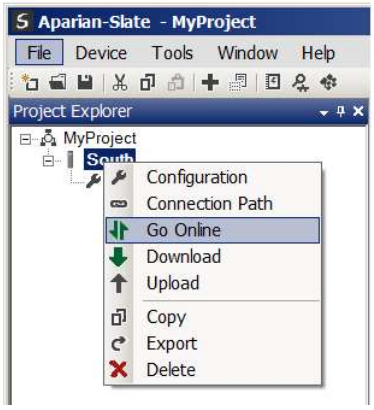


Figure 5.2. - Selecting to Go Online

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

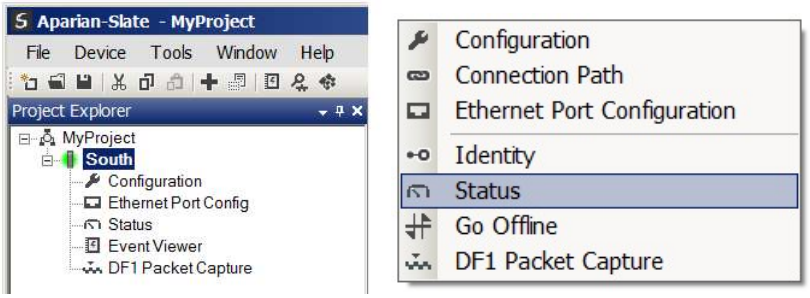


Figure 5.3. - Selecting online Status

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 current status of the module.

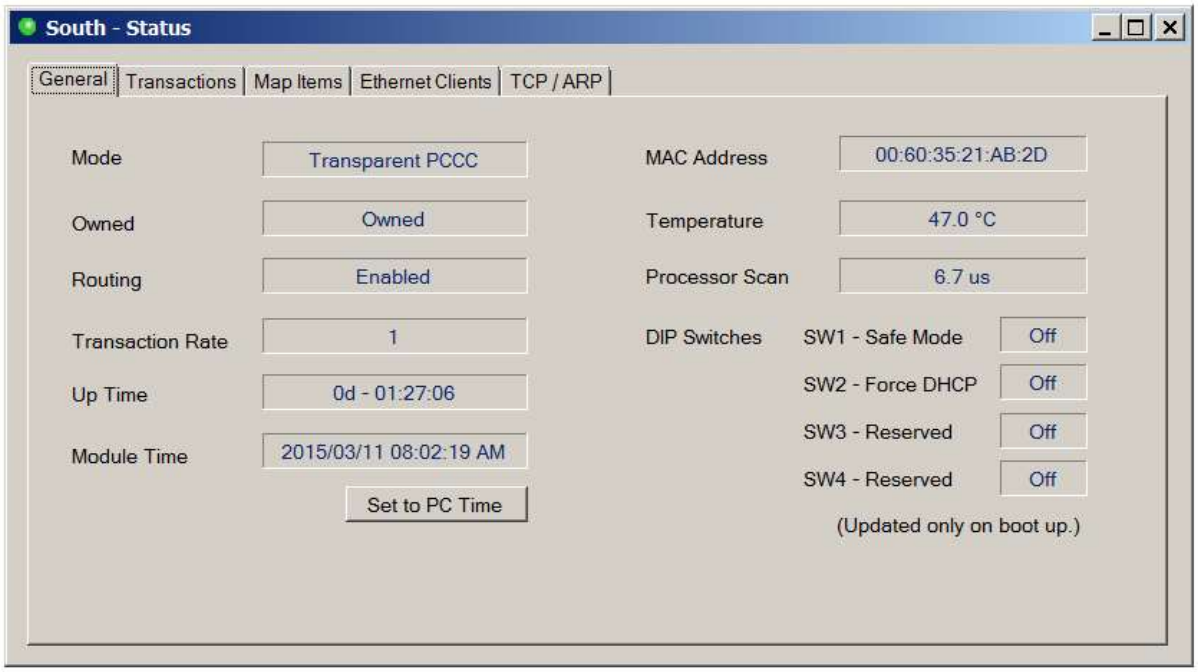


Figure 5.4. - Status monitoring - General

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

Parameter	Description
Mode	Indicates the current operating mode : Transparent, Reactive Tag, Scheduled Tag, or Unscheduled.
Owned	Indicates whether or not the module is currently owned (Class 1) by a Logix controller.
Routing	Indicates whether the routing of module is enabled or inhibited. The routing operation can be inhibited in the output assembly of the module.
Transaction Rate	The transaction rate is the number of DF1 messages per second that the module is currently routing.
Up Time	Indicates the elapsed time since the module was powered-up.
Module Time	Indicates the module's internal time. The module time is stored in UTC (Universal Coordinate Time) but displayed on this page according to the local PC Time Zone settings.
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.
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

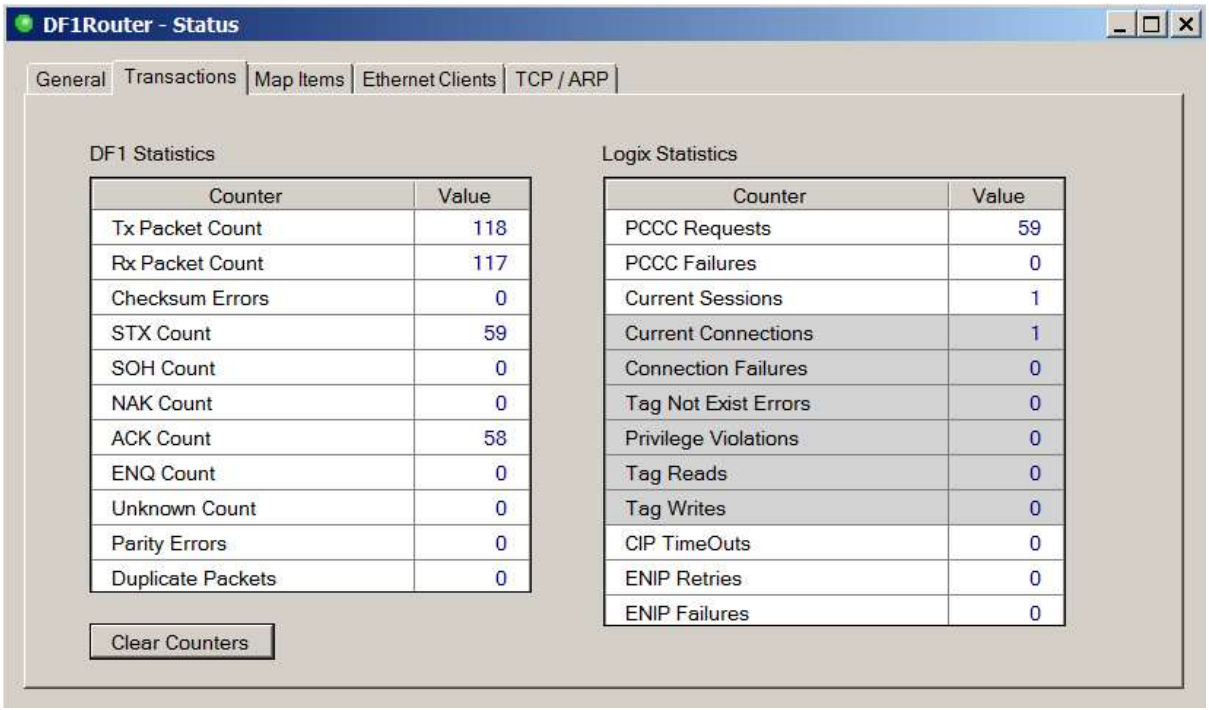


Figure 5.5. - Status monitoring - Transactions

The Transactions tab displays the statistics associated with the following :

- DF1 messages
- PCCC messages (Transparent and Scheduled Tag Mode)
- Logix Tag Mapping (Reactive Tag and Scheduled Tag Mode)

Statistic	**Description**
Tx Packet Count	The number of DF1 packets sent by the module.
Rx Packet Count	The number of DF1 packets received by the module.
Checksum errors	The number of corrupted DF1 packets received by the module.
STX count	The number of DF1 STX (Start of Text) delimiters received by the module.
SOH count	The number of DF1 SOH (Start of Header) delimiters received by the module.

NAK count	The number of NAK (Negative Acknowledge) DF1 packets received by the module.
ACK count	The number of ACK (Acknowledge) DF1 packets received by the module.
ENQ count	The number of ENQ (Enquiry) DF1 packets received by the module.
Unknown count	The number of unknown packets received by the module.
Parity errors	The number of bytes with parity errors received by the module.
Duplicate packet count	The number of duplicate packets received by the module.

Table 5.3 – DF1 statistics

The following PCCC statistics are only relevant when the module is running in either Transparent PCCC or Unscheduled mode.

Statistic	Description
PCCC Requests	The number of EtherNet/IP PCCC requests that have been sent to a Logix controller.
PCCC Failures	The number of failed EtherNet/IP PCCC responses that have been received by the DF1 Router from a Logix controller.
Current Sessions	The current number of open EtherNet/IP PCCC sessions.

Table 5.4 - PCCC statistics

The following Tag Mapping statistics are only relevant when the module is running in either Reactive Tag or Scheduled Tag mode.

Statistic	Description
Current Connections	The number of current open class 3 connections.
Connection Failures	The number of failed attempts at establishing a class 3 connections 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 Violation Errors	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.
CIP Timeout	This count increases when no response was received for the Tag Read/Write.
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.

Table 5.5 - Tag Mapping statistics

The Map Items tab will display the successful packet counts processed by each mapping item. If an item count changes, then the success count field will be displayed with a green background for approximately 3 seconds. This provides quick visual feedback as to which items are currently active.

The fields in the map items will adjust to suite the appropriate mode.

No items are displayed in Unscheduled mode.

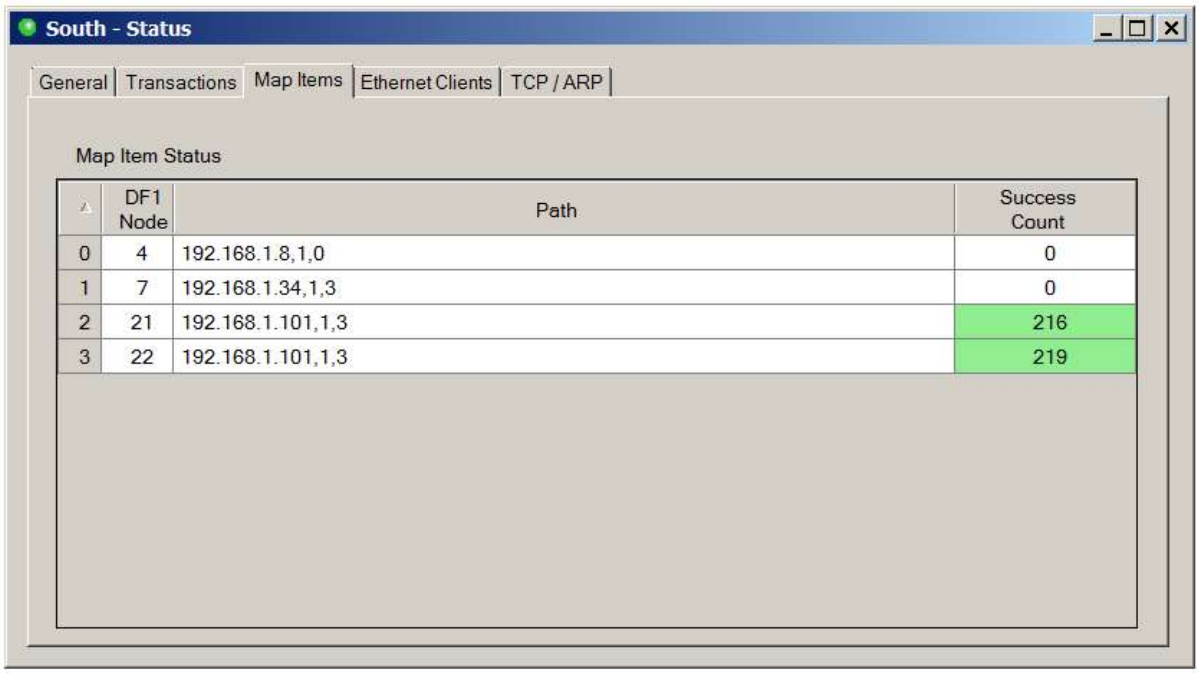


Figure 5.6. - Map Item status

5.3. DF1 PACKET CAPTURE

The module provides the capability to capture the DF1 traffic for analysis. The will allow the user and the support team to resolve any possible issue on site.

To invoke the capture of the module double-click on the DF1 Packet Capture item in the Project Explorer tree.

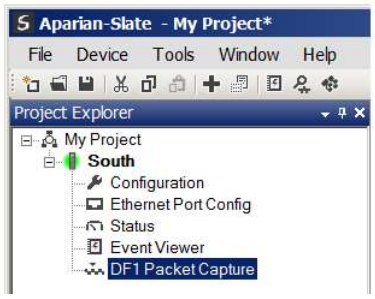


Figure 5.7. - Selecting DF1 Packet Capture

The DF1 Packet Capture window will open and automatically start capturing all DF1 packets.

NOTE: The module keeps a circular buffer of the last 20 DF1 packets, and thus there may be up to 20 packets in the capture that were received / sent before the capture was initiated.

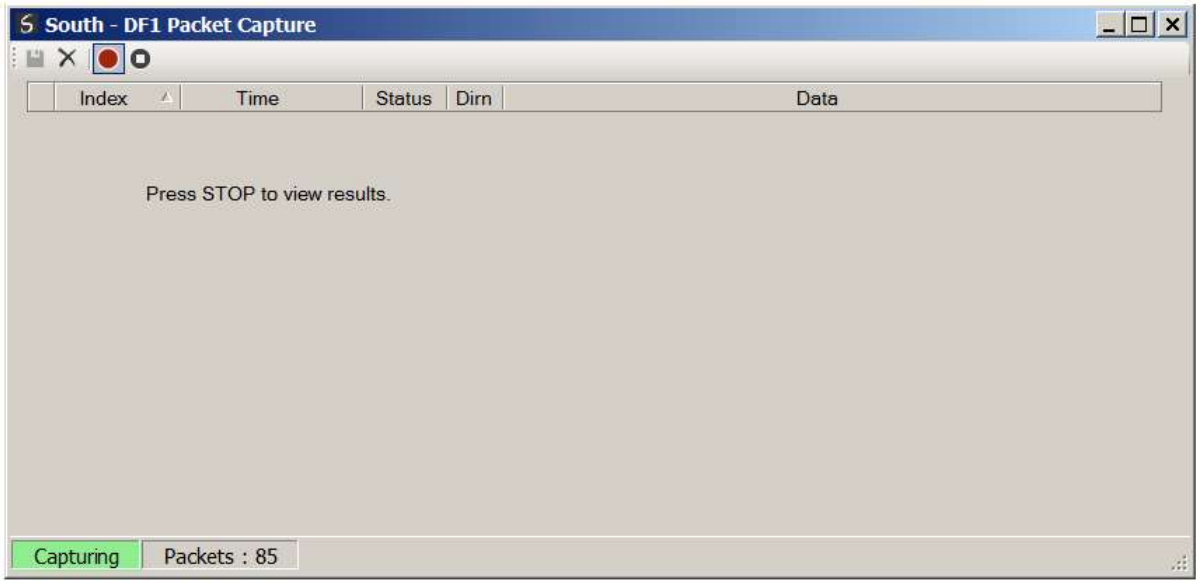


Figure 5.8 - DF1 packet capture

To display the captured DF1 packets, the capture process must first be stopped, by pressing the Stop button.

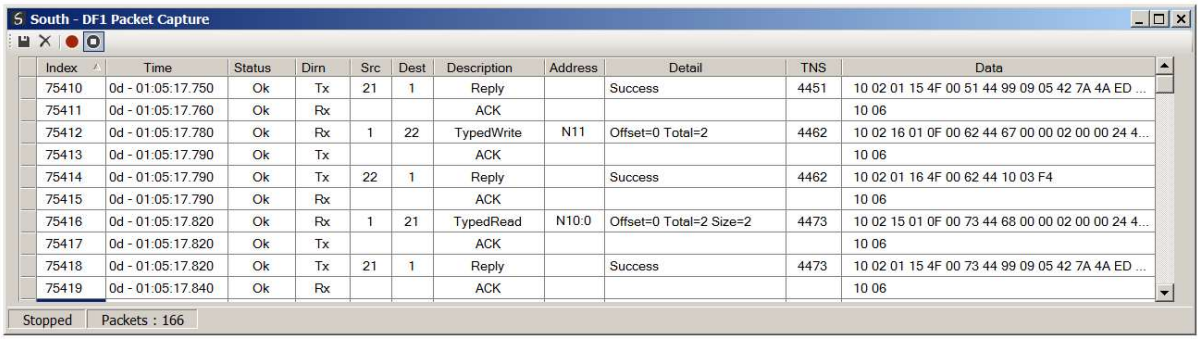


Figure 5.9. - DF1 Packet Capture complete

The captured DF1 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 DF1 constructs and valid checksums.
Dirn	The direction of the packet, either transmitted (Tx) or received (Rx).
Src	DF1 node address of the message source.
Dest	DF1 node address of the message destination.
Description	Brief description of the packet, usually the command.
Address	The string representing a PLC data address, where applicable.
Detail	Additional details associated with command.
TNS	Transaction number. Used to match request and reply messages.
Data	The packet's raw data displayed in space delimited hex.

Table 5.6. - DF1 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 DF1 Packet Capture files can be viewed by selecting the DF1 Packet Capture Viewer option in the tools menu.

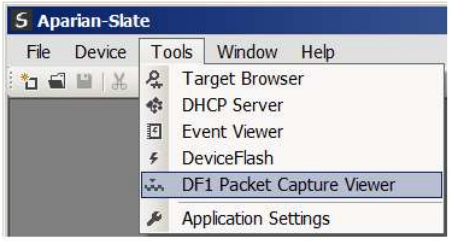


Figure 5.10. - Selecting the DF1 Packet Capture Viewer

5.4. MODULE EVENT LOG

The DF1 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 vie them in Slate, select the Event Viewer option in the Project Explorer tree.

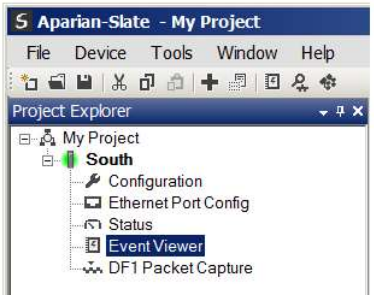
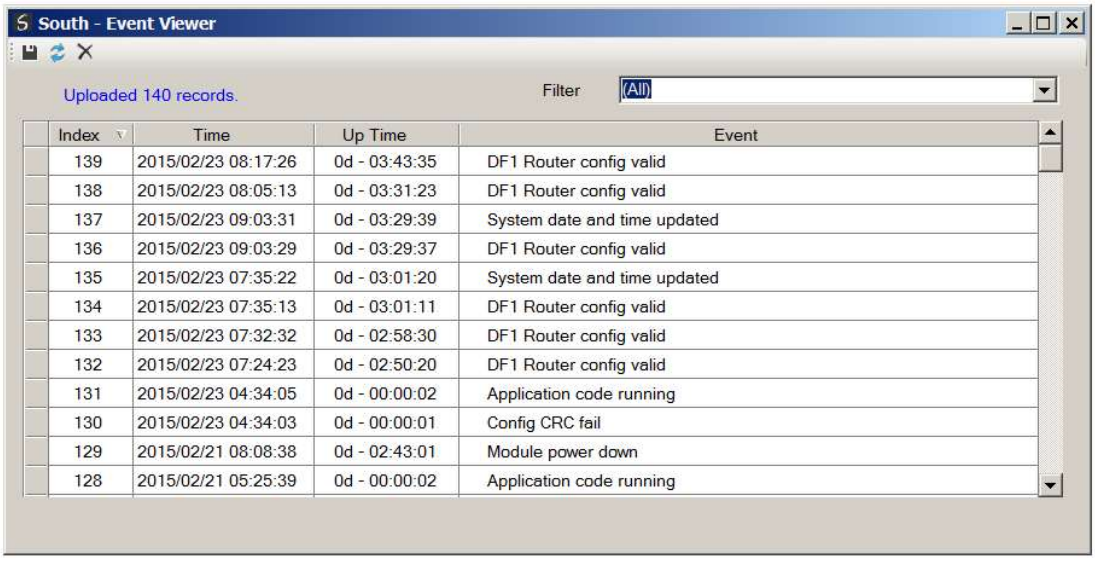


Figure 5.11. - Selecting the module Event Log

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
139	2015/02/23 08:17:26	0d - 03:43:35	DF1 Router config valid
138	2015/02/23 08:05:13	0d - 03:31:23	DF1 Router config valid
137	2015/02/23 09:03:31	0d - 03:29:39	System date and time updated
136	2015/02/23 09:03:29	0d - 03:29:37	DF1 Router config valid
135	2015/02/23 07:35:22	0d - 03:01:20	System date and time updated
134	2015/02/23 07:35:13	0d - 03:01:11	DF1 Router config valid
133	2015/02/23 07:32:32	0d - 02:58:30	DF1 Router config valid
132	2015/02/23 07:24:23	0d - 02:50:20	DF1 Router config valid
131	2015/02/23 04:34:05	0d - 00:00:02	Application code running
130	2015/02/23 04:34:03	0d - 00:00:01	Config CRC fail
129	2015/02/21 08:08:38	0d - 02:43:01	Module power down
128	2015/02/21 05:25:39	0d - 00:00:02	Application code running

Figure 5.12. – 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 DF1 Router provides a web server allowing a user without Slate or RSLogix 5000 to view various diagnostics of the module. This includes Ethernet parameters, system event log, advanced diagnostics, and application diagnostics (DF1 diagnostics).

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

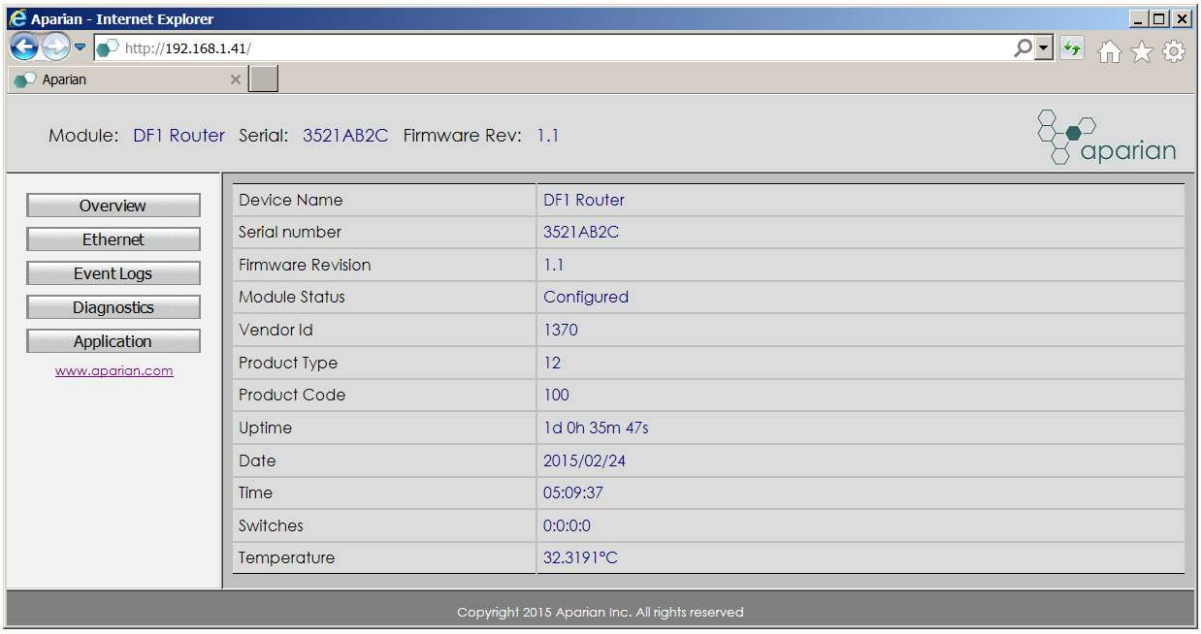


Figure 5.13. - Web interface

6. TECHNICAL SPECIFICATIONS

6.1. DIMENSIONS

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

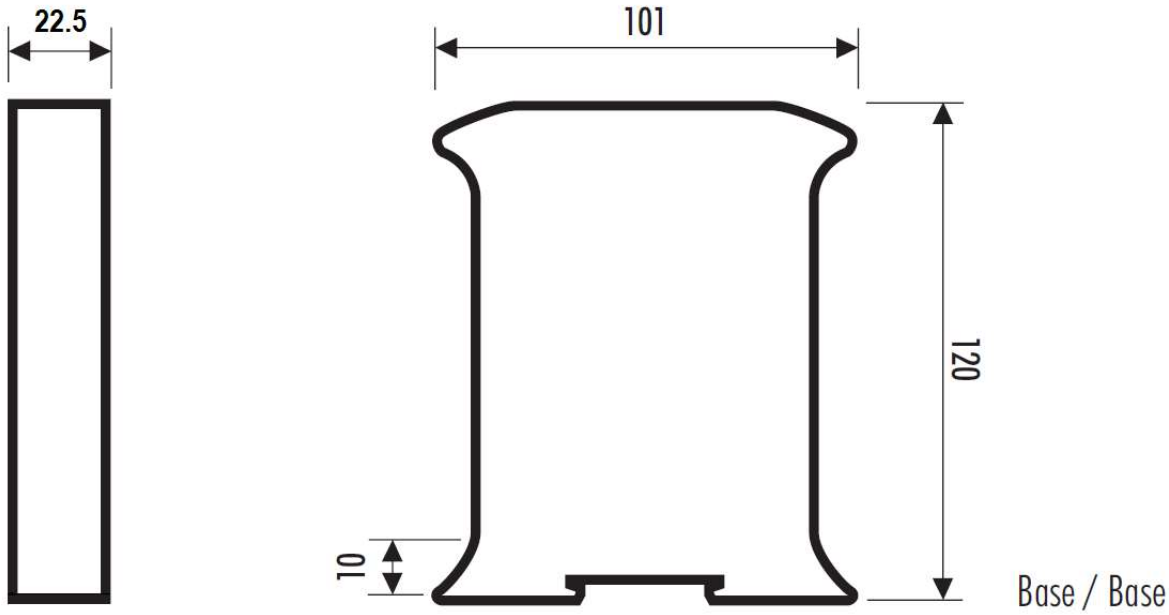


Figure 6.1 - DF1 Router enclosure dimensions

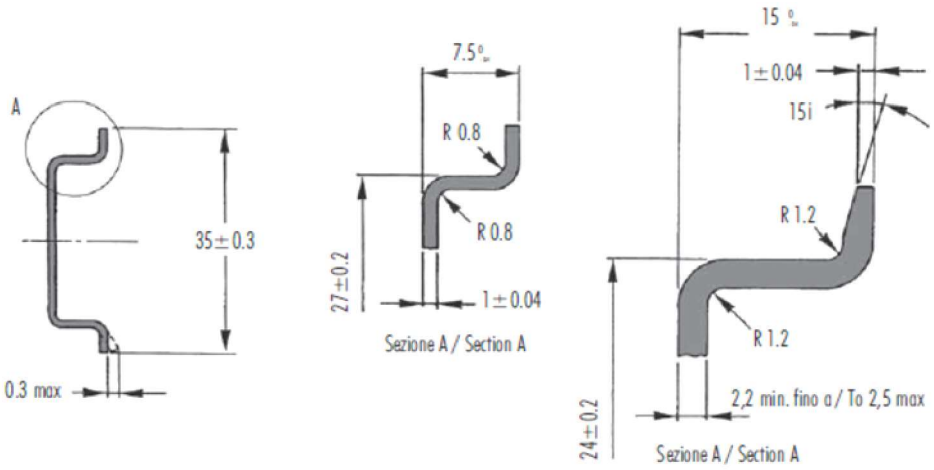


Figure 6.2 - Required DIN dimensions

6.2. ELECTRICAL

Specification	Rating
Power requirements	Input: 10 – 28V DC, (70 mA @ 24 VDC / 130 mA @ 10 VDC)
Power consumption	1.7 W
Connector	3-way terminal
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. DF1

Specification	Rating
Connector	4-way terminal
Conductor	24 – 18 AWG
Isolation voltage	2.5 kV
Protocol	DF1 Full Duplex, DF1 Half Duplex, DF1 Radio Modem
BAUD	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
Parity	None, Even, Odd
Data bits	8
Stop bits	1
Error detection	CRC, BCC
Embedded response	Auto, On
Transparent mode	Max 20 mapping items
Reactive Tag mode	Max 20 mapping items
Scheduled Tag mode	Max 20 mapping items
Reactive Tag Mode Message Support	PLC-5 Typed Read, PLC-5 Typed Write, SLC Typed Read, SLC Typed Write, PLC-2 Unprotected Read, PLC-2 Unprotected Write, PLC-2 Unprotected Bit Write
Scheduled Tag Mode Message Support	PLC-5 Typed Read, PLC-5 Typed Write, SLC Typed Read, SLC Typed Write
Rockwell Automation Controller programming support	ControlLogix, CompactLogix, MircoLogix, SLC, PLC5, Mirco800

Table 6.3 - DF1 specification

6.5. CERTIFICATIONS

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

ODVA Conformance	EtherNet/IP™ * F/W 1.014
RoHS2 Compliant	RoHS2
RCM	

Table 6.4 – Certifications

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