Process Cache

User Manual

A-PCM

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aparian

CONTENTS

Revision History

Revision	Date	Comment
1.0	29 May 2015	Initial document
1.1	25 August 2015	Add UL Listed mark

1. PREFACE

1.1. INTRODUCTION TO THE PROCESS CACHE

This manual describes the installation, configuration, operation, and diagnostics of the Aparian Process Cache module. The Process Cache module (hereafter refer to as the module) can read and store data from Logix Controllers, DF1 Serial Interfaces, or Modbus devices which can later be uploaded to an historian or SQL database. The module has the capacity to store over 16 million records in its solid-state non-volatile memory. Each stored record includes a Date Time stamp with a 50ms resolution, the Tag Name, Data Type, and Value.

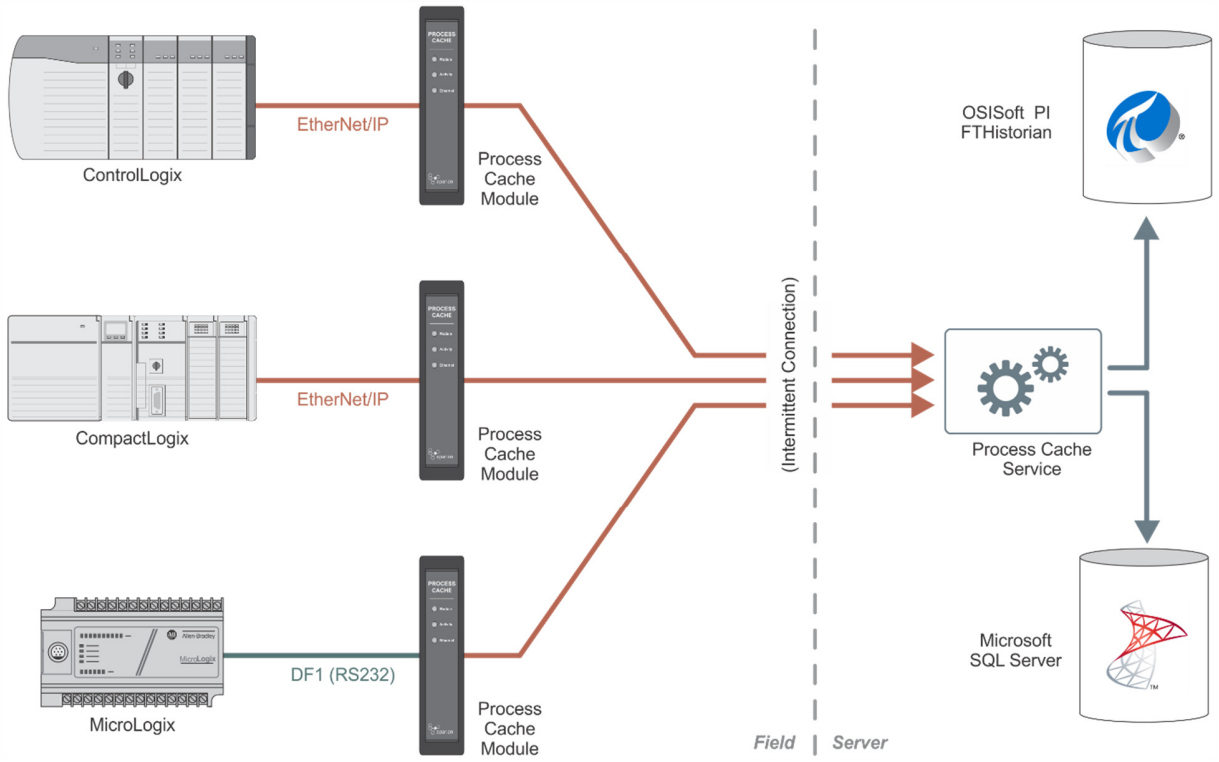


Figure 1.1. – Rockwell Controller Source Options

The process Cache could be used to log data at a remote site with limited communication with its base.

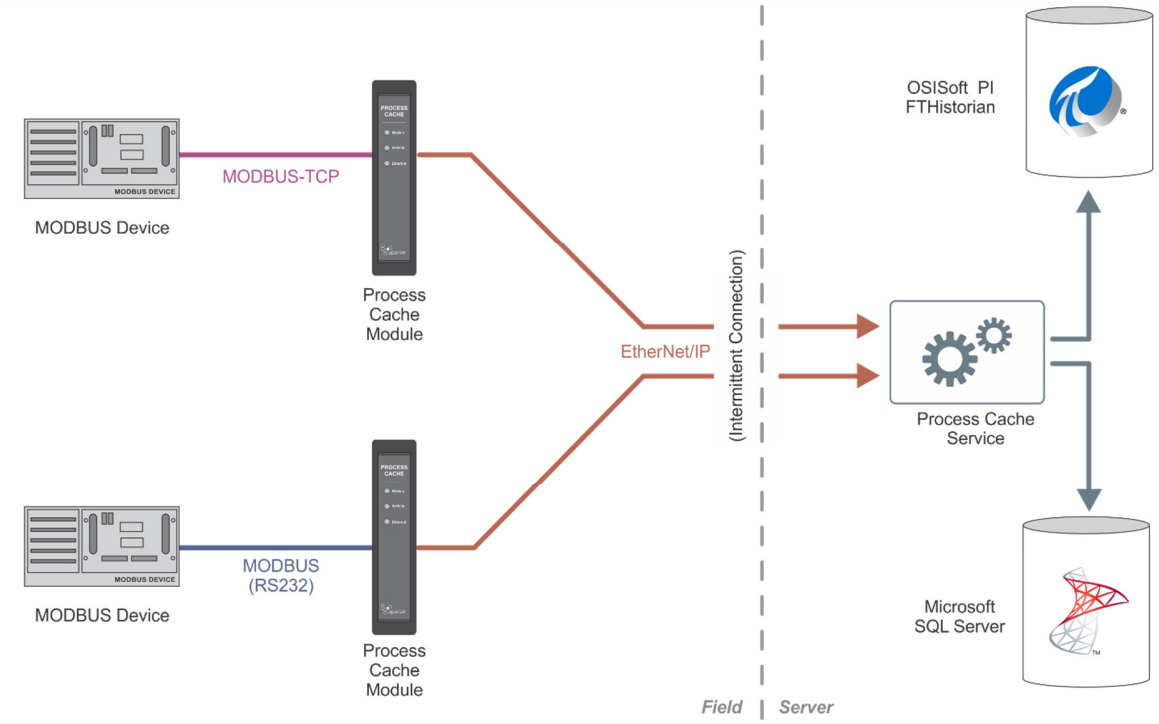


Figure 1.2. – Modbus Source Options

The Process Cache module could also be used to store records on mobile equipment such as trucks, drilling rigs, or snow ploughs. Once the equipment returns back to its base, the historical data can be uploaded and transferred to a more permanent storage. The module could also be configured to collect data and the data is only downloaded and examined if a fault occurs, otherwise the data is overwritten.

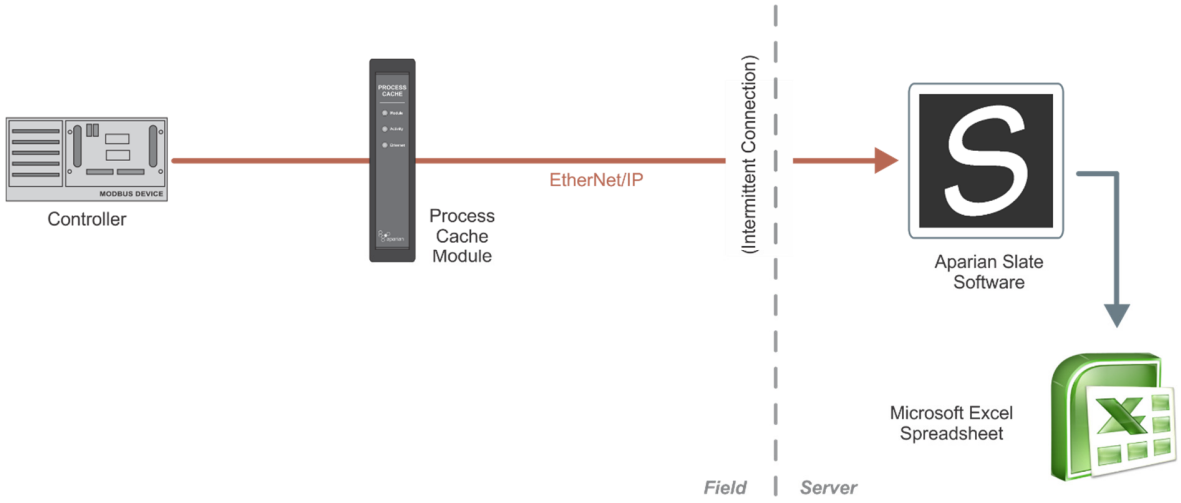


Figure 1.3. – Non-Historian Option

1.2. FEATURES

The Process Cache Module provides an extensive temporary on-board storage capability for storing process tags. A total of 16,777,216 records can be stored in the non-volatile memory.

Each record consists of the following data:

Parameter	Link
Date Time	UTC Time includes: Year, Month, Day, Hour, Minute, Second, Milliseconds. Time has a resolution of 50 milliseconds.
Tag Name	As defined in Controller for Logix or in Slate for other sources
Data Type	BOOL, SINT, INT, DINT, or REAL
Value	Tag value

Table 1.1. – Components of a Record

The log index is managed by the module and incremented each time a new record is stored. The unload index is managed externally by the unload service and only incremented after a record was been logged successfully to the SQL Database, FT Historian, or text file. Both the Log Index and Unload Indices will loop around reaching the end of the cache. The cache becomes 100% full when the log index loops around and catches up with the unload index. In this situation, either older records are overwritten (Log Mode = Overwrite) or newer records are not logged (Log Mode = Hold).

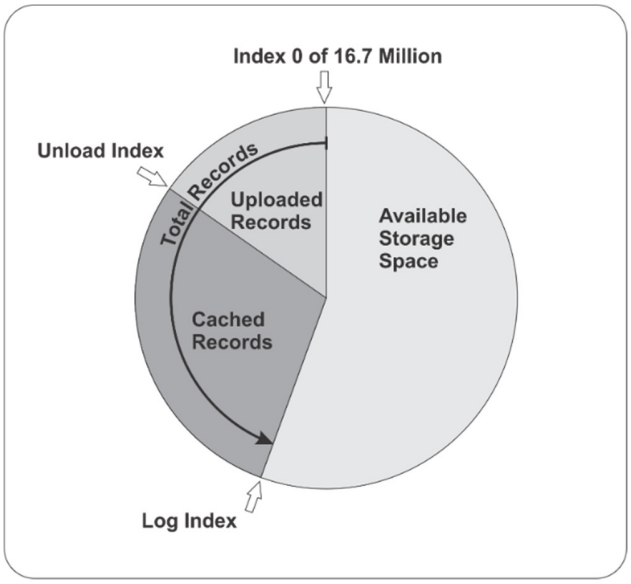


Figure 1.4. - Memory Schematic

The Process Cache module 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. Slate can also be used to monitor the modules status and used to download the historical data to a local file.

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.

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. 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
Process Cache Service Installation	http://www.aparian.com/products/processcache
User Manual Datasheet Example Code & UDTs	http://www.aparian.com/products/processcache
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
Slate User Manual	www.aparian.com/slate/D104-001 Slate User Manual.pdf
CIP Routing	The CIP Networks Library, Volume 1, Appendix C:Data Management

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 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 (earth) 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.

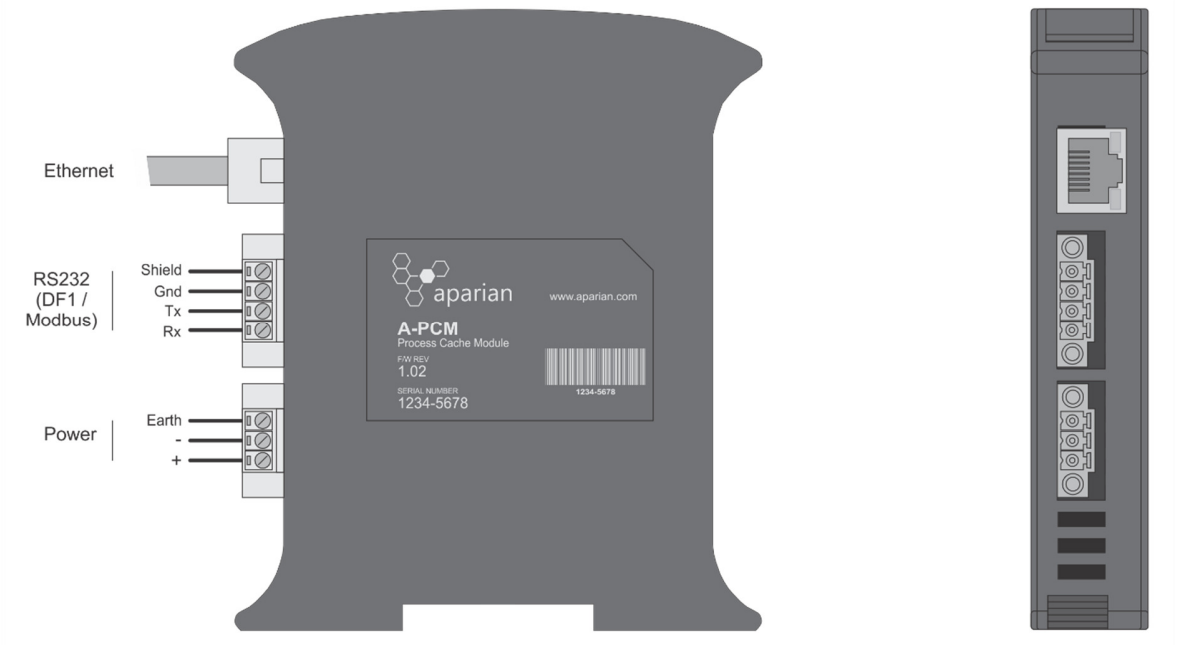


Figure 2.1. – Process Cache side and bottom view

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. – Module 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 1	Used to force the module into “Safe Mode”. When in “Safe Mode” the module will not load the application firmware and will wait for new firmware to be downloaded. This should only be used in the rare occasion when a firmware update was interrupted at a critical stage.
DIP 2	This will force the module into DHCP mode which is useful when the user has forgotten the IP address of the module.
DIP 3	Reserved
DIP 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.

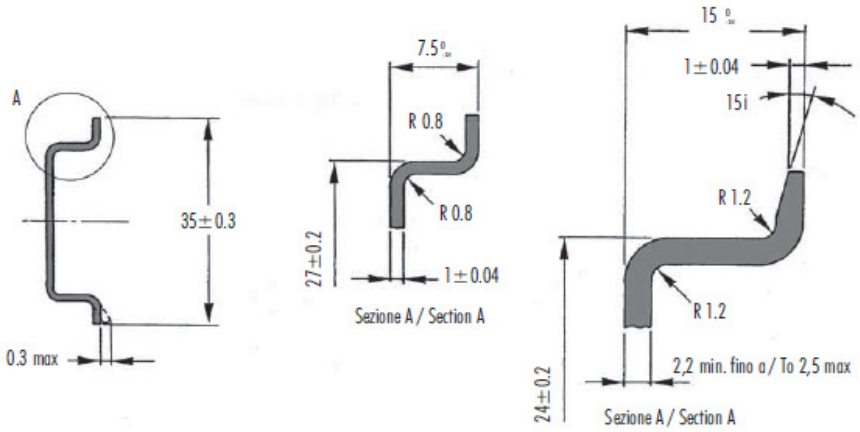


Figure 2.3. - DIN rail specification

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.

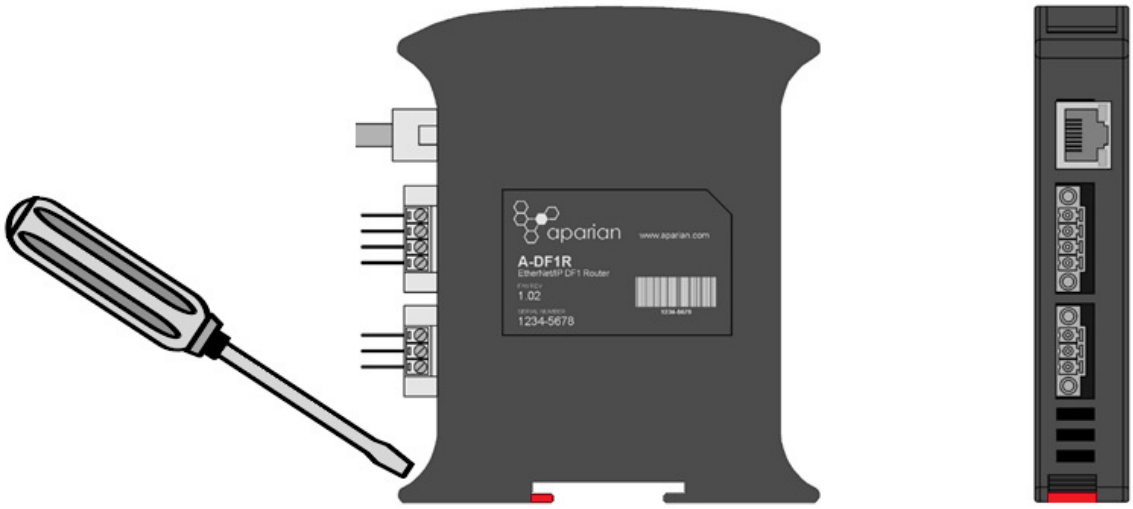


Figure 2.4. - DIN rail mouting

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.

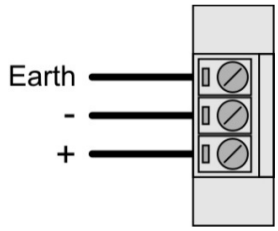


Figure 2.5. - Power connector

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 Process Cache module, and not to the other Serial device.

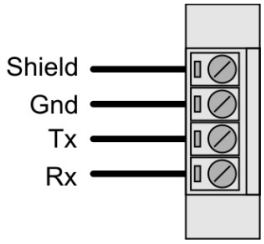


Figure 2.6. - RS232 connector

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.

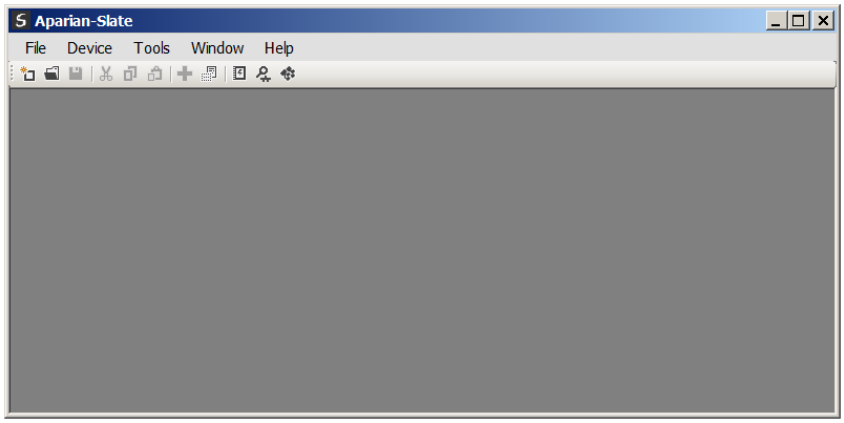


Figure 3.1. - Aparian Slate Environment

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.

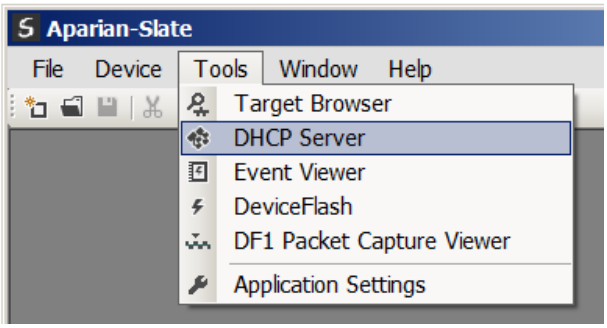


Figure 3.2. - Selecting DHCP Server

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

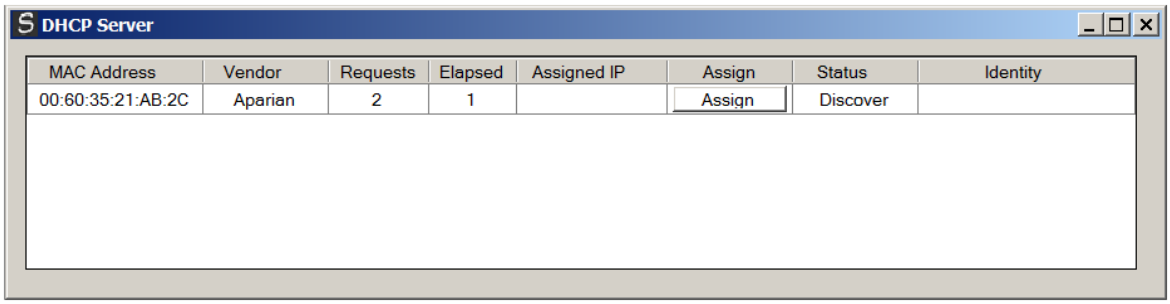


Figure 3.3. - DHCP Server

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.

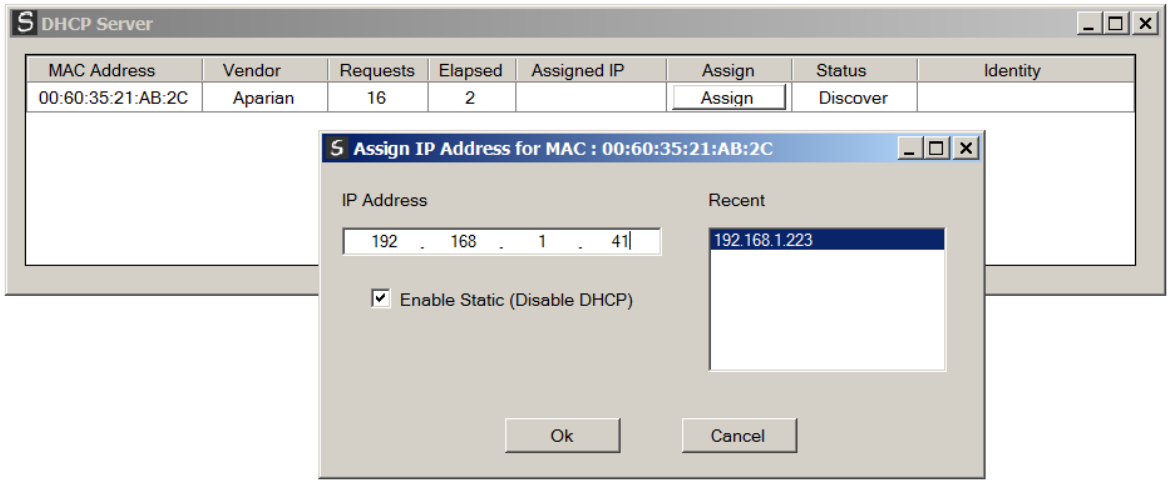


Figure 3.4. - Assigning IP Address

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.

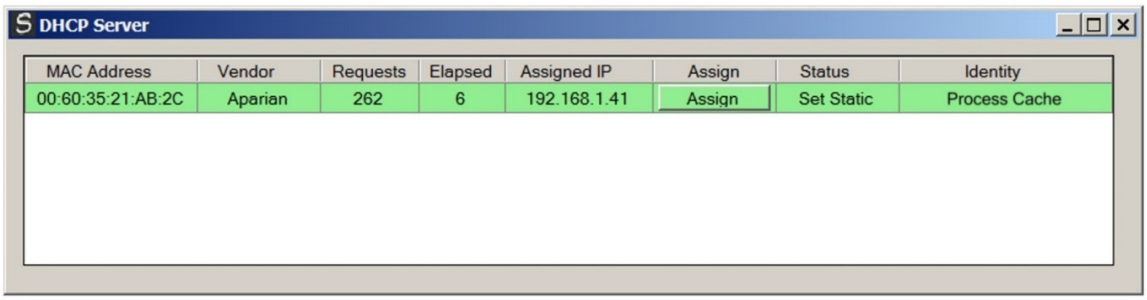


Figure 3.5. - Successful IP address assignment

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.

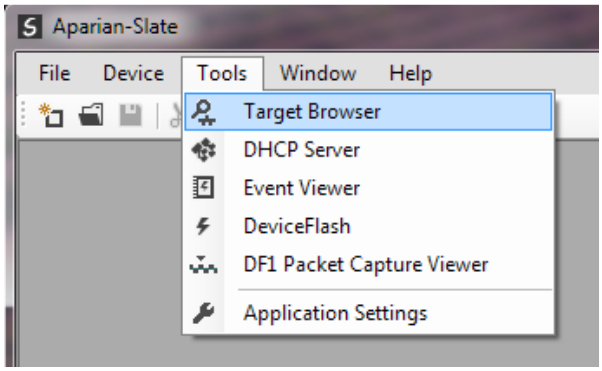


Figure 3.7. - Selecting the Target Browser

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

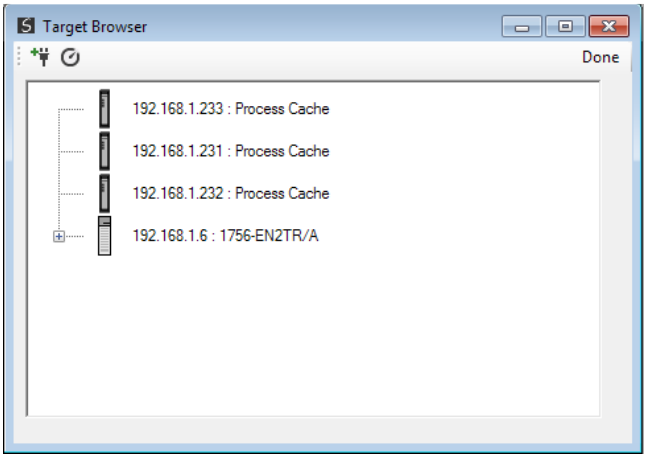


Figure 3.8. - Target Browser

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

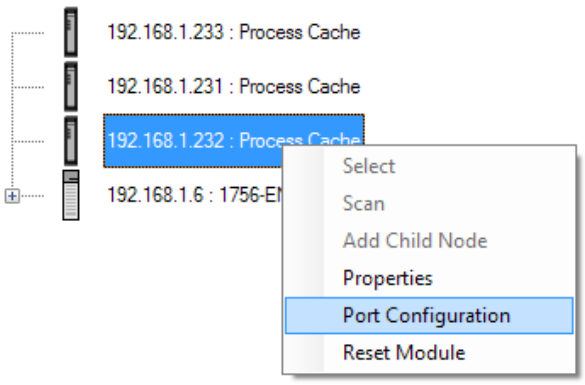


Figure 3.9. - Selecting Port Configuration

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

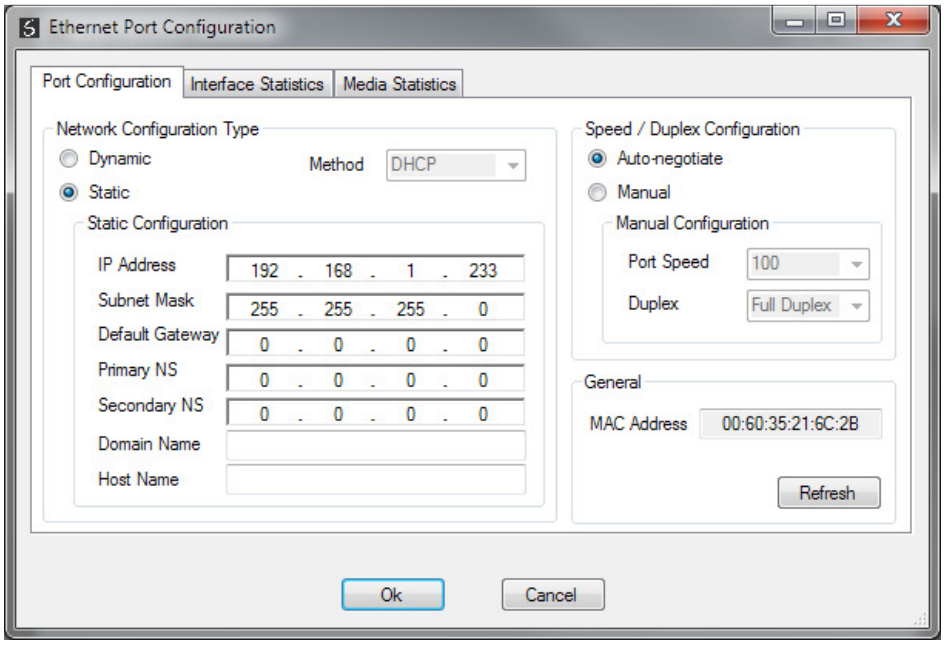


Figure 3.10. - Port Configuration

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.

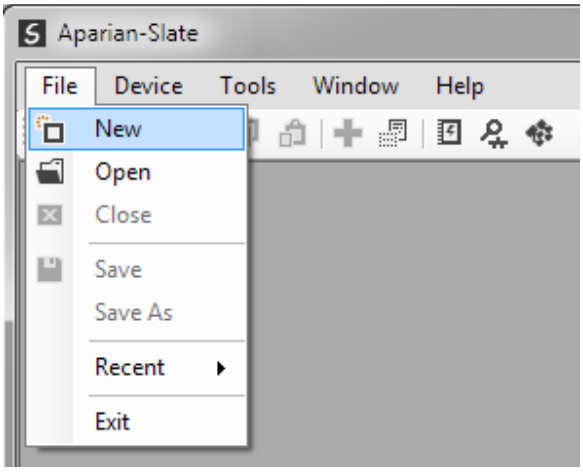


Figure 3.11. - Creating a new project

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.

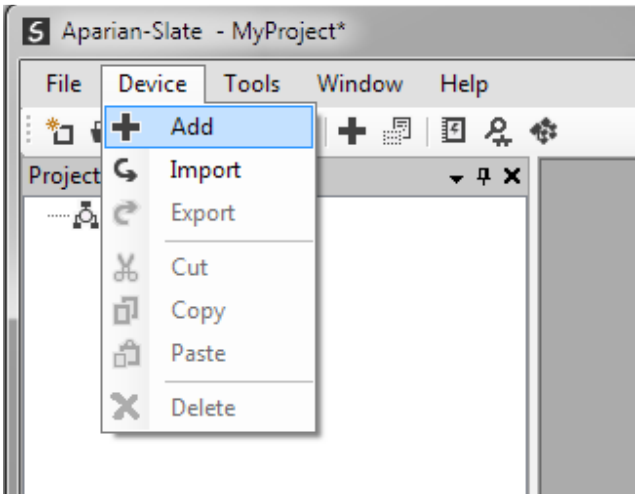


Figure 3.12. - Adding a new device

In the Add New Device window select the Process Cache Module, and click the Ok button.

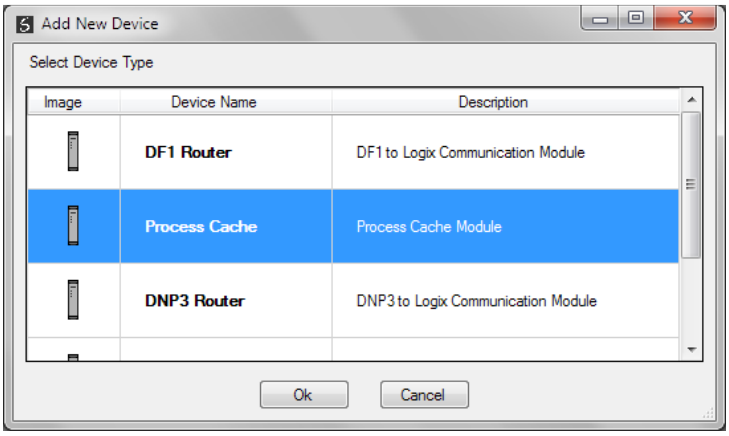


Figure 3.13. – Selecting a new Process Cache Module

The device will appear in the Project Explorer tree as shown below, and its configuration window opened.

The device configuration window can be reopened by either double clicking the module in the Project Explorer tree or right-clicking the module and selecting *Configuration*.

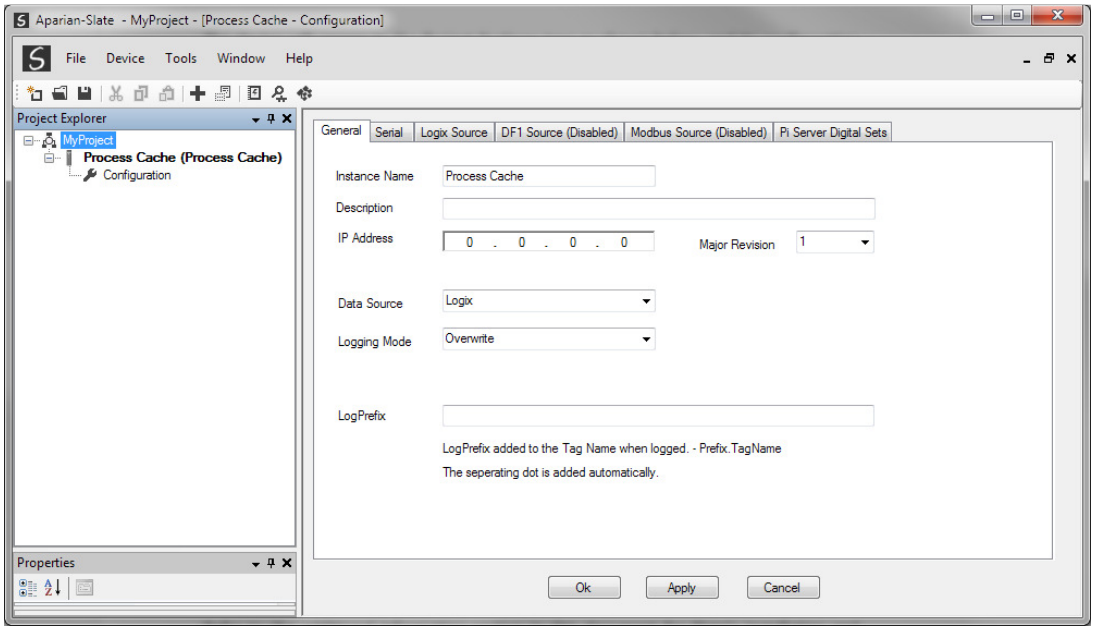


Figure 3.14. – Process Cache module configuration

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

3.4. CONFIGURING THE MODULE

The Process Cache module will be configured by Slate. **Refer** to the additional information section for documentation and installation links for Aparian Slate. The configuration consists of a general configuration, serial configuration for DF1 or Modbus RTU, as well as data source configuration and tag selections. 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 configuration and cached records.

The general configuration consists of the following parameters:

Parameter	Description
Instance Name	This parameter is a user defined name to identify between various Process Cache modules.
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
IP Address	The module's IP address used by Slate to communicated with the module.
Data Source	This parameter selects the source of the data. Logix – Rockwell Automation ControlLogix or Compact Logix controller. DF1 – Serial DF1 ModbusRTU – Serial Modbus ModbusTCP – Modbus over Ethernet
Logging Mode	This parameter determines if records are overwritten once the memory is filled. Overwrite – old records are overwritten giving priority to newer data. Hold – old records are preserved while new records are not stored.
LogPrefix	The LogPrefix is added the front of all tag names when uploaded and stored in the Historian or Sql Database. A period is automatically added as the separator. Example: LogPrefix.TagName This parameter can be left blank if not needed.

Table 3.1 - General configuration parameters

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

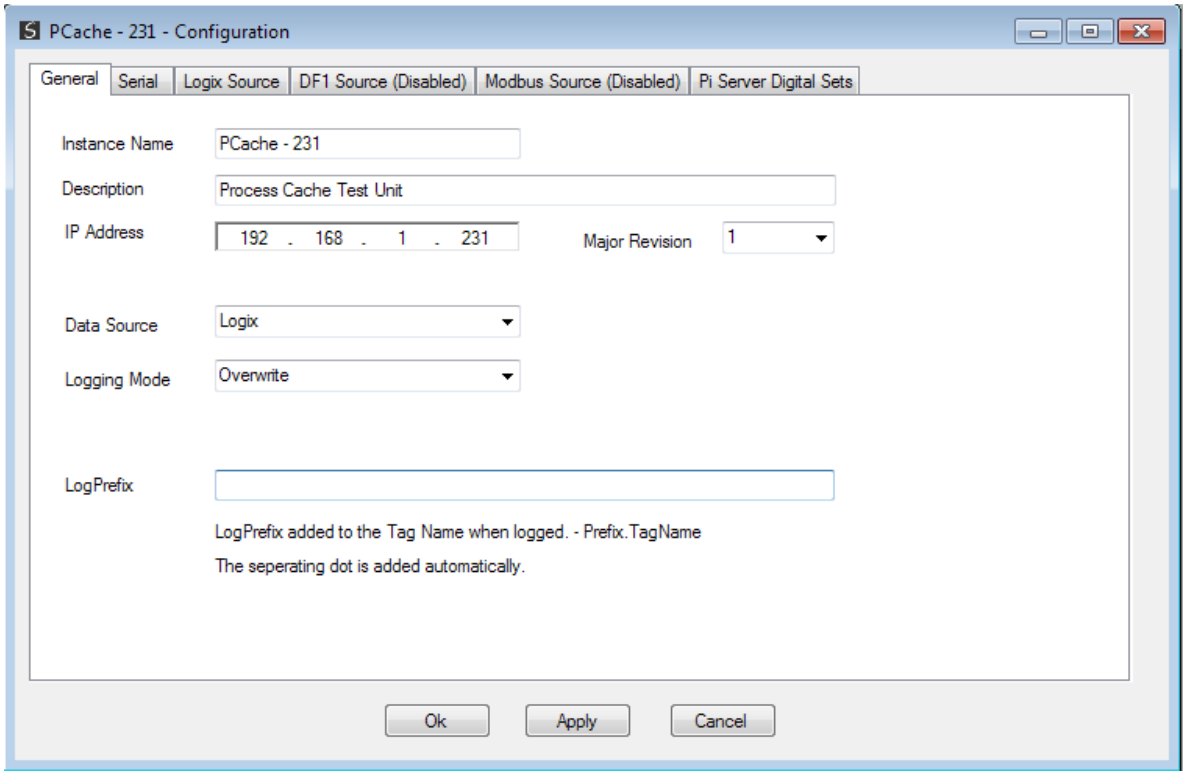


Figure 3.15. - General Configuration

The Serial configuration found using the Serial Tab consist of general Serial and DF1 specific parameters. For ModbusRTU, only the Baud Rate and Parity need be configured.

Parameter	Description
BAUD Rate	The BAUD rate will configure at what speed the data is sent 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.
Protocol	The protocol parameter will configure the module to operate in full duplex or half duplex mode on the DF1 network.

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 the local node address of the module.
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.

Table 3.2 - Serial ModbusRTU and DF1 configuration parameters

The serial configuration tab is shown in the figure below. The 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*.

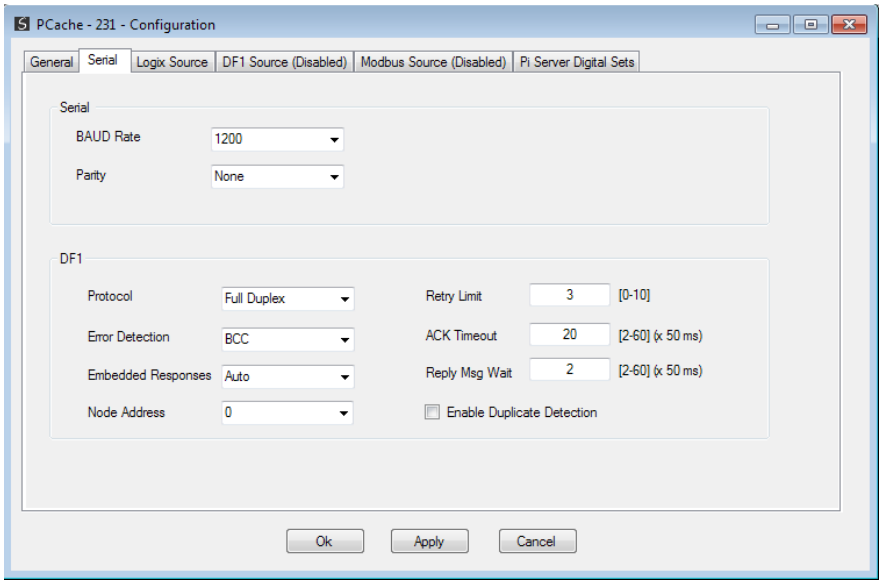


Figure 3.16 - Serial configuration

3.5. DATA SOURCE CONFIGURATION

The Data Source parameter set on the General Tab determines which the communication mode the module will use to acquire the data. The configuration of all other modes will be disabled. The Data Source options include:

- Logix – ControlLogix and Compact Logix controllers.
- DF1 – For collecting data over DF1 Serial communications.
- Modbus – for ModbusRTU (Serial) and ModbusTCP (Ethernet) communications.

Once the mode is selected, each Tab allows the configuration of up to three source devices and a total of 200 tags.

Tags can logged either as a result of their individual loggin criteria or via a group trigger. There are eight trigger groups (A thru H) and a tag can be members of any combination from none to all. Groups are in turn triggered by one or more tags. The triggering of a group ensures that all its member's values are logged at the same instance.

3.5.1. GROUP AND TAG TRIGGERS

Three parameters determine when each tag is triggered:

- Delta Y (Δy) – A change in the value of the tag by this amount or more, AND
- Min ΔT – The minimum time in seconds between each consecutive trigger, OR
- Max ΔT – The maximum time between each consecutive trigger.

The first two parameters work together to ensure tags are not logged too frequently and the Max ΔT set a minimum logging frequency.

Logix Tag (max. of 200 items.)

	Target Name	Target Tag	Group Trigger	Group Member	Data Type	Digital Set	Δy	Min ΔT	Max ΔT
▶	Truck6	OutputRate			SINT		1	10	300
	Truck6	TankLevel			INT		10	60	300
	Truck6	Speed	A	AB	SINT		10	5	300
	Truck6	Direction		AB	REAL		10	30	300
	Truck6	Temp	B	B	REAL		3	60	300
	Truck6	Mix		B	SINT		1	20	300
	Truck6	Pressure	B	B	REAL		1	20	300
*									

Figure 3.17 – Group and Tag Triggers

3.5.2. PI SERVER DIGITAL SETS

Digital Sets are used to store digital enumerations in FT Historian and OSI PI Server. All Boolean datatypes are translated to a PI Server *Digital* datatype which must have a predefined associated digital set. Digital Sets are not used when logging to a SQL Server.

Example: Tag *Pump.Running* could be set to Digital Set OFF_ON

Value: 0 = OFF,

Value: 1 = ON.

Digital Sets can also be used to enumerate larger sets. For example an error condition with three states defined as an SINT with values 0, 1, & 2 can be enumerated to OK, Warning, & Fault. See FT Historian documentation for more information.

Digital Sets cannot be created through the Aparian Slate and need to be created in FT Historian or through a PIOleDb interface. Records or type BOOL that do not have a Digital Set defined will be logged to the error file.

NOTE: Boolean tags must have a predefined Digital Set configured in FT Historian / PI Server for the tag to be logged. Digital Set names are Case sensitive and must match exactly.

A list of all Digital Sets used needs to be entered under the Pi Server Digital Set tab before they tab be associated with individual tags.

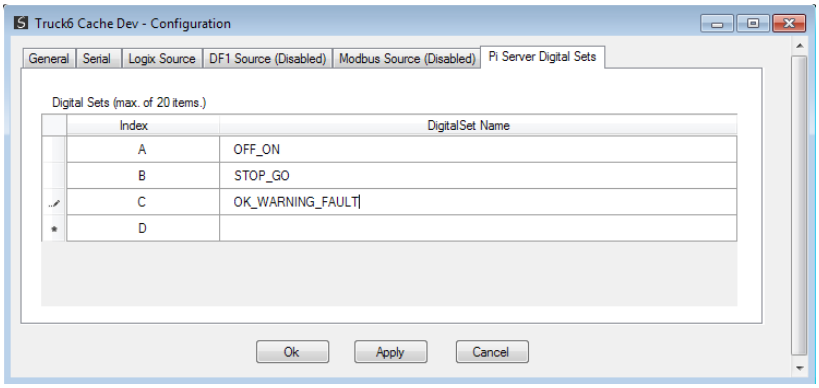


Figure 3.18. - List of Digital Sets

Logix Tag (max. of 200 items.)

Target Name	Target Tag	Group Trigger	Group Member	Data Type	Digital Set	Δy	Min ΔT	Max ΔT
Truck6	DoorLock			BOOL	NO_YES	1	30	300
Truck6	StoppedMoving			BOOL	STOP_GO	1	30	300
Truck6	Status			SINT	OK_WARNING_FAULT	1	1	300

Figure 3.19. - Associating Digital Sets to Tags

3.5.3. LOGIX SOURCE

The Logix Source tab is used to configure tags from Rockwell Automation Logix controllers over EtherNet/IP. The module can read tags from three separate controllers. A Target Name must be provided. This acts as a reference to the Logix CIP path. The Target Name does not have to match the actual controller name set in RSLogix. The Controller's CIP Path can either be typed in or selected from a list in the Target Browser.

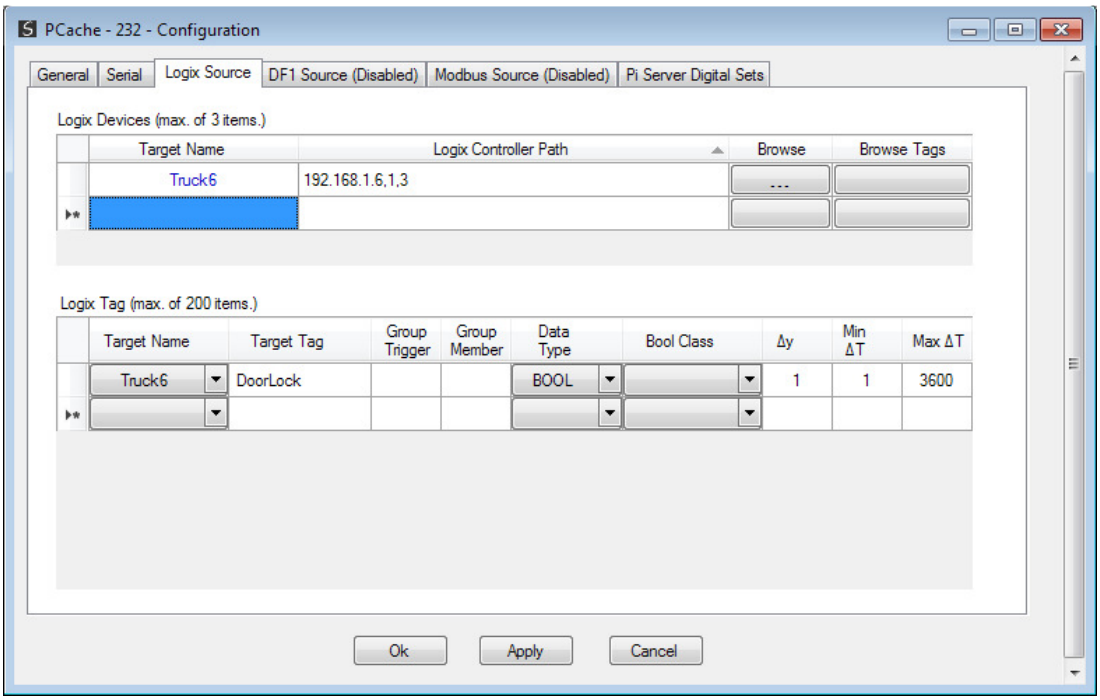


Figure 3.17 – Logix Source Configuration Tab

Click the button in the browse column to launch the Target Browser. The Target Browser will open and automatically scan for all available EtherNet/IP devices.

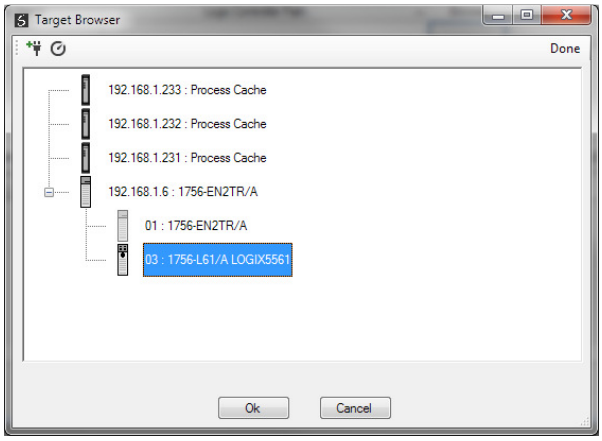


Figure 3.21. – Target Browser Window

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

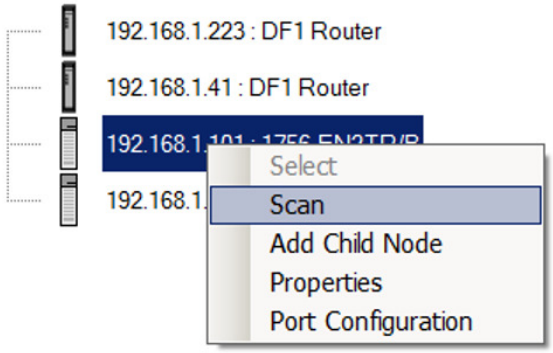


Figure 3.22. - Scanning node in the Target Browser

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

Once the controller references have been setup, individual Logix tags can be added. Tags can either be entered manually or selected using the Tag Browser associated with each controller.

Logix Tag (max. of 200 items.)

	Target Name	Target Tag	Group Trigger	Group Member	Data Type	Digital Set	Δy	Min ΔT	Max ΔT
▶	Truck6	DoorLock			BOOL	NO_YES	1	30	3600
	Truck6	RunTime			DINT		600	600	3600
	Truck6	Direction		A	REAL		5	30	1800
	Truck6	Speed	A	A	SINT		5	30	1800
*									

Figure 3.23. - Logix Tag configuration

NOTE: Tag names need to match exactly for the module to be able to correct identity the tag. Full tag names need to be provided for tags located in program scopes.

To launch the Tag Browser, click the Browse Tags button associated with the controller. Tags that are were already selected and identified will be highlighted in green. See Fig 3.24.

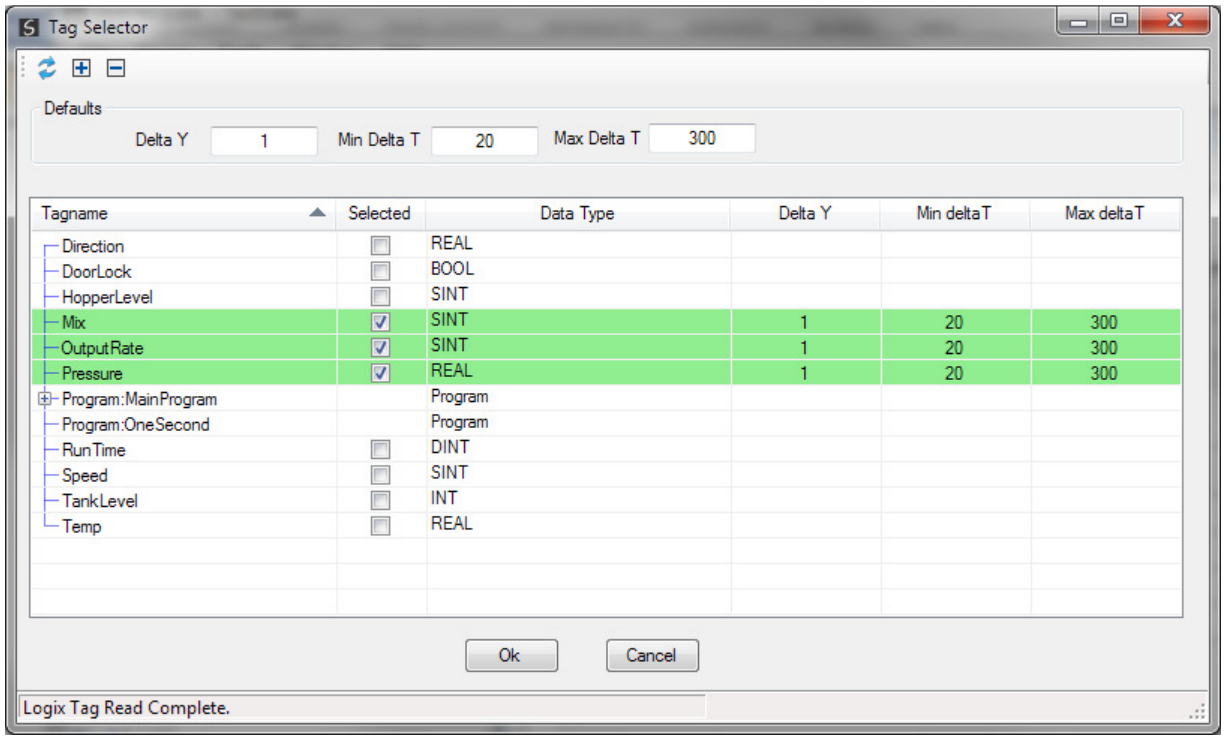


Figure 3.24. – Tag Browser Selection

Tags can be removed by selected the rows in the left hand margin, and right clicking to display the delete option.

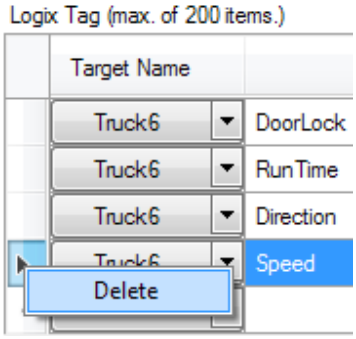


Figure 3.25 – Deleting Tags

3.5.4. DF1 SOURCE

A maximum of three DF1 Sources can be configured. The configuration of each source requires a Device Name (used as a reference for tag data sources), the Device Type (either PLC5 or SLC), and a Node Address.

Each DF1 Tag requires a unique Tagname and Data Address.

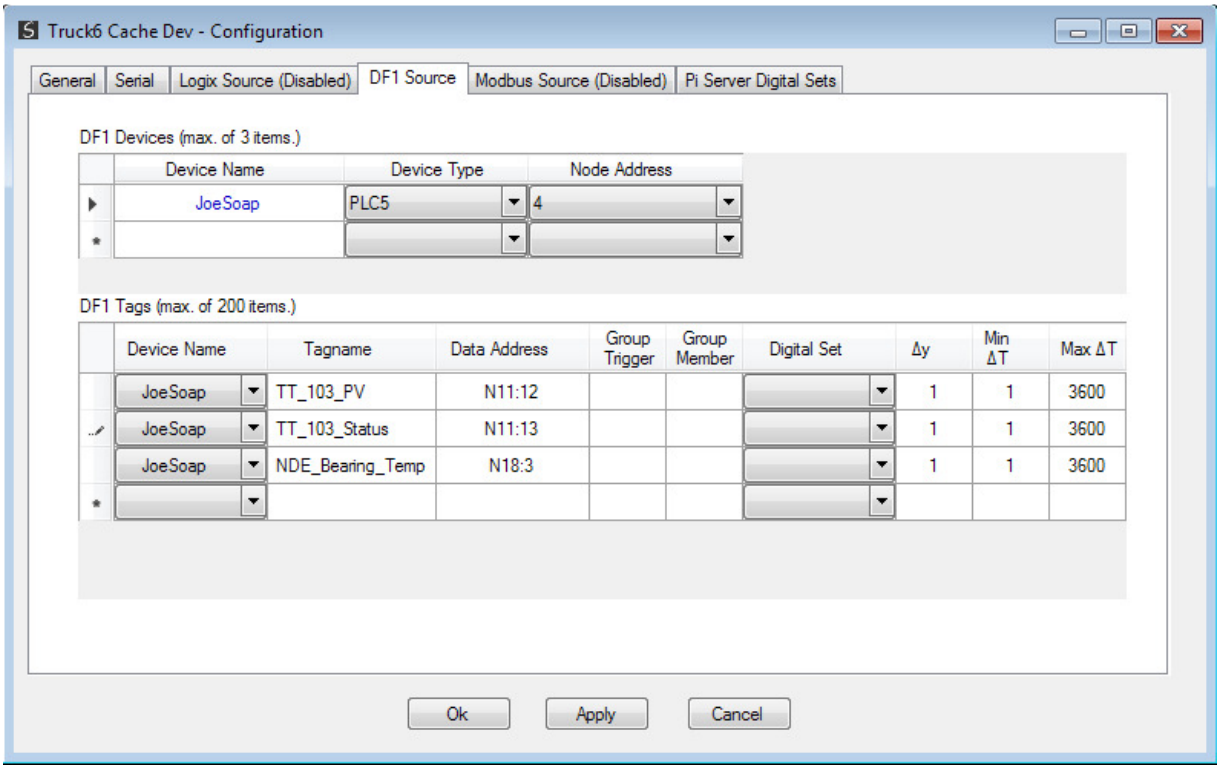


Figure 3.26. – DF1 Source configuration

3.5.5. MODBUS SOURCE

Both Modbus RTU and Modbus TCP are configured using the same tab. When Modbus RTU is selected as the data source, the IP Address column is not shown. A maximum of three Modbus sources can be configured. The configuration of each source requires a Device Name (used as a reference for tag data sources), the IP Address (for Modbus TCP), and a Node Address.

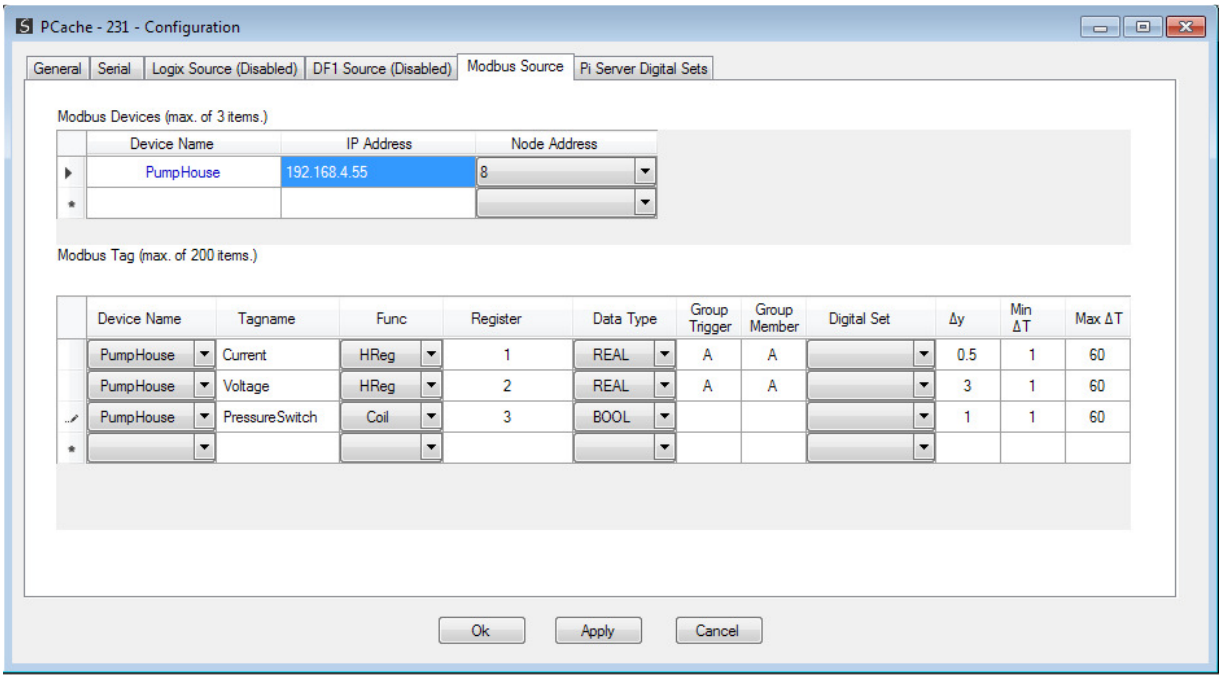


Fig 3.27 – Modbus Source Configuration

3.6. MODULE DOWNLOAD

Once the 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 Process Cache Module is not on a local network.

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

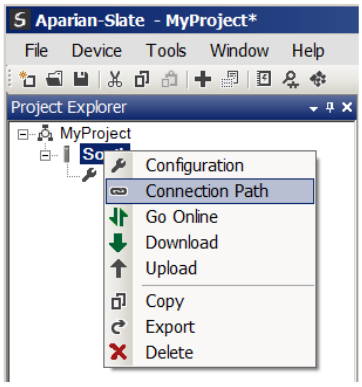


Figure 3.28. - Selecting Connection Path

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

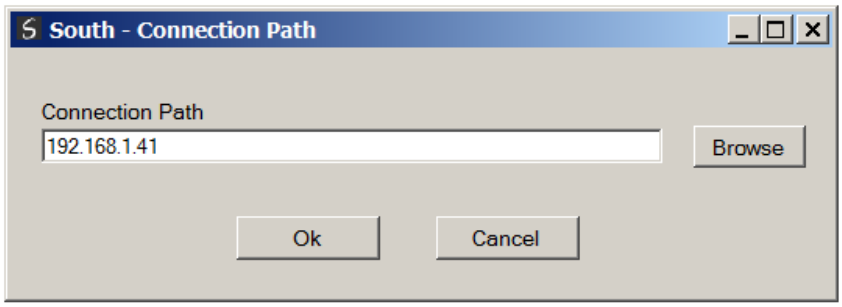


Figure 3.29. - Connection Path

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

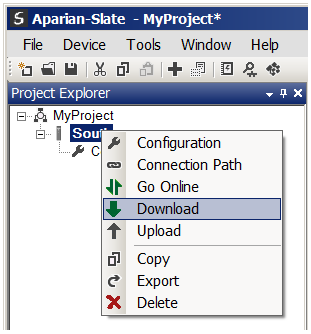


Figure 3.30. - Selecting Download

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

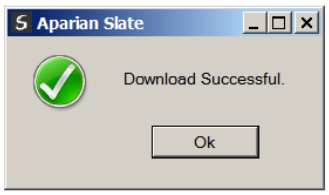


Figure 3.18. - Successful download

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.

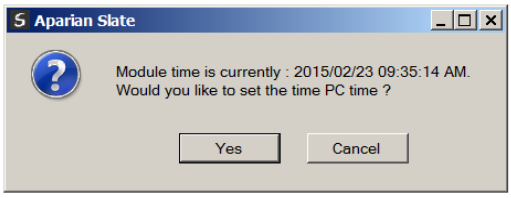


Figure 3.192. – Setting module time

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.

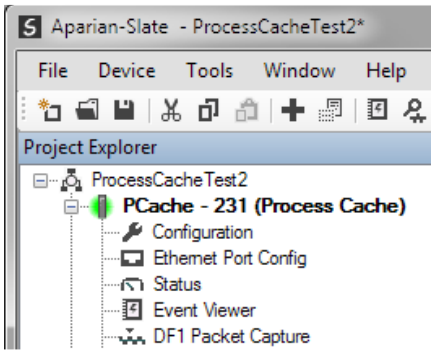


Figure 3.33 - Module Online

4. UNLOAD SERVICE

4.1. INTRODUCTION

The Process Cache Unload Service contains two parts. A background windows service (*The Service*) that communicates with the configured Process Cache modules and uploads records at a configured interval and stores the records in either a SQL database or FT Historian or PIServer. The second component is a User Interface to the service used to configure and monitor the uploading process. The user Interface is hereafter referred to as *The Monitor.*

4.2. INSTALLATION

One setup file installs both the Service and the Monitor. The installation file can be downloaded from http://www.aparian.com/products/processcache.

The Setup.exe installs in ***C:\Program Files (x86)\Aparian\Process Cache*** and automatically starts the service.

4.3. SERVICE CONFIGURATION

Launch the Monitor from the start menu

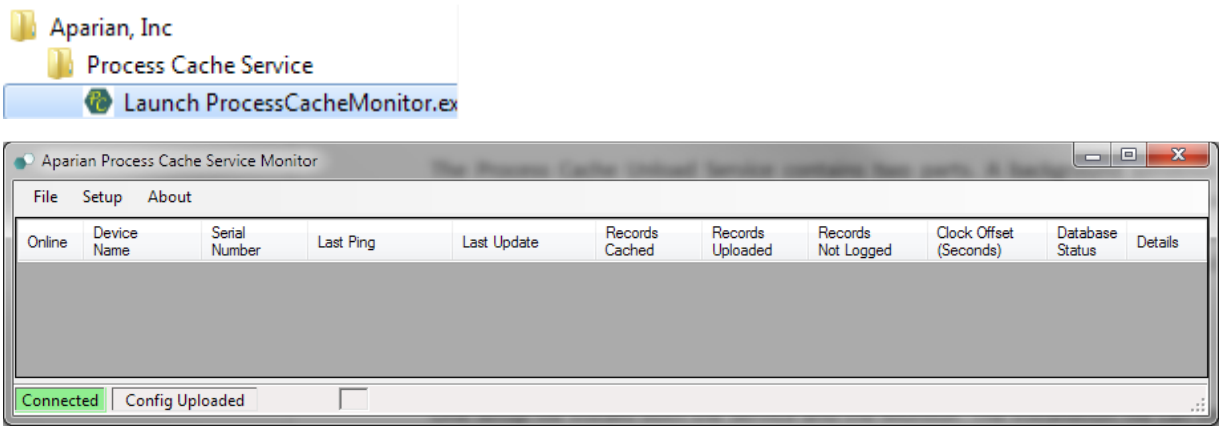


Figure 4.1. - Process Cache Service Monitor

The status bar along the bottom of the form will display the word ***Connected*** with a green background if the Monitor is able to connect to the background Service. If the status bar is Red check that the Service is running. See Trouble Shooting.

Launch the Setup Form from the menu bar.

4.3.1. GENERAL SETTINGS

The General tab contains settings that apply to all modules that connect to the service. These parameters include:

Setup Parameter	Description
Ping Interval	Defines the period (frequency) that the Service checks for the presence of Process Cache modules on the network. Presence is determined by a match of the both the IP address and the Serial Number. If present, the modules status is read.
Update Clock Interval	The frequency that the module's clock is synchronized with the server (workstation that the Service is running on).
Max Clock Offset	The maximum allowable offset between module clock and server clock.
Log Event Threshold	Sets the threshold of entries made to the Windows Event Viewer: under Applications and Services Log / Aparian. See Trouble Shooting for more information.

Table 4.1. – General Monitor Setup Parameters

If the Service determines the module's clock needs to be synchronized the actual synchronization is performed only after the upload is completed.

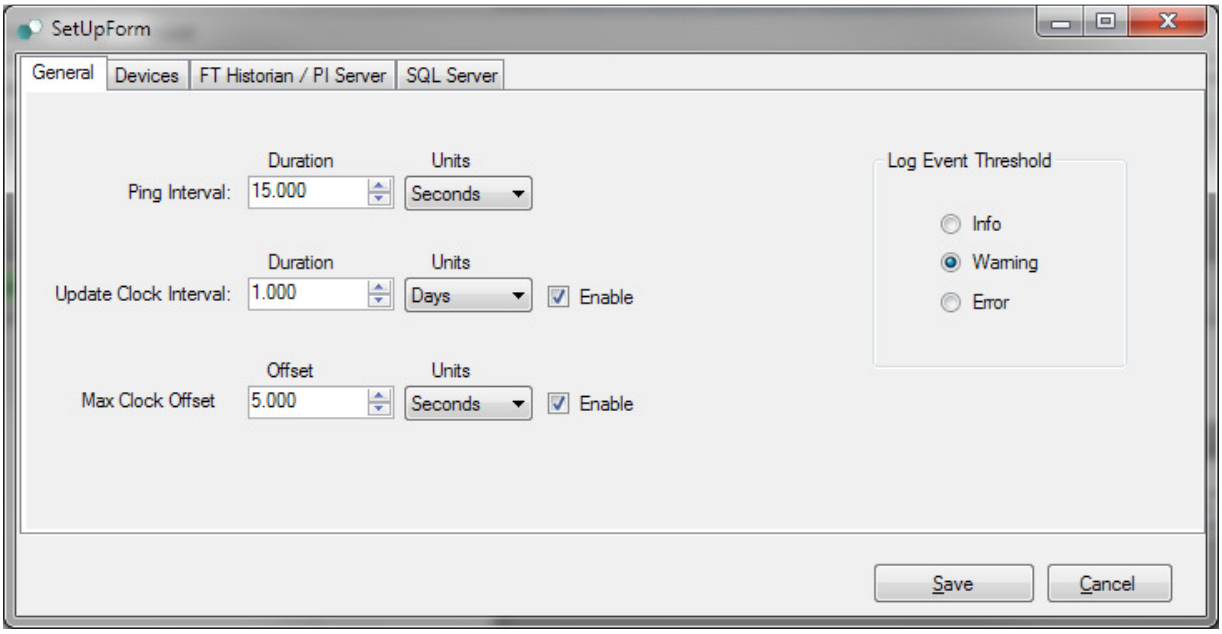


Figure 4.2. – General Monitor Settings

4.3.2. ADD DEVICES

To add Process Cache modules to the Service, select the devices tab and click add. The IP Address and module Serial Number are required to uniquely identify each module. Set the Upload Interval and the Output To either Pi Server or SQL Database.

Setup Parameter	Description
IP Address	The IP Address of the module.
Serial Number	Module Serial Number – must be in the format XXXX-XXXX where each X is an alpha-numeric value.
Upload Interval	Sets the frequency that records are uploaded from the module based on last upload event. If the module is not online the upload will be triggered when next online as determined by the Ping Interval Event in General settings.
Output To:	Sets where the uploaded records are to be logged. Select Pi Server for OSI Pi Server and FT Historian, SQL Server for logging to a SQL server.
Instance Name	This value is read from the module. (Value is configured in Slate.)
Description	This value is read from the module. (Value is configured in Slate.)
Logging Mode	This value is read from the module. (Value is configured in Slate.)
Data Source	This value is read from the module. (Value is configured in Slate.)

Table 4.2. – General Monitor Setup Parameters

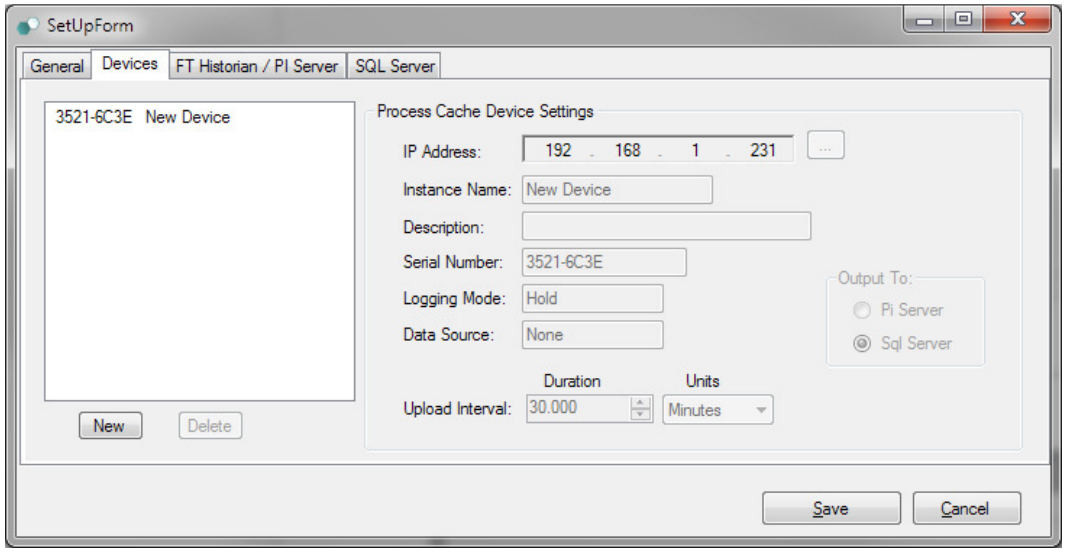


Figure 4.3. – Adding Devices to the Upload Service

The build (…) button next to the IP Address can be used to launch the target browser and selected the device if it is currently online.

4.3.3. FT Historian / Pi Server Connection Settings

If any of the devices are logging records to FT Historian or OSI Pi Server, the connection parameters need to be set. The use of the piAdmin User Name is discouraged.

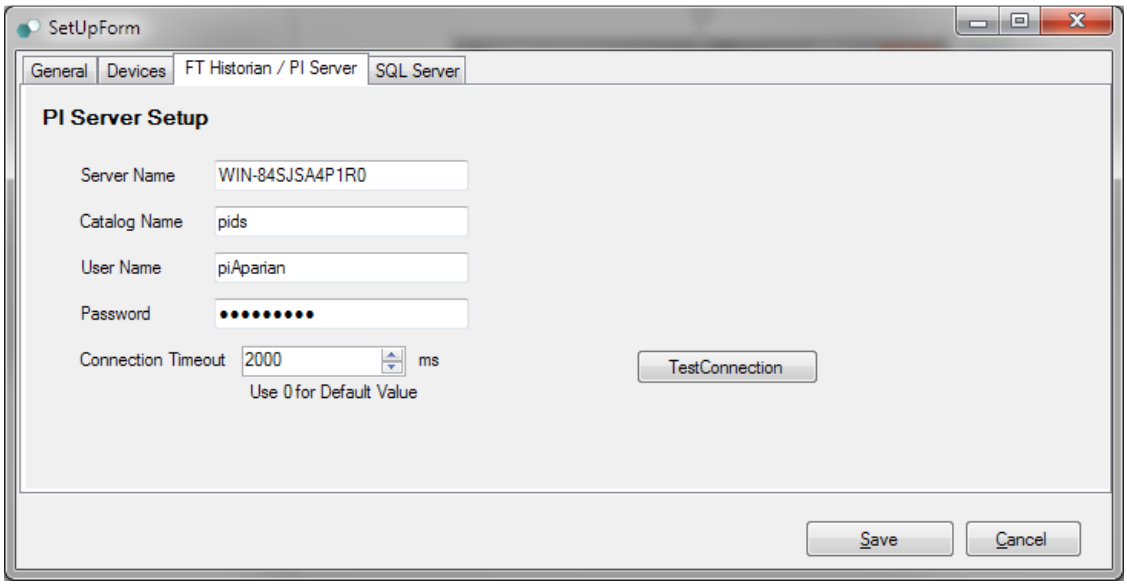


Figure 4.4. – FT Historian / Pi Server Connection Parameters

The connection can tested by selecting the Test Connection button. The test procedure ensures the connection parameters are correct and ensures that it can read data from both the Points table and Digital Sets table. If any step fails, the test is halted.

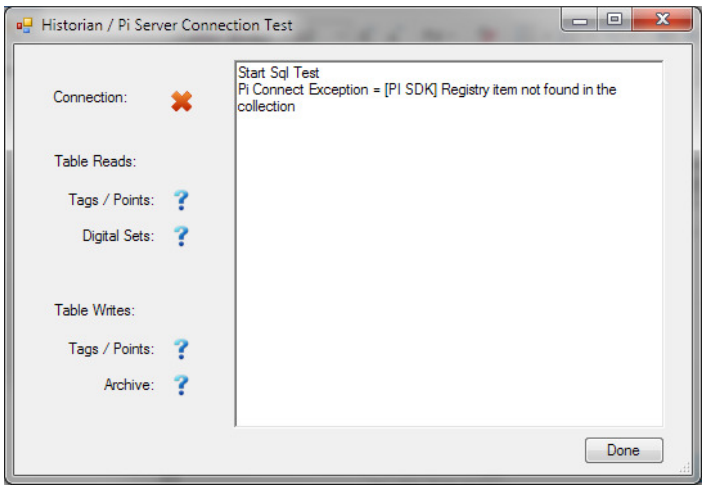


Figure 4.5. - Pi Server Connection Test

4.3.4. SQL Server Connection Settings

If any of the devices are logging records to a SQL Server database, the connection parameters need to be set.

The Setup Parameters also include the table names for the Config and Archive tables. The Config table contains information about each tag while the archive table contains the time stamped data.

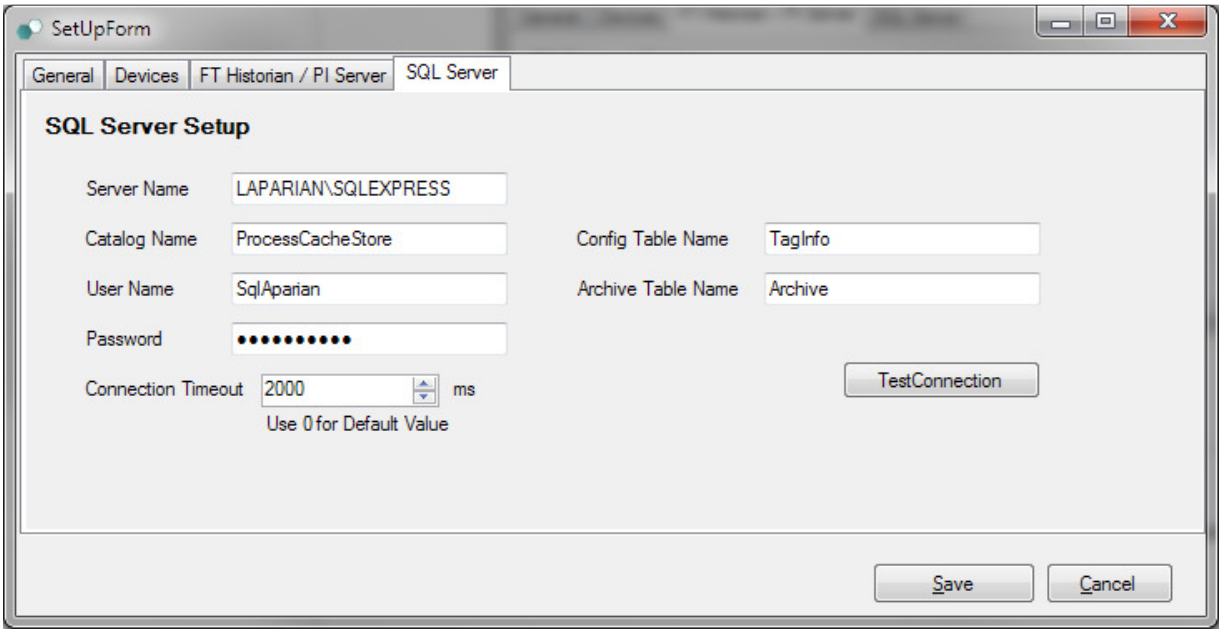


Figure 4.6 – SQL Server Connection Parameters

The Test Connection button test the connection to the SQL Server as well as read and write privileges to the Config and Archive tables.

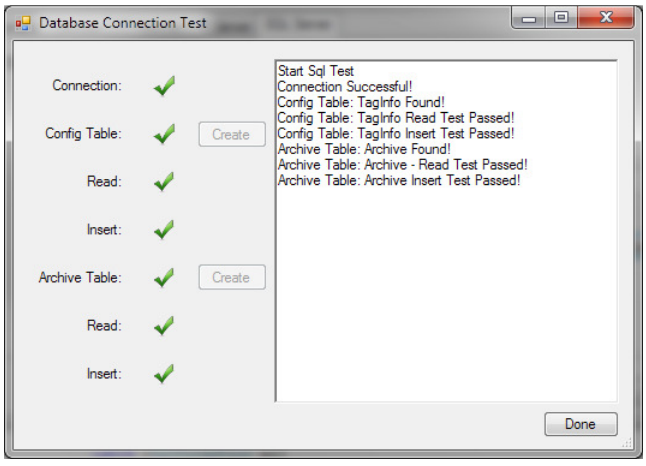


Figure 4.7. – SQL Connection Test

If either the Config or Archive table do not exist in the database, the service will create them automatically. The service will not however create the catalog (database) if it does not exist.

Table columns are as follows:

Column	DataType	Description
LastSerialNum	varchar(12)	Serial Number of last uploaded module
ControllerName	varchar(32)	Primary Key – Controller/ Target Name as configured in Slate
TagName	varchar(32)	Primary Key – Tag Name as listed in Slate
DataType	varchar(10)	Tag data type:- BOOL, SINT, INT, DINT, or REAL
TagPreFix	varchar(64)	Prefix added to TagName in Archive Table

Table 4.3. – Config Table Columns

Column	DataType	Description
DateTime	datetime	Primary Key – UTC Date and Time including milliseconds.
SerialNum	varchar(12)	Serial Number of module record was uploaded from
ControllerName	varchar(32)	Primary Key – Tag Name as listed in Slate
TagName	varchar(96)	Primary Key – Tag Name with TagPreFix with period separator
Value	real	Prefix added to TagName in Archive Table

Table 4.4. – Archive Table Columns

4.3.5. SAVE

Once the Setup is complete – click the Save button at the bottom of the form.

The setup is passed to the service which stores an encrypted copy on the local hard drive.

C:\ProgramData\Aparian\CacheServiceConfig.pcc

4.4. OPERATION

After the Setup is passed to the service, the Monitor will display the latest status from each module. Modules that are the process of unloading records will be highlighted in green.

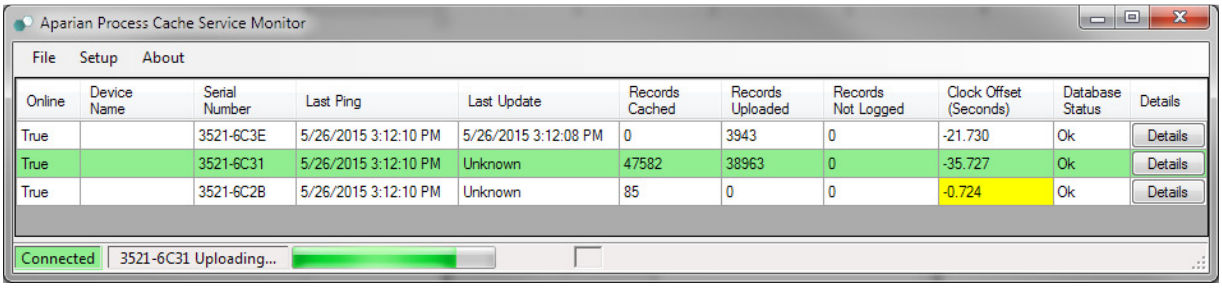


Figure 4.8. - Monitor showing upload in progress

Displayed Status parameters include:

Parameter	Description
Online	Whether the module was present during the last ping event - True / False
Device Name	Device Instance Name as configured in Slate
Serial Number	Module Serial Number
Last Ping	Date & Time of last Ping Event
Last Update	Date & Time of Last Uploaded completed
Records Cached	Records Cached in the module at last Ping Event
Records Uploaded	Records Uploaded during last upload event
Clock Offset	Clock Offset in seconds between Module and server
Database Status	Connection and Logging Status: Ok: - Connected to Database – All records logging successfully, Minor Fault: - One or more individual records incurred a log error and were written to the Error File, Fault:- A connection could not be established to the database – no records are being marked as uploaded.
Details	Display additional status information

Table 4.5. – Archive Table Columns

The following functions can be accessed by right clicking on module's row in the Monitor:

Parameter	Description
Refresh	Requests updated status and refreshes the display

View Details	Displays additional status information
Force Upload	Overrides Update Interval and forces upload at next Ping Event
Update Clock	Sets Clock Update to occur after next upload

Table 4.6. – Monitor Functions

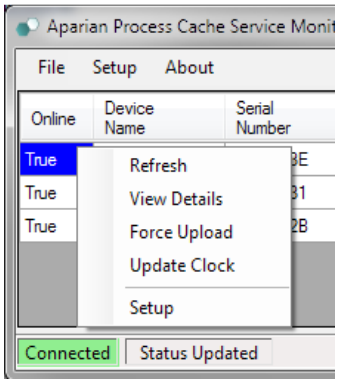


Figure 4.9 – Exposed Functions

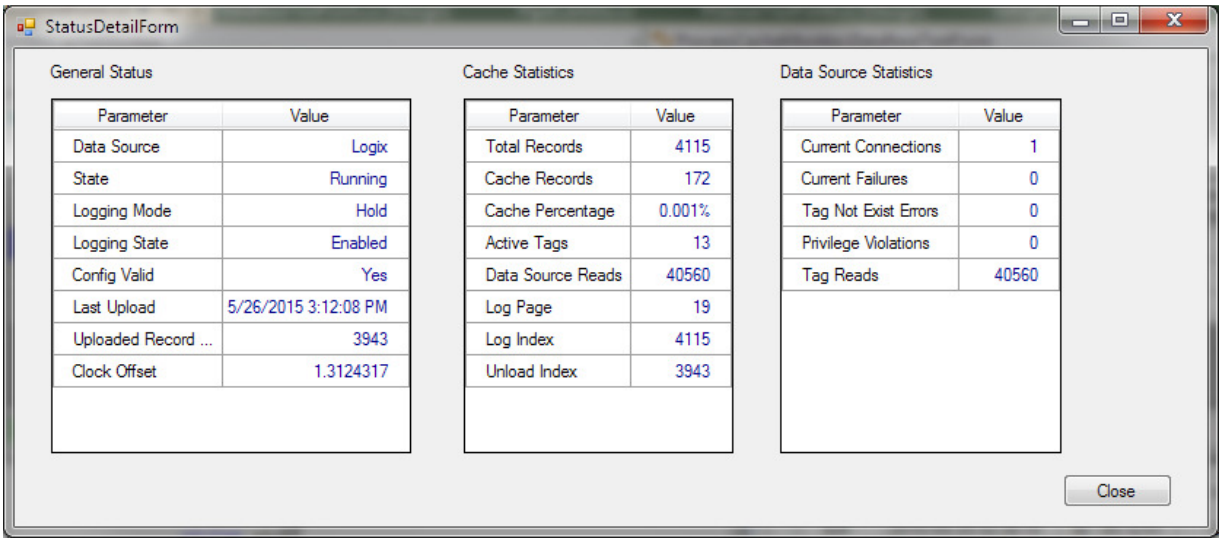


Figure 4.10. – Additional Status Information

5. RSLOGIX 5000 CONFIGURATION

5.1. 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 Process Cache Module will need to be added to the RSLogix 5000 / Studio5000 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).

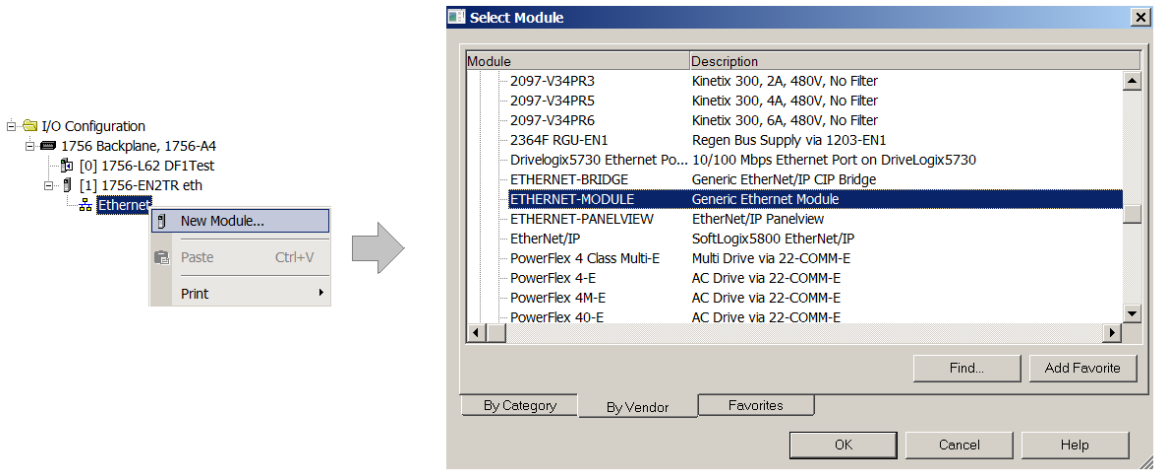


Figure 5.1. - Add a Generic Ethernet Module in RSLogix 5000

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

Connection Parameter	Assembly Instance	Size
Input	103	29 (32-bit)
Output	104	1 (32-bit)

Configuration	102	0 (8-bit)

Table 5.1. - RSLogix class 1 connection parameters for the Process Cache

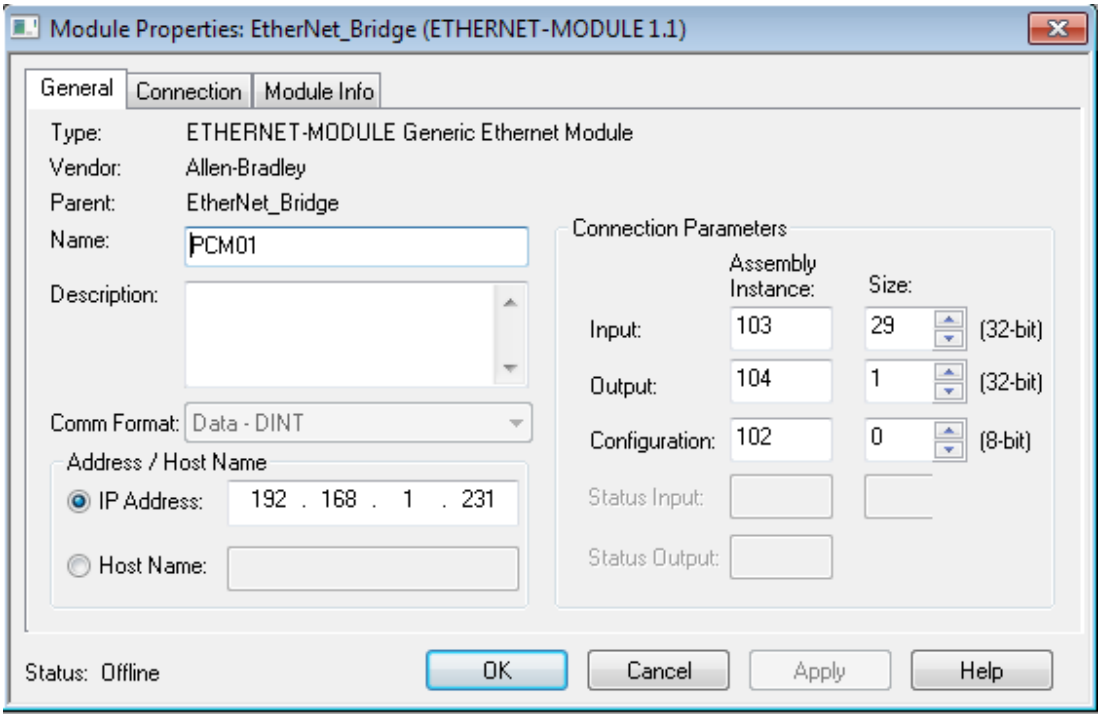


Figure 5.2. - RSLogix General module properties in RSLogix 5000

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

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.

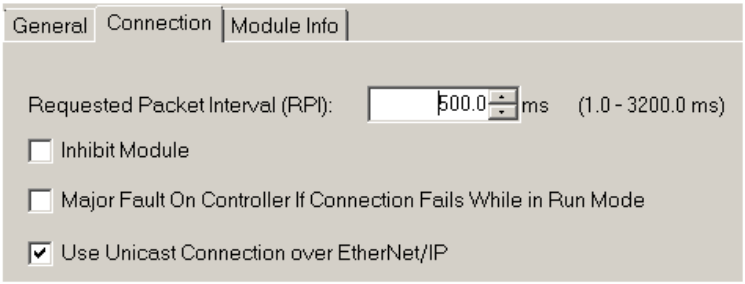


Figure 5.3. - Connection module properties in RSLogix 5000

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.

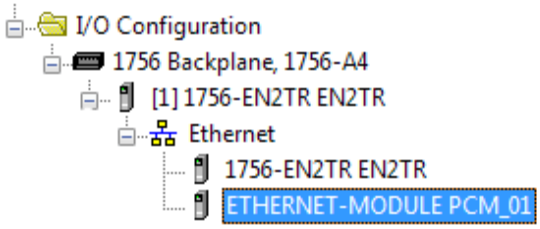


Figure 5.4. – RSLogix 5000 I/O module tree

5.2. 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.

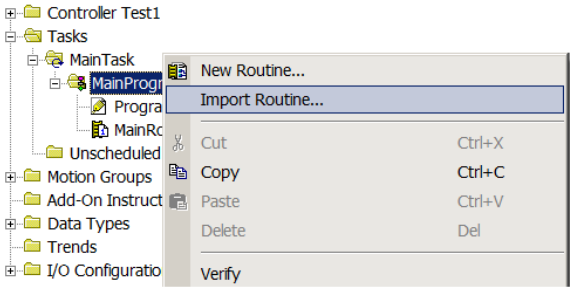


Figure 5.6. – RSLogix 5000 Importing Process Cache specific routine and UDTs

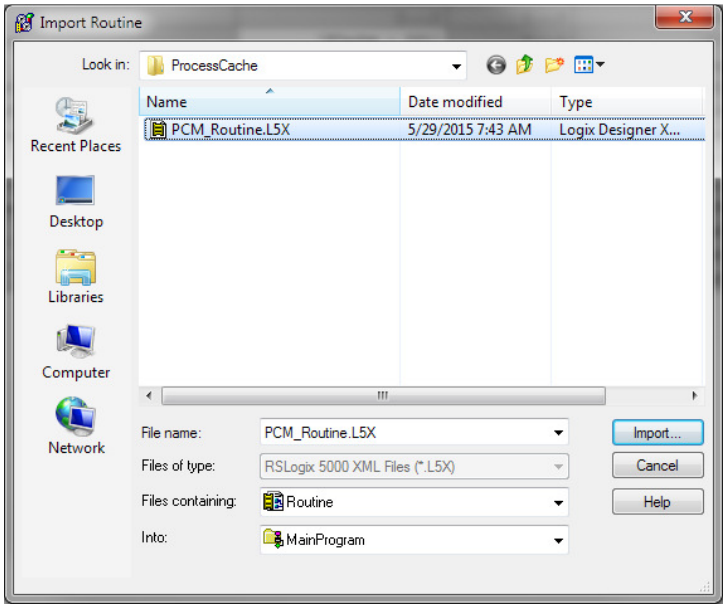


Figure 5.7. - Selecting partial import file

The import will create the following:

- The required UDTs (user defined data types)
- One controller tags representing the Input assembly.
- A routine mapping the Process Cache module to the aforementioned tag.

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

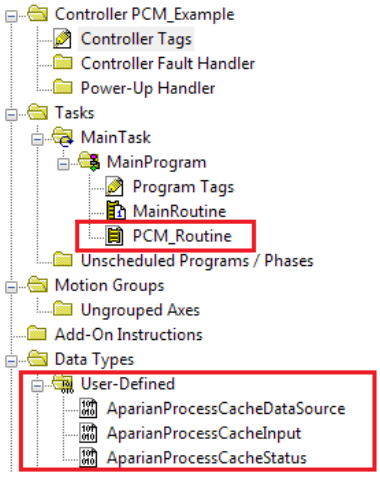


Figure 5.8. - Imported RSLogix 5000 objects

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

5.3. 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 Process Cache module. An input assembly is exchanged at a fix interval. The UDTs provided will convert the input arrays into tag based assemblies. Refer to the additional information section in this document for the input UDTs. There are no Output or Configuration assemblies.

PCM_01Input	{...}
PCM_01Input.Instance	'PCache - 231'
PCM_01Input.Status	{...}
PCM_01Input.Status.Running	1
PCM_01Input.Status.ConfigurationValid	1
PCM_01Input.Status.ContinuousLogging	1
PCM_01Input.Status.LoggingInhibited	0
PCM_01Input.Status.LoggingStopped	0
PCM_01Input.CachePercentageUsed	7.33137131e-004
PCM_01Input.CacheRecordCount	123
PCM_01Input.TotalRecordCount	288054
PCM_01Input.ActiveTagCount	13
PCM_01Input.DataSource	{...}
PCM_01Input.DataSource.EtherNetIP	1
PCM_01Input.DataSource.DF1	0
PCM_01Input.DataSource.ModbusRTU	0
PCM_01Input.DataSource.ModbusTCP	0
PCM_01Input.DataSourceReadCount	2922819

Figure 5.9. - Input assembly UDT structure

5.3.1. 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 configuration tab in Slate.
Status.Running	BOOL	Set if the module has a valid configuration and is reading tags.
Status.ConfigValid	BOOL	Set if a valid configuration is executing in the module.
Status.ContinuousLogging	BOOL	Set if Logging Mode set to Overwrite, clear for Hold.
Status.ConfigurationValid	BOOL	Set if a valid configuration is executing in the module.
Status.LoggingInhibited	BOOL	Not Used.
Status.LoggingStopped	BOOL	Not Used.
CachePercentage	REAL	The number of cached records not yet uploaded, as a percentage of the total record capacity of 16,777,216.
CacheRecordCount	DINT	The number of cached records not yet uploaded.
TotalRecordCount	DINT	The total number of cached records uploaded or not.
ActiveTagCount	DINT	The number of individual tags configured to be read.
DataSource .EtherNetIP	BOOL	Set if the data source is set to Logix.
DataSource .DF1	BOOL	Set if the data source is set to DF1.
DataSource .ModbusRTU	BOOL	Set if the data source is set to Modbus-RTU.
DataSource .ModbusTCP	BOOL	Set if the data source is set to Modbus-TCP.
DataSourceReadCount	DINT	The number of tag reads from the configured data source.

Table 5.2. - RSLogix 5000 input assembly parameters

6. DIAGNOSTICS

6.1. 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 6.1 - Process Cache front view

LED	Description
Ok	The module Ok 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.
Act	The activity LED is used for the RS232 serial port. Thus every time a successful DF1 or Modbus-RTU packet was received the LED will toggle green. The LED will toggle red if a corrupted packet was received (eg. failed checksum).
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.

Table 6.1 - Module LED operation

1.1. MODULE STATUS MONITORING IN SLATE

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

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

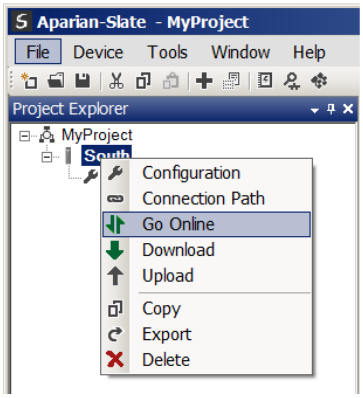


Figure 6.2. - Selecting to Go Online

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

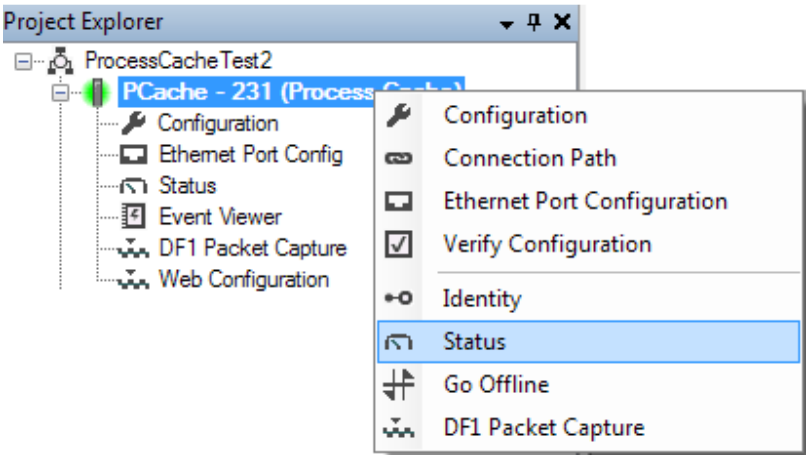


Figure 6.3. - Selecting online Status

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.

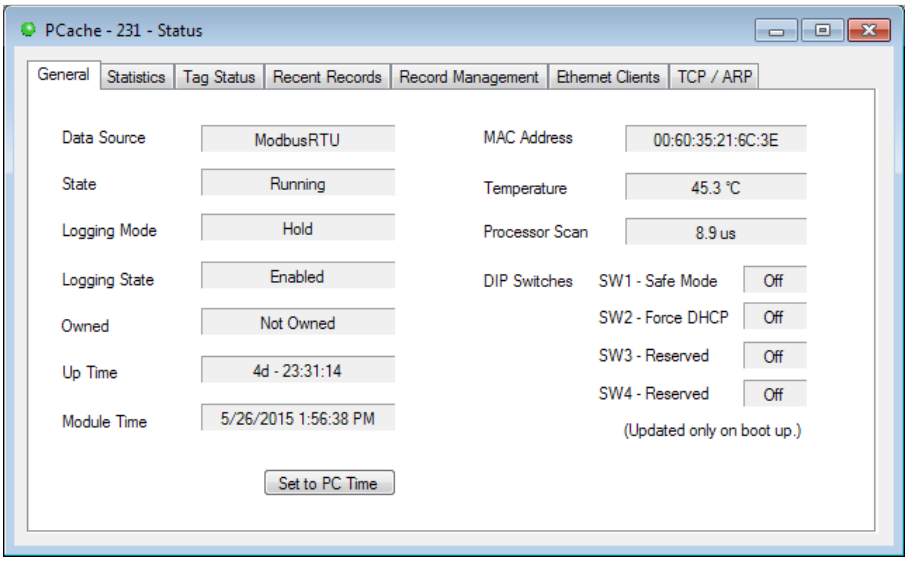


Figure 6.4. - Status monitoring - General

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

Parameter	Description
Data Source	Logix, DF1, Modbus-RTU, Modbus-TCP
State	Indicates whether or not the module is currently owned (Class 1) by a Logix controller.
Logging Mode	Hold or Overwrite – determines if records are over written when the cache is full.
Logging State	Not Used.
Owned	Indicates whether or not the module is currently owned (Class 1) by a Logix controller.
Up Time	Indicates the elapsed time since the module was powered-up.
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 6.2 - Parameters displayed in the Status Monitoring – General Tab

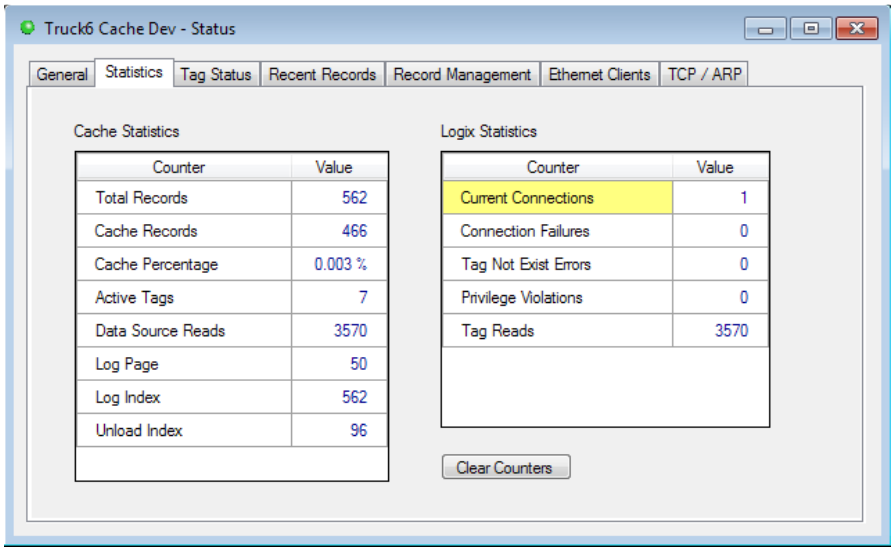


Figure 6.5. - Status monitoring - Transactions

The Statistics tab displays the statistics associated with the record cache and data source.

Statistic	**Description**
Total Records	The total number of cached records uploaded or not.
Cache Records	The number of cached records not yet uploaded.
Cache Percentage	The number of cached records not yet uploaded, as a percentage of the total record capacity of 16,777,216.
Active Tags	The number of individual tags configured to be read.
Data Source Reads	The number of tag reads from the configured data source.
Log Page	The current memory page currently being written to. Each page holds 128 records.
Log Index	The current record index being written to.
Unload Index	The upload record index. Managed by the Unload Service.

Table 6.3 – Cache 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 module.

Table 6.4 - Tag Mapping statistics

The Tag Status tab provides current values for all tags together with their trigger settings.

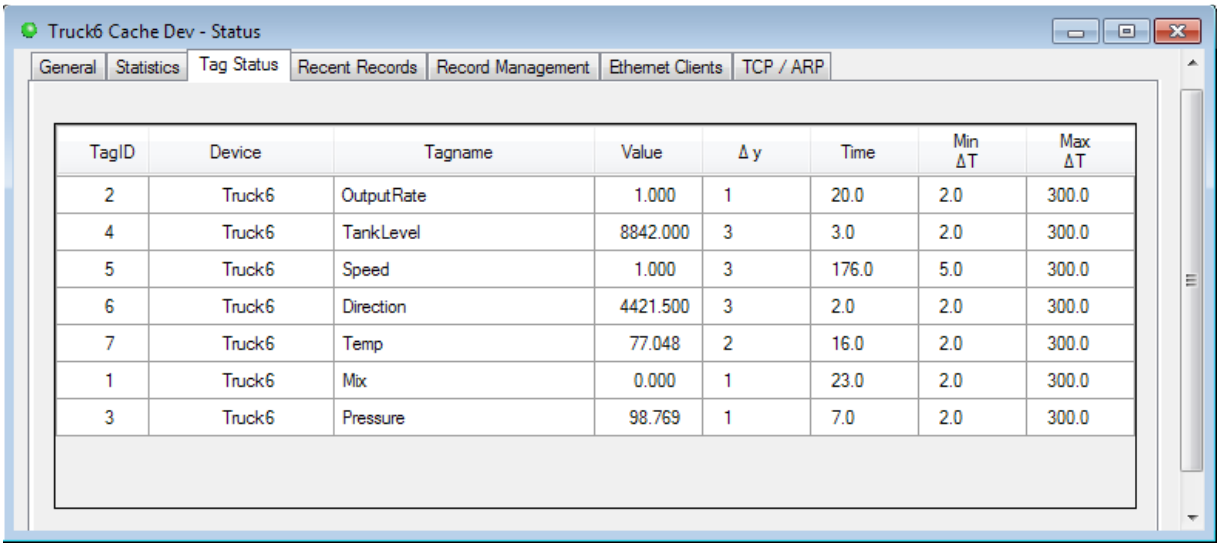


Figure 6.6. – Tag Status

The Recent Records tab provides a list of the last records recorded with their time stamp and value.

The Record Management tab provides options to down load records to a comma separated (csv) file format for import into Excel or other program. An option to Rest the Log Indices and clear the cache are also available.

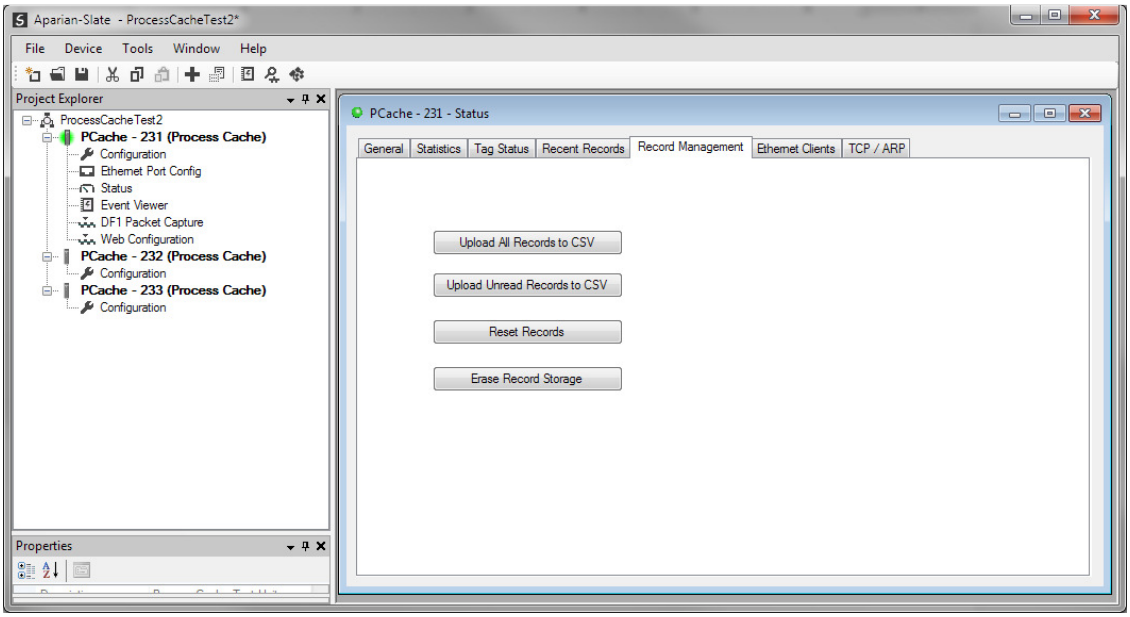


Figure 6.7 – Record Management

Ethernet Clients tab provides a count of Ethernet and EtherNet/IP connections.

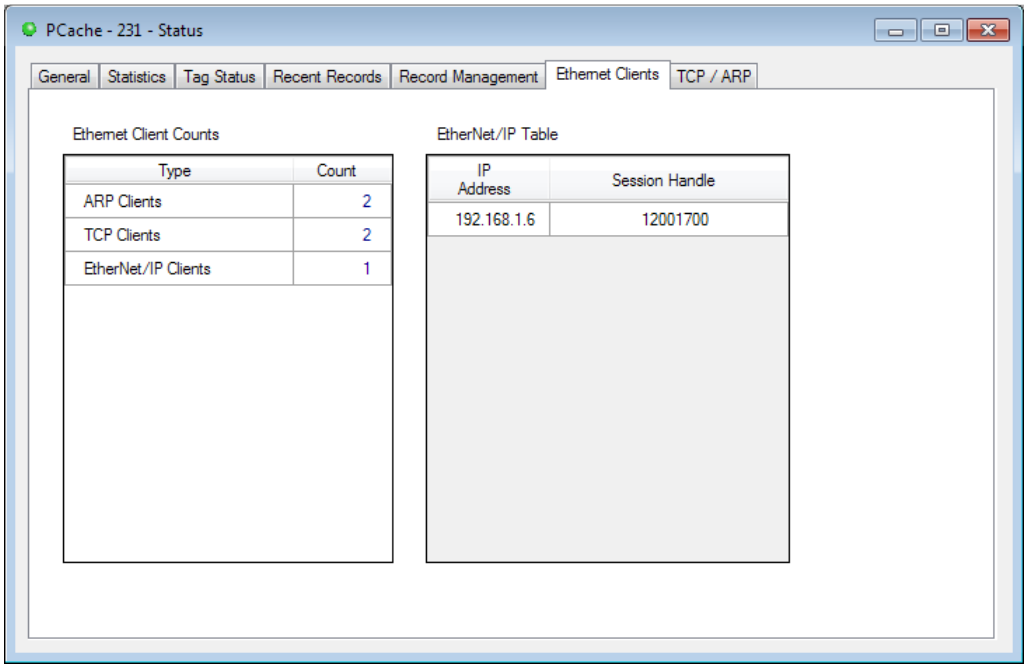


Figure 6.8 – Ethernet Connection Counts

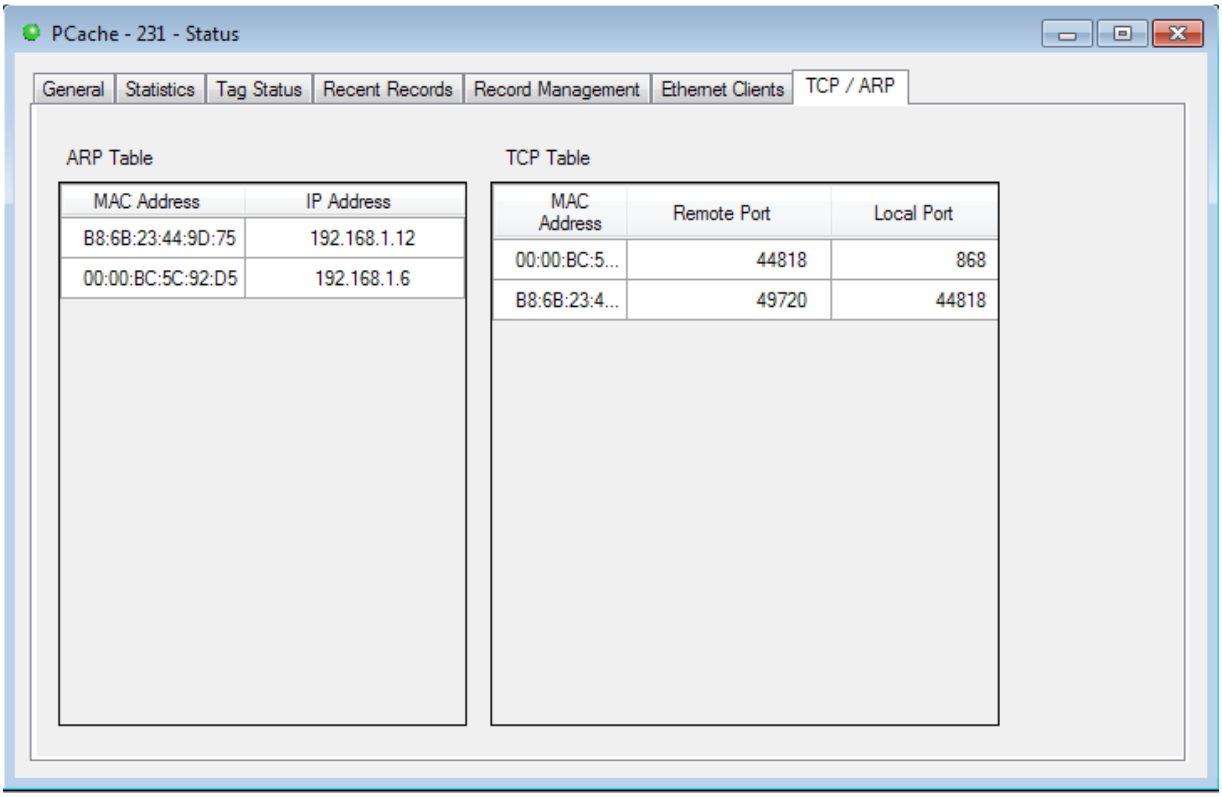


Figure 6.9 – TCP and ARP Table Entries

6.2. 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.

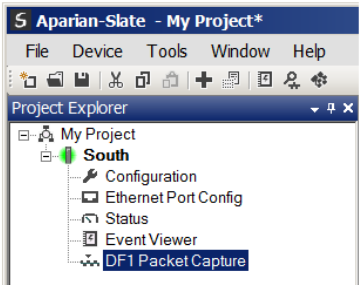


Figure 6.10. - Selecting DF1 Packet Capture

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.

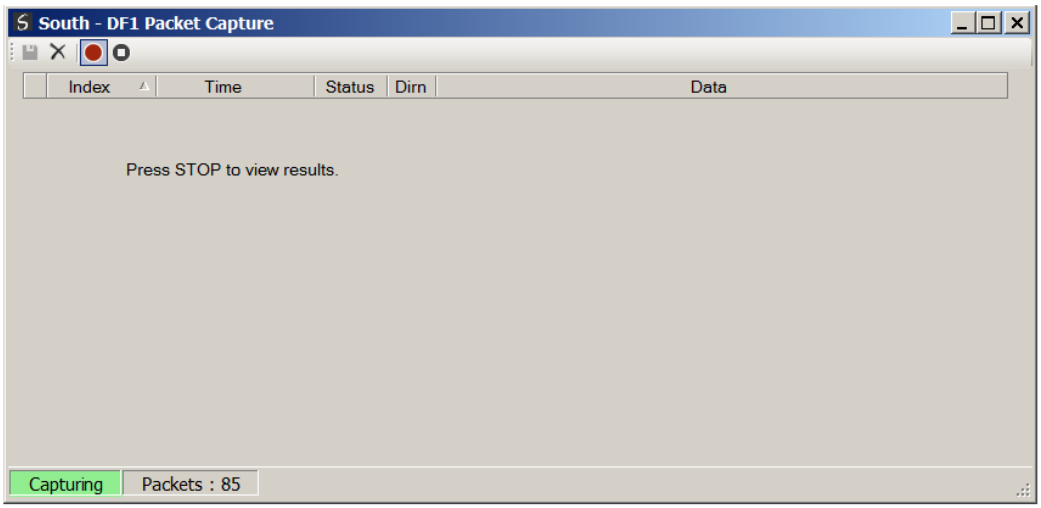


Figure 6.11 - DF1 packet capture

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

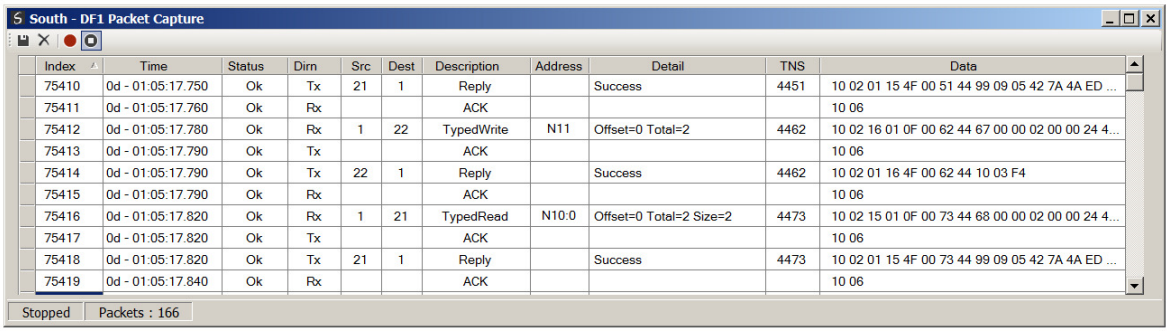


Figure 6.12. - DF1 Packet Capture complete

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 6.4. - 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.

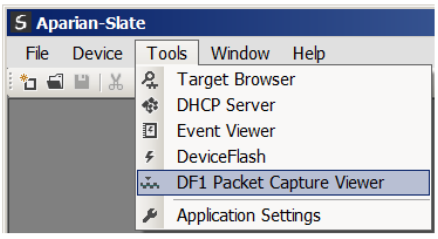


Figure 6.7. - Selecting the DF1 Packet Capture Viewer

6.3. MODULE EVENT LOG

The Process Cache 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.

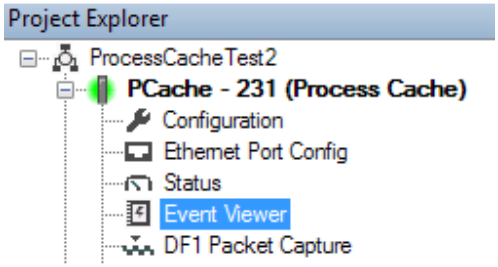


Figure 6.8. - Selecting the module Event Log

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.

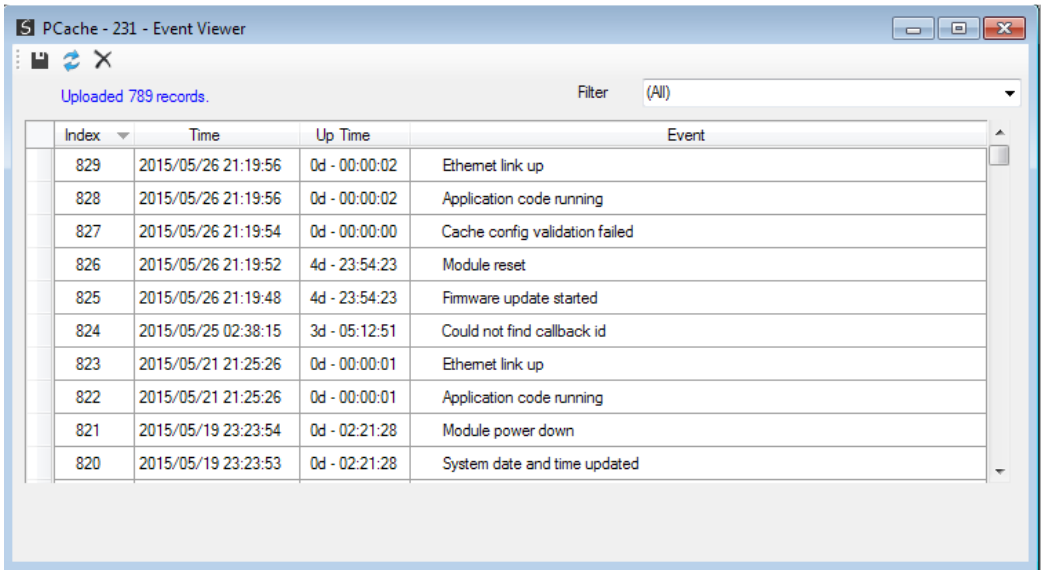


Figure 6.9. – Module Event Log

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.

6.4. WEB SERVER

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

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

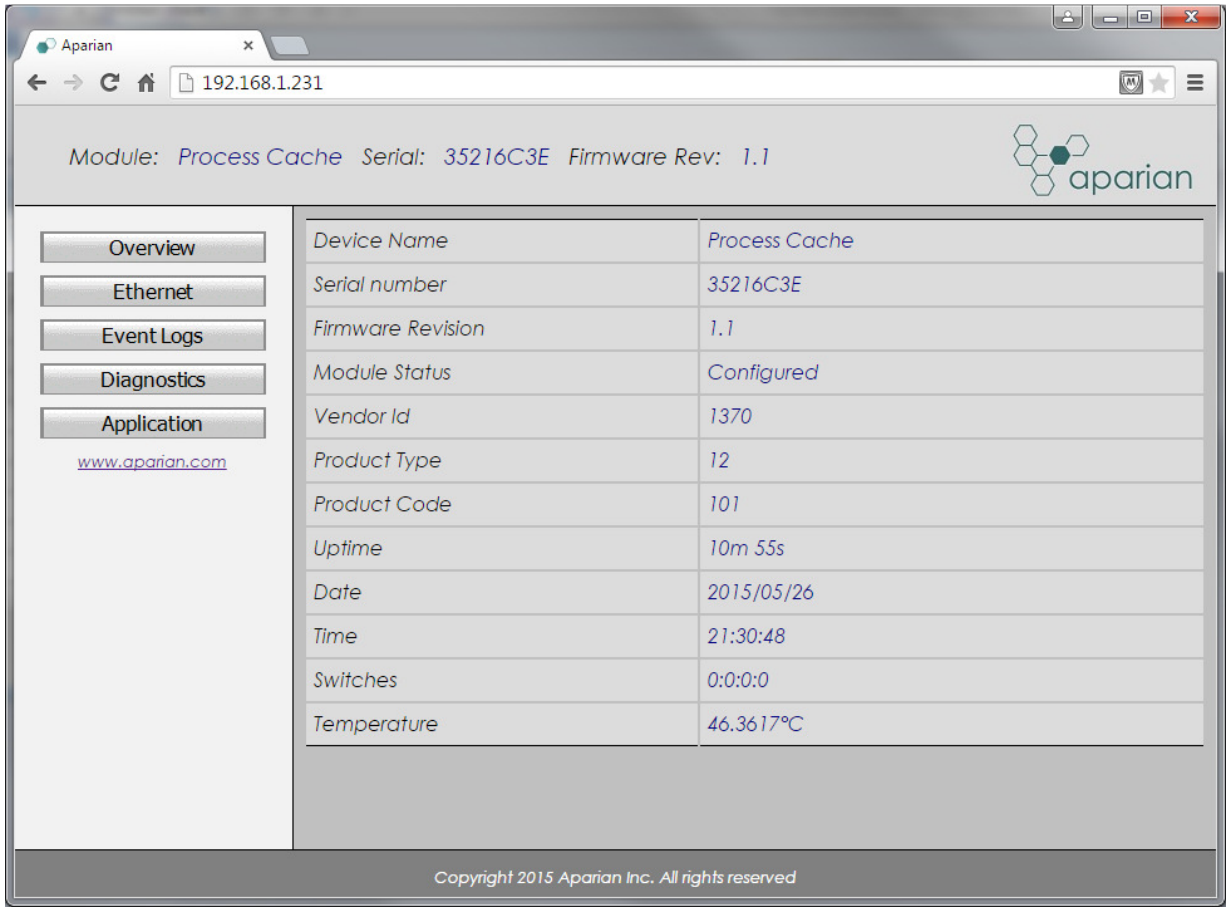


Figure 6.10. - Web interface

7. TROUBLESHOOTING

7.1. EVENT & ERROR LOGGING

The level of event and error can be set in the Service Monitor's Setup form to *Info*, *Warning*, or *Error*. So view the messages, open the Windows Event Viewer by clicking the *Start Button* and typing *Event Viewer* into the *Search Programs and Files* box. Select the Event Viewer option under Programs.

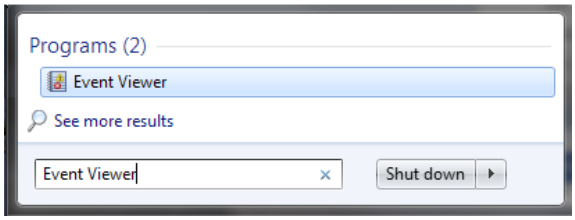


Figure 7.1. – Launching the Event Viewer

Aparian Logs all messages to the *Applications and Services Logs, Aparian.*

7.2. STARTING AND STOPPING THE UPLOAD SERVICE

To start or stop the Upload Service, launch the Windows Services Viewer by clicking the *Start Button* and typing *Services* into the *Search Programs and Files* box. Select View Local Services under Control Panel. Alternatively form the Control Panel, select *Administrative Tools*, and then *Services*.

If the Upload Service is installed, it will be displayed as "Process Cache Service" with the Description of "Aparian, Inc. Process Cache Upload and Logging Service". The status will be *Started* if running and the Startup Type as *Automatic*.

The service can be Stopped or Started by right clicking the Service in the list and selection the appropriate option.

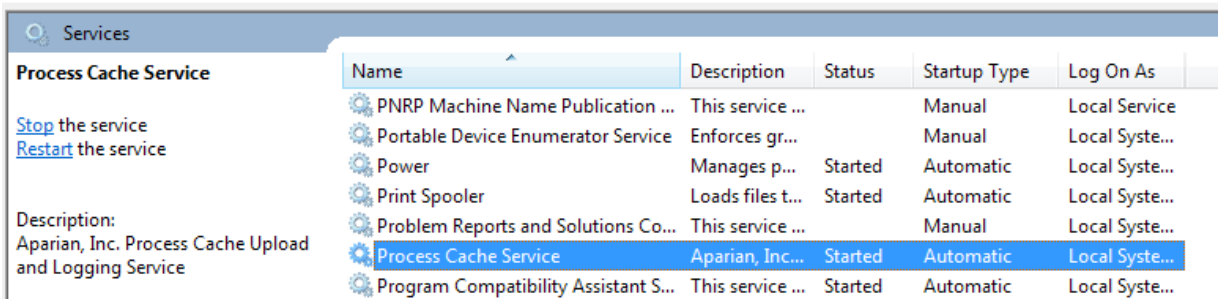


Figure 7.2. – Windows Event Viewer

If the Monitor's Status bar is Red with the ***No Connection*** message indicates that the Service is not running and needs to be started.

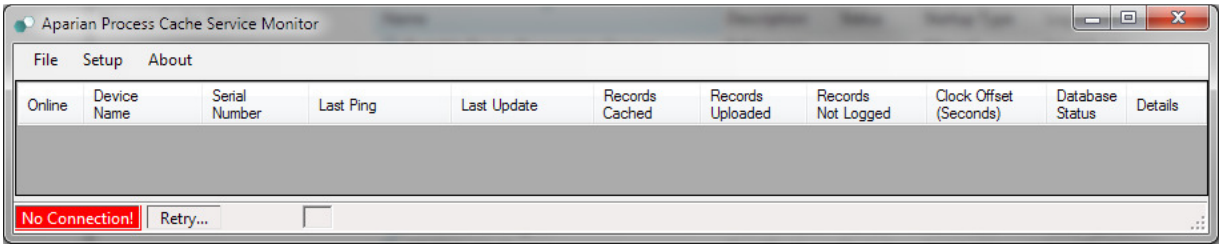


Figure 7.3. – Service Monitor with no connection to the Service

7.3. UNLOGGED RECORDS

If the Service cannot connect to the SQL database or Pi Server, the Unload Index will not be updated and records will remain on the Process Cache Device until they are overwritten (See Logging Mode). In this situation, the Service Monitor will display "Fault" as shown below.

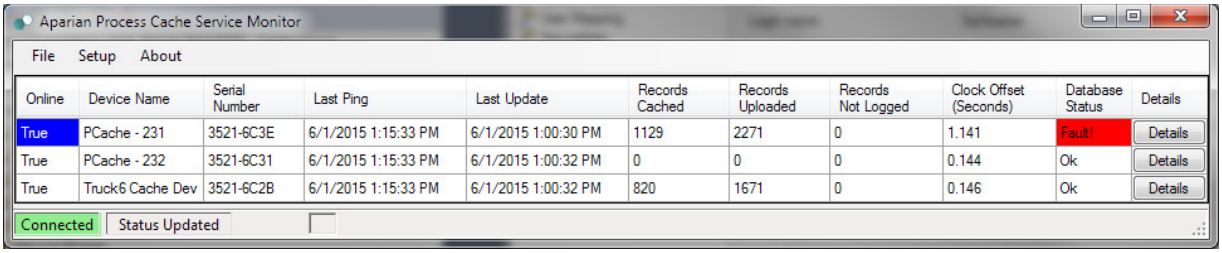


Figure 7.4. – Database Connection Fault.

To remedy this condition, check the connection parameters and run the Test Connection procedure in the Monitor Setup form for a more detailed diagnostics.

A Minor Fault is caused when individual records cannot be logged. Either because the connectivity was lost or the records parameters violated one or more database rules. These records are logged to a text file located at ***C:\ProgramData\Aparian\CacheErrantData(Date).csv***.

Primary Key violations are an exception and are ignored. Primary Key violations occur when a record has already been uploaded or already exists in the database.

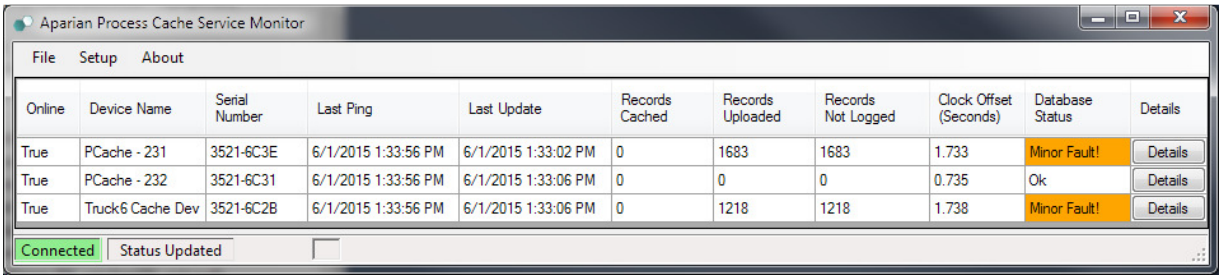


Figure 7.5. – Database Minor Fault.

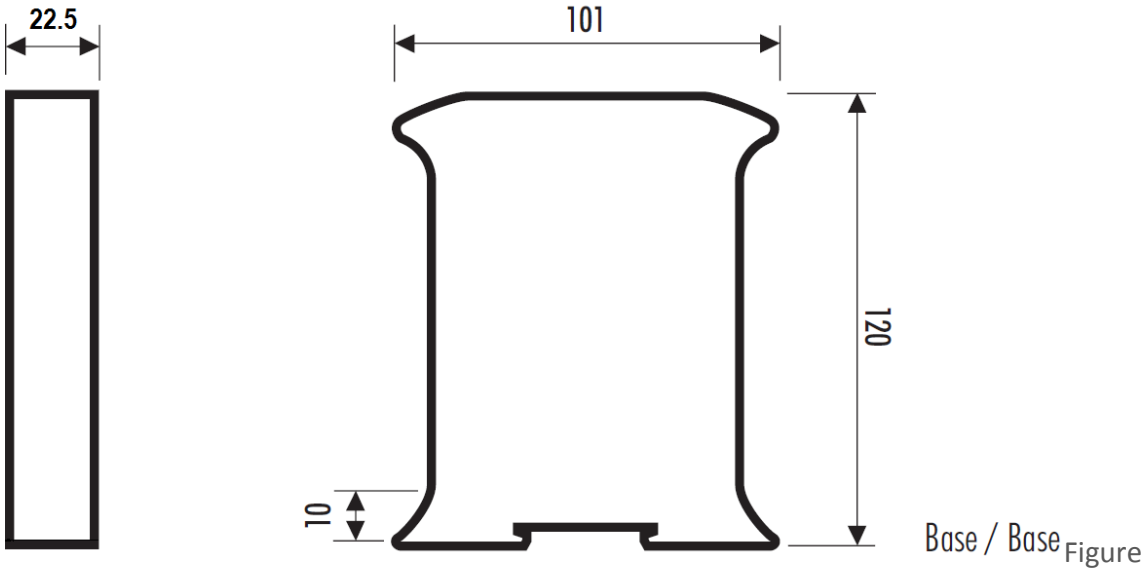
NOTE: When opening the csv file in Microsoft Excel, the DateTime field will not display seconds. Select the Column and change the Cell Format to *mm/dd/yyyy hh:mm:ss.000*.

Text file fields are: DateTime, TagID, DataType, Value, Error Message, TagName, Source Name.

8. TECHNICAL SPECIFICATIONS

8.1. DIMENSIONS

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



8.1 - Module enclosure dimensions

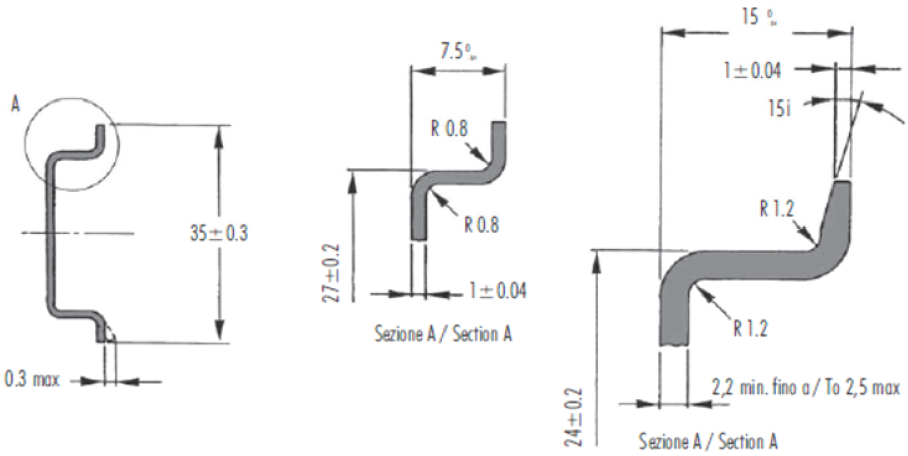


Figure 8.2 - Required DIN dimensions

8.2. ELECTRICAL

Specification	Rating
Power requirements	Input: 10 – 28V DC, (70 mA @ 24 VDC)
Power consumption	1.7 W
Connector	3-way terminal
Conductors	24 – 18 AWG
Enclosure rating	IP20, NEMA/UL Open Type
Temperature	0 – 60 °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 8.1 - Electrical specification

8.3. 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 8.2 - Ethernet specification

8.4. DATA CACHE

Specification	Rating
Max Record Count	16,777,216
Maximum tag count	200
Log criteria supported	Delta change Heart beat Tag Triggers
Minimum Log Interval	50ms
Data Types Supported	Bool, SInt, Int, DInt, Real
Cached Records Non-Volatile	Yes
Log triggers supported	Yes
Data Sources	Logix Tags DF1 Files Modbus (RTU and TCP) registers

Table 8.3 – Data Cache specification

8.5. SERIAL PORT

Specification	Rating
Connector	4-way terminal
Conductor	24 – 18 AWG
Isolation voltage	2.5 kV
BAUD	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
Parity	None, Even, Odd

Table 8.4 – Serial Port specification

8.6. DF1

Specification	Rating
Duplex	Full/Half
Error detection	CRC, BCC

Embedded response	Auto, On

Table 8.5 - DF1 specification

8.7. MODBUS

Specification	Rating
Supported Ports	Modbus RTU Modbus TCP
Functions Supported	Read Discrete Inputs Read Coils Read Input Register Read Holding Register

Table 8.6 - Modbus specification

8.8. CERTIFICATIONS

Certification	Mark
CE Mark	
UL Mark File: E476538	

Table 8.7 – Certifications

9. INDEX

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