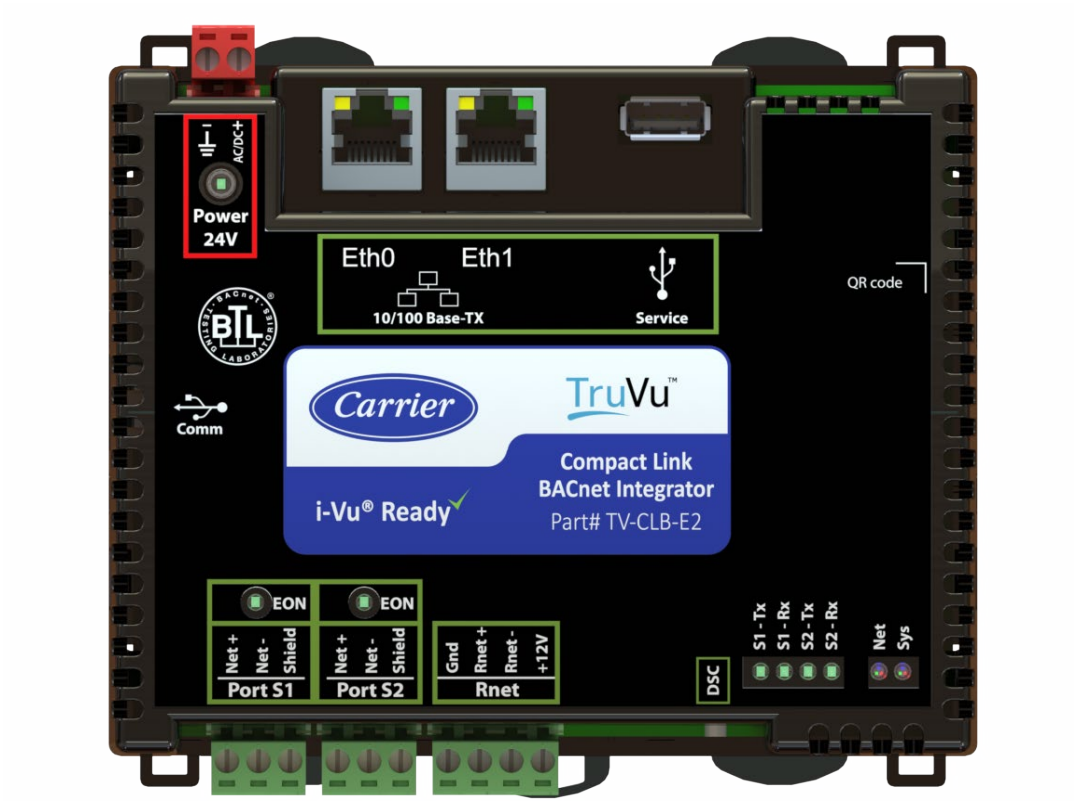
N2 Open Integration Guide

For TruVu™ controllers (drv_gen5)



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Important changes are listed in **Document revision history** at the end of this document.

Contents

Overview

You can use Carrier TruVu™ controllers to integrate N2 Open device(s) with your i-Vu® system.

Carrier	
Controllers	TruVu™ gateways
Driver	drv_gen5_108-04-20088.driverx or later
Read/write capability	Can read from and write to the third-party equipment
Ports	S1 and/or S2
Third party	
Supported equipment	Any device that supports the N2 Open protocol. VMA and DX-9100 devices are not supported.
Network media type	EIA-485 (2-wire)
Quantity of devices you can physically connect to the controller	32 devices per port (without repeaters).
Quantity of N2 integrated points	1000 points per port

The N2 Open Pluggable Protocol Driver (PPD) always retains memory of all the N2 devices and points (microblocks) that it has. On startup, the PPD immediately begins polling devices and reading and writing points according to the polling times and refresh intervals of all objects. The process requires a few minutes, after which each N2 point obtains an initial value, either from a COV/COS obtained by a Poll command to the N2 device, or an individual read or write to a point.

After initial values are obtained, the N2 PPD continues reading point values, writing any interval output points, and polling the N2 devices according to the poll timing. When a Poll command is given to an N2 device, the device returns values for any binary points that have changed state since the last poll and any analog values that have transitioned the N2 device's configured alarm or alert limits. Analog COSs are rare events, but the Poll can obtain binary COSs rather quickly.

If an N2 device is restarted (usually by power restoration), it returns an “N00” error code, which means it is waiting for initialization. The first Poll command that is given to the N2 device starts an initialization sequence. The PPD then sends down the time and date to the N2 device, then a series of Poll commands that get COS/COV values for every point (defined by microblocks or not) in the N2 device. Note that COS/COV values are not given for ADI, ADF, or BD objects, only for the more “real” AI, BI, AO, and BO objects. If you set the polling time for the device short, this operation ensures that the point values are retrieved quickly after restart, and do not have to wait to retrieve each point at its individual refresh interval.

One significant difference from the legacy LGR IPD is that this new PPD does regard the “unreliable” status bit for points, that the old IPD ignored. This improves the data quality of this integration.

Before-you-begin checklist

You need the following items, information, and skills for the integration process:

- ☐ The N2 device's user manual
- ☐ A points list for each N2 device that includes:
  - Point names
  - Network point types
  - Network point addresses
  - Read/write capabilities

  Points lists are usually available from the third-party manufacturer's representative or website.
- ☐ The addresses of the N2 devices
- ☐ A port pinout/configuration of the N2 device. Pinouts are usually available from the third-party manufacturer's representative or website.
- ☐ Verification that all communication properties have been set on the N2 devices
- ☐ Verification of communications through the port to which the Carrier controller connects
- ☐ Experience creating control programs in the Snap application
- ☐ Experience installing, wiring, setting up, and downloading to the Carrier controller

The integration process

Follow the steps in this document to integrate one or more third-party N2 devices into a i-Vu® system using the Carrier controller. To install and network the Carrier controller, see the controller's *Installation and Start-up Guide*.

1 Create a control program in the Snap application

When you create your control program, use a Network I/O microblock for each third-party point.

To...	This network point type...	Use this microblock...
Read	AI — Physical analog input on a controller	ANI ANI2
	ADF — Analog data float value in a holding register in the controller	
	ADI — Analog data integer (+/- 32,767)	
	BI — Physical binary input on a controller	BNI BNI2
	BD — Binary data	
Override	AO — Physical analog output on a controller	ANO ANO2
	ADF — Analog data float value in a holding register in the controller	
	ADI — Analog data integer value in a holding register in the controller	
	BO — Physical binary output on a controller	BNO BNO2
	BD — Binary data	

Formatting an N2 device address

Use the information below to format a valid address in each microblock that you use to read or write to a third-party point.

CAUTION
When integrating third-party devices into the i-Vu® system, most communication problems are caused by incorrect data or typing errors in the microblock's **Address** field.

To read or override a point, use the following address format.

n2://network point type/network point address/slave address

See table above	Decimal value (1-255) defined in the points list	Decimal value (1-255)

Example: n2://ai/3/5 or n2_s2://ai/3/5, (in the second example, "_s2" refers to port S2)

To release an override, add `/1` to the end of the address.

Override example: n2://ao/3/5 or n2_s2://ao/3/5

Clear override example: n2://ao/3/5/1 or n2_s2://ao/3/5/1

NOTE To override and release points, use ANO2's or BNO2's so that you can enable the override point while disabling the clear override point or vice versa. Only one of these points should be active at a time. See *Appendix B* (page 15).

Editing a microblock address

You can edit a microblock address in the following places:

- In the Snap Property Editor
- In the i-Vu® interface, on the microblock's **Properties** page > **Details** tab
- In the i-Vu® interface, on the control program's **Properties** page > **Network Points** tab

2 Download the driver and control programs

The N2 Open PPD is available with drv_gen5_108-04-20088.driverx or later. To get and download the latest driver, see the controller's *Installation and Start-up Guide*.

1 In SiteBuilder's **navigation** tree, add equipment for each of your control programs.

2 On the **Network** tree, assign the equipment to the controller by dragging each equipment from the **Geographic** tree and dropping it on the controller in the **Network** tree.

3 Click  .

4 In the i-Vu® interface, download the driver and control programs to the controller.

See the "Managing third-party points and feature licenses" section of the controller's *Installation and Start-up Guide* for instructions on how to ensure you have adequate FlexPoints licensed for your integration.

3 Set up the N2 Open driver properties

The driver properties can be configured in either the:

- Controller's Service Port setup pages - See *Appendix E* (page 19).
  or
- i-Vu® driver page - Select the controller's driver on the i-Vu® **navigation tree.**

1 On the **Protocols** tab, select the N2 tab then select the **Enabled** checkbox.

2 On the **Connections** tab, select the port the N2 devices are connected to. Port S1 and Port S2 can be used to simultaneously connect to independent N2 Open networks.

3 On the **Port S1** and/or **Port S2** tab:

a) Select "N2" from the **Protocol** drop-down.
NOTE If your controller has a **Port S1 Configuration** rotary switch, set it to 4 to use N2 on Port S1. There is no rotary switch for Port S2.

b) Set the protocol properties:

Baud Rate	Select the baud rate according to the third-party manufacturer's documentation. 9600 or 19200 (default: 9600)
Parity	Select the parity according to the third-party manufacturer's documentation. No, Even, or Odd (default: No parity)
Data Bit	Select the data bits according to the third-party manufacturer's documentation. 8 or 9 (default: 8)
Stop Bit	1
Response Timeout	Number of milliseconds the device waits for a response from the N2 device after sending a command. Valid range: 15-1000 milliseconds (default: 500)
Command Retries	Number of times a Poll (COS) command is retried before it is considered failed. Valid range: 1-5 (default: 3)
Advanced: Polling Time	The time (in min:sec) between Change of State Request commands sent to N2 devices. The COS command determines which devices are on-line and, for those devices configured to provide COV/COS information, gets new values for points that changed. Valid range: 0:15-10:00 (default: 0:30; recommended: 0:15-0:30) For this COS/COV polling to be useful, the refresh time for the integration points should be set relatively high compared to polling time. For better system performance, refresh times for analog points should be set according to the attributes of the individual point, but not any shorter than necessary. Refresh times for binary points can be set very long since they will normally be updated when the device is polled.

4 If you used the controller's Service Port to configure the properties:

   a) If the **Restart** button is displayed, restart the controller.

   b) On the i-Vu® **navigation tree**, select the controller and **Upload** parameters from the controller.

5 If you used the controller's driver pages on the i-Vu® **navigation tree**, select the controller and **Download** parameters to the controller.

4 Connect the Carrier controller to the third-party device

NOTE TruVu™ controller(s) have various combinations and names of ports and might not have rotary switches.

Use:

- 24 AWG twisted, shielded pair cable for up to 200 feet (60.96 meters)
  or
- 22 AWG twisted, shielded pair cable for up to 2000 feet (609.6 meters)

See the *Open Controller Wiring Guide* for details.

1. Turn off the controller's power.
2. Check the communications wiring for shorts and grounds.
3. Verify that the two ends of the communications trunk are properly terminated (**End-of-Net?** switch for both ports S1 and S2 may be used to terminate the controller end).
4. Verify that the communications trunk “shield” has single-point grounding.
5. If your controller has a **Port S1 configuration** rotary switch, set it to 4 to use N2 on Port S1. There is no rotary switch for Port S2
6. Wire the controller to the third-party device. See the table and notes below.
7. Turn on the controller's power.

Use controller port...	Wire controller terminal...	...to third-party device terminal...
S1 or S2	Net+	+
	Net-	-

NOTES

- If you cannot determine the connections on the N2 device, contact the third-party representative.
- Use the same polarity throughout the network segment.
- Repeaters are required for more than 32 devices on an EIA-485 network. See your third-party device manufacturer's recommendations.
- To reduce communication and data errors, terminate each end of an EIA-485 network with a resistor whose value equals the network's characteristic impedance. Some third-party manufacturers provide a built-in resistor that you enable or disable with a jumper. Make sure that only devices at the end of a network have termination enabled. Carrier controllers provide this by setting the **End of Net?** switch to "YES".

  NOTE For controllers without a physical **End of Net?** switch, **End of Net?** is configured:

  - By accessing the controller’s service port and setting the **End of Network Command** to “Yes”
  - In i-Vu®, under **Device** > **BACnet Router Properties**, set the **End of Network Command** to “Yes”

  EXAMPLE If a EIA-485 2-wire network's characteristic impedance is 120 Ohms, terminate the network by placing a 120 Ohm resistor across the **Net+** and **Net-** connectors of the Carrier and a 120 Ohm resistor across the **+** and **-** connectors of the furthest third-party device.

5 Verify the integration is set up correctly

1 On the i-Vu® **navigation** tree, select the control program for the Carrier controller.

2 Select the **Properties** page > **Network Points** tab.

If...	Then...
You see the point value you expect with no errors in the **Error** column	You have successfully established communication with the third-party device.
All points show question marks instead of values	The i-Vu® application is not communicating with the Carrier controller or the control program. Troubleshoot the controller's communications. See the controller's *Installation and Start-up Guide*.

Error message appears	Do one of the following actions based on the code or description in the **Error** column.
	• **Communications Disabled for this Microblock**
	On the microblock's **Network Points** tab (or **Properties** page > **Details** tab), enable the microblock's **Comm Enabled** field.
	• **No protocol support**
	Verify that the **Address** in the microblock has the correct prefix:
	  • For Port S1: n2://
	  • For Port S2: n2_s2://
	• **Unlicensed Point**
	You have configured more integration points than are licensed for this controller.
	See the “Managing third-party points and feature licenses” section of the controller’s *Installation and Start-up Guide* for instructions on how to ensure you have adequate FlexPoints licensed for your integration.
	• All other errors:
	See *Appendix A* (page 12) for troubleshooting information for displayed error codes.

A value is incorrect	Verify that: • The **Address** in the microblock is correct. • The retrieved value is scaled properly, if necessary. For example, scaled from Celsius to Fahrenheit. Refer to the third-party manufacturer's documentation or the controller's *Installation and Start-up Guide* for scaling information.
Output points “toggle” between override and release modes	Ensure both “override” and “release” points are defined via microblocks. Only *one* of these should be active at any given time. To control (override) an AO or BO point, deactivate its release microblock (URL with “/1” at the end) and activate its override microblock (URL without “/1”). To release the control on that point, deactivate its override microblock and activate its release microblock.

If the above solutions do not resolve the problem, gather the following information for Technical Support:

- Screenshots of the driver configuration pages:
  - **Protocols** > **N2** tab
  - **Control Programs** tab
  - **Connections** > **Port S1/S2** tab
- Log files downloaded from the driver's **Advanced > Diagnostics** tab.
- A screenshot of the **Properties** page > **Network Points** tab showing addresses and errors.
- All information from a controller Modstat copied into a text file. Right-click the Modstat, then select **Select All**. Press Ctrl+C to copy the information, then open Notepad and paste the information into a text file.
- Installation and Start-up Guide for the third-party device, if available.

Appendix A - Error codes and messages

PPD error codes

Error Message	Possible Causes/Solutions
1 - Address Error – Invalid Point Type	Point types are AI, AO, BI, BO, ADF, ADI, or BD. Any other values entered in the URL generates this error.
2 - Address Error - Invalid Point Number	Valid range for N2 object address is 1 - 255. Any other values outside that range will generate this error.
3 - Address Error - Invalid Device Address	Valid range for N2 device address is 1 - 255. Any other values outside that range generates this error.
5 - Address Error - Invalid URL Address	The URL cannot be parsed into a valid address. It may be too long or too short.
6 - Address Error - Invalid Clear Override	Either: a. an input microblock address [e.g. AI or BI] contains the override release (the "/1" at the end of the valid address) or b. an output microblock address [e.g. AO or BO] contains the override release with a number other than 1.
8 - Unsupported Microblock Type	This error is set if the PPD receives the Invalid command error 0x11 (Hex) from the N2 device. For example, if you try to write to an N2 address that is read-only.
9 - Comm Error - No Response	This point error is set when the N2 PPD receives no response after completing the user-defined retries on a Read or Write Command for that point.
10 - Comm Error - Invalid Response	This error is set when the N2 PPD receives a badly-formatted response or the response packet has an invalid checksum. This could also be because the point does not exist in the N2 device.
11 - Comm Error - Command Failed	This error is set when the N2 PPD receives an error that could not be understood.
12 – Invalid Request	This error is set when the N2 PPD receives a negative acknowledgment from the N2 device.
13 - Slave is Waiting for Identify Yourself Command	This error is set when the N2 PPD receives a negative acknowledgment with exception value of 0x00. This means that the N2 device is waiting on an "Identify Yourself" request from the N2 PPD. This is normal and only lasts until the next Poll command is given to the N2 device.
17 - Point Doesn't Exist or Value Out of Range	This error message applies to output points only. You might get this message if the point you are trying to write does not exist on the N2 device. If it does exist, then the value you are writing is invalid. For AO points, the value is outside the valid range for the point definition. BO points must have 0 or 1 values. For ADI points, the N2 PPD ensures that the value written to the N2

	device stays in the +/- 32676 range. For BD points, the N2 PPD ensures that the value written to the N2 device is in the 0-255 range. If these conditions are not met, then this error is set for the point.
18 - Command Rejected	This error message applies to output points only. If the N2 PPD receives a negative acknowledgment with error 0x12 (hex), then this error message is set for the point.
23 – Comm Error - Device is Off-Line	This device-level error is set when the N2 PPD receives no response after completing the user defined retries on a Poll command for that device. All points under this device show this error. Note that no more Read or Write commands for points on this device can occur until there is a response to the periodic Poll command.
24 – Comm Error - Field Value is Unreliable	This is informational and not really an error. The N2 device has returned the value to be "unreliable" in the point's status bits. The field equipment and sensor/actuator should be investigated to see what is wrong.
25 – Comm Error – Serial Port is Disabled (Sn)	The port with which the point is associated (S1 or S2) is disabled. *See Set up the N2 driver properties* (page 7) for instructions on how to enable the port.

General error codes

Error Code/Message	Possible Causes/Solutions
Protocol disabled or unsupported	The protocol defined in the signature of the address is either unsupported by the controller or disabled. To enable a protocol that is available on the controller: On the Network tree, click on the controller's driver, then select the Protocols tab, and then select the desired protocol tab (e.g. BACnet, Modbus, etc.) to enable. **NOTE** Enabling protocols requires a controller restart.
Initializing	This point is either: • In the process of being validated • Queued up for the initial read or write attempt to the third party device, • In the process of its initial read or write attempt to the third party device • Waiting for the initial response from the third party device. Once the startup process has completed, this error should switch to **No Error** or a different error that will identify any problems that may have occurred.”.
No Error	The microblock is not in error. No solution needed.
Communications Disabled for this Microblock	The microblock’s communications are not currently enabled. Enable the microblock’s communications by checking the box under **Com Enable** in i-Vu®.
Not Linked	The microblock was not successfully linked to the object to which it is addressed. Ensure that the address is entered correctly and that the object the microblock is addressed to is functioning properly.
Programmer Error – Invalid MB State	The data integrity of the microblock was compromised. This is the default error code if none of the other errors apply. If this error is persistent, contact Technical Support to let them know there is a defect to address.
Undefined Client Microblock Error	An error occurred while the microblock was attempting to write a value. This is the default error code when something goes wrong trying to write a value over the network. If this error is persistent, contact Technical Support to let them know there is a defect to address.
Device Offline – Temporary Backoff	The device hosting the object that the microblock is attempting to interact with is not powered on. Ensure that the device hosting the object, in which the microblock is addressed to, is powered on and functioning properly.
Communications Disabled for this Microblock	The microblock’s communications are not currently enabled. Enable the microblock’s communications by checking the box under **Com Enable** in i-Vu®.

Appendix B - N2 How to set and release N2 overrides

You can override any N2 point type (AI, AO, BI, ADF, ADI, and BD). When a point is overridden, the value sent to the device from the PPD becomes the point's value until either:

- Communication fails between the PPD and the N2 device for longer than 10 minutes. After 10 minutes of non-communications, N2 devices go into a stand-alone mode, at which time all the overrides are erased.

OR

- You release the point. To override and release a point, you must use two microblocks, with the address of the second microblock having the same URL as the first, but with a "/1" added at the end to indicate this as a release point. Ultimately, this is like having two points at the same address: one being the "normal" point from which status and values can be derived and to which override values can be provided, and the other being the release of that point.

  CAUTION To avoid unexpected results, you should only ever have one of these two points enabled and the other disabled.

  What happens in the N2 device when you do a release command depends on the point type:

  - For AO and BO points, the controller starts controlling those points again.
  - For AI and BI points, the controller will now update those points and give new values from this point on.
  - For ADF, ADI, and BD points, it depends on how that point is being used:
    - If the point is a setpoint (e.g. flow setpoint) or an operation (e.g. enable/disable heating), and there is no logic in the controller to ever change these values, then it will not change. This case is often called a "set-and-forget" and a release point is not needed.
    - If the point is something computed or updated by the N2 controller (e.g. P, I, and D terms, or machine "state" for a logic block), the N2 controller takes over again. The N2 controller will update those values and they will be displayed in I-Vu® after the release command is given.

      CAUTION If the point is used in the N2 controller's control logic, overriding the point could have unintended consequences. Setting a machine state in N2 internal logic can be dangerous. Setting an I-term to a constant value can end up with serious reset windup. You must know how the N2 controller is operating to make an intelligent decision on whether to manually control these points or not.

Appendix C - N2 Open Protocol Conformance Statement

Network point type	Supported in master mode?
Analog input (AI)	Yes
Binary input (BI)	Yes
Analog output (AO)	Yes
Binary output (BO)	Yes
Internal float (ADF)	Yes
Internal integers (ADI)	Yes
Internal bytes (BD)	Yes

N2 Open protocol command	Supported in master mode?
Sync time command	Yes
Read memory command	No
Poll without acknowledge	Yes (previous poll sent no new COS/COV data)
Poll with acknowledge	Yes (acknowledge of previous poll's COS/COV data)
Warm start	No
Read analog input command	Yes—Read-only attribute 3 (analog input value) and Read-only attribute 2, bit 1 (reliability)
Read binary input command	Yes—Read only attribute 2, bit 6 (current state) and Read-only attribute 2, bit 1 (reliability)
Read analog output command	Yes—Read-only attribute 3 (current value) and Read-only attribute 2, bit 1 (reliability)
Read binary output command	Yes—Read-only attribute 2, bit 6 (current state) and Read-only attribute 2, bit 1 (reliability)
Read internal parameter command	Yes—read only attribute 2 (current value of ADF, ADI, or BD)
Write analog input command	No
Write binary input command	No
Write analog output command	No

N2 Open protocol command	Supported in master mode?
Write binary output command	No
Write internal parameter command	No
Override analog input command	Yes
Override binary input command	Yes
Override analog output command	Yes
Override binary output command	Yes
Override internal parameter command	Yes
Override release request	Yes
Write binary input attributes request	No
Write analog output attributes request	No
Read analog input attributes request	No
Read binary input attributes request	No
Read analog output attributes request	No
Read binary output attributes request	No
Identify device type command	Yes
Upload request	No
Upload record	No
Upload complete	No
Download record	No
Download complete	No

Appendix D - Interfacing with a Johnson Controls network

When integrating a Johnson Controls network into a i-Vu® system, the Carrier controller replaces the Johnson Controls Network Control Module (NCM). To maintain the functions of the NCM, do the following:

- In Snap, recreate the global programming logic that existed in the NCM.
- If the NCM resides in a Network Control Unit (NCU) with I/O Expanders, then the GPL (graphical program language) logic that resides in the NCM must be relocated to the Carrier network.
- If you do not have a points list for the N2 devices, use HVACPro, a Johnson Controls application, to obtain point information.
- Set up the Carrier controller to trend the N2 points that the NCM was monitoring.
- Set up the Carrier controller to send alarms or the N2 points the NCM was monitoring.
- If an NCU was used, it is unlikely that the NCM's point expanders (DCM's, XBN's etc.) will be able to reside on the N2 network. Check with the Johnson Controls documentation to be sure.

Appendix E - Configuring the driver parameters by using the Service Port

You can set many driver parameters locally from the controller by using the **Service Port's** web-based controller setup interface. You can set operational parameters, such as port and communications' protocol settings, without the need to connect the i-Vu® application to the controller. Any parameters set locally through this interface take effect immediately. To connect to the controller setup pages, some Carrier controllers have an Ethernet Service Port, and some have a USB Service Port.

WARNING After setting parameters locally through the Service Port interface and then connecting the controller to the i-Vu® application, proceed carefully, as follows:

In the i-Vu® application, you must **upload** the parameters that you set locally BEFORE you **download** memory or parameters. Downloading, without uploading first, overwrites all the settings you made through the **Service Port**. Uploading first preserves those parameters.

NOTE There are a few parameters that can **only** be set through the **Service Port**, such as the controller's IP address, and these are not overwritten by a memory or parameter download from the i-Vu® application.

For more information on connecting to the Service Port, see the "Connecting to the router through the Service Port" and the "Connecting to the router through the Gig-E Port" sections of the controller's *Installation and Start-up Guide*.

Appendix F - Module Status field descriptions

Property	Description
N2 Open Protocol Details	**For each port:** ▪ Number of data packets transmitted and received by the integrator ▪ Number of communication errors and timeouts (no response)

Document revision history

Important changes to this document are listed below. Minor changes such as typographical or formatting errors are not listed.

Date	Topic	Change description	Code*
		No updates yet	

* For internal use only