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Modbus TCP/IP

Integration Guide



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Before-you-begin checklist

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

- A points list for each Modbus TCP/IP device that includes register addresses and read/write capabilities. Points lists are usually available from the third-party manufacturer's representative or website.
- The IP addresses and unit ID's of the Modbus TCP/IP devices.
- Verification that all communication properties have been set on the Modbus TCP/IP devices
- Verification of communications through the port that the i-Vu Link will connect to
- Experience creating custom control programs with ApplicationBuilder
- Experience installing, wiring, setting up, and downloading custom control programs to the i-Vu Link
- The latest version of Ethereal from the *Ethereal website* (<http://www.ethereal.com/>), downloaded and installed. Use this network analysis tool for troubleshooting.



Overview

Modbus TCP/IP Integration with the i-Vu Link

You can integrate Modbus TCP/IP devices into an i-Vu CCN system with a i-Vu Link acting as a client device.

i-Vu Link	
Modbus port	E1 10/100 BaseT Ethernet
Module driver	Modbus: drv_ivulink_modbus_<latest version>.driver *
Read/write capability	Can read from and write to the third-party equipment
Integration points supported	500
Third party	
Supported equipment	Any device that supports the Modbus TCP/IP protocol
Network media type	Ethernet
Quantity of devices you can physically connect to i-Vu Link's Ethernet port	Up to 30 Modbus TCP/IP connections. Connections could be to a Modbus TCP/IP server device or to a Modbus TCP/IP server device that is acting as a Gateway to other Modbus serial devices. Each Modbus TCP/IP server gateway can have one serial modbus slave connected over EIA-232, or up to 247 modbus slaves connected over EIA-485.

* The i-Vu Link driver supports Modbus devices connected to Port S2 and BACnet or Modbus devices connected on the Ethernet port simultaneously. The third-party point count for the i-Vu Link is the total of the 2 ports.

The integration process

Follow the steps in this document to integrate one or more third party Modbus TCP/IP devices into an i-Vu CCN system using an i-Vu Link. To install and network the i-Vu Link, see the *i-Vu Link Installation and Start-up Guide*.

1 Create custom equipment in ApplicationBuilder

- 1 Start ApplicationBuilder.
- 2 Select equipment type:
 - **CCN Values Only** - to read and write values on the CCN network and to display those points on a graphic
 - **Integration Values Only** - to read and write values from the third party network and to display those points on a graphic
 - **CCN Link Integration** - to share values from the third party network with the i-Vu Link on the CCN network and to display those points on a graphic
- 3 Click **Next**.
- 4 Type a name for the custom equipment (i.e., Hot Water System).
NOTE The name must not exceed 21 characters!
- 5 Enable **English** or **Metric** units.
- 6 Choose engineering options for your application (**Schedule and Setpoint, Runtime**, etc..)
- 7 Click **Next**.
- 8 Add **Elements** to your application.
NOTE Elements are a collection of input/output points that perform a specific operation. The input/output point that is reading or writing to the Modbus TCP/IP network is called an integration point. Integration points may be used in conjunction with CCN points to share data between the Modbus TCP/IP network and the CCN network.

The available **Elements** that you can add to your custom equipment in ApplicationBuilder are:

Point type	Used for
Read CCN Point	Reading an analog or binary value from the CCN network In: CCN Values, Link Integration
Carrier Text Point	Reading Text value from a CCN device In: CCN Values, Link Integration
Setpoint Write	Allows CCN setpoint value to be "edited" directly from graphic In: CCN Values, Link Integration

Point type	Used for
Link Integration Point to CCN Point	Reading an analog or binary value from the third party device and then writing that value to the CCN network In: Link Integration
Link CCN Passive Point to Integration Point	Exposing an analog or binary value to the CCN network so that it can be written to the third party network In: Link Integration
Read Integration Point	Reading an analog or binary value from the third party device In: Read Integration, Link Integration
Link CCN Point to Integration Point	Reading an analog or binary value from a CCN device and then writing it to the third party network In: Link Integration
Link Integration Point to CCN Passive Point	Reading an analog or binary value from the third party device and then exposing that value to the CCN network In: Link Integration
Link BACnet variable to CCN Point	Allows an analog or binary value from BACnet to write that value to the CCN network In: Link Integration

9 As you add **Elements**, enter the requested information for the integration or CCN points:

- **Display Text** - the name of the point as it will appear in i-Vu CCN (i.e., Frequency)
- **Reference Base** - the name that will be added to each point that makes up the Element, so that all points have a unique identifier (i.e., input_Freq, trendFreq, output_Freq) - this name must be unique (do not copy and paste)
- **Input Address** - enter the Modbus TCP/IP or CCN address

Define the Modbus TCP/IP or CCN address string using the syntax for each point in the list, as described below:

- **Input Scaling** - enter variables

NOTE Use Scaling when the value you are reading from the Modbus TCP/IP or CCN device needs to be scaled before showing the value on a graphic or trend. Scaling information can be found in the third party points list.

Example: You have an integration point set up to read the motor temperature of a variable speed drive. The third party points list shows that this value will be given in degrees C, but you want to display it in degrees F on a graphic. Therefore, using the formula $^{\circ}\text{F} = 9/5(^{\circ}\text{C}) + 32$, the scaling/unit conversion fields for the integration point would be filled out as follows: $([\text{value read}] + 0) \times 1.8 + 32$

- **Output Address** - enter the Modbus TCP/IP or CCN address, as described below.
- **Output Scaling** - enter variables

Continuing the example above, if you wanted the graphic to display values in $^{\circ}\text{F}$, but then you wanted to share that value with the CCN network in $^{\circ}\text{C}$, the scaling for the CCN Passive Point would be:

$([\text{value read}] + 0) \times 1 + 0$

- 10 Click **Next**.
- 11 **Equipment Name** - type a new equipment name if desired.
- 12 **Save Location** - browse to a location where you would like to save the new custom equipment.
- 13 Click **Save**.

To format a Modbus TCP/IP address

Use the information below to format a valid address in each integration point that you use to read or write to a Modbus TCP/IP device.



CAUTION!

When integrating third-party devices into an i-Vu CCN system, most communication problems are caused by incorrect data or typos in the integration point's **Address** field.

Address format:

mtcpip://register type/modbus register address/unit ID/IP address

Defined by Carrier. See table on next page.

Provided in third-party points list. See table below.

Set on third-party device if it is a TCP/IP server, or the IP address of the TCP/IP server gateway that this unit ID connects to

Example: mtcip://UINT/40128/3/192.168.168.1

To...	this kind of value...	use this type of integration point...	with this register type...	and a Modbus register address in this range... <small>1</small>
Read	0 to 65,535 Unsigned 16-bit integer Input register Holding register	ANI	Uint (not Unit)	30001-39999 or 40001-49999
	0 to 4,294,967,296 Unsigned, 32-bit (long) integer	ANI	Uint32	30001-39999 or 40001-49999
	-32,768 to +32,767 Signed 16-bit integer Input register Holding register	ANI	Sint	30001-39999 or 40001-49999
	-2,147,483,648 to 2,147,483,647 Signed, 32-bit (long) integer	ANI	Sint32	30001-39999 or 40001-49999
	Value with decimal point Input register Holding register	ANI	Float	30001-39999 ² or 40001-49999 ²

To...	this kind of value...	use this type of integration point...	with this register type...	and a Modbus register address in this range... ¹
	0 or 1 Coil Discrete (binary) output	BNI	Do	1-9999
	0 or 1 Discrete (binary) input	BNI	Di	10001-19999
	0 or 1 Input register Holding register	BNI	BIT n (where n is a value 0-15 defined in points list)	30001-39999 or 40001-49999
Write	0 to 65,535 Unsigned 16-bit integer Holding register	ANO	Uint (not Unit)	40001-49999
	-32,768 to +32,767 Signed 16-bit integer Holding register	ANO	Sint	40001-49999
	Value with decimal point Holding register	ANO	Float	40001-49999 ²
	0 or 1 Coil Discrete (binary) output	BNO	Do	1-9999
	0 or 1 Holding register	BNO	BIT n (where n is a value 0-15 defined in points list)	40001-49999

¹ The Modbus register address must be a decimal value. If you see the letters A-F in register addresses anywhere in a points list, use a scientific calculator to convert these hexadecimal values to decimal values.

If the Modbus register address (sometimes called register, address, code, or parameter) is not in this range, take the number given, then add 1 to coils; add 10,001 to discrete inputs; add 30,001 to input registers (sometimes given as 3X); and add 40,001 to holding registers (sometimes given as 4X).

In rare cases, the number given is not in the range shown above and is greater than 9999. Type a 4 (function code) at the beginning of an input register or a 3 at the beginning of a holding register. For example, to read holding register number 313567, type 413568. (Add 1 as described in the paragraph above.)

² Each Float has 2 consecutive Modbus register addresses. Use the lower number in the integration point address.

To format a CCN address

There are three different methods for defining the CCN address strings.

- 1 They can be manually typed in **ApplicationBuilder**.
- 2 You can use **Copy table point** in i-Vu CCN's table interface to copy CCN point information directly from a CCN table to ApplicationBuilder's "ccn://" address field.
- 3 You can use **Map to Point** in i-Vu CCN's table interface to map the CCN points from your custom equipment file directly to CCN table data.

NOTE Your custom equipment must already be downloaded in the i-Vu Link to use this method. (Proceed to *Assign and download custom equipment in i-Vu CCN* (page 7) first).

Method 1: Type the address manually in ApplicationBuilder

- 1 If you are actively reading or writing a point on a CCN device, then manually type in the CCN device's address, **Table Name**, and **Point Name** that you wish to read or write.

ccn://link/<Table Name>/<Point Name> ("link" indicates the CCN device that the custom equipment has been mapped to)

or

ccn://<bus, element>/<Table Name>/<Point Name>

Examples:

ccn://link/HWPO1-32/TEMP

ccn://0,2/HWPO1-32/TEMP

- 2 If the point is a CCN passive point (i.e, it's just being exposed to the CCN network), then type:
ccn://passive/<point name>, where <point name> is the name that you have chosen for this CCN point.

Example: ccn://passive/freq

Method 2: Copy table point in i-Vu CCN

- 1 Launch i-Vu CCN.
- 2 Select the desired equipment in the navigation tree.
- 3 Expand the tables underneath that equipment.
- 4 Find the specific table and point that you want to read or write.
- 5 Click **Copy** in the table interface.
- 6 Inside of **ApplicationBuilder**, hit CTRL-V to copy the CCN address from the table to the "ccn://" address field.

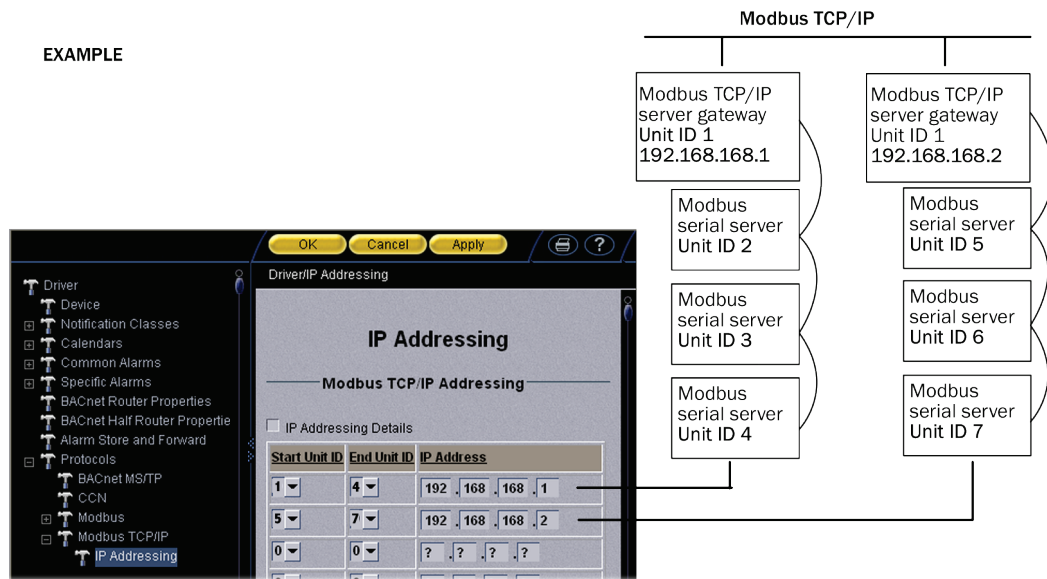
Method 3: Map to point in i-Vu CCN

- 1 Launch i-Vu CCN.
- 2 Select the desired equipment in the navigation tree.
- 3 Expand the tables underneath that equipment.
- 4 Find the specific table and point that you want to read or write.
- 5 In the table interface, navigate to the **Map to Point** column.
- 6 From the drop-down menu, select the point in the custom equipment that should be mapped.
- 7 Click **OK**.

Optional Modbus TCP/IP IP addressing method

If the unit ID of every third-party device in the system is unique, but they all use the same IP address, you can save time by omitting the IP addresses from the individual integration point addresses and mapping the unit ID's to their IP address in i-Vu CCN. See example below.

- 1 On i-Vu CCN's navigation tree, right-click on the custom equipment that you created in ApplicationBuilder. Select **Driver Properties**.
- 2 Select **Protocols > Modbus TCP/IP > IP Addressing**.



To edit an integration or CCN point address

You can edit an integration or CCN point address in the following places:

- In ApplicationBuilder
- In i-Vu CCN on the custom equipment's **Properties** page > **Equipment** tab
- In i-Vu CCN on the custom equipment's **Properties** page > **Network Points** tab

2 Assign and download custom equipment in i-Vu CCN

- 1 Click the menu button in i-Vu CCN, then select **System Setup**.
- 2 In the navigation tree, right-click the area where you want to place the custom equipment. Select **Add Equipment** from the drop-down menu.

3 Make the following entries:

Field	Notes
Display Name	Type an equipment name (i.e. ABB Drive).
Associate with	<p>If your i-Vu Link is connected to CCN devices:</p> <ul style="list-style-type: none"> Enable CCN Device and fill in the bus and element number of the CCN device that this custom equipment will be linked to. <p>NOTE This "association" is what allows you to use the term "link" in CCN address strings for this custom equipment rather than manually typing in the bus, element number into each CCN address string.</p> <p>If your i-Vu Link is NOT connected to CCN devices (only Modbus TCP/IP devices):</p> <ul style="list-style-type: none"> Enable CCN Link and pick the i-Vu Link that is physically connected to the Modbus TCP/IP network.
Equipment	<ol style="list-style-type: none"> Click Add. Browse to the .equipment file that was generated in ApplicationBuilder. Click Continue. When message appears "File uploaded successfully", click Close.

- If you have already created a custom equipment graphic for this third party device in ViewBuilder, you can also add that graphic from this screen. Under **Views**, click **Add** and browse to your .view file. Click **Continue**. When message appears **File added successfully**, click **Close**. The custom equipment should now appear in the navigation tree.
- Click **Exit Setup** and the custom equipment will be downloaded to the i-Vu Link.

Configure integration and CCN points

You can now configure the integration and CCN points.

NOTE If you have already done this in ApplicationBuilder, skip this section.

- In the navigation tree, select the desired custom equipment.
- Click **Properties** page>**Equipment** tab to see a list of all integration points.
- Define the Modbus TCP/IP or CCN address string using the syntax for each point in the list, as described in *Formatting a Modbus TCP/IP address* or *Formatting a CCN address* in this document.
- Apply unit conversion and scaling in the remaining fields, if applicable.
- After configuring each integration point, click **OK** to download the changes.

3 Connect the i-Vu Link to the third-party device

Use one of the following CAT5 or higher Ethernet cables:

- A crossover cable to connect the i-Vu Link directly to a Modbus TCP/IP server or gateway
- A straight-through cable to connect the i-Vu Link to a hub or switch, and a second straight-through cable to connect the hub or switch to a Modbus TCP/IP server or gateway

Maximum cable length: 328 feet (100 meters)

- 1 Turn off the i-Vu Link's power.
- 2 Check the communications wiring for shorts and grounds.
- 3 Wire the i-Vu Link's **Port E1** to the third-party device.
NOTE Port E1 will still be capable of BACnet communication.
- 4 Turn on the i-Vu Link's power.

4 Set up the Modbus TCP/IP driver properties

- 1 On i-Vu CCN's navigation tree, right-click on your custom equipment.
- 2 Select **Driver Properties**.
- 3 Expand **Protocols** and select **Modbus TCP/IP**.
- 4 Under **Port Configuration**, select Modbus TCP/IP as the communication type.
- 5 Set the fields under **Timing Configuration**. These settings can typically be left at their default values.
- 6 Set the fields under **Protocol Configuration** using information from the third-party manufacturer's representative. Select the **Details** checkbox for help. Click **Apply** to save changes.
- 7 On the navigation tree, select **Protocols**.
- 8 In the **Protocol Status** table, verify that Modbus TCP/IP shows **Running** on Port E1. If the status shows **Not Running** or the wrong port, repeat step 4.

5 Verify the i-Vu Link is set up correctly

- 1 On i-Vu CCN's navigation tree, select the custom equipment.
- 2 On the **Properties** page, select the **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.
A point shows question marks instead of values	i-Vu CCN is not communicating with the i-Vu Link. Troubleshoot communications. See the i-Vu Link's <i>Installation Guide</i> .
The point name is red	Look in the Error column for one of the following error codes and descriptions. <ul style="list-style-type: none"> • 1 - Communications Disabled for this Microblock Enable the integration point's Communications Enabled field on i-Vu CCN's Network Points tab. • 3 - Address Error - Unknown Protocol Specified Select the correct port on the Modbus TCP/IP driver page in i-Vu CCN, verify that Address in the integration point is correct.
A value is incorrect	Verify that: <ul style="list-style-type: none"> • The Address in the integration point 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 for scaling information.

If the above solutions do not resolve the problem, gather the following information for technical support:

- A diagnostic capture. See *To get a diagnostic capture* below.
- A screenshot of the **Driver Properties** - right-click on the custom equipment in the navigation tree > **select Driver Properties > Properties** page and the **Modbus (Modicon) > Properties** page
- A screenshot of the custom equipment's **Properties** page > **Network Points** tab showing addresses and errors

To get a diagnostic capture

Use Ethereal, a network analysis tool, to capture to a file the Ethernet communication between the i-Vu Link and the Modbus TCP/IP device.


PREREQUISITES

- The i-Vu Link's IP address
- The longest integration point or CCN point refresh time in the custom equipment that has the error you are troubleshooting. In i-Vu CCN, view the custom equipment's **Properties** page > **Network Points** tab to see all the refresh times.
- Download the latest release of Ethereal and WinPcap from the *Ethereal website* (<http://www.ethereal.com/>). Install WinPcap first, then Ethereal. Use the installation wizards' default settings.

- 1 Connect your laptop's Ethernet port to the i-Vu Link's hub or to a separate hub on the Ethernet.

NOTE If using a separate hub, the network cannot have a gateway, switch, or bridge between the laptop and the i-Vu Link.

- 2 On your desktop, select **Start > All Programs > Ethereal > Ethereal**.
- 3 Select **Capture > Options**.
- 4 In the **Interface** field, select the laptop's Ethernet card that is connected to the hub.
- 5 Verify that the IP address that appears below the **Interface** field is the IP address of the laptop that is connected to the i-Vu CCN system.
- 6 Create a filter that tells Ethereal to capture just the i-Vu Link's communication:
 - a) Click **Capture Filter**.
 - b) Click **New**.
 - c) In the **Filter name** field, type a name for the filter. For example, i-Vu Link module 39
 - d) In the **Filter string** field, type `host <i-Vu Link's IP address>`. For example, `host 192.168.168.39`
 - e) Click **OK**.
- 7 Under **Display Options**, select **Update list of packets in real time**.
- 8 Click **Start** or **Capture**.
- 9 Turn the i-Vu Link's power off, then on, using the **Power** switch or i-Vu CCN's **restartmodule** manual command.
- 10 Run the capture for one of the following periods of time:
 - o If all integration point refresh times are one minute or less, run the capture for 5 minutes from the time you turn the i-Vu Link's power back on.
 - o If any integration point refresh time is longer than 1 minute, run the capture for 5 times the longest microblock refresh time.
- 11 In Ethereal, verify that the **Protocol** column shows some Modbus or TCP entries. If not, stop the capture and make sure the network has only the hub(s) between your laptop and the i-Vu Link, then repeat steps 3 through 8.
- 12 On the menu bar, select **Capture > Stop**.
- 13 Select **File > Save As** to save your capture file.

NOTE Save in the default folder or click  next to **Browse for other folder** to select a different folder.
- 14 Send this file, the integration point's IP address, and the third-party device's IP address to Technical Support.

Appendix Modbus TCP/IP Protocol Conformance Statement

The following Modbus TCP/IP features and commands are supported by the i-Vu Link. See the *Modbus TCP/IP website* (<http://www.modbus.org>) for complete Modbus TCP/IP protocol information.

Modes	Media type	Baud Rate	Data Bits	Parity	Stop bits
RTU*	EIA-232	1200	7	None*	1*
ASCII	EIA-485, 2-wire	2400	8*	Odd	2
		4800		Even	
		9600			
		19200			
		38400			

*Most commonly used value

Function codes - command	Function code purpose
01 - Read Coil Status	Read discrete outputs
02 - Read Input Status	Read discrete inputs
03 - Read Holding Registers	Read holding registers
04 - Read Input Registers	Read input registers
05 - Force Single Coil	Write discrete outputs, one at a time
06 - Preset Single Register	Write holding registers, one at a time
15 - Force Multiple Coils	Write discrete outputs
16 - Preset Multiple Registers	Write holding registers



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