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Modbus EIA-232/485

Integration Guide



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Overview

Modbus Integration with the i-Vu Link

You can integrate Modbus devices into an i-Vu CCN system with a i-Vu Link acting as a master device.

Carrier

i-Vu Link	i-Vu Link
Modbus port	S2
Module driver	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 (Modicon) protocol	
Network media type	EIA-232, EIA-485 2-wire	
Quantity of devices you can physically connect to Port S2 on the i-Vu Link	For EIA-232:	1 Modbus slave
	For EIA-485:	Up to 247 Modbus slaves NOTE You may reach the point limitation of the i-Vu Link before connecting 247 Modbus slaves.

* 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.

NOTE To integrate a Modbus Ethernet device into an i-Vu CCN system, see the *Modbus Ethernet Integration Guide*.

Before-you-begin checklist

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

- ☐ A points list for each Modbus device that includes register addresses and read/write capabilities. Points lists are usually available from the third-party manufacturer's representative or website.
- ☐ The addresses of the Modbus devices
- ☐ The network media type required by the Modbus device: EIA-232 or EIA-485
- ☐ A port pinout/configuration of the Modbus device. Pinouts are usually available from the third-party manufacturer's representative or website.
- ☐ The Modbus network's baud rate, data bits, parity, and stop bits
- ☐ Verification that all communication properties have been set on the Modbus devices
- ☐ Verification of communications through the port that the i-Vu Link will connect to
- ☐ Experience creating custom equipment with ApplicationBuilder
- ☐ Experience installing, wiring, setting up, and downloading custom equipment to the i-Vu Link

Follow the steps in this document to integrate one or more third party Modbus 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 network is called an integration point. Integration points may be used in conjunction with CCN points to share data between the Modbus 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
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

Point type	Used for
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 or CCN address

Define the Modbus 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 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 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 EIA-232/485 address

Use the information below to format a valid address in each integration point that you use to read or write to a Modbus EIA-232/485 device.

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/device address*

Defined by
Carrier. See
table on
next page.

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

Set on third-party
device (1-247)

Example: modbus://UINT/40128/26

To...	this kind of value...	use this type of integration point...	with this register type...	and a Modbus register address in this range... ¹
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
	0 or 1 Coil Discrete (binary) output	BNI	Do	1-9999

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 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.

***NOTE** When defining Modbus TCP/IP address strings in ApplicationBuilder you can use generic placeholder text instead of actual data to make setup quicker. Then, in i-Vu CCN, you can use the **Search/Replace** feature to make global changes to the Modbus TCP/IP address strings rather than setting them up one at a time.

Example: Building a custom equipment to talk to an ABB variable speed drive, with three identical ABB drives on the project, (and their Modbus TCP/IP slave addresses are 1, 2, and 3). They will all be using the same custom equipment file. The only difference is that the Modbus TCP/IP address strings will be set up differently, because the Modbus slave addresses of each drive will be different. So in your custom equipment file, instead of entering:

modbus://UINT/40001/1 (where 1 is the Modbus TCP/IP slave address of the ABB drive),

you could enter:

modbus://UINT/40001/devaddress

Later, in i-Vu CCN, you could use the **Search/Replace** tool on the **Properties** page>**Network Points** tab to replace the generic term "devaddress" with the actual Modbus TCP/IP slave address of the ABB drive (1, 2, or 3).

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	If your i-Vu Link is connected to CCN devices: ○ Enable CCN Device and fill in the bus and element number of the CCN device that this custom equipment will be linked to. 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. If your i-Vu Link is NOT connected to CCN devices (only Modbus devices): ○ Enable CCN Link and pick the i-Vu Link that is physically connected to the Modbus network.
Equipment	1. Click Add. 2. Browse to the .equipment file that was generated in ApplicationBuilder. 3. Click Continue. 4. When message appears "File uploaded successfully", click Close.

- 4 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.
- 5 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.

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

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

Wiring specifications

For...	Use...	Maximum Length
EIA-232	18–28 AWG; twisted pair preferable	50 feet (15.24 meters)
EIA-485, 2-wire	18–24 AWG twisted, shielded pair ¹	3000 feet (914.4 meters)

¹ Shielding provides noise immunity in an electrically noisy environment. Acceptable wiring types, in order of greatest to least noise immunity, are:

- 2-pair, each pair individually shielded
- 2-pair, single overall cable shield

To wire third-party devices

- 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 S2 to the third-party device, then set the S2 jumper. See table and notes below.
- 4 Turn on the i-Vu Link's power.

For...	Use i-Vu Link port...	Wire Carrier terminal...	...to third-party device terminal	Set the port's jumper(s) on i-Vu Link
EIA-232	S2	TX Rx Signal Ground	Rx Tx Gnd	EIA-232
EIA-485, 2-wire	S2	Net+ Net-	+ -	EIA-485 2-wire

NOTES

- If you cannot determine the media type or connections of the third-party device, contact your third-party representative.
- Use the same polarity throughout the network segment.
- Repeaters are required for more than 31 devices. 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.

EXAMPLE If an EIA-485 2-wire network's characteristic impedance is 120 Ohms, terminate one pair by placing a 120 Ohm resistor across the **Net+** and **NET-** connectors of the i-Vu Link. Terminate the other pair by placing a 120 Ohm resistor across the **+** and **-** connectors of the furthest third-party controller.

- A solid receive light on the i-Vu Link indicates a wiring or polarity problem.

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 8) 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/HWP01-32/TEMP

ccn://0,2/HWP01-32/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**.

4 Set up the Modbus 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**.
- 4 Under **Port Configuration**, enable port S2 as being connected to the Modbus network.
- 5 Under **Port Configuration**, select EIA-232 or EIA-485 as the communication type.
- 6 Set the fields under **Timing Configuration**. These settings can typically be left at their default values.
- 7 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.
- 8 On the navigation tree, select **Protocols**.
- 9 In the **Protocol Status** table, verify that Modbus shows **Running** on Port S2. 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. • 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 driver page in i-Vu CCN, verify that Address in the integration point is correct. • All other errors On i-Vu CCN's navigation tree, right-click on the custom equipment and pick Driver Properties. Select < Protocols > Modbus > Error Definitions. Find the error and its possible solution.
A value is incorrect	Verify that: • 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 HyperTerminal, installed with Windows operating systems, to capture the communication between the i-Vu Link and the third-party device into a text file.

PREREQUISITES

- The i-Vu Link's IP address
- The longest integration point refresh time in the control program that has the error you are troubleshooting. In i-Vu CCN, view the control program's **Properties** page > **Network Points** tab to see all the refresh times.

- 1 Connect your computer's Ethernet port to the i-Vu Link's Ethernet port using one of the following:
 - A CAT5 or higher Ethernet crossover cable
 - A hub and a CAT5 or higher Ethernet straight-through cable
- 2 Ping the i-Vu Link to verify communications between the i-Vu Link and the computer you are using to get this capture.
- 3 On i-Vu CCN's navigation tree, right-click on custom equipment, select Driver Properties and then select **Protocols**.
- 4 Click **Properties**, select **Enable Telnet diagnostics**, then click **Accept**.
- 5 From the desktop, select **Start > Programs > Accessories > Communications > HyperTerminal**.
- 6 Type any name for your connection, then click **OK**.
- 7 In the **Connect using** field, select **TCP/IP (Winsock)**.
- 8 In the **Host address** field, type the IP address of the i-Vu Link, then click **OK**. Verify that **Login:>** appears in the window.
- 9 On the menu, select **File > Properties**. On the **Settings** tab, click **ASCII Setup**, select **Send line ends with line feeds** and **Echo typed characters locally**, then click **OK** twice.
- 10 Select **Transfer > Capture Text**, type the file path and name of the text file you are creating, then click **Start**.
- 11 Restart the i-Vu Link using the **restartmodule** manual command or the i-Vu Link's power switch.
- 12 After **Login:>**, type: `diagport` Click **Enter**.
- 13 To capture data receipts, after **diagport>**:
 - Type: `modbus rx`
 - Type: `modbus tx`
 - Type: `modbus emsg`
- 14 Verify the displayed text shows:


```
modbus reporting level status:
  rx on
  tx on
  flush off
  fc1 off
  fc2 off
  vmmsg off
  emsg on
  off
```

If `rx`, `tx`, or `emsg` show "off", repeat step 14.

- 15 After **diagport>**, type: `go`
Click **Enter**.
- 16 Run the capture for one of the following periods of time:
 - If all integration point refresh times are one minute or less, run the capture for 5 minutes.
 - If any integration point refresh time is longer than 1 minute, run the capture for 5 times the longest microblock refresh time.
- 17 Type: `stop`
Click **Enter**. Verify that you see `diagport>` before doing the next step.
- 18 From the menu, select **Transfer > Capture Text > Stop**.
- 19 After **diagport>**, type: `logout`
Click **Enter**.
- 20 From the menu, select **File > Exit**. Save the connection if you want to use the connection later with the same settings.
- 21 In i-Vu CCN, clear the **Enable Telnet diagnostics** checkbox (see step 3 and 4), then click **Accept**.
- 22 Open the text file you defined in step 10, and verify that it legibly shows the same information that HyperTerminal displayed.

Appendix - Modbus Protocol Conformance Statement

The following Modbus features and commands are supported by the i-Vu Link. See the *Modbus website* (<http://www.modbus.org>) for complete Modbus 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	Register address range*
01 - Read coils	1-9,999
02 - Read discrete inputs	10,001-19,999
03 - Read holding registers	40,001-49,999
04 - Read input registers	30,001-39,999
05 - Write single coil	
06 - Write single register	
15 - Write multiple coils	
16 - Write multiple registers	

* These register address ranges were defined in the legacy Modbus spec PI-MBUS-300 Rev. J, but do not appear in the V1.1a Modbus spec.



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