Modbus Integration Guide

for i-Vu® XT or TruVu™ controllers

 • Catalog No. 11-808-695-01 • 8/15/2025

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

Contents

Overview

You can use a Carrier i-Vu® XT or TruVu™ controller to integrate Modbus device(s) with your i-Vu® system. The controller can serve as a master or slave on a serial network, or a client or server on a TCP/IP network.

This document is divided into 4 sections that provide integration instructions for the 4 scenarios listed in the first two columns below. Determine how your Carrier controller will be used, then go to the appropriate page for the instructions.

NOTE i-Vu® XT or TruVu™ controller(s) have various combinations and names of ports and might not have rotary switches.

If the Carrier controller is to be a Modbus...	...on this media type...	...you can use this controller port...	See...
Master	EIA-485, 2 wire	S1 or S2	Controller as a master device on EIA-485
Slave	EIA-485, 2 wire	S1 or S2	Controller as a slave device on EIA-485 (page 19)
Client	Ethernet	Gig-E, Eth0, Eth1	Controller as a client device on Ethernet (page 30)
Server	Ethernet	Gig-E, Eth0, Eth1	Controller as a server device on Ethernet (page 42)

NOTES

- The third-party Modbus point count for the controller equals the total of the ports that are using Modbus.
- If multiple ports are used for Modbus, the ports can have different functionality. For example, Port S1 could be a serial master or slave, Port S2 could be a serial slave, and the Gig-E, Eth0, or Eth1 port could be an Ethernet client or server.

CAUTION If you want to upgrade a system from an older Modbus application, carefully review Appendix A - Migrating a control program used with a previous Modbus driver (page 59).

Controller as a master device on EIA-485

NOTE Modbus supports a single master on each network.

Carrier	
Controller	All i-Vu® XT or TruVu™ controllers except the i-Vu® XT Router.
Driver	drv_fwex_<latest version>.driverx
Read/write capability	Can read from and write to the third-party equipment
Third party	
Supported equipment	Any slave device that supports the Modbus (Modicon) protocol
Network media type	EIA-485
Quantity of Modbus slave devices you can physically connect to Port S1 or Port S2 on the Carrier master controller	Up to 254 Modbus slaves **NOTE** You may reach the point limitation of the Carrier controller before connecting 254 Modbus slaves.

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.
- ☐ Modbus device addresses
- ☐ 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 transmission mode, 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 the Carrier controller will connect to
- ☐ 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 section to integrate one or more third-party Modbus devices into the 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.

TIP Verify the third-party manufacturer's register addressing pattern by establishing communication with a few points whose values you can physically manipulate before you spend time addressing the remaining integration points.

Formatting a Modbus 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.

Address format:

protocol://register type/modbus register address/device address

protocol	register type	modbus register address	device address
See *Protocol* below.	See *Register type/ Register address* below.	See *Register type/ Register address* below.	Third-party device (1-254)

Example: modbus2://UINT/400128/26

NOTE To send a broadcast to all Modbus devices on the port specified by the protocol signature, use 0 for the device address in a network output microblock.

Protocol

If the point is in a Modbus device connected to the Carrier controller's port...	Use the following protocol signature *
S1	modbus1://
S2	modbus2://

* You can also use modbus:// for points on one of the ports, but not both ports.

Register type/Register address

To...	this kind of value...	use this microblock...	with this register type...	and a Modbus register address in this range... [1]
Read	0 to 65,535 Unsigned 16-bit integer Input register (**3**XXXXX)	ANI	Uint (not Unit)	**3**00001–**3**65535
	0 to 65,535 Unsigned 16-bit integer Holding register (**4**XXXXX)	ANI	Uint (not Unit)	**4**00001–**4**65535
	0 to 4,294,967,296 Unsigned, 32-bit (long) integer Input register (**3**XXXXX)	ANI	Uint32	**3**00001–**3**65535
	0 to 4,294,967,296 Unsigned, 32-bit (long) integer Holding register (**4**XXXXX)	ANI	Uint32	**4**00001–**4**65535
	–32,768 to +32,767 Signed 16-bit integer Input register (**3**XXXXX)	ANI	Sint	**3**00001–**3**65535
	–32,768 to +32,767 Signed 16-bit integer Holding register (**4**XXXXX)	ANI	Sint	**4**00001–**4**65535
	-2,147,483,648 to 2,147,483,647 Signed, 32-bit (long) integer Input register (**3**XXXXX)	ANI	Sint32	**3**00001–**3**65535
	-2,147,483,648 to 2,147,483,647 Signed, 32-bit (long) integer Holding register (**4**XXXXX)	ANI	Sint32	**4**00001–**4**65535
	Value with decimal point Input register (**3**XXXXX)	ANI	Float	**3**00001–**3**65535 [2]
	Value with decimal point Holding register (**4**XXXXX)	ANI	Float	**4**00001–**4**65535 [2]
	0 or 1 Coil / Discrete (binary) output	BNI (or ANI)	Do	1–65535 [3]
	0 or 1 Discrete (binary) input (**1**XXXXX)	BNI (or ANI)	Di	**1**00001–**1**65535

To...	this kind of value...	use this microblock...	with this register type...	and a Modbus register address in this range... [1]
	0 or 1 Input register (**3**XXXXX)	BNI	BIT*n* (where *n* is a value 0-15 defined in points list)	**3**00001–**3**65535
	0 or 1 Holding register (**4**XXXXX)	BNI	BIT*n* (where *n* is a value 0-15 defined in points list)	**4**00001–**4**65535
To...	**this kind of value...**	**use this microblock...**	**with this register type...**	**and a Modbus register address in this range...** [1]
Write	0 to 65,535 Unsigned 16-bit integer Holding register (**4**XXXXX)	ANO	Uint (not Unit)	**4**00001–**4**65535
	–32,768 to +32,767 Signed 16-bit integer Holding register (**4**XXXXX)	ANO	Sint	**4**00001–**4**65535
	Value with decimal point Holding register (**4**XXXXX)	ANO	Float	**4**00001–**4**65535 [2]
	0 or 1 Coil Discrete (binary) output	BNO (or ANO)	Do	1–65535 [3]
	0 or 1 Holding register (**4**XXXXX)	BNO (or ANO)	BIT*n* (where *n* is a value 0-15 defined in points list)	**4**00001–**4**65535

[1] The Modbus register address (sometimes called register, address, code, or parameter) must be a decimal value. If the register addresses in the points list include the letters A-F, use a scientific calculator to convert these hexadecimal values to decimal values.

If the register addresses in the points list are 5-digit numbers in the range **#**0001-**#**9999 (where **#** = the prefix **1**, **3**, or **4**), you may use the addresses as they are, or change them to fit the formats in the table above by shifting the prefix one digit to the left. For example, if you see the address **3**8129, you can also use **3**08129.

[2] Each Float uses 2 consecutive Modbus register addresses. Use the lower number in the microblock address.

[3] Enter the number without any leading zeros. For example, enter 125, not 000125.

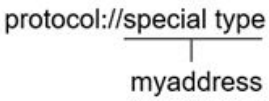
64-bit Modbus registers are not supported. See Modbus Troubleshooting (page 52) for more information on register addresses.

Special Modbus addresses

Dynamic Modbus address

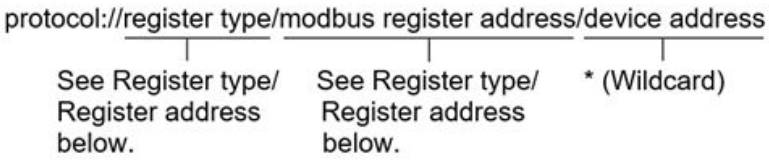
Use the following steps to format a valid dynamic Modbus address in each microblock, as required:

1. Address an ANO microblock with this special protocol address



Example: modbus://myaddress

2. Address more ANOs in the control program using an asterisk as a wildcard symbol.



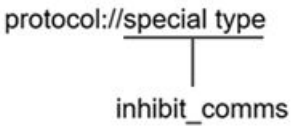
Example: modbus://UINT/40128/*

*Wildcard mode allows the address of the Modbus slave to be deferred at runtime to a value determined by the control program. A wire value in the control program can set the slave address of many network point microblocks in the same control program. Dynamic addressing allows a control program to dynamically browse from one Modbus slave device to another by changing one value in the control program that sets the Modbus slave address for all of the points that are configured to use the "wildcard" slave address.

There must be one ANO microblock within the control program configured so that its Address field is set to `modbus://myaddress`, or `modbus1://myaddress`, or `modbus2://myaddress`, as appropriate. The control program wire valuefeeding the input nib of this ANO microblock determines the Modbus slave address of all microblocks set to the wildcard address that have a matching Protocol field. To configure a network point to the wildcard address, place an * (asterisk) where the numeric slave address would normally be in the Address field, for example, `modbus://UINT/400128/*`. When running, this asterisk is replaced with a numeric slave address as determined by the wire input nib of the specially designated ANO microblock, the "myaddress" microblock. Changing the value of this ANO microblock dynamically changes the slave address of all the network point microblocks configured with the wildcard address, which allows one control program to browse from one Modbus slave to another by changing this one ANO value.

There can only be one wild card for each protocol in a single controller. This wild card applies to all control programs in that same controller.

Inhibit Device Communications



Example: modbus://inhibit_comms

The "inhibit_comms" ANO allows communications to be disabled to a single Modbus slave device based on the ANO's value. The ANO point `modbus1://inhibit_comms` disables communications to the slave device specified by the wire value of the ANO for port S1. For example, if the ANO has a value of 1 then communications is disabled for slave device 1 on the referenced port.

NOTES

- The inhibit_comms port is based on the communications port referenced in the URL. This means you can disable communications for a slave address on one port without affecting communications to the same slave address on another port.
- Points that are inhibited by the inhibit_comms ANO show an Error Code 97. This applies to both ANIs and ANOs.

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

In the i-Vu® XT or TruVu™ controller, Modbus communication is already in the standard drv_fwex driver <v103 or later>. You do not need a special Modbus driver.

If you need an updated driver or the latest SAL library, go to Carrier Control Systems Support Site and save it to your computer.

To change the driver in the controller

1. Do one of the following:

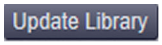
If the driver is...	
In the **Driver Version** drop-down list	a. Select the driver. b. Click **Accept**.

If the driver is...	
Not in the **Driver Version** drop-down list	a. Click **Add**. b. Browse to select the driver. c. Click **Open**. d. Click **Continue**. e. Click **Close**. f. Click **Close** again.

2. Click the **Download All Content** button.
3. Click **OK**.
4. Click **Accept**.

To update the SAL library in the i-Vu® Standard, Plus, or Pro application

1. In the i-Vu® interface, click **System Menu**  , then select **System Options** > **Update**.

   NOTE Expand **Current Libraries (.sal)** to see the current SAL libraries and their revision. Compare them to what you downloaded and determine if any of them need updating.
2. Click 

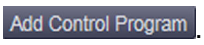
and browse to the updated .sal file that you have saved on your computer, select the file, and click **Open**.
3. Click **Continue**.
4. When process is complete, the message appears **File added successfully**.
5. Click **Close**.
6. Click **Close** again.
7. Click the **Download All Content** button.
8. Click **OK**.
9. Click **Accept**.

To update the SAL library in the i-Vu® Express application

1. Access the **Management Tool** using one of the following methods:
   - Click  , then select **System Options** > **General** tab > **Management Tool**.
   - Launch your browser and type the host name followed by /mgttool/. (Ex. https://ivu/mgttool/)
2. In the **Update Management** tab, click **Apply** to install and apply the latest SAL file.

To add a control program

NOTE i-Vu® Pro - Place the .equipment file in <system_name>**\programs**.

1. In the i-Vu® interface, select the router in the navigation tree and go to the **Devices** > **Manage** tab.
2. Select the controller in the list on the page.
3. If you are adding a new control program, click the **Add Control Program** button 

. A dialog window appears.
4. Enter a name for your control program in **Display Name** and select your controller in the **Controller** drop-down list.

5. Do one of the following:

If the control program is...	
In the **Control Program** drop-down list	Select the control program.
Not in the **Control Program** drop-down list	a. Click **Add New**. b. Browse to select the control program. c. Click **Open**. d. Click **Continue**. e. Click **Close**.

6. Click **Continue**. When message appears **File added successfully**, click **Close**.
7. Click **Close** again.
8. Right-click on the controller in the list and select **Check Status** from the list. The status of the controller should say **File Mismatch**.
9. Click the **Download All Content** button.

3 Connect the Carrier controller to the third-party device

Wiring specifications

For...	Use...
EIA-485	• 24 AWG twisted, shielded pair cable for up to 200 feet (60.96 meters) [2] or • 22 AWG twisted, shielded pair cable for up to 2000 feet (609.6 meters) See the *Open Controller Wiring Guide* for details.

To wire a third-party device with rotary switches

1. Turn off the Carrier controller's power.
2. Check the communications wiring for shorts and grounds.
3. Set switches on the Carrier controller. See table below.
4. Wire the Carrier controller to the third-party device. See table and notes below.
5. Turn on the Carrier controller's power.

For...	Use Carrier controller port...	Wire Carrier terminal...	...to third-party device terminal	Set switches on Carrier controller

EIA-485, 2-wire	S1	Net+ Net-	+ -	1. Set the rotary protocol selector switch to **3** (Modbus). **NOTE** The rotary address switches are not used for Modbus in Master Mode. 2. If this controller is on the end of the EIA-485 network segment, set the Port S1 **End of Net?** switch to **YES**. If not, set to **NO**. 3. Set master mode, baud rate, and other relevant Modbus parameters in the driver properties, as detailed in the next section.
EIA-485, 2-wire	S2	Net+ Net-	+ -	1. If this controller is on the end of the EIA-485 network segment, set the Port S2 **End of Net?** switch to **YES**. If not, set to **NO**. 2. To enable and configure Modbus on Port S2, set the parameters in the driver properties, as detailed in the next section. **CAUTION** If Port S2 is enabled for BACnet and Port S2 is also set to be the **Home Network**, you cannot enable Modbus on Port S2.

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 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. Carrier's controllers provide this terminating resistance by setting the **End of Net?** switch to **YES**. Make sure that only devices at the end of a network have termination enabled.
- A solid receive light on the Carrier controller indicates a wiring or polarity problem.
- If more than one controller is using the same slave address on the same Modbus segment, you may see unexplained data errors in the control program. Each Modbus node on a Modbus serial network must be assigned a unique node address.
- When Port S1 or S2 is in master mode, autobaud is always disabled. You can only enable autobaud when Port S1 or S2 is in slave mode.

4 Set up the driver properties

1. On the i-Vu® navigation tree, right-click the i-Vu® XT or TruVu™ controller and select **Driver Properties**.
2. Expand **Communication Status**, then select **Modbus Serial**.
3. Under **Port Configuration**, enable the port(s) on the controller that third-party device(s) are connected to.
4. For each port that you enabled, select one of the following in the **Supported Microblock Signature** field:

Select...	If the Modbus point addresses on the port use...
modbus#://	Only this signature
modbus:// & modbus#://	Both types of signatures

5. Set the remaining fields under **Port Configuration** to match the third-party device.
6. Under **Protocol Configuration**, set **This device is a** to **Master**.
7. Set the remaining fields using information from the third-party manufacturer's representative. Select the **Details** checkbox for help.
8. On the **Driver Properties** tree, select **Communication Status**.
9. In the **Protocol Status** table, verify the following for the port you enabled:
   - Modbus 1 shows **Running** on Port S1
   - Modbus 2 shows **Running** on Port S2

   If the status shows **Not Running** or the wrong port, verify that:
   - You selected the correct port in step 3 above.
   - You set the controller's switches correctly, if applicable.
   - The control program has at least one valid Modbus address. The driver must detect at least one valid address to initiate Modbus communications.

5 Verify the Carrier controller 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*.

If...	Then...
Some points show question marks instead of values	You may have exceeded the third-party points available in the controller. If so, do one of the following: • Use a controller that provides more third-party points. • Split the points between two control programs used in separate controllers. To determine the number of third-party points used in a controller: On the i-Vu® navigation tree, right-click on the controller and select **Driver Properties** > **Driver** > **Properties** > **Settings** tab, and then scroll to **Network Microblocks**. **Modbus integration points capacity** shows how many points the controller allows and **integration points active** shows how many are currently active.
The point name is red	Select the control program on the i-Vu® navigation tree. Go to **Properties** > **Network Points** tab. • **1 - Communications Disabled for this Microblock** Enable the microblock's **Communications Enabled** field on the **Network Points** tab, on the microblock's **Properties** page > **Details** tab, or in the Snap application. • **3 - Address Error - Unknown Protocol Specified** Select the correct port on the **Modbus** driver page, verify that **Address** in the microblock is correct, or set the switches correctly on the controller. • All other errors On the i-Vu® navigation tree, right-click the controller and select **Driver Properties**, then select **Communication Status** > **Modbus Error Definitions**. Find the error and its possible solution.
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 *<Technical_Instructions>* for scaling information.

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

- A diagnostic capture. See next topic.
- A screenshot of the **Driver** > **Communication Status** Properties page and the **Driver** > **Communication Status** > **Modbus Serial** > **Properties** page
- A screenshot of the **Properties** page > **Network Points** tab showing addresses and errors
- Technical instructions for the third-party device, if available

To capture communication using PuTTY

Use PuTTY, a free open source terminal emulation program that works with all Windows operating systems, to capture communication between the controller and the Modbus device into a text file.

PREREQUISITES

- Download and install PuTTY from the PuTTY website.
- Get the Carrier controller's IP address.
- Get the longest microblock refresh time in the control program that has the error you are troubleshooting. In i-Vu®, 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 controller's Gig-E 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 Carrier controller to verify communications between the controller and the computer you are using to get this capture.
3. On the i-Vu® navigation tree, right-click the controller, select **Driver Properties**, and then select **Communication Status**.
4. On the **Properties** tab, check **Enable Telnet diagnostics**, and then click **Apply**.
5. Start PuTTY.
6. Enter the controller's IP address.
7. Select **Telnet** as the **Connection Type**.
8. Click the **Logging** option in the upper left corner of the left pane.
9. Select **Printable output**.
10. Select a location for the capture text file.
11. Click **Open** to start the session.
12. After **Login:>**, type: `diagport`
    Press **Enter**.
13. To capture data receipts, after **diagport>**, do one of the following:
    - For Modbus on Port S1, type: `modbus1 rx`
    - For Modbus on Port S2, type: `modbus2 rx`

    Press **Enter**.
14. To capture data transmissions, after **diagport>**, do one of the following:
    - For Modbus on Port S1, type: `modbus1 tx`
    - For Modbus on Port S2, type: `modbus2 tx`

    Press **Enter**.
15. To capture more detailed diagnostic messages, after **diagport>**, do one of the following:
    - For Modbus on Port S1, type: `modbus1 vmsg`
    - For Modbus on Port S2, type: `modbus2 vmsg`

    Press **Enter**.
16. To capture error messages, after **diagport>**, do one of the following:
    - For Modbus on Port S1, type: `modbus1 emsg`

- For Modbus on Port S2, type: `modbus2 emsg`

Press **Enter**.

17. Verify the displayed text shows:

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

If `rx`, `tx`, `vmsg`, or `emsg` show `off`, repeat the appropriate step (13, 14, 15, or 16) to turn on capture of that item.

18. After **diagport>**, type: `go`
Press **Enter**.
19. Run the capture for one of the following periods of time:
    - If all microblock refresh times are one minute or less, run the capture for 5 minutes.
    - If any microblock refresh time is longer than 1 minute, run the capture for 5 times the longest microblock refresh time.
20. Type: `stop`
Press **Enter**. Verify that you see diagport> before doing the next step.
21. After **diagport>**, type: `logout`
Press **Enter**.
22. To end the PuTTY session, click the X in the upper right corner.
23. In the i-Vu® interface, uncheck **Enable Telnet diagnostics** (see steps 3 and 4), then click **Accept**.
24. Open the text file from the location you selected in step 11, and then verify that it legibly shows the same information that PuTTY displayed.

TIP In some cases, you may want the Carrier controller to capture the Telnet diagnostics session and then upload this capture as part of the system log files. For information on how to do this, see Appendix D (page 65).

Controller as a slave device on EIA-485

You can integrate the Carrier controller acting as a slave device into a third-party Modbus system.

Carrier	
Controller	All i-Vu® XT or TruVu™ controllers except the i-Vu® XT Router.
Driver	drv_fwex_<latest version>.driverx
Read/write capability	Can read from and write to the third-party equipment
Third party	
Supported equipment	A master device that supports the Modbus (Modicon) protocol
Network media type	EIA-485

Before-you-begin checklist

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

- ☐ A list of the points in the Carrier controller that the Modbus device will read or write to.
- ☐ The Carrier controller's address on the Modbus network
- ☐ 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
  NOTE You can set the baud rate manually or by enabling autobaud.
- ☐ Verification that all communication properties have been set on the Modbus devices
- ☐ Verification of communications through the port the Carrier controller will connect to
- ☐ 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 section to integrate the Carrier controller into a Modbus system. 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 value that you want to expose to the Modbus master.

Formatting a Modbus address

Use the information below to format a valid address in each microblock that you want to expose to the Modbus master.

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.

Address format:

protocol://register type/modbus register address

See *Protocol* below.	See *Register type/ Register address* below.	See *Register type/ Register address* below.

Example: modbus2://UINT/400128

Protocol

If the Modbus master is connected to the controller's port...	Use this protocol signature
S1	modbus1://
S2	modbus2://

NOTE You can also use the modbus:// signature for points on one of the ports, but not both ports.

Register type/Register address

When the Carrier controller is a slave device, you must expose its points so that they can be read or written to by a third-party master device.

For a third-party device to...	this kind of exposed value in the Carrier controller...	use this microblock...	with this register type...	and a Modbus register address in this range...
Write	0 to 65,535 Unsigned 16-bit integer Holding register (**4**XXXXX)	ANI	Uint (not Unit)	**4**00001–**4**65535
	–32,768 to +32,767 Signed 16-bit integer Holding register (**4**XXXXX)	ANI	Sint	**4**00001–**4**65535
	Value with decimal point Holding register (**4**XXXXX)	ANI	Float	**4**00001–**4**65535
	0 or 1 Coil Discrete (binary) output	BNI	Do	1–65535 [3]
Read	0 to 65,535 Unsigned 16-bit integer Input register (**3**XXXXX)	ANO	Uint (not Unit)	**3**00001–**3**65535
	0 to 65,535 Unsigned 16-bit integer Holding register (**4**XXXXX)	ANO	Uint (not Unit)	**4**00001–**4**65535
	–32,768 to +32,767 Signed 16-bit integer Input register (**3**XXXXX)	ANO	Sint	**3**00001–**3**65535
	–32,768 to +32,767 Signed 16-bit integer Holding register (**4**XXXXX)	ANO	Sint	**4**00001–**4**65535
	Value with decimal point Input register (**3**XXXXX)	ANO	Float	**3**00001–**3**65535
	Value with decimal point Holding register (**4**XXXXX)	ANO	Float	**4**00001–**4**65535
	0 or 1 Coil Discrete (binary) output	BNO	Do	1–65535 [3]
	0 or 1 Discrete (binary) input (**1**XXXXX)	BNO	Di	**1**00001–**1**65535

For a third-party device to...	this kind of exposed value in the Carrier controller...	use this microblock...	with this register type...	and a Modbus register address in this range...

[1] If the register addresses in the points list are 5-digit numbers in the range **#**0001-**#**9999 (where **#** = the prefix **1**, **3**, or **4**), you may use the addresses as they are, or change them to fit the formats in the table above by shifting the prefix one digit to the left. For example, if you see the address **3**8129, you can also use **3**08129.

[2] Each Float uses 2 consecutive Modbus register addresses. Use the lower number in the microblock address.

[3] Enter the number without any leading zeros. For example, enter 125, not 000125.

64-bit Modbus registers are not supported. See Modbus Troubleshooting (page 52) for more information on register addresses.

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

In the i-Vu® XT or TruVu™ controller, Modbus communication is already in the standard drv_fwex driver <v103 or later>. You do not need a special Modbus driver.

If you need an updated driver or the latest SAL library, go to Carrier Control Systems Support Site and save it to your computer.

To change the driver in the controller

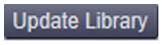
1. Do one of the following:

If the driver is...	
In the **Driver Version** drop-down list	a. Select the driver. b. Click **Accept**.
Not in the **Driver Version** drop-down list	a. Click **Add**. b. Browse to select the driver. c. Click **Open**. d. Click **Continue**. e. Click **Close**. f. Click **Close** again.

2. Click the **Download All Content** button.
3. Click **OK**.
4. Click **Accept**.

To update the SAL library in the i-Vu® Standard, Plus, or Pro application

1. In the i-Vu® interface, click **System Menu**  , then select **System Options** > **Update**.

   NOTE Expand **Current Libraries (.sal)** to see the current SAL libraries and their revision. Compare them to what you downloaded and determine if any of them need updating.
2. Click 

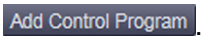
and browse to the updated .sal file that you have saved on your computer, select the file, and click **Open**.
3. Click **Continue**.
4. When process is complete, the message appears **File added successfully**.
5. Click **Close**.
6. Click **Close** again.
7. Click the **Download All Content** button.
8. Click **OK.**
9. Click **Accept.**

To update the SAL library in the i-Vu® Express application

1. Access the **Management Tool** using one of the following methods:
   - Click  , then select **System Options** > **General** tab > **Management Tool**.
   - Launch your browser and type the host name followed by /mgttool/. (Ex. https://ivu/mgttool/)
2. In the **Update Management** tab, click **Apply** to install and apply the latest SAL file.

To add a control program

NOTE i-Vu® Pro - Place the .equipment file in <system_name>**\programs**.

1. In the i-Vu® interface, select the router in the navigation tree and go to the **Devices** > **Manage** tab.
2. Select the controller in the list on the page.
3. If you are adding a new control program, click the **Add Control Program** button 

. A dialog window appears.
4. Enter a name for your control program in **Display Name** and select your controller in the **Controller** drop-down list.
5. Do one of the following:

If the control program is...	
In the **Control Program** drop-down list	Select the control program.
Not in the **Control Program** drop-down list	a. Click **Add New**. b. Browse to select the control program. c. Click **Open**. d. Click **Continue**. e. Click **Close**.

6. Click **Continue**. When message appears **File added successfully**, click **Close**.
7. Click **Close** again.
8. Right-click on the controller in the list and select **Check Status** from the list. The status of the controller should say **File Mismatch**.
9. Click the **Download All Content** button.

3 Connect the Carrier controller to the third-party device

Wiring specifications

For...	Use...
EIA-485	• 24 AWG twisted, shielded pair cable for up to 200 feet (60.96 meters) [2] or • 22 AWG twisted, shielded pair cable for up to 2000 feet (609.6 meters) See the *Open Controller Wiring Guide* for details.

To wire a third-party device with rotary switches

1. Turn off the Carrier controller's power.
2. Check the communications wiring for shorts and grounds.
3. Set switches on the Carrier controller. See table below.
4. Wire the Carrier controller to the third-party device. See table and notes below.
5. Turn on the Carrier controller's power.

For...	Use Carrier controller port...	Wire Carrier terminal...	...to third-party device terminal	Set switches on Carrier controller

EIA-485, 2-wire	S1	Net+ Net-	+ -	1. Set the rotary protocol selector switch to **3** (Modbus). 2. Set the rotary address switches to the Modbus slave address, to assign it to the Carrier controller. 3. If this controller is on the end of the EIA-485 network segment, set the Port S1 **End of Net?** switch to **YES**. If not, set to **NO**. 4. Set slave mode, baud rate, and other relevant Modbus parameters in the driver properties, as detailed in the next section. **NOTE** You can set the baud rate manually or by enabling autobaud.
EIA-485, 2-wire	S2	Net+ Net-	+ -	1. If this controller is on the end of the EIA-485 network segment, set the Port S2 **End of Net?** switch to **YES**. If not, set to **NO**. 2. To enable and configure Modbus on Port S2, set the parameters in the driver properties, as detailed in the next section. **CAUTION** If Port S2 is enabled for BACnet and Port S2 is also set to be the **Home Network**, you cannot enable Modbus on Port S2.

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 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. Carrier's controllers provide this terminating resistance by setting the **End of Net?** switch to **YES**. Make sure that only devices at the end of a network have termination enabled.
- A solid receive light on the Carrier controller indicates a wiring or polarity problem.
- If more than one controller is using the same slave address on the same Modbus segment, you may see unexplained data errors in the control program. Each Modbus node on a Modbus serial network must be assigned a unique node address.
- When Port S1 or S2 is in master mode, autobaud is always disabled. You can only enable autobaud when Port S1 or S2 is in slave mode. You cannot enter the baud rate manually when you select autobaud.

- If you have controllers on a network set to autobaud and then you change the network baud rate, click the **Synchronize** button in the i-Vu® interface or the Service Port controller setup pages to clear all Carrier slave traffic on that network, to allow them to acquire the new baud rate.

4 Set up the driver properties

1. On the i-Vu® navigation tree, expand the Carrier controller's driver.
2. Expand **Communication Status**, then select **Modbus Serial**.
3. Under **Port Configuration**, enable the port(s) on the controller that connects to the Modbus Master.
4. For each port that you enabled, select one of the following in the **Supported Microblock Signature** field:

Select...	If the Modbus point addresses on the port use...
modbus#://	Only this signature
modbus:// & modbus#://	Both types of signatures

5. Under **Port Configuration**, select the controller port that connects the third-party network.
6. Under **Protocol Configuration**, set **This device is a** to **Slave**.
7. In **Modbus Slave Address for this port is**, type the address of the Carrier controller on the third-party network.
8. On the navigation tree, select **Communication Status**.
9. In the **Protocol Status** table, verify the following for the port you enabled:
   - Modbus 1 shows **Running** on Port S1
   - Modbus 2 shows **Running** on Port S2

   If the status shows **Not Running** or the wrong port, verify that:
   - You selected the correct port in step 3 above.
   - You set the controller's switches correctly, if applicable.
   - The control program has at least one valid Modbus address. The driver must detect at least one valid address to initiate Modbus communications.

5 Verify the controller is set up correctly

1. In the navigation tree, select the Carrier controller.
2. Select the **Properties** page > **Network Points** tab.

If...	Then...
You see the point value you expect and the **Error** column shows **Initializing**	You have successfully exposed the Carrier controller's value to the third-party device.

If...	Then...
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*.
Some points show question marks instead of values	You may have exceeded the third-party points available in the controller. If so, do one of the following: • Use a controller that provides more third-party points. • Split the points between two control programs used in separate controllers. To determine the number of third-party points used in a controller: On the i-Vu® navigation tree, right-click on the controller and select **Driver Properties** > **Driver** > **Properties** > **Settings** tab, and then scroll to **Network Microblocks**. **Modbus integration points capacity** shows how many points the controller allows and **integration points active** shows how many are currently active.
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 microblock's **Communications Enabled** field on the **Network Points** tab, on the microblock's **Properties** page > **Details** tab, or in the Snap application. • **3 - Address Error - Unknown Protocol Specified** Select the correct port on the **Modbus** driver page, verify that **Address** in the microblock is correct, or set the switches correctly on the controller. • All other errors On the i-Vu® navigation tree, right-click the Carrier controller and select **Driver Properties**, then select **Communication Status** > **Modbus Error Definitions**. Find the error and its possible solution.
A value is incorrect	Verify that the Address in the microblock is correct.

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

- A diagnostic capture. See next topic.
- A screenshot of the **Driver** > **Communication Status** Properties page and the **Driver** > **Communication Status** > **Modbus Serial** > **Properties** page
- A screenshot of the **Properties** page > **Network Points** tab showing addresses and errors
- Technical instructions for the third-party device, if available

To capture communication using PuTTY

Use PuTTY, a free open source terminal emulation program that works with all Windows operating systems, to capture communication between the controller and the Modbus device into a text file.

PREREQUISITES

- Download and install PuTTY from the PuTTY website.
- Get the Carrier controller's IP address.
- Get the longest microblock refresh time in the control program that has the error you are troubleshooting. In i-Vu®, 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 controller's Gig-E 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 Carrier controller to verify communications between the controller and the computer you are using to get this capture.
3. On the i-Vu® navigation tree, right-click the controller, select **Driver Properties**, and then select **Communication Status**.
4. On the **Properties** tab, check **Enable Telnet diagnostics**, and then click **Apply**.
5. Start PuTTY.
6. Enter the controller's IP address.
7. Select **Telnet** as the **Connection Type**.
8. Click the **Logging** option in the upper left corner of the left pane.
9. Select **Printable output**.
10. Select a location for the capture text file.
11. Click **Open** to start the session.
12. After **Login:>**, type: `diagport`
    Press **Enter**.
13. To capture data receipts, after **diagport>**, do one of the following:
    - For Modbus on Port S1, type: `modbus1 rx`
    - For Modbus on Port S2, type: `modbus2 rx`

    Press **Enter**.
14. To capture data transmissions, after **diagport>**, do one of the following:
    - For Modbus on Port S1, type: `modbus1 tx`
    - For Modbus on Port S2, type: `modbus2 tx`

    Press **Enter**.
15. To capture more detailed diagnostic messages, after **diagport>**, do one of the following:
    - For Modbus on Port S1, type: `modbus1 vmsg`
    - For Modbus on Port S2, type: `modbus2 vmsg`

    Press **Enter**.
16. To capture error messages, after **diagport>**, do one of the following:
    - For Modbus on Port S1, type: `modbus1 emsg`

- For Modbus on Port S2, type: `modbus2 emsg`

Press **Enter**.

17. Verify the displayed text shows:

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

If `rx`, `tx`, `vmsg`, or `emsg` show `off`, repeat the appropriate step (13, 14, 15, or 16) to turn on capture of that item.

18. After **diagport>**, type: `go`
Press **Enter**.
19. Run the capture for one of the following periods of time:
    - If all microblock refresh times are one minute or less, run the capture for 5 minutes.
    - If any microblock refresh time is longer than 1 minute, run the capture for 5 times the longest microblock refresh time.
20. Type: `stop`
Press **Enter**. Verify that you see diagport> before doing the next step.
21. After **diagport>**, type: `logout`
Press **Enter**.
22. To end the PuTTY session, click the X in the upper right corner.
23. In the i-Vu® interface, uncheck **Enable Telnet diagnostics** (see steps 3 and 4), then click **Accept**.
24. Open the text file from the location you selected in step 11, and then verify that it legibly shows the same information that PuTTY displayed.

TIP In some cases, you may want the Carrier controller to capture the Telnet diagnostics session and then upload this capture as part of the system log files. For information on how to do this, see Appendix D (page 65).

Controller as a client device on Ethernet

You can integrate Modbus devices into the i-Vu® system with the Carrier controller acting as an IP client in either of the following scenarios:

- The client controller reads and writes to points in a Modbus server.
- The client controller communicates with a Modbus gateway server to read and write to points in Modbus server devices.

Carrier	
Controllers	All i-Vu® XT or TruVu™ controllers except the i-Vu® XT Router.
Driver	drv_fwex_<latest version>.driverx
Read/write capability	Can read from and write to the third-party equipment
Third party	
Supported equipment	Any server device that supports the Modbus (Modicon) protocol
Network media type	Ethernet
Quantity of devices you can connect to the Carrier client controller	Up to 60 Modbus TCP/IP connections.*

* You may be able to connect more devices (254 maximum) if you consider the following:

- The lower the point count per device, the more devices you can connect.
- The more devices, the slower the communication between the Carrier controller and the Modbus devices.

A practical limit in most systems is approximately 100 devices. To connect more than 60 devices, change the **Close socket after each completed transaction** setting in the driver to **Yes**.

Before-you-begin checklist

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

- ☐ The IP addresses of the Modbus server
- ☐ The Unit ID of each Modbus device that contains points that the Carrier controller will read and write to, and a points list for each device that includes point register addresses and read/write capabilities. Points lists are usually available from the third-party manufacturer's representative or website.
- ☐ Verification that all communication properties have been set on the Modbus devices
- ☐ Verification of Ethernet communication with each server that the Carrier controller will connect to

- ☐ 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 section to integrate one or more third-party Modbus devices into the 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.

TIP Verify the third-party manufacturer's register addressing pattern by establishing communication with a few points whose values you can physically manipulate before you spend time addressing the remaining integration points.

Formatting a Modbus 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.

Address format:

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

See *Register type/ Register address* below.	Provided in third-party points list. See *Register type/ Register address* below	Third-party device See *Unit ID* below.	IP address of the Modbus server

Example: mtcpip://UINT/400128/3/192.168.168.17 (IP address specified directly)

mtcpip://UINT/400128/3/17 (IP address specified indirectly, using index 17)

IP Address

You can specify the IP address of the third-party Modbus server either directly or indirectly.

Direct IP address	Enter the IP address of the third-party server in dot-decimal notation. For example, 192.168.168.17
Indirect IP address	Enter the index number of the IP address to use, For example, 17. You configure the actual IP address corresponding to each index number on the **Driver Properties** > **Communication Status** > **Modbus TCP/IP** > **IP Index Table** properties page. When you use the indirect IP address scheme, you must specify the IP addresses of the third-party Modbus server outside of the control program logic. Up to 60 IP addresses can be specified indirectly using the IP Index Table.

Unit ID

If the register address is in...	the Unit ID is...
The third-party Modbus server	0 or 255
A device on the third-party Modbus server's serial network	1–254

Register type/Register address

To...	this kind of value...	use this microblock...	with this register type...	and a Modbus register address in this range... [1]
Read	0 to 65,535 Unsigned 16-bit integer Input register (**3**XXXXX)	ANI	Uint (not Unit)	**3**00001–**3**65535
	0 to 65,535 Unsigned 16-bit integer Holding register (**4**XXXXX)	ANI	Uint (not Unit)	**4**00001–**4**65535
	0 to 4,294,967,296 Unsigned, 32-bit (long) integer Input register (**3**XXXXX)	ANI	Uint32	**3**00001–**3**65535
	0 to 4,294,967,296 Unsigned, 32-bit (long) integer Holding register (**4**XXXXX)	ANI	Uint32	**4**00001–**4**65535
	–32,768 to +32,767 Signed 16-bit integer Input register (**3**XXXXX)	ANI	Sint	**3**00001–**3**65535
	–32,768 to +32,767 Signed 16-bit integer Holding register (**4**XXXXX)	ANI	Sint	**4**00001–**4**65535
	-2,147,483,648 to 2,147,483,647 Signed, 32-bit (long) integer Input register (**3**XXXXX)	ANI	Sint32	**3**00001–**3**65535
	-2,147,483,648 to 2,147,483,647 Signed, 32-bit (long) integer Holding register (**4**XXXXX)	ANI	Sint32	**4**00001–**4**65535
	Value with decimal point Input register (**3**XXXXX)	ANI	Float	**3**00001–**3**65535 [2]
	Value with decimal point Holding register (**4**XXXXX)	ANI	Float	**4**00001–**4**65535 [2]
	0 or 1 Coil / Discrete (binary) output	BNI (or ANI)	Do	1–65535 [3]
	0 or 1 Discrete (binary) input (**1**XXXXX)	BNI (or ANI)	Di	**1**00001–**1**65535
	0 or 1 Input register (**3**XXXXX)	BNI	BIT*n* (where *n* is a value 0-15 defined in points list)	**3**00001–**3**65535
	0 or 1 Holding register (**4**XXXXX)	BNI [33]	BIT*n* (where *n* is a value 0-15 defined in points list)	**4**00001–**4**65535

To...	this kind of value...	use this microblock...	with this register type...	and a Modbus register address in this range... [1]
Write	0 to 65,535 Unsigned 16-bit integer Holding register (**4**XXXXX)	ANO	Uint (not Unit)	**4**00001–**4**65535
	–32,768 to +32,767 Signed 16-bit integer Holding register (**4**XXXXX)	ANO	Sint	**4**00001–**4**65535
	Value with decimal point Holding register (**4**XXXXX)	ANO	Float	**4**00001–**4**65535 [2]
	0 or 1 Coil Discrete (binary) output	BNO (or ANO)	Do	1–65535 [3]
	0 or 1 Holding register (**4**XXXXX)	BNO (or ANO)	BIT*n* (where *n* is a value 0-15 defined in points list)	**4**00001–**4**65535

[1] The Modbus register address (sometimes called register, address, code, or parameter) must be a decimal value. If the register addresses in the points list include the letters A-F, use a scientific calculator to convert these hexadecimal values to decimal values.

If the register addresses in the points list are 5-digit numbers in the range **#**0001-**#**9999 (where **#** = the prefix **1**, **3**, or **4**), you may use the addresses as they are, or change them to fit the formats in the table above by shifting the prefix one digit to the left. For example, if you see the address **3**8129, you can also use **3**08129.

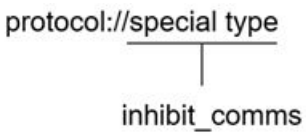
[2] Each Float uses 2 consecutive Modbus register addresses. Use the lower number in the microblock address.

[3] Enter the number without any leading zeros. For example, enter 125, not 000125.

64-bit Modbus registers are not supported. See Modbus Troubleshooting (page 52) for more information on register addresses.

Special Modbus addresses

Inhibit Device Communications



Example:mtcpip://inhibit_comms

The "inhibit_comms" ANO allows communications to be disabled to a single Modbus slave device based on the ANO's value. The ANO point `mtcpip://inhibit_comms` disables communications to the slave device specified by the wire value of the ANO for the IP port. For example, if the ANO has a value of 1 then communications are disabled for slave device 1 on the IP port.

NOTES

- The inhibit_comms port is based on the communications port referenced in the URL. You can disable communications for a slave address on one port without affecting communications to the same slave address on another port.
- Points that are inhibited by the inhibit_comms ANO show an Error Code 97. This applies to both ANIs and ANOs.

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

In the i-Vu® XT or TruVu™ controller, Modbus communication is already in the standard drv_fwex driver <v103 or later>. You do not need a special Modbus driver.

If you need an updated driver or the latest SAL library, go to Carrier Control Systems Support Site and save it to your computer.

To change the driver in the controller

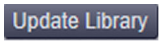
1. Do one of the following:

If the driver is...	
In the **Driver Version** drop-down list	a. Select the driver. b. Click **Accept**.
Not in the **Driver Version** drop-down list	a. Click **Add**. b. Browse to select the driver. c. Click **Open**. d. Click **Continue**. e. Click **Close**. f. Click **Close** again.

2. Click the **Download All Content** button.
3. Click **OK**.
4. Click **Accept**.

To update the SAL library in the i-Vu® Standard, Plus, or Pro application

1. In the i-Vu® interface, click **System Menu**  , then select **System Options** > **Update**.

   NOTE Expand **Current Libraries (.sal)** to see the current SAL libraries and their revision. Compare them to what you downloaded and determine if any of them need updating.
2. Click 

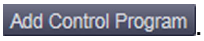
and browse to the updated .sal file that you have saved on your computer, select the file, and click **Open**.
3. Click **Continue**.
4. When process is complete, the message appears **File added successfully**.
5. Click **Close**.
6. Click **Close** again.
7. Click the **Download All Content** button.
8. Click **OK.**
9. Click **Accept.**

To update the SAL library in the i-Vu® Express application

1. Access the **Management Tool** using one of the following methods:
   - Click  , then select **System Options** > **General** tab > **Management Tool**.
   - Launch your browser and type the host name followed by /mgttool/. (Ex. https://ivu/mgttool/)
2. In the **Update Management** tab, click **Apply** to install and apply the latest SAL file.

To add a control program

NOTE i-Vu® Pro - Place the .equipment file in <system_name>**\programs**.

1. In the i-Vu® interface, select the router in the navigation tree and go to the **Devices** > **Manage** tab.
2. Select the controller in the list on the page.
3. If you are adding a new control program, click the **Add Control Program** button 

. A dialog window appears.
4. Enter a name for your control program in **Display Name** and select your controller in the **Controller** drop-down list.
5. Do one of the following:

If the control program is...	
In the **Control Program** drop-down list	Select the control program.
Not in the **Control Program** drop-down list	a. Click **Add New**. b. Browse to select the control program. c. Click **Open**. d. Click **Continue**. e. Click **Close**.

6. Click **Continue**. When message appears **File added successfully**, click **Close**.
7. Click **Close** again.

8. Right-click on the controller in the list and select **Check Status** from the list. The status of the controller should say **File Mismatch**.
9. Click the **Download All Content** button.

3 Connect the Carrier controller to the third-party device

Use one of the following CAT5 or higher Ethernet cables:

- A cross-over cable to connect the Carrier controller directly to the third-party Modbus device
- A straight-through cable to connect the controller to a hub or switch, and a second straight-through cable to connect the hub or switch to the third-party Modbus device

Maximum cable length: 328 feet (100 meters)

1. Turn off the Carrier controller's power.
2. Check the communications wiring for shorts and grounds.
3. Wire the Carrier controller's **Gig-E**, **Eth0**, or **Eth1** port to the third-party device.

   NOTE These ports are also capable of BACnet communication.
4. Turn on the Carrier controller's power.

4 Set up the driver properties

1. On the navigation tree, right-click the controller and select **Driver Properties**.
2. Expand **Communication Status**, then select **Modbus TCP/IP**.
3. Under **Port Configuration**, select **TCP/IP** as the **Communication Type**.
4. The standard **Modbus TCP Port** is 502. If a different port is to be used, type the port number. Select the **Details** checkbox for help.
5. Under **Modbus Protocol Configuration**, set **Modbus TCP/IP Mode** to **Client**.
6. Set the remaining fields under **Modbus Protocol Configuration** using information from the third-party manufacturer's representative. Select the **Details** checkbox for help.
7. If the Carrier controller has more than 60 TCP/IP connections, under **TCP/IP Protocol Configuration**, change **Close socket after each completed transaction** to **Yes**.

   NOTES

   If you connect more than 60 devices (256 maximum), consider the following:

   - The lower the point count per device, the more devices you can connect.
   - The more devices, the slower the communication between the Carrier controller and the Modbus devices.
   - A practical limit in most systems is approximately 100 devices.
8. On the navigation tree, select the controller, right-click and select **Driver Properties**, then select **Communication Status**.
9. In the **Protocol Status** table, verify that the **mtcpip** protocol shows **Running** on Port Gig-E.

5 Verify the controller is set up correctly

1. On the i-Vu® navigation tree, select 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*.
Some points show question marks instead of values	You may have exceeded the third-party points available in the controller. If so, do one of the following: • Use a controller that provides more third-party points. • Split the points between two control programs used in separate controllers. To determine the number of third-party points used in a controller: On the i-Vu® navigation tree, right-click on the controller and select **Driver Properties** > **Driver** > **Properties** > **Settings** tab, and then scroll to **Network Microblocks**. **Modbus integration points capacity** shows how many points the controller allows and **integration points active** shows how many are currently active.
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 microblock's **Communications Enabled** field on the **Network Points** tab, on the microblock's **Properties** page > **Details** tab, or in the Snap application. • **3 - Address Error - Unknown Protocol Specified** Select the correct port on the **Modbus** driver page, verify that **Address** in the microblock is correct, or set the switches correctly on the controller. • All other errors On the i-Vu® navigation tree, right-click the Carrier controller, select **Driver Properties**, then select **Communication Status** > **Modbus Error Definitions**. Find the error and its possible solution.
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 *<Technical_Instructions>* for scaling information.

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

- A diagnostic capture using Wireshark. See the following section for Wireshark instructions.

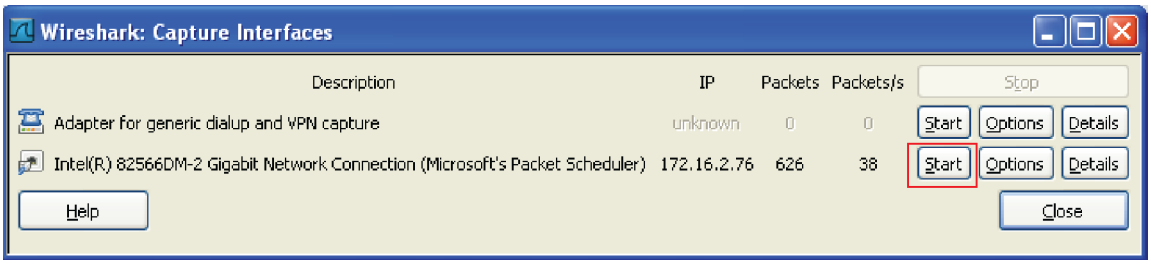
  NOTE If directed by Technical Support, you can use PuTTY to get a diagnostic capture. PuTTY instructions are after the Wireshark instructions.
- A screenshot of the driver's **Communication Status** and **Modbus TCP/IP** pages.
- A screenshot of the **Properties** page > **Network Points** tab showing addresses and errors
- All information from a 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.
- Technical instructions for the third-party device, if available

To capture communication using Wireshark

Use Wireshark, a network analysis tool, to capture the Ethernet communication between the Carrier controller and the Modbus device.

PREREQUISITE Provide an Ethernet hub (not a switch) so that Wireshark can capture all Ethernet communication, not just broadcasts.

1. Download the latest version of Wireshark from the Wireshark website.
2. Run the Wireshark install program, accepting all defaults. Include WinPcap in the installation.
3. Disconnect the network cable from the Carrier controller's Gig-E port, then plug the cable into the hub's **Uplink** port.
4. Use a separate Ethernet cable to connect the controller's Gig-E port to the hub.
5. Connect the Modbus device's Ethernet cable to the hub.
6. Connect the Ethernet port of the computer running Wireshark to the hub.
7. On the computer, click **Start** > **All Programs** > **Wireshark.**
8. From the menu bar, select **Capture** > **Interfaces**.



9. Click the **Start** button next to the adapter that is connected to the network. This starts the IP capture.

   TIP Choose the adapter that shows the **Packets** value changing.
10. Allow the capture to run long enough to ensure that there is sufficient data to allow a technician to review the problem.

11. On the menu bar, select **Capture** > **Stop** to stop the data capture.
12. Select **File** > **Save** and save the capture to a convenient location. Leave the **Save as type** default set to **Wireshark/tcpdump/... - libpcap (*.pcap, *.cap)**.
13. Send the file to Carrier Technical Support for analysis.

TIP You can color code the information in the Wireshark capture file based on user-defined criteria. See Wireshark's Help for instructions on setting up Coloring Rules.

To capture communication using PuTTY

Use PuTTY, a free open source terminal emulation program that works with all Windows operating systems, to capture communication between the controller and the Modbus device into a text file.

PREREQUISITES

- Download and install PuTTY from the PuTTY website.
- Get the Carrier controller's IP address.
- Get the longest microblock refresh time in the control program that has the error you are troubleshooting. In i-Vu®, 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 controller's Port Gig-E 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 Carrier controller to verify communications between the controller and the computer you are using to get this capture.
3. On the i-Vu® navigation tree, right-click the Carrier controller, select **Driver Properties**, then select **Communication Status**
4. On the **Properties** tab, check **Enable Telnet diagnostics**, and then click **Apply**.
5. Start PuTTY.
6. Enter the controller's IP address.
7. Select **Telnet** as the **Connection Type**.
8. Click the **Logging** option in the upper left corner of the left pane.
9. Select **Printable output**.
10. Select a location for the capture text file.
11. Click **Open** to start the session.
12. After **Login:>**, type: `diagport`
    Press **Enter**.
13. To capture data receipts, after **diagport>**, type: `mtcpip rx`
    Press **Enter**.
14. To capture data transmissions, after **diagport>**, type: `mtcpip tx`
    Press **Enter**.

15. To capture more detailed diagnostic messages, after **diagport>**, type: `mtcpip vmsg`
    Press **Enter**.
16. To capture error messages, after **diagport>**, type: `mtcpip emsg`
    Press **Enter**.
17. Verify the displayed text shows:

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

    If `rx`, `tx`, `vmsg`, or `emsg` show `off`, repeat the appropriate step (13, 14, 15, or 16) to turn on capture of that item.
18. After **diagport>**, type: `go`
    Press **Enter**.
19. Run the capture for one of the following periods of time:
    - If all microblock refresh times are one minute or less, run the capture for 5 minutes.
    - If any microblock refresh time is longer than 1 minute, run the capture for 5 times the longest microblock refresh time.
20. Type: `stop`
    Press **Enter**. Verify that you see diagport> before doing the next step.
21. After **diagport>**, type: `logout`
    Press **Enter**.
22. To end the PuTTY session, click the X in the upper right corner.
23. In the i-Vu® interface, uncheck **Enable Telnet diagnostics** (see steps 3 and 4), and then click **Accept**.
24. Open the text file from the location you selected in step 11, and then verify that it legibly shows the same information that PuTTY displayed.

TIP In some cases, you may want the Carrier controller to capture the Telnet diagnostics session and then upload this capture as part of the system log files. For information on how to do this, see Appendix D (page 65).

Controller as a server device on Ethernet

Carrier	
Controllers	All i-Vu® XT or TruVu™ controllers except the i-Vu® XT Router.
Driver	drv_fwex_<latest version>.driverx
Read/write capability	Can be read from and written to
Third party	
Supported equipment	Any client device that supports Modbus (Modicon) protocol
Network media type	Ethernet
Quantity of devices you can connect to the Carrier controller	• Up to 3 Modbus client devices • Up to 254 Modbus slaves on EIA-485

Before-you-begin checklist

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

- ☐ A list of the points in the Carrier controller that the Modbus client will read or write to.
- ☐ Verification that all communication properties have been set on the Modbus devices
- ☐ Verification of Ethernet communication with each Modbus client that the Carrier controller will connect to
- ☐ 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 section to integrate the Carrier controller into a Modbus system. 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 value that you want to expose to the Modbus client.

Formatting a Modbus address

Use the information below to format a valid address for each value that you want to expose to the Modbus client.

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.

Address format:

mtcpip://register type/modbus register address

- register type: See *Register type/ Register address* below.
- modbus register address: Provided in third-party points list. See *Register type/ Register address* below.

Example: mtcpip://UINT/400128

Register type/Register address

When the Carrier controller is a server device, you must expose its points so that they can be read or written to by a third-party client device.

For a third-party device to...	this kind of exposed value in the Carrier controller...	use this microblock...	with this register type...	and a Modbus register address in this range...
Write	0 to 65,535 Unsigned 16-bit integer Holding register (**4**XXXXX)	ANI	Uint (not Unit)	**4**00001–**4**65535
	–32,768 to +32,767 Signed 16-bit integer Holding register (**4**XXXXX)	ANI	Sint	**4**00001–**4**65535
	Value with decimal point Holding register (**4**XXXXX)	ANI	Float	**4**00001–**4**65535
	0 or 1 Coil Discrete (binary) output	BNI	Do	1–65535 [3]

For a third-party device to...	this kind of exposed value in the Carrier controller...	use this microblock...	with this register type...	and a Modbus register address in this range...
Read	0 to 65,535 Unsigned 16-bit integer Input register (**3**XXXXX)	ANO	Uint (not Unit)	**3**00001–**3**65535
	0 to 65,535 Unsigned 16-bit integer Holding register (**4**XXXXX)	ANO	Uint (not Unit)	**4**00001–**4**65535
	–32,768 to +32,767 Signed 16-bit integer Input register (**3**XXXXX)	ANO	Sint	**3**00001–**3**65535
	–32,768 to +32,767 Signed 16-bit integer Holding register (**4**XXXXX)	ANO	Sint	**4**00001–**4**65535
	Value with decimal point Input register (**3**XXXXX)	ANO	Float	**3**00001–**3**65535
	Value with decimal point Holding register (**4**XXXXX)	ANO	Float	**4**00001–**4**65535
	0 or 1 Coil Discrete (binary) output	BNO	Do	1–65535 [3]
	0 or 1 Discrete (binary) input (**1**XXXXX)	BNO	Di	**1**00001–**1**65535

[1] If the register addresses in the points list are 5-digit numbers in the range **#**0001-**#**9999 (where **#** = the prefix **1**, **3**, or **4**), you may use the addresses as they are, or change them to fit the formats in the table above by shifting the prefix one digit to the left. For example, if you see the address **3**8129, you can also use **3**08129.

[2] Each Float uses 2 consecutive Modbus register addresses. Use the lower number in the microblock address.

[3] Enter the number without any leading zeros. For example, enter 125, not 000125.

64-bit Modbus registers are not supported. See Modbus Troubleshooting (page 52) for more information on register addresses.

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

In the i-Vu® XT or TruVu™ controller, Modbus communication is already in the standard drv_fwex driver <v103 or later>. You do not need a special Modbus driver.

If you need an updated driver or the latest SAL library, go to Carrier Control Systems Support Site and save it to your computer.

To change the driver in the controller

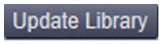
1. Do one of the following:

If the driver is...	
In the **Driver Version** drop-down list	a. Select the driver. b. Click **Accept**.
Not in the **Driver Version** drop-down list	a. Click **Add**. b. Browse to select the driver. c. Click **Open**. d. Click **Continue**. e. Click **Close**. f. Click **Close** again.

2. Click the **Download All Content** button.
3. Click **OK**.
4. Click **Accept**.

To update the SAL library in the i-Vu® Standard, Plus, or Pro application

1. In the i-Vu® interface, click **System Menu**  , then select **System Options** > **Update**.

   NOTE Expand **Current Libraries (.sal)** to see the current SAL libraries and their revision. Compare them to what you downloaded and determine if any of them need updating.
2. Click 

and browse to the updated .sal file that you have saved on your computer, select the file, and click **Open**.
3. Click **Continue**.
4. When process is complete, the message appears **File added successfully**.
5. Click **Close**.
6. Click **Close** again.
7. Click the **Download All Content** button.
8. Click **OK**.
9. Click **Accept**.

To update the SAL library in the i-Vu® Express application

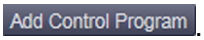
1. Access the **Management Tool** using one of the following methods:
   - Click  , then select **System Options** > **General** tab > **Management Tool**.

- Launch your browser and type the host name followed by /mgttool/. (Ex. https://ivu/mgttool/)

2. In the **Update Management** tab, click **Apply** to install and apply the latest SAL file.

To add a control program

NOTE i-Vu® Pro - Place the .equipment file in <system_name>**\programs**.

1. In the i-Vu® interface, select the router in the navigation tree and go to the **Devices** > **Manage** tab.
2. Select the controller in the list on the page.
3. If you are adding a new control program, click the **Add Control Program** button 

. A dialog window appears.
4. Enter a name for your control program in **Display Name** and select your controller in the **Controller** drop-down list.
5. Do one of the following:

If the control program is...	
In the **Control Program** drop-down list	Select the control program.
Not in the **Control Program** drop-down list	a. Click **Add New**. b. Browse to select the control program. c. Click **Open**. d. Click **Continue**. e. Click **Close**.

6. Click **Continue**. When message appears **File added successfully**, click **Close**.
7. Click **Close** again.
8. Right-click on the controller in the list and select **Check Status** from the list. The status of the controller should say **File Mismatch**.
9. Click the **Download All Content** button.

3 Connect the Carrier controller to the third-party device

Use one of the following CAT5 or higher Ethernet cables:

- A cross-over cable to connect the Carrier controller directly to the third-party Modbus device
- A straight-through cable to connect the controller to a hub or switch, and a second straight-through cable to connect the hub or switch to the third-party Modbus device

Maximum cable length: 328 feet (100 meters)

1. Turn off the Carrier controller's power.
2. Check the communications wiring for shorts and grounds.
3. Wire the Carrier controller's **Gig-E**, **Eth0**, or **Eth1** port to the third-party device.

   NOTE These ports are also capable of BACnet communication.
4. Turn on the Carrier controller's power.

4 Set up the driver properties

1. On the navigation tree, right-click the controller and select **Driver Properties**.
2. Expand **Communication Status**, then select **Modbus TCP/IP**.
3. Under **Port Configuration**, select **TCP/IP** as the **Communication Type**.
4. The standard **Modbus TCP Port** is 502. If a different port is to be used, type the port number. Select the **Details** checkbox for help.
5. Under **Modbus Protocol Configuration**, set **Modbus TCP/IP Mode** to **Server**.
6. On the **Driver Properties** tree, select **Communication Status**.
7. In the **Protocol Status** table, verify that the **mtcpip** protocol shows **Running** on Port Gig-E.

5 Verify the controller is set up correctly

1. On the i-Vu® navigation tree, select the Carrier controller.
2. Select the **Properties** page > **Network Points** tab.

If...	Then...
You see the point value you expect and the **Error** column shows **Initializing**	You have successfully exposed the Carrier controller's value to 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*.
Some points show question marks instead of values	You may have exceeded the third-party points available in the controller. If so, do one of the following: • Use a controller that provides more third-party points. • Split the points between two control programs used in separate controllers. To determine the number of third-party points used in a controller: On the i-Vu® navigation tree, right-click on the controller and select **Driver Properties** > **Driver** > **Properties** > **Settings** tab, and then scroll to **Network Microblocks**. **Modbus integration points capacity** shows how many points the controller allows and **integration points active** shows how many are currently active.

If...	Then...
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 microblock's **Communications Enabled** field on the **Network Points** tab, on the microblock's **Properties** page > **Details** tab, or in the Snap application. • **3 - Address Error - Unknown Protocol Specified** Select the correct port on the **Modbus** driver page in i-Vu®, verify that **Address** in the microblock is correct, or set the switches correctly on the controller. • All other errors On the i-Vu® navigation tree, right-click the Carrier controller, select **Driver Properties**, then select **Communication Status** > **Modbus Error Definitions**. Find the error and its possible solution.
A value is incorrect	Verify that the **Address** in the microblock is correct.

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

- A diagnostic capture using Wireshark. See the following section for Wireshark instructions.

  NOTE If directed by Tech Support, you can use PuTTY to get a diagnostic capture. PuTTY instructions are after the Wireshark instructions.
- A screenshot of the driver's **Communication Status** and **Modbus TCP/IP** pages.
- A screenshot of the **Properties** page > **Network Points** tab showing addresses and errors
- All information from a 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.
- Technical instructions for the third-party device, if available

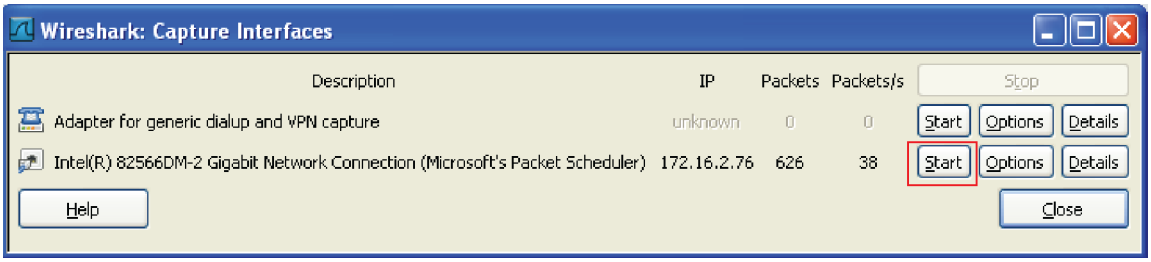
To capture communication using Wireshark

Use Wireshark, a network analysis tool, to capture the Ethernet communication between the Carrier controller and the Modbus device.

PREREQUISITE Provide an Ethernet hub (not a switch) so that Wireshark can capture all Ethernet communication, not just broadcasts.

1. Download the latest version of Wireshark from the Wireshark website.
2. Run the Wireshark install program, accepting all defaults. Include WinPcap in the installation.
3. Disconnect the network cable from the Carrier controller's Gig-E port, then plug the cable into the hub's **Uplink** port.
4. Use a separate Ethernet cable to connect the controller's Gig-E port to the hub.
5. Connect the Modbus device's Ethernet cable to the hub.
6. Connect the Ethernet port of the computer running Wireshark to the hub.

7. On the computer, click **Start** > **All Programs** > **Wireshark.**
8. From the menu bar, select **Capture** > **Interfaces**.



9. Click the **Start** button next to the adapter that is connected to the network. This starts the IP capture.

   TIP Choose the adapter that shows the **Packets** value changing.
10. Allow the capture to run long enough to ensure that there is sufficient data to allow a technician to review the problem.
11. On the menu bar, select **Capture** > **Stop** to stop the data capture.
12. Select **File** > **Save** and save the capture to a convenient location. Leave the **Save as type** default set to **Wireshark/tcpdump/... - libpcap (*.pcap, *.cap)**.
13. Send the file to Carrier Technical Support for analysis.

TIP You can color code the information in the Wireshark capture file based on user-defined criteria. See Wireshark's Help for instructions on setting up Coloring Rules.

To capture communication using PuTTY

Use PuTTY, a free open source terminal emulation program that works with all Windows operating systems, to capture communication between the controller and the Modbus device into a text file.

PREREQUISITES

- Download and install PuTTY from the PuTTY website.
- Get the Carrier controller's IP address.
- Get the longest microblock refresh time in the control program that has the error you are troubleshooting. In i-Vu®, 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 controller's Port Gig-E 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 Carrier controller to verify communications between the controller and the computer you are using to get this capture.

3. On the i-Vu® navigation tree, right-click the Carrier controller, select **Driver Properties**, then select **Communication Status**
4. On the **Properties** tab, check **Enable Telnet diagnostics**, and then click **Apply**.
5. Start PuTTY.
6. Enter the controller's IP address.
7. Select **Telnet** as the **Connection Type**.
8. Click the **Logging** option in the upper left corner of the left pane.
9. Select **Printable output**.
10. Select a location for the capture text file.
11. Click **Open** to start the session.
12. After **Login:>**, type: `diagport`
    Press **Enter**.
13. To capture data receipts, after **diagport>**, type: `mtcpip rx`
    Press **Enter**.
14. To capture data transmissions, after **diagport>**, type: `mtcpip tx`
    Press **Enter**.
15. To capture more detailed diagnostic messages, after **diagport>**, type: `mtcpip vmsg`
    Press **Enter**.
16. To capture error messages, after **diagport>**, type: `mtcpip emsg`
    Press **Enter**.
17. Verify the displayed text shows:

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

    If `rx`, `tx`, `vmsg`, or `emsg` show `off`, repeat the appropriate step (13, 14, 15, or 16) to turn on capture of that item.
18. After **diagport>**, type: `go`
    Press **Enter**.
19. Run the capture for one of the following periods of time:
    - If all microblock refresh times are one minute or less, run the capture for 5 minutes.
    - If any microblock refresh time is longer than 1 minute, run the capture for 5 times the longest microblock refresh time.
20. Type: `stop`
    Press **Enter**. Verify that you see diagport> before doing the next step.
21. After **diagport>**, type: `logout`
    Press **Enter**.
22. To end the PuTTY session, click the X in the upper right corner.

23. In the i-Vu® interface, uncheck **Enable Telnet diagnostics** (see steps 3 and 4), and then click **Accept**.
24. Open the text file from the location you selected in step 11, and then verify that it legibly shows the same information that PuTTY displayed.

TIP In some cases, you may want the Carrier controller to capture the Telnet diagnostics session and then upload this capture as part of the system log files. For information on how to do this, see Appendix D (page 65).

Modbus Troubleshooting

The following troubleshooting information depends on whether your Carrier controller is a master/client or a slave/server.

In most cases, a diagnostic capture can help determine the problem. See *To capture communication using ...* in the appropriate section of this document.

- If the Carrier controller is a Serial Master or Ethernet Client (page 52)
- If the Carrier controller is a Serial Slave or Ethernet Server (page 57)

If the Carrier controller is a Serial Master or Ethernet Client

Register addresses

Because Modbus register address formats differ from one manufacturer to another, the most common problems in a Modbus integration are caused by a microblock address having an incorrect register address.

If the Carrier controller is a serial master or Ethernet client, the register address that you include in a microblock address is the register address that you want to read from/write to in the slave/server. Microblocks support Modbus register addresses that consist of a base register address (1–65535) and a one digit prefix (except coils) that defines the type of value.

This type of value...	Has the prefix...	Example of register address
Discrete input	1	**1**03459 or **1**3459
Input register	3	**3**04564 or **3**4564
Holding register	4	**4**01563 or **4**1563
Coil	No prefix	

Base address

Most manufacturers begin counting register addresses at 1; some begin at 0. Other than contacting the manufacturer to get clarification, you can look at the register address list to see if the addressing in any table starts at 0. If any table's addressing begins at 0, you need to add 1 to each register address in order to read the right register. For example, if you are given a register address of **4**0100, you must enter the address as **4**0101 to read the correct register.

Prefix

Some manufacturers include the prefix in their register address. If you add another prefix, you will have an invalid register address. For example, if the third-party manufacturer shows a holding register address is **4**0123 and you add the prefix **4**, your register address will be **4**40123, which is an invalid address.

Errors

If the **Properties** page > **Network Points** tab shows errors, look for the error in the table below. To see a more extensive list, right-click the controller in the navigation tree, select **Driver Properties** > **Driver** > **Communication Status** > **Modbus Error Definitions**.

Error code/message	Possible solution(s)
Error ## - Modbus Exception Code - XXXX	Where: **##** = a number from 51 to 61, and **XXXX** = the exception code description A server/slave device returns a Modbus Exception Code when it cannot respond to the master/client. The most common are: • **ILLEGAL FUNCTION**: The master/client sends an unsupported function code to the slave/server. For example, the master/client tries to query with function code 16, which is not supported by the slave/server. **NOTE** Some manufacturers do not support: Function Code 15—Write Multiple Coils, or Function Code 16—Write Multiple Registers To resolve this, right-click the controller in the navigation tree, select **Driver Properties** > **Driver** > **Communication Status** > **Modbus TCP/IP**. Set **Restrict coil and register commands** to **Yes**. • **ILLEGAL DATA ADDRESS**: The master/client sends an invalid register address to the slave/server. For example, the master/client tries to read register 500, but the highest register address is 100. To resolve this error, correct the register address. • **ILLEGAL DATA VALUE**: The master/client sends an invalid value to the slave/server. For example, the master/client tries to write a decimal value 150 to a Modbus Coil. To resolve this error, change the value you are writing to a value the register can accept.
Error 94 - Response Err – Invalid Exception Code	Although rare, the Exception Code returned by the Modbus slave/server device may be incorrect. Valid Exception Code range is 1 to 11 (except 9). Use a diagnostic capture to determine the invalid exception code. Then contact the third-party manufacturer for a resolution.
Error 72 – Addr Err – Invalid Register Number Prefix or **Error 73 – Addr Err – Invalid Register Number Range**	See Register Addresses (page 52).

Error code/message	Possible solution(s)
Error 78 – Addr Err – Invalid Duplicates Found	You cannot have multiple ANO/BNO microblocks in the same controller write to the same address. If you have duplicates, only one will be processed. Remove all duplicates, and then download memory. **NOTE** You can have multiple ANI/BNI microblocks read from the same address.
Error 79 – Addr Err – Possible Overlapped Register	This error indicates registers that share a common address. For example: Modbus://FLOAT/401000/58 Modbus://UINT/401001/58 In this example, the FLOAT register type uses two register addresses, 1000 and 1001. So, the UINT's register address overlaps the FLOAT's 1001 address. The last microblock processed will get an error. To find the issue, the application programmer should check the previous and next sequential microblock register addresses.

Error code/message	Possible solution(s)
Error 11 – Unable to allocate packet	Although rare, you may see this error if you have a large number of network points (more than 250) and most microblocks have a **Refresh Time** of 10 seconds or less. To resolve this, increase the **Refresh Time** on non-critical points. Critical points can still be updated more frequently. As described below, you can use diagnostic captures to fine-tune your system to make the most of the available bandwidth. See *To capture communication using ...* in the appropriate section of this document. Only turn on the vmsg (verbose message) to see how the points are queried. Serial Master By looking at the capture, the engineer can follow how efficient the query may be. Look at the **bolded** packets below. The Master reads from device 58, Function Code 3 (Read Holding Reg) and register address 1 through 3, for the total of 3 registers. This packet is repeated twice in sequence, which may not be desirable. To resolve this, change the refresh time of microblocks with register address 2 and 3 to 10 minutes (or larger). Register addresses 2 and 3 will be read and updated when register address 1 is read and will only trigger an update if register address 1 is removed from the application. Observe the capture and make sure that the repetition is resolved. MODBUS<VM>READ Dev:58 - FC:3 - Reg:601 -> 603 - Qty:3 **MODBUS<VM>READ Dev:58 - FC:3 - Reg:1 -> 3 - Qty:3** **MODBUS<VM>READ Dev:58 - FC:3 - Reg:1 -> 3 - Qty:3** MODBUS<VM>READ Dev:58 - FC:3 - Reg:601 -> 603 - Qty:3 MODBUS<VM>READ Dev:58 - FC:3 - Reg:1 -> 3 - Qty:3 MODBUS<VM>READ Dev:58 - FC:3 - Reg:401 -> 406 - Qty:6 MODBUS<VM>READ Dev:58 - FC:4 - Reg:2001 -> 2009 - Qty:9 MODBUS<VM>READ Dev:58 - FC:4 - Reg:1001 -> 1009 - Qty:9 MODBUS<VM>READ Dev:58 - FC:4 - Reg:601 -> 603 - Qty:3 MODBUS<VM>READ Dev:58 - FC:4 - Reg:301 -> 306 - Qty:6 MODBUS<VM>READ Dev:58 - FC:4 - Reg:201 -> 206 - Qty:6 MODBUS<VM>READ Dev:58 - FC:4 - Reg:101 -> 103 - Qty:3 MODBUS<VM>READ Dev:58 - FC:4 - Reg:1 -> 3 - Qty:3

Error code/message	Possible solution(s)
	IP Client Use the same techniques described above for the Serial Master. Look at the **bolded** packets below. The client reads from Device IP 161.145.174.36 with device address 0. It reads register 65532 through 65535 twice sequentially. To resolve this, change the refresh time to 10 minutes (or larger) for each microblock in the group except for the first microblock with register address 65532. Register addresses 65533 through 65535 will be read and updated when register address 65532 is read, and will only trigger an update if register address 65532 is removed from the application. MTCPIP<VM>Rx response ID:44 MTCPIP<VM>Rx response ID:45 MTCPIP<VM>READ Dev IP:161.145.174.236 - Addr:0 - FC:3 - Reg:40009 -> 40016 - Qty:8 - ID:55 MTCPIP<VM>READ Dev IP:161.145.174.236 - Addr:0 - FC:3 - Reg:40000 -> 40007 - Qty:8 - ID:56 MTCPIP<VM>READ Dev IP:161.145.174.236 - Addr:0 - FC:3 - Reg:1 -> 12 - Qty:12 - ID:57 MTCPIP<VM>Rx response ID:46 MTCPIP<VM>Rx response ID:47 MTCPIP<VM>READ Dev IP:161.145.174.236 - Addr:0 - FC:2 - Reg:65532 -> 65535 - Qty:4 - ID:58 **MTCPIP<VM>READ Dev IP:161.145.174.236 - Addr:0 - FC:1 - Reg:65532 -> 65535 - Qty:4 - ID:59** **MTCPIP<VM>READ Dev IP:161.145.174.236 - Addr:0 - FC:1 - Reg:65532 -> 65535 - Qty:4 - ID:60** MTCPIP<VM>Rx response ID:48 MTCPIP<VM>Rx response ID:49
Error 86 – Unable to update point value	The microblock value is not updating. Serial Master In rare cases, the master may receive a valid response but cannot match it to any microblock. The only way to determine this is to review a diagnostic capture. To resolve, right-click the controller in the navigation tree, select **Driver Properties** > **Driver** > **Communication Status** > **Modbus Serial** page, and increase the **Interpacket Delay**. This solution is not desirable if the controller's point count is high. IP Client Because Modbus TC/IP does not have a timeout defined, this error may occur when the client communicates with a very slow server. If a client microblock with a low refresh time (1 second) sends a query every second but the server requires more than 2 seconds to respond, this error will be set on the microblocks after a few cycles of queries. Get a diagnostic capture using Wireshark to see the timing between query and response. Increase the refresh time to allow the server to respond before a new request is sent. This solution will slow communication between the server and client controllers.

Error code/message	Possible solution(s)
Error 40 – No response	Serial Master If the error is persistent, check the wiring, communication baud rate, and device address. If it is intermittent, right-click the controller in the navigation tree, select **Driver Properties** > **Driver** > **Communication Status** > **Modbus Serial** page, and try changing the following settings: • Increase the **Interpacket Delay** in increments of 10 ms. Maximum recommended is 100 ms, depending on the size of control program. The bigger the control program is, the smaller this setting should be. • If the query reads multiple registers, try reducing the size of **Maximum Registers to Request**. Use the diagnostics capture to determine where the issue is most likely to occur. If you need to reduce multiple registers, set the **Maximum Registers to Request** and/or **Maximum Coils/DIs to Request** to 1. You can optimize later if needed. • If the query writes to multiple registers, you may want to inhibit multiple write altogether. Use the diagnostics capture to determine where the issue is most likely to occur. In most cases, the slave device is more susceptible to multiple writes. To inhibit multiple registers writes, set **Restrict coil and register commands** to **Yes**. IP Client TCP/IP communication is successful, but the Modbus packet never gets a response from the Modbus server. Talk to the third-party vendor to determine the reason the server is not responding.
No microblock error, but a float value is not correct	FLOAT register types use 2 register addresses. The order in which they are processed differs from one manufacturer to another. If you see incorrect float values, right-click the controller in the navigation tree, select **Driver Properties** > **Driver** > **Communication Status** > **Modbus TCP/IP**. Change the value of the **Reverse Float/32 Bit Integer** field. **CAUTION** This setting is applied globally for all float values in the controller. If you have some float registers that are to be processed one way and others that are to be processed the other way, you must use separate master/client devices to talk to them.

If the Carrier controller is a Serial Slave or Ethernet Server

Register addresses

If the Carrier controller is a slave/server, register addresses are 1-based, not 0-based, and do not require any adjustment as long as the serial master or Ethernet client adheres to the Modbus protocol implementation described on the Modbus website (www.modbus.org).

If the Carrier controller is a slave/server, the register address that you include in a microblock address is the register address that you want to expose to master/client. Microblocks support Modbus register addresses that consist of a base register address (1–65535) and a one digit prefix (except coils) that defines the type of value.

This type of value...	Has the prefix...	Example of register address
Discrete input	1	**1**03459 or **1**3459
Input register	3	**3**04564 or **3**4564
Holding register	4	**4**01563 or **4**1563
Coil	No prefix	

Prefix

Some manufacturers include the prefix in their register address. If you add another prefix, you will have an invalid register address. For example, if the third-party manufacturer shows a holding register address is **4**0123 and you add the prefix **4**, your register address will be **4**40123, which is an invalid address.

Errors

If the **Properties** page > **Network Points** tab shows errors, look for the error in the table below. To see a more extensive list, right-click the controller in the navigation tree, select **Driver Properties** > **Driver** > **Communication Status** > **Modbus Error Definitions**.

Error code/message	Possible solution(s)
Error 72 – Addr Err – Invalid Register Number Prefix or **Error 73 – Addr Err – Invalid Register Number Range**	See Register Addresses (page 57).
Error 78 – Addr Err – Invalid Duplicates Found	Ensure all addresses are unique.
No microblock error, but the value displayed at the master/client is not correct	FLOAT register types use 2 register addresses. The order in which they are processed differs from one manufacturer to another. If you see incorrect float values, right-click the controller in the navigation tree, select **Driver Properties** > **Driver** > **Communication Status** > **Modbus TCP/IP**. Change the value of the **Reverse Float/32 Bit Integer** field.

Appendix A - Migrating a control program used with a previous Modbus driver

CAUTION If your control program was written for a different (older) Modbus driver, you must carefully follow the section below to make necessary changes to your control program.

If your existing integration control program...	You must...
Uses abbreviated register addresses	Change the abbreviated (invalid) addresses to complete addresses. For example, change modbus://UINT/123/1 to modbus://UINT/400123/1.
Has multiple network output microblocks in the same controller writing to the same address	Reconfigure the control program. The fwex driver does not support this.
Has hundreds of microblocks with the same refresh time in sequentially addressed registers	Increase the refresh time for non-critical points. For more information, see Error 11 in Errors in this document.
Uses register addresses in the 1–9999 range	Do nothing. The fwex driver supports a wider range of addresses (1–65535) but still supports the older address format. As long as the register address prefixes are correct (1 for discrete inputs, 3 for input registers, or 4 for holding registers), the driver will read the registers correctly.

Appendix B - Modbus Protocol Conformance Statement

The following Modbus features and commands are supported by the Carrier Modbus drivers. See the Modbus website for complete Modbus protocol information.

Serial connection:

Modes	RTU [1] ASCII	
Media type	EIA-485, 2-wire	
Baud rate	9600 [1] 19200 [1] 38400 [1]	57600 76800 115200
Data bits	7 8 [1]	
Parity	None [1] Odd Even	
Stop bits	1 [1] 2	

[1] Most commonly used value(s)

Ethernet connection:

Communication Type	TCP/IP
Media Type	Ethernet
Baud rate	10 Mbps/100 Mbps/1000 Mbps
Maximum TCP/IP Connections	60 [2]

[2] You may be able to connect more devices (254 maximum) if you consider the following:
- The lower the point count per device, the more devices you can connect.
- The more devices, the slower the communication between the Carrier controller and the Modbus devices.

A practical limit is approximately 100 devices. To connect more than 60 devices, change the **Close socket after each completed transaction** setting to **Yes** in the driver.

Serial or Ethernet:

Function codes - command	Register address range
01 - Read coils	1-65535
02 - Read discrete inputs	100001-165535

Function codes - command	Register address range
03 - Read holding registers	**4**00001-**4**65535
04 - Read input registers	**3**00001-**3**65535
05 - Write single coil	
06 - Write single register	
15 - Write multiple coils	
16 - Write multiple registers	

Appendix C - 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 i-Vu® XT or TruVu™ controller. Any parameters set locally through this interface take effect immediately. To connect to the controller setup pages, some i-Vu® XT or TruVu™ controllers have an Ethernet Service Port and some have a USB Service Port.

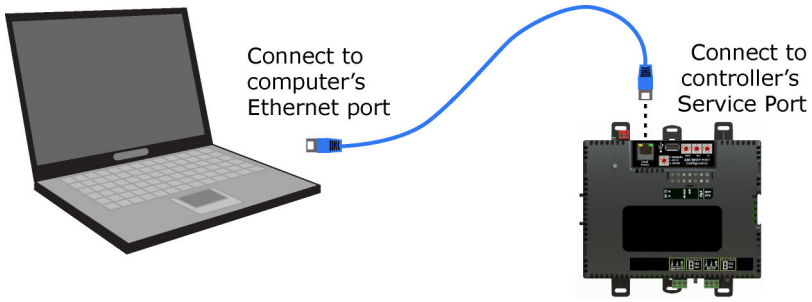
WARNING After setting parameters locally through the Service Port interface and then connecting the controller to the i-Vu® application, proceed carefully, as follows:

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.

To connect to an Ethernet Service Port:

1. Make sure your computer is set to get its IPv4 address automatically via DHCP.
2. Connect an Ethernet cable from a computer to the controller as shown below.



3. Turn off the computer's Wi-Fi if it is on.
4. If your computer uses a static IP address, use the following settings:
   - Address: 169.254.1.x, where x is 2 to 7
   - Subnet Mask: 255.255.255.248
   - Default Gateway: 169.254.1.1
5. If it uses a DHCP address, leave the address as it is.
6. Open a web browser on the computer.
7. Navigate to https://local.access or https://169.254.1.1 to see the controller setup pages.

CAUTION Do not connect the **Service Port** to the same network that the Gig-E port is connected to. The **Service Port** is intended for single computer access only and has a fixed IP address that is not compatible with a building network.

To connect to a USB Service Port

To connect the i-Vu® XT or TruVu™ to a computer using the Carrier wireless service adapter:

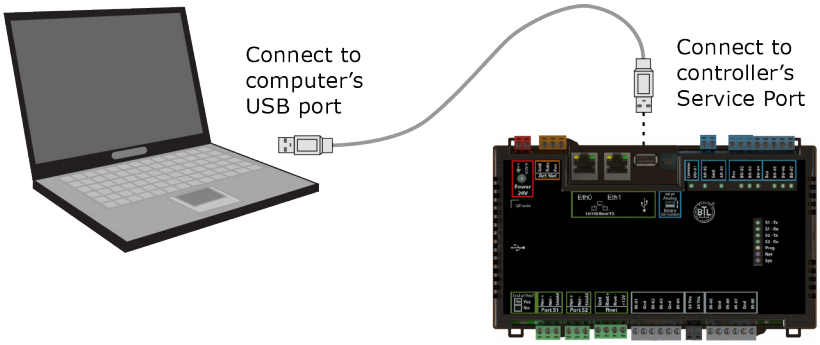
1. Insert the Carrier wireless service adapter (part# USB-W) into the controller's USB Service Port to communicate with a Wi-Fi-compatible computer.

   CAUTION If the Eth1 port is in use, connect a USB Type-A Male to Female extension cable to the USB Service Port and the Carrier wireless service adapter.
2. Open your computer's wireless network display to view your available wireless networks.

   NOTE i-Vu® XT or TruVu™ only supports the 5 GHz band and not the 2.4 GHz band.
3. Connect to the wireless network using the network SSID and password that are printed on the Carrier wireless service adapter.
4. Open a web browser on the computer and navigate to http://local.access or http://169.254.1.1 to see the controller setup pages.

To connect the i-Vu® XT or TruVu™ to a computer using a USB cable.

1. Connect a USB Type-A Male to Male USB cable from a computer to the controller's USB Service Port, as shown below.



2. A new Ethernet connection will appear on your computer.
3. If your computer uses a static IP address, use the following settings for the new connection:
   - Address: 169.254.1.x, where x is 2 to 7
   - Subnet Mask: 255.255.255.248
   - Default Gateway: 169.254.1.1

   If it uses a DHCP address, leave the address as it is.
4. Open a web browser on the computer
5. Navigate to http://local.access or http://169.254.1.1 to see the controller setup pages.

Once you have accessed the controller setup pages, set the IP address parameters on the **Ports** tab and select the **Modbus** tab to adjust Modbus parameters.

NOTE The parameters on the **Modbus** tab are also configurable on the **Driver Properties** pages in the i-Vu® interface.

NOTES

- You can enable Gig-E port and Port S2 for Modbus on the **Modbus** page of the Service Port interface.
- You can only enable Port S1 for Modbus by setting the rotary protocol selector on the controller.
- You can see the status of the protocols that are running on each port on the **Ports** tab.
- The Modbus IP index table parameters are not accessible through the Service Port.

CAUTION If Port S2 is enabled for BACnet and also set to be the **Home Network**, you cannot enable Modbus on Port S2.

Appendix D - Recording the Telnet diagnostics session(s) in the controller's system log files

You can use the Telnet diagnostics interface to analyze Modbus problems by capturing the Telnet session into log files which are stored on the controller. You can then download the log files to examine them.

To capture the log files in the controller

1. On the i-Vu® navigation tree, right-click the controller and select **Driver Properties** > **Communication Status** > **Properties** page.
2. Check **Enable Telnet diagnostics**.

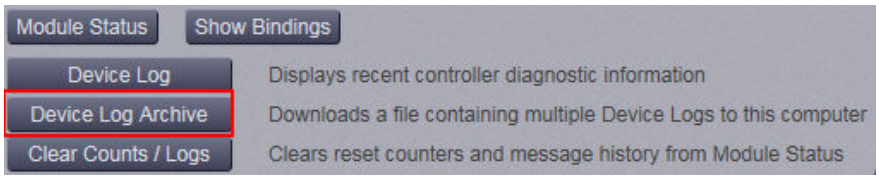
   CAUTION If unchecked, the Telnet feature of storing logs is disabled, even if you fill in the next field.
3. In the **Number of Telnet sessions to store in controller** field, fill in the number of logs (1 to 10) that you want to save.

   NOTES
   - Entering a value of **0** disables Telnet session logging and deletes past Telnet session logs. You can still use the Telnet interface, but the controller will not log the sessions if the number is **0**.
   - Once the number of log files reaches the number you entered, the oldest log file is automatically deleted when a new one is created.
   - A single log file's maximum size is 25MB.

The Telnet log files are the same as what is displayed through the Telnet interface. If you do not want to save the log files in the controller, you can also capture them by enabling that feature in the Telnet client application, i.e. PuTTY.

Download the Telnet log files

On the navigation tree, right-click the controller and select **Driver Properties** > **Driver** > **Properties** > **Update tab.** page. Click **Device Log Archive** to download all of the system logs, including the Telnet diagnostic log files that are stored on the controller. Downloading the log files does not erase them from the controller.



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*
8/15/25			X-PM-LO-J
			X-D
7/29/21			X-D
			X-D
			X-PM-LO-O
4/6/20	Controller as a slave device on EIA-485 > Connect the Carrier controller to the third-party device > To wire a third-party device	Added notes about autobaud	X-PM-KC-O
	Controller as a slave device on EIA-485 > Before you begin checklist	Added notes about autobaud	X-PM-KC-O
	Controller as a master device on EIA-485 Controller as a slave device on EIA-485 Controller as a client device on Ethernet Controller as a server device on Ethernet	Added TruVu™ MPC Processor (part #s TV-MPCXP1628, TV-MPCXP1628-NR)	X-D
4/12/19	Controller as a master device on EIA-485 Controller as a slave device on EIA-485 Controller as a client device on Ethernet Controller as a server device on Ethernet	Added TruVu™ MPC Processor (part #TV-MPCXP).	X-D
	Verify the controller is set up correctly	Changed the description of "Some points show question marks instead of values"	

* For internal use only