General

Modbus is an established data sharing protocol, serving industry for decades. There are several serial versions. The Ethernet version, called Modbus/TCP, has two types of Stations, Servers, and Clients. For purposes of simplification, we'll use these features to define the two:

Servers – Store Data.

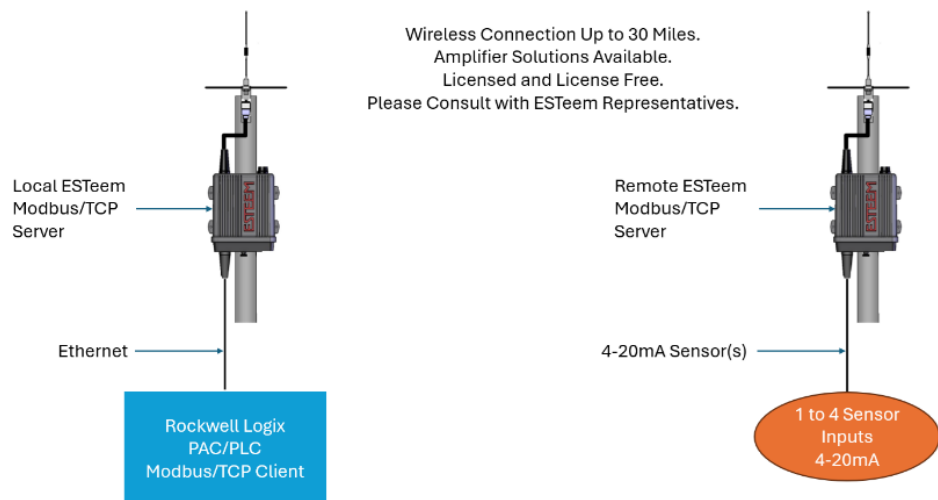Clients – Both send and receive Data to and from Servers.

The easiest way to distinguish between the two is the Clients address the Servers while Servers do not address Clients. This is simply because Clients send and request data while Servers do not. Beyond this simplistic definition some understanding of Modbus is helpful which is beyond the scope of this document. However, it is important to know that Rockwell Controllers like ControlLogix, CompactLogix, MicroLogix1400(Series B), and Micro800 all can perform Modbus communications. ControlLogix and CompactLogix use the Sample Code that is the subject of this Technical Bulletin.

Performing this requires a knowledge of Rockwell Logix Programming. Rockwell Automation and their Distributors can provide training recommendations and resources. ESTeem can also provide a configuration service to provide a completed system. Please contact ESTeem for pricing.

ESTeem 195 Model Radios – Modbus/TCP

ESTeem 195 models store valuable information on the performance and health of your radio equipment. This information is available to SCADA and Alarms/Events Servers, providing real time health of your Wireless System. Knowing RSSI losses, Voltage levels, MCU Temperature, or any of the available information can provide both awareness and troubleshooting information that reduces downtime and helps you improve performance, catching issues before they become problems.

ESTeem 195's also, uniquely, have 4 channels of 4-20mA input to which Instrumentation like Levels, Pressures, and other signal variables can be connected and transmitted, without the need for cumbersome additional hardware. This one feature makes simple remote monitoring practical. Being available in our 195 Narrow Band Radios provides low power consumption, simplicity, and reliable distance transmission even through forestry and urban environments. Even for very remote locations without Utility Power, Solar and other alternative power sources make these low power applications practical in monitoring wells, ponds, and other environmental variables.

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With our ESTeem Modbus Monitor, the Modbus Registers can easily be monitored, both on a local radio and one connected remotely. Please see Software Suite Manual.
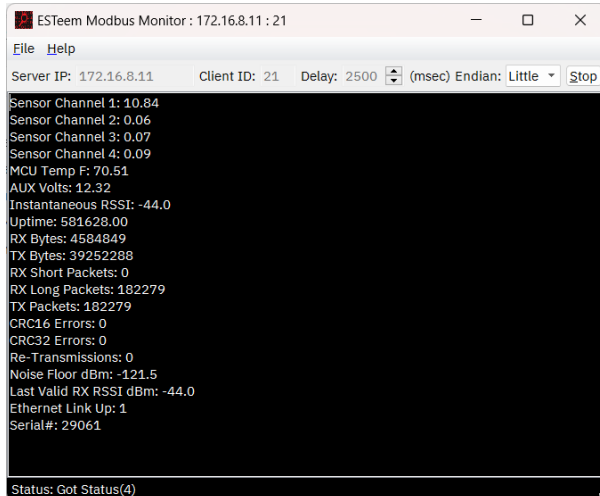
Register	Example	Description
1000	0.029145	4-20 mA Channel 1
1002	0.023357	4-20 mA Channel 2
1004	0.013176	4-20 mA Channel 3
1006	0.032828	4-20 mA Channel 4
1008	68.246094	MCU temperature (in °F)
1010	11.898932	Auxiliary voltage
1012	-123.000000	Instantaneous RSSI from any signal on the operating frequency (in dBm)
1014	474.000000	Radio uptime (in seconds)
1016	12672.000000	Total RX received (in bytes)
1018	6833.000000	Total TX sent (in bytes)
1020	4.000000	Number of header blocks / short packets (UA, SABM, etc) received
1022	99.000000	Number of long packets (> 1 block) received
1024	103.000000	Number of transmitted packets
1026	0.000000	Number of failed error correction on headers
1028	0.000000	Number of failed error correction on data
1030	0.000000	Number of re-transmits (if retries and acks enabled)
1032	-124.189369	Average noise floor (in dBm)
1034	-58.000000	RSSI of last valid packet received from ESTeem 192/195 (in dBm)
1036	1.000000	Ethernet link up/down (1 = up / 0 = down)
1038	25106.000000	Model Serial Number

*ESTeem Software Suite
[Modbus Monitoring]*

ESTeem 195 Modbus Registers

Rockwell Sample Code

Rockwell's free Sample Code Library has programming available, for download, that can quickly make use of ESTeem Radio Modbus registers. These programs will work for both Control Logix and Compact Logix versions 20 and greater. The Rockwell Sample Code has two types, Clients, and Servers. **Since ESTeem 195 Radios are Modbus Servers, we make use of the Client version.** There are also Visualization samples available for Rockwell HMI and SCADA products. While helpful for projects, they are beyond the scope of this document. Lastly there are well written manuals. Under the Manual sub-directory is "Modbus TCP Client – AOI based code for ControlLogix v…pdf" This manual is for the Sample Code we use.

Additionally, **ESTeem has developed a UDT (User Data Type) specific for the ESTeem 195 radio**. This is available upon request. The UDT provides both Descriptions and the format of Floating Point. The Rockwell Sample Code and ESTeem UDT are easily imported to your program using Logix Designer (or previous Logix programming software >= Ver 20).

One of the best resources to help get you started is a YouTube Trainer, Tim Wilbourne. This link will help you understand the basics: https://www.youtube.com/watch?v=ws_A9s_VFdo
Tim Wilbourne is a valuable resource you will benefit from Subscribing to.

OK, you've found, downloaded, and expanded your Rockwell Sample Code. Note where it is now stored. You've requested the ESTeem 195 UDT from ESTeem Wireless**.**

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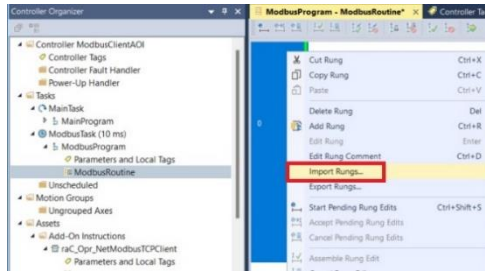
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Let's Begin

Whether starting with an existing or a new Logix program we will do this as recommended, a new Periodic Task at 10mSec.

Then below this a New Program and lastly a new Routine (Ladder).
Go to one of the rungs inside the routine (here called "ModbusRoutine"), right click and select "Import Rungs…"

At this point where the Rockwell Sample Code is stored becomes important. Drill into that location where you expanded the Sample Code and open the "Logic" Subdirectory.
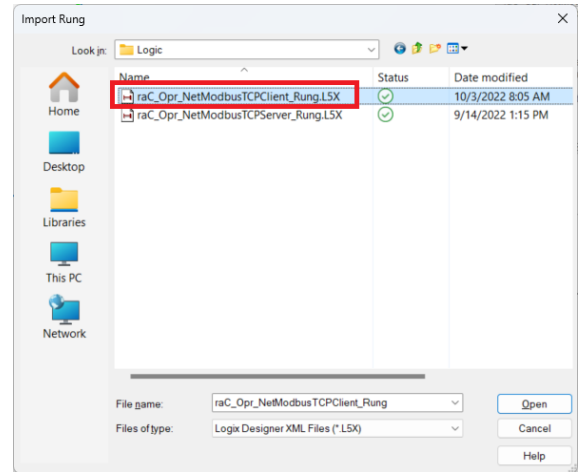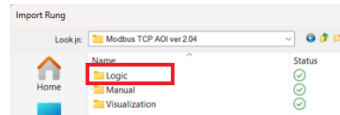
Select and [Open] the Client file (raC_Opr_NetModbusTCPClient_Rung.L5X).

If you intend to keep the names of the Tags as standard (all starting with "Client_01") then click [OK]. If you want to change them to something more meaningful this is where you [Find/Replace…] them. This is part of the Sample Code manual mentioned earlier.
For our purposes we will keep the default name, "Client_01".
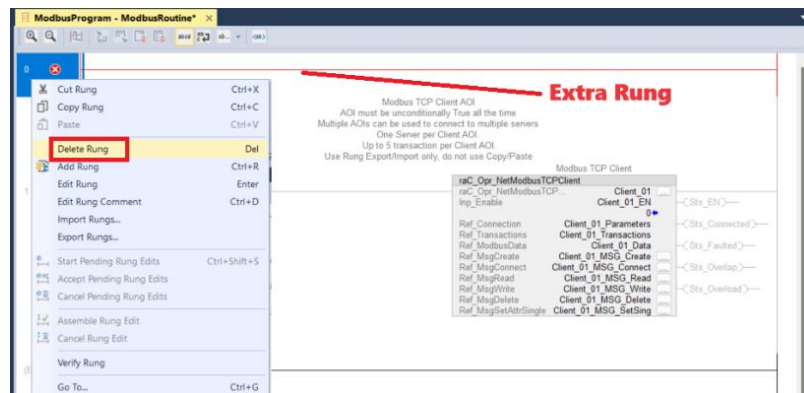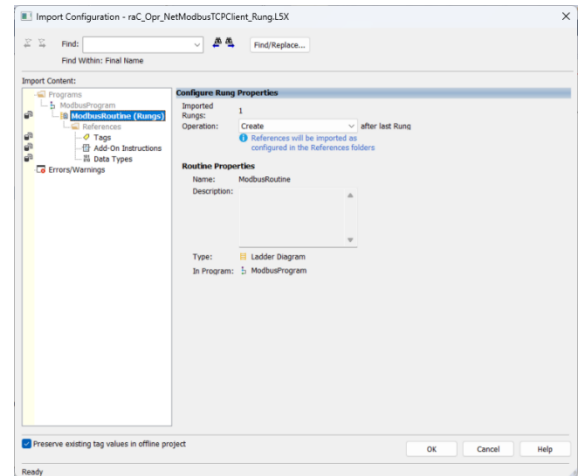
This will add the AOI (Add On Instruction) and leave an extra Rung.
Right Click on the left side of this extra rung and select "Delete Rung".

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Let's start configuring the AOI for our Modbus/TCP application. Part of this AOI is prebuilding its tags. We can navigate to everything from the Modbus TCP Client Instruction or from within the Control Tags. All data is within the Control Tags.

**Ref_Connection** – Right Click on this in the AOI and select Monitor…
Parameters, as seen in the AOI to the right of "Ref_Connection" are essentially global settings for the AOI.
Transactions, below this represent connections for each of up to 5 Servers that can be connected to this client.

Parameters

Name	Value	Data Type	Description
Client_01_Parameters.LocalSlot	0	SINT	For 1756 ControlLogix processors specify the actual slot of desired 1756-EN2T(R) module. For 1756-L8xE controllers using the built in Ethernet port specify the 1756-L8xE controller slot. For CompactLogix 5370, 5380, 5480 controllers leave **.LocalSlot** at 0.
Client_01_Parameters.LocalAddress	' '	STR0016	Specify the **.LocalAddress** of the EtherNet/IP module. For CompactLogix 5380 and 5480 in **Dual IP Mode only**, specify the IP Address of the Local Ethernet connection used for Modbus TCP communications. **Leave this field blank for all other cases.**
Client_01_Parameters.DestAddress	0	STR0016	Specify Ethernet IP Address of the Modbus Server device. This address must be specified and cannot remain blank. **For this application it is the Ethernet Address of the Radio the PLC is physically connected to.**
Client_01_Parameters.DestinationPort	502	DINT	502 is the standard Modbus TCP port.

To Start or Enable the AOI Enter a 1 into the Enable bit. To disable enter a 0.
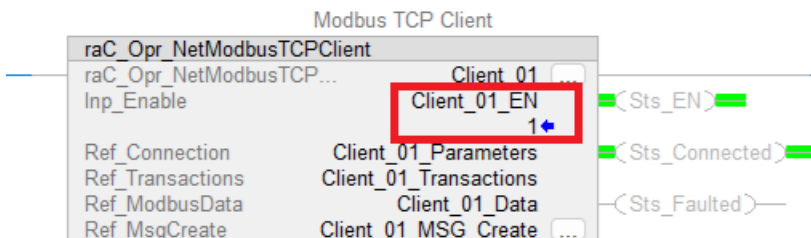
When changing parameters while enabled reset by disabling and then enabling. This reloads the new parameters settings.

Transactions: (where [0-4] represents one of the 5 transactions 0, 1, 2, 3, or 4)

Transactions

Name	Value	Data Type	Description
Client_01_Transactions[0].Enabled	1	BOOL	
Client_01_Transactions[0].PollInterval	10000	DINT	In milliseconds so 10,000 = 10 sec.
Client_01_Transactions[0].TransType	4	INT	For ESTeem Radios use TransType 4
Client_01_Transaction[0].StationID	##	SINT	The lowest octet of IP Address for radio to read Modbus data from.
Client_01_Transaction[0].BeginAddress	1000	DINT	First Modbus Register to be read
Client_01_Transaction[0].Count	40	INT	Total count of Modbus Registers to be read

One Final Note

ESTeem 195 Radios Modbus Data is made in Floating Point. Modbus data however, comes as Integer. Mentioned above is an ESTeem developed UDT. One very easy COP rung will take the 40 Modbus Registers, located in our example from Client_01_Data.InpRegisters_3xxx[0] through Client_01_Data.InpRegisters_3xxx[39] from Integer to Floating Point. From Assets\Data Types\User-Defined right click, select \Import Data Type… and locate the UDT you received from ESTeem. It is called "Esteem_195_ModbusData_DataType.L5X"

Select and [Open] and then [OK]. You have now added the ESTeem UDT to your program. Here is how to use it.

Add a rung below the AOI.
Create the instruction COP on it (copy)
The Source field is your Modbus data, in this case "Client_01_Data.InpRegisters_3xxx[0]"

The Destination Data can be a name of your choosing, if for example you are using more than one Transaction (see above) for multiple radios, you may want Destination names that represent those radios. In this case though we are using "ESTeemRadioModbusTags". Note, this is a new tag so right click on it and Create New Tag, type = Base and Data Type = Esteem_195_ModbusData, which is the name of the UDT installed. Set the Length to 40. Yes there are 40 Modbus Integers but these will be copied into 20 Floating Point Tags within the Control Tag EsteemRadioModbusTags". To see the data in Floating Point Right Click on this tag in the COP Instruction, go to Monitor… and (online and running) you have Floating Point.

Conclusion

The end result is a fairly easy 2 rung program that is the result of Rockwell Automations well tested and Documented Sample Code, ESTeem Wireless UDT and a Tech Bulletin that helps bring it together.

This programming can be repeated many times to connect to multiple radios making for a powerful Modbus/TCP Client solution.

Thank you for your attention.

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