



# Configuring MODBUS TCP

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## Understanding MODBUS TCP

Use Modicon Communication Bus (MODBUS) TCP over an Ethernet network when connecting the router to devices such as intelligent electronic devices (IEDs), distributed controllers, substation routers, Cisco IP Phones, Cisco Wireless Access Points, and other network devices such as redundant substation routers.

MODBUS is a serial communications protocol for client-server communication between a router (server) and a device in the network running MODBUS client software (client). You can use MODBUS to connect a computer to a remote terminal unit (RTU) in supervisory control and data acquisition (SCADA) systems.

The client can be an IED or a human machine interface (HMI) application that remotely configure and manage devices running MODBUS TCP. The router functions as the server.

The router encapsulates a request or response message in a MODBUS TCP application data unit (ADU). A client sends a message to a TCP port on the router. The default port number is 502.



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**Note** For information about the registers that a client can query on the router that functions as a MODBUS TCP server, see [MODBUS TCP Registers, on page 3](#).

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## MODBUS and Security

If a firewall or other security services are enabled, the router TCP port might be blocked, and the router and the client cannot communicate.

If a firewall and other security services are disabled, a denial-of-service attack might occur on the router.

To configure quality of service (QoS) to set the rate-limit for MODBUS TCP traffic, create an access-list that only permits traffic sending to port number 502 that is reserved for MODBUS communication. Then attach the access-list to the input class-map and attach it to the interface and set the rate limit to permit traffic via default port 502 and prioritize SCADA packets.

```

DUT-1:
!
class-map match-any Modbus-out-Traffic
  match qos-group 1
class-map match-any Modbus-In-Traffic
  match access-group 101
!
policy-map Modbus-In
  class Modbus-In-Traffic
    set qos-group 1
policy-map Modbus-Out
  class Modbus-out-Traffic
    police 10000000
    priority
!
!
interface GigabitEthernet0/1/1
  switchport mode access
  service-policy input Modbus-In
!
interface GigabitEthernet0/1/2
  switchport mode access
  service-policy output Modbus-Out
!
!
interface Vlan1
  no ip address
  ip access-group 101 in
  rate-limit input access-group 101 8000 8000 8000 conform-action transmit exceed-action
drop
!
!
!
access-list 101 permit tcp 10.10.10.0 0.0.0.255 any eq 502

DUT-2:

interface Vlan1
  ip address 192.168.1.2 255.255.255.0

```

This example shows that 133 SCADA packets were classified.

```

DUT-1#show policy-map interface GigabitEthernet0/1/2
GigabitEthernet0/1/2
  Service-policy output: Modbus-Out
    Class-map: Modbus-out-Traffic (match-any)
      133 packets
      Match: qos-group 1
      police cir 10000000 bc 312500
        conform-action transmit
        exceed-action drop
      conform: 133 (packets) exceed: 0 (packets)
      Priority
      Output Queue:
        Max queue-limit default threshold: 272
        Tail Packets Drop: 0

```

## Multiple Request Messages

The router can receive multiple request messages from clients and respond to them simultaneously.

You can set the number of client connections from 1 to 5. The default is 1.

# Configuring the Router as the MODBUS TCP Server

## Defaults

The router is not configured as a MODBUS TCP server.

The TCP port number is 502.

The number of simultaneous connection requests is 1.

## Enabling MODBUS TCP on the Switch

Beginning in privileged EXEC mode:

### Procedure

|               | Command or Action   | Purpose  |
|---------------|---|--|
| <b>Step 1</b> | <b>configure terminal</b><br><br><b>Example:</b><br>Router# <code>configure terminal</code> | Enter global configuration mode.   |
| <b>Step 2</b> | <b>scada modbus tcp server</b>  | Enables MODBUS TCP on the router.  |
| <b>Step 3</b> | <b>scada modbus tcp server [port <i>tcp-port-number</i>]</b>                                | (Optional) Sets the TCP port to which clients send messages. The range for <i>tcp-port-number</i> is 1 to 65535. The default is 502.                     |
| <b>Step 4</b> | <b>scada modbus tcp server [connection <i>connection-requests</i>]</b>                      | (Optional) Sets the number of simultaneous connection requests sent to the router. The range for <i>connection-requests</i> is 1 to 5. The default is 1. |
| <b>Step 5</b> | <b>end</b><br><br><b>Example:</b><br>Router(config)# <code>end</code>                       | Returns to privileged EXEC mode.   |

To disable MODBUS on the router and return to the default settings, enter the **no scada modbus tcp server** global configuration command.

To add security when using MODBUS TCP, configure an ACL to permit traffic from specific clients or configure QoS to rate-limit traffic.

## MODBUS TCP Registers

This section lists the read-only MODBUS registers. MODBUS clients use them to communicate with a MODBUS server (i.e., the IR8340 router). There are no writable registers.

## System Information Registers

Memory address spaces 0x0800 through 0x0FFF are system information registers. Clients use the 0x03 Read Multiple Registers MODBUS function code. The system-information register mapping is as follows:

**Table 1: System Information Registers**

| Address                                       | # of Registers | Description                         | R/W | Format |
|---|----------------|-------------------------------------|-----|--------|
| 0x0800  | 64             | Product ID                          | R   | Text   |
| 0x0840  | 64             | Software image name                 | R   | Text   |
| 0x0880  | 64             | Software image version              | R   | Text   |
| 0x08C0  | 64             | Host name                           | R   | Text   |
| 0x0900  | 1              | Number of Gigabit Ethernet ports    | R   | Uint16 |
| <b>CPU Core Temperature Related Registers</b> |                |                                     |     |        |
| 0x0901  | 1              | CPU core-0 temperature (in Celsius) | R   | Uint16 |
| 0x0902  | 1              | CPU core-1 temperature (in Celsius) | R   | Uint16 |
| 0x0903  | 1              | CPU core-2 temperature (in Celsius) | R   | Uint16 |
| 0x0904  | 1              | CPU core-3 temperature (in Celsius) | R   | Uint16 |
| 0x0905  | 1              | CPU core-4 temperature (in Celsius) | R   | Uint16 |
| 0x0906  | 1              | CPU core-5 temperature (in Celsius) | R   | Uint16 |
| 0x0907  | 1              | CPU core-6 temperature (in Celsius) | R   | Uint16 |
| 0x0908  | 1              | CPU core-7 temperature (in Celsius) | R   | Uint16 |

## Port Information Registers

Memory address spaces 0x1000 through 0x3FFF are read-only interface registers. Clients use the 0x03 Read Multiple Registers MODBUS function code to access the registers.

The following table shows the memory map for all interface registers, with 64-bit counters (address space 0x1000 – 0x2FFF, 8K registers):

**Table 2: System Information Registers**

| Address | # of Registers | Description       | R/W | Format |
|---------|----------------|-------------------|-----|--------|
| 0x1000  | 64             | WAN Port 1 name   | R   | Text   |
| 0x1040  | 64             | WAN Port 2 name   | R   | Text   |
| 0x1080  | 64             | LAN Port 1 name   | R   | Text   |
| 0x10C0  | 64             | LAN Port 2 name   | R   | Text   |
| 0x1100  | 64             | LAN Port 3 name   | R   | Text   |
| 0x1140  | 64             | LAN Port 4 name   | R   | Text   |
| 0x1180  | 64             | LAN Port 5 name   | R   | Text   |
| 0x11C0  | 64             | LAN Port 6 name   | R   | Text   |
| 0x1200  | 64             | LAN Port 7 name   | R   | Text   |
| 0x1240  | 64             | LAN Port 8 name   | R   | Text   |
| 0x1280  | 64             | LAN Port 9 name   | R   | Text   |
| 0x12C0  | 64             | LAN Port 10 name  | R   | Text   |
| 0x1300  | 64             | LAN Port 11 name  | R   | Text   |
| 0x1340  | 64             | LAN Port 12 name  | R   | Text   |
| 0x1380  | 1              | WAN Port 1 state  | R   | Uint16 |
| 0x1381  | 1              | WAN Port 2 state  | R   | Uint16 |
| 0x1382  | 1              | LAN Port 1 state  | R   | Uint16 |
| 0x1383  | 1              | LAN Port 2 state  | R   | Uint16 |
| 0x1384  | 1              | LAN Port 3 state  | R   | Uint16 |
| 0x1385  | 1              | LAN Port 4 state  | R   | Uint16 |
| 0x1386  | 1              | LAN Port 5 state  | R   | Uint16 |
| 0x1387  | 1              | LAN Port 6 state  | R   | Uint16 |
| 0x1388  | 1              | LAN Port 7 state  | R   | Uint16 |
| 0x1389  | 1              | LAN Port 8 state  | R   | Uint16 |
| 0x138A  | 1              | LAN Port 9 state  | R   | Uint16 |
| 0x138B  | 1              | LAN Port 10 state | R   | Uint16 |

| Address                           | # of Registers | Description   | R/W | Format |
|-----------------------------------|----------------|---|-----|--------|
| 0x138C                            | 1              | LAN Port 11 state   | R   | Uint16 |
| 0x138D                            | 1              | LAN Port 12 state   | R   | Uint16 |
| <b>Values for 64-Bit Counters</b> |                |   |     |        |
| 0x138E                            | 4              | WAN Port 1<br>Statistics – Number<br>of packets received  | R   | Uint64 |
| 0x1392                            | 4              | WAN Port 2<br>Statistics – Number<br>of packets received  | R   | Uint64 |
| 0x1396                            | 4              | LAN Port 1<br>Statistics – Number<br>of packets received  | R   | Uint64 |
| 0x139A                            | 4              | LAN Port 2<br>Statistics – Number<br>of packets received  | R   | Uint64 |
| 0x139E                            | 4              | LAN Port 3<br>Statistics – Number<br>of packets received  | R   | Uint64 |
| 0x13A2                            | 4              | LAN Port 4<br>Statistics – Number<br>of packets received  | R   | Uint64 |
| 0x13A6                            | 4              | LAN Port 5<br>Statistics – Number<br>of packets received  | R   | Uint64 |
| 0x13AA                            | 4              | LAN Port 6<br>Statistics – Number<br>of packets received  | R   | Uint64 |
| 0x13AE                            | 4              | LAN Port 7<br>Statistics – Number<br>of packets received  | R   | Uint64 |
| 0x13B2                            | 4              | LAN Port 8<br>Statistics – Number<br>of packets received  | R   | Uint64 |
| 0x13B6                            | 4              | LAN Port 9<br>Statistics – Number<br>of packets received  | R   | Uint64 |
| 0x13BA                            | 4              | LAN Port 10<br>Statistics – Number<br>of packets received | R   | Uint64 |

| Address | # of Registers | Description   | R/W | Format |
|---------|----------------|---|-----|--------|
| 0x13BE  | 4              | LAN Port 11<br>Statistics – Number<br>of packets received | R   | Uint64 |
| 0x13C2  | 4              | LAN Port 12<br>Statistics – Number<br>of packets received | R   | Uint64 |
| 0x13C6  | 4              | WAN Port 1<br>Statistics – Number<br>of packets sent      | R   | Uint64 |
| 0x13CA  | 4              | WAN Port 2<br>Statistics – Number<br>of packets sent      | R   | Uint64 |
| 0x13CE  | 4              | LAN Port 1<br>Statistics – Number<br>of packets sent      | R   | Uint64 |
| 0x13D2  | 4              | LAN Port 2<br>Statistics – Number<br>of packets sent      | R   | Uint64 |
| 0x13D6  | 4              | LAN Port 3<br>Statistics – Number<br>of packets sent      | R   | Uint64 |
| 0x13DA  | 4              | LAN Port 4<br>Statistics – Number<br>of packets sent      | R   | Uint64 |
| 0x13DE  | 4              | LAN Port 5<br>Statistics – Number<br>of packets sent      | R   | Uint64 |
| 0x13E2  | 4              | LAN Port 6<br>Statistics – Number<br>of packets sent      | R   | Uint64 |
| 0x13E6  | 4              | LAN Port 7<br>Statistics – Number<br>of packets sent      | R   | Uint64 |
| 0x13EA  | 4              | LAN Port 8<br>Statistics – Number<br>of packets sent      | R   | Uint64 |
| 0x13EE  | 4              | LAN Port 9<br>Statistics – Number<br>of packets sent      | R   | Uint64 |
| 0x13F2  | 4              | LAN Port 10<br>Statistics – Number<br>of packets sent     | R   | Uint64 |

| Address | # of Registers | Description   | R/W | Format |
|---------|----------------|---|-----|--------|
| 0x13F6  | 4              | LAN Port 11<br>Statistics – Number<br>of packets sent   | R   | Uint64 |
| 0x13FA  | 4              | LAN Port 12<br>Statistics – Number<br>of packets sent   | R   | Uint64 |
| 0x13FE  | 4              | WAN Port 1<br>Statistics – Number<br>of bytes received  | R   | Uint64 |
| 0x1402  | 4              | WAN Port 2<br>Statistics – Number<br>of bytes received  | R   | Uint64 |
| 0x1406  | 4              | LAN Port 1<br>Statistics – Number<br>of bytes received  | R   | Uint64 |
| 0x140A  | 4              | LAN Port 2<br>Statistics – Number<br>of bytes received  | R   | Uint64 |
| 0x140E  | 4              | LAN Port 3<br>Statistics – Number<br>of bytes received  | R   | Uint64 |
| 0x1412  | 4              | LAN Port 4<br>Statistics – Number<br>of bytes received  | R   | Uint64 |
| 0x1416  | 4              | LAN Port 5<br>Statistics – Number<br>of bytes received  | R   | Uint64 |
| 0x141A  | 4              | LAN Port 6<br>Statistics – Number<br>of bytes received  | R   | Uint64 |
| 0x141E  | 4              | LAN Port 7<br>Statistics – Number<br>of bytes received  | R   | Uint64 |
| 0x1422  | 4              | LAN Port 8<br>Statistics – Number<br>of bytes received  | R   | Uint64 |
| 0x1426  | 4              | LAN Port 9<br>Statistics – Number<br>of bytes received  | R   | Uint64 |
| 0x142A  | 4              | LAN Port 10<br>Statistics – Number<br>of bytes received | R   | Uint64 |



| Address | # of Registers | Description   | R/W | Format |
|---------|----------------|---|-----|--------|
| 0x142E  | 4              | LAN Port 11<br>Statistics – Number<br>of bytes received | R   | Uint64 |
| 0x1432  | 4              | LAN Port 12<br>Statistics – Number<br>of bytes received | R   | Uint64 |
| 0x1436  | 4              | WAN Port 1<br>Statistics – Number<br>of bytes sent      | R   | Uint64 |
| 0x143A  | 4              | WAN Port 2<br>Statistics – Number<br>of bytes sent      | R   | Uint64 |
| 0x143E  | 4              | LAN Port 1<br>Statistics – Number<br>of bytes sent      | R   | Uint64 |
| 0x1442  | 4              | LAN Port 2<br>Statistics – Number<br>of bytes sent      | R   | Uint64 |
| 0x1446  | 4              | LAN Port 3<br>Statistics – Number<br>of bytes sent      | R   | Uint64 |
| 0x144A  | 4              | LAN Port 4<br>Statistics – Number<br>of bytes sent      | R   | Uint64 |
| 0x144E  | 4              | LAN Port 5<br>Statistics – Number<br>of bytes sent      | R   | Uint64 |
| 0x1452  | 4              | LAN Port 6<br>Statistics – Number<br>of bytes sent      | R   | Uint64 |
| 0x1456  | 4              | LAN Port 7<br>Statistics – Number<br>of bytes sent      | R   | Uint64 |
| 0x145A  | 4              | LAN Port 8<br>Statistics – Number<br>of bytes sent      | R   | Uint64 |
| 0x145E  | 4              | LAN Port 9<br>Statistics – Number<br>of bytes sent      | R   | Uint64 |
| 0x1462  | 4              | LAN Port 10<br>Statistics – Number<br>of bytes sent     | R   | Uint64 |

| Address                           | # of Registers | Description  | R/W | Format |
|-----------------------------------|----------------|--|-----|--------|
| 0x1466                            | 4              | LAN Port 11<br>Statistics – Number<br>of bytes sent      | R   | Uint64 |
| 0x146A                            | 4              | LAN Port 12<br>Statistics – Number<br>of bytes sent      | R   | Uint64 |
| <b>Values for 32-Bit Counters</b> |                |  |     |        |
| 0x146E                            | 2              | WAN Port 1<br>Statistics – Number<br>of packets received | R   | Uint32 |
| 0x1470                            | 2              | WAN Port 1<br>Statistics – Number<br>of packets received | R   | Uint32 |
| 0x1472                            | 2              | LAN Port 1<br>Statistics – Number<br>of packets received | R   | Uint32 |
| 0x1474                            | 2              | LAN Port 2<br>Statistics – Number<br>of packets received | R   | Uint32 |
| 0x1476                            | 2              | LAN Port 3<br>Statistics – Number<br>of packets received | R   | Uint32 |
| 0x1478                            | 2              | LAN Port 4<br>Statistics – Number<br>of packets received | R   | Uint32 |
| 0x147A                            | 2              | LAN Port 5<br>Statistics – Number<br>of packets received | R   | Uint32 |
| 0x147C                            | 2              | LAN Port 6<br>Statistics – Number<br>of packets received | R   | Uint32 |
| 0x147E                            | 2              | LAN Port 7<br>Statistics – Number<br>of packets received | R   | Uint32 |
| 0x1480                            | 2              | LAN Port 8<br>Statistics – Number<br>of packets received | R   | Uint32 |
| 0x1482                            | 2              | LAN Port 9<br>Statistics – Number<br>of packets received | R   | Uint32 |

| Address | # of Registers | Description   | R/W | Format |
|---------|----------------|---|-----|--------|
| 0x1484  | 2              | LAN Port 10<br>Statistics – Number<br>of packets received | R   | Uint32 |
| 0x1486  | 2              | LAN Port 11<br>Statistics – Number<br>of packets received | R   | Uint32 |
| 0x1488  | 2              | LAN Port 12<br>Statistics – Number<br>of packets received | R   | Uint32 |
| 0x148A  | 2              | WAN Port 1<br>Statistics – Number<br>of packets sent      | R   | Uint32 |
| 0x148C  | 2              | WAN Port 2<br>Statistics – Number<br>of packets sent      | R   | Uint32 |
| 0x148E  | 2              | LAN Port 1<br>Statistics – Number<br>of packets sent      | R   | Uint32 |
| 0x1490  | 2              | LAN Port 2<br>Statistics – Number<br>of packets sent      | R   | Uint32 |
| 0x1492  | 2              | LAN Port 3<br>Statistics – Number<br>of packets sent      | R   | Uint32 |
| 0x1494  | 2              | LAN Port 4<br>Statistics – Number<br>of packets sent      | R   | Uint32 |
| 0x1496  | 2              | LAN Port 5<br>Statistics – Number<br>of packets sent      | R   | Uint32 |
| 0x1498  | 2              | LAN Port 6<br>Statistics – Number<br>of packets sent      | R   | Uint32 |
| 0x149A  | 2              | LAN Port 7<br>Statistics – Number<br>of packets sent      | R   | Uint32 |
| 0x149C  | 2              | LAN Port 8<br>Statistics – Number<br>of packets sent      | R   | Uint32 |
| 0x149E  | 2              | LAN Port 9<br>Statistics – Number<br>of packets sent      | R   | Uint32 |

| Address | # of Registers | Description  | R/W | Format |
|---------|----------------|--|-----|--------|
| 0x14A0  | 2              | LAN Port 10<br>Statistics – Number<br>of packets sent  | R   | Uint32 |
| 0x14A2  | 2              | LAN Port 11<br>Statistics – Number<br>of packets sent  | R   | Uint32 |
| 0x14A4  | 2              | LAN Port 12<br>Statistics – Number<br>of packets sent  | R   | Uint32 |
| 0x14A6  | 2              | WAN Port 1<br>Statistics – Number<br>of bytes received | R   | Uint32 |
| 0x14A8  | 2              | WAN Port 2<br>Statistics – Number<br>of bytes received | R   | Uint32 |
| 0x14AA  | 2              | LAN Port 1<br>Statistics – Number<br>of bytes received | R   | Uint32 |
| 0x14AC  | 2              | LAN Port 2<br>Statistics – Number<br>of bytes received | R   | Uint32 |
| 0x14AE  | 2              | LAN Port 3<br>Statistics – Number<br>of bytes received | R   | Uint32 |
| 0x14B0  | 2              | LAN Port 4<br>Statistics – Number<br>of bytes received | R   | Uint32 |
| 0x14B2  | 2              | LAN Port 5<br>Statistics – Number<br>of bytes received | R   | Uint32 |
| 0x14B4  | 2              | LAN Port 6<br>Statistics – Number<br>of bytes received | R   | Uint32 |
| 0x14B6  | 2              | LAN Port 7<br>Statistics – Number<br>of bytes received | R   | Uint32 |
| 0x14B8  | 2              | LAN Port 8<br>Statistics – Number<br>of bytes received | R   | Uint32 |
| 0x14BA  | 2              | LAN Port 9<br>Statistics – Number<br>of bytes received | R   | Uint32 |

| Address | # of Registers | Description   | R/W | Format |
|---------|----------------|---|-----|--------|
| 0x14BC  | 2              | LAN Port 10<br>Statistics – Number<br>of bytes received | R   | Uint32 |
| 0x14BE  | 2              | LAN Port 11<br>Statistics – Number<br>of bytes received | R   | Uint32 |
| 0x14C0  | 2              | LAN Port 12<br>Statistics – Number<br>of bytes received | R   | Uint32 |
| 0x14C2  | 2              | WAN Port 1<br>Statistics – Number<br>of bytes sent      | R   | Uint32 |
| 0x14C4  | 2              | WAN Port 2<br>Statistics – Number<br>of bytes sent      | R   | Uint32 |
| 0x14C6  | 2              | LAN Port 1<br>Statistics – Number<br>of bytes sent      | R   | Uint32 |
| 0x14C8  | 2              | LAN Port 2<br>Statistics – Number<br>of bytes sent      | R   | Uint32 |
| 0x14CA  | 2              | LAN Port 3<br>Statistics – Number<br>of bytes sent      | R   | Uint32 |
| 0x14CC  | 2              | LAN Port 4<br>Statistics – Number<br>of bytes sent      | R   | Uint32 |
| 0x14CE  | 2              | LAN Port 5<br>Statistics – Number<br>of bytes sent      | R   | Uint32 |
| 0x14D0  | 2              | LAN Port 6<br>Statistics – Number<br>of bytes sent      | R   | Uint32 |
| 0x14D2  | 2              | LAN Port 7<br>Statistics – Number<br>of bytes sent      | R   | Uint32 |
| 0x14D4  | 2              | LAN Port 8<br>Statistics – Number<br>of bytes sent      | R   | Uint32 |
| 0x14D6  | 2              | LAN Port 9<br>Statistics – Number<br>of bytes sent      | R   | Uint32 |

| Address | # of Registers | Description                                   | R/W | Format |
|---------|----------------|---|-----|--------|
| 0x14D8  | 2              | LAN Port 10 Statistics – Number of bytes sent | R   | Uint32 |
| 0x14DA  | 2              | LAN Port 11 Statistics – Number of bytes sent | R   | Uint32 |
| 0x14DC  | 2              | LAN Port 12 Statistics – Number of bytes sent | R   | Uint32 |

## Interpreting the Port State

*Table 3: Interpreting the Port State*

| Address          | Description            | Value  |
|------------------|------------------------|--|
| 0x1380 to 0x138D | Port state information | <p>The upper byte represents the interface state:</p> <ul style="list-style-type: none"> <li>• 0x0: Interface is down</li> <li>• 0x1: Interface is going down</li> <li>• 0x2: Interface is in the initializing state</li> <li>• 0x3: Interface is coming up</li> <li>• 0x4: Interface is up and running</li> <li>• 0x5: Interface is reset by the user</li> <li>• 0x6: Interface is shut down by the user</li> <li>• 0x7: Interface is being deleted</li> </ul> <p>The lower byte represents the line protocol state:</p> <ul style="list-style-type: none"> <li>• 0x0: Line protocol state is down</li> <li>• 0x1: Line protocol state is up</li> </ul> |