

Calculating the Communication Timeout on a DXM Controller



Modbus Communication Timeouts

A Modbus timeout is the amount of time a Modbus slave is given to return an acknowledgment of a message sent by the Modbus master. If the Modbus master waits for the timeout period and no response is seen, the Modbus master considers it a lost message and continues on to the next operation.

The timeout parameter is simple to set for Modbus devices directly connected to the DXM Controller, if there are no MultiHop wireless devices. If a MultiHop network is a part of the DXM Controller, special considerations need to be made to set the timeout parameter.

Wireless communications are inherently lossy networks, and controllers operating these networks must be configured to allow for enough time for hardware transmission retries. Set the **Communications** Timeout parameter to cover the expected time for messages to be sent throughout the wireless network. For the DXM Controller, the **Communications** Timeout parameter is the maximum amount of time the DXM Controller should wait after a request is sent until the response message is received from the Modbus slave device. Use the DXM Configuration Tool to set the timeout parameter on the **Settings** > General screen.

The default setting for the timeout parameter is 5 seconds.

MultiHop Networks vs DX80 Star Networks

The DX80 star Gateway collects all the data from the Nodes, which allows the host system to directly read the data from the Gateway without sending messages across the wireless network. This allows for DX80 Gateway to be treated like any other wired Modbus device.

In a MultiHop network, the data resides at each device, forcing the controller to send messages across the wireless network to access the data. For this reason, carefully consider the value of the wireless timeout parameter.

Calculating the Communications Timeout for Battery-Powered MultiHop Radios

Battery-powered MultiHop radios are configured to run efficiently to maximize battery life. By optimizing battery life, the allowed communications window for receive messages is slow (once per 1.3 seconds) and sending message rates are standard (once per 0.04 seconds).

A MultiHop device is set from the factory with the retry parameter of 8. This means that under worst-case conditions, a message is sent from the DXM Controller to an end device a total of nine times (one initial message and eight retry messages). The end device sends the acknowledgment message back to the DXM Controller a maximum of nine times (one initial message and eight retries). A single Modbus transaction may send up to two messages + 16 retry messages before the transaction is complete. In addition, the radios randomly wait up to one time period before retransmitting a retry message. So to allow for the random wait time, add one extra time period for each in-between time of retries.

To calculate the communication timeout parameter for a Master radio to a slave radio (no repeaters):

Master to Slave Send time = $(9 \times 1.3 \text{ sec}) + (8 \text{ retry wait} \times 1.3 \text{ sec}) = 22 \text{ seconds}$

Slave to Master Send time = $(9 \times 0.04 \text{ sec}) + (8 \text{ retry wait} \times 0.04 \text{ sec}) = 1 \text{ second}$

Total Send/Receive time = 23 seconds

Minimum Timeout period = 23 seconds

If the link quality of the network is poor, the maximum transfer times may happen. Set the timeout parameter to accommodate the maximum number of retries that may happen in your application.

When MultiHop repeaters are added into the wireless network, each additional level of hierarchical network increases the required timeout period. Since MultiHop repeaters are running at the highest communications rate, the overall affect is not as great.

Master to Repeater Send time = $(9 \times 0.04 \text{ sec}) + (8 \text{ retry wait} \times 0.04 \text{ sec}) = 1 \text{ second}$

Repeater to Master Send time = $(9 \times 0.04 \text{ sec}) + (8 \text{ retry wait} \times 0.04 \text{ sec}) = 1 \text{ second}$

Additional Timeout period for a repeater = 2 seconds

Using the timeout calculation above of 23 seconds, if a repeater is added to the network the timeout should be set to 25 seconds. For each additional MultiHop repeater device creating another level of network hierarchy, add an additional two seconds to the timeout period.

Adjusting the Receive Slots and Retry Count Parameters

The number of receive slots governs how often a MultiHop device can communicate on the wireless network.

Battery-powered devices typically have DIP switches that allow the user to set the number of receive slots, which directly affects the battery life of the radio. Adjusting the receive slots changes how often a message can be received. By default, the receive slots are set to 4 (every 1.3 seconds). When the receive slots are set to 32, the radio listens for an incoming message every 0.16 seconds.

Users may also leave the retry mechanism to the application that is accessing the wireless network, in this case the DXM Controller. Adjust the number of retries in the MultiHop devices by writing the number of retries desired to Modbus register 6012. The factory default setting is 8.

Calculating the Communication Timeout for 10–30 VDC MultiHop Radios

Line-powered (10–30 V dc) MultiHop devices operate at the maximum communication rate, resulting in a much lower timeout parameter setting. For each repeater added to the network, increase the timeout parameter 2 seconds.

For a Master radio to a 10–30 V dc powered slave radio (no repeaters):

Master to Slave Send time = $(9 \times 0.04 \text{ sec}) + (8 \text{ retry wait} \times 0.04 \text{ sec}) = 1 \text{ second}$

Slave to Master Send time = $(9 \times 0.04 \text{ sec}) + (8 \text{ retry wait} \times 0.04 \text{ sec}) = 1 \text{ second}$

Total Send/Receive time = 2 seconds

Minimum Timeout period = 2 seconds

Calculating the Communication Timeout for a DX80 Star Network

In the DX80 network, all Node data is automatically collected at the Gateway to be read. The DXM Controller does not use the wireless network to access the data, which allows for much faster messaging and much lower timeout values.

For a DXM Controller with an internal DX80 Gateway, set the timeout value 0.5 seconds. If other Modbus slave devices are connected to the RS-485 lines, the timeout parameter governs all communication transactions and must be set to accommodate all devices on the bus.