

Lufkin Modbus Driver

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Lufkin Modbus Driver

Help version 1.028

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Overview

The Lufkin Modbus Driver provides a reliable way to connect Lufkin Modbus devices to OPC client applications; including HMI, SCADA, Historian, MES, ERP, and countless custom applications. It intended for use with serial devices that support the Extended Lufkin Automation Modbus (ELAM) protocol and the Standard MODBUS protocol.

Channel Setup

This driver supports multiple channel properties. For more information, refer to "What is a Channel?" in the server help file.

Maximum Number of Channels

The maximum number of channels supported by this driver is 1024.

Communication Protocol

Extended Lufkin Automation Modbus (ELAM)
Standard Modbus

Supported Communication Properties

Baud Rate: All major Baud rates.

Parity: Odd, Even, and None.

Data Bits: 5, 6, 7 and 8.

Stop Bits: 1 and 2.

● **Note:** Not all of the listed configurations may be supported in every device.

Flow Control

When using an RS232/RS485 converter, the type of flow control that is required depends on the converter's needs. Some do not require any flow control whereas others require RTS flow. Consult the converter's documentation to determine its flow requirements. An RS485 converter that provides automatic flow control is recommended.

● **Note:** When using the manufacturer's supplied communications cable, it is sometimes necessary to choose a flow control setting of **RTS** or **RTS Always** in Channel Properties.

Manual Flow Control

The Lufkin Modbus Driver supports RTS Manual flow control, which is used to configure the driver for operation with radio modems that require special RTS timing characteristics. For more information, refer to the server's help documentation.

Ethernet Encapsulation

This driver supports Ethernet Encapsulation, which allows the driver to communicate with serial devices attached to an Ethernet network using a terminal server. It may be enabled for the channel through the Serial Communications properties in Channel Properties. For more information, refer to the server help file.

Communication Serialization

The Lufkin Modbus Driver supports Communication Serialization, which specifies whether data transmissions should be limited to one channel at a time. For more information, refer to "Channel Properties - Advanced" in the server help file.

Channel Properties — General

This server supports the use of simultaneous multiple communications drivers. Each protocol or driver used in a server project is called a channel. A server project may consist of many channels with the same communications driver or with unique communications drivers. A channel acts as the basic building block of an OPC link. This group is used to specify general channel properties, such as the identification attributes and operating mode.

Property Groups	[-] Identification	
General	Name	
Write Optimizations	Description	
Advanced	Driver	
	[-] Diagnostics	
	Diagnostics Capture	Disable

Identification

Name: User-defined identity of this channel. In each server project, each channel name must be unique. Although names can be up to 256 characters, some client applications have a limited display window when browsing the OPC server's tag space. The channel name is part of the OPC browser information.

• For information on reserved characters, refer to "How To... Properly Name a Channel, Device, Tag, and Tag Group" in the server help.

Description: User-defined information about this channel.

• Many of these properties, including Description, have an associated system tag.

Driver: Selected protocol / driver for this channel. This property specifies the device driver that was selected during channel creation. It is a disabled setting in the channel properties.

• **Note:** With the server's online full-time operation, these properties can be changed at any time. This includes changing the channel name to prevent clients from registering data with the server. If a client has already acquired an item from the server before the channel name is changed, the items are unaffected. If, after the channel name has been changed, the client application releases the item and attempts to re-acquire using the old channel name, the item is not accepted. With this in mind, changes to the properties should not be made once a large client application has been developed. Utilize the User Manager to prevent operators from changing properties and restrict access rights to server features.

Diagnostics

Diagnostics Capture: When enabled, this option makes the channel's diagnostic information available to OPC applications. Because the server's diagnostic features require a minimal amount of overhead processing, it is recommended that they be utilized when needed and disabled when not. The default is disabled.

• **Note:** This property is disabled if the driver does not support diagnostics.

• For more information, refer to "Communication Diagnostics" in the server help.

Channel Properties — Serial Communications

Serial communication properties are available to serial drivers and vary depending on the driver, connection type, and options selected. Below is a superset of the possible properties.

Click to jump to one of the sections: [Connection Type](#), [Serial Port Settings](#) or [Ethernet Settings](#), and [Operational Behavior](#).

• **Note:** With the server's online full-time operation, these properties can be changed at any time. Utilize the User Manager to restrict access rights to server features, as changes made to these properties can temporarily disrupt communications.

Property Groups	<input type="checkbox"/> Connection Type	
General	Physical Medium	COM Port
Serial Communications	Shared	No
Write Optimizations	<input type="checkbox"/> Serial Port Settings	
Advanced	COM ID	6
Communication Serialization	Baud Rate	9600
	Data Bits	8
	Parity	Even
	Stop Bits	1
	Flow Control	None
	<input type="checkbox"/> Operational Behavior	
	Report Comm. Errors	Enable
	Close Idle Connection	Enable
	Idle Time to Close (s)	15

Connection Type

Physical Medium: Choose the type of hardware device for data communications. Options include COM Port, None, Modem, and Ethernet Encapsulation. The default is COM Port.

- **None:** Select None to indicate there is no physical connection, which displays the [Operation with no Communications](#) section.
- **COM Port:** Select Com Port to display and configure the [Serial Port Settings](#) section.
- **Modem:** Select Modem if phone lines are used for communications, which are configured in the [Modem Settings](#) section.
- **Ethernet Encap.:** Select if Ethernet Encapsulation is used for communications, which displays the [Ethernet Settings](#) section.
- **Shared:** Verify the connection is correctly identified as sharing the current configuration with another channel. This is a read-only property.

Serial Port Settings

COM ID: Specify the Communications ID to be used when communicating with devices assigned to the channel. The valid range is 1 to 9991 to 16. The default is 1.

Baud Rate: Specify the baud rate to be used to configure the selected communications port.

Data Bits: Specify the number of data bits per data word. Options include 5, 6, 7, or 8.

Parity: Specify the type of parity for the data. Options include Odd, Even, or None.

Stop Bits: Specify the number of stop bits per data word. Options include 1 or 2.


Flow Control: Select how the RTS and DTR control lines are utilized. Flow control is required to communicate with some serial devices. Options are:

- **None:** This option does not toggle or assert control lines.
- **DTR:** This option asserts the DTR line when the communications port is opened and remains on.

- **RTS:** This option specifies that the RTS line is high if bytes are available for transmission. After all buffered bytes have been sent, the RTS line is low. This is normally used with RS232/RS485 converter hardware.
- **RTS, DTR:** This option is a combination of DTR and RTS.
- **RTS Always:** This option asserts the RTS line when the communication port is opened and remains on.
- **RTS Manual:** This option asserts the RTS line based on the timing properties entered for RTS Line Control. It is only available when the driver supports manual RTS line control (or when the properties are shared and at least one of the channels belongs to a driver that provides this support).

RTS Manual adds an **RTS Line Control** property with options as follows:


- **Raise:** This property specifies the amount of time that the RTS line is raised prior to data transmission. The valid range is 0 to 9999 milliseconds. The default is 10 milliseconds.
- **Drop:** This property specifies the amount of time that the RTS line remains high after data transmission. The valid range is 0 to 9999 milliseconds. The default is 10 milliseconds.
- **Poll Delay:** This property specifies the amount of time that polling for communications is delayed. The valid range is 0 to 9999. The default is 10 milliseconds.

 **Tip:** When using two-wire RS-485, "echoes" may occur on the communication lines. Since this communication does not support echo suppression, it is recommended that echoes be disabled or a RS-485 converter be used.


Operational Behavior

- **Report Comm. Errors:** Enable or disable reporting of low-level communications errors. When enabled, low-level errors are posted to the Event Log as they occur. When disabled, these same errors are not posted even though normal request failures are. The default is Enable.
- **Close Idle Connection:** Choose to close the connection when there are no longer any tags being referenced by a client on the channel. The default is Enable.
- **Idle Time to Close:** Specify the amount of time that the server waits once all tags have been removed before closing the COM port. The default is 15 seconds.

Ethernet Settings

 **Note:** Not all serial drivers support Ethernet Encapsulation. If this group does not appear, the functionality is not supported.

Ethernet Encapsulation provides communication with serial devices connected to terminal servers on the Ethernet network. A terminal server is essentially a virtual serial port that converts TCP/IP messages on the Ethernet network to serial data. Once the message has been converted, users can connect standard devices that support serial communications to the terminal server. The terminal server's serial port must be properly configured to match the requirements of the serial device to which it is attached. *For more information, refer to "How To... Use Ethernet Encapsulation" in the server help.*

- **Network Adapter:** Indicate a network adapter to bind for Ethernet devices in this channel. Choose a network adapter to bind to or allow the OS to select the default.
 -  *Specific drivers may display additional Ethernet Encapsulation properties. For more information, refer to Channel Properties - Ethernet Encapsulation.*

Modem Settings

- **Modem:** Specify the installed modem to be used for communications.
- **Connect Timeout:** Specify the amount of time to wait for connections to be established before failing a read or write. The default is 60 seconds.
- **Modem Properties:** Configure the modem hardware. When clicked, it opens vendor-specific modem properties.
- **Auto-Dial:** Enables the automatic dialing of entries in the Phonebook. The default is Disable. *For more information, refer to "Modem Auto-Dial" in the server help.*
- **Report Comm. Errors:** Enable or disable reporting of low-level communications errors. When enabled, low-level errors are posted to the Event Log as they occur. When disabled, these same errors are not posted even though normal request failures are. The default is Enable.
- **Close Idle Connection:** Choose to close the modem connection when there are no longer any tags being referenced by a client on the channel. The default is Enable.
- **Idle Time to Close:** Specify the amount of time that the server waits once all tags have been removed before closing the modem connection. The default is 15 seconds.

Operation with no Communications

- **Read Processing:** Select the action to be taken when an explicit device read is requested. Options include Ignore and Fail. Ignore does nothing; Fail provides the client with an update that indicates failure. The default setting is Ignore.

Channel Properties — Write Optimizations

As with any OPC server, writing data to the device may be the application's most important aspect. The server intends to ensure that the data written from the client application gets to the device on time. Given this goal, the server provides optimization properties that can be used to meet specific needs or improve application responsiveness.

Property Groups	<input type="checkbox"/> Write Optimizations	
General	Optimization Method	Write Only Latest Value for All Tags
Write Optimizations	Duty Cycle	10

Write Optimizations

Optimization Method: controls how write data is passed to the underlying communications driver. The options are:

- **Write All Values for All Tags:** This option forces the server to attempt to write every value to the controller. In this mode, the server continues to gather write requests and add them to the server's internal write queue. The server processes the write queue and attempts to empty it by writing data to the device as quickly as possible. This mode ensures that everything written from the client applications is sent to the target device. This mode should be selected if the write operation order or the write item's content must uniquely be seen at the target device.
- **Write Only Latest Value for Non-Boolean Tags:** Many consecutive writes to the same value can accumulate in the write queue due to the time required to actually send the data to the device. If the server updates a write value that has already been placed in the write queue, far fewer writes are needed to reach the same final output value. In this way, no extra writes accumulate in the server's

queue. When the user stops moving the slide switch, the value in the device is at the correct value at virtually the same time. As the mode states, any value that is not a Boolean value is updated in the server's internal write queue and sent to the device at the next possible opportunity. This can greatly improve the application performance.

● **Note:** This option does not attempt to optimize writes to Boolean values. It allows users to optimize the operation of HMI data without causing problems with Boolean operations, such as a momentary push button.

- **Write Only Latest Value for All Tags:** This option takes the theory behind the second optimization mode and applies it to all tags. It is especially useful if the application only needs to send the latest value to the device. This mode optimizes all writes by updating the tags currently in the write queue before they are sent. This is the default mode.

Duty Cycle: is used to control the ratio of write to read operations. The ratio is always based on one read for every one to ten writes. The duty cycle is set to ten by default, meaning that ten writes occur for each read operation. Although the application is performing a large number of continuous writes, it must be ensured that read data is still given time to process. A setting of one results in one read operation for every write operation. If there are no write operations to perform, reads are processed continuously. This allows optimization for applications with continuous writes versus a more balanced back and forth data flow.

● **Note:** It is recommended that the application be characterized for compatibility with the write optimization enhancements before being used in a production environment.

Channel Properties — Advanced

This group is used to specify advanced channel properties. Not all drivers support all properties; so the Advanced group does not appear for those devices.

Property Groups	[-] Non-Normalized Float Handling	
General	Floating-Point Values	Replace with Zero
Write Optimizations	[-] Inter-Device Delay	
Advanced	Inter-Device Delay (ms)	0

Non-Normalized Float Handling: A non-normalized value is defined as Infinity, Not-a-Number (NaN), or as a Denormalized Number. The default is Replace with Zero. Drivers that have native float handling may default to Unmodified. Non-normalized float handling allows users to specify how a driver handles non-normalized IEEE-754 floating point data. Descriptions of the options are as follows:

- **Replace with Zero:** This option allows a driver to replace non-normalized IEEE-754 floating point values with zero before being transferred to clients.
- **Unmodified:** This option allows a driver to transfer IEEE-754 denormalized, normalized, non-number, and infinity values to clients without any conversion or changes.

● **Note:** This property is disabled if the driver does not support floating point values or if it only supports the option that is displayed. According to the channel's float normalization setting, only real-time driver tags (such as values and arrays) are subject to float normalization. For example, EFM data is not affected by this setting.

● *For more information on the floating point values, refer to "How To ... Work with Non-Normalized Floating Point Values" in the server help.*

Inter-Device Delay: Specify the amount of time the communications channel waits to send new requests to the next device after data is received from the current device on the same channel. Zero (0) disables the delay.

● **Note:** This property is not available for all drivers, models, and dependent settings.

Channel Properties — Communication Serialization

The server's multi-threading architecture allows channels to communicate with devices in parallel. Although this is efficient, communication can be serialized in cases with physical network restrictions (such as Ethernet radios). Communication serialization limits communication to one channel at a time within a virtual network.

The term "virtual network" describes a collection of channels and associated devices that use the same pipeline for communications. For example, the pipeline of an Ethernet radio is the master radio. All channels using the same master radio associate with the same virtual network. Channels are allowed to communicate each in turn, in a "round-robin" manner. By default, a channel can process one transaction before handing communications off to another channel. A transaction can include one or more tags. If the controlling channel contains a device that is not responding to a request, the channel cannot release control until the transaction times out. This results in data update delays for the other channels in the virtual network.

Property Groups	<input type="checkbox"/> Channel-Level Settings	
General	Virtual Network	None
Serial Communications	Transactions per Cycle	1
Communication Serialization	<input type="checkbox"/> Global Settings	
	Network Mode	Load Balanced

Channel-Level Settings

Virtual Network This property specifies the channel's mode of communication serialization. Options include None and Network 1 - Network 50. The default is None. Descriptions of the options are as follows:

- **None:** This option disables communication serialization for the channel.
- **Network 1 - Network 50:** This option specifies the virtual network to which the channel is assigned.

Transactions per Cycle This property specifies the number of single blocked/non-blocked read/write transactions that can occur on the channel. When a channel is given the opportunity to communicate, this number of transactions attempted. The valid range is 1 to 99. The default is 1.

Global Settings

- **Network Mode:** This property is used to control how channel communication is delegated. In **Load Balanced** mode, each channel is given the opportunity to communicate in turn, one at a time. In **Priority** mode, channels are given the opportunity to communicate according to the following rules (highest to lowest priority):
 - Channels with pending writes have the highest priority.
 - Channels with pending explicit reads (through internal plug-ins or external client interfaces)

are prioritized based on the read's priority.

- Scanned reads and other periodic events (driver specific).

The default is Load Balanced and affects *all* virtual networks and channels.

🔦 Devices that rely on unsolicited responses should not be placed in a virtual network. In situations where communications must be serialized, it is recommended that Auto-Demotion be enabled.

Due to differences in the way that drivers read and write data (such as in single, blocked, or non-blocked transactions); the application's Transactions per cycle property may need to be adjusted. When doing so, consider the following factors:

- How many tags must be read from each channel?
- How often is data written to each channel?
- Is the channel using a serial or Ethernet driver?
- Does the driver read tags in separate requests, or are multiple tags read in a block?
- Have the device's Timing properties (such as Request timeout and Fail after x successive timeouts) been optimized for the virtual network's communication medium?

Device Setup

Supported Devices

Injection Well Controller (IWC)
 Progressive Cavity Pump (PCP)
 Rod Pump Controller (RPC)
 Variable Speed Drive (VSD)

Maximum Number of Devices

The maximum number of devices supported per channel is 2296.

IDs (PLC Network Address)

Lufkin Modbus devices are assigned device IDs in the range 0 to 2295 (decimal). When using Modbus ID 0, the driver will send only broadcast Write messages to remote stations. When configuring a device under the channel, setting the ID to 0 will place that device in broadcast mode. Only Writes will occur from this device. Reads from the broadcast device will always return zero. All other IDs will read and write data to and from the remote Lufkin Modbus device.

ID Format

Numeric format used for the device ID. Available options are Octal, Decimal, and Hex. The default setting is Decimal.

Automatic Tag Generation

Automatic Tag Generation is supported for the RPC and VSD device models. For more information on the Card Tags that will be created, refer to [Card Settings](#).

Device Properties — General

A device represents a single target on a communications channel. If the driver supports multiple controllers, users must enter a device ID for each controller.

Property Groups		
General	Identification	
Scan Mode	Name	
	Description	
	Channel Assignment	
	Driver	
	Model	
	ID Format	Decimal
	ID	2
	Operating Mode	
	Data Collection	Enable
	Simulated	No

Identification

Name: This property specifies the name of the device. It is a logical user-defined name that can be up to 256 characters long, and may be used on multiple channels.

Note: Although descriptive names are generally a good idea, some OPC client applications may have a limited display window when browsing the OPC server's tag space. The device name and channel name become part of the browse tree information as well. Within an OPC client, the combination of channel name and device name would appear as "ChannelName.DeviceName".

● For more information, refer to "How To... Properly Name a Channel, Device, Tag, and Tag Group" in server help.

Description: User-defined information about this device.

● Many of these properties, including Description, have an associated system tag.

Channel Assignment: User-defined name of the channel to which this device currently belongs.

Driver: Selected protocol driver for this device. This property specifies the driver selected during channel creation. It is disabled in the channel properties.

Model: This property specifies the specific type of device that is associated with this ID. The contents of the drop-down menu depends on the type of communications driver being used. Models that are not supported by a driver are disabled. If the communications driver supports multiple device models, the model selection can only be changed when there are no client applications connected to the device.

● **Note:** If the communication driver supports multiple models, users should try to match the model selection to the physical device. If the device is not represented in the drop-down menu, select a model that conforms closest to the target device. Some drivers support a model selection called "Open," which allows users to communicate without knowing the specific details of the target device. For more information, refer to the driver help documentation.

ID: This property specifies the device's station / node / identity / address. The type of ID entered depends on the communications driver being used. For many drivers, the ID is a numeric value. Drivers that support a Numeric ID provide users with the option to enter a numeric value whose format can be changed to suit the needs of the application or the characteristics of the selected communications driver. The ID format can be Decimal, Octal, and Hexadecimal. If the driver is Ethernet-based or supports an unconventional station or node name, the device's TCP/IP address may be used as the device ID. TCP/IP addresses consist of four values that are separated by periods, with each value in the range of 0 to 255. Some device IDs are string based. There may be additional properties to configure within the ID field, depending on the driver.

Operating Mode

Data Collection: This property controls the device's active state. Although device communications are enabled by default, this property can be used to disable a physical device. Communications are not attempted when a device is disabled. From a client standpoint, the data is marked as invalid and write operations are not accepted. This property can be changed at any time through this property or the device system tags.

Simulated: This option places the device into Simulation Mode. In this mode, the driver does not attempt to communicate with the physical device, but the server continues to return valid OPC data. Simulated stops physical communications with the device, but allows OPC data to be returned to the OPC client as valid data. While in Simulation Mode, the server treats all device data as reflective: whatever is written to the simulated device is read back and each OPC item is treated individually. The item's memory map is based on the group Update Rate. The data is not saved if the server removes the item (such as when the server is reinitialized). The default is No.

● **Notes:**

1. This System tag (_Simulated) is read only and cannot be written to for runtime protection. The System tag allows this property to be monitored from the client.

- In Simulation mode, the item's memory map is based on client update rate(s) (Group Update Rate for OPC clients or Scan Rate for native and DDE interfaces). This means that two clients that reference the same item with different update rates return different data.

Simulation Mode is for test and simulation purposes only. It should never be used in a production environment.

Device Properties — Scan Mode

The Scan Mode specifies the subscribed-client requested scan rate for tags that require device communications. Synchronous and asynchronous device reads and writes are processed as soon as possible; unaffected by the Scan Mode properties.

Property Groups	<input type="checkbox"/> Scan Mode	
General	Scan Mode	Respect Client-Specified Scan Rate ▾
Scan Mode	Initial Updates from Cache	Disable

Scan Mode: specifies how tags in the device are scanned for updates sent to subscribed clients.

Descriptions of the options are:

- **Respect Client-Specified Scan Rate:** This mode uses the scan rate requested by the client.
- **Request Data No Faster than Scan Rate:** This mode specifies the maximum scan rate to be used. The valid range is 10 to 99999990 milliseconds. The default is 1000 milliseconds.
 - **Note:** When the server has an active client and items for the device and the scan rate value is increased, the changes take effect immediately. When the scan rate value is decreased, the changes do not take effect until all client applications have been disconnected.
- **Request All Data at Scan Rate:** This mode forces tags to be scanned at the specified rate for subscribed clients. The valid range is 10 to 99999990 milliseconds. The default is 1000 milliseconds.
- **Do Not Scan, Demand Poll Only:** This mode does not periodically poll tags that belong to the device nor perform a read to get an item's initial value once it becomes active. It is the client's responsibility to poll for updates, either by writing to the `_DemandPoll` tag or by issuing explicit device reads for individual items. *For more information, refer to "Device Demand Poll" in server help.*
- **Respect Tag-Specified Scan Rate:** This mode forces static tags to be scanned at the rate specified in their static configuration tag properties. Dynamic tags are scanned at the client-specified scan rate.

Initial Updates from Cache: When enabled, this option allows the server to provide the first updates for newly activated tag references from stored (cached) data. Cache updates can only be provided when the new item reference shares the same address, scan rate, data type, client access, and scaling properties. A device read is used for the initial update for the first client reference only. The default is disabled; any time a client activates a tag reference the server attempts to read the initial value from the device.

Device Properties — Tag Generation

The automatic tag database generation features make setting up an application a plug-and-play operation. Select communications drivers can be configured to automatically build a list of tags that correspond to device-specific data. These automatically generated tags (which depend on the nature of the supporting driver) can be browsed from the clients.

If the target device supports its own local tag database, the driver reads the device's tag information and uses the data to generate tags within the server. If the device does not natively support named tags, the

driver creates a list of tags based on driver-specific information. An example of these two conditions is as follows:

1. If a data acquisition system supports its own local tag database, the communications driver uses the tag names found in the device to build the server's tags.
2. If an Ethernet I/O system supports detection of its own available I/O module types, the communications driver automatically generates tags in the server that are based on the types of I/O modules plugged into the Ethernet I/O rack.

● **Note:** Automatic tag database generation's mode of operation is completely configurable. For more information, refer to the property descriptions below.

Property Groups	Tag Generation	
General	On Property Change	Yes
Scan Mode	On Device Startup	Do Not Generate on Startup
Timing	On Duplicate Tag	Delete on Create
Auto-Demotion	Parent Group	
Tag Generation	Allow Automatically Generated Subgroups	Enable
Tag Import	Create	Create tags
Redundancy		

On Property Change: If the device supports automatic tag generation when certain properties change, the **On Property Change** option is shown. It is set to **Yes** by default, but it can be set to **No** to control over when tag generation is performed. In this case, the **Create tags** action must be manually invoked to perform tag generation.

On Device Startup: This property specifies when OPC tags are automatically generated. Descriptions of the options are as follows:

- **Do Not Generate on Startup:** This option prevents the driver from adding any OPC tags to the tag space of the server. This is the default setting.
- **Always Generate on Startup:** This option causes the driver to evaluate the device for tag information. It also adds tags to the tag space of the server every time the server is launched.
- **Generate on First Startup:** This option causes the driver to evaluate the target device for tag information the first time the project is run. It also adds any OPC tags to the server tag space as needed.

● **Note:** When the option to automatically generate OPC tags is selected, any tags that are added to the server's tag space must be saved with the project. Users can configure the project to automatically save from the **Tools | Options** menu.

On Duplicate Tag: When automatic tag database generation is enabled, the server needs to know what to do with the tags that it may have previously added or with tags that have been added or modified after the communications driver since their original creation. This setting controls how the server handles OPC tags that were automatically generated and currently exist in the project. It also prevents automatically generated tags from accumulating in the server.

For example, if a user changes the I/O modules in the rack with the server configured to **Always Generate on Startup**, new tags would be added to the server every time the communications driver detected a new I/O module. If the old tags were not removed, many unused tags could accumulate in the server's tag space. The options are:

- **Delete on Create:** This option deletes any tags that were previously added to the tag space before any new tags are added. This is the default setting.
- **Overwrite as Necessary:** This option instructs the server to only remove the tags that the communications driver is replacing with new tags. Any tags that are not being overwritten remain in the server's tag space.
- **Do not Overwrite:** This option prevents the server from removing any tags that were previously generated or already existed in the server. The communications driver can only add tags that are completely new.
- **Do not Overwrite, Log Error:** This option has the same effect as the prior option, and also posts an error message to the server's Event Log when a tag overwrite would have occurred.

● **Note:** Removing OPC tags affects tags that have been automatically generated by the communications driver as well as any tags that have been added using names that match generated tags. Users should avoid adding tags to the server using names that may match tags that are automatically generated by the driver.

Parent Group: This property keeps automatically generated tags from mixing with tags that have been entered manually by specifying a group to be used for automatically generated tags. The name of the group can be up to 256 characters. This parent group provides a root branch to which all automatically generated tags are added.

Allow Automatically Generated Subgroups: This property controls whether the server automatically creates subgroups for the automatically generated tags. This is the default setting. If disabled, the server generates the device's tags in a flat list without any grouping. In the server project, the resulting tags are named with the address value. For example, the tag names are not retained during the generation process.

● **Note:** If, as the server is generating tags, a tag is assigned the same name as an existing tag, the system automatically increments to the next highest number so that the tag name is not duplicated. For example, if the generation process creates a tag named "AI22" that already exists, it creates the tag as "AI23" instead.

Create: Initiates the creation of automatically generated OPC tags. If the device's configuration has been modified, **Create tags** forces the driver to reevaluate the device for possible tag changes. Its ability to be accessed from the System tags allows a client application to initiate tag database creation.

● **Note:** **Create tags** is disabled if the Configuration edits a project offline.

Device Properties — Timing

The device Timing properties allow the driver's response to error conditions to be tailored to fit the application's needs. In many cases, the environment requires changes to these properties for optimum performance. Factors such as electrically generated noise, modem delays, and poor physical connections can influence how many errors or timeouts a communications driver encounters. Timing properties are specific to each configured device.

Property Groups	<input checked="" type="checkbox"/> Communication Timeouts	
General	Connect Timeout (s)	3
Scan Mode	Request Timeout (ms)	5000
Timing	Retry Attempts	3
Auto-Demotion	<input checked="" type="checkbox"/> Timing	
	Inter-Request Delay (ms)	0

Communications Timeouts

Connect Timeout: This property (which is used primarily by Ethernet based drivers) controls the amount of time required to establish a socket connection to a remote device. The device's connection time often takes longer than normal communications requests to that same device. The valid range is 1 to 30 seconds. The default is typically 3 seconds, but can vary depending on the driver's specific nature. If this setting is not supported by the driver, it is disabled.

● **Note:** Due to the nature of UDP connections, the connection timeout setting is not applicable when communicating via UDP.

Request Timeout: This property specifies an interval used by all drivers to determine how long the driver waits for a response from the target device to complete. The valid range is 50 to 9,999,999 milliseconds (167.6667 minutes). The default is usually 1000 milliseconds, but can vary depending on the driver. The default timeout for most serial drivers is based on a baud rate of 9600 baud or better. When using a driver at lower baud rates, increase the timeout to compensate for the increased time required to acquire data.

Attempts Before Timeout: This property specifies how many times the driver issues a communications request before considering the request to have failed and the device to be in error. The valid range is 1 to 10. The default is typically 3, but can vary depending on the driver's specific nature. The number of attempts configured for an application depends largely on the communications environment. This property applies to both connection attempts and request attempts.

Timing

Inter-Request Delay: This property specifies how long the driver waits before sending the next request to the target device. It overrides the normal polling frequency of tags associated with the device, as well as one-time reads and writes. This delay can be useful when dealing with devices with slow turnaround times and in cases where network load is a concern. Configuring a delay for a device affects communications with all other devices on the channel. It is recommended that users separate any device that requires an inter-request delay to a separate channel if possible. Other communications properties (such as communication serialization) can extend this delay. The valid range is 0 to 300,000 milliseconds; however, some drivers may limit the maximum value due to a function of their particular design. The default is 0, which indicates no delay between requests with the target device.

● **Note:** Not all drivers support Inter-Request Delay. This setting does not appear if it is not available.

Device Properties — Auto-Demotion

The Auto-Demotion properties can temporarily place a device off-scan in the event that a device is not responding. By placing a non-responsive device offline for a specific time period, the driver can continue to optimize its communications with other devices on the same channel. After the time period has been reached, the driver re-attempts to communicate with the non-responsive device. If the device is responsive, the device is placed on-scan; otherwise, it restarts its off-scan time period.

Property Groups	[-] Auto-Demotion	
General	Demote on Failure	Enable
Scan Mode	Timeouts to Demote	3
Timing	Demotion Period (ms)	10000
Auto-Demotion	Discard Requests when Demoted	Disable

Demote on Failure: When enabled, the device is automatically taken off-scan until it is responding again.

● **Tip:** Determine when a device is off-scan by monitoring its demoted state using the `_AutoDemoted` system tag.

Timeouts to Demote: Specify how many successive cycles of request timeouts and retries occur before the device is placed off-scan. The valid range is 1 to 30 successive failures. The default is 3.

Demotion Period: Indicate how long the device should be placed off-scan when the timeouts value is reached. During this period, no read requests are sent to the device and all data associated with the read requests are set to bad quality. When this period expires, the driver places the device on-scan and allows for another attempt at communications. The valid range is 100 to 3600000 milliseconds. The default is 10000 milliseconds.

Discard Requests when Demoted: Select whether or not write requests should be attempted during the off-scan period. Disable to always send write requests regardless of the demotion period. Enable to discard writes; the server automatically fails any write request received from a client and does not post a message to the Event Log.

Device Properties — Block Sizes

Property Groups	[-] Coils	
General	Output Coils	32
Scan Mode	Input Coils	32
Timing	[-] Registers	
Auto-Demotion	Internal Registers	32
Block Sizes	Holding Registers	32
Data Encoding	[-] Block Sizes	
Framing	Perform Block Reads	Disable

Coils (8-2000 in multiples of 8): These properties specify the output and input coils. Coils can be read from 8 to 2000 points (bits) at a time. A higher block size means more points will be read from the device in a single request. The block size can be reduced to read data from non-contiguous locations within the device. The default setting is 32.

● Certain firmware versions for Lufkin devices may not support requests for blocks of coils greater than 1992. It is recommended that users with projects requiring the coil block size to be set above this value contact the vendor.

Registers (1-2500): These properties specify the internal and holding registers. The minimum block size is 1. The maximum block size depends on the ID. If the ID is 0 to 247, the configurable block size range is 1 to 125. If the ID is 248 to 2295, the configurable block size range is 1 to 2500. A higher block size means more register values will be read from the device in a single request. The block size can be reduced to read data from non-contiguous locations within the device. The default setting is 32.

● **Note:** Array data is read from a device in pieces no greater than the block size that was configured for the

associated function code. For example, with a configured holding register block size of 100, the tag "40001 [250]" would be read from a device in three transactions of 100, 100, and 50 respectively.

Perform block read on strings: When enabled, this option will block read string tags (which are normally read individually). String tags will also be grouped together depending on the selected block size. Block reads can only be performed for Modbus model string tags. The default setting is disabled.

Device Properties — Data Encoding

Two consecutive registers' addresses are used for 32-bit data types. The Data Encoding properties are used to specify whether the driver should assume the first word is the low or high word of the 32-bit value.

Property Groups	[-] Data Encoding	
Block Sizes	First Word Low	Enable
Data Encoding		

First Word Low: When enabled, the driver will use first word low in 32-bit data types and data type arrays (such as Float, DWord, Long, and LBCD). The default setting is enabled.

● **Note:** This property does not apply to the Word, Short, BCD, or Double data types.

To determine the correct Data Encoding setting, refer to both the table below and the device's documentation. For most devices, the default setting is acceptable.

Data Encoding setting	High Word	Low Word
Enabled	(31..16)	(15..0)
Disabled	(15..0)	(31..16)

Device Properties — Framing

Some terminal server devices add additional data to Modbus frames; as such, the Framing properties can be used to configure the driver to ignore the additional bytes in response messages.

Property Groups	[-] Framing	
General	Modbus TCP Framing	Disable
Data Encoding	Leading Bytes	0
Framing	Trailing Bytes	0

Descriptions of the properties are as follows:

- **Modbus TCP Framing:** When enabled, this property is used to communicate with native Modbus TCP devices using Ethernet Encapsulation. This option will be disabled when the device's ID is in the extended range (ID > 247).
- **Leading Bytes:** This property is used to specify the number of bytes to be attached to the beginning of Modbus responses. Values may range from 0 to 8.
- **Trailing Bytes:** This property is used to specify the number of bytes to be attached to the end of Modbus responses. Values may range from 0 to 8.

Using Ethernet Encapsulation

Ethernet Encapsulation must be enabled for Framing to be available; otherwise, **Modbus TCP Framing** is disabled. To enable Ethernet Encapsulation:

1. To start, open the device's **Channel Properties**.
2. In the **Serial Communications** property group, select **Ethernet Encapsulation** as a Physical Medium. This will enable Ethernet Encapsulation for the channel.
3. Next, open the device's **Device Properties**, and select the **Ethernet Encapsulation** properties group. Descriptions of the properties are as follows:
 - **IP Address:** This property specifies the device's IP address. The default setting is blank.
 - **Port:** This property specifies the port number. The default setting is 2101.
 - **Protocol:** This property specifies the protocol. The default setting is TCP/IP.

Property Groups	[-] Ethernet Settings	
General	IP Address	
Scan Mode	Port	2101
Ethernet Encapsulation	Protocol	TCP/IP

● **See Also:** [Device Setup](#)

Device Properties — Error Handling

The Error Handling properties determine how to deal with errors from the device.

Property Groups	[-] Error Handling	
General	Deactivate Tags on Illegal Address	Enable
Error Handling	Reject Repeated Messages	Disable

Deactivate Tags on Illegal Address: When enabled, the driver will stop polling for a block of data if the device returns Modbus exception code 2 (illegal address) or 3 (illegal data, such as number of points) in response to a read of that block. To read addresses that are accessible dynamically in the device, disable this option. The default setting is enabled.

Reject Repeated Messages: When enabled, the driver will expect repeated messages. When disabled, the driver will interpret a repeated message as an invalid response and will retry the request. The default setting is disabled.

● **Note:** Some message-relay equipment will echo Modbus requests back to the driver.

Device Properties — Card Settings

Card items are tags that facilitate the reading of dynagraph card data from a Lufkin device. When a client reads a card item tag, the server writes to an address on the device that initiates the loading of dynagraph card data into a memory buffer located on that same device. The server then reads the data from the device's buffer, which completes the card item read.

The Card Settings property group specifies the address that the server will write to, as well as the buffer address and length that the server will read for a particular card item.

● **Note:** The Card Settings properties are only available for the RPC and VSD device models.

Property Groups	<input type="checkbox"/> Coil Address Configuration	
General	Load Stored Card Address	103
Scan Mode	Load Shutdown1 Card Address	104
Timing	Load Shutdown2 Card Address	105
Auto-Demotion	Load Standard Card Address	106
Block Sizes	Load Start Card Address	107
Data Encoding	Load Pump-Up Card Address	108
Framing	Load Last-Stroke Card Address	109
Error Handling	Load Reference Valve Check Address	110
Card Settings	Load Working Valve Check Address	111
Tag Import	<input type="checkbox"/> Single-Pump Card Buffer Configuration	
Redundancy	Single-Pump Card Start Address	36156
	Single-Pump Card Length	209
	<input type="checkbox"/> Single-Surface Card Buffer Configuration	
	Single-Surface Card Start Address	35749
	Single-Surface Card Length	407
	<input type="checkbox"/> Five-Pump Card Buffer Configuration	
	Five-Pump Card Start Address	34704
	Five-Pump Card Length	1047
	<input type="checkbox"/> Five-Surface Card Buffer Configuration	
	Five-Surface Card Start Address	32669
	Five-Surface Card Length	2035
	<input type="checkbox"/> Valve Check Buffer Configuration	
	Valve Check Start Address	45001
	Valve Check Length	2428

Coil Address Configuration: This group contains the coil addresses to which the server writes to initiate a buffer load on a device. The addresses' default settings are device-specific and configured when the device is first created.

Buffer Configuration: These five groups contain the memory buffers. Each memory buffer has a starting address and length property that the server uses when reading the dynagraph card data. The memory buffers' default starting addresses and lengths are device-specific and configured when the device is first created.

Card Item Tag to Coil Address / Memory Buffer Mapping

The table below provides a mapping between card items and their corresponding coil address, memory buffer address, and length. To change these properties, click in the second column.

Card Item	Coil Address	Memory Buffer
Stored_SurfaceCard	Load Stored Card Address	Five-Surface Card Buffer
Stored_PumpCard	Load Stored Card Address	Five-Pump Card Buffer
Shutdown1_SurfaceCard	Load Shutdown1 Card Address	Five-Surface Card Buffer
Shutdown1_PumpCard	Load Shutdown1 Card Address	Five-Pump Card Buffer
Shutdown2_SurfaceCard	Load Shutdown2 Card Address	Five-Surface Card Buffer
Shutdown2_PumpCard	Load Shutdown2 Card Address	Five-Pump Card Buffer
Standard_SurfaceCard	Load Standard Card Address	Single-Surface Card Buffer

Card Item	Coil Address	Memory Buffer
Standard_PumpCard	Load Standard Card Address	Single-Pump Card Buffer
Start_SurfaceCard	Load Start Card Address	Single-Surface Card Buffer
Start_PumpCard	Load Start Card Address	Single-Pump Card Buffer
PumpUp_SurfaceCard	Load Pump-Up Card Address	Single-Surface Card Buffer
PumpUp_PumpCard	Load Pump-Up Card Address	Single-Pump Card Buffer
LastStroke_SurfaceCard	Load Last-Stroke Card Address	Single-Surface Card Buffer
LastStroke_PumpCard	Load Last-Stroke Card Address	Single-Pump Card Buffer
LastShutdown_SurfaceCard	Load Shutdown1 Card Address	Five-Surface Card Buffer
LastShutdown_PumpCard	Load Shutdown1 Card Address	Five-Surface Card Buffer
Reference_ValveCheck	Load Reference Valve Check Address	Valve Check Buffer
Working_ValveCheck	Load Working Valve Check Address	Valve Check Buffer

Device Properties — Redundancy

Property Groups	<input checked="" type="checkbox"/> Redundancy	
General	Secondary Path	...
Scan Mode	Operating Mode	Switch On Failure
Timing	Monitor Item	
Redundancy	Monitor Interval (s)	300
	Return to Primary ASAP	Yes

Redundancy is available with the Media-Level Redundancy Plug-In.

● Consult the website, a sales representative, or the user manual for more information.

Data Types Description

Data Type	Description
Boolean	Single bit
Word	Unsigned 16-bit value bit 0 is the low bit bit 15 is the high bit
Short	Signed 16-bit value bit 0 is the low bit bit 14 is the high bit bit 15 is the sign bit
DWord	Unsigned 32-bit value bit 0 is the low bit bit 31 is the high bit
Long	Signed 32-bit value bit 0 is the low bit bit 30 is the high bit bit 31 is the sign bit
BCD	Two byte packed BCD Value range is 0-9999. Behavior is undefined for values beyond this range.
LBCD	Four byte packed BCD Value range is 0-99999999. Behavior is undefined for values beyond this range.
String	Null terminated ASCII string Includes HiLo and LoHi byte order selection.
Float	32-bit floating point value The driver interprets two consecutive registers as a single precision value by making the last register the high word and the first register the low word.
Float Example	If register 40001 is specified as a float, bit 0 of register 40001 would be bit 0 of the 32-bit data type and bit 15 of register 40002 would be bit 31 of the 32-bit data type.

Address Descriptions

The default data types for dynamically defined tags are shown in **bold** where appropriate.

ELAM Addressing Decimal Format

Address	Range	Data Type	Access*
Output Coils [Function Codes (decimal): 01, 05, 15]	00001-09999	Boolean	Read/Write
Input Coils [Function Code (decimal): 02]	10001-19999	Boolean	Read Only
Internal Registers [Function Code (decimal): 04]	30001-39999 30001-39998 3xxxx.0-3xxxx.15	Word , Short, BCD, Float, DWord, Long, LBCD, Boolean	Read Only
Internal Registers As String with HiLo Byte Order [Function Codes (decimal): 04]	30001.2H-39999.240H .Bit is string length, range 2 to 240 bytes.	String**	Read Only
Internal Registers As String with LoHi Byte Order [Function Codes (decimal): 04]	30001.2L-39999.240L .Bit is string length, range 2 to 240 bytes.	String**	Read Only
Holding Registers [Function Codes (decimal): 03, 06, 16] [Function Codes (decimal): 03, 06, 16]	40001-49999 40001-49998 4xxxx.0-4xxxx.15	Word , Short, BCD, Float, DWord, Long, LBCD, Boolean	Read/Write
Holding Registers As String with HiLo Byte Order [Function Codes (decimal): 03, 16]	40001.2H-49999.240H .Bit is string length, range 2 to 240 bytes.	String**	Read/Write
Holding Registers As String with LoHi Byte Order [Function Codes (decimal): 03, 16]	40001.2L-49999.240L .Bit is string length, range 2 to 240 bytes.	String**	Read/Write

*All Read/Write addresses may be set as Write Only by prefixing a "W" to the address such as "W40001." This will prevent the driver from reading the register at the specified address. Any attempts by the client to read a Write Only tag will result in obtaining the last successful write value to the specified address. If no successful writes have occurred, the client will receive 0/NULL for numeric/string values for an initial value.

Caution: Setting the Client Access privileges of Write Only tags to Read Only will cause writes to these tags to fail and the client to always receive 0/NULL for numeric/string values.

****For more information, refer to [String Support](#).**

ELAM Addressing Hexadecimal Format

Address	Range	Data Type	Access
Output Coils [Function Codes (decimal): 01, 05, 15]	H00001-H0270F	Boolean	Read/Write
Input Coils [Function Code (decimal): 02]	H10001-H1270F	Boolean	Read Only
Internal Registers [Function Code (decimal): 04]	H30001-H3270F H30001-H3270E H3xxxx.0-H3xxxx.15	Word , Short, BCD, Float, DWord, Long, LBCD, Boolean	Read Only
Internal Registers As String with HiLo Byte Order [Function Codes (decimal): 04]	H30001.2H-H3270F.240H .Bit is string length, range 2 to 240 bytes.	String*	Read Only
Internal Registers As String with LoHi Byte Order [Function Codes (decimal): 04]	H30001.2L-H3270F.240L .Bit is string length, range 2 to 240 bytes.	String*	Read Only
Holding Registers [Function Codes (decimal): 03, 06, 16] [Function Codes (decimal): 03, 06, 16]	H40001-H4270F H40001-H4270E H4xxxx.0-H4xxxx.15	Word , Short, BCD, Float, DWord, Long, LBCD, Boolean	Read/Write
Holding Registers As String with HiLo Byte Order [Function Codes (decimal): 03, 16]	H40001.2H-H4270F.240H .Bit is string length, range 2 to 240 bytes.	String*	Read/Write
Holding Registers As String with LoHi Byte Order [Function Codes (decimal): 03, 16]	H40001.2L-H4270F.240L .Bit is string length, range 2 to 240 bytes.	String*	Read/Write

● *For more information, refer to [String Support](#).

String Support

The Lufkin Modbus Driver supports reading and writing holding register memory as an ASCII string. When using holding registers for string data, each register will contain two bytes of ASCII data. The order of the ASCII data within a given register can be selected when the string is defined. The length of the string can be from 2 to 240 bytes and is entered in place of a bit number. The length must be entered as an even number. The byte order is specified by appending either a "H" or "L" to the address.

String Examples

1. To address a string starting at 40200 with a length of 100 bytes and HiLo byte order, enter 40200.100H.
2. To address a string starting at 40500 with a length of 78 bytes and LoHi byte order, enter 40500.78L.

● **Note:** Write requests to String Tags are limited to a maximum of 60 registers. Requests that surpass 60 will be truncated.

Normal Address Examples

1. The 255'th output coil would be addressed as '0255' using decimal addressing or 'H0FF' using hexadecimal addressing.
2. Some documentation refers to Modbus addresses by function code and location. For instance, function code 3, location 2000 would be addressed as '42000' or 'H47D0'. The leading '4' represents holding registers or function code 3.
3. Some documentation refers to Modbus addresses by function code and location. For instance, setting function code 5, location 100 would be addressed as '0100' or 'H064'. The leading '0' represents output coils or function code 5. Writing 1 or 0 to this address would set or reset the coil.

Array Support

Arrays are supported for internal and holding register locations for all data types except for Boolean and strings. Arrays are also supported for input and output coils (Boolean data types). There are two methods of addressing an array. Examples are given using holding register locations.

4xxxx [rows] [cols]

4xxxx [cols] this method assumes rows is equal to one.

For arrays, rows multiplied by cols cannot exceed the maximum request size allowed by the protocol. For devices in standard Modbus mode, rows multiplied by cols multiplied by the data type length in registers cannot exceed 125. For devices in ELAM mode (ID > 247), rows multiplied by cols multiplied by the data type length in registers cannot exceed 2500.

● **Note:** Write requests to Array Tags are limited to a maximum of 60 registers. Requests that surpass 60 will result in only the first 60 registers of the array being written to the device.

Packed Coil Address Type

The Packed Coil address type allows access to multiple consecutive coils as an analog value. This feature is available for both input coils and output coils, polled mode only. The only valid data type is Word. The syntax is as follows:

Output coils: 0xxx#nn Word Read/Write

Input coils: 1xxx#nn Word Read Only

where xxx is the address of the first coil (decimal and hex values allowed), and nn is the number of coils to be packed into an analog value (1-16, decimal only).

The bit order will be such that the start address will be the least significant bit (LSB) of analog value.

Statistics Items

Statistical items use data collected through additional diagnostics information, which is not collected by default. To use statistical items, Communication Diagnostics must be enabled. To enable Communication Diagnostics, right-click on the channel in the Project View, select the **General** properties group, and set Diagnostics Capture to **Enable**.

Channel-Level Statistics Items

The syntax for channel-level statistics items is <channel>._Statistics.

● **Note:** Statistics at the channel level are the sum of those same items at the device level.

Item	Data Type	Access	Description
_CommFailures	DWord	Read/Write	The total number of times communication has failed (or has run out of retries).
_ErrorResponses	DWord	Read/Write	The total number of valid error responses received.
_ExpectedResponses	DWord	Read/Write	The total number of expected responses received.
_LastResponseTime	String	Read Only	The time at which the last valid response was received.
_LateData	DWord	Read/Write	The total number of times that a driver tag's data update occurred later than expected (based on the specified scan rate).
_MsgResent	DWord	Read/Write	The total number of messages sent as a retry.
_MsgSent	DWord	Read/Write	The total number of messages sent initially.
_MsgTotal	DWord	Read Only	The total number of messages sent (both _MsgSent + _MsgResent).
_PercentReturn	Float	Read Only	The proportion of expected responses (Received) to initial sends (Sent) as a percentage.
_PercentValid	Float	Read Only	The proportion of total valid responses received (_TotalResponses) to total requests sent (_MsgTotal) as a percentage.
_Reset	Bool	Read/Write	Resets all diagnostic counters. Writing to the _Reset Tag causes all diagnostic counters to be reset at this level.
_RespBadChecksum	DWord	Read/Write	The total number of responses with checksum errors.
_RespTimeouts	DWord	Read/Write	The total number of messages that failed to receive any kind of response.
_RespTruncated	DWord	Read/Write	The total number of messages that received only a partial

Item	Data Type	Access	Description
			response.
_TotalResponses	DWord	Read Only	The total number of valid responses received ($_ErrorResponses + _ExpectedResponses$).

Statistical items are not updated in simulation mode (see *device General properties*).

Device-Level Statistics Items

The syntax for device-level statistics items is `<channel>.<device>_Statistics`.

Item	Data Type	Access	Description
_CommFailures	DWord	Read/Write	The total number of times communication has failed (or has run out of retries).
_ErrorResponses	DWord	Read/Write	The total number of valid error responses received.
_ExpectedResponses	DWord	Read/Write	The total number of expected responses received.
_LastResponseTime	String	Read Only	The time at which the last valid response was received.
_LateData	DWord	Read/Write	The total number of times that a driver tag's data update occurred later than expected (based on the specified scan rate).
_MsgResent	DWord	Read/Write	The total number of messages sent as a retry.
_MsgSent	DWord	Read/Write	The total number of messages sent initially.
_MsgTotal	DWord	Read Only	The total number of messages sent (both $_MsgSent + _MsgResent$).
_PercentReturn	Float	Read Only	The proportion of expected responses (Received) to initial sends (Sent) as a percentage.
_PercentValid	Float	Read Only	The proportion of total valid responses received ($_TotalResponses$) to total requests sent ($_MsgTotal$) as a percentage.
_Reset	Bool	Read/Write	Resets all diagnostic counters. Writing to the <code>_Reset</code> Tag causes all diagnostic counters to be reset at this level.
_RespBadChecksum	DWord	Read/Write	The total number of responses with checksum errors.
_RespTimeouts	DWord	Read/Write	The total number of messages that failed to receive any kind of response.
_RespTruncated	DWord	Read/Write	The total number of messages that received only a partial response.
_TotalResponses	DWord	Read Only	The total number of valid responses received ($_ErrorResponses + _ExpectedResponses$).

Statistical items are not updated in simulation mode (see *device general properties*).

Error Descriptions

The following categories of error/warning messages may be generated. Click on the link for list of messages.

[Address Validation](#)

[Device Status Messages](#)

[Lufkin Modbus Specific Messages](#)

[Serial Communications](#)

• **See Also:**

[Modbus Exception Codes](#)

Address Validation

The following error/warning messages may be generated. Click on the link for a description of the message.

[Address <address> is out of range for the specified device or register.](#)

[Array size is out of range for address <address>.](#)

[Array support is not available for the specified address: <address>.](#)

[Data Type <type> is not valid for device address <address>.](#)

[Device address <address> contains a syntax error.](#)

[Device address <address> is not supported by model <model name>.](#)

[Device address <address> is read only.](#)

[Missing address.](#)

Address <address> is out of range for the specified device or register.

Error Type:

Warning

Possible Cause:

A tag address that has been specified statically references a location that is beyond the range of supported locations for the device.

Solution:

Verify that the address is correct; if it is not, re-enter it in the client application.

Array size is out of range for address <address>.

Error Type:

Warning

Possible Cause:

A tag address that has been specified statically is requesting an array size that is too large for the driver's address type or block size.

Solution:

Re-enter the address in the client application to specify a smaller value for the array or a different starting point.

Array support is not available for the specified address: <address>.

Error Type:

Warning

Possible Cause:

A tag address that has been specified statically contains an array reference for an address type that doesn't support arrays.

Solution:

Re-enter the address in the client application to remove the array reference or correct the address type.

Data Type <type> is not valid for device address <address>.

Error Type:

Warning

Possible Cause:

A tag address that has been specified statically has been assigned an invalid data type.

Solution:

Modify the requested data type in the client application.

Device address <address> contains a syntax error.

Error Type:

Warning

Possible Cause:

A tag address that has been specified statically contains one or more invalid characters.

Solution:

Re-enter the address in the client application.

Device address <address> is not supported by model <model name>.

Error Type:

Warning

Possible Cause:

A tag address that has been specified statically references a location that is valid for the communications protocol but not supported by the target device.

Solution:

Verify that the address is correct; if it is not, re-enter it in the client application. Also verify that the selected model name for the device is correct.

Device address <address> is read only.

Error Type:

Warning

Possible Cause:

A tag address that has been specified statically has a requested access mode that is not compatible with what the device supports for that address.

Solution:

Change the access mode in the client application.

Missing address**Error Type:**

Warning

Possible Cause:

A tag address that has been specified statically has no length.

Solution:

Re-enter the address in the client application.

Serial Communications

The following error/warning messages may be generated. Click on the link for a description of the message.

[COMn does not exist.](#)

[COMn is in use by another application.](#)

[Error opening COMn \[OS Error == <OS Error ID>\].](#)

[Serial communications error on channel <channel name> \[<error mask>\].](#)

[Unable to set comm parameters on COMn \[OS Error == <OS Error ID>\].](#)

COMn does not exist.**Error Type:**

Fatal

Possible Cause:

The specified COM port is not present on the target computer.

Solution:

Verify that the proper COM port has been selected.

COMn is in use by another application.**Error Type:**

Fatal

Possible Cause:

The serial port assigned to a device is being used by another application.

Solution:

1. Verify that the correct port has been assigned to the channel.
2. Verify that only one copy of the current project is running.

Error opening COMn [OS Error == <OS Error ID>].

Error Type:

Fatal

Possible Cause:

The specified COM port could not be opened due to an internal hardware or software problem on the target computer.

Solution:

Verify that the COM port is functional and may be accessed by other Windows applications.

Serial communications error on channel <channel name> [<error mask>].

Error Type:

Serious

Error Mask Definitions:

B = Hardware break detected.

F = Framing error.

E = I/O error.

O = Character buffer overrun.

R = RX buffer overrun.

P = Received byte parity error.

T = TX buffer full.

Possible Cause:

1. The serial connection between the device and the Host PC is bad.
2. The communications properties for the serial connection are incorrect.

Solution:

1. Verify the cabling between the PC and the PLC device.
2. Verify that the specified communications properties match those of the device.

Unable to set comm parameters on COMn [OS Error == <OS Error ID>].

Error Type:

Fatal

Possible Cause:

The serial properties for the specified COM port are not valid.

Solution:

Verify the serial properties and make any necessary changes.

Device Status Messages

The following error/warning messages may be generated. Click on the link for a description of the message.

[Device <device name> is not responding.](#)

[Unable to write to <address> on device <device name>.](#)

[Unable to write to address <address> on device <device>: Device responded with exception code <code>.](#)

[Write failed for <tag name> on device <device name>. Maximum path length of <number> characters exceeded.](#)

Device <device name> is not responding.

Error Type:

Serious

Possible Cause:

1. The serial connection between the device and the Host PC is broken.
2. The communications properties for the serial connection are incorrect.
3. The named device may have been assigned an incorrect Network ID.
4. The response from the device took longer to receive than the amount of time specified in the "Request Timeout" device property.

Solution:

1. Verify the cabling between the PC and the PLC device.
2. Verify that the specified communications properties match those of the device.
3. Verify that the Network ID given to the named device matches that of the actual device.
4. Increase the Request Timeout property so that the entire response can be handled.

Unable to write to <address> on device <device name>.

Error Type:

Serious

Possible Cause:

1. The serial connection between the device and the host PC is broken.
2. The communications properties for the serial connection are incorrect.
3. The named device may have been assigned an incorrect network ID.

Solution:

1. Verify the cabling between the PC and the PLC device.
2. Verify that the specified communications properties match those of the device.

3. Verify that the Network ID given to the named device matches that of the actual device.

Unable to write to address <address> on device <device>: Device responded with exception code <code>.

Error Type:

Warning

Possible Cause:

See [Modbus Exception Codes](#) for a description of the exception code.

Solution:

See [Modbus Exception Codes](#).

Write failed for <tag name> on device <device name>. Maximum path length of <number> exceeded.

Error Type:

Warning

Possible Cause:

Path length is limited to the indicated number of characters.

Solution:

Devise a shorter path.

Lufkin Modbus Specific Messages

The following error/warning messages may be generated. Click on the link for a description of the message.

[Bad address in block \[<start address> to <end address>\] on device <device name>.](#)

[Bad array spanning \[<address> to <address>\] on device <device>.](#)

Bad address in block [<start address> to <end address>] on device <device name>.

Error Type:

Serious

Possible Cause:

1. An attempt has been made to reference a nonexistent location in the specified device.
2. An attempt has been made to read more registers than allowed by the protocol.

Solution:

1. Verify the tags assigned to addresses in the specified range on the device and eliminate ones that reference invalid locations.
2. Decrease the register [block size](#) value to 125.

See Also:[Error Handling](#)[Block Sizes](#)**Bad array spanning [<address> to <address>] on device <device>.**

Error Type:

Serious

Possible Cause:

1. An attempt has been made to reference a nonexistent location in the specified device.
2. An attempt has been made to read more registers than allowed by the protocol.

Solution:

1. Verify that all the register addresses requested in the array exist in the device and reduce the array size such that only valid addresses (that exist in the device) are requested by the array.
2. Reduce the array size value to 125.

See Also:[Error Handling](#)[Block Sizes](#)

Modbus Exception Codes

The following data is from Modbus Application Protocol Specifications documentation.

Code Dec/Hex	Name	Meaning
01/0x01	ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the server (or slave). This may be because the function code is only applicable to newer devices, and was not implemented in the unit selected. It could also indicate that the server (or slave) is in the wrong state to process a request of this type, for example, because it is unconfigured and is being asked to return register values.
02/0x02	ILLEGAL DATA ADDRESS	The data address received in the query is not an allowable address for the server (or slave). More specifically, the combination of reference number and transfer length is invalid. For a controller with 100 registers, a request with offset 96 and length 4 would succeed. A request with offset 96 and length 5 will generate exception 02.
03/0x03	ILLEGAL DATA VALUE	A value contained in the query data field is not an allowable value for server (or slave). This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect. It specifically does not mean that a data item submitted for storage in a register has a value outside the expectation of the application program, since the MODBUS protocol is unaware of the significance of any particular value of any particular register.
04/0x04	SLAVE DEVICE FAILURE	An unrecoverable error occurred while the server (or slave) was attempting to perform the requested action.
05/0x05	ACKNOWLEDGE	The slave has accepted the request and is processing it, but a long duration of time will be required to do so. This response is returned to prevent a timeout error from occurring in the master. The master can next issue a Poll Program Complete message to determine if processing is completed.
06/0x06	SLAVE DEVICE BUSY	The slave is engaged in processing a long-duration program command. The master should retransmit the message later when the slave is free.
07/0x07	NEGATIVE ACKNOWLEDGE	The slave cannot perform the program function received in the query. This code is returned for an unsuccessful programming request using function code 13 or 14 decimal. The master should request diagnostic or error information from the slave.
08/0x08	MEMORY PARITY ERROR	The slave attempted to read extended memory, but detected a parity error in the memory. The master can retry the request, but service may be required on the slave device.
10/0x0A	GATEWAY PATH UNAVAILABLE	Specialized use in conjunction with gateways indicates that the gateway was unable to allocate an internal communication path from the input port to the output port for processing the request. This usually means that the gateway is misconfigured or overloaded.
11/0x0B	GATEWAY TARGET DEVICE FAILED TO RESPOND	Specialized use in conjunction with gateways indicates that no response was obtained from the target device. This usually means that the device is not present on the network.

Resources

In addition to this user manual, there are a variety of resources available to assist customers, answer questions, provide more detail about specific implementations, or help with troubleshooting specific issues.

[Knowledge Base](#)

[Whitepapers](#)

[Connectivity Guides](#)

[Technical Notes](#)

[Training Programs](#)

[Training Videos](#)

[Kepware Technical Support](#)

[PTC Technical Support](#)

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