# Allen-Bradley Micro800 Ethernet Driver

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# Allen-Bradley Micro800 Ethernet Driver

Help version 1.035

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## Overview

The Allen-Bradley Micro800 Ethernet Driver provides a reliable way to connect Allen-Bradley Micro800 Ethernet controllers to OPC client applications; including HMI, SCADA, Historian, MES, ERP, and countless custom applications.

## Setup

### Supported Devices

Micro850 via embedded Ethernet port.

### Communication Protocol

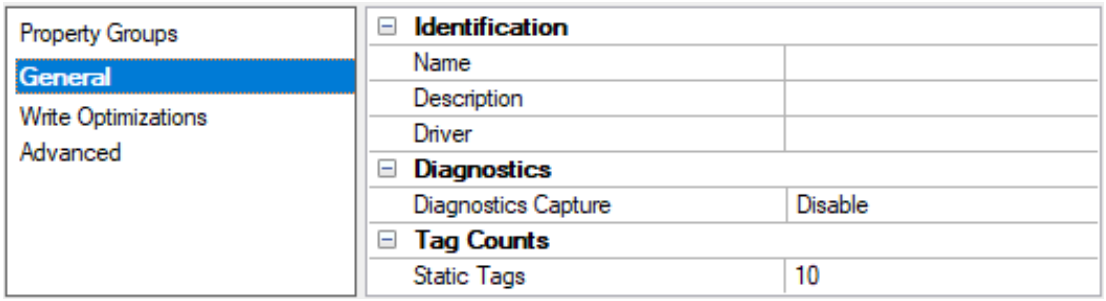
Ethernet/IP (CIP over Ethernet) using TCP/IP

### Channel and Device Limits

The maximum number of channels supported by this driver is 256. The maximum number of devices supported by this driver is 1024 per channel.

## Channel Properties — General

This server supports the use of multiple simultaneous 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.




### Identification

**Name**: Specify the 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. The property is required for creating a channel.

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

**Description**: Specify user-defined information about this channel.

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

**Driver**: Specify the protocol / driver for this channel. Specify the device driver that was selected during channel creation. It is a disabled setting in the channel properties. The property is required for creating a channel.

**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. Changes to the properties should not be made once a large client application has been developed. Utilize proper user role and privilege management to prevent operators from changing properties or accessing 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 not available if the driver does not support diagnostics.

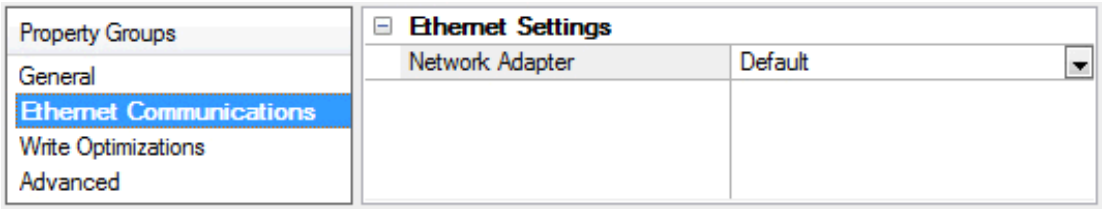
*For more information, refer to "Communication Diagnostics" and "Statistics Tags" in the server help.*

### Tag Counts

**Static Tags**: Provides the total number of defined static tags at this level (device or channel). This information can be helpful in troubleshooting and load balancing.

## Channel Properties — Ethernet Communications

Ethernet Communication can be used to communicate with devices.

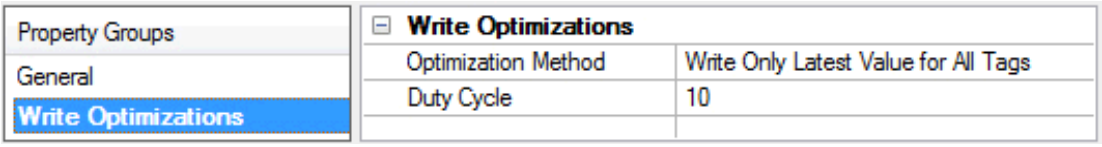



### Ethernet Settings

**Network Adapter**: Specify the network adapter to bind. When left blank or Default is selected, the operating system selects the default adapter.

## Channel Properties — Write Optimizations

The server must ensure that the data written from the client application gets to the device on time. Given this goal, the server provides optimization properties to meet specific needs or improve application responsiveness.




### 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

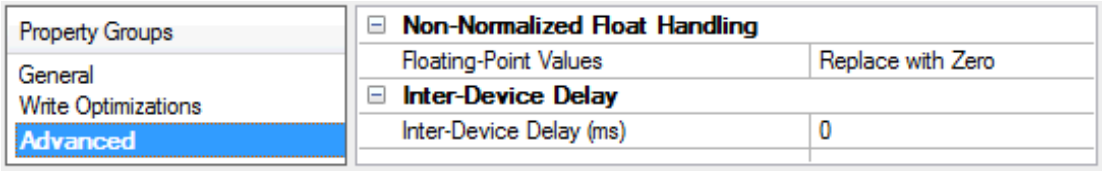
value to the device. This mode optimizes all writes by updating the tags currently in the write queue before they are sent. This is the default mode.

**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.




**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.*

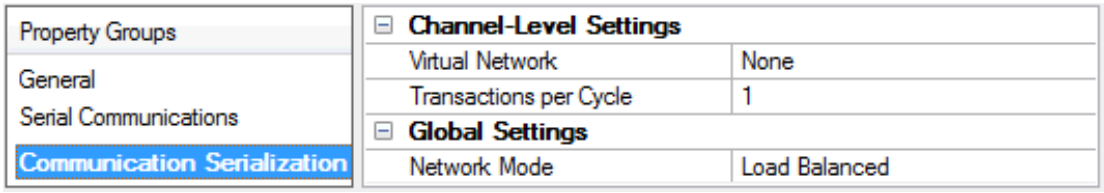
**Inter-Device Delay**: Specify the amount of time the communications channel waits to send new requests to the next device after data is received from the current device on the same channel. Zero (0) disables the delay.

**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 client radio. All channels using the same client 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.




## Channel-Level Settings

**Virtual Network**: Specify the channel's mode of communication serialization. Options include None and Network 1 - Network 500. The default is None. Descriptions of the options are as follows:

- **None**: This option disables communication serialization for the channel.
- **Network 1 - Network 500**: This option specifies the virtual network to which the channel is assigned.

**Transactions per Cycle**: Specify 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 is the 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):

1. Channels with pending writes have the highest priority.
2. Channels with pending explicit reads (through internal plug-ins or external client interfaces) are prioritized based on the read's priority.
3. 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.

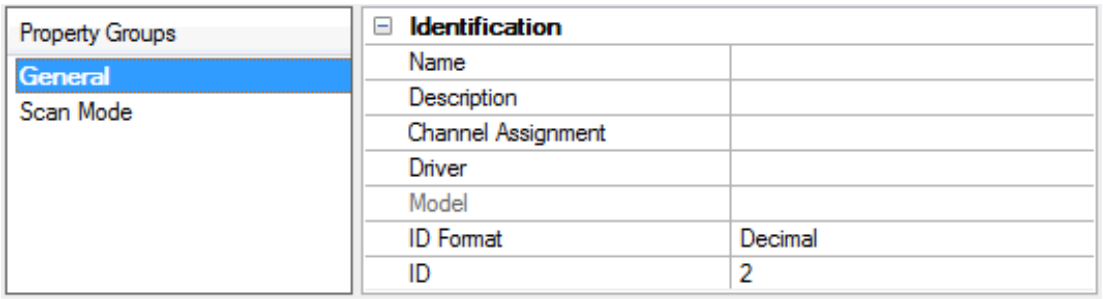
Due to differences in the way that drivers read and write data (such as in single, blocked, or non-blocked transactions); the application's Transactions per cycle property may need to be adjusted. When doing so, consider the following factors:

- 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 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.




### Identification

**Name**: Specify 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**: Specify the user-defined information about this device.
Many of these properties, including Description, have an associated system tag.

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

**Driver**: Selected protocol driver for this device.

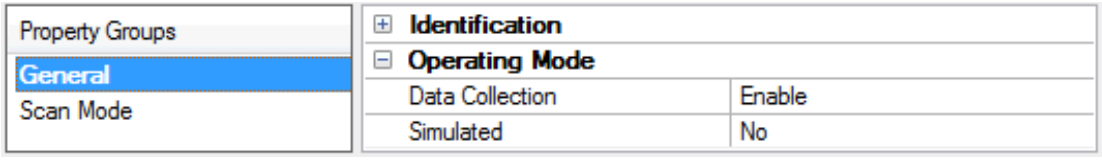
**Model**: Specify the type of device that is associated with this ID. The contents of the drop-down menu depend on the type of communications driver being used. Models that are not supported by a driver are disabled. If the communications driver supports multiple device models, the model selection can 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 documentation.*

**ID**: Specify the device's driver-specific station or node. The type of ID entered depends on the communications driver being used. For many communication 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 format is set by the driver by default. Options include Decimal, Octal, and Hexadecimal.

**Note**: 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.

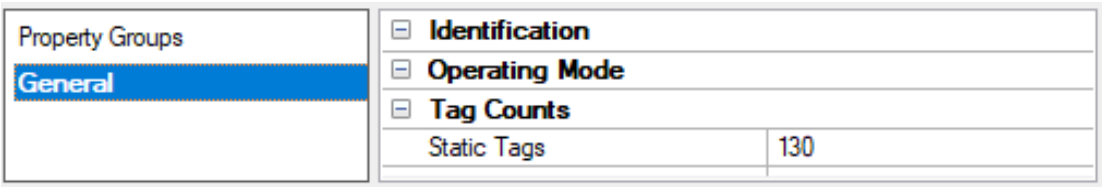
**Simulated**: Place the device into or out of Simulation Mode. In this mode, the driver does not attempt to communicate with the physical device, but the server continues to return valid OPC data. Simulated stops physical communications with the device, but allows OPC data to be returned to the OPC 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 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.
2. When a device is simulated, updates may not appear faster than one (1) second in the client.

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

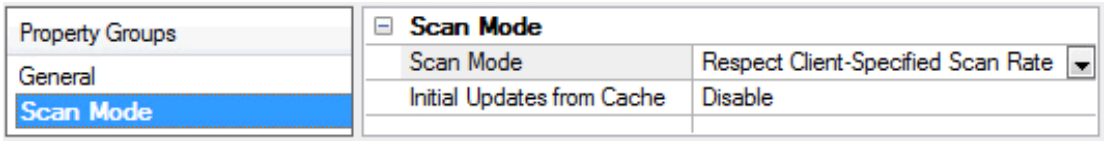
## Tag Counts




**Static Tags**: Provides the total number of defined static tags at this level (device or channel). This information can be helpful in troubleshooting and load balancing.

# 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.



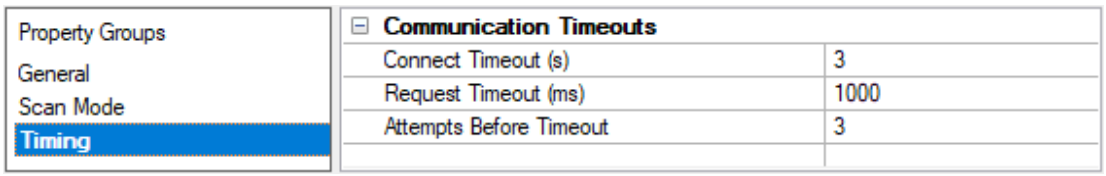

**Scan Mode**: Specify how tags in the device are scanned for updates sent to subscribing clients. Descriptions of the options are:

- **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 value set as the maximum scan rate. 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 OPC 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 — 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.




### 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.

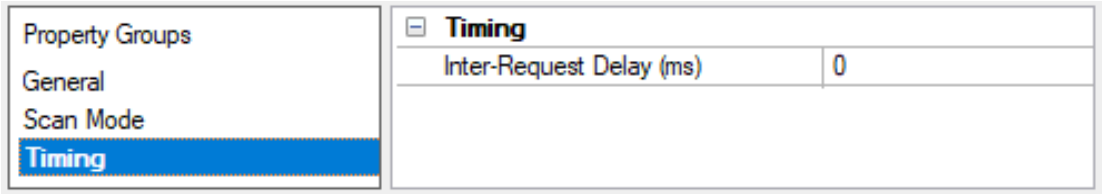
**Request Timeout**: Specify an interval used by all drivers to determine how long the driver waits for a response from the target device to complete. The valid range is 50 to 9999999 milliseconds (167 minutes). The default is usually 1000 milliseconds, but can vary depending on the driver. The default 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**: Specify 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

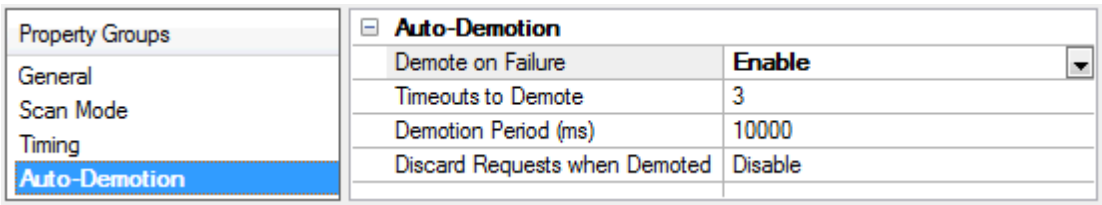
**Inter-Request Delay**: Specify how long the driver waits before sending the next request to the target device. It overrides the normal polling frequency of tags associated with the device, as well as one-time reads and writes. This delay can be useful when dealing with devices with slow turnaround 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.




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

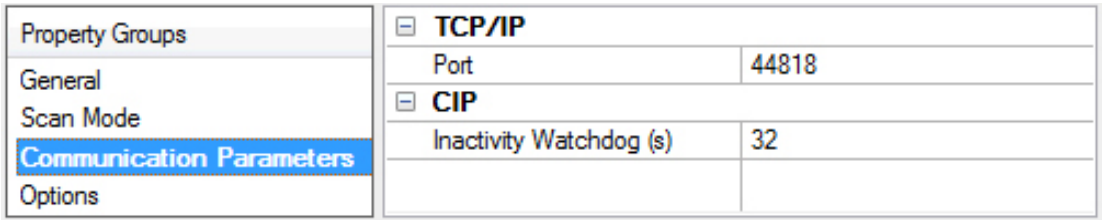
**Tip**: Determine when a device is off-scan by monitoring its demoted state using the _AutoDemoted system tag.

**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 — Communications Parameters



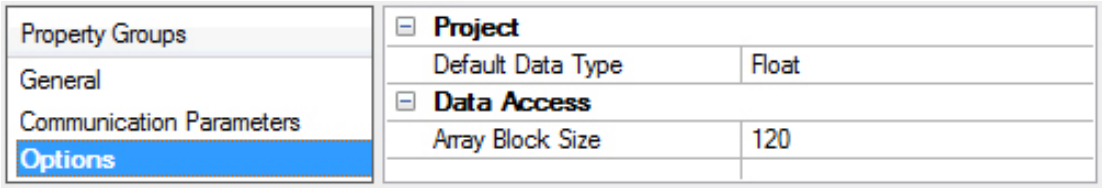

### TCP/IP

**Port**: Specify the port number the device is configured to use. The valid range is 0 to 65535. The default is 44818.

### CIP

**Inactivity Watchdog**: Indicate the amount of time, in seconds, a connection can remain idle (without read/write transactions) before being closed by the controller. In general, the larger the Inactivity Watchdog value, the more time it takes for connection resources to be released by the controller (and vice versa). The default is 32 seconds.

## Device Properties — Options




### Project

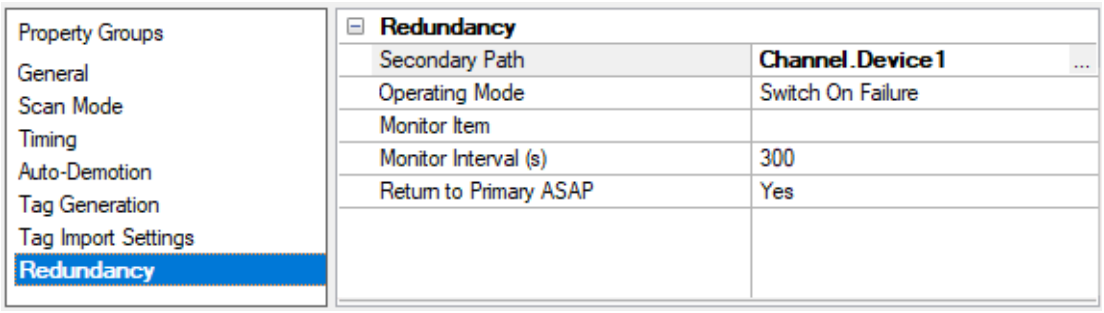
**Default Data Type**: Select the data type assigned to a client / server tag when the default type is selected during tag addition / modification / import. The default is Float. Tags are assigned the default data type when a dynamic tag is created in the client with Native as its assigned data type and when a static tag is created in the server with Default as its assigned data type.

## Data Access

**Array Block Size**: Specify the maximum number of atomic array elements to read in a single transaction. The range is from 30 to 3840 elements. The default is 120 elements.

- For Boolean arrays, a single element is considered a 32-element bit array. Setting the block size to 30 elements translates to 960 bit elements, whereas 3840 elements translate to 122880 bit elements.

## Device Properties — Redundancy




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

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

## Performance Optimizations

The Allen-Bradley Micro800 Ethernet Driver is fast, but a few guidelines may be applied to gain maximum performance. For more information on optimization at the communications and application levels, select a link from the list below.

Optimizing Communications
Optimizing Applications

## Optimizing Communications

As with any programmable controller, there are a variety of ways to enhance the overall performance and system communications.

### Keep Native Tag Names Short

Native Tags reads from and writes to the device specify its symbolic name in the communications request. As such, the longer the tag name is, the larger the request.

### Array Elements Blocked

To optimize the reading of atomic array elements, read a block of the array in a single request instead of individually. The more elements read in a block, the greater the performance. Since transaction overhead and processing consumes the most time, do as few transactions as possible while scanning as many desired tags as possible. This is the essence of array element blocking.

Block sizes are specified as an element count. A block size of 120 elements means that a maximum of 120 array elements are read in one request. The maximum block size is 3840 elements. Boolean arrays are treated differently: in protocol, a Boolean array is a 32-bit array. Thus, requesting element 0 is requesting bits 0 through 31. To maintain consistency in discussion, a Boolean array element is considered a single bit. In summary, the maximum number of array elements (based on block size of 3840) that can be requested is as follows: 122880 BOOL, 3840 SINT, 3840 INT, 3840 DINT, 3840 LINT, and 3840 REAL.

The block size is adjustable, and should be chosen based on the project at hand. For example, if array elements 0-26 and element 3839 are tags to be read, then using a block size of 3840 is overly large and detrimental to the driver's performance. This is because all elements between 0 and 3839 are read on each request, even though only 28 of those elements are of importance. In this case, a block size of 30 is more appropriate. Elements 0-26 would be serviced in one request and element 3839 would be serviced on the next.

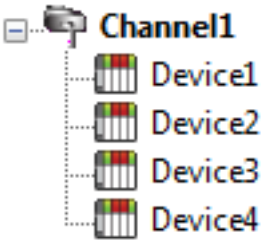
***See Also:*** *Options*

## Optimizing Applications

The Allen-Bradley Micro800 Ethernet Driver is designed to provide the best performance with the least amount of impact on the system's overall performance. While the driver is fast, there are a couple of guidelines that can be used to gain maximum performance.

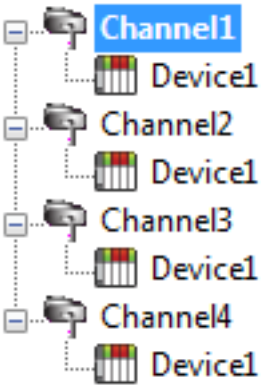
The server refers to communications protocols like Allen-Bradley Micro800 Ethernet as a channel. Each channel defined in the application represents a separate path of execution in the server. Once a channel has been defined, a series of devices must then be defined under that channel. Each of these devices represents a single Micro800 CPU from which data is collected. While this approach to defining the application provides a high level of performance, it won't take full advantage of the Allen-Bradley Micro800 Ethernet Driver or the

network. An example of how the application may appear when configured using a single channel is shown below.




Each device appears under a single channel. In this configuration, the driver must move from one device to the next as quickly as possible to gather information at an effective rate. As more devices are added or more information is requested from a single device, the overall update rate begins to suffer.

If the Allen-Bradley Micro800 Ethernet Driver could only define one single channel, then the example shown above would be the only option available; however, the driver can define up to 256 channels. Using multiple channels distributes the data collection workload by simultaneously issuing multiple requests to the network. An example of how the same application may appear when configured using multiple channels to improve performance is shown below.




Each device can be defined under its own channel. In this configuration, a single path of execution is dedicated to the task of gathering data from each device. If the application has 256 or fewer devices, it can be optimized exactly how it is shown here.

The performance improves even if the application has more devices. While fewer devices may be ideal, the application benefits from additional channels. Although spreading the device load across all channels causes the server to move from device to device again, it can now do so with far less devices to process on a single channel.

## Data Types Description

| Data Type | Description |
|---|---|
| Boolean | Single bit |
| Byte | Unsigned 8-bit value |
| Char | Signed 8-bit value |
| Word | Unsigned 16-bit value |
| Short | Signed 16-bit value |
| DWord | Unsigned 32-bit value |
| Long | Signed 32-bit value |
| BCD | Two byte packed BCD, four decimal digits |
| LBCD | Four byte packed BCD, eight decimal digits |
| Float | 32-bit IEEE Floating point |
| Double | 64-bit IEEE Floating point |
| Date | 64-bit Date/Time |
| String | Null-terminated character array |

## Address Descriptions

Micro800 uses a tag or symbol-based addressing structure referred to as Native Tags. These tags differ from conventional PLC data items in that the tag name itself is the address, not a file or register number.

The Allen-Bradley Micro800 Ethernet Driver allows users to access the controller's atomic data types: BOOL, SINT, USINT, BYTE, INT, UINT, WORD, DINT, UDINT, DWORD, LINT, ULINT, LWORD, REAL, LREAL, and SHORT_STRING. Although some of the pre-defined types are structures, they are ultimately based on these atomic data types. Thus, all non-structure (atomic) members of a structure are accessible. For example, a TIMER cannot be assigned to a server tag but an atomic member of the TIMER can be assigned to the tag (for example, TIMER.EN, TIMER.ACC, and so forth). If a structure member is a structure itself, both structures must be expanded to access an atomic member of the substructure. This is more common with user-defined and module-defined types, and is not found in any of the pre-defined types.

| Atomic Data Type | Description | Client Type | Range |
|---|---|---|---|
| BOOL | Single-bit value | VT_BOOL | 0, 1 |
| SINT | Signed 8-bit value | VT_I1 | -128 to 127 |
| USINT | Unsigned 8-bit value | VT_UI1 | 0 to 255 |
| BYTE | Bit string (8 bits) | VT_UI1 | 0 to 255 |
| INT | Signed 16-bit value | VT_I2 | -32,768 to 32,767 |
| UINT | Unsigned 16-bit value | VT_UI2 | 0 to 65535 |
| WORD | Bit string (16 bits) | VT_UI2 | 0 to 65535 |
| DINT | Signed 32-bit value | VT_I4 | -2,147,483,648 to 2,147,483,647 |
| UDINT | Unsigned 32-bit value | VR_UI4 | 0 to 4294967296 |
| DWORD | Bit string (32 bits) | VR_UI4 | 0 to 4294967296 |
| LINT | Signed 64-bit value | VT_R8 | -1.798E+308 to -2.225E-308, 0, 2.225E-308 to 1.798E+308 |
| ULINT | Unsigned 64-bit value | VT_R8 | -1.798E+308 to -2.225E-308, 0, 2.225E-308 to 1.798E+308 |
| LWORD | Bit string (64 bits) | VT_R8 | -1.798E+308 to -2.225E-308, 0, 2.225E-308 to 1.798E+308 |
| REAL | 32-bit IEEE Floating point | VT_R4 | 1.1755 E-38 to 3.403E38, 0, -3.403E-38 to -1.1755 |
| LREAL | 64-bit IEEE Floating point | VT_R8 | -1.798E+308 to -2.225E-308, 0, 2.225E-308 to 1.798E+308 |
| SHORT_STRING | Character string. The maximum is 80 characters | VT_BSTR | |

***See Also:*** *Advanced Use Cases*

**Client/Server Tag Address Rules**

Native Tag names correspond to Client/Server Tag addresses. Both Native Tag names (entered via the Connected Components Workbench) and Client/Server Tag addresses follow the IEC 1131-3 identifier rules. Descriptions of the rules are as follows:

- Must begin with an alphabetic character or an underscore.
- Can only contain alphanumeric characters and underscores.
- Can have as many as 40 characters.
- Cannot have consecutive underscores.
- Characters are not case sensitive.

**Client / Server Tag Name Rules**
Tag name assignment in the server differs from address assignment in that names cannot begin with an underscore.

***See Also**: Performance Optimizations*

## Address Formats

A Native Tag may be addressed statically in the server or dynamically from a client in several ways. The tag's format will depend on its type and intended usage. For example, the bit format would be used when accessing a bit within a SINT-type tag. For information on address format and syntax, refer to the table below.

**Note**: Every format is native to Connected Components Workbench (CCW) except for the Array formats. Therefore, when referencing an atomic data type, a CCW tag name could be copied and pasted into the server's tag address field and be valid.

***See Also**: Advanced Use Cases*

| Format | Syntax |
|---|---|
| Array Element | <Native Tag name> [dim 1, dim2, dim 3] |
| Array w/ Offset* | <Native Tag name> {# columns}<br><Native Tag name> {# rows}{# columns} |
| Array w/o Offset* | <Native Tag name> {# columns}<br><Native Tag name> {# rows}{# columns} |
| Bit | <Native Tag name>.bit<br><Native Tag name>.[bit] |
| Standard | <Native Tag name> |
| String | <Native Tag name> |

*Since these formats may request more than one element, the order in which array data is passed depends on the dimension of the array tag. For example, if rows times cols = 4 and the Native Tag is a 3X3 element array, then the elements that are being referenced are array_tag [0,0], array_tag [0,1], array_tag [0,2], and array_tag [1,0] in that exact order. The results would be different if the Native Tag were a 2X10 element array. For more information, refer to **Ordering of Array Data**.

### Expanded Address Formats

**Array Element**
At least 1 dimension (but no more then 3) must be specified.

| Syntax | Example | Notes |
|---|---|---|
| <Native Tag Name> [dim1] | tag_1 [5] | N/A |

| Syntax | Example | Notes |
|---|---|---|
| <Native Tag name> [dim 1, dim2] | tag_1 [2, 3] | N/A |
| <Native Tag name> [dim 1, dim2, dim 3] | tag_1 [2, 58, 547] | N/A |

**Array With Offset**
Since this class may request more than one element, the order in which array data is passed depends on the dimension of the Array Tag.

| Syntax | Example | Notes |
|---|---|---|
| <Native Tag name> [offset] {# of columns} | tag_1 [5] {8} | The number of elements to Read/Write equals the number of rows multiplied by the number of columns. If no rows are specified, the number of rows will default to 1. At least 1 element of the array must be addressed.<br><br>The array begins at a zero offset (array index equals 0 for all dimensions). |
| <Native Tag name> [offset] {# of rows}{# of columns} | tag_1 [5] {2}{4} | |

**Note**: If rows*cols = 4 and the Native Tag is a 3X3 element array, then the elements that are being referenced are array_tag [0,0], array_tag [0,1], array_tag [0,2] and array_tag [1,0] in that exact order. The results would be different if the Native Tag were a 2X10 element array.

**Array Without Offset**
Since this class may request more than one element, the order in which array data is passed depends on the dimension of the Array Tag.

| Syntax | Example | Notes |
|---|---|---|
| <Native Tag name> {# of columns} | tag_1 {8} | The number of elements to Read/Write equals the number of rows multiplied by the number of columns. If no rows are specified, the number of rows will default to 1. At least 1 element of the array must be addressed.<br><br>The array begins at a zero offset (array index equals 0 for all dimensions). |
| <Native Tag name> {# of rows}{# of columns} | tag_1 {2} {4} | |

**Note**: For example, if rows*cols = 4 and the Native Tag is a 3X3 element array, then the elements that are being referenced are array_tag [0,0], array_tag [0,1], array_tag [0,2] and array_tag [1,0] in that exact order. The results would be different if the Native Tag were a 2X10 element array.

**Bit**

| Syntax | Example | Notes |
|---|---|---|
| <Native Tag name> . bit | tag_1 . 0 | N/A |
| <Native Tag name> . [bit] | tag_1 . [0] | N/A |

**Standard**

| Syntax | Example | Notes |
|---|---|---|
| <Native Tag name> | tag_1 | N/A |

**String**

| Syntax | Example | Notes |
|---|---|---|
| <Native Tag name> | tag_1 | The number of characters to Read/Write equals the string length and must be at least 1. |

*For more information on how elements are referenced for 1, 2 and 3 dimensional arrays, refer to* ***Ordering of Array Data****.*

## Tag Scope

The scope of variables can be local to a program or global to a controller.

- Local variables are assigned to a specific program in the project; they are available only to that program.
- Global variables belong to the controller in the project; they are available to any program in the project.

### Local Variables

Local variables (program-scoped tags) cannot be accessed directly through the communications port of the controller, so are not directly supported within the driver. If access is required, cut and paste the tags from the Local variable table to the Global variable table.

### Global Variables

Global Variables (controller-scoped tags) are Native Tags that have global scope in the controller. Any program or task can access Global Tags; however, the number of ways a Global Tag can be referenced depends on both its Native Data Type and the address format being used.

### User-Defined Data Types

Users may create unique data types, e.g. STRING with 12 characters rather than 80. These user-defined data types may be used as local or global variables.

### Structured Variables

There are no structured variables in Micro800 controllers. Users may build unique Data Types, but each member must have a unique name.

## Addressing Atomic Data Types

The table below contains suggested usage and addressing possibilities for each Native Data Type given the available address formats. For each data type's advanced addressing possibilities, click **Advanced**.

**Note:** Empty cells do not necessarily indicate a lack of support.

### BOOL

| Tag | Standard | Array Element | Array w/wo Offset | Bit | String |
|---|---|---|---|---|---|
| Data Type | Boolean | Boolean | Boolean Array | | |

| Tag | Standard | Array Element | Array w/wo Offset | Bit | String |
|---|---|---|---|---|---|
| Advanced | | (BOOL 1 dimensional array) | (BOOL 1 dimensional array) | | |
| Example | BOOLTAG | BOOLARR[0] | BOOLARR[0]{32} | | |

### SINT, USINT, and BYTE

| Tag | Standard | Array Element | Array w/wo Offset | Bit | String |
|---|---|---|---|---|---|
| Data Type<br>Advanced | Byte, Char | Byte, Char | Byte Array, Char Array<br>(SINT 1/2/3 dimensional array) | Boolean<br>(Bit w/i SINT) | |
| Example | SINTTAG | SINTARR[0] | SINTARR[0]{4} | SINTTAG.0 | |

### INT, UINT, and WORD

| Tag | Standard | Array Element | Array w/wo Offset | Bit | String |
|---|---|---|---|---|---|
| Data Type<br>Advanced | Word, Short | Word, Short | Word Array, Short<br>Array (INT 1/2/3 dimensional array) | Boolean<br>(Bit w/i INT) | |
| Example | INTTAG | INTARR[0] | INTARR[0]{4} | INTTAG.0 | |

### DINT, UDINT, and DWORD

| Tag | Standard | Array Element | Array w/wo Offset | Bit | String |
|---|---|---|---|---|---|
| Data Type<br>Advanced | DWord, Long | DWord, Long | DWord Array, Long, Array | Boolean<br>(Bit w/i DINT) | |
| Example | DINTTAG | DINTARR[0] | DINTARR[0]{4} | DINTTAG.0 | |

### LINT, ULINT, and LWORD

| Tag | Standard | Array Element | Array w/wo Offset | Bit | String |
|---|---|---|---|---|---|
| Data Type<br>Advanced | Double, Date | Double, Date | Double Array | | |
| Example | LINTTAG | LINTARR[0] | LINTARR[0]{4} | | |

### REAL

| Tag | Standard | Array Element | Array w/wo Offset | Bit | String |
|---|---|---|---|---|---|
| Data Type<br>Advanced | Float | Float | Float Array | | |
| Example | REALTAG | REALARR[0] | REALARR[0]{4} | | |

**LREAL**

| Tag | Standard | Array Element | Array w/wo Offset | Bit | String |
|---|---|---|---|---|---|
| Data Type<br>Advanced | Double | Double | Double Array | | |
| Example | LREALTAG | LREALARR[0] | LREALARR[0]{4} | | |

**SHORT_STRING**

| Tag | Standard | Array Element | Array w/wo Offset | Bit | String |
|---|---|---|---|---|---|
| Data Type<br>Advanced | String | String | | | |
| Example | STRINGTAG | STRINGARR[0] | | | |

*See Also: Address Formats*

## Addressing Structured Data Types

Structures cannot be referenced at the structure level: only the atomic structure members can be addressed. For more information, refer to the examples below.

**Native Tag**
MyTimer @ TIMER

**Valid Client/Server Tag**
Address = MyTimer.ACC
Data type = DWord

**Invalid Client/Server Tag**
Address = MyTimer
Data type = ??

## Ordering of Array Data

### One-Dimensional Arrays - array [dim1]

1 dimensional array data is passed to and from the controller in ascending order.

for (dim1 = 0; dim1 < dim1_max; dim1++)

**Example:** 3 element array

array [0]
array [1]
array [2]

### Two-Dimensional Arrays - array [dim1, dim2]

2 dimensional array data is passed to and from the controller in ascending order.

for (dim1 = 0; dim1 < dim1_max; dim1++)
for (dim2 = 0; dim2 < dim2_max; dim2++)

**Example:** 3X3 element array
array [0, 0]
array [0, 1]
array [0, 2]
array [1, 0]
array [1, 1]
array [1, 2]
array [2, 0]
array [2, 1]
array [2, 2]

### Three-Dimensional Arrays - array [dim1, dim2, dim3]

3 dimensional array data is passed to and from the controller in ascending order.

for (dim1 = 0; dim1 < dim1_max; dim1++)
for (dim2 = 0; dim2 < dim2_max; dim2++)
for (dim3 = 0; dim3 < dim3_max; dim3++)

**Example:** 3X3x3 element array
array [0, 0, 0]
array [0, 0, 1]
array [0, 0, 2]
array [0, 1, 0]
array [0, 1, 1]
array [0, 1, 2]
array [0, 2, 0]
array [0, 2, 1]
array [0, 2, 2]
array [1, 0, 0]
array [1, 0, 1]
array [1, 0, 2]
array [1, 1, 0]
array [1, 1, 1]
array [1, 1, 2]
array [1, 2, 0]
array [1, 2, 1]
array [1, 2, 2]
array [2, 0, 0]
array [2, 0, 1]
array [2, 0, 2]
array [2, 1, 0]
array [2, 1, 1]
array [2, 1, 2]

array [2, 2, 0]
array [2, 2, 1]
array [2, 2, 2]

## Advanced Use Cases

For more information on the advanced use cases for a specific atomic data type, select a link from the list below.

**BOOL**
**SINT, USINT, and BYTE**
**INT, UINT, and WORD**
**DINT, UDINT, and DWORD**
**LINT, ULINT, and LWORD**
**REAL**
**LREAL**
**SHORT_STRING**

## BOOL

*For more information on the format, refer to **Address Formats**.*

| Format | Supported Data Types | Notes |
|---|---|---|
| Array Element | Boolean | The Native Tag must be a 1 dimensional array. |
| Array w/ Offset | Boolean Array | 1. The Native Tag must be a 1 dimensional array.<br>2. The offset must lay on a 32-bit boundary.<br>3. The number of elements must be a factor of 32. |
| Array w/o Offset | Boolean Array | 1. The Native Tag must be a 1 dimensional array.<br>2. The number of elements must be a factor of 32. |
| Bit | Boolean | 1. The Native Tag must be a 1 dimensional array.<br>2. The range is limited from 0 to 31. |
| Standard | Boolean, Byte, Char, Word, Short, BCD, DWord, Long, LBCD, Float* | None |
| String | Not supported | |

***The Float value equals the face value of the Native Tag in Float form (non-IEEE Floating point number).

### Examples

Examples highlighted signify common use cases.

**BOOL Atomic Tag - booltag = True**

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| booltag | Standard | Boolean | Value = True |
| booltag | Standard | Byte | Value = 1 |
| booltag | Standard | Word | Value = 1 |
| booltag | Standard | DWord | Value = 1 |
| booltag | Standard | Float | Value = 1.0 |
| booltag [3] | Array Element | Boolean | Invalid: Tag is not an array |
| booltag [3] | Array Element | Word | Invalid: Tag is not an array |
| booltag {1} | Array w/o Offset | Word | Invalid: Not supported |
| booltag {1} | Array w/o Offset | Boolean | Invalid: Not supported |
| booltag [3] {32} | Array w/ Offset | Boolean | Invalid: Tag is not an array |
| booltag . 3 | Bit | Boolean | Invalid: Tag is not an array |
| booltag / 1 | String | String | Invalid: Not supported |
| booltag / 4 | String | String | Invalid: Not supported |

**BOOL Array Tag - bitarraytag = [0,1,0,1]**

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| bitarraytag | Standard | Boolean | Invalid: Tag cannot be an array |
| bitarraytag | Standard | Byte | Invalid: Tag cannot be an array |
| bitarraytag | Standard | Word | Invalid: Tag cannot be an array |
| bitarraytag | Standard | DWord | Invalid: Tag cannot be an array |
| bitarraytag | Standard | Float | Invalid: Tag cannot be an array |
| bitarraytag [3] | Array Element | Boolean | Value = True |
| bitarraytag [3] | Array Element | Word | Invalid: Bad data type |
| bitarraytag {3} | Array w/o Offset | Word | Invalid: Tag cannot be an array |
| bitarraytag {1} | Array w/o Offset | Word | Invalid: Tag cannot be an array |
| bitarraytag {1} | Array w/o Offset | Boolean | Invalid: Array size must be a factor of 32 |
| bitarraytag {32} | Array w/o Offset | Boolean | Value = [0,1,0,1,...] |
| bitarraytag [3] {32} | Array w/ Offset | Boolean | Offset must begin on 32-bit boundary |
| bitarraytag[0]{32} | Array w/ Offset | Boolean | Value = [0,1,0,1,...] |
| bitarraytag[32]{64} | Array w/ Offset | Boolean | Syntax valid. Element is out of range |
| bitarraytag . 3 | Bit | Boolean | Value = True |
| bitarraytag / 1 | String | String | Invalid: Not supported |
| bitarraytag / 4 | String | String | Invalid: Not supported |

## SINT, USINT, and BYTE

*For more information on the format, refer to **Address Formats**.*

| Format | Supported Data Types | Notes |
|---|---|---|
| Array Element | Byte, Char<br>Word, Short, BCD<br>DWord, Long, LBCD<br>Float*** | The Native Tag must be an array. |
| Array w/ Offset | Byte Array, Char Array, Word Array, Short Array, BCD Array**, DWord Array, Long Array, LBCD Array**, Float Array**,*** | The Native Tag must be an array. |
| Array w/o Offset | Boolean Array<br><br>Byte Array, Char Array, Word Array, Short Array, BCD Array**, DWord Array, Long Array, LBCD Array**m Float Array**,*** | 1. Use this case to have the bits within an SINT in array form. This is not an array of SINTs in Boolean notation.<br>2. Applies to bit-within-SINT only. Example: tag_1.0{8}.<br>3. The .bit plus the array size cannot exceed 8 bits. Example: tag_1.1{8} exceeds an SINT, tag_1.0{8} does not.<br><br>If accessing more than a single element, the Native Tag must be an array. |
| Bit | Boolean | 1. The range is limited from 0 to 7.<br>2. If the Native Tag is an array, the bit class reference must be prefixed by an array element class reference. Example: tag_1 [2,2,3].0. |
| Standard | Boolean*, Byte, Char, Word, Short, BCD, DWord, Long, LBCD, Float*** | None |
| String | String | 1. If accessing a single element, the Native Tag does not need to be an array.<br><br>**Note:** The value of the string is the ASCII equivalent of the SINT value. Example: SINT = 65dec = "A".<br><br>2. If accessing more than a single element, the Native Tag must be an array. The value of the string is the null-terminated ASCII equivalent of all the SINTs in the string.<br><br>1 character in string = 1 SINT. |

*Non-zero values are clamped to True.
**Each element of the array corresponds to an element in the SINT array. Arrays are not packed.
***Float value equals theface value of Native Tag in Float form (non-IEEE Floating point number).

## Examples

Examples highlighted signify common use cases for SINT, USINT, and BYTE.

**SINT, USINT, and BYTE Atomic Tag - sinttag = 122 (decimal)**

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| sinttag | Standard | Boolean | Value = True |
| sinttag | Standard | Byte | Value = 122 |
| sinttag | Standard | Word | Value = 122 |
| sinttag | Standard | DWord | Value = 122 |
| sinttag | Standard | Float | Value = 122.0 |
| sinttag [3] | Array Element | Boolean | Invalid: Tag is not an array. Also, Boolean is invalid. |
| sinttag [3] | Array Element | Byte | Invalid: Tag is not an array. |
| sinttag {3} | Array w/o Off-set | Byte | Invalid: Tag is not an array. |
| sinttag {1} | Array w/o Off-set | Byte | Value = [122] |
| sinttag {1} | Array w/o Off-set | Boolean | Invalid: Bad data type. |
| sinttag [3] {1} | Array w/ Offset | Byte | Invalid: Tag is not an array. |
| sinttag . 3 | Bit | Boolean | Value = True |
| sinttag . 0 {8} | Array w/o Off-set | Boolean | Value = [0,1,0,1,1,1,1,0]<br>Bit value of 122 |
| sinttag / 1 | String | String | Invalid: Syntax / data type not supported. |
| sinttag / 4 | String | String | Invalid: Syntax / data type not supported. |

**SINT, USINT, and BYTE Array Tag - sintarraytag [4,4] = [[83,73,78,84],[5,6,7,8],[9,10,11,12],[13,14,15,16]]**

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| sintarraytag | Standard | Boolean | Invalid: Tag cannot be an array. |
| sintarraytag | Standard | Byte | Invalid: Tag cannot be an array. |
| sintarraytag | Standard | Word | Invalid: Tag cannot be an array. |
| sintarraytag | Standard | DWord | Invalid: Tag cannot be an array. |
| sintarraytag | Standard | Float | Invalid: Tag cannot be an array. |
| sintarraytag [3] | Array Element | Byte | Invalid: Server tag missing dimension 2 address. |
| sintarraytag [1,3] | Array Element | Boolean | Invalid: Boolean not allowed for array elements. |
| sintarraytag [1,3] | Array Element | Byte | Value = 8 |
| sintarraytag {10} | Array w/o Off-set | Byte | Value = [83,73,78,84,5,6,7,8,9,10] |
| sintarraytag {2} {5} | Array w/o Off-set | Word | Value = [83,73,78,84,5] [6,7,8,9,10] |

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| sintarraytag {1} | Array w/o Offset | Byte | Value = 83 |
| sintarraytag {1} | Array w/o Offset | Boolean | Invalid: Bad data type. |
| sintarraytag [1,3] {4} | Array w/ Offset | Byte | Value = [8,9,10,11] |
| sintarraytag . 3 | Bit | Boolean | Invalid: Tag must reference atomic location. |
| sintarraytag [1,3] . 3 | Bit | Boolean | Value = 1 |
| sintarraytag [1,3] . 0 {8} | Array w/o Offset | Boolean | Value = [0,0,0,1,0,0,0,0] |
| sintarraytag / 1 | String | String | Invalid: Syntax / data type not supported. |
| sintarraytag / 4 | String | String | Invalid: Syntax / data type not supported. |

## INT, UINT, and WORD

*For more information on the format, refer to **Address Formats**.*

| Format | Supported Data Types | Notes |
|---|---|---|
| Array Element | Byte, Char**<br>Word, Short, BCD<br>DWord, Long, LBCD<br>Float**** | The Native Tag must be an array. |
| Array w/ Offset | Byte Array, Char Array**<br>Word Array, Short Array, BCD Array<br>DWord Array, Long Array, LBCD Array***<br>Float Array ***,**** | The Native Tag must be an array. |
| Array w/o Offset | Boolean Array<br><br>Byte Array, Char Array**, Word Array, Short Array, BCD Array, DWord Array, Long Array, LBCD Array***, Float Array***,**** | 1. Use this case to have the bits within an INT in array form. This is not an array of INTs in Boolean notation.<br>2. Applies to bit-within-INT only. Example: tag_1.0{16}.<br>3. The .bit plus the array size cannot exceed 16 bits. Example: tag_1.1{16} exceeds an INT, tag_1.0{16} does not.<br><br>If accessing more than a single element, the Native Tag must be an array. |
| Bit | Boolean | 1. The range is limited from 0 to 15.<br>2. If the Native Tag is an array, the bit class reference must be prefixed by an array element class reference. Example: tag_1 [2,2,3].0. |

| Format | Supported Data Types | Notes |
|---|---|---|
| Standard | Boolean*, Byte, Char**, Word, Short, BCD, DWord, Long, LBCD, Float**** | None |
| String | String | 1. If accessing a single element, the Native Tag does not need to be an array.<br><br>**Note:** The value of the string is the ASCII equivalent of the INT value (clamped to 255). Example: INT = 65dec = "A".<br><br>2. If accessing more than a single element, the Native Tag must be an array. The value of the string is the null-terminated ASCII equivalent of all the INTs (clamped to 255) in the string.<br><br>1 character in string = 1 INT, clamped to 255.<br><br>**Note:** INT strings are not packed. For greater efficiency, use SINT strings or the STRING structure instead. |

*Non-zero values are clamped to True.
**Values exceeding 255 are clamped to 255.
*** Each element of the array corresponds to an element in the INT array. Arrays are not packed.
****Float value equals the face value of Native Tag in Float form (non-IEEE Floating point number).

## Examples

Examples highlighted signify common use cases for INT, UINT, and WORD.

**INT, UINT, and WORD Atomic Tag - inttag = 65534 (decimal)**

| Server Tag Address | Class | Data Type | Notes |
|---|---|---|---|
| inttag | Standard | Boolean | Value = True |
| inttag | Standard | Byte | Value = 255 |
| inttag | Standard | Word | Value = 65534 |
| inttag | Standard | DWord | Value = 65534 |
| inttag | Standard | Float | Value = 65534.0 |
| inttag [3] | Array Element | Boolean | Invalid: Tag is not an array. Also, Boolean is invalid. |
| inttag [3] | Array Element | Word | Invalid: Tag is not an array. |
| inttag {3} | Array w/o Offset | Word | Invalid: Tag is not an array. |
| inttag {1} | Array w/o Offset | Word | Value = [65534] |
| inttag {1} | Array w/o Offset | Boolean | Invalid: Bad data type. |
| inttag [3] {1} | Array w/ Offset | Word | Invalid: Tag is not an array. |
| inttag . 3 | Bit | Boolean | Value = True |

| Server Tag Address | Class | Data Type | Notes |
|---|---|---|---|
| inttag . 0 {16} | Array w/o Offset | Boolean | Value = [0,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1]<br>Bit value of 65534 |
| inttag / 1 | String | String | Invalid: Syntax / data type not supported. |
| inttag / 4 | String | String | Invalid: Syntax / data type not supported. |

**INT, UINT, and WORD Array Tag - intarraytag [4,4] = [[73,78,84,255],[256,257,258,259],[9,10,11,12],[13,14,15,16]]**

| Server Tag Address | Class | Data Type | Notes |
|---|---|---|---|
| intarraytag | Standard | Boolean | Invalid: Tag cannot be an array. |
| intarraytag | Standard | Byte | Invalid: Tag cannot be an array. |
| intarraytag | Standard | Word | Invalid: Tag cannot be an array. |
| intarraytag | Standard | DWord | Invalid: Tag cannot be an array. |
| intarraytag | Standard | Float | Invalid: Tag cannot be an array. |
| intarraytag [3] | Array Element | Word | Invalid: Server tag is missing dimension 2 address. |
| intarraytag [1,3] | Array Element | Boolean | Invalid: Boolean not allowed for array elements. |
| intarraytag [1,3] | Array Element | Word | Value = 259 |
| intarraytag {10} | Array w/o Offset | Byte | Value = [73,78,84,255,255,255,255,255,9,10] |
| intarraytag {2} {5} | Array w/o Offset | Word | Value = [73,78,84,255,256] [257,258,259,9,10] |
| intarraytag {1} | Array w/o Offset | Word | Value = 73 |
| intarraytag {1} | Array w/o Offset | Boolean | Invalid: Bad data type. |
| intarraytag [1,3] {4} | Array w/ Offset | Word | Value = [259,9,10,11] |
| intarraytag . 3 | Bit | Boolean | Invalid: Tag must reference atomic location. |
| intarraytag [1,3] . 3 | Bit | Boolean | Value = 0 |
| intarraytag [1,3] . 0 {16} | Array w/o Offset | Boolean | Value = [1,1,0,0,0,0,0,0,1,0,0,0,0,0,0,0]<br>Bit value for 259 |
| intarraytag / 1 | String | String | Invalid: Syntax / data type not supported. |
| intarraytag / 3 | String | String | Invalid: Syntax / data type not supported. |

## DINT, UDINT, and DWORD

*For more information on the format, refer to **Address Formats**.*

| Format | Supported Data Types | Notes |
|---|---|---|
| Array Element | Byte, Char**, Word, Short, BCD***, DWord, Long, LBCD, Float**** | The Native Tag must be an array. |
| Array w/ | Byte Array, Char Array** | The Native Tag must be an array. |

| Format | Supported Data Types | Notes |
|---|---|---|
| Offset | Word Array, Short Array, BCD Array***<br>DWord Array, Long Array, LBCD Array<br>Float Array**** | |
| Array w/o Offset | Boolean Array<br><br>Byte Array, Char Array**<br>Word Array, Short Array, BCD Array***<br>DWord Array, Long Array, LBCD Array<br>Float Array**** | 1. Use this case to have the bits within an DINT in array form. This is not an array of DINTs in Boolean notation.<br>2. Applies to bit-within-DINT only.<br>• Example: tag_1.0{32}. The .bit plus the array size cannot exceed 32 bits.<br>• Example: tag_1.1{32} exceeds an DINT, tag_1.0{32} does not.<br>• If accessing more than a single element, the Native Tag must be an array. |
| Bit | Boolean | 1. The range is limited from 0 to 31.<br>2. If Native Tag is an array, bit class reference must be prefixed by an array element class reference. Example: tag_1 [2,2,3].0. |
| Standard | Boolean*, Byte, Char**, Word, Short, BCD***, DWord, Long, LBCD, Float**** | None. |
| String | String | 1. If accessing a single element, the Native Tag does not need to be an array.<br>**Note:** The value of the string is the ASCII equivalent of the DINT value (clamped to 255). Example: SINT = 65dec = "A".<br>2. If accessing more than a single element, the Native Tag must be an array. The value of the string is the null-terminated ASCII equivalent of all the DINTs (clamped to 255) in the string.<br>1 character in string = 1 DINT, clamped to 255.<br>**Note:** DINT strings are not packed. For greater efficiency, use SINT strings or the STRING structure instead. |

*Non-zero values are clamped to True.
**Values exceeding 255 are clamped to 255.
***Values exceeding 65535 are clamped to 65535.
****Float value equals the face value of Native Tag in Float form (non-IEEE Floating point number).

## Examples

Examples highlighted signify common use cases for DINT, UDINT, and DWORD.

**DINT, UDINT, and DWORD Atomic Tag - dinttag = 70000 (decimal)**

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| dinttag | Standard | Boolean | Value = True |
| dinttag | Standard | Byte | Value = 255 |
| dinttag | Standard | Word | Value = 65535 |
| dinttag | Standard | DWord | Value = 70000 |
| dinttag | Standard | Float | Value = 70000.0 |
| dinttag [3] | Array Element | Boolean | Invalid: Tag is not an array. Also, Boolean is invalid. |
| dinttag [3] | Array Element | DWord | Invalid: Tag is not an array. |
| dinttag {3} | Array w/o Offset | DWord | Invalid: Tag is not an array. |
| dinttag {1} | Array w/o Offset | DWord | Value = [70000] |
| dinttag {1} | Array w/o Offset | Boolean | Invalid: Bad data type. |
| dintag [3] {1} | Array w/ Offset | DWord | Invalid: Tag is not an array. |
| dinttag . 3 | Bit | Boolean | Value = False |
| dinttag . 0 {32} | Array w/o Offset | Boolean | Value = [0,0,0,0,1,1,1,0,1,0,0,0,1,0,0,0,1,0,...0]<br>Bit value for 70000 |
| dinttag | String | String | Invalid: Syntax / data type not supported. |
| dinttag | String | String | Invalid: Syntax / data type not supported. |

**DINT, UDINT, and DWORD Array Tag - dintarraytag [4,4] = [[68,73,78,84],[256,257,258,259], [9,10,11,12],[13,14,15,16]]**

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| dintarraytag | Standard | Boolean | Invalid: Tag cannot be an array. |
| dintarraytag | Standard | Byte | Invalid: Tag cannot be an array. |
| dintarraytag | Standard | Word | Invalid: Tag cannot be an array. |
| dintarraytag | Standard | DWord | Invalid: Tag cannot be an array. |
| dintarraytag | Standard | Float | Invalid: Tag cannot be an array. |
| dintarraytag [3] | Array Element | DWord | Invalid: Server tag missing dimension 2 address. |
| dintarraytag [1,3] | Array Element | Boolean | Invalid: Boolean not allowed for array elements. |
| dintarraytag [1,3] | Array Element | DWord | Value = 259 |
| dintarraytag {10} | Array w/o Off- | Byte | Value = [68,73,78,84,255,255,255,255,9,10] |

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| | set | | |
| dintarraytag {2}{5} | Array w/o Offset | DWord | Value = [68,73,78,84,256] [257,258,259,9,10] |
| dintarraytag {1} | Array w/o Offset | DWord | Value = 68 |
| dintarraytag {1} | Array w/o Offset | Boolean | Invalid: Bad data type. |
| dintarraytag [1,3]{4} | Array w/ Offset | DWord | Value = [259,9,10,11] |
| dintarraytag . 3 | Bit | Boolean | Invalid: Tag must reference atomic location. |
| dintarraytag [1,3] . 3 | Bit | Boolean | Value = 0 |
| dintarraytag [1,3] .0 {32} | Array w/o Offset | Boolean | Value = [1,1,0,0,0,0,0,0,1,0,0,0,0,0,0,0]<br>Bit value for 259 |
| dintarraytag | String | String | Invalid: Syntax / data type not supported. |
| dintarraytag | String | String | Invalid: Syntax / data type not supported. |

## LINT, ULINT, and LWORD

*For more information on the format, refer to **Address Formats**.*

| Format | Supported Data Types | Notes |
|---|---|---|
| Array Element | Double*<br>Date** | The Native Tag must be an array. |
| Array w/ Offset | Double Array* | The Native Tag must be an array. |
| Array w/o Offset | Double Array* | If accessing more than a single element, the Native Tag must be an array. |
| Bit | Not supported. | Not supported. |
| Standard | Double*<br>Date** | None. |
| String | Not supported. | Not supported. |

*Double value equals the face value of Native Tag in Float form (non-IEEE Floating point number).
**Date values are in universal time (UTC), not localized time.

### Examples

Examples highlighted signify common use cases for LINT, ULINT, and LWORD.

**LINT, ULINT, and LWORD Atomic Tag - linttag = 2007-01-01T16:46:40.000 (date) == 1.16767E+15 (decimal)**

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| linttag | Standard | Boolean | Invalid: Boolean is not supported. |

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| linttag | Standard | Byte | Invalid: Byte is not supported. |
| linttag | Standard | Word | Invalid: Word is not supported. |
| linttag | Standard | Double | Value = 1.16767E+15 |
| linttag | Standard | Date | Value = 2007-01-01T16:46:40.000* |
| linttag [3] | Array Element | Boolean | Invalid: Tag is not an array. Also, Boolean is invalid. |
| linttag [3] | Array Element | Double | Invalid: Tag is not an array. |
| linttag {3} | Array w/o Offset | Double | Invalid: Tag is not an array. |
| linttag {1} | Array w/o Offset | Double | Value = [1.16767E+15] |
| linttag {1} | Array w/o Offset | Boolean | Invalid: Bad data type. |
| linttag [3] {1} | Array w/ Offset | Double | Invalid: Tag is not an array. |
| linttag . 3 | Bit | Boolean | Invalid: Syntax/data type not supported. |
| linttag / 1 | String | String | Invalid: Syntax/data type not supported. |

*Date values are in universal time (UTC), not localized time.

**LINT, ULINT, and LWORD Array Tag -**
**dintarraytag [2,2] = [0, 1.16767E+15],[9.4666E+14, 9.46746E+14] where:**
**1.16767E+15 == 2007-01-01T16:46:40.000 (date)**
**9.4666E+14 == 1999-12-31T17:06:40.000**
**9.46746E+14 == 2000-01-1T17:00:00.000**
**0 == 1970-01-01T00:00:00.000**

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| lintarraytag | Standard | Boolean | Invalid: Boolean not supported. |
| lintarraytag | Standard | Byte | Invalid: Byte not supported. |
| lintarraytag | Standard | Word | Invalid: Word not supported. |
| lintarraytag | Standard | Double | Invalid: Tag cannot be an array. |
| lintarraytag | Standard | Date | Invalid: Tag cannot be an array. |
| lintarraytag [1] | Array Element | Double | Invalid: Server tag missing dimension 2 address. |
| lintarraytag [1,1] | Array Element | Boolean | Invalid: Boolean not allowed for array elements. |
| lintarraytag [1,1] | Array Element | Double | Value = 9.46746E+14 |
| lintarraytag [1,1] | Array Element | Date | Value = 2000-01-01T17:00:00.000* |
| lintarraytag {4} | Array w/o Offset | Double | Value = [0, 1.16767E+15, 9.4666E+14, 9.46746E+14] |
| lintarraytag {2} {2} | Array w/o Offset | Double | Value = [0, 1.16767E+15][ 9.4666E+14, 9.46746E+14] |
| lintarraytag {4} | Array w/o Off- | Date | Invalid: Date array not supported. |

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| | set | | |
| lintarraytag {1} | Array w/o Offset | Double | Value = 0 |
| lintarraytag {1} | Array w/o Offset | Boolean | Invalid: Bad data type. |
| lintarraytag [0,1] {2} | Array w/ Offset | Double | Value = [1.16767E+15, 9.4666E+14] |
| lintarraytag . 3 | Bit | Boolean | Invalid: Syntax/data type not supported. |
| lintarraytag / 1 | String | String | Invalid: Syntax/data type not supported. |

*Date values are in universal time (UTC), not localized time.

## REAL

*For more information on the format, refer to **Address Formats**.*

| Format | Supported Data Types | Notes |
|---|---|---|
| Array Element | Byte, Char**<br>Word, Short, BCD***<br>DWord, Long, LBCD<br>Float**** | The Native Tag must be an array. |
| Array w/ Offset | Byte Array, Char Array**<br>Word Array, Short Array, BCD Array***<br>DWord Array, Long Array, LBCD Array<br>Float Array**** | The Native Tag must be an array. |
| Array w/o Offset | Boolean Array<br><br>Byte Array, Char Array**, Word Array, Short Array, BCD Array***, DWord Array, Long Array, LBCD Array, Float Array**** | 1. Use this case to have the bits within an REAL in array form. This is not an array of REALs in Boolean notation.<br>2. Applies to bit-within-REAL only. Example: tag_1.0{32}.<br>3. The .bit plus the array size cannot exceed 32 bits. Example: tag_1.1{32} exceeds an REAL, tag_1.0{32} does not.<br><br>If accessing more than a single element, the Native Tag must be an array. |
| Bit | Boolean | 1. The range is limited from 0 to 31.<br>2. If the Native Tag is an array, the bit class reference must be prefixed by an array element class reference. Example: tag_1 [2,2,3].0. |

| Format | Supported Data Types | Notes |
|---|---|---|
| | | **Note:** Float is casted to a DWord to allow referencing of bits. |
| Standard | Boolean*, Byte, Char**, Word, Short, BCD***, DWord, Long, LBCD, Float**** | None. |
| String | String | 1. If accessing a single element, the Native Tag does not need to be an array.<br>**Note:** The value of the string is the ASCII equivalent of the REAL value (clamped to 255). Example: SINT = 65dec = "A".<br>2. If accessing more than a single element, the Native Tag must be an array. The value of the string is the null-terminated ASCII equivalent of all the REALs (clamped to 255) in the string.<br>1 character in string = 1 REAL, clamped to 255.<br>REAL strings are not packed. For greater efficiency, use SINT strings or the STRING structure instead. |

*Non-zero values are clamped to True.
**Values exceeding 255 are clamped to 255.
***Values exceeding 65535 are clamped to 65535.
****Float value is a valid IEEE single precision Floating point number.

## Examples

Examples highlighted signify common use cases.

**REAL Atomic Tag - realtag = 512.5 (decimal)**

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| realtag | Standard | Boolean | Value = True |
| realtag | Standard | Byte | Value = 255 |
| realtag | Standard | Word | Value = 512 |
| realtag | Standard | DWord | Value = 512 |
| realtag | Standard | Float | Value = 512.5 |
| realtag [3] | Array Element | Boolean | Invalid: Tag is not an array. Also, Boolean is invalid. |
| realtag [3] | Array Element | DWord | Invalid: Tag is not an array. |
| realtag {3} | Array w/o Offset | DWord | Invalid: Tag is not an array. |
| realtag {1} | Array w/o Off- | Float | Value = [512.5] |

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| | set | | |
| realtag {1} | Array w/o Offset | Boolean | Invalid: Bad data type. |
| realtag [3] {1} | Array w/ Offset | Float | Invalid: Tag is not an array. |
| realtag . 3 | Bit | Boolean | Value = True |
| realtag . 0 {32} | Array w/o Offset | Boolean | Value = [0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,...0]<br>Bit value for 512 |
| realtag | String | String | Invalid: Syntax / data type not supported. |
| realtag | String | String | Invalid: Syntax / data type not supported. |

**REAL Array Tag - realarraytag [4,4] = [[82.1,69.2,65.3,76.4],[256.5,257.6,258.7,259.8],[9.0,10.0,11.0,12.0],[13.0,14.0,15.0,16.0]]**

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| realarraytag | Standard | Boolean | Invalid: Tag cannot be an array. |
| realarraytag | Standard | Byte | Invalid: Tag cannot be an array. |
| realarraytag | Standard | Word | Invalid: Tag cannot be an array. |
| realarraytag | Standard | DWord | Invalid: Tag cannot be an array. |
| realarraytag | Standard | Float | Invalid: Tag cannot be an array. |
| realarraytag [3] | Array Element | Float | Invalid: Server tag missing dimension 2 address. |
| realarraytag [1,3] | Array Element | Boolean | Invalid: Boolean not allowed for array elements. |
| realarraytag [1,3] | Array Element | Float | Value = 259.8 |
| realarraytag {10} | Array w/o Offset | Byte | Value = [82,69,65,76,255,255,255,255,9,10] |
| realarraytag {2} {5} | Array w/o Offset | Float | Value = [82.1,69.2,65.3,76.4,256.5]<br>[257.6,258.7,259.8,9,10] |
| realarraytag {1} | Array w/o Offset | Float | Value = 82.1 |
| realarraytag {1} | Array w/o Offset | Boolean | Invalid: Bad data type. |
| realarraytag [1,3] {4} | Array w/ Offset | Float | Value = [259.8,9.0,10.0,11.0] |
| realarraytag . 3 | Bit | Boolean | Invalid: Tag must reference atomic location. |
| realarraytag [1,3] . 3 | Bit | Boolean | Value = 0 |
| realarraytag [1,3] . 0 {32} | Array w/o Offset | Boolean | Value = [1,1,0,0,0,0,0,0,1,0,0,0,0,0,0,0]<br>Bit value for 259 |
| realarraytag | String | String | Invalid: Syntax / data type not supported. |
| realarraytag | String | String | Invalid: Syntax / data type not supported. |

## LREAL

*For more information on the format, refer to **Address Formats**.*

| Format | Supported Data Types | Notes |
|---|---|---|
| Array Element | Double* | The Native Tag must be an array. |
| Array w/ Offset | Double Array | The Native Tag must be an array. |
| Array w/o Offset | Double Array | If accessing more than a single element, the Native Tag must be an array. |
| Bit | Boolean | Invalid: Syntax/Data type not supported. |
| Standard | Double* | None. |
| String | String | Invalid: Syntax/Data type not supported. |

*Double value is a valid IEEE double precision Floating point number.

### Examples

Examples highlighted signify common use cases.

**LREAL Atomic Tag – lrealtag = 512.5 (decimal)**

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| lrealtag | Standard | Boolean | Invalid: Data type not supported. |
| lrealtag | Standard | Byte | Invalid: Data type not supported. |
| lrealtag | Standard | Word | Invalid: Data type not supported. |
| lrealtag | Standard | DWord | Invalid: Data type not supported. |
| lrealtag | Standard | Double | Value = 512.5 |
| lrealtag [3] | Array Element | Boolean | Invalid: Tag is not an array, and Boolean is invalid. |
| lrealtag [3] | Array Element | DWord | Invalid: Tag is not an array. |
| lrealtag {3} | Array w/o Offset | DWord | Invalid: Tag is not an array. |
| lrealtag {1} | Array w/o Offset | Double | Value = [512.5] |
| lrealtag {1} | Array w/o Offset | Boolean | Invalid: Bad data type. |
| lrealtag [3] {1} | Array w/ Offset | Float | Invalid: Tag is not an array. |
| lrealtag . 3 | Bit | Boolean | Invalid: Data type not supported. |
| lrealtag . 0 {32} | Array w/o Offset | Boolean | Invalid: Data type not supported. |
| lrealtag | String | String | Invalid: Syntax / data type not supported. |
| lrealtag | String | String | Invalid: Syntax / data type not supported. |

**LREAL Array Tag - realarraytag [4,4] = [[82.1,69.2,65.3,76.4],[256.5,257.6,258.7,259.8],[9.0,10.0,11.0,12.0],[13.0,14.0,15.0,16.0]]**

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| lrealarraytag | Standard | Boolean | Invalid: Tag cannot be an array. |
| lrealarraytag | Standard | Byte | Invalid: Tag cannot be an array. |
| lrealarraytag | Standard | Word | Invalid: Tag cannot be an array. |
| lrealarraytag | Standard | DWord | Invalid: Tag cannot be an array. |
| lrealarraytag | Standard | Double | Invalid: Tag cannot be an array. |
| lrealarraytag [3] | Array Element | Double | Invalid: Server tag missing dimension 2 address. |
| lrealarraytag [1,3] | Array Element | Boolean | Invalid: Boolean not allowed for array elements. |
| lrealarraytag [1,3] | Array Element | Double | Value = 259.8 |
| lrealarraytag {10} | Array w/o Offset | Byte | Invalid: Data type not supported. |
| lrealarraytag {2} {5} | Array w/o Offset | Double | Value = [82.1,69.2,65.3,76.4,256.5] [257.6,258.7,259.8,9,10] |
| lrealarraytag {1} | Array w/o Offset | Double | Value = 82.1 |
| lrealarraytag {1} | Array w/o Offset | Boolean | Invalid: Bad data type. |
| lrealarraytag [1,3] {4} | Array w/ Offset | Double | Value = [259.8,9.0,10.0,11.0] |
| lrealarraytag . 3 | Bit | Boolean | Invalid: Tag must reference atomic location. |
| lrealarraytag [1,3] . 3 | Bit | Boolean | Value = 0 |
| lrealarraytag [1,3] . 0 {32} | Array w/o Offset | Boolean | Invalid: Syntax/Data type not supported. |
| lrealarraytag | String | String | Invalid: Syntax / data type not supported. |
| lrealarraytag | String | String | Invalid: Syntax / data type not supported. |

## SHORT_STRING

*For more information on the format, refer to **Address Formats**.*

| Format | Supported Data Types | Notes |
|---|---|---|
| Array Element | String | The Native Tag must be an array. |
| Array w/ Offset | N/A | N/A |
| Array w/o Off- | N/A | N/A |

| Format | Supported Data Types | Notes |
|---|---|---|
| set | | |
| Bit | N/A | N/A |
| Standard | String | The length of the string is based on the length encoding contained within the Native Tag. If the string contains non-printable characters, these are included in the string. |
| String | N/A | The length of the string needs to be specified in the tag address. |

## Examples

Examples highlighted signify common use cases.

**SHORT_STRING Atomic Tag – stringtag = "mystring"**

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| stringtag | Standard | String | Value = mystring. |
| stringtag | Standard | Byte | Invalid: Byte is not supported. |
| stringtag | Standard | Word | Invalid: Word is not supported. |
| stringtag [3] | Array Element | Boolean | Invalid: Tag is not an array, and Boolean is invalid. |
| stringtag [3] | Array Element | Double | Invalid: Tag is not an array. |
| stringtag {3} | Array w/o Offset | Double | Invalid: Tag is not an array. |
| stringtag {1} | Array w/o Offset | Double | Value = [1.16767E+15]. |
| stringtag {1} | Array w/o Offset | Boolean | Invalid: Bad data type. |
| lintag [3] {1} | Array w/ Offset | Double | Invalid: Tag is not an array. |
| stringtag . 3 | Bit | Boolean | Invalid: Syntax/data type not supported. |
| stringtag / 1 | String | String | Invalid: Syntax/data type not supported. |

**SHORT_STRING Array Tag – stringarraytag[2,2] = [one,two].[three,four]**

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| stringarraytag | Standard | Boolean | Invalid: Boolean not supported. |
| stringarraytag | Standard | Byte | Invalid: Byte not supported. |
| stringarraytag | Standard | Word | Invalid: Word not supported. |
| stringarraytag | Standard | Double | Invalid: Tag cannot be an array. |
| stringarraytag | Standard | Date | Invalid: Tag cannot be an array. |
| stringarraytag [1] | Array Element | Double | Invalid: Server tag missing dimension 2 address. |
| stringarraytag [1,1] | Array Element | Boolean | Invalid: Boolean not allowed for array elements. |
| stringarraytag [1,1] | Array Element | String | Value: "four" |
| stringarraytag {4} | Array w/o Off- | String | Invalid: String array not supported. |

| Server Tag Address | Format | Data Type | Notes |
|---|---|---|---|
| | set | | |
| stringarraytag {2} {2} | Array w/o Offset | String | Invalid: String array not supported. |
| stringarraytag {1} | Array w/o Offset | Boolean | Invalid: Bad data type. |
| stringarraytag [0, 1] {2} | Array w/ Offset | String | Value: "three" |
| stringarraytag . 3 | Bit | Boolean | Invalid: Syntax/data type not supported. |
| stringarraytag / 1 | String | String | Invalid: Syntax not supported. |

## Error Codes

The following sections define error codes that may be encountered in the server's Event Log. For more information on a specific error code type, select a link from the list below.

Encapsulation Protocol Error Codes
CIP Error Codes

## Encapsulation Protocol Error Codes

The following error codes are in hexadecimal.

| Error Code | Description |
|---|---|
| 0001 | Command not handled |
| 0002 | Memory not available for command |
| 0003 | Poorly formed or incomplete data |
| 0064 | Invalid Session ID. |
| 0065 | Invalid length in header |
| 0069 | Requested protocol version not supported |
| 0070 | Invalid Target ID |

## CIP Error Codes

The following error codes are in hexadecimal.

| Error Code | Description |
|---|---|
| 0001 | Connection Failure* |
| 0002 | Insufficient resources |
| 0003 | Value invalid |
| 0004 | IOI could not be deciphered or tag does not exist |
| 0005 | Unknown destination |
| 0006 | Data requested would not fit in response packet |
| 0007 | Loss of connection |
| 0008 | Unsupported service |
| 0009 | Error in data segment or invalid attribute value |
| 000A | Attribute list error |
| 000B | State already exists |
| 000C | Object Model conflict |
| 000D | Object already exists |
| 000E | Attribute not configurable |
| 000F | Permission denied |
| 0010 | Device state conflict |
| 0011 | Reply will not fit |
| 0012 | Fragment primitive |

| Error Code | Description |
|---|---|
| 0013 | Insufficient command data/parameters specified to execute service |
| 0014 | Attribute not supported |
| 0015 | Too much data specified |
| 001A | Bridge request too large |
| 001B | Bridge response too large |
| 001C | Attribute list shortage |
| 001D | Invalid attribute list |
| 001E | Embedded service error |
| 001F | Failure during connection** |
| 0022 | Invalid reply received |
| 0025 | Key segment error |
| 0026 | Number of IOI words specified does not match IOI word count |
| 0027 | Unexpected attribute in list |

* **See Also:** 0x0001 Extended Error Codes
** **See Also:** 0x001F Extended Error Codes

### Allen-Bradley Specific Error Codes

| Error Code (hex) | Description |
|---|---|
| 00FF | General Error* |

* **See Also:** 0x00FF Extended Error Codes

*For unlisted error codes, refer to the Rockwell Automation documentation.*

## 0x0001 Extended Error Codes

The following error codes are in hexadecimal.

| Error Code | Description |
|---|---|
| 0100 | Connection in use |
| 0103 | Transport not supported |
| 0106 | Ownership conflict |
| 0107 | Connection not found |
| 0108 | Invalid connection type |
| 0109 | Invalid connection size |
| 0110 | Module not configured |
| 0111 | EPR not supported |
| 0114 | Wrong module |
| 0115 | Wrong device type |
| 0116 | Wrong revision |
| 0118 | Invalid configuration format |

| Error Code | Description |
|---|---|
| 011A | Application out of connections |
| 0203 | Connection timeout |
| 0204 | Unconnected message timeout |
| 0205 | Unconnected send parameter error |
| 0206 | Message too large |
| 0301 | No buffer memory |
| 0302 | Bandwidth not available |
| 0303 | No screeners available |
| 0305 | Signature match |
| 0311 | Port not available |
| 0312 | Link address not available |
| 0315 | Invalid segment type |
| 0317 | Connection not scheduled |
| 0318 | Link address to self is invalid |

- *For unlisted error codes, refer to the Rockwell Automation documentation.*

## 0x001F Extended Error Codes

The following error codes are in hexadecimal.

| Error Code | Description |
|---|---|
| 0203 | Connection timed out |

- *For unlisted error codes, refer to the Rockwell Automation documentation.*

## 0x00FF Extended Error Codes

The following error codes are in hexadecimal.

| Error Code | Description |
|---|---|
| 2104 | Address out of range |
| 2105 | Attempt to access beyond end of data object |
| 2106 | Data in use |
| 2107 | Data type is invalid or not supported |

- *For unlisted error codes, refer to the Rockwell Automation documentation.*

# Event Log Messages

The following information concerns messages posted to the Event Log pane in the main user interface. Consult the OPC server help on filtering and sorting the Event Log detail view. Server help contains many common messages, so should also be searched. Generally, the type of message (informational, warning) and troubleshooting information is provided whenever possible.

## Controller not supported. | Vendor ID = <vendor>, Product type = <type>, Product code = <code>, Product name = '<product>'.

### Error Type:
Warning

## Frame received from device contains errors.

### Error Type:
Warning

### Possible Cause:

1. The packets are misaligned (due to connection/disconnection between the PC and device).
2. There is bad cabling connecting the device causing noise.
3. An incorrect frame size was received.
4. There is a TNS mismatch.
5. An invalid response command was returned from the device.

### Possible Solution:
While the driver can recover from this error without intervention, there may be an issues with the cabling or the device itself that should be corrected.

## Write request for tag failed due to a framing error. | Tag address = '<address>'.

### Error Type:
Warning

### Possible Cause:

1. A write request for the specified tag failed after so many retries due to an incorrect request service code.
2. A write request for the specified tag failed after so many retries because the number of bytes received was more or fewer than expected.

### Possible Solution:
There may be an issue with the cabling or the device itself. Increase the retry attempts to give the driver more opportunities to recover from this error.

## Read request for tag failed due to a framing error. | Tag address = '<address>'.

### Error Type:
Warning

### Possible Cause:

1. A read request for the specified tag failed after so many retries due to an incorrect request service code.
2. A read request for the specified tag failed after so many retries because the number of bytes received was more or fewer than expected.

### Possible Solution:
There may be an issue with the cabling or the device itself. Increase the retry attempts to give the driver more opportunities to recover from this error.

## Block read request failed due to a framing error. | Block start = '<address>', Block size = <number> (elements).

### Error Type:
Warning

### Possible Cause:

1. A read request for the specified tag failed after so many retries due to an incorrect request service code.
2. A read request for the specified tag failed after so many retries because the number of bytes received was more or fewer than expected.

### Possible Solution:
There may be an issue with the cabling or the device itself. Increase the retry attempts to give the driver more opportunities to recover from this error.

## Unable to write to tag on device. | Tag address = '<address>', CIP error = <code>, Extended error = <code>.

### Error Type:
Warning

### Possible Cause:
The device returned an error within the CIP portion of the packet during a write request for the specified tag.

### Possible Solution:
The solution depends on the error codes returned. Consult the CIP and Extended code definitions.

## Unable to read tag from device. | Tag address = '<address>', CIP error = <code>, Extended error = <code>.

### Error Type:
Warning

### Possible Cause:
The device returned an error within the CIP portion of the packet during a read request for the specified tag.

### Possible Solution:
The solution depends on the error codes returned. Consult the CIP and Extended code definitions.

## Unable to read block from device. | Block start = '<address>', Block size = <number>, CIP error = <code>, Extended error = <code>.

### Error Type:
Warning

### Possible Cause:
The device returned an error within the CIP portion of the packet during a block read request for the specified tag.

### Possible Solution:
The solution depends on the error codes returned. Consult the CIP and Extended code definitions.

## Unable to write to tag on device. Controller tag data type unknown. | Tag address = '<address>', Unknown data type = <type>.

### Error Type:
Warning

### Possible Cause:
A request for the specified tag failed because the tag data type is not supported.

### Possible Solution:

1. Change the tag data type to one that is supported. In response to this error, the elements of the block are deactivated and not processed again.
2. Contact Technical Support.

## Unable to read tag from device. Controller tag data type unknown. Tag deactivated. | Tag address = '<address>', Unknown data type = <type>.

### Error Type:
Warning

### Possible Cause:
A request for the specified tag failed because the tag data type is not supported.

### Possible Solution:

1. Change the tag data type to one that is supported. In response to this error, the elements of the block are deactivated and not processed again.
2. Contact Technical Support.

## Unable to read block from device. Controller tag data type unknown. Block deactivated. | Block start = '<address>', Block size = <number>, Unknown data type = <type>.

### Error Type:
Warning

### Possible Cause:
A request for the specified tag failed because the tag data type is not supported.

### Possible Solution:

1. Change the tag data type to one that is supported. In response to this error, the elements of the block are deactivated and not processed again.
2. Contact Technical Support.

## Unable to write to tag on device. Data type not supported. | Tag address = '<address>', Unsupported data type = '<type>'.

### Error Type:
Warning

### Possible Cause:
A request for the specified tag failed because the tag data type is not supported.

### Possible Solution:
Change the tag data type to one that is supported. For example, data type Short is illegal for a BOOL array Native Tag. Changing the data type to Boolean remedies the problem.

### See Also:
Addressing Atomic Data Types

## Unable to read tag from device. Data type not supported. Tag deactivated. | Tag address = '<address>', Unsupported data type = '<type>'.

### Error Type:
Warning

### Possible Cause:
A request for the specified tag failed because the tag data type is not supported.

### Possible Solution:

Change the tag data type to one that is supported. In response to this error, the elements of the block are deactivated and not processed again.

**See Also:**
Addressing Atomic Data Types

## Unable to read block from device. Data type not supported. Block deactivated. | Block start = '<address>', Block size = <number> (elements), Unsupported data type = '<type>'.

**Error Type:**
Warning

**Possible Cause:**
A request for the specified tag failed because the tag data type is not supported.

**Possible Solution:**
Change the tag data type to one that is supported. In response to this error, the elements of the block are deactivated and not processed again.

**See Also:**
Addressing Atomic Data Types

## Unable to write to tag. Data type is illegal for tag. | Tag address = '<address>', Illegal data type = '<type>'.

**Error Type:**
Warning

**Possible Cause:**
The write request for the specified tag failed because the client tag data type is illegal for the given Native Tag.

**Possible Solution:**
Change the tag data type to one that is supported. For example, data type Short is illegal for a BOOL array Native Tag. Changing the data type to Boolean would remedy this problem.

**See Also:**
Addressing Atomic Data Types

## Unable to read tag from device. Data type is illegal for this tag. Tag deactivated. | Tag address = '<address>', Illegal data type = '<type>'.

**Error Type:**
Warning

**Possible Cause:**
The read request for the specified tag failed because the client tag data type is illegal for the given Native Tag.

### Possible Solution:
Change the tag data type to one that is supported. For example, data type Short is illegal for a BOOL array Native Tag. Changing the data type to Boolean would remedy this problem. In response to this error, the elements of the block are deactivated and not processed again.

### See Also:
Addressing Atomic Data Types

## Unable to read block from device. Data type is illegal for this block. Block deactivated. | Block start = '<address>', Block size = <number> (elements), Illegal data type = '<type>'.

### Error Type:
Warning

### Possible Cause:
A read request for the specified tag failed because the client tag data type is illegal for the given Native Tag.

### Possible Solution:
Change the tag data type to one that is supported. For example, data type Short is illegal for a BOOL array Native Tag. Changing the data type to Boolean would remedy this problem. In response to this error, the elements of the block are deactivated and not processed again.

### See Also:
Addressing Atomic Data Types

## Unable to write to tag on device. Tag does not support multi-element arrays. | Tag address = '<address>'.

### Error Type:
Warning

### Possible Cause:
A read request for the specified tag failed because the driver does not support multi-element array access to the given Native Tag.

### Possible Solution:
Change the tag data type or address to one that is supported. In response to this error, the tag is deactivated and not processed again.

### See Also:
Addressing Atomic Data Types

## Unable to read tag from device. Tag does not support multi-element arrays. Tag deactivated. | Tag address = '<address>'.

### Error Type:
Warning

### Possible Cause:
A read request for the specified tag failed because the driver does not support multi-element array access to the given Native Tag.

### Possible Solution:
Change the tag data type or address to one that is supported. In response to this error, the tag is deactivated and not processed again.

### See Also:
Addressing Atomic Data Types

## Unable to read block from device. Block does not support multi-element arrays. Block deactivated. | Block start = '<address>', Block size = <number> (elements).

### Error Type:
Warning

### Possible Cause:
A read request for the specified tag failed because the driver does not support multi-element array access to the given tag.

### Possible Solution:
Change the data type or address for tags within this block to one that is supported. In response to this error, the elements of the block are deactivated and not processed again.

### See Also:
Addressing Atomic Data Types

## Unable to write to tag on device. | Tag address = '<address>'.

### Error Type:
Warning

### Possible Cause:
1. The connection between the device and the host PC is broken.
2. The communication parameters for the connection are incorrect.
3. The named device may have been assigned an incorrect address.

### Possible Solution:
1. Verify the cabling between the PC and the device.
2. Verify that the correct port has been specified for the named device.
3. Verify that the address given to the named device matches that of the actual device.

## Unable to read tag from device. Tag deactivated. | Tag address = '<address>'.

### Error Type:
Warning

### Possible Cause:

1. The connection between the device and the host PC is broken.
2. The communication parameters for the connection are incorrect.
3. The named device may have been assigned an incorrect address.

### Possible Solution:

1. Verify the cabling between the PC and the device.
2. Verify that the correct port has been specified for the named device.
3. Verify that the address given to the named device matches that of the actual device.

### Note:
In response to this error, the tag is deactivated and not processed again.

## Unable to read block from device. Block deactivated. | Block start = '<address>', Block size = <number>.

### Error Type:
Warning

### Possible Cause:

1. The connection between the device and the host PC is broken.
2. The communication parameters for the connection are incorrect.
3. The named device may have been assigned an incorrect address.

### Possible Solution:

1. Verify the cabling between the PC and the device.
2. Verify that the correct port has been specified for the named device.
3. Verify that the address given to the named device matches that of the actual device.

### Note:
In response to this error, the block is deactivated and not processed again.

## Device responded with CIP error. | Status code = <code>, Extended status code = <code>.

### Error Type:
Warning

### Possible Cause:
The device returned an error within the CIP portion of the packet during a request. All reads and writes within the request failed.

### Possible Solution:
The solution depends on the error codes returned. Consult the CIP codes.

### See Also:
CIP Error Codes

## Memory could not be allocated for tag. | Tag address = '<address>'.

### Error Type:
Warning

### Possible Cause:
The resources needed to build a tag could not be allocated. The tag is not added to the project.

### Possible Solution:
Close any unused applications and/or increase the amount of virtual memory and try again.

## Device responded with encapsulation error.

### Error Type:
Warning

### Possible Cause:
The device returned an error within the encapsulation portion of the packet during a request. All reads and writes within the request failed.

### Possible Solution:

1. The driver attempts to recover from this error.
2. The solution depends on the error codes returned by the device.

### See Also:

1. Encapsulation Protocol Error Codes
2. Error Matrix

## Unable to read tag from device. Internal memory is invalid. | Tag address = '<address>'.

**Error Type:**
Warning

## Unable to read tag from device. Data type is illegal for tag. | Tag address = '<address>', Illegal data type = '<type>'.

**Error Type:**
Warning

**Possible Cause:**
A read request for the specified tag failed because the client tag data type is illegal for the given Native Tag.

**Possible Solution:**
Change the tag data type to one that is supported. For example, data type Short is illegal for a BOOL array Native Tag. Changing the data type to Boolean would remedy this problem. In response to this error, the tag is deactivated and not processed again.

**See Also:**
Addressing Atomic Data Types

## Unable to read tag from device. Internal memory is invalid. Tag deactivated. | Tag address = '<address>'.

**Error Type:**
Warning

## Unable to read block from device. Internal memory is invalid. Block deactivated. | Block start = '<address>', Block size = <number> (elements).

**Error Type:**
Warning

## Unable to write to address on device. Internal memory is invalid. | Tag address = '<address>'.

**Error Type:**
Warning

## Unable to read block from device. Block deactivated. | Block start = '<address>', Block size = <number>, CIP error = <code>, Extended error = <code>.

**Error Type:**
Warning

**Possible Cause:**
The device returned an error within the CIP portion of the packet during a read request for the specified tag.

**Possible Solution:**
The solution depends on the error codes returned.

**See Also:**
CIP Error Codes

## Device identity details. | IP = '<address>', Vendor ID = <vendor>, Product type = <type>, Product code = <code>, Revision = '<revision>', Product name = '<product>', Product S/N = <serial number>.

**Error Type:**
Informational

## Device does not support Fragmented Read/Write Services. Automatically falling back to Non-Fragmented Services.

**Error Type:**
Informational

# Glossary

## Native Tag-Based Addressing

| Term | Definition |
|---|---|
| Array Element | Element within a native Array Tag. For client/server access, the element must be an atomic. For example, ARRAYTAG [0]. |
| Array with Offset | Client/Server array tag whose address has a native Array Element specified. For example, ARRAYTAG [0] {5}. |
| Array w/o Offset | Client/Server array tag whose address has no native Array Element specified. For example, ARRAYTAG {5}. |
| Atomic Data Type | A pre-defined, non-structured Native data type. For example, SINT, DINT. |
| Atomic Tag | A Native Tag defined with an Atomic Data Type. |
| Client | An HMI/SCADA or data bridging software package utilizing OPC, DDE, or proprietary client/server protocol to interface with the server. |
| Client/Server Data Type | Data type for tags defined statically in the server or dynamically in a client. The data types supported in the client depends on the client in use.* |
| Client/Server Tag | Tag defined statically in the server or dynamically in a client. These tags are different entities than Native Tags. A Native Tag name becomes a Client/Server Tag address when referencing such Native Tag. |
| Client/Server Array | Row x column data presentation format supported by the server and by some clients. Not all clients support arrays. |
| CCW | Connected Components Workbench. |
| Native Data Type | A data type defined in CCW for Micro800 controllers. |
| Native Tag | A tag defined in CCW for Micro800 controllers. |
| Native Array Data Type | A multi-dimensional array (1, 2 or 3 dimensions possible) supported in CCW for Micro800 controllers. All atomic data types support Native Arrays. Not all structured data types support Native Arrays. |
| Array Tag | A Native Tag defined with a native Array Data Type. |
| Pre-Defined Data Type | A Native data type supported and pre-defined by CCW for Micro800 controllers.* |
| User-Defined Data Type | A Native data type supported by CCW and defined by the user for Micro800 controllers.* |
| Server | The OPC/DDE/proprietary server utilizing this Allen-Bradley Micro800 Ethernet Driver. |
| Structured Data Type | A pre-defined or user-defined data type, consisting of members whose data types are atomic or structure in nature. |
| Structure Tag | A Native Tag defined with a Structured Data Type. |

*The data types supported in the server are listed in **Data Types Description**.

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