

# **Busware Ethernet Driver Help**

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## Busware Ethernet Driver Help

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Help version 1.012

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### Overview

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The Busware Ethernet Driver provides an easy and reliable way to connect Busware Ethernet devices to OPC Client applications, including HMI, SCADA, Historian, MES, ERP and countless custom applications. This driver is intended for use with Busware Ethernet drivers that support the Modbus Open TCP/UDP protocol. It utilizes UDP socket communications to provide maximum performance with minimal overhead.

## Device Setup

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### Supported Devices

**BUSWARE Ethernet I/O modules models:**

E200-FB00, E201-8B00, E290-FB00, E151-FB00, E190-8B00, E250-FB00, E300-FB00, and E191-CB00

**BUSWARE RS-485 I/O connected through an Ethernet I/O module models:**

M200-FB00, M290-FB00, M151-FB00, M190-8B00, M181-4B00, M250-8B00, and M300-8B00

### Communication Protocol

Modbus Open Protocol over Ethernet using Winsock V1.1 or higher.

### Device ID (Ethernet IP Network Address without BUSWARE RS-485 bridging)

Busware Ethernet drivers are networked using standard IP addressing. Users can determine or set the IP of the Ethernet I/O modules using the BUSWARE Remote IO Toolkit. In general the Device ID has the following format `YYY.YYY.YYY.YYY`, where `YYY` designates the device IP address (each `YYY` byte should be in the range of 0 to 255). If intending to address BUSWARE RS-485 modules hung from the Ethernet module's RS-485 port, refer to the section [How do I address BUSWARE RS-485 devices over Ethernet.](#)

### Port Number

This parameter specifies the TCP/IP port number the remote device is configured to use. The default port number is 502.

### Coil Block Sizes

Coils can be read from 8 to 800 points (bits) at a time. A higher block size means more points will be read from the device in a single request. Users can reduce the block size if data needs to be read from non-contiguous locations within the device. The default is 32.

### Register Block Sizes

Registers can be read from 1 to 120 locations (words) at a time. A higher block size means more register values will be read from the device in a single request. Users can reduce the block size if data needs to be read from non-contiguous locations within the device. The default is 32.

### Connection Timeout

This parameter specifies the amount of time that the driver should wait while connecting to a device. If the timeout is reached before making a connection to a device the driver will post an error and move onto the next request. Valid connection timeouts are between 1 and 60 seconds. The default timeout is 3 seconds.

### Request Timeout

This parameter specifies how long the driver should wait for a response from the devices on the channel before timing out. Valid response timeout values range from 50 to 9990 milliseconds. The default is 250 milliseconds.

### Failure Count

This parameter specifies how many times the driver should retry a message before considering communications with the device to be lost. Once this count is reached the driver will set the ERROR tag for this device to TRUE. The valid range for the Failure count is 1 to 10 retries. The default is 3 retries.

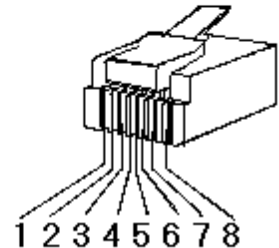
### Cable Connections

## Patch Cable (Straight Through)

|        |         |         |        |
|--------|---------|---------|--------|
| TD + 1 | OR/WHT  | OR/WHT  | 1 TD + |
| TD - 2 | OR      | OR      | 2 TD - |
| RD + 3 | GRN/WHT | GRN/WHT | 3 RD + |
| 4      | BLU     | BLU     | 4      |
| 5      | BLU/WHT | BLU/WHT | 5      |
| RD - 6 | GRN     | GRN     | 6 RD - |
| 7      | BRN/WHT | BRN/WHT | 7      |
| 8      | BRN     | BRN     | 8      |

RJ45 RJ45

10 BaseT



## Crossover Cable

|        |         |         |        |
|--------|---------|---------|--------|
| TD + 1 | OR/WHT  | GRN/WHT | 1 TD + |
| TD - 2 | OR      | GRN     | 2 TD - |
| RD + 3 | GRN/WHT | OR/WHT  | 3 RD + |
| 4      | BLU     | BLU     | 4      |
| 5      | BLU/WHT | BLU/WHT | 5      |
| RD - 6 | GRN     | OR      | 6 RD - |
| 7      | BRN/WHT | BRN/WHT | 7      |
| 8      | BRN     | BRN     | 8      |

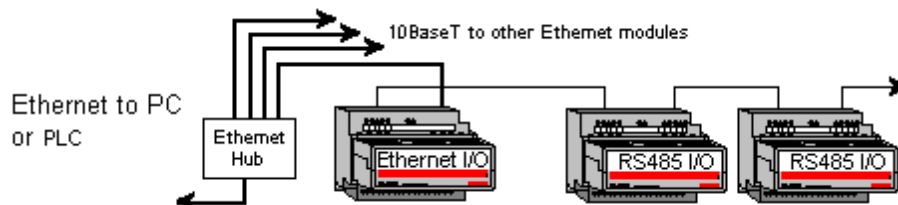
RJ45 RJ45

8-pin RJ45

**Addressing BUSWARE RS-485 Devices over the Ethernet**

The Busware Ethernet Driver can address BUSWARE RS-485 I/O connected on a RS485 party line by connecting through one of these interfaces:

Any Ethernet I/O module - Messages are passed through to the RS485 port.



These intelligent Modbus interfaces accept Modbus Ethernet commands and convert them to traditional Modbus messages and pass the command along to the RS485 port on the Ethernet interface. Replies from the station are returned to Modbus Ethernet format and passed back on the Ethernet network to the BUSWARE Ethernet I/O OPC Server.

**Device ID (Ethernet IP Network Address with BUSWARE RS-485 bridging)**

Busware Ethernet drivers are networked using standard IP addressing. Users can determine or set the IP of the Ethernet modules using the BUSWARE Remote IO Toolkit. In general the Device ID has the following format `YYY.YYY.YYY.YYY` where YYY designates the device IP address (each YYY byte should be in the range of 0 to 255).

When addressing BUSWARE RS-485 devices via the Busware Ethernet module's RS-485 port users must include the station number of the RS-485 device as part of the Ethernet IP address shown above. Using the same format as the IP address, the addition of the RS-485 station number would take the following format: `YYY.YYY.YYY.YYY.ZZZ`. The normal IP address remains the same as denoted by the `YYY.YYY.YYY.YYY`, however

the station number of the desired BUSWARE RS-485 unit on the Ethernet module's RS-485 port is denoted by the .ZZZ. The valid station number range for ZZZ is 1 to 247.

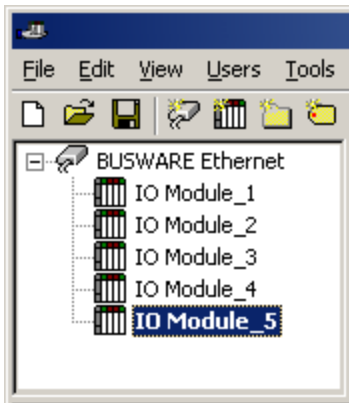
**Example**

Assume that the Busware Ethernet module is at IP address 10.1.1.10. To this Ethernet module, users wish to attach four BUSWARE RS-485 modules already configured with Modbus Station numbers of 1,2,3, and 4. In the BUSWARE Ethernet I/O OPC Server, users add four separate devices to the Ethernet project. The first device would have a Device ID of 10.1.1.10.1 , the second 10.1.1.10.2 , the third 10.1.1.10.3 , and the fourth 10.1.1.10.4. Each Device ID has the same IP address; however, the last field contains the actual station number of each BUSWARE RS-485 device attached to the RS-485 port.

## Optimizing Your Busware Ethernet Communications

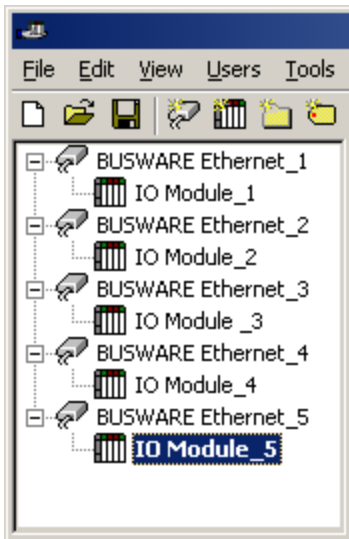
The Busware Ethernet driver has been designed to provide the best performance with the least amount of impact on the system's overall performance. While the Busware Ethernet driver is fast, there are a couple of guidelines that can be used in order to control and optimize the application and gain maximum performance.

Our server refers to communications protocols like Busware 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 Ethernet I/O module from which data will be collected. While this approach to defining the application will provide a high level of performance, it won't take full advantage of the Busware 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 Busware Ethernet channel. In this configuration, the driver must move from one device to the next as quickly as possible in order 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 Busware Ethernet driver could only define one single channel, then the example shown above would be the only option available; however, the Busware Ethernet driver can define up to 16 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 has now been defined under its own channel. In this new configuration, a single path of execution is dedicated to the task of gathering data from each device. If the application has 16 or fewer devices, it can be optimized exactly how it is shown here.

The performance will improve even if the application has more than 16 devices. While 16 or fewer devices may be ideal, the application will still benefit from additional channels. Although by spreading the device load across all channels will cause the server to move from device to device again, it can now do so with far less devices to process on a single channel.

Register Block Size and Coil Block Size, which are available on each defined device, can also affect the Busware Ethernet driver's performance. The Register Block Size refers to the number of registers that may be requested from a device at one time: it can be configured from 1-120 registers per request in order to refine the driver's performance. The Coil Block Size can be adjusted from 8 to 800. If the application has large requests for consecutively ordered data, however, the block size should be increased.

## Data Types Description

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| Data Type     | Description  |
|---------------|--|
| Boolean       | Single bit   |
| Byte          | Unsigned 8 bit value<br>bit 0 is the low bit<br>bit 7 is the high bit  |
| Char          | Signed 8 bit value<br>bit 0 is the low bit<br>bit 6 is the high bit<br>bit 7 is the sign bit   |
| Word          | Unsigned 16 bit value<br>bit 0 is the low bit<br>bit 15 is the high bit  |
| Short         | Signed 16 bit value<br>bit 0 is the low bit<br>bit 14 is the high bit<br>bit 15 is the sign bit  |
| DWord         | Unsigned 32 bit value<br>bit 0 is the low bit<br>bit 31 is the high bit  |
| Long          | Signed 32 bit value<br>bit 0 is the low bit<br>bit 30 is the high bit<br>bit 31 is the sign bit  |
| BCD           | Two byte packed BCD<br><br>Value range is 0-9999. Behavior is undefined for values beyond this range.  |
| LBCD          | Four byte packed BCD<br><br>Value range is 0-99999999. Behavior is undefined for values beyond this range.   |
| Float         | 32 bit Floating point value.<br><br>The driver interprets two consecutive registers as a Floating point value by making the second register the high word and the first register the low word. |
| Float Example | If register 40001 is specified as a Float, bit 0 of register 40001 would be bit 0 of the 32 bit word, and bit 15 of register 40002 would be bit 31 of the 32 bit word.                         |

**Note:** The above descriptions assume first word low data handling of 32 bit data types.

## Address Descriptions

Access to I/O of different types is supported by the Modbus messaging protocol via address ranges. To access the following BUSWARE data types, use the following Modbus address ranges.

| BUSWARE Data Type   | BUSWARE Address | Modbus Data Address |
|---------------------|-----------------|---------------------|
| Discrete In:        | 0 .. 9999       | 10001 .. 20000      |
| Discrete Out:       | 0 .. 9999       | 00001 .. 10000      |
| Analog In:          | 0 .. 2999       | 30001 .. 33000      |
| Analog Out:         | 0 .. 2999       | 40001 .. 43000      |
| Short Integer In    | 0 .. 1999       | 33001 .. 35000      |
| Long Integer In     | 0 .. 1999       | 35001 .. 37000      |
| Floating Point In:  | 0 .. 2999       | 37001 .. 40000      |
| Short Integer Out:  | 0 .. 1999       | 43001 .. 45000      |
| Long Integer Out:   | 0 .. 1999       | 45001 .. 47000      |
| Floating Point Out: | 0 .. 2999       | 47001 .. 50000      |

### Examples

1. Modbus data address 10001 equates to BUSWARE discrete input 0.
2. Modbus data address 30006 equates to BUSWARE analog input 5.

### Generic Modbus Addressing Decimal Format

Default data types for dynamically defined tags are shown in **bold**.

| Address   | Range                                   | Data Type   | Access     |
|---|---|---|------------|
| Output Coils<br>[Function Codes (decimal): 01, 05, 15]      | 000001-065536                           | <b>Boolean</b> , Byte, Char, Word, Short<br>*                   | Read/Write |
| Input Coils<br>[Function Code (decimal): 02]                | 100001-165536                           | <b>Boolean</b> , Byte, Char, Word, Short<br>*                   | Read Only  |
| Internal Registers<br>[Function Code (decimal): 04]         | 300001-365536<br>3xxxxx.0-<br>3xxxxx.15 | <b>Word</b> , Short, BCD<br>Float, DWord, Long, LBCD<br>Boolean | Read Only  |
| Holding Registers<br>[Function Codes (decimal): 03, 06, 16] | 400001-465536<br>4xxxxx.0-<br>4xxxxx.15 | <b>Word</b> , Short, BCD<br>Float, DWord, Long, LBCD<br>Boolean | Read/Write |

\*When accessing coils as a byte or char, the address specified must lie on a byte boundary (ie. xxxxx1, xxxxx9, xxxxx17, etc). When accessed as a word or short, the address specified must lie on a word boundary (ie. xxxxx1, xxxxx17, xxxxx33, etc).

### Examples

1. To access BUSWARE Discrete Output 0, enter a Modbus address of 00001.
2. To access BUSWARE Analog In 3, enter a Modbus address of 30004.
3. To access BUSWARE Analog Out 2, enter a Modbus address of 40003.

### Array Support

Arrays are supported for internal and holding register locations for all data types except for Boolean. There are two methods of addressing an array. Examples are given using holding register locations.

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

Rows multiplied by cols cannot exceed the block size that has been assigned to the device for the register type. For arrays of 32 bit data types, rows multiplied by cols multiplied by 2 cannot exceed the block size.

## Error Descriptions

---

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

### Address Validation

#### [Missing address](#)

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

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

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

[Device address '<address>' is Read Only](#)

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

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

### Device Status Messages

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

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

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[Winsock V1.1 or higher must be installed to use the Busware Ethernet driver](#)

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

[Block size mismatch reading \[<start address> to <end address>\] on device '<device name>'](#)

[Block request \[<start address> to <end address>\] on device '<device name>,' responded with exception = n](#)

## Address Validation

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

### Address Validation

#### [Missing address](#)

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

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

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

[Device address '<address>' is Read Only](#)

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

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

## Missing address

---

### Error Type:

Warning

### Possible Cause:

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

### Solution:

Re-enter the address in the client application.

## Device address '<address>' contains a syntax error

---

### Error Type:

Warning

### Possible Cause:

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

### Solution:

Re-enter the address in the client application.

---

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

---

**Error Type:**

Warning

**Possible Cause:**

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

**Solution:**

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

---

**Data Type '<type>' is not valid for device address '<address>'**

---

**Error Type:**

Warning

**Possible Cause:**

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

**Solution:**

Modify the requested data type in the client application.

---

**Device address '<address>' is Read Only**

---

**Error Type:**

Warning

**Possible Cause:**

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

**Solution:**

Change the access mode in the client application.

---

**Array size is out of range for address '<address>'**

---

**Error Type:**

Warning

**Possible Cause:**

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

**Solution:**

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

---

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

---

**Error Type:**

Warning

**Possible Cause:**

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

**Solution:**

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

---

**Device Status Messages**

---

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

**Device Status Messages**

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

**Unable to write to '<address>' on device '<device name>'****Device '<device name>' is not responding**

---

**Error Type:**

Serious

**Possible Cause:**

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

**Solution:**

1. Verify the cabling between the PC and the PLC device.
2. Verify that the specified communications parameters match those of the device.
3. Verify that the Network ID given to the named device matches that of the actual device.

**Unable to write to '<address>' on device '<device name>'**

---

**Error Type:**

Serious

**Possible Cause:**

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

**Solution:**

1. Verify the cabling between the PC and the PLC device.
2. Verify that the specified communications parameters match those of the device.
3. Verify that the Network ID given to the named device matches that of the actual device.

**Driver Error Messages**

---

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

**Driver Error Messages**

[Winsock initialization failed \(OS Error = n\)](#)

[Winsock V1.1 or higher must be installed to use the Busware Ethernet driver](#)

**Winsock initialization failed (OS Error = n)**

---

**Error Type:**

Fatal

| OS Error | Indication   | Possible Solution  |
|----------|--|--|
| 10091    | Indicates that the underlying network subsystem is not ready for network communication.        | Wait a few seconds and restart the driver.                                       |
| 10067    | Limit on the number of tasks supported by the Windows Sockets implementation has been reached. | Close one or more applications that may be using Winsock and restart the driver. |

**Winsock V1.1 or higher must be installed to use the Busware Ethernet driver**

---

**Error Type:**

Fatal

**Possible Cause:**

The version number of the Winsock DLL found on the system is less than 1.1.

**Solution:**

Upgrade Winsock to version 1.1 or higher.

## Device Specific Messages

---

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

### Device Specific Messages

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

[Block size mismatch reading \[<start address> to <end address>\] on device '<device name>'](#)

[Block request \[<start address> to <end address>\] on device '<device name>.' responded with exception = n](#)

### **Bad address in block [<start address> to <end address>] on device '<device name>'**

---

#### **Error Type:**

Serious

#### **Possible Cause:**

An attempt has been made to reference a nonexistent location in the specified device.

#### **Solution:**

Verify the tags assigned to addresses in the specified range on the device and eliminate ones that reference invalid locations.

### **Block size mismatch reading [<start address> to <end address>] on device '<device name>'**

---

#### **Error Type:**

Fatal for addresses falling in this block.

#### **Possible Cause:**

The driver attempted to read a block of memory in the PLC. The PLC responded with no error, but did not provide the driver with the requested block size of data.

#### **Solution:**

Ensure that the range of memory exists for the PLC.

### **Block request [<start address> to <end address>] on device '<device name>.' responded with exception = n**

---

#### **Error Type:**

Fatal for addresses falling in this block.

#### **Possible Cause:**

The driver attempted to read a block of memory in the PLC. The PLC responded with the exception error shown.

#### **Solution:**

Ensure that the range of memory or data type exists for the PLC.

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