Western Reserve Controls
The Automation Electronics Experts

User Manual

W5-JEM1

EtherNet/IP to RS-232/485 Serial Device Gateway

Cost-optimized, multi-protocol, ASCII gateway perfect for RS-232/485 Serial Device Integration

PUB006-20190314-A01

Document PUB006-20190314-A01

Rev 1.00

March 2019

Western Reserve Controls, Inc.

Revision History

Revision	Date	Author	Section	Comments
1.0	3/14/2019	Jason White John Weisenberger	All	Initial Release

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1 Overview

The W5-JEM1 is a single-channel EtherNet/IP to Serial Device Gateway that provides a flexible EtherNet/IP interface to one or more ASCII or Modbus devices. This permits it to interface with a wide variety of TIA/EIA-232 (RS-232), TIA/EIA-422 (RS-422), and TIA/EIA-485 (RS-485) devices.

The W5-JEM1 does not interpret the data being transmitted across it, and so the transferred messages may contain data of any nature or definition. This allows you to use the same gateway for many different serial protocols.

The W5-JEM1 permits communication with serial peripheral devices in the same fashion as the other EtherNet/IP products in the system. Data may be read/written using either I/O messaging or explicit messaging.

The W5-JEM1 has a 9-pin D-sub connector for connection to the serial interface port on your devices, two RJ45 connectors for connections to the EtherNet/IP network, and one 3-pin connector for power and grounding. The W5-JEM1 serial parameters are software-configurable. Each W5-JEM1 has 2 standard green/red EtherNet/IP LED's for module status and network status and two green LED's for each serial port to indicate transmit and receive activity.

Figure 1. W5-JEM1

1.1 Features

The W5-JEM1 has the following features:

- Translates between serial and EtherNet/IP permitting devices to be controlled via PLC or PC
- EtherNet/IP Conformance Tested by ODVA
- Embedded Ethernet switch with two RJ45 connectors for cost-saving daisy-chain network topologies
- Embedded web server for easy IP address configuration and device status via web browser
- Configurable serial port supports generic ASCII/serial, Modbus ASCII or Modbus RTU protocols
- Supports RTS/CTS hardware flow control for RS-232
- Configurable parameters for baud rate and frame format
- Serial Baud rates from 1200 to 115.2K baud
- Ethernet/IP packet ACK support for TX/RX between PLC and JEM
- Add on Instruction (AOI) for Rockwell PLCs
- 5-year Hardware Warranty
- WRC Evergreen™ Life Cycle Support Program

1.2 Typical Applications

- Weigh scales
- Power Monitors
- Torque Guns
- Barcode Scanners
- Printers
- SCADA Systems
- Mass Flow Controllers
- Lighting Controllers
- Variable Frequency Drives
- LED Message Signs
- HVAC Roof Top Units
- Dehumidification Units
- Robots
- Operator stations / HMI

2 General Specifications

2.1 Table of Specifications

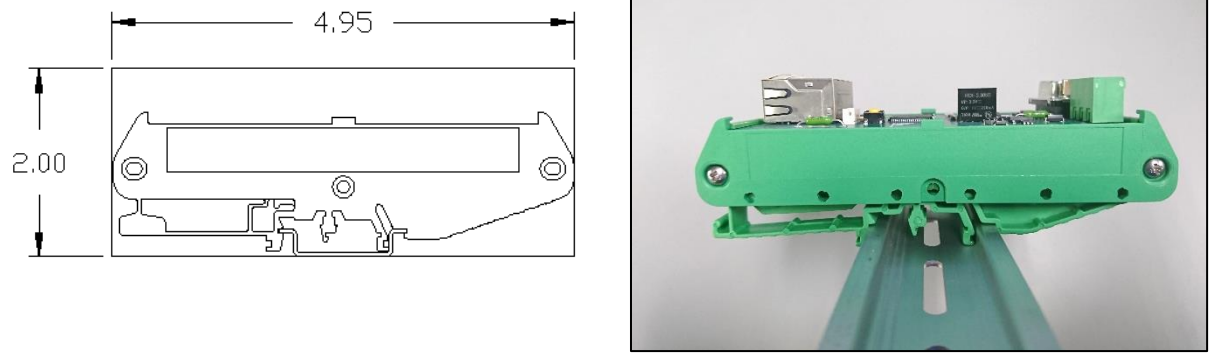
EtherNet/IP Device Profile:	Generic Device Type 0x2B (2B hex)
EtherNet/IP: **Conformance**:	Conforms to the ODVA EtherNet/IP Specification Version 1.23
Ethernet Link Speed:	10/100 MBits
IP Address selection:	Static IP configured via web browser (Factory Default: 192.168.1.10)
Power Supply:	5.0 – 28.0 Vdc 1A user replaceable fuse (spare fuse included)
Maximum Power:	2.4W, 100mA @ 24Vdc supply, 480mA @ 5Vdc supply
Minimum RPI:	4ms*
Serial Port Isolation	1000V DC Isolation
Size:	DH2: 2.000"x2.575"x 4.950" without connectors attached
Operating Temp:	-40 to +70 C
Humidity:	0-95% RH, non-condensing
RoHS:	Yes (RoHS 2)
CE Mark:	No

* Faster RPI values may be supported by certain PLC controllers.

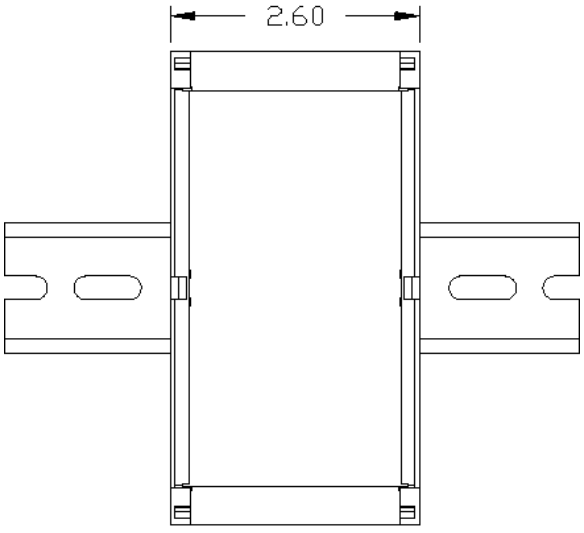
2.2 Product Drawing, Dimensions, and Photographs

Show below are the overall dimensions of the product when installed on a piece of standard DIN rail (DIN rail not included with product). This drawing does not include the height or length added by the Power, Serial, or Ethernet cables or their connectors.

Side View



Top View



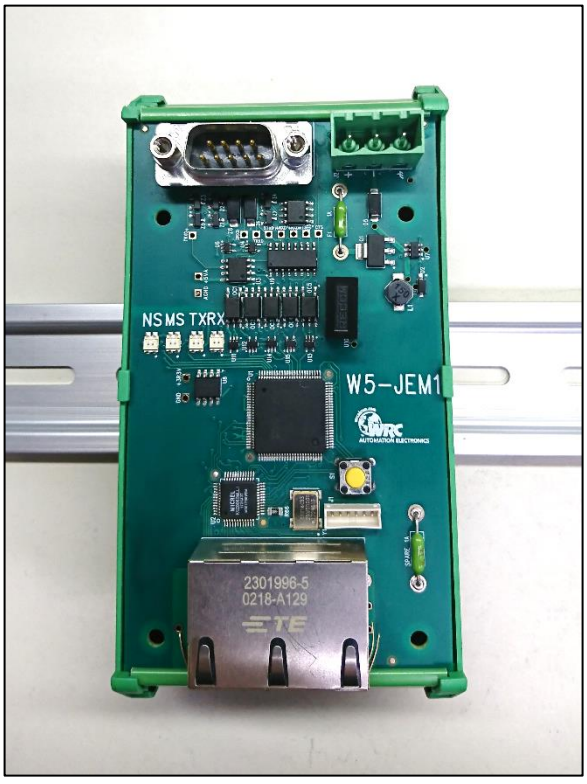
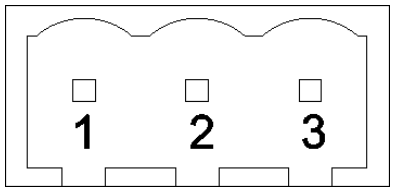


Figure 2. Product Drawings, Dimensions and Photographs

2.3 Connector Pinouts

Figure 3. Power Connector Pinout



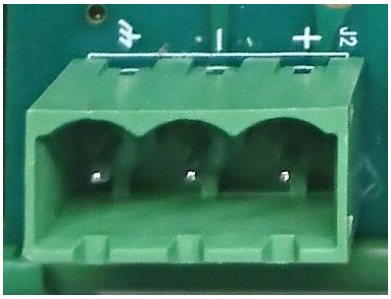
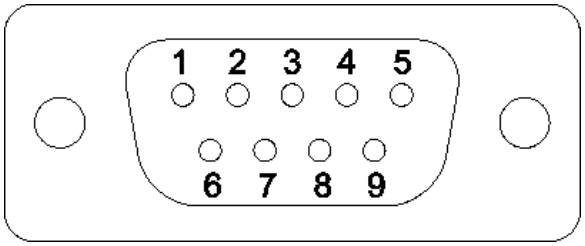
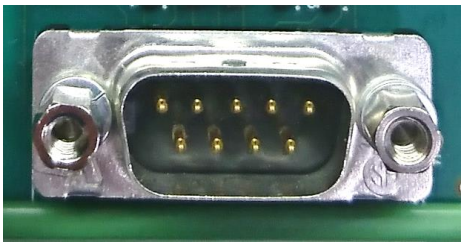


Table 1. Power Connector Pinout

Pin	Name	Description
1	GND	Chassis Ground
2	V- (COM)	Power Common
3	V+	Power In, 5V-28V

Figure 4. Male DE-9 Serial Connector Pinout





ATTENTION: You must use a cable that matches the specifications shown in the table below.

Table 2. Serial Connector Pinout

DE9 Pin #	RS-232	RS-422	RS-485
1	Do Not Connect	Transmit Data –	Transmit/Receive Data –
2	Receive Data	Do Not Connect	Do Not Connect
3	Transmit Data	Do Not Connect	Do Not Connect
4	Do Not Connect	Receive Data –	Do Not Connect
5	Common	Common	Common
6	Do Not Connect	Receive Data +	Do Not Connect
7	Request to Send	Request to Send*	Request to Send*
8	Clear to Send	Clear to Send*	Clear to Send*
9	Do Not Connect	Transmit Data +	Transmit/Receive Data +
*RTS and CTS are not supported in RS-422 and RS-485. These connections must be connected together at the JEM1 Device			

3 Hardware Installation and Set-Up

3.1 Installation

Follow the steps below:

1. In most cases it is recommended to set the device's IP address prior to installation. See section 5.7 "Setting the Device IP Address" if required.
    a. The factory default IP address is 192.168.1.10 for all units
2. Mount unit onto DIN rail
3. Wire up power (24VDC typical), common, and chassis ground to the power connector. See section 2.3 "Connector Pinouts" for a diagram.
    a. If there is no chassis ground connection or the power supply is connected to chassis ground, jumper the chassis ground connection to the common connection
4. Connect the device to the controlling PLC with an Ethernet cable
    a. The device may be connected directly or through an ethernet switch
5. Connect the W5-JEM1 to the serial device using a compatible serial cable
    a. This device requires serial cables with a special pinout. See section 3.5 "Serial Wiring Diagrams" and section 2.3 "Connector Pinouts" for further information.
6. Apply power, device is ready for use with PLC.
7. Also see section 4 "Software Quick Start" for an explanation of how to use the W5-JEM1 with a PLC

3.2 Power Supply

The device is intended to be used with standard 24V DC industrial power supplies. However, any voltage between 5V and 28V may be supplied to the device assuming sufficient current is provided.

3.3 Network Connection

The device must be connected to the controlling PLC either directly with a cable or through your local network Ethernet switch. Shown below is a diagram of some typical network setups when using a Rockwell PLC.

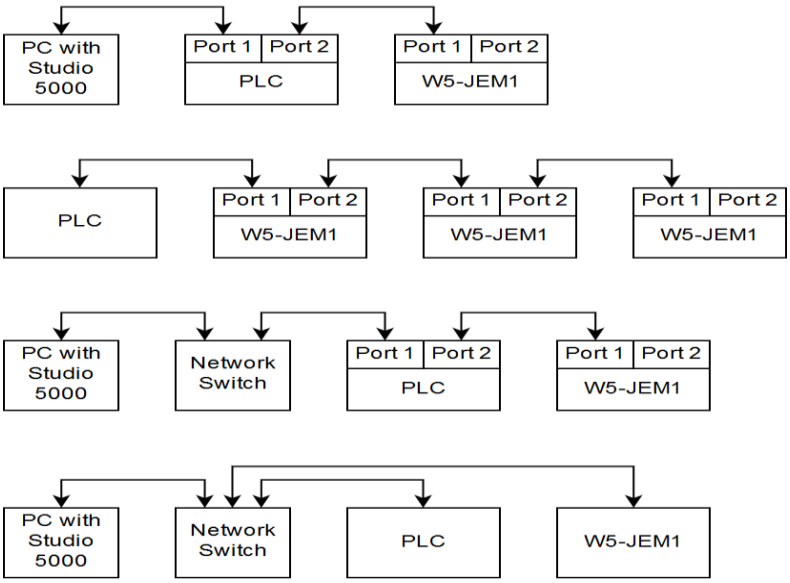


Figure 5. Several possible Ethernet network configurations

3.4 LED Indicators

Table 3. Overview of LED Indicators

LED Name	Description
RX	Indicates when data is being received on the serial line
TX	Indicates when data us being transmitted by the W5-JEM1 onto the serial line
MS	Indicates if the module is okay or if there is an error. See **Table 4** below.
NS	Indicates if the network status. See Table 5 below.

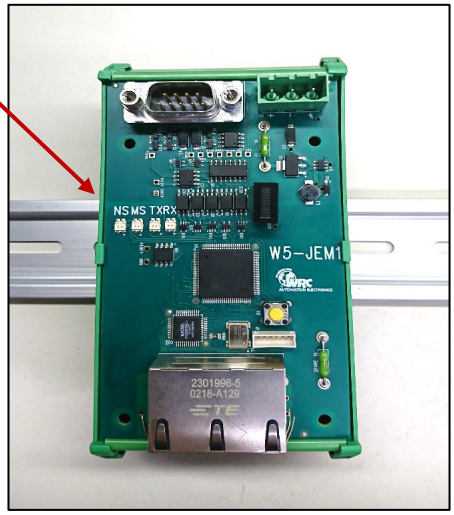


Table 4. Module Status LED (labeled MS)

LED State	**Module Status**	Meaning
Off	No Power	Device is not powered.
Green	Device Operational	W5-JEM1 is operating normally.
Flashing Red	Minor Fault	Recoverable fault.
Solid Red	Critical Fault	Device will automatically reboot to clear a critical fault after 30 seconds.

Table 5. EtherNet/IP Network Status LED (labeled NS)

LED State	**Network Status**	Meaning
OFF	No Power	W5-JEM1 has no power
Flashing Green	Online, not connected	W5-JEM1 is online but is not connected to a PLC.
Green	Online, connected	W5-JEM1 is operating normally and is connected to a PLC
Flashing Red	Connection time-out	One or more connections are timed out.

3.5 Serial Wiring Diagrams

The serial port can be operated as RS-232, RS-422, **or** RS-485 connection. Selection among RS-232, 422 or 485 is made by using the correct cable for the desired RS specification.

ATTENTION: You must use a cable that matches the specifications shown in the table below.

Table 6. D-sub Connector Pins

DB9 Pin #	RS-232	RS-422	RS-485
1	Do Not Connect	Transmit Data –	Transmit/Receive Data –
2	Receive Data	Do Not Connect	Do Not Connect
3	Transmit Data	Do Not Connect	Do Not Connect
4	Do Not Connect	Receive Data –	Do Not Connect
5	Common	Common	Common
6	Do Not Connect	Receive Data +	Do Not Connect
7	Request To Send	Request to Send*	Request to Send*
8	Clear To Send	Clear to Send*	Clear to Send*
9	Do Not Connect	Transmit Data +	Transmit/Receive Data +
*RTS and CTS are not supported in RS-422 and RS-485. These connections must be connected together at the JEM1 Device			

Note: Pay attention to distance limitations based upon RS standards and baud rate.

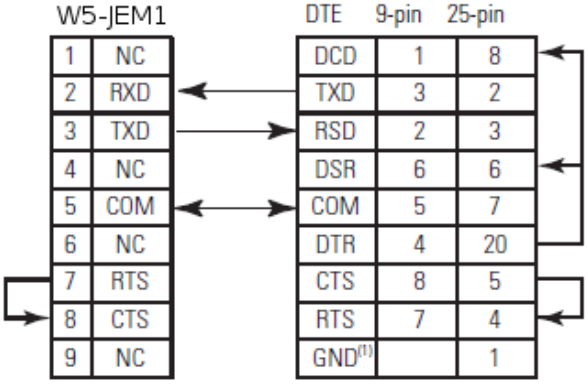


Figure 6. RS-232 Wiring Diagram – Module to DTE Device (Hardware Handshaking Disabled).

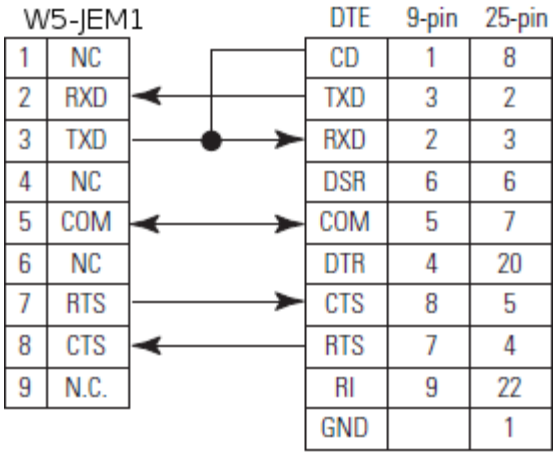


Figure 7. RS-232 Wiring Diagram – Module to Printer (Hardware Handshaking Enabled, Standard Printer Adapter Cable.)

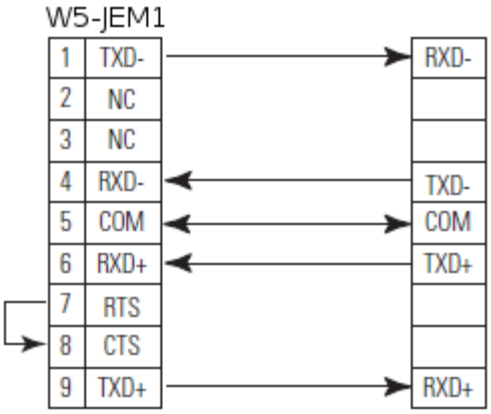


Figure 8. RS-422 Wiring Diagram

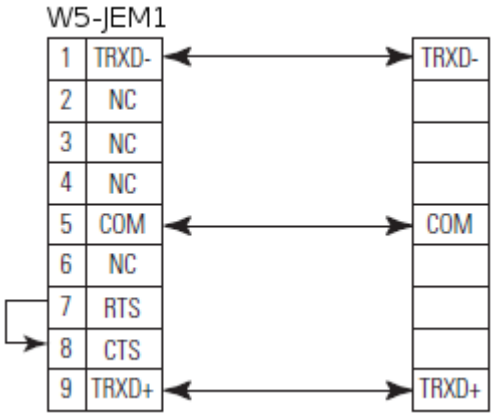


Figure 9. RS-485 Wiring Diagram

4 Software Quick Start

These instructions assume that the device is at its factory default IP address of 192.168.1.10. See section 5.7 "Setting the Device IP Address" for instructions on how to change the W5-JEM1's IP address.

4.1 Installing the Device EDS file in RSLogix or Studio 5000

1. Go to the device's webpage (192.168.1.10 by default) and click the EDS link on the webpage to download the EDS file for the device.
2. Open Studio 5000 and navigate to Tools->EDS Hardware Installation Tool in the main menu bar.
3. Navigate to the "Register an EDS File" option and click next
4. Click "Register a single file"
5. Select the EDS file that was downloaded from the device using the browse button and click next
6. Click next until the Finish button appears and click Finish

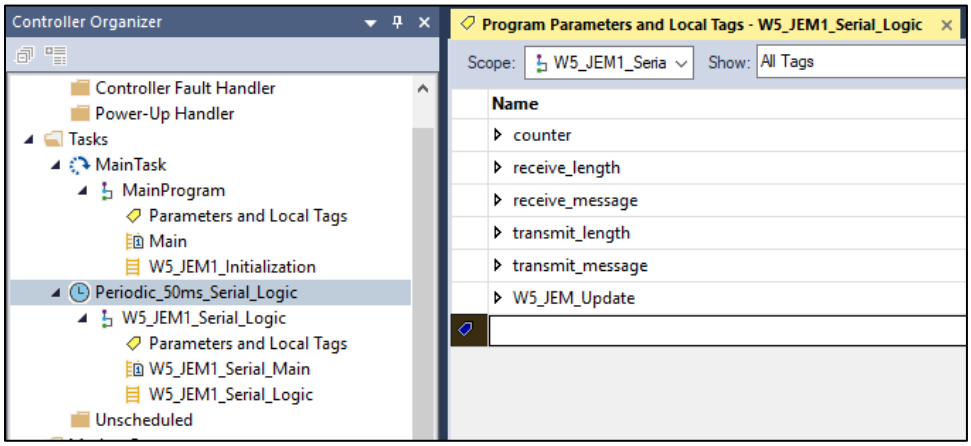
4.2 Loading the Example Program

The example program transmits and receives the string "Hello World!" at 9600 baud 8N1 once per second when the RX and TX pins are connected together on the W5-JEM1.

1. Download the example program from the W5-JEM1 product page on wrcakron.com
2. Open the example program in Studio 5000 or RS Logix 5000
    a. The controller type and IP address may need changed.
3. Ensure the W5-JEM1 is connected to the PLC with an Ethernet cable (possibly through an ethernet switch if necessary)
    a. The program assumes the W5-JEM is at the default IP address of 192.168.1.10
4. Download the project to the PLC, go online, and set the PLC to Run Mode
5. The I/O LED in Studio 5000 should be solid green. If it is not then it will be necessary to verify that the W5-JEM1 is connected to the PLC with an Ethernet cable and that W5-JEM1's IP address is 192.168.1.10.
    a. Quick tip: The Reset button can be used to reset the devices IP address to the default (See section 5.6 "Reset Button Operation"). It may be necessary to power cycle the device.
6. The TX LED on the W5-JEM1 should flicker once per second
7. Navigate to the Tasks->Periodic_50ms_Serial_Logic->W5_JEM1_Serial_Logic->Parameters and Local Tags window.
    a. The tag "transmit_data" and "transmit_length" contain the message to be transmitted
    b. The tag "receive_data" and "receive_length" contain the message that was received
        i. Be aware that for production applications it is recommended to check the device's

status bits (Controller Tags->W5_JEM1_Object->Receive_Message_Status and Module_Status) prior to transmission and reception. This step has been omitted from the demo for simplicity.

Figure 10. Parameters and Local Tags section in the example program showing the transmit_* and receive_* tags



Note: The example program can easily be modified to serve as a starting point for applications using the W5-JEM1

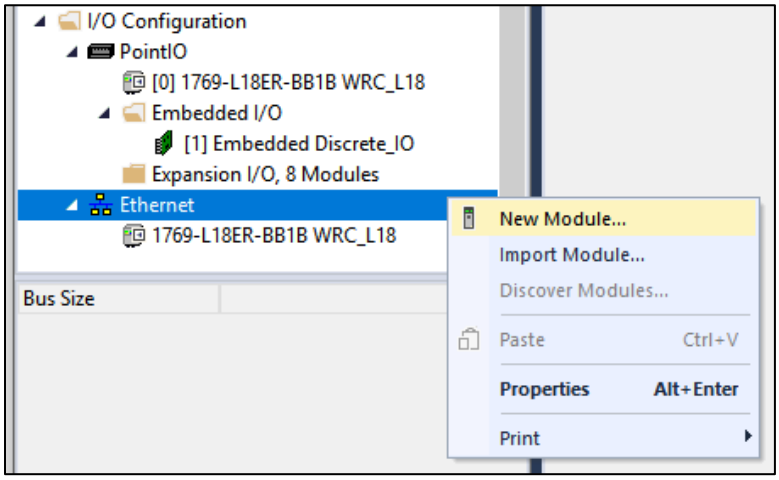
5 Software Configuration and Set-Up

5.1 Adding the Device to RSLogix or Studio 5000

Prior to adding the device to a project, it is necessary to install the device's EDS file in Studio 5000. See section 4.1 "Installing the Device EDS file in RSLogix or Studio 5000" for more details

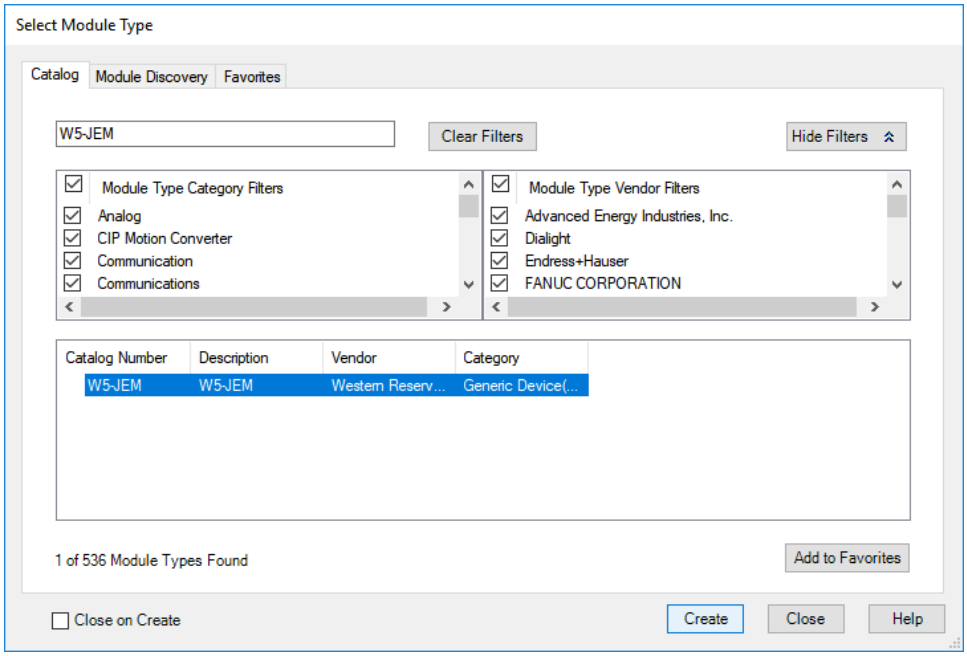
1. In the Controller Organizer Pane navigate to "I/O Configuration"
2. This part changes depending on your controller: typically, one can right-click under "Ethernet" and select "New Module". On some models of PLC that use an external ethernet adapter it may be necessary to navigate and right click on the Ethernet Adapter.

Figure 11. Adding a new Module to the I/O Configuration



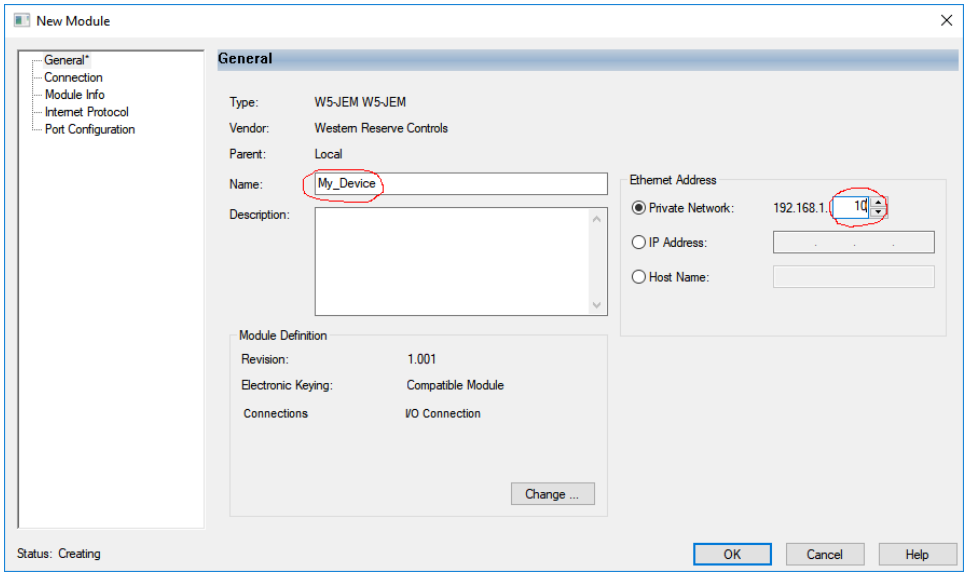
3. The "Select Module Type" dialog will open. Type in "W5-JEM" into the filter bar and select the W5-JEM1 from the list. Click Create.

Figure 12. Finding the W5-JEM1 in the Select Module Type Dialog



4. The "New Module" dialog will open.
   - Under the General Tab enter a device name such as "My_Device"
   - Select the "Private Network" radio button and enter "10" in to the private address textbox. This will tell the controller to look for the device at 192.168.1.10

Figure 13. Setting the device name and IP address

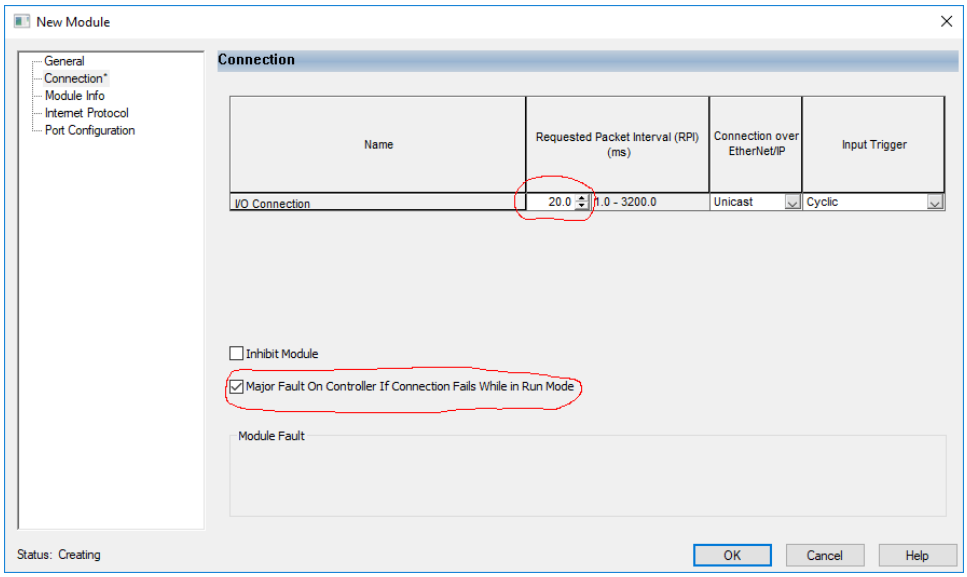


5. Under the Connection Tab inspect the Requested Packet Interval (RPI) field. The value of the field controls how fast the controller can communicate with the W5-JEM1. The default

value of 20ms is fine for most applications. See section 5.2 "Determining Module RPI" for more information about this field

6. Also under the Connection Tab (optionally) check the box "Major Fault On Controller If Connection Fails While in Run Mode." Most applcations using the W5-JEM1 need to be aware if the EtherNet/IP link between the PLC and the device has been broken. A fault handler can be implemented if required by the applcation.

Figure 14. Setting the RPI and Enabling Fault Upon I/O Connection Failure



5.2 Determining Module RPI

The RPI (Requested Packet Interval) is that rate at which the PLC and the W5-JEM1 communicate.

As a rule of thumb, it takes up to two RPI intervals for the command to transmit to propagate from the PLC program to the W5-JEM1 over EtherNet/IP. When the W5-JEM1 receives a packet, it takes up to two RPI intervals for the packet to be transferred over EtherNet/IP and recognized by the PLC program.

Characterizing the maximum throughput of the connection is achieved by connecting the W5-JEM1 in loopback (ie. connect RX and TX pins). In this configuration the time T required to transmit and receive a packet (steady state, one at a time, not using the FIFO buffers) is roughly $T = 4 * RPI + S$ where RPI is the packet interval in seconds and S is the time it takes to transmit the serial packet on the serial bus.

The RPI required to send a packet and receive a packet every T seconds can be calculated via: $RPI = \frac{T-S}{4}$ where S is the time the packet occupies on the serial bus

The value of S can be calculated by the following formula $S = \frac{N*M}{B}$ where N is the number of bits per serial frame (either 10 or 11 bits), M is the number of bytes per serial packet (typically 1-255 bytes) and B is the baud rate (typically 1200-115200 baud).

Shown below is a table of time required to transmit and received a single packet versus baud rate at a 5ms RPI. This table assumes a 16 byte packet in loopback using the 8N1 frame format.

Table 7. Loopback performance for 16 byte packets, 8N1, and RPI=5ms

Baud Rate	Time for transmit command to transfer over EtherNet/IP (2x RPI)	Time it takes to transmit packet over serial bus	Time for received packet to transfer over EtherNet/IP (2x RPI)	Total Time to Transmit and Receive in Loopback
115200	10ms	2ms	10ms	22ms
19200	10ms	9ms	10ms	29ms
9600	10ms	17ms	10ms	37ms

Table 8. Loopback performance for 16 byte packets, 8N1, and RPI=20ms

Baud Rate	Time for transmit command to transfer over EtherNet/IP (2x RPI)	Time it takes to transmit packet over serial bus	Time for received packet to transfer over EtherNet/IP (2x RPI)	Total Time to Transmit and Receive in Loopback
115200	40ms	2ms	40ms	82ms
19200	40ms	9ms	40ms	89ms
9600	40ms	17ms	40ms	97ms

NOTE: The throughputs demonstrated here are more than sufficient for most applications. However, if faster times are required the W5-JEM1 supports RPIs as low as 1ms. Verify that your PLC controller supports low RPI values before using an RPI below 5ms.

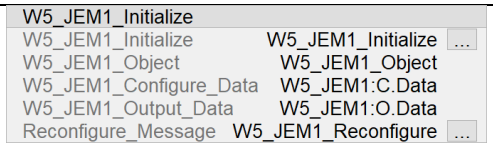
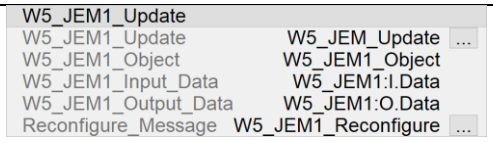
5.3 The AOI (Add-On-Instruction) for Rockwell PLCs

The following describes the structure and behavior of the provided Add-On-Instructions.

5.3.1 Provided Add-On Instructions

Two add on instructions are provided, see table below.

Table 9. Provided Add-On-Instructions

Instruction	Symbol	Description
W5_JEM1_Initialize		Used to initialize and configure the W5-JEM1. A startup delay should be implemented (e.g. via a Timer On Delay instruction that should precede this AOI). The timer's Done bit should be passed to this AOI. Should start timer only after EIP connection with W5-JEM1 is established (e.g. MyJEM1:I.ConnectionFaulted is FALSE). When initialization is complete, the Ready member of the W5_JEM1_Object structure tag will be set to TRUE, indicating PLC program may transmit/receive serial messages through the W5-JEM1.
W5_JEM1_Update		Used to transmit and receive serial data through the W5-JEM1 A startup delay of 2X the RPI must be observed before the first run of this instruction. Recommend startup delay of 200ms or 2X the RPI (whichever is greater). Also updates member tags Module_Status and Receive_Message_Status of W5_JEM1_Object, based on bits of Status field in Receive Assembly (see section Ethernet/IP Interface).

5.3.2 Provided Add-On Datatypes

The following datatypes are provided for use in conjunction with the add-on instructions

Table 10. Provided Add-On Datatypes

Datatype	Description
W5_JEM1_Object	Used to interact with the device
W5_JEM1_Configuration	Used to configure the device
W5_JEM1_Message_Status	Represents the status bits for the currently received message
W5_JEM1_Module_Status	Represents the current status of the module
W5_JEM1_Initialize	Datatype for the W5_JEM1_Initialize instruction
W5_JEM1_Update	Datatype for the W5_JEM1_Update instruction
BAUD_RATES	Used to create an "enumeration" of the available baud rates in the example program.
FRAME_FORMATS	Used to create an "enumeration" of the available frame formats in the example program.
SERIAL_MODES	Used to create an "enumeration" of the available serial modes for the W5-JEM1 in the example program.

5.3.2.1 W5_JEM1_Object Datatype

This datatype is used to configure, control, and monitor the W5-JEM1.

Table 11. W5_JEM1_Object Datatype

Member Tag	Type	Description
Receive_Message_Status	W5_JEM1_Message_Status	Status bits for the current message (parity error, framing error etc.)
Receive_Length	SINT	The length of the current message.
Receive_Data	SINT[255]	An array containing the current message.
Transmit_Length	SINT	The length of the message to be transmitted.
Transmit_Data	SINT[255]	The message to be transmitted.
Transmit_Acknowledged	BOOL	This bit is set to 1 when the message to transmit has been successfully copied into the TX FIFO.
Command_Transmit	BOOL	When set to 1 the AOI will will command a transmission of data given by Transmit_Data and Transmit_Length.. AOI will clear this bit when it has

		finished. It is recommended to wait for the Transmit_Acknowledged bit to be set before commanding another transmission.
Command_Receive	BOOL	When set to 1 the AOI will monitor the W5-JEM to see if there are any messages waiting to be received. If a message is in the receive buffer it will be copied to Receive_Data along with Receive_Length and Receive_Message_Status. When a message is received this bit is set to 0 as a signal to the user. The user must set the bit back to 1 when the user wishes to monitor for another receive message.
Module_Status	W5_JEM1_Module_Status	Status bits representing the overall status of the module. Important: the Configuration_Error status bit can be viewed here. The module will only function if it is properly configured.
Configuration	W5_JEM1_Configuration	This contains the configuration to be sent to the W5-JEM1.
Ready	BOOL	When set to 1 via the Initialize AOI, indicates PLC program may transmit / receive serial messages through the W5-JEM1. This flag is set to 0 in Initialize AOI during first scan of PLC program.

5.3.2.2 W5_JEM1_Configuration Datatype

See section 6.6 "Device Parameters" for a more detailed explanation of each function.

Table 12. W5_JEM1_Configuration Datatype

Member Tag	Type	Description
Mode	SINT	0=Reset Mode. Resets module and triggers Configuration Error bit. 1=User Defined Mode. Utilizes all configuration parameters. 2=Modbus ASCII Mode. Ignores most parameters, only certain frame formats are valid in this mode. 3=Modbus RTU Mode. Ignores most parameters, only certain frame formats are valid in this mode.

		Other Values =Reserved. Triggers Configuration Error bit.
Frame_Format	SINT	0=Mode Default (See **Table 24. Effects of the Mode Parameter**) 1=7N2 2=7E1 (Modbus ASCII mode default) 3=7O1 4=8N1 (User defined mode default) 5=8N2 6=8E1 (Modbus RTU mode default) 7=8O1 8=7E2 9=7O2 Other Values =Reserved. Triggers Configuration Error bit.
Baud_Rate	SINT	0=Mode Default (See **Table 24. Effects of the Mode Parameter**) 1=1200 2=2400 3=4800 4=9600 (User defined default) 5=19200 (Modbus RTU/ASCII default) 6=38400 7=57600 8=115200 Other Values =Reserved. Triggers Configuration Error bit.
Hardware_Flow_Control	BOOL	0=Flow Control Disabled 1=Flow Control Enabled
RX_Max_Length	INT	0=Use default value (255) Valid range: 1-255 Characters Value will be truncated to 1 byte before being sent to device.
RX_Timeout	DINT	Units: 50us/count. Values 1-60000 supported. (50us to 3 seconds) Value will be truncated to 2 bytes before being sent to device.
RX_Max_Intercharacter_Spacing	DINT	
TX_Delay	DINT	
TX_Start_Delimiter_Length	SINT	Lengths 0-2 supported. Other Values trigger Configuration Error bit.
TX_End_Delimiter_Length	SINT	
RX_Start_Delimiter_Length	SINT	
RX_End_Delimiter_Length	SINT	

TX_Start_Delimiter	SINT[2]	Any value
TX_End_Delimiter	SINT[2]	
RX_Start_Delimiter	SINT[2]	
RX_End_Delimiter	SINT[2]	

5.3.2.3 W5_JEM1_Message_Status Datatype

Each of these bits are updated each time a new message is received. They represent the status of the current message.

Table 13. W5_JEM1_Message_Status Datatype

Member Tag	Type	Description
RX_Parity_Error	BOOL	A parity error occurred in the current message.
RX_Framing_Error	BOOL	A framing error occurred in the current message.
RX_Character_Spacing_Error	BOOL	An intercharacter spacing error occurred immediately after the last character of the message.
RX_End_Delimiter_Not_Found	BOOL	The RX End delimiter was not present in the message.

5.3.2.4 W5_JEM1_Module_Status Datatype

Each of these bits are continuously updated.

Table 14. W5_JEM1_Module_Status Datatype

Member Tag	Type	Description
Configuration_Error	BOOL	This bit signals that an invalid (or no) configuration was sent to the unit over EtherNet/IP. A valid configuration must be sent before the unit can function.
RX_Buffer_Not_Empty	BOOL	If set the RX FIFO buffer is not empty.
RX_Buffer_Full	BOOL	If set the RX FIFO buffer is full.
RX_Buffer_Overflow	BOOL	If set the RX FIFO buffer has overflowed.
TX_Buffer_Empty	BOOL	If set the TX FIFO buffer is empty.
TX_Buffer_Full	BOOL	If set the TX FIFO buffer is full.
TX_Buffer_Overflow	BOOL	If set the TX FIFO buffer has overflowed.

Idle_Mode	BOOL	If set the unit has been put into idle mode by the controlling PLC. The unit cannot send and receive messages via the serial port in Idle mode and its buffers are reset.

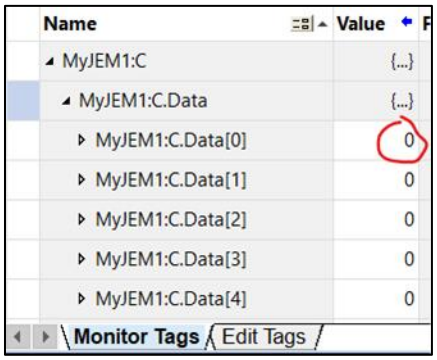
5.3.3 Configuration of the W5-JEM1 using the AOI

In the example program navigate to Controller Tags->W5_JEM1_Object.Configuration. Each of the member tags shown below represent a configuration parameter for the device.

Prior to this step, to avoid spurious TX or RX data upon device configuration, the byte in the device configuration assembly tags (Controller Tags->MyJem1:C.Data[0]) that corresponds to the Mode parameter (byte at index 0) must be set to zero. This must be done in the Monitor Tags window while the PLC is offline in LogixDesigner and before downloading the PLC program. The other bytes can be ignored, but it is recommended that they all be set to zero. Note that this is independent of the W5_JEM1_Object.Configuration tag discussed below.

NOTE: Uploading a program from the PLC or uploading tag values will upload non-zero values for the configuration assembly tags. These should be cleared (per above) before downloading the PLC program again. In the case of running a PLC Program directly on power-up (as opposed to via LogixDesigner, etc.), there is a feature in the Initialize AOI that will clear the device's configuration assembly tags prior to configuring the device with the values specified in the W5_JEM1_Object.Configuration tag. This has no effect when downloading/running program via LogixDesigner.

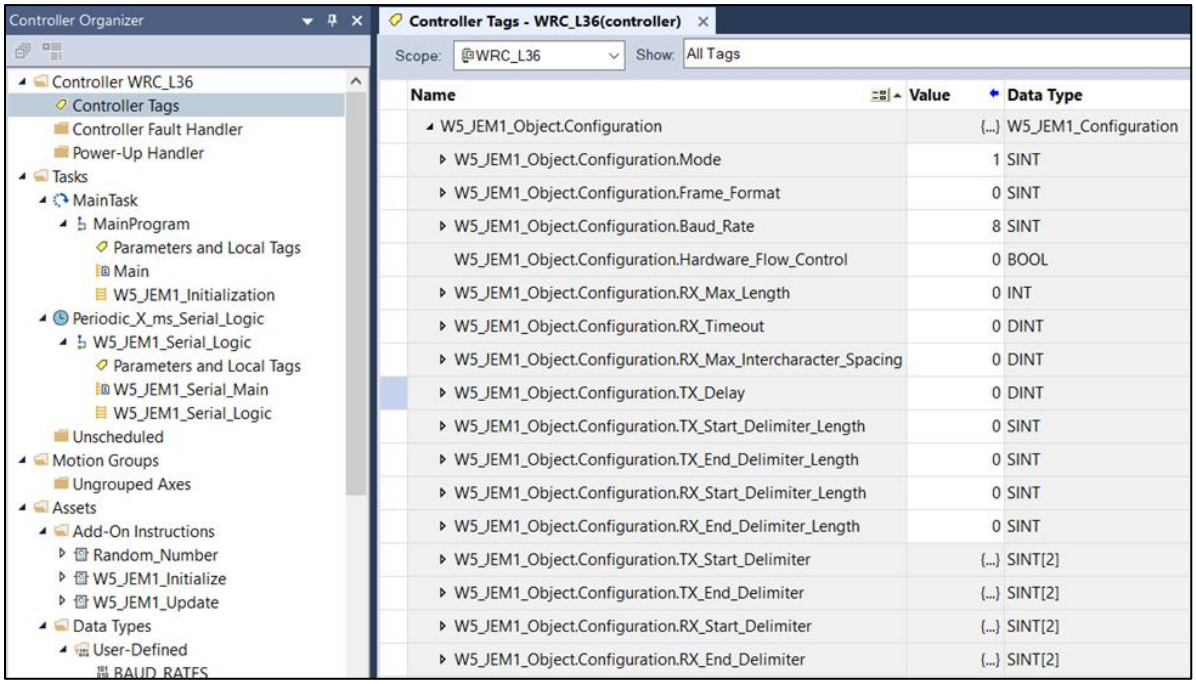
Table - Initializing Byte 0 in Device Configuration Assembly Tags



Edit the W5_JEM1_Object.Configuration tag values in offline mode and then download the program to the controller. If everything is setup correctly then the Configuration_Error bit will be set to 0 after the initialization via the Initialize AOI is finished, the Ready member of the W5_JEM1_Object structure tag will be set to TRUE.

See section 6.6 "Device Parameters" for a detailed explanation of each parameter.

Table 15. Configuring the device through the W5_JEM1_Object.Configuration tag



5.3.4 Transmitting using the AOI

To transmit perform the following steps:

1. (Optional) Check the following members of W5_JEM1_Object.Module_Status
   a. TX_Buffer_Empty, TX_Buffer_Full, TX_Buffer_Overflow, Configuration_Error
2. Set W5_JEM1_Object.Transmit_Length to the length of the message to be transmitted
3. Copy the message to be transmitted into W5_JEM1_Object.Transmit_Data
4. Set W5_JEM1_Object.Command_Transmit=1
5. (Optional) Wait for W5_JEM1_Object.Transmit_Acknowledged=1 after which it will be reset to zero when a new transmit message is commanded.

5.3.5 Receiving using the AOI

Do the following in W5_JEM1_Object

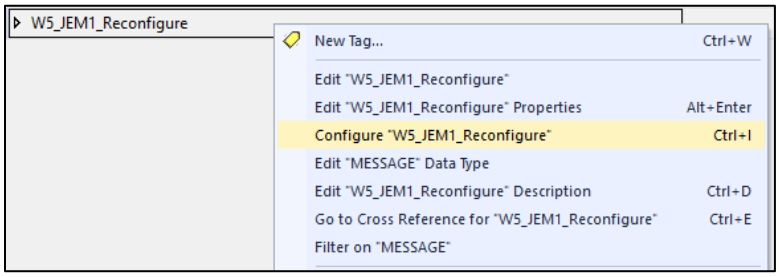
1. Set Command_Receive=1
2. Wait for Command_Receive=0
3. (Optional) Check the following members of Receive_Message_Status
   a. RX_Parity_Error, RX_Framing_Error, RX_Character_Spacing_Error, RX_End_Delimiter_Not_Found
4. (Optional) Check the following members of Module_Status
   a. RX_Buffer_Not_Empty, RX_Buffer_Full, RX_Buffer_Overflow, Configuration_Error
5. Read and act upon the values in Receive_Length and Receive_Data.

5.3.6 Setting up a PLC Project to use the W5-JEM1 AOIs and UDTs

It is recommended to use the example program as a starting point. However, if that is not possible the procedure below can be performed to add a W5-JEM1 and the corresponding Add-On-Instructions and datatypes to an existing project. This assumes the device's EDS file has already been installed.

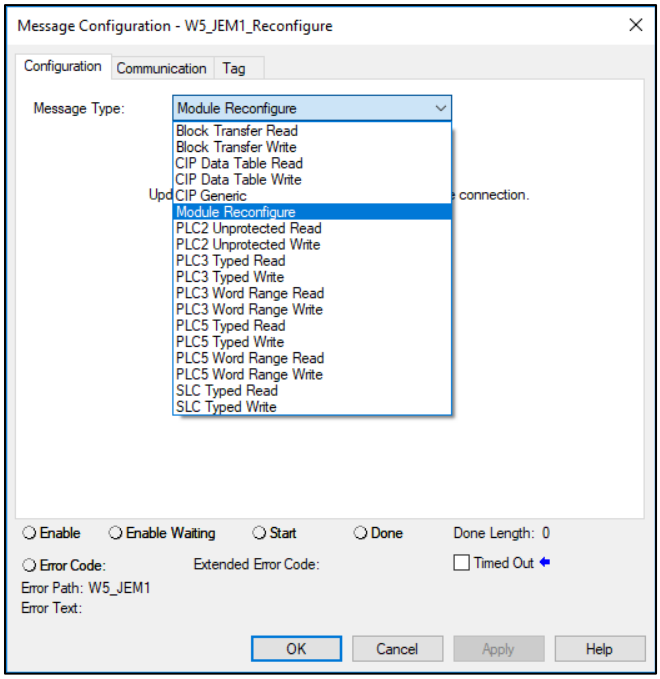
1. Add a W5-JEM1 unit named MyJEM1 to the PLC's I/O configuration
2. Create a controller tag named W5_JEM1_Reconfigure of type MESSAGE
3. Right click the tag and click Configure

Figure 15. configuring the W5_JEM1_Reconfigure tag



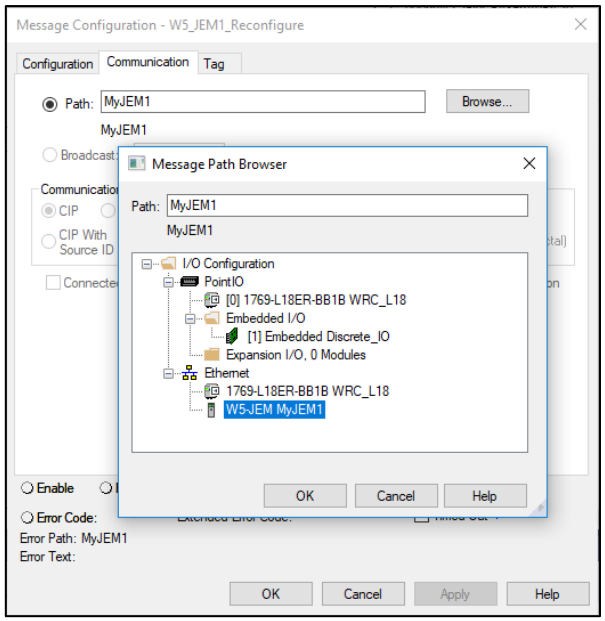
4. Select Module Reconfigure as the message type under the configuration tab

Figure 16. Selecting Module Reconfigure in the Message Configuration dialog



5. Go to the Communication Tab and click Browse. Select MyJEM1 from the I/O configuration and click OK.

Figure 17. Selecting the W5-JEM1 module in the Message Path Browser Dialog

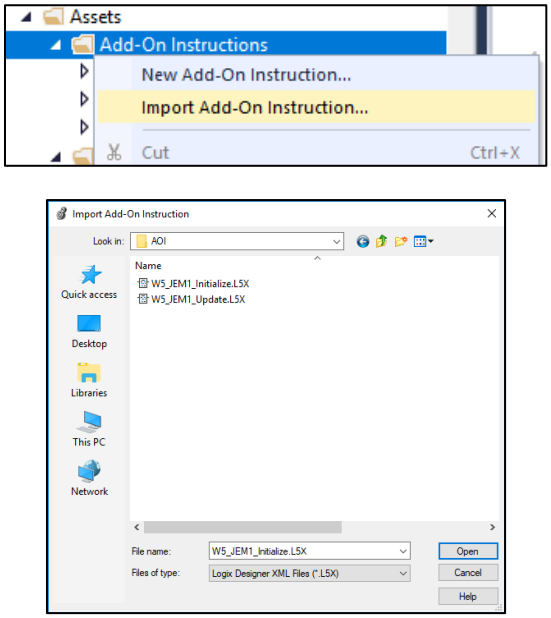


6. Click Apply and OK to exit the Message Configuration window.

7. Import the W5_JEM1_Initialize and W5_JEM1_Update Add-On-Instructions.

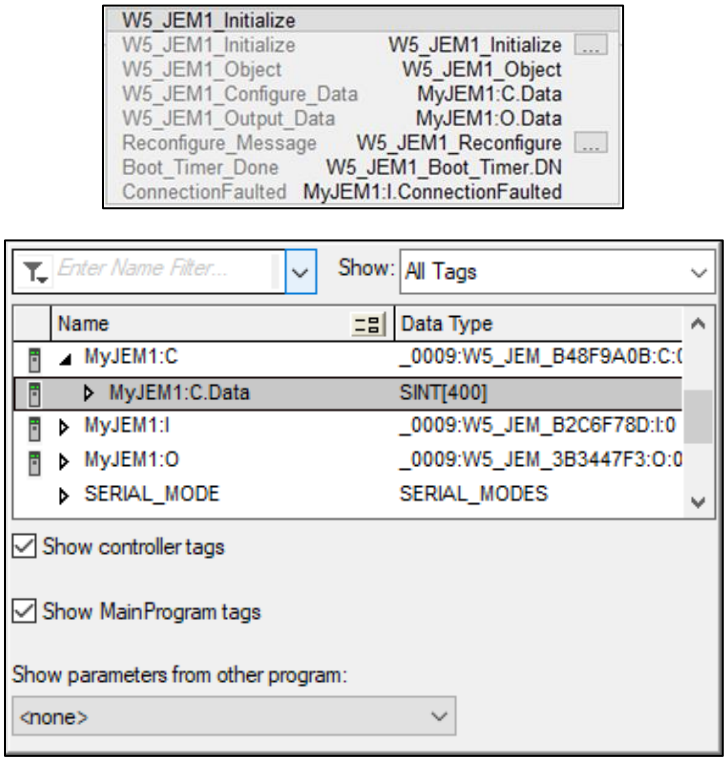
a. By default, this includes the W5_JEM1_Object, W5_JEM1_Configuration, W5_JEM1_Module_Status, and W5_JEM1_Message_Status datatypes

Figure 18. Importing the Add-On Instructions



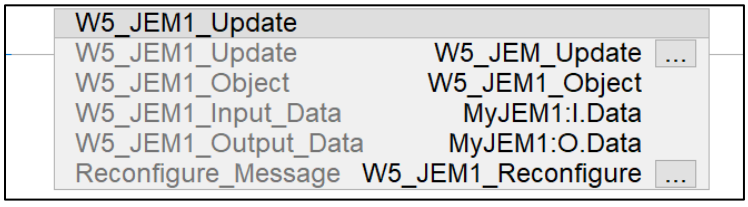
9. At the Controller Tag level create a tag named "W5_JEM1_Object" of type "W5_JEM1_Object"
    - Navigate to W5_JEM1_Object.Configuration and set the configuration
10. Create a tag named "W5_JEM1_Initialize" of type "W5_JEM1_Initialize"
11. In the main (continuously scanned) routine of the program insert a W5_JEM1_Initialize instruction.
    - Set the W5_JEM1_Initialize parameter to point to the W5_JEM1_Initialize tag
    - Set the W5_JEM1_Object parameter to point to the W5_JEM1_Object tag
    - Set the W5_JEM1_Configure_Data parameter to point to MyJEM1:C.Data
    - Set the W5_JEM1_Output_Data parameter to point to MyJEM1:O.Data
    - Set the Reconfigure_Message parameter to point to W5_JEM1_Reconfigure
    - Set the Boot_Timer_Done parameter to point to the .DN bit of the timer used for the boot delay.
    - Set the Connection_Faulted parameter to point to MyJEM1:I.ConnectionFaulted

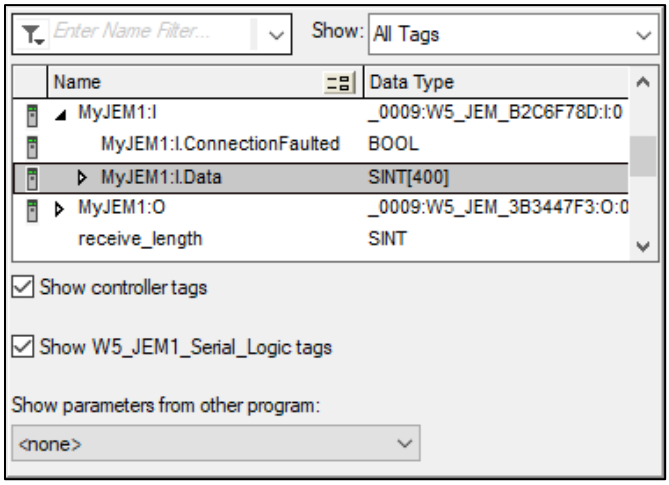
Figure 19. Setting the parameters for the W5_JEM1_Initialize Add-On Instruction



12. Create a tag named W5_JEM_Update of type W5_JEM_Update
13. In a periodic task insert a W5_JEM1_Update instruction. Important: be sure to observe the required startup delay before executing the instruction.
    - Set the W5_JEM_Update parameter to point to the W5_JEM_Update tag
    - Set the W5_JEM1_Object parameter to point to the W5_JEM1_Object tag
    - Set the W5_JEM1_Input_Data parameter to point to MyJEM1:I.Data
    - Set the W5_JEM1_Output_Data parameter to point to MyJEM1:O.Data
    - Set the Reconfigure_Message parameter to point to W5_JEM1_Reconfigure

Figure 20. Setting the parameters for the W5_JEM1_Update Add-On Instruction





14. The Add-On-Instructions have been successfully added to the program. See the example program for examples of receiving, transmitting, and on implementing the required startup delay.

5.3.7 Troubleshooting the Add-On Instruction provided with the Example Program

Table 16. Troubleshooting the AOI/Example Program

Issue	Possible Cause	Solution
PLC cannot connect to device	Device not powered	Check device LEDs, one or more LEDs should be illuminated or flashing. If not apply power to device.
	Device not connected to PLC via Ethernet	Connect PLC to Module with Ethernet Cable
	Device IP address does not match IP Address in Studio 5000 project	Open Module Properties->General Tab->IP Address and correct the IP Address
	Device IP Address matches configured value but IP address is on a different subnet than PLC	Configure IP address to be within same subnet as PLC. For example, the PLC is on 192.168.1.10 and the device is at 192.168.234.11. This is typically incorrect – the device would need to be moved into the PLCs subnet by changing its address to 192.168.1.11
	EtherNet/IP Connection Faulted	Open Module Properties->Connection tab->Module Fault Connection timeout typically indicates that one of the above problems are present and must be fixed.
Module does not transmit/receive or	PLC not connected to device	See section above.

transmit/receive is intermittent		
	Configuration Error Status Bit is set	See section below.
	User program is Ignoring Module and Message status bits and/or user program not performing error handling	Inspect and act upon device status bits. For each received message inspect the bits in W5_JEM1_Object.Receive_Message_Status Regularly inspect the bits in W5_JEM1_Object.Module_Status
	User program is attempting to transmit zero length messages	Set message length to a nonzero value
Configuration Error Bit is always set	Configuration is incorrect	Check each field in the W5_JEM1_Object.Configuration tag
	The W5_JEM1_Reconfigure tag points to the wrong device or IP address	Right click the tag and click configure. Navigate to the Communication Tab and verify that it points to the correct device.

5.4 Using the MSG Instruction on Rockwell PLCs

For low bandwidth applications an alternative to using the EDS and AOI is to use the MSG instruction. This instruction provides low level access to the W5-JEM1 and offers a way to potentially reduce system CPU usage at the expense of additional latency and software complexity in the PLC.

This method is only recommended for experienced programmers.

See Section 6 "EtherNet/IP Interface" and Rockwell's document titled "Logix 5000 Controllers Messages" for additional details.

5.5 Interfacing the device with Other PLCs

Users with non-Rockwell PLCs will be unable to use the Add-On-Instruction we provide for Studio 5000 (although they may be able to duplicate its logic by inspecting the structured text inside the AOI). As a result, they will have to directly interface with the device using EtherNet/IP. Two types of connections are supported: I/O Connections, and Explicit Messaging. I/O connections are preferred because they are capable of lower overhead and higher transfer speeds than explicit messaging. The device can be configured by writing to the Configuration Assembly. Serial data can be transmitted and received by reading and writing the Transmit, and Receive assemblies from the PLC program.

This method is only recommended for experienced programmers. See Section 6 "EtherNet/IP Interface" for details about the interface.

Wester Reserve Controls may be able to provide assistance interfacing the W5-JEM1 to other PLCs.

5.6 Reset Button Operation

Warning: Pressing the reset button while the device is connected to I/O can cause unintended operation.

When the reset button is held the MS LED turns amber and the NS LED turns off. The MS LED will flash

once every three seconds. Different operations are selected by releasing the button on the appropriate flash number. The button must be released within approximately 1.5 seconds of the flash to select the function associated with it. Holding the button for longer than three flashes will result in no special operation being performed.

Table 17. Reset Button Functions

Flash Number	Function Performed
1	Reboot Device
2	Reset Device to Factory Defaults (IP address to 192.168.1.10)
3	Enter Bootloader Mode
>3	MS LED Turns Off, No Operation Performed

5.7 Setting the Device IP Address

The device's IP address is set through its webpage (192.168.1.10 by default). In order to connect directly to the device, on many computers, it is necessary to configure the network adapter to have a static IP address with the same IP prefix as the device. The following is an example of configuring an ethernet adapter under Windows 10.

5.7.1 Configuring your PC with a Static IP Address

1. Open Network Connections. Right-click on ethernet adapter. Select Properties.

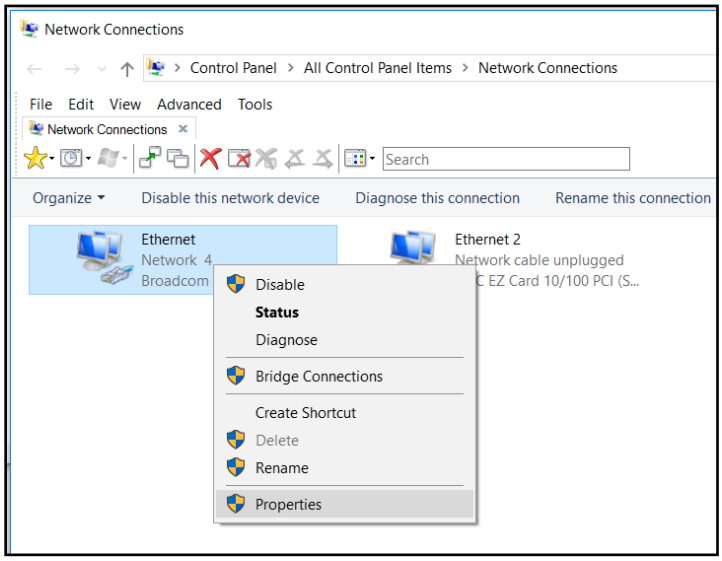


Figure 21. Open Network Connections

2. In dialog box, select item "Internet Protocol Version 4 (TCP/IP v4)", do not "uncheck" item. Then select button "Properties".

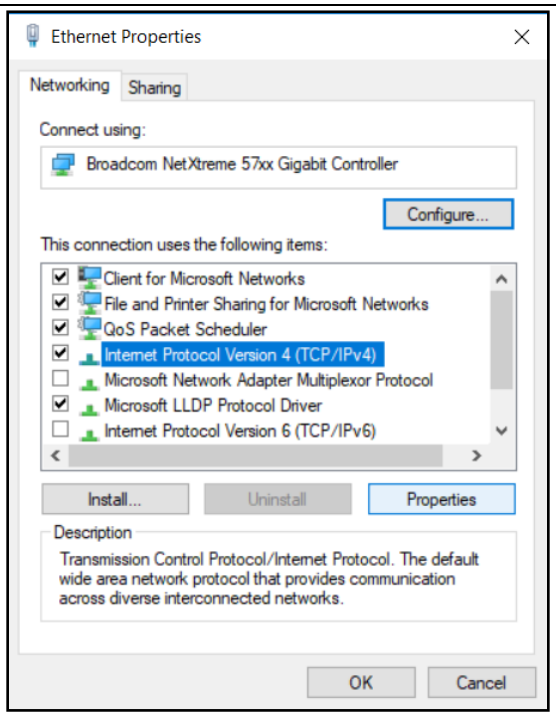


Figure 22. Select Internet Protocol Version 4 in Ethernet Properties

3. In Properties dialog, select "Use following IP address". Then enter an IP address with prefix (first three numbers must match): 192.168.1.x. Choose 'x' to be a value from 2 to 254. Example in Figure 3 shows a value of "32".

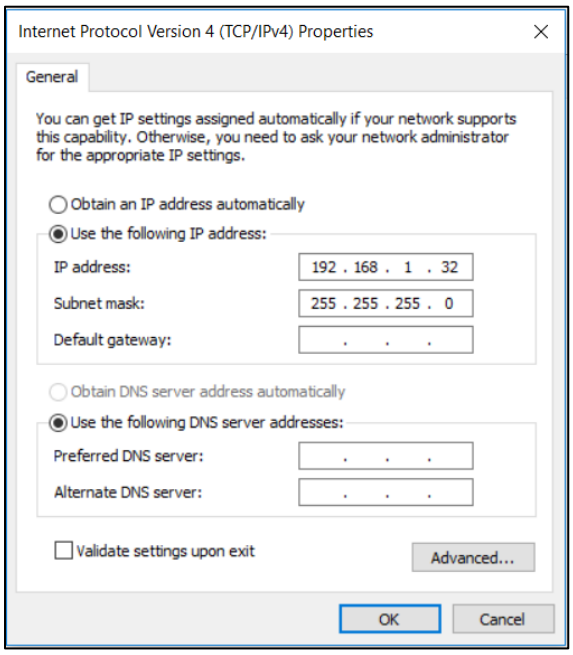


Figure 23. Select and Specify Static IP Address

4. Also, select "Use the following DNS server addresses", and clear the values in the associated box.

5. Click "OK" and exit all dialogs.
6. Done.

5.7.2 Setting Device IP Address Using Webpage

Out of the box the W5-JEM1 IP address is set to its factory default of 192.168.1.10. It's important to remember that no other Ethernet node on the same network can have the same IP address. To avoid this conflict, connect your PC directly to the W5-JEM1 being configured.

> ***NOTE**: If a device configuration webpage fails to appear in about 30 seconds, stopping the update in the browser and re-entering the webpage address in the browser URL box will usually result in the initial/updated webpage being displayed, assuming the IP address is valid.*

To change the Static IP address, follow the steps below.

1. Connect to the webpage of the W5-JEM1 using address: http://192.168.1.10
2. Enter the desired new IP address (for example, 192.168.1.39) in the 'Static IP Address' text box and click the 'Submit' button. The webpage will update to show a reminder that the new IP address will not take effect until the device is reset/re-booted.

   To verify the new IP address was programmed correctly, click the 'Reboot' link on the webpage, and the updated webpage should appear in about 10 seconds. Again, you can confirm the new IP address was correctly programmed into the device by entering the new IP address into your browser's URL text box and pressing the 'enter' key.

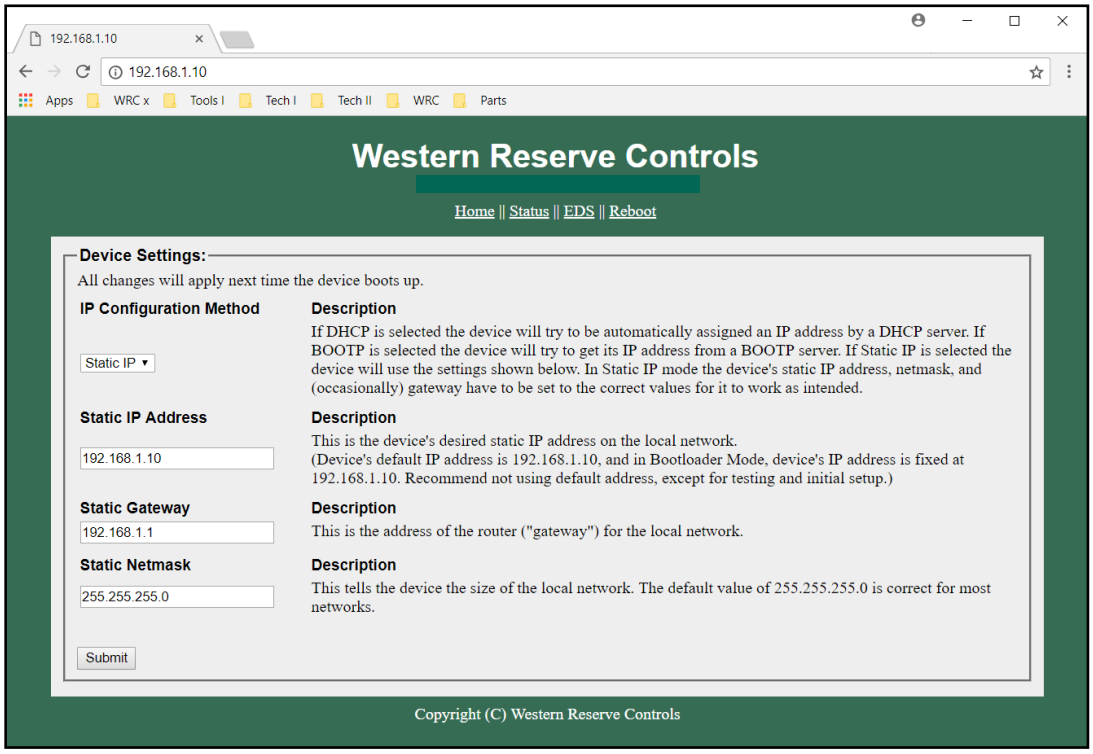


Figure 24. Device Home Page

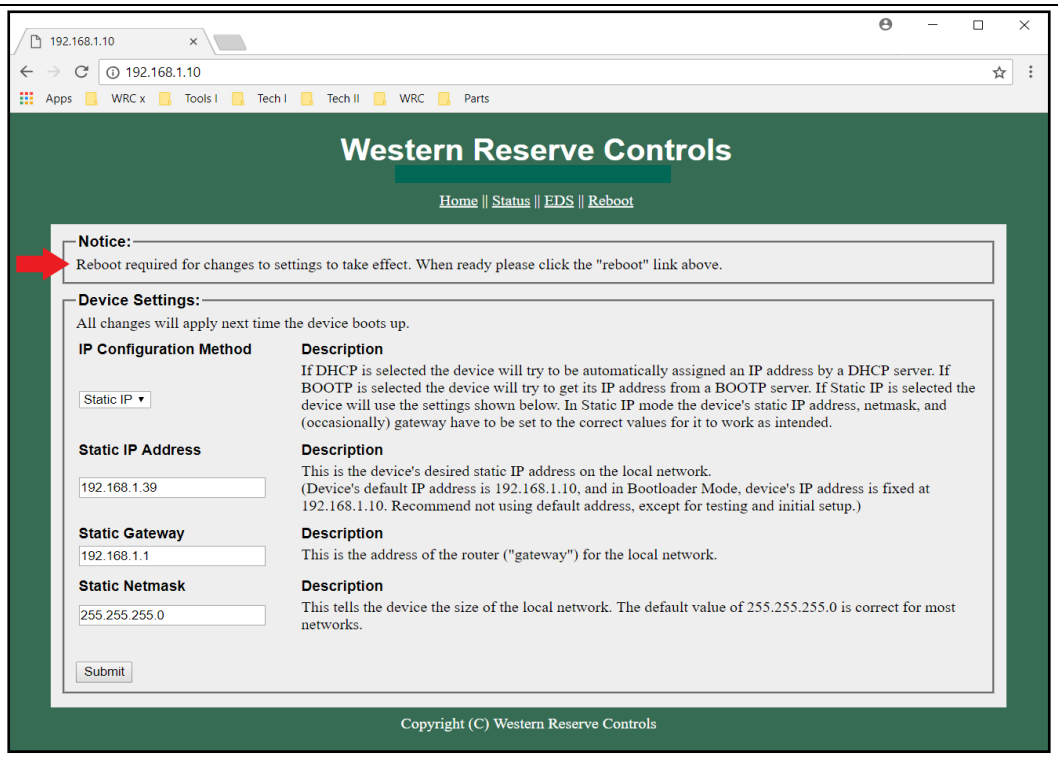


Figure 25. Reboot after Clicking Submit

5.8 Upgrading Firmware

The W5-JEM1 supports updating of the device firmware via bootloader mode. Follow instructions shown below.

To update device firmware device must be in Bootloader Mode. Only use a firmware file provided by the manufacturer (WRC) and designated for this particular product hardware.

> **WARNING:** Entering Bootloader Mode can cause unintended operation of device. Disconnect unit from all from all machinery before entering Bootloader Mode.
>
> **NOTE**: Unit's factory default IP address is 192.168.1.10, and in Bootloader Mode, unit's IP address is fixed at 192.168.1.10. Recommend not using default address, except for testing and initial setup.
>
> **NOTE**: Changing firmware may reset device settings, i.e. IP Address, etc. User may need to re-enter settings.
>
> **NOTE**: Screenshots shown in figures are for illustrative purposes (actual webpages may differ).
>
> **TIP**: If a device webpage fails to update in about 30 seconds, stopping the update in the browser, and re-entering the webpage address in the browser URL box, will usually result in the updated webpage being displayed, assuming the address is valid.

Instructions

1. See section 5.6 "Reset Button Operation" and follow the steps under 'Entering Bootloader Mode'.
2. To verify device is in Bootloader Mode, open a browser and enter the static IP address 192.168.1.10. The Firmware Update Mode webpage shown in Figure 26 should appear in about 15 seconds. Also, the MS LED should be solid amber and NS LEDs should be off.

3. Click the 'Choose File' button to open a file-select dialog, see Figure 27. Select the desired firmware file and press 'Open'.
4. Click the 'Submit' button to begin firmware download to device. The browser should display some kind of indicator of percentage of file downloaded, see Figure 28.
5. When firmware download is complete, the device will automatically reset, exit bootloader mode, and resume normal operation (observe LED behavior). Also, the webpage shown in Figure 29 will be displayed. Follow instructions on webpage.
   5.a. The page will automatically refresh only if the device is still programmed with the default static IP address of 192.168.1.10; in this case you will see the normal Home Page. Note the 'Static IP Address'.
   5.b. If the device was programmed with a different IP address (used during normal operation), (example 192.168.1.39), then the browser will not refresh, but rather, it will timeout. In this case, you must enter the IP address that was programmed into the device (i.e. 192.168.1.39 in this example) into the URL text box of the browser, and press enter. Note the 'Static IP Address'. Remember that the IP address programmed into the device, is only used during normal operation, not in Bootloader Mode.

   After reaching the Home Page during normal operation, verify that the version number for the product, is as expected (in this example, v1.4).

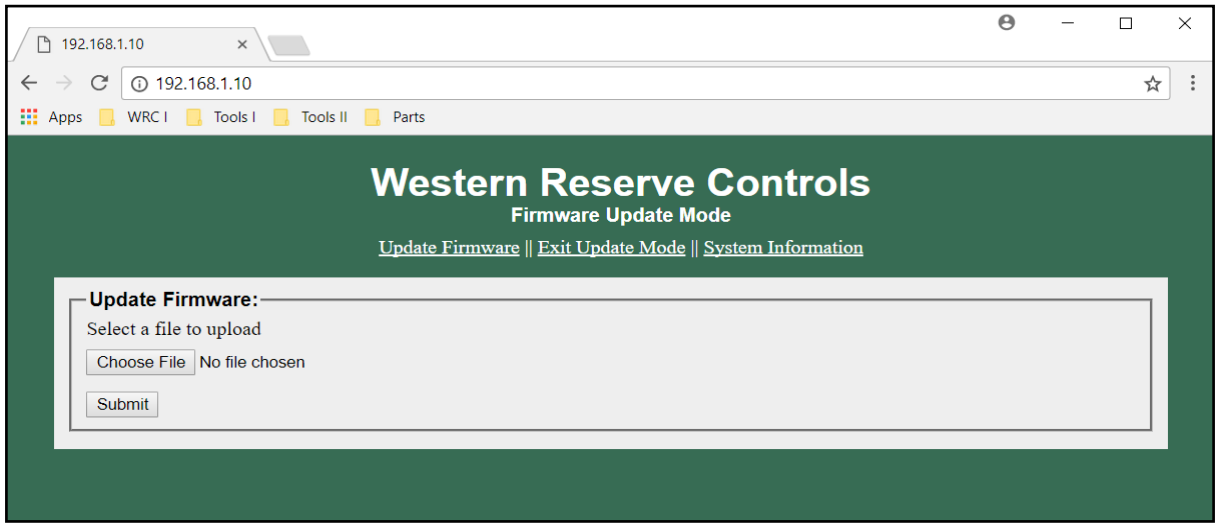


Figure 26. Firmware Update Mode Webpage

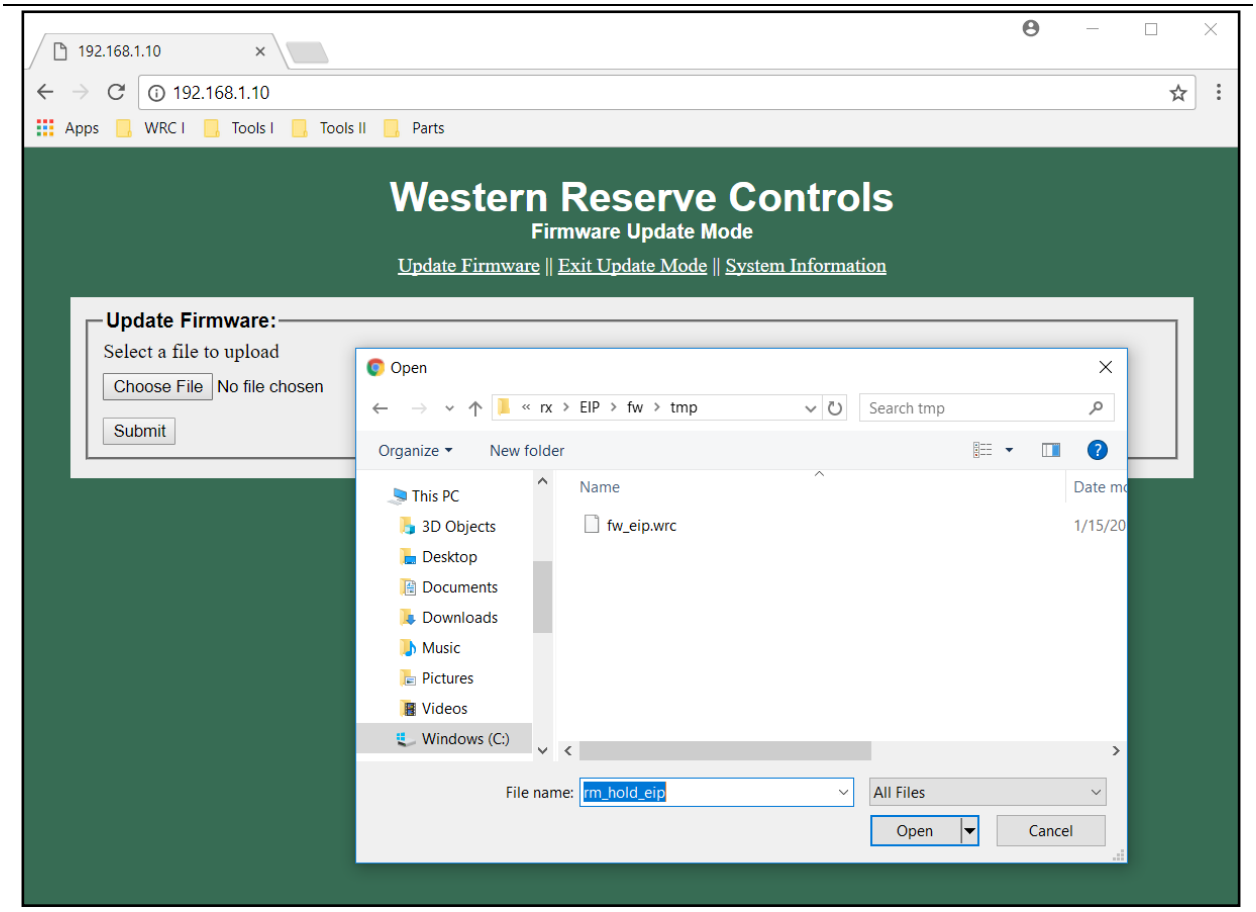


Figure 27. Select Firmware File

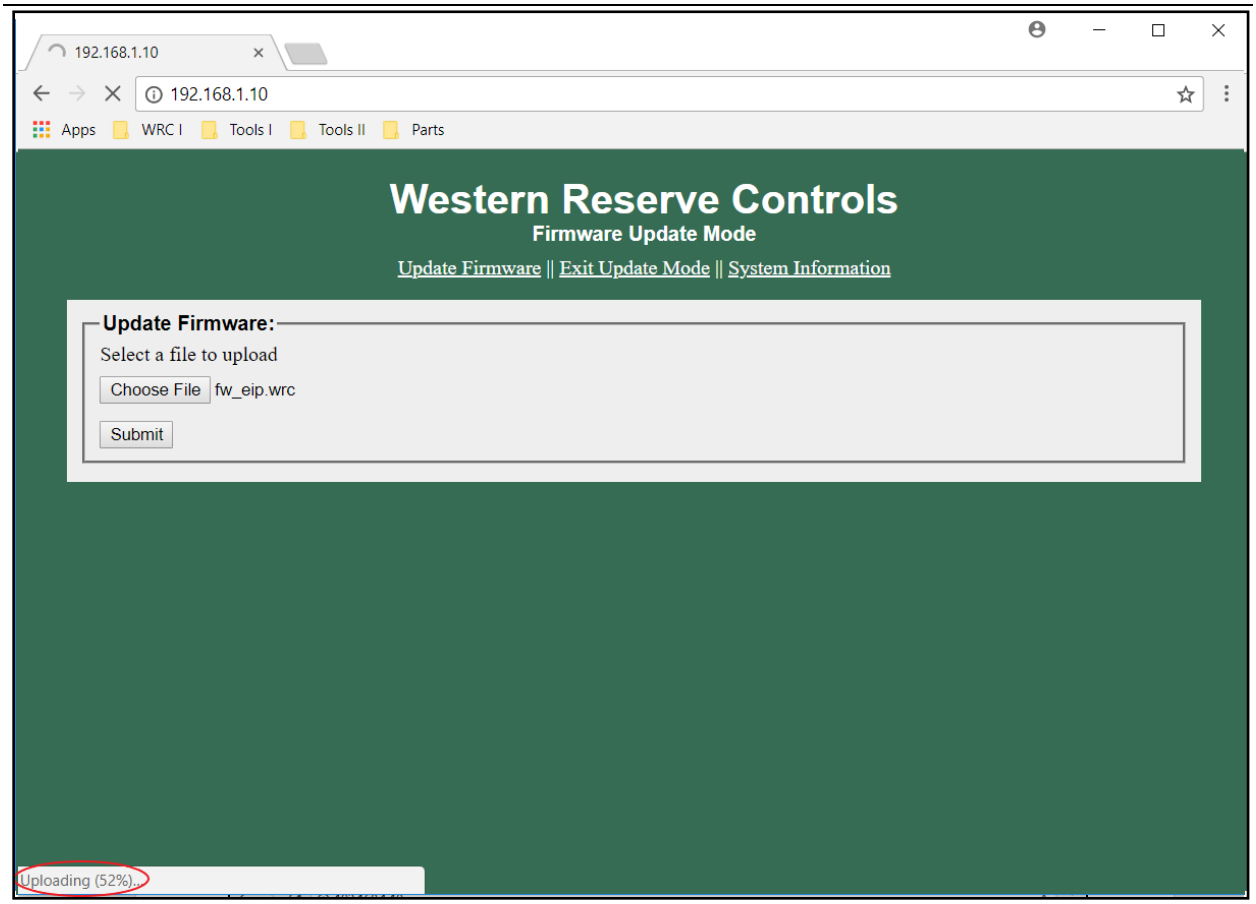


Figure 28. Downloading Firmware File

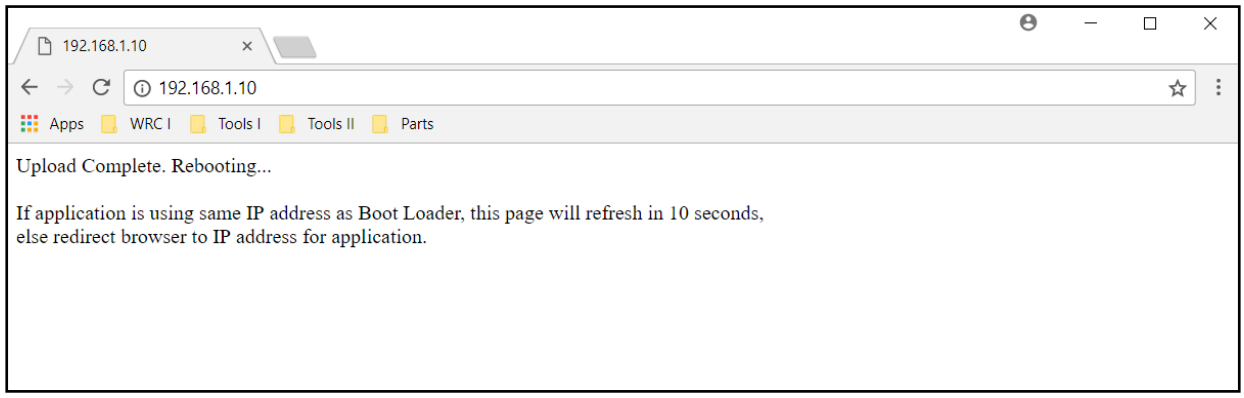


Figure 29. Firmware Download Complete

6 EtherNet/IP Interface

This section is a reference for programmers that wish to directly interface with the device using the EtherNet/IP protocol. This provides an alternative method to using the provided AOI (add-on-instruction), or create an improved one, when greater control is required. Either Explicit or I/O Messaging may be used. Typically, on Rockwell PLCs the MSG command is used in order to directly access the EtherNet/IP objects, instances, and attributes through Explicit Messaging. Assemblies can be read with the Get Attribute Single service and written with the Set Attribute Single service.

The typical use case is to:

1. Write to the configuration assembly once at power-up
    a. Done through the Set Attribute Single service on Class 4, Instance 102, Attribute 3
2. Then periodically (e.g. every 100ms):
    a. Read the Receive Assembly (Get Attribute Single service on Class 4, Instance 101, Attribute 3)
    b. Write the Transmit Assembly (Set Attribute Single service on Class 4, Instance 100, Attribute 3)

Handshaking, achieved through reading and writing the TX and RX record number parameters, must occur between the PLC and the W5-JEM1 for each packet transmitted and received.

To transmit a serial packet:

1. Write the message length into the Transmit Assembly (via the "TX Length" field)
2. Write the message data into the Transmit Assembly (via the "TX Data" field)
3. Write a new and different value into the "New TX Record Number" field of the Transmit Assembly
    a. The recommended way to obtain the new value is to read the "Current TX Record Number" field of the Receive Assembly and add one to it. It always starts from 0 each power cycle.
4. Optionally, read the receive assembly and monitor the "Current TX Record Number" and "Status Bits" fields to ensure that the command to transmit was received and that the TX FIFO buffer has not overflowed.

To receive a serial packet:

1. Be aware that the "Current RX Record Number" field of the Receive Assembly always starts at zero each time the configuration assembly is written.
2. Read the "Current RX Record Number" of the Receive Assembly. If the value has changed since the last time it was read then a packet has been received. (The first packet received will always have a RX record number of 1).
    a. The RX Record Number will remain constant until reception has been acknowledged by the PLC. If subsequent serial packets are received while the W5-JEM1 is waiting for acknowledgment they will be placed into the RX FIFO Buffer.
3. Read the Status, RX Length, and RX Data fields from the Receive Assembly
4. Once the packet data has been read out it is necessary to "Acknowledge" reception of the serial packet from the W5-JEM1.
    a. Write the value of the "Current RX Record Number" field of the "Receive Assembly" into

the "New RX Record Number" field of the Transmit Assembly. This acknowledges reception and permits the W5-JEM1 to deliver the next packet in the RX FIFO Buffer (if any)

b. Go back to step 2. If the value of "Current RX Record Number" increments again after acknowledging reception, then another serial packet has been received.

6.1 Implemented Objects

Table 18. Implemented EtherNet/IP Objects

Object Name	Class Number	Number of Instances
Identity	1 (01 hex)	1
Message Router	2 (02 hex)	1
Assembly	4 (04 hex)	3
Connection Manager	6 (06 hex)	1
Port	244 (F4 hex)	1
TCP/IP Interface	245 (F5 hex)	1
Ethernet Link	246 (F6 hex)	3

6.2 Assembly Object Instances

Assembly data is accessed through attribute 3 of each assembly instance.

Table 19. Supported Assembly Object Instances

Instance Number	Name	Size (Bytes)
100	Transmit Assembly	400
101	Receive Assembly	400
102	Configuration Assembly	400

6.3 Configuration Assembly Format

Bytes 6-23 only apply in User Defined Mode.

See section 6.6 "Device Parameters".

Table 20. Configuration Assembly Format

Byte	Parameter	Description	
0	RX/TX mode	0 – Reset 1 – Raw Serial/User Defined 2 – Modbus ASCII 3 – Modbus RTU	
1	Framing Format	0 – Mode Default 1 – 7N2 2 – 7E1 3 – 7O1 4 – 8N1 5 – 8N2	6 – 8E1 7 – 8O1 8 – 7E2 9 – 7O2
2	Baud Rate	0 – Mode Default 1 – 1200 2 – 2400 3 – 4800 4 – 9600	5 – 19200 6 – 38400 7 – 57600 8 – 115200
3	Hardware Flow Control	0 – Disabled 1 – Enabled	
4	RX Max Length: Low Byte	1-255 Characters 0 is interpreted as "use default value" (255 characters)	
5	RX Max Length: High Byte	Set to 0.	
6	RX Timeout: Low Byte	Units: 50 microsecond increments. (20=1ms, 200=10ms) 1-60000 (50us-3 seconds) 0 interpreted as "use default value for the selected mode"	
7	RX Timeout: High Byte		
8	RX Max Intercharacter Spacing: Low Byte	Units: 50 microsecond increments. (20=1ms, 200=10ms) 1-60000 (50us-3 seconds) Disabled when set to 0.	
9	RX Max Intercharacter Spacing: High Byte		
10	TX Delay: Low Byte	Units: 50 microsecond increments. (20=1ms, 200=10ms) 1-60000 (50us-3 seconds) 0 interpreted as "use default value" (1.2ms)	
11	TX Delay: High Byte		
12	TX Start Delimiter Length	0, 1, or 2 characters.	
13	TX Start Delimiter Character 0	Any Character: 0-255	
14	TX Start Delimiter Character 1		
15	TX End Delimiter Length	0, 1, or 2 characters.	
16	TX End Delimiter Character 0	Any Character: 0-255	
17	TX End Delimiter Character 1		
18	RX Start Delimiter Length	0, 1, or 2 characters.	
19	RX Start Delimiter Character 0	Any Character: 0-255	
20	RX Start Delimiter Character 1		
21	RX End Delimiter Length	0, 1, or 2 characters.	
22	RX End Delimiter Char 0	Any Character: 0-255	
23	RX End Delimiter Char 1		
24-399	Reserved. Set to zero.		

6.4 Transmit Assembly Format

Table 21. Transmit Assembly Format

Byte	Configuration	Description
0	New RX Record #	New record number. Change of value acknowledges reception and causes next packet in FIFO to load.
1	New TX Record #	New record number. Change of value triggers new packet to be queued for transmission.
2-3	Reserved	Currently ignored, set to zero.
4	TX Length low	Length of message 0-255.
5	TX Length high	Set to zero.
6-260	TX Data	Message to transmit up to 255 bytes in length.
261-398	Reserved	Set to zero.
399	Reserved 2	Set to zero.

6.5 Receive Assembly Format

Table 22. Receive Assembly Format

Byte	Configuration	Description
0	Current RX Record #	JEM1's RX Current record number. [1]
1	Current TX Record #	JEM1's TX Current record number.
2-3	Status	Current status.
4	RX Length low	Length of message 0-255.
5	RX Length high	Always zero.
6-260	RX Data	Received message up to 255 bytes in length.
261-398	Reserved	Always zero.
399	Current RX Record #	JEM1's RX Current record number. [1]

1. Due to non-atomic access in the PLC when using an I/O connection both RX Record number fields must be the same value in order to guarantee that the Controller Tag is valid and has been fully updated.

6.6 Device Parameters

This table is an abstract representation of the various configuration and operational parameters of the device. They are accessed through the Configuration, Transmit, and Receive assemblies.

Table 23 Device Parameters

Parameter	Access	Description	Parameter Choices		Type
(Internal) Idle Bit	RO	Only visible to user through status bit. Mirrors the "Run/Idle" bit of the Class 1 connection between the device and the PLC – if such a connection exists. Otherwise default value is used.	Default Value: 0 – Normal Operation 0 – Normal Operation 1 – Temporarily operate in Reset Mode (RX/TX disabled)		BOOL
Mode	RW	Detmines the overall operation of the device. Certain modes override timeouts and delimiters. See section and relevant table below for further explanation.	Power on Default: Reset Mode 0 – Reset Mode 1 – User Defined Mode 2 – Modbus ASCII Mode 3 – Modbus RTU Mode		U8
Frame Format	RW	Serial Framing Format. The number of data bits (7 or 8), parity (None, Even, Odd), and number of stop bits (1 or 2).	0 – Mode Default (See Table) 1 – 7N2 2 – 7E1 3 – 7O1 4 – 8N1	5 – 8N2 6 – 8E1 7 – 8O1 8 – 7E2 9 – 7O2	U8
Baud Rate	RW	Sets the baud rate that data is transmitted and received at.	0 – Mode Default (See Table) 1 – 1200 2 – 2400 3 – 4800 4 – 9600	5 – 19200 6 – 38400 7 – 57600 8 – 115200	U8
Hardware Flow Control	RW	Enables the RTS and CTS lines. Must be disabled for RS485 and RS422 devices.	0 – Flow Control Disabled 1 – Flow Control Enabled		U8
TX Record Number	RW	Record number of current data in FIFO buffer. Used to signal new RX/TX data and acknowledge reception of RX/TX data.			U8
RX Record Number	RW				U8
TX Data	RW	Data to transmit. FIFO buffered. Buffer depth 8 packets. TX Delimiters will be added if specified below. Max 255 characters.			Array of U8
RX Data	RO	Received data from RX FIFO buffer. RX delimiters shall be stripped from message. Max 255 characters. Includes received delimiters if any.			Array of U8
RX Maximum Packet Length	RW	If packet length is longer than this it will be broken up into two or more smaller packets,	Units: Number of Bytes Valid range: 1-255.		U16
RX Timeout	RW	If time between successive bytes is greater than or equal to RX Timeout, a frame boundary is recognized, resulting in a new packet.	Units: 50 microseconds per count. Range: 50us to 3 seconds. (1-60000) Tolerance: -100 to 0 microseconds		U16
TX Delay	RW	Minimum delay between successive packets transmitted on the serial port.	A value of 0 causes the device to assume a default value of 1200us in User Defined Mode. In Mode 0 – Reset to Default. In Mode 1 – User defined value used. In Mode 2 – RX=1 sec, TX=50ms. In Mode 3 – RX=3.5/TX=5 Character Widths.		U16
RX Maximum Intercharacter Spacing	RW	If time between successive bytes is greater than this value, a RX Intercharacter Spacing Error is flagged and a frame boundary is also recognized, resulting in a new packet. Intended for Modbus. When enabled it can be used to detect "glitches" in timing between received bytes as required by the Modbus RTU standard.	Units: 50 microseconds per count. Range: 50us to 3 seconds. (1-60000) Tolerance: 0 to 100 microseconds A value of 0 disables this feature in User Defined Mode.		U16
TX Start Delimiter	RW	TX delimiters, if of nonzero length, will be added to transmissions. RX delimiters, if of nonzero length, will be	In Mode 0 – Reset to Defaults In Mode 1 – User defined values used		Array of U8

TX End Delimiter	RW	used in conjunction with the configured RX timeout and max length to receive data. Max 2 characters	In Mode 2 – Start ":", end "\r\n" In Mode 3 – None	Array of U8
RX Start Delimiter	RW			Array of U8
RX End Delimiter	RW			Array of U8
Status	RO	Status of the current RX/TX record object	Bit 0-Configuration Error Bit 1-RX Parity Error Bit 2-RX Framing Error Bit 3-RX Intercharacter Spacing Error Bit 4-RX End Delimiter Not Found Bit 5-RX Max Length Reached Bit 6-Reserved Bit 7-Reserved Bit 8-RX Buffer Not Empty Bit 9-RX Buffer Full Bit 10-RX Buffer Overflow Bit 11-TX Buffer Empty Bit 12-TX Buffer Full Bit 13-TX Buffer Overflow Bit 14-Idle Bit 15-Reserved (Overrun Error)	U16

6.6.1 Idle Bit

The Idle bit represents the value of the "Run/Idle" header that is typically (but not always) present in the EtherNet/IP I/O connection between this device and the PLC. The default value of this parameter allows the device to be controlled both via explicit messaging and from implicit messaging connections where the header is not present.

On Rockwell PLC's when the user uses the supplied EDS file the Run/Idle header will be present. When the header is present the value of the Idle bit is controlled by the current mode of the PLC (Program, Run, or Test) as shown in the table below.

When the Idle bit is set it causes RX/TX to be disabled and clears the RX/TX buffers. When the Idle bit is cleared the device reverts to normal operation.

Figure 30. Program Mode/ Run Mode/Test Mode

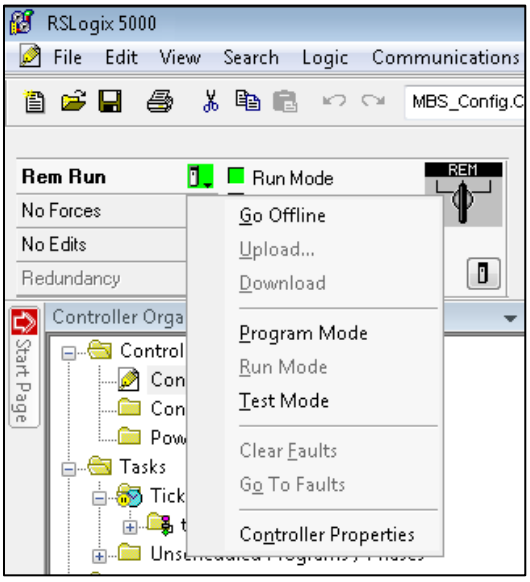


Figure 31. PLC Mode Versus Idle Bit Behavior

PLC Mode	Value of Idle Bit	Behavior
Program Mode	1	RX/TX Disabled, FIFOs cleared
Run Mode	0	RX/TX Enabled
Test Mode	1	RX/TX Disabled, FIFOs cleared

6.6.2 Mode Parameter

There are four possible modes of operation.

1. Reset – Disables RX/TX and clears all buffers.
2. User Defined – RX/TX Enabled, Allows the user to fully configure device's behavior.
3. Modbus ASCII – RX/TX Enabled, A special case of user defined mode. Overrides and automatically sets the parameters shown below for user convenience.
4. Modbus RTU – RX/TX Enabled, A special case of user defined mode. Overrides and automatically sets the parameters shown below for user convenience.

Table 24. Effects of the Mode Parameter

Mode	RX/TX Start Delimiter	RX/TX End Delimiter	RX Timeout	RX Maximum Intercharacter Spacing	TX Delay	Default Baud	Default Frame
0 – Reset	RX/TX Disabled. Delimiters and timeout reset to default values.						
1 – User Defined	User Defined – Parameter Values Used					9600	8N1
2 – Modbus ASCII	":" A colon (hex 3A).	"\r\n" Carriage Return and Newline (hex 0D 0A)	1 second	Disabled	50 Milliseconds	19200	7E1
3 – Modbus RTU	No Delimiter		3.5 character widths	1.5 character widths	5 character widths	19200	8E1

		(per Modbus spec)				

6.6.3 Frame Format

This parameter controls the format of serial data. There are three parameters that define the format of a serial frame:

- Number of Data Bits – 7 or 8
- Parity – None, Even, or Odd
- Number of Stop Bits – 1 or 2

User defined mode support all frame formats and the 8N1 frame format is the default.

Modbus RTU Mode supports the following frame formats:

- 8E1 (Default)
- 8O1
- 8N2

Modbus ASCII Mode supports the following frame formats:

- 7E1 (Default)
- 7O1
- 7N2

Using an incorrect frame format in Modbus ASCII/RTU Mode will trigger the Configuration Error bit.

6.6.4 Baud Rate

This parameter sets the speed at which data is received and transmitted over the serial line.

6.6.5 Hardware Flow Control

When enabled the transceiver uses the RTS and CTS lines to control the flow of serial data.

This should only be enabled for RS232 devices that require hardware flow control. Attempting to use flow control (RTS/CTS) on RS422/RS485, which lack RTS/CTS signals, will cause erroneous operation.

6.6.6 RX Max Length

This parameter causes packets whose length exceeds this value to be split into two or more smaller packets.

For example: if RX Max Length=5 bytes then an 8 byte packet would be split into a 5 byte packet and a 3 byte packet.

6.6.7 TX Record Number

When the TX record number is updated to a new and different value the JEM1 transmits the contents of TX

Data.

Zero length packets are ignored.

6.6.8 RX Record Number

This parameter both signals and acknowledges the reception of packets.

The behavior shall depend on whether the RX FIFO packet buffer is empty or not.

See behavior tables below.

Table 25. RX Record Behavior When a Packet is Received

When a packet is received, and the buffer is:		
Condition	**Behavior**	
Buffer Status	**RX Record Number**	**RX Record**
Empty	Shall increment.	Shall be made available for reading.
Not Empty	Shall be unaffected.	Shall be placed into the FIFO.

Table 26. RX Record Behavior When RX Record Number is Updated

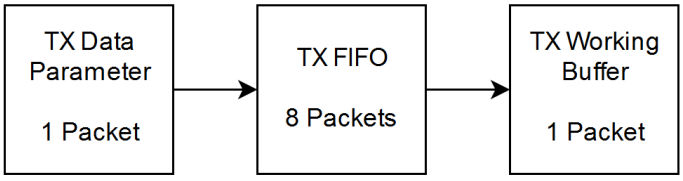
When the RX Record parameter is written with a new and different value and the buffer is:		
Condition	**Behavior**	
Buffer Status	**RX Record Number**	**RX Record**
Empty	Shall be unaffected.	Shall be empty (all zeros).
Not Empty	Shall increment.	Next packet shall be made available.

6.6.9 TX Data

This parameter is an array of bytes of a certain length. It represents the packet to be transmitted – minus TX delimiters if any.

When the command to transmit the contents of TX Data is received the contents of this parameter are copied into the TX FIFO. The FIFO permits up to 8 packets to be queued while a transmission is in progress. The transmission in progress uses the working buffer.

Figure 32. TX Buffering Setup



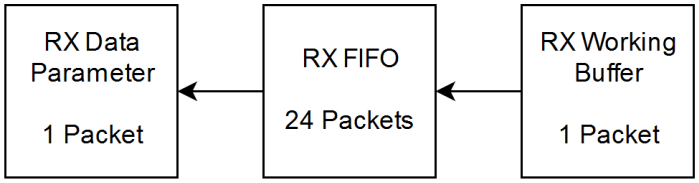
If the FIFO is full new packets received from the TX Data parameter shall be dropped.

See related status bits.

6.6.10 RX Data

This parameter is an array of bytes of a certain length. It contains the first (oldest) packet taken from the RX FIFO.

Figure 33. RX Buffering Setup



When serial characters are received, they are placed into the working buffer. When the working buffer contains a full packet, the packet is transferred into the FIFO. Under certain circumstances a single packet can be transferred from the RX FIFO into the RX Data parameter to be processed by the user.

See **Table 25** and

Table 26.

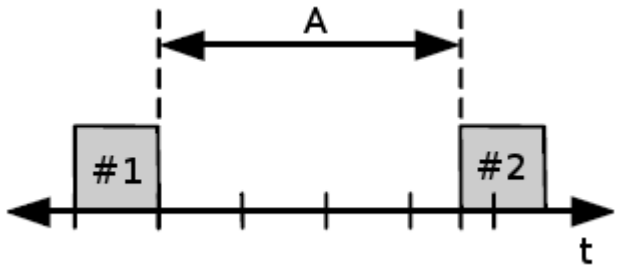
If the FIFO is full new packets received from the working buffer shall be dropped.

See related status bits.

6.6.11 RX Timeout

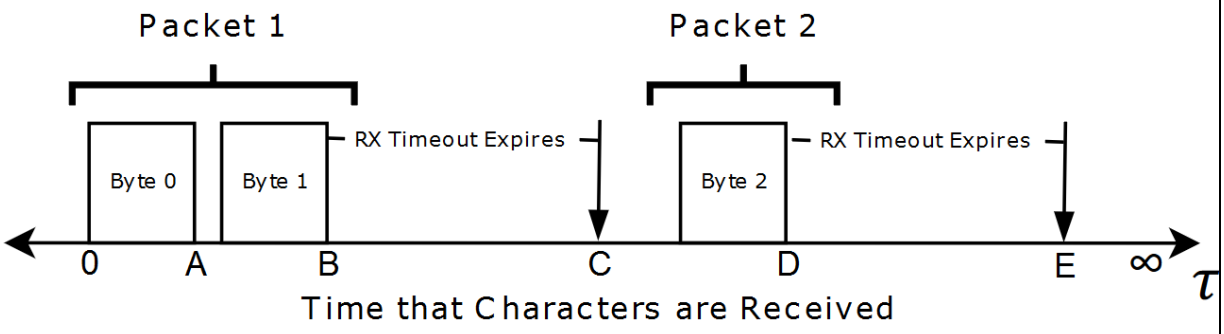
When receiving a packet each time a byte is received the RX Timeout timer is started. If a period of time greater than or equal to RX Timeout elapses then the contents of the current packet are transferred into the RX FIFO.

Figure 34. Graph showing how the timing is measured for RX Timeout



#1 – The first serial character
#2 – The second serial character
A – The period of time represented by the RX Timeout Parameter

Figure 35. Graph showing the operation of the RX Timeout feature



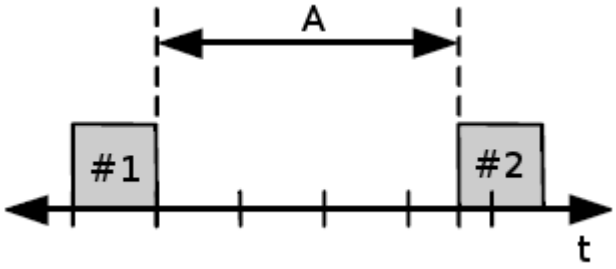
0 – Start. RX Timeout stopped because there is no data in the working buffer.
A – Byte 0 received. RX Timer started.
B – Byte 1 received. RX Timer restarted.
C – RX Timer elapses. RX Timeout occurs. RX Timer stopped. Packet 1 produced (copied to RX FIFO).
D – Byte 2 received. RX Timer started.
E – RX Timer elapses. RX Timeout occurs. RX Timer stopped. Packet 2 produced (copied to RX FIFO)

6.6.12 TX Delay

The TX delay parameter allows for a delay to be inserted between the transmission of successive packets (not characters) queued in the TX FIFO.

When a transmission is complete the device waits for the period set by this parameter before attempting to transmit the next available packet.

Figure 36. Graph showing how the timing is measured for TX Delay



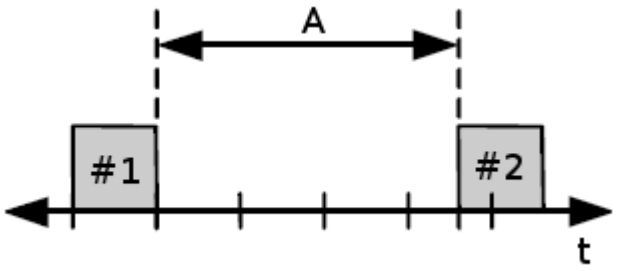
#1 – The first serial character
#2 – The second serial character
A – The period of time represented by the TX Delay Parameter

6.6.13 RX Maximum Intercharacter Spacing

This parameter is abbreviated RMIS in the graphs.

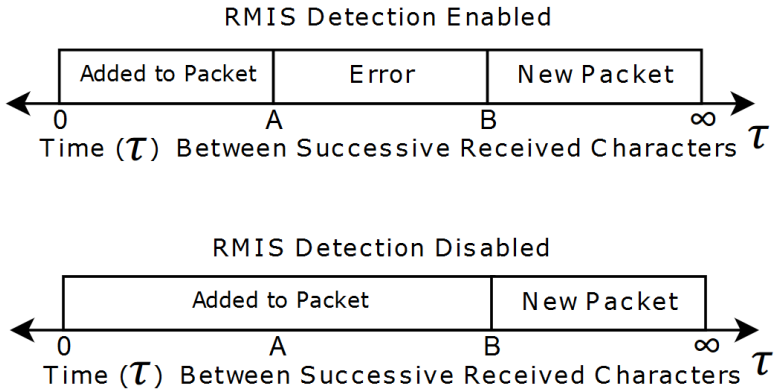
For Modbus RTU the timing between received bytes is critical. This parameter permits the detection of erroneous transmissions that fail to meet a particular timing requirement of the Modbus RTU standard. When this parameter is enabled if the time between two successive received characters falls into the window between A and B an error status bit is set and the byte is considered the start of a new packet. See graphs below.

Figure 37. Graph showing how the timing is measured for RX Maximum Intercharacter Spacing



#1 – The first serial character
#2 – The second serial character
A – The period of time represented by the RX Maximum Intercharacter Spacing Parameter

Figure 38. Graph defining the timing windows and behaviors for RX Maximum Intercharacter Spacing



Times:
0 – The start, representing zero gap between successive characters.
A – the value of the RMIS parameter
B – is the value of the RX Timeout parameter

Behaviors:
Added to Packet – The received byte is added to the current packet
Error – The received byte triggers the RMIS Error and added to a new packet.
New Packet – The received byte is added to a new packet without error.

6.6.14 TX Start Delimiter and TX End Delimiter

The TX Start Delimiter parameter permits between 0 and 2 characters to be appended to the start of each message to be transmitted.
The TX End Delimiter parameter permits between 0 and 2 characters to be appended to the end of each message to be transmitted.

6.6.15 RX Start Delimiter and RX End Delimiter

It is important to note that RMIS and RX Timeout events clear the delimiter matching filters. This causes

the filter to work strictly on a per packet basis.

If the RX Start Delimiter is of nonzero length the device will ignore all packets that do not begin with the RX start delimiter.

If the RX End Delimiter is of nonzero length the device will terminate reception of a packet and add it to the FIFO when the RX end delimiter is received. When a RX delimiter is expected but never received (ie. a RX timeout occurs) a status bit shall be set.

6.6.16 Status Bits

Shown below is a table of status bits.

Table 27. Explanation of Status Bit Behaviors

Bit #	Name	Description
0	Configuration Error (CE)	This bit indicates if the configuration assembly contains invalid settings or is unconfigured (ie. at startup). If this is so the user must correct the configuration. When an invalid configuration is sent the unit enters Reset mode. This bit is updated each time the configuration assembly is received
1	RX Parity Error (RXPE)	This bit indicates if the current packet in RX Data contained one or more bytes with a parity error.
2	RX Framing Error (RXFE)	This bit indicates if the current packet in RX Data contained one or more bytes with a framing error.
3	RX Intercharacter Spacing Error (RXISE)	This bit indicates if the current packet in RX Data experienced an RX intercharacter spacing error. If this error occurs the current packet is truncated and subsequent characters are placed into a new packet. The indicated error will have occurred directly after the last character of the truncated packet. The new packet will not have this bit set unless another spacing error occurred within it as well. As a result, the user must be aware that both packets are affected and must be handled appropriately.
4	RX End Delimiter Not Found (RXEDNF)	Indicates if the end delimiter of was not present in the packet (ie. that the packet was incomplete and the RX Timeout or RX Intercharacter Spacing Error triggered end of the packet).
5	Reserved (Bit 5)	Reserved for future use. Value can change between 0 and 1
6	Reserved (Bit 6)	Reserved for future use. Currently 0.
7	Reserved (Bit 7)	Reserved for future use. Currently 0.
8	RX Buffer Not Empty (RXBNE)	Indicates if RX Data, RX FIFO or RX working buffer contains data (are not empty) This bit updates continuously.
9	RX Buffer Full (RXBF)	Indicates if the RX FIFO is full. This bit updates continuously.
10	RX Buffer Overflow (RXBO)	Indicates if the RX working buffer has dropped an incoming packet. This occurs when the device receives a packet when the RX FIFO

		is full. If this bit is set the user is not processing received packets fast enough. This bit updates continuously.
11	TX Buffer Empty (TXBE)	Indicates if both the TX FIFO and working buffers are currently empty. This effectively signals if a device is currently transmitting one or more packets onto the serial bus. This bit updates continuously.
12	TX Buffer Full (TXBF)	Indicates if the TX FIFO buffer is currently full. If this bit is set the user must delay transmission until the FIFO is not full. This bit updates continuously.
13	TX Buffer Overflow (TXBO)	This bit indicates if the user attempted to transmit when the TX FIFO was full. If this bit is set then the packet in TX Data was not added into the FIFO and the user must retry when the FIFO is not full. This bit updates each time a packet transmission is commanded ("Each time the device attempts to copy TX Data into the TX FIFO").
14	Idle (IDLE)	The status of the internal Idle bit. This bit should be 0 during normal operation (for example PLC in run mode). If this bit is set the user's PLC has placed the device into a state where it is not allowed to receive or transmit. This is normally altered by placing the controlling PLC into "Run Mode" while connected to the device.
15	Reserved – Overrun Error	This bit is intended for internal use only. Under normal operation this bit shall never be set. However, if bit is set the device has experienced a critical timing related error and signals that some aspect of the firmware needs corrected.

7 Models and Part Numbers

WRC Order Number	**Description**
W5-JEM1-DH2	DIN Mount Serial to EtherNet/IP Gateway

END OF DOCUMENT