

Wireless IO Expansion Setup with Modbus RTU, Universal Expansion Modules and Radio Base

Applies To

Rockwell Automation, Allen Bradley:

- MicroLogix 1100, 1200, 1400, 1500

FreeWave Technologies:

- FGRO9
- FGRSR
- FGR2-C
- FGR2-IO-IOE
- IOE-X-4422P

Summary

This application note describes how to configure Allen Bradley MicroLogix programmable logic controllers (PLC) with Modbus RTU capability, FreeWave Technologies' FGR2 serial radio modem and serial I/O slave Radio Base (FGR2-IO-IOE) with Universal Expansion Modules (IOE-X-4422P). A MicroLogix 1100 is used as an example in this document; settings are common to all MicroLogix PLC's with Modbus RTU.

Point to Multipoint Master Settings

There is only one master radio in a point to multipoint network. The following steps provide an overview of the configuration procedure for serial radio modem configured as a point to multipoint master:

1. Connect the serial radio modem to a computer with the data cable provided.
2. Power the serial radio modem with a power supply within the specific voltage range.
3. Press the button on the data cable so that all 3 lights turn green.
4. With the Tool Suite configuration software, change the serial radio modem settings:
 - i. Operation mode: Point to Multipoint Master
 - ii. Baud Rate:
 - i. Serial protocol: RS232
 - ii. Baud Rate: Must match Modbus master device (PLC)
 1. Should not be higher than 19,200 for use with MicroLogix PLCs.
 - iii. Parity: Must match Modbus master device (PLC)
 1. MicroLogix defaults to "no parity."
 - iv. Stop Bits: Must match Modbus master device (PLC)
 1. MicroLogix defaults to "1."
 - v. Modbus RTU: 1
 - iii. Transmission Characteristics:
 - i. Frequency Key: Any entry from 0 through E
 1. Avoid using default value of 5.
 - ii. Transmit Power: Application dependant
 1. Select the lowest transmit power setting that provides a reliable wireless link. If unsure, use 10. For a bench test, setting transmit power to 0 should be sufficient. Increasing the transmit power increases the distance across which the radios remain linked at the expense of increased current consumption.
 - iv. MultiPoint Parameters:
 - i. Network ID: Any number between 1 and 4095, other than 255

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1. The simplest choice is to use the last 4 digits of the master radio's serial number. However, if that number is greater than 4095 select a similar network ID that is 4095 or less.
5. Press the write "All" button for settings to take effect.

Point to Multipoint Slave Radio Base and Expansion Module Settings

Up to 246 point to multipoint I/O slave radios can be linked to a single master in the default 8-bit addressing mode and up to 65,000 with the 16-bit extended addressing mode. Each expansion format Radio Base can be stacked with up to 15 Expansion Modules. The following steps provide an overview of the configuration procedure for the FGR2 and I2 serial I/O slave radio modems:

1. Stack as many Expansion Modules onto the Radio Base as necessary for your application.
2. Repeat the configuration steps for the point to multipoint master with the following exceptions in step 3:
 - i. Operation Mode: Point to Multipoint Slave
 - ii. Baud rate:
 - i. Baud rate: Must match master radio and Modbus master (PLC)
 - ii. Parity: Must match master radio and Modbus master (PLC)
 - iii. Stop bits: Must match master radio and Modbus master (PLC)
 - iii. Transmission Characteristics:
 - i. Frequency key: Must match master radio
 - ii. Slave Security: Off
3. Configure the following parameters in the "Modbus Settings"
 - i. Modbus Mode: Enabled
 - ii. Modbus Address Size: 8 Bit
 - iii. Modbus ID: 1
 - i. Each separate serial I/O slave radio must have a unique Modbus ID. Sequential addressing for each serial I/O slave radio is a logical assignment.
 - iv. Sensor Power Default: Enabled
 - i. Sensor power default applies the supply voltage of the radio to the Vsns pin for external sensing equipment (i.e. sensor power for 4-20mA sensors).
 - v. Default Delay: 10
 - i. Default delay is the number of 0.28 "ticks" that must pass after communication fails for the serial I/O slave radio modem to set the default settings to its outputs. A count of 10 means that 2.8 seconds will pass after communication fails for the I/O radio to output its defaults. A count of 100 means 28 seconds.
 - vi. Digital Out 1 Default, Digital Out 2 Default: Output OFF
 - i. Settings the default to OFF means that after communication loss occurs and the default delay elapses, the digital output will be set to OFF.
 - vii. Digital Out 1 Default, Digital Out 2 Default: Output OFF
 - i. Settings the default to OFF means that after communication loss occurs and the default delay elapses, the digital output will be set to OFF.
 - viii. AO1 Unchanged, AO2 Unchanged: Disabled
 - ix. AO1 Default Cmd, AO2 Default Cmd: 0
 - i. These settings mean that after communication loss and default delay elapses, the analog outputs will all go to 0.
4. Press the write "All" button for settings to take effect.
5. For each of the stacked Expansion Modules, select that device in the device tree and configure the following settings:
 - i. Universal Channels: Select desired functionality for each channel
 - ii. Input Channels: Select desired functionality for each channel

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- iii. Isolated Digital Inputs: Select desired functionality for each channel
- iv. Isolated Digital Outputs: Select desired functionality for each channel
 - i. In each of the separate channel tabs, additional configuration settings will appear once specific channel functionality is selected. Configure each channel as the appropriate for the application.
- v. Press the write "All" button for settings on that module to take effect.

Once configuration of all radios is complete, connect an antenna to each radio and power all devices. Upon establishing a wireless link to the master radio, the slave radio will display a solid green Carrier-Detect (CD) LED and a solid red Clear-To-Send (CTS) LED. The master radio's CTS LED will come on only when the slave radio is sending data to the master radio.

For customized network configuration information please refer to the radio specific user manual or contact FreeWave Technologies customer support. Manipulating various settings allow users to avoid noisy radio frequency spectrum, adjust frequency hopping times, add repeaters for greater network coverage and enable over-the-air diagnostics, among other benefits.

PLC Settings

The following steps provide an overview of the configuration procedure for the Modbus RTU device:

1. Obtain the MicroLogix devices that will be used to create the Modbus RTU network
2. Power up the MicroLogix and establish a connection to a PC running RSLinx and RSLogix 500.
 - i. Depending on the PLC, there are several different methods to connect to RSLinx. Best practice is to use a method that does not tie up the serial port. For this document, the connection method is via Ethernet I/P.
3. Configure the MicroLogix channel 0 port as follows:
 - i. Driver: Modbus RTU Master
 - ii. Baud: Must match point to multipoint master radio
 - i. 19,200 preferred
 - iii. Parity: Must match point to multipoint master radio
 - i. "None" preferred
 - iv. Protocol Control:
 - i. Control Line: No Handshaking
 - ii. InterChar. Timeout: 0
 - iii. Pre Transmit Delay: 0
4. Select "OK" or "Apply".
5. With the PLC, FGR2-IO-IOE and IOE-X-4422P devices configured, you will now be able to create a message instruction in the MicroLogix to either read or write to and from the FGR2-IO-IOE and/or IOE-X-4422P.

Configuring the Message Instruction in the PLC

With a the MicroLogix's serial port configured as a Modbus RTU Master, any message instruction configured to use channel 0 will automatically become a Modbus RTU message instruction. In order to read or write data to and from the FGR2-IO-IOE set the following parameters in the message instruction.

1. This Controller (MicroLogix):
 - i. Modbus Command: Dependant on data type
 - i. 1: Read Coils
 - ii. 2: Read Discrete Inputs
 - iii. 3: Read Holding Registers
 - iv. 4: Read Input Registers

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- v. 5: Write Single Coil
- vi. 6: Write Single Register
- vii. 15: Write Multiple Coils
 - 1. The FGR2-IO-IOE does not support command 15.
- viii. 16: Write Multiple Registers
 - 1. The FGR2-IO-IOE does not support command 16.
- ii. Data Table Address: Select the data table where you want the data that is to be written to or be read from in the MicroLogix PLC
- iii. Size in Elements: This is the number of elements to be transferred.
- 2. Target Device (FGR2-IO-IOE):
 - i. Message Timeout: 2
 - ii. MB Data Address: Refer to the FGRIO Modbus and Expansion Module register maps in their respective user manuals for data addresses.
 - i. Add 200 to the register address of stacked modules.
 - iii. Slave Node Address: Use the address configured in the FGR2-IO-IOE device that data is being read from or written to.

Connecting the Serial Radio Modem to the PLC

There are two basic types of physical DF1 ports on Allen Bradley devices. In both of the following connector types, only the Transmit, Receive and Ground lines are needed to establish a connection between the FGR2 radio and DF1 Full Duplex port:

1. The first DF1 port type uses a DB9 male connector (DTE type port). To connect this type of port to an FGR2 (with an RS232 port) a standard straight through connection is required.
2. The second DF1 port type uses a proprietary mini din connector. It requires an Allen Bradley PM02 cable with a DB9 female connector (DCE type port). With this cable a Null connection is required.