User Manual **MN032EN**

Effective October 2017
New information

215U-2 802.11 wireless I/O and gateway

Version 2.11

Powering Business Worldwide

Documentation note

Eaton acquired Cooper Industries in November, 2012. "Cooper Bussmann" may appear in some screen images within this guide.

⚠ ATTENTION

INCORRECT TERMINATION OF SUPPLY WIRES MAY CAUSE INTERNAL DAMAGE AND WILL VOID THE WARRANTY. TO ENSURE THAT YOUR 215U-2 WIRELESS I/O AND GATEWAY ENJOYS A LONG LIFE, CHECK THIS USER MANUAL TO VERIFY THAT ALL CONNECTIONS ARE TERMINATED CORRECTLY BEFORE TURNING ON POWER FOR THE FIRST TIME.

⚠ CAUTION

TO COMPLY WITH FCC RF EXPOSURE REQUIREMENTS IN SECTION 1.1310 OF THE FCC RULES, ANTENNAS USED WITH THIS DEVICE MUST BE INSTALLED TO PROVIDE A SEPARATION DISTANCE OF AT LEAST 20 CM FROM ALL PERSONS TO SATISFY RF EXPOSURE COMPLIANCE.

DO NOT OPERATE THE TRANSMITTER WHEN ANYONE IS WITHIN 20 CM OF THE ANTENNA. ENSURE THAT THE ANTENNA IS CORRECTLY INSTALLED IN ORDER TO SATISFY THIS SAFETY REQUIREMENT.

Avoid

- Operate the transmitter unless all RF connectors are secure and any open connectors are properly terminated
- Operate the equipment near electrical blasting caps or in an explosive atmosphere

Note: All equipment must be properly grounded for safe operations. All equipment should be serviced only by a qualified technician.

FCC notice

Part 15.19—This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Part 15.21—The grantee is not responsible for any changes or modifications not expressly approved by the party responsible for compliance. Such modifications could void the user's authority to operate the equipment.

Part 15.105(b)—This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

Note: This device should only be connected to PCs that are covered by either a FCC DoC or are FCC certified.

Manufacturer	Model number	Coax kit	Net
ELPRO	ANTMD2400-EL	Includes 5 m RG58	3 dBi gain
ELPRO	ANTWH2400-SMA	Direct mount	Unity gain
ELPRO	ANTSG2400-EL	CC3-SMA	5 dBi gain
ELPRO	ANTY2400-18EL	CC10-SMA	12 dBi gain
ELPRO	ANTZ2400-EL	CC3-SMA	8 dBi gain

Safety notices

Exposure to RF energy is an important safety consideration. The FCC has adopted a safety standard for human exposure to radio frequency electromagnetic energy emitted by FCC regulated equipment as a result of its actions in Docket 93-62 and OET Bulletin 65 Edition 97-01.

Hazardous location notices

This equipment complies with the following standards:

- IEC 60079-0:2012/A11:2013
- IEC 60079-15:2010

This equipment complies with 2014/35/EU—ATEX Directive Ex nA IIC T4 Gc –40 °C ≤ Ta ≤ +70 °C.

Special conditions

This equipment is designed to be installed in an enclosure that meets IP54.

⚠ WARNING: EXPLOSION HAZARD

DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

This equipment is suitable for use in Class 1, Division 2, Groups A, B, C and D; Tamb –40° C to +70° C or non-hazardous locations only.

This equipment shall be installed in accordance with the requirements specified in Article 820 of the National Electrical Code (NEC), ANSI/NFPA 70-2011. Section 820.40 of the NEC provides guidelines for proper grounding, and in particular specifies that the antenna ground (shield) shall be connected to the grounding system of the building, as close to the point of cable entry as practical.

This equipment shall be installed in a restricted access location, such as a dedicated equipment room or service closet.

The earth/ground terminal of this equipment shall be connected to earth ground in the equipment installation.

The external power supply installed with this equipment shall be a listed, Class 2 power supply, with a rated output between 15 Vdc and 30 Vdc, and minimum 3500 mA.

GNU free documentation license

Eaton is using a part of Free Software code under the GNU General Public License in operating the 215U-2 product. This General Public License applies to most of the Free Software Foundation's code and to any other program whose authors commit by using it. The Free Software is copyrighted by Free Software Foundation, Inc., and the program is licensed "as is" without warranty of any kind. Users are free to contact Eaton at the following email address: www.eaton.com/wireless for instructions on how to obtain the source code used for the 215U-2.

A copy of the license is included in GNU Free Document License at the end of the manual.

Important notice

ELPRO products are designed to be used in industrial environments by experienced industrial engineering personnel with adequate knowledge of safety design considerations.

ELPRO products use communications channels that are subject to noise and interference. The products are designed to operate in the presence of noise and interference, but in an extreme case noise and interference can cause product operation delays or operation failure. Like all industrial electronic products, ELPRO products can fail in a variety of modes due to misuse, age, or malfunction. We recommend that users and designers design systems using design techniques intended to prevent personal injury or damage during product operation, and provide failure tolerant systems to prevent personal injury or damage in the event of product failure. Designers must warn users of the equipment or systems if adequate protection against failure has not been included in the system design. Designers must include this Important Notice in operating procedures and system manuals.

These products should not be used in non-industrial applications, or life-support systems, without first consulting Eaton.

To avoid accidents during maintenance or adjustment of remotely controlled equipment, all equipment should be first disconnected from the 215U-2 module during these adjustments. Equipment should carry clear markings to indicate remote or automatic operation. For example: "This equipment is remotely controlled and may start without warning. Isolate at the switchboard before attempting adjustments."

Release notice

This is the September 2017 release of the 215U-2 Wireless I/O and Gateway User Manual version 2.11, which applies to firmware version 2.11.

Follow instructions

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment. Practice all plant and safety instructions and precautions. Failure to follow the instructions can cause personal injury and/or property damage.

Proper use

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (1) constitute "misuse" and/or "negligence" within the meaning of the product warranty, thereby excluding warranty coverage for any resulting damage; and (2) invalidate product certifications or listings.

Product disposal

When your product reaches the end of its useful life, it is important to take care in the disposal of the product to minimize the impact on the environment.

General instructions

The product housing is made of polycarbonate plastic (Code 7) and may be recycled through regular recycling operators in your area.

The product circuit board should be disposed according to your country's regulations for disposing electronics equipment.

Europe

In Europe, you can return the product to the place of purchase to have the product disposed in accordance with EU WEEE legislation.

Deployment of Eaton products in customer environment

There is increasing concern regarding cybersecurity across industries, where companies are steadily integrating field devices into enterprise-wide information systems. This is why Eaton has incorporated secure development life cycle in their product development to ensure that cybersecurity is addressed at all levels of development and commissioning of our products.

There is no protection method that is completely secure. Industrial Control Systems continue to be the target for attacks. The complexities of these attacks make it very difficult to have a complete secure system. A defense mechanism that is effective today may not be effective tomorrow as the ways and means of cyber-attacks constantly change. Therefore it's critical that our customers remain aware of changes in cybersecurity and continue to work to prevent any potential vulnerability of their products and systems in their environment.

At Eaton we are focusing on analyzing emerging threats and ensuring that we are developing secure products and helping our customers deploy and maintain our solutions in a secure environment. We continue to evaluate cybersecurity updates that we become aware of and provide the necessary communication on our website as soon as possible.

Eaton strongly recommends our customers to apply the deployment practices that are outlined on our Cybersecurity whitepaper "Electrical Distribution Cybersecurity considerations".

Table of contents

Introduction

Overview

The ELPRO 215U-2 Ethernet Networking I/O and Gateway is a multiple I/O node that extends communications to sensors and actuators in local, remote, or difficult to reach locations. Designed to work with wired and wireless devices, the ELPRO 215U-2 is capable of providing IP-based I/O across sprawling industrial environments typical of industrial applications.

The ELPRO 215U-2 communicates using standard 802.11 (WiFi) communications and will interoperate with existing 802.11 products and networks operating on the 2.4GHz band.

The 215U-2 can serve as an end node or network gateway and is scalable to thousands of nodes. Gather-scatter and block mapping technology offers the efficient use of network resources, allowing point-to-point transfer of process signal within complex monitoring and control systems. Integrated Modbus® server capability allows further I/O expansion through the use of ELPRO 115S expansion modules.

The module can monitor the following types of signals:

- Digital (on/off) signals, such as a contact closure or switch
- Analog (continuously variable) signals, such as tank level, motor speed, or temperature
- Pulsed signal, frequency signals, such as metering, accumulated total, or rainfall
- Internal signals, such as supply voltage, supply failure, or battery status

The modules monitor the input signals and transmit the values by radio or Ethernet cabling to another module (or modules) that have been configured to receive this information.

Input signals that are connected to the module are transmitted and appear as output signals on other modules. A transmission occurs whenever a change of state (COS) occurs on an input signal. A COS of a digital or an internal digital input is a change from "off" to "on," or a change from "on" to "off." For an analog input, internal analog input, or pulse input rate, a COS is a configurable value referred to as sensitivity. The default sensitivity is 1000 counts (3%), but you can change this value using the device's sensitivity block configuration web page.

In addition to COS messages, update messages are automatically transmitted on a configurable time basis. These updates ensure system integrity. Pulse inputs counts are accumulated and the total count is transmitted regularly according to the configured update time.

The 215U-2 modules transmit the input/output data using radio or Ethernet. The data frame includes the address of the sending module and the receiving module, so that each transmitted message is acted upon only by the correct receiving unit. Each message includes error checking to ensure that no corruption of the data frame has occurred due to noise or interference. The module with the correct receiving address will acknowledge the message with a return transmission (acknowledgment). If the original module does not receive a correct acknowledgment, it will retry multiple times before setting the communications status of that message to "fail." For critical messages, this status can be reflected on an output on the module for alert purposes. The module will continue to try to establish communications and retry each time an update or COS occurs.

The 215U-2 comes from the factory with ELPRO WIB and Modbus TCP/RTU protocols as standard. WIB protocol provides powerful enhanced features, including IP addressing, and it allows thousands of modules to exist in a system. Modbus TCP protocol provides a standards-based interface to a multitude of commercially available controls systems, including PLCs, DCS, and SCADA.

A system can be a complex network or a simple pair of modules. An easy-to-use configuration procedure allows you to specify any output destination for each input. Each 215U-2 device can have up to 19 expansion I/O modules (ELPRO 115S) connected by RS-485 twisted pair cable. Any input signal at any module may be configured to appear at any output on any module in the entire system.

The units can be configured by accessing the internal Web pages using a Web browser. See section "Connecting to the device" on **page 12** for more information.

Module structure

The 215U-2 module is made up of different interface areas with a central input and output storage area (I/O store). The I/O store is an area of memory made available for the status of the physical on-board I/O and internal I/O registers. It also provides services for other processes within the module.

The I/O store is split into eight different block types:

- Two blocks made available for bit data (discrete)
- Two blocks made available for word data (analog)
- Two blocks made available for 32-bit words data (32-bit analogs)
- Two blocks made available for floating point data (floats)

Each of these block types in turn support input and output locations that can interface with the physical I/O on the local machine and also be used for data storage when used as a gateway to external devices. These block type locations are illustrated in **Figure 1** and are described in "Register memory map" on **page 45**. There are other registers within the database that can be used for system management.

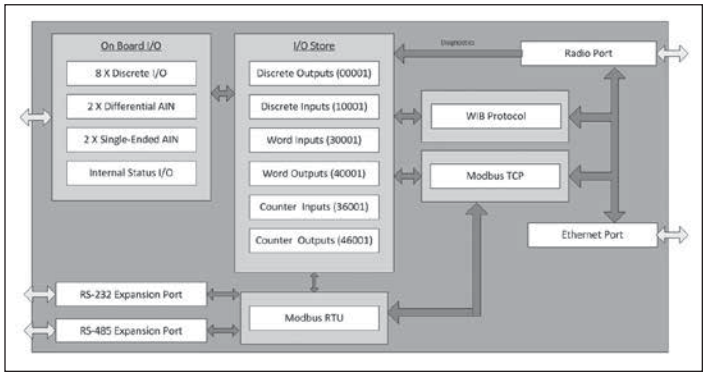


Figure 1. Module structure

The radio and Ethernet interfaces (see **Figure 1**) allow the 215U-2 to communicate with other modules within the system using a proprietary protocol called WIB. I/O Messages from other 215U-2 modules are received on the communication ports and then passed to the I/O store which will in turn update the register locations accordingly. The WIB protocol is designed to provide reliable communications suitable for an Ethernet channel or for an open license-free radio channel. It is an extremely efficient protocol for radio communications because the messages are sent using exception reporting (only transmitting when there is a change of an input signal) rather than transmitting all of the time. Update messages can also be configured at a predetermined time for integrity checks.

Each message can be comprised of multiple I/O values, referred to as a "block of I/O." The messages use error checking and return acknowledgment for greater reliability. Up to four attempts are made when transmitting the message over each hop of the radio path, and if no acknowledgment is received a Comms indication can be flagged.

The on-board I/O includes eight discrete I/O, two single-ended analog inputs, two differential analog inputs, and two current sourcing analog outputs. Each discrete I/O can function as either a discrete input (voltage-free contact input) or discrete output (transistor output). Each I/O point is linked to separate I/O registers within the I/O data store.

The following internal I/O can be accessed from the I/O store. The inputs can be used to interpret the status of a single module or an entire system:

- **Battery voltage**—The battery terminal voltage, displayed as an analog value.
- **Loop supply**—The +24 Vdc analog loop supply (ALS) used to power analog current loops, displayed as an analog value.
- **Expansion module volts**—The supply voltage of the connected expansion modules, displayed as an analog value.
- **RSSI—**The radio signal level received from the upstream device, reported as a dB level.
- **Comms Fail**—A selectable register can indicate a Communications Fail error for a particular message transmission.

The expansion port, allows 115S expansion I/O modules to be added to the module. Expansion I/O is dynamically added to the internal I/O of the 215U-2 module by adding an offset to the address.

Getting started

Most applications for the 215U-2 module require little configuration. The 215U-2 has many sophisticated features, but if you do not require these features you can use this section to configure the units quickly.

To get started quickly:

1. Read "Installation" on **page 3**, which describes the power supply, antenna/coax connections, and I/O connections.
2. Power on the 215U-2 module and set up a USB connection to your PC. For detailed steps, see "Connecting to the device" on **page 12**.

Installation

General

The 215U-2 Series modules are housed in a plastic enclosure with DIN rail mounting, providing options for up to 14 I/O points, and separate power and communications connectors. The enclosure measures 7.2" x 6.0" x 1.3" (183mm x 156mm x 33mm), including the connectors. The antenna protrudes from the top.

Power supply

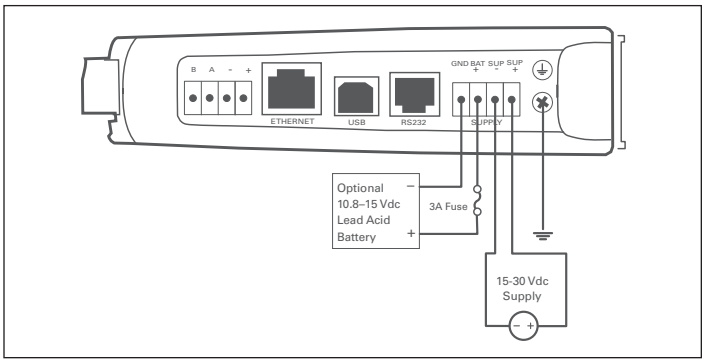


Figure 2. Supply connections

Powering from the SUP+ and SUP– terminals

The 215U-2 will operate from a 15–30 Vdc supply (nominal 24 Vdc) connected to the SUP+ and SUP– terminals. The power supply must be able to supply enough current to operate the device, to power all of the I/O circuits, and to power the device's radio transmitter when it is sending data. A 24 Vdc 2.5 A power supply such as ELPRO PSG60E or PS-DINAC-24DC-OK is suitable for all configurations, including configurations requiring battery charging and expansion I/O.

If you need to use a supply with a lower power rating; or if you need to power additional equipment in your installation; use these guidelines to determine your required power supply current. Add the relevant elements from **Table 1** to determine your power supply current requirement. Remember you also need to add current for any other equipment being powered from the same power supply, including relays, loop isolators, indicators, etc.

Table 1. Power supply current requirements

	Supply voltage		
	17 Vdc	**24 Vdc**	**30 Vdc**
Base operating current	200 mA	150 mA	120 mA
Discrete I/O (per active input or output)	11 mA	7 mA	5 mA
Analog inputs and outputs (per 20 mA loop)	55 mA	38 mA	30 mA

Connecting a back-up battery to the BAT+ and GND terminals

The 215U-2 provides an internal battery charger for Sealed Lead Acid (SLA) batteries. You can connect a 13.8 V SLA battery to the BAT+ and GND terminals to provide a backup power source if the main supply fails. While the main supply is present, the battery will charge at up to 0.5 A rate until the battery voltage reaches 14.3 V. The battery charger will then maintain a float charge on the battery at this voltage. To fully charge the SLA battery, the main supply must be at least 17 Vdc.

When you connect a backup battery, you need to provide sufficient power to support the additional charge current required when the battery is discharged (when it is recovering from an extended power interruption). **Table 2** shows the *additional* current from your power supply to support battery charging.

Table 2. Additional current to support battery charging

Supply voltage (V_{sup})	**Current required (I_{sup})**
17 Vdc	1000 mA
24 Vdc	700 mA
30 Vdc	550 mA
Formula	$I_{sup} = \frac{16.5}{V_{sup}}$

Powering expansion I/O modules

The 215U-2 allows connection of 115S Series modules to the RS-485 port to provide expanded I/O capacity. You can use the "+" and "–" connections on the 215U-2 to provide up to 500 mA supply for expansion I/O modules. If you have a back-up SLA battery connected to the 215U-2, then this connection will also be powered from the back-up supply, so that the expansion I/O modules receive the backup power as well as the main module.

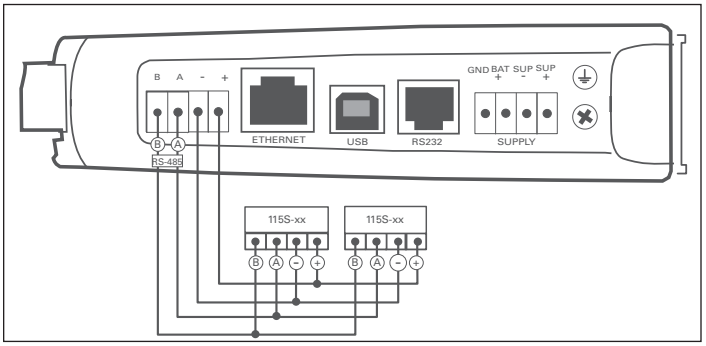


Figure 3. Expansion I/O power and RS-485

When the module is being powered from the main supply (SUP+ and SUP– terminals), you need to provide sufficient power to support the additional current required by the expansion I/O modules. **Table 3** shows the *additional* current from your power supply to support expansion I/O connection.

Table 3. Additional supply current to support expansion I/O

	Expansion I/O current (I_{exp})	**Current required (I_{sup})**		
		Supply voltage		
		17 Vdc	**24 Vdc**	**30 Vdc**
Base operating current 115S	120 mA	130 mA	90 mA	75 mA
Discrete inputs (per active input)	13 mA	14 mA	10 mA	8 mA
Discrete outputs (per active output)	25 mA	27 mA	20 mA	16 mA
Analog inputs and outputs (per 20 mA loop)	50 mA	55 mA	38 mA	30 mA
Formula	$I_{sup} = \frac{I_{exp} \times 18.4}{V_{sup}}$			

Powering the module directly from the BAT+ and GND terminals

In some situations it may be desirable to power the module directly from a 13.8 Vdc supply. This may be because this voltage supply is already available at an installation or because the power

requirements for 115S modules are more than can be supplied by the "+" and "–" expansion I/O connections.

Use **Table 4** to determine the device's current requirements at 13.8 Vdc. Remember you also need to add current for any other equipment being powered from the same power supply, including relays, indicators, and any additional 115S modules.

Table 4. Current requirements

	Supply current at 13.8 Vdc
Base operating current	230 mA
Discrete I/O (per active input or output)	10 mA
Analog inputs and outputs (per 20 mA loop)	50 mA

Internal I/O

The internal supply voltage register locations shown in the following table can be monitored using the Diagnostics Web page within the module's Web-based configuration utility (see "Product Reconfiguration" on **page 36** for details). The values can also be mapped to a register or an analog output on another module within the network.

Table 5. Internal supply voltage registers

Register	Description
30005	Local supply voltage (0–40 V scaling).
30006	Local 24 V loop voltage (0–40 V scaling). Internally generated +24 V supply used for analog loop supply. Maximum current available is 100 mA.
30007	Local battery voltage (0–40 V scaling).
30008	115S supply voltage (0–40 V scaling).
38005–38008	Floating point registers that display the actual supply voltage, battery voltage, +24 V supply, and 115S supply. Note that these are actual voltage values, whereas registers 30005–30008 display a number between 8192 and 49152 that represents the voltage scale 0–40 V.

To calculate the supply voltages from the register value use the following calculation:

$$\text{Volts} = \frac{(\text{Register Value}) - 8192}{1024}$$

High and low voltage alarm indication may be configured for each of these supply voltages. See "Analog inputs" on **page 9** for details on how to configure these alarms.

Grounding

To provide maximum surge and lightning protection each module should be effectively earthed/grounded via a GND terminal on the module. This is to ensure that the surge protection circuits inside the module are effective. The module should be connected to the same common ground point as the enclosure ground and the antenna mast ground.

The 215U-2 has a dedicated earth/ground connection screw on the bottom end plate next to the supply terminals. All earth/ground wiring should be minimum 0.8 in^2 (2 mm^2), 14 AWG. If using the 215U-2 with serial expansion I/O modules, all expansion modules must have a separate earth/ground connection from the front terminal back to the common earth or ground point. See **Figure 4**.

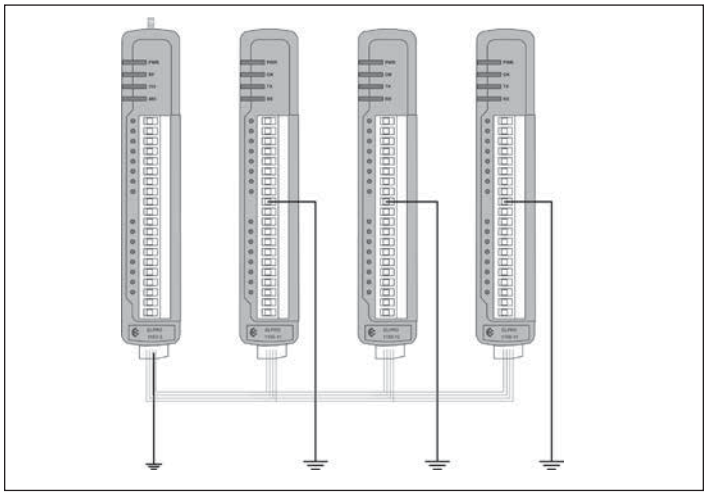


Figure 4. Grounding

Antennas

Antennas can be either connected directly to the module's RF connector or connected via 50-ohm coaxial cable (such as RG58 Cellfoil or RG213) terminated with a male SMA coaxial connector. The higher the antenna is mounted, the greater the transmission range, but as the length of coaxial cable increases so do cable losses.

The net gain of an antenna and cable configuration is the gain of the antenna (in dBi) less the loss in the coaxial cable (in dB). Maximum net gain for the 215U-2 will depend on the licensing regulation for the country of operation and the operating frequency.

Typical antennas gains and losses are:

Table 6. Typical antennas gains and losses

Antenna	Gain (dBi)
Dipole	2 dBi
Collinear	5 or 8 dBi
Directional (Yagi)	6–15 dBi
Cable type	**Loss at 2.4GHz**
RG58 cellfoil cable kits (3 m,10 m, 20 m)	-1.8dB, -6dB, -12dB
RG213 per 10 m (33 ft)	-4dB
LDF4-50 per 10 m (33 ft)	-2.2dB

The net gain of the antenna and cable configuration is determined by adding the antenna gain and the cable loss. For example, an 8 dBi antenna with 10 meters of Cellfoil (–6 dB) has a net gain of 2 dB (8 dB – 6 dB).

Dipole and Collinear antennas

Dipole and collinear antennas transmit the same amount of radio power in all directions, and are easy to install and use because they do not need to be aligned to the destination. The dipole antenna does not require any additional coaxial cable. However, a cable must be added if using any of the other collinear or directional antennas. In order to obtain the maximum range, collinear and dipole antennas should be mounted vertically, preferably at least one wavelength away (see **Figure 8** for distances) from a wall or mast and at least 3 ft (1 m) from the radio module.

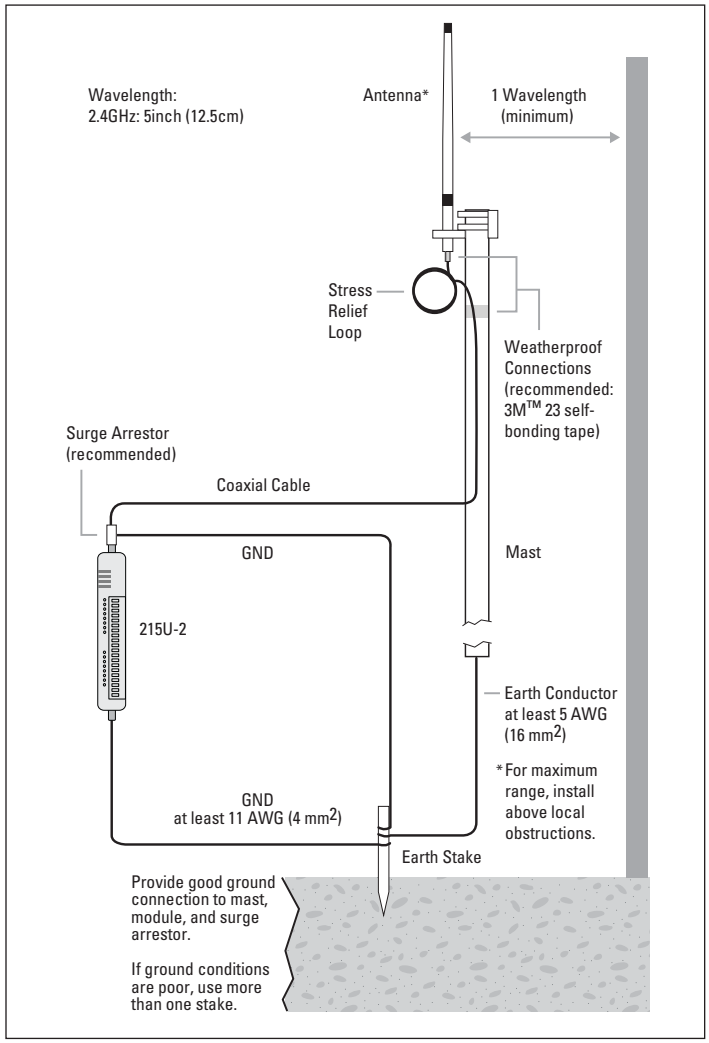


Figure 5. Antennas installation—Collinear/Dipole

Directional antennas

A directional antenna provides high gain in the forward direction, but lower gain in other directions. This type of antenna may be used to compensate for coaxial cable loss for installations with marginal radio path. Directional antennas can be any of the following:

- Yagi antenna with a main beam and orthogonal elements
- Directional radome, which is cylindrical in shape
- Parabolic antenna

Yagi antennas should be installed with the main beam horizontal, pointing in the forward direction. If the Yagi antenna is transmitting to a vertically mounted omni-directional antenna, the Yagi elements should be vertical. If the Yagi is transmitting to another Yagi, the elements at each end of the wireless link need to be in the same plane (horizontal or vertical).

Directional radomes should be installed with the central beam horizontal, and must be pointed exactly in the direction of transmission to benefit from the gain of the antenna.

Parabolic antennas should be mounted according to the manufacturer's instructions, with the parabolic grid at the back and the radiating element pointing in the direction of the transmission.

Ensure that the antenna mounting bracket is well connected to ground.

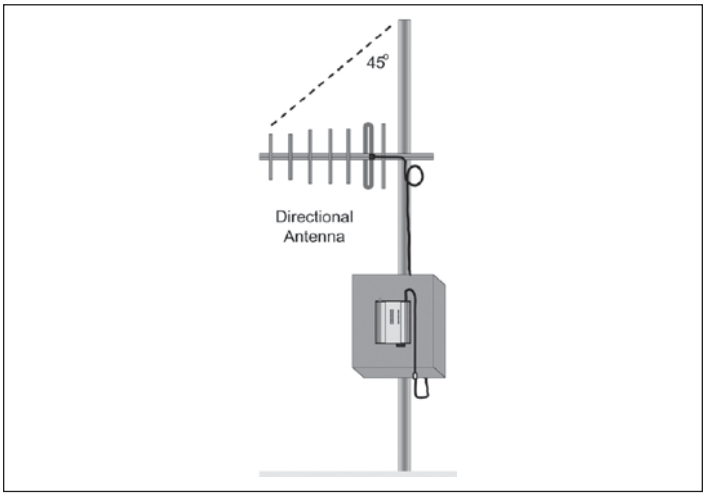


Figure 6. Directional antenna

Installation tips

Connections between the antenna and the coaxial cable should be carefully taped to prevent ingress of moisture. Moisture ingress in the coaxial cable is a common cause for problems with radio systems because it greatly increases the radio losses. We recommend that the connection be taped—first with a layer of PVC tape, next with vulcanizing tape (such as 3M™ 23 tape), and finally with another layer of PVC UV-stabilized insulating tape. The first layer of tape allows the joint to be easily inspected when troubleshooting because the vulcanizing seal can be easily removed (see **Figure 10**).

Where antennas are mounted on elevated masts, the masts should be effectively grounded to avoid lightning surges. For high lightning risk areas, approved ELPRO surge suppression devices, should be fitted between the module and the antenna. The surge supression must have a "turn on" voltage of between 10 and 20V. If the antenna is not already shielded from lightning strike by an adjacent grounded structure, a lightning rod may be installed above the antenna to provide shielding.

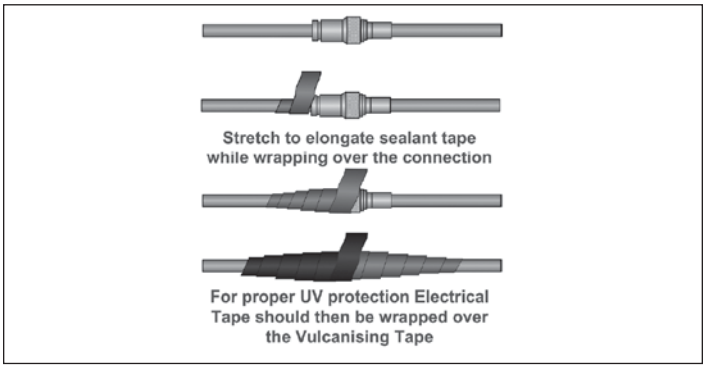


Figure 7. Vulcanizing tape

Connections

Bottom panel connections

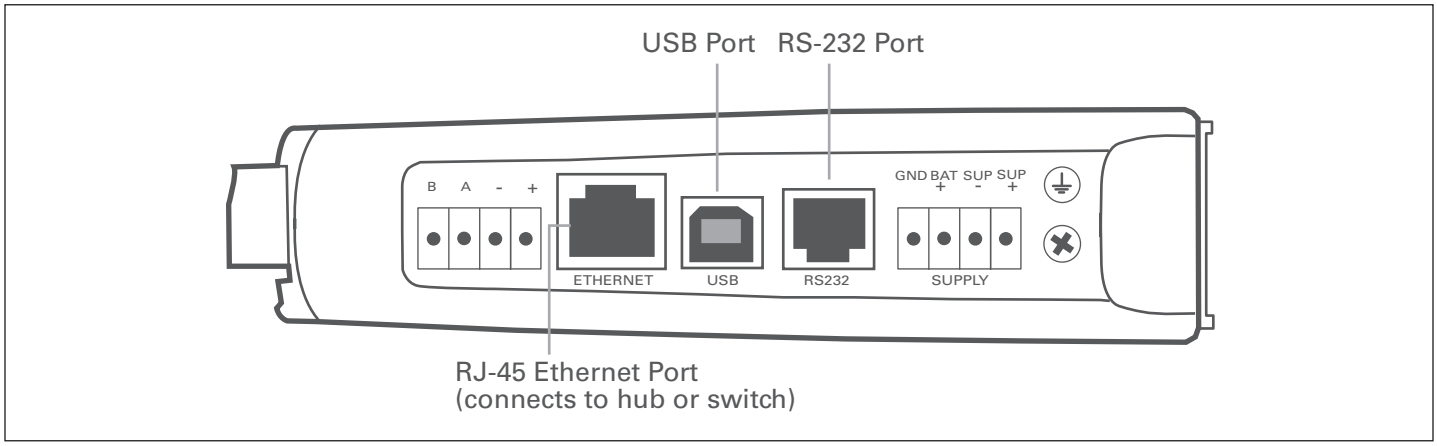


Figure 8. Bottom panel connections

Ethernet port

The 215U-2 modules provides a standard RJ-45 Ethernet port compliant to IEEE 802.3 10/100Base-T. This port provides full access to the module, including configuration, diagnostics, log file download, and firmware upload of both the local and remote units. Additionally, the Ethernet port can provide network connectivity for locally connected third-party devices with Ethernet functionality.

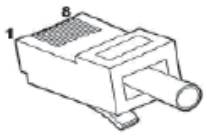
USB device port for configuration

The 215U-2 module also provides a USB device (USB-B) connector. This connector provides configuration of the device and remote configuration access to other devices in the radio network.

RS-232 port

The 215U-2 module provides an RS-232 serial port that supports operation at data rates up to 230,400 baud. This port supports Modbus protocol. The RS-232 port is accessed using an RJ-45 connector wired as a DCE according to the EIA-562 Electrical Standard.

Table 7. RJ-45 connector

RJ-45	Signal	Required	Signal name	Connector
1	RI	—	Ring Indicator	
2	DCD	—	Data Carrier Detect	
3	DTR	Y	Data Terminal Ready	
4	GND	Y	Signal Common	
5	RXD	Y	Receive Data (from module)	
6	TXD	Y	Transmit Data (to module)	
7	CTS	—	Clear to Send	
8	RTS	—	Request to Send	

RS-485 port with Modbus support

The 215U-2 module provides an RS-485 serial port that supports operations at data rates up to 230,400 baud. The default baud rate is 9600 baud, no parity, 8 data bits and 1 stop bit, which matches the 115S serial expansion module default settings. This port supports the Modbus protocol.

The RS-485 port terminal is hosted on the four-way expansion connector on the bottom edge of the module. An on-board RS-485 termination resistor provides line termination for long runs. As a general rule, termination resistors should be enabled at each end of the RS-485 cable. When using 115S expansion I/O modules, remember to enable the RS-485 termination resistor switch that is located on the end module.

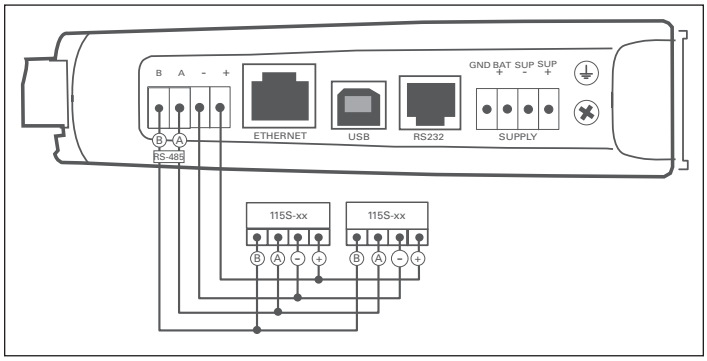


Figure 9. RS-485 connections

Side access configuration panel

A small access panel on the side of the module hides a factory boot switch, USB host port, and a small bank of DIP switches that are used for analog input voltage and current selection, external boot, and default configuration settings. Use a screw-driver to free the latch to open the access panel.

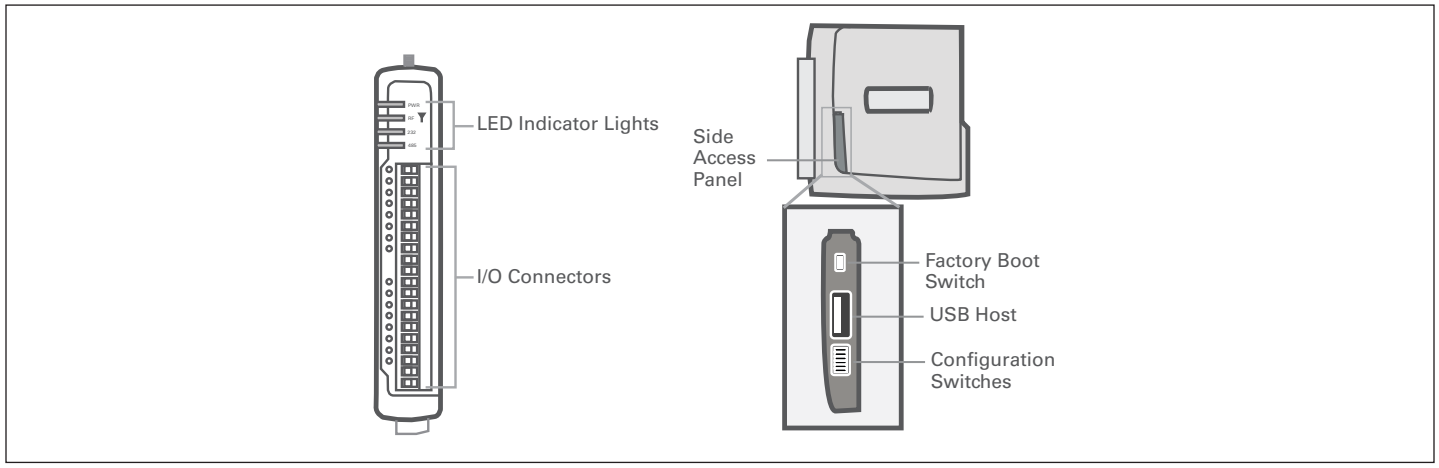


Figure 10. Access panel

Factory boot switch

The factory boot switch is used for factory setup and diagnostics. This switch should only be used if advised by ELPRO technical support.

USB host port

This port is a USB host (master port) that can interface with USB storage devices for upgrading the module firmware and for uploading logged data files. For details, see "To perform a full firmware upgrade using USB flash drive" on **page 53**. Also see "Data logging" on **page 38**.

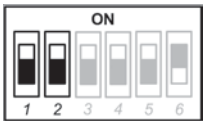
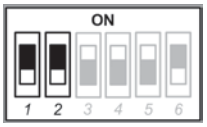
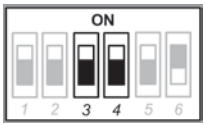
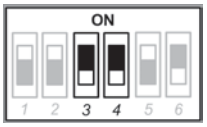
DIP switches

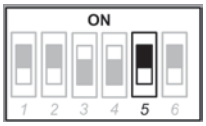
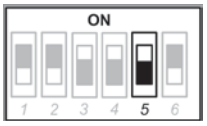
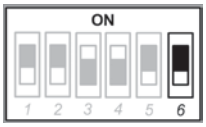
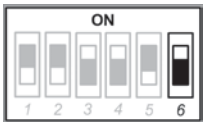
The DIP switches are used to select a number of functions within the module, as shown in the following table.

- **DIP switches 1 to 2**—Used for measuring current or voltage on analog input 3. Set DIP switches to "on" to measure current (0–20 mA) and "off" for voltage (0–5 Vdc).
- **DIP switches 3 to 4**—Used for measuring current or voltage on analog input 4. Set DIP switches to "on" to measure current (0–20 mA) and "off" for voltage (0–5 Vdc).
- **DIP switch 5**—Not used.
- **DIP switch 6**—When set to "on" (enabled) and the module is restarted, the module boots up with a known factory default configuration, including a default IP address for the Ethernet connection. See "Connecting to the module" on **page 13**.

Note: When DIP switch 6 is "on," radio and I/O functionality is disabled.

Table 8. Switch functions

Switch	Function	Current	Voltage
DIP 1 and 2	Analog input 3		
DIP 3 and 4	Analog input 4		

Switch	Function	Disabled	Enabled
DIP 5	Not used		
DIP 6	Setup mode		

Front panel connections

The front panel on the 215U-2 module provides connections for the following:

- Eight digital input/output (DIO 1–8)
- Two 12-bit, 0.1% accuracy differential analog inputs
- Two single-ended 12-bit, 0.1% accuracy analog inputs
- Two 13-bit, 0.1% accuracy current sourcing analog outputs
- Connection terminals for common and +24 V analog loop supply (ALS); maximum ALS current limit is 100 mA

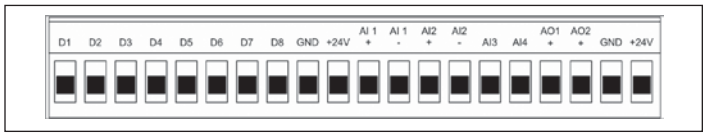


Figure 11. Front panel connections

Digital or pulsed inputs

Each digital I/O channel on the 215U-2 module can act as either an input or an output. The input/output direction is automatically determined by the connections and configuration of the I/O. If you have an I/O channel wired as an input but operate the channel as an output, no electrical damage will occur but the I/O system will not operate correctly. If you are operating the channel as an output and you read the corresponding input value, it will indicate the status of the output.

Marked D1–8, the digital inputs share the same terminals as the digital outputs on the 215U-2 module. A digital input is activated by connecting the input terminal to GND or common, either by voltage-free contact, TTL level, or transistor switch. Each digital input has an orange indication LED that will turn on when the input has been connected to a GND.

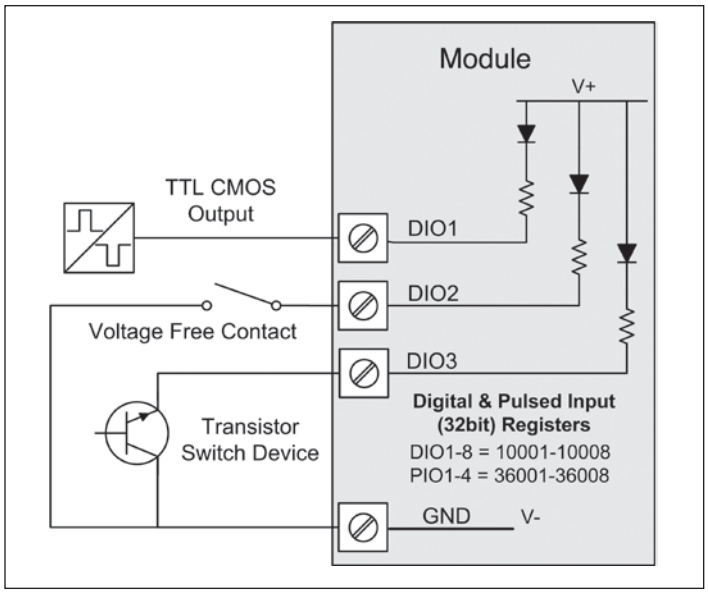


Figure 12. Digital/pulsed input wiring

Digital inputs 1–4 can be used as pulsed inputs. The maximum pulse frequency is 50 kHz for input 1 and 2, and 1 kHz for input 3 and 4. Digital/pulsed inputs are suitable for TTL signal level, NPN-transistor switch devices, or voltage-free contacts (a relay or switch with debounce capacitor).

Frequencies greater than 1 kHz need to use a TTL logic drive or an external pull-up resistor (1 KΩ to V+). Pulsed inputs are converted to two different values internally. The first value is the pulse count, which is an indication of how many times the input has changed state over a configured time period. The second value is a pulse rate, which is an analog input derived from the pulse frequency. For example, 0 Hz = 4 mA and 1 kHz = 20 mA.

All pulsed input counts are stored in non-volatile memory, so that the values are saved in the event of a power failure or a module reset.

Digital outputs (pulsed outputs)

Digital outputs are open-collector transistors, and are able to switch loads up to 30 Vdc, 200 mA. The eight digital outputs share the same terminals as the digital input. These terminals are marked D1–8.

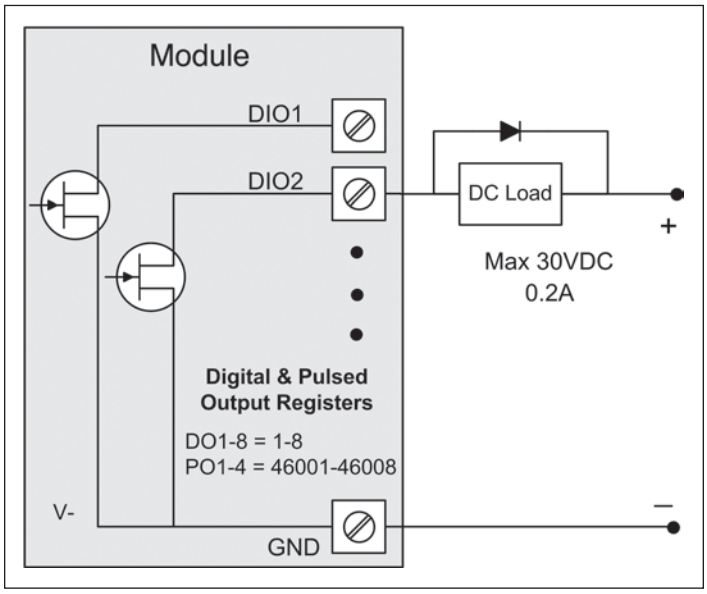


Figure 13. Digital pulsed output wiring

When active, the digital outputs provide a transistor switch to EARTH (Common). To connect a digital output, see **Figure 13**. A bypass diode (IN4004) is recommended to protect against switching surges for inductive loads such as relay coils. The digital channels D1–4 on the 215U-2 module can be used as pulse outputs with a maximum output frequency of 10 kHz.

Digital output fail-safe status

In addition to indicating the digital output status (on or off), the LEDs can also indicate a communications failure by flashing the output LED. This feature can be used by configuring a fail-safe time and status via the I/O Digital Output screen in the MConfig utility.

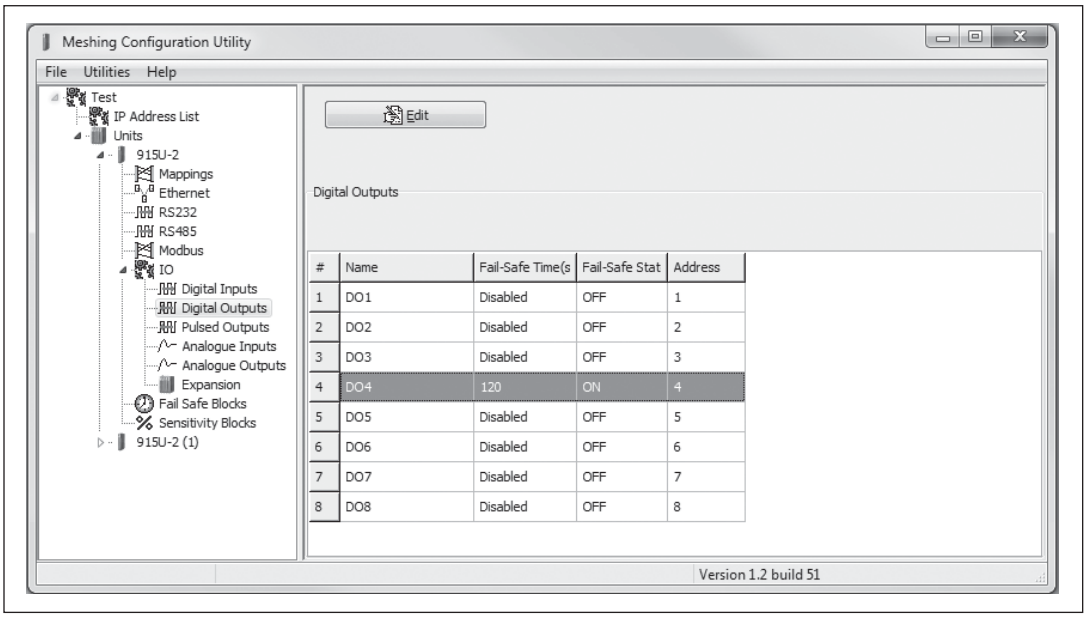


Figure 14. Digital output fail-safe times

The fail-safe time is the time the output counts down before activating a fail-safe state. Normally this would be configured for a little more than twice the update time of the mapping that is sending data to it. This is because the fail-safe timer is restarted whenever it receives an update. If you send two successive updates and fail to receive both of these messages, the timer counts down to zero and activates the fail-safe state. If the fail-safe state is enabled (on), the LED flashes briefly off and the digital output turns on. If the fail-safe state is disabled (off), the LED flashes briefly on and the digital output turns off.

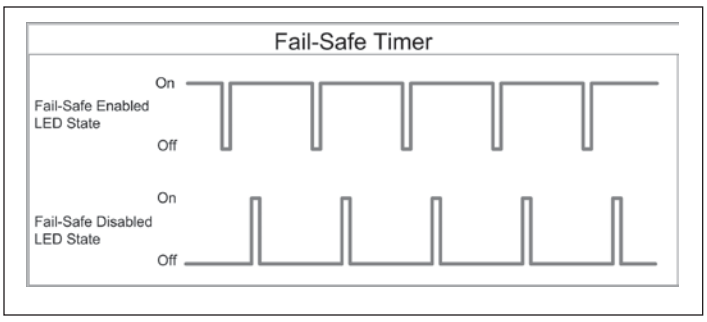


Figure 15. Fail-safe state

Analog inputs

The 215U-2 module provides two floating differential analog inputs and two grounded single-ended analog inputs. Analog inputs 1 and 2 will automatically measure current (0–20 mA) or voltage (0–25 V), depending on what is connected to the input. Analog inputs 3 and 4 must be configured to measure current (0–20 mA) or voltage (0–5 V) via the DIP switches on the configuration panel (see "Side access configuration panel" on **page 7**).

An internal 24 V analog loop supply (ALS) provides power for any current loops with a maximum current limit of 100 mA. The LEDs have an analog diagnostic function and will indicate the status of the input. The LED comes ON when any analog signal is detected, and will go OFF when the analog signal drops to zero.

Note: By default, there is a one-second delay on the input because of the filter. Filter times can be changed using the Analog Input screen within the MConfig utility. For more information, see "Analog inputs" on **page 9**.

The LEDs next to AI1+, AI2+ indicate the current on these inputs. The LEDs next to AI1– and AI2– indicate the voltage on the analog inputs.

Differential current inputs

Only analog input 1 and 2 can be wired as differential Inputs. Differential mode current inputs should be used when measuring a current loop, which cannot be connected to ground. This allows the input to be connected anywhere in the current loop. Common mode voltage can be up to 27 Vdc.

Figure 16 indicates how to connect loop-powered or externally powered devices to the 215U-2 differential analog inputs. It should also be noted that the differential inputs can also be used to connect single-ended current sinking or current sourcing devices. **Figure 18** shows how to connect to these types of devices.

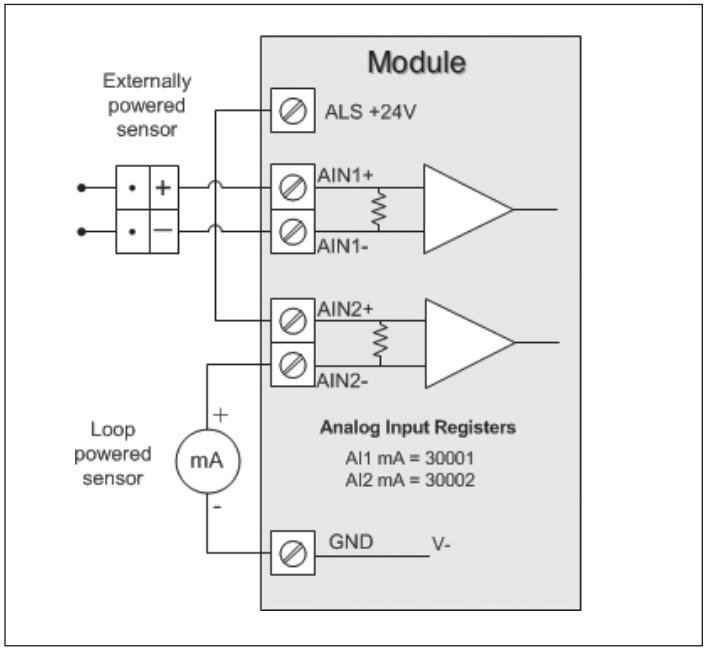


Figure 16. Differential current inputs (AI1 and AI2)

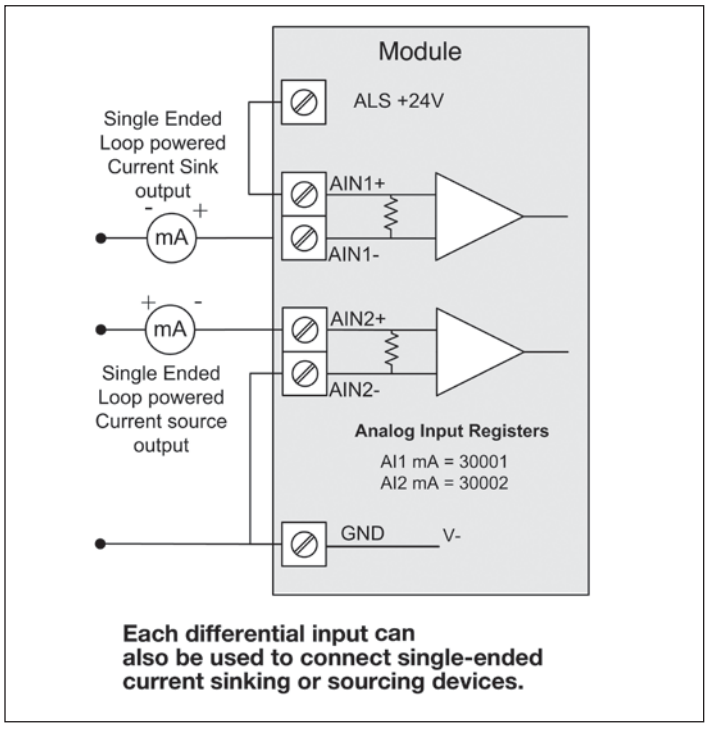


Figure 17. AI1 and AI2 single-ended current inputs

Single-ended current input mode is useful if the sensor loop is grounded to the 215U-2 module. Devices can be powered from the 24 V analog loop supply (ALS) generated internally from the module.

The DIP switches (located in the side access panel) are used to determine if the inputs will be current or voltage. DIP switches 1 and 2 are used for analog 3, and DIP switches 3 and 4 are used for analog 4. For current, set both DIP switches to the "on" position. For voltage, set both to "off."

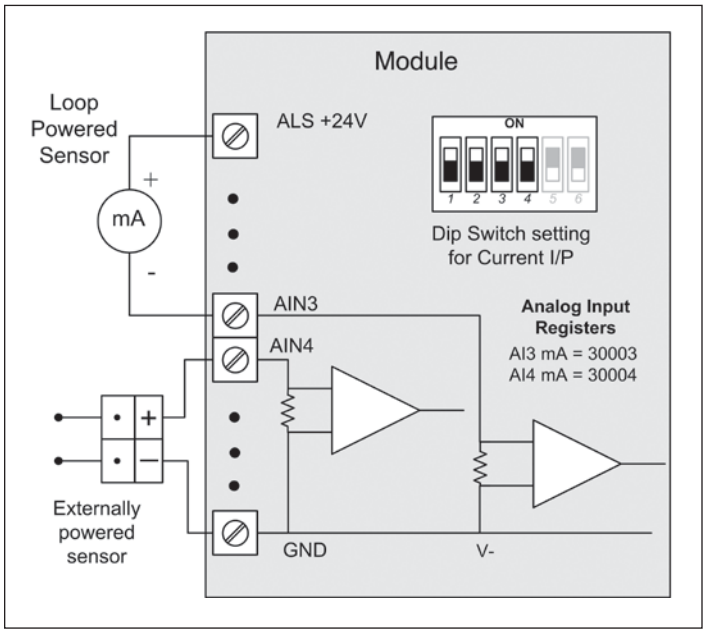


Figure 18. AI3 and AI4 Single-ended current inputs

Voltage inputs

All analog inputs can be set up to read voltage. If using analog input 1 and 2, connect the voltage source across the positive terminal of the input and ground. If using analog input 3 and 4, connect across the input terminal and GND.

Note: Default scaling gives 0–20 V for 0–20 mA output on analog 1 and 2. Default scaling for analog 3 and 4 gives 0–5 V for 0–20 mA output. For voltage input on analog 3 and 4, set both DIP switches to the OFF position.

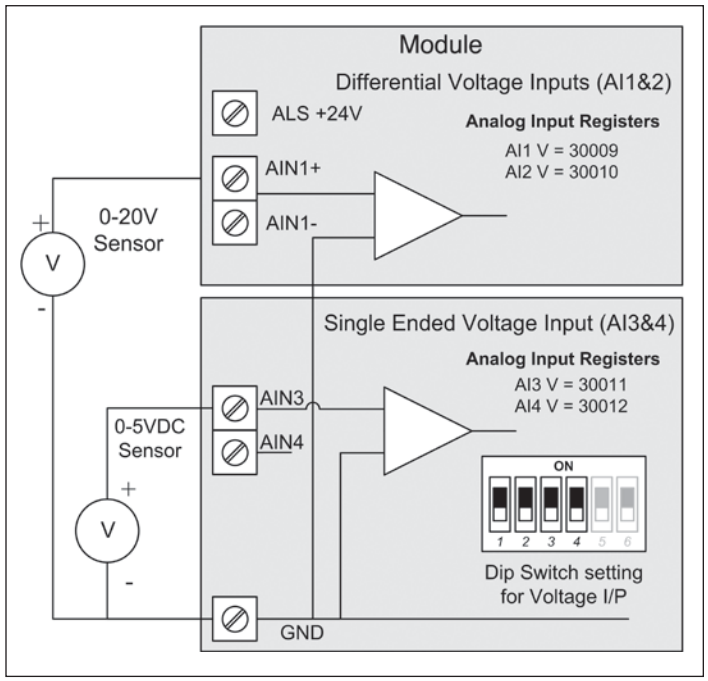


Figure 19. Single-ended voltage inputs

Analog outputs

The 215U-2 module provides two 0–24 mA DC analog outputs for connecting to analog inputs on equipment (such as PLCs, DCS, and loggers) or connecting to instrument indicators for displaying remote analog measurements. The 215U-2 analog outputs are a sourcing output and should be connected from the analog output terminal through the device or indicator to ground (GND). See **Figure 20** for connections. The LEDs provide level indication depending on current. The LEDs appear dimmed for 4 mA and bright for 20 mA.

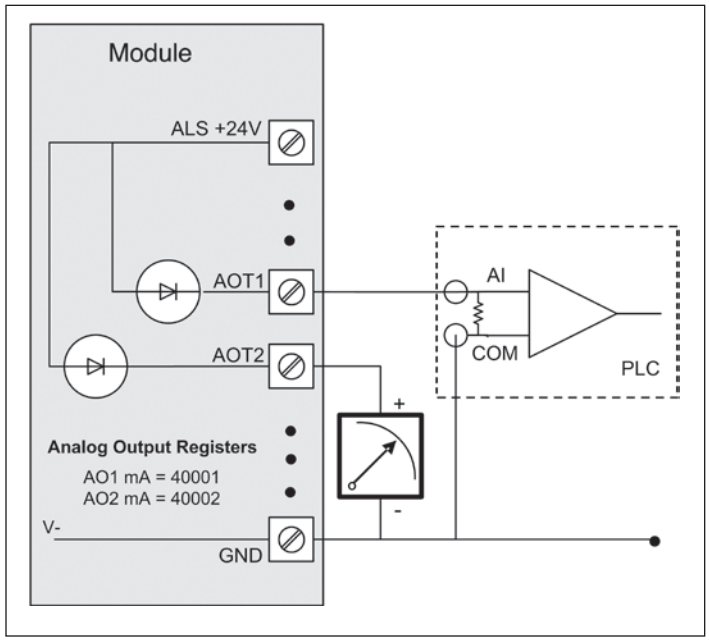


Figure 20. Analog outputs

System design

Design for failures

All well-designed systems consider system failure. I/O systems operating on a wire link will fail eventually. Failures can be short-term, such as interference on the radio channel or power supply failure, or long-term, such as equipment failure.

The modules provide the following features for system failure:

- Outputs can reset if they do not receive a message within a configured time. If an output should receive an update or change message every 10 minutes and it has not received a message within this time, some form of failure is likely. If the output is controlling machinery, it is good design to switch off the equipment until communications are re-established.
- The modules provide a fail-safe feature for outputs. This is a configurable time value for each output. If a message has not been received for this output within the configured time, the output will assume a configured value. We suggest that this reset time be a little more than twice the update time of the input. It is possible to miss one update message because of short-term interference. However, if two successive update messages are missed, long term failure is likely and the output should be reset. For example, if the input update time is three minutes, set the output reset time to seven minutes.
- A module can provide an output that activates on communication failure to another module. This can be used to provide an external alarm indicating that there is a system fault.

Testing and commissioning

We recommend that the system is fully bench tested before installation. It is much easier to find configuration problems on the bench when the modules are next to each other as opposed to being miles apart. When the system is configured and you are confident that it works, back up the configurations of all modules.

Connecting to the device

To configure the 215U-2 you connect to it using a web browser on your PC or mobile device.

Connecting to the module for the first time

On first connection, you can only connect to the device through its USB port. Once you have connected to the device for the first time, you can enable access through the Ethernet port and remotely through the 802.11 Wireless port.

Note: Before enabling the Ethernet Port or Wireless port for Configuration access, read the section "Device Security".

Connecting to the device's USB port

The USB port is located on the bottom side of the module. (Refer **Figure 11** "Bottom Panel Connections"). To connect, you need an USB cable (USB-A to USB-B) for connecting from your computer to the module's USB-B port.

If this is the first time you have used your computer to connect to an ELPRO device through the USB port, then you will need to download the USB driver file from the product's internet website. This is available from the same location that you downloaded this user manual.

You will also need to know the username/password configured for the device. If the module is new out-of-the-box you can use the default settings. Otherwise, you may need to restore these settings. If you have lost the password, you can set the username and password back to the default values. For instructions, see "Restoring the factory default connection settings" on **page 42**.

1. Install the USB Device driver to your PC. You do this by running the installer ".exe" file and following the prompts.
2. Power on the device, and wait for the device to finish booting and for the "PWR" LED to go solid green (about 1 minute).
3. Plug in the USB cable and wait for your computer to recognize the new USB device.
4. Once the device is connected, you will have an additional Network Adapter in your device manager list

   "Elpro 215U-2 USB Ethernet/ RNDIS Interface"
5. Open your web browser (recommended Internet Explorer version 10 or later) and type "http://192.168.111.1" into the browser bar. The device's USB address is always the same.

   The module responds with a username and password box.
6. Type the username and password. The default username is "user" and the default password is "user".

This connects you to the home page of the Web-based configuration utility (see **Figure 21**). This utility allows you to manage wireless connection links between all modules in the system through a standard browser, such as Microsoft® Internet Explorer®.

Connecting to the Device's Ethernet port

The Ethernet port is located on the bottom side of the module. (Refer **Figure 8** "Bottom Panel Connections"). To connect, you need an Ethernet cable for connecting to the module's Ethernet port. You also need to know the device's IP Address and the username/ password configured for the device.

The module's default settings are as follows:

IP Address	192.168.0.1XX (shown on the printed label on the side of the module)
Subnet Mask	255.255.255.0
User Name	user
Password	user

Note: You cannot access the device through Ethernet until remote access has been enabled. The first time you access the device, you need to use the USB method described above. Then you can enable remote access on the quick start configuration page.

Once you have the device's IP address and password:

1. Connect an Ethernet cable between the module's Ethernet port and the PC.
2. Configure your PC networking settings to be on the same network as the device. For instructions on how to do this, see "Configuring PC networking settings for Ethernet and Wireless" on **page 42**.
3. Open your web browser (recommended Internet Explorer version 10 or later) and type "http://" followed by the IP address of the module and press Enter.

   The module responds with a username and password box.

   If the module does not respond, check that you have configured your PC according to the section "Configuring PC networking settings for Ethernet and Wireless" on **page 42**.
4. Type the username and password. The default username is "user" and the default password is "user".

This connects you to the home page of the Web-based configuration utility (see **Figure 21**). This utility allows you to manage wireless connection links between all modules in the system through a standard browser, such as Microsoft® Internet Explorer®.

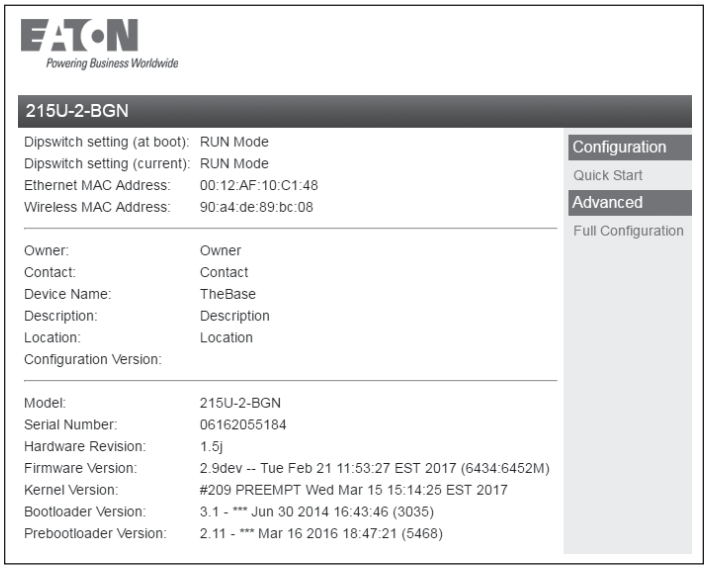


Figure 21. Device home page

Device Security

The 215U-2 supports industrial protocols such as Modbus and WIB that do not provide encryption or authentication. These protocols are convenient to use as they are widely known and supported by an extensive range of equipment.

The downside of using these protocols is that they are also vulnerable to a variety of cyber-attacks, so you must consider the security of the networks that they operate over.

As a precaution, these protocols are disabled in the default configuration. Before enabling any of these protocols, you should ensure that the following precautions are in place.

- Change the device's access password from the default ("user").
- Make sure that any network connected to the device's Ethernet port is secured from outside access. If an internet connection is present, ensure it is effectively firewalled.
- Secure the radio network using WPA-PSK encryption.
- Ensure that the radio network encryption passphrase is long (at least 20 characters) and complex. Quality of security assurance offered depends on the complexity of this passphrase. Short and simple passphrases can easily be compromised by skilled attackers.
- Ensure that knowledge of the radio network encryption passphrase is kept to a limited number of workers and ensure the access password and radio passphrase are changed whenever any of these workers' security status changes.
- Ensure physical security of the devices connected to the network.
- In the event that a device is lost or stolen, ensure that the encryption key used to secure communications on the radio network is changed.

Quick start configuration

Access the quick start configuration by clicking on the "Quick Start" text on the right side menu under "Configuration".

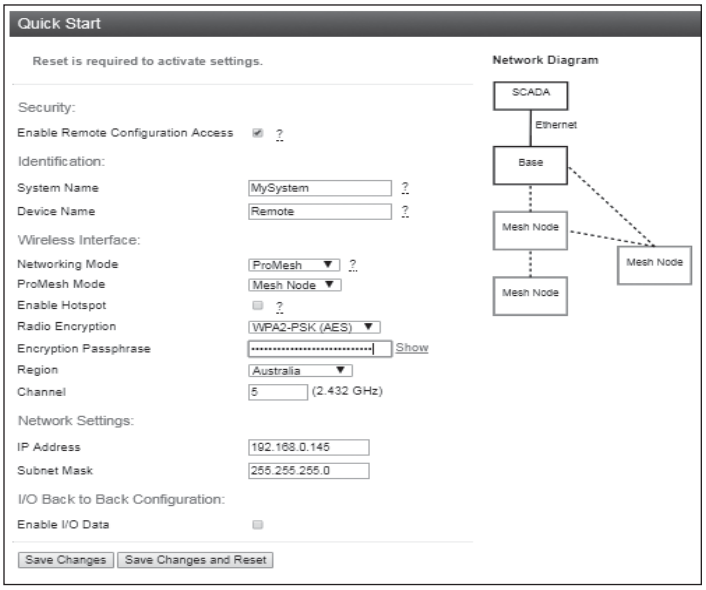


Figure 22. Quick start

- For the majority of installations, you will only need to access this Quick Start page. This configuration will get your devices connected and communicating. You can then connect remotely if you need to configure other functionality.
- Click "Full Configuration" to access advanced configuration pages. These pages provide access to additional functionality including Peer-to-Peer I/O mapping, Serial port configuration, Data Logging, Advanced networking configuration, diagnostics, and User management. These pages are described later in this manual.
- If your system is based on Modbus TCP protocol, you need to enable Modbus TCP Server by selecting Full Configuration >> Modbus TCP and checking "Enable Modbus TCP Server". Once you have the device configured, you will be able to access it using a Modbus TCP client (Master) at the IP address you configure.

Note: Before navigating away from this page, you need to click the "Save Changes" or "Save Changes and Reset" button at the bottom of the page. Otherwise your changes will be lost.

Security

Enable Remote Configuration Access: Select this to enable access to the device configuration and the dashboard web pages through Ethernet or Wireless interfaces. If this is not selected, you can only access the device web pages through the USB connection.

Identification

System Name: All devices in a system are configured with a common system name. This is used in ProMesh mode as a common network ID for all devices to connect.

Device Name: Each device in the system should be configured with a unique device name. This name is used to identify devices in diagnostic display (Connectivity) and is used in Fixed Link mode as the device ID for other devices to connect to.

Wireless Interface

Networking Mode: You can choose one of three networking modes depending on your system requirements:

- **Manual Mode** implements traditional 802.11 networking configuration. You configure units as Access Point or Client. Client units connect to an Access Point with matching SSID (System Address).
- **ProMesh Mode** implements automatic repeater configuration, where devices (Mesh Node) automatically choose and maintain the best path back to a central station (Base). All devices in the network use a common SSID (System Name).
- **Fixed Links Mode** implements a fixed repeater configuration where field devices (Remote) are configured to connect directly or via intermediate sites (Repeater) to a central station (Base).

802.11 Mode: This option is available when the Networking mode is set to Manual. A traditional 802.11 network has a single Access Point and one or more Clients.

- **System Address (ESSID):** This is the "Extended Service Set Identification" used in 802.11 mode. For a client to connect, the client needs to have this set to the same value configured on the Access Point.

ProMesh Mode: This option is available when the Networking Mode is set to ProMesh. A ProMesh network consists of a single central station (Base), and one or more remote sites (Mesh Nodes) which can each operate as a repeater for other stations.

The Mesh Nodes select the best path to the Base depending on the number of hops to the base, and based on signal strength of the hops in the path. Once connected, the Mesh Nodes monitor the path quality and will swap to use a better path if one comes available.

All devices in a ProMesh network share the same SSID (the configured "System Name").

- **Enable Hotspot:** This option is only available for Mesh Nodes in a ProMesh network. Because the ProMesh is designed to be flexible, the Mesh Nodes devices may not always advertise for a connection. If you want to be able to connect from a non ProMesh device to one of the Mesh Nodes, then select this option on that Mesh Node to ensure it remains available for connection.

Device Mode: This option is available when the Networking mode is set to "Fixed Links". A Fixed Link network consists of a central station (Base) accessing a fixed arrangement of repeater stations (Repeater) and remote stations (Remote). All devices ultimately connect to the central station (Base). Repeaters and remotes can either connect directly to the base, or connect using additional repeater stations to extend the radio range.

- **Upstream Device Name:** When the Device Mode is "Repeater" or "Remote", you need to select the Upstream device. When the connection is direct to the base, this is the Device Name of the base station. When the connection is via repeaters, this is the name of the repeater station that is used to reach the base station.

Radio Encryption: Select the desired Encryption mode. Normally this should be WPA2-PSK (AES), which is the strongest encryption available. Only select other modes if you need to do this to connect to a third party or legacy system that does not support WPA2 protocol.

Note: Selecting Encryption "None" or "WEP" makes your network vulnerable to attack. This product makes use of standard 802.11 physical signaling, so without encryption there is no protection from attackers with off-the-shelf hardware. Selecting WEP provides very limited protection from attack. WEP protocol has known weaknesses that make it relatively simple to penetrate.

Encryption Passphrase: This is the secret key for your network encryption. All devices in the network need the same passphrase to communicate.

Note: For best security, this passphrase must be long (at least 20 characters) and should not include text that could be guessed such as names, dates, etc.

Note: Always keep this passphrase private, and ensure that the system configuration is updated with a new passphrase if this key becomes compromised.

Region: The module is configured from the factory to allow operation globally. To take advantage of additional radio channels and higher allowed power in some countries, you can select a different region. The power is automatically set to the maximum for the selected region. Refer to the table below for the maximum radiated power in different regions. You can adjust the power on the Radio page ("Full Configuration >> Radio" on right side menu) to accommodate higher gain antennas if needed. Note that every time you change the Region selection, the power setting reverts to the maximum for that region.

Table 9.

Region	Allowed channels	Power setting	Maximum EIRP
North America	1-11	23 dBm (200mW)	+36 dBm
Europe	1-13	20 dBm (100mW)	+20 dBm
Australia	1-13	23 dBm(200mW)	+36 dBm

Channel: You can select a radio channel to avoid interference from other 802.11 networks in your area, or to allocate radio spectrum between several of your own networks. For 802.11 communication, channels 1,6, and 11 are non-overlapping.

Network settings

IP Address: This selects the IP address for the device. You can leave this at the default value, which is printed on the module side label. If you chose to do this, take care that you don't have two modules with the same IP address assigned (The default IP address is assigned from the factory based on the last two digits of the device serial number).

Subnet Mask: The subnet mask identifies how the IP address is divided between the local device address and the global network address. The default subnet mask of 255.255.255.0 allocates 24 bits to the network address, and 8 bits for the host device. This allows up to 254 devices (hosts) on a single network. If you need to support more devices, or if you need to operate within an existing addressing scheme, you should discuss this setting with an IP network expert.

Additional network settings items

These additional items will display on the Quickstart page if the Network Mode has been modified in the Advanced Networking configuration. Normally they will not be visible on the Quickstart page.

Network Mode: This allows you to choose between bridged and routed networking. Bridged networking is the simplest to configure and will be the correct choice in almost all networks.

- **Bridge:** The 215U-2 acts as a network bridge between the radio and Ethernet ports. Ethernet packets are transparently passed between the radio and Ethernet ports using rules learned from traffic that has already passed.
- **Router:** The 215U-2 acts as an IP Router between the radio and Ethernet ports. Only IP packets are passed between the radio and Ethernet, which are on separate sub-networks. You configure the rules for which packets are transferred on the routing configuration page.

Wireless IP Address/Netmask: When the network mode is set to Router, the Ethernet and Wireless interfaces on the device each have separate IP addresses. This sets the IP address for the wireless interface.

I/O Back to Back configuration

This provides a simple method to configure I/O mappings between two sites in a system. When the networking mode is ProMesh, you can select this check box to configure the device to automatically send the I/O data to another device connected to the same network. You can also connect 115S-12 and 115S-13 modules to provide additional I/O points.

When you select this option, input data from a remote site is sent to the system Base. Input data at the base is sent to the remote site that first sends the data to the Base. You should only set this option at the base and at one remote site in the system. For more detail on how this feature operates, refer to section "Default Back-To-Back gather scatter mapping" on **page 20**.

Save Changes: Clicking this button saves changes to non-volatile storage. Changes don't take effect until the device has been restarted. If you plan to make changes to multiple pages, use this button before navigating to another page.

Save Change and Reset: Clicking this button immediately applies the changes on you have made by saving the new configuration to non-volatile storage, then forcing the device to reset immediately. Once the device has booted, the new changes will be in effect.

Connecting to Other 802.11 devices

The 215U-2 uses standard 802.11 networking protocols and it is possible to use it in conjunction with other 802.11 devices, either joining an existing network, or allowing other devices to join the 215U-2 network.

Connecting a 215U-2 to existing 802.11 network

To connect to an existing 802.11 Access Point, you need to set encryption mode and passphrase to match the existing network.

- For a Manual Mode Client – Set the "System Address (ESSID)" field to match the SSID of the Access Point
- For a ProMesh Mesh Node, set the "System Name" field to match the SSID of the Access Point.
- For a Fixed Mesh Repeater and Fixed Mesh Remote, set the "Upstream Device" field to match the SSID of the Access Point.

Connecting your device to an existing 215U-2 network

To connect an 802.11 capable device as a client to an existing network of 215U-2 devices, you need to set the device's encryption mode and passphrase to match the settings in the existing network.

You also need to find the correct network name (SSID) to connect to. This depends on the type of network you have configured as shown below:

- **Manual:** To connect to an "Access Point" unit in "Manual" mode, connect to the network which matches the unit's configured "System Address (ESSID)" parameter.

  Note: You cannot connect to a "Station (Client)" unit.
- **Fixed Links:** To connect to a "Base" unit or a "Repeater" unit in "Fixed Links" mode, connect to the network that matches the unit's configured "Device Name". Each Base and Repeater should have a unique device name in the network.

  Note: You cannot connect to a "Field Station" unit.
- **ProMesh:** Connecting to device configured for "ProMesh" mode takes some care. In a ProMesh network all the devices share the same SSID. This is the configured "System Name", so your device may see multiple networks with the same name.

  You will always be able to connect to the "Base" unit by selecting the correct network. For "Mesh Node" units, you must check the "Enable Hotspot" check box on the unit's configuration page to ensure that it remains available for connection. Normally you can connect to the unit with the best signal strength, and use the 215U-2 ProMesh network to automatically reach the unit you need to access.

Your device might also need to be configured with the correct IP Address. You can do this through manually configuring your device, or using automatic IP address assignment (DHCP). If you need your device to be assigned an IP Address through DHCP, you can configure the DHCP server on the central unit in the 215U-2 network (This is the Base unit or the Access Point unit). You can access the DHCP Configuration by selecting "Full Configuration >> DHCP Server" on the right side menu. Refer to section "DHCP Server" on **page 27** for information on configuring the DHCP server.

Accessing Ethernet devices connected to 215U-2

You can connect devices such as PLCs or HMIs to the Ethernet port on the remote 215U-2 devices. With the default configuration, you will be able to access these devices directly from a PC or HMI at the central site.

The 215U-2 default configuration bridges the wireless and Ethernet connections. This means that all of the devices, including devices connected to the remote Ethernet ports, are connected to a single bridged network.

The 215U-2 can also be configured to route between the Wireless and Ethernet ports. If you configure your 215U-2 network as a routed network, then you will need to set up routing rules in your devices to allow the data packets to reach the correct destination.

Device configuration

This section describes how to configure the device functionality to support operation of the different device features. This section covers:

- Modbus TCP Client (Master) Configuration to bring data from locally connected Modbus TCP devices.
- Dashboard to provide easy access to I/O data from a web-browser.
- Mapping I/O Points to be sent from one device to another device in the network
- Serial functionality to support connection to RS-232 and RS-485 devices, including 115S Expansion I/O modules and Modbus RTU devices.
- Configuration of the on-board I/O (Scaling, filtering, alarm set-points, de-bounce etc.)
- Failsafe configuration to set a safe state in case of loss of communications
- Logging I/O Data and administrative events on the device.

Modbus TCP Configuration

The 215U-2 provides Modbus TCP Client and Modbus TCP Server functionality for I/O transfer. There are pre-defined areas representing Inputs and Outputs as well as the different I/O types, e.g. Bits, Words, Long, Floats, etc, which include the onboard Input/Output) and are shared for both Client and Server. For a full list of the available I/O and address, locations see section "I/O store registers" on "Register memory map" on **page 45**.

Note: Before enabling Modbus TCP functionality, review the section ["Device Security"] above.

Modbus TCP Client (Master) and Modbus TCP Server (Slave) are both supported simultaneously, and when combined with the built in Modbus TCP to RTU Gateway the 215U-2 can transfer I/O to/from almost any combination of Modbus TCP or RTU devices.

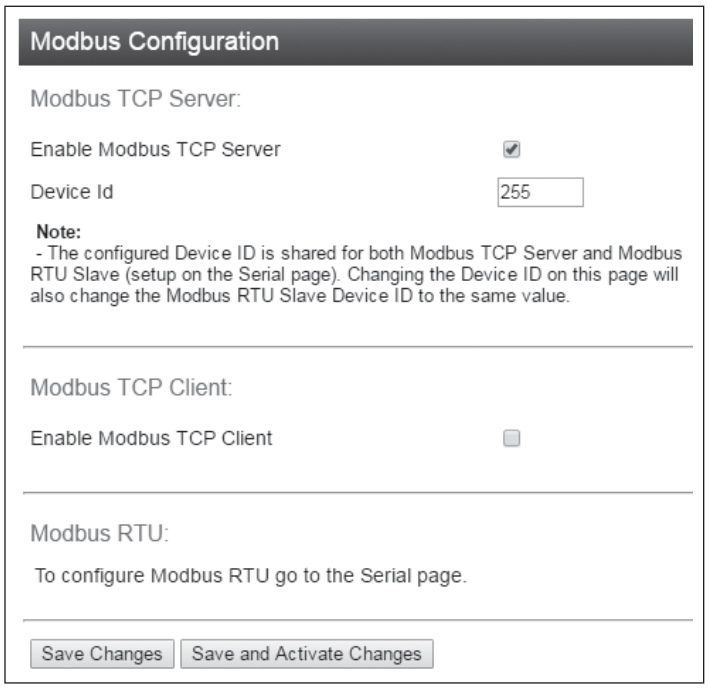


Figure 23. Modbus configuration

Enable Modbus TCP Server: The Modbus TCP Server (Slave) is disabled by default. The Modbus TCP Server will always respond to Modbus TCP messages with Device ID either 0 or 255 (messages sent to the Device's IP address on port 502).

Device ID: This allows you to set an alternate ID for your device to respond to in addition to the default IDs of 0 and 255. Set this if your Modbus Master software requires a device ID other than 0 or 255.

Enable Modbus TCP Client: Select this option to enable the device to act as a Modbus TCP Client (Master).

All Modbus Master Messages are directed either to/from the onboard I/O registers depending on configuration (described below). The Modbus TCP Client may also poll Modbus TCP (Ethernet) and Modbus RTU (serial) devices connected to either the local module or a remote 915U-2 module. This is done by enabling the Modbus TCP to RTU gateway at the corresponding serial port. See "Serial Configuration" on **page 21**.

Once you select this option additional configuration items are available to configure the Modbus functionality.

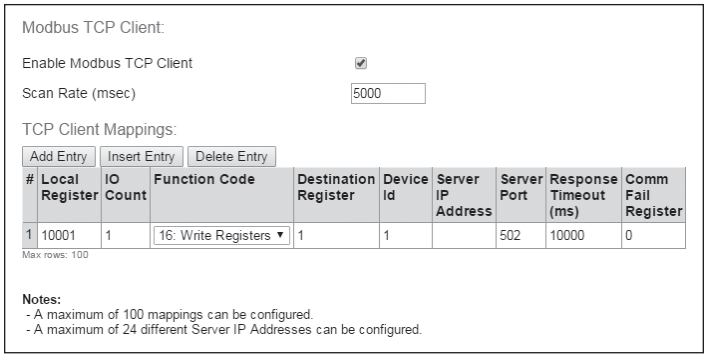


Figure 24. Modbus client mappings

Scan Rate (msec): This is the time delay in milliseconds between completing the processing of one client mapping and beginning the next. This delay begins after receiving a response to a client mapping message, or if there is no response, at the end of the timeout for that message.

TCP Client Mappings: Use the "Add Entry", "Insert Entry" and "Delete Entry" buttons to build your list of Modbus commands. For each command, you set the following items.

Local Register: This is the register in the local device that will either receive the data from the remote device (Read command) or be used as data to send to the remote device (Write command). Refer to section "Register memory map" on **page 45** for detail of the local device register map.

I/O Count: The number of registers to transfer

Function Code: The Modbus function code to use in the message

Destination Register: The register number in the remote device that will either be used as a destination for the data transfer (Write) or as a source for the data (Read).

Device ID: The Modbus Device ID (also called Device Address) for the remote device.

Note: For most Modbus TCP devices this can be 0 or 255.

Server IP Address: This is the IP address of the remote device's Modbus server.

Server Port: The TCP Port number to access the remote server (502 is the default port for Modbus TCP protocol).

Response Timeout (msec): The time that the Client (Master) will wait for a response from the remote server before deciding that the transaction has failed.

Comm Fail Register: You can choose a separate register in the local register map to indicate that the remote device has failed to respond inside the configured response timeout. If this register is a bit register, it will be set ON if the transaction fails, and OFF if the transaction is successful. If this register is a word register, it will receive an extended code indicating the reason for the failure. It will be set to zero on successful transaction. Refer to section "Modbus Error Codes" on **page 51**.

Dashboard

The 215U-2 provides a dashboard feature that allows you configure the device so that users can view the status of the device's local I/O and registers. Any authorized user can access the device's dashboard remotely using a standard web browser. You configure which registers will be displayed on the dashboard, and how they will be displayed. The dashboard provides a live status of I/O, with regular automatic refresh.

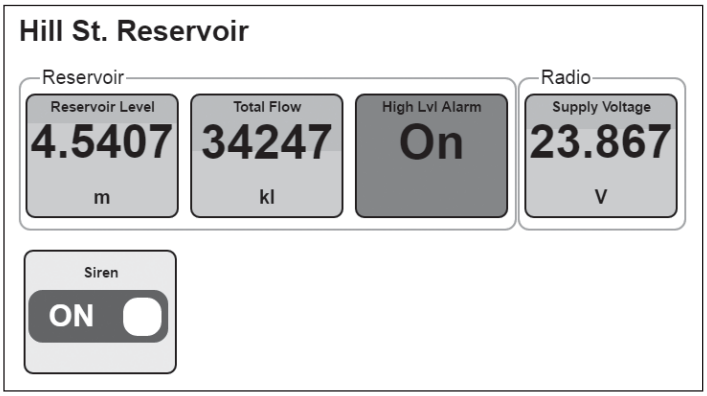


Figure 25. Modbus client mappings

To access the dashboard, use a web-browser to browse to the device's IP address. You can view the dashboard from the "Unit Information" section of the menu. You can also configure the dashboard to automatically display. The dashboard display updates automatically.

Note: Note: Before you can access the Dashboard remotely, you need to enable Remote Configuration Access on the Quick Start Page.

To Configure the dashboard display, select the "Dashboard" item from the right side menu under "Configuration". (Click "Full Configuration" under Advanced if needed).

Save Changes: Clicking this button saves changes to non-volatile storage. It also applies most of the changes you have made to the dashboard configuration. If you plan to make changes to multiple pages, use this button before navigating to another page.

Note: You can quickly edit the dashboard settings and use the "Save Changes" button to check the result without needing to wait for the device to restart. Changes to the Display Color and changes to the Home Page links don't take effect until you click "Save Changes and Reset" below.

Save Change and Reset: Clicking this button immediately applies the changes on you have made by saving the new configuration to non-volatile storage, then forcing the device to reset immediately. Once the device has booted, the new changes will be in effect.

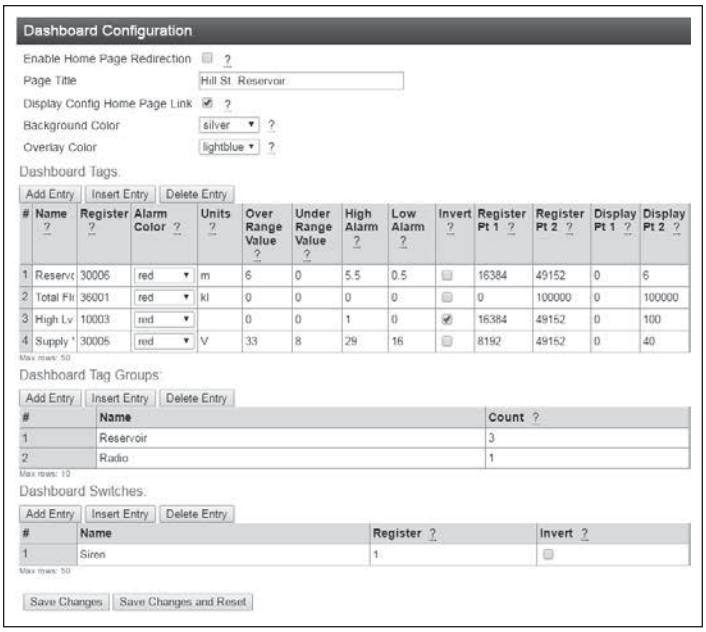


Figure 26. Dashboard configuration

Enable Home Page Redirection: Check this box if you want the dashboard to display as soon as the user accesses the device webpage. This simplifies access to the dashboard for users that are unfamiliar with the product. If you don't check this box, then you can still access the dashboard from the device menu. See "Enable Home Page Redirection".

Page Title: This is the title for the dashboard page. Choose something descriptive that identifies the site clearly.

Display Config Home Page Link: If this is selected ,the dashboard view provides a link labelled "Configuration". This provides a link to the device's regular home page. If you don't want your users to have easy access to the device's home page, then un-check this button.

Note: You can still access the home page by typing in full address to your browser bar: http://<Device_IPAddress>/operator/main.asp.

Background Color: select a background color for your display panels.

Overlay Color: Select a color for the overlay on your display panels (This shows the bar-graph level for analog values)

Dashboard Tags: This section adds the panels to the dashboard that display the I/O status. Each row of the table describes one panel. Use the "Add Entry", "Insert Entry" and "Delete Entry" buttons to build your list of items to display on the dashboard. For each item, enter the configuration parameters.

Name	The name you want to display on the individual panel
Register	The I/O Register that you want to have the value displayed
Alarm Color	The color you want the panel to change to when it is in the Alarm state
Over/Under Range Value	These settings are used for analog values. The analog bar displays between these two vales. When the scaled value goes over or under the corresponding limit, the panel shows "OVR" or "UND" rather than the measured value. To disable this feature, set these values to outside the expected range of values for the register.

High/Low Alarm For Analog values, the panel changes to the configured "Alarm Color" when the value moves above or below these limits. For Digital values, the panel changes to the alarm color if the digital value is ON and the High Alarm is One(1), or if the Digital value is OFF, and the High alarm is Zero (0).

Invert This allows you to invert the status of a digital point so that the panel shows "On" when the digital is zero, and "Off" when the digital is one.

Register/Display Pt 1/2 This sets the scaling for the Analog display. Set the high and low register value in Register Pt 1/2 field, and the desired display value in the corresponding Display Pt 1/2 fields. The display will scale linearly between these points.

Tag Groups: This section allows you to group together related display panels. Each row of the table describes one tag group. Use the "Add Entry", "Insert Entry" and "Delete Entry" buttons to build your list of tag groups, the configure the following items.

Name The name you want to give to the group of tags.

Count The number of tags to include in the group.

Dashboard Switches: This section allows you to add switches to the dashboard to control digital output points. When you slide the switch on the dashboard, the configured digital output changes state. Each row of the table describes one switch. Use the "Add Entry", "Insert Entry" and "Delete Entry" buttons to build your list of items to display on the dashboard. For each item, enter the configuration parameters.

Name The name you want to give to the switch.

Register The Digital output register you want the switch to control.

Invert Check this if you want the register state to be Off when the switch is On, and On when the switch is Off.

I/O Mapping configuration

You can configure the 215U-2 to copy the status of I/O registers to other ELPRO series products using the WIB register mapping protocol. WIB protocol is supported by many of the ELPRO product series, including 915U-2, 415U-2, 215U-2, and 115E-2 devices.

The WIB protocol is an event based protocol with integrity reporting. This allows you to configure a network supporting both low latency and low bandwidth requirements, while still supporting data integrity. WIB messages are transferred between ELPRO series devices using standard IP addressing and UDP/IP message delivery. WIB Protocol uses UDP protocol on port number 4370.

Note: Devices can be configured in Routed mode, where the devices have separate interface addresses for Radio and Ethernet ports. Make sure you enter the correct address to allow your message to reach the device via the correct interface. If the device you are mapping to is not on the same subnetwork, you may need to configure additional routing rules in your network to allow the message to reach its destination.

The 215U-2 supports three separate types of message. You can select the message types that best suit your application.

- Block Write: for transferring contiguous blocks of data, between two stations.
- Gather-Scatter Write: for transferring non-contiguous blocks of data between two stations.
- Read: for requesting contiguous blocks of data. Normally used where a single master station is controlling all communications in a system.

You can set write messages (both Block and gather-scatter) to be triggered on a time, on a change-of-state, or a combination of both. You can configure how the write messages change-of-state are triggered through the sensitivity blocks. You can configure read messages to be triggered on a time basis or by a command from a remote master station.

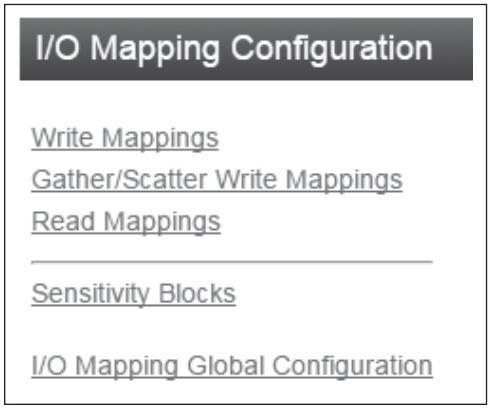


Figure 27. I/O Mapping configuration

Selecting "I/O Mappings" on the right of the screen takes you to a page where you can reach configuration pages for each mapping type.

Click on the link to reach the mapping configuration page that you need to access.

Write Mappings are messages sent from the local unit to write values into registers of a remote unit.

Block Write Mappings: These mappings work with blocks of registers. They are the best choice when you want to transfer blocks of contiguous register data from one device to another.

Gather Scatter Write Mappings: These mappings work by choosing individual I/O points and allowing each I/O point to be mapped to an individual I/O point at the remote end. They are more difficult to configure, but are the best choice when your I/O data that you need to transfer is not in contiguous blocks.

Click on the "Write Mappings" link to access the block write mappings configuration table, or on the "Gather Scatter Write Mappings" link to access the gather scatter configuration table.

Note: The 215U-2 contains one automatically generated Gather Scatter Write Mapping. This implements the Back-to-Back I/O Mapping function described in section "Default Back-To-Back Gather Scatter Mapping" on **page 20**.

Each line of the table defines one mapping message. Use the "Add Entry", "Insert Entry" and "Delete Entry" buttons to build your list of write mappings to configure. Edit the items as below:

Enabled You can enable or disable individual mappings for testing and diagnostics. Ensure this is checked for the mapping to operate.

Name Enter a descriptive name for the mapping.

Destination IP Enter the IP Address of the destination ELPRO series product.

Note: When operating in ProMesh mode, there you can use the special names "BASE" and "REMOTE" as the destination device. BASE is the IP address of the system Base device, and REMOTE is the IP address of the Mesh Node that last sent an I/O message to the Base.

Ack This option requests the remote device to send an acknowledgement that it has received the message. You can use this to receive positive indication that the message was delivered successfully. If you leave this blank, the message will be sent on a best effort basis.

Invert You can invert the values in the mapping. This is most useful for discrete values, but may also be used for analogs. Inverting an analog value reverses the scale, so that a 4mA signal will appear as 20mA and a 20mA will appear as 4mA.

Update Period (s) This is the period in seconds between updates of the messages status when there is no change in the value to force an update. This provides a way for the receiving unit to ensure the data is still valid (See section "FailSafe configuration" on "Failsafe configuration" on **page 24**). Set this to zero to disable updates.

Update Offset (s) Configures an offset time in seconds for the update mapping. Used to stagger the update transmissions so on start-up and every update period each mapping is transmitted at its own scheduled time.

If you want to schedule transmissions to happen at specific times, use this setting to provide a different offset for each mapping, and disable the "Cos Resets Update Timer" setting below so that the transmissions stay on a fixed schedule.

COS Delay (s) This is the time in seconds that the unit will delay after detecting a Change of State (COS) before transmitting the mapping message. You can set a longer COS delay to allow changing values to settle before transmitting, and to limit the number of times the mapping message is transmitted if the input is continuously varying.

COS Enabled This enables the COS function. If this is checked, then the inputs will be monitored for a change since the last transmitted value. When they change the transmission of the new values is activated.

Note: For Digtal inputs, a change is from 1 to 0 or 0 to 1. For analog inputs you can configure the change required to trigger the COS function. See section "Sensitivity Blocks" below.

COS Resets Update Timer When you select this option, the update timer is restarted each time a Change of State triggers a transmission. Leave this unchecked if you want message transmission to happen on a fixed schedule.

Force Register You can select another register to force the write mapping to be transmitted, even if there is no Change of State, and the update timer has not expired. When the register is written to a non-zero value, the transmission is triggered. Once the message has been sent, this register is set back to zero.

Note: Don't use a Discrete input register (10001-10008) as a force register. The Discrete input will not turn off, and the mapping will continue to be forced while the input is active.

Fail Register You can select a physical digital output or a digital register to signal if the write mapping was not successful. If no Acknowledgement was received for the message, then the fail signal will activate. If you are using a physical Digital Output (register 1-8), the output will turn On when the mapping fails to receive the ACK message.

Note: The "Ack" field must be checked for the fail indication to operate.

The remaining fields define which I/O points are sent in the message, and where they are placed in the destination register map. These settings depend on whether the mapping is a gather-scatter or block write mapping.

Block Write Mappings specify a starting register at the local and remote locations and a count of registers to transfer.

First Local Register This is the first register in the local unit that is transmitted to the remote site.

First Remote Register This is the location in the remote device's register map where the first of the register block is placed.

Register Count This is the number of registers in the block.

Gather Scatter Write Mappings specify each source and destination register individually. You can enter up to 32 source-destination register pairs in one gather scatter mapping.

Local 1 – 32 These are the register locations to send from the local unit. List each register that needs to be sent in the mapping.

Remote 1 – 32 These are the register locations where the data will be placed in the remote device. List the location in the remote module for each of the local input registers.

Block Read Mappings provide an alternative method of transferring data. These mappings are used when you have a central site that is polling remote sites on a regular basis.

Click on the "Read Mappings" link to access the block read mappings configuration table.

Each line of the table defines one mapping message. Use the "Add Entry", "Insert Entry" and "Delete Entry" buttons to build your list of read mappings to configure. Edit the items as below:

Enabled You can enable or disable individual mappings for testing and diagnostics. Ensure this is checked for the mapping to operate.

Name Enter a descriptive name for the mapping.

Destination IP Enter the IP Address of the destination ELPRO series product where you will read the data from.

Invert You can invert the values in the mapping. This is most useful for discrete values, but may also be used for analogs. Inverting an analog value reverses the scale, so that a 4mA signal will appear as 20mA and a 20mA will appear as 4mA.

Update Period(s) This is the period in seconds between updates of the messages status.

Update Offset(s) Configures an offset time in seconds for the update mapping. Used to stagger the update transmissions so that each read message can be timed to happen at it's own time slot.

Response Timeout(s) This is the time in seconds to wait for a response to the read request. For devices with high speed radio, a value of 1 second is normally suitable.

Force Register You can select another register to force the read request to be transmitted, even if the update timer has not expired. When the register is written to a non-zero value, the transmission is triggered. Once the message has been sent, this register is automatically set back to zero.

Note: Don't use a Discrete input register (10001-10008) as a force register. The Discrete input will not turn off, and the mapping will continue to be forced while the input is active.

Fail Register You can select a physical digital output or a digital register to signal if there was no response to the read request. If no response was received for the message within the configured response timeout, then the fail signal will activate. If you are using a physical Digital Output (register 1-8), the output will turn On when the mapping fails to receive the response message.

Sensitivity Blocks allow you to configure how much an analog signal needs to change to trigger a Change of State indication to activate a Write Mapping. You can configure multiple blocks of Analog signals. Each analog signal within the one block has the same sensitivity.

Click on the "Sensitivity Blocks" link to access the configuration table.

Each line of the table defines one sensitivity block. Use the "Add Entry", "Insert Entry" and "Delete Entry" buttons to build your list of blocks to configure. Edit the items as below:

First Register The first Analog register in this sensitivity block.

Count The number of Analog registers in this sensitivity block.

Value The sensitivity value. For 16-bit registers, this is expressed in counts. For floating point registers (range 38001 – 38040) this is expressed in the inputs units (Volts, mA, or Hz depending on the input type).

I/O Mapping Global Configuration allows you to configure advanced functions of the I/O mappings. The default values are usually suitable, and will only need changing for unusual applications.

Tx Attempts for Acknowledged Messages This is the number of times the device will transmit a Read Mapping, or a Write Mapping with the Ack Flag set, when it does not receive a response to the message. If the message is transmitted this number of times without a response, then it will indicate as failed.

Tx Count for Unacknowledged messages This is the number of times Write mappings will be transmitted if they don't have the ACK flag set. You can configure to transmit unacknowledged messages multiple times.

Acknowledge Timeout This is how long the device will wait for an Acknowledgement when it is sending Write mappings with the ACK flag set.

Note: The Response timeout for Read mappings is set in the individual read mapping configuration.

Default Back-To-Back gather scatter mapping

The 215U-2 comes pre-configured with a gather-scatter I/O mapping, allowing you to send I/O data between the Base site and one Remote site. This function is available in ProMesh mode, and maps all of the I/O to appear at the remote site. You can enable this mapping by checking the "Enable I/O Data" checkbox on the Quick Start page. You can view and edit this mapping by selecting "I/O Mappings >> Gather Scatter Mappings" from the Configuration side menu.

This pre-configured mapping supports connection of 115S-12 and 115S-13 expansion modules to your Base and Remote sites to increase the number of I/O. When you do this, you must configure the 115S-12 with address 01 and the 115S-13 with address 02. You set the address using the rotary switches on the bottom panel of the 115S module. Refer to section "Adding expansion I/O modules" on **page 22** for instructions on how to connect 115S modules.

Note: You don't need to connect the 115S modules. You can use only the base and remote modules, or just connect one 115S-12 module at one end, and one 115S-13 at the other end.

Table 10.

Input point (Local)	Output point (Remote)
215U-2	215U-2
DI1 – DI4	DO4-DO8
AI1 – AI2 (4-20mA)	AO1-AO2
Expansion 115S-12	Expansion 115S-13
DI1 – DI6	DO1 – DO6
AI1 – AI8	AO1 – AO8
Expansion 115S-13	Expansion 115S-12
DI7 – DI8	DO7 – DO8

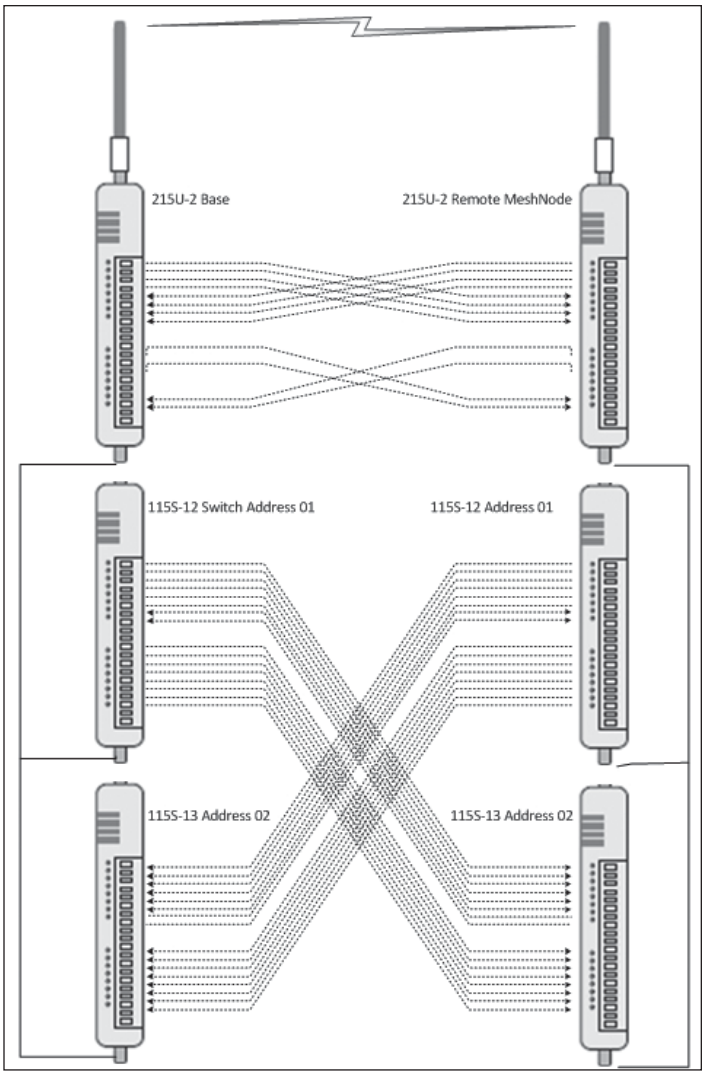


Figure 28. Back to Back mappings

Serial functionality – Connecting to RS-232 and RS-485 devices

The 215U-2 has an RS-232 and an RS-485 port for serial communications. You can use these ports to connect to external devices using serial server functionality or using the in-built Modbus client or server functionality.

From the right-side menu, select "Configuration >> Serial" to configure the serial port operation.

You can configure the operation of the RS-232 and RS-485 serial ports separately. By default, the RS-485 serial port is configured to support automatic connection to 115S I/O expansion modules. The available options for each serial port are **Port Type**. This selects the operating mode for the port.

None Disables all functionality on the serial port.

Expansion I/O Allows connection to 115S Expansion I/O modules.

Modbus RTU Slave Configures the port to act as a Modbus slave to a Modbus master device connected to the serial port.

Note: Make sure that "Enable Modbus TCP Server" is selected on the Modbus TCP page.

Serial Server You can configure the port to act as a serial server. In this mode, you connect to the device on standard TCP port to access the device's serial port from a remote TCP connection.

Modbus RTU Master Configures the port to operate as a Modbus master device. The commands are configured in the "Modbus Master Mappings" table that is enabled when you select this option (see below).

Note: Make sure that "Enable Modbus TCP Client" is selected on the Modbus TCP page.

Data Rate: Set the serial baud rate to match the connected device. Standard baud rates from 1200 baud to 115,200 baud are supported.

Data Format: Set the serial data format. Select from the drop-down options in the format <data-bits><parity><stop-bits>. The options support 7 or 8 data bits, odd (O), even (E), mark (M) or space (S) parity, and one (1) or two (2) stop bits.

Flow Control: (RS-232 port only) This allows you to enable hardware flow control on the RS-232 port. Because Modbus is a poll-response protocol, the flow control will normally be set to "None". When using the serial server, you should set this to match the settings of the device you are connecting to.

Maximum Device ID to poll: (only for Expansion I/O setting). This is the maximum device ID for connected 115S modules. Set this to match the actual number of 115S modules connected to speed up the I/O device polling.

Modbus RTU Master settings: Some additional items are available when you select this mode.

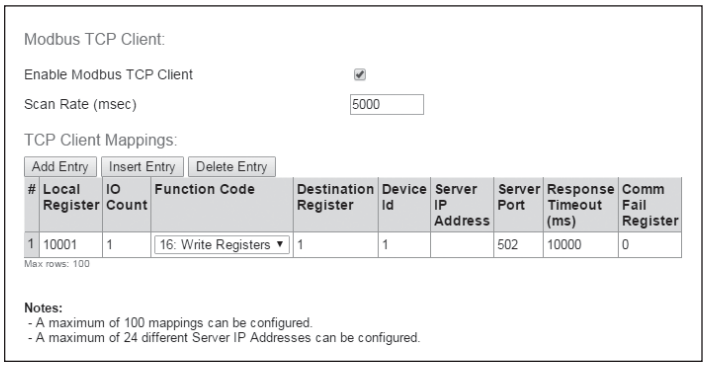


Figure 29. Modbus RTU Master settings

Scan Rate (msec): This is the time delay in milliseconds between completing the processing of one Modbus Master Mapping and beginning the next. This delay begins after receiving a response to a client mapping message, or if there is no response, at the end of the timeout for that message.

Response Timeout (msec): This is the time that the Modbus master will wait for a response from the remote Modbus slave before deciding that the transaction has failed.

Modbus Master Mappings: Use the "Add Entry", "Insert Entry" and "Delete Entry" buttons to build your list of Modbus commands. For each command, you set the following items.

Local Register This is the register in the local device that will either receive the data from the remote device (Read command) or be used as data to send to the remote device (Write command). Refer to section "Register Memory Map" on page 45 for detail of the local device register map.

I/O Count The number of I/O points to transfer. For bit (Coil) commands, this is the number of 1-bit registers to transfer. For register (Word) commands, this is the number of 16-bit registers to transfer.

Function Code	The Modbus function code to use in the message.
Destination Register	The register number in the remote device that will either be used as a destination for the data transfer (Write) or as a source for the data (Read).
Device ID	The Modbus Device ID (also called Device Address) for the remote device.
Comm Fail Register	You can choose a separate register in the local register map to indicate that the remote device has failed to respond inside the configured response timeout. If this register is a bit register, it will be set ON if the transaction fails, and OFF if the transaction is successful. If this register is a word register, it will receive an extended code indicating the reason for the failure. It will be set to zero on successful transaction. Refer to section "Modbus Error Codes" on **page 51**.

Modbus TCP to RTU Gateway allows an Ethernet Modbus/TCP Client (Master) to communicate with a serial Modbus RTU Slave. The 215U-2 performs the protocol conversion and is directly connected to the Modbus serial device (i.e. only this module needs to have Modbus TCP to RTU Gateway enabled).

Adding expansion I/O modules

You can connect additional 115S serial expansion I/O modules to the 215U-2 module if more I/O is required. The RS-485 serial port on the 215U-2 is configured by default to communicate with 115S expansion modules using the Modbus protocol. The default serial parameters of the RS-485 port on the 215U-2 are 9600 baud, no parity, 8 data bits, 1 stop bit, which match the default settings of the 115S serial expansion modules. You can change these parameters to increase poll speeds in larger systems, but the serial module's parameters must match that of the 215U-2 RS-485 port.

If more than three serial expansion I/O modules are added to the 215U-2 module, you will need to adjust the Maximum Connections setting for RS-485 or RS-232.

Note: Reducing the Maximum Connections setting will slightly improve the serial scan time. However, you need to make sure that the slave addresses fall within the Maximum Connections. If the Slave address is above the Maximum Connections, it will not be polled.

When you connect the serial expansion module, before powering on, set the expansion module address using the rotary switches on the bottom of the module. Assign addresses sequentially, starting at address 1. Make a note of the module address. This address will be used as an offset to locate the I/O within the 215U-2. Also make sure that the termination switch is "on" (down) for the last module in the RS-485 loop.

Note: Failure to terminate the RS-485 correctly will result in modules not operating correctly.

115S Expansion I/O Memory Map: The I/O data on the 115S module is read into memory locations according to their Modbus address. The maximum supported Modbus address is 19. Each 115S module has an offset that applies to the location of its registers. This offset is equal to the units' Modbus address (selected on the rotary switch on the end of the 115S expansion I/O module), multiplied by 20. If the modules Modbus address is 15, the offset value will be 15 X 20 = 300.

For example, if connecting a 115S-11 (16 x DIO) with address #15:

- Digital input 1 will be at register location 10301
- Digital Output 1 will be at register location 301.
- If using a 115S-12 (8 x DIO and 8 AIN) with address 16:
  - Digital input 1 will be at register location 10321
  - Analog input 1 will be at register location 30321 For a detailed address map of the serial expansion I/O modules, see section "Expansion I/O Registers" on **page 47**.

When adding expansion I/O modules to the 215U-2, there are two inbuilt registers indicating the communication status of the expansion I/O module:

- **Communication Fail** — Located at register location 10019 + offset value. This register indicates "1" when the module is in failure.
- **Communication OK** — Located at register location 10020 +offset value. This register indicates "1" when the module is communicating properly.

Configuration of the on-board I/O

The default I/O configuration on the 215U-2 module is suitable for most applications. If needed, you can change the configuration to meet the special needs of your application. You access the I/O configuration through the right-side menu under "Configuration >> Onboard I/O".

From Here, configure the thermocouple input directly, or select the type of I/O you want to configure.

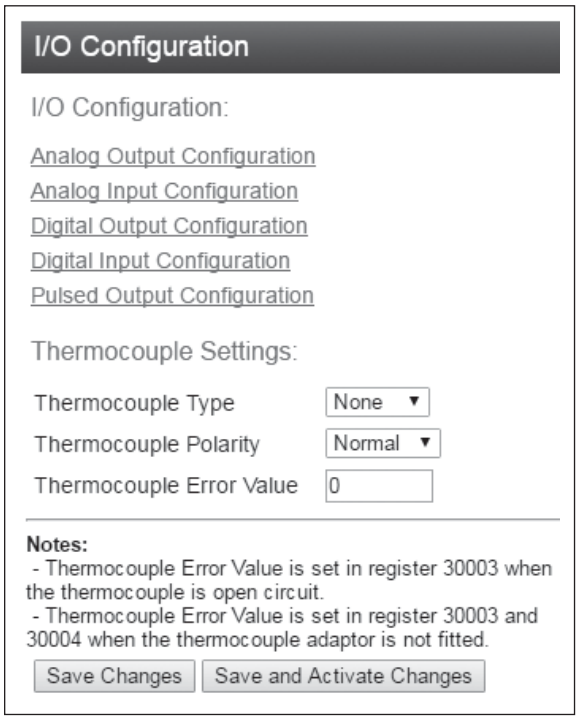


Figure 30. I/O Configuration

Configuring For use with the TC-ADP thermocouple module: You can purchase the Thermocopule module (TC-ADP) separately. This replaces analog inputs 3 and 4. Look at the documentation with the TC-ADP module for a detailed description on configuring. If you are not using the thermocouple module, ensure Thermocouple Type is set to "None".

Configuring the Analog Outputs: You can configure the analog outputs to change the way the outputs are scaled, and to set up a local fail-safe in the case that communications is lost.

Analog Output Configuration

Analog Output:

#	Name	Zero	Span	Fail-Safe Time (Sec)	Fail-Safe Value (mA)
1	AO1	-8192	0.000488281	0	1.0
2	AO2	-8192	0.000488281	0	1.0

Figure 31. Analog output configuration

Name — You can give the I/O point a descriptive name if you like.

Zero and Span — These values set the scaling of the analog outputs. The scaling values are applied to the raw register value, to give the output value in milli-amps. The raw value is a 16-bit unsigned value. The zero value has units of raw-counts. The Span value has units of milli-amps per raw-count.

Output(mA) = Span × (Raw + Zero)

Fail-Safe Time (Sec) — The output needs to receive an message updating its status before this time expires. Normally this is set to at least twice the update time for the message that sets the output status.

Fail-Safe Value (mA) — If there is no update message received within the configured Fail-Safe time, then the output is set to this value to indicate the communications failure. This value should be outside the normal range of values for the data that is setting the output.

Configuring the Digital Outputs: You can configure the digital outputs to set up a local fail-safe in the case that communications is lost.

Digital Output Configuration

Digital Output:

#	Name	Fail-Safe Time (Sec)	Fail-Safe State
1	DO1	0	☐
2	DO2	0	☐
3	DO3	0	☐
4	DO4	0	☐
5	DO5	0	☐
6	DO6	0	☐
7	DO7	0	☐
8	DO8	0	☐

Figure 32. Digital output configuration

Name — You can give the I/O point a descriptive name if you like.

Fail-Safe Time (Sec) — The output needs to receive a message updating its status before this time expires. Normally this is set to at least twice the update time for the message that sets the output status.

Fail-Safe State — If there is no update message received within the configured Fail-Safe time, then the output is set to this value to indicate the communications failure. Check this box to have the output fail "On". Clear to have the output fail to "Off".

Configuring the Analog Inputs: You can configure the behavior of the analog inputs to change the way the inputs are scaled, and to configure the behavior of the digital set-points that are associated with the analog inputs.

Analog Input Configuration

Analog Input:

#	Name	Zero	Span	Filter(sec)	Lower Setpoint	Upper Setpoint	Invert	Window
1	AI1(0-20r	8192	2048	1	0	0	☐	☐
2	AI2(0-20r	8192	2048	1	0	0	☐	☐
3	AI3(0-20r	8192	2048	1	0	0	☐	☐
4	AI4(0-20r	8192	2048	1	0	0	☐	☐
5	VSupply	8192	1024	1	0	0	☐	☐
6	24V	8192	1024	1	0	0	☐	☐
7	VBatt	8192	1024	1	0	0	☐	☐
8	VExt	8192	1024	1	0	0	☐	☐
9	AI1(0-20\	8192	2048	1	0	0	☐	☐
10	AI2(0-20\	8192	2048	1	0	0	☐	☐
11	AI3(0-5V	8192	8192	1	0	0	☐	☐
12	AI4(0-5V	8192	8192	1	0	0	☐	☐
13	PRate1	16384	2048	0	0	0	☐	☐
14	PRate2	16384	2048	0	0	0	☐	☐
15	PRate3	16384	2048	0	0	0	☐	☐
16	PRate4	16384	2048	0	0	0	☐	☐

Figure 33. Analog input configuration

Name — You can give the I/O point a descriptive name if you like.

Zero and Span — These values set the scaling of the analog inputs. The scaling values are applied to the measured value (either volts, milli-amps, or hertz), to give the 16-bit raw register value. The zero value has units of raw-counts. The Span value has units of raw-counts per measured unit.

For current input (measured value is in mA)

Raw = Zero + Span × Measured(mA)

For voltage input (measured value is in V)

Raw = Zero + Span × Measured(V)

For pulse rate input (measured value is in Hz)

Raw = Zero + Span × Measured(Hz)

Filter (sec)

Analog inputs for voltage and current measurement can be filtered to remove the effects of noise on the input. The filter time is the time for the measured value to shift by 0.632 ($1\text{-}e^{-1}$) of the changed value.

$$Measured(t) = input \times \{1 - e^{-t/filter}\}$$

Set Point Configuration

Each analog input is associated with a digital input point that acts as a set point to show the status of the analog input. Refer to Table 1 for detail of how the setpoints operate

Lower/Upper Setpoint: Configure the set points with the desired low and high measured values (mA, V, or Hz).

Invert: Check this to invert the state of the digital set-point. Clear this to set direct mode.

Window: Check this to set windowed mode for the set point. Clear this to have the set-point operate in hysteresis mode.

Table 11. Setpoint operation

Level/Mode	Invert Window	Direct Window	Invert Hysteresis	Direct Hysteresis
Above Upper Setpoint	ON	Off	ON	Off
Between Upper and Lower	Off	ON	No change	No change
Below Lower Setpoint	ON	Off	Off	ON

Configuring the Digital Inputs: You can configure the behavior of the digital inputs to control Debounce operation on these inputs. Set the debounce time to the desired delay. The physical digital input must remain changed for the configured amount of time before a change is registered and the internal register is updated with the new value. This allows the device to ignore inputs that are a result of noise or bouncing contacts.

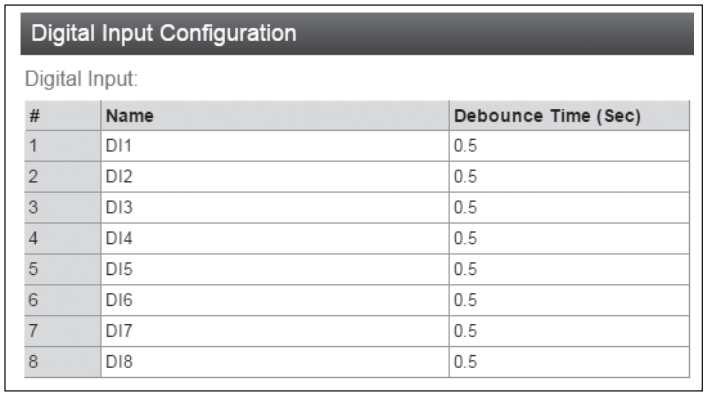


Figure 34. Digital input configuration

Save Changes: Clicking this button saves changes to non-volatile storage. Changes don't take effect until the device has been restarted. If you plan to make changes to multiple pages, use this button before navigating to another page.

Save Change and Reset: Clicking this button immediately applies the changes on you have made by saving the new configuration to non-volatile storage, then forcing the device to reset immediately. Once the device has booted, the new changes will be in effect.

Failsafe configuration

You use the failsafe configuration to set up initial values for registers and to configure how the register should behave if it doesn't get refreshed within a safety window of time. Failsafe configuration also allows you to configure the device to reboot if it reaches an unexpected state.

Note: You normally don't use the failsafe configuration for physical Inputs or outputs. For physical outputs, you can configure the failsafe behavior in the I/O Configuration screens.

Fail Safe Blocks: You use this configuration to set up the behavior of blocks of registers that you want to intialise to a certain status, or if you want to have them go to a safe value in the case that communication is lost.

The default behavior for registers without a fail-safe configuration is to intialise the register to Zero (or Off) and to have no fail-safe timeout configured.

Fail-Safe configuration can set a register to an "Invalid" state. In this state, the register will appear to be not present. Modbus polls covering this address will return an "Invalid Address" error, and Modbus master mappings sending this address will not activate. The Invalid state is cleared once a value is written to the register.

Add/Insert/ Delete Entry Use these buttons to set up your table with one entry for each block of I/O that you want to set up. The setup will be the same for each item in one block.

First Register This is the address of the first register in the block.

Count This is the number of registers in the block (the registers are always in a contiguous block).

Timeout (s) The fail-safe time out to use for this block. Set the timeout to Zero to disable the fail-safe timeout.

Initialize at Start Check this if you want to initialize the register at startup. Normally this will be checked to initialize the register.

Note: If you clear this checkbox, then at startup the register state will be "Invalid". In this state, the register will have no valid value until it has its value written through Modbus or WIB message protocol, or through the I/O Diagnostics page.

Startup Value If you checked "Initialize at start", then the register will be initialized with this value when the unit is started.

Invalidate on Fail Check this box if you want to set the register state to "Invalid" when the fail-safe timer expires. If you want to set the register to a particular value, then uncheck this box and enter a value for "Fail Value".

Fail Value This is the value that you want the register to have if the fail-safe timer expires. This will normally be a special value that indicates a failure state to your process.

Fail Safe Reboot: You can use this configuration to re-start the module if it loses communication for a long time, which could the the result of a module software error that may be recovered by a reboot. To use this feature, you need to set up a register to indicate that the system is operating correctly. If this register stays cleared (Zero or Off) for the configured time, then the module will restart.

Reboot Register The register to use to indicate the system is healthy.

Reboot Timeout (sec) The number of seconds to wait for the system health indication to return before restarting the module.

Advanced network configuration

This section describes the Advanced features of the 215U-2 available for setting up complex networks. This allows you to make changes away from the default networking setup. You might need to make changes in this section if you need to support an unusual application, or if you need to interoperate with equipment from other manufacturers. If you're setting up a network of 215U-2 devices, you normally won't need to change any of the settings in this section. To access these options, select "Full Configuration" on the right side menu to show the full configuration menu, and select from the items under the "Advanced Networking" section.

Network

This configuration repeats much of the configuration available on the Quick Start page. Settings that appear on both pages you can set on either page. Additional items that are only on the Network Configuration page are listed here.

Network Mode: This allows you to choose between bridged and routed networking. Bridged networking is the simplest to configure and will be the correct choice in almost all networks.

Bridge The 215U-2 acts as a network bridge between the radio and Ethernet ports. Ethernet packets are transparently passed between the radio and Ethernet ports using rules learned from traffic that has already passed.

Router The 215U-2 acts as an IP Router between the radio and Ethernet ports. Only IP packets are passed between the radio and Ethernet, which are on separate sub-networks. You configure the rules for which packets are transferred on the routing configuration page.

IP Address/Subnet Mask: When the network mode is set to Bridge, the Ethernet and Wireless interfaces are bridged together, and the device has a single IP Address accessible from either interface.

Ethernet IP Address/Netmask: When the network mode is set to Router, the Ethernet and Wireless interfaces on the device each have separate IP addresses. This sets the IP address for the Ethernet interface.

Wireless IP Address/Netmask: When the network mode is set to Router, the Ethernet and Wireless interfaces on the device each have separate IP addresses. This sets the IP address for the wireless interface.

Radio

These settings allow you to fine tune the operation of the radio.

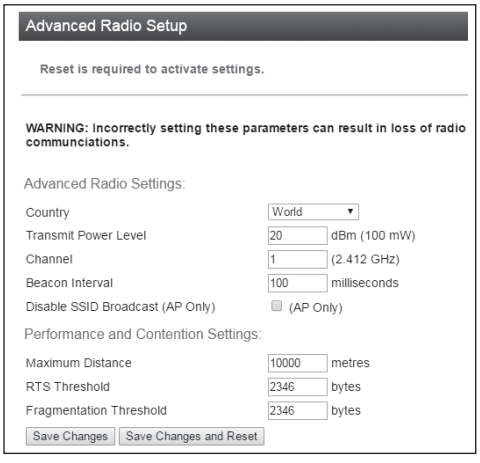


Figure 35. Advanced radio setup

Country: The module is configured from the factory to allow operation globally. To take advantage of additional radio channels and higher allowed power in some countries, you can select a different location.

Transmit Power Level: You can select a lower power level than the default. If you are using a high gain antenna, you may need to lower the transmit power to keep the EIRP inside the limit for your country.

Channel: You can select a radio channel to avoid interference from other 802.11 networks in your area, or to allocate radio spectrum between several of your own networks. For 802.11 communication, channels 1,6, and 11 are non-overlapping.

Table 12. Transmitter power and channels

Region	Allowed channels	Power setting	Maximum EIRP
United States	1-11	23 dBm (200mW)	+36 dBm
Europe	1-13	20 dBm (100mW)	+20 dBm
Australia	1-13	23 dBm(200mW)	+36 dBm

Beacon Interval: This setting applies to Access Point (Manual mode), Base (ProMesh and Fixed Link modes), Mesh Node (ProMesh) and Repeater (Fixed Link) stations. These stations regularly send a special beacon message to identify themselves and allow other devices to connect to them.

You can change the interval between beacons with this setting. You may need to increase this interval if you have a very large number of devices in close proximity which are all sending beacons.

Note: ProMesh Mesh Node stations only send beacons when they are acting as a repeater for another station, and when they are configured for Hot Spot operation (See the description for "Enable Hotspot" in "Quickstart Configuration" on **page 14**).

Disable SSID Broadcast: This setting applies to Access Point (Manual mode) devices only. By selecting this option, the device will not show in another device's list of available connections. Only devices that know the configured ESSID parameter will be able to connect to the Access Point.

Maximum Distance: This setting controls how long the expected time of flight is for the message to reach a remote location and for the Acknowledgement to return. The default setting allows for radio transmission up to 10km (6mi). For a longer radio path (single hop), increase this value accordingly.

RTS Threshold: This value sets the messages size where RTS contention control is activated. RTS contention control sends a short message to reserve the radio channel before sending the longer message. If you have a system with large messages and where remote stations cannot receive each other's messages, then setting this to a value of 100 may help reduce contention.

Fragmentation Threshold: This setting causes large frames to be broken into multiple shorter frames. Setting to a smaller value slows data throughput, but increases the likelihood that a message will be delivered successfully in situations with high level of interference. By making the data frames shorter, there is less chance of a clash with a radio transmission from an interfering device.

Save Changes: Clicking this button saves changes to non-volatile storage. Changes don't take effect until the device has been restarted. If you plan to make changes to multiple pages, use this button before navigating to another page.

Save Change and Reset: Clicking this button immediately applies the changes on you have made by saving the new configuration to non-volatile storage, then forcing the device to reset immediately. Once the device has booted, the new changes will be in effect.

Repeaters

Repeaters setting allows you to configure arbitrary radio networks between different devices. Repeaters configuration is only available to devices configured as Access Point (Manual mode). The Repeaters configuration is managed automatically in ProMesh mode and in Fixed Link mode.

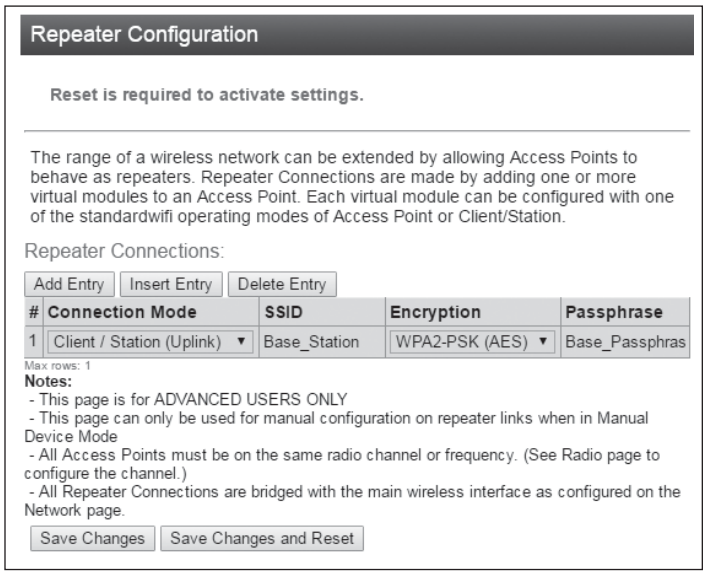


Figure 36. Repeater configuration

The 215U-2 networking architecture allows a single Virtual Client device to be configured to provide an uplink to another station. This allows you to set the 215U-2 to be an Access Point on the main Quick Start page, and also to act as a client to another central Access Point (e.g. a fixed Infrastructure node). Remotes that connect to the 215U-2 Access Point can get messages through to the central AP using the 215U-2 as a repeater.

Use the "Add Entry", button to add a row to the repeaters table. Once this is complete, select the following:

Connection Mode — For the 215U-2, the only allowed connection mode is "Client/Station (Uplink)". This creates a virtual client which you can use to connect to another central Access Point.

SSID — This is the ESSID of the Access Point you want to connect to.

Encryption — This is set to match the encryption used in the Access Point you want to connect to.

Passphrase — This is set to match the encryption passphrase in the Access Point you want to connect to.

Note: The 215U-2 only allows one entry in the Repeaters table.

IP Routing

If your system is divided into multiple IP Subnetworks, then you may need to configure IP Routing rules to allow IP data from the 215U-2 to reach its destination IP address.

If your Base station or Access Point is configured for Routed Network mode, you will need to add routing rules or to set the Gateway IP to allow messages from your 215U-2 to get out from the radio network onto the Ethernet network.

Use the "Add Entry", "Insert Entry" and "Delete Entry" buttons to manipulate the rows in the routing rules table so that you have one row for each routing rule.

The order of routing rules in the table is not important. They are always applied in order from most specific to least specific. Nevertheless, to help with understanding the routing rules, you should order the table in this way.

Once your table entry is complete, set the following:

Name — Create a descriptive name for the rule to remind you of the purpose of this rule at a later date.

Destination — This is the destination network IP address. Combined with the Netmask in the following field, this determines which destination IP addresses the rule applies to.

Netmask — This is the IP Network mask for the destination network IP address.

Gateway — This is the IP address of the gateway device that is used to reach the destination IP network. All packets that are destined for an IP address on the Destination network will be forwarded to this Gateway address for delivery to the destination network.

Enabled — You can enable or disable routing rules. Check this box to activate the rule.

Network Filtering

This configuration screen allows you to set up rules that stop unwanted traffic from entering your network. The filter applies to traffic coming from the Ethernet port which would otherwise be automatically sent over the radio network. This can be useful to reduce radio message traffic when a device is connected to a busy Ethernet network where the majority of traffic is not destined for the radio network.

Note: It is possible to configure filtering that stops your PC from accessing the device's web pages. If you are unable to access the device from the Ethernet port after configuring Filtering rules, you can either: Access the device from the USB connection; or restore the device's default network settings. For instructions, see "Restoring the factory default connection settings" on page 42.

Easy IP Filtering allows you to quickly configure filtering for a network that will only use IP protocols. If your network only uses IP protocols and IP Addresses in a single range, then use this method to configure your filtering.

Only allow IPv4 and ARP: Select this option if all of the devices on your network use IP protocol communications (TCP/IP or UDP protocols). This will automatically block all non-IP protocols from reaching the radio network.

Enable Easy IP Filtering: Select this option if all your devices' IP addresses are within a single range of addresses. By setting the first and last IP addresses, only IP messages within this range will be able to reach the radio network.

First Radio/ Device IP — Select the lowest IP address of the devices on the radio network.

Last Radio/ Device IP — Select the highest IP address of the devices on the network.

Note: Easy IP Filtering is a simple method to set up IP Filter rules. The IP Filter Rules table is disabled if you select Easy IP Filtering.

For more complex networks, where Easy IP Filtering does not provide the necessary functionality, you may need to set up multiple filtering rules to fully manage the network traffic.

IP Whitelist or Blacklist: Set this to "Whitelist" if you want to allow messages that meet the IP Filter Rules. Set this to "Blacklist" if you want to exclude messages that meet the IP Filtering Rules.

Note: If you set this to Blacklist, and you haven't selected "Only allow IPv4 and ARP" above, then the filter will block the specified messages, but any non-IP protocol messages will pass through the filter.

IP Filter Rules: These rules apply by checking the source address and destination IP addresses and ports of the message. A rule will match a message if the IP address is within the defined range, and the Port number is within the defined range.

Use the "Add Entry", "Insert Entry" and "Delete Entry" buttons to manipulate the rows in the table. For each row in the table, enter the parameters:

Enable	Check this to enable the rule. To temporarily disable a rule you can clear this checkbox.
IP Address Min/Max	These are the first and last IP addresses that this rule applies to.
Port Min/Max:	This is the range of IP Port numbers (TCP or UDP Ports) that the rule applies to.
Protocol	You can set this to allow only one protocol type (TCP, UDP or ICMP) or all three protocol types.

Note: When you select any of these protocols, ARP messages for the corresponding IP address range are also allowed by default. Also, the Port range values do not apply and are ignored for ICMP type messages.

MAC Filter Rules: These rules apply by checking the source MAC of the message. A rule will match a message if the source MAC matches the configured value.

Note: Messages that match any of the MAC filter rules are immediately passed (whitelist) or dropped (blacklist), and are not checked by the IP Filter Rules. Messages that do not match any filter rules in the whitelist are also immediately dropped. Messages that do not match any rules in a blacklist are passed and subsequently checked by the IP Filter Rules.

Use the "Add Entry", "Insert Entry" and "Delete Entry" buttons to manipulate the rows in the table. For each row in the table, enter the parameters:

Enable	Check this to enable the rule. To temporarily disable a rule you can clear this checkbox.
MAC Address	This is the MAC address that this rule applies to.

Save Changes: Clicking this button saves changes to non-volatile storage. Changes don't take effect until the device has been restarted. If you plan to make changes to multiple pages, use this button before navigating to another page.

Save Change and Reset: Clicking this button immediately applies the changes on you have made by saving the new configuration to non-volatile storage, then forcing the device to reset immediately. Once the device has booted, the new changes will be in effect.

DHCP Server

You can configure one device in your network to act as a DHCP server for other devices in the network. This lets you automatically assign IP addresses to devices that join the network. This is most useful when you want to access the network with a device such as tablet or PC to connect to the devices in the network at their fixed network addresses.

Note: You must ensure there is only one DHCP server on your local bridged network. When your Base site is configured as a Bridge (Default), this includes DHCP servers connected to the Ethernet network that is connected to your Base station. When your Base site is configured as a Router, the DHCP server will only operate on the radio network.

Enable	Check this box to enable the DHCP server functionality
IP Range Minimum/ Maximum	This sets the range of IP Addresses that are assigned to devices that connect to the network. Make sure that this address range does not overlap any existing fixed address assignments you have made on your network. Normally this range will be part of the same IP network address range as the other devices on your network.
Gateway IP Address	If the connected devices need a default gateway, you can enter this IP address here. Otherwise, leave this blank.
Primary/ Secondary DNS Server	If the connected devices will be using DNS (Domain Name Service) to register or lookup device names, enter the IP addresses of the primary (and secondary) DNS Servers here. Otherwise, leave these blank.
Lease Time:	This is the amount of time that connected devices are allocated an IP address. Once the lease time expires, the IP address becomes available for allocation to other DHCP client devices. The lease time in conjunction with the IP range limits the number of devices that can be assigned DHCP addresses within a particular period. If all of the available IP addresses are allocated to devices then new devices won't be able to join the network until some of the existing leases expire.

Save Changes: Clicking this button saves changes to non-volatile storage. Changes don't take effect until the device has been restarted. If you plan to make changes to multiple pages, use this button before navigating to another page.

Save Change and Reset: Clicking this button immediately applies the changes on you have made by saving the new configuration to non-volatile storage, then forcing the device to reset immediately. Once the device has booted, the new changes will be in effect.

VLAN Configuration

VLAN (Virtual Local Area Network) provides a method of segregating a single bridged network into multiple virtual networks that are logically separated. This allows segregation and prioritization of traffic in your network.

Note: VLAN is an advanced networking technique. You should only need to configure VLAN functionality if you have to interoperate with a network that already uses VLAN.

The following configuration items are available for VLAN.

VLAN Mode	To disable VLAN functionality, select mode "VLAN Passthrough". To enable the VLAN, select mode "VLAN Aware". **Note:** When you select mode "VLAN Aware", the IP Address and Subnet Mask settings on the main Quick Start page are ignored. The settings for Management IP/Netmask on this page are used instead.

Note: It is possible to configure a VLAN setup that stops your PC from accessing the device's web pages. If you are unable to access the device from the Ethernet port after configuring VLAN rules, you can either: Access the device from the USB connection; or restore the device's default network settings. For instructions, see "Restoring the factory default connection settings" on P19.

Add VLAN Group Click this button to add another VLAN Group. You can add multiple VLAN groups, with each group corresponding to a separate VLAN network. The first VLAN that you add is the Management VLAN, which provides access to the device Configuration on the new VLAN using the same IP Address as configured on the Quick Start page.

Name You can add a descriptive name for each VLAN group. By default the first VLAN is named "Management VLAN".

VLAN ID This is the 16-bit number that uniquely identifies the VLAN. Each configured VLAN Group should have a separate VLAN ID.

VLAN Priority This is the QoS priority given to messages on this VLAN when sending over the radio channel. The radio channel takes this setting into account when prioritizing access to the radio for multiple separate VLANs.

Bridge STP/ Priority These settings enable Spanning Tree Protocol on this VLAN. Spanning Tree Protocol is required where there are bridging loops which would otherwise allow packets to circulate continuously on the network.

Interface Membership for VLAN: This allows you to set which interfaces are part of the VLAN. The 215U-2 has two interfaces which can join the VLAN; The Ethernet Interface and the Wireless Interface.

Note: The USB interface is reserved for local access to the device and cannot be connected to a VLAN.

Interface Select the desired interface(s) to be connected to the VLAN. Use the "Add Entry" button to add an additional interface. (You need to select at least one interface for the VLAN to be reachable at the device)

Type This specifies how data packets will be treated when they are received on this interface (Ingress) or are transmitted on the interface (Egress).

Table 13.

Type	Ingress behavior	Egress behavior
Tagged	Packet is only accepted if it's VLAN ID matches the configured ID for this VLAN.	Packet is transmitted as a VLAN packet with the configured VLAN ID
Untagged	All non-VLAN packets are received into the VLAN.	Packet is transmitted as a non-VLAN packet.

System tools

Click **System Tools** on the menu to perform administrative tasks, such as clearing the system log, reading or writing the module configuration, or performing firmware upgrades.

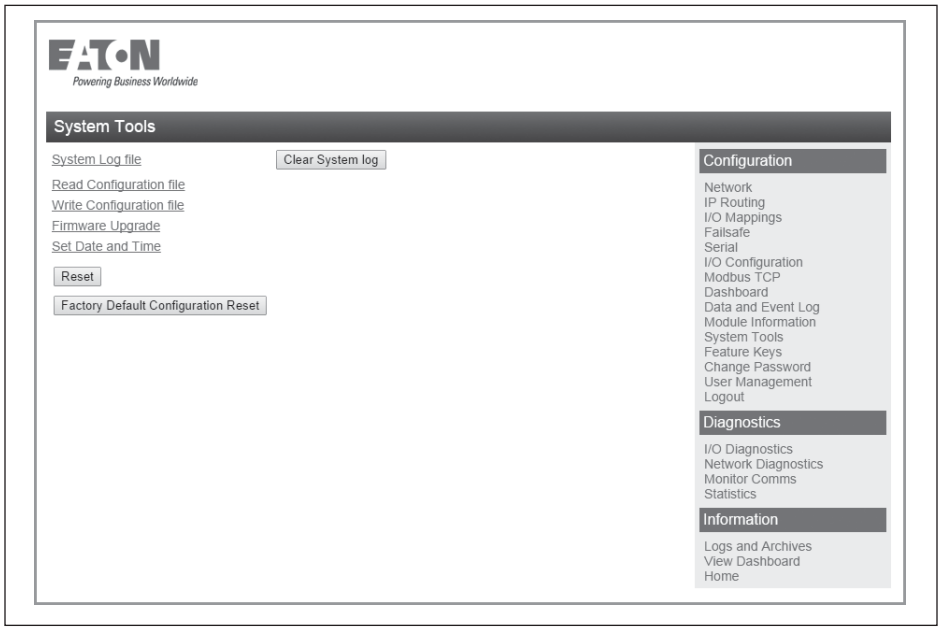


Figure 37. System tools

System Log File	Logs system instructions and other information to the screen. The log screen can then be saved to a file that may be used by ELPRO technical support to diagnose problems.
Clear System Log	Clears the log screen.
Read Configuration File	Reads the module configuration to an XML file. To save this file, select "Save As" from the File menu on your browser.
Write Configuration File	Loads a previously saved XML configuration file into the module.
Firmware Upgrade	Upgrades the module firmware. For details, see "Patch file firmware upgrade" below.
Set Date and Time	Allows you to set the date and time for the device. This feature is associated with the logging function.
Reset	Resets the module.
Factory Default Configuration Reset	Resets the module and restores its factory default configuration.

Patch file firmware upgrade

To upgrade the module firmware locally using a firmware patch file, click **System Tools** on the menu, and then click **Firmware Upgrade** and browse for the saved firmware patch file. When you locate the file, click **Send** to upload the file to the module. A status message appears. If the upgrade was successful, click **Reset**. If it was not successful, repeat the process. (The module must verify that the file is valid before you can initiate a reset.)

Note: All existing configuration parameters will be saved. However, if any new parameters are added to the firmware, the default values will be used.

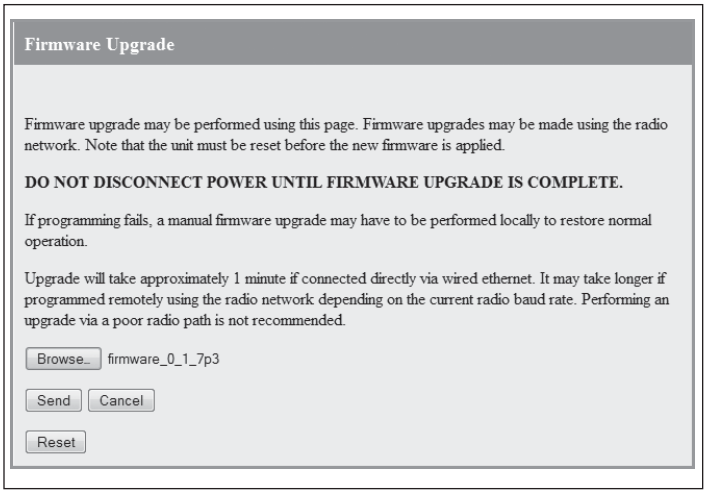


Figure 38. Firmware upgrade

Setting the date and time

This feature is associated with data logging. The module needs access to the current date and time to make effective use of data logging if this feature is enabled on the module (see "Data logging" on **page 38**).

To configure the date and time, click **System Tools** on the menu, and then click **Set Date and Time**. This displays the page in **Figure 39**. There are two ways you can set the date and time on this page:

- Manually enter the date and time.
- Enable Network Time Protocol (NTP) to retrieve the time and date from a remote time server. This method requires network access to an NTP server.

If you set the date and time manually, keep in mind that the date and time function does not support time zones or daylight savings time. Normally you should set the time to UTC (Universal Time). You can set the time to your local time, but you will need to remember to change the time if your location uses daylight savings. When the time is set manually, the module uses an internal real-time-clock to keep time during loss of power. This real time clock has power to run for at least twelve hours (typical 3-5 days). If the duration of the power loss is too long, the time at power restoration will be the time that power was lost.

To use the NTP feature, you need network access to an NTP server. You can use a public server, or set up your own server. Most modern operating systems (such as Microsoft® Windows and Linux) can be configured to operate as an NTP server. If the NTP server is on a different sub-network, you may need to configure routing rules to allow the device to reach the NTP server. Use the "Ping" command on the Network Diagnostics page to check if you have connectivity to the NTP Server IP address.

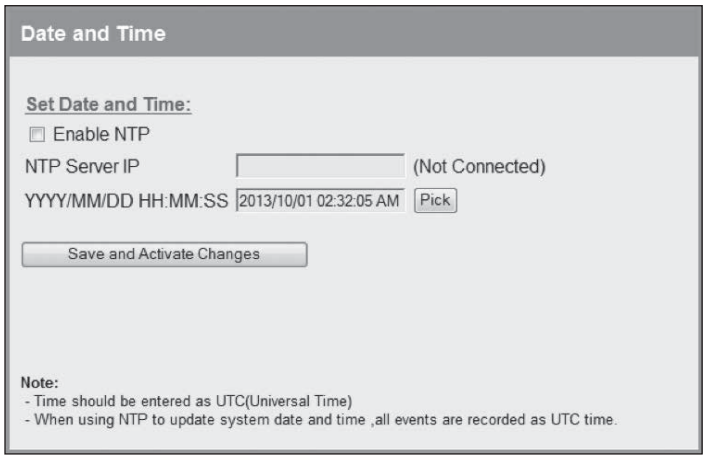
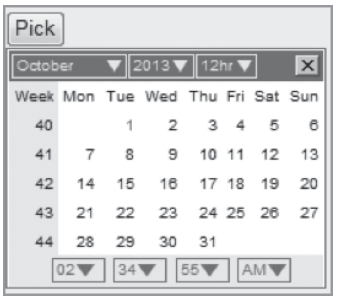


Figure 39. Date and time

Enable NTP — Select this checkbox to automatically set the time and date in the device from an external NTP server. You will also need to enter the IP address of the NTP server in the NTP Server IP field.

NTP Server IP — Enter the IP address of the NTP server if you selected the checkbox to Enable NTP.

YYY/MM/DD HH:MM:SS — Use this field to set the time manually if there is no access to an NTP server. Click **Pick** to display a date and time selection pop-up. Select the day, month, year and hour, minute and second, and click **Pick** again to set the time and close the pop-up. To set the time more precisely, try selecting a time a little in the future and waiting until that time to click **Pick**.



Save Changes and Activate — After configuring settings, click **Save Changes and Activate**.

For manual time, clicking this button sets the clock with the new time.

For NTP time, after a short delay the message next to the NTP Server IP field updates to show whether the module successfully connected to the NTP server. If the message is "Not Connected," check that the NTP server is configured correctly, and use the Ping command on the Network Diagnostics page to check that the module can reach the NTP server. After connecting to the NTP server, the displayed time changes to match the NTP server. This is normally UTC time.

Feature license keys

Feature license keys allow you to upgrade the 215U-2 module with enhanced features or to a more advanced model (for example, by enabling the data logging option). You can purchase the feature license keys by contacting your sales representative or local distributor. To complete the purchase, you will need to provide the module serial number so that the feature license key can be generated for the module. The module serial number can be found on the home page (see **Figure 40**).

After receiving the feature key certificate, follow the instructions in "Enabling a feature license key" on this page to install the feature on the module. You can also temporarily enable all feature license options by placing the module in demonstration mode. See the following section, "Using demonstration mode"

Click **Feature Keys** in the menu to enable or demo feature license key options (**Figure 40**).

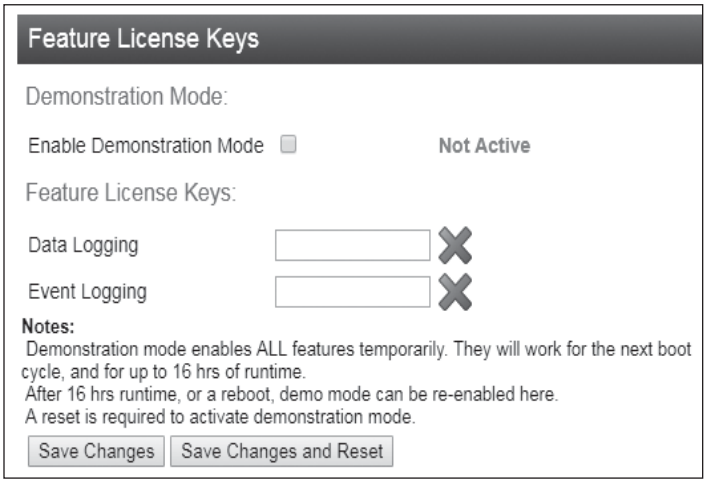


Figure 40. Feature keys

Demonstration Mode	Allows you to temporarily enable all feature license options. See the following section, "Using Demonstration Mode."
Feature License Keys	Allows you to enable advanced features after purchasing a feature license key. See "Enabling a feature license key" on this page.

Using demonstration mode

The demonstration mode option on the Feature License Keys page (**Figure 40**) temporarily allows full operation of all feature license options for 16 hours, or until the module is restarted. This allows you to try out the feature without purchasing the feature key. When the demonstration period is up, the module is restarted and demonstration mode is turned off.

To enable demonstration mode

1. Click **Feature Keys** on the menu.
2. Click to select the **Enable Demonstration Mode** checkbox.
3. Click **Save Changes and Reset**.
4. Wait for the module to complete the restart, and then click **Continue**.
   After the module resets, the message "Active" appears, indicating that the demonstration mode is activated.

Enabling a feature license key

Use the following procedure to enable a purchased feature license key.

To enable a feature license key

1. Make sure that the module serial number on the feature key certificate (**Figure 41**) matches the serial number on the label on the left side of the module.

Figure 41. Example feature key certificate

2. Click **Feature Keys** on the menu.
3. Enter the key value from the certificate into the field next to the feature.
4. Click **Save Changes**.
   If the feature license key is valid, a green checkmark appears next to the key. If the key is invalid, a red cross appears. Feature license keys are retained even if the module is returned to factory default settings.
5. If the code is valid, activate the feature by clicking **Save Changes and Reset**.

Changing your password

You can change your password by clicking **Change Password** on the menu and entering the new password in both password fields. Click **Save and Activate Changes** to change your password. Passwords must be at least eight characters.

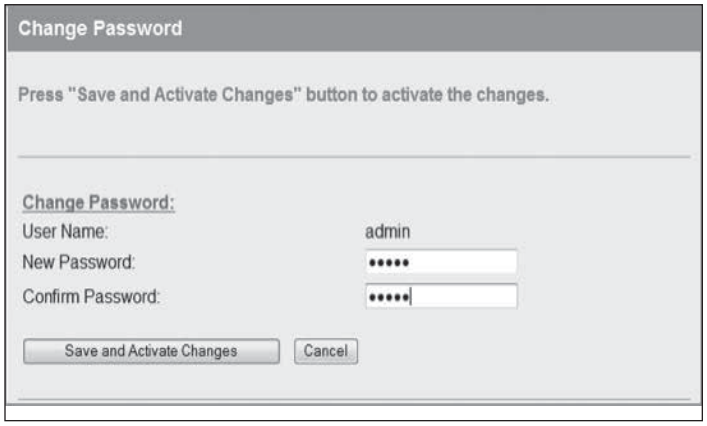


Figure 42. Change password

User management

Users with Admin privileges can click **User Management** on the menu to configure access to the module (see **Figure 43**). An Admin can add new users, change user passwords, or retire (deactivate) user access. The Admin assigns each user a "role" which limits the functions available to them according their operational needs.

Note: You cannot delete individual users from the system, but can deactivate user access by "retiring" the user. If you need to delete all user information from the module and restore the factory default user settings, see "Restoring the factory default user configuration" on **page 42**.

There are three user roles:

- **Operator**—Can view information on the device, but cannot change configuration.
- **Manager**—Can view information and change the device configuration, but cannot modify the list of users allowed to access the device.
- **Admin**—Has all of the permissions of a Manager, plus the ability to modify the user list, user passwords, and access levels. (All users can change their own passwords.)

The module comes from the factory with two default users.

Table 14. Users

Default user name	Default password	Role
admin	admin	Admin
user	user	Manager

Access to menu items is restricted by the user's role, as shown in the following table. If you click a menu item and do not have sufficient access privileges, you are prompted to enter a username and password with the necessary access privileges.

Table 15. Access privileges

Menu item	Operator	Manager	Admin
Network	—	Yes	Yes
IP Routing	—	Yes	Yes
I/O Mappings	—	Yes	Yes
Fail Safe Configuration	—	Yes	Yes
Serial	—	Yes	Yes
I/O Configuration	—	Yes	Yes
Modbus	—	Yes	Yes
Module Information	—	Yes	Yes
System Tools	—	Yes	Yes
Feature Keys	—	Yes	Yes
Data and Event Log	—	Yes	Yes
Change Password	Yes	Yes	Yes
User Management	—	—	Yes
I/O Diagnostics	Yes	Yes	Yes
Connectivity	Yes	Yes	Yes
Logs and Archives	Yes	Yes	Yes
Home	Yes	Yes	Yes

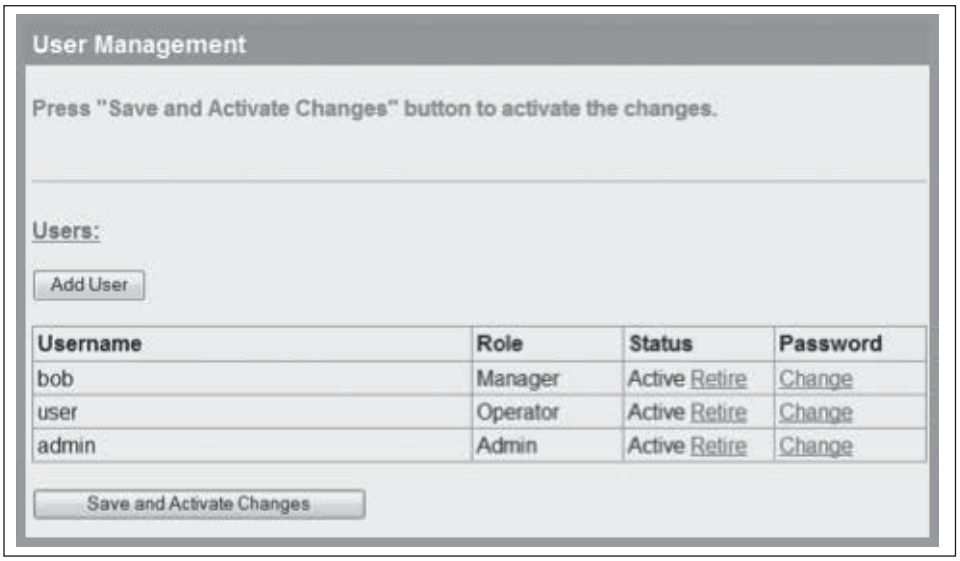


Figure 43. User management

To add a user

1. Click **User Management** on the menu.
2. Click **Add User**.
3. Enter a username and password, and confirm the password. Passwords must be at least eight characters.
4. Select a role for the user.
5. Click **Create** to add the user.
6. To add additional users, repeat steps 2 through 5.
7. When you have finished adding users, click **Save and Activate Changes**.

To retire a user

1. Click **User Management** on the menu.
2. In the Status column for the user, click **Retire**.
3. Click **OK** to confirm.
   The user's status changes from "Active" to "Retired."
4. Click **Save and Activate Changes**.
   This disables access to the module by the retired user.

To change a user password

1. Click **User Management** on the menu.
2. In the Password column for the user, click **Change**.
3. Enter a new password for the user and confirm the new password.
4. Click **Apply**.
5. Click **Save and Activate Changes**.

Recovery after lost admin password

If you lose the password for your admin account you can revert to the default password by resetting the device configuration to factory default. Refer to the section [Restoring the factory default settings] on p42.

Diagnostics

This chapter describes network diagnostic tools and information available from the module's Web-based configuration utility. To access this utility, see "Connecting and logging on" on **page 15**.

IO diagnostics

Click **IO Diagnostics** from the home page of the Web-based configuration utility to read and write I/O store registers within the module.

To read a register location, enter an address location (for example, 10001 for digital inputs), enter a count (number of consecutive registers), and then click **Read** (see **Figure 44**). The returned address location and the returned values appears at the bottom of the page.

To write to outputs, enter the address location, count, and value, and then click **Write**. You will see the outputs change to the value you entered. For example, write to Register 1 with a count of 8 and a value of 1 will turn all the local digital outputs on. Write to Register 40001 with a count of 2 and a value of 49152 will set the two local physical analog outputs to 20 mA.

Note: If the value "~" appears at the bottom of the page when reading a register, it indicates that the register has been initialized to the "Invalid" state through the fail-safe configuration and therefore has no value (not even zero).

A mapping will only be sent when all registers have a value. To set an initial value for registers upon startup, use the Fail-safe Block Configuration menu in the Web-based configuration utility or use the MConfig utility (see "Fail-safe blocks" on **page 15**). If there is a mapping configured and any one of the source register values has the value "~" the mapping will not be sent (see "Invalid register state" on **page 15**).

Using the I/O Diagnostics page, you can check the register locations for the "~" values and even write values if required. If you see the value "3" when reading the status of the DIO on the module it indicates that the DIO is being used as an output in the "on" state.

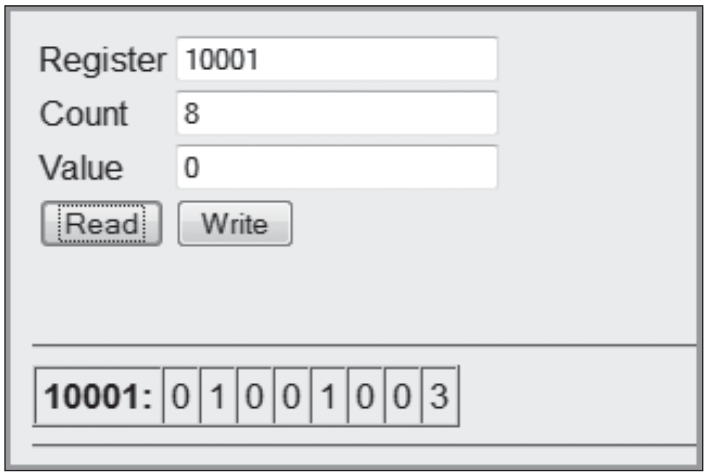


Figure 44. I/O diagnostics

Register	Register address location.
Count	Number of consecutive registers, starting from the register location specified in the Register field.
Value	Value to be written.
Read	To read a register location, enter an address location (for example, 10001 for digital inputs), enter a count (number of consecutive registers), and then click **Read**.
Write	To write to outputs, enter the address location, count, and value, and then click **Write**.

Watchdog error log

The module uses a various processes to control aspects of its internal functions, such as radio operation, I/O functionality, and Modbus communications. Each process runs independently, and can interact with the other processes to provide a robust wireless I/O product.

All processes are monitored by an internal "watchdog." If a processes has a problem and stops running, the watchdog will identify the problem and restart the module. The watchdog also creates a text file showing which process had the problem. This text file is stored in a directory called "dog" off the main root IP address of the module. To display this text file in your browser, enter http://<Device IP Address>/operator/.

If the watchdog directory continues to show text files, it may indicate a problem with the module or its configuration. If this happens, save the module configuration (see "System tools" on **page 28**) and the list of watchdog files, and then contact Eaton technical support.

The following table describes the different watchdog processes.

Table 16. Watchdog process

Watchdog process	
A00	Internal process monitor
A01	I/O processing application
A02	Fail-safe manager application
A03	Modbus application
A04	I/O mapping application
A06	AODV meshing protocol application
A07	Data logging application
A15	Warm restart backup

Module information registers

Certain registers in the module show modules characteristics, such as the serial number, firmware version, and so on. This information is available on the home page of the module's Web-based configuration utility. However, having the information available in registers allows a host system to read the values via Modbus, if Modbus has been activated.

- Register 30494, 30495 and 30496 = Module serial number
- Register 30497, 30498 and 30499 = Module firmware version
- Register 30500 = Firmware patch level

Expansion I/O error registers

The 215U-2 has diagnostics registers allocated for each expansion I/O module. These registers indicate the module type, error counts, error codes, and so on. Each expansion I/O module has the following registers.

- 30017 + Offset = Modbus error counter (number of errors the modules has had)
- 30018 + Offset = Last 115S status code/Modbus error code

Register 30018 will display one of the following 115S status codes (hexadecimal code 1–5 and 81), as well as displaying Modbus response codes similar to what is shown on **page 55**, but with the most significant byte being one of the following values, 82, 84, 8F or 90.

Table 17. Expansion I/O Status Codes

Dec code	Hex code	Name	Meaning
1	0001	No Response	No response from a poll
2	0002	Corrupt/invalid	Corrupt or invalid data
3	0003	CRC Fail	CRC error check does not match the message. Indicates this a different message or possible data corruption.
4	0004	Response did not match request	The response heard was not the correct ID; possibly heard other RS-485 traffic.
5	0005	Message type did not match request	The response heard did not match the requested poll (different command response); possibly heard other RS-485 traffic.
129	0081	Problem accessing local memory	Could not access register location, possibly because the register is not initialized.
> 32768	??01- ??0B	Standard Modbus Error Codes	As per **page 51**

- 30019 + Offset = Modbus Lost Link Counter (number of Communication Errors)
- 30020 + Offset = Modbus Module Type:

  dec 257 (101 hex) indicates a 115S-11
  dec 513 (201 hex) indicates a 115S-12
  dec 769 (301 hex) indicates a 115S-13

Diagnostic registers—device statistics

Commonly used statistics for diagnostics and system monitoring can be accessed in onboard I/O Registers. via an external device using any of the supported I/O transfer protocols (WIB, MODBUS).

When statistics logging is enabled, the statistics are logged to

RSSI: The signal strength to the upstream device (Repeater or base station)

Connected Time: The amount of time the current upstream connection has been established (in hours)

Generation Count: The number of times the current upstream connection has been established. This value is 1 when the device first connects, then if the link is lost it increments once each time the link is re-established. Note that if both the upstream device and the local device are re-started, the Generation count will reset to 1. If only one device is re-started, then the generation count is designed to be retained.

Upstream IP Address: The address of the Upstream device (Base, Repeater or Manual Mode Access Point).

The following information about the device uptime is available for all devices:

Module Uptime: The amount of time the module has been powered on. You can compare this against the connected time to determine if the module has been losing link.

Analog Input Registers. These are listed in detail in "Input registers" on **page 45**.

Statistics registers provide the following information about the upstream connection (Towards the base station). If the module is configured as a base, or configured in manual mode without any Client functionality, then these registers will be zero.

Channel and radio statistics are available for all devices, and are available averaged over the last minute, last hour, and last 60-hour periods.

Channel Utilization: This is the percentage of time the radio channel has been busy with radio transmissions from any devices within receiving range of this device.

Background Noise: This is the background noise level on the radio channel when the radio is not receiving valid data.

Retried Transmissions: This is the percentage of radio transmissions that were successful, but required at least one re-transmission before they were acknowledged. This statistic does not apply to broadcast transmissions, which are not acknowledged.

Failed Transmissions: This is the percentage of transmissions that were unsuccessful due to not receiving an acknowledgement message to any of the re-transmissions. This statistic does not apply to broadcast transmissions, which are not acknowledged.

Statistics registers also record information about downstream connections. These registers are used by all devices that have downstream connections—Base station, Repeater, and Manual Mode Access Points. For Manual Mode clients, and for Field Station devices, these registers are unused and available as general purpose storage.

RSSI List:	This is a block of 255 register locations. For each downstream device, the last byte of the device's IP address is used to determine which location to store the signal strength. For example, a downstream device with IP Address 192.168.0.199 will have its RSSI stored in I/O register offset 199. If no device is connected with the IP address, the register has the value Zero.

Monitoring communications

Monitor IP comms on Ethernet port

Click **Monitor IP Comms** on the home page of the Web-based configuration utility to view the IP communication data frames. From here you can decode the data frame and read the transmitted and received I/O values.

Note: This data is output in tcpdump format.

Data logging

The data logging feature allows you to record the status of I/O registers on a regular basis. Data is saved to non-volatile memory, and can be retrieved at a later time. You can enable data logging on 215U-2 version 2.0 modules with the purchase of a feature key license (see "Feature license keys" on **page 31**).

Data is logged to an internal data file in ".csv" format. Each row of the file is a single record, consisting of a timestamp and values of all of the configured log items at that time. When the file reaches a configured maximum number of rows, the file is "rolled," that is, the file is compressed and archived and a new log file is created.

The amount of memory available for storing logged data depends on the device type. The available data logging memory is indicated in the log files. When the memory is full, the oldest data log file is deleted.

Table 18. Data logging

Device	Data logging memory
215U-2	200 KB
215U-2XM	200 MB

Configuring data logging

To configure data logging, you need to specify how frequently the data is to be stored, what data is to be stored, and the maximum number of records stored in each log file. Click **Data and Event Log** on the home page of the Web-based configuration utility to configure these settings (see **Figure 46**).

Note: You need Administrator or Manager privileges to configure data and event logging.

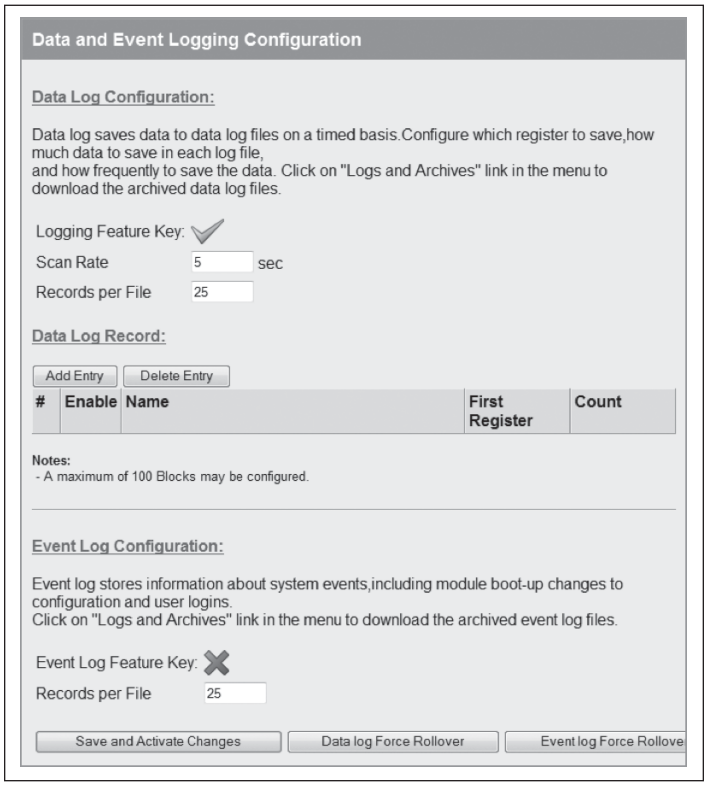


Figure 45. Data and event logging configuration

Data log configuration

Scan Rate — Enter the rate that you want data to be recorded (fastest rate is every 5 seconds).

Records per File — Enter the maximum number of records you want in a file (up to 3,000 records per file). When the maximum is reached, the file is archived and a new data log file is created.

Data Log Record — Each entry in this table specifies a block of registers to be included in the log. To add an entry, click Add Entry and fill in the Name, First Register, and Count information. Select the Enable checkbox to enable data logging for the block. You can configure up to 100 register blocks. Use Delete to remove an entry that you no longer want.

For a configuration example, see **Figure 47** and **Table 20**.

Enable — When this checkbox is selected, data logging is enabled for this block of registers. When it is cleared, a placeholder symbol "-" is stored to the log file.

Name — Name to appear in the column heading within the log file to identify data for this entry. If no name is entered, the register number is used as the column heading.

First Register — Address of the first register to be logged.

Count — Number of registers to be logged.

Event Log Configuration — These settings apply only to modules that have the 915U-AT (Audit Trail) feature key enabled. Event Logging is discussed in a separate document.

The configuration example in see **Figure 47** will log six registers in each log record. **Table 20** shows an example of the logged data for this configuration.

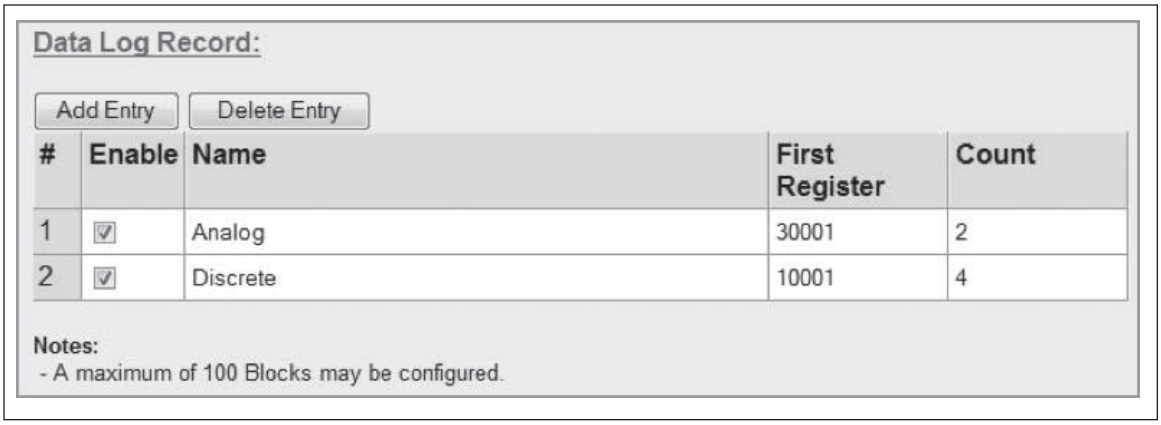


Figure 46. Data log record

Table 19. Data log example

Timestamp	Analog01	Analog02	Discrete01	Discrete02	Discrete03	Discrete04
2014-04-08 03:43:47	8192	8192	0	0	0	0
2014-04-08 03:43:52	8192	8192	0	0	0	0
2014-04-08 03:43:57	8192	8192	0	0	0	0
2014-04-08 03:44:02	8192	8192	0	0	0	0
2014-04-08 03:44:07	8192	8192	0	0	0	0

Viewing current data

To view the latest logged data, click **Logs and Archives** on the home page of the Web-based configuration utility. The latest data is shown in a ".csv" format on the screen.

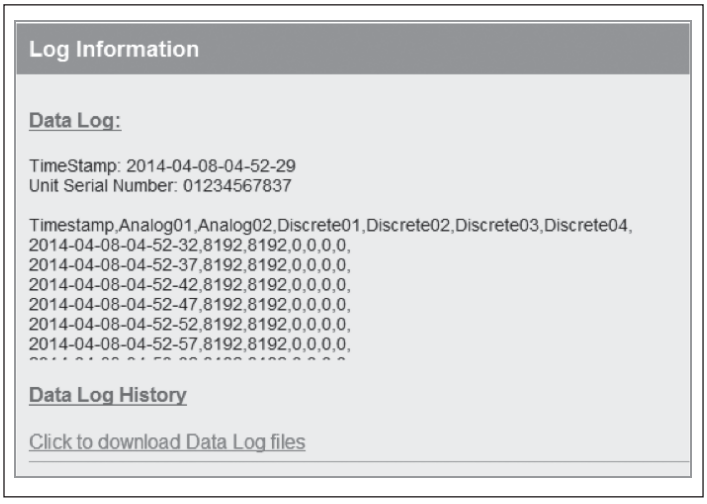


Figure 47. Log information

Retrieving logged data

The module supports remote retrieval of files via HTTP and FTP, as well as local retrieval of files via USB flash drive.

To retrieve logged data files via HTTP

1. Click **Logs and Archives** on the home page of the Web-based configuration utility.
2. Click the link "Click to download data log files."
   This displays a listing of all of the stored data log files. Files are named with the time and date created and the module serial number, in the format yyyymmddhhmmss-nnnnnnnnnnn-DAT.log.

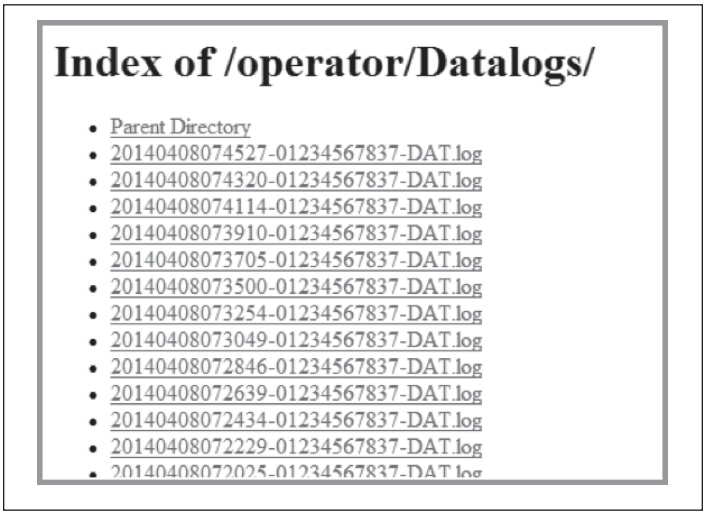


Figure 48. Data log listing

3. Right-click the file that you want to retrieve.

4. Click **Save Target as** to save the file to your local computer.

To retrieve logged data files using a USB drive

1. Make sure that the USB drive is formatted for a FAT file system. This is the normal file system on USB drives.
2. Create a directory named "logs" (all lowercase) on the USB drive.
3. Using a small screwdriver, open the hatch on the side of the module.
4. Plug the USB drive into the USB Host port (see **Figure 50**). Within 10 seconds, the module should recognize the USB drive and the OK LED should flash red-green. If the module does not recognize the USB drive, check to make sure that the drive is formatted with FAT file system and that it contains a directory named "logs".

   When the USB drive is recognized, the module copies the data log files to the USB drive. Once all files are copied, the OK LED turns solid green. The data log files are not deleted from the module when they are copied to USB drive.

   If the module encounters an error or if the USB drive does not have sufficient space to fit all of the files, the OK LED turns solid red to indicate a failure. Remove the USB drive and try another one until the files are successfully transferred and the OK LED turns green.

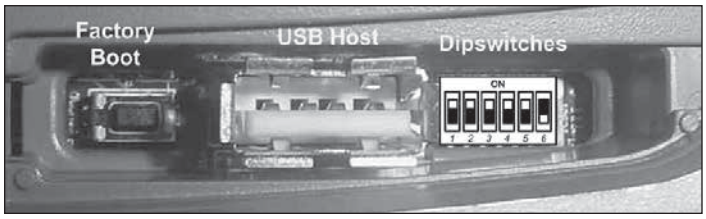


Figure 49. USB port

5. Remove the USB drive from the module USB port. The log files are contained in a directory under the "logs" directory. This subdirectory is named with the module device name, or the module serial number if no device name was configured for the module. The device name is configured on the Module Information configuration page. The following example shows the contents of a USB drive after retrieving log files from a module. In this example, the module serial number is 01234567837.

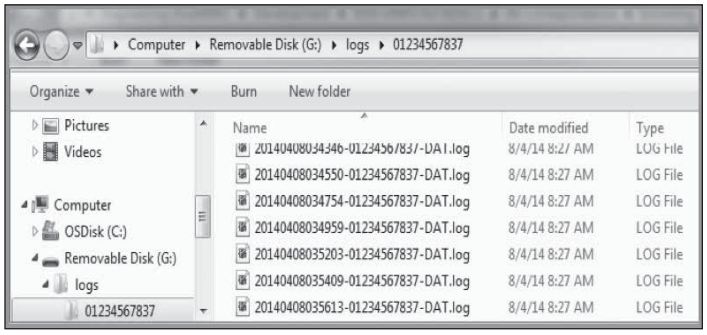


Figure 50. Log file directory on USB drive

You can leave the files on the USB drive. The next time you plug in the USB drive, only the new files are retrieved from the module. You can also use the same USB drive to retrieve data from multiple modules. The data for each module is stored in a separate directory.

If you configure your modules with a device name, the data is stored in a directory with that name. Take care that each module has a unique device name. Data from modules with the same device name will be stored in the same directory.

Retrieving stored log file data

The log files are stored in comma-separated-value (.csv) format. To increase storage space, each log file is compressed using the Tar-Gzip method when it is stored to internal flash memory. The log files can be opened and the compressed .csv files recovered using an archive manager, such as 7-Zip, that can operate with Tar-Gzip (.tgz) files.

Specifications

Specifications for the 215U-2 are provided in the following table.

Table 20. 215U-2 specifications

Item	Specification
Input/Output	
Discrete Input	8 Digital I/O (1–4 Configurable as Pulsed Input or Output) On-State Voltage: < 2.1 Vdc Wetting Current: 3.3 mA Max I/P Pulse Rate: DI 1/2: 50 kHz; DI 3/4: 1 kHz Min I/P Pulse Width: DI 1/2: 10 µsec; PI 3/4: 0.2 msec
Discrete Output	8 Digital I/O (1–4 Configurable as Pulsed Input or Output) On-State Voltage: DO Max, < 0.5 V Maximum Current: 200 mA Max O/P Pulse Rate: PO Max Rate, 1 kHz
Analog Inputs	4 AI (2 Differential, 2 Single Ended) Current Range: 0–24 mA Current Resolution: 14 bits Accuracy (Current): 0.1% Voltage Input Range: AI 1/2: 0–20 V, AI 3/4: 0–5 V Voltage Resolution: 14 bits Accuracy (Voltage): 0.1% full scale
Analog Output	2 AO (Sourcing) Current Range: 0–24 mA Current Resolution: 13 bits Accuracy (Current): 0.1% (20 µA)
Ethernet Ports	
Ethernet Port	10/100base®; RJ-45 Connector, IEEE 802.3
Link Activity	Link, 100Base via LED
Serial Ports	
RS-232 Port	EIA-562 (RJ-45 Connector)
RS-485 Port	2-Pin Terminal Block, Non-isolated ①
Data Rate (Bps)	1200, 2400, 4800, 9600, 14400, 19200, 38400, 57600, 76800, 115200, 230400 bps
Serial Settings	7/8 Data Bits; Stop/Start/Parity (Configurable)
Protocols and Configuration	
Protocols Supported	TCP/IP, UDP, HTTP, FTP, TFTP, Telnet, Modbus RTU Master/Slave, Modbus-TCP Client/Server, WIB I/O
User Configuration	All User Configurable Parameters via HTTP
Configurable Parameters	Unit details, I/O mappings and parameters. For configuration details, see in this manual. Modbus TCP/ RTU Gateway Embedded Modbus Master/Slave for I/O Transfer
Security	Data Encryption: 802.11 Encryption Standards to WPA-2 with 128-bit AES encryption
LED Indication/Diagnostics	
LED Indication	Power/OK; Wireless Link/Activity; RS-232; RS-485; Digital I/O; Analog I/O Status
Reported Diagnostics	Connectivity Information/Statistics, System Log File
Compliance	
EMC	EN 301 489-17
Hazardous Area	UL Class 1, Division 2; ATEX; IECEx Na IIC (ATEX, IEC Ex Pending)
Safety	EN 62368 (RoHS Compliant, UL Listed)
Radio	FCC Part 90, AS/NZS 4268, EN 300 328
General	
Size	5.91" x 7.09" x 1.38" (180 mm x 150 mm x 35 mm)
Housing	IP20 Rated PolyCarbonate
Mounting	DIN Rail
Terminal Blocks	Removable; Max Conductor 12 AWG 0.1 in^2 (2.5 mm^2)
Temperature Rating	–40 to +160 °F (–40 to +70 °C)
Humidity Rating	0–99% RH Non-condensing
Weight	1.1 lb (0.5 kg)
Power Supply	
Nominal Supply	15 to 30 Vdc; Under/Over Voltage Protection
Battery Supply	10.8 to 15 Vdc
Average Current Draw	230 mA @ 12 V (Idle), 150 mA @ 24 V (Idle)

Note: Specifications subject to change.

① Maximum Distance 4000 ft (1219.2 m).

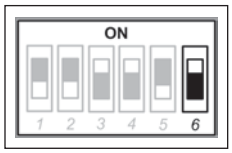
Troubleshooting

Restoring the factory default connection settings

You can use this procedure to restore the device to the factory default configuration if you don't have access to credentials to access the device. You will need a USB cable and USB driver files installed on your computer to complete this procedure (see below).

Note: The following procedure will delete all configuration, user accounts and log files from the device.

1. Open the side configuration panel on the module, and set DIP switch #6 to "on."

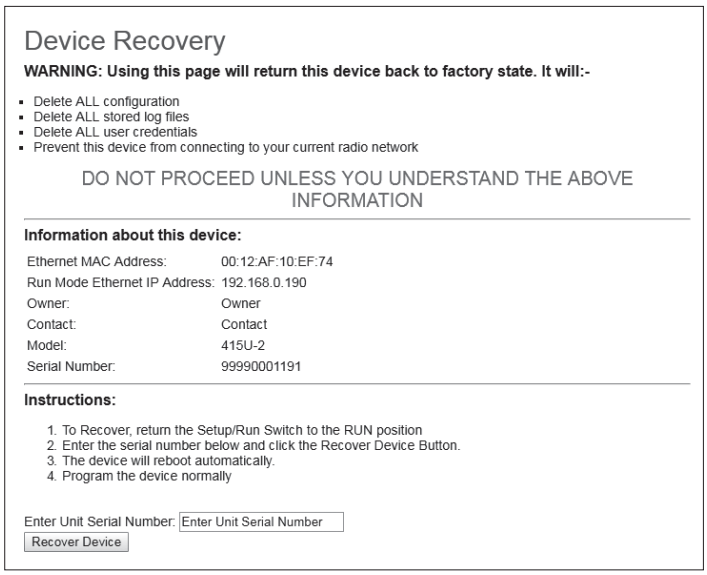


2. Power cycle the module.

When the 215U-2 is powered on with DIP switch #6 set to "on," the module goes into a special mode that allows you to restore the device to factory configuration.

Once the device has powered up, connect to the USB port. The USB port is located on the bottom side of the module. (Refer Figure 11 "Bottom Panel Connections"). To connect, you need an USB cable (USB-A to USB-B) for connecting from your computer to the module's USB-B port . If this is the first time you have used your computer to connect to an ELPRO device through the USB port, then you will need to download the USB driver file from the product's internet website. This is available from the same location that you downloaded this user manual. The filename is "ElproUSB.inf".

Open your web browser, and enter the IP address 192.168.111.1. You should see the following page:



Enter the device serial number (as an additional precaution against accidentally deleting the device), Set DIP switch 6 to "off", and click "Recover Device". Click "OK" to start device recovery. Once you have clicked OK, disconnect the USB Cable. Once the device has restarted, you can plug the USB cable back in to access the device using the default credentials.

Important: Remember to set DIP switch #6 to "off" and power cycle the module to return to normal operation after you have completed configuration. Otherwise, the module will continue to boot into the default IP address

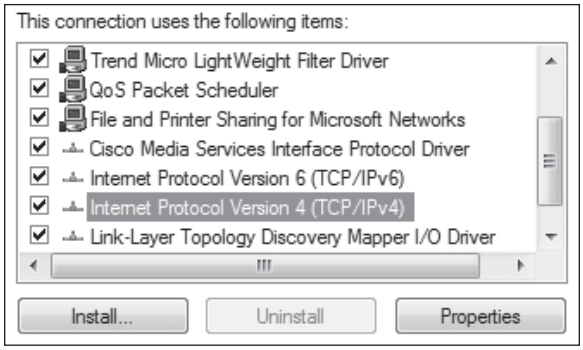
Configuring PC networking settings for Ethernet and Wireless

If you are unable to connect to the device through either the Ethernet or Wireless connection, use this guide to ensure you have your PC configured correctly.

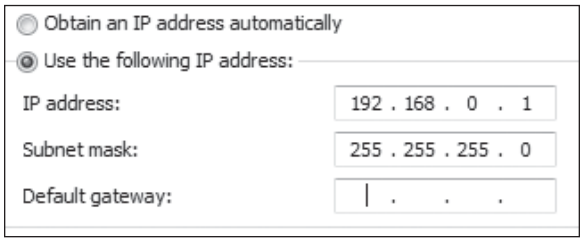
Note: To connect Wirelessly you need to have first configured the module to accept the PC wireless connection. See section "Connecting your device to an existing 215U-2 network" on **page 12** for more information.

(The following description is for Windows 7. Other operating systems have similar settings)

1. On the PC, open Control Panel, then select **Network and Sharing Center**.
2. Click "**Change Adapter Settings**" on the left of the screen. You should see a list of available network adapters.
3. Find the correct network connection in the list. For Ethernet, this will normally be "**Local Area Connection**". For Wireless connection, this will normally be "**Wireless Network Connection**"
4. Right click on the network connection and select **Properties** from the context menu.
5. Select "**Internet Protocol Version 4 (TCP/IPv4)**" and click on **Properties**.



6. On the General tab, select **Use the following IP address**: and enter IP address 192.168.0.1, and subnet mask 255.255.255.0, then click **OK**.



Note: If you have configured your 215U-2 network to provide IP addresses via DHCP, you should select "**Obtain IP address automatically"**.

7. Verify the Ethernet connection to the module by using the "ping" command. Start a command window (click **Start** menu and type "command" into the search box). At the command prompt, type "ping <IP Address>. If you have restored the default connection settings, then the IP address will be the address printed on the module's side label.

Configuring PC networking settings for USB

You should normally be able to connect to the USB without any additional setup. The 215U-2 is configured to automatically assign IP address to devices connecting to the USB through DHCP. If you are unable to connect, then you may need to set your PC to request the IP address from the 215U-2.

(The following description is for Windows 7. Other operating systems have similar settings)

1. On the PC, open Control Panel, then select **Network and Sharing Center**.
2. Click "**Change Adapter Settings**" on the left of the screen. You should see a list of available network adapters.
3. Find the correct network connection in the list. This will be named "Local Area Connection XX" and have description "Elpro 215U-2 USB Ethernet/RNDIS".
4. Right click on the network connection and select Properties from the context menu.
5. Select "**Internet Protocol Version 4 (TCP/IPv4)**" and click on **Properties**.
6. On the **General** tab, ensure **Obtain IP Address automatically** is selected.
7. Verify the Ethernet connection to the module by using the "ping" command. Start a command window (click Start menu and type "command" into the search box). At the command prompt, type "ping 192.168.111.1".

LED function

Front panel LEDs

When the module is initially connected to power, it performs internal setup and diagnostics checks to determine if it is operating correctly. These checks take approximately 80 seconds. The following table shows how the LEDs appear when the module is operating correctly.

Table 21. Front panel LEDs

LED	Condition	Meaning
PWR	Green	System OK
PWR	Red	System boot (initial or system fault)
PWR	Orange	Start of system boot
PWR	Fast Flash	System boot, stage 1
PWR	Slow Flash	System boot, stage 2
RF	Green	RF Link established
RF	Flash Off from Green	Radio Receive (RF Link established)
RF	Flash Green from Off	Radio Receive (No RF Link)
RF	Orange Flash	Radio transmit
232	Green	Transmitting RS-232 data
232	Red	Receiving RS-232 data
232	Orange	Transmitting and receiving RS-232 data
485	Green	Transmitting RS-485 data
485	Red	Receiving RS-485 data

LED boot sequence

Upon reset, the PWR LED appears solid red for about 2 seconds (system boot), followed by 12 seconds of Orange (start of system boot process). The PWR LED then fast flashes between red and green for 30 seconds (stage 1 of system boot process) followed by a slow flashes for 50 seconds (stage 2 of system boot process). At the end of the boot sequence the PWR should appear solid green. The time periods are approximate, and depend on the hardware and firmware revisions.

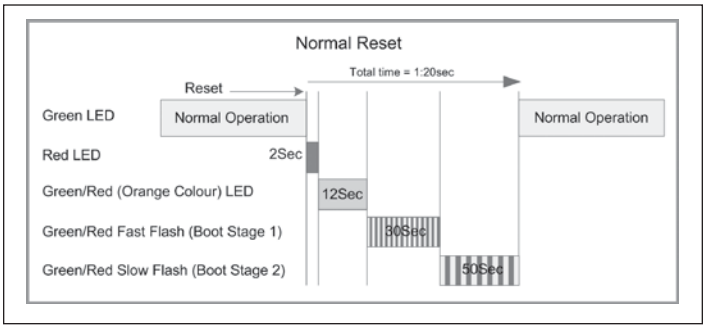
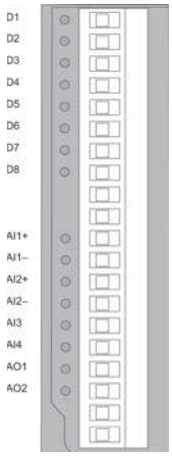


Figure 51. Boot sequence

Input and output LEDs



LED indicator	Condition	Meaning
D 1–8	Orange	Digital input is on
D 1–8	Flashing Orange -(Long On)	Update failure (fail-safe state is on)
D 1–8	Flashing Orange -(Long Off)	Update failure (fail-safe state is off)
AI 1 and 2 +	Orange	Analog input current indication
AI 1 and 2 –	Orange	Analog input voltage indication
AI 3 and 4	Orange	Analog input current or voltage indication
AO1 and 2	Orange	Analog output current indication

Digital inputs

LEDs display the status of each of the eight DIOs when used as inputs. If the LED is on, it indicates that the input is on.

Digital outputs

When the DIOs are used as outputs, the LEDs display the status of each of the digital outputs. If an LED is on, it indicates that the output is on. The LEDs also indicate if the output is in a fail-safe state by flashing at different rates. If an LED is mostly on (long on) it indicates that the fail-safe state shown on the Digital Output Configuration page is on. If an LED is mostly off (long off) it indicates that the fail-safe state shown on the Digital Output Configuration page is OFF. See "Fail-safe blocks" on **page 15** for details.

Analog inputs

There are two LEDs for each differential analog input. The first LED (+) is used to indicate that the analog input is reading a current (mA). The second LED (–) indicates that the input is reading voltage. Each of the analog input LEDs will come on when there is a signal present at the analog input.

Analog outputs

Each analog output has an LED in series that indicates the output current by increasing or decreasing the intensity of the LED. For example, at 4 mA the LED appears dimmed, and at 20 mA, the LED appears bright.

Ethernet LEDs

On the end plate, the Ethernet socket incorporates two LEDs that indicate the Ethernet status.

- **100 M**—Green LED indicates presence of a 100-Mbps Ethernet connection. With a 10-Mbps connection, the LED is off.
- **LINK**—Orange indicates an Ethernet connection. The LED briefly flashes with activity.

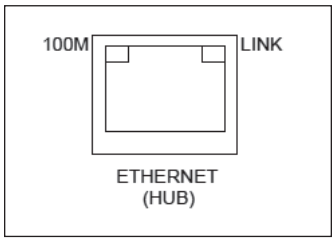


Figure 52. Ethernet socket

Register memory map

Digital output registers (coils)

Address range	Description
0001 – 0008	Local DIO1–DIO8 as digital outputs
0009 – 0020	Spare
0021 – 0400	Space for locally attached 115s expansion I/O modules. Twenty register per module address, maximum number of modules is 19.
0401 – 6000	General purpose bit storage used for: Staging area for data concentrator; Fieldbus mappings storage; Force mapping registers
6001 – 10000	Not Available

Digital input registers (bits)

Address range	Description
10001 – 10008	Local DIO1–DIO8 as digital inputs
10009 – 10020	Set point status from analog inputs 1 through 12
10021 – 10400	Space for locally attached 115s expansion I/O modules. Twenty register per module address, maximum number of modules is 19.
10401 – 16000	General purpose bit storage used for: Staging area for data concentrator; Fieldbus mappings storage;
16001 – 20000	Not Available

Input registers (words)

Address range	Description	
30001 – 30004	Local AI1–AI4 (analog inputs, current mode) AI1 and AI2: 4–20 mA differential AI3 and AI4: 4–20 mA sink	
30005	Local supply voltage (0–40 V scaling)	
30006	Local 24 V loop voltage (0–40 V scaling)	
30007	Local battery voltage (0–40 V scaling)	
30008	115S supply voltage (0–40 V scaling)	
30009 – 30010	Local AI1, AI2, Voltage Mode. 0-24V Scales to 0-24mA.	
30011 – 30012	Local AI3, AI4, Voltage Mode. 0-5V Scales to 0-20mA	
30013 – 30016	Local pulse input rates: PI1–PI4	
30018 – 30020	Spare	
30021 - 30400	Space for locally attached 115s expansion I/O modules. Twenty registers per module address, maximum number of modules is 19.	
30401	RSSI: When configured as a Remote, Repeater, or Manual Client, the RSSI of the connected upstream device in –dBm	
30402	Connected Time: When configured as a Remote, Repeater, or Manual Client, the time (in hours) that the connection to the upstream device has been made.	
30403	Generation Count: When configured as a Remote, Repeater, or Manual Client, the generation count of the connection to the upstream device. This is the number of times the connection has been lost and re-established	
30404 – 30405	Upstream IP Address: When configured as a Remote, Repeater, or Manual Client, the IP Address of the upstream device.	
	Most Significant Byte	High byte of Register 30404
	Second Byte	Low byte of Register 30404
	Third Byte	High byte of register 30405
	Least Significant Byte	Low byte of register 30405
30406	Radio 802.11 Channel number (1 – 13)	
30407 – 30408	Radio Transmit Frequency (in MHz). 32-bit. Most significant word at lower (odd) address.	
30409 – 30410	Radio Receive Frequency (Same as Transmit Frequency)	
30411	Module uptime: The time (in hours) that this module has been up and running	
30412	Channel Utilization % (average of last 60 seconds)	
30413	Background Noise (average of last 60 seconds)	
30414	Tx retry % (average of last 60 seconds): The percentage of total transmissions that required at least one retry	
30415	Tx failed % (average of last 60 seconds): The percentage of total transmissions that failed to get an acknowledgement after all retries exhausted.	

Address range	Description
30416 – 30419	Channel Utilization, Background noise, Tx Retry % and Tx Failed % (average of the last 60 minutes)
30420 – 30423	Channel Utilization, Background noise, Tx Retry % and Tx Failed % (average of the last 60 hours)
30424 – 30493	Spare - General purpose word storage used for: Staging area for data concentrator; Fieldbus mappings storage;
30494 – 30500	Internal information registers: serial number, firmware version and patch level
30494	First four digits of serial number (Encodes Manufacture Month & Year
30495	Next three digits of serial number (Encodes Manufactured Firmware version)
30496	Remaining four digits of the serial number
30497	First part of Current Firmware version
30498	Second part of Current Firmware version
30499	Third part of Current firmware version
30500	Patch Level of current firmware version
30501 – 32000	General purpose word storage used for: Staging area for data concentrator; Fieldbus mappings storage;
32001 - 32255	RSSI List: When configured as an Base, Repeater, or Manual AP. The RSSI of each connected downstream is added to an I/O register according to the last byte of that device's IP Address. For example, a downstream device with IP Address 192.168.0.199 will have its RSSI stored in I/O register 32000 + 199 = 32199. If no device is connected with that IP address, the corresponding register has the value Zero.
32256 – 36000	General purpose word storage used for: Staging area for data concentrator; Fieldbus mappings storage;
36001 - 36008	Local pulsed inputs 1–4, big endian format Most significant word at lower/odd address
36009 – 36040	Spare space for 32-bit register values
36041 – 38000	Not Available
38001 - 38032	Local analog inputs as floating point values. ModScan format (sign + exponent + most significant 7 bits of significant at even/higher addressed location; lower 16 bits of significant at lower/odd addressed location) (example: Analog input 1 at 12.3 mA gives registers 38001=CCCD, 38002=4144)
38033 – 38040	Spare space for floating point values
38041 – 40000	Not Available

Output registers (holding registers)

Address range	Description
40001 – 40002	Local AO1 and AO2:analog outputs
40003 – 40020	Spare
40021 – 40400	Space for locally attached 115s expansion I/O modules. Twenty registers per module address, maximum number of modules is 19.
40401 – 46000	General purpose word storage area used for: Staging area for data concentrator; Fieldbus mappings storage
46001 – 46008	Local pulsed outputs 1–4. Big endian format. Most significant word at lower/odd address
46009 – 46040	Spare 32-bit registers
46041 – 48000	Not Available
48001 – 48004	Local analog outputs as floating point values. ModScan format (sign + exponent + most significant 7 bits of significant at even/higher addressed location) Lower 16 bits of significant at lower/odd addressed location (example: Analog output 1 at 12.3 mA gives registers 48001=CCCD, 48002=4144)
48005 – 48040	Spare space for floating point values
48041 Onwards	Not available

Expansion I/O registers

Adding expansion I/O modules to the 215U-2 will automatically add the I/O from the 115S modules to the internal 215U-2 I/O store. To calculate the register location in the I/O store, find the address of the I/O point in the tables in this appendix, and then add the offset. The offset is the Modbus address, multiplied by 20.

Examples:

- Digital input #1 on an 115S-11 with address 5 would be: (5x20) +10001 = 10101
- Digital output #2 on an 115S-11 with address 6 would be: (6x20) +2 = 122
- Analog input #3 on an 115S-12 with address 3 would be: (3x20) +30003 = 30063.
- Analog output #8 on an 115S-13 with address # 7 would be: (7x20) + 40007 = 40147

I/O store for 115S-11 expansion I/O modules

I/O store	Description
0001 + Offset 0016 + Offset	DIO outputs 1–16
10001 + Offset 10016 + Offset	DIO inputs 1–16
10019 + Offset	Modbus Comms Fail indication for this 115S module
10020 + Offset	Modbus Comms Fail indication (inverse) for this 115S module
30001 + Offset 30004 + Offset	115S-11 pulsed input rate 1–4
30005 + Offset 30012 + Offset	115S-11 pulsed input count
30017 + Offset	Modbus Error counter for this 115S module
30018 + Offset	Modbus Last Error code for this 115S module (see "Expansion I/O error registers" on **page 35**.)
30019 + Offset	Modbus Lost Link counter for this 115S module
30020 + Offset	Module type (0x0101) = 257/error status
40009 + Offset 40016 + Offset	Pulsed output target 1–8 (1 register per pulsed output)

I/O store for 115S-12 expansion I/O modules

I/O store	Description
0001 + Offset 0008 + Offset	DIO outputs 1–8
10001 + Offset 10008 + Offset	DIO Inputs 1–8
10019 + Offset	Modbus Error indication for 115S module
10020 + Offset	Detected indication for this 115S module
30001 + Offset 30008 + Offset	Inputs AIN 1–AIN 8
30017 + Offset	Modbus Error counter for this 115S module
30018 + Offset	Modbus Last Error code for this 115S module (see "Expansion I/O error registers" on **page 35**)
30019 + Offset	Modbus Lost Link counter for this 115S module
30020 + Offset	Module type (0x0201) = 513/error status
40009 + Offset 40016 + Offset	Pulsed output target 1–8 (1 register per output)

I/O store for 115S-13 expansion I/O modules

I/O store	Description
0001 + Offset 0008 + Offset	DIO outputs 1–8
10001 + Offset 10008 + Offset	DIO inputs 1–8
10019 + Offset	Modbus Error indication for 115S module
10020 + Offset	Detected indication for this 115S module
30017 + Offset	Modbus Error counter for this 115S module
30018 + Offset	Modbus Last Error code for this 115S module (see "Expansion I/O error registers" on **page 35**)
30019 + Offset	Modbus Lost Link counter for this 115S module
30020 + Offset	Module type (0x0301) = 769/error status
40001 + Offset 40008 + Offset	Analog output 1–8
40009 + Offset 40016 + Offset	Pulsed output target 1–8 (one register per pulsed output)

Physical I/O registers

I/O	Input	Output
Digital I/O 1	10001	1
Digital I/O 2	10002	2
Digital I/O 3	10003	3
Digital I/O 4	10004	4
Digital I/O 5	10005	5
Digital I/O 6	10006	6
Digital I/O 7	10007	7
Digital I/O 8	10008	8
Analog Input 1 (mA)	30001	—
Analog Input 2 (mA)	30002	—
Analog Input 3 (mA)	30003	—
Analog Input 4 (mA)	30004	—
Input 5 – Local V Supply	30005	—
Input 6 – Local +24 V Analog Loop	30006	—
Input 7 – Local V Battery	30007	—
Input 8 – Local V Expansion I/O	30008	—
Analog Input 1 (Volts)	30009	—
Analog Input 2 (Volts)	30010	—
Analog Input 3 (Volts)	30011	—

I/O	Input	Output
Analog Input 4 (Volts)	30012	—
Pulse Rate 1	30013	—
Pulse Rate 2	30014	—
Pulse Rate 3	30015	—
Pulse Rate 4	30016	—
Analog 1 Set point	10009	—
Analog 2 Set point	10010	—
Analog 3 Set point	10011	—
Analog 4 Set point	10012	—
Analog 5 Set point	10013	—
Analog 6 Set point	10014	—
Analog 7 Set point	10015	—
Analog 8 Set point	10016	—
Analog 9 Set point	10017	—
Analog 10 Set point	10018	—
Analog 11 Set point	10019	—
Analog 12 Set point	10020	—
Analog Output 1	—	40001
Analog Output 2	—	40002
Pulsed Input 1 Count	36001-36002	—
Pulsed Input 2 Count	36003-36004	—
Pulsed Input 3 Count	36005-36006	—
Pulsed Input 4 Count	36007-36008	—
Pulsed Input 1 Rate	30013	—
Pulsed Input 2 Rate	30014	—
Pulsed Input 3 Rate	30015	—
Pulsed Input 4 Rate	30016	—
Pulsed Output 1 Count	—	46001-46002
Pulsed Output 2 Count	—	46003-46004
Pulsed Output 3 Count	—	46005-46006
Pulsed Output 4 Count	—	46007-46008
Analog Input 1 Floating Point (mA)	38001-38002	—
Analog Input 2 Floating Point (mA)	38003-38004	—
Analog Input 3 Floating Point (mA)	38005-38006	—
Analog Input 4 Floating Point (mA)	38007-38008	—
Input 5 – Local V Supply Floating Point	38009-38010	—
Input 6 – Local +24 V Analog Loop Floating Point	38011-38012	—
Input 7 – Local V Battery Floating Point	38013-38014	—
Input 8 – Local V Expansion I/O Floating Point	38015-38016	—
Analog Input 1 Floating Point (Volts)	38017-38018	—
Analog Input 2 Floating Point (Volts)	38019-38020	—
Analog Input 3 Floating Point (Volts)	38021-38022	—
Analog Input 4 Floating Point (Volts)	38023-38024	—
Pulse Rate 1 Floating Point	38025-38026	—
Pulse Rate 2 Floating Point	38027-38028	—
Pulse Rate 3 Floating Point	38029-38030	—
Pulse Rate 4 Floating Point	38031-38032	—
Analog O/P Floating Point	—	48001
Analog O/P Floating Point	—	48002
Analog O/P Floating Point	—	48003
Analog O/P Floating Point	—	48004

115S serial expansion modules I/O registers

	115S-11		115S-12		115S-13	
Description	**Inputs**	**Outputs**	**Inputs**	**Outputs**	**Inputs**	**Outputs**
Digital I/O 1	10001	1	10001	1	10001	1
Digital I/O 2	10002	2	10002	2	10002	2
Digital I/O 3	10003	3	10003	3	10003	3
Digital I/O 4	10004	4	10004	4	10004	4
Digital I/O 5	10005	5	10005	5	10005	5
Digital I/O 6	10006	6	10006	6	10006	6
Digital I/O 7	10007	7	10007	7	10007	7
Digital I/O 8	10008	8	10008	8	10008	8
Digital I/O 9	10009	9	—	—	—	—
Digital I/O 10	10010	10	—	—	—	—
Digital I/O 11	10011	11	—	—	—	—
Digital I/O 12	10012	12	—	—	—	—
Digital I/O 13	10013	13	—	—	—	—
Digital I/O 14	10014	14	—	—	—	—
Digital I/O 15	10015	15	—	—	—	—
Digital I/O 16	10016	16	—	—	—	—
Analog I/O 1	—	—	30001	—	—	40001
Analog I/O 2	—	—	30002	—	—	40002
Analog I/O 3	—	—	30003	—	—	40003
Analog I/O 4	—	—	30004	—	—	40004
Analog I/O 5	—	—	30005	—	—	40005
Analog I/O 6	—	—	30006	—	—	40006
Analog I/O 7	—	—	30007	—	—	40007
Analog I/O 8	—	—	30008	—	—	40008
Pulsed I/O Count 1	30017-30018	30009	—	30009	—	30009
Pulsed I/O Count 2	30019-30020	30010	—	30010	—	30010
Pulsed I/O Count 3	30020-30022	30011	—	30011	—	30011
Pulsed I/O Count 4	30023-30024	30012	—	30012	—	30012
Pulsed I/O Count 5	—	30013	—	30013	—	30013
Pulsed I/O Count 6	—	30014	—	30014	—	30014
Pulsed I/O Count 7	—	30015	—	30015	—	30015
Pulsed I/O Count 8	—	30016	—	30016	—	30016
Pulsed I/O Rate 1	30001	—	—	—	—	—
Pulsed I/O Rate 2	30002	—	—	—	—	—
Pulsed I/O Rate 3	30003	—	—	—	—	—
Pulsed I/O Rate 4	30004	—	—	—	—	—
Supply Voltage	30033	—	30033	—	30033	—
Analog Loop Supply	30034	—	30034	—	30034	—

All expansion I/O is calculated by adding the offset to the I/O address in the table. The offset is calculated by multiplying the module address by 20.
For example:
Digital input #1 on an 115S-11 (address 5) would be: (5x20) + 10001 = 10100
Digital output #2 on an 115S-11 (address 6) would be: (6x20) + 2 = 121
Analog input #3 on an 115S-12 (address 3) would be: (3x20) + 30003 = 30063
Analog output #7 on an 115S-13 (address 7) would be: (7x20) + 40007 = 40147

Modbus error codes

The following are Modbus error response codes that the Modbus RTU Master or TCP Client will generate and write to a general purpose analog register (30501, 40501, and so on) in the event of a poll fail. Codes 65281 through 65291 (FF01 through FF0B) reflect Modbus error codes returned from the remote device as codes 01 through 0B. These codes and descriptions are taken from the Modbus protocol reference. Codes 65024, 64512, 63488 and 65535 (FE00, FC00, F800, and FFFF) are generated by the Modbus master (Client) on detection of an error with the communications such as a failure to respond or a garbled message.

Code (decimal)	Hex code	Name	Meaning
65281	FF01	Illegal Function	The function code received in the query is not an allowable action for the server (or slave). This may be because the function code is only applicable to newer devices, and was not implemented in the unit selected. It might also indicate that the server (or slave) is in the wrong state to process a request of this type
65282	FF02	Illegal Data Address	The data address received in the query is not an allowable address for the server (or slave). More specifically, the combination of reference number and transfer length is invalid. For a controller with 100 registers, the PDU addresses the first register as 0, and the last one as 99. If a request is submitted with a starting register address of 96 and a quantity of 4 registers, this request will successfully operate on registers 96, 97, 98, 99. If a request is submitted with a starting register address of 96 and a quantity of 5, this request will fail with Exception Code 0x02 "Illegal Data Address."
65283	FF03	Illegal Data Value	A value contained in the query data field is not an allowable value for server (or slave). This indicates a fault in the structure of the remainder of a complex request. For example, it may indicate that the implied length is incorrect. It does not mean that a data item submitted for storage in a register has a value outside the expectation of the application program. The Modbus protocol is unaware of the significance of any particular value of any particular register.
65384	FF04	Slave Device Failure	An unrecoverable error occurred while the server (or slave) was attempting to perform the requested action
65285	FF05	Acknowledge	Specialized use in conjunction with programming commands (Included for completeness). The server (or slave) has accepted the request and is processing it, but significant time will be required to complete this task. This response is returned to prevent a timeout error from occurring in the client (or master).
65286	FF06	Slave Device Busy	Specialized use in conjunction with programming commands (Included for completeness). The server (or slave) is engaged in processing a long–duration program command. The client (or master) should retransmit the message later when the server (or slave) is free.
65288	FF08	Memory Parity Error	Specialized use in conjunction with function codes 20 and 21 and reference type 6, to indicate that the extended file area failed to pass a consistency check. (Included for completeness)
65290	FF0A	Gateway Path Unavailable	Specialized use in conjunction with gateways. Indicates that the gateway was unable to allocate an internal communication path from the input port to the output port for processing the request. Typically indicates that the gateway is mis-configured or overloaded.
65291	FF0B	Gateway Device Failed to Respond	Specialized use in conjunction with gateways. Indicates that no response was obtained from the target device. Typically indicates that the device is not present on the network.
65024	FE00	Invalid Response from Slave	Command type or slave address did not match request. This error usually indicates that the response from another request has been received after issuing the current request.
64512	FC00	Server Offline	Could not connect to the Modbus TCP server (Applies to Modbus TCP Client only).
63488	F800	Invalid Local Memory Address	Local address is invalid in the command. The memory location does not exist or is not initialized
65535	FFFF	No Response	There was no response to the poll message

Error Response from Remote modbus Server (Slave)

Error code generated by local Modbus Client (Master)

Full firmware upgrade

You can upgrade the firmware using a USB flash drive containing the firmware files. A full USB upgrade is necessary if a patch file is not available or the existing firmware is a much older version and would require multiple patch files to upgrade to the latest version.

Note: The feature keys and configuration are not changed or erased during a full upgrade.

The following procedure provides instructions for performing a full USB firmware upgrade on a 215U-2.

Requirements

- USB flash drive
- Firmware files (contact ELPRO technical support for these files)
- PC for transferring files

To prepare the USB flash drive

Not all USB flash drives are configured correctly for use as a firmware upgrade drive. Use the following procedure to check the configuration of the USB drive and re-configure the drive if necessary.

1. Plug USB drive into the USB port on the PC and wait until Windows recognizes the drive and completes the driver installation.
2. Open the Windows Start menu, choose Run, and then enter "CMD" to open a command prompt. Then, type "diskpart" at the command prompt. This opens the Diskpart utility.

```
C:\>diskpart
Microsoft DiskPart version 6.1.7601
Copyright (C) 1999-2008 Microsoft
Corporation.
On computer: TEST_COMPUTER
```

3. Type command "list disk" to list available disks, and identify the USB drive based on the size.
   In the following example, the USB drive is a 1911 MB (2 GB) drive, which corresponds to Disk 1.

```
DISKPART> list disk
Disk ### Status Size Free DynGpt
----------------------------------------
Disk 0Online232 GB0 B
Disk 1Online 1911 MB0 B
```

4. When you have identified the USB disk, enter the "select Disk X" command to select this disk.

⚠ WARNING

THE COMMANDS THAT FOLLOW THIS STEP CAN DESTROY THE CONTENTS OF THE SELECTED DISK, MAKE SURE THAT YOU HAVE SELECTED THE CORRECT DRIVE BEFORE CONTINUING. SELECTING THE WRONG DRIVE COULD FORMAT YOUR PC'S HARD DRIVE.

```
DISKPART> select Disk 1
Disk 1 is now the selected disk.
```

5. Enter the command "list partition" to check how the USB drive is partitioned.
   This command indicates whether the drive is correctly configured for use as a firmware upgrade drive on the 215U-2.
   - If the drive contains only one partition and the "Offset" value is non-zero, as shown in the example below, you can proceed to format the drive and use it "as is" for firmware upgrade. Skip to step 7 for instructions on how to format the drive using the Diskpart utility.

```
DISKPART> list partition
  Partition ###  Type       Size     Offset
  -------------  ----       ----     ------
  Partition      1Primary   1910 MB  64 KB
```

   - If the "Offset" is zero or if there is more than one partition, as shown in the examples below, go to steps 6 and 7 below to re-configure the drive.

```
  Partition ###  Type       Size     Offset
  -------------  ----       ----     ------
  Partition      1Primary   1911 MB  0 KB
```

```
  Partition ###  Type       Size     Offset
  -------------  ----       ----     ------
  Partition      1Primary   100 MB   64 KB
  Partition      2Primary   1810 MB  101 KB
```

6. Enter the command "clean" to delete all partitions on the disk, and then enter "list disk" to check that all memory is now free. In the example below, the asterisk (*) indicates that Disk 1 is the selected disk.

```
DISKPART> clean
DiskPart succeeded in cleaning the disk.
DISKPART> list disk
  Disk ###  Status   Size    Free     DynGpt
  --------  ------   ----    ------   ------
  *         Disk 0   Online  1911 MB  1910 KB
```

7. Enter the command "create partition primary" to create a partition on the USB drive. Then, enter the "list partition" command and note that there is only one partition, and that the offset is non-zero.

```
DISKPART> create partition primary
DiskPart succeeded in creating the
specified partition
  Partition ###    Type       Size     Offset
  -------------    ----       ----     ------
  Partition        1Primary   1910 MB  64 KB
```

8. Finally, format the drive using the Diskpart command line. The file system format should be selected as FAT32 using the option "fs=fat32". You can select any convenient label. In the example below the label "FW_UPGRADE" was used.

```
DISKPART> format fs=fat32 label=FW_
UPGRADE
100 percent completed
DiskPart successfully formatted the
volume.
```

   Alternatively, you can format the drive from within the Windows GUI environment using the following procedure.

To format the USB flash drive

1. Plug the USB flash drive in to the USB port on the PC.
2. Right-click the drive and select **Format** from the menu.

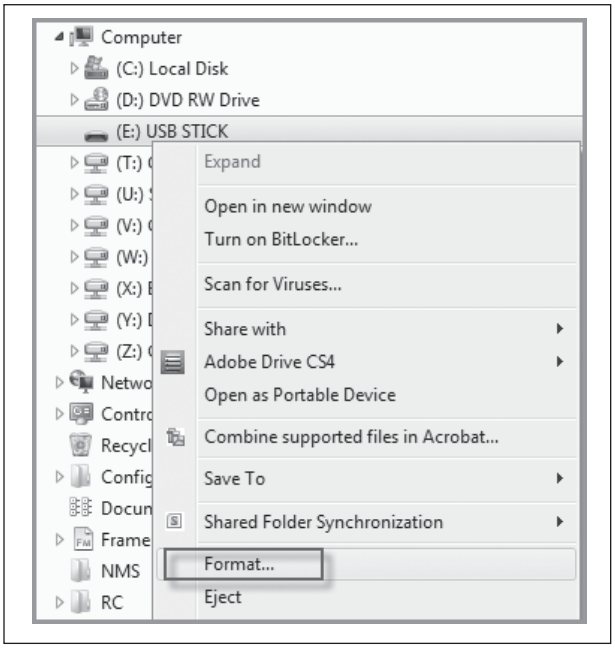


Figure 53. Formatting USB flash drive

3. Make sure that **Quick Format** is not selected, and then click **Start**.

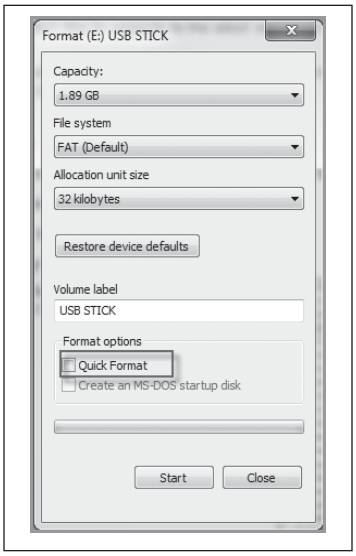


Figure 54. Quick format

4. When formatting is complete, copy the supplied firmware files to the USB flash drive root directory.

   The files should look similar to the following figure.

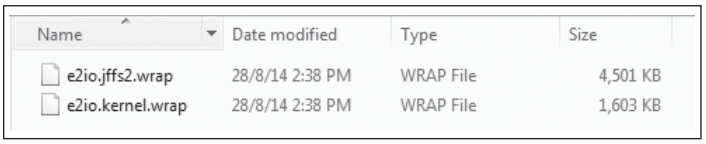


Figure 55. Firmware files

5. Remove the USB flash drive from the PC.

To perform a full firmware upgrade using USB flash drive

1. Connect to the module's Web-based configuration utility and make a note of the current firmware version, which appears on the home Web page.

   This will enable you to compare versions to confirm that the upgrade procedure has been performed successfully.

Model:	215U-2-BGN
Serial Number:	07172095071
Hardware Revision:	1.7g
Firmware Version:	2.10dev -- Tue Jul 25 13:39:17 AEST 2017 (6975M)
Kernel Version:	#1 PREEMPT Wed Jul 19 16:02:49 AEST 2017
Bootloader Version:	3.4 - May 2 2017 16:40:43 (6685)
Prebootloader Version:	2.11 - May 2 2017 16:40:29 (6685)

Figure 56. Firmware version

2. Power off the 215U-2if it is currently powered on.
3. Remove the cover from the small access panel on side of module to reveal a USB port and switches.

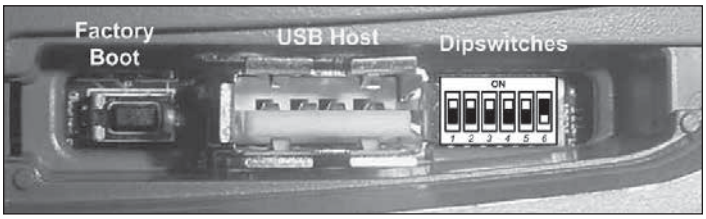


Figure 57. Module USB port and switches

4. Plug USB stick into USB port and power on the 215U-2 module.
5. The PWR LED will flash, as indicated in [Figure 58 below].

Note: Do not remove the flash drive or interrupt power to the module while the upgrade is in progress. If the upgrade process is interrupted, the module may become unserviceable and will need to be returned to Eaton for repair.

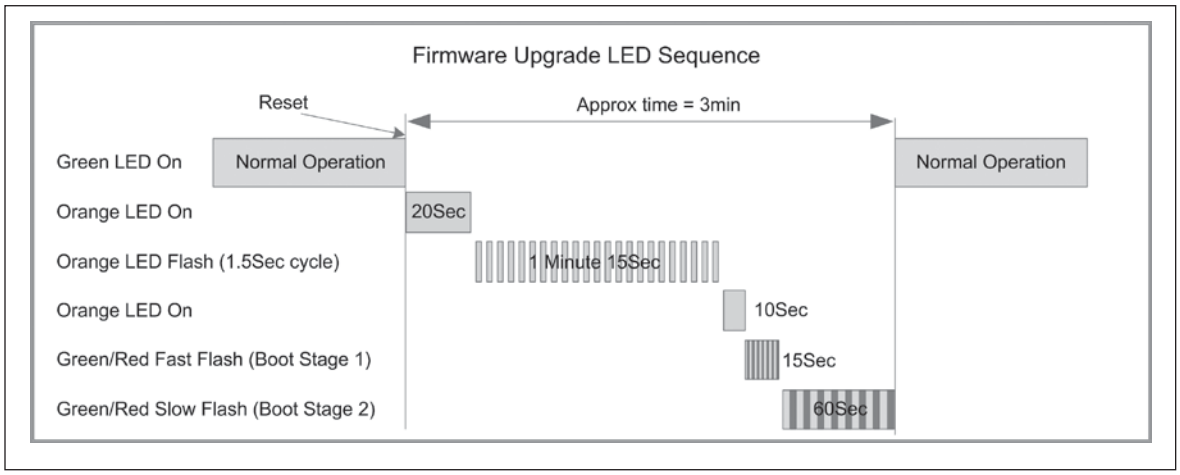


Figure 58. Firmware upgrade LED indicators

6. When the upgrade is complete, remove the USB flash drive from the module's USB port and replace the access panel cover.

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Glossary

Term	Definition
802.11 A standards for wireless networking allowing high speed wireless connection between devices. ACK	Acknowledgment.
Access Point	An access point connects wireless network stations (or clients) to other stations within the wireless network and also can serve as the point of interconnection between the wireless network and a wired network. Each access point can serve multiple users within a defined network area. Also known as a base station.
Antenna Gain	Antennas do not increase the transmission power, but instead focus the signal. Rather than transmitting in every direction (including the sky and ground), antenna focus the signal either more horizontally or in one particular direction. This gain is measured in decibels.
AWG	American wire gauge (AWG), also known as the Brown and Sharpe wire gauge, is a standardized wire gauge system used predominantly in the United States and Canada for the diameters of round, solid, nonferrous, electrically conducting wire.
Bandwidth	The maximum data transfer speed available to a user through a network.
COS	Change of state. For a digital input, a COS is a change from "off" to "on," or a change from "on" to "off." For an analog input, internal analog input, or pulse input rate, a COS is a configurable value called sensitivity.
CSA	The Canadian Standards Association (CSA), is a not-for-profit standards organization that develops standards in 57 areas. The CSA registered mark shows that a product has been independently tested and certified to meet recognized standards for safety or performance.
DCS	A Distributed Control System (DCS) is a computerized control system used to control the production line in industry. The entire system of controllers is connected by networks for communication and monitoring.
DHCP	Dynamic Host Configuration Protocol is a utility that enables a server to dynamically assign IP addresses from a predefined list and limit their time of use so that they can be reassigned. Without DHCP, an IT manager would need to manually enter in all the IP addresses of all the computers on the network. When DHCP is used, whenever a computer logs onto the network, an IP address is automatically assigned to it.
DIO	Digital input/output.
DIN Rail	A DIN rail is a metal rail of a standard type widely used for mounting circuit breakers and industrial control equipment inside equipment racks.
DNS	Domain name service (DNS) is a program that translates URLs to IP addresses by accessing a database maintained on a collection of Internet servers. The program works behind the scenes to facilitate surfing the Web with alpha versus numeric addresses. A DNS server converts a name like mywebsite.com to a series of numbers like 107.22.55.26. Every website has its own specific IP address on the Internet.
Encryption Key	An alphanumeric (letters and/or numbers) series that enables data to be encrypted and then decrypted so it can be safely shared among members of a network. WEP uses an encryption key that automatically encrypts outgoing wireless data. On the receiving side, the same encryption key enables the computer to automatically decrypt the information so it can be read. Encryption keys should be kept secret.
EIRP	Equivalent isotropically radiated power (EIRP) or, alternatively, effective isotropically radiated power is the amount of power that a theoretical isotropic antenna (which evenly distributes power in all directions) would emit to produce the peak power density observed in the direction of maximum antenna gain. EIRP can take into account the losses in transmission line and connectors and includes the gain of the antenna. The EIRP is often stated in terms of decibels over a reference power emitted by an isotropic radiator with an equivalent signal strength. The EIRP allows comparisons between different emitters regardless of type, size or form.
Hub	A multiport device used to connect PCs to a network via Ethernet cabling. Wired hubs can have numerous ports and can transmit data at speeds ranging from 10 Mbps to multi-Gigabyte speeds per second. A hub transmits packets it receives to all the connected ports. A small wired hub may only connect four computers; a large hub can connect 48 or more.
Hz	Hertz. The international unit for measuring frequency, equivalent to the older unit of cycles per second. One megahertz (MHz) is one million hertz. One gigahertz (GHz) is one billion hertz. The standard US electrical power frequency is 60 Hz, the AM broadcast radio frequency band is 535–1605 kHz, the FM broadcast radio frequency band is 88–108 MHz, and wireless 802.11b/g LANs operate at 2.4 GHz.
IEEE	Institute of Electrical and Electronics Engineers, New York, www.ieee.org. A membership organization that includes engineers, scientists and students in electronics and allied fields. It has more than 300,000 members and is involved with setting standards for computers and communications.
I/O	Input/Output. The term used to describe any operation, program, or device that transfers data to or from a computer.
IP	Internet Protocol (IP) is a set of rules used to send and receive messages across local networks and the Internet.
IP Address	A 32-bit number that identifies each sender or receiver of information that is sent across the Internet. An IP address has two parts: an identifier of a particular network on the Internet and an identifier of the particular device (which can be a server or a workstation) within that network.
ISM	The industrial, scientific and medical (ISM) radio bands are portions of the radio spectrum reserved internationally for industrial, scientific, and medical purposes other than telecommunications.
LAN	Local Area Network (LAN) is a system of connecting PCs and other devices within the same physical proximity for sharing resources such as an Internet connections, printers, files, and drives.
LQI	Link quality indicator (LQI) is used in wireless networks to indicate how strong the communications link is. LQI is a computed value, based on the received signal strength as well as the number of errors received.
Receive Sensitivity	The minimum signal strength required to pick up a signal. Higher bandwidth connections usually have less receive sensitivity than lower bandwidth connections.
Router	A device that forwards data from one WLAN or wired local area network to another.

Term	Definition
RSSI	Received signal strength indicator (RSSI) is a measurement of the power present in a received radio signal. In an IEEE 802.11 system, RSSI is the relative received signal strength in a wireless environment, in arbitrary units. RSSI is an indication of the power level being received by the antenna. Therefore, the higher the RSSI number (or less negative in some devices), the stronger the signal.
Transmit Power	The power at which the wireless devices transmits, usually expressed in mW or dBm.
MAC Address	Media Access Control (MAC) address is a unique code assigned to most forms of networking hardware. The address is permanently assigned to the hardware, so limiting a wireless network's access to hardware (such as wireless cards) is a security feature employed by closed wireless networks. But an experienced hacker armed with the proper tools can still figure out an authorized MAC address, masquerade as a legitimate address, and access a closed network. Every wireless 802.11 device has its own specific MAC address hard-coded into it. This unique identifier can be used to provide security for wireless networks. When a network uses a MAC table, only the 802.11 radios that have had their MAC addresses added to that network's MAC table will be able to get onto the network.
Modbus	Modbus is a serial communications protocol for use with its programmable logic controllers (PLCs).
PLC	A programmable logic controller (PLC) is a digital computer used for automation of electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures.
Proxy Server	Used in larger companies and organizations to improve network operations and security, a proxy server is able to prevent direct communication between two or more networks. The proxy server forwards allowable data requests to remote servers and/or responds to data requests directly from stored remote server data.
RJ-45	Standard connectors used in Ethernet networks. RJ-45 connectors are similar to standard RJ-11 telephone connectors, but RJ-45 connectors can have up to eight wires, whereas telephone connectors have four.
RTU	A remote terminal unit (RTU) is a microprocessor-controlled electronic device that interfaces objects in the physical world to a distributed control system or SCADA system by transmitting telemetry data to a master system, and by using messages from the master supervisory system to control connected objects.
SCADA	SCADA (supervisory control and data acquisition) is a type of industrial control system (ICS). Industrial control systems are computer controlled systems that monitor and control industrial processes that exist in the physical world. SCADA systems historically distinguish themselves from other ICS systems by being large scale processes that can include multiple sites, and large distances.
Server	A computer that provides its resources to other computers and devices on a network. These include print servers, Internet servers and data servers. A server can also be combined with a hub or router.
SMA	SMA (SubMiniature version A) connectors are semi-precision coaxial RF connectors for coaxial cable with a screw type coupling mechanism. The connector has a 50 Ω impedance. It is designed for use from DC to 18 GHz.
Sub Network or Subnet	Found in larger networks, these smaller networks are used to simplify addressing between numerous computers. Subnets connect together through a router.
Switch	A type of hub that efficiently controls the way multiple devices use the same network so that each can operate at optimal performance. A switch acts as a networks traffic cop: rather than transmitting all the packets it receives to all ports as a hub does, a switch transmits packets to only the receiving port.
TCP	Transmission Control Protocol (TCP) isprotocol used along with the Internet Protocol (IP) to send data in the form of individual units (called packets) between computers over the Internet. While IP takes care of handling the actual delivery of the data, TCP takes care of keeping track of the packets that a message is divided into for efficient routing through the Internet. For example, when a Web page is downloaded from a Web server, the TCP program layer in that server divides the file into packets, numbers the packets, and then forwards them individually to the IP program layer. Although each packet has the same destination IP address, it may get routed differently through the network. At the other end, TCP reassembles the individual packets and waits until they have all arrived to forward them as single message.
TCP/IP	The underlying technology behind the Internet and communications between computers in a network. The first part, TCP, is the transport part, which matches the size of the messages on either end and guarantees that the correct message has been received. The IP part is the user's computer address on a network. Every computer in a TCP/IP network has its own IP address that is either dynamically assigned at startup or permanently assigned. All TCP/IP messages contain the address of the destination network as well as the address of the destination station. This enables TCP/IP messages to be transmitted to multiple networks (subnets) within an organization or worldwide.
TTL	Transistor–transistor logic (TTL) is a class of digital circuits built from bipolar junction transistors and resistors. It is called TTL logic because both the logic gating function (AND) and the amplifying function are performed by transistors.
WAN	Wide area network (WAN) is a communication system of connecting PCs and other computing devices across a large local, regional, national or international geographic area. Also used to distinguish between phone-based data networks and Wi-Fi. Phone networks are considered WANs and Wi-Fi networks are considered Wireless Local Area Networks (WLANs).
Wi-Fi	Wireless Fidelity. An interoperability certification for wireless local area network (LAN) products based on the Institute of Electrical and Electronics Engineers (IEEE) 802.11 standard.

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

Printed in USA
Publication No. MN032EN / CSSC-1703-4112
October 2017

Powering Business Worldwide