User's Manual

IM 22B01D01-01E-A

M1115NL Wireless I/O

YOKOGAWA

Yokogawa Corporation of America
2 Dart Road, Newnan, Georgia U.S.A. 30265
Tel: 1-800-888-6400 Fax: 1-770-254-0928

IM 22B01D01-01E-A

1st Edition

Thank you for your selection of the M1115NL I/O Module. We trust it will give you many years of valuable service.

ATTENTION!

Incorrect termination of supply wires may cause internal damage and will void warranty. To ensure your M1115NL module enjoys a long life, double check ALL your connections with the user manual before turning the power on.

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.
Avoid:
- Operating DAWN WIreless the transmitter when someone is within 20 cm of the antenna
- Operating the transmitter unless all RF connectors are secure and any open connectors are properly terminated
- Operating the equipment near electrical blasting caps or in an explosive atmosphere

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

SAFETY Notice:

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.

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FCC Notice:

This M1115NL module uses the “E2_900M Wireless Data Modem” radio and complies with Part 15.247 of the FCC Rules.
Operation is subject to the following two conditions:

This device may not cause harmful interference and must accept any interference received, including interference that may cause undesired operation.

This device must be operated as supplied by DAWN WIreless. Any changes or modifications made to the device without the written consent of DAWN WIreless may void the user’s authority to operate the device.

This device must be installed by professional installers in compliance with 47 CFR Part 15 Subpart C Section 15.204 and 15.205, who will be responsible for maintaining EIRP no greater than 36 dBm in accordance with 47 CFR Part 15 Subpart C Section 15.247 (b)(2)(4).

In accordance with 47 CFR Part 15 Subpart C Section 15.204 only the following antenna/coax cable kits can be used.

Manufacturer	Model Number	Coax Kit	Net
YOKOGAWA	SG-900-6	CC10/900	5dBi Gain
YOKOGAWA	SG-900-6	CC20/900	2dBi Gain
YOKOGAWA	SG-900EL	CC10/900	2dBi Gain
YOKOGAWA	SG-900EL	CC20/900	-1dBi Loss
YOKOGAWA	YU6/900	CC20/900	4dBi Gain

- Part 15 –This device has been tested and found to comply with the limits for a Class A digital device, pursuant to Part15 of the FCC rules (Code of Federal Regulations 47CFR Part 15). Operation is subject to the condition that this device does not cause harmful interference.
- Notice Any changes or modifications not expressly approved by DAWN WIreless could void the user’s authority to operate this equipment.

This Device should only be connected to PCs that are covered by either FCC DoC or are FCC certified.

IMPORTANT Notice:

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

DAWN Wireless radio products are used on unprotected license-free radio bands with radio noise and interference. The products are designed to operate in the presence of noise and interference, however in an extreme case, radio noise and interference could cause product operation delays or operation failure. Like all industrial electronic products, DAWN Wireless 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 consulting DAWN Wireless first.

- A radio license is not required in some countries, provided the module is installed using the aerial and equipment configuration described in the M1115NL Installation Guide. Check with your local distributor for further information on regulations.
- Operation is authorized by the radio frequency regulatory authority in your country on a non-protection basis. Although all care is taken in the design of these units, there is no responsibility taken for sources of external interference. Systems should be designed to be tolerant of these operational delays.
- To avoid the risk of electrocution, the aerial, aerial cable, serial cables and all terminals of the M1115NL module should be electrically protected. To provide maximum surge and lightning protection, the module should be connected to a suitable earth and the aerial, aerial cable, serial cables and the module should be installed as recommended in the In stallation Guide
- To avoid accidents during maintenance or adjustment of remotely controlled equipment, all equipment should be first disconnected from the M1115NL module during these adjustments. Equipment should carry clear markings to indicate remote or automatic operation. E.g. “This equipment is remotely controlled and may start without warning. Isolate at the switch board before attempting adjustments.”
- The M1115NL module is not suitable for use in explosive environments without additional protection.
- The M1115NL operates unlicensed Radio frequencies and proprietary protocols to communicate over the radio. Nevertheless, if your system is not adequately secured, third parties may be able to gain access to your data or gain control of your equipment via the radio link. Before deploying a system make sure you have considered the security aspects of your installation carefully.

Limited Lifetime Warranty, Disclaimer, and Limitation of Remedies

DAWN Wireless products are warranted to be free from manufacturing defects for the “serviceable lifetime” of the product. The “serviceable lifetime” is limited to the availability of electronic components. If the serviceable life is reached in less than three years following the original purchase from DAWN Wireless, DAWN Wireless will replace the product with an equivalent product if an equivalent product is available.

This warranty does not extend to:

- Failures caused by the operation of the equipment outside the particular product’s specification, or
- Use of the module not in accordance with this User Manual, or
- Abuse, misuse, neglect or damage by external causes, or
- Repairs, alterations, or modifications undertaken other than by an authorized Service Agent.

DAWN Wireless liability under this warranty is limited to the replacement or repair of the product. This warranty is in lieu of and exclusive of all other warranties. This warranty does not indemnify the purchaser of products for any consequential claim for damages or loss of operations or profits and DAWN Wireless is not liable for any consequential damages or loss of operations or profits resulting from the use of these products. DAWN Wireless is not liable for damages, losses, costs, injury or harm incurred as a consequence of any representations, warranties or conditions made by DAWN Wireless or its representatives or by any other party, except as expressed solely in this document.

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11. Overview

The M1115NL range of I/O modules has been designed to provide standard “off-the-shelf” telemetry functions, for an economic price. Telemetry is the transmission of data or signals over a long distance via radio or twisted-pair wire cable.

Although the M1115NL Series is intended to be simple in its application, it provides many sophisticated features, which will be explained in the following chapters.

This manual should be read carefully to ensure that the modules are configured and installed to give reliable performance.
The M1115NL telemetry module extends the functionality provided by the earlier 105U and 905U E-series modules. It provides on-board I/O via a front mounting 20-way connector and has provision for extra expansion modules (DAWN Wireless 115S or MODBUS devices) to be connected using a standard RS485 serial connection.

The module can monitor the following types of signals
- Digital (on/off) signals - Contact Closure or Switch
- Analog (continuously variable) signals – Tank level, Motor speed, temperature, etc
- Pulsed signal - Frequency signal – Metering, accumulated total, rainfall, etc
- Internal Signals – Supply voltage, Supply failure, battery status, etc.

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.

The M1115NL radio has been designed to meet the requirements of unlicensed operation for remote monitoring and control of equipment. A radio licence is not required for the M1115NL in many countries.

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 “Change-of-State” of a digital or an internal digital input is a change from “off” to “on” or vice-versa.

For an analog input, internal analog input or pulse input rate a “Change-of-State” is a configurable value called “Sensitivity”. The default Sensitivity is 1000 counts (3%) but can be changed in the Sensitivity Block page.

In addition to change-of-state messages, update messages are automatically transmitted on a configurable time basis. This update ensures the integrity of the system.

Pulse inputs counts are accumulated and the total count is transmitted regularly according to the configured update time.

The M1115NL modules transmit the input/output data using radio or Ethernet. The data frame includes the “address” of the transmitting module and the receiving module, so that each transmitted message is acted on 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 (acknowledgement). If the original module does not receive a correct acknowledgement, it will retry 1 to 5 times (default is 3) before setting the communications fail status of that message. 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 change-of-state occurs.

A system can be a complex network or a simple pair of modules. An easy-to-use configuration procedure allows the user to specify any output destination for each input.

Two versions of the M1115NL are available. The Legacy version provides operation with existing DAWN Wireless I/O devices (905 series and 105 series modules). The second version provides enhanced features, including IP addressing, allowing thousands of modules to exist in a system, and allowing automatic routing of messages through repeater stations.

Each M1115NL radio can have up to 24 expansion I/O modules (DAWN Wireless 115S) connected by RS485 twisted pair provided there is sufficient power to power all modules with I/O. Any input signal at any module may be configured to appear at any output on any module in the entire system.

Modules can be used as repeaters to re-transmit messages on to the destination module. Repeaters can repeat messages on the radio channel or from the radio channel to the serial channel (and serial to radio). Using Legacy protocol, up to five repeater addresses may be configured for each input-to-output link. The meshing protocol will automatically select other stations to act as repeaters if required.

The units may be configured via ethernet using a web browser or via USB port and system configuration software. The web based configuration and software configuration is defined in Chapter 4 - Configuration.

1.2 Module Structure

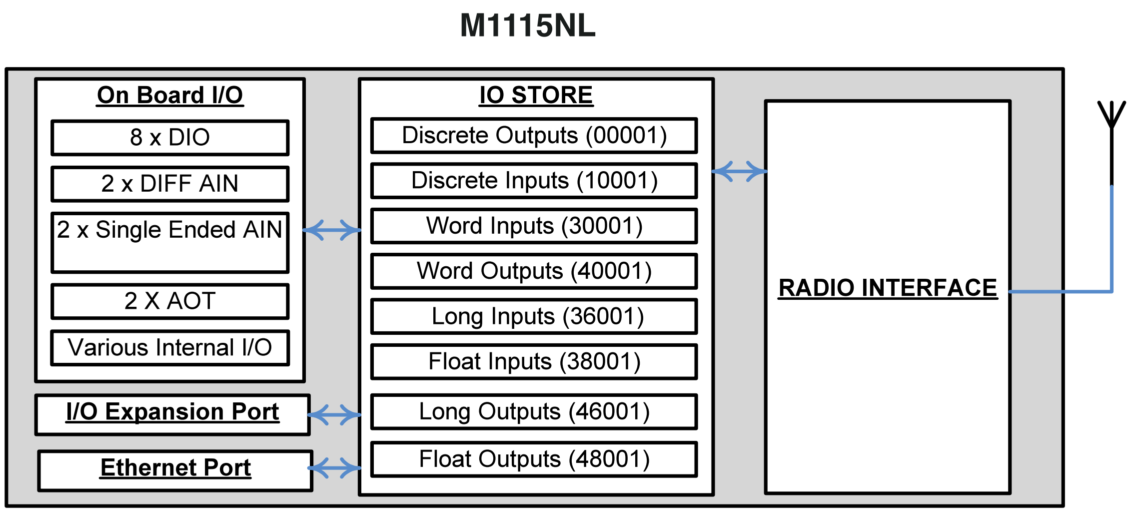


Figure 1 – Module Structure

The M1115NL is made up of a number of basic sections, which all interface with a central Input and output storage area (I/O Store).

The I/O Data Store provides storage for I/O data as well as providing services to other processes in the system. The I/O Store provides eight different blocks of data - two containing input and output bit data, two containing input and output word data, two containing long-word type data and two containing floating-point data. The two files of each type in turn support inputs and outputs on the local machine, and data storage for the gateway function of the machine. These files are mapped into the address map as described below. There are other registers values within the database that can be used for system management - these will be discussed later in this manual.

The Radio Interface allows the M1115NL to communicate with other modules within the system using a proprietary radio protocol called “WIBMesh”. Messages from other M1115NL modules are received by the radio port and used to update the input values in the I/O Data Store. The WIBMesh protocol is an extremely efficient protocol for radio communications. Radio messages can be sent using exception reporting - that is, when there is a change of an input signal - or by read/write messages. Each message will be comprised of multiple I/O values termed as a “block” of I/O).

There are also update messages, which are sent for integrity purposes. Messages include error checking, with the destination address sending a return acknowledgment. Up to four attempts are made to transmit the message over each hop of the radio path, if no acknowledgement is received. The WIBMesh protocol is designed to provide reliable radio communications on an open license-free radio channel.

The On-Board I/O in the form of - 8 discrete I/O, 2 single ended analog inputs, 2 differential analog inputs, and 2 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.

There are also a number of Internal I/O that can be accessed from the I/O Data Store. These 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 – Monitors the +24V DC Analog Loop Supply (ALS), used to power analog current loops and displays this as an Analog value.
- Expansion Module Volts – Monitors the Supply voltage of the connected expansion modules, displayed as an Analog value.
- RSSI – Will indicate the radio signal level for the selectable address, displayed as a dB level. Note: Only available in Legacy version. Otherwise, refer to Communication diagnostics functions
- Comms Fail – A selectable register can indicate a Communications fail for the selected address. Note: Only avail able in Legacy version. Otherwise, refer to Communication diagnostics functions

Lastly, the Expansion port, which enables 115S expansion I/O modules to be added to the module. Expansion module I/O is dynamically added to the I/O of the M1115NL by adding an offset to the address.

1.3 Getting Started

Most applications for the M1115NL require little configuration. The M1115NL has many sophisticated features, however if you do not require these features, this section will allow you to configure the units quickly.

First, read Chapter 2 - , “Installation”, which will go through the power supply, antenna/coax connections and any I/O connections.

Power the M1115NL and make an Ethernet connection to your PC (refer to Section 4.2 “First time Configuration”)

Set the M1115NL address settings as per Section 0 ”Network Configuration”

Save the configuration and the M1115NL module is now ready to use.

Chapter 2 - Installation

2.1 General

All M1115NL Series modules are housed in a plastic enclosure with DIN rail mounting, providing options for up to 12 I/O points, and separate power & communications connectors. The enclosure measures 170 x 150 x 33 mm including connectors. The antenna protrudes from the top

2.2 Power/Supply

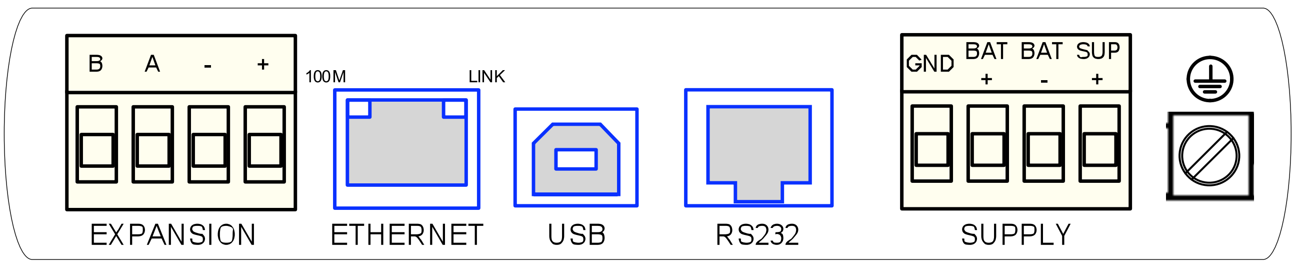


Figure 2 – Power Connections

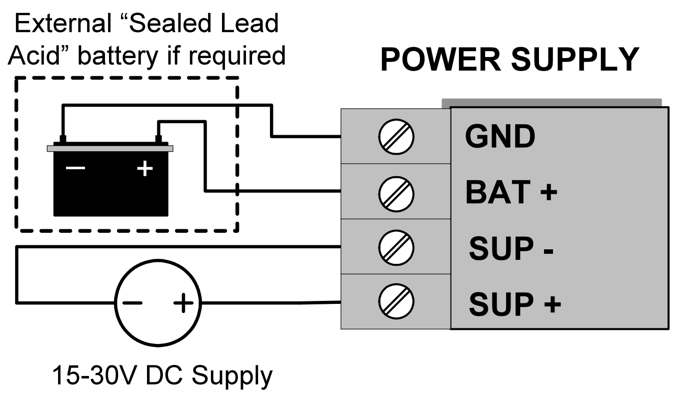


Figure 3 – Supply Connections

2.2.1 Requirements

The M1115NL power supply is a switch-mode supply and will accept a 15 - 30 volt DC power source connected to the “Sup + & Sup -” terminals.

Both Supply and Battery connections have reverse polarity and over voltage protection.

If powered from the “Sup + & Sup -” terminals the Power Supply must be able to supply enough current to power all operations, e.g. Module Quiescent current, Peak Transmit current, Digital and Analog I/O including loop supply, Battery charging (if applicable), etc.

The recommended “Supply” power source is +24VDC 2Amp (+12VDC 4Amp).

The module can be operated primarily from the supply terminals or in conjunction with a battery connected to the “BAT + & GND” terminals.

If a backup battery is used then the module Supply can have a lower current rating as the Peak current will be supplied by the battery.

To calculate the Power Supply current limit, use the following criteria.

Quiescent Current of the module is 200mA.

Module I/O total is 500mA

Peak Transmit current is 500mA

External Expansion I/O connected is 1000mA Max

Battery charging is 1000mA (Internally limited)

The following table represents the Supply current limit for different requirements

	Expansion I/O	No Expansion I/O
No Battery fitted	2200mA	1200 mA
Battery fitted	2700 mA	1700 mA

E.g. If there is a battery connected and no expansion I/O the minimum current needed is 1.7Amps @13.8V this is because the battery will provide peak current during radio transmissions.

If a backup battery is not connected and I/O modules are required and then the minimum current needed will be approximately 2.2Amps @13.8V.

This is allowing for 500mA Peak Transmit current and up to 1 amp for expansion I/O

The power supply should be CSA Certified Class 2 approved for normal operation and if being used in Class I Div 2 explosive areas, the power supply must have a Class I Div 2 approval.

The power supply automatically charges a 13.8V Sealed Lead-Acid battery connected to the “BAT+” and “GND” terminals at up to 1A.

The power supply input and battery charging are hosted on a 4-way terminal on the bottom edge of the module abelled “Supply”.

2.2.2 Expansion I/O Supply

To allow increased I/O Capacity, a second 4-way terminal labelled “Expansion I/O” provides a +12 Volt supply (up to 1A) and RS485 communications for any 115S serial expansion I/O modules.

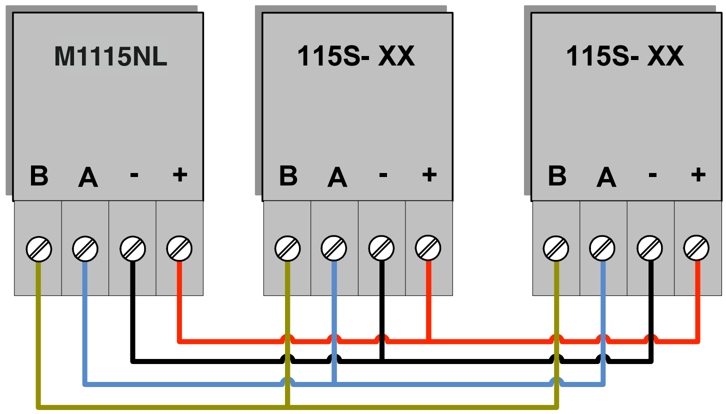


Figure 4 – Expansion I/O power & RS485

As a guide when using the I/O power connection from the M1115NL, the number of I/O modules is limited to three 115S-11 (using inputs), one 115S-12, or one 115S-13.

If more I/O Modules are required, you will need to calculate the overall current consumption using the following criteria and power the modules from an external supply.

115S Module Static Current drain = 120mA

115S Digital Inputs require 13mA per active input

115S Digital Outputs require 25mA per active output

115S Analog Inputs and Outputs require 50mA per I/O when operating at 20mA

E.g. a single 115S-11 using inputs only has a current consumption of approximately 320mA so you could connect up to three 115S-11 modules to the Expansion port without overloading the on board I/O power supply.

A single 115S-12 using all analog inputs and digital outputs has a current consumption of approximately 720mA so you could only connect one.

Keep in mind that when calculating the current consumption for the expansion I/O, the maximum available current from the onboard power supply is 1 Amp. If the overall Expansion I/O current consumption is over the 1 Amp maximum an external power source will be required. The M1115NL provides up to 1 Amp for battery charging.

2.2.3 Internal I/O

The internal Supply voltages can be monitored by reading the Modbus locations below.
The registers can also be mapped to a register or an analog output on another module within the radio network.

30005	Local Supply voltage (8-40V scaling)
30006	Local Battery voltage (8-40V scaling)
30007	Local 24V loop voltage (8-40V scaling) – Internally generated +24V supply used for analog loop supply. Maximum Current limit is 150mA
30008	115S Supply Voltage (8-40V scaling)

Floating Point Registers 38005 – 38008 also indicate the Supply voltage, Battery Voltage, +24V Supply and 115S Supply voltages but in a voltage scale.

There are no dedicated discrete low voltage alarm indicators however each supply voltage does have a High and a low Setpoint Status which can be used for this type of alarm.

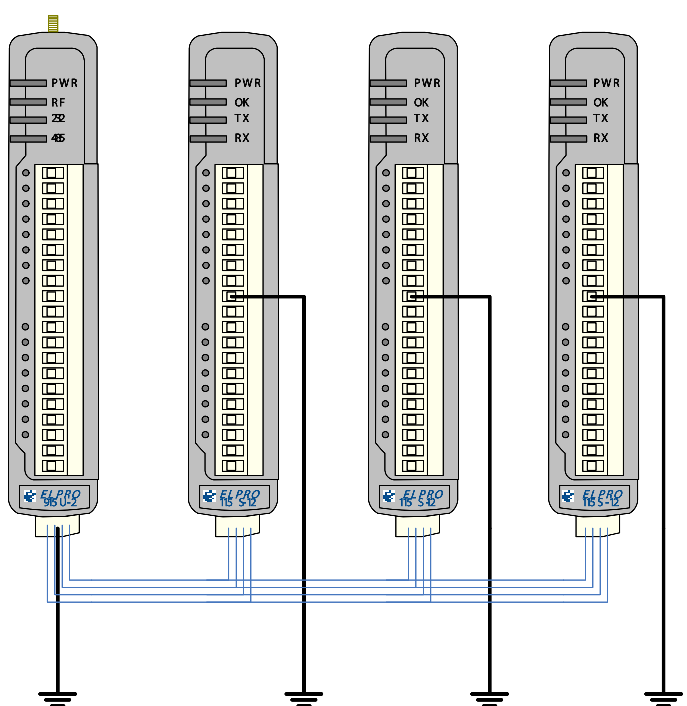
See section 0“Analog Inputs” for details on how to configure these alarms.

2.2.4 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 or earth point as the enclosure “earth” and the antenna mast “earth”.

The M1115NL has a dedicated Earth connection screw on the bottom end plate next to the Supply terminals. All EARTH wiring should be minimum 2mm² - 14 AWG

If using the M1115NL with serial Expansion I/O modules then all expansion modules must have a separate earth connection from the front terminal back to the common earth or ground point. See Figure 5 below



2.3 Radio

The following radio variants are available in the M1115NL dependent on the country of operation**.**

2.3.1 900 MHz Spread Spectrum radio

The radio operates in the 902-928 MHz ISM band and uses frequency hopping spread spectrum modulation, which is a method of transmitting radio signals by rapidly switching the carrier among many frequency channels, using a pseudo random sequence known to both transmitter and receiver as Hop Sets.

There are two Hop sets and each one uses a different pseudo random sequence of radio channels. Each Hop Set is made up of 50 channels, which cycle through to the next channel after each transmission. (Some countries use fewer channels, e.g. New Zealand).

The receiver is continually scanning all channels in the hop-set and when a valid data packet is heard, it locks on to the channel and receives the data.

A spread-spectrum transmission offers some advantages over a fixed-frequency transmission. These are - Spread-spectrum signals are more resistant to narrowband interference, they are difficult to intercept or eavesdrop because of the pseudorandom transmission sequences and transmissions can share a frequency band with other types of conventional transmissions with minimal interference.

2.3.2 Meshing capability

The DAWN Wireless WIBMesh protocol is based on the “Ad hoc On Demand Distance Vector” (AODV) routing algorithm which is a routing protocol designed for ad hoc networks.

AODV is capable of unicast and multicast routing and is an on demand algorithm, meaning that it builds and maintains these routes only as long as they are needed by the source devices.

The Protocol creates a table, which shows the connection routes to other device in the system. The Protocol uses sequence numbers to ensure the routes are kept as current as possible. It is loop-free, self-starting, and can scale to a large numbers of nodes.

See section 3.4 “WIBMesh” for more details on configuration.

2.4 Antenna

The M1115NL module will operate reliably over large distances. The distance that can be reliably achieved will vary with each application and depend on the type and location of antennas, the degree of radio interference, and obstructions (such as hills or trees) to the radio path.

Typical reliable distances are detailed below, however longer distances can be achieved if antennas are mounted in elevated locations – such as on a hill or on a radio mast.

Using the 900 MHz Spread Spectrum radio the distances achievable will be:

- USA/Canada 15 miles - 6dB net gain antenna configuration permitted (4W EIRP)
- Australia/NZ 12 km - Unity gain antenna configuration (1W EIRP)

To achieve the maximum transmission distance, the antennas should be raised above intermediate obstructions so the radio path is true “line of sight”. Because of the curvature of the earth, the antennas will need to be elevated at least 15 feet (5 metres) above ground for paths greater than 3 miles (5 km). The modules will operate reliably with some obstruction of the radio path, although the reliable distance will be reduced. Obstructions that are close to either antenna will have more of a blocking effect than obstructions in the middle of the radio path. For example, a group of trees around the antenna is a larger obstruction than a group of trees further away from the antenna.

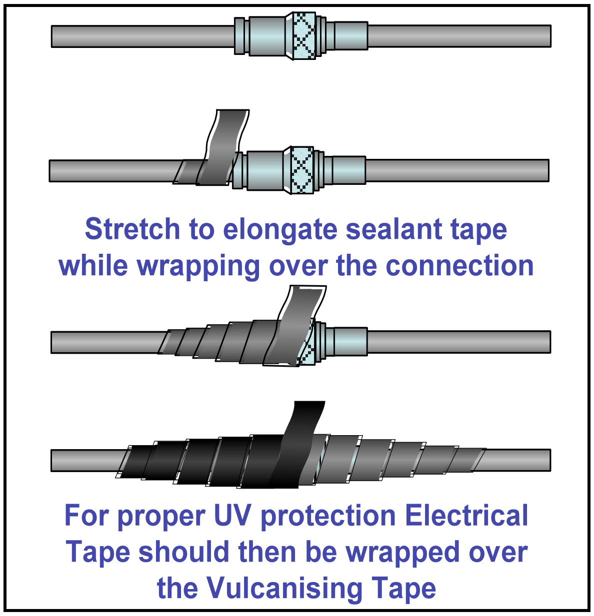
The M1115NL module provides a range of test features, including displaying the radio signal strength. Line-of-sight paths are only necessary to obtain the maximum range. Obstructions will reduce the range however, but may not prevent a reliable path. A larger amount of obstruction can be tolerated for shorter distances. For very short distances, it is possible to mount the antennas inside buildings. All radio paths require testing to determine if they are reliable - refer section 5.4 “Network Statistics” Where it is not possible to achieve reliable communications between two modules, then a third module may be used to receive the message and re-transmit it. This module is referred to as a repeater. This module may also have input/output (I/O) signals connected to it and form part of the I/O network - refer to Chapter 4 Configuration of this manual.

An antenna should be connected to the module via 50 ohm coaxial cable (e.g. RG58, RG213, Cellfoil, etc) terminated with a male SMA coaxial connector. The higher the antenna is mounted, the greater the transmission range will be, however as the length of coaxial cable increases so do cable losses. For use on unlicensed frequency channels, there are several types of antennas suitable for use. It is important antennas are chosen carefully to avoid contravening the maximum power limit on the unlicensed channel - if in doubt refer to an authorised service provider.
The net gain of an antenna/cable configuration is the gain of the antenna (in dBi) less the loss in the coaxial cable (in dB).

The net gain of the antenna/cable configuration is determined by adding the antenna gain and the cable loss. For example, a 6 element Yagi with 70 feet (20 metres) of Cellfoil has a net gain of 4dB (10dB – 6dB).

Maximum Gain per region	
Country	Max Gain (dB)
USA / Canada	6
Australia / New Zealand	0
Europe	0
Typical Antenna Gains	
Antenna	Gain (dB)
Dipole with integral 15’ cable	0
5dBi Collinear (3dBd)	5
8dBi Collinear (6dBd)	8
6 element Yagi	10
9 element Yagi	12
16 element Yagi	15
Typical Coax losses (900 MHz)	
Cable Type	Loss (dB per 30ft / 10m)
RG58	-5dB
RG213	-2.5dB
CC10 (3m Cellfoil)	-3dB
CC20 (6m Cellfoil)	-6dB

Connections between the antenna and 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, as it greatly increases the radio losses.



We recommend that the connection be taped, firstly with a layer of PVC Tape, then with a vulcanising tape such as "3M 23 tape", and finally with another layer of PVC UV Stabilised insulating tape. The first layer of tape allows the joint to be easily inspected when trouble shooting as the vulcanising seal can be easily removed.

Where antennas are mounted on elevated masts, the masts should be effectively earthed to avoid lightning surges. For high lightning risk areas, surge suppression devices between the module and the antenna are recommended. If the antenna is not already shielded from lightning strike by an adjacent earthed structure, a lightning rod may be installed above the antenna to provide shielding.

Dipole and Collinear antennas.

A collinear antenna transmits the same amount of radio power in all directions - and they are easy to install and use because they do not need to be aligned to the destination. The dipole antenna with integral 15 'cable does not require any additional coaxial cable; however a cable must be used with the collinear antennas.
Collinear and dipole antennas should be mounted vertically, preferably 1 wavelength away from a wall or mast to obtain maximum range.

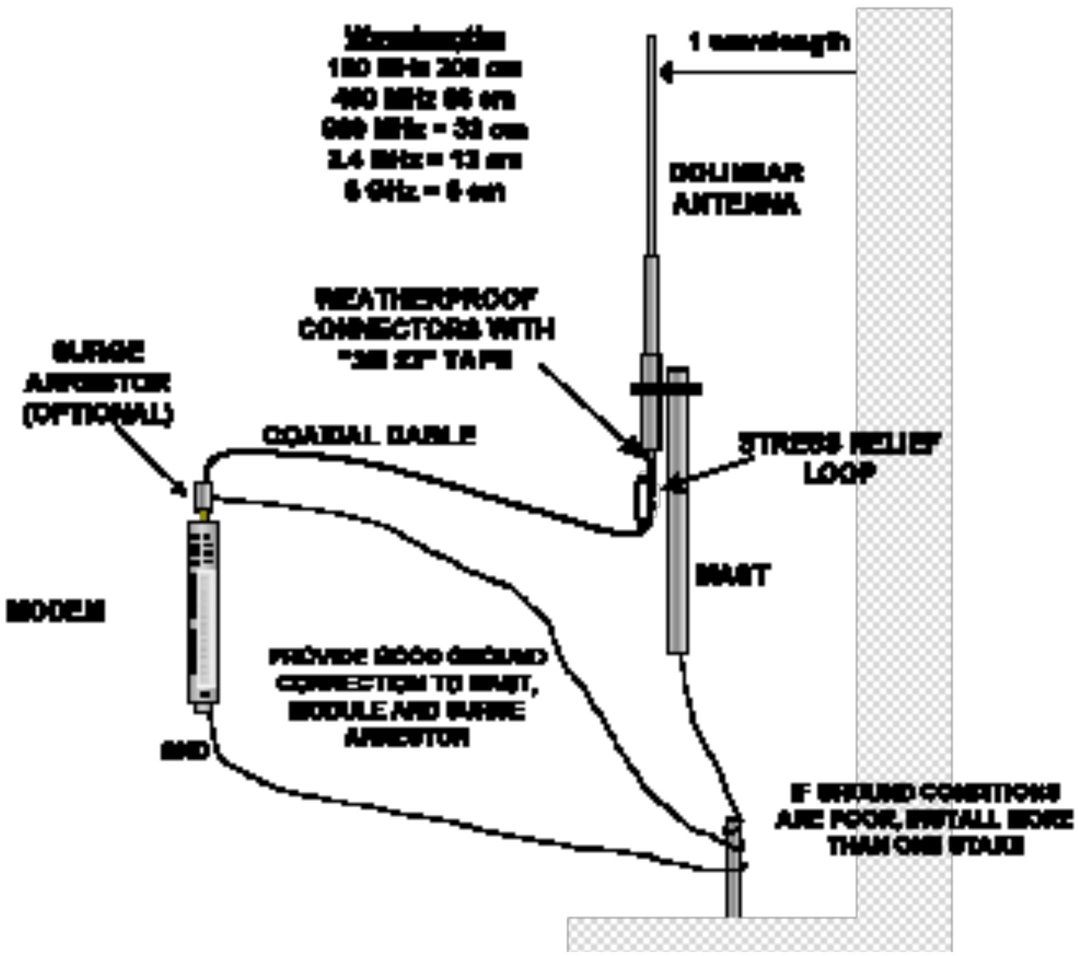


Figure 7 – Collinear Antenna mounting

Yagi antennas.

A Yagi antenna provides high gain in the forward direction, but lower gain in other directions. This may be used to compensate for coaxial cable loss for installations with marginal radio path.

The Yagi gain also acts on the receiver, so adding Yagi antennas at both ends of a link provides a double improvement.

Yagi antennas are directional. That is, they have positive gain to the front of the antenna, but negative gain in other directions.

Hence, Yagi antennas 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. The Yagi antennas may be installed with the elements in a vertical plane (vertically polarised) or in a horizontal plane (horizontally polarised), however both antenna must be in the same plane for maximum signal. If the antenna are mounted in different planes the receive signal level will be reduced by around 30dB.

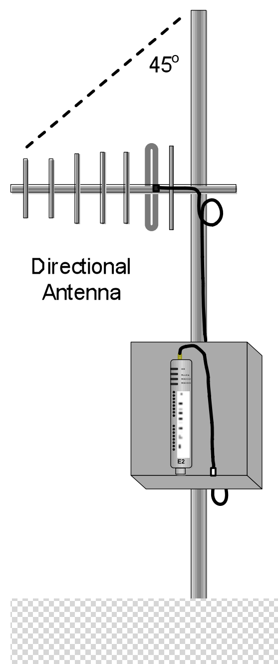


Figure 8 - Yagi Antenna Mounting

For a two-station installation, with both modules using Yagi antennas, horizontal polarisation is recommended. If there are more than two stations transmitting to a common station, then the Yagi antennas should have vertical polarisation, and the common (or “central” station should have a collinear (non-directional) antenna.

Note that Yagi antennas normally have a drain hole on the folded element - the drain hole should be located on the bottom of the installed antenna.

2.5 Connections

2.5.1 Bottom panel connections

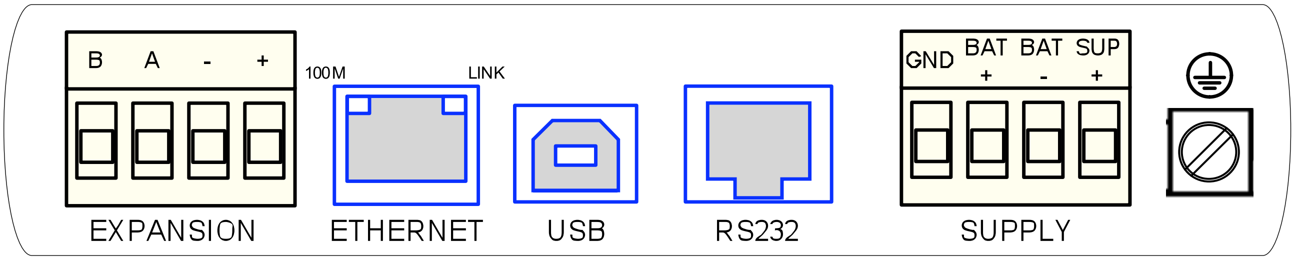


Figure 9 – Bottom Panel Connections

Ethernet port

The M1115NL modules provides a standard RJ-45 Ethernet port compliant to IEEE 802.3 10/100 BaseT. 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.

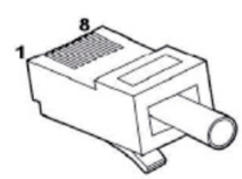
USB Device Port for configuration

The M1115NL 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 M1115NL module provides an RS-232 serial port, which support operations at data rates up to 230,400 baud. This port supports MODBUS protocol.

The RS-232 port is provided by an RJ-45 connector wired as a DCE according to EIA-562 Electrical Standard.

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 Modem)	
6	TXD	Y	Transmit Data (to Modem)	
7	CTS		Clear to Send	
8	RTS		Request to Send	

RS-485 port with Modbus Support.

The M1115NL module provides an RS-485 serial port, which supports operations at data rates up to 230,400 baud. Default baud rate is 9600 baud, No Parity, 8 data bits and 1 stop bit which match the 115S serial expansion modules defaults. This port Supports MODBUS protocol.

The RS-485 port is provided by two screw terminals. On-board termination of the RS-485 circuit is built-in.

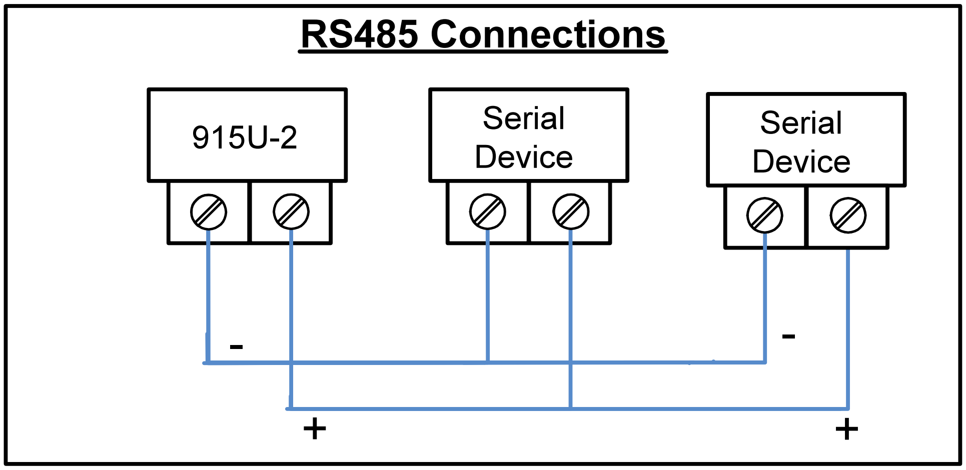


Figure 10 – RS485 Connections

2.5.2 Side Access Configuration Panel

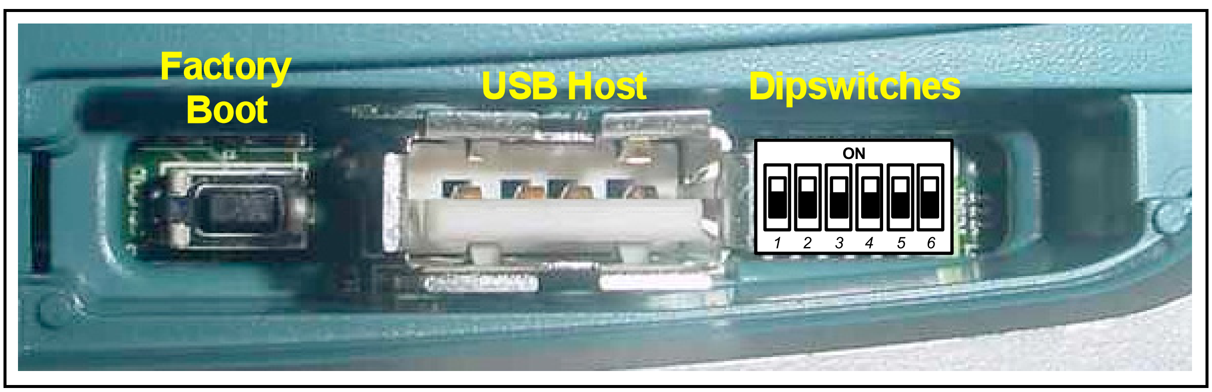


Figure 11 – Side Access Panel

On the side of the module is a small access cover that hides a “Factory Boot” switch, USB Host port and a small bank of dipswitches that are used for Analog input voltage/current selection, External Boot and Default configuration settings.

“Factory Boot” switch

The “Factory Boot” switch is used for factory setup and diagnostics. This switch should not normally be used, except if advised by DAWN Wireless support.

USB Host port

This port is a USB Host (Master port), which can interface with USB storage devices for data logging (Future) and for upgrading the module Firmware – See section 4.4 “System Tools” for details on how this is done.

Dipswitches

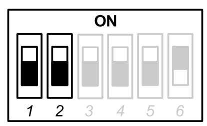
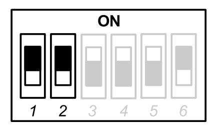
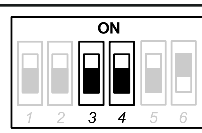
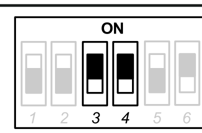
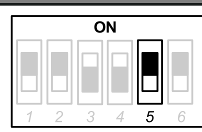
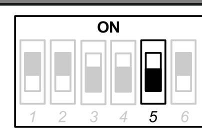
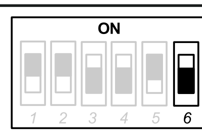
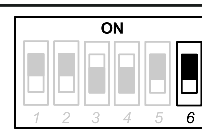
The Dipswitches are used to select a number of functions within the module; the table below indicates the different switch positions.

- Dipswitches 1 to 2 – Selection for measuring Current or Voltage on Analog Input 3. Set DIP switches ON to measure Current (0-20mA) and OFF for Voltage (0-5VDC).

- Dipswitches 3 to 4 – Selection for measuring Current or Voltage on Analog Input 4. Set DIP switches ON to measure Current (0-20mA) and OFF for Voltage (0-5VDC).

- Dipswitch 5 – DIP Switch not used

- Dipswitch 6 – When set to ON (Enabled), the module will boot up with a known factory default including a default IP address for Ethernet connection. (Refer to 4.1 “Default ”)

Switch	Function	Current	Voltage
DIP 1 & 2	Analog Input #3		
DIP 3 & 4	Analog Input #4		
Switch	**Function**	**Enabled**	**Disabled**
DIP 5	Not used		
DIP 6	Default Configuration		

Front panel connections

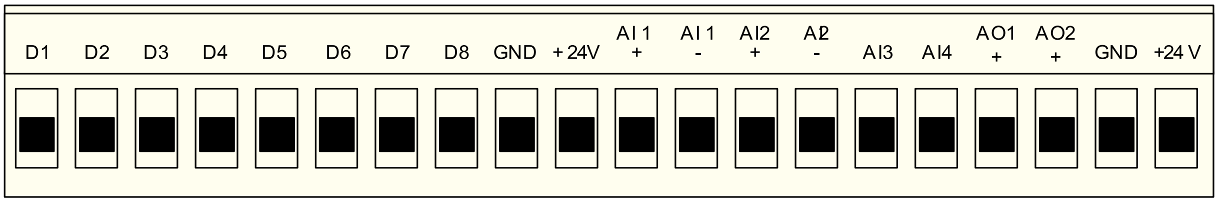


Figure 12 – Front Panel Connections

The M1115NL front panel provides connections for the following

- Eight Digital Input /Output (DIO1-8).
- Two 12 bit, 0.1% accuracy differential analog inputs.
- Two single ended 12 bit, 0.1% accuracy analog inputs.
- Two 15 bit, 0.1% accuracy current sourcing analog outputs.
- Connection terminals for Common and +24V Analog Loop Supply (ALS maximum current limit is 150mA).

2.5.3 Digital Inputs

Each digital I/O channel on the M1115NL 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 however, the I/O system will not operate correctly.

If operating the channel as an output and performing a “read inputs” on this location it will indicate the status of the output.

Marked DIO1-8 the Digital inputs share the same terminals as the Digital outputs on the M1115NL module.

A digital input is activated by connecting the input terminal to EARTH 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 or common.

Discrete Input / Output Used as input

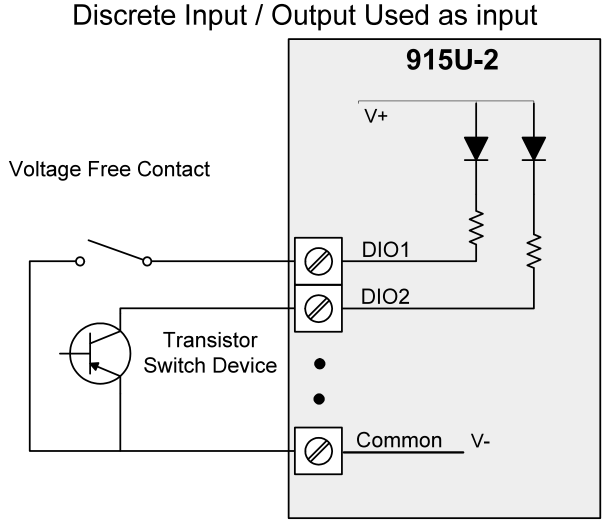


Figure 13 – Digital Input Wiring

2.5.4 Pulsed Inputs

The M1115NL supports 8 x digital signals, of which inputs 1-4 can be used as pulsed inputs.

The maximum pulse frequency is 50 KHz for Input 1 & 2 and 1 KHz for Input 3 & 4.

Digital/Pulsed inputs are suitable for TTL signal Level, NPN-transistor switch devices or voltage-free contacts (relay/ switch with debounce capacitor).

Pulsed Inputs

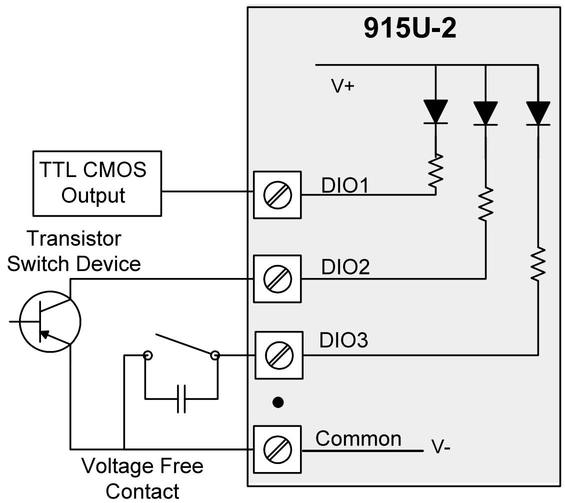


Figure 14 – Pulsed Input Wiring

Frequencies greater than 1 KHz need to use a TTL logic drive or an external pull-up resistor. Pulsed inputs are converted to two different values internally. First is the Pulse Count, which is an indication of how many times the input has changed state over a configured time period. Secondly there is a Pulse Rate which is an analog input derived from the pulse frequency. E.g. 0 Hz = 4mA and 1 KHz = 20mA.

2.5.5 Digital Outputs (Pulsed Outputs)

Digital outputs are open-collector transistors and are able to switch loads up to 30VDC, 200mA.

The 8 digital outputs share the same terminals as the digital input. These terminals are marked DIO1-8.

Discrete Input / Output Used as output

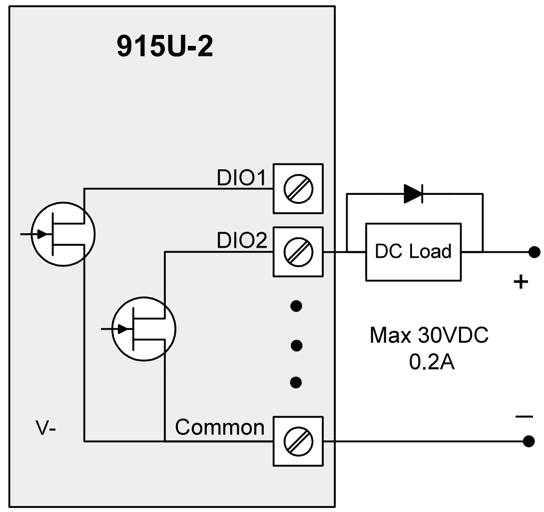


Figure 15 – Digital Output Wiring

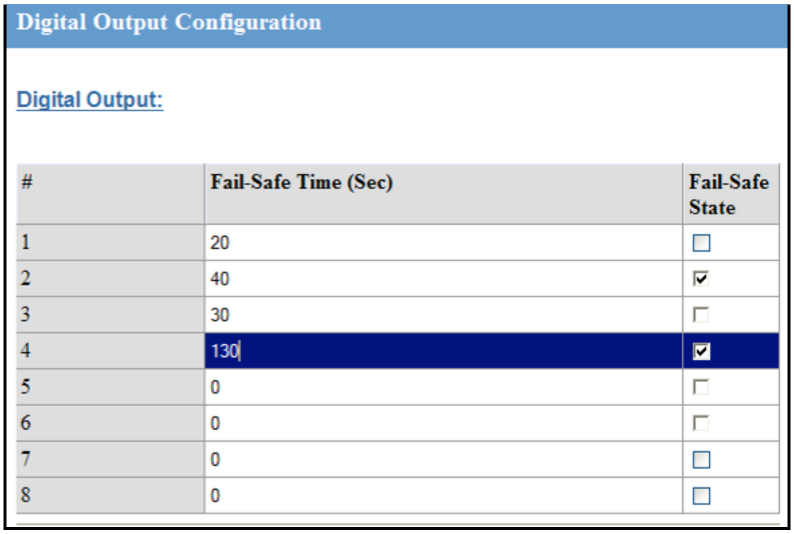
When active, the digital outputs provide a transistor switch to EARTH (Common).

To connect a digital output, refer to “Figure 15” above. A bypass diode (IN4004) is recommended to protect against switching surges for inductive loads such as relay coils.

The digital channels DIO1-4 on the M1115NL module can be used as pulse outputs with a maximum output frequency of 1 KHz.

Digital Output Fail Safe Status

As well as indicating the Digital Output status (on / off), the LEDs can also indicate a communications failure by flashing the Output LED. This feature can be utilised by configuring a Fail Safe time and status on the “I/O Configuration” web page as shown below.



Digital Output Configuration

Digital Output:

#	Fail-Safe Time (Sec)	Fail-Safe State
1	20	[ ]
2	40	[x]
3	30	[ ]
4	130	[x]
5	0	[ ]
6	0	[ ]
7	0	[ ]
8	0	[ ]

Figure 16 – Digital Output Failsafe 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 we send successive update messages and fail to receive both the timer counts down to zero and then activates the Failsafe state.

If the Failsafe state is enabled (ON) this will indicate with the LED flashing briefly OFF and the digital output will turn on.

If the Failsafe state is disabled (OFF) this will indicate with the LED flashing briefly ON and the digital output will turn off.

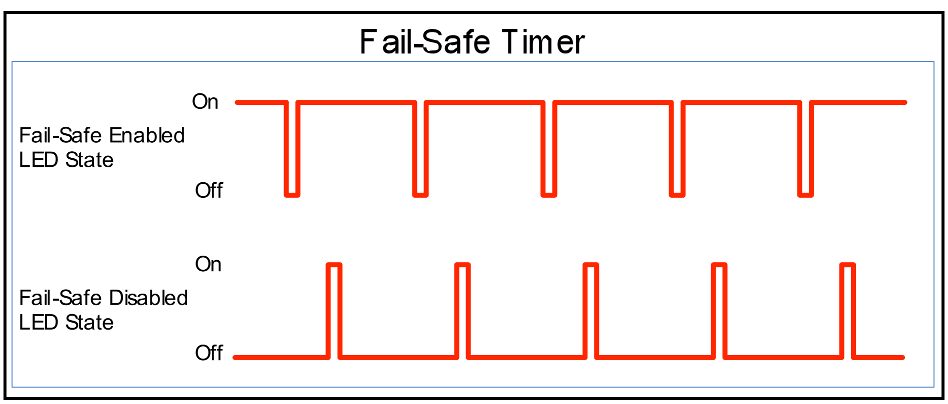


Figure 17 - Fail-Safe State

2.5.6 Analog Inputs

The M1115NL can provide two floating differential analog inputs and two grounded single-ended analog inputs.

Analog Input 1 & 2 can automatically measure Current (0-20 mA) or Voltage (0-25V) depending on what is connected to the input.

Analog input 3 & 4 must be configured to measure Current (0-20mA) or Voltage (0-5V) via the DIP switches under the Side Access Configuration Panel (See Section 2.5.2).

An internal 24V Analog Loop Supply (ALS) provides power for any current loops with a maximum current limit of 150mA.

The LEDs have an analog diagnostic function and will indicate the status of the input.

If the current is less than 3.5 mA the LED will be off and if greater than 20.5mA the LED will be on.

The LED will flicker with the duty cycle relative to the analog reading in this range. (Note by default there is a 5 second delay on the input because of the Filter)

Also, LEDs beside AI1+, AI2+ flash according to current on these inputs. LEDs beside AI1- and AI2- flash according to the voltage on the Analog inputs.

Differential Current Inputs (AIN 1 & 2 only)

Differential mode current inputs should be used when measuring a current loop, which cannot be connected to earth or ground. This allows the input to be connected anywhere in the current loop. Common mode voltage can be up to 27VDC.

The diagram below indicates how to connect Loop powered or externally powered devices to the M1115NL Differential Analog Inputs.

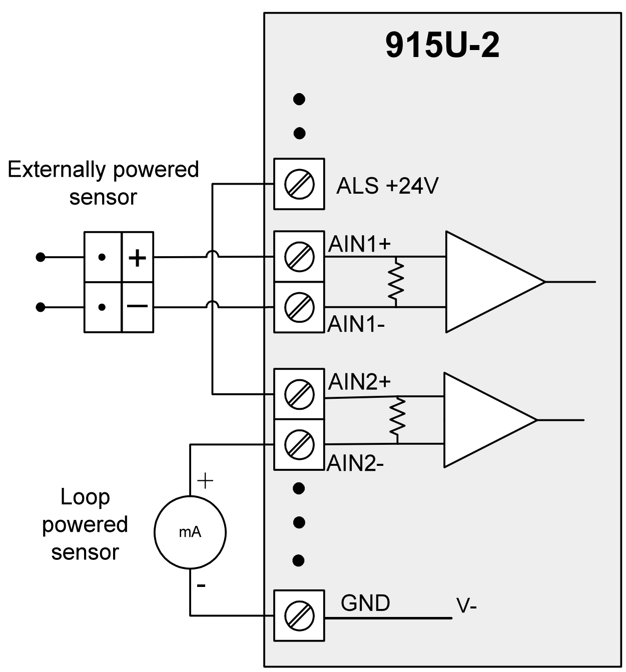


Figure 18 – Differential Current Inputs

Single Ended Current Inputs (AIN 3 & 4 only)

Single-ended current input mode is useful if the sensor loop is grounded to the M1115NL module. Devices can be powered from the 24V Analog Loop Supply (ALS) generated internally from the module.

The Dip Switches are used to determine if the inputs will be current or voltage.

Dip Switches 1 & 2 are used for or Analog 3 and Dip Switches 3 & 4 are used for Analog 4

For Current set both Dip Switches to the “On” position, for Voltage set both to “Off”

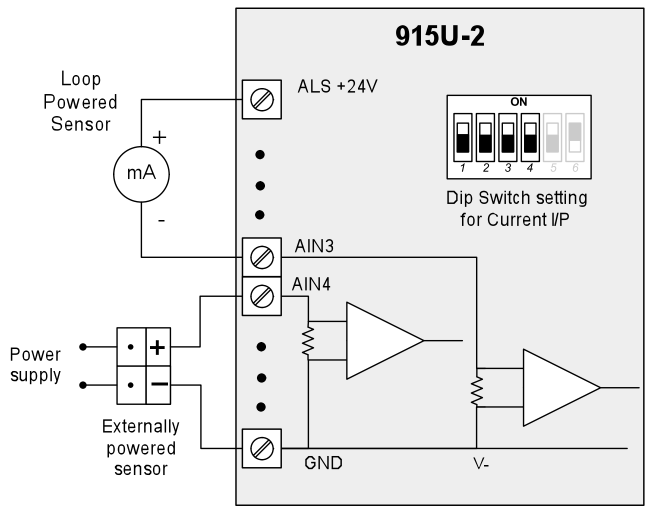


Figure 19– Single Ended Current Inputs

Single Ended Voltage Inputs

All analog inputs can be setup to read voltage.

If using Analog input 1 & 2 connect the voltage source across the positive terminal of the input and Common.

If using Analog input 3 & 4 then connect across the input terminal and Common.

Note:

Default scaling gives 0-25V for 4-20mA output on Analog 1 and 2.

Default scaling for analog 3 and 4 gives 0-5V for 4-20mA output.

For Voltage input on analog 3 and 4 set both Dip Switches to the “Off” position,

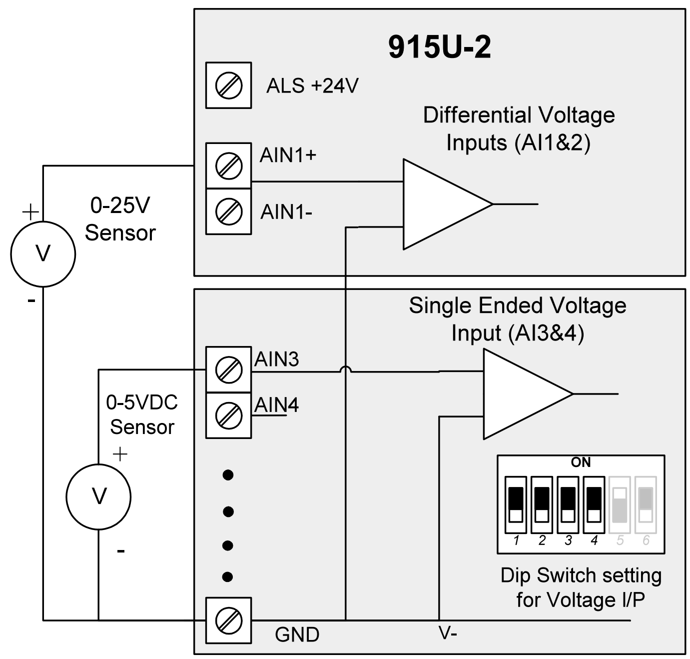


Figure 20 - Voltage Inputs

2.5.7 Analog Outputs

The M1115NL module provides two 0 - 24 mA DC analog outputs for connecting to instrument indicators for the display of remote analog measurements.

The M1115NL Analog outputs are a sourcing output and should be connected from the analog output terminal through the device or indicator to Common. See diagram for connections.

The LEDs function as a primitive level indicator depending on current - Dim for 4mA and Bright for 20mA

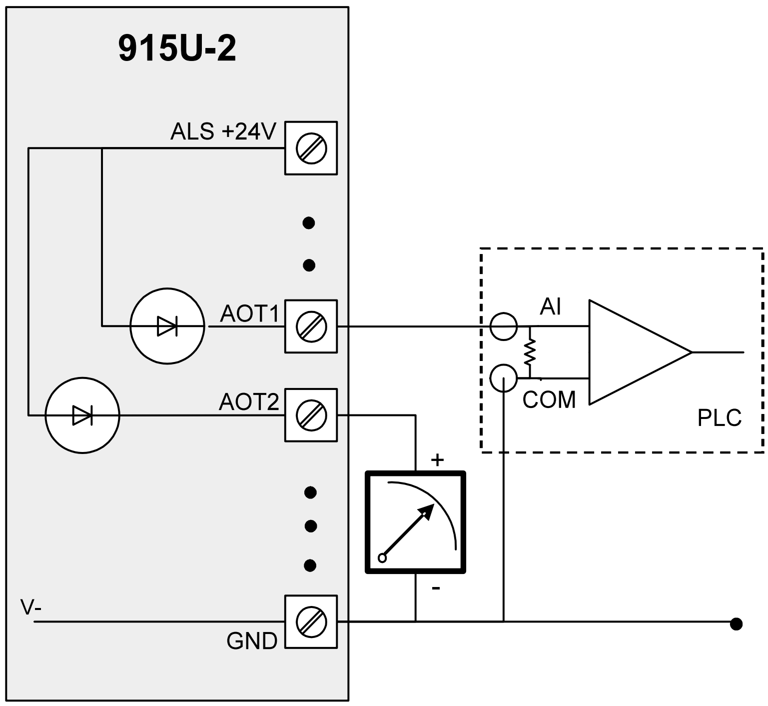


Figure 21- Analog Outputs

Chapter 3 - Operation

3.1 Overview

The M1115NL range of I/O modules has been designed to provide standard “off-the-shelf” telemetry functions, at an economic price. Telemetry is the transmission of data or signals over a long distance via radio or twisted-pair wire cable

3.2 Indications

When power is initially connected to the module it will perform some internal setup and diagnostics checks to determine if the module is operating correctly. These checks will take approximately 40 seconds. The table below shows the correct LED sequences.

3.2.1 Front Panel Indications

LED Indicator	Condition	Meaning
PWR	GREEN	System OK
PWR	Fast Flash	System Boot – Stage 1
PWR	SLOW Flash	System Boot – Stage 2
PWR	RED	System Boot – Initial / System Failure
RF	GREEN	Receiving Radio data
RF	RED	Transmitting Radio data
232	GREEN	Receiving RS232 data
232	RED	Transmitting RS232 data
232	ORANGE	Transmitting and Receiving RS232 data
485	GREEN	Receiving RS485 data
485	RED	Transmitting RS485 data

3.2.2 Boot Sequence “PWR” LED Indications

Normal Reset

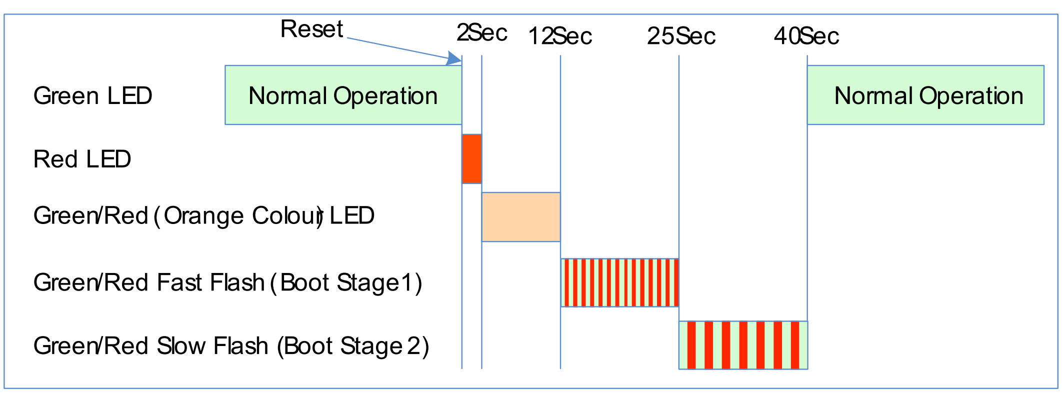
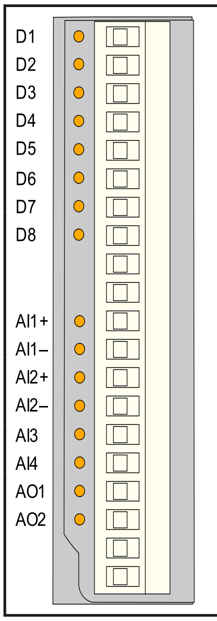


Figure 22 - Boot Sequence

3.2.3 Input / Output Indications



LED Indicator	Condition	Meaning
D 1- 8	ORANGE	Digital input ON
D 1- 8	FLASHING ORANGE - Mostly On	Update Failure - Failsafe state On
D 1- 8	FLASHING ORANGE - Mostly Off	Update Failure - Failsafe state Off
AI 1 & 2 +	ORANGE	Analog input current indication
AI 1 & 2 –	ORANGE	Analog input voltage indication
AI 3 & 4	ORANGE	Analog input current or voltage indication
AO1 & 2	ORANGE	Analog output current indication

Digital Inputs

LED's display the status of each of the eight DIO's when used as inputs. (If the LED is lit then the input is on).

Digital Outputs

When the DIO's are used as outputs the LEDs will display the status of each of the digital output (If the LED is lit then the output is on). The LED's also indicate if the output has not been updated by flashing. Mostly ON will indicate the Failsafe state is ON and mostly OFF will indicate the Failsafe state is OFF.

Analog Inputs

Two LEDs exist for each Differential analog input. The first LED (+) is used to indicate the analogue input is reading a Current (mA), the second LED (-) indicates the input is reading Voltage.

Each of the analog input LEDs will flash with increasing speed and intenseness depending on the level of the input (4mA = slow/dim and 20mA= fast/bright)

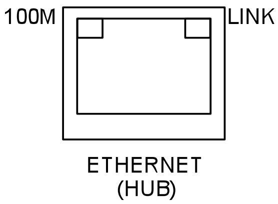
For each of the single ended analog channels, the LED indicates when the input is reading Current or Voltage by flashing the LED with the level of the input (4mA = slow/dim and 20mA= fast/bright).

Analog Outputs

Each Analog output has an LED in series which will indicate the output current by increasing/decreasing the intensity of the LED. (4mA = dim and 20mA= bright)

3.2.4 Ethernet Indications

On the end plate, the ethernet socket incorporates two LED's These LEDs indicating the Ethernet status



100M – GREEN LED indicates presence of a 100 Mbit /s Ethernet connection, with a 10 Mbit /s connection the LED will be off.

LINK – ORANGE indicates an Ethernet connection and LED briefly flashes "off" with activity.

3.3 System Design

3.3.1 Radio Channel Capacity

Messages sent on a cable link are much faster than on a radio channel, and the capacity of the radio channel must be considered when designing a system. This becomes more important as the I/O size of a system increases.

The modules are designed to provide “real-time” operation or Change of State (COS). When an input signal changes, the change message is sent to the output. The system does not require continuous messages as in a polling system. Update messages are intended to check the integrity of the system, not to provide fast operation. Update times should be selected based on this principle. The default update time in the mappings is 10 minutes - we recommend that you leave these times as is unless particular inputs are very important and deserve a smaller update time.

It is important that radio paths be reliable. For large systems, we recommend a maximum radio channel density of 300 messages per minute, including change messages and update messages. We suggest that you do not design the system with more than 300 messages per minute as this does not take into account any network communication overheads. Note that this rate assumes that all radio paths are reliable and the network topology (mesh) is stable - poor radio paths will require retransmissions and will reduce the channel density. If there are other users on the radio channel, then this peak figure will also decrease.

Having remotes radios dropping in and out of communications can also increase overall network traffic because the network would need to relearn the communication paths each time the module comes back on line.

Dual Band Operation

The M1115NL radio band is split into two sub-bands, 902-914 MHz (Low) and 915–928 MHz (High). In America and Canada, the M1115NL uses both sub-bands - but in other countries, e.g. Australia only the high band is available. In America and Canada, it is possible to restrict the frequency hopping of the 905U to only the high or low band. If there are many 905U systems in the same area, this technique will help to separate systems to avoid radio interference. Note that this technique is only possible in countries that utilize the full 902-928MHz bandwidth, i.e. America / Canada, etc.

The radio sub-band can be changed by selecting the “Hop Set” on the Radio page.

3.3.2 Radio Path Reliability

Radio paths over short distances can operate reliably with a large amount of obstruction in the path. As the path distance increases, the amount of obstruction that can be tolerated decreases. At the maximum reliable distance, “line-of-sight” is required for reliable operation. The curvature of the earth becomes more of an obstacle if the path is greater than several kilometres (or miles), and therefore needs to be allowed for. For example, the earth curvature over 5 miles (8km) is approx 10 feet (3m), requiring antennas to be elevated at least 13 feet (4m) to achieve “line-of-sight” even if the path is flat.

A radio path may act reliably in good weather, but poorly in bad weather - this is called a “marginal” radio path. If the radio path is more than 20% of the maximum reliable distance (see Specification section for these distances), we recommend that you test the radio path before installation. Each M1115NL module has a radio path-testing feature - refer to Section 5.2 ”Connectivity” of this manual.

There are several ways of improving a marginal path:-

- Relocate the antenna to a better position. If there is an obvious obstruction causing the problem, then locating the antenna to the side or higher will improve the path. If the radio path has a large distance, then increasing the height of the antenna will improve the path.

- Use an antenna with a higher gain. Before you do this, make sure that the radiated power from the new antenna is still within the regulations of your country. If you have a long length of coaxial cable, you can use a higher gain antenna to cancel the losses in the coaxial cable.

If it is not practical to improve a marginal path, then the last method is to use another module as a repeater. A repeater does not have to be between the two modules (although often it is). If possible, use an existing module in the system, which has good radio path to both modules. The repeater module can be to the side of the two modules, or even behind one of the modules, if the repeater module is installed at a high location (for example, a tower, or mast). Repeater modules can have their own I/O and act as a “normal” M1115NL module in the system.

3.3.3 Design for Failures

All well designed systems consider system failure. I/O systems operating on a wire link will fail eventually, and a radio system is the same. Failures could be short-term (interference on the radio channel or power supply failure) or long-term (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, then some form of failure is likely. If the output is controlling some machinery, then it is good design to switch off this equipment until communications has been re-established.
- The modules provide a “drop outputs on comms fail” time. This is a configurable time value for each output. If a message has not been received for this output within this time, then the output will reset (off, in-active, “0”). 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 radio interference, however if two successive update messages are missed, then long term failure is likely and the output should be reset. For example, if the input update time is 3 minutes, set the output reset time to 7 minutes.
- A module can provide an output, which activates on communication failure to another module. This can be used to provide an external alarm that there is a system fault.

3.3.4 Indicating a Communications Problem

There are two ways to indication communications problems.

Fall-to-transmit alarm

The first method is to setup a communications indication on a register of your choice when configuring a mapping. This can be done using an existing mapping (do not need to setup a special comms mapping).

When entering a Block Write or Gather/Scatter Mapping you need to enter into the “FailReg” field a register location that you wish to indicate a communications fail (As mentioned previously this register can be a local DIO (Reg 1-8) or an internal register.

When ever the module tries to send this mapping and fails to get a response (Ack) it will turn on the output.

The Comms Fail indication will clear on the next successful transmission of the mapping.

This method will work with any number repeaters in the link; however it will only indicate a failure to transmit if the mapping has the “ACK” field checked.

It will not give a Fail indication if the mappings are configured as Transmit only (do not have the "Ack" ticked).

Fail-to-receive alarm

The second method is to set up a "Comms Link" indication on the receiving end using normal Write Mappings on the transmitting end and the "Fail Safe Time" function on the receiving end. Setup a comms mapping from an unused digital input (can be an internal signal, i.e. Supply fail) and have it mapped to the output that will indicate the communication status. The input will be updated at a given time interval (default will be 5 seconds) but select a time that will give a good indication of failure but not update so much that it generates too many comms check messages, e.g. 30 seconds.

On the receiving end, configure a "Fail Safe Time" on the output that it being mapped to of twice the update time e.g. 1 minute. Next, configure the Fail Safe State to be on "ticked" which will turn on the output when it fails to be updated. Alternatively, you could invert the mapping so the output was always on and then trigger the "Fail Safe State" to go off when not updated.

This method will work with any number repeaters in the link.
You should use separate outputs to indicate "comms OK" of different remote modules

3.3.5 Testing and Commissioning

We recommend that that the system is fully tested on the bench before installation. It is much easier to find configuration problems on the bench when the modules are next to each other as apposed to being miles apart.

When the system is configured and you are happy that it all works, backup the configurations of all the modules.

After installation, record the radio signal strength and background noise level for each radio link. If there are future communications problems, you can compare the present measurements to the as-commissioned values. This is an effective way of finding problems with antennas, cables, and changes in the radio path (for example, the erection of new buildings).

3.4 WIBMesh

The DAWN WIreless WIBMesh protocol is based on the "Ad hoc On-demand Distance Vector" (AODV) routing algorithm which is a routing protocol designed for ad hoc networks.

AODV is capable of unicast (single addressed message) routing and is an "on-demand" protocol, meaning that it builds and maintains these routes only as long as they are needed by the source devices. In other words the network is silent until a connection is needed. The Protocol creates a table, which shows the connection routes to other device in the system and uses sequence numbers to ensure the routes are kept as current as possible.

When a module in a network needs to make a connection to another module it broadcasts a request for connection. Other modules forward this message, and record the module address that they heard it from, creating a table of temporary routes back to the starting module. If a module receives a request and it already has an existing route to the request destination, it will send a message backwards through the temporary route to the requesting module.

Each request for a route has a sequence number. Modules use this sequence number so that they do not repeat route requests that they have already passed on. Another such feature is that the route requests have a "time to live" number that limits how many times they can be retransmitted. Another such feature is that if a route request fails, another route request may not be sent until twice as much time has passed as the timeout of the previous route request.
The original starting module then begins using the route that has the least number of hops. Unused entries in the routing tables are recycled after a time.

When a link fails, a routing error is passed back to a transmitting node, and the process repeats.

Chapter 4 - Configuration

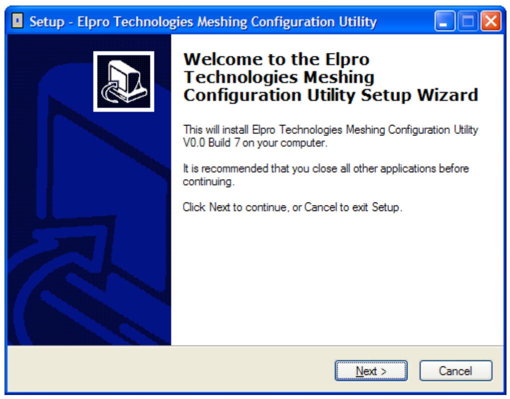
4.1 Module Configuration

Module configuration can be done using the DAWN Wireless MConfig utility or via inbuilt web pages. We recommend the software be used as the primary config as is easier to use and simplifies the overall configuration. It is also project based which means you can group a number of modules in one configuration file.

For instructions on web page based configurations see Appendix E: “Web Page Configuration”

The Utility is available from the download section on the DAWN Wireless Technologies web site - www.DAWN WIrelesstech.com.

After downloading, run the file to install the software on to your computer.



The software is compatible with all current Windows versions and uses a simple point and click interface. Configuration of the module can be via USB or Ethernet connection.

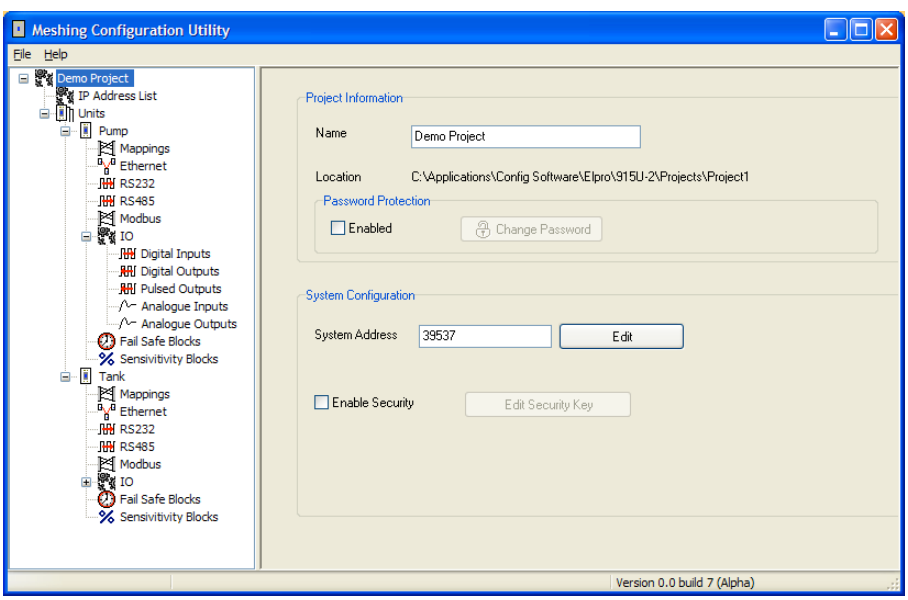


Figure 24 - Configuration Software

4.2 First time Configuration

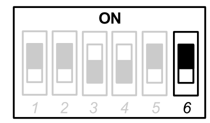
The M1115NL has a built-in web server, containing web pages for analyzing and minor modification to the module's configuration. The configuration can be accessed using any web browser however we recommend using Microsoft® Internet Explorer 8.

4.2.1 Default IP Address

The default factory IP Address of the M1115NL is 192.168.0.1XX, where XX is the last two digits of the serial number (the default "Setup IP address" is shown on the printed label on the side of the module)

Netmask 255.255.255.0

Username is "user" and the default password is "user"



The M1115NL will temporarily load some factory-default settings if powered up with the #6 dipswitch under the side configuration panel switched on. When in SETUP mode, wireless operation is
disabled. The previous configuration remains stored in non-volatile memory and will only change if a configuration parameter is modified and the change saved.

Do not forget to set the switch back to the OFF position and re-cycle the power at the conclusion of the configuration for normal operation otherwise, it will continue to boot into the default IP address.

4.2.2 Accessing Configuration

The Default IP address is in the range 192.168.0.XXX and so will require a PC on this network or be able to change the network settings to access the module configuration.

This is the procedure for changing A PC network settings.

You will need a "straight-through" Ethernet cable between the PC Ethernet port and the M1115NL. The factory default Ethernet address for the M1115NL is 192.168.0.1XX where XX are the last two digits of the serial number (check the label on the back of the module).

Connect the Ethernet cable between unit and the PC configuring the module.
Open the side configuration panel and set the #6 Dipswitch to ON.

With this switch on the M1115NL will always start with the Ethernet IP address 192.168.0.1XX, subnet mask 255.255.255.0, Gateway IP 192.168.0.1 and the radio IP address 192.168.2.1. Do not forget to set the switch back to the OFF position and restart the module at the conclusion of configuration.

4.2.3 Power up the M1115NL module

Open “Network Settings” on your PC under Control Panel. The following description is for Windows XP - earlier Windows operating systems have similar settings.

Open “Properties” of Local Area Connection.

Select Internet Protocol (TCP/IP) and click on Properties.

On the General tab, enter IP address 192.168.0.1, Subnet mask 255.255.255.0 and press “OK”

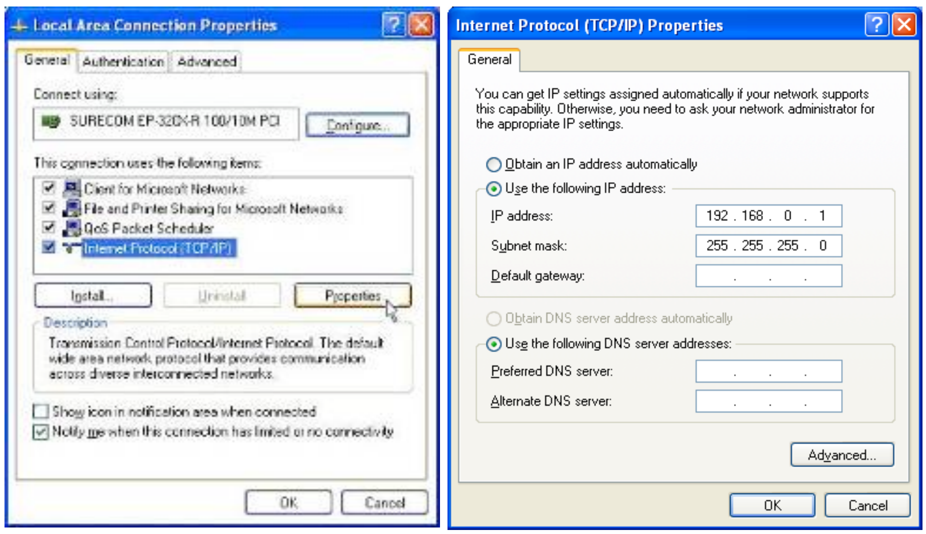


Figure 25 – Network Settings

The simplest way to check ethernet communications is to use the “Ping” command

From the Windows Start menu, select “Run” then type “command”

A Command Prompt DOS window will open and from there you can use the Ping command to check if you are able to connect to the module.

Type ping 192.168.0.1XX (where XX is the last two digits of the serial number)

You should then see a reply like below.

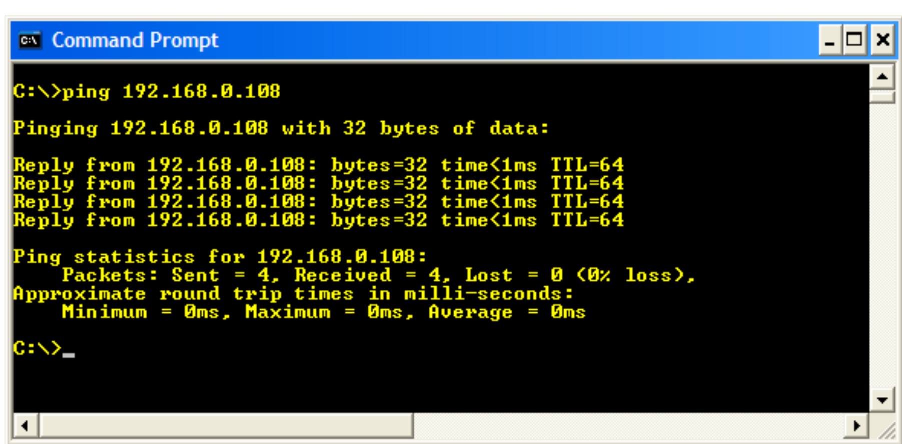


Figure 26 - Ping

You can then open Internet Explorer and ensure you can connect to the IP address selected. If the PC uses a proxy server, ensure that Internet Explorer will bypass the Proxy Server for local addresses.

This option may be modified by opening Tools -> Internet Options -> Connections Tab -> LAN Settings->Proxy Server -> bypass proxy for local addresses.

Enter the default IP address for the M1115NL   https://192.168.0.1XX where XX is the last two digits of the serial number.

Enter the username “user” and default password “user”.

When Configuration is complete switch the M1115NL Factory Default dip-switch to RUN and cycle power to resume normal configured operation.

You should now see the Module Welcome Screen (below)

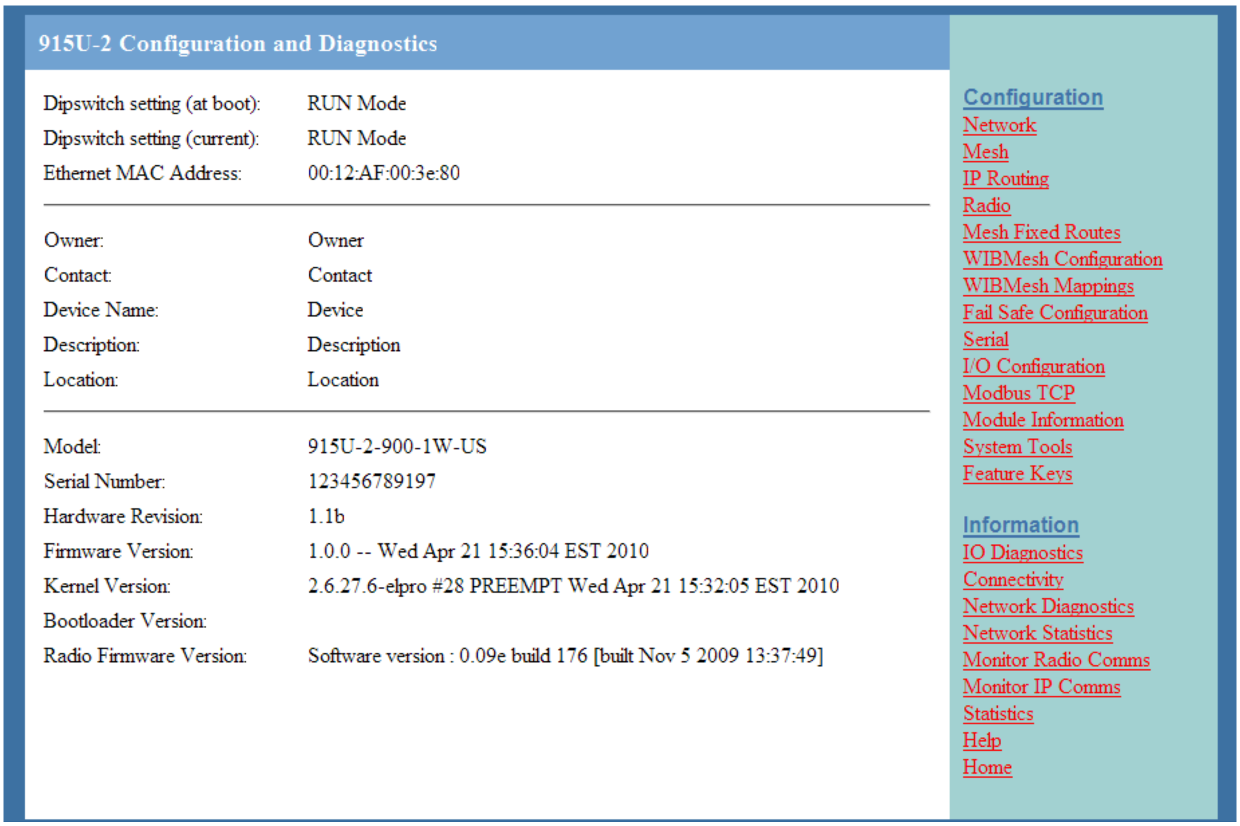


Figure 27 - Main Welcome Screen

4.2.4 Over the Air Web Based Configuration

The M1115NL modules communicate using Standard Ethernet Protocols which makes it possible to connect to other M1115NL module within the radio network for over the air diagnostics or configuration changes.

A little forethought when designing the system is required as some minor configuration settings are needed to implement the over air configuration.

The Multi point to point system shown below in Figure 28 will require the following.

- Default Gateway address in all remote modules needs to point back to the Central M1115NL module radio IP address (i.e. 10.0.0.1)
- Central M1115NL needs to have the “IP Gateway Mode” enabled on the “Mesh” webpage (see Appendix F: “Web Page Configuration“ for details).
- Ethernet IP address range on the remote modules must be different to the Ethernet IP address range on the Central M1115NL module or disabled (see Appendix F: “Web Page Configuration“)
- PC must have its Default Gateway address set to the Central M1115NL Ethernet IP Address or it must have a route added to its default routing table, e.g. “ROUTE ADD 10.0.0.0 MASK 255.255.255.0 192.168.1.1

If the system is configured as per above it will allow configuration and diagnostics access for all remote modules from the PC connected to the Central M1115NL module.

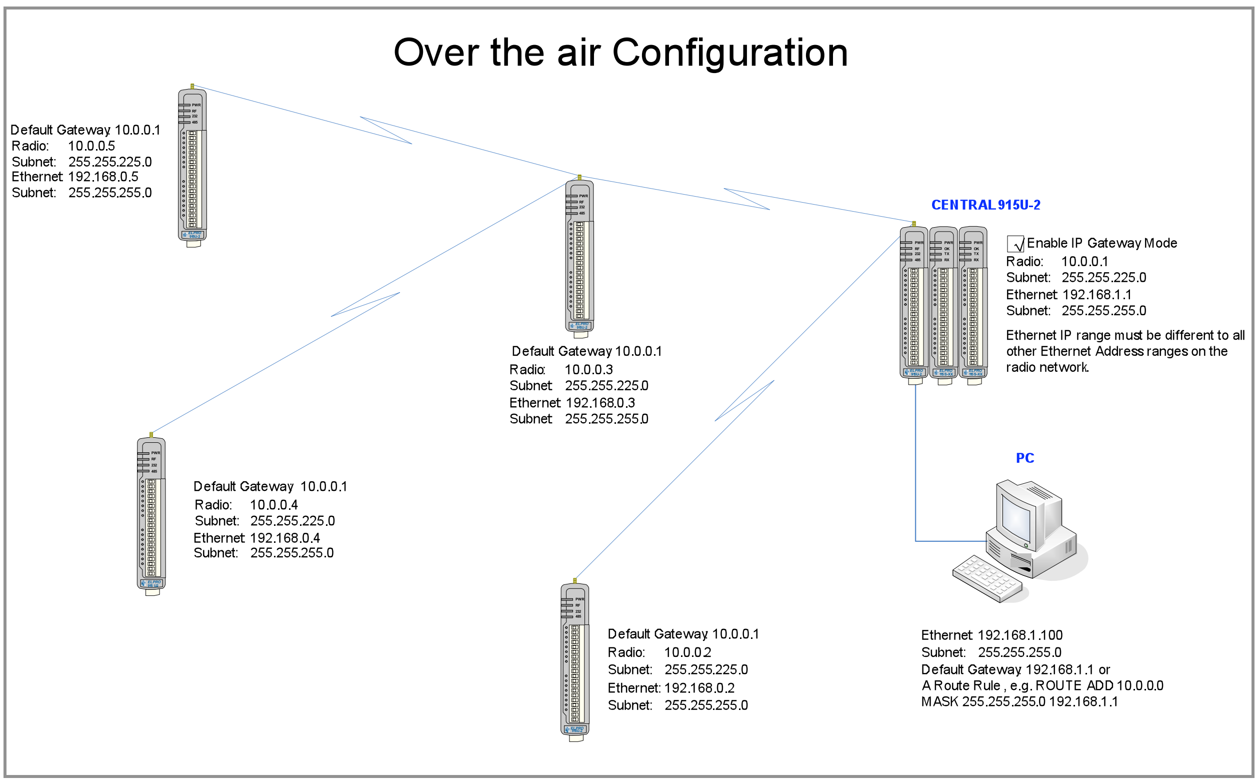


Figure 28 - Over the air Configuration

4.3 Module Information Web Page

This Web page is primarily for information purposes. With the exception of the password, the information entered here is displayed on the home configuration webpage of the M1115NL.

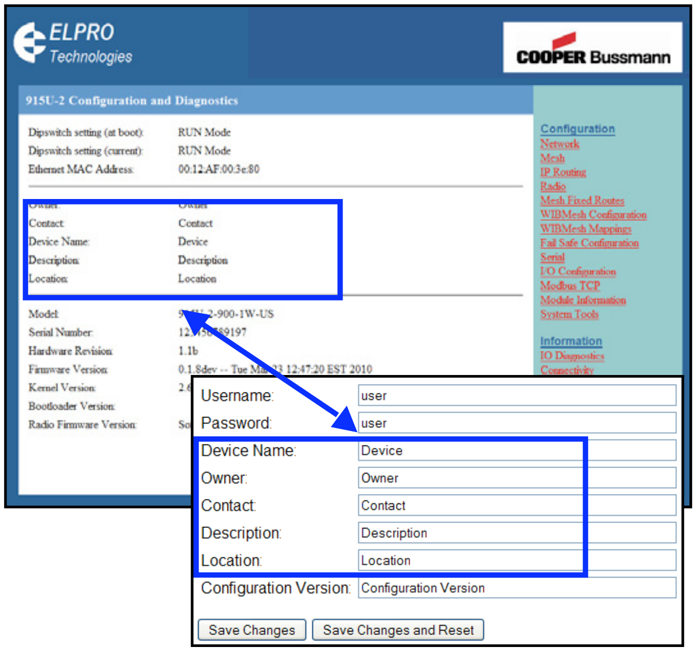


Figure 29 - Module Information

Username **default = "user"**	Configuration of Username. This is the username used to access the configuration on the M1115NL. Take care to remember this username if you change it as it will be needed to access the M1115NL in future.
Password **default = "user"**	Configuration of Password. This is the password used to access the configuration on the M1115NL. Take care to remember this password if you change it as it will be needed to access the module in future.
Device Name	A text field if you wish to label the M1115NL. Also name is used as a DNS Host name with a DHCP Client
Owner	A text field for owner name.
Contact	A text field for owner phone number, email address etc.
Description	A text field used for a description of the purpose of the unit.
Location	A text field used to describe the location of the M1115NL.
Configuration Version:	A text field to enter in a version description.

4.4 System Tools Web page

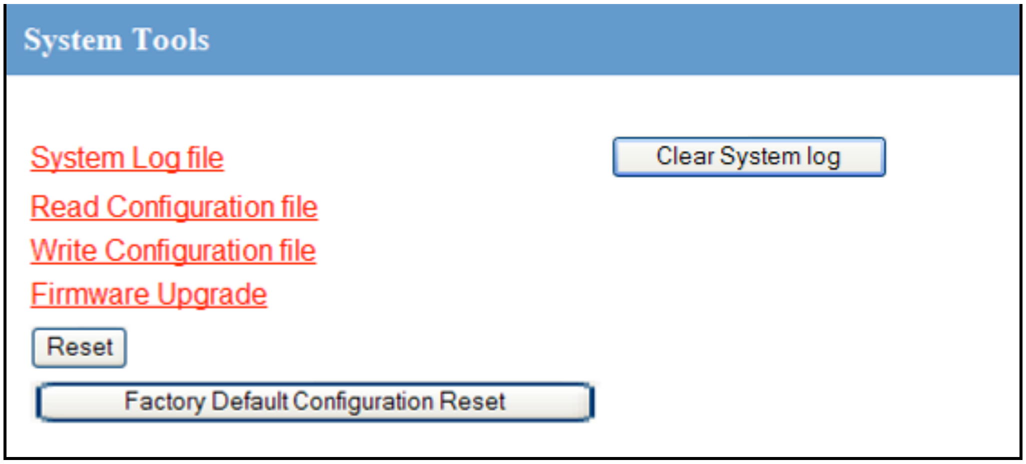


Figure 30 - System Tools

System Log File

Logs system instructions, etc to the screen where the log screen can be saved to a file. Not normally used, however maybe used by Technical Support to diagnose problems.

The “Clear System Log” clears the log screen.

Reading Configuration File

Reads the module configuration into an XML file, which can be saved by selecting “Save As” from the File menu.

Writing Configuration File

Allows a previously saved XML configuration file to be loaded back into the module.

Firmware Upgrade – Web Page

This option allows the module firmware to be upgraded locally. The process is done by selecting “Firmware update” and then browsing for the saved firmware file.

Locate and load the firmware file, press the “Send” button which will upload the file to the module and then press the “Reset” button. The module will do some checks to ensure the file is valid before a reset can be initiated.

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

Firmware Upgrade – USB

Firmware can also be upgraded by plugging a USB flash drive with the firmware files installed into the USB port underneath the “Access Configuration Panel” on the side of the module. The module will automatically identify that a USB drive has been plugged in and will initiate the upgrade process.

Instructions for upgrading Firmware are as follows

1. You will need valid DAWN Wireless M1115NL Firmware upgrade files. Contact DAWN Wireless Technologies for the latest version. Files must not be renamed, compressed, or zipped.

2. You will also need a dedicated USB Flash drive which needs to be formatted and completely free of any other file. Copy the firmware files to the Flash drive making sure they are in the root of the drive and not in a sub directory.

3. Before upgrading the firmware it is good practice to backup the existing configuration. Go to the “System Tools” webpage and save the configuration by selecting “Read Configuration File” and when the XML file is displayed press <CTRL> F5 to refresh the cache and select “Save As” or “Save Page As” on the File menu to save the XML as a file.

4. To upgrade, remove the “Configuration Panel” from the side of the module and plug the Flash drive into the USB port. If the module is mounted on a DIN rail with other I/O modules it will need to be removed to gain access to the side panel.

5. Power cycle the module to begin the upgrade process. As the module powers up it will recognise that a Flash drive has been installed and start upgrading the firmware. You will see the normal boot up LED sequence (see 3.2 “Indi cations” for details) however the orange indication will be on for longer.

DO NOT remove the Flash drive or interrupt the power to the module while this is happening. If the upgrade process is interrupted module could become unserviceable and will need to be returned to DAWN Wireless for repair.

Upgrade will take approximately 2 minutes and 40 seconds, 120 seconds over the normal boot time. When update is complete (Solid Green PWR LED indication) remove the flash drive.

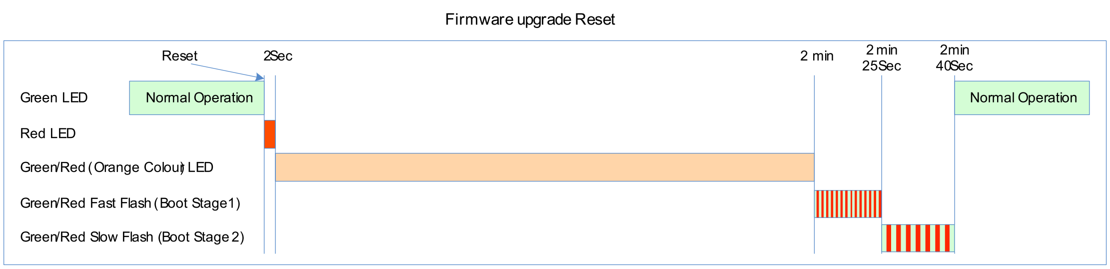


Figure 31 - Firmware Upgrade LED Indications

6. The upgrade process will clear the module flash so you will need to load the configuration file back into the module. To do this select “Write Configuration File” from the “System Tools” menu. Browse for the saved XML file and when loaded press Send and then Reset.

4.5 Feature Licence Keys Web Page

Allows the module to be upgraded with enhanced features or upgraded to a more advanced model .i.e. enabling the Modbus option.

The Feature Licence unlock codes are purchasable by contacting DAWN WIreless Technologies or your local distributor. The module serial number is needed to generate the Feature Licence Key which can be found on the default startup web page of the module, for details on what this looks like see Figure 27 – Main Welcome Screen on page number 46 of this manual.

The upgrade or advanced features are made available by entering in the purchased “Feature Licence Key” into the appropriate box next to the feature or enhancement. After entering the code press “Save Changes and Reset”. The screen will indicate the validity of the code by showing a green tick or a red cross.

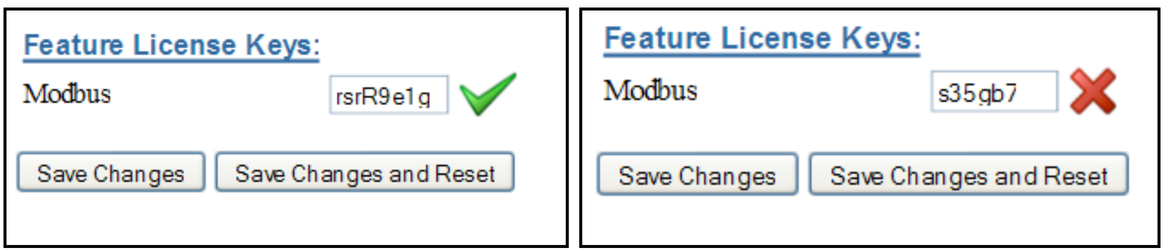


Figure 32 - Feature License Keys

4.6 Address Map

The I/O data store provides storage for all I/O data, either local or received from the system.

The I/O Store provides eight different “data files”, two bit, two word, two long-word and two floating point files. In addition each file type supports both inputs and outputs of the device and data storage for the gateway function.

These files are mapped into the address range as described below.

Store name	Type	Size	Address
dot	discrete outputs	3000 (bits)	00001
din	discrete inputs	2500 (bits)	10001
ain	word inputs (16-bit)	2500 (words)	30001
aot	word outputs(16-bit)	2500 (words)	40001
pin	long inputs (32-bit)	20 (longwords)	36001
real_ain	float inputs (32-bit)	20 (floats)	38001
pot	long outputs (32-bit)	20 (longwords)	46001
real_aot	float outputs (32-bit)	20 (floats)	48001

4.5 Feature Licence Keys Web Page

The addressing utilises standard Modbus protocol formatting as well as being common for DAWN Wireless protocol.

The following table shows the basic onboard I/O available in a standard M1115NL module with no expansion I/O connected. For a more detailed I/O map (showing the full register range), see Appendix B: "I/O Store Registers" at the end of the manual.

4.6.1 Standard M1115NL I/O (Basic I/O)

Address	Input / Output Description
0001 - 0008	Local DIO1 – DIO8 (as Outputs)
10001 - 10008	Local DIO1 – DIO8 (as inputs)
10009 - 10020	Setpoint status from Analog inputs 1 through 12. (AI1, 2, 3, 4 Current Mode), (Internal Supplies), (AI1, 2, 3, 4 Voltage Mode)
30001 - 30004	Local AI1 – AI4. (Current Mode) (AI1, AI2 4-20mA diff, AI3, AI4 4-20mA Sink)
30005 **30006** **30007** **30008**	Local Supply voltage (8-40V default scaling) Local 24V loop voltage (8-40V default scaling) Local Battery voltage (8-40V default scaling) 115S Expansion I/O Supply Voltage (8-40V default scaling)
30009 - 30012	Local AI1 – AI4. (Voltage Mode) (AI1, AI2 0-10V, AI3, AI4 0-5V)
30013 - 30016	Local Pulse rate inputs PI1 – PI4
36001 - 36008	Local Pulsed input counts – (PI1 Most significant word is 36001 and Least significant word is 36002)
38000 - 38021	Local Analog inputs as Floating point values (mA, Volts or Hz)
40001 - 40002	Local AO1 – AO2
48001 - 48002	Local AO1 – AO2 as floating point values (mA)

4.7 Serial Expansion I/O

4.7.1 Adding modules

Additional 115S serial expansion I/O modules can be added if more I/O is required.

When connecting expansion I/O module to the M1115NL the RS485 serial port is configured to communicate DAWN Wireless protocol by default.

The default serial parameters of the RS485 port are 19200, N, 8, 1 which match the defaults of the 115S serial expansion modules. The parameters can be changed, to increase poll speeds in larger systems however the serial modules will need to match that of the M1115NL RS485 port.

Also if more than 3 serial expansion modules are added the "Maximum Connections" for the RS485 port on the "Serial" page will need to be adjusted.

Note: Reducing the "Maximum connections" will slightly improve the serial scan time however make sure the slave addresses falls within the "Maximum connections". If the Slave address is above the "Maximum connections", it will not be polled.

Next, connect the serial expansion module and take note of the module address (Rotary switches on the bottom) as this address will be used as an offset to locate the I/O within the M1115NL.

Also make sure the last module in the RS485 loop has the termination switch on (down).

Failure to terminate the RS485 correctly will result in the modules not operating correctly.

4.7.2 115S Expansion I/O Memory Map

I/O data on the 115S module is read into memory locations according to their Modbus address. The maximum number of Modbus addresses is 24.

Each 115S module has an "Offset" which applies to the location of all of its registers. This Offset is equal to the units Modbus address multiplied by 20.

If the modules Modbus address is 15, the Offset value will be 15 X 20 = 300.

E.g. 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 & 8 AIN) with address 16
- Digital input 1 will be at register location 10321
- Analog input 1 will be at register location 30321

See Appendix C: "Expansion I/O Store Registers". For a more detailed address map of the serial expansion I/O modules.

Chapter 5 - Diagnostics

5.1 IO Diagnostics

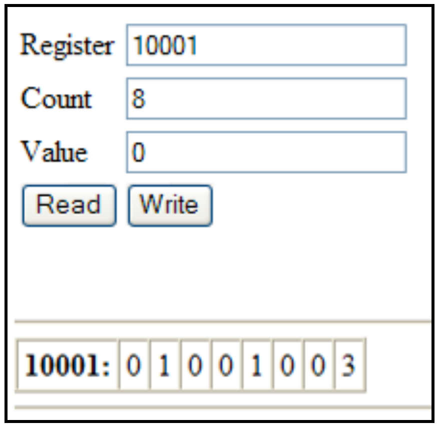


Figure 33 - I/O Diagnostics

Selecting this option from the main screen will allow some basic reading and writing of the I/O store registers within the module.

To read a register location, enter an address location, e.g. 10001 (for digital Inputs), enter a count (number of consecutive registers) and then press the “Read” button

Below the buttons, you will see the returned address location and the returned values

To “Write” to outputs, enter the address location, count, and value and then press the “Write” button.

You will then see the outputs change to the value you entered.

E.g. 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 turn all the Local Digital Outputs on.

Note: If when reading a register and getting the symbol “–“this indicates that the register has not been written to and so it has no value (not even zero).

Note: if there is a mapping configured and any one of the source register values has a “–“ the mapping will not be sent (see section 0“Invalid” register state” for more details.

A mapping will only be sent when all registers have a value.

Using the I/O Diagnostics you can check the register locations for these “-“ values and even write values if required.

If when reading the Status of the DIO on the module you see the value “3”, this indicates that the DIO is being used as an output in the “ON” state.

5.1.1 Modbus Error Registers

Each of the Expansion I/O modules have diagnostics registers that can indicate any Modbus Errors, Codes, Counts, etc.

30017 + Offset = Modbus Error Counter (number of errors the modules has had)

30018 + Offset = Modbus Last Error Code (see Appendix D for codes)

30019 + Offset = Modbus Lost Link Counter (number of Communication Errors)

30020 + Offset = Modbus Module Type

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

dec 769 (301hex) indicates a 115S-13

5.2 Connectivity

The Connectivity webpage displays connections and available networks. The “Connected Devices” section displays the radio channel, received signal strength, and radio data rate for each Client or Access Point by their MAC Address. The readings shown are based upon the last received data message from the Access Point or Client. Client stations also display a list of detected Access points (Site Survey), including network name (SSID), channel and maximum data rate.

Connected Devices:

```
# Total entries: 4
# Dest            Next            Hops  RSSI  Qual  Flags Iface Expires
  192.168.2.107   192.168.2.107      1   -62  100         er0   30426
  192.168.2.110   192.168.2.110      1   -85  100         er0   32180
  192.168.2.102   192.168.2.108      3     ~     ~        er0   44782
  192.168.2.108   192.168.2.108      1   -38  100         er0   44782
```

Figure 34 - Connectivity

Note that when updating the Connectivity webpage, it is necessary to hold down the <ctrl> key while pressing the refresh button. Otherwise, the information will not be updated.

	Description
Dest	Destination IP Address
Next	Next IP Address
Hops	Number of Hops
RSSI	RSSI (Radio Signal Strength Indication) measured in dBm which is a negative value scaled from -30dBm (good) to -120dBm (bad). RSSI is displayed for destination addresses, which are direct neighbours. If the Destination IP is not the next hop, you will see an RSSI value of “~”

<table>
<tr><th></th><td>which indicates no direct link to that station.</td></tr>
<tr><th>Qual
(Link Quality
Index)</th><td>The LQI is a logarithmic representation of the number of bit errors in the frame that were corrected by the Forward Error Correction algorithm. Each data bit is encoded with 7 forward error correction bits, so a 100 byte frame contains 100 * 8 bits / byte * 7 FEC bits/bit = 5600 bits. (see below this table for details)
<table>
<tr><th>LQI</th><th>Description</th></tr>
<tr><td>100</td><td>No Errors (or better than 1 in 100,000)</td></tr>
<tr><td>80</td><td>1 in 10,000 raw bit errors</td></tr>
<tr><td>60</td><td>1 in 1000 raw bit errors</td></tr>
<tr><td>40</td><td>1 in 100</td></tr>
<tr><td>20</td><td>1 in 10.</td></tr>
</table>
</td></tr>
<tr><th>Flags</th><td>Addition indications for this entry</td></tr>
<tr><th>Iface</th><td>The connection interface (er0 = Ethernet radio, eth0 = Ethernet LAN)</td></tr>
<tr><th>Expires</th><td>This is the timeout in msec for the entry</td></tr>
</table>

LQI (Link Quality Indication)

- Because a typical frame is around 80 bytes (4480bits), you should not normally see any readings between 75 and 99.
- Communication becomes unreliable with LQI around 30.
- As the LQI drops below 25, nearly every frame will have enough bit errors that the FEC will no longer be able to recover the original data, so the frame will be corrupted. Hence you will hardly ever see a reading below 25.
- With signal strength (RSSI) -100 dBm or better, the LQI should always read 100. You should expect LQI readings below 100 with signal strength -105 dBm or worse.

If you have good signal strength and are getting LQI readings less than 100, this is a sign of interference, or of a problem with the radio of the unit you are using.

5.3 Network Diagnostics

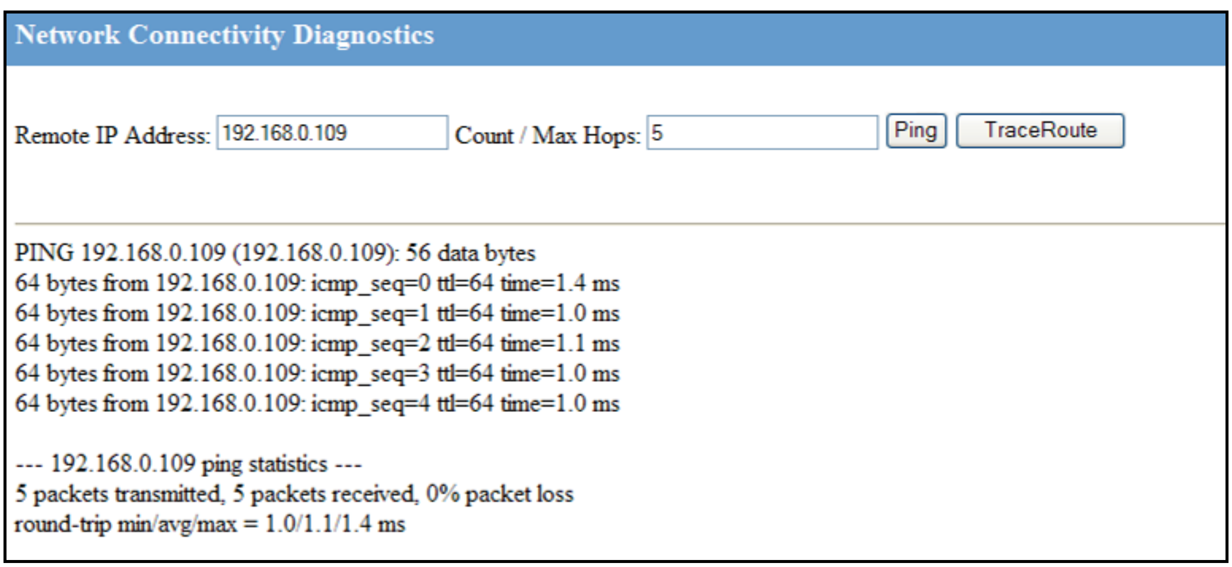


Figure 35 - Network Diagnostics

Network Diagnostics allows you to check the communications path to other modules within the system.

There are two options for checking the communications.

Ping

Ping is a standard Network instruction that sends out a small data probe to the IP address configured letting you know if you have a communication path or not.

You will receive a response for each Ping, which will show a packet size, IP Address, Sequence number and a time in milliseconds.

Followed by a summary showing the number of packets transmitted, the number of packets received, any lost packets and the Minimum, Average and Maximum Ping times in milliseconds.

A Ping can be done on either the Radio Network or Ethernet Network. The ping command will automatically select the correct network interface according to the address selected.

Remote IP Address – This is the IP address that you want to Ping
Count / Max Hops – This is the number of Ping probes that are send out. You should see this many responses come back.

Trace Route

Because the modules use the AODV protocol which is a routing protocol capable of finding its own path through the network it can be difficult to determine the selected communications path.

“Trace Route” allows you to trace the communications path through the network.

Example from the screen shot below:

1	192.168.2.108	(192.168.2.108)	874 ms

“1” = Hop number

“192.168.2.108” = DNS Name of the device.

“(192.168.2.108)” = IP Address of the device.

“874 ms” = A roundtrip response time (ping) in milliseconds from the Local IP to each hop point.

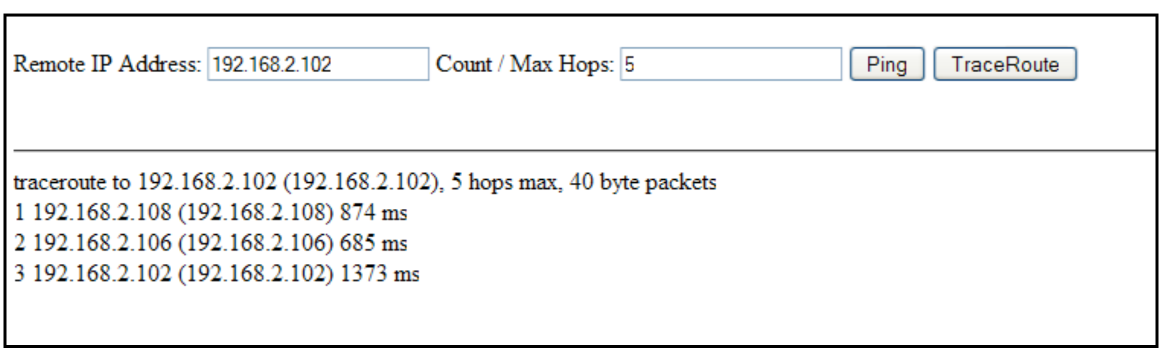


Figure 36 - Trace Route

E.g. The above example shows the Ping time from the Host to the first IP address (192.168.0.102) is 874 msec, The jump from Hop1 (192.168.0.108 to Hop2 (192.168.0.106) is 685msec, etc.

5.4 Network Statistics

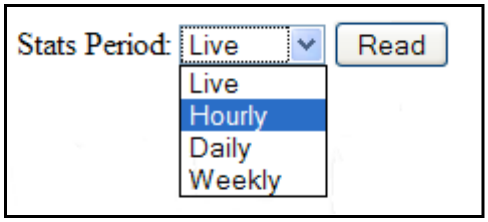


Figure 37- Network Statistics Perioid

After enabling the “Gather Statistics” on the Main Network page, this page will display the average Receive and Transmit traffic throughput over a configured time period.

From the drop down “Stats Period”, select the appropriate sample period then press the “Read” button.

The following is a list of available sample periods and what will be displayed:

Live, this will display the average Transmit and Receive data through put in kbit/s and the number of data packets seen on the radio interface (er0), displayed in packet pre minute.

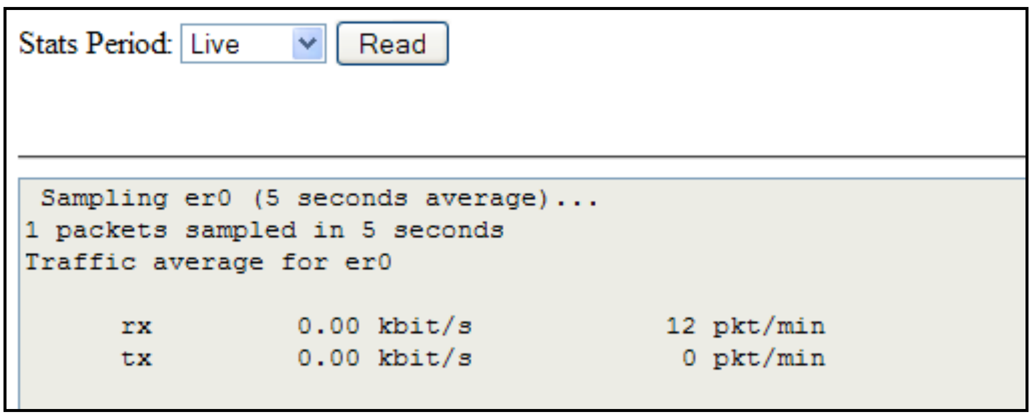
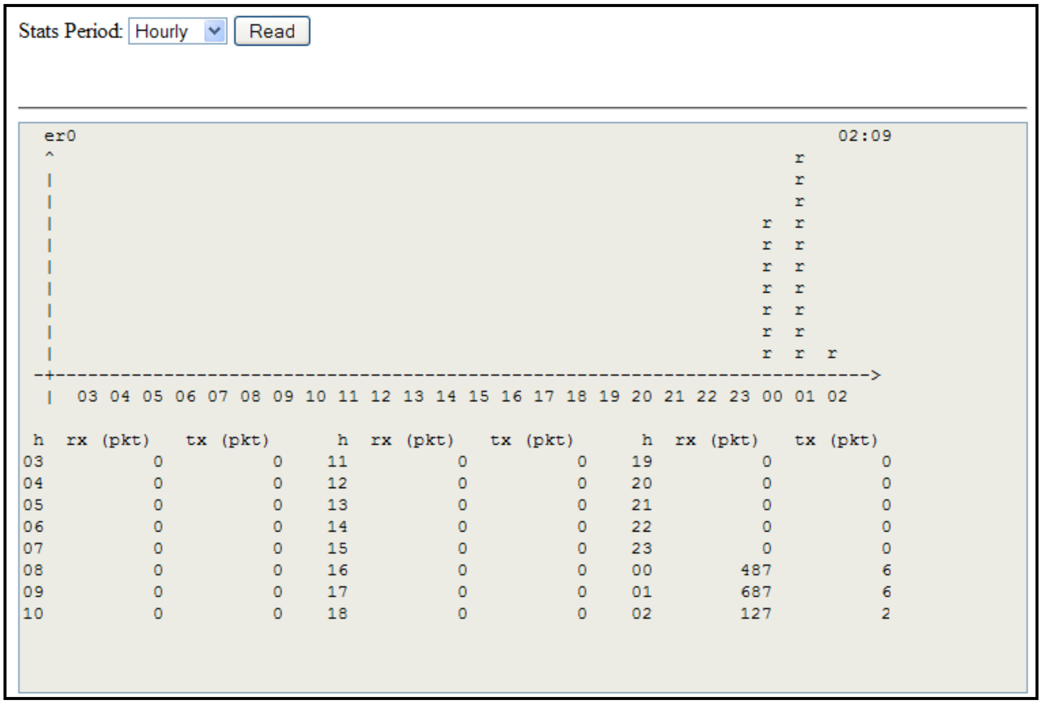


Figure 38 - Network Statistics

Hourly, this will display a graph showing overall transmit (t) and Receive (r) data on an hourly scale in accordance with the module Date and time stamp. (“rt” indicate both Transmit and Receive)

Below the graph is a table showing the average data throughput (in packets) for transmit and receive and for each hour.



Stats Period: Hourly | Read

```
 er0                                                                      02:09
 ^                                                                     r
 |                                                                     r
 |                                                                     r
 |                                                                  r  r
 |                                                                  r  r
 |                                                                  r  r
 |                                                                  r  r
 |                                                                  r  r
 |                                                                  r  r
 |                                                                  r  r  r
-+--------------------------------------------------------------------------->
 |  03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00 01 02
```

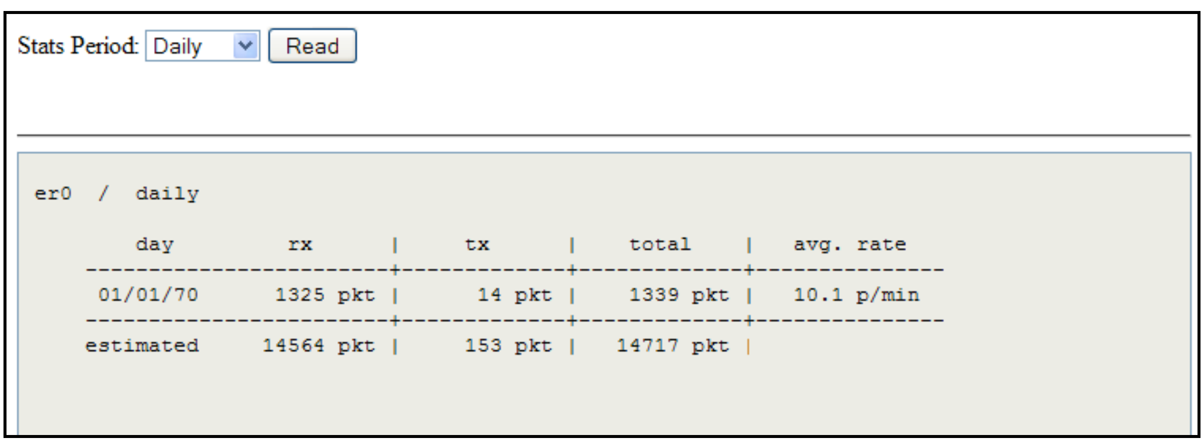
h	rx (pkt)	tx (pkt)	h	rx (pkt)	tx (pkt)	h	rx (pkt)	tx (pkt)
03	0	0	11	0	0	19	0	0
04	0	0	12	0	0	20	0	0
05	0	0	13	0	0	21	0	0
06	0	0	14	0	0	22	0	0
07	0	0	15	0	0	23	0	0
08	0	0	16	0	0	00	487	6
09	0	0	17	0	0	01	687	6
10	0	0	18	0	0	02	127	2

Figure 39 - Hourly Statistics

Daily and Weekly, period shows the average throughout over the daily or weekly time period.

Also shows the average number of packet received (rx) and Transmitted (tx) as well as the total.

Average is an estimated value based on the amount of data gathered in the time available.



Stats Period: Daily | Read

er0 / daily

day	rx	tx	total	avg. rate
01/01/70	1325 pkt	14 pkt	1339 pkt	10.1 p/min
estimated	14564 pkt	153 pkt	14717 pkt	

Figure 40 - Daily Weekly Statistics

5.5 Monitor Radio Comms

The Monitor Comms page shows radio communication frames that are received or transmitted by the radio.

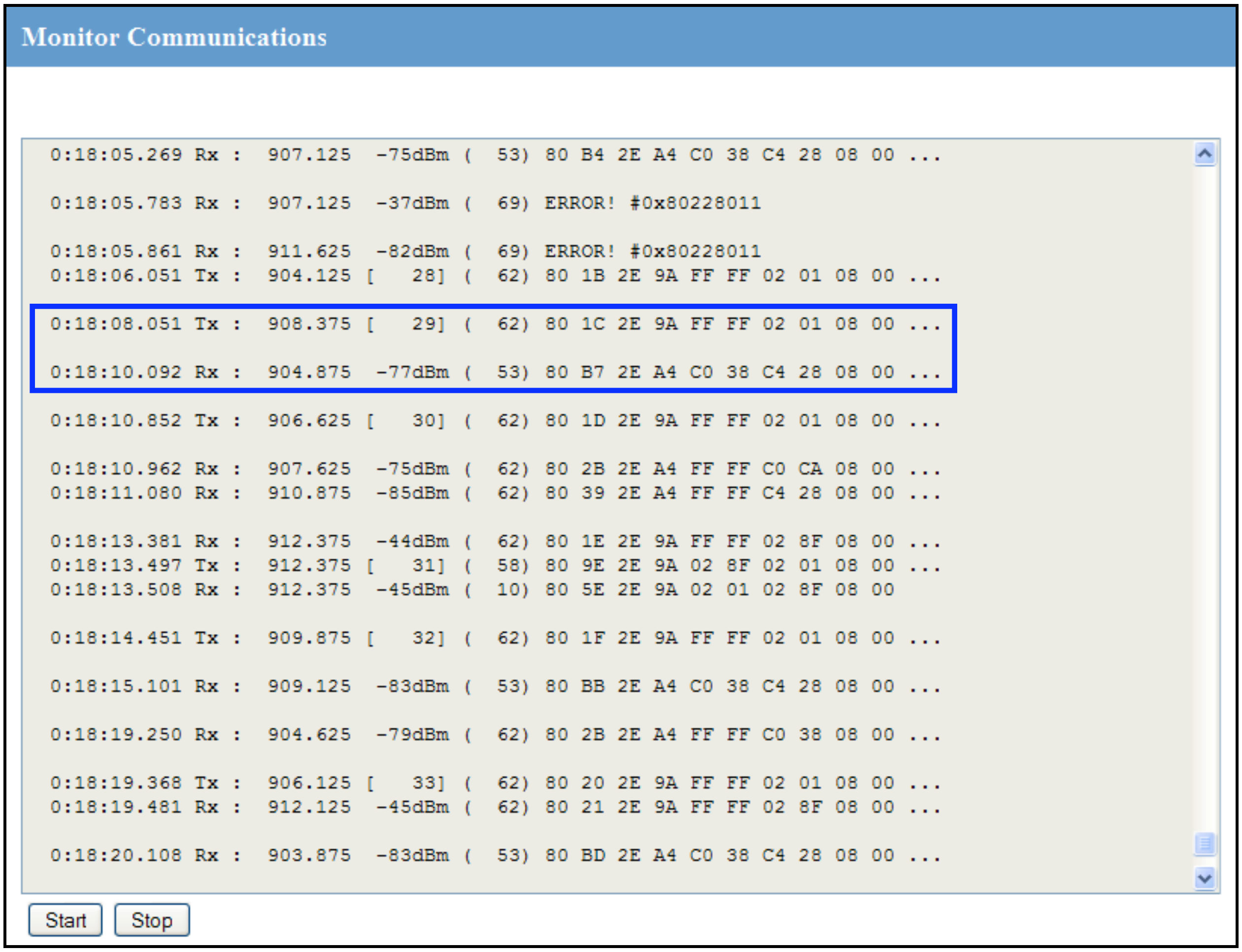


Figure 41 - Monitor Comms

The Table below shows some data frames from the communication log screen above.

Below that is another table explaining each of the field within the data frame.

Corrupted data frames are shown with an "ERROR!" in the frame.

Time	TX/RX	Frequency	Signal Level	Data Length	Data
0:18:10.092	Rx :	904.875	-77dBm	(53)	80 B7 2E A4 C0 38 C4 28 08 00
0:18:10.852	Tx :	906.625	[30]	(62)	80 1D 2E 9A FF FF 02 01 08 00

Time	Time stamp indicating the time from when the module was turned on.
TX/RX	Indicates whether the message is received or transmitted
Frequency	Shows the Frequency of the RX/TX frame
Signal Level	Shows the Receive Signal Level on any received message or internal sequence number for the transmitted message.
Data Length	Total length of the transmitted or received message
Data	The TX Data frame from above is dissected below First two bytes (80 11) = Frame Flags Second two bytes (2E 9A) = Network Address Third two bytes (FF FF) = Destination Address, (FFFF is A broadcast address) Fourth two bytes (02 01) = Source Address (Convert each byte to decimal and they will be the last two bytes of the Radio IP address.) Fifth two bytes (08 00) = EtherType flag (Internet Protocol, Version 4)

5.6 Statistics

The Statistics webpage is used for advanced debugging of M1115NL. This webpage details the state of the M1115NL and performance information.

The page is useful to DAWN WIreless technical support personnel in diagnosing problems with the module.

Note that when updating the Statistics webpage, it is necessary to hold down the <ctrl> key while pressing the refresh button. Otherwise, the information will not be updated.

Figure 42 - Module Statistics

Chapter 6 - Specifications

6.1 Specifications

General		
EMC specification	FCC Part 15 EN 300 683 AS 3548	FCC Part 90 89/336/EEC
Radio specification	FCC Part 15.427 AS 4268.2 RFS29 NZ	
Emission designator	160KF1D	
Hazardous Spec	Class 1 Div 2 Hazardous Areas - (pending)	
IP Rating	IP40	
Housing	High Density Thermo-Plastic 5.91”x 7.09” x 1.38” (170 x 150 x 33 mm)	
Mounting	DIN Rail mounting	
Terminal blocks	Removable Terminals up to 12 gauge (2.5mm2) conductors	
LED indication	Power, RF, RS232, and RS485 serial, I/O. Ethernet Link and 100Mbit indication	
Operating Temp	-40 to +140 °F, -40 to +60°C,	
Humidity	99% RH non-condensing	
Weight	1.1 lb (500gm)	1.3lb (600gm) boxed
Power Supply		
Power Supply	15 to 30VDC	Overvoltage and Reverse voltage protected
Battery supply	12 to 15VDC	
AC Supply	N/A	
Solar Supply	2 Watt solar option (Factory fitted)	
Analog Loop Supply	24VDC 150mA	
Static Current Drain	220mA	
TX Current drain	500mA	
Batt charging current	1.0 Amp nominal	
Radio Transceiver		
Operating Frequency	902 – 928 MHz	
Channels / Hop-sets	50 channels, 2 hop sets	
Line of Site Range	15 mile LOS (USA / Canada) 12km LOS (Australia/ NZ)	
Antenna Connector	SMA Female	
Radio data rate	19200 baud	
Transmitter		
Transmit power	1W 1W	USA/Canada 4W EIRP Australia / NZ 1W EIRP
Modulation	FSK	
Receiver		

RX Sensitivity	-109dBm	FER = 12%
Serial Ports		
RS232 Port	RJ45	to EIA-562 specification
RS485 Port	2 pin terminal block	
Data rates	110 – 230400 baud	
Parity	Odd, Even, None.	
Stop Bits	1,2,	
Digital Inputs/Outputs		
DIO	8 x	
DI On-state Voltage	<2.1VDC	
Wetting Current	5mA	
Max I/P Pulse Rate	DI 1 & 2 = 50KHz, DI 3 & 4 = 1KHz	
Min I/P Pulse Width	100uSec using TTL pulsed inputs	
DO Max voltage	30VDC	
DO Max current	200mA	
Max Pulse out Rate	1 KHz	
Analog Input / Outputs		
Analog Input	2 x Differential	2 x Single Ended
Current Range	0-24mA	0-24mA
Current Resolution	14bit	13bit
Voltage Range	AI 1 & 2 = 0-25V	AI 3 & 4 = 0-5V
Voltage Resolution	13bits	
Input Impedance AI1, AI2 (to common)	55K ohm	
Input Impedance AI3, AI4 (V)	25 K ohm	
Input Impedance (I)	100 ohm	
Calibrated Accuracy	0.1%	
Analog Output	2 x 24mA sourcing outputs	
Current Range	0-24mA	
Current Resolution	15 bits	
Calibrated Accuracy	0.1%	
System Parameters		
Encryption	DAWN WIreless 64 bit Proprietary	128 bit AES
User Configuration	Web page and Software Configuration	

Appendix A: dBm to mW conversion table

dBm to mW Conversion			
Watts	dBm	Watts	dBm
10 mW	10 dB	200 mW	23 dB
13 mW	11 dB	316 mW	25 dB
16 mW	12 dB	398 mW	26 dB
20 mW	13 dB	500 mW	27 dB
25 mW	14 dB	630 mW	28 dB
32 mW	15 dB	800 mW	29 dB
40 mW	16 dB	1.0 W	30 dB
50 mW	17 dB	1.3 W	31 dB
63 mW	18 dB	1.6 W	32 dB
80 mW	19 dB	2.0 W	33 dB
100 mW	20 dB	2.5 W	34 dB
126 mW	21 dB	3.2 W	35 dB
158 mW	22 dB	4.0 W	36 dB

Appendix B: I/O Store Registers

"Output Coils"

0001 **0008**	Local DIO1 – DIO8 (as Outputs) at address 1-8.
0009 **0020**	Spare
0021 **0040**	Locally attached 115S modules DIO Outputs (See 115S detail below)
0041 **0500**	(space for up to 24 115S modules – 20 registers for each module)
0501 **3000**	General Purpose Bit Storage – Used for: Staging area for data concentrator Fieldbus Mappings storage Force Mapping registers (assigned in Config)
3001 **10000**	Not Available

"Input Bits"

10001 **10008**	Local DIO1 – DIO8 (as inputs) at address 1-8.
10009 **10020**	Setpoint status from Analog inputs 1 through 12.
10021 **10040**	Locally attached 115S modules DIO Inputs (See 115S detail below)
10041 **10500**	(space for up to 24 115S modules)
0501 **12500**	General Purpose Bit Storage – Used for: Staging area for data concentrator Fieldbus Mappings storage
12501 **30000**	Not Available

“Input Registers”

30001 **30004**	Local AI1 – AI4. (Current Mode) (AI1, AI2 4-20mA differential, AI3, AI4 4-20mA Sink)
30005 **30006** **30007** **30008**	Local Supply voltage (8-40V scaling) Local Battery voltage Local 24V loop voltage 115S Supply Voltage
30009 **30012**	Local AI1 – AI4. (Voltage Mode) (AI1, AI2 0-10V, AI3, AI4 0-5V)
30013 **30016**	Local Pulse rate inputs PI1 – PI4
30018 **30020**	Spare
30021 **30040**	Locally attached 115smodules (See 115S detail below)
30041 **30500**	(space for up to 24 115S modules)
30501 **32500**	General Purpose word Storage – Used for: Staging area for data concentrator Fieldbus Mappings storage
32501 **36000**	Not Available
36001 **36008**	Local Pulsed inputs 1-4.B.E Format. Most significant word at lower / odd address.
36009 **36040**	spare
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) (12.3 => 38001=CCCD, 38002=4144)
38033 - 38040	Spare space for floating point values
32501 **40000**	Not Available

"Holding Registers"

40001 **40002**	Local AO1 – AO2
40003 **40020**	Spare
40021 **40040**	Locally attached 115S modules (See 115S detail below)
40041 **40500**	(space for up to 24 115S modules)
40501 **42500**	General Purpose word Storage – Used for: Staging area for data concentrator Fieldbus Mappings storage
42501 **46000**	Not Available
46001 **46008**	Local Pulsed Outputs 1-4. B.E Format. Most significant word at lower / odd address.
46009 **46040**	spare
46041 **48000**	Not Available
48001 **48004**	Local Analog outputs as floating point values Modscan Format (Sign + Exponent + Most significant 7 bits of significand at Even / Higher Addressed location. Lower 16 bits of significand at lower / Odd addressed location) (12.3 => 48001=CCCD, 48002=4144)
48005 **48040**	Spare space for floating point values
48041 **onwards**	Not Available

Appendix C: Expansion I/O Store Registers

To calculate the I/O Store register you need to find the address of the I/O point from the module tables below and then add the offset.

The Offset is the Modbus address multiplied by 20.

E.g1. Digital input #1 on an 115S-11 with address 5 would be: (5x20) +10001 = 100+10001 = 10101

E.g2. Digital output #2 on an 115S-11 with address 6 would be: (6x20) +2 = 120+2= 122

E.g3. Analog input #3 on an 115S-12 with address 3 would be: (3x20) +30003 = 60+30003 = 30063.

E.g4. Analog Output #8 on an 115S-13 with address # 7 would be: (7x20) + 40007 = 140+40007 = 40147

I/O store for a 115S-11 Expansion I/O module

0001 + Offset **0016 + Offset**	DIO Outputs 1 - 16
0017 + Offset **0020 + Offset**	Spare
10001 + Offset **10016 + Offset**	DIO Inputs 1 - 16
10017 + Offset **10018 + Offset**	Spare
10019 + Offset	Modbus Error indication for this 115S module
10020 + Offset	Detected indication for this 115S module
30001 + Offset **30004 + Offset**	115S-11 pulsed input rate 1 – 4
30005 + Offset **30012 + Offset**	115S-11 Pulsed input count
30013 + Offset **30016 + Offset**	Spare
30017 + Offset	Modbus Error Counter for this 115S module
30018 + Offset	Modbus Last Error Code for this 115S module
30019 + Offset	Modbus Lost Link Counter for this 115S module
30020 + Offset	Module type (0x0101) = 257. / Error Status
40001 + Offset **40008 + Offset**	Spare
40009 + Offset **40016 + Offset**	Pulsed Output target 1 – 8 (1 register per pulsed output)
40017 + Offset **40020 + Offset**	Spare

I/O store for a 115S-12 Expansion I/O module

0001 + Offset **0008 + Offset**	DIO Outputs 1 - 8
0009 + Offset **0020 + Offset**	Spare
10001 + Offset **10008 + Offset**	DIO Inputs 1 - 8
10009 + Offset **10018 + Offset**	Spare
10019 + Offset	Modbus Error indication for 115S module
10020 + Offset	Detected indication for this 115S module
30001 + Offset **30008 + Offset**	Inputs AIN 1 – AIN8
30009 + Offset **30016 + Offset**	Spare
30017 + Offset	Modbus Error Counter for this 115S module
30018 + Offset	Modbus Last Error Code for this 115S module
30019 + Offset	Modbus Lost Link Counter for this 115S module
30020 + Offset	Module type (0x0201) = 513. / Error Status
40001 + Offset **40008 + Offset**	Spare
40009 + Offset **40016 + Offset**	Pulsed Output target 1 – 8 (1 register per output)
40017 + Offset **40020 + Offset**	Spare

I/O store for a 115S-13 Expansion I/O module

0001 + Offset 0008 + Offset	DIO Outputs 1 - 8
0009 + Offset 0020 + Offset	Spare
10001 + Offset 10008 + Offset	DIO Inputs 1 - 8
10009 + Offset 10018 + Offset	Spare
10019 + Offset	Modbus Error indication for 115S module
10020 + Offset	Detected indication for this 115S module
30001 + Offset 30016 + Offset	Spare
30017 + Offset	Modbus Error Counter for this 115S module
30018 + Offset	Modbus Last Error Code for this 115S module
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 (1 register per pulsed output)
40017 + Offset 40020 + Offset	Spare

Appendix D: Modbus Error Codes

Code	Name	Meaning
0	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 could also indicate that the server (or slave) is in the wrong state to process a request of this type
02	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 with a quantity of 4 registers, then 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 registers of 5, then this request will fail with Exception Code 0x02 "Illegal Data Address".
03	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, such as that the implied length is incorrect. It specifically does NOT mean that a data item submitted for storage in a register has a value outside the expectation of the application program, since the MODBUS protocol is unaware of the significance of any particular value of any particular register.
04	Slave Device Failure	An unrecoverable error occurred while the server (or slave) was attempting to perform the requested action.
05	Acknowledge	Specialized use in conjunction with programming commands. The server (or slave) has accepted the request and is processing it, but a long duration of time will be required to do so. This response is returned to prevent a timeout error from occurring in the client (or master).
06	Slave Device Busy	Specialized use in conjunction with programming commands. 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.
08	Parity Error	failed to pass a consistency check.

Appendix E: Web Page Configuration

Network Configuration

You can view or modify Ethernet network parameters by selecting the “Network” menu. When prompted for username and password, enter “user” as the username, and “user” as the password in the password field (This is the factory default – See section 4.3 ”Module Information ” to change). If you have forgotten the IP address or password, the Factory Default switch may be used to access the existing configuration. Refer to section above for this procedure.

The Network Configuration page allows configuration of parameters related to the wired and wireless Ethernet interfaces. In general, IP address selection will be dependant upon the connected wired Ethernet device(s) – before connecting to an existing LAN consult the network administrator.

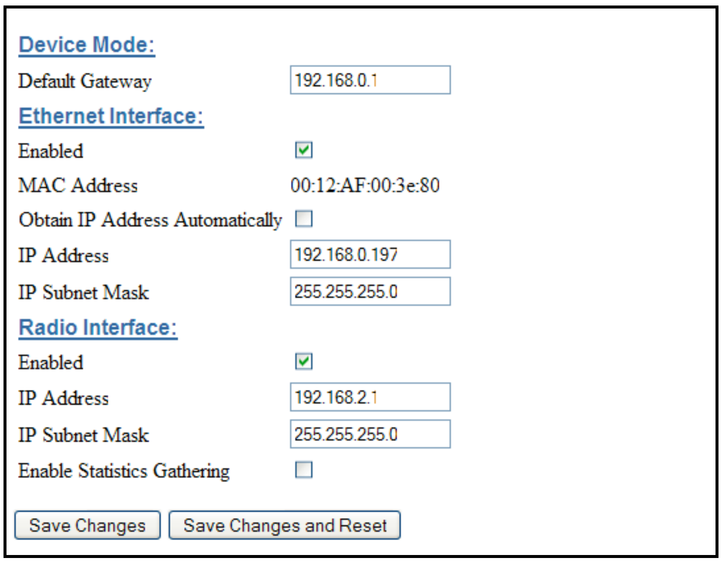


Figure 43 - Network Configuration Screen

Note: If configuring a system of M1115NL radios and the Ethernet IP address of each of the M1115NL modules is configured with the same Address and if using a common PC to do the configuring there can be some issues with web pages not reading correctly.

This is because Web Browsers associate web pages with an Ethernet IP address, they also cache web pages to speed up the loading process.

This means that if a browser connects to a previously loaded IP address it may sometimes load the web page from the cache and not from the live device.

To overcome this all modules must be configured with an individual ethernet IP address or when connecting to the module force the web pages to be reloaded from the Device instead of from cache by pressing <CRTL F5> after the page has loaded.

Web Browsers can be configured to flush the cache after each session, review browser help for details on how this is done.

Device Mode	
Default Gateway	This is the address that the device will use to forward messages to remote hosts that are not connected to any of the local networks (Ethernet or Wireless). This is only required if the wired LAN has a Gateway unit which connects to devices beyond the LAN - for example, Internet access. If there is no Gateway on the LAN, set to the same address as the Station used for remote configuration - that is, the “Ethernet Interface IP Address” below.
Ethernet Interface	
Enabled	Enables or disables the Ethernet interface. If the Ethernet connection is not used you can disable which will marginally improve the boot time and lower the current drain. To restore the Ethernet port, you can set the Factory Defaults DIP-Switch and reboot the module
MAC Address	This is the unique hardware address of the M1115NL and is assigned in the Factory.
Obtain IP Address Automatically	Checking this item enables DHCP client on the M1115NL. A DHCP client requests its IP address from a DHCP server, which assigns the IP Address automatically. To use this option, you will need to have a DHCP server configured on your network. The module will attempt to register its configured unit name with any connected DNS server.
IP Address	The IP address of the M1115NL on its wired (Ethernet Interface) port and wireless (Wireless Interface) port. This should be set to the IP address you require.
IP Subnet Mask	The IP network mask of the M1115NL on its wired (Ethernet Interface) port and wireless (Wireless Interface) port. This should be set to appropriate subnet mask for your system (Typically 255.255.255.0).
Radio Interface	
Enabled	Enables or disables the Radio interface. If using the module as an Ethernet I/O based device.
IP Address	The IP address of the M1115NL on its Radio (Wireless Interface) port. This should be set to the IP address you require. Default will be 192.168.2.1
IP Subnet Mask	The IP network mask of the M1115NL on its wired (Ethernet Interface) port and wireless (Wireless Interface) port. This should be set to appropriate subnet mask for your system (Typically 255.255.255.0).
Enable Statistic Gathering	Enabling this option will allow the radio to gather information about the radio throughput, which can then be viewed on the “Network Statistics” web page.
Save Changes	Save changes to non-volatile memory. The module will need to be restarted before the changes take effect.
Save Changes and Reset.	Save settings to non-volatile memory, and reboot M1115NL. Once the module has completed the reboot sequence, all changes are in effect.

Mesh

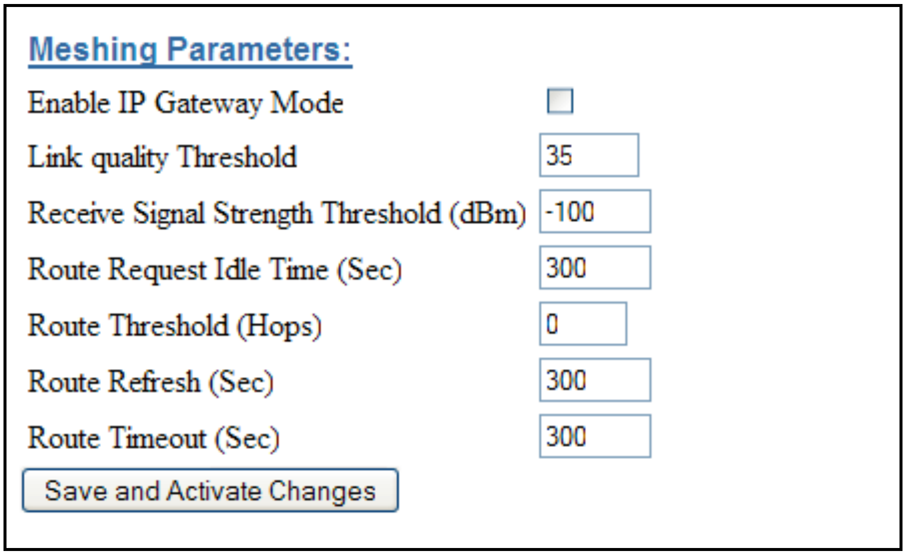


Figure 44- Mesh Configuration

Enable IP Gateway Mode	Enabling this option will advertise all other communicating modules that an Ethernet Network is connected (IP address range configured under Network Settings) and that all traffic for this network can be routed through this IP address. Care should be taken when enabling this option as it can increase overall network traffic. Default is off – Should remain off unless there is an Ethernet network connected and other devices on the radio network need to communicate to it.
Link Quality Threshold	The radio will use this threshold levels when establishing a mesh link with other radios in the system. It represents a 0-100% level of link quality (100 being the best). If the Link Quality is lower than the threshold the link will be ignored. Link Quality can be monitored on the Connectivity web page. If the link quality is lower than this threshold, then mesh routes will not be assigned over this link
Receive Signal Strength Threshold	The radio will use this threshold level when establishing a mesh link with other radios in the system. When establishing a mesh the radio sends out a broadcast message and then monitors the signal strength from all other nodes that respond, if any of the signal levels are below the “Receive Signal Strength Threshold” the mesh link will be ignored. This threshold is used in conjunction with the “Link Quality Threshold” above
Route Request Idle Time (Sec)	Configures the time the unit will back off if a route request to another unit fails. If the destination unit is switched off, and this parameter is zero, the network may become congested with route request messages, preventing other traffic from using the radio network. Setting this parameter to higher values reduces the network congestion.
Route Threshold	Configures the number of additional hops that this unit reports

(Hops)	when replying to mesh routing requests. This parameter should be set to zero for units that should always act as repeater units, and higher for units that are less preferred as repeaters. Setting this parameter to 10 means the unit will never be used as a repeater.
Route Refresh (Sec)	Configures the period at which the unit will try to find a better (shorter) route for an existing route. This is used where network topology changes can occur that potentially allow a shorter path to be taken. Without route refresh, the existing route would continue to be used. Setting this parameter to zero disables route refresh operation.
Route Timeout (Sec)	Configures the time the route will remain active for after the last time it has been used. When this timeout expires, the route is deleted from the unit and will have to be re-discovered the next time communication with that destination unit is required. Normally, this time should be greater than the WIBMesh update time to a destination, so that the routes will not time out, and remain active.
Save Changes and Activate.	function to load new configuration.

IP Routing

When a M1115NL receives an IP frame that is destined for an IP address on a different network, it checks to see if the network address matches one of its own interfaces (i.e. hard-wired Ethernet, or Radio) and forwards the frame appropriately. However, if the IP network address does not match the network address of any of its interfaces, the M1115NL will forward the frame to its default gateway. In this case it is assumed that the default gateway has a valid route to the destination.

In some cases, it is not practical to have just one default gateway (i.e. routed wireless networks with more than two M1115NL routers. If more than one “next-hop router” is required, the M1115NL allows for up to 100 routing rules to be configured. A routing rule specifies a destination network (or host) IP address and the corresponding next-hop router that messages for the specified destination will be forwarded to (Gateway). It is assumed that the Gateway will then deliver the data to the required destination (or forward it on to another router that will).

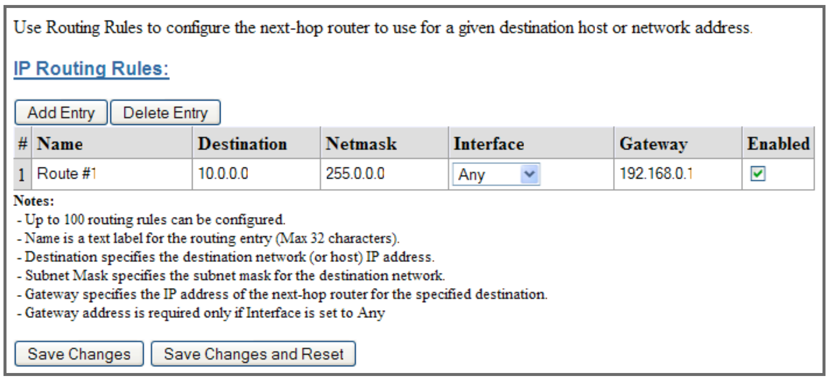


Figure 45 - IP Routing

IP Routing	
Name	A name to describe the routing rule (Max 32 characters).
Destination	The destination network or Host IP address. You can specify a whole network by entering the IP range 192.168.0.0 with a Netmask of 255.255.255.0 or specify an individual host IP address by setting the Netmask to 255.255.255.255.
Netmask	The subnet mask for the destination network.
Interface	Choose the interface to use for the route. Selections are Radio, Ethernet or Any – Default is Any.
Gateway	Specifies the IP address of the next-hop router for the specified destination.
Enabled	Check this box to enable the rule. You can Uncheck the box to disable a routing rule without needing to re-enter the information at a later time.
Save Changes	Save changes to non-volatile memory. The module will need to be restarted before the changes take effect.
Save Changes and Reset.	Save settings to non-volatile memory, and reboot M1115NL. Once the module has completed the reboot sequence, all changes are in effect.

Radio Settings

Select the “Radio” Menu to change the following configuration parameters. If a change is made, you need to select “Save Changes” to retain the changes. Changes will not take effect until the unit is reset.

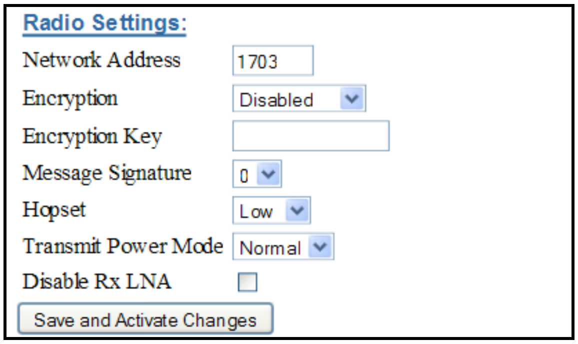


Figure 46 - Radio Configuration Screen

Radio Settings	
Network Address	A unique address that is used to differentiate one wireless system from another, All radios that are required to communicate within the system will need to have the same Network Address Messages received with a different System Address will be ignored. It is used to prevent Cross-talk between systems. Valid values are between 0 and 32768
Encryption	Can select either 64 bit DAWN WIreless Proprietary or 128 bit AES encryption level from the drop down list
Encryption Key	Up to 32 characters are available for Encryption key.
Message Signature	The radio preamble is a section of data at the head of a packet that contains a unique “signature” that the radio locks on to when receiving messages. Any message with a different signature is ignored. There are 4 different Message Signatures and all modules that communicate together will need to have the same one set.
Hopset	From here you can select from available Hopset bands, If the radio has a Country code of US/Canada then there are 2 bands available, Low (902-914MHz) and High (915-928MHz) If country is Australia or New Zealand then the only option is the high band
Transmit Power Mode	Change the Transmit power level from the Normal (1 W) to Low Power (100 mW)
Disable Rx LNA	Check box to disable the LNA (Low Noise Amplifier) Reduces the Receive Sensitivity by about 12dB, used during Demos, Bench testing, etc.
Save Changes and Reset.	Save settings to non-volatile memory, and reboot M1115NL. Once the module has completed the reboot sequence, all changes are in effect.

Mesh Fixed Routes

In large radio systems there will often be a number of radios that will act as Repeaters for the other radios. Because these sites are generally stationary they do not need to learn the different paths and can have fixed routes back to the destination. We configure these routes with Mesh Fixed Route Rules.

You can configure up to 100 fixed Route Rules for each site and the rules can be targeted to a specific IP address by using a Host Route or a complete Subnet.

Example #1

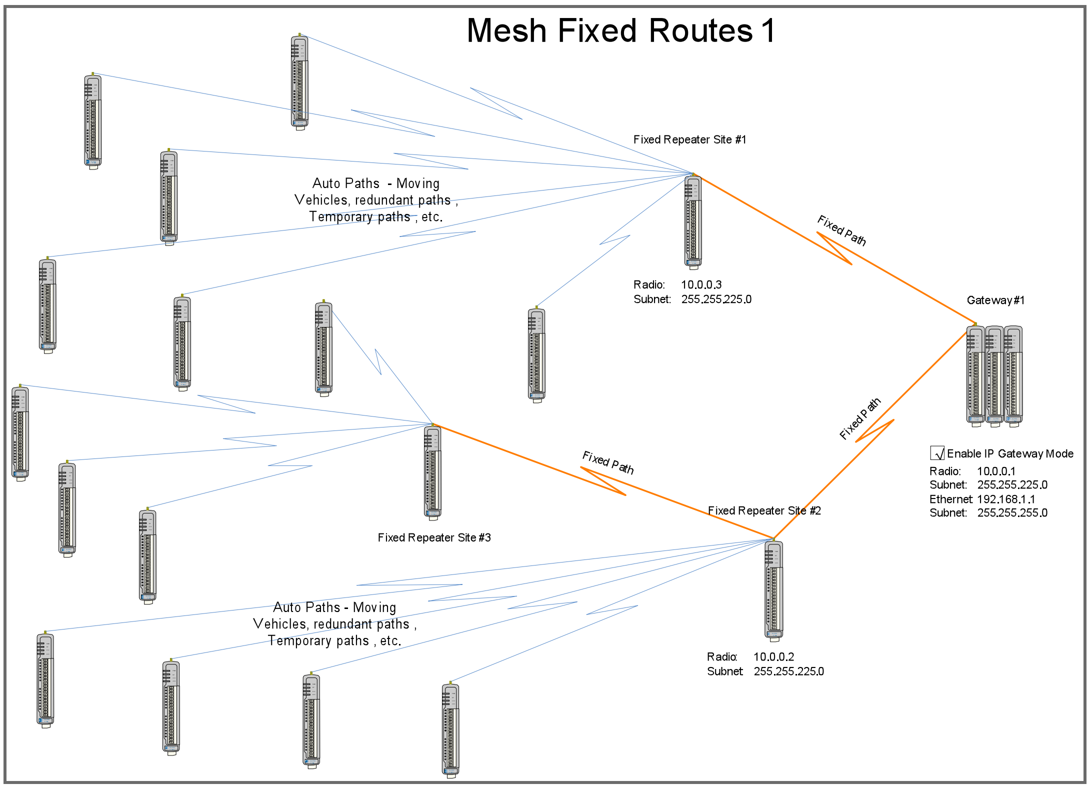


Figure 47 - Mesh Fixed Route #1

The Network Diagram above shows a typical network with mesh fixed routes. Normally a meshing network will automatically learn the routes within a network and setup appropriate communication paths to the destination. When manually configuring these routes all communication paths need to be setup by using Mesh Fixed Routing Rules.

Mesh Fixed Routing Rules:

Add Entry | Delete Entry

#	Name	Destination	Next	Hops	IP Gateway	External	Enabled
1	Rep#3 to Gateway #1	10.0.0.1	10.0.0.2	2	☐	☐	☑
2	Rep#3 to Rep #2	10.0.0.2	10.0.0.2	1	☐	☐	☑

Figure 48 - Mesh Fixed Route#2 Routing Rules

Figure 48 above show the Mesh Fixed Routing Rules for the network diagram in Figure 47 above.

In fixed Route #1 it shows the Destination IP Address will be 10.0.0.1 and its Next hop will be 10.0.0.2, there will be a total of 2 hops and the ”IP Gateway” and “External” are un ticked as the destination will be the local I/O on 10.0.0.1.

In Route #2 is a route showing the communication path with repeater #2. The destination and next addresses are both 10.0.0.2 because it’s a single hop and again the “IP Gateway” and “External” are un ticked as the communications is all local and not through a Gateway or out of the mesh.

Example #2

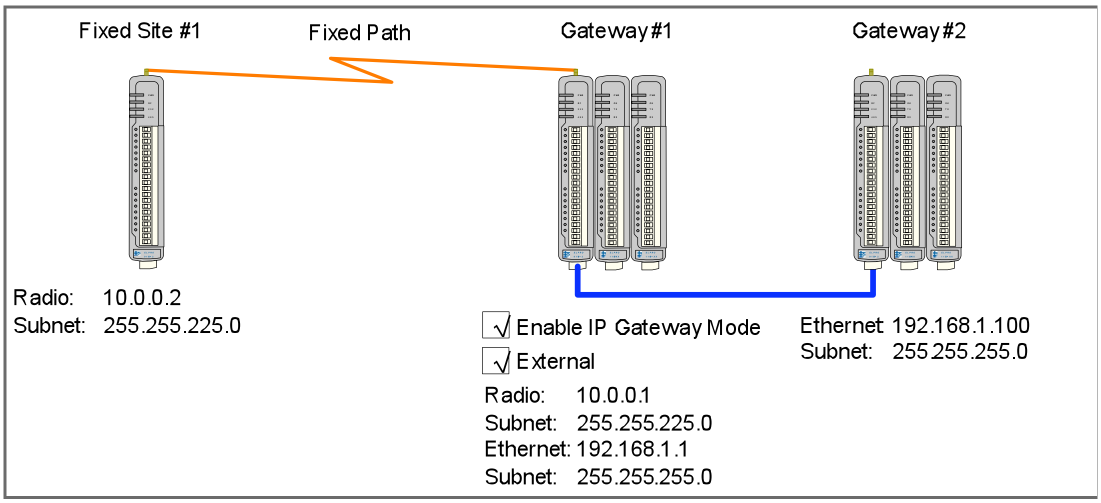


Figure 49 Mesh Fixed Route #2

Mesh Fixed Routing Rules:

Add Entry | Delete Entry

#	Name	Destination	Next	Hops	IP Gateway	External	Enabled
1	Fixed Site #1 to Gateway #1	10.0.0.1	10.0.0.1	1	☑	☐	☑
2	Fixed Site #1 to Gateway #2	192.168.1.100	10.0.0.1	2	☐	☑	☑

Figure 50 - Mesh Fixed Route #2 Routing Rules

Figure 50 shows the routing rules for the network diagram Figure 49- Mesh Fixed Route #2” above

The first route shows the destination and next addresses are both 10.0.0.1 as it’s a single hop. Because the destination is a Gateway on an external network the IP Gateway must be enabled.

The second routing rules shows the Destination (192.168.1.100) is an external network and is outside of the radio mesh, therefore the External tick box must be enabled. The next address will be 10.0.0.1, which is the IP Gateway.

IP Routing	
Name	A name that describes the routing rule (Max 32 characters).
Destination	The destination network or Host IP address. You can specify a whole network by entering the IP range 192.168.0.0 with a Netmask of 255.255.255.0 or specify an individual host IP address.
Next	Specifies the IP address of the next hop router for the specified destination. Next is the same as destination for the final hop. Next is the same as destination for one-hop routes.
Hops	Indicates the number of routing hops to the destination.
IP Gateway	Indicates the Destination acts as a gateway out of the mesh
External	Indicates that it is routed through a Gateway out side of the mesh
Enabled	Check this box to enable the rule. You can Uncheck the box to disable a routing rule without needing to re-enter the information at a later time.
Save Changes and activate	Save changes to non-volatile memory, and restarting the function to load new configuration.

WIBMesh Configuration

WIBMesh is an extremely efficient proprietary radio protocol used for radio communications. The protocol is based on the “Ad hoc On Demand Distance Vector” (AODV) routing algorithm which is a routing protocol designed for ad hoc networks. There is very little configuration for the WIBMesh as the protocol automatically routes through the mesh to the destination.

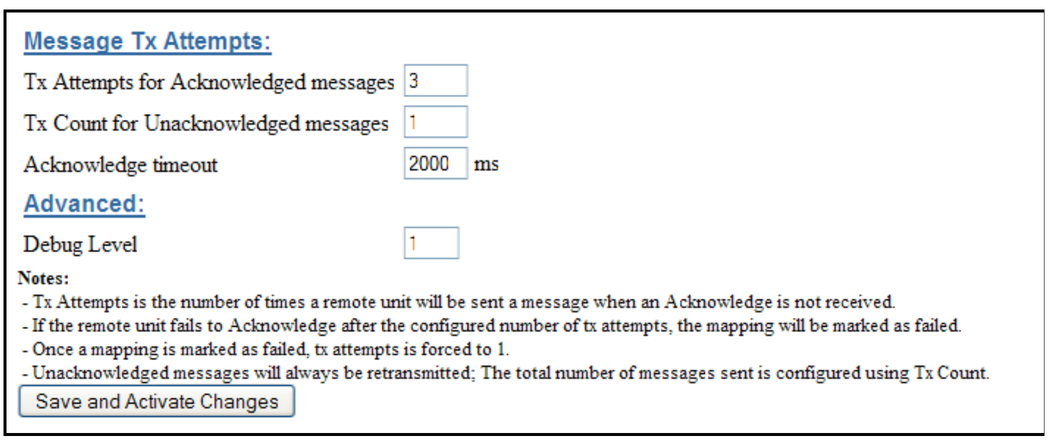


Figure 51- WIBMesh Configuration Screen

WIBMesh Configuration	
TX Attempts for Acknowledged messages	How many times the configured module will attempt to communicate a message to another module (message reties). After failing to communicate the module will be flagged as being in comms fail. If it tries to communicate to the remote module again, it will reduce the number of attempts down to one as it has been flagged as being in Comms fail. If communications is restored the module will go back to transmitting the number of time configured in “Tx Attempts for Acknowledged messages”.
TX count for unacknowledged messages	The number of times it transmits the same data message. It is used if the M1115NL has been setup as a transmit only module (similar to the older DAWN WIreless 905U-K or 505U-K modules). It is done by not selecting the “Ack” tick box in any Block Write and Gather/Scatter Block mappings. (See 0 “WIBMesh Mappings” below) Being a Transmit only module there is no communication handshake between modules so transmitting the same message a number of times gives a greater reliability in communications.
Acknowledge timeout	Time to wait for the Acknowledgement before the message is timed out. The default time is 2 Seconds but the time can be increased to 10 seconds for very long Mesh networks
Debug Level	The level of debug information that can be shown via the serial port during normal operation and boot up. A value between 1 (only show normal operating parameters) and 8 (showing all debug messages)
Save Changes and Reset.	Save settings to non-volatile memory, and reboot M1115NL. Once the module has completed the reboot sequence, all changes are in effect.

WIBMesh Mappings

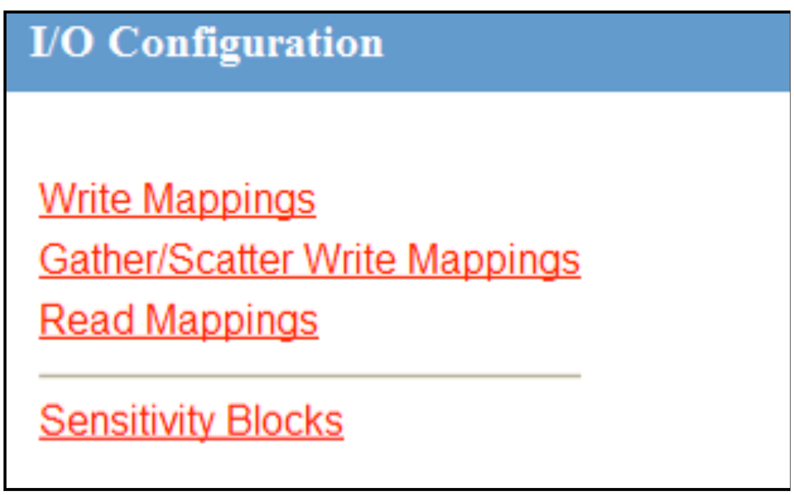


Figure 52 - WIBMesh Mappings

Selecting WIBMesh Mappings from the right hand side of the main menu will show the I/O Configuration screen.

This is where you configure Read, Write and Gather/Scatter mappings as well as any Sensitivity Blocks.

Write Mappings (Writing Local IIO to remote I/O)

Block Write Mappings:

Add Entry | Delete Entry

#	Destination IP	Ack	Invert	Update Period (s)	Update Offset (s)	COS Delay (s)	COS Enabled	COS Resets Update Timer	Force Register	Fail Register	First Local Register	First Remote Register	Register Count
1	192.168.2.25	☐	☐	1200	0	30	☑	☑	0	0	30001	40001	4

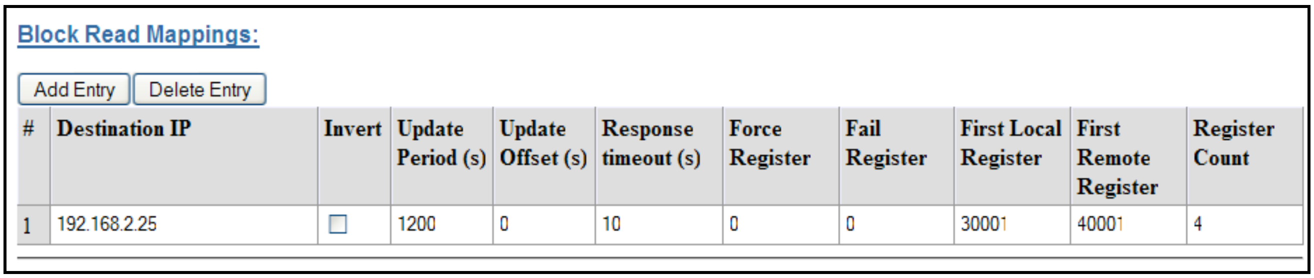
Figure 53 - Write Mappings

Add or delete mapping by using the buttons then select “Save and Activate Changes”.

Block Write Mapping	
Destination IP	This is the IP address that you wish to write the I/O to. If mapping M1115NL I/O to another M1115NL I/O via radio, the destination IP address must be the radio IP address. If mapping via ethernet port (or WAN) then the destination IP Address will be the Ethernet IP of the destination.
Ack	Selecting this box means the mapping will be acknowledged when the end device receives the message. This is an end-to-end acknowledgement, and is over and above the normal hop-by-hop frame acknowledgment between links.
Invert	This will allow the mapping to be inverted. E.g. if the digital input is on and inverted then the output will be off and visa versa. Applies to all of the I/O in the mapping and can only be used with Words and Bits, No Floating Point or Long values can be inverted.
Update Period (sec)	This is the period that the mappings are sent as an update or check signal. (Zero disabled updates)
Update Offset (sec)	Configures an offset time for the update mapping. Used to stagger the update transmissions so on start-up and every update period the module does not send all mapping at the same time. Default will be 0 however the normal would be around 5 seconds.
Change of State (COS) Delay (sec)	You can enter a delay period such that the message is delayed from sending for the configured time. Used to hold off the transmissions to allow more COS messages to be added to the mapping.
Change of State (COS) Enabled	Can enable or disable the COS messages. If enabled the values will be sent on COS and if the value complies with any Sensitivity blocks (see Sections 0 “Sensitivity Block”). If COS is disabled, messages would only be sent on the update period.
Force Reg	The Update Period Timer will be reset if this option is enabled and a COS is received in between updates, meaning it will not receive another update until a further Update period has elapsed - Can help reduce the amount of radio traffic produced when multiple mappings are configured. Note: If the Turn on an I/P and at <30s past COS, check COS is sent 30s past change and old COS time is not used Turn on an I/P and at >30s past COS, check COS is only sent at the old COS time and not at 30s past the change or both.
Force Reg	Register location that when written to will force the Write Mapping to be sent. E.g. External device can initiate the transmissions. (reg 501 – 3000)

Fail Reg	Register location that indicates a failure to communicate with the configured remote Destination Address. Note: Register must be Bit register, i.e. Digital I/O or internal Bit registers (10501, 501, etc) also 'Ack' must be enabled.
First Local Reg	Starting Local address that values will be written to.
First Remote Reg	Starting Remote address that the values will read from.
Reg Count	Total number of register values (consecutive)
Activate.	Save changes to non-volatile memory, and restarting the function to load new configuration.

Read Mappings (Read remote I/O and storing it locally)


Block Read Mappings:

Add Entry | Delete Entry

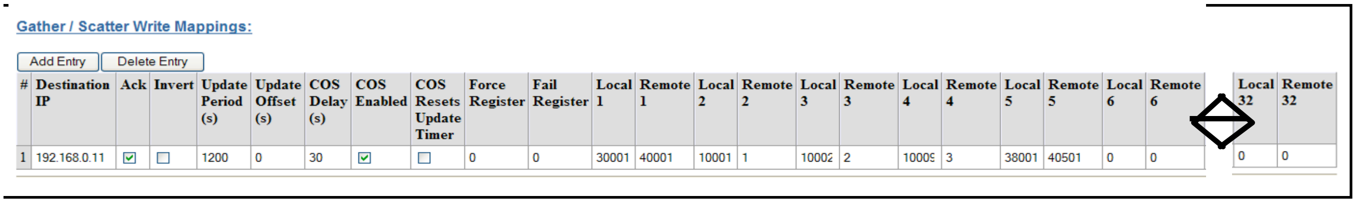
#	Destination IP	Invert	Update Period (s)	Update Offset (s)	Response timeout (s)	Force Register	Fail Register	First Local Register	First Remote Register	Register Count
1	192.168.2.25	☐	1200	0	10	0	0	30001	40001	4

Figure 54 - Read Mappings

Add or delete mapping by using the buttons then select "Save and Activate Changes".

Block Read Mapping	
Destination IP	This is the IP address that you wish to read the I/O from. If reading I/O via radio from another M1115NL the destination IP address must be the radio IP address.
Invert	This will allow the mapping to be inverted. E.g. if the digital input is on and inverted then the output will be off and visa versa. Applies to all the I/O in the mapping and can only be used with Words and Bits, No Floating Point or Long values can be inverted
Update Period (sec)	This is the period that the mappings are sent as an update or check signal. (Zero disables the update)
Update Offset (sec)	Allows an offset to be configured for each mapping. Used to stagger the transmissions so on start-up the module does not try to read all mapping at the same time. Default will be 0 however the normal would be around 5 seconds.
Response Timeout	The time the module needs to count down before registering a communications failure for the configured read mapping. When the time out is complete, the FailReg will be activated.
Force Reg	Register location that when written to will force the Read Mapping to be sent. E.g. External device can initiate the transmissions.
Fail Reg	Register location that will indicate a failure to communicate with the remote Destination Address. Note: Register must be Bit register, i.e. Digital I/O or internal Bit registers (10501, 501, etc) also 'Ack' must be enabled.
First Local Reg	Starting Local address that values will be written to.
First Remote Reg	Starting Remote address that the values will read from.
Reg Count	Total number of register values (consecutive)
Save Changes and Activate.	Save changes to non-volatile memory, and restarting the function to load new configuration.

Gather/Scatter Write Mappings



Gather / Scatter Write Mappings:

Add Entry | Delete Entry

#	Destination IP	Ack	Invert	Update Period (s)	Update Offset (s)	COS Delay (s)	COS Enabled	COS Resets Update Timer	Force Register	Fail Register	Local 1	Remote 1	Local 2	Remote 2	Local 3	Remote 3	Local 4	Remote 4	Local 5	Remote 5	Local 6	Remote 6	Local 32	Remote 32
1	192.168.0.11	☑	☐	1200	0	30	☑	☐	0	0	30001	40001	10001	1	10002	2	10009	3	38001	40501	0	0	0	0

Figure 55 - Gather/Scatter Mappings

Gather/Scatter Write Mapping	
Destination IP	This is the IP address that you wish to write the I/O to. If mapping M1115NL I/O to another M1115NL I/O via radio, the destination IP address must be the radio IP address. Use the Ethernet IP of the destination if mapping via ethernet port (or WAN).
Ack	Selecting this box will mean the mapping will be acknowledged when the end device gets the mapping. This is over and above the normal Ethernet frame acknowledgments between links.
Invert	This will allow the mapping to be inverted. E.g. if the digital input is on and inverted then the output will be off and visa versa. Applies to all the I/O in the mapping and can only be used with Words and Bits, No Floating Point or Long values
Update Period	This is the period that the mappings are sent as an update or check signal.
Update Offset	Allows an offset to be configured for each mapping. Used to stagger the transmissions so on start-up the module does not try to send all mapping at the same time. Default will be 0 however the normal would be around 5 seconds.
Change of State (COS) Delay	You can enter a delay period such that the message is delayed from sending for the configured time. Used to hold off the transmissions to allow more COS messages to be added to the mapping.
Change of State (COS) Enabled	Can enable or disable the COS messaged. If disabled messages would only be sent on the update period.
COS Resets Update Timer	Enabling this timer will mean If a COS is received in between any updates it will reset the Update timer, meaning it will not receive another update until the further Update period has passed.- used to reduce the amount of radio traffic
Force Reg	Register location that when written to will force the Write Mapping to be sent. E.g. External device can initiate the transmissions.
Fail Reg	Register location that indicates a failure to communicate with the configured remote Destination Address. Note: Register must be Bit register, i.e. Digital I/O or internal Bit registers (10501, 501, etc) also ‘Ack’ must be enabled.
Reg Count	Total number of register values (consecutive)
L1 & R2 – L32 & R32	Local and Remote pairs. Up to 32 scattered local I/O registers can be mapped to 32 scattered remote I/O registers
Save Changes and Activate.	Save changes to non-volatile memory, and restarting the function to load new configuration.

Sensitivity Block

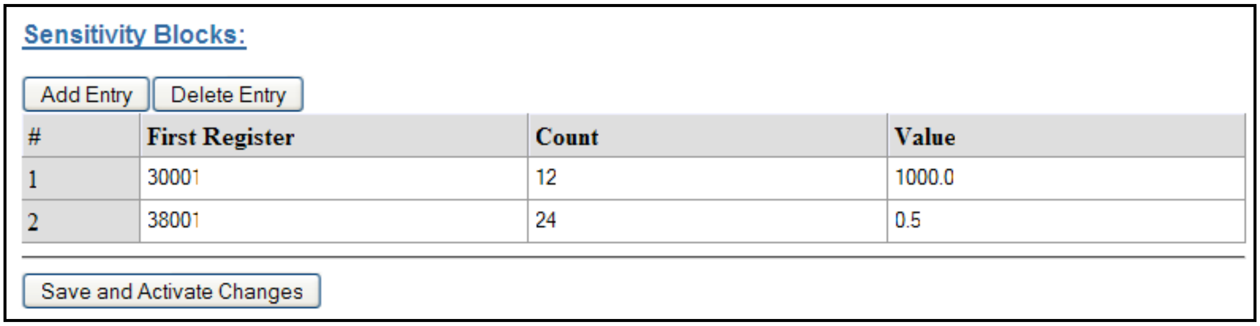


Figure 56 - Sensitivity Block

All registers have a configurable “Sensitivity” value, which determines how much the register needs to change by before being sent as a “Change of State” (COS).

All registers have a default sensitivity value of 1 except the following.

The 12 analog inputs have a sensitivity of 1000 (3.2%) and the 24 floating point values will have a default sensitivity of 0.5 units. In the case of 38001 – 38004 this will be 0.5mA, in the case of 38005-38012 it will be Volts and in 38013 – 38016 it will be Hertz. (The reason is so the module does not send every single bit change of an analog value and subsequently saturate the radio channel with unwanted change messages.

If a lower sensitivity is required then the above blocks can be adjusted and up to 48 more Sensitivity Blocks can be configured for different registers or different values.

They are configured as per the table below

Sensitivity Blocks	
First Register	This is the starting register
Count	Indicates the number of registers in the sensitivity block
Value	This is the number of counts the value needs to change by to force a COS, e.g. a value of 1000 would be a change of 1000 counts in the total range (32768), which would represent about 3%
Save Changes and Activate.	Save changes to non-volatile memory, and restarting the function to load new configuration.

M1115NL Module I/O Registers

I/O	Description	Input	Output
Digital I/O 1	Digital Input/Output 1	10001	1
Digital I/O 2	Digital Input/Output 2	10002	2
Digital I/O 3	Digital Input/Output 3	10003	3
Digital I/O 4	Digital Input/Output 4	10004	4
Digital I/O 5	Digital Input/Output 5	10005	5
Digital I/O 6	Digital Input/Output 6	10006	6
Digital I/O 7	Digital Input/Output 7	10007	7
Digital I/O 8	Digital Input/Output 8	10008	8
Analog Input 1	Analog input 1 mA	30001	
Analog Input 2	Analog input 2 mA	30002	
Analog Input 3	Analog input 3 mA	30003	
Analog Input 4	Analog input 4 mA	30004	
Analog Input 5	Local Supply Voltage	30005	
Analog Input 6	Local Battery Voltage	30006	
Analog Input 7	Local +24V Loop Supply	30007	
Analog Input 8	Local 115S Supply Voltage	30008	
Analog Input 9	Analog Input 1 Volts	30009	
Analog Input 10	Analog Input 2 Volts	30010	
Analog Input 11	Analog Input 3 Volts	30011	
Analog Input 12	Analog Input 4 Volts	30012	
Analog Input 13	Pulsed Input Rate 1	30013	
Analog Input 14	Pulsed Input Rate 2	30014	
Analog Input 15	Pulsed Input Rate 3	30015	
Analog Input 16	Pulsed Input Rate 4	30016	
Analog Setpoint 1	Analog Setpoint 1	10009	
Analog Setpoint 2	Analog Setpoint 2	10010	
Analog Setpoint 3	Analog Setpoint 3	10011	
Analog Setpoint 4	Analog Setpoint 4	10012	
Analog Setpoint 5	Analog Setpoint 5	10013	
Analog Setpoint 6	Analog Setpoint 6	10014	
Analog Setpoint 7	Analog Setpoint 7	10015	
Analog Setpoint 8	Analog Setpoint 8	10016	
Analog Setpoint 9	Analog Setpoint 9	10017	
Analog Setpoint 10	Analog Setpoint 10	10018	
Analog Setpoint 11	Analog Setpoint 11	10019	
Analog Setpoint 12	Analog Setpoint 12	10020	
Analog Output 1	Analog Output 1		40001
Analog Output 2	Analog Output 2		40002
Pulsed Input 1 Count	Pulsed Input Count 1	36001-36002	

Pulsed Input 2 Count	Pulsed Input Count 2	36003-36004	
Pulsed Input 3 Count	Pulsed Input Count 3	36005-36006	
Pulsed Input 4 Count	Pulsed Input Count 4	36007-36008	
Pulsed Input 1 Rate	Pulsed Input Rate 1	30013	
Pulsed Input 2 Rate	Pulsed Input Rate 2	30014	
Pulsed Input 3 Rate	Pulsed Input Rate 3	30015	
Pulsed Input 4 Rate	Pulsed Input Rate 4	30016	
Pulsed Output 1 Count	Pulsed Output Count 1		46001-46002
Pulsed Output 2 Count	Pulsed Output Count 2		46003-46004
Pulsed Output 3 Count	Pulsed Output Count 3		46005-46006
Analog I/P Floating Point	(FP) Analog input 1	38001-38002	
Analog I/P Floating Point	(FP) Analog input 2	38003-38004	
Analog I/P Floating Point	(FP) Analog input 3	38005-38006	
Analog I/P Floating Point	(FP) Analog input 4	38007-38008	
Analog I/P Floating Point	(FP) Analog input 5	38009-38010	
Analog I/P Floating Point	(FP) Analog input 6	38011-38012	
Analog I/P Floating Point	(FP) Analog input 7	38013-38014	
Analog I/P Floating Point	(FP) Analog input 8	38015-38016	
Analog I/P Floating Point	(FP) Analog input 9	38017-38018	
Analog I/P Floating Point	(FP) Analog input 10	38019-38020	
Analog I/P Floating Point	(FP) Analog input 11	38021-38022	
Analog I/P Floating Point	(FP) Analog input 12	38023-38024	
Analog I/P Floating Point	(FP) Analog input 13	38025-38026	
Analog I/P Floating Point	(FP) Analog input 14	38027-38028	
Analog I/P Floating Point	(FP) Analog input 15	38029-38030	
Analog I/P Floating Point	(FP) Analog input 16	38031-38032	
Analog I/P Floating Point	(FP) Analog Output 1		48001
Analog I/P Floating Point	(FP) Analog Output 2		48002
Analog I/P Floating Point	(FP) Analog Output 3		48003
Analog I/P Floating Point	(FP) Analog Output 4		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 module address multiplied by 20 to the I/O address in the table.

E.g
Digital input #1 on an 115S-11 (address 5) would be: (5x20) + 10001 = 100 + 10001 = 10100

Digital output #2 on an 115S-11 (address 6) would be: (6x20) + 2 = 120 + 2= 121
Analog input #3 on an 115S-12 (address 3) would be: (3x20) + 30003 = 60 + 30003 = 30063.

Analog Output #8 on an 115S-13 (address 7) would be: (7x20) + 40007 = 140 + 40007 = 40146

Fail Safe Configuration

Fail Safe Block configuration allows registers to be set to a pre configured value on startup as well as configuring the outputs to reset to a predefined value after a timeout period has elapsed, when the real value comes in it will update as normal. Also if the value is lost because of a communication problem it can be configured to set the output to a failsafe value after the pre-configured time.

“Invalid” register state

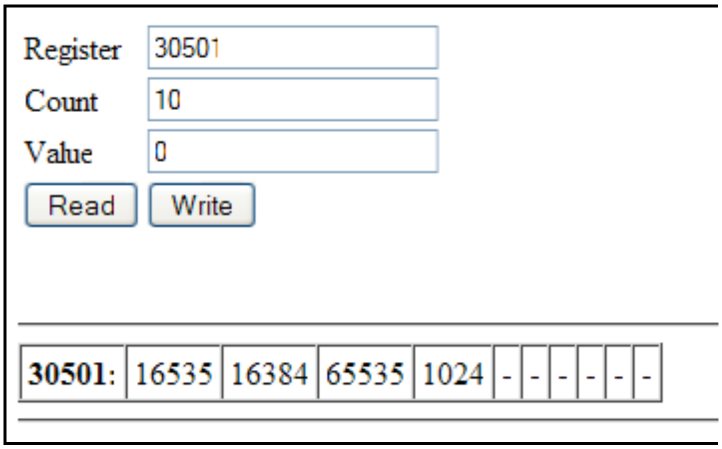


Figure 57 - Invalid Register State

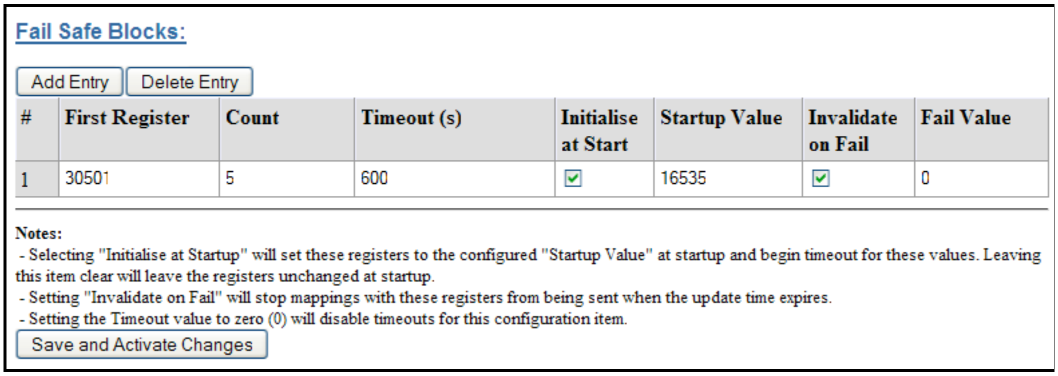
All registers within the module can have various states depending on what type of register it is and what sort of value it holds, an analog would be between 0 and the maximum 65535, a digital can be 0 or 1, etc.

All registers that are not associated with any physical I/O have another state which we call “invalid”, this state means that the value has not been written to and so does not hold a value but more a non value or null.

If you were to read the registers using the “I/O Diagnostics” an invalid register would read “~“as shown in Figure 57 above.

Any mapping with an invalid register will be inhibited from sending. This is to ensure the data that gets to the destination is valid and not just default values that the module starts up with. Refer to section 0“Fail Safe Blocks” below for a way of giving registers a valid value at start-up

Fail Safe Blocks



Fail Safe Blocks:

Add Entry | Delete Entry

#	First Register	Count	Timeout (s)	Initialise at Start	Startup Value	Invalidate on Fail	Fail Value
1	30501	5	600	☑	16535	☑	0

Notes:
- Selecting "Initialise at Startup" will set these registers to the configured "Startup Value" at startup and begin timeout for these values. Leaving this item clear will leave the registers unchanged at startup.
- Setting "Invalidate on Fail" will stop mappings with these registers from being sent when the update time expires.
- Setting the Timeout value to zero (0) will disable timeouts for this configuration item.

Save and Activate Changes

Figure 58 - Fail Safe Blocks

In the screen shot above, register 30501 is an analog value that has been mapped from another module, it has an update interval of 1 minute.

On startup this module will write a value of 16535 into register 30501 and then start counting down from the “Timeout” value (in this case 600 seconds).

If after 600 seconds, the module still has not received an update from the other module, register 30501 will be set to the “Fail Value” (in this case 0).

If the “Invalidate on Fail” were ticked, the value would be set to a null or invalidated value (-).

If this register was mapped to some other location the mapping would be inhibited until the” Invalid” value was updated with a real value.

The maximum number of Fail Safe blocks you can have is 50.

Fail Safe Blocks	
First Register	This is the starting register
Count	Indicates the number of registers in the Fail Safe block
Timeout	This is the starting timeout value in seconds. (setting value to 0 will disable the Timeouts)
Initialise at Startup	Indicates that on startup the Fail Safe Block registers will be set to the Startup value.
Startup Value	This is the value that the Fail Safe block registers will be set to on Startup if the “Initialise at Startup” is ticked.
Invalidate on Fail	If ticked will set the registers back to an Invalid state (See above) when failed.
Fail Value	The value the register will be set to if “Invalidate on Fail” is ticked and the timeout is reached, otherwise this value is ignored.
Save Changes and Activate.	Save changes to non-volatile memory, and restarting the function to load new configuration.

Serial Configuration

The M1115NL has an RS-232, and an RS-485 port for serial communications. These ports may be used to connect external Modbus RTU devices via the Modbus TCP to RTU Gateway and or DAWN WIreless serial expansion I/O modules.

Modbus TCP to RTU Gateway

The Modbus TCP to RTU Gateway allows an Ethernet Modbus/TCP Client (Master) to communicate with a serial Modbus RTU Slave. The M1115NL makes this possible by internally performing the necessary protocol conversion. The conversion is always performed by the M1115NL, which is directly connected to the Modbus serial device (i.e. only this module needs to have Modbus TCP to RTU Gateway enabled).

The example below demonstrates how a Modbus/TCP Client (Master) can connect to one or more Modbus RTU (i.e. serial) Slaves. In this example the remote M1115NL is configured with the “RS232 Modbus/TCP to RTU Gateway” enabled

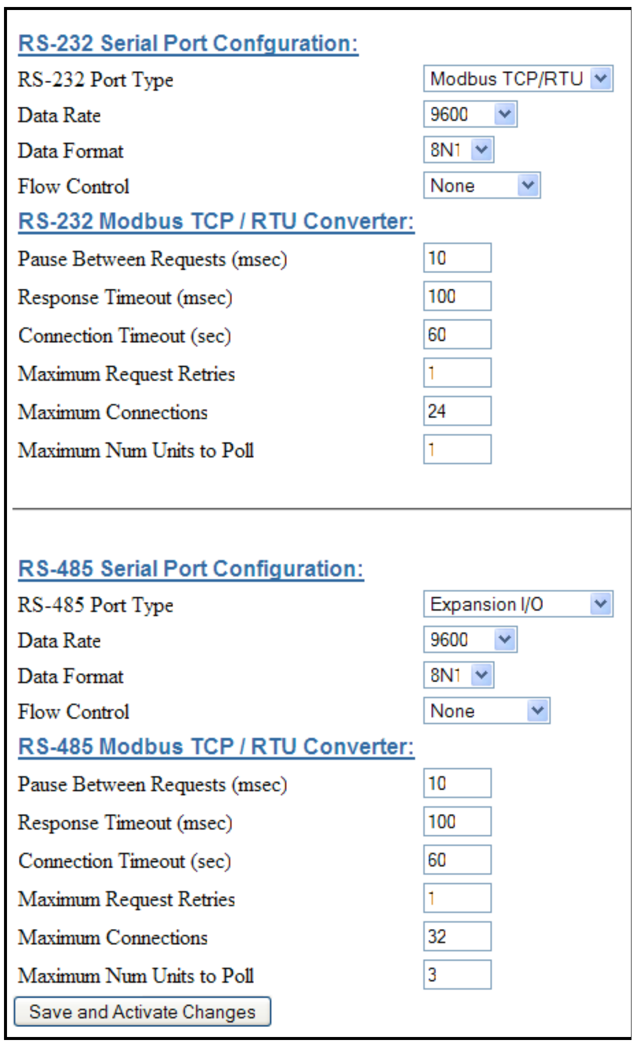


Figure 59 - Serial Port Configuration

Once enabled, the gateway converts the Modbus/TCP queries received from the Master into Modbus RTU queries and forwards these over the RS232 port to the Slave.

When the serial response to the query arrives from the Slave, it is converted to a Modbus/TCP response and forwarded via the network to the Modbus/TCP Master. If no response was received serially by the M1115NL within the configured Response Timeout, the M1115NL will initiate a number of retries specified by the configured Maximum Request Retries.

The Modbus TCP to RTU Gateway may be configured to operate on either the RS 232 or RS 485 port.

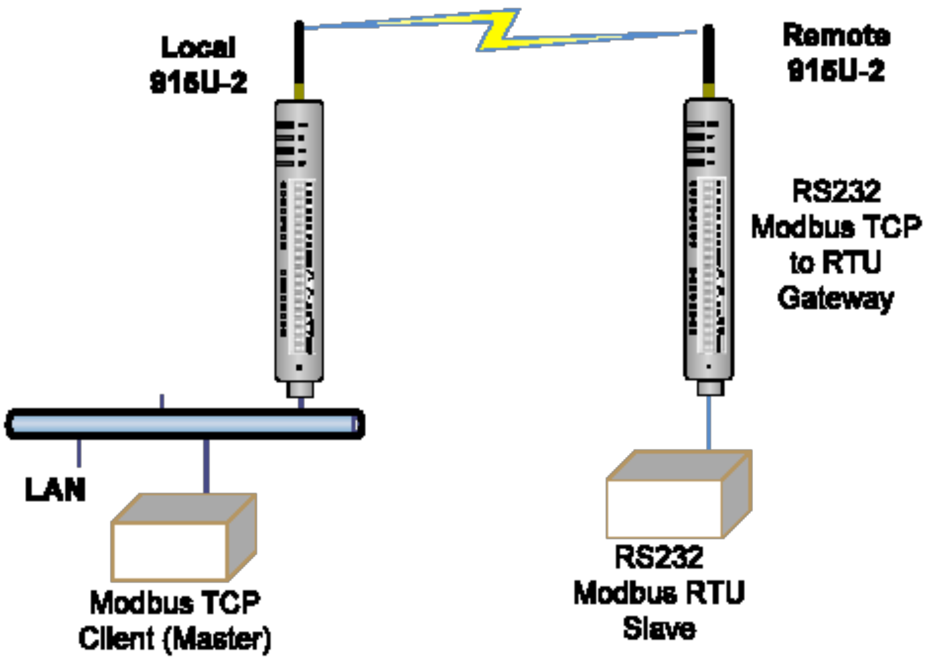


Figure 59 - Serial Port Configuration

RS232 / RS485 Modbus TCP / RTU Converter	
Pauses Between Requests	Enter the delay between serial request retries in milliseconds
Response Timeout	Enter the serial response timeout in milliseconds – a serial retry will be sent if a response is not received within this timeout.
Connection Timeout	Enter the TCP connection timeout in seconds – if no Modbus/TCP data is received within this timeout then the TCP connection will be dropped. Set this field to zero for no timeout.
Maximum Request Retries	Enter the maximum number of request retries performed serially.
Maximum Connections	Enter the maximum number of simultaneous TCP connections to the server allowed.
Maximum num units to Poll	This is the maximum number of slave addresses that the Modbus Client will scan or poll for. Default is 3. If adding more that 3 115S expansion I/O module this number will need to be increased.
Save Changes and Activate.	Save changes to non-volatile memory, and restarting the function to load new configuration.

Expansion I/O

By default the RS485 port will be automatically enabled for “Expansion I/O “.

This means that when expanding the I/O all that is needed is to add the DAWN WIreless Expansion I/O module/s, e.g. 115S-11, 115S-12, or 115S-13 to the RS485 port and the I/O will automatically be available from within the M1115NL’s I/O store. See Appendix B: “I/O Store Registers” for location addresses.

By default the Data Rate, Data Format will all be standard 9600, N81 and none for Flow Control which matches the default Serial baud rate and data Format of the 115S serial expansion module.

Serial parameters can be adjusted for compatibility or faster serial performance by adjusting the rates and format and then selecting the “Save and Activate” Button.

Serial port parameters will also need to be changed on the expansion I/O module by using the 115S Configuration Utility which can be downloaded from the DAWN WIreless Technologies Website (www.dawnwirelesstech.com)

Note: Be aware that using settings other than the default will mean new modules from the factory will require a reconfigure using the 115S configuration utility to change these serial settings.

RS232 / RS485 Serial Port Configuration	
RS232 / RS485 Port	Select the desired functionality. Select either Modbus TCP / RTU or Expansion I/O
Data Rate	The serial data rate desired. Serial data rates available range from 110bps to a maximum of 230,400bps.
Data Format	The data format desired. All the standard data formats are supported.
Flow Control	Selects CTS/RTS or None

I/O Configuration

Main I/O Configuration Selection page
From here you select the I/O type that you wish to configure.
The Thermocouple Type selection is also done from this page.

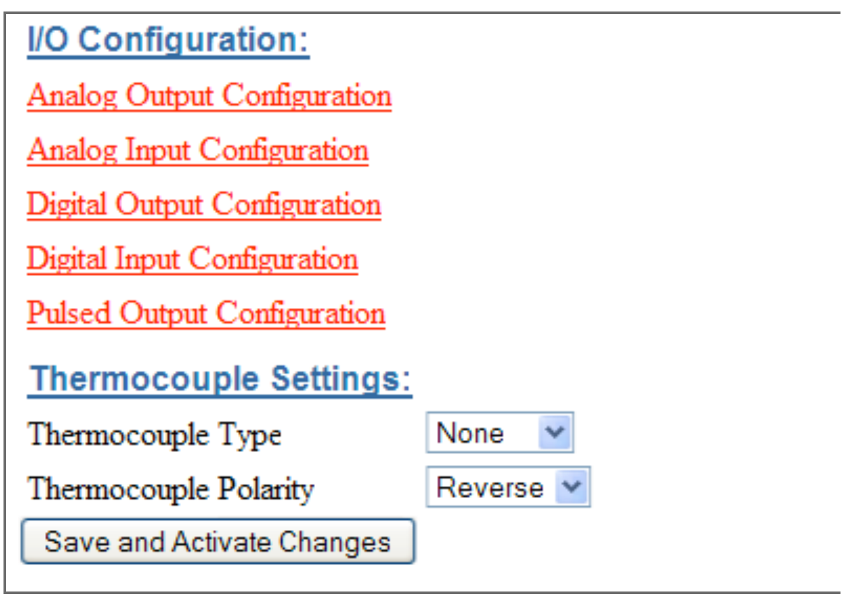


Figure 61 - I/O Configuration

Thermocouple Settings	
Thermocouple Type	Selects the type of Thermocouple.
Thermocouple Polarity	Selects the Thermocouple Polarity, Normal, or Reverse.

Analog Inputs

Figure 62 - Analog Input Configuration

The M1115NL Analog inputs have the following configuration parameters.

Name – The inputs can be named to help with configuration or use the default, up to 30 characters including spaces.
Zero / Span – These variables will change the Scale of the Analog Inputs.
Zero – Starting Value (counts) when measured value is zero
Span – Number of counts per measured value (mA, V, Hz, etc)
Filter (sec) – The Filter time Constant is the time the analog takes to settle on a step changed of an analog value. By default, all the inputs except the Pulse Rates have a Time constant of 5 seconds. Pulsed input rates are not filtered.
Lower & Upper Setpoints – The Setpoint is a discrete signal that is controlled using the Upper and Lower Setpoints, Invert and Window selection boxes. All the analogs have these controls and they can be used to turn on an output locally or at a remote location. The internal setpoint status must be mapped to a remote output for this option to have effect.

The two main Setpoint control options are.

- Deadband (Default) - If the Analog Input is greater than the Upper Set point, the set-point status will be active (on, “1”). The setpoint will reset (off, “0”) when the Analog Input is less than the Lower Set Point. Note that the Upper Set Point must always be higher than the Lower Set Point.”

- Windowed – If the analog value is inside the upper and lower setpoints, the setpoint will be active (on, “1”), and if the analog value is outside of these setpoints the setpoint will be reset (off, “0”)

Invert –This option toggles the Setpoint control logic between the default normal and inverted state. This function does not change the operation, only invert the operation, e.g. if setpoint is on, inverting will mean the setpoint will be off. Window – This option toggles the Set point operation between the default Deadband and Windowed modes.

The Analog is a 16-bit word that has an overall Raw range of 8192 to 49152 decimal (Total = 32768). The input Engineering range can have many different forms i.e. 0-20mA, 0-5V, or 0-1000Hz which is why the zero and span can be scaled to give the correct Raw range.

Calculating Span

The Span us calculated by using the formula

Span = DAWN WIreless Raw Range / Engineering Range

The Raw range is the number of counts between minimum and maximum analog values. DAWN WIreless standard is minimum= 8192 and maximum value is 49152 so the Range is 40960 counts (49152-8192).

The Engineering range will be the range of engineering units – 1-20mA = 20, 0-5V = 5

Some example Span calcs - If the Engineering range is 0-20mA (20) the Span would be 2048 (40960/20).

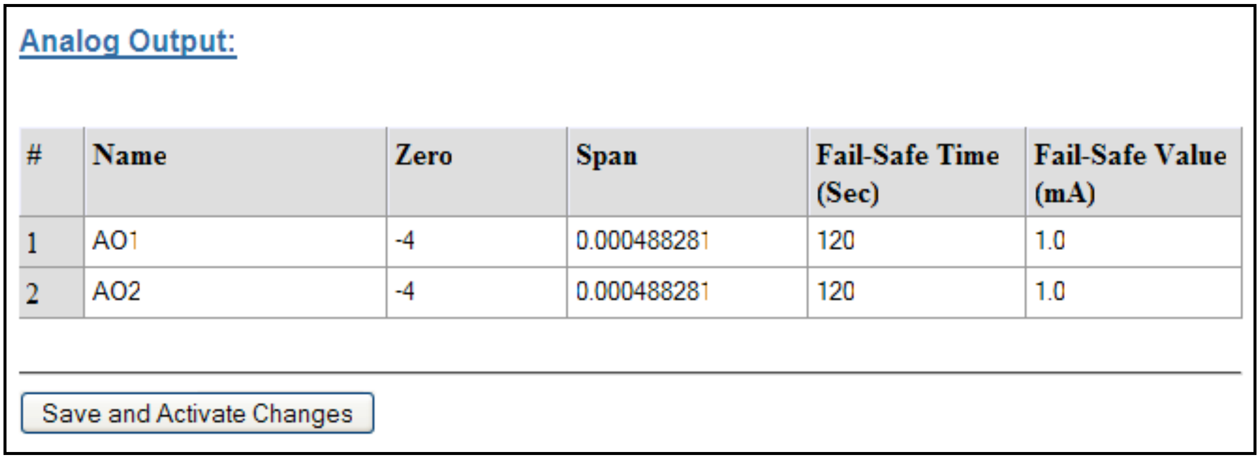
If the Engineering range is 0-5V (5) the Span would be 8192 (40960/5)

Calculating Zero
The zero is calculated by using the formula -
Zero = Raw DAWN WIreless Scale – (Engineering Value x Span).
E.g. If the Engineering Range is 0-20mA the Engineering value will be 20. The span from the 0-20mA calculation above was 2048 therefore the Zero calculation will be 49152 – (20x2048) = 8192

For a 0-5V input the Engineering Value will be 5, the Span from the 0-5V calculation above was 8192 therefore the Zero calculation will be 49152 – (5x8192) = 8192

Input	Engineering Range	Raw Range (Total)	Zero	Span
AI1(4-20mA)	0-20mA	8192-49152 (40960)	8192	$\frac{40960}{20} = 2048$
AI3(0-5V)	0-5Volts	8192-49152 (40960)	8192	$\frac{40960}{5} = 8192$
PRate1 (mA)	0-16mA	16384/49152 (32768)	16384	$\frac{40960}{16} = 2048$

Analog Outputs



Analog Output:

#	Name	Zero	Span	Fail-Safe Time (Sec)	Fail-Safe Value (mA)
1	AO1	-4	0.000488281	120	1.0
2	AO2	-4	0.000488281	120	1.0

Save and Activate Changes

Figure 63 - Analog Output Configuration

Name – The inputs can be named to help with configuration or use the default, up to 30 characters including spaces.

Zero / Span – These variables will change the Scale of the Analog Outputs.

Zero – Starting Value of 8192 counts = -4

Span – Number of mA per bit

Engineering Range	Zero	Span
4-20mA	-4	$\frac{16mA}{32768} = 0.0004882815$
0-20mA	-4	$\frac{20mA}{32768} = 0.0006103515$

Failsafe Time (sec) – The Fail Safe Time is the time the output needs to count down before activating the failsafe state. Receiving an update or a COS message will reset the Fail Safe Timer back to its starting value. If the Fail Safe Timer gets down to zero then the output will be set to the Fail Safe state (mA)
It is recommend this Fail Safe Time be configured for a little more than twice the update time of the input that is mapped to it, that way the output will reset if it fails to receive two update messages. Entering a zero in the Fail Safe Time will disable.

Failsafe value (mA) – The value that you wish the output to be set to on activation of the failsafe timeout.

Digital Input

Digital Input:

#	Name	Debounce Time (Sec)
1	DI1	0.5
2	DI2	0.5
3	DI3	0.5
4	DI4	0.5
5	DI5	0.5
6	DI6	0.5
7	DI7	0.5
8	DI8	0.5

Save and Activate Changes

Figure 54 - Digital Input Configuration

Name – The inputs can be named to help with configuration or use the default, up to 30 characters including spaces. Debounce Time (sec) – Debounce is the time which an input must stay stable before the module decides that a change of state has occurred. If a digital input changes (on - off) and changes again (off - on) in less than the debounce time, then the module will ignore both changes. Default debounce time is .5 seconds.

DIgital Output

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	☐

Save and Activate Changes

Figure 65 - Digital Output Configuration

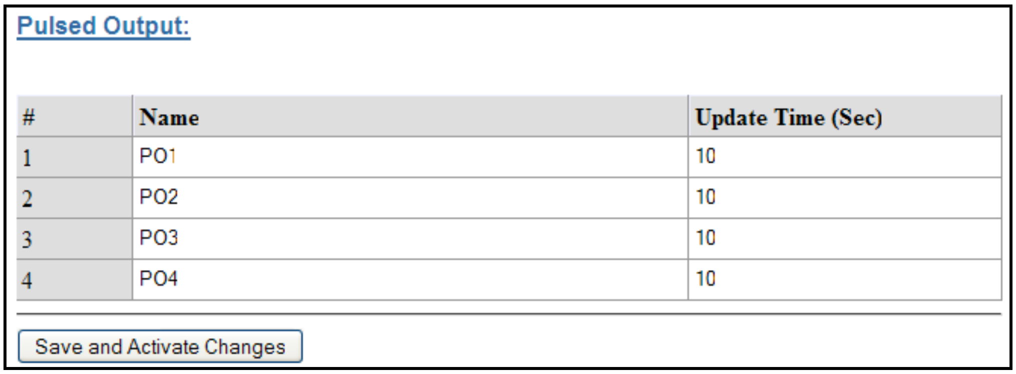
Name – The inputs can be named to help with configuration or use the default, up to 30 characters including spaces.

Failsafe Time (sec) – The Fail Safe Time is the time the output needs to count down before activating the failsafe state. Receiving an update or a COS message will reset the Fail Safe Timer back to its starting value. If the Fail Safe Timer gets down to zero then the output will be set to the Fail Safe state (ON or OFF)

It is recommend this Fail Safe Time be configured for a little more than twice the update time of the input that is mapped to it, that way the output will reset if it fails to receive two update messages.

Fail Safe State – The value that you wish the output to be set to on activation. Checking the box will turn the output ON when a failure occurs and un-checking the box will turn the output OFF.

Pulsed Outputs



#	Name	Update Time (Sec)
1	PO1	10
2	PO2	10
3	PO3	10
4	PO4	10

Figure 66 - Pulsed Output Configuration

Name – The inputs can be named to help with configuration or use the default, up to 30 characters including spaces.
Update Time (sec) – Time that the output will be updated with the latest received value. The time is related to the update time of the pulsed input that is mapped to it. E.g. If the pulsed input update time is configured for 10 seconds the number of pulses will be counted and send to the receiving module every 10 seconds. The receiving module will then output the pulse count over the configured update time, i.e.10 seconds

Modbus TCP Transfer

The M1115NL 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 please see Appendix B: "I/O Store Registers" at the end of this document.

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 M1115NL can transfer I/O to/from almost any combination of Modbus TCP or RTU devices.

Modbus TCP Server (Slave) enables the M1115NL to accept connections from one or more Modbus TCP Clients (Masters). All Modbus transactions routed to the onboard Modbus TCP Server are directed either to/from the onboard general purpose I/O registers. The Modbus TCP Server is shared with the Modbus TCP to RTU Gateway, so that the Modbus "Device ID" is used to determine if a Modbus transaction is to be routed to the onboard Modbus TCP Server or to a Modbus RTU device connected to the serial port. Care should therefore be taken that all serially connected Modbus devices use a different Modbus Device ID (i.e. Modbus Slave Address) to the onboard Modbus TCP Server. Up to 32 separate connections to the Modbus TCP Server are supported.

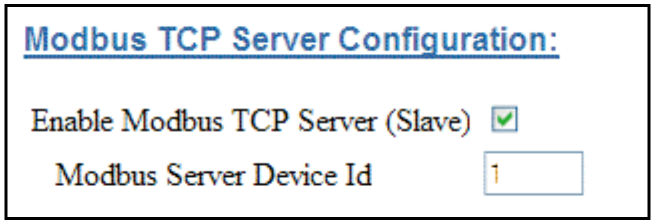


Figure 67 - Modbus Server

Modbus TCP Client (Master) enables the M1115NL to connect to one or more Modbus TCP Servers (Slaves).

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 M1115NL module. This is done by enabling the Modbus TCP to RTU gateway at the corresponding serial port (see section 0“Serial Configuration”).

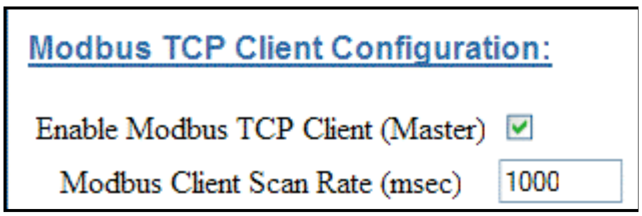
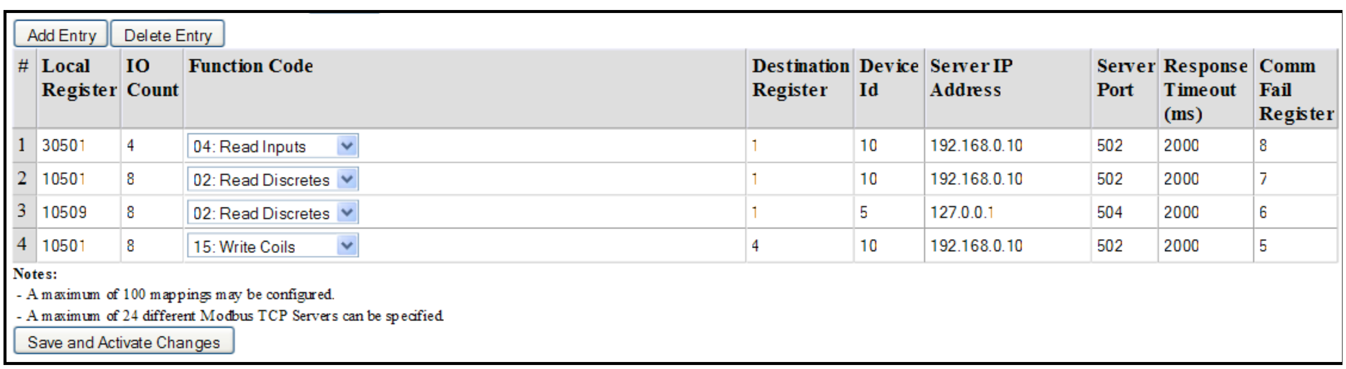


Figure 68 - Modbus Client

Modbus TCP Client functionality allows connections to a maximum of 24 different Modbus TCP Servers and up to 100 mappings can be configured.

The screen shot shows below some example Client Mappings.



Add Entry | Delete Entry

#	Local Register	IO Count	Function Code	Destination Register	Device Id	Server IP Address	Server Port	Response Timeout (ms)	Comm Fail Register
1	30501	4	04: Read Inputs	1	10	192.168.0.10	502	2000	8
2	10501	8	02: Read Discretes	1	10	192.168.0.10	502	2000	7
3	10509	8	02: Read Discretes	1	5	127.0.0.1	504	2000	6
4	10501	8	15: Write Coils	4	10	192.168.0.10	502	2000	5

Notes:
- A maximum of 100 mappings may be configured.
- A maximum of 24 different Modbus TCP Servers can be specified.

Save and Activate Changes

Figure 69 - Modbus TCP Client Mappings

The first mapping shows the Modbus Client (Master) is configured to read analog values from a device connected on the LAN. The mappings function code is “04 Read Inputs” and is reading a count of 4 values (Analogs) from Ethernet IP address 192,168.0.10, Device ID #10, starting at address 1, and then writing these values into its own local registers starting at 30501. The server Port is 502, which is a standard Modbus TCP Port address.

Note: Destination Registers start at zero as the offset is calculated from the Modbus Function Code, e.g. 3X, 4X, 1X, etc.

The next mapping shows something similar however, instead of analog value they are digital values. The Function code is “02 Read Discretes” again from IP address 192.168.0.10 and Device ID #10. It will read 8 values starting from address 1 and writing them to the local address starting at 10501.

The third mapping is similar to the second however, instead of reading from an Ethernet device it will read from a Serial device connected to the local RS485 port.
Mapping shows a function code “02: Read Discretes” from Device ID #5 connected to the Localhost IP address 127.0.0.1 (*Note) It is reading 8 values from address 1 and then writing these values to local register 10509. One main difference is that the Server Port is configured for 504, which is the port number assigned for serial RS485 devices, Port 503 can also be used if using devices on the RS232

The last mapping shows the Modbus Client can also write values to Modbus devices either on serial or TCP. This mapping is setup to “Write Coils” with an I/O Count of 8 from the local address 10501 to Device 10 on Server IP address 192.168.0.10 at address location 4.

The Modbus Client Scan rate is set to 1000msec (see Figure 68 above) and each mapping is configured with a response timeout (in this case 2000msec). This time is how long the master will wait for a response before indicating the failure on the Comms Fail Register. (In this example register 8 -5 are register for local digital outputs 8 – 5)

*Note: The IP address 127.0.0.1 is a standard loopback address that represents “localhost” (this computer). Using the loopback address will mean if the module address is ever changed the Server IP address will not need to be changed as it will automatically use the localhost address.

Modbus TCP Configuration

Enable Modbus TCP Server (Slave)	Check this box to enable the onboard Modbus TCP Server. All Modbus TCP connections to the module IP Address and specified Modbus Server Device ID will be routed to the onboard I/O registers.
Modbus Server device ID	Specify the Modbus Device ID for the onboard Modbus TCP Server. Allowed values are 0 to 255
Enable Modbus TCP Client (Master)	Check this box to enable the onboard Modbus TCP Client. I/O to be transferred via the Modbus TCP client is specified with Modbus TCP Client Mappings.
Modbus Client Scan Rate	Enter the delay (in milliseconds) between executions of consecutive Modbus TCP Client Mappings to the same Server.

Modbus TCP Mappings

Local Register	Enter the starting onboard I/O register number that the specified Modbus Master transaction will transfer I/O to/from.
I/O Count	Specify the number of consecutive I/O register to be transferred for the specified transaction.
Function Code	Specify the Modbus Function Code for the transaction.
Destination Register	Enter the starting I/O register number in the destination device that the specified Modbus Master transaction will transfer I/O to/from.
Device ID	Enter the Modbus Device ID of the destination Modbus device
Server IP Address	Specify the IP Address of the destination Modbus TCP Server for the specified transaction.
Server Port	502 is the general Modbus TCP port number and used if accessing the internal registers. Port 503 has been assigned for the RS-232 port or to 504 for the RS-485 port.
Response Timeout (ms)	Enter the timeout (in milliseconds) to wait for a response to the specified transaction.
Comm Fail Register	Enter the onboard I/O Register number to store the communication status of the specified transaction. The Specified register will be set to 0 if communications is successful, 0xFFFF if there is no connection to the specified server, or 0xFFxx where xx is the Modbus Exception Code
Modbus Client Scan Rate	Enter the delay (in milliseconds) between executions of consecutive Modbus TCP Client Mappings to the same Server.

Appendix F: GNU Free Document Licence

Version 2, June 1991

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