Operating Manual

pMDDL2350
pMDDL2450
pMDDL2550
2x2 MIMO OEM Wireless Digital Data Link

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150 Country Hills Landing NW
Calgary, Alberta
Canada T3K 5P3

Phone: (403) 248-0028
Toll Free: 1-855-353-0028
www.microhardcorp.com

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Important User Information (continued)

About This Manual

It is assumed that users of the products described herein have either system integration or design experience, as well as an understanding of the fundamentals of radio communications.

Throughout this manual you will encounter not only illustrations (that further elaborate on the accompanying text), but also several symbols which you should be attentive to:

Caution or **Warning**
Usually advises against some action which could result in undesired or detrimental consequences.

Point to Remember
Highlights a key feature, point, or step which is noteworty. Keeping these in mind will simplify or enhance device usage.

Tip
An idea or suggestion to improve efficiency or enhance usefulness.

Information
Information regarding a particular technology or concept.

Important User Information (continued)

Regulatory Requirements / Exigences Réglementaires

WARNING:
To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 23 cm or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance is not recommended. The antenna used for this transmitter must not be co-located in conjunction with any other antenna or transmitter.

WARNING:
Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received including interference that may cause undesired operation.

WARNING:
Changes or modifications not expressly approved by Microhard Systems Inc. could void the user's authority to operate the equipment. This device has been tested with UFL to Reverse Polarity SMA connectors with the antennas listed in Appendix A When integrated in OEM products, fixed antennas require installation preventing end-users from replacing them with non-approved antennas. Antennas not listed in the tables must be tested to comply with FCC Section 15.203 (unique antenna connectors) and Section 15.247 (emissions).

WARNING:
MAXIMUM EIRP
FCC Regulations allow up to 36 dBm equivalent isotropically radiated power (EIRP). Therefore, the sum of the transmitted power (in dBm), the cabling loss and the antenna gain cannot exceed 36 dBm.

WARNING:
EQUIPMENT LABELING
The FCC and IC numbers depend on the model of the radio module. Do NOT use the Marketing Name of the product but the Model to distinguish the Certifications Numbers. This device has been modularly approved. The manufacturer, product name, and FCC and Industry Canada identifiers of this product must appear on the outside label of the end-user equipment.

WARNING:
This device complies with Industry Canada's license-exempt RSSs. Operation is subject to the following two conditions:
(1) This device may not cause interference; and (2) This device must accept any interference, including interference that may cause undesired operation of the device.

SAMPLE LABEL REQUIREMENT / EXIGENCE D'ÉTIQUETTE:

pMDDL2450:

FCCID: NS918PMDDL2450
IC: 3143A-18PMDDL2450

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

Applicable Regulatory Approvals		
Model	**FCC**	**Industry Canada**
pMDDL2450	NS918PMDDL2450	3143A-18PMDDL2450
pMDDL2350	Not Applicable	Not Applicable
pMDDL2550	Not Applicable	Not Applicable

Please Note: These are only sample labels; different products contain different identifiers. The actual identifiers should be seen on your devices if applicable.

Important User Information (continued)

Regulatory Requirements / Exigences Réglementaires

WARNING:

Pour satisfaire aux exigences de la FCC d'exposition RF pour la base et mobiles sur une distance de séparation de 23 cm ou plus doit être maintenue entre l'antenne de cet appareil et des personnes lors de fonctionnement du dispositif. Pour assurer la conformité des opérations au plus près que cette distance n'est pas recommandée. L'antenne utilisée pour ce transmetteur ne doit pas être co-localisés en conjonction avec toute autre antenne ou transmetteur.

WARNING:

Son fonctionnement est soumis aux deux conditions suivantes : (1) ce dispositif ne doit pas causer d'interférences nuisibles et (2) cet appareil doit accepter toute interférence reçue, incluant les interférences qui peuvent provoquer un fonctionnement indésirable .

WARNING:

Les changements ou modifications non expressément approuvés par Microhard Systems Inc. pourraient annuler l'autorité de l'utilisateur à utiliser l'équipement . Ce dispositif a été testé avec MCX et connecteurs SMA à polarité inverse sur les antennes répertoriées à l'annexe A Lorsqu'il est intégré dans les produits OEM , antennes fixes nécessitent une installation empêchant les utilisateurs finaux de les remplacer par des antennes non approuvées . Antennes ne figurant pas dans les tableaux doivent être testés pour se conformer à la Section 15.203 (connecteurs d'antenne uniques) et à la Section 15.247 (émissions) .

WARNING:

MAXIMUM EIRP
Règlement FCC permettent jusqu'à 36 dBm puissance isotrope rayonnée équivalente (EIRP) . Par conséquent, la somme de la puissance émise (en dBm), la perte de câblage et le gain d'antenne ne peut pas dépasser 36 dBm.

WARNING:

ÉQUIPEMENT DE MARQUAGE
Les numéros FCC et IC dépendent du modèle du module radio . Ne pas utiliser le nom marketing du produit, mais le modèle de distinguer les numéros Certifications . Ce dispositif a été approuvé de façon modulaire . Le fabricant , nom du produit, et les identificateurs de la FCC et d'Industrie Canada de ce produit doivent figurer sur l'étiquette à l'extérieur de l'équipement de l'utilisateur final .

WARNING:

Cet appareil est conforme aux CNR exempts de licence d'Industrie Canada . Son fonctionnement est soumis aux deux conditions suivantes : (1) Ce dispositif ne peut causer des interférences ; et (2) Ce dispositif doit accepter toute interférence , y compris les interférences qui peuvent causer un mauvais fonctionnement de l'appareil.

SAMPLE LABEL REQUIREMENT / EXIGENCE D'ÉTIQUETTE:

pMDDL2450:

FCCID: Pending
IC: Pending

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

Approbations Réglementaires Applicables		
Type	**FCC**	**Industrie Canada**
pMDDL2450	En Attendant	En Attendant
pMDDL2350	Non Utilisé	Non Utilisé
pMDDL2550	Non Utilisé	Non Utilisé

Please Note: S'il vous plaît noter: Ce sont des exemples d'étiquettes seulement; différents produits contiennent des identifiants différents. Les identifiants réels devrait être vu sur vos périphériques le cas échéant.

Revision History

Revision	Description	Initials	Date
1.0.0	Preliminary Release. Based on Firmware v1.4.0 Build 1005	PEH	July 2017
1.1.0	Added information about antenna installation	PEH	Nov 2017
1.2.0	Added reference to pMDDL2350 & pMDDL2550	PEH	Dec 2017
1.2.1	Added FCC/IC Approvals, updated images	PEH	May 2018
1.3.0	Updated to reflect firmware version v1.4.0 Build 1008	PEH	June 2018
1.3.1	Updated to firmware v1.4.0 Build 1012. Added Mesh and Repeater modes.	PEH	Feb 2019
1.3.2	Added notes about Mesh Mode	PEH	Mar 2019
1.3.3	Added picture of motherboard with thermal pad	PEH	Aug 2019
1.4.0	Updated to firmware v1.4.0 Build 1020. Updated Drawings, WebUI, AT Commands.	PEH	Feb 2020
1.4.1	Updated to firmware v1.4.0 Build 1023-6. Added AT Commands.	PEH	Apr 2020
1.4.2	Updated to firmware v1.4.0 Build 1024.	PEH	Oct 2020

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1.0 Overview

The pMDDL is a feature rich, high power, 2x2 MIMO Wireless OEM Digital Data Link. The pMDDL is designed to provide high performance wireless capabilities in a compact and rugged OEM module for system integration. The pMDDL features simultaneous dual 10/100 Ethernet & Serial (RS232) Gateway capabilities for high speed wireless applications

The pMDDL can be configured using a built-in WebUI interface which does not require any additional software or tools to setup or download. The unit can operate as a Master, Slave or Relay (future) to establish robust long range wireless links between locations.

Providing reliable wireless Ethernet bridge functionality as well gateway service for most equipment types which employ an RS232 interface, the pMDDL can be used in various types of applications such as:

- High-speed backbone
- IP video surveillance
- Voice over IP (VoIP)
- Ethernet wireless extension
- UAV/UAS
- Legacy network/device migration
- SCADA
- Remote Telemetry
- Multicast Video

1.1 Performance Features

Key performance features of the pMDDL include:

- Adjustable, High Power Tx (up to 1W Total) w/ Excellent Rx Sensitivity
- Up to 25 Mbps data rate*
- Master, Slave/Remote, Relay (future) operating modes
- Point to Point, Point to Multipoint topology support
- Firewall with ACL Security, Port Forwarding
- Serial Gateway (RS232)
- Dual 10/100 Ethernet Ports
- RSSI LED pins for Antenna Alignments
- Industrial grade operating temperature (-40°C to +85°C)
- Administration via local console, telnet, web browser, SNMP
- Local and remote wireless firmware upgradable

** See Section 1.3 Performance Specifications*

1.0 Overview

1.2 Specifications

For detailed specifications, please see the specification sheets available on the Microhard website @ http:///www.microhardcorp.com for your specific model.

Electrical/General

Frequency: pMDDL2350: 2.304 - 2.390 GHz
pMDDL2450: 2.402 - 2.482 GHz
pMDDL2550: 2.500 - 2.570 GHz

Link Rate: See Section 1.3 Performance Specifications

TX Power: 20 dBm - 30 dBm Total (Adjustable)

Channel Bandwidth: 4, 8 MHz (Selectable)

Error Detection/Control: CRC, ARQ

Data Encryption*: 128-bit AES (Optional 256-bit)
*(*Requires Export Permit)*

Serial Port: 300bps to 921kbps - TTL Level RS232

Ethernet: Dual 10/100 BaseT, Auto - MDI/X, IEEE 802.3

USB: 2.0

Network Protocols: TCP, UDP, TCP/IP, ARP, ICMP, DHCP, HTTP, HTTPS*, SSH*, SNMP, FTP, DNS, Serial over IP (*May require an export permit)

Operating Modes: Master, Slave/Remote, Relay (Future)

Management: Local Serial Console, Telnet, WebUI, SNMP, FTP & Wireless Upgrade

Diagnostics: Status LED's, RSSI, remote diagnostics, SNR

Input Voltage: OEM: Digital Voltage: 3.3 VDC (500mA)
RF Voltage: 5.0 VDC (1.5A)
Enclosed: 7 - 30 VDC

Current:

		MIMO ON		MIMO OFF	
	Tx Power (dBm)	Vcc @ 3.3V	VRF @ 5V	Vcc @ 3.3V	VRF @ 5V
Peak Avg. Transmit Current (mA)	20	400 - 460	640	400 - 460	340
	22	400 - 460	720	400 - 460	390
	24	400 - 460	780	400 - 460	450
	26	400 - 460	860	400 - 460	520
	28	400 - 460	1000	400 - 460	620
	30	400 - 460	1200	400 - 460	790
Instantaneous Current Draw	-	500	1500	500	1000
Typical Receive Current Draw (mA)	-	400 - 460	-	400 - 460	-

Table 1-1: pMDDL Current Consumption

1.0 Overview

Environmental

Operation Temperature: -40°F(-40°C) to 185°F(85°C)

Humidity: 5% to 95% non-condensing

Mechanical

Dimensions:	OEM:	1.05” (26.5mm) X 1.3” (33mm) X 0.13” (3.5mm)
	ENC:	3.05” (77mm) X 2.2” (55mm) X 1.1” (28mm)
Weight:	OEM:	Approx. 7 grams
	ENC:	Approx. 170 grams
Connectors:	OEM:	Antenna: UFL x2 (ANT1, ANT2) Data: 80 Pin SMT
	ENC:	RP-SMA Femalex3 Data: RJ-45 x2 (Ethernet) Female DB9 (Serial) USB Type A Micro-AB USB (Console)
		Power: SMT: 4-Pin Micro MATE-N-LOK AMP 3-794618-4 (Mating Connector: 4-Pin Micro MATE-N-LOK AMP 794617-4)

1.0 Overview

1.3 Performance Specifications

MIMO (2X2) ON			
Modulation	**IPerf Throughput (Mbps)**	**Throughput @ Sensitivity (dBm)**	**Maximum Total Tx Power (dBm) +/- 1dB**
8 MHz Channel Bandwidth			
BPSK_1/2	3	-99.5	30dBm
QPSK_1/2	5.9	-98	30dBm
QPSK_3/4	8.8	-96	30dBm
16QAM_1/2	11.6	-92	30dBm
16QAM_3/4	17.1	-90	30dBm
64QAM_2/3	22.8	-85	30dBm
64QAM_3/4	25.5	-83.5	30dBm
64QAM_5/6	27.8	-81	30dBm
4 MHz Channel Bandwidth			
BPSK_1/2	1.51	-102.5	30dBm
QPSK_1/2	2.98	-101	30dBm
QPSK_3/4	4.4	-99	30dBm
16QAM_1/2	5.8	-95.5	30dBm
16QAM_3/4	8.6	-93	30dBm
64QAM_2/3	11.4	-88	30dBm
64QAM_3/4	12.8	-86	30dBm
64QAM_5/6	14	-83.5	30dBm
MIMO OFF			
Modulation	**IPerf Throughput (Mbps)**	**Throughput @ Sensitivity (dBm)**	**Maximum Tx Power (dBm) +/- 1dB**
8 MHz Channel Bandwidth			
BPSK_1/2	3	-96.5	30dBm
QPSK_1/2	5.8	-95	30dBm
QPSK_3/4	8.6	-93	30dBm
16QAM_1/2	11.5	-89	30dBm
16QAM_3/4	16.9	-87	30dBm
64QAM_2/3	22.2	-82	28dBm
64QAM_3/4	24.7	-80.5	28dBm
64QAM_5/6	27.4	-78	27dBm
4 MHz Channel Bandwidth			
BPSK_1/2	1.5	-99.5	30dBm
QPSK_1/2	2.9	-98	30dBm
QPSK_3/4	4.3	-96	30dBm
16QAM_1/2	5.7	-92.5	30dBm
16QAM_3/4	8.4	-90	30dBm
64QAM_2/3	11.3	-85	28dBm
64QAM_3/4	12.5	-83	28dBm
64QAM_5/6	14	-80.5	27dBm

Table 1-2: pMDDL Performance Specifications

2.0 Quick Start

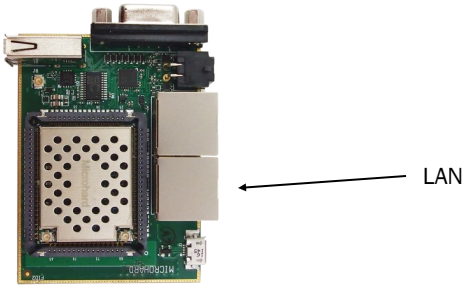
This QUICK START guide will walk you through the setup and configuration of a few basic applications. The QUICK START will rely on the *WebUI* for configuration. This walkthrough also assumes the units used are installed in microhard interface/ development boards or custom boards that allow access to the LAN port. See the appropriate section for pin-outs.

Note that the units arrive from the factory with a Radio Configuration of 'Master' and the Local Network setting configured as 'Static' (IP Address **192.168.168.1**, Subnet Mask 255.255.255.0). DHCP is enabled by default, and will assign an IP to a connected device or computer with DHCP enabled.

2.1 Getting Started

- ✓ Connect an appropriate Antenna to the ***ANTENNA*** connector of the pMDDL.
- ✓ Connect and/or apply a suitable power source to the unit. Allow the unit to boot up fully, the CPU LED (Blue) should be on in a solid state
- ✓ Connect A PC to the ***LAN*** port (eth0) of the pMDDL, using an Ethernet Cable.

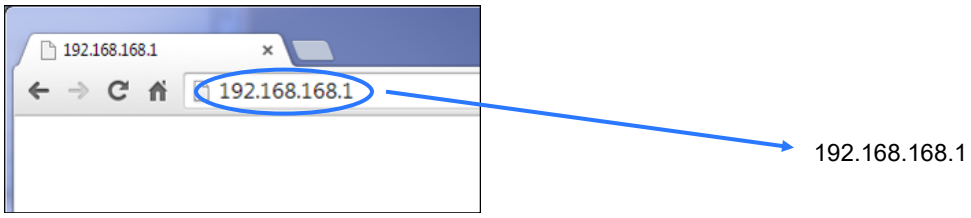
To reset to factory defaults, press and hold the CONFIG for 8 seconds with the pMDDL powered up. The pMDDL will reboot with factory default settings.



The factory default network settings:

IP: 192.168.168.1
Subnet: 255.255.255.0

- ✓ The PC must have its Network Setting (TCP/IP Properties) set to DHCP (The modem will assign a IP address to you), or STATIC with an IP Address of (e.g.) 192.168.168.10 and a Subnet Mask of 255.255.255.0.
- ✓ Open a Browser Window and enter the IP address 192.168.168.1 into the address bar.



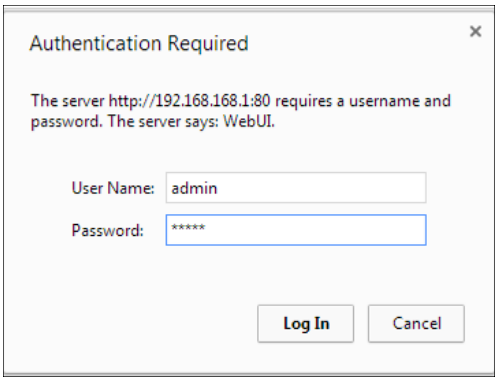
2.0 Quick Start

The factory default login:

User name: admin
Subnet: admin

You will be forced to change the default password upon logging in for the first time.

✓ The pMDDL will then ask for a Username and Password. Enter the factory defaults listed below.

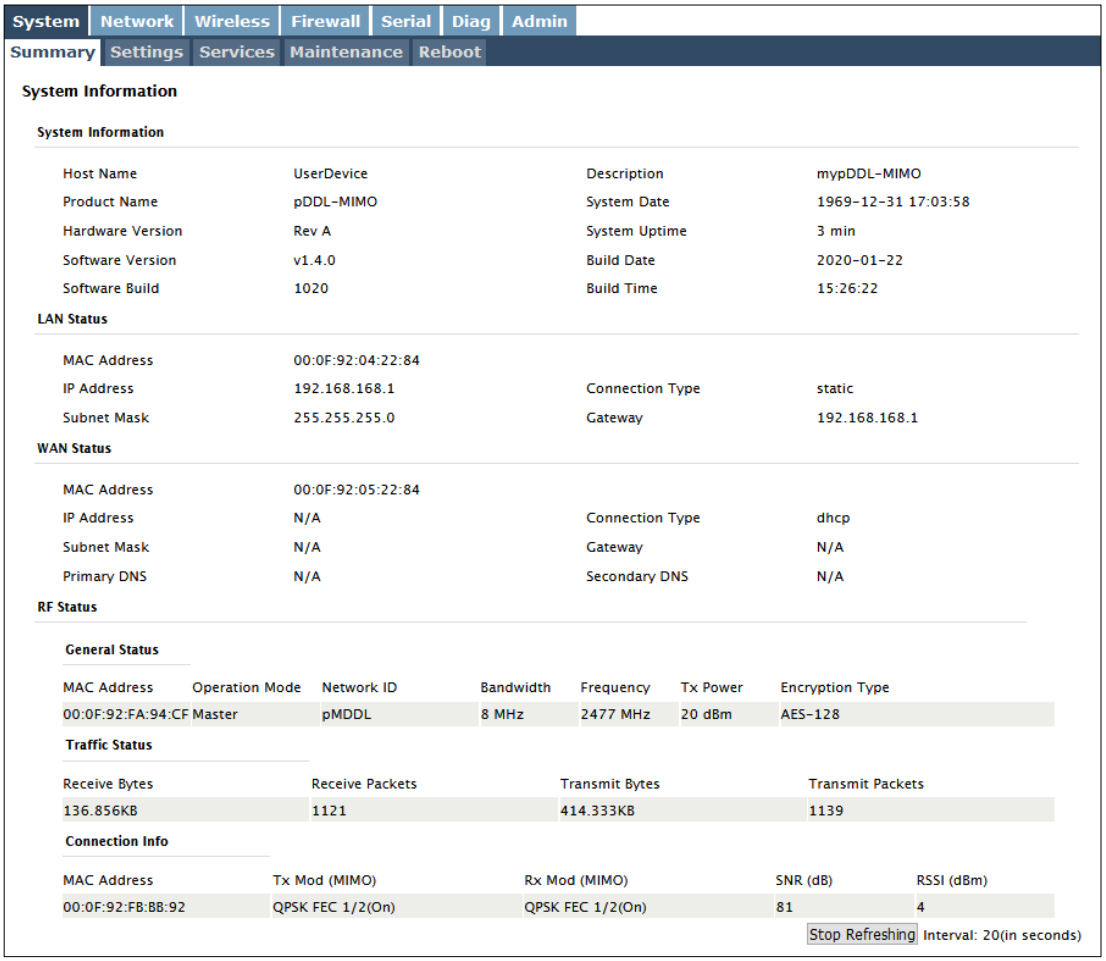


The Factory default login:

User name: **admin**
Password: **admin**

Once successfully logged in for the first time, the pMDDL will force a password change

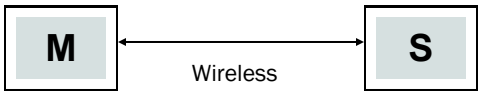
✓ Once successfully logged in, the System Summary window will be displayed.



2.0 Quick Start

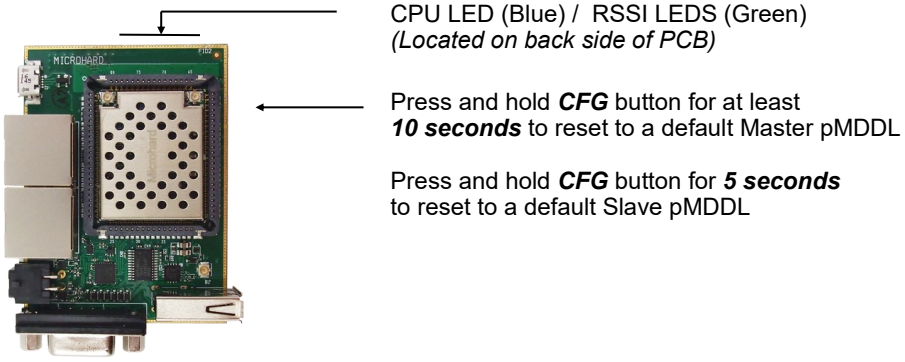
2.2 Simple Master and Slave - Auto (Using Defaults)

This **Quick Start** example requires (2) pMDDL units, one will be configured as a Master (M), the second unit will be configured as a Slave/Remote (S). This example will use factory defaults to set up each unit so that a simple network will be established.



✓ Use ***Section 2.1*** *Getting Started* to power up a pair of pMDDL modules mounted in a Pico Ethernet Motherboard.

✓ Master: Once the pMDDL is fully booted (solid blue CPU LED), press and hold the CFG button. Once the CPU LED begins to flash, continue to hold for at least **10 seconds**, then release.



✓ The pMDDL will then reset all settings to default values, and set the following settings that are required to automatically create a link with a slave:

- IP Address: **192.168.168.1**, Operating Mode: **Master**
- Network ID: **pMDDL**, Channel Bandwidth: **8 MHz**
- Channel-Frequency: **76 - 2477 MHz**

✓ Slave: Ensure the pMDDL is fully booted (solid blue CPU LED), then press and hold the CFG button. Once the CPU LED begins to flash, continue to hold for **5 seconds**, then release.

✓ The pMDDL will then reset all settings to default values, and set the following settings that are required to automatically create a link with a slave:

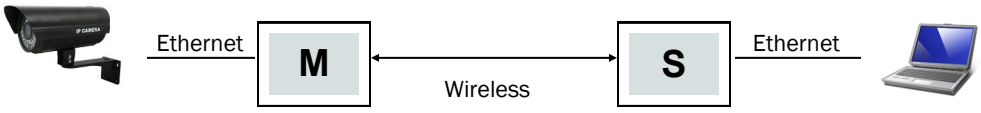
- IP Address: **192.168.168.2**, Operating Mode: **Slave**
- Network ID: **pMDDL**, Channel Bandwidth: **8 MHz**
- Channel-Frequency: **76 - 2477 MHz**

✓ Once both units have finished changing settings (~60 seconds) a wireless link should automatically be established between them, this can be seen by observing the RSSI LEDS, they should be on solid, indicating a link (the more LEDs illuminated = stronger the link).

2.0 Quick Start

2.3 Simple Master and Slave — Manual Setup

This **Quick Start** example requires (2) pMDDL units, one will be configured as a Master (M), the second unit will be configured as a Slave/Remote (S). This example will show the basic steps required to set up each unit so that a simple network will be established.



For the best performance it is required to connect the Master to the video source (camera) and the remote to the video receiver. The pMDDL can support Point-to-Multipoint applications and multiple remotes could be used to view the video from multiple locations.

2.3.1 Configuring the Master

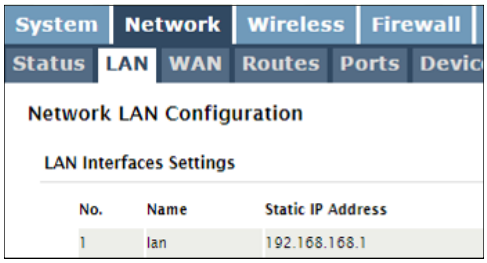
✓ Use ***Section 2.1*** *Getting Started* to connect, power up and log in to a pMDDL unit.

✓ Give the pMDDL unit a unique IP address.

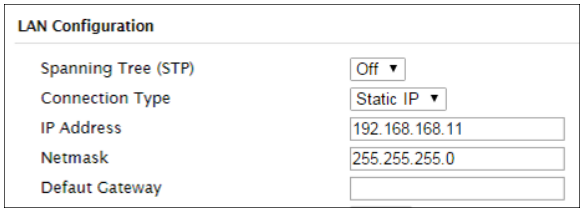
To connect to an existing network, contact your Network Administrator for valid network settings.

Select ***Network*** from the top/main navigation.

Select ***LAN*** from the submenu list. Select Edit on the LAN interface 1.



Choose *Static IP* for the ***Connection Type***.



Enter the following Network Information:

IP Address: 192.168.168.11
IP Subnet Mask: 255.255.255.0

Click on the **Submit** button to write the changes to the pMDDL. The **Cancel** button will revert back to last values saved to the unit.

Refer to **Section 5.2.2** *LAN* for additional information.

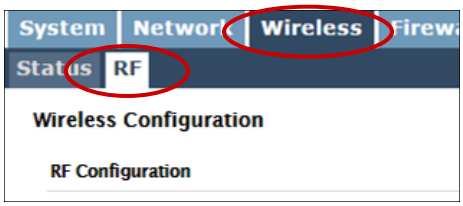
Once the IP Address is changed, you will need to type the new address into your browser to continue the configuration.

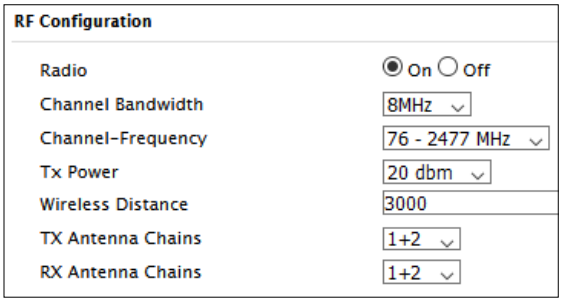
2.0 Quick Start

2.3.1 Configuring the Master (Con't)

✓ Configure the pMDDL as a Master

Select ***Wireless*** from the top/main navigation, and then *RF* from the submenu list.



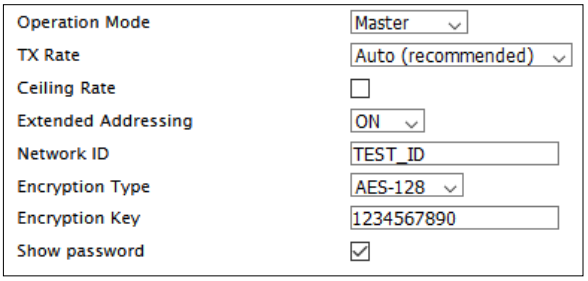


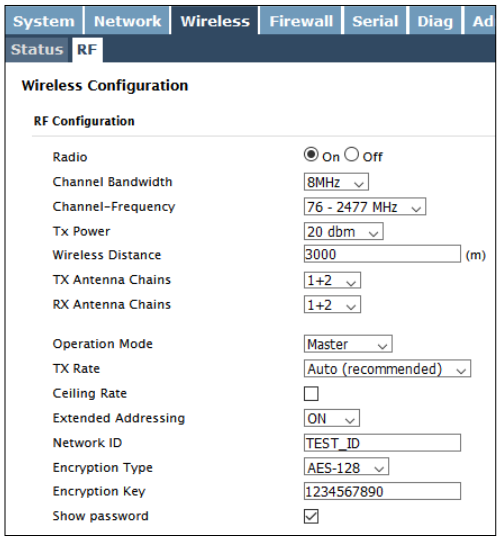
In the RF Configuration ensure the ***Compatibility Mode***, ***Channel Bandwidth*** and ***Channel-Frequency*** are set the same on each module.

For bench or close proximity testing it is best to use a lower power setting to prevent RF saturation. Select 20dBm from the ***TX Power*** setting.

Select Master from the **Operation Mode** dropdown box.

Set a **Network ID**, which will need to be the same on each unit in the network. This example uses **TEST_ID.**





The remaining settings in the ***Wireless*** menu should be left as defaults for this exercise.

Refer to **Section 5.3** *Wireless* for additional information.

Click on the **Submit** button to write the changes to the pMDDL. The **Cancel** button will revert back to previously saved values

If any additional settings need to be changed, ensure they are also changed on the Slave.

2.0 Quick Start

2.3.2 Configuring the Slave/Remote

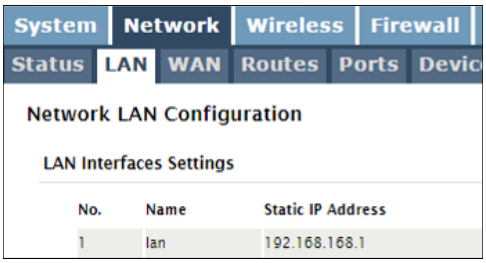
The following procedure describes the steps required to set up a pMDDL unit as a Slave (S). A Slave provides a single wireless connection (i.e to an Master) and provides a wired connection to a PC or other devices.

✓ Use ***Section 2.1*** *Getting Started* to connect, power up and log in to a second pMDDL unit.

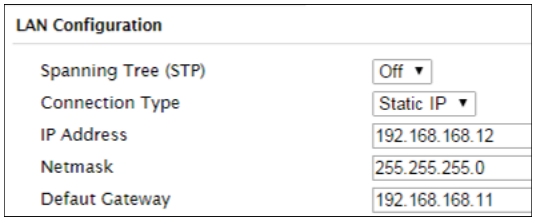
✓ Give the pMDDL unit an unique IP address.

Select ***Network*** from the top/main navigation.

Select ***LAN*** from the submenu list. Select Edit on the LAN interface 1.



To connect to an existing network, contact your Network Administrator for valid network settings.



Refer to **Section 5.2.2** *LAN* for additional information.

Choose *Static IP* for the ***Connection Type***.

Enter the following Network Information:

IP Address: 192.168.168.12
IP Subnet Mask: 255.255.255.0
Default Gateway: 192.168.168.11

Click on the **Submit** button to write the changes to the pMDDL. The **Cancel** button will revert back to last values saved to the unit.

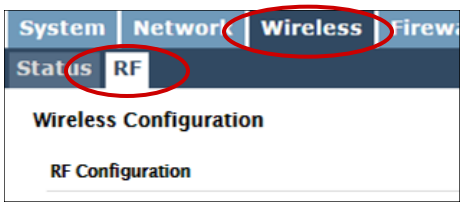
Once the IP Address is changed, you will need to type the new address into your browser to continue the configuration.

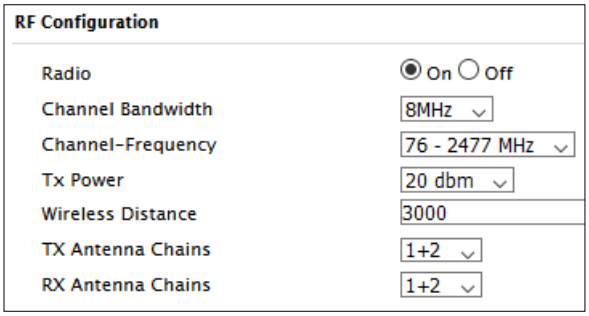
2.0 Quick Start

2.3.3 Configuring the Slave/Remote (Con't)

✓ Configure the pMDDL as a Slave

Select ***Wireless*** from the top/main navigation, and then *RF* from the submenu list.



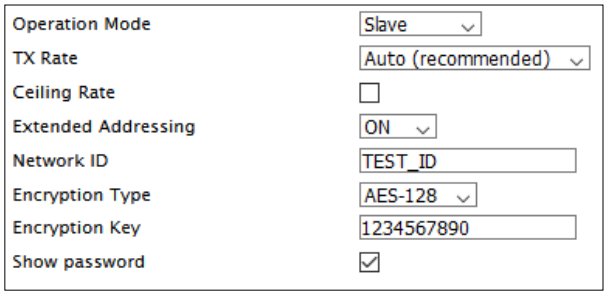


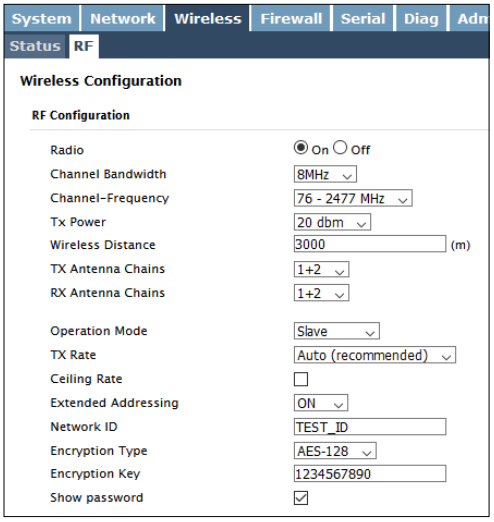
In the RF Configuration ensure the ***Compatibility Mode***, ***Channel Bandwidth*** and ***Channel-Frequency*** are set the same on each module.

For bench or close proximity testing it is best to use a lower power setting to prevent RF saturation. Select 20dBm from the ***TX Power*** setting.

Select **Slave** from the ***Operating Mode*** dropdown box.

Set a **Network ID**, which will need to be the same on each unit in the network. This example uses **TEST_ID.**





The remaining settings in the ***Wireless*** menu should be left as defaults for this exercise.

Refer to **Section 5.3** *Wireless* for additional information.

Click on the **Submit** button to write the changes to the pMDDL. The **Cancel** button will revert back to previously saved values

If any additional settings need to be changed, ensure they are also changed on the Slave.

2.0 Quick Start

2.3.3 Testing the Connection

✓ Visually check to see if the pMDDL units are communicating.

The ***RSSI*** LED's represent signal strength, the more LED's that are illuminated, the stronger the signal. The ***Wireless > Status*** window also has a Connection Status section similar to that seen below:

RSSI LED's that are 'cycling' or 'scanning' indicate that the unit is searching for a signal.

RF Status

General Status

MAC Address	Operation Mode	Network ID	Bandwidth	Frequency	Tx Power	Encryption Type
00:0F:92:FB:BB:92	Slave	TEST_ID	8 MHz	2477 MHz	20 dBm	AES-128

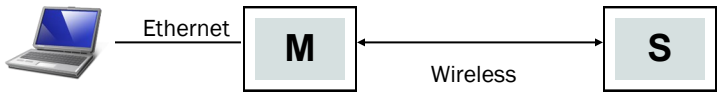
Traffic Status

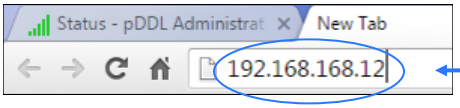
Receive Bytes	Receive Packets	Transmit Bytes	Transmit Packets
302.424KB	634	80.613KB	573

Connection Info (1)

MAC Address	Tx Mod (MIMO)	Rx Mod (MIMO)	SNR (dB)	RSSI (dBm)	Signal Level	RSSI Graph
00:0F:92:FA:94:CF	16-QAM FEC 1/2(On)	16-QAM FEC 3/4(On)	77	-7		

✓ With a PC connected to the Master (M), type in the IP address of the Slave (S) into the URL address bar of your browser. You should be able to connect, log in and view the WebUI of the Slave via the wireless connection.





Open a browser and type in the address of the slave: ***192.168.168.12***

Log into the unit.

The System Summary screen should be displayed

If any additional settings need to be changed, ensure they are also changed on all radios.

3.0 Hardware Features

3.1 pMDDL OEM Module

The pMDDL modems are available as OEM modules for complete integration into custom designs. The OEM module supplies all the required raw signals to allow the unit to be tightly integrated into applications to efficiently maximize space and power requirements. The Microhard development board can provide a convenient evaluation platform to test and design with the module. (Contact Microhard Systems for details)

Any pMDDL module may be configured as a Master, Slave(Remote), or Relay (future). This versatility is very convenient from a 'sparing' perspective, as well for convenience in becoming familiar and proficient with using the module: if you are familiar with one unit, you will be familiar with all units.

Image 3-1: pMDDL2450 Top View

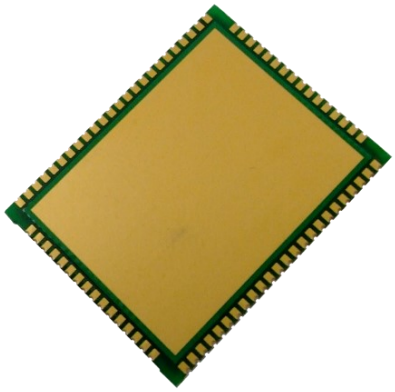
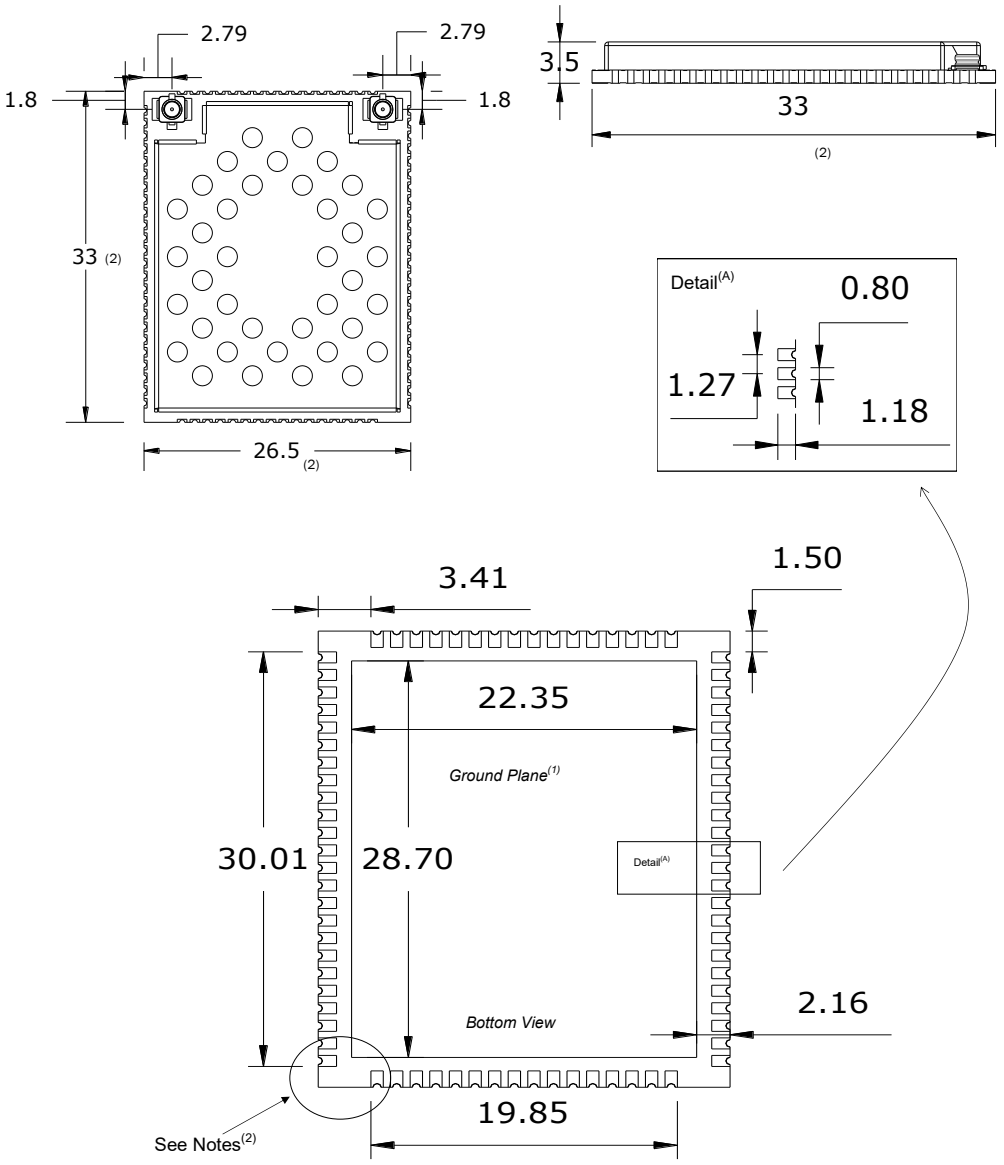


Image 3-2: pMDDL2450 Bottom View

3.0 Hardware Features

3.1.1 Mechanical Drawings

The pMDDL OEM Modules have an extremely small form factor as seen *below*.



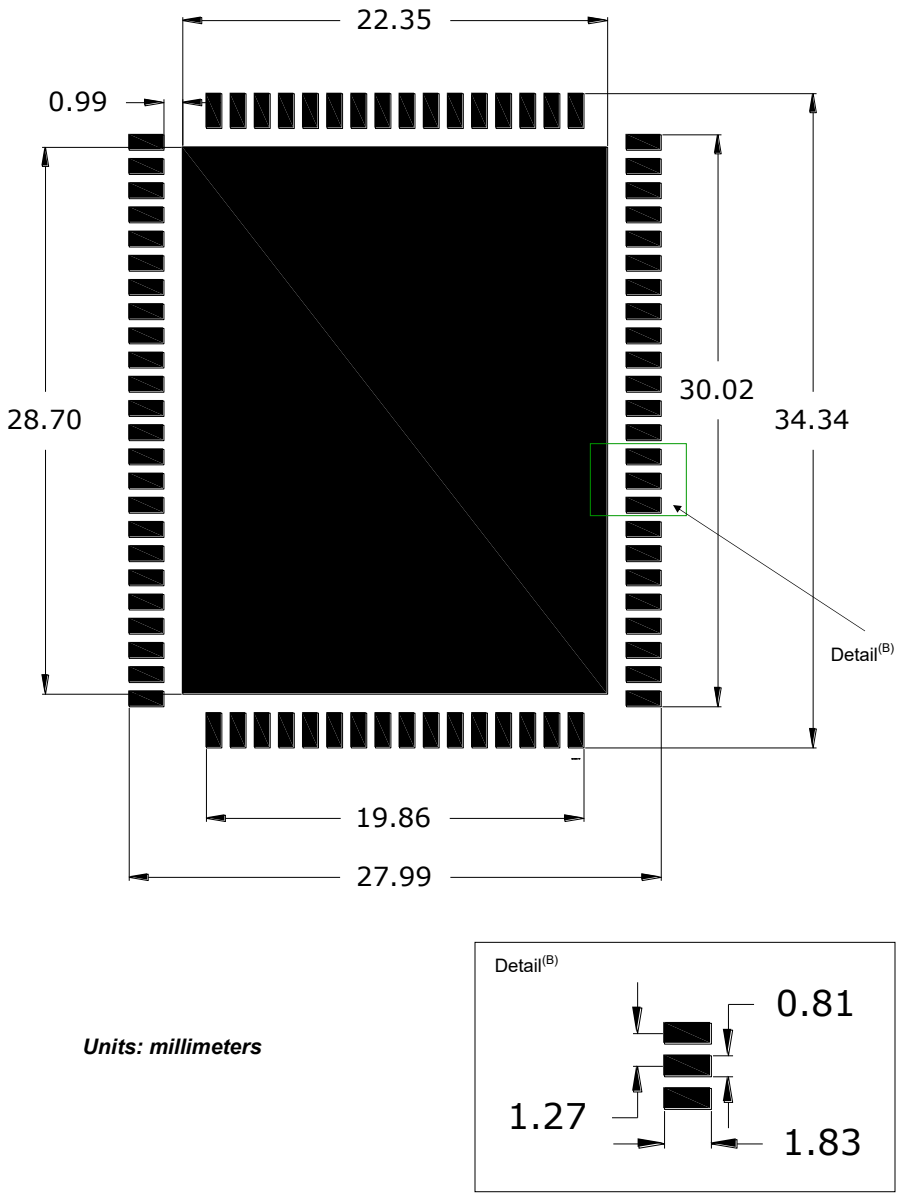
Units: millimeters

1. Ground plane must be connected to GND for required heat dissipation.
2. Due to manufacturing methods additional PCB material may be present on the corners that cannot be removed. Designs should allow for a small tolerance of this additional material, ± 0.25mm

Drawing 3-1: pMDDL OEM Mechanical

3.0 Hardware Features

3.1.2 Recommended Solder Mask (Pad Landing)

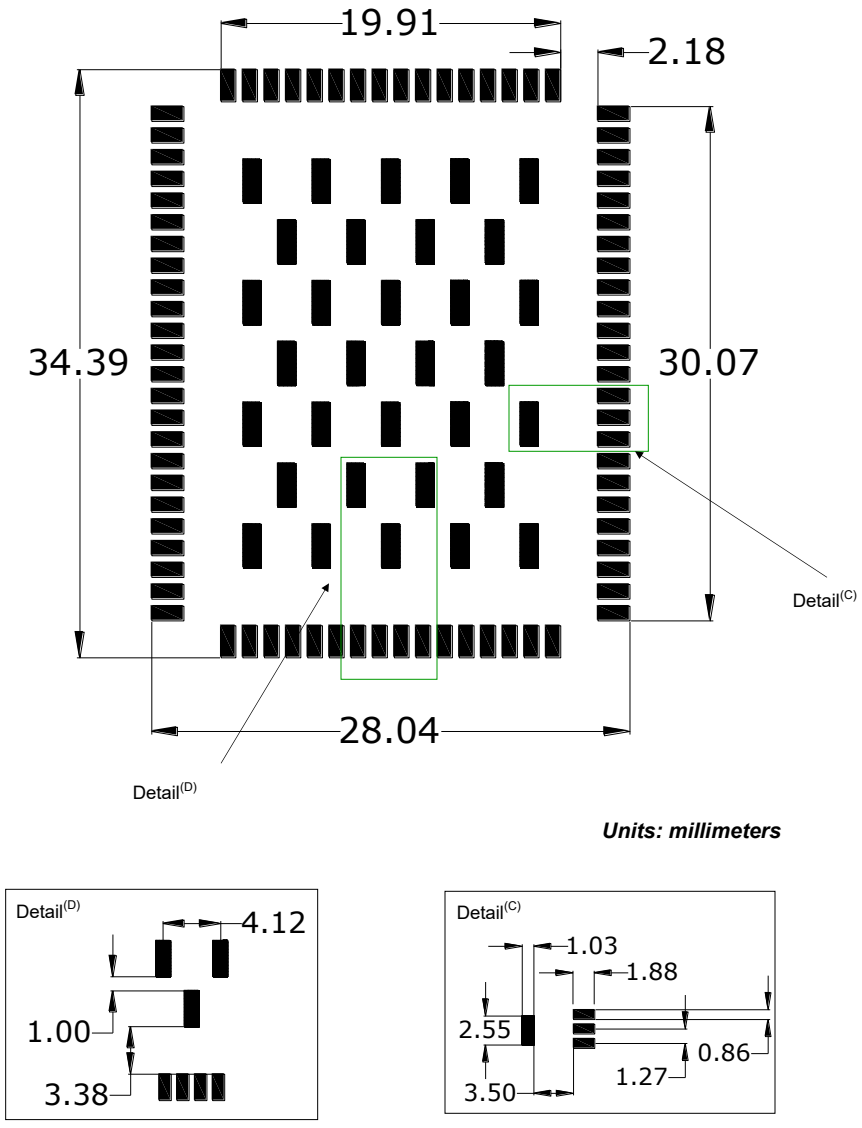


Units: millimeters

Drawing 3-2: pMDDL Recommended Solder Mask

3.0 Hardware Features

3.1.3 Recommended Solder Paste Pattern



Drawing 3-3: pMDDL Recommended Solder Paste

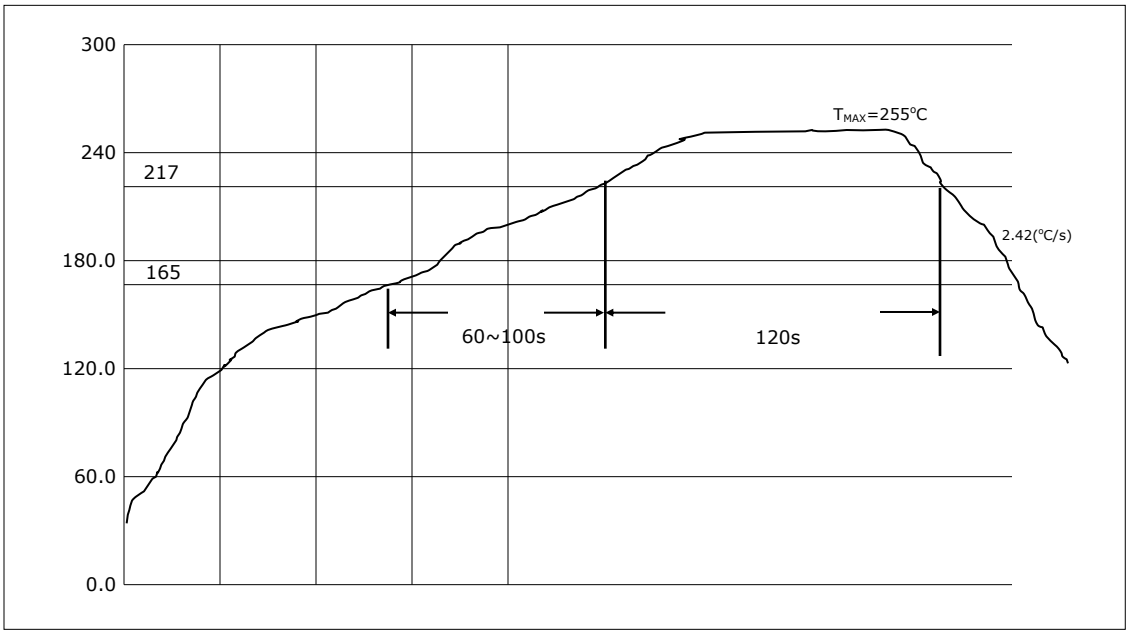
3.1.4 OEM Connectors

Antenna
All pMDDL OEM Modules use an UFL connector for the antenna connection.

Data
The interface to the pMDDL OEM module is a tight integration using 80 pad SMT connections.

3.0 Hardware Features

3.1.5 SMT Temperature Profile



Drawing 3-4: pMDDL Reflow Profile

Temperature Zone	Time	Parameter
Preheat zone: (40°C - 165°C)	-	Heating rate: 0.5°C/s-2°C/s
Soak Zone: (165°C - 217°C)	60 - 100s	-
Reflow zone: (>217°C)	120s	Peak reflow: 255°C
Cooling zone	Cooling rate: 2°C/s ≤ Slope ≤ 5°C/s	

Table 3-1: pMDDL Reflow Parameters

Zone	Temperature (°C)
1	120
2	140
3	160
4	180
5	215
6	255
7	255
8	255
9	250
10	130
Chain Speed: 60cm/min	

Table 3-2: pMDDL Oven Temperature Profile

3.1.6 SMT Baking Instructions (MSL)

The pMDDL OEM modules must be baked before mounting, the following baking instruction should be followed for the best results:

a) Minimum of 8 to 12 hours at 125°C +/- 5°C for high-temperature device containers.
b) Unused modules should be stored at ≤ 10% RH

3.0 Hardware Features

3.1.7 Heat Dissipation

For optimal performance it is important to include adequate heat dissipation strategies that incorporate a heat sink or fan into any designs that integrate the pMDDL OEM module (also required for designs that utilize the optional socket).

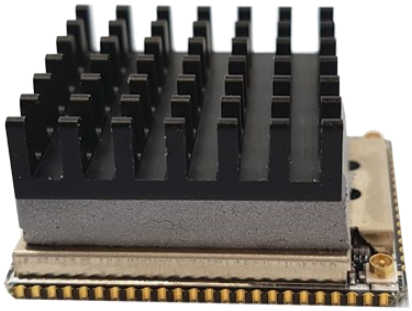
Below are two recommended heat dissipation strategies:

Heat Sink (w/Thermal Gap Filler)

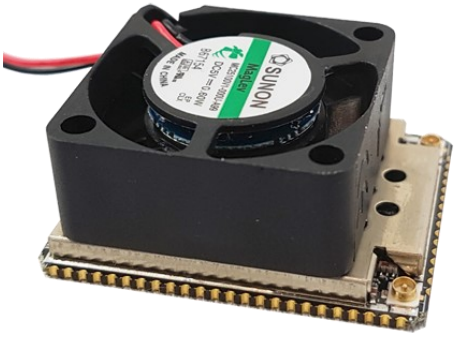
Heat Sink - Wakefield-Vette 625-25ABT4E*
25mm x 25mm x 6.4mm (Fin height)
12^0 C/W @ 500 LFM
5.45 grams

Thermal Gap Filler - Laird Technologies Tflex HR600*
25mm x 25 mm (Cut to Size)
5mm Thickness
3.0 W/m-K
5 grams

pMDDL OEM or OEM/Socket



Fan (Requires power source)



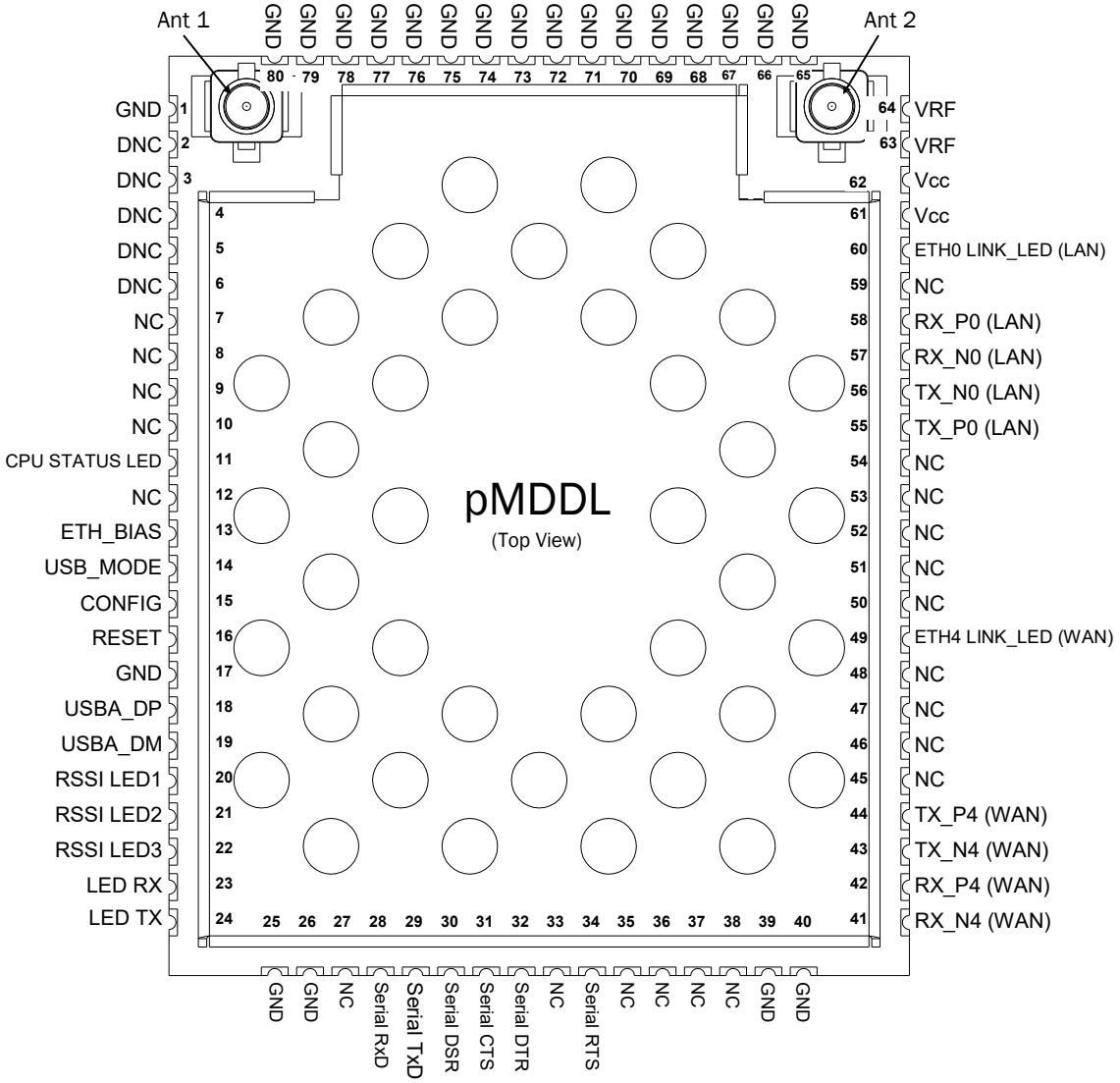
External Fan - Sunon MC25100V1-000U-A99*
25mm x 25mm x 10mm
3.5 CFM (0.099m^3/min)
13,000 RPM
2.5~6VDC
7.71 grams

pMDDL OEM or OEM/Socket

* Or equivalent

3.0 Hardware Features

3.1.8 pMDDL OEM Pin Descriptions



Drawing 3-5: pMDDL 80-pin OEM Connection Info

Inputs and outputs are 3.3V nominal (3.0V min — 3.6V max) unless otherwise specified.

The above drawing depicts a top view of the pMDDL OEM Module. A full description of the connections and function of each pin is provided on the pages that follow.

Heat Dissipation

For optimal performance it is important to include adequate heat dissipation including a heat sink in any designs that integrate the pMDDL OEM module (also required for designs that incorporate the optional socket).

3.0 Hardware Features

Caution: During power up or reset, output pins from the Pico are in an unknown state. It is advised to use pull up or pull down resisters as appropriate.

Pin Name	No.	Description	Dir
GND	*1,17,25-26,39-40,65-80*	Ground reference for logic, radio, and I/O pins.	
DNC	2,3,4,5,6	Reserved for factory use only.	
NC	7,8,9,10,12,27, 33,35,36,37,38, 45,46,47,48,50, 51,52,53,54,59	**Currently Not Supported. For Future Expansion**	
CPU STATUS LED	11	Active high output indicates CPU/Module status. Active high, cannot drive LED directly. Requires current limiting resistor. 8mA maximum.	O
ETH_BIAS	13	Bias Voltage to Ethernet PHY transformer	
USB_MODE	14	Indicates if the interface is in host/device mode. 0 = Device (Connected through 1K resistor to GND), 1 = Host.	I
Config	15	Active low. In normal mode, pull it low and hold for more than 8 seconds will reset the system to default settings. Pull it low upon power up will put the module into recovery mode.	I
RESET	16	Active low input will reset module	I
USBDP	18	USB D+ signal; carries USB data to and from the USB 2.0 PHY	
USBDM	19	USB D- signal; carries USB data to and from the USB 2.0 PHY	
LED_1 (RSSI1)	20	Receive Signal Strength Indicator 1. Active high, cannot drive LED directly. Requires current limiting resistor. 8mA maximum.	O
LED_2 (RSSI2)	21	Receive Signal Strength Indicator 2. Active high, cannot drive LED directly. Requires current limiting resistor. 8mA maximum.	O
LED_3 (RSSI3)	22	Receive Signal Strength Indicator 3. Active high, cannot drive LED directly. Requires current limiting resistor. 8mA maximum.	O
LED_RX	23	Active high output indicates receive and synchronization status. Active high, cannot drive LED directly. Requires current limiting resistor. 8mA maximum.	O
LED_TX	24	Active high output indicates module is transmitting data over the RF channel. Active high, cannot drive LED directly. Requires current limiting resistor. 8mA maximum.	O
Serial RxD	28	Receive Data. Logic level input into the modem. It is recommended to wire this pin out through a zero ohm resister to a header and jumper block for external access to the serial port for modem recovery procedures.	I
Serial TxD	29	Transmit Data. Logic level Output from the modem. It is recommended to wire this pin out through a zero ohm resister to a header and jumper block for external access to the serial port for modem recovery procedures.	O
Serial DSR	30	Data Set Ready. Active low output. *The DSR line set high enables the transmitter of the RS485 driver.*	O
Serial CTS	31	Clear To Send. Active low output.	O
Serial DTR	32	Data Terminal Ready. Active Low output.	O
Serial RTS	34	Request To Send. Active low input.	I

Table 3-3: pMDDL Pin Description

All serial communications signals are logic level (0 and 3.3V). DO NOT connect RS-232 level (+12, -12VDC) signals to these lines without shifting the signals to logic levels.

3.0 Hardware Features

Pin Name	No.	Description	Dir
RX_N4	41	Ethernet Port 4 (WAN) Receive Pair	
RX_P4	42		
TX_N4	43	Ethernet Port 4 (WAN) Transmit Pair	
TX_P4	44		
ETH4 LINK_LED	49	Active high output indicates Ethernet port 4 link status. Active high, cannot drive LED directly. Requires current limiting resistor. 8mA maximum.	O
TX_P0	55	Ethernet Port 0 (LAN) Transmit Pair	
TX_N0	56		
RX_N0	57	Ethernet Port 0 (LAN) Receive Pair	
RX_P0	58		
ETH0 LINK_LED	60	Active high output indicates Ethernet port 0 link status. Active high, cannot drive LED directly. Requires current limiting resistor. 8mA maximum.	O
Vcc/dd	61,62	Positive voltage supply voltage for the digital section of the module (3.3V).	I
Vpa/rf	63,64	Positive voltage supply voltage for the radio module (5V).	I

Caution: During power up or reset, output pins from the Pico are in an unknown state. It is advised to use pull up or pull down resisters as appropriate.

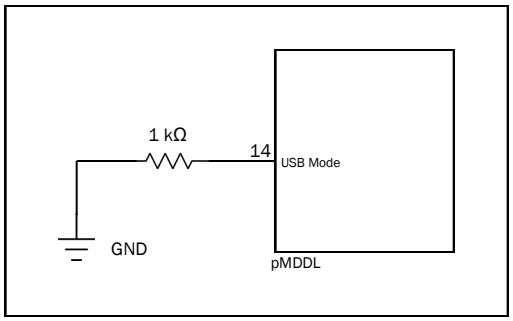
Table 3-3: pMDDL Pin Description (continued)

All serial communications signals are logic level (0 and 3.3V). DO NOT connect RS-232 level (+12, -12VDC) signals to these lines without shifting the signals to logic levels.

See ***Appendix D: Sample Interface Schematic*** for a sample schematic that can be used to interface to the pMDDL OEM module.

3.1.9 USB Device Mode

The pMDDL can be set to operate as a USB Device. When set as a USB device, Microhard Composite Drivers can be installed on a USB Host to provide Ethernet and Serial functionality to the USB port on the pMDDL. To enable USB Device mode, Pin 14 must be connect to GND through a 1K resistor as shown below:



Drawing 3-6: pMDDL USB Device Mode

3.0 Hardware Features

3.2 pMDDL Enclosed

The pMDDL-ENC is a robust and compact enclosed unit that provides easy access to all the standard interfaces for connecting and working with the pMDDL. The enclosed model is ideal for base stations and applications where a full integration is not required and the modem can be used right out of the box with only software configuration required.

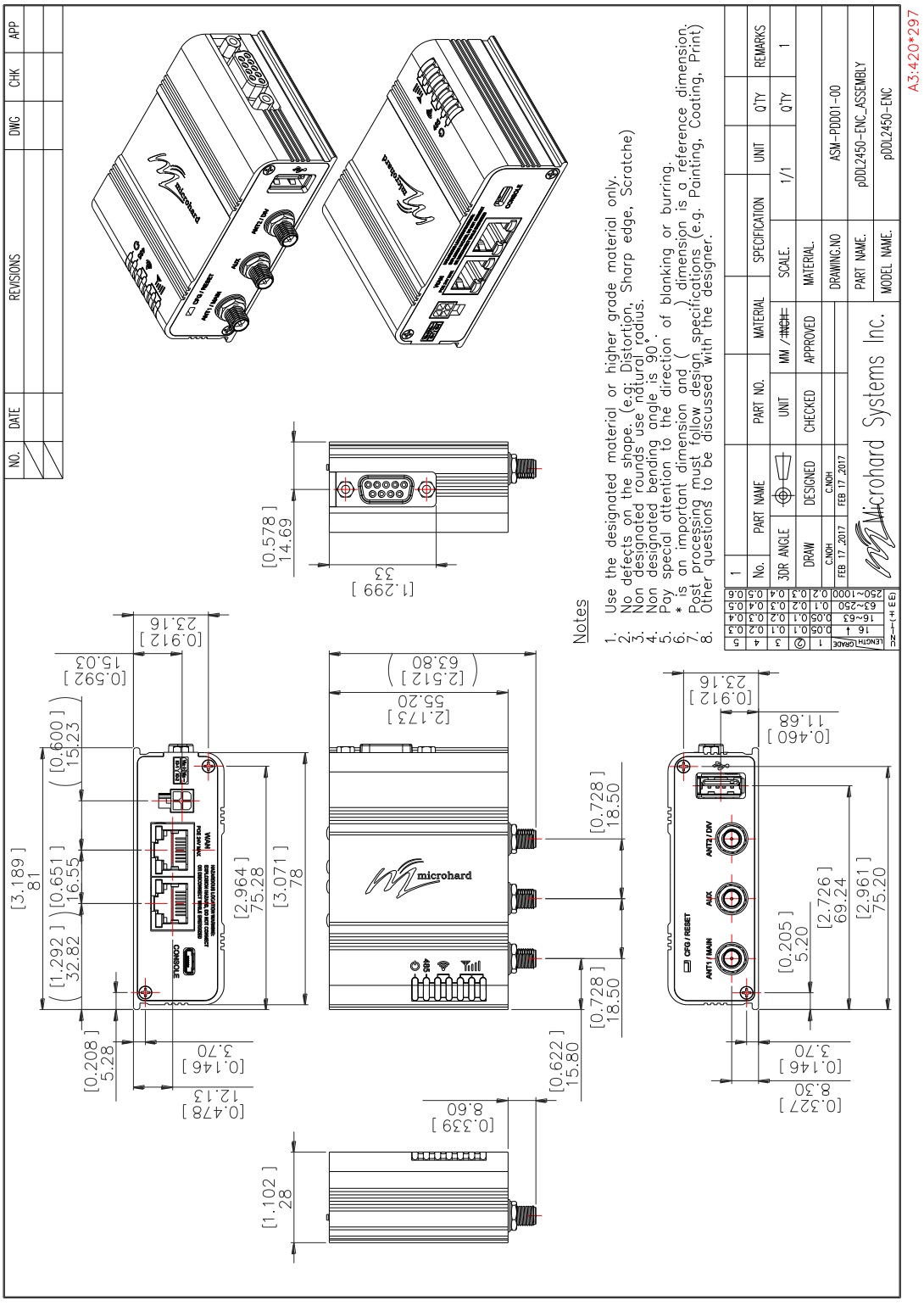
The pMDDL-ENC includes the following standard indicators and interfaces:

- 2x RJ45 Ethernet Ports
- DE9 Female Serial Port Interface
- USB Type A (Future)
- Micro-AB USB (Console - Future)
- Power / IO Connector (7-30 VDC)
- Power / CPU Status LED (Blue)
- Wireless Activity (Tx/Rx) LED's (Red/Green)
- RSSI (x3) LED's (Green)
- RS485 LED (Blue)
- Config Button (Reset/Recovery Operations)
- 3x RP-SMA Female Antenna (ANT1, ANT2, Aux)

Image 3-3: pMDDL-ENC

3.0 Hardware Features

3.2.1 pMDDL-ENC Mechanical Drawings



3.0 Hardware Features

3.2.2 pMDDL-ENC Connectors & Indicators

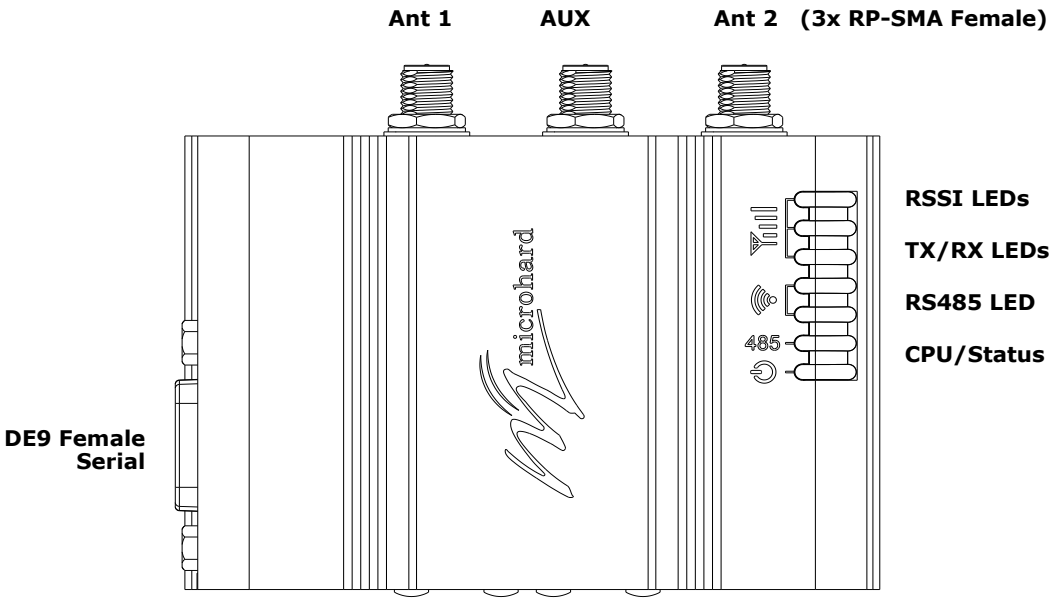


Figure 3-1: pMDDL-ENC Top View

Antennas:

The pMDDL-ENC module uses a RP-SMA Female connectors. ANT1 and ANT2 are marked on the Enclosure. AUX is used to trigger an external amplifier as it goes high (3.3V) during TX.

RSSI LEDs (Green):

The RSSI LEDs indicate the Received Signal Strength on the Wireless Link. On a Master it will indicate an average RSSI value based on connected units. On a Slave the RSSI LEDs will represent the signal strength between the Slave and the Master it is connected to. (The more LEDs illuminated, the stronger the signal)

TX/RX LEDs (Red/Green):

The TX/RX LEDs indicate wireless traffic to/from the pMDDL module.

RS485 LED (Blue):

The RS485 LED indicates that the serial port has been configured as a RS485 port.

CPU/Status (Blue):

The CPU/Status LED indicates that power has been applied to the module. A Solid LED indicates normal operation, while flashing indicates boot or firmware upgrade status.

3.0 Hardware Features

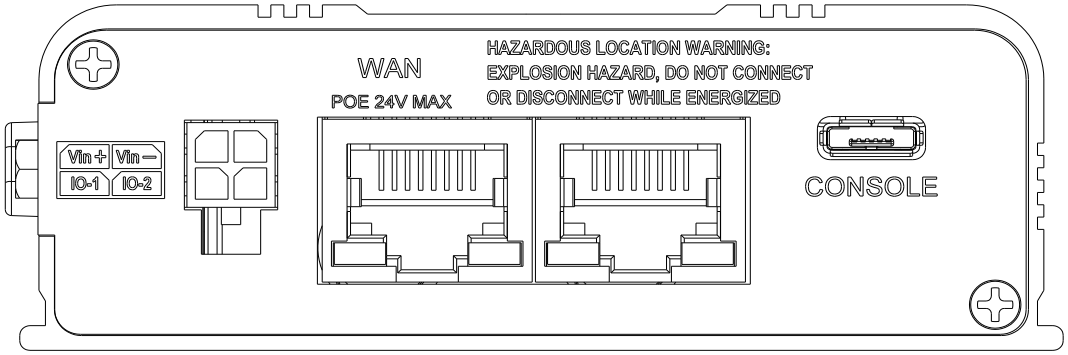


Figure 3-2: pMDDL-ENC Back View

Ethernet LAN:

The Ethernet LAN port is a standard RJ45 port to connect local network devices. The default IP address for this port is *192.168.168.1*.

Ethernet WAN:

The Ethernet WAN port is a standard RJ45 Port that can be used as a separate WAN port for Router functions, or can be bridged (via software) to the LAN as a additional switch port for local devices.

The pMDDL-ENC can be powered using ***Passive PoE from 12—30 VDC Maximum*** on the WAN port using a PoE injector that meets the following requirements:

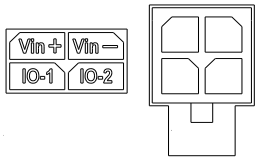
Ethernet RJ45 Connector Pin Number								
Source Voltage	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
12 - 30 Vdc	Data	Data	Data	DC+	DC+	Data	DC-	DC-

Table 3-2: Ethernet (WAN) PoE Connections

Power:

The pMDDL-ENC can powered using an input voltage in the 7-30 VDC range.

Power



Console:

The console port is a Micro-AB USB port that uses a generic FTDI driver as a USB/Serial Interface. When a cable is connected to this port from a PC the FTDI driver should automatically be installed. (Future Development - Coming Soon)

3.0 Hardware Features

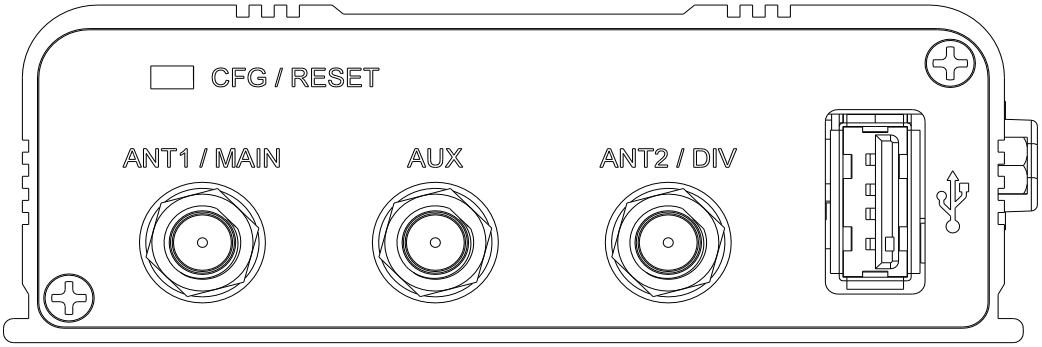


Figure 3-3: pMDDL-ENC End View

CFG/RESET Button:

The Config button on the pMDDL can be used to either reset the modem into its factory default configuration, or it can be used to perform a firmware recovery procedure.

Factory Default Settings: While power is applied and the pMDDL in an operational state, press and hold the *Config* Button for more than 10 seconds to reset to a factory default Master, alternatively hold the button for 5 seconds for a factory default Slave.

Firmware Recovery: To load the firmware on the unit it is recommended to use the normal WebUI to perform a firmware update (Maintenance). In the event that the firmware cannot be loaded using the standard WebUI (non responsive unit), pressing and holding the *Config* Button while powering-up the module will force the pMDDL into a firmware recovery mode. There are 3 main modes, HTTP, TFTP and Master Reset. The table below shows the time required to hold the *Config* button while power is applied:

0 to 5 seconds HTTP Recovery	5 to 10 seconds TFTP Recovery	10 to 15 seconds Master Reset	15+ seconds No Effect

HTTP Recovery: Set an IP on a PC to 192.168.1.1. Open a web browser and Navigate to 192.168.1.39. This will open a simple webpage which will allow a firmware file to be loaded.
TFTP Recovery: Set an IP on a PC to 192.168.1.1. Use a TFTP session to push the firmware file to the modems recovery IP of 192.168.1.39. See Appendix for Firmware Recovery Procedure.
Master Reset: Runs Master Reset, file system is erased.

DE9 Serial:

The RS232/485 Serial data port can be used to communicate with Serial devices or it can be configured to operate as a console port. See Table 3-3 for pin assignments.

RS232/RS485 modes are selected through the serial port configuration in the WebUI. The LED on the pMDDL-ENC will illuminate when in RS485 mode.

USB (Type A, 2.0):

(Future Development)

Pin No.	RS232	RS485 Full-Dup	RS485 Half-Dup
1	DCD		
2	RXD	TX-	Data-
3	TXD	RX+	
4	DTR		
5	Ground		
6	DSR		
7	RTS	RX-	
8	CTS	TX+	Data+
9	N/C		

Table 3-3: DE9 Data Pin Assignment

3.0 Hardware Features

3.3 pMDDL Development Board

The pMDDL Development board provides a platform in which to test and evaluate the operation of the pMDDL without the need to design a custom interface PCB right from the start. The pMDDL includes a socket to insert the pMDDL and provides standard interfaces/indicators for:

- Ethernet (RJ45 x2)
- RS232 Serial Port
- USB Port (Type A)
- Power (9-30 VDC)
- CPU Status LED
- Tx/Rx LED's
- RSSI (x3) LED's
- Config Button (Reset/Recovery Operations)

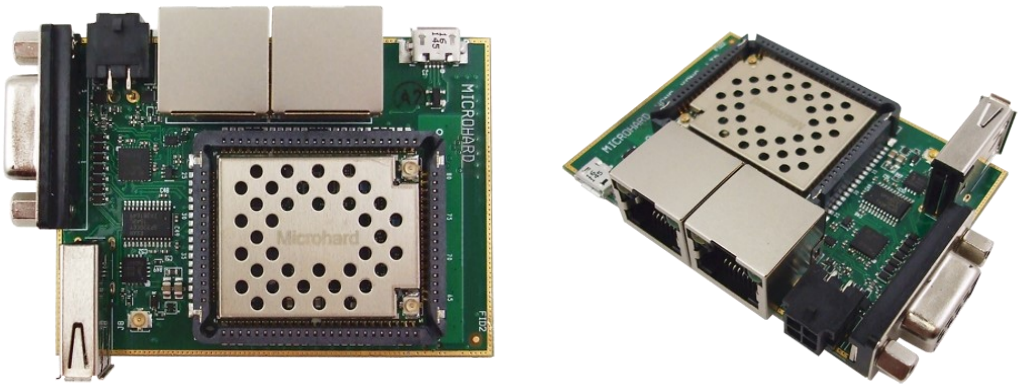
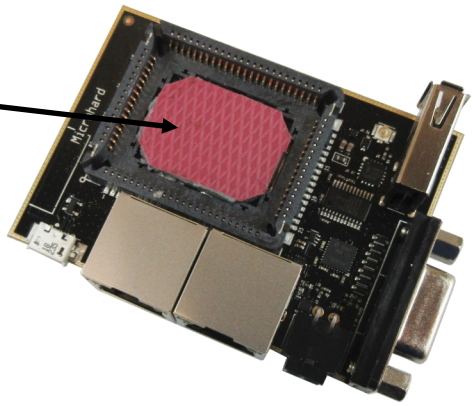


Image 3-3: pMDDL Development Board

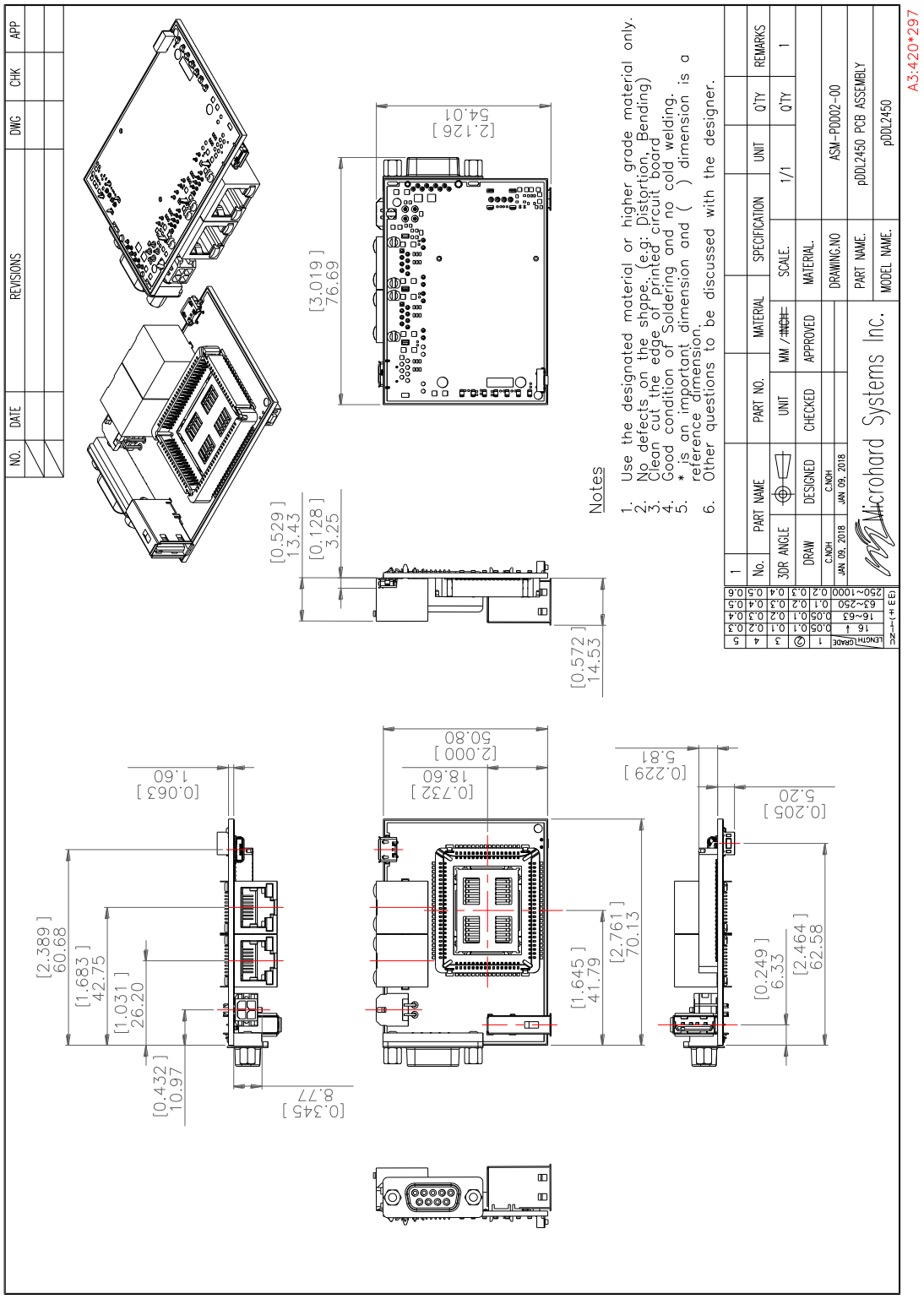
The pMDDL Motherboard is now shipping with a thermal pad under the pMDDL OEM module to aid with heat dissipation.

Be sure to remove protective film before installing pMDDL modules for best performance



3.0 Hardware Features

3.3.1 pMDDL Development Board Mechanical Drawings



3.0 Hardware Features

3.3.2 pMDDL Development Board Connectors & Indicators

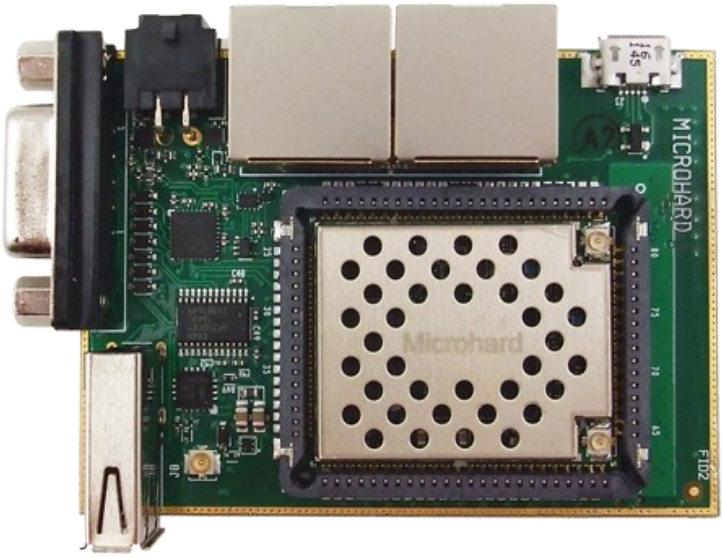


Figure 3-4: pMDDL Development Board

Antennas:

The pMDDL OEM module uses a UFL connectors, Ensure proper orientation as seen above to prevent damage to the pMDDL module and to the development board. ANT1 and ANT2 are marked on the module.

Ethernet LAN:

The Ethernet LAN port is a standard RJ45 port to connect local network devices. The default IP address for this port is *192.168.168.1*.

Ethernet WAN:

The Ethernet WAN port is a standard RJ45 Port that can be used as a separate WAN port for Router functions, or can be bridged (via software) to the LAN as a additional switch port for local devices.

The pMDDL development board can be powered using ***Passive PoE from 12—30 VDC Maximum*** on the WAN port using a PoE injector that meets the following requirements:

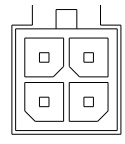
Ethernet RJ45 Connector Pin Number								
Source Voltage	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
12 - 30 Vdc	Data	Data	Data	DC+	DC+	Data	DC-	DC-

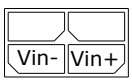
Table 3-2: Ethernet (WAN) PoE Connections

Power:

The pMDDL development board can powered using an input voltage in the 9-30 VDC range.

Power





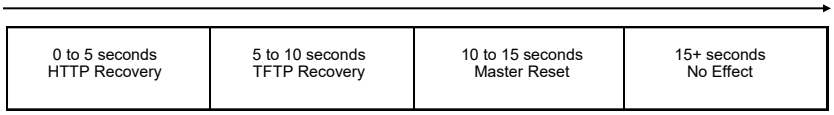
3.0 Hardware Features

Config Button:

The Config button on the pMDDL can be used to either reset the modem into its factory default configuration, or it can be used to perform a firmware recovery procedure.

Factory Default Settings: While power is applied and the pMDDL in an operational state, press and hold the *Config* Button for more than 10 seconds to reset to a factory default Master, alternatively hold the button for 5 seconds for a factory default Slave.

Firmware Recovery: To load the firmware on the unit it is recommended to use the normal WebUI to perform a firmware update (Maintenance). In the event that the firmware cannot be loaded using the standard WebUI (non responsive unit), pressing and holding the *Config* Button while powering-up the module will force the pMDDL into a firmware recovery mode. There are 3 main modes, HTTP, TFTP and Master Reset. The table below shows the time required to hold the *Config* button while power is applied:



HTTP Recovery: Set an IP on a PC to 192.168.1.1. Open a web browser and Navigate to 192.168.1.39. This will open a simple webpage which will allow a firmware file to be loaded.

TFTP Recovery: Set an IP on a PC to 192.168.1.1. Use a TFTP session to push the firmware file to the modems recovery IP of 192.168.1.39. See Appendix for Firmware Recovery Procedure.

Master Reset: Runs Master Reset, file system is erased.

RS232 Serial:

The RS232 Serial data port can be used to communicate with RS232 Serial devices or it can be configured to operate as a console port. See Table 3-3 for pin assignments.

Name	Data Port	Input or Output
DCD	1	O
RXD	2	O
TXD	3	I
DTR	4	I
SG	5	
DSR	6	O
RTS	7	I
CTS	8	O
RING	9	O

Table 3-3: Data DE9 RS232 Pin Assignment

CPU/Status:

The CPU/Status LED indicates that power has been applied to the module. A Solid LED indicates normal operation, while flashing indicates boot or firmware upgrade status.

TX/RX LEDs:

The TX/RX LEDs indication wireless traffic to/from the pMDDL module.

RSSI LEDs:

The RSSI LEDs indicate the Received Signal Strength on the Wireless Link. On a Master it will indicate an average RSSI value based on connected units. On a Slave the RSSI LEDs will represent the signal strength between the Slave and the Master it is connected to. (The more LEDs illuminated, the stronger the signal)

4.0 Configuration

4.0 Web User Interface

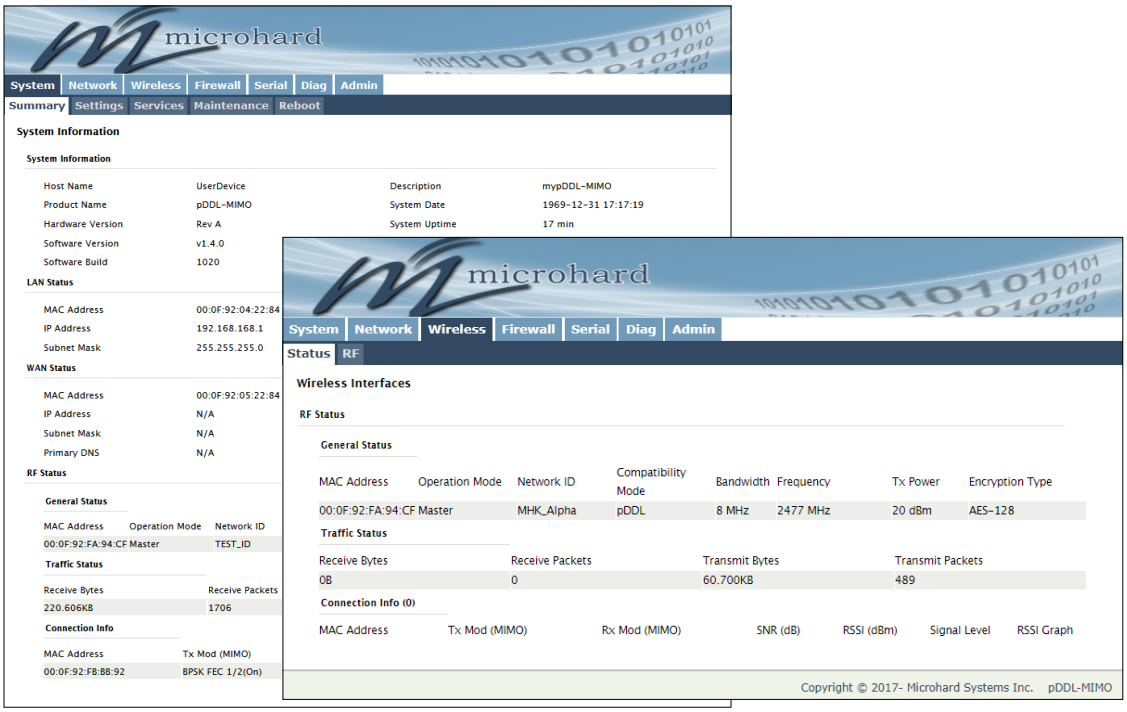


Image 4-0-1: WebUI

The factory default network settings:

IP: 192.168.168.1
Subnet: 255.255.255.0

Initial configuration of an pMDDL using the Web User (Browser) Interface (Web UI) method involves the following steps:

- configure a static IP Address on your PC to match the default subnet **or** if your PC is configured for DHCP, simply connect a PC to the LAN port of the pMDDL and it will be assigned a IP address automatically.
- connect the pMDDL LAN port to PC NIC card using an Ethernet cable
- apply power to the pMDDL and wait approximately 60 seconds for the system to load
- open a web browser and enter the factory default IP address (192.168.168.1) of the unit:
- logon window appears; log on using default Username: ***admin*** Password: ***admin***
- use the web browser based user interface to configure the pMDDL as required.
- refer to **Section 2.0: Quick Start** for step by step instructions.

In this section, all aspects of the Web Browser Interface, presented menus, and available configuration options will be discussed.

4.0 Configuration

4.0.1 Logon Window

Upon successfully accessing the pMDDL using a Web Browser, the Logon window will appear.

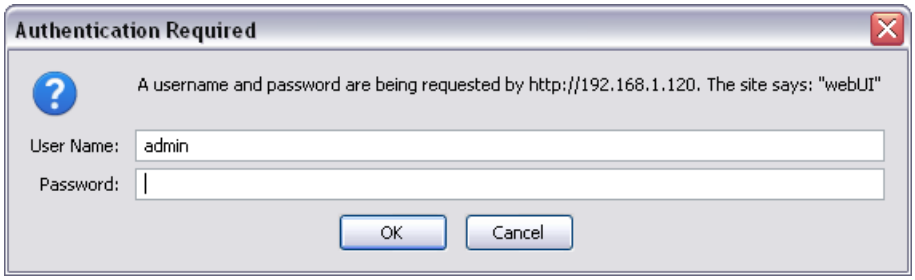


Image 4-0-2: Logon Window

For security, do not allow the web browser to remember the User Name or Password.

The factory default User Name is: **admin**
The default password is: **admin**

Note that the password is case sensitive. It may be changed (discussed further along in this section), but once changed, if forgotten, may not be recovered.

It is advisable to change the login Password. Do not FORGET the new password as it cannot be recovered.

When entered, the password appears as 'dots' as shown in the image below. This display format prohibits others from viewing the password.

The 'Remember my password' checkbox may be selected for purposes of convenience, however it is recommended to ensure it is deselected - particularly once the unit is deployed in the field - for one primary reason: security.

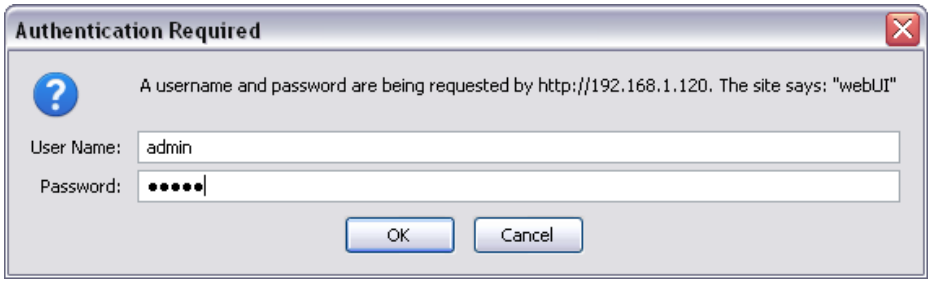


Image 4-0-3: Logon Window : Password Entry

After successfully logging into the Pico DDL for the first time, you will be forced, and prompted to change the admin password.

4.0 Configuration

4.1 System

The main category tabs located at the top of the navigation bar separate the configuration of the pMDDL into different groups based on function. The System Tab contains the following submenus:

- Summary - Status summary of entire radio including network settings, version information, and radio connection status.
- Settings - Host Name, System Log Settings, System Time/Date.
- Services - Enable/Disable and configure port numbers for SSH, Telnet, HTTP and HTTPS services.
- Maintenance - Remote firmware Upgrades, reset to defaults, configuration backup and restore.
- Reboot - Remotely reboot the system.

4.1.1 System > Summary

The System Summary screen is displayed immediately after initial login, showing a summary and status of all the functions of the pMDDL in a single display. This information includes System Status, LAN/WAN network information, version info, Radio Status etc.

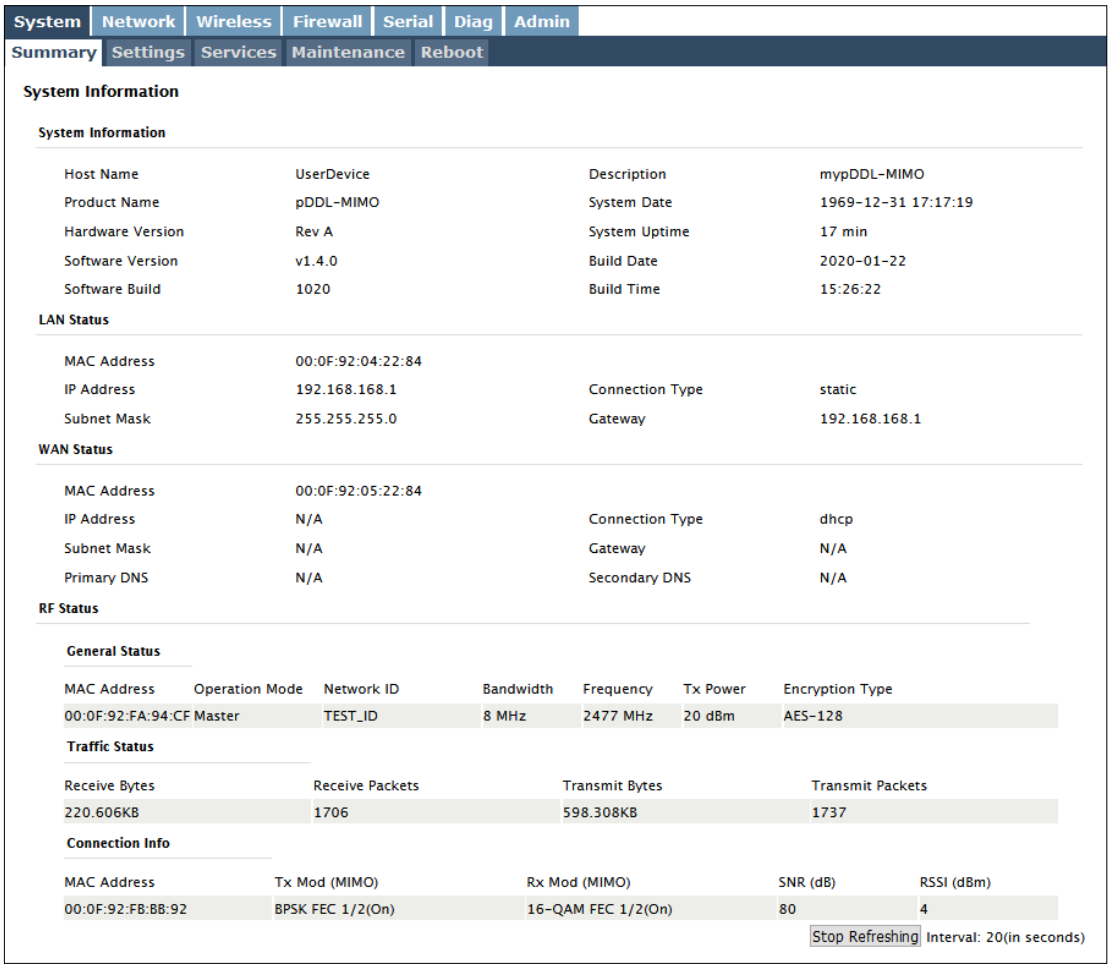


Image 4-1-1: System Summary Window

4.0 Configuration

4.1.2 System > Settings

System Settings

Options available in the System Settings menu allow for the configuration of the Host Name, Description, Console Timeout, System Log server and System Time settings.

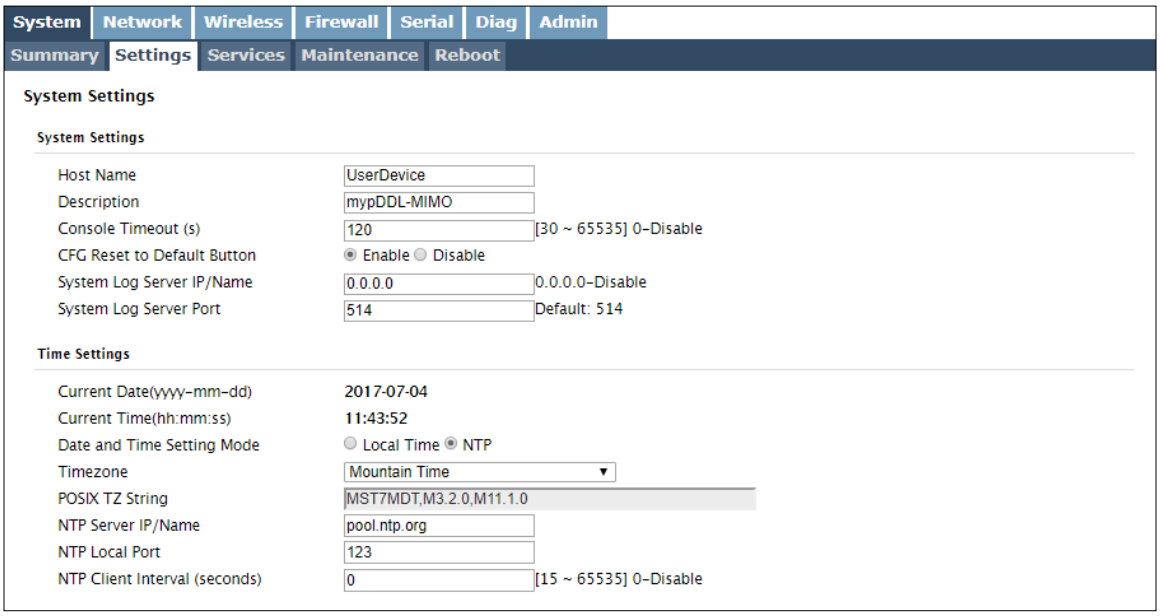


Image 4-1-2: System Settings > System Settings

Host Name

The Host Name is a convenient identifier for a specific pMDDL unit. This feature is most used when accessing units remotely: a convenient cross-reference for the unit's WAN IP address. This name appears when logged into a telnet session.

Values (characters)

pMDDL **(varies)**

up to 64 characters

Description

The description is a text field that can be used to describe the unit or system. This value can be viewed on the System > Summary screen.

Values (characters)

pMDDL **(varies)**

up to 64 characters

Console Timeout (s)

This value determines when a console connection (made via Console Port or Telnet) will timeout after becoming inactive.

Values (seconds)

60
0-65535

4.0 Configuration

CFG Reset to Default Button

Enabled by default, when the CFG button on the front of the pMDDL is held down for 10s while the unit is powered up, the unit will reset and all settings will be reset to factory defaults. When disabled the unit will reset, but the settings will not be overwritten.

Values (Selection)

Enable
Disable

System Log Server IP

The pMDDL can report system level events to a third party System Log server, which can be used to monitor events reported by the pMDDL.

IP Address

0.0.0.0

System Log Server Port

Enter the UDP listening port of the System Log Server. The default port number is generally 514, but could vary from Server to Server.

UDP Port

514

Time Settings

The pMDDL can be set to use a local time source, thus keeping time on its own, or it can be configured to synchronize the date and time via a NTP Server. The options and menus available will change depending on the current setting of the Date and Time Setting Mode, as seen below.

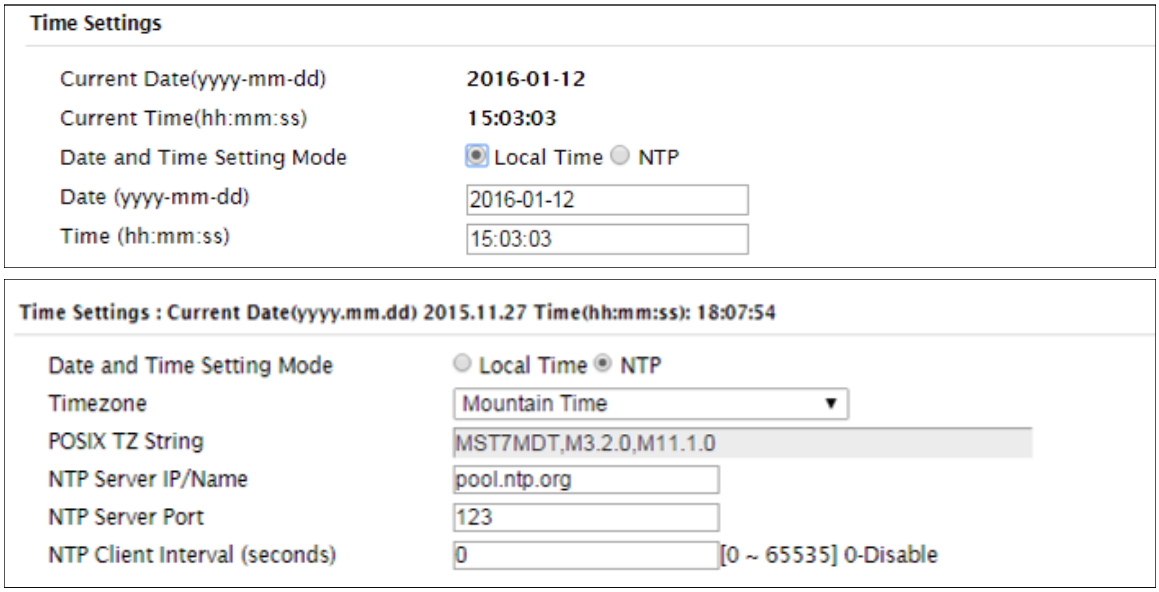


Image 4-1-3: System Settings > Time Settings

Network Time Protocol (NTP) can be used to synchronize the time and date or computer systems with a centralized, referenced server. This can help ensure all systems on a network have the same time and date.

Date and Time Setting Mode

Select the Date and Time Setting Mode required. If set for 'Local Time' the unit will keep its own time and not attempt to synchronize with a network server. If 'NTP' is selected, a NTP server can be defined.

Values (selection)

Local Time
NTP

4.0 Configuration

Date	
The calendar date may be entered in this field. Note that the entered value is lost should the pMDDL lose power for some reason.	**Values (yyyy-mm-dd)** **2016-01-12** *(varies)*

Time	
The time may be entered in this field. Note that the entered value is lost should the pMDDL lose power for some reason.	**Values (hh:mm:ss)** **11:27:28** *(varies)*

Timezone	
If connecting to a NTP time server, specify the time zone from the dropdown list.	**Values (selection)** *(varies)*

POSIX TZ String	
This displays the POSIX TZ String used by the unit as determined by the Timezone setting.	**Values (read only)** *(varies)*

NTP Server	
Enter the IP Address or domain name of the desired NTP time server.	**Values (address)** **pool.ntp.org**

NTP Port	
Enter the IP Address or domain name of the desired NTP time server.	**Values (port#)** **123**

NTP Client Interval	
By default the modem only synchronizes the time and date during system boot up (default: 0), but it can be modified to synchronize at a regular interval. *This process does consume data and should be set accordingly.*	**Values (seconds)** **0**

4.0 Configuration

4.1.3 System > Services

Certain services in the pMDDL can be disabled or enabled for either security considerations or resource/ power considerations. The Enable/Disable options are applied after a reboot and will take affect after each start up.

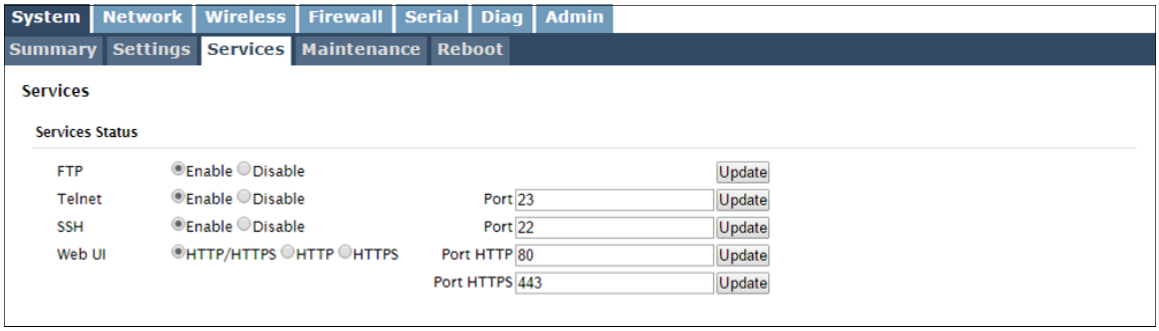


Image 4-1-4: System > Services

FTP

The FTP service can be enabled/disabled using the Services Status Menu. The FTP service is used for firmware recovery operations.

Values (port)

Enable / Disable

Telnet

Using the Telnet Service Enable/Disable function, you can disable the Telnet service from running on the pMDDL. The port used by the Telnet service can also be modified. The default is 23.

Values (port)

23

SSH

Using the SSH Service Enable/Disable function, you can disable the SSH service (Port 22) from running on the pMDDL. The port used by the SSH service can also be modified. The default is 22.

Values (port)

22

Web UI

The default web server port for the web based configuration tools used in the modem is port 80 (http) and port 443 (HTTPS).

Change as required, but keep in mind that if a non standard port is used, it must be specified in a internet browser to access the unit. (example: http://192.168.168.1:8080).

Values (selection)

HTTP/HTTPS
HTTP
HTTPS

4.0 Configuration

4.1.4 System > Maintenance

Firmware Upgrade

Occasional firmware updates may be released by Microhard Systems which may include fixes and/or new features. The firmware can be updated wirelessly using the WebUI.

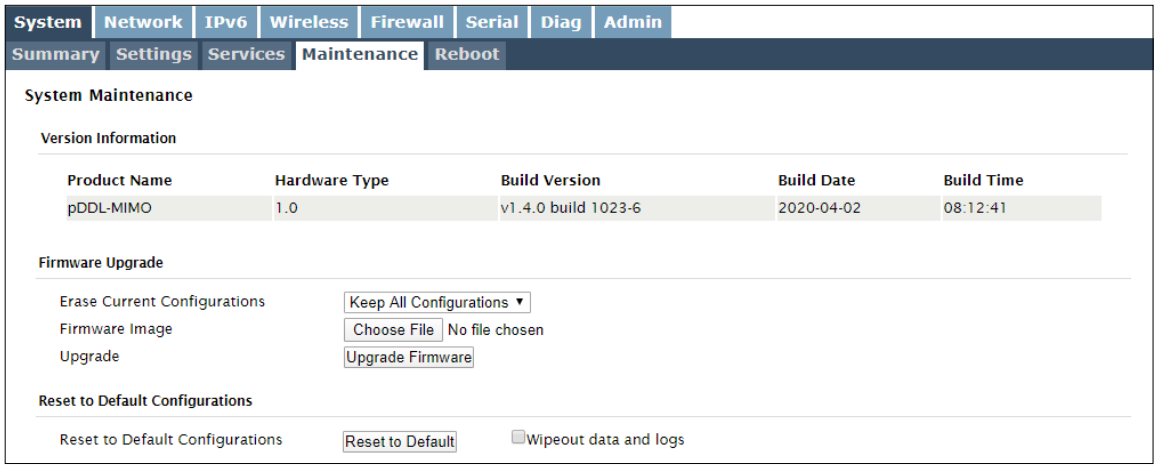


Image 4-1-5: Maintenance > Firmware Upgrade

Erase Current Configuration

Choose to keep or erase the current configuration. Erasing the configuration of the pMDDL unit during the upgrade process will upgrade, and return the unit to factory defaults, including the default IP Address and password.

Values (check box)

Keep ALL Configuration
Erase Configuration

Firmware Image

Use the Browse button to find the firmware file supplied by Microhard Systems. Select “Upgrade Firmware” to start the upgrade process. This can take several minutes.

Values (file)

(no default)

Reset to Default Configurations

The pMDDL may be set back to factory defaults by using the Reset to Default option under System > Maintenance > Reset to Default. ***Caution* - All configuration settings will be lost!!!**

Additionally you can select the “Wipeout data and logs” check box to delete all data including historical logs and any other data from the device. ***Caution* - All configuration settings & data/logs will be lost!!!**

4.0 Configuration

Security for Configurations / Backup & Restore Configuration

The configuration of the pMDDL can be backed up to a file at any time using the Backup Configuration feature. The file can the be restored using the Restore Configuration feature. It is always a good idea to backup any configurations in case of unit replacement.

The configuration files cannot be edited offline, they are used strictly to backup and restore units. A password can be added to the Backup and Restore files. If the password is lost, files that have been backed up with a password can not be restored.

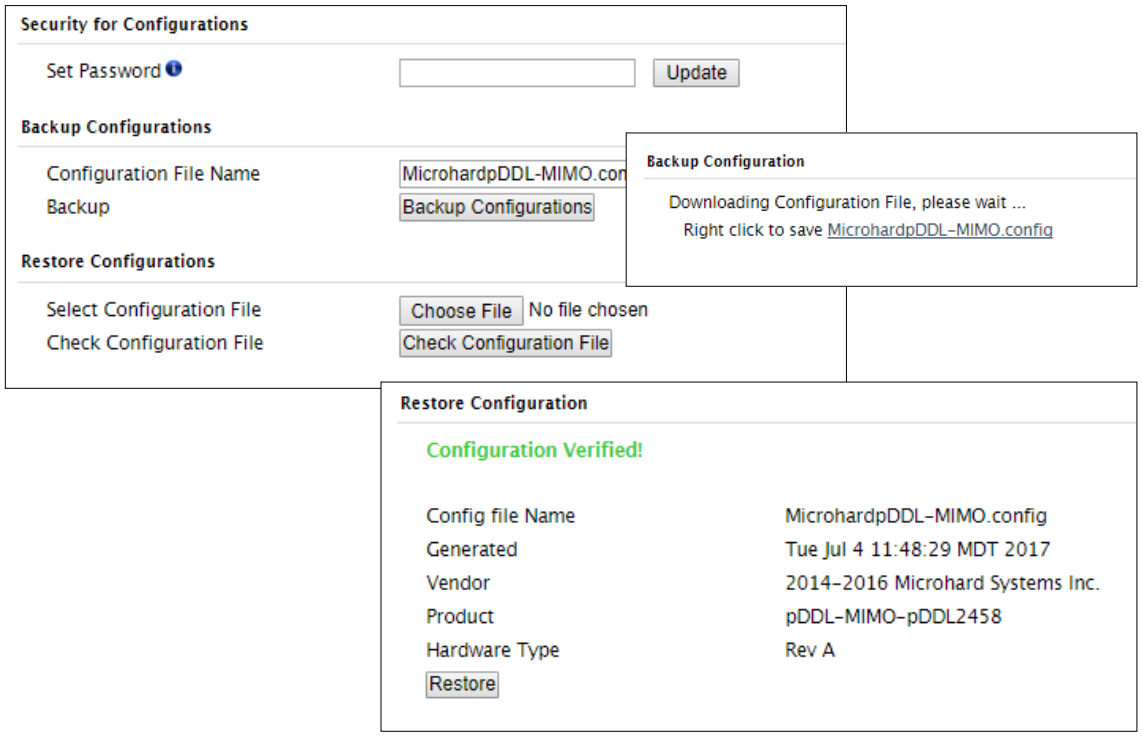


Image 4-1-6: Maintenance > Reset to Default / Backup & Restore Configuration

Configuration File Name / Backup

Use this field to name the configuration file. The .config extension will automatically be added to the configuration file.

Select Configuration file / Check Configuration File / Restore

Use the 'Browse' button to find the backup file that needs to be restored to the unit. Use the 'Check Restore File' button to verify that the file is valid, and then the option to restore the configuration is displayed, as seen above.

If the selected file is password protected the password must be set before restoring the file using the "Set Password" field under "Security for Configurations".

4.0 Configuration

4.1.5 System > Reboot

The pMDDL can be remotely rebooted using the System > Reboot menu. As seen below a button 'Reboot Now' is provided. Once pressed, the unit immediately reboots and starts its boot up procedure. An automatic Scheduled Reboot (up to 3) can also be configured to force the pMDDL to reboot daily, weekly or monthly.

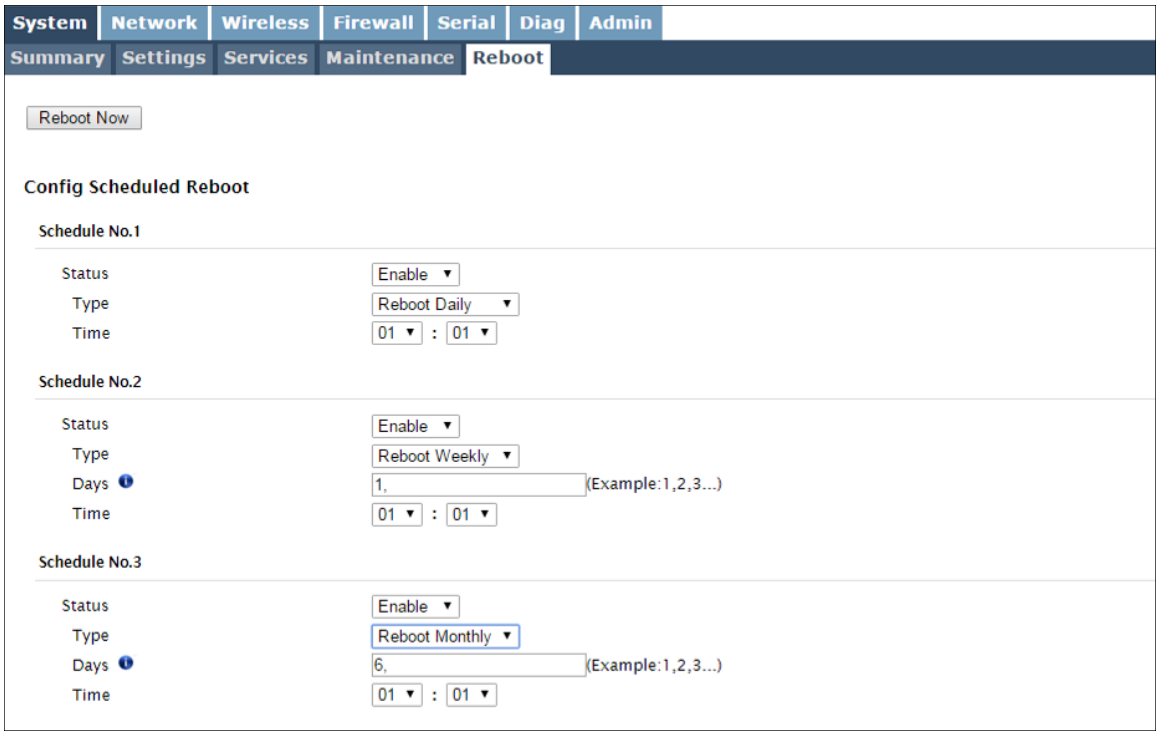


Image 4-1-7: System > Reboot

Status

Enable or disable the Scheduled Reboot.

Values (selection)

Enable / **Disable**

Type

Set the reboot schedule to reboot the modem once a day, week or month at a time and date specified below.

Values (selection)

Reboot Daily
Reboot Weekly
Reboot Monthly

Days / Time

When set to Weekly, set the day (1 is Sunday, 7 is Saturday) in which to reboot the modem. In a monthly configuration it is simply the date of the month (1 to 31). Once the day or date has been selected, specify the time (24hr clock) in which to initiate the scheduled reboot.

Values

(varies)

4.0 Configuration

4.2 Network

4.2.1 Network > Status

The Network Summary display gives a overview of the currently configured network interfaces including the Connection Type (Static/DHCP), IP Address, Net Mask, Default Gateway, DNS, and IPv4 Routing Table.

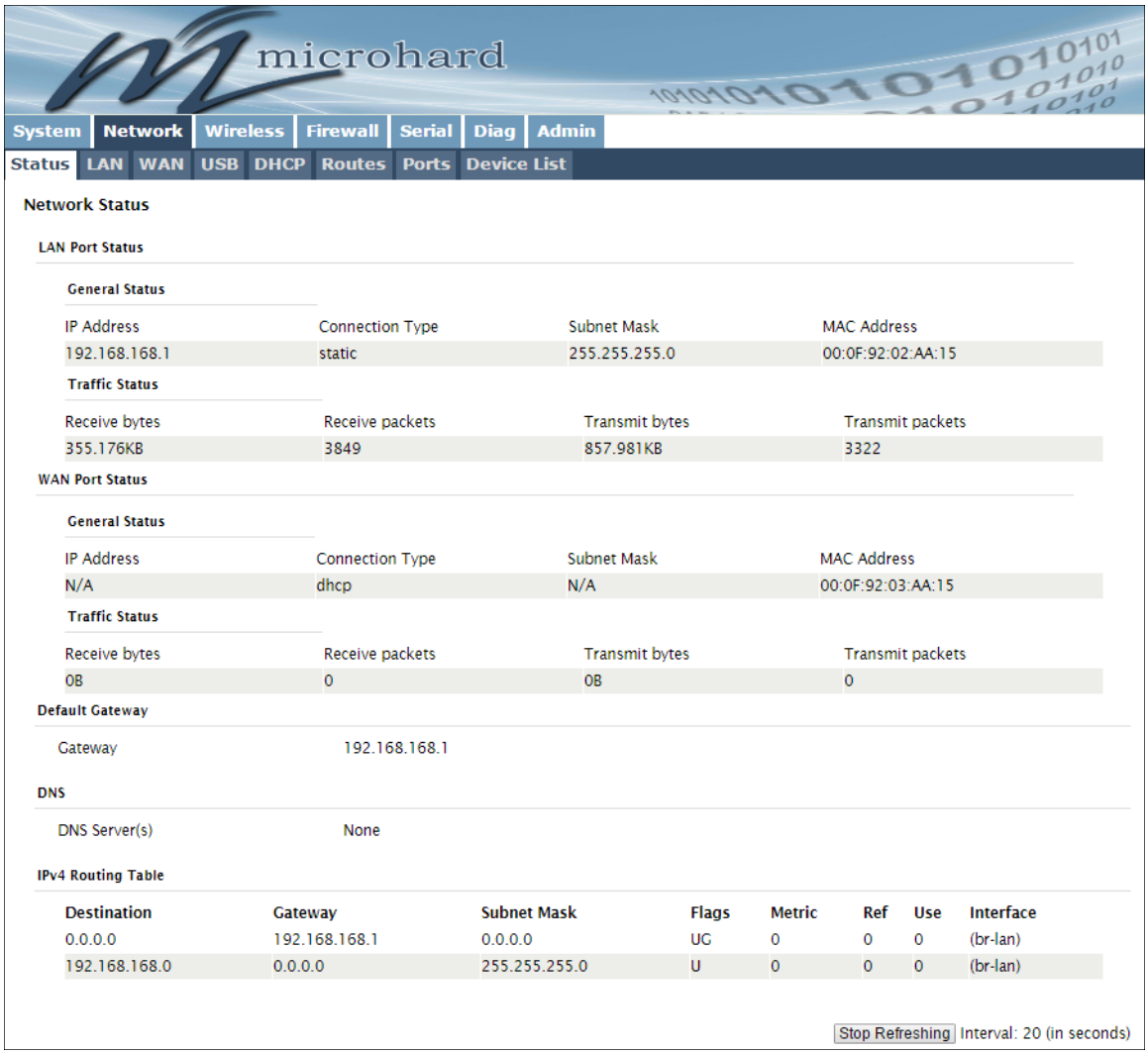


Image 4-2-1: Network > Network Status

4.0 Configuration

4.2.2 Network > LAN

LAN Port Configuration

The LAN Ethernet port(s) on the pMDDL are for connection of devices on a local network. By default, this port has a static IP Address. It also, by default is running a DHCP server to provide IP Addresses to devices that are connected to the physical LAN port (directly or via a switch).

Image 4-2-2: Network > Network LAN Configuration

LAN Add/Edit Interface

By selecting the Add or Edit buttons the LAN network interface can be configured, or additional LAN interfaces can be created.

DHCP: Dynamic Host Configuration Protocol may be used by networked devices (Clients) to obtain unique network addresses from a DHCP server.

Advantage:
Ensures unique IP addresses are assigned, from a central point (DHCP server) within a network.

Disadvantage:
The address of a particular device is not 'known' and is also subject to change.

STATIC addresses must be tracked (to avoid duplicate use), yet they may be permanently assigned to a device.

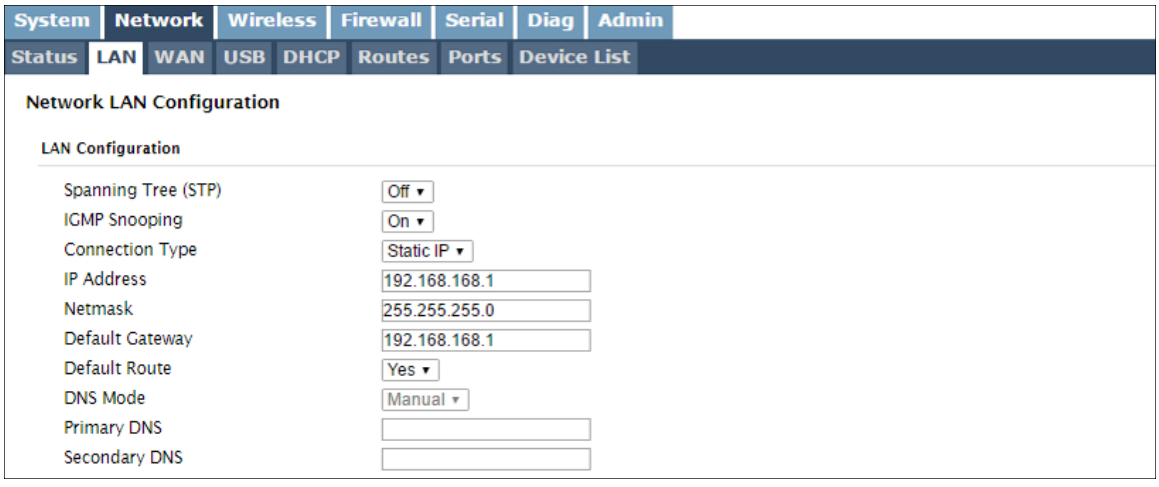


Image 4-2-3: Network > LAN Port Configuration

Within any IP network, each device must have its own unique IP address.

Spanning Tree (STP)

This option allows the pMDDL to participate in the Spanning Tree protocol with other devices to prevent local loops. By default this is disabled.

Values (selection)

Off
On

4.0 Configuration

The factory default network settings:

IP: 192.168.168.1
Subnet: 255.255.255.0
Gateway: 192.168.168.1

IGMP Snooping

Enable or disable IGMP snooping on the pMDDL. **IGMP snooping** is the process of listening to Internet Group Management Protocol traffic. This allows the pMDDL to listen in on the **IGMP** conversations between network devices. The pMDDL then maintains a map of which links need which IP multicast streams.

Values (selection)

On
Off

Connection Type

This selection determines if the pMDDL will obtain an IP address from a DHCP server on the attached network, or if a static IP address will be entered. If a Static IP Address is chosen, the fields that follow must also be populated.

Values (selection)

DHCP
Static

IP Address

If 'Static' Connection Type is selected, a valid IPv4 Address for the network being used must be entered in the field. If 'DHCP' is chosen this field will not appear and it will be populated automatically from the DHCP server.

Values (IP Address)

192.168.168.1

A SUBNET MASK is a bit mask that separates the network and host (device) portions of an IP address.

The 'unmasked' portion leaves available the information required to identify the various devices on the subnet.

Netmask

If 'Static' Connection Type is selected, the Network Mask must be entered for the Network. If 'DHCP' is chosen this field will not appear and it will be populated automatically from the DHCP server.

Values (IP Address)

255.255.255.0

Default Gateway

A GATEWAY is a point within a network that acts as an entrance to another network.

In typical networks, a router acts as a gateway.

If the pMDDL is integrated into a network which has a defined gateway, then, as with other hosts on the network, this gateway's IP address will be entered into this field. If there is a DHCP server on the network, and the Connection Type (see previous page) is selected to be DHCP, the DHCP server will populate this field with the appropriate gateway address.

Values (IP Address)

(no default)

A simple way of looking at what the gateway value should be is: If a device has a packet of data is does not know where to send, send it to the gateway. If necessary - and applicable - the gateway can forward the packet onwards to another network.

DNS

Set the DNS (Domain Name Server) for use by devices on the LAN port, if required.

Values (IP Address)

(no default)

Within any IP network, each device must have its own unique IP address.

4.0 Configuration

LAN DHCP

A pMDDL may be configured to provide dynamic host control protocol (DHCP) service to all attached (either wired or wireless devices. By default the DHCP service is enabled, so devices that are connected to the physical Ethernet LAN ports, as well as any devices that are connected by Wireless will be assigned an IP by the pMDDL. The LAN DHCP service is available for each interface, and is located in the add/edit interface menus.

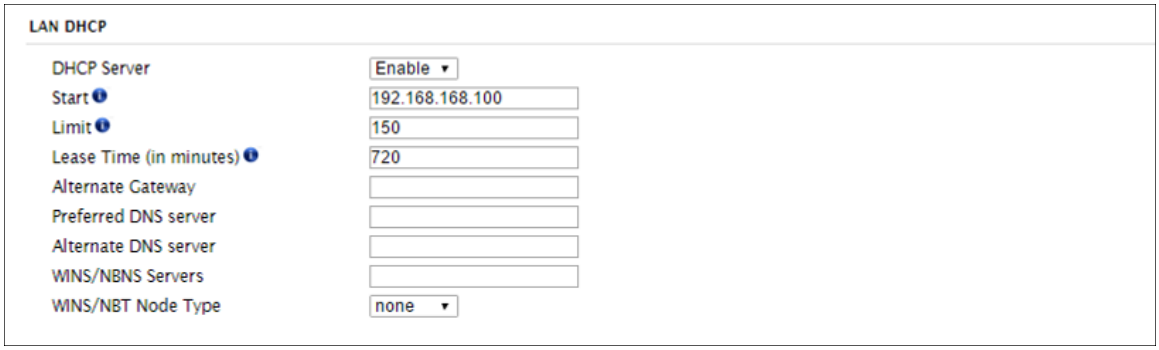


Image 4-2-4: Network > DHCP Server

DHCP Server

The option is used to enable or disable the DHCP service for devices connected to the LAN Port(s).

Values (selection)

Enable / Disable

Start

Select the starting address DHCP assignable IP Addresses. The first octets of the subnet will be pre-set based on the LAN IP configuration, and can not be changed.

Values (IP Address)

192.168.168.100

Prior to enabling this service, verify that there are no other devices - either wired (e.g. LAN) or wireless with an active DHCP SERVER service. (The Server issues IP address information at the request of a DHCP Client, which receives the information.)

Limit

Set the maximum number of IP addresses that can be assigned by the pMDDL.

Values (integer)

150

Lease Time

The DHCP lease time is the amount of time before a new request for a network address must be made to the DHCP Server.

Values (minutes)

720

Alternate Gateway

Specify an alternate gateway for DHCP assigned devices if the default gateway is not to be used.

Values (IP Address)

(IP Address)

4.0 Configuration

DNS: Domain Name Service is an Internet service that translates easily-remembered domain names into their not-so-easily-remembered IP addresses.

Being that the Internet is based on IP addresses, without DNS, if one entered the domain name www.microhardcorp.com (for example) into the URL line of a web browser, the website 'could not be found').

Preferred DNS Server

Specify a preferred DNS server address to be assigned to DHCP devices.

Values (IP Address)

(IP Address)

Alternate DNS Server

Specify the alternate DNS server address to be assigned to DHCP devices.

Values (IP Address)

(IP Address)

Domain Name

Enter the Domain Name for the DHCP devices.

Values (string)

(IP Address)

WINS/NBNS Servers

Enter the address of the WINS/NBNS (NetBIOS) Server. The WINS server will translate computers names into their IP addresses, similar to how a DNS server translates domain names to IP addresses.

Values (IP/Domain)

(no default)

WINS/NBT Node Type

Select the method used to resolve computer names to IP addresses. Four name resolution methods are available:
B-node: broadcast
P-node: point-to-point
M-node: mixed/modified
H-node: hybrid

Values (selection)

none
b-node
p-node
m-node
h-node

4.0 Configuration

4.2.3 Network > WAN

WAN Configuration

The WAN configuration refers to the wired WAN connection on the pMDDL. The WAN port can be used to connect the pMDDL to other networks, the internet and/or other network resources.

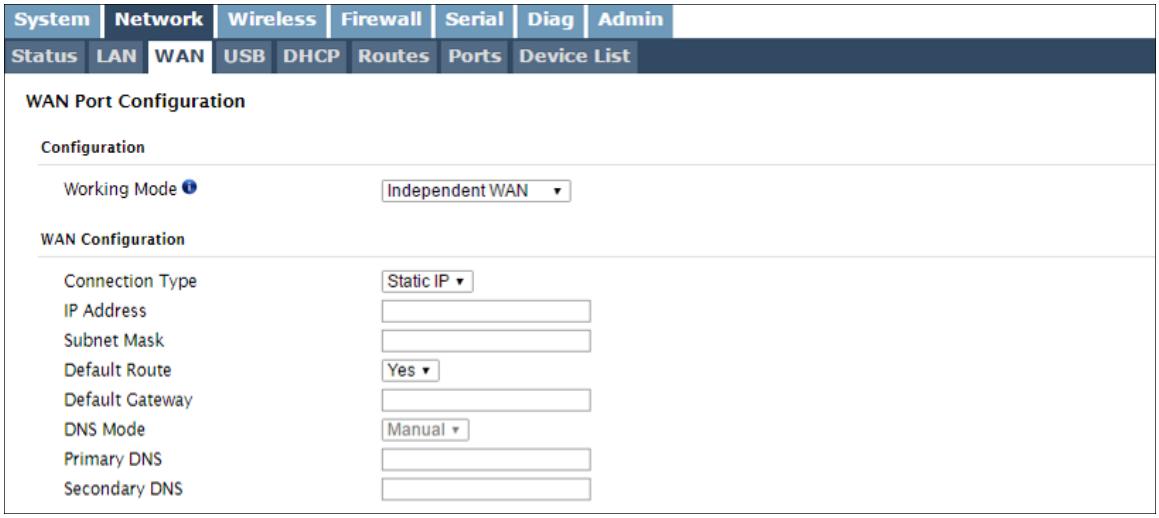


Image 4-2-6: Network > WAN Configuration

DHCP: Dynamic Host Configuration Protocol may be used by networked devices (Clients) to obtain unique network addresses from a DHCP server.

Advantage:
Ensures unique IP addresses are assigned, from a central point (DHCP server) within a network.

Disadvantage:
The address of a particular device is not 'known' and is also subject to change.

STATIC addresses must be tracked (to avoid duplicate use), yet they may be permanently assigned to a device.

Working Mode

Use this to set the function of the physical WAN port. If set to independent WAN , the physical WAN port will operate as a standard WAN port. Alternatively it can be configured to be bridged to the LAN, and operate as a second LAN port, or even as an independent LAN.

Values (selection)

Independent WAN
Bridged with LAN Port
Independent LAN

Connection Type

This selection determines if the pMDDL will obtain an WAN IP address from a DHCP server, or if a static IP address will be entered. If a Static IP Address is chosen, the fields that follow must also be populated.

Values (selection)

DHCP
Static

IP Address

If 'Static' Connection Type is selected, a valid IPv4 Address for the network being used must be entered in the field. If 'DHCP' is chosen this field will not appear and it will be populated automatically from the DHCP server.

Values (IP Address)

(no default)

Netmask

If 'Static' Connection Type is selected, the Network Mask must be entered for the Network. If 'DHCP' is chosen this field will not appear and it will be populated automatically from the DHCP server.

Values (IP Address)

(no default)

4.0 Configuration

Default Gateway

If the pMDDL is integrated into a network which has a defined gateway, then, as with other hosts on the network, this gateway's IP address will be entered into this field. If there is a DHCP server on the network, and the Connection Type (see previous page) is selected to be DHCP, the DHCP server will populate this field with the appropriate gateway address.

Values (IP Address)

(no default)

Default Route

The Default Route parameter allows you to set this interface as the default route in the routing table. This is result in all data being sent to the WAN interface if there the destination network is not directly connected (LAN, Wireless etc), and no other route has been specified. In cases where the WAN is the primary connection this would be set to **Yes.**

Values (selection)

No / Yes

DNS Servers

The following section will allow a user to specify DNS Server(s) to be used by the WAN interface of the pMDDL.

Mode

Select between Manual or Auto for DNS server(s) for the WAN interface. If set to Auto the pMDDL will try to automatically detect the DNS servers to use, which is normally the case when the WAN is DHCP. Manual required the DNS addresses to be known and entered below.

Values (selection)

Manual / **Auto**

Primary DNS

DNS (Domain Name Service) Servers are used to resolve domain names into IP addresses. If set to auto and the Connection Type is set for DHCP the DHCP server will populate this field and the value set can be viewed on the Network > Status page. To add additional static servers, enter them here.

Values (IP Address)

(no default)

Secondary DNS

DNS (Domain Name Service) Servers are used to resolve domain names into IP addresses. If set to auto and the Connection Type is set for DHCP the DHCP server will populate this field and the value set can be viewed on the Network > Status page. To add additional static servers, enter them here.

Values (IP Address)

(no default)

4.0 Configuration

4.2.4 Network > USB

USB Port Configuration

Normally, the pMDDL module is bootstrapped to USB host mode that allows select generic devices to be used to extend Ethernet and serial functions (USB to Ethernet Adapters, USB to Serial Converters).

Alternatively, the pMDDL can be set to Device mode by pulling PIN 14 (on OEM module) low through an 1k resistor to switch the USB mode. Older development boards will not support this and will either need to be modified or new boards will need to be acquired. In USB device mode, there are two functions supported, RNDIS/CDC Ethernet and CDC Serial port, when connected a host machine (PC etc).

RDNIS Ethernet and CDC Serial composite drivers are available from Microhard Systems.

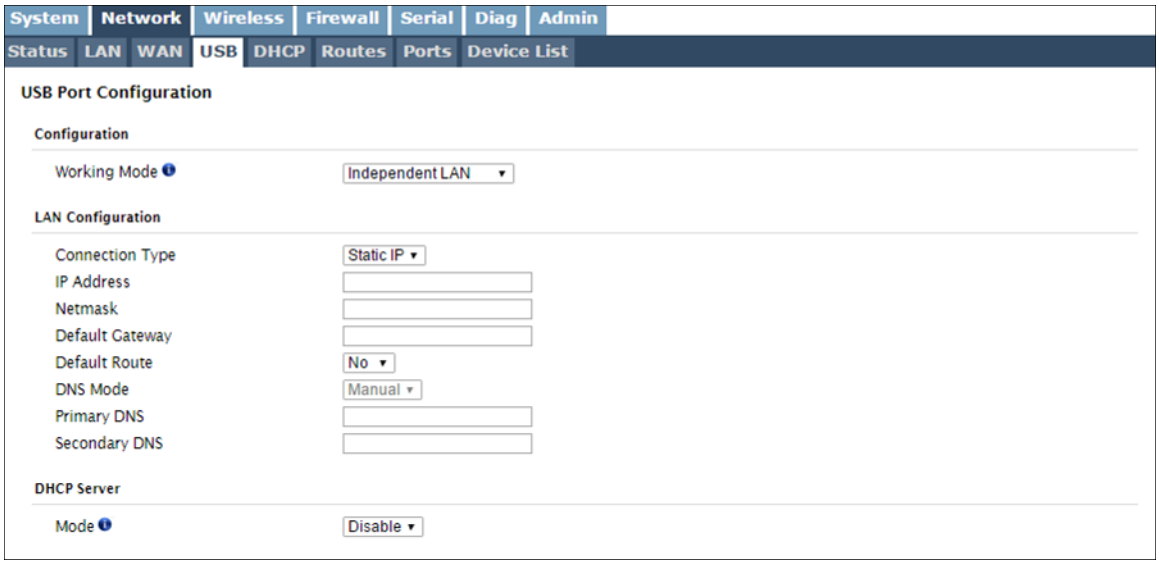


Image 4-2-7: Network > USB

Working Mode

The RNDIS Ethernet USB port can be configured to operate as an additional LEN Ethernet Port with the current LAN (Bridged) or it can be configured to operate as a independent LAN (Subnet).

Values (selection)

Independent LAN
Bridge with LAN Port

LAN Configuration

When bridged with LAN the network parameters are set from the Network > LAN menu. When set to Independent the port can be configured as Statis or DHCP. Again refere to the LAN configuration for help with the displayed fields and definitions.

DHCP Server

When in Independent mode the pMDDL can run a DHCP service on the USB port to assign IP addresses and lease information. Refer to Network > LAN > DHCP for help with parameters and definitions.

4.0 Configuration

4.2.5 Network > DHCP

Static IP Addresses (for DHCP Server)

In many applications it is required to know the IP address of connected devices in order to implement security and firewall rules as well as for Port Forwarding rules. The Static IP Address (for DHCP Server) features MAC binding to allow connected devices to automatically obtain a specific IP address.

For configuration of the LAN DHCP Service see Network > LAN > (Edit) > LAN DHCP.

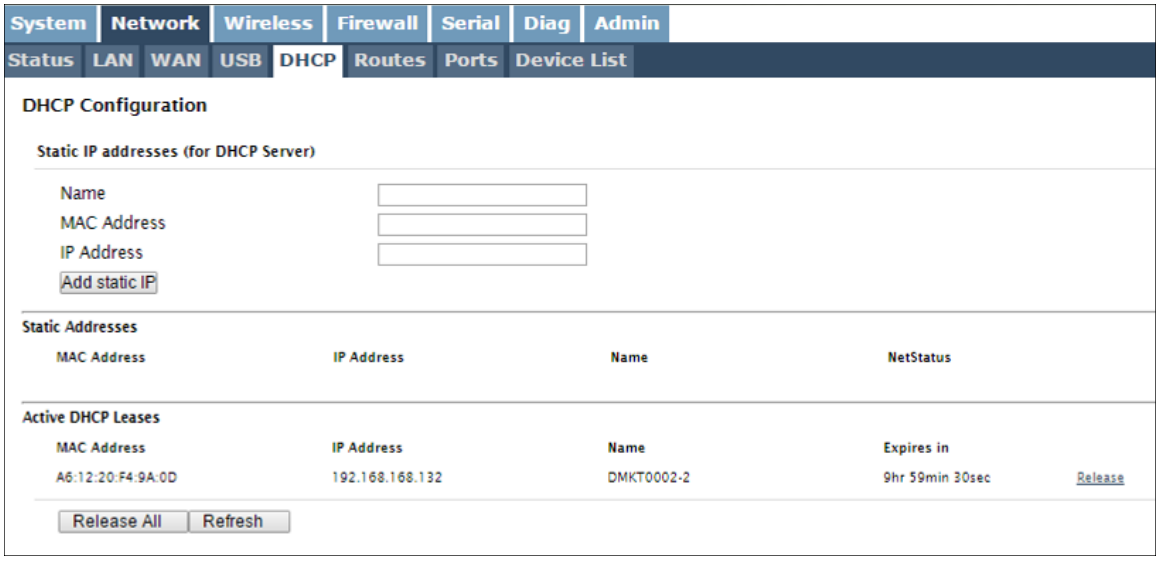


Image 4-2-8: Network > DHCP

Static Addresses

Displays the MAC Binding table that is configured in the pMDDL device.

Active DHCP Leases

Displays the active DHCP leases for any IP Addresses that have been assigned. This includes the IP address, the MAC, Device Name as well as the lease expiry.

4.0 Configuration

4.2.6 Network > Routes

Static Routes Configuration

It may be desirable to have devices on different subnets to be able to talk to one another. This can be accomplished by specifying a static route, telling the pMDDL where to send data.

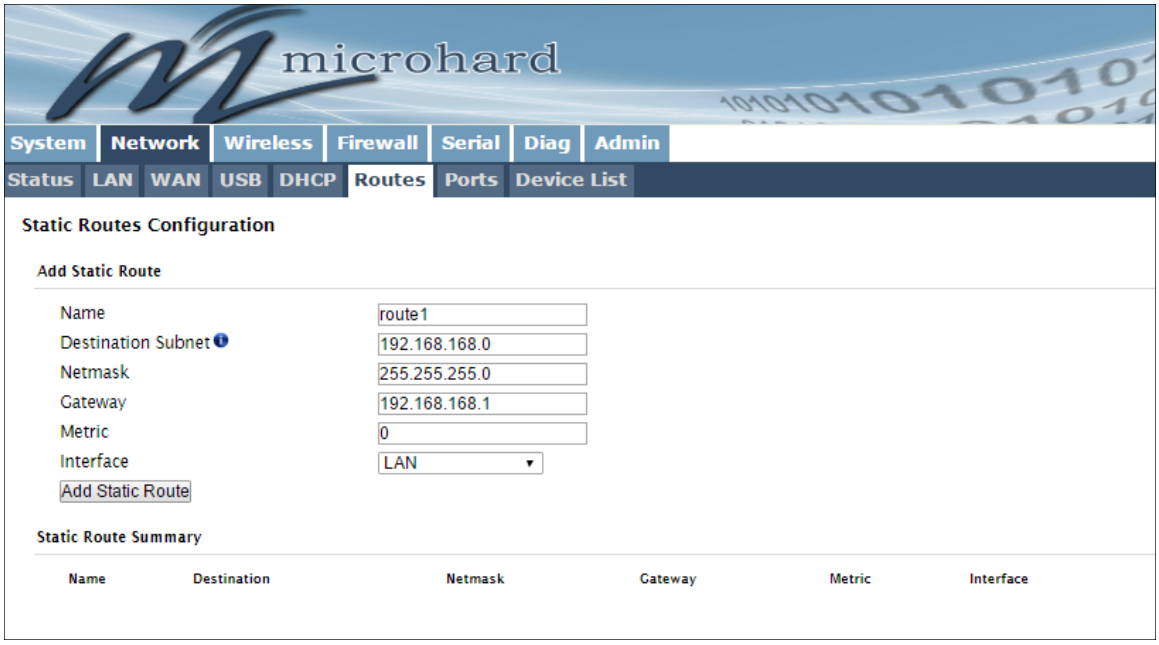


Image 4-2-9: Network > Routes

Name

Routes can be names for easy reference, or to describe the route being added.

Values (characters)

(no default)

Destination

Enter the network IP address for the destination.

Values (IP Address)

(192.168.168.0)

Gateway

Specify the Gateway used to reach the network specified above.

Values (IP Address)

192.168.168.1

Netmask

Enter the Netmask for the destination network.

Values (IP Address)

255.255.255.0

4.0 Configuration

Metric

In some cases there may be multiple routes to reach a destination. The Metric can be set to give certain routes priority, the lower the metric is, the better the route. The more hops it takes to get to a destination, the higher the metric.

Values (Integer)

0

Interface

Define the exit interface. Is the destination a device on the LAN, LAN1 (If physical WAN port is bridged as an independent LAN), or the WAN?

Values (Selection)

LAN / LAN1 / WAN / USB / None

4.0 Configuration

4.2.7 Network > Ports

The Network > Ports menu can be used to determine the characteristics of the physical Ethernet interfaces on the pMDDL. As seen below the Mode (Auto/Manual), Auto-Negotiation, Speed (10/100Mbit/s) and the Duplex (Full/Half) can all be configured on the pMDDL.

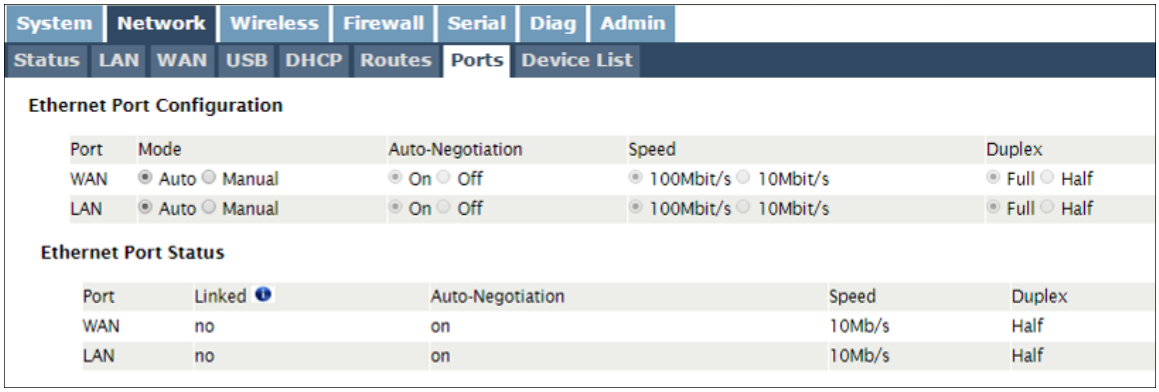


Image 4-2-10: Network > Ports

Mode

If set to Auto, the pMDDL will negotiate and determine the best connection speed and mode.

Values (selection)

Auto / Manual

Auto-Negotiation

Enable or disable auto-negotiation.

Values (selection)

On / Off

Speed

If the mode and auto negotiation are set you manual the connection speed can be specified.

Values (selection)

100Mbit/s / 10 Mbit/s

Duplex

Selection between full or half duplex for the direction of data.

Values (selection)

Full / Half

4.0 Configuration

4.2.8 Network > Device List

The Network > Device List shows the current ARP table for the local network adapter. The MAC address and IP address are shown, however not only DHCP assigned devices are listed in the device list, any devices, even those statically assigned, that are connected through the local network interface (s) are displayed, including those connected through a hub or switch.

Devices can also be filtered by the network that they are attached to. Devices with a MAC and no IP and vise versa can also be filtered.

Image 4-2-11: Network > Device List

4.0 Configuration

4.3 Wireless

4.3.1 Wireless > Status

The Status window gives a summary of all radio or wireless related settings and connections.

The **General Status** section shows the MAC address of the current radio, the Operating Mode (Master, Slave etc), the Network ID being used, the Compatibility Mode, Channel Bandwidth and frequency information and the type of security used.

Traffic Status shows statistics about the transmitted and received data.

The pMDDL shows information about all Wireless connections in the **Connection Info** section. The MAC address, TX & RX Modulation, Signal to Noise ratio (SNR), Signal Strength (RSSI), and a graphical representation of the signal level or quality, as well as a RSSI Graph Link.

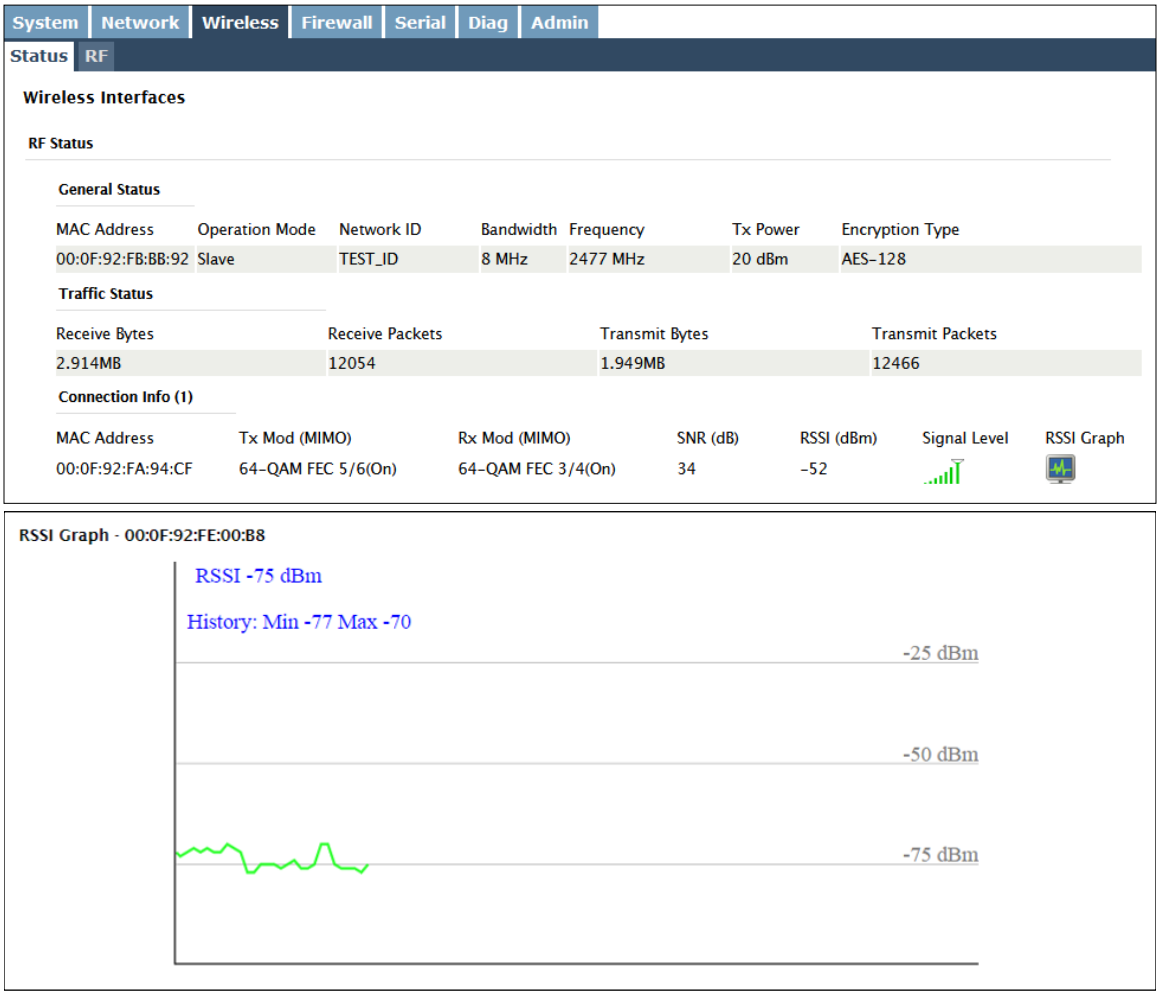


Image 4-3-1: Wireless > Status (RSSI Graph Shown Below)

4.0 Configuration

4.3.2 Wireless > RF

RF Configuration

The RF Configuration allows for the configuration of the radio module. You can turn the radio on or off, adjust the TX power, select the channel bandwidth and frequency, as well as the operating mode of the radio as seen below.

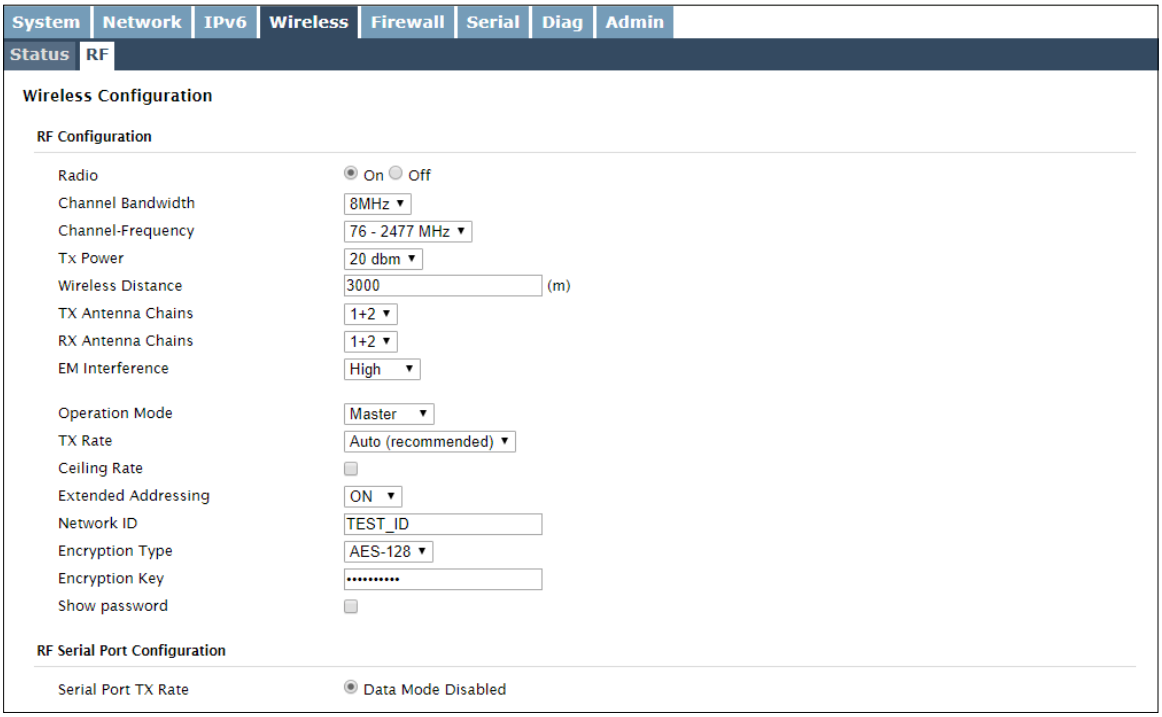


Image 4-3-2: Wireless > RF Configuration

Radio

This option is used to turn the radio module on or off. If turned off Wireless connections can not be made. The default is On.

Values (selection)

On / Off

Channel Bandwidth

Select the channel bandwidth from the list. Refer to the specifications to see the relationship and performance between channel bandwidth, throughput and sensitivity.

Generally a larger channel has greater throughput, at the cost of sensitivity, while a smaller channel tends to be more robust, but at the cost of throughput.

Values (selection)

8 / 4 MHz

4.0 Configuration

Refer to FCC (or as otherwise applicable) regulations to ascertain, and not operate beyond, the maximum allowable transmitter output power and effective isotropic radiated power (EIRP).

The TX power, Channel-Bandwidth and TX Rate can all be changed on-the-fly using AT commands.

See AT Command Section for details.

Channel-Frequency

Set the Channel-Frequency. This must be the same on each unit in a network. The frequency shown is the center frequency and is available in 1 MHz increments, values shown will vary with the Channel Bandwidth selected above.

The noise floor of the specified channel will dramatically affect the quality of the link, it is essential to select the cleanest channel for superior performance.

Values (MHz)

pMDDL2350: 2304 - 2390 MHz
pMDDL2450: 2405 - 2479 MHz
pMDDL2550: 2500 - 2570 MHz

TX Power

This setting establishes the transmit power level which will be presented to the antenna connector(s) of the pMDDL.

Unless required, the Tx Power should be set not for maximum, but rather for the minimum value required to maintain an adequate system fade margin.

TX Power reflects the Total RF power for the pMDDL. In MIMO mode this means that the total RF power is split between antenna interfaces. When MIMO is disabled a total of 30 dBM can be presented to the ANT 1 Antenna.

Values (selection)

20 dBm	25 dBm
21 dBm	26 dBm
22 dBm	27 dBm
23 dBm	28 dBm
24 dBm	29 dBm
	30 dBm

Wireless Distance

The Wireless Distance parameter allows a user to set the expected distance the wireless signal needs to travel. The pMDDL sets various internal timeouts to account for this travel time. Longer distances will require a higher setting, and shorter distances may perform better if the setting is reduced.

Values (meters)

3000

TX Antenna Chains / RX Antenna Chains

The pMDDL can be configured to operate in MIMO Mode (TX and RX chains both use ANT1 + ANT2), In this mode the total TX Power is split between the ANT1 & ANT1 antennas (max 27dBm) and both antennas are used to receive. This provides multipath immunity and generally equals the most robust signal quality.

You can also disable the MIMO functionality and TX on only ANT1, which allows the full TX to be used (Max 30dBm). The RX can then be set to operate on only ANT1 or on both ANT1 & ANT2 (RX Diversity). This may mean greater distances can be achieved, at the cost of the signal not being as robust.

Valid Combinations:

TX Chains	RX Chains
1 + 2	1 + 2
1	1 + 2
1	1

Values (selection)

1 + 2
1

EM Interference

The EM Interference parameter is used to control the maximum transmission length in order to mitigate surrounding EM interference (EMI). "High" is for high EMI scenario, under which every transmission is shorter. "Normal" is for maximizing the throughput when EMI is not very high.

Values (selection)

Normal / High

4.0 Configuration

Operation Mode	Values (selection)
Master - A Master may provide a wireless data connection to many slaves/remotes.	Master
Slave/Remote - A Salve may sustain one wireless connection, i.e. to an Master.	**Slave**
Repeater - A Repeater may provide a wireless connection to a Master/Repeater and many remotes.	Repeater
Mesh - In a Mesh network, all units need to be configured as a Mesh node . In this mode data will find a path along the Mesh node until it reaches its destination. This is ideal for ensuring data reaches its intended destination, and for providing redundancy, but comes at the cost of overall throughput	Mesh

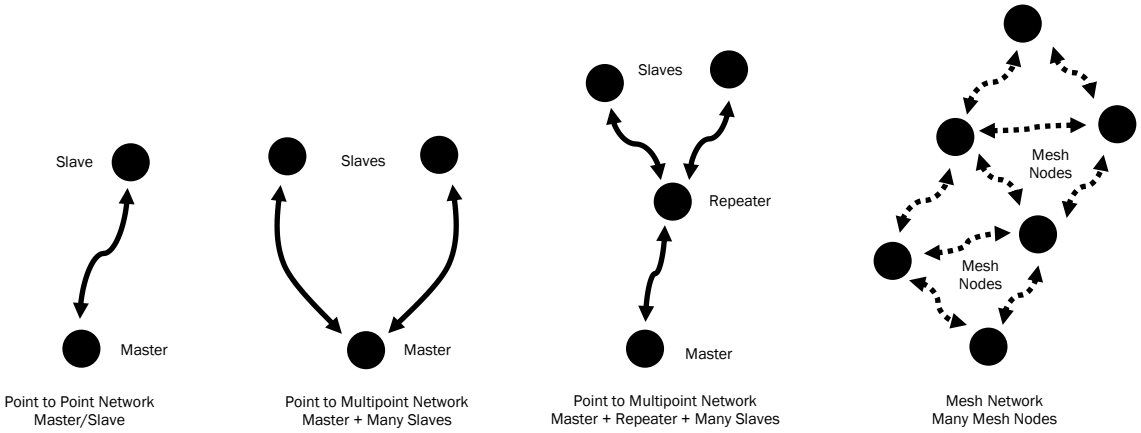


Diagram 4-3-1: Operating Modes

For video applications it is required to connect the video source (camera) to the radio designated as the Master. Video receivers would then be connected to the Slave radios, this would allow for multiple viewing stations. See the diagram below for an example.

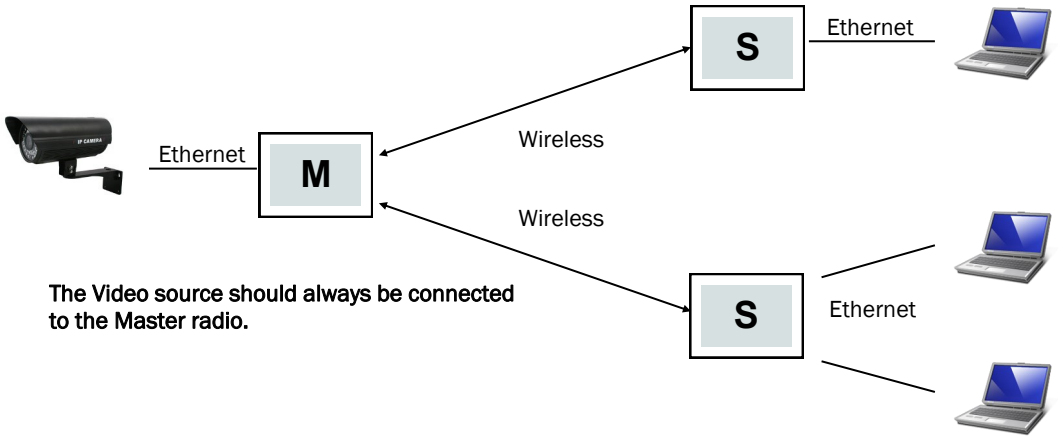


Diagram 4-3-2: Video Application

4.0 Configuration

Notes on Mesh Mode:

Wireless Mesh Networks (WMN) can act as a scalable backbone by connecting separate mesh points and even by connecting a WMN to a wired network. It is flexible, self-forming and self-healing. Microhard mesh networks provide either a open mesh mode and secure mesh mode. In secure mesh mode, the data traffic is encrypted by AES128 and can prevent unwanted mesh points from joining the mesh network.

Microhard mesh protocols provide a optimized path selection algorithm, and maintain path stability and keep a high performance of throughput and low latency. To set up a pMDDL station to Mesh mode, in the menu Wireless--->RF---> "Operation Mode", drop down and choose "Mesh" mode. In the same page, you need to set up a common "Mesh ID" to all joining mesh points.

For a secure mesh network, enable "Encryption Type" and select "AES-128". When all pMDDL stations are configured as mesh nodes properly, they will form a Wireless Mesh Network automatically by the path selection protocol. In the Wireless--->Status page, you can view all the mesh peers connected with this pMDDL station.

We also have another parameter that controls the stability of the mesh path, the Degree of Mesh Path Agility. When mesh nodes self-discover other nodes and form a mesh path, a path table is established in each node. In real world applications, as the environment changes, a "better" mesh path maybe generated dynamically.

This change to the path tables comes at a cost, for example, to re-establish a new path, the link may momentarily break. On one hand, the nodes try to keep the original path to keep the link more stable. On the other hand, the nodes need to refresh their tables to reflect new and changing environments. Overall, this parameter controls how sensitive the nodes refresh their mesh path tables. The recommended setting is "Medium".

Application notes : Due to the nature of mesh networks, in multiple hop situations, the throughput will reduce and the latency will increase. Mesh network are particularly not suitable for multicast/broadcast applications. In some dynamic scenario (constantly changing), path switching may take some time to happen and may result in packet loss during switching.

TX Rate

This setting determines the modulation type and in turn the rate at which the data is to be wirelessly transferred. **The default and recommended setting is 'Auto'.** When in 'Auto' the unit will transfer data at the highest possible rate in consideration of the receive signal strength (RSSI).

Refer to Section 1.3 Performance Specifications for a table breakdown of performance at selected rates. If setting a fixed TX Rate It is recommended to retain a fade margin of at least 10 dBm for optimum performance. For example, for a link (8MHz channel) with a signal strength of at least –75dBm, a TX rate of 16-QAM 3/4 FEC is recommended. Setting to the highest rate with a poor link may result in reduced performance.

Values (selection)

Auto (recommended)
64-QAM 5/6 FEC
64-QAM 3/4 FEC
64-QAM 2/3 FEC
16-QAM 3/4 FEC
16-QAM 1/2 FEC
QPSK FEC 3/4
QPSK FEC 1/2
BPSK FEC 1/2

Ceiling Rate

The Ceiling Rate parameter is visible when the TX Rate is set to AUTO. The Ceiling rate limits the maximum Tx rate of the link. In the environments where EM reflection is rich, the largely varied magnitude of signal strength often causes negotiated Tx rates to be a bit higher than it should be. To avoid this, putting a maximum rate limit results in better performance .

Values (selection)

64-QAM 5/6 FEC
64-QAM 3/4 FEC
64-QAM 2/3 FEC
16-QAM 3/4 FEC
16-QAM 1/2 FEC
QPSK FEC 3/4
QPSK FEC 1/2
BPSK FEC 1/2

4.0 Configuration

Change the default value for the Network ID to something unique for your network. Do this for an added measure of security and to differentiate your network from others which may be operating nearby.

Extended Addressing

Enable or disable extended addressing.

For multicast traffic sending from the Master to multiple receivers, it is recommended to configure the system with "Extended Addressing" disabled and also select a proper multicast rate defined by the link budget. In this case, the multicast traffic will be delivered on the specified RF rate to multiple receivers without adding extra overhead to the RF link. Devices on the Slaves side just need to subscribe the multicast address being used by the transmitting device connected on the Master side.

Values (selection)

On / Off

Network ID / Mesh ID

Each network of pMDDL modules must an a unique Network ID. This Network ID must be set in each unit on the network.

When configured to operate as a Mesh Network, this becomes the Mesh ID and must be specified on every unit to participate.

Values

pMDDL

Degree of Mesh Path Agility

That parameter controls the stability of the mesh path.

When mesh nodes self-discover other nodes and form a mesh path, a path table is established in each node. In real world applications, as the environment changes, a "better" mesh path maybe generated dynamically.

This change to the path tables comes at a cost, for example, to re-establish a new path, the link may momentarily break. On one hand, the nodes try to keep the original path to keep the link more stable. On the other hand, the nodes need to refresh their tables to reflect new and changing environments. Overall, this parameter controls how sensitive the nodes refresh their mesh path tables.

The recommended setting is "Medium".

Values

High
Medium
Low

Encryption Type

The encryption types defines the type of security used for the Wireless Interface, to join a network a device must know the correct Encryption Key. Security options are dependent on the version type. Export versions may not have all optional available to meet regulatory requirements set government policies.

Values (selection)

Disabled
AES-128

Encryption Key

This is the password, or preshared key that is required by any device to connect to the wireless interface of the pMDDL. It is **strongly recommended** to always have a password defined, and changed from the factory default.

Values (string)

1234567890

4.0 Configuration

Show Password	
Check this box to show the currently configured password for the encryption passphrase.	**Values (selection)** **unchecked**

Comport Tx Rate	
When using Ethernet and Serial data. If the volume of serial data is high, leave at the default (Normal Rate), if the volume of Ethernet data is high set com data to High Rate (Compressed).	**Values (selection)** **Normal** / High

4.0 Configuration

4.4 Firewall

4.4.1 Firewall > Summary

The Firewall Summary allows a user to see detailed information about how the firewall is operating. The All, Filter, Nat, Raw, and Mangle options can be used to view different aspects of the firewall.

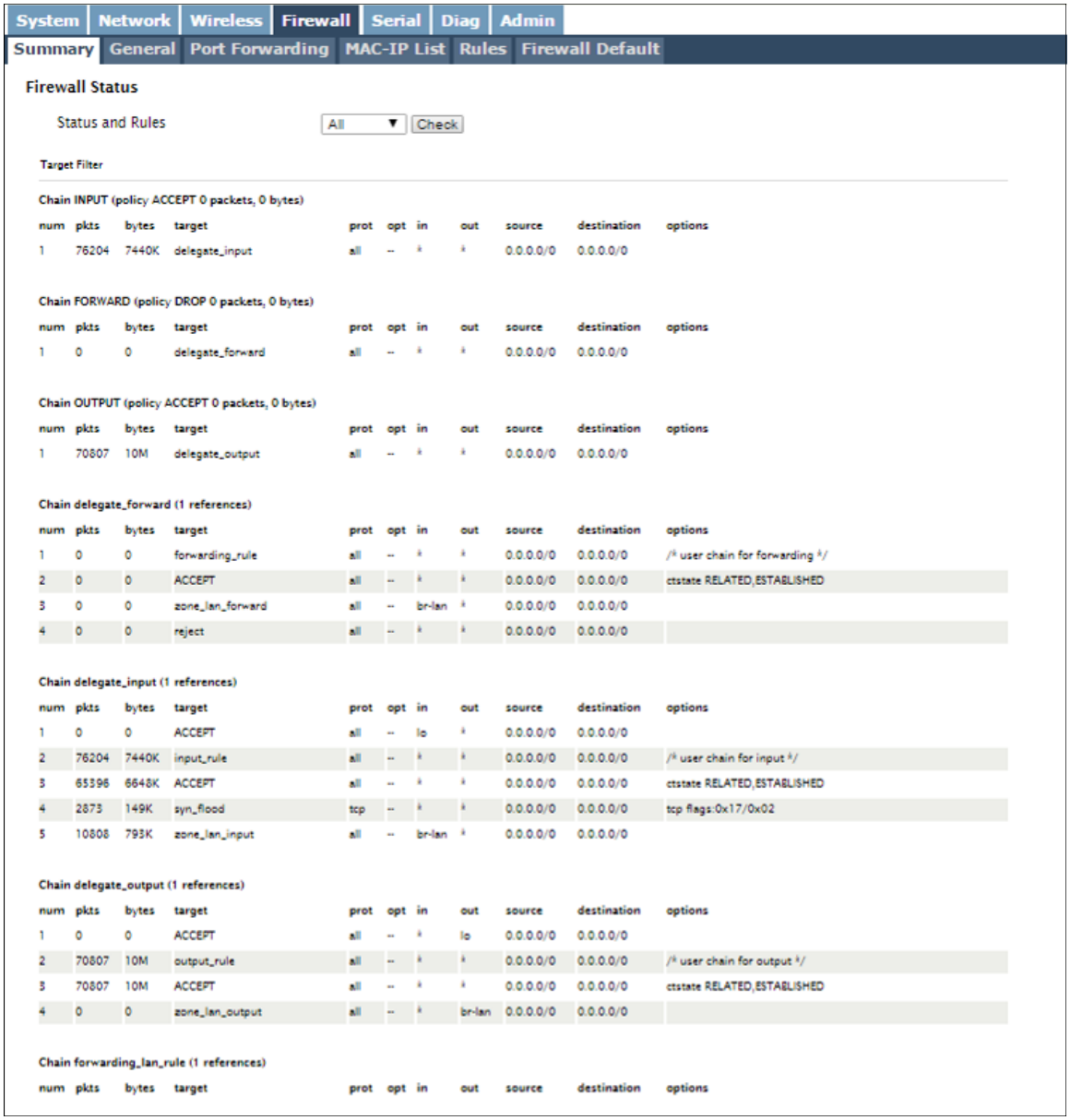


Image 4-4-1: Firewall > Status

4.0 Configuration

4.4.2 Firewall > General

The General Firewall settings allow users to enable or disable the firewall, and to decide which areas of the modem to protect. The Firewall can also be reset to factory defaults from this area of the WebUI.

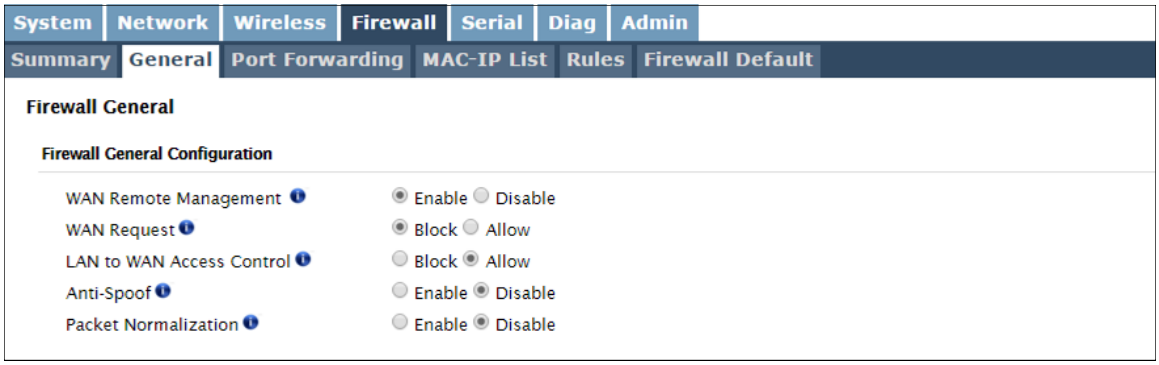


Image 4-4-2: Firewall > General

WAN Remote Management

Allow remote management of the pMDDL on the WAN side using the WebUI on port 80(HTTP), and 443 (HTTPS). If disabled, the configuration can only be accessed from the LAN.

Values

Enable / Disable

WAN Request

When Blocked the pMDDL will block all requests from devices on the WAN unless specified otherwise in the Access Rules, MAC List, IP List configurations. Access to ports 80 (HTTP) and 443 (HTTPS-if enabled), is still available unless disabled in the **WAN Remote Management** option.

Values

Block / Allow

LAN to WAN Access Control

Allows or Blocks traffic from the LAN accessing the WAN unless specified otherwise using the Access Rules, MAC, and IP List configuration.

Values

Block / **Allow**

Anti-Spoof

The Anti-Spoof protection is to create some firewall rules assigned to the external interface (WAN) of the firewall that examines the source address of all packets crossing that interface coming from outside. If the address belongs to the internal network or the firewall itself, the packet is dropped.

Values

Enable / **Disable**

Packet Normalization

Packet Normalization is the normalization of packets so there are no ambiguities in interpretation by the ultimate destination of the packet. The scrub directive also reassembled fragmented packets, protecting some operating systems from some forms of attack, and drops TCP packets that have invalid flag combinations.

Values

Enable / **Disable**

4.0 Configuration

4.4.3 Firewall > Port Forwarding

The pMDDL can be used to provide remote access to connected devices. To access these devices a user must define how incoming traffic is handled by the pMDDL. If all incoming traffic is intended for a specific connected device, DMZ could be used to simplify the process, as all incoming traffic can be directed towards a specific IP address.

In the case where there is multiple devices, or only specific ports need to be passed, Port forwarding is used to forward traffic coming in from the WAN to specific IP Addresses and Ports on the LAN. Port forwarding can be used in combination with other firewall features, but the Firewall must be enabled for Port forwarding to be in effect. If the WAN Request is blocked on the General Tab, additional rules and/or IP Lists must be set up to allow the port forwarding traffic to pass through the firewall.

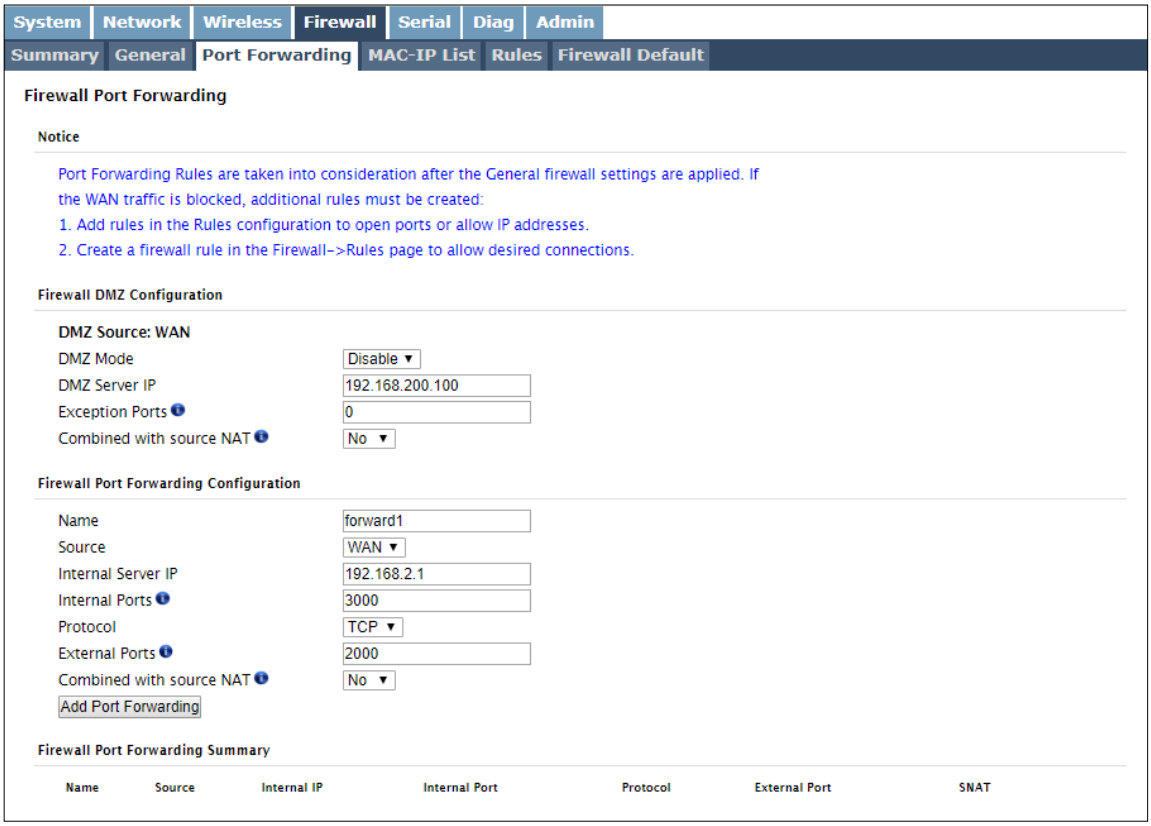


Image 4-4-3: Firewall > Port Forwarding

If DMZ is enabled and an exception port for the WebUI is not specified, remote management will not be possible. The default port for remote management is TCP 80.

DMZ Mode

Enable or disable DMZ Mode. DMZ can be used to forward all traffic to the DMZ Server IP listed below.

Values (selection)

Disable / Enable

DMZ Server IP

Enter the IP address of the device on the LAN side of the pMDDL where all the traffic will be forwarded to.

Values (IP Address)

192.168.100.100

4.0 Configuration

Exception Port	
Enter a exception port number that will NOT be forwarded to the DMZ server IP. Usually a configuration or remote management port that is excluded to retain external control of the pMDDL. *Up to 15 ports can be specified using list (port1, port2, etc) or by port range (start: stop)*	**Values (Port #)** **0**

If the firewall is set to block incoming traffic on the WAN interface, additional rules or IP/MAC lists must be configured to allow desired traffic access.

Firewall Port Forwarding Configuration

Name	
This is simply a field where a convenient reference or description is added to the rule. Each Forward must have a unique rule name and can use up to 10 characters.	**Values (10 chars)** **Forward**

Source	
Select the source for the traffic, if applicable.	**Values (selection)** *(none)*

Internal Server IP	
Enter the IP address of the intended internal (i.e. on LAN side of the pMDDL) server. This is the IP address of the device you are forwarding traffic to.	**Values (IP Address)** **192.168.2.1**

Internal Port	
Target port number of the internal server on the LAN IP entered above. *Single port or port ranged can be specified (start: stop)*	**Values (Port #)** **3000**

Protocol	
Select the type of transport protocol used. For example Telnet uses TCP, SNMP uses UDP, etc.	**Values (selection)** **TCP** / UDP / Both

External Port	
Port number of the incoming request (from WAN-side). *Single port or port ranged can be specified (start: stop)*	**Values (Port #)** **2000**

4.0 Configuration

4.4.4 Firewall > MAC-IP List

MAC List configuration can be used to control which physical LAN devices can access the ports on the pMDDL, by restricting or allowing connections based on the MAC address. IP List configuration can be used to define who or what can access the pMDDL, by restricting or allowing connections based on the IP Address/Subnet.

MAC-IP List can be used alone or in combination with LAN to WAN Access Control to provide secure access to the physical ports of the pMDDL.

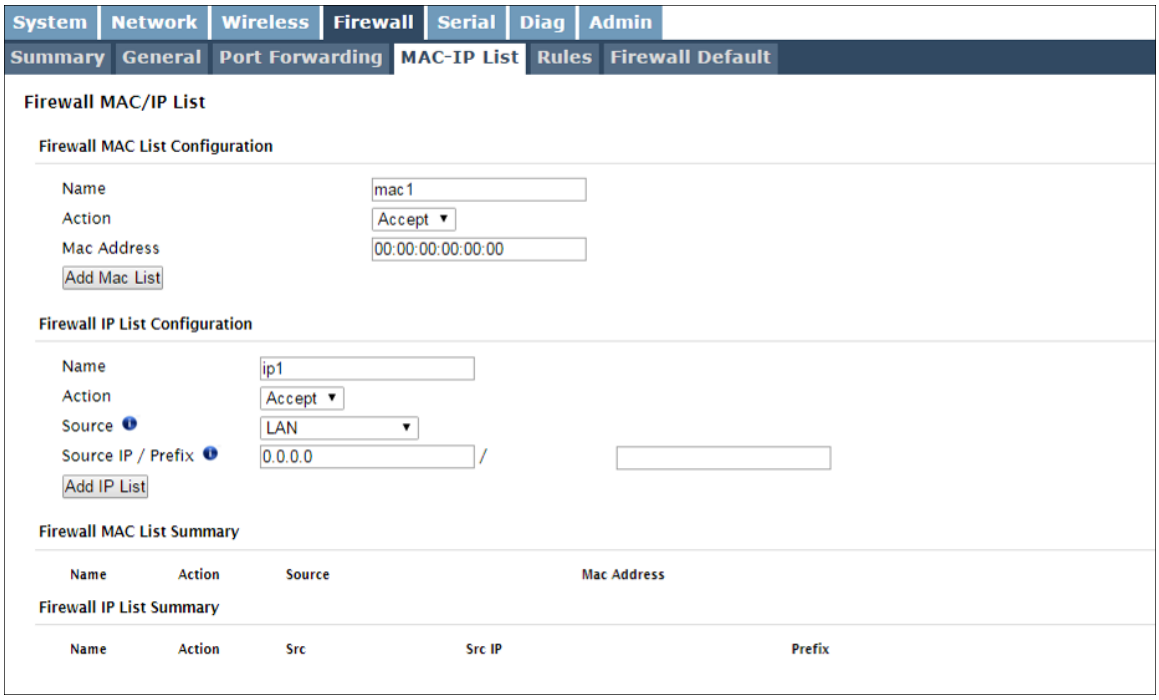


Image 4-4-4: Firewall > MAC-IP List

Firewall MAC List Configuration

Rule Name

The Rule Name field is required to give the rule a convenient name for reference. Each rule must have a unique name, up to 10 characters in length.

Values (10 chars)

MAC_List

MAC Address

Specify the MAC Address to be added to the list. Must be entered in the correct format as seen above. Not case sensitive.

Values (MAC Address)

00:00:00:00:00:00

4.0 Configuration

Firewall MAC List Configuration (Continued)

Action	
The Action is used to define how the rule handles the connection request. ACCEPT will allow a connection, while REJECT (error) and DROP (quietly dropped), will refuse connections.	**Values (selection)** **ACCEPT** DROP REJECT

Firewall IP List Configuration

Rule Name	
The Rule Name field is required to give the rule a convenient name for reference. Each rule must have a unique name, up to 10 characters in length.	**Values (10 chars)** **IP_List**

Action	
The Action is used to define how the rule handles the connection request. ACCEPT will allow a connection, while REJECT (error) and DROP (quietly dropped), will refuse connections.	**Values (selection)** **ACCEPT /** DROP / REJECT

Source	
Enter the specific zone that the IP List will apply to, LAN, WAN or None (both).	**Values (Selection)** LAN/LAN1/WAN/USB **NONE**

Source IP Address	
Match incoming traffic from the specified source IP range. Boxes accept single IP Addresses without network masks, example: 192.168.1.0 to 192.168.1.255 represents all IP Addresses in the 192.168.1.0/24 network. (Put same IP in both boxes for a single IP match.)	**Values (IP Address)** **192.168.0.0**

Destination Address	
Match incoming traffic from the specified destination IP range. Boxes accept single IP Addresses without network masks, example: 192.168.1.0 to 192.168.1.255 represents all IP Addresses in the 192.168.1.0/24 network. (Put same IP in both boxes for a single IP match.)	**Values (IP Address)** **192.168.0.0**

4.0 Configuration

4.4.5 Firewall > Rules

The Rules configuration can be used to define specific rules on how local and remote devices access different ports and services. MAC List and IP List are used for general access, and are applied before rules are processed.

It is highly recommended to block as much traffic as possible from the modem, especially when using a public IP address. The best security would to be to allow traffic only from trusted IP addresses, and only the specific ports being used, and block everything else. Not configuring the firewall and the firewall rules correctly could result in unpredictable data charges from your provider.

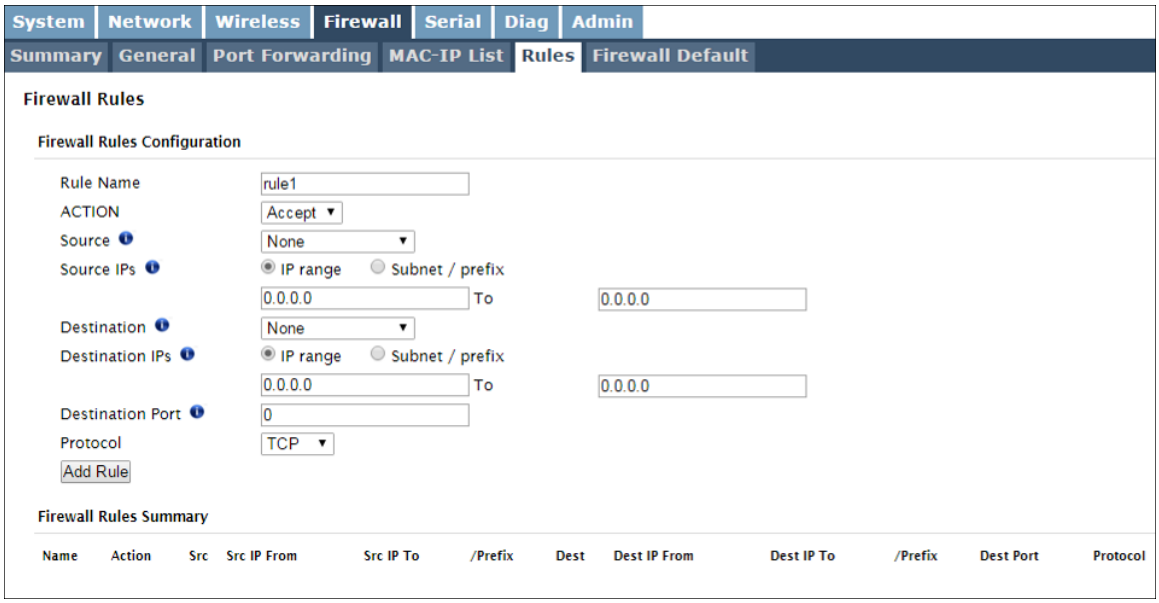


Image 4-4-5: Firewall > Rules

Rule Name

The rule name is used to identify the created rule. Each rule must have a unique name and up to 10 characters can be used.

Values (10 Chars)

characters

Action

The Action is used to define how the rule handles the connection request.

ACCEPT will allow a connection, while REJECT (error) and DROP (quietly dropped), will refuse connections.

This is configured based on how the **WAN Request** and **LAN to WAN Access Control** are configured in the previous menus.

Values (selection)

ACCEPT
DROP
REJECT

Source

Select the zone which is to be the source of the data traffic. The LAN/WAN refers to local connections on the pMDDL.

Values

LAN/WAN/Independent
LAN/**None**

4.0 Configuration

Source IPs	
Match incoming traffic from the specified source IP range. Boxes accept single IP Addresses without network masks, example: 192.168.1.0 to 192.168.1.255 represents all IP Addresses in the 192.168.1.0/24 network. (Put same IP in both boxes for a single IP match.)	**Values (IP Address)** **192.168.0.0 to 192.168.0.0**

Destination	
Select the zone which is the intended destination of the data traffic. The selections shown will reflect any network interfaces configured.	**Values (selection)** LAN/WAN/**None** *(varies)*

Destination IPs	
Match incoming traffic from the specified destination IP range. Boxes accept single IP Addresses without network masks, example: 192.168.1.0 to 192.168.1.255 represents all IP Addresses in the 192.168.1.0/24 network. (Put same IP in both boxes for a single IP match.)	**Values (IP Address)** **192.168.0.0 to 192.168.0.0**

Destination Port	
Match incoming traffic directed at the given destination port or port range. (To specify a port range use a From:To (100:200) format)	**Values (port)** **0**

Protocol	
The protocol field defines the transport protocol type controlled by the rule.	**Values** **TCP** UDP Both ICMP

4.0 Configuration

4.4.6 Firewall > Default

The firewall can be returned to default setting without requiring the entire modem to be reset to defaults. It is recommended to restart the modem once changes to the firewall or a reset is performed.

Image 4-4-6: Firewall > Default

4.0 Configuration

4.5 Serial

4.5.1 Serial > Summary

The Serial > Summary window gives a summary of the on board serial data port. A second serial port can be added to the pMDDL OEM by interfacing a FTDI USB to Basic UART IC as shown in **Appendix D: Serial Port Extension**.

GS0 - If the pMDDL has been set to USB Device mode (Pin 14 connected to GND through a 1K resistor), the GS0 tab will appear and the USB port can be used to connect to a USB host that has the Microhard Composite Drivers installed. The USB port will appear as a serial device on the host system.

The Summary window shows a number of status items that aid in viewing the operation, statistics, and troubleshooting of the RS232 & USB Serial Ports.

General Status

- Port Status - Shows if the RS232 has been enabled in the configuration.
- Baud Rate - The current baud rate used to interface with the connected device.
- Connect As - The type of IP Protocol Config is displayed here (TCP, UDP, SMTP, PPP, etc)
- Connect Status - Shows if there are any current connections / if the port is active.

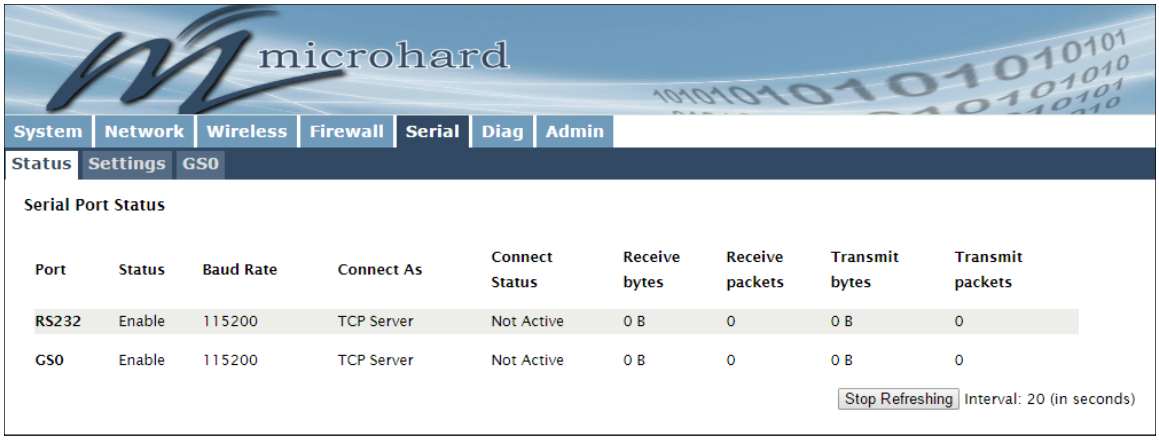


Image 4-5-1: Serial > Summary

4.0 Configuration

4.6.2 Serial > Settings

This menu option is used to configure the serial device server for the serial communications port. Serial device data may be brought into the IP network through TCP, UDP, or multicast; it may also exit the pMDDL network on another pMDDL serial port. The fully-featured RS232 interface supports hardware handshaking.

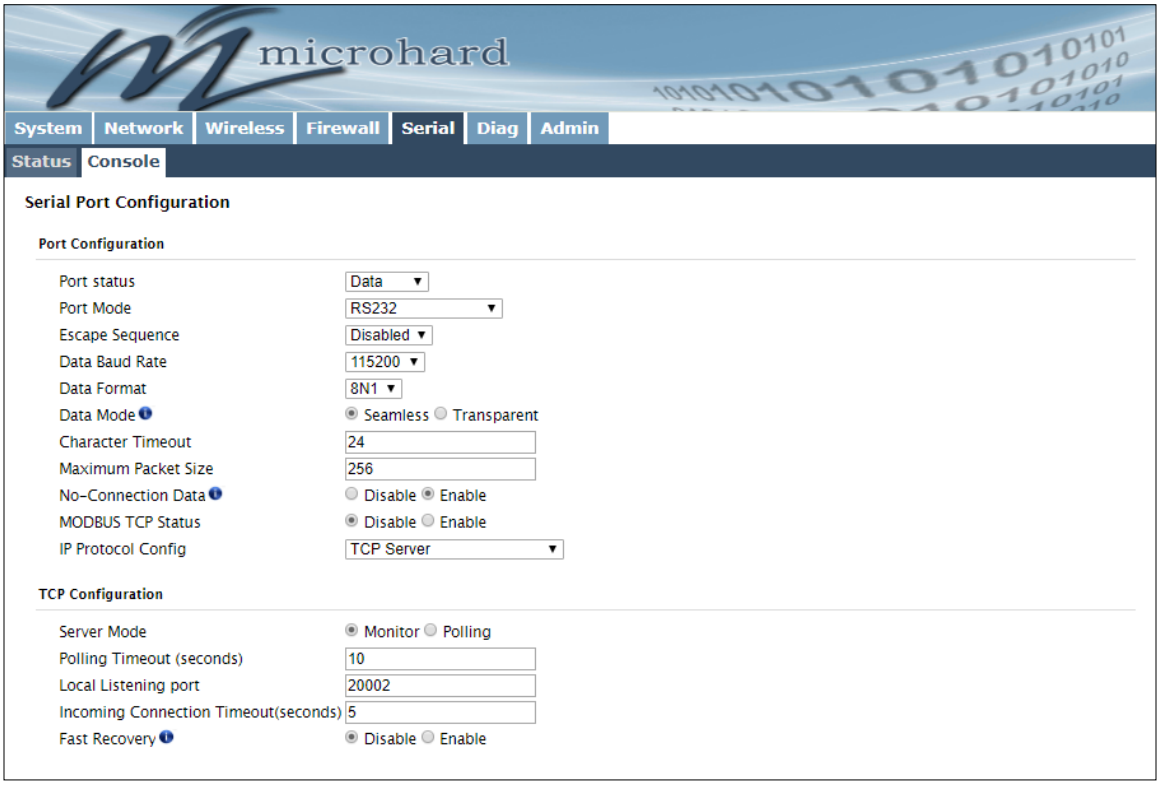


Image 4-5-2: Serial > Settings Configuration

4.0 Configuration

Port Status

Select operational status of the Serial Port. The port is in console mode by default.

Values (selection)

Data / **Console**

Port Mode

Select the port mode of the data port. When using supported motherboards or on the enclosed models, this will allow setting the port to RS485 modes.

Values (selection)

RS232
RS485 Full Duplex
RS485 Half Duplex

Escape Sequence

Enabling the escape sequence allows users to temporarily exit data mode and enter console mode for the serial port.

Values (selection)

Enabled / **Disabled**

Note: Most PCs do not readily support serial communications greater than 115200bps.

Escape Guard Interval

Appears only when the Escape Sequence is enabled. Enter the time interval in which the escape sequence must be entered fully.

Values (seconds)

1

Escape Sequence String

Only shown when the escape sequence is enabled. Enter the characters to be used for the escape sequence.

Values (characters)

+++

Data Baud Rate

The serial baud rate is the rate at which the modem is to communicate with the attached local asynchronous device.

Values (bps)

921600	**9600**
460800	7200
230400	4800
115200	3600
57600	2400
38400	1200
28800	600
19200	300
14400	

Data Format

This setting determines the format of the data on the serial port. The default is 8 data bits, No parity, and 1 Stop bit.

Values (selection)

8N1
8E1
8O1

4.0 Configuration

Data Mode

This setting defines the serial output data framing. In Transparent mode (default), the received data will be output promptly from the pMDDL.

Values (selection)

Seamless / **Transparent**

When set to Seamless, the serial port server will add a gap between data frames to comply with the MODBUS protocol for example. See 'Character Timeout' below for related information.

Character Timeout

In Seamless mode (see Data Mode described on the preceding page), this setting determines when the serial server will consider the recently -received incoming data as being ready to transmit. As per the MODBUS standard, frames will be marked as 'bad' if the time gap between frames is greater than 1.5 characters, but less than the Character Timeout value.

Values (characters)

24

The serial server also uses this parameter to determine the time gap inserted between frames. It is measured in 'characters' and related to baud rate.

Example: If the baud rate is 9600bps, it takes approximately 1ms to move one character. With the Character Timeout set to 4, the timeout period is 4ms. When the calculated time is less than 3.5ms, the serial server will set the character timeout to a minimum value of 3.5ms.

If the baud rate is greater than 19200bps, the minimum character timeout is internally set to 750us (microseconds).

Maximum Packet Size

Defines the buffer size that the serial server will use to receive data from the serial port. When the server detects that the Character Timeout criteria has been met, or the buffer is full, it packetizes the received frame and transmits it.

Values (bytes)

256

No-Connection Data

When enabled the data will continue to buffer received on the serial data port when the radio loses synchronization. When disabled the pMDDL will disregard any data received on the serial data port when radio synchronization is lost.

Values (selection)

Disable / Enable

MODBUS TCP Status

This option will enable or disable the MODBUS decoding and encoding features.

Values (selection)

Disable / Enable

4.0 Configuration

IP Protocol Config

This setting determines which protocol the serial server will use to transmit serial port data over the pMDDL network.

The protocol selected in the IP Protocol Config field will determine which configuration options appear in the remainder of the RS232 Configuration Menu.

Values (selection)

TCP Client
TCP Server
TCP Client/Server
UDP Point-to-Point
UDP Point to Multipoint (P)
UDP Point to Multipoint (MP)
PPP (Not supported on USB)

TCP Client: When TCP Client is selected and data is received on its serial port, the pMDDL takes the initiative to find and connect to a remote TCP server. The TCP session is terminated by this same unit when the data exchange session is completed and the connection timeout has expired. If a TCP connection cannot be established, the serial port data is discarded.

UDP: User Datagram Protocol does not provide sequencing information for the packets sent nor does it establish a 'connection' ('handshaking') and is therefore most suited to communicating small packets of data.

- **Remote Server Address**
  IP address of a TCP server which is ready to accept serial port data through a TCP connection. For example, this server may reside on a LAN network server.
  Default: **0.0.0.0**
- **Remote Server Port**
  A TCP port which the remote server listens to, awaiting a session connection request from the TCP Client. Once the session is established, the serial port data is communicated from the Client to the Server.
  Default: **20001**
- **Outgoing Connection Timeout**
  This parameter determines when the pMDDL will terminate the TCP connection if the connection is in an idle state (i.e. no data traffic on the serial port).
  Default: **60** (seconds)
- **Fast Recovery**
  Sets the TCP session parameters and buffers to be set such that TCP sessions recover faster in environments where the wireless link is weak/unstable. This is ideal for critical, near real time applications such as flight control data. Data is not buffered during outages.
  Default: **Disable**

TCP: Transmission Control Protocol in contrast to UDP does provide sequencing information and is connection -oriented; a more reliable protocol, particularly when large amounts of data are being communicated.

Requires more bandwidth than UDP.

TCP Server: In this mode, the pMDDL Series will not INITIATE a session, rather, it will wait for a Client to request a session of it (it's being the Server—it 'serves' a Client). The unit will 'listen' on a specific TCP port. If a session is established, data will flow from the Client to the Server, and, if present, from the Server to the Client. If a session is not established, both Client-side serial data, and Server-side serial data , if present, will be discarded.

- **Local Listening Port**
  The TCP port which the Server listens to. It allows a TCP connection to be created by a TCP Client to carry serial port data.
  Default: **20001**
- **Incoming Connection Timeout**
  Established when the TCP Server will terminate the TCP connection is the connection is in an idle state.
  Default: **300** (seconds)
- **Fast Recovery**
  Sets the TCP session parameters and buffers to be set such that TCP sessions recover faster in environments where the wireless link is weak/unstable. This is ideal for critical, near real time applications such as flight control data. Data is not buffered during outages.
  Default: **Disable**

4.0 Configuration

IP Protocol Config (Continued…)

A UDP or TCP port is an application end-point. The IP address identifies the device and, as an extension of the IP address, the port essentially 'fine tunes' where the data is to go 'within the device'.

Be careful to select a port number that is not predetermined to be associated with another application type, e.g. HTTP uses port 80.

TCP Client/Server: In this mode, the pMDDL will be a combined TCP Client and Server, meaning that it can both initiate and serve TCP connection (session) requests. Refer to the TCP Client and TCP Server descriptions and settings described previously as all information, combined, is applicable to this mode.

UDP Point-to-Point: In this configuration the pMDDL will send serial data to a specifically-defined point, using UDP packets. This same pMDDL will accept UDP packets from that same point.

- **Remote IP Address**
  IP address of distant device to which UDP packets are sent when data received at serial port.
  Default: **0.0.0.0**
- **Remote Port**
  UDP port of distant device mentioned above.
  Default: **20001**
- **Listening Port**
  UDP port which the IP Series listens to (monitors). UDP packets received on this port are forwarded to the unit's serial port.
  Default: **20001**
- **UDP Timeout(s)**
  UDP Timeout in seconds.
  Default: **10**

UDP Point-to-Multipoint (P): This mode is configured on an Bullet which is to send multicast UDP packets.

- **Multicast IP Address**
  A valid multicast address this unit uses to send multicast UDP packets upon receiving data from the serial port. The default value is a good example of a valid multicast address.
  Default: **224.1.1.2**
- **Multicast Port**
  A UDP port that this Nano IP will send UDP packets to. The Multipoint (MP - see the UDP Point-to-Multipoint (MP) description) stations should be configured to listen to this point in order to receive multicast packets from this Nano IP Series.
  Default: **20002**
- **Listening Port**
  The UDP port that this unit receives incoming data on from multiple remote units.
  Default: **20012**
- **Time to Live**
  Time to live for the multicast packets.
  Default: **1** (hop)
- **Multicast Interface**
  Select, if applicable, which interface to send/listen for Multicast packets.
  Default: **default**

UDP Point-to-Multipoint (MP): This protocol is selected on the units which are to receive multicast UDP packets. See the previous description of UDP Point-to-Multipoint (P).

- **Remote IP Address**
  The IP address of a distant device (IP Series or, for example, a PC) to which the unit sends UDP packets of data received on the serial port. Most often this is the IP address of the Master IP Series.
  Default: **0.0.0.0**
- **Remote Port**
  The UDP port associated with the Remote IP Address (above). In the case of this 'Remote' being the Master Nano IP Series, the value in this field should match the Listening Port of the Master (see UDP Point-to-Multipoint (P)).
  Default: **20012**

4.0 Configuration

IP Protocol Config (Continued…)

- **Multicast IP Address**
  A valid MULTICAST address that this unit will use to receive multicast UDP packets sent by a UDP Point-to-Multipoint (P) unit. Note that the default value for this field matches the default Multicast IP Address of the UDP Point-to-Multipoint (P) configuration described on the previous page.
  Default: **224.1.1.2**
- **Multicast Port**
  The UDP port that this unit will use, along with the Multicast IP Address detailed above, to receive the multicast UDP packets sent by the UDP Point-to-Multipoint (P) unit.
  Default: **20002**
- **Multicast Interface**
  Select, if applicable, which interface to send/listen for Multicast packets.
  Default: **default**

PPP: The serial port can be configured as a PPP server for a serial connection with a PC or other device. The attached PC could then use a dedicated serial (WindowsXP - dialup/modem) type PPP connection to access the network resources of the pMDDL.

- PPP Mode
  Can be set for Active or Passive. If set for Active, the PPP server will initiate the PPP connection with a PPP client. The server will periodically send out link requests following PPP protocol. If set to Passive, the PPP server will not initiate the PPP connection with PPP client. The server will wait passively for the client to initiate connection.
  Default: **Passive**
- Expected String
  When a client (PC or device) initiates a PPP session with the modem, this is the handshaking string that is expected in order to allow a connection. Generally this doe not need to be changed.
  Default: **CLIENT**
- Response String
  This is the handshaking string that will be sent by the modem once the expected string is received. Generally this does not need to be changed.
  Default: **CLIENTSERVER**
- PPP LCP Echo Failure Number
  The PPP server will presume the peer to be dead if the LCP echo-requests are sent without receiving a valid LCP echo-reply. If this happens, PPP server will terminate the connection. Use of this option requires a non-zero value for the LCP Echo Interval parameter. This option can be used to enable PPP server to terminate after the physical connection has been broken (e.g., the modem has hung up).
  Default: **0**
- PPP LCP Echo Interval
  The PPP server will send an LCP echo-request frame to the peer every ‘n’ seconds. Normally the peer should respond to the echo-request by sending an echo-reply. This option can be used with the LCP-echo-failure option to detect that the peer is no longer connected.
  Default: **0**
- PPP Local IP
  Enter the local PPP IP Address, the IP Address of the pMDDL COM Port.
  Default: **192.168.0.1**
- PPP Host IP
  Enter the PPP Host IP here. This is the IP of the PC or attached device.
  Default: **192.168.0.99**
- PPP Idle Timeout(s)
  It is the timeout for tearing down the ppp connection when there is no data traffic within the time interval. When there is data coming, new ppp connection will be created.
  Default: **30**

4.0 Configuration

4.6.3 Serial > GS0

This tab only appears if the pMDDL has been set to operate as a USB Device (Pin 14 connected to GND through a 1k resisitor). Microhard USB Serial Composite Drivers are available which allow the pMDDL to appear as a serial device to a USB Host (PC etc.)

The USB port can be set to “Idle” or to operate as a Data port as seen below:

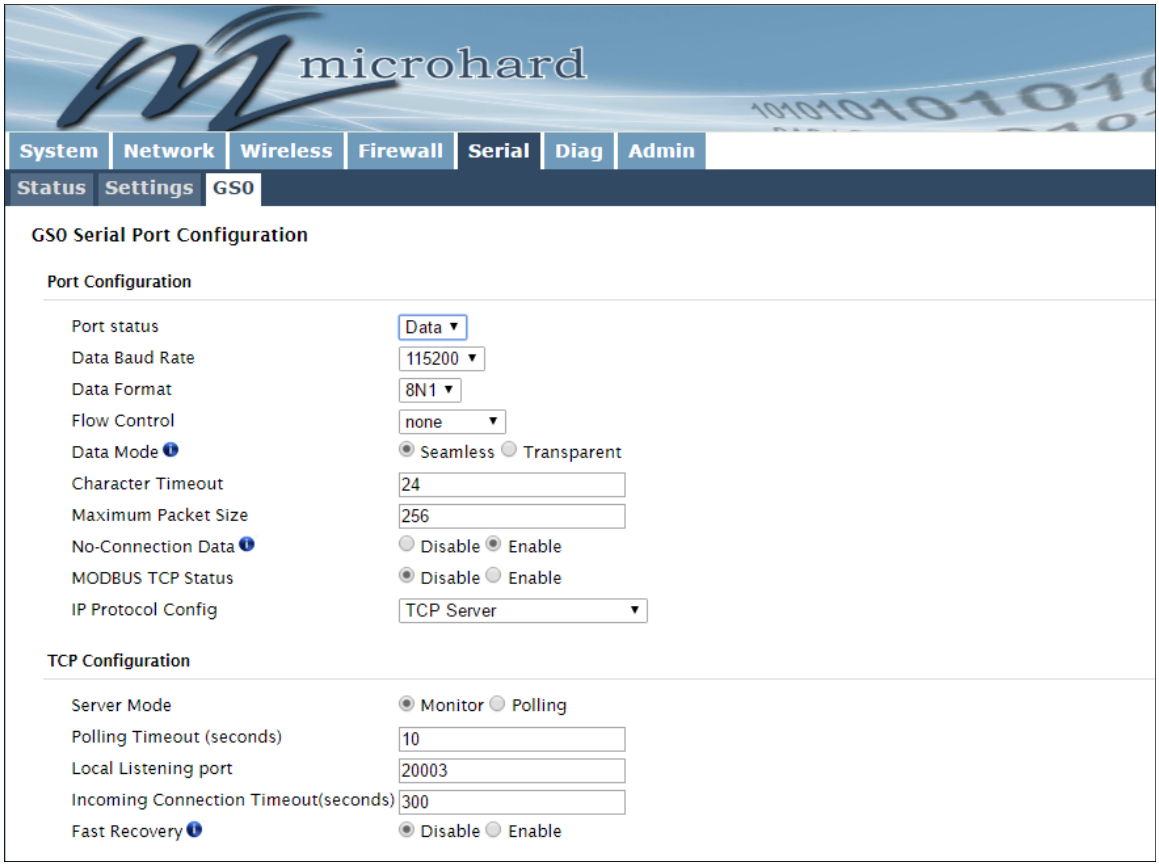


Image 4-5-2: Serial > Settings Configuration

GS0 Serial Port Configuration

The USB port configuration is identical to the Serial Port > Settings parameters. For help or definitions of each field, refer to the previous section of this manual which describes the available settings.

4.0 Configuration

4.6 Diag

4.6.1 Diag > Ping

The Network Tools Ping feature provides a tool to test network connectivity from within the pMDDL unit. A user can use the Ping command by entering the IP address or host name of a destination device in the Ping Host Name field, use Count for the number of ping messages to send, and the Packet Size to modify the size of the packets sent.

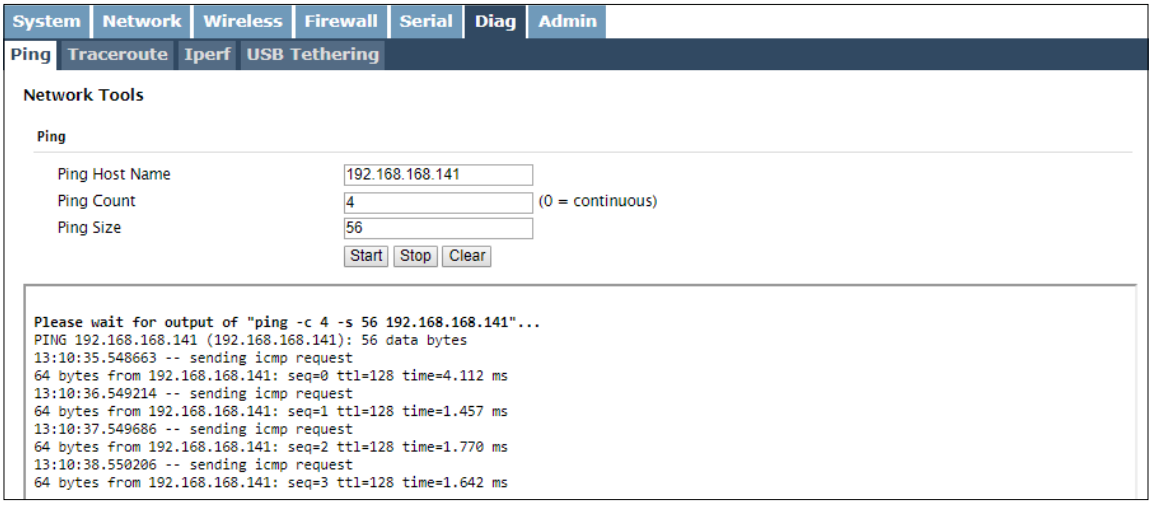


Image 4-6-1: Diagnostics > Ping

4.6.2 Diag > Traceroute

The **Traceroute** command can be used to provide connectivity data by providing information about the number of hops, routers and the path taken to reach a particular destination.

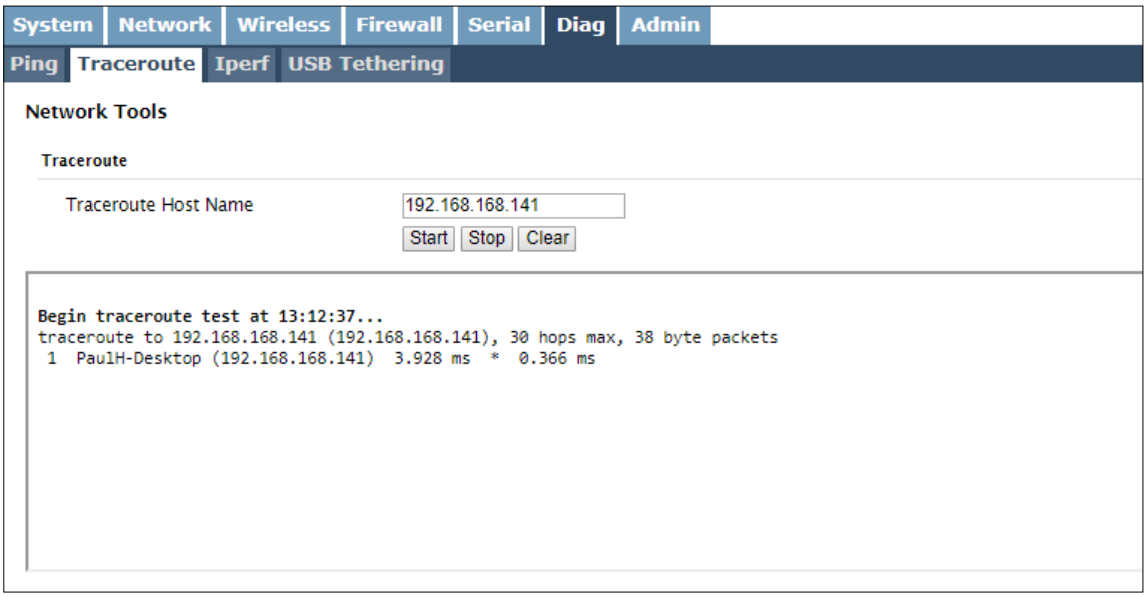


Image 4-6-2: Diagnostics > Trace Route

4.0 Configuration

4.6.3 Diag > Iperf

The pMDDL features an integrated Iperf server/client to use to measure and analyze throughput of TCP/ UDP packets to and/or from the pMDDL. Iperf is a 3rd party utility that can be loaded on any PC to measure network performance. For additional information about Iperf, please visit the Iperf website.

The pMDDL can be configured to operate as a Server, listening for an incoming connection from another device (with Iperf), or PC running an Iperf client. If set to Iperf client, the pMDDL will connect to or send packets to a specified Iperf server.

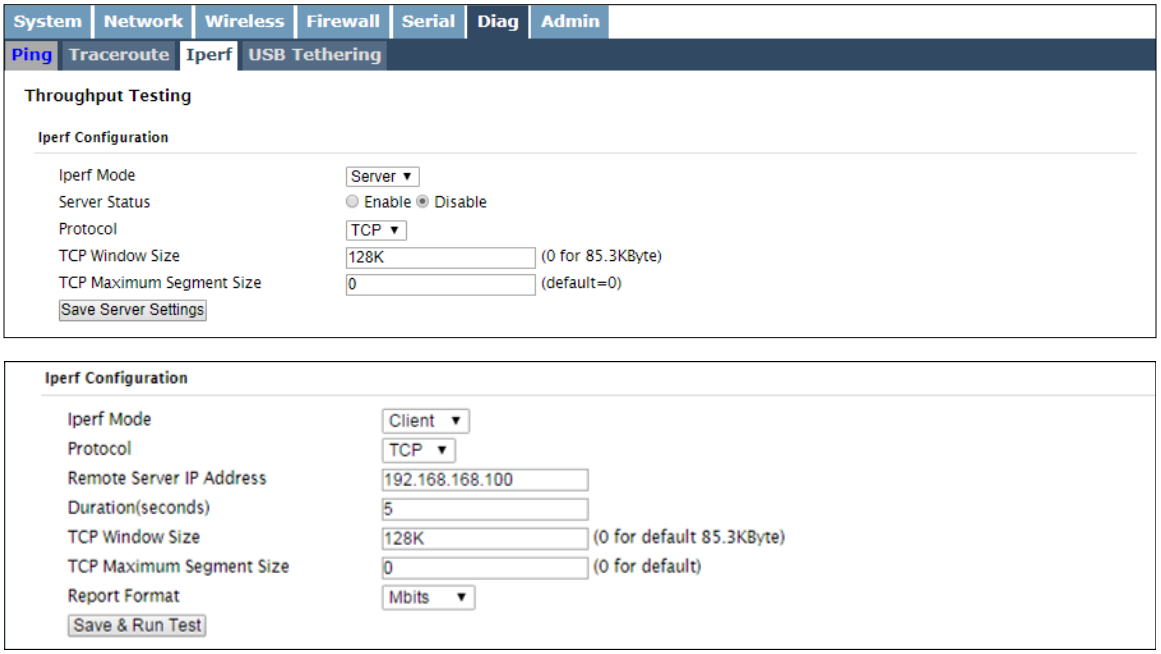


Image 4-6-3: Diag > Iperf

Iperf Mode

Select between an Iperf Server (listens for incoming connections) and client (initiates a connection with a server)

Values (selection)

Server / Client

Server Status

If the Iperf mode to set to Server, this Server Status allows a user to Enable or Disable the server.

Values (selection)

Enable / Disable

Protocol

Select the type of packets to be sent to test the throughput. TCP packets are connection oriented and require additional overhead for the handshaking that occurs, while UDP is a connectionless, best effort oriented protocol.

Values (selection)

TCP / UDP

4.0 Configuration

4.6.4 Diag > USB Tethering

The pMDDL can be Tethered to certain Android Mobile Devices to view a video stream from a remote video encoder. ***This is a preliminary feature that has limited support at this time. Contact Microhard for more information.***

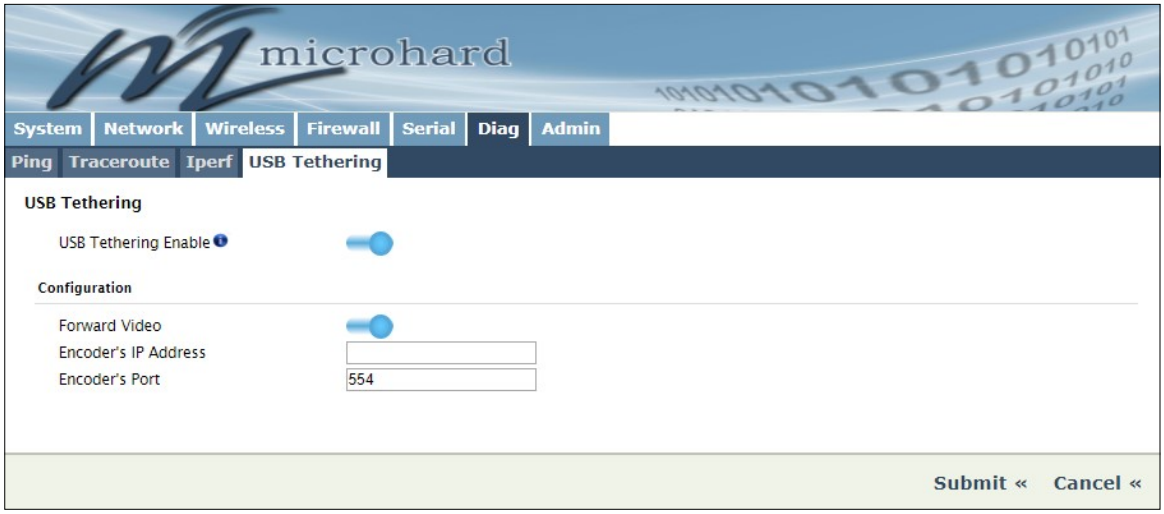


Image 4-6-4: Diag > USB Tethering

USB Tethering Mode

Enable USB Tethering. Enabling USB Tethering with open all WAN requests on the firewall to allow for proper operation

Values (selection)

ON/**OFF**

Forward Video

If enabled the pMDDL will allow video to be viewed from an attached android device from an remote video source.

Values (selection)

Enable / Disable

Encoder's Address

Enter the IP address of the external encoder of which the video source Is located.

Values (IP Address)

(no default)

Encoder'sPort

Enter the port number for the video encoder's.

Values (IP Address)

554

4.0 Configuration

4.7 Admin

4.7.1 Admin > Users

Password Change

The Password Change menu allows the password of the user ‘admin’ to be changed. The ‘admin’ username cannot be deleted, but additional users can be defined and deleted as required as seen in the Users menu below. After the modem has been reset to factory defaults, it is mandatory to change the default password for admin, the modem will prompt a user to do so upon the first login.

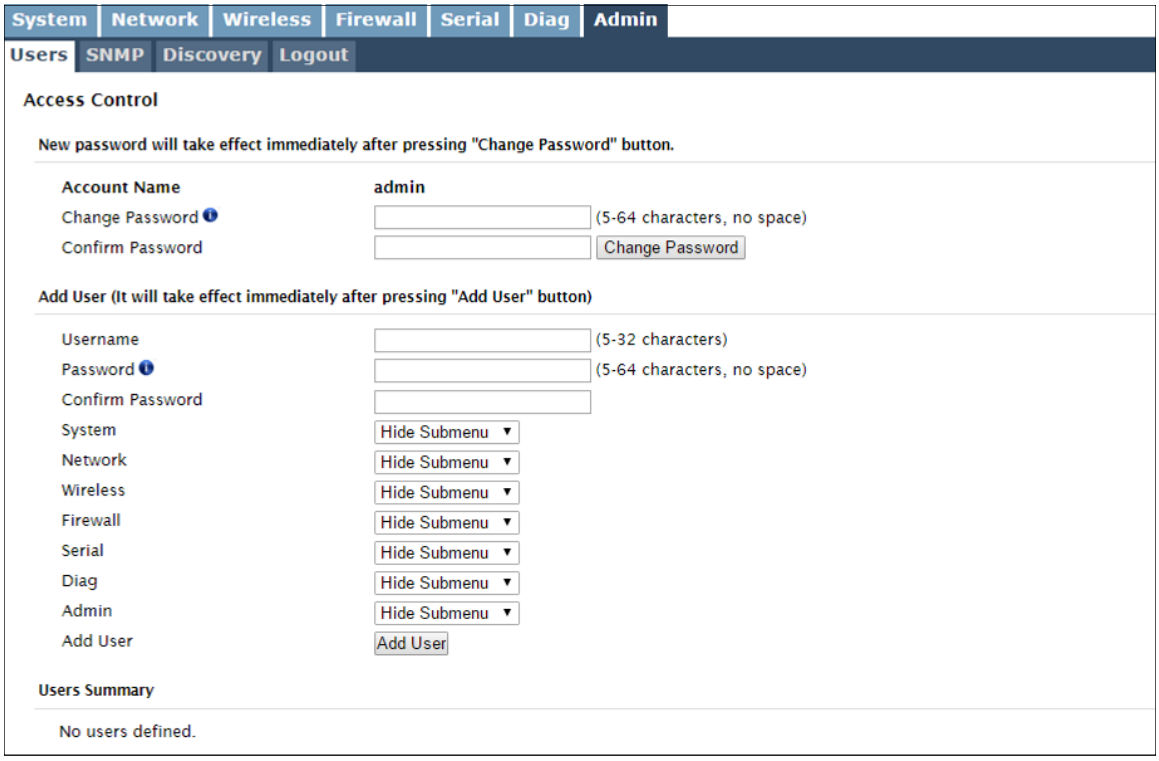


Image 4-7-1: Users > Password Change

New Password

Enter a new password for the ‘admin’ user. It must be at least 5 characters in length. **The default password for ‘admin’ is ‘admin’**.

Values (characters)

admin

Confirm Password

The exact password must be entered to confirm the password change, if there is a mistake all changes will be discarded.

Values (characters)

admin

4.0 Configuration

Add Users

Different users can be set up with customized access to the WebUI. Each menu or tab of the WebUI can be disabled on a per user basis as seen below.

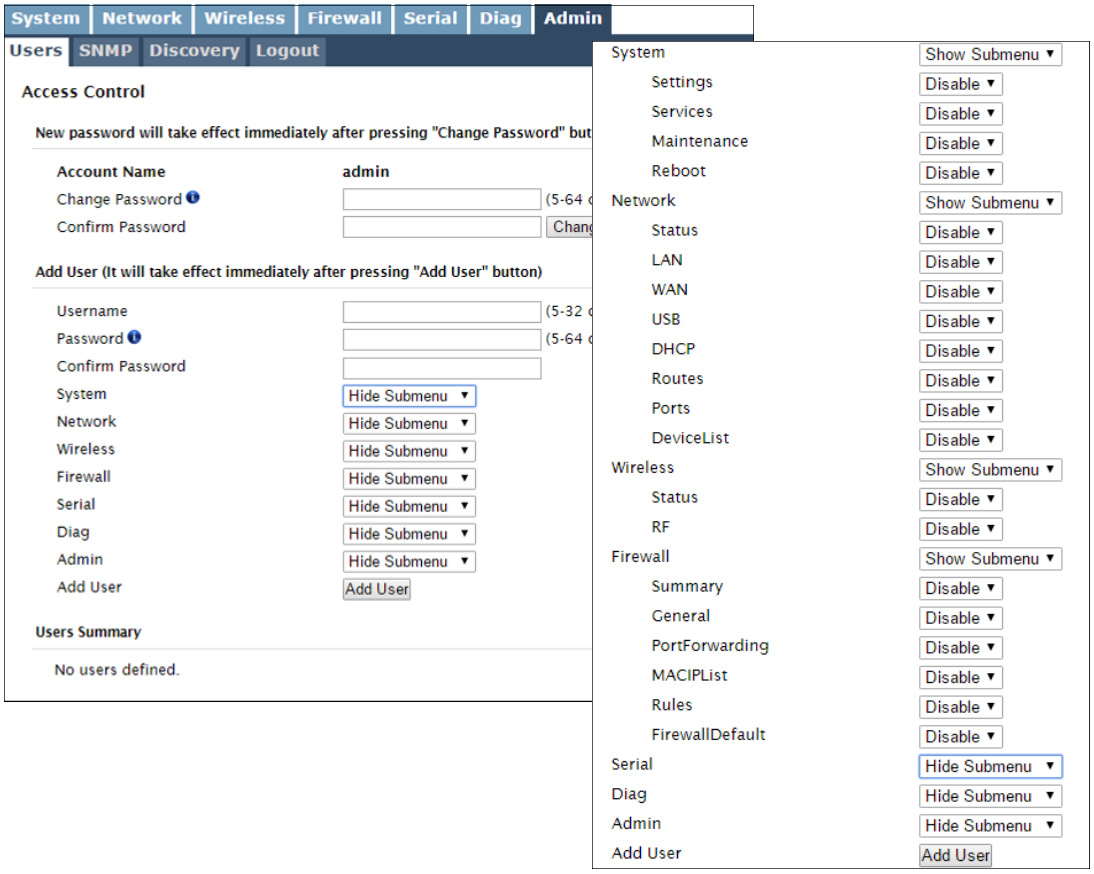


Image 4-7-2: Access Control > Users

Username

Enter the desired username. Minimum or 5 character and maximum of 32 character. Changes will not take effect until the system has been restarted.

Values (characters)

(no default)
Min 5 characters
Max 32 characters

Password / Confirm Password

Passwords must be a minimum of 5 characters. The Password must be re-entered exactly in the Confirm Password box as well.

Values (characters)

(no default)
min 5 characters

4.0 Configuration

4.7.2 Admin > SNMP

The pMDDL may be configured to operate as a Simple Network Management Protocol (SNMP) agent. Network management is most important in larger networks, so as to be able to manage resources and measure performance. SNMP may be used in several ways:

- configure remote devices
- monitor network performance
- detect faults
- audit network usage
- detect authentication failures

SNMP: Simple Network Management Protocol provides a method of managing network devices from a single PC running network management software.

Managed networked devices are referred to as SNMP agents.

A SNMP management system (a PC running SNMP management software) is required for this service to operate. This system must have full access to the pMDDL. Communications is in the form of queries (information requested by the management system) or traps (information initiated at, and provided by, the SNMP agent in response to predefined events).

Objects specific to the pMDDL are hosted under private enterprise number **21703**.

An object is a variable in the device and is defined by a Management Information Database (MIB). Both the management system and the device have a copy of the MIB. The MIB in the management system provides for identification and processing of the information sent by a device (either responses to queries or device-sourced traps). The MIB in the device relates subroutine addresses to objects in order to read data from, or write data to, variables in the device.

An SNMPv1 agent accepts commands to retrieve an object, retrieve the next object, set and object to a specified value, send a value in response to a received command, and send a value in response to an event (trap).

SNMPv2c adds to the above the ability to retrieve a large number of objects in response to a single request.

SNMPv3 adds strong security features including encryption; a shared password key is utilized. Secure device monitoring over the Internet is possible. In addition to the commands noted as supported above, there is a command to synchronize with a remote management station.

The pages that follow describe the different fields required to set up SNMP on the pMDDL. MIBS may be requested from Microhard Systems Inc.

The MIB file can be downloaded directly from the unit using the ***'Get MIB File'*** button on the Network > SNMP menu.

4.0 Configuration

SNMP Settings

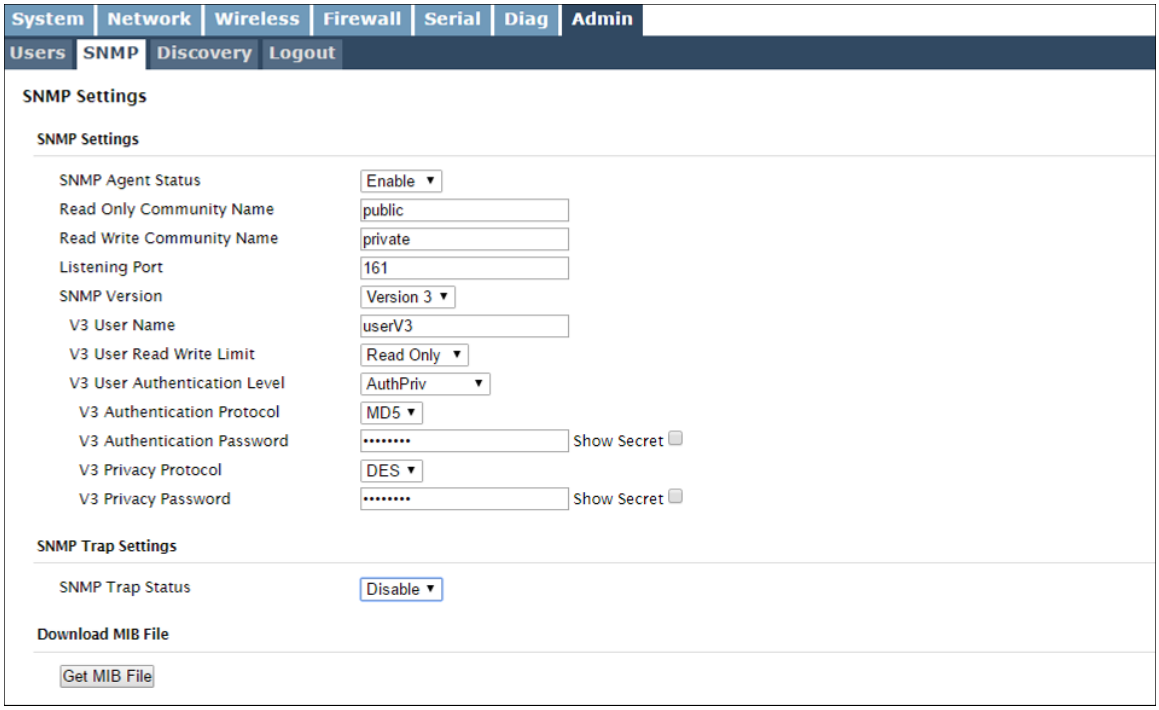


Image 4-7-3: Admin > SNMP

SNMP Agent Status

If disabled, an SNMP service is not provided from the device. Enabled, the device - now an SNMP agent - can support SNMPv1, v2, & v3.

Values (selection)

Disable / Enable

Read Only Community Name

Effectively a plain-text password mechanism used to weakly authenticate SNMP queries. Being part of the community allows the SNMP agent to process SNMPv1 and SNMPv2c requests. This community name has only READ priority.

Values (string)

public

Read Write Community Name

Also a plain-text password mechanism used to weakly authenticate SNMP queries. Being part of the community allows the SNMP agent to process SNMPv1 and SNMPv2c requests. This community name has only READ/WRITE priority.

Values (string)

private

Listening Port

Enter the UDP port on which the pMDDL listens for incoming SNMP get/set messages. The default is port 161.

Values (UDP Port)

161

4.0 Configuration

SNMP Version

Select the SNMP version used. Only SNMP version 1 & 2 support SNMP traps (See MIB).

Values (selection)

Version 1 / **Version 2** / Version 3

SNMP V3 User Name

Defines the user name for SNMPv3.

Values (string)

V3user

V3 User Read Write Limit

Defines accessibility of SNMPv3; If Read Only is selected, the SNMPv3 user may only read information; if Read Write is selected, the SNMPv3 user may read and write (set) variables.

Values (selection)

Read Only / Read Write

V3 User Authentication Level

Defines SNMPv3 user's authentication level:

NoAuthNoPriv: No authentication, no encryption.
AuthNoPriv: Authentication, no encryption.
AuthPriv: Authentication, encryption.

Values (selection)

NoAuthNoPriv
AuthNoPriv
AuthPriv

V3 User Authentication Password

SNMPv3 user's authentication password. Only valid when V3 User Authentication Level set to AuthNoPriv or AuthPriv.

Values (string)

00000000

V3 User Privacy Password

SNMPv3 user's encryption password. Only valid when V3 User Authentication Level set to AuthPriv (see above).

Values (string)

00000000

Auth Failure Traps

If enabled, an authentication failure trap will be generated upon authentication failure. (SNMP v1 & v2 only).

Values (selection)

Disable / Enable

Trap Community Name

The community name which may receive traps. (SNMP v1 & v2 only).

Values (string)

TrapUser

Trap Manage Host IP

Defines a host IP address where traps will be sent to (e.g. SNMP management system PC IP address). (SNMP v1 & v2 only).

Values (IP Address)

0.0.0.0

4.0 Configuration

SNMP Trap Settings

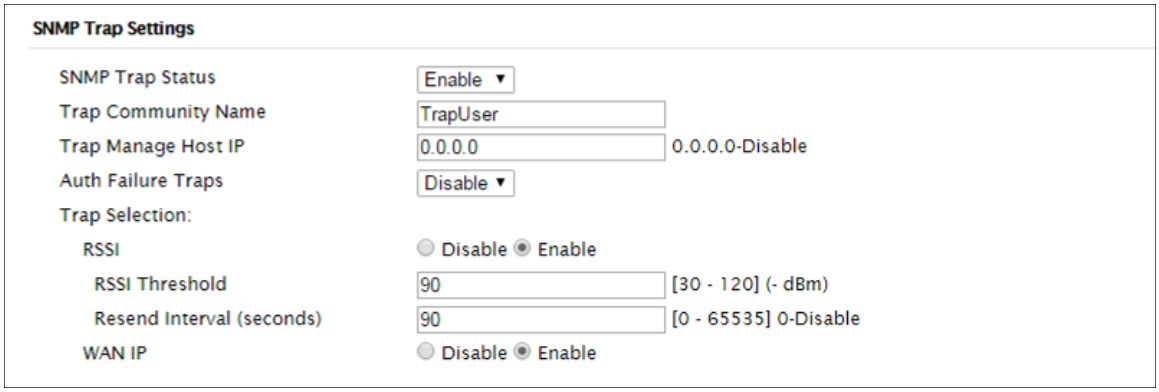


Image 4-7-4: Admin > SNMP Trap Settings

SNMP Trap Status

Enable or disable autonomous SNMP traps from the device.

Values (selection)

Disable / Enable

Trap Community Name

Effectively a plain-text password mechanism used to weakly authenticate SNMP queries. Being part of the community allows the SNMP agent to process SNMP traps.

Values (string)

TrapUser

Trap Manage Host IP

Enter the IP address of the SNMP host to which SNMP traps are sent from the device.

Values (IP Address)

0.0.0.0

Auth Failure Traps

Enable or Disable authentication requirements for outgoing configured SNMP event traps.

Values (selection)

Disable / Enable

RSSI

Enable or Disable RSSI traps. The threshold in which that traps are triggered can also be configured, as well as the frequency at which the traps are sent when the threshold has been crossed.

Values (selection)

Disable / Enable

90 (30-120) in -dBm

90 (0 - 65535 seconds, 0=disabled.)

4.0 Configuration

WAN IP	
Enable or Disable WAN IP Traps. Device will send a trap any time the WAN IP has been changed. Generally used with dynamic IP addresses.	**Values (selection)** **Disable /** Enable

4.0 Configuration

4.7.3 Admin > Discovery

Server Status Settings

Microhard Radios employ a discovery service that can be used to detect other Microhard devices on a network. This can be done using a stand alone utility from Microhard System's called 'IP Discovery' or from the Tools > Discovery menu. The discovery service will report the MAC Address, IP Address, Description, Product Name, Firmware Version, Operating Mode, and the Network ID.

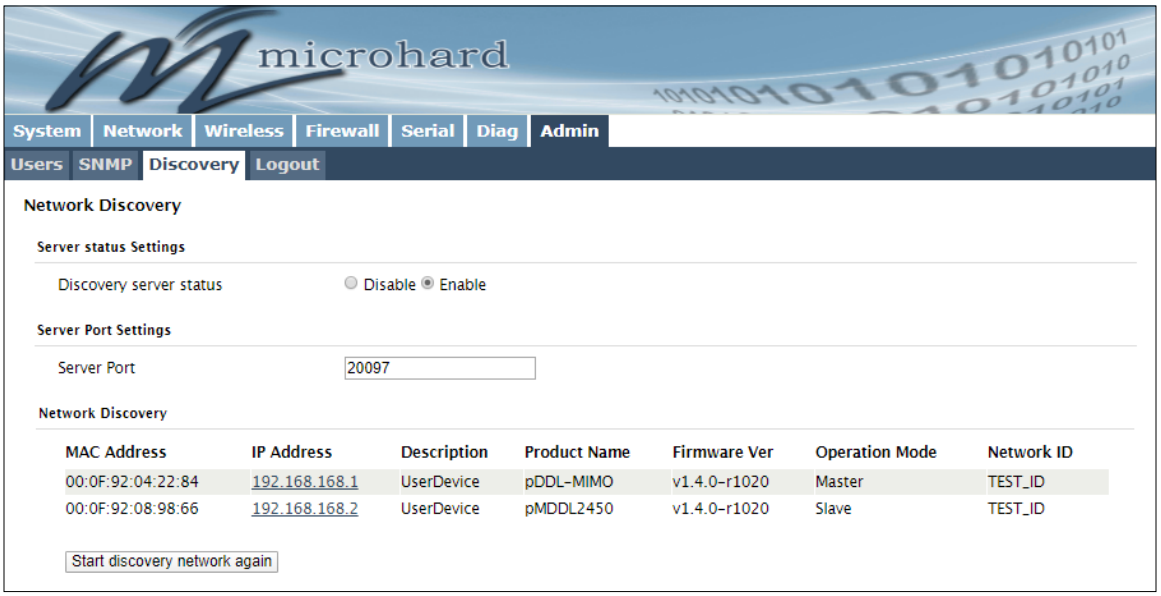


Image 4-7-5: Admin > Discovery

Discovery Service Status

Use this option to disable or enable the discovery service.

Values (selection)

Disable / **Enable**

Server Port Settings

Specify the port running the discovery service on the pMDDL unit.

Values (Port #)

20097

Network Discovery

The Network discovery tool allows the pMDDL to send a broadcast to all Microhard devices on the same network. Other units on the network will respond to the broadcast and report their MAC address, IP address (With a hyperlink to that units WebUI page), description, firmware version.

The discovery service can be a useful troubleshooting tool and can be used to quickly find and indentify other units on the network.

4.0 Configuration

4.7.4 Admin > Logout

The logout function allows a user to end the current configuration session and prompt for a login screen.

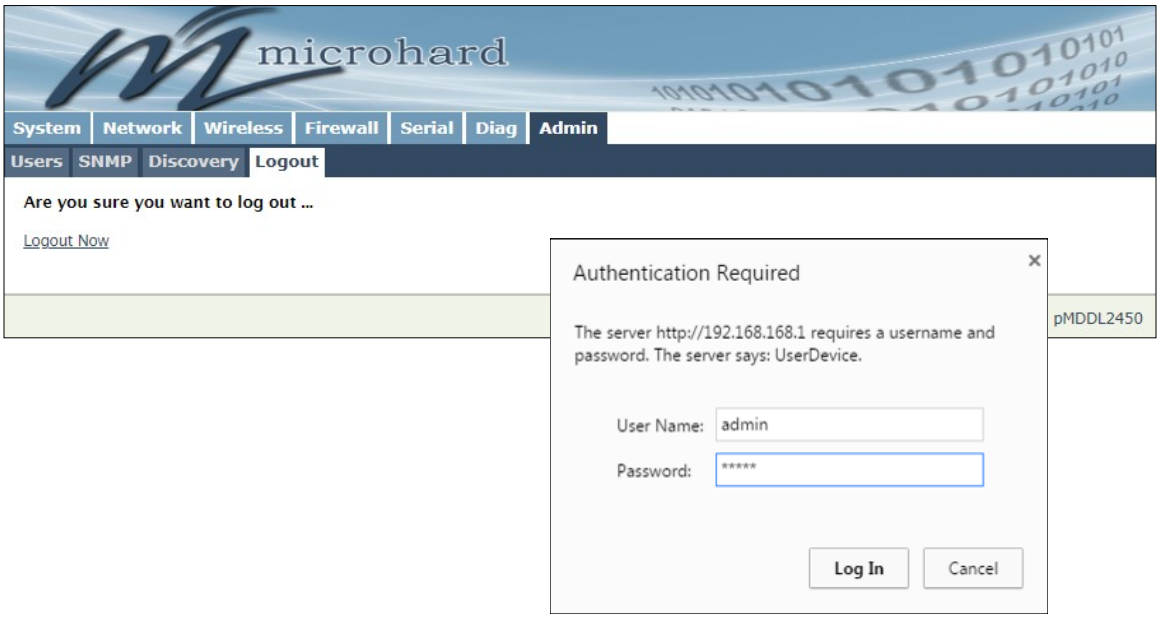


Image 4-7-6: Admin > logout

5.0 AT Command Line Interface

5.1 AT Command Overview

AT Commands can be issued to configure and manage the pMDDL, via TCP/IP (telnet).

5.1.1 Telnet (TCP/IP)

Telnet can be used to access the AT Command interface of the pMDDL. The default port is TCP Port 23. A telnet session can be made to the unit using any Telnet application (Windows Telnet, Tera Term, ProComm etc). Once communication is established, a login is required to continue.

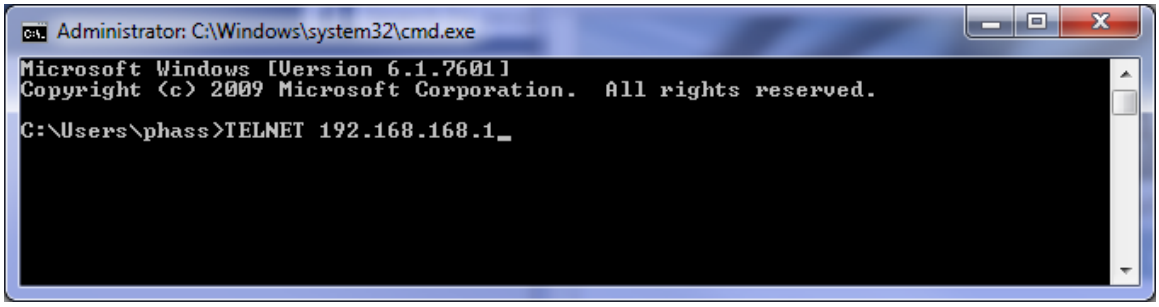


Image 5-1: Establishing a Telnet Session

A session can be made to the WAN IP Address (if allowed in the firewall settings) for remote configuration, or to the local RJ45 interface.

Once a session is established a login is required to continue. As seen in the Serial port setup, the default login is **admin**, and the password is **admin.** Once verified, the AT Command Line Interface menu is shown and AT Commands can now be issued. (Type "?" or Help to list the commands).

The factory default network settings:

IP: 192.168.168.1
Subnet: 255.255.255.0
Gateway: 192.168.168.1

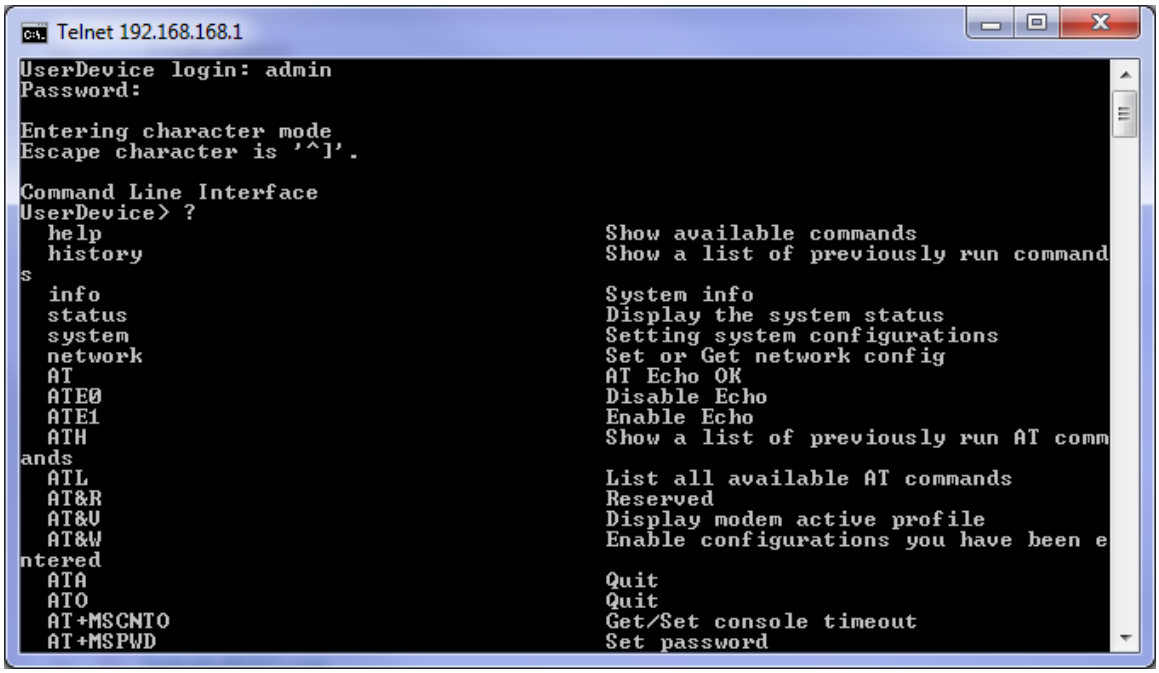


Image 5-2: Telnet AT Command Session

5.0 AT Command Line Interface

5.2 AT Command Syntax

The follow syntax is used when issuing AT Commands on the pMDDL

- All commands start with the AT characters and end with the <Enter> key
- Microhard Specific Commands start with +M
- Help will list top level commands (ATL will list ALL available AT Commands)
- To query syntax of a command: AT+<command_name>=?
- Syntax for commands that are used only to query a setting:
  AT<command_name>
- Syntax for commands that can be used to query *and* set values:
  AT<command_name>=parameter1,parameter2,… (Sets Values)
  AT<command_name>? (Queries the setting)

Query Syntax:
AT+MSCNTO=? <Enter>
+MSCNTO:
Command Syntax: AT+MSCNTO=<Timeout_s>
Parameter:
<Timeout_s> 30 to 65535 in seconds, 0-Disable
OK

Setting a value:
AT+MSCNTO=300 <Enter>
OK

Query a setting:
AT+MSCNTO? <Enter>
+MSCNTO: 300 seconds
OK

A screen capture of the above commands entered into a unit is shown below:

Image 5-3: Telnet AT Command Syntax

Once AT commands are entered, they must be saved into the file system to enable the changes.

AT&W	Saves changes.
ATO or ATA	Exits the AT Command Line Interface, if used before AT&W, changes are discarded.

5.0 AT Command Line Interface

5.3 Supported AT Commands

Basic AT Commands			
AT Command	**Description**	**Syntax**	**Effect**
AT	AT echo OK	AT <enter>	Immediate
ATE0	Disable echo	ATE0 <enter>	Immediate
ATE1	Enabled local echo	ATE1 <enter>	Immediate
ATH	Show a list of previously run commands	ATH <enter>	Immediate
ATL	Show a list of all available AT Commands	ATL <enter>	Immediate
AT&R	Read modem profile to editable profile. (Reserved)	AT&R <enter>	Immediate
AT&V	Read modem active profile	AT&V <enter>	Immediate
AT&W	Enable configuration changes that have been entered	AT&W <enter>	Immediate
ATA	Quit. Exits AT command session and returns to login prompt	ATA <enter>	Immediate
ATO	Quit. Exits AT command session and returns to login prompt	ATO <enter>	Immediate
Administrative AT Commands			
AT Command	**Description**	**Syntax**	**Effect**
AT+MADISS	Get/Set discovery service used by the modem	**AT+MADISS[=<Mode>[,<Port>]]** Mode: 0 - Disable 1 - Discoverable Port: 1 to 65535. Default is 20097	AT&W
AT+MASNMP	Get/Set SNMP service	**AT+MASNMP[=<Mode>[,<ROCommunity>,<RWCommunity>,<Port>,<Version>]]** <Mode>: 0 - Disable 1 - Enable <ROCommunity>: Read Only Community Name 1 to 32 characters <RWCommunity>: Read Write Community Name 1 to 32 characters <Port>: Listening Port 0 to 65535. Default is 161 <Version>: SNMP version 1 - Version 1 2 - Version 2 3 - Version 3 (Use AT+MASNMPV3 to set Authentication and Privacy parameters)	AT&W
AT+MASNMPV3	Get/Set SNMP Version 3	**AT+MASNMPV3=<UserName>,<RWLimit>,<AuthLevel>[,<Auth>,<AuthPassword>[,<Privacy>,<PrivacyPassword>]]** <UserName> : V3 User Name 1 to 32 characters <RWLimit> : V3 User Read Write Limit 0 - Read Only 1 - Read Write <AuthLevel> : V3 User Authentication Level 0 - NoAuthNoPriv 1 - AuthNoPriv 2 - AuthPriv <Auth> : V3 Authentication Protocol 0 - MD5 1 - SHA <AuthPassword> : V3 Authentication Password 5 to 64 characters <Privacy> : V3 Privacy Protocol 0 - DES 1 - AES <PrivacyPassword>: V3 Privacy Password 5 to 64 characters Usage: NoAuthNoPriv : AT+MASNMPV3=<UserName>,<RWLimit>,0 AuthNoPriv : AT+MASNMPV3=<UserName>,<RWLimit>,1,<Auth>,<AuthPassword> AuthPriv : AT+MASNMPV3=<UserName>,<RWLimit>,2,<Auth>,<AuthPassword>,<Privacy>,<PrivacyPassword>	AT&W

5.0 AT Command Line Interface

Administrative AT Commands (Continued)			
AT Command	**Description**	**Syntax**	**Effect**
AT+MASNMPTRAP	Get/Set SNMP Trap	**AT+MASNMPTRAP[=<Mode>[,<Name>,<IP>[,<AuthFailureTraps>]]** <Mode>: 0 - Disable 1 - Enable <Name>: Trap Community Name. 1 to 32 characters <IP>: Trap Manage Host IP. Default 0.0.0.0 (Disable) <AuthFailureTraps>: 0 - Disable 1 - Enable Usage: AT+MASNMPTRAP AT+MASNMPTRAP=0 AT+MASNMPTRAP=1[,<Name>,<IP>[,<AuthFailureTraps>]]	AT&W
Serial Port AT Commands			
AT Command	**Description**	**Syntax**	**Effect**
AT+MCPS2	Get/Set Serial port	**AT+MCPS2=<Mode>** Parameters: COM2 Mode: 0 - Console 1 - Data	AT&W
AT+MCBR2	Get/Set Serial port baud rate	**AT+MCBR2=<Baud Rate Type>** Parameters: COM2 Baud Rate Type: 0 - 300 1 - 600 2 - 1200 3 - 2400 4 - 3600 5 - 4800 6 - 7200 7 - 9600 8 - 14400 9 - 19200 10 - 28800 11 - 38400 12 - 57600 13 - 115200 14 - 230400 15 - 460800 16 - 921600	AT&W
AT+MCDF2	Get/Set Serial port data format	**AT+MCDF2=<Data Formate Type>** Parameters: COM2 Data Formate Option: 0 - 8N1 2 - 8E1 3 - 8O1	AT&W
AT+MCDM2	Get/Set Serial port data mode	**AT+MCDM2=<Data Mode Type>** Parameters: COM2 Data Mode Option: 0 - Seamless 1 - Transparent	AT&W
AT+MCCT2	Get/Set Serial port character timeout	**AT+MCCT2=<timeout>** Parameters: COM2 timeout: 1 to 65535 in seconds	AT&W
AT+MCMPS2	Get/Set Serial port maximum packet size	**AT+MCMPS2=<size>** Parameters: COM2 maximum packet size: 1 to 2048	AT&W
AT+MCNCDI2	Get/Set Serial port no-connection data intake	**AT+MCNCDI2=<Mode>** Parameters: COM2 Mode Option: 0 - Disable 1 - Enable	AT&W
AT+MCMTC2	Get/Set Serial port Modbus tcp configuration	**AT+MCMTC2=<Status>** Parameters: COM2 Modbus Status: 0 - Disable 1 - Enable	AT&W

5.0 AT Command Line Interface

Serial Port AT Commands (Continued)			
AT Command	**Description**	**Syntax**	**Effect**
AT+MCIPM2	Get/Set Serial port IP protocol mode	**AT+MCIPM2=<IP Protocol Config>** Parameters: COM2 IP Protocol Config: 0 - TCP Client 1 - TCP Server 2 - TCP Client/Server 3 - UDP Point to Point 4 - UDP Point to Multipoint(P) 5 - UDP Point to Multipoint(MP) 8 - PPP	AT&W
AT+MCTC2	Get/Set Serial port tcp client configuration when IP protocol mode is TCP Client	**AT+MCTC2=<Remote Server IP>,<Remote Server Port>,<Outgoing timeout>** Parameters: COM2: Remote Server IP : valid IP address Remote Server Port : 1 to 65535 Outgoing timeout : 1 to 65535 in seconds	AT&W
AT+MCTS2	Get/Set Serial port tcp server configuration when IP protocol mode is TCP Server	**AT+MCTS2=<Server Mode>,<Polling Timeout>,<Local Listening Port>,<Connection timeout>** Parameters: Server Mode : 0 - Monitor; 1 - Polling Polling timeout : 1 to 65535 in seconds Local Listening Port : 1 to 65535 Connection timeout : 1 to 65535 in seconds	AT&W
AT+MCTCS2	Get/Set Serial port tcp client/server configuration when IP protocol mode is TCP Client/Server	**AT+MCTCS2[=<Remote Server IP>,<Remote Server Port>,<Outgoing timeout>,<Server Mode>,<Polling Timeout>,<Local Listener Port>,<Incoming timeout>]** Parameters: Remote Server IP : valid IP address Remote Server Port : 1 to 65535 Outgoing timeout : 1 to 65535 in seconds Server Mode : 0 - Monitor; 1 - Polling Polling timeout : 1 to 65535 in seconds Local Listening Port : 1 to 65535 Incoming timeout : 1 to 65535 in seconds	AT&W
AT+MCUPP2	Get/Set Serial port UDP point to point configuration when IP protocol mode is UDP point to point	**AT+MCUPP2[=<Remote IP>,<Remote Port>,<Listening Port>,<UDP Timeout>]** Parameters: Remote IP : valid IP address Remote Port : 1 to 65535 Listening Port : 1 to 65535 UDP Timeout : 1 to 65535 in seconds	AT&W
AT+MCPPP2	Get/Set Serial port PPP configuration when IP protocol mode is PPP	**AT+MCPPP2[=<Mode>,<CCP negotiation>,<LCP Echo Failure Number>,<LCP Echo Interval>,<Local IP>,<Host IP>, <Idle Timeout>[,<Expected String>,<Response String>]]** Parameters: COM2: Mode : 0 - Active; 1 - Passive CCP negotiation : 0 - Disable; 1 - Enable LCP Echo Failure Number : [0 .. 65535] LCP Echo Interval : [0 .. 65535] Local IP : Valid IP address Host IP : Valid IP address Idle Timeout : 1 to 65535 in seconds Expected String : (Optional) 0 - 63 characters Response String : (Optional) 0 - 63 characters	AT&W
AT+MCUPMP2	Get/Set Serial port UDP point to multipoint as point configuration when IP protocol mode is set to UDP point to multipoint (P)	**AT+MCUPMP2[=<Multicast IP>,<Multicast Port>,<Listening Port>,<Time To Live>,<Multicast Interface>** Parameters: COM2: Multicast IP : valid IP address Multicast Port : 1 to 65535 Listening Port : 1 to 65535 Time To Live : 1 to 255 in seconds Multicast Interface : 0 - default 1 - LAN	AT&W
AT+MCUPMM2	Get/Set Serial port UDP point to multipoint as MP configuration when IP protocol mode be set to UDP point to multipoint (MP)	**AT+MCUPMM2[=<Remote IP>,<Remote Port>,<Multicast IP>,<Multicast Port>,<Multicast Interface>]** Parameters: COM2: Remote IP : valid IP address Remote Port : 1 to 65535 Multicast IP : valid IP address Multicast Port : 1 to 65535 Multicast Interface : 0 - default 1 - LAN	AT&W
AT+MCESCP2	Get/Set Serial support escape sequence configuration	**AT+MCESCP2[=<Escape Mode>[,<Escape Guard Interval>,<Escape Sequence String>]]** Parameters: COM2: Escape Mode : 0 - Disabled; 1 - Enabled Escape Guard Interval : 1 to 10 seconds Escape Sequence String : 3 to 7 characters	AT&W

5.0 AT Command Line Interface

Firewall AT Commands			
AT Command	**Description**	**Syntax**	**Effect**
AT+MFGEN	Get/Set firewall general configuration	**AT+MFGEN[=<Config>[,<Mode>]]** Parameters Config : 0 - WAN Remote Management 1 - WAN Request 2 - LAN to WAN Access Control 3 - Anti-Spoof 4 - Packet Normalization Mode : 0 - Disable (Block) 1 - Enable (Allow)	AT&W
AT+MFDMZ	Get/Set firewall DMZ configuration	**AT+MFDMZ[=<DMZ Source>[,<DMZ Mode>[,<DMZ Server IP>,<Exception Port>]]]** Parameters: DMZ Source : 0 - WAN DMZ Mode : 0 - Disable 1 - Enable DMZ Server IP : Valid IP address Exception Port : 0 - 65535	AT&W
AT+MFPORTFWD	Get/Set firewall Port Forwarding rule	**AT+MFPORTFWD[=<Name>[,<Operation>[,<Source>,<Internal IP>,<Internal Port>,<Protocol>,<External Port>,<SNAT>]]]** Parameters: Name : Name of Port Forwarding rule, 1 - 64 characters Operation : ADD - Add a rule EDIT - Edit a rule DEL - Delete a rule Source : 0 - WAN 1 - USB Internal IP : Valid IP address Internal Port : Valid port number, 1 - 65535 Protocol : 0 - TCP 1 - UDP 2 - TCPUDP External Port : Valid port number, 1 - 65535 Source NAT : 0 - No; 1 - Yes Usage: AT+MFPORTFWD AT+MFPORTFWD=<Name> AT+MFPORTFWD=<Name>,DEL AT+MFPORTFWD=<Name>,ADD,<Source>,<Internal IP>,<Internal Port>,<Protocol>,<External Port>,<SNAT> AT+MFPORTFWD=<Name>,EDIT,<Source>,<Internal IP>,<Internal Port>,<Protocol>,<External Port>,<SNAT>	AT&W
AT+MFMAC	Get/Set firewall MAC list	**AT+MFMAC[=<Name>[,<Operation>[,<Action>,<Mac Address>]]]** Parameters: Name : Name of firewall MAC list name, 1 - 64 characters Operation : ADD - Add a firewall MAC list EDIT - Edit a firewall MAC list DEL - Delete a firewall MAC list Action : 0 - Accept 1 - Drop 2 - Reject MAC Address : Valid MAC address Usage: AT+MFMAC AT+MFMAC=<Name> AT+MFMAC=<Name>,DEL AT+MFMAC=<Name>,ADD,<Action>,<Mac Address> AT+MFMAC=<Name>,EDIT,<Action>,<Mac Address>	AT&W
AT+MFIP	Get/SET firewall IP list	**AT+MFIP[=<Name>[,<Operation>[,<Action>,<Source>,<IP Address>[,<Prefix>]]]]** Parameters: Name : Name of firewall IP list name, 1 - 64 characters Operation : ADD - Add a firewall IP list EDIT - Edit a firewall IP list DEL - Delete a firewall IP list Action : 0 - Accept 1 - Drop 2 - Reject Source : 0 - LAN 1 - Independent LAN 2 - WAN 3 - USB Source IP : Valid IP address Prefix : 0 ~ 32. 32 (default) - single IP address Usage: AT+MFIP AT+MFIP=<Name> AT+MFIP=<Name>,DEL AT+MFIP=<Name>,ADD,<Action>,<Source>,<IP Address>[,<Prefix>] AT+MFIP=<Name>,EDIT,<Action>,<Source>,<IP Address>[,<Prefix>]	AT&W

5.0 AT Command Line Interface

Firewall AT Commands (Continued)			
AT Command	**Description**	**Syntax**	**Effect**
AT+MFRULE	Get/Set firewall rule	**AT+MFRULE[=<Name>[,<Operation>[,<Action>,<Source>,<Src IP Format>,<Src IP From/Subnet>, <Src IP To/Prefix>, <Destination>,<Dest IP Format>,<Dest IP From/Subnet>,<Dest IP To/Prefix>, <Dest Port>,<Protocol>]]]** Parameters: Name : Name of firewall rule name, 1 - 64 characters Operation : ADD - Add a firewall rule EDIT - Edit a firewall rule DEL - Delete a firewall rule Action : 0 - Accept 1 - Drop 2 - Reject Source : 0 - LAN 1 - Independent LAN 2 - WAN 3 - USB 4 - None IP Format : 0 - IP Range 1 - Subnet / Prefix IP From/Subnet: Valid IP address. 0 - Set to blank IP To/Prefix : Valid IP address. 0 - Set to blank; or 0 ~ 32 for Prefix Destination : 0 - LAN 1 - Independent LAN 2 - WAN 3 - USB 4 - None IP Format : 0 - IP Range 1 - Subnet / Prefix IP From/Subnet: Valid IP address. 0 - Set to blank IP To/Prefix : Valid IP address. 0 - Set to blank; or 0 ~ 32 for Prefix Port/Range : Port 0 ~ 65535 or Port range specified as 100:200 format Protocol : 0 - TCP 1 - UDP 2 - TCPUDP 3 - ICMP	AT&W
AT+MFRST	Reset to default firewall	**AT+MFRST <enter>**	Immediate
Network AT Commands			
AT Command	**Description**	**Syntax**	**Effect**
AT+MNLAN	Show/Add/Edit/Delete the network LAN interface	**AT+MNLAN** **AT+MNLAN=<LAN Name>** **AT+MNLAN=<LAN Name>,DEL** **AT+MNLAN=<LAN Name>,ADD/EDIT,<Protocol>[,<IP>,<Netmask>[,<Gateway>]] Where <Protocol>=0** **AT+MNLAN=<LAN Name>,ADD/EDIT,<Protocol> Where <Protocol>=1 or 3** **AT+MNLAN=<LAN Name>,EDIT,<Protocol>[,<IP>,<Netmask>] Where <Protocol>=2 and** <LAN Name>="lan" Parameters: LAN Name : Name of Network LAN interface. System built-in one is "lan" Operation : ADD - Add a new LAN interface EDIT - Edit an exsiting LAN interface DEL - Delete an existing LAN interface Protocol : 0 - Static IP 1 - DHCP with LAN alias disabled 2 - DHCP with LAN alias enabled, only for "lan" 3 - None. Not for "lan" IP Address : Valid IP address Netmask : Valid netmask Gateway : Valid IP address. 0 - Reset	AT&W
AT+MNLANDHCP	Get/Set LAN DHCP server on LAN interface	**AT+MNLANDHCP=<LAN Name>[,<Mode>[,<Start IP>,<Limit>,<Lease Time>[,<Alt. Gateway>, <Pre. DNS>,<Alt. DNS>,<WINS/NBNS Servers>,<WINS/NBT Node>]]]** Parameters: LAN Name : Name of Network LAN interface Mode : 0 - Disable DHCP Server 1 - Enable DHCP Server Start IP : The starting address DHCP assignable IP Addresses Limit : The maximum number of IP addresses. min=1 max=16777214 Lease Time : The DHCP lease time in minutes. 2~2147483647 minutes. 0 means'infinity' Alt. Gateway : Alternate Gateway for DHCP assigned devices if the default gateway is not to be used Pre. DNS : Preferred DNS server address to be assigned to DHCP devices Alt. DNS : Alternate DNS server address to be assigned to DHCP devices WINS/NBNS Server : WINS/NBNS Servers WINS/NBT Node : WINS/NBT Node Type 0 - none 1 - b-node 2 - p-node 3 - m-node 4 - h-node	AT&W

5.0 AT Command Line Interface

Network AT Commands (Continued)			
AT Command	**Description**	**Syntax**	**Effect**
AT+MNLANSTP	Get/Set the network LAN inetrafce: Spanning Tree (STP)	**AT+MNLANSTP=<LAN Name>[,<STP>]** Parameters: LAN Name : Name of Network LAN interface Spanning Tree : 0 - Off 1 - On	AT&W
AT+MNLANIGMP	Get/Set the network LAN interface: IGMP Snooping	**AT+MNLANIGMP=<LAN Name>[,<IGMP Snooping>]** Parameters: LAN Name : Name of Network LAN interface IGMP Snooping : 0 - Off 1 - On	AT&W
AT+MNLANDR	Get/Set the network LAN interface: Default Route	**AT+MNLANDR=<LAN Name>[,<Default Route>]** Parameters: LAN Name : Name of Network LAN interface Default Route : 0 - No 1 - Yes	AT&W
AT+MNLANDNS	Get/Set the network LAN interface: DNS	**AT+MNLANDNS=<LAN Name>[,<Mode>[,<Primary DNS>,<Secondary DNS>]]** Usage: AT+MNLANDNS=<LAN Name> AT+MNLANDNS=<LAN Name>,<Mode> Where <Mode>=0 AT+MNLANDNS=<LAN Name>,<Mode>[,<Primary DNS>,<Secondary DNS>] Where <Mode>=1 Parameters: LAN Name : Name of Network LAN interface Mode : 0 - Auto 1 - Manual Primary DNS : Valid IP Address or 0 (Reset) Secondary DNS : Valid IP address or 0 (Reset)	AT&W
AT+MNWAN	Get/Set the network WAN interface	**AT+MNWAN[=<Mode>[,<Protocol>[,<IP>,<Netmask>[,<Gateway>]]]]** Usage: AT+MNWAN AT+MNWAN=<Mode>,<Protocol>,<IP>,<Netmask>[,<Gateway>] Where <Mode>=0 and <Protocol>=0 AT+MNWAN=<Mode>,<Protocol>,<IP>,<Netmask> Where <Mode>=2 and <Protocol>=0 AT+MNWAN=<Mode>,<Protocol> Where <Mode>=0/2 and <Protocol>=1 AT+MNWAN=<Mode>,<Protocol> Where <Mode>=2 and <Protocol>=2 AT+MNWAN=<Mode> Where <Mode>=1 Parameters: Mode : 0 - Independent WAN 1 - Bridge with LAN Port 2 - Independent LAN Protocol: 0 - Static IP 1 - DHCP 2 - None IP : Valid IP address Netmask : Valid netmask Gateway : Valid IP address. 0 - Reset	AT&W
AT+MNWANDR	Get/Set the network WAN interface: Default Route	**AT+MNWANDR[=<Default Route>]** Parameters: Default Route : 0 - No 1 - Yes	AT&W
AT+MNWANDNS	Get/Set DNS Server when WAN port works as Independent WAN	**AT+MNWANDNS[=<Mode>[,<Primary DNS>,<Secondary DNS>]]** Usage: AT+MNWANDNS AT+MNWANDNS=<Mode> Where <Mode>=0 AT+MNWANDNS=<Mode>[,<Primary DNS>,<Secondary DNS>] Where <Mode>=1 Parameters: Mode : 0 - Auto 1 - Manual Primary DNS : Valid IP Address or 0 (Reset) Secondary DNS : Valid IP address or 0 (Reset)	AT&W
AT+MNWANLANDHCP	Get/Set LAN DHCP server when the WAN port is set as Independent LAN	**AT+MNWANLANDHCP[=<Mode>[,<Start IP>,<Limit>,<Lease Time>[,<Alt.Gateway>,<Pre.DNS>,<Alt.DNS>]]]** Usage: AT+MNWANLANDHCP AT+MNWANLANDHCP=<Mode> Where <Mode>=0 AT+MNWANLANDHCP=<Mode>,<Start IP>,<Limit>,<Lease Time>[,<Alt.Gateway>,<Pre.DNS> ,<Alt.DNS>] Where <Mode>=1 Parameters: Mode : 0 - Disable DHCP Server 1 - Enable DHCP Server Start IP : The starting address DHCP assignable IP Addresses Limit : The maximum number of IP addresses. min=1 max=16777214 Lease Time : The DHCP lease time in minutes. 2~2147483647 minutes. 0 means 'infinity' Alt. Gateway : Alternate Gateway for DHCP assigned devices if the default gateway is not to be used Pre. DNS : Preferred DNS server address to be assigned to DHCP devices Alt. DNS : Alternate DNS server address to be assigned to DHCP devices	AT&W

5.0 AT Command Line Interface

Network AT Commands (Continued)			
AT Command	**Description**	**Syntax**	**Effect**
AT+MNIPMAC	Show/Add/Delete/Release/ReleaseAll the MAC-IP address binding	**AT+MNIPMAC[=<Operation>[,<Name>[,<IP Address>,<MAC Address>]]]** Usage: AT+MNIPMAC AT+MNIPMAC=SHOW,<Name> AT+MNIPMAC=ADD,<Name>,<IP Address>,<MAC Address> AT+MNIPMAC=DEL,<NAME> AT+MNIPMAC=RELEASE,<NAME> AT+MNIPMAC=RELEASEALL Parameters: Operation : SHOW - Show the details of the MAC-IP address binding ADD - Add a new MAC-IP address binding DEL - Delete an existing MAC-IP address binding RELEASE - Release the active DHCP lease RELEASEALL - Release all active DHCP leases Name : Name of the MAC-IP binding, 1-64 characters IP Address : Valid IP address MAC Address: The physical MAC address of the device or interface	AT&W
AT+MNEMAC	Get the MAC address of the local Ethernet interface	**AT+MNEMAC <enter>** Sample Output: +MNEMAC: "00:0F:92:02:F9:0F" OK	Immediate
AT+MNPORT	Get/Set the Ethernet port configuration	**AT+MNPORT[=<Ethernet Port>[,<Mode>[,<Auto Negotiation>,<Speed>,<Duplex>]]]** Parameters: Ethernet Port : 0 - WAN 1 - LAN Mode : 0 - Auto 1 - Manual Auto-Negotiation : 0 - Off : 1 - On Speed : 0 - 10 Mbit/s 1 - 100 Mbit/s Duplex : 0 - Full 1 - Half	AT&W
AT+MNSTATUS	Get the network status	**AT+MNSTATUS <enter>** Sample Output: LAN Port Status General Status IP Address : 192.168.168.1 Connection Type : static Subnet Mask : 255.255.255.0 MAC Address : 00:0F:92:02:F9:0F Traffic Status Receive bytes : 262.633KB Receive packets : 3345 Transmit bytes : 168.370KB Transmit packets : 2229 WAN Port Status General Status IP Address : N/A Connection Type : dhcp Subnet Mask : N/A MAC Address : 00:0F:92:03:F9:0F Traffic Status Receive bytes : 0B Receive packets : 0 Transmit bytes : 0B Transmit packets : 0 Default Gateway : 192.168.168.1 DNS Server(s) : None Kernel IP routing table Destination Gateway Subnet Mask Flags Metric Ref Use Iface 0.0.0.0 192.168.168.1 0.0.0.0 UG 0 0 0 br-lan 192.168.168.0 0.0.0.0 255.255.255.0 U 0 0 0 br-lan	Immediate

5.0 AT Command Line Interface

Network AT Commands (Continued)			
AT Command	**Description**	**Syntax**	**Effect**
AT+MNUSB	Show/Edit the network USB Interface	**AT+MNUSB[=<Mode>[,<Protocol>[,<IP>,<Netmask>[,<Gateway>]]]]** Usage: AT+MNUSB AT+MNUSB=<Mode>,<Protocol>,<IP>,<Netmask>[,<Gateway>] Where <Mode>=0 and <Protocol>=0 AT+MNUSB=<Mode>,<Protocol> Where <Mode>=0 and <Protocol>=1 AT+MNUSB=<Mode> Where <Mode>=1/2 Parameters: Mode : 0 - Independent LAN 1 - Bridge with LAN Port 2 - Bridge with WAN Port Protocol: 0 - Static IP 1 - DHCP IP : Valid IP address Netmask : Valid netmask Gateway : Valid IP address. 0 - Reset	AT&W
AT+MNUSBDHCP	Get/Set USB DHCP server on USB interface	**AT+MNUSBDHCP[=<Mode>[,<Start IP>,<Limit>,<Lease Time>[,<Alt. Gateway>,<Pre. DNS>,<Alt. DNS>]]]** Parameters: Mode : 0 - Disable DHCP Server 1 - Enable DHCP Server Start IP : The starting address DHCP assignable IP Addresses Limit : The maximum number of IP addresses Lease Time : The DHCP lease time in minutes. 2~2147483647 minutes. 0 means 'infinity' Alt. Gateway : Alternate Gateway for DHCP assigned devices if the default gateway is not to be used Pre. DNS : Preferred DNS server address to be assigned to DHCP devices Alt. DNS : Alternate DNS server address to be assigned to DHCP devices	AT&W
AT+MNUSBDR	Get/Set the network USB interface: Default Route	**AT+MNUSBDR[=<Default Route>]** Parameters: Default Route : 0 - No 1 - Yes	AT&W
AT+MNUSBDNS	Get/Set the network USB interface: DNS	**AT+MNUSBDNS[=<Mode>[,<Primary DNS>,<Secondary DNS>]]** Usage: AT+MNUSBDNS AT+MNUSBDNS=<Mode> Where <Mode>=0 AT+MNUSBDNS=<Mode>[,<Primary DNS>,<Secondary DNS>] Where <Mode>=1 Parameters: Mode : 0 - Auto 1 - Manual Primary DNS : Valid IP Address or 0 (Reset) Secondary DNS : Valid IP address or 0 (Reset)	AT&W

5.0 AT Command Line Interface

System AT Commands			
AT Command	**Description**	**Syntax**	**Effect**
AT+MSCNTO	Get/Set the console timeout	**AT+MSCNTO=<Timeout_s>** Parameter: <Timeout_s> : 30 to 65535 in seconds, 0-Disable	AT&W
AT+MSPWD	Set password	**AT+MSPWD=<New Password>,<Confirm Password>** Parameters: <New Password> : 5-64 characters except space <Confirm Password> : Same as <New Password>	AT&W
AT+MSGMI	Get manufacturers identification	**AT+MSGMI <enter>** Sample Output: +MSGMI: 2017-2019 Microhard.	Immediate
AT+MSSYSI	Get system summary information	**AT+MSSYSI <enter>** Sample Output: +MSSYSI: LAN Port: MAC : 00:0F:92:04:22:84 IP : 192.168.168.1 MASK : 255.255.255.0 System: Device : UserDevice Product : pDDL-MIMO Image : pMDDL Hardware : Rev A Software : v1.4.0 build 1020 Copyright : 2017-2019 Microhard Systems Inc. System Time : Wed Dec 31 18:19:43 2019	Immediate
AT+MSGMR	Get modem Record information	**AT+MSGMR <enter>** Sample Output: +MSGMR: Hardware Version : Rev A Software Version : v1.4.0 build 1020 Copyright : 2017-2019 Microhard Systems Inc. System Time : Wed Dec 31 18:20:34 2019	Immediate
AT+MSIMG	Get the image status for both active and inactive images	**AT+MSIMG <enter>** Active Version : v1.4.0-r1020 Active Build Time : 2020-01-22 15:26:22 Inactive Version : v1.4.0-r1012 Inactive Build Time : 2018-08-24 16:54:09	Immediate
AT+MSMNAME	Get/Set modem Name setting	**AT+MSMNAME=<Modem_Name>** Parameter: <Modem_Name> : 1 - 64 characters. Must be alphanumeric or dots(.), or dashes(-) or underscores(_)	AT&W
AT+MSRTF	Reset the modem to the factory default settings from non-volatile (NV) memory	**AT+MSRTF=<Action>** Parameter: <Action>: 0 - Pre-set action 1 - Confirm action	AT&W
AT+MSREB	Reboot the modem	**AT+MSREB <enter>** Sample Output: Rebooting...	Immediate
AT+MSNTP	Get/Set NTP server	**AT+MSNTP[=<Mode>[,<Server>,<Port>,<Client Interval>]]** Parameters: <Mode> : 0 - Local Time; 1 - NTP <Server> : Valid IP Address or Name <Port> : 1 to 65535. Default is 123 <Client Interval> : 15 to 65535 in seconds, 0-Disable	AT&W
AT+MSSYSLOG	Get/Set Syslog server settings	**AT+MSSYSLOG[=<Server>[,<Port>]]** Parameters: <Server> : Valid IP Address or Name. 0.0.0.0 - Disable. 1 to 256 characters <Port> : 1 to 65535. Default is 514	AT&W
AT+MSSERVICE	Get/Set service status and port	**AT+MSSERVICE[=<Service>[,<Mode>[,<Port>]]]** Parameters: <Service> : 0 - FTP 1 - Telnet 2 - SSH <Mode> : 0 - Disable 1 - Enable <Port> : 0 to 65535. For Telnet (23 by default) and SSH (22 by default) only	AT&W
AT+MSWEBUI	Get/Set Web UI protocol and port	**AT+MSWEBUI[=<Mode>[,<HTTP Port>][,<HTTPS Port>]]]** Parameters: <Mode> : 0 - HTTP/HTTPS 1 - HTTP 2 - HTTPS 3 - Disable <HTTP Port> : 2 to 65534. 80 by default <HTTPS Port> : 2 to 65534. 443 by default	AT&W
AT+MSTR	Get Traffic status on interfaces	**AT+MSTR[=<Interfaces>]** <Interfaces> : 0 - WIFI 1 - Serial COM 2 - WAN 3 - LAN **AT+MSTR=0 <enter>** WIFI RX packets: 408 RX bytes : 57.301KB TX packets: 0 TX bytes : 0B	Immediate

5.0 AT Command Line Interface

Serial USB - AT Commands			
AT Command	**Description**	**Syntax**	**Effect**
AT+MUSBPS	Get/Set Serial USB Port Status *Only available when valid USB to Serial Adapter is connected*	**AT+MUSBPS[=<USB Serial>[,<Mode>]]** Parameters: USB Serial : 0 - GS0 Mode : 0 - Idle 1 - Data	AT&W
AT+MUSBBR	Get/Set Serial USB port baud rate *Only available when valid USB to Serial Adapter is connected*	**AT+MUSBR[=<USB Serial>[,<Baud Rate>]]** Parameters: USB Serial: 0 - GS0 Baud Rate : 0 - 300 1 - 600 2 - 1200 3 - 2400 4 - 3600 5 - 4800 6 - 7200 7 - 9600 8 - 14400 9 - 19200 10 - 28800 11 - 38400 12 - 57600 13 - 115200 14 - 230400 15 - 460800 16 - 921600	AT&W
AT+MUSBDF	Get/Set Serial USB data format *Only available when valid USB to Serial Adapter is connected*	**AT+MUSBDF[=<USB Serial>[,<Data Format>]]** Parameters: USB Serial: 0 - GS0 Data Format: 0 - 8N1 1 - 8E1 2 - 8O1	AT&W
AT+MUSBFC	Get/Set Serial USB port flow control	**AT+MUSBFC[=<USB Serial>[,<Flow Control>]]** Parameters: USB Serial: 0 - GS0 Flow Control: 0 - none 1 - RTS/CTS	AT&W
AT+MUSBDM	Get/Set Serial USB port data mode	**AT+MUSBDM[=<USB Serial>[,<Data Mode>]]** Parameters: USB Serial: 0 - GS0 Data Mode: 0 - Seamless 1 - Transparent	AT&W
AT+MUSBCT	Get/Set USB port character timeout	**AT+MUSBCT[=<USB Serial>[,<Timeout>]]** Parameters: USB Serial: 0 - GS0 Timeout: 1 to 65535 in seconds	AT&W
AT+MUSBMPS	Get/Set Serial USB port maximum packet size	**AT+MUSBMPS[=<USB Serial>[,<Maximum Packet Size>]]** Parameters: USB Serial : 0 - GS0 Maximum Packet Size : 1 to 2048	AT&W
AT+MUSBNCDI	Get/Set Serial USB port no-connection data intake	**AT+MUSBNCDI[=<USB Serial>[,<No-Connection Data>]]** Parameters: USB Serial: 0 - GS0 No-Connection Data: 0 - Disable 1 - Enable	AT&W
AT+MUSBMTC	Get/Set Serial USB port modbus tcp configuration	**AT+MUSBMTC[=<USB Serial>[,<Modbus Status>]]** Parameters: USB Serial: 0 - GS0 Modbus Status: 0 - Disable 1 - Enable	AT&W
AT+MUSBIPM	Get/Set Serial USB port IP protocol mode	**AT+MUSBIPM[=<USB Serial>[,<IP Protocol Config>]]** Parameters: USB Serial : 0 - GS0 IP Protocol Config : 0 - TCP Client 1 - TCP Server 2 - TCP Client/Server 3 - UDP Point to Point 4 - UDP Point to Multipoint(P) 5 - UDP Point to Multipoint(MP)	AT&W

5.0 AT Command Line Interface

Serial USB - AT Commands			
AT Command	**Description**	**Syntax**	**Effect**
AT+MUSBTC	Get/Set Serial USB port tcp client configuration when IP protocol mode is TCP Client	**AT+MUSBTC[=<USB Serial>[,<Remote Server IP>,<Remote Server Port>,<Outgoing timeout>[,<Fast Recovery>]]]** Parameters: USB Serial : 0 - GS0 Remote Server IP : valid IP address Remote Server Port : 1 to 65535 Outgoing timeout : 1 to 65535 in seconds Fast Recovery : 0 - Disable; 1 - Enable	AT&W
AT+MUSBTS	Get/Set Serial USB port tcp server configuration when IP protocol mode is TCP Server	**AT+MUSBTS[=<USB Serial>[,<Server Mode>,<Polling Timeout>,<Local Listening Port>,<Connection timeout>[,<Fast Recovery>]]]** Parameters: USB Serial : 0 - GS0 Server Mode : 0 - Monitor; 1 - Polling Polling timeout : 1 to 65535 in seconds Local Listening Port : 1 to 65535 Connection timeout : 1 to 65535 in seconds Fast Recovery : 0 - Disable; 1 - Enable	AT&W
AT+MUSBTCS	Get/Set Serial USB port tcp client/server configuration when IP protocol mode is TCP Client/ Server	**AT+MUSBTCS[=<USB Serial>[,<Remote Server IP>,<Remote Server Port>,<Outgoing timeout>, <Server Mode>,<Polling Timeout>,<Local Listener Port>,<Incoming timeout>[, <Fast Recovery>]]]** Parameters: USB Serial : 0 - GS0 Remote Server IP : valid IP address Remote Server Port : 1 to 65535 Outgoing timeout : 1 to 65535 in seconds Server Mode : 0 - Monitor; 1 - Polling Polling timeout : 1 to 65535 in seconds Local Listening Port : 1 to 65535 Incoming timeout : 1 to 65535 in seconds Fast Recovery : 0 - Disable; 1 - Enable	AT&W
AT+MUSBUPP	Get/Set Serial USB port UDP point to point configuration when IP protocol mode is UDP point to point	**AT+MUSBUPP[=<USB Serial>[,<Remote IP>,<Remote Port>,<Listening Port>,<UDP Timeout>]]** Parameters: USB Serial : 0 - GS0 Remote IP : valid IP address Remote Port : 1 to 65535 Listening Port : 1 to 65535 UDP Timeout : 1 to 65535 in seconds	AT&W
AT+MUSBUPMP	Get/Set Serial USB port UDP point to multipoint as point configuration when IP protocol mode be set to UDP point to multipoint (P)	**AT+MUSBUPMP[=<USB Serial>[,<Multicast IP>,<Multicast Port>,<Listening Port>,<Time To Live>,<Multicast Interface>]]** Parameters: USB Serial: 0 - GS0 Multicast IP: valid IP address Multicast Port: 1 to 65535 Listening Port: 1 to 65535 Time To Live: 1 to 255 in seconds Multicast Interface: 0 - default 1 - LAN	AT&W
AT+MUSBUPMM	Get/Set Serial USB port UDP point to multipoint as MP configuration when IP protocol mode be set to UDP point to multipoint (MP)	**AT+MUSBUPMM[=<USB Serial>[,<Remote IP>,<Remote Port>,<Multicast IP>,<Multicast Port>,<Multicast Interface>]]** Parameters: USB Serial: 0 - GS0 Remote IP: valid IP address Remote Port: 1 to 65535 Multicast IP: valid IP address Multicast Port: 1 to 65535 Multicast Interface: 0 - default 1 - LAN	AT&W

5.0 AT Command Line Interface

Wireless (Radio) AT Commands			
AT Command	**Description**	**Syntax**	**Effect**
AT+MWRADIO	Get/Set radio status, On or Off	**AT+MWRADIO[=<Radio>]** <Radio> 0 - Off 1 - On	AT&W
AT+MWDISTANCE	Get/Set radio Wireless Distance	**AT+MWDISTANCE[=<Distance>]** <Distance> 1 - 200000 in meter	AT&W
AT+MWTXPOWER AT+MWTXPOWERQ	Get/Set radio Tx power Set run-time radio Tx power* *Can be used to temporarily change output power on the fly without taking unit offline.	**AT+MWTXPOWER[=<Tx Power>]** <Tx Power> 7 - 7 dbm 8 - 8 dbm 9 - 9 dbm 10 - 10 dbm 11 - 11 dbm 12 - 12 dbm 13 - 13 dbm 14 - 14 dbm 15 - 15 dbm 16 - 16 dbm 17 - 17 dbm 18 - 18 dbm 19 - 19 dbm 20 - 20 dbm 21 - 21 dbm 22 - 22 dbm 23 - 23 dbm 24 - 24 dbm 25 - 25 dbm 26 - 26 dbm 27 - 27 dbm 28 - 28 dbm 29 - 29 dbm 30 - 30 dbm	AT&W Immediate
AT+MWBAND AT+MWBANDQ	Get/Set radio channel-bandwidth Set run-time radio channel-bandwidth* *Can be used to temporarily change channel bandwidth on the fly without taking unit offline.	**AT+MWBAND[=<Channel Bandwidth>[,<Symbol Rate>]]** Available radio channel bandwidth for pMDDL mode 0 - 8 MHz 1 - 4 MHz	AT&W Immediate
AT+MWFREQ2400	Get/Set radio channel-frequency (Options vary by channel bandwidth)	**AT+MWFREQ2400[=<MHz Channel Frequency>]** <Channel Frequency> : 4 - 2405 MHz . . . 78- 2479 MHz	AT&W
AT+MWMIMO	Get/Set radio MIMO	**AT+MWMIMO[=<MIMO>]** <MIMO> : 0 - Off 1 - On	AT&W
AT+MWMCASTRT	Get/Set radio Multicast Rate	**AT+MWMCASTRT[=<Multicast Rate>]** <Multicast Rate> : 0 - QPSK FEC 1/2 1 - QPSK FEC 3/4 2 - 16-QAM FEC 1/2 3 - 16-QAM FEC 3/4 4 - 64-QAM FEC 2/3	AT&W
AT+MWVMODE	Get/Set radio mode	**AT+MWVMODE[=<Virtual Interface Mode>]** <Virtual Interface Mode> : 0 - Master 1 - Slave 2 - Repeater	AT&W

5.0 AT Command Line Interface

Wireless (Radio) AT Commands (Continued)			
AT Command	**Description**	**Syntax**	**Effect**
AT+MWVRATE	Get/Set radio TX Rate	**AT+MWVRATE[=<Virtual Interface TX Rate>]** <Virtual Interface TX Rate> : 0 - auto 1 - 64-QAM FEC 5/6 2 - 64-QAM FEC 3/4 3 - 64-QAM FEC 2/3 4 - 16-QAM FEC 3/4 5 - 16-QAM FEC 1/2 6 - QPSK FEC 3/4 7 - QPSK FEC 1/2 8 - BPSK FEC 1/2	AT&W
AT+MWCRATE	Get/Set Ceiling Rate	**AT+MWCRATE[=<Status>[,<Tx Ceiling Rate>]]** <Status> : 0 - Disable , 1 - Enable <Tx Ceiling Rate> : 0 - 64-QAM FEC 5/6 1 - 64-QAM FEC 3/4 2 - 64-QAM FEC 2/3 3 - 16-QAM FEC 3/4 4 - 16-QAM FEC 1/2 5 - QPSK FEC 3/4 6 - QPSK FEC 1/2 7 - BPSK FEC 1/2 Note : Tx Ceiling Rate Setting is available when radio TX Rate is auto	AT&W
AT+MWMDEG	Get/Set Degree of Mesh Path Agility	**AT+MWMDEG[=<Degree of Mesh Path Agility>]** <Degree of Mesh Path Agility> : 0 - High 1 - Medium 2 - Low	AT&W
AT+MWVRATEQ	Set run-time radio TX Rate* *Can be used to temporarily change TX Rate on the fly without taking unit offline.	**AT+MWVRATEQ[=<Virtual Interface TX Rate>]** <Virtual Interface TX Rate> : 0 - auto 1 - 64-QAM FEC 5/6 2 - 64-QAM FEC 3/4 3 - 64-QAM FEC 2/3 4 - 16-QAM FEC 3/4 5 - 16-QAM FEC 1/2 6 - QPSK FEC 3/4 7 - QPSK FEC 1/2 8 - BPSK FEC 1/2	Immediate
AT+MWEXTADDR	Get/Set radio extended addressing	**AT+MWEXTADDR[=<Extended Addressing>]** <Extended Addressing> : 0 - Off 1 - On	AT&W
AT+MWNETWORKID	Get/Set radio Network ID	**AT+MWNETWORKID[=<Network ID>]** <Network ID> Radio Virtual Interface Network ID: 1-64 characters	AT&W
AT+MWMESHID	Get/Set radio Mesh ID	**AT+MWMESHID[=<Mesh ID>]** <Mesh ID> Radio Virtual Interface Mesh ID: 1-64 characters	AT&W
AT+MWVENCRYPT	Get/Set radio Encryption Type & Key	**AT+MWVENCRYPT[=<Encryption Type>[,<Key>]]** <Encryption Type> Radio Virtual Interface Encryption Type: 0 - Disabled 1 - AES-128 <Key>: Min 8 characters, Max 64 characters	AT&W
AT+MWRESYNC	RF Re-Sync from the slave side	**AT+MWRESYNC <enter>**	Immediate

5.0 AT Command Line Interface

Wireless (Radio) AT Commands (Continued)			
AT Command	**Description**	**Syntax**	**Effect**
AT+MWINTFSCAN	Generate radio channel interference information in 10 to 30 seconds. Available for the pMDDL2450 & 2550.	**AT+MWINTFSCAN[=<Sorting>]** The spectral scan action takes about 10 to 30 seconds. <Sorting> : 0 - Not sorting the scan result (default) 1 - Sorting the scan result Sample Result: AT+MWINTFSCAN=1 FREQ LVL_AVG LVL_MAX ACTIVITY 2537 -92 -89 40 2538 -92 -89 40 2558 -92 -89 47 2504 -92 -88 67 2514 -92 -88 67 2516 -92 -88 66 2559 -92 -88 54 2560 -92 -88 51 2505 -92 -87 76 2515 -92 -87 61 2517 -92 -87 70 2535 -92 -87 32 2536 -92 -87 30 2557 -92 -87 42 2500 -92 -86 65 2502 -92 -86 71 2506 -92 -86 69 2518 -92 -86 63 2561 -92 -86 51 2503 -92 -85 72 2519 -92 -84 82 2567 -92 -84 58 2501 -92 -83 65 2508 -92 -83 70 2507 -92 -82 78 2562 -92 -82 53 2513 -92 -76 67 2556 -92 -68 58 2520 -91 -84 79 2568 -91 -83 64 2563 -91 -82 57 2564 -91 -82 56 2566 -91 -82 64 2570 -91 -81 51 2565 -91 -80 62 2569 -91 -80 63 2552 -91 -79 86 2521 -91 -78 73 2509 -91 -76 79 2512 -91 -74 64 2553 -91 -73 71 2539 -91 -64 38 2549 -90 -79 56 2550 -90 -79 56 2551 -90 -76 91 2510 -90 -69 82 2554 -90 -67 71 2555 -90 -67 69 2534 -90 -39 35 2511 -89 -70 87 2548 -89 -61 65 2523 -88 -65 85 2522 -88 -64 85 2540 -88 -63 50 2524 -87 -70 80 2526 -87 -69 86 2525 -87 -67 92 2546 -87 -67 67 2527 -87 -65 76 2541 -87 -63 52 2547 -87 -61 62 2542 -87 -60 59 2545 -86 -71 61 2544 -86 -64 57 2529 -86 -57 68 2530 -86 -54 65 2543 -85 -63 51 2528 -85 -62 100 2531 -84 -51 63 2532 -80 -38 62 2533 -78 -34 38	Immediate

5.0 AT Command Line Interface

Wireless (Radio) AT Commands (Continued)			
AT Command	**Description**	**Syntax**	**Effect**
AT+MWSTATUS	Get the status of RF	**AT+MWSTATUS <enter>** Sample Output: General Status MAC Address : 00:0F:92:FA:38:30 Operation Mode : Master Network ID : pMDDL Bandwidth : 4 MHz Frequency : 2441 Tx Power : 20 dBm Encryption Type : AES-128 Traffic Status Receive Bytes : 0B Receive Packets : 0 Transmit Bytes : 89.076KB Transmit Packets : 550 OK Connection Info MAC Address : 00:0F:92:FA:59:F9 Tx Mod : 64-QAM FEC 5/6 Rx Mod : 64-QAM FEC 2/3 SNR (dB) : 75 RSSI (dBm) : -24	Immediate
AT+MWSNR	Get the value of SNR (Slave)	**AT+MWSNR <enter>** Sample Output: 43	Immediate
AT+MWNOISEFLOOR	Get the value of Noise Floor (Slave)	**AT+MWNOISEFLOOR <enter>** Sample Output: -99	Immediate
AT+MWSQTHRESH	Get/Set Squelch threshold	**AT+MWSQTHRESH[=<Squelch Threshold>]** Squelch Threshold : -1 to -128 (-1 = Turn off the threshold)	AT&W
AT+MWRSSI	Get radio RSSI	**AT+MWRSSI <enter>** Sample Output: 00:0F:92:FA:59:F9 -74 dBm	Immediate

6.0 Installation

The installation, removal, or maintenance of any antenna system components must be undertaken only by qualified and experienced personnel.

The are a number of factors to consider when preparing to deploy a radio network, several of which have been touched-upon or detailed elsewhere within this manual. Following is a listing of a number of factors, in no particular order:

Network Topology

The pMDDL currently supports Master and Slave modes which can create either Point to Multipoint or Point to Point network topologies.

Throughput

The pMDDL is capable of up to 25 Mbps throughput. The network topology has an effect on how this available throughput is 'shared' between all nodes on the network.

Distance

The physical distance between the modems dictates such things as required antenna performance and heights. When contemplating antenna types, keep in mind the directivity (omnidirectional or directional) of the antennas being used.

Terrain

Along with distance, the terrain is a very important consideration with respect to antenna height requirements. The term 'line-of-sight' (LOS) refers to being able to 'see' one location from another - a minimum requirement for a radio signal path. In addition to LOS, adequate clearance must also be provided to satisfy 'Fresnel Zone' requirements - an obstruction-free area much greater than the physical LOS, i.e. LOS is not enough to completely satisfy RF path requirements for a robust communications link.

Transmit Power

Having read thus far through the factors to be considered, it should be clear that they are all interrelated. Transmit power should be set for the minimum required to establish a reliable communications path with adequate fade margin. Required transmit power is dictated primarily by distance, antenna type (specifically the 'gain' of the antennas being used), and the receive sensitivity of the distant modem. Cable and connector losses (the physical path from the modem's 'antenna connector' to the antenna's connector) must also be taken into account.

Receive Sensitivity

The Pico Series has exceptional receive sensitivity, which can produce a number of benefits, such as: added fade margin for a given link, being able to use less expensive coaxial cable or antenna types, being able to operate at greater distances for a given distant transmitter power (perhaps negating the requirement for a Repeater site!). Distance, antenna gain, transmit power, and receive sensitivity are critical 'numbers' for radio path calculations. Fortunately, the Pico Series features the maximum available transmit power combined with exceptional receive sensitivity - two 'numbers' which will produce the most favorable path calculation results.

6.0 Installation

Fade Margin

When all radio path numbers are being considered and hardware assumptions are being made, another factor to consider is the 'fade margin' of the overall system. The fade margin is the difference between the anticipated receive signal level and the minimum acceptable receive level (receive sensitivity). Being that the Pico Series performs to exacting specifications, the overall deployment should be such that the modems may be utilized to their full potential to provide a reliable and robust communications link. A typical desired fade margin is in the order of 20dB, however oftentimes a 10dB fade margin is acceptable.

Frequency

The 2.4 GHz frequency range is not effected by rain to any significant degree, and is also able to penetrate through foliage and 'around obstacles' to a certain degree. This being the case, some may choose to scrimp on the physical deployment, particularly when it comes to antenna (tower) heights. Path calculations provide results which specify 'required' antenna heights. For cost savings and in taking advantage of the characteristics of the frequency range, sometimes the height requirements are not adhered to: this may result in unreliable communications.

Power Requirements

The Pico Series may be integrated into a system (Development Board, or custom) which accepts a range of DC input voltages (supply current requirements must also be met). In some deployments, power consumption is critical. A number of features related to minimizing power consumption are available with the pMDDL such the ability to operate at lower transmit power given the receive sensitivity of the distant modem.

Interference

The channel selection of the pMDDL often allows it to work well in an environment within which there may be sources of in-band interference. Cavity filters are also available if required: contact Microhard Systems Inc. for further information.

6.0 Installation

6.1 Path Calculation

FCC regulations allow for up to 36dBi effective isotropic radiated power (EIRP). The sum (in dBm) of the transmitted power, the cabling loss, and the antenna gain cannot exceed 36dBi.

Assuming adequate antenna heights, a basic formula to determine if an adequate radio signal path exists (i.e. there is a reasonable fade margin to ensure reliability) is:

Fade Margin = System Gain - Path Loss

where all values are expressed in dB.

As discussed on the previous page, a desired fade margin is 20dB.

System gain is calculated as follows:

System Gain = Transmitter Power + (Transmitter Antenna Gain - Transmitter Cable and Connector Losses) + (Receiver Antenna Gain - Receiver Cable and Connector Losses) + | Receiver Sensitivity |.

where all values are expressed in dB, dBi, or dBm, as applicable.

Assuming a path loss of 113dB for this example, the fade margin = 143-113 = 30dB.
30dB exceeds the desired fade margin of 20dB, therefore this radio communications link would be very reliable and robust.

On the following page are examples of actual path loss measurements taken in an open rural environment; the path loss numbers do not apply to urban or non-LOS environments.

Example:

Tx power = 30dBm
Tx antenna gain = 6dBi
Tx cable/connector loss = 2dB
Rx antenna gain = 3dBi
Rx cable/connector loss = 2dB
Rx sensitivity = -108dBm

System Gain = [30+(6-2)+(3-2)+108]dB
= [30+4+1+108]dB
= 143dB.

6.0 Installation

Distance (km)	Master Height (m)	Remote Height (m)	Path Loss (dB)
5	15	2.5	116.5
5	30	2.5	110.9
8	15	2.5	124.1
8	15	5	117.7
8	15	10	105
16	15	2.5	135.3
16	15	5	128.9
16	15	10	116.2
16	30	10	109.6
16	30	5	122.4
16	30	2.5	128.8

Table 6-1: Path Loss

To satisfy FCC radio frequency (RF) exposure requirements for mobile transmitting devices, a separation distance of 23cm or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operation at less than this distance is not recommended. The antenna used for this transmitter must not be co-located in conjunction with any other antenna or transmitter.

Never work on an antenna system when there is lightning in the area.

6.2 Installation of Antenna System Components

The installation, removal, or maintenance of any antenna system components must be undertaken only by qualified and experienced personnel.

6.2.1 Antennas

The two most common types of antenna are the omnidirectional (’omni’) and directional (Yagi).

An **omni** typically has 3-6dBi gain and spreads its energy in all directions (hence the name ’omnidirectional’). The ’pattern’ of the energy field is in the shape of a donut, with the antenna mounted vertically at the centre. This vertical-mounted antenna produces a signal which is vertically ’polarized’.

A **Yagi** has a more focused antenna pattern, which results in greater gain: commonly, 6-12dBi. The pattern of a Yagi is in the shape of a large raindrop in the direction in which the antenna is pointed. If the elements of the Yagi are perpendicular to the ground (most common orientation) the radiated signal will be vertically polarized; if parallel to the ground, the polarization is horizontal.

The network topology, application, and path calculation are all taken into consideration when selecting the various antenna types to be used in a radio network deployment.

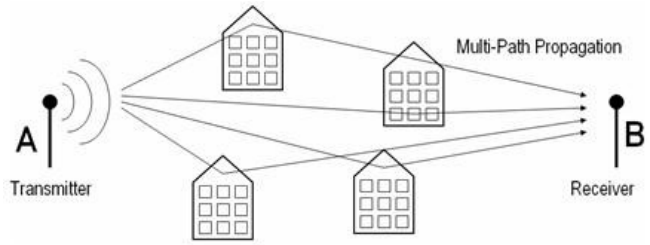
6.0 Installation

6.2.2 2X2 MIMO Antenna Selection, Placement & Orientation

For optimal performance of the pMDDL modems one must consider and plan for the specific application and environment where the pMDDL modules will be used. Described below are some of the considerations that must be taken into account while using pMDDL modems.

Multipath Environments

A multipath environment is where the signal from origin to destination may not have a direct path as seen in the illustration below:



In a multipath rich conditions is it recommended that each pMDDL end have a pair (2) of omni directional antennas that have at least half-wavelength distance between them. A set of (4) Omni-directional antennas is good for a pair of pMDDL radios.

The wavelength* is determined by the specific frequency being used by the pMDDL. For example the length of a wavelength @ 2.450 MHz is 122 mm, therefore the half wavelength is 61 mm. This would mean that the pair of antennas on each pMDDL system would have to be spaced at least 61 mm apart.

** Refer to a wavelength calculator or antenna manufacturer for accurate wavelength calculations*

LOS (Line of Sight) Environments

In good LOS applications, where the main LOS signal is much stronger than other components, orthogonally polarized antennas on both radios will out perform other types of antennas in terms of spatial separation. With these types of antenna systems it is recommended to space each pair of antennas at least one or more wavelengths apart on each end of the system to achieve as much spatial diversity as possible.

- Circular polarized antennas (Left Hand Circular Polarization (LHCP) and Right Hand Circular Polarization (RHCP)) will work with circular polarized antennas (LHCP and RHCP) for best match.
- Circular polarized antennas (LHCP and RHCP) will work with linear orthogonal antennas (V-POL and H-POL) at about 3 db loss. This combination results in preferable performance for UAV applications as circular polarized antennas at GCS acquire adequate signal no matter what the UAV antennas' orientation change to.
- Linear polarized antennas (V-POL and H-POL) will work with linear orthogonal antennas (V-POL and H-POL) for best match.
- OMNI directional antennas work with OMNI directional antennas due to dimension & weight limitation, two antennas are one or more wavelengths apart .

Circular Polarized Antenna

Linear Orthogonal Antenna

OMNI Directional Antenna(s)

6.0 Installation

6.2.3 Coaxial Cable

The following types of coaxial cable are recommended and suitable for most applications (followed by loss at 2.4GHz, in dB, per 100 feet):

- LMR 195 (10.7)
- LMR 400 (3.9)
- LMR 600 (2.5)

For a typical application, LMR 400 may be suitable. Where a long cable run is required - and in particular within networks where there is not a lot of margin available - a cable with lower loss should be considered.

When installing cable, care must be taken to not physically damage it (be particularly careful with respect to not kinking it at any time) and to secure it properly. Care must also be taken to affix the connectors properly - using the proper crimping tools - and to weatherproof them.

6.2.4 Surge Arrestors

The most effective protection against lightning-induced damage is to install two lightning surge arrestors: one at the antenna, the other at the interface with the equipment. The surge arrestor grounding system should be fully interconnected with the transmission tower and power grounding systems to form a single, fully integrated ground circuit. Typically, both ports on surge arrestors are N-type female.

Direct human contact with the antenna is potentially unhealthy when a pMDDL is generating RF energy.

Always ensure that the pMDDL equipment is powered down (off) during installation.

To comply with FCC regulations, the maximum EIRP must not exceed 36dBm.

Installation, maintenance, and removal work must be done in accordance with applicable codes.

Appendix A: Serial Interface

Module (DCE)		Signal		Host (e.g. PC) (DTE)
1		DCD	→	IN
2		RX	→	IN
3	←	TX		OUT
4	←	DTR		OUT
5		SG		
6		DSR	→	IN
7	←	RTS		OUT
8		CTS	→	IN

Arrows denote the direction that signals are asserted (e.g., DCD originates at the DCE, informing the DTE that a carrier is present).

The interface conforms to standard RS-232 signals, so direct connection to a host PC (for example) is accommodated.

The signals in the asynchronous serial interface are described below:

DCD *Data Carrier Detect* - Output from Module - When asserted (TTL low), DCD informs the DTE that a communications link has been established with another device.

RX *Receive Data* - Output from Module - Signals transferred from the pMDDL are received by the DTE via RX.

TX *Transmit Data* - Input to Module - Signals are transmitted from the DTE via TX to the pMDDL.

DTR *Data Terminal Ready* - Input to Module - Asserted (TTL low) by the DTE to inform the module that it is alive and ready for communications.

SG *Signal Ground* - Provides a ground reference for all signals transmitted by both DTE and DCE.

DSR *Data Set Ready* - Output from Module - Asserted (TTL low) by the DCE to inform the DTE that it is alive and ready for communications. DSR is the module's equivalent of the DTR signal.

RTS *Request to Send* - Input to Module - A "handshaking" signal which is asserted by the DTE (TTL low) when it is ready. When hardware handshaking is used, the RTS signal indicates to the DCE that the host can receive data.

CTS *Clear to Send* - Output from Module - A "handshaking" signal which is asserted by the DCE (TTL low) when it has enabled communications and transmission from the DTE can commence. When hardware handshaking is used, the CTS signal indicates to the host that the DCE can receive data.

Notes: It is typical to refer to RX and TX from the perspective of the DTE. This should be kept in mind when looking at signals relative to the module (DCE); the module transmits data on the RX line, and receives on TX.

"DCE" and "module" are often synonymous since a module is typically a DCE device.
"DTE" is, in most applications, a device such as a host PC.

Appendix B: Firmware Recovery Procedure

In event that your unit becomes unresponsive it may be required to perform a firmware recovery procedure outlined below:

1. Download and save firmware file in a local folder, for example C:\;

2. Separate the PC from the network and set IP to static:

192.168.1.1
255.255.255.0

3. Connect PC Ethernet port to the Ethernet port of the modem to be recovered

4. Start a ping on the PC

C:\>ping 192.168.1.39 -t
Pinging 192.168.1.39 with 32 bytes of data:
Request timed out.
Request timed out.

5. Power cycle modem while pressing and holding CFG (Config) button;

6. Release the CFG button when ping responded:

C:\>ping 192.168.1.39 -t
Pinging 192.168.1.39 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Reply from 192.168.1.39: bytes=32 time<1ms TTL=128
Reply from 192.168.1.39: bytes=32 time<1ms TTL=128
Reply from 192.168.1.39: bytes=32 time<1ms TTL=128
Reply from 192.168.1.39: bytes=32 time<1ms TTL=128

Note, If ping responds as shown above, then you can probably recover the unit, please proceed. Otherwise, send the unit back for RMA.

7. Now use TFTP to push firmware file into the corrupted unit:

For example, on Windows 7 using following command line:

tftp -i 192.168.1.39 put pMDDL-v1_3_0-r1005.bin (use the filename saved).

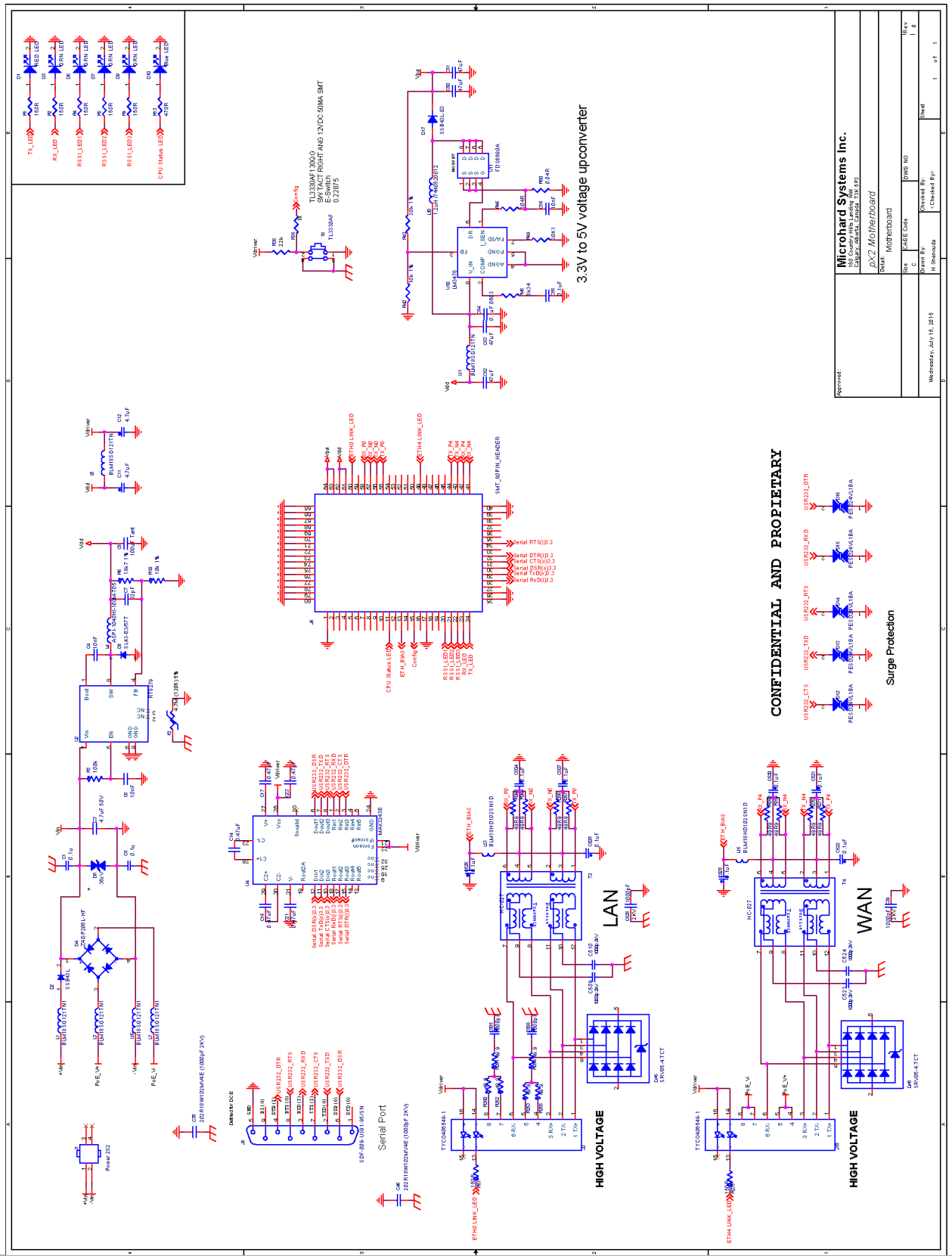
8. Wait until above command to successfully transferred the image, similar message should show

Transfer successful: xxxxxxx bytes in 5 seconds, nnnnnnn bytes/s, note the number might change for different firmware file

Note, if you see message above, the unit will re-flash itself and reboot, otherwise call for help or send back for RMA.

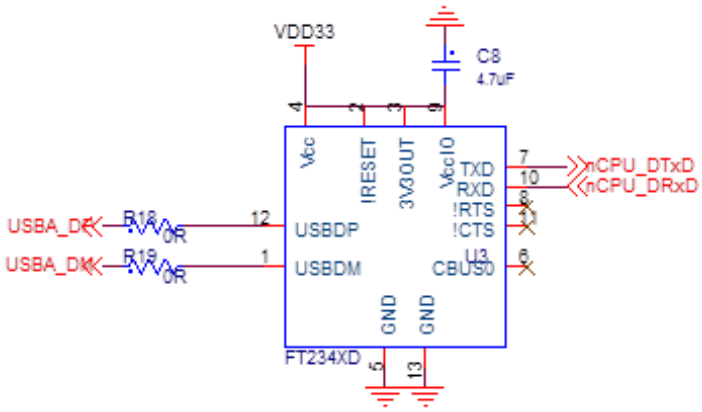
9. Wait for the unit to recover and reboot.

Appendix C: Sample Interface Schematic



Appendix D: Serial Port Extension

The pMDDL can support a second serial port by utilizing a FT234XD USB to serial UART interfaced to the USB lines of the pMDDL. The sample circuit below shows how this is done.



Drawing App-D: FTDI USB to Basic UART

Appendix E: Troubleshooting

Below is a number of the common support questions that are asked about the pMDDL. The purpose of the section is to provide answers and/or direction on how to solve common problems with the pMDDL.

Question: *What is the default IP Address of the pMDDL?*

Answer: The default IP address for the LAN is 192.168.168.1.

Question: *What is the default login for the pMDDL?*

Answer: The default username is ***admin****, the default password is* ***admin****. You will be prompted to change the password as soon as you login using the default.*

Question: *How do I reset my modem to factory default settings?*

Answer: If you are logged into the pMDDL navigate to the System > Maintenance Tab. If you cannot log in, power on the pMDDL and wait until the modem complete the boot up process. Press and hold the Config button for 8 seconds to reset to a factory default Master.

Question: *I connected a device to the serial port of the pMDDL and nothing happens?*

Answer: In addition to the basic serial port settings, the IP Protocol Config has to be configured. Refer to the COM0/1 Configuration pages for a description of the different options.

Additional topics will be added in future releases.

150 Country Hills Landing NW
Calgary, Alberta
Canada T3K 5P3

Phone: (403) 248-0028
Toll Free: 1-855-353-0028
www.microhardcorp.com