



**TELEDYNE PARADISE DATACOM**

A Teledyne Technologies Company

**AXIOM-X**

Small Form Factor Satellite Modem Card



# Installation and Operating Handbook

**V2.4**

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## 1. Introduction

### Introduction to AXIOM-X

The AXIOM-X is a compact, powerful, IP centric, single board satellite modem, supporting L2 bridging and L3 routing. Designed for simple mechanical integration into other equipment manufacturers (OEM) products or terminals, for example, man-packs, vehicles, ships and aircraft, designed for portable communications and communications on-the-move. Physically small with low power consumption, the modem is compatible with our QFlex-400, QMultiFlex-400 and AXIOM rack mount and Compact series modems. Although physically small, this does not limit performance as the AXIOM-X is capable of supporting up to 575Mbps of aggregate data throughput and in excess of 160,000 IP packets per second.

### DVB-S2(X)

The AXIOM-X supports the most powerful spectrally efficient modulation and coding available: DVB-S2 and DVB-S2X. Where DVB-S2X extends the MODCOD range up to 256APSK rate 3/4, providing 6.0 Bit's/Hz for a decoding threshold of 19.57 dB. This extended range may be exploited by broadband applications on modern high-throughput satellites (HTS).

DVB-S2X Increases the granularity in modulation and coding (MODCODs). Compared to the coarse MODCODs available in DVB-S2 that provide roughly 1 dB granularity in decoding threshold, DVB-S2X MODCODs are typically only 0.3 to 0.5 dB apart. This allows selecting a MODCOD that more precisely fits the link characteristics, reducing unnecessary margins and providing better throughput! This is especially so when utilising Adaptive Coding and Modulation (ACM).

## 2. General Description

### ISO 9001 Accreditation:

Teledyne Paradise datacom conforms to ISO 9001, the international standard that specifies requirements for a quality management system (QMS). Organizations use the standard to demonstrate the ability to consistently provide products and services that meet customer and regulatory requirements. UKAS is the national accreditation body for the United Kingdom and assess businesses against internationally agreed standards.

### Safety Compliance:

To ensure operator safety, this AXIOM-X satellite modem conforms to the provisions of EMC Low Voltage Directive 2006/95/EC and complies with the following standard, when fitted to a suitable chassis:

- EN 62368-1;2014 Edition 2 'Safety of Information Technology Equipment, Including Electrical Business Equipment'.

 2017  
EN 55032 - Class B  
EN 55035  
EN 62368

Prior to installation and at all points during operation the following points must be observed.

### Environmental Compliance:

All Teledyne Paradise Datacom satellite modem products are compliant with the following EC environmental directives:

- The Reduction of Hazardous Substances (RoHS) Directive 2011/65/EU.
- The Waste Electrical and Electronic Equipment (WEEE) Directive 2012/19/EU.

The equipment should not be directly connected to the Public Telecommunications Network.

Operation of the equipment in an environment other than that stated will invalidate the safety standards.

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***WARNING: The equipment must not be operated in an environment in which it is exposed to any of the following:***

- *Unpressurised altitudes greater than 3000 meters.*
  - *Extreme temperatures outside the stated operating range.*
  - *Excessive dust.*
  - *Moisture or humid atmosphere above 95% relative humidity.*
  - *Excessive vibration.*
  - *Flammable gases.*
  - *Corrosive or explosive atmosphere.*
- 

### Electromagnetic Compatibility (EMC) Compliance:

This satellite modem conforms to the provisions of EMC Directive 2004/108/EC and complies with the following EC and FCC standards:

- Emissions: EN 55032: 2015 Class B – ‘Information Technology Equipment – Radio Disturbance Characteristics – Limits and Methods of Measurement’.
- Immunity: EN 55035:2017 (incorporating EN61000-3-2:2014 class A) – ‘Information Technology Equipment – Immunity Characteristics – Limits and Methods of Measurement’.
- Federal Communications Commission (FCC) Federal Code of Regulation Part 15, Subpart B.

Connections to transmit and receive L-Band interfaces must be made with double-screened coaxial cable (for example, RG223/U).

The modem Ethernet ports should not be connected directly to outdoor Ethernet cables that may be subject to transient over-voltages due to atmospheric discharges and faults in the power distribution network. Instead, the modem should be connected via an Ethernet switch or router to provide isolation from over-voltages as recommended within EN 61000-3-2:2014 class A.

## Unpacking:

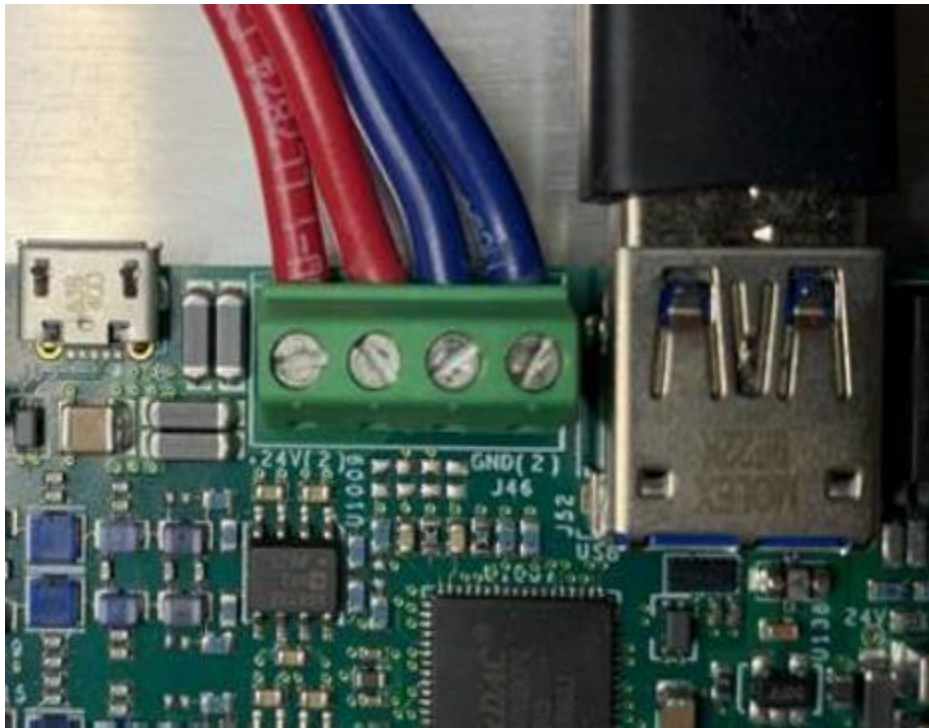
Prior to unpacking, inspect the exterior of the shipping container for any signs of damage during transit. If damage is evident, please contact the carrier with a view to submitting a damage report.

Carefully unpack the AXIOM-X PCB, taking care not to discard any packing materials as this can be used for storage and further shipment. In addition, should the need arise for the unit to be returned to Teledyne Paradise Datacom then it is recommended that the original packing carton is used as it is designed to provide the necessary level of protection during shipment.

Once unpacked, visually inspect the AXIOM-X PCB to ensure there are no signs of damage.

## DC Supply:

This satellite modem is classified by EN 61000-3-2:2014 class A safety standard as a 'Pluggable Equipment Type A'. A regulated 24V DC power supply must be used. The power supply connector on the AXIOM-X allows for a second power supply to be connected in parallel in order to provide protection against the failure of a single supply. Typical power consumption is 25W; typical maximum power consumption is 33W.



24V and Ground connector orientation

No power supply or power cord is provided. The installation of the satellite modem and the connection to the power supply must be made in compliance with local and national wiring regulations for a Category II 'impulse over-voltage' installation. The satellite modem should allow a convenient means of disconnection from the line supply.

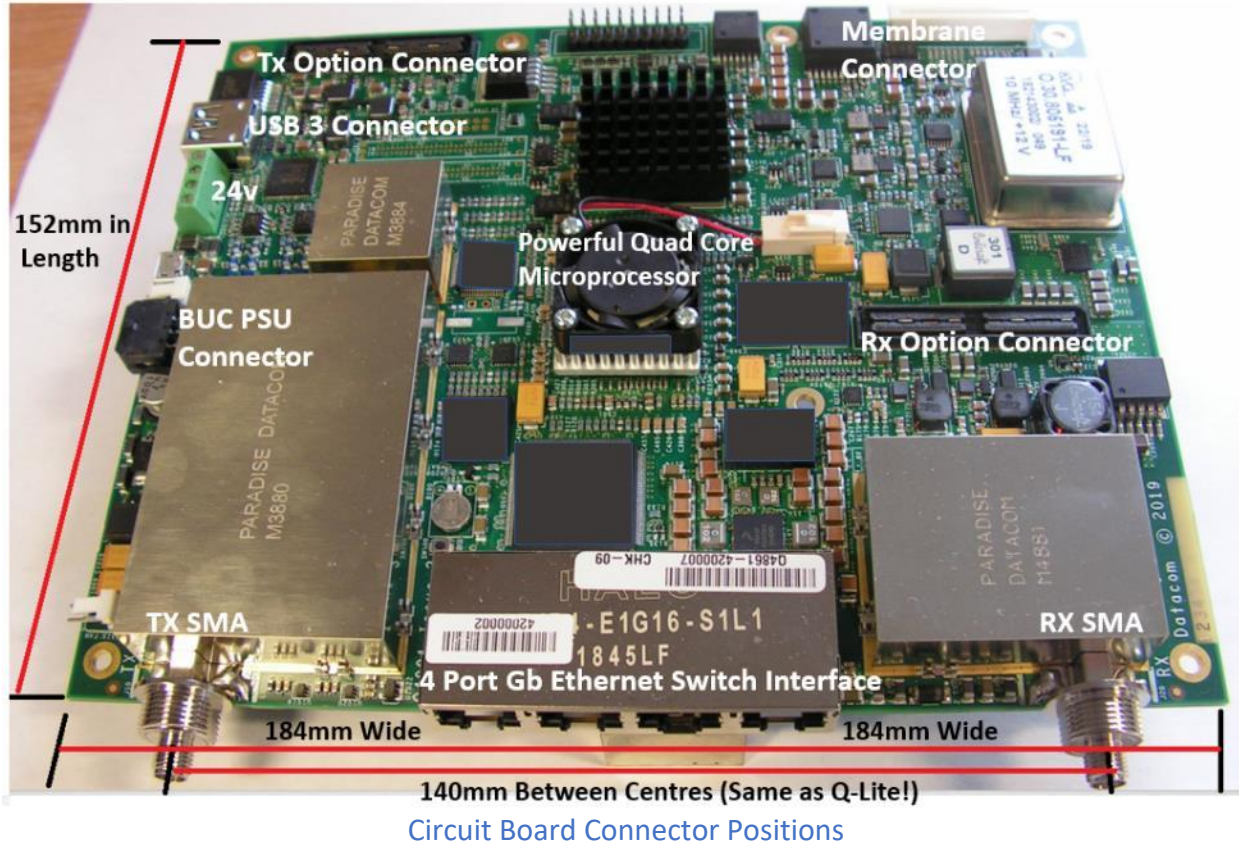
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***WARNING: This satellite modem requires the use of a regulated 24V power supply that provides a line conductor and ground connection (i.e. it's not a floating input).  
The power system must have a direct ground connection.***

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*Teledyne Paradise Datacom maintains a program of continuous product improvement and reserves the right to change specifications without prior notice.*

## System Overview:



## Connectors:

**24V DC Connectors:** A four-way screw-terminal is provided with twin 24V and ground pins, allowing for a second independent power source to be used to increase reliability.

**Ethernet Connectors:** Four Gigabit Ethernet RJ45 connectors are provided for modem Monitor and Control (M&C) and satellite traffic.

**Tx SMA:** The L-Band transmit interface connector.

**Rx SMA:** The L-Band receive interface connector.

**BUC PSU connector:** An additional connector is provided, which allows 24V or 48V DC to be provided to power a BUC via the IFL.

**USB 3 Connector:** Used to upgrade the unit's software, provides a WiFi connection when a suitable dongle is connected.

**Membrane Connector:** Allows a small membrane with LED's to be fitted for external status indication.

**Tx Option Connector:** For future expansion, supports twin Modulator capability with applicable models.

**Rx Option Connector:** For future expansion, supports multi-demod capability with applicable models.

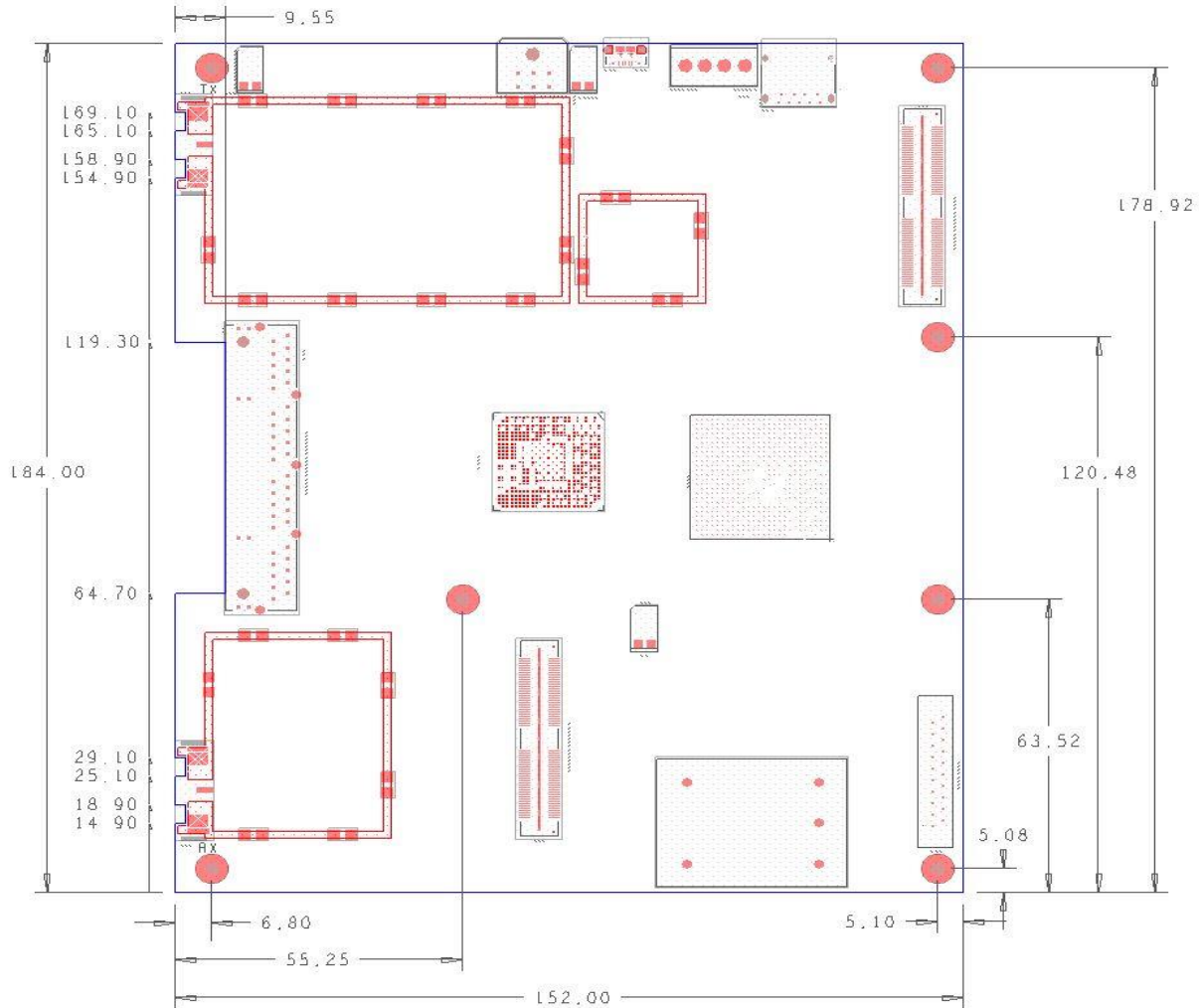


## Enclosure design:

When designing an enclosure, adequate ventilation and cooling should be provided. The modem operating temperature range is  $-40^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$ . The AXIOM-X PCB is suitable for incorporation into enclosures that mount the board to a metal chassis and employ fans to move air out of the box. Power supply regulation devices dissipate heat via the circuit-board mounting holes, which need to be attached to a metal plate or chassis. Other devices dissipate heat into the enclosure and this typically will need to be expelled by a fan within the enclosure. The microprocessor has its own fan to move heat away from the device locally. However, the microprocessor fan and FPGA heatsink supplied are only suitable for use in fan assisted chassis designs at ambient temperatures up to 50 Celsius. For deployment in designs at higher ambient temperatures these devices should be replaced with other thermal management solutions.

It is possible to design an enclosure that does not have fans to remove heat. Heatsinks can be used to remove heat from any of the devices and cans on the top of the board including the mounting holes. Any such design could replace the microprocessor fan or it can be retained if desired. The fan should be retained if the enclosure design involves simply moving air around internally to dissipate the heat. In addition, any heatsink can also be cooled by fans, if required. Thermal profile information for the board is available from Technical Support if needed.

As measured from the top side of the circuit board, the highest component height is 18mm with the processor fan fitted. If this fan is not fitted, then the tallest components are the shielding cans at 13mm.



Circuit Board Dimensions (mm)

The exposed pad underneath U2000, circled below, may require a piece of Thermal Interface Material to be fitted, dependent on chassis design and operational temperature requirements. When used this Thermal Interface Material needs to be flush with the chassis. The rate of heat transfer needs to be at least 5 W/mK using a material that is 0.190" thick, for example Laird Tflex HD7190 is suitable.

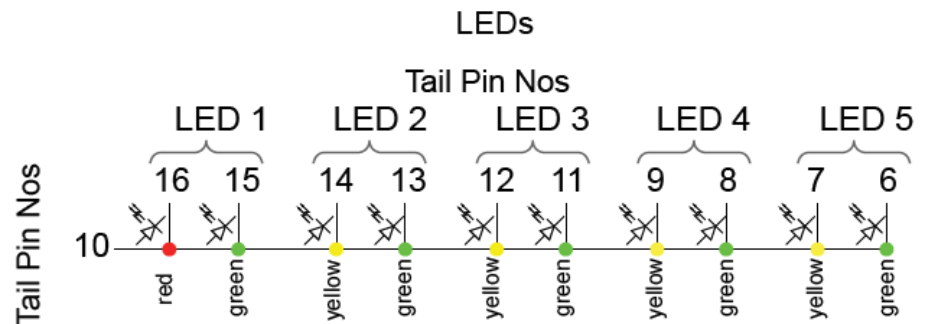


## Attaching LED's

The 20-way ZIF membrane connector fitted to the motherboard (Molex 39-53-2205) allows a bank of LED's to be connected to the AXIOM-X Modem, to show status. The Molex datasheet can be found here: <https://docs.rs-online.com/910c/0900766b80d47f72.pdf>

Pinout and Membrane schematic:

Membrane - J44	
Pin	Function
1	-
2	-
3	-
4	-
5	-
6	Tx. Carrier (Green)
7	Tx. Carrier (Yellow)
8	Test (Green)
9	Test (Yellow)
10	+3.3 Volts
11	Tx. Status (Green)
12	Tx. Status (Yellow)
13	Rx. Status (Green)
14	Rx. Status (Yellow)
15	Unit Status (Green)
16	Unit Status (Red)
17	-
18	-
19	-
20	-



Pin 10 supplies 3.3 Volts to the LEDs.

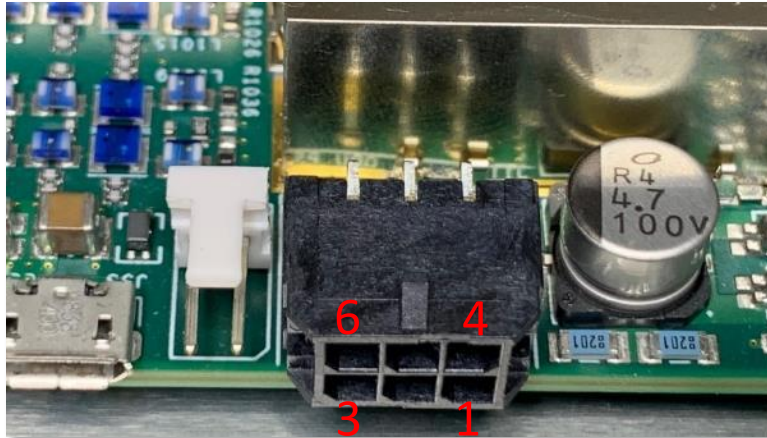
The appropriate resistors are provided on the motherboard. Red and yellow LEDs have 180 Ohm resistors and the green LEDs have 220 Ohm resistors.

Refer to P17 for LED operation and meaning.

## BUC DC PSU

The primary 24v DC power supply allows powering a Block Up Converter (BUC) via the IFL (A BUC power supply SAF is required). This can source a maximum of 4 amps. Alternatively, a 24v or 48v DC power supply may provide BUC power when connected to the separate BUC power supply connector on the AXIOM-X (24v DC max 4A, 48v DC max 2A) (Refer to AXIOM-X [Circuit Board Connector Positions P8](#)).

AXIOM-X +VDC BUC PSU Connector:



J11 - Molex 43045-0600, with socket pinout

**Cableform Information:**

Housing: Molex - 43025-0600

Connector Housing, Dual Row, Micro-Fit 3.0 43025 Series, Receptacle, 6 Positions, 3 mm

[43025-0600 - Molex - Connector Housing, Dual Row, Micro-Fit 3.0 43025 Series \(newark.com\)](https://www.newark.com/molex/43025-0600/Connector-Housing-Dual-Row-Micro-Fit-3.0-43025-Series/pd)

Crimps: Molex - 43030-0007

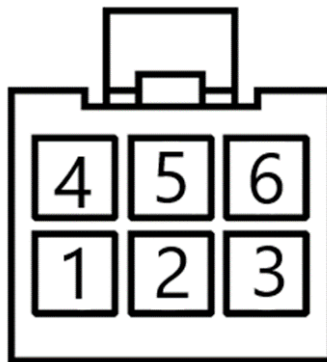
[43030-0007 - Molex - Contact, Micro-Fit 3.0™, Micro-Fit 3.0 43030 Series \(newark.com\)](https://www.newark.com/molex/43030-0007/Contact-Micro-Fit-3.0-Micro-Fit-3.0-43030-Series/pd)

**Wiring Pins:**

4&5 = +VDC

1&2 = GND

Wire loop from pin 3 to 6



Pinout when viewed from the Plug

The connector has a link wire between pin 3 and 6 allowing the processor to determine if an external BUC PSU is fitted or not. When it is fitted the modem uses the external supply for the BUC. If it is not fitted the modem can use the primary 24 Volt supply. Both the current and Voltage supplied to the BUC can be monitored.

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**WARNING:** It is highly recommended that 10MHz, DC and carrier services are Switched off prior to disconnecting or connecting the modem L-band RF cables in order to avoid potential for damage.

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## LNB DC PSU

The AXIOM-X primary power supply may be used to provide DC to a Low Noise Block-downconverter, this can be set to, 13V, 15V, 18V or 20V at a maximum current of 0.5A via the Rx IFL. In addition, 22kHz control can be enabled, which allows a suitable LNB to operate over the entire Ku frequency band by switching the LO from 9.75 to 10.6 GHz. The LO switching is achieved either by changing voltage from 13V to 18V or by sending a 22kHz tone.

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**WARNING:** It is highly recommended that DC is switched off to the LNB prior to disconnecting or connecting the modem L-band RF cables in order to avoid potential for damage.  
*When disabled a residual voltage of <0.5v is present on Rx port connector.*

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## L-Band Frequency Operation

The unit supports L-band operation, via transmit and receive SMA connectors, supporting 50Ω operation from 950 to 2150MHz with 1Hz step size. A high-stability L-band 10MHz reference signal for output to a Block Up Converter (BUC) can also be enabled to phase-lock the BUC's local oscillator to a highly stable frequency reference.

## Configuration Devices:

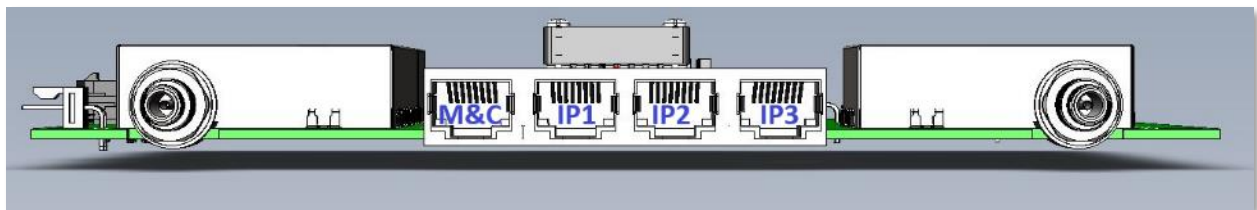
The AXIOM-X operates without requiring an LCD front panel display. The configuration, monitoring and control is via an intuitive Ethernet based web browser that can be operated via a tablet, mobile or laptop PC and allows the user to install, configure and monitor the modem from any suitable device. In addition, Wi-Fi capability further enhances the ease of use and provides greater flexibility for remote control and installation using portable devices.

All the latest editions of major browsers are supported, for example Chrome, Firefox, Edge, iOS Safari and Android. For smaller devices, graphs / overview pages may have alternative views and appropriate text warnings regarding device orientation, where a more suitable view can be obtained, are displayed.

## Ethernet connectors

Four Gigabit Ethernet RJ45 connectors are provided for modem Monitor and Control (M&C) and satellite traffic. Ethernet speed, duplex, and cable termination (crossover versus straight-through) are auto-negotiated. Line speed and duplex can also be set to fixed values. The Ethernet ports can be bridged together under software control. However, initially the M&C port is not bridged to the traffic ports, so only the M&C port is available for the web user Interface (and the other ports support IP satellite traffic). When the M&C port is bridged to the other ports then M&C and traffic can be passed using any port.

These provide a combined 160,000 packets-per-second processing capability and up to 575Mbps of aggregate throughput over satellite.



## RJ45 Ethernet Port Functions: M&C IP1 IP2 IP3

M&C control can be via the Simple Network Management Protocol (SNMP), an embedded web server that sends web pages to a web browser, a Telnet-style terminal emulation application or via TCP packets that encapsulate Paradise Universal Protocol (PUP) commands.

A dual IPv4/IPv6 TCP/IP stack is provided. IPv4 support is provided for all IP functions as the default. With respect to IPv6, bridging and routing are supported along with an IPv6 embedded web server. Modem IP addresses and static routes can also be entered and displayed in IPv6 format.

MTU: The Maximum Transmission Unit size is 10,000 bytes. This defines the largest Ethernet frame that can be supported by the modem in bridging mode, without fragmenting the Ethernet frames into smaller frames.

M&C VLAN: M&C traffic destined for the modem at the other end of the link can be transmitted in a special VLAN. When enabled, all M&C traffic destined for the far end is sent over satellite using VLAN 0. The M&C packets will be received and processed by the modem at the other end of the link when the equivalent control is enabled on that modem. This technique for remote control means that the M&C port does not need to be bridged to the traffic port(s) thereby facilitating the use of separate M&C and traffic networks that use different subnets.

### Modulator Specification:

The transmit baseband digital circuit encodes terrestrial IP traffic presented to the modem on the Ethernet ports into satellite frames and generates in-phase (I) and quadrature (Q) digital signals that are passed to high-speed digital-to-analogue converters. The analogue I and Q signals are then presented to an analogue modulator along with a local oscillator at the required RF frequency, this generates the modulated signal to be transmitted to satellite.

Function	Description
Modulator	<b>DVB-S2:</b> QPSK, 8PSK & 16APSK <b>DVB-S2X:</b> QPSK, 8PSK, 8APSK-L 16APSK, 16APSK-L, 32APSK, 32APSK-L, 64APSK & 64APSK-L Options for <b>Advanced Modulation:</b> 128APSK, 256APSK and 256APSK-L
Output Power	0 to -40dBm (950 to 2150MHz)
Transmit Filter Roll-off	<b>DVB-S2:</b> 20%, 25%, 35% <b>DVB-S2X:</b> 5%, 10%, 15%, 20%, 25%, 35%
Frequency	<b>L-band:</b> 950 to 2150MHz (1Hz resolution)
Tx Data Rate Limits	<b>DVB-S2/S2X:</b> 100kbps to 345Mbps
Data Rate Options	<b>Standard: 2Mbps</b> <b>Options:</b> 5Mbps, 10Mbps, 25Mbps, 100Mbps & 345Mbps
Tx Symbol Rate Limits	<b>DVB-S2/S2X:</b> 100ksps to 1000Msps
Harmonics & Spurious	Better than -55dBc / 4kHz in-band (at 0dBm to -30dBm output)
BUC PSU SAF Option	Allows 24V DC, or a separate 48V input to power a BUC via the IFL (4A/2A Max respectively)
BUC 10MHz Reference	Via IFL cable; 10MHz ± 0.01 ppm; 2dBm ± 2dBm

**Modulator Outline Specification Table**

### Demodulator Specification:

The received RF signal from the satellite is presented to a variable gain low noise amplifier for signal conditioning. This is then passed to a DVB-S2X satellite ASIC that demodulates and decodes the signal providing a digital signal for the receive baseband circuit to generate the terrestrial IP traffic.

Tx and Rx L-Band ports are fitted with 50Ω SMA connectors as standard.

The carrier signal level at the input of the modem must be in the following range:

Minimum signal level: **-140 + 10 log (symbol rate) dBm**

Maximum signal level: **-78 + 10 log (symbol rate) dBm**

The maximum wanted-to-composite power level that is supported with no implementation loss is defined by the equation:

Maximum wanted-to-composite power level: **-102 + 10 log (symbol rate) dBm**

The maximum input power level is **-3dBm**.

Function	Description
Demodulator	<b>DVB-S2:</b> QPSK, 8PSK & 16APSK <b>DVB-S2X:</b> QPSK, 8PSK, 8APSK-L 16APSK, 16APSK-L, 32APSK, 32APSK-L, 64APSK & 64APSK-L Options for <b>Advanced Modulation:</b> 128APSK, 256APSK and 256APSK-L
Transmit Filter Roll-off	<b>DVB-S2:</b> 20%, 25%, 35% <b>DVB-S2X:</b> 5%, 10%, 15%, 20%, 25%, 35%
Frequency	<b>L-band:</b> 950 to 2150MHz (1Hz resolution)
Rx Data Rate Limits	<b>DVB-S2/S2X:</b> 100kbps to 230Mbps
Rx Data Rate options	<b>Standard:</b> 2Mbps <b>Options:</b> 5Mbps, 10Mbps, 25Mbps, 100Mbps & 230Mbps
Rx Symbol Rate Limits	<b>DVB-S2/S2X:</b> 100ksps to 100Msps (85Msps @ 8PSK/8APSK, 64Msps @ 16APSK, 51Msps @ 32APSK, 43Msps @ 64APSK, 36Msps @ 128APSK, 32Msps @ 256APSK)
Input Range	Minimum: $-140 + 10 \log (\text{symbol rate})$ Maximum: $-78 + 10 \log (\text{symbol rate})$
LNB Voltage	Selectable 13V, 15V, 18V or 20V DC to LNB via IFL cable; maximum 0.5A
22kHz Tone	LO control, allows a Ku Band LNB to be switched from low to high band or vice versa

Demodulator Outline Specification Table



## Supported Modulation and Code Rates

The following table lists the DVB-S2 and DVB-S2X Modulations and code rates supported. These are for Short and Normal FEC frame sizes (16,200 bits and 64,800 bits respectively). Both supported unless otherwise stated. (Note: DVB-S2 32APSK is available when DVB-S2X is purchased and so is not available when the low-cost DVB-S2 option only is purchased.)

Function	Description
DVB-S2	<b>QPSK:</b> 1/2, 2/3, 3/4, 1/4, 1/3, 2/5, 3/5, 4/5, 5/6, 8/9 & 9/10 <b>8PSK:</b> 2/3, 3/4, 3/5, 5/6, 8/9 & 9/10 <b>16APSK:</b> 2/3, 3/4, 4/5, 5/6, 8/9 & 9/10 <b>32APSK:</b> 3/4, 4/5, 5/6, 8/9 & 9/10
DVB-S2X Short Frames	All available <b>DVB-S2</b> Modulations and code rates plus: <b>QPSK:</b> 11/45, 4/15, 14/45, 7/15, 8/15 & 32/45 <b>8PSK:</b> 7/15, 8/15, 26/45 & 32/45 <b>16APSK:</b> 7/15, 8/15, 26/45, 3/5 & 32/45 <b>32APSK:</b> 2/3 & 32/45
DVB-S2X Normal Frames	All available <b>DVB-S2</b> Modulations and code rates plus: <b>QPSK:</b> 13/45, 9/20 & 11/20 <b>8PSK:</b> 23/36, 25/36 & 13/18 <b>16APSK:</b> 26/45, <b>3/5</b> , 28/45, 23/36, 25/36, 13/18, 7/9 & 77/90 <b>32APSK:</b> 32/45, 11/15 & 7/9 <b>64APSK:</b> 4/5, 5/6, 11/15 & 7/9 <b>128APSK:</b> 3/4 & 7/9 <b>256APSK:</b> 3/4 & 32/45
DVB-S2X-L Normal Frames (see note*)	<b>8APSK:</b> 5/9-L & 26/45-L <b>16APSK:</b> 1/2-L, 8/15-L, 5/9-L, 3/5-L & 2/3-L <b>32APSK:</b> 2/3-L <b>64APSK:</b> 32/45-L <b>256APSK:</b> 2/3-L, 29/45-L, 31/45-L & 11/15-L

### MODCOD's Supported

**Note\***MODCODs optimised for linear transponders are indicated by an `L` suffix, these are for use on quasi-linear channels which are subject to phase noise.

## Router and Advanced specifications:

Function	Description
Network Support	Layer 2 Bridging, Layer 3 Routing, Jumbo Frames to 10k bytes, up to 160,000 pps
Management	HTTP/S Web Server, SNMP v1, v2c & v3, AAA RADIUS Secure User Login & Access Control Lists & SSH
Protocols	IPv4/IPv6, IEEE 802.1q /p VLAN support, NAT, DHCP, Network Time Protocol (NTP), Active Queue Management (AQM), MPEG over IP, OpenAMIP Protocol Support
Advanced IP Features	Robust Header Compression (RFC 3095), Payload Compression, Dynamic Routing (RIP V1, V2; OSPF V2, V3; BGP V4) and TCP Acceleration
DVB Features	ACM/VCM, DVB Encapsulation, GSE Encapsulation

### Router and Advanced Outline Specification Table

## Interface, Mechanical and Environmental Specifications:

Function	Description
Traffic Interface	4-port Gigabit Ethernet switch (RJ45 connectors; used for IP traffic and M&C)
IF Tx and Rx	L-band: 950 to 2150MHz (1Hz resolution) SMA connectors
Power Supply	Regulated 24 Volt DC input $\pm 0.5V$ (not provided)
Mechanical	Size: 184mm x 152mm; Weight: 288g
Environmental	-40°C to 85°C Operating Temperature; 95% relative humidity, non-condensing, FCC, CE and RoHS compliant, Safety: EN 62368-1;2014 Edition 2 Emissions: EN 55032: 2015 Class B, Immunity: EN55035:2017 (EN 61000-3-2:2014 class A.); Conformal Coating option; Shock & Vibration—MIL-810G currently in progress

Interface Outline Specification Table

### Traffic Shaping and QoS

This functionality provides guaranteed throughput for priority traffic, supporting Committed and Burst Information Rates. Stream classification can be via VLAN ID, IP address, IEEE 802.1p priority, Diffserv DSCP and MPLS EXP.

The CIR is the guaranteed bandwidth, in bits per second (bps) or as a percentage, that will be allocated to the specified data stream. This is the level of bandwidth that is guaranteed under all normal circumstances. If excess bandwidth becomes available it can be allocated in a controlled manner to other streams. The BIR defines the maximum amount of bandwidth, beyond the CIR, that a stream can be allocated, if spare bandwidth becomes available. Each BIR must be less than or equal to the transmission data rate of the modem.

Stream classification may be based on VLAN ID. VLAN tags can be added externally or by the modem.

IP address is used to classify a data stream based on either the source and/or destination addresses in the IP packet as well as by a range for the source and/or destination port numbers in the TCP or UDP header in the packet.

IEEE 802.1p priority Classification may be implemented on the 3-bit Priority Code Point field of an IEEE 802.1q VLAN tag (also referred to as an IEEE 802.1p Priority Tag). This is part of a 32-bit field inserted into an Ethernet frame between the MAC address and length field.

The priority tag has eight possible values, each of which maps directly to an equivalent internal class within the modem (for which a BIR, CIR, etc. can be set). Each packet passed to the modem must have this field set to the appropriate value in order for the modem to recognize the different data streams






Differentiated services or DiffServ is a networking architecture that specifies a simple, scalable mechanism for classifying and managing network traffic and providing QoS. DiffServ can, for example, be used to provide low-latency to critical network traffic such as voice or streaming media while providing simple best-effort service to non-critical services such as web traffic or file transfers.

The MPLS experimental bits (EXP) field is a 3-bit field in the MPLS header that you can use to define the QoS treatment that the Modem should allocate to a packet.

## LED Indicators

### Front Panel:

When a front panel membrane is attached, the LED indicators have the following meaning:

<b>UNIT STATUS</b> 	Green – Unit Okay	Red – Unit Fault
<b>RX TRAFFIC</b> 	Green – Unit Okay	Off – Rx Disabled or Rx Fault
<b>TX TRAFFIC</b> 	Green – Unit Okay	Off – Tx Disabled or Tx Fault
<b>TEST MODE</b> 	Amber – Test Enabled	Off – Test Disabled
<b>TX CARRIER</b> 	Green – Carrier Enabled	Off – Carrier Disabled

### Front Panel LED Functionality

### Web User Interface:

The functionality of the Web User Interface LED mimic is different to the front panel display. The WUI display has the following meaning:



### Web User Interface LED Mimic Functionality

<b>UNIT STATUS:</b> <b>GREEN</b> – OK/Enabled <b>RED</b> – Alarm NONE/GREY - Off/Disabled	<b>RX TRAFFIC:</b> <b>GREEN</b> – OK/Enabled <b>YELLOW</b> - Alarm NONE/GREY - Off/Disabled	<b>TX TRAFFIC:</b> <b>GREEN</b> – OK/Enabled <b>YELLOW</b> - Alarm NONE/GREY - Off/Disabled
<b>TEST MODE:</b> <b>YELLOW</b> – On NONE/GREY - Off/Disabled	<b>TX CARRIER:</b> <b>GREEN</b> – OK/Enabled NONE/GREY - Off/Disabled	

## SAF / HW options available

Several software options, known as Software Activated Features (SAF), are available as shown in the following Table. These can be purchased on a pay-as-you-go basis and activated in deployed units as required, simply by entering a feature code via the modem's Web user interface. Feature codes are encrypted codes issued by Teledyne Paradise Datacom, uniquely associated with individual modems.

To allow evaluation of modem features, all of the SAF features of the modem that it is capable of supporting can be activated for a 10-day period by entering a feature code of 0. This is referred to as Demonstration Mode, or a demo test shot. Demonstration Mode can be activated up to three times after which any further attempts to use it will be rejected. Note that it is not necessary to wait for Demonstration Mode to time out before reactivating it: it can be activated twice to give a 20-day demonstration period and three times to give 30 days. The user will be alerted shortly before the demonstration period times out. As well as allowing feature evaluation, Demonstration Mode can be

used to test compatibility with other equipment and allows rapid substitution of equipment in a crisis. To enable one or more features permanently (referred to as Permanent Mode), a modem-specific feature code needs to be obtained from Teledyne Paradise Datacom. The code is tied to the modem serial number (available via the user interfaces and on the back panel).

The features that have been temporarily enabled on a modem can be viewed along with the time remaining before they become disabled, as can the features that have been permanently enabled and those that can potentially be enabled.

SAF			
<b>Basic Operation</b>			
Tx Path SAF	On	Rx Path SAF	On
Tx Data Rate Mbps	345	Rx Data Rate Mbps	230
<b>Advanced Operation</b>			
DVB-S2X	On	Advanced Modulation	On
Header & Payload Compression	On	TCP Acceleration	On
BUC PSU	On	Pre-distorter	Off
Encryption	Off	Demodulators(2-16)	N/A
Annex-M Slice(1-4)	N/A	Tx2	N/A
Rx2	N/A	BOD	N/A
Dual	N/A		
<b>Others</b>			
SAF test time remaining	0	Demo test shots remaining	4
<small>SAF Mix for the modem is Y00408830001300000000900000000410/E89671F0</small>			

### Software Accessible Features (SAF) available within the Modem

The SAF function keeps the initial cost of a modem to the minimum and allows simple field upgrading at a later date, as required.

In the table, the SAF Code column lists the acronyms by which features are referred to on the modem’s Web user interface. Each AXIOM-X has DVB-S2 features enabled as standard, supporting QPSK, 8PSK and 16APSK.

SAF Code	Description
Tx Path	Enables Transmit path
Rx Path	Enables Receive path
Tx Data Rate 5	Enables Transmit data rates between 100kbps and 5Mbps
Tx Data Rate 10	Enables Transmit data rates between 100kbps and 10Mbps
Tx Data Rate 25	Enables Transmit data rates between 100kbps and 25Mbps
Tx Data Rate 100	Enables Transmit data rates between 100kbps and 100Mbps
Tx Data Rate 345	Enables Transmit data rates between 100kbps and 345Mbps
Rx Data Rate 5	Enables Receive data rates between 100kbps and 5Mbps
Rx Data Rate 10	Enables Receive data rates between 100kbps and 10Mbps
Rx Data Rate 25	Enables Receive data rates between 100kbps and 25Mbps
Rx Data Rate 100	Enables Receive data rates between 100kbps and 100Mbps
Rx Data Rate 230	Enables Receive data rates between 100kbps and 230Mbps
DVB-S2X	Enables DVB-S2X Modulations and Code Rates

128/256	Enables Advanced Modulations, supporting 128/256APSK
Compression	Enables Header and Payload Compression: Header Compression Enables Ethernet, TCP, UDP, IP and RTP packet header compression Payload Compression Enables TCP and UDP payload compression compliant to RFC 1951
Acceleration	Enables TCP acceleration. Acceleration of TCP data over satellite, supported to the prevailing data rate of the modem
BUC PSU	Enables the BUC PSU software feature to provide DC via the IFL to power a BUC
Pre-distorter	Tx adaptive pre-distorter, providing up to 2dB compensation for linear and non-linear distortion in the channel.
Encryption	AES 256-bit key encryption of IP packets. (Encryption is export controlled technology and is provided on the AXIOM-X Encryption model only.)

Software Accessible Features Table

### Standard Features

Function	Description
Data Rate	100kbps to 2.048Mbps
DVB-S2 Tx / Rx	QPSK, 8PSK & 16APSK, CCM/ACM, 20%, 25%, 35% Roll off
Ethernet Interface	4-port Gigabit Ethernet switch for M&C and traffic
RF Interface	L-band, 950 to 2150MHz
10MHz Reference	high-G 10MHz reference (with G sensitivity rating of 1 x10-9/g)
AUPC	Automatic Uplink Power Control
Traffic Shaping	Supports CIR/BIR/priority settings for IP streams classified by IP address, Diffserv class, IEEE 802.1p priority tag, MPLS EXP field and VLAN ID
Dynamic Routing	RIP, OSPF and BGP

Standard Features Table

### Optional Features

Function	Description
Tx Data Rate Options	5Mbps data rate, extends Base operation to 5Mbps
	10Mbps data rate, extends 5Mbps operation to 10Mbps
	25Mbps data rate, extends 10Mbps operation to 25Mbps
	100Mbps data rate, extends 25Mbps operation to 100Mbps
	345Mbps data rate, extends 100Mbps operation to 345Mbps
Tx Data Rate Options	5Mbps data rate, extends Base operation to 5Mbps
	10Mbps data rate, extends 5Mbps operation to 10Mbps
	25Mbps data rate, extends 10Mbps operation to 25Mbps
	100Mbps data rate, extends 25Mbps operation to 100Mbps
	230Mbps data rate, extends 100Mbps operation to 230Mbps
Advanced IP Features	Header Compression: IP/UDP/TCP/RTP packet header compression (RFC 3095) plus Ethernet header compression. Payload Compression: TCP/UDP packet payload compression using the Deflate

	algorithm
	TCP Acceleration: Up to 10,000 concurrent accelerated TCP connections to 100Mbps subject to prevailing data rate limits
DVB-S2X Tx / Rx	DVB-S2X CCM, ACM, VCM: QPSK, 8PSK, 8APSK, 16APSK, 32APSK & 64APSK Tx operation per EN 302 307-2. Includes 5%, 10%, 15%, 20%, 25% & 35% spectral roll-offs. Includes DVB features; IP-over-DVB encapsulation.
Advanced Modulation	DVB-S2X Advanced Modulations: 128APSK, 256APSK, 256APSK-L
BUC PSU SAF	Enables the BUC PSU software feature to provide DC via the IFL to power a BUC. 4A Max at 24V supplied via the Modem PSU or 48V can be separately connected to the IFL via the AXIOM-X

Optional Features Table

## 3.Operation

### Web User Interface:

The modem includes an embedded web server that allows full monitoring and control of the modem via a web browser (on port 80). Secure connections via HTTPS (on port 443) are also supported. Non-secure connections via HTTP (port 80) can optionally be disabled.

The following browsers are supported: Chrome, Firefox, Edge, iOS and Android, these allow access from a PC / laptop and also via a Mobile or tablet.

To connect to the modem from a PC or laptop, ensure an Ethernet cable is connected to the Remote M&C RJ45 socket on the rear of the modem. However, if using WiFi ensure the dongle is plugged into the Modems USB port and search on your device for the AXIOM-X network signature. The default, factory set M&C details are as follows:

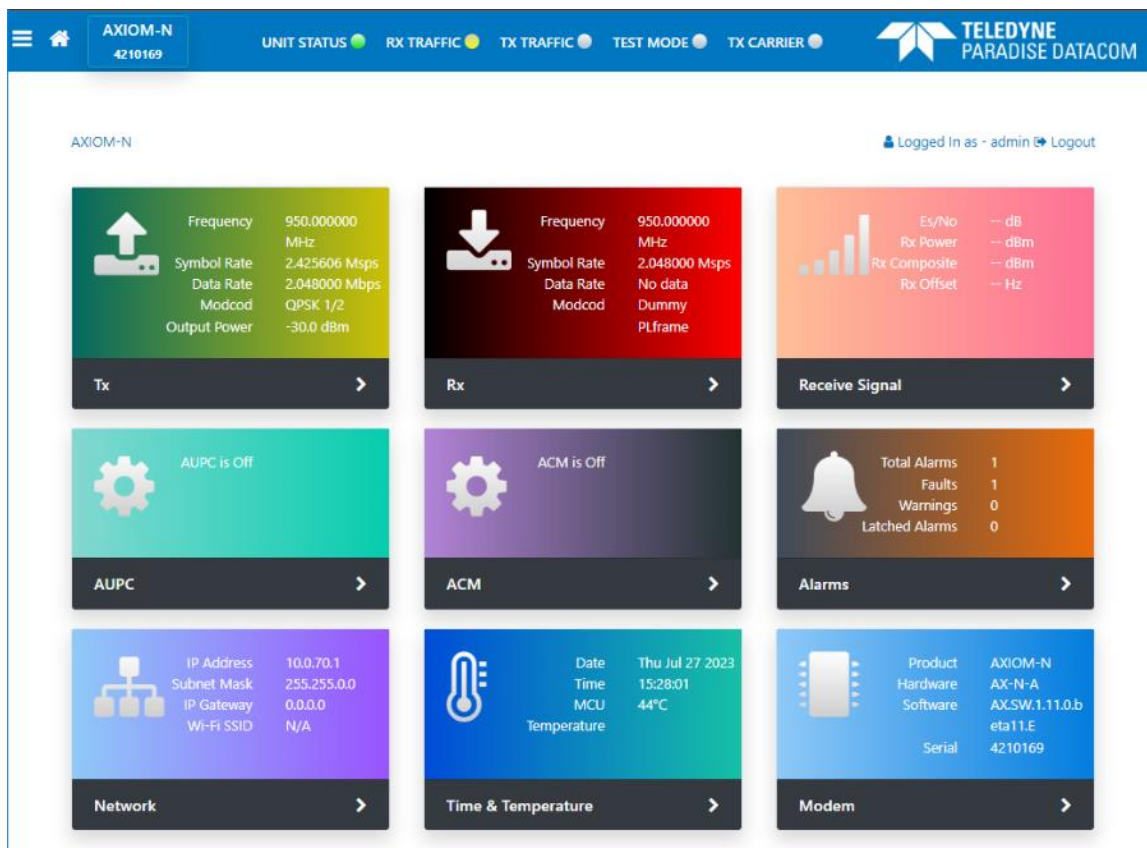
**IP address / subnet mask: 10.0.70.1 / 24**

Ensure the device being used to browse to the AXIOM-X is within this subnet range and has a unique IP address, for example 10.0.70.2 / 24. Enter the modem's IP address into the web browser address bar. The following login screen will be displayed and the browser will then request a username and password. The default user names and password are as follows:

**admin: paradise**  
**user: paradise**

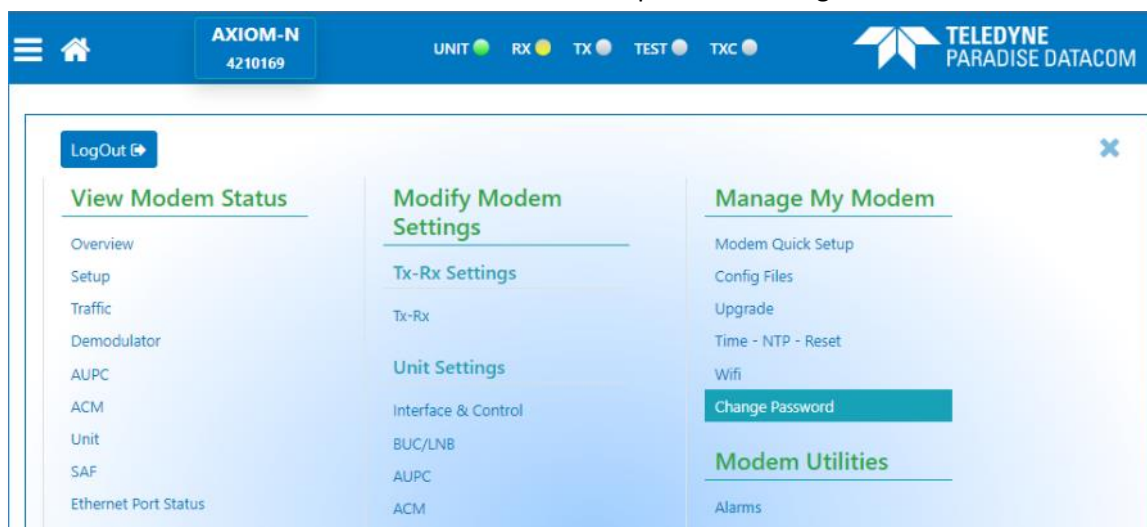
## Web Browser login screen

The Modems web server will load displaying the following Home screen:



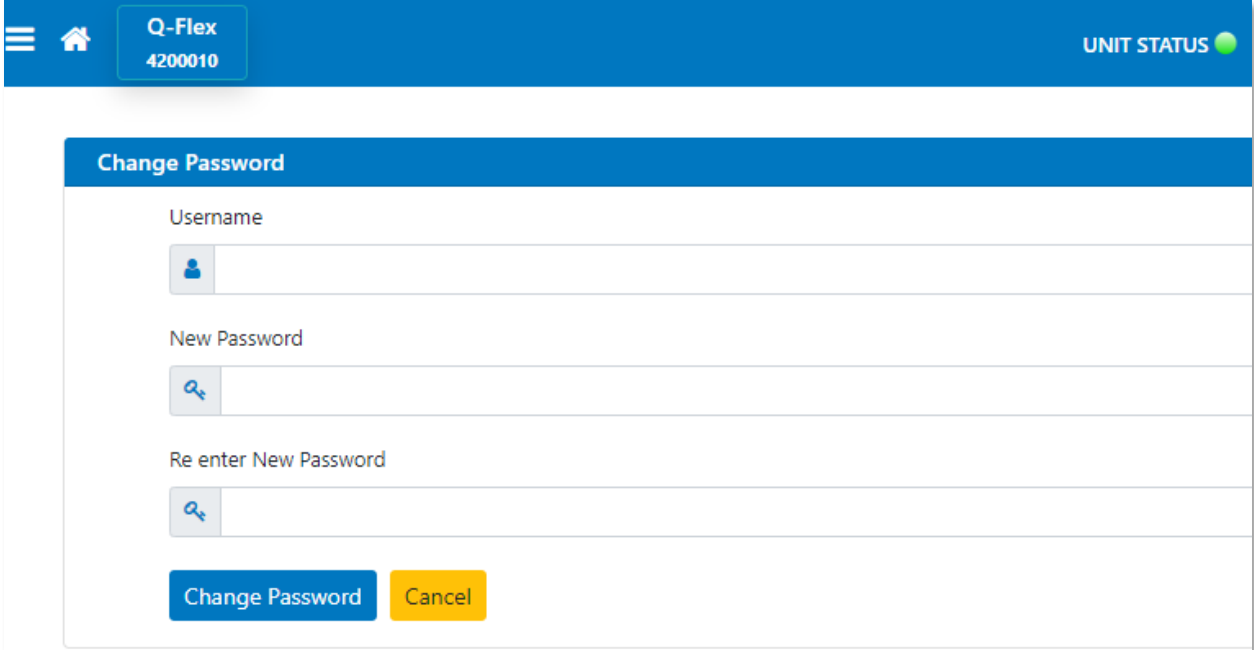
Web Browser Home screen

It is recommended that passwords are changed from their default values. Selecting 'Change Password' within the browser session allows the user to access the password change screen.



Password Change

The new password requires entering twice. When entered, the login details are sent in an encrypted form back to the modem.



Password Change entry screen

Selecting the appropriate Home screen tab allows the user to navigate through any of the associated menus, for example selecting **Tx**, **Rx** or **Modem** allows the configuration associated with each group to be accessed. Status information, displayed in a graphical format can also be obtained, for example Es/No or Receive power, within the **Signal** menu. Alarms, faults and warnings can be accessed from the **Alarms** menu.


**Note:** [Access Control Lists](#): The user can setup access control lists to control which IP addresses can access the modem. This can be from an individual IP address or a range of IP addresses from a particular subnet. Please contact Paradise technical support for more information.

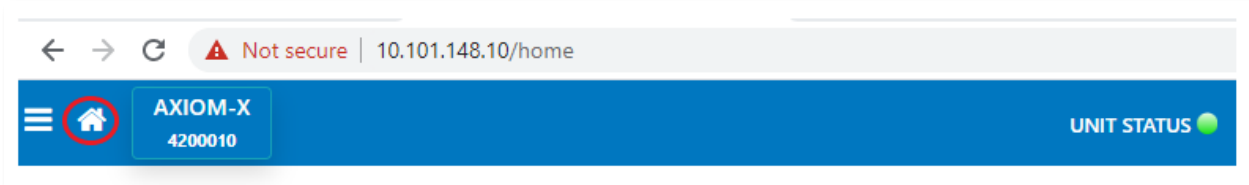
Selecting **Network** allows the M&C IP address and subnet mask to be changed to a suitable address for interoperating with other network devices, or the corporate LAN.



IP Addresses			
M&C IP address	<input type="text" value="10.101.148.10"/>	M&C IP subnet mask	<input type="text" value="255.255.0.0"/>
Traffic IP address	<input type="text" value="0.0.0.0"/>	Traffic IP subnet mask	<input type="text" value="255.255.0.0"/>
Satellite IP address	<input type="text" value="0.0.0.0"/>	Satellite IP subnet mask	<input type="text" value="255.255.255.252"/>
Modem IP gateway	<input type="text" value="10.101.0.1"/>	M&C IPv6 address	<input type="text" value="::"/>
Remote control port IPv6 subnet prefix	<input type="text" value="64"/>	Traffic IPv6 address	<input type="text" value="::"/>
Traffic port IPv6 subnet prefix	<input type="text" value="64"/>	Satellite IPv6 address	<input type="text" value="::"/>
Satellite port IPv6 prefix	<input type="text" value="64"/>	Modem IPv6 gateway	<input type="text" value="::"/>

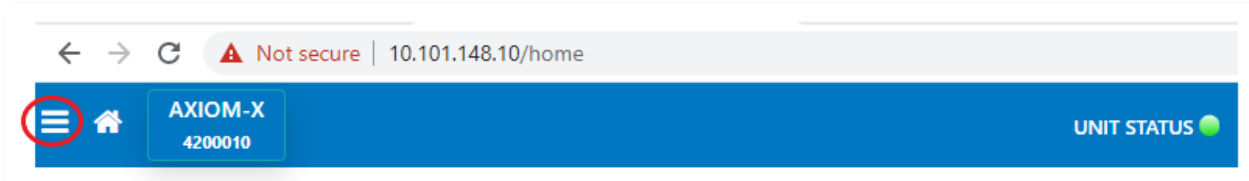
### Network screen

Update the M&C IP address and Subnet Mask, then commit the changes using the Green Submit button at the base of each section. Prior to submitting an entry no action will be taken. If you wish to return to the previous setting (and the Submit button has not been used) selecting cancel will return the fields to the values populated with the previous entered data. Similarly, selecting the icon:  will undo the change, returning the field to the previous setting. Changes can be entered and submitted at the same time or individually. An IP traffic address is not required when operating in Ethernet bridging modes.




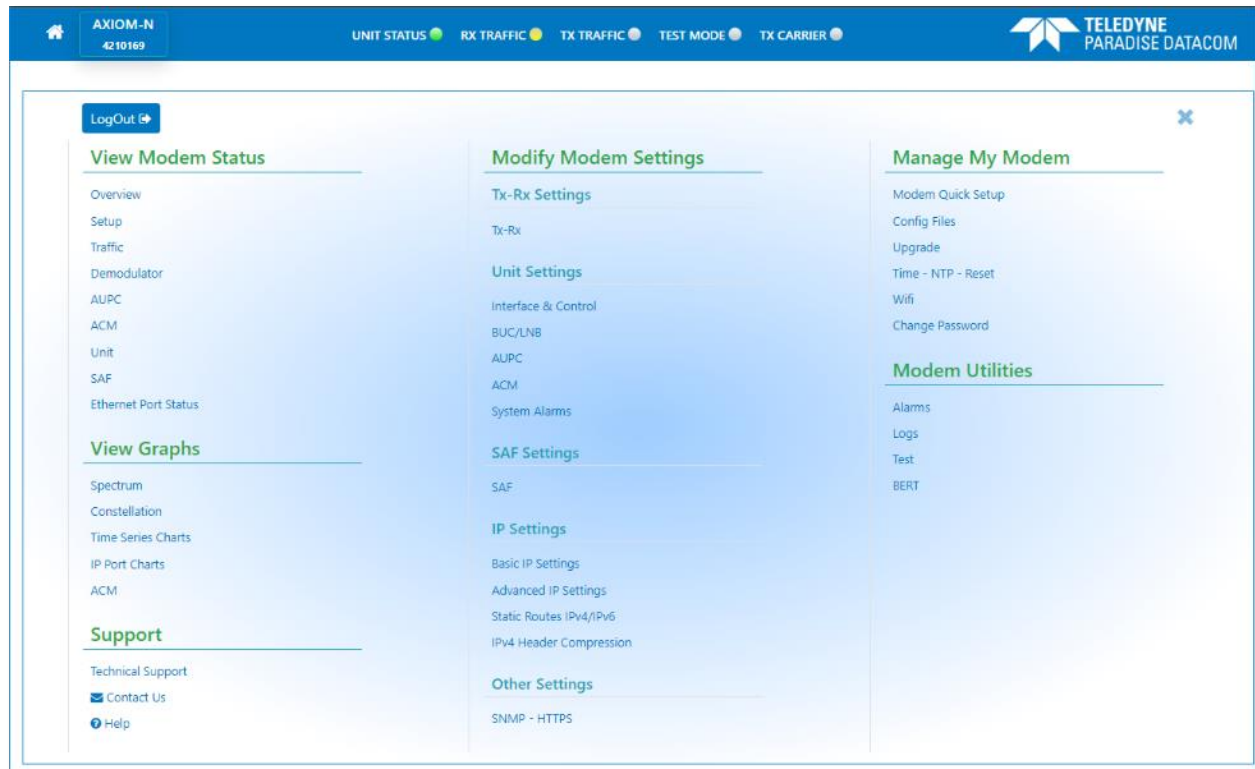
### Return Home

From any menu, selecting the Home button, circled above, will return the browser to the Home screen.




### Detailed Home Screen access

Similarly, selecting the three lines in a column icon  (Sometimes called a Hamburger), also circled above, presents the user with a more detailed Home screen, allowing individual configuration and monitoring functions to be directly accessed.



Detailed Home screen

Selecting **View Modem Status > Overview** allows an alternative Bubble or Flat view to be displayed. (Flat View by selecting the **Switch to Flat View** tab within Bubble View) Both Bubble and Flat views allow direct access to Transmit, Receive or other menu functions, for example AUPC or ACM. Initially flat view provides an overview of the unit's configuration, where selecting the cogs  associated with each group, allows access to edit a particular group's configuration, or device information and status to be obtained.

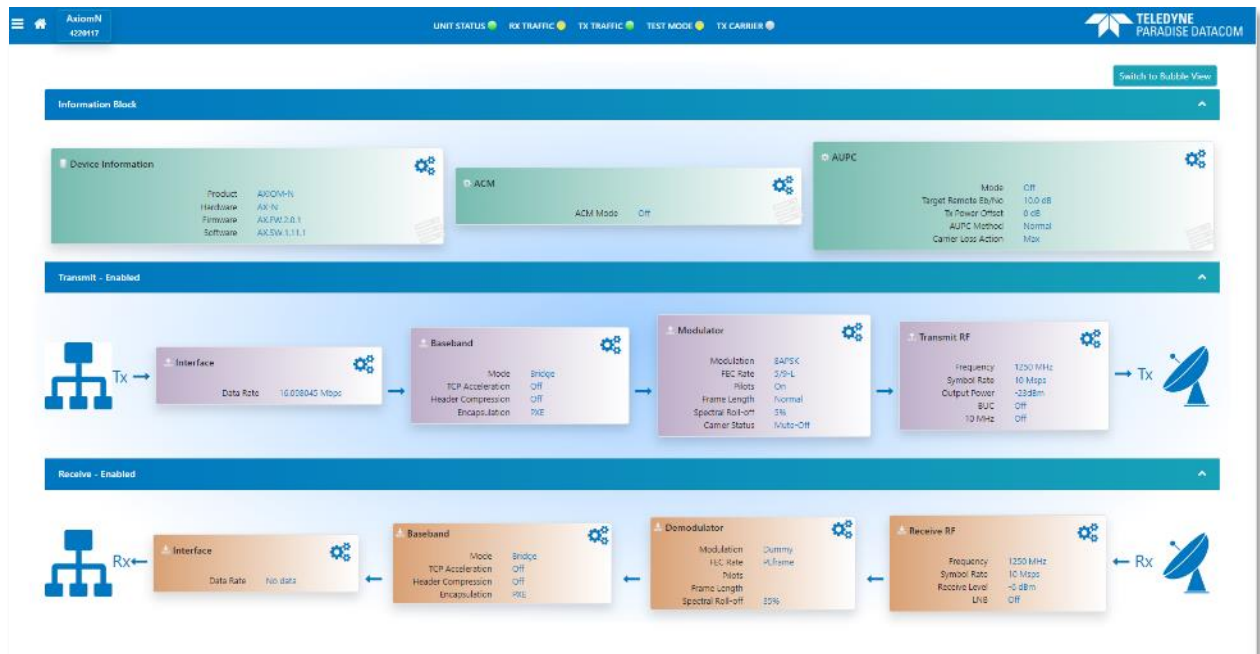
Expand Bubble view by clicking on the group required, allowing a more detailed menu selection to be displayed. Double clicking the required bubble allows access to edit a particular group of parameters, for example, expanding **Receive > Demodulator** allows access to the demod configuration menus.



Select `Edit` mode prior to making any changes, as even in Admin mode the menus may still be view only!



Bubble View



Flat View

The Web Interface detailed Home Screen allows easy access to all the configuration menus, including the quick setup menus, alarms, logs and graphs. These menus are detailed within the following sections.

## Carrier:

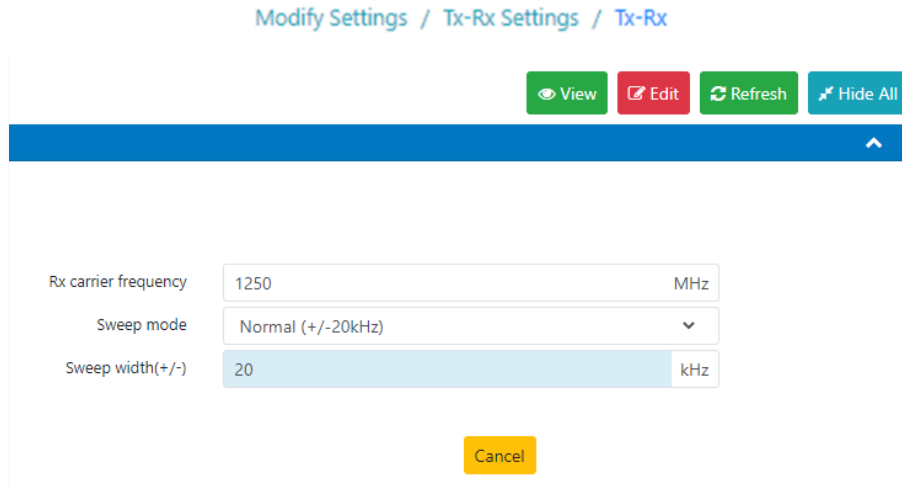
[Modify Settings](#) / [Tx-Rx Settings](#) / [Tx-Rx](#)

Carrier & Service	
Tx service	<input type="text" value="DVBS2X"/>
Modem carrier	<input type="text" value="Off"/>
Tx carrier frequency	<input type="text" value="1250"/> MHz
Output power (auto saved)	<input type="text" value="-23"/> dBm
Tx spectral roll-off	<input type="text" value="5%"/>
Tx spectral inversion	<input type="checkbox"/>
<input type="button" value="Submit"/>	

- **Tx service:** Allows the transmit service to be set to DVB-S2, DVB-S2X or if the unit is Rx only, off.
  - **Off:** The transmit service is set to off
  - **DVB-S2:** The transmit service uses DVB-S2 Modulation and code rates.
  - **DVB-S2X:** The transmit service uses DVB-S2X Modulation and code rates, which is an extension to the DVB-S2 Modulation and code rates and also allows additional roll off factors of 5%, 10% and 15% to be configured.
- **Modem Carrier:** Allows the Modems carrier to be enabled or controlled by other actions.
  - **Off:** Disables the transmit carrier.
  - **On:** Enables the transmit carrier.
  - **Traffic Port Enabled:** Controls the transmit carrier by the IP port traffic link state i.e. when the port goes down the carrier is disabled.
  - **Rx Enabled:** Disables the transmit carrier if the demodulator loses lock. The transmit carrier will be re-enabled once the demodulator locks.
  - **On (mute on loss of M&C):** Disables the transmit carrier if the M&C to the unit is lost. If M&C is re-established the transmit carrier will be re-enabled.
- **Tx carrier frequency:** Allows the configuration of the transmit L-Band frequency to satellite. Range: 950 to 2150 MHz. If the BUC control is enabled this field will automatically display the SHF transmit frequency.
- **Tx spectral roll-off:** This allows the slope of the carrier edges to become steeper as the roll-off percentage decreases. A lower roll-off factor improves spectral efficiency. The following options are available:
  - 5%, 10%, 15%, 20%, 25% and 35%

Note: if the units SAF features are limited to DVB-S2, then 20%, 25% and 35% spectral roll-off's only will be available.

- **Output power:** This is the units transmit output power and can be set in the range of: 0 to -40dBm with a step size of 0.1dBm.
- **Tx spectral inversion:** This is an on / off control and allows the modem to compensate for any other equipment in the transmit or receive chain that introduces a spectral inversion.



Modify Settings / Tx-Rx Settings / Tx-Rx

View Edit Refresh Hide All

Rx carrier frequency 1250 MHz

Sweep mode Normal (+/-20kHz)

Sweep width(+/-) 20 kHz

Cancel

- **Rx carrier frequency:** Allows the configuration of the receive L-Band frequency from satellite. Range: 950 to 2150 MHz. If the LNB control is enabled this field will automatically display the SHF receive frequency.
- **Sweep mode:** Allows the user to select the demodulator sweep width.
  - **Normal:** The sweep width is controlled automatically by the modem. The default sweep width used is +/-20kHz and is the optimum sweep width for most carriers.
  - **Other:** The allows the user to set the sweep width in order to compensate for carrier frequency uncertainty introduced in either the ground equipment or the space segment (due to, for example, frequency conversion errors). At very low data / symbol rates, reducing the sweep width may speed up carrier acquisition and prevent the potential to lock to a small adjacent carrier.
- **Sweep width:** Controls the Rx signal sweep width when the Sweep mode is set to Other. The carrier acquisition process sweeps either side of the centre frequency so the total sweep width is actually twice the value entered. The default sweep width used by the modem is  $\pm 20$ kHz. Set within the range of: 1kHz to  $\pm 700$ kHz; step size: 1kHz

## Service, Modulation and Coding:

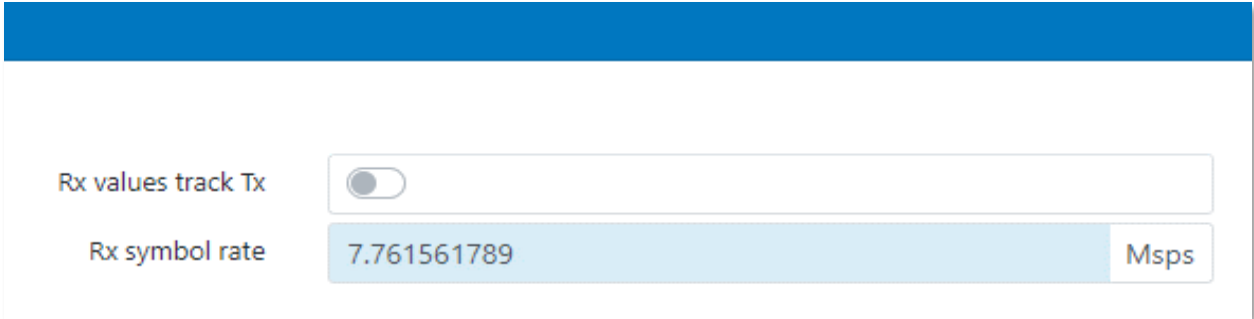
[Modify Settings](#) / [Tx-Rx Settings](#) / [Tx-Rx](#)

### Modulation & Coding

Tx rate control	<input type="text" value="Symbol rate"/>
Tx symbol rate	<input type="text" value="10"/> Msps
Tx data rate	<input type="text" value="16.098045"/> Mbps
Tx modulation	<input type="text" value="8APSK"/>
Tx FEC code rate	<input type="text" value="5/9-L"/>
Tx FEC frame size	<input type="text" value="Normal"/>
Tx pilot tones	<input checked="" type="checkbox"/>

- **Tx rate Control:** This allows the user to select the rate control to be fixed as either symbol rate or transmit bit rate.
  - **Date rate:** Allows the Modem rate control to be set to terrestrial data rate.
  - **Symbol rate:** Fixes the rate control to symbol rate.
- **Tx symbol rate:** Allows the entry of symbol rate, if the Tx rate control is set to symbol rate. Range 100kps to 100Msps; step size 1ps.
- **Tx data rate:** Setting the Tx rate control to data rate, allows the Modem to be configured with the terrestrial bit rate. Range 100kbps to 345Mbps; step size 1bps.
- **Tx modulation:** Allows the transmit Modulation to be set.
- **Tx FEC code rate:** Allows the Forward Error Correction code rate to be set.
- **FEC frame size:** Short or Normal frames sizes may be selected.
  - **Short:** Short frames comprise of 16,200 bits per FEC frame and are generally used where latency may be an issue, for example on low bit rate or symbol rate links.
  - **Normal:** These comprise of 64,800 bits per FEC frame and are more bandwidth efficient, have better performance in the space segment, but the tradeoff is at the expense of greater latency than short frames (four times the latency.) To an approximation, latency is inversely proportional to data rate, i.e. latency will halve as data rate doubles and vice versa.
- **Pilot tones:** Pilots are an On/Off control. DVB-S2/S2X pilot tones are unmodulated symbols, which are injected into the carrier on a regular basis in order to help the demodulator lock onto the carrier.

Modify Settings / Tx-Rx Settings / Tx-Rx

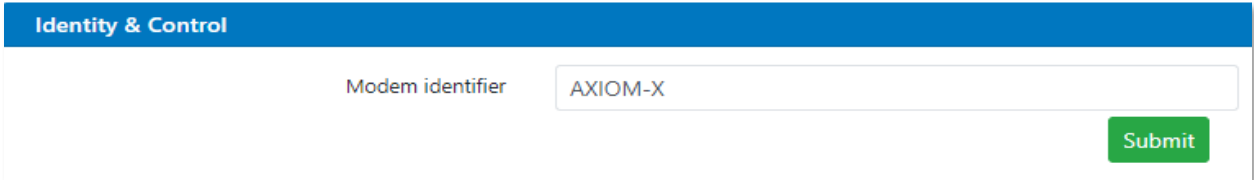


The screenshot shows a settings panel with a blue header. Below the header, there are two settings: 'Rx values track Tx' with a toggle switch currently turned off, and 'Rx symbol rate' with a text input field containing '7.761561789' and a unit dropdown menu set to 'Mpsps'.

- **Rx values track Tx:** This is an On/Off control that allows the receive path to be automatically configured to be the same as the transmit path, thereby simplifying set up. There are a number of exceptions including carrier frequency and spectral inversion.
- **Rx symbol rate:** Allows the entry of receive symbol rate. Range 100kpsps to 100Mpsps; step size 1psps. However, this is derated for higher order modulations, as follows: 8PSK/8APSK:85Ms/s, 16APSK: 64Mpsps; 32APSK: 51Mpsps, 64APSK: 43Mpsps, 128APSK: 36Mpsps, 256APSK: 32Mpsps.

### Interface and Control:

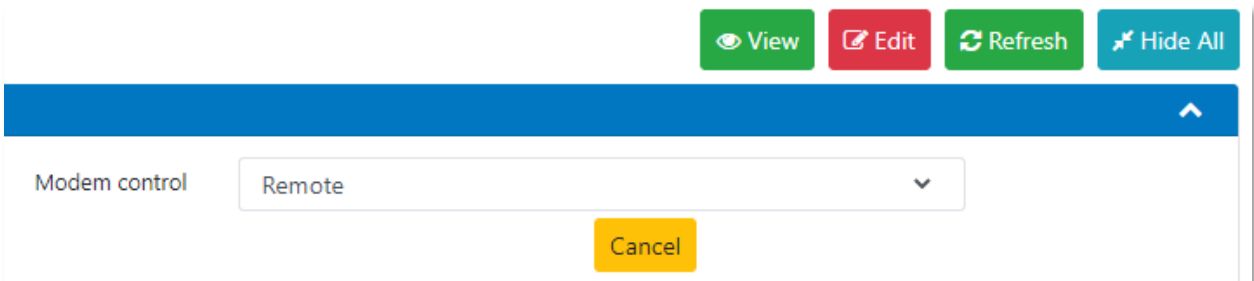
Modify Settings / Unit Settings / Interface & Control



The screenshot shows a settings panel with a blue header labeled 'Identity & Control'. Below the header, there is a 'Modem identifier' text input field containing 'AXIOM-X' and a green 'Submit' button.

- **Modem identifier:** Allows the user to set a unique identifier for the Modem.

Modify Settings / Unit Settings / Interface & Control

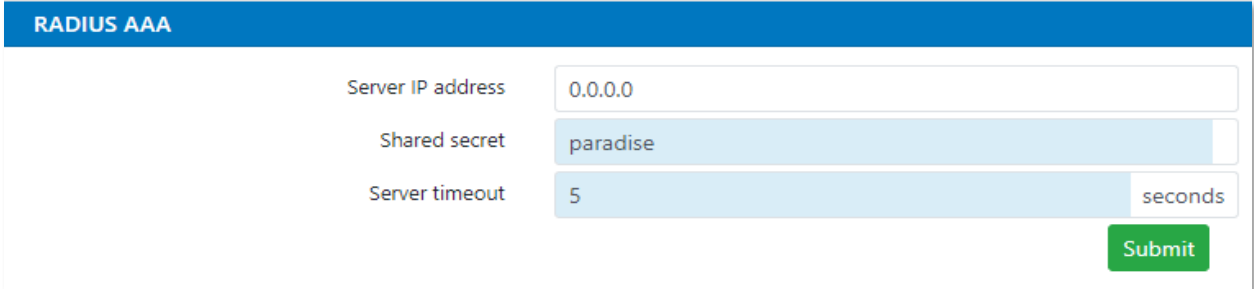


The screenshot shows a settings panel with a blue header. Below the header, there are four buttons: 'View' (green), 'Edit' (red), 'Refresh' (green), and 'Hide All' (blue). Below these buttons is a 'Modem control' dropdown menu currently set to 'Remote' and a yellow 'Cancel' button.

- **Modem Control:** Allows access for an individual admin user to be in sole control or to allow multiple users.
  - **Giveaway:** In Giveaway mode, control is granted to the first admin user that logs in. If an attempt is made to log in as admin when there is already an admin user logged in, then the login drops to view-only permissions, thereby ensuring there can never be two users in control of the modem at the same time.
  - **Remote:** Allows any users to login as admin and make changes.

## RADIUS AAA:

[Modify Settings](#) / [Unit Settings](#) / [Interface & Control](#)

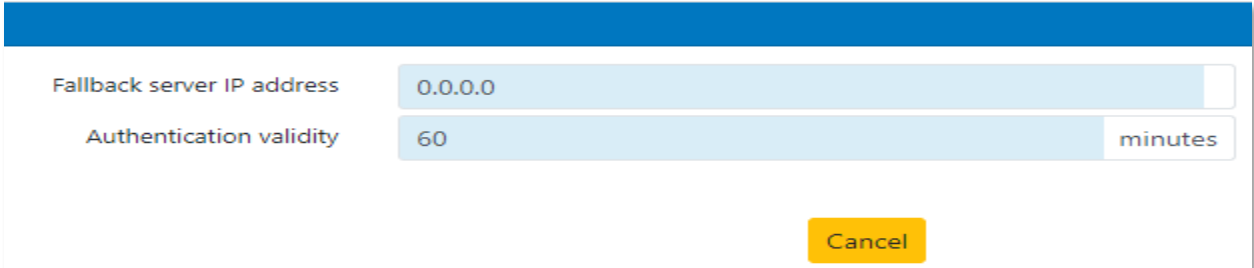


Server IP address	0.0.0.0
Shared secret	paradise
Server timeout	5 seconds

Submit

The modem supports a RADIUS client that communicates with the server in order to authenticate each user and to provide the authorised level of access (administrator or view-only). This allows users to log in using their personal organization login credentials. All login and configuration change activities are recorded in the modem's log, giving greater visibility and accountability.

- **Server IP Address:** This sets the IP address for a network server that supports the RADIUS AAA server, which is to be used for authenticating the users' login credentials.
- **Shared Secret:** The Shared secret is a user-assigned alphanumeric string, which is used as an authentication key (essentially a password) between the RADIUS client in the modem and the RADIUS server on the network.
- **Server timeout:** This controls the timeout when connecting to the RADIUS server. Two attempts will be made before reverting to use the fallback RADIUS server. If the fallback server connection attempts also fail then the user will be presented with the standard (non-RADIUS) login prompt. Range: 1 to 60 seconds; step size: 1 second.



Fallback server IP address	0.0.0.0
Authentication validity	60 minutes

Cancel

- **Fallback Server IP Address:** This sets the IP address for a fallback RADIUS network server, to be used in the event that the primary server cannot be contacted. The timeout period is specified by the Server timeout value.
- **Authentication validity:** This controls the period between automatic re-authentication of the connection to the RADIUS server. This is done in the background and no user intervention is necessary unless the connection to the RADIUS server has failed, when the user may be prompted to log in again using the fallback RADIUS server (or standard modem log in if no RADIUS server is available). Range: 5 to 60 minutes; step size: 1 minute.



### Notes for RADIUS Network Administrators:

The modem RADIUS authentication feature will work out-of-the-box, subject to the modem having access to a RADIUS server on the user's network. By default, all authorised users will receive administrator privileges. If you want some users to get administrator access and some view-only access then customisation of the RADIUS server configuration is required as explained below.

The standard RADIUS Access-Accept response from the RADIUS server can have an optional field added to it in order to distinguish between administrator and view-only user login authorisation. This involves the addition of a vendor-specific attribute using an SMI network management private enterprise code of 64534 (to denote Teledyne Paradise Datacom), which is one of a range reserved for private use. A vendor-specific attribute named 'Access-Level' is used, where a value of 0 equates to 'Modem Administrator' and a value of 1 equates to 'Modem User' (view only). If the modem receives an Access-Accept response with no Access Level attribute, or with an Access-Level value that is not supported, then the modem will default to administrator access being granted. The full specification of this attribute of the Access-Accept response is as follow:

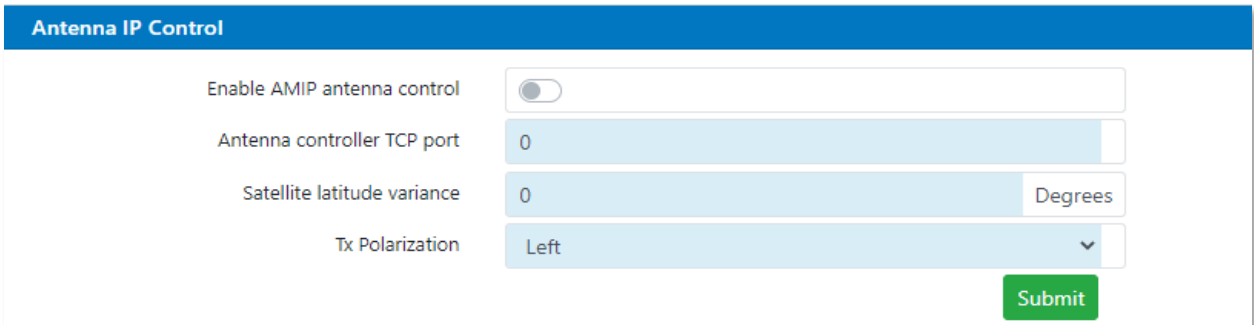
- A. Type: (one byte) value 0x1A - indicates a vendor specific attribute.
- B. Length: (one byte) value 0x09 – indicates the entire vendor-specific attribute field is nine bytes in length.
- C. Vendor ID: (four bytes) 0x0000FC16 – indicates Paradise private-use.
- D. Vendor type: (one byte) value 0x01 – indicates the vendor-specific attribute is 'Access-Level'.
- E. Vendor length: (one byte) value 0x03 – indicates the remainder of the vendor-specific attribute field following the Vendor ID is three bytes in length.
- F. Vendor data: (one byte) value 0='Modem Administrator'; value 1='Modem User' – indicates the authorised login access level.

### Open AMIP:

Open AMIP is an industry standard specification for the interface between Antenna Control Units and satellite Modems.

To facilitate this communication, the AMIP control needs to be enabled and the and TCP port number need to be entered.

#### [Modify Settings](#) / [Unit Settings](#) / [Interface & Control](#)

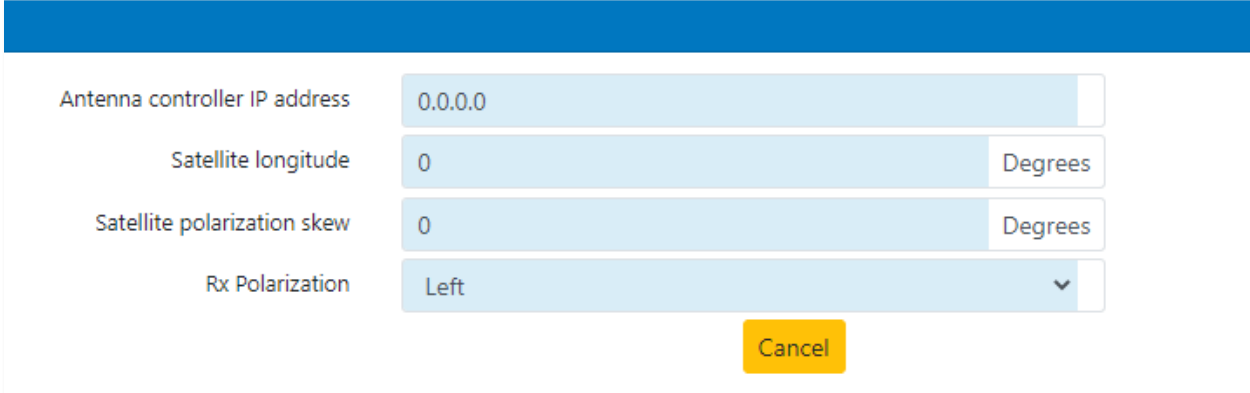


Antenna IP Control	
Enable AMIP antenna control	<input type="checkbox"/>
Antenna controller TCP port	<input type="text" value="0"/>
Satellite latitude variance	<input type="text" value="0"/> Degrees
Tx Polarization	<input type="text" value="Left"/>
<input type="button" value="Submit"/>	

- **Enable AMIP antenna control:** When enabled, allows the Modem Tx Mute control and Rx Lock status to be provided via the AMIP protocol.

- **Antenna controller TCP port:** Enter the antenna controller TCP port number.
- **Satellite latitude variance:** Enter Satellite Latitude Variance (if working with Inclined Orbit satellites).
- **Tx polarization:** Enter the Tx polarization: Left, Right, Horizontal or Vertical.

[Modify Settings](#) / [Unit Settings](#) / [Interface & Control](#)



The screenshot shows a configuration window with a blue header bar. Below the header, there are four configuration fields:

- Antenna controller IP address:** A text input field containing "0.0.0.0".
- Satellite longitude:** A text input field containing "0" and a "Degrees" label to its right.
- Satellite polarization skew:** A text input field containing "0" and a "Degrees" label to its right.
- Rx Polarization:** A dropdown menu with "Left" selected and a downward arrow icon.

At the bottom center of the configuration area, there is a yellow "Cancel" button.

- **Antenna controller IP address:** The antenna controller IP address, used to establish open AMIP communications between the Modem and antenna controller.
- **Satellite longitude:** Enter the required satellite coordinates for the antenna system to locate the desired satellite.
- **Satellite polarization skew:** During Cross-Pol isolation tests, enter the known skew value of the satellite, then as instructed by the NOC, increase or decrease the satellite skew parameter.
- **Rx polarization:** Enter the Rx polarization: Left, Right, Horizontal or Vertical.

### AUPC Configuration:

Automatic Uplink Power Control (AUPC) provides a mechanism to counteract changes in atmospheric conditions, such as rain, that degrade the performance of satellite links. It does this by monitoring the remote-end signal-to-noise ratio (Eb/No) and automatically adjusting the local power output of the satellite link in order to maintain the specified remote-end Eb/No. Note that if the rain is falling at the local end of the link then the power seen at the satellite will be unchanged. However, if the rain is falling at the remote end of the link then the power seen by the satellite will increase, which if not controlled carefully has the potential to affect other carriers or saturate the transponder. Carrier power must be kept to the levels agreed with the satellite operator.

Eb/No information is injected, at a low rate with extremely low overhead, into the return channel. The modem can be set to simply monitor the remote Eb/No, or to maintain it at a specified level. A deferred alarm can be set to activate if the remote Eb/No falls below a user-set threshold. A target Eb/No level has to be set along with a maximum transmit power level for the local end. The transmit power is adjusted to keep the remote Eb/No at the target value. If the satellite link is lost, then the transmit power can be frozen at its current level until the link is restored, or it can be returned to its nominal value.

---

**WARNING:** Authorisation from the satellite operator may be necessary prior to Activating AUPC!

---

Modify Settings / Unit Settings / AUPC

AUPC	
AUPC mode	Off
Maximum AUPC power offset	1 dBm
AUPC method	Normal
Local demod unlocked action	Off
<input type="button" value="Submit"/>	

- **AUPC mode:** This controls the AUPC mode.
  - **Off:** Disables AUPC
  - **Monitor:** The modem will monitor the remote Modems Eb/No via the return channel, without making any changes to the local Tx power level.
  - **Maintain remote Eb/No:** The modem will maintain the remote Eb/No at the specified target level. For correct operation this requires both local and remote Modems to be configured the same.
- **Maximum AUPC Power Offset:** This is the maximum increase in Tx power level that AUPC is allowed to make in order to maintain remote Eb/No. Range: 0dBm to 25.0dBm; step size: 0.1dBm
- **AUPC method:** Allows the user to set the appropriate AUPC method.
  - **Normal:** This should be selected when the AXIOM, Q-Series or Quantum modems are being used at either end of the satellite link and the mode is set to DVB.
  - **Self:** In this mode, the modem will adjust the power output in an attempt to maintain the Eb/No at its target level using the Eb/No from its own received carrier rather than the Eb/No value being passed back from any remote modem.
- **Local demod unlocked action:** Defines the Local demod unlocked action.
  - **Freeze at current value:** The carrier power is frozen at its current value.
  - **Set to nominal:** The AUPC delta power is set to zero, causing the carrier to return to its nominal power level.
  - **Set to max:** The AUPC delta power is set to the maximum power limit as defined by Maximum AUPC power offset.
  - **Off:** There is no local demod loss action enabled.

Modify Settings / Unit Settings / AUPC

Target remote Eb/No	<input type="text" value="10"/>	<input type="text" value="dB"/>
Maximum negative AUPC power offset	<input type="text" value="1"/>	<input type="text" value="dBm"/>
Carrier loss action	<input type="text" value="Set to max"/> ▼	
Stream Identifier	<input type="text" value="4"/>	

- **Target remote Eb/No:** This is the remote Eb/No that AUPC tries to maintain by adjusting the local Tx power level. Range: 0.1dBm to 15.0dBm; step size: 0.1dBm.
- **Maximum Negative AUPC Power Offset:** This is the maximum decrease in Tx power level that AUPC is allowed to make in order to maintain remote Eb/No. Range: 0dBm to 25.0dBm; step size: 0.1dBm.
- **Carrier loss action:** Defines the specific loss action to be taken if the demodulator loses lock.
  - **Freeze at current value:** The carrier power is frozen at its current value.
  - **Set to nominal:** The AUPC delta power is set to zero, causing the carrier to return to its nominal power level.
  - **Set to max:** The AUPC delta power is set to the maximum power limit as defined by Maximum AUPC power offset.
- **Stream Identifier:** Used in a point to Multipoint system, the stream identifier specifies which demod on the Hub unit is being used to demodulate the carrier from this particular remote Modem. Range 1 to 128.

**Carrier loss action explained:**

The distinction between the two carrier loss actions is as follows: The Carrier loss action covers the situation where the distant modem's demodulator has unlocked, resulting in no Eb/No information being available from the distant modem. In this situation, you may, for example, want to increase the AUPC uplink level from the local modem to the maximum. The Local demod unlocked action covers the situation where the local demodulator has unlocked, also resulting in no Eb/No information being available from the distant modem. In this situation, because there is no carrier being received from the distant modem, you may, for example, want to set the AUPC uplink level from the local modem to its nominal level since there is no indication in this scenario of a problem with the distant modem receiving the local modem's carrier.

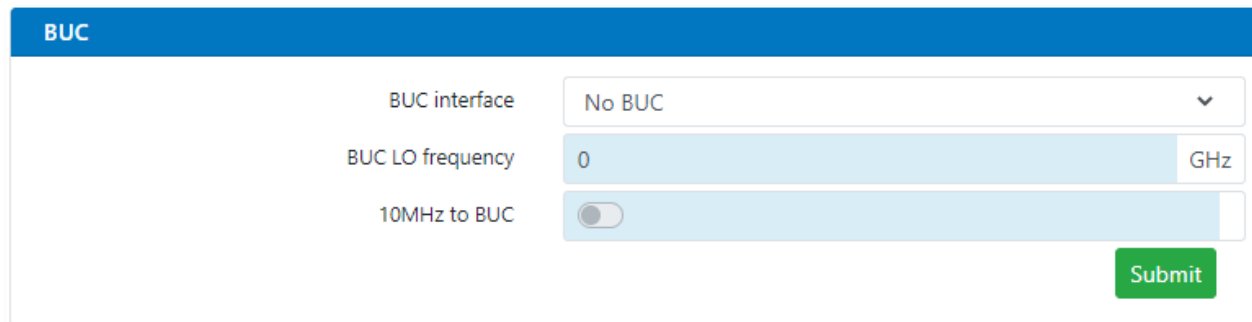
### AUPC functionality:

The following procedure should be followed to ensure correct AUPC operation:

- Prior to switching on AUPC, configure the modems at both ends of the link and ensure the satellite link is operating correctly.
- Set the transmit power to achieve the remote Eb/No expected under clear-sky conditions.
- To receive an indication of when the remote Eb/No falls below a defined threshold, set a target Eb/No minimum threshold (which may cause a backward alarm to be generated under these conditions).
- Set the AUPC mode to monitor the remote Eb/No in order to determine if it is working correctly. If the remote-end Eb/No is not available on the Web interface Status screen then the modems are not configured correctly.
- Record the remote Eb/No under clear-sky conditions and then set the AUPC mode to maintain the remote Eb/No.
- Set a target Eb/No and set the maximum power level.
- Review the remote Eb/No to confirm that it is being maintained correctly under different atmospheric conditions. The web user interface remote Eb/No and power graphs can be used to review AUPC performance.

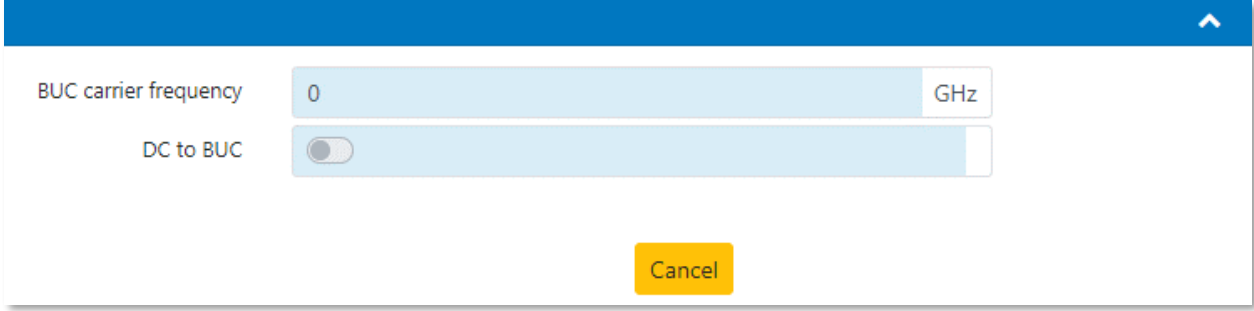
### BUC:

[Modify Settings](#) / [Unit Settings](#) / [BUC/LNB](#)



- **BUC Interface:** Effectively allows the Modem IF to be set as either L-Band or SHF, the latter requiring the BUC local oscillator frequency to be entered.
  - **BUC:** Indicates that a BUC is fitted and allows the setting of SHF. There is no BUC communication with the modem.
  - **No BUC:** Indicates that no BUC is fitted and so the IF is set as L-Band frequencies between 950 and 2150MHz.
- **BUC LO Frequency:** This is the local oscillator frequency of the BUC and can be configured between -99.999 GHz to 99.999 GHz; step size: 0.0000001 GHz. If the BUC LO frequency is set, the L-band transmit carrier frequency will no longer be available and will automatically be controlled by the modem to achieve the requested BUC transmit frequency.
- **10MHz to BUC:** This allows a 10MHz reference to be provided from the Modem via the IFL and provides a high-stability 7.5x10-8/yr. Reference Oscillator to phase lock the BUC.

Modify Settings / Unit Settings / BUC/LNB



- **BUC Carrier Frequency:** This is the BUC transmit frequency used to transmit towards satellite. Set within the range of 0.95 to 99.999 GHz; step size: 0.0000001 GHz (i.e. 100 Hz)
- **DC to BUC:** This allows DC to be provided from the Modem to power a BUC via the IFL.

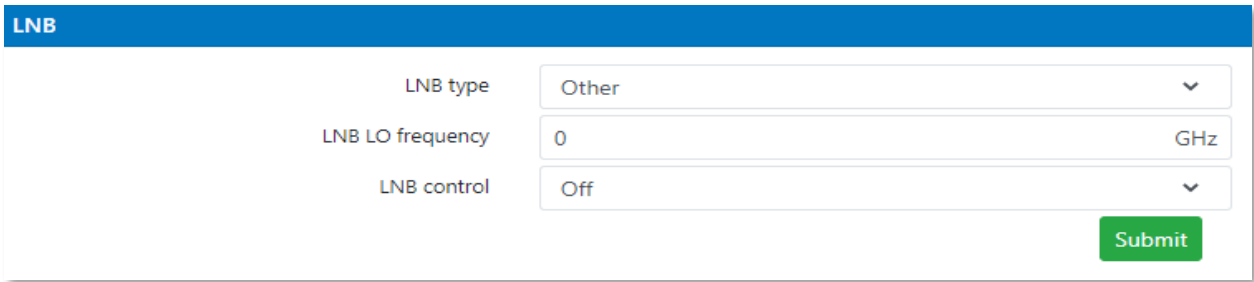
**Note:** the LO frequency control to allow for Low and High-side operation, is as follows: Low-side operation is where the LO frequency is below the SHF wanted frequency band. High-side operation is where the LO frequency is above the SHF wanted frequency band. Low-side operation requires the entry of the LO frequency with no additional information. High-side operation requires the entry of the LO with a minus sign before the frequency. An example is for a 950 MHz L Band Tx output, a 13.05 GHz LO will result in the modem reporting a 14 GHz output frequency. Entering a -13.05 GHz LO frequency will result in a 12.10 GHz output frequency.

**Note:** In addition to the above low and high side operation, **enabling a BUC LO frequency will cause the modem L Band frequency to revert to the minimum frequency of 950 MHz.**

***WARNING: It is highly recommended that all 10MHz and DC services are switched off to the BUC before connecting or disconnecting the modem L-band RF cables in order to avoid the potential for damage.***

**LNB:**

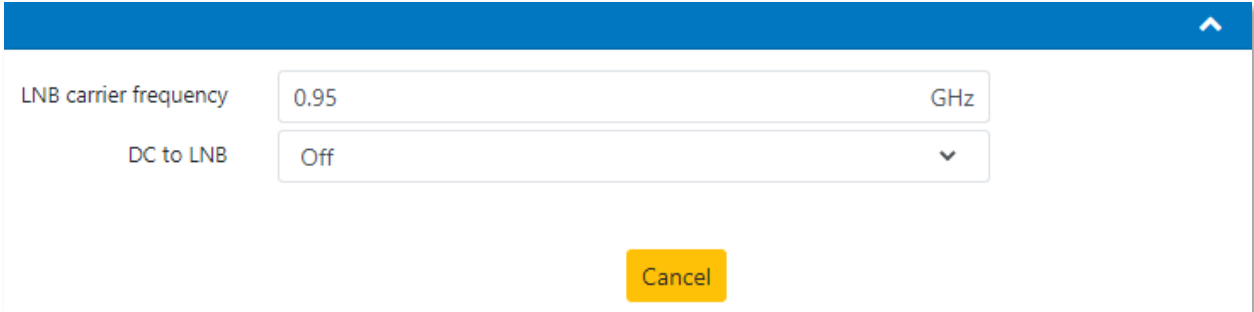
Modify Settings / Unit Settings / BUC/LNB



- **LNB Type:** This allows the appropriate LNB to be selected:
  - **C 3.635 – 4.200 GHz:** This presets the LNB LO frequency to 5150MHz.
  - **Ku 10.95 – 11.45 GHz:** This presets the LNB LO frequency to 10000MHz
  - **Ku 11.2 – 11.7 GHz:** This presets the LNB LO frequency to 10250MHz
  - **Ku 11.7 – 12.2 GHz:** This presets the LNB LO frequency to 10750MHz

- **Ku 12.25 – 12.75 GHz:** This presets the LNB LO frequency to 11300MHz
  - **None:** This indicates that no LNB is fitted and the displayed / configured IF will be at L-Band
  - **Other:** An LNB is connected but this is not one of the ones listed above and allows the user to input the LO frequency.
- **LNB LO Frequency:** This is the local oscillator frequency of the LNB. If the LNB LO frequency has been set the L-band receive carrier frequency will no longer be available and will automatically be controlled by the modem to achieve the requested LNB receive frequency.
  - **LNB Control:** Allows a suitable LNB to operate over the entire Ku frequency band by switching the LO from 9.75 to 10.6 GHz
    - **Off:** No 22 kHz tone control, LO set to 9.75 GHz
    - **22kHz:** Sets the LNB LO to 10.6 GHz by sending a 22 kHz tone at 0.5V peak to peak to the LNB via the IFL.

Modify Settings / Unit Settings / BUC/LNB



- **LNB Carrier Frequency:** This is the LNB frequency used to receive from satellite. Set within the range of 0.95 to 99.999 GHz; step size: 0.0000001 GHz (i.e. 100Hz)
- **DC to LNB:** This allows DC to be provided from the Modem to power an LNB via the IFL.
  - **Off:** No DC is provided to the LNB.
  - **13V, 15V, 18V & 20V:** Allows the selection of one of these voltages to power an LNB via the IFL. Max 0.5A

**Note:** The LNB frequency selection works in the same manner as the BUC LO frequency. i.e. the addition of a minus sign before the frequency will subtract the LO from the L Band output frequency.

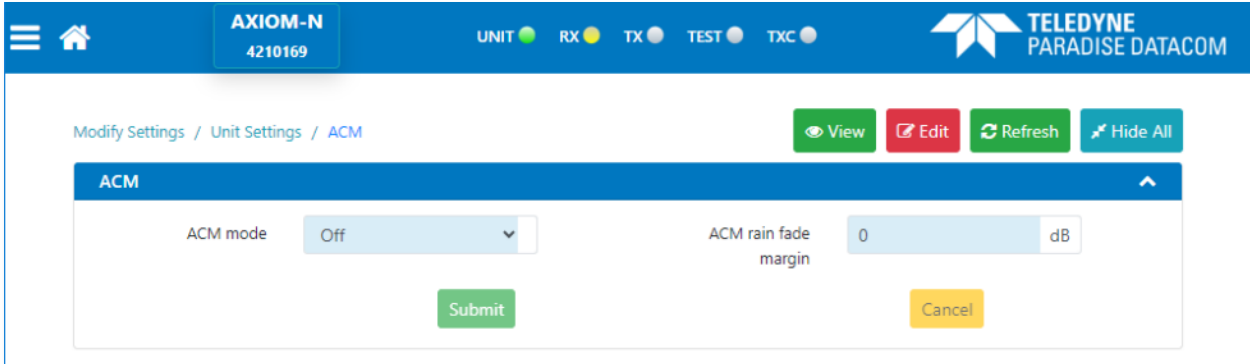
---

**WARNING:** It is highly recommended that DC is switched off to the LNB prior to disconnecting or connecting the modem L-band RF cables in order to avoid potential for damage.

---

## ACM Configuration:

[Modify Settings](#) / [Unit Settings](#) / [ACM](#)



Modify Settings / Unit Settings / ACM

ACM

ACM mode: Off

ACM rain fade margin: 0 dB

Submit Cancel

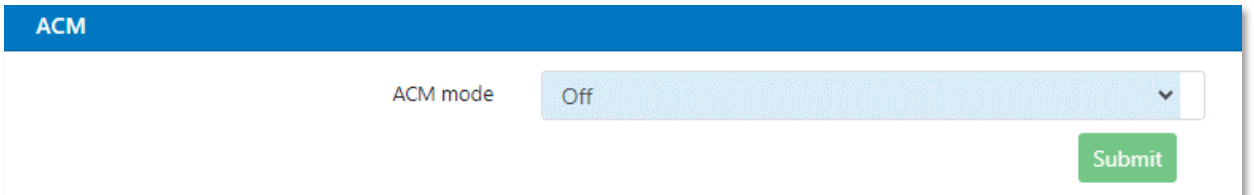
ACM - Adaptive Coding and Modulation, automatically changes the link modulation and code rate (MODCOD) to compensate for varying link conditions, thereby optimising link availability and throughput. If configured correctly, ACM will allow access to the unused link margin, but more importantly attempts to preserve link availability even in the most adverse of conditions.

When ACM is on, the choice of modulation and FEC rate in the transmit path is dynamically matched to the reported  $E_s/N_0$  from the remote modem. Symbol rate and carrier power are unchanged, but data rate will vary with the choice of MODCOD.

The modem will automatically insert regular  $E_s/N_0$  information into the return carrier (with no material effect on bandwidth). This is used to control the carrier MODCOD selection of the other modem, should it have ACM enabled.

Monitor mode provides an environment where ACM functionality can be simulated but does not actually change the modulation and code rate. However, monitor mode does record what MODCOD's would have been selected and includes recording the time, remote  $E_s/N_0$  and the data rate allowing ACM to be tested in a non-intrusive way on a live link and also confirms any projected bandwidth savings prior to going live.

[Modify Settings](#) / [Unit Settings](#) / [ACM](#)



ACM

ACM mode: Off

Submit

- **ACM mode:** Defines whether ACM is enabled or not and if so, in what capacity.
  - **Off:** Disables ACM in both transmit and receive paths.
  - **On:** Enables ACM in both transmit and receive paths.
  - **Monitor:** This is a test mode that simulates ACM being on but does not actually change MODCOD.



- **ACM rain fade margin:** This sets a margin used in the ACM control process when making decisions on what MODCOD to select based on the current Es/No reading from the remote modem. Range: 0dB to 9.9dB; step size: 0.1dB

By setting an ACM rain fade margin to a non-zero value, ACM operation will cope with a faster rate of rain fade without losing demodulator lock than would otherwise be the case.

**Note** that the ACM control process has its own non-configurable operating margin built in (which will cope with Es/No changes of up to 1dB/s) and therefore any additional rain fade margin should be empirically tested for optimum results. Setting an ACM margin that is higher than necessary will reduce the benefits of using ACM since non-optimal MODCOD's may be used due to the need to maintain a larger margin between the actual Es/No and the Es/No required by the dynamically selected MODCOD's.

## Alarm Settings:

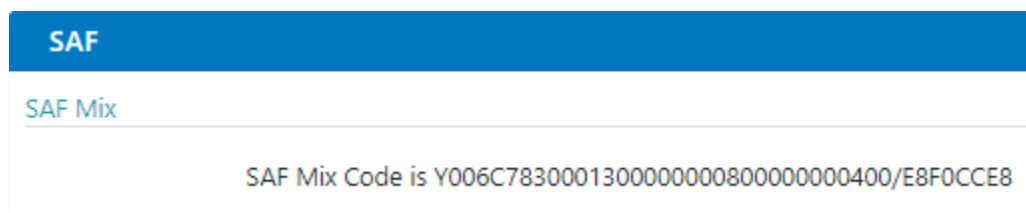
[Modify Settings](#) / [Unit Settings](#) / [System Alarms](#)

- **Local Eb/No alarm threshold:** This allows the user to set an Eb/No threshold below which a deferred alarm will be generated for the local received carrier. Range: 0dB to 99.0dB; step size: 0.1dB.
- **BUC DC alarm enable:** If the Modem is providing DC power to the BUC via the IFL, then the modem can monitor this supply for under or over current conditions that cause the BUC to shut down.
  - **Ignore:** The BUC DC alarm feature is disabled
  - **Display fault when active:** If the BUC DC current is outside of the configured maximum or minimum limits a deferred alarm is raised.

- **BUC DC current minimum:** Sets the minimum threshold at which a deferred alarm is raised.  
Range: 0.1A to 4.0A; step size: 0.01A
- **BUC DC current maximum:** Sets the maximum threshold at which a deferred alarm is raised.  
Range: 0.1A to 4.0A; step size: 0.01A
- **M&C and IP port down alarms:** The Ethernet port down alarm checkboxes can be used to enable or disable individual alarms associated with each Ethernet port on the modem. These can be used to indicate that a cable has been removed or developed a fault, or that the terrestrial equipment attached to a particular port has potentially developed a fault.
- **Traffic port alarm threshold:** Allows the user to set a bit rate threshold below which an alarm is raised. Range: 0 to 345Mbps; step 1kbps.
- **Remote Eb/No alarm threshold:** This allows the user to set an Eb/No threshold below which a deferred alarm will be generated for the remote Modem (i.e. this units transmitted carrier). Range: 0dB to 99.0dB; step size: 0.1dB.
- **LNB DC alarm enable:** If the Modem is providing DC power to the LNB via the IFL, then the modem can monitor this supply for under or over current conditions that cause the LNB to shut down.
  - **Ignore:** The LNB DC alarm feature is disabled
  - **Display fault when active:** If the LNB DC current is outside of the configured maximum or minimum limits a deferred alarm is raised.
- **LNB DC current minimum:** Sets the minimum threshold at which a deferred alarm is raised.  
Range: 1mA to 500mA; step size: 1mA
- **LNB DC current maximum:** Sets the maximum threshold at which a deferred alarm is raised.  
Range: 1mA to 500mA; step size: 1mA

### SAF entry screens:

[Modify Settings](#) / [SAF](#) / [SAF](#)



- **SAF Mix:** The Software Accessible Feature code is a number that represents all of the features that have been permanently enabled within the modem.

Modify Settings / SAF / SAF

SAF Test Shots

SAF test time remaining 0      Demo test shots remaining 0

- **SAF Demonstration Test Shots:** This field displays the remaining time period before any temporarily enabled features time out, the number of unused demo test shots remaining and the ability to start and stop a test shot. A test shot enables all of the modem features for a 10-day period (subject to suitable hardware being fitted and with some exceptions).

New SAF Code

New SAF Code

- **New SAF code:** This edit box is used to enter a code provided by Paradise that unlocks additional modem features. When unlocked, the features immediately become available. The act of unlocking SAF features will not itself interfere with any services being provided by the modem. Entering a code of '0' will enable a test shot.

**SNMP configuration:**

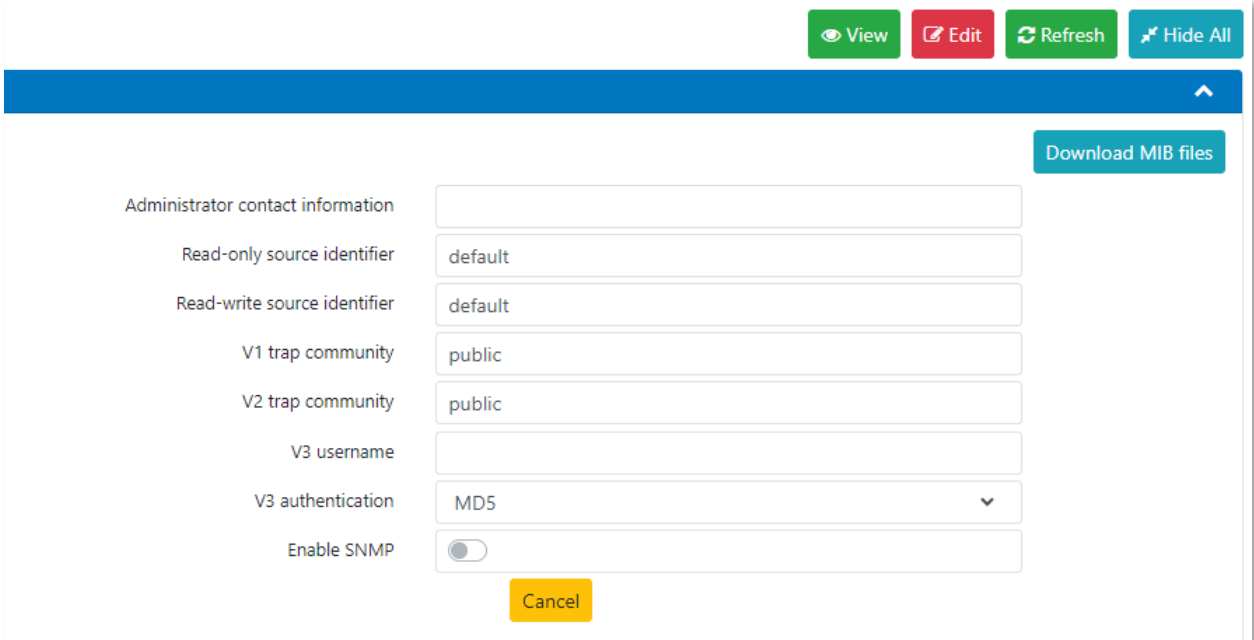
Other Settings / SNMP - HTTPS

**SNMP**

System location	<input type="text" value="Modem location"/>
Read-only access community name	<input type="text" value="public"/>
Read-write access community name	<input type="text" value="private"/>
V1 trap Rx	<input type="text"/>
V2 trap Rx	<input type="text"/>
Default trap sink community	<input type="text" value="public"/>
V3 password	<input type="text"/>
Enable V3 encryption	<input type="checkbox"/>

SNMP is disabled by default and must be enabled before it can be used. Once enabled, the modem will always respond to SNMP commands. SNMP V1, V2c or V3 can be used to communicate between an SNMP manager and the SNMP agent on the modem. The modem's SNMP configuration settings have the standard meanings defined by the relevant SNMP standards and are therefore not described in

detail. The community names represent passwords that must be present in each SNMP read or write requests in order for the commands to be executed. The source identifier fields are used to define the source IP addresses that read/write requests will be accepted from. The trap receiver fields are used to define the IP address of a trap server to which trap notifications will be sent when modem alarms arise (and when they disappear).



The image shows a web-based configuration form for SNMP. At the top right, there are four buttons: 'View' (green), 'Edit' (red), 'Refresh' (green), and 'Hide All' (blue). Below these is a blue header bar with a 'Download MIB files' button on the right. The main form area contains several input fields and a toggle switch:

- Administrator contact information: empty text input
- Read-only source identifier: text input with 'default' value
- Read-write source identifier: text input with 'default' value
- V1 trap community: text input with 'public' value
- V2 trap community: text input with 'public' value
- V3 username: empty text input
- V3 authentication: dropdown menu with 'MD5' selected
- Enable SNMP: toggle switch currently turned off

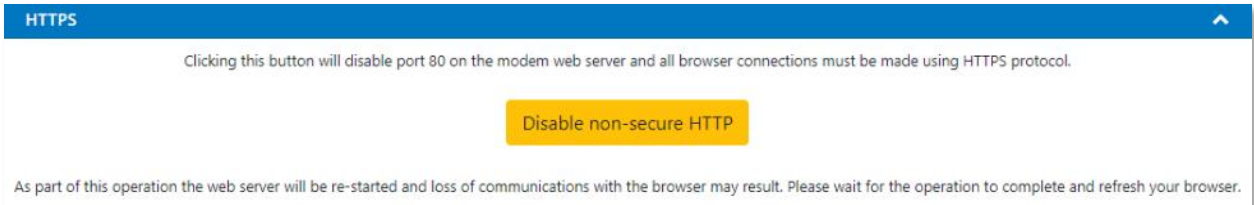
A yellow 'Cancel' button is located at the bottom center of the form.

SNMP can be controlled by the SNMP enable setting. SNMP is switched off by default. The modem does not need to be configured to tell it which version of SNMP is being used and will respond correctly to all SNMP commands regardless of the version.

The modem’s SNMP Management Information Bases (MIBs) can be downloaded directly from the modem using the Download MIB files hyperlink at the top right hand side of the SNMP configuration screen.

### HTTPS configuration:

#### Other Settings / SNMP - HTTPS



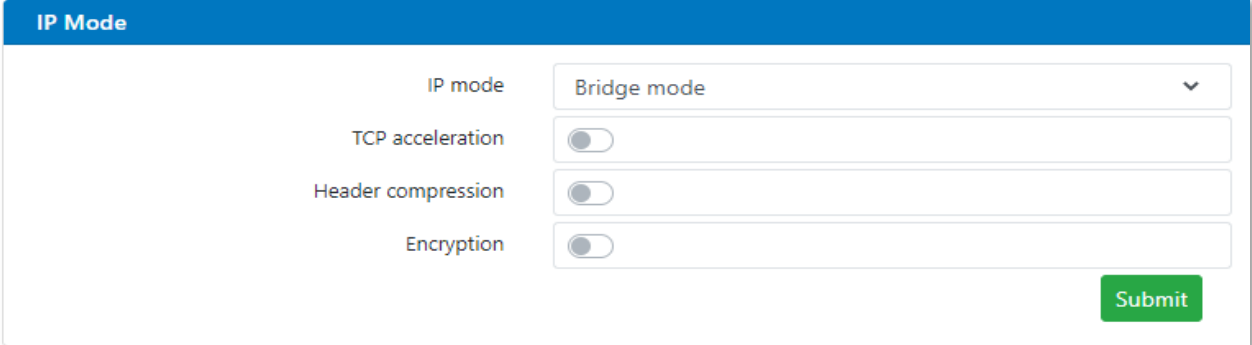
The image shows a web-based configuration screen for HTTPS. At the top, there is a blue header bar with the text 'HTTPS' and an upward arrow. Below the header, a message reads: "Clicking this button will disable port 80 on the modem web server and all browser connections must be made using HTTPS protocol." A yellow button labeled "Disable non-secure HTTP" is centered on the screen. At the bottom, a note states: "As part of this operation the web server will be re-started and loss of communications with the browser may result. Please wait for the operation to complete and refresh your browser."

Secure HTTPS connections to the modem’s web server (on port 443) are always enabled. However, it is possible to disable (and re-enable) standard HTTP requests (on port 80) using this screen.

As part of this operation the web server will be re-started and loss of communications with the browser may result. Please wait for the operation to complete and refresh your browser.

## IP Mode:

IP Settings / Basic IP Settings



IP Mode	
IP mode	Bridge mode
TCP acceleration	<input type="checkbox"/>
Header compression	<input type="checkbox"/>
Encryption	<input type="checkbox"/>

Submit

- **IP mode:** Allows Bridging, Routing or Trunking modes to be selected.
  - **Bridge Mode:** In this mode the modem acts as an Ethernet bridge, preserving the original Ethernet frames (including additional fields such as VLAN and MPLS headers) over satellite.
  - **Routing Mode:** In this mode IP packets are forwarded based on the contents of the modem's routing table, which can be configured manually with static routes or controlled dynamically by enabling dynamic routing. Dynamic routing populates the routing table based on information forwarded by other routers in the network. Static routing allows the modem to be operated as a two-port static router, one port being the terrestrial interface and the other port being the satellite interface. Static routing is useful for small networks that do not require dynamic routing – it can be activated by selecting routing mode but not enabling any dynamic routing protocols. Each route comprises a Destination IP Address, Subnet Mask and a Gateway Address. If the destination address of a packet fails to match any entries in the routing table, and the packet has a destination address outside of the local network, the packet will be sent to the default gateway, if specified, otherwise the packet will be discarded.
  - **Trunking Mode:** Implements a Layer 2 bridge in hardware. This results in a much higher packet handling capability (up to 250,000 packets per second as opposed to a maximum of 160,000 packets per second when in other modes). Because the processor is bypassed in this mode, jitter is also minimised and typically registers close to zero when measured with Ethernet test equipment. ACM (and AUPC) can be used in Trunking mode but other IP features such as TCP acceleration cannot be used because they require the packets to be passed through the processor.

When the M&C and IP traffic ports are on the same subnet then the ports can be bridged together (sharing a single IP address) and all M&C requests will then automatically find their way to the remote modem. If the M&C port were to be removed from the bridge then only the IP traffic data is bridged over the main channel. However, if M&C of the remote Modem is required, an M&C VLAN facility has been added to allow all M&C traffic (on its own separate subnet) to pass over satellite in its own VLAN, allowing easy M&C connectivity.

## Ethernet Port Operation

Modem Settings			Ethernet Operation	
Bridging/Routing Mode	M&C and IP Traffic Ethernet Ports	TCP Acceleration	Operation of M&C Port	Operation of IP Traffic Port
Bridging	Bridged	Off	M&C address shared with IP Traffic port; M&C traffic will be bridged over satellite as required	IP Traffic address not used; port is addressed via M&C address; traffic will be bridged over satellite as required
Bridging	Bridged	On	This combination of modem settings is illegal (M&C port will be automatically removed from bridge)	
Bridging	Bridge disabled	Off	M&C port has dedicated address; M&C traffic will not be bridged over satellite	IP Traffic port has dedicated address; traffic will be bridged over satellite as required
Bridging	Bridge disabled	On	M&C port has dedicated address; M&C traffic will not be bridged over satellite; modem gateway is applied to M&C subnet	IP Traffic address not used; IP Traffic port dedicated to satellite traffic only, which will be accelerated and bridged over satellite as required
Routing	Bridged	Off	This combination of modem settings is illegal (M&C port will be automatically removed from bridge)	
Routing	Bridged	On	This combination of modem settings is illegal (M&C port will be automatically removed from bridge)	
Routing	Bridge disabled	Off	M&C port has dedicated address, which must be on a different subnet to IP Traffic port; M&C traffic will be routed over satellite as required	IP Traffic port has dedicated address; traffic will be routed over satellite as required
			<b>Modem gateway applied to either port as specified by subnet</b>	
Routing	Bridge disabled	On	M&C port has dedicated address, which must be on a different subnet to IP Traffic port; M&C traffic will be routed and accelerated over satellite as required	IP Traffic port has dedicated address; traffic will be routed and accelerated over satellite as required
			<b>Modem gateway applied to either port as specified by subnet</b>	

- TCP Acceleration:** When enabled, this feature allows the Modem to accelerate TCP data to mitigate the effects of the round-trip delay where TCP sees this latency as congestion and so throttles back the rate at which data is sent to the Modem. When enabled, TCP packets are processed by a Performance Enhancing Proxy (PEP) that overcomes this limitation. Packets received by the modem will be either bridged or routed as determined by the IP mode setting.

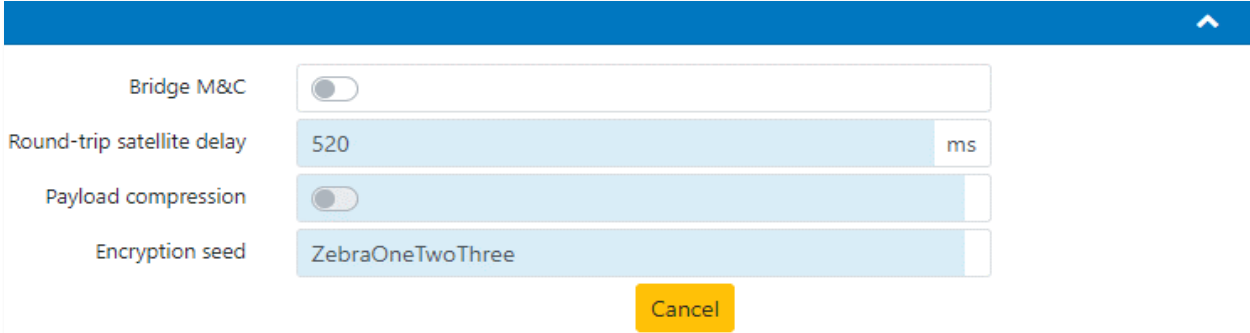
## Configuring TCP Acceleration

- **Bridging Mode:** In order to make it easier to set up, TCP acceleration does not use an IP address for the IP traffic port when used in bridging mode. The M&C Ethernet port cannot be bridged to the IP Traffic port when using bridged TCP acceleration. M&C control must be provided via a separate subnet to that used for satellite traffic. The modem gateway is applied to the M&C subnet.
- **Routing Mode:** In this mode, the M&C Ethernet port and IP Traffic port have dedicated addresses and must be on separate subnets. All packets on both ports will be accelerated and passed over satellite as required. The modem gateway is applied to either the M&C subnet or IP Traffic subnet as specified by the user.
- **Header Compression:** Supports IP, UDP and RTP header compression in accordance with the Robust Header Compression (ROHC) standard RFC 3095 (profiles 2 and 3). ROHC typically reduces the 40 bytes of IP, UDP and RTP header, which is typically used with Voice over IP data, down to between 1 and 3 bytes. Ethernet header compression is also supported in addition, and this reduces 14 bytes of Ethernet frame down to typically 1 byte. Overall savings from compression from both types of compression (e.g. for a G.729 voice stream) can be as high as 60%.

When header compression is enabled, Ethernet, UDP, TCP, RTP and IP packet headers are compressed in order to save satellite bandwidth. The relative bandwidth saving is greater for smaller packets. The compressed packets will be either bridged or routed as determined by the IP mode setting. Selective compression of packets can be controlled via the IP settings > IPv4 Header Compression tab, which allows routes to be added

- **Encryption:** If the unit is an AXIOM-Encryption model, then AES 256-bit key encryption of IP packets is supported. Encryption is export-controlled technology and is only provided on the Encryption models.

### IP Settings / Basic IP Settings



Bridge M&C	<input type="checkbox"/>
Round-trip satellite delay	520 ms
Payload compression	<input type="checkbox"/>
Encryption seed	ZebraOneTwoThree

Cancel

- **Bridge M&C:** This allows the user to bridge the RJ45 Ethernet ports together or whether they have separate M&C and traffic IP addresses allocated to them. When the Remote M&C Ethernet port is bridged to the satellite IP Traffic port then the modem Ethernet ports act as an Ethernet switch.

**WARNING:** When the Remote M&C Ethernet port is out of the bridge, then satellite IP traffic and M&C traffic are processed separately and therefore the M&C and traffic Ethernet connectors are no longer interchangeable. Care should be taken in selecting this mode for a remote modem since if the cables have been incorrectly installed, then it could result in M&C communications with the remote modem being lost.

- **Round-trip satellite delay:** This sets a satellite round-trip delay that is used in conjunction with TCP acceleration. It controls the size of the modem’s internal packet buffer to match the bandwidth-delay product of the link (i.e. the link’s data capacity multiplied by the end-to-end delay). This helps to maintain the throughput at its maximum level when TCP acceleration is on. The Satellite buffer size also plays an important role in preventing oscillations in throughput when TCP acceleration is on – it is recommended that this should normally be set to 8 and is configured on the IP settings > Advanced IP Settings tab.  
**Range** 0ms to 999ms; step size: 1ms.
- **Payload Compression:** Allows the compression of IP packets to save satellite bandwidth. The compressed packets will be either bridged or routed as determined by the IP mode setting.
- **Encryption seed:** This is the seed used to generate the key, which is used for encrypting and decrypting IP packets. The key used in the encryption process is generated using the encryption seed, which is an alphanumeric string. Keys are not exchanged over the air and the encryption seed must therefore be set to be the same on both the transmit and receive modems. For security reasons it is recommended that the encryption seed is changed on a regular basis.

## IP Addresses:

[IP Settings](#) / [Basic IP Settings](#)

IP Addresses	
M&C IP address	<input type="text" value="10.101.148.10"/>
Traffic IP address	<input type="text" value="0.0.0.0"/>
Satellite IP address	<input type="text" value="0.0.0.0"/>
Modem IP gateway	<input type="text" value="10.101.0.1"/>
Remote control port IPv6 subnet prefix	<input type="text" value="64"/>
Traffic port IPv6 subnet prefix	<input type="text" value="64"/>
Satellite port IPv6 prefix	<input type="text" value="64"/>
<input type="button" value="Submit"/>	

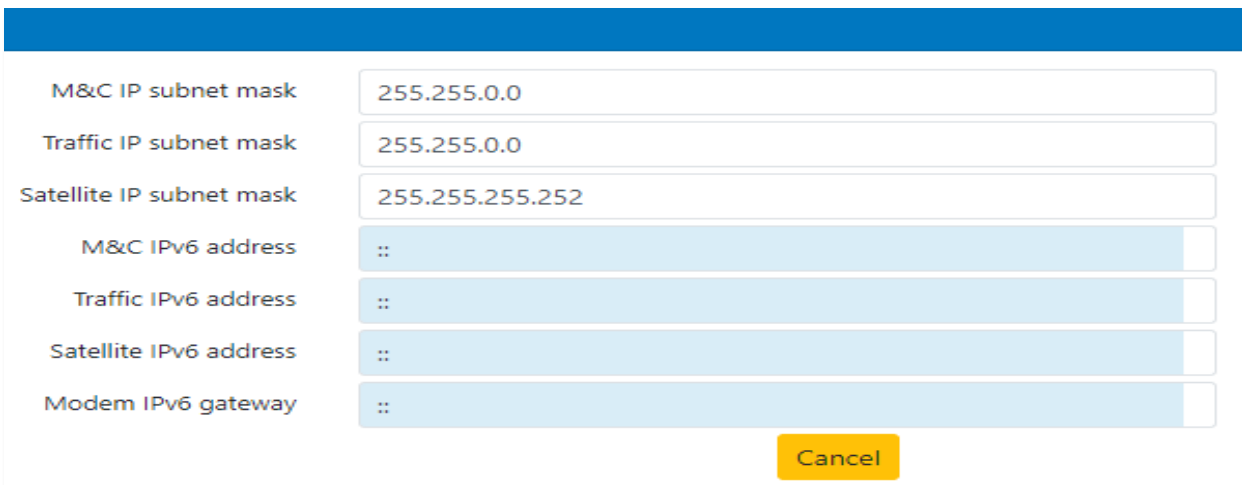
- **M&C IP address:** This sets the IP address for remote control. When the M&C and traffic Ethernet ports are bridged together then this address is used for both M&C purposes and satellite traffic. An IP address of 0.0.0.0 causes the modem to request its IP address from a Dynamic Host Control Protocol (DHCP) server on the network, removing the need to allocate static IP addresses to each modem. The allocated IP address can be seen on the View->Unit screen. A request to the DHCP server is made every minute until a reply is received.



When changing the IP address, devices communicating with the modem may take several minutes to recognize the new address unless the Address Resolution Protocol (ARP) table on the device is flushed.

- **Traffic IP address:** This sets the IP address for the modem’s IP Traffic port. (DHCP is not supported for this address and therefore an address must be manually entered.)
- **Satellite IP address:** This sets the IP address for the modem’s satellite IP port. This is only used when in routing mode, when the modem acts as a two-port router.
- **Modem IP gateway:** This sets the IP address of a default gateway. The gateway represents the ‘next hop’ destination, which is normally the address of a router, for packets destined for somewhere other than the local network. This is used whenever the IP mode is set to Routing. An address of 0.0.0.0 means that the gateway is not set.
- **Remote control port IPv6 subnet prefix:** Indicates the network portion of the M&C port address. Prefix length range from 0 to 128, Typical length is /64.
- **Traffic port IPv6 subnet prefix:** Indicates the network portion of the traffic port address. Prefix length range from 0 to 128, Typical length is /64.
- **Satellite port IPv6 prefix:** Indicates the network portion of the satellite port address. Prefix length range from 0 to 128, Typical length is /64.

#### IP Settings / Basic IP Settings



M&C IP subnet mask	255.255.0.0
Traffic IP subnet mask	255.255.0.0
Satellite IP subnet mask	255.255.255.252
M&C IPv6 address	::
Traffic IPv6 address	::
Satellite IPv6 address	::
Modem IPv6 gateway	::

Cancel

- **M&C IP subnet mask:** Sets the remote control port IP subnet mask.
- **Traffic IP subnet mask:** This sets the subnet mask for the modem’s IP Traffic port.
- **Satellite IP subnet mask:** This sets the subnet mask for the modem’s satellite IP port.
- **M&C IPv6 Address:** Assigns an IPv6 address to the M&C interface.
- **Traffic IPv6 Address:** Assigns an IPv6 address to the traffic interface.
- **Satellite IPv6 Address:** Assigns an IPv6 address to the satellite interface. This is only used when in routing mode, when the modem acts as a two-port router.
- **Modem IPv6 gateway:** This sets a default gateway IP address. The gateway represents the ‘next hop’ destination, which is normally the address of a router, for packets destined for somewhere other than the local network. This is used whenever the IP mode is set to Routing.

## IP Miscellaneous:

### IP Settings / Basic IP Settings

IP Miscellaneous	
IP encapsulation type	ULE <input type="button" value="v"/>
MPE MAC address	00:00:00:00:00:00 <input type="button" value="x"/>
M&C Ethernet speed/duplex	Auto <input type="button" value="v"/>
IPv4/IPv6 mode	IPv4 only <input type="button" value="v"/>
Enable M&C VLAN	<input type="checkbox"/>
M&C VLAN CIR	0 % <input type="button" value="x"/>
<input type="button" value="Submit"/>	

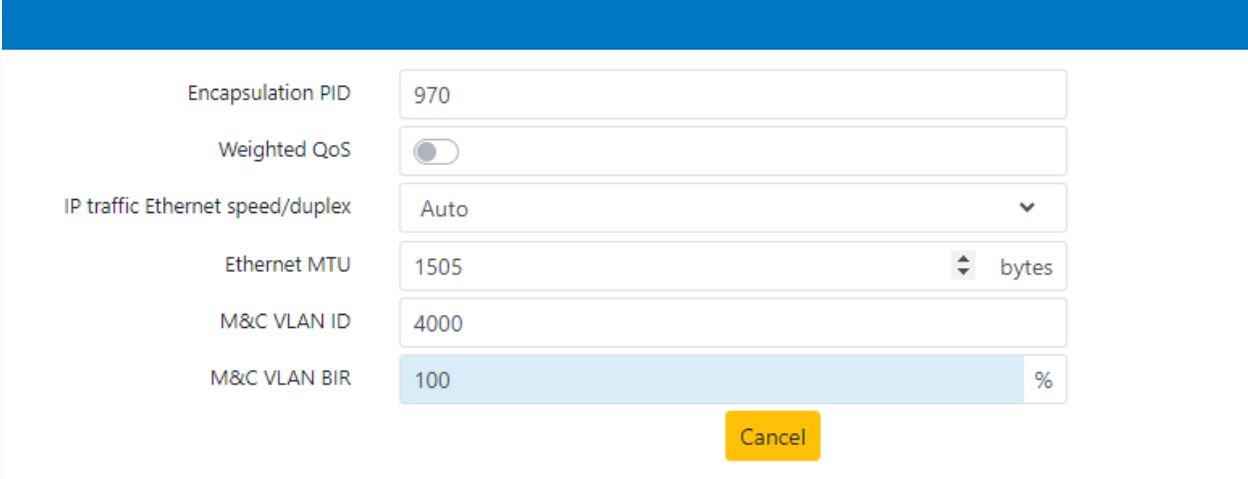
- **IP encapsulation type:** Sets the protocol used to encapsulate IP packets / Ethernet Frames into 188-byte MPEG2 transport stream packets.
  - **ULE:** This selects Unidirectional Lightweight Encapsulation (ULE) as the encapsulating protocol. ULE adds an overhead of around 5% to 7%.
  - **MPE:** This selects Multi-Protocol Encapsulation (MPE) as the encapsulating protocol. This protocol is widely supported and is therefore useful for interoperability. MPE adds an overhead of around 10%.
  - **PXE:** This selects proprietary Paradise XStream Encapsulation (PXE) as the encapsulating protocol. PXE is extremely efficient and only adds an overhead of around 2%.
  - **MPEG over IP:** When sending MPEG2 packets encapsulated inside IP packets, the modem can reduce the satellite transmission overhead by removing the IP headers and sending only the MPEG2 packets. On the receive side, the MPEG2 packets are encapsulated back into IP packets, using IP address and port number information entered by the user. (IP Settings > Advanced IP Settings > MPEG2 Transport Stream.) When decapsulating and encapsulating MPEG2 packets, the modem needs to know whether the IP packets contain just UDP headers, or UDP and RTP headers.
  - **GSE:** This selects Generic Stream Encapsulation (GSE) as defined in the DVBS2X standard. On the transmit side, the modem implements the GSE High Efficiency Mode (HEM) since this gives the most efficient packing and padding, thereby maximizing bandwidth utilization and efficiency. On the receive side, the modem implements both HEM and the GSE Lite mode. GSE adds an overhead of around 2%.
- **MPE MAC Address:** For DVB-S2 IP services, this is used for filtering of Multi-Protocol Encapsulation (MPE) packets on the receive side. The receiver will filter against whatever MAC address has been provided, which can therefore be a virtual MAC address rather than the receiver's address. (There is currently no equivalent modulator support to allow a specific MAC address to be added to MPE packets. A Paradise modulator will always set the MPE MAC address to all zeros or the modulator's MAC address, depending on whether it is in routing or bridging mode.)

- **M&C / IP Traffic Ethernet speed/duplex:** The different Ethernet speed and duplex settings are listed in the following table for the modem’s Ethernet interfaces. Changes will be effective immediately but when an auto-negotiated mode is selected then any Ethernet connection will be briefly disconnected while the change takes effect. The Auto setting is recommended for normal use but because Ethernet auto-negotiation varies between different manufacturers it may be necessary to fix the speed and duplex in some circumstances. The type of cable (crossover or straight) is always automatically sensed by the modem, which will work with both.

Speed	Duplex setting	Description
Auto	Auto	In this mode the modem will auto-negotiate the Ethernet speed and duplex settings.
Set to either 10M, 100M or 1000M	Half duplex	In these modes the modem will auto-negotiate the Ethernet speed and duplex setting, but as part of the negotiation will ‘advertise’ the configured speed as half duplex.
Set to either 10M, 100M or 1000M	Full duplex	In these modes the modem will auto-negotiate the Ethernet speed and duplex setting, but as part of the negotiation will ‘advertise’ the configured speed as half duplex.
Set to either 10M, 100M or 1000M (Fixed)	Half duplex	The modem’s Ethernet interfaces will be fixed to the required speed and half duplex operation.
Set to either 10M, 100M or 1000M (Fixed)	Full duplex	The modem’s Ethernet interfaces will be fixed to the required speed and full duplex operation.

- **IPv4/IPv6 mode:** This enables the entry and display of IP addresses in either format, as follows:
  - **IPv4 only:** Allows entry and display in IPv4 format only. The modem will bridge IPv4 and IPv6 packets when in IPv4 mode but will route only IPv4 packets.
  - **IPv4 and IPv6:** Allows entry and display in either IPv4 format or IPv6 format. The modem will bridge and route both IPv4 and IPv6 packets in this mode.
- **Enable M&C VLAN:** This controls whether M&C traffic destined for the remote modem is transmitted via VLAN 0. The M&C packets will be received and processed by the remote modem when the equivalent control is enabled on the remote modem. This technique for remote control means that the M&C port does not need to be bridged to the traffic port(s) thereby facilitating the use of separate M&C and traffic networks that use different subnets.
- **M&C VLAN CIR:** This is the guaranteed bandwidth, as a percentage, that will be allocated to the M&C data between Modems.

IP Settings / Basic IP Settings



- **Encapsulation PID:** When encapsulating Ethernet frames or IP packets into MPEG2 packets as part of a DVB-S2(X) IP service, this specifies the Packet ID (PID) value to be entered into the MPEG2 packets that are being created. Note that the value is in decimal, not hexadecimal. The PID can then be used for filtering MPEG2 packets on the receive side. The encapsulation PID must be left at its default value of 970 if DVB-S2 AUPC or DVB-S2 ACM is being used.

**Range:** 0 to 8190; step size: 1

- **Weighted QoS:** This control enables IEEE 802.1p packet prioritization. It is mutually exclusive with the traffic shaping feature and when traffic shaping is enabled then strict-priority and fair-weighting queuing are automatically switched off.

This allows for eight classes of data to be specified as part of a three-bit field within the Layer 2 IEEE 802.1q VLAN header. The packets must already be tagged at the point of entry into the modem. Priority 7 is typically used for network-critical traffic such as dynamic routing protocol packets; priorities 5 and 6 for video and voice, etc. The modem uses the priority tag to decide how to process each packet. The options are:

- **Strict-priority queuing:** packets are queued for transmission based solely on their priority with the highest always being sent first. Strict-priority queuing is active whenever Weighted QoS is set to Off.
- **Fair-weighting queuing:** higher-priority packets are transmitted first but lower-priority packets are given a percentage of the bandwidth. Fair-weighting queuing is active whenever Weighted QoS is set to On.

The implementation of IEEE 802.1p packet prioritization is as follows:

The eight QoS priority levels are mapped to three TCP/IP queues in the modem.

- Packets with highest QoS priority (level 7) are sent to high priority TCP/IP queue.
- Delay-sensitive packets (QoS levels 6 and 5) are sent to the medium priority queue.
- The remainder (QoS levels 4 to 0) are sent to the low priority TCP/IP queue.

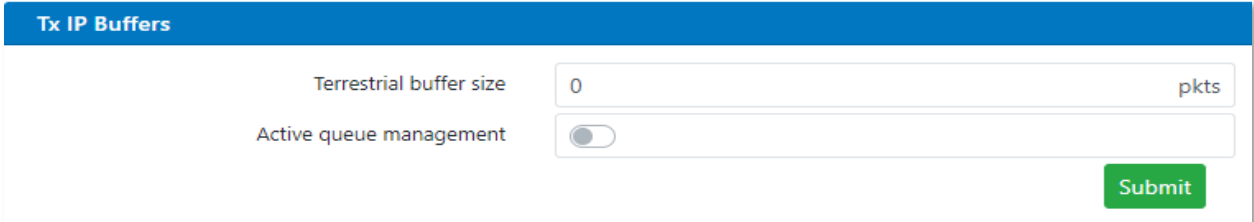
For strict-priority queuing, all packets in the high-priority queue are processed before any in the medium-priority queue, which in turn are processed before any in the low-priority queue.

For fair-weighting queuing, for every four packets sent from the high-priority queue, two are sent from medium-priority queue and one from the low-priority queue.

- **Ethernet MTU:** This controls the Ethernet Maximum Transmission Unit (MTU) size, which defines the largest Ethernet frame that can be handled by the modem in bridging mode without fragmentation into smaller frames.  
Range: 1500 to 10k bytes; step 1 byte.
- **M&C VLAN ID:** This allows the M&C VLAN traffic destined for the remote Modem to be transmitted in a user defined VLAN. The remote Modem will also require the same unique M&C VLAN ID setting.  
**Note:** when first enabled, the Modem will need rebooting for the new M&C VLAN to take effect.
- **M&C VLAN BIR:** This defines the maximum amount of bandwidth, beyond the CIR, that the M&C VLAN can be allocated, should spare bandwidth become available.

## Tx IP Buffers:

### IP Settings / Advanced IP Settings



Tx IP Buffers	
Terrestrial buffer size	<input type="text" value="0"/> pkts
Active queue management	<input type="checkbox"/>
<input type="button" value="Submit"/>	

- **Terrestrial buffer size:** Allows the user to set the length of the transmit packet queue. A value of 0 allows the Modem to select the optimum queue size. Range 0 to 99999 packets; step 1 packet.  
The terrestrial buffer is used to buffer IP packets coming into the IP terrestrial ports for transmission over satellite. Satellite delay and the quality of the service in general can be controlled by the size of this buffer in conjunction with setting the size of the satellite buffer. The buffer should be set large enough to accommodate bursts of packets being received by the modem. Setting the buffer larger than necessary could result in large packet delays building up should more packets be sent to the modem than can be transmitted.

The optimal size for the buffer depends on the link data rate, the packet sizes, the number of packets and the specific application (some applications being able to tolerate packet loss and/or delays more than others). When the buffer is full then received packets will be dropped until space in the buffer is freed up.

It is generally desirable for the terrestrial buffer to be set so that packets are not dropped unnecessarily before they have been assessed by the traffic shaper as to priority, etc. At the same time, a large buffer could result in old data being kept, which it might be better to drop by making the buffer smaller so that only the most recent data is kept in an overload situation.

- **Active Queue management:** Enables an algorithm that controls delay.  
Although the terrestrial and satellite buffers can be tuned to match the specific needs of a particular user application, passive buffer management has inherent limitations and drawbacks. Active Queue Management (AQM) is an intelligent and pro-active form of TCP/IP queue management that overcomes the potential for inconsistent end-to-end packet delays and the problems of 'buffer bloat'. Buffer bloat is where packet buffers in the system are over-sized in order to try to prevent

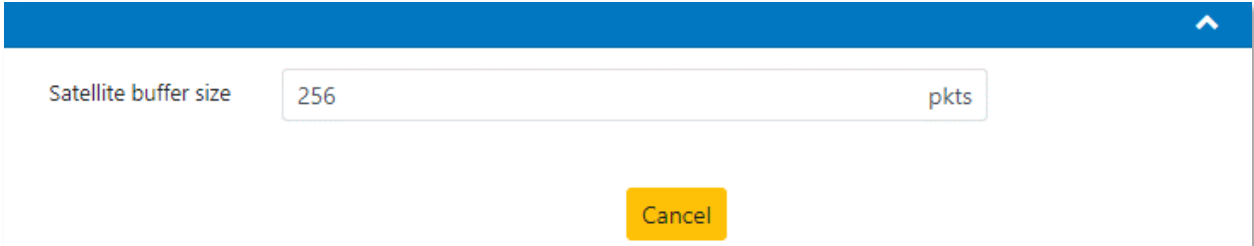
packet loss. The result is often that performance at the application level suffers due to excessive buffering of packets during periods of congestion, leading to extremely high latency levels with old data being kept almost indefinitely in the hope that extra bandwidth will become available and any overload will ease.

Most buffer management in TCP/IP devices is passive and relies on the user setting internal buffer sizes to be consistent with the needs of the application and its data rates. However, TCP/IP is bursty by nature and if the rate of arrival of packets at the satellite modem exceeds its transmission capabilities, then packets start to back up and will eventually get dropped if the overload continues.

Active Queue Management continually measures the packet delay through the modem and rather than let the backlog of packets build up, it ensures that the delay through the modem is kept constant by dropping packets early if required. (The modem implements a form of active queue management called CoDel, which stands for Constant Delay. The delay has been preset to 5ms, from packet ingress to egress, which is suitable for most applications. It can be changed ‘under the hood’ – please contact Customer Support for details.) The effect of this is that transit times through the network typically continue to be constant even in an overload situation.

The use of AQM can be combined with traffic shaping to ensure that high priority traffic is unaffected when demands on bandwidth are exceeded. The use of AQM is especially important for latency sensitive applications and where the packet latency over the satellite link is measured to ensure compliance with a Service Level Agreement (SLA). It needs to be enabled on the modems at both ends of the satellite link in order to be effective.

#### IP Settings / Advanced IP Settings



Satellite buffer size  pkts

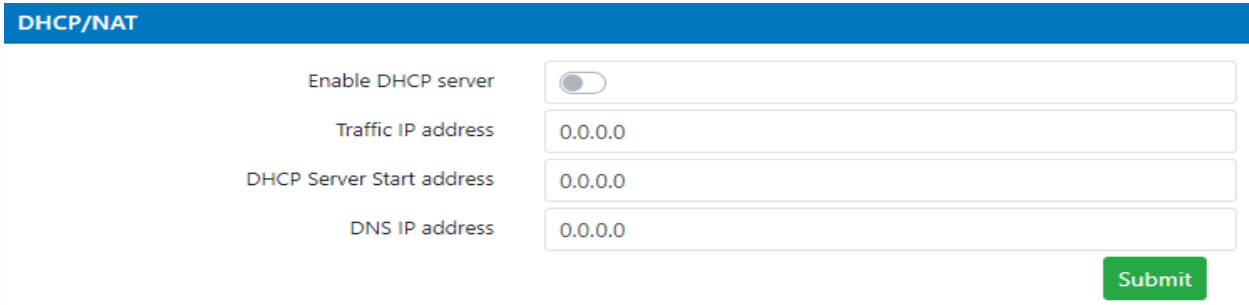
Cancel

- **Satellite buffer size:** Allows the user to set the length of the satellite buffer size within the HDLC driver. Range 1 – 4096 packets; step 1 packet. The Satellite buffer default size of 256 normally should be used unless shaping is enabled, in which case set it to 8. However, the following applies: The satellite buffer is used to buffer IP packets ready for transmission over satellite. The buffer is situated after all internal packet processing has been completed, including traffic shaping and encapsulation. Satellite delay and the quality of the service in general can be controlled by the size of this buffer. The buffer should be set large enough to even out peaks and troughs in throughput that would result from setting a smaller buffer size. Setting the buffer larger than necessary could result in large packet delays building up should more packets be available than can be transmitted. The traffic shaper can be used to ensure that the combined output from all classes of traffic does not exceed the available satellite bandwidth, even when ACM (which dynamically adjusts the data rate) is active.

The optimal size for the buffer depends on the link data rate, the packet sizes, the number of packets and the specific application (some applications being able to tolerate packet loss and/or delays more than others). When the buffer is full then new packets for transmission will be dropped until space in the buffer is freed up. However, as a general rule, it is recommended that the satellite buffer size is set to 8 for most applications that involve shaping and particularly when TCP acceleration is being used, unless an alternative buffer size is found to give better performance. Setting the buffer too large can cause throughput to oscillate when TCP acceleration is being used.

## DHCP/NAT:

[IP Settings](#) / [Advanced IP Settings](#)



DHCP/NAT	
Enable DHCP server	<input type="checkbox"/>
Traffic IP address	<input type="text" value="0.0.0.0"/>
DHCP Server Start address	<input type="text" value="0.0.0.0"/>
DNS IP address	<input type="text" value="0.0.0.0"/>

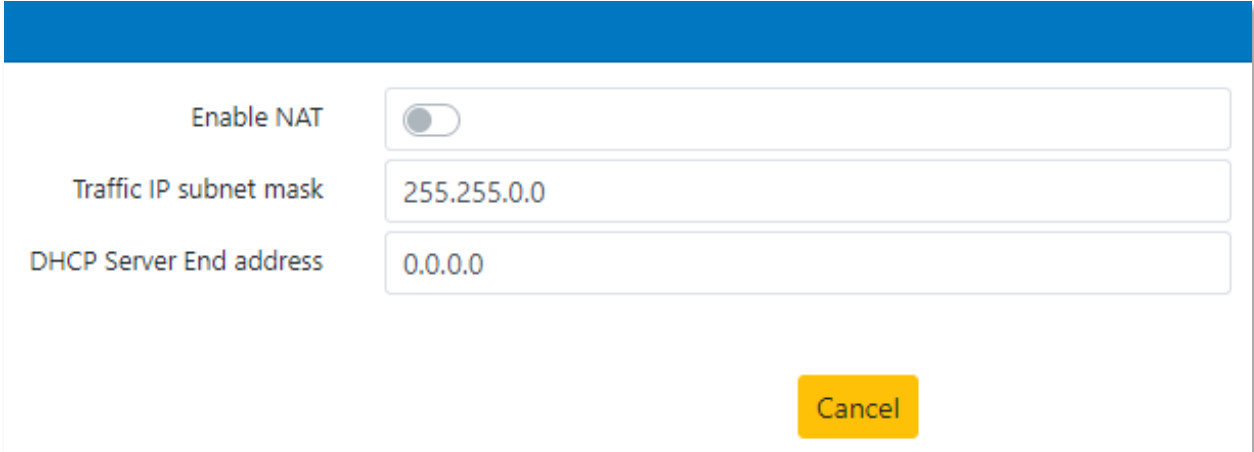
Submit

The modem supports the automatic allocation of IP addresses to network devices using DHCP, combined with the ability to hide all of these addresses behind an optional NAT firewall. With DHCP and NAT enabled, this gives the ability for all of the near-side network devices to appear as a single IP address when viewed from the far end of the satellite link. This is supplemented by the use of a caching DNS proxy server in the modem that can reduce the number of satellite round trips associated with connecting to the actual DNS server.

When DHCP is active, the modem's M&C port has a separate IP address to the modem's IP traffic address. The modem IP traffic address effectively doubles up as the DHCP server address and proxy DNS server address in this situation.

- **Enable DHCP server:** Enables a DHCP server within the modem. This can be used to serve a configurable range of IP addresses to local network devices, as required.
- **Traffic IP address:** Sets the IP traffic address where DHCP requests will result in the Traffic IP address being returned as the location of a DNS server. This is actually the address of a proxy DNS server on the modem, as well as being the address of the DHCP server.
- **DHCP Server Start/End address:** These entry fields allow a range of IP addresses to be defined that are managed by the modem. It will allocate these to local network devices when they make DHCP IP address allocation requests to the DHCP server on the modem.
- **DNS IP address:** This is the address of an actual DNS server that the modem can use to satisfy any DNS requests that it receives. The modem supports a proxy DNS server (defined by the Traffic IP address) and, when DHCP and NAT are enabled, will cache DNS results in order to reduce the number of satellite round trips that are required. The DNS server IP address is normally included as part of the network connection details on Windows PCs.

IP Settings / Advanced IP Settings



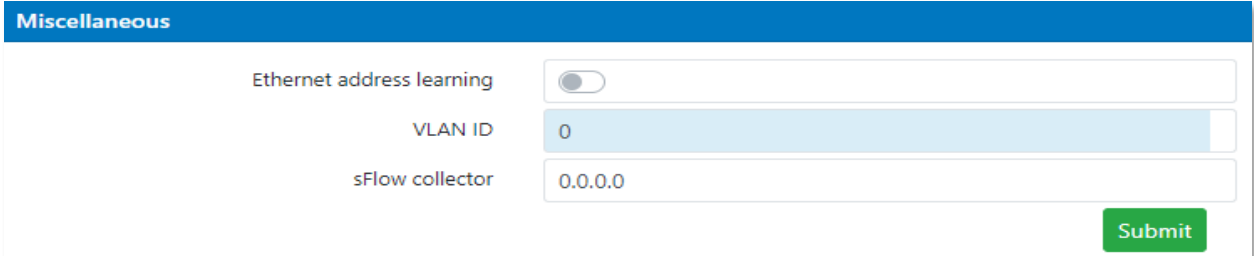
Enable NAT	<input type="checkbox"/>
Traffic IP subnet mask	255.255.0.0
DHCP Server End address	0.0.0.0

Cancel

- **Enable NAT:** Enables a NAT firewall within the modem. The DHCP server must be enabled before it can be used. The NAT sits between the terrestrial IP traffic port(s) and the satellite port on the modem and converts all local IP addresses as defined by the DHCP server address range to (and from) a single IP address (as defined by the Traffic IP address) when viewed from the far end of the satellite link. The use of NAT is optional, and it can only be used when DHCP is also enabled.

**Miscellaneous:**

IP Settings / Advanced IP Settings



<b>Miscellaneous</b>	
Ethernet address learning	<input type="checkbox"/>
VLAN ID	0
sFlow collector	0.0.0.0

Submit

- **Ethernet address learning:** Ethernet (or MAC) address learning helps to protect against the possibility of traffic storms caused by inadvertent loops in the network. If address learning is disabled then traffic sent to one port will also be flooded onto all other traffic ports since the modem will be unaware of which devices are connected to which switch port.
- **VLAN ID:** Allows a value to be set for the VLAN IDs of the remote modems. The VLAN ID should be used to uniquely identify each remote modem. It is used to filter the wanted from the unwanted IP packets in point-to-multipoint systems. The VLAN tags are removed by the remote modems prior to onward transmission.  
When VLAN filtering is enabled, the remote modem will also automatically receive M&C traffic from the hub QMultiFlex-400 on VLAN 0, when the M&C VLAN setting has been enabled on the QMultiFlex-400. This provides a convenient way of establishing remote control of the modem from the hub while also allowing the M&C and IP traffic to be on separate networks.



## IP Settings / Advanced IP Settings



The screenshot shows a configuration interface with a blue header bar. Below the header, there are two rows of settings, each with a label and a toggle switch. The first row is labeled 'Enable VLAN filtering' and the second row is labeled 'Enable dynamic routing'. Both toggle switches are currently in the 'off' position, indicated by the grey circle being on the left side of the slider.

- **Enable VLAN filtering:** VLAN filtering is used in point-to-multipoint mode only, in order to ensure that just the relevant packets are processed at each remote site, with all non-relevant packets being discarded. The hub modem will automatically add the appropriate VLAN tags to the packets to be transmitted to the remote modems. Filtering out irrelevant packets at the remote sites stops them circulating in the wider network and potentially causing packet storms.  
When VLAN filtering is enabled, each remote modem can be assigned a VLAN ID which is used by the hub to tag each packet destined for any device attached to a network off that particular remote modem. The tags are added at the hub (either by QMultiFlex-400 or a suitably configured Ethernet switch) and removed by the remote modem. The remote modem uses the tag to filter out unwanted broadcast data.
- **Enable dynamic routing:** Supports RIP V1 and V2, OSPF V2 and V3 and BGP V4. However, the 64 static routes have precedence over dynamic routes. When dynamic routing is on, traffic will be automatically routed across satellite correctly by automatic exchange of routing information with other routers. The routing information exchange uses satellite bandwidth and is therefore an overhead. The amount of bandwidth required depends on the size of the routing tables that are exchanged and the frequency with which they are exchanged.

Dynamic routing is supported via the Quagga software package and can only be used on point-to-point links. It is possible to enable routing, TCP acceleration and traffic shaping together at the same time (but routing is incompatible with the header compression feature).

Configuration of dynamic routing protocols can be complex and for this reason the modem provides only a default configuration for the RIP and OSPF protocols that can be enabled from the user interfaces. These will be all that is required in many cases. Further configuration of all routing protocols is available for expert users, via a telnet interface to the Quagga software (the Quagga user manual available from <http://www.quagga.net/docs/quagga.pdf>). You can telnet into a different command line interpreter for setting up each routing protocol and one that can be used for basic-level setup of all routing protocols. These provide 'Cisco IOS-like' commands that will be familiar to users of Cisco equipment.

When using telnet to login to the Quagga (the default password is 'paradise') various port numbers are used to access the routing protocol to be configured, as follows:

- RIP: port 2602
- OSPF: port 2604
- BGP: port 2605
- Zebra: port 2601

## MPEG2 Transport Stream:

[IP Settings](#) / [Advanced IP Settings](#)

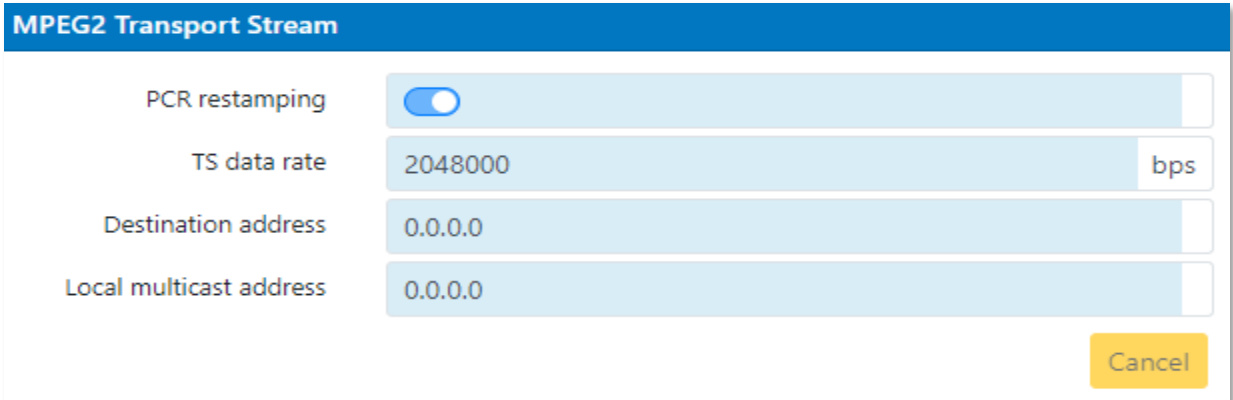
MPEG2 Transport Stream	
Null packet insertion	On
MPEG over IP type	UDP/TS
Nominal de-jitter buffer delay	0 ms
Destination port	0
Local port	0
<input type="button" value="Submit"/>	

- **Null packet insertion:** Not currently implemented.
- **MPEG Over IP Type:** Indicates whether IP packets will contain just UDP Transport Stream packets, or UDP, RTP Transport Stream packets. When sending MPEG2 packets encapsulated inside IP packets, the modem can reduce the satellite transmission overhead by removing the IP headers and sending only the MPEG2 packets. On the receive side, the MPEG2 packets are encapsulated back into IP packets, using IP address and port number information entered by the user. When decapsulating and encapsulating MPEG2 packets, the modem needs to know whether the IP packets contain just UDP headers, or UDP and RTP headers.
  - **UDP/TS:** This indicates that the MPEG2 transport stream packets are encapsulated into IP packets using the UDP protocol
  - **UDP/RTP/TS:** This indicates that the MPEG2 transport stream packets are encapsulated into into IP packets using the UDP and RTP protocols.
- **Nominal De-jitter Buffer Delay:** This setting controls a de-jitter buffer that can be used to remove IP network jitter that may be present in MPEG-over-IP transport streams. Note: A value must be entered to the TS data rate field in order to use the de-jitter buffer. De-jittering of multiple concurrent transport streams is supported, regardless of whether the streams have been generated using independent clocks or not (i.e. whether or not the various stream PCR reference clocks are asynchronous with respect to each other)  
Setting the de-jitter buffer delay to 0 sets the buffer depth to give maximum resilience to IP network jitter. Setting the de-jitter buffer larger than necessary will increase packet latency (the buffer can accommodate a maximum of over 1000 MPEG packets). Consequently, if the peak-to-peak IP network jitter is known, latency can be minimised by setting the de-jitter buffer depth to a little over half of the peak-to-peak jitter value. For example, if the TS data rate is 6Mbps (which is 750k bytes per second), the de-jitter buffer latency for a half-full quiescent level will be  $K * 750e3 = 136.533ms$  (where K is the de-jitter buffer size, which is  $(200*1024)/2$ ), enabling the buffer to cope with IP network peak-to-peak jitter in the order of  $136.533ms * 2 = 270ms$  peak-to-peak. The maximum peak-to-peak IP network jitter the de-jitter buffer can cope with falls as TS data rate increases.  
The current implementation assumes that the transport stream rate is Constant Bit Rate (CBR).

There are two potential ways of configuring the modem when using CBR operation:

1. Prevent any TS rate adaptation by setting the Tx clock source to External, Null packet insertion to Off and PCR restamping to Off, which effectively sets the modulator data rate (Tx data rate) to the TS data rate. This will minimise the required bandwidth.
  2. Perform TS rate adaptation by setting the Tx clock source to Internal, Null packet insertion to On and PCR restamping to On. In this mode the de-jitter buffer is active and will output a transport stream at the TS data rate. Following null packet insertion and PCR restamping, the de-jittered stream will be transmitted at the Tx data rate.
- **Destination port:** The destination UDP port number is used in a similar way to to the destination address below, when creating a copy of the original IP packet in order to wrapper received MPEG2 packets.
  - **Local port:** The local port number is used in conjunction with the local multicast address above in order to fully define the address and port number the modem should listen to for incoming multicast packets on the Modems transmit path.

#### IP Settings / Advanced IP Settings



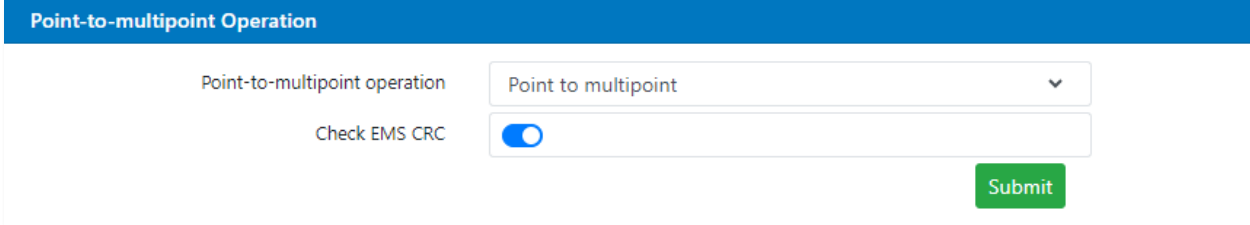
MPEG2 Transport Stream	
PCR restamping	<input checked="" type="checkbox"/>
TS data rate	2048000 bps
Destination address	0.0.0.0
Local multicast address	0.0.0.0

Cancel

- **PCR restamping** is an On/Off control that controls whether MPEG2 Program Clock Reference (PCR) timestamps in received MPEG2 transport stream packets (via the ASI or IP interfaces) are adjusted for any delay introduced by the modem. By adjusting the timestamps as required, potential jitter in the play out of the packets at the receiver/decoder can be eliminated.
- **TS Data Rate:** The TS data rate is the MPEG-over-IP transport stream bit rate being input to the modem. A value must be entered in order to use the de-jitter buffer. Note that the normal Tx data rate defines the transmit data rate after any transport stream rate adaption by the modem.
- **Destination Address:** When using MPEG2 over IP, the IP packet wrapper is discarded in order to save satellite bandwidth. The user-entered destination address is therefore used on the receive side in order to recreate a copy of the original IP packet.
- **Local Multicast Address:** When using MPEG2 over IP, the modem can listen on a local multicast address in order to detect packets to be sent over satellite.

## Point-to-Multipoint Operation:

[IP Settings](#) / [Advanced IP Settings](#)



Point-to-multipoint Operation

Point-to-multipoint operation

Check EMS CRC

Submit

The default setting is point-to-point mode, although the Modem can be used as a remote unit in a point-to-multipoint system with a QMultiFlex-400™ Hub modem. The operation of the modem with respect to packet processing is different in each case and therefore it is necessary to explicitly set the required mode.

‘Point-to-multipoint multistreaming’ is where the Q-Flex receives a shared outbound consisting of multiple modcods (where each stream in the outbound is using a different modcod from the other streams). For example, one remote may receive 8PSK ¾ while another receives QPSK 9/10 and another receives 16APSK 8/9, all as part of the same shared outbound carrier from the hub. (The shared outbound is partitioned using traffic shaping in the QMultiFlex-400 Hub, which allows a number of streams to be created, each associated with a particular modcod). To demodulate just one of the streams (modcods) in the outbound, the Point-to-multipoint-multistream setting is used – see below. The AXIOM needs to be set to receive the entire outbound carrier (in terms of receive symbol rate) but the normal receive modcod selection should be for just the modcod of the stream that is to be demodulated.

- **Point-to-multipoint operation:** The Modem may be used in point to point or point to multipoint modes.
  - **Point to point:** The modem is being used in a point-to-point mode involving communication to or from a single other modem.
  - **Point to multipoint:** The modem is being used as a remote modem in a point-to-multipoint system.
  - **Point to multipoint multistream:** The modem is being used as a remote modem in a point-to-multipoint system with a QMultiFlex-400 Hub system where the shared outbound consists of multiple modcods (i.e. DVB-S2/S2X VCM mode). The maximum number of streams is 6.
- **Check EMS CRC:** EMS is used when the modem is a remote in a point-to-multipoint network & uses a CRC to validate packets. This control determines whether this CRC is checked, packets failing the check will be discarded. Not checking the CRC may be useful when the hub modem is running older software.

IP Settings / Advanced IP Settings

- **Stream identifier:** Set this to the required stream number for the particular remote, which is entered via the traffic shaping feature of the QMultiFlex-400 Hub Modem generating the shared outbound carrier.

IP Settings / Advanced IP Settings

- **Ethernet Port VLAN ID's:** This allows the user to set individual VLAN ID's for all of the ports associated with the Ethernet switch, creating convenient separation for all ports, which can also be used on separate Subnets if necessary.

**IPv4 and IPv6 Static Routes:**

IP Settings / IPv4/IPv6 Static Routes

- **Choose IPv4/IPv6:** Allows the user to select between Internet Protocol version 4 or the later version 6 for static route entry.

**IPv4 Routes:**

IP Settings / IPv4/IPv6 Static Routes

Route Example	Command	Status
Static route 0	add -net x.x.x.x netmask x.x.x.x gw x.x.x.x	✓ ✗ ↺
Static route 1	add -net xxx.xxx.xxx.xx netmask xxx.xxx.xxx.xx gw xxx.xxx.xxx.xx	✓ ✗ ↺
Static route 2	add -net xxx.xxx.xxx.xx netmask xxx.xxx.xxx.xx gw xxx.xxx.xxx.xx	✓ ✗ ↺

Each route consists of a destination IP address, subnet mask and a gateway address. The Apply all routes button can be selected to apply all entered static routes together or the tick can be selected once a particular entry is ready to be committed. To delete an entry simply select the cross next to the line entry, or the three quarter round arrow to return to the previous entry.

## IPv6 Routes:

IP Settings / IPv4/IPv6 Static Routes

Each route consists of a destination IPv6 address and prefix length along with the gateway address. The Apply all routes button enables all entered static routes to be applied together or the check box at the end of the entry line can be selected when a particular entry is ready to be committed. To delete an entry simply select the cross next to the line entry.

## IPv4 Header Compression Routes:

IP Settings / IPV4 Header Compression

The Header Compression Routes screen allows up to 16 static routes to be added. The compressed packets will be either bridged or routed as per the IP mode setting. IP, UDP and RTP header compression is supported in accordance with the Robust Header Compression (ROHC) standard RFC 3095 (profiles 2 and 3). ROHC typically reduces the 40 bytes of IP, UDP and RTP header, which is typically used with Voice over IP data, down to between 1 and 3 bytes. Ethernet header compression is also supported in addition and this reduces 14 bytes of Ethernet frame down to typically 1 byte. Overall savings from compression from both types of compression (e.g. for a G.729 voice stream) can be as high as 60%.

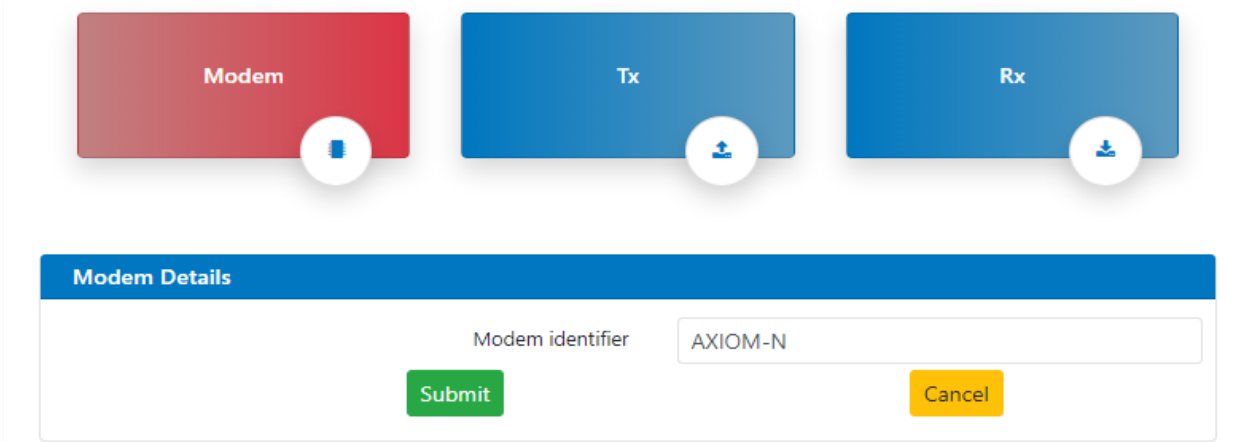
When header compression is on, Ethernet, UDP, TCP, RTP and IP packet headers are compressed in order to save satellite bandwidth. The relative bandwidth saving is greater for smaller packets. The one-way packet processing limit for header compression is 60,000 packets per second (pps); the two-way limit is 45,000 pps. IP/UDP/RTP header compression is compliant with the RFC 3095 (Robust Header Compression) standard. IP payload compression is provided (compliant with the RFC 1951 'DEFLATE' standard). This compresses TCP and UDP packet payloads by typically 50%.

## Quick Start Guide:

### Modem quick Setup menus:

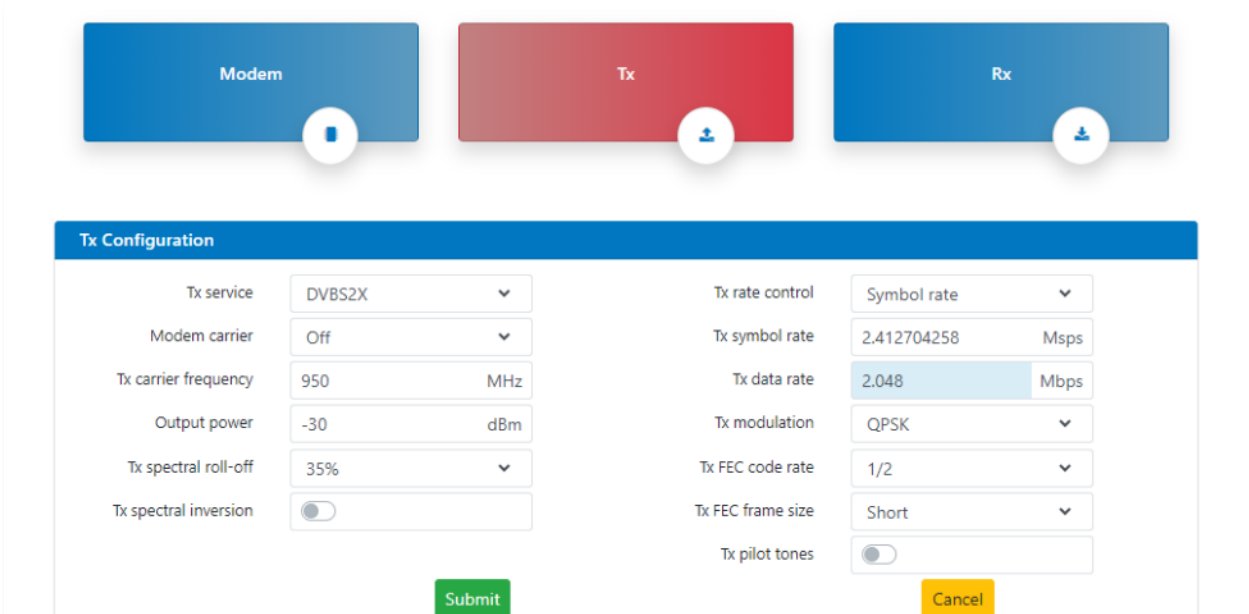
[Manage My Modem](#) / [Modem Quick Setup](#)

The AXIOM series Modems support a quick setup facility, allowing the user to quickly change key parameters to support a carrier migration, maintenance window etc. assuming the base configuration is pre-configured and remains the same. The first menu allows the user to update the Modems identifier.



The screenshot shows three menu buttons: 'Modem' (red), 'Tx' (blue), and 'Rx' (blue). Below them is the 'Modem Details' section with a text input field for 'Modem identifier' containing 'AXIOM-N', a green 'Submit' button, and a yellow 'Cancel' button.

The 2<sup>nd</sup> menu allows the user to update the Modems transmit parameters. Data rate or symbol rate, MODCOD, transmit frequency, spectral inversion and Modem carrier control are some of the parameters that can be updated via the Tx quick setup menus.



The screenshot shows three menu buttons: 'Modem' (blue), 'Tx' (red), and 'Rx' (blue). Below them is the 'Tx Configuration' section with various parameters:


Tx service	DVBS2X	Tx rate control	Symbol rate
Modem carrier	Off	Tx symbol rate	2.412704258 Msps
Tx carrier frequency	950 MHz	Tx data rate	2.048 Mbps
Output power	-30 dBm	Tx modulation	QPSK
Tx spectral roll-off	35%	Tx FEC code rate	1/2
Tx spectral inversion	<input type="checkbox"/>	Tx FEC frame size	Short
		Tx pilot tones	<input type="checkbox"/>

At the bottom are green 'Submit' and yellow 'Cancel' buttons.


The 3<sup>rd</sup> menu allows the user to update the Modems receive parameters. Symbol rate (when Rx values track Tx is disabled) receive frequency, and sweep mode are the parameters that can be updated via the Rx quick setup menus.

Manage My Modem / Modem Quick Setup [View](#) [Edit](#) [Refresh](#)


Modem



Tx



Rx



**Rx Configuration**

Rx carrier frequency	<input type="text" value="950"/> MHz	Rx values track Tx	<input type="checkbox"/>
Sweep mode	<input type="text" value="Normal (+/-20kHz)"/> ▼	Rx symbol rate	<input type="text" value="2.048"/> Msps
Sweep width(+/-)	<input type="text" value="20"/> kHz		

SubmitCancel

### Create New Configuration:

Manage My Modem / Config Files

**Create New Configuration**

Current modem configuration will be saved with a name of your choice.

Enter a name for config file(without spaces):

(.conf extension will be automatically added to your filename)

Save

This allows the current unit configuration to be stored to a named configuration memory for recall later. Configurations are saved to a partition within the unit's memory and assuming an average size, the unit can store approximately 1024 configurations. The memories are non-volatile and will persist between successive modem power-ups. Configuration memories can be assigned any desired name using the alphanumeric keypad, but please note, no spaces are allowed between characters. A .conf file extension will be added to the filename.

### Upload New Configuration:

Manage My Modem / Config Files

**Upload New Configuration**

Browse

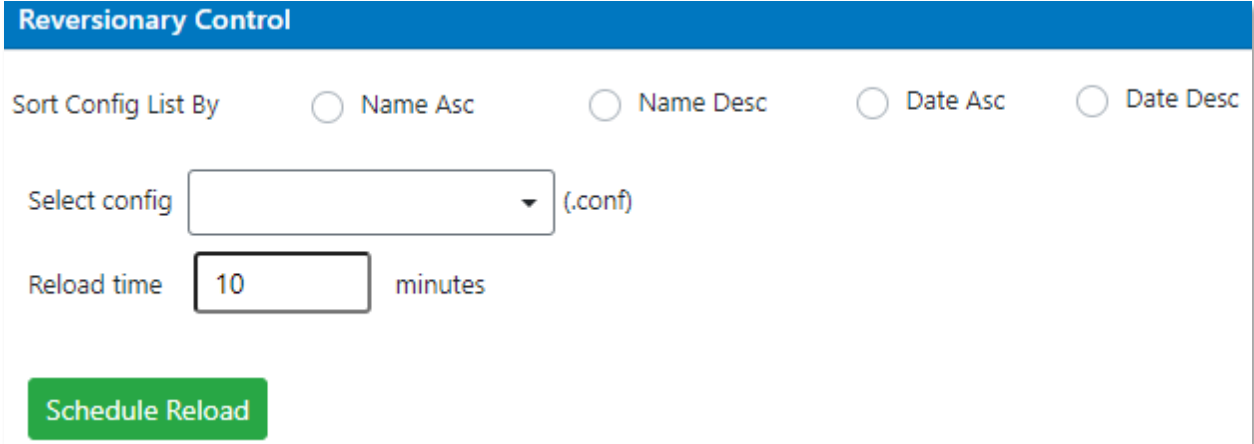
Upload

This is used to upload one or more configuration memories to the modem from a PC or network drive to allow configurations to be shared between different modems or a base configuration to be uploaded.

### Reversionary Control:

Manage My Modem / Config Files





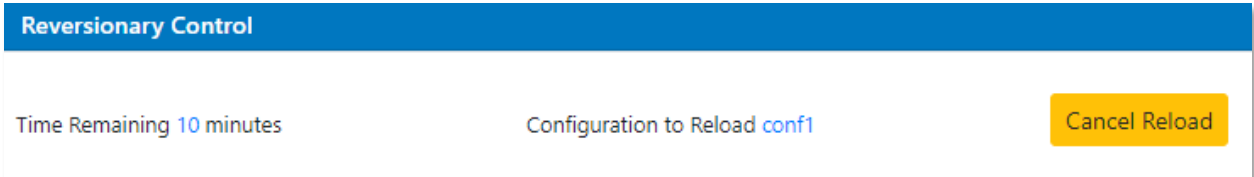
Reversionary Control supports a method for recovering a remote modem from a failure during a change to the modem's configuration. In essence, this works in a similar way to the Cisco Reload command, where a known trusted configuration is loaded after a defined timeout period in the event that the reload operation is not cancelled by the operator in a timely manner after completing the necessary configuration changes.

The procedure for protecting and recovering a remote modem from failure during a configuration change is as follows.

Save the current Modems configuration. This configuration will be recalled should a reconfiguration of the remote modem result in a loss of communications with the modem.

Prior to making any configuration change to the remote modem, select the configuration just saved specifically for reversionary control by selecting this from the ``select config`` entry box and set an appropriate reload time. This is the time in minutes that the operator needs to make all the necessary configuration changes to the remote modem. It represents a timeout period after which the modem will automatically reload the selected configuration memory unless the operator intervenes to cancel the timeout.

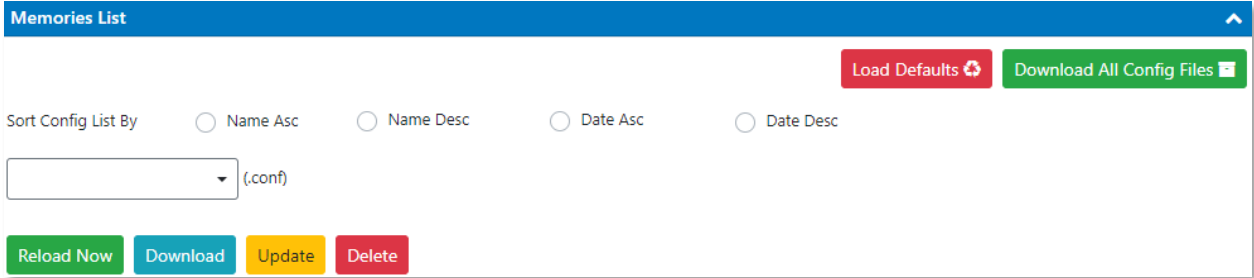
Select the ``Schedule Reload`` button to start the timeout period, at which point the screen will change to that shown below:



This also shows the remaining timeout period along with the name of the configuration memory that will be reloaded. In addition, a ``Cancel Reload`` button is now available. Make any necessary changes to the remote modem's configuration and after completing the changes, navigate back to the reload screen and cancel the timeout by clicking the ``Cancel Reload`` button. The screen will now revert to its original format.

## Memories List:

Manage My Modem / Config Files



Selecting within the text box displays a list of all the configuration memories stored on the modem. These can be sorted into the desired name or date format for easy identification using the radial buttons above the text box. The following actions are available:

### Reload Now

Select a stored configuration from within the text box and click the button to reconfigure the Modem with the stored contents. The Modem will acknowledge the action as complete.

### Download

Select a stored configuration from within the text box and click the button to save to a PC or target device.

### Update

Select a stored configuration from within the text box and click the button to update that particular configuration with any recent changes made to the Modem's configuration. The Modem will acknowledge the action as complete.

### Delete

Select a stored configuration from within the text box and click the button to delete the saved configuration. The Modem will acknowledge the action as complete.

### Load Defaults

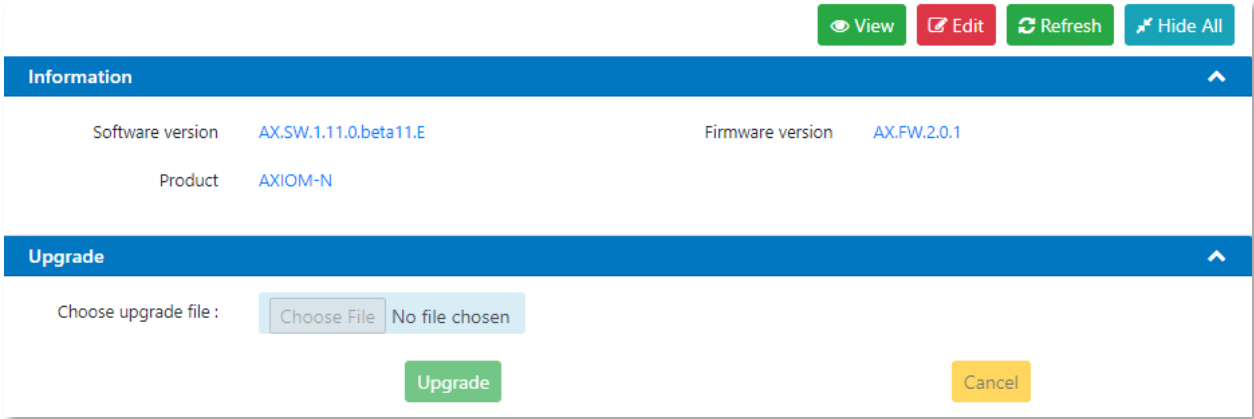
Allows the unit to be set back to factory defaults, clearing the configuration. However, when recalled the modem's current M&C IP address, netmask, gateway, control, Modem ID and passwords are all retained.

### Download All Config Files

Allows all of the saved configurations to be downloaded to a PC or target device. These are zipped together and saved to a file with the following name: confarchive.tar.gz

## SW upgrade:

[Manage My Modem](#) / [Upgrade](#)



Software version	AX.SW.1.11.0.beta11.E	Firmware version	AX.FW.2.0.1
Product	AXIOM-N		

Choose upgrade file :  No file chosen

Information regarding the current Software and Firmware versions along with product details are displayed here. The modem software may be upgraded from the upgrade tab.

***WARNING: do not upgrade the Modems SW when in Trunking mode, instead, save the units configuration, then switch to Bridge mode under [IP Settings / Basic IP Settings \(IP Mode\)](#). In addition, prior to updating the software ensure ACM, Header Compression or TCP acceleration features are also switched off. Again it may be advisable to save the Modems current configuration and recall once the upgrade has completed.***

To upgrade the Software, browse to the location of the upgrade file and open the file before starting the upgrade. During the upgrade process the modem will drop any service that it is providing.

The upgrade typically takes a couple of minutes. The modem will restart automatically when the upgrade is complete and will resume operation using the same configuration as prior to the upgrade. Check the new Software is commensurate with the file name used to upgrade the Modem.

A remote modem can also be upgraded over the satellite link by browsing to the remote modem's IP address and following the same upgrade process. Note that the speed of the upgrade is dependent on the bandwidth available over satellite. An approximate time can be worked out by comparing the size of the upgrade file with the bandwidth available. In the event that an upgrade is unsuccessful then the modem will revert to a backup version of software. (**Note:** this backup software is programmed during factory initialisation and may be several versions behind the units current software.)


### SW upgrade via USB:

A software upgrade may also be completed via USB. Copy the target zip file (AXIOM\*.zip) containing the required software update to a USB memory stick (make sure no other files are resident on the USB stick) once inserted the upgrade will start automatically. The Ethernet port LED's will flash during the upgrade process and once complete will stop flashing. At this point all LED's will be on and the modem can be manually rebooted.

## Time:

[Manage My Modem](#) / [Time - NTP - Reset](#)

### Time

Current modem time	16:33:51 21/07/2020	
Choose and set new time	<input type="text" value="04:49:03 PM"/> <input type="text" value="07/21/2020"/>	<input type="button" value="OK"/> <input type="button" value="Cancel"/>
Set to local PC time	16:49:08 21/07/20	<input type="button" value="OK"/> <input type="button" value="Cancel"/>

This allows the modem's real time clock to be set. The modem includes a battery and maintains the time when powered down. In addition, local PC time can be set as the current modem time.

## NTP:

[Manage My Modem](#) / [Time - NTP - Reset](#)

### NTP

Enable NTP synchronisation	<input type="checkbox"/>	NTP server IP address	<input type="text" value="0.0.0.0"/>	<input type="button" value="NTP Sync"/>
Local offset from UTC	<input type="text" value="0"/> Hours	Enable IEEE 1588 packet synchronisation	<input type="checkbox"/>	
<input type="button" value="Submit"/>			<input type="button" value="Cancel"/>	

Network Time Protocol (NTP) is supported to synchronise the modem to any networked system. This requires the input of an NTP server IP address, which provides a master source of Coordinated Universal Time (UTC). The modem will request the current time from the NTP server on a regular basis. A time offset can be applied to the modem to account for any regional deviation from UTC.

In addition, IEEE 1588 packet synchronisation can be enabled. This uses a protocol for synchronizing clocks connected via a network, such as Ethernet, requiring little network bandwidth, processing power or administrative setup.

## Reset:

[Manage My Modem](#) / [Time - NTP - Reset](#)

### Reset

Any existing links will be broken and may take several minutes to be re-established.

This allows the modem to be reset, following a confirmation.

## 4.Status

### View Modem Status:

#### Setup:

[View Modem Status](#) / [Modem Status](#)

Setup			
Tx service	DVBS2X	Rx service	DVBS2X
Tx data rate	10 Mbps	Rx data rate	10 Mbps
Tx symbol rate	3.030133929 Msps	Rx symbol rate	3.030134 Msps
Tx clock source	Internal	Rx clock source	Satellite
Tx modulation	16APSK	Rx modulation	16APSK
Tx FEC code rate	5/6	Rx FEC code rate	5/6
Tx carrier frequency	1050 MHz	Rx carrier frequency	1050 MHz
BUC carrier frequency	0 GHz	LNB carrier frequency	0.95 GHz
Tx spectral inversion	Off	Rx spectral inversion	Auto
Tx carrier bandwidth at -3dB	3.030133929 MHz		
Tx carrier bandwidth at -30dB	4.065833705 MHz		
Modem carrier	On		
Output power	-30 dBm		
TxPredistorter	Off		

All of the main configuration information is displayed here, including Modulation and coding (Rx will be available if the demodulator is locked to an incoming carrier) transmit and receive frequencies, offsets to SHF (if a local oscillator frequency is set), along with spectral inversions and transmit output power. In addition, the -3dB and -30dB carrier bandwidths are displayed. These are useful for performing bandwidth comparisons between different modem configurations, especially when using different spectral roll-off factors. There are various definitions of occupied bandwidth and therefore the -30dB point may be used by way of comparison.

#### Traffic:

[View Modem Status](#) / [Modem Status](#)

Traffic			
Tx OK Since	Tx OK since 06:52:22 on 12/07/20	Rx OK Since	Rx Demod unlocked (PL sync)
Tx carrier status	Normal	IP Tx buffer fill	0 %

In the absence of transmit or receive path fault messages then [Tx OK since time / date](#) & [Rx OK since time / date](#) messages will be displayed, to inform the user of the working time since the last event. When a transmit or receive path fault exists, then a fault message is displayed instead.

[Tx carrier status](#): Displays the transmit carrier status, which could be one of the following:

- **Normal**: the carrier is on.
- **Mute-Off**: the carrier has been muted by the user.
- **Mute-Ext**: the carrier is muted due to an alarm detected by the modem hardware.
- **Mute-Ter**: the carrier is muted due to the Traffic port being down.

- **Mute-Flt:** the carrier is muted due to an alarm detected by the modem software.
- **Mute-Cfg:** the carrier is muted due to the modem being in the process of reconfiguring.

**IP Tx buffer fill:** this shows a percentage of how full the modem’s transmit buffer towards satellite is.

### Demodulator:

[View Modem Status / Modem Status](#)

Demodulator			
Es/No	29.8 dB	Eb/No	25.6 dB
Rx power level	-63 dB	Rx composite power level	-62 dB
Rx frequency offset	91 Hz		

The demodulator status is continually updated with the following information:

**Es/No:** The ratio of energy per symbol to noise spectral density.

**Eb/No:** The ratio of energy per bit to noise spectral density.

**Rx power level:** The level of the wanted carrier.

**Rx composite power level:** All of the power in the receive channel bandwidth, comprising of both the wanted and unwanted signals. (The power in the 950-2150MHz band.)

**Rx frequency offset:** This is the offset from the expected carrier frequency and indicates any frequency shift that is introduced by the satellite and frequency conversion equipment.

### Unit:

[View Modem Status / Modem Status](#)

Unit			
<b>M &amp; C IP Address</b>			
M&C IP address	10.0.70.1	M&C IPv6 address	::
M&C IP subnet mask	255.255.0.0	Remote control port IPv6 subnet prefix	64
Modem IP gateway	0.0.0.0	Modem IPv6 gateway	::
IPv4/IPv6 mode	IPv4 only		
<b>Manufacturing</b>			
Product	AXIOM-N	PCB MIH	2
Part Number	AX-N-A	PCB Assembly	Q4861
ChassisChecksum		Checksum	13
ChassisSerialNumber	4210169	PCBSerialNumber	4210169
<b>RF Options</b>			
Transmit Assembly	-	Receive Assembly	-
Serial Number	-	Serial Number	-
Checksum	-	Checksum	-
<b>System</b>			
Software version	AX.SW.1.11.0.beta11.E	Firmware version	AX.FW.2.0.1
<b>PSU</b>			
+5V	5.07	+12V	11.99
3.3V	3.28		
<b>Temperature</b>			
Modem Temperature	43 °C		

Unit information is provided here, including M&C IP addresses, software and firmware versions along with unit serial number. Key PSU rail information (with a tolerance of +/- 2 % for each rail) and unit temperature are also displayed.

## SAF:

[View Modem Status](#) / [Modem Status](#)

SAF			
<b>Basic Operation</b>			
Tx path SAF	On	Rx path SAF	On
Tx Data rate Mbps	345	Rx Data rate Mbps	230
<b>Advanced Operation</b>			
DVB-S2X	On	128/256	On
Compression	On	Acceleration	On
BUC	Off	Pre-distorter	On
Encryption	Off	Eco	Off
<b>Others</b>			
SAF test time remaining	0	Demo test shots remaining	0
SAF Mix for the modem is Y006C7830001300000000800000000400/E8F0CCE8			
<b>Temporary SAF</b>			
SAF Code		Hours Remaining	

This displays the status of the Software Activated Feature (SAF) indicating whether they are on, off or temporarily enabled. The maximum supported bit rate is also displayed for transmit and receive paths. If a demonstration test shot is enabled, test time remaining will be displayed, along with the number of remaining demo test shots. Information on any temporary SAF (such as any temporary licenses) is also available.

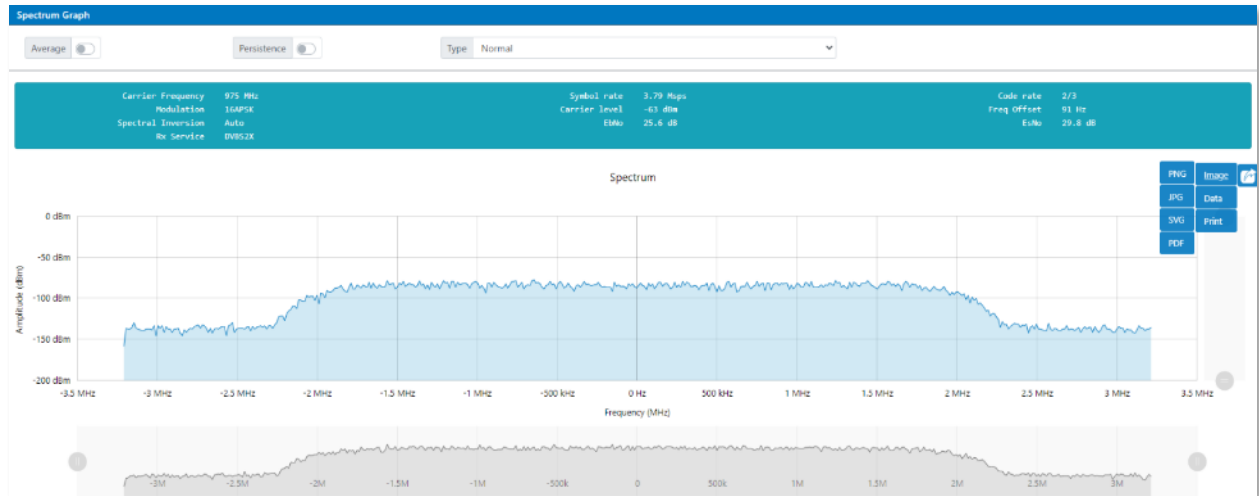
## Ethernet Port Status:

[View Modem Status](#) / [Modem Status](#)

Ethernet Port Status					
Port	M&C	IP1	IP2	IP3	
Alarm Status	<span style="color: green;">●</span>	<span style="color: red;">●</span>	<span style="color: red;">●</span>	<span style="color: red;">●</span>	
Alarm Enabled	On	On	On	On	
Status	Up	Down	Down	Down	
Speed	1000	1000	1000	1000	
Duplex	Full	Half	Half	Half	

Indicates the status of the individual Ethernet traffic and M&C ports, including whether any alarm monitoring is enabled, whether the ports are up or down and the negotiated port speed and duplex.

## View Graphs: Spectrum Graph:

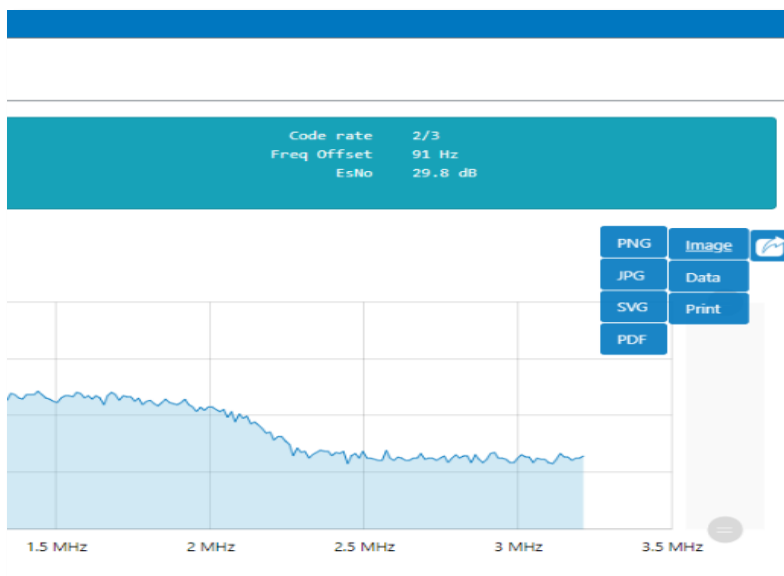


The Rx Spectrum Monitor is a powerful real-time spectrum analyser that is used to view the received signal spectrum. The Span can be set to Normal, which limits the frequency span to that of the carrier, or Super Wide, which displays a frequency span of +/-25MHz of the carrier's centre frequency. Super Wide is useful for checking for adjacent interfering carriers.

A zoom control is available by holding down the left mouse key and moving the cross-hairs over the area of interest, release the mouse button and the graph will redraw to suit. The 'Reset zoom' button can be used to revert to the normal display resolution.

Persistence leaves the spectrum to build up over time and is useful for identifying transient signals such as intermittent interference. The Persistence button acts as an on/off toggle.

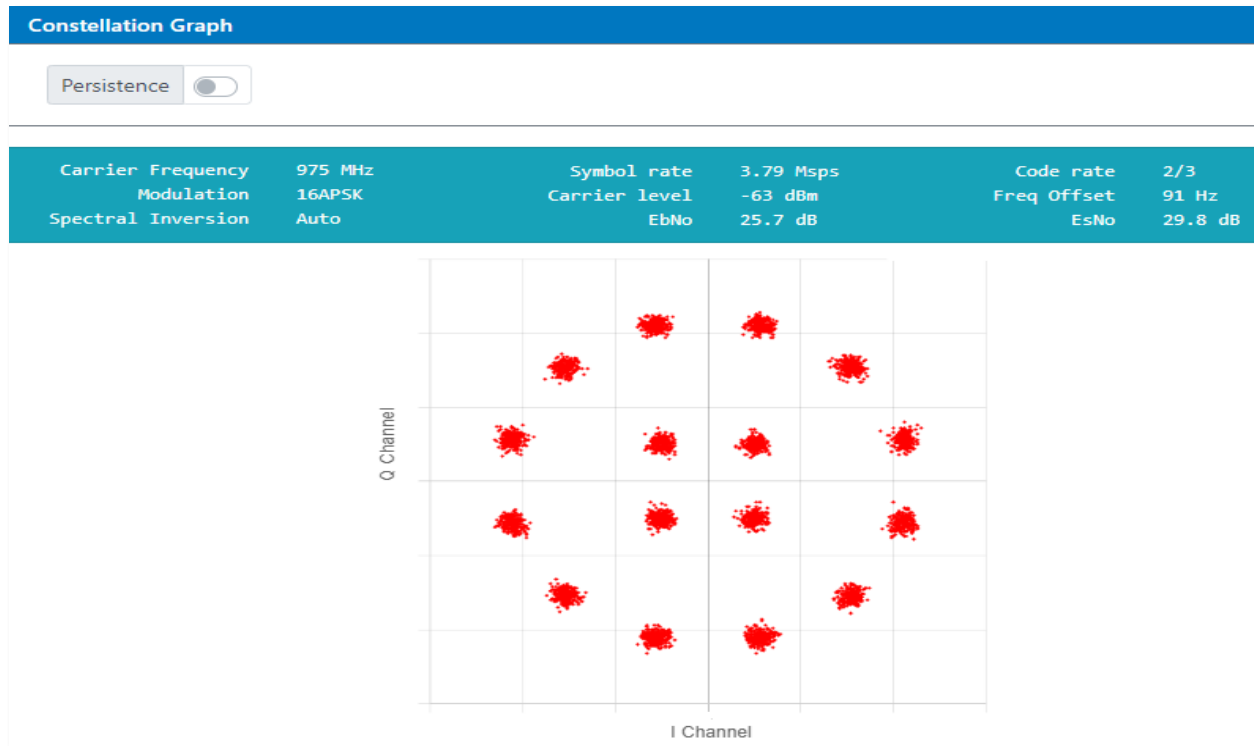
Average increases the number of samples that are used in forming the displayed spectrum. The Average button acts as an on/off toggle.



The spectral views can be saved to a target PC as a record of current link conditions or for future reference when a link is being commissioned. This ability is available from the tabs on the right hand side of the spectral view screen. Formats supported are image files, for example PNG, JPG, GIF, Adobe Systems SVG files and PDF or Data files, for example JSON, CSV or XLXS, which can be exported from the Modem. A print option is also available to spool to a local or networked printer.



## Constellation Graph:



The Rx Constellation Monitor can be used to check for correct modem operation including checking for signal distortion and phase noise. The persistence mode is useful for showing any long-term effects due to phase noise and interference. Excessive phase noise can cause cycle skips, which is seen as unwanted rotations within the constellation. The mouse right click operation can be used to save the constellation graph to a file.

## Time Series Charts:

The web user interface supports the display of the following time-based graphs:

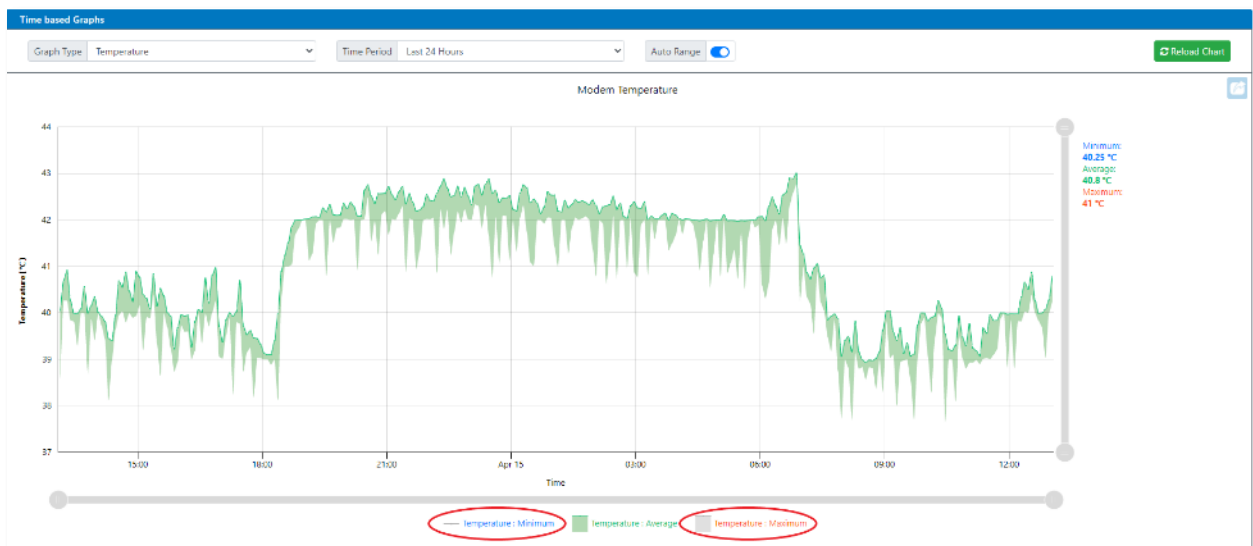
- Modem internal temperature.
- The modem received signal Es/No.
- The modem received signal Eb/No.
- The modem received power level.
- Receive frequency offset from center frequency.
- The transmit power level with AUPC enabled.
- The distant modem Eb/No with AUPC enabled.
- The Rx Eb/No and power level.

These time-based graphs are available live (i.e. from the point in time where the graphs are first viewed) or at various time periods, including a show all view. Graphical values are stored until the modem is powered down. The recording of all values occurs automatically once the modem is powered up and is not dependent on whether the graphs are being viewed or not (excluding the live graphs). Maximum, minimum and average values are recorded, the instantaneous value can be read by moving the cursor cross hairs to the region of interest and hovering over a particular point on the graph.



Example Temperature 24 hour graphs

toggling the range values, found at the base of the graph will turn off / on any individual ranges. The following shows the minimum and maximum range graphs turned off, leaving just the average 24hr graph. All other graphs share this capability.



Temperature, average only 24 hour graph

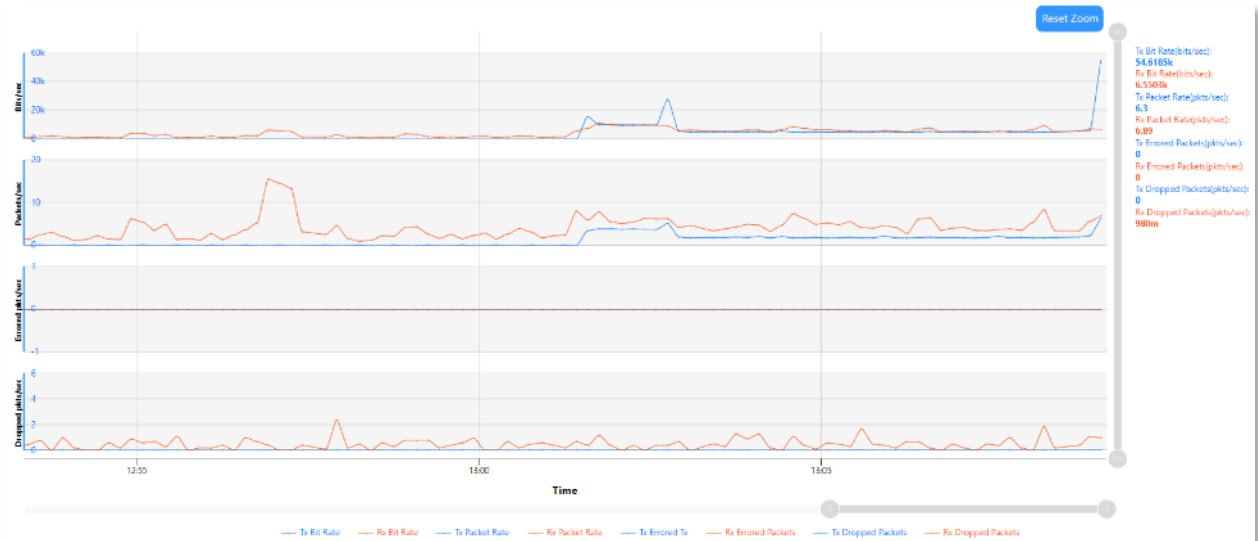
### IP port Charts:

The following shows an example of an IP throughput graph. IP graphs support the display of throughput (including errored and dropped packets) for transmit and receive in bits per second and packets per second for M&C, traffic and satellite ports.



Last Hour M&C Graph

The throughput for each graph can be viewed over several different time periods, including minute, hour, 24 hours and 4 weeks. A zoom function exists, which allows the user to zoom in on a period of interest. Simply move the cursor cross hairs, whilst holding the left mouse button down to cover a select period, release the mouse button and the graph will redraw covering the wanted area. Alternatively, use the time-based zoom controls on the lower and right hand side of the screens to narrow the area of interest, as per the example. Reset the zoom to the normal view using the **Reset Zoom** control. The cross hairs can also be used to see instantaneous values for each graph at any point in time on the selected graph.



Expanded last hour M&C Graph

## ACM Graphs:

The ACM shows the minimum, average and maximum terrestrial data rate over the selected time period. This graph shows how the terrestrial data rate varies over time in direct relation to dynamic changes of MODCOD based on varying Es/No from the remote modem. It does not show actual IP throughput (which is available on the other IP throughput graphs). The ACM graph therefore shows the actual bandwidth available over time, which can be used to determine the benefit of using ACM, particularly when viewed over longer time periods where the effects of short-term fluctuations are removed.

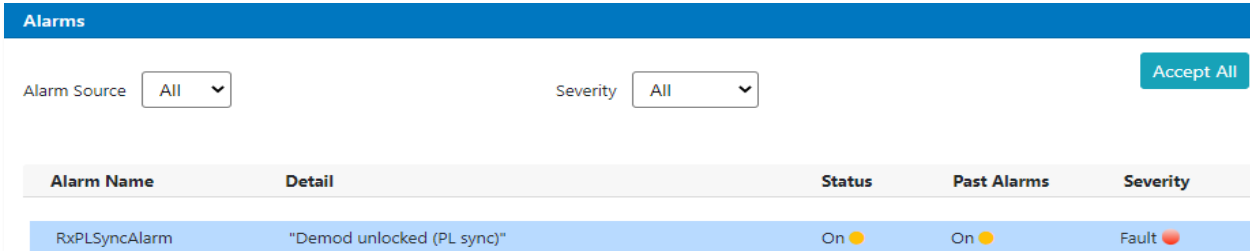
By viewing the ACM graph over a long time period such as a month, an average available bandwidth figure is produced that can be factored into new or revised service level agreements that incorporate the benefits of ACM when compared to the nominal data rate of the link without ACM.

It is possible to put ACM into a monitor mode where the ACM graph logs what the terrestrial data rate would be for the prevailing conditions, without ever actually changing the MODCOD. This is useful for assessing the potential benefit of ACM on an existing link without disrupting the current service in any way, or for evaluating ACM in a representative test scenario prior to deployment.

## Modem Utilities:

### Alarms:

[Modem Utilities](#) / [Modem Alarms](#)



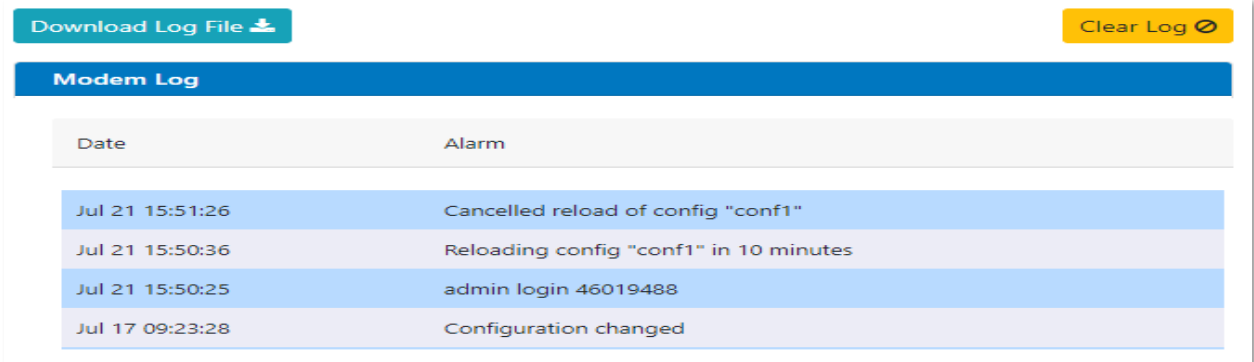
Alarm Name	Detail	Status	Past Alarms	Severity
RxPLSyncAlarm	"Demod unlocked (PL sync)"	On <span style="color: yellow;">●</span>	On <span style="color: yellow;">●</span>	Fault <span style="color: red;">●</span>

System alarms can be viewed on the Modem Utilities > Alarms tab. Alarms are latched and their status will be shown as Off if they are no longer active. The [Accept All](#) button can be used to delete all of the alarms after which the web page will automatically update to show details of any alarms that are still persistent. Alarms may be further filtered by selecting the drop down menus associated with Alarm Source (Tx, Rx or Unit) or Severity (faults or warnings).

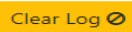

In addition, selecting (clicking) one of the top status bar LED's, which provide an overview of the Modems operation, allows the user to see any active alarms directly, without going to alarm page.

## Log:

Modem Utilities / Logs



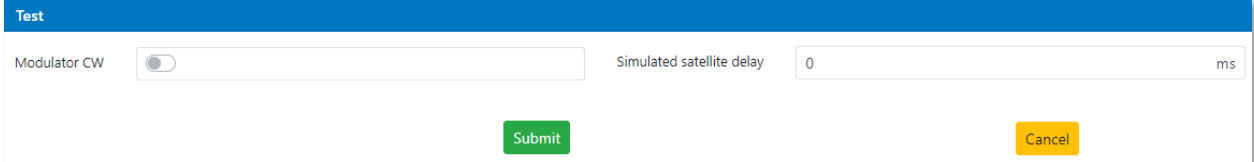
Date	Alarm
Jul 21 15:51:26	Cancelled reload of config "conf1"
Jul 21 15:50:36	Reloading config "conf1" in 10 minutes
Jul 21 15:50:25	admin login 46019488
Jul 17 09:23:28	Configuration changed

The system log can be viewed using Modem Utilities > logs tab. The  button can be used to delete all of the entries within the Modem log. The  button can be used to download a text file of the log contents to a PC or target device.

## 5. Troubleshooting

### Test:

Manage My Modem / Test



The following test functions are supported:

- **Modulator CW:** Enabling Tx CW causes a pure carrier to be transmitted rather than the normal modulated carrier. This is useful for evaluating phase noise, spurious and to determine the terminal 1dB compression point, i.e. the power level where the BUC enters compression. The 1dB compression point (P1dB) indicates the power level that causes the gain to drop by 1 dB from its previous value. For each measurement increment the transmit power level by 1dB whilst the hub operator monitors the operation. Note the Modem transmit power at which the BUC approaches the P1dB point. This value may be used as a maximum when AUPC is configured or to establish the highest order MODCOD for ACM, which should of course match the link budget.  
Note: CW mode should not be used over a live satellite link without the satellite operator's permission or supervision.
- **Simulated satellite delay:** This allows a one-way satellite delay (in milliseconds) to be entered. This can be used in modem back-to-back testing to simulate the normal satellite delay. It should always be set to 0 when using IP over satellite. Note that the use of this feature is currently incompatible with the use of IP traffic shaping (as the two features compete for the same internal resources).

If looking at the integrity of the unit, a cabled IF loopback can be applied between Transmit and Receive connectors. This will loop back the Modulated carrier to the demodulator, to test if the demodulator locks. The Transmit and Receive carrier frequencies will need to be the same. Note – this causes the modem to retransmit on its terrestrial port packets that it has received, which can cause traffic storms and ideally is only to be used when IP test equipment is connected.

### BERT:

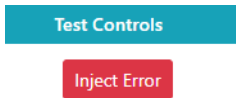
The internal Bit Error Rate Test facility injects a pseudo-random bit pattern into the main traffic channel and allows the BER results to be monitored in the corresponding or remote unit’s analyser. Naturally when this capability is enabled customers traffic is overwritten with the internal BERT data from the generator.

#### Manage My Modem / BERT

The screenshot shows a web interface for BERT control. It has a blue header bar with the text 'BERT'. Below the header, there are two dropdown menus: 'Tx BERT generator' and 'Rx BERT analyser', both currently set to 'Off'. There are two buttons: a green 'Submit' button and a yellow 'Cancel' button.

**Tx BERT generator:** Enables the internal BERT. Note: This will overwrite customers traffic.

- **Off:** Disables the internal BERT.
- **Generate Packets to Tx sat:** The generator sends continuous 1518-byte packets to the Modulator. When enabled the user can inject single bit errors, which should increment the analysers Rx error count.



**Rx BERT analyser:** Enables the internal BERT analyser.

- **Off:** Disables the internal BERT analyser.
- **Analyse Rx Datapath:** Enables the analyser showing the following metrics.

#### Manage My Modem / BERT

The screenshot shows a 'Results' table with the following data:

Results	
Rx frame sync	<span style="color: green;">●</span> Rx frame LOS events 0
Rx pattern sync	<span style="color: red;">●</span> Rx pattern LOS events 0
Rx average BER	0.00E+00
Rx errors	0
Rx bits	0
Round trip time	0.000000 μs
Elapsed time	0 days, 0 Hrs, 0 Minutes, 0 Seconds

- **Rx frame sync:** Green indicates that the DVB PLS header sync has been achieved, whereas Red indicates a sync loss. A Frame loss events counter is also available. This will increment if, for example, there are poor signal conditions.
- **Rx pattern sync:** Green indicates that the BERT pattern sync has been achieved. Red indicates a sync loss condition. A Rx pattern loss events counter is also available.
- **Rx Average BER:** Indicates the number of bit errors in relation to the number of bits received.

- **Rx errors:** Indicates the total number of errors since the start of the test.
- **Rx bits:** Indicates the total number of Rx data bits since the start of the test.
- **Round trip time:** Indicates the total transit time, in microseconds, if a remote Modem has a loopback applied.
- **The Elapsed Time:** indicates the time since the test was started or restarted.

### Resetting to Defaults:

If the M&C IP address or admin password has been lost, preventing access to the Modem’s web user interface, there are a couple of options to reset the unit to factory defaults or a known configuration.

Copy a configuration from another unit to a USB memory stick’s root directory, save this as:

[usb\\_restore\\_config.conf](#)

**Note:** This can be any configuration, including one that has been knowingly set to factory defaults using the `load defaults` tab within the donor Modems memory list, found under:

[Manage My Modem](#) / [Config Files](#)

Save the current configuration first, prior to defaulting the config.

Plug the USB memory stick to the Modem’s USB port and reboot the Modem. The config will be loaded on start up. Loading defaults clears the unit’s configuration and sets the admin and user passwords to paradise, the M&C IP address and subnet mask back to factory defaults of: 10.0.70.1/24 allowing the user to reconfigure the unit as desired.

### Fault and warning descriptions:

[Modem Utilities](#) / [Modem Alarms](#)

Fault Text	Description
Unit Fault: Operating temperature exceeded.	This alarm is raised at 104 degrees C, check the ventilation ensuring that any enclosure fans are still operating and any heatsinks are positioned correctly.
Unit Fault: An internal fault has occurred.	This indicates that the software has been unable to initialise the hardware. Power the modem down and back up to see whether this clears the problem. If not, please consult Paradise technical support.
Unit Fault: Tx Synth has lost lock.	Power the modem down and back up to see whether this clears the problem. If not, please consult Paradise technical support.
Unit Fault: One or more PSU rails are out of range.	One or more power supply rails are outside of limits, check the 24v DC input is within tolerance. We recommend a +24V DC +/- 0.5 volts power supply is used, although the unit will operate with +/- 5% tolerance.
Tx Fault: BUC PSU outside limits.	The current drawn by the BUC has exceeded the limits set within the unit configuration: <a href="#">Modify Settings</a> / <a href="#">SAF &amp; Alarm Settings</a> / <a href="#">System Alarms &amp; SAF</a> BUC DC Current Min / Max
Tx Fault: Tx channel DPLL has lost lock.	Power the modem down and back up to see whether this clears the problem. If not, please consult Paradise technical support.

Tx Fault: Tx terrestrial DPLL has lost lock.	Power the modem down and back up to see whether this clears the problem. If not, please consult Paradise technical support.
Tx Fault: IP 1-3 port down alarm	Raises an alarm when either IP1, IP2 or IP3 traffic ports go down. Check the Ethernet cables are still seated correctly and the speed and Duplex settings between the Modem and connected equipment's are compatible.
RX Fault: Demod unlocked (PL sync)	Physical Layer sync lost. When this alarm is raised the demodulator cannot lock to the carrier at the specified frequency. Check the unit's configuration is compatible with the transmit, check the wanted carriers signal to noise using the units built in spectrum analyser.

Warning Text	Description
Unit warning: AUPC at maximum power offset	While attempting to maintain a constant Eb/No at the distant modem, the AUPC function has adjusted the modem power level to the maximum offset allowed. Check AUPC settings: <a href="#">Modify Settings / Unit Settings / AUPC</a>
Unit warning: Temporary SAF features %s will expire in less than 48 hours	Indicates that one or more SAF features that have been purchased on a temporary license are about to expire. A new purchase order should be raised if the features are still required.
Unit warning: Tx MC Port Down Alarm	If this warning is latched within the alarms then the M&C port connectivity may be intermittent, check the Ethernet cable is seated correctly and the speed and Duplex settings between the Modem and connected equipment's are compatible.
Unit warning: Fan Failure Alarm	One or more of the cooling fans have failed.
Tx warning: Tx symbol rate outside range	The modems current configuration exceeds the permissible symbol rate, check the configuration.
Tx warning: Tx Timer Mute Alarm	The Tx carrier is muted because M&C is lost and the carrier option has been set to 'On-mute on loss of M&C' in the carrier contrc <a href="#">Modify Settings / Tx-Rx Settings / Tx-Rx</a>
Tx warning: Rx symbol rate outside range	The modems current configuration exceeds the permissible symbol rate, check the configuration.
Rx warning: Rx EbNo Below Threshold	The receive Eb/No is below the user set threshold. Default is 3dB and this can be edited in the following menu: <a href="#">Modify Settings / Unit Settings / System Alarms</a>
Rx warning: Rx distant EbNo Below Threshold	The distant Modems receive Eb/No is below the user set threshold. This can be edited in the following menu: <a href="#">Modify Settings / Unit Settings / System Alarms</a>



## Glossary:

Acronym	Description
QPSK	Quadrature Phase Shift Keying: a digital modulation scheme that conveys data by modulating the phase of the carrier. 2 bits per symbol.
8PSK	Eight Phase Shift Keying: a digital modulation scheme that conveys data by modulating the phase of the carrier. 3 bits per symbol.
8APSK, 16APSK, 32APSK, 64APSK, 128APSK and 256APSK	Amplitude and Phase Shift Keying: a digital modulation scheme that conveys data by modulating the phase and amplitude of the carrier. 8APSK 3 bits per symbol, 16APSK 4 bits per symbol, 32APSK 5 bits per symbol, 64APSK 6 bits per symbol, 128APSK 7 bits per symbol and 256APSK 8 bits per symbol.
ACM	Adaptive Coding and Modulation, where the MODCOD is changed in sympathy with the atmospheric conditions.
AGC	Automatic Gain Control, where closed loop feedback keeps the desired output level constant.
AUPC	Automatic Up-link Power Control, where feedback from the distant end Modem is used to change the local transmit power in an attempt to keep the remote signal to noise ratio at the desired level.
BER	Bit Error Rate, the number of bit errors over time.
BERT	Bit Error Rate Tester, an internal test facility, which can be enabled to test the integrity of the satellite link.
BPDU	A bridge protocol data unit is a data message transmitted across a local area network to detect loops in network topologies. A BPDU contains information regarding ports, switches, port priority and addresses and contain the necessary information to configure and maintain spanning tree.
BSC	Base Station Controller, is a network element that controls and monitors a number of base stations and provides the interface between the cell sites and the mobile switching center (MSC).
BUC	Block Up Converter, converts a band of frequencies from a lower frequency to a higher frequency band, for example L-Band to C-Band.
C/N	Carrier-to-noise ratio and is the signal-to-noise ratio (SNR) of a modulated signal.
Carrier	The Carrier is a CW signal modulated with an input signal to convey information.
CRC	Cyclic Redundancy Check is a technique used to detect errors in digitally transmitted data.
CW	Continuous Wave used in satellite line ups and for evaluating phase noise or spurious transmission only. It is based on transmitting a carrier signal at a fixed frequency.
CCM	Constant coding and modulation. A DVB-S2 / X mode where the MODCOD is not changed during operation.
COTM	Communications on the Move, Modular systems for ground, airborne, and maritime platforms conducting satellite communications whilst being able to be moved to different locations.
DHCP	Dynamic Host Configuration Protocol is a network management protocol where a DHCP server dynamically assigns IP addresses and other network configuration parameters to each device on a network so they can communicate with other devices. This is rather than a user assigning network

	IP addresses on a per unit. Normally DHCP addresses are assigned for a period of time, or lease. When the lease expires the host can no longer use that IP address.
DNS	A Domain Name Server, translates more easily remembered domain names to numerical IP addresses needed for locating and identifying computer services and devices with the underlying network protocols. By providing a worldwide, distributed directory service, the Domain Name System has been an essential component of the functionality of the Internet for a long time.
DSCP	The Differentiated Services Code Point specifies a mechanism for classifying and managing network traffic providing quality of service (QoS) on IP networks. DiffServ can, be used to provide low-latency to critical network traffic such as voice or streaming media while providing simple best-effort service to non-critical services, like web browsing or file transfers.
DVB	Digital Video Broadcasting is an internationally accepted open standard for digital video transmission. ETSI EN 302 307-1 covers DVB second generation (DVB-S2) and ETSI EN 302 307-2 covers DVB second generation extensions (DVB-S2X).
Eb/No	The ratio of energy per bit to noise power spectral density and is a measure of signal-to-noise ratio.
Es/No	The ratio of energy per symbol to noise spectral density.
EIRP	Effective Isotropic Radiated Power is the product of transmitter power and antenna gain in a given direction relative to an isotropic antenna of a radio transmitter. Normally the EIRP is given in dBi.
FEC	Forward error correction is a system of adding redundant data bits to the incoming bit stream to help the decoder resolve any missing or corrupted bits in the transmission from the source.
Frame	Packetised digital data transmission, for DVB-S2/X the FEC frame size is either 64,800 bits (Normal) or 16,200 bits (Short).
HTTP(S)	Hypertext Transfer Protocol (HTTP) is an application-layer protocol for transmitting hypermedia documents, such as HTML. It was designed for communication between web browsers and web servers. HTTPS is an extension of HTTP and is used for secure communication over a network.
Hub	A central earth station, which manages all of the remote stations within a network.
ICMP	Internet Control Message Protocol is a protocol used by network devices, including routers, to send error messages and operational information indicating success or failure when communicating with another IP address, for example, an error is indicated when a host or router could not be reached.
IESS	Intelsat Earth Station Standards, which provide users with a common source of reference for the performance characteristics required from earth stations.
IF	Intermediate Frequency, where a carrier frequency is at an intermediate step during the conversion to the final transmit radio frequency.
IFL	Interfacility Link – used to establish communications or pass DC and 10MHz reference signals to RF equipment from the Modem, such as a BUC or LNB.
Jumbo frames	Ethernet frames with more than 1500 bytes of payload, for example the AXIOM supports up to 10kbytes.

LDPC	Low-density parity-check code is a linear error correcting code, to support the transmission of digital data over noisy medium.
LNB	Low-noise block down converter is part of a receiving system and is usually installed on the satellite antenna, containing an amplifier and down converter (from SHF to L-Band).
LO	The Local Oscillator usually is built into conversion equipment (for example a BUC or LNB) and is used to convert IF to RF and vice versa.
Long Frames	DVB-S2 FEC frames which are 64,800 bits long.
M&C	Monitor and Control, the system used to control elements within the network.
MCPC	Multiple channels per carrier, several data streams are combined or multiplexed into a single bitstream before being modulated onto a carrier transmitted from a single location to one or more remote sites.
MESH	Network stations that can communicate directly with each other rather than via the Hub, thus eliminating a double hop.
MIB	Management Information Base is a database of information used for SNMP communications
MODCOD	Modulation and FEC Coding associated with a particular modulated carrier.
Mux	Multiplexer, where two or more information streams are combined to be transmitted as one signal.
MTU	Maximum Transmission Unit is the size of the largest network layer protocol data unit that can be transmitted in a single network transaction. A larger MTU is associated with reduced overhead, whereas a smaller MTU may reduce network delay.
NAT	Network Address Translation is designed for IP address conservation and translates private addresses in an internal network to a single address to the outside world. This provides additional security by effectively hiding the entire internal network behind that address. NAT offers the dual functions of security and address conservation and is typically implemented in remote-access environments.
NMS	Network management System, used to control and monitor network elements.
ODU	Outdoor Unit, usually equipment that is located outside of the Hub buildings closer to the antennas.
Outroute	Usually is the transmit carrier in the forward direction from the Hub to all remotes.
Pilot tones	Pilot tones are unmodulated symbols, which are injected into the carrier on a regular basis in order to help the demodulator lock onto the carrier.
PUP	Paradise Universal Protocol, is a protocol for communicating and controlling a Paradise Modem.
PLL	Phase Locked Loop, is a control system that generates an output signal whose phase is related to the phase of an input signal.
PRBS	Pseudo-Random Bit Sequence, generated within a BERT set to test the integrity of a particular link or Modem.
RF	Radio Frequency

SAF	Software Activated Feature are software options that can be activated within the Paradise Modems.
SCPC	Single Channel Per Carrier, one transmit data stream per carrier.
Short frames	DVB-S2 FEC frames 16,200 bits long. Used where lower latency is required, at the expense of coding gain.
SNMP	Simple Network Management Protocol, used to monitor and control network elements. SNMPv1 is the original version with more recent versions being SNMP V2C and SNMP V3, featuring improvements in performance, flexibility and security.
SNTP	Simple Network Time Protocol is a protocol for synchronizing the Modem time with a networked time server.
SR	Symbol Rate, is measured in baud or symbols per second.
SSH	Secure Shell provides a secure connection between two hosts over a potentially insecure network.
Star	A network with a Hub as the central station and several remote stations.
STP	Spanning Tree Protocol is a network protocol that builds loop-free Ethernet networks to help prevent packet storms and circulating packets.
SW	Software – is the embedded code which allows the unit to function.
TCP	Transmission Control Protocol provides reliable delivery of data between server and client running over an IP network.
Telnet	Telecommunication Network is an application protocol used on the Internet or local area network to provide a bidirectional interactive text-oriented communication, using a virtual terminal connection.
TFTP	Trivial File Transfer Protocol is a very basic file transfer protocol.
UDP	User Datagram Protocol uses a simple connectionless communication model with a minimum of protocol mechanisms, usually used for streaming video etc.
USB	Universal Serial Bus is a specification to establish communication between devices and a host controller.
VLAN	A virtual LAN allows networks to be segmented based on function, or application, without regard for physical location of the user or device. Satellite Modems can use VLAN's to keep traffic and management data separate for example.
VSAT	Very Small Aperture Terminal – a satellite terminal with a small antenna, used with remote or mobile systems to communicate to a hub.
WFQ	Weighted fair queuing is a method of dividing the available bandwidth between different priority queues ready for transmission.

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