



Maven Wireless

Commissioning Exo / Strato / TOR

Off air repeater

User manual

Document version: 1.2



Exo-Strato



TOR

CONFIDENTIAL

Revision History

Revision	Date	Value
1.0	2021-05-31	Initial revision
1.1	2024-03-08	US format

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Warranty

Standard product warranty is 12 months or as otherwise agreed.



All outdoor antennas must be installed with lightning protection. Damage to modules, as a result of lightning is not covered by the warranty.



Antennas must be connected before switching on AC or DC power. Energizing the equipment prior to the connection of the antenna cable(s) is regarded as faulty installation procedure and therefore not covered by the Maven Wireless warranty.

Unauthorized changes to equipment

Any changes or modifications not expressly approved by Maven Wireless (who are responsible for compliance) could void the user's authority to operate the equipment.

The equipment must be installed and operated in accordance with any license required from the radio authorities in the country concerned. In most cases a failure to obtain or the contravention of a license is a criminal offence. It is the user's responsibility to ensure any required licenses are obtained, that system installations are commissioned in accordance with their terms and that no changes can later be made which contravene them.

Standards and approvals

The Maven Repeater complies with the following standards

- EMC Directive 2004/108/EC
- Low Voltage Directive 73/23/EEC
- R&TTE Directive 1999/5/EC
- UL 62368-1, NEMA 4X
- FCC 15B, ICES-003; FCC 22, 24, 27, 90

General Safety Warnings and Compliance

Always observe standard safety precautions during installation, operation and maintenance of this product.

Safety to personnel

Before installing, replacing or modifying any of the equipment, the entire manual should be read and understood. The user needs to supply the appropriate AC or DC power to the equipment. Incorrect power setting can damage the equipment and may cause injury to the user.

Be aware that the equipment can in certain conditions become very warm and can cause minor injuries if handled without protection such as gloves.

Electrical Shock

To prevent electrical shock when installing, modifying or replacing the system power wiring, disconnect the wiring at the power source before working with uninsulated wires or terminals.

Non Ionizing Radiation

The repeater unit outputs Radio Frequencies at high power. The connected antenna system must be engineered to comply with the requirements of 1999/519/EC: Council Recommendation of the limitation of exposure of the general public to electromagnetic fields 0Hz to 300GHz. Otherwise, in cases where the general public is not admitted to the coverage area, such other occupational limits as may be applicable.

Maven Wireless customers must adhere to the standards when designing and commissioning coverage systems by ensuring that the combination of output power, splitting losses, antenna gains and separation distances to accessible areas yield field strengths below safe levels.

Note that in some instances it will be necessary to shut down units in order for work to be performed on or near system antennas. Adequate warning notices should be posted to ensure every installation is safe.

RF Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, this equipment should be installed and operated with minimum distance 20 cm (7.9 inches) between the antenna and your body during normal operation. Users must follow the specific operating instructions for satisfying RF exposure compliance.

FCC Compliance Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two

conditions:

- (1) this device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation. Please note that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Maven Wireless customers must adhere to the standards when designing and commissioning coverage systems by ensuring that the combination of output power, splitting losses, antenna gains and separation distances to accessible areas yield field strengths below safe levels.

Note that in some instances it will be necessary to shut down units in order for work to be performed on or near system antennas. Adequate warning notices should be posted to ensure every installation is safe.

Unit Weight

The repeater units weigh up to 25kg (55 lb). It can be lifted by one man but due care with handling is required. Personnel should have received suitable training and be provided with adequate PPE, and at a minimum, safety shoes and preferably a lifting belt.

For use only by Trained Personnel

The devices should be installed and energized only by trained personnel who are familiar with the type of equipment and the associated hazards.

The repeater has an access cover protected by keys. The keys should only be issued to suitably trained persons. There are no user serviceable parts inside and maintenance must be carried out by trained staff in workshop conditions. Apart from the access cover, the devices must not be opened on site.

Login details of user accounts must be controlled so that only competent persons possess the privilege to adjust frequency bands and operating levels.

Use in accordance with this manual

The protection provided by the equipment may be impaired if installed and used in a manner not specified by the manufacturer. Follow all guidance contained in this manual.

Electrical & Environmental Ratings Exo-Strato

Voltage Rating	115-230V AC
AC Frequency	50/60 Hz
Current	5.2-2.6 A rms AC
Temperature	-25 to +55 °C
Relative Humidity	10 to 100 % Non-Condensing
Indoor/Outdoor Use	Indoor/Outdoor, IP66
Environment	Weather Protected, Not Temperature Controlled - EN 300-019-1-3, Class3.3
Operational Spacing	Horizontal side by side - 300 mm Horizontal front to back - 300 mm Vertical top to bottom - 500 mm
Dimensions	670 x 383 x 270 mm (26.4 x 15 x 10.6 in)
Weight	25 kg (55 lb)

Electrical & Environmental Ratings TOR

Voltage Rating	24 VDC; 110 VAC versions available
Current	18A - 2A
Temperature	-25 to +55°C
Relative Humidity	10 to 100% Non-condensing
Indoor/Outdoor Use	Indoor, IP20
Environment	OT1, see User Manual for complete specification
Operational Spacing	Horizontal side by side - no restrictions Horizontal front to back - not allowed Vertical top to bottom - 12mm
Dimensions	4u x 19" x 310 mm
Weight	max 20 kg

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General Description

Maven digital off-air repeater operating principles

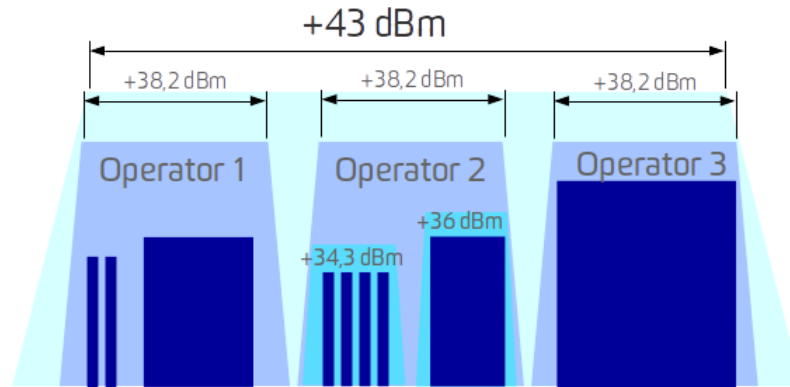
The Maven digital off-air repeater is a bidirectional frequency-selective amplifier:

- Downlink signals from the base (donor) antenna port are digitized, the signals which should be amplified are selected by digital filtering and are re-transmitted with the wanted gain on the mobile (server) antenna port.
- Uplink signals from the mobile (server) antenna port are similarly digitized, filtered and re-transmitted on the base (donor) port.
- In both directions, excessive signal levels are limited by fast-acting automatic level control (ALC). The isolation between antennas is monitored to prevent oscillation in case of inadequate isolation margin.

Coverage in the Maven digital off-air repeater is software-defined. Each operator specifies in the management GUI which frequency ranges they are using for their carriers, which are then known to the system as a named “sector input”. The sector inputs are filtered into separate bidirectional (downlink /uplink) digital data streams. Each operator can then decide:

- What sector inputs should be enabled (establishing the flow of signals between base and mobile antenna ports).
- What downlink and uplink gain should be provided for each enabled sector input. Uplink gain can either be specified as a fixed value, or relative to the downlink gain.
- What share of the maximum output power at each antenna port is allocated to each operator, and for each operator how they allocate that power to sector inputs of different technologies.

The separation of sector inputs by digital filtering allows the signals from several operators to be combined with different power levels, while still allowing each operator to define their own coverage parameters without being affected by changes in the other operator signals. In the uplink, only the signals specified by the operator are passed by the filtering which means that signals from uncoordinated mobile terminals do not appear as an interfering signal at the base stations. Coverage parameters can be changed at any time via the management GUI, allowing signals to be added or removed, power levels to be changed, or sectorization to be adjusted remotely.



Separate sector inputs enabled with different power levels per technology and operator (Exo shown)

Migration from analogue repeaters

Maven digital off-air repeaters offer a flexibility in system design which does not exist with analogue band-selective products. In an analogue band-selective repeater, all signals in the frequency band experience the same amplification. There is no choice in which signals are carried: the entire frequency range connected at one end is hard-wired to appear at the other end, and there is no selectivity to prevent unwanted signals from interfering. The relative signal levels are fixed for each operator as they appear at the antenna input, with no scope to set different gains or maximum signal levels for different carriers.

The Maven digital repeater offers high-speed precise automatic level control and squelch per carrier, as well as advanced diagnostic and control functions such as oscillation prevention.

- | | |
|---|--|
| <ul style="list-style-type: none"> • Combined input signals transmitted between fixed base and mobile ports. • No selectivity against unwanted downlink or uplink signals. • No option to apply different gain or maximum signal level to different signals. • Only indirect measurements of signal properties. | <p>Maven digital repeater</p> <ul style="list-style-type: none"> • Input signals split into individual sector inputs which can be separately controlled. • Unwanted downlink / uplink signals removed by digital filtering. • High speed ALC and squelch per carrier, directly in the digital data path. • Advanced diagnostic and control functions based on the digital signal data, such as oscillation prevention |
|---|--|

RF-Geofencing

Maven Wireless Off air repeaters can be ordered with a GPS equipped modem. The GPS equipped repeaters can be configured to have different RF configurations depending on the physical location of the repeater, so called RF Geofencing.

RF Setup of GPS equipped repeaters is slightly different in that different profiles are setup which are then enabled depending on current location of the repeater.



Example of RF profile dialog in a GPS equipped repeater

The RF setup of this manual explains commissioning of non-GPS equipped repeaters. Full details (and required additional software tools) are described on the Maven Wireless Service Desk. Please contact the Maven Support team on how to get access to the Maven Service Desk.

Repeater Commissioning

Overview

The Maven repeater is commissioned using any standard web browser using the USB port. The functionality of commissioning is the same for Exo / Strato / TOR except for icons on GUI.

Commissioning a repeater mainly consists of

1. First verify proper antenna isolation and ensure antenna cables are properly connected by performing return loss measurements.
2. Configure the desired Sector inputs / donor signals
3. Enable the RF in the repeater
4. Fine tune uplink and downlink gain and power output
5. Optionally configure the modem for remote access.

Detailed instructions on how to configure RF is described in the chapter RF Commissioning, while modem setup is detailed in the chapter Configure Modem



Commissioning must respect the terms of any license from the Radio Authorities in the country concerned. Maximum output powers at certain nodes might also be constrained by Non Ionizing Radiation Safe Levels. All commissioning must respect the parameters decided at the system design stage.

Browser Compatibility

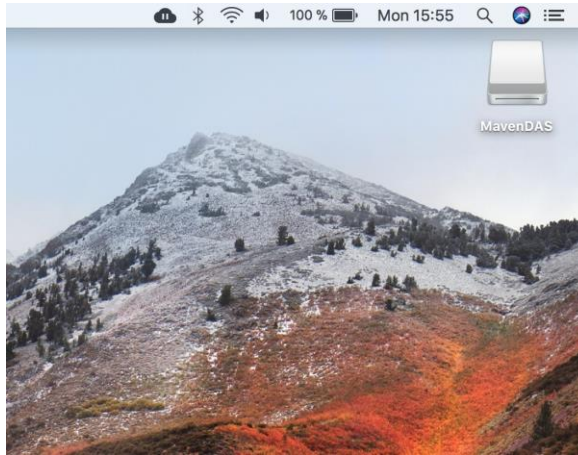
Maven repeaters can be accessed via any modern web browser such as Chrome, Firefox, Safari or Edge as long as they are updated to the latest version.

Using one of these is strongly recommended.

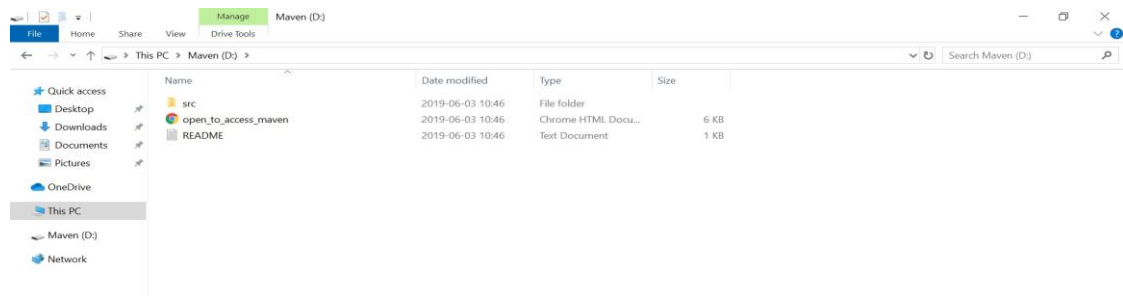
Accessing the Unit

Connect the provided USB cable from the laptop to the micro USB connection of the unit (labelled LOCAL MANAGEMENT).

A removable disk will now be presented in your operating system, on Mac it will typically be a drive on the desktop.



On Windows it normally ends up as a drive in the Explorer, or as a new window:



Open the drive and open the link, [open_to_access_maven.html](#) which will provide a link to reach the login dialog of the Maven repeater.

On most occasions the access works out of the box, but should there be any problems, the opened link provides detailed instructions on how to set up your particular OS to access the equipment.

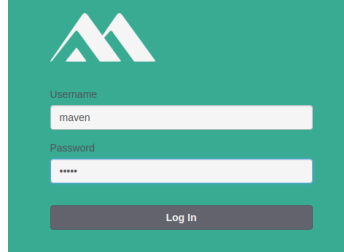


When opening the connection to a unit for the first time, the browser will warn about insecure certificates. These must be added as exceptions in the browser before proceeding.

Default Login Parameters

Login credentials are case sensitive.


Username	Password
maven	maven



It is strongly recommended to change the password in accordance with network policy after first login to the system

User Interface Navigation

When successfully logged in to the system, the RF Status page is presented to the user.

A number of different screens are available from the main menu, available by clicking on the  in the upper left corner of the web interface. The following chapters describe each page and the tasks to carry out on each one.

RF Status

The RF status page displays all relevant RF parameters and signal levels of the system. This is where new RF inputs are configured and where they are routed to the different remote nodes.

ID / Description	Range [MHz]	Gain [dB] Uplink / Downlink	Downlink ALC [dBm]	Uplink RF In [dBm]	Downlink RF Out [dBm]
MS - Birka Paradise	800		-92.7	-49.5	
Stats-0-3-15	900		-89.7	-49.5	
Serial: 0000P	1800		-88.5	-49.5	

The left hand side shows all Sector Inputs and corresponding measured RF levels.

The Right hand side shows all enabled RF signals through the repeater and corresponding signal levels. From the right hand side, it is also possible to bring up the spectrum analyzer and the Return Loss measurement tools.

See RF Commissioning chapter for details on setting up the RF through the repeater.


System Elements

Select System element option to check version info and hardware readings as well as changing SSH setting, site name change.

System Elements						
	Site Name	Equipment	Serial	Article Number	Settings	
	MS - Birka Paradise	Stato-6-6-13	000AP	RAM00014B		

Hardware Readings								
Measurement	Value	Band	800 DL	900 DL	1800 DL	800 UL	900 UL	1800 UL
Digital Engine Temperature [Celsius]	55.5	Voltage [Volts]	28.1	28.1	28.1	28.1	28.1	28.1
Digital Engine Power Supply [Volts]	11.7	Temperature [Celsius]	38.1	49.9	48.3	38.4	51.3	49.5
		Return Loss [dB]	0.8	-	-	-	-	-
		TX Status						

Node Settings

To edit the Node Settings settings, click  in the right hand side of the row for the unit, which brings up the following dialog:

Node Settings ✕

Node
MS - Birka Paradise

SYSTEM

Ethernet

Site Name & Location

Secure Shell

ALARMS

Alarm Configuration

External Alarm

Clear Log

Software Version: 2.5.2-82-gb779af4
Boot Loader Version: boot_loader-1.0.2-12-g2df486c

Close


Change Ethernet / IP Settings

To edit Ethernet / IP Settings click on  Ethernet :

Node Settings

Node
MS - Birka Paradise

<

Ethernet 


Configure IPv4

IPv4 Address 192.168.1.100

Subnet Mask 255.255.255.0

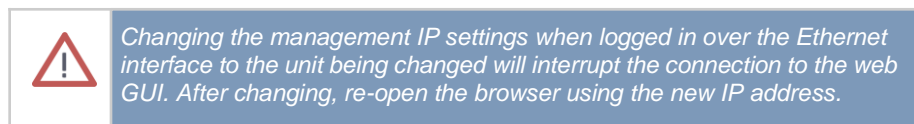
Router 192.168.1.1

MAC F8:B5:68:80:04:07

 Changing management IP settings when logged in over the Ethernet interface will interrupt the connection to the web GUI. After changing, re-open the browser using the new IP address.

Software Version: 2.5.2-82-gbf79af4
Boot Loader Version: boot_loader-1.0.2-12-g2df486c

The repeater can either automatically receive its IP settings via DHCP, in which case the received parameters are displayed as read-only or can have its IP settings configured manually. After making a change, click Save to set the parameters.



Change Site Name and Location

Site name is a specific name for this hardware unit. A recommendation is to give the node a name so that it is easy to figure out where the unit is installed.


To change the Site name click on  Site Name which brings up the Site Name dialog.

Node Settings ✕

Node
MS - Birka Paradise

←

Update Site Name & Location



Site Name


GPS Coordinates

Latitude	Longitude
59.4060107	17.9522841

Software Version: 2.5.2-82-gbf79af4
Boot Loader Version: boot_loader-1.0.2-12-g2df486c

Close
Save


Configuring the GPS coordinates will cause the repeater to be automatically displayed on the graphical maps when integrated to the Maven NMS.

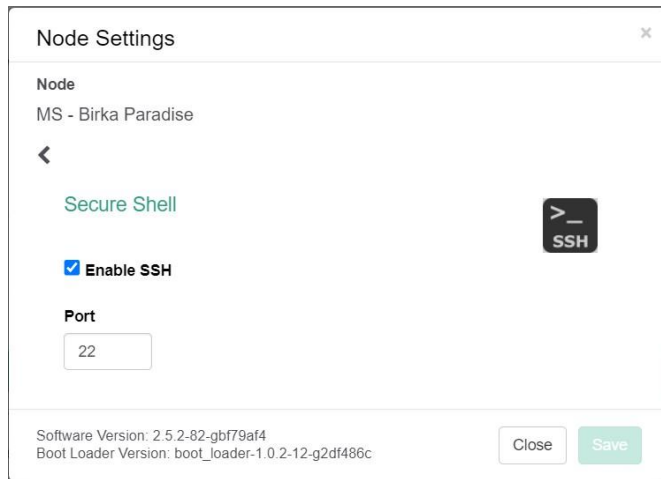


For repeaters with built in GPS, the latitude and longitude of the repeater cannot be changed but is automatically updated with the current location of the repeater.

The Site Name is a configurable name that can be given to this installation to easily identify the site remotely.

Change SSH settings

To change SSH setting click  Secure Shell



By default SSH is enabled on the standard port 22, allowing remote access over the Ethernet interface (if connected). SSH can be disabled, or the port number can be changed to a different non-standard value if required by the customer network configuration. After making any changes, click Save.

SSH to the repeater is required in order to perform remote firmware upgrade from the NMS. Remember to re-enable SSH in this case.

Hardware Readings

This page displays various levels as measured in the repeater, such as voltage levels and temperatures.

For Exo repeaters TX Status indicates current status of the downlink output power linearization process.

System Elements		Site Name	Equipment	Serial	Article Number	Settings
		MS - Birka Paradise	Strela-S-8-18	8106P	RAM0014B	GF

Hardware Readings		Band	800 DL	900 DL	1800 DL	800 UL	900 UL	1800 UL
Measurement	Value	Voltage [Volts]	28.1	28.1	28.1	28.1	28.1	28.1
Digital Engine Temperature [Celsius]	56.5	Temperature [Celsius]	38.1	49.9	45.3	38.4	51.3	49.5
Digital Engine Power Supply [Volts]	11.7	Return Loss [dB]	0.8	-	-	-	-	-
		TX Status	●	●	●	●	●	●

Open Alarms

The repeater continuously monitors all critical parameters of the installation and triggers an alarm if any abnormal condition or fault is detected.

The Open Alarms menu option gives an overview of all currently active alarms in the repeater. As soon as the alarm condition is no longer met it will be removed from the open alarms list. If any alarms are shown as active (bold) in the system status panel of the top of the screen, clicking on the active alarm entry will automatically select the open alarms page.

Event Time	Severity	Alarm Identifier	Class	Probable Cause	Additional Info
2021-02-01 10:00:29	Warning	Low isolation - oscillation prevention is reducing CL gain Oscillation - Sustain - 005PP-263	equipmentAlarm	performanceDegraded	Isolation estimate was 96.6 dB
2021-02-01 09:28:50	Critical	Power amplifier return loss measurement Power amplifier - ReturnLoss - 1	environmentalAlarm	cableTamper	Return loss in 800.DL is 1 dB
2021-01-20 11:38:42	Warning	Remote Unit Access Cover AccessCover	environmentalAlarm	enclosureDoorOpen	Access Cover opened

Field	Description
Event Time	This indicates at what time alarm happened
Severity	X.733 Alarm Severity level, one of: Critical Major Minor Warning
Alarm Identifier	Description of the alarm source, plus the unique alarm identifier in the particular node
Class	X.733 Alarm Class, one of communicationsAlarm qualityOfServiceAlarm processingErrorAlarm equipmentAlarm environmentalAlarm integrityViolation operationalViolation physicalViolation securityServiceOrMechanismViolation timeDomainViolation other
Probable Cause	A hint of what the reason for the alarm might be, as defined by X.733. Such as lossOfSignal degradedSignal enclosureDoorOpen powerProblem Refer ITU Recommendation X.733 for full list.
Additional Info	Additional information about this particular alarm, such as current levels or status when the alarm was triggered.

Please refer to the document *Maven Wireless Exo Alarms*, *Maven Wireless TOR Alarms* and *Maven Wireless Strato Alarms* for a complete list of alarms and how to respond to an alarm indication.

Alarm Log

The alarm log shows a chronological log of all alarms and alarm clear events that have occurred in the repeater.

Alarm Log								
1 2 3 4 5 20		<input type="button" value="Refresh"/>	<input type="button" value="Clear Alarm Log"/>		Results 1-20 of 399	Entries Per Page <input type="text" value="20"/>		
Event Time	ID / Raise ID	Severity	Site Name	Alarm Identifier	Class	Probable Cause	Additional Info	
2021-02-01 10:03:48	399 / 398	✔ Cleared	MS - Birka Paradise Serial: 00D6P	Excessive downlink sub-band signal level - automatic level control is reducing DL gain DOWlink: 00D6P-283	equipmentAlarm	performanceDegraded	DL is not in ALC	
2021-02-01 10:03:44	398 / -	! Warning	MS - Birka Paradise Serial: 00D6P	Excessive downlink sub-band signal level - automatic level control is reducing DL gain DOWlink: 00D6P-283	equipmentAlarm	performanceDegraded	DL is in ALC	
2021-02-01 10:01:14	397 / 392	✔ Cleared	MS - Birka Paradise Serial: 00D6P	Excessive downlink sub-band signal level - automatic level control is reducing DL gain DOWlink: 00D6P-283	equipmentAlarm	performanceDegraded	DL is not in ALC	
2021-02-01 10:00:29	396 / -	! Warning	MS - Birka Paradise Serial: 00D6P	Low isolation - oscillation prevention is reducing DL gain DOWlink: Subband: 00D6P-283	equipmentAlarm	performanceDegraded	Isolation estimate was 66.6 dB	
2021-02-01 09:59:01	395 / 394	✔ Cleared	MS - Birka Paradise Serial: 00D6P	Low isolation - oscillation prevention is reducing DL gain DOWlink: Subband: 00D6P-283	equipmentAlarm	performanceDegraded	00D6P-283 DL Isolation OK	
2021-02-01 09:58:59	394 / -	! Warning	MS - Birka Paradise Serial: 00D6P	Low isolation - oscillation prevention is reducing DL gain DOWlink: Subband: 00D6P-283	equipmentAlarm	performanceDegraded	Isolation estimate was 66.3 dB	
2021-02-01 09:58:11	393 / 391	✔ Cleared	MS - Birka Paradise Serial: 00D6P	Low isolation - oscillation prevention is reducing DL gain DOWlink: Subband: 00D6P-283	equipmentAlarm	performanceDegraded	00D6P-283 DL Isolation OK	
2021-02-01 09:52:37	392 / -	! Warning	MS - Birka Paradise Serial: 00D6P	Excessive downlink sub-band signal level - automatic level control is reducing DL gain DOWlink: 00D6P-283	equipmentAlarm	performanceDegraded	DL is in ALC	
2021-02-01 09:45:20	391 / -	! Warning	MS - Birka Paradise Serial: 00D6P	Low isolation - oscillation prevention is reducing DL gain DOWlink: Subband: 00D6P-283	equipmentAlarm	performanceDegraded	Isolation estimate was 65.8 dB	
2021-02-01 09:44:51	390 / 389	✔ Cleared	MS - Birka Paradise Serial: 00D6P	Excessive downlink sub-band signal level - automatic level control is reducing DL gain DOWlink: 00D6P-283	equipmentAlarm	performanceDegraded	DL is not in ALC	
2021-02-01 09:44:44	388 / -	! Warning	MS - Birka Paradise Serial: 00D6P	Excessive downlink sub-band signal level - automatic level control is reducing DL gain DOWlink: 00D6P-283	equipmentAlarm	performanceDegraded	DL is in ALC	
2021-02-01 09:44:24	388 / 387	✔ Cleared	MS - Birka Paradise Serial: 00D6P	Low isolation - oscillation prevention is reducing DL gain DOWlink: Subband: 00D6P-283	equipmentAlarm	performanceDegraded	00D6P-283 DL precautionary gain reduction	
2021-02-01 09:43:50	387 / -	! Warning	MS - Birka Paradise Serial: 00D6P	Low isolation - oscillation prevention is reducing DL gain DOWlink: Subband: 00D6P-283	equipmentAlarm	performanceDegraded	Isolation estimate was 62.8 dB	

Field	Description
Event Time	This indicates at what time alarm happened
ID / Raise ID	This is a unique event ID of the alarm throughout the system. If this is an alarm clear (Severity is Cleared), the Raise ID is the ID of the alarm that is cleared.
Severity	X.733 Alarm Severity level, one of: Critical Major Minor Warning
Alarm Identifier	Description of the alarm source, plus the unique alarm identifier in the particular node
Class	X.733 Alarm Class, one of communicationsAlarm qualityOfServiceAlarm processingErrorAlarm equipmentAlarm environmentalAlarm integrityViolation operationalViolation physicalViolation securityServiceOrMechanismViolation timeDomainViolation other

Probable Cause	A hint of what the reason for the alarm might be, as defined by X.733. Such as lossOfSignal degradedSignal enclosureDoorOpen
----------------	--

	powerProblem Refer ITU Recommendation X.733 for full list.
Additional Info	Additional information about this particular alarm, such as current levels or status when the alarm was triggered.

Clear Alarm Log

 **Clear Alarm Log** By clicking this, all non-active alarms in the repeater will be cleared out.

Engineering Tools

This menu contains various engineering tools to simplify installation and commission, such as Spectrum Analyzer, Isolation measurements and Return loss Measurement status.

Engineering Tools


Spectrum Analyzer

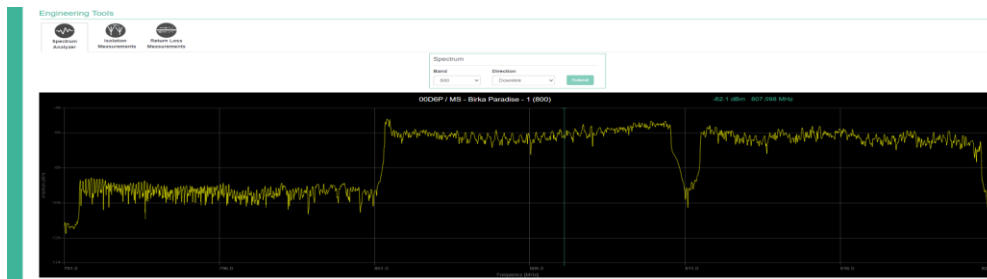

Isolation Measurements


Return Loss Measurements

Spectrum Analyzer

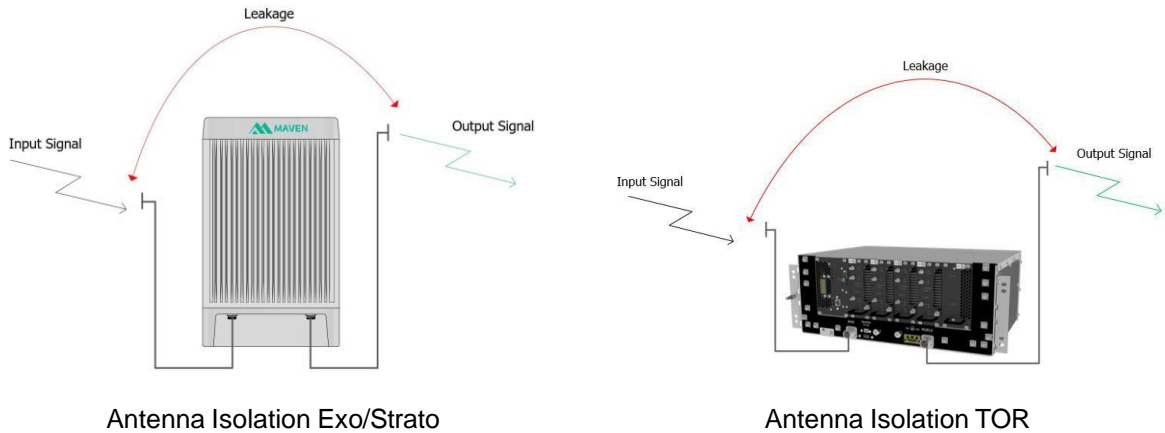
The repeater contains a built in spectrum analyzer which can be used to inspect the spectrum per band in uplink or downlink and is good for troubleshooting to for example ensure that the expected base station signal is present.

In order to start the spectrum analyzer, select band and direction click Submit to display the measurements



Isolation Measurements

In order to achieve optimal operational performance in the repeater it is important that the repeater has adequate isolation.



Isolation is the loss between Downlink (Mobile facing) and Uplink (Base facing) antennas. Isolation must exceed gain by a suitable margin to avoid ringing around which degrade signal quality and may create interference.

Depending on configured RF technology, a repeater needs around 10-15 dB more isolation than gain to operate in an optimal way.

The repeater continuously monitors the antenna isolation and decreases the gain (and sends an alarm) should the isolation be too low. Isolation might change if antenna position suddenly changes or there is something that reflects the radio signal such as a truck passing close to the antenna.

During commissioning of the repeater a tool is available to perform exact antenna isolation measurements by providing a pilot tone out on one antenna and listening on the other antenna for received pilot tone.

Return Loss Measurements



The return loss tool is used to verify that the antenna system is properly connected. It is measured by disabling RF and activating a pilot tone, which gives a known signal from which any reflection is measured.

Engineering Tools

Spectrum Analyzer

Isolation Measurements

Return Loss Measurements

Band: Direction: Test Duration: (min)

Measurement	Result
Forward Power	25.0 dBm
Reflected Power	25.1 dBm
Return Loss	-0.1 dB

Return loss is also estimated continually during normal operation using the current active RF signals.

Settings

This menu option allows to configure password, time/date and optionally the modem should the repeater have a modem installed.

Settings



Change Password



Time and Date



Modem Settings



RF Geofencing

Change Password

This allows to change the web login for the repeater

Change Password

Old Password

New Password

Confirm New Password

Change Password

Configure Time and Date

Click  to change Time and Date in the repeater.

Date	Time		
Monday, February 1 2021	10:27:31		
Set the time: <input type="radio"/> Manually <input checked="" type="radio"/> From the browser			
Date	Year	Month	Day
	<input type="text" value="2021"/>	<input type="text" value="04"/>	<input type="text" value="28"/>
Time	Hour	Minutes	
	<input type="text" value="12"/>	<input type="text" value="01"/>	
<input type="button" value="Reset"/>		<input type="button" value="Save"/>	

By selecting Manually current time can be filled in the different fields.

If choosing from the browser option the current browser time will be filled in to the fields.

Click [Save](#) to set the configured time in the repeater.

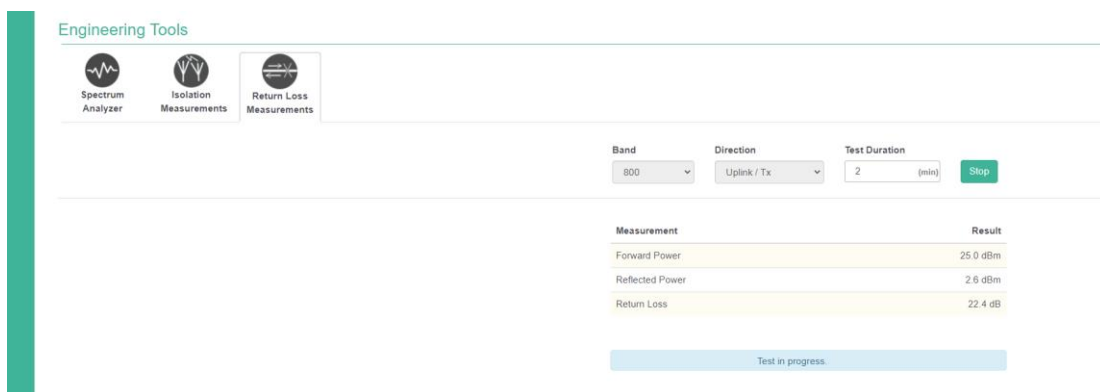
RF Commissioning

Commissioning a repeater consists of a few different steps as described below.

Verify Return Loss

First step in the commissioning process is to verify that the antenna cables are properly tightened. This is done using the Return Loss Measurements tool.

Return loss should be measured in both downlink and uplink. When the value for return loss has been recorded, stop the measurement.



The screenshot shows the 'Engineering Tools' interface. On the left, there are three icons: 'Spectrum Analyzer', 'Isolation Measurements', and 'Return Loss Measurements'. The 'Return Loss Measurements' tool is active, displaying the following configuration and results:

Measurement	Result
Forward Power	25.0 dBm
Reflected Power	2.6 dBm
Return Loss	22.4 dB

Configuration details: Band: 800, Direction: Uplink / Tx, Test Duration: 2 (min). A 'Stop' button is visible. A status bar at the bottom indicates 'Test in progress.'

Should an error be reported, double check the antenna connections, double check that the antenna cables are dry, clean and properly tightened and re-perform the measurements.

Verify Antenna Isolation

Second step is to ensure that the antenna isolation is adequate.



In Engineering Tools, click on [Isolation Measurements](#) to bring up the Isolation Measurements tool. First it is necessary to find a downlink frequency range without active RF.

Once a “quiet” frequency has been found, enter the frequency and start the Isolation Measurement. When measurements are completed satisfactory, optionally stop the measurement or it will automatically stop after the configured timeout.

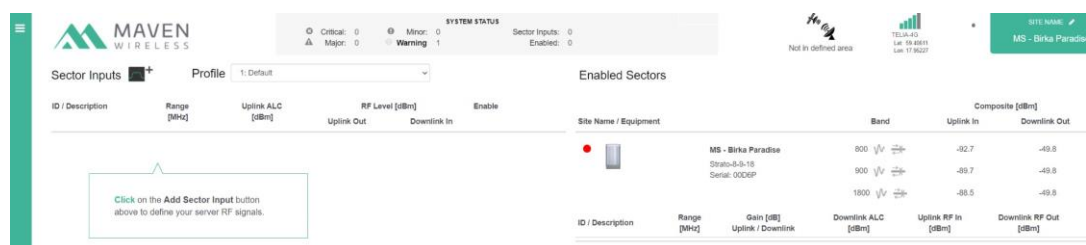


Should the measured isolation not meet requirements, please verify antenna alignment, and adjust the separation to get the desired isolation.

Setting up RF

Once the installation has been verified it is time to define what carriers should be provided in the repeater coverage area.

The RF status page displays all relevant RF parameters and signal levels of the system. This is where new RF inputs are configured and enabled. The repeater can support up to 32 sector inputs.



The left hand side shows all Sector Inputs, which are the BTS signals configured for the repeater. The right hand side displays all enabled Sector inputs and corresponding signal levels on the server (mobile) antenna.

Adding a Sector Input

Configure connected Sector inputs by clicking on the icon next to the Sector Inputs caption, which brings up the Sector Inputs dialog.

Each field that requires attention or which contains a user error is highlighted with a red line. The

Add Sector Input button is disabled until all fields have been properly completed.

Configure Description, Band and Technology

Sector Input Name / Description

For each Sector Input it is possible to set a user-friendly name making it easy to identify this Sector Input, by operator, by technology, by location, etc.

Band

Configures the frequency band this sector input operates on.

Technology

Configures which cellular standard this sector input contains. The correct setting is important to obtain optimum RF performance.

Add Sector Inputs

Sector Input Name / Description

Configure Filter Bandwidth and Center Frequency

Filter Bandwidth and Center Frequency

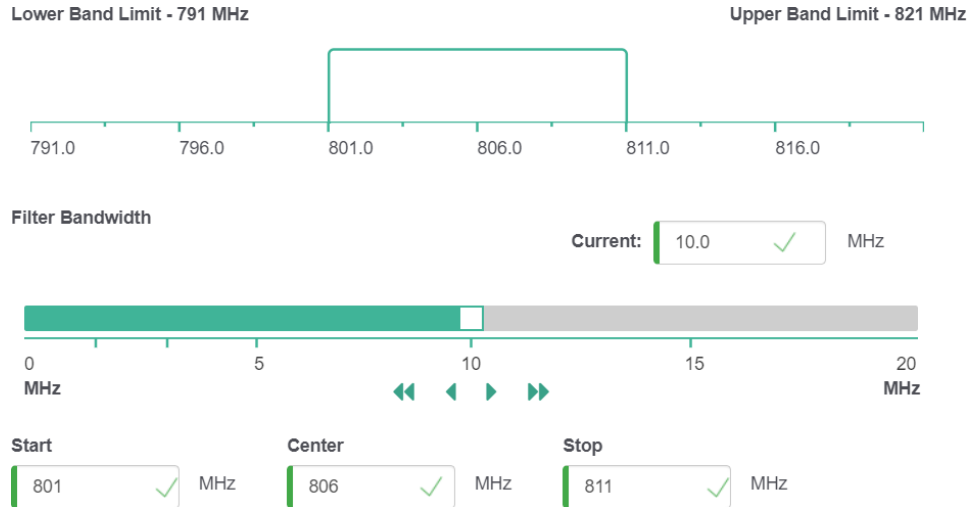
The drop down contains all available filter types for this band and technology.


Select the Bandwidth matching the signal and enter corresponding center frequency.

Center Frequency

Once the filter and center frequency are configured to be within the band limits the Add Sector Input button is enabled. Click to add the sector and return to the start screen.

Ticking the 'Add more' checkbox allows more Sector Inputs to be added without returning to the start screen.



By clicking on the  edit button next to the created sector input it is possible to configure the parameters related to this sector input.

Gain Trail

Uplink gain trailing causes the uplink gain to track the downlink gain for example if the downlink gain should be reduced due to operation of the automatic level control. When gain trailing is activated, the user selects the nominal uplink gain (to apply at full downlink gain). A reduction in the downlink gain of the repeater will cause a corresponding reduction in the uplink gain. This maintains the balance between downlink and uplink path loss to and from mobile terminals and ensures that power control and interference management in the cellular network will function as expected.

Oscillation Prevention

This option should be kept enabled so that Oscillation due to feedback is prevented and interference to the cellular network is avoided. Gain reduction and eventually shutdown is used to achieve this. During installation the Base and Donor antennas must be installed sufficiently far apart or screened by obstructions so that the RF loss (isolation) between them is at least the required operating Gain + margin of 15dB.

Oscillation prevention is designed to work ONLY with cellular signals. When using CW test signals, disable oscillation prevention to avoid falsely triggering the detection mechanism.

Editing Sector Input ✕

<p>Description</p> <p>Test Sector 1</p> <p>Frequency Range [MHz]</p> <p>801.0 - 811.0</p> <p>Technology</p> <p>LTE</p>	<p>Equipment</p> <p>Strato-8-9-18</p> <p>Uplink ALC [dBm]</p> <p>30</p> <p><input checked="" type="checkbox"/> Oscillation Prevention</p> <p><input type="checkbox"/> Gain Trail</p> <p><input type="checkbox"/> Mute</p> <p>Alarm Threshold</p> <p><input type="checkbox"/> Uplink Overload [dB]</p>
---	--

Close Apply

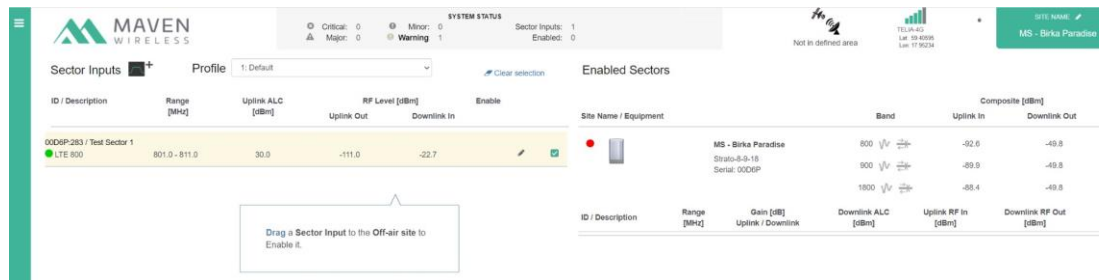
Oscillation prevention behavior with different RF technologies

The oscillation prevention algorithm looks for a delayed copy of the transmitted signal in the received signal on the other antenna. The performance of the algorithm varies due to the statistical characteristics of the modulation used for different technologies.

- Wideband signals (LTE, WCDMA): oscillation prevention algorithm has full sensitivity, and can reduce gain / generate isolation alarm well before 0 dB isolation margin.
- Narrowband signals (GSM): oscillation prevention has reduced sensitivity and can only reliably detect low isolation below approximately 2 dB isolation margin. This also means that the oscillation prevention algorithm will cause increases in gain to be more gradual, to verify that the gain increase will not cause oscillation.

Enabling RF Output

When Sector Inputs are configured they are enabled by dragging them to the Enabled Sectors side of the window.



When successfully dragged, a dialog is displayed to configure the RF settings for this sector input.

Uplink Gain

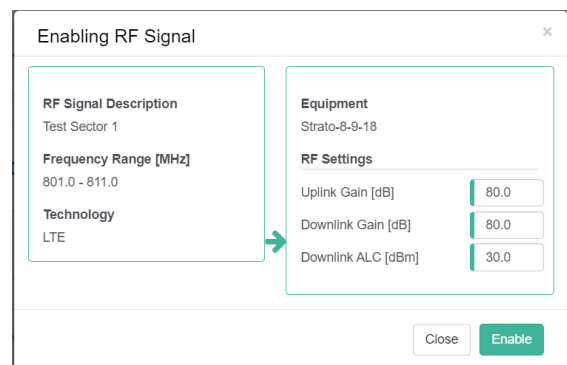
This is the end to end gain from input to output in the uplink path, adjustable in 0.1 dB steps.

Downlink Gain

This is the end to end gain from input to output in the downlink path, adjustable in 0.1 dB steps.


Downlink ALC

This is the maximum output power in the downlink path for this sector input.



When desired gain and ALC is configured, clicking enables the RF output for this Sector Input.

Changing RF Settings

In order to fine tune the gain and ALC parameters, simply click the edit icon  and change the desired parameters.

Editing RF Signal ✕

RF Signal Description
Test Sector 1

Frequency Range [MHz]
801.0 - 811.0

Technology
LTE

Equipment
Strato-8-9-18

RF Settings

Uplink Gain [dB]

Downlink Gain [dB]

Downlink ALC [dBm]

Overload Alarm Threshold


Downlink [dB]


Close Apply

Overload Alarm Threshold

This configures how far into ALC a signal should go before triggering a DIOverload alarm.

Disabling an enabled Sector Input


Clicking the  icon on an enabled Sector Input disables the RF output.



Deleting a route means the remote node will no longer transmit RF signals for this Sector Input from the antenna, the RF coverage in this remote for this Sector Input is removed.






Deleting a Sector Input

A Sector Input can only be deleted when that Sector Input is not enabled.





● Critical: 1 ● Major: 0 ● Minor: 0 ● Warning: 2





SYSTEM STATUS Sector Inputs: 2 Enabled: 1


 Not in defined area  13.344, 4.5  10:34:43  Sat 10/05/20  Lmt 17/0021


Sector Inputs Profile: 1: Default Clear selection

ID / Description	Range [MHz]	Uplink ALC [dBm]	RF Level [dBm]		Enable
			Uplink Out	Downlink In	
00D6P-283 / Test Sector 1 LTE 800	801.0 - 811.0	30.0	-30.7	-23.0	Enabled 
00D6P-284 / Test Sector 2 LTE 900	937.5 - 947.5	30.0			

Enabled Sectors

Site Name / Equipment	Band	Composite [dBm]	
		Uplink In	Downlink Out
 MS - Birka Paradise Strato-8-9-18 Serial: 00D6P	800 	-85.3	-32.1
	900 	-89.8	-49.8
	1800 	-88.6	-49.8

Clicking the next  to non-routed sector inputs deletes the Sector Input.



This cannot be undone. Double check that the routing to delete is the intended routing.

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Configure Modem

The repeater can be equipped with a built in 4G-modem to provide remote access over the

mobile network, in which case the  icon is visible in the Settings page.

The modem is connected to the BTS antenna via a 15 dB coupler ensuring the modem always receives good signal strength.

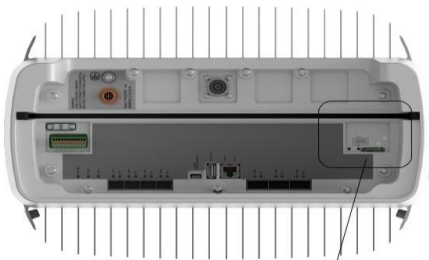
Once the modem is enabled, the unit will initialize the modem and register to the network according to the settings. Should a failure to initialize occur, the unit will continually try to register to the network until successful, including power cycling the modem.

It is also possible to configure a server IP address, and should the unit fail to ping the server IP, the modem will be power cycled and re-registered onto the network to ensure that the modem comes back online regardless of errors encountered.

Modem initialisation log and advanced registration data is available to further troubleshoot the modem in case a problem occurs.

Modem Configuration Procedure

Insert SIM card in the SIM slot - SIM-card type is MicroSIM.



SIM Card Slot

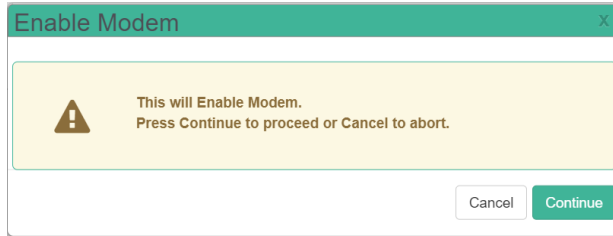
Exo-Strato



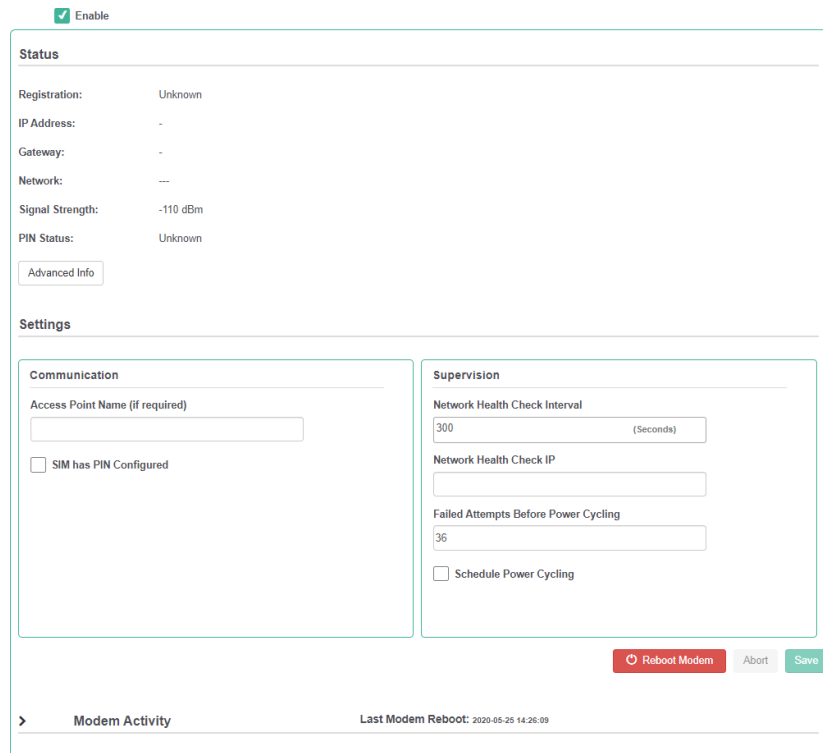
TOR



1. Click **Modem Settings**
2. If modem is not yet enabled, clicking the icon will prompt to enable the modem



3. Click **Continue** to set up the configuration. This brings up the Modem Settings dialog



Status Section - this displays runtime parameters for the modem connection, such as Registration status, IP addresses and signal strength.

Settings - this is where the various modem parameters are configured

4. Depending on SIM configuration, the modem might register automatically, or there might be network-specific parameters to configure.

Access Point Name - the APN allows for the unit to connect to a specific network. **SIM**

has PIN Configured - this is where the SIM card PIN code is configured should it be shipped with PIN code enabled.



It is STRONGLY advised to only connect the unit to a private network / APN and not to a public APN / Internet connection in order to minimize risk of the unit being compromised

5. In order to ensure that the unit is always accessible, the Supervision section allows to

configure parameters used to check the unit always has a network connection: **Network Health Check IP** - if this field is configured, the unit will at configurable intervals try to ping the configured IP address.

Network Health Check Interval - this is how often to ping the configured IP address.

Failed Attempts Before Power Cycling - this indicates how many consecutive pings should fail before the unit will power cycle the modem.

Scheduled Power Cycling - if this is checked, the unit will at this time of the day power cycle the modem and re-register on the network.

6. Once all parameters are configured, click Save to initiate a modem initialization with the new parameters.
7. Wait for the modem to register, this normally takes less than 60 seconds.
8. The modem screen should be displaying the received IP address and various runtime parameters.

Enable

Status

Registration:	Registered to network, roaming
IP Address:	10.43.56.69
Gateway:	10.43.56.70
Network:	TELIA-4G
Signal Strength:	-64 dBm
PIN Status:	SIM PIN successfully unlocked (or disabled)

Advanced Info

Settings

Communication

Access Point Name (if required)

SIM has PIN Configured

Supervision

Network Health Check Interval
 (Seconds)

Network Health Check IP

Failed Attempts Before Power Cycling

Schedule Power Cycling

Reboot Modem Abort Save

> **Modem Activity** Last Modem Reboot: 2021-02-01 08:44:53

Advanced Info gives detailed information about the current cell info - please contact Maven Support should this data need to be decoded.

9. Modem configuration done.

Basic Modem Troubleshooting

The Modem Activity log in the bottom of the screen gives a clear indication of any potential reason why the modem does not register properly to the network.

Modem Activity		Last Modem Reboot: 2021-02-01 10:29:13
2021-02-01 09:29:28.587	- Waiting 45 seconds for modem to boot...	
2021-02-01 09:29:22.546	- Waiting for modem wake up indication...	
2021-02-01 09:29:19.542	- SIM card detected	
2021-02-01 09:29:16.516	- Power ON...	
2021-02-01 09:29:13.512	- Waiting 3 seconds...	
2021-02-01 09:29:13.500	- Power OFF...	
2021-02-01 09:29:06.589	- Power cycling modem...	
2021-02-01 09:29:02.116	- Issuing power off command to modem...	
2021-02-01 09:28:53.168	- Disabling modem...	
2021-02-01 09:28:44.260	- Received modem signal strength: -64 dBm	
2021-02-01 09:28:44.251	- Registered network type: 4G	
2021-02-01 09:28:44.232	- Registered to network TELIA	
2021-02-01 09:28:44.222	- Registration status: Registered to network, roaming	
2021-02-01 09:28:44.189	- Checking registration status...	
2021-02-01 09:28:44.187	- SIM PIN successfully unlocked (or disabled)	
2021-02-01 09:28:44.177	- Checking PIN status...	
2021-02-01 09:28:44.177	- Checking modem status...	
2021-02-01 09:28:33.062	- Received modem signal strength: -64 dBm	
2021-02-01 09:28:33.052	- Registered network type: 4G	
2021-02-01 09:28:33.033	- Registered to network TELIA	
2021-02-01 09:28:33.023	- Registration status: Registered to network, roaming	
2021-02-01 09:28:32.976	- Checking registration status...	
2021-02-01 09:28:32.974	- SIM PIN successfully unlocked (or disabled)	
2021-02-01 09:28:32.965	- Checking PIN status...	
2021-02-01 09:28:32.965	- Checking modem status...	
2021-02-01 09:28:21.875	- Received modem signal strength: -64 dBm	
2021-02-01 09:28:21.857	- Registered network type: 4G	
2021-02-01 09:28:21.838	- Registered to network TELIA	
2021-02-01 09:28:21.820	- Registration status: Registered to network, roaming	
2021-02-01 09:28:21.813	- Checking registration status...	
2021-02-01 09:28:21.812	- SIM PIN successfully unlocked (or disabled)	
2021-02-01 09:28:21.804	- Checking PIN status...	
2021-02-01 09:28:21.803	- Checking modem status...	
2021-02-01 09:28:10.716	- Received modem signal strength: -66 dBm	
2021-02-01 09:28:10.705	- Registered network type: 4G	
2021-02-01 09:28:10.684	- Registered to network TELIA	
2021-02-01 09:28:10.670	- Registration status: Registered to network, roaming	
2021-02-01 09:28:10.664	- Checking registration status...	
2021-02-01 09:28:10.662	- SIM PIN successfully unlocked (or disabled)	
2021-02-01 09:28:10.653	- Checking PIN status...	
2021-02-01 09:28:10.652	- Checking modem status...	
2021-02-01 09:27:59.530	- Received modem signal strength: -64 dBm	
2021-02-01 09:27:59.520	- Registered network type: 4G	
2021-02-01 09:27:59.498	- Registered to network TELIA	
2021-02-01 09:27:59.488	- Registration status: Registered to network, roaming	
2021-02-01 09:27:59.478	- Checking registration status...	
2021-02-01 09:27:59.476	- SIM PIN successfully unlocked (or disabled)	
2021-02-01 09:27:59.465	- Checking PIN status...	
2021-02-01 09:27:59.465	- Checking modem status...	
2021-02-01 09:27:48.386	- Received modem signal strength: -68 dBm	
2021-02-01 09:27:48.378	- Registered network type: 4G	

Common errors:

- **Wrong PIN code** - the log should indicate if there is a failure unlocking the SIM card. Reconfiguring the PIN code will cause the unit to retry unlocking.
- **Too low signal strength** - if the SIM card is successfully unlocked, but it is not registering to the network it might be because of too low signal strength. The modem normally needs around -105 dBm received signal level to register to the network. Check the antenna placement and ensure that there is a serving cell into the unit.
- **Wrong APN** - if the modem manages to register to the network but does not succeed in getting an IP address, the Access Point Name might be wrong. Double check and update correspondingly.