



ePMP

User Guide

Force 300 Products

000v019

System Release 4.3.0.1

- Product Description
- System Planning
- Configuration
- Operation and Troubleshooting
- Legal and Reference Information

ePMP 5 GHz Force 300-25 High Gain Radio
ePMP 5 GHz Force 300-16 Radio

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Safety and regulatory information

This section describes important safety and regulatory guidelines that must be observed by personnel installing or operating ePMP equipment.

IMPORTANT SAFETY INFORMATION



Warning

To prevent loss of life or physical injury, observe the safety guidelines in this section.

Power lines

Exercise extreme care when working near power lines.

Working at heights

Exercise extreme care when working at heights.

Grounding and protective earth

ePMP devices and mounting structures must be properly grounded to protect against lightning. It is the user's responsibility to install the equipment in accordance with national regulations. In the USA, follow Section 810 of the *National Electric Code, ANSI/NFPA No.70-1984* (USA). In Canada, follow Section 54 of the *Canadian Electrical Code*. These codes describe correct installation procedures for grounding the outdoor unit, mast, lead-in wire and discharge unit, size of grounding conductors and connection requirements for grounding electrodes. Other regulations may apply in different countries and therefore it is recommended that installation be contracted to a professional installer.

Powering down before servicing

Always power down and unplug the equipment before servicing.

Primary disconnect device

The ePMP power supply is the primary disconnect device.

External cables

Safety may be compromised if outdoor rated cables are not used for connections that will be exposed to the outdoor environment.

RF exposure near the antenna

Strong radio frequency (RF) fields will be present close to the antenna when the transmitter is on. Always turn off the power to the ePMP device before undertaking maintenance activities in front of the antenna.

Minimum separation distances

Install the ePMP device so as to provide and maintain the minimum separation distances from all persons.

The minimum separation distances for each frequency variant are specified in **Calculated distances and power compliance margins** on page 170.

IMPORTANT REGULATORY INFORMATION

The ePMP product is certified as an unlicensed device in frequency bands where it is not allowed to cause interference to licensed services (called primary users of the bands).

Radar avoidance

In countries where radar systems are the primary band users, the regulators have mandated special requirements to protect these systems from interference caused by unlicensed devices. Unlicensed devices must detect and avoid co-channel operation with radar systems.

The ePMP provides detect and avoid functionality for countries and frequency bands requiring protection for radar systems.

Installers and users must meet all local regulatory requirements for radar detection. To meet these requirements, users must set the correct country code during commissioning of the ePMP equipment. If this is not done, installers and users may be liable to civil and criminal penalties.

Contact the Cambium helpdesk if more guidance is required.

Specific expertise and training required for professional installers

To ensure that the ePMP is installed and configured in compliance with the requirements of Industry Canada and the FCC, installers must have the radio engineering skills and training described in this section. This is particularly important when installing and configuring an ePMP system for operation in the 5 GHz band (5150 – 5250 MHz – FCC only, 5250 – 5350 MHz, 5470 – 5725 MHz and 5725 – 5850 MHz).

Ethernet networking skills

The installer must have the ability to configure IP addressing on a PC and to set up and control products using a web browser interface.

Lightning protection

To protect outdoor radio installations from the impact of lightning strikes, the installer must be familiar with the normal procedures for site selection, bonding and grounding. Installation guidelines for the ePMP can be found in section [System planning](#) on page [36](#).

Training

The installer needs to have basic competence in radio and IP network installation. The specific requirements applicable to the ePMP must be gained by reading this user guide and by performing sample setups at base workshop before live installations.

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About This User Guide

This guide describes the planning, installation, configuration and operation of the Cambium ePMP Series of point-to-point wireless Ethernet systems. It is intended for use by the system designer, system installer and system administrator.

For radio network design, see:

- [Product description](#)
- [System hardware](#)
- [System planning](#)
- [Legal and reference information](#)

For system configuration, monitoring and fault finding, see:

- [Configuration](#)
- [Operation and Troubleshooting](#)

General information

VERSION INFORMATION

The following shows the issue status of this document:

Issue	Date of issue	Remarks
000v012	May 2018	System Release 4.1 (Software Release 4.1)
000v013	June 2018	System Release 4.1.1 (Software Release 4.1.1)
000v015	August 2018	System Release 4.1.2 (Software Release 4.1.2)
000v018	October 2018	System Release 4.1.4 (Software Release 4.1.4)
000v019	January 2019	System Release 4.3.0.1 (Software Release 4.3.0.1)

CONTACTING CAMBIUM NETWORKS

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Purpose

Cambium Networks ePMP documents are intended to instruct and assist personnel in the operation, installation and maintenance of the Cambium ePMP equipment and ancillary devices. It is recommended that all personnel engaged in such activities be properly trained.

Cambium disclaims all liability whatsoever, implied or expressed, for any risk of damage, loss or reduction in system performance arising directly or indirectly out of the failure of the customer, or anyone acting on the customer's behalf, to abide by the instructions, system parameters, or recommendations made in this document.

Cross references

References to external publications are shown in *italics*. Other cross references, emphasized in **green text** in electronic versions, are active links to the references.

Feedback

We appreciate feedback from the users of our documents. This includes feedback on the structure, content, accuracy, or completeness of our documents.

For feedback, go to <https://support.cambiumnetworks.com>.

Problems and warranty

Reporting problems

If any problems are encountered when installing or operating this equipment, follow this procedure to investigate and report:

- 1 Search this document and the software release notes of supported releases.

- 2 Visit the support website:
<https://support.cambiumnetworks.com/>
- 3 Ask for assistance from the Cambium product supplier.
- 4 Gather information from affected units, such as any available diagnostic downloads.
- 5 Escalate the problem by emailing or telephoning support:
<http://www.cambiumnetworks.com/support/contact-support>

Repair and service

If unit failure is suspected, obtain details of the Return Material Authorization (RMA) process from the support website.

Warranty

Cambium's standard hardware warranty is for one (1) year from date of shipment from Cambium or a Cambium distributor. Cambium warrants that hardware will conform to the relevant published specifications and will be free from material defects in material and workmanship under normal use and service. Cambium shall within this time, at its own option, either repair or replace the defective product within thirty (30) days of receipt of the defective product. Repaired or replaced product will be subject to the original warranty period but not less than thirty (30) days.

To register ePMP products or activate warranties, visit the support website.

For warranty assistance, contact the reseller or distributor.



Caution

Do not open the radio housing for repair or diagnostics; there are no serviceable parts within the housing.

Portions of Cambium equipment may be damaged from exposure to electrostatic discharge. Use precautions to prevent damage.

Security advice

Cambium Networks systems and equipment provide security parameters that can be configured by the operator based on their particular operating environment. Cambium recommends setting and using these parameters following industry recognized security practices. Security aspects to be considered are protecting the confidentiality, integrity, and availability of information and assets. Assets include the ability to communicate, information about the nature of the communications, and information about the parties involved.

In certain instances Cambium makes specific recommendations regarding security practices, however the implementation of these recommendations and final responsibility for the security of the system lies with the operator of the system.

Cambium Networks ePMP equipment is shipped with default web management interface login credentials. It is highly recommended that these usernames and passwords are modified prior to system installation.

Warnings, cautions, and notes

The following describes how warnings and cautions are used in this document and in all documents of the Cambium Networks document set.

Warnings

Warnings precede instructions that contain potentially hazardous situations. Warnings are used to alert the reader to possible hazards that could cause loss of life or physical injury. A warning has the following format:



Warning text and consequence for not following the instructions in the warning.

Cautions

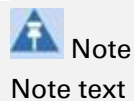
Cautions precede instructions and are used when there is a possibility of damage to systems, software, or individual items of equipment within a system. However, this damage presents no danger to personnel. A caution has the following format:



Caution text and consequence for not following the instructions in the caution.

Notes

A note means that there is a possibility of an undesirable situation or provides additional information to help the reader understand a topic or concept. A note has the following format:



Caring for the environment

The following information describes national or regional requirements for the disposal of Cambium Networks supplied equipment and for the approved disposal of surplus packaging.

In EU countries

The following information is provided to enable regulatory compliance with the European Union (EU) directives identified and any amendments made to these directives when using Cambium equipment in EU countries.



Disposal of Cambium equipment

European Union (EU) Directive 2002/96/EC Waste Electrical and Electronic Equipment (WEEE)

Do not dispose of Cambium equipment in landfill sites. For disposal instructions, see

<https://support.cambiumnetworks.com>

Disposal of surplus packaging

Do not dispose of surplus packaging in landfill sites. In the EU, it is the individual recipient's responsibility to ensure that packaging materials are collected and recycled according to the requirements of EU environmental law.

In non-EU countries

In non-EU countries, dispose of Cambium equipment and all surplus packaging in accordance with national and regional regulations.

Product description

This chapter provides a high level description of the ePMP product. It describes the function of the product, the main product variants and typical installation. It also describes the main hardware components.

The following topics are described in this chapter:

- The key features, typical uses, product variants and components of the ePMP are explained in **Overview of ePMP** on page 14.
- How the ePMP wireless link is operated, including modulation modes, power control and security is described under **Wireless operation** on page 16.
- The ePMP management system, including the web interface, installation, configuration, alerts and upgrades is described in **System management** on page 18.

Overview of ePMP

This section introduces the key features, typical uses, product variants and components of the ePMP portfolio as a whole (802.11n and 802.11ac products).

PURPOSE – EPMP PORTFOLIO

Cambium ePMP Series products are designed for Ethernet bridging over point-to-multipoint and point-to-point microwave links in the unlicensed 2.4 GHz, 2.5 GHz (Brazil only), and 5 GHz bands. Users must ensure that the ePMP Series complies with local operating regulations.

Force 300 devices support point-to-point microwave links in the unlicensed 5 GHz band.

The ePMP Series acts as a transparent bridge between two segments of the operator and customers' networks. In this sense, it can be treated as a virtual wired connection between the Access Point and the Subscriber Module. The ePMP Series forwards 802.3 Ethernet packets destined for the other part of the network and filters packets it does not need to forward.

KEY FEATURES

Force 300-25

Force 300-25 is a rugged high-capacity outdoor point-to-point link wireless device in the unlicensed 5 GHz frequency bands with a maximum UDP throughput of 500+ Mbps (when operating with 80 MHz channel bandwidth). It is capable of operating in line-of-sight (LOS) and near-LOS conditions. Force 300-25 is available as an integrated unit with a dual-polarized 25 dBi narrow Beamwidth dish antenna. One point-to-point link consists of two Force 300-25 devices.

Force 300-25 is based on highly-integrated wireless semiconductor components designed to meet the IEEE 802.11ac standard, however the Force 300-25 device has a proprietary air interface for the main point-to-point link.

Force 300-25 is powered by standard power-over-Ethernet to a 1000Base-T port.

Management of the unit is conducted via the same interface as the bridged traffic (in-band Management).

A summary of the main Force 300-25 characteristics is listed under **Table 1**.

Table 1 Main characteristics of the Force 300-25 Series

Characteristic	Value
Topology	PTP (Future support for PMP)
Wireless link condition	LOS, near LOS
Scheduler	TDD
Connectivity	Ethernet
Operating frequencies	Unlicensed bands, 5 GHz
Channel bandwidth	20 MHz, 40 MHz, 80 MHz
Data rate	500+ Mbps

Force 300-16

Force 300-16 is a rugged high-capacity outdoor point-to-multipoint or point-to-point link wireless device in the unlicensed 5 GHz frequency bands with a maximum UDP throughput of 500+ Mbps (when operating with 80 MHz channel bandwidth). It is capable of operating in line-of-sight (LOS) and near-LOS conditions. Force 300-16 is available as an integrated unit with a dual-polarized 16 dBi integrated antenna.

Force 300-16 is based on highly-integrated wireless semiconductor components designed to meet the IEEE 802.11ac standard, however the Force 300-16 device has a proprietary air interface for the main point-to-point link.

Force 300-16 is powered by standard power-over-Ethernet to a 1000Base-T port.

Management of the unit is conducted via the same interface as the bridged traffic (in-band Management).

A summary of the main Force 300-16 characteristics is listed under [Table 2](#).

Table 2 Main characteristics of the Force 300-16 Series

Characteristic	Value
Topology	PMP, PTP
Wireless link condition	LOS, near LOS
Scheduler	TDD
Connectivity	Ethernet
Operating frequencies	Unlicensed bands, 5 GHz
Channel bandwidth	20 MHz, 40 MHz, 80 MHz
Data rate	500+ Mbps

TYPICAL INSTALLATION EQUIPMENT

The Force 300 is a solution consisting of integrated outdoor units, indoor power supply units/LAN injectors, cabling and surge suppression equipment.

The main hardware components of a Force 300 installation are as follows:

- **Force 300 Integrated Radio:** An integrated outdoor transceiver unit containing all the radio, networking, and surge suppression electronics.
- **Force 300 Power Supply:** An indoor power supply module providing Power-over-Ethernet (PoE) supply and 100/1000 Base-T to the Force 300 device.
- **Force 300 Radio Cabling and lightning protection:** Shielded Cat5e cables, grounding cables, and connectors.

For more information about these components, including interfaces, specifications and Cambium part numbers, see [System hardware](#) on page 20.

Wireless operation

This section describes how the ePMP wireless link is operated, including modulation modes, power control and security.

TIME DIVISION DUPLEXING

TDD cycle

ePMP links operate using Time Division Duplexing (TDD). The links employ a TDD cycle in which the Access Point determines which Subscriber Modules may transmit and when based on the configured downlink/uplink ratio (duty cycle). Three fixed Downlink/Uplink frame ratios are available – 75/25, 50/50 and 30/70.

OFDM AND CHANNEL BANDWIDTH

The Force 300 transmits using Orthogonal Frequency Division Multiplexing (OFDM). This wideband signal consists of many equally spaced sub-carriers. Although each sub carrier is modulated at a low rate using conventional modulation schemes, the resultant data rate from all the sub-carriers is high.

The channel bandwidth of the OFDM signal is 20 MHz, 40 MHz or 80 MHz, based on operator configuration.

Each channel is offset in center frequency from its neighboring channel by 5 MHz.

ADAPTIVE MODULATION

The Force 300 can transport data over the wireless link using a number of different modulation modes ranging from 256-QAM to QPSK. For a given channel bandwidth and TDD frame structure, each modulation mode transports data at a fixed rate. Also, the receiver requires a given signal to noise ratio in order to successfully demodulate a given modulation mode. Although the more complex modulations such as 256-QAM will transport data at a much higher rate than the less complex modulation modes, the receiver requires a much higher signal to noise ratio.

The Force 300 provides an adaptive modulation scheme where the receiver constantly monitors the quality of the received signal and notifies the far end of the link of the optimum modulation mode with which to transmit. In this way, optimum capacity is achieved at all times.

MIMO

Multiple-Input Multiple-Output (MIMO) technique provides protection against fading and increases the probability of a received decoded signal to be usable.

RADAR AVOIDANCE

In regions where protection of radars is part of the local regulations, the ePMP must detect interference from radar-like systems and avoid co-channel operation with these systems.

To meet this requirement, the ePMP implements the following features:

- The equipment can only transmit on available channels, of which there are none at initial power up. The radar detection algorithm will always scan a usable channel for 60 seconds for radar interference before making the channel an available channel.
- This compulsory channel scan will mean that there is at least 60 seconds service outage every time radar is detected and that the installation time is extended by at least 60 seconds even if there is found to be no radar on the channel

There is a secondary requirement for bands requiring radar avoidance. Regulators have mandated that products provide a uniform loading of the spectrum across all devices. In general, this prevents operation with fixed frequency allocations. However:

- ETSI regulations do allow frequency planning of networks (as that has the same effect of spreading the load across the spectrum).
- The FCC does allow channels to be avoided if there is actually interference on them.



Note

When operating in a region which requires DFS, ensure that the AP is configured with alternate frequencies and that the SM is configured to scan for these frequencies to avoid long outages.

ENCRYPTION

The ePMP supports optional encryption for data transmitted over the wireless link. The encryption algorithm used is the Advanced Encryption Standard (AES) with 128-bit key size. AES is a symmetric encryption algorithm approved by U.S. Government organizations (and others) to protect sensitive information.

COUNTRY CODES

Some aspects of wireless operation are controlled, enforced or restricted according to a country code. ePMP country codes represent individual countries (for example Denmark) or regulatory regions (for example FCC or ETSI).

Country codes affect the following aspects of wireless operation:

- Maximum transmit power
- Radar avoidance (future release)
- Frequency range



Caution

To avoid possible enforcement action by the country regulator, always operate links in accordance with local regulations

FURTHER READING ON WIRELESS OPERATION

For information on planning wireless operation, see:

- The regulatory restrictions that affect radio spectrum usage, such as frequency range and radar avoidance are described under [Radio spectrum planning](#) on page [36](#).
- The factors to be taken into account when planning links such as range, path loss and data throughput are described under [Link planning](#) on page [38](#).
- The safety specifications against which the ePMP has been tested are listed under [Compliance with safety standards](#) on page [168](#) . It also describes how to keep RF exposure within safe limits.
- How ePMP complies with the radio regulations that are enforced in various countries is explained in [Compliance with radio regulations](#) on page [176](#).

For more information on configuring and operating the wireless link, see:

- The configuration parameters of the ePMP devices described under [Configuration](#) on page [41](#).
- Post-installation procedures and troubleshooting tips explained under [Operation and Troubleshooting](#) on page [99](#).

System management

This section introduces the ePMP management system, including the web interface, installation, alerts and upgrades, configuration and management software.

MANAGEMENT AGENT

ePMP equipment is managed through an embedded management agent. Management workstations, network management systems or PCs can be connected to this agent using the module's Ethernet port, over the air (Subscriber Module connection via Access Point) or by using the device WiFi management interface.

The management agent supports the following interfaces:

- Hypertext Transfer Protocol (HTTP)
- Hypertext Transfer Protocol secure (HTTPS)
- Simple Network Management Protocol (SNMP)
- Network Time Protocol (NTP)
- System logging (Syslog)
- cnMaestro™ Cloud-based or On-premises Management System
- Dynamic Host Configuration Protocol (DHCP)

WEB SERVER

The ePMP management agent contains a web server. The web server supports access via the HTTP and HTTPS interfaces.

Web-based management offers a convenient way to manage the ePMP equipment from a locally connected computer or from a network management workstation connected through a management network, without requiring any special management software. The web-based interfaces are the only interfaces supported for installation of ePMP, and for the majority of ePMP configuration management tasks.

Identity-based user accounts

When identity-based user accounts are configured, a security officer can define from one to four user accounts, each of which may have one of the four possible roles:

- ADMINISTRATOR (default username/password "admin"), who has full read and write permission.
- INSTALLER (default username/password "installer"), who has permission to read and write parameters applicable to unit installation and monitoring.
- HOME (default username/password "home"), who has permission only to access pertinent information for support purposes
- READONLY (default username/password "readonly"), who has permission to only view the Monitor page.

SNMP

The management agent supports fault and performance management by means of an SNMP interface. The management agent is compatible with SNMP v2c using one Management Information Base (MIB) file which is available for download from the Cambium Networks Support website (<https://support.cambiumnetworks.com/files/epmp>).

NETWORK TIME PROTOCOL (NTP)

The clock supplies accurate date and time information to the system. It can be set to run with or without a connection to a network time server (NTP). It can be configured to display local time by setting the time zone and daylight saving in the Time web page.

If an NTP server connection is available, the clock can be set to synchronize with the server time at regular intervals.

ePMP devices may receive NTP data from a CMM module or an NTP server configured in the system's management network.

The Time Zone option is configurable on the **Configure > System** page and may be used to offset the received NTP time to match the operator's local time zone.

SOFTWARE UPGRADE

Software upgrades may be issued via the radio web interface (**Tools > Software Upgrade**) or via cnMaestro (cloud.cambiumnetworks.com). For software upgrades, see

<https://support.cambiumnetworks.com/files/epmp>.

FURTHER READING ON SYSTEM MANAGEMENT

For more information on system management, see:

- **Operation and Troubleshooting** on page **99**

System hardware

This chapter describes the site planning and hardware components of an ePMP link.

The following topics are described in this chapter:

- Factors to be considered when planning the proposed network is described under **Site planning** on page 20.
- The Force 300-25 module hardware, part numbers, mounting equipment, and specifications are described under **Force 300-25** on page 23.
- The Force 300-16 module hardware, part numbers, mounting equipment, and specifications are described under **Force 300-16** on page 29.
- The power supply hardware, part numbers and specifications are described under **Force 300 Series Power Supply** on page 32.
- Cable standards and lengths are described under **Ethernet cabling** on page 34.
- Surge suppression requirements and recommendations are described under **Surge Suppression unit** on page 35.

Site planning

Conduct a site survey to ensure that the proposed sites meet the requirements defined in this section.

SITE INSTALLATION

An ePMP site typically consists of a high supporting structure such as a mast, tower or building for the devices.

Find a location for the device that meets the following requirements:

- The equipment is high enough to achieve the best radio path.
- People can be kept a safe distance away from the equipment when it is radiating. The safe separation distances are defined in **Calculated distances and power compliance margins** on page 170.
- The equipment is lower than the top of the supporting structure (tower, mast or building) or its lightning air terminal.
- There is one Ethernet interface, a copper Cat5e connection from the device to the power supply and network terminating equipment.

GROUNDING AND LIGHTNING PROTECTION

Structures, equipment and people must be protected against power surges (typically caused by lightning) by conducting the surge current to ground via a separate preferential solid path. The actual degree of protection required depends on local conditions and applicable local regulations. To adequately protect an ePMP installation, both ground bonding and transient voltage surge suppression are required.



Warning

Electro-magnetic discharge (lightning) damage is not covered under warranty. The recommendations in this guide, when followed correctly, give the user the best protection from the harmful effects of EMD. However 100% protection is neither implied nor possible.

Details of lightning protection methods and requirements can be found in the international standards IEC 61024-1 and IEC 61312-1, the U.S. National Electric Code ANSI/NFPA No. 70-1984 or section 54 of the Canadian Electric Code.

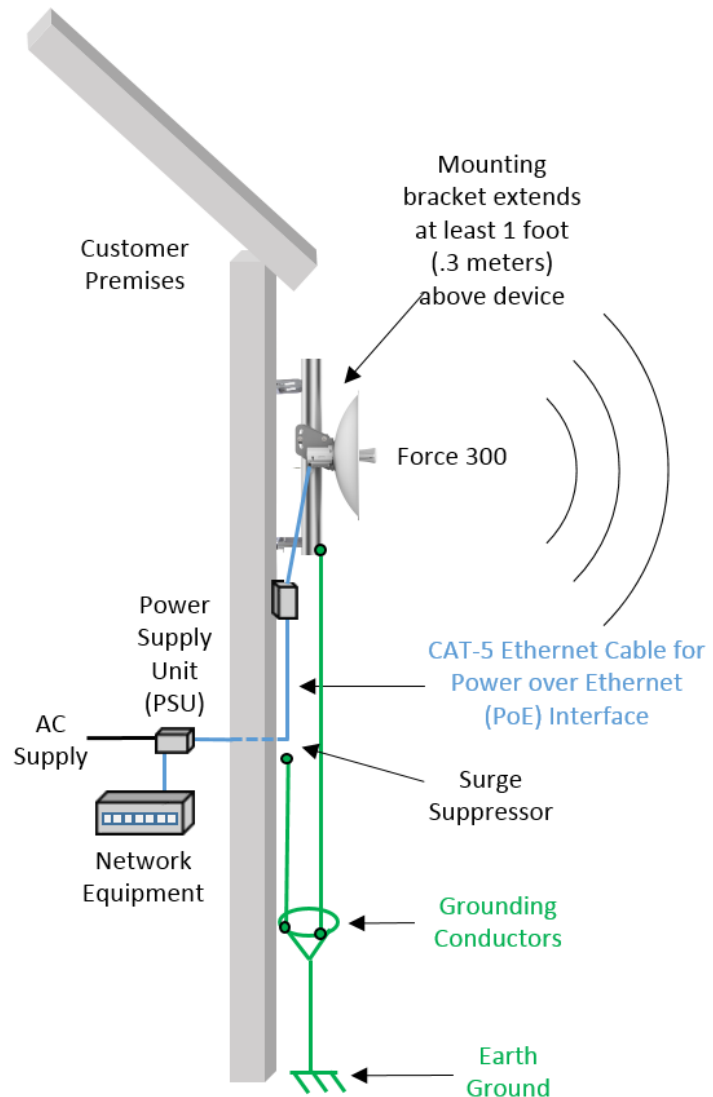


Figure 1 Force 300 Cabling Diagram



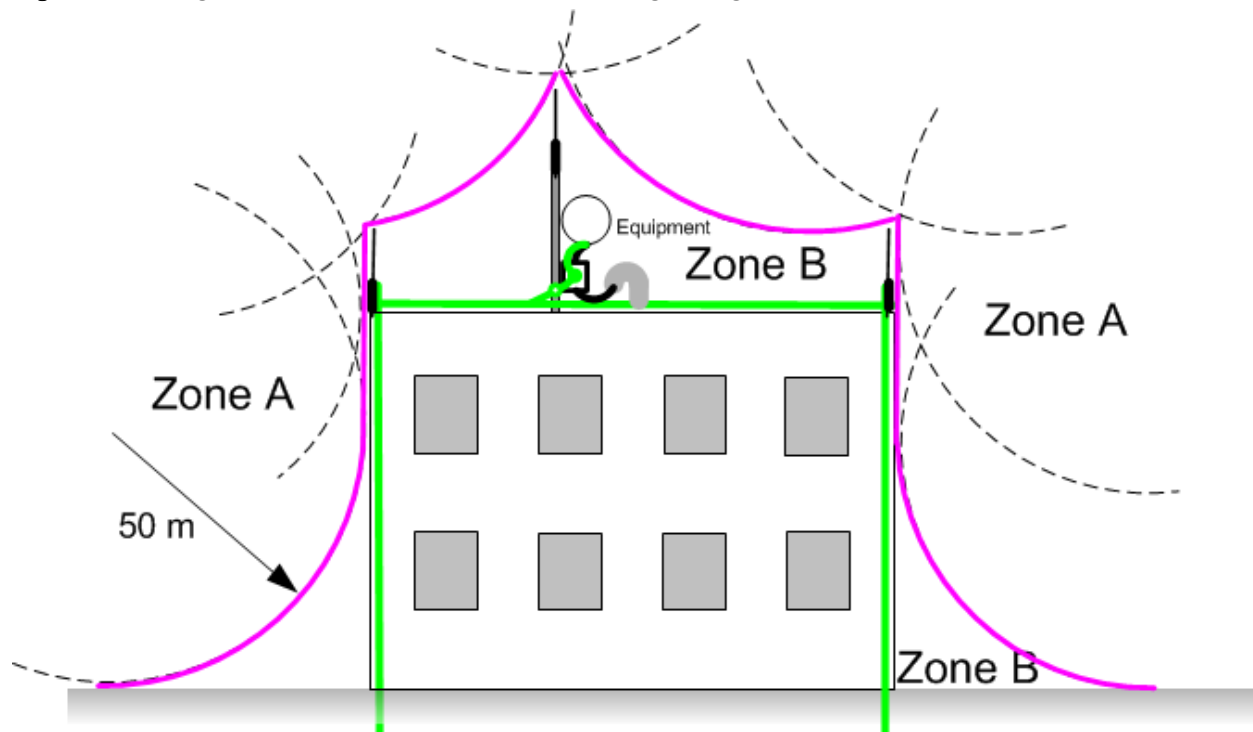
Note

International and national standards take precedence over the requirements in this guide.

LIGHTNING PROTECTION ZONES

Use the rolling sphere method (**Figure 2**) to determine where it is safe to mount equipment. An imaginary sphere, typically 50 meters in radius, is rolled over the structure. Where the sphere rests against the ground and a strike termination device (such as a finial or ground bar), all the space under the sphere is considered to be in the zone of protection (Zone B). Similarly, where the sphere rests on two finials, the space under the sphere is considered to be in the zone of protection.

Figure 2 Rolling sphere method to determine the lightning protection zones



Assess locations on masts, towers and buildings to determine if the location is in Zone A or Zone B:

- **Zone A:** In this zone a direct lightning strike is possible. Do not mount equipment in this zone.
- **Zone B:** In this zone, direct EMD (lightning) effects are still possible, but mounting in this zone significantly reduces the possibility of a direct strike. Mount equipment in this zone.

 Warning

Do not mount equipment in Zone A which can put the equipment, structures and life at risk.

Force 300-25

For details of the Force 300-25 hardware, see:

- [Force 300-25 Integrated description](#) on page 23
- [Force 300-25 part numbers](#) on page 24
- [Force 300-25 mounting bracket](#) on page 25
- [Force 300-25 specifications](#) on page 26
- [Force 300-25 heater](#) on page 26
- [Force 300-25 wind loading](#) on page 28
- [Force 300-25 software packages](#) on page 28

FORCE 300-25 INTEGRATED DESCRIPTION

The Force 300-25 device is a self-contained transceiver unit that houses both radio and networking electronics.

Figure 3 Force 300-25 Integrated



FORCE 300-25 PART NUMBERS

Choose the correct regional variant to adhere to local licensing restrictions.

Each of the parts listed in **Table 3** includes the following items:

- One integrated unit
- One power supply 1000/100 Base-TX LAN injector (excluding C050910CZ01A)
- One line cord (excluding C050910CA01A)

Table 3 Force 300-25 part numbers

Cambium description	Cambium part number
ePMP Force 300-25-25 5 GHz High Gain Radio (FCC) (US Cord)	C058910C102A
ePMP Force 300-25-25 5 GHz High Gain Radio (IC) (Canada/US Cord)	C050910C104A
ePMP Force 300-25-25 5 GHz High Gain Radio (EU) (EU Cord)	C050910C203A
ePMP Force 300-25-25 5 GHz High Gain Radio (EU) (UK Cord)	C050910C303A
ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (no Cord)	C050910C001A
ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (US Cord)	C050910C101A
ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (EU Cord)	C050910C201A
ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (UK Cord)	C050910C301A
ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (India Cord)	C050910C401A
ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (China Cord)	C050910C501A
ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (Brazil Cord)	C050910C601A
ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (Argentina Cord)	C050910C701A
ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (ANZ Cord)	C050910C801A
ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (South Africa Cord)	C050910C901A
ePMP Force 300-25-25 5 GHz High Gain Radio (RoW) (No PSU)	C050910CZ01A

Table 4 Force 300-25 accessory part numbers

Cambium description	Cambium part number
PoE Gigabit DC Injector, 15W Output at 30V, Energy Level 6 Supply	N000900L001
CABLE, UL POWER SUPPLY CORD SET, ARGENTINA	N000900L013
CABLE, UL POWER SUPPLY CORD SET, AUS/NZ	N000900L011
CABLE, UL POWER SUPPLY CORD SET, Brazil	N000900L010
CABLE, UL POWER SUPPLY CORD SET, CHINA	N000900L015
CABLE, UL POWER SUPPLY CORD SET, EU	N000900L008
CABLE, UL POWER SUPPLY CORD SET, INDIA	N000900L012
CABLE, UL POWER SUPPLY CORD SET, UK	N000900L009
CABLE, UL POWER SUPPLY CORD SET, US	N000900L007

FORCE 300-25 MOUNTING BRACKET

Figure 4 Force 300-25 module mounting bracket

The Force 300-25 module is designed to be pole-mounted using the mounting bracket provided in the box with the radio.

FORCE 300-25 INTERFACES

The Ethernet port is located on the rear of the integrated unit. This interface is described in [Table 5](#).

Table 5 Force 300-25 Series – rear interfaces

Port name	Connector	Interface	Description
Eth	RJ45	PoE input	Power over Ethernet (PoE).
		100/1000BASE-T Ethernet	Data

FORCE 300-25 SPECIFICATIONS

The Force 300-25 integrated module conforms to the specifications listed in [Table 6](#) and [Table 7](#). The integrated module meets the low level static discharge specifications identified in [Electromagnetic compatibility \(EMC\) compliance](#) on page [168](#) and provides internal surge suppression but does not provide lightning suppression.

Table 6 Force 300-25 physical specifications

Category	Specification
Dimensions (Diameter x Depth)	47 cm x 31 cm (18.5 in x 12.2 in)
Weight	2.4 kb (5.2 lbs)

Table 7 Force 300-25 environmental specifications

Category	Specification
Temperature	-30°C (-22°F) to +55°C (131°F)
Wind loading	124 mph (200 kph) maximum. See Force 300-25 wind loading on page 28 for a full description.
Humidity	95% condensing
Environmental	IP55

FORCE 300-25 HEATER

At startup, if the Force 300-25 module temperature is at or below 32° F (0° C), an internal heater is activated to ensure that the device is able to successfully begin operation. The unit's heater is only activated when the unit is powered on and will not apply heat to the device once startup is complete. When the unit temperature is greater than 32° F (0° C), the heater is deactivated and the unit continues its startup sequence.

The effect on device startup time at various temperatures is defined in [Table 8](#).

Table 8 Force 300-25 startup times based on ambient temperature

Initial Temperature	Startup time (from power on to operational)
-22° F (-30° C)	20 minutes
-4° F (-20° C)	6 minutes

14° F (-10° C)

2 minutes, 30 seconds

FORCE 300-25 WIND LOADING

Ensure that the device and the structure on which it is mounted are capable of withstanding the prevalent wind speeds at a proposed ePMP site. Wind speed statistics are available from national meteorological offices.

The device and its mounting bracket are capable of withstanding wind speeds of up to 200 kph (124 mph).

Wind blowing on the device will subject the mounting structure to significant lateral force. The magnitude of the force depends on both wind strength and surface area of the device. Wind loading is estimated using the following formulae:

$$\text{Force (in kilograms)} = 0.1045aV^2$$

Where:	Is:
a	surface area in square meters
V	wind speed in meters per second

$$\text{Force (in pounds)} = 0.0042Av^2$$

Where:	Is:
A	surface area in square feet
v	wind speed in miles per hour

Applying these formulae to the ePMP device at different wind speeds, the resulting wind loadings are shown in **Table 9** and **Table 10**.

Table 9 Force 300-25 wind loading (Kg)

Type of ePMP device	Largest surface area (square meters)	Wind speed (meters per second)		
		30	40	50
Force 300-25 Integrated	0.09	16 Kg	28.4 Kg	44.4 Kg

Table 10 Force 300-25 wind loading (lb)

Type of ePMP device	Largest surface area (square feet)	Wind speed (miles per hour)		
		80	100	120
Force 300-25 Integrated	1.87	50.3 lb	78.5 lb	113.1 lb

FORCE 300-25 SOFTWARE PACKAGES

Force 300-25 devices may be upgraded by downloading new software packages from the Cambium Networks website or by using the Cambium Network Services Server. The software packages applicable to ePMP integrated radios are named:

- ePMP-AC-v4.3.0.1.img (or higher version number)

Force 300-16

For details of the Force 300-16 hardware, see:

- [Force 300-16 Integrated description](#) on page 29
- [Force 300-16 part numbers](#) on page 29
- [Force 300-16 Interfaces](#) on page 30
- [Force 300-16 specifications](#) on page 30
- [Force 300-16 heater](#) on page 31
- [Force 300-16 software packages](#) on page 32

FORCE 300-16 INTEGRATED DESCRIPTION

The Force 300-16 device is a self-contained transceiver unit that houses both radio and networking electronics.



Figure 5 Force 300-16 Integrated

FORCE 300-16 PART NUMBERS

Choose the correct regional variant to adhere to local licensing restrictions.

Each of the parts listed includes the following items:

- One integrated unit
- One power supply 1000/100 Base-TX LAN injector (excluding C050910CZ11A)
- One line cord (excluding C050910C011A, C050910CZ11A)

Table 11 Force 300-16 part numbers

Cambium description	Cambium part number
ePMP 5 GHz Force 300-16 Radio (FCC) (US cord)	C058910C112A
ePMP 5 GHz Force 300-16 Radio (IC) (Canada/US cord)	C050910C114A
ePMP 5 GHz Force 300-16 Radio (EU) (EU cord)	C050910C213A
ePMP 5 GHz Force 300-16 Radio (EU) (UK cord)	C050910C313A
ePMP 5 GHz Force 300-16 Radio (ROW) (no cord)	C050910C011A
ePMP 5 GHz Force 300-16 Radio (ROW) (US cord)	C050910C111A
ePMP 5 GHz Force 300-16 Radio (ROW) (EU cord)	C050910C211A
ePMP 5 GHz Force 300-16 Radio (ROW) (UK cord)	C050910C311A
ePMP 5 GHz Force 300-16 Radio (ROW) (India cord)	C050910C411A

ePMP 5 GHz Force 300-16 Radio (India) (India cord)	C050910C412A
ePMP 5 GHz Force 300-16 Radio (ROW) (China cord)	C050910C511A
ePMP 5 GHz Force 300-16 Radio (ROW) (Brazil cord)	C050910C611A
ePMP 5 GHz Force 300-16 Radio (ROW) (Argentina cord)	C050910C711A
ePMP 5 GHz Force 300-16 Radio (ROW) (ANZ cord)	C050910C811A
ePMP 5 GHz Force 300-16 Radio (ROW) (South Africa cord)	C050910C911A
ePMP 5 GHz Force 300-16 Radio (ROW) (No PSU)	C050910CZ11A

Table 12 Force 300-16 accessory part numbers

Cambium description	Cambium part number
PoE Gigabit DC Injector, 15W Output at 30V, Energy Level 6 Supply	N000900L001
CABLE, UL POWER SUPPLY CORD SET, ARGENTINA	N000900L013
CABLE, UL POWER SUPPLY CORD SET, AUS/NZ	N000900L011
CABLE, UL POWER SUPPLY CORD SET, Brazil	N000900L010
CABLE, UL POWER SUPPLY CORD SET, CHINA	N000900L015
CABLE, UL POWER SUPPLY CORD SET, EU	N000900L008
CABLE, UL POWER SUPPLY CORD SET, INDIA	N000900L012
CABLE, UL POWER SUPPLY CORD SET, UK	N000900L009
CABLE, UL POWER SUPPLY CORD SET, US	N000900L007

FORCE 300-16 INTERFACES

The Ethernet port is located on the rear of the integrated unit.

Table 13 Force 300-16 Series – rear interfaces

Port name	Connector	Interface	Description
Eth	RJ45	PoE input	Power over Ethernet (PoE).
		100/1000BASE-T Ethernet	Data

FORCE 300-16 SPECIFICATIONS

The Force 300-16 integrated module conforms to the specifications listed in [Table 14](#) and [Table 15](#). The integrated module meets the low level static discharge specifications identified in [Electromagnetic compatibility \(EMC\) compliance](#) on page [168](#) and provides internal surge suppression but does not provide lightning suppression.

Table 14 Force 300-16 physical specifications

Category	Specification
----------	---------------

Dimensions (Diameter x Depth)	12.4 cm x 25.1 cm x 11.9 cm (4.9 in x 9.9 in x 4.7 in) – with mounting bracket
Weight	0.5 kg (1.1 lbs) – with mounting bracket

Table 15 Force 300-16 environmental specifications

Category	Specification
Temperature	-30°C (-22°F) to +60°C (140°F)
Wind loading	112 mph (180 kph) maximum. See Force 300-16 wind loading on page 31 for a full description.
Environmental	IP55

FORCE 300-16 HEATER

At startup, if the Force 300-16 module temperature is at or below 32° F (0° C), an internal heater is activated to ensure that the device is able to successfully begin operation. The unit's heater is only activated when the unit is powered on and will not apply heat to the device once startup is complete. When the unit temperature is greater than 32° F (0° C), the heater is deactivated and the unit continues its startup sequence.

The effect on device startup time at various temperatures is defined in [Table 16](#).

Table 16 Force 300-16 startup times based on ambient temperature

Initial Temperature	Startup time (from power on to operational)
-22° F (-30° C)	20 minutes
-4° F (-20° C)	6 minutes
14° F (-10° C)	2 minutes, 30 seconds

FORCE 300-16 WIND LOADING

Ensure that the device and the structure on which it is mounted are capable of withstanding the prevalent wind speeds at a proposed ePMP site. Wind speed statistics are available from national meteorological offices.

The device and its mounting bracket are capable of withstanding wind speeds of up to 180 kph (124 mph).

Wind blowing on the device will subject the mounting structure to significant lateral force. The magnitude of the force depends on both wind strength and surface area of the device. Wind loading is estimated using the following formulae:

$$\text{Force (in kilograms)} = 0.1045aV^2$$

Where:

a

V

Is:

surface area in square meters

wind speed in meters per second

$$\text{Force (in pounds)} = 0.0042Av^2$$

Where:

A

v

Is:

surface area in square feet

wind speed in miles per hour

Applying these formulae to the ePMP device at different wind speeds, the resulting wind loadings are shown in [Table 17](#) and [Table 18](#).

Table 17 Force 300-16 wind loading (Kg)

Type of ePMP device	Largest surface area (square meters)	Wind speed (meters per second)		
		30	40	50
Force 300-16 Integrated	0.03	2.8 Kg	5 Kg	7.8 Kg

Table 18 Force 300-16 wind loading (lb)

Type of ePMP device	Largest surface area (square feet)	Wind speed (miles per hour)		
		80	100	120
Force 300-16 Integrated	1.34	9.1 lb	14.3 lb	20.6 lb

FORCE 300-16 SOFTWARE PACKAGES

Force 300-16 devices may be upgraded by downloading new software packages from the Cambium Networks website or by using cnMaestro. The software packages applicable to ePMP integrated radios are named:

- ePMP-AC-v4.3.0.1.img (or higher version number)

Force 300 Series Power Supply

For details of the ePMP power supply units, see:

- [Power supply description](#) on page [32](#)
- [Power supply part numbers](#) on page [33](#)
- [Power supply interfaces](#) on page [33](#)
- [Power supply specifications](#) on page [34](#)
- [Power supply location](#) on page [34](#)

POWER SUPPLY DESCRIPTION

The power supply is an indoor unit that is connected to the ePMP module and network terminating equipment using Cat5e cable with RJ45 connectors. It is also plugged into an AC or DC power supply so that it can inject Power over Ethernet (PoE) into the module.

POWER SUPPLY PART NUMBERS

Each module requires one power supply and one power supply line cord (line cord included with radio device, see [Table 3](#)).

Table 19 Power supply component part numbers

Cambium description	Cambium part number
ePMP Pwr Supply for GPS Radio - no cord (spare)	N000900L001

POWER SUPPLY INTERFACES

The power supply interfaces are illustrated in [Figure 6](#) and described in [Table 20](#) and [Table 21](#).

Figure 6 Power supply interfaces

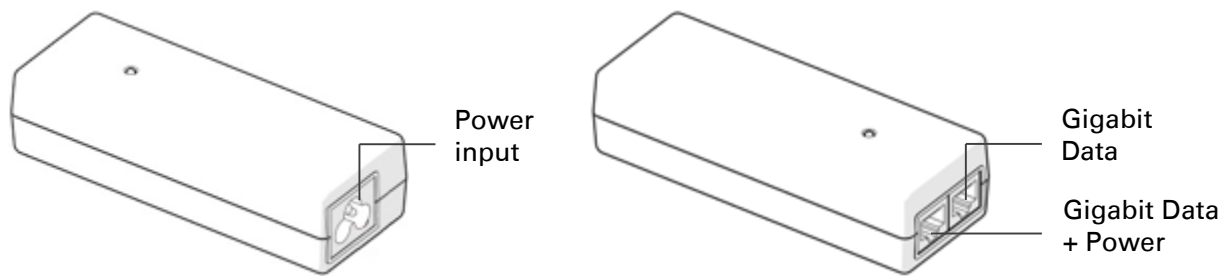


Table 20 Power supply interface functions - N000900L001

Interface	Function
Power input	Mains power input.
Power output	30V
Gigabit Data + Power	RJ45 socket for connecting Cat5e cable to radio
Gigabit Data	RJ45 socket for connecting Cat5e cable to network.

Table 21 Power Supply LED functions

LED	Function
Power (green)	Power supply detection

POWER SUPPLY SPECIFICATIONS

The ePMP power supply conforms to the specifications listed in [Table 22](#), [Table 23](#), and [Table 24](#).

Table 22 Power supply physical specifications

Category	Specification
Dimensions (H x W x D)	14 x 6.5 x 3.6 cm (5.5 x 2.55 x 1.42 in)
Weight	0.26 lbs

Table 23 Power supply environmental specifications

Category	Specification
Ambient Operating Temperature	0° C to +40° C
Humidity	20% - 90%

Table 24 Power supply electrical specifications

Category	Specification
AC Input	100 to 240 VAC
Efficiency	Meets Energy Level 6
Over Current Protection	Short circuit, with auto recovery
Hold up time	10 ms minimum at maximum load, 120 VAC

POWER SUPPLY LOCATION

Find a location for the power supply that meets the following requirements:

- The power supply can be mounted on a wall or other flat surface.
- The power supply is kept dry, with no possibility of condensation, flooding or rising damp.
- The power supply can be accessed to view status indicators.
- The power supply can be connected to the ePMP module drop cable and network terminating equipment.
- The power supply can be connected to a mains or DC power supply that meets the requirements defined in [Table 24](#).

Ethernet cabling

For details of the Ethernet cabling components of an ePMP installation, see:

- [Ethernet standards and cable lengths](#) on page 35
- [Outdoor Cat5e cable](#) on page 35

ETHERNET STANDARDS AND CABLE LENGTHS

All configurations require a copper Ethernet connection from the power supply port to the power supply and network terminating equipment.

For each power supply, the maximum permitted drop cable length is specified in [Table 25](#).

Table 25 Power supply drop cable length restrictions

Part number	Description	Maximum cable length (*1)
N000900L001	Power Supply for Radio with Gigabit Ethernet (no cord)	330 feet (100m)

(*1) Maximum length of Ethernet cable from device to network device needs to follow 802.3 standards. If the power supply is not the network device the cable from the power supply to the network device must be included in the total maximum cable length.

OUTDOOR CAT5E CABLE

For copper connections from the device to the power supply, use Cat5e cable that is shielded with copper-plated steel.



Caution

Always use Cat5e cable that is shielded with copper-plated steel. Alternative types of Ethernet cables are not supported by Cambium Networks.

Surge Suppression unit

The ePMP integrated units both contain 1 Joule-rated surge suppression built into the device. With this built-in surge suppression, it is not required to install a surge suppressor at the unit's mounting location. However, it is required to install a surge suppressor at the Ethernet cable's building ingress into the power supply's indoor location.

System planning

This chapter provides information to help the user to plan an ePMP link.

The following topics are described in this chapter:

- How to plan ePMP links to conform to the regulatory restrictions that apply in the country of operation is explained under [Radio spectrum planning](#) on page [36](#).
- Factors to be considered when planning links such as range, path loss and throughput are described under [Link planning](#) on page [38](#).
- The grounding and lightning protection requirements of a ePMP installation are described under [Grounding and lightning protection](#) on page [20](#).
- Factors to be considered when planning ePMP data networks are described under [Data network planning](#) on page [39](#).

Radio spectrum planning

This section describes how to plan ePMP links to conform to the regulatory restrictions that apply in the country of operation.



Caution

The user must ensure ePMP product operates in accordance to local regulatory limits.



Note

Contact the applicable radio regulator to check if registration of the ePMP link is required.

GENERAL WIRELESS SPECIFICATIONS

The wireless specifications that apply to Force 300 variants are listed under [Table 26](#). The wireless specifications that are specific to each frequency variant are listed in [Table 27](#).

Table 26 Force 300 wireless specifications (all variants)

Item	Specification
Channel selection	Manual selection (fixed frequency).
Manual power control	To avoid interference to other users of the band, maximum power can be set lower than the default power limit.
Maximum transmit power	26 dBm
Integrated device antenna type	Dish antenna
Duplex scheme	Adaptive TDD
Over-the-air encryption	AES
Error Correction	FEC

Table 27 Force 300 wireless specifications, 5 GHz band

Item	5 GHz
RF band (GHz)	5.150 – 5.970 MHz
Channel bandwidth	20 MHz, 40 MHz, or 80 MHz
Typical antenna gain	Integrated dish antenna – 25 dBi
Antenna 3dB beamwidth (Integrated dish)	6-10° azimuth, 6-10° elevation

REGULATORY LIMITS

The local regulator may restrict frequency usage and channel width and may limit the amount of conducted or radiated transmitter power.

Many countries impose EIRP limits (Allowed EIRP) on products operating in the bands used by the ePMP Series. For example, in the 5 GHz band, these limits are calculated as follows:

- In the 5.8 GHz band (5725 MHz to 5875 MHz), the EIRP must not exceed the lesser of 36 dBm or $(23 + 10 \times \text{Log Channel width in MHz})$ dBm.

Some countries (for example the USA) impose conducted power limits on products operating in the 5 GHz band.

CONFORMING TO THE LIMITS

Ensure the link is configured to conform to local regulatory requirements by configuring the correct country code (located in the web management interface, under **Configure > Radio**). In the following situations, the country code does not automatically prevent operation outside the regulations:

- When operating in ETSI regions, it is required to enter a license key in the ePMP web management interface to unlock valid country-specific frequencies. This key may be obtained from <https://support.cambiumnetworks.com/licensekeys/epmp>.

AVAILABLE SPECTRUM

The available spectrum for operation depends on the region. When configured with the appropriate country code, the unit will only allow operation on those channels which are permitted by the regulations.

Certain regulations have allocated certain channels as unavailable for use:

- Some European countries have allocated part of the 5.8 GHz band to Road Transport and Traffic Telematics (RTTT) systems.

Where regulatory restrictions apply to certain channels, these channels are barred automatically by the use of the correct country code. For example, at 5.8 GHz in some European countries, the RTTT band 5795 MHz to 5815 MHz is barred. With the appropriate country code configured for this region, the ePMP will not operate on channels within this band.

The number and identity of channels barred by the license key and country code is dependent on the channel bandwidth.

CHANNEL BANDWIDTH

Select the required channel bandwidth for the link. The selection depends upon the ePMP frequency variant and country code, as specified on page 177.

The wider a channel bandwidth the greater is its capacity. As narrower channel bandwidths take up less spectrum, selecting a narrow channel bandwidth may be a better choice when operating in locations where the spectrum is very busy.

Both ends of the link must be configured to operate on the same channel bandwidth.

Link planning

This section describes factors to be taken into account when planning links, such as range, obstacles path loss and throughput.

RANGE AND OBSTACLES

Calculate the range of the link and identify any obstacles that may affect radio performance.

Perform a survey to identify all the obstructions (such as trees or buildings) in the path and to assess the risk of interference. This information is necessary in order to achieve an accurate link feasibility assessment.

PATH LOSS

Path loss is the amount of attenuation the radio signal undergoes between the two ends of the link. The path loss is the sum of the attenuation of the path if there were no obstacles in the way (Free Space Path Loss), the attenuation caused by obstacles (Excess Path Loss) and a margin to allow for possible fading of the radio signal (Fade Margin). The following calculation needs to be performed to judge whether a particular link can be installed:

$$L_{free_space} + L_{excess} + L_{fade} + L_{seasonal} < L_{capability}$$

Where:

Is:

L_{free_space}	Free Space Path Loss (dB)
L_{excess}	Excess Path Loss (dB)
L_{fade}	Fade Margin Required (dB)
$L_{seasonal}$	Seasonal Fading (dB)
$L_{capability}$	Equipment Capability (dB)

Free space path loss is a major determinant in received (Rx) signal level. Rx signal level, in turn, is a major factor in the system operating margin (fade margin), which is calculated as follows:

$$\text{System Operating Margin (fade margin) dB} = \text{Rx signal level (dB)} - \text{Rx sensitivity (dB)}$$

Thus, the fade margin is the difference between strength of the received signal and the strength that the receiver requires for maintaining a reliable link.

ADAPTIVE MODULATION

Adaptive modulation ensures that the highest throughput that can be achieved instantaneously will be obtained, taking account of propagation and interference. When the link has been installed, web pages provide information about the link loss currently measured by the equipment, both instantaneously and averaged.

Data network planning

This section describes factors to be considered when planning ePMP data networks.

ETHERNET INTERFACES

The ePMP Ethernet ports conform to the specifications listed in [Table 28](#).

Table 28 Force 300 Ethernet bridging specifications

Ethernet Bridging	Specification
Protocol	10BASE-Te/100BASE-Tx/1000BASE-T IEEE 802.3 IEEE 802.3at (PoE) IEEE802.3u compliant Auto-negotiation
Interface	10/100/1000BaseT (RJ-45)
Maximum Ethernet Frame Size	1700 bytes
Service classes for bridged traffic	3 classes



Note

Practical Ethernet rates will depend on network configuration, higher layer protocols and platforms used.

Over the air throughput will be capped to the rate of the Ethernet interface at the receiving end of the link.

MANAGEMENT VLAN

Decide if the IP interface of the device management agent will be connected in a VLAN. If so, decide if this is a standard (IEEE 802.1Q) VLAN or provider bridged (IEEE 802.1ad) VLAN, and select the VLAN ID for this VLAN.

Use of a separate management VLAN is strongly recommended. Use of the management VLAN helps to ensure that the device management agent cannot be accessed by customers.

QUALITY OF SERVICE FOR BRIDGED ETHERNET TRAFFIC

Decide how quality of service will be configured in ePMP to minimize frame loss and latency for high priority traffic. Wireless links often have lower data capacity than wired links or network equipment like switches and routers, and quality of service configuration is most critical at network bottlenecks.

ePMP provides three priority types for traffic waiting for transmission over the wireless link – Voice, High and Low. Low is the lowest priority and Voice is the highest priority. Traffic is scheduled using strict priority; in other words, traffic in a given priority is transmitted when all higher-priority transmissions are complete.

Configuration

This chapter describes all configuration and alignment tasks that are performed when an ePMP system is deployed.

Configure the units by performing the following tasks:

- [Preparing for configuration](#) on page 41
- [Using the web interface](#) on page 43

Preparing for configuration

This section describes the checks to be performed before proceeding with unit configuration.

SAFETY PRECAUTIONS

All national and local safety standards must be followed while configuring the units.



Warning

Ensure that personnel are not exposed to unsafe levels of RF energy. The units start to radiate as soon as they are powered up. Respect the safety standards defined in [Compliance with safety standards](#) on page 168, in particular the minimum separation distances.

Observe the following guidelines:

Never work in front of the antenna when the device is powered. Always power down the power supply before connecting or disconnecting the Ethernet cable from the module.

REGULATORY COMPLIANCE

All applicable radio regulations must be followed while configuring the units and aligning the antennas. For more information, [Compliance with safety standards](#) on page 168.

Connecting to the unit

To connect the unit to a management PC, use the following procedures:

- [Configuring the management PC](#) on page 41
- [Connecting to the PC and powering up](#) on page 42

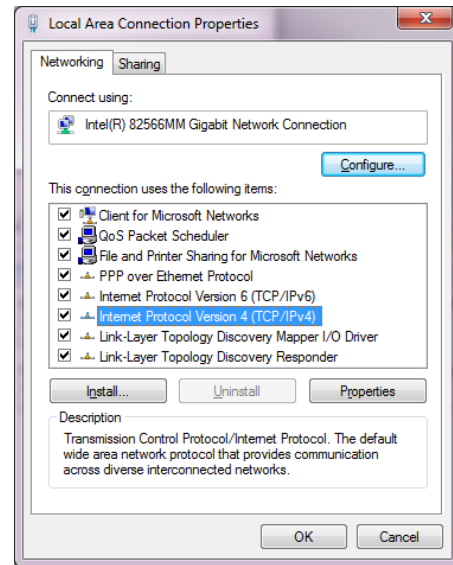
CONFIGURING THE MANAGEMENT PC

Use this procedure to configure the local management PC to communicate with the ePMP module.

Procedure:

- 1 Select **Properties** for the Ethernet port.
In Windows 7 this is found in **Control Panel > Network and Internet > Network Connections > Local Area Connection**.
- 2 Select the Internet Protocol (TCP/IP) item:

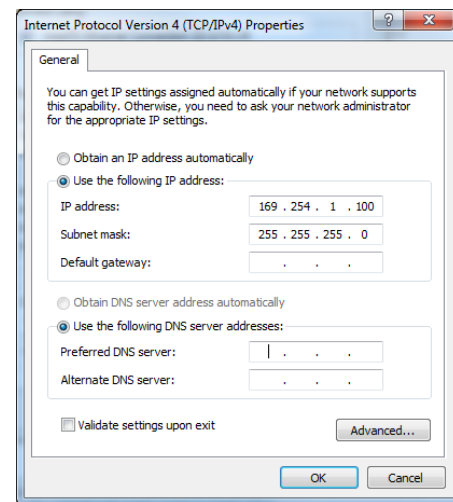
3 Click Properties.



4 Enter an IP address that is valid for the 169.254.1.x network, avoiding 169.254.1.1. A good example is 169.254.1.100:

5 Enter a subnet mask of 255.255.255.0. Leave the default gateway blank.

6 Click OK, then click Close



CONNECTING TO THE PC AND POWERING UP

Use this procedure to connect a management PC directly to the ePMP for configuration and alignment purposes and to power up the ePMP device.

Procedure:

- 1** Check that the device and power supply are correctly connected (the device Ethernet port is connected to the power supply Ethernet power port – see the *ePMP Installation Guide* for more information).
- 2** Connect the PC Ethernet port to the LAN (AP: “Gigabit Data”, SM: “10/100Mbit Data”) port of the power supply using a standard (not crossed) Ethernet cable.

- 3 Apply mains or battery power to the power supply. The green Power LED must illuminate continuously.

**Note**

If the Power and Ethernet LEDs do not illuminate correctly, see [Testing hardware](#) on page 100.

Using the web interface

To understand how to use the ePMP web interface, see:

- [Logging into the web interface](#) on page 43

LOGGING INTO THE WEB INTERFACE

Use this procedure to log into the web interface as a system administrator.

Equipment and tools:

- ePMP device connected to power supply by Ethernet cable.
- PC connected to power supply by Ethernet cable.
- Power Supply powered up.
- Minimum supported browser version – Chrome v29, Firefox v24, Internet Explorer 10, Safari v5.

Procedure

- 1 Connect an Ethernet cable from the host machine to the power supply **Gigabit Data** port
- 2 Configure the host machine with an IP address in the 169.254.1.x subnet (excluding 169.254.1.1)
- 3 Connect an Ethernet cable from the power supply **Gigabit Data+Power** port to the device
- 4 Connect the power supply to power mains
- 5 In your browser, navigate to the device default IP address **169.254.1.1**.

admin
password
Log in

**Note**

If **Device IP address Mode** is set to **DHCP** and the device is unable to retrieve IP address information via DHCP, the device management IP is set to 192.168.0.2 (SM mode) or the previously-configured static Device IP Address. Units may always be accessed via the Ethernet port at 169.254.1.1.

- 6 Login with username **admin** and password **admin**



Note

New ePMP devices all contain default username and password configurations. It is recommended to change these password configurations immediately. These passwords may be configured in the management GUI in section **Configuration > System > Account Management**.

Using the installation wizard – Access Point

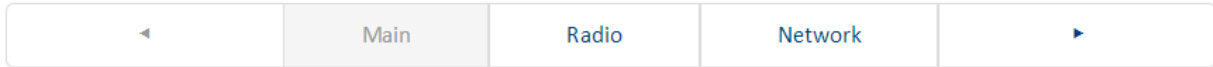
The ePMP device features a guided configuration mechanism for configuring key parameters for link operation.



This setup is accessed on the **Installation** page by clicking the **Start Setup** button. Click **Finish Setup** to commit the changes to the device.

INSTALLATION WIZARD STEP 1 – MAIN SYSTEM PARAMETERS

Installation



Main

Device Name *

Radio Mode * Access Point Subscriber Module

SSID

Wireless Security Open WPA2

WPA2 Pre-shared Key

Attribute	Meaning
Main	
Device Name	The configured identifier used in an NMS such as cnMaestro
Radio Mode	<p>Access Point: The unit controls the point-to-point link and its maintenance. On startup, the Access Point transmits until a link with the Subscriber Module is made.</p> <p>Subscriber Module: The unit listens for its peer and only transmits when the peer has been identified.</p>

Attribute	Meaning
SSID	SSID is a unique identifier for a wireless LAN which is specified in the Access Point’s beacon. (Access Point Mode). SSID must be same at both ends and different to site name.
Wireless Security	<p>Open: All Subscriber Module devices requesting network entry are allowed registration.</p> <p>WPA2: The WPA2 mechanism provides AES radio link encryption and Subscriber Module network entry authentication. When enabled, the Subscriber Module must register using the Authentication Pre-shared Key configured on the Access Point and Subscriber Module.</p>
WPA2 Pre-shared Key	Configure this key on the Access Point, then configure the Subscriber Module with this key to complete the authentication configuration. This key must be between 8 to 128 symbols.

INSTALLATION WIZARD STEP 2 – RADIO PARAMETERS

Installation

Cancel Finish Setup

◀
Main
Radio
Network
▶

Radio

Country Other ▼

Downlink/Uplink Ratio 75/25 50/50 30/70

Max Range miles | min: 1 | max: 124

Channel Bandwidth 20 MHz 40 MHz 80 MHz

Frequency Carrier 4950 MHz ▼

Attribute	Meaning
Radio	
Country	Defines the country code being used by the device. The country code of the Subscriber Module follows the country code of the associated Access Point, unless it is an FCC SKU in which case the country code is United States or Canada. Country code defines the regulatory rules in use for the device.
Downlink/Uplink Ratio	The schedule of downlink traffic to uplink traffic on the radio link. The three options, 75/25 , 50/50 and 30/70 , allow the radio to operate in a fixed ratio on every frame. In other words, this ratio represents the amount of the total radio link’s aggregate throughput that will be used for downlink resources,

Attribute	Meaning
	and the amount of the total radio link’s aggregate throughput that will be used for uplink resources.
Max Range	This parameter represents cell coverage radius. Subscriber Modules outside the configured radius will not be able to connect. It is recommended to configure Max Range to match the actual physical distance of the farthest subscriber.
Channel Bandwidth	Configure the channel size used by the radio for RF transmission.
Frequency Carrier	Configure the frequency carrier for RF transmission. This list is dynamically adjusted to the regional restrictions based on the setting of the Country parameter. Ensure that a thorough spectrum analysis has been completed prior to configuring this parameter.

INSTALLATION WIZARD STEP 3 – NETWORK PARAMETERS

Installation

Cancel Finish Setup

◀
Main
Radio
Network
▶

Network

IP Assignment Static DHCP

IP Address


Subnet Mask

Gate way

Preferred DNS Server

Alternate DNS Server

Attribute	Meaning
Network	
IP Assignment	<p>Static: Device management IP addressing is configured manually in fields IP Address, Subnet Mask, Gateway, Preferred DNS Server, and Alternate DNS Server.</p> <p>DHCP: Device management IP addressing (IP address, Subnet Mask, Gateway, and DNS Server) is assigned via a network DHCP server, and parameters IP Address, Subnet Mask, Gateway, Preferred DNS Server, and Alternate DNS Server are not configurable.</p>

Attribute	Meaning
IP Address	<p>Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network.</p> <p> Note If IP Address Assignment is set to DHCP and the device is unable to retrieve IP address information via DHCP, the device management IP is set to fallback IP 192.168.0.1 (Access Point) or 192.168.0.2 (Subscriber Module).</p>
Subnet Mask	Defines the address range of the connected IP network. For example, if Device IP Address (LAN) is configured to 192.168.2.1 and IP Subnet Mask (LAN) is configured to 255.255.255.0, the device will belong to subnet 192.168.2.X.
Gateway	Configure the IP address of the device on the current network that acts as a gateway. A gateway acts as an entrance and exit to packets from and to other networks.
Preferred DNS Server	Configure the primary IP address of the server used for DNS resolution.
Alternate DNS Server	Configure the secondary IP address of the server used for DNS resolution.

Using the installation wizard – Subscribe Module

The ePMP device features a guided configuration mechanism for configuring key parameters for link operation.



This setup is accessed on the **Installation** page by clicking the **Start Setup** button.

Click **Finish Setup** to commit the changes to the device.

INSTALLATION WIZARD STEP 1 – MAIN SYSTEM PARAMETERS

Installation

Cancel Finish Setup

◀
Main
Radio
Network
▶

Main

Device Name *

Radio Mode * Access Point Subscriber Module

Wireless Security WPA2 Open

WPA2 Pre-shared Key

Attribute	Meaning
Main	
Device Name	The configured identifier used in an NMS such as cnMaestro
Radio Mode	<p>Access Point: The unit controls the point-to-point link and its maintenance. On startup, the Access Point transmits until a link with the Subscriber Module is made.</p> <p>Subscriber Module: The unit listens for its peer and only transmits when the peer has been identified.</p>
Wireless Security	<p>Open: All Subscriber Module devices requesting network entry are allowed registration.</p> <p>WPA2: The WPA2 mechanism provides AES radio link encryption and Subscriber Module network entry authentication. When enabled, the Subscriber Module must register using the Authentication Pre-shared Key configured on the Access Point and Subscriber Module.</p>
WPA2 Pre-shared Key	Configure this key on the Access Point, then configure the Subscriber Module with this key to complete the authentication configuration. This key must be between 8 to 128 symbols.

INSTALLATION WIZARD STEP 2 – RADIO PARAMETERS

Installation

Cancel Finish Setup

◀ Main Radio Network ▶

Radio

Preferred Access Points Add new AP Show Details

SSID	Wireless Security	WPA2 Pre-shared Key
Table is empty		

Scan Channel Bandwidth 80 MHz 40 MHz 20 MHz

20 MHz Scan List

Radio Frequency 20 MHz Scan List Unselect All Select All

<input type="checkbox"/> 4920 MHz	<input type="checkbox"/> 4925 MHz	<input type="checkbox"/> 4930 MHz	<input type="checkbox"/> 4935 MHz	<input type="checkbox"/> 4940 MHz	<input type="checkbox"/> 4945 MHz	<input type="checkbox"/> 4950 MHz	<input type="checkbox"/> 4955 MHz	<input type="checkbox"/> 4960 MHz	<input type="checkbox"/> 4965 MHz	<input type="checkbox"/> 4970 MHz	<input type="checkbox"/> 4975 MHz
<input type="checkbox"/> 4980 MHz	<input type="checkbox"/> 4985 MHz	<input type="checkbox"/> 4990 MHz	<input type="checkbox"/> 4995 MHz	<input type="checkbox"/> 5000 MHz	<input type="checkbox"/> 5005 MHz	<input type="checkbox"/> 5010 MHz	<input type="checkbox"/> 5015 MHz	<input type="checkbox"/> 5020 MHz	<input type="checkbox"/> 5025 MHz	<input type="checkbox"/> 5030 MHz	<input type="checkbox"/> 5035 MHz
<input type="checkbox"/> 5040 MHz	<input type="checkbox"/> 5045 MHz	<input type="checkbox"/> 5050 MHz	<input type="checkbox"/> 5055 MHz	<input type="checkbox"/> 5060 MHz	<input type="checkbox"/> 5065 MHz	<input type="checkbox"/> 5070 MHz	<input type="checkbox"/> 5075 MHz	<input type="checkbox"/> 5080 MHz	<input type="checkbox"/> 5085 MHz	<input type="checkbox"/> 5090 MHz	<input type="checkbox"/> 5095 MHz
<input type="checkbox"/> 5100 MHz	<input type="checkbox"/> 5105 MHz	<input type="checkbox"/> 5110 MHz	<input type="checkbox"/> 5115 MHz	<input type="checkbox"/> 5120 MHz	<input type="checkbox"/> 5125 MHz	<input type="checkbox"/> 5130 MHz	<input type="checkbox"/> 5135 MHz	<input type="checkbox"/> 5140 MHz	<input type="checkbox"/> 5145 MHz	<input type="checkbox"/> 5150 MHz	<input type="checkbox"/> 5155 MHz
<input type="checkbox"/> 5160 MHz	<input type="checkbox"/> 5165 MHz	<input type="checkbox"/> 5170 MHz	<input type="checkbox"/> 5175 MHz	<input type="checkbox"/> 5180 MHz	<input type="checkbox"/> 5185 MHz	<input type="checkbox"/> 5190 MHz	<input type="checkbox"/> 5195 MHz	<input type="checkbox"/> 5200 MHz	<input type="checkbox"/> 5205 MHz	<input type="checkbox"/> 5210 MHz	<input type="checkbox"/> 5215 MHz
<input type="checkbox"/> 5220 MHz	<input type="checkbox"/> 5225 MHz	<input type="checkbox"/> 5230 MHz	<input type="checkbox"/> 5235 MHz	<input type="checkbox"/> 5240 MHz	<input type="checkbox"/> 5245 MHz	<input type="checkbox"/> 5250 MHz	<input type="checkbox"/> 5255 MHz	<input type="checkbox"/> 5260 MHz	<input type="checkbox"/> 5265 MHz	<input type="checkbox"/> 5270 MHz	<input type="checkbox"/> 5275 MHz
<input type="checkbox"/> 5280 MHz	<input type="checkbox"/> 5285 MHz	<input type="checkbox"/> 5290 MHz	<input type="checkbox"/> 5295 MHz	<input type="checkbox"/> 5300 MHz	<input type="checkbox"/> 5305 MHz	<input type="checkbox"/> 5310 MHz	<input type="checkbox"/> 5315 MHz	<input type="checkbox"/> 5320 MHz	<input type="checkbox"/> 5325 MHz	<input type="checkbox"/> 5330 MHz	<input type="checkbox"/> 5335 MHz
<input type="checkbox"/> 5340 MHz	<input type="checkbox"/> 5345 MHz	<input type="checkbox"/> 5350 MHz	<input type="checkbox"/> 5355 MHz	<input type="checkbox"/> 5360 MHz	<input type="checkbox"/> 5365 MHz	<input type="checkbox"/> 5370 MHz	<input type="checkbox"/> 5375 MHz	<input type="checkbox"/> 5380 MHz	<input type="checkbox"/> 5385 MHz	<input type="checkbox"/> 5390 MHz	<input type="checkbox"/> 5395 MHz
<input type="checkbox"/> 5400 MHz	<input type="checkbox"/> 5405 MHz	<input type="checkbox"/> 5410 MHz	<input type="checkbox"/> 5415 MHz	<input type="checkbox"/> 5420 MHz	<input type="checkbox"/> 5425 MHz	<input type="checkbox"/> 5430 MHz	<input type="checkbox"/> 5435 MHz	<input type="checkbox"/> 5440 MHz	<input type="checkbox"/> 5445 MHz	<input type="checkbox"/> 5450 MHz	<input type="checkbox"/> 5455 MHz
<input type="checkbox"/> 5460 MHz	<input type="checkbox"/> 5465 MHz	<input type="checkbox"/> 5470 MHz	<input type="checkbox"/> 5475 MHz	<input type="checkbox"/> 5480 MHz	<input type="checkbox"/> 5485 MHz	<input type="checkbox"/> 5490 MHz	<input type="checkbox"/> 5495 MHz	<input type="checkbox"/> 5500 MHz	<input type="checkbox"/> 5505 MHz	<input type="checkbox"/> 5510 MHz	<input type="checkbox"/> 5515 MHz
<input type="checkbox"/> 5520 MHz	<input type="checkbox"/> 5525 MHz	<input type="checkbox"/> 5530 MHz	<input type="checkbox"/> 5535 MHz	<input type="checkbox"/> 5540 MHz	<input type="checkbox"/> 5545 MHz	<input type="checkbox"/> 5550 MHz	<input type="checkbox"/> 5555 MHz	<input type="checkbox"/> 5560 MHz	<input type="checkbox"/> 5565 MHz	<input type="checkbox"/> 5570 MHz	<input type="checkbox"/> 5575 MHz
<input type="checkbox"/> 5580 MHz	<input type="checkbox"/> 5585 MHz	<input type="checkbox"/> 5590 MHz	<input type="checkbox"/> 5595 MHz	<input type="checkbox"/> 5600 MHz	<input type="checkbox"/> 5605 MHz	<input type="checkbox"/> 5610 MHz	<input type="checkbox"/> 5615 MHz	<input type="checkbox"/> 5620 MHz	<input type="checkbox"/> 5625 MHz	<input type="checkbox"/> 5630 MHz	<input type="checkbox"/> 5635 MHz
<input type="checkbox"/> 5640 MHz	<input type="checkbox"/> 5645 MHz	<input type="checkbox"/> 5650 MHz	<input type="checkbox"/> 5655 MHz	<input type="checkbox"/> 5660 MHz	<input type="checkbox"/> 5665 MHz	<input type="checkbox"/> 5670 MHz	<input type="checkbox"/> 5675 MHz	<input type="checkbox"/> 5680 MHz	<input type="checkbox"/> 5685 MHz	<input type="checkbox"/> 5690 MHz	<input type="checkbox"/> 5695 MHz
<input type="checkbox"/> 5700 MHz	<input type="checkbox"/> 5705 MHz	<input type="checkbox"/> 5710 MHz	<input type="checkbox"/> 5715 MHz	<input type="checkbox"/> 5720 MHz	<input type="checkbox"/> 5725 MHz	<input type="checkbox"/> 5730 MHz	<input type="checkbox"/> 5735 MHz	<input type="checkbox"/> 5740 MHz	<input type="checkbox"/> 5745 MHz	<input type="checkbox"/> 5750 MHz	<input type="checkbox"/> 5755 MHz
<input type="checkbox"/> 5760 MHz	<input type="checkbox"/> 5765 MHz	<input type="checkbox"/> 5770 MHz	<input type="checkbox"/> 5775 MHz	<input type="checkbox"/> 5780 MHz	<input type="checkbox"/> 5785 MHz	<input type="checkbox"/> 5790 MHz	<input type="checkbox"/> 5795 MHz	<input type="checkbox"/> 5800 MHz	<input type="checkbox"/> 5805 MHz	<input type="checkbox"/> 5810 MHz	<input type="checkbox"/> 5815 MHz
<input type="checkbox"/> 5820 MHz	<input type="checkbox"/> 5825 MHz	<input type="checkbox"/> 5830 MHz	<input checked="" type="checkbox"/> 5835 MHz	<input type="checkbox"/> 5840 MHz	<input type="checkbox"/> 5845 MHz	<input type="checkbox"/> 5850 MHz	<input type="checkbox"/> 5855 MHz	<input type="checkbox"/> 5860 MHz	<input type="checkbox"/> 5865 MHz	<input type="checkbox"/> 5870 MHz	<input type="checkbox"/> 5875 MHz
<input type="checkbox"/> 5880 MHz	<input type="checkbox"/> 5885 MHz	<input type="checkbox"/> 5890 MHz	<input type="checkbox"/> 5895 MHz	<input type="checkbox"/> 5900 MHz	<input type="checkbox"/> 5905 MHz	<input type="checkbox"/> 5910 MHz	<input type="checkbox"/> 5915 MHz	<input type="checkbox"/> 5920 MHz	<input type="checkbox"/> 5925 MHz	<input type="checkbox"/> 5930 MHz	<input type="checkbox"/> 5935 MHz
<input type="checkbox"/> 5940 MHz	<input type="checkbox"/> 5945 MHz	<input type="checkbox"/> 5950 MHz	<input type="checkbox"/> 5955 MHz	<input type="checkbox"/> 5960 MHz	<input type="checkbox"/> 5965 MHz	<input type="checkbox"/> 5970 MHz					

Attribute	Meaning
Radio	
Preferred Access Points	
SSID	The Preferred Access Points SSID defines the Access Point SSID to which the Subscriber Module device will attempt registration.
Wireless Security	<p>Open: The Subscriber Module device will attempt registration to the Preferred Access Points SSID with no security mechanism.</p> <p>WPA2: The WPA2 mechanism provides AES radio link encryption and Subscriber Module network entry authentication. When enabled, the Subscriber Module must register using the Authentication Pre-shared Key configured on the Access Point and Subscriber Module.</p>
WPA2 Pre-shared Key	The Preferred Access Points WPA2 Pre-shared Key must be configured on the Subscriber Module device to match the pre-shared key configured on the Access Point for registration with WPA2 security.

Attribute	Meaning
Scan Channel Bandwidth	Configure the channel size used by the radio for RF transmission.
Radio Frequency Scan List	Configure the frequency carrier for RF transmission. This list is dynamically adjusted to the regional restrictions based on the setting of the Country parameter. Ensure that a thorough spectrum analysis has been completed prior to configuring this parameter.

INSTALLATION WIZARD STEP 3 – NETWORK PARAMETERS

Installation

Cancel Finish Setup

◀
Main
Radio
Network
▶

Network

IP Assignment Static DHCP

i IP Address

Subnet Mask

Gateway

Preferred DNS Server

Alternate DNS Server

Attribute	Meaning
Network	
IP Assignment	<p>Static: Device management IP addressing is configured manually in fields IP Address, Subnet Mask, Gateway, Preferred DNS Server, and Alternate DNS Server.</p> <p>DHCP: Device management IP addressing (IP address, Subnet Mask, Gateway, and DNS Server) is assigned via a network DHCP server, and parameters IP Address, Subnet Mask, Gateway, Preferred DNS Server, and Alternate DNS Server are not configurable.</p>
IP Address	<p>Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network.</p> <div style="border: 1px solid #ccc; padding: 5px; margin-top: 5px;"> <p> Note</p> <p>If IP Address Assignment is set to DHCP and the device is unable to retrieve IP address information via DHCP, the device management IP is set to fallback IP 192.168.0.1 (Access Point) or 192.168.0.2 (Subscriber Module).</p> </div>

Attribute	Meaning
Subnet Mask	Defines the address range of the connected IP network. For example, if Device IP Address (LAN) is configured to 192.168.2.1 and IP Subnet Mask (LAN) is configured to 255.255.255.0, the device will belong to subnet 192.168.2.X.
Gateway	Configure the IP address of the device on the current network that acts as a gateway. A gateway acts as an entrance and exit to packets from and to other networks.
Preferred DNS Server	Configure the primary IP address of the server used for DNS resolution.
Alternate DNS Server	Configure the secondary IP address of the server used for DNS resolution.

Using the menu options

Use the menu navigation bar in the left panel to navigate to each web page. Some of the menu options are only displayed for specific system configurations. Use [Table 29](#) to locate information about using each web page.

Table 29 Menu options and web pages

Main menu	Menu option	Web page information
Status		Status page on page 54
Installation		Installation page on page 56
Configuration		Configuration menu on page 57
	Radio	Configuration > Radio page on page 58
	System	Configuration > System page on page 63
	Network	Configuration > Network page on page 67
	Security	Configuration > Security page on page 73
Monitor		Monitor menu on page 74
	Performance	Monitor > Performance page on page 75
	System	Monitor > System page on page 80
	Wireless	Monitor > Wireless Page on page 82
	Throughput Chart	Monitor > Throughput Chart page on page 86
	Network	Monitor > Network page on page 86
	System Log	Monitor > System Log Page on page 89
Tools		Tools menu on page 89
	Software Upgrade	Tools > Software Upgrade page on page 89
	Backup / Restore	Tools > Backup/Restore page on page 91
	Spectrum Analyzer	Tools > Spectrum Analyzer page on page 92

Main menu	Menu option	Web page information
-----------	-------------	----------------------

eAlign

Tools > Spectrum Analyzer page

Use the **Spectrum Analyzer** page to measure signal levels of frequencies across the full range of the device or in a custom range.

Figure 24 Tools > Spectrum Analyzer page

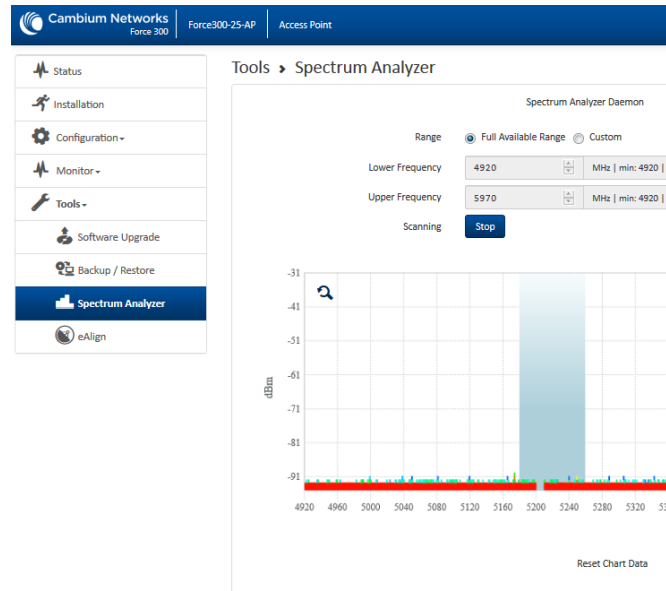


Table 44 Tools > Spectrum Analyzer page attributes

Attribute	Meaning
Spectrum Analyzer Daemon	Disabled: The Spectrum Analyzer process is disabled. Enabled: The Spectrum Analyzer process is enabled and necessary for displaying results in the web interface.
Range	Full Available Range: The entire operating range is scanned. Custom: The device scans only the range defined by the Lower Frequency and Upper Frequency .
Lower / Upper Frequency	When Range is configured to Custom , indicates the frequency range the device will scan.
Scanning	Click Start to begin scanning, and Stop to terminate scanning.

Tools > eAlign page on page 92

Wireless Link Test

Tools > Wireless Link Test page on page 95

Main menu	Menu option	Web page information
	Ping	Tools > Ping page on page 96
	Traceroute	Tools > Traceroute page on page 97

STATUS PAGE

Figure 7 Status page

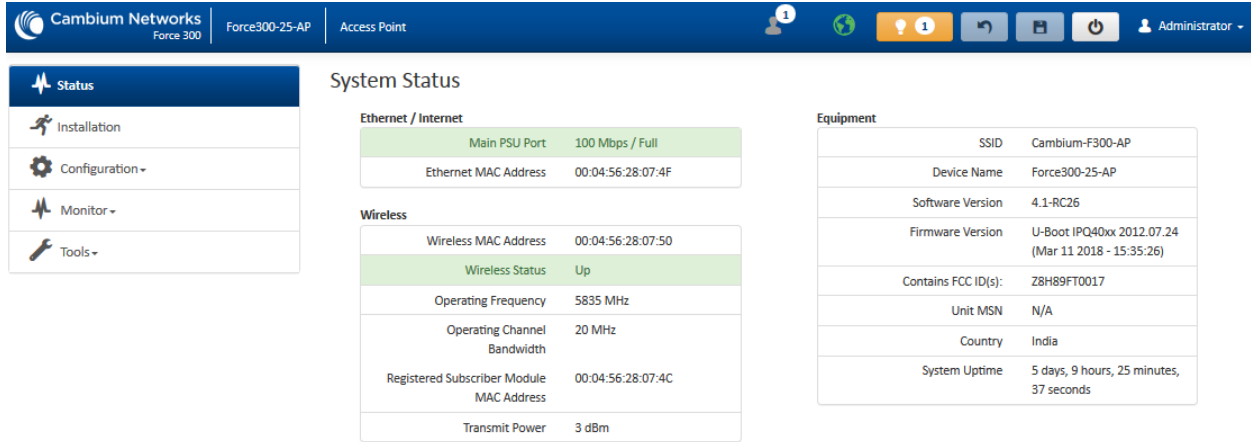


Table 30 Status page attributes

Attribute	Meaning
Ethernet / Internet	
Main PSU Port	Displays the current port speed and duplex mode to which the Ethernet port has auto-negotiated, or displays the current port speed and duplex mode that have been configured manually.
Ethernet MAC Address	The hardware address of the device LAN (Ethernet) interface.
Wireless	
Wireless MAC Address	MAC address is a unique identifier assigned to ath0/eth0 interface for communication on the physical network segment. The Wireless MAC address is always one greater than the Ethernet MAC Address.
Wireless Status (Access Point Mode)	Up: The device wireless interface is functioning and sending beacons. Down: The device wireless interface has encountered an error disallowing full operation. Reset the device to reinitiate the wireless interface.
Wireless Status (Subscriber Module Mode)	Up: The device wireless interface is functioning and the device has completed network entry.

Attribute	Meaning
	Down: The device wireless interface has encountered an error disallowing full operation. Evaluate radio and security configuration on the Access Point and Subscriber Module device to determine the network entry failure.
Operating Frequency	Indicates the current operating frequency for the radio interface.
Operating Channel Bandwidth	Indicates the current operating channel bandwidth for the radio interface.
Registered Subscriber Module MAC Address (Access Point Mode)	Indicates the MAC address of the Subscriber Module registered to the device.
Registered Access Point MAC Address (Subscriber Module Mode)	Indicates the MAC address of the Access Point to which the Subscriber Module is registered.
Transmit Power	The total transmit power of the device. The Subscriber Module has two transmit chains and total transmit power sums the power from both chains. This does not include antenna gain. Transmitter Output Power may be limited by regulatory rules for the country in use.
Equipment	
SSID (Access Point Mode)	SSID is a unique identifier for a wireless LAN which is specified in the Access Point's beacon. SSID must be same at both ends and different to site name.
Device Name	The configured identifier used in an NMS such as cnMaestro.
Software Version	The currently operating version of software on the device.
Firmware Version	U-boot software is used to boot and then invokes the software used for the device. This specifies the u-boot version number used on the device.
Contains FCC ID(s)	FCC ID of the device.
Unit MSN	Unit serial number.
Country	Defines the country code being used by the device. The country code of the Subscriber Module follows the country code of the associated Access Point, unless it is an FCC SKU in which case the country code is United States or Canada. Country code defines the regulatory rules in use for the device.

Attribute	Meaning
System Uptime	The total uptime of the radio since the last reset.

INSTALLATION PAGE

Figure 8 Installation page

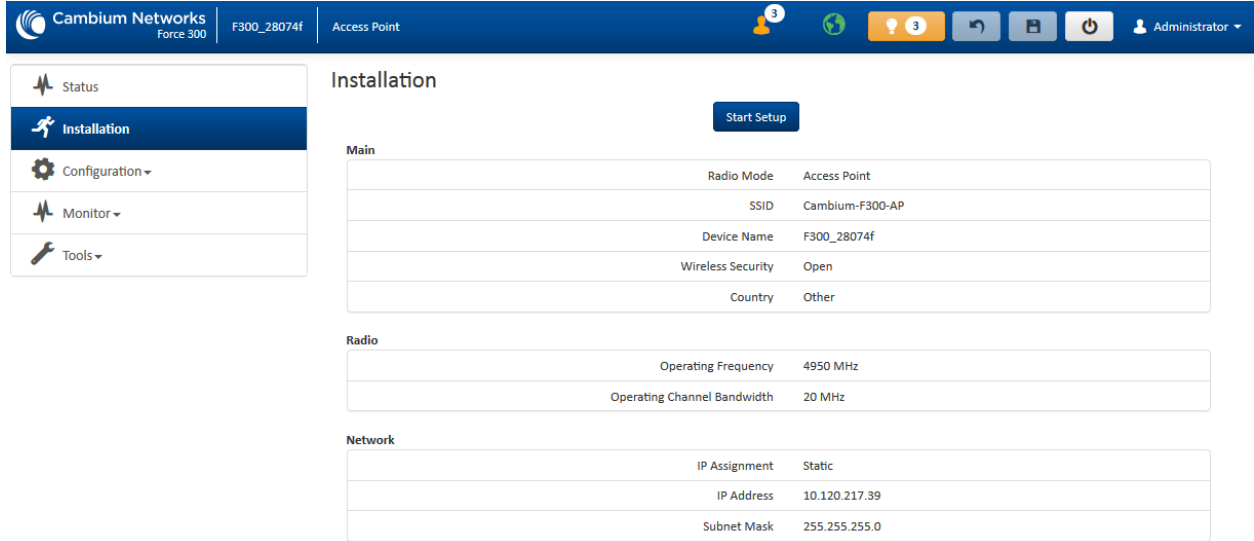




Table 31 Installation page attributes

Attribute	Meaning
<p>Start Setup</p> 	The installation page features a guided setup option Start Setup to configure key parameters for link operation. See section Using the installation wizard on page 44 for more information.
Main	
Radio Mode	<p>Access Point: The unit controls the point-to-point link and its maintenance. On startup, the Access Point transmits until a link with the Subscriber Module is made.</p> <p>Subscriber Module: The unit listens for its peer and only transmits when the peer has been identified.</p>
SSID (Access Point Mode)	SSID is a unique identifier for a wireless LAN which is specified in the Access Point’s beacon. (Access Point Mode). SSID must be same at both ends and different to site name.
Device Name	The configured identifier used in an NMS such as cnMaestro
Wireless Security (Access Point Mode)	Indicates the type of security used for Subscriber Modules registering to the Access Point.

Attribute	Meaning
Country	Defines the country code being used by the device. The country code of the Subscriber Module follows the country code of the associated Access Point, unless it is an FCC SKU in which case the country code is United States or Canada. Country code defines the regulatory rules in use for the device.
Radio	
Operating Frequency	The current frequency at which the device is operating.
Operating Channel Bandwidth	The current channel size at which the device is operating.
Network	
IP Assignment	<p>Static: Device management IP addressing is configured manually in fields IP Address, Subnet Mask, Gateway, Preferred DNS Server, and Alternate DNS Server.</p> <p>DHCP: Device management IP addressing (IP address, Subnet Mask, Gateway, and DNS Server) is assigned via a network DHCP server, and parameters IP Address, Subnet Mask, Gateway, Preferred DNS Server, and Alternate DNS Server are not configurable.</p>
IP Address	<p>Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network.</p> <p> Note</p> <p>If IP Address Assignment is set to DHCP and the device is unable to retrieve IP address information via DHCP, the device management IP is set to fallback IP 192.168.0.1 (Access Point) or 192.168.0.2 (Subscriber Module) .</p>
Subnet Mask	Defines the address range of the connected IP network. For example, if Device IP Address (LAN) is configured to 192.168.2.1 and IP Subnet Mask (LAN) is configured to 255.255.255.0, the device will belong to subnet 192.168.2.X.

CONFIGURATION MENU

Use the **Configuration** menu to access all applicable device configuration parameters.

Configuration > Radio page

Figure 9 Configuration > Radio page (Access Point Mode)

The screenshot displays the 'Configuration > Radio' page for an Access Point Mode. The interface includes a top navigation bar with the Cambium Networks logo, device ID 'F300_28074f', and 'Access Point' mode. A left sidebar contains navigation options: Status, Installation, Configuration, Radio (selected), System, Network, Security, Monitor, and Tools. The main content area is divided into several sections:

- General:** Radio Mode (Access Point selected), Driver Mode (TDD PTP), Point-To-Point Access (First Subscriber Module selected), and Country (Other).
- Access Point Configuration:** SSID (Cambium-F300-AP), Max Range (3 miles), and Range Unit (Miles selected).
- Power Control:** Antenna Gain (25 dBi) and Slave Module Target Receive Level (-55 dBm).
- Scheduler:** Downlink/Uplink Ratio (50/50 selected).
- Radio Configuration:** Channel Bandwidth (20 MHz selected), Frequency Carrier (4950 MHz), Transmitter Power (3 dBm), and Downlink Max Rate (DS MCS 9 - 256-QAM 5/6).

Figure 10 Configuration > Radio page (Subscriber Module Mode)

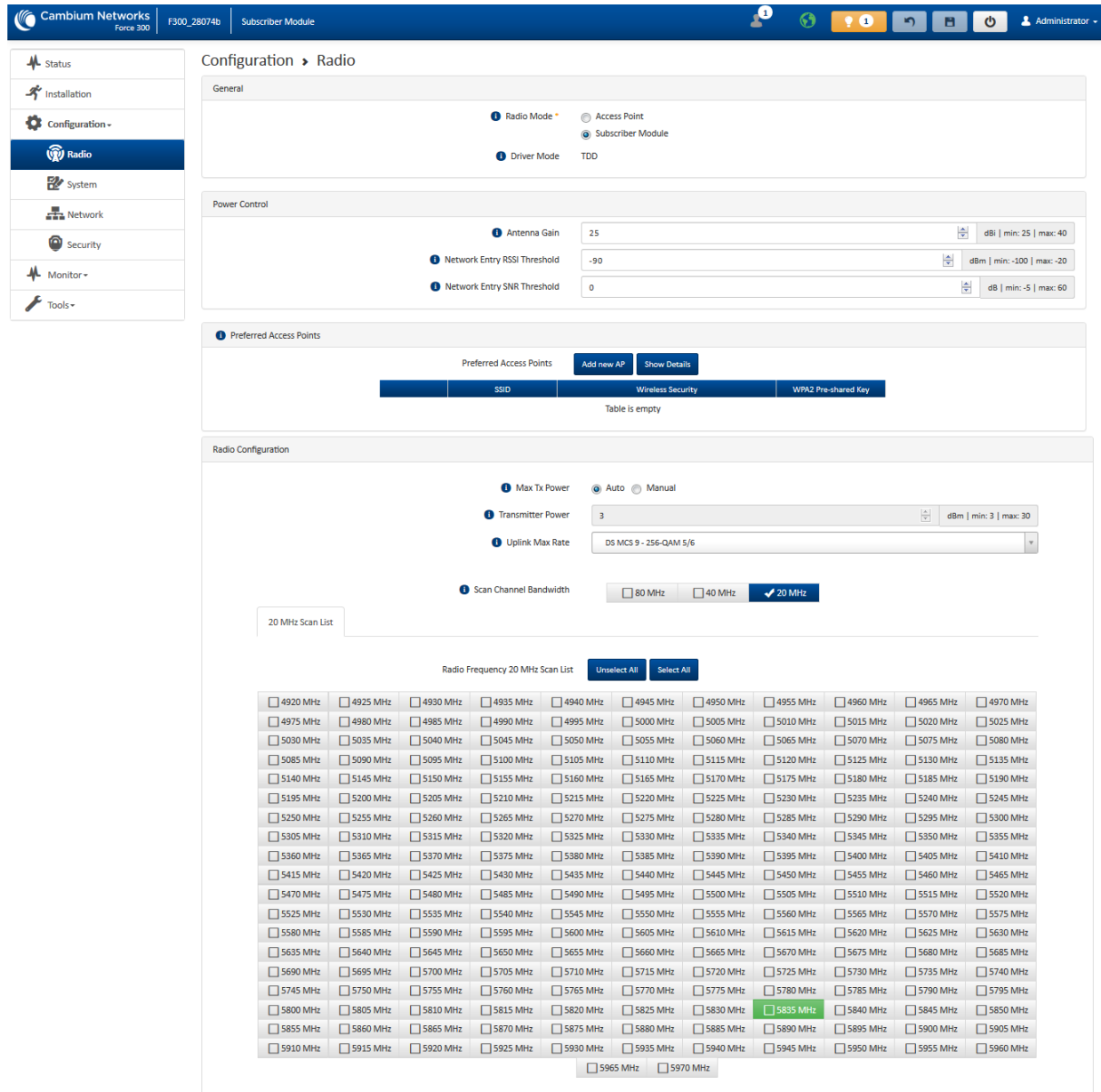


Table 32 Configuration > Radio page attributes

Attribute	Meaning
General	
Radio Mode	<p>Access Point: The unit controls the point-to-point link and its maintenance. On startup, the Access Point transmits until a link with the Subscriber Module is made.</p> <p>Subscriber Module: The unit listens for its peer and only transmits when the peer has been identified.</p>

Attribute	Meaning
Driver Mode	TDD PTP: The Access Point is operating in point-to-point (PTP) mode using TDD scheduling.
Point-To-Point Access (Access Point Mode)	First Subscriber Module: The system is configured to accept only the 1st registered Subscriber Module. Network entry is denied for all subsequent Subscriber Module network entry requests. MAC Filtering: The system is configured to accept only one Subscriber Module registration, and this registration is limited by Subscriber Module MAC Address (the Subscriber Module Wireless MAC Address).
Country (Access Point Mode)	Defines the country code being used by the device. The country code of the Subscriber Module follows the country code of the associated Access Point, unless it is an FCC SKU in which case the country code is United States or Canada. Country code defines the regulatory rules in use for the device.
Access Point Configuration (Access Point Mode)	
SSID (Access Point Mode)	SSID is a unique identifier for a wireless LAN which is specified in the Access Point's beacon. (Access Point Mode). SSID must be same at both ends and different to site name.
Max Range (Access Point Mode)	This parameter represents cell coverage radius. Subscriber Modules outside the configured radius will not be able to connect. It is recommended to configure Max Range to match the actual physical distance of the farthest subscriber.
Range Unit (Access Point Mode)	Units of measurement on the device are displayed in either miles (m) or kilometers (km).
Power Control	
Antenna Gain	The total gain of the antenna in use by the device. For integrated devices, this parameter defaults to 25 dBi.
Slave Module Target Receive Level (Access Point Mode)	Defines the desired receive power level at the Access Point from registered Subscriber Module. Access Points use this parameter to control the transmission power of the Subscriber Module in order to reduce system self-interference.
Network Entry RSSI Threshold (Subscriber Module Mode)	This defines the Downlink RSSI threshold below which a Subscriber Module will not register to a Access Point.
Network Entry SNR Threshold	This defines the Donwlink Signal-to-Noise-Ratio (SNR) threshold below which the Subscriber Module will not register to a Access Point.

Attribute	Meaning
(Subscriber Module Mode)	
Preferred Access Points (Subscriber Module Mode)	
Preferred Access Points list (Subscriber Module Mode)	The Preferred Access Points List is comprised of a list of up to 16 Access Point devices to which the Subscriber Module device sequentially attempts registration. For each Access Point configured, if authentication is required, enter the Wireless Security type and WPA2 Pre-shared Key associated with the configured SSID .
Scheduler (Access Point Mode)	
Downlink/Uplink Ratio (Access Point Mode)	The schedule of downlink traffic to uplink traffic on the radio link. The three options, 75/25 , 50/50 and 30/70 , allow the radio to operate in a fixed ratio on every frame. In other words, this ratio represents the amount of the total radio link's aggregate throughput that will be used for downlink resources, and the amount of the total radio link's aggregate throughput that will be used for uplink resources.
Radio Configuration	
Max Tx Power (Subscriber Module Mode)	Auto: The Access Point can control, using ATPC (Automatic Transmit Power Control), the TX power of the Subscriber Module up to the maximum capability of the Subscriber Module's transmitter (based on regulatory limits). Manual: The Access Point can control the TX power of the Subscriber Module up to the value configured in the Transmitter Power field.
Channel Bandwidth (Access Point Mode)	Configure the channel size used by the radio for RF transmission.
Frequency Carrier (Access Point Mode)	Configure the frequency carrier for RF transmission. This list is dynamically adjusted to the regional restrictions based on the setting of the Country parameter. Ensure that a thorough spectrum analysis has been completed prior to configuring this parameter.
Transmitter Power	The total transmit power of the radio interface. The device has two transmit chains for each channel and total transmit power sums the power from both chains. This does not include antenna gain. Transmitter Output Power may be limited by regulatory rules for the country in use.

Attribute	Meaning
Downlink Max Rate (Access Point Mode)	Specifies the maximum downlink MCS value that the Rate Adapt algorithm will choose for Radio 1. If an installation is exhibiting packet loss due to downlink interference, modifying Downlink Max Rate to limit the device maximum MCS rate may result in more reliable packet delivery. This is especially true in installations among changing and unpredictable interference.
Uplink Max Rate (Subscriber Module Mode)	Specifies the maximum uplink MCS value that the Rate Adapt algorithm will choose for Radio 1. If an installation is exhibiting packet loss due to uplink interference, modifying Uplink Max Rate to limit the device maximum MCS rate may result in more reliable packet delivery. This is especially true in installations among changing and unpredictable interference.
Scan Channel Bandwidth (Subscriber Module Mode)	The selected scan channel bandwidths are scanned by the Subscriber Module. Any combination may be selected. When a bandwidth is selected, a tab for the bandwidth appears and a listing of all available channels is presented once the tab for the bandwidth is selected. Each bandwidth tab may contain a number on the left side. This number defines how many channels have been selected for that bandwidth. If no channels are selected for a bandwidth, then all channels are scanned.

Configuration > System page

Figure 11 Configuration > System page

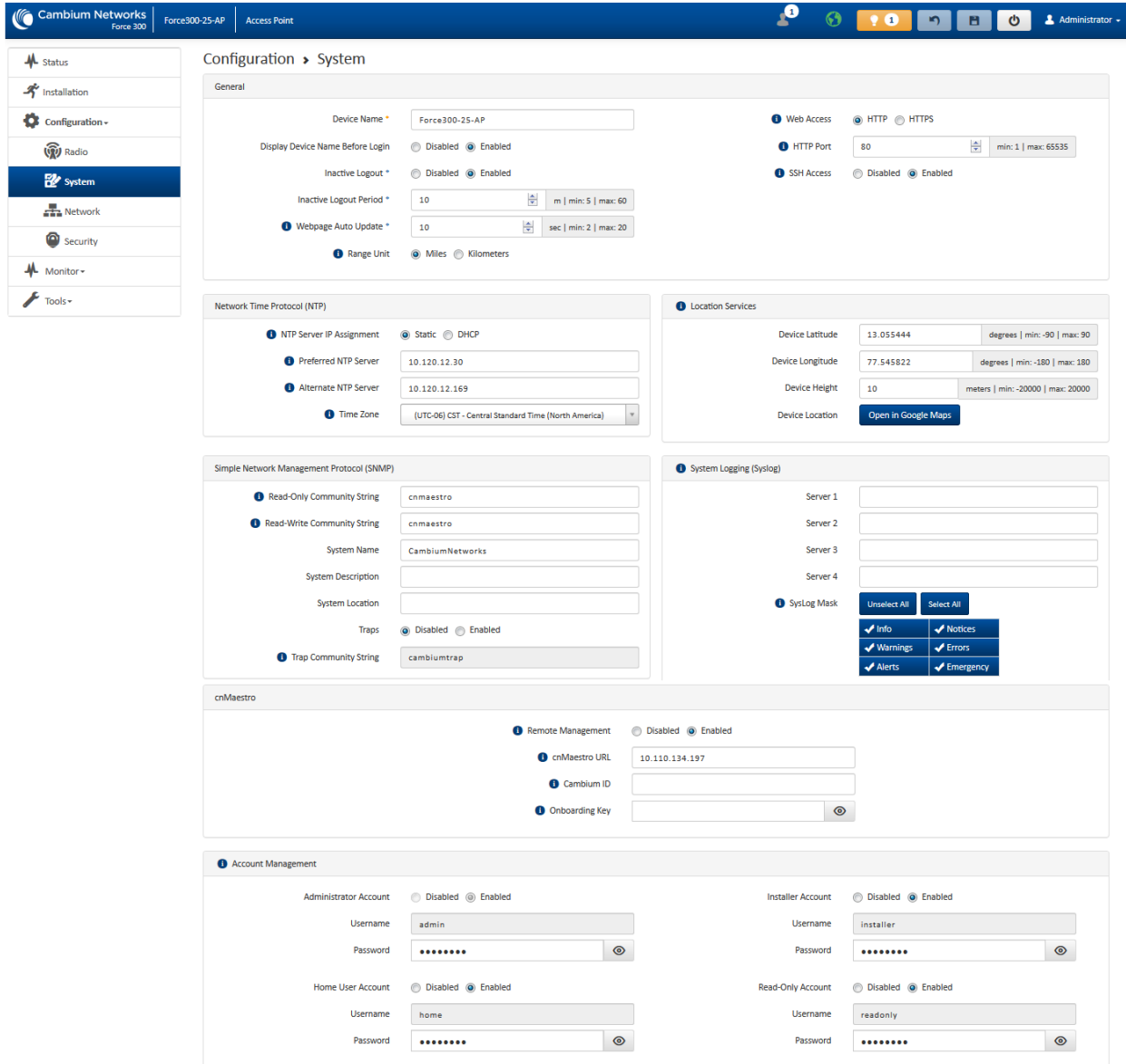







Table 33 Configuration > System page attributes

Attribute	Meaning
General	
Device Name	The configured identifier used in an NMS such as cnMaestro.
Display Device Name Before Login	Disabled: For security, the configured Device Name is hidden on the device login screen. Enabled: The configured Device Name is displayed upper-left on the device login screen.

Attribute	Meaning
Inactive Logout	<p>Disabled: The device will not automatically log out users after a period of inactivity.</p> <p>Enabled: After the period configured in Inactive Logout Period has lapsed, the device will automatically log out the user.</p>
Inactive Logout Period	Represents the amount of time for which a user will remain logged in. After this period has lapsed, the user will be automatically logged out.
Webpage Auto Update	<p>Configure the interval for which the device retrieves system statistics for display on the management interface. For example, if this setting is configured to 5 seconds, the statistics and status parameters displayed on the management interface will be refreshed every 5 seconds (default).</p> <p>Webpage Auto Update is a session only configuration change. It is updated with the <Enter> key and is not savable when using the save button.</p>
Range Unit	Units of measurement on the device are displayed in either miles (m) or kilometers (km).
Web Access	<p>HTTP: The device web management interface is accessed via HTTP.</p> <p>HTTPS: The device web management interface may only be accessed via secure HTTPS.</p>
HTTP Port	This specifies the TCP/UDP port to be used with HTTP or HTTPS. The default value for HTTP is 80 and for HTTPS is 443.
SSH Access	<p>Disabled: Access to the device through SSH is not possible.</p> <p>Enabled: Cambium engineers can access the device through SSH which enables them to login to the radio and troubleshoot. SSH Access is Enabled by default.</p>
Network Time Protocol (NTP)	
NTP Server IP Assignment	<p>Static: The device retrieves NTP time data from the servers configured in fields NTP Server IP Address.</p> <p>DHCP: The device retrieves NTP time data from the server IP issued via a network DHCP server.</p>
Preferred NTP Server	Configure the primary NTP server IP addresses from which the device will retrieve time and date information.
Alternate NTP Server	Configure an alternate or secondary NTP server IP addresses from which the device retrieves time and date information.
Time Zone	The Time Zone option may be used to offset the received NTP time to match the operator's local time zone.
Location Services	
Device Latitude	Configure Latitude information for the device in decimal format.
Device Longitude	Configure Longitude information for the device in decimal format.

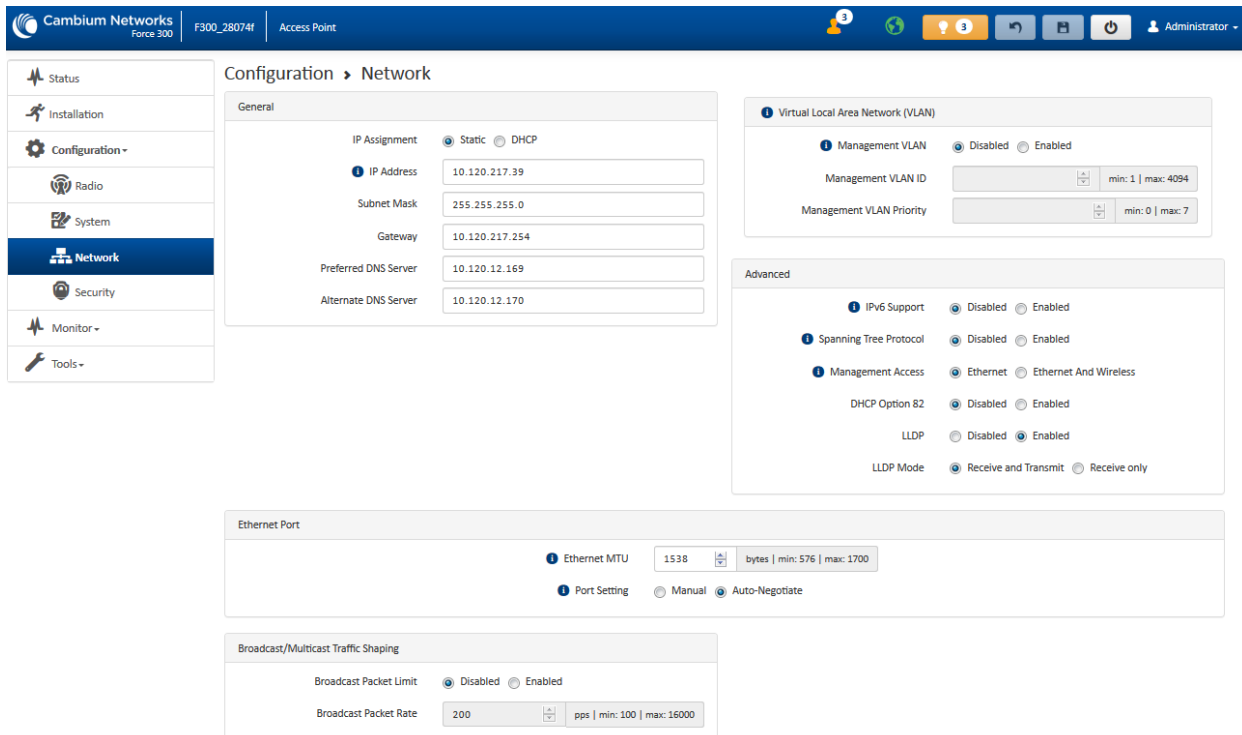
Attribute	Meaning
Device Height	Configure height above sea level for the device in meters.
Device Location	Hyperlink to display the device location in Google Maps Open in Google Maps
Simple Network Management Protocol (SNMP)	
Read-Only Community String	Specify a control string that can allow a Network Management Station (NMS) to read SNMP information. No spaces are allowed in this string. This password will never authenticate an SNMP user or an NMS to read/write access. The Read-only Community String value is clear text and is readable by a packet monitor.
Read-Write Community String	Specify a control string that can allow a Network Management Station (NMS) to access SNMP information. No spaces are allowed in this string.
System Name	Specify a string to associate with the physical module. This parameter can be polled by the NMS. Special characters are supported.
System Description	Specify a description string to associate with the physical module. This parameter can be polled by the NMS. Special characters are supported.
System Location	Specify a description string to associate with the physical location. This parameter can be polled by the NMS. Special characters are supported.
Traps	Disabled: SNMP traps for system events are not sent from the device. Enabled: SNMP traps for system events are sent to the servers configured in table Trap Servers .
Trap Community String	Configure a SNMP Trap Community String which is processed by the servers configured in Trap Servers . This string is used by the trap server to decide whether or not to process the traps incoming from the device (i.e. for traps to successfully be received by the trap server, the community string must match).
System Logging (Syslog)	
Server 1-4	Specify up to four syslog servers to which the device sends syslog messages.
Syslog Mask	Configure the levels of syslog messages which the devices send to the servers configured in parameters Server 1-4 .  Caution Choose only the syslog levels appropriate for your installation. Excessive logging can cause the device log file to fill and begin overwriting previous entries.

Attribute	Meaning
cnMaestro	
Remote Management	When Enabled , the device will be managed by cnMaestro - the Cambium Remote Management System, which allows all Cambium devices to be managed in the cloud.
cnMaestro URL	Configure the URL of cnMaestro. The default value is https://cloud.cambiumnetworks.com .
Cambium ID	Configure the Cambium ID that the device will use for on-boarding on to cnMaestro.
Onboarding Key	Configure the password/key associated with the Cambium-ID that the device will use for on-boarding on to cnMaestro.
Account Management	
Administrator Account	<p>The Administrator account has full read and write permissions for the device.</p> <p>Disabled: The disabled user is not granted access to the device management interface. The administrator user level cannot be disabled.</p> <p>Enabled: The user is granted access to the device management interface.</p>
Username	The username associated with the administrator account, used upon device login.
Password	Configure a custom password to secure the device. Only 'Administrator' account can override this password. The password character display may be toggled using the visibility icon  .
Installer Account	<p>The Installer account has permissions to read and write parameters applicable to unit installation and monitoring.</p> <p>Disabled: The disabled user is not granted access to the device management interface.</p> <p>Enabled: The user is granted access to the device management interface.</p>
Username	The username associated with the installer account, used upon device login.
Password	Configure a custom password to secure the device. Only 'Administrator' account can override this password. The password character display may be toggled using the visibility icon  .
Home User Account	<p>The Home User account has permissions to access pertinent information for support purposes.</p> <p>Disabled: The disabled user is not granted access to the device management interface.</p> <p>Enabled: The user is granted access to the device management interface.</p>

Attribute	Meaning
Username	The username associated with the home user account, used upon device login.
Password	Configure a custom password to secure the device. Only 'Administrator' account can override this password. The password character display may be toggled using the visibility icon  .
Read-Only Account	The Read-Only account has permissions to view the Monitor page only. Disabled: The disabled user is not granted access to the device management interface. Enabled: The user is granted access to the device management interface.
Username	The username associated with the read-only account, used upon device login.
Password	Configure a custom password to secure the device. Only 'Administrator' account can override this password. The password character display may be toggled using the visibility icon  .

Configuration > Network page

Figure 12 Configuration > Network page (Access Point Mode)



The screenshot displays the 'Configuration > Network' page for a Cambium Networks device in Access Point Mode. The interface includes a navigation sidebar on the left with options like Status, Installation, Configuration, Radio, System, Network (selected), Security, Monitor, and Tools. The main content area is divided into several configuration sections:

- General:** IP Assignment is set to Static. IP Address is 10.120.217.39, Subnet Mask is 255.255.255.0, Gateway is 10.120.217.254, Preferred DNS Server is 10.120.12.169, and Alternate DNS Server is 10.120.12.170.
- Virtual Local Area Network (VLAN):** Management VLAN is Disabled. Management VLAN ID is set to 1, and Management VLAN Priority is set to 0.
- Advanced:** IPv6 Support is Disabled. Spanning Tree Protocol is Disabled. Management Access is set to Ethernet. DHCP Option 82 is Disabled. LLDP is Enabled. LLDP Mode is set to Receive and Transmit.
- Ethernet Port:** Ethernet MTU is 1538 bytes. Port Setting is set to Auto-Negotiate.
- Broadcast/Multicast Traffic Shaping:** Broadcast Packet Limit is Disabled. Broadcast Packet Rate is set to 200 pps.

Figure 13 Configuration > Network page (Subscriber Module Mode)

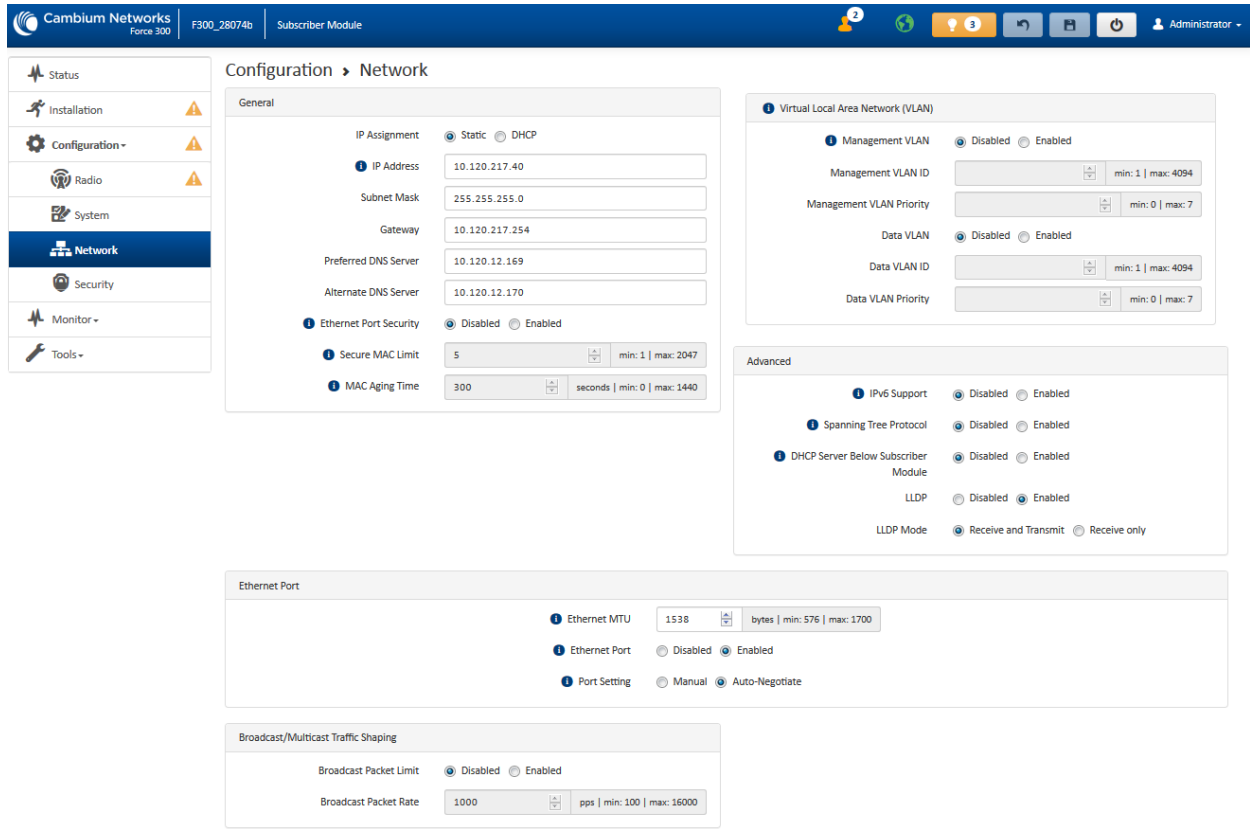




Table 34 Configuration > Network page attributes

Attribute	Meaning
General	
IP Assignment	<p>Static: Device management IP addressing is configured manually in fields IP Address, Subnet Mask, Gateway, Preferred DNS Server, and Alternate DNS Server.</p> <p>DHCP: Device management IP addressing (IP address, Subnet Mask, Gateway, and DNS Server) is assigned via a network DHCP server, and parameters IP Address, Subnet Mask, Gateway, Preferred DNS Server, and Alternate DNS Server are not configurable.</p>
IP Address	<p>Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network.</p> <p> Note</p> <p>If IP Address Assignment is set to DHCP and the device is unable to retrieve IP address information via DHCP, the device management IP is set to fallback IP 192.168.0.1 (Access Point) or 192.168.0.2 (Subscriber Module).</p>

Attribute	Meaning
Subnet Mask	Defines the address range of the connected IP network. For example, if Device IP Address (LAN) is configured to 192.168.2.1 and IP Subnet Mask (LAN) is configured to 255.255.255.0, the device will belong to subnet 192.168.2.X.
Gateway	Configure the IP address of the device on the current network that acts as a gateway. A gateway acts as an entrance and exit to packets from and to other networks.
Preferred DNS Server	Configure the primary IP address of the server used for DNS resolution.
Alternate DNS Server	Configure the secondary IP address of the server used for DNS resolution.
IPv6 Assignment	<p>IPv6 Assignment specifies how the IPv6 address is obtained.</p> <p>Static: Device management IP addressing is configured manually in fields IPv6 Address and IPv6 Gateway.</p> <p>DHCPv6: Device management IP addressing (IP address and gateway) is assigned via a network DHCP server, and parameters IPv6 Address and IPv6 Gateway are unused. If the DHCPv6 server is not available previous static IPv6 address will be used as a fallback IPv6 address. If no previous static IPv6 address is available, no IPv6 address will be assigned. DHCPv6 will occur over the wireless interface by default.</p>
IPv6 Address	Internet protocol version 6 (IPv6) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network. IPv6 addresses are represented by eight groups of four hexadecimal digits separated by colons.
IPv6 Gateway	Configure the IPv6 address of the device on the current network that acts as a gateway. A gateway acts as an entrance and exit to packets from and to other networks.
Ethernet Port Security (Subscriber Module Mode)	<p>Disabled: No MAC address limit / gaining timers are imposed for bridging at the Subscriber Module device Ethernet port.</p> <p>Enabled: By configuring Secure MAC Limit and MAC Aging Time, a limit is imposed on the number and duration of bridged devices connected to the Subscriber Module Ethernet port.</p>
Secure MAC Limit (Subscriber Module Mode)	Configure the number of simultaneous secure MAC addresses that will be allowed at the Ethernet interface of the Subscriber Module
MAC Aging Time (Subscriber Module Mode)	Configure the time for which the secure MAC addresses should be allowed to age. Once the Aging timer expires for a MAC address, it will be removed from the internal table and no longer count as an active MAC. Set the time to 0 to disable aging.

Attribute	Meaning
Virtual Local Area Network (VLAN)	
Management VLAN	<p>Enabled: The device management interface can be assigned to a Management VLAN to separate management traffic (remote module management via SNMP or HTTP) from user traffic (such as internet browsing, voice, or video). Once the management interface is enabled for a VLAN, the management interface can be accessed only by packets tagged with a VLAN ID matching the management VLAN ID.</p> <p>A VLAN configuration establishes a logical group within the network. Each computer in the VLAN, regardless of initial or eventual physical location, has access to the same data based on the VLAN architecture. For the network operator, this provides flexibility in network segmentation, simpler management and enhanced security.</p> <p>Disabled: When disabled, all IP management traffic is allowed to the device.</p>
Management VLAN ID	<p>Configure this parameter to include the device's management traffic on a separate VLAN network. For example, if Management VLAN ID is set to 2, GUI access will only be allowed from frames tagged with VLAN ID 2. This parameter only takes effect if the MGMT VLAN parameter is enabled.</p>
Management VLAN Priority	<p>ePMP devices can prioritize VLAN traffic based on the eight priorities described in the IEEE 802.1p specification. Management VLAN Priority represents the VLAN Priority or Class of Service (CoS). Operators may use this prioritization field to give precedence to device management traffic.</p> <p>This parameter only takes effect if the Management VLAN parameter is enabled. Configure this parameter to set the value of the Priority code point field in the 802.1q tag for traffic on the management VLAN originating from the Subscriber Module. The default value is 0.</p>
Data VLAN (Subscriber Module Mode)	<p>Enabled: A VLAN tag will be added to all untagged traffic entering the Subscriber device LAN port before sending it to the Access Point and remove tags in the opposite direction from traffic (tagged with Data VLAN ID) entering on the Subscriber Module device WAN port before sending to the Subscriber Module device LAN port.</p> <p>Disabled: When disabled, no changes are made to untagged traffic passing through the Subscriber Module device.</p>
Data VLAN ID (Subscriber Module Mode)	<p>Configure this parameter to include this VLAN tag to all untagged traffic entering on the Subscriber Module device LAN port before sending it to the Access Point device and remove tags in the opposite direction from traffic (tagged with Data VLAN ID) entering on the Subscriber Module device WAN port before sending to the Subscriber Module device LAN port.</p>

Attribute	Meaning
Data VLAN Priority (Subscriber Module Mode)	<p>ePMP devices can prioritize VLAN traffic based on the eight priorities described in the IEEE 802.1p specification. Data VLAN Priority represents the VLAN Priority or Class of Service (CoS). Operators may use this prioritization field to give precedence to device user data.</p> <p>This parameter only takes effect if the Data VLAN parameter is enabled. Configure this parameter to set the value of the Priority code point field in the 802.1q tag for traffic on the Data VLAN originating from the Subscriber Module device. The default value is 0.</p>
Advanced	
IPv6 Support	Systemwide IPv6 Protocol Support. When enabled, appropriate IPv6 modules and services will be loaded.
Spanning Tree Protocol	<p>Disabled: When disabled, Spanning Tree Protocol (802.1d) functionality is disabled at the Access Point.</p> <p>Enabled: When enabled, Spanning Tree Protocol (802.1d) functionality is enabled at the Access Point, allowing for prevention of Ethernet bridge loops.</p>
DHCP Server Below Subscriber Module (Subscriber Module Mode)	<p>Disabled: This blocks DHCP servers connected to the Subscriber Module device LAN side from handing out IP addresses to DHCP clients above the Subscriber Module device (wireless side).</p> <p>Enabled: This allows DHCP servers connected to the Subscriber Module device LAN side to assign IP addresses to DHCP clients above the Subscriber Module device (wireless side). This configuration is typical in PTP links.</p>
Management Access (Access Point Mode)	<p>Ethernet: Only allow access to the Access Point's web management interface via a local Ethernet (LAN) connection. In this configuration, the Access Point's web management interface may not be accessed from over the air (i.e. from a device situated below the Subscriber Module).</p> <p>Ethernet and Wireless: Allow access to the Access Point's web management interface via a local Ethernet (LAN) connection and from over the air (i.e. from a device situated below the Subscriber Module).</p> <hr/> <p> Caution</p> <p>Access Points configured with Management Access Interface set to Ethernet and Ethernet and Wireless are susceptible to unauthorized access.</p>
DHCP Option 82 (Access Point Mode)	<p>Disabled: The device does not insert the "remote-id" (option ID 0x2) and the "circuit-id" (ID 0x01). DHCP Option 82 is 'Disabled' by default.</p> <p>Enabled: The device inserts "remote-id" (option ID 0x2) to be the Subscriber Module MAC address and the "circuit-id" (ID 0x01) to be the Access Point's MAC address. Those two fields are used to identify the remote device and connection from which the DHCP request was received.</p>

Attribute	Meaning
LLDP	<p>The Link Layer Discovery Protocol (LLDP) is a vendor-neutral link layer protocol (as specified in IEEE 802.1AB) used by ePMP for advertising its identity, capabilities, and neighbors on the Ethernet/wired interface.</p> <p>Disabled: ePMP does not receive or transmit LLDP packets from/to its neighbors.</p> <p>Enabled: ePMP can receive LLDP packets from its neighbors and send LLDP packets to its neighbors, depending on the LLDP Mode configuration below.</p>
LLDP Mode	<p>Receive and Transmit: ePMP sends and receives LLDP packets to/from its neighbors on the Ethernet/LAN interface.</p> <p>Receive Only: ePMP receives LLDP packets from its neighbors on the Ethernet/LAN interface and discovers them.</p>
Ethernet Port	
Ethernet MTU	<p>Specify the device MTU or Maximum Transmission Unit; the size in bytes of the largest data unit that the device is configured to process. Larger MTU configurations can enable the network to operate with greater efficiency, but in the case of retransmissions due to packet errors, efficiency is reduced since large packets must be resent in the event of an error.</p>
Ethernet Port (Subscriber Module Mode)	<p>Disabled: The primary Ethernet port is disabled (a mechanism for restricting access for non-payment).</p> <p>Enabled: The primary Ethernet port is enabled.</p>
Port Setting	<p>Allows the Gigabit Ethernet port duplex settings and port speed to be either manually configured or auto-negotiated with the connected ethernet device on the other end of the link.</p> <p>Guidelines for using Port Setting:</p> <ol style="list-style-type: none"> 1. When auto-negotiation is turned on, this applies to both Port Speed and Port Duplex Mode. 2. If the other end of the ethernet connection supports auto-negotiation, then Auto-Negotiate should be selected. 3. If the other end of the ethernet connection does not support auto-negotiation, then Manual should be selected and both ends of the link should manually set the port speed and port duplex mode.
Port Speed	<p>With Port Setting configured to Manual, the Gigabit Ethernet port speed can be forced to 1000 Mbps, 100 Mbps or 10 Mbps.</p>
Port Duplex Mode	<p>With Port Setting configured to Manual, the Gigabit Ethernet port duplex mode can be forced to Full or Half.</p>

Configuration > Security page

The **Security** page is used to configure system security features including authentication and Layer2/Layer3 Firewall rules.



Caution

If a device firewall rule is added with **Action** set to **Deny** and **Interface** set to **LAN** or **WAN** and no other rule attribute are configured, the device will drop all Ethernet or wireless traffic, respectively. Ensure that all firewall rules are specific to the type of traffic which must be denied, and that no rules exist in the devices with only **Action** set to **Deny** and **Interface** set to **LAN** or **WAN**. To regain access to the device, perform a factory default.

Figure 14 Configuration > Security page

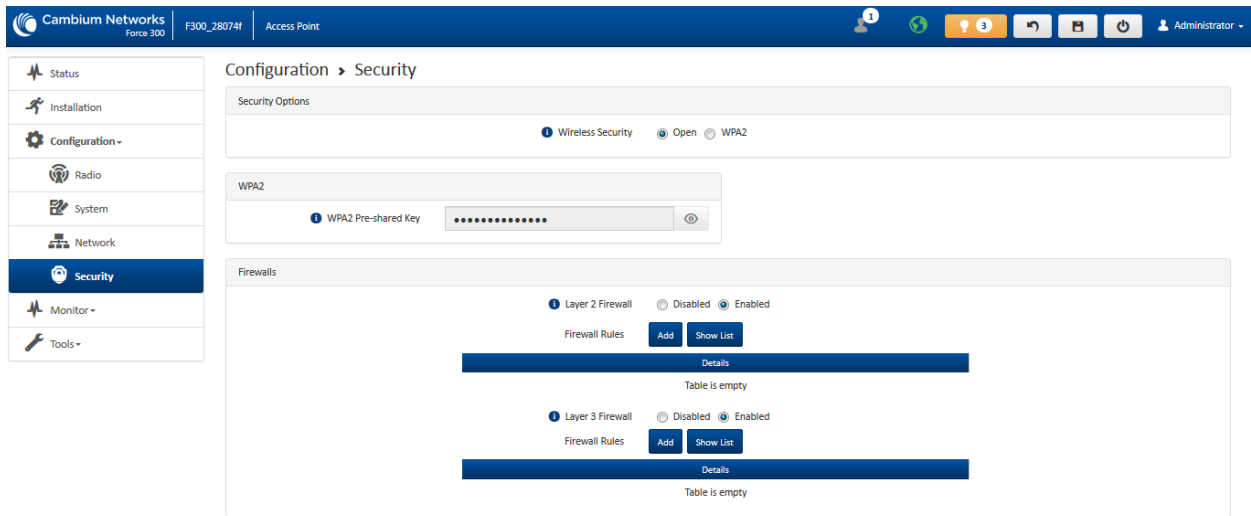


Table 35 Configuration > Security page attributes

Attribute	Meaning
Security Options	
Wireless Security	For Access Point mode devices, select the security mode enforced upon network entry. For Subscriber Module mode devices, select the security mode utilized upon network entry attempts. Open: All Subscriber Module devices requesting network entry are allowed registration. WPA2: The WPA2 mechanism provides AES radio link encryption and Subscriber Module network entry authentication. When enabled, the Subscriber Module must register using the Authentication Pre-shared Key configured on the Access Point and Subscriber Module.
Security Options	

Attribute	Meaning
WPA2 Pre-shared Key	Configure this key on the Access Point, then configure the Subscriber Module with this key to complete the authentication configuration. This key must be between 8 to 128 symbols.
Firewalls	
Layer 2 Firewall	<p>Enabled: Modifications to the Layer 2 Firewall Table are allowed and rules are enforced.</p> <p>Disabled: Modifications to the Layer 2 Firewall Table are not allowed and rules are not enforced.</p>
Layer 2 Firewall Rules	The Layer 2 firewall table may be used to configure rules matching layer 2 (MAC layer) traffic which result in forwarding or dropping the traffic over the radio link or Ethernet interface.
Layer 3 Firewall	<p>Disabled: Modifications to the Layer 3 Firewall Table are not allowed and rules are not enforced.</p> <p>Enabled: Modifications to the Layer 3 Firewall Table are allowed and rules are enforced.</p>
Layer 3 Firewall Rules	The Layer 3 firewall table may be used to configure rules matching layer 3 (IP layer) traffic which result in forwarding or dropping the traffic over the radio link or Ethernet interface.

MONITOR MENU

Use the **Monitor** menu to access device and network statistics and status information. This section may be used to analyze and troubleshoot network performance and operation.

Monitor > Performance page

Figure 15 Monitor > Performance page

The screenshot displays the 'Monitor > Performance' page for a Cambium Networks device (F300_28074b). The interface includes a navigation sidebar on the left with options like Status, Installation, Configuration, Monitor, Performance (selected), System, Wireless, Throughput Chart, Network, System Log, and Tools. The main content area is titled 'Monitor > Performance' and contains several data panels:

- Reset Statistics:** Shows 'Time Since Last Reset' as 0000:11:01:20 and a 'Reset Stats' button.
- Ethernet Statistics - Transmitted:** Lists metrics such as Total Traffic (0 Kbits), Total Packets (0), Packet Errors (0), Packet Drops (0), Multicast / Broadcast Traffic (0 Kbits), Broadcast Packets (0), and Multicast Packets (0).
- Ethernet Statistics - Received:** Lists metrics such as Total Traffic (0 Kbits), Total Packets (0), Packet Errors (0), Packet Drops (0), Multicast / Broadcast Traffic (0 Kbits), Broadcast Packets (0), and Multicast Packets (0).
- Wireless Statistics - Downlink:** Lists metrics such as Total Traffic (209442 Kbits), Total Packets (124508), Error Drop Packets (0), Multicast / Broadcast Traffic (173865 Kbit), Broadcast Packets (0), and Multicast Packets (0).
- Wireless Statistics - Uplink:** Lists metrics such as Total Traffic (179879 Kbits), Total Packets (67875), Error Drop Packets (0), Capacity Drop Packets (0), Retransmission Packets (0), Multicast / Broadcast Traffic (0 Kbits), Broadcast Packets (0), Multicast Packets (0), Link Quality (Uplink) (1%), and Link Capacity (Uplink) (1%).
- System Statistics:** Lists metrics such as Session Drops (0) and Device Reboots (16).
- Downlink Packets Per MCS:** A table showing packet counts and percentages for various MCS and QAM combinations (e.g., DS MCS 9 - 256-QAM 5/6: 60213 (100%), SS MCS 9 - 256-QAM 5/6: 0 (0%)).
- Uplink Packets Per MCS:** A table showing packet counts and percentages for various MCS and QAM combinations (e.g., DS MCS 9 - 256-QAM 5/6: 67968 (100.5%), SS MCS 9 - 256-QAM 5/6: 0 (0%)).

Table 36 Monitor > Performance page attributes

Attribute	Meaning
Reset Statistics	

Attribute	Meaning
Time Since Last Reset	Time since the stats were last reset.
Ethernet Statistics – Transmitted	
Total Traffic	Total amount of traffic in Kbits transferred from the device Ethernet interface.
Total Packets	Total number of packets transferred from the device Ethernet interface.
Packet Errors	Total number of packets transmitted out of the device Ethernet interface with errors due to collisions, CRC errors, or irregular packet size.
Packet Drops	Total number of packets dropped prior to sending out of the device Ethernet interface due to Ethernet setup or filtering issues.
Multicast / Broadcast Traffic	Total amount of multicast and broadcast traffic in Kbits sent via the device Ethernet interface.
Broadcast Packets	Total number of broadcast packets sent via the device Ethernet interface.
Multicast Packets	Total number of multicast packets sent via the device Ethernet interface.
Ethernet Statistics – Received	
Total Traffic	Total amount of traffic in Kbits received by the device Ethernet interface.
Total Packets	Total number of packets received by the device Ethernet interface.
Packet Errors	Total number of packets received by the device Ethernet interface with errors due to collisions, CRC errors, or irregular packet size.
Packet Drops	Total number of packets dropped prior to sending out of the device wireless interface due to Ethernet setup or filtering issues.
Multicast / Broadcast Traffic	Total amount of multicast and broadcast traffic in Kbits received by the device Ethernet interface.
Broadcast Packets	Total number of broadcast packets received via the device Ethernet interface.
Multicast Packets	Total number of multicast packets received via the device Ethernet interface.
Wireless Statistics – Downlink	
Total Traffic	Total amount of traffic transmitted out of the device wireless interface in Kbits.
Total Packets	Total number of packets transmitted out of the device wireless interface.
Error Drop Packets	Total number of packets dropped after transmitting out of the device Wireless interface due to RF errors (No acknowledgement and other RF related packet error).

Attribute	Meaning
Capacity Drop Packets (Access Point Mode)	Total number of packets dropped after transmitting out of the device wireless interface due to capacity issues (data buffer/queue overflow or other performance or internal packet errors).
Retransmission Packets (Access Point Mode)	Total number of packets re-transmitted after transmitting out of the device wireless interface due to the packets not being received by the receiving device.
Multicast / Broadcast Traffic	Total amount of multicast and broadcast traffic transmitted out of the device wireless interface in Kbits.
Broadcast Packets	Total number of broadcast packets transmitted out of the device wireless interface.
Multicast Packets	Total number of multicast packets transmitted out of the device wireless interface.
Wireless Statistics – Uplink	
Total Traffic	Total amount of traffic received via the device wireless interface in Kbits.
Total Packets	Total number of packets received via the device wireless interface.
Error Drop Packets	Total number of packets dropped prior to sending out of the device Ethernet interface due to RF errors (packet integrity error and other RF related packet error).
Capacity Drop Packets (Subscriber Module Mode)	Total number of packets dropped after transmitting out of the device wireless interface due to capacity issues (data buffer/queue overflow or other performance or internal packet errors).
Multicast / Broadcast Traffic	Total amount of multicast and broadcast traffic received on the device wireless interface in Kbits.
Broadcast Packets	Total number of broadcast packets received on the device wireless interface.
Multicast Packets	Total number of multicast packets received on the device wireless interface.
Link Quality (Uplink) (Subscriber Module Mode)	<p>Defines the Packet Error Rate (PER) in the uplink direction by percentage. A background color corresponds to a percentage range.</p> <p>Blue is between 80 and 100%.</p> <p>Green is between 50 and 80%.</p> <p>Yellow is between 30 and 50%.</p> <p>Red is between 0 and 30%.</p>

Attribute	Meaning
Link Capacity (Uplink) (Subscriber Module Mode)	<p>Defines the capacity of the uplink as defined by MCS. DS MCS 9 provides the greatest capacity. SS MCS 1 provides the least. Capacity of the link is defined as the percentage throughput of the actual link as compared to a link that was always running at DS MCS 9. A background color corresponds to a percentage range.</p> <p>Blue is between 80 and 100%.</p> <p>Green is between 50 and 80%.</p> <p>Yellow is between 30 and 50%.</p> <p>Red is between 0 and 30%.</p>
System Statistics	
Session Drops	Total number of Subscriber Module sessions dropped on the Access Point.
Device Reboots	Total number of reboots of the device.
Network Entry Attempts (Access Point Mode)	Total number of Network Entry Attempts by Subscriber Module devices.
Successful Network Entries (Access Point Mode)	Total number of successful network entry attempts.
Network Entry Authentication Failures (Access Point Mode)	Total number of failed Network Entry Attempts by Subscriber Module devices.
Subscriber Module Statistics (Access Point Mode)	
MAC Address	MAC Address of the Subscriber Module connected to the Access Point.
Total Uplink (Kbits)	Total amount of traffic received via the Access Point wireless interface from the Subscriber Module in Kbits.
Total Uplink Packets	Total number of packets received via the Access Point wireless interface from this Subscriber Module.
Uplink Packet Drops	Total number of packets dropped prior to sending out of the Access Point Ethernet interface due to RF errors (packet integrity error and other RF related packet error) from the Subscriber Module.
Total Downlink (Kbits)	Total amount of traffic transmitted out of the Access Point wireless interface in Kbits.
Total Downlink Packets	Total number of packets transmitted out of the Access Point wireless interface.

Attribute	Meaning
Downlink Packet Drops	Total number of packets dropped after transmitting out of the Access Point wireless interface due to RF errors (No acknowledgement and other RF related packet error).
Downlink Capacity Packet Drops	Total number of packets dropped after transmitting out of the Access Point Wireless interface due to capacity issues (data buffer/queue overflow or other performance or internal packet errors).
Downlink Retransmitted Packets	Total number of packets re-transmitted after transmitting out of the Access Point Wireless interface due to the packets not being received by the Subscriber Module.
Downlink Power (dBm)	The transmit power of the Access Point for the downlink packets to the Subscriber Module.
Downlink Packets Per MCS	
MCS 1 – MCS 9 DS / SS	Number of packets (and percentage of total packets) transmitted out of the device wireless interface for every modulation mode used by the device transmitter, based on radio conditions. DS represents dual-stream transmissions and SS represents single-stream transmissions.
Uplink Packets Per MCS	
MCS 1 – MCS 9 DS / SS	Number of packets (and percentage of total packets) received on the device wireless interface for every modulation mode, based on radio conditions. DS represents dual-stream transmissions and SS represents single-stream transmissions.
Downlink Frame Time	
Total Frame Time Used (Access Point Mode)	Percentage of frame time used in the uplink.

Monitor > System page

Figure 16 Monitor > System page

Table 37 Monitor > System page attributes

Attribute	Meaning
Hardware Version	Board hardware version information.
Unit MSN	Serial Number information.
Firmware Version	U-Boot version information.
Software Version	The currently operating version of software on the device.
Software Version (Active Bank)	The currently operating version of software on the device.
Software Version (Inactive Bank)	The backup software version on the device, used upon failure of the active bank. Two software upgrades in sequence will update both the Active Software Bank Version and the Inactive Software Bank Version .
Device-Agent Version	The operating version of the device agent, which is used for communication with cnMaestro.
Date and Time	Current date and time, subject to time zone offsets introduced by the configuration of the device Time Zone parameter. Until a valid NTP server is configured, this field will display the time configured from the factory.
System Uptime	The total system uptime since the last device reset.
Wireless MAC Address	The hardware address of the device wireless interface.

Attribute	Meaning
Ethernet MAC Address	The hardware address of the device LAN (Ethernet) interface.
DFS Status	<p>N/A: DFS operation is not required for the region configured in parameter Country Code.</p> <p>Channel Availability Check: Prior to transmitting, the device must check the configured Frequency Carrier for radar pulses for 60 seconds). If no radar pulses are detected, the device transitions to state In-Service Monitoring.</p> <p>In-Service Monitoring: Radio is transmitting and receiving normally while monitoring for radar pulses which require a channel move.</p> <p>Radar Signal Detected: The receiver has detected a valid radar pulse and is carrying out detect-and-avoid mechanisms (moving to an alternate channel).</p> <p>In-Service Monitoring at Alternative Channel: The radio has detected a radar pulse and has moved operation to a frequency configured in DFS Alternative Frequency Carrier 1 or DFS Alternative Frequency Carrier 2.</p> <p>System Not In Service due to DFS: The radio has detected a radar pulse and has failed channel availability checks on all alternative frequencies. The non-occupancy time for the radio frequencies in which radar was detected is 30 minutes.</p>
Contains FCC ID(s)	The device FCC ID.
Read-Only Users	Displays the number of active Read-Only users logged into the radio.
Read-Write Users	Displays the number of active Read-Write users logged into the radio.
Factory Reset Via Power Sequence	<p>Enabled: When Enabled under Tools->Backup/Restore->Reset Via Power Sequence, it is possible to reset the radio's configuration to factory defaults using the power cycle sequence explained under Resetting ePMP to factory defaults by power cycling on page 103.</p> <p>Disabled: When Disabled, it is not possible to factory default the radio's configuration using the power cycle sequence.</p>
cnMaestro Connection Status	The current management status of the device with respect to the Cambium Cloud Server. When Enabled under Configuration->System , the device will be managed by the Cambium Remote Management System, which allows all Cambium devices to be managed from the Cambium Cloud Server.
cnMaestro Account ID	The ID that the device is currently using to be managed by the Cambium Cloud Server.

Monitor > Wireless Page

Figure 17 Monitor > Wireless page (Access Point Mode)

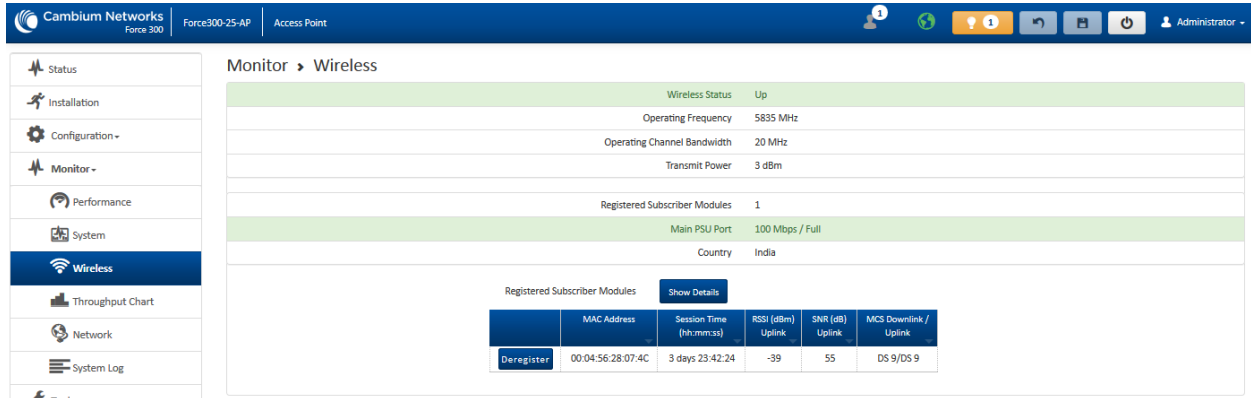


Figure 18 Monitor > Wireless page (Subscriber Module Mode)

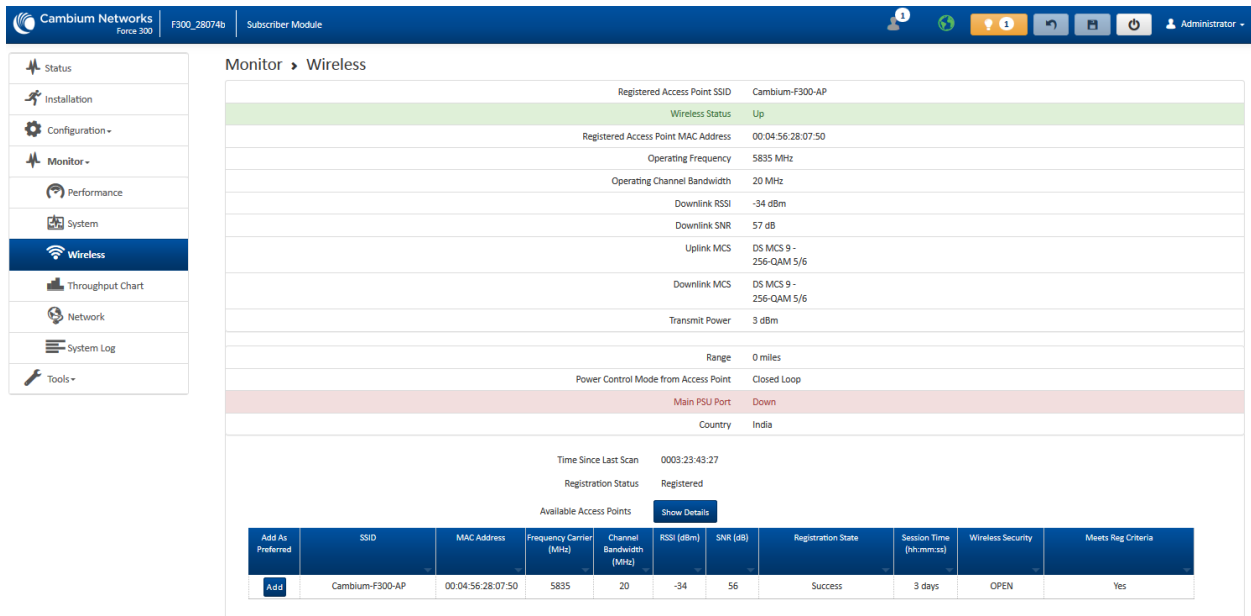




Table 38 Monitor > Wireless page attributes

Attribute	Meaning
Registered Access Point SSID (Subscriber Module Mode only)	SSID of the Access Point to which the Subscriber Module is registered.
Wireless Status (Access Point Mode)	Up: The device wireless interface is functioning and sending beacons. Down: The device wireless interface has encountered an error disallowing full operation. Reset the device to reinitiate the wireless interface.

Attribute	Meaning
Wireless Status (Subscriber Module Mode)	Up: The device wireless interface is functioning and the device has completed network entry. Down: The device wireless interface has encountered an error disallowing full operation. Evaluate radio and security configuration on the Access Point and Subscriber Module device to determine the network entry failure.
Registered Access Point MAC Address (Subscriber Module Mode)	Wireless MAC address of the Access Point to which the Subscriber Module is registered.
Range (Subscriber Module Mode)	The calculated distance from the Access Point, determined by radio signal propagation delay.
Operating Frequency	The current frequency at which the device is operating.
Operating Channel Bandwidth	The current channel size at which the device is transmitting and receiving.
Downlink RSSI (Subscriber Module Mode)	The level of signal being received from the Access Point.
Downlink SNR (Subscriber Module Mode)	The Signal-to-Noise Ratio of the signal being received from the Access Point.
Transmitter Power	The current power level at which the device is transmitting.
Uplink MCS (Subscriber Module Mode)	Specifies the current MCS utilized for uplink transmission.
Registered Subscriber Modules (Access Point Mode)	The count of registered Subscriber Modules.
Main PSU Port	The speed and duplex at which the configured LAN port is operating.

Attribute	Meaning
Country	Defines the country code being used by the device. The country code of the Subscriber Module follows the country code of the associated ACCESS POINT, unless it is an FCC SKU in which case the country code is United States or Canada. Country code defines the regulatory rules in use for the device.
Registered Subscriber Modules (Access Point Mode)	Use the Registered Subscriber Modules table to monitor the registered Subscriber Module device, their key RF status and statistics information. Click the Deregister button to disassociate the Subscriber Module device from the Access Point.
	
MAC Address (Access Point Mode)	The MAC address of the Subscriber Module wireless interface.
Session Time (hh:mm:ss) (Access Point Mode)	Time duration for which the Subscriber Module has been registered and in session with the Access Point.
MCS Downlink (Access Point Mode)	Current MCS at which the Subscriber Module is operating on the downlink.
Add As Preferred (Subscriber Module Mode)	Click the Add  button to add the Access Point to the Preferred Access Points List under Configuration>Radio .
SSID (Subscriber Module Mode)	The SSID of the visible Access Point.
MAC Address (Subscriber Module Mode)	The MAC address of the visible Access Point.
Frequency Carrier (MHz) (Subscriber Module Mode)	The current operating frequency of the visible Access Point.
Channel Bandwidth (MHz)	The current operating channel bandwidth of the visible Access Point.

Attribute	Meaning
(Subscriber Module Mode)	
RSSI (dBm) (Subscriber Module Mode)	The current measured Received Signal Strength Indicator at the Access Point.
SNR (dB) (Subscriber Module Mode)	The current measured Signal-to-Noise Ratio of the Subscriber Module to Access Point link.
Registration State (Subscriber Module Mode)	<p>The indication of the result of the Subscriber Module device network entry attempt:</p> <p>Successful: Subscriber Module registration is successful</p> <p>Failed: Out of Range: The Subscriber Module is out of the Access Point's configured maximum range (Max Range parameter)</p> <p>Failed: Capacity limit reached at Access Point: The Access Point is no longer allowing Subscriber Module network entry due to capacity reached</p> <p>Failed: No Allocation on Access Point: The Subscriber Module to Access Point handshaking failed due to a misconfigured pre-shared key between the Subscriber Module and Access Point</p> <p>Failed: SW Version Incompatibility: The version of software resident on the Access Point is older than the software version on the Subscriber Module</p> <p>Failed: PTP Mode: ACL Policy: The Access Point is configured with PTP Access set to MAC Limited and the Subscriber Module's MAC address is not configured in the Access Point's PTP MAC Address field</p> <p>Failed: Other: The Access Point does not have the required available memory to allow network entry</p>
Session Time (hh:mm:ss) (Subscriber Module Mode)	This timer indicates the time elapsed since the Subscriber Module registered to the Access Point.
Wireless Security (Subscriber Module Mode)	This field indicates the security state of the Access Point to Subscriber Module link.
Meets Reg Criteria (Subscriber Module Mode)	<p>Yes: The scanned Access Point meets the Network Entry criteria defined by the internal Network Algorithm.</p> <p>No: The scanned Access Point does not meet the Network Entry criteria defined by the internal Network Algorithm.</p>

Monitor > Throughput Chart page

Use the Throughput Chart page to reference a line chart visual representation of system throughput over time. The blue line indicates downlink throughput and the orange line indicates uplink throughput. The X-axis may be configured to display data over seconds, minutes, or hours, and the Y-axis is adjusted automatically based on average throughput. Hover over data points to display details.

Figure 19 Monitor > Throughput Chart page

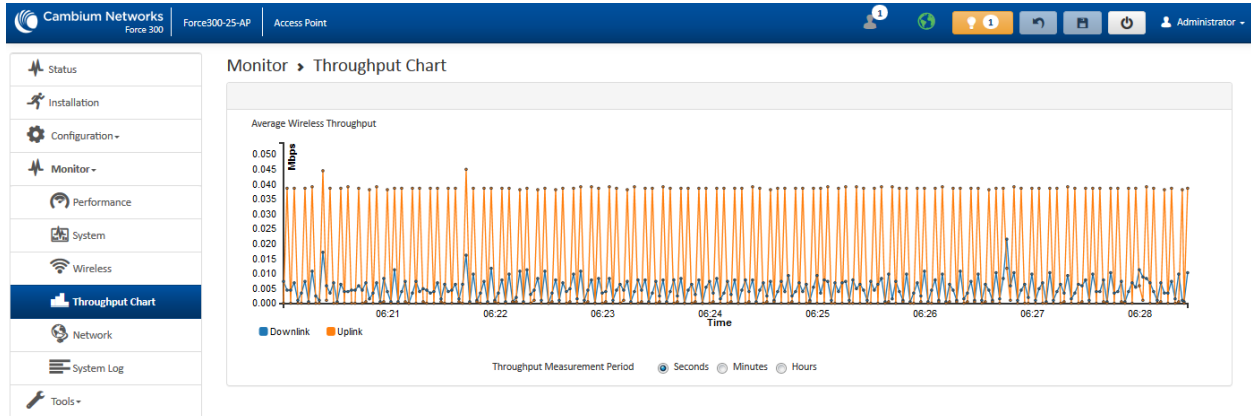


Table 39 Monitor > Throughput Chart page attributes

Attribute	Meaning
Throughput Measurement Period	Adjust the X-axis to display throughput intervals in seconds, minutes, or hours

Monitor > Network page


Use the Network Status page to reference key information about the device network status.

Figure 20 Monitor > Network page

The screenshot shows the 'Monitor > Network' page in the Cambium Networks ePMP interface. The page is divided into several sections:

- Ethernet Interface:** Shows IP Assignment as Static, IP Address as 10.120.217.39, Subnet Mask as 255.255.255.0, Default Gateway as 10.120.217.254, MTU Size as 1538, Main PSU Port as 100 Mbps / Full, Port Speed as 100 Mbps, and Port Duplex Mode as Full.
- Network Status:** Shows DNS Server IP as 10.120.12.30, 10.120.12.169, DHCP Option 82 as Disabled, and NTP Status as NTP Enabled, Date and Time is not obtained.
- ARP Table:** A table with columns for MAC Address, IP Address, and Interface. It lists two entries: 00:22:BE:6E:40:00 (10.120.217.254, Bridge) and 00:04:56:28:07:4C (10.120.217.40, Bridge).
- Bridge Table:** A table with columns for MAC Address, Port, Subscriber Module MAC, and Aging Timer (secs). It lists one entry: 00:04:56:28:07:4C (WLAN, N/A, 0).

Table 40 Monitor > Network page attributes

Attribute	Meaning
Ethernet Interface	
IP Assignment	<p>Static: Device management IP addressing is configured manually in fields IP Address, Subnet Mask, Gateway, Preferred DNS Server, and Alternate DNS Server.</p> <p>DHCP: Device management IP addressing (IP address, Subnet Mask, Gateway, and DNS Server) is assigned via a network DHCP server, and parameters IP Address, Subnet Mask, Gateway, Preferred DNS Server, and Alternate DNS Server are not configurable.</p>
IP Address	<p>Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network.</p> <p> Note If IP Address Assignment is set to DHCP and the device is unable to retrieve IP address information via DHCP, the device management IP is set to fallback IP 192.168.0.1 (Access Point) or 192.168.0.2 (Subscriber Module).</p>
Subnet Mask	<p>Defines the address range of the connected IP network. For example, if Device IP Address (LAN) is configured to 192.168.2.1 and IP Subnet Mask (LAN) is configured to 255.255.255.0, the device will belong to subnet 192.168.2.X.</p>

Attribute	Meaning
Default Gateway	Configure the IP address of the device on the current network that acts as a gateway. A gateway acts as an entrance and exit to packets from and to other networks.
MTU Size	The currently configured Maximum Transmission Unit for the device Ethernet (LAN) interface. Larger MTU configurations can enable the network to operate with greater efficiency, but in the case of retransmissions due to packet errors, efficiency is reduced since large packets must be resent in the event of an error.
Main PSU Port	The speed and duplex at which the configured LAN port is operating.
Port Speed	The speed at which the configured LAN port is operating.
Port Duplex Mode	The duplex at which the configured LAN port is operating.
Network Status	
DNS Server IP	The configured IP address(es) of the network DNS servers.
DHCP Option 82	Status of DHCP Option 82 operation in the network.
NTP Status	Represents the status of NTP retrieval in the network.
ARP Table	
MAC Address	MAC Address of the devices on the bridge.
IP Address	IP Address of the devices on the bridge.
Interface	Interface on which the ePMP identified the devices on.
Bridge Table	
MAC Address	The hardware address of the ePMP device.
Port	The port to which the device is connected.
Subscriber Module MAC	MAC Address for the connected Subscriber Module device.
Aging Timer (secs)	Time set for the MAC addresses in the Bridge table before renewal.

Monitor > System Log Page

Use the System Log page to view the device system log and to download the log file to the accessing PC/device.

Figure 21 Monitor > System Log page

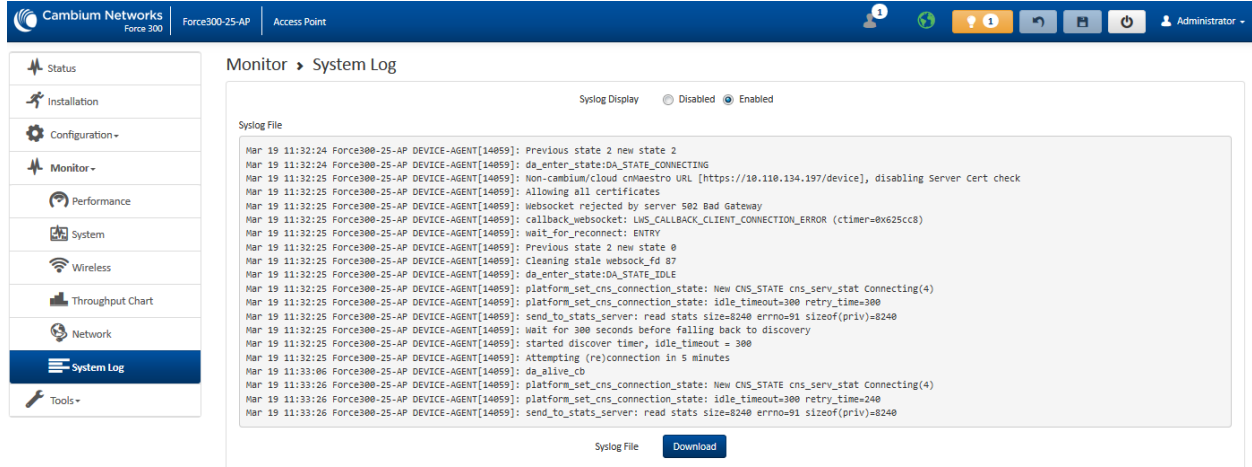


Table 41 Monitor > System Log page attributes

Attribute	Meaning
Syslog Display	Enabled: The system log file is displayed on the management GUI. Disabled: The system log file is hidden on the management GUI.
Download	Use this button to download the full system log file to a connected PC or device.

TOOLS MENU

The **Tools** menu provides several options for upgrading device software, configuration backup/restore, analyzing RF spectrum, and analyzing interferers.

Tools > Software Upgrade page

Use the **Software Upgrade** page to update the device radio software to take advantage of new software features and improvements.



Caution

Please read the Release Notes associated with each software release for special notices, feature updates, resolved software issues, and known software issues. The Release Notes may be accessed at the [Cambium Support Center](#).

Figure 22 Tools > Software Upgrade page

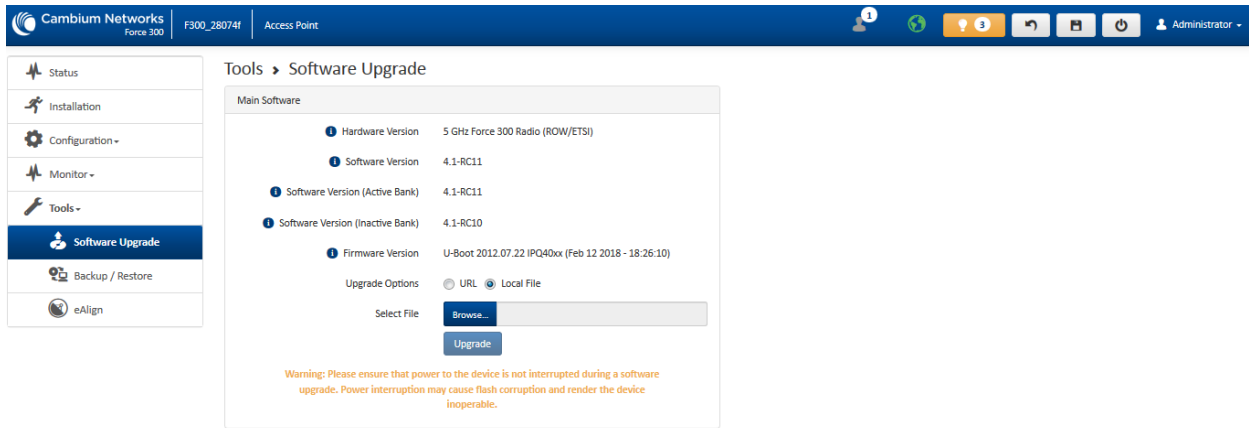



Table 42 Tools > Software Upgrade page attributes

Attribute	Meaning
Main Software	
Hardware Version	Defines the board type and frequency band of operation.
Software Version	Defines the current operating software version.
Software Version (Active Bank)	ePMP devices two banks of flash memory which each contain a version of software. The version of software last upgraded onto the Flash memory is made the Active Bank. This software will be used by the device when rebooted.
Software Version (Inactive Bank)	The version of software that was the Active Bank is made the Inactive Bank when another version of software is upgraded onto the Flash memory. The Inactive Bank of software will be used by the device in case the Active Bank cannot be used due to a failure condition.
Firmware Version	The current U-boot version.
Upgrade Options	URL: A webserver may be used to retrieve software upgrade packages (downloaded to the device via the webserver). For example, if a webserver is running at IP address 192.168.2.1 and the software upgrade packages are located in the home directory, an operator may select option From URL and configure the Software Upgrade Source field to http://192.168.2.1/<software_upgrade_package> . Local File: Click Browse to select the local file containing the software upgrade package.
Select File	Click Browse to select a local file (located on the device accessing the web management interface) for upgrading the device software.
Upgrade	Click the Upgrade button to begin the software upgrade process.

Attribute	Meaning
	 Caution Please ensure that power to the device is not interrupted during a software upgrade. Power interruption may cause flash corruption and render the device inoperable.

Tools > Backup/Restore page

Use the **Backup/Restore** page to update the device radio software to take advantage of new software features and improvements.

Figure 23 Tools > Backup/Restore page

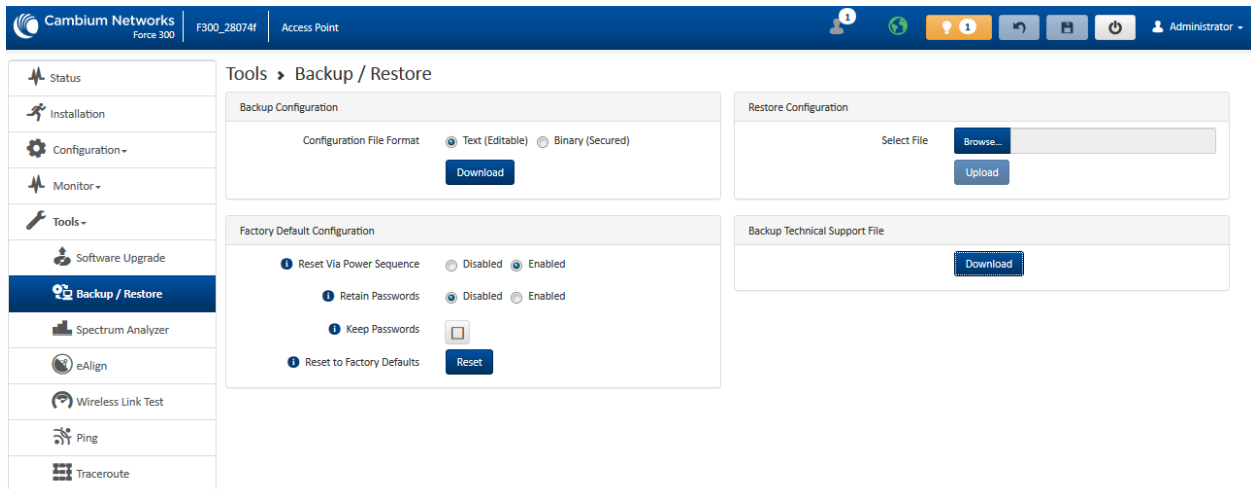




Table 43 Tools > Backup/Restore page attributes

Attribute	Meaning
Backup Configuration	
Configuration File Format	<p>Text (Editable): Choosing this option will download the configuration file in the .json format, and can be viewed and/or edited using a standard text editor.</p> <p>Binary (Secured): Choosing this option will download the configuration file in the .bin format, and cannot be viewed and/or edited using an editor. Use this format for a secure backup.</p>
Restore Configuration	
Select File	Click Browse to select a local file (located on the device accessing the web management interface) for restoring the device configuration.
Factory Default Configuration	
Reset Via Power Sequence	Enabled: When Enabled, it is possible to reset the radio’s configuration to factory defaults using the power cycle sequence explained under Resetting ePMP to factory defaults by power cycling on page 103.

Attribute	Meaning
	Disabled: When Disabled, it is not possible to factory default the radio's configuration using the power cycle sequence.
Retain Passwords	<p>When set to Enabled, then after a factory default of the radio for any reason, the passwords used for GUI and CLI access will not be defaulted and will remain unchanged. The default value of this field is Disabled.</p> <hr/> <p> Caution</p> <p>If the passwords cannot be retrieved after the factory default, access to the radio will be lost/unrecoverable. This feature prevents unauthorized users from gaining access to the radio for any reason, including theft.</p>
Keep Passwords	When the Keep Passwords checkbox is selected, the passwords used for GUI and CLI access will not be defaulted and will remain unchanged. This is one-time option, and it does not apply to factory default procedures completed by power cycling (Reset Via Power Sequence).
Reset to Factory Defaults	<p>Use this button to reset the device to its factory default configuration.</p> <hr/> <p> Caution</p> <p>A reset to factory default configuration resets all device parameters. With the Subscriber Module device in default configuration it may not be able to register to a Access Point device configured for your network.</p>
Backup Technical Support File	
Download	The Backup Technical Support File is a compressed archive of the applicable statistics and configuration parameters used by Cambium Support for troubleshooting. This file is downloaded from the ePMP device to the accessing device.

Tools > Spectrum Analyzer page

Use the **Spectrum Analyzer** page to measure signal levels of frequencies across the full range of the device or in a custom range.

Figure 24 Tools > Spectrum Analyzer page

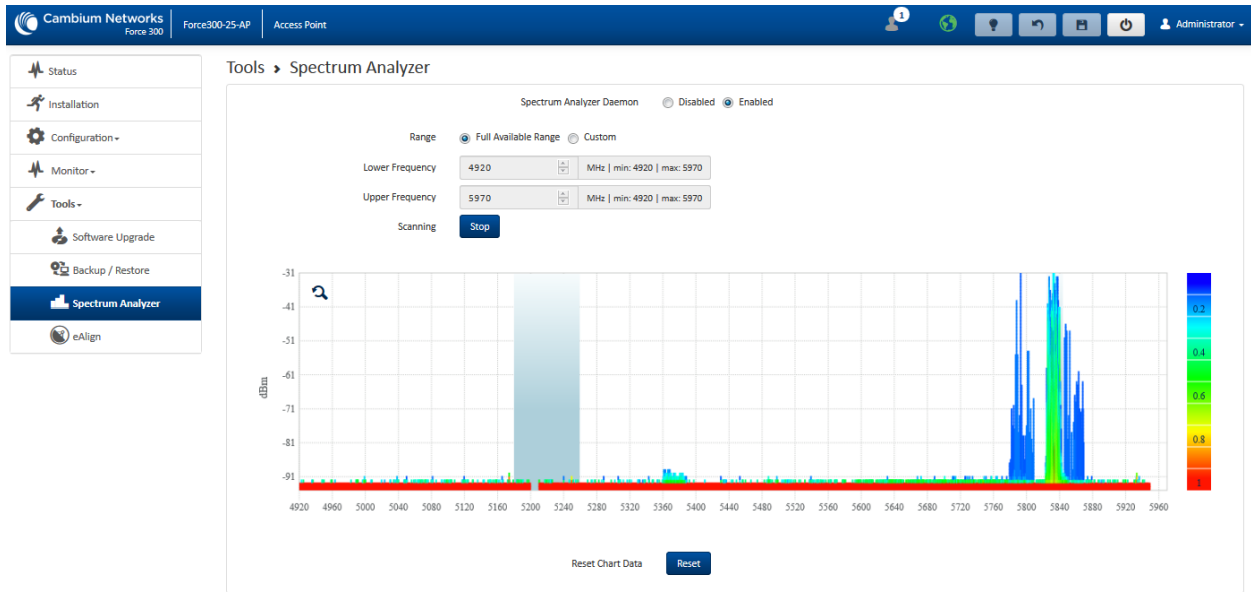


Table 44 Tools > Spectrum Analyzer page attributes

Attribute	Meaning
Spectrum Analyzer Daemon	Disabled: The Spectrum Analyzer process is not running on the device. Enabled: The Spectrum Analyzer process is running on the device, necessary for displaying results in the web management interface.
Range	Full Available Range: The entire operating range of the device will be scanned. Custom: The device scans only the range defined by Lower Frequency and Upper Frequency .
Lower / Upper Frequency	When Range is configured to Custom , indicates the range in MHz for which the device will scan.
Scanning	Click Start to begin scanning, and Stop to terminate scanning.

Tools > eAlign page

Use the eAlign page to aid with link alignment.

Figure 25 Tools > eAlign page



Note

A valid link to an SM is required to provide meaningful RSSI measurements.

**Caution**

ePMP supports Automatic Transmit Power Control (ATPC) where the Subscriber Module devices are instructed by the Access Point to adjust their Tx power in order for the Subscriber Module device signal (UL RSSI) to arrive at the Access Point at a predetermined RSSI level (configurable on the Access Point under **Configuration>Radio>Power Control>Subscriber Module Target Receive Level**). This feature is beneficial to keep the overall noise floor in the sector to an acceptable level. However, the feature negates the purpose of eAlign measurements on the Access Point device since, during the alignment, the Subscriber Module may constantly change its Tx power. It is recommended to turn off ATPC and set the Subscriber Module Tx power to maximum allowable power during alignment.

While aligning the link using eAlign, please follow these steps:

Procedure:

- 1 On the Subscriber Module, set **Configuration>Radio>Power Control>Max Tx Power** to **Manual**.
- 2 Set **Configuration>Radio>Power Control>Transmitter Power** to **26 dBm** (or maximum value allowed by regulations).
- 3 Click the **Save** button
- 4 Perform link alignment using **eAlign**
- 5 Once alignment is complete, set **Configuration>Radio>Power Control>Max Tx Power** back to **Auto**
- 6 Click the **Save** button

Tools > Wireless Link Test page

Use the Wireless Link Test page to conduct a simple test of wireless throughput. This allows user to determine the throughput that can be expected on a particular link without having to use external tools.

Figure 26 Tools > Wireless Link Test page

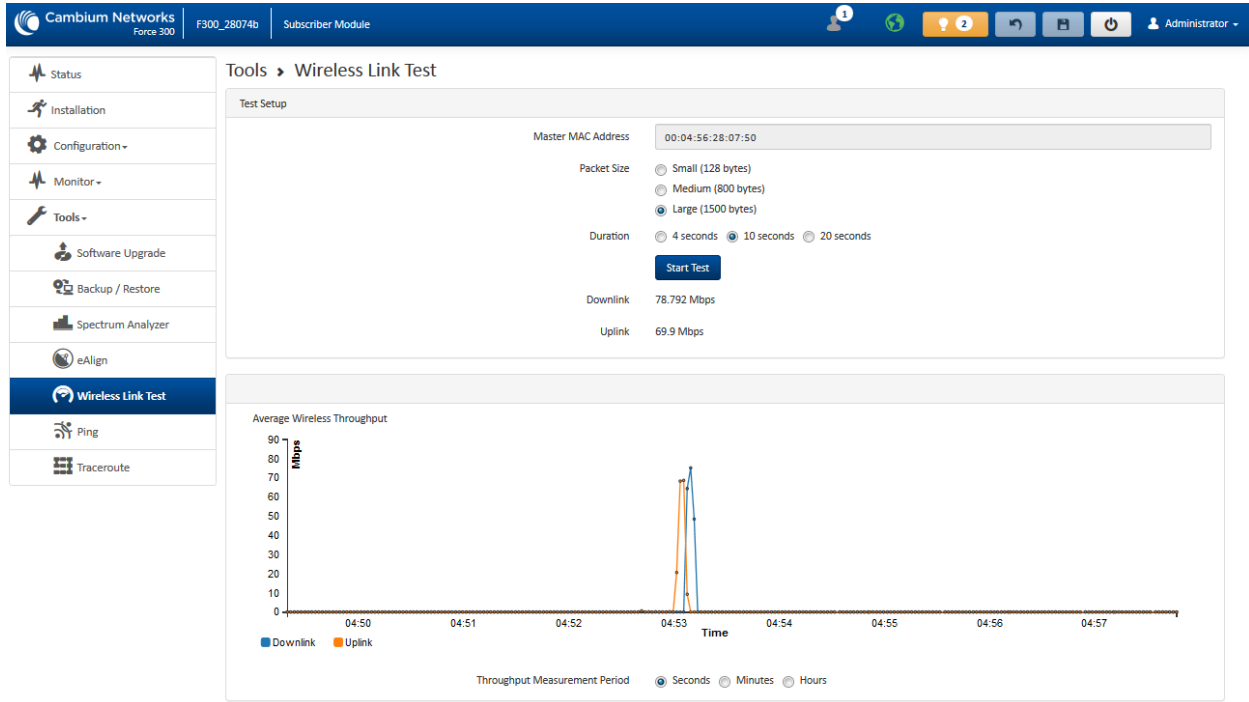


Table 45 Tools > Wireless Link Test page attributes

Attribute	Meaning
Test Setup	
Master MAC Address	Displays the MAC address of the registered device
Packet Size	Choose the Packet Size to use for the throughput test
Duration	Choose the time duration in seconds to use for the throughput test
Downlink	This field indicates the result of the throughput test on the downlink, in Mbps
Uplink	This field indicates the result of the throughput test on the uplink, in Mbps
Average Wireless Throughput	Auto-adjusting chart displaying the average throughput of the link

Tools > Ping page

Use the Ping page to conduct a simple test of IP connectivity to other devices which are reachable from the network. If no ping response is received or if "Destination Host Unreachable" is reported, the target may be down, there may be no route back to the device, or there may be a failure in the network hardware (i.e. DNS server failure).

Figure 27 Tools > Ping page

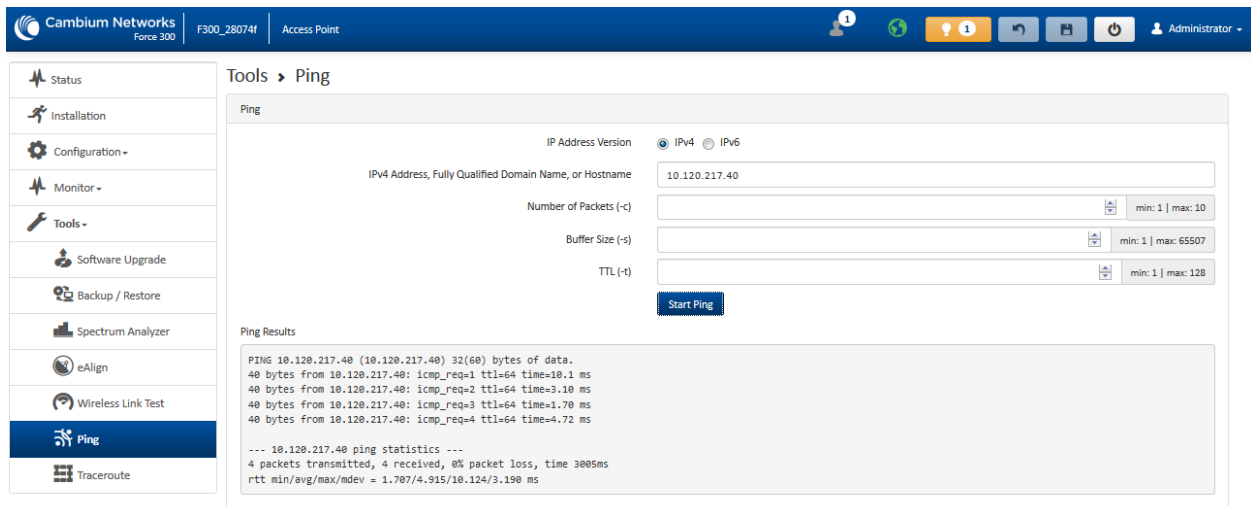


Table 46 Tools > Ping page attributes

Attribute	Meaning
Ping	
IP Address Version	IPv4: The ping test is conducted via IPv4 protocol. IPv6: The ping test is conducted via IPv6 protocol.
IP Address	Enter the IP address of the ping target.
Number of packets (-c)	Enter the total number of ping requests to send to the target.
Buffer size (-s)	Enter the number of data bytes to be sent.
TTL (-t)	Set the IP Time-To-Live (TTL) for multicast packets. This flag applies if the ping target is a multicast address.
Ping results	Results of the Ping test are displayed in the box.

Tools > Traceroute page

Use the Traceroute page to display the route (path) and associated diagnostics for IP connectivity between the device and the destination specified.

Figure 28 Tools > Traceroute page

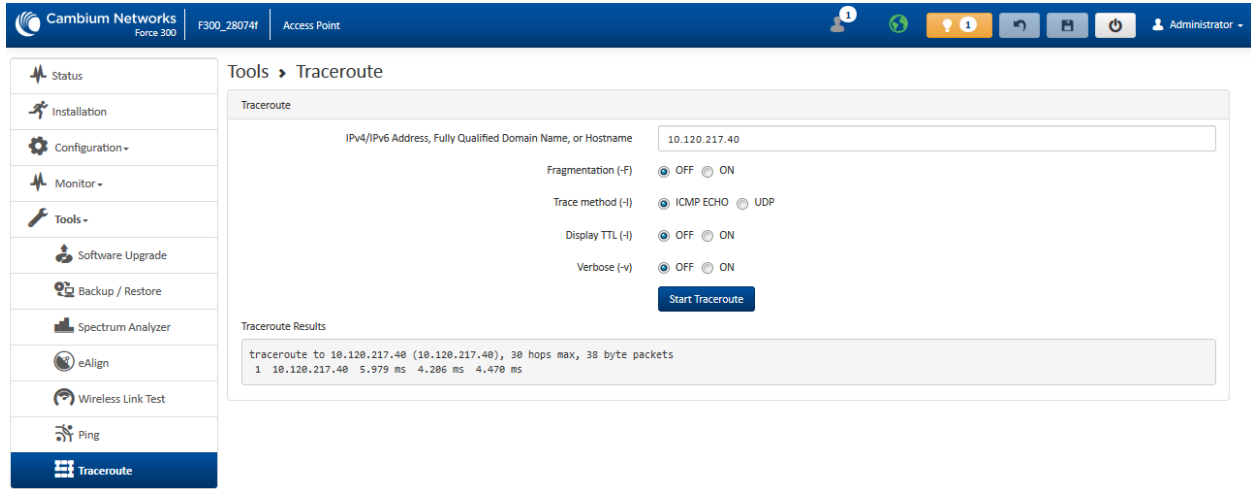


Table 47 Tools > Traceroute page attributes

Attribute	Meaning
Traceroute	
IP Address	Enter the IP address of the target of the traceroute diagnostic.
Fragmentation (-F)	ON: Allow source and target to fragment probe packets. OFF: Do not fragment probe packets (on source or target).
Trace method (-l)	ICMP ECHO: Use ICMP ECHO for traceroute probes. UDP: Use UDP for traceroute probes.
Display TTL (-l)	ON: Display TTL values for each hop on the route. OFF: Suppress display of TTL values for each hop on the route.
Verbose (-v)	ON: ICMP packets other than TIME_EXCEEDED and UNREACHABLE are displayed in the output. OFF: Suppress display of extraneous ICMP messaging.
Traceroute Results	Traceroute test results are displayed in the box.

Operation and Troubleshooting

This chapter provides instructions for operators of ePMP networks. The following topics are described:

- **General Planning for Troubleshooting** on page **99**
- **Upgrading device software** on page **99**
- **Testing hardware** on page **100**
- **Troubleshooting the radio link** on page **102**
- **Resetting ePMP to factory defaults by power cycling** on page **103**

General Planning for Troubleshooting

Effective troubleshooting depends in part on measures that you take before you experience trouble in your network. Cambium recommends the following measures for each site:

Procedure:

- 1 Identify troubleshooting tools that are available at your site (such as a protocol analyzer).
- 2 Identify commands and other sources that can capture baseline data for the site. These may include:
 - Ping
 - tracet or traceroute
 - Throughput Test results
 - Throughput data
 - Configure GUI page captures
 - Monitor GUI page captures
 - Session logs
- 3 Start a log for the site, including:
 - Operating procedures
 - Site-specific configuration records
 - Network topology
 - Software releases
 - Types of hardware deployed
 - Site-specific troubleshooting process
 - Escalation procedures
 - GPS latitude/longitude of each network element

Upgrading device software

To take advantage of new features and software improvements for the ePMP system, monitor the Cambium Networks PMP Software website: <https://support.cambiumnetworks.com/files/epmp>

To upgrade the device software, follow this procedure:

Procedure:

- 1 Log in to the device GUI via the management IP
- 2 Navigate to page **Tools, Software Upgrade**
- 3 Under the **Main Software** section, set the **Upgrade Option** to **URL** to pull the software file from a network software server or select **Local File** to upload a file from the accessing device. If **URL** is selected, enter the server IP address, Server Port, and File path.
- 4 If **Local File** is selected, click **Browse** to launch the file selection dialogue
- 5 Click **Upgrade**

**Caution**

Do not power off the unit in the middle of an upgrade process.

- 6 Once the software upgrade is complete, click the **Reset** icon.

Testing hardware

This section describes how to test the hardware when it fails on startup or during operation.

Before testing hardware, confirm that all outdoor cables, that is those that connect the device to equipment inside the building, are of the supported type, as defined in [Ethernet cabling](#) on page **34**

CHECKING THE POWER SUPPLY LED

When the power supply is connected to the main power supply, the expected LED behavior is:

- The Power (green) LED illuminates steadily.

If the expected LED operation does not occur, or if a fault is suspected in the hardware, check the LED states and choose the correct test procedure:

- [Power LED is off](#) on page **100**
- [Ethernet LED is off](#) on page **100**

POWER LED IS OFF

Meaning: Either the power supply is not receiving power from the AC/DC outlet, or there is a wiring fault in the unit.

Action: Remove the device cable from the PSU and observe the effect on the Power LED. If the Power LED does not illuminate, confirm that the mains power supply is working, for example, check the plug. If the power supply is working, report a suspected power supply fault to Cambium Networks.

ETHERNET LED IS OFF

Meaning: There is no Ethernet traffic between the device and power supply.

Action: The fault may be in the LAN or device cable:

- Remove the LAN cable from the power supply, examine it and confirm it is not faulty.
- If the PC connection is working, remove the AP/SM cable from the power supply, examine it, and check that the wiring to pins 1,2 and 3,6 is correct and not crossed.

Test Ethernet packet errors reported by the device

Log into the device and click **Monitor, Performance**. Click **Reset System Counters** at the bottom of the page and wait until **LAN RX – Total Packet Counter** has reached 1 million. If the counter does not increment or increments too slowly, because for example the ePMP system is newly installed and there is no offered Ethernet traffic, then abandon this procedure and consider using the procedure **Test ping packet loss** on page 101.

Check the **LAN RX – Error Packet Counter** statistic. The test has passed if this is less than 10.

Test Ethernet packet errors reported by managed switch or router

If the device is connected to a managed Ethernet switch or router, it may be possible to monitor the error rate of Ethernet packets. Please refer to the user guide of the managed network equipment. The test has passed if the rate of packet errors reported by the managed Ethernet switch or router is less than 10 in 1 million packets.

Test ping packet loss

Using a computer, it is possible to generate and monitor packets lost between the power supply and the AP/SM. This can be achieved by executing the Command Prompt application which is supplied as standard with Windows and Mac operating systems.

**Caution**

This procedure disrupts network traffic carried by the device under test.

Procedure:

1. Ensure that the IP address of the computer is configured appropriately for connection to the device under test, and does not conflict with other devices connected to the network.
2. If the power supply is connected to an Ethernet switch or router then connect the computer to a spare port, if available.
3. If it is not possible to connect the computer to a spare port of an Ethernet switch or router, then the power supply must be disconnected from the network in order to execute this test:
 - Disconnect the power supply from the network.
 - Connect the computer directly to the LAN port of the power supply.
4. On the computer, open the Command Prompt application.
5. Send 1000 ping packets of length 1500 bytes. The process will take 1000 seconds, which is approximately 17 minutes.

If the computer is running a Windows operating system, this is achieved by typing (for an IPv6 address, use the ping6 command):

```
ping -n 1000 -l 1500 <ipaddress>
```

where <ipaddress> is the IP address of the AP or SM under test.

If the computer is running a MAC operating system, this is achieved by typing:

```
ping -c 1000 -s 1492 <ipaddress>
```

where <ipaddress> is the IP address of the AP/SM under test.

6. Record how many Ping packets are lost. This is reported by Command Prompt on completion of the test.

The test has passed if the number of lost packets is less than 2.

Troubleshooting the radio link

This section describes how to test the link when there is no radio communication, when it is unreliable, or when the data throughput rate is too low. It may be necessary to test both ends of the link.

MODULE HAS LOST OR DOES NOT ESTABLISH RADIO CONNECTIVITY

If there is no wireless activity, follow this:

Procedure:

- 1 Check that the devices are configured with the same **Frequency Carrier**.
- 2 Check that the **Channel Bandwidth** is configured the same at both ends of the link.
- 3 On the Access Point, verify that the **Max Range** setting is configured to a distance slightly greater than the distance between the Access Point and the other end of the link.
- 4 Check that the Access Point **Synchronization Source** is configured properly based on the network configuration.
- 5 Verify the authentication settings on the devices. If **Authentication Type** is set to **WPA2**, verify that the **Pre-shared Key** matches between the Access Point and the Subscriber Module **Preferred Access Points List**.
- 6 Check that the software at each end of the link is the same version.
- 7 Check that the desired Access Point SSID is configured in the Subscriber Module **Preferred Access Points List**.
- 8 On the Subscriber Module, check the **DL RSSI** and **DL CINR** values. Verify that for the Subscriber Module installed distance, that the values are consistent with the values reported by the LINKPlanner tool.
- 9 Check Tx Power on the devices
- 10 Check that the link is not obstructed or misaligned.
- 11 Check the DFS status page (**Monitor, System Status**) at each end of the link and establish that there is a quiet wireless channel to use.
- 12 If there are no faults found in the configuration and there is absolutely no wireless signal, retry the installation procedure.
- 13 If this does not work then report a suspected device fault to Cambium Networks.

LINK IS UNRELIABLE OR DOES NOT ACHIEVE DATA RATES REQUIRED

If there is some activity but the link is unreliable or does not achieve the data rates required, proceed as follows:

Procedure:

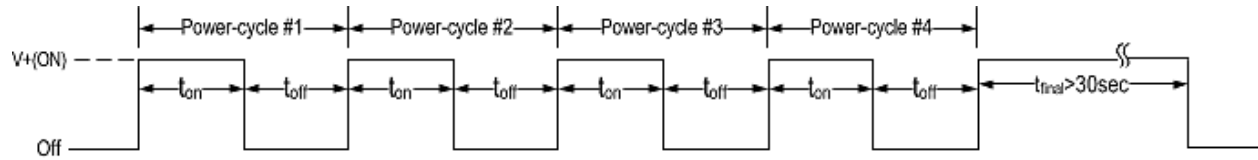
- 1 Check that the interference has not increased by monitoring the uplink and downlink CINR values reported in the Access Point page **Monitor, Wireless Status**
- 2 Check that the RSSI values reported at the device are proper based on the distance of the link – the LINKPlanner tool is designed to estimate these values.
- 3 Check that the path loss is low enough for the communication rates required.
- 4 Check that the device has not become misaligned.
- 5 Review your Quality of Service configuration and ensure that traffic is properly classified and prioritized.

Resetting ePMP to factory defaults by power cycling

Operators may reset an ePMP radio to default factory configuration by a sequence of power cycling (removing and re-applying power to the device). This procedure allows operators to perform a factory default reset without a tower climb or additional tools. The procedure is depicted in [Figure 29](#).

Procedure:

- 1 Remove the Ethernet cable from PoE jack of the power supply for at least 10 seconds.
- 2 Reconnect the Ethernet cable to re-supply power to the ePMP device for **3-5 seconds** and disconnect cable to power off the ePMP device for **3-5 seconds**. (1st power cycle)
- 3 Reconnect the Ethernet cable to re-supply power to the ePMP device for **3-5 seconds** and disconnect cable to power off the ePMP device for **3-5 seconds**. (2nd power cycle)
- 4 Reconnect the Ethernet cable to re-supply power to the ePMP device for **3-5 seconds** and disconnect cable to power off the ePMP device for **3-5 seconds**. (3rd power cycle)
- 5 Reconnect the Ethernet cable to re-supply power to the ePMP device for **3-5 seconds** and disconnect cable to power off the ePMP device for **3-5 seconds**. (4th power cycle)
- 6 Reconnect the Ethernet cable to re-supply power to the ePMP device for at least **30 seconds** and allow it to go through the boot up procedure (Note: Device will go through an additional reset automatically). This will reset the current configuration files to factory default configuration (e.g. IP addresses, Device mode, RF configuration etc.). The device can be pinged from a PC to check if boot up is complete (Successful ping replies indicates boot up is complete).
- 7 Access the ePMP device using the default IP address of 192.168.0.1 (AP) or 192.168.0.2 (SM).

Figure 29 Power cycle timings**Where:** $V+(ON)$

Off

 t_{on} t_{off} **Is:**

Power through PoE has been applied to the device

Power through PoE has been removed from the device

Time duration for which the device has been powered on. This should be 3-5 seconds.

Time duration for which the device has been powered off. This should be 3-5 seconds.

Legal and reference information

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The following topics are described in this chapter:

- **Cambium Networks end user license agreement** on page **105**
- **Hardware warranty** on page **167**
- **Limit of liability** on page **168**
- **Compliance with safety standards** on page **168** lists the safety specifications against which the ePMP has been tested and certified. It also describes how to keep RF exposure within safe limits.
- **Compliance with radio regulations** on page **176** describes how the ePMP complies with the radio regulations that are enforced in various countries.
- **Notifications** on page **178** contains notes made to regulatory bodies for the ePMP.

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lzma

LZMA SDK 4.65

LZMA SDK provides the documentation, samples, header files, libraries, and tools you need to develop applications that use LZMA compression.

LZMA is default and general compression method of 7z format in 7-Zip compression program (www.7-zip.org). LZMA provides high compression ratio and very fast decompression.

LZMA is an improved version of famous LZ77 compression algorithm. It was improved in way of maximum increasing of compression ratio, keeping high decompression speed and low memory requirements for decompressing.

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LZMA SDK includes:

- ANSI-C/C++/C#/Java source code for LZMA compressing and decompressing
- Compiled file->file LZMA compressing/decompressing program for Windows system

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loginrec.h
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*
* curve25519-donna: Curve25519 elliptic curve, public key function
*
* http://code.google.com/p/curve25519-donna/
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* Adam Langley <agl@imperialviolet.org>
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* Derived from public domain C code by Daniel J. Bernstein <djb@cr.yp.to>
*
* More information about curve25519 can be found here
* http://cr.yp.to/ecdh.html
*
* djb's sample implementation of curve25519 is written in a special assembly
* language called qhasm and uses the floating point registers.
*
* This is, almost, a clean room reimplementation from the curve25519 paper.
It
* uses many of the tricks described therein. Only the crecip function is taken
* from the sample implementation.
*/

```

ebtables

```

/*
* ebtables.c, v2.0 July 2002
*
* Author: Bart De Schuymer
*
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net-snmp

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System threshold, output power and link loss

For up-to-date data, please refer to:

- [LINKPlanner](#)

Compliance with safety standards

This section lists the safety specifications against which the ePMP has been tested and certified. It also describes how to keep RF exposure within safe limits.

ELECTRICAL SAFETY COMPLIANCE

The ePMP hardware has been tested for compliance to the electrical safety specifications listed in [Table 48](#).

Table 48 ePMP safety compliance specifications

Region	Standard
USA	UL 60950-1, 2 nd Edition
Canada	CSA C22.2 No.60950 2 nd Edition
International	International CB certified and certified to IEC 60950-1:2005 (modified) plus EN60950-1:2006 + A1:2010

ELECTROMAGNETIC COMPATIBILITY (EMC) COMPLIANCE

The ePMP complies with European EMC Specification EN301 489-1 with testing carried out to the detailed requirements of EN301 489-4.

The EMC specification type approvals that have been granted for ePMP are listed under [Table 49](#).

Table 49 EMC emissions compliance

Region	Specification (Type Approvals)
USA	FCC CFR 47 Part 15 class B
Canada	RSS210, Issue 8 RSS247, Issue 1 (May 2015)

Europe

ETSI EN301 489-4

HUMAN EXPOSURE TO RADIO FREQUENCY ENERGY

Standards

Relevant standards (USA and EC) applicable when working with RF equipment are:

- ANSI IEEE C95.1-1991, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
- Council recommendation of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (1999/519/EC) and respective national regulations.
- *Directive 2004/40/EC of the European Parliament and of the Council of 29 April 2004* on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) (18th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC).
- US FCC limits for the general population. See the FCC web site <http://www.fcc.gov> and the policies, guidelines, and requirements in Part 1 of Title 47 of the Code of Federal Regulations, as well as the guidelines and suggestions for evaluating compliance in FCC OET Bulletin 65.
- Health Canada limits for the general population. See the Health Canada web site http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/99ehd-dhm237/limits-limités_e.html and Safety Code 6.
- EN 50383:2002 Basic standard for the calculation and measurement of electromagnetic field strength and SAR related to human exposure from radio base Subscriber Modules and fixed terminal Subscriber Modules for wireless telecommunication systems (110 MHz - 40 GHz).
- BS EN 50385:2002 Product standard to demonstrate the compliances of radio base Subscriber Modules and fixed terminal Subscriber Modules for wireless telecommunication systems with the basic restrictions or the reference levels related to human exposure to radio frequency electromagnetic fields (110 MHz – 40 GHz) – general public.
- ICNIRP (International Commission on Non-Ionizing Radiation Protection) guidelines for the general public. See the ICNIRP web site <http://www.icnirp.de/> and Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields.

Power density exposure limit

Install the radios for the ePMP family of PMP wireless solutions so as to provide and maintain the minimum separation distances from all persons.

The applicable power density exposure limit from the standards (see [Human exposure to radio frequency energy](#) on page 169) is:

- **10 W/m²** for RF energy in the 5 GHz frequency band.

Calculation of power density

Peak power density in the far field of a radio frequency point source is calculated as follows:

**Note**

The following calculation is based on the ANSI IEEE C95.1-1991 method, as that provides a worst case analysis. Details of the assessment to EN50383:2002 can be provided, if required.

$$S = \frac{P.G}{4\pi d^2}$$

Where:

S

P

G

d

Is:power density in W/m²

maximum average transmit power capability of the radio, in W

total Tx gain as a factor, converted from dB

distance from point source, in m

Rearranging terms to solve for distance yields:

$$d = \sqrt{\frac{P.G}{4\pi.S}}$$

Calculated distances and power compliance margins

The calculated minimum separation distances, recommended distances and resulting margins for each frequency band and antenna combination is shown in the tables below. These are conservative distances that include compliance margins. At these and greater separation distances, the power density from the RF field is below generally accepted limits for the general population.

Explanation of terms used:

Tx burst – maximum average transmit power in burst (Watt)

P – maximum average transmit power capability of the radio (Watt)

G – total transmit gain as a factor, converted from dB

S – power density (W/m²)

d – minimum distance from point source (meters)

R – recommended distances (meters)

Table 50 through Table 53 below list the power compliance margins for the following Force 300-25 devices:

Model Number	Part Number	FCC ID	Industry Canada
C058910P102A	C058910C102A	Z8H89FT0017	109W-0017
C058910P104A	C058910C104A		

Table 50 Force 300-25 Power compliance margins, 5.1 GHz, FCC, PTP Mode

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m ²)	d (m)	R (m)
PTP	20 MHz	Integrated Dish, 25 dBi	0.000389	316	10	0.03	0.1
PTP	80 MHz	Integrated Dish, 25 dBi	0.000141	316	10	0.02	0.1
PTP	20 MHz	On-board, 2 dBi	0.957194	2	10	0.11	0.3
PTP	80 MHz	On-board, 2 dBi	0.058614	2	10	0.03	0.1

Table 51 Force 300-25 Power compliance margins, 5.8 GHz, FCC, PTP Mode

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m ²)	d (m)	R (m)
PTP	20 MHz	Integrated Dish, 25 dBi	0.001660	316	10	0.06	0.1
PTP	80 MHz	Integrated Dish, 25 dBi	0.000719	316	10	0.04	0.1
PTP	20 MHz	On-board, 2 dBi	0.997700	2	10	0.11	0.3
PTP	80 MHz	On-board, 2 dBi	0.276058	2	10	0.06	0.1

Table 52 Force 300-25 Power compliance margins, 5.1 GHz, ISEDC, PTP Mode

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m ²)	d (m)	R (m)	S @ 20 cm (W/m ²)
PTP	20 MHz	Integrated Dish, 25 dBi	0.000389	316	9.01	0.03	0.1	0.24
PTP	80 MHz	Integrated Dish, 25 dBi	0.000141	316	9.01	0.02	0.1	0.09
PTP	20 MHz	On-board, 2 dBi	0.957194	2	9.01	0.12	0.3	3.02
PTP	80 MHz	On-board, 2 dBi	0.058614	2	9.01	0.03	0.1	0.18

Table 53 Force 300-25 Power compliance margins, 5.8 GHz, ISEDC, PTP Mode

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m ²)	d (m)	R (m)	S @ 20 cm (W/m ²)
PTP	20 MHz	Integrated Dish, 25 dBi	0.001660	316	9.69	0.07	0.1	1.04
PTP	80 MHz	Integrated Dish, 25 dBi	0.000719	316	9.69	0.04	0.1	0.45
PTP	20 MHz	On-board, 2 dBi	0.997700	2	9.69	0.11	0.3	3.15
PTP	80 MHz	On-board, 2 dBi	0.276058	2	9.69	0.06	0.1	0.87

**Note**

Gain of antenna in dBi = $10 \cdot \log(G)$.

The regulations require that the power used for the calculations is the maximum power in the transmit burst subject to allowance for source-based time-averaging.

At EU 5.8 GHz the products are generally limited to a fixed EIRP which can be achieved with the Integrated Antenna. The calculations above assume that the maximum EIRP allowed by the regulations is being transmitted.

Table 54 Force 300-25 Power compliance margins, 5.8 GHz (EIRP 36 dBm)

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m ²)	d (m)	R (m)
PTP	20 MHz	Integrated Dish, 25 dBi	0.012589	316	10	0.18	0.2
PTP	80 MHz	Integrated Dish, 25 dBi	0.012589	316	10	0.18	0.2

**Note**

If there are no EIRP limits in the country of installation, use the distance calculations in [Table 55](#) and [Table 56](#).

Table 55 Force 300-25 Power compliance margins, 5.1 GHz, PTP Mode (full Tx power)

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m ²)	d (m)	R (m)
PTP	20 MHz	Integrated Dish, 25 dBi	0.794	316	10	1.41	2.0
PTP	80 MHz	Integrated Dish, 25 dBi	0.794	316	10	1.41	2.0

Table 56 Force 300-25 Power compliance margins, 5.8 GHz, PTP Mode (full Tx power)

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m ²)	d (m)	R (m)
PTP	20 MHz	Integrated Dish, 25 dBi	0.794	316	10	1.41	2.0
PTP	80 MHz	Integrated Dish, 25 dBi	0.794	316	10	1.41	2.0

[Table 57](#) through [Table 63](#) below list the power compliance margins for the following Force 300-16 devices:

Part Number	FCC ID	Industry Canada
C058910C112A	Z8H89FT0016	109W-0016
C058910C114A		

Table 57 Force 300-16 Power compliance margins, 5.1 GHz, FCC

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m ²)	d (m)	R (m)
PTP SM	20 MHz	Patch Array, 16 dBi	0.021	40	10	0.08	0.1

PTP SM	80 MHz	Patch Array, 16 dBi	0.013	40	10	0.06	0.1
PTP SM	20 MHz	On-board, 2 dBi	0.678	2	10	0.09	0.1
PTP SM	80 MHz	On-board, 2 dBi	0.089	2	10	0.03	0.1

Table 58 Force 300-16 Power compliance margins, 5.8 GHz, FCC

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m ²)	d (m)	R (m)
PTP SM	20 MHz	Patch Array, 16 dBi	0.1	40	10	0.18	0.3
PTP SM	80 MHz	Patch Array, 16 dBi	0.1	40	10	0.18	0.3
PTP SM	20 MHz	On-board, 2 dBi	0.830	2	10	0.11	0.3
PTP SM	80 MHz	On-board, 2 dBi	0.389	2	10	0.07	0.1

Table 59 Force 300-16 Power compliance margins, 5.1 GHz, ISEDC

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m ²)	d (m)	R (m)	S @ 20 cm (W/m ²)
PTP SM	20 MHz	Patch Array, 16 dBi	0.021	40	9.01	0.09	0.1	1.69
PTP SM	80 MHz	Patch Array, 16 dBi	0.013	40	9.01	0.07	0.1	1.02
PTP SM	20 MHz	On-board, 2 dBi	0.678	2	9.01	0.10	0.3	2.14
PTP SM	80 MHz	On-board, 2 dBi	0.089	2	9.01	0.04	0.1	0.28

Table 60 Force 300-16 Power compliance margins, 5.8 GHz, ISEDC

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m ²)	d (m)	R (m)	S @ 20 cm (W/m ²)
PTP SM	20 MHz	Patch Array, 16 dBi	0.1	40	9.69	0.18	0.3	7.92
PTP SM	80 MHz	Patch Array, 16 dBi	0.1	40	9.69	0.18	0.3	7.92
PTP SM	20 MHz	On-board, 2 dBi	0.830	2	9.69	0.10	0.2	2.62
PTP SM	80 MHz	On-board, 2 dBi	0.389	2	9.69	0.07	0.1	1.23

**Note**

Gain of antenna in dBi = $10 \cdot \log(G)$.

The regulations require that the power used for the calculations is the maximum power in the transmit burst subject to allowance for source-based time-averaging.

At EU 5.8 GHz the products are generally limited to a fixed EIRP which can be achieved with the Integrated Antenna. The calculations above assume that the maximum EIRP allowed by the regulations is being transmitted.

Table 61 Force 300-16 Power compliance margins, 5.8 GHz (EIRP 36 dBm)

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m ²)	d (m)	R (m)
PTP SM	20 MHz	Patch Array, 16 dBi	0.1	40	10	0.18	0.3
PTP SM	80 MHz	Patch Array, 16 dBi	0.1	40	10	0.18	0.3

**Note**

If there are no EIRP limits in the country of installation, use the distance calculations in [Table 62](#) and [Table 63](#).

Table 62 Force 300-16 Power compliance margins, 5.1 GHz (full Tx power)

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m ²)	d (m)	R (m)
PTP SM	20 MHz	Patch Array, 16 dBi	0.794	40	10	0.5	1.0
PTP SM	80 MHz	Patch Array, 16 dBi	0.794	40	10	0.5	1.0

Table 63 Force 300-16 Power compliance margins, 5.8 GHz (full Tx power)

Conn Type	Channel Bandwidth	Antenna	P (W)	G	S (W/m ²)	d (m)	R (m)
PTP SM	20 MHz	Patch Array, 16 dBi	0.794	40	10	0.5	1.0
PTP SM	80 MHz	Patch Array, 16 dBi	0.794	40	10	0.5	1.0

Compliance with radio regulations

This section describes how the ePMP complies with the radio regulations that are enforced in various countries.

**Caution**

Changes or modifications not expressly approved by Cambium Networks could void the user's authority to operate the system.

TYPE APPROVALS

This system has achieved Type Approval in various countries around the world. This means that the system has been tested against various local technical regulations and found to comply. The frequency bands in which the system operates may be unlicensed and, in these bands, the system can be used provided it does not cause interference. The system is not guaranteed protection against interference from other products and installations.

The radio specification type approvals that have been granted for ePMP frequency variants are listed under **Table 49**.

Table 64 Force 300 Radio certifications

Frequency band	Region	Regulatory approvals
5 GHz	USA	FCC Part 15 Class B
	Canada	IC RSS-210 Issue 8, Annex 8 (or latest) IC RSS247 Issue 1 (May 2015)
	Europe	ETSI EN302 502 v1.2.1 ETSI EN301 893 v1.7.1

FCC AND ETSI COMPLIANCE TESTING

The system has been tested for compliance to both US (FCC) and European (ETSI) specifications. It has been shown to comply with the limits for emitted spurious radiation for a Class B digital device, pursuant to Part 15 of the FCC Rules in the USA and appropriate European ENs. These limits have been designed to provide reasonable protection against harmful interference. However the equipment can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to other radio communications. There is no guarantee that interference will not occur in a particular installation. To comply with FCC RF exposure limits for general population or uncontrolled exposure, the antenna(s) used for the ePMP transmitter must be installed to ensure a separation distance specified in **Table 50** and **Table 51** from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

OEM Responsibilities to comply with FCC and Industry Canada Regulations

The ePMP Module is certified for integration into products only by OEM integrators under the following conditions:

1. The antenna(s) must be installed such that a minimum separation distance specified in **Table 50** through **Table 53** is maintained between the radiator (antenna) and all persons at all times.

- The transmitter module must not be co-located or operate in conjunction with any other antenna or transmitter. As long as the two conditions above are met, further transmitter testing is not required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

**Note**

In the event that these conditions cannot be met (for certain configurations or co-location with another transmitter), then the FCC and Industry Canada authorizations are no longer considered valid and the FCC ID cannot be used.

**Note**

A Class B Digital Device is a device that is marketed for use in a residential environment, notwithstanding use in commercial, business and industrial environments.

Notwithstanding that Cambium Networks has designed (and qualified) the ePMP products to generally meet the Class B requirement to minimize the potential for interference, the ePMP product range is not marketed for use in a residential environment.

End Product Labeling

The ePMP Module is labeled with its own FCC ID and IC Certification Number. If the FCC ID and IC Certification Number are not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. In that case, the final end product must be labeled in a visible area with the following:

Table 65 Force 300 Product labeling

Device	Label
Force 300-25	"Contains Transmitter Module FCC ID: Z8H89FT0017" or "Contains FCC ID: Z8H89FT0017"
Force 300-16	"Contains Transmitter Module FCC ID: Z8H89FT0016" or "Contains FCC ID: Z8H89FT0016"

Notifications

This section contains notifications of compliance with the radio regulations that are enforced in various regions.

5.1 GHZ REGULATORY COMPLIANCE

The ePMP complies with the regulations that are enforced in the USA, Canada and Europe. The relevant notifications are specified in this section.

5.1 GHz GHz FCC and IC notification

U.S. Federal Communication Commission (FCC) and Industry Canada (IC) Notification.

This device complies with part 15.407 of the US FCC Rules and Regulations and with RSS-210 Issue 8 of Industry Canada. 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. In Canada, users must be cautioned to take note that high power radars are allocated as primary users (meaning they have priority) of 5250 – 5350 MHz and 5470 – 5725 MHz and these radars could cause interference and/or damage to license-exempt local area networks (LELAN). To comply with FCC/IC RF exposure limits for general population or uncontrolled exposure, the antenna(s) used for the ePMP transmitter must be installed at a separation distance specified in **Table 50** through **Table 53**.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the US FCC Rules and with RSS-210 of Industry Canada. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

- Increase the separation between the affected equipment and the unit;
- Connect the affected equipment to a power outlet on a different circuit from that which the receiver is connected to;
- Consult the dealer and/or experienced radio/TV technician for help.

FCC IDs and Industry Canada Certification Numbers are reproduced on the product label (**Figure 30**).

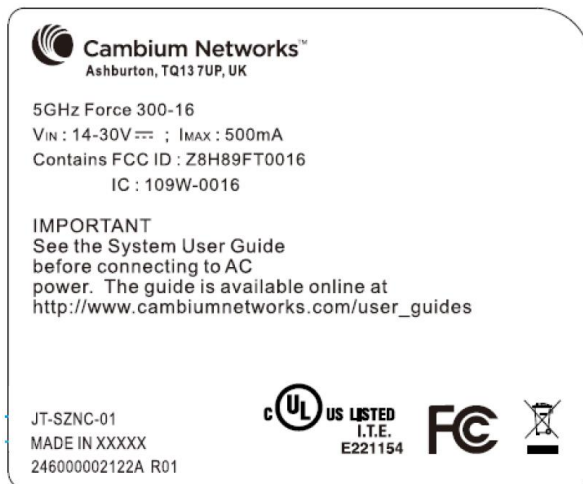
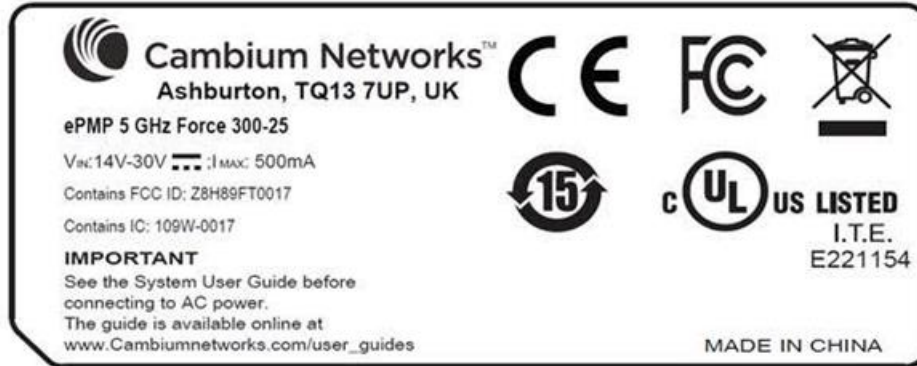
End Product Labeling

The ePMP Module is labeled with its own FCC ID and IC Certification Number. If the FCC ID and IC Certification Number are not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. In that case, the final end product must be labeled in a visible area with the following:

Table 66 Force 300 Product labeling

Device	Label
Force 300-25	"Contains Transmitter Module FCC ID: Z8H89FT0017" or "Contains FCC ID: Z8H89FT0017"
Force 300-16	"Contains Transmitter Module FCC ID: Z8H89FT0016" or "Contains FCC ID: Z8H89FT0016"

Figure 30 FCC and IC certifications on 5 GHz product labels



Wherever necessary, the end user is responsible for obtaining any National licenses required to operate this product and these must be obtained before using the product in any particular country. Contact the appropriate national administrations for details on the conditions of use for the bands in question and any exceptions that might apply.

5.8 GHZ REGULATORY COMPLIANCE

This system has achieved Type Approval in various countries around the world. This means that the system has been tested against various local technical regulations and found to comply. The frequency band in which the system operates is “license exempt” and the system is allowed to be used provided it does not cause interference. The licensing authority does not guaranteed protection against interference from other products and installations.

U.S. Federal Communication Commission (FCC)

This device complies with part 15 of the US 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.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the US FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

- Increase the separation between the affected equipment and the unit;
- Connect the affected equipment to a power outlet on a different circuit from that which the receiver is connected to;
- Consult the dealer and/or experienced radio/TV technician for help.

Industry Canada (IC)

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B conforme à la norme NMB-003 du Canada.

RSS-GEN issue 3 (7.1.3) Licence-Exempt Radio Apparatus:

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

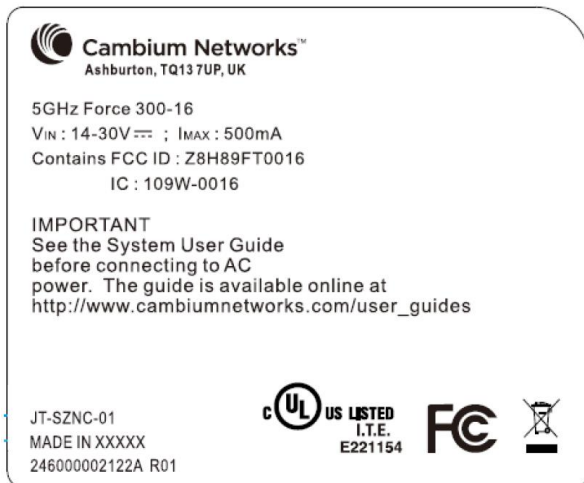
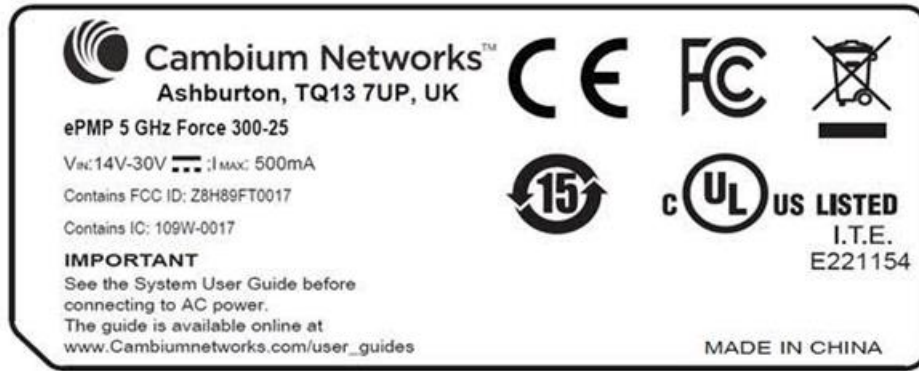
Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

In Canada, high power radars are allocated as primary users (meaning they have priority) of the 5650 – 5850 MHz spectrum. These radars could cause interference or damage to license-exempt local area network (LE-LAN) devices.

Product labels

FCC IDs and Industry Canada Certification Numbers are reproduced on the product label (**Figure 31**).

Figure 31 FCC and IC certifications on 5.8 GHz product label



Wherever necessary, the end user is responsible for obtaining any National licenses required to operate this product and these must be obtained before using the product in any particular country. Contact the appropriate national administrations for details on the conditions of use for the bands in question and any exceptions that might apply.

Radio Specifications



FORCE 300 PRODUCT SPECIFICATIONS

For up-to-date performance and mechanical specifications for Force 300 products, please visit:

<https://www.cambiumnetworks.com/products/pmp-distribution/>

Glossary

Table 67 Glossary

Term	Definition
AES	Advanced Encryption Standard
ANSI	American National Standards Institute
CINR	Carrier to Interference plus Noise Ratio
CMM	Cluster Management Module
DFS	Dynamic Frequency Selection
EIRP	Equivalent Isotropically Radiated Power
EMC	Electromagnetic Compatibility
EMD	Electromagnetic Discharge
ETH	Ethernet
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission
FEC	Forward Error Correction
GUI	Graphical User Interface
HTTP	Hypertext Transfer Protocol
IC	Industry Canada
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
LAN	Local Area Network
LED	Light Emitting Diode
LOS	Line of Sight
MIMO	Multiple In Multiple Out
MTU	Maximum Transmission Unit
nLOS	Near Line of Sight
NTP	Network Time Protocol
OFDM	Orthogonal Frequency Division Multiplexing
PC	Personal Computer
PMP	Point to Multipoint
PTP	Point to Point
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keyed
RF	Radio Frequency
RMA	Return Merchandise Authorization
RSSI	Received Signal Strength Indication
RTTT	Road Transport and Traffic Telematics
RX	Receive
SAR	Standard Absorption Rate
SNMP	Simple Network Management Protocol
SW	Software
TDD	Time Division Duplex
TDWR	Terminal Doppler Weather Radar
TX	Transmit
UNII	Unlicensed National Information Infrastructure
URL	Uniform Resource Locator