

Cambium Universal Global Positioning System

User Guide



UGPSUSERGUIDEvF November 2012
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Contents

Universal GPS User Guide

What is covered in this manual?	2
Version information	2
Limit of Liability	2
Contacting Cambium Networks	3
Product Description	4
Overview	4
UGPS Power Source Configurations	6
External Power Only	6
UGPS and CMM Configurations	14
Product Specifications	15
UGPS Installation and Operation	16
General Installation Considerations	16
Installation Procedure	18
IP Default Bypass	21
GPS Status and Location Data Readout	24
Retrieving GPS Status and Location Data via Radio Web Management GUI	24
Retrieving GPS Status and Location Data via SNMP	25
UGPS Power Port and Timing Port Pinouts	28
Regulatory, Legal, and Safety Notices	29
IMPORTANT NOTE ON MODIFICATIONS	29
Universal GPS module label	29
NATIONAL AND REGIONAL REGULATORY NOTICES	29
U.S. Federal Communication Commission (FCC) Notification	29
Industry Canada Notification	30
Equipment Disposal	30
LIMIT OF LIABILITY	31

What is covered in this manual?

The audience for this document includes network planners, system operators, network administrators, and equipment installers. This guide covers the UGPS product details as well as UGPS installation instructions.

Version information

The following shows the issue status of this document since it was first released.

Version	Date of issue	Description
A	APR 2011	Initial release
B	JUN 2011	Diagram updates, pinout inclusions, overview updates
C	JUL 2011	Diagram updates, supported product updates
D	JAN 2012	Diagram updates, additional IP Default Bypass information
E	JAN 2012	Diagram update
F	NOV 2012	Supported product updates, contact information update

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What is covered in this manual?

Contacting Cambium Networks

PMP support website: <http://www.cambiumnetworks.com/support>

Cambium main website: <http://www.cambiumnetworks.com/>

Sales enquiries: solutions@cambiumnetworks.com

Email support: support@cambiumnetworks.com

Telephone numbers:

For full list of Cambium support telephone numbers, see:

<http://www.cambiumnetworks.com/support/technical.php>

Address:

Cambium Networks

3800 Golf Road, Suite 360

Rolling Meadows, IL 60008

Product Description

Overview

The Cambium Networks Universal Global Positioning System (UGPS) is a stand-alone GPS antenna and receiver with the capability to provide a 1PPS GPS synchronization signal to Cambium Networks access points (APs), backhaul masters (BHMs), or cluster management modules (CMMs).

The UGPS features two timing ports for sending GPS timing sync. One or two access points/backhaul masters/cluster management modules may be synchronized directly by the two timing ports.

Currently the UGPS may be used with the following Cambium Networks equipment:

- PMP 100 FSK AP
- PTP 100 FSK BH
- PMP 430 OFDM AP
- PMP 400 OFDM AP
- PTP 200 OFDM BH
- PTP 230 OFDM BH (capable of sourcing power to the UGPS via PTP 230 timing port)
- PMP 320 WiMAX AP (AP Software version e2.2 and later)
- CMM3 (CMM3 in Slave mode, CMM3 will receive GPS synchronization pulse, but no GPS location data)
- CMM4 (CMM4 in Slave mode, CMM4 will receive GPS synchronization pulse, but no GPS location data)

The connector interface for the UGPS is detailed in [Figure 1](#) below:

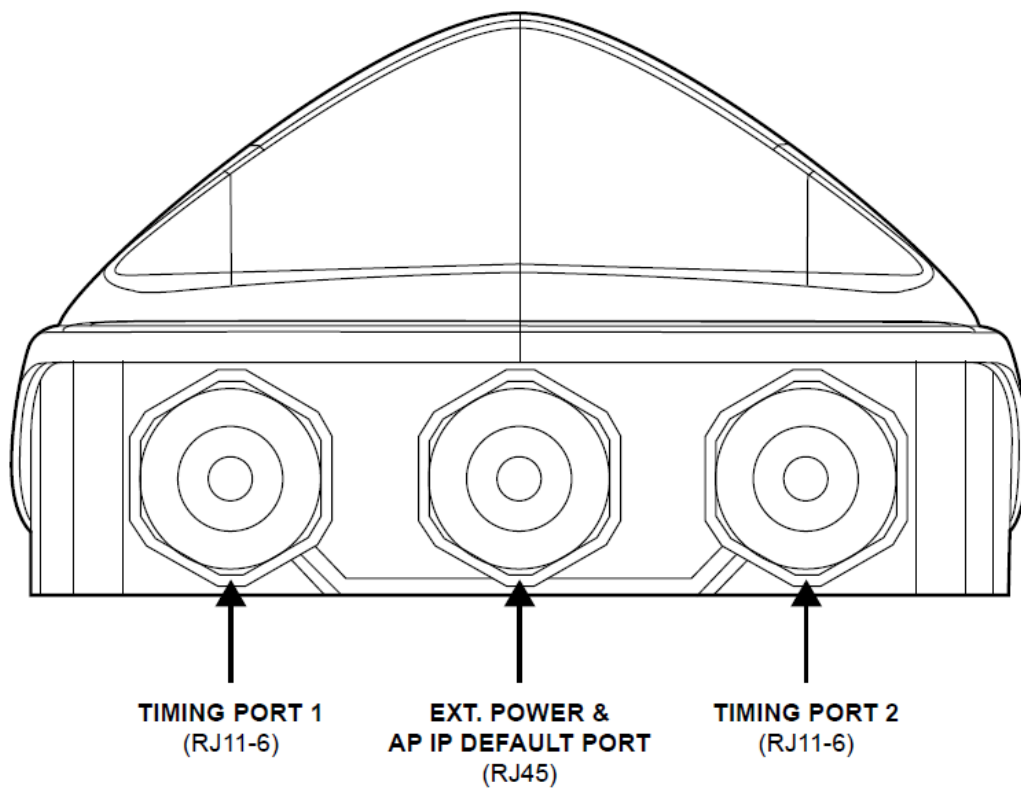


Figure 1: UGPS Connector Interface

UGPS Power Source Configurations

The UGPS module may be powered by an external source via the UGPS External Power Port. Alternately, the UGPS may be powered by a PTP 230 backhaul master via one of the UGPS Timing Ports. When the UGPS is powered by via one of the Timing Ports, the radio provides the necessary power to enable 1 PPS synchronization timing and serial GPS location data by the UGPS (which is sent back to the radio via the associated Timing Port). If the UGPS is receiving power on the External Power Port (via 29.5V DC power supply or CMM port) *and* power on Timing Port 1 or Timing Port 2 simultaneously, the UGPS defaults to using the external power supply.

External Power Only

Shown below are examples of external only powering for PMP 100 and PMP 400/430 units. In this case the UGPS is powered via RJ-45 cable connected to a Motorola approved 29.5V DC power supply. The UGPS may also receive power through the RJ-45 Power Port via a power-over-Ethernet port on a CMM4. The radios receive their GPS synchronization through an RJ-11 cable connected to either Timing Port 1 or Timing Port 2 of the UGPS.

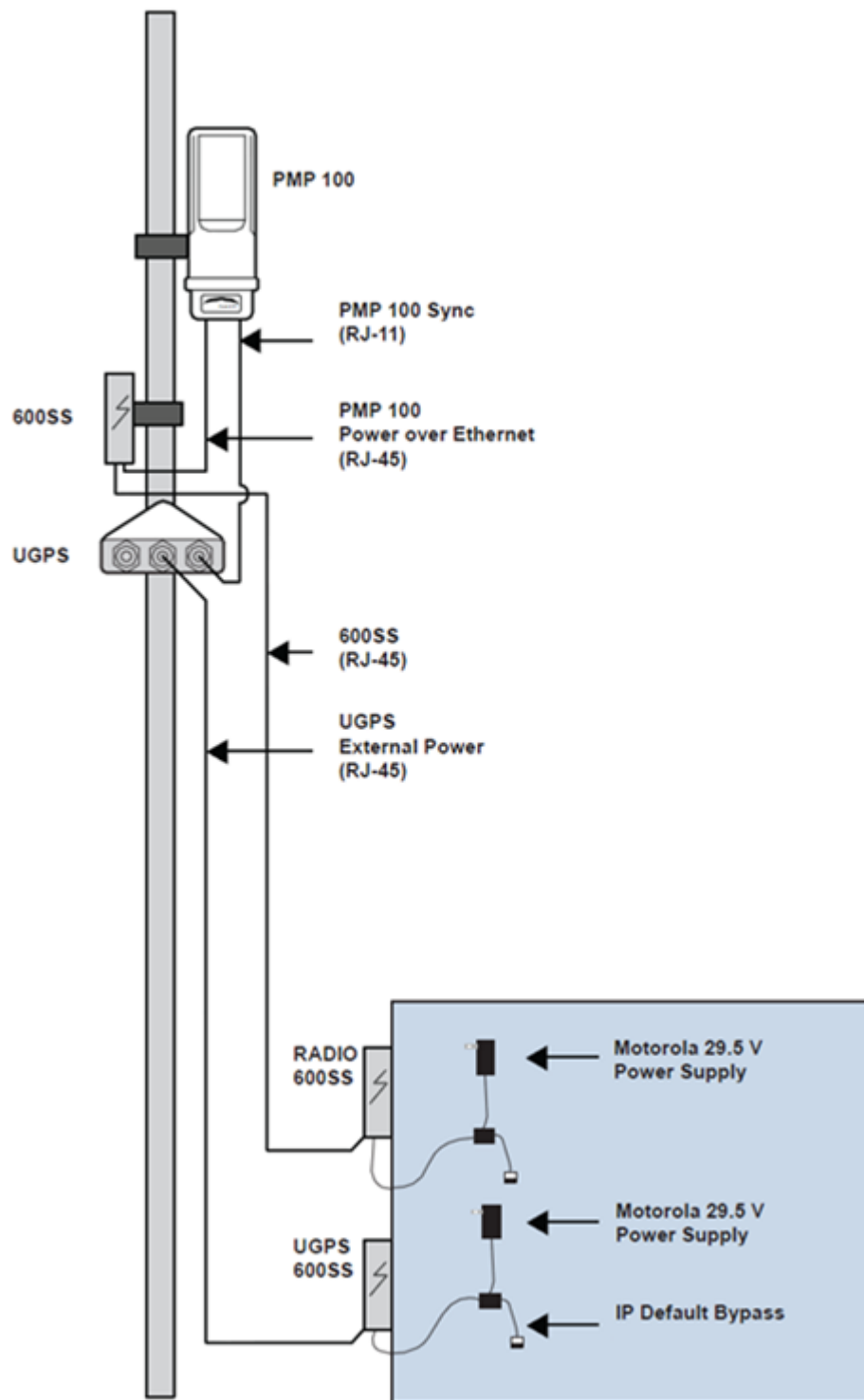


Figure 2: PMP 100 AP Receiving Synchronization from External Powered UGPS

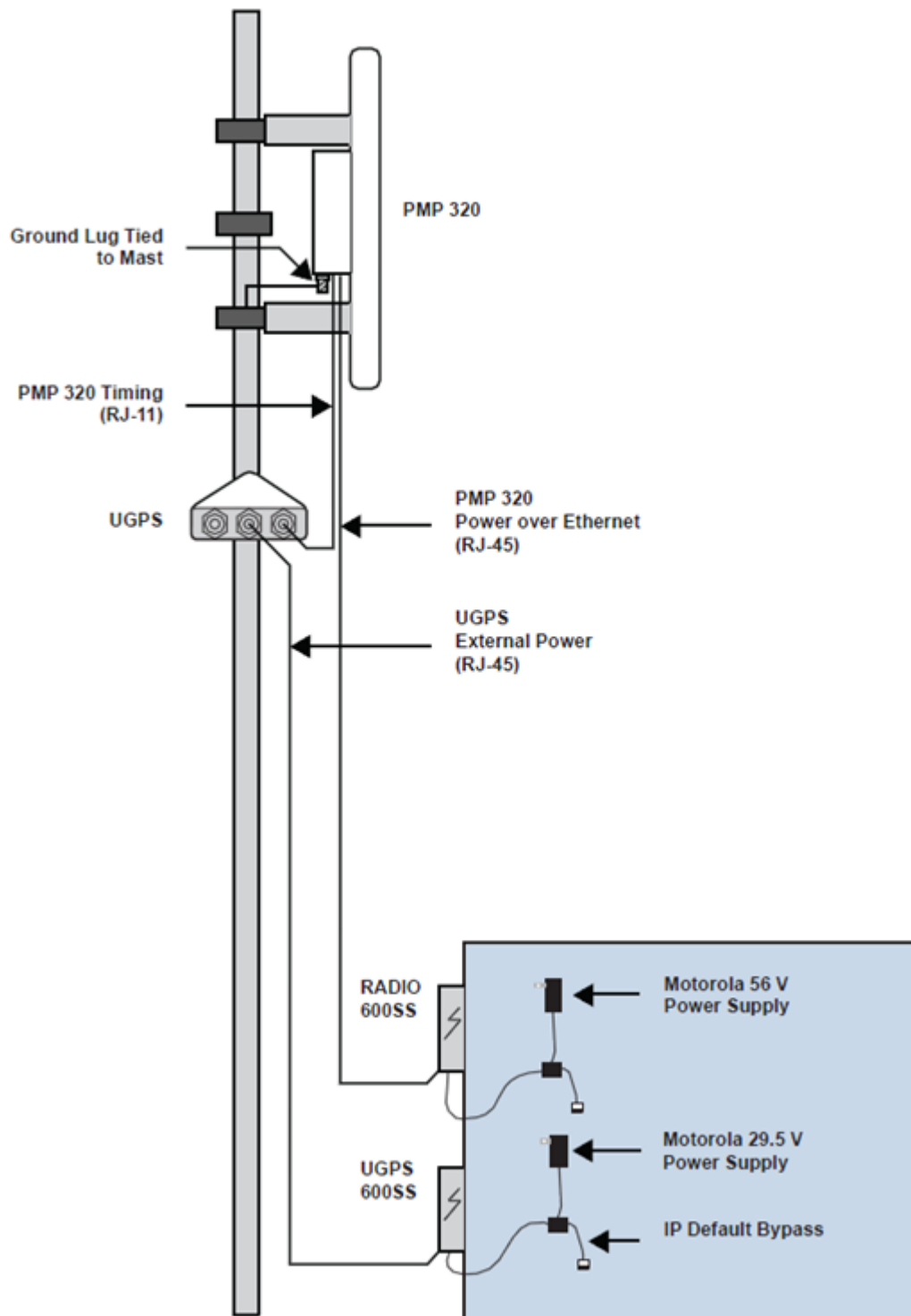


Figure 3: PMP 320 Receiving Synchronization from External Powered UGPS

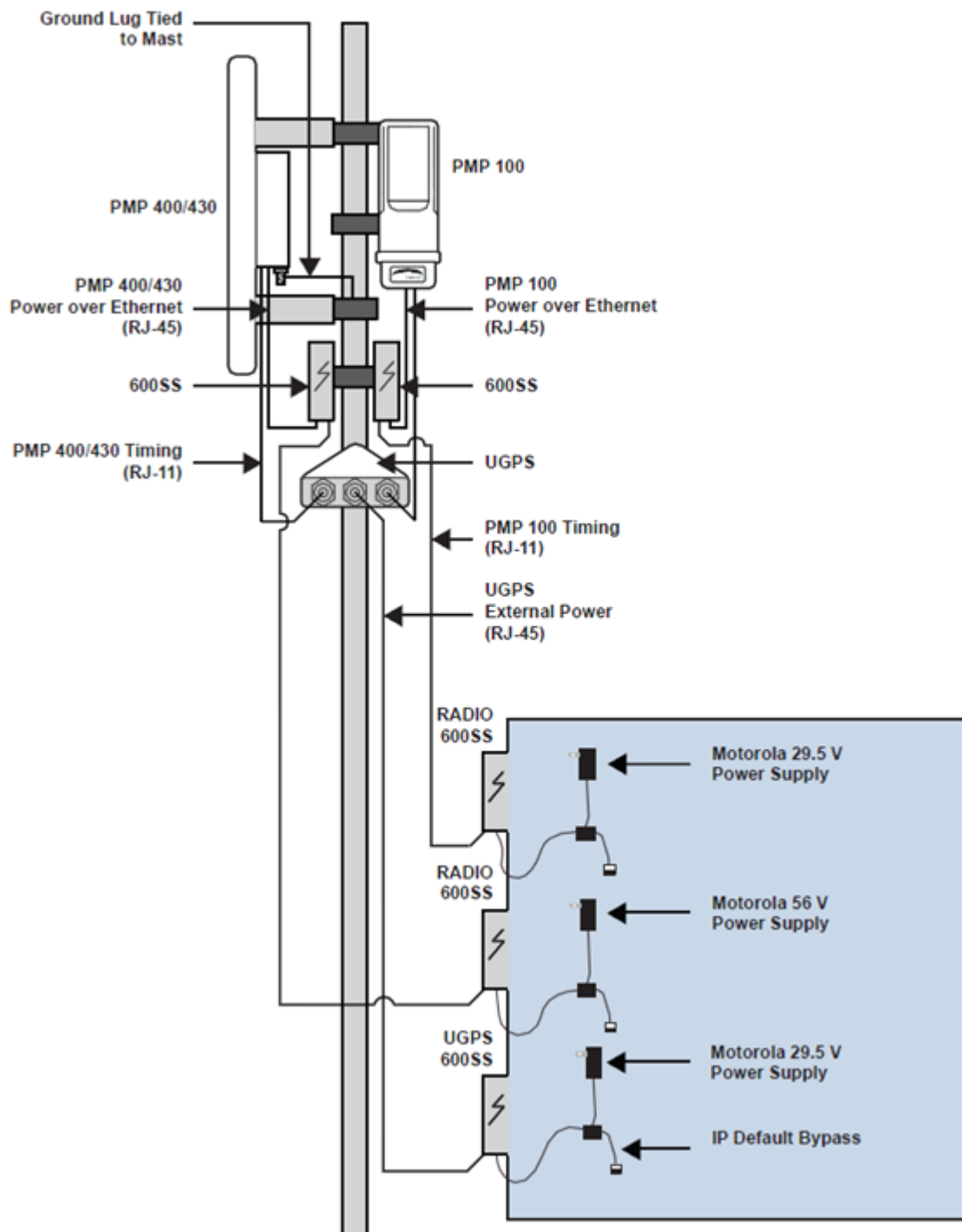


Figure 4: One PMP 400/430 AP and one PMP 100 AP Receiving Synchronization from External Powered UGPS

Power from the Radio via UGPS Timing Port 1 or UGPS Timing Port 2

Shown below is an example of a UGPS unit powered from a PTP 230 BHM through an RJ-11 cable connected to either Timing Port 1 or Timing Port 2 of the UGPS. The UGPS may be powered by either Timing Port, and up to two radios may receive synchronization over the Timing Ports when the UGPS is powered in this fashion.

NOTE

This UGPS powering mode is currently supported only by PTP 230 BHM . Future Cambium Networks hardware releases will also support providing power to the UGPS.

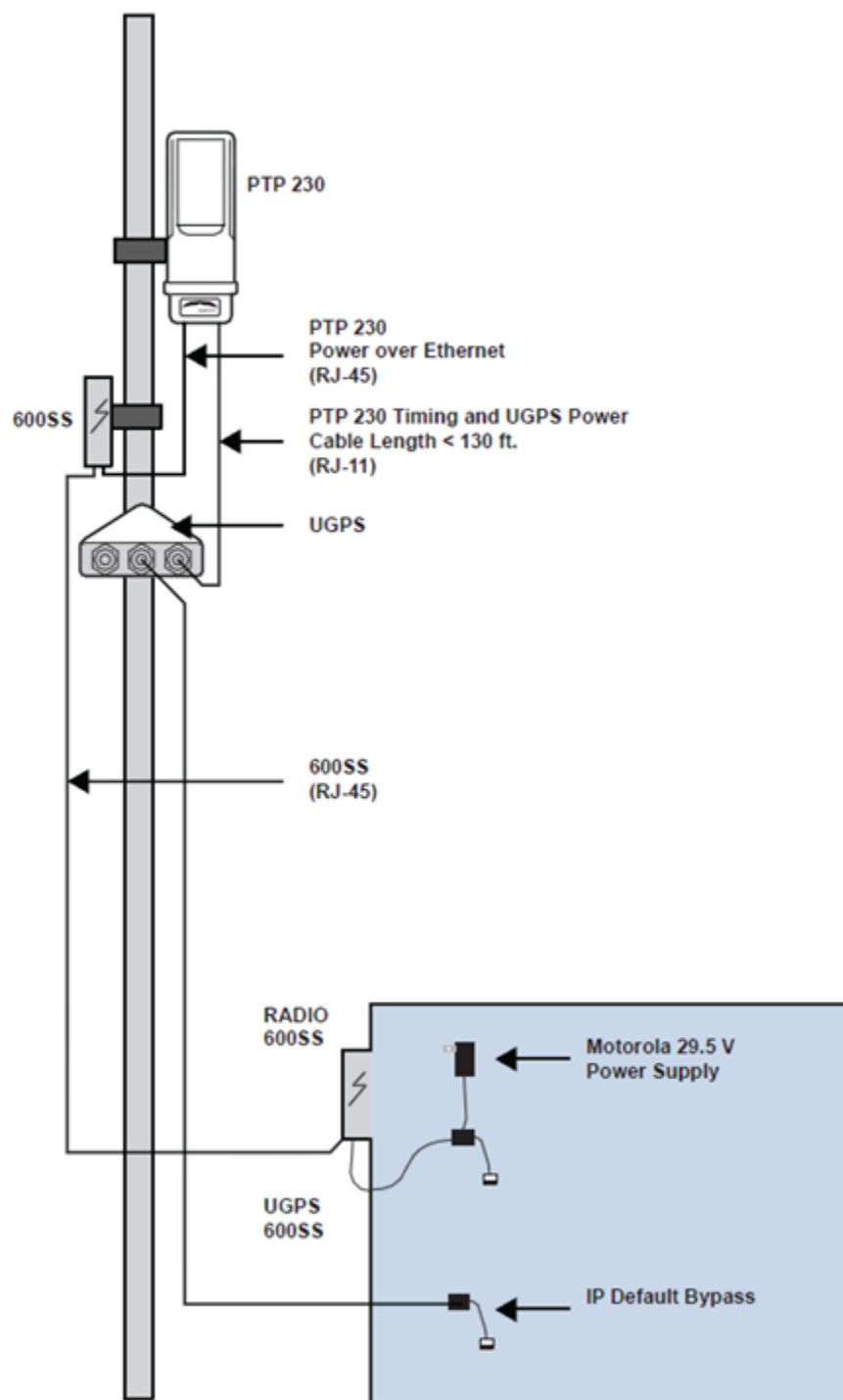


Figure 5: PTP 230 Backhaul Master Powering UGPS and Receiving Synchronization

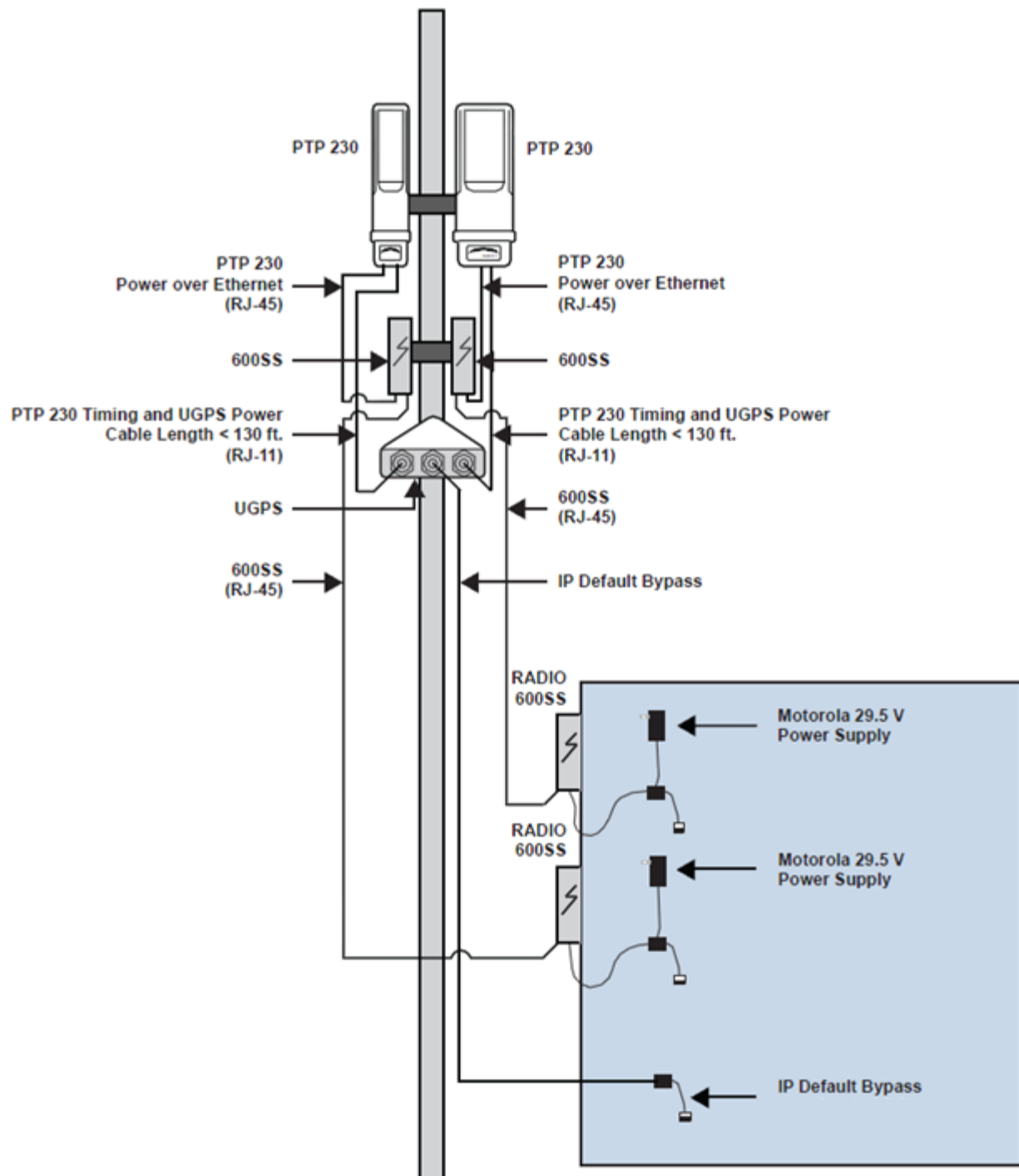


Figure 6: Two PTP 230 Backhaul Masters Powering UGPS and Receiving Synchronization

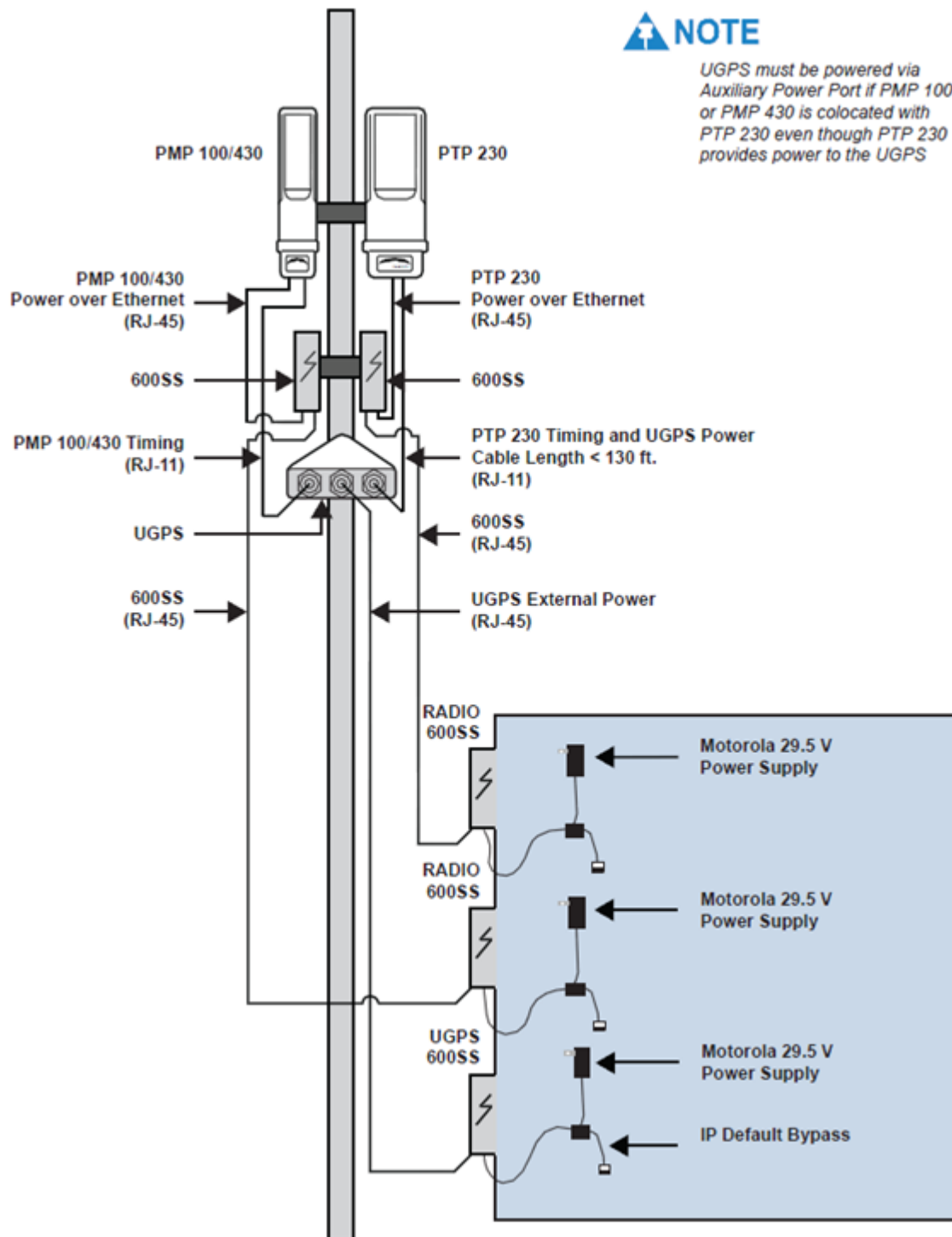


Figure 7: PTP 230 Backhaul Master Powering UGPS/Receiving Synchronization and PMP 100 / 430 Receiving Synchronization

UGPS and CMM Configurations

The UGPS may be used as a GPS synchronization source for Cambium Networks CMM3 and CMM4 (Cluster Management Module) units. The UGPS provides GPS synchronization to the CMM unit via the CMM's sync port. This allows any access points or backhaul masters connected to the CMM to receive sync. This configuration requires that the CMM3 or CMM4 be configured to "Slave" mode via the CMM GUI. When using the UGPS as a synchronization source for a CMM3 or CMM4, a special sync cable must be used. This cable may be constructed from an RJ-11 cable using the pin configuration in [Figure 9](#).

When using a CMM unit, the UGPS may also be used as a redundant sync source for the CMM. If a CMM encounters an issue with the primary, coaxial-connected GPS receiver an operator may remotely login to the CMM and set the synchronization source to "Slave" to begin receiving sync from the UGPS (connected via RJ-11 cable with the pin configuration in [Figure 9](#)).

NOTE

PMP 320 Systems - When using both the UGPS for timing and a CMM4 for timing in a PMP 320 network (same AP site or an adjacent AP site), timing discrepancies between the UGPS and CMM4 can cause interference between the sites. To address this issue, operators may opt to use one type of timing in the network (either UGPS or CMM4). Alternatively, operators may contact technical support to set up remote access to troubleshoot the AP units that are exhibiting the issue. A future PMP 320 software release will address this timing issue.

Product Specifications

Antenna

Frequency Band L1 (1575.42 ±10 MHz)
Polarization..... Patch

Receiver

Tracking Channels..... 12 (Min.) Continuous Tracking
Update Rate 1 Hz (NMEA)
Timing Accuracy (1PPS)..... 100ns RMS
Position Accuracy <3 m (Vertical), <10m (Horizontal)

Data Interface

Communications Standard NMEA-0183
Interface Technology 1PPS (8Vp-p Level-Shifted Pulse, 100ms Duty Cycle)
TX GPS LOCATION DATA (8Vp-p Level-Shifted –
Serial 8/N/1 9600bps)

Acquisition

Cold Start..... 35 seconds (Typical and under open clear sky)

Sensitivity

Acquisition -148dBm
Tracking..... -165dBm

Electrical

Voltage 4.3V - 6V DC (Timing Ports 1 & 2: +Vap)
10V - 30V DC (External Power Port: +Vext)
Power 250mW (2 APs Loaded; Vap=4.3V DC)
500mW (2 APs Loaded; Vap=0V DC; Vext=30V DC)
Cable Length 35m (120 ft.) 2 APs Loaded; Vap(min) = 4.3V DC
100m. (330 ft.) 2 APs Loaded; Vap=0V; Vext=30V DC

Environmental

Operating Temperature -40C to +85C
Humidity..... 95%
Ingress Protection..... IP67

Mechanical

Dimensions 6 inch(Length) x 3.5 inch(Width) x 4 inch(Dome Height)
Electrical Interface RJ11-6 Position Shielded(x2), RJ45-8 Position Shielded
Connector IP67 Rated Connector (Lapp Cord Grip Style)
Weight 15 Oz.

UGPS Installation and Operation


General Installation Considerations

- The unit may be pole mounted or surface mounted (on a horizontal surface with an unobstructed view of the sky).
- The UGPS should NOT be installed as the highest object at the site.
- Orient the GPS antenna so that it has clear access to the southern horizon (if installed north of the equator) or clear access to the northern horizon (if installed south of the equator).
- Note locations of 600SS surge suppressors when installing the UGPS unit. Reference [UGPS Power Source Configurations](#) diagrams. Compatible power supplies for the UGPS are listed in [Table 1](#).
- Observe cable length specifications in [Table 2](#).
- Cambium Networks recommends using shielded Category 5E cables for outdoor installations.
- The UGPS Power over Ethernet pinout (External Power Port) differs from IEEE Standard 803.3af, and the two should not be intermixed. The UGPS Power over Ethernet pinout is the same as Cambium Networks FSK broadband radios.

Table 1: Compatible 29.5V Power Supplies

Model	Description
ACPSSW-09B	US, UK and EU clips included
ACPSSW-10B	Argentina clip
ACPSSW-11A	Australia clip
ACPSSW-12A	Fixed Blade China
ACPSSW-13B	Fixed Blade US
ACPSSW-14A	Brazil clip
ACPSSW-20A	Infrastructure grade (shielded cable), US, UK and EU clips
ACPSSW-21A	Infrastructure grade (shielded cable), AC adapter clip (IEC 2-wire AC cord also required)

Table 2: Cable Length Specification

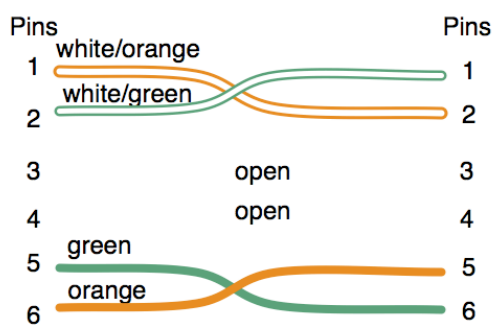
Configuration	Powering Method	Maximum Cable Length (feet)
External power source, up to two access points/backhaul masters	29.5V DC AC/DC Adapter (see Table 1) via UGPS Ext. Power Port	330
Access point/backhaul master power source, up to two access points/backhaul masters  NOTE This UGPS powering mode is supported only by PTP 230 BHM . Future Cambium Networks hardware releases will also support providing power to the UGPS.	Access Point/Backhaul master RJ-11 GPS power via UGPS Timing Port	130

 **NOTE**

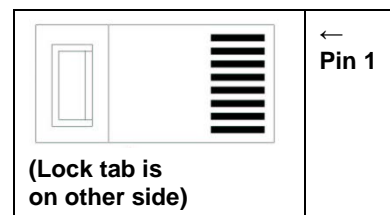
When using the UGPS as a synchronization source for a CMM3 or CMM4, a special sync cable must be used. This cable may be constructed from the an RJ-11 cable using the pin configuration in Figure 8

RJ-11, 6 pin 6 connector

RJ-11, 6 pin 6 connector



Note: Only 2 pairs are used

Figure 9: UGPS to CMM Cable Pin Configuration**Figure 10:** Location of Pin 1

Installation Procedure

Use the following procedure to install the UGPS module and to verify operation.

Procedure 1 UGPS Installation – External Powered

- 1 Pole mount or surface mount the GPS antenna following the installation guidelines and specifications listed in this chapter.
- 2 For PMP 100/400/430 and PTP 100/200 series, configure (via web management interface) the access points/backhaul masters to sync to received GPS signal (via the timing port). Navigate to **Configuration > General** and set the **Sync Input** to **Sync to Received Signal (Timing Port/UGPS)**. Since the UGPS will be configured with an external power source, set the **UGPS Power** value to **Disabled**.

Sync Setting	
Sync Input :	Sync to Received Signal (Timing Port/UGPS)
uGPS Power :	<input type="radio"/> Enabled <input checked="" type="radio"/> Disabled
Verify GPS Message Checksum :	<input checked="" type="radio"/> Enabled <input type="radio"/> Disabled

Figure 11: Configuring the Sync Input and Disabling UGPS Power – PMP 100/400/430 and PTP 100/200 Series

For PMP 320 series, configure (via web management interface) the access point to sync to received GPS signal (via the AP's RJ-11 port). Navigate to **Configuration > Settings** and set the **Sync Source** to **UGPS**.

AP Configuration / General / Settings	
Operation mode	Internal AAA
CPE Isolation	Disable CPE Isolation
AP GUI access from PC below CPE	Air Mng Disable
Sync Source	UGPS
Sync Holdoff Interval [sec]	None
Maximum Supported CPEs	200
Maximum Service Flow per AP	800
Maximum Service Flow per CPE	8

Update

Figure 12: Configuring the Sync Source - PMP 320 Series

3	<p>For PMP 100/400/430 and PTP 100/200 series, click Save Changes and reboot the radio.</p> <p>For PMP 320 series, click Update, click the Save icon and reboot the radio.</p>
4	<p>If connecting the UGPS to a CMM3 or CMM4, configure the CMM (via the CMM web management interface) to Slave mode (access points/backhaul masters connected to the CMM will need to be set to receive GPS sync signal from the power port). Navigate to Configuration > CMM and set Sync Source to Slave (RJ11 Port). A reboot on the CMM is required for these changes to take effect.</p>
5	<p>Connect an RJ-11 6 pin cable from Timing Port 1 of the UGPS to the RJ-11 utility port of the access point/backhaul master to receive GPS sync signal. If applicable, repeat this step for additional access points and backhaul masters. If the UGPS is to send sync to a CMM, use a special sync cable constructed per Figure 9.</p>
6	<p>Install a 600SS surge supressor between the power supply and the UGPS module. Reference the diagrams in section UGPS Power Source Configurations.</p>
7	<p>Connect an RJ-45 8 pin Ethernet cable from the UGPS power port to the 600SS surge supressor.</p>
8	<p>Connect an RJ-45 8 pin Ethernet cable from the 600SS surge supressor to the power supply.</p>
9	<p>Verify on the access point/backhaul master/CMM that the GPS synchronization signal is being received properly. Reference section GPS Status and Location Data Readout.</p>

Procedure 2 UGPS Installation – Powered by BH Timing Port (PTP 230 Only)

1	<p>Pole mount or surface mount the GPS antenna following the installation guidelines and specifications listed in this chapter.</p>
----------	---

- 2 Configure (via the web management interface) the backhaul master to sync to received signal (timing port). Navigate to **Configuration > General** and set the **Sync Input** to **Sync to Received Signal (Timing Port/UGPS)**. Since the UGPS will be configured to receive power over the UGPS Timing Ports, set the **UGPS Power** value to **Enabled** to configure the radio to power the UGPS.



The screenshot shows a web interface titled "Sync Setting". It contains three configuration rows:

- Sync Input :** A dropdown menu set to "Sync to Received Signal (Timing Port/uGPS)".
- uGPS Power :** Radio buttons for "Enabled" (selected) and "Disabled".
- Verify GPS Message Checksum :** Radio buttons for "Enabled" (selected) and "Disabled".

Figure 13: Configuring the Sync Input and Enabling UGPS Power – PTP 230 Series

- 3 Click **Save Changes** and reboot the radio.

- 4 Connect an RJ-11 6 pin cable from Timing Port 1 or 2 of the UGPS to the timing port of the access point/backhaul master providing power and receiving sync.

 **NOTE**

This UGPS powering mode is currently supported only by PTP 230 BHM . Future Cambium Networks hardware releases will also support providing power to the UGPS.

- 5 Verify on the access point/backhaul master that the GPS synchronization signal is being received properly. Reference section [GPS Status and Location Data Readout](#).

Procedure 3 UGPS Installation – Powered by CMM PoE Port

- 1 Pole mount or surface mount the GPS antenna following the installation guidelines and specifications listed in this chapter.
- 2 Verify that the CMM is powered by a 29.5V Cambium Networks power supply. This ensures that the CMM can provide the proper power-over-Ethernet output via CMM ports.
- 3 Connect an RJ-45 8 pin Ethernet cable from the External Power Port of the UGPS to an Ethernet port on the CMM4.

- 4 On the CMM4 web management GUI navigate to **Configuration > Ports**. In this configuration the CMM4 port connected to the UGPS via RJ-45 cable must be configured with **Power On** and **Device Type Canopy 29V** as Port 1 in [Figure 14](#).

 **NOTE**

The CMM Ethernet port will only provide 29V power to the UGPS if the CMM is powered by a 29V power supply. If the CMM is powered by a 56V power supply, it will not provide 29V power via the PoE ports.

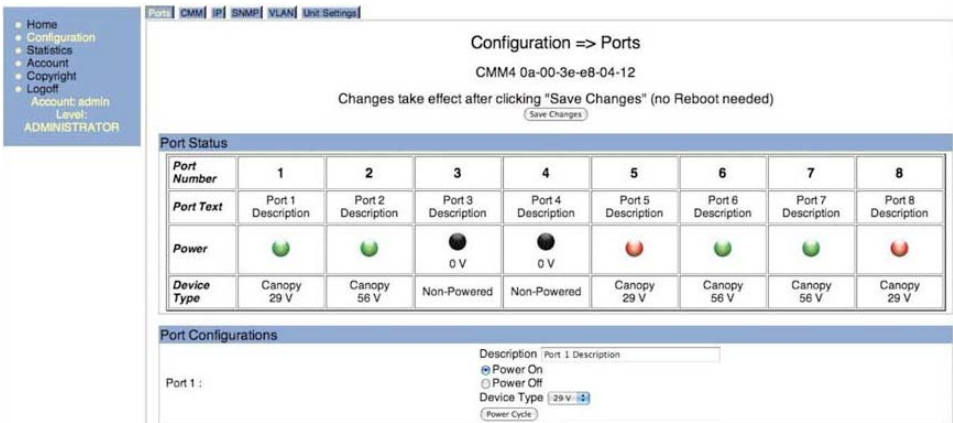


Figure 14: CMM Port Configuration for UGPS Power

IP Default Bypass

Since the UGPS is connected to the access point/backhaul master timing port, the UGPS module provides a bypass to perform an IP Default to a device connected on UGPS Timing Port 1 or 2. To perform an IP Default for a radio connected to the UGPS follow the procedures below:

Procedure 4 IP Default Procedure – UGPS receiving external power

1	Using the power adapter providing UGPS power, plug the “To Computer” RJ-45 plug of the power adapter cable into an RJ-45 coupler.
2	Attach an RJ-45 8 pin Ethernet cable to the coupler listed in Step 1, and pin out the loose end of the cable.

3	<p>Jumper the RJ-45 pins per the wiring table below:</p> <p>Table 3: UGPS IP Default Bypass Wiring</p> <table border="1"> <thead> <tr> <th>AP to Default</th><th>Wiring on External Power Connector</th></tr> </thead> <tbody> <tr> <td>Timing Port 1</td><td>Connect Pins 3 and 6</td></tr> <tr> <td>Timing Port 2</td><td>Connect Pins 1 and 2</td></tr> </tbody> </table>	AP to Default	Wiring on External Power Connector	Timing Port 1	Connect Pins 3 and 6	Timing Port 2	Connect Pins 1 and 2
AP to Default	Wiring on External Power Connector						
Timing Port 1	Connect Pins 3 and 6						
Timing Port 2	Connect Pins 1 and 2						
4	<p>For PMP 100/400/430 and PTP 100/200/230 series, reboot the radio to be defaulted while the RJ-45 pins are jumpered. After the radio has finished rebooting, the software will be restored to a factory default configuration.</p> <p>For PMP 320 series, once the RJ-45 pins are jumpered while the radio is powered up, the pin contacts may then be separated and the radio may be rebooted. When the radio powers back up, the software will be restored to a factory default configuration.</p>						

Procedure 5 IP Default Procedure – UGPS receiving power from backhaul master timing port

1	<p>With the UGPS unit powered by the backhaul master's timing ports, connect an RJ-45 8 pin Ethernet cable to the External Power Port on the UGPS and pin out the loose end of the cable.</p>						
2	<p>Jumper the RJ-45 pins per the wiring table below:</p> <p>Table 4: UGPS IP Default Bypass Wiring</p> <table border="1"> <thead> <tr> <th>AP to Default</th><th>Wiring on External Power Connector</th></tr> </thead> <tbody> <tr> <td>Timing Port 1</td><td>Connect Pins 3 and 6</td></tr> <tr> <td>Timing Port 2</td><td>Connect Pins 1 and 2</td></tr> </tbody> </table>	AP to Default	Wiring on External Power Connector	Timing Port 1	Connect Pins 3 and 6	Timing Port 2	Connect Pins 1 and 2
AP to Default	Wiring on External Power Connector						
Timing Port 1	Connect Pins 3 and 6						
Timing Port 2	Connect Pins 1 and 2						
3	<p>Reboot the radio to be defaulted while the RJ-45 pins are jumpered. After the radio has finished rebooting, the software will be restored to a factory default configuration.</p>						

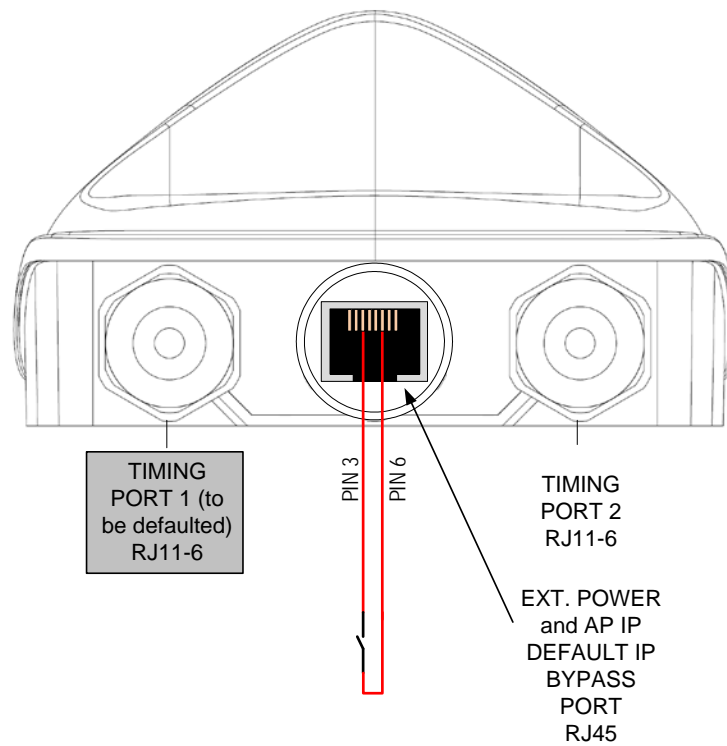


Figure 15: IP Default Bypass – Default Radio on Timing Port 1

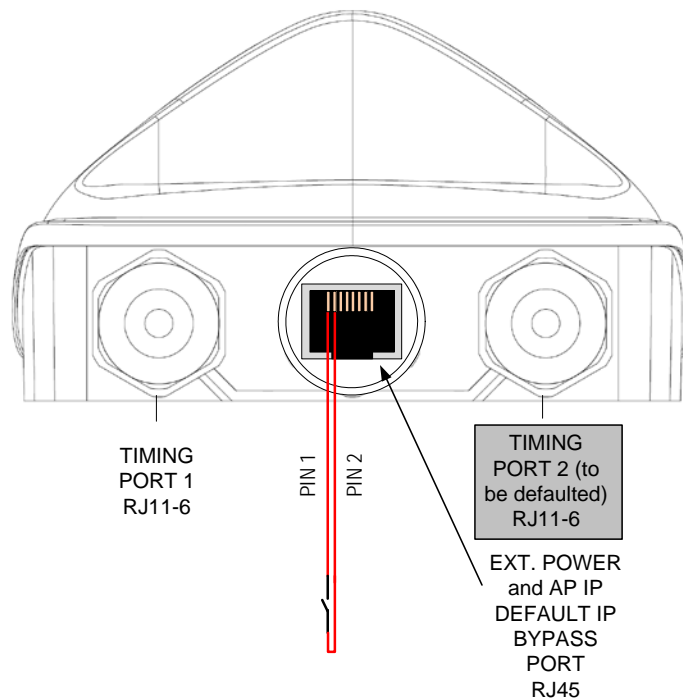


Figure 16: IP Default Bypass - Default Radio on Timing Port 2

GPS Status and Location Data Readout

The UGPS provides location data to connected synchronized devices and may be retrieved by the access point/backhaul/cluster management module web GUI or by SNMP. GPS status and location data readout is currently available on PMP 100/320/400/430, and PTP 100/200/230, series radios.

Retrieving GPS Status and Location Data via Radio Web Management GUI

Procedure 6 Retrieving GPS Status and Location Data via Radio Web Management GUI – PMP 100/400/430 and PTP 100/200/230 Series

1	With the UGPS powered and connected to the radio, navigate to Home > GPS Status .
2	<p>GPS Location Data is displayed in section GPS Status.</p>

Figure 17: GPS Status and Location Data – PMP 430 Example

Procedure 7 Retrieving GPS Status and Location Data via Radio Web Management GUI – PMP 320

1	With the UGPS powered and connected to the radio, navigate to Configuration > General > Properties .
----------	---

- 2 GPS Location Data is displayed as below:

AP Configuration / General / Properties

Description	Motorola PMP 320 Access Point
Name	PMP320
Contact	John
Location	West
Installation Latitude	42.061975
Installation Longitude	-88.048596

Figure 18: GPS Status and Location Data – PMP 320 Example

Retrieving GPS Status and Location Data via SNMP

To retrieve GPS Status and Location Data via SNMP (Simple Network Management Protocol) from synchronized devices operators may use the following procedures.

Procedure 8 Retrieving GPS Status and Location Data via SNMP – PMP 100/400/430 and PTP 100/200/230 Series

- | | |
|---|--|
| 1 | With the UGPS powered and connected to the radio, on the radio web management GUI navigate to Configuration > SNMP . |
| 2 | Verify that the Community String and Accessing Subnet values are set as desired. |

3Perform a “snmpget” command for the OID desired based on [Table 5](#).**Table 5:** GPS OIDs – PMP 100/400/430 and PTP 100/200/230 Series

Object Name, OID	Description
whispGPSStatus, .1.3.6.1.4.1.161.19.3.1.3.1	GPS synchronization info (1: GPS Synchronized, 2: GPS Lost Sync, 3: Generating Sync)
gpsSyncSource, .1.3.6.1.4.1.161.19.3.1.3.2	Source of GPS sync pulse
gpsSyncStatus, .1.3.6.1.4.1.161.19.3.1.3.3	Current GPS sync status
gpsTrackingMode, .1.3.6.1.4.1.161.19.3.1.3.4	GPS tracking mode
gpsTime, .1.3.6.1.4.1.161.19.3.1.3.5	GPS time
gpsDate, .1.3.6.1.4.1.161.19.3.1.3.6	GPS date
gpsSatellitesTracked, .1.3.6.1.4.1.161.19.3.1.3.7	Current number of satellites GPS is tracking
gpsSatellitesVisible, .1.3.6.1.4.1.161.19.3.1.3.8	Number of satellites visible to the GPS
gpsHeight, .1.3.6.1.4.1.161.19.3.1.3.9	GPS height
gpsLatitude, .1.3.6.1.4.1.161.19.3.1.3.11	GPS latitude
gpsLongitude, .1.3.6.1.4.1.161.19.3.1.3.12	GPS Longitude

Procedure 9 Retrieving GPS Status and Location Data via SNMP – PMP 320

1 With the UGPS powered and connected to the radio, on the radio web management GUI navigate to **Administration > User Management** and verify SNMP user data.

2 Perform a “snmpget” command for the OID desired based on [Table 6](#).

Table 6: SNMP Details – PMP 320 Series

Object Name, OID	Description
danSyncStatus, .1.3.6.1.4.1.32584.1.1.3.2	Source of GPS sync pulse (0: No sync, 1: Sync present, 2: External sync missing – operating on internal clock, 3: Transition state - about to lose sync)
danLatitude, .1.3.6.1.4.1.32584.1.1.1.5	System installation Latitude, Range -90 to 90
danLongitude, .1.3.6.1.4.1.32584.1.1.1.6	System installation Longitude, Range -180 to 180

UGPS Power Port and Timing Port Pinouts

See tables below for UGPS pinout information.

Table 7: Power Port Pinout

Pin	Function
1	Ground (for IP Default jumper to Pin 2)
2	Timing Port 2 AP IP Default Pin
3	Ground (For IP Default jumper to Pin 6)
4	Ground (+Vaux Return)
5	Ground (+Vaux Return)
6	Timing Port 1 AP IP Default Pin
7	+Vaux (10V-30V DC)
8	+Vaux (10V-30V DC)

Table 8: Timing Port Pinout

Pin	Function
1	1 PPS Sync Pulse (8Vo-p)
2	N/A
3	GPS Location Data – Serial 9600 bps (8Vo-p)
4	V+ (4V DC – 6V DC)
5	N/A
6	Ground (V+ Return)

Regulatory, Legal, and Safety Notices

IMPORTANT NOTE ON MODIFICATIONS

Intentional or unintentional changes or modifications to the equipment must not be made unless under the express consent of the party responsible for compliance. Any such modifications could void the user's authority to operate the equipment and voids the manufacturer's warranty.

Universal GPS module label

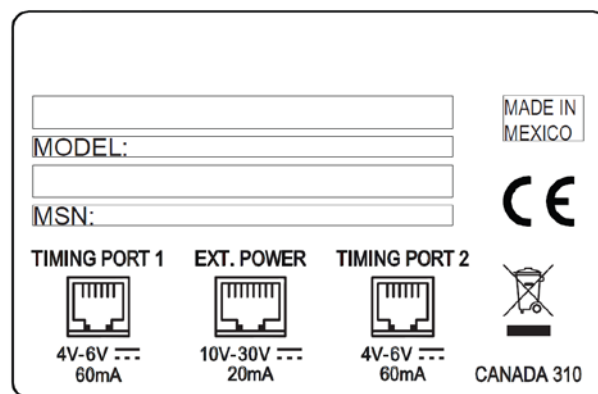


Figure 19: UGPS Label

NATIONAL AND REGIONAL REGULATORY NOTICES

U.S. Federal Communication Commission (FCC) Notification

This device complies with Part 15 of the US FCC Rules and Regulations. 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 Notification

This Category II radiocommunication device complies with Industry Canada Standard RSS-310.

Ce dispositif de radiocommunication de catégorie II respecte la norme CNR-310 d'Industrie Canada.

Operation is subject to the following two conditions:

- This device may not cause harmful interference and
- 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. 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

Equipment Disposal

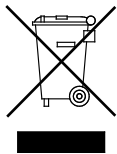


Figure 20: Waste Disposal of Electronic and Electric Equipment

Please do not dispose of Electronic and Electric Equipment or Electronic and Electric Accessories with your household waste. In some countries or regions, collection systems have been set up to handle waste of electrical and electronic equipment. In European Union countries, please contact your local equipment supplier representative or service center for information about the waste collection system in your country.

LIMIT OF LIABILITY

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