

Figure 115: Radio tab of BHS, example

In the Radio tab of the BHS, you may set the following parameters.

Custom Radio Frequency Scan Selection List

Specify the frequency that the BHS should scan to find the BHM. The frequency *band* of the BHS affects what channels you select.



IMPORTANT!

In the 2.4-GHz frequency band, the BHS can register to a BHM that transmits on a frequency 2.5 MHz higher than the frequency that the BHS receiver locks when the scan terminates as successful. This establishes a poor-quality link. To prevent this, select frequencies that are at least 5 MHz apart.

In a 2.4-GHz BHS, this parameter displays all available channels, but has only three recommended channels selected by default. See [2.4-GHz AP Cluster Recommended Channels](#) on Page 137.

In a 5.2- or 5.4-GHz BHS, this parameter displays only ISM frequencies. In a 5.7-GHz BHS, this parameter displays both ISM and U-NII frequencies. If you select all frequencies that are listed (default selections), then the module scans for a signal on any channel. If you select only one, then the module limits the scan to that channel. Since the frequencies that this parameter offers for each of these two bands are 5 MHz apart, a scan of *all* channels does not risk establishment of a poor-quality link as in the 2.4-GHz band. Nevertheless, this can risk establishment of a link to the wrong BHM.

A list of channels in the band is provided in [Considering Frequency Band Alternatives](#) on Page 136.

(The selection labeled **Factory** requires a special software key file for implementation.)

Color Code

Specify a value from 0 to 254. For registration to occur, the color code of the BHM and the BHS *must* match. On all Canopy modules, the default setting for the color code value is 0. This value matches only the color code of 0 (*not* all 255 color codes).



RECOMMENDATION:

Note the color code that you enter. Ensure that you can readily associate this color code both with the module and with the other data that you store about the module.

Transmitter Output Power

Nations and regions may regulate transmitter output power. For example

- Both 900-MHz and 5.7-GHz modules are available as connectorized radios, which require the operator to adjust power to ensure regulatory compliance. In addition to setting the power in the 5.7-GHz connectorized module, the operator

must set the antenna gain/cable loss such that the module can accurately report received power at the antenna.

- Legal maximum allowable transmitter output power and EIRP (Equivalent Isotropic Radiated Power) in the 2.4-GHz frequency band varies by country and region. The output power of Series P9 2.4-GHz modules can be adjusted to meet these national or regional regulatory requirements.
- Countries and regions that permit the use of the 5.4-GHz frequency band (CEPT member states, for example), generally require equipment using the band to have adjustable power.

The professional installer of Canopy equipment has the responsibility to

- maintain awareness of applicable regulations.
- calculate the permissible transmitter output power for the module.
- confirm that the initial power setting is compliant with national or regional regulations.
- confirm that the power setting is compliant following any reset of the module to factory defaults.

For information on how to calculate the permissible transmitter output power to enter in this parameter, see [Adjusting Transmitter Output Power](#) on Page 326.

The Radio tab also provides the following buttons.

Save Changes

When you click this button, any changes that you made on this tab are recorded in flash memory. However, these changes *do not* apply until the next reboot of the module.

Reboot

When you click this button

1. the module reboots.
2. any changes that you saved by a click of the **Save Changes** button are implemented.

18.5.4 SNMP Tab of the BHS

An example of the SNMP tab in a BHS is displayed in [Figure 116](#).

Figure 116: SNMP tab of BHS, example

In the SNMP tab of the BHS, you may set the following parameters.

Community String

Specify a control string that allows Prizm or an NMS (Network Management Station) to access MIB information about this BHS. No spaces are allowed in this string. The default string is **Canopy**.

The **Community String** value is clear text and is readable by a packet monitor. Additional security derives from the configuration of the **Accessing Subnet**, **Trap Address**, and **Permission** parameters.

Accessing Subnet

Specify the addresses that are allowed to send SNMP requests to this BHS. Prizm or the NMS has an address that is among these addresses (this subnet). You must enter both

- The network IP address in the form xxx.xxx.xxx.xxx
- The CIDR (Classless Interdomain Routing) prefix length in the form /xx

For example

- the /16 in 198.32.0.0/16 specifies a subnet mask of 255.255.0.0 (the first 16 bits in the address range are identical among all members of the subnet).
- 192.168.102.0 specifies that any device whose IP address is in the range 192.168.102.0 to 192.168.102.254 can send SNMP requests to the BHS, presuming that the device supplies the correct **Community String** value.

The default treatment is to allow all networks access (set to 0). For more information on CIDR, execute an Internet search on “Classless Interdomain Routing.”

Trap Address 1 to 10

Specify ten or fewer IP addresses (xxx.xxx.xxx.xxx) to which trap information should be sent. Trap information informs Prizm or an NMS that something has occurred. For example, trap information is sent

- after a reboot of the module.
- when Prizm or an NMS attempts to access agent information but either
 - supplied an inappropriate community string or SNMP version number.
 - is associated with a subnet to which access is disallowed.

Read Permissions

Select **Read Only** if you wish to disallow Prizm or NMS SNMP access to configurable parameters and read-only fields of the SM.

Site Name

Specify a string to associate with the physical module. This parameter is written into the *sysName* SNMP MIB-II object and can be polled by Prizm or an NMS. The buffer size for this field is 128 characters.

Site Contact

Enter contact information for the module administrator. This parameter is written into the *sysContact* SNMP MIB-II object and can be polled by Prizm or an NMS. The buffer size for this field is 128 characters.

Site Location

Enter information about the physical location of the module. This parameter is written into the *sysLocation* SNMP MIB-II object and can be polled by Prizm or an NMS. The buffer size for this field is 128 characters.

The SNMP tab also provides the following buttons.

Save Changes

When you click this button, any changes that you made on the Configuration page are recorded in flash memory. However, these changes *do not* apply until the next reboot of the module.

Reboot

When you click this button

1. the module reboots.
2. any changes that you saved by a click of the **Save Changes** button are implemented.

18.5.5 Quality of Service (QoS) Tab of the BHS

An example of the Quality of Service tab of the BHS is displayed in [Figure 117](#).

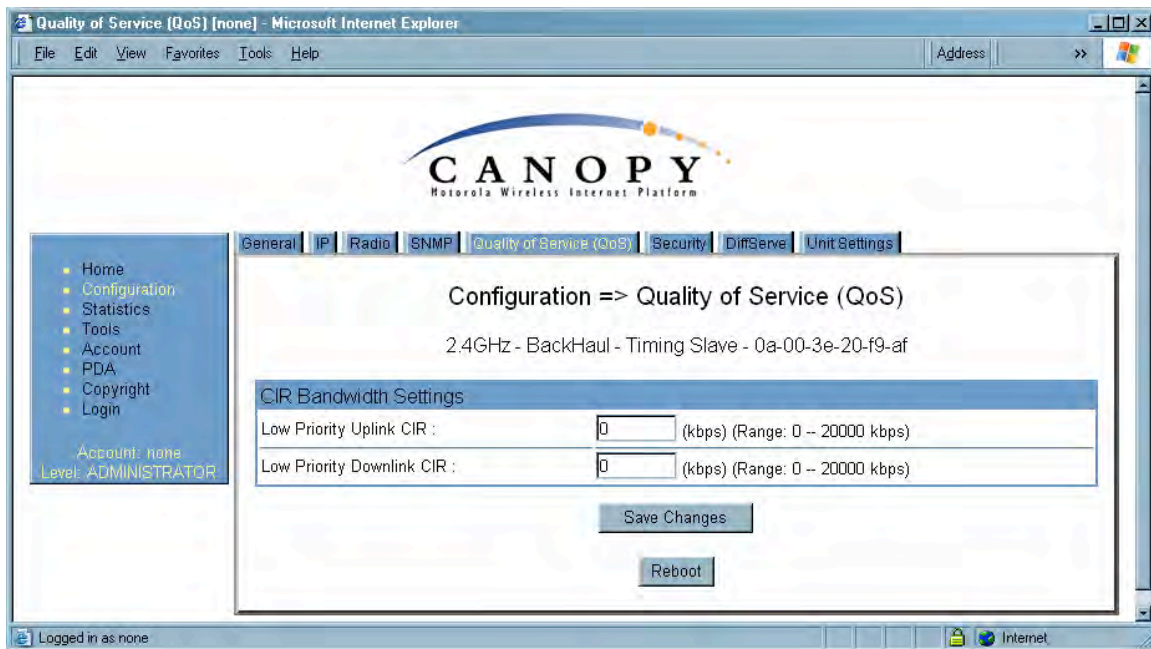


Figure 117: Quality of Service (QoS) tab of BHS, example

In the Quality of Service (QoS) tab of the BHS, you may set the following parameters.

Low Priority Uplink CIR

See

- [Committed Information Rate](#) on Page 88
- [Setting the Configuration Source](#) on Page 292.

Low Priority Downlink CIR

See

- [Committed Information Rate](#) on Page 88

- [Setting the Configuration Source](#) on Page 292.

18.5.6 Security Tab of the BHS

An example of the Security tab in a BHS is displayed in [Figure 118](#).

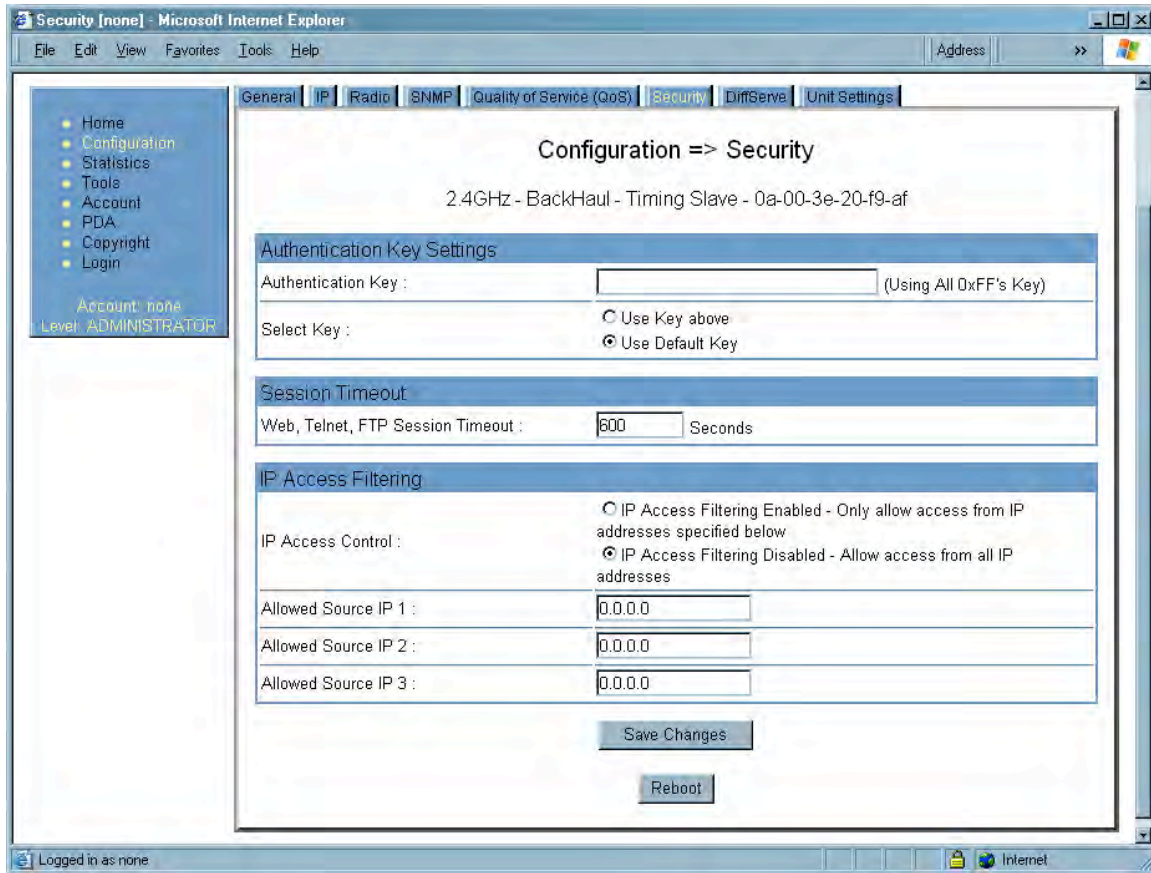


Figure 118: Security tab of BHS, example

In the Security tab of the BHS, you may set the following parameters.

Authentication Key

Only if the BHM to which this BHS will register requires authentication, specify the key that the BHS should use when authenticating. For alpha characters in this hex key, use only upper case.



NOTE:

Canopy recommends that you enter 32 characters to achieve the maximal security from this feature.

Select Key

The **Use Default Key** selection specifies that the link should continue to use the automatically generated authentication key. See [Authentication Manager Capability](#) on Page 383.

The **Use Key above** selection specifies the 32-digit hexadecimal key that is permanently stored on both the BHS and the BHM.

Web, Telnet, FTP Session Timeout

Enter the expiry in seconds for remote management sessions via HTTP, telnet, or ftp access to the BHS.

IP Access Control

You can permit access to the BHS from any IP address (**IP Access Filtering Disabled**) or limit it to access from only one, two, or three IP addresses that you specify (**IP Access Filtering Enabled**). If you select **IP Access Filtering Enabled**, then you must populate at least one of the three **Allowed Source IP** parameters or have no access permitted from any IP address, including access and management by Prizm.

Allowed Source IP 1 to 3

If you selected **IP Access Filtering Enabled** for the **IP Access Control** parameter, then you must populate at least one of the three **Allowed Source IP** parameters or have no access permitted to the BHS from any IP address. You may populate as many as all three.

If you selected **IP Access Filtering Disabled** for the **IP Access Control** parameter, then no entries in this parameter are read, and access from all IP addresses is permitted.

The Security tab of the BHS also provides the following buttons.

Save Changes

When you click this button, any changes that you made on this tab are recorded in flash memory. However, these changes *do not* apply until the next reboot of the module.

Reboot

When you click this button

1. the module reboots.
2. any changes that you saved by a click of the **Save Changes** button are implemented.

18.5.7 DiffServe Tab of the BHS

An example of the DiffServe tab in a BHS is displayed in Figure 119.

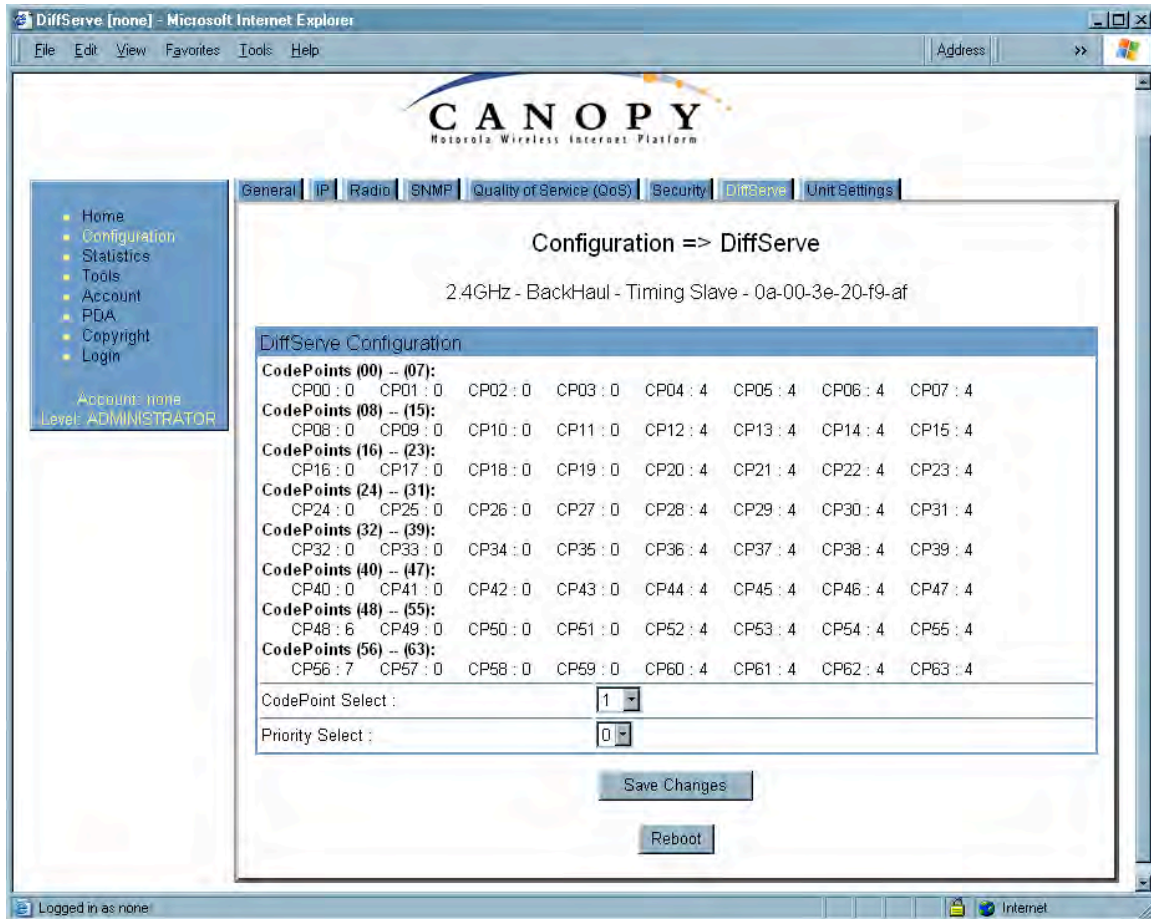


Figure 119: DiffServe tab of BHS, example

You may set the following Differentiated Services Configuration page parameters.

**CodePoint 1
through
CodePoint 47**

The default priority value for each settable CodePoint is shown in [Figure 119](#). Priorities of 0 through 3 map to the low-priority channel; 4 through 7 to the high-priority channel. The mappings are the same as 802.1p VLAN priorities.

Consistent with RFC 2474

- **CodePoint 0** is predefined to a fixed priority value of **0** (low-priority channel).
- **CodePoint 48** is predefined to a fixed priority value of **6** (high-priority channel).
- **CodePoint 56** is predefined to a fixed priority value of **7** (high-priority channel).

**CodePoint 49
through
CodePoint 55**

**CodePoint 57
through
CodePoint 63**

You cannot change any of these three fixed priority values. Among the settable parameters, the priority values (and therefore the handling of packets in the high- or low-priority channel) are set in the BHM for the downlink and in the BHS for the uplink. See [DSCP Field](#) on Page 89.

18.5.8 Unit Settings Tab of the BHS

An example of the Unit Settings tab in a BHS is displayed in [Figure 120](#).

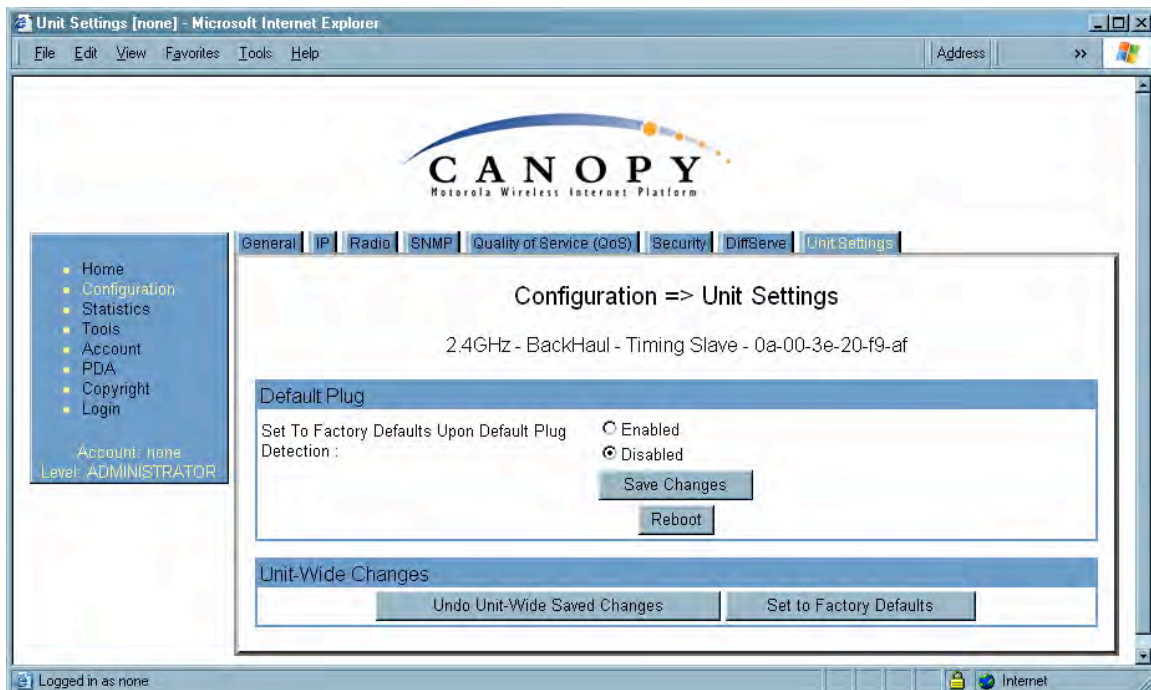


Figure 120: Unit Settings tab of BHS, example

The Unit Settings tab of the BHS contains an option for how the BHS should react when it detects a connected override plug. You may set this option as follows.

Set to Factory Defaults Upon Default Plug Detection

If **Enabled** is checked, then an override/default plug functions as a default plug. When the module is rebooted with the plug inserted, it can be accessed at the IP address 169.254.1.1 and no password, and all parameter values are reset to defaults.

A subscriber, technician, or other person who gains physical access to the module and uses an override/default plug *cannot* see or learn the settings that were previously configured in it. When the module is later rebooted with no plug inserted, the module uses the new values for any parameters that were changed and the default values for any that were not.

If **Disabled** is checked, then an override/default plug functions as an override plug. When the module is rebooted with the plug inserted, it can be accessed at the IP address 169.254.1.1 and no password, and all previously configured parameter values remain and are displayed. A subscriber, technician, or other person who gains physical access to the module and uses an override/default plug *can* see and learn the settings. When the module is later rebooted with no plug inserted, the module uses the new values for any parameters that were changed and the previous values for any that were not.

See [Overriding Forgotten IP Addresses or Passwords on AP, SM, or BH](#) on Page 373.

The Unit Settings tab also contains the following buttons.

Save Changes

When you click this button, any changes that you made on all tabs are recorded in flash memory. However, these changes *do not* apply until the next reboot of the module.

Reboot

When you click this button

1. the module reboots.
2. any changes that you saved by a click of the **Save Changes** button are implemented.

Undo Unit-Wide Saved Changes

When you click this button, any changes that you made in any tab but did not commit by a reboot of the module are undone.

Set to Factory Defaults

When you click this button, *all configurable parameters on all tabs* are reset to the factory settings.

18.6 ADJUSTING TRANSMITTER OUTPUT POWER

Authorities may require transmitter output power to be adjustable and/or lower than the highest that a module produces. Canopy adjustable power modules include a Radio tab parameter to reduce power on an infinite scale to achieve compliance. If you set this parameter to lower than the supported range extends, the value is automatically reset to the lowest supported value.

The professional installer of Canopy equipment has the responsibility to

- maintain awareness of applicable regulations.
- calculate the permissible transmitter output power for the module.
- confirm that the initial power setting is compliant.

- confirm that the power setting is compliant following any reset of the module to factory defaults.

The total gain per antenna in 900-MHz and 5.7-GHz Canopy radios is stated in [Table 51](#).

Table 51: Total gain per antenna

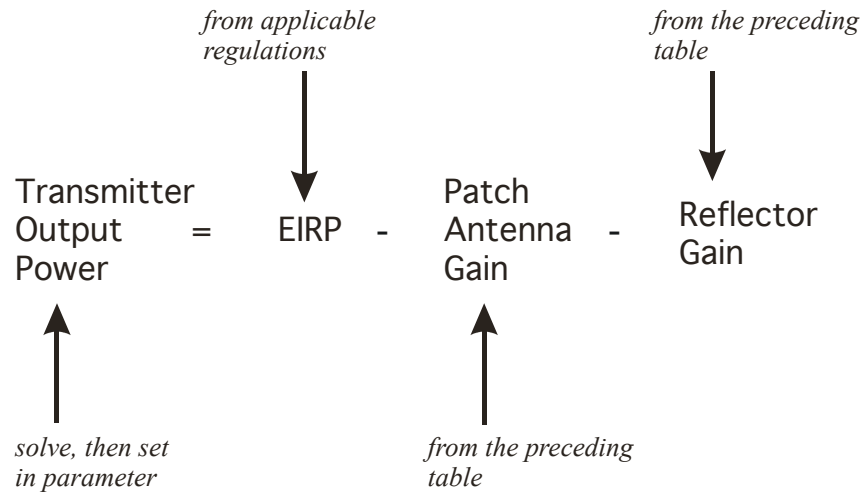
Antenna	Antenna Gain	Cable Loss ¹	Net Gain
900-MHz Integrated	12.5 dBi	0.2 dB	12 dBi
900-MHz Connectorized with Mars, MTI, or Maxrad antenna.	10 to 10.5 dBi	0.3 dB	10 dBi
5.7-GHz Connectorized	variable	0.3 dB + from any additional cable	See Note 2
5.7-GHz Connectorized with Mars antenna	15.5 dBi	0.3 dB	15 dBi
NOTES: 1. Received signal measurements take this loss into account, but the transmitter output power setting cannot. Set the transmitter output power higher by this amount. 2. Antenna gain minus cable loss.			

Integrated patch antenna and reflector gains are provided in [Table 52](#).

Table 52: Patch antenna and reflector gain

Frequency Band Range	Gain	
	Patch Antenna	Reflector
2.4 GHz	8 dBi	11dBi
5.2, 5.4, or 5.7 GHz	7 dBi	18dBi

The calculation of transmitter output power is as follows:



Transmitter output power is settable as dBm on the Radio tab of the module. Example cases of transmitter output power settings are shown in [Table 53](#).

Table 53: Transmitter output power settings, example cases

Frequency Band Range and Antenna Scheme	Region	Maximum EIRP in Region	Transmitter Output Power Setting	
			AP, SM, or BH with No Reflector	SM or BH with Reflector
900 MHz Integrated	U.S.A. Canada	36 dBm (4 W)	24 dBm	
900 MHz Connectorized	U.S.A. Canada	36 dBm (4 W)	26 dBm ¹	
	Australia	30 dBm (1 W)	Depends on antenna	
2.4 GHz Integrated	U.S.A. Canada	Depends on antenna gain	25 dBm	25 dBm
	CEPT states	20 dBm (100 mW)	12 dBm	1 dBm
5.2 GHz Integrated	U.S.A. Canada	30 dBm (1 W)	23 dBm	
5.4 GHz Integrated	CEPT states	30 dBm (1 W)	23 dBm	5 dBm
5.7 GHz Connectorized	UK	33 dBm (2 W)	Depends on antenna	
5.7 GHz Connectorized	U.S.A	36 dBm (4W)	21 dBm ²	
NOTES: 1. With Mars, MTI, or Maxrad antenna. This is the default setting, and 28 dBm is the highest settable value. The lower default correlates to 36 dBm EIRP where 10-dBi antennas are used. The default setting for this parameter is applied whenever Set to Factory Defaults is selected. 2. Only AP available				

19 INSTALLING COMPONENTS

**RECOMMENDATION:**

Use *shielded* cable for all Canopy infrastructure connections associated with BHs, APs, and CMMs. The environment that these modules operate in often has significant unknown or varying RF energy. Operator experience consistently indicates that the additional cost of shielded cables is more than compensated by predictable operation and reduced costs for troubleshooting and support.

19.1 PDA ACCESS TO CANOPY MODULES

For RF spectrum analysis or module aiming on a roof or tower, a personal digital assistant (PDA) is easier to carry than, and as convenient to use as, a notebook computer. The PDA is convenient to use because no scrolling is required to view

- spectrum analysis results.
- RSSI and jitter.
- master module evaluation data.
- information that identifies the module, software, and firmware.

To access this data in a format that fits a 320 x 240 pixel PDA screen, the PDA must have all of the following:

- a Compact Flash card slot.
- any of several Compact Flash wired Ethernet cards.
- a wired Ethernet connection to the module.
- a browser directed to <http://Module/IPAddress/pda.html>.

The initial PDA tab reports link status, as shown in [Figure 121](#).

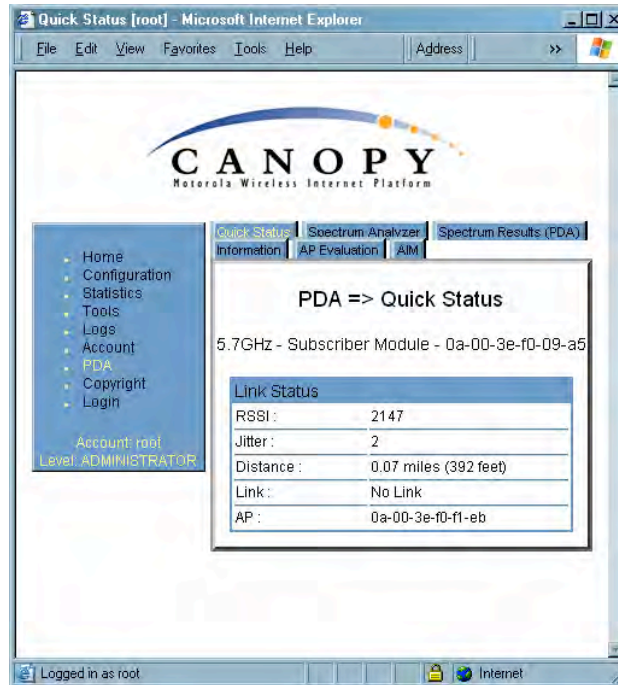


Figure 121: PDA Quick Status tab, example

An example of the Spectrum Analyzer tab for PDAs is displayed in Figure 122. For additional information about the Spectrum Analyzer feature, see [Monitoring the RF Environment](#) on Page 363.

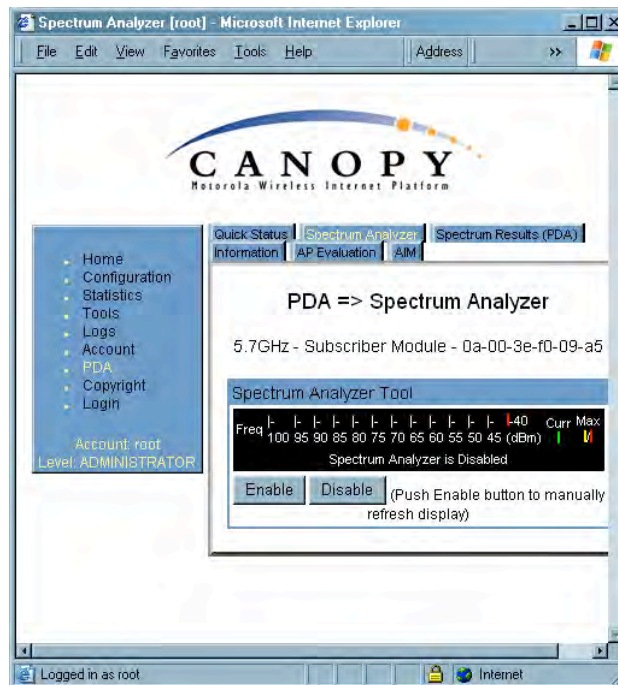


Figure 122: PDA Spectrum Analyzer tab of SM, example

Examples of the Spectrum Results and Information tabs for PDAs are shown in [Figure 123](#) and [Figure 124](#).

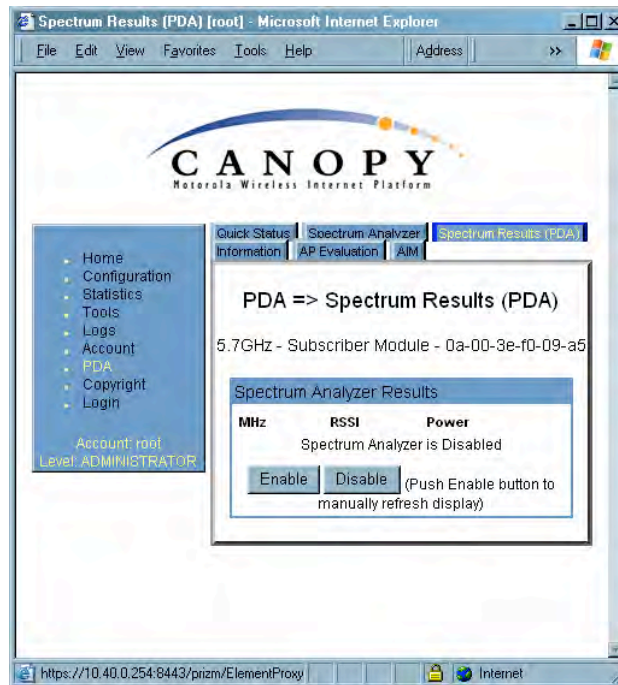


Figure 123: PDA Spectrum Results tab of SM, example

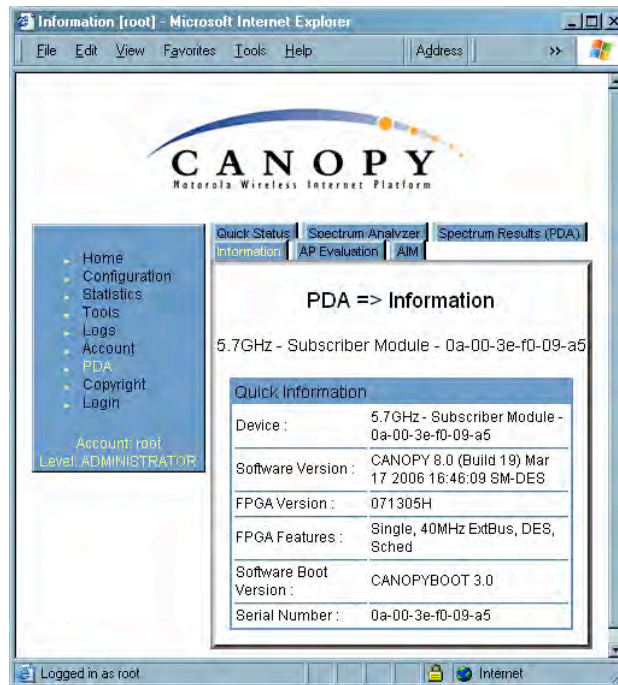


Figure 124: PDA Information tab of SM, example

Examples of the AP Evaluation and Aim tabs for PDAs are shown in [Figure 125](#) and [Figure 126](#).

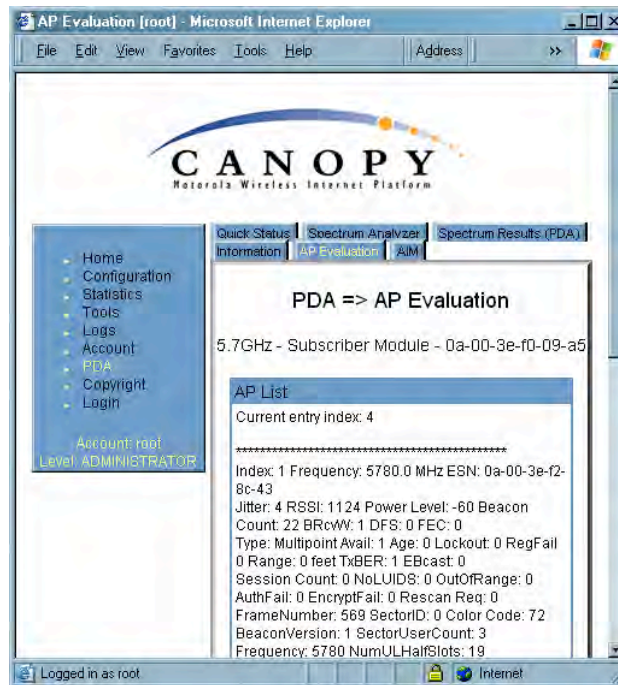


Figure 125: PDA AP Evaluation tab of SM, example

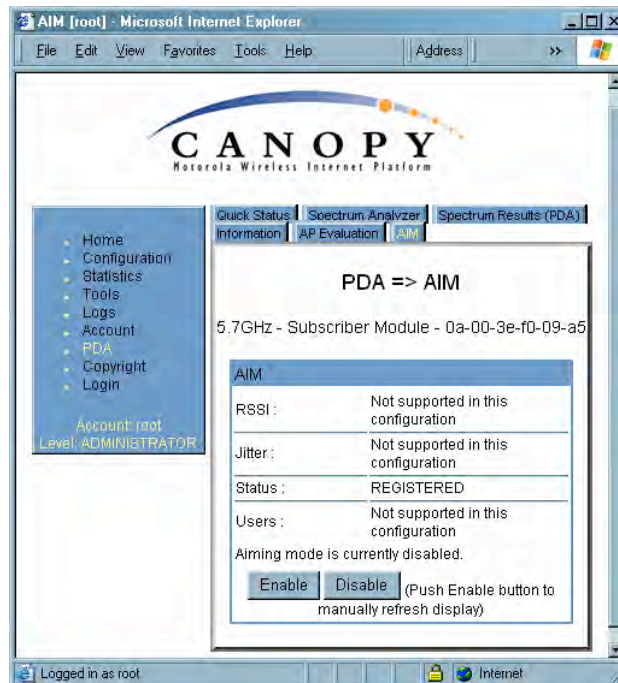


Figure 126: PDA Aim tab of SM, example

19.2 INSTALLING AN AP

To install the Canopy AP, perform the following steps.

Procedure 19: Installing the AP

1. Begin with the AP in the powered-down state.
2. Choose the best mounting location for your particular application. Modules need not be mounted next to each other. They can be distributed throughout a given site. However, the 60° offset must be maintained. Mounting can be done with stainless steel hose clamps or another equivalent fastener.
3. Align the AP as follows:
 - a. Move the module to where the link will be unobstructed by the radio horizon and no objects penetrate the Fresnel zone. (The Canopy System Calculator page [AntennaElevationCalcPage.xls](#) automatically calculates the minimum antenna elevation that is required to extend the radio horizon to the other end of the link. The Canopy System Calculator page [FresnelZoneCalcPage.xls](#) automatically calculates the Fresnel zone clearance that is required between the visual line of sight and the top of a high-elevation object.)
 - b. Use a local map, compass, and/or GPS device as needed to determine the direction that one or more APs require to each cover the intended 60° sector.
 - c. Apply the appropriate degree of downward tilt. (The Canopy System Calculator page [DowntiltCalcPage.xls](#) automatically calculates the angle of antenna downward tilt that is required.)
 - d. Ensure that the nearest and furthest SMs that must register to this AP are within the beam coverage area. (The Canopy System Calculator page [BeamwidthRadiiCalcPage.xls](#) automatically calculates the radii of the beam coverage area.)
4. Using stainless steel hose clamps or equivalent fasteners, lock the AP in the proper direction and downward tilt.
5. Remove the base cover of the AP. (See [Figure 52](#) on Page 178.)
6. Attach the cables to the AP.
(See [Procedure 5](#) on Page 184.)

NOTE: When power is applied to a Canopy module or the unit is reset on the web-based interface, the module requires approximately 25 seconds to boot. During this interval, self-tests and other diagnostics are being performed. See [Table 43](#) on Page 179.

===== end of procedure =====

19.3 INSTALLING A CONNECTORIZED FLAT PANEL ANTENNA

To install a connectorized flat panel antenna to a mast or structure, follow instructions that the manufacturer provides. Install the antenna safely and securely, consistent with industry practices.

The Universal Mounting Bracket available from Motorola (Part Number SMMB-1 and consisting of a mounting bracket and L-shaped aluminum tube) holds one Canopy module, but cannot hold both the module and a connectorized antenna. The SMMB-2 is a heavy duty bracket that can hold both a 900-MHz module and its connectorized antenna. See [Module Support Brackets](#) on Page 59.

**IMPORTANT!**

Connectorized antennas *require* professional installation.

The professional installer is responsible for

- selection of an antenna that the regulatory agency has approved for use with the Canopy 900-MHz AP and SM.
- setting of the gain consistent with regulatory limitations and antenna specifications.
- ensuring that the polarity—horizontal or vertical—is identical on both ends of the link. (This may be less obvious where an integrated antenna is used on one end and a connectorized on the other.)
- use of moisture sealing tape or wrap to provide long-term integrity for the connection.

19.4 INSTALLING A GPS ANTENNA

The following information describes the recommended tools and procedures to mount the GPS antenna.

Recommended Tools for GPS Antenna Mounting

The following tools may be needed for mounting the GPS antenna:

- 3/8" nut driver
- 12" adjustable wrench
- 7/16" wrench
- Needle-nose pliers

Mounting a GPS Antenna

Perform the following procedure to mount a GPS antenna.

Procedure 20: Mounting the GPS antenna

1. Ensure that the mounting position
 - has an unobstructed view of the sky to 20° above the horizon.
 - *is not* the highest object at the site. (This is important for lightning protection.)
 - *is not* further than 100 feet (30.4 meters) of cable from the CMM2 or CMMmicro.
2. Select a pole that has an outside diameter of 1.25 to 1.5 inches (3 to 4 cm) to which the GPS antenna bracket can be mounted.
3. Place the U-bolts (provided) around the pole as shown in [Figure 127](#).
4. Slide the GPS antenna bracket onto the U-bolts.
5. Slide the ring washers (provided) onto the U-bolts.

6. Slide the lock washers (provided) onto the U-bolts.
7. Use the nuts (provided) to securely fasten the bracket to the U-bolts.

===== end of procedure =====

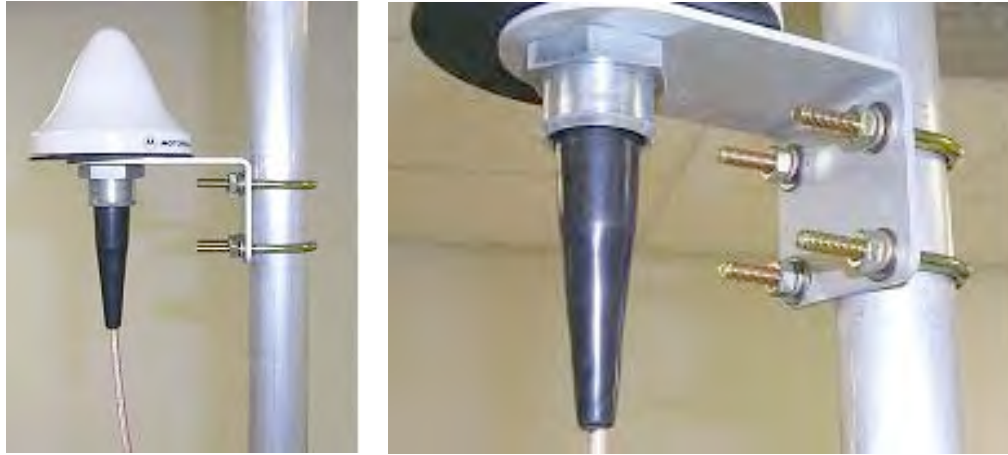


Figure 127: Detail of GPS antenna mounting

19.4.1 Recommended Materials for Cabling the GPS Antenna

The following materials are required for cabling the GPS antenna:

- up to 100 feet (30.4 meters) of LMR200 coaxial cable
- 2 Times Microwave N-male connectors (Times Microwave P/N TC-200-NM) or equivalent connectors.

19.4.2 Cabling the GPS Antenna

Connect the GPS coax cable to the female N-connector on the GPS antenna.

19.5 INSTALLING A CMM2

Ensure that you comply with standard local or national electrical and climbing procedures when you install the CMM2.

19.5.1 CMM2 Installation Temperature Range

Install the CMM2 outside only when temperatures are above -4°F (-20°C). The bulkhead connector and the bushings and inserts in the bulkhead connector are rated for the full -40° to $+131^{\circ}\text{F}$ (-40° to $+55^{\circ}\text{C}$) range of the CMM2. However, for dynamic operations (loosening, tightening, and inserting), they are compliant at, and rated for, only temperatures at or above -4°F (-20°C).

19.5.2 Recommended Tools for Mounting a CMM2

The following tools may be needed for mounting the CMM2:

- 3/8" nut driver
- 12" adjustable wrench
- 14-mm wrench for pole-mounting
- needle-nose pliers

19.5.3 Mounting a CMM2

Perform the following procedure to mount the CMM2.

Procedure 21: Mounting the CMM2

1. Ensure that the mounting position
 - *is not* further than 328 feet (100 meters) of cable from the furthest AP or BH that the CMM2 will serve.
 - *is not* closer than 10 feet (3 meters) to the nearest AP or BH.
 - *is not* further than 100 feet (30.4 meters) of cable from the intended mounting position of the GPS antenna.
 - allows you to fully open the door of the CMM2 for service.
2. Select a support structure to which the flanges of the CMM2 can be mounted.
3. If the support structure is a wall, use screws or bolts (neither is provided) to attach the flanges to the wall.
4. If the support structure is an irregular-shaped object, use adjustable stainless steel bands (provided) to attach the CMM2 to the object.
5. If the support structure is a pole that has an outside diameter of 3 to 8 cm, or 1.25 to 3 inches, use a toothed V-bracket (provided) to
 - a. attach the V-bracket to the pole as shown in Figure 128.
 - b. attach the CMM2 flanges to the V-bracket.

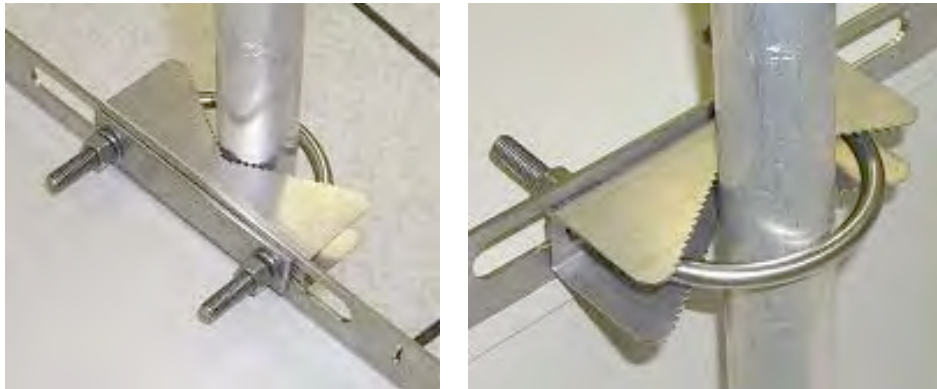


Figure 128: Detail of pole mounting

===== end of procedure =====

19.5.4 Cabling a CMM2



IMPORTANT!

Where you deploy CMM2s, one AP in each AP cluster must be connected to the master port on the CMM2, and each module connected to a CMM2 must be configured to **Sync to Received Signal (Timing Port)**. If either is not done, then the GPS receiver sends no sync pulse to the remaining ports.

Perform the following procedure to attach the CMM2 cables on both ends:

Procedure 22: Cabling the CMM2

1. Carefully review the practices recommended in [Best Practices for Cabling](#) on Page 182.
2. Remove the base cover from any AP or BH that is to be connected to this CMM2. See [Figure 52](#) on Page 178.
3. Remove the GPS sync cable knockout from the base cover.
4. For any AP that is to be connected to this CMM2, set the AP **Sync Input** Configuration Page parameter to the **Sync to Received Signal (Timing Port)** selection.
5. Review the schematic drawing inside the CMM2.
6. Set the 115-/230-volt switch in the CMM2 consistent with the power source. See [Figure 129](#).

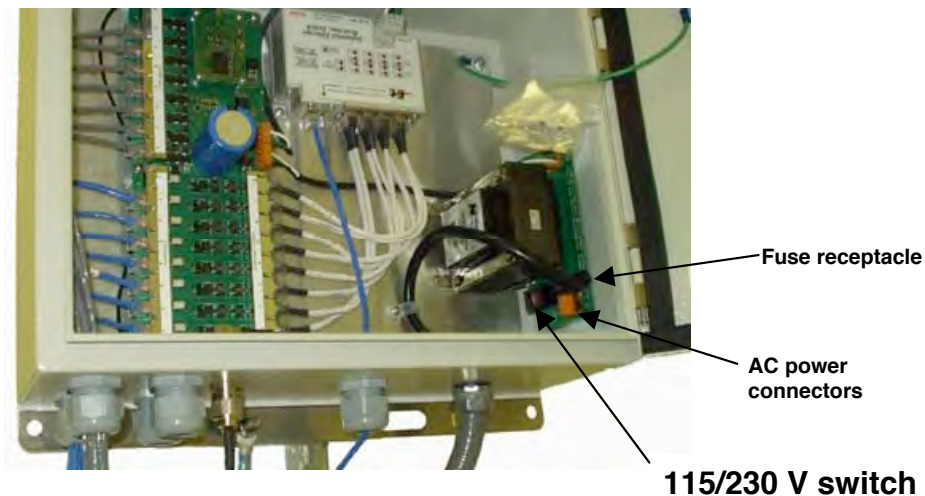


Figure 129: Location of 115-/230-volt switch



CAUTION!

Failure to set the 115-/230-volt switch correctly can result in damage to equipment.



IMPORTANT!

The AC power connectors are labeled **N** for Neutral, **L** for Line, and **PE** for Protective Earth (PE) $\downarrow$ or ground. The maximum thickness of wire to be used is 4 mm² or 12 AWG.

7. Route the Ethernet cables from the APs and or BHs to the CMM2.

The strain relief plugs on the CMM2 have precut holes. Each hole of the strain relief is designed to hold two CAT 5 UTP cables or one shielded cable. The Ethernet cables have RJ-45 (standard Ethernet) connectors that mate to corresponding ports inside the CMM2.

These ports are labeled **J3**. Eight J3 ports are available on the CMM2 to accommodate any combination of APs and BHs.

The logical connections in the CMM2 are displayed in [Figure 130](#).

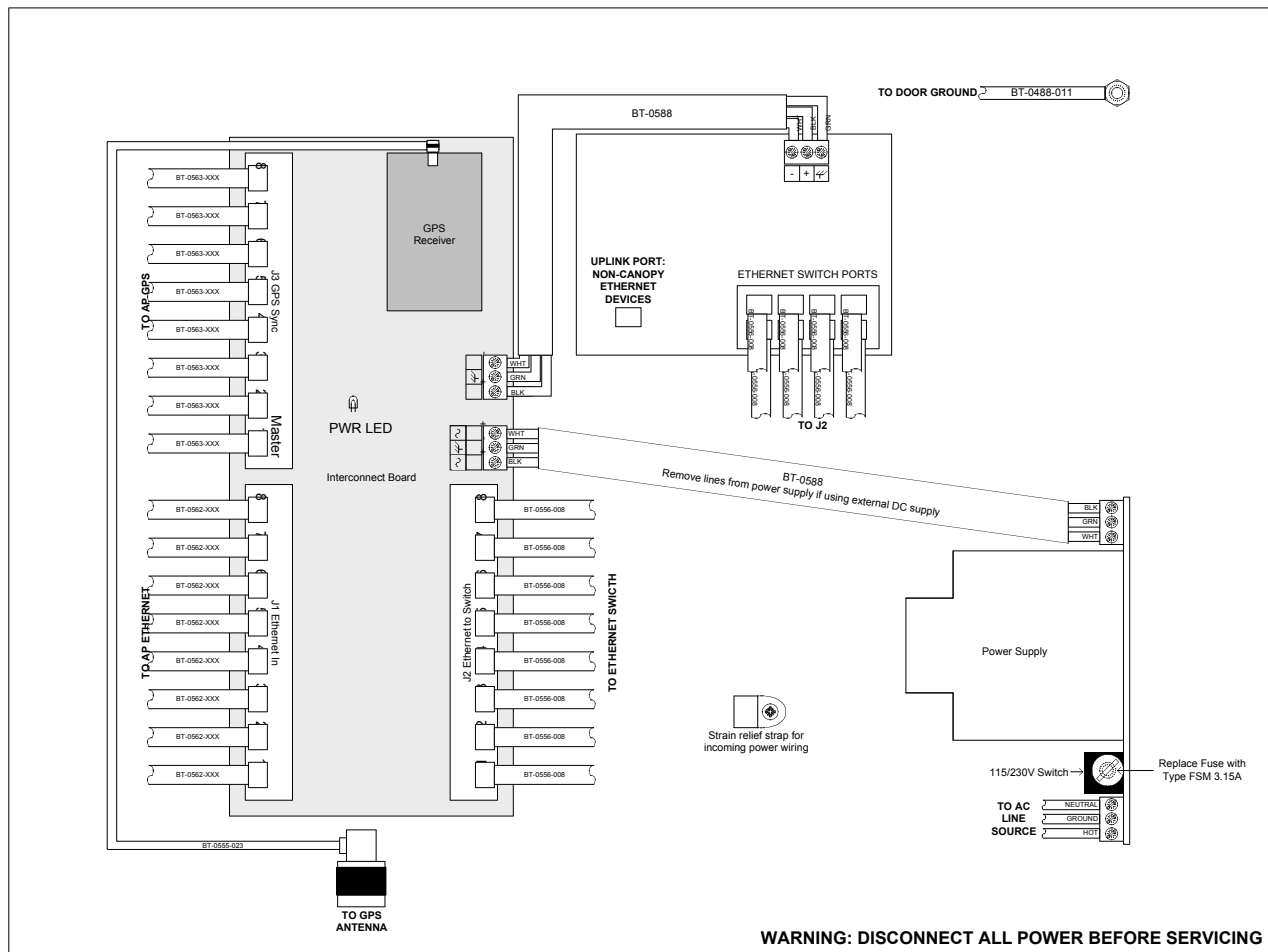


Figure 130: Layout of logical connections in CMM2

8. Connect the Ethernet cable from the first AP or BH to the **Port 1** in the J3 ports in the CMM2. This port is the *master* Ethernet port for the CMM2 and should be connected first in all cases. [Figure 131](#) on Page 341 is a photograph of a properly wired CMM2.

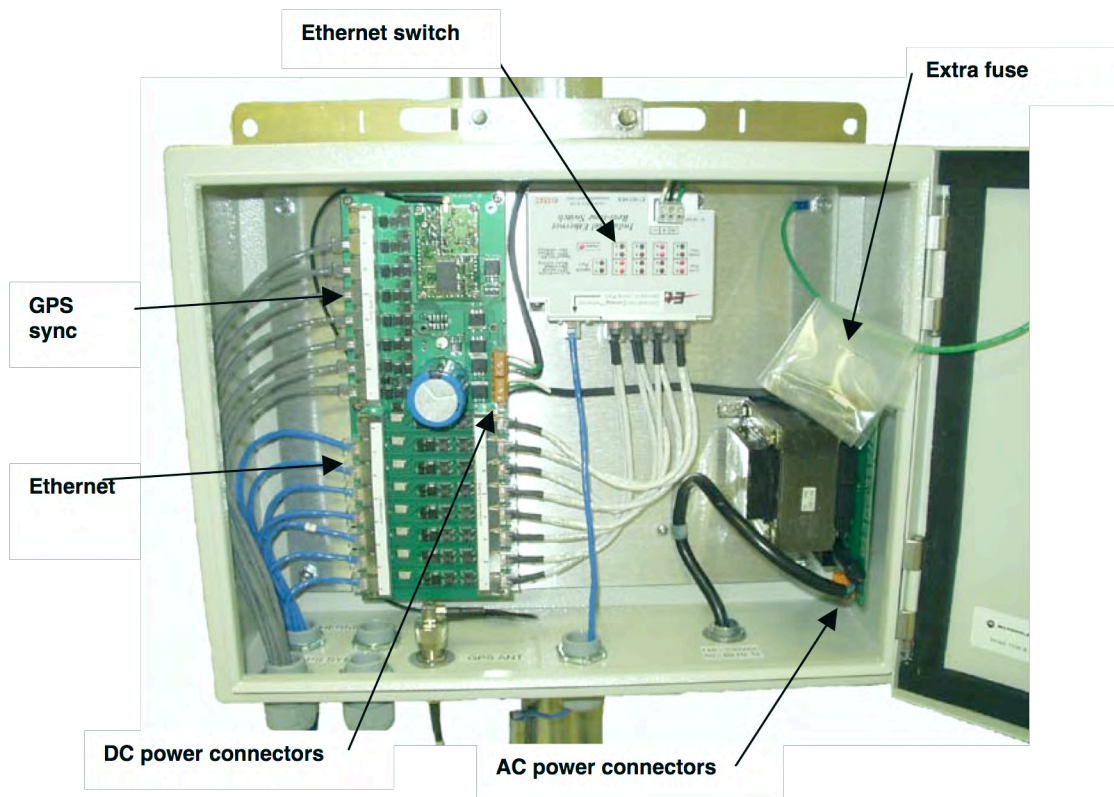


Figure 131: Canopy CMM2, front view

9. Connect the remaining Ethernet cables to the remaining J3 ports.
10. Route the GPS sync (serial) cables from the APs to the CMM2.

The GPS sync cables have 6-conductor RJ-11 connectors that mate to corresponding ports inside the CMM2.

These ports are labeled **J1**. Eight J1 ports are available on the CMM2 to accommodate any combination of APs and BHs.

11. Connect the GPS sync cable from the first AP or BH to the **Port 1** in the J1 ports in the CMM2. See [Figure 131](#) on Page [341](#).

This port is the *master* GPS sync port for the CMM2 and should be connected first in all cases. This is necessary to initialize the GPS on the CMM2.

12. Connect the remaining GPS sync cables to the remaining J1 ports.
13. If this CMM2 requires network connection, perform the following steps:
 - a. Route a network cable into the CMM2.
 - b. Connect to the uplink port on the switch.
 - c. Properly ground (connect to Protective Earth [PE] $\perp$) the Ethernet cable. The Canopy Surge Suppressor provides proper grounding for this situation.
NOTE: Instructions for installing a Canopy Surge Suppressor are provided in [Procedure 28](#) on Page [346](#).

14. Connect GPS coaxial cable to the N-connector on the outside of the CMM2. See [Figure 53](#) on Page 180.
15. Connect AC or DC power to the CMM2, consistent with [Figure 130](#) on Page 340.
NOTE: When power is applied, the following indicators are lighted:
 - the power LED on the Ethernet switch
 - the green LED on the circuit board, as shown in [Figure 132](#).



Figure 132: Port indicator LED on Ethernet switch

16. Verify that each port indicator LED on the Ethernet switch is lit (each AP or BH is reliably connected to the Ethernet switch).
17. Replace the base cover on each AP or BH.
18. Close and lock the CMM2.

===== end of procedure =====

19.5.5 Verifying CMM2 Connections

To verify the CMM2 connections after the APs and or BHs have been installed, perform the following steps:

Procedure 23: Verifying CMM2 connections

1. Access the web-based interface for each AP or BHM by opening <http://<ip-address>>, where the <ip-address> is the address of the individual module.
2. In the General Status tab of the Home page, verify that the System Time field displays the time in GMT.

===== end of procedure =====

19.6 INSTALLING A CMMmicro

Ensure that you comply with standard local or national electrical and climbing procedures when you install the CMMmicro.

19.6.1 CMMmicro Temperature Range

Install the CMMmicro outside only when temperatures are above -4°F (-20°C). The bulkhead connector and the bushings and inserts in the bulkhead connector are rated for the full -40° to $+131^{\circ}\text{F}$ (-40° to $+55^{\circ}\text{C}$) range of the CMMmicro. However, for dynamic operations (loosening, tightening, and inserting), they are compliant at, and rated for, only temperatures at or above -4°F (-20°C).

19.6.2 Recommended Tools for Mounting a CMMmicro

The following tools may be needed during installation:

- 3/8" nut driver
- 12" adjustable wrench
- 14-mm wrench for installation of pole-mounting brackets
- needle-nose pliers

19.6.3 Mounting a CMMmicro

Perform the following procedure to mount the CMMmicro.

Procedure 24: Mounting the CMMmicro

1. Ensure that the mounting position
 - *is not* further than 328 feet (100 meters) from the furthest AP or BH that the CMMmicro will serve.
 - *is not* closer than 10 feet (3 meters) to the nearest AP or BH.
 - *is not* further than 100 feet (30.5 meters) of cable from the intended mounting position of the GPS antenna.
 - allows you to fully open the door for service.
2. Select a support structure to which the flanges can be mounted.
3. If the support structure is a wall, use screws or bolts (neither is provided) to attach the flanges to the wall.

If the support structure is an irregular-shaped object, use adjustable stainless steel bands (provided) to attach the CMMmicro to the object.

4. If the support structure is a pole that has an outside diameter of 1.25 to 3 inches (3 to 8 cm), use a toothed V-bracket (provided) to
 - d. attach the V-bracket to the pole as shown in [Figure 128](#) on Page 338.
 - e. attach the CMMmicro flanges to the V-bracket.

===== end of procedure =====

19.6.4 Installing the Power Supply for the CMMmicro

Install the CMMmicro power converter in only a hut, wiring closet, or weatherized NEMA-approved enclosure. This is imperative to keep moisture away from the power converter, not to shield it from harsh temperatures.

**WARNING!**

Although the output of the power converter is 24 V, the 100-W power rating classifies the converter as a Class 2 electric device. For this reason, whenever you work on power in the CMMmicro, you must *first* disconnect the DC converter from the AC power source.

Perform the following procedure to install the provided power supply.

Procedure 25: Installing the Power Supply for the CMMmicro

1. Connect the 6-ft (2-m) AC power cord to the power converter (but not yet to an AC receptacle).
2. Select the length of power cord as follows:
 - a. If either mounting the unit inside with the power converter or outside within 9 ft (2.8 m) of the power converter, select the 10-ft (3-m) DC power cord (rated for outdoor use).
 - b. If mounting the unit outside and further than 9 ft (2.8 m) from the power converter, ensure that this additional length of cord is either UV-resistant or shielded from UV rays.
 - use a terminal block, connector, or splice to add the additional length.
 - protect the terminal block, connector, or splice (as inside a weatherized enclosure, for example).

Table 54: Wire size for CMMmicro power runs of longer than 9 feet (2.8 m)

DC Power Cord Length	Proper Wire Size
9–90 ft (3–25 m)	12 AWG (4 mm ²)
91–145 ft (26–45 m)	10 AWG (6 mm ²)
146–230 ft (46–70 m)	8 AWG (10 mm ²)
>230 ft (>70 m)	6 AWG (16 mm ²)

3. Refer to [Figure 76: CMMmicro connections](#) on Page 220.
4. Feed the power cord through the bulkhead connector of the CMMmicro.
5. Connect the converter lead whose insulation has a white stripe to +V on the CMMmicro terminal block.
6. Connect the converter lead whose insulation is solid black to –V on the CMMmicro terminal block.

===== end of procedure =====

19.6.5 Cabling a CMMmicro

Perform the following procedure to attach the CMMmicro cables on both ends:

Procedure 26: Cabling the CMMmicro

1. Remove the base cover from any AP or BH that is to be connected to this CMMmicro. See [Figure 52](#) on Page 178.

2. Review the schematic drawing inside the CMMmicro and see [Figure 76: CMMmicro connections](#) on Page 220.
3. Note that the inserts in the bulkhead connector bushings have precut holes.
4. Remove the hard silicon spacer.
5. Route the Ethernet cables from the APs through the bulkhead connectors to the Ethernet switch inside the CMMmicro.
6. If the BH at this site is a 30/60- or 150/300-Mbps BH
 - a. connect the BH outdoor unit (ODU) to the ODU port of the power indoor unit (PIDU).
 - b. connect the PIDU to an unpowered port of the CMMmicro.
 If the BH is of another modulation rate, route the Ethernet cables from the BH through the bulkhead connectors to the Ethernet switch in the CMMmicro.
7. If the site has a wired network feed, route the cable into the CMMmicro and connect it to an *unpowered* port on the switch.
8. Mount a Canopy surge suppressor at a low point of the network feed and connect the surge suppressor to solid ground.
9. On the door label, record the MAC and IP addresses of the CMMmicro and all connected equipment.
10. Consistent with practices in your company, note the above information to add later to the company equipment database.
11. Connect the GPS coax cable from the GPS antenna to the female BNC connector in the CMMmicro.
12. If this CMMmicro requires network connection, perform the following steps:
 - a. Route a network cable into the CMMmicro.
 - b. Connect to the uplink port on the switch.
 - c. Properly ground (connect to Protective Earth [PE] ↓) the Ethernet cable. The Canopy Surge Suppressor provides proper grounding for this situation.
NOTE: Instructions for installing a Canopy Surge Suppressor are provided as part of [Procedure 28](#) on Page 346.
13. Connect the DC power cable to the CMMmicro.
14. Plug the DC converter into an AC receptacle.
15. Verify that the LEDs light.

===== end of procedure =====

19.6.6 Verifying CMMmicro Connections

To verify the CMMmicro connections after the APs and or BHs have been installed, perform the following steps.

Procedure 27: Verifying CMMmicro connections

1. Access the web-based interface for each AP or BH by opening <http://<ip-address>>, where the <ip-address> is the address of the individual module.
2. In the Status page, verify that the time is expressed in GMT.
3. In the menu on the left-hand side of the web page, click on **GPS Status**.
4. Verify that the AP or BH is seeing and tracking satellites. (To generate the timing pulse, the module must track at least 4 satellites.)

===== end of procedure =====

19.7 INSTALLING AN SM

Installing a Canopy SM consists of two procedures:

- Physically installing the SM on a residence or other location and performing a course alignment using the alignment tone ([Procedure 28](#)).
- Verifying the AP to SM link and finalizing alignment using review of power level and jitter, link tests, and review of registration and session counts ([Procedure 29](#) on Page [349](#)).

Procedure 28: Installing the SM

1. Choose the best mounting location for the SM.
2. Select the type of mounting hardware appropriate for this location. (For mounting 2.4, 5.2, 5.4, and 5.7 GHz SMs, Motorola offers the SMMB-1 mounting bracket. For mounting 900 MHz SMs, Motorola offers the SMMB-2 mounting bracket.)
3. Remove the base cover of the SM. (See [Figure 52](#) on Page [178](#).)
4. Terminate the UV outside grade Category 5 Ethernet cable with an RJ-45 connector, and connect the cable to the SM. (See [Procedure 8](#) on Page [192](#).)
5. Optionally, attach the SM to the arm of the Canopy Passive Reflector dish assembly as shown in [Figure 133](#).



RECOMMENDATION:

A reflector in this instance reduces the beamwidth to reduce interference. The arm is molded to receive and properly aim the module relative to the aim of the dish. Use stainless steel hose clamps for the attachment.

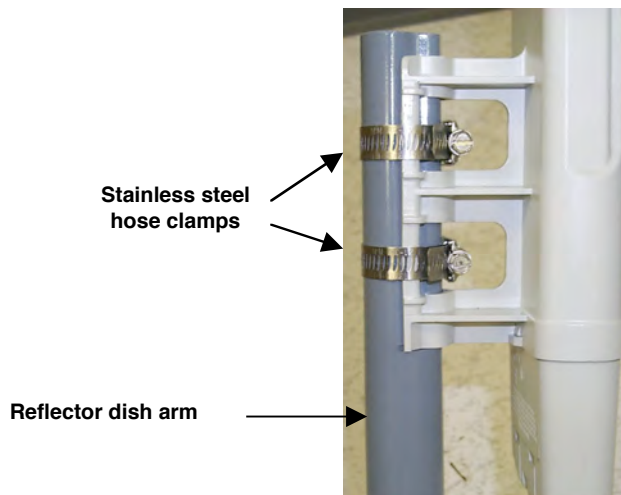


Figure 133: SM attachment to reflector arm

6. Use stainless steel hose clamps or equivalent fasteners to lock the SM into position.
NOTE: The SM grounding method is shown in [Figure 134](#).

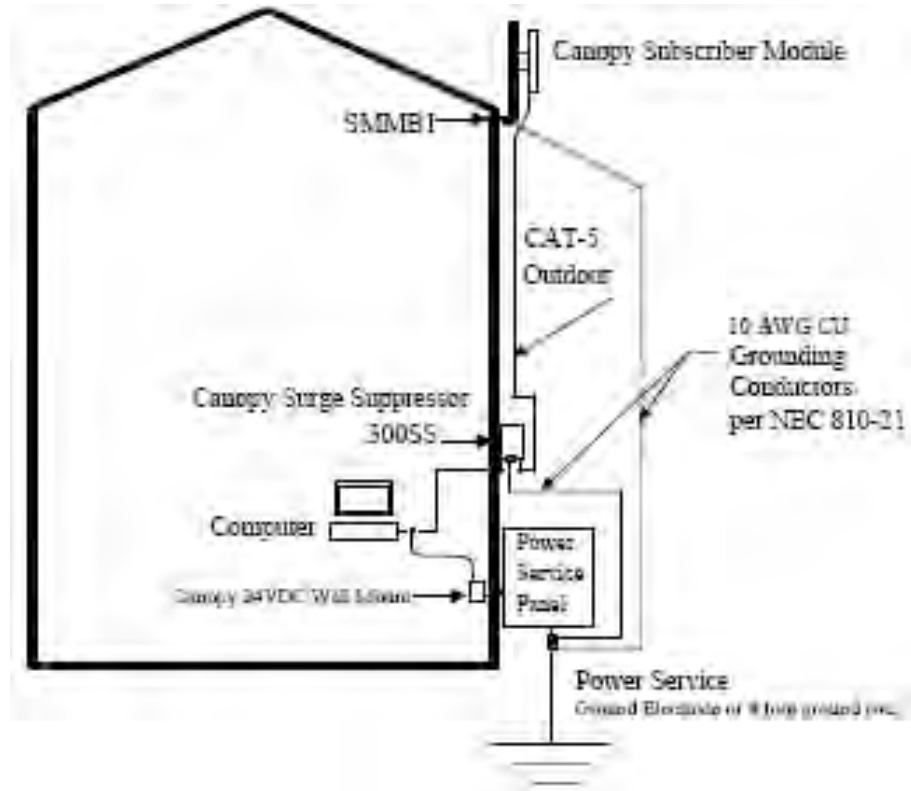
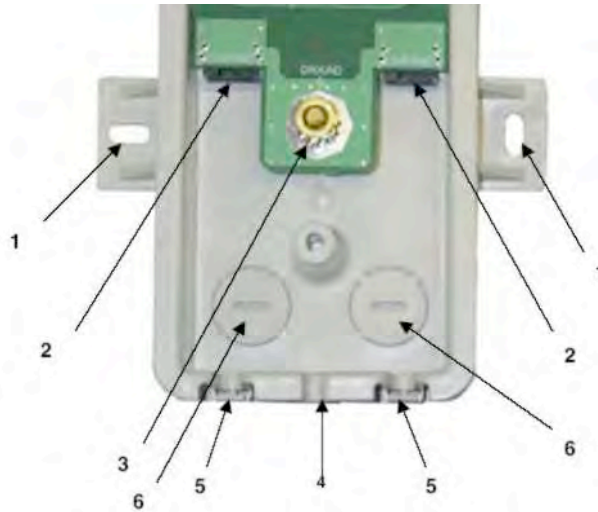


Figure 134: SM grounding per NEC specifications

7. Remove the cover of the 300SS Surge Suppressor.



KEY TO CALLOUTS

- 1 Holes—for mounting the Surge Suppressor to a flat surface (such as an outside wall). The distance between centers is 4.25 inches (108 mm).
- 2 RJ-45 connectors—One side (neither side is better than the other for this purpose) connects to the Canopy product (AP, SM, BHM, BHS, or cluster management module). The other connects to the AC adaptor's Ethernet connector.
- 3 Ground post—use heavy gauge (10 AWG or 6 mm²) copper wire for connection. Refer to local electrical codes for exact specifications.
- 4 Ground Cable Opening—route the 10 AWG (6 mm²) ground cable through this opening.
- 5 CAT-5 Cable Knockouts—route the two CAT-5 cables through these openings, or alternatively through the Conduit Knockouts.
- 6 Conduit Knockouts—on the back of the case, near the bottom. Available for installations where cable is routed through building conduit.

Figure 135: Internal view of Canopy 300SS Surge Suppressor

8. With the cable openings facing downward, mount the 300SS to the *outside* of the subscriber premises, as close to the point where the Ethernet cable penetrates the residence or building as possible, and as close to the grounding system (Protective Earth) as possible.
9. Using diagonal cutters or long nose pliers, remove the knockouts that cover the cable openings to the 300SS.
10. Connect an Ethernet cable from the power adapter (located inside the residence or building, outward through the building penetration) to either RJ-45 port of the 300SS.
11. Connect another Ethernet cable from the other RJ-45 port of the 300SS to the Ethernet port of the SM.
12. Refer to [Grounding SMs](#) on Page 172.

13. Wrap an AWG 10 (or 6mm²) copper wire around the Ground post of the 300SS.
14. Tighten the Ground post locking nut in the 300SS onto the copper wire.
15. Securely connect the copper wire to the grounding system (Protective Earth) according to applicable regulations.
16. Connect a ground wire to the 300SS.
17. Replace the cover of the 300SS surge suppressor.
18. For coarse alignment of the SM, use the Audible Alignment Tone feature as follows:
 - a. Set the **2X Rate** parameter in the SM to **Disable**.
 - b. At the SM, connect the RJ-11 6-pin connector of the Alignment Tool Headset to the RJ-11 utility port of the SM.
 Alternatively, instead of using the Alignment Tool Headset, use an earpiece or small battery-powered speaker connected to Pin 5 (alignment tone output) and Pin 6 (ground) of an RJ-11 connector.
 - c. Listen to the alignment tone for
 - pitch, which indicates greater signal power (RSSI/dBm) by higher pitch.
 - volume, which indicates better signal quality (lower jitter) by higher volume.



Figure 136: Audible Alignment Tone kit, including headset and connecting cable

- d. Adjust the module slightly until you hear the highest pitch and highest volume.
- e. If the Configuration web page of the SM contains a **2X Rate** parameter, set it back to **Enable**.
19. When you have achieved the best signal (highest pitch, loudest volume), lock the SM in place with the mounting hardware.

===== end of procedure =====

19.8 VERIFYING AN AP-SM LINK

To verify the AP-SM link after the SM has been installed, perform the following steps.

Procedure 29: Verifying performance for an AP-SM link

1. Using a computer (laptop, desktop, PDA) connected to the SM, open a browser and access the SM using the default IP address of <http://169.254.1.1> (or the IP address configured in the SM, if one has been configured.)
2. On the General Status tab of the Home page in the SM (shown in Figure 66 on Page 198), look for **Power Level** and **Jitter**.
IMPORTANT: The received **Power Level** is shown in dBm and should be maximized. **Jitter** should be minimized. However, better/lower jitter should be favored over better/higher dBm. For example, if coarse alignment gives an SM a power level of -75 dBm and a jitter measurement of 5, and further refining the alignment drops the power level to -78 dBm and the jitter to 2 or 3, the latter would be better, with the following caveats:
 - When the receiving link is operating at 1X, the **Jitter** scale is 0 to 15 with desired jitter between 0 and 4.
 - When the receiving link is operating at 2X, the **Jitter** scale is 0 to 15 with desired jitter between 0 and 9.

**NOTE:**

For historical reasons, **RSSI** is also shown and is the unitless measure of power. The best practice is to use **Power Level** and ignore **RSSI**, which implies more accuracy and precision than is inherent in the measurement.

3. Fine-adjust the SM mounting, if needed, to improve **Jitter** or **Power Level**.
4. Click the Link Capacity Test tab of the Tools web page in the SM.
NOTE: Use of this tool is described under [Using the Link Capacity Test Tool \(All\)](#) on Page 432.
5. Perform several link tests of 10-second duration as follows:
 - a. Type into the **Duration** field how long (in seconds) the RF link should be tested.
 - b. Leave the **Packet Length** field (when present) set to the default of 1522 bytes or type into that field the packet length at which you want the test conducted.
 - c. Leave the **Number of Packets** field set to 0 (to flood the link).
 - d. Click the **Start Test** button.
 - e. View the results of the test.
6. If these link tests fail to consistently show 90% or greater efficiency in 1X operation or 50 to 60% efficiency in 2X, troubleshoot the link, using the data as follows:
 - If the downlink is consistently 90% efficient, but the uplink is only 40%, this indicates trouble for the SM transmitting to the AP. Have link tests performed for nearby SMs. If their results are similar, investigate a possible source of interference local at the AP.
 - If the uplink is consistently 90% efficient, but the downlink is only 40%, this indicates trouble for the AP transmitting to the SM. Investigate a possible source of interference near the SM.

If these link tests consistently show 90% or greater efficiency in 1X operation, or 50 to 60% efficiency in 2X operation, in both uplink and downlink, continue this procedure.

7. Open the Session Status tab in the Home page of the AP.
NOTE: An example of this page is shown in [Figure 137](#).

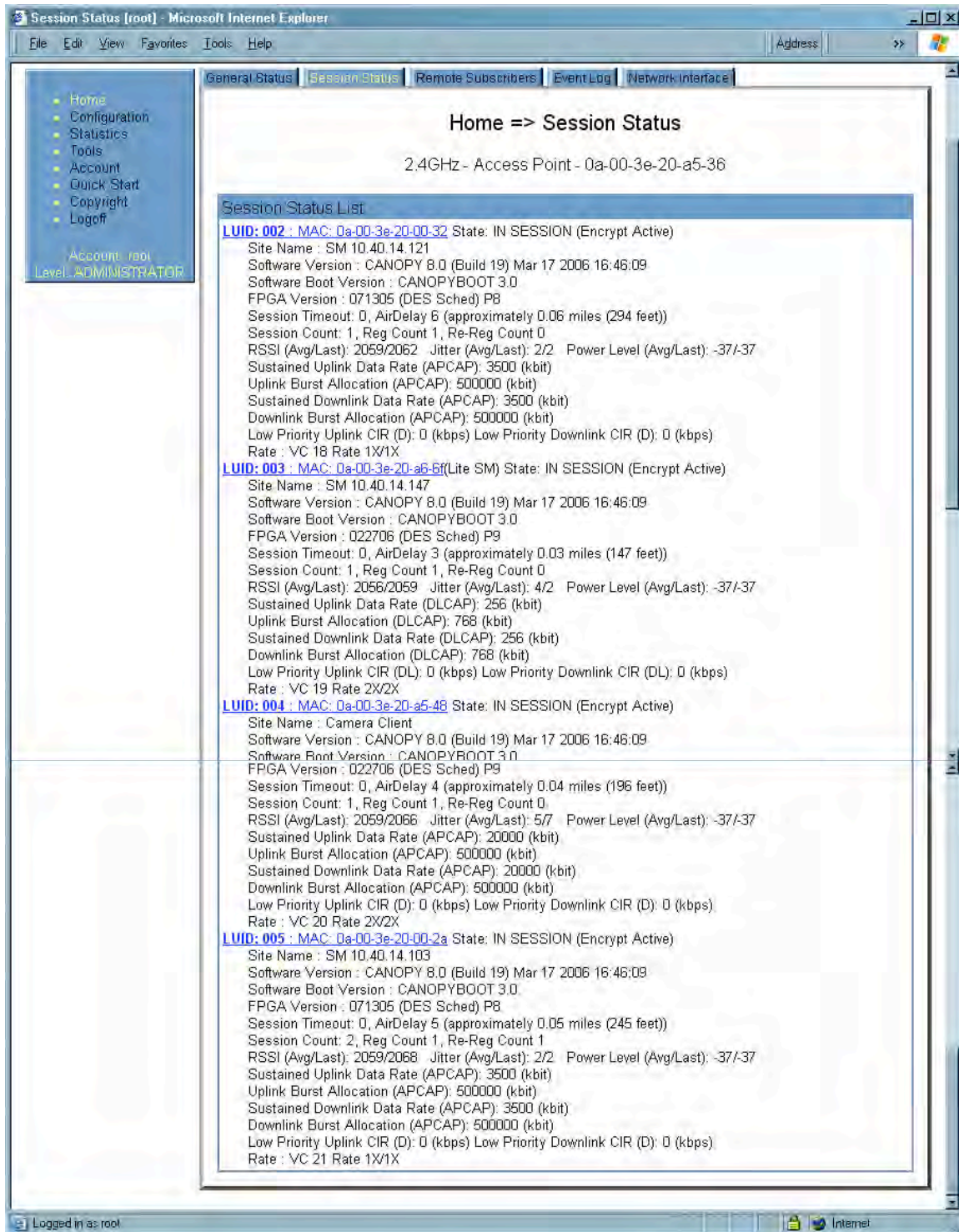


Figure 137: AP/SM link status indications in the AP Session Status tab

8. Find the Session Count line under the MAC address of the SM.

9. Check and note the values for Session Count, Reg Count, and Re-Reg Count.
10. Briefly monitor these values, occasionally refreshing this page by clicking another tab and then the Session Status tab again.
11. If these values are low (for example, 1, 1, and 0, respectively, meaning that the SM registered and started a stable session once) and not changing
 - a. consider the installation successful.
 - b. monitor these values from the network office over the next several hours and days.

If these values are greater than 1, 1, and 0, or they increase while you are monitoring them, troubleshoot the link. (For example, recheck jitter as described in [Procedure 28: Installing the SM](#) or recheck link efficiency as described in this procedure, then look for sources of RF interference or obstructions.)

===== end of procedure =====

19.9 INSTALLING A REFLECTOR DISH

The internal patch antenna of the module illuminates the Canopy Passive Reflector Dish from an offset position. The module support tube provides the proper angle for this offset.

19.9.1 Both Modules Mounted at Same Elevation

For cases where the other module in the link is mounted at the same elevation, fasten the *mounting hardware leg* of the support tube vertical for each module. When the hardware leg is in this position

- the reflector dish has an obvious downward tilt.
- the *module leg* of the support tube is *not* vertical.

For a mount to a non-vertical structure such as a tapered tower, use a plumb line to ensure that the hardware leg is vertical when fastened. Proper dish, tube, and module positions for a link in this case are illustrated in [Figure 138](#). The dish is tipped forward, not vertical, but the focus of the signal is horizontal.

-----EARTH-----

Figure 138: Correct mount with reflector dish

Improper dish, tube, and module positions for this case are illustrated in [Figure 139](#).

-----EARTH-----

Figure 139: Incorrect mount with reflector dish

19.9.2 Modules Mounted at Different Elevations

For cases where the other module in the link is mounted at a different elevation, the assembly hardware allows tilt adjustment. The proper angle of tilt can be calculated as a factor of both the difference in elevation and the distance that the link spans. Even in this case, a plumb line and a protractor can be helpful to ensure the proper tilt. This tilt is typically minimal.

The number of degrees to offset (from vertical) the mounting hardware leg of the support tube is equal to the angle of elevation from the lower module to the higher module (b in the example provided in [Figure 40](#) on Page 145).

19.9.3 Mounting Assembly

Both the hardware that Mounting Assembly 27RD provides for adjustment and the relationship between the offset angle of the module and the direction of the beam are illustrated in [Figure 140](#).

Figure 140: Mounting assembly, exploded view

19.10 INSTALLING A BH TIMING MASTER

To install the Canopy BHM, perform the following steps:

Procedure 30: Installing the BHM

1. Access the General tab of the Configuration page in the BHM.
2. If this is a 20-Mbps BH, set the **2X Rate** parameter to **Disabled** (temporarily for easier course aiming).
3. Click the **Save Changes** button.
4. Click the **Reboot** button.
5. After the reboot is completed, remove power from the BHM.
6. Choose the best mounting location for your particular application.
7. Attach the BHM to the arm of the Canopy Passive Reflector dish assembly as shown in [Figure 141](#).



RECOMMENDATION:

The arm is molded to receive and properly aim the module relative to the aim of the dish. (See [Figure 138](#) on Page 352.) Stainless steel hose clamps should be used for the attachment.

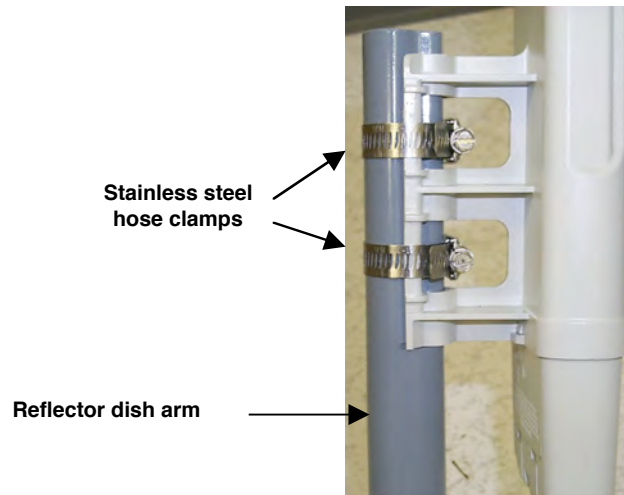


Figure 141: BH attachment to reflector arm

8. Align the BHM as follows:
 - a. Move the module to where the link will be unobstructed by the radio horizon and no objects penetrate the Fresnel zone. (The Canopy System Calculator page [AntennaElevationCalcPage.xls](#) automatically calculates the minimum antenna elevation that is required to extend the radio horizon to the other end of the link. The Canopy System Calculator page [FresnelZoneCalcPage.xls](#) automatically calculates the Fresnel zone clearance that is required between the visual line of sight and the top of a high-elevation object.)
 - b. Use a local map, compass, and/or GPS device as needed to determine the direction to the BHS.
 - c. Apply the appropriate degree of downward or upward tilt. (The Canopy System Calculator page [DowntiltCalcPage.xls](#) automatically calculates the angle of antenna downward tilt that is required.)
 - d. Ensure that the BHS is within the beam coverage area. (The Canopy System Calculator page [BeamwidthRadiiCalcPage.xls](#) automatically calculates the radii of the beam coverage area.)
9. Using stainless steel hose clamps or equivalent fasteners, lock the BHM into position.
10. Remove the base cover of the BHM. (See [Figure 52](#) on Page 178.)
11. If this BHM *will not* be connected to a CMMmicro, optionally connect a utility cable to a GPS timing source and then to the RJ-11 port of the BHM.
12. Either connect the BHM to the CMM or connect the DC power converter to the BHM and then to an AC power source.
RESULT: When power is applied to a Canopy module or the unit is reset on the web-based interface, the module requires approximately 25 seconds to boot. During this interval, self-tests and other diagnostics are being performed.
13. Access the General tab of the Configuration page of this BHM.
14. If the CMM is a CMMmicro, set the **Sync Input** parameter to the **Sync to Received Signal (Power Port)** selection.
 If the CMM is a CMM2, set the **Sync Input** parameter to the **Sync to Received Signal (Timing Port)** selection.

===== end of procedure =====

19.11 INSTALLING A BH TIMING SLAVE

Installing a Canopy BHS consists of two procedures:

- Physically installing the BHS and performing a course alignment using the alignment tone ([Procedure 31](#)).
- Verifying the BH link and finalizing alignment using review of power level and jitter, link tests, and review of registration and session counts ([Procedure 32](#) on Page [356](#)).

Procedure 31: Installing the BHS

1. Choose the best mounting location for the BHS.
2. Remove the base cover of the BHS. (See [Figure 52](#) on Page [178](#).)
3. Terminate the UV outside grade Category 5 Ethernet cable with an RJ-45 connector, and connect the cable to the BHS. (See [Procedure 8](#) on Page [192](#).)
4. Attach the BHS to the arm of the Canopy Passive Reflector dish assembly as shown in [Figure 133](#) on Page [346](#).



RECOMMENDATION:

The arm is molded to receive and properly aim the BH relative to the aim of the dish. Use stainless steel hose clamps for the attachment.

5. Use stainless steel hose clamps or equivalent fasteners to lock the BHS into position.
6. Remove the cover of the 300SS Surge Suppressor.
7. With the cable openings facing downward, mount the 300SS as close to the grounding system (Protective Earth) as possible.
8. Using diagonal cutters or long nose pliers, remove the knockouts that cover the cable openings to the 300SS.
9. Connect an Ethernet cable from the power adapter to either RJ-45 port of the 300SS.
10. Connect another Ethernet cable from the other RJ-45 port of the 300SS to the Ethernet port of the BHS.
11. Refer to [Grounding SMs](#) on Page [172](#).
12. Wrap an AWG 10 (or 6mm²) copper wire around the Ground post of the 300SS.
13. Tighten the Ground post locking nut in the 300SS onto the copper wire.
14. Securely connect the copper wire to the grounding system (Protective Earth) according to applicable regulations.
15. Connect a ground wire to the 300SS.
16. Replace the cover of the 300SS surge suppressor.
17. For coarse alignment of the BHS, use the Audible Alignment Tone feature as follows:
 - a. If the Configuration web page of the BHS contains a **2X Rate** parameter, set it to **Disable**.

- b. At the BHS, connect the RJ-11 6-pin connector of the Alignment Tool Headset (shown in [Figure 136](#) on [Page 349](#)) to the RJ-11 utility port of the SM.

Alternatively, instead of using the Alignment Tool Headset, use an earpiece or small battery-powered speaker connected to Pin 5 (alignment tone output) and Pin 6 (ground) of an RJ-11 connector.

- c. Listen to the alignment tone for
 - pitch, which indicates greater signal power (RSSI/dBm) by higher pitch.
 - volume, which indicates better signal quality (lower jitter) by higher volume.
- d. Adjust the module slightly until you hear the highest pitch and highest volume.
- e. If the Configuration web page of the BHS contains a **2X Rate** parameter, set it back to **Enable**.

18. When you have achieved the best signal (highest pitch, loudest volume), lock the BHS in place with the mounting hardware.

===== end of procedure =====

19.12 UPGRADING A BH LINK TO BH20

To replace a pair of 10-Mbps BHs with 20-Mbps BHs, you can minimize downtime by temporarily using the 10-Mbps capability in the faster modules. However, both interference and differences in receiver sensitivity can make alignment and link maintenance more difficult than in the previous 10-Mbps link. The effects of these factors are greater at greater link distances, particularly at 5 miles or more.

In shorter spans, these factors may not be prohibitive. For these cases, set the first replacement module to **1X Rate** and establish the link to the 10-Mbps BH on the far end. Similarly, set the second replacement module to **1X Rate** and re-establish the link. With both of the faster modules in place and with an operational link having been achieved, reset their modulation to **2X Rate** (20 Mbps).

19.13 VERIFYING A BH LINK

To verify the backhaul link after the BHS has been installed, perform the following steps.

Procedure 32: Verifying performance for a BH link

1. Using a computer (laptop, desktop, PDA) connected to the BHS, open a browser and access the BHS using the default IP address of <http://169.254.1.1> (or the IP address configured in the BHS, if one has been configured.)
2. On the General Status tab of the Home page in the BHS (shown in [Figure 71](#) on [Page 210](#)), look for **Power Level** and **Jitter**.

IMPORTANT: The received **Power Level** is shown in dBm and should be maximized. **Jitter** should be minimized. However, better/lower jitter should be favored over better/higher dBm. For example, if coarse alignment gives a BHS a power level of -75 dBm and a jitter measurement of 5, and further refining the alignment drops the power level to -78 dBm and the jitter to 2 or 3, the latter would be better, with the following caveats:

- When the receiving link is operating at 1X, the **Jitter** scale is 0 to 15 with desired jitter between 0 and 4.

- When the receiving link is operating at 2X, the **Jitter** scale is 0 to 15 with desired jitter between 0 and 9.

**NOTE:**

For historical reasons, **RSSI** is also shown and is the unitless measure of power. The best practice is to use **Power Level** and ignore **RSSI**, which implies more accuracy and precision than is inherent in its measurement.

3. Fine-adjust the BHS mounting, if needed, to improve **Jitter** or **Power Level**.
4. Click the Link Capacity Test tab of the Tools web page in the BHS.
NOTE: Use of this tool is described under [Using the Link Capacity Test Tool \(All\)](#) on Page [432](#).
5. Perform several link tests of 10-second duration as follows:
 - a. Type into the **Duration** field how long (in seconds) the RF link should be tested.
 - b. Leave the **Packet Length** field (when present) set to the default of 1522 bytes or type into that field the packet length at which you want the test conducted.
 - c. Leave the **Number of Packets** field set to 0 (to flood the link).
 - d. Click the **Start Test** button.
 - e. View the results of the test.
6. If these link tests fail to consistently show 90% or greater efficiency in 1X operation or 50 to 60% efficiency in 2X, troubleshoot the link, using the data as follows:
 - If the downlink is consistently 90% efficient, but the uplink is only 40%, this indicates trouble for the BHS transmitting to the BHM. Investigate a possible source of interference near the BHM.
 - If the uplink is consistently 90% efficient, but the downlink is only 40%, this indicates trouble for the BHM transmitting to the BHS. Investigate a possible source of interference near the BHS.

If these link tests consistently show 90% or greater efficiency in 1X operation, or 50 to 60% efficiency in 2X operation, in both uplink and downlink, continue this procedure.
7. Open the Session Status tab in the Home page of the BHM.
NOTE: An example of this page is shown in [Figure 142](#).

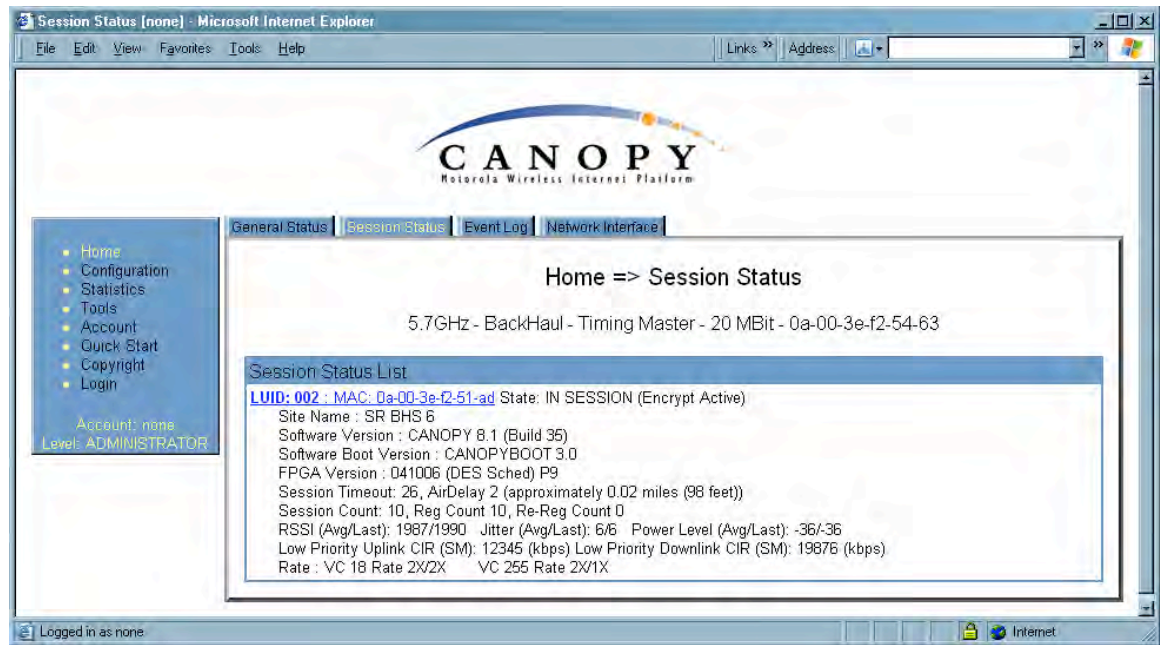


Figure 142: Session Status tab of BHM

8. Find the **Session Count** line under the MAC address of the BHS.
9. Check and note the values for **Session Count**, **Reg Count**, and **Re-Reg Count**.
10. Briefly monitor these values, occasionally refreshing this page by clicking another tab and then the Session Status tab again.
11. If these values are low (for example, 1, 1, and 0, respectively, meaning that the BHS registered and started a stable session once) and not changing
 - a. consider the installation successful.
 - b. monitor these values from the network office over the next several hours and days.

If these values are greater than 1, 1, and 0, or they increase while you are monitoring them, troubleshoot the link. (For example, recheck jitter as described in [Procedure 28: Installing the SM](#) or recheck link efficiency as described in this procedure, then look for sources of RF interference or obstructions.)

===== end of procedure =====

20 VERIFYING SYSTEM FUNCTIONALITY

To verify system functionality after the APs and or BHs have been installed, perform the following steps.

Procedure 33: Verifying system functionality

1. For each installed AP, use a computer or PDA connected to an SM set to a compatible configuration (frequency and color code, for example) and verify link functionality.
2. For each BH installed, use a notebook computer connected to a BH (BHM or BHS, as appropriate) set to a compatible configuration and verify link functionality.
3. If a network data feed is present and operational, use an SM or BHS to verify network functionality.

===== end of procedure =====

OPERATIONS GUIDE