15 AVOIDING HAZARDS

Use simple precautions to protect staff and equipment. Hazards include exposure to RF waves, lightning strikes, and power surges. This section specifically recommends actions to abate these hazards.

15.1 PREVENTING OVEREXPOSURE TO RF ENERGY

To protect from overexposure to RF energy, install Canopy radios so as to provide and maintain the minimum separation distances from all persons shown in Table 40.

Table 40: Exposure separation distances

Canopy module	Minimum separation distance from all persons	
Antenna of 900-MHz AP or SM	60 cm	24 in
2.4-, 5.2-, 5.4-, or 5.7-GHz radio with no reflector	20 cm	8 in
2.4-, 5.4-, or 5.7-GHz radio with a reflector	1.5 m	60 in (5 ft)
Antenna of connectorized 5.7 GHz AP	20 cm	8 in

At these and greater separation distances, the power density from the RF field is below generally accepted limits for the general population.

NOTE:
These are conservative distances that include compliance margins. In the case of the reflector, the distance is even more conservative because the equation used models the reflector as a point source and ignores its physical dimensions.

15.1.1 Details of Calculations for Separation Distances and Power Compliance Margins

Limits and guidelines for RF exposure come from:

- US FCC limits for the general population. See the FCC web site at http://www.fcc.gov, and the policies, guidelines, and requirements in Part 1 of Title 47 of the Code of Federal Regulations, as well as the guidelines and suggestions for evaluating compliance in FCC OET Bulletin 65.
- Health Canada limits for the general population. See the Health Canada web site at http://www.hc-sc.gc.ca/rpb and Safety Code 6.
- ICNIRP (International Commission on Non-Ionizing Radiation Protection) guidelines for the general public. See the ICNIRP web site at http://www.icnirp.de/ and Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields.

The applicable power density exposure limits from the documents referenced above are

- 6 W/m^2 for RF energy in the 900-MHz frequency band in the US and Canada.
- 10 W/m^2 for RF energy in the 2.4-, 5.2-, 5.4-, and 5.7-GHz frequency bands.

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

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

where
S = power density in W/m^2
P = RMS transmit power capability of the radio, in W
G = total Tx gain as a factor, converted from dB
d = distance from point source, in m

Rearranging terms to solve for distance yields

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

Calculated Distances and Power Compliance Margins

Table 41 shows calculated minimum separation distances d, recommended distances and resulting power compliance margins for each frequency band and antenna combination.

Table 41: Calculated distances and power compliance margins

Frequency Band	Antenna	Variable			*d* (Calculated)	Recommended Distance	Power Compliance Margin
		P	*G*	S			
900 MHz	external	0.4 W (26 dBm)	10.0 (10 dB)	6 W/m^2	0.23 m	60 cm (24 in)	7
2.4 GHz	internal	0.34 W (25 dBm)	6.3 (8 dB)	10 W/m^2	0.13 m	20 cm (8 in)	2.3
	internal plus reflector	0.34 W (25 dBm)	79.4 (19 dB)	10 W/m^2	0.46 m	1.5 m (5 ft)	10
5.2 GHz	internal	0.2 W (23 dBm)	5.0 (7 dB)	10 W/m^2	0.09 m	20 cm (8 in)	5
	internal plus reflector	0.0032 W (5 dBm)	316 (25 dB)	10 W/m^2	0.09 m	1.5 m (5 ft)	280
5.4 GHz	internal	0.2 W (23 dBm)	5.0 (7 dB)	10 W/m^2	0.09 m	20 cm (8 in)	5
	internal plus reflector	0.0032 W (5 dBm)	316 (25 dB)	10 W/m^2	0.09 m	1.5 m (5 ft)	280

Frequency Band	Antenna	Variable			*d* (Calculated)	Recommended Distance	Power Compliance Margin
		P	***G***	**S**			
5.7 GHz	internal	0.2 W (23 dBm)	5.0 (7 dB)	10 W/m^2	0.09 m	20 cm (8 in)	5
	internal plus reflector	0.2 W (23 dBm)	316 (25 dB)	10 W/m^2	0.71 m	1.5 m (5 ft)	4.5
	external	0.125 W (21 dBm)	31.6 (15 dB)	10 W/m^2	0.18 m	20 cm (8 in)	1.27

15.2 GROUNDING CANOPY EQUIPMENT

Effective lightning protection diverts lightning current safely to ground, Protective Earth (PE) ⏚. It neither attracts nor prevents lightning strikes.

WARNING!

Lightning damage *is not* covered under the Canopy warranty. The recommendations in Canopy guides give the installer the knowledge to protect the installation from the harmful effects of ESD and lightning. These recommendation must be thoroughly and correctly performed. However, complete protection is neither implied or possible.

15.2.1 Grounding Infrastructure Equipment

To protect both your staff and your infrastructure equipment, implement lightning protection as follows:

- Observe all local and national codes that apply to grounding for lightning protection.
- Before you install your Canopy modules, perform the following steps:
  - Engage a grounding professional if you need to do so.
  - Install lightning arrestors to transport lightning strikes away from equipment. For example, install a lightning rod on a tower leg other than the leg to which you mount your module.
  - Connect your lightning rod to ground.
  - Use a Canopy 300SS Surge Suppressor (or Transtector ALPU-ORTs for OFDM BH installations) on the Ethernet cable where the cable enters any structure. (Instructions for installing a Canopy 300SS Surge Suppressor are provided in Procedure 28 on Page 346.)
- Install your modules at least 2 feet (0.6 meters) below the tallest point on the tower, pole, or roof.