



## **Cisco 6300 Embedded Services Access Points (ESW-6300) RF and Mechanical Integration Guide**

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# Cisco 6300 Embedded Services Access Points (ESW-6300) RF and Mechanical Integration Guide

## Overview

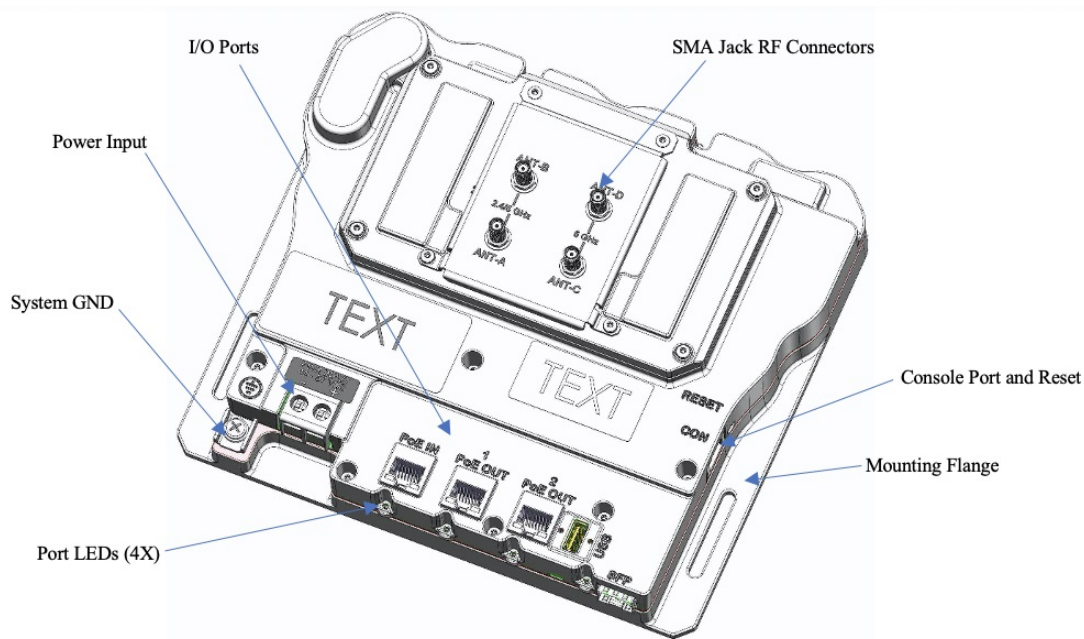
This reference design provides mounting details, antenna spacing and configuration guidelines, environmental guidelines, and other operational guidelines pertaining to the integration of the Cisco® ESW-6300 embedded wireless product into a third-party outdoor enclosure.

This reference design provides an example of how to integrate the embedded wireless product into an appropriate third-party enclosure and describes the hardware that is compatible with the access point. Note that this document may not explain specific needs for every method of integration. The included drawings of the Cisco product are accurate; any dimensions of third-party equipment are **for reference only**.

## Summary

The ESW-6300 unit is designed to be embedded into a custom or modified off the shelf enclosure that is not designed, manufactured or productized by Cisco. The ESW-6300 can be mounted in any direction, provided it is fastened down at each of its 4 separate mounting points (i.e., two on the top of the module and one on each side). The ESW-6300 has four SMA jack RF coaxial connectors to connect to two dual band or four single band external antennas. The reset button and console port are accessed through a port on the right side of the unit where the words “RESET” and “CON” are shown. It is important that the partner-provided enclosure allows enough room to access these ports for troubleshooting and diagnostics. This document will not comment on the integration or procurement of other devices such as power supplies, injectors, radios, etc. It will be limited to the integration of the ESW-6300 only. If additional devices are to be installed, then the size of the enclosure must be increased accordingly.

Figure 1: ESW-6300 overview



## Audience

This guide is intended for purchasers and/or integrators of the ESW-6300 Embedded Services Access Point.

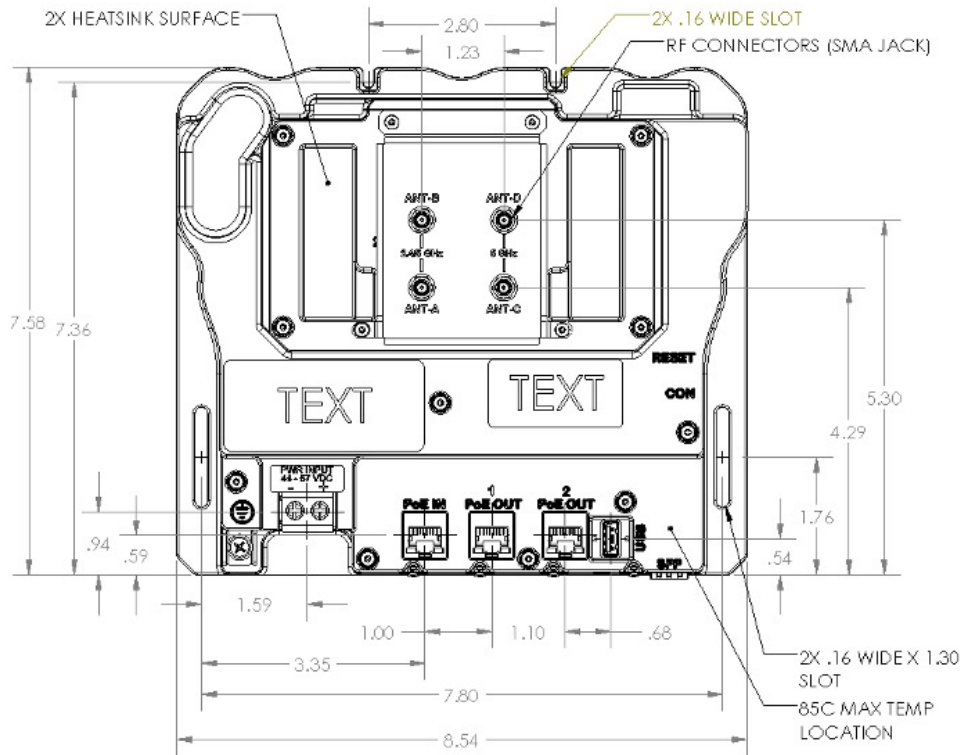
## Product Category

The ESW-6300 is an IP30 rated product. If it is deployed outdoors, then it must be integrated into an IP65 or greater enclosure.

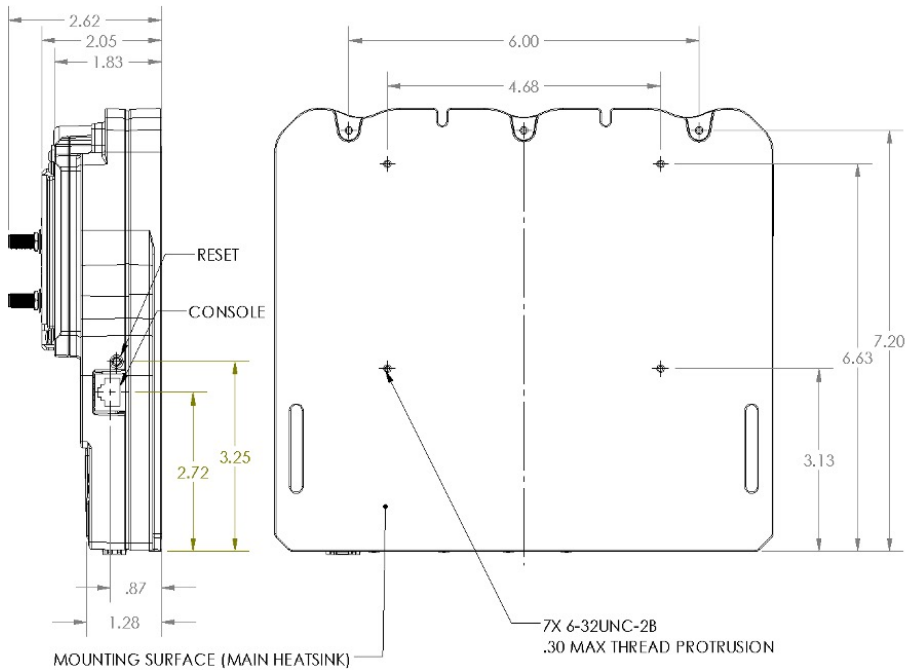
## ESW-6300 Outline

The ESW-6300 is made from Alodined diecast Aluminum Alloy A413 and weighs 3.2 lbs. The back of the access point is designed to be heat sunk. For optimal performance, the main heatsink (the back), shown as “Mounting Surface (Main Heatsink)” in Figure 3 below should be mounted to a flat and thermally conductive material that has an efficient thermal path to the external ambient air for optimal thermal performance. There are also two optional heatsinks shown as “2X Heatsink Surface” on Figure 2 below (the front). External ambient maximum temperature could be marginally increased if heatsinks are applied to additional thermal interface surface. A specific thermal interface material is not required.

**Figure 2: Dimensioned Front View (inches)**



**Figure 3: Dimensioned Side and Rear View (inches)**



## Mounting the ESW-6300

### Mounting hardware

There are four mounting points for the ESW-6300. These locations are designed to use a #6 or M3.5 Pan Head screw with small pattern washer (0.260 inches in max diameter).

The outer diameter of the washer and the screw head cannot be larger than 0.260 inches; otherwise they will not seat properly. Screw length should be long enough to ensure five threads of engagement into the mating surface. Additionally a locking method such as a lock washer or Loctite should be employed.

**Figure 4: Mounting Locations - Front View**

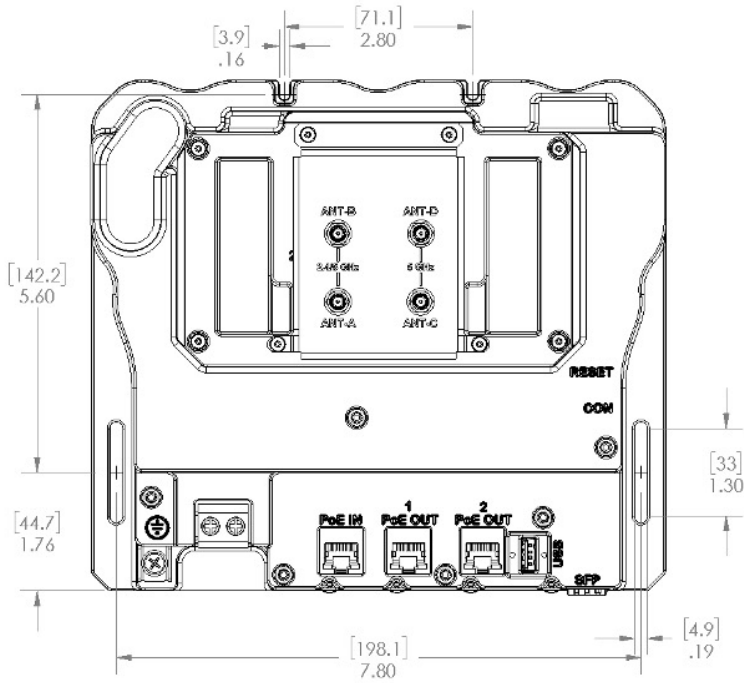
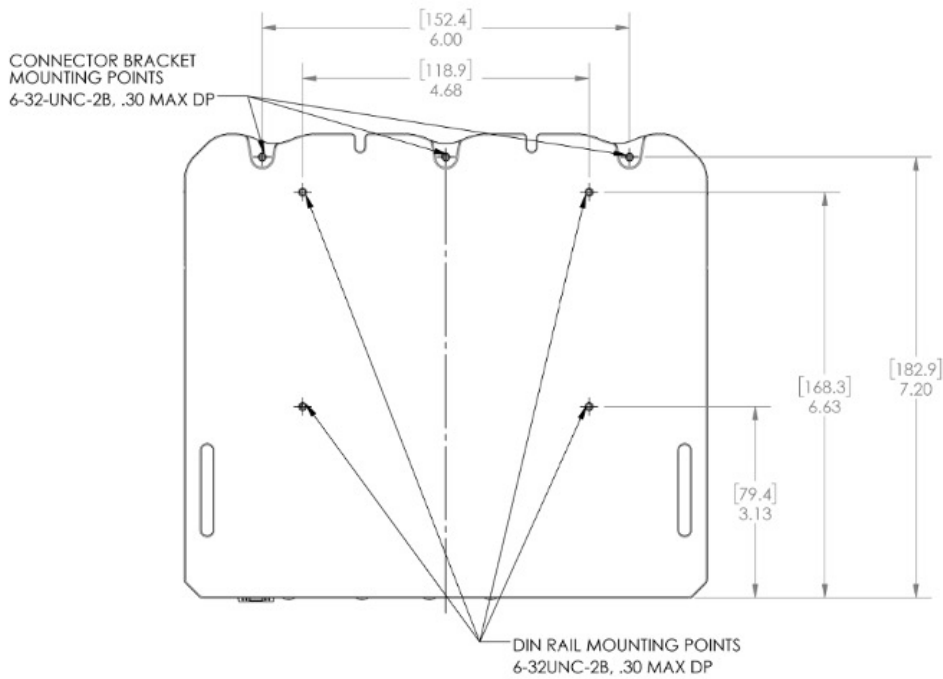


Figure 4 above shows the typical mounting locations on the ESW-6300. The threads and holes on the back (shown in Figure 5), on the heat sink side of the ESW-6300 are for rear mounting or attaching the DIN rail bracket. Front mounting is recommended.

**Figure 5: Mounting Locations Rear View**

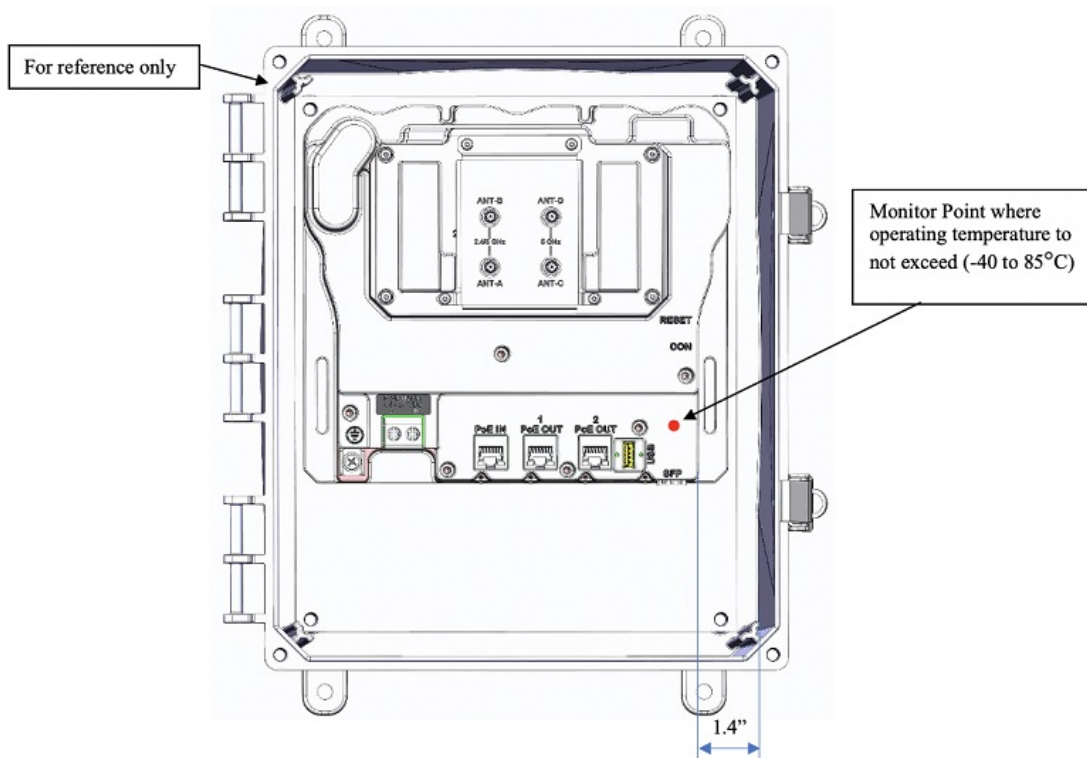


## Enclosure Design

### Sizing Recommendations

An enclosure greater than or equal to 12 inches tall x 10 inches wide x 4 inches deep is recommended. Actual enclosure size may vary due to individual needs or if additional devices are to be installed with the ESW-6300. Figure 6 shows how it fits in the smallest recommended IP66/68 enclosure. This spacing allows for reasonable space to access all usable ports and buttons.

**Figure 6: ESW-6300 Inside Integra P/N H12104H-6P Housing (not supplied or covered by Cisco warranty)**



It is highly recommended that the enclosure you choose is made of a **non-corrosive or corrosion resistant material**.

Reset and console ports are located on the right side of the access point. There should be enough room available on that side for easy access of these ports to engage a RJ45 cable. As a reference, Figure 6 shows just under 1.4 inches of space between the wall and the two “RESET” and “CON” labels.

### Environmental Specification

The enclosure of choice must have an IP65 or higher certification if it is to be mounted in a non-controlled environment. The enclosure must be sealed from dust and hose-downs such as power washing.

The ESW-6300 has an operating case temperature range of -40 to 85°C. The monitor point location where this operating temperature range should not be exceeded is shown in Figure 6. The external operating temperature range of the overall enclosure assembly will be limited by the ESW-6300 monitor point thermal limits, or any other component within the enclosure that has thermal limits less than the ESW-6300. Actual external ambient temperatures should be determined by testing or thermal analysis. For example, in the non-metallic enclosure shown in Figure 6 the external ambient will be limited to roughly 45°C maximum. Solar load should be included if applicable.

## RF Configurations

The ESW-6300 is a Wi-Fi access point including a 2x2 MIMO 2.4 GHz radio and a 2x2 MIMO 5 GHz radio.

The ESW-6300 may be configured to operate in dual band or single band mode.

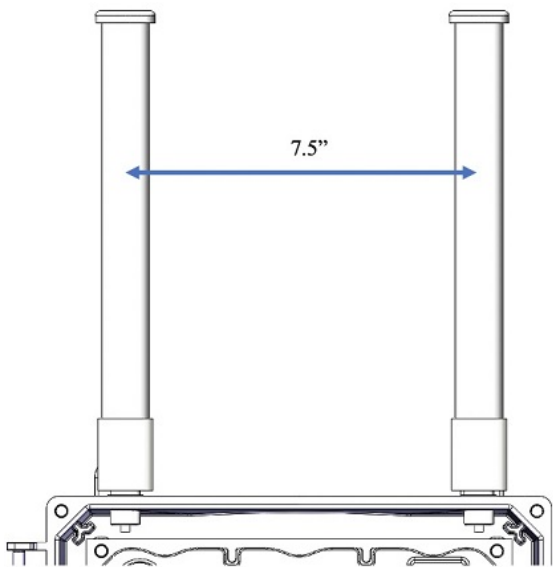
- In dual band mode the 2.4 GHz and 5 GHz signals are diplexed onto the two antenna ports labeled “2.4/5 GHz ANT-A” and “2.4/5 GHz ANT-B”. The two antenna ports labeled “5 GHz ANT-C” and “5 GHz ANT-D” are not used.
- In single band mode the 2.4 GHz radio uses the two antenna ports labeled “2.4/5 GHz ANT-A” and “2.4/5 GHz ANT-B” and the 5 GHz radio uses the two antenna ports labeled “5 GHz ANT-C” and “5 GHz ANT-D”.

Any omnidirectional antenna mounted directly to the enclosure housing the ESW-6300 can **only be mounted vertically**.

2.4 GHz antennas mounted directly to the enclosure should be spaced at least 6 inches apart, center to center. If allowed, separation of 7.5 inches or greater is recommended for optimal MIMO performance. 5 GHz antennas mounted directly to the enclosure should be spaced at least 3 inches apart, center to center. Any spacing less than 6 inches between 2.4 GHz antennas or 3 inches between 5 GHz antennas may limit the ability of the radio to demodulate two independent spatial streams, resulting in reduced throughput.

In Figure 7, the antennas are spaced 7.5 inches apart on the same enclosure as Figure 3. If you require other antennas on your enclosure for other products, it is important to keep them away from the antennas for the ESW-6300 Wi-Fi access point. For example, at least 40 dB isolation must be maintained between any 2.4 GHz Wi-Fi antenna and any 2.4 GHz 802.15.4 radio.

**Figure 7: 7.5 inches of spacing between the center of antennas for 2.4 GHz applications**



The cables routing to the antennas will be of different lengths depending on the enclosure of choice and the antenna locations. The ESW-6300 uses four antennas when configured in single-band antenna mode. Possible configurations are shown in Table 1. If you plan on using the two optional front heatsinks, the cables must be routed to avoid interference between the heatsink and the thermally conductive mating surface.

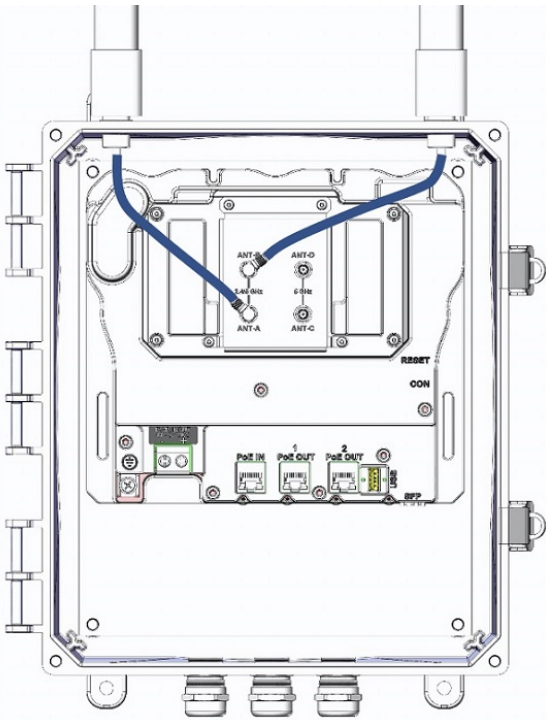
Cable ties or clamps should be used to eliminate any routing or handling stress transmitted to the ESW-6300 SMA connectors.



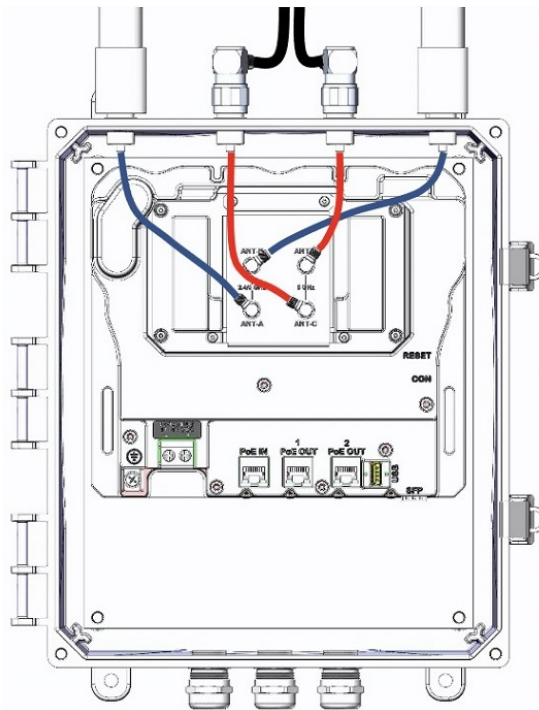


**Note** Cable routing shown below is for configuration reference only. Actual routing should employ standard practices such as, avoid routing over areas that could cause abrasion, avoid restricting I/O connectors or hardware access, provide ample cable strain relief and minimum bend radius and provide locations for cable ties.

**Table 1: ESW-6300 Access Point Cable Routing and Antenna Placement**

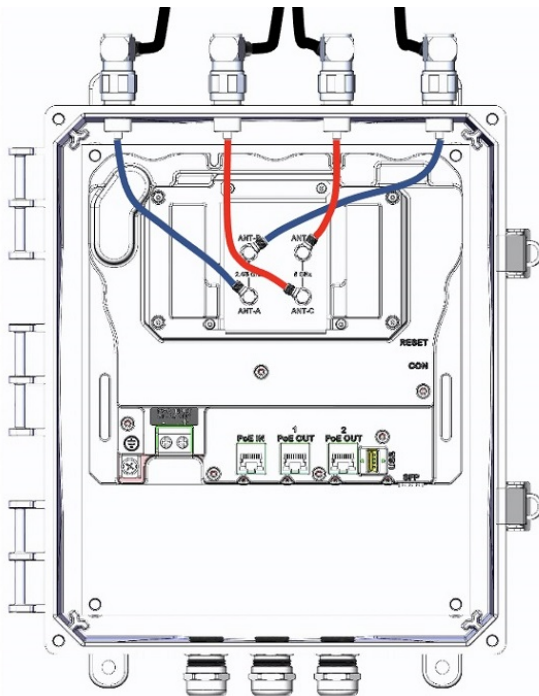
<p>1. Omnidirectional coverage with dual-band antennas</p>		<ul style="list-style-type: none"><li>• Uses only 2 antennas spaced a <b>minimum</b> of 7.5 inches apart.</li><li>• Uses the “2.4/5 GHz” SMA ports</li><li>• Cable routing is shown for reference. The two optional heat sinks are not shown in this drawing. <b>Do not route cables over the two optional heat sinks if you plan to use them.</b></li></ul>
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2. Local coverage on 2.4GHz;  
backhaul on 5 GHz



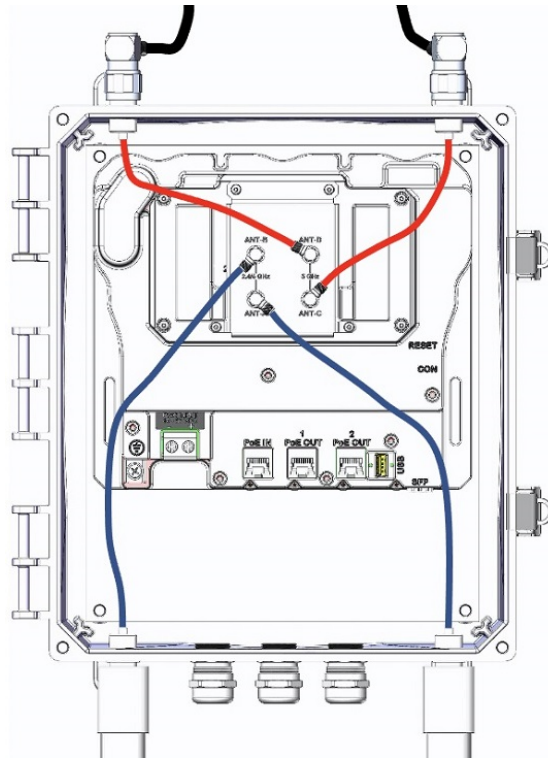
- Uses 2 chassis-mounted antennas and 2 external coaxial cables (i.e. LMR-400 or LMR-600 cables)
- The outer two ports (blue) are used for 2.4 GHz antennas. The inner two ports (red) are used for 5 GHz cables.
- Cable routing is shown for reference. The two optional heat sinks are not shown in this drawing. **Do not route cables over the two optional heat sinks if you plan to use them.**

3. All antennas mounted  
remotely



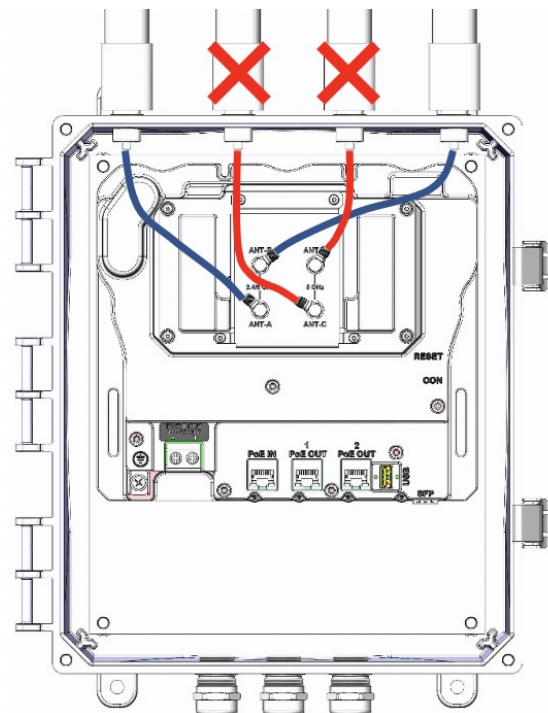
- Uses 4 external cables (i.e. LMR-400 or LMR-600).
- The outer two cables (blue) connect to 2.4 GHz antennas
- The inner two cables (red) connect to 5 GHz antennas
- Cable routing is shown for reference. The two optional heat sinks are not shown in this drawing. **Do not route cables over the two optional heat sinks if you plan to use them.**

4. Local coverage with one radio, remotely mounted backhaul on the other radio, variant



- Can use chassis-mounted antennas for either 2.4 GHz or 5 GHz if the minimum spacing guidelines are followed
- 7.5 inch antennas spacing recommended for 2.4 GHz
- 3 inch spacing required for 5 GHz
- Cable routing is shown for reference. The two optional heat sinks not shown in this drawing. **Do not route cables over the two optional heat sinks if you plan to use them.**

5. Incorrect setup. Do not do this. 4 adjacent antennas.



- **DO NOT** put 4 antennas next to each other.
- This can degrade the antennas' radiation patterns.
- Use option 1, 2, or 4 shown above instead.

## Internal RF Cables and Bulkhead Connectors

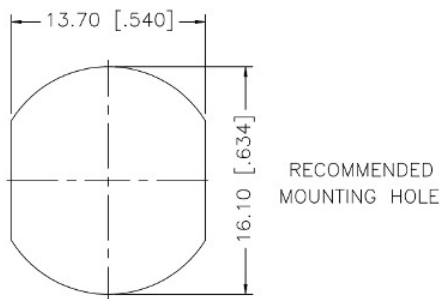
The internal cables connect to external antennas or coaxial cables via a N-type straight jack bulkhead connector. Holes must be drilled/punched in the enclosure for the connectors to be mounted in.

The size of the holes depend on which bulkhead connector is chosen. The bulkhead shown on the 3D models on this document is representative of the **style** recommended. Selection of connector and manufacturer is solely the responsibility of the integrator. Any part numbers supplied by Cisco are for reference only and no guarantee is implied.

The manufacturer’s part number for the style shown in this document can be found in the section [Suggested Parts, on page 15](#). A “punch tool” is also referenced. Punch tools are a convenient method for putting a “D” or “Double-D” hole into the enclosure. A number of manufacturers make these tools, and the tool has to be matched with the connector that is selected.

The suggested hole cut out for the N-type bulkhead referenced in the layouts is shown in Figure 8. Connector holes should employ an anti-rotation feature, such as a “D” hole or “Double D” hole as shown in Figure 8. The actual dimensions of such a hole are dependent on the actual connector selected. The dimensions in Figure 8 are for reference only, and apply only to the connector shown in our reference design.

**Figure 8: Double-D N-Bulkhead Connector Recommended Mounting Hole**



It is important that the cables are never bent or formed beyond the minimum bend radius found in their data sheet. Table 2 shows bend radius limitations for several different cables. Many other cables not listed may be used.

**Table 2: Cables and their respected bend radius**

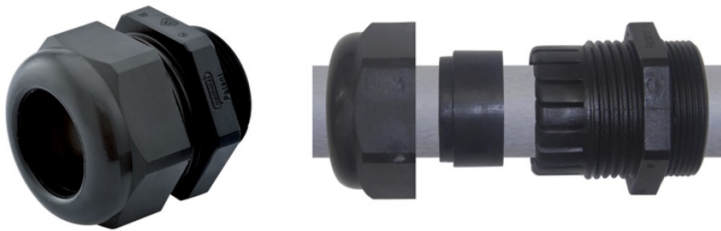
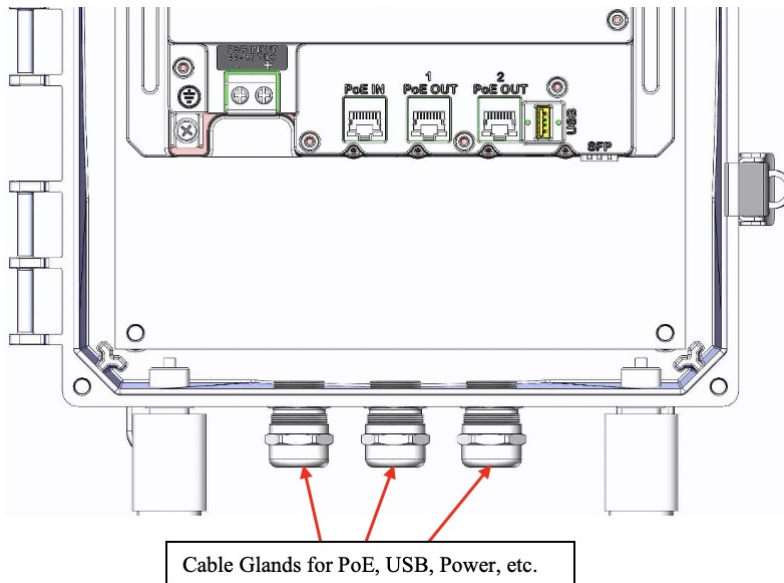
Coaxial Cable Manufacturer and Part Number	Nominal Outside Diameter (inches, mm)	Static Minimum Bend Radius (inches, mm)	Repeated Minimum Bend Radius (inches, mm)
Times Microwave LMR-100A	0.110, 2.79	0.25, 6.4	1.0, 25.4
Times Microwave LMR-195	0.195, 4.95	0.5, 12.7	2.0, 50.8
Times Microwave LMR-240	0.240, 6.10	0.75, 19.1	2.5, 63.5
Times Microwave LMR-400	0.405, 10.29	1.0, 25.4	4.0, 101.6
Times Microwave LMR-600	0.590, 14.99	1.5, 38.1	6.0, 152.4

High quality RF cable assemblies are essential for a “solid” working product. It is recommended that the RF cable assemblies be purchased assembled and tested by a qualified RF cable assembly vendor. Cable type, length, and connector types must be specified to the RF cable assembly vendor. More information on a typical third-party product can be found in the section [Suggested Parts, on page 15](#).

## External Cable Routing

Cable glands are the suggested means of cable entry for the power and I/O cables. It is suggested to use a corrosion-resistant material for the cable gland. The cable gland should be the correct size such that it can pass the RJ45 Ethernet connectors or power cables and still cinch down on the cable and provide a seal. A suggested size is PG13 or M20. The cable gland is not a Cisco product and Cisco does not endorse any specific third-party cable gland. Figure 9 shows the placement of cable glands on the access point.

**Figure 9: Cable Glands**



## Power Wires and Tie Downs

Figure 10 shows how to connect DC power wires. The green wire on the left is grounded to the chassis. The red wire on the right side is the positive DC wire. The black wire in the middle is the negative DC wire. Appropriate American Wire Gauge (AWG) and temperature range for the wire needs to be selected for the application.

**Figure 10: Power Supply Wiring**

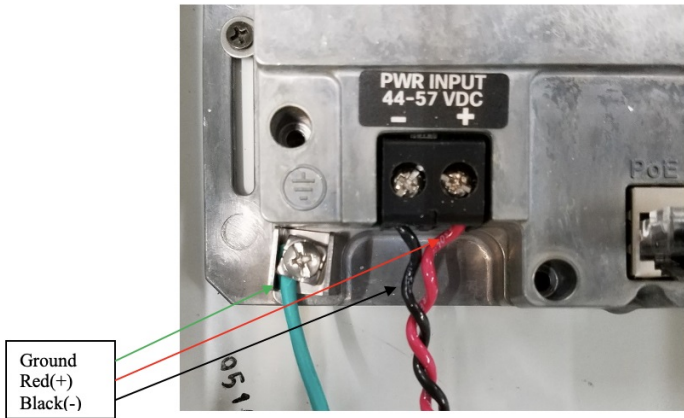
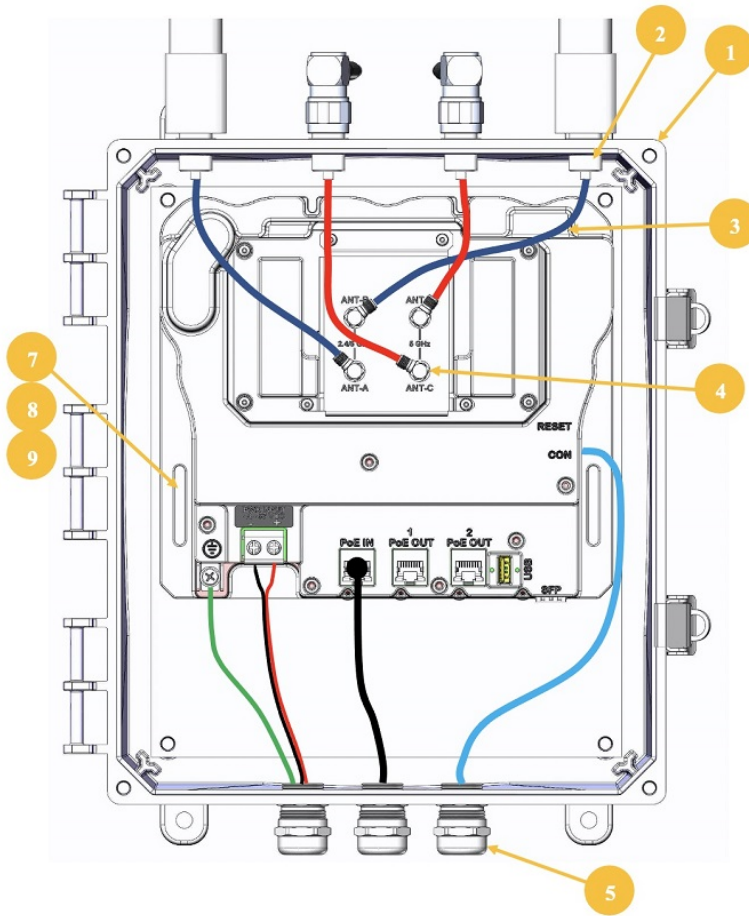


Figure 11 shows an example of a third-party enclosure with an ESW-6300 mounted inside. Cable ties are wrapped around a cable tie block in order to keep the optional front heatsinks available for use. This may not be the most optimal cable management in every case.

**Figure 11: ESW-6300 and Third-Party Enclosure Assembly Example**



## Suggested Parts

**NOTE AND DISCLAIMER:** The following parts, outlined in Table 3, are not mandatory in terms of type or manufacturer. Third-party manufacturers and part numbers are mentioned only as engineering references. Use of the third-party parts specified in this document is not required by Cisco, nor are these parts specifically recommended over any competitive equivalent. Alternate vendors are available. Cisco does not provide support for any third-party product.

**Table 3: Parts List (for reference only)**

Num	Qty	Item	Description
1	1	Enclosure	Integra Traditional High Impact Polycarbonate hinged enclosure with opaque cover. (IP66/68) (Part # H12104H-6P)
2	4	N connector	Amphenol RF N-Type Straight Clamp Jack for RG-174, RG-316, LMR-100 Bulkhead (Part # 172223)  <b>*should be purchased pre-assembled to Items 3 and 4</b>
3	4	RF cable	Times Microwave LMR-100A Flexible Low Loss Communications Coax (Part # LMR-100A)  <ul style="list-style-type: none"> <li>• Cable lengths will vary based on the size of your enclosure.</li> <li>• Dual shielded cables are recommended if any other equipment that generates RF signals or noise is present inside the enclosure.</li> </ul> <b>*should be purchased pre-assembled to Items 2 and 4</b>
4	4	SMA connector	Amphenol RF SMA Plug Right Angle Crimp Plug (Part # 132123)  <ul style="list-style-type: none"> <li>• These are shown connecting to the ESW-6300 RF ports.</li> <li>• Cables run from ESW-6300 radio connectors to external bulkhead connectors. In the examples shown in this document cables are crimped onto the right angle SMA connectors.</li> </ul> <b>*should be purchased pre-assembled to Items 2 and 3</b>
5	3	Cable gland	PG13 Gland. SealCon (Part # CD13AR-RV)  <ul style="list-style-type: none"> <li>• Shown on bottom for ethernet, USB, and power cables.</li> </ul> <b>Or,</b> <ul style="list-style-type: none"> <li>• M20 Cable Gland, With Locknut, IP65, Nylon, Pro Power (Part # M20DB)</li> </ul>
6	2	Cable tie mount	Essentra Components: MFTH-2-01A-RT-M, for use with .09 inch zip ties
7	4	#6 screw	18-8 Stainless Steel #6-32 ½ inch long screws from McMaster (Part # 91772A148)  <ul style="list-style-type: none"> <li>• Used to secure ESW-6300 inside enclosure</li> </ul>



Num	Qty	Item	Description
8	4	#6 split lock	18-8 Stainless Steel Split Lock Washer for #6 Screw from McMaster (Part # 92146A540)
9	4	#6 washer	18-8 Stainless Steel Military Spec #6 Washers from McMaster (Part # 90945A715)
Ref	Ref	External RF cable	<p>Times Microwave LMR-400 or LMR-600 Flexible Low Loss Communications Coax (Part # LMR-400 or LMR-600)</p> <ul style="list-style-type: none"> <li>• Choose a cable type that fits the specifications for your environment</li> <li>• LMR-400 has a minimum repeated bend radius of 4.0 inches (101.6 mm). LMR-600 has a minimum repeated bend radius of 6.0 inches (152.4 mm).</li> </ul> <p>Cisco offers a variety of outdoor coaxial cables with N male connectors. For more information, visit: <a href="#">Cisco Industrial Routers and Industrial Wireless Access Points Antenna Guide</a></p>
Ref	Ref	Lightning arrestor	<p>Lightning Arrestor (Cisco CGR-LA-NF-NF= or Cisco CGR-LA-NM-NF=)</p> <ul style="list-style-type: none"> <li>• Lightning protection may be required if external RF cables are used</li> <li>• Cisco CGR-LA arrestors pass DC – 6 GHz. CGR-LA-NF-NF= has two N female connectors, CGR-LA-NM-NF= has one N male and one N female connector.</li> </ul> <p>Datasheet: see <a href="#">Lightning Arrestor for the Cisco 1240 Connected Grid Router</a>  Installation instructions: see <a href="#">Cisco Lightning Arrestors section in Connected Grid Antennas Installation Guide</a></p>
Ref	Ref	Punch tool (N-Type)	<p>Punch Tool for N-Connector referenced in Item 2</p> <p>Z-Tech: u2D-06400546</p>

## Access Point Specifications

### Technical Specifications

For detailed specifications, refer to the Cisco Catalyst ESW-6300 Embedded Services Access Point data sheet at:

<https://www.cisco.com/c/en/us/products/collateral/wireless/6300-series-embedded-services-access-points/datasheet-c78-742906.html>

### Power Consumption Budget

The following table lists the power consumption budget for the ESW-6300 access point.



**Table 4: ESW-6300 Power Consumption**

<b>Element</b>	<b>Absolute Max Power (Watts)</b>
Total power budget when using DC power source (44-57VDC)	19.7
<b>Optional components</b>	
2 clients of 802.3af (PoE) connected	30.8
1 client of 802.3at (PoE+) connected	30.0
Fiber used as backhaul	1.2
USB 2.0/3.0 add-on module connected	4.5
<b>Total Power Consumption</b>	
Total power consumption when DC powered (44-57VDC)	56.2
<b>Note</b>	For DC power source, if you want to output 802.3at type 2 PoE out power, DC input must be $\geq 51V$ . If you want to output 802.3af PoE out power, DC input must be $\geq 45V$ .

## Canada Regulatory Information

### IC ID

IC: 2461N-ESW6300

HVIN: 68-102256-01

### Canadian Compliance Statement

This device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science, and Development Canada's license-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of this device.

Le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. L'appareil ne doit pas produire de brouillage.
2. L'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

### Maximum Permissible Exposure

This device has been evaluated for RF exposure for humans in reference to ANSI C 95.1 (American National Standards Institute) limits. The evaluation was based on RSS-102 Rev 5.

ESW-6300-CON - To maintain compliance, the minimum separation distance for antennas that have 8 dBi to 14 dBi gain, is 23.6 inches (60 cm) from general bystanders.

Ce device a été évalué pour l'exposition aux RF pour les humains en référence à la norme ANSI C 95.1 (American National Standards Institute) limites. L'évaluation a été basée sur RSS-102 Rev 2.

ESW-6300-CON - La distance minimale de séparation de l'antenne de toute personne jusqu'à 8 dBi et 23.6" (60 cm) pour les gains d'antenne de 14 dBi pour assurer le respect.

## Allowed Antennas

The radio transmitter IC-ID 2461N-ESW6300 has been approved by Innovation, Science, and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Antenna	Frequency Band	Peak Gain	Antenna Type
AIR-ANT2547V-N	Dual-band	2.4 GHz: 4 dBi; 5 GHz: 7 dBi	Omnidirectional
AIR-ANT2547VG-N	Dual-band	2.4 GHz: 4 dBi; 5 GHz: 7 dBi	Omnidirectional
AIR-ANT2547V-N-HZ	Dual-band	2.4 GHz: 4 dBi; 5 GHz: 7 dBi	Omnidirectional
AIR-ANT2568VG-N	Dual-band	2.4 GHz: 6 dBi; 5 GHz: 8 dBi	Omnidirectional
AIR-ANT2513P4M-N	Dual-band	13 dBi	Directional, 4 port
AIR-ANT2450V-N-HZ	2.4 GHz	5 dBi	Omnidirectional
AIR-ANT2450VG-N	2.4 GHz	5 dBi	Omnidirectional
AIR-ANT2450HG-N	2.4 GHz	5 dBi	Omnidirectional
AIR-ANT2480V-N	2.4 GHz	8 dBi	Omnidirectional
AIR-ANT2413P2M-N	2.4 GHz	13 dBi	Directional, 2 port
AIR-ANT5150VG-N	5 GHz	5 dBi	Omnidirectional
AIR-ANT5150HG-N	5 GHz	5 dBi	Omnidirectional
AIR-ANT5180VG-N	5 GHz	8 dBi	Omnidirectional
AIR-ANT5114P2M-N	5 GHz	13 dBi	Directional, 2 port

## Notice of Professional Installation

This device is for professional installation only.

THE SPECIFICATIONS AND INFORMATION REGARDING THE PRODUCTS IN THIS MANUAL ARE SUBJECT TO CHANGE WITHOUT NOTICE. ALL STATEMENTS, INFORMATION, AND RECOMMENDATIONS IN THIS MANUAL ARE BELIEVED TO BE ACCURATE BUT ARE PRESENTED WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED. USERS MUST TAKE FULL RESPONSIBILITY FOR THEIR APPLICATION OF ANY PRODUCTS.

THE SOFTWARE LICENSE AND LIMITED WARRANTY FOR THE ACCOMPANYING PRODUCT ARE SET FORTH IN THE INFORMATION PACKET THAT SHIPPED WITH THE PRODUCT AND ARE INCORPORATED HEREIN BY THIS REFERENCE. IF YOU ARE UNABLE TO LOCATE THE SOFTWARE LICENSE OR LIMITED WARRANTY, CONTACT YOUR CISCO REPRESENTATIVE FOR A COPY.

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

The following information is for FCC compliance of Class B devices: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the 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 the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If the equipment causes interference to radio or television reception, which can be determined by turning the equipment off and on, users are encouraged to try to correct the interference by using one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Modifications to this product not authorized by Cisco could void the FCC approval and negate your authority to operate the product.

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