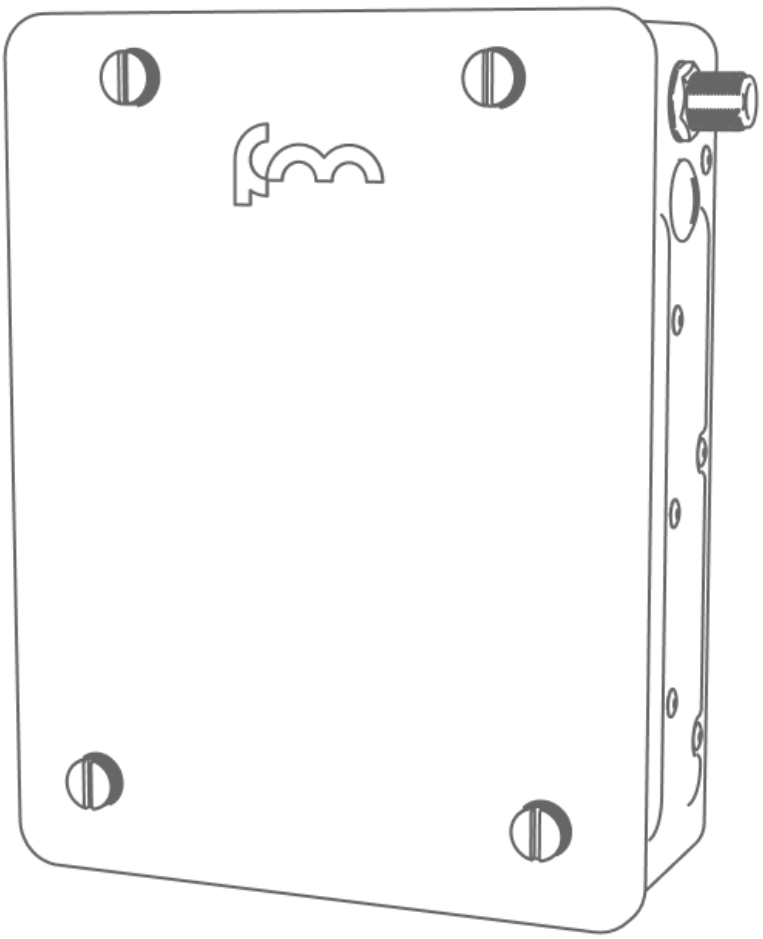


Cisco Ultra-Reliable Wireless Backhaul FM SHIELD

Specialized installation solution for radio transceivers

(Formerly Fluidmesh)
Edition 1.4 (For ENDO-, MOBI- and FIBER-series radio transceivers)

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1. Reporting mistakes and recommending improvements

You can help improve this manual.

If you find any mistakes, or if you know of a way to improve the procedures that are given, please let us know by E-mailing your suggestions to documentation@fluidmesh.com.

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2. Introduction

FM-SHIELD is compatible with all FM3200 Endo, FM4200 Mobi, FM4200 Fiber, FM3500 Endo, FM4500 Mobi and FM4500 Fiber radios.

FM-SHIELD provides an easy-to-use, reliable, and robust method of installing Fluidmesh radios in extreme environments. FM-SHIELD is an auxiliary mounting kit designed to withstand specialized hazards, such as extreme vibration, highly-pressurized hot and cold water, and destructive impacts from heavy objects. FM-SHIELD also provides a solid platform from which to install and maintain a Fluidmesh radio under challenging conditions.

FM-SHIELD was designed with open-pit and underground mining in mind, with specific focus on haul trucks, dozers, shovels, drills and loaders. The difficult environmental conditions of mining often mean that radios can only be installed inside the cabins of vehicles. This requires longer-than-optimum antenna cables, leading to degraded RF performance. In addition, the cabs of mining vehicles usually have limited space for installation and maintenance of radio gear, leading to unwanted complication. FM-SHIELD solves all these problems, allowing customers to install a Fluidmesh radio outside a vehicle and as close as possible to its antennas, thus limiting RF losses and increasing transmission ranges. As usual, power and connectivity can be provided by POE using a CAT5/6 cable, or through dedicated data and DC power connections.

FM-SHIELD exploits the protective concept of *spaced armor*, as used on modern battle tanks.

FM-SHIELD works as follows:

1. A Fluidmesh unit is placed inside an FM-SHIELD.
2. The majority of any high-pressure water that strikes FM-SHIELD is deflected, without reaching the radio unit inside.
3. Any water that is not successfully deflected loses almost all of its kinetic energy, and therefore, its ability to penetrate the radio unit's integral housing. The de-energized water is routed harmlessly down the inside of the FM-SHIELD, and drains away.

2.1. What can FM-SHIELD do?

FM-SHIELD was designed to offer specialized environmental protection for Fluidmesh radio units.

FM-SHIELD offers specific protection against intensely concentrated water spray (for example, from high-pressure cleaning equipment), while also offering enhanced protection against sharp and blunt-force impacts (for example, from minor vehicle collisions, falling rocks, and similar).

FM-SHIELD is compatible with all Fluidmesh FM4200 Mobi, FM4200 Fiber, FM3200 Endo, FM3500 Endo, FM4500 Mobi and FM4500 Fiber radios.

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If correctly mounted on a suitable tubular mounting point, FM-SHIELD can withstand winds of up to 112 MPH (180 Km/h).

2.2. What can FM-SHIELD *not* do?

Fluidmesh engineers have observed that auxiliary armor designed to offer protection against highly pressurized water frequently has the opposite effect. Such protection is often better at *keeping water in* if it does penetrate.

Since FM-SHIELD addresses this conventional problem with an unconventional solution, it is important to note that traditional IP (ingress protection) ratings do not apply. FM-SHIELD does not attempt to isolate a radio unit inside a sealed box. Instead, it defeats the penetrating power of high-pressure water by placing a hardened, semi-permeable physical barrier between the water source and the radio unit.

It is also important to note that:

- FM-SHIELD is not waterproof, and is not designed to protect against water immersion to any depth.
- FM-SHIELD is not rated for protection against the following:
    - Bullets and other high-velocity projectiles.
    - Effects produced by explosives or fragmentation devices.
    - Fire.
    - Corrosive or oxidizing agents.
    - Ionizing radiation.
    - Vandalism or insurgent activity.

2.3. What radio units is FM-SHIELD compatible with?

FM-SHIELD is compatible with all Cisco FM3200 Endo, Cisco FM3500 Endo, Cisco 4200-series and Cisco 4500-series radio transceiver devices.

FM-SHIELD is not compatible with FM Ponte kit, FM1200 Volo, FM1300 Otto and FM3200 Base transciever devices.

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3. Installing the FM-SHIELD

3.1. Installing a radio transceiver in the FM-SHIELD



IMPORTANT

Fluidmesh radio transceivers are designed to be mounted in the *vertical* plane, with their RP-SMA or QMA antenna connectors facing *upward,* and their data/power connectors facing *downward*.

The FM-SHIELD must always be installed in a way that ensures correct positioning of the relevant radio unit.



IMPORTANT

If installed in an FM-SHIELD, FM3200 Endo and FM3500 Endo radio units must be removed from the FM-SHIELD to gain access to their hardware *Reset* buttons.

If you are installing a FM3200 Endo or FM3500 Endo radio unit, and you need access to the unit's hardware *Reset* button during configuration, it is strongly recommended that you do the following steps *before* installing the radio unit in the FM-SHIELD housing:

1. Temporarily connect all antenna, power and data cables to the radio unit.
2. Configure the radio unit.
3. Verify the operation of the radio unit.



NOTE

Two *QMA-to-N* antenna connector leads are included with the FM-SHIELD. These leads are specifically designed for use with Cisco 4200-series and Cisco 4500-series radio transceivers.

If the FM-SHIELD will be used to protect a FM3200 Endo or FM3500 Endo radio transceiver, two *RP-SMA-to-N* antenna connector leads must be purchased separately.

Install a radio transceiver unit within the FM-SHIELD by doing the steps that follow.

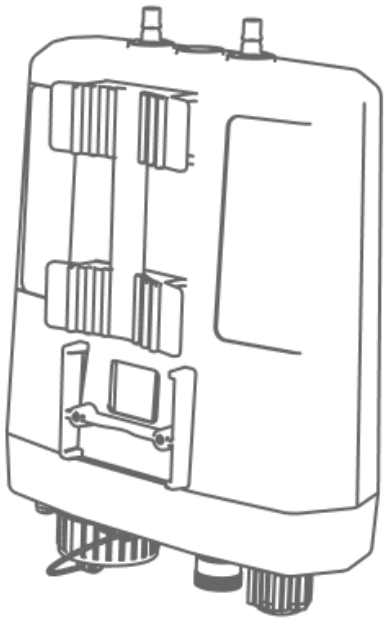


NOTE

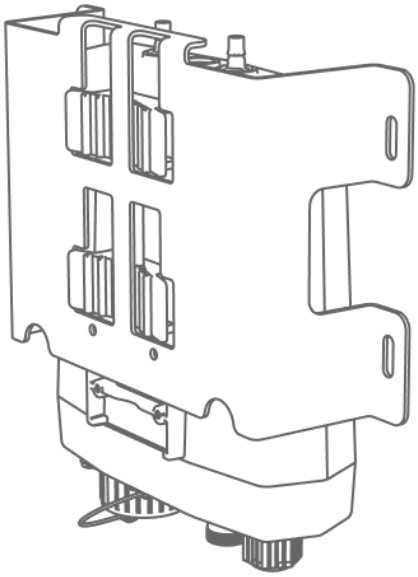
In this section, an FM4500 Fiber radio transceiver is used for demonstration. Procedures for all other radio transceivers are similar.

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1. Place the radio transceiver unit on the work surface. The unit's rear side must face UP (below).

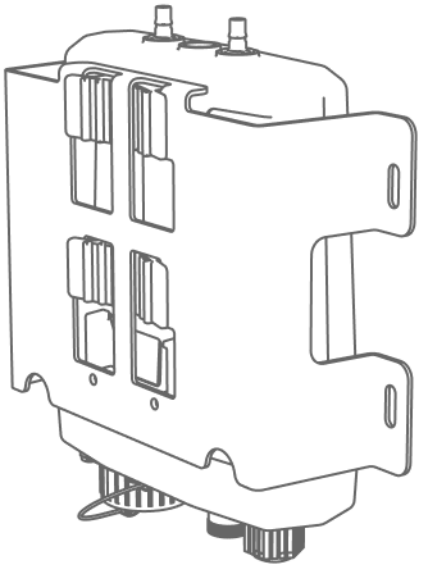


2. Place the main bracket over the radio unit. The radio unit's mounting lugs must protrude through the slots in the main bracket (below).

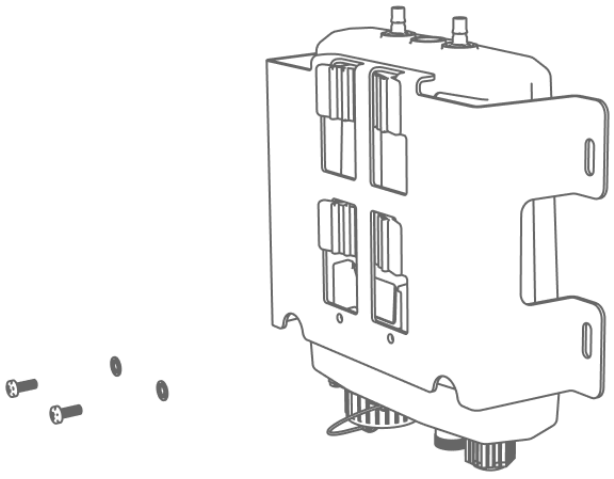


3. Slide the bracket down over the radio unit's mounting lugs, until the bracket locks into position (below).

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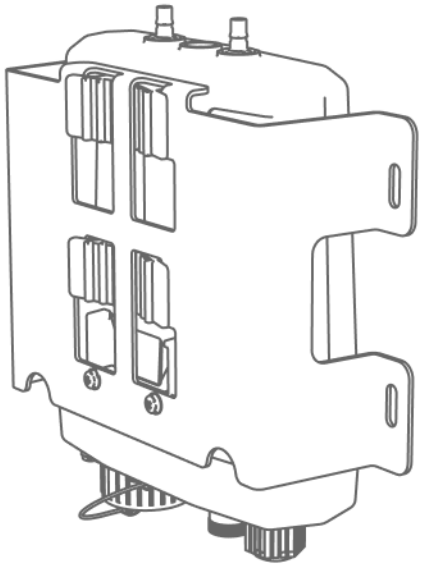


4. Place M3 spring washers over the shafts of two M3x8 pan-head screws (below).



5. If the FM-SHIELD will be subjected to extreme vibration, apply low-strength thread-locking compound (such as Loctite 222 or a name-branded equivalent) to the threads of the two M3x8 pan-head screws.
6. Insert the M3x8 pan-head screws through the securing holes on the main bracket (below).

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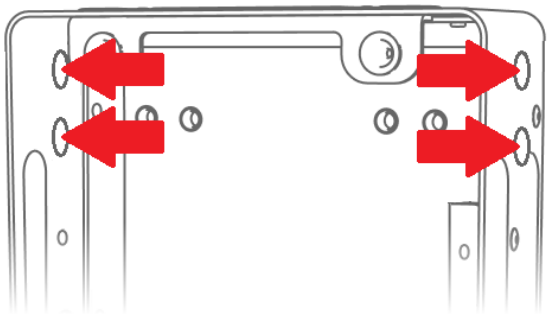


7. Tighten the screws.
8. The FM-SHIELD housing has four antenna connector exit holes (below).

IMPORTANT

If you are doing a single-radio-with-two-antenna installation, *FM-SHIELD-SPL* signal splitters must be purchased separately. Do not use *QMA-to-N* or *RP-SMA-to-N* antenna connector leads, or *FM-SPLITTER* signal splitters.

For instructions on how to install FM-SHIELD-SPL splitters, refer to “Using signal splitters with FM-SHIELD” (page 26).



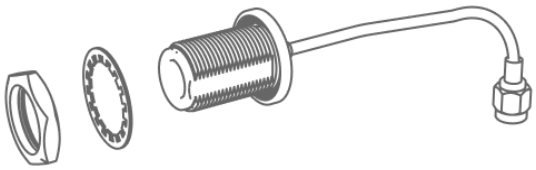
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IMPORTANT

When installed in its mounting location, the FM-SHIELD will need:

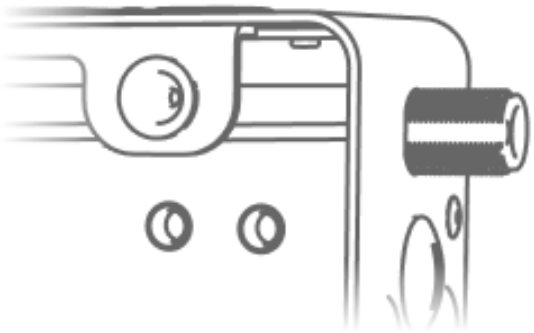
- A minimum of 5.90 in (150mm) clearance between the bottom edge of the metal housing, and the horizontal surface nearest to it.
- A minimum of 3.94 in (100mm) clearance between the sides of the metal housing, and the vertical surfaces nearest to them.

9. Install the antenna connector leads inside the FM-SHIELD housing by doing the following steps:

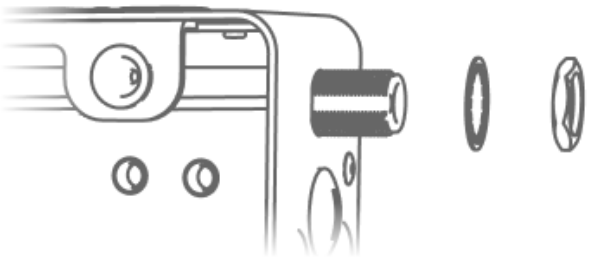


a. Remove the securing nut and washer from the N-female terminal of each antenna connector lead (above).

b. Insert the N-female terminal of each antenna connector through the chosen exit hole in the FM-SHIELD housing. The threaded side of the N-female terminal must face *out* (below).



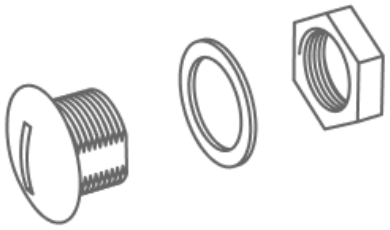
c. Install the washer and securing nut on the N-female terminal (below).



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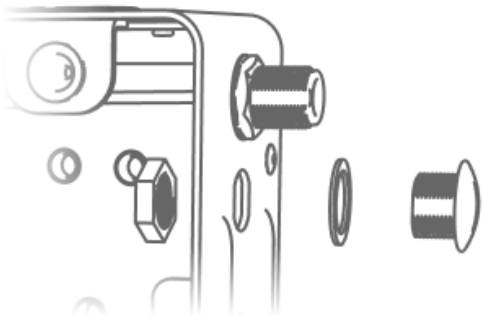
d. Tighten the securing nut.

10. Install the plastic blanking plugs in the unused antenna connector exit holes of the FM-SHIELD, by doing the following steps:



a. Remove the securing nut and washer from the body of each blanking plug (above).

b. Insert the main body of each blanking plug through the chosen exit hole in the FM-SHIELD housing. The threaded side of the plug must face *in* (below).



c. Install the washer and securing nut over the threaded body of each blanking plug.

d. Tighten the nut.

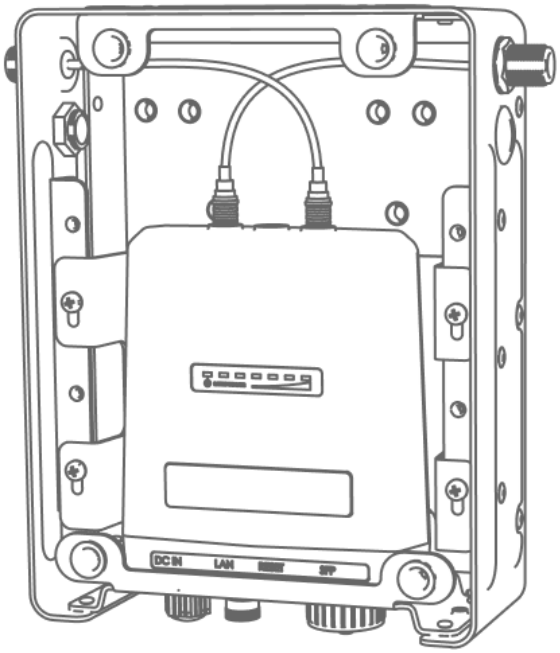
11. Connect the RP-SMA or QMA connectors on the antenna leads to their assigned antenna connectors on the radio unit.

CAUTION

Always *cross* the antenna leads before connecting the RP-SMA or QMA connectors to the radio unit's antenna terminals (below).

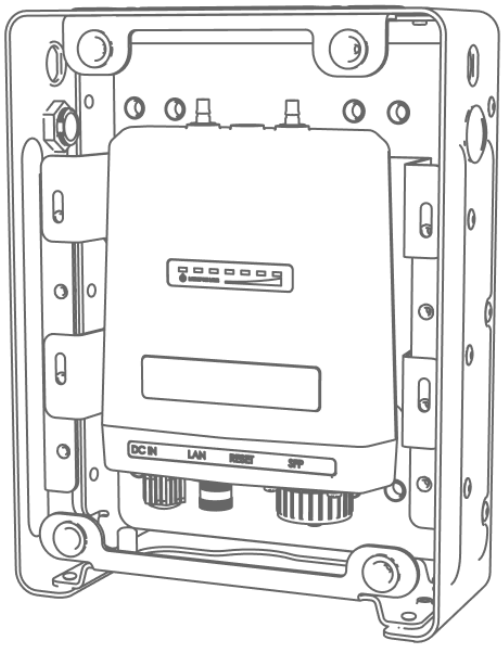
Never connect the RP-SMA or QMA connector of an antenna lead to the antenna terminal that is closest to the lead's N-female connector. Damage to the antenna lead may result.

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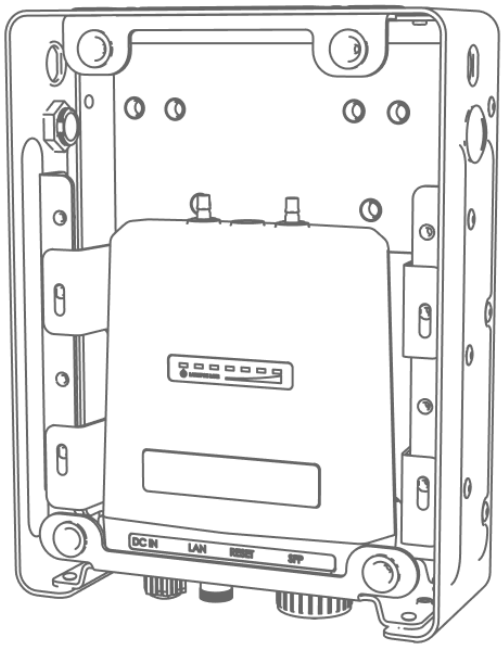


12. Route the power and data cables for the radio unit through the bottom of the FM-SHIELD housing.
13. Connect the power and data connectors to the radio unit as shown in the user manual for the relevant radio unit.
14. Position the radio unit/main bracket assembly inside the FM-SHIELD housing (below). Note the following points:
    - The radio unit's LED panel must face the *cover lid* side of the FM-SHIELD housing.
    - The power and data terminals of the radio unit must face in the direction of the open access hole on the *lower* end of the housing.

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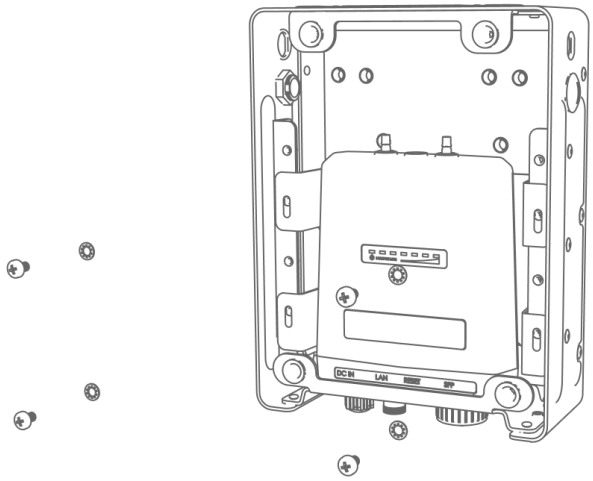


15. Slide the radio unit/main bracket assembly down the FM-SHIELD housing until the bottom side of the radio unit is flush against the access hole on the lower end of the housing (below).

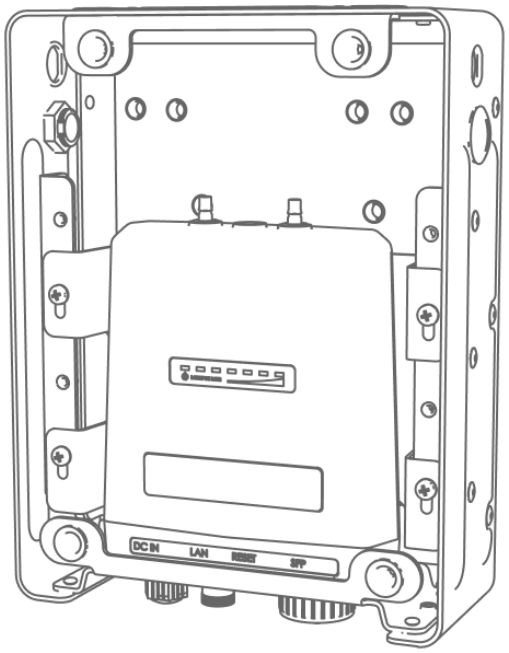


16. Place M4 grounding washers over the shafts of four M4x6 pan-head screws (below).

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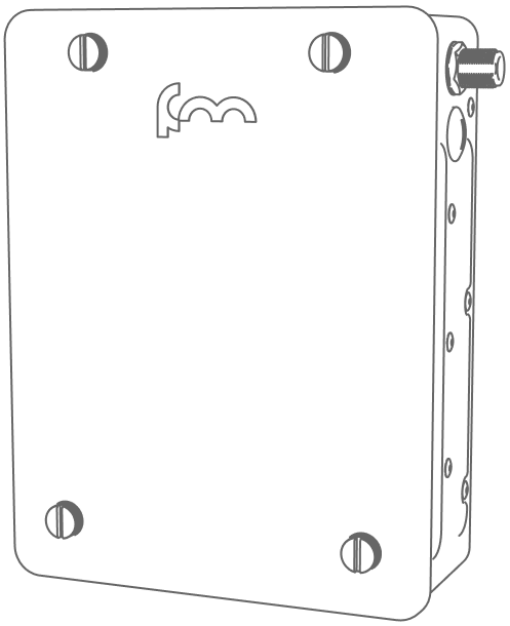


17. Insert the M4x6 pan-head screws through the securing holes on the main bracket, into the FM-SHIELD housing (below).



18. Tighten the screws.
19. Place the polycarbonate cover lid over the open side of the FM-SHIELD housing (below). Note that the cover lid only fits correctly one way.

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20. Tighten the four quick-release cover lid screws by hand only.

> **CAUTION**
> Do not over-tighten the cover lid screws. Over-tightening the screws may damage the cover lid.

21. Connect the relevant antennas to the exterior antenna terminals of the FM-SHIELD.
22. If the radio unit/FM-SHIELD assembly must be installed on a tubular mounting point (such as a grab rail), proceed to Installing FM-SHIELD on a tubular mounting point (page 16) below. For all other mounting options, proceed to Installing the FM-SHIELD on a mounting bracket or other flat surface (page 23) below.

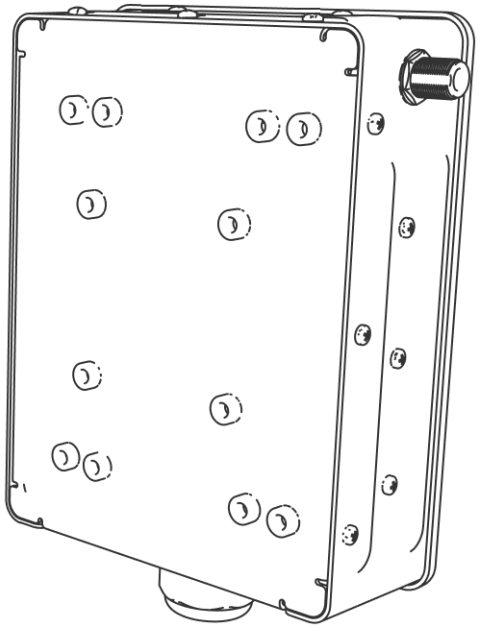
3.2. Installing FM-SHIELD on a tubular mounting point

FM-SHIELD can be installed on vertically-oriented and horizontally-oriented tubular mounting points, such as grab rails.

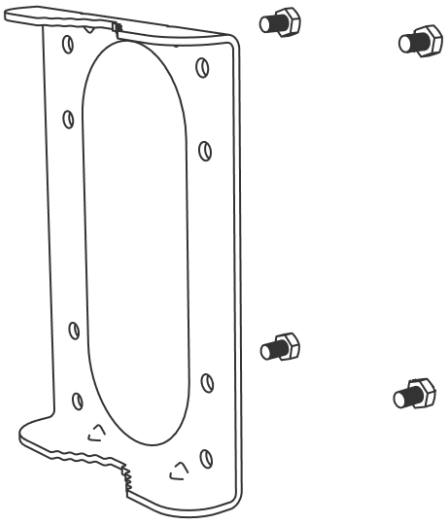
Install the FM-SHIELD on a tubular mounting point by doing the following steps:

1. Orient the FM-SHIELD so that the side its mounting bracket will be installed on faces *up* (below).

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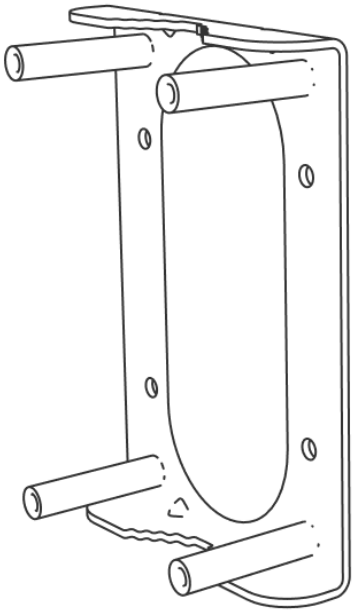


2. Place M6 spring washers over the shafts of four M6x10 hex-head screws.
3. Insert the M6x10 hex-head screws into the outer holes on the front side of the mounting bracket (below).



4. Screw an M6x45 threaded sleeve onto each of the M6x10 hex-head screws (below). Tighten the screws.

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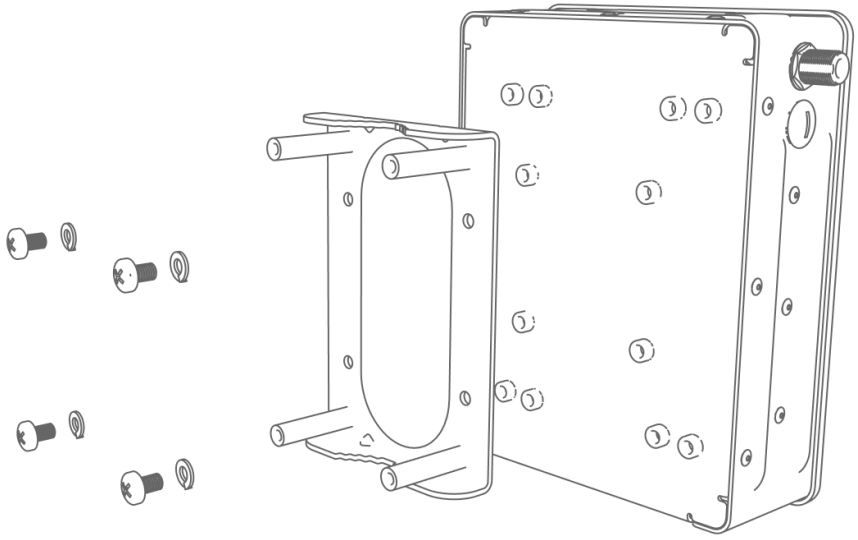


5. Place the mounting bracket on the bracket-mounting side of the FM-SHIELD housing.

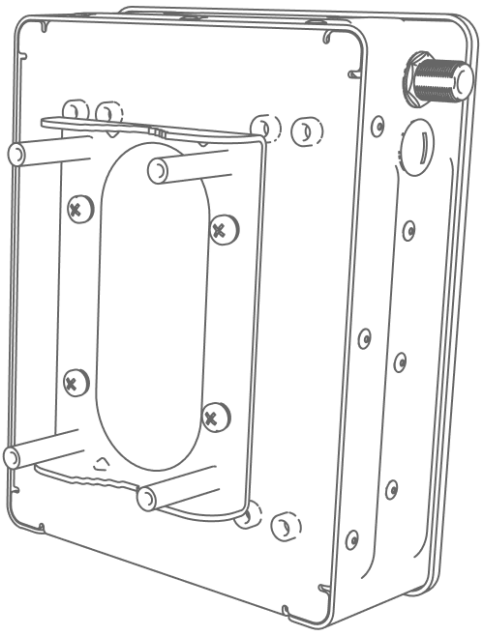
> **NOTE**
>
> If the FM-SHIELD will be installed on a *vertically-oriented* tubular mounting point, place the mounting bracket in such a way that the bracket's long sides are *parallel* to the length of the FM-SHIELD housing.
>
> If the FM-SHIELD will be installed on a *horizontally-oriented* tubular mounting point, place the mounting bracket in such a way that the bracket's long sides are *perpendicular* to the length of the FM-SHIELD housing.
>
> Make sure the four mounting bracket securing holes are aligned with the four M6x1.0 threaded holes on the rear side of the FM-SHIELD housing.

6. Place M6 spring washers over the shafts of four M6x10 pan-head screws (below).

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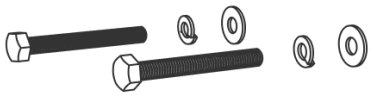


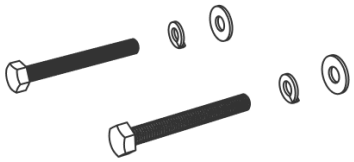
7. Insert one M6x10 pan-head screw into each of the securing holes on the mounting bracket (a typical installation is shown below).



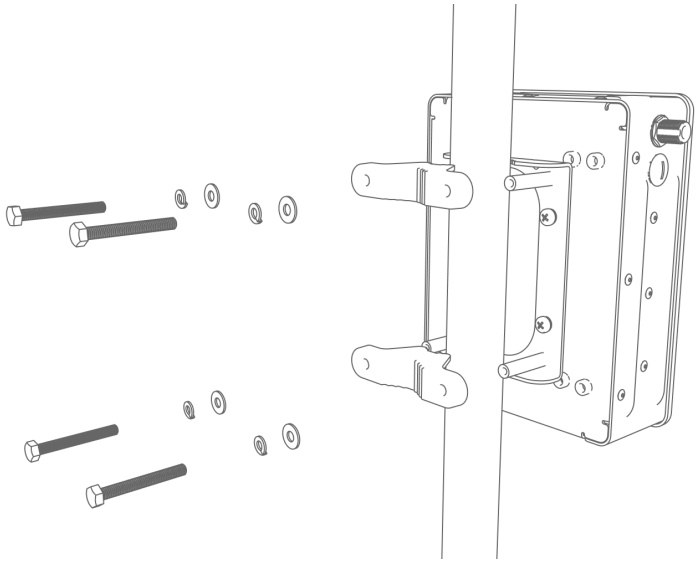
8. Tighten the screws.
9. Place M6 spring washers and M6 flat washers over the shafts of four M6x50 hex-head screws (below).

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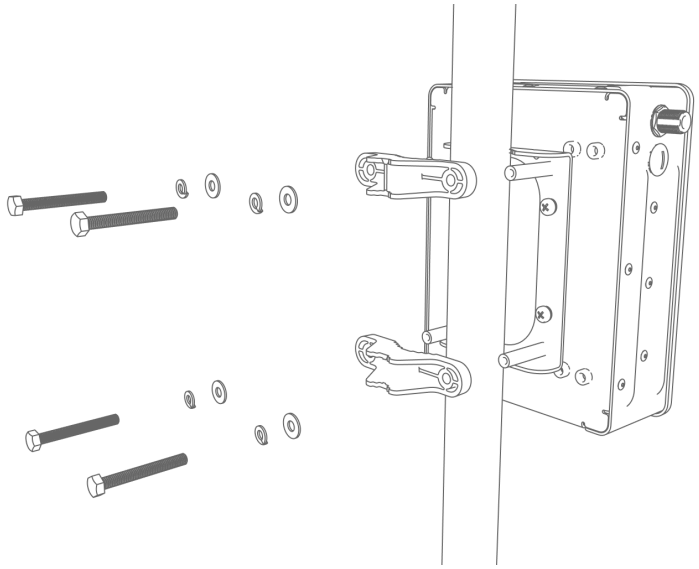


10. Choose a configuration for the mounting bracket clamps as follows:
    - If installing the FM-SHIELD on a tubular mount of 0.75” to 1.5” (19mm to 38mm) diameter, insert the M6x50 hex-head screws through the mounting bracket clamps as shown below:



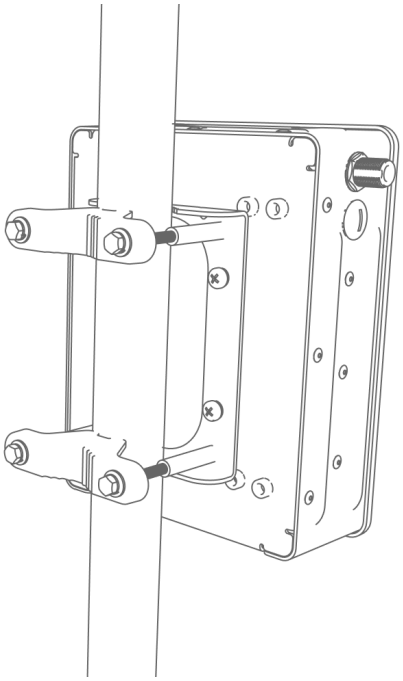
    - If installing the FM-SHIELD on a tubular mount of 1.75” to 2.5” (44mm to 63mm) diameter, insert the M6x50 hex-head screws through the mounting bracket clamps as shown below:

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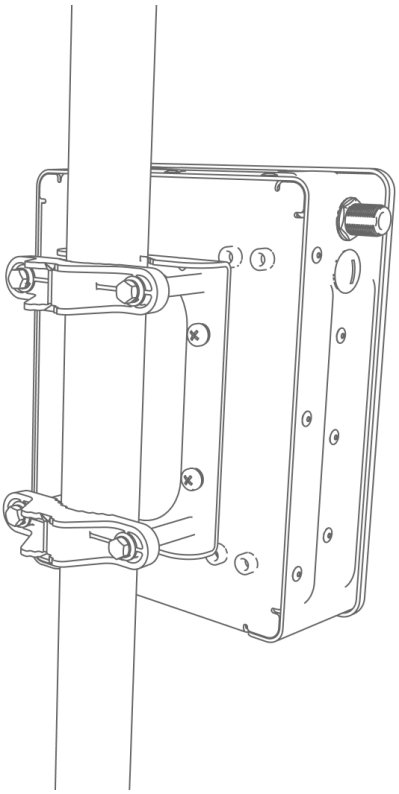


11. Place the radio unit/FM-SHIELD assembly against the tubular mounting point. Note the following points:
    - The radio unit/FM-SHIELD assembly must be oriented *vertically*, with the radio unit's power and data connectors facing *downward*.
    - The radio unit/FM-SHIELD assembly must be placed at a suitable height, and facing in a direction that allows easy access for installation and maintenance personnel.
    - The chosen mounting point must not expose the radio unit to unnecessary risk of damage, theft, exposure and other hazards.
12. Screw each of the M6x50 utility pole clamp screws into an M6x45 threaded sleeve. Tighten the M6x50 screws.
13. If installing the FM-SHIELD on a tubular mounting point of 0.75" to 1.5" (19mm to 38mm) diameter, the finished installation should look like this:

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14. If installing the FM-SHIELD on a tubular mounting point of 1.75” to 2.5” (44mm to 63mm) diameter, the finished installation should look like this:



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15. Connect the FM-SHIELD housing to a clean ground point as shown in Ensuring a clean ground (page 24).

3.3. Installing the FM-SHIELD on a mounting bracket or other flat surface

FM-SHIELD can be installed on any flat, vertically-oriented surface (such as a wall or custom mounting bracket) that is capable of supporting the combined mass of the radio unit, FM-SHIELD and auxiliary mounting hardware.

IMPORTANT

No standard solution is currently available for mounting the FM-SHIELD on a vertical flat surface. However, custom mounting solutions can be manufactured on request. For more information, please consult your local Fluidmesh representative.

The vertical surface the FM-SHIELD is mounted on may need M6 mounting holes. All mounting holes are shown on the *FM-SHIELD template for hole mounting*. To quickly install FM-SHIELD, you can print the template and use it to accurately mark the positions of the needed mounting holes.

To view the *FM-SHIELD template for hole mounting*, do the following steps:

1. Click this link.
2. Log in to the Fluidmesh Partners Portal using your login credentials.
3. Click this link.
4. Download and print the *FM-SHIELD template for hole mounting* file.

IMPORTANT

For accurate results, you must:

- Print the image on A4 paper.
- Select *A4* as the print paper size.
- Set the print scale to *100%.*
- Select the *Fit picture to frame* option (if available).
- When the template is printed, make sure that the black rectangle seen below the diagram measures exactly 100mm (3.94 inches).

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M6x1.0 threaded screws will be needed to install the FM-SHIELD on a substrate. The formula for calculating the length of the mounting screws is as follows:

Screw shank length = Substrate thickness (including voids) + thickness of washers + thickness of nut + 2mm

When installing the FM-SHIELD, note these important points:

- The radio unit/FM-SHIELD assembly must always be oriented *vertically*, with the radio unit's power and data connectors facing *downward.*
- The radio unit/FM-SHIELD assembly must be placed at a suitable height, and facing in a direction that ensures easy access for installation and maintenance personnel.
- The chosen mounting point must not expose the radio unit to unnecessary risk of damage, theft, exposure and other hazards.

The installed FM-SHIELD will need:

- A minimum of 5.90 in (150mm) clearance between the bottom edge and its nearest horizontal surface.
- A minimum of 3.94 in (100mm) clearance between the sides and their nearest horizontal surfaces.

You must connect the FM-SHIELD housing to a clean ground point as shown in "Connecting the FM-SHIELD to a clean ground" (page 24).

3.4. Connecting the FM-SHIELD to a clean ground



CAUTION

To avoid damage to the protected radio transceiver unit, it is essential to connect the FM-SHIELD to a clean ground/earth point as shown in this section.

A 'clean ground' or 'clean earth' is defined as a condition in which:

- There is zero difference in electrical potential between any network point and the specified ground point under normal working conditions.
- The specified ground point is isolated from the mains electrical power supply across the entire wired network to which the radio unit is connected.

The clean ground must conform to the following specifications:

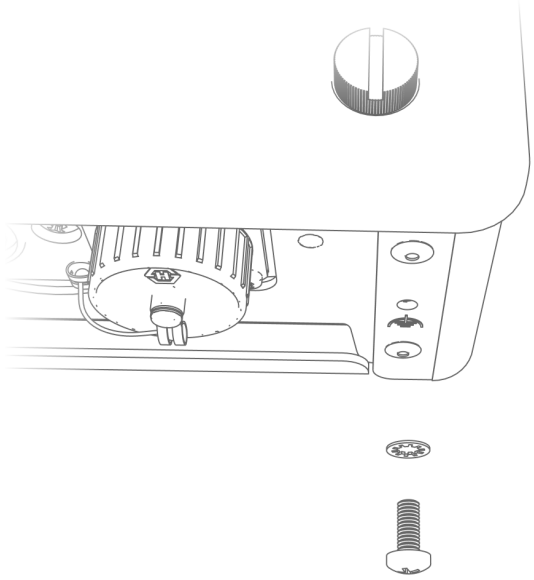
- The clean grounding system must not be connected to any other grounding system.

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- Grounding cables used for clean grounding must not be in close proximity to other grounding cables or power cables.
- The clean grounding system must conform to the standards specified in *IEC 60950 (Information technology equipment – Safety)* and *EN 50310 (BSI Telecommunications bonding networks standards for buildings and other structures).*
- Grounding pits used for clean grounding must be separated from all other grounding pits by a distance of at least 1 800mm.
- Clean grounds must have an earth impedance of less than 1 Ohm.

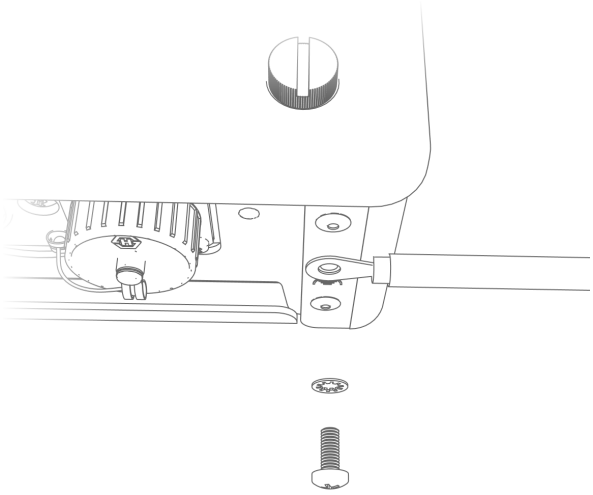
Connect the FM-SHIELD housing to a suitable clean ground point by doing the following steps:

1. Remove the pan-head ground-terminal screw and grounding washer from the lower edge of the FM-SHIELD (below).

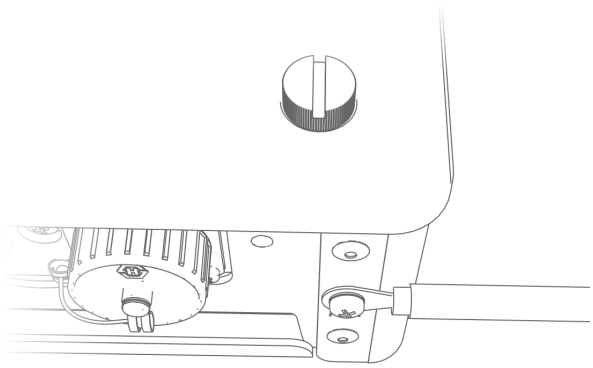


2. Insert the bare end of a suitable ground (earth) lead into the exposed end of a suitable eye-type terminal.
3. Secure the ground lead and terminal together by crimping the wire end of the terminal with a suitable tool.
4. Place the eye end of the terminal over the shaft of the screw. Make sure that the grounding washer is placed between the screw head and the terminal (below).

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5. Re-insert the pan-head ground-terminal screw into its threaded hole.



6. Tighten the screw.
7. Route the other end of the ground lead to a suitable clean ground point, and secure the ground lead in place.

3.5. Using signal splitters with FM-SHIELD

If you are doing a single-radio-with-two-antenna installation, and the radio is to be installed inside an FM-SHIELD, you must use FM-SHIELD-SPL signal splitters.

Note that FM-SHIELD-SPL is designed for use with MOBI and FIBER radios only. FM-SHIELD-SPL is not compatible with ENDO radios.

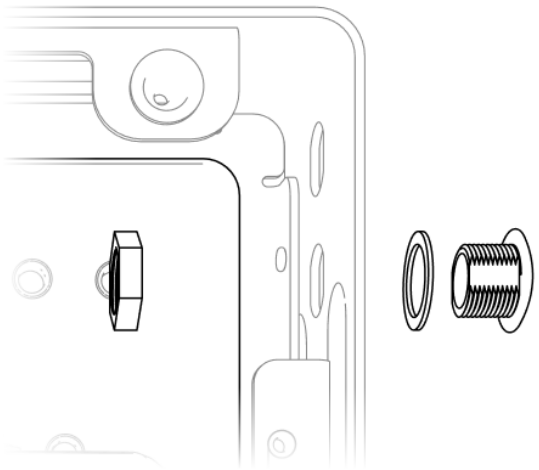
CAUTION

If using signal splitters with FM-SHIELD, do not use FM-SPLITTER signal splitters. This signal splitter type is not designed for use with FM-SHIELD.

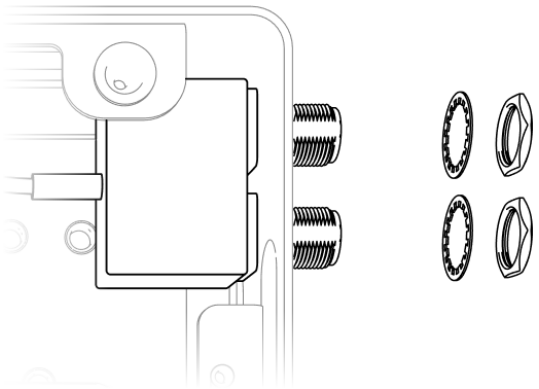
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To connect two antennas to a single FM-SHIELD-mounted MOBI or FIBER radio as part of a single-radio-with-two-antenna installation, do the following steps:

1. Remove the four protective plugs from the outer casing of the FM-SHIELD by unscrewing the nuts (below).



2. Place the main body of a splitter through the correct casing holes (below).

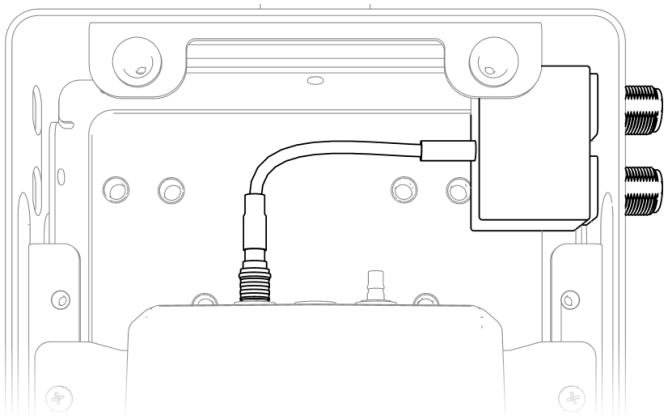


3. Secure the splitter to the casing using the lock washers and nuts (above).

CAUTION
Do not over-tighten the nuts, as this may result in damage to the N-female connectors.

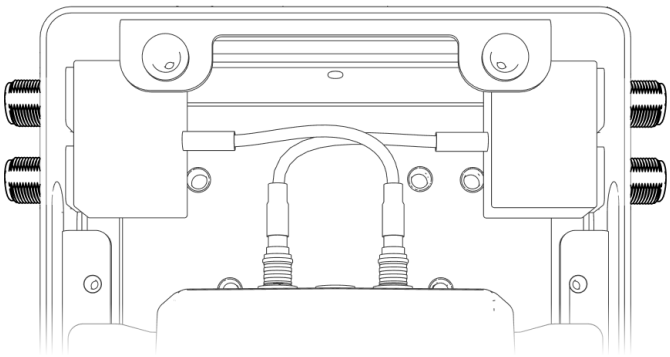
4. Press the splitter's QMA-female connector onto the QMA-male connector on the *opposite* side of the radio (below).

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CAUTION
Do not connect the splitter's QMA-female connector to the QMA-male connector on the *same* side of the radio, as this may damage the signal wire.

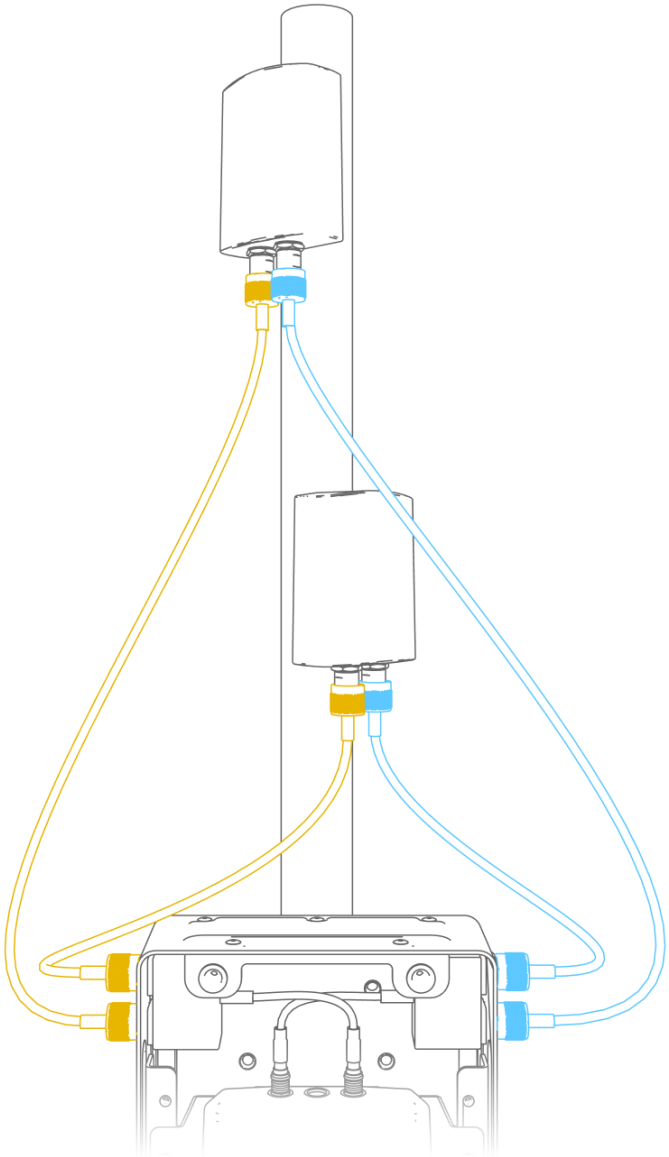
5. Repeat Step 2 to Step 4 above to install the second splitter (below).



6. Familiarize yourself with the connection diagram below.

IMPORTANT
This diagram shows the correct connections to set up a polarization split between the two antennas. The correct connections must be made to avoid cross-polarization, and consequent drops in network performance.

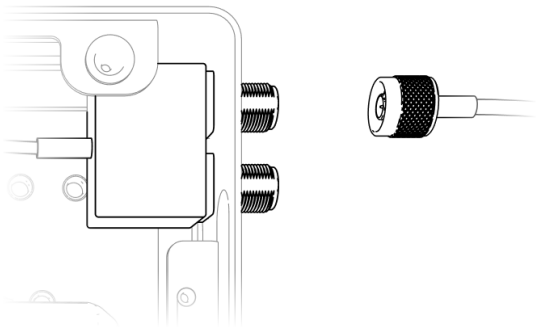
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TIP
The yellow connections can be made to carry a horizontally *or* vertically polarized signal. The blue connections will always carry the opposing signal.

7. Screw each N-male antenna cable connector onto its correct N-female splitter connector (below). Tighten each cable connector by hand only.

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IMPORTANT

When connecting an antenna to a radio, only use shielded co-axial antenna cables of type LMR 240 or LMR 400.

Always use the shortest practical antenna cable runs. The maximum permissible length of any single antenna cable is 3 feet (1 metre).

8. Screw each N-male antenna cable connector onto its correct N-female antenna connector (below). Tighten each cable connector by hand only.



9. Waterproof all N-type antenna connectors on the FM-SHIELD and the two antennas by wrapping them with outdoor-rated, self-shrinking sealing tape.

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4. Notices and copyright



WARNING

Installation of Fluidmesh hardware devices and their supporting infrastructure must be done by suitably qualified personnel only. In some countries, installation by a certified electrician may be required.

Fluidmesh hardware installations must comply with all applicable local legislation.



WARNING

Never disassemble a Fluidmesh hardware device to any extent that is not described in the relevant device user's manual. Fluidmesh devices contain no user-serviceable parts. Disassembling a Fluidmesh hardware device will invalidate the device warranty, and may compromise the operational integrity of the device.

On some Fluidmesh radio transceiver devices, the lower access cover must be removed to gain access to the hardware *Reset* button. Do not operate a radio transceiver device for extended periods if its lower access cover has been removed.



WARNING

To avoid danger from non-ionizing radiation and/or electric shock and/or high-intensity laser or LED light sources, be sure to install the unit only in a location with restricted access.



WARNING

To avoid danger from electric shock, do not expose the unit to water or high humidity if the unit is powered ON, or if any access covers have been removed from the unit enclosure.

Do not place liquid-filled objects on or above the unit.

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5. Contact us

Worldwide Headquarters:

Fluidmesh Networks LLC

81 Prospect Street

Brooklyn, New York 11201

United States of America

Tel. +1 (617) 209 -6080

Fax. +1 (866) 458-1522

info@fluidmesh.com

Technical Support desk: support@fluidmesh.com

www.fluidmesh.com

Regional headquarters for Europe, the Middle East and Africa:

Tel. +39 02 0061 6189

Regional headquarters for the United Kingdom:

Tel. +44 2078 553 132

Regional headquarters for France:

Tel. +33 1 82 88 33 6

Regional headquarters for Australia and New Zealand:

Tel: +61 401 747 403

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