

# Cisco Ultra-Reliable Wireless Backhaul FM SHARK

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## Installation and Configuration Manual

(Formerly Fluidmesh)  
Edition 1.0 (For FM-SHARK-14, FM-SHARK-16, FM-SHARK-PCT16 and FM-SHARK DUAL  
antennas)

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## 1. HAZARDOUS CONDITION WARNINGS

Like all other global technology vendors, Fluidmesh is required to comply with all local health and government regulations in the locations in which we operate. This includes meeting radio frequency (RF) exposure limits for our products.

Our equipment is tested in accordance with regulatory requirements as a condition to our ability to market and sell in any given jurisdiction. As an equipment manufacturer, Fluidmesh defers to expert national and international health organizations responsible for guidance on the safety of RF signals, specifically the US Food and Drug Administration (FDA), Health Canada, the World Health Organization (WHO), and other national and global health agencies.

In May 2019, the FDA stated that there is "no link between adverse health effects and exposure at or under the current RF energy exposure limit", and that the current FCC RF exposure limits are sufficient to insure the safety of users.

If any Fluidmesh hardware unit breaks down or malfunctions, emits smoke or an unusual smell, if water or other foreign matter enters the unit enclosure, or if the unit is dropped onto a hard surface or damaged in any way, power off the unit immediately and contact an authorized Fluidmesh Networks dealer for assistance.

If you are adjusting and/or controlling a Fluidmesh device using control software such as the RACER™ interface or the device's local Configurator interface, do not make configuration changes unless you know with certainty that your changes will not negatively impact people or animals in the vicinity of the device and its antennas.

## 1.1. Radio-frequency transmission hazard



### WARNING

The system shown in this manual is designed to be installed and operated in a way that avoids contact with the antennas by human beings. The legislation quoted in this section is designed to reduce overall exposure of human beings to RF radiation.

This section gives minimum separation distances between antennas and humans. It is strongly recommended that the system be installed in a location where these minimum separation distances can be maintained at all times.

**United States:** This system has been evaluated for RF exposure for humans, in accordance with FCC regulation CFR 47 Part 2.1091. To maintain compliance, the minimum separation distance from the antenna to general bystanders is 20cm/7.9in. (all FM Ponte kit and x200 radio transceivers), or 21cm/8.3 in. (all FM1300 Otto and x500 radio transceivers).

**Canada:** This system has been evaluated for RF exposure for humans, in accordance with ISED regulation RSS-102. To maintain compliance, the minimum separation distance from the antenna to general bystanders is 20cm/7.9in. for all Fluidmesh radio transceivers.

**Europe / Australia / New Zealand:** This system has been evaluated for RF exposure for humans, in accordance with standard EN 62232. To maintain compliance, the minimum separation distance from the antenna to general bystanders is 20cm/7.9in. for all Fluidmesh radio transceivers.

Before activating any device capable of transmitting RF signals, make sure that all persons and animals are protected from possible RF exposure.

Make sure that all RF feeds are securely connected to an appropriate antenna. Never activate any RF-capable device that is not connected to an antenna.

## 2. 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](mailto:documentation@fluidmesh.com).

## 3. Introduction

This manual gives field-level installation instructions for installing Fluidmesh antennas. It is intended for use by wireless networking professionals who have been tasked with installing Fluidmesh radio antennas.

To prevent personal injury and equipment damage, and to ensure optimum network performance:

- Install all network hardware where it cannot be physically damaged.
- Shield all network hardware from salt water and chemical spray.
- Keep a safe distance from all RF-radiating devices when such devices are powered on, make sure that all persons and animals are protected from possible RF exposure before activating any device capable of transmitting RF signals, and do not stand in line with powered RF-radiating devices.
- Make sure that all RF feeds are securely connected to an appropriate antenna before activating any device capable of transmitting RF signals.

### 3.1. FM-SHARK-series antennas

The SHARK series are heavy-duty antennas designed for external mounting on railway rolling stock (locomotives and cars). The SHARK 14, SHARK 16 and SHARK PCT16 are unidirectional, while the SHARK DUAL is bi-directional.

The SHARK antennas are suited for direct mounting onto metal-bodied railway rolling stock.

## 4. Installation

### 4.1. Environmental rating

Fluidmesh SHARK-series antennas are designed to railway standard EN50155. As such, they are designed to withstand adverse environmental conditions up to and including those specified by ingress protection (IP) rating IP67.

### 4.2. General installation practices to follow and avoid

When installing and adjusting an antenna in any scenario that uses Fluidmesh hardware, install and adjust the antenna according to the following recommendations.



#### NOTE

Not all recommendations listed in this section will apply to all antennas.

- Make sure the antenna and its transceiver unit are properly grounded (earthed) to prevent the antenna and transceiver from accumulating static electricity or producing sparks. If the antenna and/or transceiver are mounted in a flammable environment, stray sparks could ignite the flammable materials, causing an explosion and/or flash fire.
- Wherever practically possible, keep all antenna cabling runs under 10 feet (three metres). Radio signals conducted through antenna cabling before being transmitted from an antenna suffer from a phenomenon called signal attenuation. The signal gradually dissipates along the length of the cable due to electrical resistance before being transmitted from the antenna, reducing signal amplitude.
- Do not bend or kink antenna cabling. Kinks and bends may cause breaks and/or narrow points in the cable's electrical conductor, resulting in degraded signal amplitude.
- Be sure to comply with the minimum and maximum co-location distances specified by Fluidmesh for each antenna type. This helps avoid co-location interference (in which the radio transmissions from two or more antennas partially cancel each other out).
- Note that during test and adjustment of stationary antennas, an antenna placement adjustment of between four and five feet (1.2m to 1.5m) may be needed.
- A signal quality test and adjustment must always be done during an installation to verify signal quality and amplitude. If the test and adjustment procedure is not done, the installation is at risk of under-performing due to poor line-of-sight and other factors.



- If applicable, avoid installing antennas inside audio loudspeaker enclosures. The proximity of a radio antenna to the metal in speaker bodies causes degraded performance due to radio reflections. In addition, the energy of radio (microwave) transmissions that strike metal is partially or completely dissipated as a flow of electrons, requiring higher transmission power to broadcast a viable signal. Non-metallic loudspeaker enclosures made of polycarbonate or other plastics, enclosures painted with non-metallic paint, and antennas mounted under or behind shrouds are all acceptable.


### 4.3. Contents of the kit

The antenna kit contains the following components:

#### 4.3.1. FM-SHARK

- 1x FM-SHARK series antenna.
- 1x EPDM mounting gasket.

### 4.4. Installing the antenna




**IMPORTANT**

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

#### 4.4.1. Installing a SHARK-series antenna

To install a SHARK-series antenna, do the following steps:

1. Decide where on the locomotive or train car the antenna must be mounted, taking access and line-of-sight between the antenna and trackside antennas into account.

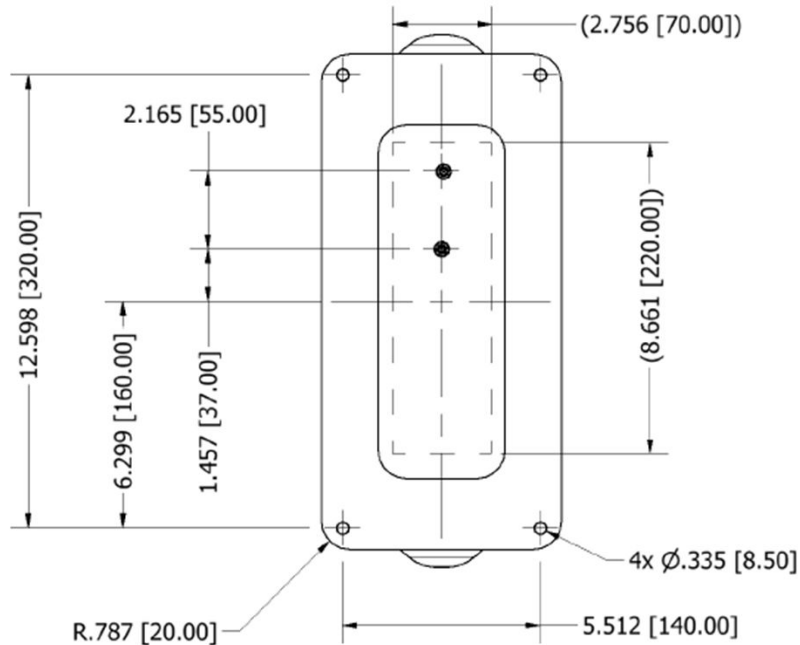


**NOTE**

As a general rule, SHARK antennas are usually installed on the first or last car of the train.

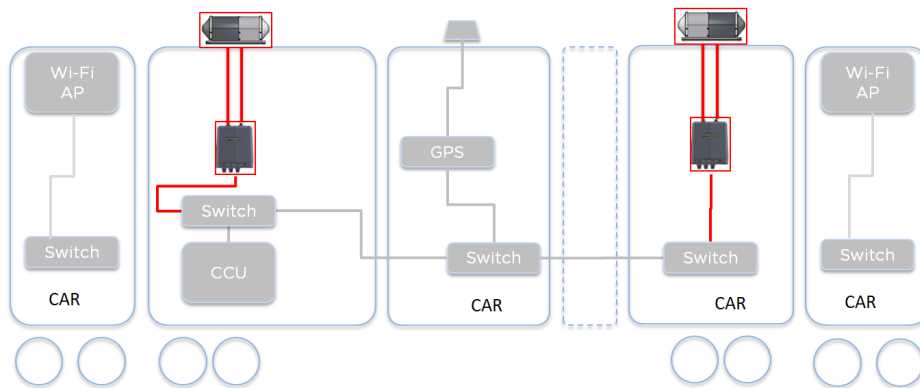
2. Orient the antenna correctly:
  - The antenna must be installed on a surface parallel to the surface of the Earth. As a general rule, SHARK antennas are usually installed on the roof of a train.
  - If a SHARK 14, SHARK 16 or SHARK PCT16 antenna is being installed, the antenna's radome must face *forward* if the antenna is mounted on the *first* car, and must face *rearward* if the antenna is mounted on the *last* car.

- If a SHARK DUAL antenna is being installed, the antenna radomes must face in the direction of train travel.
3. Using appropriate tools, cut a mounting cavity and four mounting holes that correspond to the antenna's mounting points and QMA connector locations (below).



4. Place the EPDM gasket over the mounting cavity.
5. Place the antenna securely over the EPDM gasket. Make sure the mounting holes in the base of the antenna align correctly with the mounting holes on the vehicle roof.
6. Place one flat M8 washer over each of the four mounting holes.
7. Place one M8 hexagonal screw in each mounting hole, from the inside of the vehicle.
8. Place one flat M8 washer over the threaded end of each hexagonal screw.
9. Screw a nut onto the threaded end of each hexagonal screw.
10. Fully tighten the nuts.

A typical 'single-antenna-per-radio' installation is configured as seen in the image below:



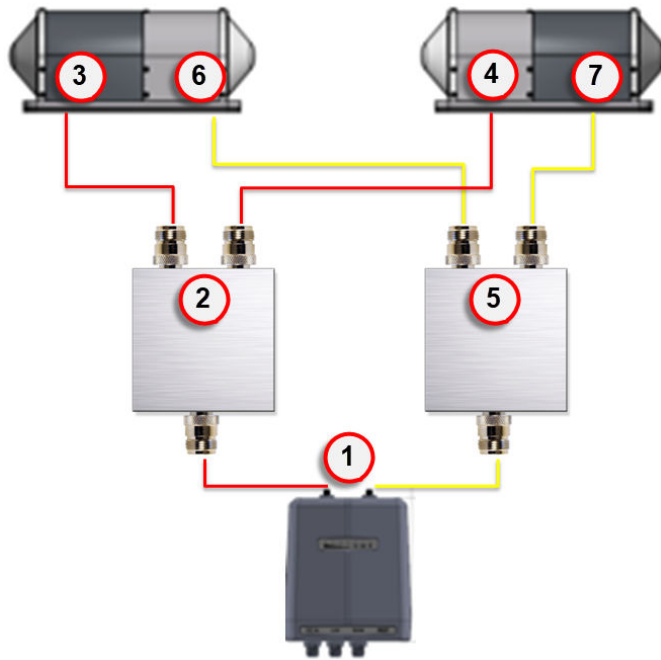
Connect a SHARK antenna to a Cisco 4200-series or Cisco 4500-series radio transceiver as part of a ‘single-antenna-per-radio’ installation by doing the following steps:

1. Connect the two QMA connectors on the radio to the two QMA connectors on the antenna, using shielded co-axial cables as specified in this section.
2. Screw the QMA male interface connectors of the antenna cables into the QMA female interface connectors of the antenna and the radio.

Alternatively, you can connect two SHARK antennas to a single Cisco 4200-series or Cisco 4500-series radio transceiver, as part of a ‘two-antenna-per-radio’ installation.

Connect two SHARK antennas to a single Cisco 4200-series or Cisco 4500-series radio transceiver by doing the following steps:

1. Connect the two QMA connectors on the transceiver unit (1, below) to the SIGNAL IN N-female connectors on the two signal splitter units.



2. Connect one SIGNAL OUT N-female connector on the first signal splitter unit (2, above) to a QMA connector on the first antenna (3, above).
3. Connect the remaining SIGNAL OUT N-female connector on the first signal splitter unit to a QMA connector on the second antenna (4, above).
4. Connect one SIGNAL OUT N-female connector on the second signal splitter unit (5, above) to the remaining QMA connector on the first antenna (6, above).
5. Connect the remaining SIGNAL OUT N-female connector on the second signal splitter unit to the remaining QMA connector on the second antenna (7, above).

## 5. Specifications

The table below contains the general specifications for the antenna.

### 5.1. SHARK-series antenna specifications

**Table 1. SHARK-14, SHARK-16, SHARK-PCT16 and SHARK DUAL specifications**

	<b>Dimensions (in millimetres)</b>	<b>Mass</b>	<b>Working frequency range</b>	<b>Gain</b>	<b>Polarization</b>
FM-SHARK-14	250 x 170 x 95.76	2.27 Kg (5 lbs)	4900 MHz to 5900 MHz	13 to 14 dBi	Dual slant 45°
FM-SHARK-16	376 x 165 x 160	3.9 Kg (8.5 lbs)	4900 MHz to 5900 MHz	16 dBi ± 0.5 dB	Dual slant 45°, linear
FM-SHARK-PCT16	376 x 165 x 160	3.9 Kg (8.5 lbs)	4900 MHz to 5900 MHz	16 dBi ± 0.5 dB	Dual slant 45°, linear
FM-SHARK DUAL	210 x 140 x 85	3.9 Kg (8.5 lbs)	4900 MHz to 5900 MHz	10 to 13 dBi	Dual slant 45°, linear

## 6. 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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This Agreement shall not be governed by the 1980 U.N. Convention on Contracts for the International Sale of Goods. Rather, this Agreement shall be governed by the laws of the State of Illinois, including its Uniform Commercial Code, without reference to conflicts of laws principles. You agree to the exclusive jurisdiction and venue of the State and Federal courts in Illinois, United States.

This Agreement is the entire agreement between you and Fluidmesh, and supersedes any other communications or advertising with respect to the Fluidmesh Firmware and accompanying documentation. If any provision of this Agreement is held invalid or unenforceable, such provision shall be revised to the extent necessary to cure the invalidity or unenforceability, and the remainder of the Agreement shall continue in full force and effect.

This Agreement and all documents, notices, evidence, reports, opinions and other documents given or to be given under this Agreement (collectively with this Agreement, 'Documents') are and will be written in the English language only. In the event of any inconsistency between any Document in the English language and any translation of it into another language, the English-language Document shall prevail. If you are acquiring the Fluidmesh Firmware on behalf of any part of the U.S. Government, the following provisions apply: The Fluidmesh Firmware and accompanying documentation are deemed to be 'commercial computer software' and 'commercial computer software documentation' respectively, pursuant to DFAR Section 227.7202 and FAR 12.212(b), as applicable. Any use, modification, reproduction, release, performance, display or disclosure of the Fluidmesh Firmware and/or the accompanying documentation by the U.S. Government or any of its agencies shall be governed solely by the terms of this Agreement and shall be prohibited except to the extent expressly permitted by the terms of this Agreement. Any technical data provided that is not covered by the above provisions is deemed to be 'technical data-commercial items' pursuant to DFAR Section 227.7015(a). Any use, modification, reproduction, release, performance, display or disclosure of such technical data shall be governed by the terms of DFAR Section 227.7015(b).

Fluidmesh is a trademark of Cisco Systems in the United States and worldwide.

## 8. Contact us

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