FIRST FRC Radio

VH-109 FRC Radio

Overview

The Vivid-Hosting VH-109 radio is the next generation FIRST FRC radio.

- Unfiltered power input capable
- Ruggedized for demanding FIRST FRC robots
- Configurable Passive Power over Ethernet outputs for powering downstream devices
- Based on WIFI2.4G 802.11b/g/n,WIFI6E 802.11ax for a modern, superior wireless experience

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🛠️ FCC/IC Notice

Overview

💡 Specifications

Feature	Value
Nominal Voltage	12V
Voltage Input Range	4.5V-19V
AC-DC Power Supply	ADS-12FG-12N 12012EPCU100-240VAC 50/60Hz 12.0V @ 1.0A Output
Battery Input	Designed for 12V SLA Batteries,e.g.: Energy’s (P/N NP18-12,NP18-12B,NP18-12BFR)MK Battery(P/N ES17-12)Duracell Ultra Battery (P/NDURA12-18NB)
WiFi Technology	WIFI2.4G WIFI6E
Fast Ethernet (100 Mbps) Ports w/Selectable Passive PoE	2
Fast Ethernet (100 Mbps) Ports w/Passive PoE Input	1
Gigabit Ethernet (1000 Mbps) Ports	1

Wireless

Feature	Value
Channel Width	802.11b/g/n20/n40 MHz 802.11ax 20, 40, 80, 160 MHz
Frequency (FCC/IC regulated operating areas)	WIFI2.4G: 2412~2462MHz WIFI 6E: 5945-7125 MHz
Frequency (CE regulated operating areas)	WIFI2.4G: 2412~2472MHz WIFI 6E: 5945-6425MHz
Output Power (AP Mode)	LPI Mode
Output Power (STA Mode)	/

💻 Ports

Ethernet Ports

Port Name	PoE Capable	Downstream Device	Port Speed
RIO	4.5-19V Input	NI roboRIO	10/100 Mbps
AUX1	Yes (Off by default)	Camera, Switch, etc.	10/100 Mbps
AUX2	Yes (Off by default)	Camera, Switch, etc.	10/100 Mbps
DS	No	Switch, Laptop, etc.	10/100/1000 Mbps


DS
AUX1


AUX2
RIO
12V
− +

Getting Started

⚙️ Usage

The VH-109 radio was designed for use in the FIRST robotics competition.

It can either be used as a wireless bridge, placed on your robot, connected to the robot controller or as an indoor wireless access point connected to your robot driver station.

By configuring the VH-109 radio as a wireless bridge, you'll be able to wirelessly connect your robot controller to the field side network connected to your robot driver station.

When configured as a **WIRELESS ACCESS POINT**, due to regulatory requirements, the VH-109 radio **cannot be powered using a battery source** and is for **indoor use only**. The device is regulated by the FCC LPI (Low Power Indoor) requirements when in this mode. At this time, the product is powered by AC power POE

Only when the VH-109 radio is configured as an **Indoor Clients** may it be powered using a battery.

🔨 Mounting your Radio

The radio should be mounted against a metal tube or plate.

> ⓘ It is recommended that teams mount against a metal tube/plate to act as a heatsink for the radio during extended operation.

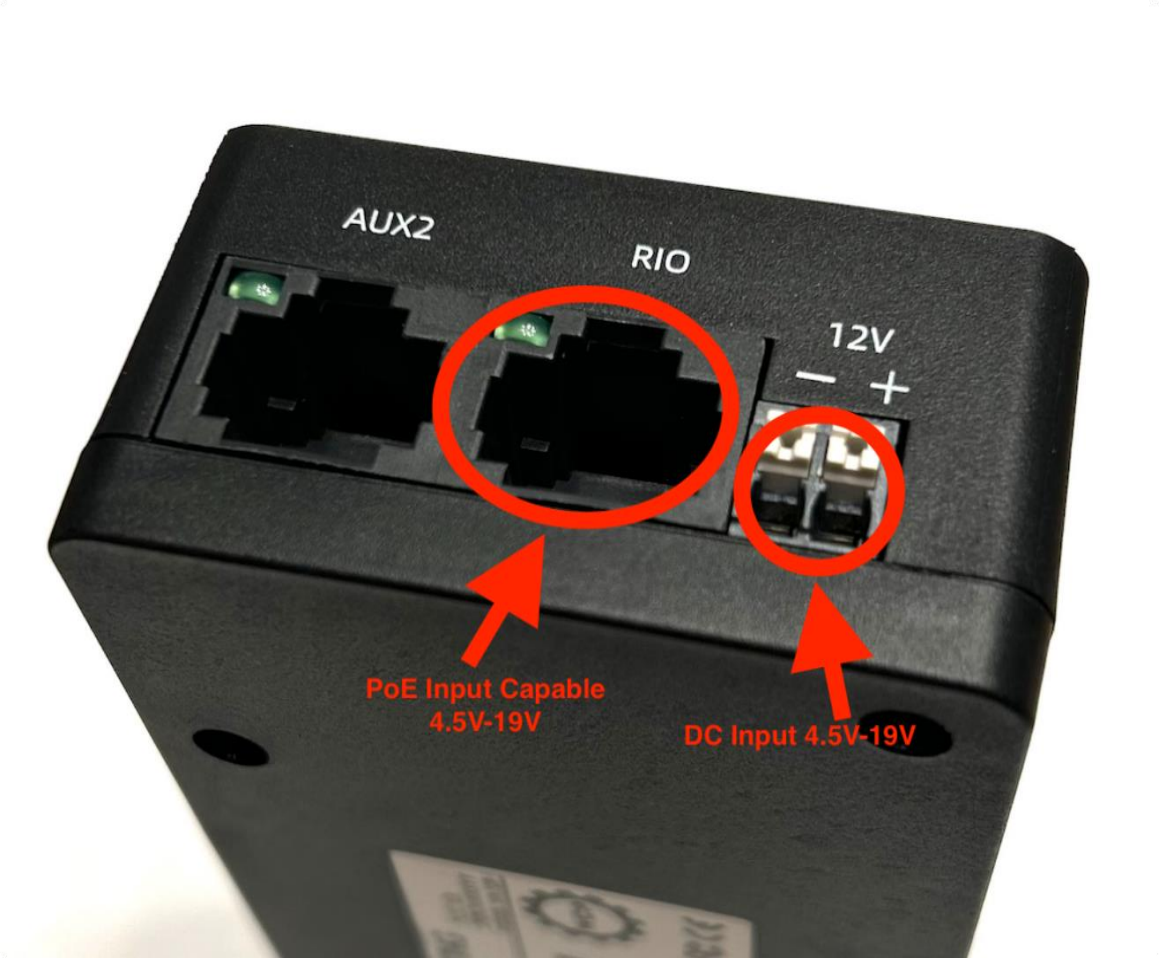
Zip tie notches are included in the event that teams opt out of using VHB or another adhesive to attach the radio to their robots.

📪 Wiring Your Radio

Powering your Radio

The VH-109 radio was designed to operate directly off battery voltage but is compatible with the sources of radio power for the OM5P radio. The radio can also be dual powered using both the 12V Weidmuller DC input or using Passive Power over Ethernet on the RIO port simultaneously however, the inputs need the SAME source and voltage.

> ⚠ When configured as a wireless access point, due to regulatory requirements, the VH-109 radio cannot be powered using a battery source. The device is regulated by the FCC LPI (Low Power Indoor) requirements when in this mode.
>
> When configured as a wireless access point, the device must be powered using an AC to DC adapter that is sold separately.



👩‍💻 Programming your Radio

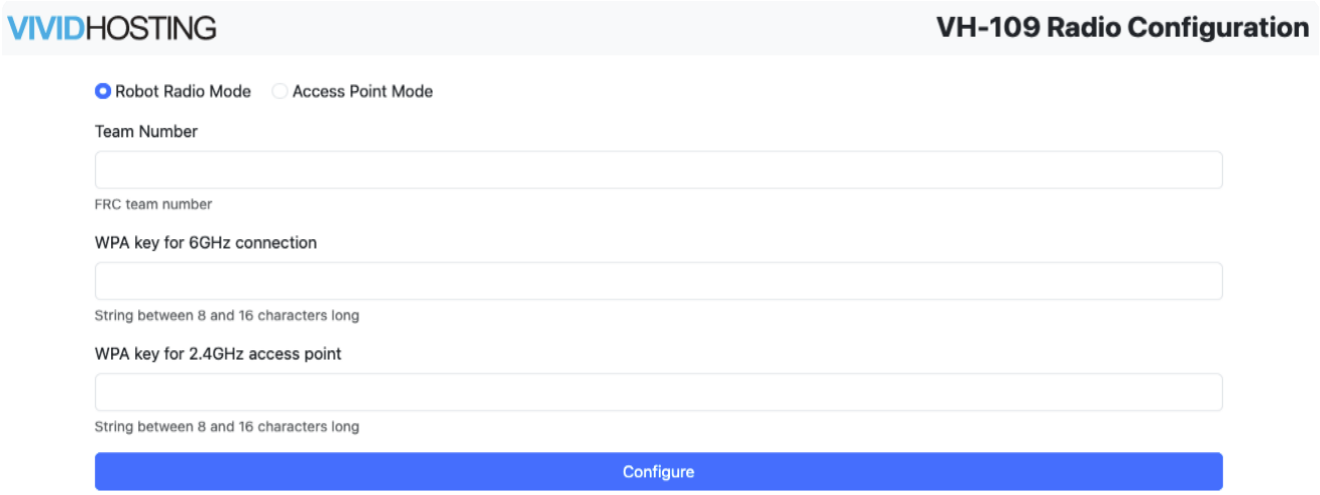
Configuring your computer

> ⓘ When at an official FIRST event, the Vivid-Hosting Radio Kiosk will be available for teams to easily program their radios with a GUI interface.

> ⓘ The configuring computer must have it's network interface configured with an IP address in the 192.168.69.0/24 subnet to reach the management IP of the VH-109 radio.
>
> For example, the network interface on your driver station laptop can be temporarily configured to:
>
> **IP Address**: 192.168.69.2
>
> **Subnet Mask**: 255.255.255.0
>
> **Gateway**: Leave Blank
>
> **DNS**: 192.168.69.1 or Leave Blank

Programming your Radio

Navigate to `http://192.168.69.1:8081/`



Team Bridge Mode

This is the default configuration for the VH-109 radio to act as a ROBOT RADIO for FRC competitions.

- Select "Robot Radio Mode"
- Enter the team number
- Enter the 6 GHz WPA/SAE key
- Enter the 2.4 GHz WPA/SAE key (See note below)

> When DIP switch #3 is in the ON position AND a valid connection to an 6GHz 802.11ax Wi-Fi access point is not present, the radio will simultaneously broadcast as a 2.4GHz 802.11ax Wi-Fi access point with the SSID of "FRC-XXYY" where XXYY is the programmed team number.
>
> Once the radio successfully connects to a 6GHz 802.11ax Wi-Fi access point, the 2.4Ghz 802.11ax Wi-Fi access point will shut down until the device is power cycled.

Team Access Point Mode

You can also configure your radio to act as a wireless access point, similar to what's used on a competition FIRST field with FMS.

- Select "Access Point Mode"
- Enter the team number
- Enter the 6 GHz WPA/SAE key
- Select a wireless channel

> When configured as a **WIRELESS ACCESS POINT**, due to regulatory requirements, the VH-109 radio **cannot be powered using a battery source** and is for **indoor use only**. The device is regulated by the FCC LPI (Low Power Indoor) requirements when in this mode.
>
> Only when the VH-109 radio is configured as a indoor client device may it be powered using a battery.

Programming your Radio (Advanced)

REST API

A RESTful API interface is included to place the radio in "Team Bridge" or "Team Access Point" mode.

Configuring as a Bridge (TEAM_ROBOT_RADIO)

```
curl -XPOST http://192.168.69.1:8081/configuration -d '{"mode":"TEAM_ROBOT_RADIO",   "teamNumbe
```

By placing the radio into Bridge or "TEAM_ROBOT_RADIO" mode, the radio will be configured to connect to an 802.11ax Wi-Fi 6E access point with the corresponding SSID of the team number listed.

JSON Key	Description	Value
mode	Sets mode to bridge/robot radio	"TEAM_ROBOT_RADIO"
teamNumber	FRC team number	Decimal
wpaKey6	SAE password for the 6GHz Wi-Fi connection	String between 8 and 16 characters long
wpaKey24	SAE password for the 2.4GHz Wi-Fi access point	String between 8 and 16 characters long

When DIP switch #3 is in the ON position AND a valid connection to an 6GHz 802.11ax Wi-Fi access point is not present, the radio will simultaneously broadcast as a 2.4GHz 802.11ax Wi-Fi access point with the SSID of "FRC-XXYY" where XXYY is the programmed team number.

Once the radio successfully connects to a 6GHz 802.11ax Wi-Fi access point, the 2.4Ghz 802.11ax Wi-Fi access point will shut down until the device is power cycled.

Configuring as an Access Point (TEAM_ROBOT_RADIO)

```
curl -XPOST http://192.168.69.1:8081/configuration -d '{"mode":"TEAM_ROBOT_RADIO",   "teamNumb
```

By placing the radio into Access Point or "TEAM_ACCESS_POINT" mode, the radio will be configured to broadcast as an 802.11ax Wi-Fi 6E access point with the corresponding SSID of the team number listed using the SAE key provided.

JSON Key	Description	Value
mode	Sets mode to Access Point	"TEAM_ACCESS_POINT"
teamNumber	FRC team number	Decimal
wpaKey6	SAE password for the 6GHz Wi-Fi connection	String between 7 and 16 characters long
channel	Selects a Wi-Fi 6E 20 MHz channel	Decimal

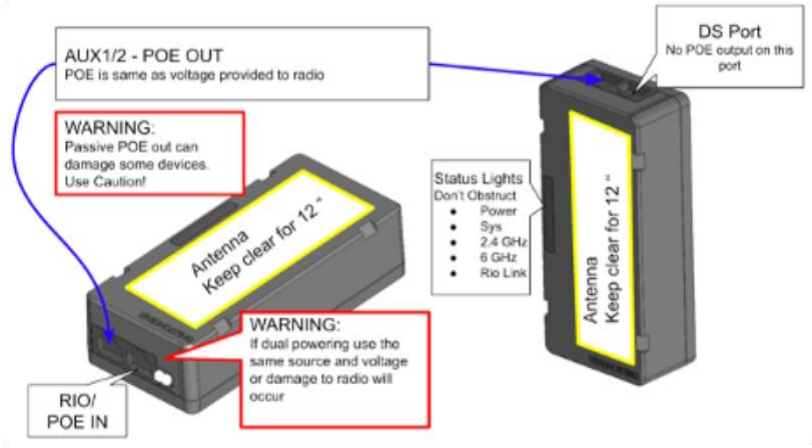
⚠ When configured as a **WIRELESS ACCESS POINT**, due to regulatory requirements, the VH-109 radio **cannot be powered using a battery source** and is for **indoor use only**. The device is regulated by the FCC LPI (Low Power Indoor) requirements when in this mode.

Only when the VH-109 radio is configured as a indoor client device may it be powered usinga battery.

Passive Power over Ethernet (PoE) for Downstream Devices

Powering Robot Devices

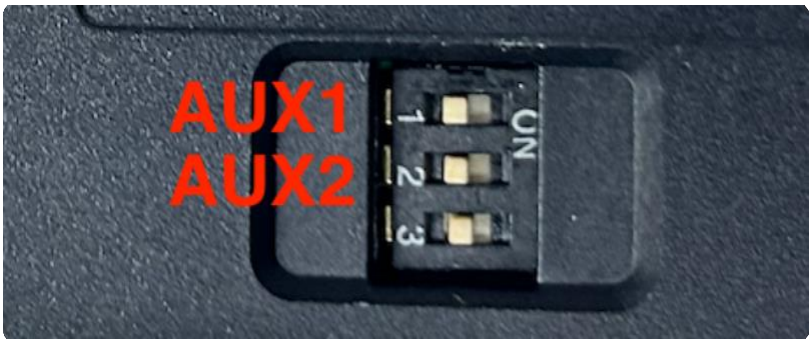
The VH-109 radio provides POE passthrough to two ports labeled AUX1 and AUX2. Please use caution when using these ports as they can potentially have energized DC pins, and some devices may suffer damage if not designed for Passive POE injection.



By enabling the PoE output using the switches on the bottom of the radio, the corresponding ethernet port will be energized with the same voltage level provided by either the PoE input on the RIO port or the 12V Weidmuller input.

Power over Ethernet is controlled using the DIP switches on the bottom face of the radio.

Switch Number	Port
1	AUX1
2	AUX2



Regulatory

🛠️ FCC/IC Notice

Regulatory Entity	ID/Submission
FCC	2BBOU10923
IC	31699-VH109
CE	

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

> ⚠ FCC Warning: Any Changes or modifications not expressly approved by the Vivid-Hosting, LLC. could void the user's authority to operate the equipment.

> ℹ 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 this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by 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.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

The device user manual must contain the following information. The user manual must be filed as an exhibit in the application filing.

Indoor Devices (6ID) operating in the 5.925-7.125 GHz band

FCC regulations restrict the operation of this device to indoor use only.

The operation of this device is prohibited on oil platforms, cars, trains, boats, and aircraft, except that operation of this device is permitted in large aircraft while flying above 10,000 feet in the 5.925-6.425 GHz band.

Operation of transmitters in the 5.925-7.125 GHz band is prohibited for control of or communications with unmanned aircraft systems.

Indoor Clients (6XD) operating in the 5.925-7.125 GHz band

The device user manual must contain the following information. The user manual must be filed as an exhibit in the application filing.

Operation of transmitters in the 5.925-7.125 GHz band is prohibited for control of or communications with unmanned aircraft systems.

IC warning

- English:

This device complies with Industry Canada licence-exempt RSS standard(s).

Operation is subject to the following two conditions: (1) This device may not cause interference, and (2) This device must accept any interference, including interference that may cause undesired operation of the device.

- French:

L'émetteur/récepteur exempt de licence contenu dans 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'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This equipment complies with IC RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20cm de distance entre la source de rayonnement et votre corps.

Devices shall not be used for control of or communications with unmanned aircraft systems.

Operation shall be limited to indoor use only.

Operation on oil platforms, automobiles, trains, maritime vessels and aircraft shall be prohibited except for on large aircraft flying above 3,048 m (10,000 ft).

CE-RED Notice

CE Requirements:

• (Simple EU declaration of conformity) declares that the radio equipment types in compliance with the essential requirements and other relevant provisions of RED Directive 2014/53/EU.

Frequency Bands and Power

The frequency bands and transmitting power (radiated and/or conducted) nominal limits applicable to this radio equipment are as follows:

Wi-Fi 2412-2472MHz: 20dBm.

Wi-Fi 5945-6425MHz: 23dBm.

Restriction Information

This product can be used in EU countries and regions, including: Belgium (BE), Bulgaria (BG), Czech Republic (CZ),Denmark (DK), Germany (DE), Estonia (EE), Ireland (IE), Greece (EL), Spain (ES), France (FR), Croatia (HR), Italy(IT), Cyprus (CY), Latvia (LV), Lithuania (LT), Luxembourg (LU), Hungary (HU), Malta (MT), Netherlands (NL), Austria(AT), Poland (PL), Portugal (PT), Romania (RO), Slovenia (SI), Slovakia (SK), Finland (FI), Sweden (SE) and United Kingdom (UK).

For the warning information of the frequency restriction, please refer to the package or manual section.

AT	BE	BG	CH	CY	CZ	DE	DK
EE	EL	ES	FI	FR	HR	HU	IE
IS	IT	LI	LT	LU	LV	MT	NL
NO	PL	PT	RO	SE	SI	SK	UK(NI)

RF Exposure Statement

The distance between user and products should be no less than 20cm.

Restricted to indoor use only (including trains where metal coated windows are fitted and aircraft) Outdoor use (including in road vehicles) is not permitted.

An LPI access point or bridge that is supplied power from a wired connection, has an integrated antenna and is not battery powered.

An LPI client device is a device that is connected to an LPI access point or another LPI client device and may or may not be battery powered.