

# WFD-46 Wi-Fi/DCC Booster Module with Output Voltage Adjustment

# Operating Manual

This document is online at <http://www.wifitrax.com/manuals/WFD-46/WFD-46-Manual.pdf>.

Please see our website for information on our limited warranty.

**WifiTrax Model Science**



[www.wifitrax.com](http://www.wifitrax.com)

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# **WFD-46 Wi-Fi/DCC Booster Module Operating Manual**

This product is not a toy. Keep away from children. It is not suitable for use by persons under 14 years of age.  
Warning: This product contains chemicals known to the state of California to cause cancer, birth defects or other reproductive harm.

# WFD-46 Wi-Fi/DCC Booster Module Operating Manual

## Version History

Version	Changes
1.0	First Release, Version 1 Firmware

# WFD-46 Wi-Fi/DCC Booster Module Operating Manual

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# WFD-46 Wi-Fi/DCC Booster Module Operating Manual

## Scope of this Document

This document describes detailed use of the WFD-46 Wi-Fi/DCC Booster Module. For a simple starting guide, please see the leaflet at <http://www.wifitrax.com/appNotes/quickStart/WFD-46-Quick-Start.pdf>.

This manual applies to firmware version 1, i.e., version numbers 1.X.X.

# WFD-46 Wi-Fi/DCC Booster Module Operating Manual

## What does WFD-46 Wi-Fi/DCC Booster Do?

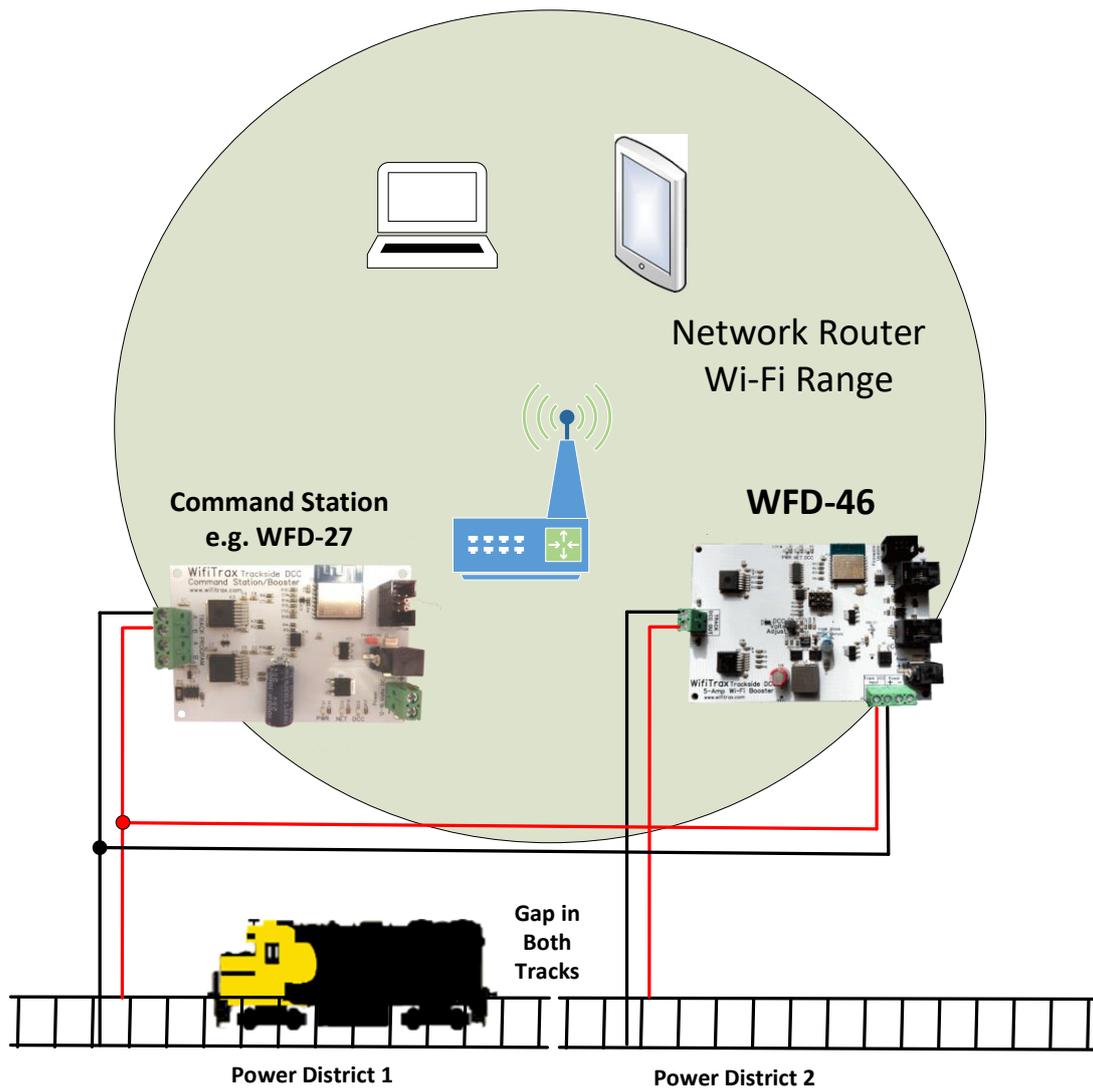


Figure 1 WFD-46 in Context. A WFD-27 Command Station/Booster is used to Supply a DCC Signal to the WFD-46 and also Supplies DCC to the First Power District

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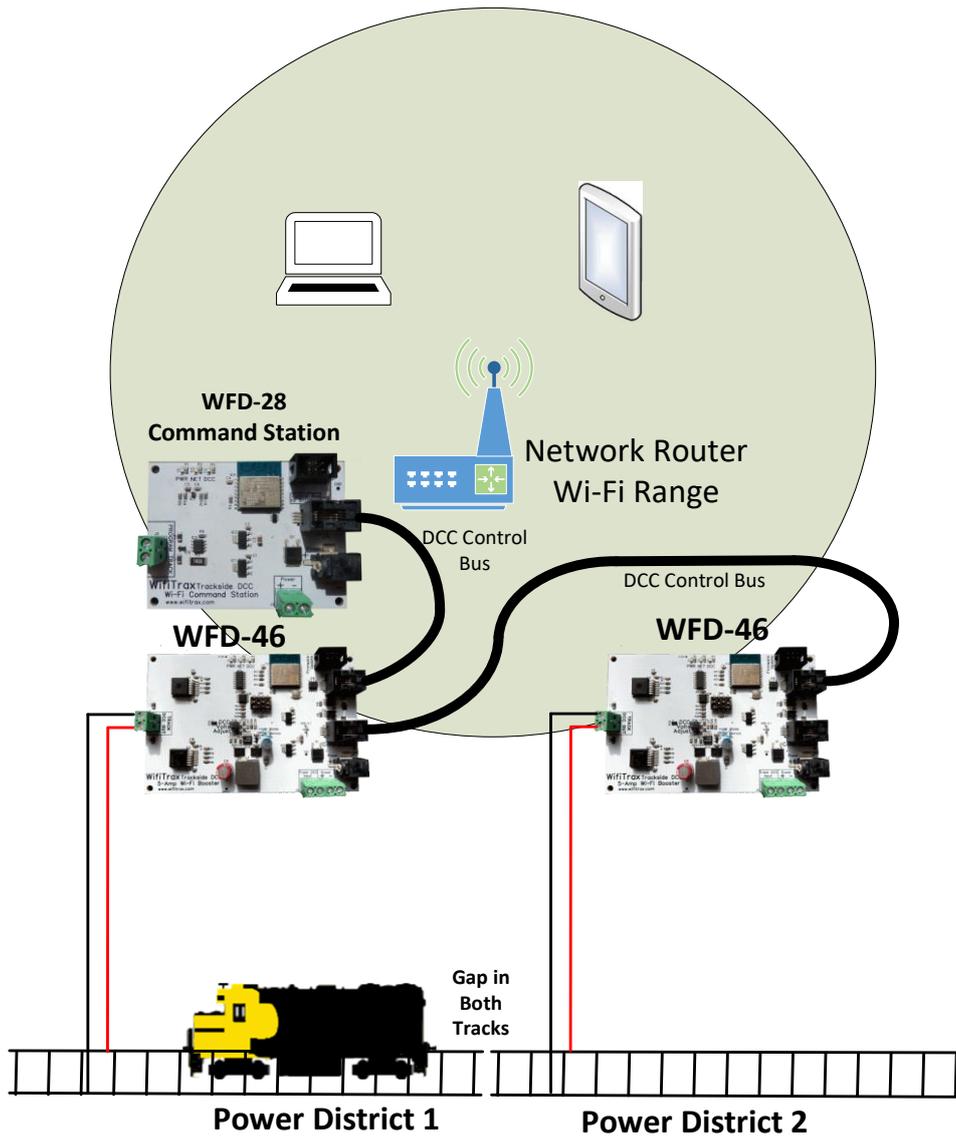


Figure 2 WFD-46 in Context. A WFD-28 Command Station is used to Supply a DCC Signal to two WFD-46 via a DCC Control Bus Cable. Each WFD-46 Supplies a Separate Power District

The WFD-46 Wi-Fi/DCC Booster is a 5 Amp/3 Amp DCC Booster that receives a DCC signal from a DCC Command Station and delivers high-power DCC Power to a Power District consisting of a section of track isolated by a gap in both rails. Here is a summary of its features:

- 5 Amp continuous capability
- Variable DCC Output Voltage 9.8 Volts – 20 Volts in two ranges
- 3 Amp or 5 Amp Overcurrent Protection
- Input from Track DCC or DCC Control Bus
- Auto-reversing for return loops, wye etc.
- Wi-Fi Monitoring of Status
- DCC Control Bus Loop-through for Effectively Unlimited Chaining

# WFD-46 Wi-Fi/DCC Booster Module Operating Manual

Switch	Function	On	Off	Remarks
1	Output Voltage Range	Range 1 9.8V to 15V PP	Range 2 13V to 20V PP	Range 1 needs 18V Input Range 2 needs 24V Input
2	Overcurrent Shutdown	3 Amp	6 Amp	
3	DCC Input Source	Control Bus RJ-11 Socket	Track DCC Terminals	
4	Auto Reverse Enable	Disabled	Enabled	

Table 1 WFD-46 DIP Switch Settings

The output bipolar DCC to the track, rated at 5 Amp continuous can be adjusted in two ranges:

**Range 1:** 9.8 Volts to 15 Volts Peak-Peak with an 18 Volt DC input

**Range 2:** 13 Volts to 20 Volts Peak-Peak with a 20 Volt DC input

The range is selected using a dip switch number 1 on the module as Table 1.

Short circuit protection is provided and may be set at 3 Amp or 5 Amp by dipswitch 2 on the module as Table 1. The booster will cut off power when the current drawn goes significantly above that level.

The booster may receive its input DCC signal either from track bipolar DCC or a DCC Control Bus. This is specified by Dip Switch 3 in Table 1.

Figure 1 shows it receiving its input signal from a WFD-27 Wi-Fi/DCC Command Station Booster. In this configuration, the WFD-27 provides DCC track power to one power district and the WFD-46 supplies DCC track power to another. Both are protected independently against short circuits on the track.

Figure 2 shows a WFD-28 Wi-Fi/DCC Command Station Only providing input DCC signal via a control bus to two WFD-46 which each provide DCC track power to a separate power district.

When Auto-reverse is enabled by Dip Switch 1 in Table 1, the DCC output to the track will reverse very quickly as soon as a locomotive causes a short by bridging one or both of the gaps between two blocks or power districts with opposite polarity. Once one of the blocks has switched the short will no longer exist and the loco will proceed. Note that if two adjacent districts are powered by WFD-46, only one will normally reverse but it will be indeterminate. To be sure which one reverses, you can disable auto reversing on one of the WFD-46.

You can access the Web Pages of each WFD-46 to adjust certain settings or view their status. Consult the section "Using the WFD-46 Web Pages" for details.

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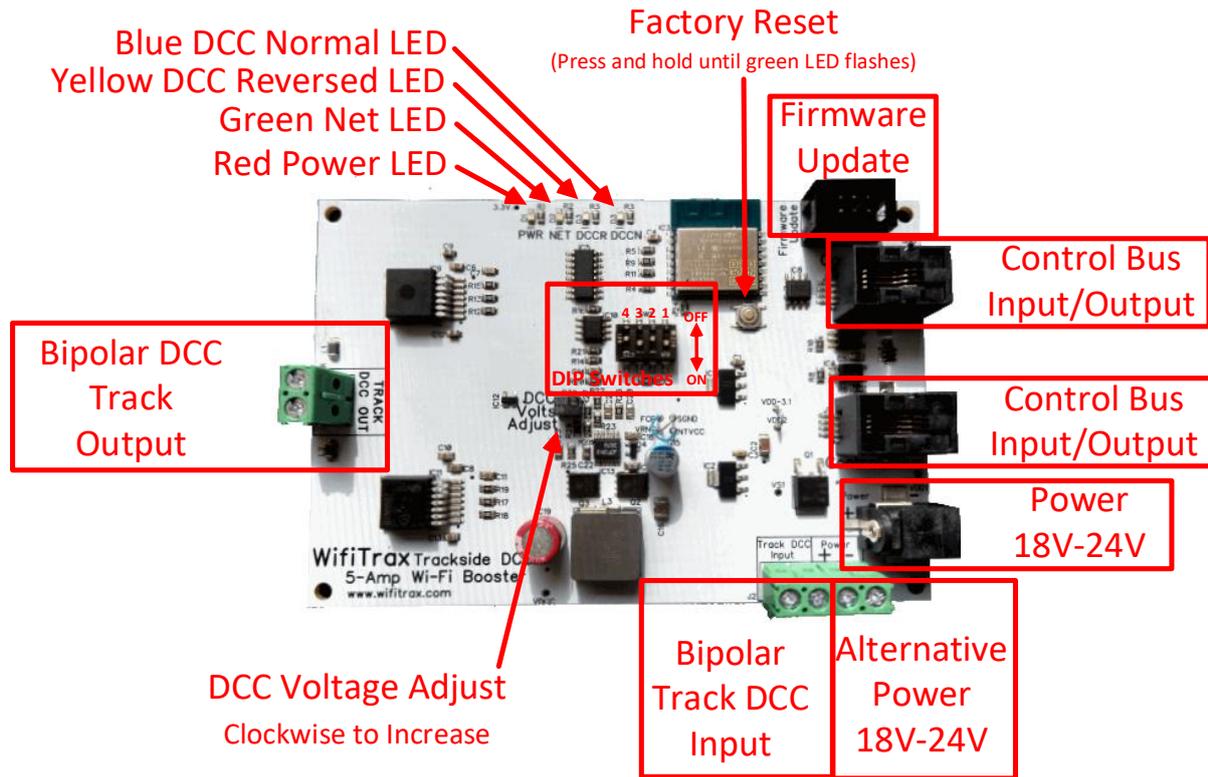


Figure 3 Connections, switches, LEDs etc. on the WFD-46

Figure 3 shows the WFD-46 module with its connectors labelled.

There is a pair of screw connectors at left that provide bipolar track DCC output to power the section of track controlled by the booster.

DCC Input may be provided using one or other of the Control Bus Input/Outputs, the other then being available to loop on to another WFD-46 module.

Alternatively, DCC input may be provided using the two screw terminals near the bottom right, marked Bipolar Track DCC Input. To select one or the other use DIP Switch 3 as Table 1. When DCC Input is taken from the Bipolar Track DCC Input, both of the Control Bus Sockets act as outputs than can be connected to the Control Bus inputs of another WFD-46 module.

Power between 18V and 24V DC can be provided using the Power Barrel Connector Socket, in which case the Alternative Power Screw Terminals are available as Power Output to another module. Otherwise, the Alternative Power terminals can be used as input power to the module. The correct polarity must be observed, but the module is protected against accidental reversal.

The 6-Pin connector at the top right is used for firmware update via a Wifitrax FWA-20 module and the Wifitrax Workshop software for Windows.

The Factory Reset button will reset the module to its factory default settings when pressed and held for 8-10 seconds. The green LED will flash rapidly when reset has been started. All settings will revert to factory default and any home net settings will be lost.

The DIP Switches in the middle are described in Table 1.

Turn the Voltage Adjust screw clockwise to increase the output voltage and counter-clockwise to decrease it.

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The LEDs at the top are:

- (1) Red LED - Power: Lights whenever power is applied to the module.
- (2) Green LED – Network: Flashes when the module receives Wi-Fi Network Traffic. Lights continuously when the module is connected to a home network router and flashes briefly off when module receives traffic.
- (3) Yellow LED – DCC: Lights continuously when a valid DCC input is present at the module and the output is reversed.
- (4) Blue LED – DCC: Lights continuously when a valid DCC input is present at the module and the output is not reversed. Flashed rapidly when a short has been detected and the track output is shut down. Flashes slowly when the voltage of the power input is not adequate to provide the required output voltage

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## Let's get Started!

### Installing your new WFD-46 on Your Layout

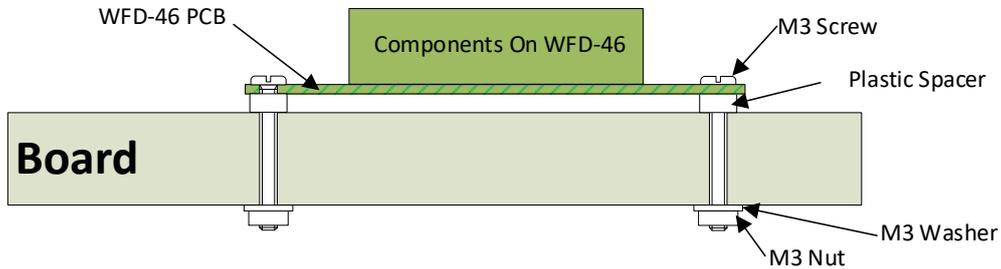


Figure 4 Mounting the WFD-46 on a Baseboard

Mount the WFD-46 module on a convenient board on your layout using the mounting kit provided. You may also mount it inside a suitable plastic box. Do not use a metal box as this will affect the Wi-Fi signal.

**It is most important that the module never comes into contact with any metal objects or any power such as your track! The electronics uses 3.3 Volts provided by an on-board voltage stabilizer and contact with any higher voltages will destroy it.**

All the WFD-46 capability can be used without using its Wi-Fi features, but connecting to its Wi-Fi access point provides useful information about its performance on your layout. These Wi-Fi features are described in Section “Using the WFD-46 Web Pages” on page 17.

### Usage Scenarios of WFD-46

The WFD-46 provides a single output of Bipolar DCC to the track exactly like any other DCC Booster. It does not contain a DCC Command Station so you cannot use it alone to control trains; instead, you must supply an input DCC signal from a DCC Command Station and that command station generates the commands to locomotives and accessories. That signal can be provided as Bipolar Track DCC or as a DCC Control Bus.

The WFD-46 also provides a DCC Control Bus output that can be used as the input to other WFD-46 modules.

It is the way these inputs and outputs are connected that scenarios the context of the WFD-46, that is, the way it fits into the DCC system controlling your layout.

In this Getting Started section, we will consider two common contexts:

- (1) One DCC Power District using one WFD-46 with a WFD-28 Wi-Fi Command Station,
- (2) Two DCC Power Districts using one WFD-46 with a WFD-27 Wi-Fi Command Station/Booster.

If you already have a WFD-27 and are adding a Booster, use scenario (2).

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## Getting Started with a WFD-28 Wi-Fi Command Station

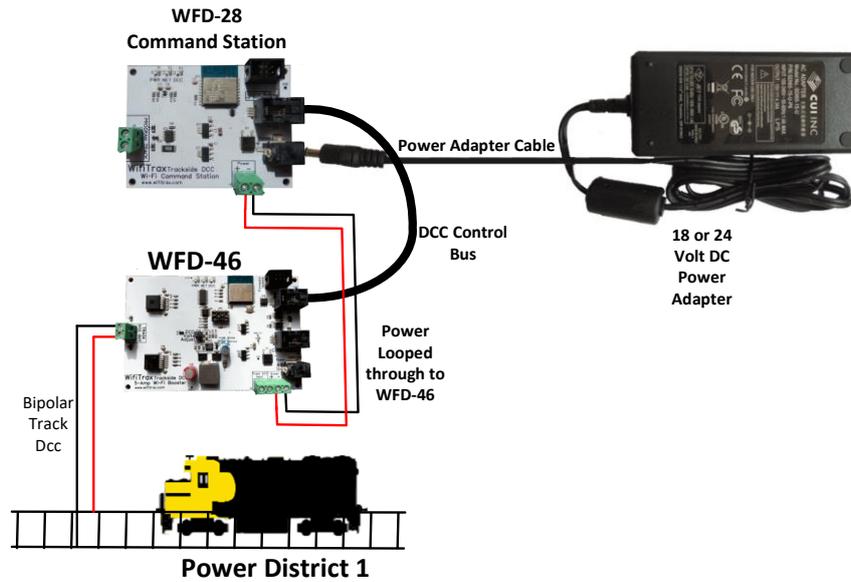


Figure 5 Connecting a WFD-46 to a WFD-28 Wi-Fi Command Station

Here we suppose you have bought both a WFD-28 Wi-Fi Command Station and a WFD-46 Wi-Fi Booster, You've already mounted them on your layout and want to connect them up and get started. Figure 5 shows how to connect these up and the steps are below:

- (1) Connect a Power Adapter to the WFD-28 Command Station. Both the WFD-28 and the WFD-46 (the Command Station and the Booster) need power. The power adapter that you select depends on the voltage and current requirements of your layout. 14 Volts is usually considered a suitable peak to peak voltage for DCC used on HO locomotives. The WFD-46 has a voltage adjustment which is set to 14 Volts on leaving the factory. An 18 Volt power adapter is recommended with at least 5 Amp capacity.
- (2) Connect power "looped-through" from the Command Station to the Booster. Use the Alternative Power screw terminals as a power Output to supply the WFD-46 Booster. **Make sure that you observe the correct polarity.** The WFD-46 Booster is protected against power reversal but it is best not to rely on it. The module will not work in a power-reversed situation.
- (3) Use a Command Bus cable to connect the DCC Command Bus output from the WFD-44 Command Station to one of the Command Bus inputs on the WFD-46 Booster. The Command Bus cable uses an RJ9 or RJ10 (4P4C) connector at each end. The cables should be "Straight-through", that is not reversed. You can buy DCC Control Bus cables from various DCC manufactures such as NCE, you can make your own, or you can order one from Wifitrax.
- (4) Connect the Track Output from the WFD-46 Booster to your track. It does not matter which way around but it is a good idea to adopt a convention and stick to it when you add more boosters. That way, all the power districts will be in-phase unless you reverse on using Auto-Reverse or manually using the Wi-Fi Web Pages.
- (5) Check the DIP Switch settings on your WFD-46 Booster (See Table 1 for details). It is recommended that the initial settings for simple, single district operation is as Table 2.
- (6) Check all your connections, place a locomotive on the track with a known DCC address and turn on power.

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(7) Consult the Quick Start Guide for WFD-28 or the WFD-28 Manual to beginning running trains.

Switch	Function	Recommended Setting	Remarks
1	Output Voltage Range	On	Range 1: 14 Volts Output
2	Overcurrent Shutdown	On	3 Amp Shutdown
3	DCC Input Source	On	Control Bus Input
4	Auto Reverse Enable	On	Auto Reverse Disabled

Table 2 WFD-46 DIP Switch Settings for Simple Single Power District Operation

## Getting Started with a WFD-27 Wi-Fi Command Station/Booster

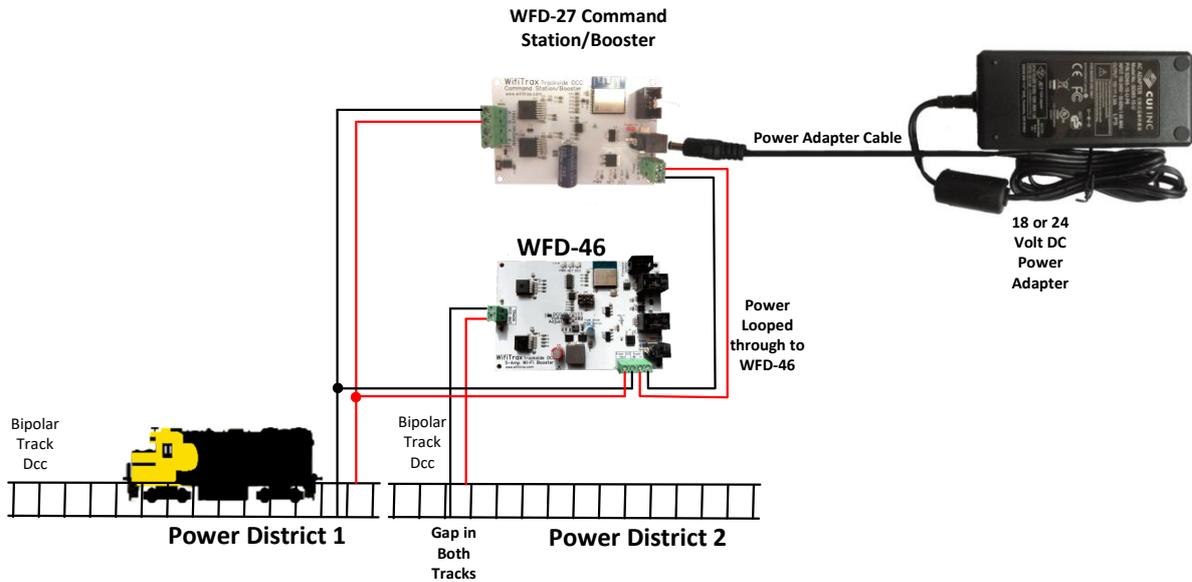


Figure 6 Connecting a WFD-46 to a WFD-27 Wi-Fi Command Station/Booster

Here we suppose you already have a WFD-27 Wi-Fi Command Station/Booster and are adding a WFD-46 Wi-Fi Booster, You've already mounted them on your layout and want to connect them up and get started. Figure 5 shows how to connect these up and the steps are below:

- (1) Connect a Power Adapter to the WFD-27 Command Station/Booster. Both the WFD-27 and the WFD-46 (the Command Station and the Booster) need power. The power adapter that you select depends on the voltage and current requirements of your layout. 14 Volts is usually considered a suitable peak to peak voltage for DCC used on HO locomotives. The WFD-46 has a voltage adjustment which is set to 14 Volts on leaving the factory. An 18 Volt power adapter is recommended with at least 5 Amp capacity. The WFD-27 does not have adjustable voltage. Usually the WFD-27 output voltage is about 1 volt below its supply voltage.
- (2) Connect power "looped-through" from the Command Station/Booster to the Booster. Use the Alternative Power screw terminals as a power Output from the WFD-27 to supply the WFD-46 Booster. **Make sure that you observe the correct polarity.** The WFD-46 Booster is protected against power reversal but it is best not to rely on it. The module will not work in a power-reversed situation.
- (3) Connect the Track Output from the WFD-27 Command Station/Booster to your track. It does not matter which way around.

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- (4) Also connect the Track Output from the WFD-27 to the Track DCC Input screw terminals on the WFD-46.
- (5) Connect the Track Output from the WFD-46 Booster to your track. It does not matter which way around but it is a good idea to adopt a convention and stick to it when you add more boosters. That way, all the power districts will be in-phase unless you reverse on using Auto-Reverse or manually using the Wi-Fi Web Pages.
- (6) Check the DIP Switch settings on your WFD-46 Booster (See Table 1 for details). It is recommended that the initial settings for simple, single district operation is as Table 3. Note that the DCC Input Source is set to Track DCC Terminals and the Auto-Reverse is enabled. This will allow the WFD-46 to set its output polarity correctly when a locomotive bridges the gaps at the junction between power districts.
- (7) Check all your connections, place a locomotive on the track with a known DCC address and turn on power.
- (8) Consult the Quick Start Guide for WFD-27 or the WFD-27 Manual to beginning running trains.

Switch	Function	Recommended Setting	Remarks
1	Output Voltage Range	On	Range 1: 14 Volts Output
2	Overcurrent Shutdown	On	3 Amp Shutdown
3	DCC Input Source	Off	Track DCC Terminals
4	Auto Reverse Enable	Off	Auto Reverse Enabled

Table 3 WFD-46 DIP Switch Settings for Dual District Operation with a WFD-27 Command Station/Booster

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## Using the WFD-46 Web Pages

The WFD-46 provides many features which are made available via web pages that you can access with a browser.

### Accessing the WFD-46 Setup Web Pages using a Web Browser

#### Setup Advanced Features using a Web Browser

On your hand-held device or computer open a browser such as in Table 4.

Device	Operating System	Browser Options
iPhone, iPad	IOS	Safari
Android Tablet or Phone	Android	Chrome
Windows Computer	Windows XP, 7, 8, 10,11	Internet Explorer, Edge, Chrome, etc.

Table 4 Web Browsers available on different platforms

- (1) If you are working in Direct Mode, connect your device to the Wi-Fi Access Point of your WFD-46, that is wftrx\_WFD46\_1\_XXXXXXX\_7, where XXXXXXXX is the 8-digit serial number. If you are working in Home Net mode connect your device to your home net.
- (2) Type the IP Address of the WFD-46 into the Address Bar of the browser.
  - a. In Direct Mode type 192.168.7.1 and hit the enter key or “Go” button (the http:// may appear automatically. Do NOT use “https” (the WFD-46 does not support secure sockets).
  - b. In Home Net mode, type the IP Address that was assigned by your router and hit the enter key. Please see the section “Tips to Manage your Home Network” on page 29 to see how to find this out.

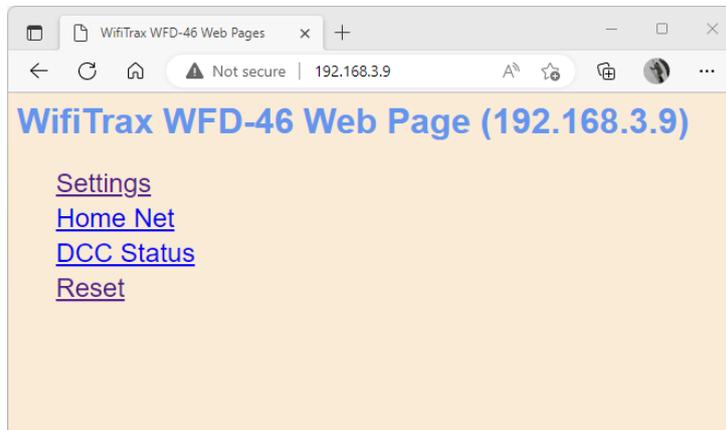


Figure 7 The WFD-46 Web Setup Main Menu

- (3) You should now see the Web Setup Main Menu as in Figure 7. You can click or tap on any of the headings in the menu to access the setup for that feature.

### General Settings Web Page

To modify General Settings, tap the “Settings” heading in Figure 7.

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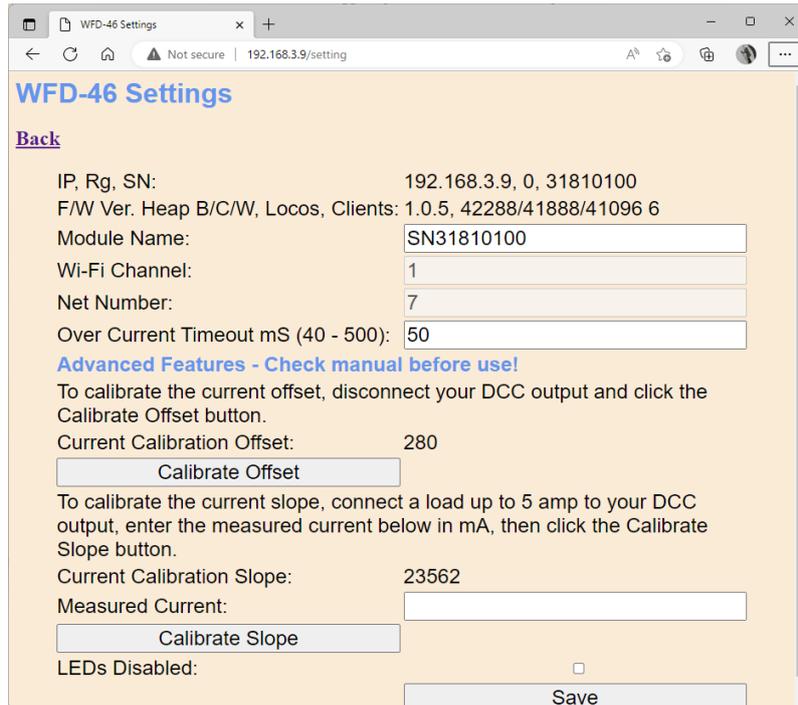


Figure 8 The WFD-46 General Settings Web Page

The first line contains the IP address (IP), the Region Code (Rg) and the Serial Number (SN)

## IP Address

If you are working in direct mode this will display 192.168.7.1. If you are in Home-Net mode it will display the IP Address assigned to the module by your router. You cannot change this from the Settings page, but you should keep a note of it since it is needed to access these Web Pages. Better still add it to your browser favourites and consider setting an IP Address Reservation in your router..

## Region Code

This will be 0 for all regions other than the Americas or 1 for North and South America. In the Americas only Wi-Fi channels 1 – 11 are allowed whereas in the rest of the world 1 – 13 are permitted, both by law and by the firmware.

## Serial Number

This is a unique number for your particular module. You may be asked for this if you request help or report a problem to WifiTrax.

The second line shows Firmware Version (F/W Ver.), Heap space Maximum/Current/Minimum over a period of a minute and a reset count.

## Firmware Version

This is the version of the WFD-46 firmware installed at the factory. You cannot change this but if you ask for WifiTrax support, you may be asked for it. You can upgrade your firmware using WifiTrax Workshop and the FWA-20 Workshop Adapter Module.

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## Module Name

This defaults to the value SNXXXXXXXX where XXXXXXXX is the 8-digit serial number. You can change this to a name up to 10 characters long which cannot include spaces. Type the name you want in the text box (such as “Booster1”) and tap Save.

## Wi-Fi Channel

This is the Wi-Fi channel in the 2.4GHz Wi-Fi band that the WFD-46 will use only when operating in Direct Mode. It will have no effect in Home Net mode as the channel will be determined by your router. You can set the channel to a value from 1 to 13, (1 to 11 in the Americas) and the default value is 1 after a factory reset. You do not normally need to change this but it may be helpful if other interfering devices are being used nearby. You need to cycle power before the channel change will have an effect. Once you have cycled power, the WFD-46 Wi-Fi access point will be of the form wftrx\_WFD46\_N\_XXXXXXXX\_7 where N is your selected channel.

**Note: Only channels 1 to 11 may be used in North and South America and Taiwan, 1 to 13 may be used in Europe and Asia/Pacific. It is your responsibility to avoid breaking the law by adhering to these conditions.**

## Net Number

This defines the subnet that the WFD-46 will use to set its own IP Address and to allocate IP Addresses to hand-held devices that connect in Direct Mode.

**It has no effect in Home Net mode.**

If you change this value, by typing an integer from 1 to 14 and tapping Save, the WFD-46 will use this after cycling power. The subnet will be 192.168.N.0 where N is the net number. The unit’s IP Address will then be 192.168.N.1 and it will assign IP Addresses: 192.168.N.2 to 192.168.N.5

The WFD-46 Wi-Fi access point will be of the form wftrx\_WFD46\_1\_XXXXXXXX\_N where N is your selected net number.

## Over Current Timeout mS

This is the time in milli-Seconds that an overcurrent situation is tolerated before the booster shuts down its output. This should normally be set as short as possible to avoid any damage to wiring, track or locomotives in the event of a direct short. When the DIP Switch 2 is set to the On position, the shutdown threshold will be somewhat greater than 3 Amps. When the DIP Switch 2 is set to the Off position, the shutdown threshold will be around 6 Amps. Once this threshold is reached, the module will shut down its output after the Overcurrent Timeout has elapsed. When shutdown occurs, the blue DCC LED will blink rapidly. After a short period of time, output will be restored and if the short persists, the module will shut down again.

Sometimes users install an auto-reverser or overcurrent protection device in addition to that provided by the WFD-46. In this case the WFD-46 Overcurrent Timeout can be made longer to avoid premature shutdown before the other device has time to operate.

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## Current Calibration

**This is an advanced feature and requires electronic tools for its use, that is an ammeter and a high-power resistor or other device to provide a load of at least an amp. Do not click these buttons unless these tools are available or you will lose the factory calibration and be unable to restore the current readout.**

**You cannot use the built-in web browser in the WiThrottle or Engine Driver apps to do this. You must use a full browser such as Edge, Chrome or Safari. This is because the built-in app browsers do not allow the warning pop-ups to be displayed.**

The WFD-46 has on-board measurement of the approximate current being drawn by the equipment (locos, accessories, etc.) on the power district it supplies. This is calibrated before leaving the factory but the calibration can be repeated by the user.

The calibration consists of an offset and slope value. The displayed current is calculated according to the following equation:

$$I_{Load} = \frac{(V_{ADC} - Offset) \times Slope}{1000}$$

Where  $I_{Load}$  is the measured load current that is displayed,  $V_{ADC}$  is the Analog to Digital Converter reading on the module,  $Offset$  is the calibrated offset value and  $Slope$  is the calibrated slope value.

To recalibrate the Offset, remove all loads from the WFD-46 module and click the “Calibrate Offset” button. A popup warning appears. Make sure the conditions are correct, then click OK.

To recalibrate the Slope, connect a load resistor with a series ammeter in place of the track connections, type the value of the current indicated on the ammeter, **in mA**, in the Measured Current textbox. The value must be between 1000mA and 6999mA, that is, between 1 and 6.999 Amp. When this is correct click the “Calibrate Slope” button. A popup will warn you. If everything is correct, click OK to continue.

## LEDs Disabled

When this checkbox is checked, the LEDs on the module are disabled, except the red Power LED. Some users may be annoyed by flashing LEDs and use this to reduce distraction.

## Home Net Web Page

Remember, Direct Mode is when you connect your tablet or computer to the module’s access point, wftrx\_WFD46\_1\_XXXXXXXX\_7. Home-Net mode is when the module connects itself to your router and you access it via your router.

This page allows you to change your WFD-46 from Direct Mode to Home Net Mode and back again. Once you have changed to Home-Net mode, you will not be able to work in Direct Mode, but if for some reason the WFD-46 cannot join your Home Net (maybe you typed it wrong, put in the wrong password or the router was turned off), the WFD-46 will attempt to connect for about 30 seconds then revert to Direct mode. You will then see the wftrx\_WFD46\_1\_XXXXXXXX\_7 access point which you can connect to and correct the problem. It’s always worth restarting your home router if you’ve checked everything and connection does not succeed, as these so often seem to get locked up somehow!

# WFD-46 Wi-Fi/DCC Booster Module Operating Manual

To change to Home Net mode, tap the Home Net heading in Figure 7. Optionally download the FindModules app for later use (see section “FindModules App”).

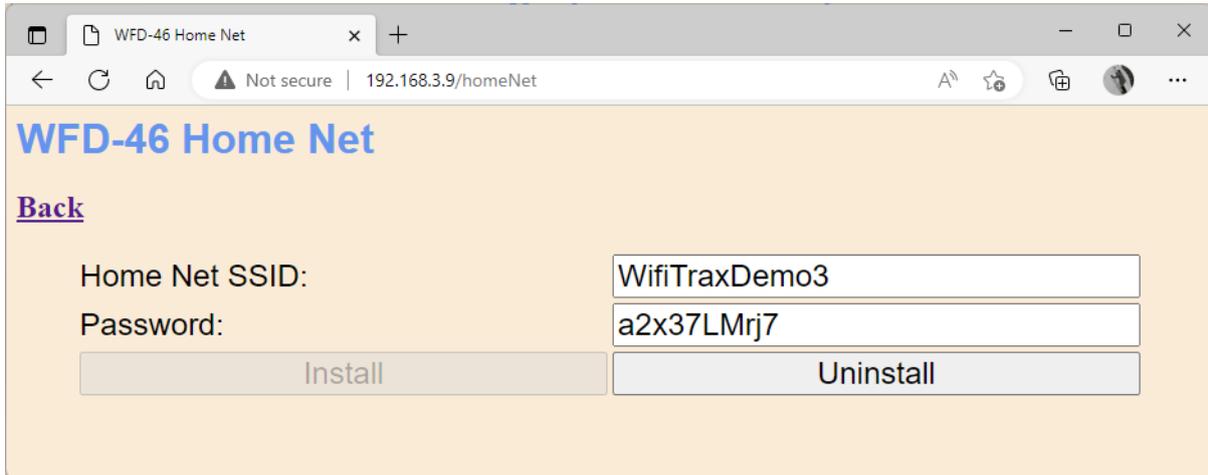


Figure 9 The WFD-46 Home Net Web Page

Figure 9 shows the Home Net web page. Your Home Net SSID (Service Set Identifier) is the name of your home network.

Type the SSID of your home Wi-Fi router in the Home Net SSID textbox. This must be the SSID of a 2.4GHz Wi-Fi Access Point.

Some routers provide both 2.4GZ and 5GHz Wi-Fi Access Points. They also sometimes provide a Guest Network. **The 5GHz Access Point will NOT work and neither will the Guest Network.** If you have renamed your access points on your Wi-Fi Router take a look at the Admin Pages on your router to check which is the correct one.

Type the password (shared key) for your home Wi-Fi Access Point into the Password textbox. Be careful as **both** SSIDs and passwords are case sensitive and take care not to add any extra spaces to your password at the beginning or end.

Check the section “Tips to Manage your Home Network” on page 29 to see some tips on finding out the SSID and password for your home network. This will often be provided by your internet service provider on a card, but you may have changed it.

When you are satisfied these are correct, tap “Install”. The unit will restart and connect to the Home Wi-Fi Network you have specified. To continue to drive your locomotive, you must reconnect your phone, tablet or computer to your home network and use the WFD-46’s IP Address on that network.

To access the web pages, you need to use the IP address that has been allocated to the WFD-46 by your router instead of the fixed 192.168.7.1 address in direct mode.

Find the IP Address of the module on your home network either using the FindModules app or see the section “Tips to Manage your Home Network” on page 52 to find the IP Address and to set your router so it always assigns the same address. Once you have connected to the server, you can access the web pages the same as in Direct mode.

## FindModules App

This is a simple Web Page that uses JavaScript to find your WFD-46 and other modules on your network. If you click on it before you connect your module to your home network, a file will be

# WFD-46 Wi-Fi/DCC Booster Module Operating Manual

downloaded by your browser and saved in your Downloads folder. This should automatically display or you can use your browser menu to open it.

After you have connected the WFD-46 to your home net, and returned your computer to your home net, opening the file from the Downloads folder will display a screen as in Figure 10.

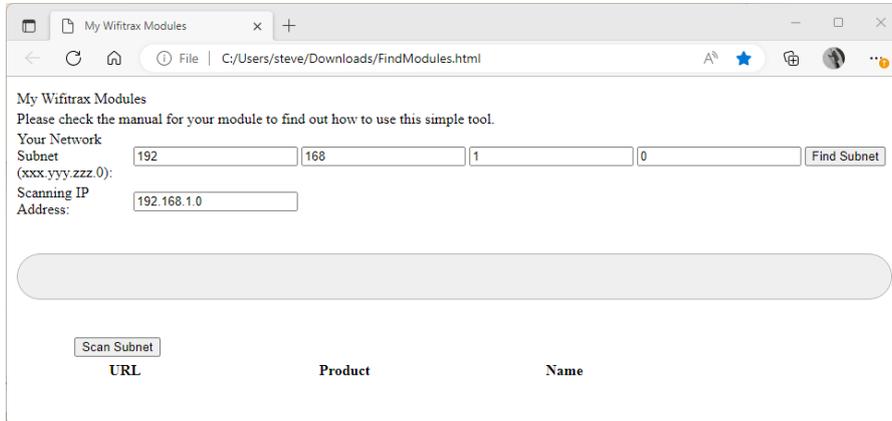


Figure 10 The FindModules Screen.

To use this tool, you must first find out your subnet. If you know this, type it in and click the Find Subnet button. The Subnet should display green. Your subnet is usually the first three numbers of your computer's IP Address, followed by zero, so if your computer's IP Address is 192.168.15.5, your subnet is usually 192.168.15.0.

Once you have the right subnet as in Figure 11, tap the Scan Subnet button. The tool will test all the addresses on the subnet until the WFD-46 is found and display its details as Figure 12. Click on the URL to open the WFD-46 Main Menu. You can also right click on the URL and open in a separate browser window or tab.

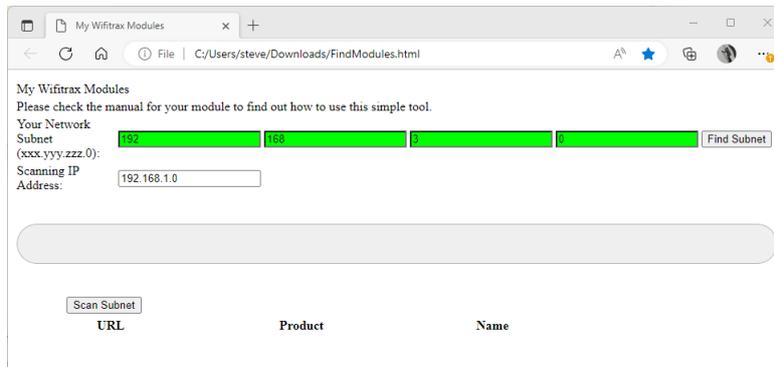


Figure 11 The FindModules tool shows that the correct subnet has been found.

# WFD-46 Wi-Fi/DCC Booster Module Operating Manual

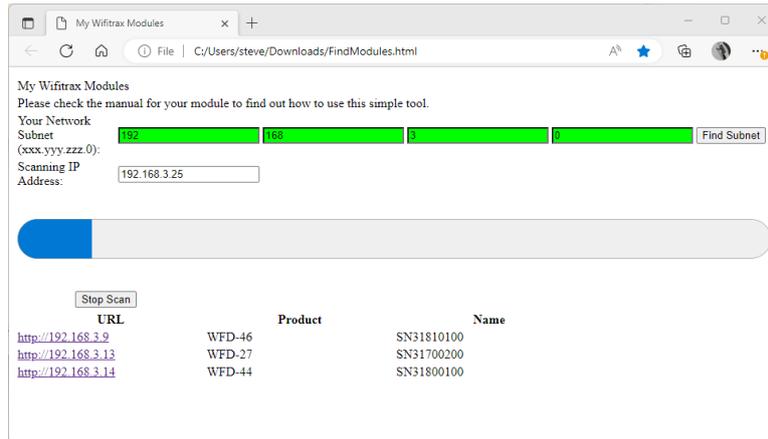


Figure 12 The FindModules tool shows that the WFD-46 Module and others have been found.

Once all your known modules have been found, you can click the “Stop Scan” button.

## Changing IP Addresses due to Router Restart

It is likely that if you restart your router, the IP Addresses assigned to your modules will change so it is a good idea to go to your router admin pages and assign reserved IP Addresses to all your modules including the WFD-46. See the section “Tips to Manage your Home Network” on page 52.

## DCC Status

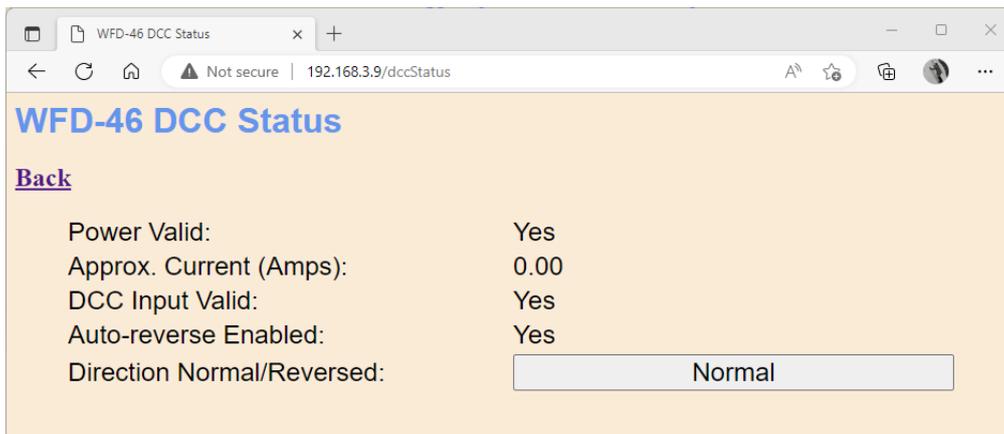


Figure 13 The WFD-46 DCC Status Page

The DCC Status Page in Figure 13 shows the status of the Bipolar DCC Track output of the WFD-46 module. It contains the following information:

### Power Valid

This indicates that the voltage supplies to the output drivers of the WFD-46 is properly regulated at the desired voltage. If the voltage that you provide at the input is insufficient for the output voltage setting, the output will shut down, the blue LED will flash **slowly** and the Power Valid reading on this page will display as No.

Note that the desired output voltage is determine **both** by the DIP Switch 1 in Table 1 **and** the Screw Voltage Adjuster (potentiometer) shown in Figure 3. For example, if you have set the high range (13V to 20V PP) you will need about 24 Volts at the input power terminals (or barrel connector) to obtain the 20V PP maximum. If you have selected the low range (9.8V to 15V PP), you will need 18

# WFD-46 Wi-Fi/DCC Booster Module Operating Manual

volts at the input terminals to obtain an output of 15V. If you are using lower settings, say 12V PP, you can make do with 13 – 15V at the input.

## *Approximate Current*

This is a display of the AC Current, in Amps, being supplied to the track. This is not a precision reading, but should serve as a guide to how much current is being drawn by locomotives and accessories on the power district supplied by the WFD-46.

## *DCC Input Valid*

This shows “Yes” if a valid DCC input is present on either the Control Bus input or the Bipolar Track DCC Input terminals, according to the setting of DIP Switch 3 (see Table 1). If there is no valid DCC input because of a missing connection or an incorrect DIP Switch 3 setting, this will show “No”.

## *Auto-Reverse Enabled*

This shows “Yes” if Auto-Reverse is enabled by the setting of DIP Switch 4 (see Table 1). To change this, you must power down, change the setting of DIP Switch 4 and power up again.

## *Direction Normal/Reversed*

This only displays when Auto-Reverse is enabled. It shows as either Normal or Reversed and is displayed as a button. You can manually change the direction by clicking the button. When Auto-Reverse is enabled, the Normal/Reverse will be restored after cycling power.

## Factory Reset

You may factory reset your WFD-46 by selecting the Reset option on the main menu page. You will be asked to confirm the reset, as Figure 14 and then the unit will immediately revert to its factory configuration. All the settings will take their default values and Home Net settings will be removed. The locomotive roster and Accessory List will return to their default values.

## Factory Reset Button

You can also reset your WFD-46 by pressing and holding the Reset button on the module for about 10 seconds. When the green LED starts to flash rapidly, release the button. You will need to use your figure nail or a small screwdriver carefully to operate the reset button and you should feel a distinct click when you press it correctly.

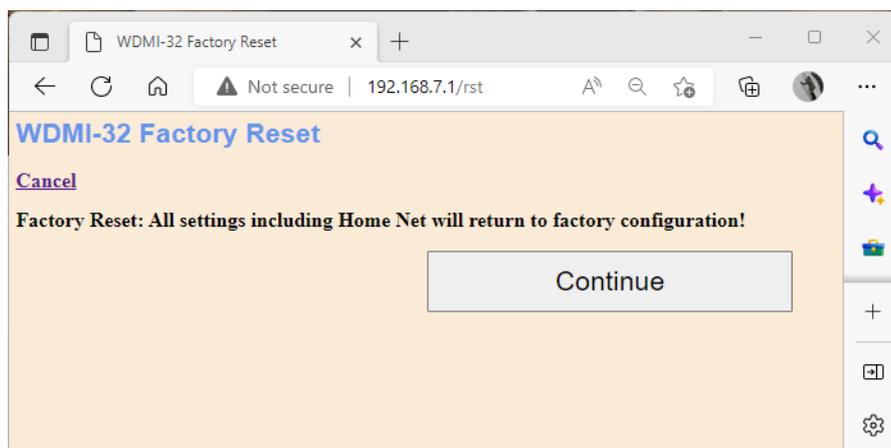


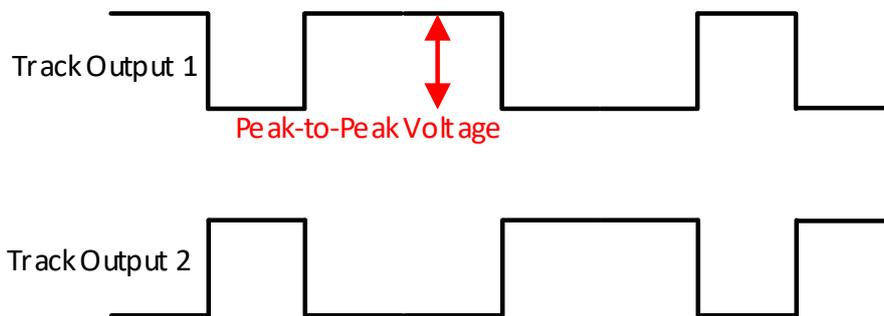
Figure 14 Factory reset confirmation page

# WFD-46 Wi-Fi/DCC Booster Module Operating Manual

## Adjusting the Output DCC Voltage of the WFD-46

Digital Command Control (DCC) uses a form of square wave signal on the track to provide both power and control. Control is achieved by encoding commands in the form of sequences of ones and zeros. The waveform is not strictly square because the cycles are not all the same length, the cycle for a zero being at least twice as long as for a one. The decoder in each locomotive or for each turnout decodes the commands and performs the action specified by the DCC command station connected to your WFD-46.

There are two track output terminals on the WFD-46 and the DCC voltage waveform on these fluctuates in the opposite direction. We say they are in opposite phase as shown in Figure 15. The output voltage of the DCC power and control going to your track is usually measured as the Peak-to-Peak (PP) voltage of one of them as shown in Figure 15.



*Figure 15 Peak-to Peak Voltage of a DCC Voltage Waveform.*

When using multiple Power Districts, it is best to make sure that the Peak-to-Peak voltage of the DCC waveform is the same at each power district. If this is not the case, locomotives may jerk slightly when travelling from one to another.

The WFD-46 can supply a DCC output peak-to-peak voltage from about 9.8 to 20.0 Volts as shown in Table 1. There are two ranges selected by Switch Number 1 in Table 1. Once you have selected the range, you can adjust the voltage using the screw trimmer potentiometer shown in Figure 3.

There is an easy way to measure the Peak-to-Peak voltage of the DCC waveform. Connect a voltmeter set to a range of around 20 Volts DC between any one of the track output connectors and the ground connector, as in Figure 16. The DC Voltmeter will show the average of the voltage where it is connected, that is between one of the output terminals and ground. Because the DCC waveform spends exactly half of its time at zero and half its time at the maximum voltage, we can say that the Peak-to-Peak voltage will be exactly twice what your voltmeter measures. So, for example, if your voltmeter measures 7.00 Volts, the Peak-to-Peak voltage will be 14.00 Volts.

# WFD-46 Wi-Fi/DCC Booster Module Operating Manual

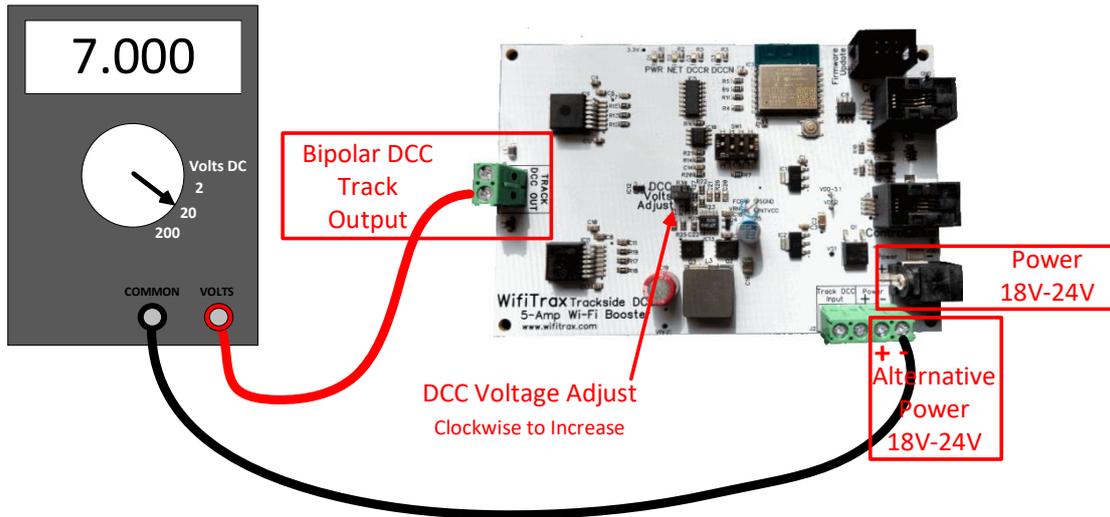


Figure 16 Voltmeter Connections to Measure the Track DCC Voltage.

To set up your power districts to the same voltage, first decide on a suitable voltage, say 14 Volts Peak-to-Peak for HO. Then connect your voltmeter to each district in turn, as in Figure 16, and adjust the voltage of each WFD-46 so that the voltmeter shows exactly half your required voltage (that is 7.00 volts in the case where the required voltage is 14 Volts Peak-to-Peak).

# WFD-46 Wi-Fi/DCC Booster Module Operating Manual

## Power Districts and Making Use of the Auto-Reverse Feature

There are many articles written about the use of DCC Power Districts. An internet search will reveal much information such as the following article published in Model Railroader:

<https://www.trains.com/mrr/how-to/build-model-railroad/adding-dcc-power-districts-for-optimal-operation/>

You can run a model railroad with just a DCC Command Station and Booster such as shown in Figure 5. The track will have up to 5 Amps capacity, however, if you have many locomotives that are continuously placed on the track, allowing 0.5 Amps for each one when running, that capacity is soon seen as not limitless. So, if you intend to run a lot of locomotives, increasing the current capacity can be achieved by dividing your layout into Power Districts with a separate 5 Amp booster for each one.

Another main reason for separation into districts is to make it easier to cope with shorts due to a derailment. Each district has its own overcurrent protection, so a short in one area does not bring down the whole layout.

A third reason is to allow for track plans that will result in a short circuit without special provisions. An example is shown in Figure 17. Without gaps, there will be a continuous short circuit due to the classic “return loop” configuration. Even with gaps, a short will occur when the locomotive traverses one or other of the gaps.

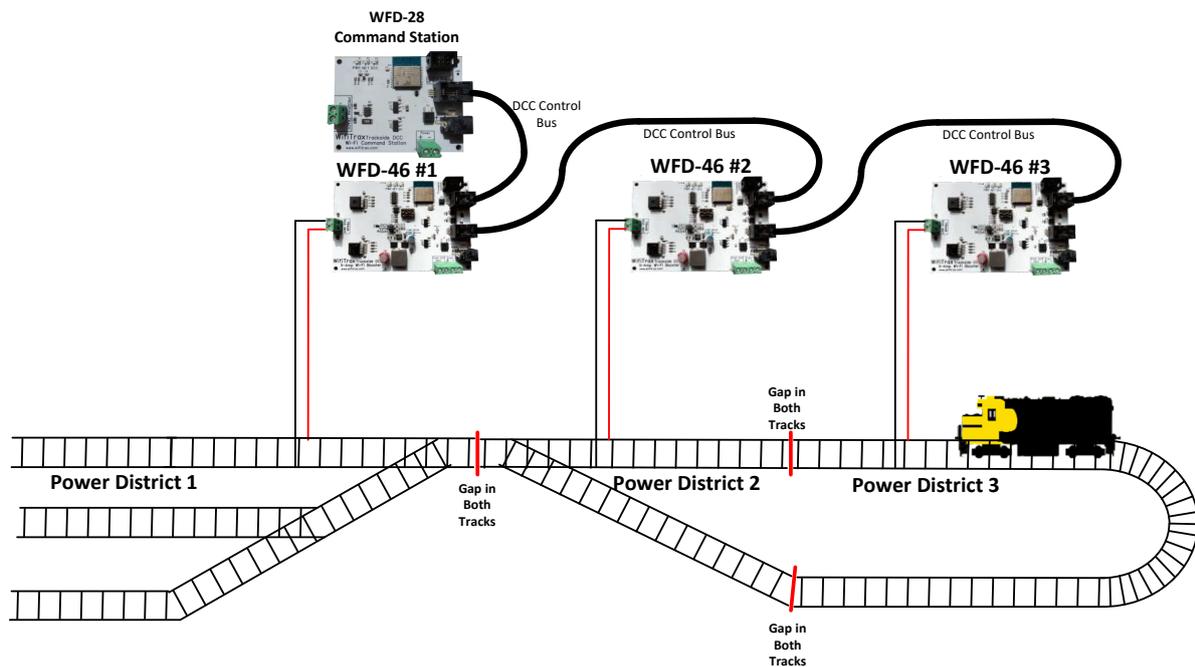


Figure 17 Typical Arrangement using three WFD-46 with Return Loop

The WFD-46 provides automatic reverse to handle these situations. When a locomotive crosses a gap between sections of track where the DCC waveforms are “out of phase” a short will occur. Clearly in Figure 17, whichever way around we connect Power District 3, one of the gaps between it and Power District 2 will be out of phase. The WFD-46 auto-reverser, detects a short at a gap and very quickly changes the polarity of its track DCC outputs. This happens so quickly that the WFD-46 does not detect an overcurrent condition.

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In Figure 17 only WFD-46 #3 needs to have Auto-Reverse enabled by setting DIP Switch Number 4 set to the Off position as Table 1. The other boosters can have auto-reverse disabled. It does not matter if they are all enabled, except that the polarity will become indeterminate throughout the layout since either #2 or #3 may change polarity when a gap is crossed. Once #2 has changed, #1 will need to change when the gap between District 1 and District 2 is crossed, so it is better to be rigorous.

Similarly, one could leave all boosters auto-reverse enabled and connect them up with random polarity and rely on auto-reverse to sort things out. This idea is not recommended, however, again because the polarity of the whole layout will be indeterminate. So for this configuration, the recommendation is in Table 5 Booster Auto-Reverse Configuration for Layout in Figure 17.

Booster	District	Auto-reverse
<b>WFD-46 #1</b>	Power District 1	Disabled
<b>WFD-46 #2</b>	Power District 2	Disabled
<b>WFD-46 #3</b>	Power District 3	Enabled

Table 5 Booster Auto-Reverse Configuration for Layout in Figure 17.

## Tips to Manage your Home Network

### A Few Things to Know

Here are a few technical sounding terms that we're going to use repeatedly in this manual. They might sound clever but they are really very simple so let's bite the bullet and get used to them right away!

**IP Address.** This stands for *Internet Protocol Address*. We all use the internet and this is crucial. All it means, is the address given to any computer or other device on the internet. It's got four numbers, each 0 to 255. For example, 10.0.0.27, 192.168.15.5 and 59.48.123.5 are all IP Addresses. You'll see 192.168.(something).(something) a lot because it's defined as a private part of the internet, and the local network in your house is private.

**Subnet.** The internet has lots of networks all connected together by gateways. A subnet is a local group of computers or devices. A subnet almost always has the first three digits of an IP Address followed by a zero. So, 192.168.15.0 is a Subnet and 192.168.15.4 or 192.168.15.17 are IP Addresses in that subnet. It's like a street in your neighbourhood where each house has a number.

**Router.** A router is a box of electronics that joins two or more subnets and routes messages from one to the other. It's like the Post Office. It also allocates IP Addresses to computers and devices on the subnet it manages.

**Wi-Fi Access Point.** This is an electronic device that allows a device to access a subnet using Wi-Fi. Wi-Fi is a special form of Radio. Usually, a Router has a Wi-Fi Access Point. All Wifitrax modules also have their own Access Point. An Access Point is identified by an **SSID** and often requires a password. Sometimes routers have more than one SSID. **Wifitrax products can only use the 2.4GHz access point on a router and NOT the 5GHz or Guest Network access points.**

**SSID.** It stands for "Service Set Identifier" but it's just the name of a Wi-Fi Access Point.

That's it, now let's really talk about your router!

### Connection to your Home Router

When you join a WFD-46 module to your home-net mode, it will immediately restart and try to connect to the Wi-Fi Access point that you specified in the SSID, using the password that you supplied. From then on, it will try to connect each time you power on. If the connection is unsuccessful, it will give up after about 30 seconds and revert back to Direct mode to allow you to connect and either correct the problem or return it to Direct mode.

### Why does my module fail to connect to the router?

There could be several reasons if this happens.

- (1) Usually, failure to connect occurs because the password or SSID is incorrect, so you would need to double check that. Be sure that the case is correct in both the SSID and the Password. Make sure there are no extra spaces at the end or beginning. Make sure you have not entered a letter "O" when it should have been a zero "0".
- (2) You might have used the 5GHz SSID. You **MUST** use the 2.4GHz SSID. Wifitrax modules will **NOT** connect to a 5GHz Wi-Fi access point.
- (3) The router could be too far away or is turned off.

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- (4) Routers need to allocate a unique IP Address to each module connecting. Your router may refuse a connection because it has insufficient IP Addresses available. This could be that it has not been setup properly or it could be that many guests have connected and all the available IP Addresses have been used up. Cycling power on the router will often correct this.
- (5) Sometimes routers refuse connections because of some unknown internal hang-up problem – perhaps a firmware bug – and need to be restarted from time to time.
- (6) Also, occasionally there are so many people operating Wi-Fi devices in an area that there is just too much radio traffic. In this case changing the router to a different channel may work. Remember that in Home-net mode, the WFD-46 always uses the Wi-Fi channel of the router that it is connected to.

## Home Net IP Address Assignment

Every device connected to a network needs an IP Address and when your WFD-46 successfully connects to your home router, the router will allocate it an IP Address from a list of unused addresses. This process is called DHCP (dynamic host control protocol) and you can Google the term to find all the information you would like. IP Addresses are leased to connected devices and it is possible that the next time you turn on your WFD-46, the lease will have expired and the router will give it a different IP Address.

This changing IP Address does not matter if you are using 3rd-party apps using the Hoffman WiThrottle Protocol (like Engine Driver and WiThrottle) because they discover one or more WFD-46 modules using a protocol called Multicast DNS. The WFD-46 broadcasts its presence, with its information, to all devices connected to the network, and the Engine Driver and WiThrottle apps display WiThrottle servers found in this way in their list of discovered servers. You then connect to your choice of WiThrottle server when you start the app.

Sometime the Discovery process using Multicast DNS does not work reliably, in which case you can connect to the WiThrottle Server you connected to last time, from the Recent list. Or if you know the IP Address of your module, you can type it in manually.

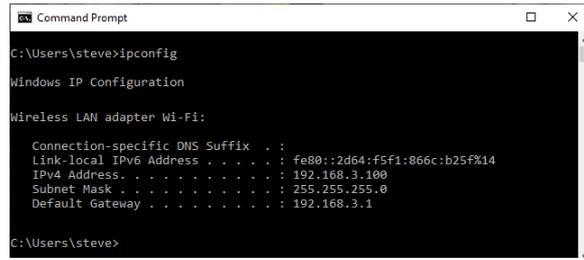
Also, if you want to access your WFD-46 from a browser such as Internet Explorer, Edge, Chrome or Safari, you need to know its IP Address.

## Finding the IP Address Assigned to your WFD-46 Module

There are several good ways of finding the IP Address assigned by your router.

- (1) Once you have connected using an app such as WiThrottle or Engine Driver, you can use the “Web Page” menu item or tab to view the Settings page as in section “General Settings Web Page”. Once you see the IP Address, you can make a note of it and type it into a browser as in section “[Setup Advanced Features using a Web Browser](#)”.
- (2) You can use the FindModules app described in the section “FindModules App”.
- (3) Probably the best way is to get it from the Admin page of your router.
  - a. To do this, you need to first type the address of your gateway into a browser. You can find this by opening a Windows command console and typing the ipconfig command:

# WFD-46 Wi-Fi/DCC Booster Module Operating Manual



```
Command Prompt
C:\Users\steve>ipconfig

Windows IP Configuration

Wireless LAN adapter Wi-Fi:

    Connection-specific DNS Suffix . . . : 
    Link-local IPv6 Address . . . . . : fe80::2d64:f5f1:866c:b25f%14
    IPv4 Address. . . . . : 192.168.3.100
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.3.1

C:\Users\steve>
```

Figure 18 Using ipconfig to find your computer's IP Address and Default Gateway

- b. Figure 18 shows the result. The computer's IP Address is 192.168.3.100 and 192.168.3.1 is its default gateway. Now take the default gateway IP Address, 192.168.3.1 in this example, and type it into the address bar of your favorite browser, then hit the Enter key.

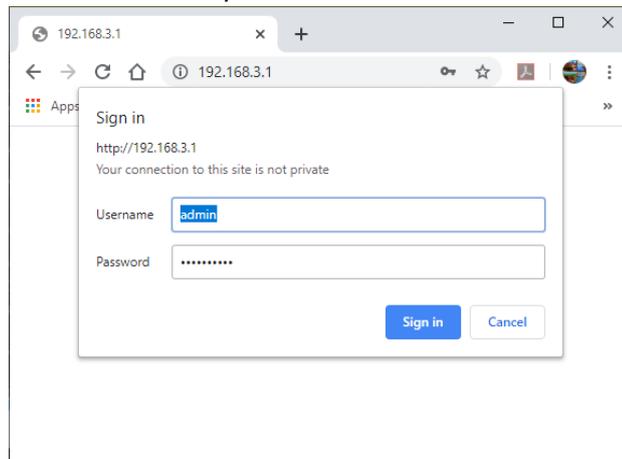


Figure 19 Access your router by using the IP Address of your default gateway in a browser

- c. The browser will ask for your Username and Password to access your router's admin page. You can find this in one of these places, unless you have changed it:
  - i. A sticker on your router, at the back or underneath. Look for the Admin user name and password (this is not always the same as your Wi-Fi password),
  - ii. On a card supplied by your internet service provider or telco,
  - iii. In the leaflet that came with your router.
- d. Once you have given the credentials, you will see the Admin page. A typical one is shown in Figure 20. Find the "Attached Devices" option and click on it.

# WFD-46 Wi-Fi/DCC Booster Module Operating Manual

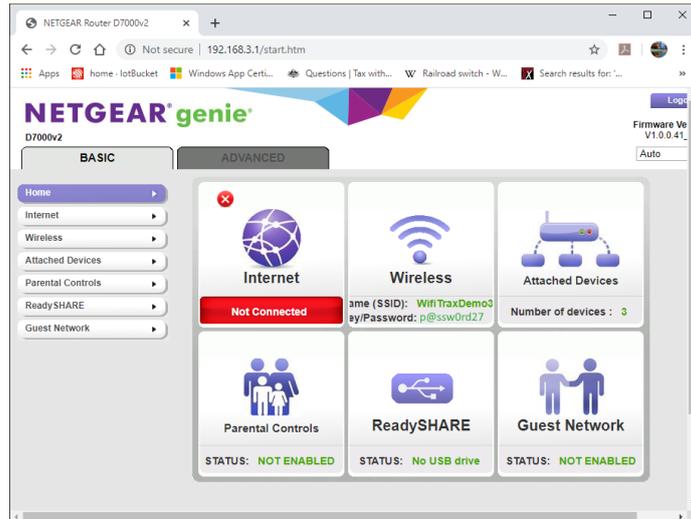


Figure 20 A typical router admin page

2.4G Wireless Devices (Wireless intruders also show up here)

SSID	IP Address	MAC Address	Device Name
WifiTrax:Demo3	192.168.3.6	54:27:1E:FA:CE:DB	SSS105
	192.168.3.101	34:8A:7B:04:03:8C	Galaxy-Tab-A
	192.168.3.104	40:A1:08:C0:07:08	android-ccc7f7865134c727
--	192.168.3.8	DC:4F:22:39:EA:CD	ESP_39EACD

5G Wireless Devices (Wireless intruders also show up here)

SSID	IP Address	MAC Address	Device Name
------	------------	-------------	-------------

VPN Client Devices

Device Name	Remote IP Address	Local IP Address	Connection Time
-------------	-------------------	------------------	-----------------

Figure 21 Typical "Attached Devices" page of a router

- e. You will see a screen something like Figure 21. Find the row where the MAC address matches that printed on the bag label of your WFD-46 device. Here the MAC Address DC : 4F : 22 : 39 : EA : CD matches the STA MAC Address on the bag label, so 192 . 168 . 3 . 8 is the IP Address. Another clue is that the Device Name of Wifitrax Modules begins with the letters "ESP\_".
- f. Now open another tab in your browser and type the IP Address, 192 . 168 . 3 . 8 in this example, into the address bar to get the main menu web page of your module as Figure 22.

# WFD-46 Wi-Fi/DCC Booster Module Operating Manual

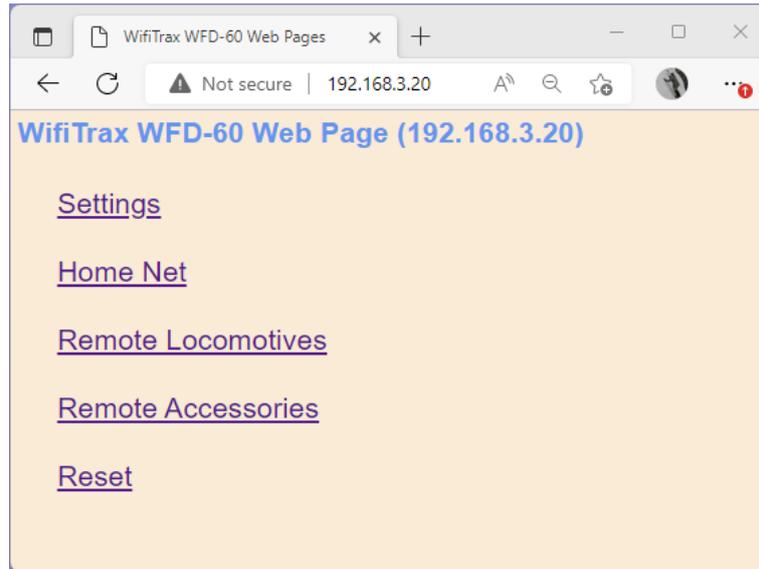


Figure 22 Use the IP Address to open the main menu web page

## Reserving a Fixed IP Address

That's all well and good but earlier it was said that routers do not always assign the same IP Address.

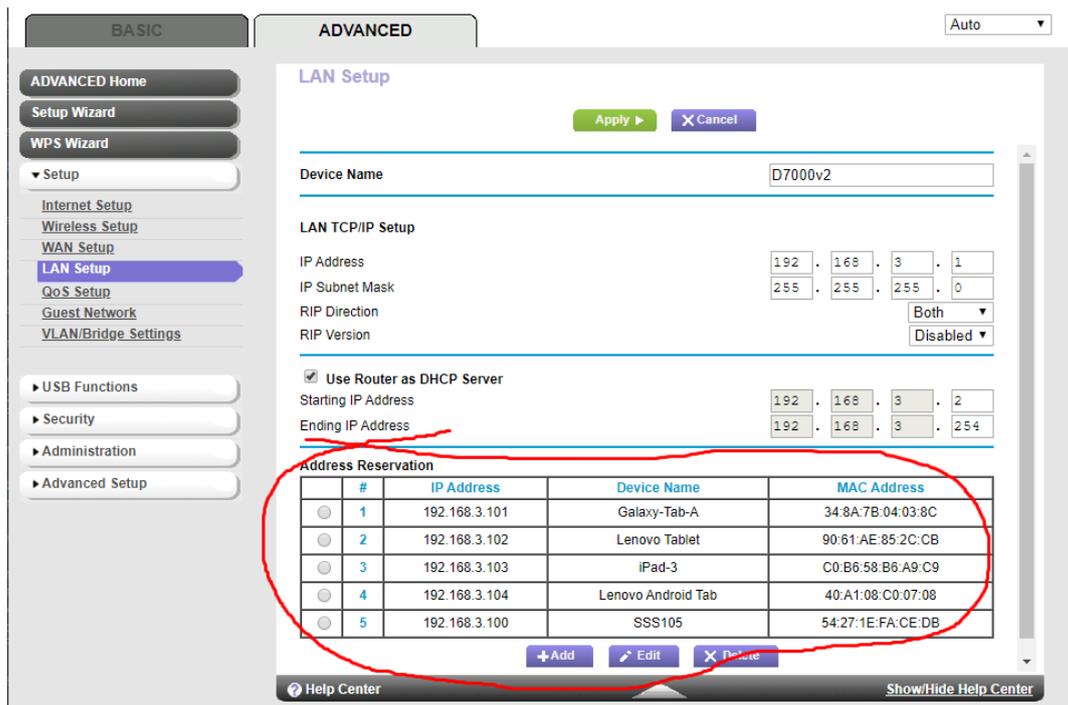


Figure 23 An IP Address reservation table in a router

So, while you're in the router admin page you can *reserve a fixed IP Address* for your WFD-46 module. In the Netgear D7000v2 that is used here as an example, you need to click the Advanced tab, then the Setup menu and the LAN Setup sub-menu (LAN stands for Local Area Network). The table at the bottom of Figure 23 shows the Address Reservation Table. In this router, you can see that there are already 5 reservations and to add a new one, we hit the Add button.

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Then type in the information from Figure 21. In this example it's

IP Address: 192.168.3.8  
MAC Address: DC:4F:22:39:EA:CD  
Device Name: WFD-46

Then hit Add as Figure 24.

The screenshot shows the 'Address Reservation' configuration page. On the left is a sidebar with navigation options: ADVANCED Home, Setup Wizard, WPS Wizard, Setup (expanded), Internet Setup, Wireless Setup, WAN Setup, LAN Setup (highlighted), QoS Setup, Guest Network, and VLAN/Bridge Settings. The main content area has a title 'Address Reservation' and buttons for '+ Add', 'X Cancel', and 'G Refresh'. Below is an 'Address Reservation Table' with one row: # 1, IP Address 192.168.3.8, Device Name SSS105, and MAC Address 54:27:1e:fa:ce:db. At the bottom, there are input fields for IP Address (192.168.3.8), MAC Address (DC:4F:22:39:EA:CD), and Device Name (WFD-46).

Figure 24 Adding an address reservation

Usually, you have to click the Apply button to restart the router, then check the reservation page to make sure the new one is there. Now your module will always have the same IP Address.

## More Information

Article about Wi-Fi/DCC:

<http://www.wifitrax.com/appNotes/WiFi-DCC.pdf>

Access all the articles:

<http://www.wifitrax.com/appNotes/howToArticles.html>

# WFD-46 Wi-Fi/DCC Booster Module Operating Manual

## FCC Information

Radio or TV Interference (this information is MANDATED by the FCC)

This equipment incorporates Espressif Wi-Fi Transceiver Module ESP-WROOM-02D.

FCC Identifier: 2AC7Z-ESPWROOM02D.

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 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. 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 the 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. **Note that any modifications to the equipment not expressly approved by WifiTrax voids the user's authority to operate under and be in compliance with CFR 47 rules**, as administered by the Federal Communication Commission. WifiTrax believes any conscientiously installed equipment following guidelines in this manual would be unlikely to experience RFI problems.

For Canadian Users: "This digital apparatus does not exceed the Class B limits for Radio noise emission from digital apparatus set out in the Radio Interference Regulation or the Canadian Department of Communications." Le present appareil numerique n emet pas de bruits radio-electriques dépassant les limites applicables aux appareils numeriques de la classe B prescrites dans le Reglement sur le brouillage radioelectrique edicte par le ministere des Communications du Canada.

## EU Declaration of Conformity

1. Radio equipment: WifiTrax Model Wi-Fi/DCC Booster Module

2. Name and address of the manufacturer or his authorised representative:

WifiTrax Model Science (A business owned by Steve Shrimpton Sciences Pty. Ltd. a company registered with the Australian Securities and Investments Commission ACN: 076 070 258)

116 The Gully Road, Berowra NSW 2081 Australia

3. This declaration of conformity is issued under the sole responsibility of the manufacturer.

4. Object of the declaration:

WifiTrax Model WFD-46 Wi-Fi/DCC Booster Module as pictured in Figure 25 and identified by a label on underside of module bearing the model number WFD-46.

# WFD-46 Wi-Fi/DCC Booster Module Operating Manual

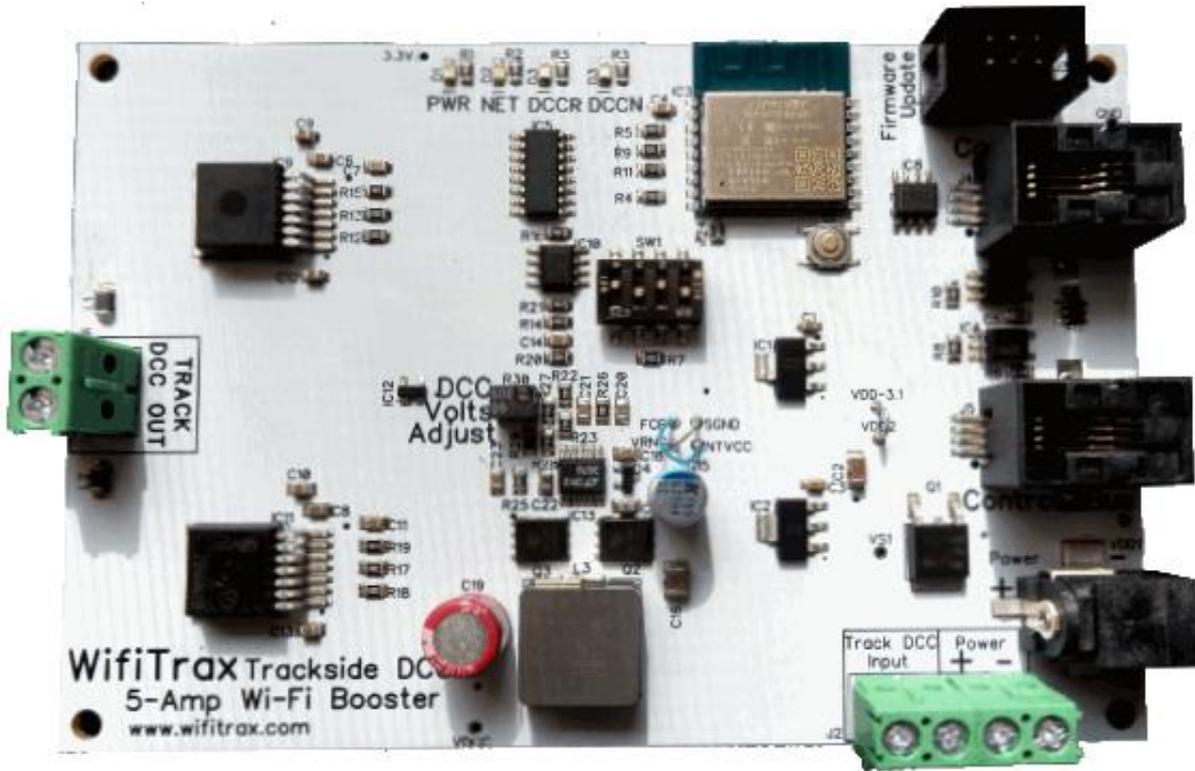


Figure 25 Identifying Illustration for WifiTrax Model WFD-46 EU Declaration of Conformity

5. The object of the declaration described above is in conformity with the relevant Union harmonisation legislation: Directive 2014/53/EU

6. Description of accessories and components, including software, which allow the radio equipment to operate as intended and covered by the EU declaration of conformity:

ESP-WROOM-02D Wi-Fi Internet of Things Module, Espressif Systems (Shanghai) Co., Ltd.

EU-type Examination (Module B) Certificate No. 192140277/AA/00

Issued by Telefication BV, The Netherlands, Chamber of Commerce 51565536, [www.telefication.com](http://www.telefication.com)

7. Additional information:

Manufacturer has undertaken engineering analysis and appropriate testing to determine the subject of this declaration performs in its electromagnetic characteristics in the manner specified for the radio module identified in item 6 above.

Module is configured for EU market to allow Wi-Fi Channels 1 through 13 in the 2.4GHz Wi-Fi band.

Signed for and on behalf of: WifiTrax Model Science November 7, 2022, Berowra NSW Australia