

# **RF Switch Operating Manual**

**Rev 011a**  
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**Designed and Produced to enhance your Amateur Radio Experience by**

**Team XCR**

It is recommended that you join the Team XCR User Group on the web at:

**<https://groups.io/g/team-xcr/topics>**

This is a low noise group that will keep you up to date.

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# 1 Introduction

This project is an all-inclusive[1] Remote RF Switch (Antenna Selector) which provides a convenient way to remotely select HF antennas. The Switch uses Power-Via-Coax and WiFi (browser) for control. Thus, eliminating the need to an additional cable or control box. It provides a convenient user interface located on your existing logging PC.

The User interface is entirely via a browser. This can be a small window open on your logging PC. Simply click on the desired antenna and the connection will be made.

Additional information is displayed below the virtual buttons. Specifically, the DC voltage at the Switch and (if installed) the temperature, humidity and barometric pressure. The sensor is enclosed so the indicated values reflect the inside of the enclosure.

## 1.1 Amateur Radio Kit

This project is presented for amateur radio use. As such, it is a collection of parts which, when properly assembled and operated, provide a useful operating tool. If the kit assembly or operation is beyond your skill level, please return the unassembled kit for a full refund (minus shipping).

Your assembly and operation is your acknowledgment and acceptance of the risks associated with amateur radio operations and kit assembly.

If you wish to use this project for other applications, please email the details of your intended operation.

## 1.2 License

This project is released under terms of the TAPR Non-Commercial License. You may build units for your own use, but may not sell units for a profit without a license from Team XCR.

## 1.3 Lightning

The RF Switch provides **NO** lightning protection.

Let me be totally honest with you. There COULD have been some ESD devices installed but they would mostly help advertising a capability which has no basis in the real world. A few MOV's could be sprinkled around, but without a very substantial path to ground they are nearly worthless.

Protection needs to be all or nothing. Protecting from all threats is a challenge. Best practice would be to install a metal plate with Polyphasers and a VERY SOLID path to Ground. Then route the coax to the Switch. Another protection installation should be place prior to the coax entering the shack.

In the case of no user installed protection, the Switch will NOT serve as fuse for the coax to the shack. A direct strike will likely consume the switch and you will have to search for the remnants.

Protection is entirely a USER RESPONSIBILITY.

Installation of this Switch indicates your acceptance of this responsibility.

## Notes

1. This switch requires external +12VDC which may be supplied via a user supplied Bias T in the shack or at the site of the Switch installation. The user is responsible for providing power. See MFJ-4116 available from various dealers.
2. Refer to <http://arrl.org> for more information on ESD protection, in particular the ARRL has books on lightning protection.

## 1.4 Network Security

The switch works on your Local Area Network (LAN). There is no need to need to change any router settings to operate the Switch locally.

If you desire to operate the switch from beyond your LAN, it is necessary to modify router settings. Since this IoT device is simply designed for LAN operation, there is no provision for protecting from hackers. The same may be true for other amateur radio devices on your LAN.

If you desire to operate this IoT device from outside of your LAN, it is strongly recommended that you contact an IT professional and seek advice on providing protection for your network.

## 1.5 Caveat

This device is designed to switch antennas which are well matched **AT THE ANTENNA.**

Without using a Tuner, whether separate or internal to the radio, the SWR should be better than 2:1.

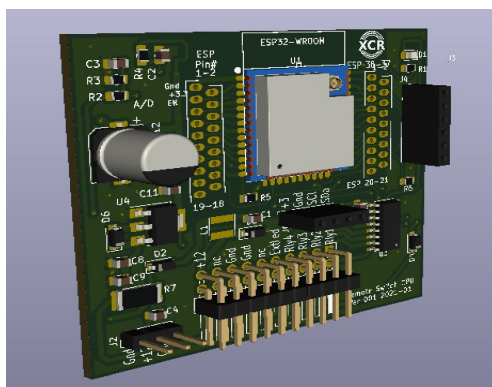
If your use a random wire or other antenna which is NOT 50 Ohms or has a SWR > 2:1, do NOT route the coax through this switch. The mismatch will result in high voltages which may be beyond the design parameters and may **damage the switch.**

## 1.6 Isolation

The measure of attenuation between switch ports (selected to unselected) is the isolation. Good isolation is only required when there are multiple RADIOS connected. The isolation prevents power from a transmitting radio from going into the receiver of another radio.

This switch is designed to switch ONLY antennas (not select from multiple radios). A single relay provides about 30db of isolation. Transmitting 1000W on antenna 1 results in 1 W going to antennas 2, 3, 4. This has essentially no impact on the intended operation.

HF antennas do not typically have big isolation in space (coupling from antenna 1 to antenna 2) as they are physically near each other. In a common yard, isolation may only be 20-40db.



## 2 Operation

In order to provide the most rapid system availability, when power is applied, the RF Switch attempts to connect to the local LAN. This uses the stored SSID and parameters.

If there are no stored parameters or the RF Switch is unable to connect to the LAN, then it reverts to Access Point (AP) Mode.

### 2.1 Initial Configuration

The following steps will configure the RF Switch to your LAN and shack.

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Before you begin, you will need the following information: **(Note that ALL of these are CASE Sensitive)**

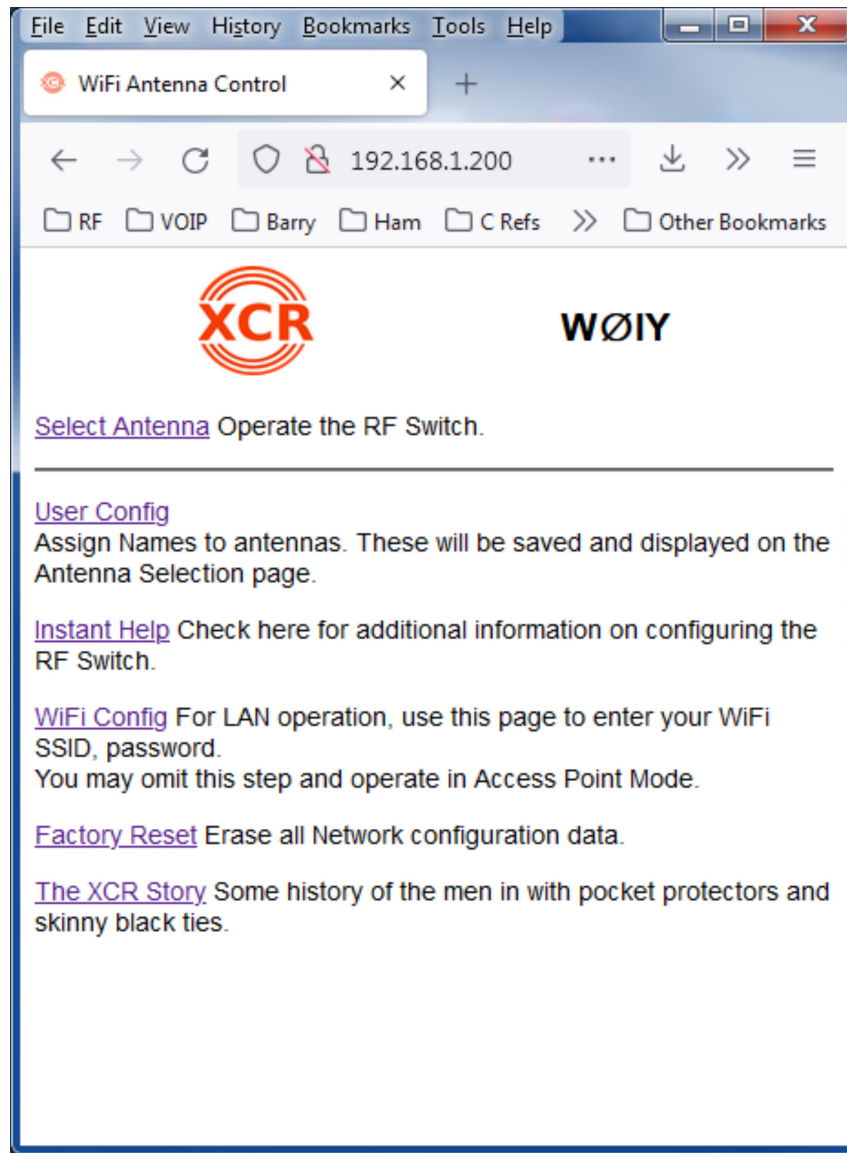
- SSID – the name of your network
  - WiFi Password
  - You may need to be log into your router as the administrator. This will require the admin name and password, which may or may not be the same as your wifi password. It depends on how you setup the router.
- 

#### 2.1.1 AP Mode

To directly access the RF Switch, use your smart phone or PC. This discussion will consider that you are using your smart phone.

1. Open your phone and navigate to WiFi page.  
On Android you can do this by Swiping down from the top to expose some icons, then holding your finger on the WiFi icon for a few seconds.
2. There will be a list of available WiFi signals with their respective SSID displayed. One of the listed items will be the “**RF Switch**” Select this item.
3. You should see the page change to “Connecting to RE Switch”. There may be a gripe that there is no internet connection. Allow the connection to proceed. Some phones OS are seriously unhappy with this.
4. Now open your browser. Where you usually enter a URL, enter” **192.168.4.1**  
You should now see the RF Switch **Main Menu**

The Main Menu page provides access to the configuration and operational pages. At the bottom of each page is a link back to the Main Menu.



*Illustration 1: Main Menu*

## 2.2

### 2.2.1 WiFi Configuration

The WiFi configuration consists of entering your credentials: SSID, password, etc. These are then stored in memory on the CPU board. You should only need to do this once.

It is important to enter ALL of the data on the WiFi Config page as the data is all stored as a set. If you

leave a field blank, the file will be created with no data for that parameter. This may cause the CPU to be unable to connect to your LAN. If the WiFi LAN connection fails, the CPU will revert to Access Point mode and you will be able to access the RF Switch via your phone, tablet or laptop.

The following table list the parameters you will need to connect to a LAN.

Parameter	Example	Comment
SSID	w0iylan	UPPER/lower case matters! You can find the SSID by accessing you LAN router or buy scanning WiFi with a phone app.
Password	Abc123	This is the WiFi password. It is configured in your router when you did WiFi setup.
IP Address	192.168.1.200	This will be the IP address of the RF Switch. You may need to check the available range in the router setup.
Gateway	192.168.1.1	This is the IP address inside your router. For most folks 192.168.1.1 is the correct number. Network savy folks may have established a different IP address (like 10.10.10.1
SubnetMask	255.255.255.0	For 99.9% of users, the example is the correct answer.
DHCP	OFF (unchecked box)	If you want the router to assign a IP address for the RF Switch, enable this and then omit IP Address, Gateway and Subnet Mask. You will have to go into your router to find the IP address which was assigned.



File Edit View History Bookmarks Tools Help

ESP Wi-Fi Manager

192.168.1.200/wifimanager.htm

RF VOIP Barry Ham C Refs Other Bookmarks

**XCR**

You may operate the RF Switch in either of 2 modes.

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### Access Point Mode

In **AP Mode** you control the switch via a direct WiFi link from a **browser on your phone or tablet**. Use this on Field Day or a DXpedition. If you are reading this for the first time, you are already in AP mode.  
Do NOT complete the form below.  
To operate the RF Switch, navigate to the MAIN MENU, then select the Select Antenna page.

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### LAN Mode

In **LAN Mode**, you control the switch via a browser on your **Network Connected Device (PC or Tablet)**. This is the most common mode for home stations.  
Fill in the form below with your WiFi SSID (name) and Password. If you prefer to specify the IP address, enter a value. A default is provided. If you are unsure, simply delete the numeric value and leave the field blank.  
After clicking Submit, the RF Switch will save the values, then reboot in LAN Mode.  
Open a browser and in the URL field, enter the IP address 192.168.1.200 or whatever value you entered. If you did not specify an IP address, check your router for connected devices to determine the IP address of the RF Switch.

You **MUST** enter **ALL** parameters as they are all stored at one time. If you only enter data for one parameter, that one will be saved but all others will be EMPTY.

SSID

Password

DHCP ☒ Use DHCP

IP Address

Gateway Address

Subnet Mask

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Help is available:  
[Instant HELP](#)  
[More extensive Help](#)

*Illustration 2: LAN Configuration Page*

## 2.2.2 User Customization

Users can enter their callsign and antenna names. Each is stored individually in CPU memory and will be retained. The strings are limited to 25 characters. UPPER/lower, numbers and figures are all ok.

File Edit View History Bookmarks Tools Help

User Configuration

192.168.1.200/users

RF VOIP Barry Ham C Refs Other Bookmarks

**XCR**

**Callsign:**  
WØIY

Submit

For those with a Ø in your callsign, enter you call like this:  
W\&#8709\;IY but OMIT the \"\" shashes.  
The slashed Ø is & # 8 7 0 9

Edit the antenna name and press Submit beside the entry.

1	Dipole 80-40	<input type="text"/>	Submit
2	40m Vertical	<input type="text"/>	Submit
3	6m Yagi	<input type="text"/>	Submit
4	20-15-10 Yagi	<input type="text"/>	Submit

[Main Menu](#)

Illustration 3: User Configuration Page

## 2.3 Program Update

### WARNING

DO NOT SELECT THIS OPTION IF YOU ARE NOT READY TO LOAD.

YOU CAN BRICK THE CPU!!!

Once you begin the Program Update process, there is NO turning back. If you stop

A new addition to the RF Switch is the ability to update the software via WiFi. You need to have your browser open to the Main Menu. The URL at the top will be the IP address of the RF Switch. For this example it will be 192.168.1.1

Your stored credentials are not affected by this update.

### Procedure:

1. Using your PC browser, go to <https://github.com/team-xcr> (or <https://github.com/w0iy>)
2. Navigate to the 4 Way RF Switch repository
3. Select the file [RF\\_Sw\\_xxxx.ino.esp32.bin](#) This is the executable  
This is a binary file compiled for the RFW CPU.  
Download the file and remember where it is located (sub-directory)
4. Select the file [RF\\_Sw\\_xxxx.spiffs.bin](#)  
This is a binary file with all of the supporting HTML, TXT and PNG files.  
Download the file and remember where it is located (sub-directory)
5. Using the PC browser, go the RFS Main Menu.  
The URL will show 192.168.1.1/index.html (or whatever IP you are using)
6. Edit the URL to be: 192.168.1.1/update and hit Enter
7. The page will update to show the Elegant OTA page.  
Select the FIRMWARE button  
Select Browse  
  
<<< insert pic ???????????????? >>>>
8. This will open a window with FILE EXPLORER.  
Navigate to the directory containing the [RF\\_Sw\\_xxxx.ino.esp32.bin](#) (executable) file you downloaded. NOTE the **INO** in the file name.  
  
<<< insert pic >>>>
9. Double click on the bin file.  
The OTA feature will begin to upload the file. It takes about 15 seconds.

Wait for the BACK button to appear.

10. This shows the Elegant OTA page.  
Select the FILESYSTEM button  
Select Browse
11. In the File Explorer, navigate to the directory containing the [RF\\_Sw\\_xxxx.spiffs.bin](#) (**executable**) file you downloaded. Note the **SPIFFS** in the filename.  
<<< insert pic >>>>
12. Double click on the bin file.  
The OTA feature will begin to upload the file. It takes about 15 seconds.  
Wait for the BACK button to appear.
13. Using the Browser BACK arrow, return to the Main Menu.

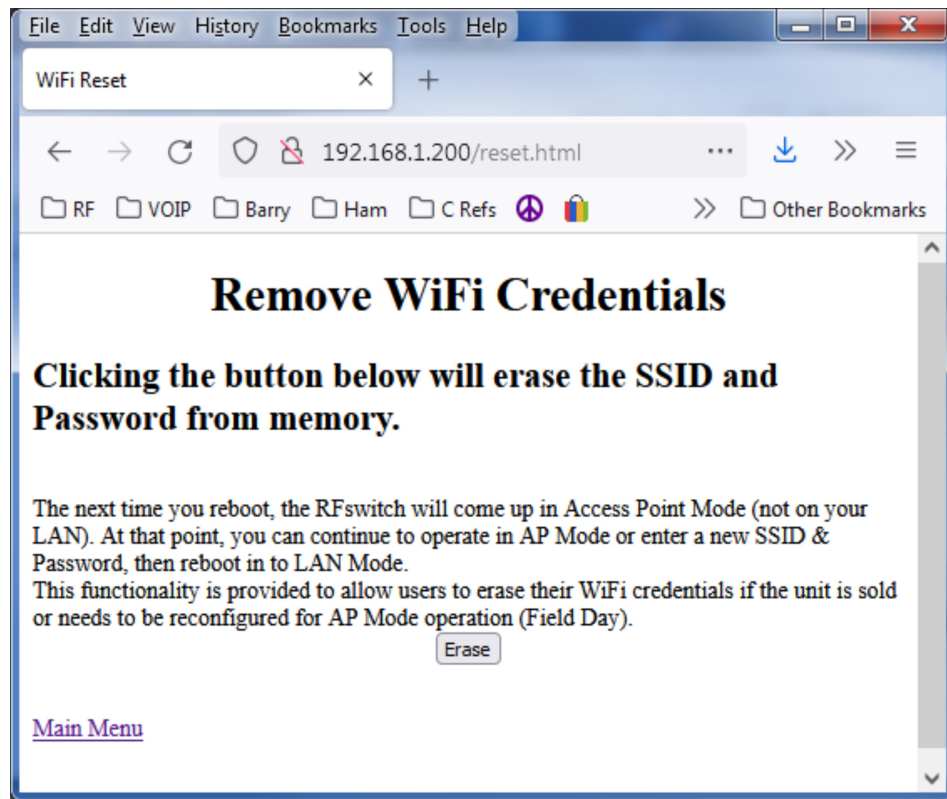
At this point the CPU will reset and begin to operate with the newly loaded software. All of your custom data will be retained. There is some chance the CPU will not return to LAN mode after a update. You may have to cycle power or reset the RFS once or twice before it returns to LAN mode.

You may retain .bin files and load a previous version if you desire. There is no configuration function to prohibit this process.

## 2.4 Factory Reset

This page allows you to erase the contents of the WiFi Configuration. If you change WiFi credentials or wish to use the RFS without a LAN, you may erase the data.

Note that if you operate the RFS away from your LAN, the device will attempt to connect, fail and switch to Access Point mode. When you return home, the LAN will be connected automatically.



*Illustration 4: LAN Reset Page*

## 2.5 Help

This page has a minimal description which may be useful. There are also links which you may select to go to the Team-XCR web page (provided you have an internet connection).

## 2.6 LEDs

There are several LEDs on the RFS which convey different information.

### 2.6.1 CPU Power LED

This GREEN LED indicates that power is applied to the CPU PCB. It should be moderately bright. If it is dim or flickers, check the power source to the RFS.

### 2.6.2 CPU Activity and Status LED

As an indicator of CPU activity, the BLUE LED blinks every 3-5 seconds. This indicates the CPU is alive and performing as intended.

When the user selects an antenna, the BLUE LED illuminates for about 2 seconds, followed by brief flashes indicating the number of the antenna selected (1, 2, 3, 4). When Ground All is selected, there is a long flash, but no short blinks.

After a few seconds delay, the LED returns to showing normal activity blinks.

### **2.6.3 External LED**

The external LED operation is identical to the BLUE activity LED when an antenna selection is made. There are no “activity” flashes as this may attract unwanted attention to the RFS. To visually confirm the RFS is operational, just select an antenna.

If no external LED is desired, simply omit the installation of the device.

### 3 Need Help?

Please email questions to: [barry.w0iy@gmail.com](mailto:barry.w0iy@gmail.com)

You can expect an answer in less than 24 hrs.

Please join the Team-XCR user group at: <https://groups.io/g/team-xcr>

You **MUST** have the WiFi antenna connected. Without the antenna range is only a few inches!

#### 3.1 Serial Port Debugging

If you are having trouble with the WiFi setup or operation, the best thing to do is connect a computer to the USB port on the CPU board.

For Win PCs the open source Putty program is commonly used. It is available as a free download. You will need to install Putty and configure it for the RF Switch.

On the Putty configuration screen, select “**Serial**” (round button)

Set the speed to **115200**. Y

ou may have to select a different Serial Line (Com port) depending on what is plugged into the PC.

Select Open to activate the

The screen will display messages regarding the state of the program and WiFi parameters. This can be of value in determining if the WiFi connection to the LAN has been made or if the RF Switch is in AP Mode.





