RF Switch User's Manual

and

4 Way Remote Switch Assembly Instructions

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Team-XCR

Your e**X** **C**ollins **R**adio friends from Cedar Rapid, IA.

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1 Introduction

This project is an all-inclusive[1] Remote RF Switch (RFS) which provides a convenient way to remotely select HF antennas. The Switch uses Power-Via-Coax and WIFI (browser) for control.

The user interface is entirely via a web browser client such as Linux, Firefox, Edge or Google. This can be a small window open on your logging PC or phone etc. Simply click on the desired antenna and the connection will be made.

The RFS uses a browser interface which provides a convenient user interface using a PC, phone or tablet. The RFS will need to be configured “or provisioned” to work with your WIFI in your home. In additional a good WIFI signal between your home router and the location of the internet switch is necessary.

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

Note:

The basic kit does not include the “Bias-T”. A Bias-T is a device located in the shack which allows DC injection over the coax line going to the RFS. You can purchase this from W0IY or from other sources.

1.1 Amateur Radio Kit

This project is presented for amateur radio use and enhancement of your shack operation. The kit is a collection of parts which, when properly assembled and operated, provide enhanced control of your shacks operation by allow you to remotely select 4 antennas over a single coax.

Tip

*The provided enclosure is suitable for mounting in a garage or under and eve. It is **Weather Resistant**. Depending on your environment, a conformal coating may be applied to prevent corrosion or moisture accumulation on the PCB.*

The kit has a very low parts count and uses standard through-hole parts. The user, on average, should be able to be assemble in less than 4 hours. This guide will provide the step-by-step approach to install and build your kit. I would encourage you to read over and review the photos of the kit and determine if this is in your capabilities.

User Assembled Parts

Capacitor	15
Resistors	5
LEDs	6
Relays switch’	4
Headers	1
Metal Shelf	1
Mechanical PL259/ SO239 mounting in enclosure	5

If the kit assembly or operation is beyond your skill level, consider asking a fellow amateur for assistance or return the unassembled kit for a full refund of the kit price (shipping costs not refundable).

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 or adapt this project for other applications, please email the details of your intended operation. A number of people are using the antenna switch to control antenna selection for contesting, and DX'ing.

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.

1.3 Lightning

The Antenna 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.

If you have questions on Lighting protection, please see the follow links from the ARRL.

http://www.arrl.org/lightning-protection

Installation of this Switch indicates your acceptance of this responsibility.

Notes

1. 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.
3. http://www.arrl.org/lightning-protection
4. http://www.arrl.org/files/file/QST/This Month in QST/June2017/Chusid-Morgan.pdf

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 Internet-of-Things (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 security for your network.

Network setup and provision of the WiFi credentials for the RFS to your LAN will be describe after the build of the switch.

1.5 Antenna Matching

If you are unfamiliar with antenna matching, please search the internet and do some learning this will also help you get the most out of your antenna system and radios.

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

NO LONG WIRE or RANDOM WIRE ANTENNAS!

This is NOT a limitation of this RFS. It normally a fine print caveat for all antenna switches.

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

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 or high currents which may be beyond the design parameters and will likely **damage the switch**.

1.6 Isolation Design of the Antenna Switch

The antenna switch as a design was tested to get the best antenna port to antenna port 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 (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 RF Switch Assembly Instructions

In all cases where this text refers to “Install” components on the PCB, this indicates the leads should be bent, the component installed on the PCB and that it be soldered. Use only the minimum of solder necessary to ensure a good connection, not a large round ball of solder.

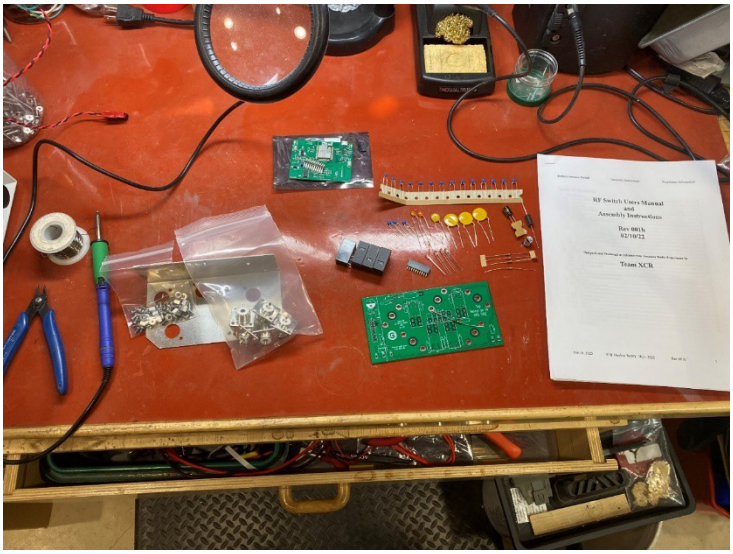
Please read through the complete instructions section 2.1 to build the switch and look over the photos to make sure it is clear prior to building the antenna switch.

PLEASE read the Options section Chapter 4 as you may want to incorporate some changes to the standard build. The option section refers to how you want your switch ground the antenna ports when the antenna switch is not powered. It will require modification to the PWB prior to building.

The Switch requires a 12v power supply or wall wart to test and verify operation. Equipment to solder, and build the board. Wire clippers and other kit building supplies such as flux, screw drivers, etc.

The Switch is a combination of 2 printed circuit boards (PCB) and one mechanical hardware PL259/ SO239 and mechanical plate for mounting.

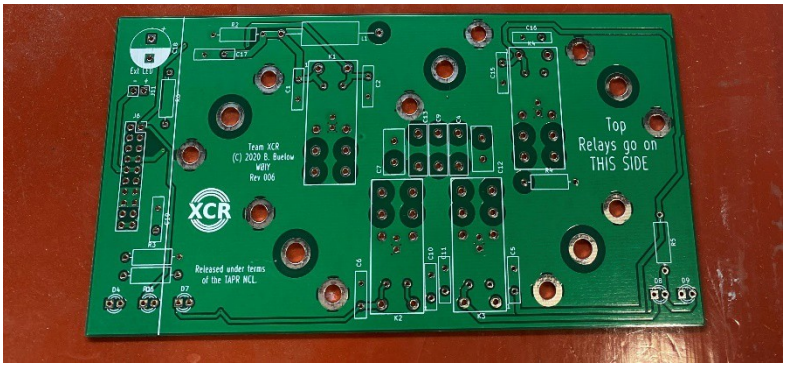
Getting Ready for assembly of the Antenna Switch



Get your kit on the bench and get your parts and boards organized this photo has extra parts, but as you can see a soldering iron, solder, wire clippers, and your instructions.

Antenna Switch CPU board

The only item installed on the CPU board is the header jumper. Please keep this on the Static protected bag, make sure to practice good Electro Static Discharge (ESD) protection when handling this board, rare but it could be damaged by static discharge.



Antenna Switch relay board

This the relay board showing the top side. The top side is the side where most of the components are installed – the back side of this board will have 4 capacitors installed. The larger holes will be for solder the PL259/ SO239 coax connectors to the board. (this the last step) …

It is important to know what is the bottom of the plate this will be further defined later. But the plate is now showing the bottom of the plate.

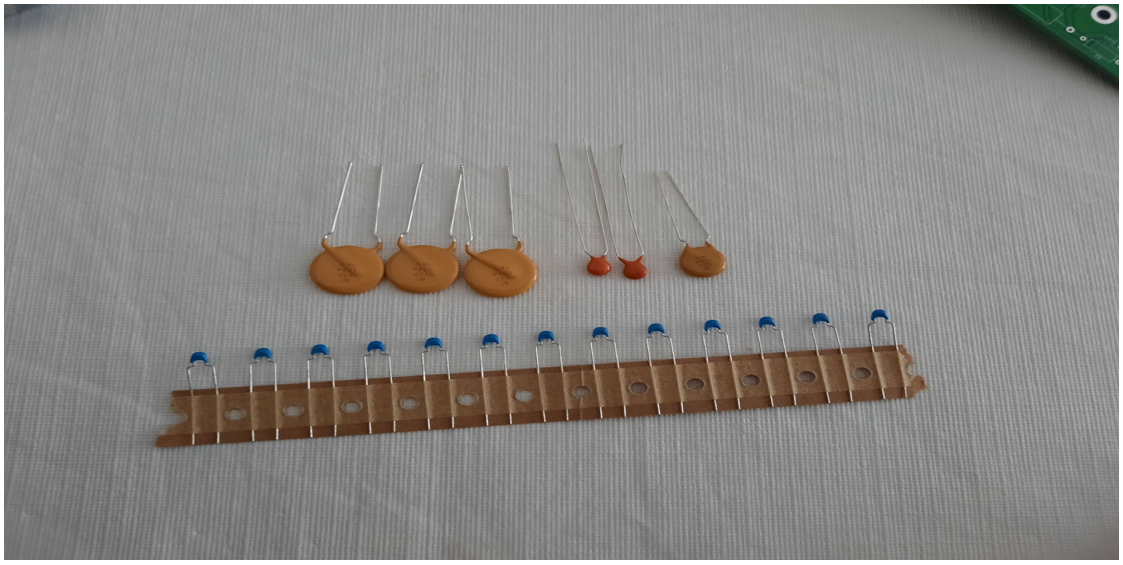
Mechanical Plate (Shelf)

2.1 PCB and Switch mechanical Assembly

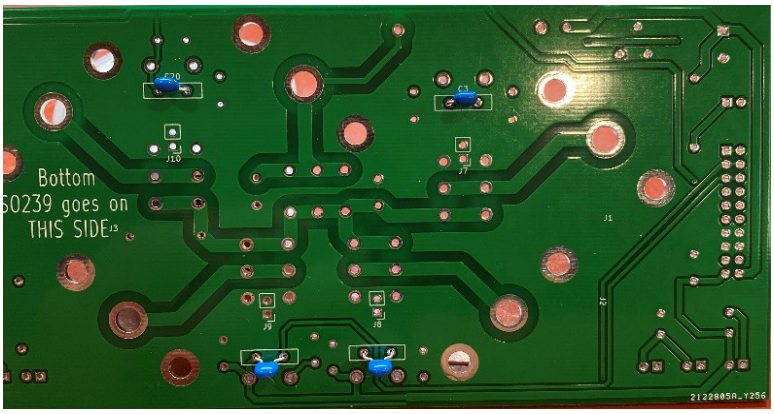
The Switch PCB is user assembled and requires soldering. It is important to establish the Top and Bottom of the PCB. The relays and most components are mounted on the TOP side. The SO239 are mounted to the BOTTOM side. The silk screen indicates the Top and the Bottom.

This section of the instructions only will install the capacitors to the board we will later tell you when to install the resistor, LEDs and relays and PL259/ SO239 coax connectors.

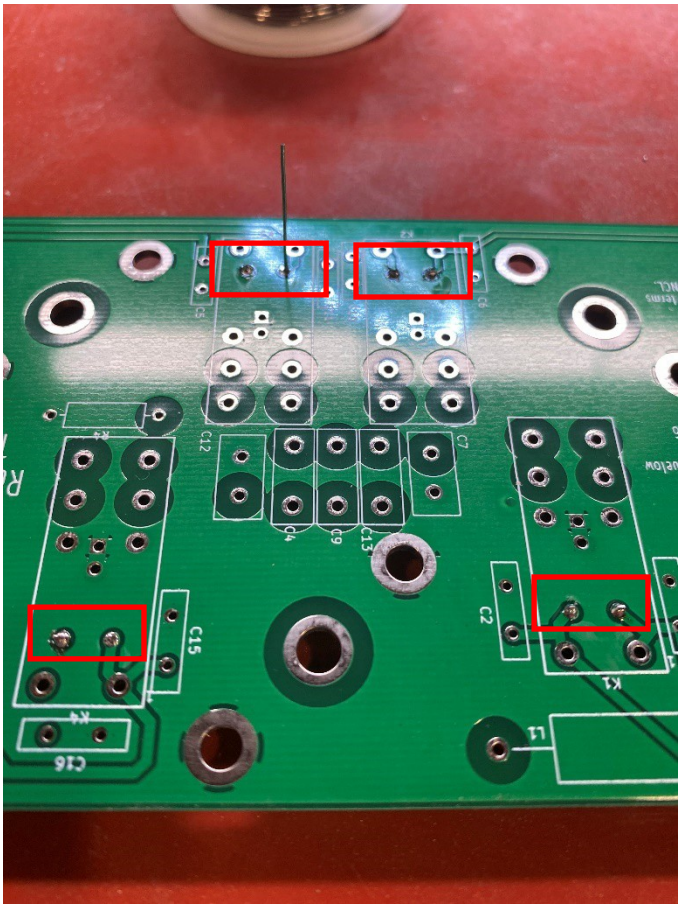
1. Identify the various capacitors. Most of the caps are 0.01uF, but they have different voltage ratings.
   - The long strip are .01uf @ 50V. Four of these will be installed first. Marked 103 on the capacitor.
   - The 3 large caps (C4, C9, C13) .01uF @ 1KV pass RF, but block the DC path in the Bias T portion of the circuit.
   - A single medium size cap (C17, may be orange or yellow) is used as a bypass cap after the inductor.
   - **See box in red below** ----- NOT REQUIED → 2 small caps (C12, C13) 6.8pF are used for impedance matching. Do NOT install. (Note: this is included in the build notes for kits that had be shipped with these capacitors. If your kit has this caps please keep them and do not install on the board.



1. Install and solder 4x bypass caps (.01uf @50V) (C3,C8, C14, C20 – marked 103) on the **Bottom** side of the PCB. Apply a small amount of solder to the bottom side. After soldering, clip the Top side leads flush with the PCB as the relay will be mounted over the pads. Do no use a large amount of solder on the top side as the relay will be mounted over these pads.

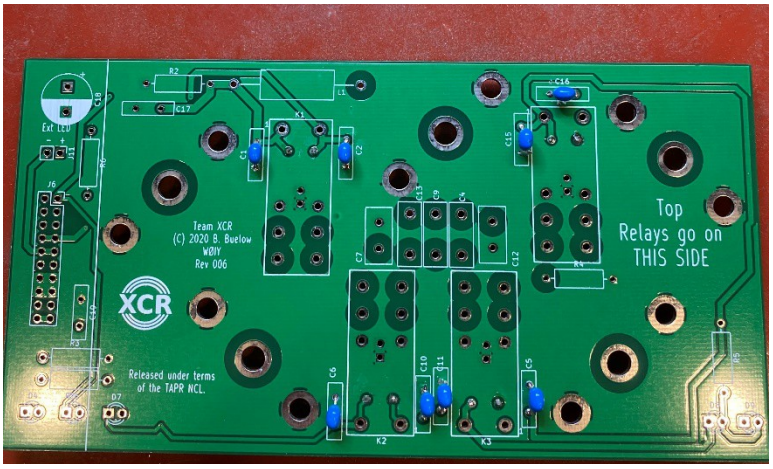


See the 4 capacitors installed on the board, in the next step we will turn the board over and observe and clip the leads. This is a important step to insure that you are able to install the relay flat to the board.



The red box shows the locations of the capacitors that come up from the back (this is showing the top of the board). One of the leads is not cut yet for reference. Please ensure the leads are cut close to the board and no huge amount of solder will prevent the relay that is eventually installed over them.

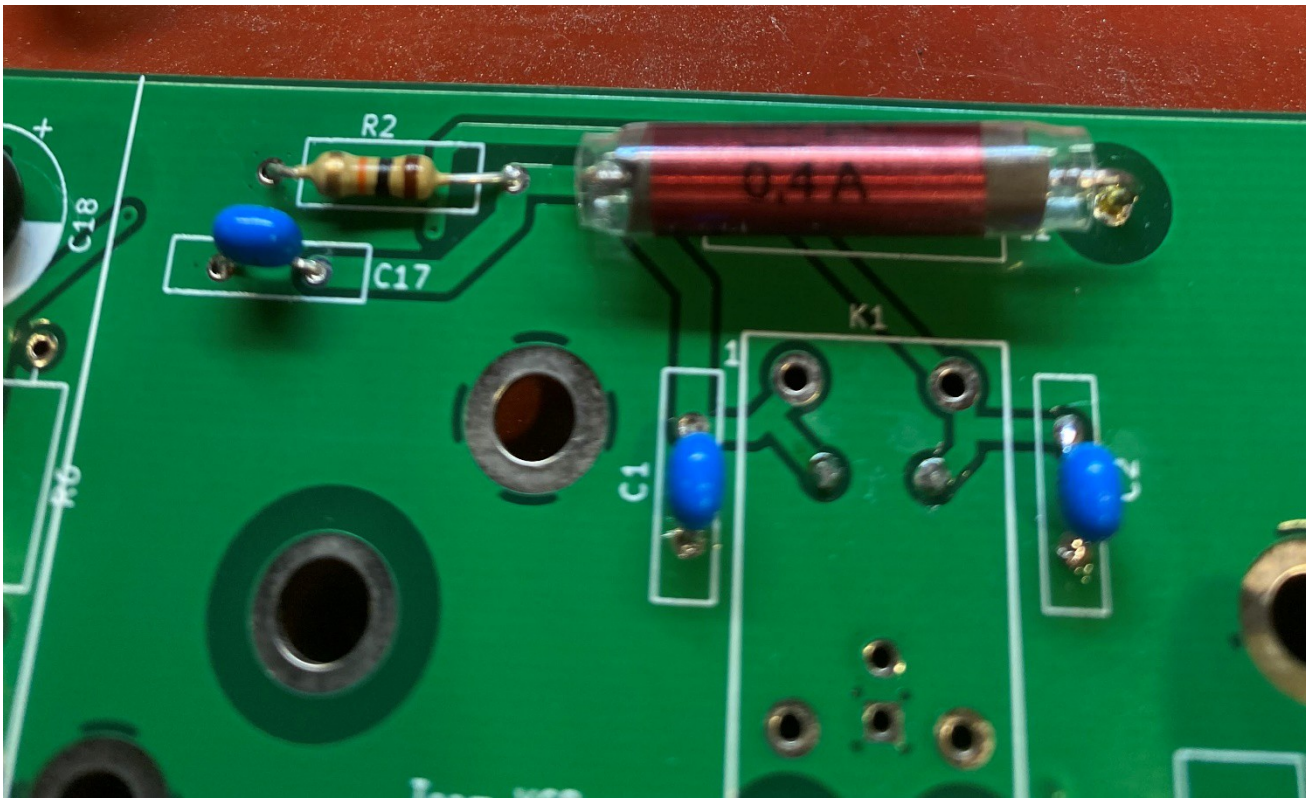
2. Install and solder the relay coil **bypass caps** (.01uf @50V) on the TOP side of the PCB. These should be installed tight to the PCB and not interfere with the relay mounting.
   Qty: 8 Marked 103 50V C1, 2, 5, 6, 10, 11, 15, 16



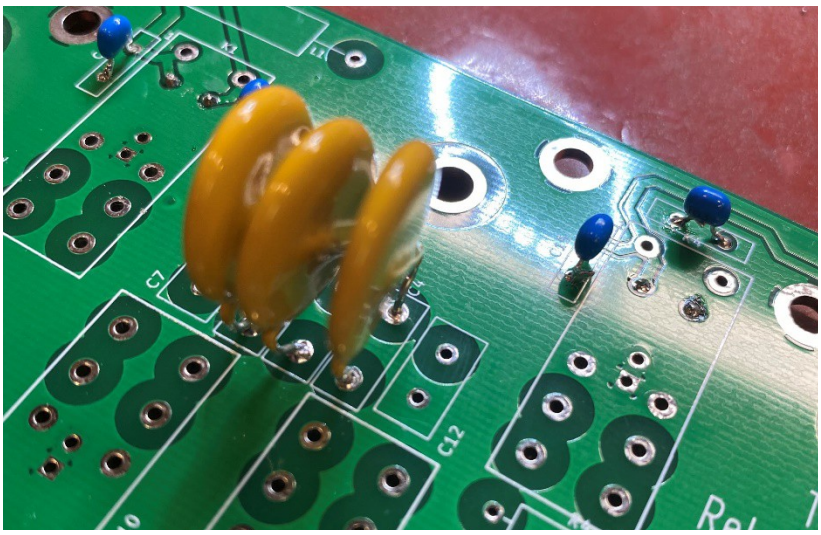
At this point you have installed 12 of the capacitors that are used with the relays of the switch. 8 on the top of the board as seen here, and the prior 4 on the back of the board.

3. Install and solder the Bias T components to the Top side (upper left of board).
   L1, R2, C17 are located towards the top rear of the PCB.

L1 is a wirewound coil (see red component below), Marked EPCOS
R2 10K, (Brown, Black, Orange)
C17 .01uF Marked 103



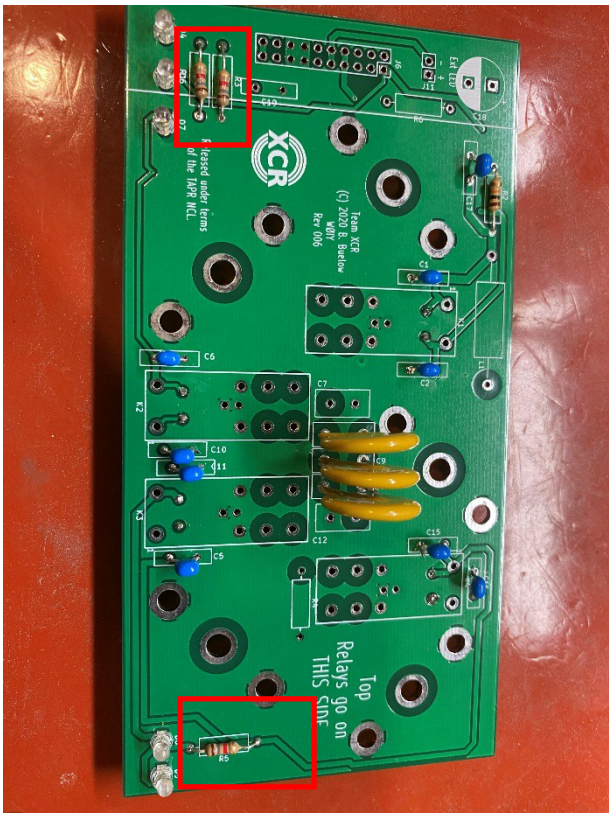
4. Install and solder the LARGE series Caps (.01 1KV 3x) (C4, C9, C13) near the Top center of the PCB.



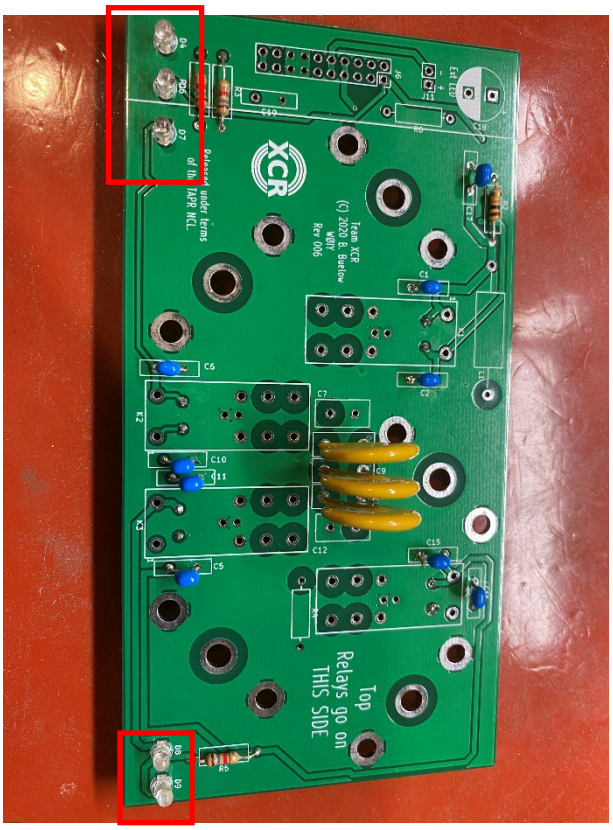
All three are the same and install.

5. Do NOT NOT NOT install shunt caps (6.8pf 2x) (C7, C12) near the Top center of the PCB. These are NOT required as the PCB impedance is near 50 Ohms.

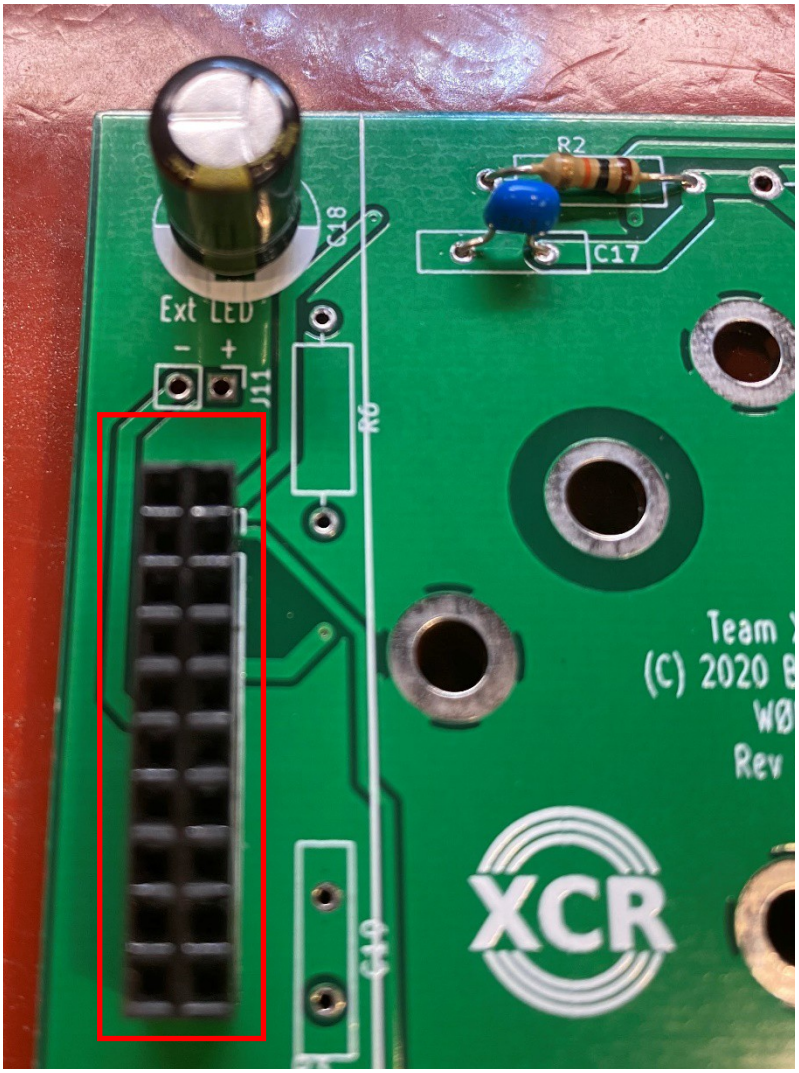
6. Install LED dropping resistors (1.8K 3 resistors color Brown, Gray, Red) on the Top side of the PCB. See red box in photo below.
   R5 on the lower right
   R3 on lower left
   R1 immediately below R3



7. Install and solder the LEDs (5x). See Red box in photo.
   <u>NOTE – LEDs are polarized and need to installed properly:</u>
   SHORT lead goes in the SQUARE pad
   LONG lead goes in the ROUND pad



8. Install and solder J6 2x10 **Female** straight header connector. Install C18 Cap. Verify polarity on the cap. The strip is on the negative see board.

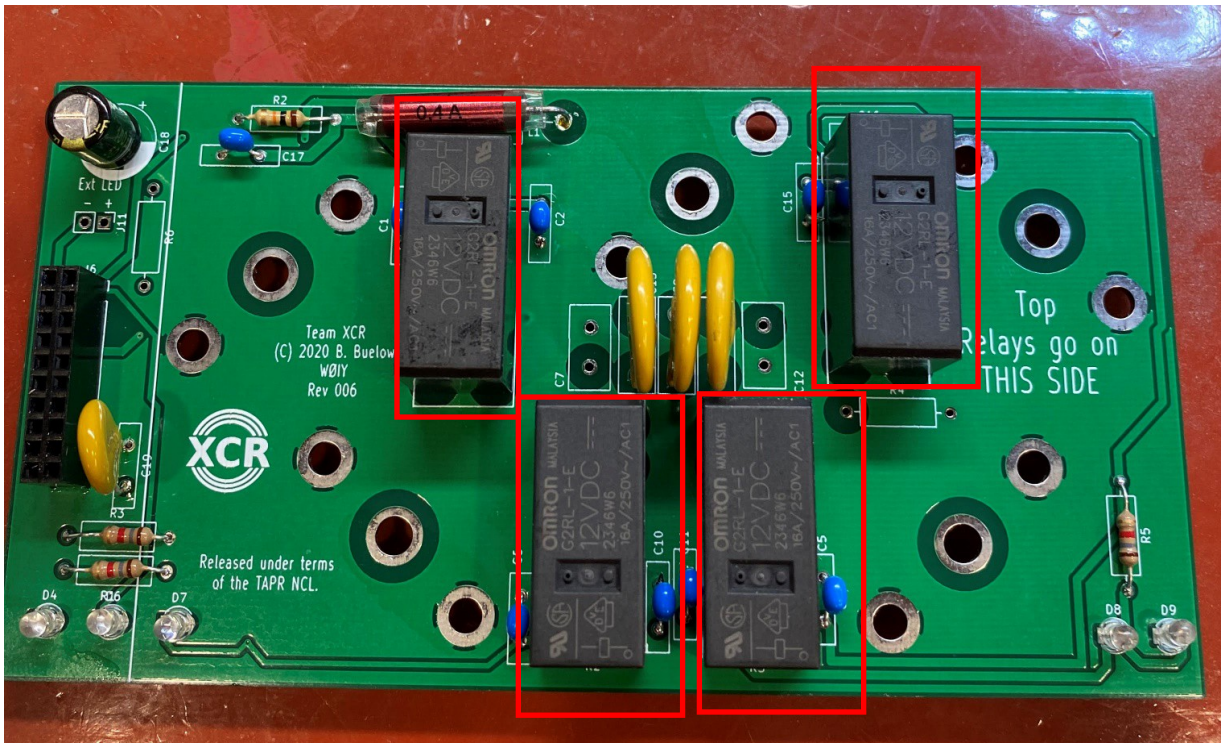


C18

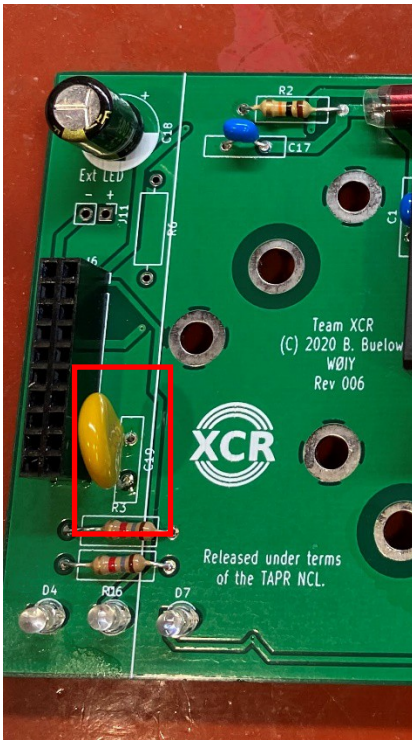
Make sure it is oriented correctly before soldering. This is the only polarized capacitor in the kitand needs to be orientated correctly on the PWB. See the 2 row connector is also installed in this step.

<u>NOTE – check the section on Options (Section 4.2) if you do NOT want unused antennas to be Grounded.</u>

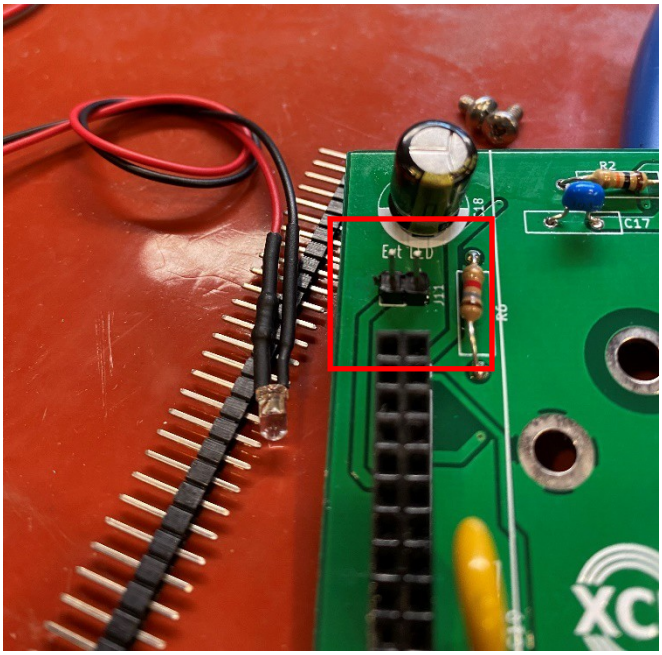
9. Install (Top side) and solder the relays (G2LR 4x). These only fit one way. Please make sure they are flat to the PWB. Remember you may have those capacitor leads that stuck up from the back side..



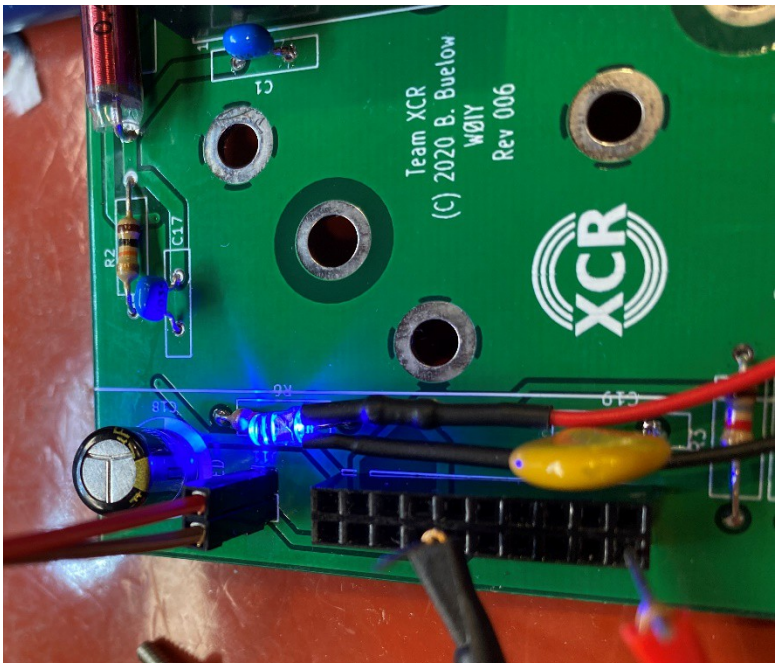
10. Install (Top side) and solder the C19 1 KV Marked 103. This is the capacitor that is located next to the Connector.

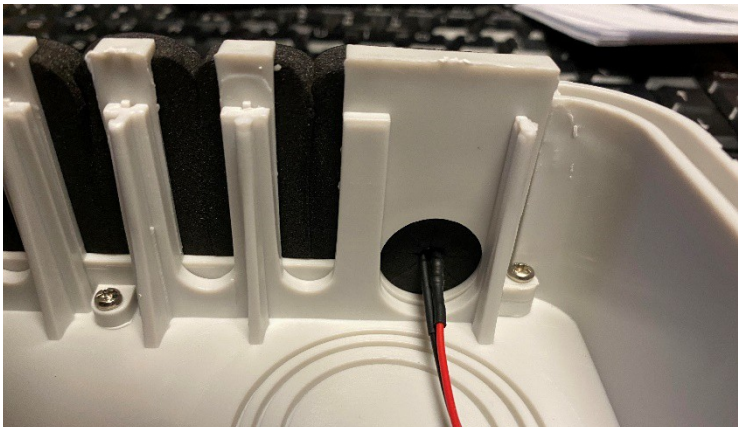


11. The last step is to setup a remote LED – this is user choice. It is not required but when the Antenna Switch is powered the LED will be on. This includes installation of the 1.8K 1 resistors color Brown, Gray, Red. I suggest that this LED be on a cable to allow the LED to be installed on the bottom of the case in the "round hole" in the case. The bottom foam can easily cut or burned with your soldering iron and punch the LED through the hole. If the antenna switch is mounted upper higher like on a tower this will allow you to see if the LED is lighted and power is getting the switch from the Bias-T over the coax.
12. Add small diameter Red/Black wires (not provided) to the 5mm LED. The wires should allow the LED to be placed out the about 1" out the bottom of the enclosure. Insulate the leads all the way to the LED plastic body to prevent shorts.
    Black wire to LONG LED lead
    Red wire to SHORT LED lead
13. Connect the Red/Black wires) from the LED to the Switch PCB J11 located near C18.
    Note the polarity must be correct or the LED may be damaged.
14. Route the wire through the bottom moisture barrier and orient the LED to point towards the shack. When the user commands the Switch to change antennas, the LED will blink the number of times associated with the selected antenna. Once for antenna 1. Twice for antenna 2, etc.



To make the led remote and removal the cable - you can use a header pin and install this in the PWB.





This is showing the LED going through the foam and the led than can be seen from outside the box.

2.2 PCB Testing

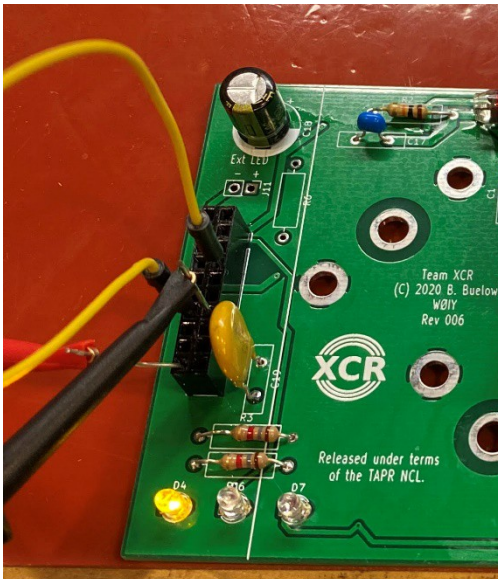
Do NOT install the CPU/Control PCB!

Note that J6 is on the Top Left of the PCB. This is a 20-pin connector. Pin 1 is at the Top of the connector on the Inside of PWB(right). It has a square pad. Pin numbers are arranged:

Pin 2		Pin 1	Relay 1
Pin 4		Pin 3	Relay 2
Pin 6		Pin 5	Relay 3
Pin 8		Pin 7	Relay 4
Pin 10		Pin 9	
Pin 12		Pin 11	
Pin 14	LED D5 SW2	Pin 13	LED D4 SW1
Pin 16	LED D7 SW4	Pin 15	LED D6 SW3
Pin 18		Pin 17	
Pin 20	12V + positive	Pin 19	12V + positive

1. Apply +12VDC via J6-19/20(+) and Ground to J6-13/14/15/16. For example, apply 12v positive to pin 20 and ground pin 14.
   1 - LED (Power indicator) should illuminate
   If the LED does not illuminate, check the voltage and polarity of the test power leads.

2. Prepare a jumper wire with male pin on both ends. See photo of test setup. With your 12v supply attach the positive on Pin 20, Ground is connected to ground Pin 13. The board should have the power led on (the prior step). With the test cable (yellow in pin 14) and the other end in Pin 7. This will light the led and click relay 4. This should also make the relay 4 click on. Without changing power positions walk the Pin 1,3,5,7. Below we can step through the individual relays. (Note: this photo does not have the LED for power installed I will need to update the photo).



3. Repeat using pin 1 for Relay 1 and LED D7
4. Repeat using pin 3 for Relay 2 and LED D7
5. Repeat using pin 5 for Relay 3 and LED D8
6. Repeat using pin 7 for Relay 4 and LED D9
   If you can hear the relay, but the LED doesn't illuminate, the LED may be installed backwards.

2.3 CPU PCB

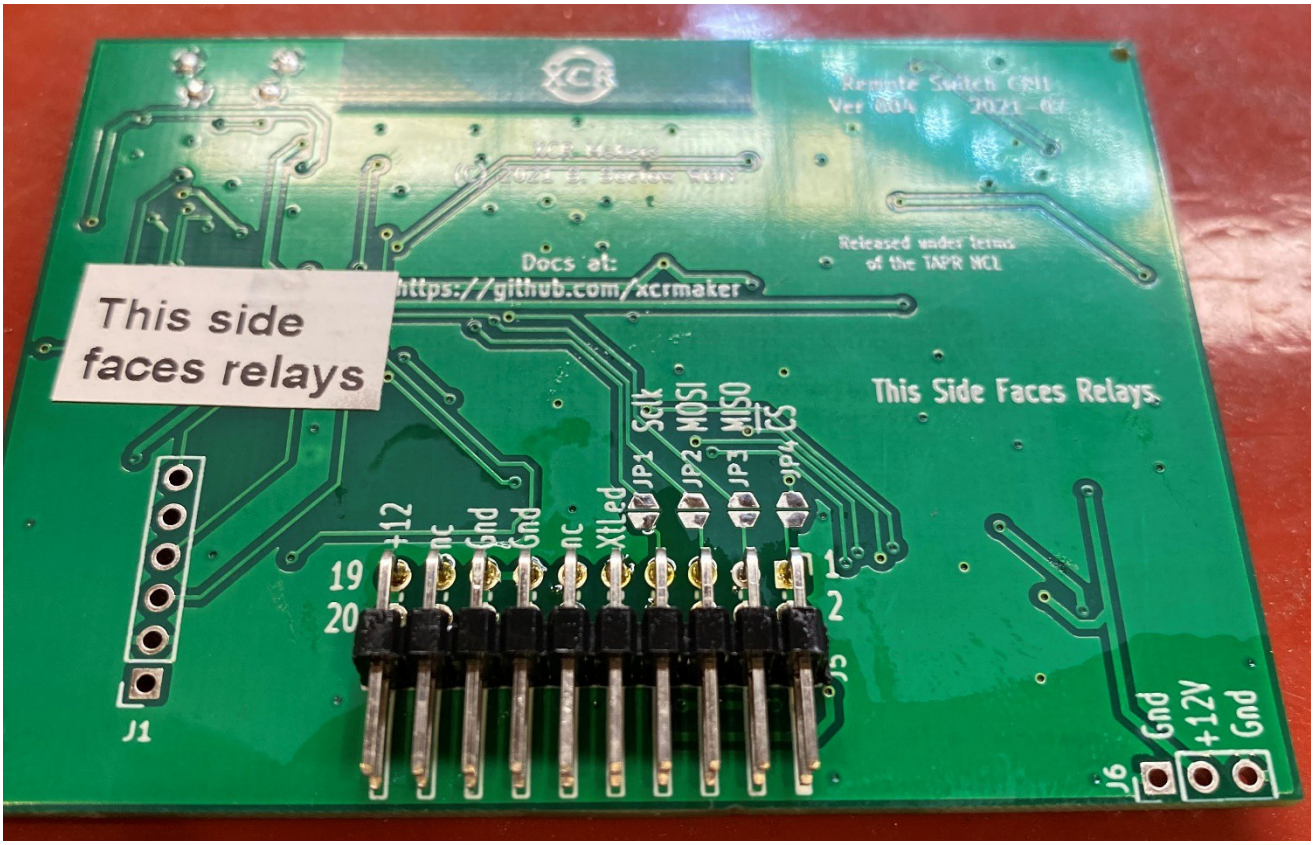
The Control comes mostly assembled, programmed and tested. You may have to install the male 90-degree header.

PLEASE PLEASE PLEASE USE CAUTION when handling the Control PCB as IT IS STATIC SENSITIVE!

2.3.1 CPU PCB Assembly

Install J5 the 2x10 pin male header on the BACK side of the CPU board. Place the shorter pins into the PCB. The black plastic should be positioned as shown in the figure.

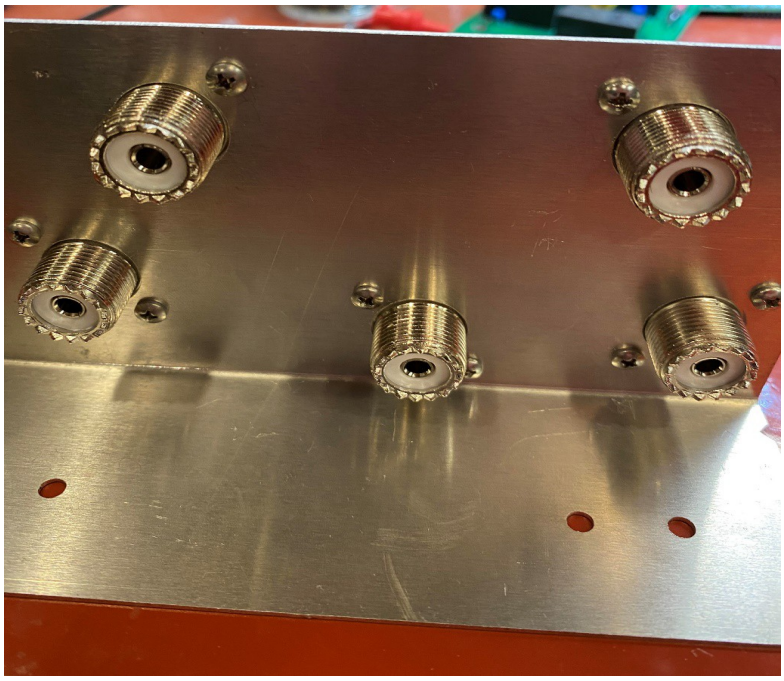
1. Align the pins parallel with the PCB surface and Solder one pin.
   Examine the pin alignment. If necessary, briefly heat the previously soldered pin and adjust the alignment.
   When it is correctly aligned solder the other pins.



2. Install the cable from the WIFI antenna to the CPU. Carefully align the small connector and snap it into place using a hard flat tool. Use even pressure to ensure the connector goes straight down, not at an angle. This should be done once. The connector is fragile and is a surface mount device. Be Gentle!
   If necessary, you can remove the coax connector using a knife tip to lift the connector directly up.

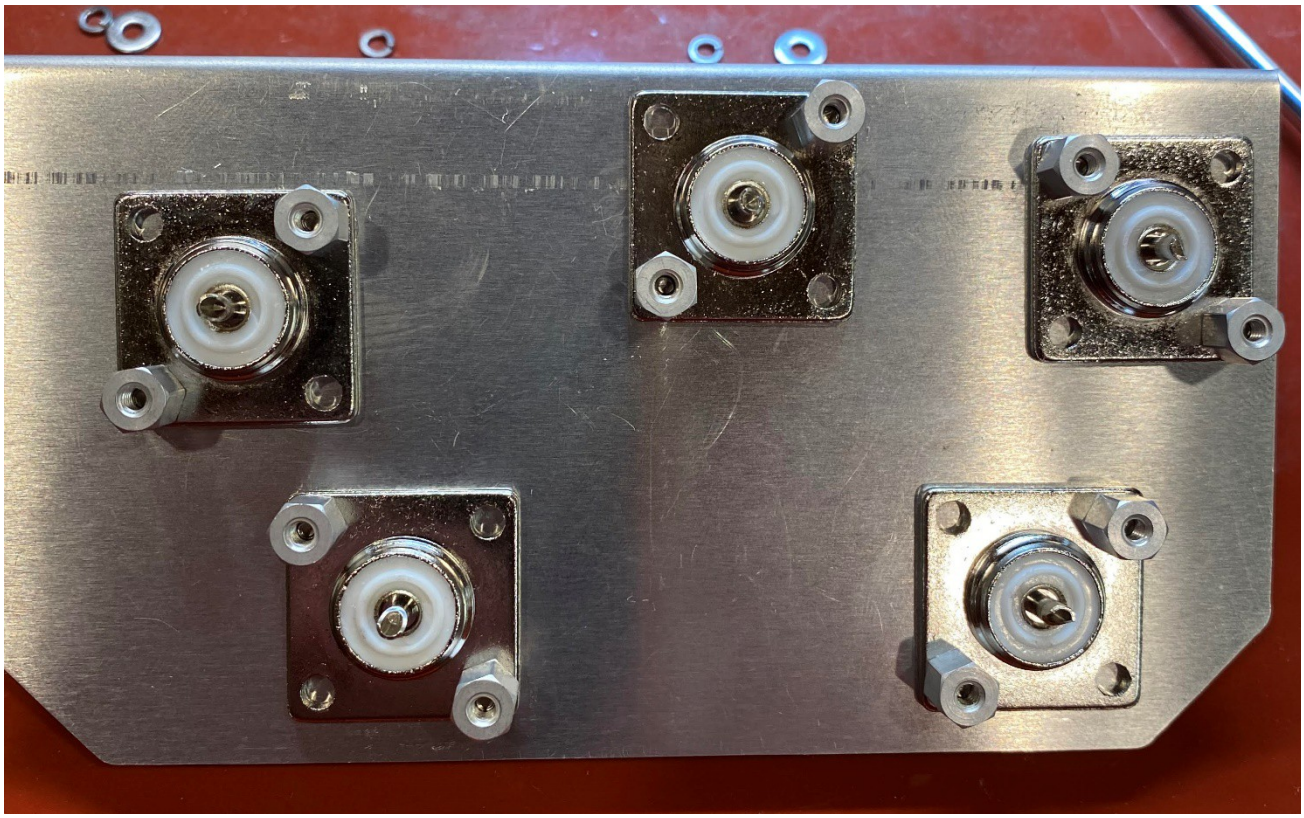
2.4 Mechanical Assembly

1. Mount the 5x SO239s to the chassis using #4-40 x 1/4” screws (the slightly longer of the 2 sizes provided) and 4-40 x 1/4” hex posts. The connectors are mounted on the top of the plate and extend through the shelf. See how the plate is bent this is looking from the bottom. The 3 holes will be used to mount the plate and switch to the enclosure.



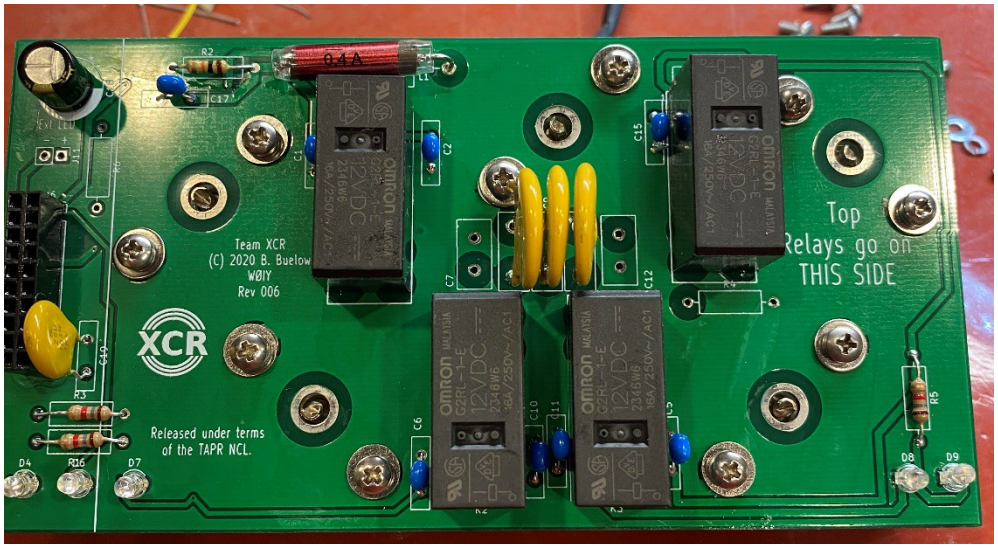
Carefully examine the following figure for proper placement of the SO239 body.
The SO239 body must be mounted flush on the TOP side of the shelf.

GENTLY tighten the hex post. It may be necessary to adjust the connector position later. The photo below shows a view of the plate that will be installed to the bottom of the Switch board. The center pins will be solder to the PWB and the Hex posts will be attached to the PWB with longer screws without any lock washer or washer (see photo above) .



2. When all SO239 are installed, place the assembled PCB over the SO239s. You may find that not all of them are aligned. Adjust the SO239 as necessary and use a screw driver and nut driver to tighten the screws through the shelf and connectors. 10X Hex nut on the connectors above.

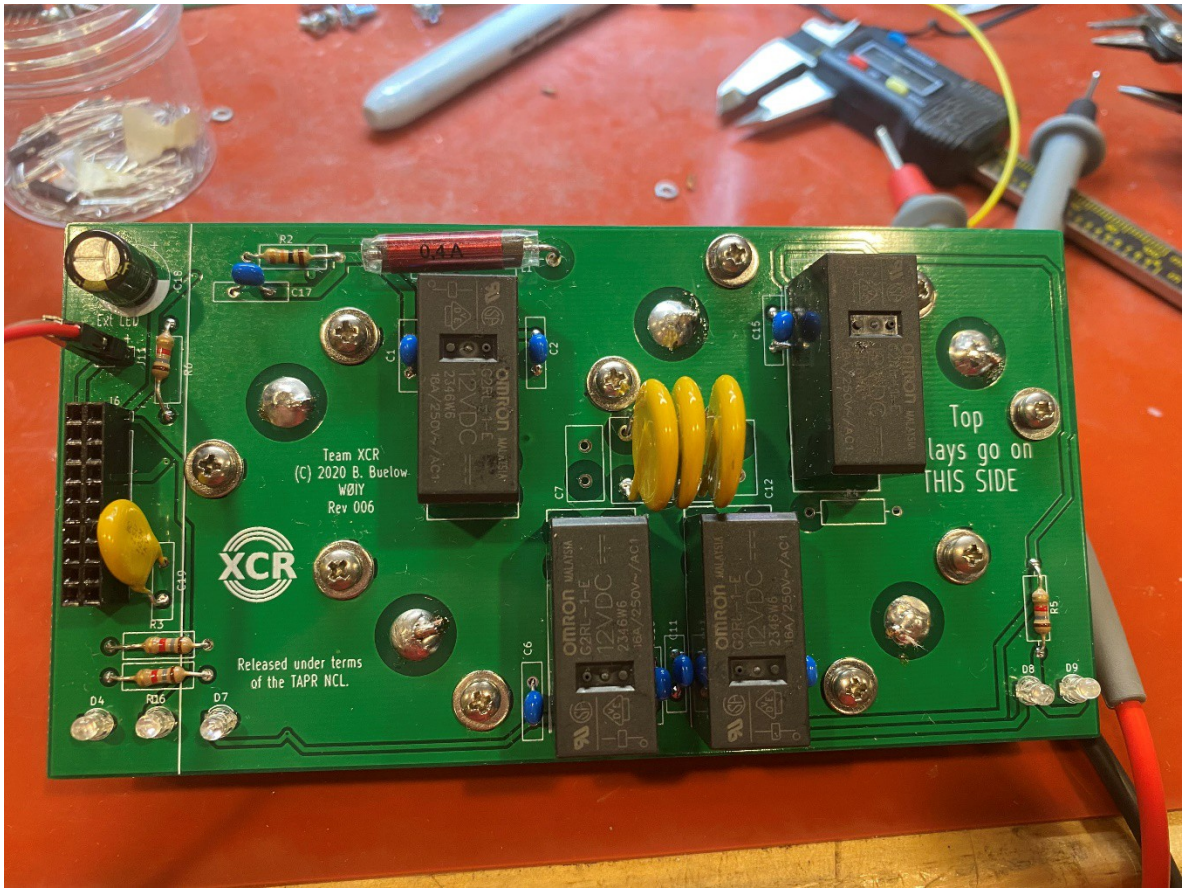
3. Mount the assembled PCB using #4-40 - 3/16” screws (slightly shorter than 1/4”), using the lock washer and washer. See photo below. Tighten all of the screws top to the hex posts below.



4. Solder the SO239 Center Pin to the PCB. Depending on the alignment, you may need to use a short piece of wire to bridge the gap from the center pin to the PCB ring. A short piece of #14 copper is suggested. Insert one end into the SO239 solder cup and the other onto the PCB ring.

   Do NOT apply a large amount of solder to bridge a gap as this will just run down and lay on the connector insulation. Potentially causing a path to Ground.

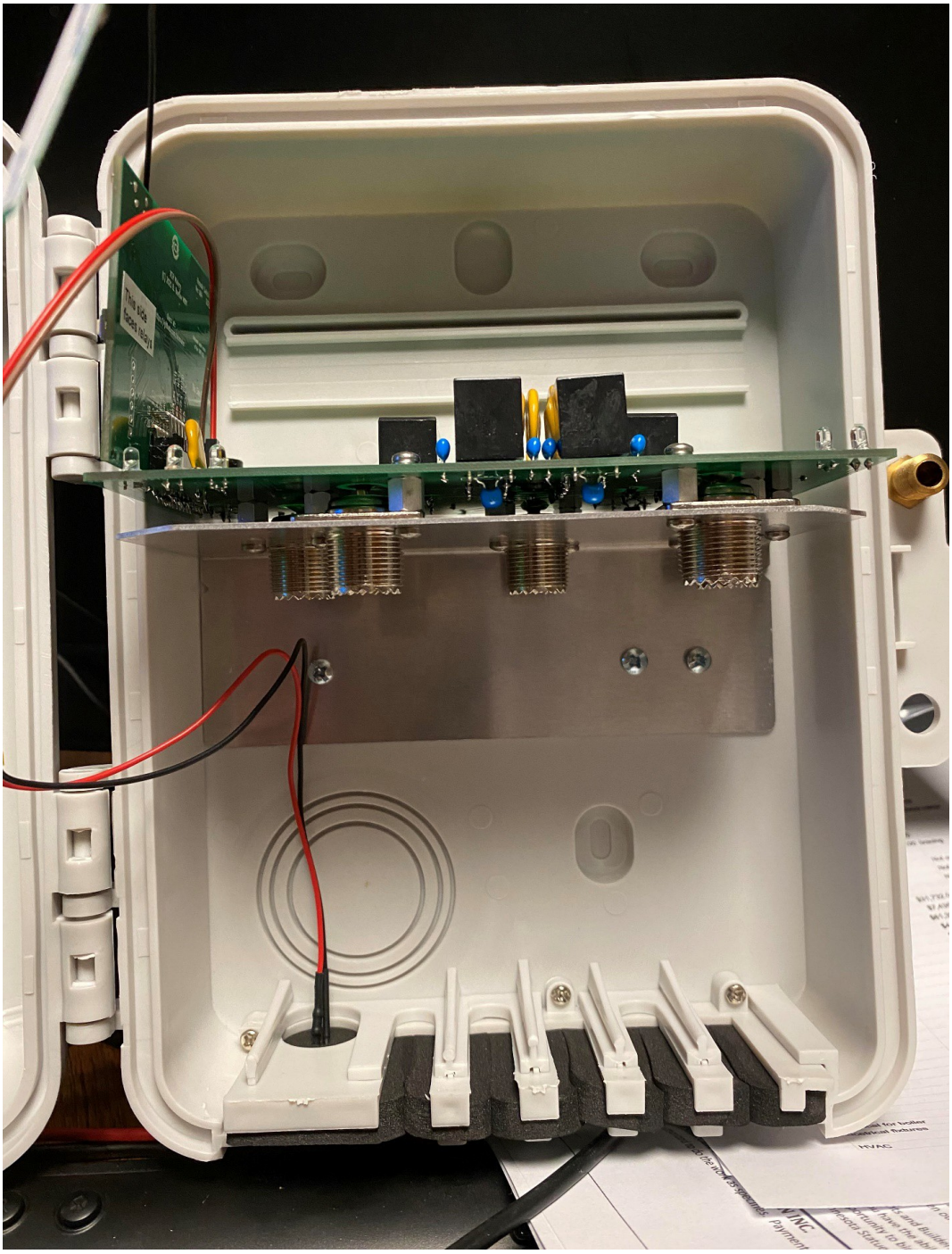
Here is the final assembled board looking form the top of the switch board. Take some time to review and ensure that every part is installed.



2.5 Installation in Enclosure

1. Remove power from the Switch.
   Observing Anti-Static precautions, carefully remove the CPU Control board.
2. Install the main pcb and shelf bracket into the enclosure. The screw holes should align with a slot near the top of the enclosure. Be sure to leave room to install the CPU board without interfering with the enclosure. The CPU board is 2.25” tall.
3. Use the pointed metal screws (2X) to attach the shelf assembly to the enclosure. DO NOT OVER TIGHTEN as you will strip the plastic. Do NOT use longer screws which may penetrate the rear of the enclosure and allow moisture to enter.
4. Verify that the Switch assembly is NOT powered.
5. Install the CPU PCB by plugging it into the socket on the Switch assembly. Look at the notations on both PCB to ensure it is facing the correct direction. The large metal CPU should be on the side **OPPOSITE** the relays.
   There is NO keying in this connector. Align it carefully!

One of the two shelf mounting holes may be used as a location of attaching a GROUND wire to the switch. This is **HIGHLY RECOMMENDED**.



2.6 Bias T Assembly

In order to put 12VDC on to the coax to the RFS, a Bias T is used. The simple device allows +12VDC to flow through a choke on to the main RF path (coax) while simultaneously preventing the DC from flowing IN TO the radio. This DC blocking function is done with simple capacitors.

Note that the Bias T must be installed in the proper direction to allow the DC to flow to the RFS and prevent the DC from flowing into the Radio.

Assemble the Bias T by installing:

1. 3x 0.01uf 1kv capacitors
2. 1x EPCOS inductor
3. LED, DC barrel connector
4. Drill the enclosure to allow mounting of the SO-239s (2x)
5. Drill the enclosure to accommodate the hex posts which will mount the PCB. You can use the PCB as a template for the 2 holes. #4 screws are provided.
6. After assembling the PCB, mount it to the enclosure using #4 hardware and hex posts.
7. Mount the 2x SO-239s
8. Use a short piece of #14 wire (not provided) from the SO-239 to the PCB.
9. Test the Bias T by applying +12VDC.
   Observe the LED illuminate
   Measure the DC voltage on the Antenna side SO239
   Verify there is NO DC voltage on the SO-239 to the Radio
10. Install the label on the enclosure to indicate the proper connections.

2.7 Bench Testing

This step is to establish a connection to the RF Switch via WIFI.

This step is easiest to perform using a phone or tablet [1].

1. Apply power to the RF Switch either directly to the RF PCB or using the Bias T. Observe the main power LED is illuminated.
2. Have your phone search for available WIFI signals. One will be RF Switch. Select this Access Point.
3. Once connected, go to your browser and in the window for the URL, enter: **192.168.4.1** The browser should display the RF Switch Main Menu.

Note:

1. Some Apple iphone users have difficulty with this step as the RF Switch does not provide internet connectivity as would usually be the case when connecting to a WiFi hotspot or router. If you have trouble, try using a (non-Apple) phone, tablet or laptop.

3 Configuration

Refer to Section 5.1.1 for addition commentary on WIFI Configuration.

1. Apply +12VDC to the Switch assembly.

   The primary means of providing power is via a Bias T (not supplied but available separately) or for testing, apply +12V to the LEFT side of L1.
   The main power LED should illuminate.
2. After a brief startup period, the LED on the Control assembly should blink at a steady rate.

   During startup, each of the relays will be momentarily engaged. This will also illuminate the associated LED on the Switch assembly.
3. Using a cellphone or laptop with WIFI capability, look for the WIFI signal with the SSID of "Switch". Connect to this device.
4. You will now need to load the SSID and Password for your WIFI router. These are case sensitive!
5. Save the entry
6. Remove power from the Switch.
7. Wait 10 seconds.
8. Apply +12VDC
9. The Control will now connect to your WIFI LAN.
   During the connection process, the CPU LED will be on steady.
   Once connected, the CPU LED will blink.

This step is easiest to perform using a cellphone or tablet. Select the WiFi configuration which allows you to select different Access Points, such as you would do in a restaurant. Search for nearby signals.

A list will appear and there should be an entry for "RF Switch". Ensure your device connects. There is no internet connectivity and the device may gripe. Just ignore the message.

Open your browser. Where you would normally enter Google or a URL, enter: 192.168.4.1

You should see the RFS Main Menu.

Proceed to WiFi Configuration.

3.1 AP vs. LAN

Initially, there may be no or an invalid WiFi configuration (such as for the factory test LAN). It may take a few seconds for the CPU to determine the WiFi config doesn't find a matching router, then

default to AP mode. During this time, the CPU BLUE LED will be on.

The first time you run the RFS, you should configure the WiFi for your LAN. See the section below.

Cycling power, or pressing the RESET button on the CPU will start the WiFi search again. The CPU will alternate between AP and LAN modes on each reset.

When the CPU is in **AP** mode, the CPU LED will be illuminated for about 10 seconds.
When the CPU is in **LAN** mode, the CPU LED will be illuminated for about 2 seconds, then blink about every 3-5 seconds.

3.2 WiFi Configuration

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

The WiFi configuration consists of entering your credentials:

- SSID
- WiFi password
- Other optional WiFi parameters

Mandatory: SSID and WiFi password

Recommended: IP address

Optional: Gateway, Subnet Mask

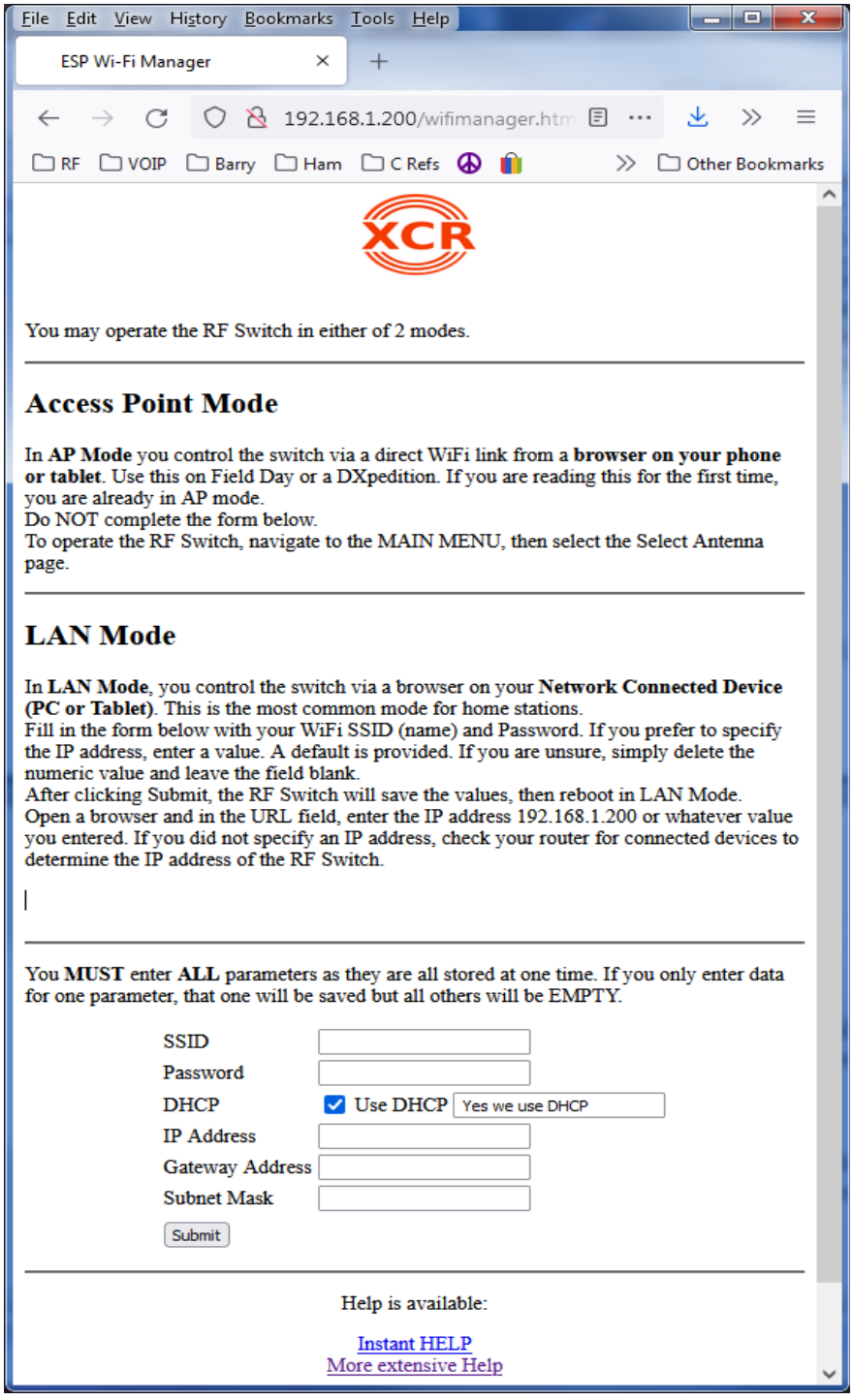
These are then stored in memory on the CPU board. You should only need to do this once, but you can change the parameters at any time.

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

Parameter	Example	Comment
SSID	mylan	Required You can find the SSID by accessing you LAN router or buy scanning WiFi with a phone app. UPPER/lower case matters!
Password	Abc123	Required This is the WiFi password. It is configured in your router WiFi setup. It may or may not be the same as your router admin access password.
IP Address	192.168.1.200	Recommended This will be the local IP address of the RFS. If you omit the IP address, one will be assigned by the router.
Gateway	192.168.1.1	Optional This is the IP address of 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)
Subnet Mask	255.255.255.0	Optional For 99.9% of users, the example is the correct answer.
DHCP	OFF	Optional If you want the router to assign a IP address for the RF Switch, enable this and then omit Gateway and Subnet Mask. You will have to go into your router table to find the IP address which was assigned.

3.3


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.
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.
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
Yes we use DHCP
IP Address
Gateway Address
Subnet Mask
Submit
Help is available:
Instant HELP
More extensive Help

4 Install the Remote Switch

Determine a location for the Switch. Mount the enclosure using the top and bottom mounts. A piece of treated weather resistant plywood would make a suitable mount. Place the switch near the top of the wood panel and provide strain reliefs below it.

4.1 Install Station Coax

All coax cables entering/exiting the switch should have a 1 turn loop in the external coax cable and be attached to a suitable structure with a strain relief. The switch is alone is NOT a suitable mechanical structure to support long coax runs to dipoles and long wire antennas. The external loop assists in preventing moisture intrusion and provides some value for lightning protection.

The coax from the station MUST be connected to the proper SO239. It is the center connector in the back row. See the photo.

RG58 and RG8X will easily flex and allow attachment to the switch SO239s. RG8 and LMR are more rigid. These will take some effort to form within the enclosure. Route the more rigid cables to the more central connectors.

4.2 Station Bias T

Install a Bias T in the shack. NOTE the orientation of the device to route the +12VDC to the remote Switch (NOT INTO THE RIG!!!)

<<<<< insert photo >>>>>>>>>>>>>> ??????????????

Apply +12VDC to the Bias T. The Switch should then power up and be available via you browser.

Do NOT apply a higher voltage to the Bias T as the Switch only needs 12v for the relays and a 3 terminal regulator makes 3.3v for the CPU.

There is over voltage protection in the switch which may be activated above +14VDC.

4.3 LED Indicator

If the remote Switch is visible from the shack, and you have installed the Blue LED. When the user commands the Switch to change antennas, the LED will blink the number of times associated with the selected antenna. Once for antenna 1. Twice for antenna 2, etc.

4.4 Cable Attachment

Attach the antenna coaxial cables through the bottom moisture barriers and attach to the desired position.

Provide a strain relief for the coax about 8-10” below the Switch to prevent the weight of the coax from pulling on the connections.

It is good practice to add 1-2 turns of the coaxial cable into a loop below the strain relief. This can

have some minor positive effect for lightning. Polyphasor or other devices should be installed per recommended electrical codes and best practices.

A heavy ground wire, attached to a well installed ground rod may be connected to the shelf bracket. This SHOULD NOT be the primary grounding method for the tower.

5 Options

5.1 Optional Environmental Sensor <<<< Not Yet Available>>>>

This is an optional small PCB that plugs into the Control. It senses temperature, humidity and barometric pressure. These parameters will be displayed on the web page when the sensor is installed. As the sensor is in the enclosure, it will read the internal temperature, humidity and pressure.

5.2 Ground Un-Selected Antennas

By default, the Un-Selected antennas are tied to Ground. When Power is removed, all antennas are tied to Ground. This may be appropriate if you are switching the phase of an array.

IMPORTANT → Carefully read the section on Lightning!

The RFS PCB may be modified to allow the user to not default to ground antenna ports. This is personal option. The grounding helps bleed off voltage accumulated on the antenna during environmental events. REFER TO THE OPTIONS SECTION.

If you wish to NOT have the antenna grounded, you can drill out the holes for the Normally Closed relay pads PRIOR TO INSTALLING THE RELAYs. The relay is SPDT with each relay element (NO, NC, Com) connected to 2 pins. You MUST open BOTH pads of the NC contact to eliminate the connection to Ground.

Using a .25” drill bit, by hand, carefully remove a small amount of copper pad around BOTH the TOP and BOTTOM of the PCB. Do NOT drill through the board. This operation is very easily done and does NOT require the use of a power tool! Be sure to make a substantial gap, not just a thin cut.

You should be able to solder a wire to the normally closed contacts if you have special phasing requirements.

5.3 High Power Operation

The relays are rated for 16A, which equates to 12.8KW. The PCB is NOT rated for 12.8KW.

If you intend to operate above 1.KW, you may want to add extra current carrying capability to the PCB. This can be done by placing a section of bare #14 wire across the PCB trace and soldering to the relay terminals and SO239 center pin. Avoid sharp points on the ends of the wire.

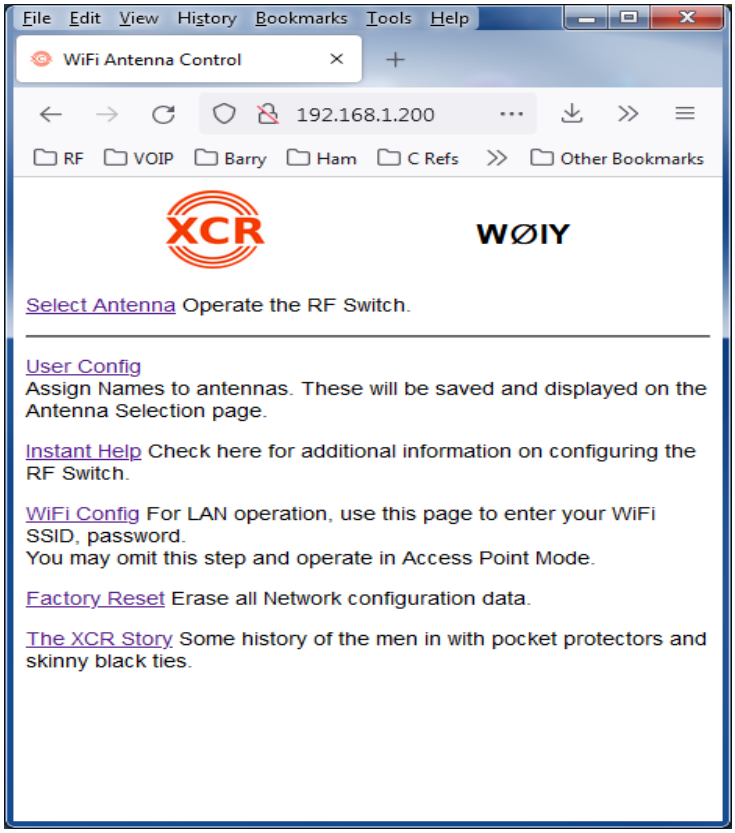
6 Operation

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.

Tip --->

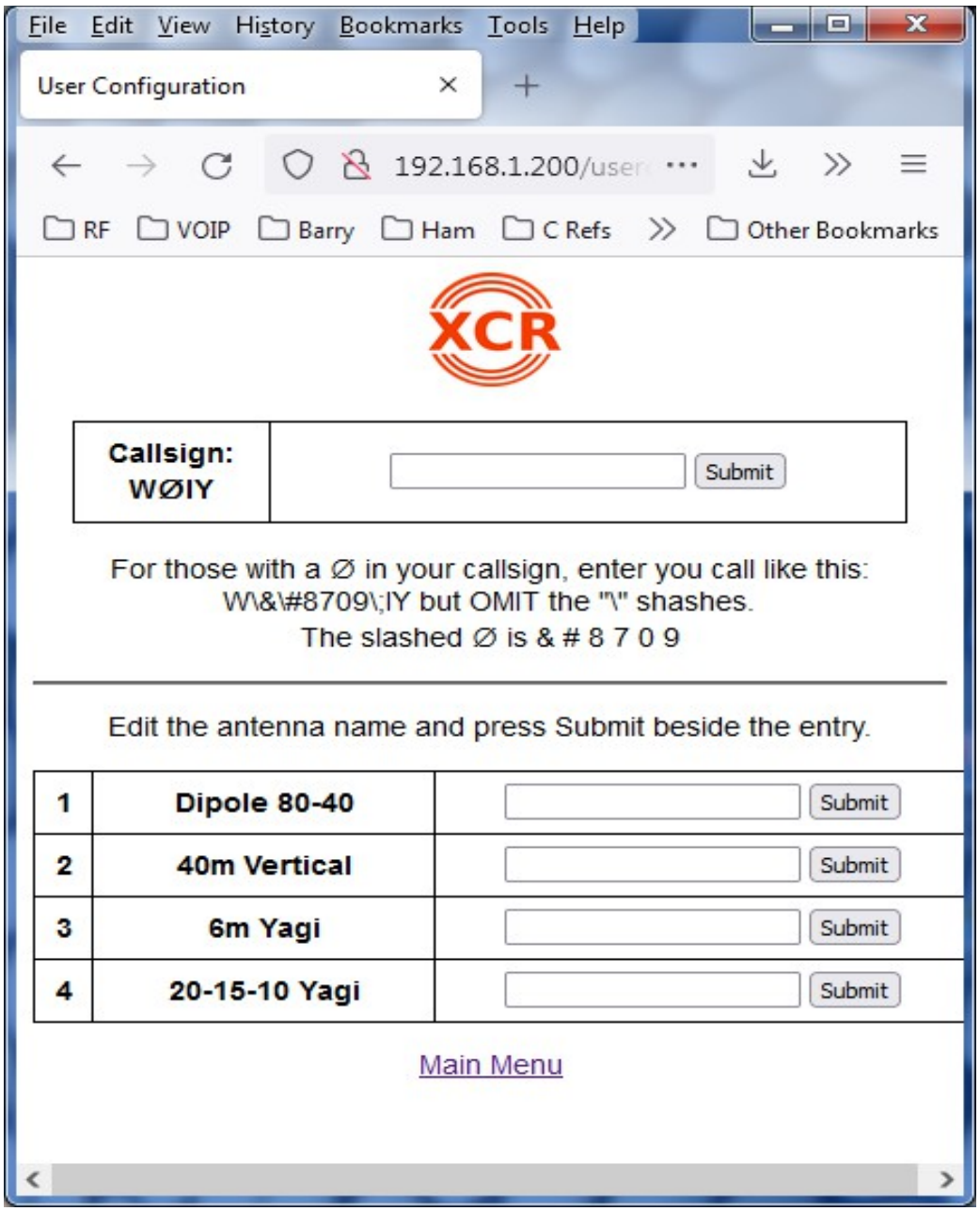
For LAN operation, a good RF path needs to exist between the RFS and your LAN WiFi Router. You can test this path by going to the proposed location of the RFS and use you phone to check the WiFi signal strength. There are free Android apps to identify WiFi signals and display their strength.

*If you need more WiFi signal at the RFS location, you may want to get a **WiFi Range Extender.** These are available from online retailers and are not expensive. They will provide enhanced WiFi coverage for your LAN and support all WiFi devices.*



6.1.1 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.



Default User Configuration

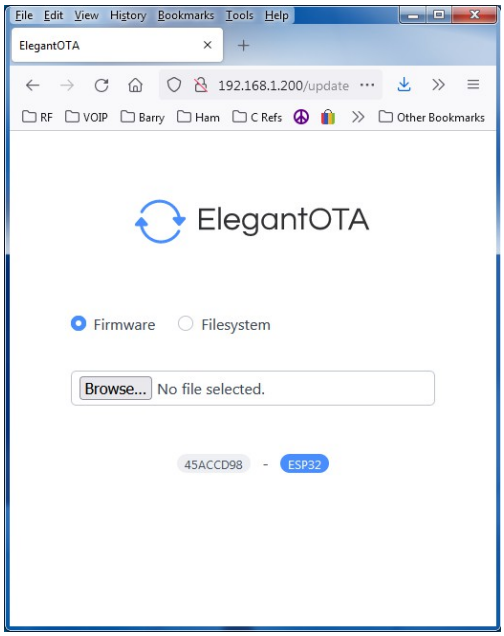
6.2 Program Update

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

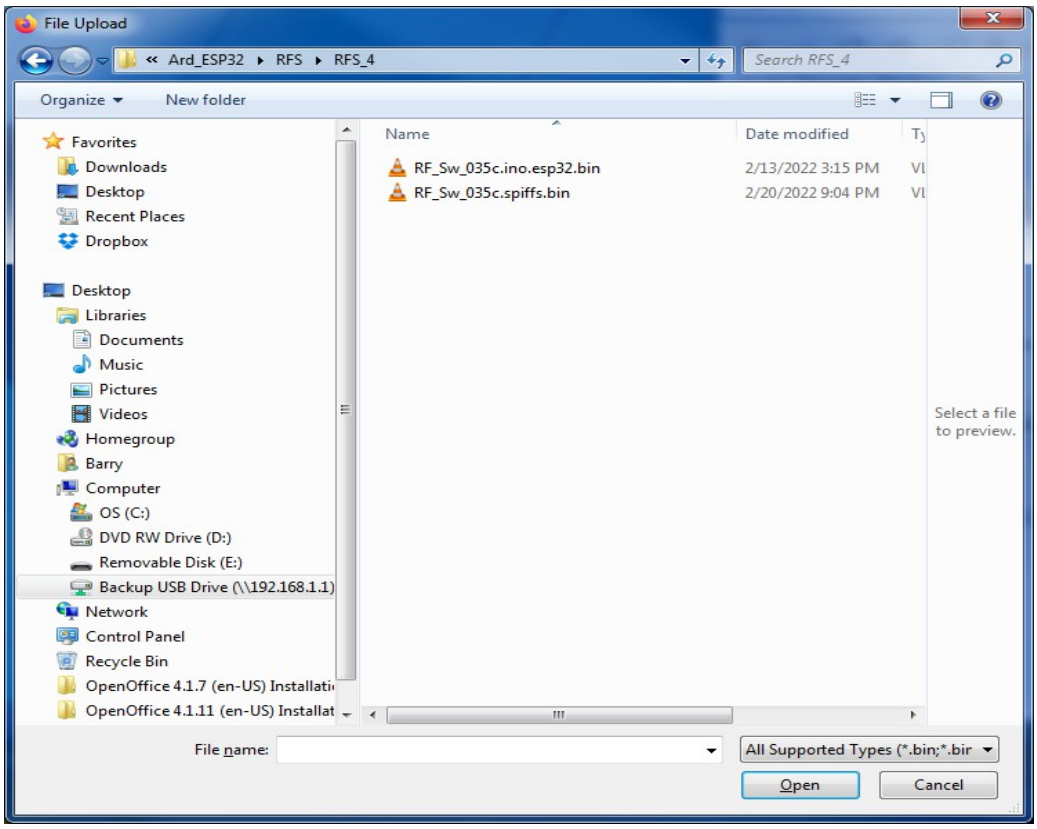
Your stored credentials are not affected by this update.

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



8. This will open a window with **FILE EXPLORER**.
   Navigate to the directory containing the **RF_Sw_xxxx.ino.esp32.bin** file you downloaded. NOTE the **INO** in the file name.
   <<< insert pic >>>>



9. Double click on the **RFSxx.ino.esp32.bin** file.
   The OTA feature will begin to upload the file. It takes about 15 seconds.
   Wait for the BACK button to appear.

Now load the supporting HTML and TXT files.

10. On the Elegant OTA page.
    Select the **FILESYSTEM** button
    Select Browse

11. In the File Explorer, navigate to the directory containing the RFSxxxx.**spiffs.bin** file you downloaded. Note the **SPIFFS** in the filename.

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 lost as the process erases files before writing.

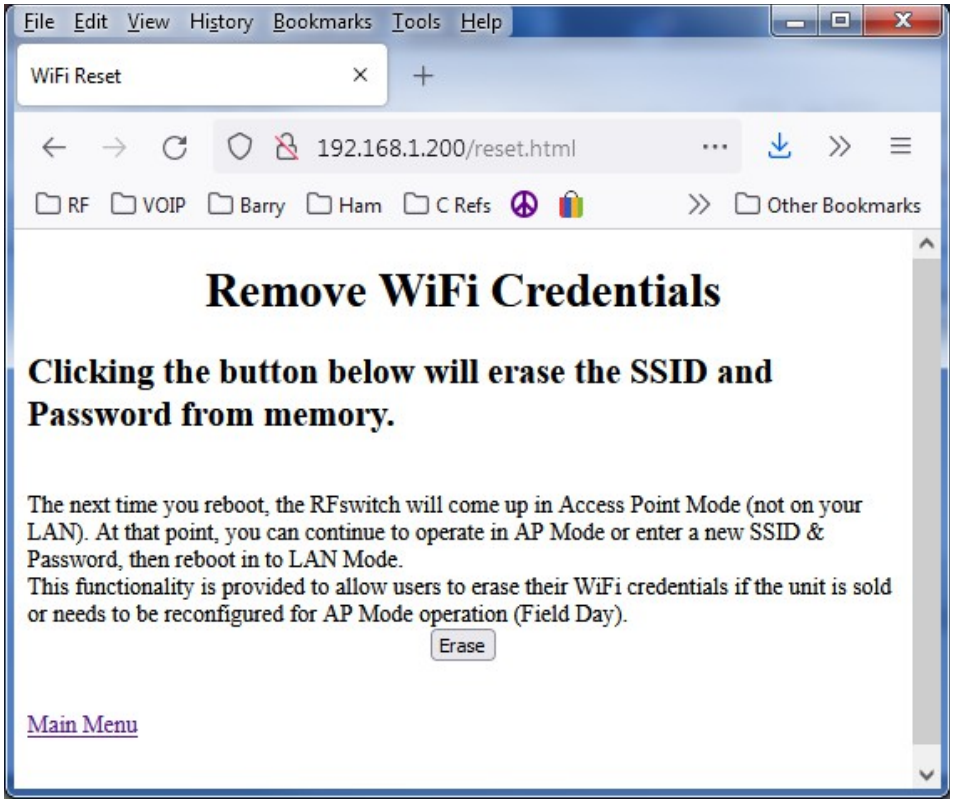
The CPU will not return to LAN mode after a update as the WiFi credentials were lost.

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

6.3 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.



6.4 Help

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

6.5 LEDs

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

6.5.1 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.

6.5.2 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 and 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.

6.5.3 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.

7 Need Help?

Please join the Team-XCR support group at:

https://groups.io/g/team-xcr

Please email questions to: barry.wØiy @ gmail.com

You can expect an answer in less than 24 hrs.