

# Mod a Ricochet radio modem to take an external antenna

by **Myself** on November 11, 2007

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## intro: Mod a Ricochet radio modem to take an external antenna

The product of a before-its-time business model, **Ricochet modems** are great technology with a surprisingly low price tag. They act just like regular modems, but with an RF layer instead of a phone line. Build your own dial-in access server, control a microcontroller project, or do other serial tricks from thousands of feet away!

Transmitting one watt at 900 MHz, the modems pack quite a punch, but the stock rubber-duck antennae suck. What's worse, the internal antenna connector is a **Hirose H.FL**, a nice little connector that unfortunately never caught on, meaning the availability of pigtails and parts is terrible. Adding better antennae makes it easy to surpass the maybe-a-mile distances achievable on the stock omnis, but first, we need a way to connect those antennae.

Fortunately, it's relatively easy to replace the H.FL with the much more common (and much smaller) **U.FL connector**, which is found on MiniPCI wireless cards, among other places. Thus modified, the modem is easy to equip with the new antenna of your choice. The operation is straightforward, and this instructable is as much about good soldering technique as it is about the specific task at hand.

Because the radio modem was certified to meet FCC **Part 15** requirements with its built-in antenna, changing that antenna breaks the certification, just like **changing the antenna on an 802.11 device**. This may fall under **part 15.23** but I'm not a lawyer and can't say for certain whether a user-modified device counts as a home-built device. Refrain from pissing people off, and the feds should have no reason to **bother you**.

Or, if you're an amateur radio operator, you can **operate** under **Part 97**. Either way, if half-mile links were typical on the rubber ducks, just imagine what you'll achieve with some decently directional antennae!

This is my first instructable. Please be unsparing with your constructive criticism.



## step 1: Materials, tools, and work space.

You'll need a **Ricochet modem**, obviously. They work better in pairs, so get at least two. They come up on eBay occasionally, and you can expect to pay ten or twenty bucks including shipping. The pictures in this instructable were taken with a GT modem, but the GS and SX also use H.FL connectors internally, and the procedure is generic. (The SX is first-generation, though, so skip it unless you have a good reason.)

Some U.FL connectors would be nice, obviously. I got mine from Digi-Key, where they're \$1.39 each as of this writing. You can also scavenge them from dead Mini-PCI wireless cards, if you have any sitting around, but removing them intact is tricky.

And of course, you'll need new antennae and cables, since the stock ones won't fit anymore. The easy availability of U.FL pigtails from a number of sources was the reason behind this instructable.

For the GT modem, you'll need a 1/16" hex (Allen) key or driver. For the GS, it's a T6 Torx.

A set of really fine needle-nose pliers is essential. I like **box-joint pliers**, which have less lateral play than the cheaper pin joint. Tweezers are a fine idea, too.

Get a good soldering iron, or temperature-controlled station. Get the finest tip they offer, in the neighborhood of 3/64" if it's available. I use a refurbished Edsyn 951SX "Loner" station that I got at a ham swap from EAE Sales. It's changed the way I think about solder, and is easily the best tool purchase I ever made. If you do a lot of electronics work (and you're on this site, you should!), consider it money well spent.

Paste flux is the most overlooked part of any soldering setup. Get good flux and use it every time the iron touches something. Soldering should be called "soldering and fluxing", but I guess that doesn't roll off the tongue so easily. I can't emphasize this enough, use flux! It dissolves oxides, it conducts heat, and it solves all the surface-tension problems that make soldering awkward. If you've had a bad experience with solder, I bet this is why. (If you're getting a solder station from EAE, Bruce will set you up with the right flux and solder, too.)

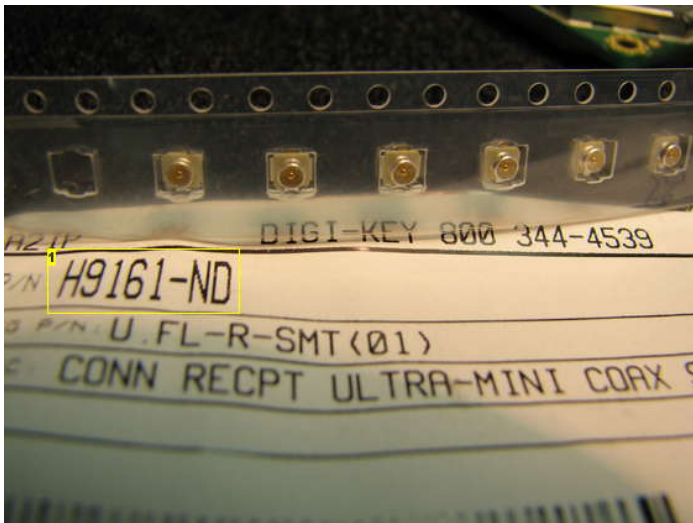
Oh yes, solder! For most electronics work, finer solder is better. If it's stiff enough not to droop when you extend it five or six inches, throw it back in the plumbing toolbox and get some real electronics solder. Rosin core is nice but not essential if you're using external flux.

Some desoldering braid is nice to have, too. It's cheap and it lasts a long time, so throw some on your Digi-Key order. (I do a LOT of soldering, and I can't remember the last time I reached the end of a spool of braid.)

A vise really helps. Your workbench deserves a **Panavise 350** or something similar. They're made in the USA and lifetime warranted, so shell out the bucks and rest assured that your great grandkids will marvel at your foresight in buying such a useful, timeless tool.

Safety glasses. Solder and flux can spatter, and small parts can go flying. You only get one set of eyes, so please treat them well! I've been extremely pleased with the **MSA SafetyWorks** glasses, which I get at Home Depot. They're absurdly clear, and the lenses are very flat so they don't shift the image like other glasses I've tried. If you feel like you're underwater or on another planet when wearing safety glasses, you're wearing the wrong safety glasses. They're cheap, so keep trying new ones until you find a style you like. Then keep the old ones around for guests to use.

<http://www.instructables.com/id/Mod-a-Ricochet-radio-modem-to-take-an-external-ant/>



**Image Notes**

1. See what I did there? I saved you a search!



**Image Notes**

1. The GT modem has but one button. Long and short presses convey your intent.
2. WWC marketed Ricochet better than Metricom themselves did.



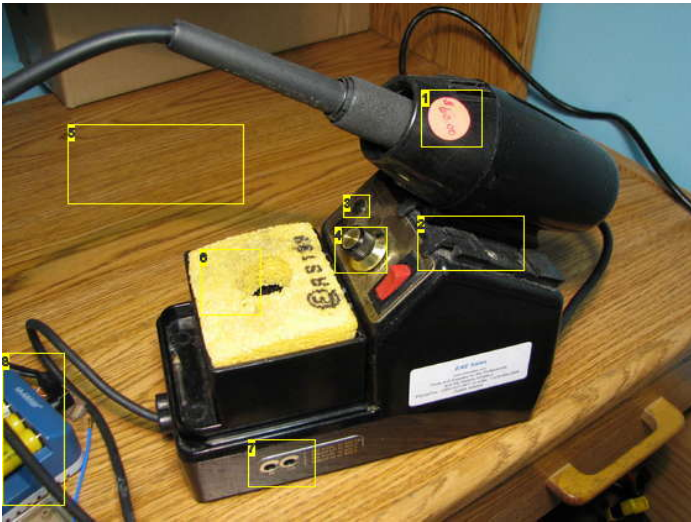
**Image Notes**

1. The GS modem's power/speaker switch is in its armpit.



**Image Notes**

1. Oh, hello scissors! Didn't see you when I lined up this shot.
2. Plumber's flux. I should probably use something made for electronics, but this actually works really well.
3. Mmm, lead. Not RoHS compliant in the least! Also, avoid breathing the fumes.
4. The super-thin braid doesn't absorb much solder, but it gets into tight places.
5. I've had this roll since high school and still haven't used all five feet.
6. This little wisp is the solder itself. Very thin.
7. Twentytwo thousandths! That's about as thick as 23AWG wire.

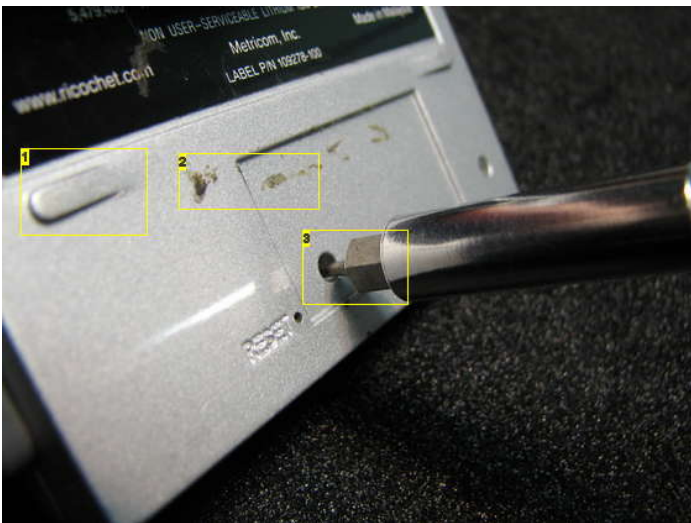


#### Image Notes

1. Not only am I cheap, I'm also too lazy to pull the tag off my refurb iron, despite having had it for over a year now.
2. Apparently you can get other accessories and tool-holders that slide onto these mounts.
3. This lamp illuminates when the heater is on. As the tip warms up, the duty cycle drops. An infrequent flicker means it's ready. Because the heater initially runs full-blast, it comes up to temperature very quickly, ready to solder in about 20 seconds.
4. This knob adjusts the tip temperature.
5. This space normally has stuff in it.
6. The sponge should be soaked through, then wrung out. Damp but not sopping.
7. I know better than to mess with the temperature calibration, because I lack the measurement equipment to recalibrate it when I'm done.
8. The LaCrosse BC-900 battery analyzer excels at two things: Changing the way you think about rechargeable batteries, and taking up bench space.

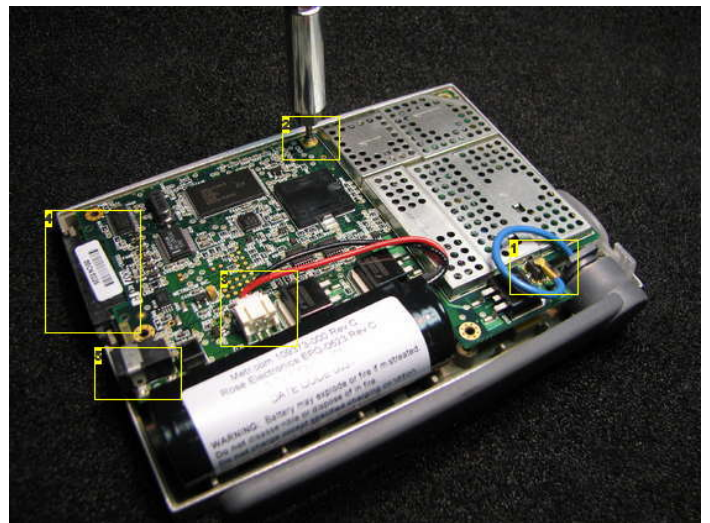
## step 2: Open the victim.

Open the modem, remove the internal screw securing the board to the chassis, and disconnect the battery and antenna from the board.



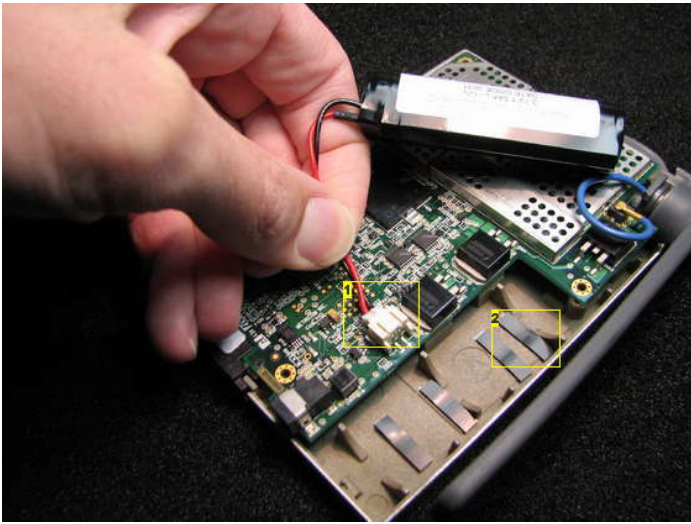
#### Image Notes

1. Never did figure out what these bumps were for.
2. Adhesive goop from previous Velcro.
3. There are five external screws. If you can only find four, it's because there's Velcro covering this one.



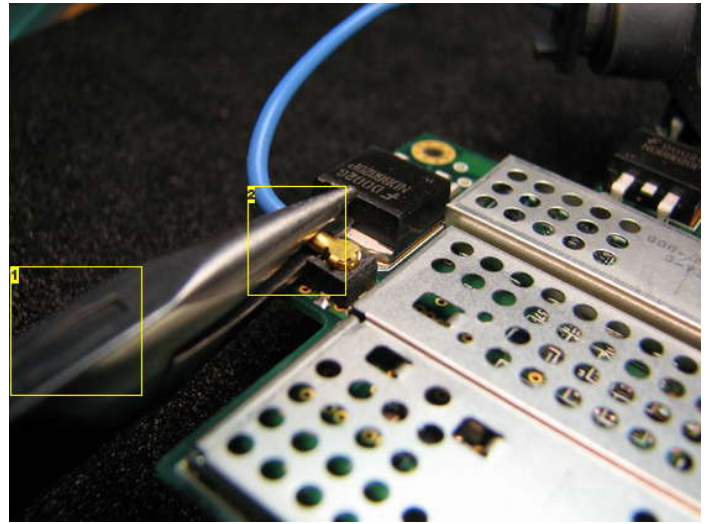
#### Image Notes

1. Our quarry.
2. The sole internal screw, which secures the board to the chassis.
3. Not much slack in those battery wires! Remove the battery and unplug this.
4. Here's where the data cables plug in.
5. And the power jack, of course.



**Image Notes**

1. Yoink!
2. Squishy strips keep the battery from rattling. They thought of everything!

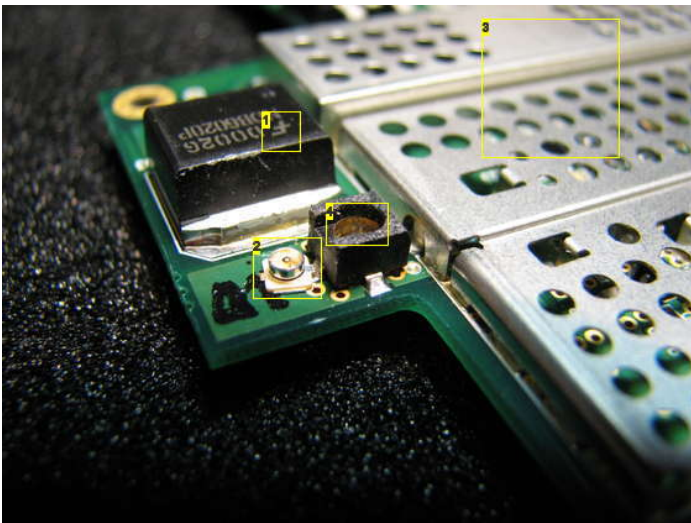


**Image Notes**

1. Box-joint pliers don't go sideways under load.
2. Grip gently, twist counterclockwise, rock back and forth.

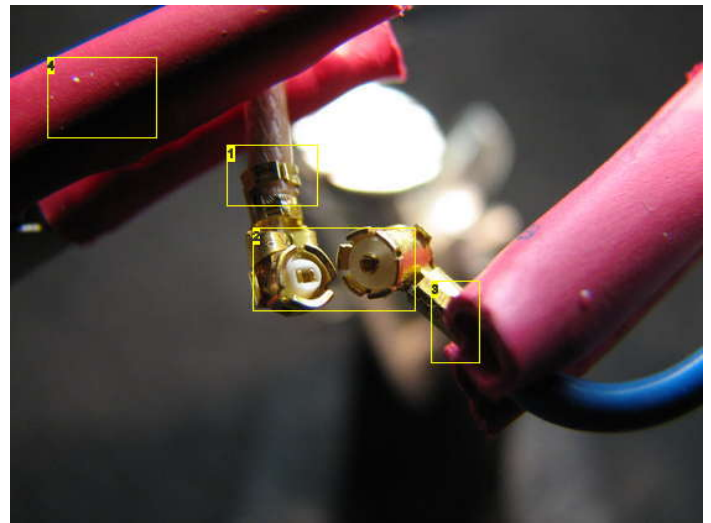
**step 3: Some perspective.**

Just so you understand what we're getting into, here are some pictures of the old H.FL next to the new U.FL. The size difference really is as dramatic as the datasheet makes it look!



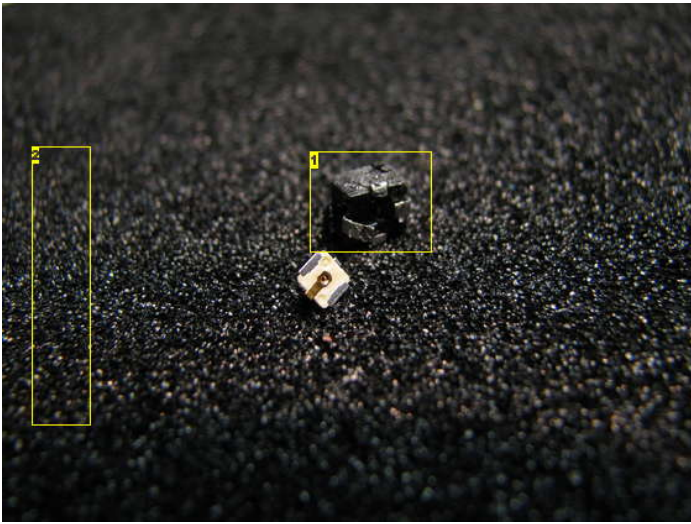
**Image Notes**

1. Fairchild Semiconductor.
2. Isn't it cute? Funny that they fit the same PCB pads.
3. More shiny shields than Archimedes' army!
4. You could almost lose that little U.FL jack in here, couldn't you?



**Image Notes**

1. Only one point of attachment to the cable jacket. The U.FL is popular, but not very strong!
2. The U.FL fits around its jack, while the H.FL fits inside, so the plugs are almost the same diameter. The H.FL is a lot taller, though.
3. The H.FL grips the cable over a much longer distance, making it stronger.
4. Heat-shrink on the alligator clips keeps the Helping Hands from damaging soft insulation.



**Image Notes**

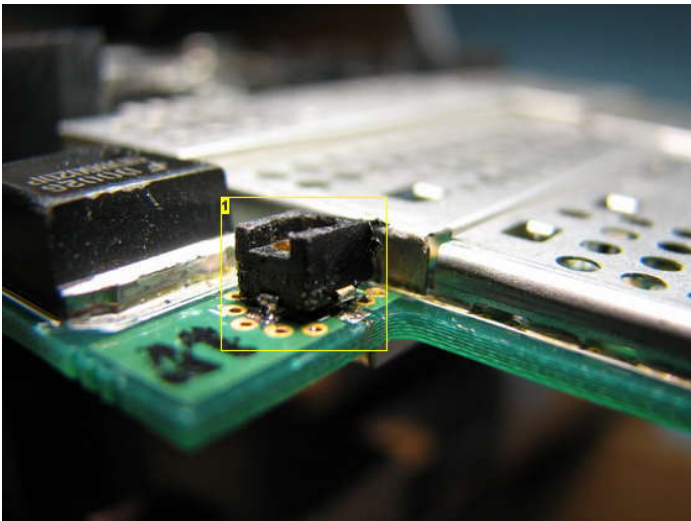
1. Time-travel photo! Future H.FL jack, freshly removed from his board, joins present-day U.FL jack in mooning the camera.
2. Conductive antistatic foam makes a great work surface, and really shows off depth-of-field.

**step 4: Remove the old jack.**

Secure the board in a vise. Use the ultra-fine desoldering braid, along with the ultra-fine soldering iron tip, to remove as much solder as possible from the signal pin. Then heat the ground pins and pry on the jack. Eventually move back to the signal pin.

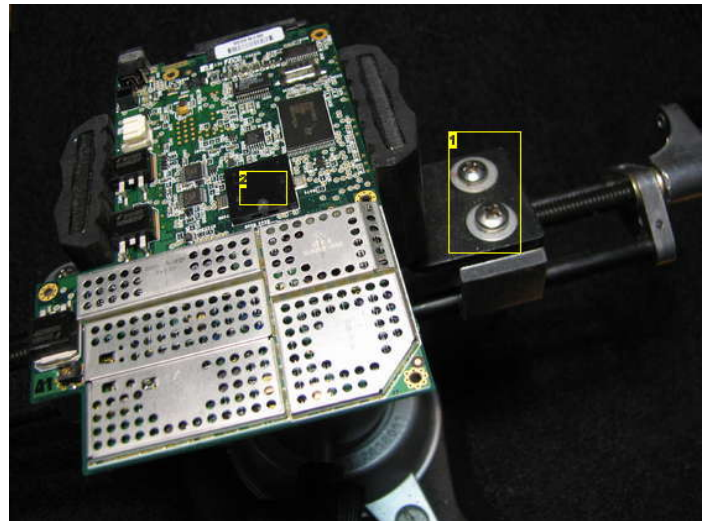
With constant leverage on the jack, every time you melt one pad, it should move just a little. Just hop around from pad to pad, and eventually it should pop free.

The text in this step is mostly extraneous, all the goodies are in the photos.



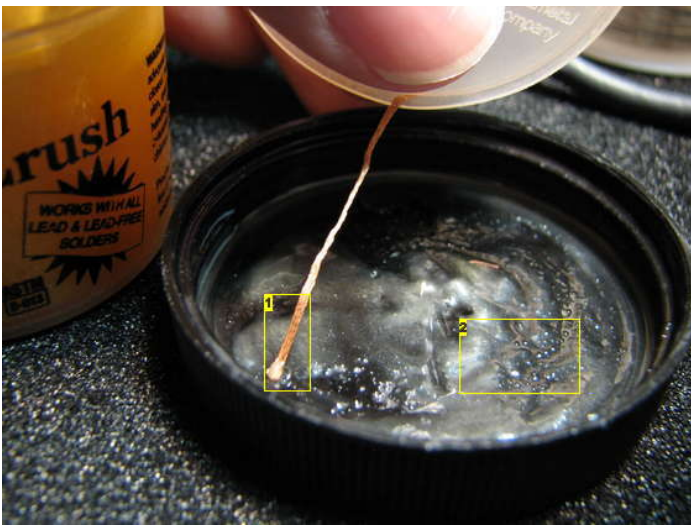
**Image Notes**

1. It bidded! It badged! It booged!



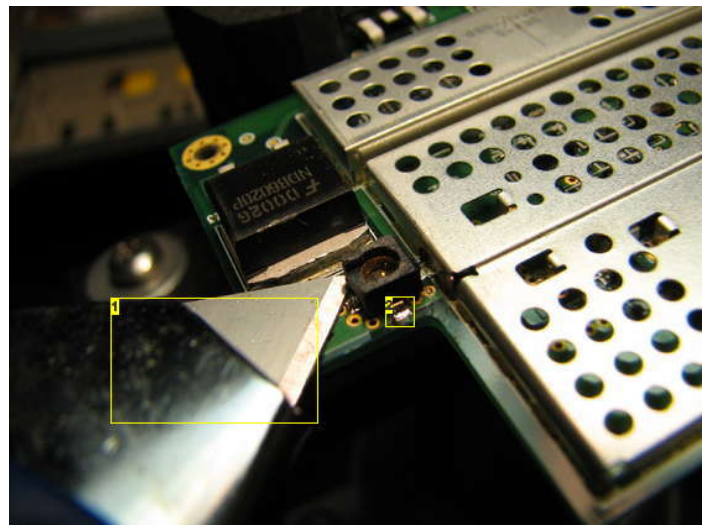
**Image Notes**

1. The use of straight-blade screws is my only complaint about Panavise's build quality. I replaced mine with Phillips-head, so jaw flips are easier.
2. In case you were wondering, this is the speaker. That's why it has so few leads and no markings.



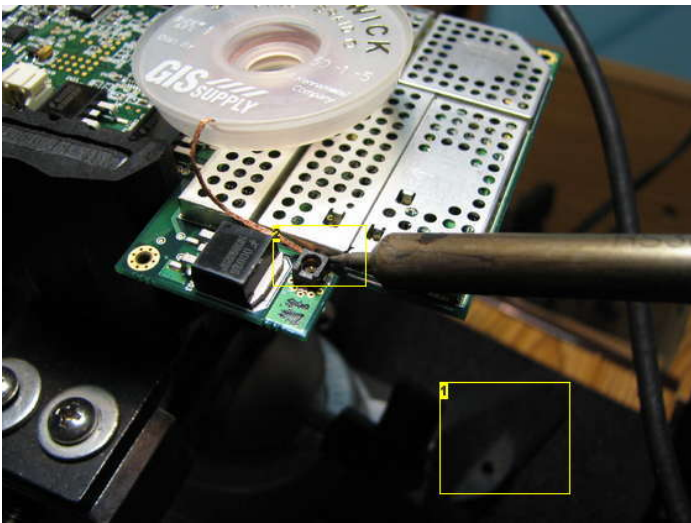
**Image Notes**

1. Hey, you wanna go out Friday and get fluxed up?
2. The flux in the container lid is all I've ever needed.



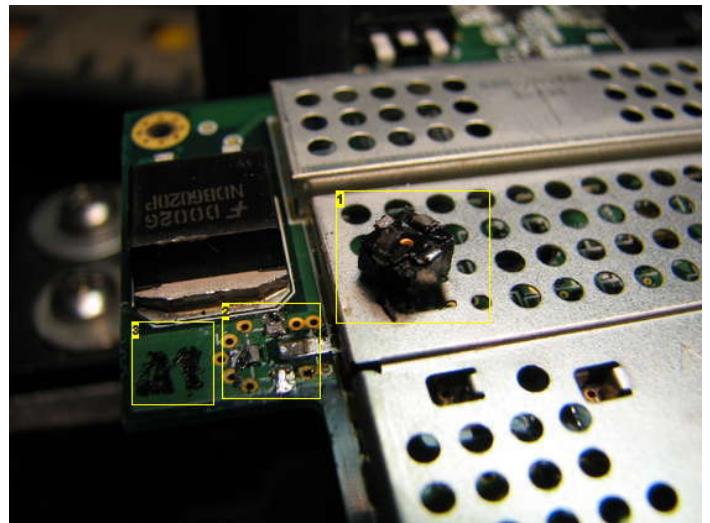
**Image Notes**

1. A tool not listed in step 1! Yes, there are benefits to reading all the steps before starting. The snap-off utility knife has a fine edge and a low price tag, so it's perfect for prying. Wear eye protection!
2. While prying gently, just touch the iron to each pad in sequence.



**Image Notes**

1. The Panavise's cast-iron base keeps the vise from going anywhere unexpected. Thankfully it works despite being way out of focus.
2. The iron is off for this shot, otherwise you'd see a curl of smoke rising from back there.



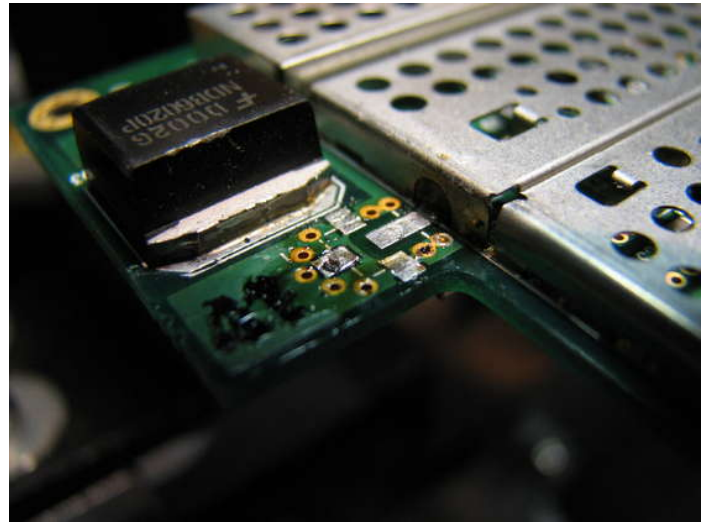
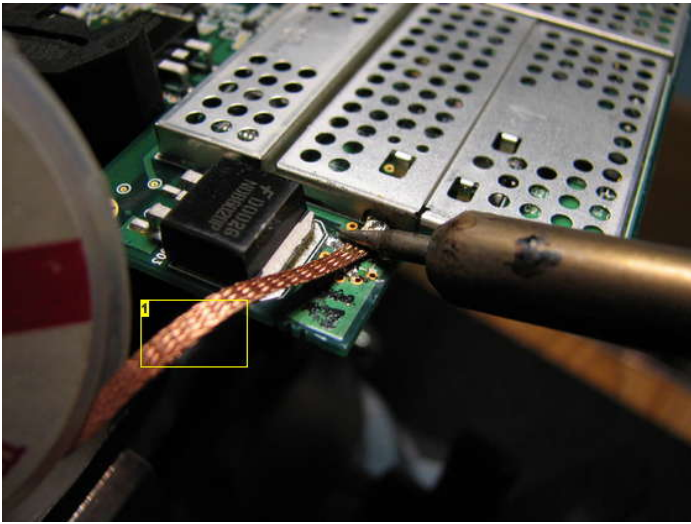
**Image Notes**

1. The jack landed right here when it finally let go of the board. I didn't pose this, I swear.
2. Eww, gross! Solder and crap all over! We'll clean that up in the next step.
3. What's this gunk, anyway?

**step 5: Prep the board for the new jack.**

Clean up all that nasty solder residue by "mopping" the area with some absorbent braid. It works just like a towel, but for molten metal. Isn't that a fun concept to contemplate?

Use flux, and hold the braid far enough back that you don't burn your fingers. Copper is a very good heat conductor!



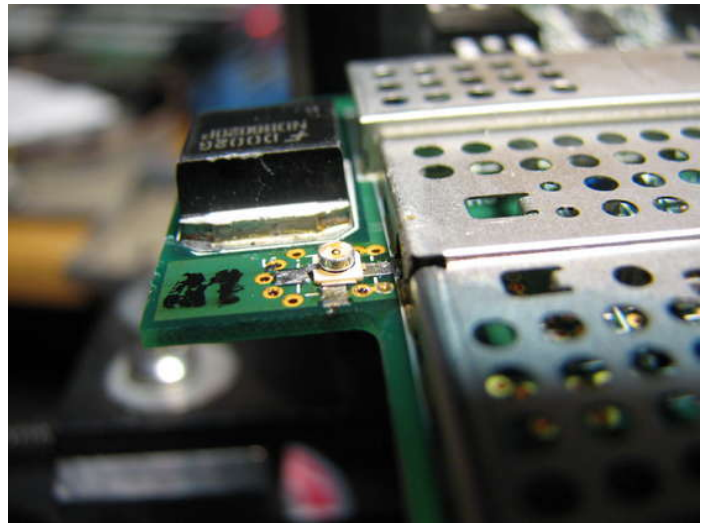
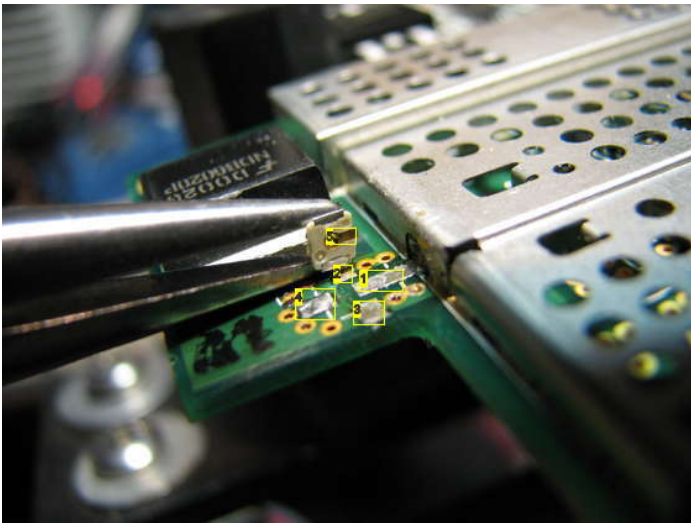
#### Image Notes

1. This is not enough distance to keep from burning your fingers.

### step 6: Line up the new jack.

Here's where having a sturdy, stable vise really pays off! If you bump the board during this process, the jack will skitter out of alignment. A bit of flux might help "lick it and stick it" in place.

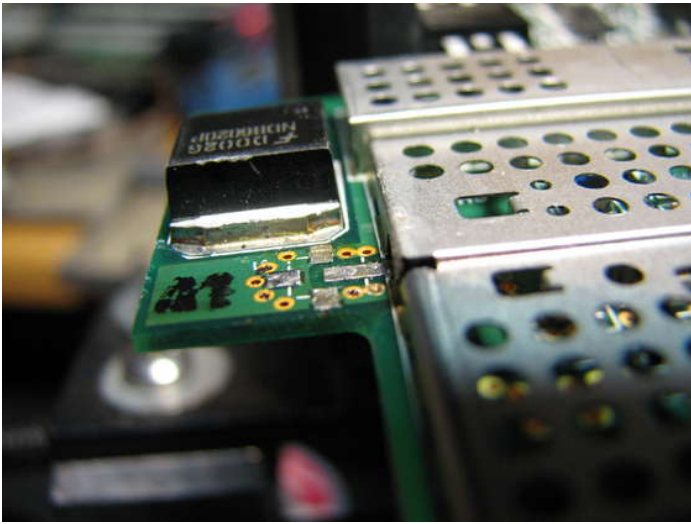
Flip between images 2 and 3 in this step to see how the jack lines up on the pads.



#### Image Notes

1. signal pad, center pin goes here.
2. ground pad
3. ground pad
4. Place the jack far enough forward (to the right) that the center pin doesn't touch this ground pad.
5. Center pin. To view the image without these distracting yellow boxes, click the 'i' icon in the upper left corner. Try the high-res version!



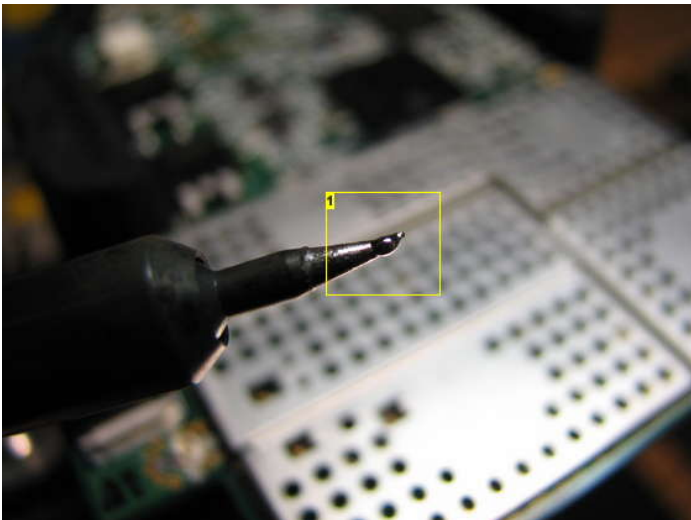


### step 7: Solder the new jack into place.

Clean the iron tip by wiping it on the sponge. Get a bit of flux on the end of the solder, then touch it to the iron so a tiny droplet of solder clings to the iron.

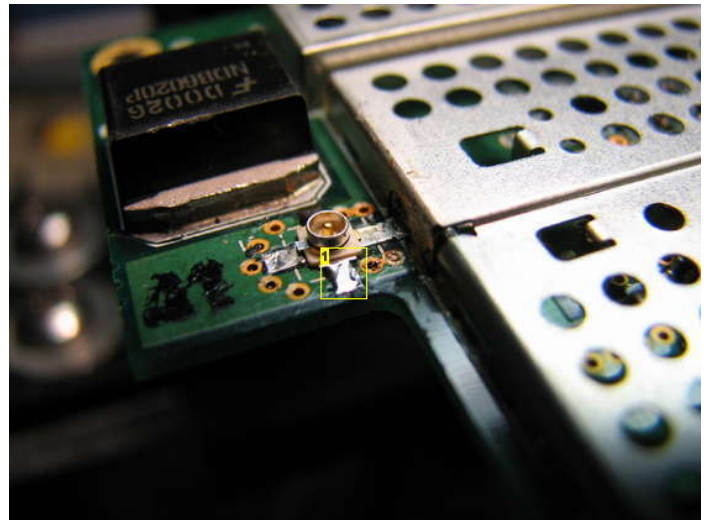
Hold the jack in place with a toothpick, popsicle stick, or whatever. Touch the molten solder to the intersection of the jack and one ground pad. If there was flux on the pad, the solder should flow and make the connection. Remove the iron and check your work.

Repeat the process for the other ground pad, then for the signal pad. The rearmost ground pad, which was used for the H.F.L connector, doesn't need to be used for the U.F.L connector but I soldered it anyway.



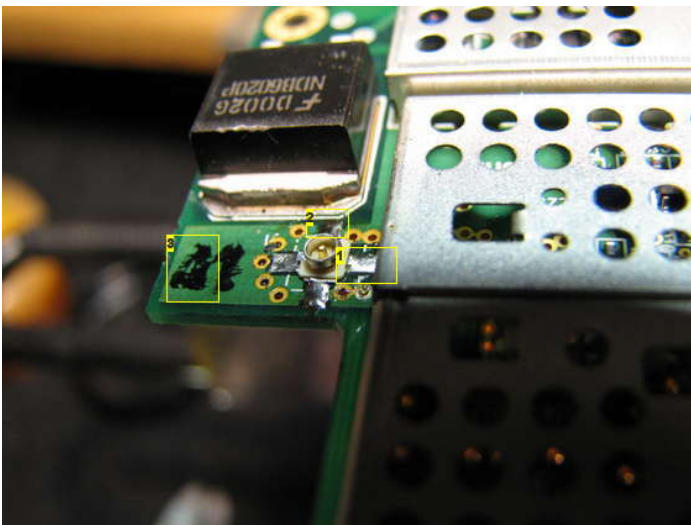
#### Image Notes

1. Give me a drop please, Vasili. One. Drop. Only.



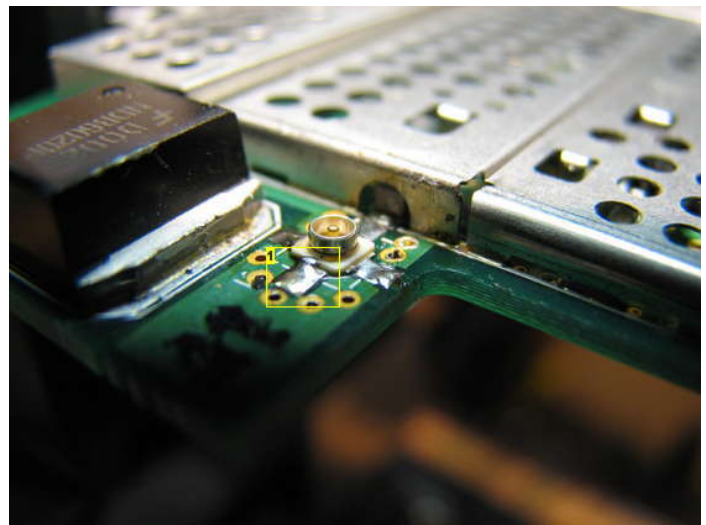
#### Image Notes

1. The first pin generously tacked down. It's easy to clean up later after the others are attached.



**Image Notes**

1. Center pin soldered to signal pad.
2. You'll have to take my word that this ground is attached too.
3. Never did figure out what this was.



**Image Notes**

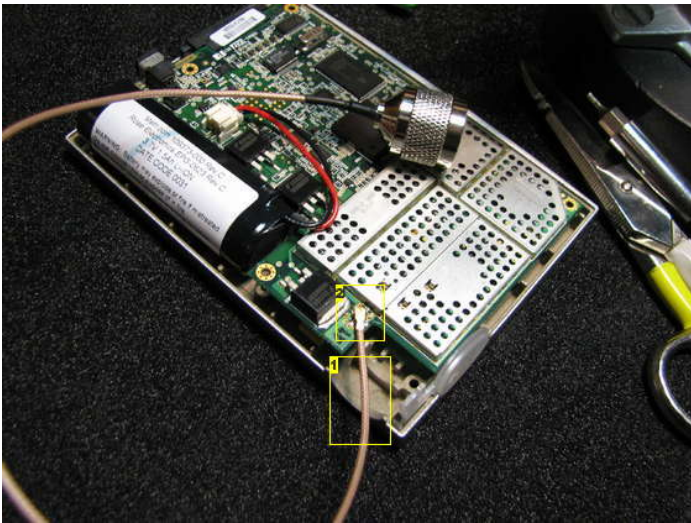
1. The U.FL datasheet doesn't even show a pad for the rearmost ground, but the board had one so I gobbled some solder on there.

**step 8: Finish up!**

Attach the pigtail, close the modem, and perform some form of strain-relief to keep stress off that flimsy little U.FL connector.

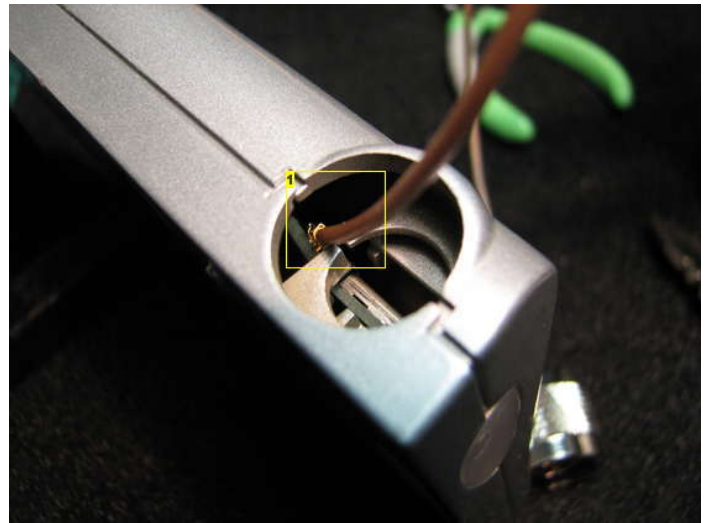
Build or buy a spiffy 900MHz antenna, and connect it. Fire the modem up in the presence of another one, and watch them start blinking when they find each other. Pat self on back.

Since these modems will go 2000 feet or farther on the stock antennae, you should have no trouble getting several miles out of them, given a couple dB of gain and some decent mountings. Use them like any other modems, running a dial-in server or even a Ricochet BBS for your friends.



**Image Notes**

1. Angle the cable so it comes out the hole left by the antenna.
2. Just smush the pigtail onto the connector, keeping it level and flat while you do so. If you've installed MiniPCI wireless cards in laptops, this should be old hat.



**Image Notes**

1. Plenty of room here! I wish an N bulkhead connector would mount where the antenna used to be. Not quite, alas.



**Image Notes**

1. A more permanent strain relief would be prudent. For now, stretchy tape has plenty of holding power.
2. this is the story, of a copper braid-y..
3. Cameo appearance by Helping Hands.
4. Pliers, starved for attention, had to appear in the last shot.
5. And the award for Best Supporting Fixture goes to...
6. Oh, hello screwdriver! Haven't seen you since Step 2!

**Related Instructables**



**Mr. Microphone Hack!** by Kipkay



**10 \$ WIFI 16dBi Super Antenna Pictorial** by hanzablast



**Increase effective distance on 'ebay' flash remote trigger transmitter with antenna** by babylonfive



**Maxwell House Wireless Antenna** by burningsuntech



**Create your own radio broadcast from an ltrip** by Inmate1440



**adsl modem cooling fan mod** by gez



**New antenna for Sony Ericsson GC83 wireless network card** by Caferacer



**Build a 500 metre radio data link for under \$40.** by James Moxham



**Comments**

4 comments [Add Comment](#)



**wikipityler** says:  
What is a ricochet radio modem?

Nov 17, 2007. 6:58 PM [REPLY](#)



**Myself** says:

Nov 18, 2007. 5:57 AM [REPLY](#)

It's just like a regular modem, but without the phone line. You dial, the other modem rings, they connect, you move data. It just happens over RF instead of twisted pair. And it happens faster, typically 100-200kbps.

I should probably make that clearer in the intro, thank you for pointing it out. There's a ModemBasics page on the Ricochet hackers' wiki, which I'm working on expanding.

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**wikityler** says:

Nov 18, 2007. 11:31 PM [REPLY](#)

Cool. You have no idea how useful that link was for a project of mine.

---



**Myself** says:

Nov 19, 2007. 7:52 AM [REPLY](#)

Do tell! In private, if necessary. ;)

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