GBPPR 2.4 GHz 'Warspying' Device

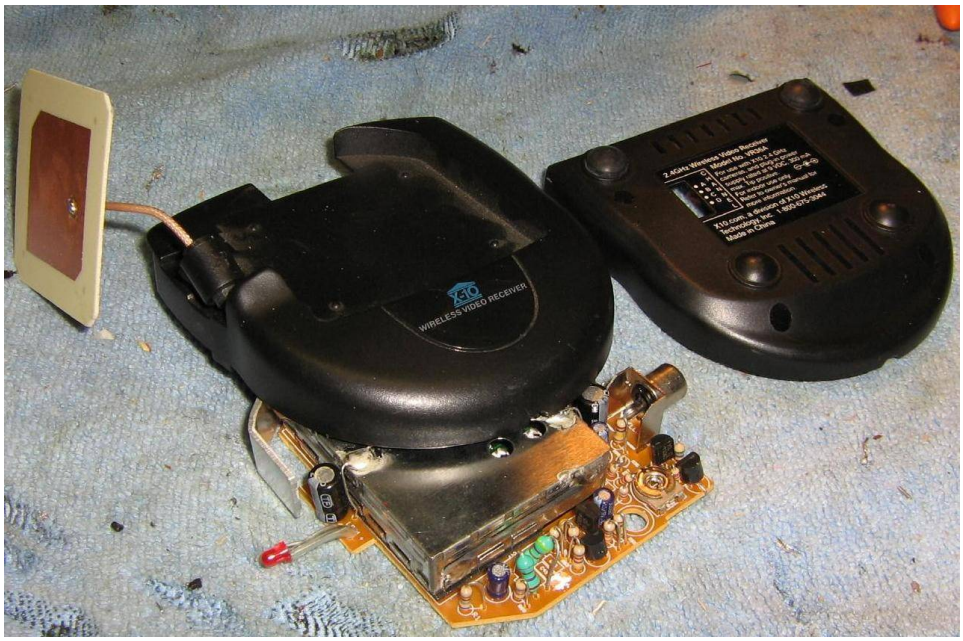
Overview

One of the newest toys people are playing with are cheap 2.4 GHz wireless video cameras. And, of course, another new hobby followed which was deemed "warspying." This basically consists of traveling around and trying to intercept the unencryped analog video signal these units transmit. The two major manufactures of these little wireless video units, Wavecom and X10, both utilize the same four transmit/receive frequencies. They are usually:

Channel	Operating Frequency (GHz)	TP Voltage
A	2.411	3.31
B	2.434	3.65
C	2.453	3.94
D	2.473	4.20

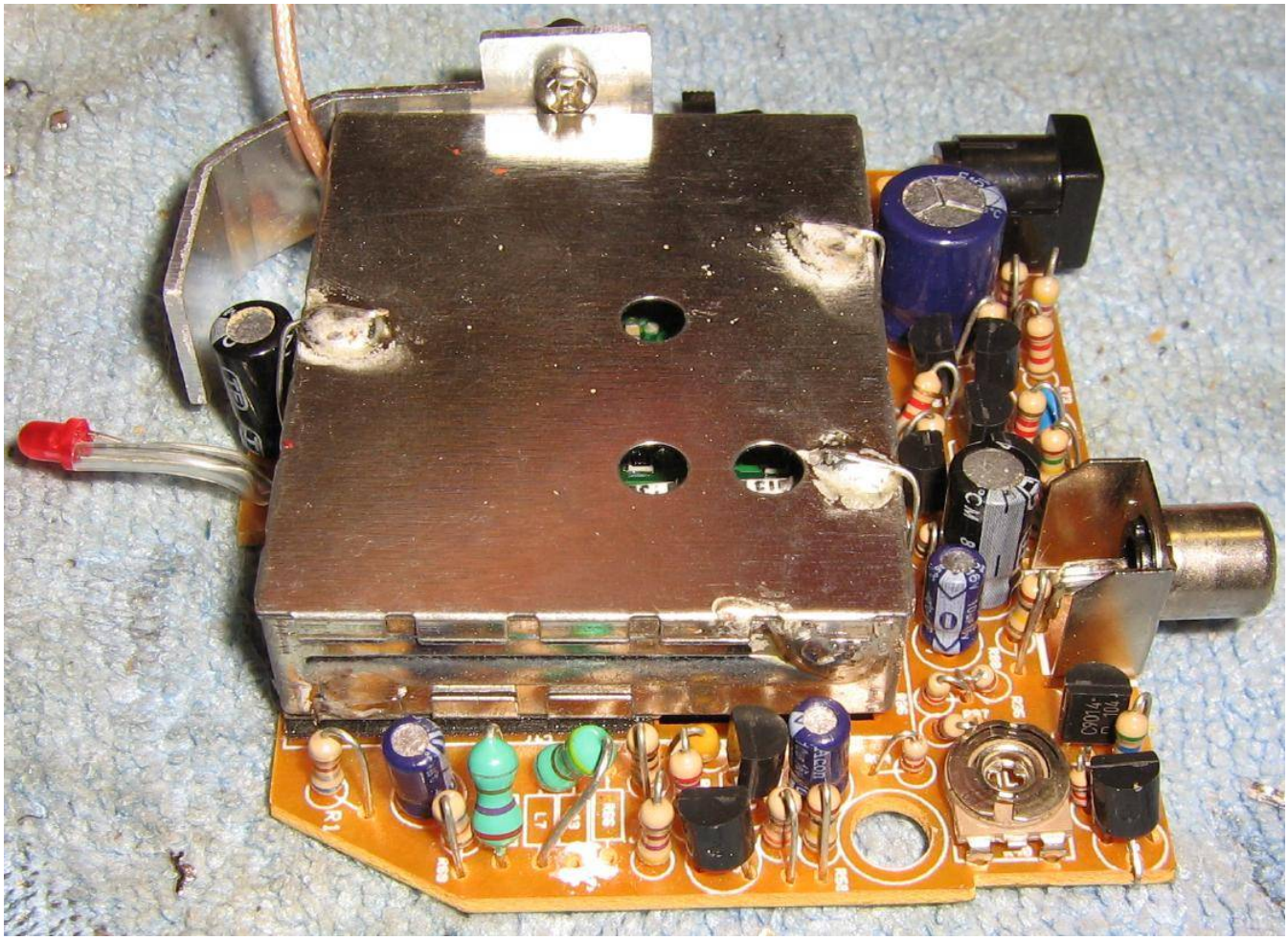
The "TP Voltage" value is the voltage I measured at the output of the 4–position "Channel Select" switch on a X10 Model VR36A Video Receiver. This is the switch that selects the unit's receiving frequency. As you can see, by adjusting the voltage at this point, you can also adjust the receive frequency. This means these units can be modified to receive "out–of–band" wireless video transmissions between approximately 2.3 – 2.7 GHz. This is handy, because some television stations can legally use frequencies outside of the standard unlicensed 2.4 GHz band (2.402–2.483 GHz) to operate their remote video links. You know, the video signals which are sent by those trucks with the microwave dish mounted on a pneumatic lift.

Pictures & Construction Notes



Overview of the "X10 Model No. VR36A 2.4 GHz Wireless Video Receiver" for use with X10's wireless camera systems operating in the unlicensed 2.4 GHz band.

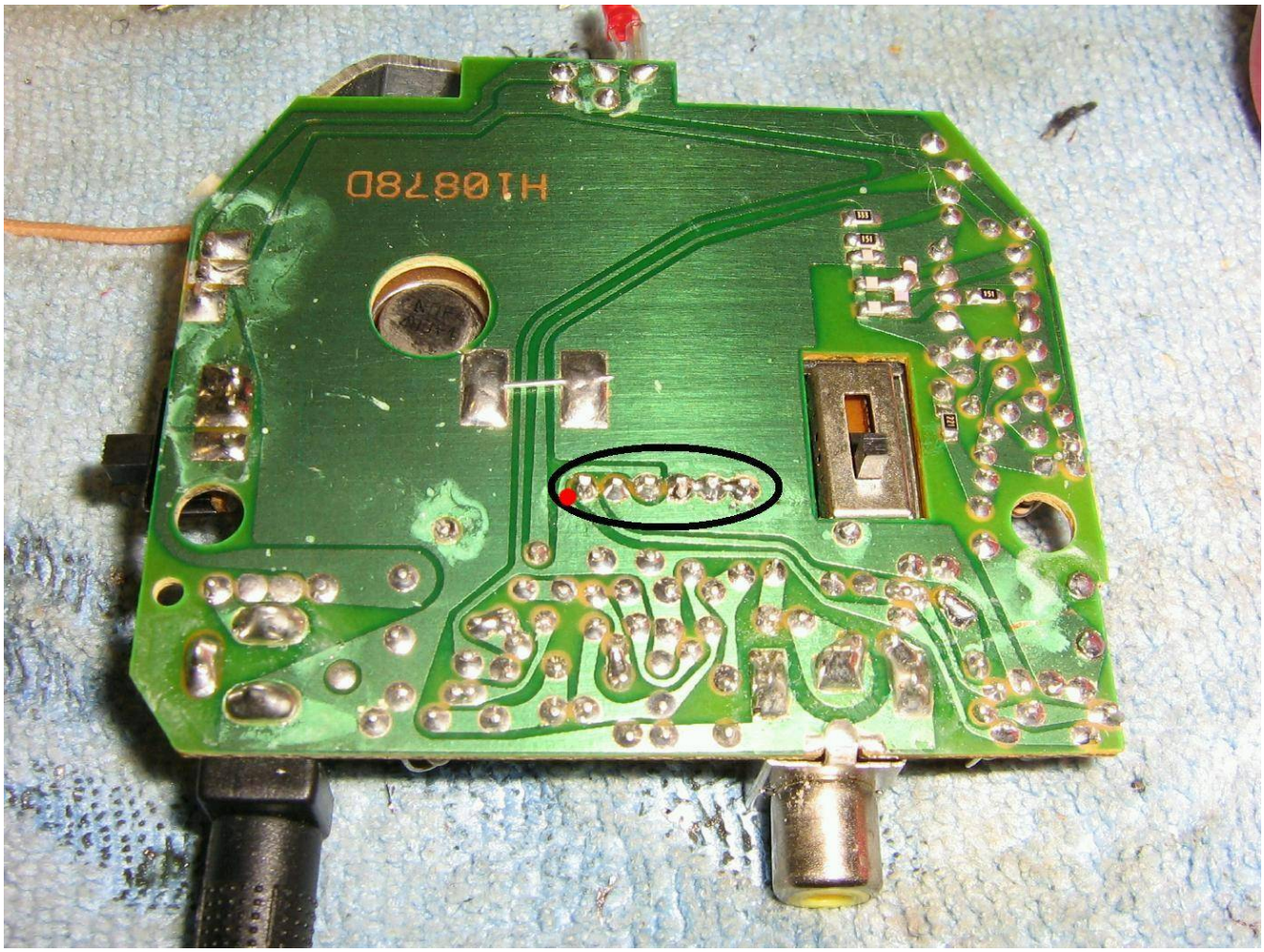
Note that the stock antenna is just a simple little patch antenna.



Internal view of the X10 VR36A receiver.

The power LED is on the left. The actual 2.4 GHz video receiver module is the silver box in the middle. The +9 VDC power input is via the connector on the top−right. The video output signal is via the RCA jack on the bottom−right.

The 2.4 GHz video receiver module only has four main connections. The 2.4 GHz antenna input (via the coax connection on the upper−left), +5 VDC for power, baseband video out, and ground.



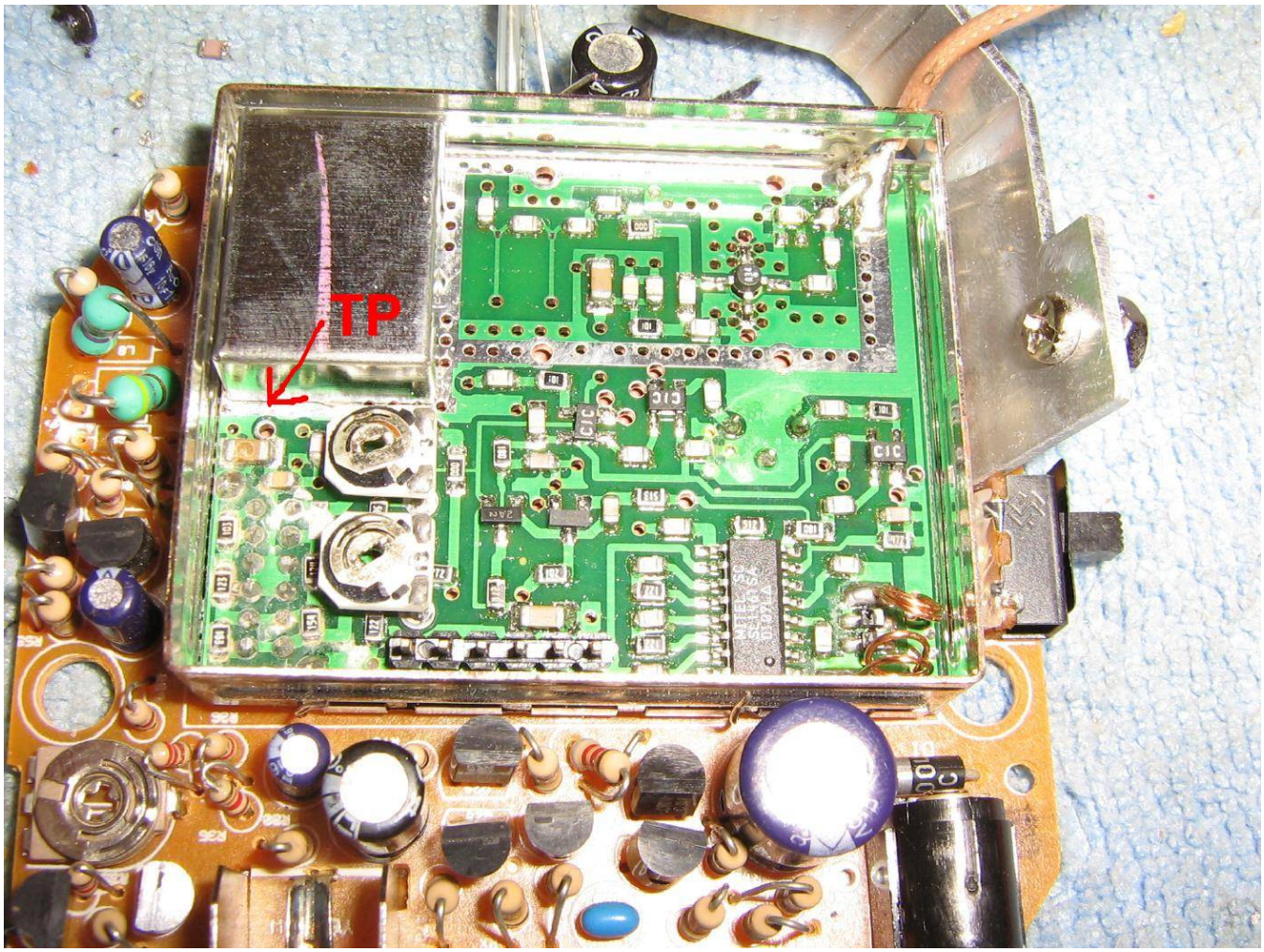
Underside view of the X10 VR36A receiver.

+9 VDC power input is on the lower−left, and the video output is on the lower−right.

The 4−position "Channel Select" switch is on the right−side. The switch is in the "Channel A" position.

The six pins circled are the connections to the actual 2.4 GHz video receiver module.

Four of them are ground, one is +5 VDC, and one (red dot) is the baseband video output.

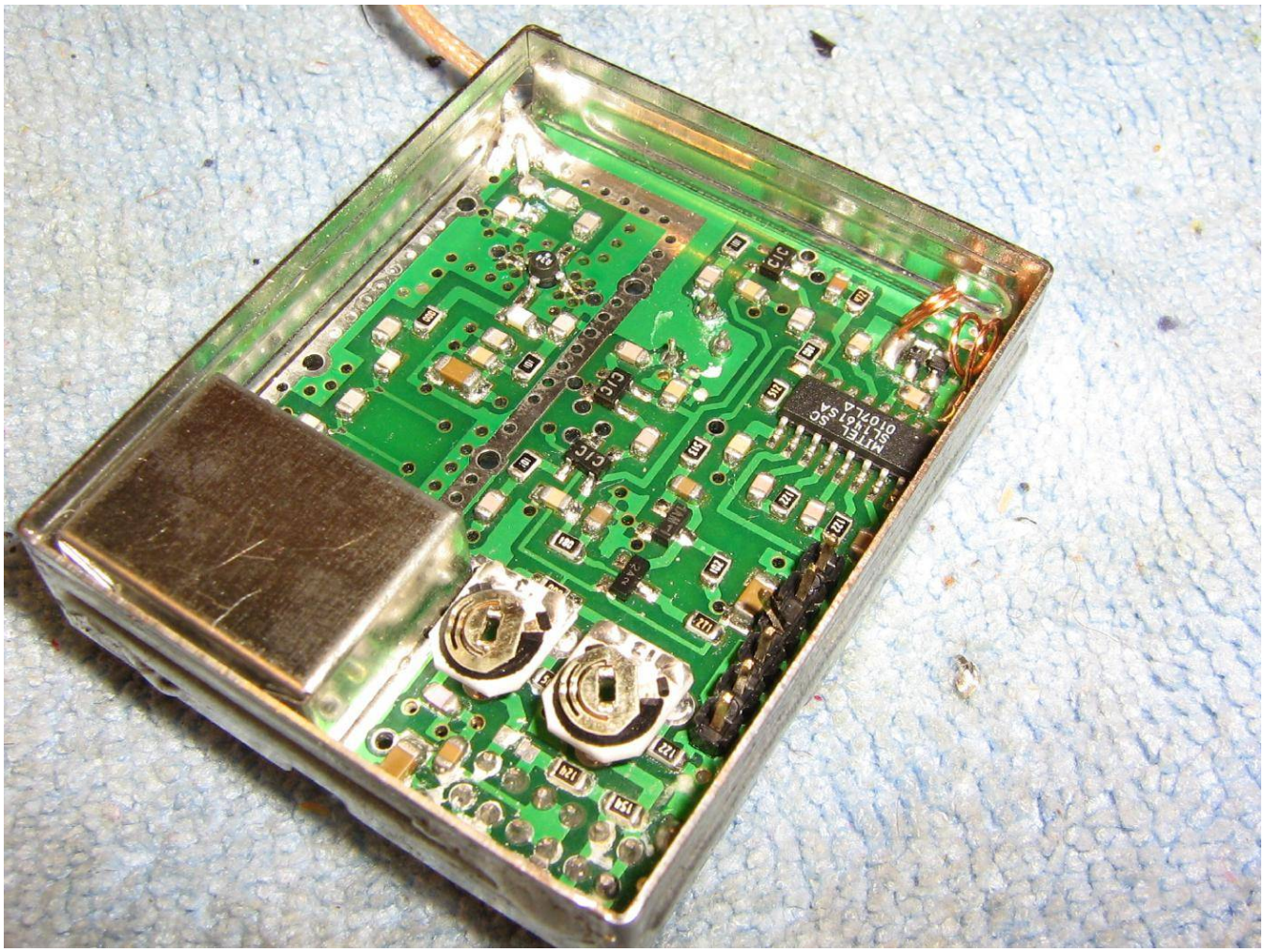


Overview of the 2.4 GHz video receiver module.

The antenna input is via the piece of coax on the upper−right. It is amplified around 16 dB using a Sirenza SGA−3486 MMIC and then high−pass filtered before entering the shielded mixer/local oscillator section. This module, and most others, use an IF output frequency of 480 MHz and a low−side local oscillator. This means to receive a video signal at 2.45 GHz, the local oscillator needs to be set to 1.97 GHz.

This is where the "Channel Select" switch comes into play. As you can see in the above photo, the switch is used to select between four different resistive voltage dividers which determine the voltage on the local oscillator's tuning line. The two potentiometers appear to be "fine tune" controls for this voltage. The "TP Voltages" in the chart at the beginning of this article where taken at the plated through−hole labeled **TP** in the above photo.

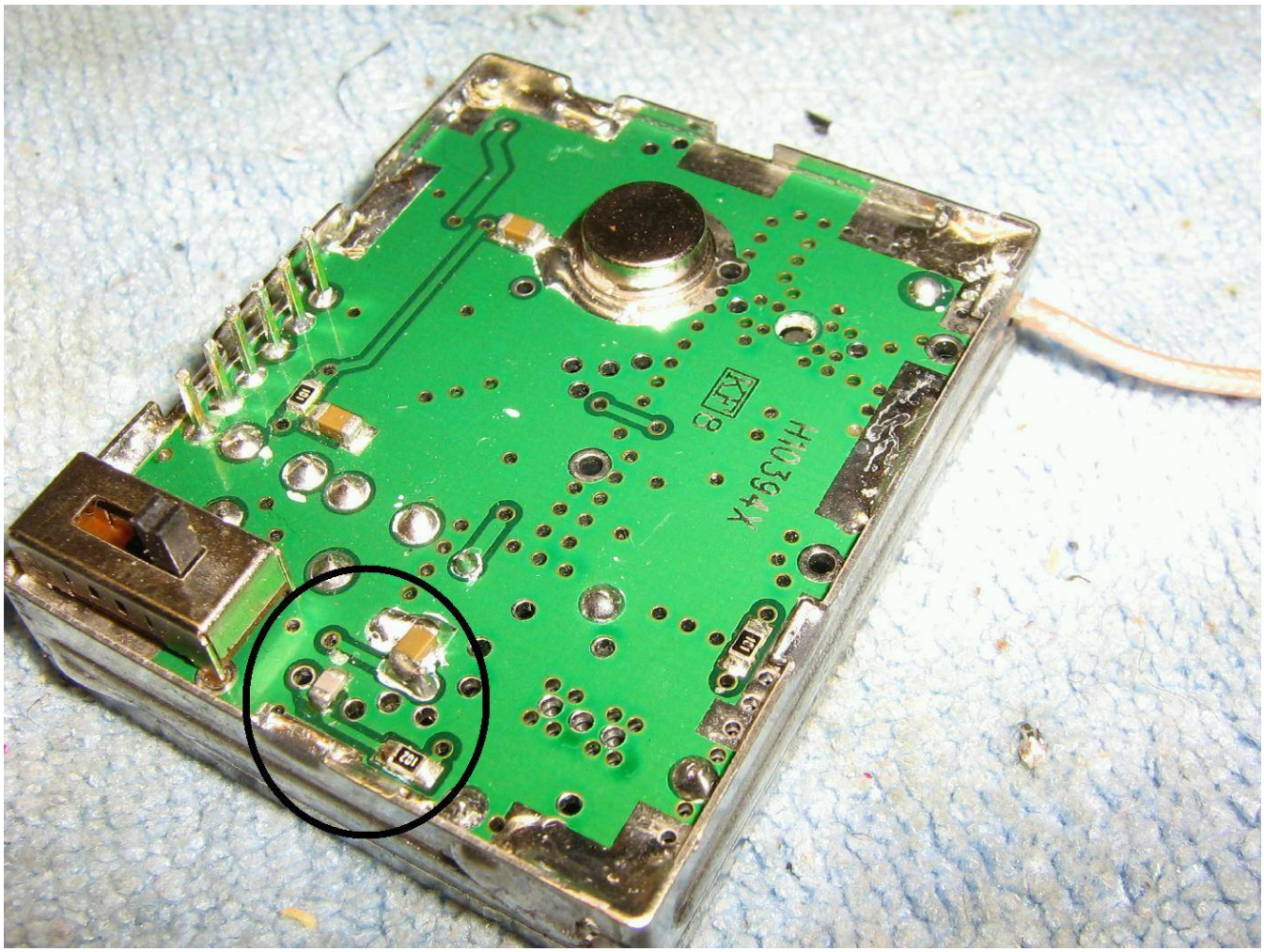
The idea is that by manually adjusting the voltage on this local oscillator tuning line, we can then make the module receive "out−of−band" video signals.



Alternate internal view of the 2.4 GHz video receiver module.

You'll need to remove the 2.4 GHz video receiver module to perform the next modifications.

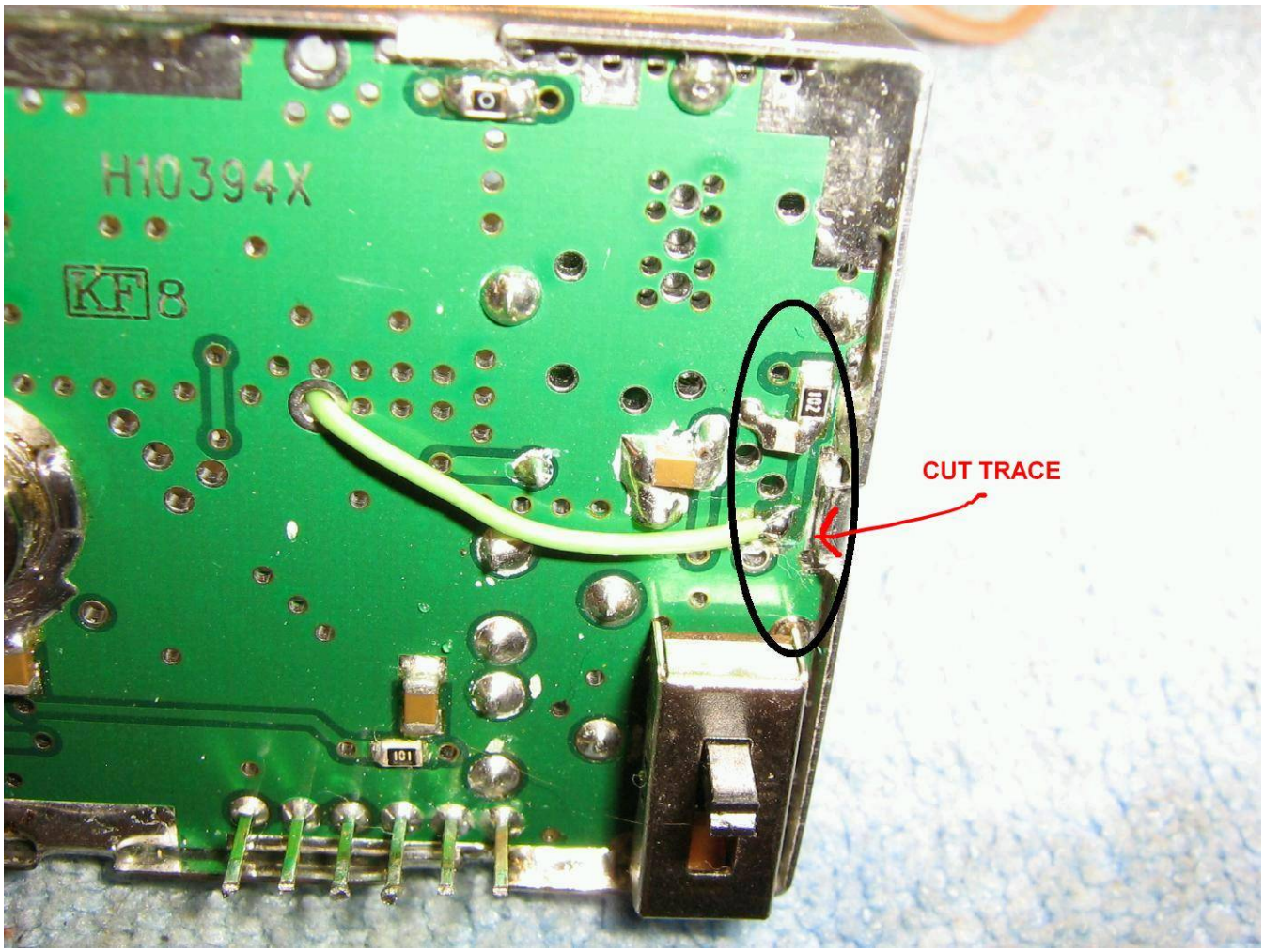
This is a little better view of the voltage−dividing resistors and the "Channel Select" switch pin−out.



Bottom view of the 2.4 GHz video receiver module.

The circled portion is the voltage tuning line input for the mixer/local oscillator section.

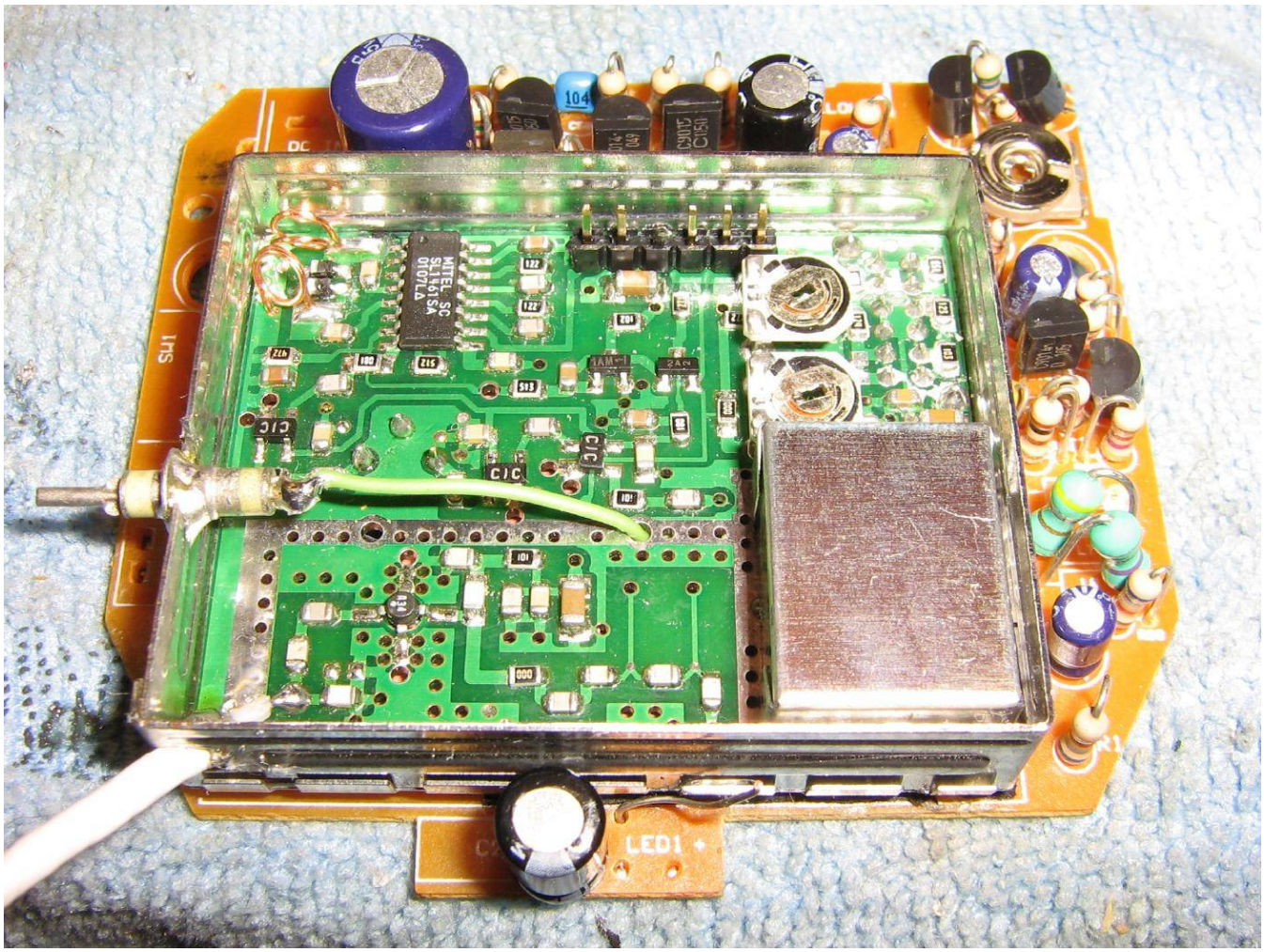
A series 1,000 ohm resistor and shunt capacitor help to form a low–pass filter to remove any noise on the tuning line.



Overview of the manual tuning modification.

You'll need to cut the trace on the voltage tuning line (right after the plated through–hole) and move the shunt capacitor next to the 1,000 ohm resistor.

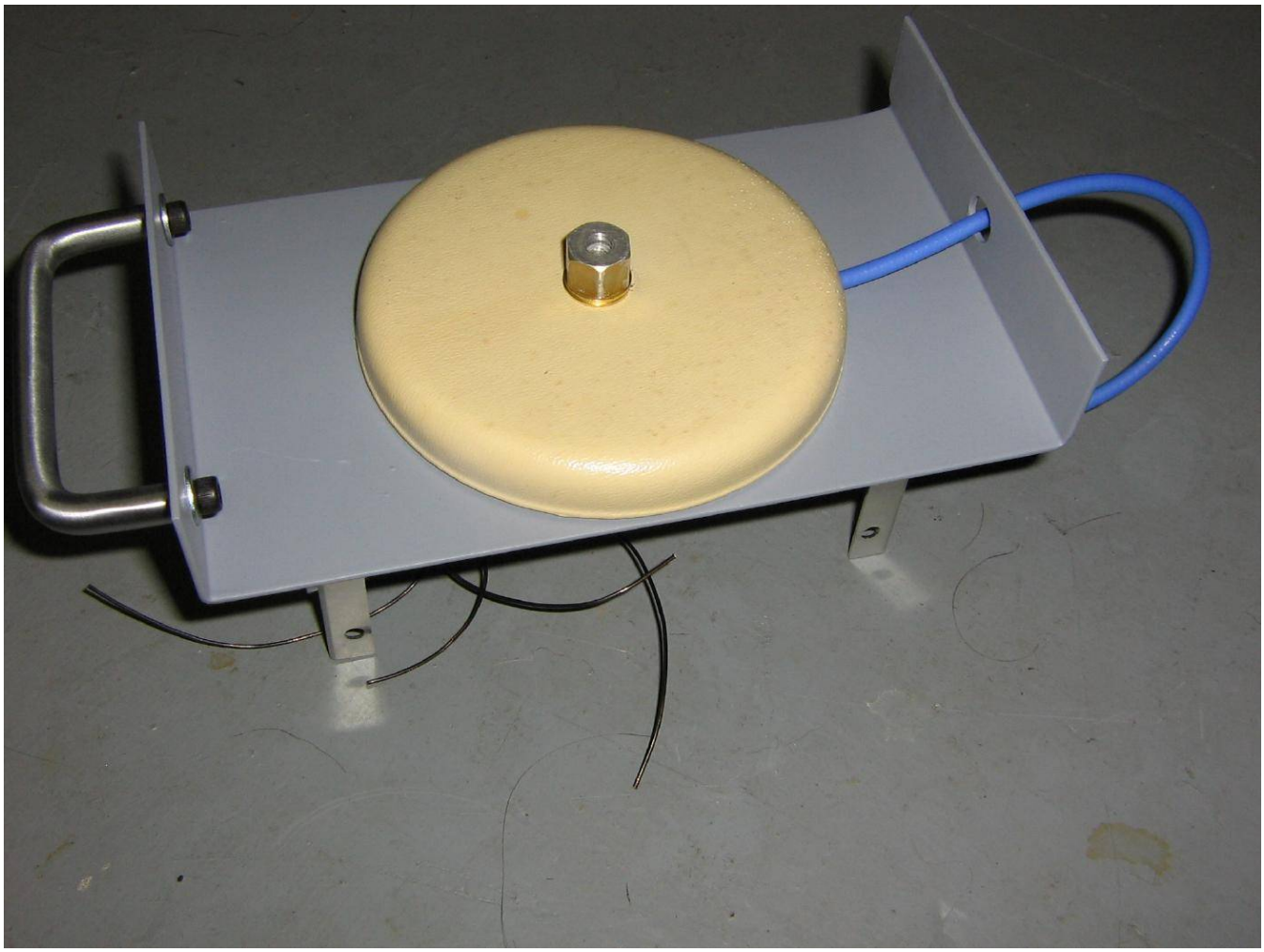
Then you'll solder an extension wire onto this "new" voltage tuning line and route it to the top of the board.



Overview of the "new" external voltage tuning line.

I ran it to a panel–mounted 1,000 pF feed–through capacitor. This capacitor is optional, but very helpful.

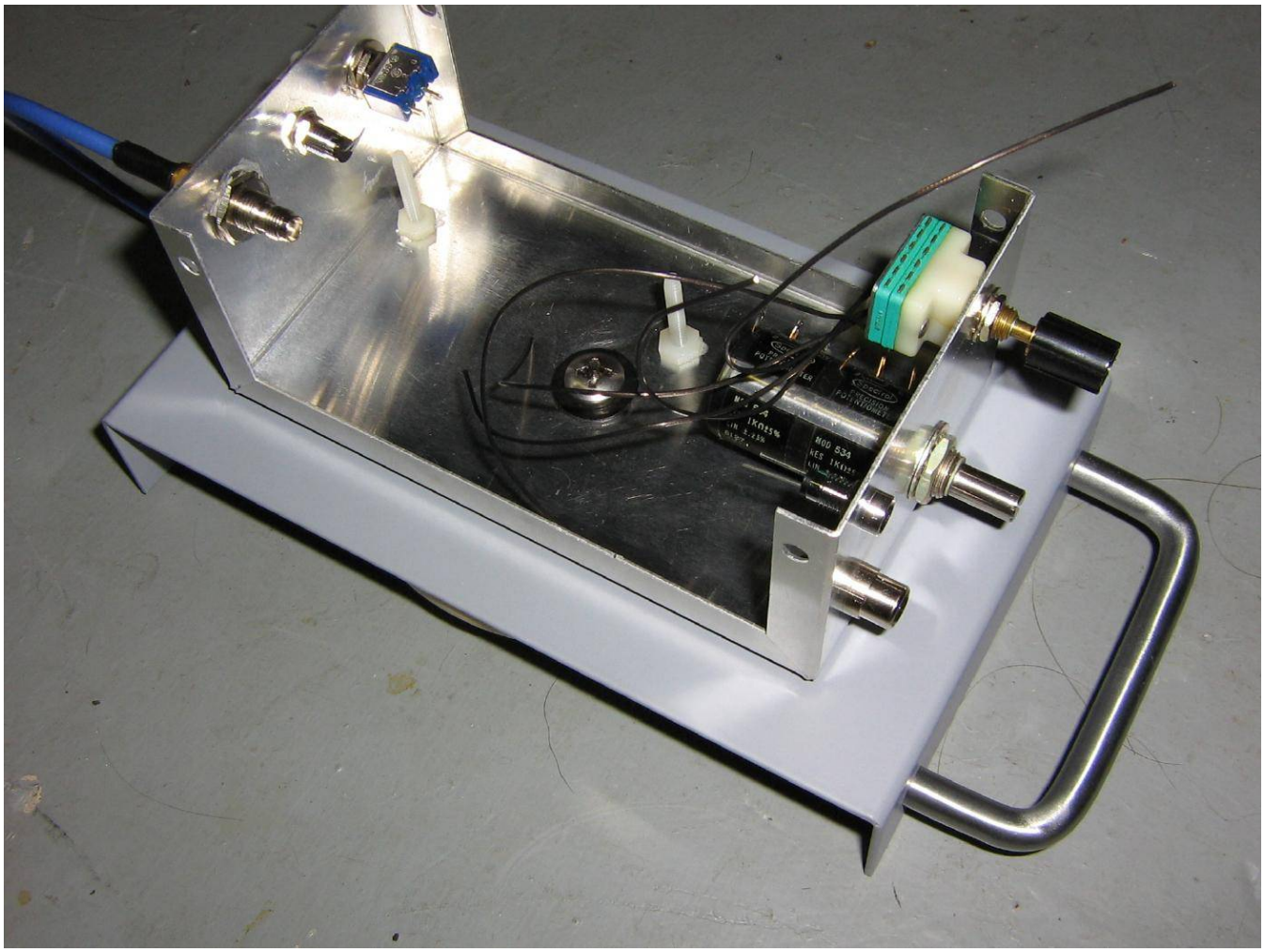
Also, you may wish to add a better piece of coax on the module's RF input. I added a piece of nice Teflon coax with a male SMA connector.



For this project, we'll mount the 2.4 GHz video receiver to the back of an old California Amplifier 2.5 GHz MMDS integrated downconverter and 22–element Yagi antenna.

You'll want to replace the stock coax on the Yagi with something of higher quality and with a RF connector. This will allow you to use the antenna for other projects, if so needed.

A handle was also added to the back plate of the Yagi antenna for mounting or holding.

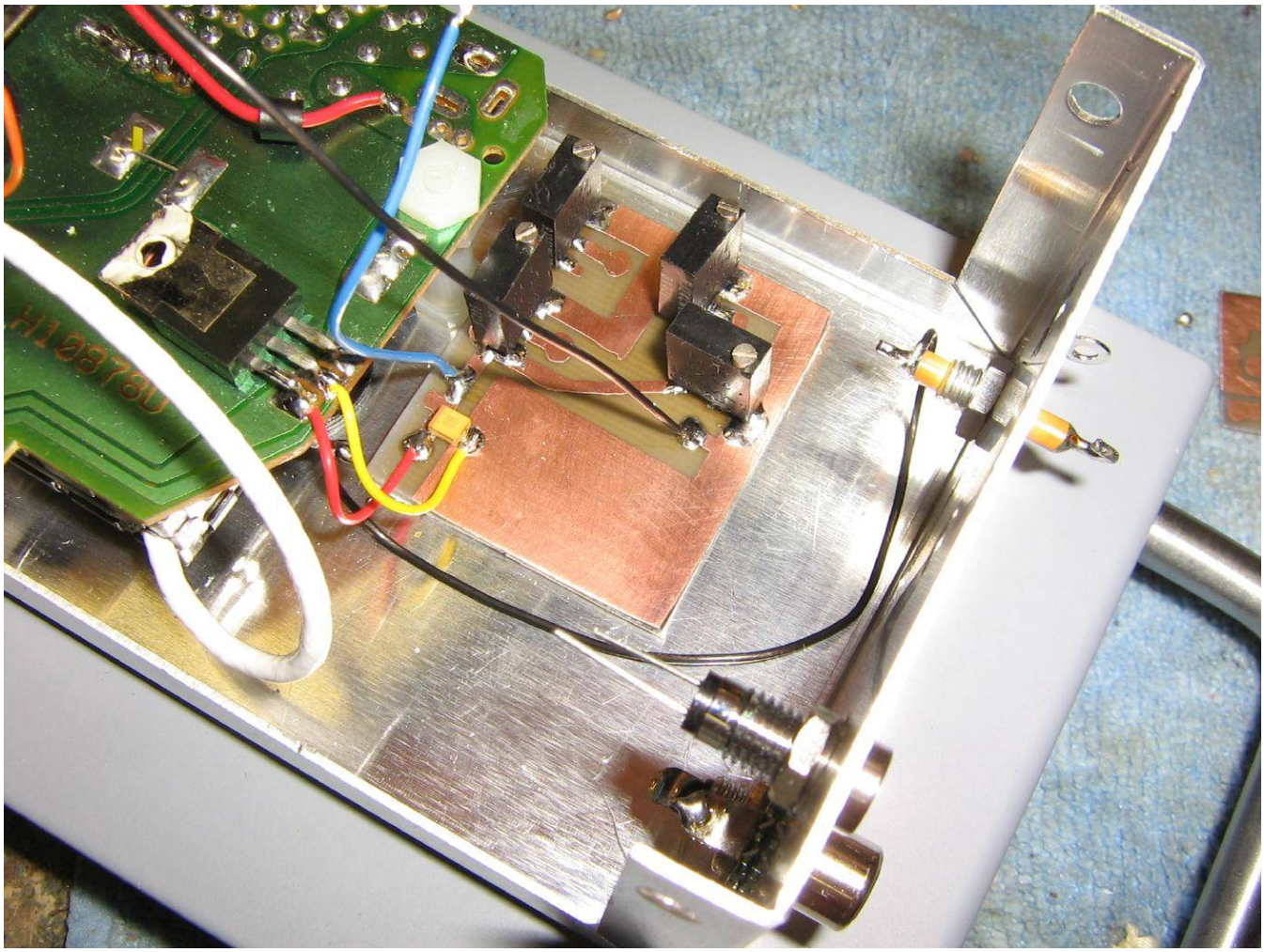


Case overview used to hold the modified VR36A receiver.

The stock downconverter was removed and a stainless steel 1/4−20 bolt was added to secure both the antenna parts and the aluminum project case. The circuit board of the VR36A will be mounted to the case using some nylon stand−offs and hardware.

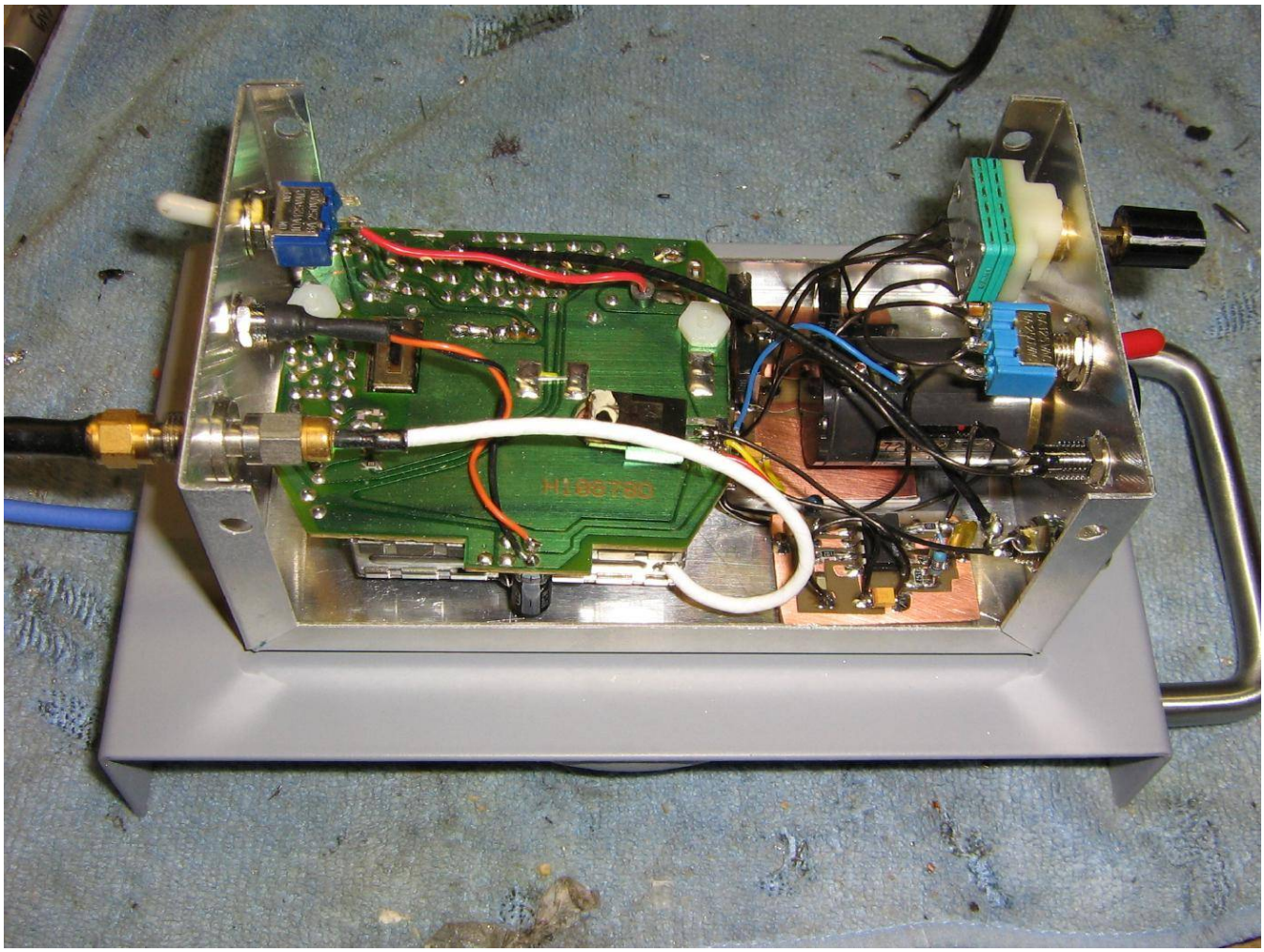
A panel−mount, feed−through female SMA−to−SMA connector is used to bring the RF signal into the module. Next to that is a panel−mounted LED and the power switch.

The panel−mount switch with the green back is a 4−position switch. Next to the switch is a multiturn 1,000 ohm potetiometer, and a RCA jack for the video output.



Overview of the potentiometers for setting the voltage levels which correspond to each of the four stock channels.

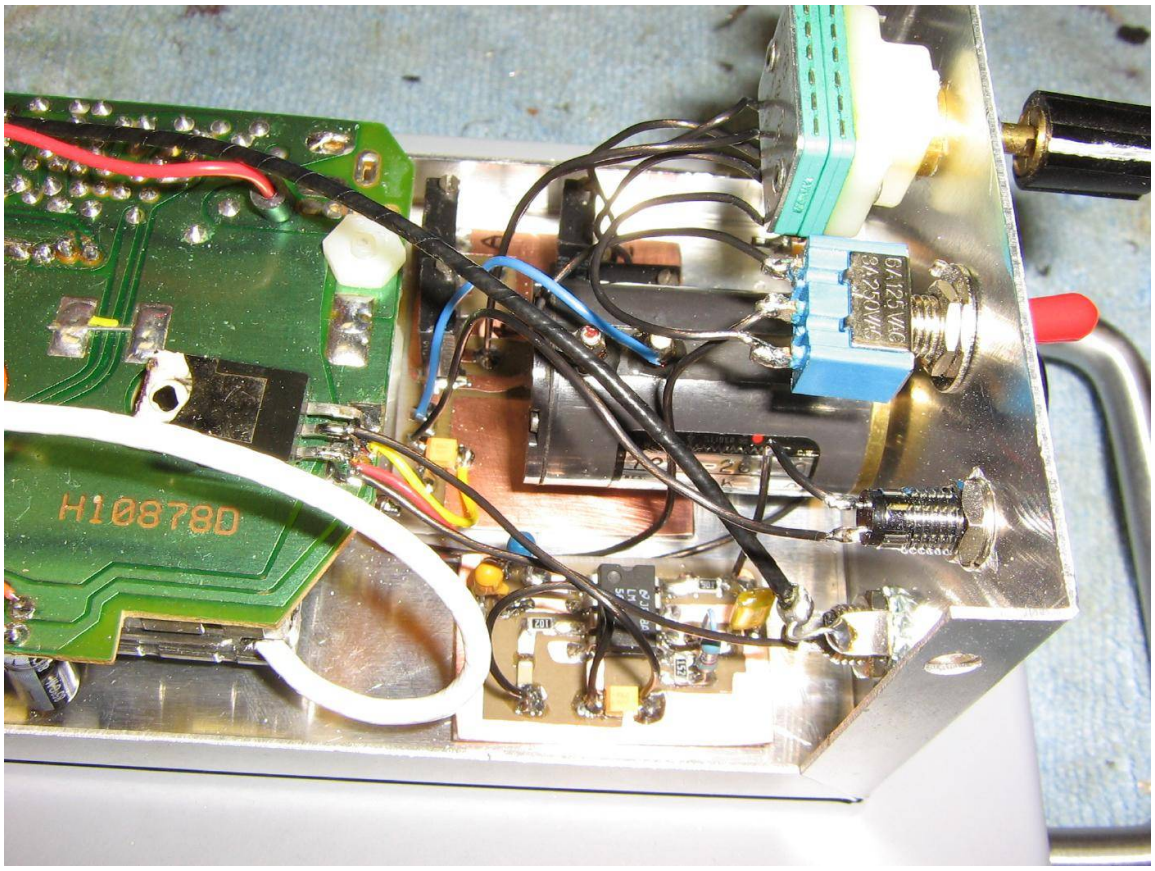
An optional feed−through capacitor (upper−right) was added as a test point to externally monitor the voltage on the module's tuning line.



Completed 'warspying' device overview.

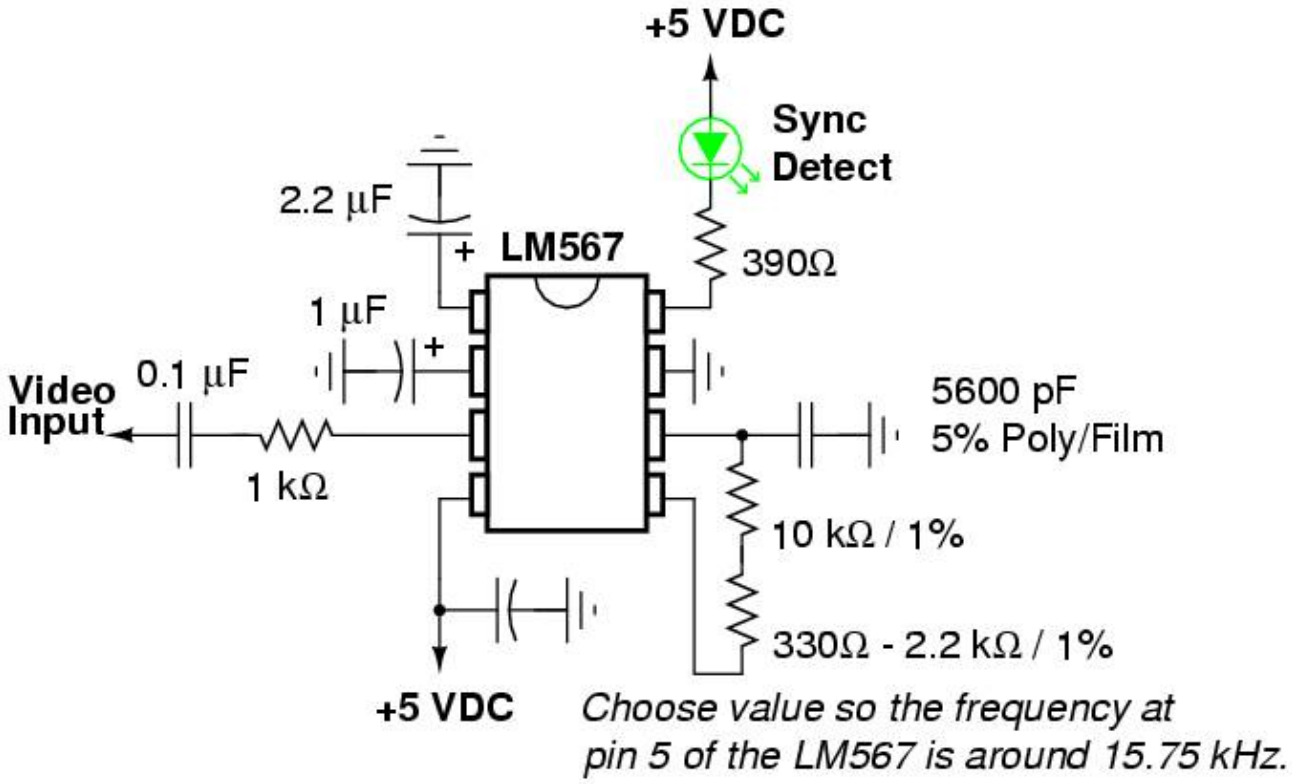
An optional 15.75 kHz horizontal synchronization detector circuit using a LM567 tone decoder was added to help determine if you are actually receiving a video signal.

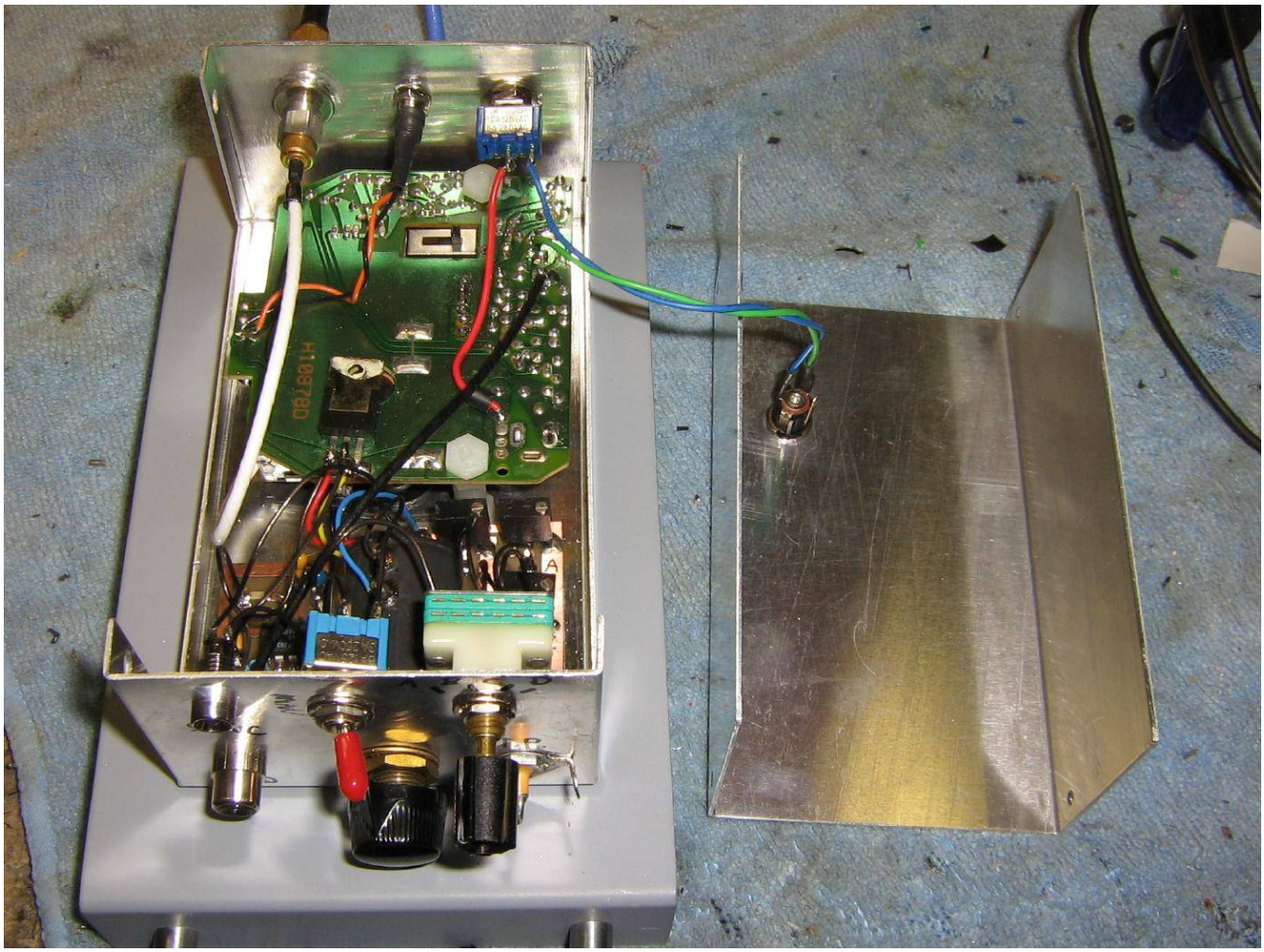
You should also try and replace the stock 7805 voltage regulator with one which has better noise and voltage stability specifications.



Closeup view.

15.575 kHz Horizontal Syncronization Frequency Detector

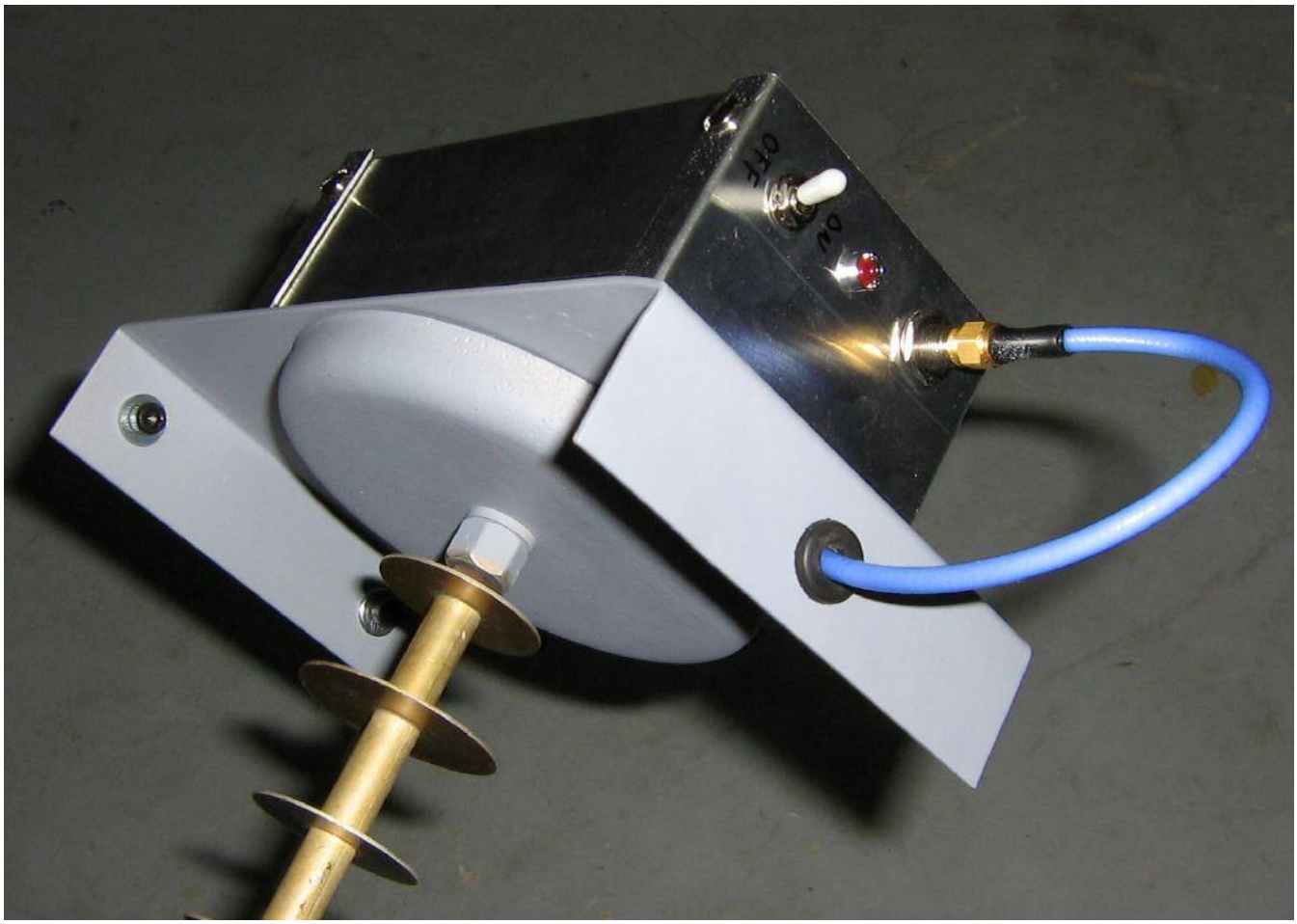




Alternate internal view.

Originally, I was going to use an internally–mounted 9 volt battery, but the current draw is quite high, 300 mA or so, and the battery would die quickly.

An external power jack was added to run the circuit from a 12 volt lead–acid battery pack or cigarette lighter.



Finished case overview.

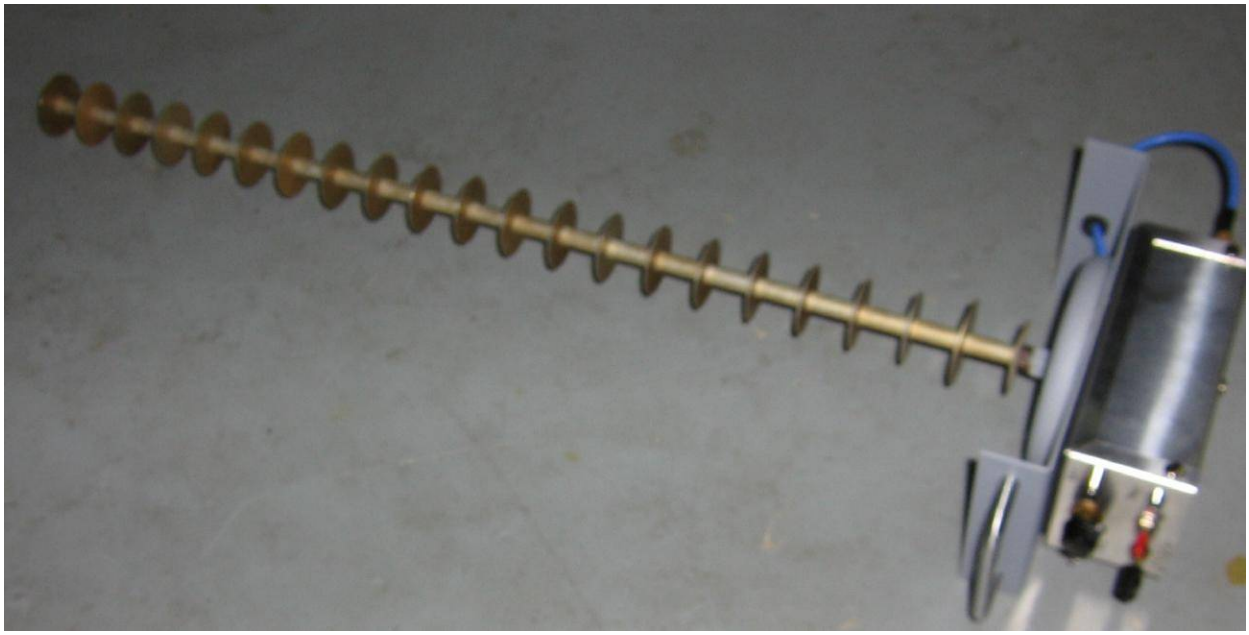
Power switch, power LED, and SMA jack for RF input.

Finished case overview.

Video output and 15.75 kHz horizontal synchronization detection LED on the left.

Selector switch to choose between the four stock channels and manual tuning. The multiturn 1,000 ohm manual tuning potentiometer is in the middle.

The new 4–position channel select switch and the tuning voltage test point are on the right.

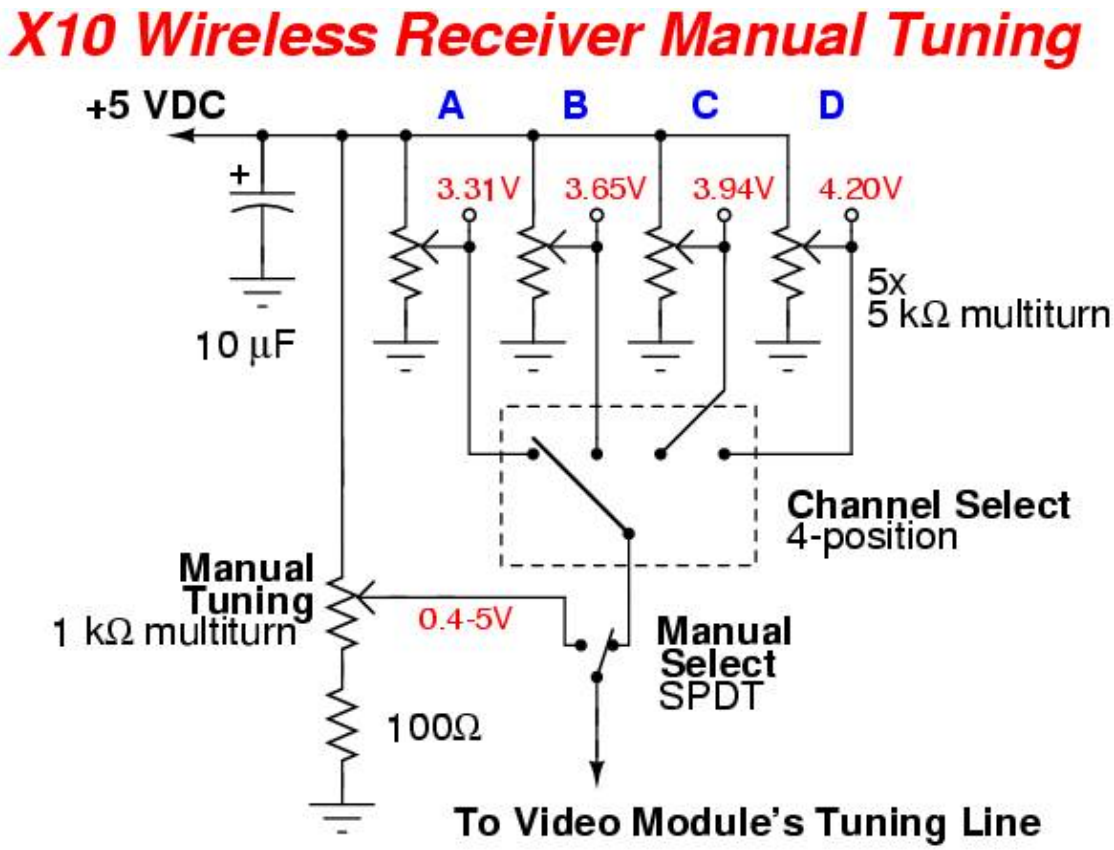


Finished overview.

The video output can be monitored via a battery–powered TV, or other monitor, with a "video input" jack.

The "Portable Video Camera Viewer" project discussed in *GBPPR 'Zine*, Issue #22 will also work.

"A" is the default channel for the corresponding X10 transmitters.



"Warspying," an article by Particle Bored in *$2600 Magazine* Vol. 19, No. 4:

WARSPYING

by Particle Bored

Are you having a hard time figuring out what to do with your X10 camera now that you are done playing practical jokes on friends and family? For less than $50 you can put the X10 receiver in your car and begin screwing around with complete strangers.

Standard disclaimer: I don't accept responsibility for my own actions, so I definitely won't assume responsibility for yours. If TV's in vehicles are illegal in your area, or should you get decapitated from a TV flying around in your car it's your problem.

Here is what you will need to get started:

Jensen J53-BW TV/Monitor (only $25 at Target)
X10 Receiver
DC Power cord with "L" connector
DC Power "Y" adapter
Velcro

The Jensen TV is a 5" black and white portable monitor that has both video and audio RCA input jacks. It can run on AC, DC, or batteries and comes with a car lighter adapter.

The X10 receiver is intended for indoor use, so it is shipped with only an AC adapter. If you look at the output of the adapter though, you'll see that it is 12 volt DC which means you can run the receiver straight off your car battery. Since I wanted the system to be easily removed, I decided to power it with another lighter cord (the one with the "L" connector). It is positive-tipped, so make sure you have the polarity right.

Now plug everything together. Nearly all of the connectors can only go in one place. The RCA connectors are fully color-coded, so if you can't figure out how to do it, fire up the IM client on your Mac and ask your grandmother.

I mounted the monitor and receiver on my dashboard with Velcro. If this method obstructs your view you can put the monitor on the passenger seat or floor. Make sure you don't mount anything where it might hinder the deployment of an airbag.

Now hit the road. I found my first camera within 60 seconds on the very next block. I typically find one about every 15 minutes.

In closing here are a few things I learned the first day:

- Don't worry about the channel switch on your receiver - most folks leave it on the default channel "A".

- The transmitters have a range of only around 100 yards so you will need to be somewhat close to your target.

- You'll tend to get audio before video, so you'll know you are onto something when the static on the TV goes away. Keep your eyes on the road and pull over when you start receiving audio.

- You'll notice several definite patterns appear on the monitor at times. For example, I have seen both narrow and wide horizontal lines. If you identify the devices that cause them, write to the Letters section of *2600* and let everyone know. I would bet one of them is a 2.4 GHz cordless phone....

- I was able to get perfect cable TV twice. Is someone using wireless for extensions or something?