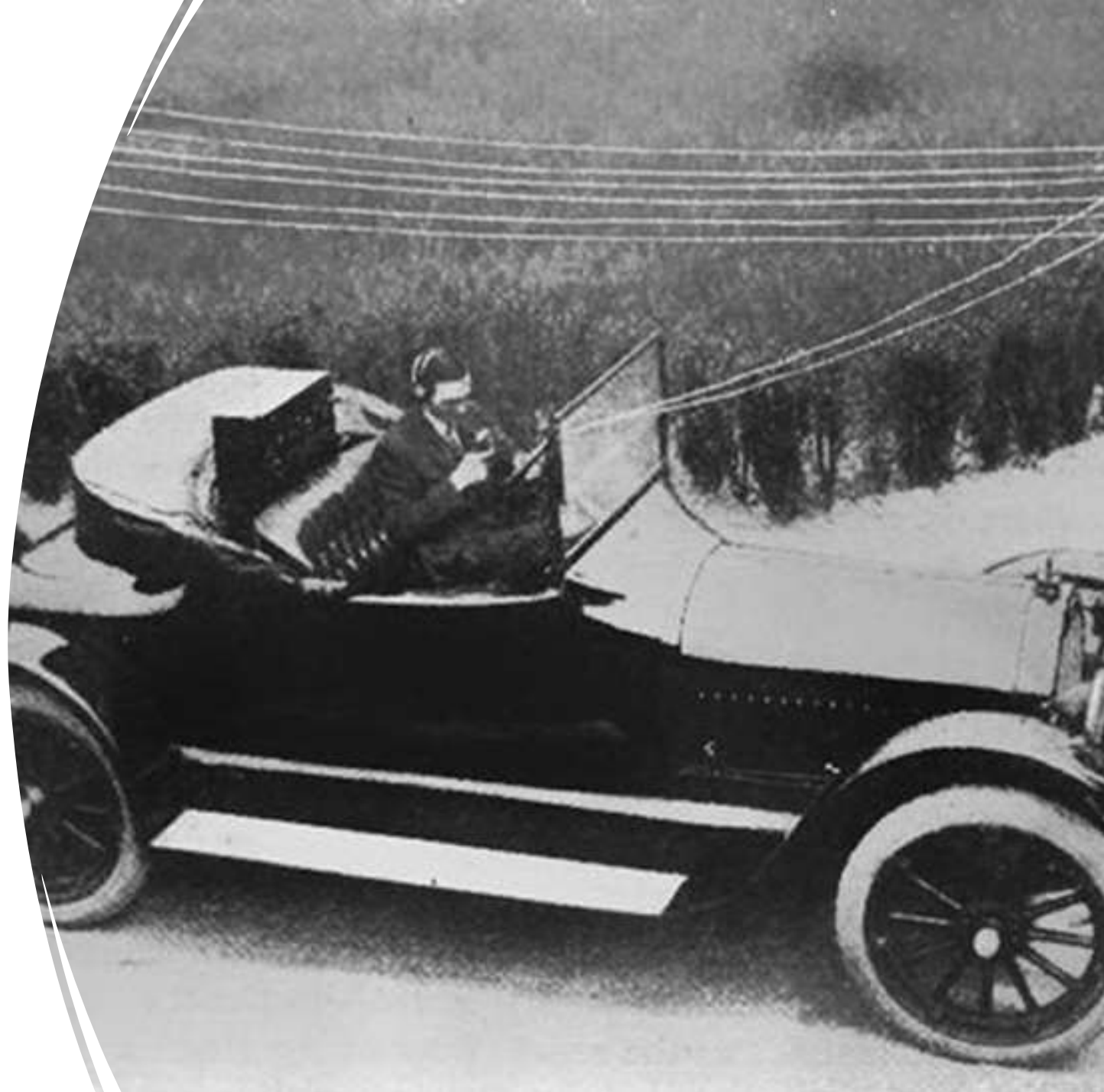


Mobile HF Effective Installation Techniques

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May 2021



Acknowledgements

The successful implementation of my high-performance mobile HF station would not be possible without the mentoring and help from:

Phil MacCormick VE7KJR
Ian Procyk VE7HHS

Introduction

- My goal was to install and use an HF mobile station in my Tacoma truck
- My first approach and application utilized an ICOM IC-7000, an LDG antenna tuner and a Little Tarheel II screwdriver antenna





Results

- I did not exploit an “auto-tuner” for the screwdriver antenna, so I installed an “up/down” DPDT rocker switch in my truck’s dashboard to control antenna tuning
- I applied a reflected tape on the antenna and used markers to approximately identify the bands that I wanted to tune
- Once I moved the actuator/contacter to the intended band, I then invoked the LDG tuner to ensure a good impedance match
- Overall, this simple configuration worked well – and within budget

... so far, so good 👍



“Two-Footitis”

... the need to move up to a boat 2-feet longer than the one you have – is an ailment that hits most sailors at one time or another as their passion for the sport grows

- Well, just adapt this to ham radio 😊
- The Little Tarheel II is a very good beginners' screwdriver mobile HF antenna
 - Performance was good and priced accordingly
- But after a few years of manual tuning and the desire to extend range and capabilities, I opted for a Hi-Q 480 antenna
- This is where things got interesting, and frustrating at the same time

Hi-Q 480

<https://www.hiqantennas.com/>

- These are rugged screwdriver antennas intended for harsh environments
- The 480 model has a 4 inch coil and can be tuned between 6m and 80m
- The coil wire is #12 gauge enamel coated to handle SSB legal limit RF power
 - No concerns for my 100W mobile radio
- No moving parts outside, no length changes - the contactor (RF coupler) travels within the sealed coil housing
- The main shaft is aluminum and has an internal rotating magnet
- 2 magnet sense switches are used to count each $\frac{1}{2}$ rotation of the internal shaft



Hi-Q 480 | Pulse Counting

- 2 magnet sense switches are used to count each $\frac{1}{2}$ rotation of the internal shaft
- Pulse counting allows automatic tuners to remember the position of resonant frequencies
- To protect the sensor along with the RF conducting shaft from the elements, I used a large diameter heat shrink tube extending from the base of the coil down the entire length of the shaft



Mounting

- With the lightweight and small Tarheel antenna, I was able to mount it on a metal tab attached on my truck bed wall under the lip of my fiberglass canopy
- However, for the heavier and larger Hi-Q, I needed to take another approach
- I needed to design a mount such that it:
 1. eliminates the need to adjust the antenna every time I need to open the truck's rear hatch;
 2. does not block any signal lights;
 3. is rugged and can hold the antenna securely even at highway speeds;
 4. has cable management;
 5. is esthetically appealing.
- This is where Phil VE7KJR came to my rescue



Mounting Bracket

- A custom $\frac{1}{2}$ " square metal tube was created by welding pre-cut sections together
- The bracket was then welded to a 2" steel tube that was then welded to the tow-hitch mount under the truck



Wiring

- I used RG-58 coax and 4 conductor wire cable
- The 4-conductor cable is for
 - 12 VDC – motor control (up/down)
 - Pulse counter – required for automatic tuners
- Both cables were routed from the radio/tuner, under the truck bed and up through the inside channel of the mounting bracket

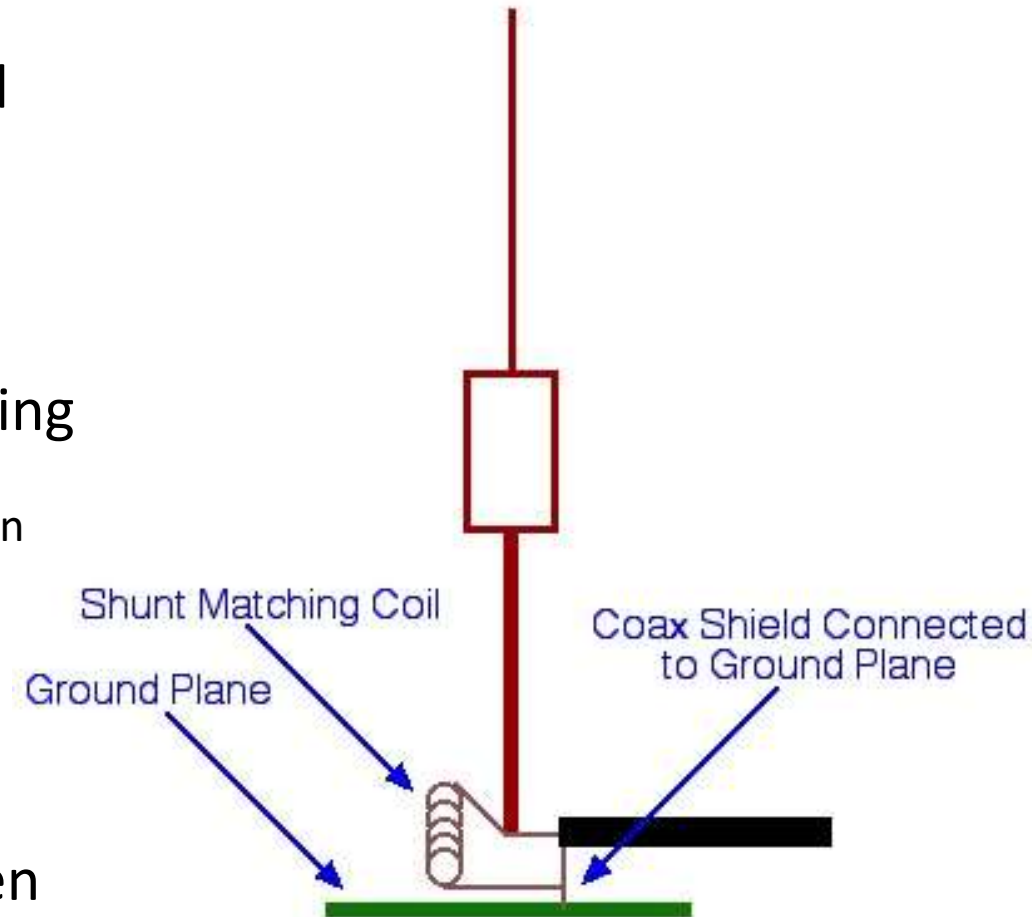
Antenna RF Connectivity

- You can use a terminal lug to attach the centre conductor of coax cable to the base of the antenna
- Instead, I designed a copper plate assembly that mounts the RF isolator (from ground) and connects it to a SO-239 chassis mount connector for easier maintenance



Shunt Coil | Matching

- A shunt coil is required to ensure proper impedance matching for the various bands such as 80m, 40m and 20m
- One end of the coil is attached to the antenna's feed point at the 9/16th bolt and the other end goes to chassis ground
- It may be possible to achieve a $<2:1$ match on 80m using a shunt coil
 - This will result in an approximately 1.4:1 match on 40m, which is an acceptable compromise
- The match will improve on higher frequencies
- The shunt coil is made using #14 or heavier enamel copper wire, close-wound on a 1.25" to 1.5" mandrel, and then stretched slightly to create an air gap of approximately one half of the wire's diameter between the turns



Shunt Coil Design

- The coil needs to be $\sim 1 \mu\text{H}$, but the actual value may be between $.5 \mu\text{H}$ and $1.5 \mu\text{H}$ depending on the input impedance of the antenna in question
- But for best results, the finished coil should be between .75 to 1.25 inches ID
- The coil at right is 1 inch in diameter, has 9 turns, and wound with #14 gauge enameled wire
- The number of coil turns and spacing required (inductive reactance), depends on the quality of the antenna, the mounting location and style, and the amount of ground losses present
- I used a liquid rubber compound to coat the coil in order to protect it from the environment



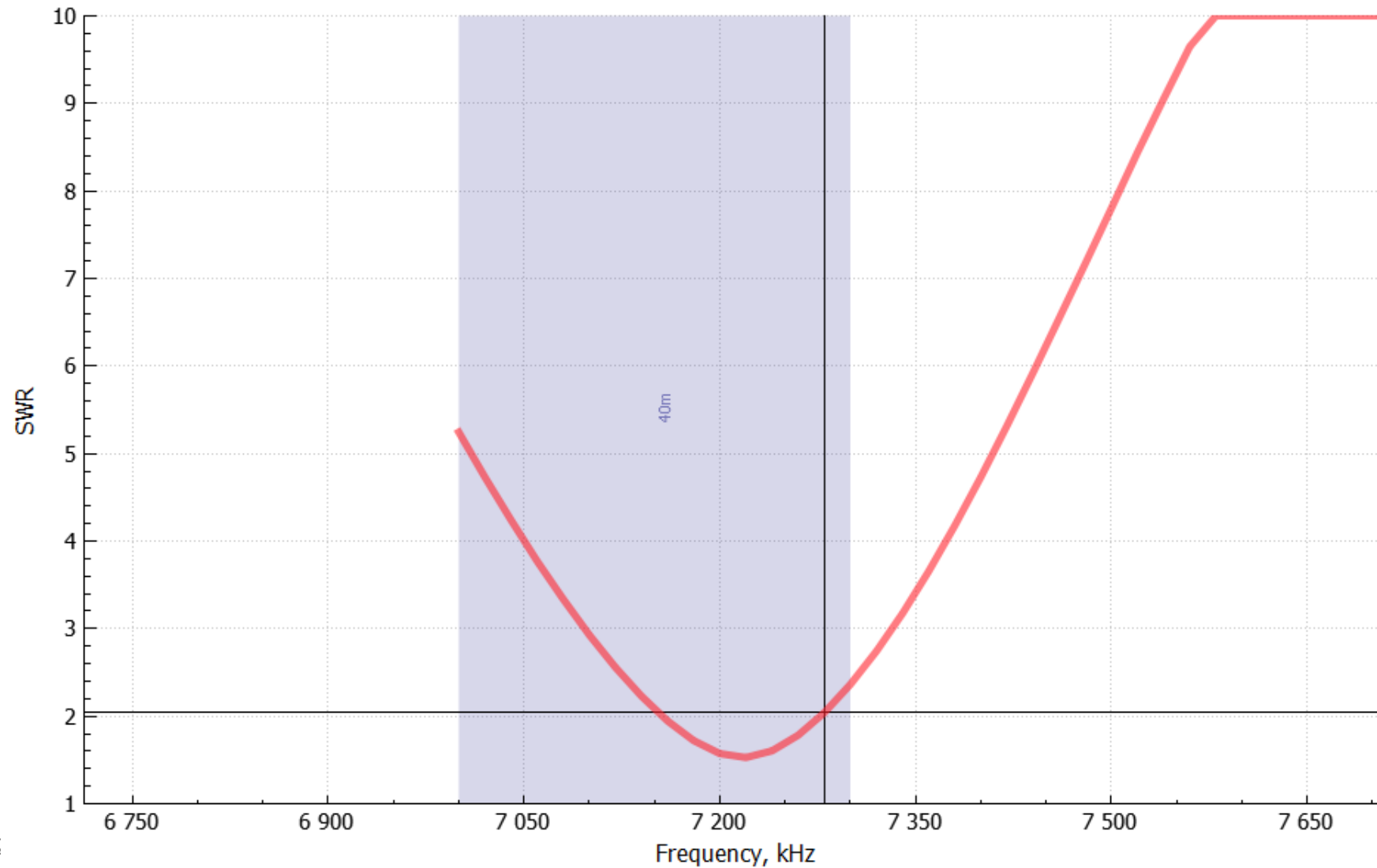
RFI Suppression

- RF choking is ***critical!***
- I used snap-on chokes over the coiled coax cable under the truck
- <https://www.dxengineering.com/parts/dxe-csb31-750-5>

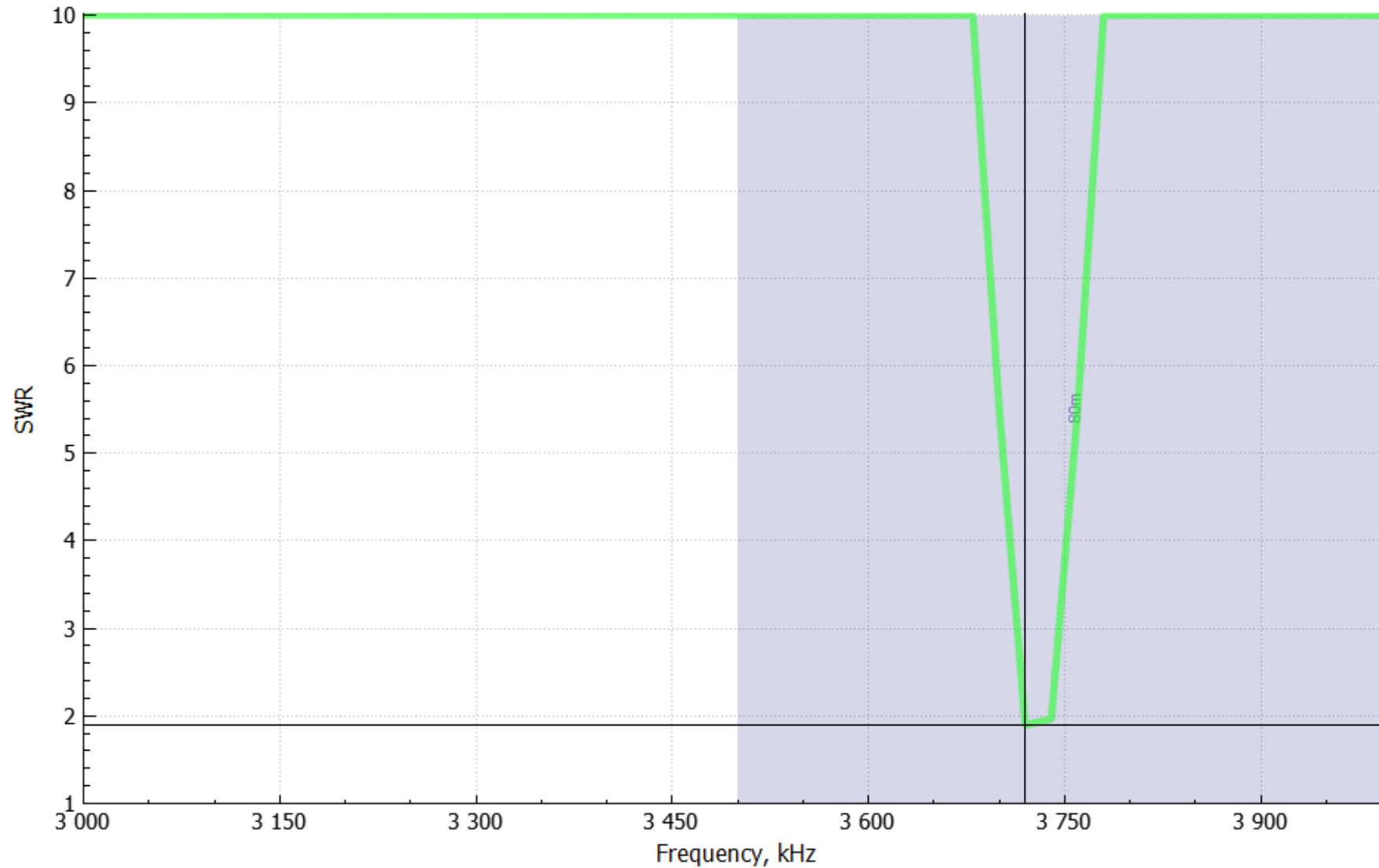


Ferrite Chokes, RFI
Suppression, Snap-
On, Mix 31, 0.75 in
I.D

SWR Measurements: 40m

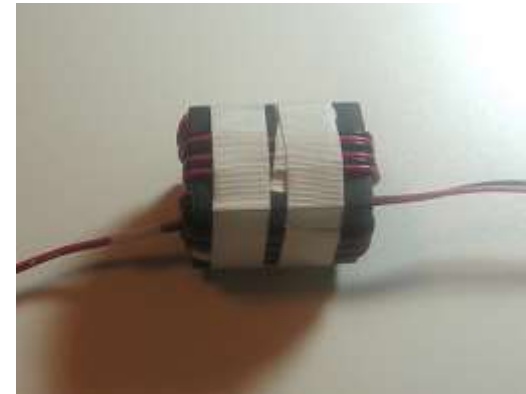


SWR Measurements: 80m



RFI Suppression Control Cable

- Along with eliminating spurious RFI emissions on the primary coax cable (common mode), it is vital to suppress any RFI on the control lines: 12VDC (up/down) and pulse counters
- Without any suppression, it is impossible for the automatic tuner to properly count the pulses
- It will also cause damage to the automatic tuner
- The design details are located here:
<https://www.k0bg.com/choke.html>
- Use the same snap-on chokes as outlined in "RFI Suppression"
- I mounted the finished choke coils into a waterproof plastic enclosure



Final Mounting Assembly



Bonding – Ground Plane

- Bonding (not grounding) all of the vehicle's metal chassis components together is very important to create an effective RF “ground” plane
- All metal chassis components (front cab, engine hood, tail gate, etc., need to be bonded together using ½” braided cable
- Even bond the tail pipe to the chassis to reduce any spurious engine noise
- Make sure to use a “star” configuration, i.e. only one point of bonding contact to each metal component to avoid “current loops”



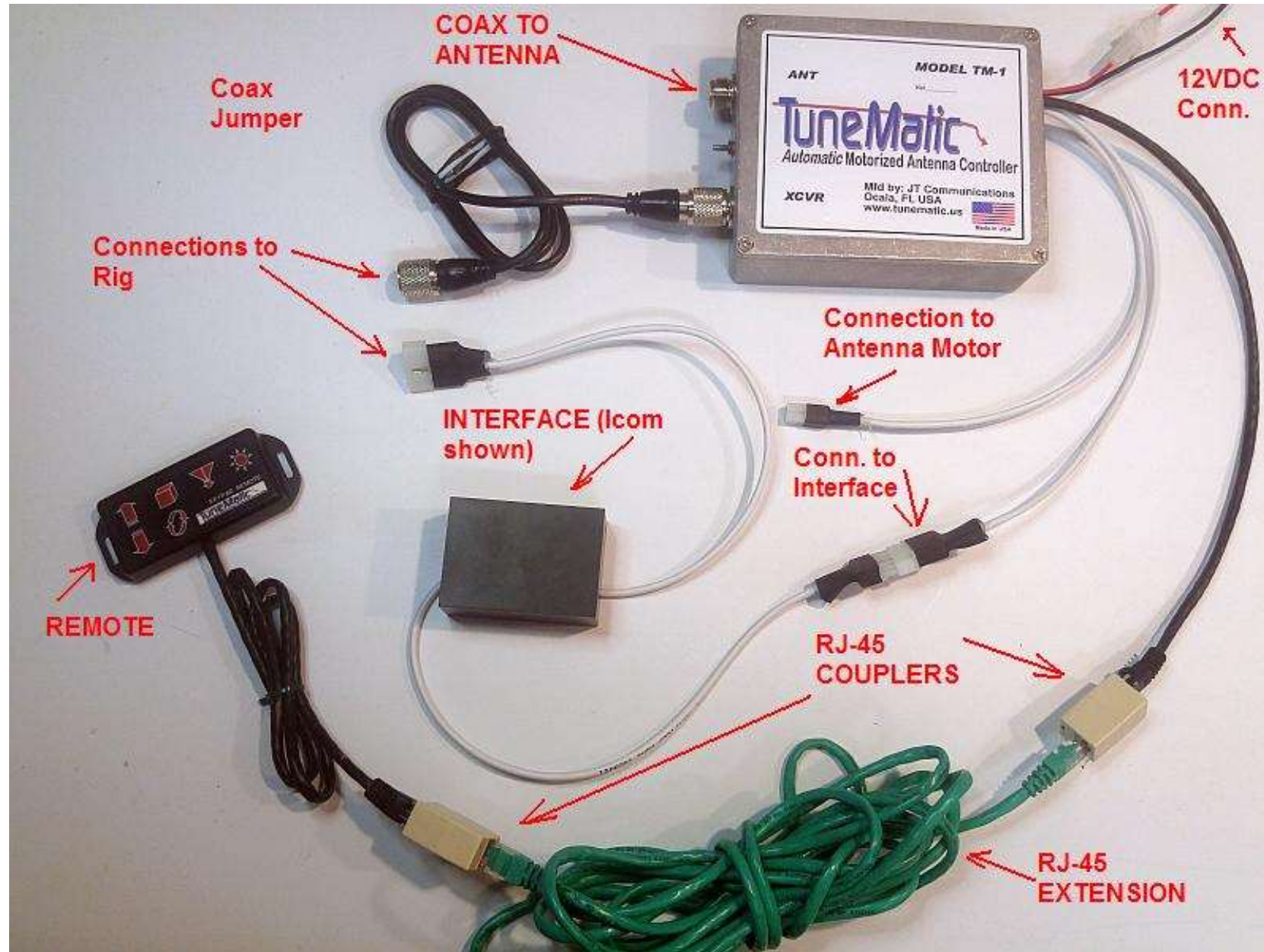
Auto-Tuner

- Instead of manually “tuning” the antenna by using an DPDT switch to control direction (up/down), I wanted to automate the process
- There are several highly rated automatic screwdriver antenna tuners on the market
- After reading reviews such as eHam Review, I selected the TuneMatic



TuneMatic TM-1

- I wanted a unit with a simple remote head and the ability to mount the tuner in a convenient location in my truck
- The TuneMatic TM-1 was the perfect match to my requirements



Console

- I removed the cup holder underneath my dashboard and created a metal panel to mount and easily access the remote consoles of the IC-7000 and TuneMatic TM-1
- I added an RJ-45 connector (lower left) to provide stress relief of the microphone (blue cable right)
- Connectors and cables are added to allow for use of an optional headset and/or connection to the truck's integrated audio system so that I can listen on speakers



Equipment Installation

The radio, tuner and other components were mounted on a plastic board and installed in the compartment behind the passenger seat



Key Points | Review

Mounting bracket (antenna location)

RFI suppression

Bonding (ground-plane)

Matching (shunt coil)

Waterproofing of all external components



Result

An easy to operate, high performance, rugged mobile RF station resulting in exceptional signal reports from operators at locations such as Reno Nevada, Alberta, Yukon and others...

References

- <https://k0bg.com/>
- <https://www.k0bg.com/coil.html>
- <https://www.k0bg.com/match.html>
- <https://www.k0bg.com/problems.html>
- <https://www.k0bg.com/rfi.html>
- <https://www.k0bg.com/choke.html> This is important. I made 2 of these: 1x for the DC pair (up and down) and 1x for the pulse counters. Without these, my TuneMatic controller did not work properly. I placed these into a plastic enclosure for protection against the environment.

THANK YOU

