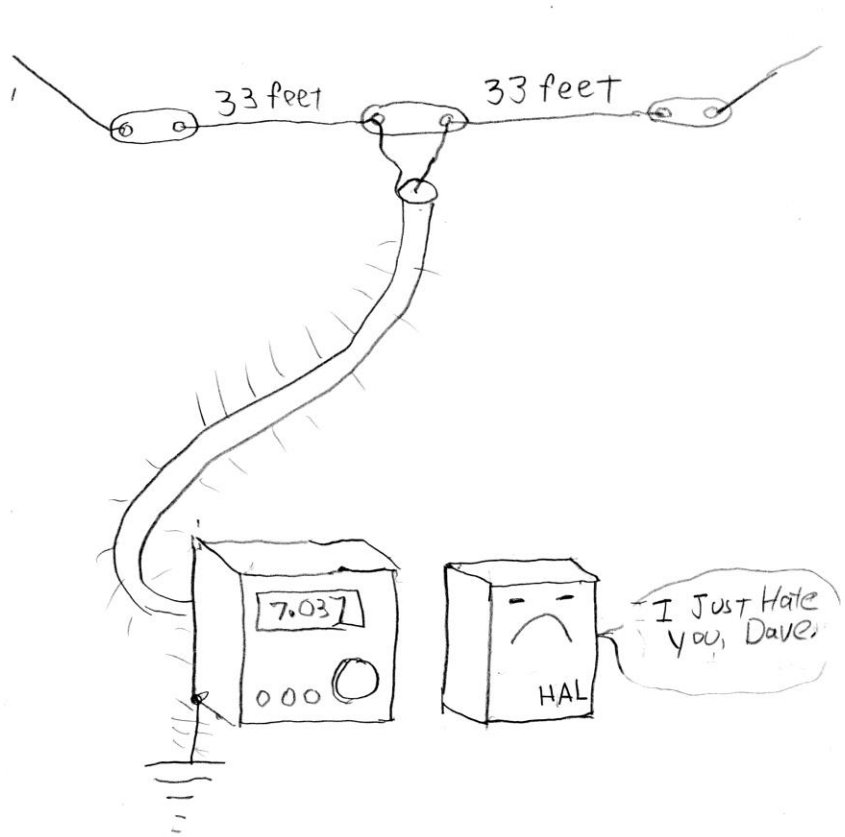
Baluns, Ununs, and Other Transformers

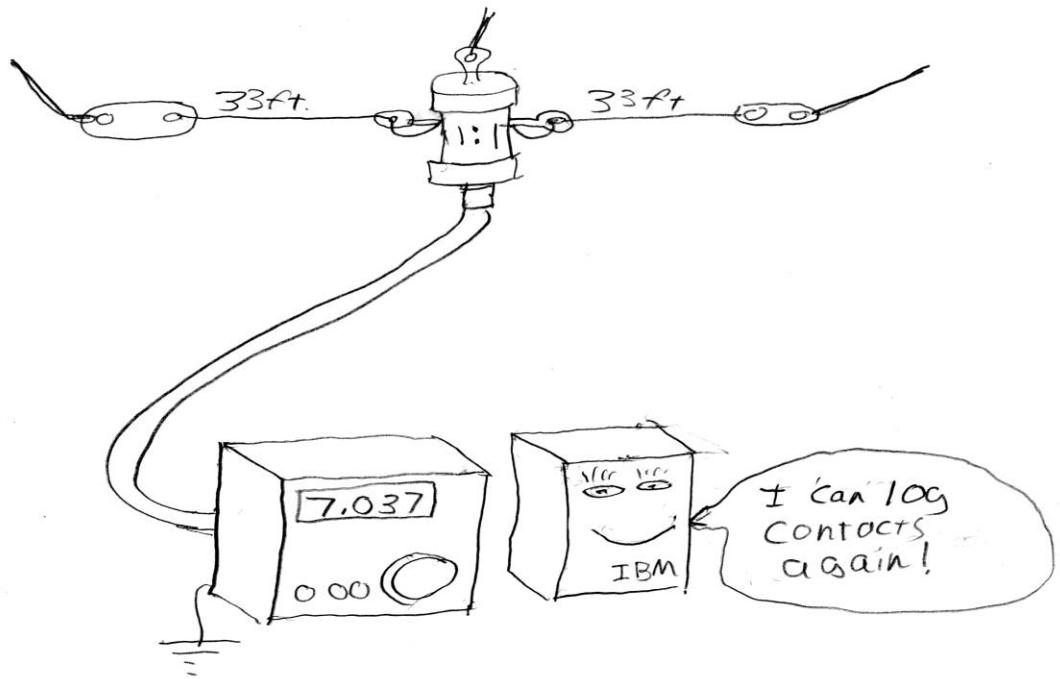
KB8PGW November 2026

Introduction to Baluns and Ununs



A dipole fed directly with Coaxial Cable

- The outer shield of the coax is connected the antenna
- This makes the coax shield radiate RF – it is part of the antenna
- The ground connection is HOT (in a RF sense)
- The operator may experience RF shocks or burns
- The Computer is NOT happy.
- This Ham (and the computer) need a 1:1 choke balun.



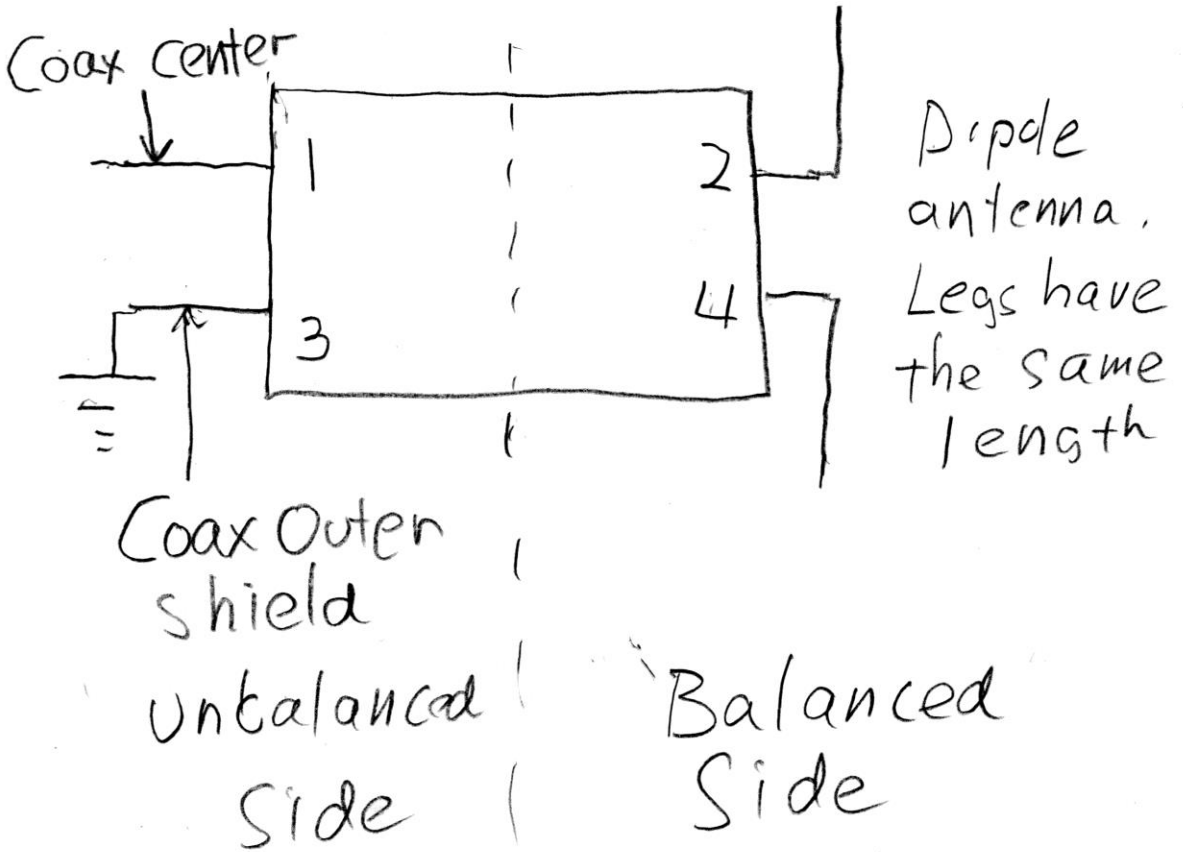
- This works great for a single band antenna set up

Results

- Only (mostly) the antenna radiates RF
- The ground connection is cooler
- The operator (and the computer) experiences less RF exposure
- The Computer is a lot happier.
- An added bonus: the balun makes a nice center support for the antenna.

The 1:1 Balun

- The Balun is an impedance matching device. In this case we are using a 1:1 ratio (not to be confused with SWR)



Balun with bifilar winding

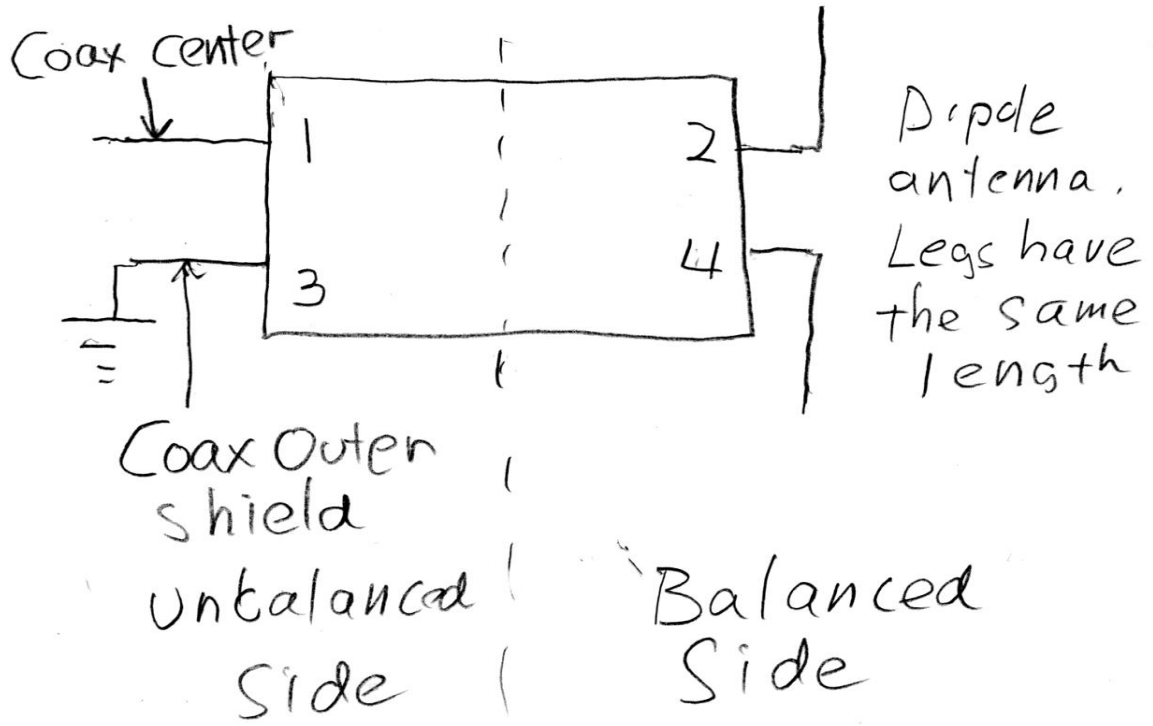


Balun using coaxial cable



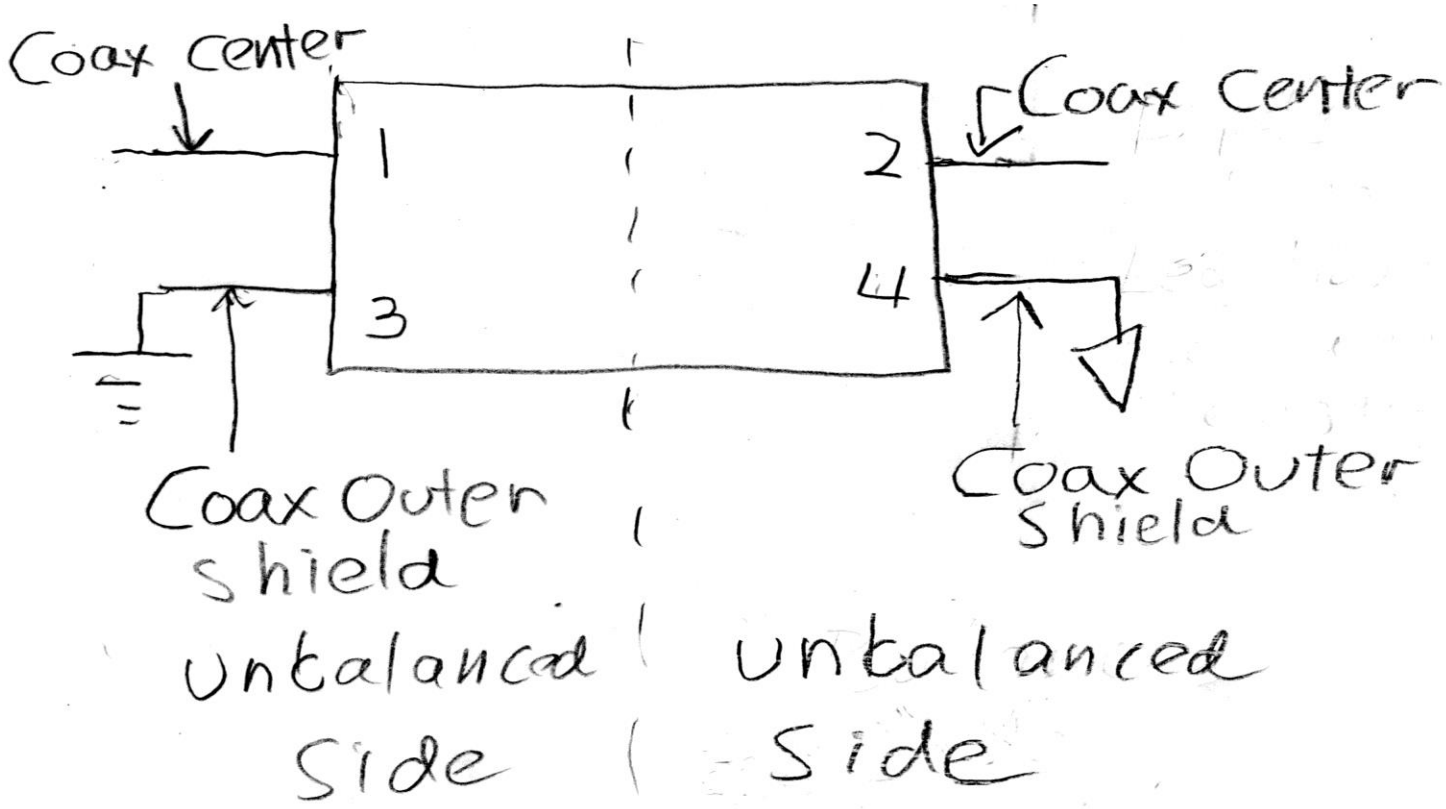
The choking effect

- The 1:1 balun isolates terminal 3 from terminals 2 and 4 at the antenna. A good balun has greater than 20dB of isolation.

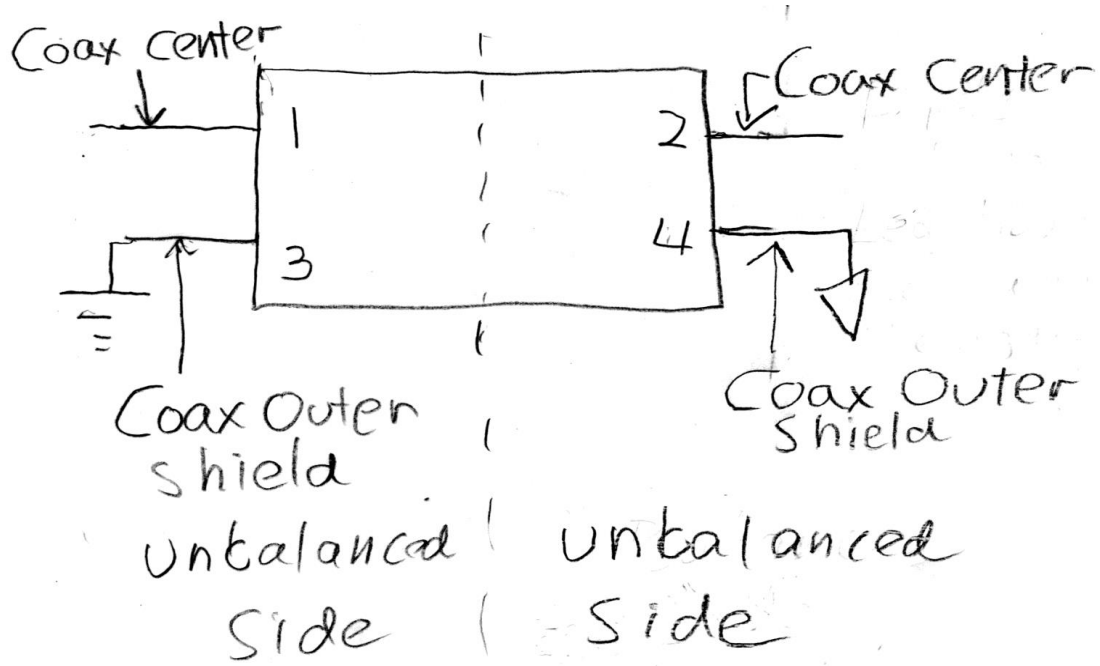


The Unun

- A Unun is similar to a Balun in operation, sometimes it is called a common mode choke



- The Unun is useful to suppress RF from feeding back into the radio room on the outer shield of the coaxial cable

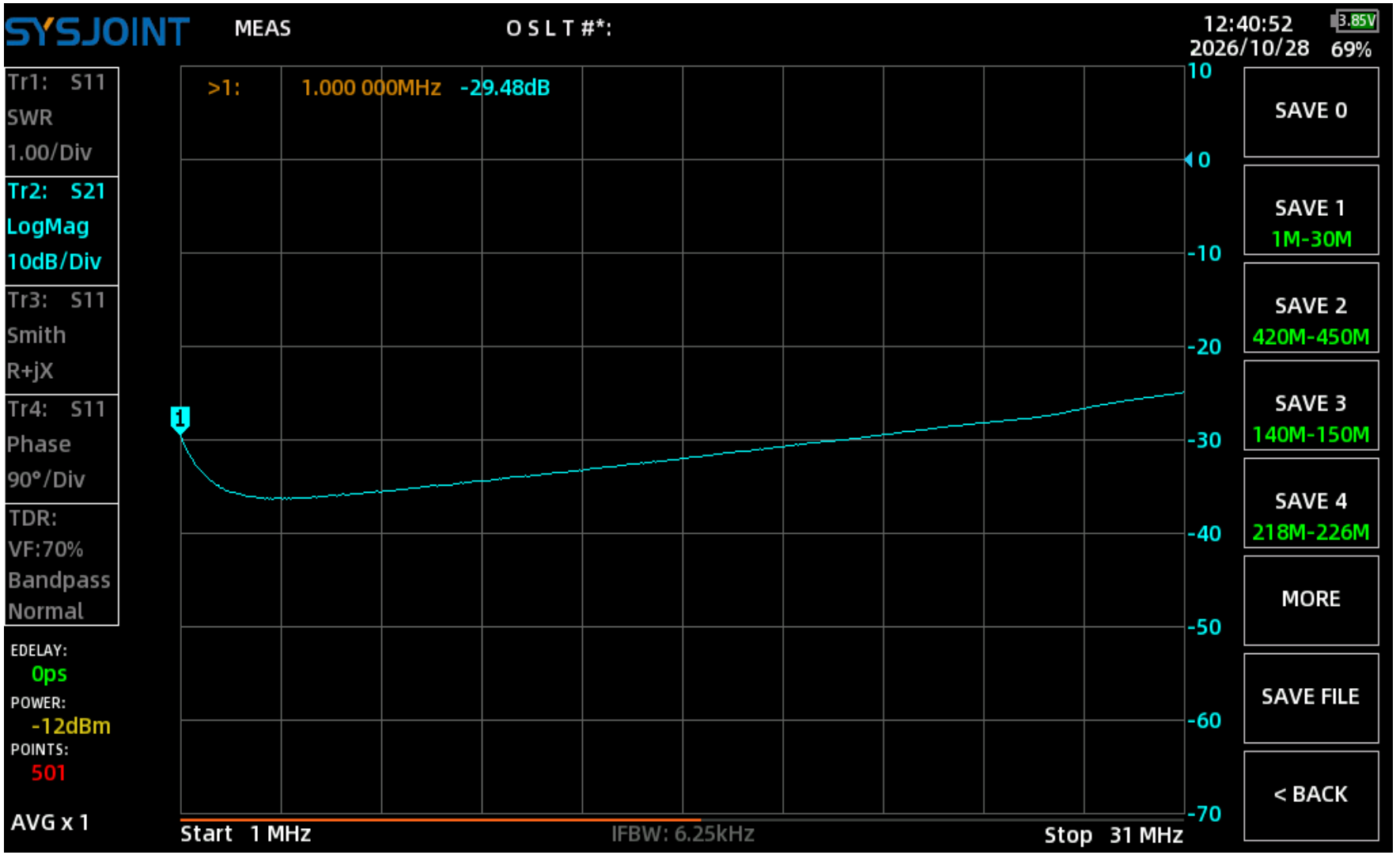


“Big Bertha”

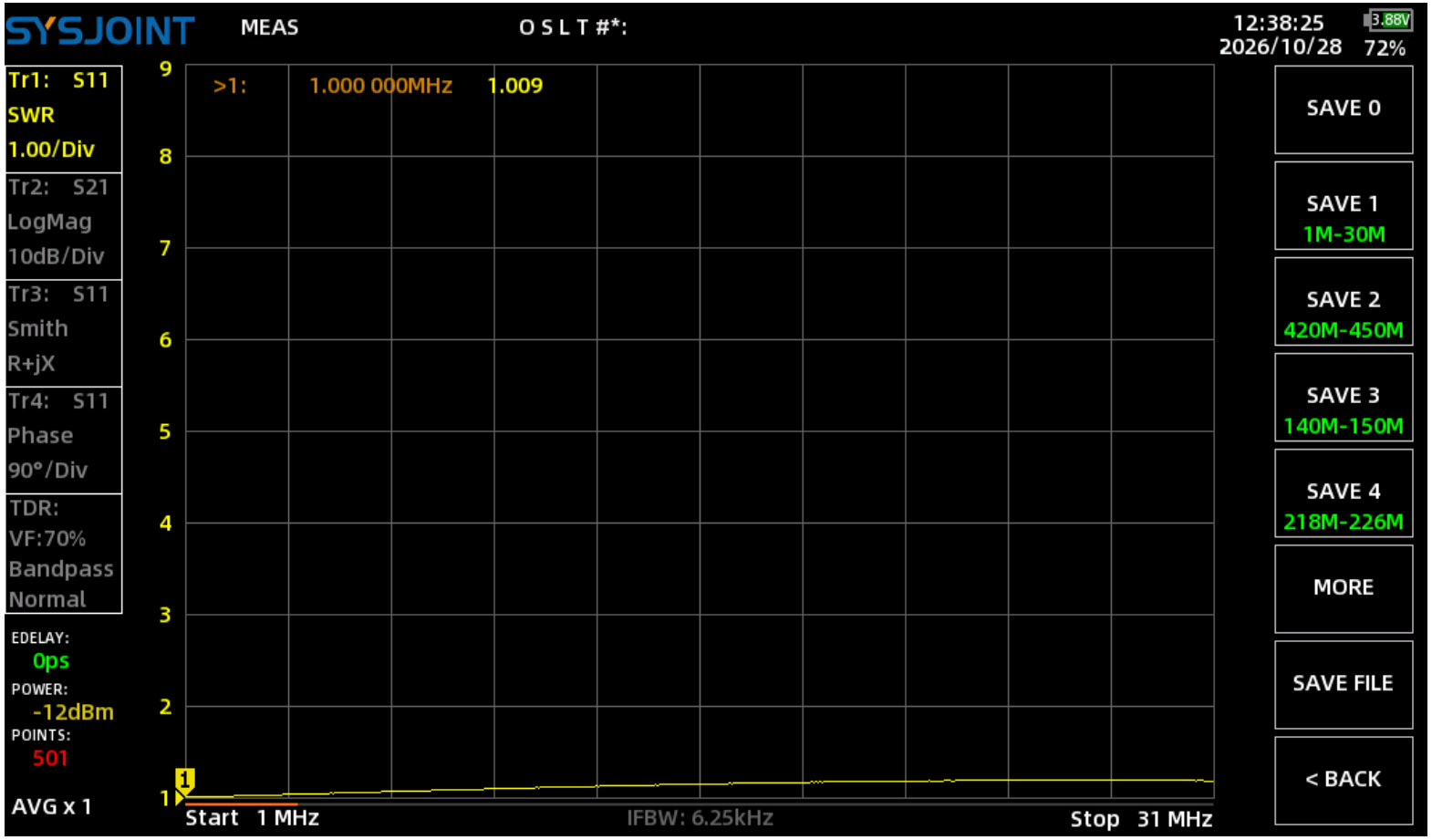


- This Unun is wound using Belden 9913 on a large ferrite mix 29 toroidal core
- The design meets the expectations of obtaining more than 20 dB of isolation across the frequencies of interest
- The Unun has very low loss across the same band of frequencies

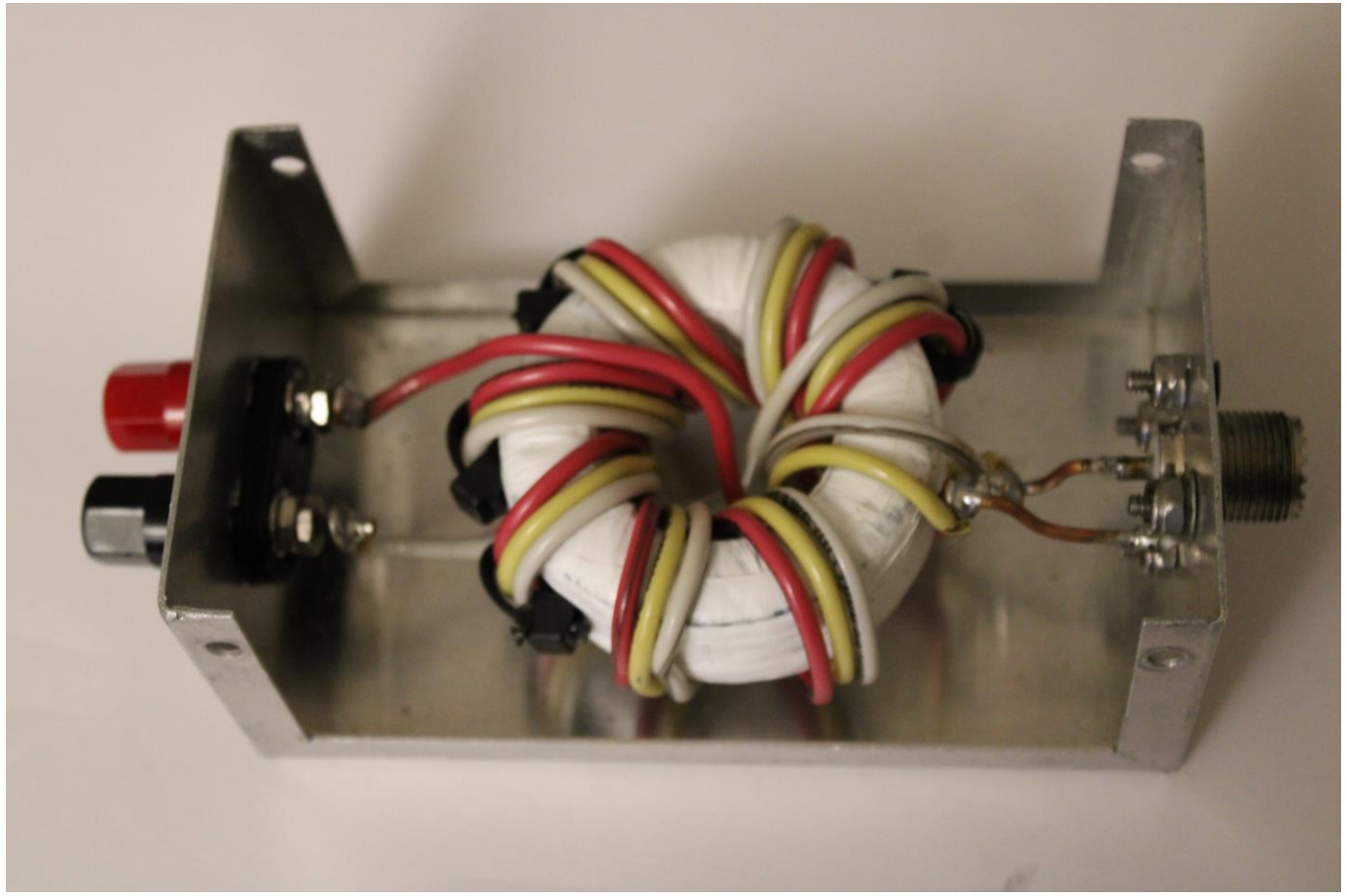
Isolation from ground



Resulting SWR into a 50-ohm termination



The 9:1 Balun



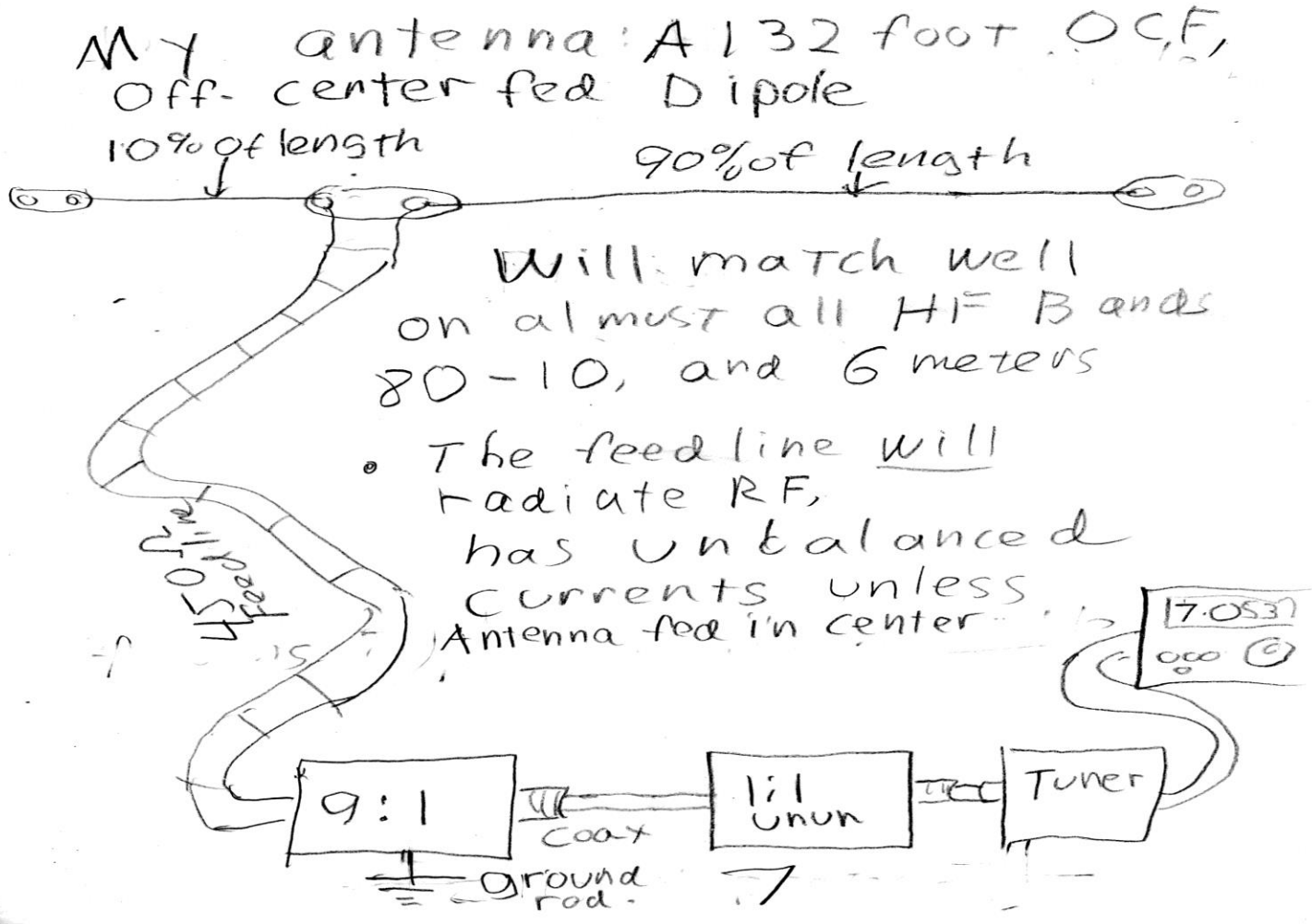
What I use at my station

- The 9:1 balun matches a 50-ohm source to a 450-ohm feed line – usually called “ladder line” or “window line”

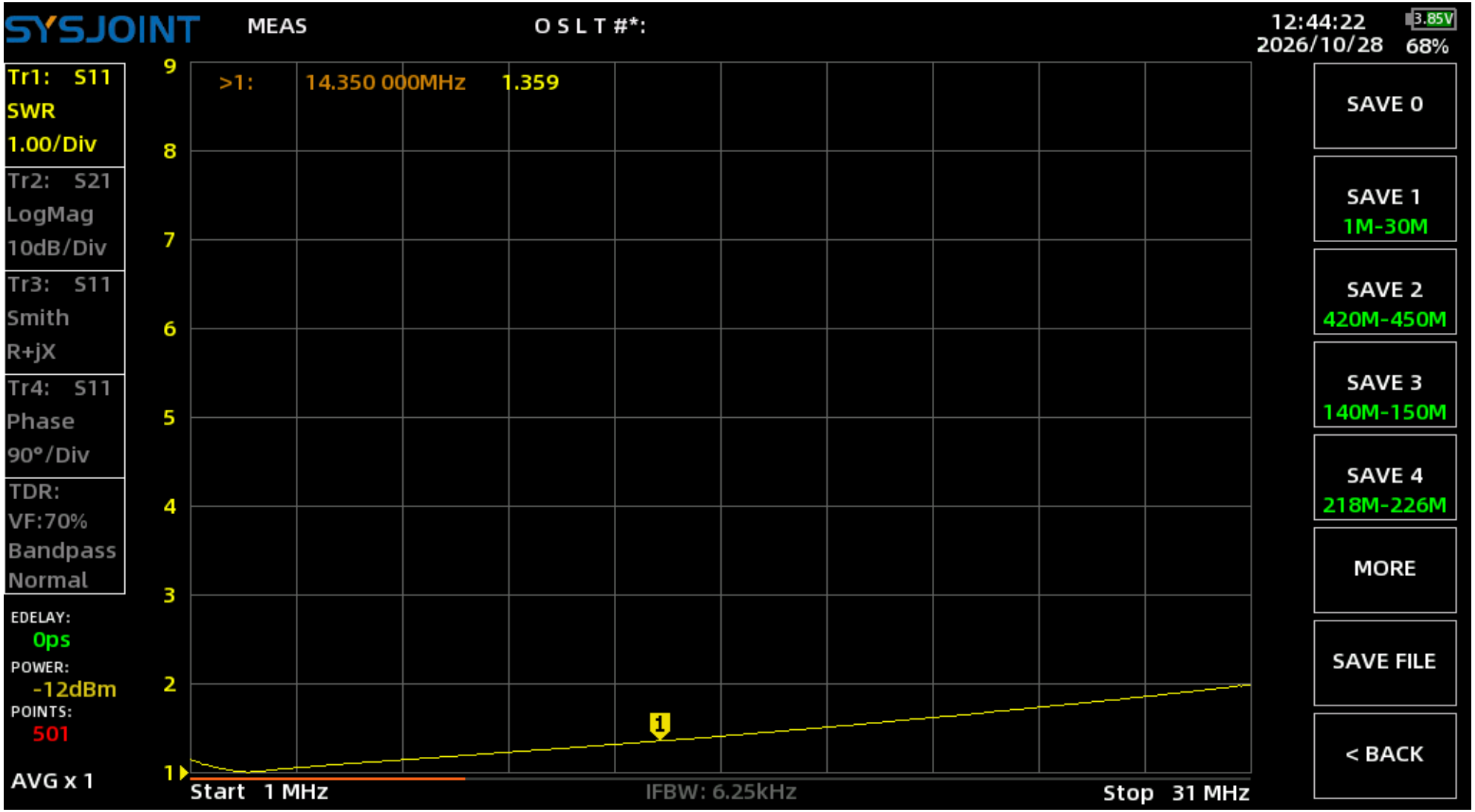
- Multi-band antennas can have higher SWR (standing wave ratio) and subsequently more loss for long runs of coaxial cable. The ladder line has little loss even with very high SWR conditions.

- I chose the 9:1 balun for my system because it provides a nice transition between the coax and ladder line, and this balun works fairly well across the HF bands that I mostly operate on

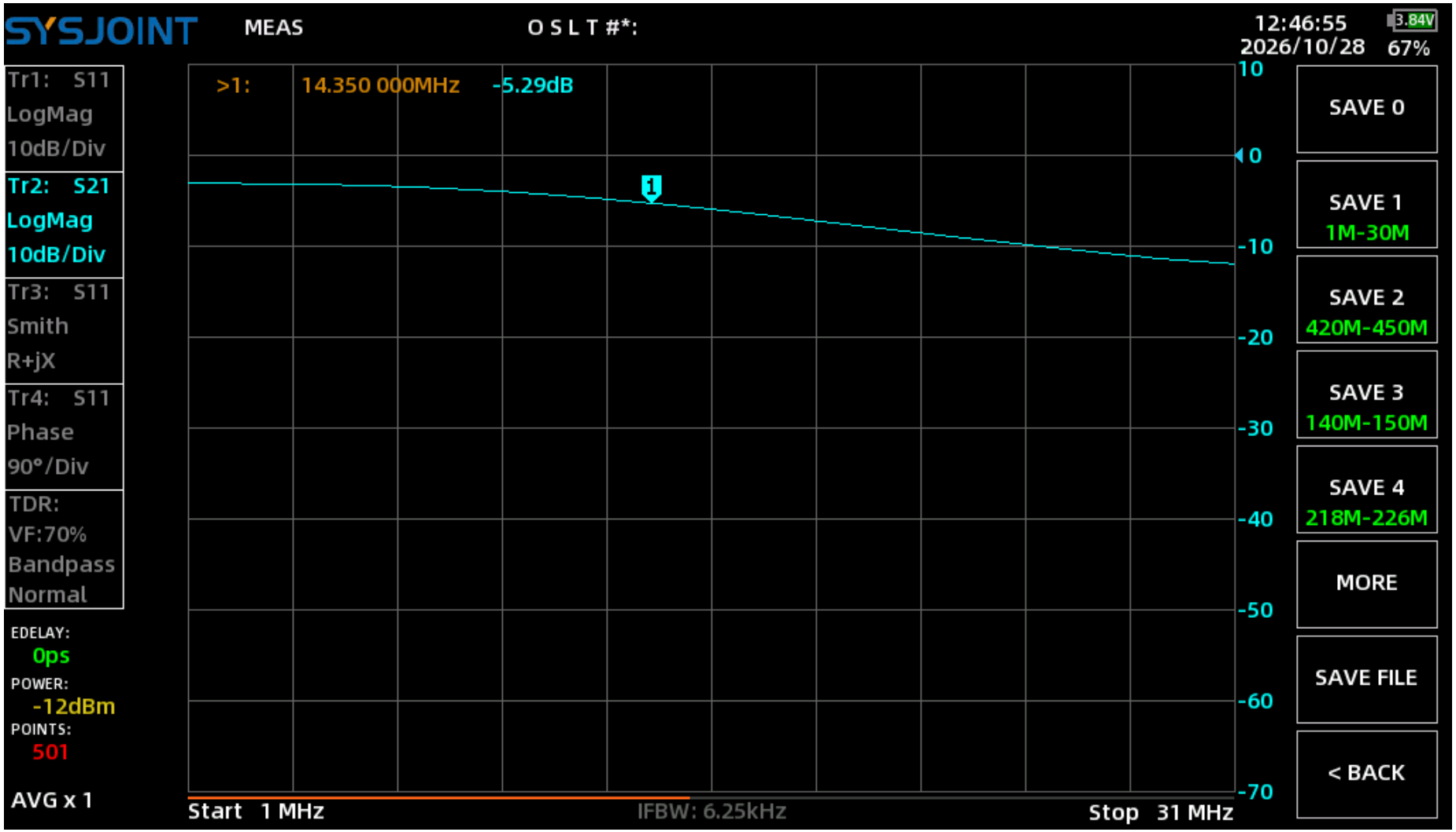
My antenna: A 132 foot OCF, Off-center fed Dipole



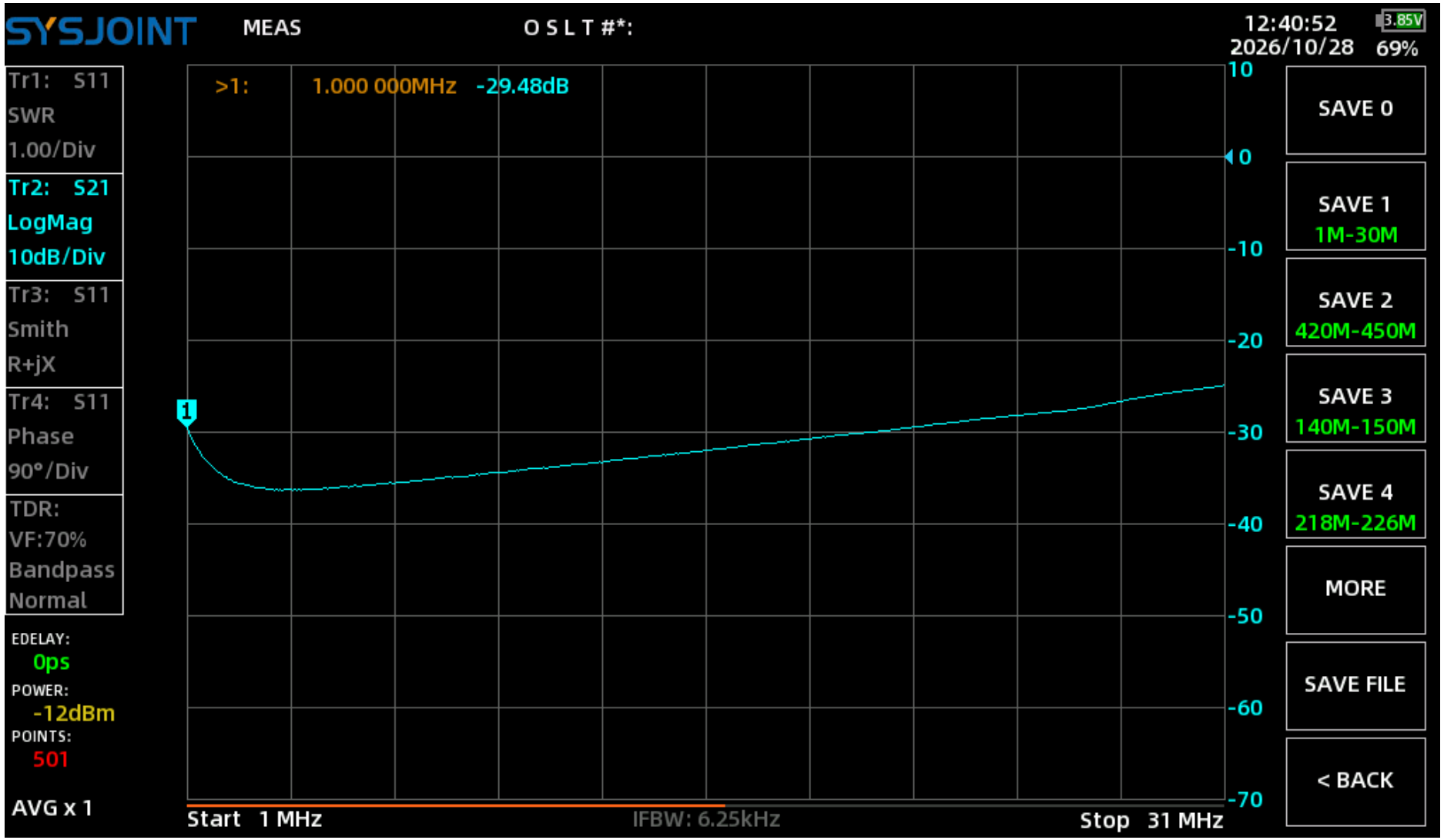
SWR measured of the 9:1 Balun into 50 ohm load



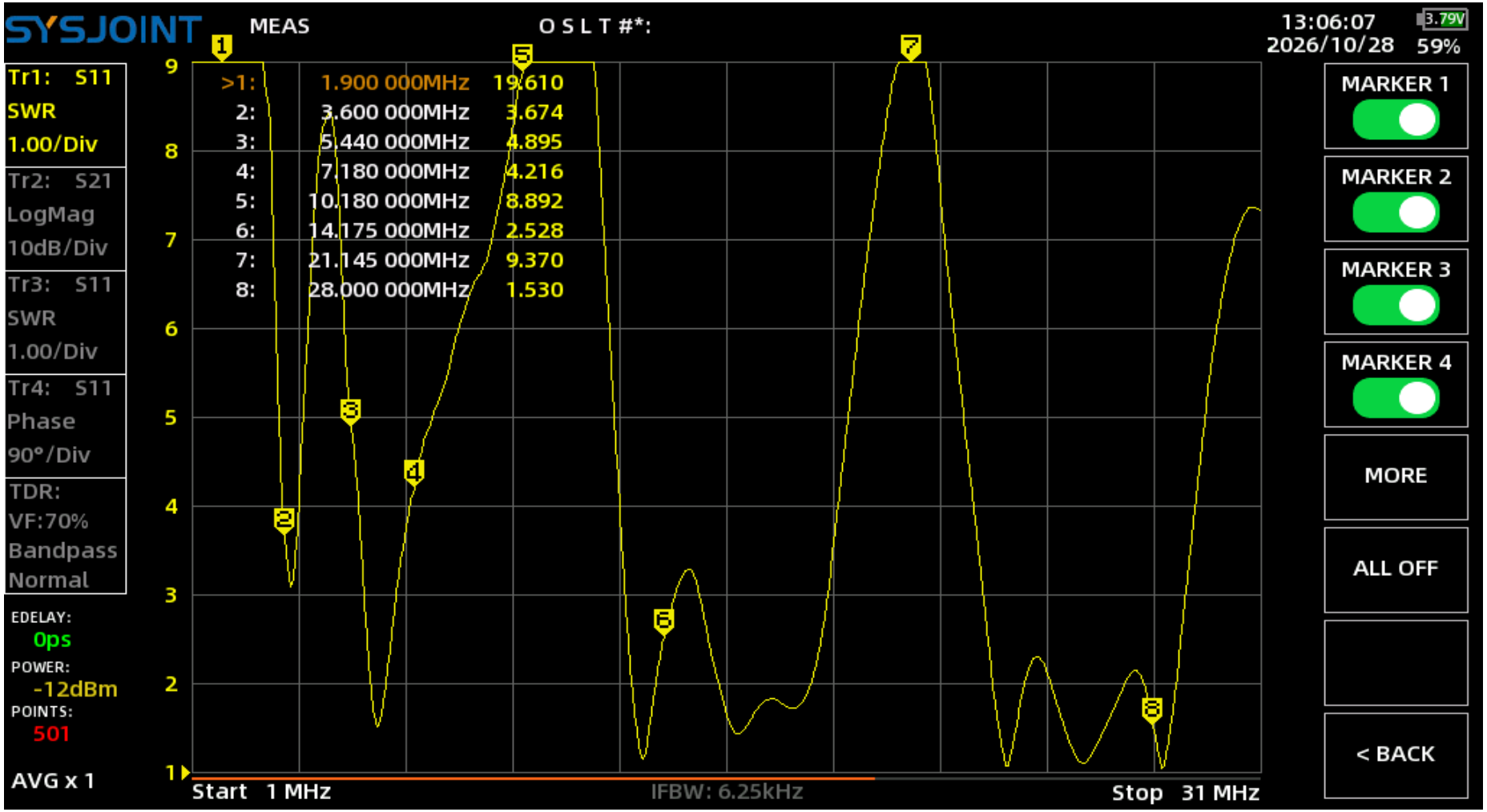
The 9:1 Balun does not isolate from ground well.



The Unun makes up for the 9:1 Balun



Analysis of the system before the tuner



Analysis of the system

- SWR not too bad on the bands I work on, the tuner can comfortably match them to 50 ohms
- There is little actual loss of signal, the ladder line is practically lossless
- The tuner gets things straightened out at the Balun to a 50 ohms match before a long run of coax to the radio, avoiding loss in the Coax

Building your own 1:1 Balun: choose the correct ferrite mix

- Avoid powdered iron cores. Use ferrite materials.

- Type 31 is excellent for a 1:1 Balun, and favors operation on the lower HF bands

- Type 43 is excellent for a 1:1 Balun, and favors operation on the higher HF bands

- Wind as many turns of wire pairs or coax around it as you can

Building your own 4:1, 9:1 or higher ratio Balun: choose the correct ferrite mix

- Mix 61 is preferred for transmission line transformers. I use two large stacked cores for these devices

- Type K mix has similar characteristics as Type 61 for this kind of impedance matching

4:1, 9:1 and higher matching ratio

- Type 43 has been used for 49:1 baluns

- Powdered iron is supposed to be good but be prepared to use a lot more windings to obtain a good result

Enclosures

- Plastic is OK. PVC junction boxes work nicely and are easier to drill the required holes. These can be obtained locally.

- Metal is better, and provides a nice way to ground to earth on the outside of the house before entry. These are becoming harder to find.

- No case will work fine if it does not bother you

Questions or Comments?

