Initiation Date:
20 May 2018

Participant(s):
WB4GCS

Initial Symptoms:
Trying to limit 80 M interference to close-by 40 M receiver over and above what the bandpass filters do. Let's see what a shorted stub does, and what an open stub does.

The object of this exercise was not to build a stub to attenuate any particular frequency, but rather to characterize the behavior. For a "stub", I used a piece of feedline which I had on hand of length that would resonate in the low HF region. As it happened, I had a piece of RG-58 that is 32.5 feet long and which worked nicely.

Expected Results:
A half-wavelength cable will reflect at the "input" end, whatever the impedance is at the "load" end. A quarter-wavelength cable will reflect the inverse – a shorted "load"end will reflect as an open, and vice-versa. This is useful in trapping out unwanted frequencies.

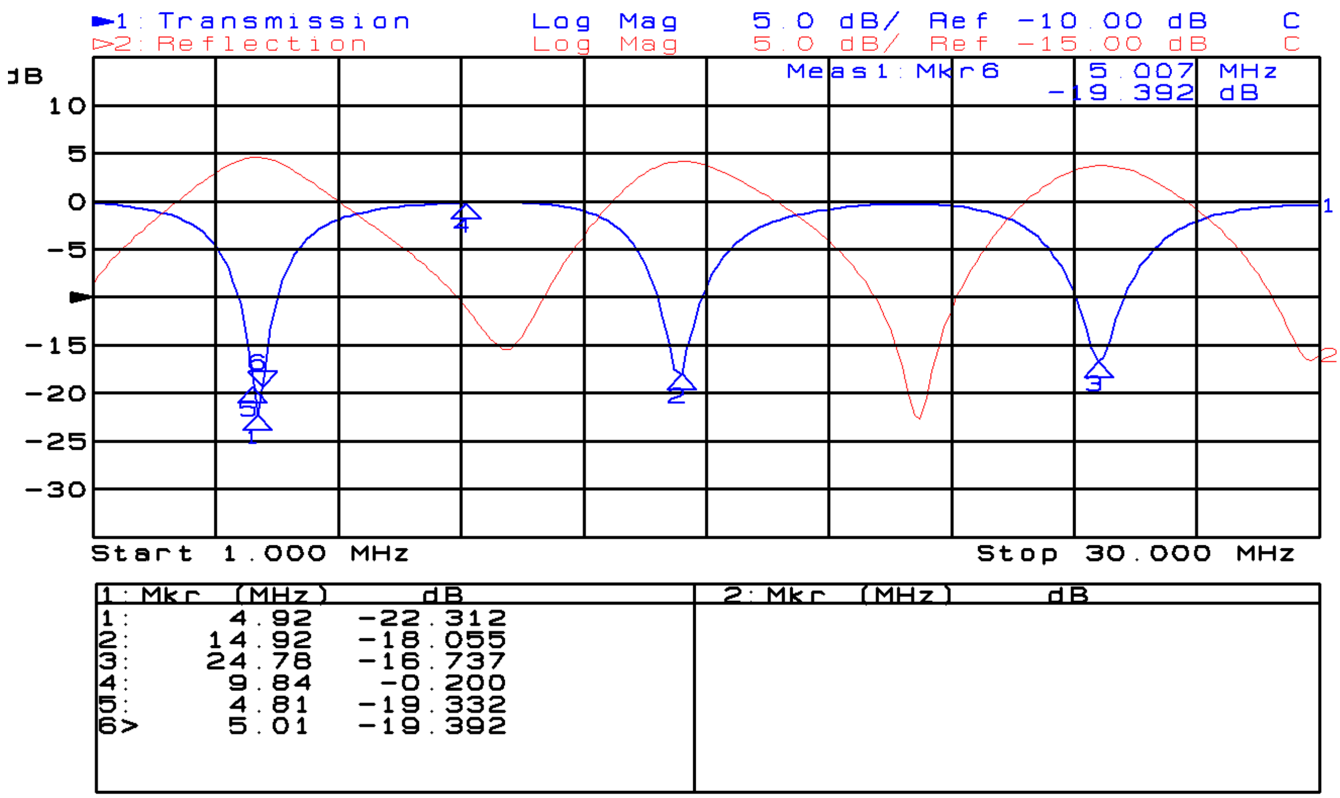
In microwave work, a short is much more absolute and repeatable than an "open", due to the non-infinite resistance of the "open" connection and fringing capacitance. While these effects are greatly reduced at HF compared to microwaves, they are there. Therefore, I would prefer a shorted stub. Nice idea, but this may not be practical – let's see what happens.

In the experiment at hand, we expect that the shorted stub will provide a notch at the frequency for which the the cable is one-half electrical wavelength long. (This means including velocity factor of the cable!) Now, coaxial stub behavior is periodic at a rate of numbers of half-wavelengths long, so notches will be expected at certain harmonics, so we need to measure the first few harmonics for collateral effects.

Similarly, we expect the open stub will provide a notch at the frequency for which the cable is one-quarter electrical wavelength long. Again, this behavior repeats every half-wavelength, so we need to look at harmonics for collateral effects.

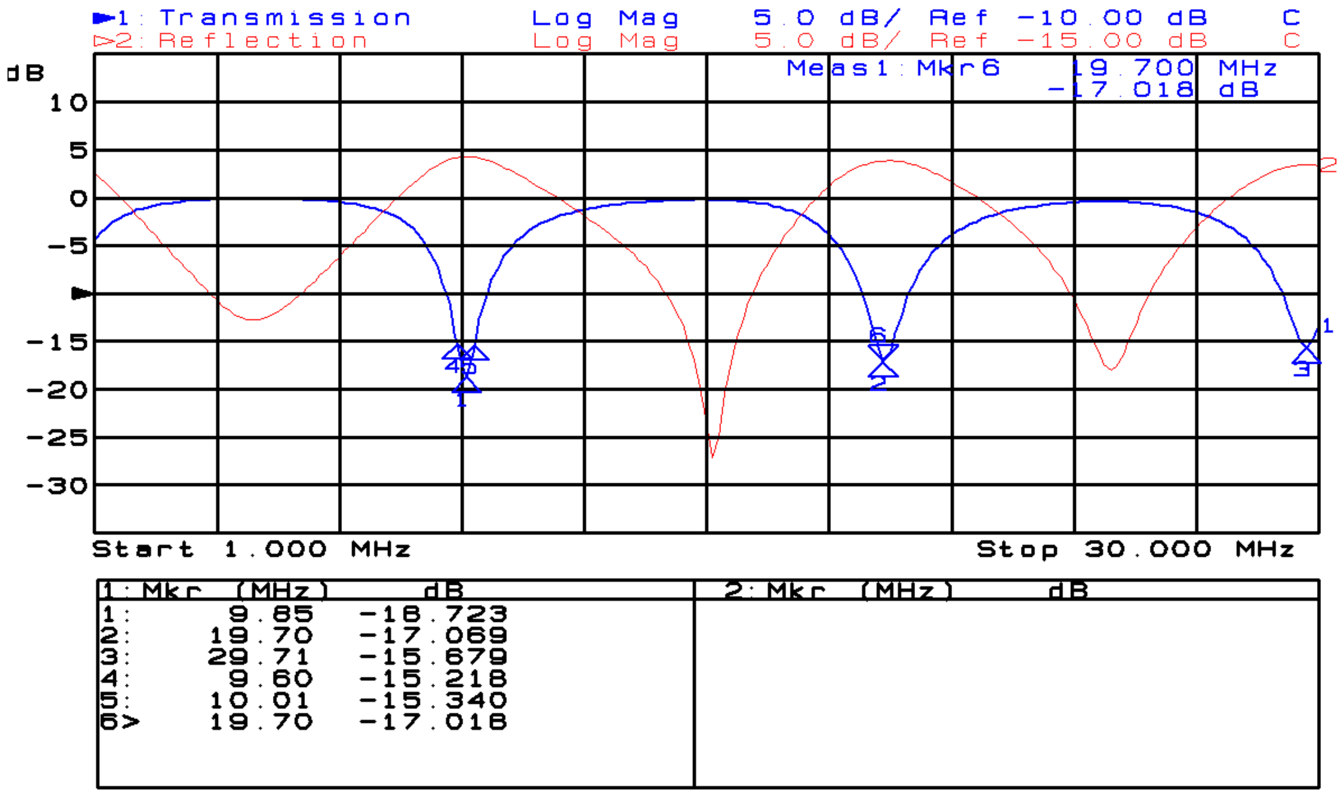
Actions:
1. Warm up analyzer.
2. Calibrate for transmission and reflection over range of 1 – 30 MHz. (Use two jumper cables and a coaxial TEE.)
3. Attach stub and measure.

Observations:
Open 32.5-foot stub:



The first resonance, 4.92 MHz, is the frequency at which the line is 1/4-wavelength long.

Shorted 32.5-foot stub



The first resonance, 9.85 MHz, is at the frequency for which the line is a half-wavelength long.

Analysis:

The open quarter-wave stub attenuates by 22 db.
The 3db bandwidth is 0.2 MHz, for a Q of 24.60, which isn't great, but suitable for our purposes.
The second harmonic, 9.84 MHz is not attenuated. This (using a suitably longer cable as a stub) could work to attenuate 80 interference with a receiver on 40 Meters.

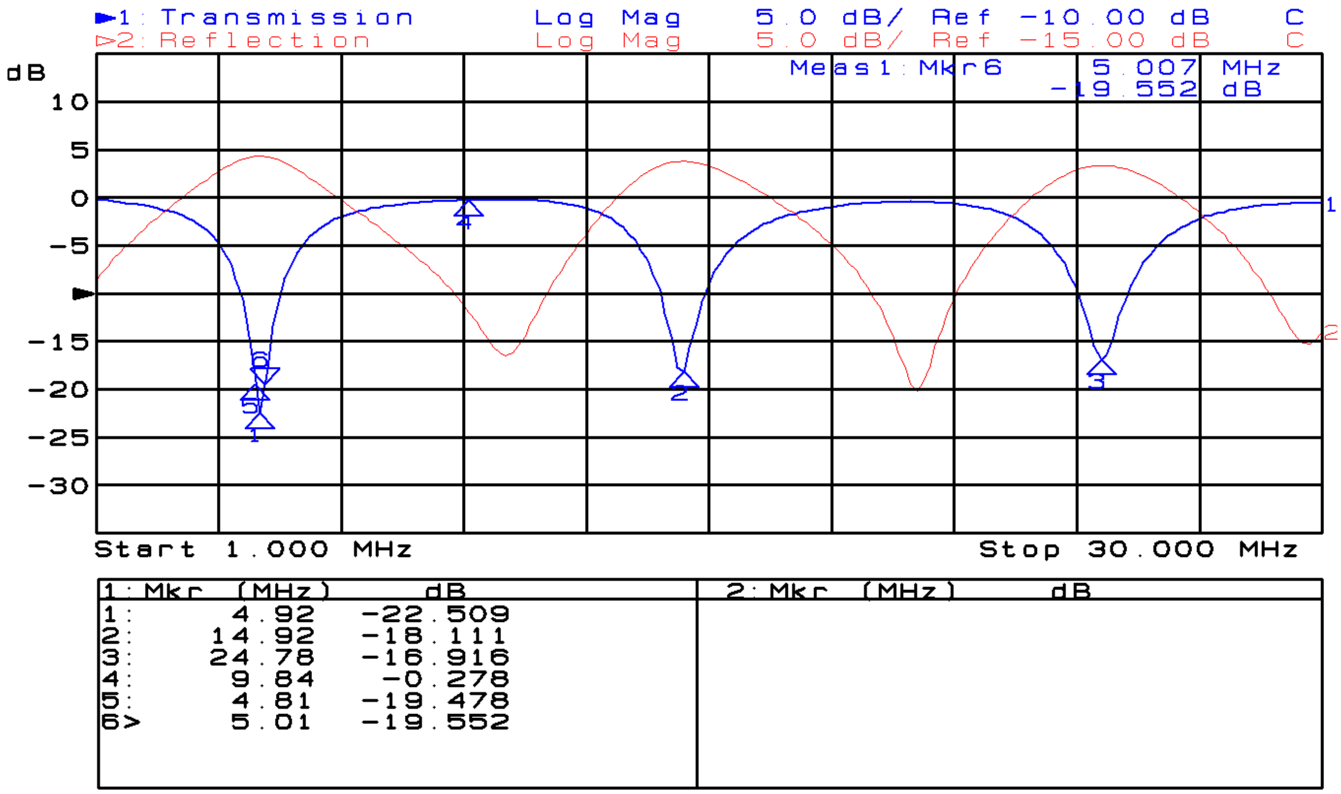
The shorted half-wave stub attenuates by almost 20 db.
The 3db bandwidth is 0.4 MHz, for a Q of 24.62, which isn't great, but suitable for our purposes.
The second harmonic, 19.7 MHz is also attenuated. This is a problem for a transmitter on 80 and a receiver on 40 meters.

Hypothesis:

This stub is made of an old piece of RG-58 which I had on-hand. A better, lower loss cable, such as LMR-400, would be expected to have deeper notches.

Plan:

Change the distance from the source and re-measure. (Inserted a 6-foot long RG-223 Jumper betweeen the signal source and the stub.



Results:

The notches are very close to their original location, suggesting insensitivity to location along the feed line.

Conclusion:

An OPEN quarter-wave stub cut for 80 meters could provide an additional 20 db of attenuation of 80 meter noise at the 40 meter radio. It should be located as close to the receiver being protected as possible.