Optimization or Calibration of an HF Antenna

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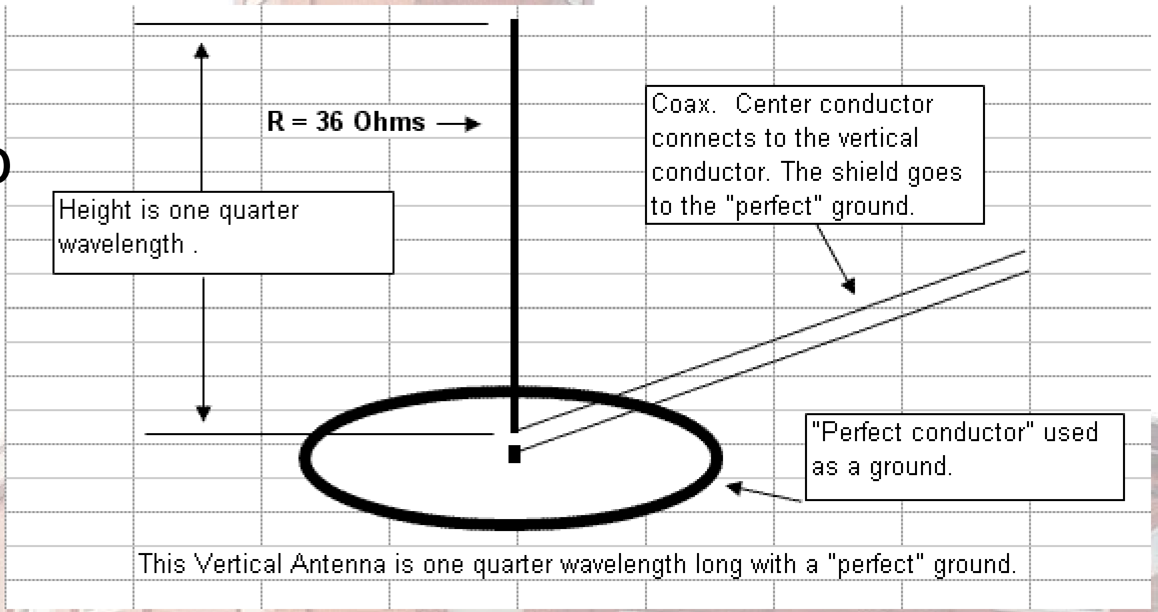
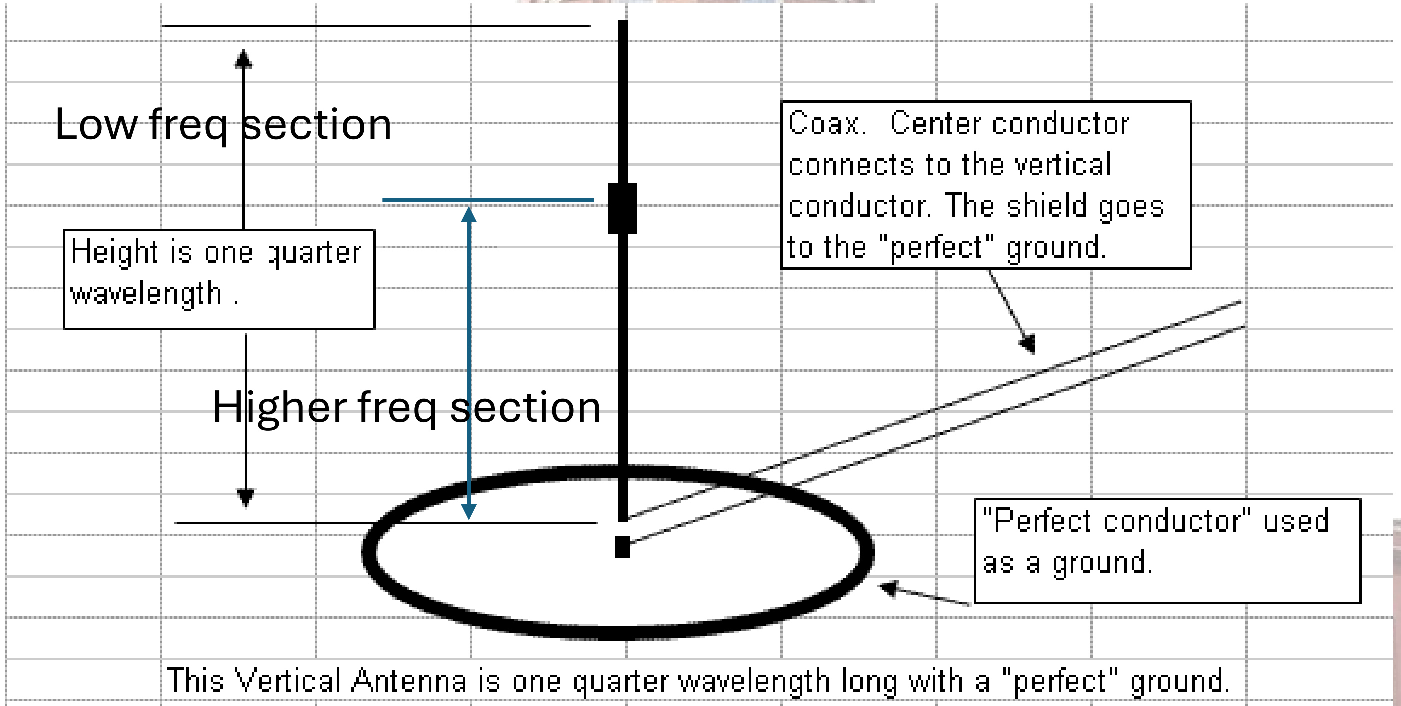
Fundamental Antenna Theory

- All antennas must account for a half-wavelength
- Verticals
  - Quarter wave for vertical element
  - Quarter for the counterpoise
  - Two quarters make a half
- The counterpoise can be even two steel rods in an X pattern.
- Always described as having a gap but none is needed.



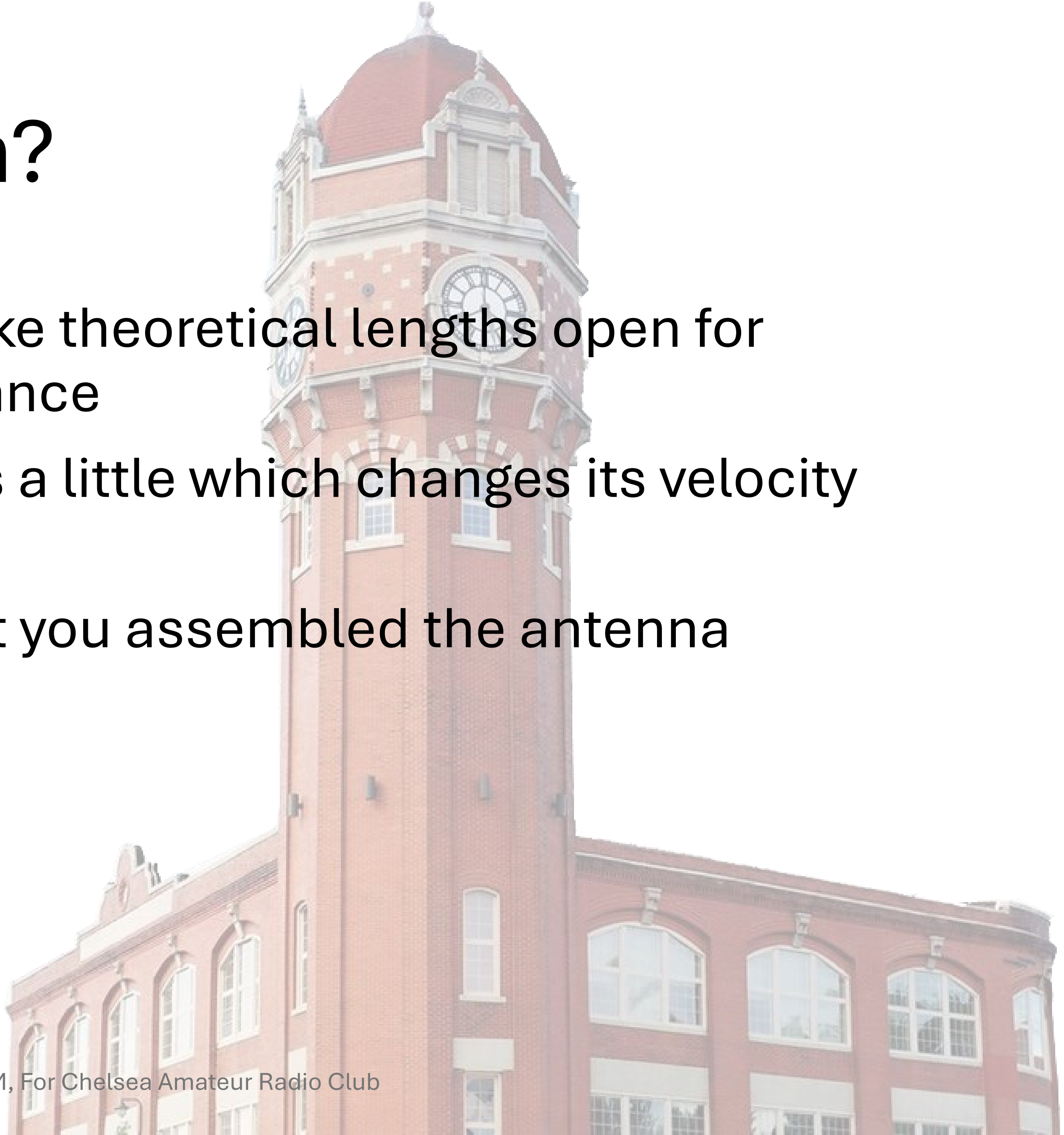
Multiple Bands on One Antenna

- Many antennas from one installation by tricking the signal in.
- Place a choke somewhere along the radiating element.
- Adds a second antenna.
- Choke
  - is transparent to lower signals coming in.
  - Blocks higher frequency signals coming in.
- Counterpoise can be as large as you want.



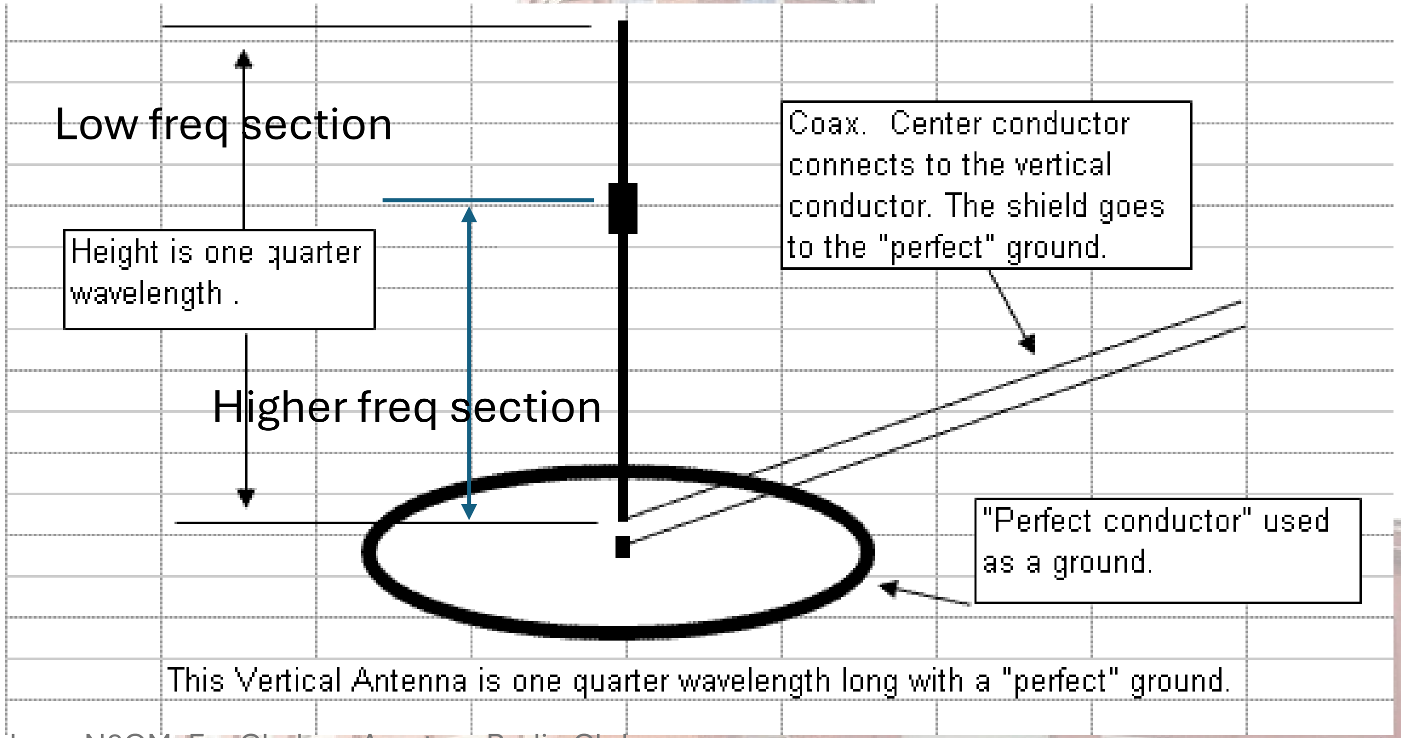
Why Have Calibration?

- Manufacturing tolerances make theoretical lengths open for tweaking for optimal performance
- When antenna ages it oxidizes a little which changes its velocity factor.
- Serves as a double-check that you assembled the antenna correctly in the first place.



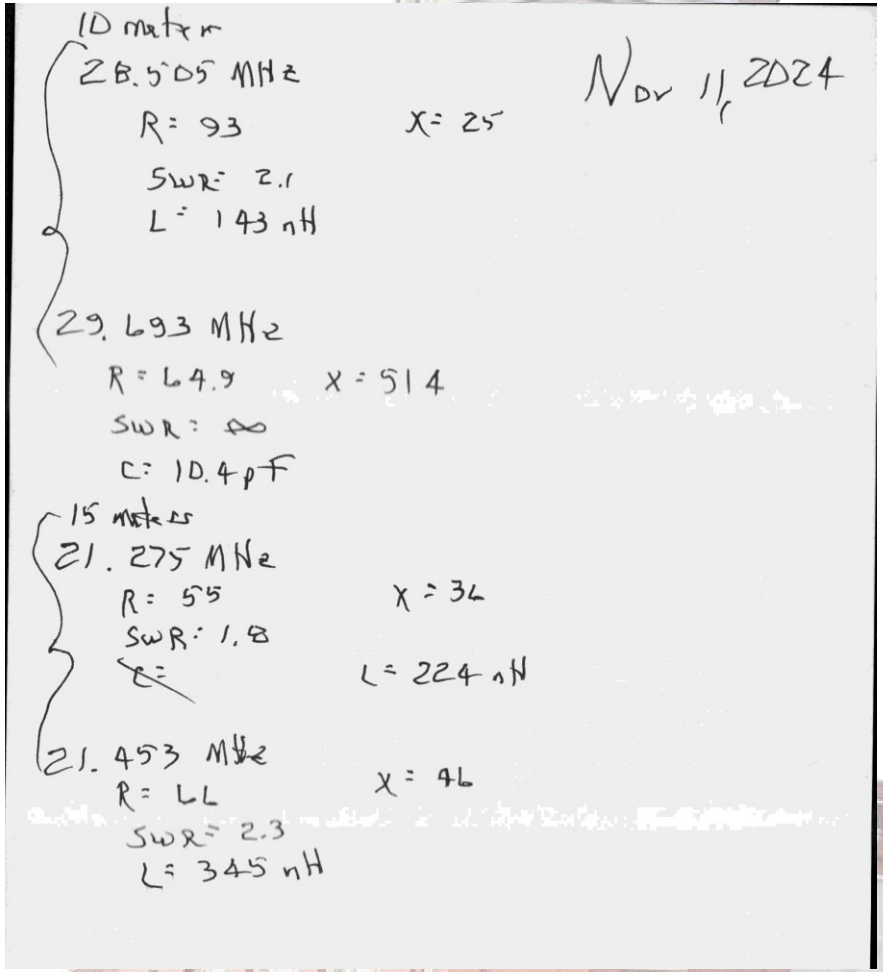
Calibration Theory

- The higher of the two frequencies DOES NOT USE the upper section of this antenna. It ONLY uses the lower section.
- Start with highest frequency which has the shortest wavelength.
- Why: The other adjustments daisy-chain on this one. All the other frequencies will be using this section while the lower frequencies (longest wavelengths) won't "see" or use this section.



Collect Vector Impedances for Bands

- Measurements at band limits for each band the antenna was designed to work for.
- Example for 10 meters
  - 28.505 MHz
  - 29.693 MHz



10 meter

28.505 MHz

R = 93 X = 25

SWR = 2.1

L = 143 nH

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29.693 MHz

R = 64.9 X = 514

SWR = ∞

C = 10.4 pF

15 meters

21.275 MHz

R = 55 X = 36

SWR = 1.8

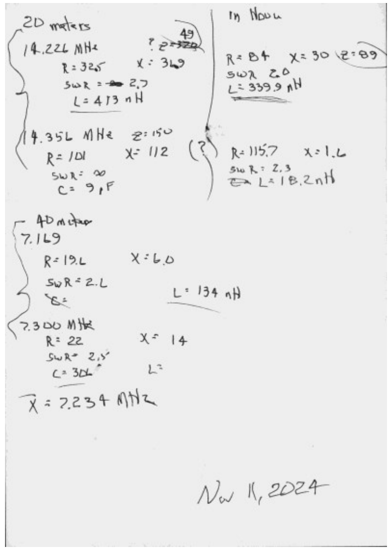
L = 224 nH

21.453 MHz

R = 66 X = 46

SWR = 2.3

L = 345 nH



20 meters

14.226 MHz

R = 325 X = 369 Z = 49

SWR = 2.7

L = 413 nH

14.356 MHz Z = 150

R = 101 X = 112

SWR = ∞

C = 9 pF

In Noon

R = 84 X = 30 Z = 89

SWR 2.0

L = 339.9 nH

R = 115.7 X = 1.6

SWR = 2.3

L = 18.2 nH

40 meter

7.169

R = 19.6 X = 6.0

SWR = 2.6

L = 134 nH

7.300 MHz

R = 22 X = 14

SWR = 2.5

C = 306

L =

$\bar{X}$ = 7.234 MHz

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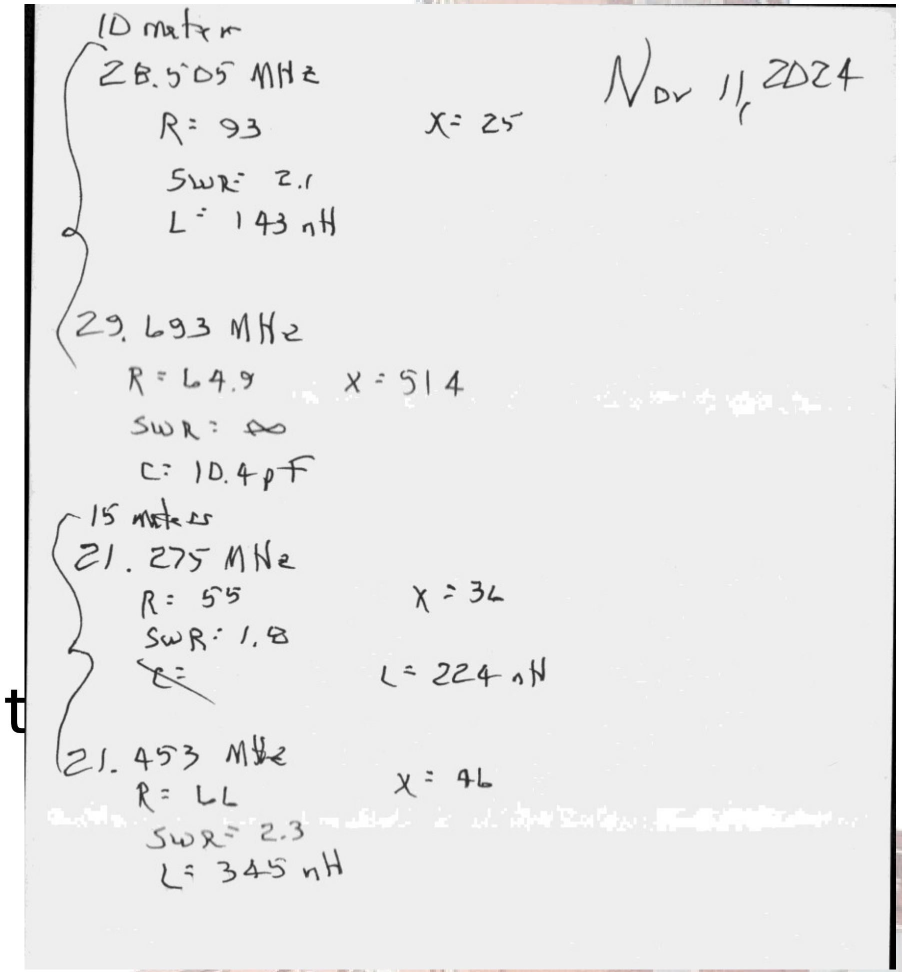
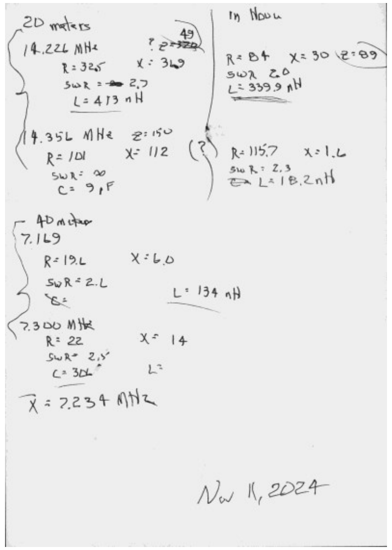
SWR

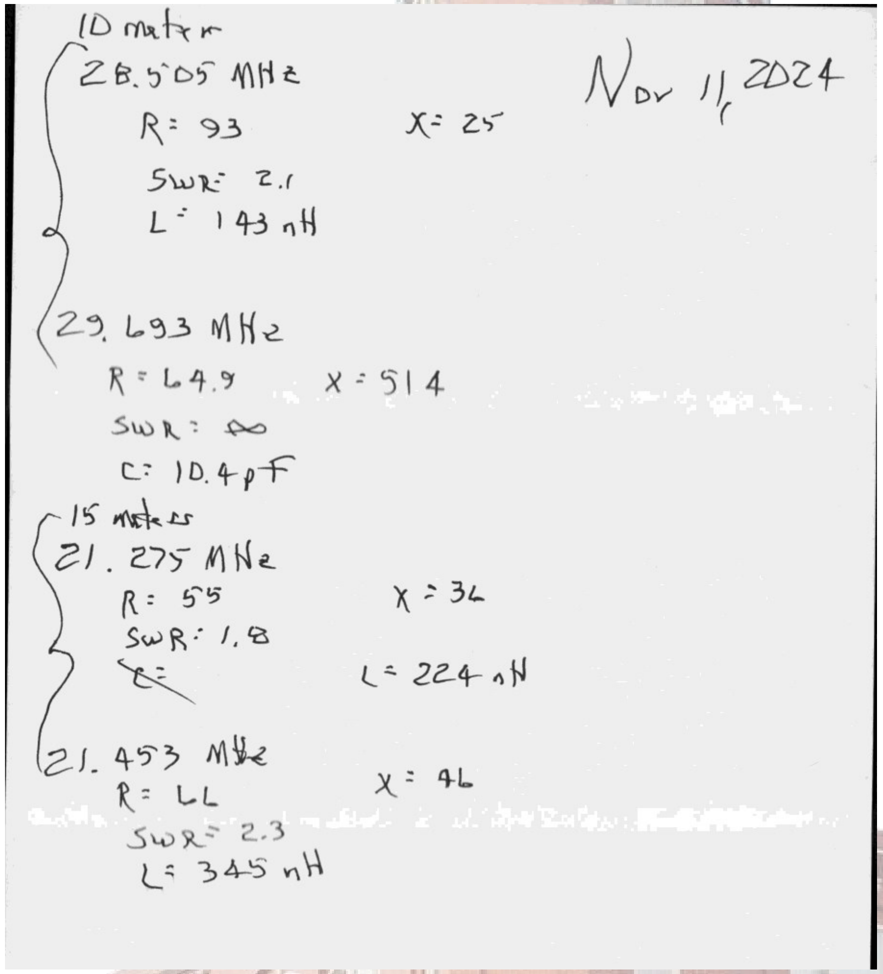
- The SWR measurement is only useful when the antenna has a somewhat fixed length such as a mag-mount mobile antenna.
  (Tuck that thought away for a later slide!!!!!)
- You can change its length slightly but ONLY slightly.
- Especially useful if you don't have a vector impedance measurement instrument.

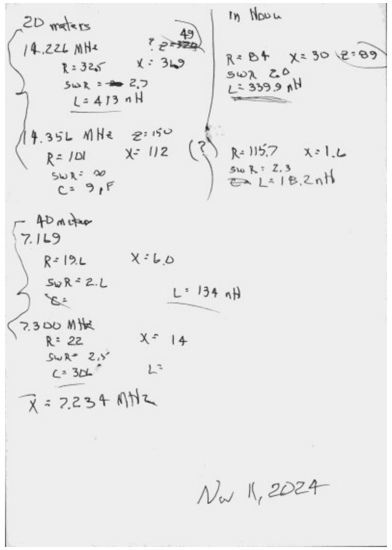




Vector Impedance

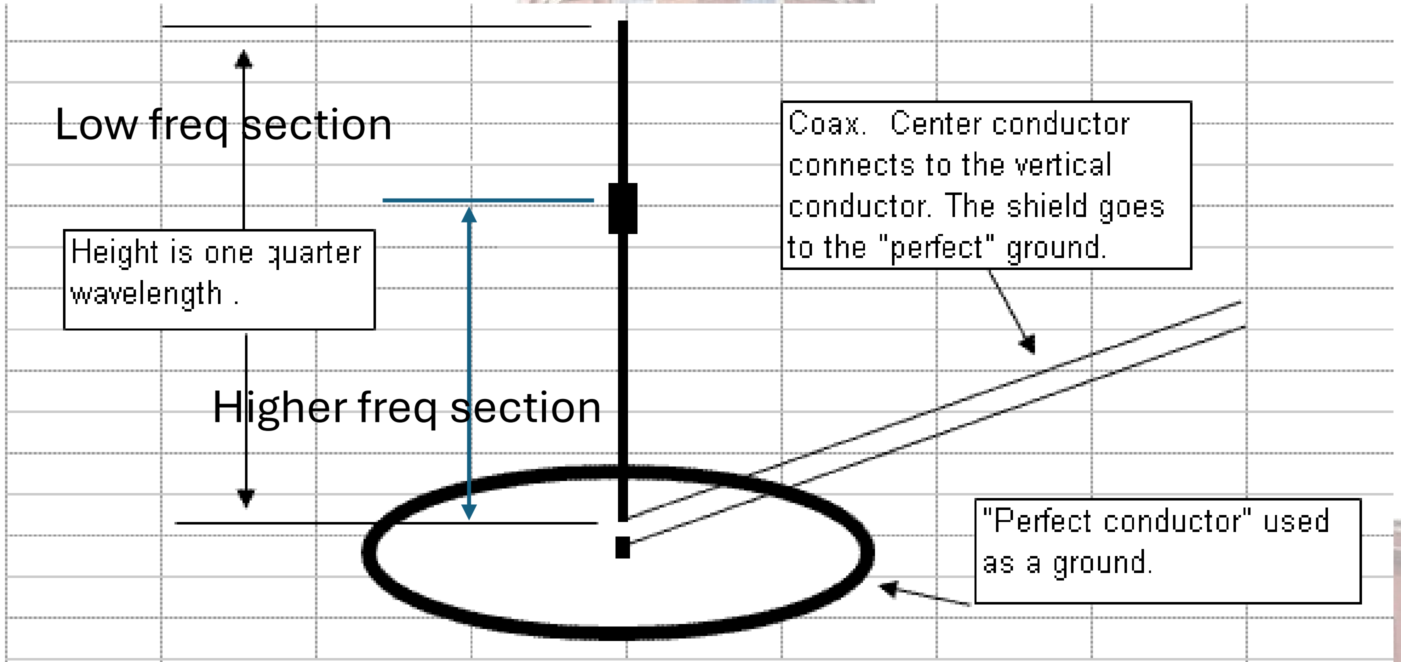
- Vector impedance tells you if you are long or short.
- Example At 15 meters
  (see at right)
  - At low end L=224 nH
  - At high end L=345 nH
- Applicable antenna section is too long.
- This info would be not seen with SWR only.





Make a Fixed Length into a Multi-Band

- Use a choke to “trap” higher frequencies.
- To the casual onlooker the antenna below appears to be just one antenna. But it is two antennas in one.
- Each antenna is a FIXED LENGTH!!!
- Thus, you can optimize using a mere SWR measurement.
- But still better off with vector impedances.



This Vertical Antenna is one quarter wavelength long with a "perfect" ground.