

SWR AND RESONANT ANTENNAS

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SWR AND RESONANT ANTENNAS

- ▶ If you are a Ham Radio Operator and you are going to use your privileges you must have an antenna. Antenna building is a huge part of our hobby and over the past 50 years I have discovered some tips to help achieve an antenna that matches the radio, frequency and can fit your lot.
 - ▶ So the 1st step is to plan on what can work for you within your budget and fit your lot.
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FEW THINGS TO KNOW;

- ▶ Radios today are design for a 50 ohm coax impendence and with transistors for finals these radios need a very low SWR and the impendence within the 50 to 70 ohms.
- ▶ Antennas are effecteded by;
 - ▶ Location of antenna
 - ▶ Ground conditions
 - ▶ Artificial grounds
 - ▶ Height above ground and a bunch of things you cannot determine.
 - ▶ Length and velocity factor of your feed line (coax).
 - ▶ Angle and bends of the wire antenna all effect the resonance of the antenna.
- ▶ All this said if you are a ham you will need to be able to adjust / build or have someone else do it for you. So here are some things that will help you in this process.

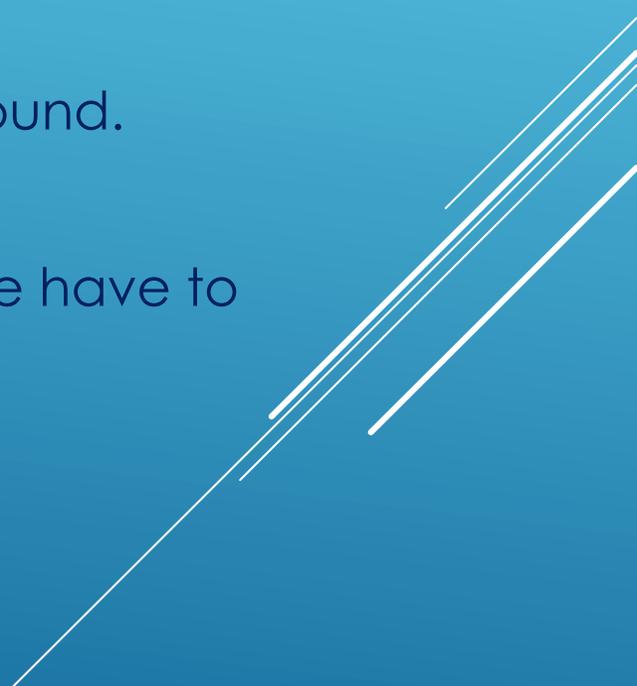
ITEMS TO MEMORIZE

- ▶ This formula $234/\text{Frequency in MHz} = 1/4 \text{ wave length}$
 - ▶ This is close but not exact - **ALWAYS CUT WIRE LONGER AND FOLD BACK ON ITSELF AT END INSULATOR.**
 - ▶ Two Apps for your Smart Phone
 - ▶ **Antenna Tool**
 - ▶ **HamAntCal**
 - ▶ You will notice that a dipole, inverted vee and vertical are calculated to different lengths. Cause is the placement of the wires or elements.
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- A decorative graphic consisting of several parallel white lines of varying lengths, slanted diagonally from the bottom right towards the top right, set against a blue gradient background.

REMEMBER

- ▶ The higher the frequency the smaller the adjustments.
 - ▶ $\frac{1}{4}$ " on your 146 MHz antenna can change resonant several KHz
 - ▶ $\frac{1}{4}$ " on your 40 meter dipole did not change but a KHz.
- ▶ Reason being $\frac{1}{4}$ wave for our 145.17 is only 19.66" whereas on 40 meters it is 33' 5.14"
- ▶ One way to look at this is how many $\frac{1}{4}$ " do you have in the antenna you are working on.
- ▶ Important to remember so you know to cut a $\frac{1}{4}$ ' or a few inches.

THE GOOD AND THE BAD

- ▶ The Good – We can operate from 1.8 MHz to 1240MHz and beyond.
 - ▶ The Bad – We need a lot of Antennas
 - ▶ Antennas work best when they are at least $\frac{1}{4}$ wave above ground.
 - ▶ For 40 meters that is about 33 feet, but for 80 it is 66 feet.
 - ▶ With this said you work with what you can and in this hobby we have to make compromises.
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- A decorative graphic consisting of several parallel white lines of varying lengths, slanted upwards from left to right, located in the bottom right corner of the slide.

EVEN MORE BAD NEWS . . .

- ▶ Lower in frequency the narrower the band width is.
 - ▶ $\frac{1}{4}$ wave 2 meter covers the whole 4 MHz of the band
 - ▶ $\frac{1}{4}$ wave on 40 meters you are bless to get 100 KHZ below 2:1
- ▶ Gets worse the lower you go.

HOW I MAKE A DIPOLE ANTENNA . . .

- ▶ I use #16 MTW control panel type wire – more flexible than THHN – a lot of ham will only use copper clad exposed wire. All I can say is I work the world using #16 MTW and it is easy to work with. This is available at any electrical supply source.
- ▶ I use a 1:1 Balun as a connection point for wires and coax and to shunt RF from coming back to shack.
- ▶ I use end insulators I purchase at Tractor Supply – they are used in electric farm animal fencing.
- ▶ Rope I use to tie off the ends is from Bass Pro Shop and is green fishing cord use for Trout Lines.
- ▶ Either use formula or APP to determine length.

HOW I MAKE A DIPOLE ANTENNA CONTINUED

- ▶ Remember to add extra according to what band, lower the frequency the longer the extra is.
- ▶ If possible put antenna in place to measure SWR but that is not always possible. It will change for the better when raised most likely, but could change resonant frequency a bit.
- ▶ Measure the SWR to determine where resonant frequency is.
- ▶ If antenna needs adjusting and most likely it will remember this;
 - ▶ If the lowest SWR is BELOW the frequency you shorten your wire.
 - ▶ If the lowest SWR is HIGHER than frequency you lengthen your wire.
- ▶ You do this by adjusting the wrap wire by wrapping more to shorten and by unwrapping some to lengthen.
- ▶ Just remember the lower the frequency the longer the antenna or the higher the frequency the shorter the antenna.
- ▶ When it is at its best you can then cut off extra or leave in place along as it is secured tight to the antenna wire..

OK SWR – WHAT IS IT . . .STANDING WAVE RATIO

- ▶ Again your radio is design to send RF into 50 ohm coax.
- ▶ At the end of the coax the antenna it is expected to be at 50 ohms also.
- ▶ Because antenna are not resonant but at one frequency it becomes mismatch very quick when you change frequency.
- ▶ Think of it as a water pipe that is 1" in diameter.
- ▶ We put a 1" valve at the end and feed water into the pipe at a volume to maintain the 1".
- ▶ With valve open 100% we have full flow and no back pressure.
- ▶ Now we start closing the valve and we create back pressure – this is the same with RF Power.
- ▶ More mismatch we are the more SWR.
- ▶ Because of this mismatch the power (RF) that the antenna cannot absorb will return back to the radio. The ratio of this power is SWR. Say you are transmitting 100 watts. You measure this on a watt meter. Now reverse the watt meter and you measure 10 watts returning. This would be just a little over 2 To 1 SWR.

DEVICES THAT MEASURE SWR

- ▶ RF Amp Meter – inserted into feed line and measure amps forward and then reverse.
- ▶ SWR Bridge – Better than Amp Meter. Does not measure watts but has adjustable set point you set while transmitting and then switch to measure SWR. Takes steps and time.
- ▶ Watt meter with forward and reverse settings. Faster, just throw a switch, but then must look up on a chart to determine SWR.
- ▶ Most modern radios now have built in automatic SWR meters, can monitor all the time fast but only measures the power out of your radio and if you have an amplifier it is only part of the story.
- ▶ NOTE: All of these require you transmitting on the air, putting a carrier that can bother someone.

WELCOME THE ANTENNA ANALYZER

- ▶ Not sure when the first one was available that most hams could afford, but would think maybe 25 years ago.
- ▶ One of the neatest products for our hobby.
- ▶ With these devices you replace your radio with the analyzer.
- ▶ The analyzer has a VFO and digital read out which can tune from our 1.8 (160) to up to 500 MHz
- ▶ They output a very low signal (20 mill watts or so) enough to measure your SWR yet not enough that anyone could detect you outside your shack.
- ▶ They are very portable and have a cost range from used \$100 to \$500.
- ▶ MFJ has at least 7 models ranging from little over \$100 to \$400
- ▶ Rig Expert has 6 models and has one that measure from .01 to 1400 MHz from \$335 to \$999.
- ▶ Comet CCA500MarkII – has one model from 1.8 to 500 MHz and list for \$439.
 - ▶ .

OTHER USES FOR THE ANTENNA ANALYZER

- ▶ Can be used as a signal generator to check receivers.
- ▶ Can be used in place of your rig to tune your manual antenna tuner. Thus not transmitting on the air and then when adjusted just switch back to your rig.
- ▶ As a Digital Grid Dip Meter - MFJ cells Grid Dip Coils or make your own.
- ▶ Newer MFJ unit's measure;
- ▶ Coax loss, shorts and lengths which is very nice.
- ▶ Complex L and C of coils, traps and tank circuits.
- ▶ Bit of caution – I never use the method of powering the unit by putting batteries in it. I have seen more than once a unit ruined due to the double A's leaking.
- ▶ I power it by a small security 12volt battery from Tanners and a homemade wire harness or by a 120 VAC wall wart.

LAST BUT NOT LEAST;

- ▶ Measuring SWR has really changed over the 45 years I have been fighting it.
- ▶ Before Antenna Analyzers;
 - ▶ Had to use the radio and a meter and type several measurements.
 - ▶ Many trips back and forth from antenna to radio – Good for weight loss.
- ▶ Very time consuming.
- ▶ Transmitted on the air and cause interferences.
- ▶ After Antenna Analyzers;
 - ▶ Analyzer can easily sweep the band.
 - ▶ Can be outside by antenna
 - ▶ No interference with a carrier.
 - ▶ Fast setup and check out
- ▶ Life is good if you are working on antennas and owe a good Analyzer.

ANY QUESTIONS

