

Jesus Faith & Antennas

By Gerald Tausch

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About the Author : A Life of Making

I come from a long line of makers—my dad was a maker, my grandad was a maker, and now my children and grandchildren are carrying on the tradition. For me, being a maker means seeing something and thinking, "I can make that, I can fix that." From a young age, I was surrounded by tools—wood, saws, wrenches, soldering guns, and old electronics waiting to be taken apart. My dad never scolded me for the things I ruined; instead, he fueled my curiosity.

I still remember one busy day at my dad's restaurant when I was upstairs experimenting with motors and transformers. With no diagrams and only guesswork, I ended up plunging the entire restaurant into darkness—twice. But instead of getting mad, my dad calmly showed me the right way to wire things, and that sparked a lifelong passion for making, even without formal credentials.

Over the years, I've created many things—from patents for tank vision blocks and infrared curing systems for NASA to a cabin built from 7,000 board feet of hemlock and a carefully crafted jewelry box. But my greatest creation, alongside my wife Merry Beth, is our family: three children, seven grandchildren, and four great-grandchildren. We've had our challenges, but Merry Beth's steady guidance kept us on course.

This book might be the last new thing I ever make—or maybe not. Stay tuned; perhaps Jesus has more in store for the Tausch family.

Dedication

To my dearest Merry Beth, born February 4, 1944.

From the moment we met, your love has been my constant source of strength. Your unwavering encouragement and belief in me carried me through the many challenges I faced in writing this book. Even in the toughest times, your faith in the Lord gave you the grace and wisdom to stand by me, offering guidance and support, no matter the circumstances.

I still feel your presence with me every day, and though I miss you deeply, I find comfort in knowing that we will be together again one day.

Thank you for everything, my love. For your unfaltering devotion, for being my greatest champion, and for the life we shared.

With all my heart,

Your boyfriend and husband,

Jerry

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*Jesus is the reason for the season.
Jesus is the reason for this book.
Often churches allow non-members
to participate in one of their bible
studies, take a bible study for a year
and see if you can agree.
Jesus is the reason for the season!.*

Preface

Faith is a puzzle of uncertainty and strength mixed with tomorrow's coming and yesterday's memories. As a five-year-old child in the 1950s, I wandered around upstairs of a restaurant owned by my Ellis Island-registered Czech parents. Did I acquire faith because of them? One day, a customer saw me playing on the railroad tracks and told my father my first spanking soon arrived. Did my spanking build my faith? What about when three black men came to the restaurant's back door and asked my grandmother if they could get served dinner in the back, away from all the other customers? My father came into the kitchen, saw the men, and said come on in, sit wherever you want. They replied no and that they didn't want to start trouble. I was eight years old then and didn't understand what happened. My parents and grandmother talked about what to do in the Czech language, and I understood them as they tried to find a solution. Dad said, "Well, you could eat back in the kitchen, but we will need a few minutes to clear off the table." They said they would wait. I grabbed my toys from the table. Mom, Dad, and Grandmother put aside all the dishes and pans, pulled in 3 chairs, and set the table. They ate, paid, thanked Mom, and left as they came out the back door. We had moved from Salem, Ohio, to Sebring, Ohio. Sebring is 10 miles west of Salem, and we moved there in 1946 when I was two years old. When I was seven, I began roaming the streets of Sebring on my bicycle with my baseball glove strung over the bike's handlebars and a ball pushed inside my glove. There was a newspaper, comic book, and hobby shop just up from where we lived on 15th Street. I loved it so much. The smell and looking at the large balsa wood

airplanes hanging from the ceiling by slender pieces of wire was a very magical place for me. But in a short time, it disappeared. I couldn't believe it. It was there yesterday, and now it has gone out of business. Sebring had Turner's drug store and soda fountain, White Palace restaurant, and the Strand Movie Theater across the Street from the "Tausch's Restaurant" where I lived. I could see the projectionist hanging out the window right behind the projection camera in a scorching place on a 90 degree summer night. I saw every cowboy movie made from 1950 to 1962. I loved Albert and Lew Costello movies. They always made me laugh. Leonard Hardware was one building up away from the restaurant. My job was to take my Red Flier wagon and bring back to Dad some screws and nuts. I always got first-rate service there. The next best place for me was Hoop's bus station, just a bit further south and across the Pennsylvania railroad tracks. You could buy 24-inch cubes of ice grabbed and held with huge tongs, which Mr. Hoops handled quite adroitly, doing it well despite his club foot, I am sure, that made it more difficult. Mr. Hoops made the best chocolate malted milkshakes extra thick you had to suck your lungs out to bring it up. It was so good. That was another one of my jobs to go and buy the shakes for everyone just before the TV program Lawrence Welk came on. I had to do it rain or come shine. In the Tausch family, you learned that everyone had a rank and specific responsibilities. As you might have guessed, my rank could have been better. One Saturday night, just before Lawrence came on, I rebelled and said, "It wasn't fair; I had to get shakes every time." After the laughter stopped, I still had to go and get the shakes. I wanted one, too. I just figured Mom and Dad weren't quite Americanized and didn't know about democracy. It wouldn't have mattered much between you and me if they had. From the upstairs windows, I watched and listened to arguing voices from the Street and the restaurant's back alley-way at night. My friend Joe and I would go behind the beer joints in the morning looking for loose money drunks had dropped while searching for their car keys the night before. The smell of the beer was unavoidable and a bit sickening to smell. Backs of beer joints always seemed ugly, dark, dank, and humid. There were lots of beer joints. Joe's dad happened to have a beer joint just up the street from our restaurant. Joe lived in a charming home on the better side of town and he had a yard to mow. I didn't. I always wanted a yard. One day, Dad brought an empty Quaker oats tube, some wire, a pair of Baldwin earphones, a variable capacitor, and a gallium cat's whisker. He said, "We will make a crystal set radio." I was excited about having my own radio. It took a couple of hours to make. We made it on a small piece of plywood. It was very wild looking to me, all those wires and a black knob for turning the variable capacitor. We went outside, Dad climbed a wooden ladder and hung a wire to the underside of the restaurant's over hanging roof. Dad said, "Now we have our antenna." Dad connected a length of wire to one end of the antenna and the other end ran under

my bedroom window and then connected to the radio. Then we put a small rod outside into the ground along the restaurant wall just under my bedroom window. We ran a wire from that rod up and under the same window the antenna had come in on. That was our ground wire. Dad said crystal sets only work well with a ground connection. That was it. I loved listening to my crystal set radio from my bed and listening to radio shows such as John Dollar, Gun Smoke, Amos and Andy, and many others. I would tell people my radio doesn't need electricity to work. I was proud to have it. My affection for this simple childhood experience made me interested in all things radio. No one encouraged me to read a bible that I remember. My parents never denigrated church-going people. The best I can remember, church was related to marriage, and for them to encourage me toward a particular faith that was different from my wife's could result in unhappiness. They came from the "old country" to escape unhappiness, and some of that unhappiness came because people of different faiths couldn't resolve the differences each faith required their allegiance to. Not living by the "old country" ways was a mindset my parents had, and this attitude surfaced often in many ways. They never stopped us from going to church, either. My sisters went and took me a few times. One Sunday morning, Mom tied my tie and tucked my shirt. She sang Czech songs in Czech as she straightened my tie, telling me how handsome I was. I don't notice much difference between people who attend church and those who don't, except for one thing. When church people are dealing with a problem, they look at it from a secular point of view. and religious view as expressed in the often heard phrase "what would Jesus do.?" As luck would have it Merry Beth my high school sweat heart had always gone to church. When we got married we always went to church and church Sunday school. She knew the ropes and we did okay. Three kids later and lots of Christmases plus a few gran-kids and 54 years of marriage she passed away from breast cancer. So I keep wondering how does one know whether or not their faith is real. I think about it a lot and decided when you are born Jesus takes out a faith bank account in your name. As you go through life you make deposits and withdrawals. So for me I am praying Jesus is looking at my account and with excitement he calls for Peter, John and the rest of his disciples and says hey, "look at this guy's account. I think we got us a keeper."

*Watching the red and gold autumn leaves
gently falling is like watching little
magic carpets withering around,
demanding to say I am the
prettiest. After spending the
day making giant mountains
of leaves, you realize the
whole family is bone tired.
Satisfying contentment is flooding
over you when your head hits the cool pillow. Then your lips smile
a bit when you realize Jesus is the reason for the season. When that
moment comes, it will be the moment you'll be born again.*



Introduction

This book will interest amateur radio (ham radio) operators, electronic and communication specialists, and the average electronic hobbyist. The ideas presented are different.

1. It shows how to transmit radio signals on three or more antennas simultaneously, while normally only one antenna is used.
2. Explanation of completely new wire antenna and feed line attachment techniques. Feed line detachment from antenna made easy. (Normally, connections are soldered.)
3. Use older radio equipment as infrastructure, or back plane of ready-made circuits, audio amplifiers, antenna switching, timing circuits, and many others.

Modifications

- Amp meter • Voltmeter
- Temp heat sink monitor
- Added Freq Counter
- Dig readout PTO Freq
- Dig readout Freq. in/out



The book's left-hand page margins will contain single line humorous thoughts, and or, an occasional radio equation mixed in. These thoughts will be found at back of the book under the title of "Jerry's World." The same thing applies to the right-hand page margins, except the thoughts will come from the Bible, and they are also found at back of the book with the title of "Jesus World." If they are words from Jesus, they will be in red italic.

The main thrust of the book concerns transmitting on more than one antenna at the same time. There are two basic approaches to this:

- 1) Antennas having no phase relation-ship.
- 2) Antennas that have a phase relation-ship.

The first case might be something like this: one antenna a horizontal, and the other a vertical, the horizontal being parallel to the earth and the vertical antenna being plum to the earth. Both cases come with a lot of latitude. The second case is two dipole antennas, one following the other with the space between them determining the overall gain they make together. See the top of Figure 6 of Chapter 1 shows the concept of In-Line antennas. Figure 7 of Chapter 2 shows the system components necessary for simulation transmitting on three different antennas. This book covers the basic principles involved in doing this. The following story explains how I became interested in having a ham radio station capable of doing this. (Ref. To Figure7)

In my usual ham radio career, it's midnight or later when I finally finish the wiring outside and inside the house in order to try out a new idea. I get it all done and I am eager to try it out. I sit at my desk and I power up my station. Kx3(Kx3 is a 10watt transceiver made by Elecraft Corp.) is set for 3.900 megahertz. The Kx3 determines the frequency that all the antennas will be radiating on. I have already tuned the A-1 and A-2 antennas one at a time to resonance with 50 watts of rf output on each antenna. For some reason I become nervous about turning them both on at the same time. I have a history of creating smoke filled radio rooms. My past record created a fear factor in me when-ever it comes to turning things on for the first time. After all, nothing to fear here both antennas worked fine by themselves and being sufficiently under-educated; there is nothing to see here (I hope).When I turned them on, each antenna's watt meter went from 50 watts to 75 watts. I turned them off. I needed clarification about what was going on. Was I seeing a wiring mistake? I had already added an ampere and volt meter to monitor the DC voltage and current at the input to the 100-watt solid-state amps, which are part of the Ten-Tec Triton 4s

These meters remained constant during the testing, so I knew the Triton amplifiers were not providing additional power to the antennas. When I did turn them on, each antenna's watt meter went from 50 watts to 75 watts. I turned the amplifiers off. I needed clarification about what was going on. Was I seeing a wiring mistake? I had already added an ampere and volt meter to monitor the current and DC voltage at the input to the 100-watt solid-state amps, which are part of the Ten-Tec Triton 4s. These meters remained

constant during the testing, so I knew the Triton amplifiers were not providing electrical power to the antennas.

These two antennas appeared to be acting as one antenna. Using this idea got my imagination going. I decided I would try this idea on all of the different band and frequencies my license would permit.

Because the different frequencies require different wire lengths, plus the antenna half-wave separation between them is different per band, requires a lot of work if you want to try In-Line antennas on all the radio bands. I felt I needed a simpler and easier method of wire antenna assembly. The extra wattage shown on my watt meters represents the gain that In-Line antennas provide. My 75-meter

antennas were 10 feet apart, not 120 feet. With 10 feet of separation, the expected gain is 1.6 dB. The extra 25 watts on each watt meter

is very close to 1.6 dB, which is 1.4 times 50, giving 72.2 watts. I became confident that In-Line antennas work. Now, I needed an easier way to configure these antenna wires in length and distance between.

I made all my wire antennas start as 2-meter VHF dipoles with an attached feed line, and all wires hose clamped to the rope. I chose

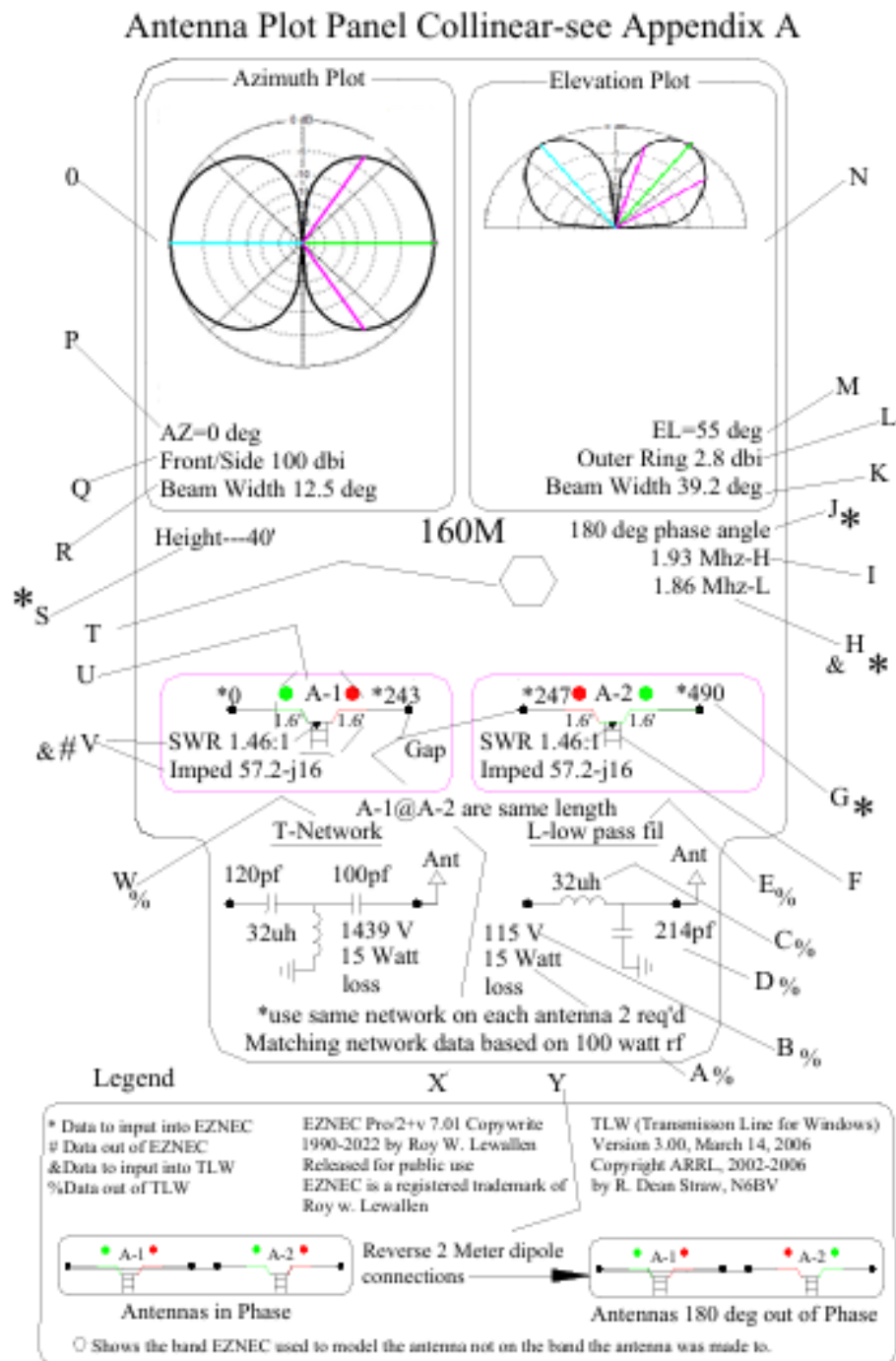
146.52 Mhz as my standard for making wire antennas. (If all hams adopted this standard, sharing designs would become easy.)Details are shown later in the book. I modeled quite a few different In-Line antenna designs. Keeping track of all the data proved cumbersome. I made a table to place the data into.

Along with the EZNEC data, I included TLW data, which will show the expected impedance at the antenna and provide tuning suggestions for the actual capacitor and inductance values. Plus, the voltages and power losses across tuning components. This data on the design frequency plus the data from other bands will help you decide whether the design is worth the effort for multi-band use.

There are four tables, one for each of the antenna arrangements. Match the letter on the table, then find the same letter listed in the explanation

- A. Power loss in tuner in watts.
- B. Voltage across inductor
- C. Inductance is required to match the antenna impedance to 50 ohms.
- D. Capacitance is required to match the antenna impedance to 50 ohms.
- E. TLW outputs a Low pass L solution for matching antenna impedance to 50 ohms.
- F. Feed line choice for operator convenience.
- G. The antenna's overall lengths are A-1 and A-2.
- H. The frequency used to generate the Plot Panels.
- I. The frequency used to determine antenna wire length.
- J. Phase angle inputted into EZNEC.
- K. This is the angle between the two red radial lines shown in the elevation view as part of the antenna's radiation pattern.
- L. This represents the antenna's theoretical maximum gain potential.
- M. This angle shows the radio waves' upward direction as they leave the antenna.
- N. This is the EZNEC output plot for the elevation pattern of the antenna.
- O. This is the EZNEC output plot for the azimuth pattern of the antenna.
- P. This is the angle of looking from the top down toward the ground. With zero degrees on the right side of the x-axis, the Azimuth angle would go in a counterclockwise direction from this zero to, in this case, the azimuth is zero degrees.
- Q. This parameter represents the antenna's ability to favor signals from the front instead of signals from the back of the antenna.
- R. This parameter shows the width of the signal angle when it leaves the antenna. Beam width is the included angle between 3db signal drop-off points.
- S. Antenna height above ground.
- T. This symbol is a placeholder showing the frequency band being used to generate the curves shown in the plot panel. In other words, the symbol holds a band that is a harmonic of the antenna.
- U. This is the data area for antenna A-1 to input into EZNEC.
- V. This data comes from EZNEC and is inputted into TLW.

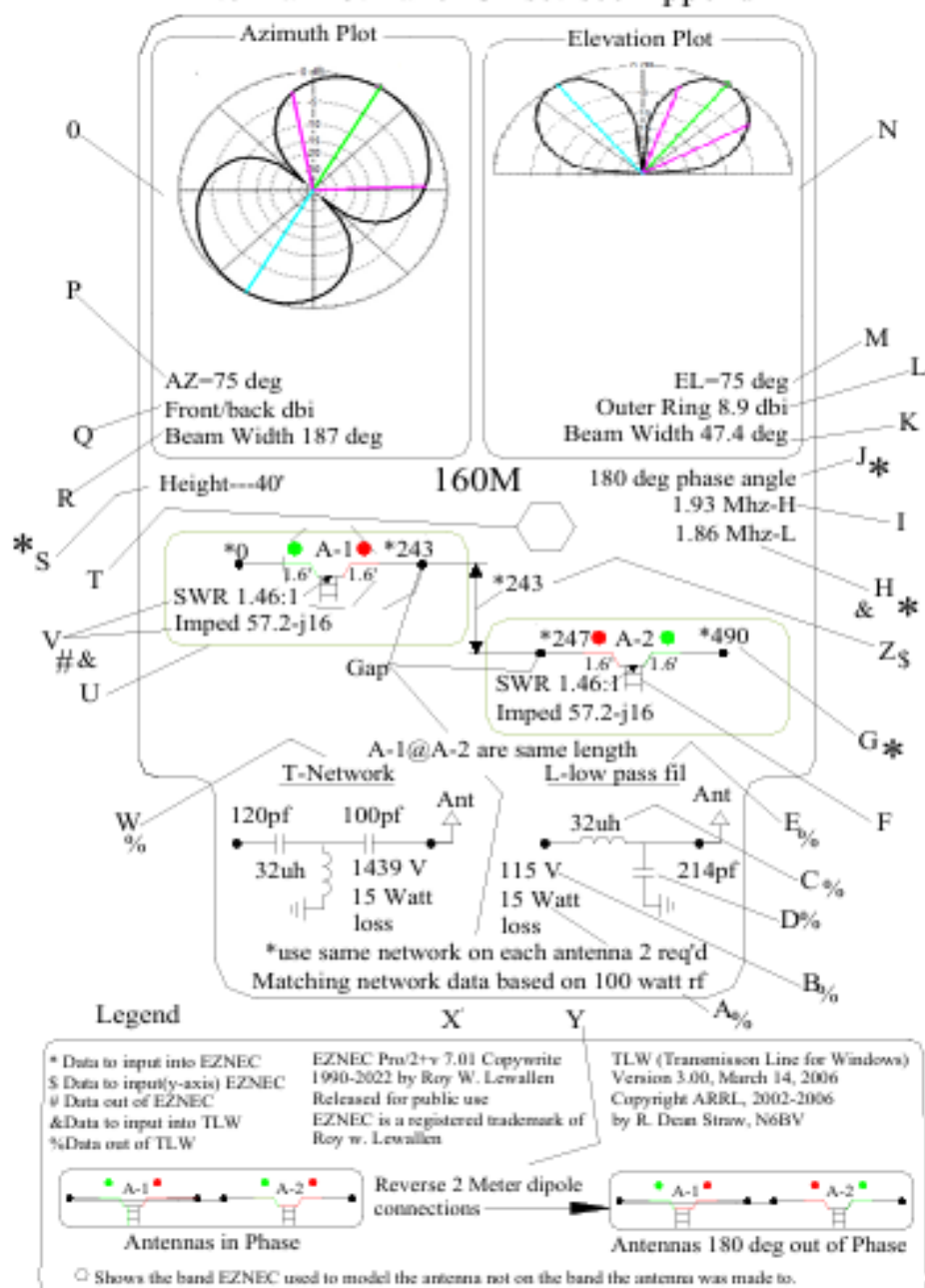
W. This data comes from TLW for T-network antenna tuners



Drawing 1: In-Line Antenna Straight Plot Panel

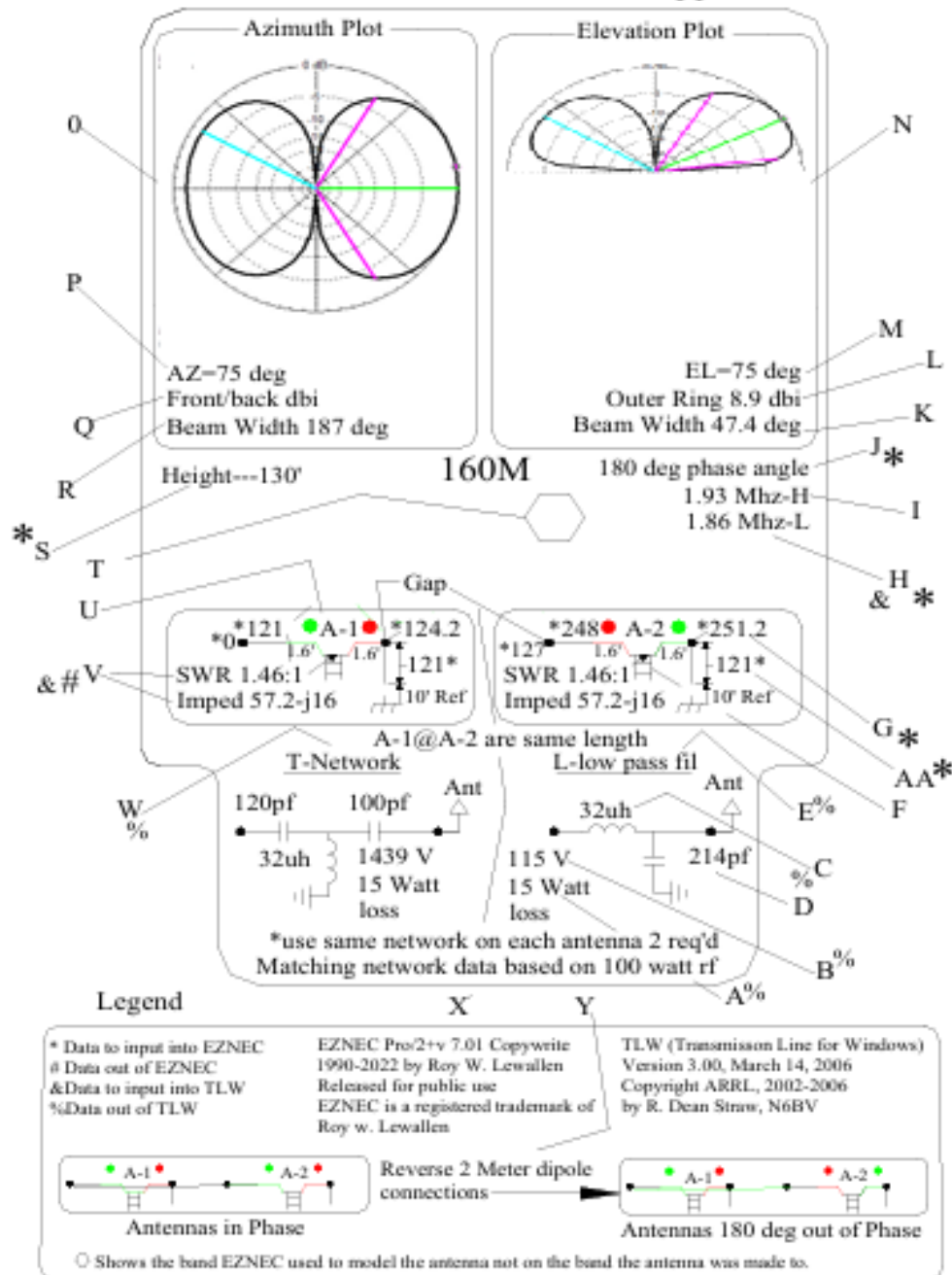
- X The gap shows the separation points between A-1 and A-2 antennas.
- Y. The green dot represents the ground side of your antenna. The red dot represents the hot side of the antenna. The antennas are wired in phase when the dots show green, red, green, and red. So, the other wiring possibility makes the antennas 180 degrees out of phase. Having a way to switch the wires around is the reason for making the antennas with a 2-meter start and making the necessary connections easy using hose clamps. When the antennas are wired in phase, the 90-degree out-of-phase is handled in the shack by connecting a length of coax on the driver side of the system that will provide the 90-phase shift (phasing line). Connecting the phasing line to a rotary switch lets you choose the antenna that becomes 90 degrees out of phase. The gap for 160 and 80 meters is set to 4 feet. For all other bands, the gap is wired for a half wavelength.
- Z. This is the offset distance between the A-1 and A-2 antennas, which is inputted into EZNEC on the “Y” axis.
- AA- This is the length of wire hanging downward for the in-line antennas A-1 and A-2.

Antenna Plot Panel Offset-see Appendix B



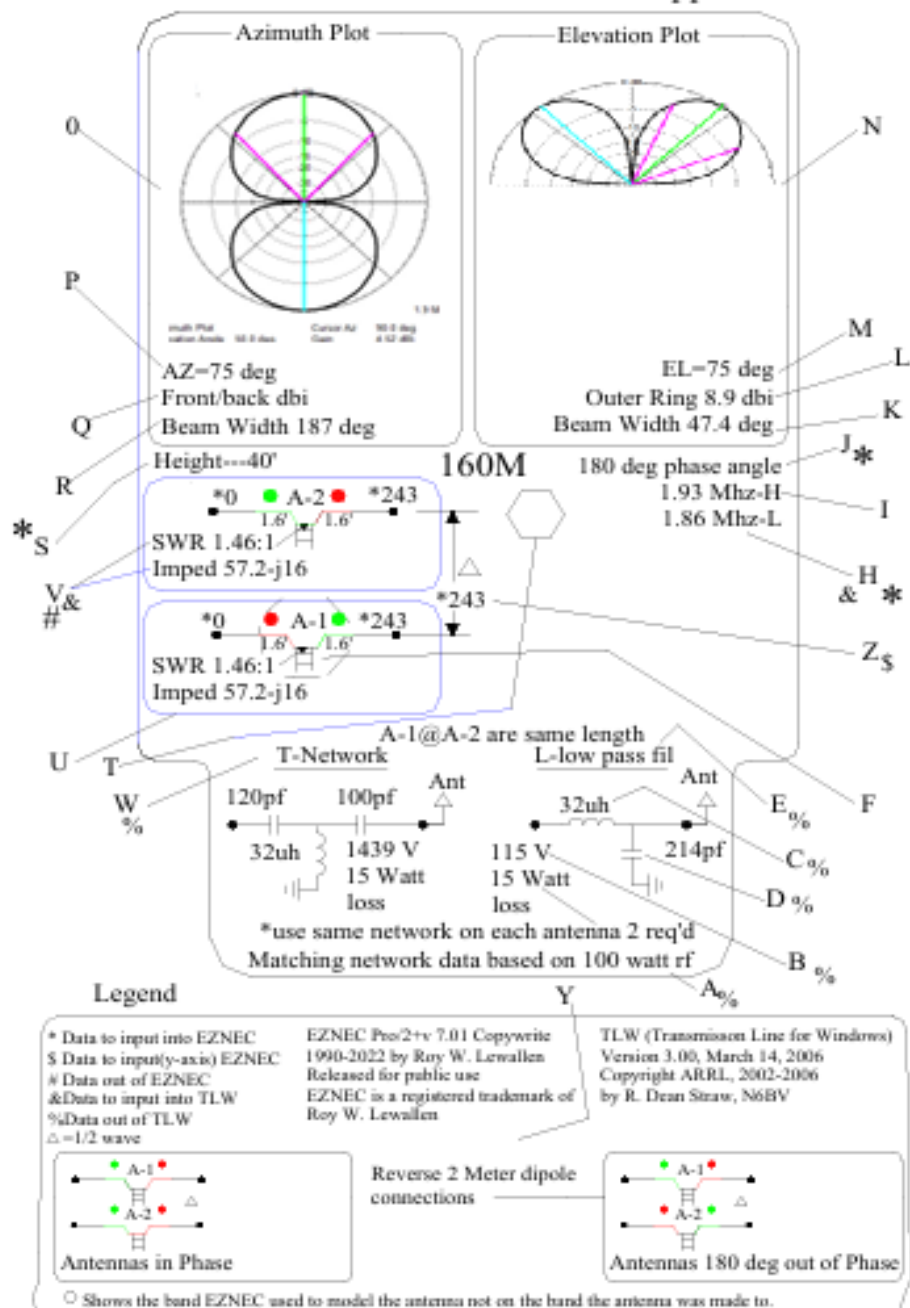
Drawing 2: In-Line Antenna Offset Plot Panel

Antenna Plot Panel Vertical-see Appendix C

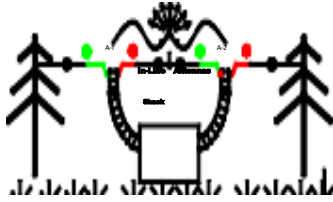


Drawing 3: In-Line Antenna Vertical Plot Panel

Antenna Plot Panel Parallel-see Appendix D



Drawing 4: Parallel Antenna Plot Panel



Chapter 1

In-Line Antennas

In-line antennas follow each other in a straight line with separation between them. My In-Line antennas are made from two individual dipole antennas tied end to end with a half wavelength of separation. The Radio Amateurs Handbook shows multiple versions of In-Line antennas called “collinear.” Those antenna designs found in the handbook are based on having one source of RF energy. For these antennas to have signal gain, the antenna builder must add a maze of wiring between the dipole inputs in order to provide proper phasing and impedance. Inter-connecting these elements requires involved wiring techniques. Ultimately, you will have an antenna with gain only for one band. My dual RF sources into my dipoles provide gain, and with an antenna tuner, gain on other bands and frequencies.

The antennas I am showing in this book are based on three ideas:

- 1) Build the antenna using rope. 2) Build your single antenna by starting with a 2-meter dipole connected to an RF connector or a feed line of choice. This assembly method

will allow reversing the antennas phase to 180 degrees out of phase. In most cases, this rotates your signal by making it an end-fire antenna(you will lose some gain).

See Chapter 3 for antenna assembly techniques. 3) The third idea is splitting one rf source into two separate identical sources, each fed into one of the rf amplifier inputs simultaneously and in phase. The final powers are added together outside at the antenna, and their sum is multiplied by the antenna's gain $(Sp1+Sp2) \times 2$ (3db)=Total Power Out. On-air testing validated Fig.1 patterns. It was a lot of fun getting the increased signal reports as I turned off and on one of the antennas.

Signal reports validated the plots, and the increase in signal reports agreed with the expected 3 db gain. When the other phase angles were tried, the signal reports agreed with what the patterns predicted.

Fig.1 shows the four basic antenna designs energized by two RF sources. (See Chapter 2 zone of decisions for details.) The patterns shown are typical for each of the four different arrangements: 1) In- Line, 2) offset, 3) vertical, 4) parallel. The gain of each arrangement is shown at the bottom of the elevation plots. Fig.2 shows the antennas with less than one power source. Comparing the patterns between Fig. 1 and 2 lets you visualize the benefits of dual RF sources. These plots were made with 40-meter dipoles at the frequency of 7.2 Mhz at a forty- foot elevation. See Fig. 3 and 4 for comparison plots at 40 and 100-foot heights. Plots of other frequencies will look similar to the ones shown.

I have provided plots for all the high-frequency bands for all four designs. The plots were made at 0, 90, and 180-degree phase angles, with an additional plot with one source. I also provided plots of the antennas being used at frequencies other than the frequency the antenna was designed for. I did this for all four antenna designs; see the appropriate appendices for these plots. The right-hand page will have the main plots, and the left will have plots at the other non-resonate frequencies.

I could find no advantage to increasing the $\frac{1}{2}$ wavelength between antennas A-1 and A-2. The gain would decrease, and the patterns would become muddled.

The offset in the offset In-Line antenna caused a twenty-five-degree bend in the azimuth pattern. If your property layout is just right, this bend could be taken advantage of. However, this antenna requires additional ropes and greatly complicates finding something to attach the ropes to

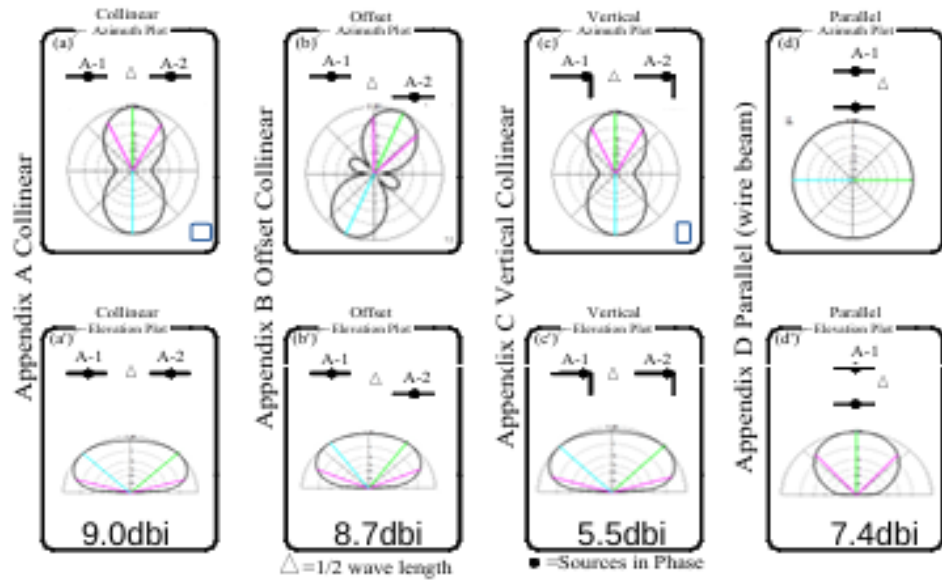


Figure 1: Two antennas & 2 rf sources

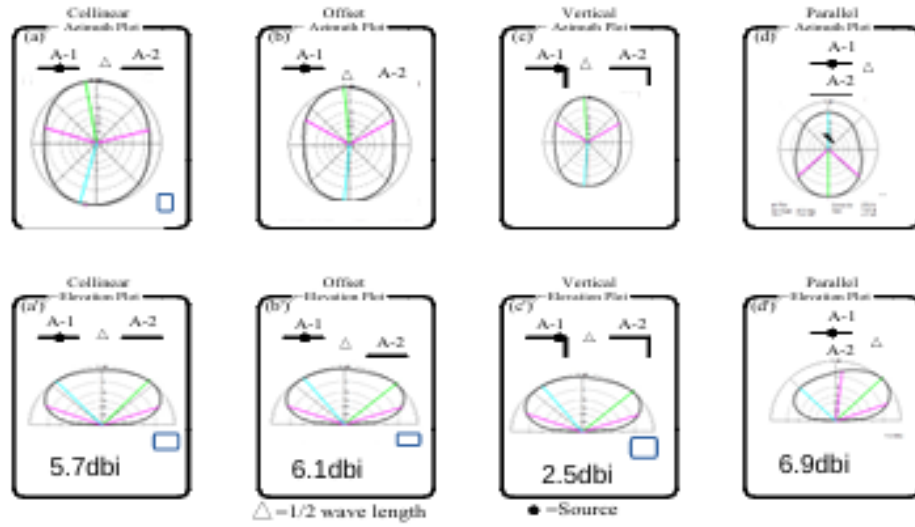
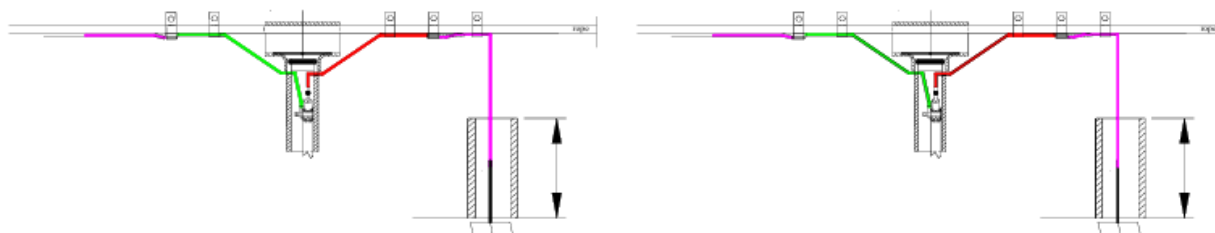


Figure 2: Two antennas & 1 rf source

See the appendices for additional bending when phase angles between antennas are changed. Of course, the higher the frequency, the easier these designs become. I modeled this same antenna with a 50x wavelength offset see Fig. 5. As this offset distance gets more prominent, each bit of increase provides little benefit. Fig. 1c is what I call a vertical In-Line antenna. You make this antenna by dangling down one of the $\frac{1}{4}$ wave wires that make up the regular In-Line antenna. Since these wires were attached to the rope with hose clamps, loosen an end clamp and let the wire drop down.

Put some weight on the loose end. If it's windy, put a small stake in the ground, attach the loose end of the wire with a string, and attach the other end to a stake. I did this to try and have my signals fly off at a lower radiation angle. I only tried this on fifteen meters, and it worked well. I usually use antenna tuners, but I trimmed the antenna for a 2:1 SWR match by adding or subtracting a little length of wire to the wire attached to the rope, not the one hanging down.



The parallel antenna is shown in Fig. 1d. For the most part, it is a wire beam, and textbooks can go over the fine-tuning of element lengths. My main goal was to showcase the benefits of using rope as an antenna attachment method. This wire beam can be made from your In-Line antenna by loosening the end hose clamps on each wire and stretching the wires out, holding them parallel to the end height that matches the height of the attached end. If you make your antenna using rope, you can make the space between the antennas whatever you want. Chapter 3 gives details on making wire antennas using rope and hose clamps. Antennas do not have to be straight wires to make an In-Line antenna. I modeled full wave rectangular and delta loops hung down from the rope. Feed line placement is essential in the RF take-off angle of these antennas. I suggest getting EZNEC and searching for a feed-line feed point that provides your transmitting goals. These antenna types are more complicated than what I had planned for. Simple is what I like. They are not included in this book.

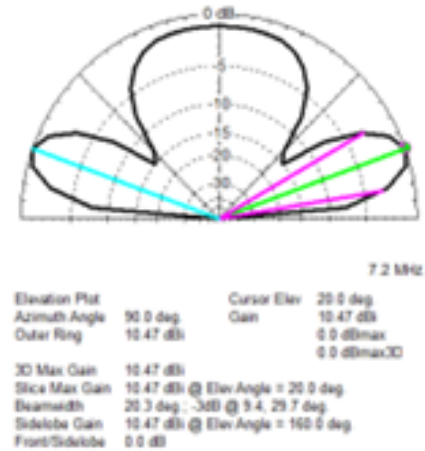
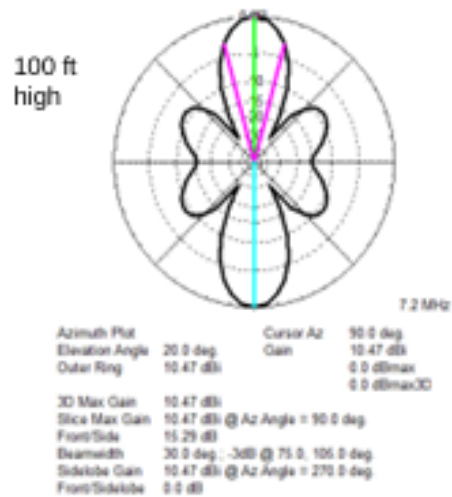
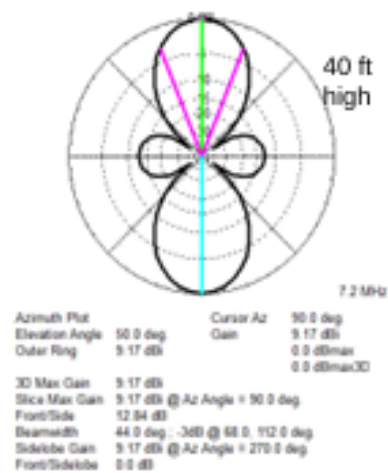


Figure 3: 40 ft high
on 7.2 Mhz

Figure 4: 100ft high
on 7.2 Mhz



K8WIK's Radio Station Collinear Dipoles - Power Summers with Gain

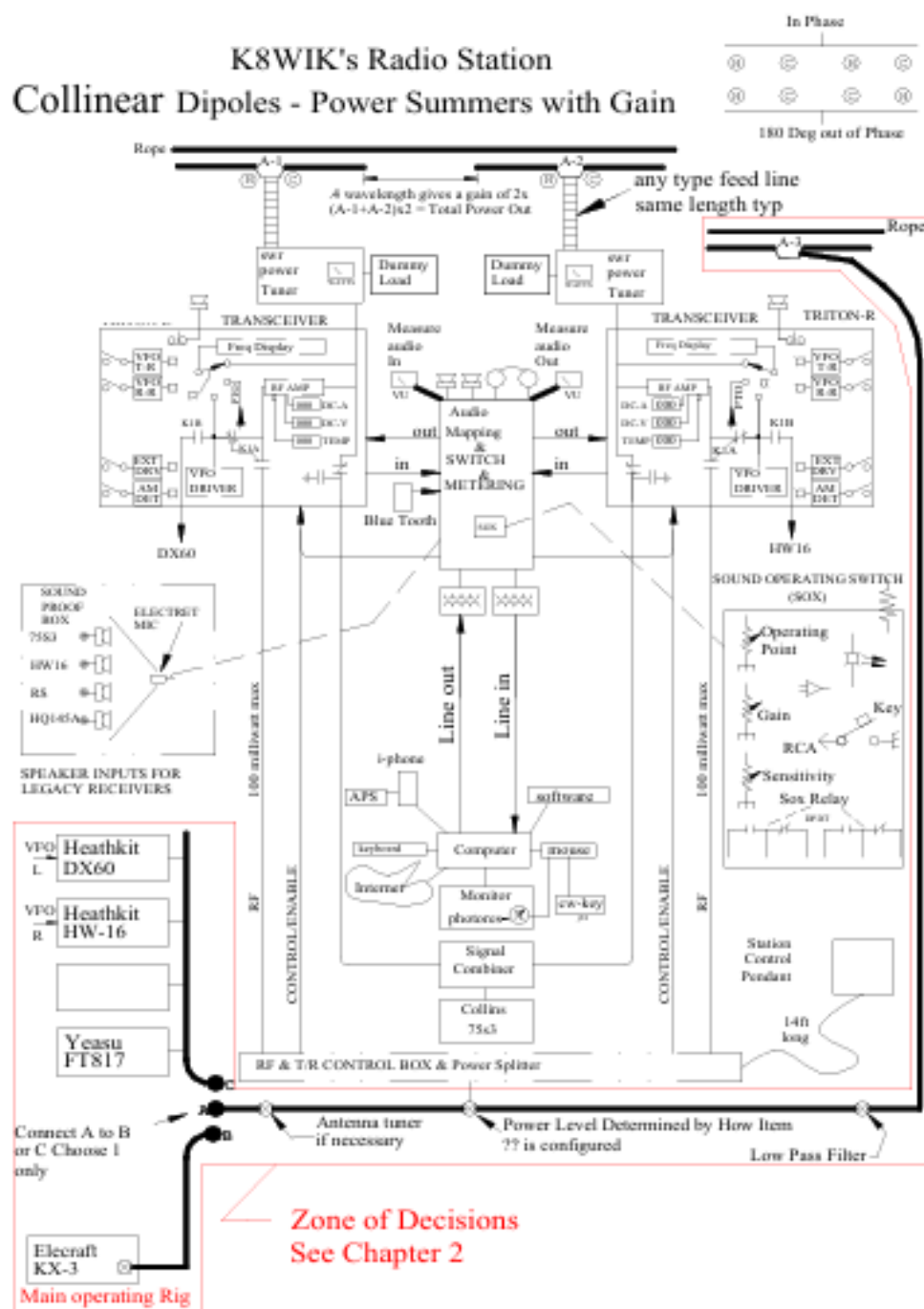
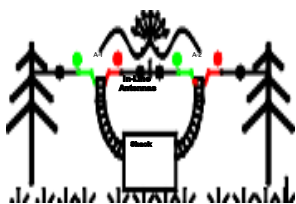


Figure 6: K8WIK's Ham Radio Station



Chapter 2

Zone of Decisions

Fig.6 and Fig.7 outline the zone of decisions in red. The equipment shown is a sample of radio equipment spanning 80 years. Hundreds of other radios made within these 80 years are similar to mine. These radios will function in much the same way as mine. A ham can own radio equipment with a wide range of features. For instance, one example is my Heathkit DX-60, an old-fashioned electronic tube screen grid amplitude-modulated 60-watt transmitter manufactured in and around 1960.

Another example would be the more modern solid-state portable and rugged Yeasu FT-817, an all-band, all-mode, 5-watt RF output transceiver or a modern 100-watt radio such as the Icom 7100 band all- mode 100-watt transceiver. I use Elecraft Kx3, an all-band, all-mode, 10-watt solid-state transceiver, as my regular everyday radio. This miniature radio equipment can be configured to operate in the decision- making zone. Also, home-brew equipment can be made to work in this zone. The end goal within the zone of decision is to provide the right amount of power to a dual RF amplifier and antenna system (DAS).

This power can be had by sampling part of the transmitter's output power. Combining radio types with different power levels and sampling techniques can be confusing. It was for me, so I used various ways to accomplish the required sample size on paper. See Figures 11 through 20 to see the different ways I connected my transmitters to the DAS input of the tee attenuator.

Figure 7 shows Figure 6 with the RF circuit chain only. I made the control box bigger and added a T attenuation circuit. This little circuit takes a 50-ohm input and provides a 25-ohm output. The two Ten Tec 100-watt RF amplifiers have a 50-ohm input impedance. Two 50-ohm impedances in parallel look like a single 25-ohm impedance. Splitting the input into two single in-phase outputs (0 phase angle) is a must starting point for controlling the direction in which your radio signal is heading.

The tee network has two main functions. One is to make the RF amplifiers' inputs less sensitive. I needed less sensitivity to control the output. The other primary function is to provide a nonreactive input, allowing the input to be broad-banded, meaning no additional components are needed.

The tee network is shown in Figures 8 and 9. Figure 8 represents this tee network, as the Chemandy Corporation shows on its online calculator. Chemandy has a large selection of online calculators. I knew I wanted a 50-ohm input and 25-ohm output impedance. The online calculator required an acceptable signal loss given in decibels. I guessed 9db. The calculator said I was wrong and then gave me the exact values for the tee network and the actual db loss for this network—the Chemandy software provided the values of the tee network to three decimal places. You can plug in the value of the resistor values you have in your junk box and let the online calculator check how close you are to the exact numbers shown. Two percent resistance variation should work. Only use non-inductive resistors.

Now, we need to know the wattage of the resistors. Suppose you get the wattage wrong on the upside—you're good. If you're off on the downside, things will go badly. Smoke is okay for campfires but not for radios. I downloaded LT-Spice (free) and modeled this network, as shown in Figure 9. I have given you the wattage for the tee

In Phase

180 Deg out of Phase



network and those are constant and shouldn't need changing. When you start from scratch, you must determine how much power you need to drive your amplifier. The calculation is shown in Fig. 9. The circle is the voltage of your rf at the power level of your transmitter. LT-Spice needs that parameter to do its work. As you explore this program, you will be changing this parameter to test changes in your design. Don't let the program intimidate you, (don't give up) you will figure it out.

Once you figure out how to use LT-Spice you'll never leave town without it. I set Lt-Spice as an AC model at ten kc. I just liked looking at sinusoidal waves, and it seemed easier to read. Spice doesn't care about this circuit being reactive or non reactive. The results will be the same whether it is set up for AC or DC.

Modern software packages have eliminated most of the tedious math required for circuit design. The best thing is to use the software to teach yourself how to do radio circuits without buying a lot of test equipment. I've included inductance and capacitance values in antenna models to match 50 ohm antenna input impedances.

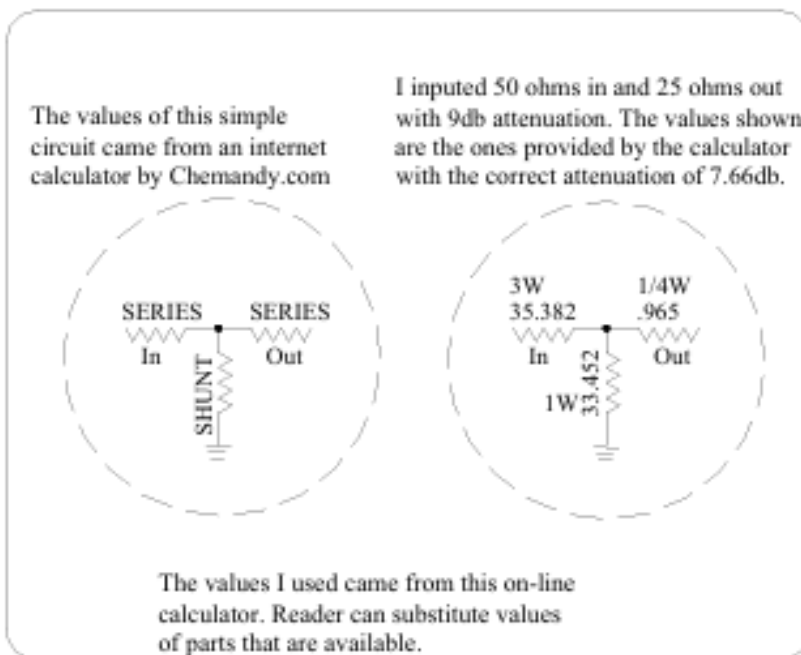


Figure 8: Chemandy Corp.Calculator

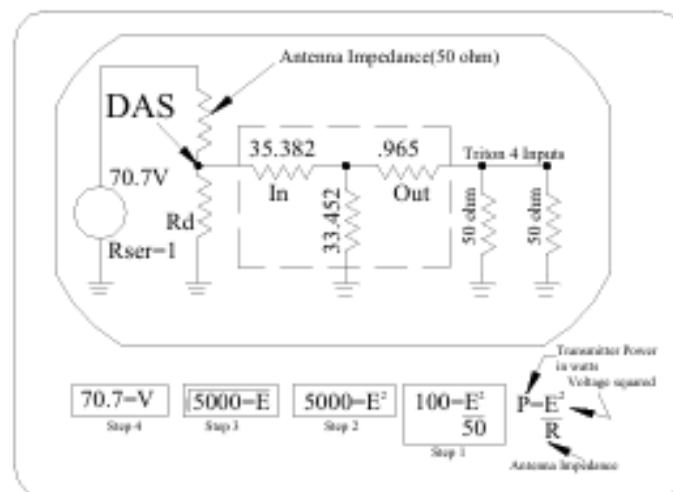


Figure 9: DAS & Rd Power/voltage splitting

Zone of Decisions is about providing DAS (dual antenna system) 10 volts of rf energy at 100 milliamps per rf amplifier. This power is necessary to drive the Ten Tec rf amplifiers to full 100 watts into a 50 ohm load. Other amplifiers will require different driving power. Use the same approach to determine proper values.

Figure 10:

Explanation

1. A-1 and A-2 antennas represent two identical dipoles spaced apart in a straight line, making them In-Line, which results in signal gain. Appendices A through D show an array of In-Line antenna arrangements. Non-gain arrangements can be any combination of horizontal and vertical.
2. DX-60 is shown as a placeholder so that any transmitter will work.
3. A-3 antenna is vital in sampling a small amount of rf to feed the two Ten Tec Triton 4 transceivers. Its overall use is up to the imagination of the radio station operator.
4. A low pass circuit is needed to minimize transmitter harmonics. You will be feeding two RF amplifiers that have no input filtering. It is imperative to respect this situation and keep your signal clean.
5. A dummy load is used as an antenna tuner. We show how to wire it up with low—and high-impedance antennas. Since A-1 and A-2 provide the signal you expect the operator on the receiving end to hear, A-3 is more important for receiving and fun for trying something different.
6. Rd is a resistor that provides the voltage drop to drive the two RF amplifiers. The value of Rd depends on how you configure your station—figures 11 through 20 show many configurations with all the necessary resistor values.
7. This represents the voltage necessary to feed into the DAS to increase the signal strength of the RF amps

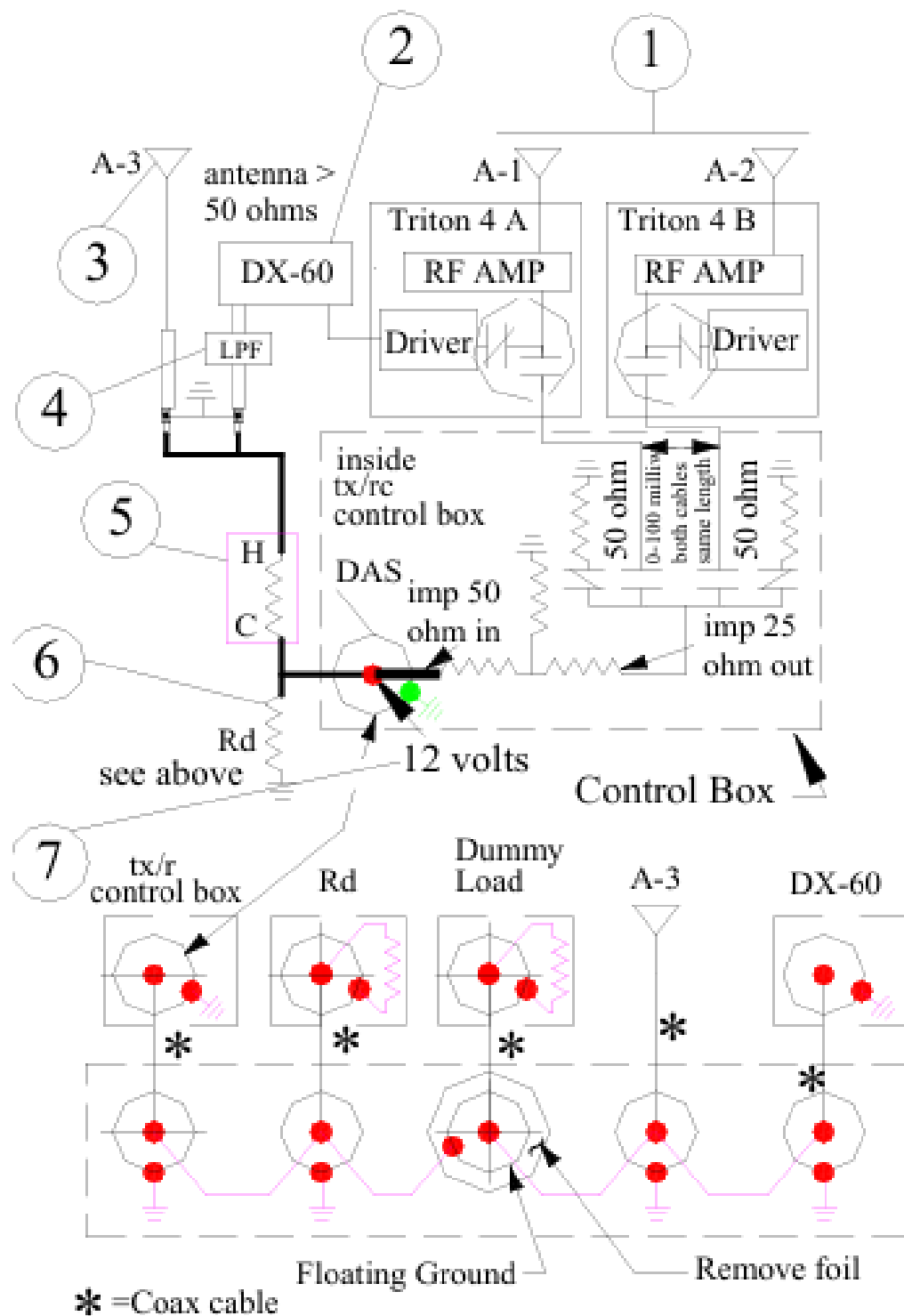


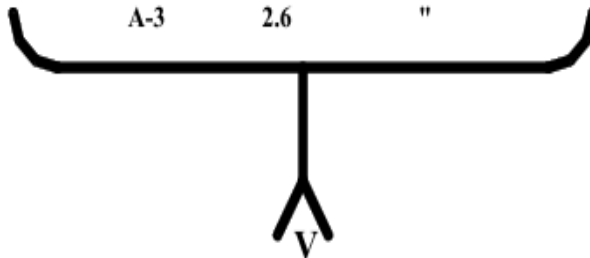
Figure 10: Generalized Antenna Connections

What to Consider

This Figure shows the least complicated way of connecting the FT-817 to the DAS.

- FT-817 will be running about 2 watts
- The tuner will be tuning A-3 and DAS
- A-3 and DAS are wired in parallel
SWR minimum 2:1 because of DAS
- Depending on the FT-817 internal low pass filter to reduce harmonics
- Then you will have:

Antenna	Out Power	Units
A-1	65	watts
A-2	65	"
A-3	2.6	"

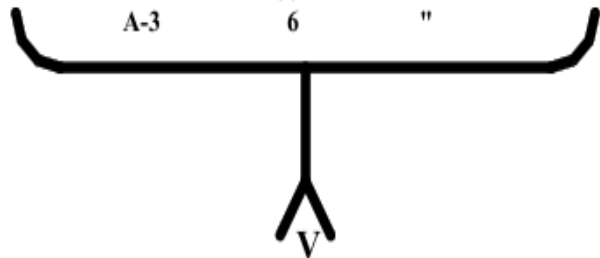


What to Consider

This Figure shows the least complicated way of connecting the KX3 to the DAS

- KX3 will be running about 5 watt
- The tuner will be tuning A-3 and DAS
- A-3 and DAS are wired in parallel
- Depending on the KX3 internal low Pass filter to reduce harmonics
- Keep KX3 power and tuning power @ .5 watts as starting point
SWR minimum 2:1 because of DAS
- Then you will have:

Antenna	Out Power	Units
A-1	100	watts
A-2	100	"
A-3	6	"



What to Consider

This Figure shows the
FT-817 driving A-3 & Rd (in series)

- . Ground side of antenna feed line connected to Rd and DAS
- . Drive voltage provided by voltage drop across Rd
- . Set drive voltage for DAS at 5 watts max on FT-817
- . Then you will have:

Antenna	Out Power	Units
A-1	60	watts
A-2	60	"
A-3	1.4	"



What to Consider

This Figure shows the
KX3 driving A-3 & Rd (in series)

- . Ground side of antenna feed line connected to Rd and DAS
- . Drive voltage provided by voltage drop across Rd
- . Set KX3 to 10 watts
- . Then you will have:

Antenna	Out Power	Units
A-1	100	watts
A-2	100	"
A-3	3	"



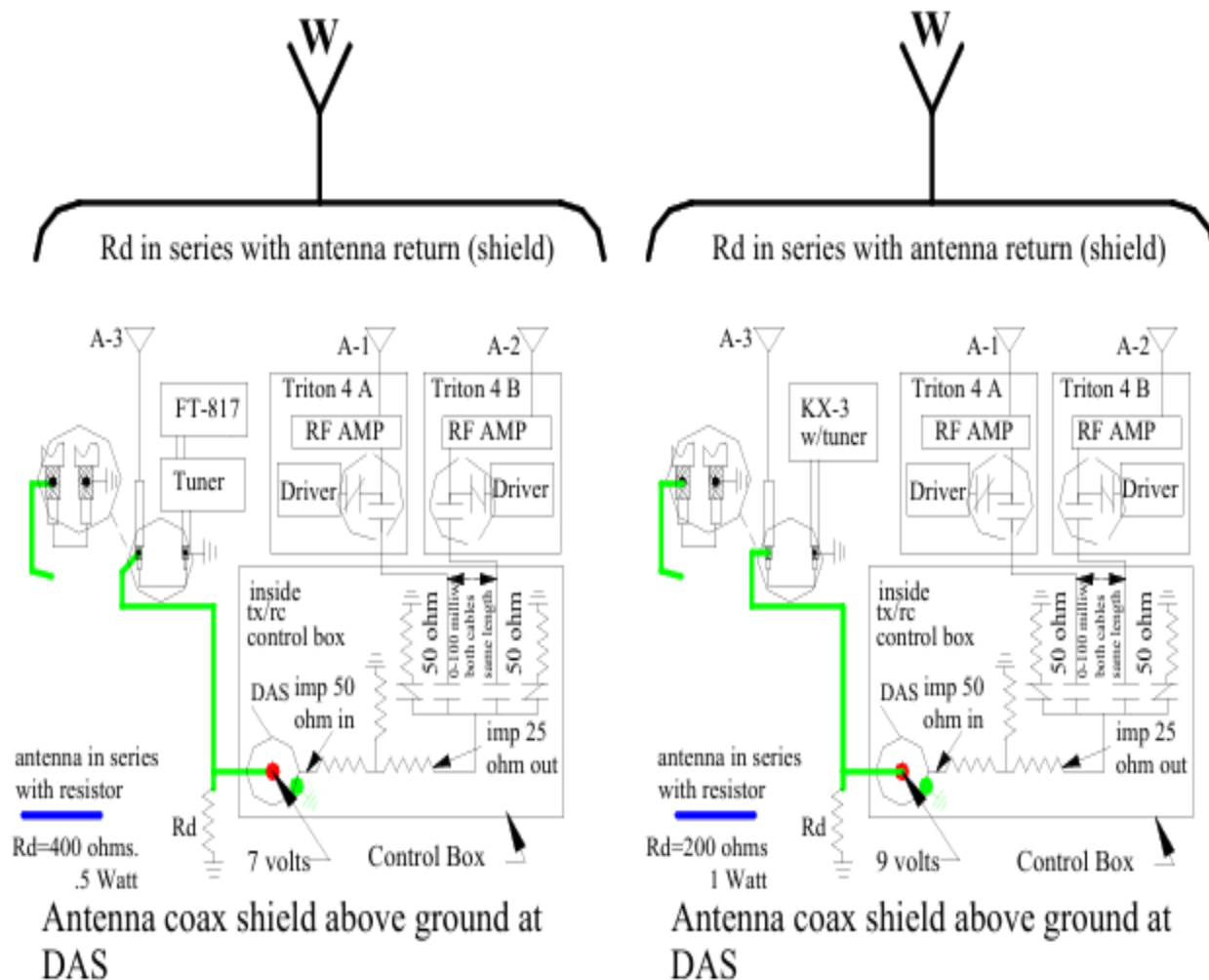


Figure 14: FT-817 Driving A-3,DAS & Rd

Figure 13: Kx3 Driving A-3,DAS &

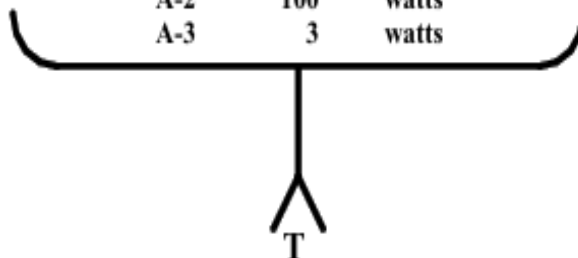
This Figure shows DX-60 in series with low impedance antenna (less than 50 ohms) dummy load and Rd with no tuner required.

- Goal to operate with a low impedance antenna without a tuner.
- Use Low Pass Filter
- Setup DX-60 to accept drive from a seperate vfo or drive output in the Triton 4.
- Make series knock out board mount in plastic electrical utility box.

Set drive voltage for DAS at 60 Watts
Use Heath Kit instructions.

Then you will have:

Antenna	Out Power	Units
A-1	100	watts
A-2	100	watts
A-3	3	watts



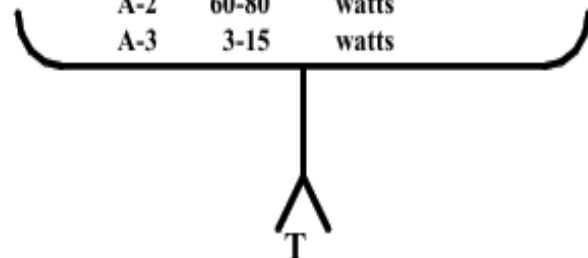
This Figure shows DX-60 in parallel with high impedance antenna (greater than 50 ohms), dummy load and Rd with no tuner required.

- Goal to operate with a high impedance antenna without a tuner.

Rd= 20 ohms	Rd=20 ohms
8 watt	8 watt
Ant. @ 1k ohm>	Ant. @ 200 ohm
3 watts out	15 watts out
- Setup DX-60 to accept drive from a seperate vfo or drive output in the Triton 4.
- Make parallel knock out board mount in plastic electrical utility box.
- Set drive voltage for DAS at 60 Watts
Use Heath Kit instructions.

Then you will have:

Antenna	Out Power	Units
A-1	60-80	watts
A-2	60-80	watts
A-3	3-15	watts



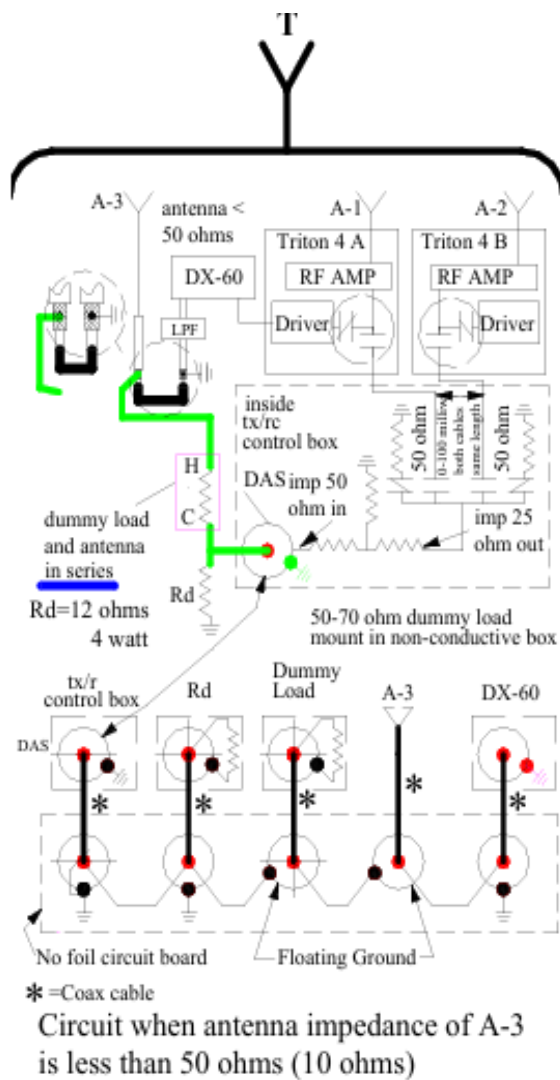


Figure 16: DX-60 Driving A-3,DAS & Rd

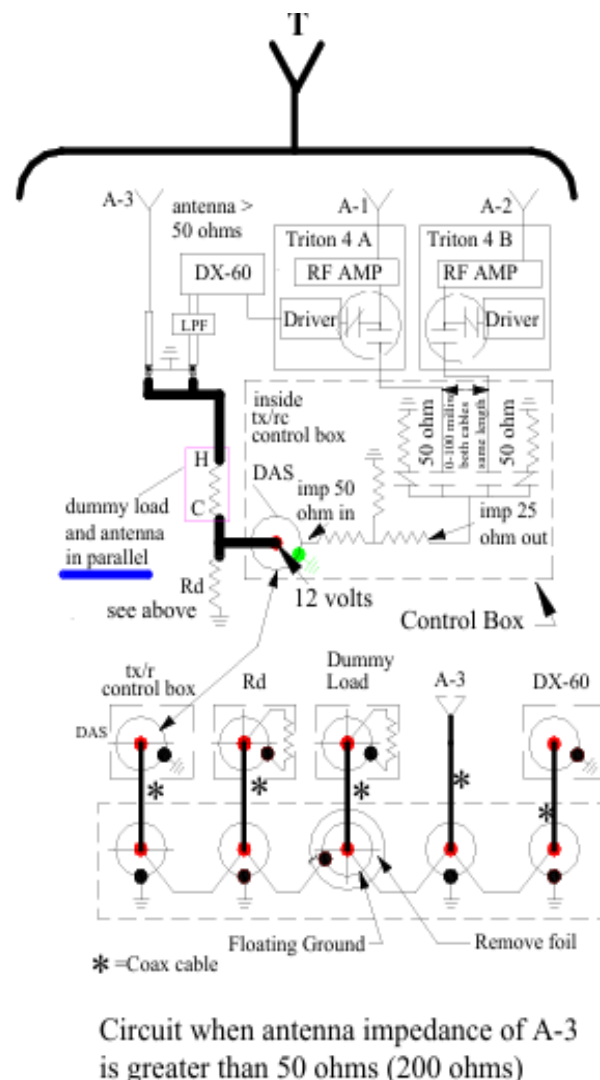


Figure 15: IC-7100 Driving A-3,DAS &

What to Consider

This Figure shows the FT-817 in series with low impedance antenna (less than 50 ohms), dummy load and Rd with no tuner required

- Goal to operate with a low impedance antenna without a tuner
- Make series knock out board mount in plastic electrical utility box
- Assume A-3 impedance 10 ohm (less is ok)
- FT-817 set @ 5 Watts
- Then you will have:

Antenna	Out Power	Units
A-1	9	watts
A-2	9	"
A-3	.4	"

U

What to Consider

This Figure shows the FT-817 in parallel with high impedance antenna (greater than 50 ohms), and dummy load and Rd with no tuner required

- Goal to operate with a high impedance antenna without a tuner
- Make parallel knock out board mount in plastic electrical utility box
- FT-817 set @ 5 Watts
- 200 >> ohm A-3 antenna impedance
- Then you will have:

Antenna	Out Power	Units
A-1	15	watts
A-2	15	"
A-3	1.3	"

U

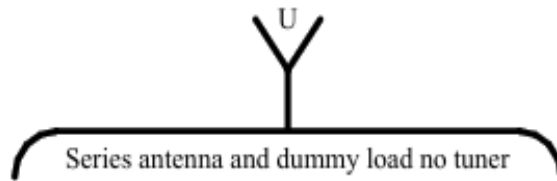


Figure 18: FT-817 Drv, Series low ant.

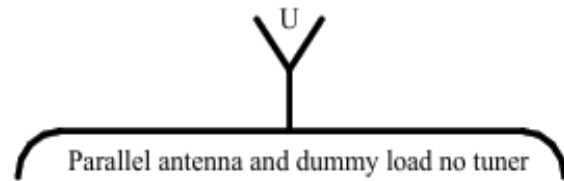


Figure 17: FT-817 Drv high imp.

What to Consider

The Figure shows Ft-817 supplying input power RF to the DAS

- Goal to operate outside the house
- A-3 antenna will be receive only
- A-3 can be run near by so coupling distance between Ft-817 antenna and A-3 antenna gives the desired results.



This Figure A-3 antenna special use

- Create a system that would allow multiple stations to access the DAS
- Allow for band switching with necessary filtering.
- Example Field Day and allow access by digital mode stations to take turns getting into the DAS.



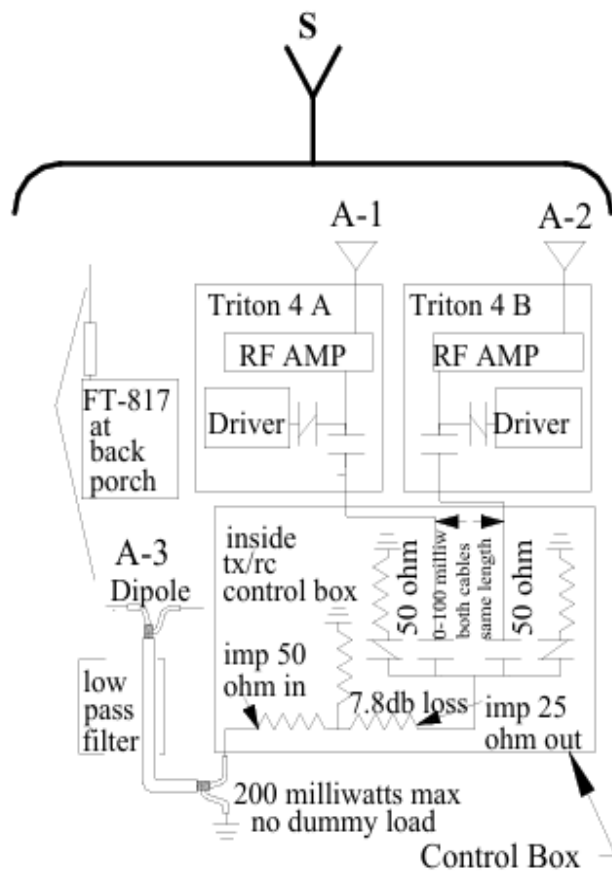


Figure 20: A-3 antenna special use

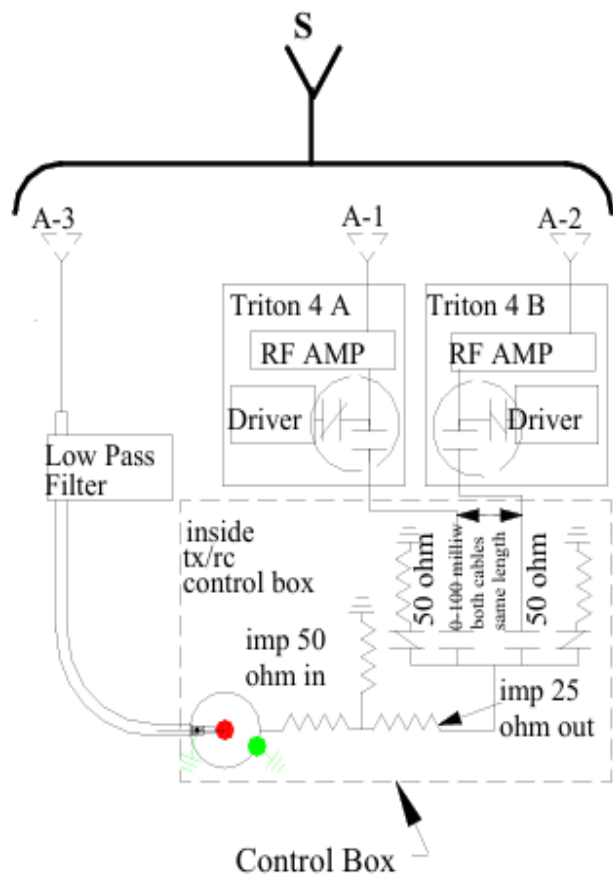


Figure 19: FT-817 Portable into A-#.

Looking at the top of Figure 7 you can choose to transmit on A-1 and A-2 or pick just one. If A-1 and A-2 are not in In-Line fashion, you could set both antennas as compliments to each other. For example, one could be horizontal, the other a vertical antenna. and the fly. The figures below represent how I configured and wired the elements, such as antennas, dummy loads, power-dropping resistors, and the DAS circuit used to input the RF power amplifiers found in the Ten-Tec Triton 4s. These figures represent a mindset the radio station operator can have while deciding which figure to use. One of the mindsets could go like this. A-1 and A-2 are in-line dipole antennas set to the desired frequency and phase angle. You plan on running 100 watts on each antenna using an antenna tuner if necessary. A-3 is what I call the driving antenna. The radio connected to A-3 is the radio station's main operating radio. Output of power of A-1 and A-2 antennas provide the signal distant radio station operator will hopefully hear. The primary purpose of an A-3 antenna is to provide listening back from the distant station.

Figure11:

Figure 11 shows the Kx3 connected to the A-3 antenna parallel to the DAS input. Caution is required here because the Kx3 is capable of delivering 10 watts. One Triton 4 amplifier requires 100 milliwatts of input power. The power input for two Tritons is 200. milliwatts. The Kx3 can overpower the Triton amps. Set both the transmitting and the tune-up power feature in the Kx3 to a minimum value and gradually increase the Kx3's output power until you reach the power you desire. You can easily set this up if both Tritons are connected to a dummy load. Figure 11 shows the Kx3 with its internal antenna tuner. The Kx3 tuner will tune both the A-3 antenna and DAS impedance. Because the DAS is a fixed 50 ohms parallel to the antenna, the SWR will not be less than 2:1. The Kx3 tuner will find a match. Stretch out an antenna for good receiving reception. This antenna should be as far away from A-1 and A-2 as possible

In this configuration, you will be putting out a small amount of rf shared by the antenna A-3 and the input side of the DAS. The 1970s and 80s Ten-Tec transceivers are suitable for this type of application. Having one transceiver provides a good building block for a ham radio station. The Triton amp is connected to the Triton's drive circuit. This is a connection via an RCA connector. Pull out this connector and plug in the DAS via another RCA connector see Figure 7. I usually set the transceiver in CW mode. With the key down, the Triton switches from receive to transmit. The amp is now enabled and waiting for some RF from the Kx3. No harm is done to the amplifier while it is sitting in the enabled mode. The Triton's drive control plays no part here. There is no timing issue, and you can take your time to figure out how to blend this different way of operating a ham radio

station. You can parallel both Triton cw key inputs. This is a simple connection to the ground. I also put in relays and switches to choose the power amp that my contact hears best. I did all this, and it's a fun capability. On some occasions, after turning off both power amps, I find out my contact can still hear that little bit of RF radiating from antenna A-3.

Figure 12:

Figure 12 uses the Yeasu FT-817, which has a maximum output of 5 watts. In this case, the R_d should be a 400 ohms .5 watt noninductive resistor. It has lower power than the Kx3 and requires a larger R_d resistor.

Figure13:

Figure 13 In the previous figures, there was no need to sample RF from the Kx3 or the because you were driving them directly—not quite directly, though, because you were also driving some RF into the A-3 antenna.

Figure 13 adds an R_d resistor to the circuit to provide the necessary voltage to the DAS. Connecting R_d requires lifting the ground(shield side of the A-3 antenna feed line) and connecting it to the R_d sampling resistor. Lifting the ground side of your antenna is not customary. So, when you do this, please have a reminder note put in front of your rig reminding you of this change.

When you tune the circuit, you tune the antenna, R_d , and the DAS

The Kx3 allows you to easily adjust the maximum output power and has a separate power out for tuning purposes. To be safe, set both settings to a minimum before you start.

Figure 14:

Figure 14 shows an old DX-60 AM transmitter providing sixty watts and requires R_d to be 30 ohms, 8-watt non-inductive resistor. The frequency used by the DX-60 comes from the Triton 4's internal drive circuit. I mentioned earlier that an RCA connector connected the Triton's RF power amplifier. The signal out of this driver in transmit mode is a frequency allowed for amateur use. The drive control on the Triton 4 makes this very easy. When you put the key down, the RF power amplifiers are ready, the Triton drive signal goes to the DX-60, and you transmit AM on three antennas with gain if you use an In-Line antenna. Of course, the power out will be less because the signal is an AM phone.

added an AM detector to the Triton and was transceiving with that arrangement. AM's reception on the foreign broadcasts was excellent because of their strong signals. The Triton 4 needs more gain for receiving to make AM transceiving useful. I recommend adding a separate low-pass filter to the DX-60's output. The Triton inputs have no filtering and are broad-band amplifiers, so they amplify whatever they see. Be careful and check your output signal for stray signals.

Figure 15:

Figure 15 shows how to connect the driving transmitter power to the DAS without an antenna tuner. In this example, the A-3 antenna impedance is 200 ohms or more. The circuit shown puts A-3 in parallel with the dummy load and R_d .

The connections are shown as a small diagram under the schematic. It shows how to wire the connections. The circuit can be built on a single-sided circuit board with foil removed from the "dummy load's" common side.

The DX-60 shown could have been any transmitter. You have to make sure your resistors are sized correctly

On the cold side of the dummy load, an R_d resistor connected to the ground will provide the required 6-volt voltage to drive A-1 and A-2 to 15 watts with the Ft-817 output set at 5 watts. R_d is a 50-ohms .5-watt resistor. In this case, the A-3 antenna will radiate 1.3 watts and the A-1 and A-2 15 watts each. A small diagram at the bottom of Figure 15 shows a plan for making a simple box with the necessary connectors to support this type of connection. Just ensure you have allowed a floating ground connection for the dummy load.

Figure 16:

Figure 16 shows how to connect an antenna with an impedance lower than 50 ohms. For this figure, it is assumed the antenna is just a piece of wire hung out somewhere you want and happens to have a low impedance. It could be better, but if you build the circuit at the bottom of Figure 16, it will be easy to set this up. You will take an antenna and series connect the cold end to a 50-ohm dummy load and R_d resistor. R_d resistor is 35 ohms 2 watts noninductive type. After setting this up, the A-3 antenna should radiate .4 watts.

The diagram under the schematic shows a non-conducting circuit board for connecting the schematic wiring.

Figure17:

Figure 17 shows a QRP rig being used without a tuner, similar to Figure 15. No low-pass circuit is involved here; we rely on the FT-817 output to be satisfactory. The A-3 antenna impedance should be near 200 ohms or more.

Figure 18:

Figure 18 shows a QRP rig being used without a tuner, similar to Figure 16. No low-pass circuit is involved here; we rely on the FT-817 output to be satisfactory. The A-3 antenna impedance should be near 50 ohms or less.

Figure19:

Figure 19 shows the A-3 antenna connected to the DAS through a low-pass filter, allowing the imagination to flights of fancy. Theoretically, if a distant station signal was strong enough, he could access your DAS and retransmit his signal. The important thing is the idea. Ham radio operators try many things and have stations that push radio technology around

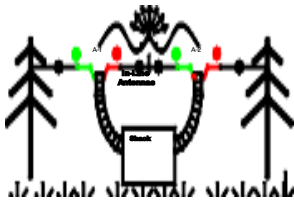
Figure 20:

Figure 20 shows a way of using the idea shown in Figure 19. Another possible use would be in an emergency, where multiple stations would use their lower power to access a zone of geography where their signal would be amplified and relayed to report on an emergency detail. Many stations could be involved, so a communications protocol must be followed.

Shared access to a DAS system on field day would allow multiple operators to use the same antenna without changing it. The possibilities are endless.

In the previous figures, I revealed ways to sample a small amount of RF energy from one transmitter to an antenna connection. Then, using that sample to energize two other antennas to a higher power level, each antenna can be connected to a specific power amplifier.

Those previous figures revealed many combinations of different types of radios. Some of these radios were old-fashioned, and others were relatively modern. Many hams enjoy using old-fashioned radios as well as more contemporary types. These figures show how an amateur radio operator can blend old-fashioned and modern radios, taking advantage of each radio's unique characteristics. It's a special kind of radio fun. Chapter 3 will present a different way of having fun by knowing how to make wire antennas using rope, which takes away much of the tension stress that antenna wires experience and lets the rope do the suffering



Chapter 3

Antenna -- Rope

My idea for making wire antennas is to standardize a specific construction technique and add additional wire depending on the design frequency. Antennas would start as two-meter dipoles cut for

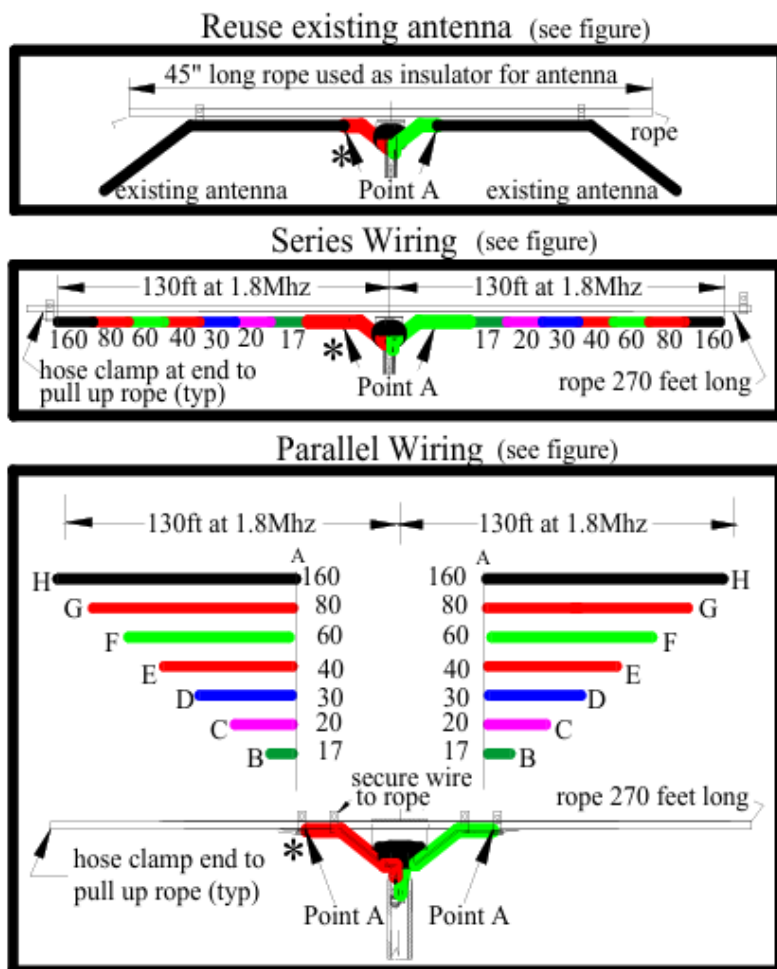
146.52 Mhz, plus an attached feed line. There are many ways this can be accomplished. My idea is to make the center insulator from rope. A simple hose clamp will attach antenna wires to the rope. Other hose clamps make electrical connections to this 2-meter dipole. The wire will be added to each end of the two-meter dipole. The length of these additions will be made according to the desired operating frequency.

If your wire antennas are already made, you can take a 45-inch piece of rope and use it as an insulator. Your old antenna can be clamped to the rope by a hose clamp. I've done this, and it gives excellent mechanical results. Swapping feed lines between antennas is easy once you change over a couple of antennas in this way.

When you go portable, you won't need to buy more feed lines; you'll borrow from an existing antenna.

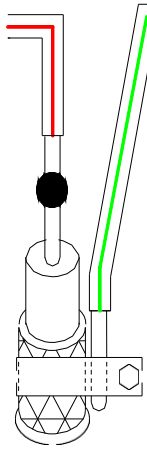
A	2m 146.52 Simplex
B	17m =B+A=xxx
C	20m=C+A=xxx
D	30m=D+A=xxx
E	40m=E+A=xxxx
F	60m=F+A=xxxx
G	75-80m=G+A=XXXX
H	160m=H+A=xxxx

This drawing shows three. Different ideas about antennas include rope as a wire support and an electrical insulator. The upper view shows how to reuse an existing antenna using a 45" long rope as the dipole's center insulator. More detailed versions of these drawings are down a page or two.



Once the hose clamp is attached to the rope, it will never fall off. This little fact frees one of your hands while tightening the clamp. Stainless steel clamps are corrosion-free, and tightening wires against the rope makes a reliable connection. I did not place any tape or waterproofing on these connections. I usually use thin wire so water can wick into the interior of the wire. I haven't had a problem. I would waterproof these connections when you are confident changes are unnecessary.

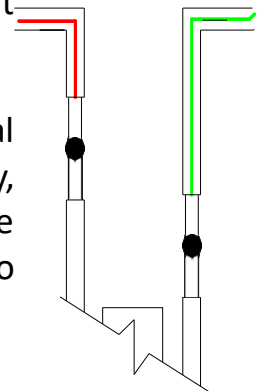
This small cutout shows a hose clamp clamping a wire to the shield side of a piece of coaxial cable. A half-inch hose clamp will work well on coax cable with a 5/16-inch diameter up to just under ½ inches. This is easy to do and works quite well.



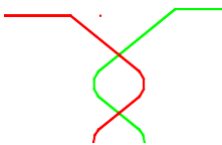
A split bolt works better than the hose clamp for a more miniature diameter coax. The black dot could be a solder joint, another split bolt, or a similar fastener. The previous figures show that these connections easily fit inside the 1-inch PVC pipe. Coating these connections with liquid tape will help keep these connections from deteriorating. The overall assembly is very close to being watertight on its own. This little assembly process works very well with RG-6 Coax. Connecting a two-meter antenna to a feed line and assembling your antennas, as previously shown, means you are no longer held hostage to the ceramic insulator and solder connections that make a wire antenna. You can remove this assembly and try another feed line or test the assembly to look for deterioration or broken wires.

This cutout shows a 450-ohm ladder line just over one inch wide. The PVC pipe's internal diameter is one inch, allowing for an acceptable connection without distorting the ladder line.

The two black dots represent solder joints or some mechanical connection. The main thing is to stagger the connections. That way, you will avoid shorting out the two connections. The green wire should be marked outside of the one-inch pipe in case you want to make your In-Line antennas 180 degrees out of phase.



Twisted Pair



The sketch shows a twisted pair as a feed line and an antenna. The impedance depends on the distance between the centers of each wire. This works well and is easy to handle. Generally, the impedance is around 100 ohms.

Fig. 21a shows wire lengths increasing left to right representing the length of an antenna required for transmitting on a particular amateur frequency and band. The wires for this antenna are hose clamped to a piece of rope. You can take this to the maximum shown or selectively choose the bands you are interested in using. Changing bands would require lowering the antenna de-clamp a position or re-clamp to use that band again. Because you are attaching the wire to the rope the wire can be almost any gauge and tensile strength, since it's the rope being pulled on. You could use wires from the old junk box or try some type of tubing or metal shape or form. It would allow for experimenting with winding a few loops at specific points for adjusting to a better swr. Fig. 21a shows one $1/4$ wave you will need another identical $1/4$ wave in order to make a $1/2$ wave dipole.

Fig. 21b lays out the hose clamp position to attach the wire to the rope. Each piece of wire should have two clamps at 4 inches in from each end. The 4 inches makes it easier to position the exposed wire, where another clamp will be placed for making a good electrical connection. Fig. 21c shows the position for the hose clamps for making the electrical connection for the matching wires. These connections could also be made with wire nuts, split bolts or some other wire fastener. Fig. 21d shows wire clamp 4 used as a location point along the antenna representing the highest frequency allowed for that band. If set it would allow that particular wire for that articulare band to be folded back. Putting some type of identifier at these spots along with hose clamps allow for easy and fast adjustment to go from the low end of the band to the high end of the band. This approach makes it a good field day antenna.

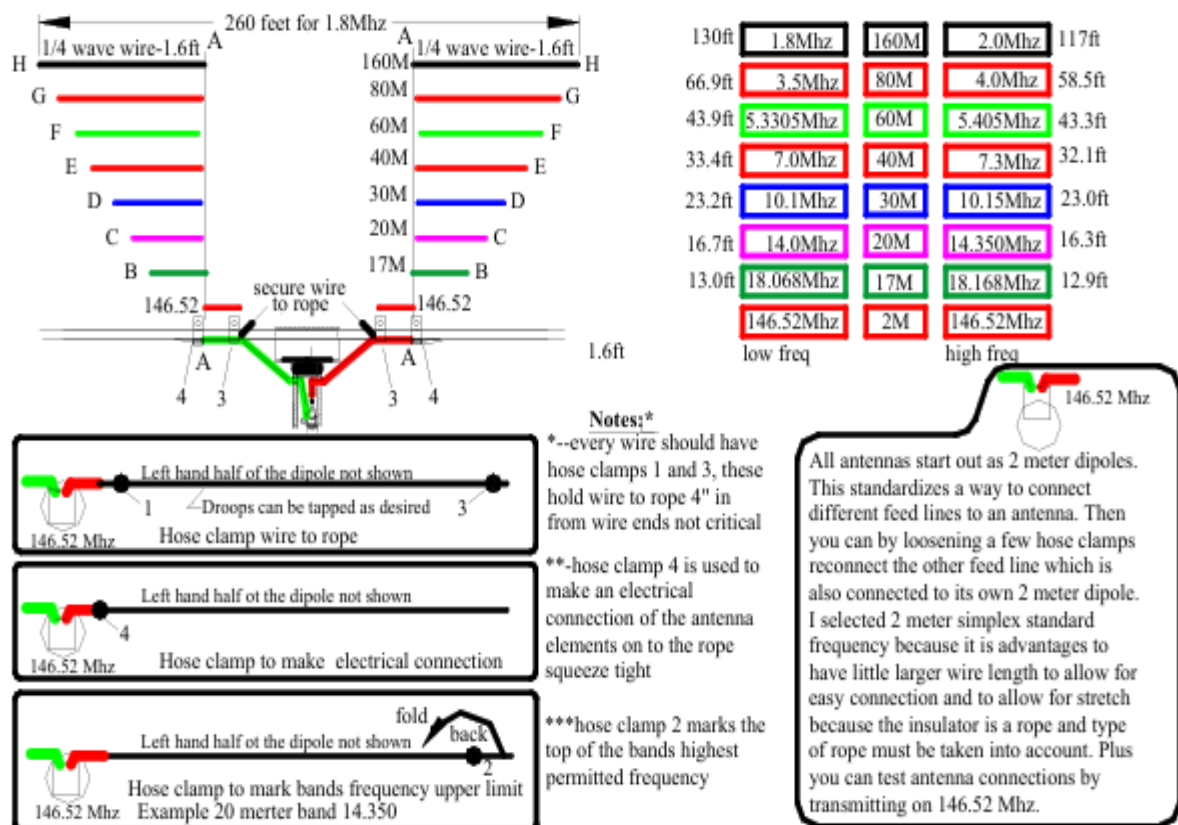


Figure 21:Dipole, Rope & Connections.

He restoreth my soul; he leadeth me in the paths of righteousness for his name sake.

It seems every little bit of good wraps around a little bit of bad.

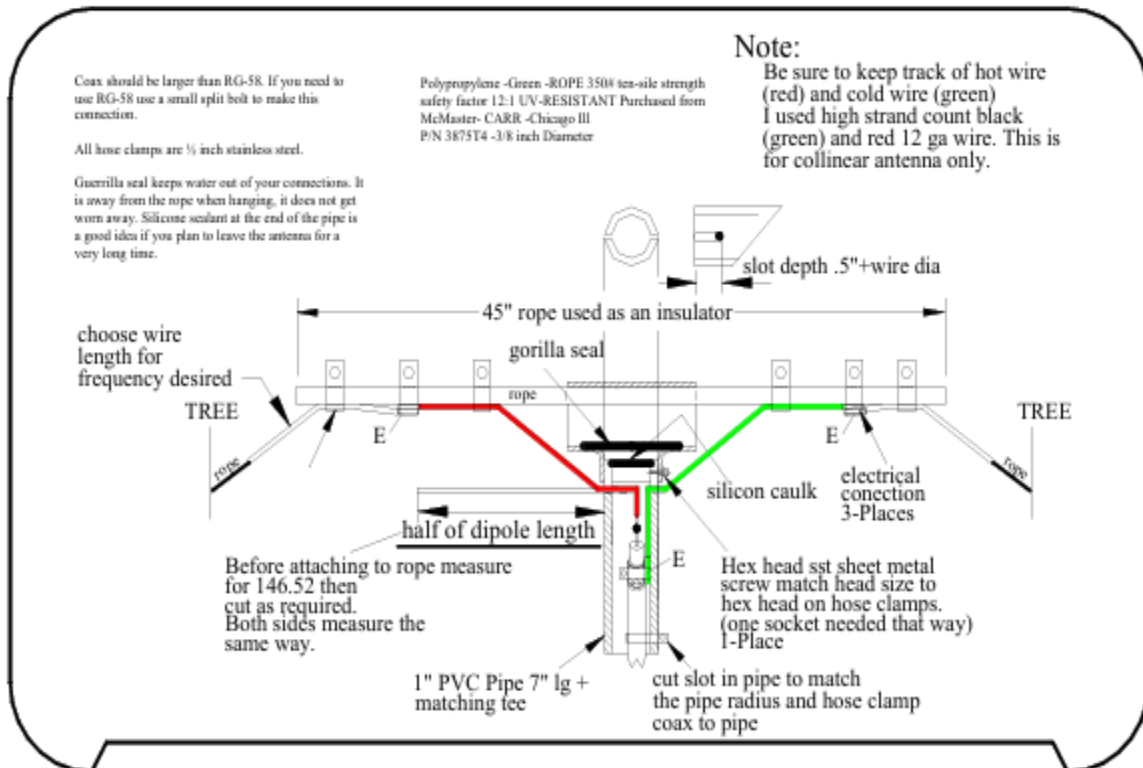


Figure 22:Dipole, Rope, Coax

The one bad thing you have done is how you'll be remembered.

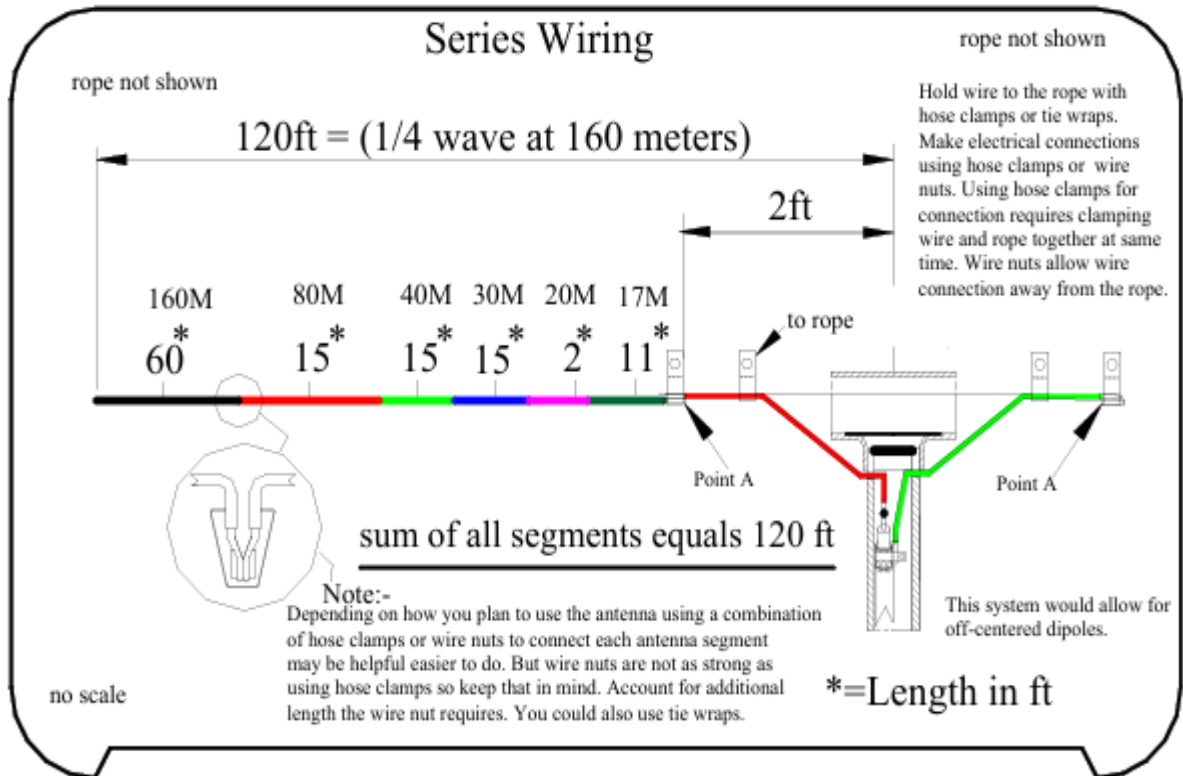


Figure 24:Dipole, Series Wiring

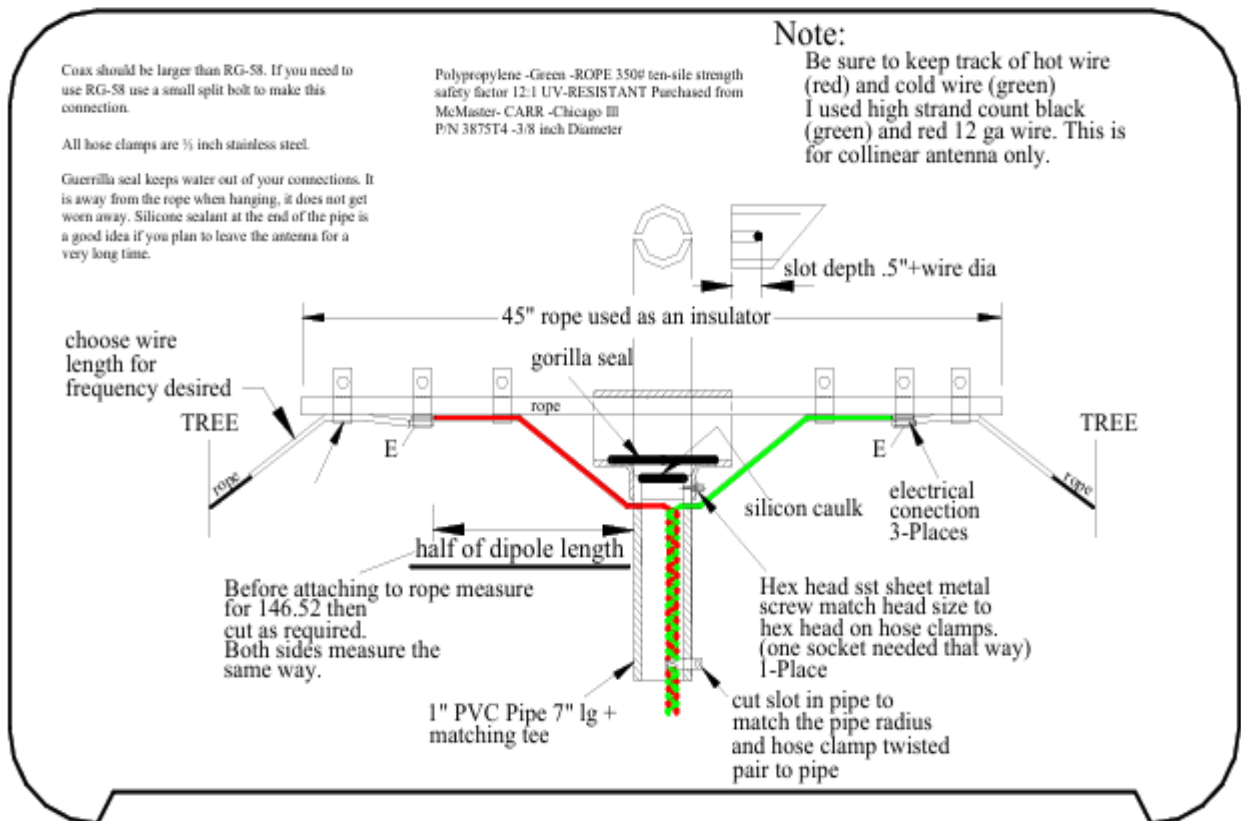
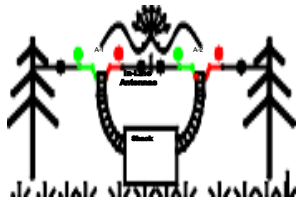


Figure 25 Dipole, Twisted Pair Wire Antenna

Thy rod and thy staff they confert me.



Chapter 4

Pin Cushion-L

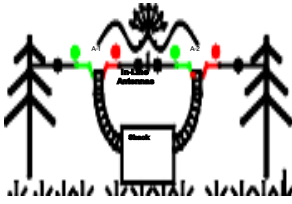


The picture shows an antenna tuner I made with 20ga thhn stranded wire.

The tuner's core is a 1/8-inch thick, 2-1/4-inch diameter, by 3-inch long cardboard roll discarded from a printer paper roll. I added double-sided 1/2-inch wide tape to the roll

I placed four strips of this tape 90 degrees apart along the entire tube length. I took a straight pin, used a pair of pliers, and pinched down on the pin very close to the pin's pointed end. I drove the pin through the wire. The first wire was a short piece that went to a rotary switch. I continued with the pin onto the coil itself. I followed the same method until all the taps were in place. I close-wrapped the coil for 20 turns with an inductance of 15 uh(microhenries). The tuner worked well, and I used it with my QRP rigs and ran 100 watts into it with no problems.

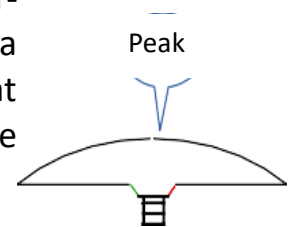
I used MFJ tuners and needed to replace the riveted components with #4-40 screws and nuts. One night, I saw sparks from the tuner's case edges. When trying new things, I found that keeping things as simple as possible until you understand the results of your new circuit or assembly technique. On the back of my MFJ tuner, I built a 50-ohm dummy load, connecting it to the MFJ coax connector using a banana jack. This arrangement eliminated a cable, making things straightforward and more accessible to care for.



Chapter 5

Experiments w/Photons

I should try to explain how radio waves function, which would make the purpose of the experiments more straightforward to comprehend. Electrons are not particles; they are energy fields that roam around a valence band in a slightly helter-skelter way. A radio oscillator creates an RF voltage, which causes a current to push this energy field to a higher valence band. When that RF current is at its peak and begins to lose that energy in the valence band, the energy changes to a photon as a particle.



When that particle reaches the top of the wire from inside the wire, the photon changes from a particle to a wave. That first photon will look like that little sketch at that exact spot. Magic happens instantaneously with absolutely no time delay and no acceleration time. As the wave moves away, it grows longer, adding more cycles like the little sketch. The wave continues to grow and becomes weaker until the wave hits an atom somewhere. If that is somewhere in your antenna wire, the wave will create a voltage for your receiver.

In-line waves add when they're at the same frequency and headed in the same direction. If the waves are coming at each other at an angle, they will add and subtract amplitudes at the crossing point and continue as if nothing had ever happened.

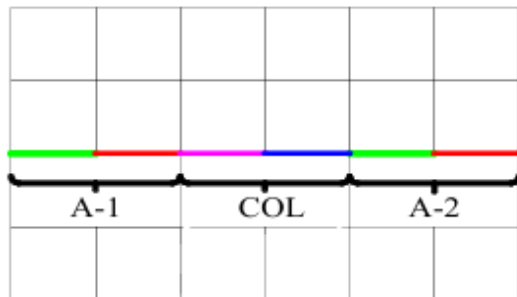
In-line antennas fed 180 degrees out of phase act differently. The endpoints of each antenna at the feed point have the same



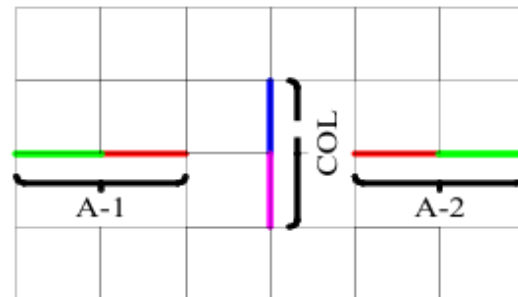
In Phase



180deg out of Phase

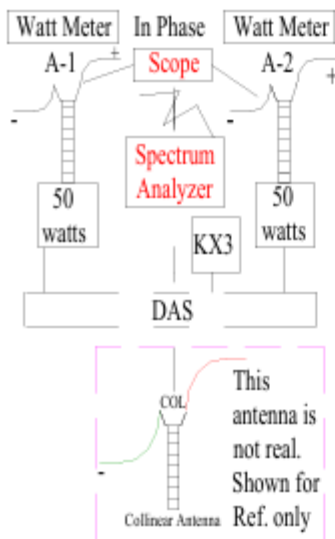


in Phase

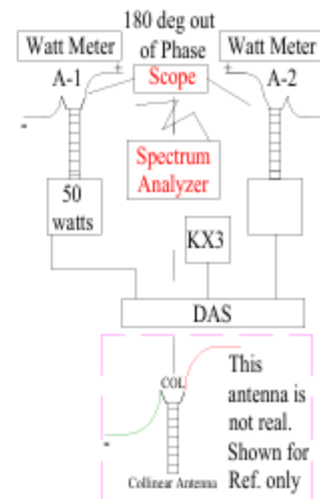


180 deg. out of Phase

polarity. The waves are trying to push each other away. The radiation pattern is now 90 degrees different than the in-phase In-Line. The center of the In-Line is still at the midpoint between the antennas. The above grid shows a bare minimum illustration of the relationship between A-1 and A-2 antennas in the "in phase" mode on the left and the "out of phase" mode on the right. The red and green colors make a dipole and represent the same idea shown throughout this book. The magenta and blue color represent the imaginary dipole called COL. In the case of the in-phase wave of A-1 and the in-phase wave of A-2, both waves leave their respective wires and meet at the COL spot. (This theory is from quantum mechanics.) They commingled instantly. Since both waves are at the same frequency, the amplitudes of both waves are combined to create a single wave with twice the amplitude of either A-1 or A-2. The expected gain of 3db will come when the antennas are $\frac{1}{2}$ wavelength apart. The imaginary antenna length is $\frac{1}{3}$ of the overall size, making the signal narrower but stronger. The sketch on the right, 180 degrees out of phase, shows A-1 and A-2 on different wave lobes. The Original In-Line antennas of the 1930s were fed from one source divided equally outside near the antennas. Since I drive each antenna from its own source, I want to know if the A-1 and A-2 lobes could be modulated differently without creating some type of interference or signal interaction. Some of the following tests will try to answer those types of questions



The two sketches show the basic outline of the equipment used to create an In-Line signal less the spectrum analyzer and oscilloscope, which are used to monitor the test for an anomaly, especially in the frequency domain. The sketch on the left is in phase, and the sketch on the right is 180 deg out of phase



Experiments:

Experiment #1: In-Line Antenna A-1 & A-2

Definition-inphase	Circuit	Goal
When A-1 & A-2 are energized the in phase waves come together to make a collinear antenna. The total length of this antenna is three half waves long. The total power is summed by collinear action. 2/3 of the total length is jammed into the center half wave. I figured gain by dividing the total power by .66. This is 66 percent of the antenna length jammed into the remain 1/3 of the antenna overall length. $(Sp1+Sp2)/.66=Max\ Power-@3db\ gain$	* = CW mode	This is the setup for the shown circuit. The main goal is to make sure the equipment is functioning, including test equipment. The watt meters should show 50 watts each and the scope should show A-1 and A-2 are in phase. The spectrum analyzer should show the intended frequency and harmonics and or other side products.

Experiment #2: Matching frequency & phase

Definition-inphase	Circuit	Goal
A-1 is energized by the KX3 at the same frequency as the FT-817. We know from previous test that the collinear operation is up and capable of functioning if the KX3 can be made to have the same phase at the same frequency as the FT817. All wiring created on test 1 should remain the same for this test.	* = CW mode	Both radios having the same exact frequency and phase is unlikely. The purpose of the test is to find out how critical frequency and phase are for having made a collinear response. Should this test show this alignment to be forgiving then I will replace the KX3 with one of the Tritons and evaluate the response of this configuration. End goal is to find out if old radios could be used for this application and what are the minimum requirements.

Experiment #3: In-Line 180⁰ Degrees Out of Phase

Definition-out of phase 180. ⁰	Circuit	Goal
This test is like test 1, it establishes a base line in which to compare the other tests concerning 180 deg out of phase configurations. A-1 and A-2 are bucking each other, their radiation pattern is turned 90 degrees and radiate towards the ends of the antenna wire. This means that source signal of A-1 and A-2 could be different. If this is true a new and different operating scheme will be possible.	* = CW mode	This is the setup for the shown circuit. The main goal is to make sure the equipment is functioning, including test equipment. The watt meters should show 50 watts each and the scope should show A-1 and A-2 are 180 out of phase. The spectrum analyzer should show the intended frequency and harmonics and or other side products. Field strength meters used to verify that signal strengths are same off the ends.

Experiment #4: Can A-1 & A-2 Be Modulated Differently?

Definition-out of phase 180°	Circuit	Goal
We now believe this wiring arrangement provided proof that the A-1 and A-2 signals were out of phase and the field strength off the ends are the same. Adjust power in to provide 10 watts out. Then provide an 800 hertz tone into the mic. A-1 and A-2 are bucking each other, their radiation pattern is turned 90 degrees and radiate towards the ends of the antenna wire. This means that source signal of A-1 and A-2 could be different. If this is true a new and different operating scheme will be possible.	* = AM mode	The goal is to find out whether or not the 800 hz signal favors one end over the other and by how much. When modulating the KX3 the power of the A-1 antenna should follow the modulation. Monitoring the other antenna A-2 for any interaction between the two antennas. The spectrum analyzer should show the intended frequency and harmonics and or other side products. Field strength meters used to verify that signal strengths off the ends.

Experiment #5: Two Different Modulation Frequencies

Definition-out of phase 180°	Circuit	Goal
This test is to show what would happen if both antennas were providing an AM signal with each signal at different modulation frequency.	* = AM mode	The goal is to find out whether or not the 800 hz signal favors one end over the other and by how much. The goal is to find out whether or not the 500 hz signal favors one end over the other and by how much. The spectrum analyzer should show the intended frequency and harmonics and or other side products. Field strength meters used to verify that signal strengths off the ends.

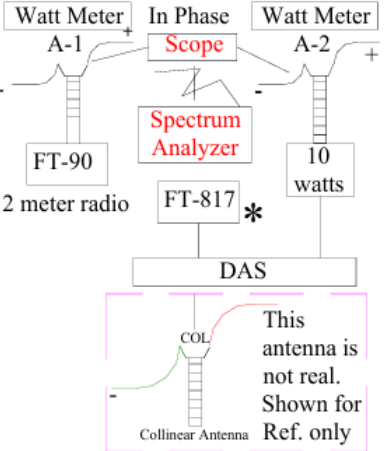
The following two experiments set up the collinear antennas to be used as signal combiners. We can combine two antenna waves at the center point between both antennas at the same frequency and phase.

This next test will reveal that two different frequencies combine but combine differently. They combine in a serial configuration, with the higher frequency waves coming before lower frequency waves. They want to be that way, like the rays from the sun. The sun's rays do the same thing. Higher energy waves are blue, and red waves have lower energy and frequency. That is why rainbows always have the same color order. If we can have two different frequencies emanate from the same center, they will create this serial-looking wave. Think about it like this: each wave in space would form a doughnut. In this case, both doughnuts are trying to occupy the same space. They resolve their differences by adding amplitudes, creating a more enormous doughnut. When out of phase, they make a fatter and slightly less-than-perfect doughnut

Experiment #6 In-Line plus 2 meters at A-3

Definition-2 frequency wave	Circuit	Goal
A-1 and A-2 are setup as collinear antennas. A-3 antenna is a 2 meter dipole set at the center of the space between A-1 and A-2. The resulting collinear wave created when A-1 and A-2 are energized centers itself at exactly midway between them. By having the two meter antenna A-3 at this location and turned on at the same time we are making one wave with 2 different frequencies.	* = CW mode	After monitoring this test at the beginning and seeing nothing out of reason, a mobile rig will listen for both signals and set the spectrum analyzer up and look for the signals as was done when the analyzer was in the shack. We will listen for 40 meter signal and use the same antenna to listen for the 2 meter signal. I will be looking for a location where the two meter radio does not hear the signal using a two meter antenna, but hears it when using the mobile 40 meter ham stick antenna.

Experiment #7: A-1=2 meters A-2=40 meters

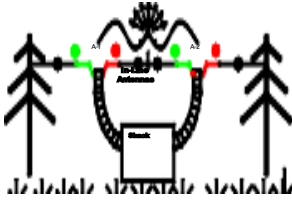
Definition:Col 2 & 40 meter Collinear antenna A-1 is fed from 2 meter radio and A-2 is driven by FT-817 The definition of collinear antenna is they should be in a straight line. These two antennas are made for two different frequencies and should react to each other in the same way when both antennas are fed identically. The two waves will combine end to end forming one wave with 2 frequencies. Sun light is electromagnetic and appears to function this way why shouldn't radio waves?	Circuit:  *=CW mode	Goal Goal is to make a single radio wave from two different frequencies. Each wave knows the other wave is there so they come together because there electrical fields are minus to plus and opposites attract.
--	--	--

Software developers create programs to do things. They know the software is close to useless, but that is not a problem. They remain undeterred and release the software as their beta version 1.001. After you buy the software, find it lacking, and complain about it, the company reminds you in the sweetest of voices that the software is at a beta-level release. You have no right to assume it will work.

Your aggravation can go on for quite a while. The software company will make improvements and change the version number to 1.02. Numbers are unlimited; new versions improve sales under the beta protection umbrella. Many weeks later, once again, sales became an embarrassment to the vice president of sales. The V.P. decided on a new CD cover jacket and a new release at 2.00. Of course, the software isn't better, and the V.P. remains unconcerned. The product only needs a better sales pitch. Sales pick up again, and all is well. The software improvements realize little benefit to the end user.

"Glitches" became the new catchphrase for the sales department to push back on recent customer complaints. Then, you feel better one day because the software seems excellent and usable. You finish a 100-page sales presentation for the afternoon meetings. Feeling good, you hit the print button, and the printer hyperregurgitates printer toner from a ten thousand dollar printer. A small cloud, resembling a thermonuclear reaction, darkens everything. You call for cleanup on aisle 9, but no help comes. The software provider reminds you that the problem is a simple glitch and asks for patience. The following software release, version 2.023, will address this particular glitch. You should know by now that glitches are a fact of life, like rain and snow; no one can be held responsible for a fact of life.

Stuck Between Beta & Glitch



Chapter 6

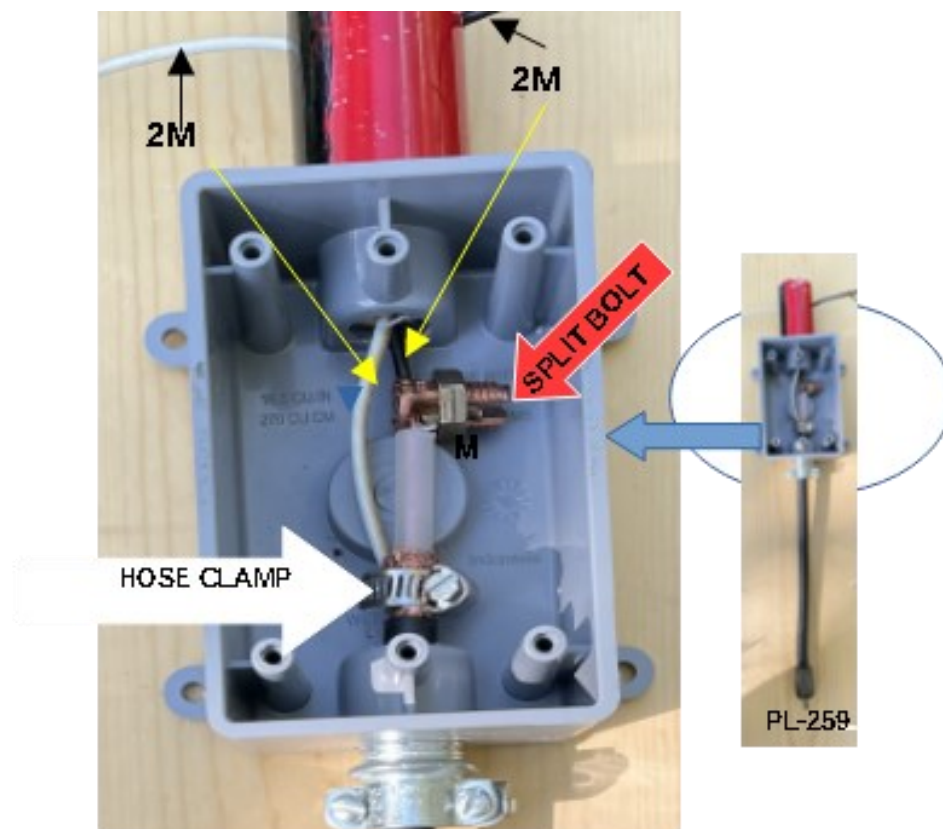
Look Back & Leftovers

Looking Back-Ideas to Remember

The starting point for wire antennas is a two-meter dipole with an attached feed line.

1. A rope can serve as an insulator and wire support at the same time.
2. Once the half-inch stainless steel hose clamp surrounds the rope, it cannot fall off.
3. In-line antennas with two sources allow for summing of the power of both sources plus gain nearing 3db.
4. Adjusting the phase angle between the two sources can modify the direction of the radio wave. (see Appendices)
5. Two sources can allow for multi-band In-Line antennas.
6. Using rope to support the antenna wire allows for using wire with poor tensile strength.
7. In-line antennas 180 degrees out of phase will radiate off the ends
8. Changing the offset between the In-Line antennas by half wavelength will bend the azimuth angle by about 45 degrees (see Figure 1 Appendix B.) A 90-phase angle is provided by making a length of coax $\frac{1}{4}$ wave at the desired band and frequency.

9. 180° phase angles can be made by reversing the hot and cold side of the antenna directly at the antenna or in the shack. Switching the phasing between A-1 and A-2 antennas will allow control of radio wave direction.
10. I have never tried this, but I will take a roll of aluminum foil, cut it to three inches, and warp it around the rope. I will spray a very light adhesive coating on the rope (just barely) to hold the foil in place. 3M Corporation makes the spray adhesive; the container is light blue. Then, hose clamp the end of your two-meter antenna down on top of the aluminum foil. No soldering is required.
11. Stretch out the rope for the antenna at chest height with enough tension to keep the rope taught while you attach the hose clamps. Stretching the rope out at chest height makes for a comfortable process. Be sure to thread through the PVC "tee" fittings. Leaving an extra "tee" between the A-1 and A-2 antennas wouldn't hurt

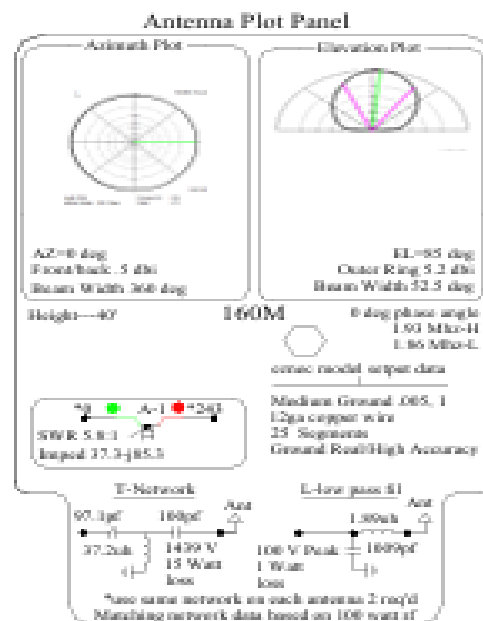
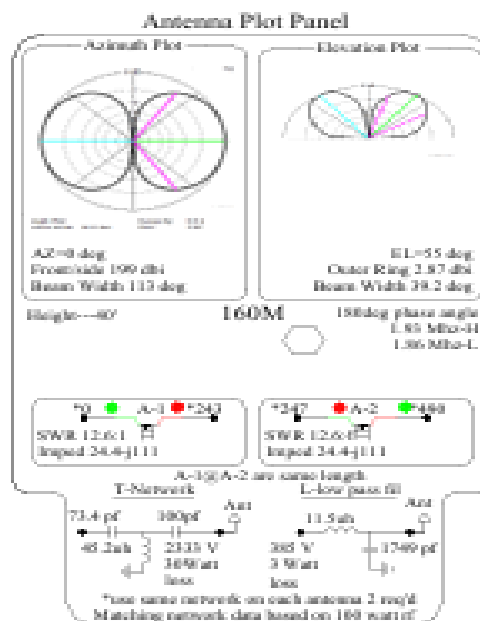
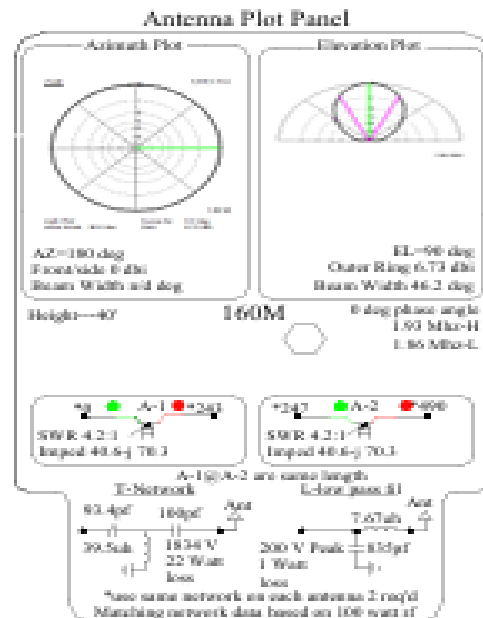
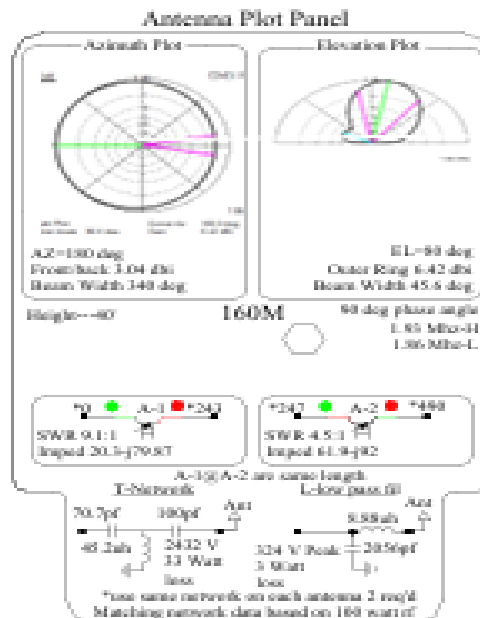


This picture is a small idea that shows the versatility of making wire antennas, as shown in this book. All the parts shown can be purchased at Home Depot. This plastic box comes with a stainless steel cover. When mounted similarly, the 5/16-inch diameter rope can easily manage a much larger box. If done this way with a 2-meter antenna as your starting point, this minor assembly can be moved from antenna to antenna. Maybe it's a unique set of parts you use to check the resonance of your antenna. Perhaps it contains a high current torrid and high voltage wire to make a coaxial balun. It would be nice to use this assembly on different antennas instead of buying another batch of expensive parts and avoid using up a batch of time winding another one.

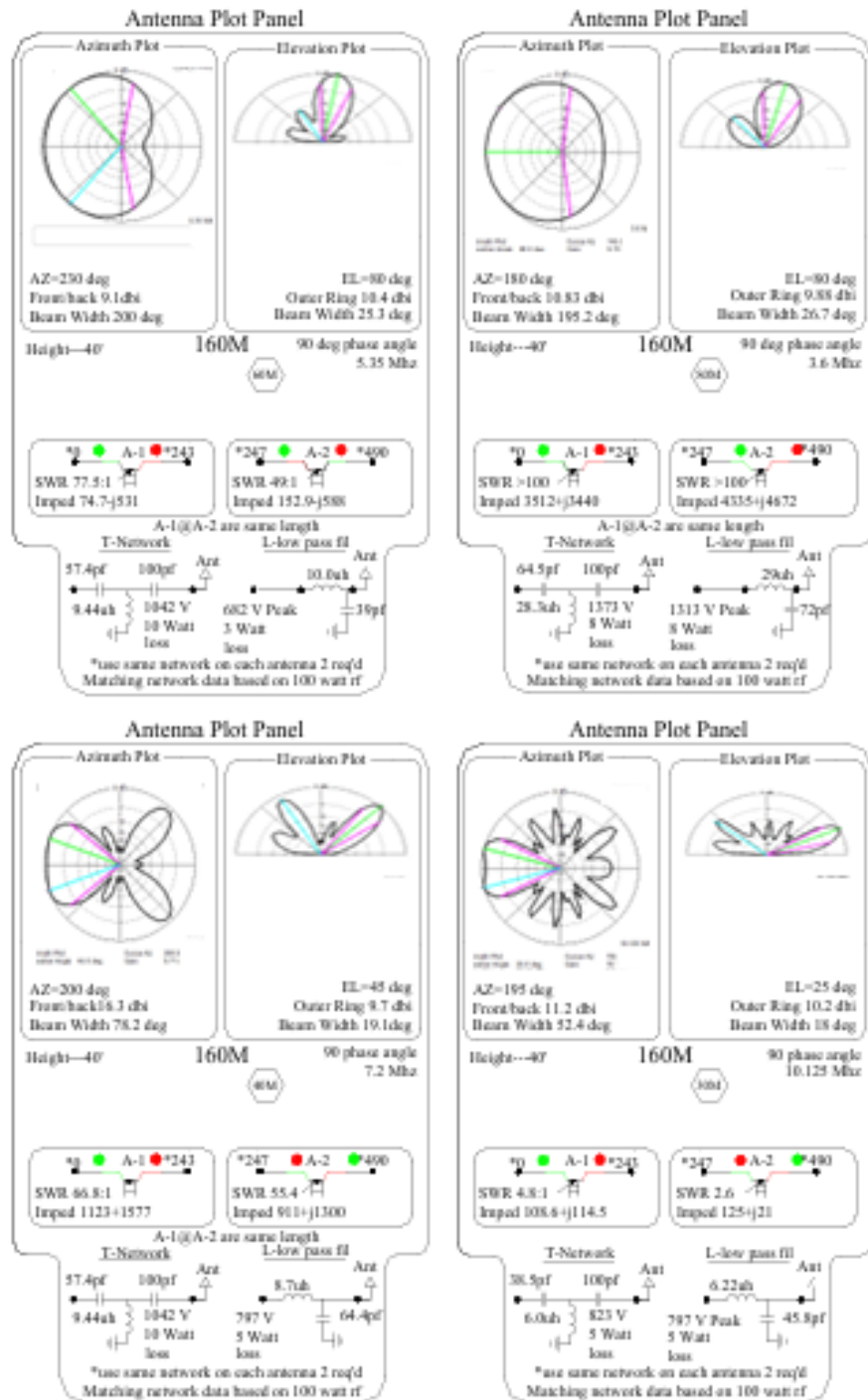
Appendix A In-Line Collinear Antennas

IN-LINE IN-LINE 160 METERS.....	64
IN-LINE IN-LINE 160 METERS-80M ^H -60M ^H -40M ^H -30M ^H	65
IN-LINE IN-LINE 160 METERS-20M ^H -17M ^H -15M ^H -12M ^H	66
IN-LINE IN-LINE 160 METERS-10M ^H -6M ^H	67
IN-LINE IN-LINE 80 METERS.....	68
IN-LINE IN-LINE 80 METERS 60M ^H -40M ^H -30M ^H -20M ^H	69
IN-LINE IN-LINE 60 METERS.....	70
IN-LINE IN-LINE 60 METERS 40M ^H -30M ^H -20M ^H - 17M ^H	71
IN-LINE IN-LINE 40 METERS.....	72
IN-LINE IN-LINE 40 METERS-30M ^H -20M ^H -17M ^H -15M ^H	73
IN-LINE IN-LINE 30M ⁹⁰ -20M ⁹⁰ --17M ⁹⁰ -15M ⁹⁰	74
IN-LINE IN-LINE 12M ⁹⁰ -10M ⁹⁰ -6M ⁹⁰	75

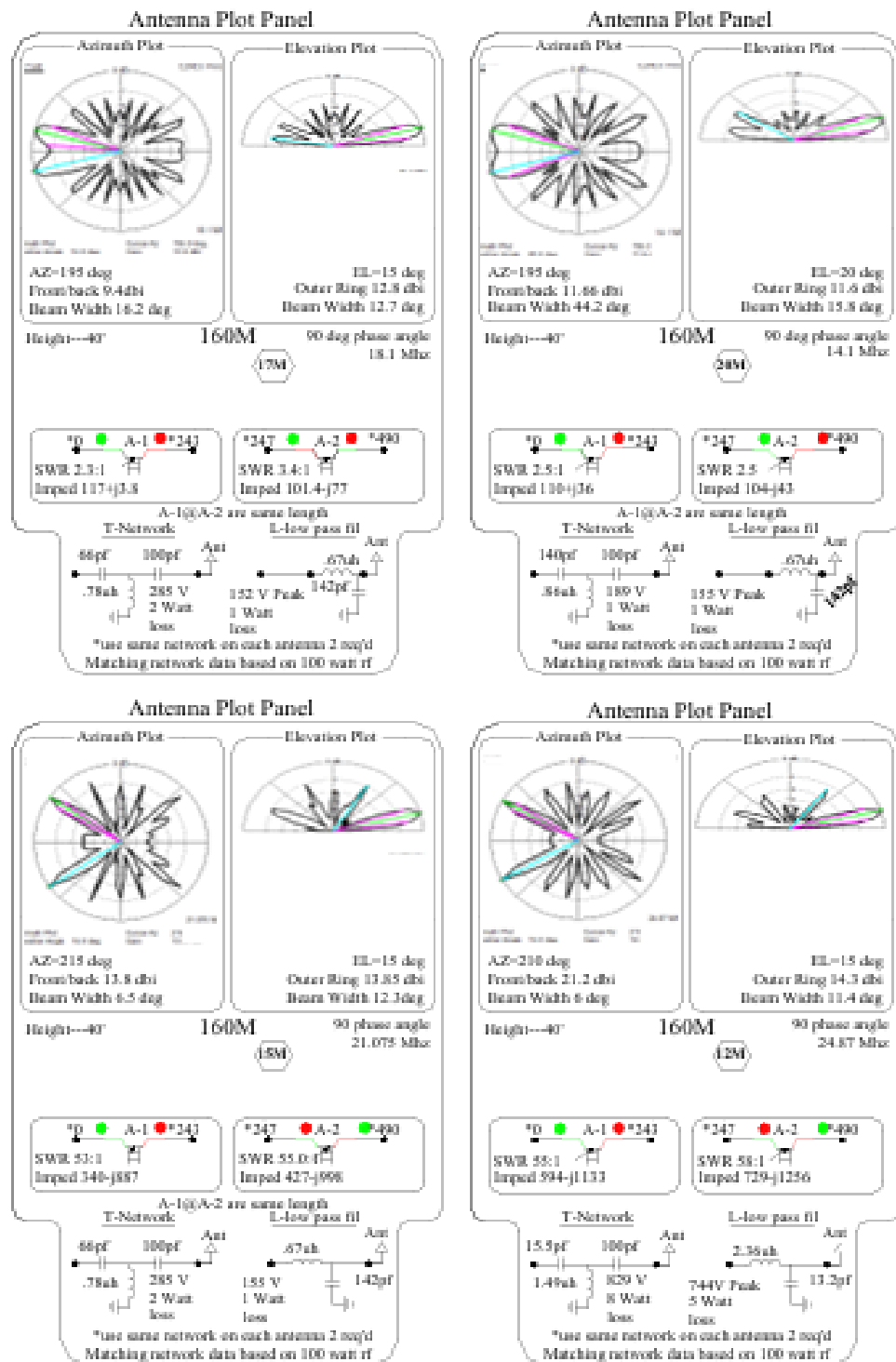
In-Line In-Line 160 Meters



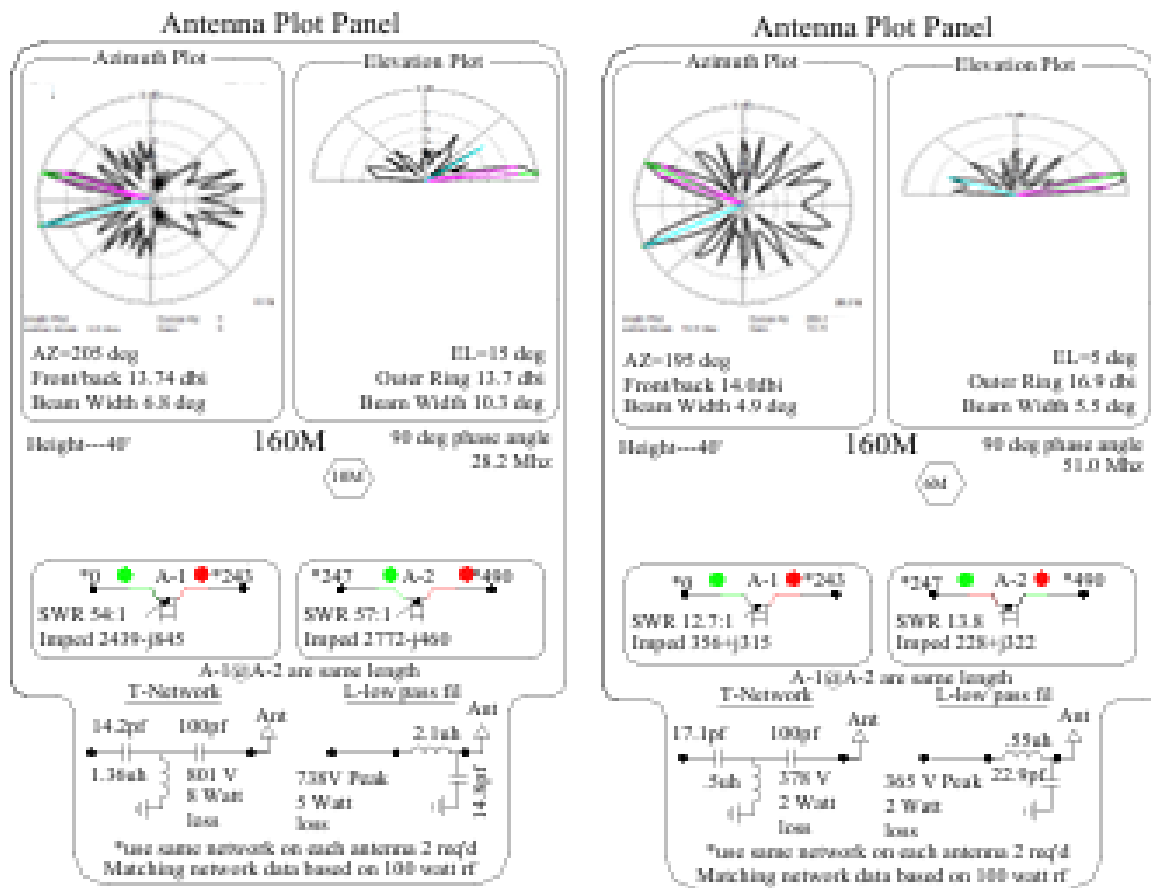
**In-Line In-Line 160 Meters-80M^H-60M^H-40M^H-
30M^H**



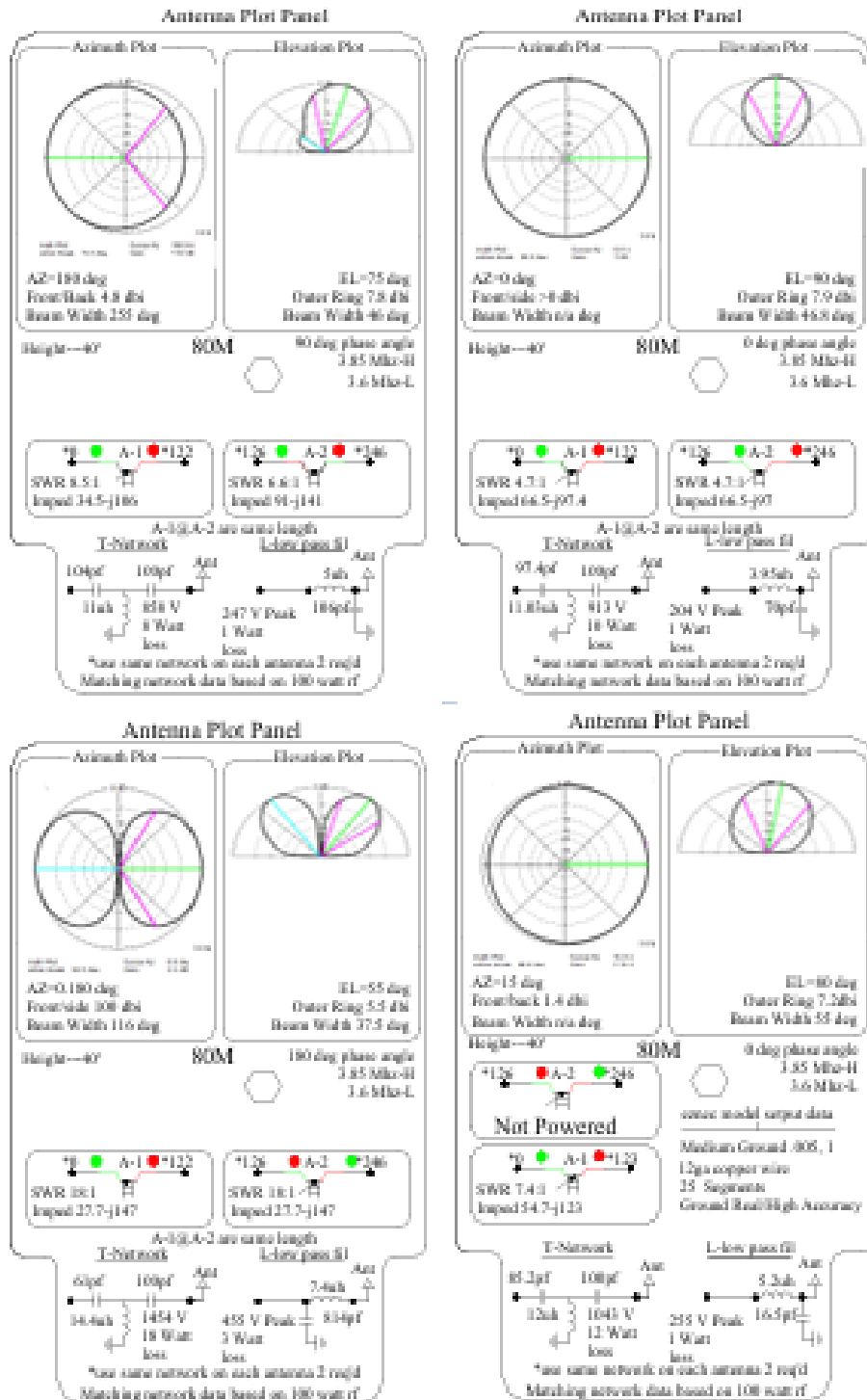
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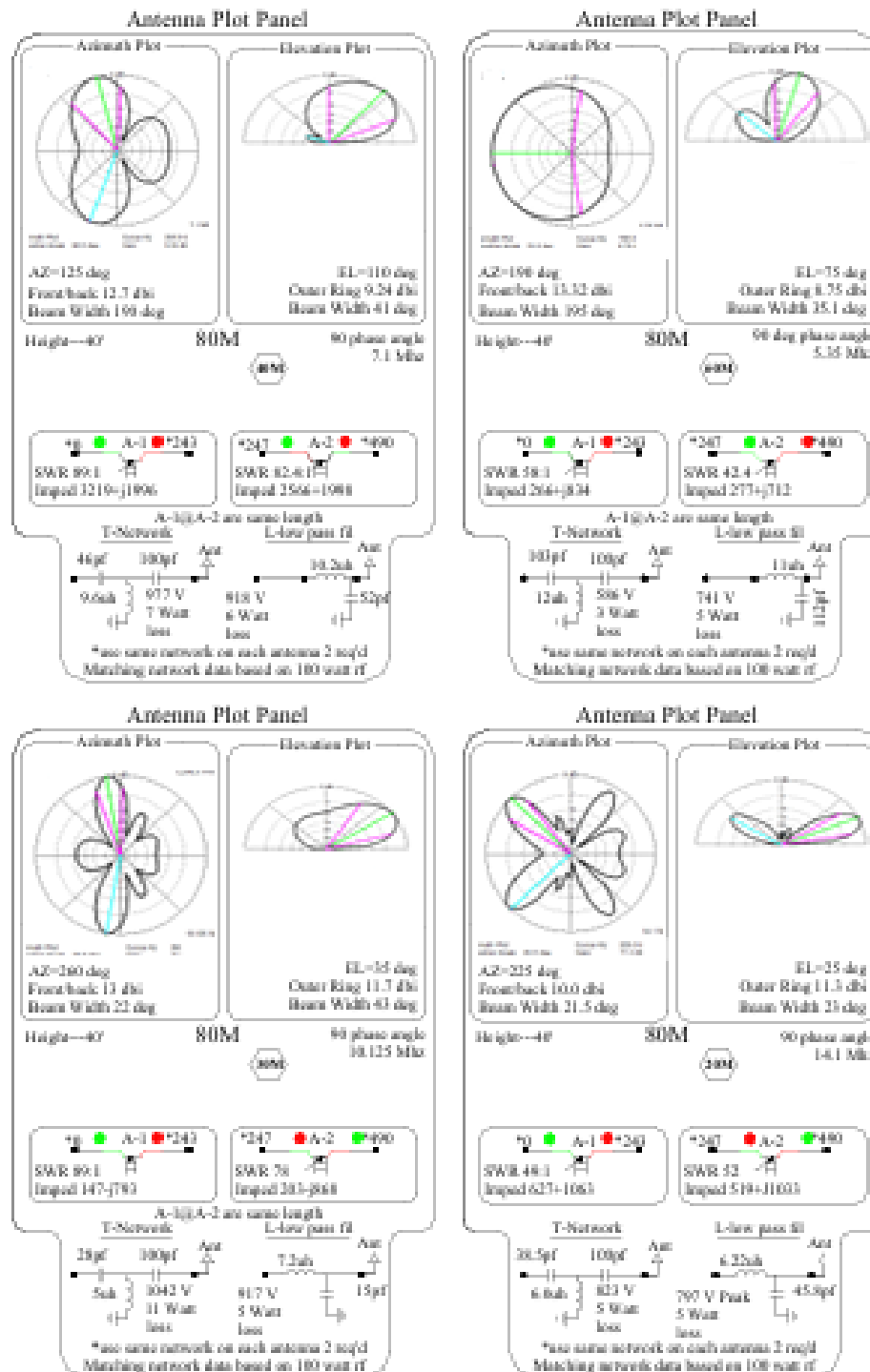
In-Line In-Line 160 Meters-10M^H-6M^H



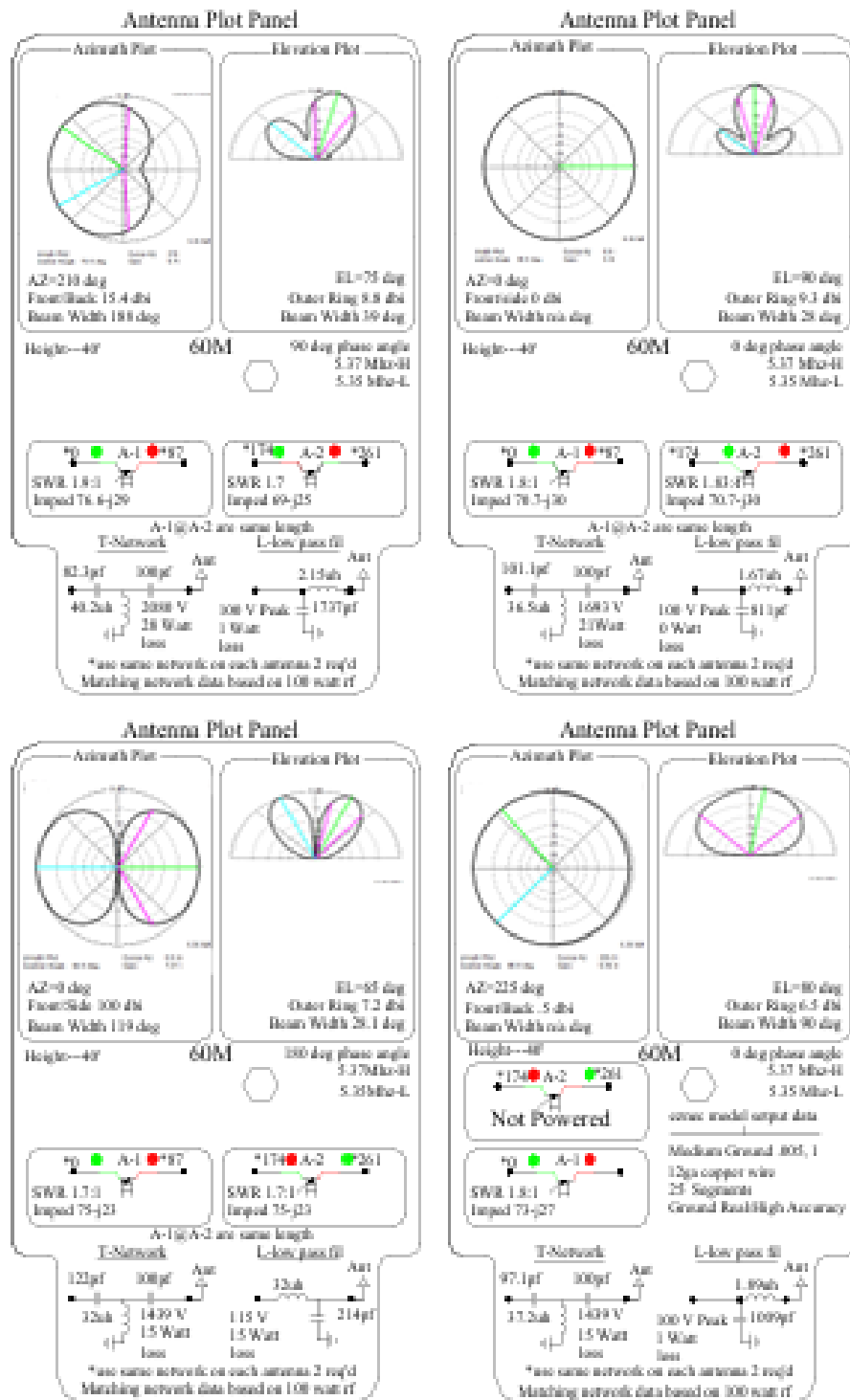
In-Line In-Line 80 Meters



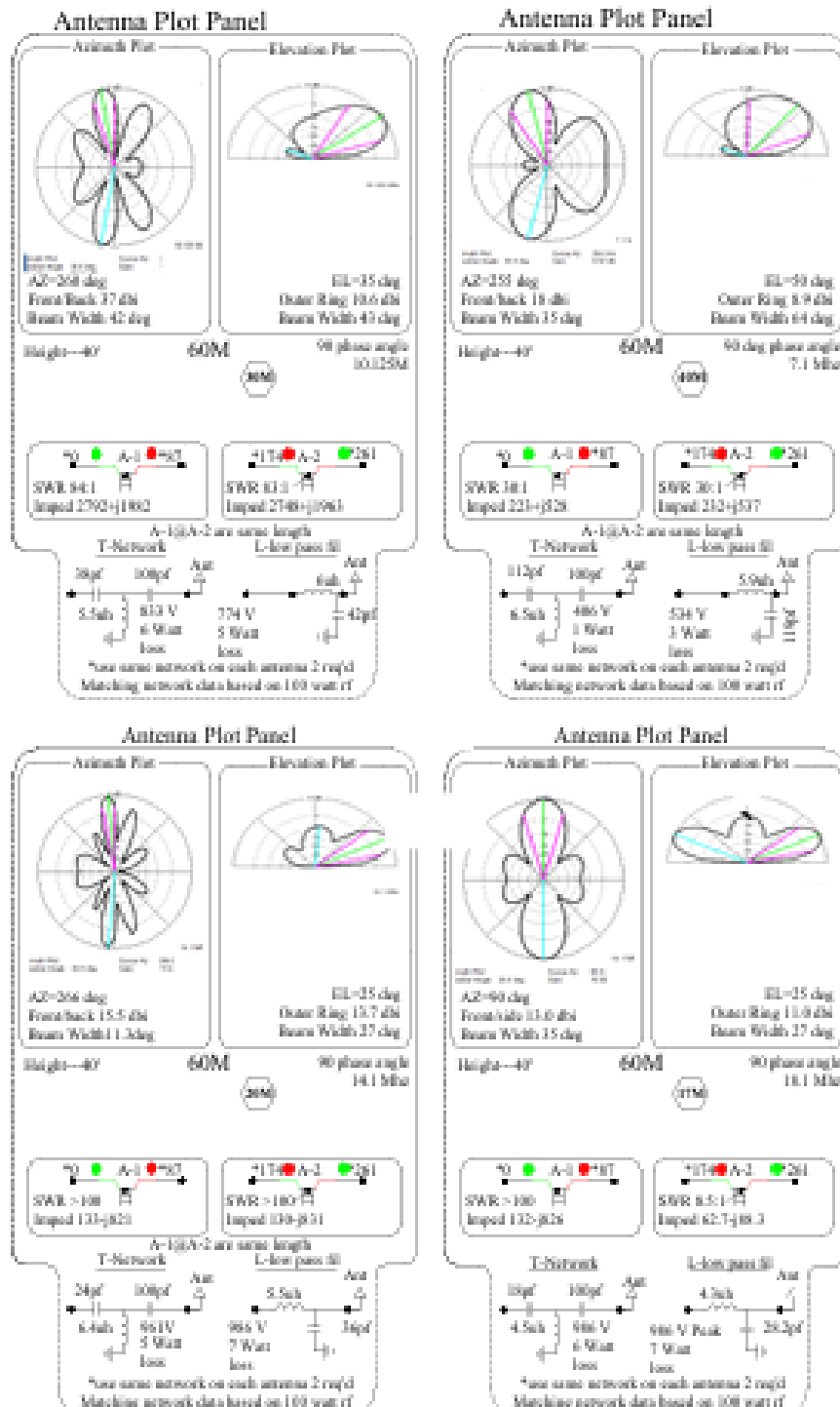
**In-Line In-Line 80 Meters 60M^H-40M^H-30M^H-
20M^H**



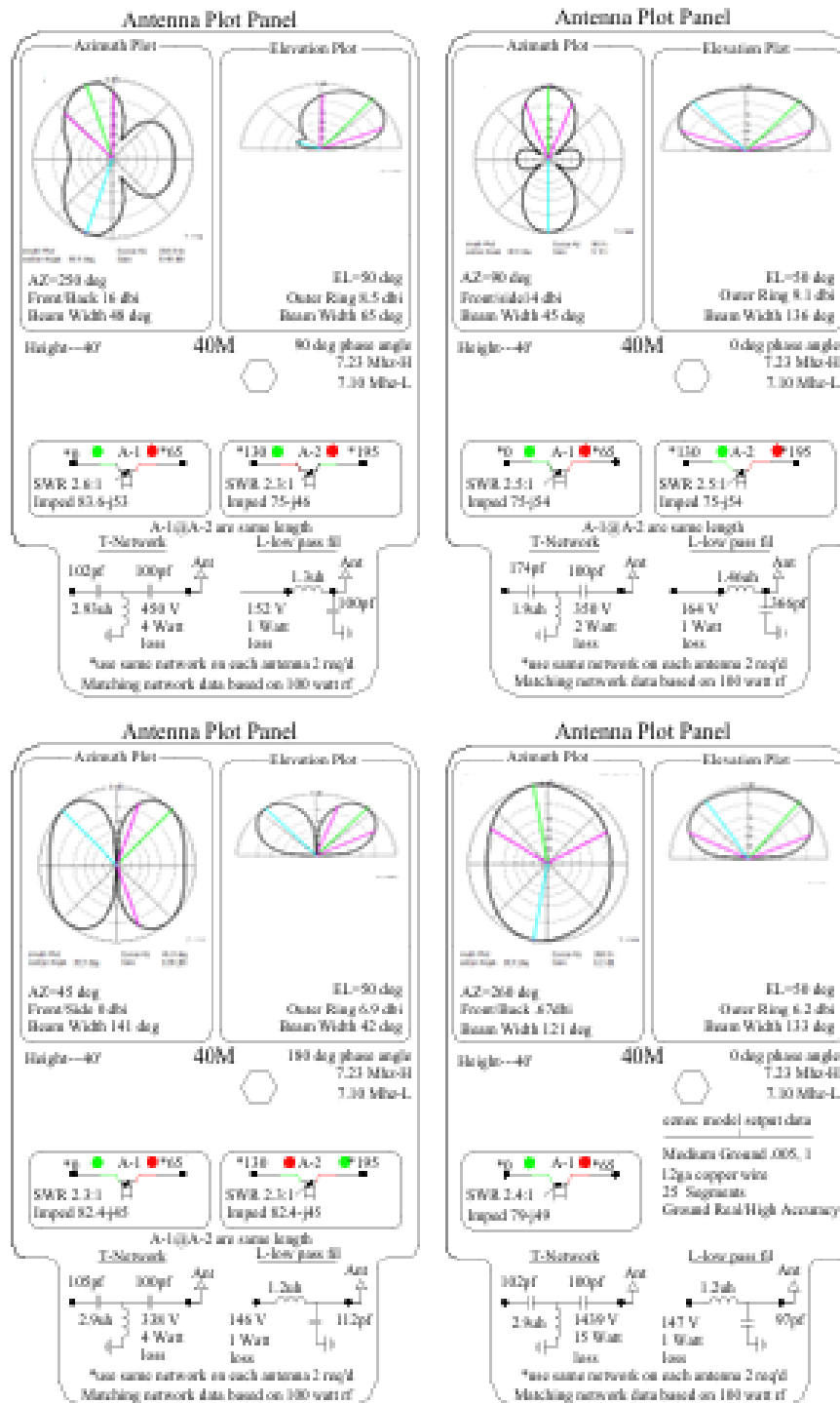
In-Line In-Line 60 Meters



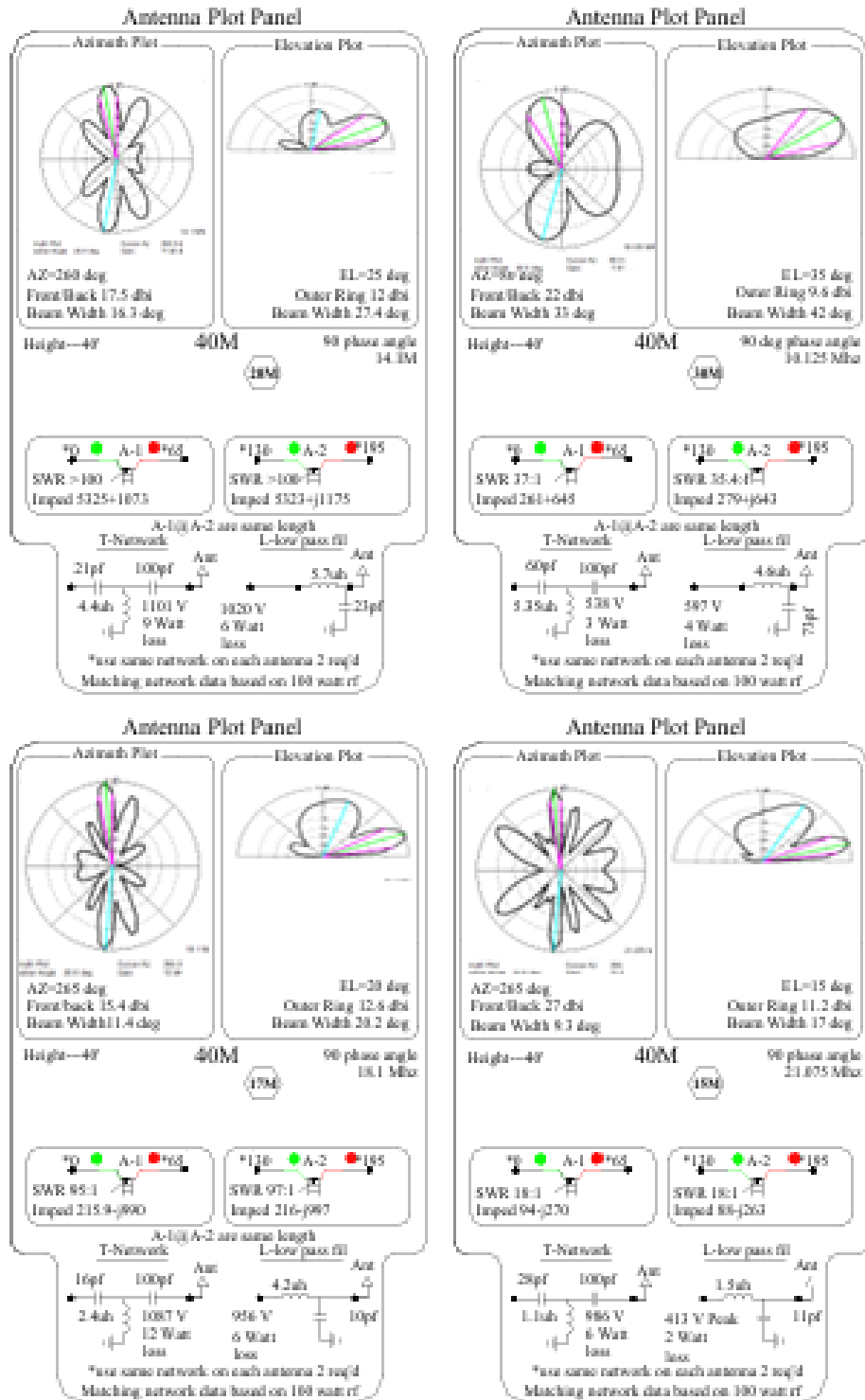
In-Line In-Line 60 Meters 40M^H-30M^H-20M^H-17M^H



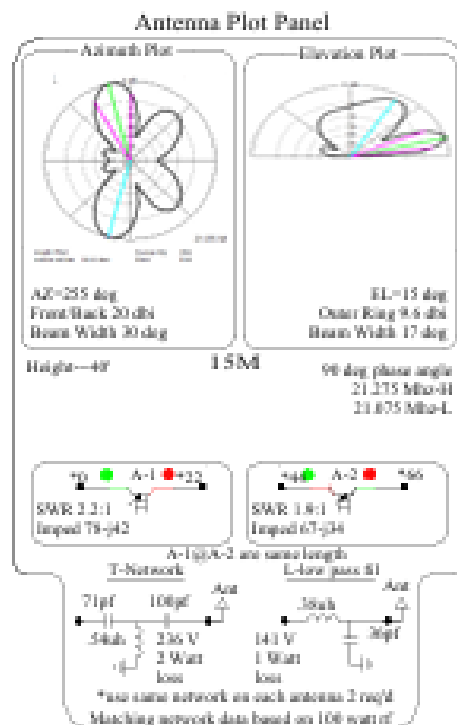
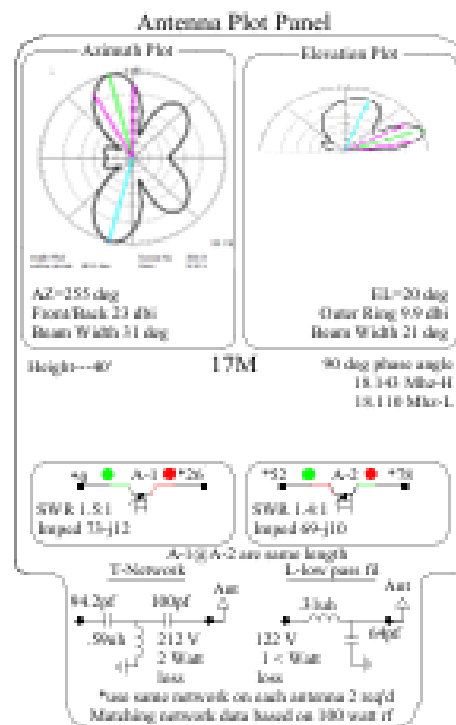
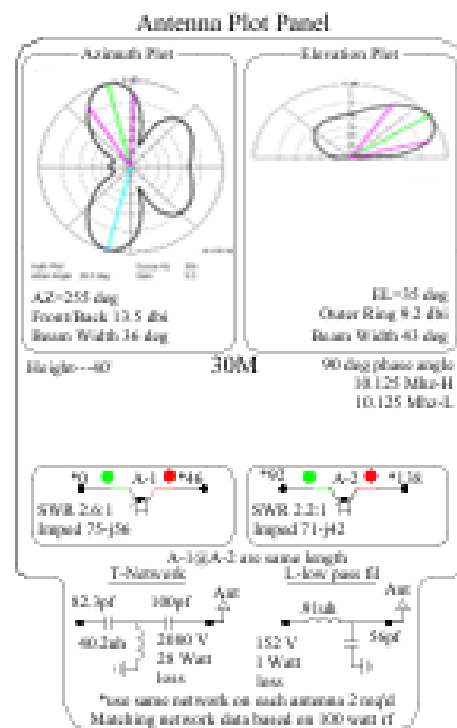
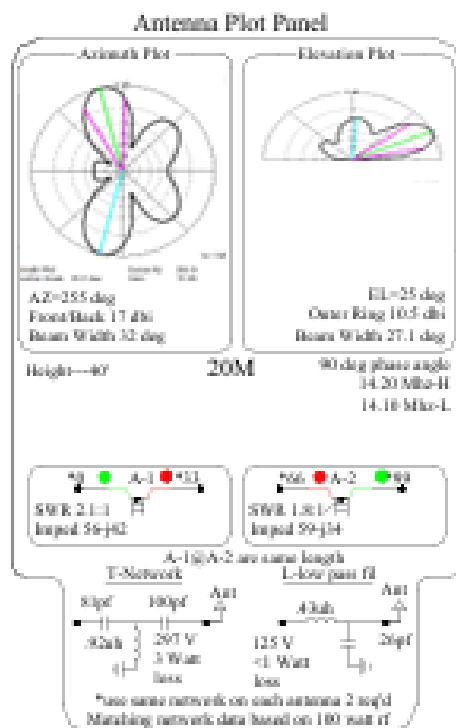
In-Line In-Line 40 Meters



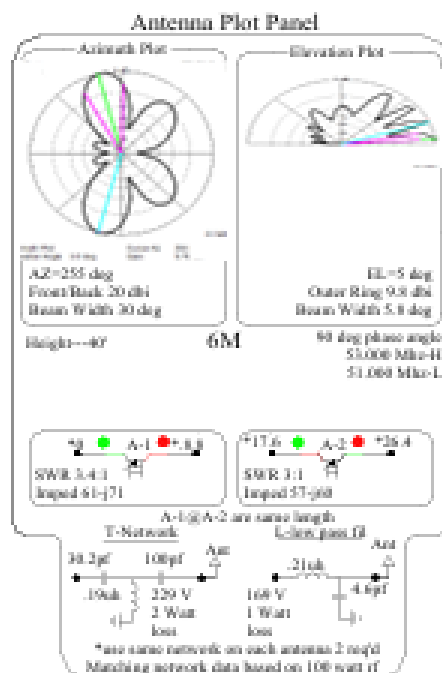
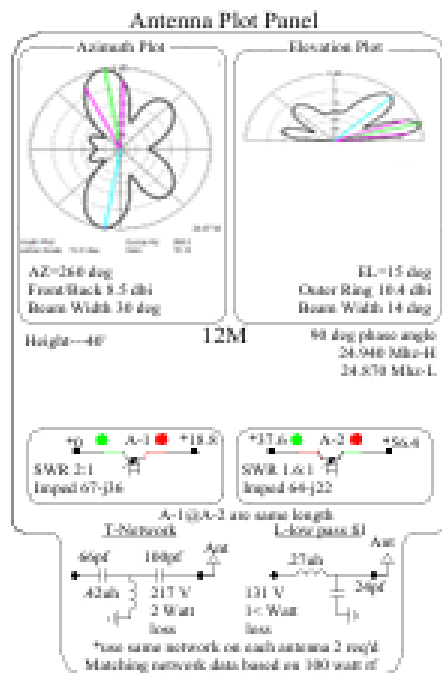
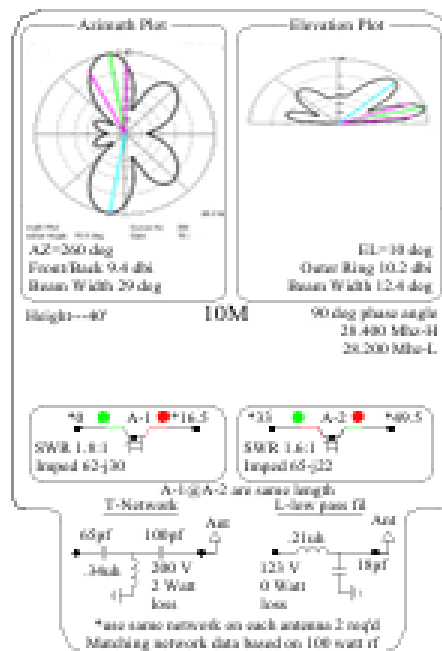
In-Line In-Line 40 Meters-30M^H-20M^H-17M^H-15M^H



In-Line In-Line 30M⁹⁰-20M⁹⁰--17M⁹⁰-15M⁹⁰



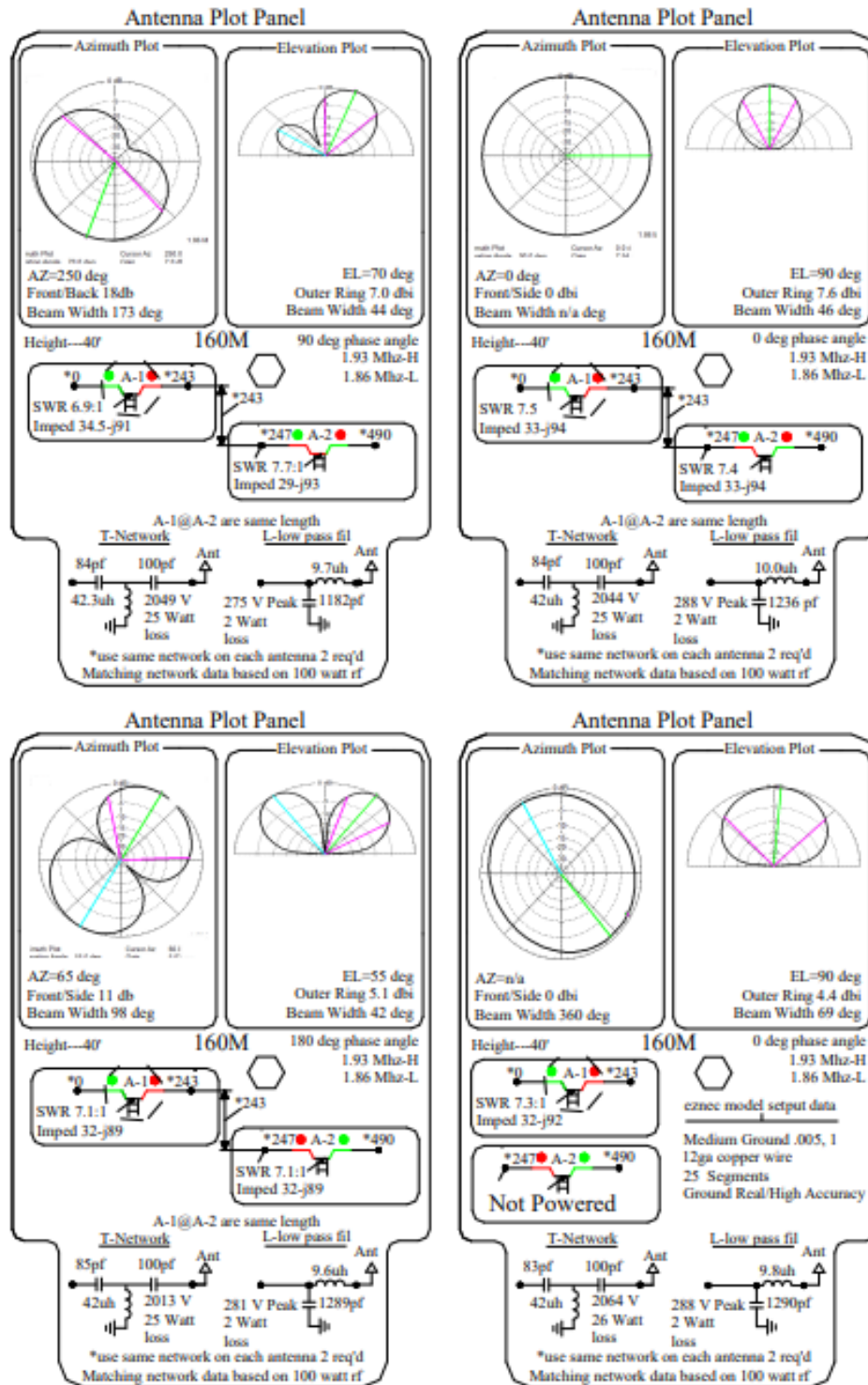
In-Line In-Line 12M⁹⁰-10M⁹⁰-6M⁹⁰



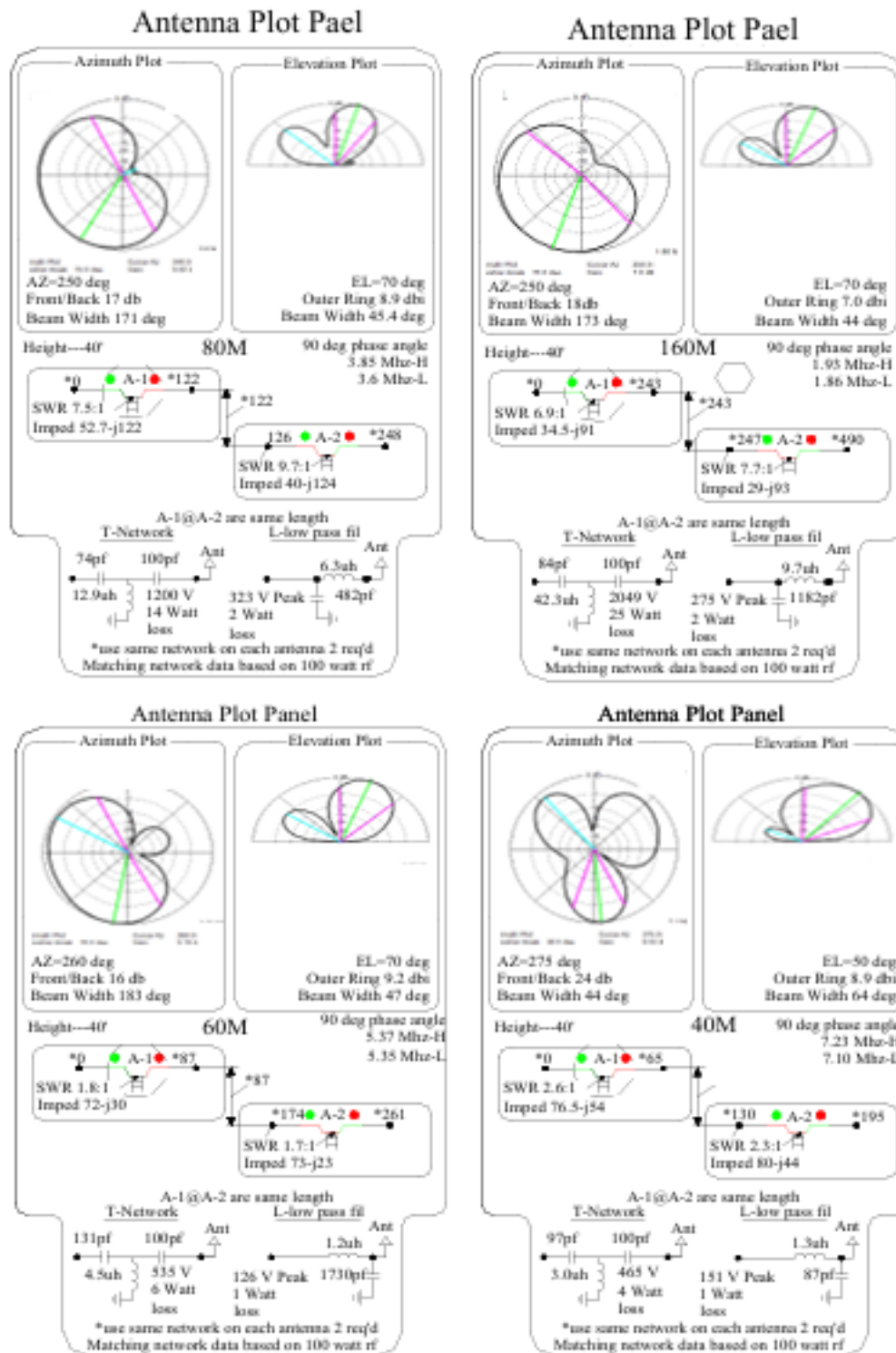
Appendix B Off-Set In-Line

OFF-SET IN-LINE 160 METER	77
OFF-SET IN-LINE 160 METER-160M ⁹⁰ -80M ⁹⁰ -60M ⁹⁰ -40M ⁹⁰	78
OFF-SET IN-LINE ANTENNA 30M ⁹⁰ -20M ⁹⁰ -17M ⁹⁰ -15M ⁹⁰	79
OFF-SET IN-LINE ANTENNA 12M ⁹⁰ -10M ⁹⁰ -6M ⁹⁰	80

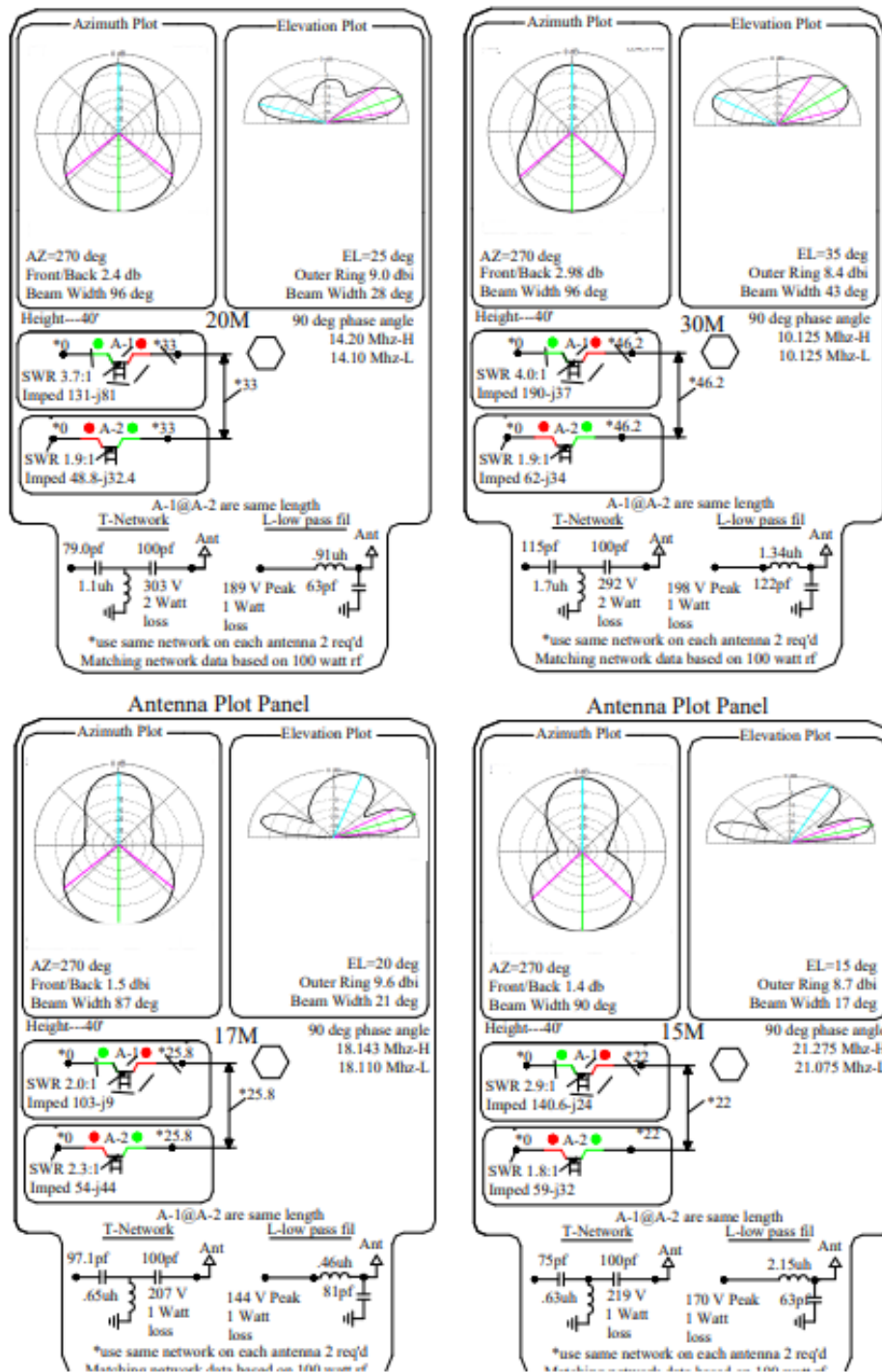
Off-Set In-Line 160 Meter



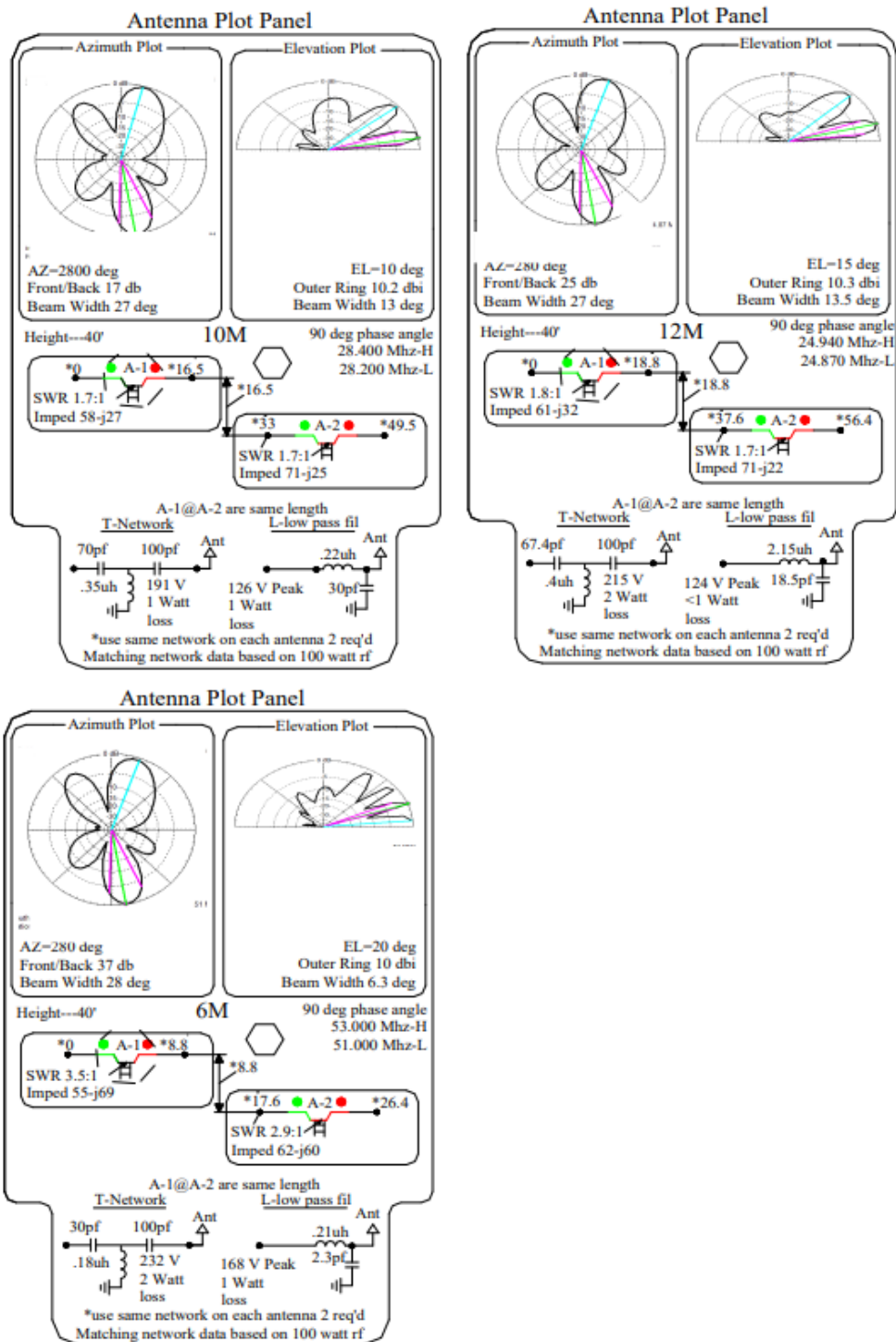
Off-Set In-Line 160 Meter-160M⁹⁰-80M⁹⁰-60M⁹⁰-40M⁹⁰



Off-Set In-Line Antenna 30M⁹⁰-20M⁹⁰-17M⁹⁰- 15M⁹⁰



Off-Set In-Line Antenna 12M⁹⁰-10M⁹⁰-6M⁹⁰

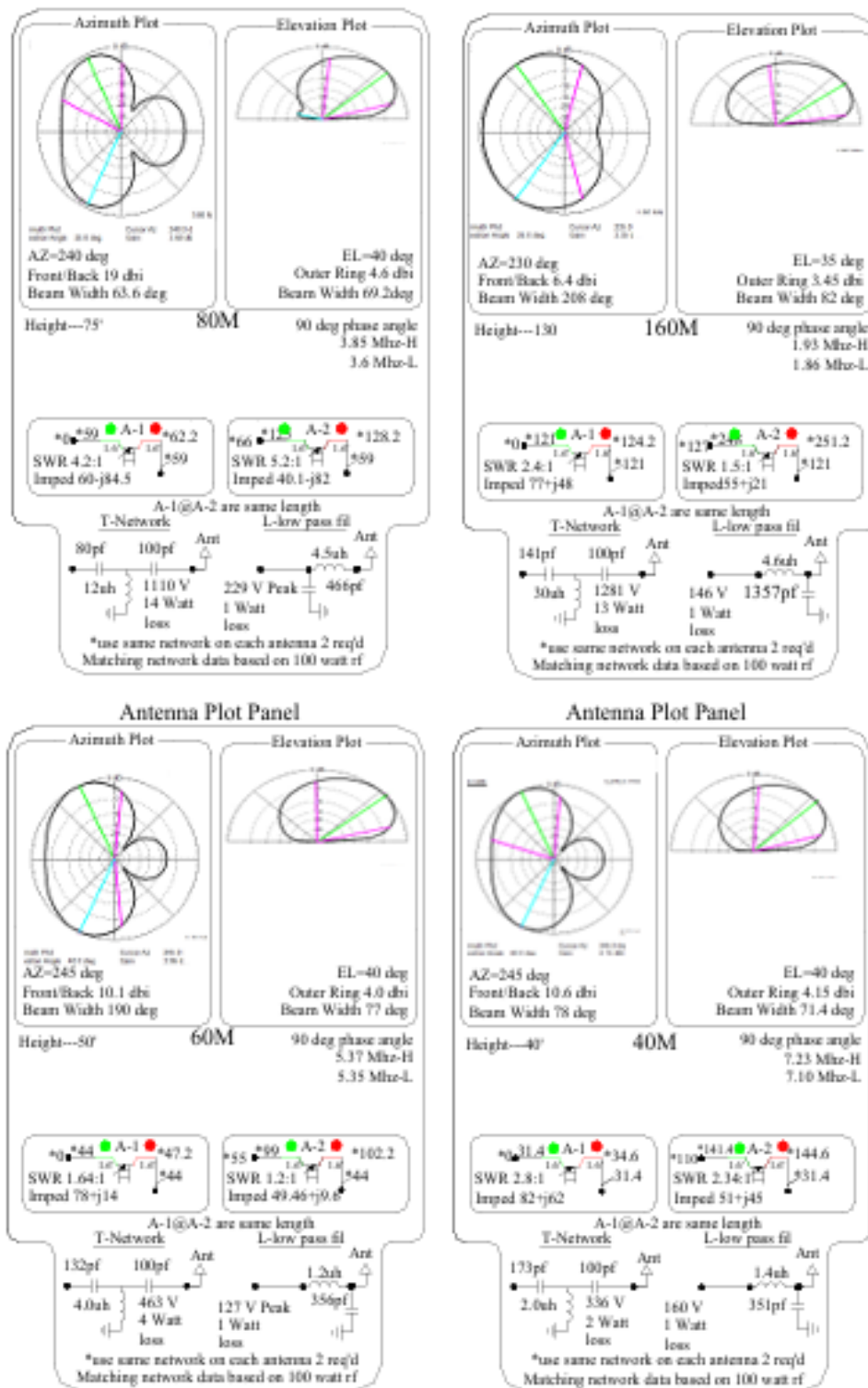


Appendix C Vertical Collinear

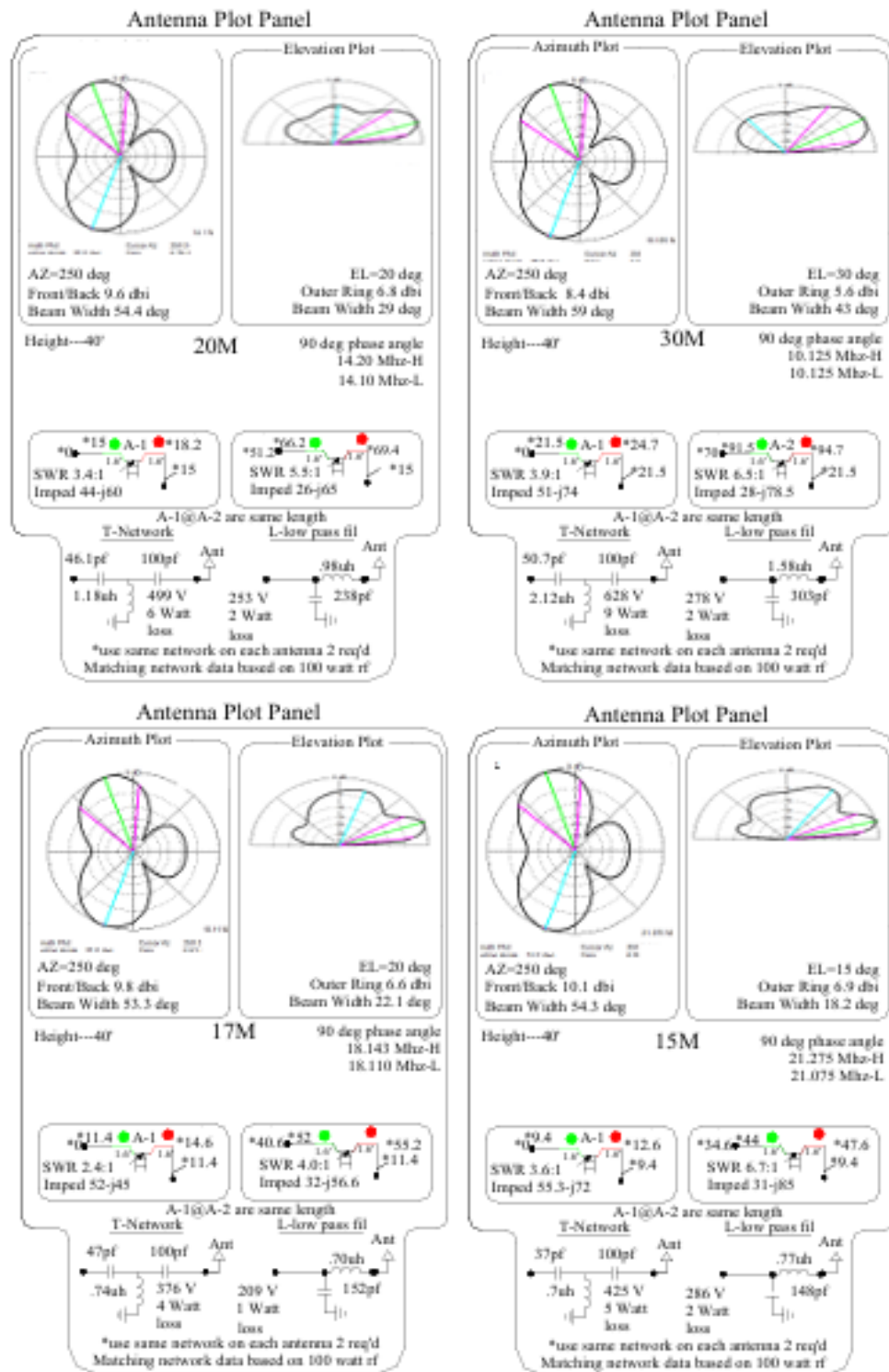
VERTICAL IN-LINE 160M ⁹⁰ -80M ⁹⁰ -60M ⁹⁰ -40M ⁹⁰	82
VERTICAL IN-LINE 30M ⁹⁰ -20M ⁹⁰ -17M ⁹⁰ -15M ⁹⁰	83
VERTICAL IN-LINE 12M ⁹⁰ -10M ⁹⁰ -6M ⁹⁰	84

In-Line Vertical antennas are made from the same dipoles found in Appendix A. The leg pointing to ground must be protected against being touched when transmitting. This configuration does reduce the take off angle of the radio wave.

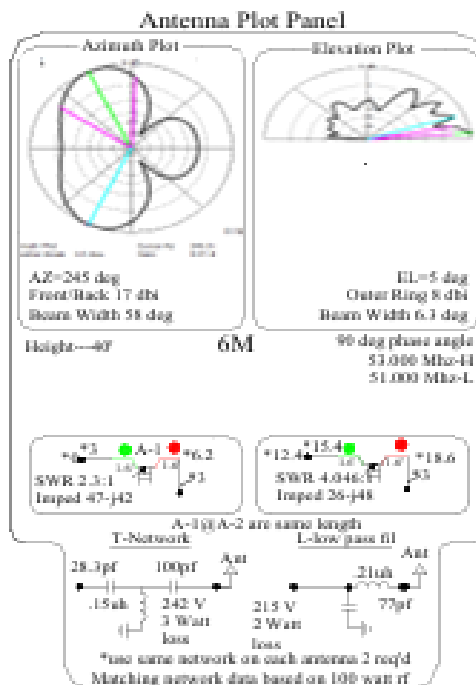
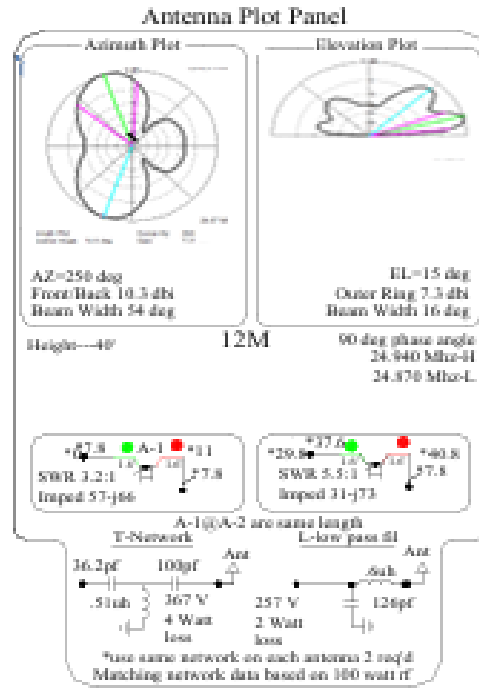
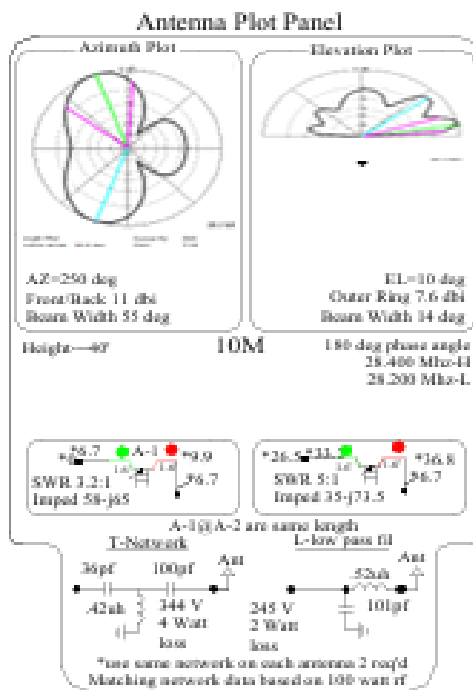
Vertical In-Line 160M⁹⁰-80M⁹⁰-60M⁹⁰-40M⁹⁰



Vertical In-Line 30M⁹⁰-20M⁹⁰-17M⁹⁰-15M⁹⁰



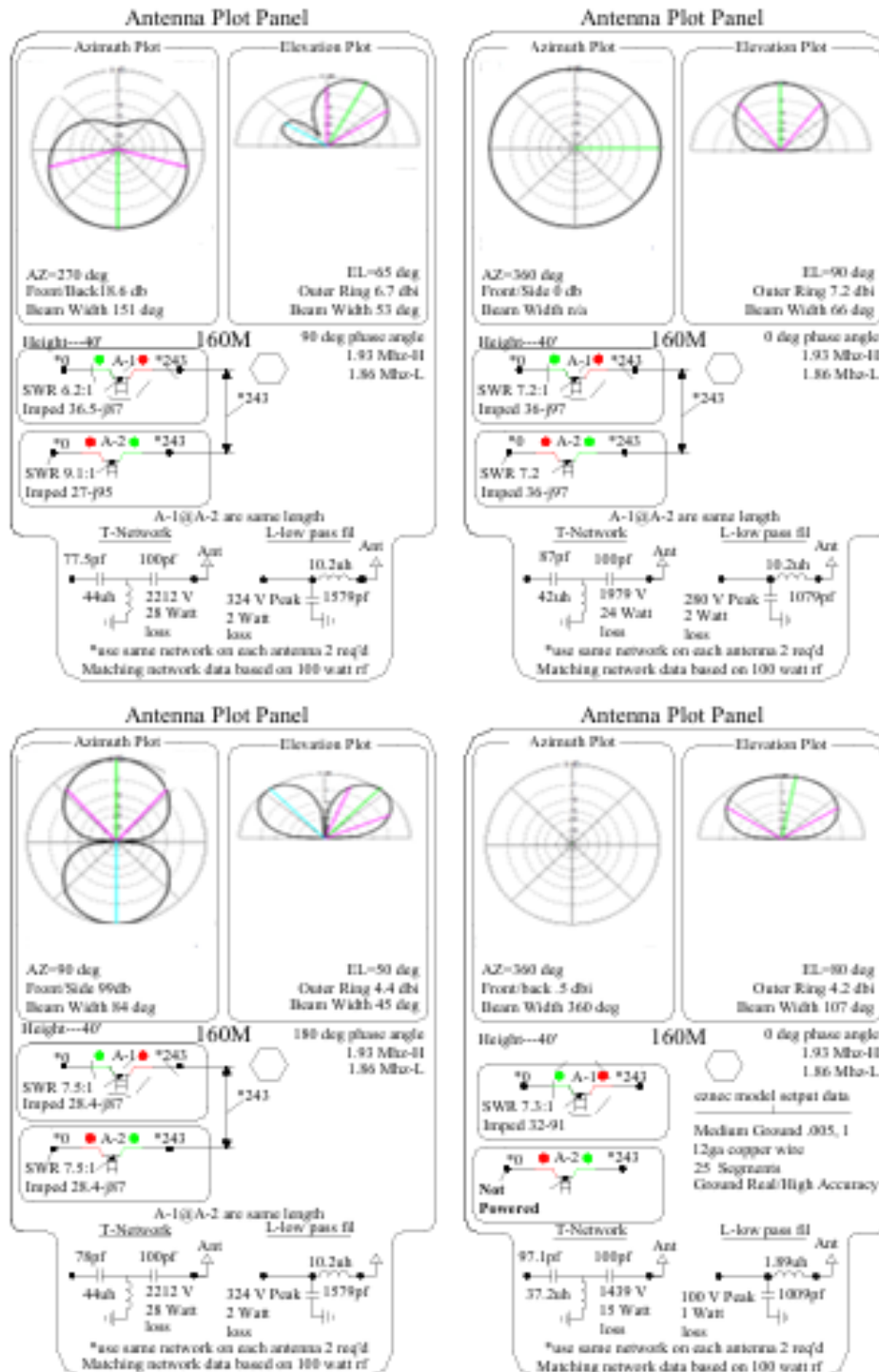
Vertical In-Line 12M⁹⁰-10M⁹⁰-6M⁹⁰



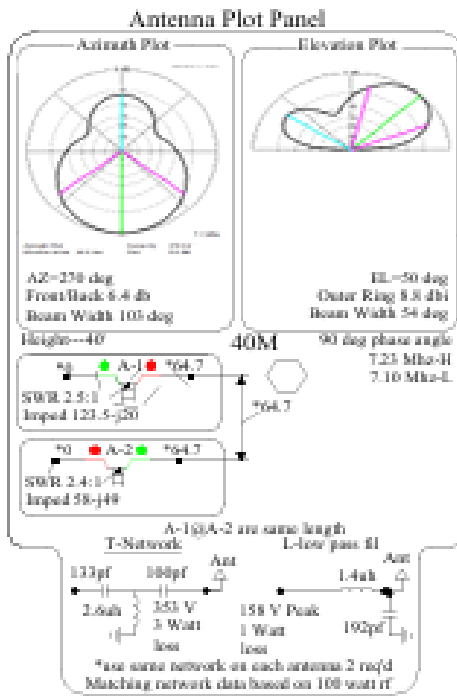
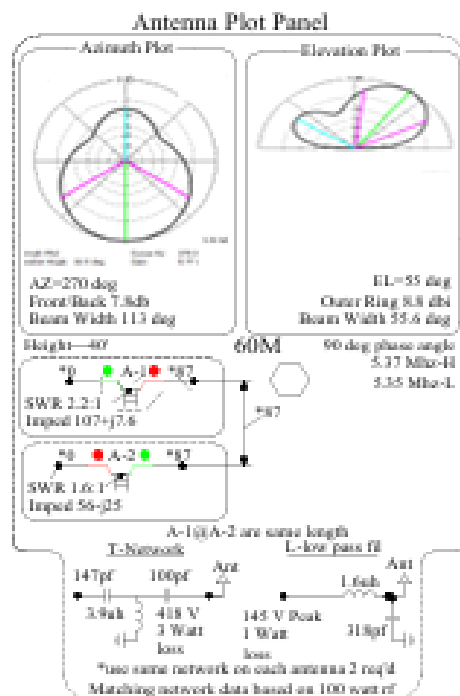
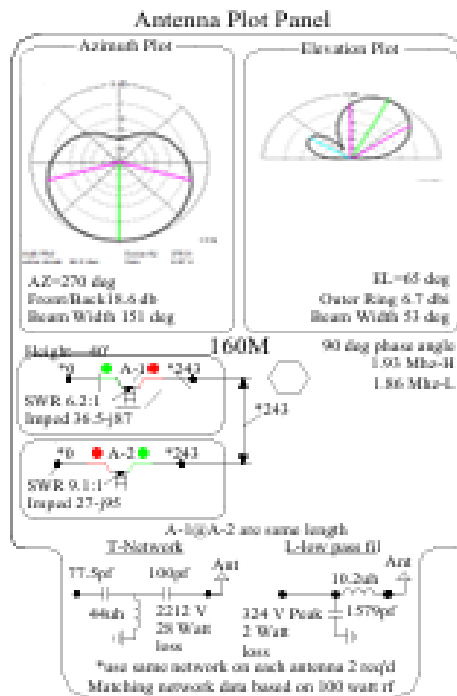
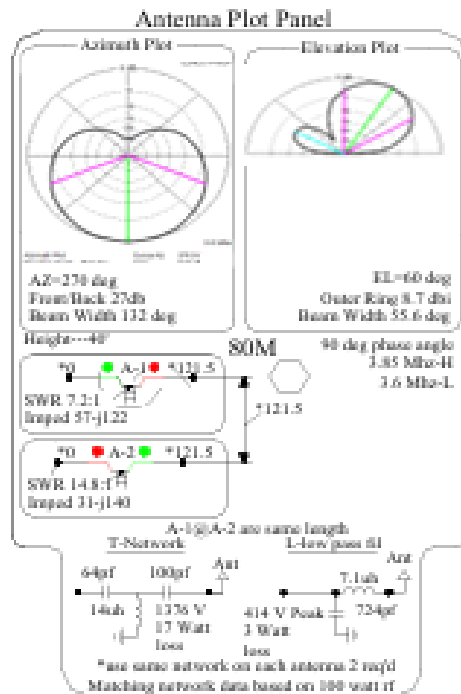
Appendix D Parallel Dipoles

PARALLEL DIPOLES 160METERS.....	86
PARALLEL DIPOLES 160M ⁹⁰ -80M ⁹⁰ -60M ⁹⁰ -40M ⁹⁰	87
PARALLEL DIPOLES 30M ⁹⁰ -20M ⁹⁰ -17M ⁹⁰ -15M ⁹⁰	88
PARALLEL DIPOLES 12M ⁹⁰ -10M ⁹⁰ -6M ⁹⁰	89

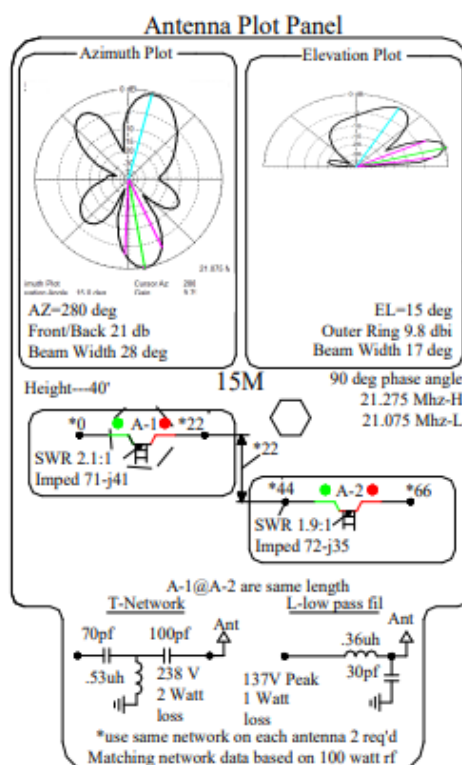
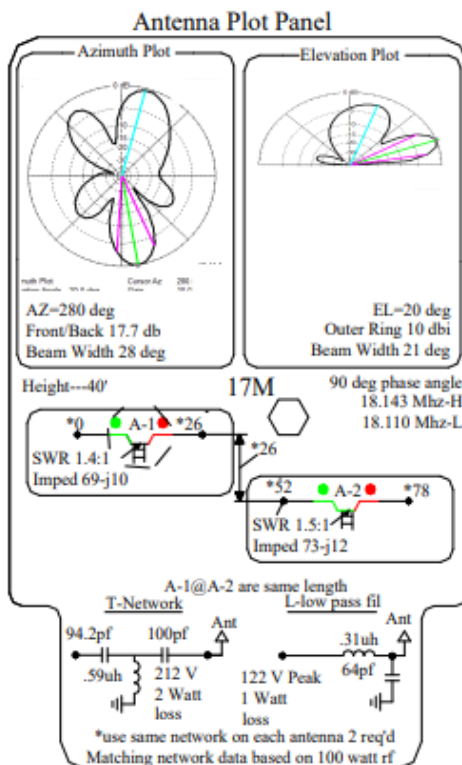
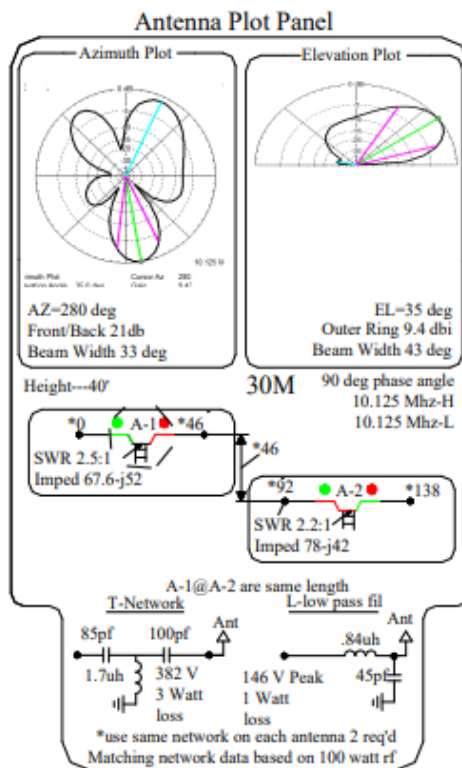
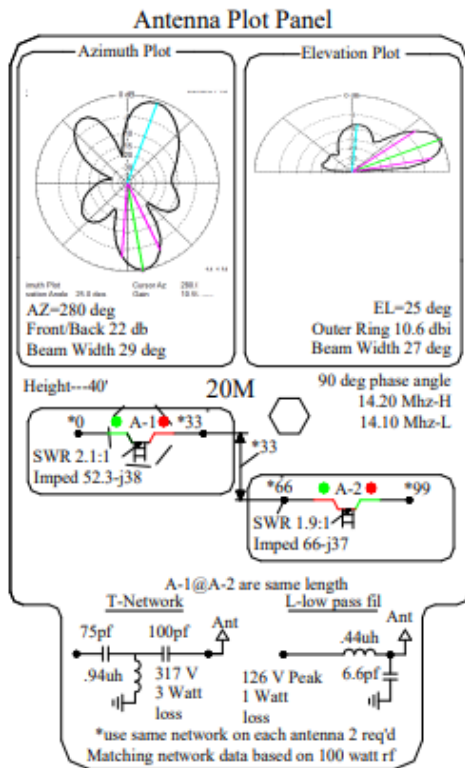
Parallel Dipoles 160Meters



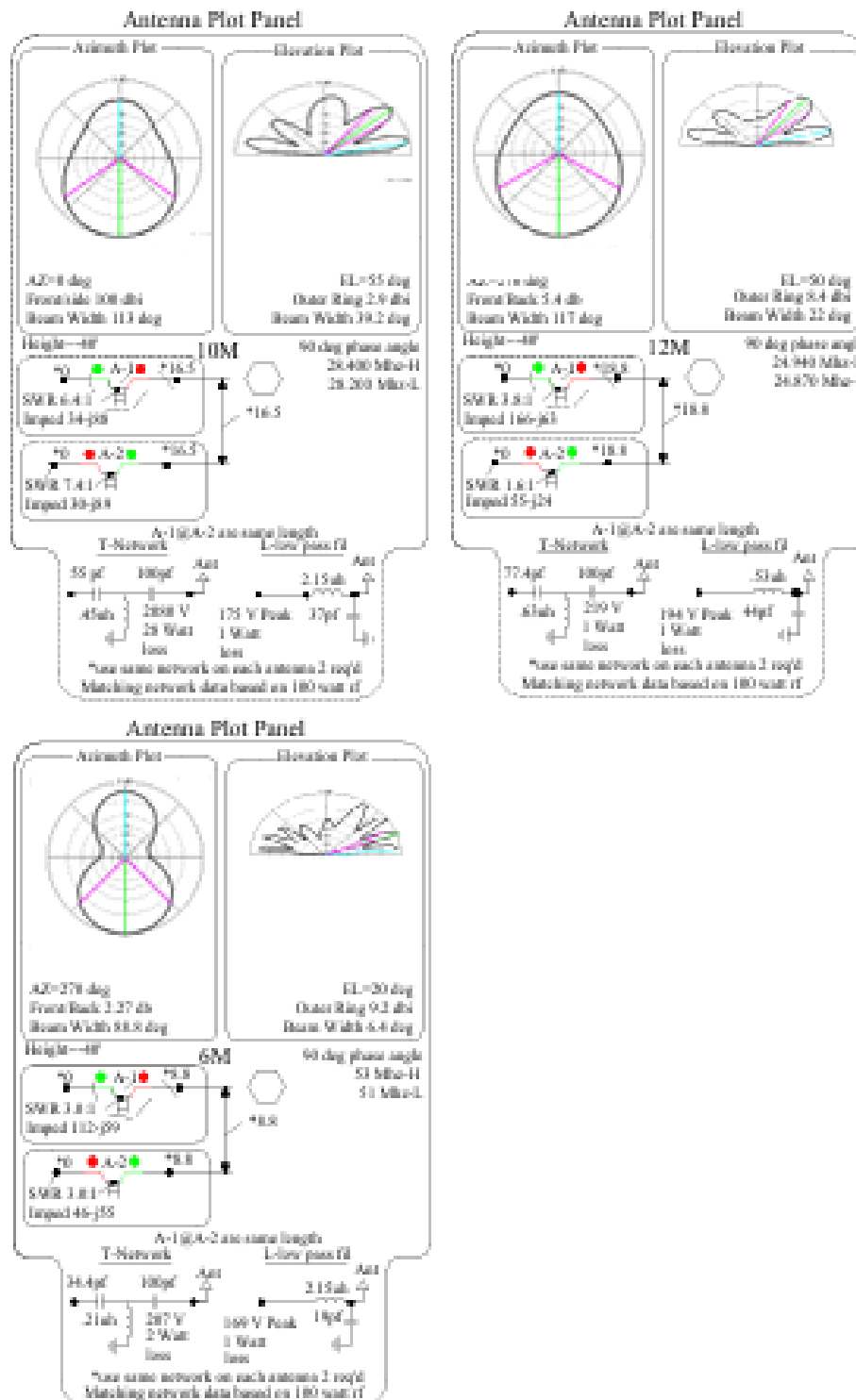
Parallel Dipoles 160M⁹⁰-80M⁹⁰-60M⁹⁰-40M⁹⁰



Parallel Dipoles 30M⁹⁰-20M⁹⁰-17M⁹⁰-15M⁹⁰



Parallel Dipoles 12M⁹⁰-10M⁹⁰-6M⁹⁰

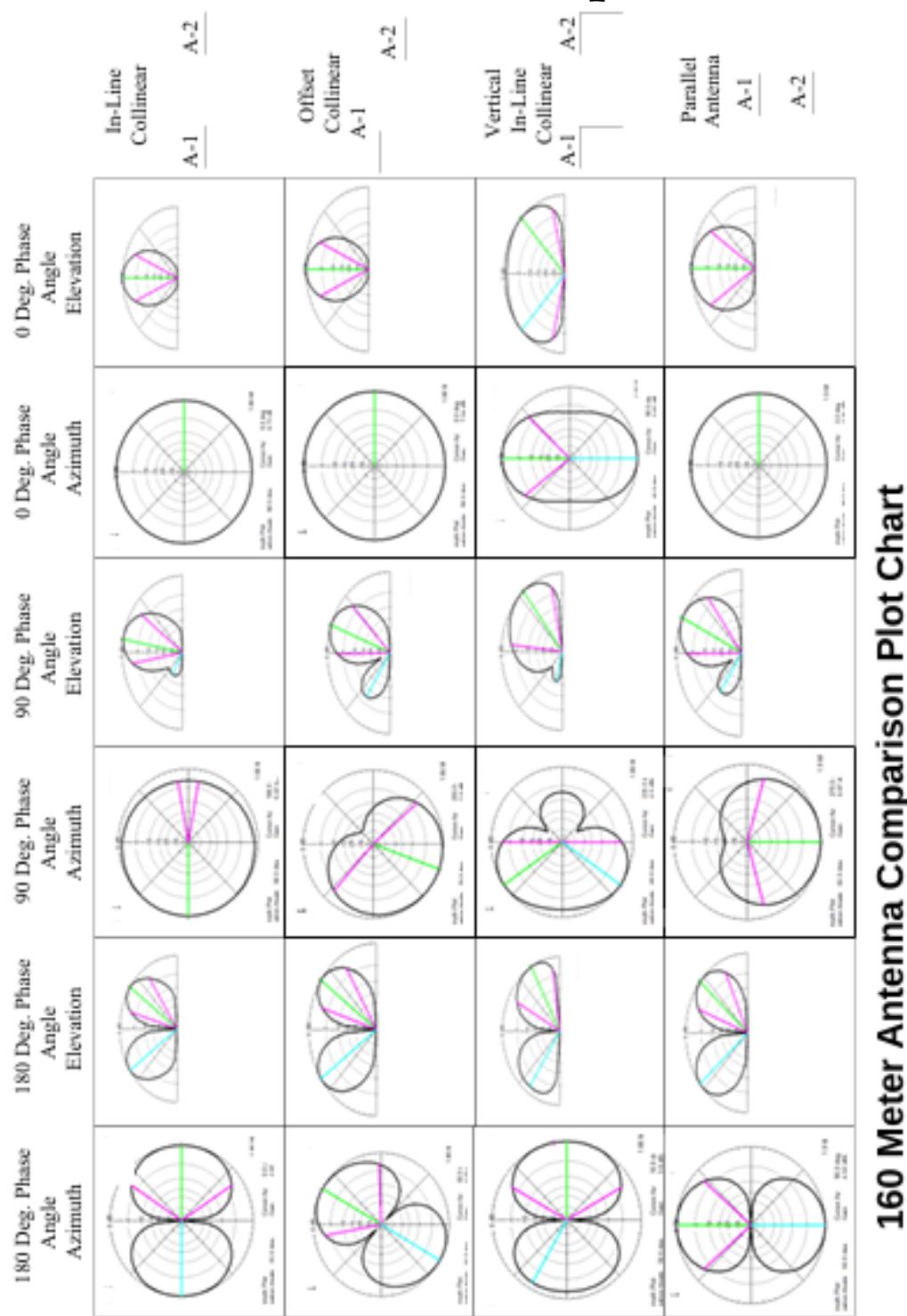


Appendix E Master Plot Charts

160	METER FOUR ANTENNA COMPARISON PLOT CHART	91
80	METER FOUR ANTENNA COMPARISON PLOT CHART	92
60	METER FOUR ANTENNA COMPARISON PLOT CHART	93
40	METER FOUR ANTENNA COMPARISON PLOT CHART	94
30	METER FOUR ANTENNA COMPARISON PLOT CHART	95
20	METER FOUR ANTENNA COMPARISON PLOT CHART	96
17	METER FOUR ANTENNA COMPARISON PLOT CHART	97
15	METER FOUR ANTENNA COMPARISON PLOT CHART	98
12	METER FOUR ANTENNA COMPARISON PLOT CHART	99
10	METER FOUR ANTENNA COMPARISON PLOT CHART	100
6	METER FOUR ANTENNA COMPARISON PLOT CHART	101

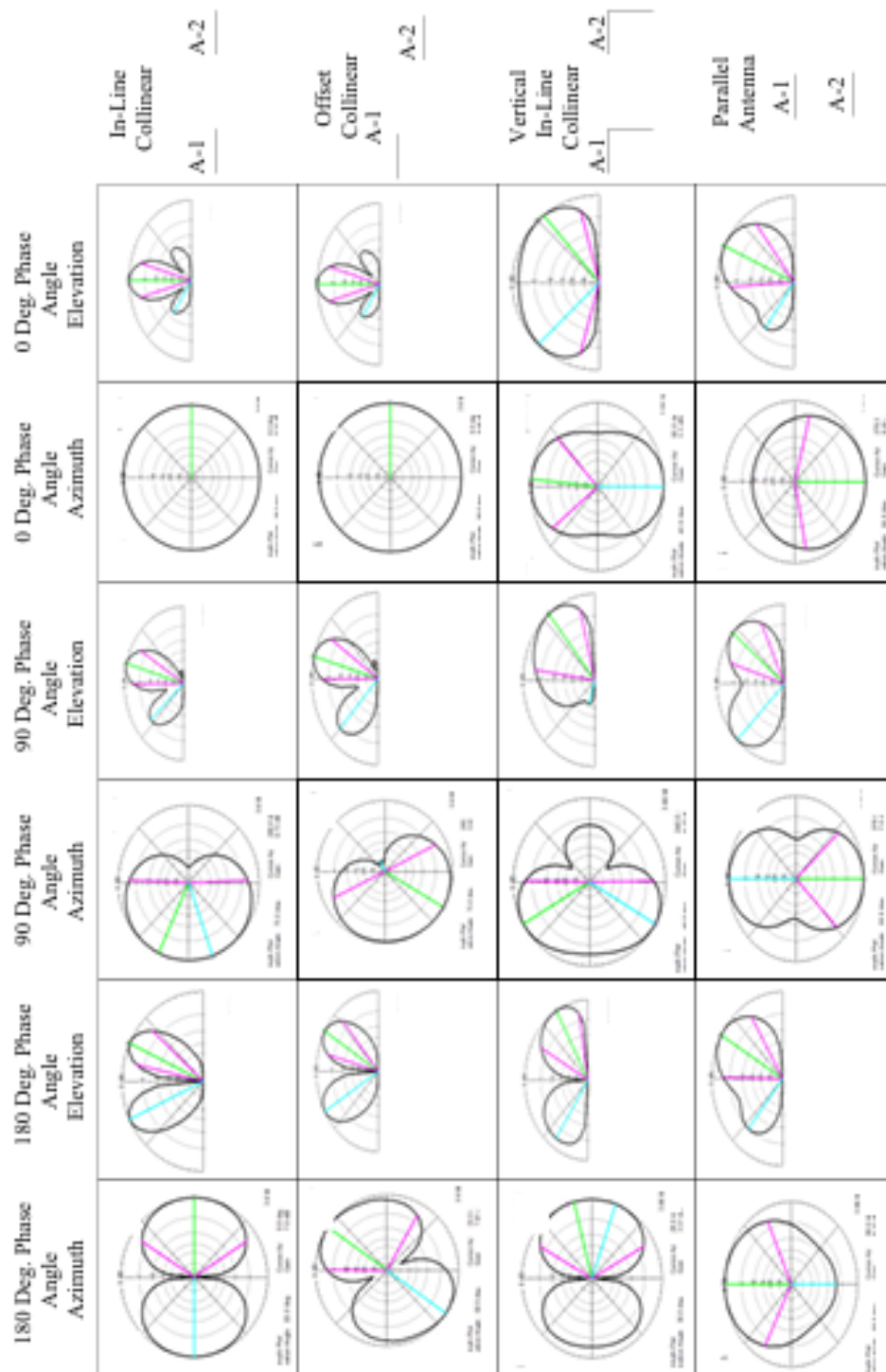
These charts allow for easier understanding of the difference in antenna performance on any given band. Only the elevation and azimuth patterns are shown for 0°, 90°, 180° phase angles. Pick a design you like then go to that antenna type as is shown in one of the other Appendices. Appendix A is the foundation for all the various antennas. The gain performance shown there should get you real close to what you can expect.

160 Meter Four Antenna Comparison Plot Chart



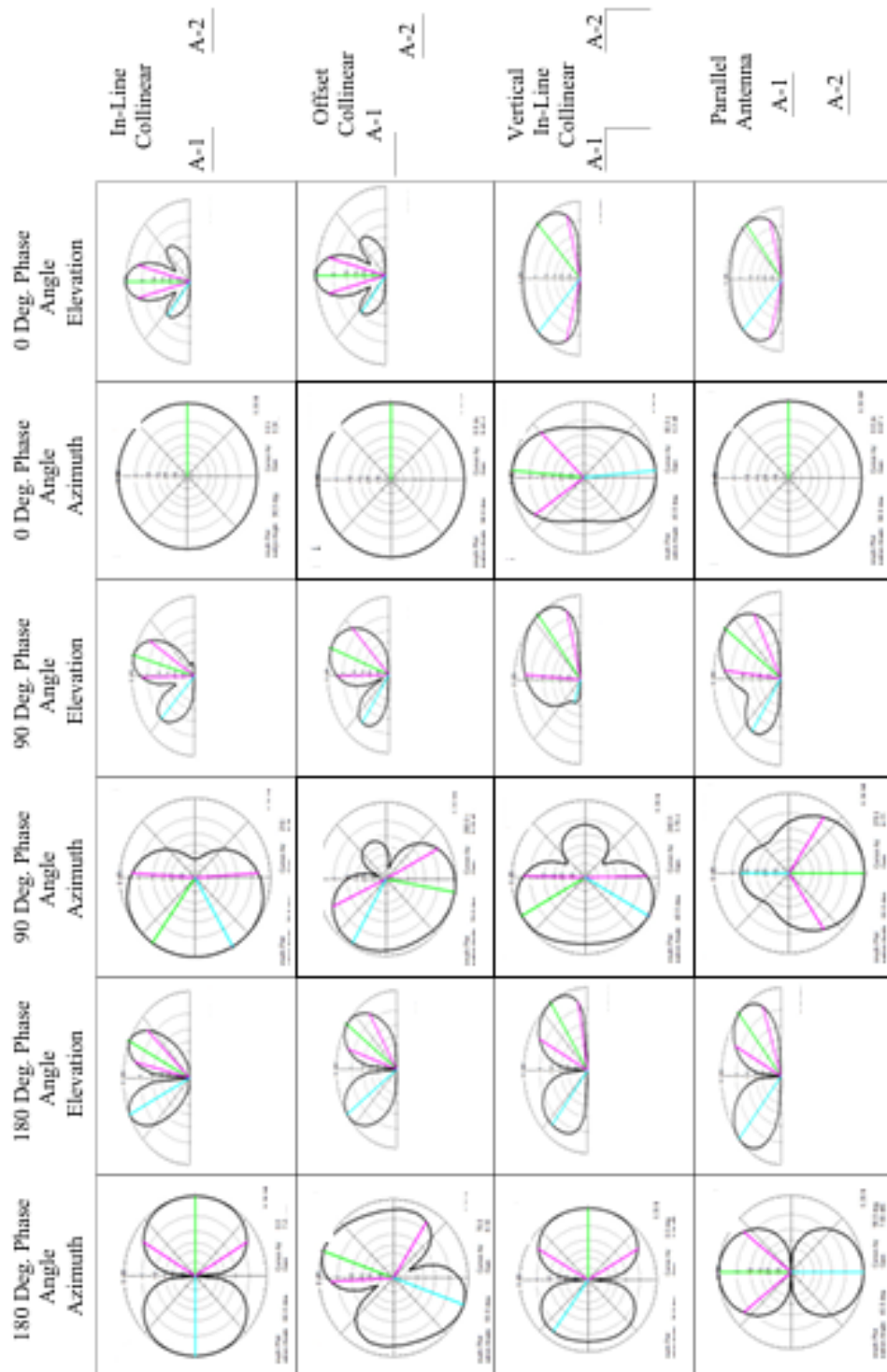
160 Meter Antenna Comparison Plot Chart

80 Meter Four Antenna Comparison Plot Chart



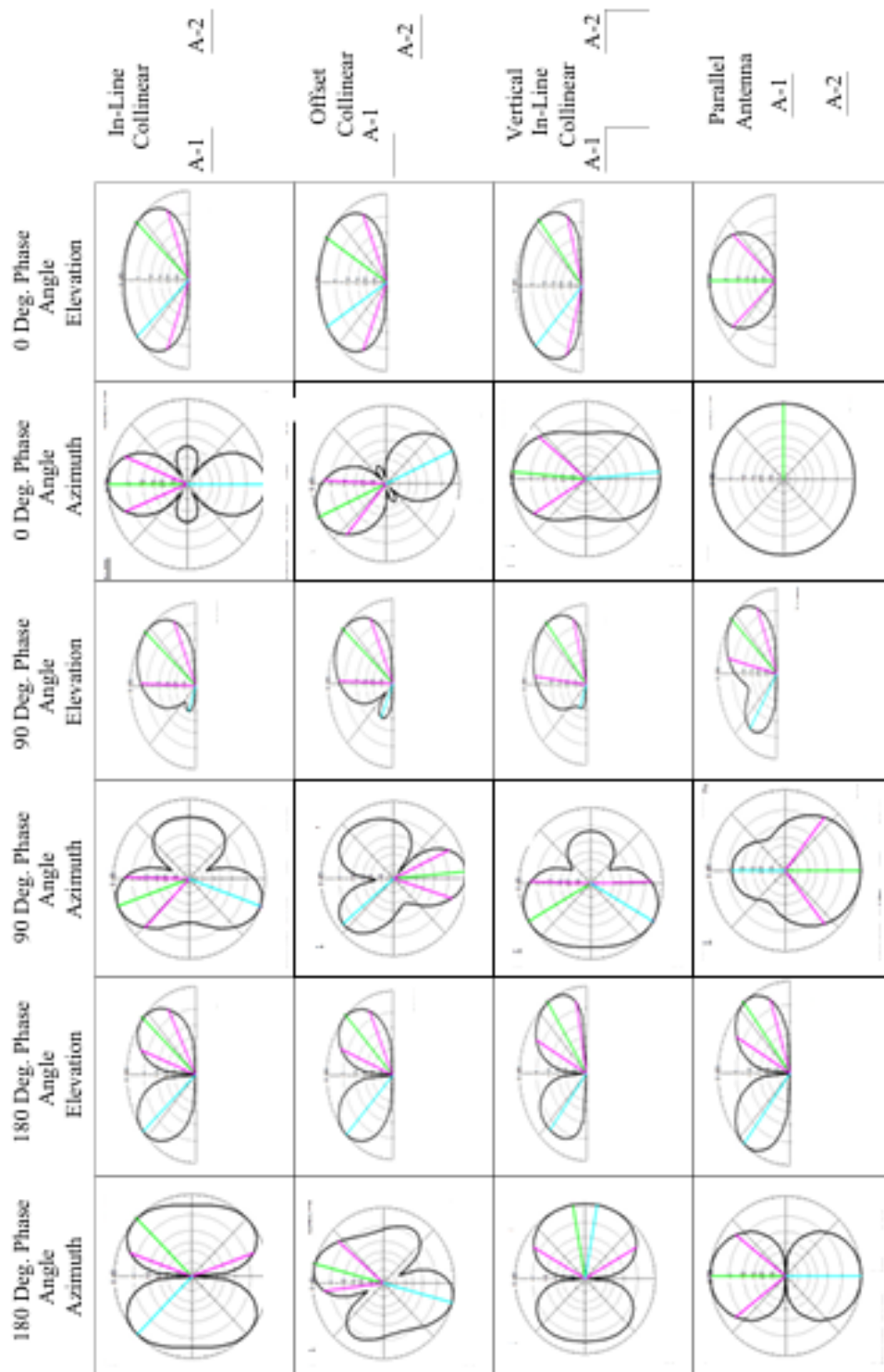
80 Meter Antenna Comparison Plot Chart

60 Meter Four Antenna Comparison Plot Chart



60 Meter Antenna Comparison Plot Chart

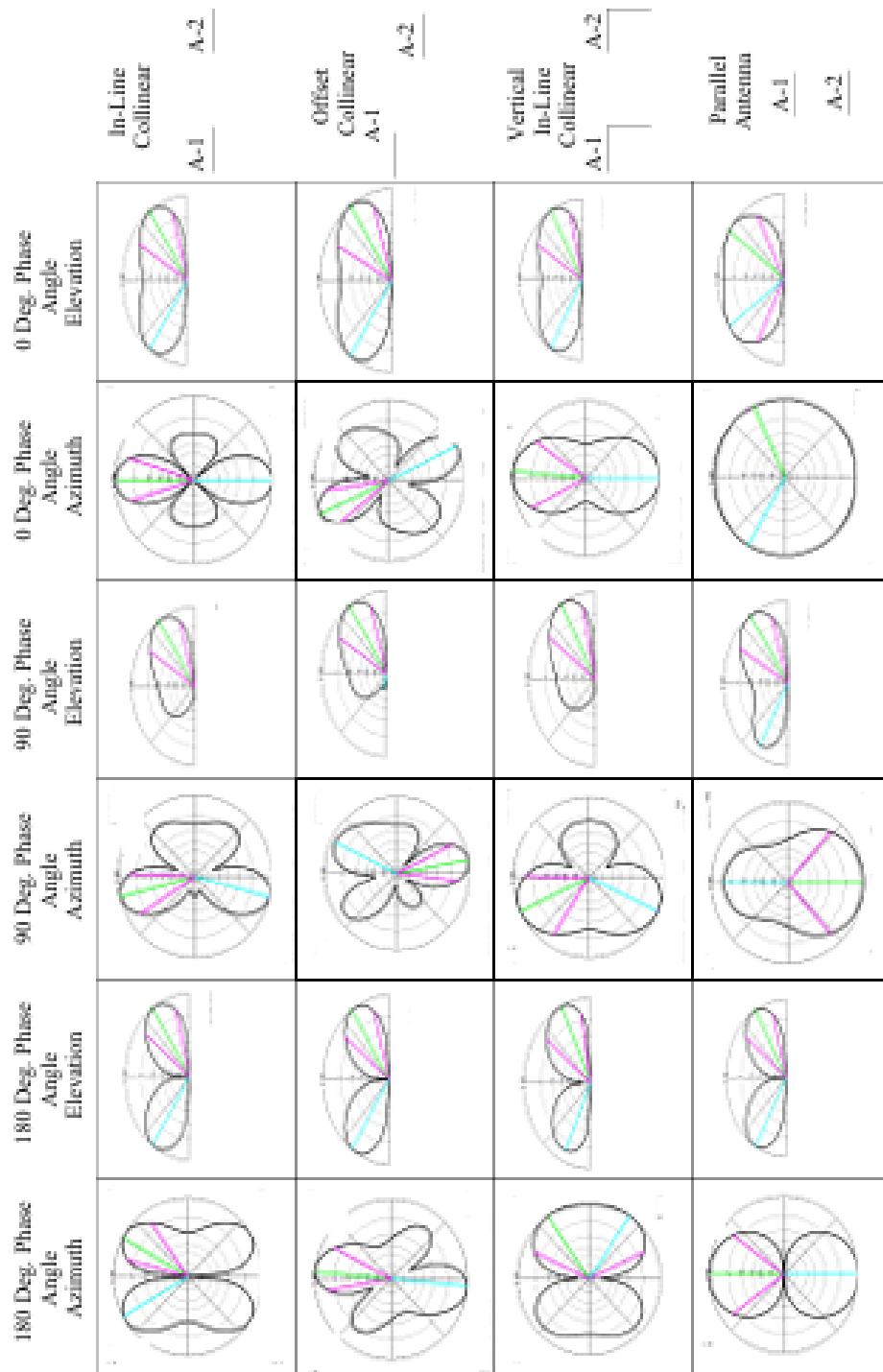
40 Meter Four Antenna Comparison Plot Chart



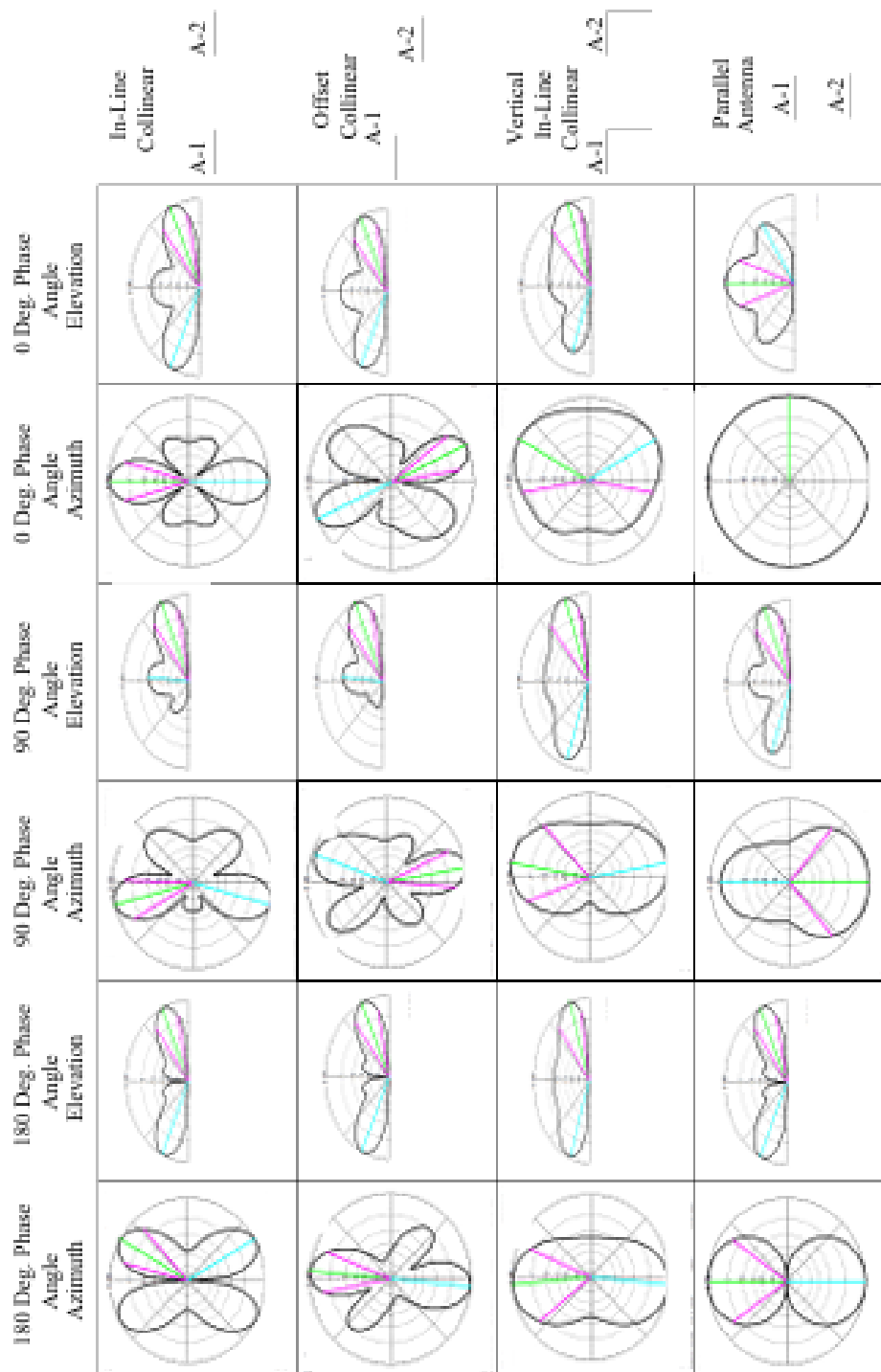
40 Meter Comparison Chart

30 Meter Four Antenna Comparison Plot Chart

30 Meter Comparison Chart

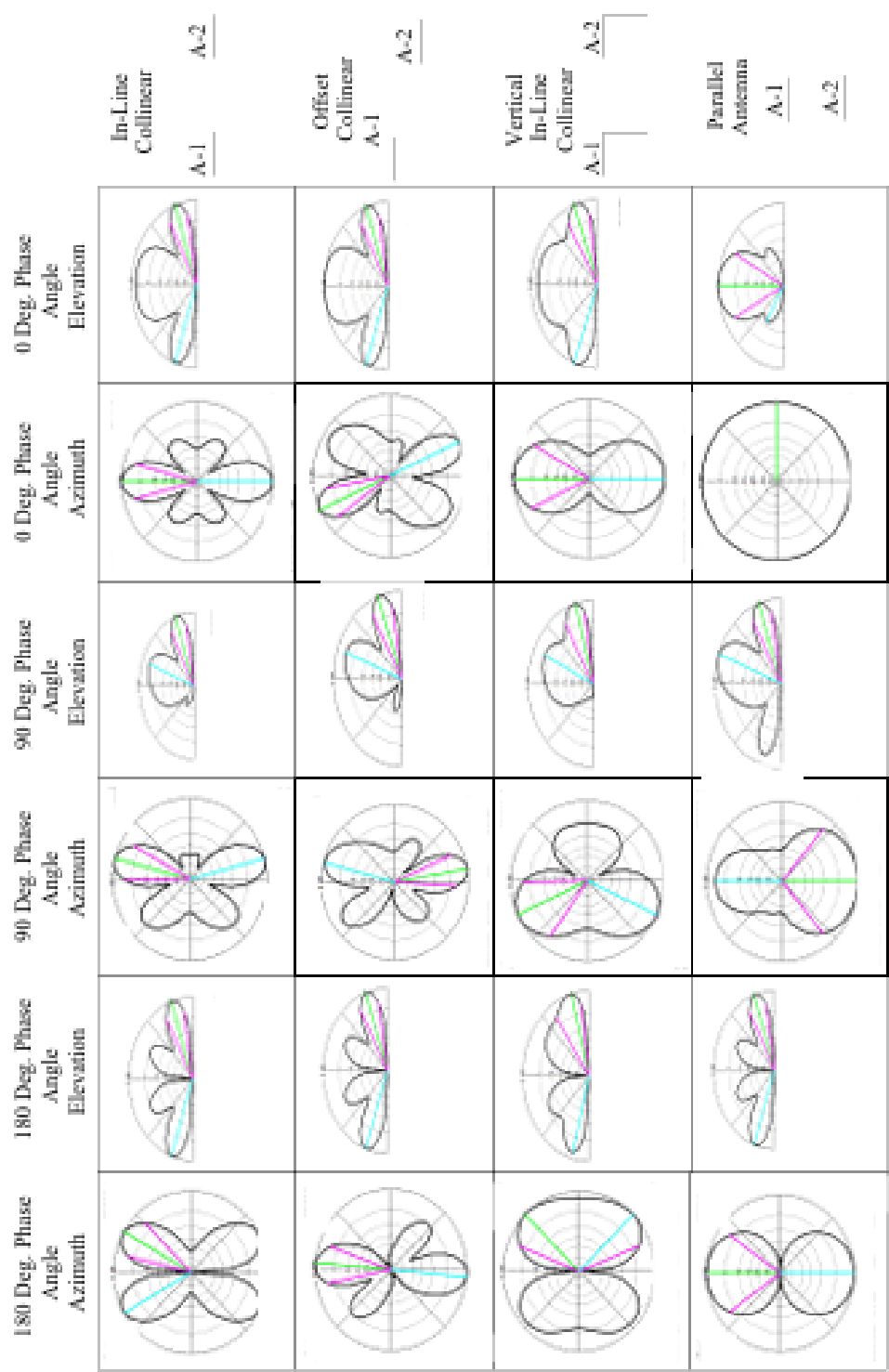


20 Meter Four Antenna Comparison Plot Chart



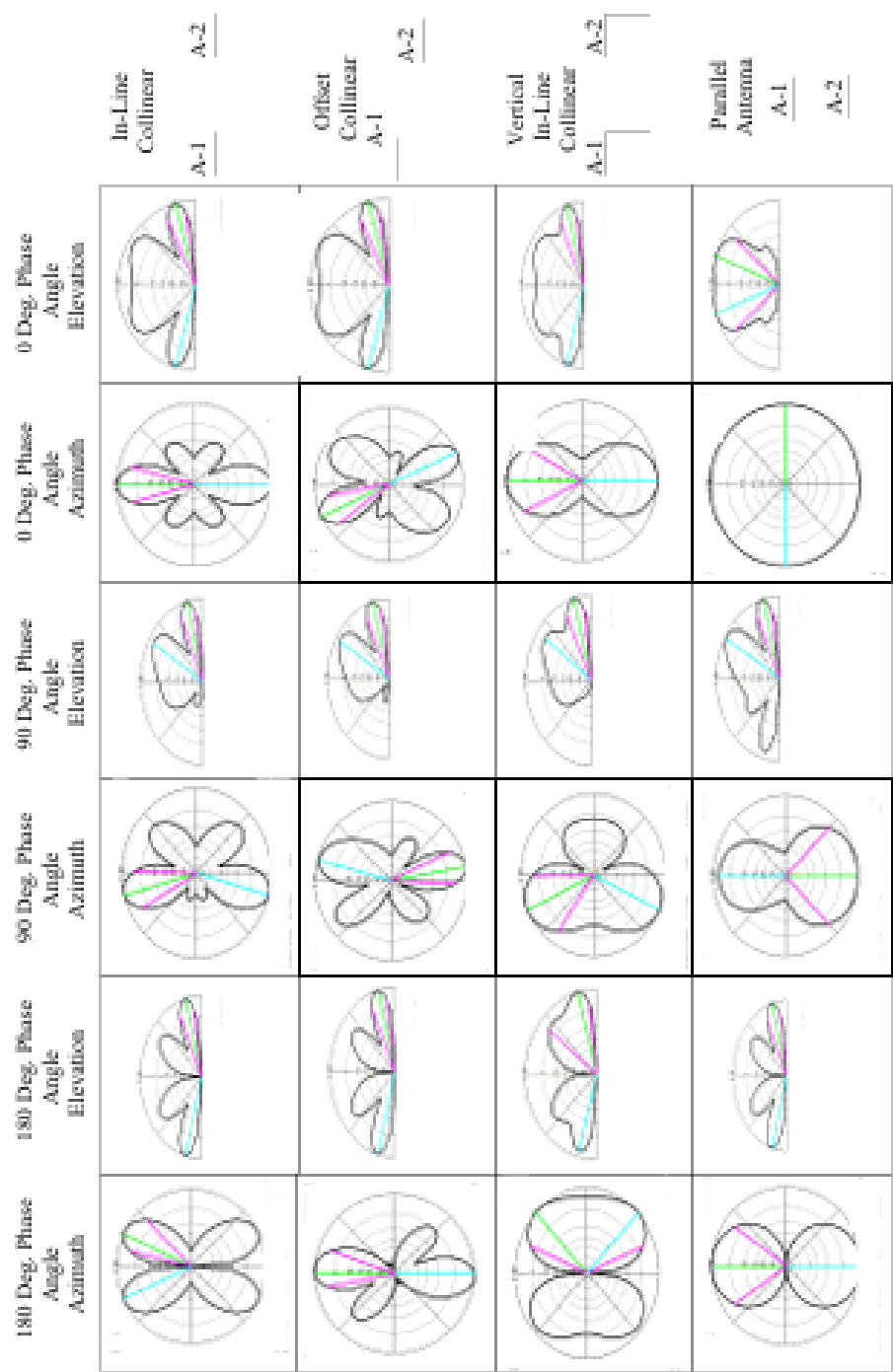
20 Meter Antenna Comparison Plot Chart

17 Meter Four Antenna Comparison Plot Chart



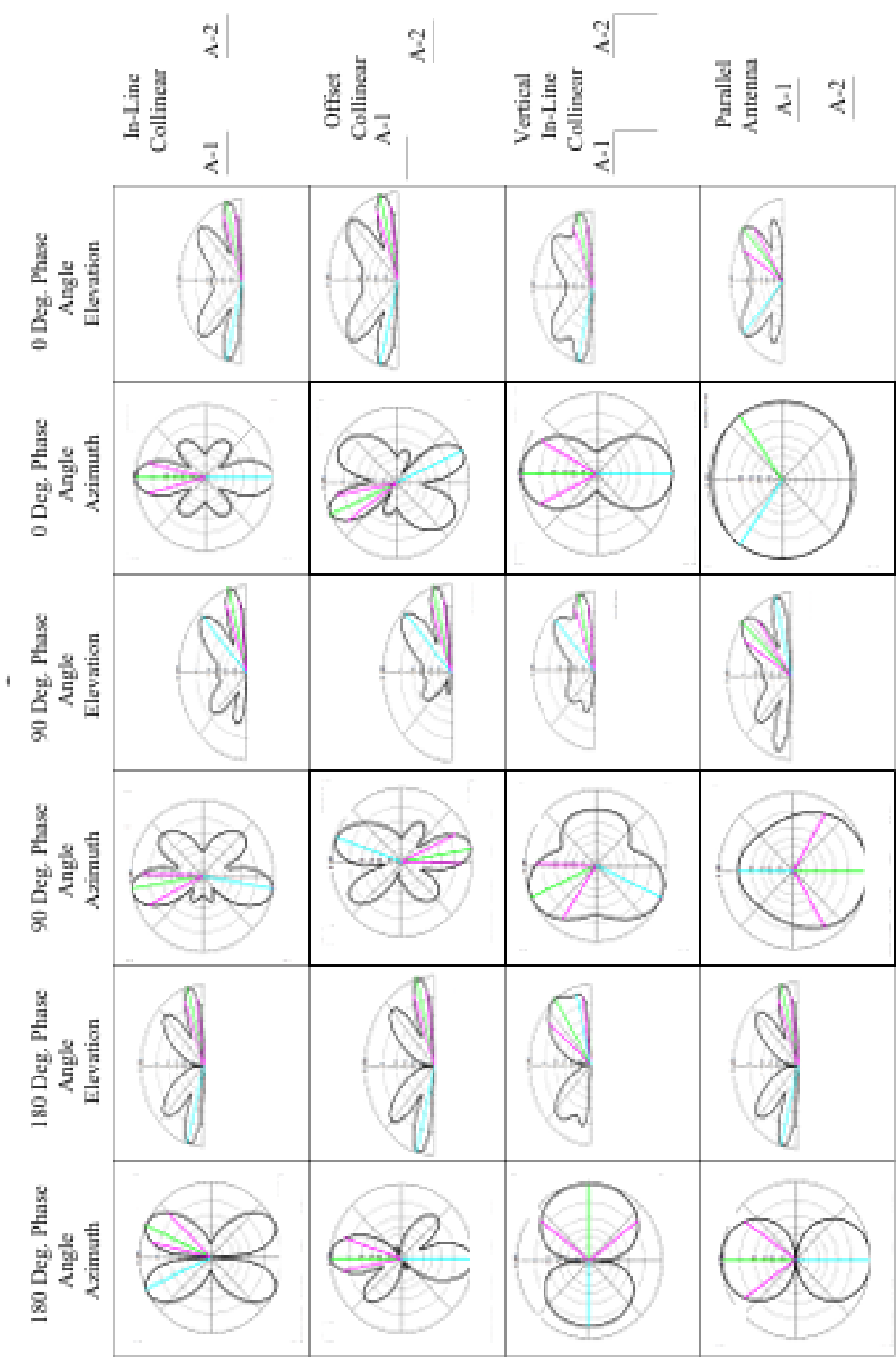
17 Meter Antenna Comparison Plot Chart

15 Meter Four Antenna Comparison Plot Chart



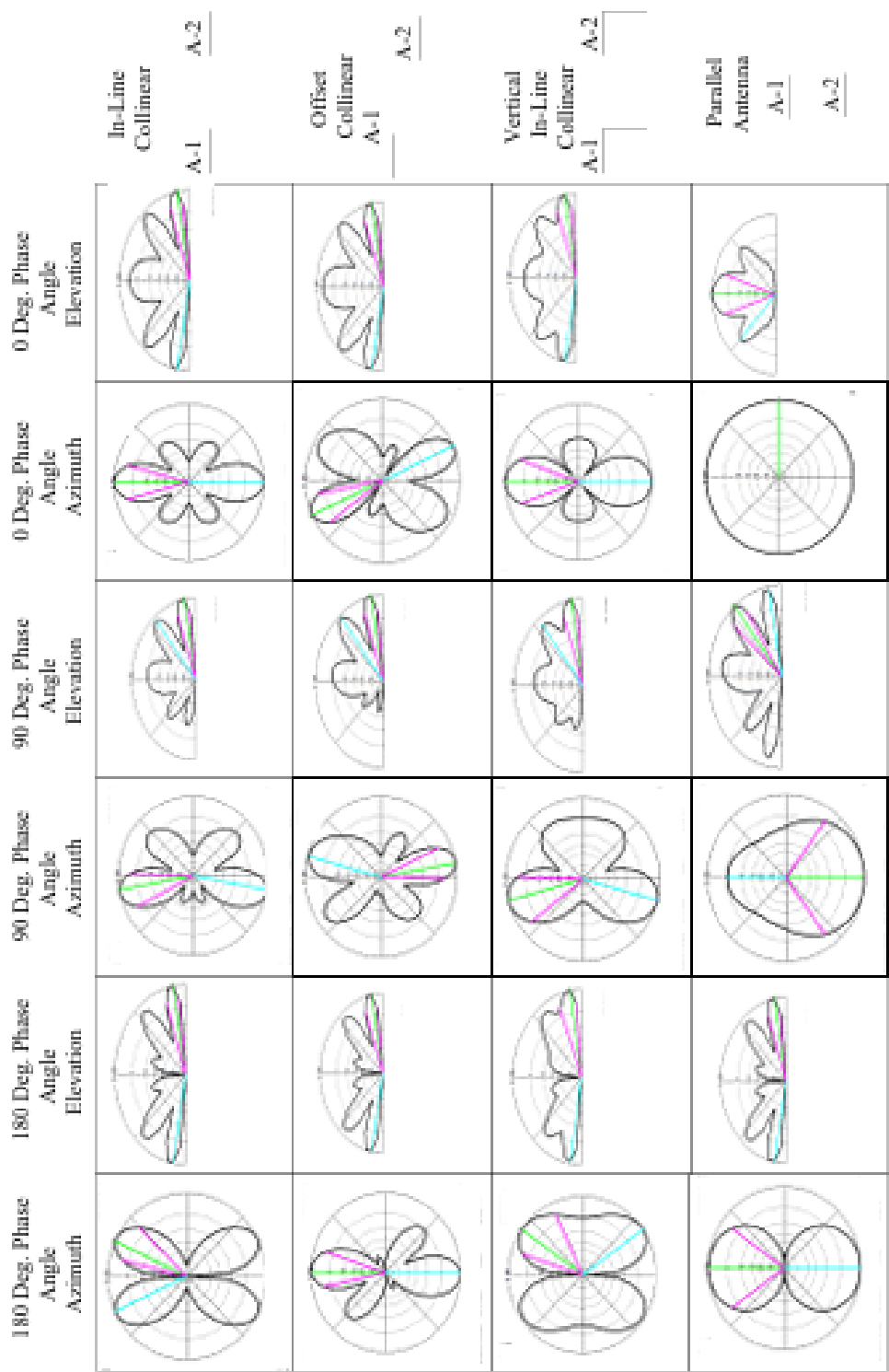
15 Meter Antenna Comparison Plot Chart

12 Meter Four Antenna Comparison Plot Chart



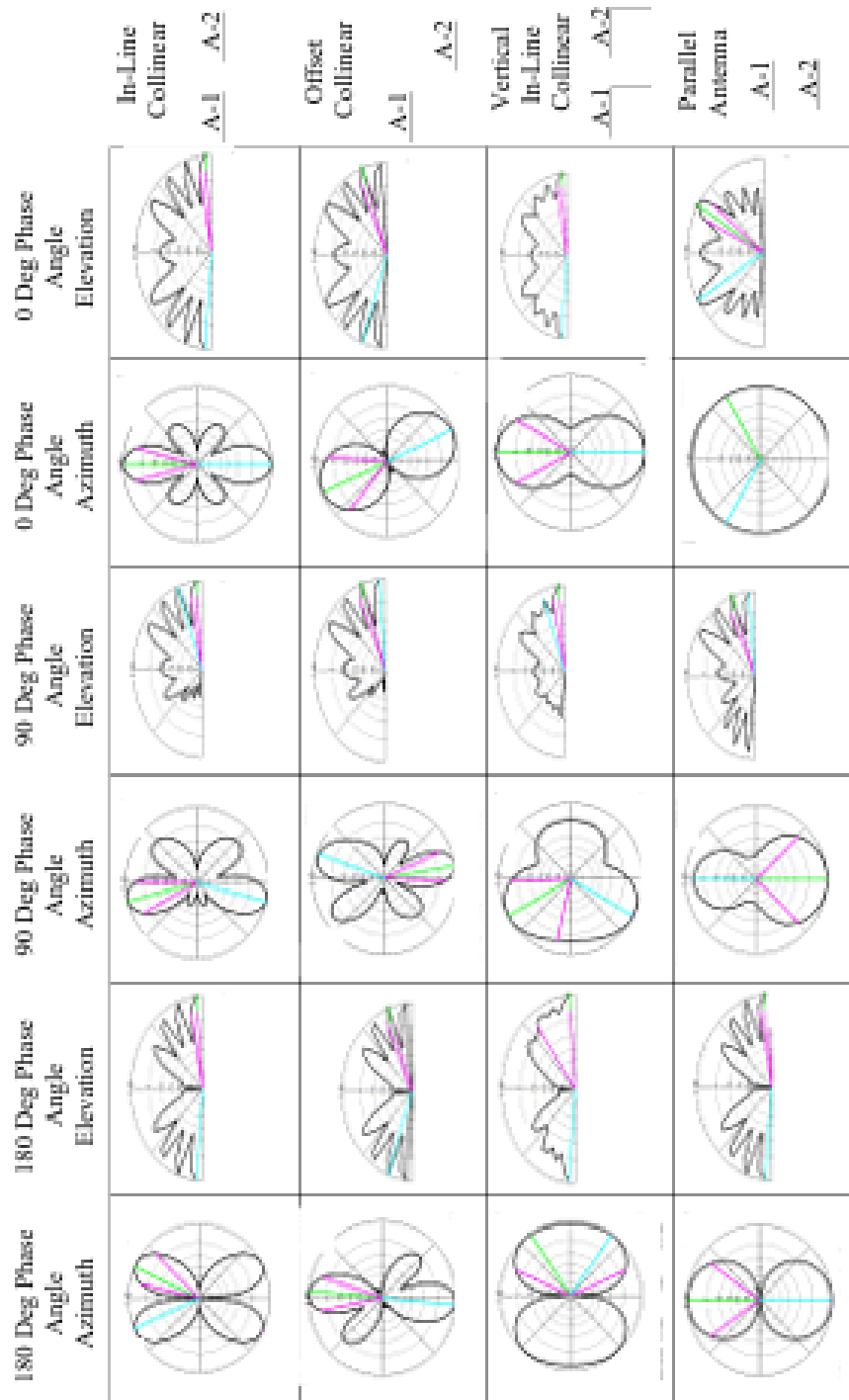
12 Meter Antenna Comparison Plot Chart

10 Meter Four Antenna Comparison Plot Chart



10 Meter Four Antenna Comparison Plot Chart

6 Meter Four Antenna Comparison Plot Chart



6 Meter Four Antenna Comparison Plot Chart

JERRY'S WORLD

What is guiding you? Faith or an unguided conscience	xxii
Courage requires action with no understanding of the end	2
Bravery requires action with an understanding of the end	4
A quality human being uses words to unite rather than to divide	8
Big money allows you to make big mistakes without feeling guilty	10
To err is human; to get even divine	12
Jesus never would have died if the 60 percent rule had been enforced	14
Photons are the building blocks of creation	16
My ladder is a couple rungs short, so I can get to heaven faster	18
Woman is better than man	20
A man is worse than a woman	22
Neither man nor woman understands the other	24
Spending time with children allows you to feel unburdened	26
Do not demand a child clean his plate; hunger knows what it knows	28
Fun can be very contagious; allow it to happen and get infected	30
How many whacked-out knuckle-headed nitwits do you know?	32
It seems every little bit of good wraps around a little bit of bad	34
The one bad thing you have done is how you'll be remembered	36
If you're at the fuse box, make sure you're standing on a dry board	38
The infinity above zero is mesmerizingly large	40
The infinity below zero is mesmerizingly large	42
Create logic to explain the unexplainable	44
The earth's magnetic core starts about 2000 miles down	46
Truth and morality must become what the other is	48
A gentle rain is God's reminder that life is good	50
The future is the past with a cleaner face	52
Faith softens disappointments	54

JESUS'S WORLD

Our Father	xxi
Which art in heaven	1
Hallowed be thy name	3
Thy kingdom come	5
Thy will be done in earth,	7
as it is in heaven	9
Give us this day our daily bread	11
And forgive us our debts	13
as we forgive our debtors	15
And lead us not into temptation	17
but deliver us from evil	19
For thine is the kingdom	21
and the power and the glory,	23
forever	25
A-men	27
The Lord is my shepherd; I shall not want	29
He maketh me to lie down in green pastures; he leadeth me beside the still waters	31
He restoreth my soul; he leadeth me in the paths of righteousness for his name's sake	33
Yea, though I walk through the valley of the shadow of death, I will fear no evil: for thou art with me;	35
Thy rod and thy staff they comfort me	37
Thou preparest a table before me in the presence of mine enemies: thou anointest my head with oil;	39
My cup runneth over	41
Surely goodness and mercy shall follow me all the days of my life:	43
And I WILL DWELL IN THE HOUSE OF THE LORD forever	45