Majors Field Amateur Radio Club
Greenville, TX

Volume 3, Issue 4
April 2015

AIRWAVES

INSIDE THIS ISSUE:

Special points of interest:

- 2-Meter Repeater Upgrade almost done.
- Antenna Restrictions got you down? Check out this article.
- VE Session May 19th to get your upgrade.

Repeater Upgrade

Greenville TX - The WD5GSL/R 2-meter repeater got a hefty upgrade on Sunday, as Jim Brown – W5ZIT delivered and installed a new transmitter, power supply and controller. The old transmitter was a mobile version of the GE MASTR II VHF transmitter. However, Jim provided the club with a new GE MASTR II BASE STATION transmitter. Along with the transmitter/receiver, we also got a new Power Supply and a new CAT 300DX controller as well.

The installation started on Sunday, April 19th when Jon Brown – WB5KSD, Scott Davis – KK7JS, Peter Van Horn – KA5YDC, Mark Bushnell – AE5FG and Michael Ketchum – K5MDK met up with Jim at the security desk to get the new equipment brought in. The install went very quickly, as all of the new repeater components came with a small rack cabinet. We removed the old mobile transmitter and controller and simply patched the new transmitter and receiver into the existing duplexer with two temporary cables.

There are some open items left to finalize the installation: (a) we need to replace the temporary coax cables with new cables of exact size. (b) we also need to find two keys for the new cabinet. (c) the controller needs some programming tweaking with regards to the club announcements.

We are really grateful to Jim Brown – W5ZIT for thinking of us when he came across this commercial repeater that was a great replacement for our 2-meter repeater here at L-3. Thank you Jim! ❖

Antenna Restrictions: How We Got Here and Where We Are Going

By: Stan Starks, NW5Q *{used with permission by the author}*

Recently we've been hearing a lot about antenna restrictions and legislation introduced in the U.S. Congress. From the PARK March meeting, it became clear to me that there is a significant amount of confusion about this topic and what the ARRL is really trying to accomplish. It's a topic that I have spent a lot of time researching, so allow me to attempt to bring some clarity to the matter. We all must have a common understanding to have any chance of successfully affecting change.

To get started, we have to understand that there are two types of antenna/tower restrictions. First comes the ordinances set by county and municipal governments. Second and usually much more oppressive are the Covenants, Conditions, and Restrictions (CC&R's) put in place by Home Owner's Associations (HOA's). At this time they are viewed (and treated) very differently.

A key FCC ruling is referred to as PRB-1 and dates back to 1985. It is still in effect today and provides considerable guidance to government bodies (but not HOA's). In Part 97, Section 97.15(b) provides a short summary of the 11 page document: *PRB-1 states that local governments must reasonably accommodate amateur radio operations, but they may still zone for height, safety and aesthetics concerns.* This is definitely not a blank check, but it does at least afford one the opportunity to present their case and get serious consideration for antenna or tower projects.

Now let's briefly look at TV antennas and small satellite dishes to see how they are treated. If we think back to the early 1990's,

Antenna Restrictions: How We Got Here and Where We Are Going

(Continued)

the FCC was anxious to migrate all of the off-air TV stations to digital (HDTV) because they wanted to vacate TV Channels 2-6 as well as some UHF channels.

You may not realize it and your HOA quite possibly doesn't realize it either, but they cannot seriously restrict satellite dishes under 1 meter in diameter, nor any type of outdoor TV antenna. The ruling allows you to put any outside TV antenna up to a height of as much as 12 feet above the roof line of your house, if needed. A summary of the ruling and a detailed Q and A is available here: http://www.fcc.gov/guides/over-air-reception-devices-rule. I've often jokingly suggested that hams in HOA's should just put their TV antenna up above the roof line and then "guy it" with a 40m inverted "Vee". Rest assured that we will never see this level of blanket accommodation for amateur radio antennas.

So what is all the recent hyperbole about? Well, bill HR-1301 has just been introduced in Congress which would direct the FCC to extend the PRB-1 guidance to apply to HOA CC&R's.

This would at least prevent HOA's from flat out prohibiting amateur radio activity and antennas. It would also permit us the opportunity to present our case to the HOA for antennas and hopefully negotiate some reasonable solution. Although the ARRL has significant support for this legislation, the National Association of Realtors, other realtor groups, all of the HOA management companies and others are vehemently opposed and are lobbying aggressively against it. With that level of opposition, coupled with this dysfunctional Congress, I think the chances of success are very slim at best. Still, if we don't try, we will surely never succeed. We need to do what we can to support it - detailed information for doing that is [at the end of this article].

Now on a more personal note, if you live in an HOA with antenna restrictions, let me suggest a far more proactive approach than just waiting for a "miracle" from Congress. While there are certainly significant differences between HOA's, my experience has been that most struggle to get participation. So, go to your HOA annual meeting and volunteer to be on the Board, or failing that, maybe get on the Architectural Control Committee. At least make an effort to get involved and you may find that there are opportunities to begin to influence things from the inside.

I say this because three years ago I reluctantly took that action and became my HOA's Board Secretary. A huge void had developed and I simply couldn't risk "crazy" people filling it. Once in place as Secretary, I volunteered to rewrite and simplify our Covenants. In the process I eliminated all antenna/radio restrictions (mostly outdated anyway) and inserted PRB-1 like language. It was seriously a lot of work, but just last month, my revised Covenants finally achieved enough community support to be approved and they will now be formally implemented.

Now, you will probably not be afforded such a great opportunity, but that doesn't really matter because my primary point here is that if you get involved with your HOA Board, you will automatically become an insider. When my HOA got the one and (so far) only complaint about my antennas, the Board didn't really want to deal with it, so I was personally given the opportunity to write the response for the HOA and completely deflect it. Now of course your mileage may vary. My HOA is small and perhaps not typical, but I still think if you are an insider you are much more likely dealing from a position of strength. Otherwise, you seriously run the risk of just being just another HOA victim. Please, get involved, what can it hurt?

For more specific information on the act, you can check out the ARRL's website at http://www.arrl.org/hr-1301.

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Club Meeting Minutes

Majors Field Amateur Radio Club

March 26, 2015

I. Meeting opened informally at 11:45

II. Announcements:
- a. VE Session on 3/31 – Req. Hall.
- b. Tech License Class 4/7 thru 5/12 on Tuesdays @5:30 in PD North Conf Room.
- c. Ad will be placed in E-Trader and flyers will be posted on L3 building doors.
- d. SVARA Meeting on 4/16 at 7pm on 2nd floor of Greenville Hospital.

III. Officer Reports
- a. Secretary / Treasurer – John Nelson – N0DFW
  - i. Minutes of last meeting passed out.
  - ii. Bank Statement Report balance presented ($939.05).
  - iii. 4-band 10/15/20/40 M Vertical purchased from DX Engineering for $187.95 (including shipping).
  - iv. Dues Collection discussed.

Meeting Minutes *(continued)*

b. Vice-President – Stephen Denison – W5SMD
   i. Need instructors for class.
   ii. Gordon West slides are available.
c. President – Michael Ketchum – K5MDK
   i. Discussed remote HF station needs.
   ii. Discussed need for a vertical HF antenna.
   iii. Need to make sure we can get computer on the network before spending any money.

IV. Old Business
a. None.

V. New Business
(See presidents comments above in section III item c.)

VI. Presentation
a. Mark Rice presented and discussed an interesting topic on "whisper mode" transmissions.

VII. Adjournment
Meeting adjourned at 12:45.

VIII. Members Attending

b.	Michael Ketchum	K5MDK
c.	Stephen Denison	W55MD
d.	John Nelson	N0DFW
e.	Victor Paul	WB0TEV
f.	Mark Bushnell	AE5FG
g.	Mark Rice	KK5MR
h.	Will Sanitate	

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Understanding Antennas For The Non-Technical Ham

Each month for the next year or so, I'll be printing excerpts of a book by Jim Abercrombie – N4JA on antenna design. This was a splendid suggestion by David Hunter – KC7CEX. The book is available on-line for free and can be located by Googling the title and the author's last name. Now, part 7…

A resonant antenna may still have SWR if its radiation resistance is not exactly 50 ohms. Not many resonant antennas have a radiation resistance of exactly 50 ohms, and most real antennas have a small amount of SWR. An antenna is resonant only at one frequency per band. It will also be resonant on its harmonic frequencies, where its radiation resistance will range from high to very high. Hams talk about using resonant antennas. What is meant by this is they use an antenna on its fundamental frequency close to resonance, the resistance is near 50 ohms, and the SWR without a tuner is near 1:1.

To calculate the impedance of an antenna with both resistance and reactance requires a mathematical procedure called the Pythagorean Theorem. That type of math is beyond the scope of this book. However, you should know how to use the Pythagorean Theorem to solve impedance problems on the Extra-Class test. Otherwise, you will have to memorize the answers from the question pool.

2. Feeding Dipoles Efficiently

For maximum power transfer from transmitter to the antenna, the antenna system must be resonant, and the resistance of the load (antenna system) has to be equal to the internal resistance of the source (transmitter). Notice we said an antenna system, not the antenna, must be resonant. As mentioned previously, an antenna system consists of the antenna, the feed-line, and any matching networks (tuners). A tuner at the input end of the feed-line can make a non-resonant antenna system resonant, and have a resistance of 50 ohms, and that matches the internal resistance of the transmitter. A tuner will not change the SWR between the tuner and the dipole part of an antenna system, and will not remove the reactance from the dipole.

When the load of an antenna system does not match the source and the impedance is high, the load will not draw power from the source and high RF voltages will be present at the output of the final transistors. In this case, high RF voltages can damage the output transistors of the transmitter. When the impedance of the load is low, too much of the power may be dissipated across the internal resistance of the transmitter possibly destroying the output transistors. These are the two reasons why transceivers "fold back" their power when the SWR is high.

<u>It is a myth that the dipole part of an antenna has to be resonant to be efficient</u>. When power reaches the radiating part of the antenna system, it obeys the "The Law of Conservation of Energy." The Law of Conservation of Energy states, "Energy can neither be created nor destroyed. Only its form can be changed." (What is important is to get the power to the dipole itself, because in some systems power is lost in the feed-line, especially when using coax with high SWR) The miniscule amount of power in the dipole that does not radiate is changed into heat, another form of energy. Because the dipole part of an antenna system is made of conductors with low loss resistance, 99% or more of the power reaching it will radiate regardless of its length if that length is reasonable. The loss resistance of the conductors of the radiating part of most antenna system is so low it can be ignored. (Short mobile HF antennas are an exception because they may be lossy because of the very high current flowing in them.)

Not all the energy fed into an antenna system will reach the antenna itself. If the system has a tuner, part of the power is lost in the inductor of the tuner and part is lost in the feed-line. When properly tuned, tuners using T-networks lose about 10% of the power and L-network tuners lose about 5% of the power being fed to them. Notice we said properly tuned. However, improper tuning of the antenna tuner may cause you to believe the feed-line is matched,

Understanding Antennas For The Non-Technical Ham

(continued)

when this happens there is a very high circulating current in the inductor causing it to get hot. This causes extremely high losses, and very little power reaches the radiating part of the antenna. In addition, so much heat is produced in the inductor that it can be damaged. We melted the plastic insulation that forms the inductor on one tuner this way. For this reason, some hams don't like tuners, preferring to use resonant antennas. Read the instructions for your tuner for proper tuning or you may wind up with a poor signal and a damaged tuner. The resistive losses in the conductors of the feed-line and the dielectric losses in the feed-line also rob power from the system. These are the reasons for you to use the best tuners and feed-lines possible.

Another loss to be considered is feed-line radiation. Any energy that radiates from the feed-line does not reach the radiating part of the antenna, and it may be absorbed by near-by objects and may not radiate in the desired direction. When coax radiates, it is called common-mode radiation. If the feed line can radiate, it can also receive signals. This can be detrimental because the coax can then pick up noise from near-by power lines, etc. Feed-line radiation will also destroy the directional pattern of a beam antenna. The causes of feed-line radiation will be described in the next section.

As we pointed out earlier, when you are using a half-wave resonant dipole fed with low-loss coax without using a tuner, almost all of the power coming out of the transmitter will radiate. On its resonant frequency, the dipole is one of the most efficient antenna systems a ham can use. However, a half-wave resonant dipole has a finite bandwidth. Why use a tuner with resonant antennas? On 160 and 80 meters the bands are wide compared to the percentage of frequency. The width of 80 meters is 500 kHz and its frequency is 3500 kHz. The width of 80 meters is 14% of the frequency. The 350 kHz of 40 meters is 5% of the frequency and most of the band can be covered without a tuner. The 350 kHz width of the 20 meter band is 350 divided by 14000 kHz, or 2.5 % of the frequency, etc. The percentage of frequency for a band will determine if a resonant dipole will work the whole band without a tuner. If you are planning to move around on 160 or 80 meter bands, it makes sense to have a tuner, because the bandwidth of resonant dipoles on those two bands is narrow. For example, the normal 2:1 SWR bandwidth of an 80 meter dipole is less than 200 kHz and the band is 500 kHz wide. However, if you have an antenna resonant for the voice portion of the band, you can still use a tuner to work the CW part of the band without inducing more than a dB of loss. Except for 40 and 10 meters, full-sized resonant dipoles on the rest of the HF bands will have enough bandwidth for them to cover the whole band.

The best place to insert a tuner is up at the antenna feed-point. However, if it is placed there, you wont be able to reach the tuners controls. Therefore, it is more practical to place it between the transceiver and the shack-end of the antenna feed-line. A piece of 50-ohm coax connects the radio to the tuner. With the tuner located in the shack, adjustments can be made. Remote automatic antenna tuners can be placed at the antennas feed-point, but the disadvantage of them is that the ones available today will not handle high power.

A coax-fed dipole and a tuner should not be used to feed an antenna on its even harmonically related bands. The even harmonics are 2, 4, 6, etc, times the fundamental resonant frequency. If an 80-meter antenna being fed with coax through a tuner is used on 40 meters, it will put out a weak signal because the SWR will be around a hundred to one. Coax has a tremendous loss with SWR this high. Only a few Watts from a hundred-Watt transmitter will reach the antenna. However, you will be able to make contacts with those few Watts. If you want to use any antenna having high SWR, ladder-line has much less loss than coax. If you feed an 80-meter dipole on 40 meters using ladder-line and a tuner, it will only be slightly less efficient than a half-wave 40-meter coax-fed resonant dipole. However, the SWR will still be high between the tuner and the antenna, but this doesnt matter since ladder-line has an insignificant loss. Since the feed-point impedance will be high, the SWR will only be about 9:1 in the ladder-line because ladder-line is a high impedance feed-line.

Extremely short antennas may not work at all because of the above mentioned reasons. To reiterate, the extremely high capacitive reactance may make it impossible for its reactance to be tuned out and reactance prevents a transmitter from delivering power to the antenna. Even if you are able to tune out the capacitive reactance, tuning it out requires an inductor and most of the power will be lost in the inductor. Do not take the statement about the Conservation of Energy to mean you can put up any piece of wire and it will radiate your entire signal.

3. The Cause of Feed-Line Radiation

Contrary to popular myth, SWR in a feed-line will not cause it to radiate. The cause of feed-line radiation is unequal current in the two conductors of the feed-line. What are the causes of unbalanced current in a feed-line? They are an unbalanced feed-line feeding a balanced antenna; the feed-line being brought away from and parallel to one leg of the antenna; the antenna not being fed in its center; and one leg of the antenna being close to metal objects. In coax, unbalance causes RF to travel on the outside surface of the coax shield, and the shield radiates. When everything is balanced, coax normally has current flowing on its center conductor and on the inside of its shield. The shield prevents it from radiating.

Ladder-line will also radiate when it is fed from the output of a tuner not having a balun. Baluns are discussed in the next section. Since the output of a transceivers tuner is unbalanced and feeding ladderline directly from your transceivers tuner, the currents in the ladder-line will not be balanced. When balanced, ladder-line has equal currents with a 180-degree phase difference, which produce waves

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(continued)

that null each other out, and no radiation takes place. Hams mistakenly refuse to bring ladder-line into the shack because of a fear of feed-line radiation, but ladder-line does not radiate when balanced. The simple cure for feed-line radiation is to use a balun at the antenna feed-point for coax and a balun at the output of the tuner when using ladder-line.

4. Baluns

The word "Balun" is a contraction of " balanced to unbalanced." It is pronounced "bal un" like "bal" in "balanced and like "un" in "unbalanced". Many hams mistakenly pronounce an "M" at the end of the word making it "balum." A balun transforms the unbalanced transmitter output to a balance feedline such as ladder-line. It is also used to connect an unbalanced feed-line such as coax to a balanced dipole. In the latter case, the balun is located at the antenna feed-point and is constructed so the balun takes the place of the center insulator.

There are two kinds of baluns: voltage baluns and current baluns. They both accomplish the same thing. The difference in baluns is in the way they are wound. A voltage balun produces equal voltage with opposite polarity at its output. As its name implies, a current balun provides equal currents with opposite polarity at its output.

Running the coax through ferrite beads can make a 1 to 1 current balun. In addition, you can build a 1 to 1choke current balun by winding 8 to 10 turns of coax around a two-liter soda bottle and placing the coiled coax at the antenna feed-point. Any balun is designed to "divorce" your antenna from the feed line. It is used to prevent common mode radiation of coax, which makes the coax to be part of your antenna. You want it to be able to deliver all your power to the radiator itself. A choke balun does this perfectly, without using any ferrite beads or toroids. In most cases common mode coax radiation does not occur when a balun is not used, but it is preferable to use one to be safe.

Other baluns provide a step-up or step-down impedance transformation. A 4-to-1 balun steps up the impedance four times. It will transform a 50-ohm impedance to 200 ohms. This type of balun transformer is used at the output of tuners to increase the tuning range of a tuner 4 times. If a tuner without a balun can match 500 ohms, a 4-to-1 balun will increase the range of impedances it can match to 2000 ohms. Many hams think the 4-to-1 balun is used to match 50 ohms to 450-ohm ladder-line but it is not. It would take a 9-to-1 balun to match 50 ohms to 450 ohms, and it is not important to match the impedance to ladder-line.

A balun should always be placed at the input end of ladder-line or open wire feeders to prevent feed-line radiation. When using ladder-line a step up balun is commonly used although a 1:1 balun will work.

X. OTHER TYPES OF DIPOLES

1. A Shortened Dipole Using Loading Coils

If you are unable to put up a full-sized dipole on your property, putting loading coils into the dipole could shorten the antenna. See section IX, part 1. A short antenna has capacitive reactance and the capacitive reactance can be tuned out with a coil. The overall length of the shortened antenna will be determined by the amount of inductance in the coil. Pre-tuned antennas of this type are available from at least one manufacturer. The main problem with loaded antennas is they are very narrow banded. If the loading coils are wound with small diameter wire, the coils may introduce unwanted loss into the antenna. Loading coils can also be found in shortened vertical antennas for high frequency (HF) mobile use.

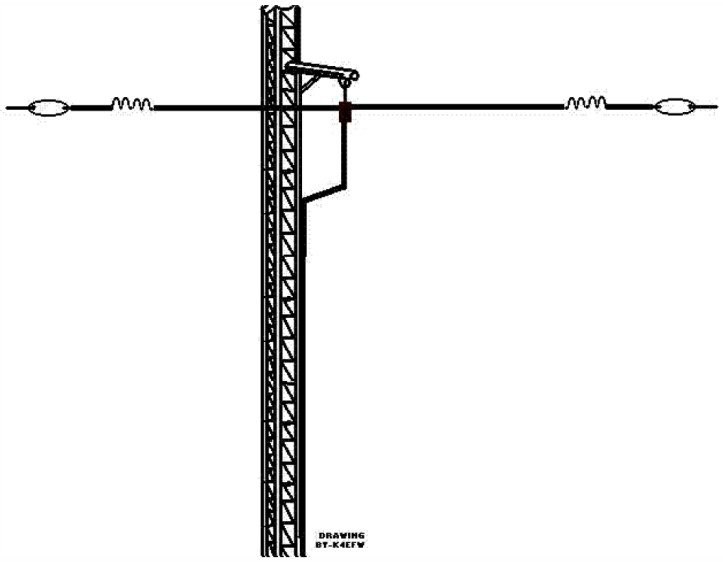

Figure 5. A Shortened Loaded Dipole

2. All Band Dipole

In the figure below, a dipole is cut to a half wave on the lowest band you want to operate. Feeding it with ladder-line and a tuner makes it possible for you to work all the other higher bands. The only losses in this antenna system are the loss in the tuner and the very small loss in the ladder-line. This system is more than 90% efficient. As mentioned above the balun in the tuner will be used, or if your tuner doesnt have a balun, an external balun can be connected between the tuner and ladder-line with a short run of coax. Four-to-one baluns are the most commonly used ones for this arrangement.

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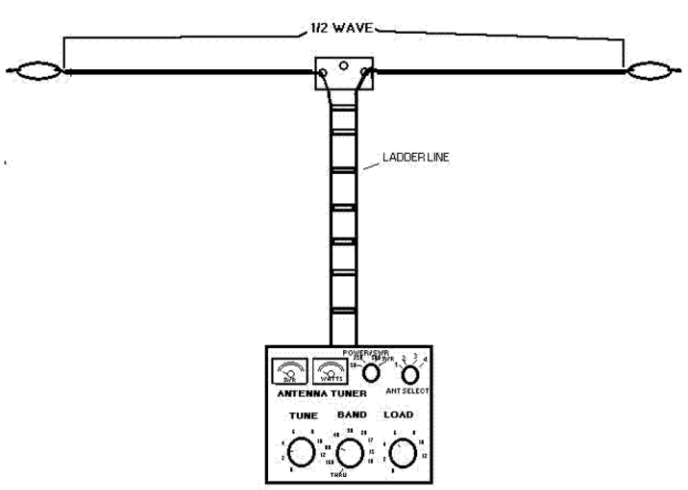

3. The Sloping Dipole

A lower angle of radiation can be achieved by tying one end of a half-wave dipole to a high support and the other end near the ground. It is fed with or without a balun with 50-ohm coax. The sloping dipole will show some directivity and have low angle gain in the direction of the slope. More directivity can be gained if the dipole is strung from a tower, and the tower is acting as a passive reflector. The sloping dipole is mostly a vertically polarized radiator and it works well for DX. Since the sloping dipole is fed in its center, it does not need to be grounded to the earth as a quarter-wave vertical does. Make sure the bottom end of a sloping dipole is at least 10 feet above ground because like all dipoles there is high RF voltage on its ends.

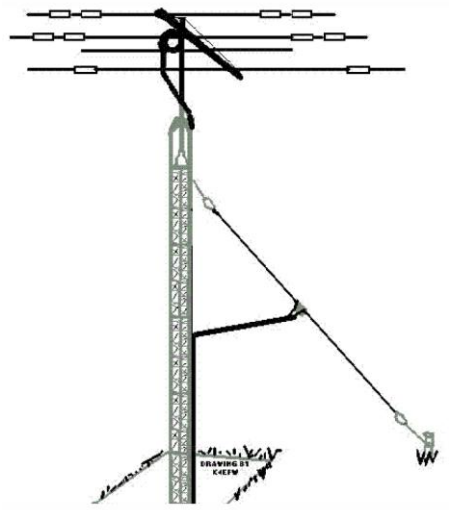

Figure 7. Half-Wave Resonant Sloping Dipole

In the picture above, the field of maximum radiation is in the direction of the slope or toward the right side of the picture. The formula for the length of a sloping dipole is the same for any half-wave resonant dipole.

4. The Folded Dipole

The B&W Company makes a folded dipole that claims to have a good match on all bands and it does. However, on the low bands much of the power is burned up in the resistor that connects the two ends together. The power going toward the ends encounter the resistor and is consumed as heat. All that power is lost and does not radiate, and no power is reflected back to the feed point making the antenna have low SWR. On the higher bands, a large part of the power radiates before it reaches the resistor and the antenna is moderately efficient on those bands. On 80 meters the 90 foot-long dipole model will produce a signal at least 10 dB lower than that from a resonant dipole.

If you remember the single channel TV antennas used years ago, the driven element was a folded dipole. Folded dipoles are very broad-banded. That is the reason they were used for TV antennas since a TV channel is 4 MHz wide.

When constructing a folded dipole, the formula for calculating the length of it is the same as for any dipole. The folded dipole consists of two parallel conductors with the ends tied together. The conductors can be spaced from less than an inch to more than two inches apart when made from TV ribbon or ladder-line. At the ends, strip the insulation back several inches, Twist the bare wires together, solder them, and run them through insulators. The feed-point is in the center of only one of the two parallel conductors.

The feed-point impedance of a folded dipole at resonance is close to 300 ohms resistive and can be fed directly with 300-ohm TV twin-lead or a tuner with its balun. This antenna was very popular years ago when coax was expensive and 300-ohm TV twin-lead was relatively cheap. A length of 450-ohm can be substituted for the twin-lead. An alternate feed method is placing a 6:1 balun at the feed-point and then feeding it with 50-ohm coax. The folded dipole will not radiate its second harmonic, so it is not good for a multi-band tuner-fed antenna.

To be continued next month

Amateur Radio Entry-Level FCC License

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Consider getting your

FCC Amateur Radio License

Classes each Tuesday, April 7th through May 19th at 5:30pm

These classes and the FCC License Exam are provided FREE of charge by the Majors Field Amateur Radio Club

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Go to www.wd5gsl.org for more info

If interested, e-mail classes@wd5gsl.org or call (903) 457-4127

Calendar

2015

April

30 MFARC Meeting PD North Conference Room at 11:45am

May

5 Technician License Class 5:30pm @ PD North Conf Rm

12 Technician License Class 5:30pm @ PD North Conf Rm

19 **VE Session @ HCR Hospital Conf Rm at 5:30pm.**

21 SVARA Meeting at 7:00pm at Hunt Regional Hospital

28 MFARC Meeting PD North Conference Room at 11:45am

June

12 HamCom (ARRL West Gulf Convention) – Irving, TX www.hamcom.org

13 ARRL June VHF Contest

18 SVARA Meeting at 7:00pm at Hunt Regional Hospital

25 MFARC Meeting PD North Conference Room at 11:45am

27 Field Day 2015

REGULAR ACTIVITIES

Daily DFW Early Traffic Net (NTS) at 6:30pm 146.88 – PL 110.9Hz

Daily DFW Late Traffic Net (NTS) at 8:30pm 146.72 – PL 110.9Hz

Daily DFW CW Traffic Net (NTS) at 7:00pm and at 10pm on 3541 KHz www.k6jt.com

Thurs Sabine Valley Amateur Radio Association Net Every Thursday night at 7:00pm on the K5GVL/R 146.780 MHz (+) PL 114.8Hz

Friday **Majors Field Amateur Radio Club Talk-In Net** Every Friday morning on your way in to work or on your way home on the WD5GSL/R 147.160 MHz (+) PL 100.0Hz

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We're on the Web!

See us at:

www.w5gsl.org

Your article submissions are welcomed. Please submit to **editor@wd5gsl.org**

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Club Station

Club Station: TBD

VHF Repeater: WD5GSL/R
147.160 MHz (+) PL 100.0 Hz
Friday Morning Talk-In Net

UHF Repeater: WD5GSL/R
444.625 MHz (+) PL 151.4 Hz
Temporary Antenna Position Limits Range Currently

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