



President-Mark Hetherington - KF5KUW    Vice-President-James Hunt - KI5DQ    Secretary-Sarah Richardson – KI5PZF

Treasurer-Sharon McEachern – KK5SM    Trustee- Dr.Mike Durbin - K5MJD

# Fannin County Amateur Radio Club

## K5FRC

Volume 1 Issue 8 - August 2023

### AUGUST 2023 K5FRC TREASURER'S REPORT

Currently, the club has a balance of \$4,448.43 in its checking account and a balance of \$224.09 in its savings account. Since our last club meeting, the club has had the following deposits and expenditures: A deposit of \$144 on 7-20-23 included two individual memberships of \$24 from Bob Irish and Keith Schoenefeld. WELCOME!!! Also from this deposit was \$96 from monies collected at the last club's meeting antenna raffle.

The club has had 2 expenditures since last month's meeting. They are as follows:

USPS PO Box of \$70

Gail Young/Tax Assessor for trailer tags of \$59.75.

I will also send out an updated roster prior to our next meeting to include our new members.

Reminder: If you need to renew your ARRL membership, you can do so through the club and the club will receive a commission from ARRL. I will have the forms at our next meeting.

73's,

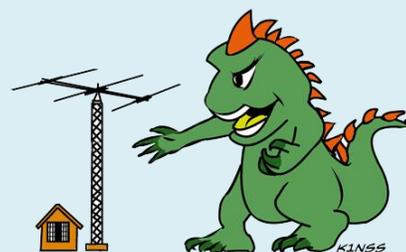
Sharon  
KK5SM

Sent from my iPhone

### The Origin of Q Codes

The original Q-signals were created in the early 1900s by the British Postmaster General for use by British ships and coast stations. They proved to be so useful, however, that radio operators worldwide began using them. One reason they proved to be so useful is that they can even be used by operators speaking different languages. When an English-speaking operator receives **QTH?** they understand it to mean, "What is your location?"

At the Second International Radiotelegraph Convention in London in July 1912, the delegates adopted a list of 45 different Q-codes. Many are no longer in use, but, many, such as QTH, QSY, QRM, and others, are still used today more than 100 years later.



### K5FRC REPEATERS

**145.470 (100Hz tone; -600Khz offset)**  
**C4FM or Analog; IRLP 3602;**  
**ECHOLINK 143903**

Tuesday Night Net 8:00 PM

442.525 (100HZ TONE; +5.0 Mhz offset)  
C4FM or Analog;

443.750 (100Hz tone; +5.0Mhz offset)  
C4FM or Analog;

FCARC meets every third Saturday at  
9:00 AM at the Bois D'Arc Creek  
Cowboy Church

ZOOM sessions are held every Tuesday  
at 7:00 PM CST before the net on the  
145.470 Mhz repeater. Website:

[www.k5frc.org](http://www.k5frc.org)

Facebook: [www.facebook.com/K5FRC/](https://www.facebook.com/K5FRC/)

Mark, KF5KUW is the administrator.

Website: [www.k5frc.org](http://www.k5frc.org)

## *President's Report*

President's Report  
August 2023

As I contemplate what to write about this month, my first thoughts are about who we lost from our club this past month. Bill Purcell, KF5GJY (SK), was a long-time member of our club. He was our club's Treasurer for a number of years, but more importantly, he was our friend and a noticeable part of our family.

When I think upon the numerous memories I have of and with Bill, I can both laugh and feel good inside. I remember when one Field Day, it was hotter than the dickens (for those of you in Texas, like it is now), and although we were in the shade with a light breeze blowing, we were all fading fast from the heat that afternoon. Then Bill shows up with a couple gallons of Blue Bell ice cream, a package of bowls, spoons, and a couple ice cream scoops. We all felt so much better afterwards! And when we thought he had gone home for the day, he comes back with several large bags of ice and refills all the coolers.

At the last club meeting he was able to attend before his health failed him, we were discussing the importance and need to put radios and antennas into the Volunteer Fire Departments around the county. The club was going back and forth with one another, as we were considering building some J-Pole antennas for this need. Bill speaks up, and challenges the club to match his donation, as he was giving \$100 to the club to help offset the expenses associated with building these. This inspired our club members to also give donations towards this great cause, and the club also had voted to approve the funding for this project.

I would like to ask the club to consider recognizing Bill for making these J-Pole antennas available to help out our VFD's, and for helping make this happen. And I encourage everyone to remember Bill in your own way, share your memories and good times with the rest of us, and as Bill used to remind us every time when he led our prayer starting our meeting, remember our veterans and those in harms way, who bravely put themselves in harms way so that we may remain free.

I had to stop for a bit after writing the text above, as the memories just kept coming and coming.

We are now into the hottest part of the summer around this neck of the woods, with 100+ degree days happening way too many times. Added to this our higher moisture levels, and the heat index can and has gone over 120 degrees. This is DANGEROUS heat, so please take extra precautions, drink lots and lots of water (can there be too much water being consumed?), stay in the shade as much as you can, and apply a damp or wet cloth to your neck and head if you start getting impacted by the heat.

Lastly, I would encourage everyone to spend more time inside on your HF radios making contacts all over the bands. If you don't have an HF radio, reach out to others in our club who do have them, and see if you can come join them for some fun. And those of you with just a Technician license, remember that you also have privileges on 10 meters, which has often been open around the world. That is one of my favorite bands, and I have enjoyed making contacts with Africa, Europe, Australia, New Zealand, Indonesia, and Japan.

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## **SECRETARY REPORT**

Fannin County Amateur Radio Club

Meeting minutes for 7/15/2023 at the Bois d'Arc Creek Cowboy Church.

The meeting was called to order at 9:07 AM by president, Mark Hetherington, KF5KUW. After Mark lead the pledge of allegiance Roy Riales, KE5WDG was asked to lead the invocation/opening prayer.

New members: Keith Schoenefeld (AA5KS), and Bob Irish (K5ZOC) For the benefit of our new members, Mark Hetherinton had those in attendance go around the table and introduce themselves. Each member gave their name, call sign, where they live, how long they have been with the club, and affiliations like RACES or Skywarn. As part of the introduction, Mark went over the requirements for RACES. The Fannin County Sherriff's Office now requires RACES certification to operate in the Fannin County EOC. Skywarn certification must be renewed every two years. A course will be taught in Fannin County next year (2024), and every other year going forward Advance classes are only available online, and best options are to also look at Norman OK NWS site for these.

1) Old business and reminders for upcoming events.

- Field Day at Lake Fannin.

Mark Hetherington commented that the overall review of the recent field day was positive. Kudos for cooks Mike Lindsey, KD5UNY and Bob Yakel, KG5KKE. There was a request that summer field day be held at the Bois d'Arc Creek Cowboy Church next year "because there is air conditioning" although it was very hot, the event was a success.

- Juneteenth antenna repairs at TMC Bonham.

Ralf Borgarht, KI5LVS briefly presented what was accomplished. Sarah Richardson, KI5PZF and Mark Hetherington, worked with Ralf on the project. The project is incomplete. The coax cable was heavily water damaged and will need to be replaced. Also the beam antenna on the tower needs to be adjusted so there is no interference from the roof. Beam needs to be raised higher on tower to lower high SWR caused by being too close to building roof. The hospital has no budget to replace the coaxial cable. We need 200' of weather proof coaxial cable to complete the project. Keith Mumaw, KI5VNL suggested buying cable from a discount warehouse or online. Bob and Dee Dee Yakel (KI5VFV) checking out ADR industries in Houston Texas for pricing. The topic will need further discussion after more information about pricing for parts becomes available. We will need to schedule another session to complete repairs to the antenna at TMC Bonham.

- October 7<sup>th</sup> Autumn in Bonham

FCARC will be responsible for all communications during this event. Keith Mumaw needs volunteers for every rest stop on the route(s) and SAG wagon pickup with APRS radio. Kieth Mumaw is coordinating volunteers at the rest stop and will be making list for rest area coverage. Email Keith if you are interested in participating. This year, the club will be running live video from the Bois d'Arc Lake Administrative Center. Live video will go to Bonham Chamber of Commerce building downtown.

There will also be lots going on at the Bonham square. Next year Lake Ralph Hall will be featured as part of the bike rally.

- October club meeting at Coffeemill Lake

Mark Hetherington reminded us that this year is a “go kit” contest year. This is an opportunity to attract visitors and for publicity. Keith Mumaw suggested that everybody should bring something that they built, ready to go and have a club contest for the best go kit.

- Skywarn

Mark Hetherington reminded us to keep our radios on during hazardous weather, monitor, report, and be ready to go out if needed. The county does not have 100% communications after the outages during the last episode of storms.

- Sarah Richardson is in Maine vacationing. Duncan Berry, KG5NDO will be taking notes for club meetings for July and August.

1) New Business, club officer reports, and ongoing projects.

- Bill Purcell, KF5GJY is not doing well. He has been diagnosed with stage 4 pancreatic cancer. If you want to reach out him, at 817 793-9600 and his daughter will share it with him. Text only please.
- Vice President, James Hunt, KI5DQ

- Following up on a post to the group email, James explained the dangers of plastic, uncertified, and “daisy chaining” power strips. If you want to keep your equipment, ground properly and use certified power strips.

- Discussion: Cell phones, cars, and auto insurance. Not all cellular coverage will give your exact location. Not all services will have access to the same towers. Be aware of differences in 911 coverage.

- Trustee: Mike Durbin,

-Treasurer’s report: Sharon McEachern, KI5NJZ is away, getting a child settled in college in Austin. The club’s treasurer report is included with the newsletter attached to Fannin hams or the website.

- The IRLP/Echolink issue has been repaired and the crosslink between the repeaters is operational. The NWS has not confirmed the problem has been fixed (yet).

- J-Pole project

-Keith Mumaw gave a brief overview of the project. Pending the approval and participation of local fire chiefs, the club will lend the antennas to all local fire departments. The antennas will enable any operator with a hand-held to communicate with a repeater in-county. This will provide emergency communications in the event of an outage or supplement communications. The local fire departments will also be able to receive information directly from the NWS. We will train fire department personnel.

-The club started to assemble the antennas at the last field day at Lake Fannin. Duncan Berry took the parts home, and, Duncan Berry and Bob Yakel (for the most part) finished the antennas. Keith Mumaw took the antennas and will complete them. The antennas only needed a wire to connect the coax center, final soldering of some parts, and tuning.

-Mike Durbin and Bob Yakel brought up the possibility of using magnetic mount omni's where the J-pole may not be feasible.

- Mike and Jody Lindsey will retire from cooking for club events. We will need someone to step up.
- Keith Shoenefeld asked if we were offering a Technician class. We can start a new technician class anytime for those who are interested. Contact Mark Hetherington
- Fund Raiser for Evan

-Evan Brown, a Honey Grove firefighter was critically injured on the way to a call on June 9<sup>th</sup>. He remains in critical condition at Medical City in Plano. A fundraiser to help with medical costs is scheduled on August 5<sup>th</sup>. Fighting for Evan! 2-9 PM at Four 31 Venue in Honey Grove. See Facebook for details- posted in the "what's going on", Fannin County page.

## 2) Items brought up for a vote.

- Following club officer reports. Mike Durbin asked if those present had read the club newsletter and the minutes of the last meeting. Mark Hetherington asked for a motion to accept the minutes. Keith Mumaw made the motion. Mike Durbin seconded the motion. There was no further discussion of last meeting's minutes and the motion passed with a unanimous vote by all club members present.
- Following discussion of new business, club officer reports, and ongoing projects, Mark Hetherington asked for a motion to adjourn. Keith Mumaw made a motion to adjourn, Fuzzy Vaughan, W5FZY seconded. With no further discussion, the motion was carried with a unanimous vote and the meeting was adjourned at 10:15 AM.

Following the meeting there was a raffle, Mike Durbin raffled the club's Hustler 6BTV antenna. This is a good 6 band HF vertical antenna. Anybody who signed the guest book at the field day at Lake Fannin, or made five contact got a ticket. (Also \$1/ticket at the meeting). New member Keith Schoenefeld walked away with nice antenna.

Submitted by Duncan Berry  
7/16/2023

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## VICE PRESIDENTS REPORT

13August2023  
James Hunt - KI5DQ  
Vice-President and Safety Officer

### **Summer Time safety tips and awareness.**

#### **2023 SKYWARN Schedule**

The National Weather Service (NWS) SKYWARN Program is now complete.

<https://www.weather.gov/fwd/skywarnmap>

Your NWS certificates are good for 2 years.

The K5FRC 145.470- and 442.525+ repeaters have SKYWARN nets during inclement weather events. They have direct link to the NWS.

#### **The Lithium-Ion Battery – a real experience....**

A few years ago, was recharging a Lithium-Ion battery (name brand and charger) within the garage and on the concrete floor... Safety Safety Safety.

The battery started smoking tremendously, unplugged the charger and thrown out onto the driveway. Later took the “name brand” battery apart, observed two of the deformed cells.

Power tools, LED lighting, automobiles, and the increase in everyday electronic devices have demanded the production of lithium batteries and, therefore, lithium battery storage.

The demand for lithium-ion (Li-ion) batteries is predicted to grow.

According to a blueprint report by the US Dept of Energy Federal Consortium for Advanced Batteries, the lithium battery market is predicted to grow by a factor of 5 to 10 by 2030.

Because lithium-ion batteries can store large amounts of energy, fire and explosion risks are high.

Lithium-ion batteries are known to spontaneously ignite and pose fire hazards due to overheating from poor battery design, damage to the battery through a drop or strike, electrical shorting, overcharging, rapid discharge, or increased storage temperatures.

Li-ion batteries contain lithium metal, which is highly combustible.

Safety issues induced by electrical abuse. When a battery is in an overcharge or over-discharge state, or is undergoing an external short circuit, it experiences electrical abuse, and a series of undesirable electrochemical reactions occurs in it.

There are many reasons for battery overcharging. One of the main reasons is the inconsistency of battery cells. If the voltage of any battery cell cannot be effectively monitored by the management system, there will be risks of its overcharging. Since excess energy is stored into the battery, overcharging is very dangerous.

Typically, all batteries are first charged to a specific SOC, but some batteries initially have higher SOC before charging.

Thus, such batteries would become overcharged if they are charged any further.

Overcharge is the most dangerous types of electrical abuse and one of the most frequently observed reasons for LIB safety accidents.

The other two types of electrical abuse, over-discharge and external short circuiting, are relatively benign and do not cause instant and fast-developing accidents.

They can, however, still impair a LIB's state of health (SOH).

"Elevated temperatures can accelerate degradation of almost every battery component and can lead to significant safety risks, including fire or explosion".

"If a laptop or cellphone is noticeably hot while it's charging, unplug it. Minimize exposure to low temperatures, especially when charging."

Batteries should also be routinely inspected to make sure there is no cracking, bulging or leaking, and people should always use the charger that came with the device or use one from a reputable supplier.

When charging an electric scooter or bike, it should always be done out-doors and away from any combustibles.

Always use the designed charger for the batteries.

Always purchase name-brands, never knock-offs.

Always charge cool battery, never a hot battery.

Ambient temperature should be 85 degrees maximum.

Thanks n 73,

James

KI5DQ



## **Trustees' report**

Simple report **All systems are up and operational**

### **NOW FOR TRUSTEE FUN INFO**

#### THE EFFECTS OF VSWR ON TRANSMITTER PERFORMANCE AND RADIATED POWER

by

Mike Durbin Ph. D. E.E.

K5MJD

"Your VSWR should be as close to 1:1 as possible, otherwise " you won't get out very well." Have you heard that one before?

A 1:1 VSWR implies a perfect match between the transmitter coax and antenna. The only problem is that it is possible to have a low VSWR and still have a very poorly radiated signal. My dummy load is 1:1 and doesn't get well at all. VSWR is not an easy concept to understand

Early in electronics you learned that to get maximum power into an antenna required that the impedance match the transmitter impedance This is true of antennas and transmitters as well but what about handy talkies with NO feedline? (That is another story I think you will understand better at the end of this article.) The antenna is usually located some distance from the transmitter and requires

a feedline to transfer power. If the feedline has no loss, and matches BOTH the transmitter output impedance AND the antenna input impedance, then - and only - then will maximum power be delivered to the antenna. In this case the VSWR will be 1:1 Anything other than a perfect match will cause a "standing wave".

There are several ways VSWR, (also known as reflection coefficient, reflected power, transmitter power loss, and return loss) or its effects can be described and measured. The proportion of incident (or forward) power, which is reflected toward the transmitter by a mismatched antenna is called, reflected power, and is determined by the reflection coefficient at the antenna. The reflection coefficient "p" is simply a measure of this mismatch seen at the antenna by the feedline and is equal to:

$$P = (Z1 - Zo) / (Z1 + Zo)$$

Here Z1 is the antenna impedance and Zo is the feedline impedance. Both Z1 and Zo are complex numbers so "p" is also a complex number. Remember from AC mathematics that a complex number has a "phase angle" associated with it. The phase of the reflected signal will be advanced or delayed depending upon whether the antenna appears inductive or capacitive to the feedline. If the antenna appears inductive the voltage will be advanced in phase, and if the antenna is capacitive, the voltage will be retarded. The reflective signal travels back to the transmitter and adds to the incident signal at that point.

As the two travelling waves pass each other in opposite directions, they set up an interference pattern called a "standing wave". At certain places on the feedline the voltages will add producing a voltage maximum, and at others their relative phase difference will cause a voltage minimum to exist on the feedline. These maximum and minimum points occur ¼ wavelength apart. VSWR measurements on coax are usually made at the transmitter end of the feedline. Therefore, you are presented with the VSWR of the entire system which includes all losses associated with the system. This causes us to get readings not necessarily true of the actual antenna performance. Those of you with remote sensing VSWR meters with the sensor mounted at the antenna are the only ones getting a true VSWR measurement.

Many VSWR meters are calibrated to read FORWARD power as well as REFLECTED power. They may actually be measuring voltage, and simply have the scales calibrated in power. The important point is to understand what the meter is telling you. Assuming for the moment that the VSWR meter contributes no errors, the FORWARD reading is the SUM of the forward power and the reflected power. As a result, it is greater than your actual power output. The REFLECTED power reading is that amount of power which was not initially absorbed by the antenna and has been sent back down the feedline. At the transmitter end it encounters the transmitter output circuitry and is re-reflected towards the antenna. This happens because you do, in fact, have a VSWR greater than 1:1 as seen by the transmitter. When the re-reflected power encounters the antenna, a portion of it is absorbed and the whole process starts over again.

The fact that feedlines have losses and, antennas have something called radiation efficiency are what make proper interpretation of VSWR important. Power is lost due to feedline attenuation and this loss goes up as the VSWR goes up. The efficiency of an antenna is determined by the ratio of its "radiation resistance" to its "loss resistance". Antenna efficiency can simply be described by the following equation:

$$\% \text{ Efficiency} = [Ra / (Ra + Rloss)] \times 100$$

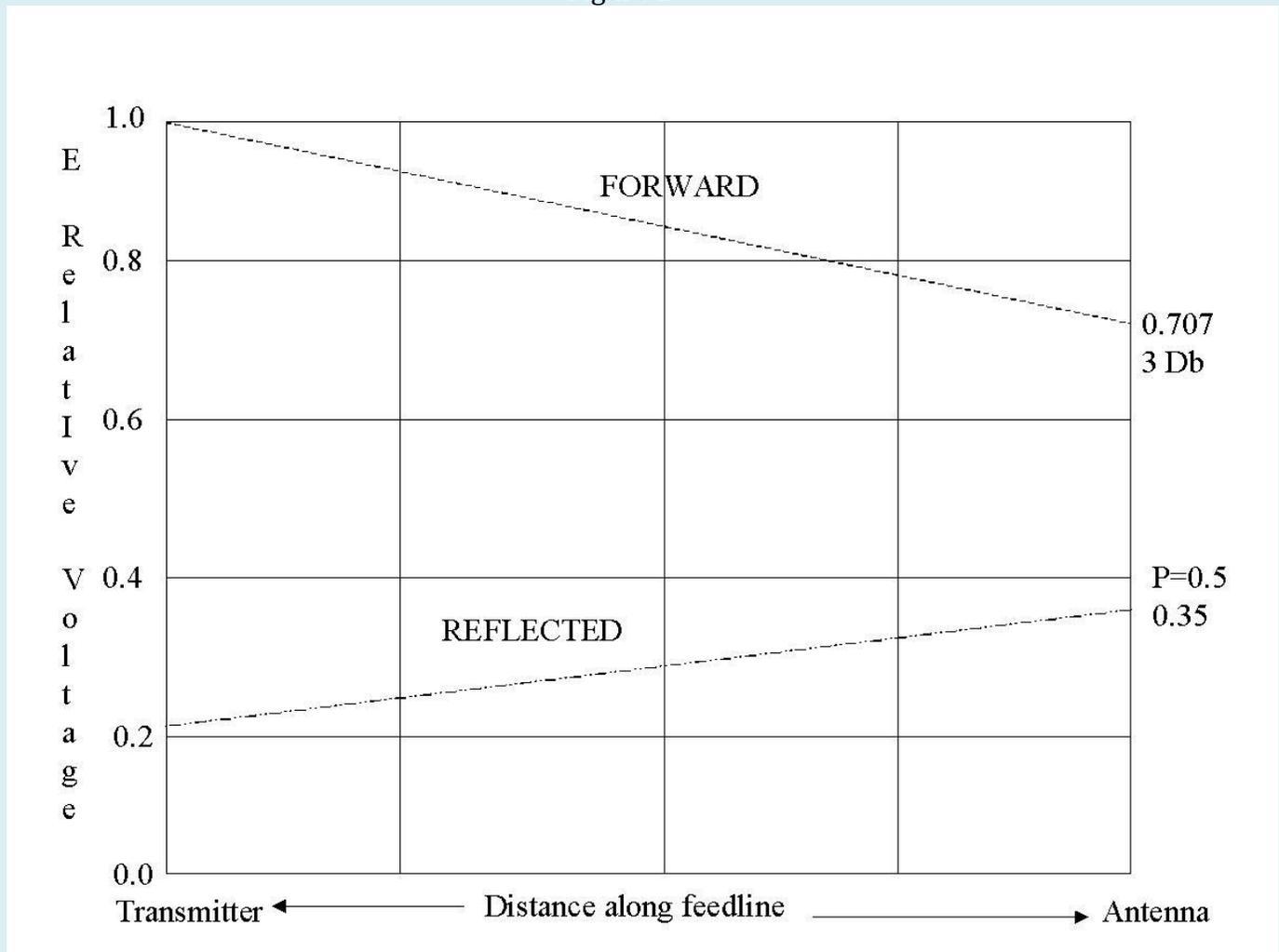
The radiation resistance is Ra, and Rloss is made up of any associated losses of the antenna such as loading coils and ground systems. How well you "get out" therefore depends more on low losses and efficient antennas than on what your actual VSWR is as the following example will show. Also

remember that radiation angle has a lot to do with the actual distance and direction your signal travel. Things like incidence angles of reflection for HF and take off angles for higher frequencies also affect your antennas performance. i.e. Try and use a low angle repeater antenna to talk to a satellite directly overhead and you will see that no matter how good your antenna is for low angles the satellite signal goes away when overhead.

## THE EFFECTS OF ATTENUATION ON VSWR

I said in the beginning VSWR may appear to be very low and yet there could be serious things wrong with your antenna system. Dummy loads? Figure 1 shows how this can happen. The curves in the figure represent the forward and the reflected voltage on an antenna which has a feedline loss of 3 dB, and a reflection coefficient of  $p=0.5$ . In this example the actual value of voltage is "E". We are only interested in relative values of "E" so any actual number is not important. The length of the feedline is not important since I am only concerned with the total loss between transmitter and antenna.

Figure 1



The signal voltage "E" starts out at full value -1.0 E - on the feed line and is attenuated at a 3-db rate. This means that the voltage will only be 71% - or  $0.707E$  - when it reaches the antenna terminals. Remember that while 3-db is a factor of two for power considerations, power is proportional to  $E$ -squared, consequently  $E$  will be only  $0.71E$  when it arrives at the antenna input. The top curve in Figure 1 shows the FORWARD voltage decay as it travels down the feedline to the antenna input. Since the antenna in this example has a reflection coefficient of 0.5, this means that 1/2 of the incident voltage will be reflected down the feedline. This value is  $(0.5 \times 0.71E)$  or  $0.35E$  volts. The reflected voltage will suffer the same 3-db attenuation on the return trip. When it arrives back at the transmitter

end of the feedline its value is only (0.71 X 0.35E) or 0.25 volts. The VSWR meter sees this value and since

$$VSWR = (E_{fwd} + E_{ref}) / (E_{fwd} - E_{ref})$$

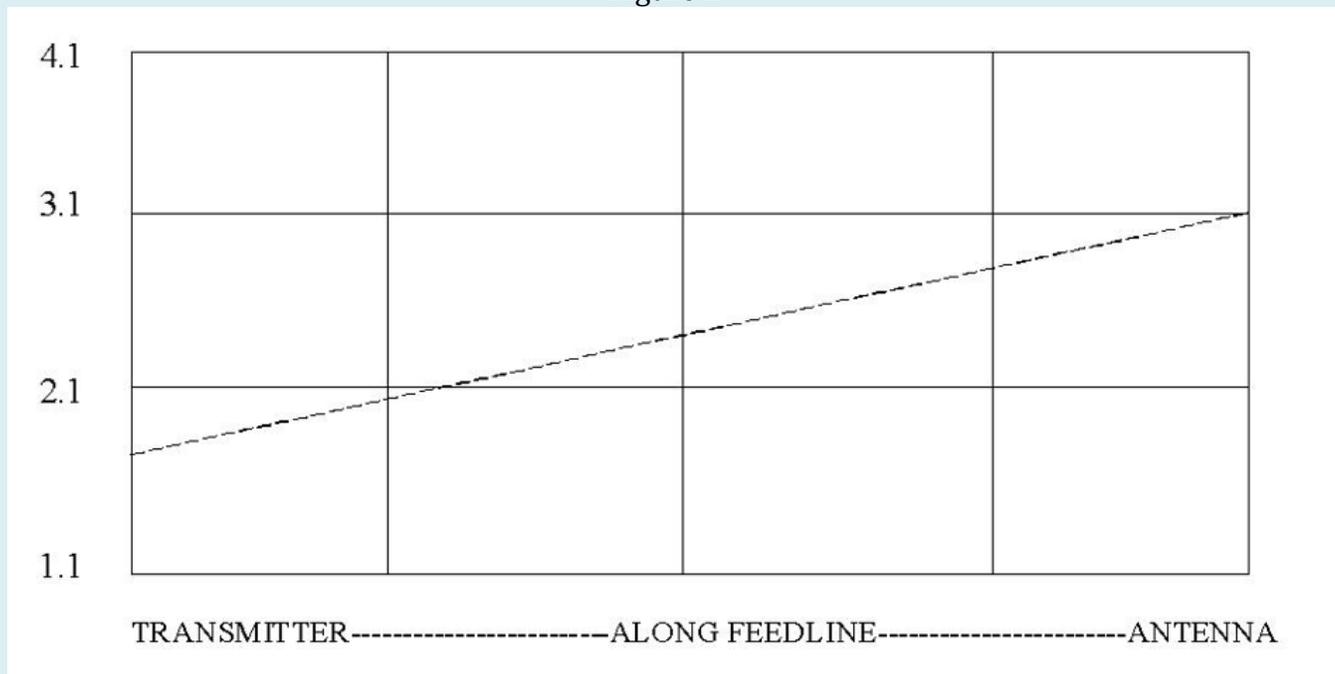
the VSWR meter will read 1.67:1

Happy with that VSWR? Well-read on to see just how good your antenna really is. The 3-dB loss down the feedline means only 1/2 of your output power reaches the antenna, and if your antenna has significant losses, something less than 1/2 of your power will be radiated depending upon how bad the losses really are. If for instance, the loss resistance equals your radiation resistance, the antenna is only 50% efficient meaning only 1/4 of your output power is radiated. Yet that reading of 1.67:1 looks fine. A reflection coefficient of  $p = 0.5$  means your antenna is not well matched to the feedline. VSWR can be calculated from the reflection coefficient by the following:

$$VSWR = (1+p)/(1-p)$$

Using this formula your VSWR at the antenna is 3:1. But my VSWR meter reads good so I must be radiating good and therefore the repeater is deaf... HOW MANY TIMES HAVE I HERD THAT. The difference in the input and output VSWR values is due to the loss introduced by the feedline. Figure 2 shows how this loss can cause you to get a different VSWR depending upon where you measure VSWR in a feedline. You can measure VSWR at the antenna end of the feedline, and get a true reading, can't you? This is not very practical but there are some meters that allow this.

Figure 2



You can use 1/2 wavelengths of coax between your VSWR meter and the antenna because a 1/2 wavelength of cable repeats the impedance it sees. This would give you a truer reading but how many 1/2 wavelengths are there in 100 feet of coax? Let's assume you have an efficient antenna, fed with a low-loss feedline so that the VSWR meter at the transmitter gives you a true reading of 1.65:1. There is no real reason to try to lower it, in fact the same would hold true if the reading were 2:1. Figure 3 is a august newsletter.docx Page 11 of 13 Vol 1 Issue 5

chart showing the equivalence of VSWR to RETURN LOSS(dB), REFLECTED POWER (%) and TRANSMISSION LOSS(dB). Return loss is related to reflection coefficient by the equation:

$$\text{Return Loss} = -20\log_{10}(p)$$

It is just another way of measuring VSWR. For example, with a perfect 1:1 VSWR there would be no reflected power consequently the return loss on the feedline would appear to be infinite. A short or open circuit at the antenna is the worse coefficient would be  $p = 1.0$ . All incident power would be reflected, and with a lossless feedline the return loss would be 0-dB. this is what the RETURN LOSS (dB) column refers to.

The most informative columns in Figure 3 are the REFLECTED POWER(%) and the TRANSMISSION LOSS(dB) columns since they provide an answer to our question of whether further reduction of VSWR is worthwhile. Figure 3 shows that for a VSWR of 1.6:1 the reflected power is only 5.5% of the incident power, and the transmission loss is only 0.24 dB. In more familiar terms, if you count an S-unit as 6 dB, then the 0.24 dB loss is only 1/22 of an S-unit. A reduction of the VSWR to 1.5:1 would provide only a 0.09 dB reduction in transmission loss. This is not worth the effort it would take to achieve such a miniscule increase in power.

FIGURE 3.0

VSWR	RETURN LOSS dB	REFLECT PWR %	TRANS LOSS	VSWR	RETURN LOSS dB	REFLECT PWR %	TRANS LOSS
1.00	-----	0.0000	0.000	2.5	7.30	18.00	0.88
1.1	26.4	0.228	0.100	3.0	6.00	24.90	1.25
1.2	20.8	0.816	0.0353	3.5	5.10	31.00	1.61
1.3	17.68	1.71	0.073	4.0	04.4	36.00	1.93
1.4	15.55	2.78	0.122	4.5	03.9	40.60	2.27
1.5	14.0	4.00	0.180	5.0	03.5	44.40	2.56
1.6	12.6	5.50	0.240	6.0	02.9	50.80	3.08
1.7	11.7	6.80	0.310				
1.8	10.9	8.20	0.370				
1.9	10.2	9.60	0.440				
2.0	09.5	11.0	0.500				

Examination of the chart shows that a VSWR of 2.6:1 results in only about 1 dB of transmission loss. A high VSWR of 6:1 shows just a 3 dB transmission loss, but this is 1/2 an S-unit. You will still be getting out but this is becoming a significant loss. Your feedline will be dissipating more power than it should, and there may be other serious things wrong with your antenna system. Not to mention the fact that your nice new solid-state radio cannot tolerate reflected power and turns its self-down as reflected power goes up.

So, my answer is to use the best antenna and feedline you can and then worry about that antenna tuning. There is an old saying in ham radio that "a dime in the antenna is worth a dollar in the transmitter any day".

So, there you have it for this little article.

Want to try a good experiment put two identical antennas exactly  $\frac{1}{2}$  wavelength apart and watch what happens to your radiated signal... Ever heard of phase canceling? Totally different subject but thought I would get you thinking.

73's for now K5MJD