Dixie Amateur Radio Club

July 2010 Volume 34, Issue 7

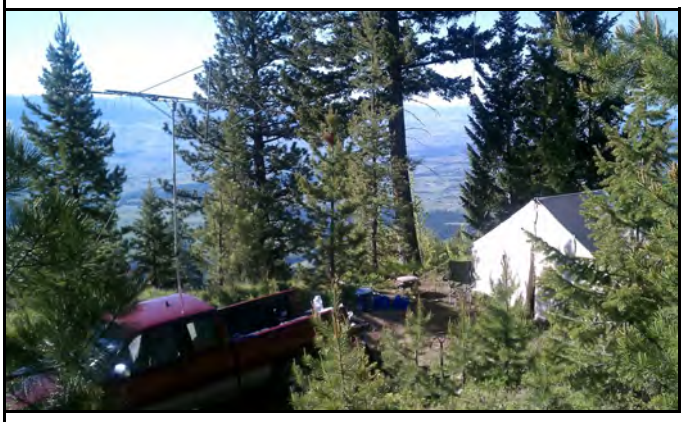
W7DRC Operations

Field Day 2010 A Big Success!

The 2010 ARRL Field Day was held June 26 and 27th at Highland Park in Washington City. According to Field Day chairman Kory Talbot, KE7MMH, a good time was had by all the participants.

“It was a little slow in the morning hours, but thanks to Scott and Jaden Taylor, we kept our stations going throughout the night,” Kory stated.

W7DRC ended the contest with 109 digital contacts and 460 voice contacts. So before bonus points added in, that works out to a total of 1356 points. A very respectable score.



Other DARC members that participated with other efforts in Southern Utah included Dan Farwell, W8EQA, who participated with K7UT in Hurricane, Gary Zabriskie, N7ARE operated a QRP solo effort at Lava Point Campground at Zion NP, and Ric Wayman, K7DLX operated a 3 man effort with new ham Alan Boyack , KF7HFI and John Poat, K6MJB from Long Beach, CA, in the parking lot of the Leeds Volunteer Fire Dept.

The ARRL Field Day is always held the last full weekend in June. W7DRC is involved every year, in various locations throughout the county.

If you didn’t get involved this year, make plans for next year! June 25-26, 2011. Stay tuned as to location, number of stations, and how YOU can make it a good event for all concerned.

Who Are We?

The Dixie Amateur Radio Club, Inc. is a non-profit IRS 501(c)(3) association of federally licensed Amateur Radio operators (also known as "ham radio" operators) who primarily reside in southwestern Utah, mostly in the greater St. George City metropolitan area. We also have members who live in rural areas of Washington County and in areas outside of the county. The Dixie Amateur Radio Club, Inc. is a formally "Affiliated Club" with the American Radio Relay League (ARRL) "The National Association for Amateur Radio".

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Affiliated Club

2010 Board Members

President...C. R. "Nick" Nickle W7CRN

Vice-President....Kory Talbot KE7MMH

Secretary..... Kevin Merrill KE7TLW

Treasurer.....Harold Wells KE7OZG

Board Member.....Scott Taylor KE7YIQ

Board Member..Bruce Bissell KE7LGD

Board Member....Ken Forshee KE7DZI

Past Presidents of DARC

2009.....Ken Forshee KE7DZI
2008.....Ric Wayman K7DLX
2007.....Hal Whiting KI2U
2006.....Hal Whiting KI2U
2005.....Gary Zabriskie N7ARE
2004.....Dan Farwell W8EQA
2003.....Dan Farwell W8EQA
2002.....Ron Sappington WI7Z
2001.....Travis Lofthouse KD7FRN
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Can anyone help me complete this list? Please contact Ric Wayman at k7dlxham@gmail.com

SUBMISSIONS WANTED!

Send your ideas, bios, articles, cartoons, etc. to Ric Wayman at k7dlxham@gmail.com.

ALL HELP WILL BE APPRECIATED!

Nick Nickle, W7CRN

President's Corner

The July Board of Directors meeting will be held on Thursday, July 1st at 7:00 PM in room E of the Community Arts Building, 86 South Main Street in St George, members are welcome to attend.

At the July 21st club meeting we will take a look at the Offset Attenuator that has been posted in the Fox Hunt section of the web site – how and why it works, and how to make one. We will also look at how to make your own printed circuit boards.

Field Day – Thanks to everyone that participated in the Field Day event (June 26-27), particularly to Kory Talbot KE7MMH for all his effort in planning and organizing the activity. We had a good turnout on Saturday for set up and operation during the day, and for hamburgers and hotdogs Saturday evening, but could have used more operator help during the wee hours Saturday night and Sunday morning.

Donation to the Club - I would like to thank Ms Kris Neal and Mr. Clark Webb for their generous donation of the following Kenwood radio equipment to the Dixie Amateur Radio Club. HF transceiver TS-830, HF transceiver TS-130S, 2 meter transceiver TS-7850, 2 meter handheld TR-2600A, antenna tuner AT-130, speaker SP-230, desk mike MC-50, and other miscellaneous equipment. This equipment was the property of their late grandfather Ott Webb N7BRR a long time member of the Dixie Amateur Radio Club. Kris and Clark said, "We are honored that Grandpa's equipment will remain with his club and in the community he cherished".

Coming events - International Amateur Radio Union HF Championships (July 10-11), BSA Utah Operation On Target (July 17), St George Marathon (Oct 2), Huntsmans World Senior Games (Oct 4-19).

A sign-up sheet for the 34th St George Marathon will be available at the July 21st club meeting for volunteer radio operators that would like to participate in this event. Lynn Bateman KE7MXZ will be the Marathon event coordinator again this year.

Thanks & 73,

Nick

W7CRN

Farwell and Good

My Little QRP Story

By Dan Farwell, W8EQA

DEFINITION: QRP, reduced power, 5 watts output or less measured at the transmitter output.

Dear Friends:

I'm the last guy I ever thought would get involved, yes, excited about operating QRP!

I came back to ham radio after a 28-year hiatus with a bad taste in my mouth for struggling to work DX as a teenager with a lowly 100 watts.

When I came back to Ham Radio in 1995 it was with an older tube set and an AMPLIFIER!

Several years of bliss and two hundred countries later I upgraded to a real late-model rig and a bigger amplifier. Life was good.

One day my loudenboomer let me down. Just the two 3-500 tubes I needed were a small fortune.

OK, so, I'll just use 100 watts for all my Dxing and contesting efforts (UGH!)

Several years of low power operating proved that I could work the new ones (just not the first day of the Dxpedition) And I could get a decent score in a contest with some alterations in operating style. (Sneak up, don't just barge in! LISTEN, LISTEN, LISTEN!!) All the while the power knob was turned hard right to full output!

In January of 2002 a dear friend became a silent key and left me an Elecraft K-2 QRP transceiver. My first instinct was to say, "I don't really think I'm QRP material" (Life's too short etc, etc). Several weeks passed and I finally got up the nerve to get out the book and check it out. (I couldn't sell it unless I knew everything worked- right?)

A few days before the ARRL DX CW contest I caught ten meters open and worked a handful of juicy DX. No, I didn't just work the DX; I pulled them out of small pileups. What made it exciting was when a couple of these stations broke from their cookie-cutter "599 BK" exchange to ask me what antenna I was using and was I really QRP?

Hey, this QRP thing might be fun even with a Mosley classic beam at only 35 feet.

The following weekend I decided to "experiment" with QRP again. I had a limited time frame to work the DX contest so I tried a 15-meter single band approach. 150 QSOs and 58 countries later I was overjoyed. How could I get worked up over such a paltry result?

Well, I realized I was better than half way to my DXCC QRP award!!

The rest is history. Now I'm hooked. Please, have pity on me.

73 de W8EQA

Dan Farwell, W8EQA, is a past president of the DARC, and an honorary life member. His contributions to the club are numerous. He lives in St. George with his wife Melody, W7RRR, and when not working for the Wal-Mart Distribution Center can be found on the HF bands running the rare DX stations. This is part of a series Dan has written about his life as a ham operator and knowledge he has gained through the years he would like to share.

SWR Meters Make You Stupid! (part 3)

by Eric P. Nichols (KL7AJ)

A standing wave in itself can do NOTHING good or bad to any piece of amateur radio equipment. Blaming “standing waves” for transmitter damage or other ills is like blaming the number Pi for the truck tire that ran over your foot. Yes, Pi describes the diameter and circumference of the truck tire that ran over your foot, but Pi is NOT a truck tire!

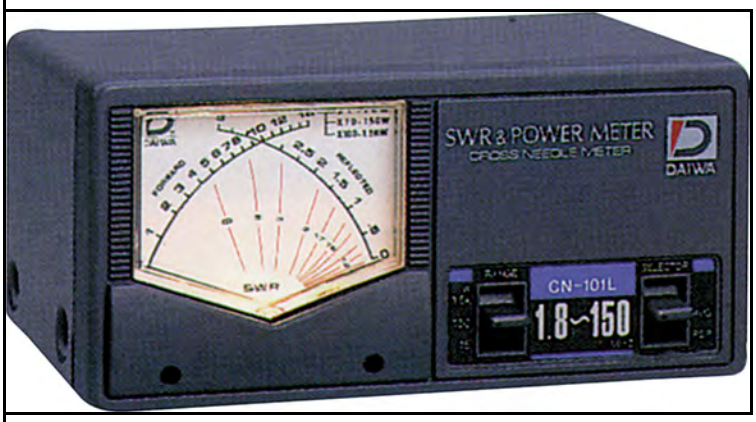
Does this mean that we ignore standing waves? Not at all! But we need to know that Standing Waves are an INDICATION...not the THING ITSELF. With the PROPER INTERPRETATION, they can tell us a few things. Unfortunately, most hams have no clue how to properly interpret standing waves.

Fortunately, we don't HAVE to! There are other MUCH more meaningful indications than standing wave ratio that we can use to know what's really happening. REAL things with REAL effects.

Conjugal Rights

The Superposition Theorem allows us to do some really amazing things with transmission lines. But to understand this requires that you have ABSOLUTE FAITH in Ohm's Law. We already showed how consistent our physical universe is. You don't violate physical laws...they violate YOU. They apply EVERYWHERE, from all viewpoints.

We talked briefly about characteristic impedance of a transmission line...how it's built into the physical construction of the line...how it's totally independent of length...how it doesn't care what's at the far end.



However, despite this seeming rigidity, the Superposition Theorem allows us to ALTER the impedance of a transmission line at different locations, using the magic of wave interference. Let's look how this works.

Let's return to the case of a transmission line with a dead short at the termination. We know the forward and reflected power are the same, but the voltages are exactly out of phase. (Grudgingly deferring to the SWR-obsessed, we have infinite SWR on this transmission line). Now, moving BACK from the termination by wave, we see something interesting. We have added an extra 90 degrees of phase lag to our reflected signal, but that OVERLAPS the outbound signal 90 degrees BEFORE the latter reaches the termination. So, what happens is the two overlapping voltages are now 0 (or 360 degrees, depending on how you look at it) apart. In other words, wave back from the termination, the voltages are IN PHASE, and therefore add.

We now have a maximum voltage point. But when we look at the POWER, something doesn't add up. Or does it?

How much power is delivered to the load? Well, a dead short doesn't dissipate ANY power, so the answer is zero. How much power is reflected? All of it. At any point along the transmission line, the reflected power equals the forward power, so the TOTAL power has to equal zero. But we're measuring a HIGH voltage wave back from the termination. How do we reconcile a high voltage with no power? The answer is Ohm's law. What circuit condition, in combination with a very high voltage gives us zero power? Infinite resistance! That's right. One quarter wave back from the termination, we have an infinite resistance load. Physically, it's a chunk of transmission line; electrically it's a chunk of air. Pretty amazing, isn't it?

How about if we go back a half-wave from the termination? Well, we get an additional 180 degree phase change between forward and reflected voltages. The forward and reflected voltages cancel, and we get zero. Let's double check. Zero volts across zero ohms is how much power? Zero!

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SWR Meters Make You Stupid! (cont.)

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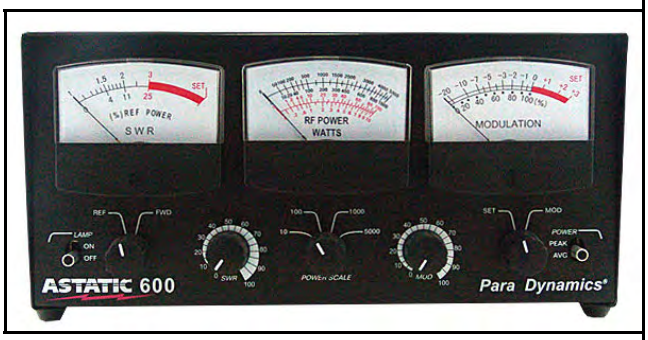
Transmission lines REPEAT the load impedance every half wave, and INVERT the impedance every quarter wave. And also every ODD multiple of a quarter wave. However, in every case, if we have either a dead short or an open termination, the total power is zero.

If we insert a transmitter at any point in the transmission line, how much power will the transmitter put out? ZERO!

What heresy is this??!! A transmitter's OUTPUT power is determined by the LOAD impedance? Are we nuts?

Well, do you believe Ohm's Law or not? How you answer the following two questions will reveal who the REAL heretic is!



How much power can a transmitter put into a dead short?

(Answer: Zero).

How much power can a transmitter put into an open circuit?

(Answer: Zero.)

You CANNOT violate Ohms law. It violates you if you try.

Often I hear statements like “If you have a big mismatch, all that reflected power is going to come back and burn up your transmitter!”

Impossible. Absolutely impossible...at least in this world. And most likely in the next, as well. All that reflected power, as we've clearly demonstrated, prevents the transmitter from generating the power in the first place!

Engrave this on the inside of your eyelids:

WHERE A TRANSMISSION LINE EXISTS, THE POWER GENERATED BY ANY RADIO TRANSMITTER EQUALS THE FORWARD POWER MINUS THE REFLECTED POWER IN THE TRANSMISSION LINE. ALWAYS.

It's important to note the clause “where a transmission line exists,” because, as we mentioned very early in the article, this is far from always the case. Think of all those hand-held radios out there with a whip sticking right out of the radio.

Are we saying that it's impossible to damage any radio transmitter by having a “bad” load? No, not at all. You can torch almost any transmitter by putting a dead short on it. And you can fry most modern radios by having an open circuit on them, as well, mainly by over-voltage of the output transistors. But it is NOT the SWR that does the damage! NEVER NEVER NEVER. A transmitter always sees an IMPEDANCE; it never sees an SWR. And don't ever forget it.

We've talked about reflections. We've talked about MULTIPLE reflections. And it is with regard to multiple reflections that things get really useful and clever.

The conjugate matching theorem tells us that maximum power will be transferred between a generator (transmitter) and a load when the load impedance is the COMPLEX CONJUGATE of the source impedance. This is a good thing to know. Without going into a lot of esoteric math, what the conjugate match theorem tells us is that you can match ANYTHING to ANYTHING with just two components, one parallel and one series. And sometimes less, if you're lucky.

When it comes to transmission lines, it translates into this: Any reflection in a transmission line can be compensated for with an equal and opposite reflection elsewhere in the transmission line.

We should, in all fairness, add one small caveat to this: The load impedance must have a real value of resistance less than infinity but greater than zero. What this means is that you really CAN'T match into a dead short or an open circuit...but you can come really really really close to doing it, if you have large enough matching components. The real point is that you only need TWO of them.

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SWR Meters Make You Stupid! (cont.)

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Let's look at a practical example to demonstrate this. Let's say we have a dipole antenna that has a radiation resistance of 50 ohms. To keep things simple, let's assume our antenna is perfectly resonant. (Reactive terminations of transmission lines can be a bit trickier to analyze). We want to feed this with 450 ohm ladder line. We know that we will have a 9:1 impedance mismatch at the antenna. (Assuming our transmission line is very good, we'll have the same mismatch at the INPUT end as well). Once again, in deference to our SWR worrywarts, we have an SWR of 9:1. Now, this is one case where this SWR information is good to know. What this tells us is that we have a WIDE RANGE of impedances to choose from, depending on our transmission line length. We know that if we pick a multiple of a half-wavelength, our transmission line input impedance will REPEAT the load impedance. So, if we cut our line to be a full wavelength long, we will have 50 ohms impedance, which will make most transmitters happy all by itself. What if we choose a transmission line length of wave? We know the impedance of a wave line INVERTS itself. The quarter wave transmission line is a very useful special case. If the load is resistive (which in this case it is), the input impedance is equal to the characteristic impedance squared, divided by the load impedance. (This is called the “geometric mean”). So this gives us 450 squared divided by 50= 202,500/50=4050 ohms.

Well, not too many transmitters are going to be happy with a 4050 ohm load...even if it IS purely resistive! So, this might not be too smart a choice of transmission line length.

On the other hand, what if we replace our dipole with the venerable Double Zepp, mentioned in the beginning of this fascinating chapter? As it turns out, the impedance at the center of a double Zepp is on the order of 2500-3000 ohms at resonance. Let's use a value of 2500 ohms, just for jollies. If we were to connect a 450 ohm line to the center of that, wave long, what might we expect to see at the input end? Using our same geometric mean formula, we have 450 squared divided by 2500, which gives us an impedance of 81 ohms at the input end. Oh, joy joy! This is well within the “happy” range of any typical ham transmitter. With no further adjustments whatsoever, our transmitter will put out 96% of the power that it would put into a perfect 50 ohm load...assuming the transmitter is truly optimized for 50 ohms. (I have to admit I cheated to come up with the answer...the venerable ARRL Antenna Book has all kinds of handy graphs to show power loss vs impedance mismatching and such. It's okay to use cheat charts and computers as long as you don't use them as a substitute for thought processes).

What have we done with the impedance inversion of the wave transmission line? We've performed a conjugate match. The impedance looking back TOWARD the transmitter with the wave section in place is the COMPLEX CONJUGATE of the antenna impedance itself.

Now, sections of transmission lines are not the only means of performing conjugate matching. In fact, using “series sections” as described in the above has become a bit of a lost art in most modern ham shacks. Standard practice now is to use a “lumped constant” antenna tuner, using one or more coils and capacitors to perform the conjugate match. As mentioned earlier, there is NO fundamental difference between lumped constants and distributed components as far as the physics is concerned. Any combination of distributed and lumped components may be used to achieve a conjugate match. In the above example, it might be practical to use a lumped component tuner to move that 81 ohms down to 50 ohms for the truly obsessive. More commonly, a lumped tuner would be used to tune out REACTANCES where the antenna is operated somewhat removed from its resonant frequency.

It should be emphasized that NO amount of twiddling of an antenna tuner at the INPUT end of a transmission line has any effect whatsoever on the standing wave ratio on that transmission line. The SWR is determined ONLY by the load

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SWR Meters Make You Stupid! (cont.)

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impedance at the line termination. The antenna tuner only adjusts the impedance the transmitter sees.

Now, this fact brings up another very interesting point. Let's say we have a 100 watt transmitter, designed for a 50 ohm load. We have a wide range antenna tuner immediately after the transmitter. Beyond that, we have a length of transmission line, finally terminated in a severely mismatched antenna. Let's use our very first example, with a 450 ohm transmission line and a 50 ohm antenna. We have a 9:1 SWR on the transmission line. Taking a gander at another ARRL Handbook chart, we see that we will have about 60 watts of reflected power on the transmission line.

Now, remember what I had you engrave on the inside of your eyelids a while back? Transmitted power is equal to forward power minus reflected power.

Now, if we twiddle the antenna tuner so that our transmitter sees 50 ohms, we know the transmitter is putting out 100 watts. On the far side of the antenna tuner (away from the transmitter) we see 60 watts of power reflected from the antenna toward the antenna tuner. Does something seem amiss? Is our transmitter only putting out 40 watts? No...it's seeing 50 ohms...so we know it's putting out 100 watts (assuming the transmitter is functioning properly). Let's look at the FORWARD power on the transmission line. 160 watts! Well, how about that? Now the math works out...but WHERE does that extra 60 watts come from? Our transmitter can only put out 100 watts. What have we overlooked?

It's simple. It's a DOUBLE reflection. The 60 watts of REFLECTED power is RE-REFLECTED from the antenna tuner...actually added IN PHASE with the original forward power. But WHY the double reflection?

Without KNOWING it...when we adjusted our antenna tuner to make our transmitter “happy” we created a conjugate match on the other side of the tuner. It's actually a gross mismatch looking toward the transmitter...but it's a gross mismatch in the exact Complex Conjugate of the impedance looking the other way!

Actually, in this example, we have TWO complex conjugate pairs...one at the junction of the input of the tuner and the transmitter...and another at the junction of the antenna tuner's output and everything after it!

Again, this is stuff you can CONSISTENTLY DEMONSTRATE on the work bench. I always love showing a room full of skeptical “SWR Gurus” how the forward power on the output of a tuner EXCEEDS the power capacity of the transmitter!

Well, I suppose I could go on and on about this absolutely intriguing subject, but instead I'll refer you to two pieces of required reading:

“My Feedline Tunes My Antenna,” By Byron Goodman, W1DX (SK). Originally published in QST in 1956, it has been reprinted several times since. A genuine classic, and a fine example of clear analytical thinking...a rarity in ham radio today.

“Reflections” by Walt Maxwell, W2DU. This is the most eloquent and detailed work on the subject ever written. Most of the material in this EPILOGUE chapter was stolen, not in prose, but in principle, from Walt's writings. This originally appeared in a series of QST articles in the 1970s, but has been consolidated in a couple of excellent books, Reflections and Reflections II. I understand there's a Reflections III coming out soon

K7DLX's Word Search