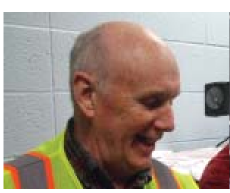
The Modulator

Newsletter of the Newport County Radio Club, February 2017

Pixies are Coming to Town

Dang, that's a cute l'il radio, where'd you get it? NCRC of course! Ten bucks gets the radio and case, plus sockets, TECH band crystal, and a spare output transistor. Get it on the club web site or at a meeting. New to kits? No problem! Learn soldering at the February meeting and assembly in March. Plenty of helping hands to assist you.

Dirmid Gray, K1UFD
Rich Brendlinger, N3RWB
Silent Keys



Dirmid Gray, K1UFD

Rich Brendlinger, N3RWB

Both Dirmid and Rich were active NCRC members. Dirmid was a committed emergency communications operator and Rich was a three-time club Vice President and an avid DX hunter.

73 Dirmid and Rich from your friends at NCRC. You will be missed.

Another Dandy Winter Field Day

Like a Well-Oiled Machine

Under the able leadership of Paul Silverzweig, N1PSX, NCRC set up two stations for the 2017 Winter Field Day. Drawing on our experience from last year's successful WFD, Paul was able to make this year's operation run even smoother.

Many helping hands Saturday morning

Club members responded to the call and pitched in. As John King, WA1ABI, put it: " I appreciated help from the many club members who worked at setup and demobilization, and those who provided equipment and supplies. This event would not have been possible without their support."

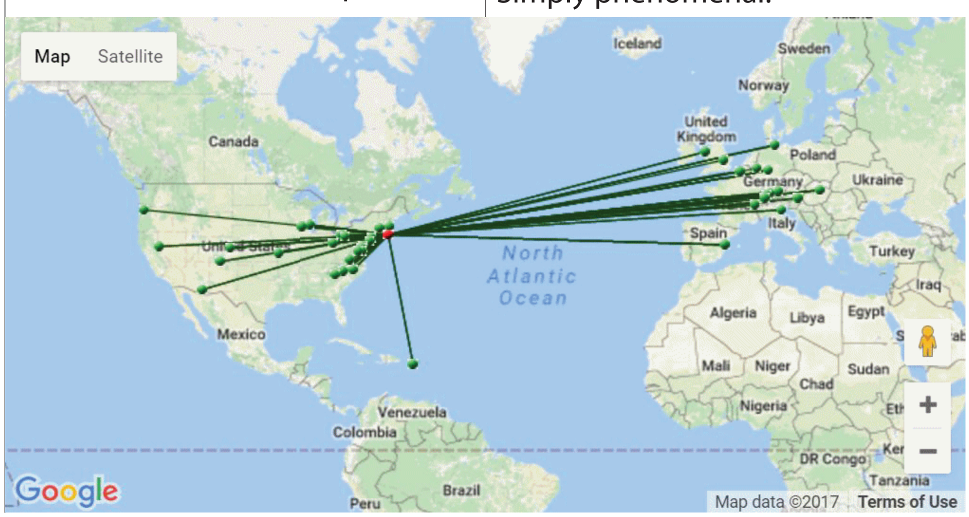
Big signals at the Glen

As all HF ops know, we are heading into the bottom of Solar Cycle 24, but that didn't slow down our stations on the lower bands! Here are a pair of comments:

"Phenomenal rock crushing 40m signal. Blasting into EU – way before sunset! Stateside front ends being damaged."

"If we thought our 40m signal was good (and it was) check out our 80m signal!"

Most hams think of 80 meters as a local communications band, but take a look at the reverse beacon plots from late Saturday night. Simply phenomenal!



80 Meter propagation paths late Saturday night.

Hans und Fritz and the Great Acorn Caper

The following is not really intended for NCRC members, but rather for their kids, grand kids, and anyone else who might demonstrate a fledgling interest in non-biological science. On the other hand, who could know?

The Katzenjammer Kids

"Look Hans, it's Lena and her goofy friends playing mit der garden hose!" "Yah Fritz, let's have some fun." The Katzenjammer kids unscrewed the hose and pushed an acorn in the end. "This'll be great Hans, that acorn'll come flying out and bean one of them!"

Ah, the best laid plans; the prank didn't work. Instead of shooting out, the acorn stuck half way down the hose. This reduced the water to a trickle and the girls, discovering this, came tearing after the brothers mit schlingen und schlangen.

So what's that you say, too young to know the Katzenjammer Kids? Well, this is a radio club newsletter, so I'll let that go. And in any case, the real purpose here is to introduce an excellent analogy to resistors and current flow.

Hang on, hang on...

The club Pixie Project has stirred considerable interest among members for multiple reasons. Of special note is that old hands are having fun improving this bare bones design. Our Prez, Paul Fredette, has grabbed this opportunity to bring some real radio context to the theory that underlies the higher license class exams. Let's see how an acorn and hose analogy illuminates his *Parallel Series by Paul* article.

An acorn stuck in a garden hose is a good representation of a resistor. Instead of water flowing in a hose, in an electrical circuit, electrons flow along conductors. Let's compare the two:

- In a hose, an acorn reduces the flow of water. In a circuit, a resistor reduces the flow of electrons.
- In a hose, flow is measured in gallons per minute. In a circuit, flow, appropriately named current (I), is measured in Amperes—electrons per second.
- In a hose, water pressure is measured in pounds per square Inch—PSI. In a circuit, electron pressure is measured in Volts—V.
- In a hose, water pressure above the acorn is high. In a circuit, voltage measured above the resistor is high.
- In a hose, water pressure below the acorn is lower. In a circuit, voltage measured below the resistor is lower.

Hey—not bad, right? And it gets better.

Imagine that you measured the water pressure in the hose between the faucet and the acorn. House water pressure often runs around 50 Pounds per Square Inch (PSI), so we would read the pressure at about 50 PSI upstream from the acorn. If we repeat this measurement on the downstream side of the acorn, we would expect a much lower pressure. We can call the difference between the upstream and downstream measurements the pressure drop caused by the acorn. If our analogy is accurate, we would expect a similar electrical measurement in a resistor circuit to show a *voltage drop*.

At this point, we need to clarify the difference between a water hose as an <u>open system</u> and an electrical circuit as a <u>closed system</u>. The following is basic to electronics, but because it is often taken for granted, it can become a stumbling block later on. The name *circuit* implies a return path, so theoretically a single electron makes a complete trip around a DC circuit[1].

Any measure of pressure is a comparison between two conditions. Water pressure in an open hose starts at house service pressure and eventually reaches zero as the flow exits the hose. The two conditions compared in water systems are the pipe pressure and the surrounding air. Because that hose empties into open air, we can assume that the water pressure gauge and the end of the hose share a common reference point—the surrounding air. Therefore measuring water pressure at any point along the hose with a pressure gauge is equal to measuring water pressure compared to the open end of the hose.

Measuring voltage in a circuit is also a comparison between two conditions, but unlike an open

Hans und Fritz and the Great Acorn Caper, Continued

hose, a volt meter does not enjoy a common "open air" side with the circuit to make its comparison. Instead, the meter leads must be applied to either side of the circuit section to be measured. This will measure the voltage (pressure difference) on either side of the circuit section.

Now let's go back to the hose and acorn analogy. Imagine a hose with two acorns stuck about a foot apart. This arrangement presents three different places to measure pressure; upstream, between the two acorns, and downstream.

The first measurement, between the faucet and the original acorn, would show the house water pressure—about 50 PSI. The second measurement, between the acorns, would show the same lower pressure caused by the original first acorn. Finally measuring downstream from the second acorn would show the lowest pressure.

From these three measurements, three pressure drops can be calculated compared to house pressure:

1. The upstream pressure reads 50 PSI. No pressure drop.
2. The between acorns pressure reads 30 PSI. Pressure drop of 20 PSI.
3. The below both acorns pressure reads 5 PSI. Pressure drop of 45 PSI.

So far we have been dealing with the effect of acorns on water flow and resistors on electron flow. Before moving on, we need to introduce another idea. Looking at the acorn data, we can see that each acorn has a "reducing factor." We can see in this example that the "reducing factor" of the two acorns must not be equal. Why? Because they produced different pressure drops. In electrical circuits, we have the same concept with a well-defined term, Resistance, measured in Ohms, to describe the "reducing factor" of resistors on the flow of electrons.

In a resistor circuit where current flows first through one resistor, then another, the resistors are said to be in series. Just like the acorns in a hose, each resistor causes a voltage drop and together, their combined resistance causes the total voltage drop. This makes calculating series resistance a snap; imagine the two resistors are just one big resistor, and add their individual resistances.

Finally, before we leave series resistances, let's consider the current in a series resistance circuit. We've seen that measuring voltage (electron pressure) in a series resistance circuit produces different voltages depending on where we make those measurements. But what of the electron flow, current (I), measured in Amperes? Would we find different current measurements depending on where we measured? In other words, does current change like voltage changes depending on the measurement point?

Hans und Fritz can help here: In the two acorns in our hose model, only a trickle came out of the end of the hose. Was the water flowing faster anywhere else along the hose? Clearly not—where would all that fast moving water go, if at the hose end, it could only trickle out? The flow anywhere in the hose depended on the flow at the end! Similarly, our analogy tells us that current flow in a resistance circuit depends on the total resistance and is uniform throughout the circuit. As a side note, Hans und Fritz are here describing part of Kirchoff's First law.[2]

More troublesome to new hams is the idea of parallel resistance circuits. We have seen in the hose analogy that adding acorns to the hose increases resistance to water flow. This is because there is a single flow pathway and each additional acorn further slows the water. But suppose that instead of one hose with a single acorn stuck inside, we had two similar hoses. Neither hose is especially useful, because both are blocked by a single acorn. Now imagine that you hooked up both hoses to the faucet and combined their ends. In this parallel arrangement, one hose's trickle adds to the other hose's trickle and we get more water out even though this is a two-acorn arrangement.

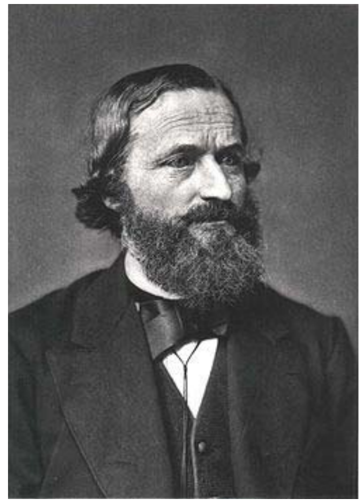
Hans und Fritz will leave you with this final thought: Adding resistance in series increases the total resistance of a circuit and reduces current. But adding resistance in parallel decreases the total resistance of a circuit

Hans und Fritz and the Great Acorn Caper, Continued

and increases current. And finally, finding the combined resistance of two parallel resistors is easy if both resistors are equal, but things get a bit more detailed when they are unequal. Can you visualize this using the hose analogy? You'll need two hoses and three acorns. Paul picks up the story here with his first of the Pixie Series.

Auf Wiedersehen y'all,

H&F



Gustav Robert Kirchoff

Notes

[1] In many DC circuits that single electron never makes it to its starting point because they travel so incredibly slowly—around an arm's length in an hour at 110 volts! That's ~0.0006 miles per hour! Whoa- that's counter intuitive! After all, you don't wait for the light to come on; you flip the switch and there it is. But wait—think of the cart boy in the supermarket parking lot. As soon as he pushes the last cart, the first cart (soon) begins to move. But it may take several seconds for that last cart to pass by. Same thing with electrons, the first electron moves almost instantly, but individual electrons in the stream are only poking along. It's worse in an AC circuit where the electron flow rapidly changes direction. Essentially electrons simply vibrate in place in an AC circuit. You don't buy electrons from the power company; you pay them to shake the electrons you already have!

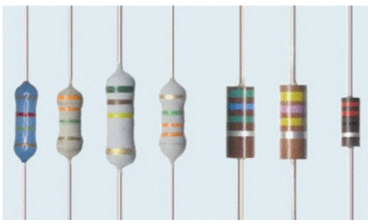
[2] Gustav Robert Kirchoff was a German physicist who made significant contributions to multiple fields of science and clearly stands as one of the great men of science. Why is this concept Kirchhoff's *first* law? Because he formulated his circuit laws, which are now ubiquitous in electrical engineering in 1845, while still a student!

Paul Fredette's, K1YBE, first article, The Parallel Series - Part 1, follows. I hope to resolve the difficulty rendering a Word document before the next article.

The Parallel Series—Part 1, by Paul Fredette, K1YBE

I hope to present a series of Modulator articles that draw parallels between simple resistor circuit models and frequency dependent circuits like the matching filter in our Pixie radio project.

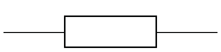
Let's begin with what a resistor is. Here are several:



Between the wire leads might be a mix of clay and carbon, or perhaps a spiral cut foil, or some other way of reducing electron flow. The color bands indicate the degree of reducing in Ohms.

Elegant artwork has been produced using these colorful components, but time is non-trivial in electrical engineering, so we need a quicker way of drawing resistors. Here are two time savers:

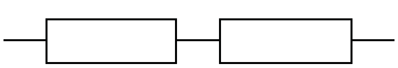
Traditional resistor symbol



Even simpler symbol

The Series Circuit

Two resistors connected as shown here are in series.



Series resistors R1 and R2

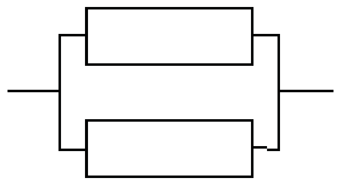
Together they act as a resistor with a value equal to the sum of the individual ones. So R1 and R2 could be replaced with a single resistor, R3.

$$R1 + R2 = R3$$

Series resistor rule

Parallel resistors

A bit more complicated is the arrangement of resistors in parallel.



Parallel resistors R1 and R2

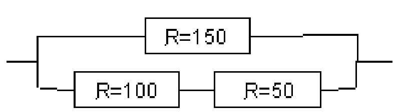
When R1 and R2 are connected in parallel, the equivalent resistance is less than the resistance of either R1 or R2. Here's how their combined resistance is computed:

$$\frac{R1 \text{ X } R2}{R1 + R2} = R3$$

Parallel resistor rule

Series and Parallel Resistances

Using the series resistance and parallel resistance rules, can you calculate the equivalent resistance of the 3-resistor circuit below? Hint: Determine which resistance rule to use first.

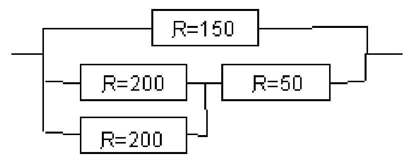


Series and parallel resistances

You might be surprised to know that all components can be analyzed as a type of resistor with a value we call IMPEDANCE instead of RESISTANCE. Common practice is to use Z for impedance and R for resistance. The technique allows us to analyze circuits with resistors, capacitors, and inductors (coils), once we know whether the arrangement is in series or parallel.

Back to the Pixie

I'll now replace the 100 ohm resistor with a pair of 200 ohm. Can you compute the equivalent resistance of the 4 resistors?



Complex resistances

No need to panic. Remember *Pick Up Sticks*? No different here, just figure out the order to proceed. Both resistor rules reduce two resistors to a new single equivalent resistance. There are four resistors, so that means there are three of these simple problems. First determine the order of operations, then go to it!

So, how does this relate to the Pixie? That new fourth "resistor" can be considered to be the antenna of known impedance.

Take a look at the Pixie schematic in the last Modulator or at the Pixie tab at www.w1sye.org. Find the circuit connected to the antenna. Did you have an "A-ha!" moment?

Next time we'll find the answer to this one using the carrier frequency in the 40m band.

73, Paul K1YBE