The Modulator

Newsletter of the Newport County Radio Club, March 2017

Portsmouth Repeater Down

As most of you have already discovered, our 145.450 MHz repeater, W1SYE, is off the air. The Town of Portsmouth determined that the water system storage tank needs significance maintenance. This tank supports the repeater antenna and the electronics are housed in the valve pit adjacent to the tank. Because it is weather-dependent, the exact duration of this maintenance is not known, but the repeater down time is likely to be at least a month.

On short notice, Willy, W1LY, supervised club members as they removed the antenna and transmission line from the water tank last Wednesday. Both items were taken to Paul Fredette's, K1YBE, storage facility in Portsmouth.

Although we did not anticipate this operation, the budget adopted last year includes money for replacement of part of the repeater electronics. We are now inspecting all repeater components to capitalize on this unexpected event.

The transmission line is expensive hard line and is good enough to be reused. A new G7 antenna will be purchased and the old one will be refurbished and kept as an emergency spare antenna. John King, WA1ABI, has volunteered to prepare and temporarily store the new antenna at the Portsmouth fire station.

The Smell of Hot Solder

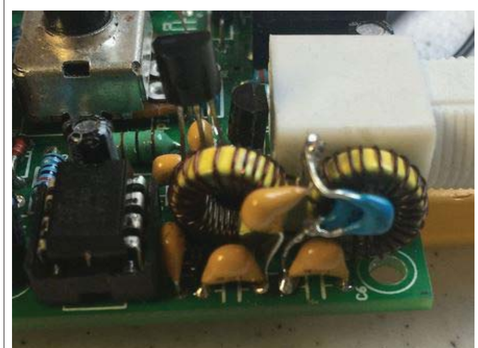
More Pixies Than Neverland

There are at least 25 Super Pixie kits among club members with more added every few days. Some are in the hands of first timers while others are taking on new lives under the irons of experienced builders.

The Pixie was designed with the smallest form and fewest parts as a goal. The result is a radio that works, is fun, and costs less than a latte. But that goal forced several compromises.

Heat Up That Iron

Those compromises are challenges that have produced some interesting bench time. One of the most pressing projects is suppressing harmonics above the nominal transmit frequency. Built out of the bag, the Pixie produces harmonic products that exceed FCC requirements. Constructing a low pass filter is easy enough, but we would prefer a mod that is easy to add to the stock radio.



Here is a 5-pole filter added to a Pixie by Willy, W1LY. This does the trick, but the two toroids are a bit difficult to squeeze in.

Below as Willy, W1LY, says: "Here is my portable Pixie with 12v power supply, 2 xtal switch, 5-pole low pass filter, and audio band pass filter. It is sick what happens when there is a Christmas tin hanging around the kitchen."

The Parallel Series, Divide and Conquer

Part Two of the on-going series by Paul Fredette, K1YBE

While analyzing the output filter of the Pixie radio, I used a well-known trick in circuit analysis called a *voltage divider* and want to share it before moving on to its frequency related circuit behavior.

The voltage divider shown in figure 1 is a simple circuit with a power source and 2 components. I'll use resistors for an example with a 50 ohm (Ω) source impedance and 50 ohm load impedance:

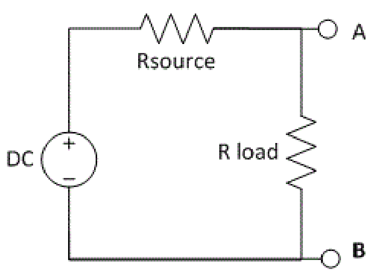


Figure 1

Using knowledge of series and parallel circuits from part 1, the 2 resistors in series can be combined as one with the sum of both resistances. This will allow us to compute the total current in the circuit with Ohm's law (E=IR). Since the voltage from the source is 10V, the current is:

10V / (50Ω + 50Ω) = 0.1 A
= 100 ma
(Milliamperes)

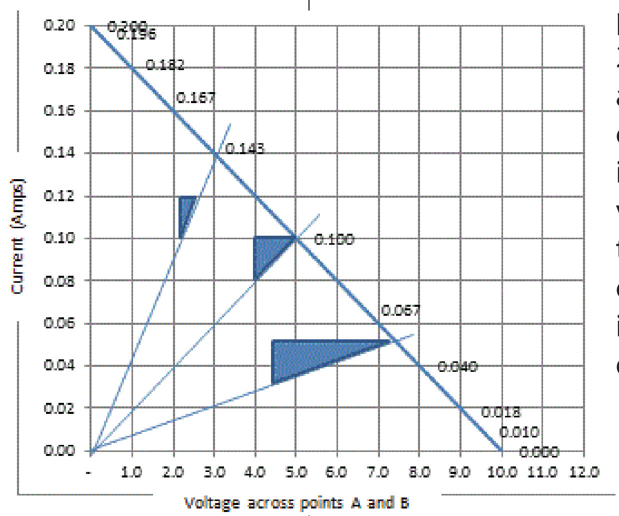
Now go back to the two resistors carrying 0.1A, the voltage across <u>each</u> one is E=IR:

0.1A • 50Ω = 5 Volts

Since both resistors are equal, their individual voltages nicely add to 10 V and matches the source voltage.

The circuit divided the 10V source voltage by 2 but we could divide it any number of ways with a different load resistor.

Let's illustrate this on a graph with current on the vertical and voltage on the horizontal. The solid line can be used for any load resistor.



If you draw a line from the 0,0 point to where the desired voltage intersects the solid line, the ratio of voltage change to current change will be the resistance of the load resistor. This is illustrated with the triangles shown on each of the 22, 50 and 150 ohm cases showing how the much the voltage changes for the same 0.02 amp change in current.

Let's back up and remove the load resistor and test for 2 conditions:

1. A to B is an open circuit
2. A to B is a short circuit.

The open circuit of Case 1 has no current flowing and the terminal points A and B would measure 10 Volts.

The short circuit of Case 2 imagines a load resistor of 0 ohms. The only resistance in the circuit is the source resistor. In this case the current is 10V/50ohms or 200 ma. The graph shows these points connected with a blue line. Any resistor we place in the A to B position will be a point on this line. The A to B circuit is often called the "Load". In the Pixie case it might be the Antenna.

The graph also shows the points for 22 ohms and 150 ohms. See if you can verify that the 150 ohm case is 7.5 V and divides the 10 V by 1.333…

The 22 ohm case is 3.1 V. What was 10 V divided by? There is a general answer to this. The "open circuit" voltage is the source voltage (10V) multiplied by Rload and divided by the sum of the 2 resistors

This leads us to another neat trick called an equivalent circuit. For more detail on this you might like look at Thevenin's Theorem:

http://www.electronics-tutorials.ws/dccircuits/dcp_7.html

Let's go back to the case with two 50 ohm resistors and the voltage divided by 2. Calculating the resistance of the load and source resistors in parallel, we can use this to create the circuit on the right of Fig 3 with a source of the divided voltage (5V) and a source resistance of two 50 ohm resistors in parallel: 25 ohms.

The Parallel Series, Divide and Conquer, Continued

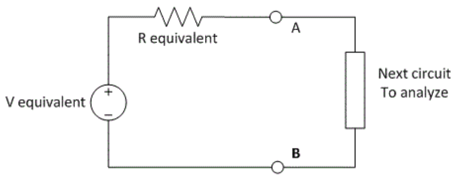


Figure 2

Compare this with Figure 1 and you see they look the same except for values. Let's find the open and closed circuit conditions of our new circuit:

Case 1 (open) is 5V

Case 2 is 5V/25 ohms = 0.2 A.

We can now add another circuit to the equivalent circuit of Figure 2 and start all over again to add circuits together. This will be done for the Pixie output filter in the next part of this series. You might want to try it yourself. Don't worry it they are resistors, capacitors on inductors. Just consider them a box with a unique value of impedance (e.g. Zx)

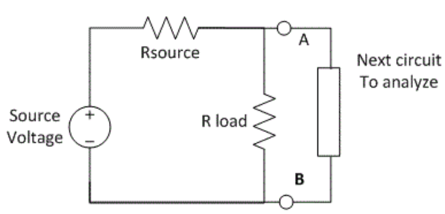


Figure 3

If you draw a line between the case 1 and case 2 points as in the graph, it represents the result for all the combinations of "next circuits" connected to A and B. The graph shows the lines for resistive loads of 22, 50 and 150 ohms

So let's summarize. If we have a voltage divider circuit, we can replace it with an equivalent source with new source voltage, V equivalent, equaling the original V source times R load/(R source + R load) and a new source impedance, Zequivalent, of the two impedances in parallel. From part 1 this is our Product Over Sum rule:

$$Zequivalent = \frac{(Zsource \text{ x } Zload)}{(Zsource + Zload)},$$

For the brave who made it to this point, the equivalent voltage for resistors is the original source voltage "divided" by:

$$1 + \frac{Rsource}{Rload}$$