Parallel resistance made easy

Try these simple one and two step approaches.

by Michael Yurkovich

Not too many years ago, $50 would buy you the latest four-function pocket calculator. Today, that same calculator can be bought for as little as $5. And at that price, just about everybody has one. Yet as popular as the simple pocket calculator is, hardly anything has been written about using them to solve simple electronics problems. That may be due to the availability of moderatley priced scientific calculators with dozens of functions built-in.

Not every new electronic hobbyist has one of those super calculators, however. But the $5 add-subtract-multiply-divide unit can still be used to solve what could otherwise be very tedious calculations. In particular, calculating the net resistance of a parallel network can be a real problem. But not with your five dollar calculator.

Product over the sum

The easiest parallel network to work with is the simple two-resistor combination. The net resistance of two resistors in parallel can be calculated by dividing their product by their sum. For example, if you had two 100 ohm resistors in parallel, the net resistance would be equal to 10,000 (100 x 100) divided by 200 (100 + 100), which is 50 ohms.

Although you could have figured this example in your head, calculating the net resistance of a 27 ohm and 68 ohm resistor isn't quite as easy. Using your pocket calculator, you can get the product (1836) and the sum (95), and then make your division to get the answer of 19.3 ohms. But this involves three separate computations.

You can simplify the process by changing the product-over-the-sum to the sum-over-the-dividend. In this case you simply add the two resistors, then divide by one resistor, then divide again by the second resistor. After you've completed this computation, divide 1 by the result you've just gotten.

Following this procedure, you find that 27 + 68 ÷ 27 ÷ 68 equals .05174. Dividing 1 by .05174 gives you 19.327, or simply 19.3. Following this procedure, you saved one step in computation.

The product-over-the-sum and its derivative only work for two resistors. If more than two are connected in parallel, you'll have to use the old reciprocal-of-the-sum-of-the-reciprocals approach, which is even more difficult to use than to say. Simply put, you must divide 1 by each of the resistances, then add together the results. Then, you have to divide 1 by the sum you've just calculated.

Simple method

You can avoid the grief involved in using the reciprocal approach with this handy method. Let's call the resistors R1, R2, R3, and R4, though you could add as many as you wanted. Just divide R2 by R1, add 1 and divide by R2, then multiply by R3, add 1 and divide by R3, then multiply by R4, add 1 and divide by R4. If there are more resistors, just continue multiplying by the next resistor, adding 1 and the dividing by that resistor. Then divide 1 by the result.

As an example, lets assume the values to be 27, 33, 47 and 56 ohms. You would folow this procedure: 33 ÷ 27 (1.22222) + (2.22222) ÷ 33 (.06734) x 47 (3.16498) + 1 (4.16498) ÷ 47 (.08861) x 56 (4.96216) + 1 (5.96216) ÷ 56 = 0.10646. Then 1 ÷ 0.10646 gives you the net resistance of 9.3931 ohms.

Try it a few times and you'll see how really easy it is. The beauty of it is that the entire procedure up to the last step is a continuous operation—you don't have to write anything down or clear the calculator until the last step.

If your calculator has a constant math function, you can even save that last step. Constant math functions vary from calculator to calculator, so check out the instruction sheet that came with yours. The idea of a constant math function is that you can keep repeating the step by hitting the function button. In other words, 1+1 gives you two, but hitting the + button again gives you 3 and so on.

Using constant math, you can replace the last step, dividing one by the result of the chain computations, with the operation of ÷ = =. In our example, after entering ÷ 56, you would just hit ÷ = = and there would be the answer of 9.3931.

The same procedure outlined for parallel resistors can also be used to calculate the net capacitance of a series capacitor circuit. Just substitute the values of each capacitor for the values of the resistors. Or, if you've calculated the reactances, the values of X_C for the values of R.

As you can see, at least in the area of parallel resistance and series capacitance circuits, the simple four-function calculator can save you a lot of time and aggravation. Considering the bargain prices of these wonders, you can hardly afford not to have one. ■

Heath's H-8 computer is quite a machine just as it comes. But following these simple procedures, you can make your H-8 even better and more useful.

by Carmine Prestia
Contributing Editor

It seems that no matter what kind of gadget you are using these days, you always find out its limitations rather quickly. The microcomputer is no exception. Standing by itself it really can't do all that much. It needs peripherals to communicate with and do things in the outside world. After doing some programming with my Heath H8 I began to run into some of its limitations.

My system consists of the H8 Computer with 12K bytes of memory, the H9 Video Terminal, the H10 Paper Tape Reader/Punch, and the ECP-3801 Magnetic Tape Drive. There's a full review of this system in the June issue of ME.

The first problem came when I ran out of memory! The H8 had 12K of Memory. That is 12288 *bytes*, or words, each representing a piece of data or character. Since Extended Benton Harbor BASIC takes around 8K of memory, only about 4K *bytes* are free for programming. That didn't mean a lot to me until a couple of my programs generated a *MEM*ory *OV*erflow message. When that happens you either get more memory or shorten your program. I chose more memory!

The next problem to confront me was output, the H9 Video Terminal was my only input/output device. Not many other terminals can beat the speed or convenience of a CRT. However, if you need printed copies of the program results, or a program listing, there is no hard copy output. To make matters worse, when information *scrolls* off of the screen, it is lost. To solve the problem I needed some kind of printer.

Heath had the answer to both of these problems in their catalog. To add to the H8's memory I used the H8-3, 4K chip set.

More Memory

The kit consists of eight IC sockets and eight 4044 memory ICs to add 4096 more *bytes* of RAM . . . Random Access Memory. Installing the kit was almost too easy. It took less than an hour. I had to remove one of the memory boards, solder the sockets to the board, and install the ICs.

Be careful with the chips. They are CMOS and can easily be zapped by static electricity. Heath gives excellent instructions on how to handle the ICs and prevent problems. For more information