 By Bonnie Baker, Microchip Technology Inc

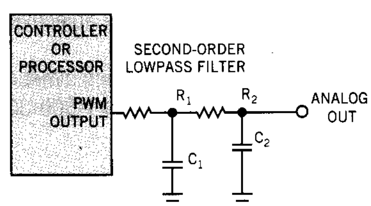
Update your cookbook for the new year

IMAGINE THAT YOU NEED to design a 100-Hz sine-wave signal for your upcoming project. Your first line of defense may be to dust off your analog cookbooks, surf the Web, or do both, as a quick option. These steps are great starting points, but you may be missing a powerful alternative. Engineers are always under the gun to produce designs fast. But before you jump into using an analog circuit for this problem, you might want to consider tackling your analog problems with a digital engine, such as a microcontroller or microprocessor.

A multitude of analog circuits generate a sinusoidal signal. Some of the options are the phase-shift, Wien-bridge, quadrature, and Bubba oscillators. More exist, but these choices are the most popular. The oscillator-design equations are readily available and can help your design time.

A slight bump in the road exists with the cookbook approach: You may need to work through the inadequacies of these older references. One shortcoming may be that the cookbook circuit doesn't work in a single-supply environment. Another problem could be that the circuit you are thinking about using looks good in theory but not so good on the bench. The standard cookbooks on your shelf may be antiquated and may not address changes in the electronics industry.

Imagine that you build a cookbook oscillator circuit, and it performs satisfactorily. Luck is with you, until marketing tells you that you really need a 200-Hz signal. You can return to your design, replace the resistors and capacitors in the circuit to achieve this change, or switch your design strategy to a digital-centric option. You might ask how it is possible to build an analog sinusoidal signal with a digital device. In this case, it is straightforward. First, send a PWM signal to one of your controller's output pins. You can generate this signal with your firmware or by using a PWM peripheral inside your controller or processor.



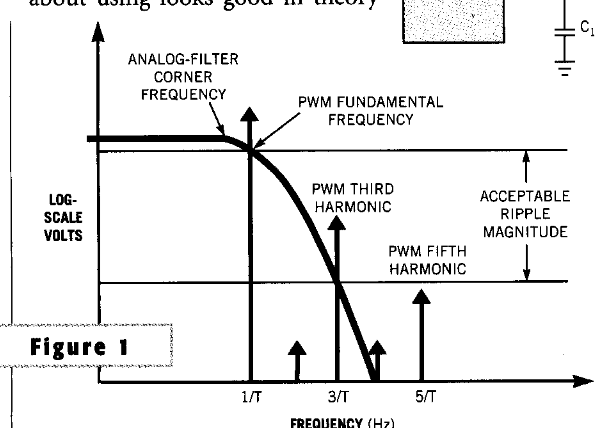


Figure 1

The PWM frequency equals 1/T, with a 50% duty cycle. You can dynamically change this frequency with the microcontroller or microprocessor firmware. This second-order filter attenuates the already smaller PWM third harmonic by 40 dB.

Then, change the PWM signal into a sine wave with an analog lowpass filter (**Figure 1**). In the **figure**, a second-order lowpass filter removes higher frequencies from the PWM signal.

This first attempt at developing an oscillator is an inflexible, hardware-centric approach. In addition, you could adjust the analog option only by changing components in the circuit. The new digital design is programmable. The digital design can also be smaller and have a lower cost, requiring almost no external components. You make modifications using keystrokes and reprogramming rather than by replacing hardware components. You can change the frequency or even the phase and still obtain good results. For these reasons, this third option seems most inviting.

More digital replacements for analog functions are cropping up every day. On-chip peripherals, such as comparators, PWMs, and timers, are enhancing this migration. So many digital alternatives exist that you might expect the next electronics cookbook to be about digital replacements for many of the older analog circuits. Granted, digital options are not in a position to replace all of the analog options out there. Analog will still have a place in the signal chain, in which you need analog speed or precision and an interface to the real world. But consider taking your analog cookbook off the shelf and adding a new chapter on digital alternatives.□

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