

Generate swept sine/cosine waveforms with two filters

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Demodulators, directional circuits, and other electronics applications often need two sine waves with a 90° difference in phase—a sine wave and its cosine wave. Engineers typically use analog filters to create the phase shift. This approach, however, offers a limited frequency range. Using the circuit in **Figure 1**, you can make a swept sine/cosine pair at frequencies of less than 1 Hz to 25 kHz.

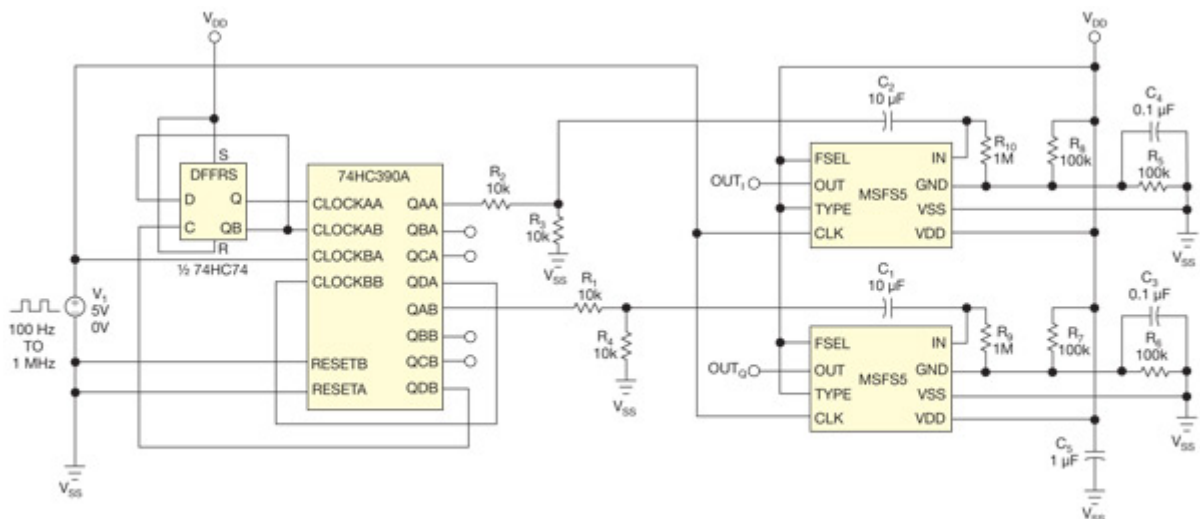


Figure 1 This circuit lets you make a swept sine/cosine pair at frequencies of less than 1 Hz to 25 kHz.

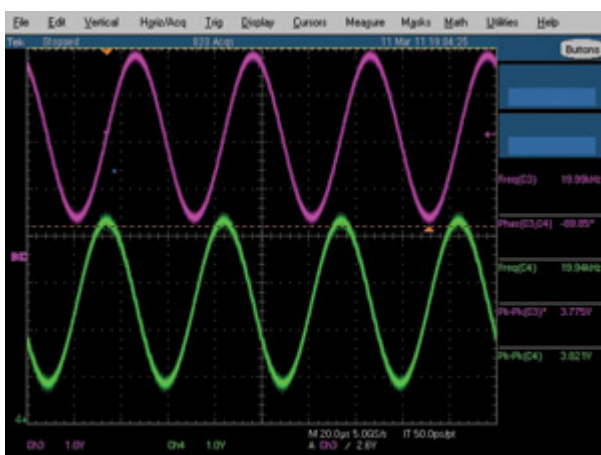


Figure 2 The phase reading on the scope is -89.85°.



Figure 3 When swept in frequency, the phase varies from -89 to -91°.

The [Mixed Signal Integration](#) MSFS5 selectable lowpass/bandpass switched-capacitor filter removes the harmonics from a square wave you apply to its inputs. The clock for the MSFS5 is 100 times the

The

input square wave. The [74HC390](#) and [74HC74](#) form a divide-by-25 and a divide-by-two circuit. The Q outputs from the [74HC74](#) connect to the two divide-by-two circuits in the [74HC390A](#), which produces square waves that are 1/100 of the filter clock's frequency and are 90° out of phase from each other. A square wave at CMOS levels would saturate the filter, so the circuit uses resistor dividers R₁ through R₄ to reduce the signal's amplitude.

Figure 2 shows the output of the two filters at 20 kHz with a system clock of 2 MHz. Note that the phase reading on the scope is at -89.85°. When swept in frequency, the phase varies from -89 to -91°. **Figure 3** shows a 20-kHz Lissajous pattern.

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Measuring the circuit's distortion using a spectrum analyzer and an [Audio Precision](#) audio analyzer shows a THD (total harmonic distortion) of -49 dB. Testing shows that the circuit has no discontinuity at the filter outputs with either FSK (frequency-shift keying) or FM (frequency modulation).