

Circle 520

Varactor Diode Stabilizes Temperature For FM Quadrature Demodulator

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A quadrature detector is used to demodulate frequency shift keying (FSK) and other types of FM signals. The MC13156 shown is an FM subsystem integrated circuit that downconverts the RF to a 10.7-MHz intermediate frequency (IF), amplification, and limiting prior to the quadrature detector (Fig. 1).

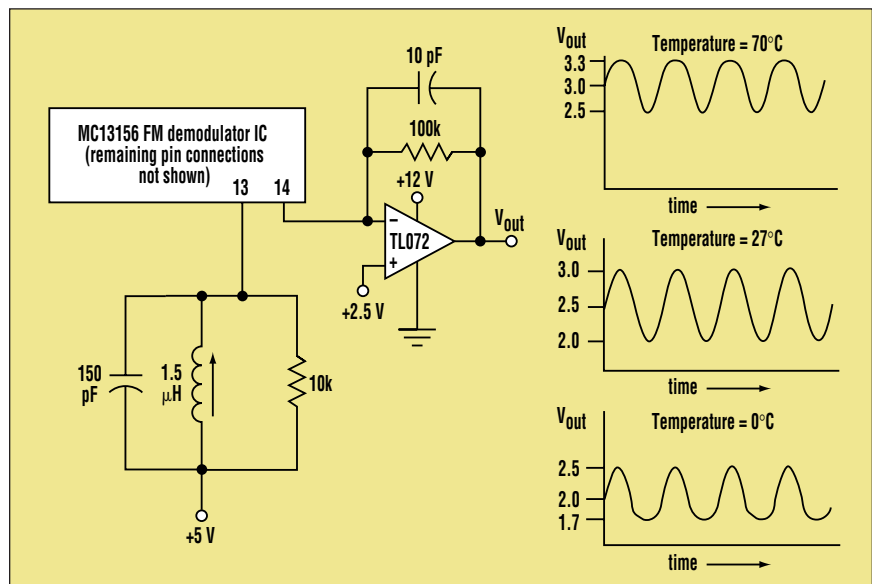
The quadrature circuit inside the MC13156 relies upon the external tank circuit connected to pin 13. The tank consists of the 150-pF capacitor and the 1.5- μ H inductor. It must be reliably tuned to 10.7 MHz and must not drift from that center frequency over the full specified temperature range. The TL072 op amp in Figure 1 is part of an external data slicer with a current source output provided at pin 14 of the MC13156 for the demodulated data.

However, depending on the temperature tolerance of the inductor and the capacitor in the tank circuit, the deviation of the input FM signal, and the Q of the tank circuit, the demodulated waveform will vary over temperature. Figure 1 shows the distortion that can occur at the temperature extremes. A common method for reducing the temperature effects is to decrease the Q of the tank. However, this also reduces the gain of quadrature detector.

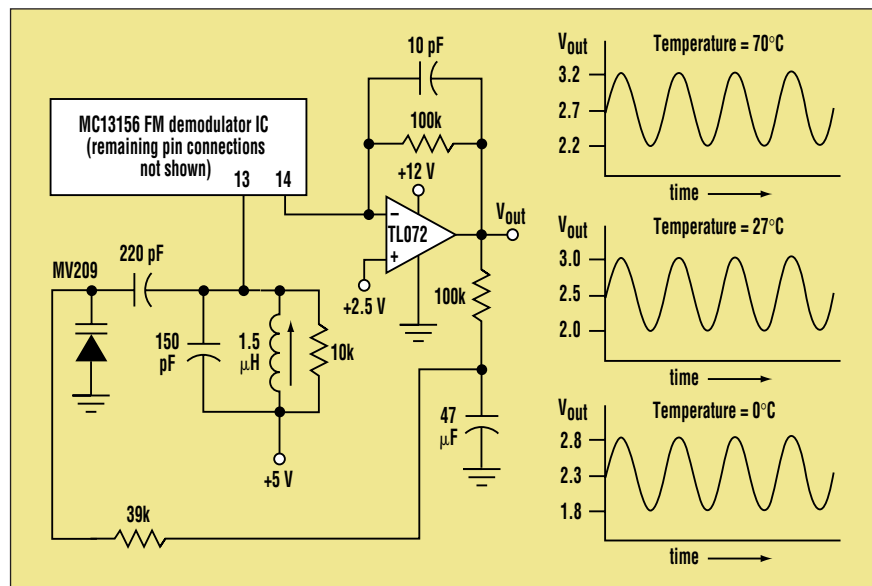
It's possible to take advantage of the shift in the dc output level over temperature in the output waveform (Fig. 1, again). The shift in the average dc level is caused by the change in the resonant frequency of the tank circuit as the ambient temperature changes. By filtering out the ac voltage at the output of the TL072, the dc level can be fed back to a varactor diode that's been added in parallel with the 150-pF capacitor (Fig. 2).

In this manner, the resonant fre-

quency of the tank circuit can be held more closely to 10.7 MHz at the temperature extremes, providing the results shown in Figure 2. Many other variations of this technique exist, including the use of an op-amp integrator in the feedback loop to hold the resonant frequency to exactly 10.7 MHz over any specified temperature range. Although the MC13156 IC was used in this example, the same approach can be taken with other discrete or integrated quadrature detectors.



1. This typical quadrature detector arrangement has no provision for temperature compensation. Consequently, the demodulated waveform will vary over temperature, resulting in signal distortion at both the upper and lower temperature extremes.



2. When operating with additional temperature compensation circuitry, the resonant frequency of the quadrature detector's tank circuit can be held more closely to 10.7 MHz at the upper and lower temperature extremes, significantly reducing distortion in the output waveforms shown.