

Keywords: sensors, AC drive, clock signals, inverting charge pump

APPLICATION NOTE 4402

# Square-wave Oscillator Includes No External Components

May 19, 2009

*Abstract: Digital systems that are not very demanding about their clock frequency, like multiplexed panel indicators and display sequencers, often require a square-wave (clock) generator for driving digital or AC-powered subsystems. Some sensors also require the use of an AC drive. This application note presents a square-wave oscillator that requires no external components except the bypass capacitor. This circuit generates a square-wave that is useful as a clock signal or AC drive for the excitation of sensors.*

This design idea appeared in the March 10, 2006 issue of *EE Times*.

Systems often require a square-wave (clock) generator for driving digital or AC-powered subsystems. These same systems may not be very restrictive about the frequency of the signal. Such frequency-tolerant digital systems include multiplexed panel indicators and display sequencers.

Some sensors also require the use of an AC drive. Electro-chemical sensors (e.g., for monitoring tilt, conductivity, and moisture) cannot tolerate DC current, because it degrades the materials of which they are made. Capacitive sensors operate on a principle that calls for AC drive. With piezoresistive sensors, an AC drive cancels DC errors and low-frequency noise. Fluxgate sensors also need an AC drive.

The circuit of **Figure 1** requires no external components except the bypass capacitor. This circuit generates a square wave that is useful as a clock signal or as an AC drive for the excitation of sensors. The design produces a powerful 3V to 5V square-wave output with very low source impedance (less than 10Ω). It also provides rail-to-rail excursions in a small SOT23 package. The output frequency is reasonably stable with variations in supply voltage and temperature (**Figure 2**).

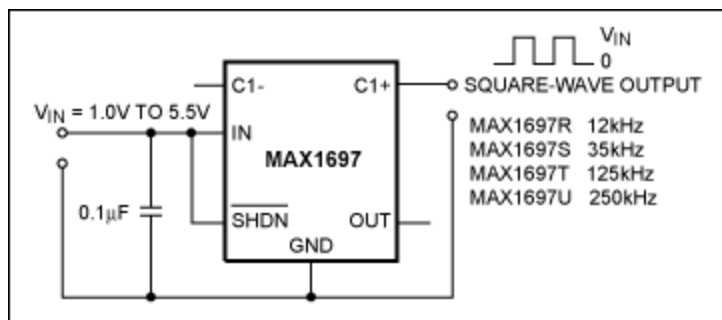


Figure 1. Formed from a single MAX1697 (an inverting charge pump), this circuit produces a square

wave that is useful in many applications.

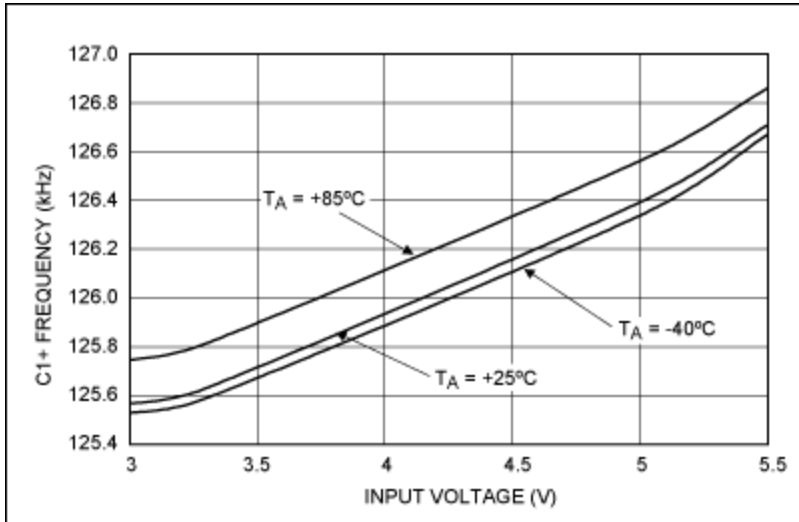


Figure 2. Frequency vs. input voltage for the MAX1697T. Output frequency for the Figure 1 circuit varies only ~1% over the allowable extremes of temperature and supply voltage.

The IC shown is an inverting charge pump, the MAX1697, which was originally designed to supply a negative voltage in positive single-supply systems. Its rail-to-rail capability means that the output-amplitude precision depends directly on the level of  $V_{IN}$ . Duty-cycle error is a fraction of 1%.

The circuit has a dependable start response, even with supply voltages below 1V (depending on the MAX1697 version used). Note that the tradeoff for simplicity in this circuit is a lack of flexibility in output frequency. As shown in Figure 1, four nominal frequencies are available according to the IC version chosen (i.e., 12kHz, 35kHz, 125kHz, and 250kHz). **Figure 3** is a scope shot of the output waveform.

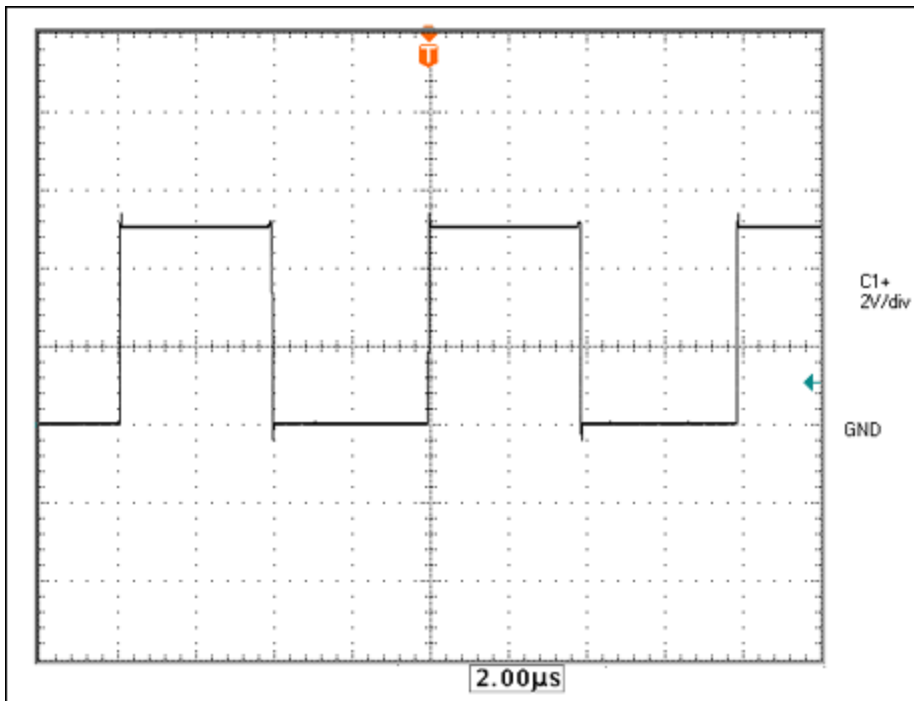


Figure 3. Output waveform for the Figure 1 circuit. Data were gathered on a MAX1697T;  $V_{IN} = 5V$ .

#### Related Parts

[MAX1697](#)

60mA, SOT23 Inverting Charge Pump with Shutdown

[Free Samples](#)

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