Keywords: isolated power, H-bridge drivers, dc-blocking capacitors, isolation capacitors

APPLICATION NOTE 4553

Isolated Power Using Capacitors

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Abstract: An integrated H-bridge driver for isolated power-supply circuits (MAX256) usually drives the primary of a transformer, but it can also drive a pair of capacitors that substitute for the transformer in providing isolation and power transfer.

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Isolated power is usually generated with a transformer, but it can also be generated using capacitors. For some systems, the constraints of size and cost may favor capacitors.

In **Figure 1**, the IC (MAX256) is an integrated primary-side controller and H-bridge driver for isolated power-supply circuits. Its oscillator, protection circuitry, and internal FET drivers usually provide up to 3W of power to the primary winding of a transformer. In this case, the device drives a pair of capacitors that substitute for the transformer in providing isolation and power transfer.

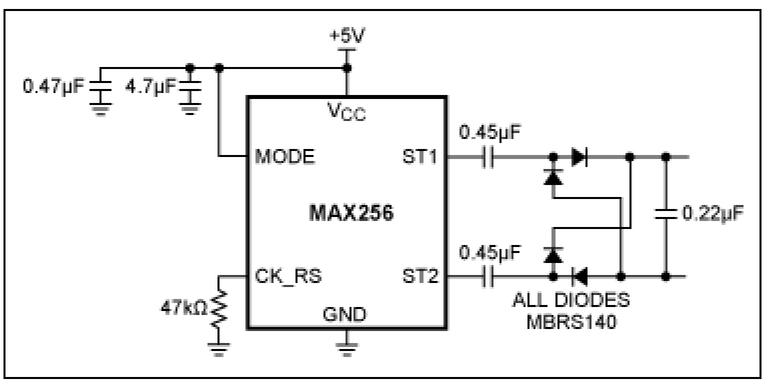

Figure 1. This simple circuit generates a capacitively isolated output voltage.

The IC's adjustable switching frequency (100kHz to 1MHz) allows the use of small isolation capacitors, as illustrated below by an equation giving the capacitor impedance at 1MHz. Losses are negligible at low output power:

$$X_C = \frac{1}{2\pi fC} = 1/(2 \times 3.14 \times 10^6 \times 0.45 \times 10^{-6}) \cong 0.35\Omega$$

Complementary square-wave drive signals from the IC (ST1 and ST2) are coupled by the isolation capacitors and full-wave rectified by the diodes to produce an isolated output voltage. The high switching frequency also allows use of a small output capacitor. Ignoring switching losses, the output voltage is:

$V_{OUT} = V_{IN} - 2V_{CAP} - 2V_{DIODE}$, where $V_{CAP} = I_{OUT} \times X_C$. Assuming I_{OUT} = 500mA

$V_{OUT} = 5 - 2(0.5 \times 0.35) - 2(0.5) = 5 - 0.35 - 1 \cong 3.7V$

This circuit suits applications for which the potential difference across the isolation barrier is fixed. (Capacitors provide isolation at dc, but not for ac signals.) With the component values shown and a 500mA load, ripple voltage is about 10% of the dc output level. You can reduce this ripple by increasing the value of the output capacitor. Other circuit performance includes the power-up response with 8Ω (~0.5A) load (**Figure 2**), the no-load power-up response (**Figure 3**), and the load-transient response obtained by connecting 8Ω to an unloaded output (**Figure 4**). (In Figures 2 to 4, Channel 3 is the +5V supply (V_{CC}), and Channel 4 is the voltage across the output capacitor.)

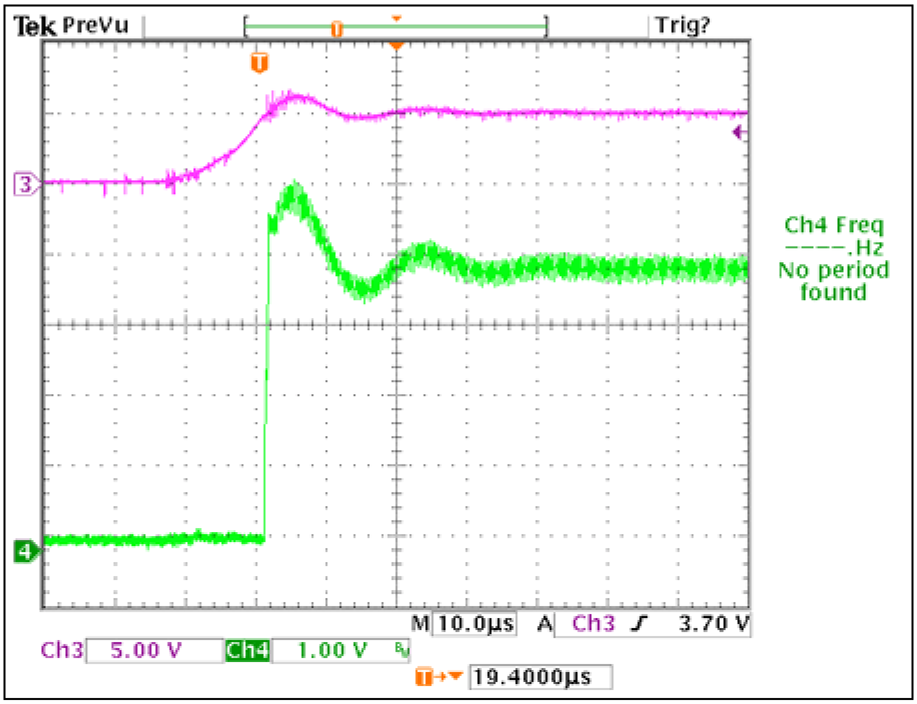

Figure 2. Power-up response of the Figure 1 circuit with 8Ω load.

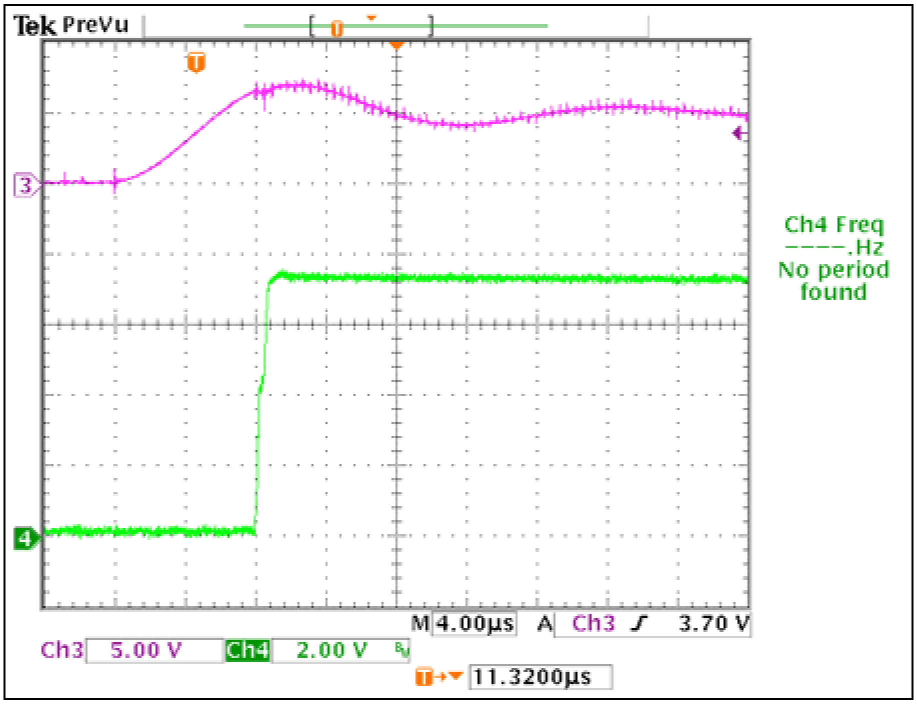

Figure 3. Power-up response of the Figure 1 circuit with no load.

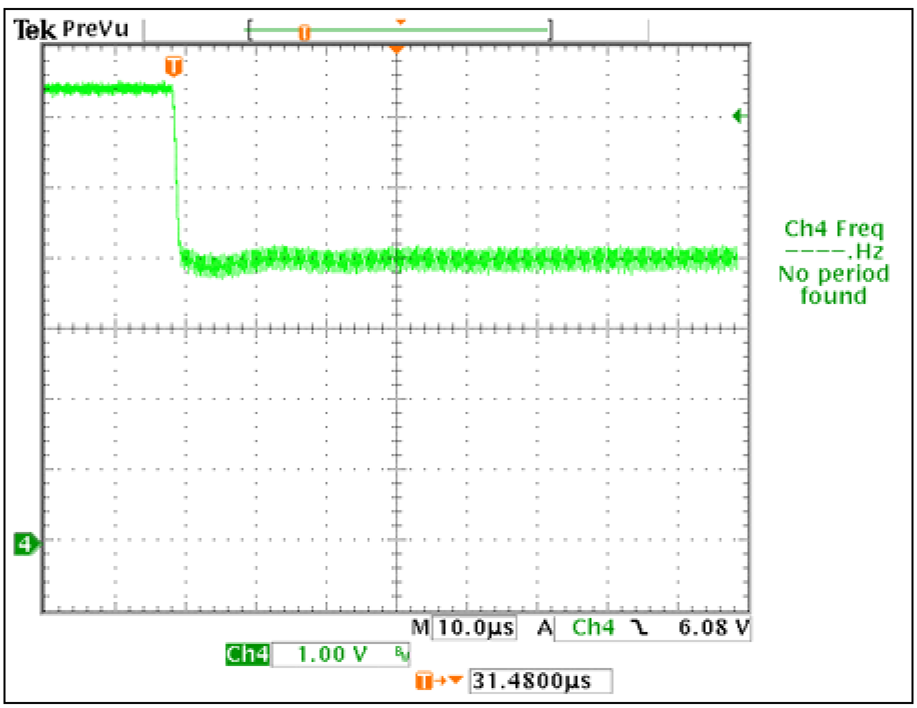

Figure 4. Load-transient response of the Figure 1 circuit, switching from no load to 8Ω load.

Related Parts		
MAX256	3W Primary-Side Transformer H-Bridge Driver for Isolated Supplies	Free Samples

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