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Design Note

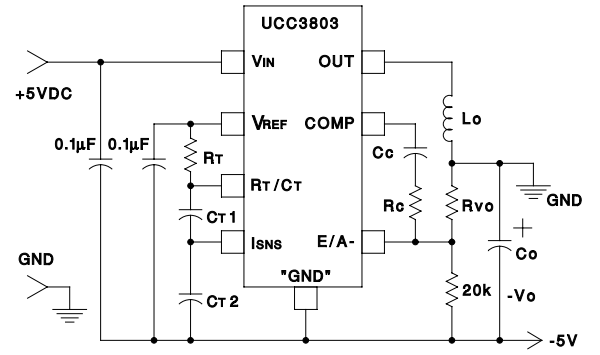
Simple Techniques to Generate a Negative Voltage Bias Supply from a Positive Input Voltage

by Bill Andreycak

Developing a low power negative supply voltage from a positive input supply can be accomplished using some very common PWM control ICs. Typical applications include generating a negative five through twelve volt (-5V to -12V) supply for analog function ICs (OP amps), RS-232 communication circuits, and MOSFET or IGBT gate drives at power levels below a few Watts.

Many PWM ICs contain a high current totem pole output which goes high during the device's ON-time or pulse width. The exact pulse width is modulated to regulate a converter's output voltage during changes in input voltage and output current. The IC's totem pole output can also be used as the main switch in low power applications. One example of this is a Flyback converter configured as shown in Figure 1.

Figure 1: Low Power Negative Output Voltage +5V to -5V Inverter



With this arrangement, the inductor (L) charges when the IC output is high and discharges or flies-back when the IC output goes low. Energy stored during the inductors charging time is transferred to the output capacitor (Cout) during the flyback, or OFF portion of the cycle. When a BiCMOS PWM control IC is used, the external diode can be replaced by the MOS channel and body diode of the IC's lower totem pole transistor thus saving one component. Reverse recovery characteristics are not a concern since current also flows through the MOS transistor channel in parallel with the body diode.

The circuit can be designed for either continuous or discontinuous inductor current operation, depending on the application. Discontinuous mode is generally preferred at lower power levels to minimize inductor size. Continuous inductor current operation is more applicable with higher load currents. High frequency switching and surface mount packaging options minimize overall size.

Conventional duty cycle control (voltage mode) is less complex to implement as the control technique than current mode control. The principal difficulty is sensing the inductor current which is not referenced to the IC's return connection, -Vout instead of ground. Adding a current sense transformer is possible, but will increase cost and complexity. Overcurrent protection is obtained by using the IC's internal maximum current limit at the switch.

Note that the BiCMOS UCC3803 device used in the example circuit of Figure 1. has a maximum low impedance input supply voltage rating of 12VDC. This limits it's applications to less than negative seven volts outputs (-7V max) with a +5V DC input. Higher voltage outputs, for example -12V to -15V, can be obtained by using a UC3843 with a higher maximum input voltage (30VDC). Here too there are some limitations. These fully bipolar ICs draw higher supply current and have higher undervoltage lockout (UVLO) thresholds, but are acceptable choices for some applications.

The IC datasheet should be referred to for additional information. Application Notes within the IC databook contain general information about the design of the Flyback converter, and others. For further assistance contact a Unitrode Field Application Engineer or the factory.

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