

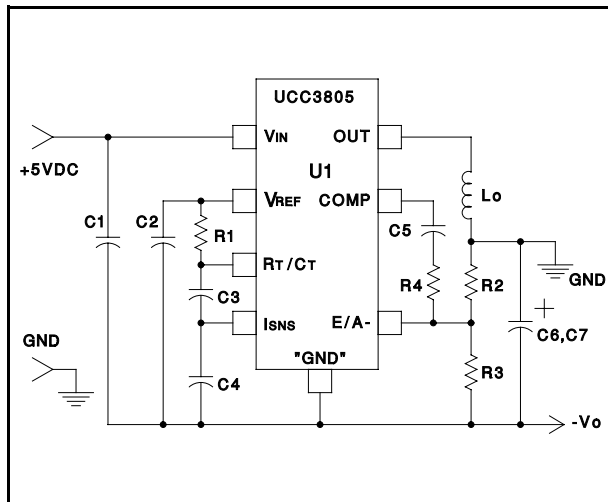
**Highly Efficient Low Power
DC to DC Inverter Converts
+5V Input to -3V Output**

*** Achieves 73% Efficiency at 0.2 Watt**

by Bill Andreyca

Operational Notes : The UCC3805 PWM control IC is used in this Flyback inverter application to perform three functions; control, switching and output rectification. During the PWM ON-time, the upper totem pole switch of the IC's output is turned on applying the 5 volt input across the inductor (L_o) which stores energy. The PWM output goes low when the correct duty cycle is achieved to regulate the output voltage, V_o . This turns off the upper totem pole switch and turns on the lower one, connecting the inductor to the output voltage (-3V) rail. The lower totem pole switch acts as a synchronous rectifier in parallel with the internal MOS body diode. This condition necessitates discontinuous inductor current operation at all times to avoid high cross-conduction currents in the IC output stage.

Circuit Schematic



The duty cycle is controlled using conventional voltage mode operation. The IC's oscillator timing waveform (R_T/C_T) is capacitively divided down to the appropriate amplitude (1V max) and fed into the I_{SNS} pin. A regulated output is obtained by resistively

dividing down the output to 2.0 volts above the IC's "ground" (which is at -3V) and input to the error amplifier's inverting input ($E/A-$). A 400kHz oscillator frequency results in 200kHz switchmode power conversion due to the IC's internal divide-by-two toggle flip-flop. This is done to limit the maximum duty cycle to below 50% while maintaining the benefits of high frequency operation.

A 200 milliwatt converter was constructed to deliver -3.0 volts at approximately 65 milliamps from a +5 volt input supply. Peak efficiency at full load measured 73% with $V_{IN} = +5.5V$, 69% with +5.0V and 60% at +4.75V input.

Higher switching frequencies are a practical choice to reduce the inductor volume, although some degradation in efficiency is to be expected. The use of surface mount components results in a very compact DC to DC converter, suitable for "on-card" regulators and distributed power applications.

List of Materials

C1	0.1 μ F / 16V
C2	0.1 μ F / 16V
C3	100pF / 6V
C4	270pF / 6V
*C5	1nF / 6V
C6	1.0 μ F / 6V
C7	100 μ F / 6V
SPRAGUE	#592D-107X06R3R2
L1	150 μ H / 0.4 μ J
COILCRAFT	# DT3316-154
R1	30k / 0.1W
R2	11.0k / 0.1W
R3	20.0k / 0.1W
*R4	100k / 0.1W
U1	UCC3805 PWM

Other Applications:

+5V to -2V : A minus two volt (-2V) output can be obtained with the same circuit by simply replacing resistor R2 with a short circuit. The inductor value may need to be modified depending on the desired output current.

+5V to -5V : A minus five volt (-5V) output is obtained by using a 30k ohm value for resistor R2. Note that the UCC3803 device is recommended (without the toggle flip flop) to achieve a higher maximum duty cycle. The inductor value needs to

be calculated based upon output current and switching frequency. Higher overall efficiency can be obtained than in the -3V application due to the higher output voltage (-5V).

Consult Unitrode Design Note DN-43 for other simple DC-DC inverter applications, or contact a Unitrode Field Applications Engineer.

* Coilcraft telephone number: 1-800-322-COIL

* Sprague telephone number: 1-207-324-4140