

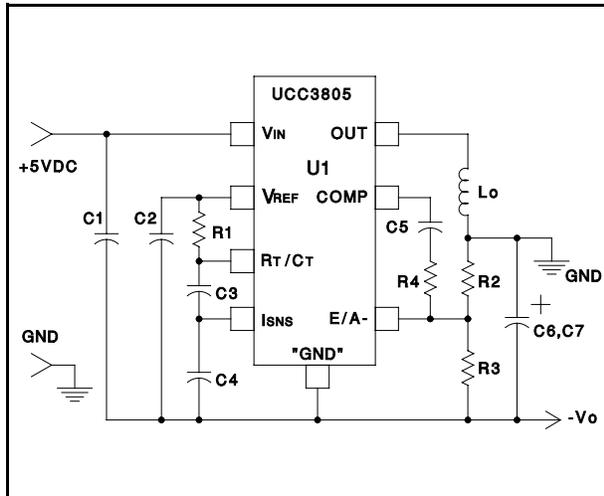
**Highly Efficient Low Power
DC to DC Inverter Converts
+5V Input to -3V Output**

*** 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 (Lo) which stores energy. The PWM output goes low when the correct duty cycle is achieved to regulate the output voltage, Vo. 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 (RT/CT) is capacitively divided down to the appropriate amplitude (1V max) and fed into the ISNS pin. A regulated output is obtained by resis-

tively 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 VIN = +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	0.1μF / 16V
C2	0.1μF / 16V
C3	100pF / 6V
C4	270pF / 6V
*C5	1nF / 6V
C6	1.0μF / 6V
C7	100μF / 6V
SPRAGUE	#592D-107X06R3R2
L1	150μH / 0.4μJ
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

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