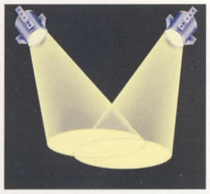
Feature I

DC/DC Converter For Telecom Applications



In many telecom applications, it is necessary to provide a POTS (Plain Old Telephone Set) analog line interface. SGS-THOMSON offers a variety of SLIC (Subscriber Line Interface Circuit) devices as a solution. A SLIC provides the functions of signal transmission, loop supervision, ringing and battery feed. In order to provide the necessary DC power to the analog telephone line, a -48V to -68V DC power supply with current capability of at least 50-60 mA is typically required. Although such power supplies are commonly available in Central Office and PABX systems where SLICs are used as on-line cards, such is not the case for most other equipment.

A typical PC power supply does not provide a -48V to -68V power supply in the case of an ISDN interface card for a PC. However, it is a requirement that a full-feature ISDN interface card provide POTS interface to the ISDN line. A SLIC device such as the L3037 is an optimal choice for providing the POTS interface because it does not require an additional ringing signal generator for ringing, but the -48V to -68V power supply remains an issue. These issues were important considerations in the SGS-THOMSON Fast-Link ISDN PC card development process.

As a broad range supplier, ST also offers a variety of PWM (Pulse Width Modulation) power supply controllers for DC/DC conversion applications. There are many application notes that are available for step-down converters, step-up converters and high-current regulators, but there is little information available on using PWM controllers for step-up polarity inversion applications.

The SG3524 is essentially used in a boosted current polarity inversion configuration optimized to boost the output voltage.

Since the only power supplies with sufficient current capability available in a PC are +5V and +12V, it is necessary to use one of these supplies as the source for the DC/DC converter that will generate the -48V to -68V output.

The +12V supply of the PC was chosen for the SGS-THOMSON Fast-Link ISDN board because of the amount of step-up required from +12V to -48V. Due to cost considerations, the SG3524 regulating PWM was chosen as the controller for the DC/DC conversion. The current requirements for the -48V to -68V supplied by the L3037 are typically limited to 55mA or less, so a low-cost 2N4033 or MPSA56 transistor may be used as the output switching transistor controlled by the pulse width modulator.

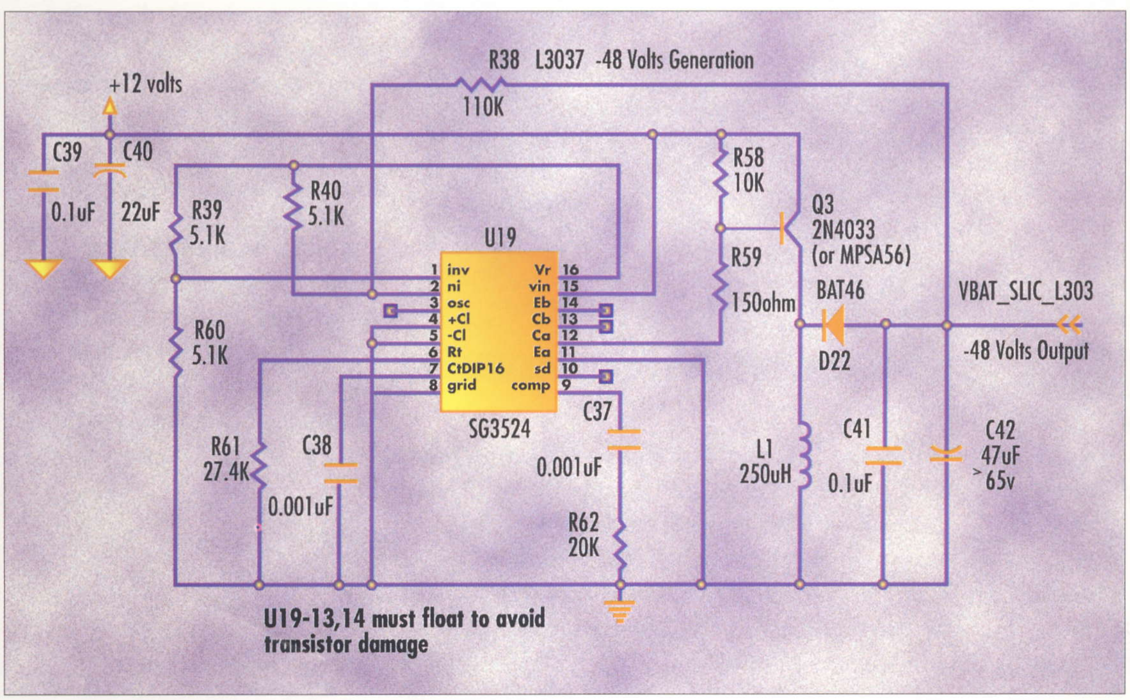


Figure 1: +12V to -48V DC/DC Converter

The principle used in the stepping up of the voltage from +12V to -48V is similar to that used in the ignition system of automobiles, in which an inductor (commonly called a coil) is a key component. In older automobiles the switching is done by the "points" or by a transistor in "electronic ignition" systems, and the frequency of switching is determined by the speed of the engine. In our application the regulation of the output voltage as well as a polarity inversion is required.

As a broad range supplier, ST also offers a variety of PWM (pulse width modulation) power supply controllers for DC/DC conversion applications.

The SG3524 is essentially used in a boosted current polarity inversion configuration optimized to boost the output voltage (see figure 1). In this circuit, PNP transistor Q3 is used as a switch controlled by the pulse width modulator output. When Q3 is ON, power is supplied by the +12V supply to store energy in inductor L1. During this time, diode D22 is reversed biased so output current is supplied from the charge stored in C42. When Q3 turns OFF, inductor L1 will force current to keep flowing through it, increasing the voltage across L1 until D1 turns ON. The output current is supplied through L1/D1 to the load to replenish any charge lost by C42 during the time Q3 was OFF. The output voltage is smoothed by capacitors C41 and C42 to give a relatively clean DC output. The current flowing through L1 is approximately the nominal load current Io plus a delta current, due to the changing voltage across L1. The standard rule is to use a delta current at approximately 40% of the nominal load current Io.

As with most PWM devices, the SG3524 has an internal oscillator to control the ON and OFF times of the switching output. In the SG3524, the capacitor and resistor connected to the Ct and Rt pins on the device determine the frequency of the oscillator used for the pulse width modulation. For this particular application, a frequency of approximately 44 KHz is used, due to the design constraints associated with the use of low-cost available components. It should be noted that the frequency of the oscillator will have a significant effect on the size of the inductor L1 and the capacitor C42.

SG3524

The SG3524 was designed for switching regulators of either polarity, transformer-coupled DC/DC converters, transformerless voltage doublers and polarity converter applications employing fixed frequency, pulse width modulation techniques.

The design equations for the circuit are as follows:

Rf = 5.1K [((Vout - Vin) / (Vin - 2.5V)) -1]

R38 = 110K used in the circuit described

Fosc = 1 / (R61 x C38)

44 KHz used in the circuit described

L1 = [(Vin)2 |Vout|] / [(2Io x 0.2) (Vin + |Vout|)2 (Fosc)]

L1 = 250 uH used in the circuit described

C42 = (Io |Vout|) / [Fosc (|Vout| + Vin) Vripple]

C42 = 47 uF used in the circuit described

The R38 resistor is used as the feedback resistor Rf. Changing the value of R38 will adjust the output voltage of this circuit from -48V to -68V DC.

The design equations for the circuit are shown in the above sidebar.

When using the circuit as described, a boosted current polarity inversion DC/DC converter can be implemented to provide -48V to -68V DC on a PC card in a relatively small amount of board space.

It should be noted that just by modifying the component values, the approach used in this application for providing the required -48V to -68V DC can be used in an application in which only a single 5V power supply is available.

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