RS-232 Line Driver Power Supply

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INTRODUCTION

A large segment of today's systems comply with the Electronic Industries Association (EIA) RS-232 specification for the interface between data processing and data communications equipment. Because this specification calls for the use of positive and negative signal levels, the designer quite often needs to add a dual supply to a board which can otherwise operate from a single 5V supply. The LM1578A Switching Regulator can be used to convert the already existing supply into a separate ±12V supply for powering the interface line drivers.

CIRCUIT DESCRIPTION

The power supply, shown in *Figure 1*, operates from an input voltage as low as 4.2V, and delivers an output of ±12V at ±40 mA with an efficiency of better than 70%. The circuit provides a load regulation of ±1.25% (from 10% to 100% of full load) and a line regulation of ±0.08%. Other notable features include a cycle-by-cycle current limit and an output voltage ripple of less than 40 mVp-p.

A unique feature of this flyback regulator is its use of feedback from BOTH outputs. This dual feedback configuration results in a sharing of the output voltage regulation by each output so that one output is not left unregulated as in single feedback systems. In addition, since both sides are regulated, it is not necessary to use a linear regulator for output regulation.

COMPONENT SELECTION

The following design procedure is provided for the user who wishes to tailor the power supply circuit to fit their own specific converter application.

The feedback resistors, R2 and R3, may be selected as follows by assuming a value of 10 kΩ for R1;

$R2 = (V_{OUT} - 1V)/45.8\ \mu A = 240\ k\Omega$

$R3 = (|V_{OUT}| + 1V)/54.2\ \mu A = 240\ k\Omega$

Actually, the currents used to program the values for the feedback resistors may vary from 40 μA to 60μA, as long as their sum is equal to the 100 μA necessary to establish the 1V threshold across R1 (10 kΩ). Ideally, these currents should be equal (50 μA each) for optimal control. However, as was done here, they may be mismatched in order to use standard resistor values. This results in a slight mismatch of regulation between the two outputs.

The current limit resistor, R4, is selected by dividing the current limit threshold voltage (approximately 100 mV) by the maximum peak current level in the output switch (750 mA steady-state). For our purposes R4 = 100 mV/750 mA = 0.13Ω. A value of 0.1Ω, used here, will trip the current limit at 1A peak. A more conservative design would use 0.15Ω for this resistor.

Capacitor C1 sets the oscillator frequency according to the equation C1 = 80/f, where C1 is in nano-Farads and f is the frequency of the oscillator in kHz. This application runs at 80 kHz and used a 1 nF (1000 pF) silver-mica capacitor. The oscillator section provides a 10% deadtime each cycle to protect the output transistor.

Capacitor C2 serves as a compensation capacitor for operating the circuit in the synchronous conduction mode. That is, the output transistor will switch on each cycle, thereby eliminating the random noise spikes which occur with non-synchronous operation and are at best difficult to filter. This capacitor is optional and may be omitted if desired. If used, a value of 10 to 50 pF should be sufficient for most applications.

The choice for an output capacitor value depends primarily on the allowed output ripple voltage, ΔV_{OUT}. In most cases, the capacitor's equivalent series resistance (ESR) at the switching frequency produces more ripple voltage than does the charging and discharging of the capacitor. The capacitor should be chosen to have an ESR $\leq \Delta V_{OUT}/100$ mA, where 100 mA is approximately the greatest ripple current produces by the transformer secondary. Higher-value capacitors tend to have lower ESR; 1000 μF aluminum electrolytic was used in this circuit to assure low ESR, under 0.4Ω.

The input capacitors, C5 and C6, are used to reduce the transients that may be fedback to the main supply. Capacitor C5 is a 100 μF electrolytic and is bypassed by C6, a 0.1 μF ceramic disc.

For good efficiency, the diodes must have a low forward voltage drop and be fast switching. 1N5819 Schottky diodes work well.

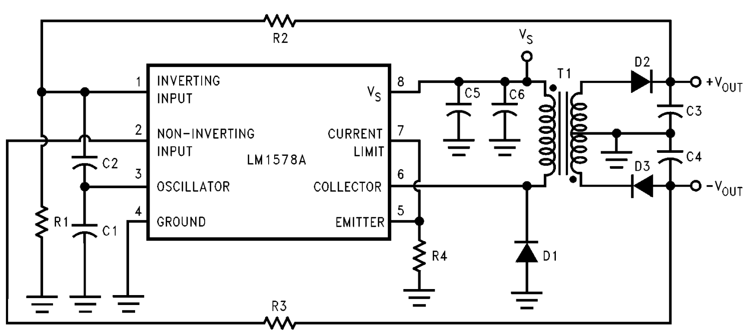

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FIGURE 1. RS-232 Power Supply (See Table I, Parts List)

Transformer selection should be picked for an output transistor "on" time of 0.4/f, and a primary inductance high enough to prevent the output transistor switch from ramping higher than the transistor's rating of 750 mA. Pulse Engineering (San Diego, Calif.) and Renco Electronics, Inc. (Deer Park, N.Y.) can provide further assistance in selecting the proper transformer for a specific application need. The transformer used in the power supply was a Pulse Engineering PE-64287 with turns ratio of Np:Ns:Ns = 1:1.6:1.6 and primary inductance of 50 μH.

Table I is a parts listing for the components used in the building of the power supply circuit.

TABLE I
Parts List

R1 = 10 kΩ
R2 = 240 kΩ
R3 = 240 kΩ
R4 = 0.1Ω
C1 = 1000 pF
C2 = 18 pF
C3 = 220 μF
C4 = 220 μF
C5 = 100 μF
C6 = 0.1 μF
All diodes are 1N5819
T1 = Pulse Engineering PE-64287

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