LINEAR TECHNOLOGY

DESIGN NOTES

No Design Switching Regulator
5V, 5A Buck (Step Down) Regulator – Design Note 48

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Introduction

This simple, no design regulator, is a step down DC to DC converter designed to convert an 8V to 40V input to a regulated 5V output. The 5V output is capable of sourcing up to 5A of output current.

This converter is based on the Linear Technology LT1074 switching regulator IC. This device needs only a few external parts to make up a complete regulator including thermal protection and current limit. This design uses off-the-shelf parts for low cost and easy availability of components. Specifications for the circuit are in Table 1.

Circuit Description

Figure 1 shows the schematic of the circuit. For the purpose of this explanation assume that the output is at a constant +5V DC and that the input voltage is greater than +8V DC.

At intervals of ≈10µs (100kHz) the control portion of the LT1074 turns on the switch transistor between the V_{IN} and V_{SW} pins impressing a voltage across the inductor, L1. This causes current to build up in the inductor while also supplying current to the load and capacitor C1.

The control circuit determines when to turn off the switch during the 10µs interval to keep the output voltage at +5V DC. When the switch transistor turns off, the magnetic field in the inductor collapses and the polarity of the voltage across the inductor changes to try and maintain the current in the inductor. This current in the inductor is now directed (due to the change in voltage polarity across the inductor) by the diode, D1, to the load. The current will flow from the inductor until the switch turns on again, (continuous operation) or until the inductor runs out of energy (discontinuous operation).

Referring back to Figure 1, the divider circuit of R1 and R2 is used to set the output voltage of the supply against an internal voltage reference of 2.21V DC.

R3 and C2 make up the frequency compensation network used to stabilize the feedback loop.

Conclusion

This Design Note demonstrates a fully characterized step down converter circuit that is both simple and low cost. This design can be taken and reliably used in a production environment without the need for any custom components. A P.C. board layout and FAB drawing are available from Linear Technology.

Table 1. Performance Summary (Operating Temperature Range 0°C to 50°C)

Input Voltage Range			+ 8.0V to + 40.0V DC
Output	Output Voltage (± 0.15V DC)		+ 5.00V DC
	Max Output Current V_{IN} = 8.0V to 40.0V		5.0A DC
	Typical Output Ripple at I_{OUT} = 4.0A DC @ Switching Frequency	With Optional Filter (L2 & C4) Without Optional Filter (L2 & C4)	5mVp-p 50mVp-p
	Load Regulation V_{IN} = 8V	At I_{OUT} = 0.5A DC to I_{OUT} = 5.0A DC	0.5%
	Line Regulation I_{OUT} = 5A	At V_{IN} = + 8.0V DC to V_{IN} = + 40.0V DC	0.5%

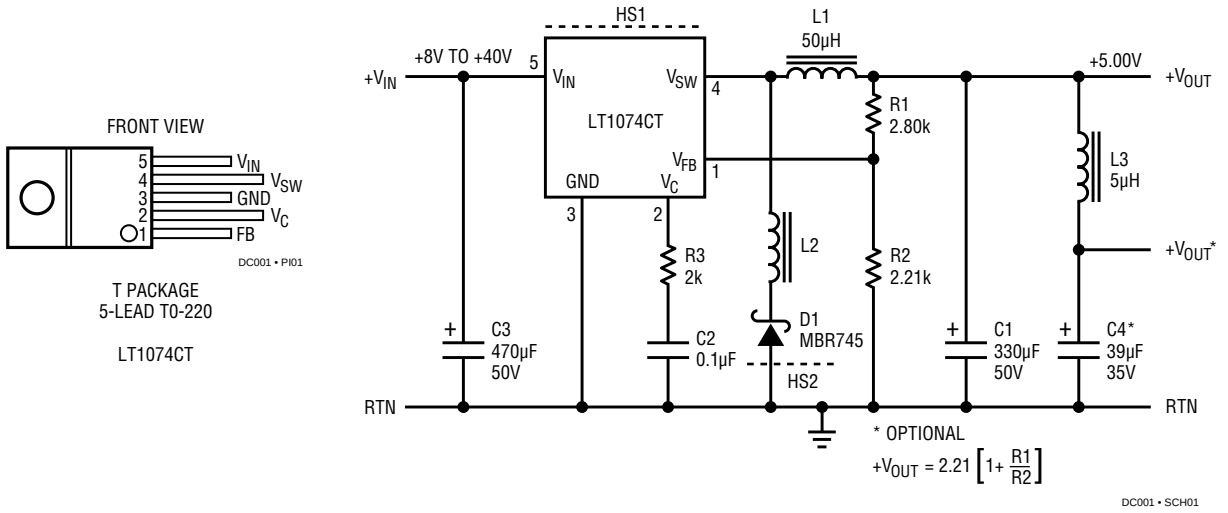

Figure 1. Package and Schematic Diagrams

Table 2. Parts List

REFERENCE DESIGNATOR	QUANTITY	PART NUMBER	DESCRIPTION	VENDOR
PCB	1	001A	PCB FAB, Buck Switching Regulator	LTC
D1	1	MBR745	Diode, Schottky, 7A, 45V	Motorola
HS2	1	6038B-TT	Heatsink	Thermalloy
L2	1	2664000101	Shield Bead	Fair-Rite
VR1	1	LT1074CT	Switching Regulator, 100kHz	LTC
HS1	1	7020B-MT	Heatsink	Thermalloy
C1	1	SXE50VB331M12X20LL	Cap, Alum Elect, 330µF, 50V	United Chemicon
C2	1	CKO6BX104K	Cap, Ceramic, 0.1µF, 50V	AVX
C3	1	UPL1H471MRH	Cap, Alum Elect, 470µF, 50V	Nichicon
C4	1	UPL1V390MAH	Cap, Alum Elect, 39µF, 35V	Nichicon
L1	1	CTX50-5-MP	Inductor, 50µH, 5A	Coiltronics
L3	1	CTX5-5-FR	Inductor, 5µH, 5A	Coiltronics
R1	1	MF 1/8W 2.80kΩ	RES, MF, 1/8W, 1%, 2.80kΩ	
R2	1	MF 1/8W 2.21kΩ	RES, MF, 1/8W, 1%, 2.21kΩ	
R3	1	CF 1/4W 2kΩ	RES, CF, 1/4W, 5%, 2kΩ	

For literature on our Switching Regulators, call **(800) 637-5545**. For applications help, call (408) 432-1900, Ext. 456

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