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Positive Input to Negative Output Conversion using a Buck Converter

Device	Application	Input Voltage	Output Voltage	Topology	I/O Isolation
NCP3170 NCP3020	Power supplies	Positive	Negative	Buck	None

Input Voltage	+5, 8, 12 Vdc
Output Voltage	-3.3, -5 Vdc
Nominal Current	0.5 A or 8 A
Nominal Efficiency	80 - 90%

Introduction

The buck-boost is usually the topology of choice for voltage inverting applications. There are plenty of components to choose from and most of them even come with integrated transistors or mosfets. They can work in hysteretic mode or they can switch at a fixed frequency. Very often when more power is required, an external transistor is used and while the circuit can deliver the needed power, the efficiency is very poor.

This Design Note describes an alternate solution that is very simple, but little known. It provides superior efficiency while using commonly available components.

Circuit Description

The circuit is built around a buck converter. Depending on output power, a regulator with integrated fets or a controller with external fets can be used.

The circuit in Figure 1 uses the NCP3170A to obtain a -5 V rail from a +8 V input at up to 0.5A output current. Efficiency reaches 85%

The circuit in Figure 2 converts a +12 V input into -3.3 V or -5V at up to 8A. 90% efficiency is achievable.

There are many more options available for buck controllers and converters as well as for mosfets. The user needs to pay attention to the voltage rating of the part. In this application the controller and the mosfets will need to withstand a voltage equal to input voltage plus output voltage. For example the circuit in figure 1 needs to be able to handle 8 + 5 = 13 V.
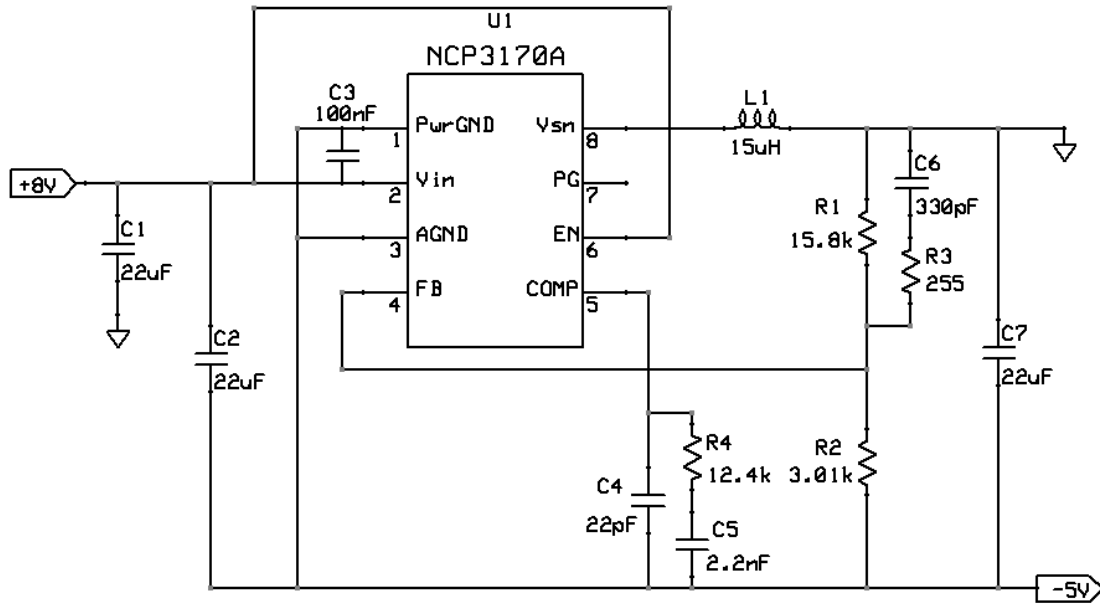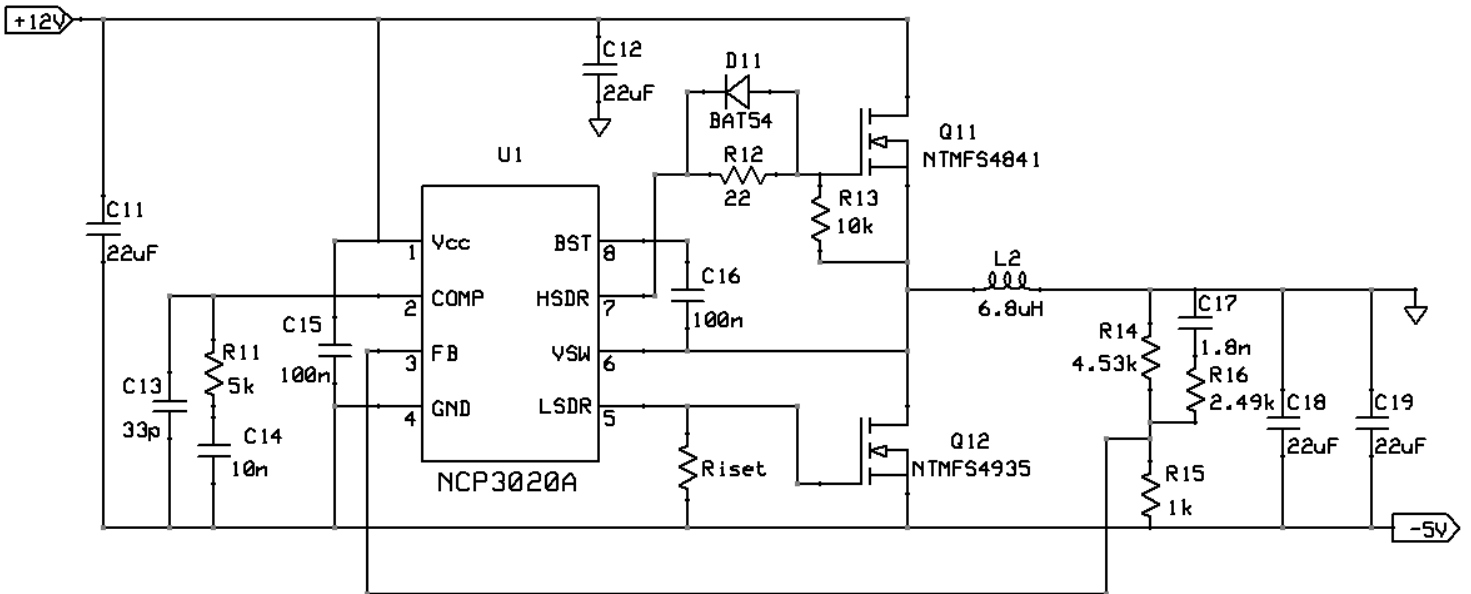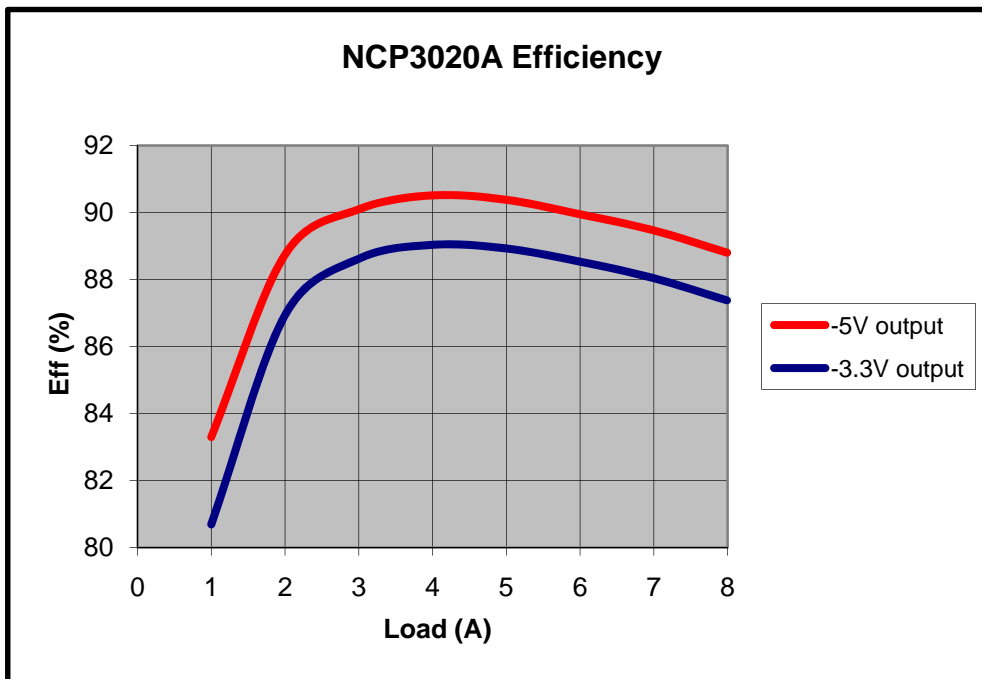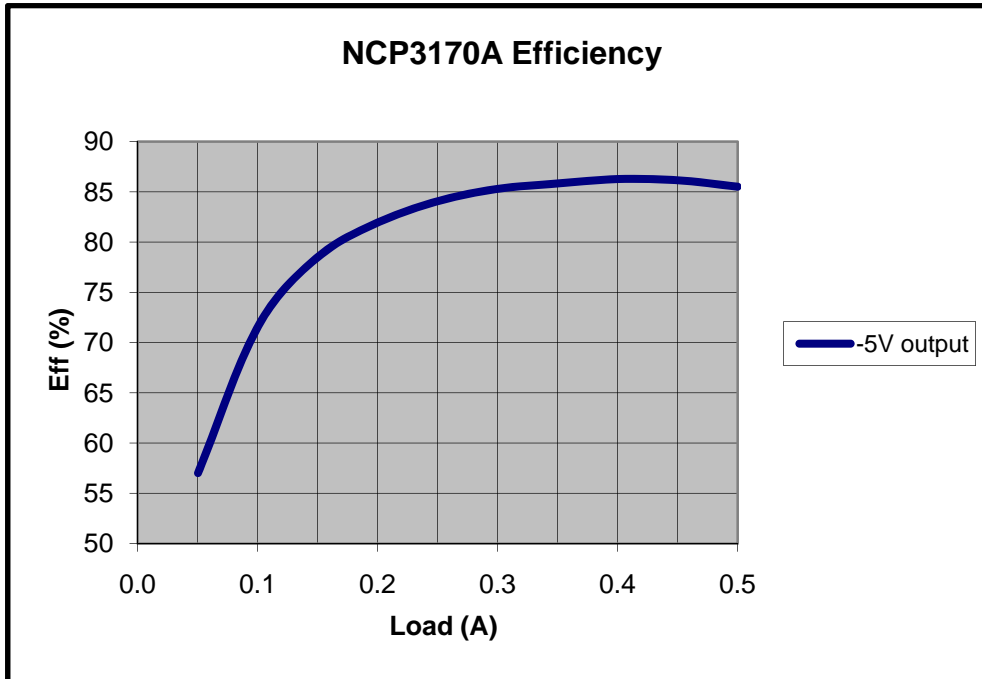
Figure 1

Figure 2

Efficiency Curves

NCP3170A Efficiency

NCP3020A Efficiency

Key Features

- Simple and familiar topology
- High efficiency
- Many options available for component selection

References

- Data sheet [NCP3170](#): 3A Switching regulator
- Data sheet [NCP3020](#): 28V Synchronous Buck Controller

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