4.5-V to 17-V Input, 3.3-V Output, High-Efficiency DC/DC Converter

PMP - DC/DC Low-Power Converters

ABSTRACT

This design was created to help those desiring to design-in a Stellaris® ARM® Cortex™-M3 MCU into a system requiring a high input voltage range that encompasses both 5V and 12V and is concerned about maintaining high efficiency and long battery life. This particular design allows for an input voltage between 4.5V to 17V.

1 Features

- 4.5-V to 17-V input voltage range
- Fixed 3.3-V output eliminates need for external voltage-setting resistors
- TPS62111 is capable of driving up to 1500-mA
- High-efficiency (up to 94%)
- Low quiescent current (20 μA)
- Small 4 mm × 4 mm QFN-16 package

2 Introduction

This reference design is for the Stellaris® ARM® Cortex™-M3 MCU devices and accounts for voltage and current, requirements given below. The Stellaris® devices only require a single 3.3V input, so no sequencing is required. The operating input voltage for this reference design is 4.5V to 17V. This design is optimized for high input voltage range and small design/low part count.

3 Requirements

The power requirements for each Stellaris® ARM® Cortex™-M3 MCU family are listed below.

For more information and other reference designs, please visit www.ti.com/processorpower.

Table 1. Stellaris® ARM® Cortex™-M3 MCU Family Power Requirements

DEVICE FAMILY	PIN NAME	VOLTAGE (V)	I_{MAX}(mA)	TOLERANCE	SEQUENCING ORDER	TIMING DELAY	COMMENTS
LM3S100 series LM3S300 series LM3S600 series LM3S800 series LM3S1000 series LM3S2000 series LM3S3000 series LM3S5000 series	VDD	3.3	170	±10%	—	—	Internal regulator supplies power to device core
LM3S6000 series LM3S8000 series	VDD	3.3	225	±10%	—	—	Internal regulator supplies power to device core
LM3S9000 series	VDD	3.3	150	±10%	—	—	Internal regulator supplies power to device core
LM3S2B93, LM3S2B2793, LM3S5B91, LM3S5791	VDD	3.3	100	±10%	—	—	Internal regulator supplies power to device core
Note: The "Imax" currents listed are worst case expected values.							

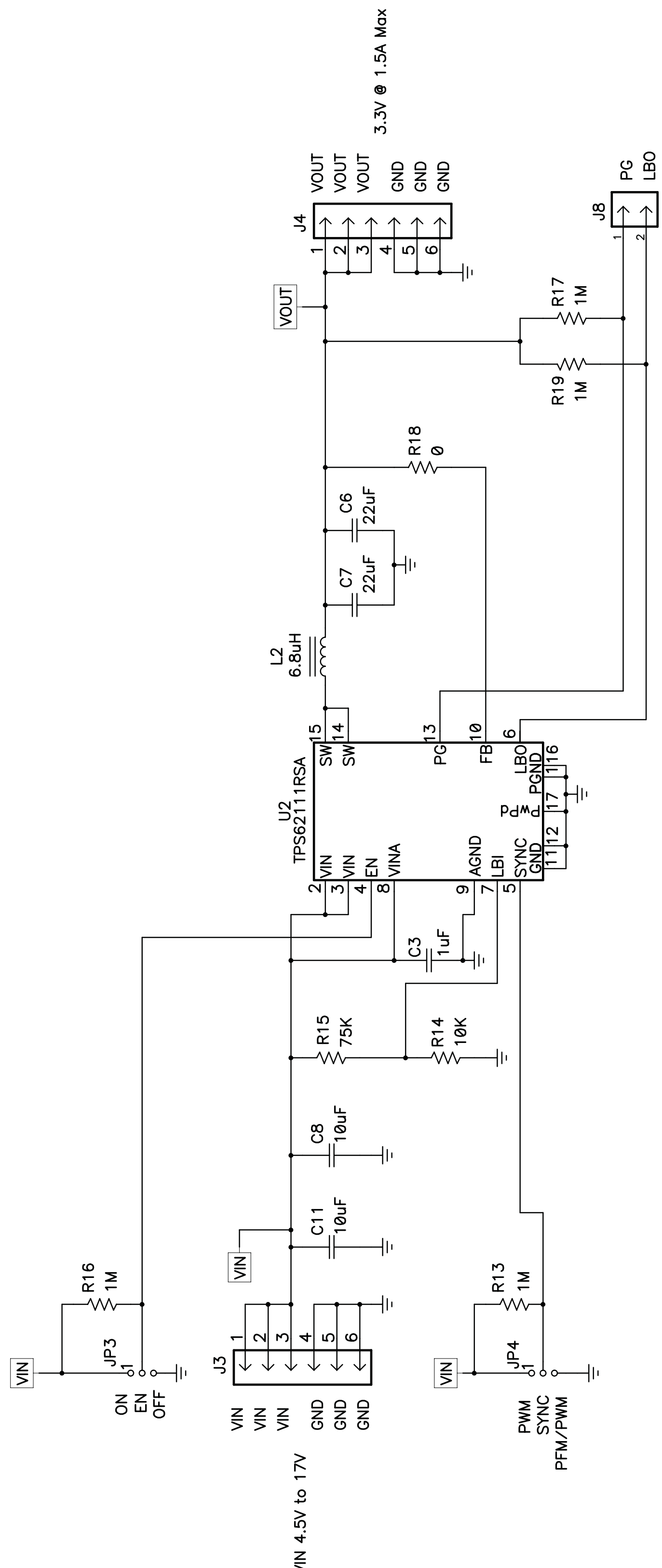

Figure 1. PMP4777 Reference Design Schematic

4 List of Materials

Table 2. PMP4777 List of Materials

REF DES	QTY	VALUE	DESCRIPTION	SIZE	PART NUMBER	MFR
C3	1	1 μF	Capacitor, Ceramic, 25 V, X7R, 10%	0603	C1608X7R1E105K	TDK
C6, C7	2	22 μF	Capacitor, Ceramic, 10 V, X5R, 20%	1206	C3216X5R1A226	TDK
C8, C11	2	10 μF	Capacitor, Ceramic, 25 V, X5R, 20%	1206	C3216X5R1E106	TDK
L2	1	6.8 μH	Inductor, SMT, 3.0 A, 97 milliohm	0.276" × 0.276"	HA3808-AL	Coilcraft
R13, R16, R17, R19	4	1 MΩ	Resistor, Chip, 1/16-W, 1%	0603	Std	Std
R14	1	10 kΩ	Resistor, Chip, 1/16-W, 1%	0603	Std	Std
R15	1	75 kΩ	Resistor, Chip, 1/16-W, 1%	0603	Std	Std
R18	1	0	Resistor, Chip, 1/16-W, 1%	0603	Std	Std
U2	1		IC, Synchronous step-down converter, 17 V, 1.2 A	QFN-16	TPS62111RSA	TI

5 Test Results

The input and output startup waveforms are shown in Figure 2 through Figure 5. The output ripple voltages are shown in Figure 6 and Figure 7. Figure 8 shows the transient response. The switching node waveform is shown in Figure 9.

5.1 Test Results

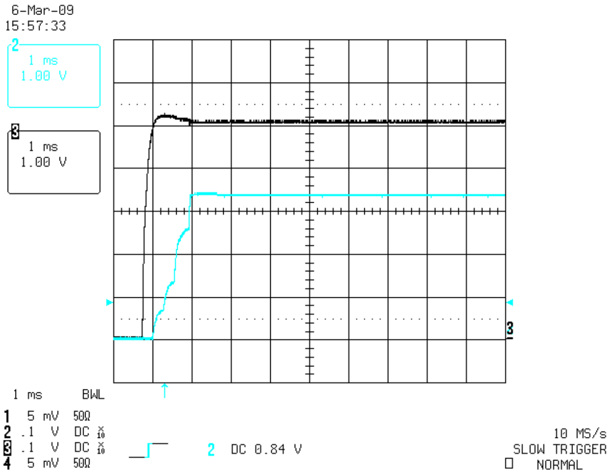

Figure 2. Startup V_{IN} = 5 V, I_{LOAD} = 1.5 A

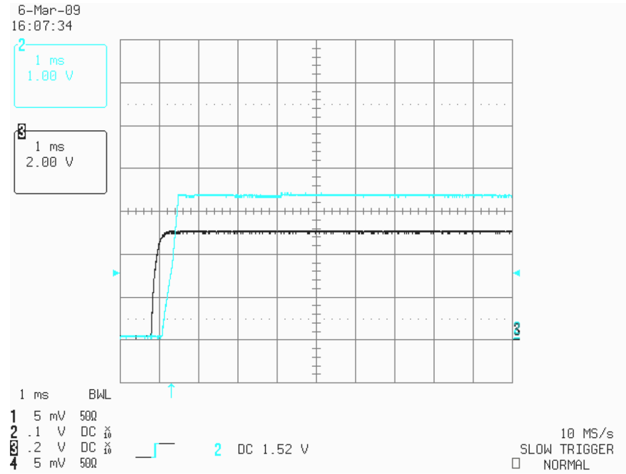

Figure 3. Startup V_{IN} = 5 V, No Load

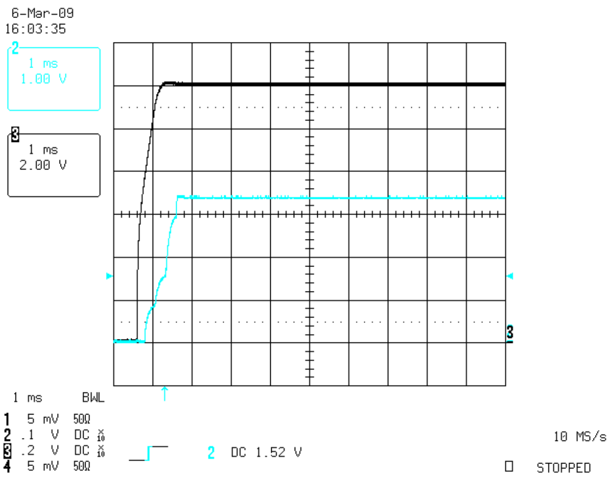

Figure 4. Startup V_{IN} = 12 V, I_{LOAD} = 1.5 A

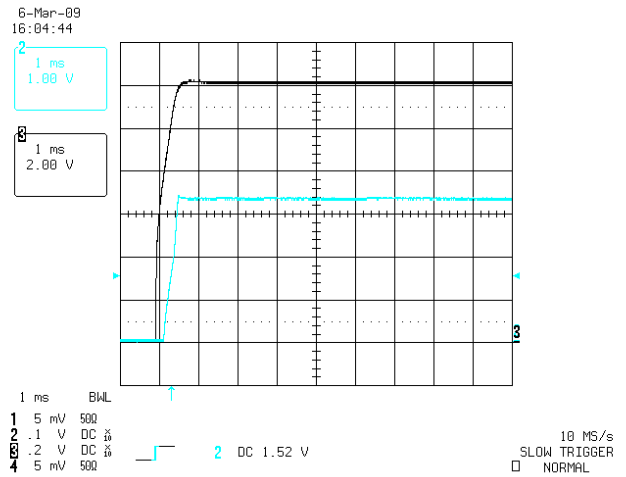

Figure 5. Startup V_{IN} = 12 V, No Load

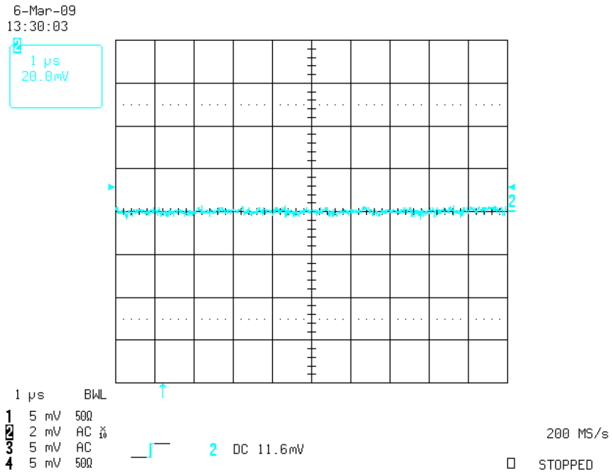

Figure 6. Output Ripple Voltage, V_{IN} = 5 V

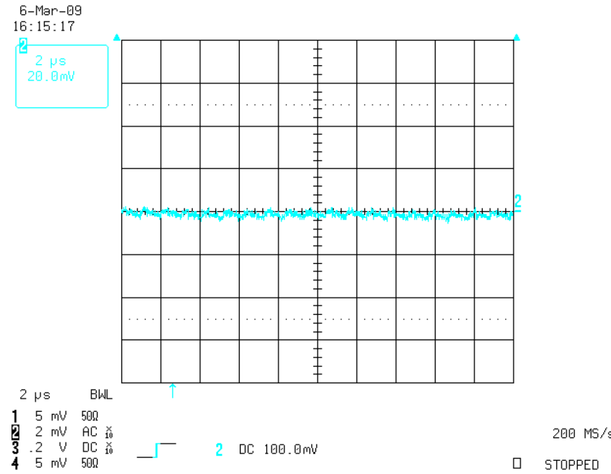

Figure 7. Output Ripple Voltage, V_{IN} = 12 V

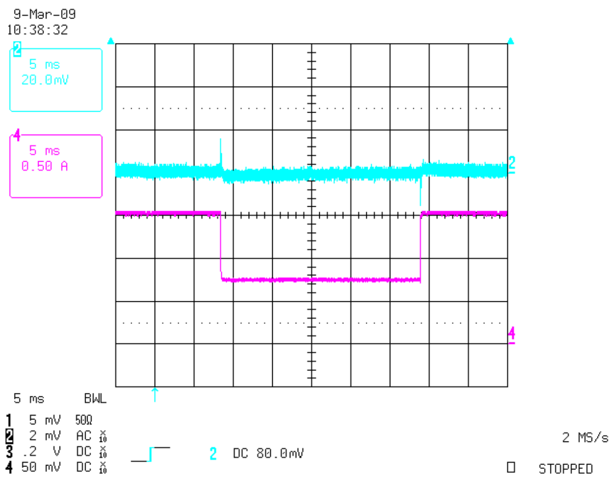

Figure 8. Load Transient Stepped Between 750 mA and 1.5 A, Vin = 12 V

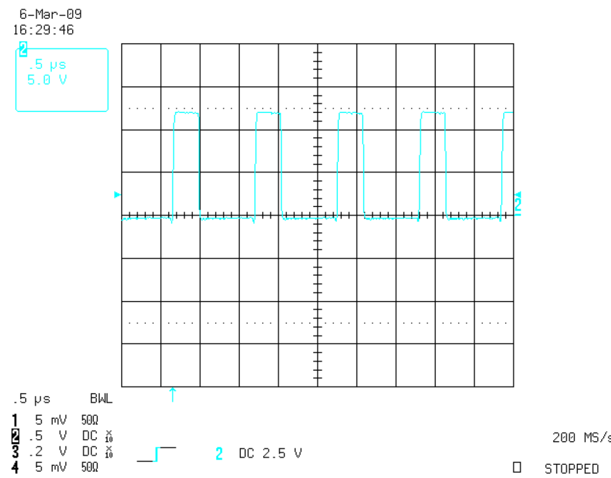

Figure 9. Switching Node Waveform, V_{IN} = 12 V

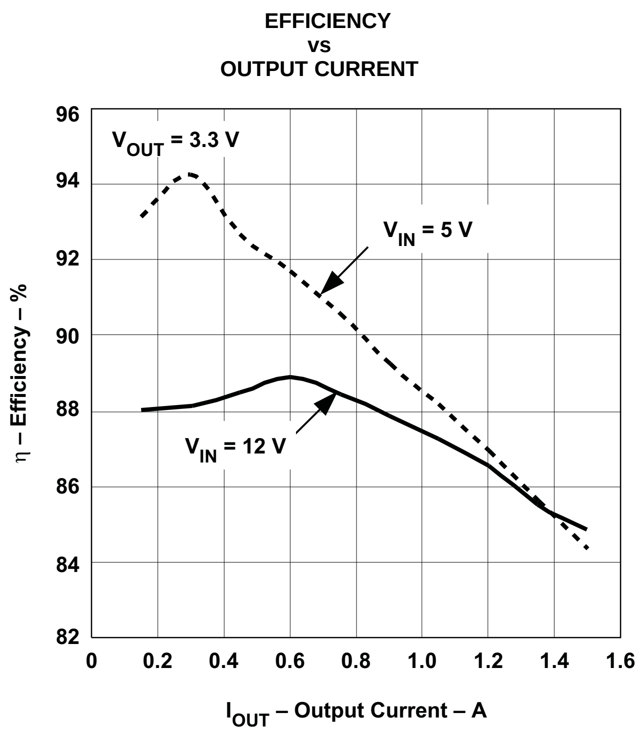

Figure . Figure 10. TPS62111 Efficiency

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