Texas Instruments

Application Report
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High-Vin, High-Efficiency Power Solution Using DC/DC Converter for TMS320C2834x Microcontrollers

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PMP - DC/DC Low-Power Converters

ABSTRACT

This reference design is intended for users designing with the TMS320C2834x microcontrollers. This design, employing sequenced power supplies, describes a system with an input voltage of 12 V and uses high-efficiency DC/DC converters with integrated FETs for a simple, small design.

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1 Introduction

In multivoltage architectures, coordinated management of power supplies is necessary to avoid potential problems and ensure reliable performance. Power supply designers must consider the timing and voltage differences between core and I/O voltage supplies during power-up and power-down operations.

Sequencing refers to the order, timing, and differential in which the two voltage rails are powered up and down. A system designed without proper sequencing may be at risk for two types of failures. The first of these represents a threat to the long-term reliability of the dual-voltage device, whereas the second is more immediate, with the possibility of damaging interface circuits in the processor or system devices such as memory, logic, or data converter integrated circuits (IC).

Another potential problem with improper supply sequencing is bus contention. Bus contention is a condition in which the processor and another device both attempt to control a bidirectional bus during power up. Bus contention may also affect I/O reliability. Power supply designers should check the requirements regarding bus contention for individual devices.

Table 1 shows the power-on sequencing for TMS320C2834x microcontrollers. As mentioned in the table, all voltage rails must be powered up within 5 ms.

2 Power Requirements

The power requirements are as specified in Table 1.

Table 1. TMS320C2834x Power Specifications

	Pin Name	Voltage (V)	Imax (mA)	Tolerance	Sequencing Order	Timing Delay
Core	VDD	1.1 / 1.2 (1)	1000 (2)	±5%	1	All voltage rails must be powered up within 5 ms.
I/O	VDD18	1.8	80	±5%	2	
I/O	VDDIO	3.3	200	±5%	2	

(1) CVDD = 1.2 V for 300-MHz devices; CVDD = 1.1 V for 200-MHz devices.
(2) Maximum current on VDD at 300 MHz is 1000 mA; maximum current on VDD at 200 MHz is 600 mA.

3 Features

The design uses the following high-efficiency DC/DC converters with integrated FETs.

Devices	**TPS62111 (for 3.3 V), TPS62290 (for 1.2 V), TPS71718 (1.8 V)**
Power supply specs:	
Vin	12 V ± 10%
Vout1	1.1 V/1.2 V ± 5% at 1000 mA
Vout2	1.8 V ± 5% at 80 mA
Vout3	3.3 V ± 5% at 200 mA (but design to maximum capable)
Sequencing	1) Vout1 2) Vout2 and Vout3

TPS62111

- High-efficiency, synchronous step-down converter with up to 95% efficiency
- Up to 1.5-A output current
- High efficiency over a wideload-current range due to PFM/PWM operation mode
- Fixed 3.3-V output eliminates need for external voltage-setting resistors

TPS62290

- High-efficiency, step-down converter
- Up to 1-A output current
- Power Save mode at light-load currents
- Output voltage accuracy in PWM mode ±1.5%

TPS71718

- 150-mA low-dropout regulator with Enable
- Low-noise: 30 µV typical (100 Hz to 100 kHz)
- Excellent load/line transient response
- Small SC70-5, 2-mm × 2-mm SON-6, and 1.5-mm × 1.5-mm SON-6 packages

More information on these devices can be found in the following data sheets.

1. *TPS62110/11/12/13, 17-V, 1.5-A, Synchronous Step-Down Converter* data sheet (SLVS585)
2. *TPS62290/91/93, 1-A Step Down Converter in 2 x 2 SON Package* data sheet (SLVS764)
3. *TPS71718 (TPS717xx), Low Noise, High-Bandwidth PSRR Low-Dropout 150mA Linear Regulator* data sheet (SBVS068)

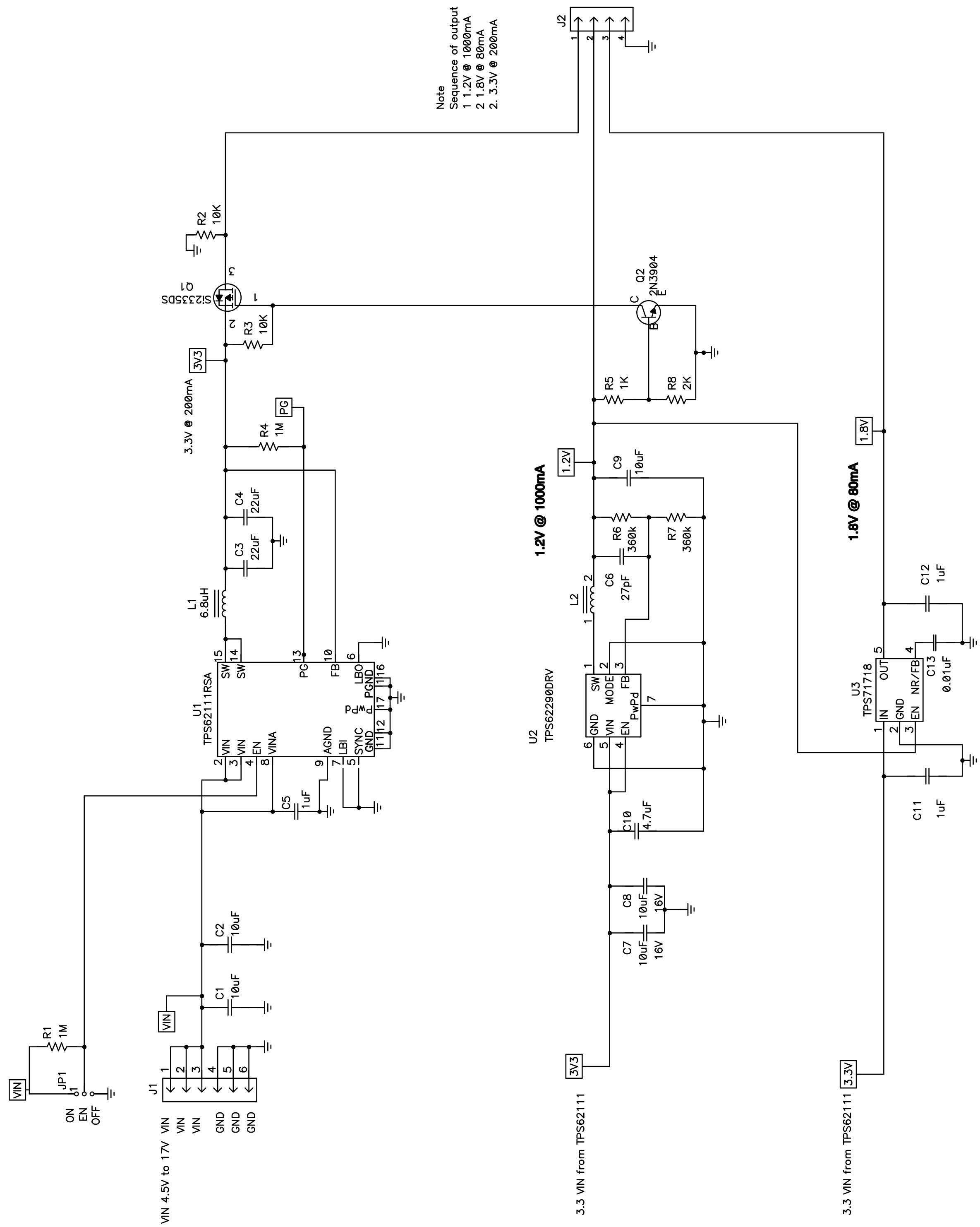

Figure 1. PMP4997 Reference Design Schematic

Proper sequencing is ensured in the design with the use of NPN transistors and a P-channel MOSFET. As required, Core 1.2 V at 1000 mA (TPS62290) comes first , which in turn pulls down the gate of a P-channel MOSFET with the use of a NPN transistor (3.3 V at 200 mA comes up from TPS62111) and also enable TPS71718. Thus, the required sequence is followed.

4 Bill of Materials

Table 2. PMP4997 Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR	Area
2	C1	10uF	Capacitor, Ceramic, 25V, X5R, 20%	1206	C3216X5R1E106	TDK	15390
	C2	10uF	Capacitor, Ceramic, 25V, X5R, 20%	1206	C3216X5R1E106	TDK	15390
2	C3	22uF	Capacitor, Ceramic, 10V, X5R, 20%	1206	C3216X5R1A226	TDK	15390
	C4	22uF	Capacitor, Ceramic, 10V, X5R, 20%	1206	C3216X5R1A226	TDK	15390
1	C5	1uF	Capacitor, Ceramic, 25V, X7R, 10%	0603	C1608X7R1E105K	TDK	5650
1	C6	27pF	Capacitor, Ceramic, 0.01uF, 10-V, X7R, 15%	0603	Std	TDK	5650
2	C7	10uF	Capacitor, Ceramic, 16V, X7R, 20%	1206	C3216X7R1C106MT	TDK	15390
	C8	10uF	Capacitor, Ceramic, 16V, X7R, 20%	1206	C3216X7R1C106MT	TDK	15390
1	C9	10uF	Capacitor, Ceramic, 6.3V, X5R, 10%	0603	C0603CH0J106k	TDK	5650
1	C10	4.7uF	Capacitor, Ceramic, 10V, X5R, 10%	0603	C0603CH1A475K	TDK	5650
2	C11	1uF	Capacitor, Ceramic, 6.3V, X5R, 20%	0603	C1608X5R1E105M	TDK	5650
	C12	1uF	Capacitor, Ceramic, 6.3V, X5R, 20%	0603	C1608X5R1E105M	TDK	5650
1	C13	0.01uF	Capacitor, Ceramic, 50V, COG, 10%	0402	Std	Std	2800
1	J1	PTC36SAAN	Header, Male 6-pin, 100mil spacing, (36-pin strip)	0.100 inch x 6	PTC36SAAN	Sullins	70000
1	J2	PEC36SAAN	Header, Male 4-pin, 100mil spacing, (36-pin strip)	0.100 inch x 4	PEC36SAAN	Sullins	50000
1	JP1	PTC36SAAN	Header, 3-pin, 100mil spacing, (36-pin strip)	0.100 x 3	PTC36SAAN	Sullins	34100
1	L1	6.8uH	Inductor, SMT, 3.0A, 97 milliohm	0.276 x 0.276 inch	HA3808-AL	Coiltronics	90000
1	L2	2.2uH	Inductor, SMT, 2.1A, 0.110ohm	0.118 x 0.118 inch	LPS3015-222ML	Coilcraft	26,560
1	Q1	Si2335DS	MOSFET,P-ch, -12 V, 4 A, 51 milliohm	SOT23	Si2335DS	Vishay	14105
1	Q2	2N3904	Transistor, NPN, 40V, 200mA, 625mW	TO-92	2N3904	Fairchild	37800
1	R1	1M	Resistor, Chip, 1/16-W, 1%	0603	Std	Std	9100
2	R2	10K	Resistor, Chip, 1/16W, x%	0603	Std	Std	5,650
	R3	10K	Resistor, Chip, 1/16W, x%	0603	Std	Std	5,650
1	R4	1M	Resistor, Chip, 1/16W, x%	0603	Std	Std	5,650
1	R5	1K	Resistor, Chip, 1/16W, x%	0603	Std	Std	5,650
2	R6	360k	Resistor, Chip, 1/16W, 1%	0603	Std	Std	5650
	R7	360k	Resistor, Chip, 1/16W, 1%	0603	Std	Std	5650
1	R8	2K	Resistor, Chip, 1/16W, x%	0603	Std	Std	5,650
1	U1	TPS62111RSA	IC, Synchronous Step-Down Converter, 17V, 1.2A	QFN-16	TPS62111RSA	TI	54289
1	U2	TPS62290DRV	IC, 2.25MHz 1000mA Step-Down Converter	SON-6[DRV]	TPS62290DRV	TI	20736
1	U3	TPS71718	IC, 150mA, Low Iq, Wide Bandwidth, LDO Linear Regulators	SC70	TPS71718	TI	18600

Notes: 1. These assemblies are ESD sensitive, ESD precautions shall be observed.

2. These assemblies must be clean and free from flux and all contaminants. Failure to use clean flux is unacceptable.

3. These assemblies must comply with workmanship standards IPC-A-610 Class 2.

4. Reference designators marked with an asterisk ('**') cannot be substituted. All other components can be substituted with equivalent MFG's components.

5 Test Results

The start-up waveform is shown in Figure 2 which specifies the sequencing order that is required.

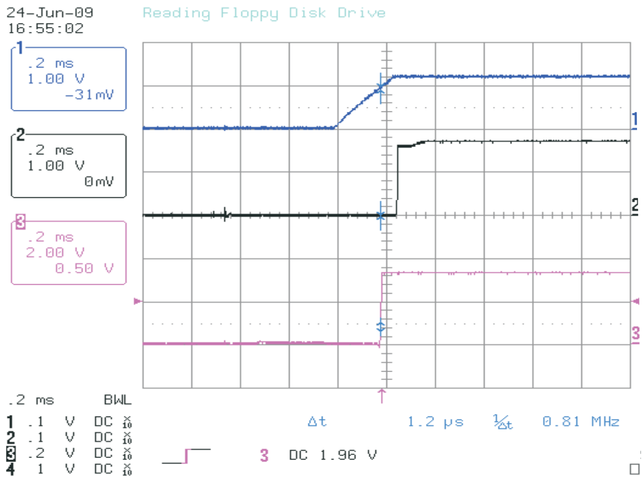

Figure 2. Sequencing in Start-up Waveform

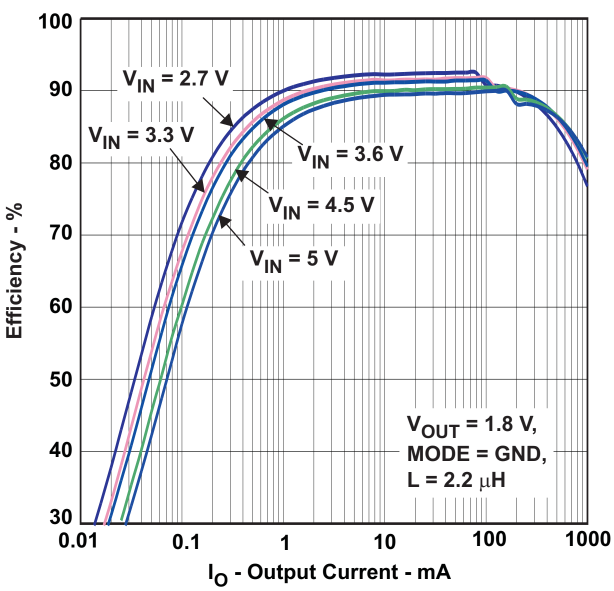

Figure 3. Efficiency vs Output Current, TPS62290

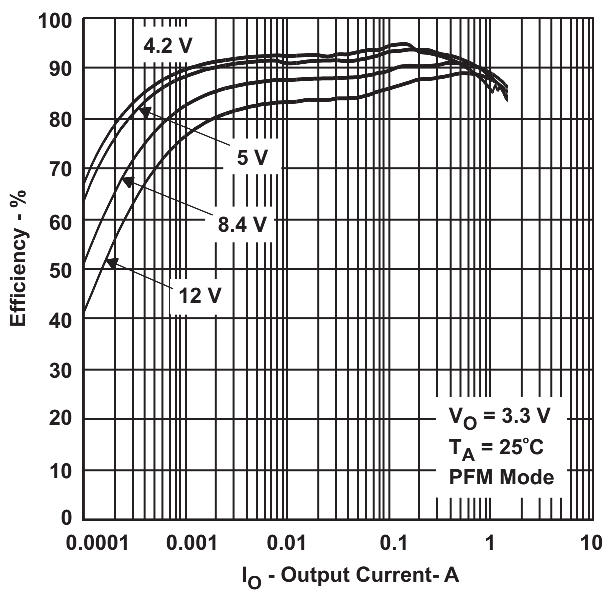

Figure 4. Efficiency vs Output Current, TPS62111