Application Report

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High-Vin, High-Efficiency Power Solution Using DC/DC Converter for the DM365

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PMP - DC/DC Low Power Converters

ABSTRACT

This reference design is intended for users designing with theTMS320DM365 Processor. This design is ideal for achieving the requirement of a high input voltage range that encompasses both 5V and 12V, while maintaining high efficiency and long battery life. This particular configuration allows for an input voltage between 4.5V to 17V.

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1 Introduction

In multi-voltage 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, while 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 ICs.

Another potential problem with improper supply sequencing is bus contention. Bus contention is a condition when the processor and another device both attempt to control a bi-directional 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.

2 Power Requirements

The power specifications and sequencing requirements for TMS320DM365 Processor is shown in the table below.

Table 1. TMS320DM365 Power Specs

	PIN NAME	VOLTAGE (V)	Imax (mA)	TOLERANCE	SEQUENCING ORDER
Core	CVDD, VDD12_PRTCSS, VDDA12_DAC, VPP	1.2 *	650	5%	1
I/O	VDDS18, VDD18_PRTCSS, VDDMXI, VDD18_SLDO, VDD18_DDR, VDDA18_PLL, VDDA18_USB, VDDA18_VC, VDDA18_ADC, VDDA18_DAC	1.8	95	5%	2
I/O	VDDS33, VDDA33_USB, VDDA33_VC	3.3	51	5%	3
I/O	VDD_AEMIF1_18_3 3, VDD_AEMIF2_18_3 3, VDD_ISIF18_33	1.8 / 3.3	65	5%	Ramp with appropriate voltage

Note:

- If running DM365 @ 300MHz, then CVDD, VDD12_PRTCSS, VDDA12_DAC and VPP = 1.35V and Imax = 800mA.
- If using PRTCSS, power-up sequencing changes to:

1. Power on PRTCSS core (1.2-V) while RESET is low
2. Power on PRTCSS I/O (1.8-V)
3. Power on Main core (1.2-V)
4. Power on Main I/O (1.8-V))
5. Power on Main/Analog I/O (3.3-V)

3 Features

The design uses the following high-efficiency DCDC Converters with integrated FETs

Devices:	**TPS62111(3.3V),TPS62290(1.2V),TPS62231(1.8V)**
Power supply specs:	
Vin	12 V ± 10%
Vout1	1.2 V ± 5% at 800 mA
Vout2	1.8 V ± 5% at 200 mA
Vout3	3.3 V ± 5% at 200 mA
Sequencing	1) Vout1 2) Vout2 3) Vout3

TPS62111

- High Efficiency Synchronous Step Down Converter With up to 95% Efficiency
- Up to 1.5-A Output Current
- High Efficiency Over a Wide Load-Current range Due to PFM/PWM Operation Mode
- Fixed 3.3V 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%

TPS62231

- 3 MHz switch frequency
- Up to 94% efficiency
- Output Peak Current up to 500 mA
- Small External Output Filter Components (1.0µH/ 4.7µF)
- Small 1 × 1.5 × 0.6mm 3 SON Package
- Fixed 1.8 V eliminates need for external voltage-setting resistors

More information on the Devices can be found from the data sheets.

TPS62111 –SLVS585A

TPS62290 –SLVS764C

TPS62231 –SLVS941

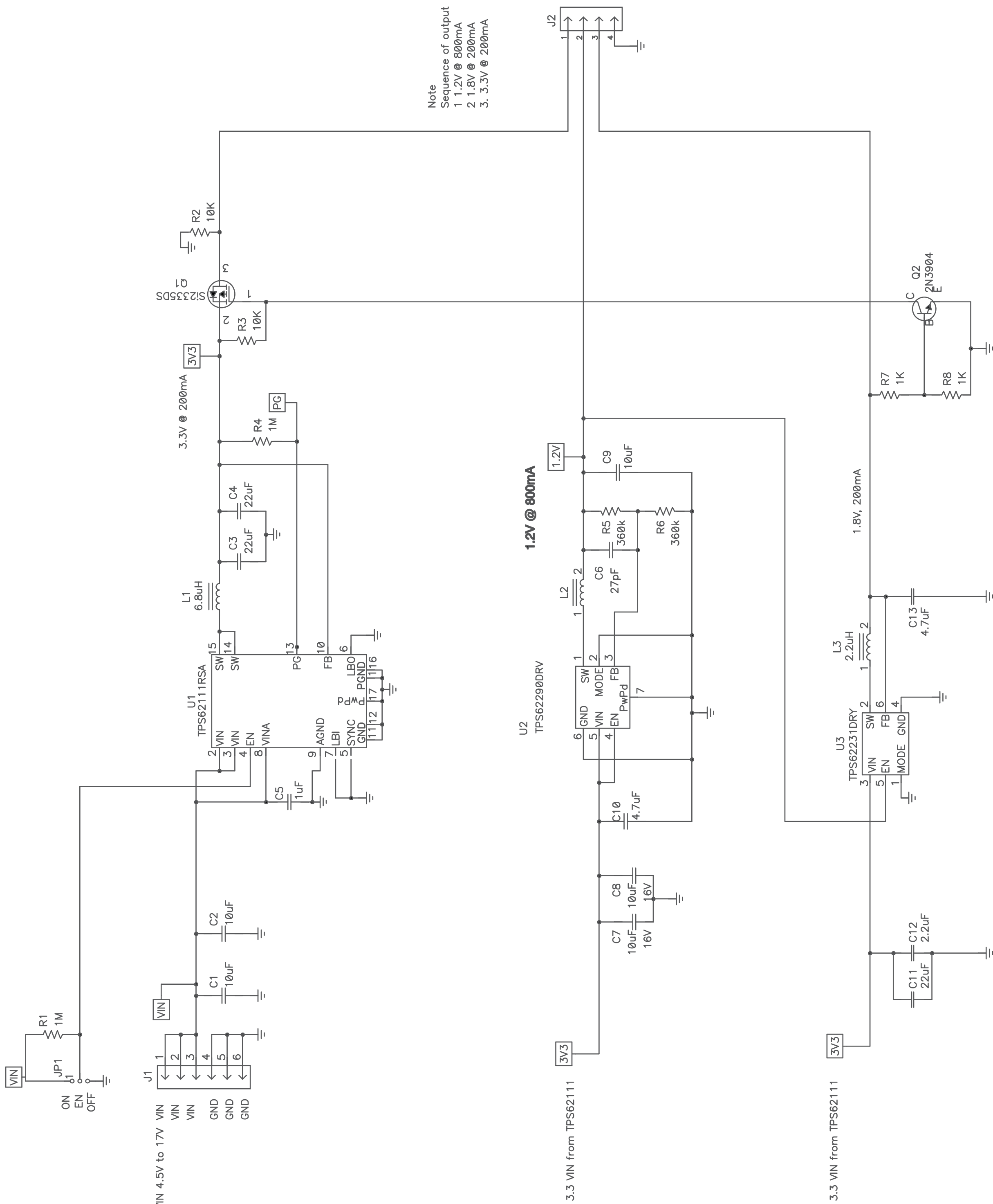

Figure 1. PMP4997 Reference Design Schematic

Proper sequencing is insured in the design with the use of NPN transistors and a P channel MOSFET. The Core 1.2V at 800mA (TPS62290) comes first, and enable TPS62231(1.8V at 200mA) which in turn pull down the gate of a P channel MOSFET with the use of a NPN transistor and hence 3.3V at 200mA comes up from TPS62111 thus, following the required sequence.

4 List of Material

Table 2. PMP5046 List of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR	Area
2	C1	10 µF	Capacitor, Ceramic, 25V, X5R, 20%	1206	C3216X5R1E106	TDK	15390
	C2	10 µF	Capacitor, Ceramic, 25V, X5R, 20%	1206	C3216X5R1E106	TDK	15390
2	C3	22 µF	Capacitor, Ceramic, 10V, X5R, 20%	1206	C3216X5R1A226	TDK	15390
	C4	22 µF	Capacitor, Ceramic, 10V, X5R, 20%	1206	C3216X5R1A226	TDK	15390
1	C5	1 µF	Capacitor, Ceramic, 25V, X7R, 10%	0603	C1608X7R1E105K	TDK	5650
1	C6	27 pF	Capacitor, Ceramic, 0.01 µF, 10-V, X7R, 15%	0603	Std	TDK	5650
2	C7	10 µF	Capacitor, Ceramic, 16V, X7R, 20%	1206	C3216X7R1C106MT	TDK	15390
	C8	10 µF	Capacitor, Ceramic, 16V, X7R, 20%	1206	C3216X7R1C106MT	TDK	15390
1	C9	10 µF	Capacitor, Ceramic, 6.3V, X5R, 10%	0603	C0603CH0J106k	TDK	5650
1	C10	4.7 µF	Capacitor, Ceramic, 10V, X5R, 10%	0603	C0603CH1A475K	TDK	5650
1	C11	22 µF	Capacitor, Ceramic, 10V, X5R, 20%	1210	Std	Std	83,600
1	C12	2.2 µF	Capacitor, Ceramic, 6.3V, X5R, 20%	0402	JDK105BJ225MV	Taiyo Yuden	2800
1	C13	4.7 µF	Capacitor, Ceramic, 6.3V, X5R, 20%	0402	JDK105BJ475MV	Taiyo Yuden	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	6.8 µH	Inductor, SMT, 3.0A, 97 mΩ	0.276 x 0.276 inch	HA3808-AL	Coiltronics	90000
1	L2	2.2 µH	Inductor, SMT, 2.1A, 0.110Ω	0.118 x 0.118 inch	LPS3015-222ML	Coilcraft	26,560
1	L3	2.2 µH	Inductor, SMT, 0.7A, 230-milliohm	0805	MIPSZ20120D2R2	FDK	10160
1	Q1	Si2335DS	MOSFET,P-ch, -12 V, 4 A, 51 mΩ	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
2	R5	360k	Resistor, Chip, 1/16W, 1%	0603	Std	Std	5650
	R6	360k	Resistor, Chip, 1/16W, 1%	0603	Std	Std	5650
2	R7	1K	Resistor, Chip, 1/16W, x%	0603	Std	Std	5,650
	R8	1K	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	TPS62231DRY	IC, 3MHz Ultra Small Step Down Converter, x.x V	QFN	TPS62232DRY	TI	6020

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. Use of no clean flux is not acceptable.
3. These assemblies must comply with workmanship standards IPC-A-610 Class 2.
4. Ref designators marked with an asterisk ('**') cannot be substituted. All other components can be substituted with equivalent MFG's components.

5 Test Result

The startup waveform, shown in Figure 2, demonstrates that the required sequencing order is followed.

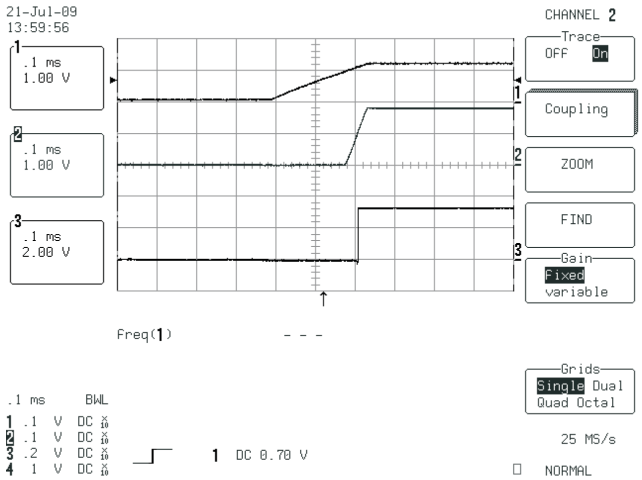

Figure 2. Shows Sequencing in Start up Waveform

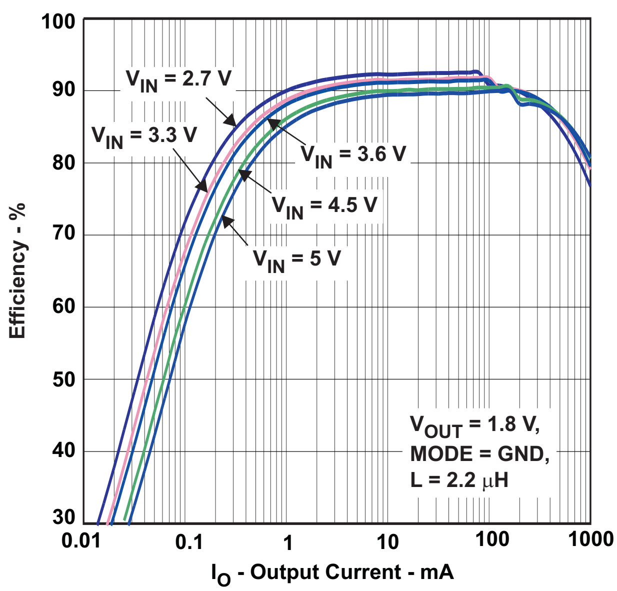

Figure 3. Efficiency vs Output Current (TPS62290)

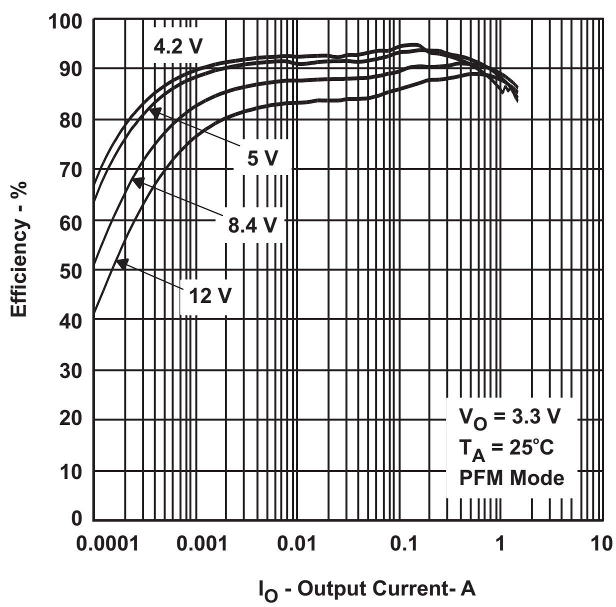

Figure 4. Efficiency vs Output Current (TPS62111)

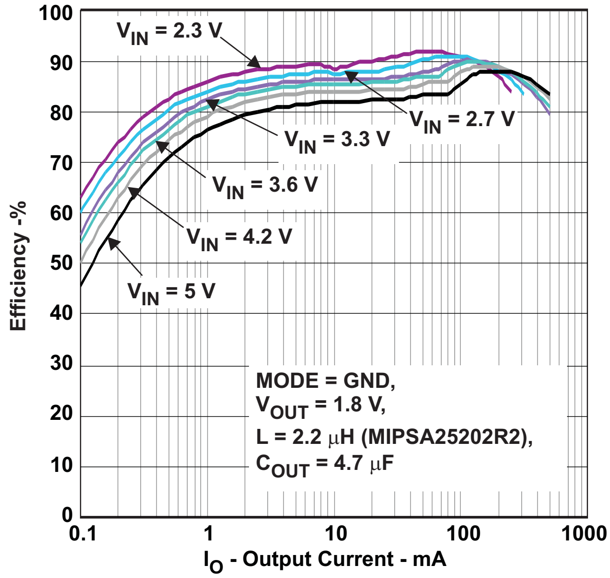

Figure 5. Efficiency vs Output Current (TPS62231)