Low Cost Power Solution for TMS320C6201 DSP Applications Application Report

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ABSTRACT

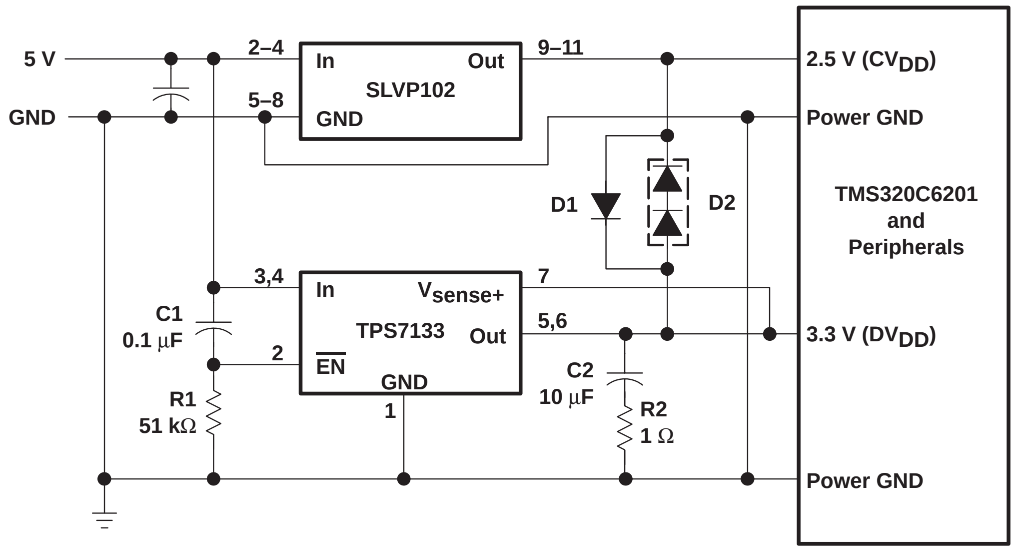
This application report describes a low-cost power solution using the SLVP101 EVM and the TPS7133 low drop-out voltage regulator for TMS320C6201 DSP applications .

Introduction

Texas Instruments TMS320C6x Digital Signal Processors (DSP) require two power supply voltages. For example, the TMS320C6201 core requires 2.5 V at 2 A, and the I/O interface requires 3.3 V at 500 mA. In single-DSP applications, the power requirement is usually higher to cover the whole application; the start-up sequencing and the protection between two outputs are also important for TMS320C6201 DSPs. According to the power specification, the 2.5-V output must be brought up before the 3.3-V output, and the voltage difference between the two outputs must never exceed 2 V. Cost and component count are also important considerations for DSP users. The design in this application report meets all these requirements using low cost TL5001 PWM controllers and TPS7133 low drop-out voltage regulators by Texas Instruments. The TL5001 PWM controller used in the SLVP102 evaluation module (EVM) supplies 2.5-V/3-A for core power; a TPS7133 supplies 3.3-V/0.75-A I/O power. The component count is minimized to approximately 40, including the board and connectors. The SLVP109 EVM, a soon-to-be-available drop-in replacement for the SLVP102, will reduce the component count further to about 30. The input and logic voltage for both outputs is 5 V.

Circuit Description

Figure 1 shows the SLVP102 and TPS7133 power circuit in a typical application with a TMS320C6201 DSP.



NOTE: Check references for more details.

Figure 1. Typical Application

The SLVP102 is a nominal 5-V input to 2.5-V output regulator designed by Texas Instruments. It provides a cost-effective solution for supplying 2.5 V core power to a high-performance DSP such as the TMS320C6201. The EVM satisfies all requirements for powering this DSP, such as low cost, low parts count, good transient response, and excellent output voltage accuracy. The SLVP109, a new EVM available soon, is functionally the same as the SLVP102, but has fewer components.

The TPS7133 is a nominal 5-V input to 3.3-V low-dropout voltage regulator also designed by Texas Instruments. A 1-Ω resistor (R2) in series with a 10-µF output capacitor (C2) provides the output voltage regulation stability. A resistor (R1) and capacitor (C1) connected to the enable pin provide the correct start-up sequence.

Protection diodes D1 and D2 prevent excessive voltage differences (>2 V) between two outputs under any conditions. During normal operation, the forward voltage across each section of D2 is only 0.4 V, not enough to conduct. Therefore, D2 will not be on during normal operation.

Resistor R1 and capacitor C1 connected to the TPS7133 enable pin provide the start-up sequencing (2.5 V first, then 3.3V) required by the TMS320C6201. At start-up, the high voltage on the enable pin disables the TPS7133. After a few milliseconds, the voltage on the enable pin goes low, and the TPS7133 is brought up. Figure 7 shows the start-up waveforms. It can be seen from the waveforms that the 2.5-V output reaches the nominal voltage first, then 3.3 V.

Removal of fault conditions automatically resets both regulators.

The two modules should be placed close to the DSP to minimize the trace resistance and inductance, and to minimize the ground loop current between the two output grounds. This ground loop current can generate radiated EMI noise that can adversely affect any circuitry within the loop. The ground connection must be made directly on the DSP to help minimize the problem.

Specifications

This section contains specifications, operating conditions, and measurement data for the power circuit.

Recommended Operating Conditions

	MIN	TYP	MAX	UNIT
V_{IN}	4.5	5	5.5	V
Operating ambient temperature, T_A	0		85	°C

Electrical Characteristics Over Recommended Operating Conditions

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output voltage setpoint 1	Over all conditions	2.425	2.5	2.575	V
Output voltage setpoint 2	Over all conditions	3.201	3.3	3.399	V
Load regulation of 2.5 V	Over all conditions		0.01%	0.1%	
Line regulation of 3.3 V	Over all conditions		2%	3%	
Output current 1 (2.5 V)	T_A = 25°C	0		3	A
Output current 2 (3.3 V)	T_A = 25°C	0		0.75	A
Efficiency	T_A = 25°C, both full load		75%		
Switching frequency of 2.5 V output	T_A = 25°C		200		kHz
Turn on input voltage	T_A = 25°C	4.30		4.49	V
Under voltage lock out	T_A = 25°C, 50% load	4.30		4.48	V
Over current inception 1	T_A = 25°C, V_{IN} = 5 V		3.25		A
Over current inception 2	T_A = 25°C, V_{IN} = 5 V		1.2		A
Short circuit current 1†	T_A = 25°C, V_{IN} = 5 V		0		A
Short circuit current 2†	T_A = 25°C, V_{IN} = 5 V		0		A

† Under short circuit condition, the outputs are turned off.

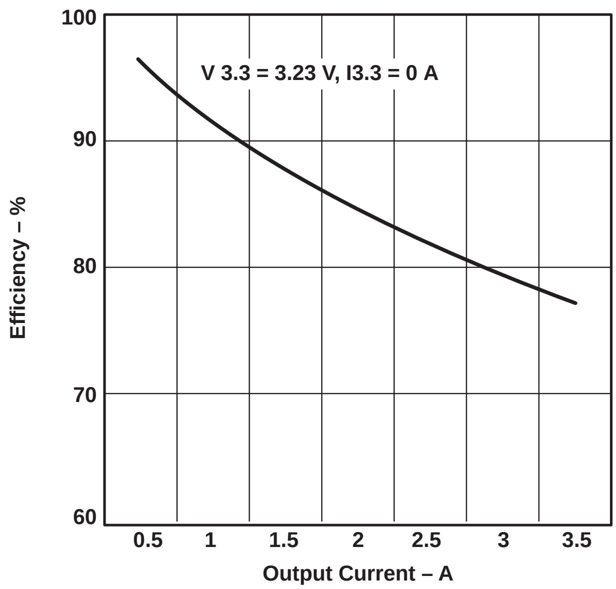


Figure 2. Efficiency of 2.5-V Output at 3.3 V/0 A

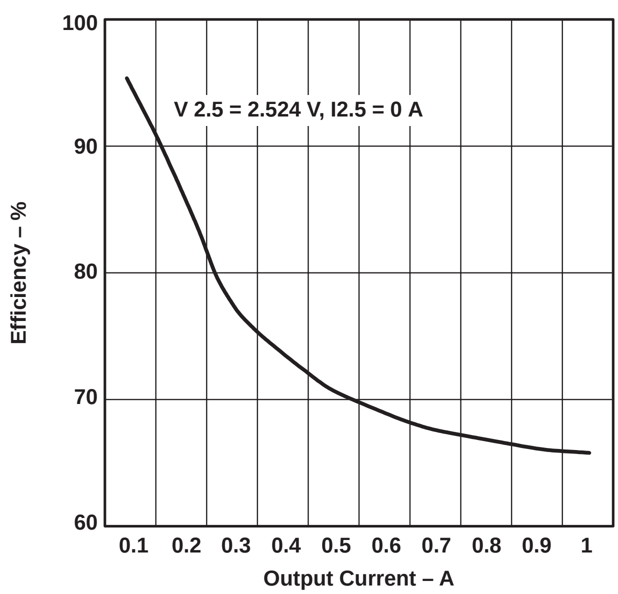
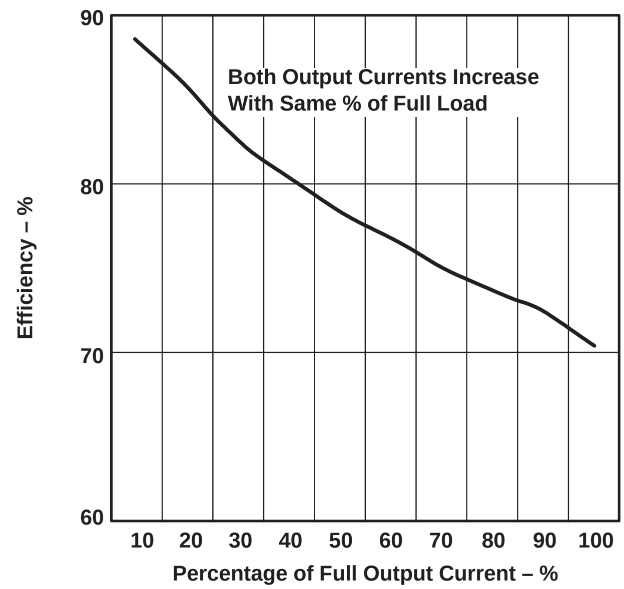


Figure 3. Efficiency of 3.3-V Output at 2.5 V/0 A



NOTE: The current on 3.3 V output is up to 1 A.

Figure 4. Efficiency of Both Outputs at Same Output Current Increasing Rate

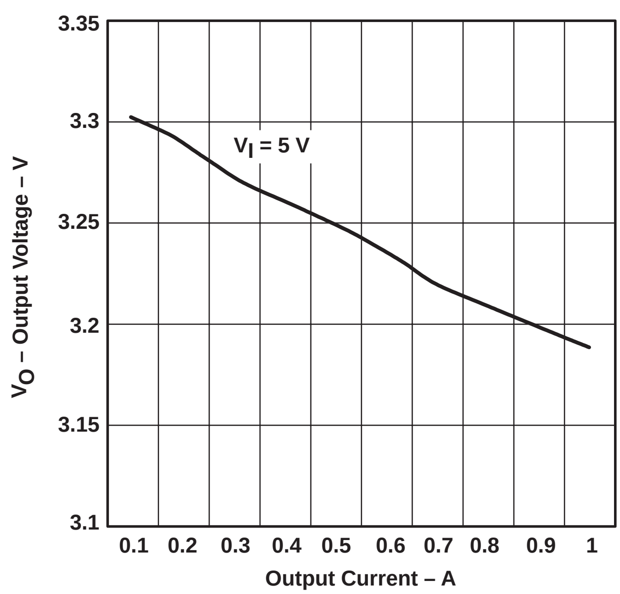


Figure 5. Load Regulation on 3.3-V Output

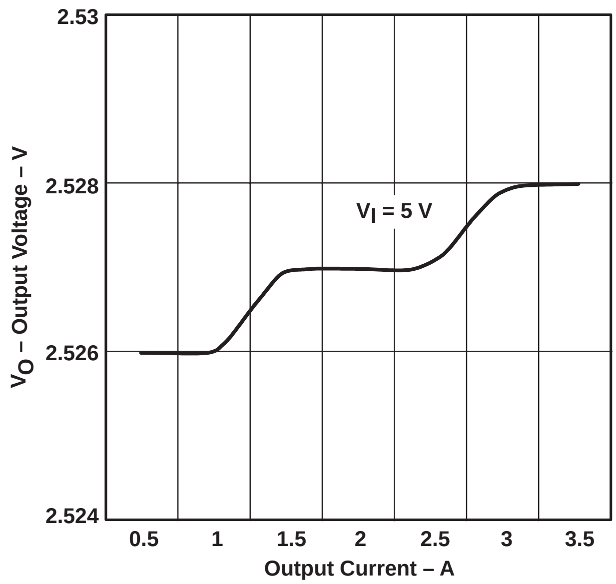


Figure 6. Load Regulation of 2.5-V Output

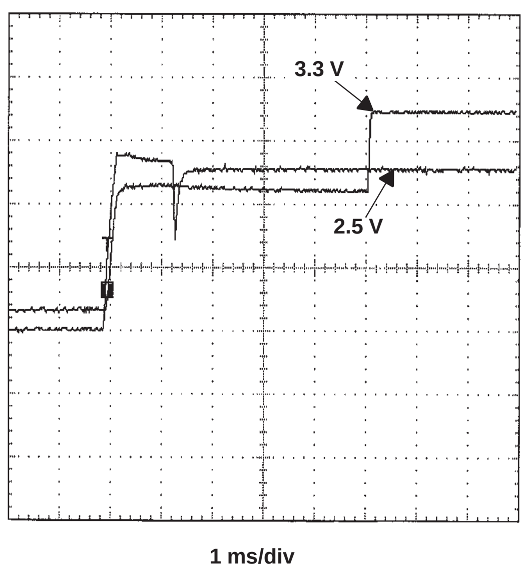


Figure 7. Output Voltage Start-Up Waveforms

Summary

The SLVP102 EVM and TSP7133 provide a simple, cost-effective solution for powering high-performance DSPs.

References

1. *SLVP102, SLVP102, and SLVP103 Buck Converter Design Using the TL5001 User's Guide*, Texas Instruments, 1998, Literature No. SLVU005.
2. *TL5001, TL5001A, TL5001Y Pulse-Width-Modulation Control Circuits*, Texas Instruments, Revised 1998, Literature No. SLVS084D.
3. *TPS7101Q, TPS7133Q, TPS7148Q, TPS7150Q, TPS7101Y, TPS7133Y, TPS7148Y, TPS7150Y Low-Dropout Voltage Regulators*, Texas Instruments, revised 1997, Literature No. SLVS092F.