Saving Valuable Board Space with Dynamic Voltage Scaling in Portable Devices

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ABSTRACT

Dynamic Voltage Scaling (DVS) is a feature typically found in dc-dc converters that power various processors. DVS allows the system controller to change the converter output voltage when needed. In portable applications, this feature enhances overall battery life and reduces application processing time. This application report discusses the DVS feature as it is implemented with the TPS728xx series of low-dropout linear regulators with a selectable dual-voltage level output from Texas Instruments.

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1 Introduction

Dynamic Voltage Scaling (DVS) is a feature typically used in dc-dc converters that power various processors. The DVS feature allows the system controller to change the output voltage of the converter when needed. In portable applications, every microampere of either ground current or leakage current saved adds up to enhanced battery life. Scaling down the voltage applied to the processor reduces the leakage current. Reducing the applied voltage also helps to run the microprocessor under lowered clock frequencies, thereby saving valuable battery power during an idle or sleep mode.

Certain portable applications may not warrant the use of an inductive dc-dc converter; for example, if the output current requirement is below 200mA, or there is a lack of premium board space available, an inductive dc-dc converter may not be suitable. Moreover, noise on the output rails generated by a switching dc-dc converter may also not be acceptable in some applications.

The TPS728xx series of LDOs from Texas Instruments with a pin-selectable DVS feature provides an ideal solution, offering low noise while saving premium board space.

2 Using the DVS Feature

Figure 1 shows a typical handset application. This type of portable application illustrates the the limited board space available for an inductive dc-dc converter.

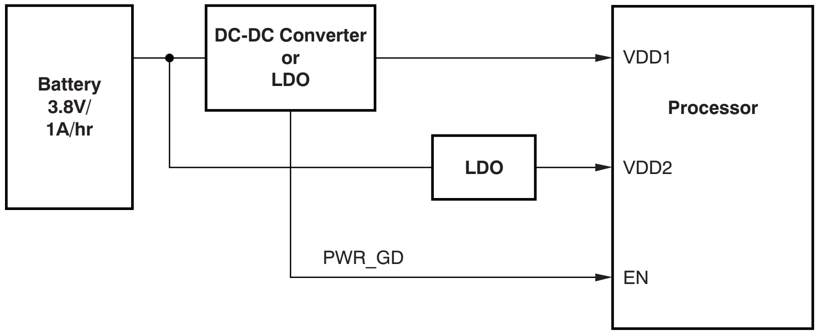

Figure 1. Typical Power Management Implementation for an Application Processor in a Mobile Phone

Processors normally require more than one voltage rail for power. The voltages are scaled based on whether the processor is running an application or is in idle (sleep) mode. A DVS implementation using a catalog dc-dc converter would require additional external components such as resistors and a MOSFET, as shown in Figure 2.

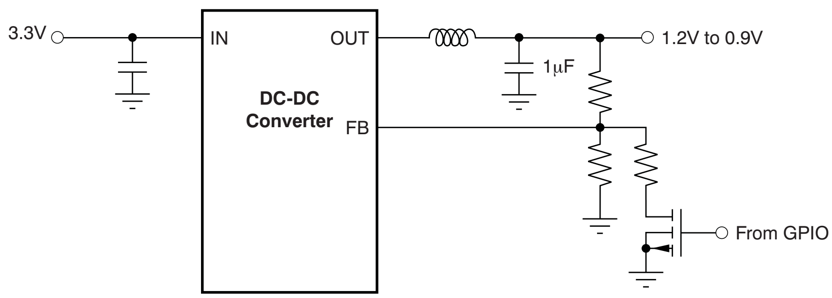

Figure 2. DVS Implementation on a DC-DC Converter with External Components

3 Using the TPS728xx Series

The TPS728 series of LDOs feature a VSET pin that selects between two voltages at the output. The two voltages are preset at the factory through the use of innovative EEPROM programming; output voltages from 0.9V to 3.6V (in 50mV increments) are available for both output voltage levels. Figure 3 shows a typical application using the TPS728.

The reduction in the number of external components by use of TPS728 is evident.

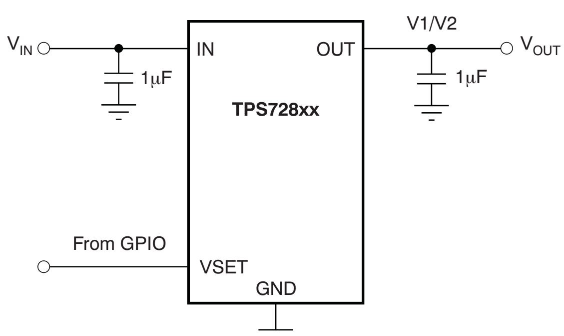

Figure 3. TPS728xx Application Circuit

Figure 4 and Figure 5 show typical voltage transition waveforms for the TPS728xx series of devices.

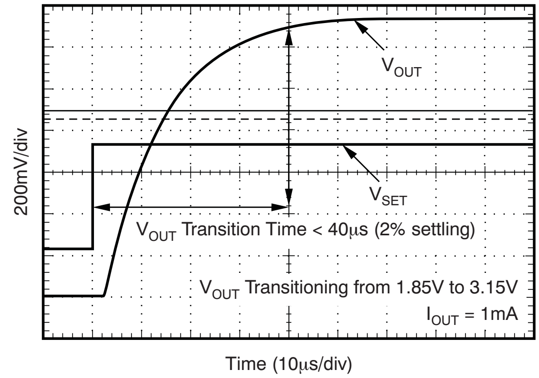

Figure 4. Typical Voltage Transition Waveform on VSET Toggle from 0→1

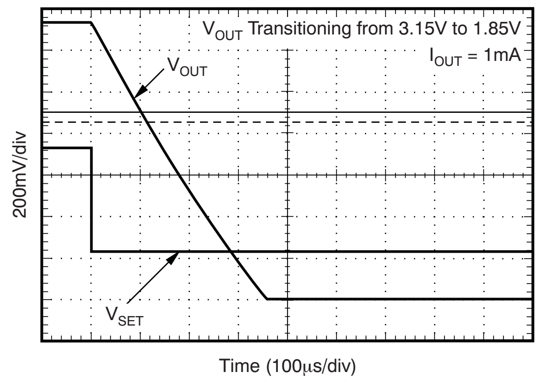

Figure 5. Typical Voltage Transition Waveform on VSET Toggle from 1→0

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